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# MAMMALS OF SOUTHWESTERN OKLAHOMA

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The mammals of southwestern Oklahoma have received limited and sporadic attention from collectors. The few surveys currently available are now somewhat dated. Martin and Preston (1970) provided a comprehensive assessment of the mammals of Harmon County. Mammals of the Wichita Mountains of Comanche County were treated in a series of publications by Glass and associates (bats—Glass and Ward, 1959; small mammals—Glass and Halloran, 1961; carnivores and ungulates, Halloran and Glass, 1959). More recent studies have mostly dealt with specific taxa, and these are cited in the following species accounts.

Caire *et al.* (1990) compiled the first comprehensive listing of the mammals of Oklahoma since Blair's (1939) preliminary assessment of mammalian diversity in the state. Specimens of Oklahoma mammals from major collections around the country were listed in their book, thereby providing a valuable point of departure for later survey work, such as the present study. However, a series of specific studies and general collecting in southwestern Oklahoma by parties from Midwestern State University and Texas Tech University have amassed more than a thousand specimens since the original canvassing of collections by Caire *et al.* (1990). Included among these specimens are 46 county records of occurrence and some significant extensions of known geographic ranges. The addition of these records to the literature refines our knowledge of the distribution of these species in south-

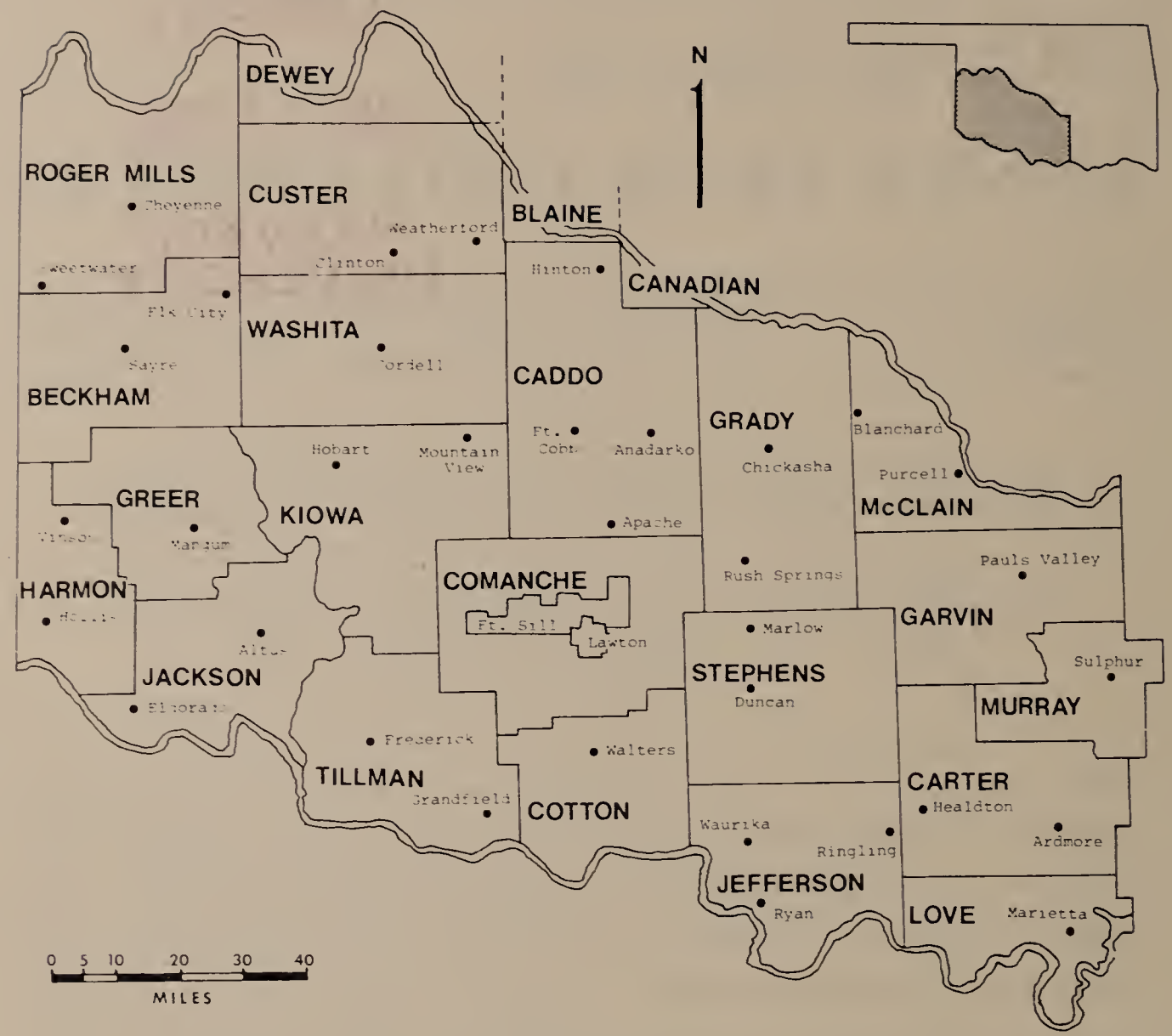


FIG. 1.—Political boundaries and major landmarks of southwestern Oklahoma commonly referenced in text.

western Oklahoma, and highlights areas currently warranting detailed comprehensive surveys.

We have arbitrarily defined southwestern Oklahoma as the 20 southwestern contiguous counties, and parts of three others, bordered on the north by the Canadian River, on the south by the Red River, and to the west by the Texas Panhandle (Fig. 1). Elevations from east to west gradually range from about 600 feet to slightly higher than 2000 feet. Some peaks in the Wichita Mountains approach 2500 feet in elevation. The climate also changes from east to west, becoming progressively less equable, warmer, and dryer.

There are several recognized native vegetative zones in the area (Fig. 2). However, largely in response to environmental gradients, most of southwestern Oklahoma is actually a broad, ecotonal mosaic between arid western grasslands and the relatively mesic deciduous woodlands, which barely enter our study area from the east. Blair and Hubbell (1938) first recognized 11 unique ecological associations of the state,

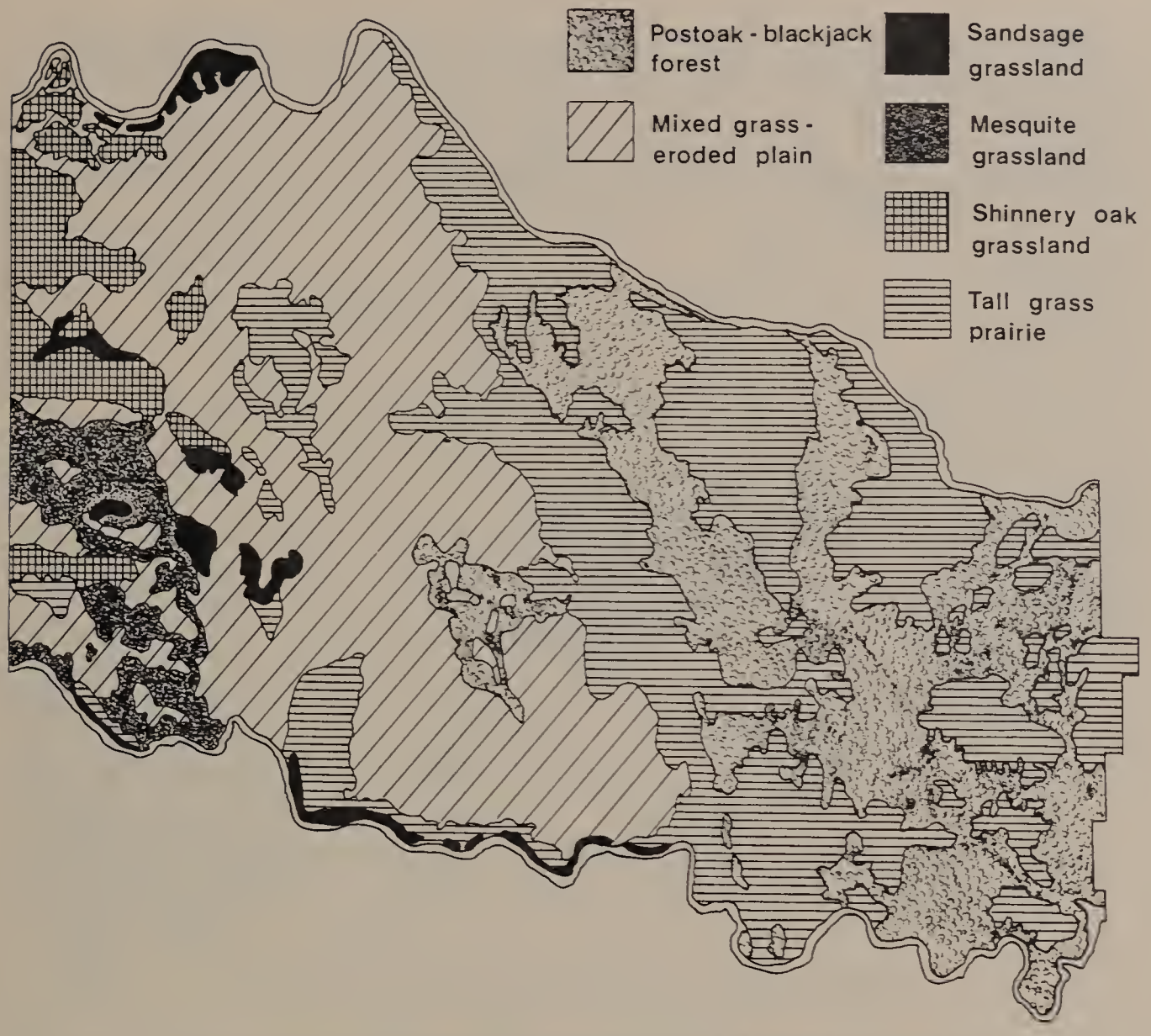


FIG. 2.—Native vegetative zones of southwestern Oklahoma, adapted from Duck and Fletcher (1943).

based on major vegetative subdivisions and the characteristic animals residing in each. Five of these are represented in southwestern Oklahoma (Fig. 3).

The diversity of the regional mammalian fauna is due mostly to the presence of both eastern (eastern deciduous woodlands) and western (Great Plains grasslands) components, many of which reach the extremities of their ranges in southwestern Oklahoma. However, the ranges of some northern plains and subtropical elements also enter the region from the north and south, respectively.

## METHODS

Small mammals were collected using snap traps and live traps, and specialized traps intended for gophers and moles. Most bats were collected by hand from their day roosts. Many larger animals were salvaged from those killed along roads or were obtained from hunters and trappers; others were shot. Most smaller specimens were prepared as museum

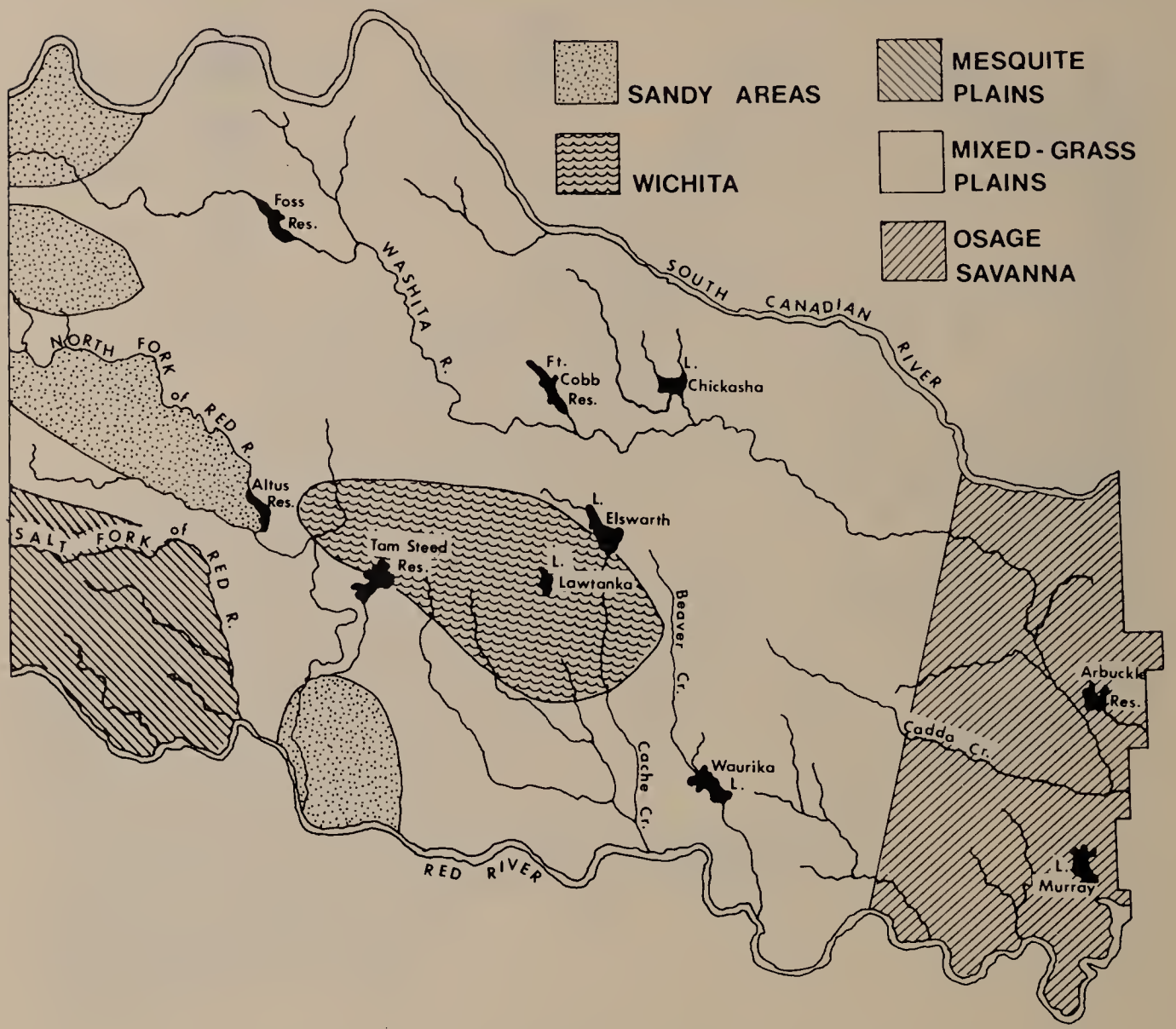


FIG. 3.—Biotic districts of southwestern Oklahoma, adapted from Blair and Hubbell (1938).

study skins accompanied by skulls or skeletons. Larger specimens were most often represented by skulls alone or by skeletons. Material deposited in The Museum of Texas Tech University is indicated by the acronym TTU; all other specimens are in the Collection of Recent Mammals at Midwestern State University.

The presence of most species in the following accounts is documented by specimens listed herein or by Caire *et al.* (1990). A few, although undocumented, are treated if judged likely to have occurred in the area during modern times. We have chosen to exclude the introduced mice and rats (*Mus* and *Rattus*), which occur uniformly throughout the region, and the feral hog (*Sus scrofa*), which is rapidly becoming a widespread pest here and in adjacent parts of Texas. Measurements are given in millimeters. Subspecific treatments follow Hall (1981), except where indicated. With few exceptions, Jones *et al.* (1992) served as the authority for use of common names.

Most of the examined specimens listed below have not been previously reported in the literature; asterisks indicate those counties from which a species is reported herein for the first time. Unless otherwise indicated, previously documented county records are from Caire *et al.* (1990).

## Species Accounts

### *Didelphis virginiana virginiana* Kerr, 1792

Virginia Opossum

The opossum occurs throughout southwestern Oklahoma, although less commonly in the northwestern counties. Vehicular traffic takes a particularly heavy toll on this species, and its remains are common along often-traveled roadways.

*Specimens examined* (4).—Comanche Co.: Cache Creek and Hwy. 277, 1. *Greer Co.: 2 mi. E Mangum, 1. *Jefferson Co.: 6 mi. N, 4 mi. W Waurika, 1. Tillman Co.: 4 mi. N Tipton, 1.

*County records.*—Caddo, Carter, Comanche, Cotton, Custer, Garvin, Grady, *Greer, Jackson, *Jefferson, McClain, Murray, Stephens, Tillman, Washita.

### *Blarina hylophaga hylophaga* Elliot, 1899

Elliot's Short-tailed Shrew

The short-tailed shrew seems an uncommon resident of wooded or heavily vegetated regions of the study area. However, our specimens (and probably most others) were incidentally taken; specific attempts directed towards collecting the species with pitfall traps probably will prove it to be more common and widespread than is presently thought. We found *Blarina hylophaga* most often associated with either the prairie vole (*Microtus ochrogaster*) or woodland vole (*M. pinetorum*).

This shrew is the smallest member of the genus *Blarina* and as such sometimes may be confused with the smaller least shrew, *Cryptotis parva*. We follow George *et al.* (1981) in our taxonomic assignment. The type locality of this taxon is Dougherty, Murray County.

*Specimens examined* (6).—Comanche Co.: Wichita Wildlife Refuge, near Crater Lake, 2; 3 mi. W, 2.4 mi. S Cache, 1; 8.6 km. E, 3.3 km. S Fort Sill, 1; 10.2 km. E, 3.7 km. S Fort Sill, 1. *Grady Co.: 7.7 mi. E Chickasha County Courthouse, 1 (TTU).

*County records.*—Carter, Comanche, Garvin, *Grady, Kiowa, Murray.

### *Cryptotis parva parva* (Say, 1823)

Least Shrew

The least shrew is an inhabitant of southwestern Oklahoma where dense grassland vegetation exists, especially in the eastern sections, and where *Blarina* does not occur. Common associates include the cotton rat (*Sigmodon hispidus*), which shares its runways with shrews and harvest mice (*Reithrodontomys fulvescens* and *R. montanus*).

This is usually the most widespread and abundant of our local shrews, but, like others, seldom is taken by standard collecting methods. Our Jefferson County specimen was recovered from the custody of a house cat. The examination of regurgitated owl pellets or the use of pitfall traps often show these shrews to be abundant in areas where usual collecting methods have failed to produce specimens.

So rapid is the early growth of the least shrew, that juveniles are seldom taken. All of our specimens appear to be adults.

*Specimens examined* (12).—Comanche Co.: Cache, 1; 10.7 km. E Fort Sill, 1; 1 mi. S Meers, 1. *Cotton Co.: 0.5 mi. E Red River Bridge (Hwy. 277), 1. *Greer Co.: 2.5 mi. W Quartz Mountain State Park, 1; 1 mi. S, 2 mi. W Granite, 1 (TTU). Jefferson Co.: 1 mi. W Ringling, 1. Kiowa Co.: 19 mi. S, 2 mi. E Mountain View, 1; 0.8 mi. W, 1.5 mi. S Mountain View, 1 (TTU). *Stephens Co.: Duncan, 2. *Tillman Co.: 0.5 mi. N Grandfield, 1.

*County records*.—Canadian, Comanche, *Cotton, Custer, Garvin, Grady, *Greer, Jefferson, Kiowa, *Stephens, *Tillman.

### *Notiosorex crawfordi crawfordi* (Coues, 1977)

Desert Shrew

The desert shrew is about the size of *Cryptotis*, but the conspicuous ears readily distinguish it from the least shrew. This tiny mammal is presently known from the more arid southwestern part of our area of study, where most specimens were collected by hand from among the excavated dens of the southern plains woodrat, *Neotoma micropus* (Baker and Spencer, 1965; Martin and Preston, 1970). However, this species is not restricted to arid habitats, and we have even taken it from mesic canyons in pinyon pine woodlands of northeastern New Mexico. It may well occur over much of southwestern Oklahoma.

*County records*.—Comanche, Greer, Harmon, Jackson.

### *Scalopus aquaticus aereus* (Bangs, 1896)

Eastern Mole

The conspicuously elevated soil above the runways of the eastern mole is commonly observed along sandy terraces and soil drifts of fencelines throughout southwestern Oklahoma. In many areas, burrow systems are so extensive that there is little chance of capturing a mole by use of a single trap.

This species seldom leaves its underground shelter. However, one specimen was captured by hand as it foraged in surface leaf litter in broad daylight. In northern Texas, we have found occasional specimens dead on the surface—the undamaged bodies bearing no evidence as to cause of death. The most recent revision of the eastern mole from Oklahoma and adjacent states is that of Yates and Schmidly (1977).

*Specimens examined* (9).—Comanche Co.: 3.5 mi. S Cache, 1 (TTU). *Cotton Co.: 2 mi. NW Burkburnett, Texas, 1; 2 mi. NE Burkburnett, Texas, 2; 3 mi. NE Burkburnett, Texas, 1; 0.1 mi. E Red River Bridge (Hwy. 277), 2; 3 mi. E Burkburnett, Texas, 1. *Jefferson Co.: 8 mi. N Byers, Texas, 1.

*County records.*—Beckham, Blaine, Caddo, Canadian, Carter, Comanche, *Cotton, Custer, Dewey, Grady, Greer, Harmon, Jackson, *Jefferson, Love, McClain, Stephens.

### *Myotis ciliolabrum ciliolabrum* (Merriam, 1886)

Western Small-footed Myotis

*Myotis ciliolabrum* is an uncommon little bat in southwestern Oklahoma, where its occurrence seems restricted by the availability of caves for roosting sites. Glass and Ward (1959) remarked on the lack of winter-taken specimens, but speculated that the species probably hibernated in Oklahoma. No specimens of the western small-footed myotis have been taken in southwestern Oklahoma since recorded in the mid-1950s by Glass and Ward (1959), and the status of the species there must be considered questionable.

The taxonomy of this species has experienced varied treatment. Glass and Ward (1959) referred Oklahoma specimens to *M. subulatus*, but Glass and Baker (1965) assigned them to *M. leibii*. However, most authorities presently follow van Zyll de Jong (1984) in regarding western population of the *leibii* group as *M. ciliolabrum*.

*County records.*—Comanche, Greer, Kiowa.

### *Myotis velifer magnamolaris* Choate and Hall, 1967

Cave Myotis

The cave myotis is a locally abundant bat where caves afford the preferred roosting sites, although the acceptability of buildings as a substitute permits *Myotis velifer* to exist throughout much of the western half of Oklahoma. Populations of this species hibernate locally, and some colonies of the cave myotis in northern Texas contain bats the year around.

Glass and Ward (1959) reported that females in Oklahoma give birth to young in late June, and that volant young have been observed in mid-July. We follow Dalquest and Stangl (1984) in assigning Oklahoma representatives of the cave myotis to *Myotis velifer magnamolaris*.

*Specimen examined* (1).—Greer Co.: 18 mi. NW Mangum, 1.

*County records*—Blaine, Canadian, Comanche, Custer, Dewey, Greer, Harmon, Kiowa, Roger Mills, Washita.

### *Lasiurus borealis* (Müller, 1776)

Red Bat

This is a tree bat that prefers woodland foraging grounds. It is commonly observed feeding on insects attracted to street lights in urban areas. The sexes segregate seasonally (as in adjacent areas of northern Texas—Dalquest and Horner, 1984; Jones *et al.*, 1987), and only females reside in Oklahoma in the warm months. They arrive in early spring to give birth and rear their annual litter of up to four young. Consequently, any males from southwestern Oklahoma are likely to be young animals or migrants. By late summer, most females and young, now of adult size, have migrated southward.

*Lasiurus borealis* is a common bat throughout much of the eastern part of the study area. Farther west, it probably is closely restricted to wooded riparian habitat. We follow Baker *et al.* (1988) in considering the red bat as a monotypic species.

*County records.*—Blaine, Comanche, Custer, Dewey, Greer, Harmon, Kiowa, Murray.

### *Lasiurus cinereus cinereus* (Palisot de Beauvois, 1796)

Hoary Bat

Similar to the smaller red bat, *Lasiurus cinereus* is a migratory, tree-roosting species. Little can be deduced of its life history in the state

from the few Oklahoma records. Certainly, as a powerful, wide-ranging flyer, it can be expected throughout southwestern Oklahoma, at least as a warm-weather transient. Tyler and Scott (1982) observed that Oklahoma records for males are from the western half of the state, whereas females comprised most of the records from the south and east. The single record from our study area is of a female from the Wichita Mountains.

*County record.*—Comanche.

### *Lasiurus seminolus* (Rhoads, 1895)

Seminole Bat

The Seminole bat is a woodland species of the southeastern United States. It closely resembles *Lasiurus borealis* in appearance and habits. Only two records (presumably extralimital of the typical range) exist for Oklahoma—one from the extreme southeasternmost part of the state and the other from the Arbuckle Mountains of Murray County.

*County record.*—Murray.

### *Lasionycteris noctivigans* (Le Conte, 1831)

Silver-haired Bat

Like *Lasiurus cinereus*, the silver-haired bat is a noted migrant, which could be expected as a transient at any place in Oklahoma. However, records from the state are few. Discoveries of apparently hibernating *Lasionycteris* in November from nearby Payne County, and in December from Comanche County (Tyler and Payne, 1982), suggest that the species may overwinter in the southern part of the state.

*County records.*—Comanche, McClain.

### *Nycticeius humeralis humeralis* (Rafinesque, 1818)

Evening Bat

The evening bat is a common and widespread bat of the woodlands of eastern Oklahoma. Westward in our study area, it becomes progressively more scarce, and probably is restricted to riparian habitat.

*County records.*—Comanche, Jackson, Murray.

### *Pipistrellus hesperus maximus* Hatfield, 1936

Western Pipistrelle

The western pipistrelle is an aridland species that is distributed from the desert Southwest along a narrow band across the southern Texas Panhandle and into southwestern Oklahoma. This small bat is probably resident in other counties adjacent to those in which it has been taken, and is to be expected where rocky terrain affords the preferred cracks and crevices in which it roosts. This species emerges at early dusk, and has a slow, fluttering flight.

*County records*.—Comanche, Greer, Kiowa.

### *Pipistrellus subflavus subflavus* (F. Cuvier, 1832)

Eastern Pipistrelle

Only in southwestern Oklahoma and adjacent Texas does the eastern pipistrelle occur sympatrically with its western relative. In size and flight, the two species are comparable, but *Pipistrellus subflavus* is richer in color, and it is locally more apt to roost and hibernate in caves.

*County records*.—Comanche, Custer, Greer, Harmon, Kiowa, Murray, Washita.

### *Eptesicus fuscus fuscus* (Palisot de Beauvois, 1796)

Big Brown Bat

The big brown bat generally is perceived to range more or less continuously across the United States (Hall, 1981), but a recent study by Manning *et al.* (1989) clearly indicated the extremely localized distribution in Texas; Oklahoma records (Caire *et al.*, 1990) demonstrate a comparable spotty distribution.

Two morphologically similar subspecies of *Eptesicus fuscus* occur near Oklahoma—*E. f. fuscus*, a taxon characterized by birth of twins, and the western *E. f. pallidus* Young, 1908, which typically gives birth to a single young (Manning *et al.*, 1989). The former is the race thought to occur in southwestern Oklahoma (Jones and Manning, 1990).

The big brown bat is commonly found in caves, but it also roosts in buildings. The apparent absence of *E. fuscus* from the gypsum caves of Greer, Harmon, and Kiowa counties is surprising, considering the attention these sites have been given by bat collectors in the past.

*County record*.—Garvin.

### *Plecotus townsendii pallescens* (Miller, 1897)

Townsend's Big-eared Bat

Most of the known records of this big-eared bat come from in and around the gypsum caves of western Oklahoma, but the species also is known from the granite hills of the region, where caves and crevices afford preferred roosting and hibernation sites. These colonial bats seem to have little difficulty avoiding mist nets, and are most often taken by hand from their roosts.

Adjacent northern Texas populations have declined during the past 20 years (Dalquest and Horner, 1984), whereas the numbers of other local cave-dwelling bats (*Myotis velifer, Pipistrellus subflavus*) have remained stable. Human disturbance of colonies is a major threat to this species, which now is protected by Oklahoma law (Caire *et al.*, 1990); perhaps a particular susceptibility to pesticides acquired by eating insect prey also plays a role. The effect of insecticides, as well as formal protection of cave roosts, deserve further investigation.

*Specimens examined* (4).—Comanche Co.: Wichita Mountains Wildlife Refuge, 3. Greer Co.: 18 mi. NW Mangum, 1.

*County records*.—Comanche, Custer, Greer, Harmon, Kiowa, Washita.

### *Antrozous pallidus bunkeri* Hibbard, 1934

Pallid Bat

*Antrozous pallidus* is another colonial western bat that reaches the eastern extent of its range in Oklahoma. This powerful flier is readily taken in mist nets, but its unusual (for local bats) habit of sometimes foraging on the ground for invertebrate prey has resulted in its being collected in snap traps set for mice.

Oklahoma specimens available to Caire *et al.* (1990) were all taken from caves, but it also commonly roosts in man-made structures. Our Harmon County specimens represent those collected from a maternity colony on 11 May from between the support timbers of a bridge over the Red River. At the same time, another colony was located on the Texas side of the bridge (Jones *et al.*, 1987). Of 12 pregnant females, Manning *et al.* (1987) reported one with a single embryo, eight with the typical twins, one with three embryos, and another carrying quadruplets.

No hibernating population has yet been discovered in Oklahoma (Caire *et al.*, 1990), although this bat typically hibernates in the vicinity of its summer grounds. The status of Oklahoma and Texas *Antrozous*

recently was reviewed and specimens were assigned to *A. p. bunkeri* by Manning *et al.* (1988).

*Specimens examined* (14).—Harmon Co.: 7.2 mi. S, 1 mi. W Hollis, 14 (TTU).

*County records*.—Comanche, Greer, Harmon (Manning *et al*., 1988).

### *Tadarida brasiliensis mexicana* (Saussure, 1860)

Brazilian Free-tailed Bat

The free-tailed bat is a seasonal migrant that can be expected throughout the study area during summer and autumn months. *Tadarida* is a powerful flier, and often ranges miles from its roost to forage each night. It takes advantage of caves, buildings, and bridges for shelter during the day. Caves are preferred as maternity roosts, but to date none of the local caves is known to host such gatherings (Glass, 1982).

*Specimens examined* (104).—Comanche Co.: The Narrows, Wichita Mountains Wildlife Refuge, 2. Greer Co.: 15 mi. W Mangum, 12; 2 mi. W Reed, 67. Harmon Co.: 7.2 mi. S, 1 mi. W Hollis, 23 (TTU).

*County records*.—Comanche, Custer, Greer, Harmon, Jackson, McClain, Murray.

### *Dasypus novemcinctus mexicanus* Peters, 1864

Nine-banded Armadillo

The past century has seen a dramatic spread northward of the armadillo (see, for example, Schultz, 1972; McBee and Baker, 1982). Caire *et al.* (1990) summarized its history in Oklahoma. Our specimens from Greer, Jackson, and Roger Mills counties represent westernmost records from the state, and indicate that the northward migration in Oklahoma is keeping pace with similar documented advancements in the adjacent Texas Panhandle (Jones *et al*., 1988). Because *Dasypus* is adversely affected by cold weather, it will be of interest to continue monitoring the progress of its range expansion.

*Specimens examined* (5).—*Greer Co.: 7.5 mi. W Quartz Mountain State Park, 1. *Jackson Co.: 8 mi. E Altus, 1. *Jefferson Co.: 2 mi. W, 1 mi. S Ringling, 1 (TTU). *Roger Mills Co.: 1 mi. S Cheyenne, 1. Stephens Co.: Lake Waurika, 8 mi. N, 5 mi. W Waurika, 1.

*County records*.—Caddo, Carter, Comanche, Cotton, *Greer, *Jackson, *Jefferson, *Roger Mills, Stephens.

### *Sylvilagus aquaticus aquaticus* (Bachman, 1837)

Swamp Rabbit

The swamp rabbit occupies most of the eastern half of Oklahoma, where swampy, wooded habitat exists. The westernmost record is from the Wichita Mountains of Comanche County, where sightings are not uncommon. Possibly, this rabbit reached these mountains by riparian corridors during relatively recent times, for Glass and Halloran (1961, and cited earlier studies) made no mention of it.

*County records*.—Comanche, Love.

### *Sylvilagus audubonii neomexicanus* Nelson, 1907

Desert Cottontail

The desert cottontail prefers more open, undisturbed, and often rugged habitat than either of the other two species of *Sylvilagus* in the study area. Martin and Preston (1970) took the two specimens from Harmon County in a prairie dog town, and the Caddo County specimen was killed along a roadway through rugged, juniper-cloaked hills—a habitat preference noted earlier by Blair (1954).

*Specimens examined* (3).—*Caddo Co.: 13.5 mi. W Apache, 1. Harmon Co.: 2.25 mi. W, 0.75 mi. N Hollis, 2 (TTU).

*County records*.—*Caddo, Comanche, Harmon, Jackson.

### *Sylvilagus floridanus* (J. A. Allen, 1890)

Eastern Cottontail

The eastern cottontail is the most common and widespread *Sylvilagus* in southwestern Oklahoma. In the Wichita Mountains of Comanche County, the three cottontails known from the region occur together. Where the range of *S. floridanus* overlaps that of the swamp rabbit, the latter occurs in the swampy lowlands. Where the desert cottontail occurs, the eastern cottontail is relegated to disturbed or riparian habitat.

Two subspecies of *S. floridanus* potentially occur in southwestern Oklahoma. The subspecific boundaries as mapped by Hall (1981) indicate western, *S. f. llanensis* Blair, 1938, and eastern, *S. f. alacer* (Bangs, 1896), populations, which presumably intergrade in the central region of our study area—the eastern Wichita Mountains (Blair, 1939, 1954; Glass and Halloran, 1961). We are unable to separate any of our nine Oklahoma specimens from a large and morphologically quite variable

series of eastern cottontails (presumably good *S. f. alacer*) from adjacent Wichita County in northern Texas. Perhaps the zone of intergradation between the two nominal taxa is much broader than previously supposed. However, pending a more detailed study of the situation, we are reluctant to assign specimens arbitrarily to subspecies.

*Specimens examined* (9).—Cotton Co.: 6 mi. SSW Temple, 1; 11 mi. NE Burkburnett, Texas, 1; 4 km. N Randlett, 1; Red River Bridge (Hwy. 277), 2; 6 mi. E Randlett, 1. Harmon Co.: 8 mi. N, 1.5 mi. W Hollis, 1 (TTU). Jefferson Co.: Waurika, 1; 6 mi. W Ringling, 1 (TTU). Tillman Co.: 6 mi. SW Grandfield, 1.

*County records.*—Blaine, Caddo, Canadian, Comanche, Cotton, Custer, Dewey, Garvin, Grady, Harmon, Jackson, Jefferson, Kiowa, Love, McClain, Stephens, Tillman.

### *Lepus californicus melanotis* Mearns, 1890

Black-tailed Jackrabbit

The jackrabbit is a conspicuous member of the local fauna throughout southwestern Oklahoma, although it is less common and of only local occurrence in eastern counties.

*Specimens examined* (2).—Cotton Co.: 4 km. N Randlett, 1. Harmon Co.: 12.5 mi. N, 3.8 mi. W Hollis, 1 (TTU).

*County records.*—Blaine, Caddo, Canadian, Carter, Comanche, Cotton, Custer, Dewey, Garvin, Harmon, Jackson, Jefferson, McClain, Stephens, Tillman.

### *Spermophilus spilosoma marginatus* Bailey, 1890

Spotted Ground Squirrel

The spotted ground squirrel is mostly restricted to the sandy soils of river terraces, where it is commonly found in association with *Dipodomys ordii*. Although diurnal, this is a secretive species. Each of our three specimens were trapped when the anticipated catch was *Dipodomys*.

Three specimens were taken in 1939 from a meadow and prairie dog town in the Wichita Mountains (Glass and Halloran, 1961), but none has been collected there since. Our Cotton County specimens, which are from along the Red River represent easternmost records for Oklahoma. The deep sandy terraces there are dominated by sage and bluestem, which do not extend much farther to the east. Probably this ground squirrel is similarly limited.

*Specimens examined* (3).—*Cotton Co.: 4 mi. N Burkburnett, Texas, 1; 2.5 mi. NE Burkburnett, Texas, 1; 6 mi. SE Randlett, 1.

*County records*.—Caddo, Comanche, *Cotton, Harmon, Jackson, Tillman.

### *Spermophilus tridecemlineatus texensis* Merriam 1898

Thirteen-lined Ground Squirrel

The thirteen-lined ground squirrel is a resident of short-grass prairies, where it often is seen posed conspicuously in an upright position to survey its surroundings. The species is today most common in such situations as parks, cemeteries, and golf courses. Roadsides, which serve as avenues for dispersal, support lesser numbers of individuals.

All specimens of the study area probably are assignable to *Spermophilus tridecemlineatus texensis*, a relatively dark subspecies. However, the range of the distinctly paler *S. t. arenicola* (Howell, 1928) approaches the extreme northwestern corner of the region. We observed, but did not collect, ground squirrels of this species in Roger Mills County, which might have been examples of either subspecific taxon.

*Specimens examined* (2).—Jackson Co.: 3.2 mi. N Altus, 1; Altus AFB, 1.

*County records*.—Beckham, Caddo, Canadian, Comanche, Cotton, Custer, Dewey, Garvin, Greer, Harmon, Jackson, Jefferson, Kiowa, Tillman.

### *Cynomys ludovicianus ludovicianus* (Ord, 1815)

Black-tailed Prairie Dog

The prairie dog is restricted today to isolated towns throughout the western half of Oklahoma. Caire *et al.* (1990) discussed the persecution and subsequent decline of the species in Oklahoma, a decline that ultimately led to a moratorium on control methods by state wildlife officials in 1972.

*Specimens examined* (4).—Comanche Co.: 1 mi. S, 0.8 mi. E Elgin, 1; 0.5 mi. S Elgin, 1. Cotton Co.: 6 mi. W Walters, 1. Kiowa Co.: 8 mi. NW Roosevelt, 1.

*County records*.—Blaine, Canadian, Comanche, Cotton, Custer, Dewey, Garvin, Grady, Greer, Harmon, Jackson, Jefferson, Kiowa, McClain, Roger Mills, Stephens, Washita.

### *Sciurus carolinensis carolinensis* Gmelin, 1788

Gray Squirrel

The gray squirrel barely extends into our study area from the east. Farther east in Oklahoma, it becomes increasingly more important as a game animal, where it is sometimes referred to as the "cat squirrel."

*Sciurus carolinensis* prefers dense, mature hardwood forests, and may be restricted to forested bottomlands where its range overlaps with that of the larger and more versatile fox squirrel, *S. niger*.

This species has been stocked in city parks beyond its natural range, and is, for example, established within the city limits of Lubbock, Texas, on the High Plains. It would not be surprising if such introductions occurred in western Oklahoma at some point in the future.

*County records*.—Garvin, Murray.

### *Sciurus niger rufiventer* É. Geoffroy St.-Hilaire, 1803

Fox Squirrel

The fox squirrel occurs in wooded situations across southwestern Oklahoma, and is commonly found in towns and cities. Its ability to survive in riparian woodlands has permitted it to extend its range far into the western grasslands. Even small, wooded stream banks can sustain populations of *Sciurus niger*.

*Specimens examined* (3).—Comanche Co.: Wichita Mountains Wildlife Refuge, 1; Lawton, 1. Cotton Co.: 5 mi. NW Thornberry, Texas, 1.

*County records*.—Beckham, Blaine, Caddo, Carter, Comanche, Cotton, Custer, Dewey, Grady, Harmon, Jackson, Kiowa, Murray, Stephens, Tillman.

### *Glaucomys volans saturatus* Howell, 1915

Southern Flying Squirrel

Mature hardwood forests, especially those in the vicinity of permanent water, provide the necessary requirements for flying squirrels. Riparian woodlands apparently offer a western dispersal route for *Glaucomys*, perhaps accounting for its recorded (marginal) occurrence in the Wichita Mountains (Caire *et al.*, 1990). We have received reports of occurrence of flying squirrels along the oak woodlands of East Cache Creek in Cotton County, where the attempts of hunters to flush a fox squirrel from the hollow of a dead tree instead rousted a flying squirrel. The species no doubt ranges south from the Wichita Mountains, along the oak woodlands of this waterway.

Special efforts involving setting traps in trees are required to collect most specimens of the flying squirrel; we have seldom taken it from traps set on the ground. Depending on available habitat, specific collecting will no doubt produce records more westerly than those that exist today.

Adjacent specimens of the flying squirrel from Texas were referred by Hall (1981) to *G. v. texensis* Howell, 1915. The wooded banks of the Red River along the eastern half of our study area would seem to minimize the effectiveness of this watercourse as a barrier to gene flow, but the few available specimens prevent the assessment of any intergradation between Texas and Oklahoma specimens.

*Specimens examined* (2).—*Jefferson Co.: 3.5 mi. W Ringling, 1. *Murray Co.: 4 mi. S Dougherty, 1.

*County records*.—Comanche, Garvin, *Jefferson, *Murray.

### *Geomys bursarius*

Plains Pocket Gopher

This pocket gopher occurs throughout southwestern Oklahoma where suitable soil conditions prevail, but is particularly abundant along sandy stream terraces. The *Geomys bursarius* species complex has been extensively investigated in recent years (Baker *et al.*, 1989; Block and Zimmerman, 1991; Bohlin and Zimmerman, 1982; Burns *et al.*, 1985). A distinct subdivision among Oklahoma gophers has been variously interpreted as representing differentiation of specific (Heaney and Timm, 1983) or subspecific (Honeycutt and Schmidly, 1979) magnitude. The taxonomic implications of the generic subdivisions of more northerly populations were discussed by Sudman *et al.* (1987). The issue is yet to be resolved, and we tentatively retain the more conservative subspecific treatments below.

#### *Geomys bursarius major* Davis, 1940

*Specimens examined* (24).—Caddo Co.: 6 mi. E Binger, 1; Apache, 1. Cotton Co.: 3 mi. E Devol, 1; 6 mi. SSW Walters, 1; 1 mi. N Burkburnett, Texas, 1; 2 mi. N Burkburnett, Texas, 1 (TTU); 4 mi. WSW Randlett, 1; 6.7 mi. SW Randlett, 1. Greer Co.: 1.8 mi. E, 2.3 mi. N Granite, 1; 1.3 mi. E, 1.3 mi. N Granite, 1; 8.5 mi. W Quartz Mountains State Park, 2. Harmon Co.: 10 mi. N, 1 mi. W Hollis, 1 (TTU); 0.5 mi. N Gould, 4 (TTU). Jefferson Co.: Red River Bridge (Hwy. 79), near Waurika, 1. Stephens Co.: 3 mi. SE Duncan, 1; Lake Waurika, 8 mi. N, 5 mi. W Waurika, 2; Velma. Tillman Co.: 6.5 mi. WSW Grandfield, 1; 3 mi. W, 4.9 mi. S Grandfield, 1.

*County records*.—Beckham, Caddo, Canadian, Comanche, Cotton, Custer, Dewey, Greer, Harmon, Jackson, Jefferson, Kiowa, Roger Mills, Stephens, Tillman, Washita.

#### *Geomys bursarius sagittalis* (Merriam, 1895)

*Specimen examined* (1).—Love Co.: 2 mi. E Greenville, 1.

*County records*.—Carter, Garvin, Grady, Love, McClain, Murray.

### *Perognathus flavescens copei* Rhoads, 1894

Plains Pocket Mouse

Little is known of the plains pocket mouse in Oklahoma (Caire *et al.*, 1989). It is an uncommon animal in the state, with a preference for sandy sagebrush habitat. Blair (1954) found the species locally abundant in the adjacent Texas Panhandle, but we have been unable to take it in seemingly favorable habitat in the present study area.

*Specimen examined* (1).—Roger Mills Co.: Spring Lake Recreation Area, 1 (TTU).

*County records*.—Blaine, Dewey, Harmon (Martin and Preston, 1970), Roger Mills.

### *Perognathus flavus bunkeri* Cockrum, 1951

Silky Pocket Mouse

The silky pocket mouse exhibits considerable habitat diversity across its range. Blair (1954) found it to be rare in the mesquite plains of northern Texas and extreme southwestern Oklahoma, whereas Martin and Preston (1970) reported it as locally abundant in Harmon County. Our specimen from Cotton County, where the species appears to be quite scarce, is the easternmost record for the state. Curiously, to the south of the Red River, in the mesquite grasslands of northern Texas, *Perognathus flavus* is common (Blair, 1954, Dalquest and Horner, 1984).

Caire *et al.* (1990) noted that four subspecies are mapped (Hall, 1981) as occurring in or adjacent to southwestern Oklahoma. Our study area falls within the range of *P. f. bunkeri*, but inadequate material does not allow an independent assessment of this subspecific assignment.

*Specimens examined* (2).—*Cotton Co.: 0.5 mi. E Red River Bridge (Hwy. 277), 1. Harmon Co.: 6 mi. S, 2.5 mi. W Hollis, 1 (TTU).

*County records*.—*Cotton, Custer, Greer, Harmon, Jackson, Roger Mills.

### *Chaetodipus hispidus spilotus* Merriam, 1889

Hispid Pocket Mouse

The hispid pocket mouse is widespread and at times locally abundant in southwestern Oklahoma. Particularly favored situations seem to be well-drained, friable soils of grasslands, with at least some exposed earth, and even grassy parks of the eastern counties provide suitable habitat. Its characteristic and predictably located burrows make this

one of the few small mammals that can be selectively taken with a single trap. A female captured on 20 October carried a single tiny embryo.

*Specimens examined* (48).—Caddo Co.: 4 mi. E, 2 mi. N Apache, 2; 3.8 mi. E, 1 mi. N Apache, 5.. Comanche Co.: 1 mi. E Meers, 1; north Fort Sill, 1; 8.6 km. E, 3.3 km. S Fort Sill, 4; 3.6 mi. S Cache, 1 (TTU). Cotton Co.: 7 mi. SW Randlett, 2; 0.1 mi. E Red River Bridge (Hwy. 277), 1. Grady Co.: 7.7 mi. E Chickasha County Courthouse, 2 (TTU). *Greer Co.: 10 mi. SE Mangum 1; 8.5 mi. W Quartz Mountains State Park, 4. Harmon Co.: 9 mi. N, 1 mi. W Hollis, 1; 15 mi. N, 1.5 mi. E Hollis, 2 (TTU); 17 mi. N, 2.5 mi. W Hollis, 2 (TTU); 18 mi. N, 9.5 mi. W Hollis, 2 (TTU); 18 mi. N, 9.5 mi. E Hollis, 1 (TTU); 4.5 mi. N Gould, 1 (TTU); 4.5 mi. N, 0.5 mi. W Gould, 1 (TTU). Jefferson Co.: 5.3 mi. SW Waurika, 4. Roger Mills Co.: Spring Lake Recreation Area, 1 (TTU). *Stephens Co.: Lake Waurika, 9.5 mi. N, 5 mi. W Waurika, 1. Tillman Co.: 18 mi. W, 1 mi. S Grandfield, 1; 15 mi. W, 4 mi. S Grandfield, 1; 8 mi. W, 1.5 mi. S Grandfield, 1; 6.5 mi. WSW Grandfield, 4; 3 mi. SE Grandfield, 1.

*County records*.—Beckham, Blaine, Caddo, Canadian, Comanche, Cotton, Custer, Dewey, Garvin, Grady, *Greer, Harmon, Jackson, Jefferson, Kiowa, McClain, Roger Mills, *Stephens, Tillman.

## *Dipodomys elator* Merriam, 1894

Texas Kangaroo Rat

Since the collection of two specimens from Comanche County at the turn of the century (Bailey, 1905), the Texas kangaroo rat was unknown from Oklahoma until Baumgardner's (1987) report of a specimen taken in 1969 from near the Red River bridge in Cotton County. *Dipodomys elator* has been seen in northern Texas traveling along roadways, and the later Oklahoma record may represent an instance of bridge-crossing. We have trapped near the site of that capture on many occasions since 1969, but have failed to produce additional specimens of the Texas kangaroo rat.

Other workers have attempted to discover modern populations in Oklahoma (Martin and Preston, 1970, for example); results of the most recent survey (Moss and Melhop-Cifelli, 1990) led to the conclusion that *D. elator* no longer occurs in the state. However, areas of preferred heavily grazed grassland (Stangl *et al.*, 1992) still exist in southwestern Oklahoma, and continued surveillance for its presence is warranted.

*County records*.—Comanche, Cotton (Baumgardner, 1987).

## *Dipodomys ordii richardsoni* (J. A. Allen, 1891)

Ord's Kangaroo Rat

Ord's kangaroo rat seems absent from the southeastern counties of our study area, but elsewhere it is common and often locally abundant along well-drained, sandy terraces. A female taken on 21 October carried three small embryos.

*Specimens examined* (108).—Caddo Co.: 3.5 mi. E, 1.3 mi. N Apache, 1. Cotton Co.: Red River and Hwy. 277, 63; 5 mi. N Byers, Texas, 2; 2 mi. N Burkburnett, Texas, 1 (TTU); 6 mi. ESE Burkburnett, Texas, 1 (TTU). Greer Co.: 8 mi. S, 4 mi. E Granite, 3; 2.5 mi. N, 1.5 mi. E Granite, 1 (TTU). Harmon Co.: 10 mi. SE Hollis, 6; 17 mi. N, 2.5 mi. W Hollis, 4 (TTU); 15 mi. N, 1.5 mi. E Hollis, 2 (TTU); 1.5 mi. W Gould, 1 (TTU). Jackson Co.: 12 mi. S Altus, 1; 13.6 mi. S Altus, 2. *Jefferson Co.: Waurika, 1; 6 mi. SW Waurika, 1. Roger Mills Co.: Black Kettle National Grasslands, 1 (TTU); Spring Lake Recreation Area, 1 (TTU). Tillman Co.: 4.0 mi. N Tipton, 2; 1.6 mi. S, 0.5 mi. W Davidson, 1; 1.6 mi. S Davidson, 2; 7 mi. N Oklaunion, Texas, 1; 6.8 mi. NNW Burkburnett, Texas, 1; 11 mi. WSW Grandfield, 7; 3 mi. SE Grandfield, 1; 4 mi. SE Grandfield, 1.

*County records*.—Beckham, Blaine, Caddo, Canadian, Cotton, Custer, Dewey, Grady, Greer, Harmon, Jackson, *Jefferson, Kiowa, McClain, Roger Mills, Tillman.

## *Castor canadensis texensis* Bailey, 1905

Beaver

The beaver occurs in southwestern Oklahoma along streams, rivers, and in lakes and stock ponds—just about everywhere that permanent water is found. Where an abundance of trees exist for building materials, as in the eastern counties, its presence along small streams sometimes is marked by dams, less often by lodges. Farther west, often along surprisingly small streams, shelter commonly consists of a burrow into a bank with an underwater entrance. In each instance, however, trees gnawed off near the base provide evidence of their presence. Caire *et al.* (1989) remarked on this scarcity of dams and lodges in western Oklahoma, although on one occasion we observed a dam and small lodge in northwestern Roger Mills County. Three young animals, with their third molars not yet erupted, were obtained from Caddo County on 22 June.

*Castor* is commonly trapped for its pelt in Oklahoma. Subsequent to the earlier depletion of populations of the beaver by fur trappers, intermingling of survivors with transplants from elsewhere probably has obscured subspecific distinctions (Caire *et al.*, 1990). The grounds for our assignment is on geographic grounds only.

*Specimens examined* (7).—Caddo Co.: 3.8 mi. E, 1.6 mi. N Apache, 5. Roger Mills Co.: Spring Lake Recreation Area, 1 (TTU). Stephens Co.: 10 mi. NE Duncan, 1.

*County records*.—Blaine, Caddo, Canadian, Comanche, Cotton, Grady, Jefferson, Kiowa, McClain, Roger Mills, Stephens.

### *Oryzomys palustris texensis* J. A. Allen 1894

Marsh Rice Rat

The rice rat is an uncommon resident of marshy lowlands in southeastern Oklahoma, and almost nothing is known of its habits in the state. The species might be confused with the black rat (*Rattus rattus*) or a pale cotton rat (*Sigmodon hispidus*). It has only recently (Gettinger, 1991) been reported from among cattails along the margins of Lake Murray, at the eastern periphery of our study area, although no voucher specimens were saved. We follow the recent review of the genus in the United States by Humphrey and Setzer (1989) in our subspecific assignment.

### *Reithrodontomys fulvescens laceyi* J. A. Allen, 1896

Fulvous Harvest Mouse

Although common and widespread in the eastern half of Oklahoma, *Reithrodontomys fulvescens* has been reported as scarce (single specimen from Wichita Mountains—Glass and Halloran, 1961) or absent (Blair, 1939, 1954; Martin and Preston, 1970) from the western counties. Dalquest and Horner (1984) recorded an expansion of known range in northern Texas during recent years, and the five new county records presented herein, particularly those from Greer and Kiowa counties, are evidence that the species is similarly spreading in Oklahoma. It is likely that the range of the fulvous harvest mouse is now continuous across western Oklahoma into much of the Texas Panhandle, as was mapped by Hall (1981).

Typical associates of the fulvous harvest mouse include such mesic grassland mammals as *Cryptotis parva*, *Microtus ochrogaster*, and *Sigmodon hispidus*. Where grassy parks in woodland situations also support such species as *Blarina hylophaga*, *M. ochrogaster*, *Peromyscus attwateri*, and *P. leucopus*, we also have found this harvest mouse to be abundant. It appears to be scarce on sandy soils and sparsely vegetated areas, where the smaller plains harvest mouse (*R. montanus*) is present.

Lactating females were taken on 9 and 18 November. A female obtained on 27 April carried four embryos measuring 13 in crown-rump length.

*Specimens examined* (42).—Caddo Co.: 1.5 mi. E, 0.3 mi. N Apache, 1; 2 mi. E Apache, 1; 3.5 mi. E, 1.8 mi. N Apache, 3; 4 mi. E, 1.7 mi. N Apache, 2; 3.7 mi. E, 1 mi. N Apache, 2; 4 mi. E, 2 mi. N Apache, 1; 1 mi. E Apache, 1; 2 mi. S, 1 mi. W Anadarko, 1 (TTU). Comanche Co.: 2 mi. S Meers, 1; 5 mi. SW Boone, 1; 10.7 km. E, 3.7 km. S Fort Sill, 3. *Cotton Co.: north of Burkburnett, Texas, 1; 0.1 mi. E Red River Bridge (Hwy. 277), 2. *Grady Co.: 7.7 mi. E Chickasha, 1. *Greer Co.: 1.3 mi. E, 2.3 mi. N Granite, 2; 2 mi. N, 1.5 mi. E Granite, 4 (TTU). Jefferson Co.: 8 mi. W Waurika, 1; 6 mi. W, 1 mi. N Ringling, 1. *Kiowa Co.: 0.8 mi. W, 1.5 mi. S Mountain View, 7 (TTU). *Love Co.: 2 mi. W Greenville, 1. McClain Co.: 2 mi. E Blanchard, 2 (TTU); 1 mi. W Blanchard, 1 (TTU). Murray Co.: 1 mi. S Dougherty, 1. *Tillman Co.: 1.9 mi. S, 4.2 mi. W Grandfield, 1.

*County records*.—Caddo, Comanche, *Cotton, Garvin, *Grady, *Greer, Jefferson, *Kiowa, *Love, McClain, Murray.

### *Reithrodontomys montanus griseus* Bailey, 1905

Plains Harvest Mouse

The plains harvest mouse is the least common but most widespread of Oklahoma *Reithrodontomys*, occurring locally in grassy regions around the state. However, preferred habitat is the relatively open, sparsely vegetated arid plains of the west, where it is commonly found with *Peromyscus maniculatus*. Three females taken on 12 October, 9 November, and 5 February carried four, four, and five embryos, respectively, measuring (crown-rump) 10, 10, and 11.

*Specimens examined* (11).—*Caddo Co.: 4 mi. E, 2 mi. N Apache, 2; 4.9 mi. E, 4.1 mi. N Apache, 1; 3.7 mi. E, 1 mi. N Apache, 1; 5.5 mi. W, 0.8 mi. N Apache, 1. Comanche Co.: Fort Sill, 1. Cotton Co.: 3 mi. NE Burkburnett, Texas, 1; 6 mi. E Burkburnett, Texas, 1. *Greer Co.: 2 mi. N, 1.5 mi. E Granite, 1 (TTU). Harmon Co.: 4.5 mi. N Gould, 1 (TTU). Tillman Co.: 3.5 mi. SW Grandfield, 1.

*County records*.—*Caddo, Canadian, Comanche, Cotton, Custer, Dewey, *Greer, Harmon, Jackson, McClain, Roger Mills, Tillman.

### *Peromyscus attwateri* J. A. Allen, 1895

Texas Mouse

Broken (and usually rocky), wooded habitat is preferred by the Texas mouse. It is an adept climber, and even traps set in trees for flying squirrels take an occasional specimen of the Texas mouse. Caire *et al.* (1990) claimed that *Peromyscus attwateri* can be taken on every rocky ledge from every mountain in the Wichita Mountains, and our ex-

perience there and elsewhere in suitable habitat suggests this is true. Where conditions are favorable, this mouse is usually extremely abundant. The number of embryos carried by four females taken on 20 October were four, four, five, and six, respectively, measuring 14, 21, 23, and 9 in crown-rump length.

*Specimens examined* (38).—Comanche Co.: Wichita Mountains, 6; 9 mi. NNW Indiahoma, 13; Cache, 1; 3 mi. N, 0.3 mi. E Medicine Park, 1. *Greer Co.: 10 mi. N Altus, 2; Quartz Mountains State Park, 1. Kiowa Co.: 19 mi. S, 2 mi. E Mountain View, 1; 15.6 mi. W Apache, 13.

*County records*.—Caddo, Carter, Comanche, Custer, *Greer, Jackson, Kiowa, Murray, Washita.

### *Peromyscus leucopus* (Rafinesque, 1818)

White-footed Mouse

The white-footed mouse is one of the most common of Oklahoma mammals. This species is ubiquitous in the study area. Caire *et al.* (1990) observed that few species of Oklahoma mammals have not been taken in association with *Peromyscus leucopus*.

The species has not been revised since Osgood (1909), whose study indicated the occurrence of *P. l. tornillo* in the extreme northwestern (Roger Mills County) corner of our study area, and of *P. l. texanus* in the south-central region (southern Tillman and Cotton counties). Intergrading populations (those not assignable to a defined subspecies—Osgood, 1909) were indicated as occupying the western half of our area, whereas no specimens were available to Osgood from the remaining eastern counties. Subsequent workers of the region have offered only tentative or qualified (taking into account individual variation and intergrade populations) subspecific assignments (Blair, 1939, 1945; Martin and Preston, 1970). We decline to follow these earlier examples.

A distinct genetic subdivision within the distribution of the species has been documented (Baker *et al.*, 1983), which divides the overall range into approximately equal northeastern and southwestern halves. The zone of intergradation, described on the basis of independent chromosomal (Stangl, 1986) and biochemical (mitochondrial DNA and protein—Nelson *et al.*, 1987) studies, appears to extend across the northern tier of counties in our study area. The subspecific implications of these findings were discussed by Stangl and Baker (1984), who concluded that any valid subspecific boundaries must reflect this major genetic subdivision.

Reproductive activity in southern Oklahoma exhibits peaks in June and November, and is largely suppressed in August and January (Stangl, 1984). Reproductive data collected subsequent to that study are as follows. Five females taken in October had embryo counts (and respective crown-rump measurements) of four (8), four (16), five (4), five (12), and six ("tiny"). Embryo counts (and respective crown-rump measurements) for three November-taken animals were four (18), five (3), and six (16). A female obtained in December carried three embryos measuring 11.

*Specimens examined* (313).—Blaine Co.: 1.5 mi. S, 2 mi. E Roman Nose State Park, 2 (TTU). Caddo Co.: 0.5 mi. N Apache, 1; 0.3 mi. N Apache, 5; 1.5 mi. E, 1.3 mi. N Apache, 1; 1 mi. E Apache, 2; 1.2 mi. E, 0.5 mi. S Apache, 1; 1.9 mi. W jct. Hwys. 21 and 9 in Anadarko, 24 (TTU); 2 mi. S, 1 mi. W Anadarko, 4 (TTU); 1.4 mi. N Fort Cobb, 12 (TTU). Carter Co.: 2 mi. W Springer, 1. Comanche Co.: 2 mi. S Meers, 1; 6 mi. W Wichita Mountains Wildlife Refuge, 1; Wichita Mountains Wildlife Refuge, 1; Wichita Mountains, 3; Camp Boulder, 2; 9 mi. NNW Indiahoma, 3; 10.7 km. E Fort Sill, 1; 7.9 km. E, 3.7 km. S Fort Sill, 2; 8.6 km. E, 3.3 km. S Fort Sill, 1; 11 mi. E Lawton, 1; 9 mi. W, 6 mi. S Lawton, 1; 6.5 mi. S, 2 mi. W Cache, 8 (TTU); 5 mi. SSW Cache, 3 (TTU). Cotton Co.: near jct. Red River and Hwy. 277, 27; 2 mi. N Burkburnett, Texas, 3 (TTU); 3.2 mi. W Temple on East Cache Creek, 2; Cache Creek, 2 mi. E Taylor, 4. Grady Co.: 7.7 mi. E Chickasha County Courthouse, 13 (TTU). *Greer Co.: 1.8 mi. E, 2.8 mi. N Granite, 1; 8 mi. S, 4 mi. E Granite, 2; 8.5 mi. W Quartz Mountains State Park, 10; Quartz Mountain State Park, 2; 2 mi. N, 1.5 mi. E Granite, 1 (TTU). Harmon Co.: 10 mi. N, 1 mi. W Hollis, 6 (TTU); 7.5 mi. S, 3 mi. E Hollis, 1 (TTU); 12.5 mi. N, 7.5 mi. E Hollis, 1 (TTU); 15 mi. N, 1.5 mi. E Hollis, 1 (TTU). Jackson Co.: 7 mi. SW Eldorado, 2; 12 mi. S Altus, 1; 10 mi. S Altus, 1 (TTU). Jefferson Co.: 6 mi. W Ringling, 4 (TTU); 6 mi. W, 1 mi. N Ringling, 2; 3.5 mi. W Ringling, 2; 3 mi. W Ringling, 2 (TTU); 2.5 mi. W, 0.5 mi. S Ringling, 2; 3 mi. W Ringling, 7; 5.5 mi. N Byers, Texas, 1; Red River Bridge (Hwy. 79), 2. Kiowa Co.: 19 mi. S, 2 mi. E Mountain View, 2; 0.8 mi. W, 1.5 mi. S Mountain View, 1. *Love Co.: 2 mi. W Greenville, 1. McClain Co.: 2 mi. E Blanchard, 33 (2 MWSU, 31 TTU); 1 mi. W Blanchard, 54 (TTU); 2 mi. E Raiford, 3 (TTU). Murray Co.: 2 mi. S Dougherty, 4. Roger Mills Co.: Spring Creek Recreational Area, 11 (TTU). Stephens Co.: 8 mi. NE Duncan, 1; Lake Waurika, 8 mi. N, 5 mi. W Waurika, 3. Tillman Co.: 2 mi. W Hwy. 183 and Red River, 1; 1.6 mi. S Davidson, 1; 7 mi. N Oklaunion, Texas, 1; 6.5 mi. WSW Grandfield, 2; 6.6 mi. W, 4 mi. S Grandfield, 1; 6 mi. SW Grandfield, 1,; 2 mi. S Grandfield, 1; 3 mi. W, 4.9 mi. S Grandfield, 1; 11 mi. WSW Grandfield, 10.

*County records.*—Blaine, Beckham, Caddo, Canadian, Carter, Comanche, Cotton, Custer, Dewey, Garvin, Grady, *Greer, Harmon, Jackson, Jefferson, Kiowa, *Love, McClain, Murray, Roger Mills, Stephens, Tillman, Washita.

### *Peromyscus maniculatus* (Wagner, 1845)

Deer Mouse

*Peromyscus maniculatus* is a widespread species. Although usually uncommon, we have found that this mouse can be locally abundant, especially in relatively undisturbed expanses of grasslands where it is the only *Peromyscus* present. Common associates include *Perognathus flavus*, *Reithrodontomys montanus*, *R. fulvescens*, *Microtus ochrogaster*, and *Onychomys leucogaster*.

The systematic relationships among populations of *P. maniculatus* are complex and not fully understood. Caire and Zimmerman (1975) examined chromosomal and morphological variation among the species in Oklahoma, where *P. m. ozarkiarum* (at the eastern edge of our study area) intergrades with *P. m. luteus* (occupying the western three-quarters or more of the region) to the west, but not with adjacent populations of *P. m. pallescens* in Texas. Lacking chromosomal characters of the two Oklahoma subspecies makes definitive subspecific assignments of specimens from near the point of contact tenuous.

Embryo counts and respective measurements (crown-rump) for gravid females are as follows: September, five (8); October, four (24), five (4), five (5), and six (5); November, five (7) and six (15); and December, five (8).

*Specimens examined* (107).—Blaine Co.: 5 mi. W Canton, 1 (TTU). Caddo Co.: 4 mi. E, 2 mi. N Apache, 2; 4 mi. E, 1.7 mi. N Apache, 6; 3.5 mi. E, 1.3 mi. N Apache, 12; 0.3 mi. N, 1.5 mi. E Apache, 4; 0.5 mi. N Apache, 1; 1 mi. E Apache, 1; 5 mi. W, 3 mi. S Apache, 3. Comanche Co.: 5 mi. W, 3 mi. S Apache, 2; Wichita Mountains, 1; 2 mi. S Meers, 1; Fort Sill, 1; 7.9 km. E, 3.7 km. S Fort Sill, 1; 11 mi. E, 4.5 mi. S Lawton, 4; 3.5 mi. S Cache, 2 (1 MWSU, 1 TTU); 9 mi. W, 6 mi. S Lawton, 2; Cotton Co.: 3 mi. E Devol, 1; 5.2 mi. NNE Burkburnett, Texas, 1. 6.7 mi. SW Randlett, 1; 1 mi. N, 2 mi. E Burkburnett, Texas, 1; 5 mi. N Byers, Texas, 1. Custer Co.: 4 mi. N, 0.3 mi. W Weatherford, 1. *Dewey Co.: 3.3 mi. W Canton, 3 (TTU). Grady Co.: 7.7 mi. Chickasha County Courthouse, 1 (TTU). Greer Co.: 8.5 mi. W Quartz Mountains State Park, 1. Harmon Co.: 12.5 mi. N, 7.5 mi. E Hollis, 3 (TTU); 1.5 mi. W Int. Hwy. 30 and Elm Creek fork of Red River, 2 (TTU). Jefferson Co.: 2 mi. S Waurika, 1; Terral, 2. Kiowa Co.: 19 mi. S, 2 mi. E Mountain View, 1; 1.8 mi. S, 0.9 mi. W Mountain View, 22 (TTU); 0.8 mi. W, 1.5 mi. S Mountain View, 9 (TTU). *Stephens Co.: Lake Waurika, 8 mi. N, 5 mi. W Waurika, 3. Tillman Co.: 1.6 mi. S Davidson, 1; 19 mi. W, 1 mi. S Grandfield, 1; 11 mi. WSW Grandfield, 1; 2 mi. W Grandfield, 1; 5 mi. S Grandfield, 1. Washita Co.: 2 mi. W Burns Flat, 5 (TTU).

*County records*.—Beckham, Blaine, Caddo, Canadian, Carter, Comanche, Cotton, Custer, *Dewey, Garvin, Grady, Greer, Harmon, Jackson, Jefferson, Kiowa, McClain, Murray, Roger Mills, *Stephens, Tillman, Washita.

### *Peromyscus pectoralis laceianus* Bailey, 1906

Encinal or White-ankled Mouse

The range of *Peromyscus pectoralis* in Oklahoma seems limited to a series of limestone ledges in oak woodland near Marietta, Love County. Kilpatrick and Caire (1973) found the species in association with *P. leucopus* and *Neotoma floridana,* but *P. attwateri* (which prefers similar habitat) was locally absent.

The subspecific status of Oklahoma and adjacent Texas populations was reviewed by Schmidly (1972) and Kilpatrick and Zimmerman (1976).

*County record.*—Love (Kilpatrick and Caire, 1973).

### *Baiomys taylori taylori* (Thomas, 1887)

Northern Pygmy Mouse

The pygmy mouse is a species of subtropical grasslands that has been spreading north and west through Texas in recent years (Choate *et al.*, 1990). *Baiomys* now occurs throughout most of north-central Texas and into the southern Panhandle of that state (Jones and Jones, 1992), but until quite recently (Stangl and Dalquest, 1986), it was unknown from Oklahoma. The adverse affects that severe spells of cold weather are known to have on northerly populations of the pygmy mouse (Stangl and Kasper, 1987) result in the periodic stalling or reversal of northward movements. Caire (1991) reported on a breeding population of *Baiomys* found in 1989 in southern Harmon County, and from a locality where the species had not been taken during trapping efforts in the preceding several years. The advance nevertheless seems persistant, and *B. taylori* now is to be looked for throughout the southernmost tier of counties in southwestern Oklahoma.

*Specimen examined* (1).—Cotton Co.: 2 mi. NE Burkburnett, Texas, 1.

*County records.*—Cotton (Stangl and Dalquest, 1986), Harmon (Caire, 1991).

### *Onychomys leucogaster breviauritus* Hollister, 1913

Northern Grasshopper Mouse

*Onychomys leucogaster* is seldom abundant in southwestern Oklahoma, except for patches of favored habitat. This grasshopper mouse is closely associated with sandy river terraces, where it is found with *Dipodomys ordii.* One individual was trapped while still partially

emerged in the vertical burrow of a hispid pocket mouse, *Chaetodipus hispidus*.

*Specimens examined* (15).—Caddo Co.: 4 mi. E, 2 mi. N Apache, 1. Greer Co.: 1.8 mi. E, 2.3 mi. N Granite, 2; 8.5 mi. W Quartz Mountains State Park, 2. Harmon Co.: 10 mi. SE Hollis, 1; 12.5 mi. N, 7.5 mi. E Hollis, 1 (TTU); 17 mi. N, 2.5 mi. W Hollis, 1 (TTU); 4 mi. N, 0.5 mi. W Gould, 1 (TTU); 8 mi. N, 1.5 mi. W Gould, 1 (TTU). Roger Mills Co.: Spring Creek Recreational Area, 2 (TTU). Tillman Co.: 18 mi. W, 0.5 mi. S Grandfield, 1; 17 mi. W, 1.5 mi. S Grandfield, 2.

*County records*.—Blaine, Caddo, Canadian, Custer, Dewey, Greer, Harmon, Jackson, Roger Mills, Tillman.

### *Sigmodon hispidus texianus* (Audubon and Bachman, 1853)

Hispid Cotton Rat

*Sigmodon hispidus* occurs nearly everywhere that sufficient grassy cover permits the construction and maintenance of its characteristic runways. These passageways are shared with a variety of small mammals, including *Cryptotis*, *Peromyscus*, and *Reithrodontomys*. The cotton rat is far more abundant than our numerous collection records below would indicate, because collectors seldom have the time to save each specimen taken from every locality.

Embryo counts (and respective crown-rump measurements) for females taken in the following months are: June, seven (23); September, 10 (24); and October, six (25) and seven (18).

*Specimens examined* (59).—Caddo Co.: 2 mi. S, 1 mi. W Anadarko, 4 (TTU). *Carter Co.: 2 mi. N Ardmore, 1. Comanche Co.: 9 mi. NNW Indiahoma, 1; 1 mi. W Lawton, 1; 9 mi. W, 6 mi. S Lawton, 1. Cotton Co.: 3.2 mi. W Temple on East Cache Creek, 1; 5.2 km. W Randlett, 1; near jct. Red River and Hwy. 277, 4; 1 mi. NE Burkburnett, Texas, 1; 2 mi. NE Burkburnett, Texas, 1; 5.2 mi. NE Burkburnett, 1. *Greer Co.: 8.5 mi. W Quartz Mountains, 3. Harmon Co.: 9 mi. N, 1 mi. W Hollis, 2; 10 mi. N, 1 mi. W Hollis, 3 (TTU). Jackson Co.: 0.5 mi. N Altus, 1; 7 mi. SW Eldorado, 1. *Jefferson Co.: 6 mi. W, 1 mi. N Ringling, 1; 5.3 mi. SW Waurika, 1. McClain Co.: 2 mi. W Blanchard, 10 (TTU); 1 mi. W Blanchard, 4 (TTU). Roger Mills Co.: Spring Creek Recreational Area, Black Kettle National Grasslands, 7 (TTU). Stephens Co.: Lake Waurika, 8 mi. N, 5 mi. W Waurika, 2. Tillman Co.: 2.8 mi. W Tipton, 1; 17 mi. W, 1.5 mi. S Grandfield, 1; 15 mi. W, 4 mi. S Grandfield, 1; 11 mi. WSW Grandfield, 1; 6.5 mi. WSW Grandfield, 3.

*County records*.—Beckham, Blaine, Caddo, Canadian, *Carter, Comanche, Cotton, Custer, Dewey, Garvin, Grady, *Greer, Harmon, Jackson, *Jefferson, Kiowa, McClain, Murray, Roger Mills, Stephens, Tillman.

## *Neotoma floridana attwateri* Mearns, 1897

Eastern Woodrat

The eastern woodrat occupies the eastern woodlands of our study area. It often builds its large, conspicuous stick nests at the bases of trees, shrubs, or other structures. We observed one such nest that actually extended up a low-lying branch that was in contact with the main nest to a second chamber situated about six feet off the ground in an oak tree. Other den sites commonly included hollow logs, deserted buildings, rock crevices, and caves. Occasional animals apparently do not construct a nest, for we have taken these rats in traps set by inconspicuous burrows at the bases of trees in areas that were devoid of typical nests.

All woodrats can climb, but *Neotoma floridana* appears to be a particularly nimble (if somewhat cautious), partly arboreal species. The cambium of tender twigs provides at least seasonal nutrition for this rat, for the ground surrounding several nests (one early March) were found to be littered with short sections of denuded branches (probably of the dominant hackberry). Vast expanses of bark also had been stripped from the upper reaches of large hackberry trees along the near-by floodplain—presumably from animals stranded for a time above flood waters. In Caddo County, traps set in the crotches of oak trees 20 to 30 feet above ground, where piles of acorn hulls suggested *Glaucomys*, took only *N. floridana*. The climbing ability of the eastern woodrat was demonstrated for us by an animal routed from its nest that easily negotiated thin branches more than 30 feet above the ground. Females taken in February and March, respectively, carried two and three embryos measuring 30 and 16 in crown-rump length.

Caire *et al.* (1990) listed *N. f. osagensis* as the subspecies of southwestern Oklahoma, following Hall (1981). However, in the most recent revision of the species, apparently overlooked by Hall, Birney (1973) synonomized this taxon under *N. f. attwateri*.

Specimens examined (25).—Caddo Co.: 3.5 mi. E, 1.5 mi. N Apache, 1; 1.5 mi. E, 0.3 mi. N Apache, 1. Comanche Co.: 0.6 mi. W Wichita Mountains Wildlife Refuge, 1; 7.9 km. E, 3.7 km. S Fort Sill, 1. Cotton Co.: 6 mi. SSW Walters, 1; 1 mi. N, 1 mi. E Burkburnett, Texas, 3; 4 mi. S Randlett, 1. *Jefferson Co.: 6 mi. W Ringling, 1; 6 mi. SW Waurika, 2; 7 mi. NE Byers, Texas, 1 (TTU). *Kiowa Co.: 15.6 mi. W Apache, 1. *Love Co.: 2 mi. W Greenville, 2. McClain Co.: 2 mi. E Blanchard, 2 (TTU); 1.1 mi. W Blanchard, 1 (TTU); 1 mi. W Blanchard, 4 (TTU). Murray Co.: 1.5 mi. S Dougherty, 1; 2 mi. S Dougherty, 1.

*County records*.—Blaine, Caddo, Canadian, Carter, Comanche, Cotton, Custer, Dewey, Grady, *Jefferson, *Kiowa, *Love, McClain, Murray.

### *Neotoma micropus canescens* J. A. Allen, 1891

Southern Plains Woodrat

The southern plains woodrat occupies the more arid and open western parts of the study area. The ranges of this animal and the closely related eastern woodrat are mutually exclusive, the eastern boundary of the range of *Neotoma micropus* coinciding almost precisely with the western limits of *N. floridana*.

Despite the often close proximity of the two species (and their capability of producing viable young under laboratory conditions), natural hybridization is unknown in southwestern Oklahoma. Birney (1973), however, detailed the breakdown in reproductive isolation between the two species at a site just to the north in Major County. Along the southern bank of Red River in Cotton County, the eastern woodrat occurs under and to the east of the bridge, whereas we took *N. micropus* only 100 yards west of the same bridge (from higher on the bank, therefore in Texas, and so not listed herein). Specimens have been taken from this point of contact at intervals over several years, and none has evinced intermediate characteristics. A female taken on 14 August carried four embryos measuring 10 in crown-rump length.

Caire *et al.* (1990) followed Hall's (1981) major subdivision of *N. micropus*. While recognizing the variability within the subspecies *N. m. canescens*, Birney (1973) chose to retain all United States specimens of the species under this heading. We follow Birney's review.

*Specimens examined* (66).—Greer Co.: 8 mi. S, 4 mi. E Granite, 1; 10 mi. SE Mangum, 1; 8.5 mi. W Quartz Mountains State Park, 3. Harmon Co.: 1 mi. W Oklahoma Hwy. 30 and Elm Fork of Red River, 4 (TTU); 5.5 mi. N, 2 mi. W Hollis, 8 (TTU); 5 mi. N, 2 mi. W Hollis, 1 (TTU); 2.5 mi. S, 11 mi. E Hollis, 1 (TTU); 7.5 mi. S, 3 mi. E Hollis, 1 (TTU); 10 mi. W Hollis, 1 (TTU); 6.4 mi. S Hollis, 36; lower slope of Elm Fork, Red River, 2 (TTU); 10 mi. N, 1 mi. W Hollis, 1 (TTU); 1.5 mi. N, 0.5 mi. W Gould, 1 (TTU); 4.5 mi. N, 2.5 mi. W Gould, 1 (TTU); 1 mi. W jct. Hwy. 30 and Elm Fork of Red River, 1 (TTU). Roger Mills Co.: Spring Creek Recreational Area, 2 (TTU). Tillman Co.: 4.0 mi. N Tipton, 1.

*County records*.—Beckham, Greer, Harmon, Jackson, Kiowa, Roger Mills, Tillman.

### *Microtus ochrogaster haydenii* (Baird, 1858)

Prairie Vole

The southernmost known population of *Microtus ochrogaster* is found on the artillery firing range of Fort Sill in the Wichita Mountains of Comanche County. Choate (1989) reported that this vole preferred well-drained soils dominated by a variety gramma grasses, but avoided denser, tall bunch grasses and lower, damper habitats. Common associates were *Blarina, Cryptotis, Chaetodipus hispidus,* and *Reithrodontomys fulvescens*. However, the most abundant of small mammal species was *Sigmodon hispidus*, which tended to force *Microtus* into small, isolated colonies. The artillery range is protected from other human activities that would adversely affect the habitat, and the results are favorable to *M. ochrogaster*. If the recent reduction of defense spending should result in abandonment of this range or change in its usage, this population might become endangered, and, therefore, should be closely monitored.

The isolation of the Wichita Mountains voles from more northerly Oklahoma populations seems not to be complete, for Smith (1992) collected two specimens in adjacent Caddo County, and one of us (WWD) observed a low-flying raven in Roger Mills County carrying a vole in its bill. Recent records of the prairie vole from the Texas (Jones *et al.*, 1988) and Oklahoma (Dalquest *et al.*, 1990; Dalquest and Baskin, 1991; Reed and Choate, 1988) panhandles further support the possibility of a more continuous distribution of the species in our study area.

Choate (1989) reported reproductive activity in the Comanche County population during every month of the year except July and August. For 12 adult females, litter sizes ranged from one to six (mean 3.0).

*Specimens examined* (73).—Caddo Co.: 3.8 mi. E, 1.8 mi. N Apache, 2. Comanche Co.: 7.9 km. E, 3.7 km. S Fort Sill, 18; 8.6 km. E, 3.3 km. S Fort Sill, 23; 10.4 km. E, 1.8 km. S Fort Sill, 5; 10.1-10.7 km. E, 3.7 km. S Fort Sill, 25.

*County records*.—Caddo (Smith, 1992), Comanche (Choate, 1989).

### *Microtus pinetorum nemoralis* Bailey, 1898

Woodland Vole

We have taken this uncommon vole in its deeply cut runways under the protective thatch of grassy parks among stands of oak, but also under other circumstances (for example, in the leaf litter of dense

forest, and in rank, overgrown vegetation of railroad rights-of-way) in the absence of runways or other obvious evidence of its presence.

*Specimens examined* (10).—Comanche Co.: near Crater Lake, Wichita Mountains Wildlife Refuge, 3. *Love Co.: 2 mi. E Greenville, 1. McClain Co.: 1.1 mi. W Blanchard, 1 (TTU); 1 mi. W Blanchard, 1 (TTU). *Murray Co.: 0.5 mi. SSE Dougherty, 1; 2 mi. S Dougherty, 3.

*County records*.—Caddo, Carter, Comanche, *Love, McClain *Murray.

### *Ondatra zibethicus cinnamominus* (Hollister, 1910)

Muskrat

The muskrat probably occurs in some numbers throughout most of our study area where permanent water exists. It is apparently most common in northeastern Oklahoma, and progressively scarcer to the south and west in the state (Caire *et al.*, 1990).

Martin and Preston (1970 and references cited therein) report muskrats from Harmon County as inhabiting lakes and waterways in sandsage habitat. We have observed this species a short distance to the northwest in Donley County, Texas (Stangl *et al.*, 1989), under similar circumstances, and from where we recovered the remains of one animal from the regurgitated pellets of a great horned owl (*Bubo virginianus*).

*County records*.—Caddo, Jackson, Kiowa.

### *Erethizon dorsatum epixanthum* Brandt, 1835

Porcupine

*Erethizon dorsatum* occurs throughout the study area, but it can be surprisingly inconspicuous for an animal of its size and familiarity. Residents often are unaware of its presence until the telltale quills are removed from the pelt of a skinned furbearer, or from domestic dogs. Voucher specimens are typically the skulls of individuals killed on highways by automobiles. We follow Stangl *et al.* (1991) in assigning all Oklahoma porcupines to *E. d. epixanthum*.

*Specimens examined* (1).—*Tillman Co.: 3 mi. S Davidson, 1.

*County records*.—Comanche, Custer, Garvin, Greer, Harmon, Jackson, Kiowa, Roger Mills, *Tillman.

### *Myocastor coypus* (Molina, 1782)

Nutria

The nutria has been raised commercially for its fur, but accidental escapes and purposeful introductions into the wild have led to established populations of this semiaquatic South American furbearer throughout much of the United States (Hall, 1981). A nutria farm once existed in north-central Oklahoma (Garfield County) during the 1960s, and regionally, *Myocastor* was introduced near Hinton (Caddo County) and Fort Sill (Comanche County) during the early 1950s (Caire *et al.*, 1990). Although no voucher specimens appear to exist for the species in the region, it can be expected throughout the study area in conditions preferred by muskrat and beaver.

### *Canis latrans* Say, 1823

Coyote

The coyote is a ubiquitous carnivore in our study area. We took only two specimens (both road-killed animals), but the species was heard at night from nearly all sites at which we collected, and individuals often were sighted crossing roadways during daylight hours.

Halloran and Glass (1959) reported that the jackrabbit and various invertebrates comprised the bulk of food items of 48 mostly winter-taken coyotes from the Wichita Mountains, and cited an observation where *Canis latrans* killed three pronghorn on that wildlife refuge.

With the extermination of larger carnivores from the study area, the coyote has no natural enemy save man. It is widely trapped for its pelt, and Martin and Preston (1970) reported that coursing this fleet canid with dogs is a locally popular pastime. One landowner informed us of an infestation of red mange in coyotes from south-central Oklahoma in the late 1970s. The animals presumably were infected from a domestic dog, and starving, practically denuded coyotes were common for a time. Few survived the winter, and populations remained below normal for a few years thereafter.

Hall (1981) indicated that the western third of our study area is occupied by *C. l. latrans* Say, 1823, whereas eastern populations are referred to *C. l. frustror* Woodhouse, 1851—an arrangement followed by Caire *et al.* (1990).

*Specimens examined* (3).—Cotton Co.: 8 mi. S Temple, 1 (TTU). Harmon Co.: 7.5 mi. S, 3 mi. E Hollis, 1 (TTU). Jackson Co.: 3.8 mi. W Tipton, 1.

*County records.*—Beckham, Canadian, Comanche, Cotton, Custer, Dewey, Grady, Harmon, Jackson, Jefferson, Kiowa, Love, McClain, Murray.

### *Canis lupus nubilis* Say, 1823

Gray Wolf

The gray wolf probably never was common in southwestern Oklahoma as the region is situated along the southeastern limits of its recent historic range. The few early historical accounts from the state are summarized by Tyler and Anderson (1990), although early travelers often failed to distinguish between the wolf and smaller coyote. Of interest to this report are the included nonverified reports of the wolf from the Wichita Mountains in the mid-1700s, and from the Canadian River of central Oklahoma in 1820.

Halloran and Glass (1959) indicated that four specimens were taken from the Wichita Mountains in 1906, and that sightings persisted there until 1933. Since that time, occasional subfossil remains have been recovered from caves in western Oklahoma (Woodward County—Caire *et al.*, 1990), and Goetze (1989) reported the ulna of a wolf from presumably Pleistocene sediments in Tillman County.

*County records.*—Comanche.

### *Canis rufus rufus* Audubon and Bachman, 1851

Red Wolf

The red wolf probably occurred as far west in Oklahoma as the Wichita Mountains. As its numbers declined, the genetic integrity of this species was destroyed by introgression from coyotes and possibly dogs. Pure red wolf stock may have disappeared from Oklahoma by the turn of the century, and most museum specimens of "*Canis rufus*" taken since then were determined to be large coyotes or red wolf-coyote hybrids (Nowak, 1979). The uncertainty of distinguishing large coyotes from the red wolf or wolf-coyote hybrids (Nowak, 1979) necessitates that records based on red wolves taken in late years be accepted with caution.

Sightings of wolves are occasionally reported in eastern Oklahoma and farther west along the Red River, but these likely relate to large coyotes or perhaps coyote-dog crosses.

*County records.*—Comanche, Garvin, Tillman.

### *Vulpes vulpes fulva* (Demarest, 1820)

Red Fox

The red fox occurs throughout the state where sufficiently dense cover exists. Tyler (1979) reported on the occurrence of the species in western Oklahoma, and offered evidence that it has spread westward in the state only since the 1960s, and is successfully reproducing in Custer, Jackson, Kiowa, and Tillman counties. The success of this species has apparently been at some expense to the gray fox (Caire *et al.*, 1990). *Vulpes vulpes* is hunted and trapped for its pelt, but the uncertainty of its status in the state led to a closing the harvest season in 1976 (Hatcher, 1982).

The validity of the subspecific taxonomy of the red fox is questionable, given that it has been widely transplanted for sporting purposes. Tyler (1979) cited a transplant of some Minnesota-taken red foxes to Dewey County in the early 1970s.

*Specimen examined* (1).—Jackson Co.: near Altus, 1.
*County records*.—Jackson, Kiowa, Tillman.

### *Urocyon cinereoargenteus ocythous* Bangs, 1899

Gray Fox

This fox commonly inhabits rough, broken country, preferably in the presence of woodlands. It is an important and easily trapped furbearing species. Halloran and Glass (1959) recounted earlier reports that indicated this fox was scarce to nonexistent in the Wichita Mountains in the early 1900s, but it had become abundant by the 1940s and 1950s.

*Urocyon* is an opportunistic omnivore. Stomach contents of animals taken in the Wichita Mountains revealed insects, *Peromyscus*, and parts of a rabbit according to Halloran and Glass (1959). Those authors also cited the report of an adult wild turkey being killed and partially eaten by a gray fox.

Subspecific assignment is tentative, and based on geographic grounds. The Red River boundary between Oklahoma and Texas is mapped as separating *U. c. ocythous* from *U. c. floridanus* Rhoads, 1895, to the south in Texas.

*Specimens examined* (2).—*Cotton Co.: 5 mi. SSW Walters, 1; 8 mi. S Temple, 1.
*County records*.—Caddo, Comanche, *Cotton, Kiowa, Murray.

### *Ursus americanus americanus* Pallas, 1780

Black Bear

Although the black bear once may have ranged throughout Oklahoma (Tyler and Anderson, 1990), by the 1900s the species seems to have persisted regionally only in the Wichita Mountains of Comanche County. Sightings occurred there as late as 1934 (Halloran and Glass, 1959; Halloran, 1963). Our specimen from Tillman County is the lower jaw of an adult bear, probably dating to pre-Columbian times.

*Specimen examined* (1).—Tillman Co.: 10 mi. E, 2 mi. S Davidson, 1.
*County record*.—Comanche, Tillman (Stangl and Dalquest, 1986).

### *Bassariscus astutus flavus* Rhoads, 1894

Ringtail

The ringtail is documented in southwestern Oklahoma mostly from rugged, woodland habitat associated with rock outcrops. It is a secretive species that apparently escaped the earlier notice of Halloran and Glass (1959) during their inventory of Wichita Mountains carnivores.

*County records*.—Comanche, Greer, Jackson, Jefferson, Kiowa, McClain, Tillman.

### *Procyon lotor hirtus* Nelson and Goldman, 1930

Common Raccoon

In our study area, the raccoon may be the most abundant carnivore. Its remains are commonly found along roadways, especially where they intersect streams and rivers. *Procyon* is an important furbearer, but is often numerous and bold enough to become a pest, especially within the boundaries of parks and wildlife refuges, where it is protected. Halloran and Glass (1959) reported the species becoming numerous enough in the Wichita Mountains to be live-trapped for export elsewhere in the state. Animals at one state park began foraging through empty camp sites at sundown, and repeatedly invaded our occupied camp after dark. A later visitor told us that these animals disappeared after one fall when the price of raccoon pelts exceeded 30 dollars in value.

The raccoon sometimes also interferes with collecting activities of scientists. One particularly persistent individual literally tore open the side of an aluminum Sherman live trap to remove a captured eastern woodrat, leaving only some fur and blood.

*Specimens examined* (10).—Carter Co.: 2 mi. W Baum, 2. *Cotton Co.: 6 mi. N Randlett, 2. Comanche Co.: Wichita Mountains Wildlife Refuge, 1. *Jefferson Co.: 13 mi. E Waurika, 1; 5 mi. W Ringling, 1; 5 mi. N Byers, Texas, 1. *Kiowa Co.: 3 mi. NW Snyder, 1 (TTU). Stephens Co.: 4 mi. S Loco, 1 (TTU).

*County records.*—Caddo, Carter, Comanche, *Cotton, Custer, Dewey, Garvin, Grady, Harmon, *Jefferson, McClain, Stephens, Tillman.

### *Mustela nigripes* (Audubon and Bachman, 1851)

Black-footed Ferret

The range of the black-footed ferret probably once coincided closely with that of *Cynomys ludovicianus*, thus enveloping all but the eastern-most counties of our study area. Eradication efforts directed towards the prairie dog probably have eliminated this mustelid from all of Oklahoma, except perhaps the Panhandle. The Kiowa County record is based on the skull since lost—Caire *et al.*, 1990—of a specimen taken in 1904 from near Mountain View.

*County record.*—Kiowa.

### *Mustela vison letifera* Hollister, 1913

Mink

The mink is a secretive and seldom-seen animal, unless trapped or glimpsed in the headlights of an automobile at night. Preferred habitat is brushy or wooded areas, usually in the vicinity of permanent water. The species is to be expected throughout southwestern Oklahoma along streams and rivers.

*Specimen examined* (1).—*Jefferson Co.: 0.5 mi. N Terral (1).

*County records.*—Caddo, Canadian, Comanche, Custer, Jackson, *Jefferson, Tillman.

### *Taxidea taxus berlandieri* Baird, 1858

Badger

The badger occurs throughout the region. Characteristic diggings are more commonly seen than the animal itself, although it sometimes forages abroad during daylight hours.

*County records.*—Blaine, Caddo, Comanche, Custer, Dewey, Garvin, Grady, Jackson, Kiowa, McClain, Roger Mills, Tillman.

### *Spilogale putorius interrupta* (Rafinesque, 1820)

Eastern Spotted Skunk

The spotted skunk is rarely observed. It probably occurs throughout the area, especially in broken country. Martin and Preston (1970) cited reports by Harmon County residents that this little skunk was more common there during the 1930s than during the late 1960s. A similar decline on the Wichita Mountains Wildlife Refuge since the 1920s is discussed by Halloran and Glass (1959).

*County records*.—Caddo, Comanche, Custer, Grady, Jackson, Kiowa, Tillman, Washita.

### *Mephitis mephitis* (Schreber, 1776)

Striped Skunk

Distributed throughout the region, it is particularly abundant in agricultural or settled areas. The characteristic odor is often detected even when the animal is not. Automobiles take a great toll on this bold species, and most of our animals were salvaged from roadkills.

Halloran and Glass (1959) discussed a severe 1940 "die-off" of spotted and striped skunks in the Wichita Mountains Wildlife Refuge, which was attributed to a pneumonic epizootic. Those populations were said to have recovered completely by 1954.

Two subspecies are mapped by Hall (1981) as occurring in the region—*Mephitis mephitis varians* Gray, 1837, to the west, and *M. m. mesomelas* Lichtenstein, 1832, to the east.

*Specimens examined* (6).—Carter Co.: 20 mi. W Ardmore, 3 (TTU). *Jefferson Co.: 1 mi. W Waurika, 1; 5 mi. N Byers, Texas, 1. Tillman Co.: 6.5 mi. WSW Grandfield, 1.

*County records*.—Blaine, Carter, Comanche, Custer, Dewey, Grady, *Jefferson, McClain, Tillman.

### *Lutra canadensis canadensis* (Schreber, 1776)

River Otter

The otter probably was widespread but never common in Oklahoma. Caire *et al.* (1990) cited early accounts of the species from Caddo, Comanche, and Kiowa counties of the study area, but no specimens appear to have been preserved.

*Lutra* wanders widely along watercourses, and often also overland. It still may be an occasional visitor to our easternmost counties. The

presence of this shy animal often is revealed only by its droppings, which are left characteristically on rocks protruding from streams.

### *Felis concolor stanleyana* Goldman, 1938

Mountain Lion

Caire *et al.* (1990) and Tyler and Anderson (1990) provided reports from travelers since the mid-1700s that make clear reference to the mountain lion from such regional localities as the Wichita Mountains (Comanche County), Cache Creek (Comanche or Cotton counties), near Grandfield (Tillman County), along the Canadian River (McClain and Roger Mills counties), and near the Red River (Harmon or Jackson counties).

No currently established populations seem to exist here or elsewhere in the state, but *Felis concolor* is a noted wanderer, and the several reliable sightings and occasional animals taken by hunters from southwestern Oklahoma (for example, 1983 in Roger Mills County—Caire *et al.*, 1990) probably represent visitors from New Mexico or Texas.

### *Lynx rufus texensis* J. A. Allen, 1895

Bobcat

The secretive bobcat occurs throughout the region, but it is not commonly observed unless trapped or cornered by dogs. Both means have been employed in its capture, for its pelt is presently more valuable than that of other furbearers. Caire *et al.* (1990) cited evidence that trapping pressure on the species has adversely affected populations in Oklahoma. Martin and Preston (1970) reported that this cat often is hunted with hounds in Harmon County.

Trapping records of *L. rufus* from the Wichita Mountains Wildlife Refuge indicate that population fluctuations sometimes occur. During the period of 1932-1944, 24 bobcats were taken, but not until the 1956 recovery of a dead animal was the species again recorded from there (Halloran and Glass, 1959).

We follow the assessment of Schmidly and Read (1986), who assigned specimens from our study area to *L. r. texensis*.

*Specimens examined* (4).—Cotton Co.: 6 mi. NE Burkburnett, Texas, 1. Harmon Co.: 8.5 mi. N, 2.5 mi. W Hollis, 1 (TTU). *Jefferson Co.: 8 mi. W Waurika, 1. Tillman Co.: Frederick Lake, 1 (TTU).

*County records.*—Beckham, Blaine, Caddo, Canadian, Comanche, Cotton, Garvin, Grady, Harmon, *Jefferson, Kiowa, Love, McClain, Roger Mills, Stephens, Tillman.

### *Tayassu tajacu angulatus* (Cope, 1889)

Javelina or Collared Peccary

There seems to have been no basis for previous authorities (culminating with Hall, 1981) regarding the range of the javelina as extending into extreme north-central (Montague County) Texas. However, animals transplanted to Wilbarger County, Texas, now have spread successfully into adjacent regions of Texas, and they sometimes forage into southern Oklahoma along the floodplain of the Red River (Stangl and Dalquest, 1990). Future expansion into southern Oklahoma by *Tayassu* probably will depend on ameliorating climatic conditions. Stangl and Dalquest (1990) reported on the adverse affects of cold weather on these animals at the northern periphery of the range in Texas.

### *Cervus elaphus* Linnaeus, 1758

Wapiti or Elk

The elk once occurred in southwestern Oklahoma at least as far east as the Wichita Mountains; numerous reports dating to the early 1800s make reference this species (Tyler and Anderson, 1990). The last animal was reported killed there in 1881 (Halloran and Glass, 1959). The subspecific identity of these early herds of *Cervus elaphus* is uncertain, for no specimens were ever preserved. Some authorities have assigned these native populations to the extinct *C. e. merriami* Nelson, 1902 (for example, Caire *et al.*, 1990; Hall, 1981)—a geographically distant taxon otherwise known only from isolated desert mountain ranges in Arizona and southern New Mexico. Others think the applicable subspecies (as mapped by Hall, 1981) was *C. e. canadensis* Erxleben, 1777, as earlier supposed by Halloran and Glass (1959). We favor the latter as more probably correct.

Specimens living in the Wichita Mountains today are derived from the successful reintroduction in 1912 of animals from the Jackson Hole (Wyoming) herd (*C. e. nelsoni* Bailey, 1935—as mapped by Hall, 1981).

*Specimens examined* (2).—Comanche Co.: Wichita Mountains Wildlife Refuge, 2.
*County record.*—Comanche.

### *Odocoileus hemiones crooki* (Mearns, 1897)

Mule Deer

No specimens of the mule deer are known from the region, although the species once may have ranged east to the Wichita Mountains as late as the 1800s (Caire *et al.*, 1990). *Cervus hemiones* occurs today in the rugged, broken lands of the Texas Panhandle, often in association with juniper. It is not unlikely that occasional individuals wander into the western counties of Oklahoma.

Halloran and Glass (1959) recounted an unsuccessful attempt in 1929 to stock mule deer in the Wichita Mountains of Comanche County.

### *Odocoileus virginianus texanus* (Mearns, 1898)

White-tailed Deer

Despite the absence of specimens from much of the region, the white-tailed deer is found throughout the eastern counties, and along wooded or riparian habitat elsewhere to the west. The species apparently was extirpated, or nearly so, by the late 1800s from all of southwestern Oklahoma except the Wichita Mountains, from which dispersing and transplanted individuals later spread to repopulate the area (Caire *et al.*, 1990).

*County records.*—Caddo, Comanche, Murray, Stephens.

### *Antilocapra americana americana* (Ord, 1815)

Pronghorn

The pronghorn was common in the region as far east as the Wichita Mountains as late as the 1800s (Caire *et al.*, 1990; Halloran and Glass, 1959; Nelson, 1925); Tyler and Anderson (1990) cited reports of its local abundance as recently as 1890 in Greer County, and 1900 in Tillman County. Hunting and habitat destruction led to its demise in southwestern Oklahoma.

Caire *et al.* (1989) and Halloran and Glass (1959) provided details of several failed attempts to re-establish regional populations since 1910.

### *Bison bison bison* (Linnaeus, 1758)

Bison

The last of the native bison had vanished from southwestern Oklahoma by the late 1800s. Caire *et al.* (1990) summarized the decline

and disappearance of the species in Oklahoma, and provide terminal dates of 1885 for Beckham County and 1878 for Tillman County. Remains of the bison are abundant in examined Holocene sediments of Tillman (Goetze, 1989) and Caddo (Smith, 1991) counties.

Local ranchers sometimes maintain a few animals, and a confined herd in the Wichita Mountains Wildlife Refuge dates back to the original 1907 restocking. Our specimens include the skeleton of a 13-year-old bull, which was suffering from a circular wound of perhaps 30 centimeters in diameter and was infested with screwworm larvae, before being put to death on 18 October 1984 by refuge personnel.

*Specimens examined* (3).—Comanche Co.: Wichita Mountains Wildlife Refuge, 3.
*County record*.—Comanche.

### *Ovis canadensis canadensis* Shaw, 1804

Bighorn or Mountain Sheep

Although never native to Oklahoma, an unsuccessful attempt was made to establish a population on the Wichita Mountains Wildlife Refuge in 1929 with seven animals from Alberta, Canada (Halloran and Glass, 1959). One was poached by a hunter, and the others lost weight and died within a year of the introduction.

## Species of Possible Occurrence

The known ranges of several species of western (Great Plains) or eastern (deciduous woodlands) origin closely approach the limits of our defined study area. Intensive field surveys of marginal eastern and western counties may uncover the presence of elusive or uncommon species, as well as document the expansion of others.

*Bats*.—Attempts to collect bats have been strongly biased towards cave-roosting species. We feel that there is a high probability that the persistent use of mist nets in the eastern woodlands of our study area will produce westernmost records for some of the eastern *Myotis* species (for example, *M. austroriparius*, *M. keeni*, *M. lucifugus*, and *M. sodalis*). Similar collecting methods also are apt to yield more records of migrant species, including *Nyctinomops macrotis*.

*Cratogeomys castanops* (yellow-faced pocket gopher).—Known from the adjacent Texas Panhandle. An unlikely possibility in westernmost counties of study area at present, although this taxon has been expanding its range in areas where arid conditions prevail.

*Reithrodontomys megalotis* (western harvest mouse).—Recorded from Ellis County. To be looked for in grasslands of northwestern counties.

*Reithrodontomys humulis* (eastern harvest mouse).—Recently taken from Pottawatomie County, adjacent to northeastern corner of study area.

*Peromyscus gossypinus* (cotton mouse).—Recorded from Bryan County and eastward. May occur in wooded southeastern counties of region.

*Neotoma albigula* (white-throated woodrat).—Occurs in adjacent counties of Texas. To be looked for near junipers in broken country of westernmost counties.

*Vulpes velox* (swift fox).—May be uncommon resident of northwesternmost counties.

*Mustela frenata* (long-tailed weasel).—Known from north-central Oklahoma and Texas Panhandle. Probably occurs uncommonly in at least northern and western parts of study area.

## Summary and Conclusions

The rich mammalian diversity of southwestern Oklahoma is a result of the presence of both western (Great Plains) and eastern (deciduous woodlands) faunas, which intergrade over much of the region. However, it must be recognized that results of any study such as ours must be treated as tentative, temporary, and soon outdated, given the dynamic nature of animal distributions, shifting climatic regions, and the effects of human alterations on ecological conditions.

The current global warming trend favors a northward expansion of such subtropical species as *Dasypus novemcinctus* and *Baiomys taylori*. Past abuses through hunting, trapping, and especially habitat destruction has led to the local extirpation of some species (*Ursus americanus, Bison bison, Antilocapra americana*, for example). Although diligent collecting efforts should lead to the discovery of uncommon or reclusive resident species (see list of species of hypothetical occurrence), discoveries also may reflect active expansion or contraction of the ranges of others. Riparian habitats continue to serve as avenues of westward dispersal for woodland taxa such as *Sylvilagus aquaticus*, and *Glaucomys volans*, just as sandy river terraces afford penetration to the east by others (for example, *Spermophilus spilosoma, Dipodomys ordii, Perognathus flavus, Onychomys leucogaster*). The clearing of land for agricultural purposes can further the eastern expansion of grasslands species such as *Chaetodipus hispidus and Spermophilus tridecemlineatus*, but it can lead to extirpation locally of woodlands species. Purposeful introductions of some mammals (for example, *Vulpes vulpes, Sciurus carolinensis, Tayassu tajacu*) have led to establishment of populations beyond their native ranges—sometimes at the expense of resident native species.

It is clear that future distributional studies in southwestern Oklahoma (as well as elsewhere) should be directed to areas where little

or no collecting has occurred in the past. However, our best understanding of the dynamics of mammalian faunas and their associated ecosystems may result from efforts directed to areas intensively worked in the past, because such studies provide baseline data for necessary chronological comparisons.

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# MAMMALS FROM THE SOUTHERN BORDER OF THE KANSAN BIOTIC PROVINCE IN WESTERN TEXAS

LARRY L. CHOATE, RICHARD W. MANNING,
J. KNOX JONES, JR., CLYDE JONES, AND SCOTT E. HENKE

The Kansan Biotic Province, as defined by Dice (1943:26), is "the short-grass region covering the southern part of the semiarid Great Plains." The province extends from western Nebraska and eastern Wyoming southward to include the Staked Plains, or Llano Estacado, of western Texas and adjacent New Mexico. The southern edge of the Kansan is coincident with the merging of the Llano Estacado with the Balconian Biotic Province (Edwards Plateau) to the southeast and the Chihuahuan Biotic Province to the southwest (see Blair, 1950). Biotic provinces can be subdivided into biotic districts; the High Plains (Llano) section of the Kansan, for example, is referred to as the Short-grass Plains Biotic District (Blair, 1950).

At various times from 1989 through 1991, field parties from Texas Tech University collected or observed mammals in an area made up of parts of seven Texas counties (Andrews, Ector, Glasscock, Howard, Martin, Midland, and Winkler) that form the southern border of the Kansan Biotic Province, principally where it intersects the Chihuahuan (Fig. 1). This region is unique in that it reflects interchange between biotic provinces—a place where Chihuahuan elements such as *Dipodomys merriami*, *D. spectabilis*, and creosote bush (*Larrea tridentata*) invade the extreme southern part of the Kansan Province. Little attention has been given to mammals from this interesting seven-county area, the subject of the present paper.

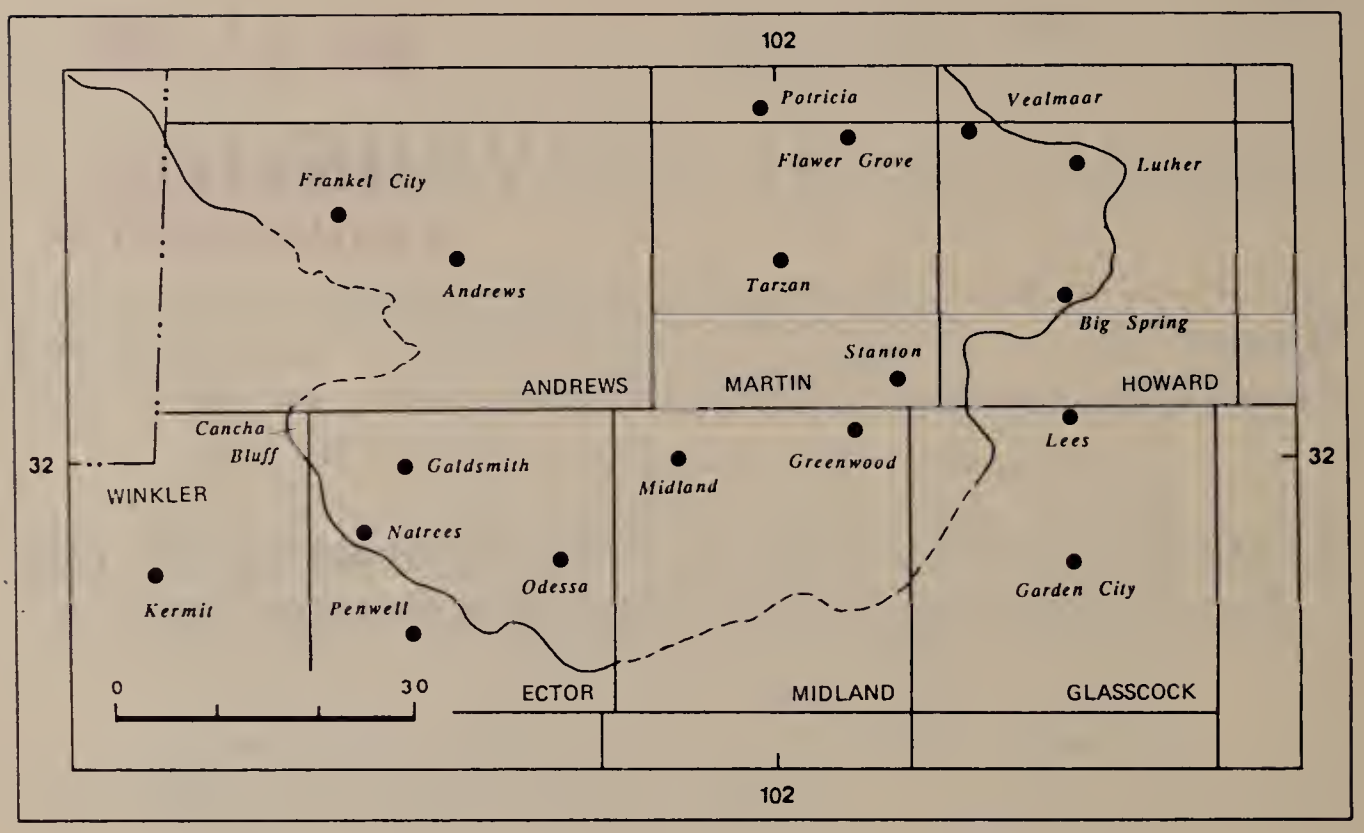


FIG. 1.—Map of southern end of Kansan Biotic Province in Texas showing seven-county study area, outline of provincal boundary, and location of place-names used in text. Scale at lower left is in miles.

A temperate, dry-steppe climate characterizes the southern edge of the Kansan Province. Prevailing winds are southwestwardly from November through March but from the south or southeast during the rest of the year except for frequent surges of cold air from the north in winter. Most precipitation falls between May and October, with July and September the only months on average in which more than two inches is recorded. Thunderstorms are commonplace in late spring and summer months. The freeze-free season exceeds 200 days (an average of 213 in Andrews County, for example). See Table 1 for some comparative weather data.

Of the seven counties included in whole or in part in the region here defined as the southern border of the Kansan Biotic Province, only one (Martin County) is entirely within the study area. The others are included as follows (Fig. 1): eastern and northern two-thirds of Andrews County; northwestern half and south along southwestern edge of Howard County; northwestern Glasscock County; northern half to two-thirds of Ector and Midland counties; and extreme northeastern corner (Concho Bluff) of Winkler County. Most of the southern Llano is relatively flat, lacking marked relief except for a few gullies and draws, which carry water only as runoff following heavy precipitation. The escarpment of the Llano (thus the border of the Kansan Province)

TABLE 1.—*Comparative climatic data from Andrews, Andrews County* (*Conner* et al., *1974*), *and the Midland-Odessa Regional Airport, Midland County* (*Watson, 1978*).

| | Andrews County (3172 feet) | Midland County (2912 feet) |
|---|---|---|
| | Moisture (inches) | |
| Mean annual precipitation | 13.89 | 13.04 |
| Mean annual snowfall | 2.10 | 1.40 |
| | Temperature (°F) | |
| Average January | | |
| Daily minimum | 29.5 | 30.9 |
| Daily maximum | 59.3 | 57.1 |
| Average July | | |
| Daily minimum | 68.6 | 71.2 |
| Daily maximum | 95.5 | 94.5 |
| Average annual | | |
| Minimum | 49.4 | 51.5 |
| Maximum | 77.4 | 77.2 |

is well marked in the south only along the eastern border in Howard County, in Ector County, at Concho Bluff in Winkler County, and to a degree in northwestern Andrews County. Elsewhere, there is a more or less gradual transition southward from the High Plains; in much of southwestern Andrews County such a break as there may have been between the Llano Estacado and the Chihuahuan Desert to the south now is covered by shifting Quaternary sands of eolian origin.

Save for small impoundments, there are few bodies of standing water in the seven-county area. The three mineralized salt lakes in Andrews County (Baird, Shafter, and Whalen) and Natural Dam Lake and Red Deer Lake in Howard County being the largest.

Much of the study area here defined is covered by mesquite grasslands and thus given over primarily to cattle grazing. Croplands (cotton, sorghum, and small grains) are found mostly eastwardly and Havard shin oak-mesquite shrublands are commonplace in northern and western Andrews County (McMahan *et al.*, 1984). A creosote-prickly pear grassland is found on Concho Bluff and in immediately adjacent areas. Some typical habitats of the southern end of the Kansan Biotic Province are shown in Figures 2-5.

Soils range from fine sands to sandy loams (about 80 percent of Andrews County) to loamy and gravelly substrates (most of High

Plains part of Ector County, for example). Loamy soils, some calcareous, make up about 80 percent of the surface layers of dominant soil types in Martin County, with sandy soils of the Miles-Patricia Association making up the remaining 20 percent. Petroleum products are important to the economy of the region, and much of the rangeland also contains active or abandoned oil and natural gas wells.

## Methods and Acknowledgments

Our field work in the southern part of the Kansan Biotic Province began in January of 1989, although parties from Texas Tech University had visited several localities in the area in the early 1970s. We used conventional trapping techniques and equipment (Sherman live traps, Museum Special snap traps, Victor rat traps, gopher traps, and steel leg holds) to collect specimens; we also used shotguns, especially to obtain lagomorphs, and examined mammals killed along roadways whenever we found them, salvaging those that could be saved. Observations of occurrence of larger mammals were recorded in field notes. Most collecting efforts took place in 1989 and early in 1990, but Henke's work on coyotes and their prey populations continued on a regular basis through 1991.

Most of the specimens listed as examined in the following accounts are deposited in The Museum of Texas Tech University (and thus bear no acronym for institutional identification). A few were examined from among the holdings in other collections as follows (identifying acronym in parentheses): Angelo State University (ASU); Midwestern State University (MWSU); Sul Ross State University (SRSU); Texas Cooperative Wildlife Collection, Texas A&M University (TCWC); Texas Natural History Collection, University of Texas (TNHC); and Wayland Baptist University (WBU). We are indebted to persons associated with these several collections.

Kem Canon and student associates from the Department of Range and Wildlife Mangement at Texas Tech were most helpful in the field in the early months of this study. Funds provided by the National Rifle Association helped underwrite Henke's efforts, whereas funds from the University, principally through Dean Clyde Hendrick of the Graduate School, assisted in defraying costs of museum-related field activities. We are grateful to those named and to many others for assisting our efforts. This publication is a contribution from The Museum, the Department of Biological Sciences, and the Department of Range and Wildlife Management (contribution no. T-9644 of the College of Agricultural Sciences) at Texas Tech University.

## Accounts of Species

All measurements of specimens in the following accounts are in millimeters. Even though ordinal and familial headings are not utilized, included taxa are in generally accepted phylogenetic order through genera, but species within the same genus are entered alphabetically. Both scientific and vernacular names of species follow Jones *et al.* (1992). Measurements and comments on morphology and reproduc-

FIG. 2.—Rocky break of Llano Estacado at edge of Concho Bluff, northeastern Winkler County, Texas.

FIG. 3.—Sparse short-grass prairie, with scattered small mesquite and yucca, near Shafter Lake, Andrews County, Texas.

FIG. 4.—Creosote-mesquite grassland atop Concho Bluff, Winkler County, Texas.

FIG. 5.—Typical mesquite grassland, Andrews County, Texas. Yucca (foreground) and prickly pear also are common in such associations.

tion relate to adults unless noted otherwise. Cranial measurements were taken to the nearest .01 millimeter by the same person using the same pair of digital calipers.

Only six orders of native mammals have been recorded from the southern part of the Kansan Biotic Province—Chiroptera, Xenarthra, Lagomorpha, Rodentia, Carnivora, and Artiodactyla. Representatives of two more, however, may occur there. The opossum (*Didelphis virginiana*, order Didelphimorphia) probably has invaded by now the southeastern part of the study region; at least it should be looked for in that area. Two shrews, *Cryptotis parva* and *Notiosorex crawfordi* of the order Insectivora, probably occur in the southeast and throughout the study area, respectively, but we have no record of either (there is an otherwise unspecified record for *N. crawfordi* plotted by Davis, 1974, in Howard County). The cast pellets of owls are an excellent source of shrew remains. Only two kinds of bats (Chiroptera) have been reported from the seven-county area although several more species certainly pass through it during seasonal migrations, and there could be warm-weather populations of one or two species near places where the rocky escarpment of the Llano prevails.

### *Lasiurus borealis* (Müller, 1776)

Eastern Red Bat

Both Davis (1974) and Schmidly (1991) mapped a record of this monotypic species from an unknown locality in Howard County. We have been unable to trace the source of this report, although it seems not to have been based on a museum specimen. Certainly *L. borealis*, a tree-roosting bat, is a potential resident of any of the larger populated places in the southern part of the Kansan Province, and also any other areas of deciduous trees located near a permanent source of water.

### *Tadarida brasiliensis mexicana* (Saussure, 1860)

Brazilian Free-tailed Bat

The only specimen of this species from the southern end of the Kansan Biotic Province is a male captured in Midland on 14 October 1956. The relatively unworn teeth indicate that this was a rather young bat, although the phalangeal epiphyses are well fused. In any event, the autumn date of capture clearly suggests a migrant.

In addition to the one specimen, Schmidly (1991:151) mapped Texas Department of Health records for *T. brasiliensis* from northeastern Ector County and southwestern Howard County. Because the exact localities where these bats originated were not given, it is impossible to know certainly whether the Howard County specimen originated from the Llano Estacado or just to the east of it.

### *Dasypus novemcinctus mexicanus* Peters, 1864

Nine-banded Armadillo

This species no doubt occurs at least sparingly in the southeastern part of our study area. We took no specimens, however, nor did we find any armadillos killed on roadways. The only record from the region is from 22 mi. N Stanton, Martin County (Bailey, 1905:52).

### *Sylvilagus audubonii neomexicanus* Nelson, 1907

Desert Cottontail

The desert cottontail is widespread in the seven-county study area, occupying most available upland habitats. Based on specimens examined and field observations, this rabbit is considerably more common on the southern part of the Llano Estacado than is its congener, *S. floridanus*. Adult desert cottontails can be distinguished externally from eastern cottontails by paler dorsal pelage, buffy-yellowish rather than reddish-brown nape, and larger ears that usually exceed 60 in length. Cranially, *audubonii* has noticeably inflated auditory bullae, considerably larger than those of *floridanus*, and usually a narrower mesopterygoid fossa and shorter palatal bridge.

Few reproductive data are available. Adult females have been reported as lactating from mid-April, early May, and early October. Pregnant females, each carrying two fetuses, were collected in May (crown-rump lengths 52 and 55) and one female carrying three fetuses (length not recorded) was taken in October.

*Specimens examined* (20). —Andrews Co.: 5 mi. N, 9 mi. E Andrews, 1; 4 mi. N, 6 mi. W Andrews, 1; 4 mi. N, 3 mi. E Andrews, 1; 6 mi. N Texas Hwy. 158 and 3 mi. W FM 1788 [13.5 mi. S, 13 mi. E Andrews], 1. Ector Co.: 6 mi. N Notrees, 1; 4 mi. N Notrees, 1; 1.5 mi. N Notrees, 1; 1 mi. N Notrees, 1; 1 mi. E Notrees, 1; 1 mi. S, 1 mi. E Notrees, 1; 9 mi. N Odessa, 3; 6 mi. [S]W Odessa, 1. Howard Co.: Big Spring, 1 (ASU). Midland Co.: 7 mi. S Stanton, 1; 8 mi. S Stanton, 1 (TCWC); 8 mi. W Midland, 1; 0.5 mi. N, 2.5 mi. E Greenwood, 1. Winkler Co.: 7 mi. N, 4 mi. W Notrees, 1.

*Additional record* (Nelson, 1909:236). —Martin Co.: Stanton.

### *Sylvilagus floridanus llanensis* Blair, 1938

Eastern Cottontail

This rabbit is much less numerous than is the desert cottontail in our area of coverage and is represented by records from only three counties—Andrews, Howard, and Martin. Likely it will be found elsewhere, especially in habitats associated with mesic vegetation or near human dwellings. *Sylvilagus floridanus* may be distinguished externally, sometimes with difficulty, from *S. audubonii* by characters described in the account of the latter.

Reproductive data for this species from the southern Kansan Biotic Province are lacking but the pattern is not expected to differ appreciably from that described from elsewhere in western Texas (see Jones *et al.*, 1988, and Pesaturo *et al.*, 1990).

*Specimens examined* (3).—Andrews Co.: 6 mi. N, 7 mi. E Andrews, 1. Howard Co.: 4 mi. N, 3 mi. W Luther, 1; Big Spring,1.

*Additional record* (Nelson, 1909:178).—Martin Co.: Stanton.

### *Lepus californicus texianus* Waterhouse, 1848

Black-tailed Jackrabbit

This hare was common to abundant on the southern part of the Llano in 1989 and 1990. Many were seen along roadways at night, especially in Andrews and Ector counties where, admittedly, we spent more time than elsewhere.

Reproductive data for females are as follows: one was nonpregnant on 4 February; one was lactating and also carrying three fetuses (crown-rump length, 27) on 15 April; of nine taken on 5-6 May, one was lactating and had two placental scars, six were lactating and also carried two to three fetuses (crown-rump lengths, 25-95, the latter near term), whereas two were pregnant, one with a single fetus (28 in length) and the other with twins measuring 20; one taken on 5 June was lactating and also gravid with two fetuses (50 in length), whereas another was lactating only; two with no indication of reproductive activity were taken in mid-July; one female was lactating on 20 October, but two others collected on the same date and another taken on 8 October evinced no reproductive activity. Adult males obtained in May (two), June, and July (two) had testes measuring 35, 46, 52, 47, and 50 , respectively.

We refer our specimens to the subspecies *L. c. texianus* following Nelson (1909), and also because they are paler, especially on the rump, than material referable to *L. c. melanotis* from the Texas Panhandle to the north and Rolling Plains to the east. In color, they resemble specimens from Brewster County and elsewhere in Trans-Pecos Texas with which we compared them. A systematic review of *L. californicus* in Texas and nearby regions is needed. The type locality for *texianus*, one of the oldest species-group names to be applied to this hare, was not known with certainty. It was thought to be located in Texas, based on the name, "probably from western Texas" (Nelson, 1909:142). Recently, the type locality was restricted by Hoffmeister (1986:143) to "10 mi. S Alpine, Brewster Co., Texas."

External measurements of two adult males, followed by the average (and extremes) of 10 adult females, all from the vicinity of Notrees, Ector and Winkler counties, are as follows: total length, 530, 555, 587.2 (555-616); length of tail, 66, 80, 88.5 (67-110); length of hind foot, 133, 130, 130.9 (125-138); length of ear, 125, 122, 123.0 (114-135).

*Specimens examined* (33). —Andrews Co.: 7 mi. N, 7 mi. E Andrews, 2; 4 mi. N, 7 mi. W Andrews, 1; 4 mi. N, 3 mi. E Andrews, 1; 1 mi. N, 11 mi. E Andrews, 1; 9.5 mi. S, 5 mi. E Andrews, 2; 6 mi. N Texas Hwy. 158 and 3 mi. W FM 1788 [13.5 mi. S, 13 mi. E Andrews], 1. Ector Co.: 2.5 mi. N Notrees, 1; 1 mi. E Notrees, 3; 1 mi. S, 1 mi. E Notrees, 5; 2 mi. S, 1 mi. E Notrees, 3; 3 mi. S, 1 mi. E Notrees, 2; 14 mi. N Odessa, 1; 9 mi. N Odessa, 3. Glasscock Co.: Texas Hwy. 137, 7 mi. S [SSE] Stanton, 1. Howard Co.: 3 mi. N Big Spring, 1. Martin Co.: 13 mi. N, 1 mi. W Tarzan, 1; 0.5 mi. S Stanton, 1. Midland Co.: 6.5 mi. S, 1 mi. E Stanton, 1; 3 mi. NE Midland, 1. Winkler Co.: 6 mi. N, 3 mi. W Notrees, 1.

Additional records (Nelson, 1909:145).—Martin Co.: Stanton. County unknown: "Llano Estacado (near 32° north latitude)."

### *Spermophilus mexicanus parvidens* Mearns, 1896

Mexican Ground Squirrel

This is the common ground squirrel of the southern part of the Llano Estacado, occurring northward on the plateau at least to Lubbock, County. We found *S. mexicanus* abundant on the city golf course in Andrews and it was common along the southern roadside of State Highway 302 to the east of Notrees. North of the latter locality, we took specimens along a graded county road; we saw a squirrel just inside Winkler County (6 mi. N, 3 mi. W Notrees) that had burrowed into the raised and relatively loose soil covering a recently buried cable.

Bailey (1905) noted that *S. mexicanus* closed its burrows during cold weather. We observed an instance of burrow plugging under different circumstances. In July of 1989 in Andrews County, an adult ground squirrel was chased into its burrow, which it plugged just below the surface. A second individual, a young of the year, attempted to enter the same burrow a few moments later, and was easily shot because it could not break through the plugged passageway.

April-taken females evinced no gross evidence of reproductive activity; one taken on 6 May carried seven fetuses (11 in crown-rump length). Lactating and postlactating females and young of the year of both sexes were collected in mid-July. Adult males had testes measuring (dates in parentheses) as follows: 16 x 10 (16 April); 15 in length (5 May); 25 x 12 (6 May).

A specimen taken in mid-July had its cheekpouches filled with seeds of the buffalogourd (*Cucurbita*). Cothran (1983) reported a possible hybrid from Andrews between *S. mexicanus* and *S. tridecemlineatus*, the thirteen-lined ground squirrel, but the latter does not occur in the southern part of the Kansan Biotic Province.

*Specimens examined* (19).—Andrews Co.: 4 mi. N, 2 mi. E Andrews, 1; 1 mi. N, 0.5 mi. E Andrews, 1; Andrews (Andrews golf course), 10. Ector Co.: 1 mi. N Notrees, 2; 2 mi. E Notrees, 2; 4 mi. E Notrees, 1; 3 mi. S, 2 mi. E Notrees, 1. Howard Co.: 7 mi. NE Big Spring, 1 (TCWC).

*Additional records*.—Howard Co.: Big Spring (Cothran, 1983; Howell, 1938). Martin Co.: Stanton (Howell, 1938). Midland Co.: Midland (Cothran *et al.*, 1977). Winkler Co.: 6 mi. N, 3 mi. W Notrees (see text).

## *Spermophilus spilosoma marginatus* Bailey, 1890

Spotted Ground Squirrel

The spotted ground squirrel occurs throughout the southern part of the Kansan Biotic Province but appears to be nowhere especially common. Sandy and sandy loam soils seem preferred, hard and deep soils are avoided. A male was shot on 6 May along the edge of a roadway north of Notrees as it sat in the shade of a mesquite tree. Judging from its movements after being shot, its burrow probably was in a grassy area just behind the mesquite. The testes of the male measured 17 in length. The uterus of a female taken on 14 April was flaccid but not otherwise suggestive of reproductive condition.

*Specimens examined* (5). —Andrews Co.: Shafter Lake, 1 (SRSU); 4 mi. S, 18 mi. E Andrews, 1. Ector Co.: 6 mi. N, 1 mi. E Notrees, 1. Martin Co.: 10 mi. S Flower Grove, 1; 0.5 mi. N, 0.2 mi. E Tarzan, 1 (WBU).

### *Cynomys ludovicianus ludovicianus* (Ord, 1815)

Black-tailed Prairie Dog

The prairie dog now is absent from much of the southern Llano Estacado, likely the result of a century of eradication efforts. The presence of mature mesquite trees over much of the area, which otherwise supports grasslands utilzed for cattle grazing, also probably is a factor in exclusion of *Cynomys*. A small group of prairie dogs is maintained as a novelty inside the city limits of Andrews. Doubtless, small "towns" of these rodents occur throughout the study area, and ephemeral populations become established from time to time by dispersing individuals, only to disappear for a variety of reasons.

*Specimen examined* (1).—Midland Co.: 0.5 mi. N, 2.5 mi. E Greenwood, 1.

*Additional record.*—Ector Co.: no specific locality (Cottam and Caroline, 1969:300).

### *Geomys bursarius major* Davis, 1940

Plains Pocket Gopher

Although the plains pocket gopher occurs widely across the northern half of the Llano Estacado, it is found only in the southeastern part of the study area (from Midland to Big Spring). *Geomys bursarius* differs from the parapatric *Cratogeomys castanops* in having reddish to brownish pelage, rather than straw-colored to buffy-gray pelage, in having two longitudinal grooves on the upper incisors rather than a single groove, and in being smaller in size. *G. bursarius* inhabits sandy to sandy loam soils, whereas the larger *C. castanops* tends to burrow in more gravelly substrates.

The plains pocket gopher can be separated externally from *G. knox-jonesi* by slightly larger size, a relatively shorter tail, and darker pelage. These congeners apparently have similar habitat requirements, and there are no known contact zones between them in the seven-county study area.

Pregnant females have been taken on 5 January (one fetus, crown-rump length, 36), 24 February (four fetuses), and 25 February (five fetuses, crown-rump length, 7). Juveniles have been collected in June. These few data suggest a mid-winter to late winter breeding season in the area.

*Specimens examined* (30).—Glasscock Co.: 1 mi. S, 12 mi. W Lees, 1. Howard Co.: 2 mi. N Big Spring, 1; Big Spring, 2; 2 mi. NE Big Spring, 2. Martin Co.: 2.5-3 mi. N Stanton, 8; Stanton, 2 (TCWC); 2.5 mi. SSE Stanton, 2. Midland Co.: 3.5 mi.

S, 1.5 mi. E Stanton, 1; 5 mi. S Stanton, 3; 6.5 mi. S, 1.5 mi. E Stanton,1; 1-3 mi. N Midland, 3; 2.5 - 4 mi. E Midland, 4.

### *Geomys knoxjonesi* Baker and Genoways, 1975

Jones' Pocket Gopher

*Geomys knoxjonesi* is known along the southern border of the Kansan Province only from Andrews and Martin counties. Originally described as a subspecies of *G. bursarius* (Baker and Genoways,1975), Jones' pocket gopher differs from that species in having paler-colored pelage, being smaller externally and cranially, by karyotypic differences (Baker *et al.*, 1989), and, with the exception of a narrow contact zone in eastern New Mexico, by allopatry. *Geomys knoxjonesi* is smaller and more reddish (rather than yellowish or grayish yellow) in color than the parapatric *Cratogeomys castanops*. Otherwise it differs from *C. castanops* in a manner similar to that described for *G. bursarius*.

The only reproductive data available from the study area is of a pregnant female taken on 16 July that carried two fetuses (crown-rump length, 14). That female also was molting.

*Specimens examined* (7).—Andrews Co.: 10 mi. NW Andrews, 1; 5 mi. N, 7 mi. E Andrews, 1; 0.5 mi. N Andrews, 1; 2.5 mi. E Andrews, 1 (TCWC). Martin Co.: 14.2 mi. SW Patricia, 2 (MWSU); 21.9 mi. S Patricia, 1.

### *Cratogeomys castanops perplanus* Nelson and Goldman, 1934

Yellow-faced Pocket Gopher

Occurring primarily in loamy to gravelly soils, *Cratogeomys castanops* is known only from the eastern part of the study area (Hollander, 1990) where it apparently is parapatric with *Geomys bursarius*. Findley (1987) suggested that *G. bursarius* excludes *Cratogeomys* from the more friable soils where the two occur together in New Mexico; although no direct information of competitive exclusion is available from the study area, these two species do not occur sympatrically there. Nor are *C. castanops* and *G. knoxjonesi* found together in the southern part of the Kansan Province. However, in Terry County, approximately 50 miles northward, a population of *C. castanops* apparently displaced one of *G. knoxjonesi* over several years from an area of sandy loam soils (R. J. Baker, personal communication).

Tunnels in burrow systems of *C. castanops* usually are greater than nine centimeters in diameter, rather than less than eight (as in *Geomys*),

and typical mounds of earth thrown up by *Cratogeomys* may approach twice the volume of those of *Geomys*.

The systematics of this pocket gopher were revised by Hollander (1990). Two pregnant females, one of which was molting, were recorded on 6 June in Martin County; each carried two fetuses, crown-rump lengths 15 and 18. One other molting individual was taken on 19 November in Howard County, and two juveniles in the process of molt were recorded on 22 October from Martin County.

*Specimens examined* (6).—Howard Co.: 1.5 mi. WSW Vealmoor, 1. Martin Co.: 8 mi. N Tarzan, 2; 9 mi. N 12.5 mi. W Stanton, 3.

*Additional records* (Hollander, 1990:54).—Howard Co.: Big Spring. Martin Co.: Stanton.

## *Perognathus flavescens copei* Rhoads, 1894

Plains Pocket Mouse

Pocket mice as a group are not especially abundant in the southern part of the Kansan Biotic Province, and *P. flavescens* is the least common of the three perognathines found there. All of our specimens were trapped on soils characterized as fine sand through fine sandy loam. Normally, the silky mouse also occurred along with the plains pocket mouse and was the more common of the two. For example, in 150 Sherman traps set in sparse grassland with scattered mesquite on the night of 16-17 July 1989, 4 mi. N and 5 mi. E Andrews, we took 10 *P. flavus*, one *P. flavescens*, three *Dipodomys ordii*, and one *Onychomys leucogaster*. In another 150 Shermans set two miles farther east on the same night, we took 10 *P. flavus*, one *D. ordii*, one *O. leucogaster*, and two *Neotoma micropus*, but no *flavescens*; mesquite trees were larger and grass cover heavier than at the previous site.

Two adult males trapped in March had testes 5 and 6 in length, whereas those of two males taken in July each measured 5. Females collected in May and July evinced no reproductive activity. Molt was still in progress on the rumps of two July-taken adults and on the flanks of another, likely indicating only one annual molt of adult pelage.

*Specimens examined* (9).—Andrews Co.: 1 mi. S, 1 mi. E Frankel City, 1; 4 mi. N, 5 mi. E Andrews, 1; 3 mi. N, 6 mi. W Andrews, 1; 5 mi. S, 6 mi. E Andrews, 1; 6 mi. S, 6 mi. E Andrews, 1; 8.5 mi. S, 4 mi. E Andrews, 2; 9.5 mi. S, 5 mi. E Andrews, 1. Midland Co.: 5 mi. S, 15 mi. E Midland, 1.

### *Perognathus flavus gilvus* Osgood, 1900

Silky Pocket Mouse

Even though we examined almost 150 of these small heteromyids from the seven-county study area, we rarely found them abundant. In one instance, however, we took 27 individuals in 160 Sherman traps along with two *Chaetodipus hispidus*, six *Dipodomys ordii*, one each *Reithrodontomys megalotis* and *R. montanus*, three *Peromyscus leucopus* and one *P. maniculatus*. Moreover, this species is much more widespread and common than its congener, *P. flavescens* (see the account above), being more catholic in habitat tolerance. Principally this results from occurrence of *P. flavus* on both sandy soils and more indurate substrates.

Pregnant females have been taken in April, May, and June; furthermore, an April-captured female had six placental scars. Number of fetuses averaged 3.5 in four gravid animals. We obtained a young animal, still molting from juvenile pelage, on 12 January 1989 from a locality in Andrews County just off the Llano, indicating some autumn breeding. Length of testes in adult males ranged from 2-6 in March, 4-8 in April, 4-10 in May, and 3-7 in July. Molting adults were collected in March and mostly in July.

For many years, silky pocket mice were regarded as representing two closely related species, *P. flavus* and *P. merriami*, which were partly allopatric in distribution, but overlapped principally in central and western Texas and eastern New Mexico. After a thorough morphometric analysis, Wilson (1973) concluded that *flavus* and *merriami* were conspecific, with three subspecies in Texas—*merriami* in central Texas, *gilvus* on the Southern High Plains and in adjacent areas, and *flavus* in the northern Panhandle and Trans-Pecos. More recently, Lee and Engstrom (1991) resurrected *merriami* to specific status, based on allozymic data, and reported that it was sympatric with *flavus* in southeastern New Mexico, but that intermediates were found only in one sample (Carlsbad, New Mexico). For all specimens examined by them of the *P. flavus* group, the overall Rogers' genetic similarity was 0.82, near the lower limit (0.85) frequently used to denote conspecificity.

With this background, we diligently examined material from the southern end of the Kansan Biotic Province and compared it with specimens of presumed *P. f. flavus* from the northern Texas Panhandle and material from elsewhere in the region, seeking morphological characters that could be used to distinguish *flavus* from *merriami*. In earlier works (Osgood, 1900; Davis, 1974), certain cranial features

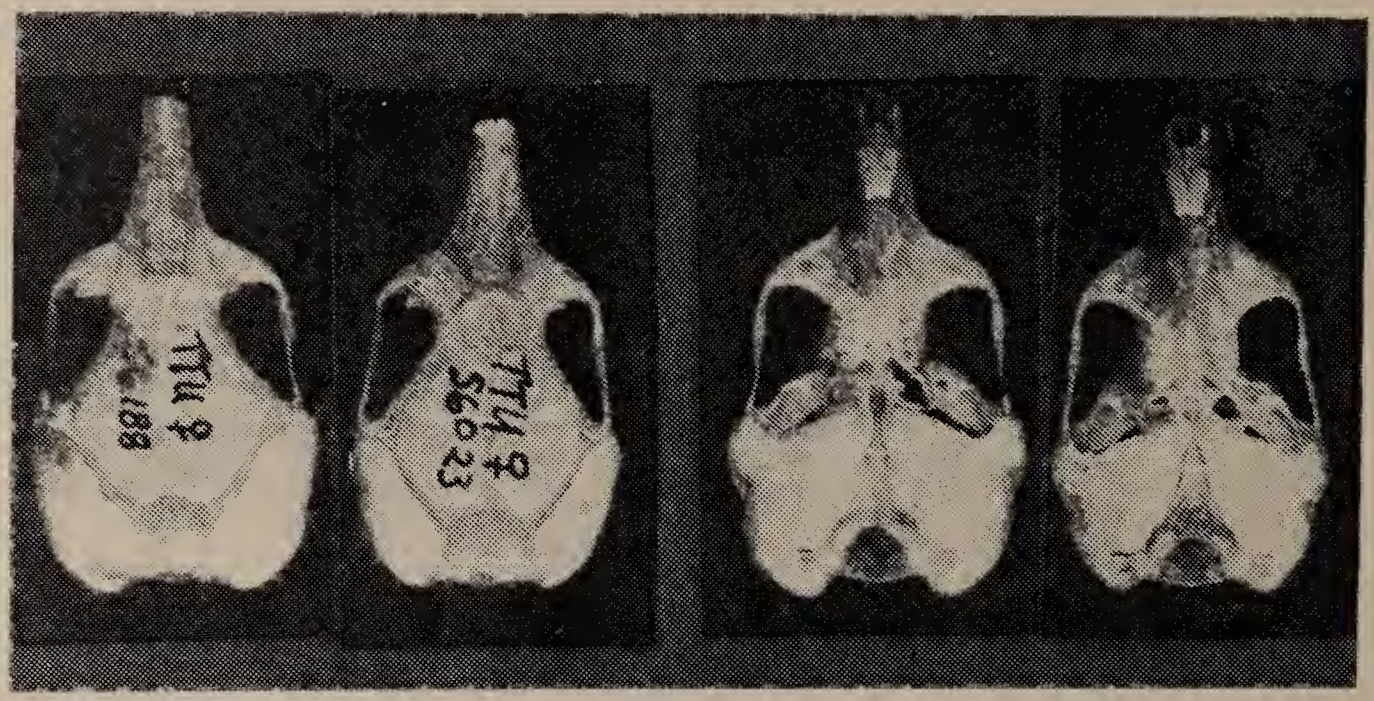

FIG. 6.—Crania of two specimens of *Perognathus flavus* from the same population in Ector County showing extremes in variation of bullar size and other features.

(for example, differences in size of bullae, nasals, and interparietals, and in shape of zygomatic plate, mastoid breadth, and so on) were claimed as useful in separating *flavus* from *merriami*, but we found these to be so variable in our series of silky pocket mice as to be of no use at the specific level (see also Wilson, 1973). In mice from several series for example, the range in continuous variation was so great as to encompass "typical" specimens of both taxa (see Fig. 6). We have opted, therefore, to retain the single species *flavus* until additional evidence, perhaps from other kinds of data sets, is available to help resolve this problem.

*Specimens examined* (148).—ANDREWS CO.: 12 mi. NE Andrews, 1 (WBU); 1 mi. E Frankel City, 3; 1 mi. S Frankel City, 1; 4 mi. N, 9 mi. W Andrews, 7; 4 mi. N, 6 mi. W Andrews, 16; 4 mi. N, 3 mi. E Andrews, 10; 4 mi. N, 5 mi. E Andrews, 10; 3 mi. N, 11 mi. W Andrews, 10; 3 mi. N, 6 mi. W Andrews, 12; 1 mi. N, 19 mi. E Andrews, 1; 17 mi. E Andrews, 2; 6 mi. S, 6 mi. E Andrews, 1; 7 mi. S, 4 mi. E Andrews, 1; 8.5 mi. S, 4 mi. E Andrews, 3; 9.5 mi. S, 5 mi. E Andrews, 5; 14 mi. S Andrews, 1. ECTOR CO.: 4 mi. W Goldsmith; 8; 4.6 mi. S, 8.6 mi. E Goldsmith, 1; 4 mi. NNW Notrees, 2; 4 mi. N Notrees, 29; 9 mi. N Odessa, 2; 1 mi. N Notrees, 1; 3 mi. S, 3 mi. E Notrees, 2; 3.5 mi. S, 1 mi. E Notrees, 2. GLASSCOCK CO.: 0.5 mi. S, 11 mi. W Lees, 1. MARTIN CO.: 15 mi. S Flower Grove, 1; 7 mi. N, 17 mi. W Stanton, 1; 7 mi. N, 1 mi. E Stanton, 1. MIDLAND CO.: vic. Midland Regional Airport, 2; 5 mi. S, 15 mi. E Midland, 2. WINKLER CO.: 7 mi. N, 4 mi. W Notrees, 9.

*Additional records* (Osgood, 1900:23).—HOWARD CO.: Big Spring. MARTIN CO.: Stanton.

### *Chaetodipus hispidus paradoxus* (Merriam, 1889)

Hispid Pocket Mouse

We took this species in small numbers, frequently singly, in grasslands, sometimes in areas with scattered mesquite. It is, however, generally distributed over the study area. *Dipodomys*, *Perognathus*, and *Onychomys* were common associates.

We examined but one pregnant female, which was taken on 6 June and contained five fetuses (7 in crown-rump length). Individuals with placental scars were obtained in July and October, and one with swollen mammae (but not lactating) was trapped on 11 August. Adult males had testes measuring 10 x 5 in March, 12 x 5 in April, 9 x 5 and 9 x 6 in June, and 9 x 5 and 10 x 6 in July. An October-taken male had abdominal testes (5 x 1).

*Specimens examined* (34).—Andrews Co.: 4 mi. N, 6 mi. W Andrews, 3; 3 mi. N, 6 mi. W Andrews, 2; 5 mi. S, 6 mi. E Andrews,1; 7 mi. S, 4 mi. E Andrews, 1; 9.5 mi. S, 5 mi. E Andrews, 1. Ector Co.: 4 mi. W Goldsmith, 1; 8 mi. S Goldsmith, 9; 4 mi. N Notrees, 2. Glasscock Co.: 0.5 mi. S, 11 mi. W Lees, 1. Howard Co.: 2.5 mi.WSW Vealmoor, 1; 2 mi. S, 0.5 mi. W Luther, 1; 2.5 mi. S, 3.5 mi. W Luther, 1; 3 mi. S, 3.5 mi. W Luther, 1; 3.5 mi. S, 2.5 mi. E Luther 1. Martin Co.: 12 mi. S Flower Grove, 1; 15 mi. S Flower Grove, 1; 9 mi. N, 12.5 mi. W Stanton, 1; 7 mi. N, 17 mi. W Stanton, 1. Midland Co.: 6.5 mi. S, 1 mi. E Stanton, 3; vic. Midland Regional Airport on FM 1788, 1.

### *Dipodomys merriami ambiguus* Merriam, 1890

Merriam's Kangaroo Rat

This kangaroo rat reaches the northeastern limit of its distribution on the southern end of the Kansan Biotic Province where it is known to occur primarily on coarse or gravelly soils in Ector, Martin, Midland, and Winkler counties. *D. merriami* occasionally is taken in the same trap line as *D. ordii*; it frequently associates with *Perognathus flavus* and *D. spectabilis*, and sometimes with *Chaetodipus*, *Onychomys*, *Peromyscus*, and *Reithrodontomys*.

Two pregnant females, each carrying two fetuses (crown-rump length 6 mm in each instance), were trapped on 13 January and 7 May. Testicular measurements of adult males were largest in January, 12 x 5, April, 12 x 6, and October, 14 x 5.

Lidicker (1960:180) noted that specimens assigned to *D. m. ambiguus* from the northeastern edge of the range of the species in Texas had "a tendency to increased size and darker coloration" as compared

TABLE 2.—*Cranial measurements of* Dipodomys merriami *from Ector and Winkler counties, Texas, compared with those of specimens from Big Bend National Park, Brewster County, Texas. Measurements as described by Lidicker (1960:128).*

| Specimens averaged, and sex | Greatest length of skull | Basal length | Length of nasals | Rostral breadth | Interorbital breadth | Maxillary breadth | Greatest breadth of skull | Length of max. toothrow |
|---|---|---|---|---|---|---|---|---|
| Ector and Winkler counties, Texas (19) | | | | | | | | |
| Average (13 M, 6 F) | 36.72 | 25.74 | 13.34 | 3.38 | 13.34 | 20.14 | 23.24 | 4.57 |
| Minimum | 35.71 | 24.95 | 12.53 | 3.12 | 12.46 | 19.19 | 22.73 | 4.31 |
| Maximum | 37.54 | 26.75 | 13.85 | 3.55 | 14.10 | 20.93 | 23.89 | 4.92 |
| Big Bend National Park, Brewster County, Texas (20) | | | | | | | | |
| Average (12 M, 8 F) | 35.79 | 24.72 | 13.16 | 3.16 | 13.26 | 19.71 | 22.58 | 4.53 |
| Minimum | 34.25 | 23.94 | 12.38 | 2.86 | 12.22 | 17.41 | 21.35 | 4.20 |
| Maximum | 37.84 | 25.96 | 13.95 | 3.51 | 13.80 | 20.47 | 23.71 | 4.79 |

to typical specimens of the subspecies. We note these same trends in our more recently acquired material. A re-evaluation of variation in Texas populations of the species is in order. Lidicker (*loc. cit.*) thought there was "some evidence that this easternmost population may be worthy of subspecific recognition." Some comparative cranial measurements are given in Table 2.

*Specimens examined* (42).—ECTOR CO.: 6 mi. N Notrees, 1; 4 mi. N Notrees, 4; 4 mi. W Goldsmith, 1; 3 mi. S, 1.5 mi. E Notrees, 1; 8 mi. S Goldsmith, 2; 12 mi. WSW Odessa (1 mi. E Odessa Meteor Crater), 5. MARTIN CO.: 19 mi. S Patricia, 1; 19.9 mi. S Patricia, 1; 15 mi. S Flower Grove, 4; 9 mi. W Tarzan, 1. MIDLAND CO.: Midland Regional Airport, 1; 5 mi. S, 15 mi. E Midland,1. WINKLER CO.: 7.5-10.0 mi. NW Notrees, 6; 7 mi. N, 4 mi. W Notrees, 1; 6 mi. N, 7 mi. W Notrees, 1; 6 mi. N, 5 mi. W Notrees, 10; 19 mi. E Kermit, base of Concho Bluff, 1.

### *Dipodomys ordii medius* Setzer, 1949

Ord's Kangaroo Rat

Widespread and common over much of the seven-county area, this kangaroo rat typically is taken on sandy soils. Although not colonial, it often is found in relatively dense populations. The mammalian species most often trapped in association with *D. ordii* was *Onychomys leucogaster*.

On Concho Bluff, Winkler County, in January 1989, we collected *D. ordii*, *D. merriami*, and *D. spectabilis* at a single trap site. The caliche soils there generally favored *merriami* and *spectabilis*; the vegetation

included junipers, creosote, some mesquite, yucca, *Opuntia*, and several species of grasses. This restricted area represents a transition zone, vegetationally, between the Kansan and Chihuahuan Biotic provinces—an area where creosote bushes outnumber the small mesquite trees by four or five plants to one.

Females evincing reproductive activity have been recorded from March and April in Andrews and Winkler counties: two animals, each carrying two fetuses (crown-rump lengths, 8 and 28 mm), were taken on 18 March along with one that was lactating and had two placental scars; one lactating animal was taken on 19 March and another on 15 April. Males with testes measuring 10 mm or more in length have been collected in January (one specimen), March (four), April (two), June (three), July (two), and October (one).

*Specimens examined* (55).—Andrews Co.: 1 mi. S Frankel City, 2; 1 mi. S, 1 mi. E Frankel City, 1; 4 mi. N, 9 mi. W Andrews, 1; 4 mi. N, 3 mi. E Andrews, 1; 4 mi. N, 5 mi. E Andrews, 3; 3 mi. N, 11 mi. W Andrews, 1; 3 mi. N, 10 mi. W Andrews, 2; 2 mi. N, 18 mi. E Andrews, 2 (WBU); 5 mi. S, 6 mi. E Andrews, 3; 6 mi. S, 6 mi. E Andrews, 4; 7 mi. S, 3 mi. E Andrews, 2; 7 mi. S, 4 mi. E Andrews, 1; 8.5 mi. S, 4 m. E Andrews, 2; 14 mi. S Andrews, 1; 15 mi. SW Andrews, 1 (TCWC). Ector Co.: 4 mi. N Notrees, 1. Glasscock Co.: 0.5 mi. S, 11 mi. W Lees, 2. Martin Co.: 19 mi. S Patricia, 9; 19.9 mi. S Patricia, 1; 15 mi. S Flower Grove, 2; 7 mi. N, 1 mi. E Tarzan, 3; 7 mi. N, 17 mi. W Stanton, 1. Midland Co.: 6.5 mi. S, 1 mi. E Stanton, 2; 7 mi. SE Midland, 1; 5 mi. S,15 mi. E Midland, 1. Winkler Co.: 10 mi. [NW] Notrees, 1; 7 mi. N, 4 mi. W Notrees, 3; 6 mi. N, 4 mi. W Notrees, 1.

### *Dipodomys spectabilis baileyi* Goldman, 1923

Banner-tailed Kangaroo Rat

This Chihuahuan Desert species is uncommon on the southern end of the Kansan Biotic Province, reaching the northeastern limit of its distribution there. It has been recorded, however, from all counties except Glasscock and Howard, and is known also from Gaines County just to the north of the study area. *Dipodomys spectabilis* builds multi-entrance mounds for homesites, mostly in caliche soils (Fig. 7). Well-established trails lead away from some mounds, many of which were found atop buried pipelines where previous excavation presumably enabled the rats to dig more easily in the loosened caliche. Unless occupied by a female with young, typically only one rat is found in a single mound-burrow system. There are, however, other species of mammals, other vertebrates, and invertebrates that have been documented as inhabiting these mounds. On Concho Bluff, Winkler Coun-

FIG. 7.—*Dipodomys spectabilis* mound in caliche, surrounded by short grasses, Ector County, Texas.

ty, a specimen of *D. ordii* was trapped adjacent to a *spectabilis* mound, and a ground squirrel (*Spermophilus mexicanus)* was seen occupying a mound there. Several *Perognathus flavus* and *D. merriami* were trapped atop mounds southeast of Notrees in Ector County. It is likely that woodrats, *Neotoma micropus*, and other rodents habitually utilize abandoned mounds (we trapped a *N. micropus* at a mound in Ector County).

Little information is available to us on reproduction. A pregnant female containing two fetuses was taken from Ector County on 2 September, and a male with scrotal testes was trapped in Martin County on 25 June.

*Specimens examined* (37).—ANDREWS CO.: 2 mi. N, 18 mi. E Andrews, 1 (WBU). ECTOR CO.: 4 mi. NNW Notrees, 2; 1 mi. NNW Notrees, 1; 5 mi. NE Penwell, 1. MARTIN CO.: 19 mi. S Patricia, 1; 19.9 mi. S Patricia, 3; 12 mi. S Flower Grove, 1; 15 mi. S Flower Grove, 4; 9 mi. W Tarzan, 3; 1 mi. S, 18 mi. W Stanton, 3. MIDLAND CO.: 5 mi. N, 8 mi. W Midland, 3. WINKLER CO.: 11 mi. NW Notrees, 1; 9.5 mi. NW Notrees, 1; 8 mi. NW Notrees, 5; 7 mi. N, 4 mi. W Notrees, 4; 7.5 mi. NW Notrees, 2.

*Additional record* (Bailey, 1905:147).—ECTOR CO.: Odessa.

### *Reithrodontomys megalotis megalotis* (Baird, 1858)

Western Harvest Mouse

Normally occurring in weedy-grassy habitats, *Reithrodontomys megalotis* is more likely to be found in brushy areas than is *R. mon-*

TABLE 3.—*Comparative cranial measurements of adults of* Reithrodontomys megalotis *from the northern, central, and southern parts of the Texas High Plains. Sample sizes in parentheses.*

| Specimens averaged, and sex | Greatest length of skull | Zygomatic breadth | Breadth of braincase | Postorbital constriction | Depth of cranium | Length of rostrum | Breadth of rostrum | Length of max. toothrow |
|---|---|---|---|---|---|---|---|---|
| Sherman County, northern Panhandle (19) | | | | | | | | |
| Average (7 M, 12 F) | 20.62 | 10.65 | 10.08 | 3.17 | 7.62 | 7.15 | 3.50 | 3.30 |
| Minimum | 19.83 | 10.30 | 9.62 | 3.03 | 7.60 | 6.80 | 3.22 | 3.03 |
| Maximum | 21.23 | 11.30 | 10.44 | 3.44 | 8.09 | 7.69 | 3.88 | 3.53 |
| Bailey, Lamb, and Hale counties, Muleshoe Sandhills (25) | | | | | | | | |
| Average (12 M, 13 F) | 21.33 | 10.79 | 10.24 | 3.22 | 7.98 | 7.59 | 3.42 | 3.35 |
| Minimum | 20.52 | 10.41 | 9.90 | 3.02 | 7.59 | 7.05 | 3.06 | 3.18 |
| Maximum | 22.15 | 11.37 | 10.71 | 3.49 | 8.50 | 8.07 | 3.76 | 3.59 |
| Southern Kansan Biotic Province (8) | | | | | | | | |
| Average (8 M) | 21.26 | 10.59 | 10.05 | 3.18 | 8.06 | 7.94 | 3.43 | 3.27 |
| Minimum | 20.90 | 10.41 | 9.65 | 3.08 | 7.79 | 7.31 | 3.18 | 3.13 |
| Maximum | 21.81 | 10.97 | 10.27 | 3.32 | 8.42 | 8.20 | 3.58 | 3.41 |

*tanus*. It tends to prefer stands of grasses having a dense basal cover, and often is taken in association with *Baiomys taylori* where that species is present. Specimens are at hand from all counties in the study area except Midland and Glasscock, in both instances likely the result of inadequate trapping efforts. Only one pregnant female (three fetuses, crown-rump length 4, 7 May) is available to us. Length of testes of young adult and adult males were as follows: January, 8, 8; March, 6, 8; April, 6, 8, 8; May, 8, 9, 9; June, 8, 10; July, 6, 7, 10, 11; October, 9. Two males taken on 7 May were in the process of spring molt.

Comparative cranial measurements of western Texas populations are given in Table 3. Average external measurements (extremes in parentheses) for eight fully adult males from our seven-county area are as follows: total length, 144.7 (137-149); length of tail, 72.1 (66-76); length of hind foot, 17.0 (16-18); length of ear, 14.2 (13-16); weight (grams), 10.1 (8.0-12.0). Ratio of tail length to head and body length of these males averaged 99.7 (83.9-115.1). We tentatively refer our specimens to *R. m. megalotis* pending review of variation in this harvest mouse in western Texas and adjacent regions.

*Specimens examined* (25).—ANDREWS CO.: 4 mi. N, 9 mi. W Andrews, 2; 3 mi. N, 11 mi. W Andrews, 2. ECTOR CO.: 4 mi. W Goldsmith, 4; 8 mi. S Goldsmith, 1; 1 mi. N

Notrees, 1. Howard Co.: 1 mi. N Luther, 3; 1 mi. S Luther, 2; 3.5 mi. S, 5 mi. W Big Spring, 4. Martin Co.: 7 mi. N, 1 mi. E Tarzan, 2; 10 mi. N, 5 mi. E Stanton, 2. Winkler Co.: 6 mi. N, 5 mi. W Notrees, 2.

### *Reithrodontomys montanus griseus* Bailey, 1905

Plains Harvest Mouse

The plains harvest mouse occurs throughout the southern end of the Kansan Biotic Province where adequate grassy cover is found. This species commonly associates with both *Reithrodontomys megalotis* and *Baiomys taylori*, but cohabits with a variety of small mammals. For example, in 310 Sherman live traps set in habitats in Martin County varying from dense mesquite with an understory of grasses to grassy areas cleared of mesquite, we took the following on 22 October 1989 along with two *R. montanus*: four *Neotoma micropus*, three *Sigmodon hispidus*, and one each *Perognathus flavus*, *Chaetodipus hispidus*, *Dipodomys ordii*, *Peromyscus leucopus*, and *Baiomys taylori*.

Reproductive data for females from the seven-county area are: in mid-March, three pregnant females carrying four, four, and two fetuses (crown-rump lengths 12, 6, and 17, respectively), two lactating females, and one animal with two placental scars; on 22 October, one pregnant female carrying six fetuses (14 in length) and one lactating animal. Testes of males measured 4-6 in length in March and 3-4 in April; a November-taken animal had abdominal testes.

*Specimens examined* (23).—Andrews Co.: 1 mi. S Frankel City, 3; 4 mi. N, 9 mi. W Andrews, 4; 3 mi. N, 11 mi. W Andrews, 4; 3 mi. N, 6 mi. W Andrews, 1; 5-6 mi. S, 6 mi. E Andrews, 2; 7 mi. S, 3 mi. E Andrews, 1; 7 mi. S, 4 mi. E Andrews, 1. Ector Co.: 4 mi. N Notrees, 1. Howard Co.: 2.5 mi. WSW Vealmoor, 1. Martin Co.: 7 mi. N, 17 mi. W Stanton, 2. Winkler Co.: 6 mi. N, 5-6 mi. W Notrees, 3.

### *Peromyscus leucopus tornillo* Mearns, 1896

White-footed Mouse

The white-footed mouse is widespread but relatively uncommon at the southern end of the Kansan Biotic Province, occurring in brushy habitats typical of mesquite grasslands and some fencerows. Individuals frequently were trapped at or near the base of mesquite trees. Unlike *P. maniculatus*, this species often is taken on brush-covered rocky outcroppings. According to Hall (1981), the subspecies in the region is *P. l. texanus* Woodhouse, but specimens examined more nearly approach *P. l. tornillo* to which they are here referred, rather than the

smaller and darker *texanus*. A systematic study of the southwestern populations of this taxon is in order. Average (and extreme) external measurements of 15 adults (six males, nine females) from Andrews, Ector, and Martin counties are as follows: total length, 178.0 (167-189); length of tail, 78.9 (75-86); length of hind foot, 21.5 (21-22); length of ear, 16.7 (15-18). Weight (grams) of these same 15 mice (no pregnant females) averaged 22.8 (17.0-31.0).

Reproductive activity has been documented for females during winter and spring. One pregnant animal (four fetuses—crown-rump length, 13) was taken on 19 March in Andrews County, and lactating animals were trapped on 13 January (Winkler County), 18 March (Andrews County), and 15 April (Winkler County); a female in post-lactating condition was taken on 19 May from Midland County. Males with a testicular length of 12 or greater were collected in January (two animals), March (two), and June (two).

*Specimens examined* (48).—Andrews Co.: 1 mi. S Frankel City, 2; 4 mi. N, 9 mi. W Andrews, 3; 3 mi. N, 10-11 mi. W Andrews, 11; 7 mi. S, 3-4 mi. E Andrews, 3. Ector Co.: 4 mi. N Notrees, 3; 8 mi. S Goldsmith, 1; 3.5 mi. S, 1 mi. E Notrees, 1; 12 mi. WSW Odessa, 1. Martin Co.: 7 mi. N, 1 mi. E Tarzan, 2; 7 mi. N, 5 mi. E Tarzan, 3; 7 mi. N, 17 mi. W Stanton, 1. Midland Co.: 5 mi. S, 15 mi. E Midland, 3. Winkler Co.: 6-7 mi. N, 4-6 mi. W Notrees, 13; 7.5 mi. NW Notrees, 1.

### *Peromyscus maniculatus luteus* Osgood, 1905

Deer Mouse

*Peromyscus maniculatus* probably is widespread on the southern part of the Kansan Biotic Province, but records of occurrence currently exist only for Andrews and Ector counties. This mouse is most often associated with weedy-grassy habitats, but it does not seem to prefer the dense basal cover sought by *Baiomys taylori* and *Reithrodontomys megalotis*.

We tentatively follow Judd (1970) in referring our material of this species to the race *P. m. luteus*, which currently is recorded as occurring from South Dakota southward to the southern edge of the High Plains. However, specimens from the Llano Estacado are not typical of *luteus*, and a thorough systematic evaluation of deer mice from northwestern Texas and adjacent areas is needed. Specimens from our study sites are not suggestive of *P. m. blandus*, the race that occurs to the southwest in the Chihuahuan Biotic Province, but they do resemble in some ways the subspecies *P. m. pallescens* of central Texas (type locality, San Antonio, Bexar County).

We have record of only one pregnant female from the study area, an animal carrying four fetuses (crown-rump length, 18) that was taken on 18 March in Andrews County. Testes of males ranged in length from 8-11 in March, and 6-9 in May.

*Specimens examined* (25).—Andrews Co.: 4 mi. N, 9 mi. W Andrews, 1; 3 mi. N, 11 mi. W Andrews, 6; 2 mi. N, 18 mi. E Andrews, 1; 7 mi. S, 3 mi. E Andrews, 1. Ector Co.: 4 mi. W Goldsmith, 1; 4 mi. N Notrees, 3; 9 mi. N Odessa, 5; 1 mi. N Notrees, 1; 3.5 mi. S, 1 mi. E Notrees, 1; 2 mi. N Odessa, 3, Odessa, 1 (MWSU); 10 mi. E Odessa, 1.

### *Baiomys taylori taylori* (Thomas, 1887)

Northern Pygmy Mouse

One of the smallest mammals from the southern border of the Kansan Biotic Province, *Baiomys taylori* has greatly expanded the limits of its distribution northwestwardly during the present century (see Choate *et al.*, 1990, 1991, for example). The species currently is on record only from the eastern third of our study area. Pygmy mice typically are found in weedy-grassy habitats and usually are taken in association with *Sigmodon hispidus* and *Reithrodontomys megalotis*, and sometimes *Chaetodipus hispidus*, *Reithrodontomys montanus*, and *Peromyscus maniculatus*.

Three pregnant females have been recorded from the study area in June, each containing two fetuses (crown-rump lengths 5, 10, and 14). Also in June, one lactating female and one postlactating individual were taken. The greatest testicular length recorded for males trapped in the study area was 7 in April.

*Specimens examined* (26).—Glasscock Co.: 0.5 mi. S, 11 mi. W Lees, 2. Howard Co.: 1 mi. N Luther, 4; 1 mi. S Luther, 1; 3.5 mi. S, 5 mi. W Big Spring, 3. Martin Co.: 7 mi. N, 1 mi. E Tarzan, 4; 7 mi. N, 5 mi. E Tarzan, 5; 10 mi. N, 5 mi. E Stanton, 2; 7 mi. N, 17 mi. W Stanton, 1. Midland Co.: 6.5 mi. S, 1 mi. E Stanton, 3; 4 mi. N, 18 mi. W Midland, 1.

### *Onychomys leucogaster arcticeps* Rhoads, 1898

Northern Grasshopper Mouse

This mouse is common throughout the southern edge of the Kansan Biotic Province, often occurring on sandy soils in association with *Dipodomys ordii*. The dorsum of individuals of *O. leucogaster* in adult pelage is dichromatic, dull gray or pinkish cinnamon; the venter is white. The predatory habits of grasshopper mice are well docu-

mented, but *O. leucogaster* readily is taken in live or snap traps baited with rolled oats.

Three pregnant females collected in Andrews County on 18-19 March contained four (crown-rump length 5), five (7), and seven fetuses (23). Another animal, taken at the same time, was lactating. Testicular measurements of six males trapped concurrently with the above-listed females were 18 x10 (two animals), 20 x 10 (three animals), and 22 x 14. Another male, taken in mid-July, had testes measuring 15 x 8.

*Specimens examined* (60).—Andrews Co.: 1 mi. S Frankel City, 4; 1 mi. S, 1 mi. E Frankel City, 3; 4 mi. N, 9 mi. W Andrews, 2; 4 mi. N, 3 mi. E Andrews, 1; 4 mi. N, 5 mi. E Andrews, 1; 3 mi. N, 6 mi. W Andrews, 1; 5 mi. S, 6 mi. E Andrews, 2; 6 mi. S, 6 mi. E Andrews, 4; 7 mi. S, 3-4 mi. E Andrews, 3. Ector Co.: 6 mi. N Notrees, 3; 4 mi. N Notrees, 2; 9 mi. N Odessa, 1; 11 mi. W Odessa, 1; 12 mi. WSW Odessa, 9. Martin Co.: 19 mi. S Patricia, 4; 19.9 mi. S Patricia, 1; 15 mi. S Flower Grove, 3. Midland Co.: 8 mi. S Stanton, 1 (TCWC); 10 mi. NW Midland, 1; 4 mi. NW Midland, 1 (MWSU). Winkler Co.: 9-10 mi. NW Notrees, 3; 7 mi. N, 4 mi. W Notrees; 1; 7 mi. NNW Notrees, 1; 7.5 mi. NW Notrees, 5; 6 mi. N, 5 mi. W Notrees, 2.

### *Sigmodon hispidus texianus* (Audubon and Bachman, 1853)

Hispid Cotton Rat

Widespread and common throughout the study area, *Sigmodon hispidus* typically is found in the vicinity of low lying or mesic areas that support dense, coarse vegetation such as Johnsongrass and careless weed. This rat also occurs in mesquite grasslands, especially those that are not overgrazed. It sometimes occurs in relatively dense populations that must be substantially reduced in order to capture other species of rodents. Where *S. hispidus* occurs in large numbers, obvious runways often are present.

On 19 March a female gave birth to five young in a live trap (neonates were 60 in total length), and a female taken on 7 May carried six fetuses (crown-rump length, 14). Two pregnant females containing seven and six fetuses were trapped on 7 June (crown-rump lengths 5 and 39, respectively), and two lactating animals were collected on the same date, one of which contained three placental scars. Four pregnant animals trapped on 21-22 October contained four (crown-rump length, 20), four (40), seven (14), and five (21, lactating) fetuses. Males with testes 15-26 in length were collected in March (five animals), June (five), July (two), and October (one).

FIG. 8.—*Neotoma albigula* nest under rock near break of Llano Estacado, Ector County, Texas.

*Specimens examined* (50).—ANDREWS CO.: 1 mi. S Frankel City, 1; 3 mi. N, 11 mi. W Andrews, 5. ECTOR CO.: 4 mi. N Notrees, 1; 4 mi. W Goldsmith, 1; 8 mi. S Goldsmith, 6. GLASSCOCK CO.: 0.5 mi. S, 11 mi. W Lees, 1. HOWARD CO.: 2.5 mi. WSW Vealmoor, 6; 1 mi. N Luther, 3. MARTIN CO.: 7 mi. N, 1 mi. E Tarzan, 13; 7 mi. N, 5 mi. E Tarzan, 3; 10 mi. N, 5 mi. E Stanton, 1; 7 mi. N, 17 mi. W Stanton, 3. MIDLAND CO.: 6.5 mi. S, 1 mi. E Stanton, 3; 4 mi. NW Midland, 1; 10 mi. W Midland, 1. WINKLER CO.: 7.5 mi. NW Notrees, 1.

### *Neotoma albigula albigula* Hartley, 1894

White-throated Woodrat

Specimens of this woodrat are known from the study area only from outcroppings on Concho Bluff, but the species probably occurs elsewhere in rocky breaks at the edge of the Llano Estacado. Insofar as known, *N. albigula* does not occupy mesquite grasslands, but rather is restricted to saxicolous habitats. Nests (Fig. 8) may be more or less exposed along a precipitous rock face or entirely hidden within fissures in rocks. Junipers, desert hackberry trees, or other brush may be utilized to support nests if these plants occur in close proximity to rocky areas.

The white-throated woodrat sometimes is difficult to distinguish from *N. micropus* based solely on color of dorsal pelage, although *albigula* usually has a buffy or pale brownish hue as opposed to the pale

FIG. 9.—Typical *Neotoma micropus* nest at base of small mesquite tree in Andrews County, Texas.

gray of *micropus*. The gular and chest hairs of *albigula* are white throughout, whereas those of *micropus* are typically white-tipped but darker at their bases.

*Specimens examined* (21).—WINKLER CO.: 9.5-10.0 mi. NW Notrees, 4; 6 mi. N, 6 mi. W Notrees, 1; 6 mi. N, 5 mi. W Notrees, 3; 7.5 mi. NNW Notrees, 13.

### *Neotoma micropus canescens* Allen, 1891

Southern Plains Woodrat

*Neotoma micropus* is a common inhabitant of the southern part of the Kansan Biotic Province. It builds conspicuous above-ground nests of sticks, *Opuntia* pads, leaves, cattle dung, bones, and other refuse (Fig. 9). These often are placed at the base of some stable, upright structure such as a fence post, mesquite tree, or cholla stalk, or may be constructed in patches of *Yucca* or *Opuntia*. Each nest usually is occupied by a single individual; however, over a period of years, many different woodrats may reside in a single nest, each contributing to the overall structure.

In mesquite-short grass habitats that are little disturbed, *N. micropus* houses frequently can be found in fairly large numbers. Although this

species typically does not nest in rocky outcroppings, it will occupy rocks in the absence of *N. albigula*, a saxicolous competitor.

One pregnant female that contained four fetuses (crown-rump length, 42) was taken in Andrews County on 17 July, and three lactating animals were collected from Andrews, Ector, and Martin counties in May, June, and October. A postlactating female was taken in Ector County on 21 October. Males with testes measuring 17-21 in length were trapped in the study area in March, May, June, and October.

*Specimens examined* (93).—Andrews Co.: 10 mi. NW Andrews, 1 (TCWC); 4 mi. N, 9 mi. W Andrews, 1; 4 mi. N, 3 mi. E Andrews, 2; 5 mi. S, 6 mi. E Andrews, 1; 7 mi. S, 3-4 mi. E Andrews, 3; 14 mi. S Andrews, 2. Ector Co.: 4 mi. N Notrees, 6; 8 mi. S Goldsmith, 4; 9 mi. N Odessa, 3; 3 mi. N Odessa, 1; 3.5 mi. S, 1 mi. E Notrees, 3; . Howard Co.: 2.5 mi. WSW Vealmoor, 2; 7 mi. E Vealmoor, 2 (TNHC). Martin Co.: 19 mi. S Patricia, 1; 19.9 mi. S Patricia, 4; 7 mi. N, 1 mi. E Tarzan, 9; 7 mi. N, 5 mi. E Tarzan, 1; 15 mi. S Flower Grove, 4; 0.5 mi. N, 0.2 mi. E Tarzan, 1 (WBU); Tarzan, 1; 7 mi. N, 17 mi. W Stanton, 4; 3 mi. N Stanton, 1. Midland Co.: 9 mi. S Stanton, 1 (TCWC); 4 mi. NE Midland, 1; Midland, 1; 0.5 mi. S, 8 mi. W Midland, 1. Winkler Co.: 9-10 mi. NW Notrees, 2; 7.5 mi. NNW Notrees, Concho Bluff, 26; 7.5 mi. NW Notrees, 4.

### *Mus musculus*

House Mouse

The house mouse is recorded only from Martin and Midland counties, but doubtless occurs throughout the study area in association with human habitation.

*Specimens examined* (7).—Martin Co.: 7 mi. N, 1 mi. E Tarzan, 1; 7 mi. N, 5 mi. E Tarzan, 1. Midland Co.: 4 mi. NW Midland (on Texas Hwy. 158) and1.5 mi. N on private road, 1; 4 mi. NW Midland, 3; 3 mi. N Midland, 1.

### *Erethizon dorsatum epixanthum* Brandt, 1835

Common Porcupine

This largest of rodents on the Llano Estacado evidently occurs sparingly but widely over the study area. We have examined two specimens. One is a dentary bone found at the base of a woodrat (*Neotoma albigula*) midden on Concho Bluff (6 mi. N and 5 mi. W Notrees), in Winkler County; the other is a skull obtained from an animal killed along a road 15 mi. W Andrews, Andrews County. Another dead animal was found 4 mi. N and 16 mi. W Andrews and a juvenile was observed 6 mi. S and 4 mi. E Andrews. We follow Stangl *et al.* (1991) in use of the subspecific name *epixanthum*.

### *Canis latrans texensis* Bailey, 1905

Coyote

The coyote is the most conspicuous carnivore in the seven-county area comprising the southern end of the Kansan Biotic Province and certainly one of the most common. Henke estimated one coyote per 2.67 square miles in Andrews County in the summer of 1991. When animals were removed from a study site, new individuals moved into the vacated areas within a week or two. It was commonplace to see coyotes abroad in the daytime, particularly in the colder months.

Few good series of external measurements are available for *C. latrans*. We selected at random 20 adults of each sex that were collected by Henke in Andrews County in March 1990 and April 1991 and for which total length, length of tail, length of hind foot (measured to the nearest half inch and converted to mm), and weight (in kilograms) had been recorded. Average, extremes (in parentheses), and one standard deviation for males, followed by females, were: 1227.4 (1168-1295) ± 37.2, 1172.8 (1041-1283) ± 67.9; 398.0 (343-432) ± 25.8, 378.4 (305-432) ± 36.5; 159.1 (152-178) ± 10.9, 156.0 (133-178) ± 10.9; 11.1 (8.5 -13.4) ± 1.4, 10.9 (7.9-13.4, one pregnant with five small fetuses) ± 1.5.

On 26-28 March, 11 of 26 females were pregnant. These carried an average of 4.63 fetuses, the extremes being four and six.

*Specimens examined* (66).—Andrews Co.: 9 mi. N, 9 mi. W Andrews, 1; 8 mi. N, 7-10 mi. W Andrews, 4; 8 mi. N, 8-13 mi. E Andrews, 5; 8 mi. N, 15-17 mi. E Andrews, 15; 7 mi. N, 7 mi. E Andrews, 1; 7 mi. N, 11-15 mi. E Andrews, 4; 5 mi. N, 21.5 mi. E Andrews, 2; 4 mi. N, 12 mi. E Andrews, 1; 4 mi. N, 19.5-23 mi. E Andrews, 6; 12-21 mi. E Andrews, 7; 1 mi. S, 16-20.5 mi. E Andrews, 3; 2 mi. S, 15.5-21 mi. E Andrews, 8; 4 mi. S, 19 mi. E Andrews, 3; 6-7 mi. S, 6 mi. E Andrews, 5. Midland Co.: 3 mi. S, 10 mi. W Midland, 1 (TCWC).

*Additional records* (J. K. Jones, Jr., field notes, 1989).—Ector Co.: 2 mi. N Notrees; 1 mi. N Notrees.

### *Vulpes velox velox* (Say, 1823)

Swift Fox

The swift fox probably occurs sparingly throughout much of the southern part of the Llano Estacado, but it certainly is much less common there than in the northern part of the region, say from Lubbock northward. We know of no specimens taken in recent years. Bailey (1905:179) reported these foxes from Stanton, Martin County, and

Midland, Midland County. We have a trapper's report that one was taken in Ector County. Specimens from the Llano are assigable to *V. v. velox*, but, the subspecies *V. v. macrotis* has been reported from just to the south of the southern edge of the Kansan Province.

### *Vulpes vulpes fulva* (Desmarest, 1820)

Red Fox

This fox is uncommon everywhere on the High Plains of western Texas. We have examined but a single specimen (sex unknown) from our study area (or possibly just east of the break of the Llano) from a place 5.6 mi. E Big Spring, Howard County. Additionally, Henke observed a red fox on 26 April 1991 in mesquite grassland 1 mi. S and 12 mi. E Andrews, Andrews County.

### *Urocyon cinereoargenteus scottii* Mearns, 1891

Common Gray Fox

Evidently the most common and widespread of the three foxes along the southern end of the Kansan Biotic Province, this species is, nevertheless, nowhere abundant. Specimens examined include a male from 12 mi. N and 17 mi. E Andrews, Andrews County, obtained on 24 January 1991, and a female from an unknown locality along State Highway 349 in Midland County taken on 14 October 1985. In addition a photograph of an individual captured in Andrews appeared in the local newspaper on 25 April 1991, and a road-killed female was recorded from 4 mi. S and 17 mi. E Andrews on 24 January 1991.

### *Bassariscus astutus flavus* Rhoads, 1894

Ringtail

Our only record of this procyonid comes from Big Spring, Howard County (MWSU). It likely occurs elsewhere along rocky breaks of the Llano.

### *Taxidea taxus berlandieri* Baird, 1858

American Badger

Although our records of the badger are from Andrews, Howard, and Martin counties, this large mustelid occurs generally over the seven-county area. Specimens examined come from 10 mi. N Big Spring,

Howard County, and 5 mi. W Tarzan (=22 mi. N Midland on State Highway 349), Martin County.

We noted road-killed badgers in Andrews County at the following locations: 4.5 mi. N and 8 mi. E Andrews, 4 mi. N and 2.5 mi. E Andrews, 3 mi. S and 14 mi. E Andrews, and 6 mi. S and 8 mi. E Andrews. We also observed these animals at several places in Andrews County and saw a subadult 6.5 mi. S and 1 mi. E Stanton, in Midland County on 6 June 1989.

### *Mephitis mephitis varians* Gray, 1837

Striped Skunk

*Mephitis mephitis* is generally distributed over the seven-county area and one of the most common carnivores. We examined two specimens, a male from 3 mi. N Stanton, Martin County, and a individual of unknown sex from about 1 mi. N Big Spring, Howard County. Representative sightings and road kills, all from Andrews County, are 6 mi. N and 7 mi. E Andrews, 1 mi., N and 5 mi. E Andrews, and 11.5 mi. E Andrews.

### *Lynx rufus texensis* Allen, 1895

Bobcat

Bobcats are found throughout the southern part of the Kansan Biotic Province, but they are uncommon. Our only specimen is an adult (sex unknown) from about 1 mi. N Big Spring, Howard County. Additionally, Bailey (1905:170) listed records from Odessa, Ector County, and Stanton, Martin County, and we observed bobcats at several localities in Andrews County, including 8.5 mi. N and 16 mi. E Andrews and 6.5 mi. S and 3 mi. E Andrews.

### *Tayassu tajacu angulatus* (Cope, 1889)

Collared Peccary

We saw tracks of peccaries around a small pond 4 mi. NNW Notrees, Ector County, in April 1989. About the same time, a local rancher (B. Cole) told us there was a small herd of five or six individuals that inhabited Concho Bluff, Winkler County, and the area immediately east of it in Ector County where our observation was made. The group had been seen by residents in the two-county area for about two years and had been more or less protected by local land owners. Additionally, a

peccary was killed on State Highway 115 at a place 6 mi. N and 15 mi. E Andrews, Andrews County, in the summer of 1990. As early as 1902, Bailey (1905:59) recorded one found 2 mi. NE Odessa, Ector County, but this animal "was very thin and evidently a wanderer."

### *Odocoileus hemionus crooki* (Mearns, 1897)

Mule Deer

The mule deer is relatively common in the seven-county area. We obtained no specimens, but we observed these deer on a number of occasions. Representative sightings are: 25 individuals seen 10.5 mi. N and 15.5 mi. E Andrews, Andrews County, on14 January 1991; three groups totaling 12 deer (including bucks, does, and fawns) seen on 12 January 1991 in the area 8.5 mi. N and 9 mi. E Andrews, Andrews County; three does near the line between Andrews and Martin counties, 7.5 mi. N and 21 mi. E Andrews, on 29 July 1991.

### *Odocoileus virginianus texanus* (Mearns, 1898)

White-tailed deer

We found this species to be rare along the southern border of the Kansan Biotic Province. The only individual observed was a buck seen by Henke at a place 0.5 mi. S and 25.5 mi. E Andrews, in Martin County, on 29 July 1991.

### *Antilocapra americana*

Pronghorn

The pronghorn, probably representing the subspecies *A. a. mexicana* Merriam, 1901, once was common to abundant over the seven-county area. The species was, however, extirpated and later reintroduced, possibly through release of animals representing other than the native race. In any event, *A. americana* now occurs sparingly along the southern border of the Kansan Province. Henke observed two bucks in Martin County, at a location 1 mi. N and 22.5 mi. E Andrews, on 26 July 1991.

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# TAXONOMIC STATUS OF MISCELLANEOUS NEOTROPICAL VIPERIDS, WITH THE DESCRIPTION OF A NEW GENUS

JONATHAN A. CAMPBELL AND WILLIAM W. LAMAR

Despite the contributions made to crotaline systematics over the last few decades (for example, Gloyd, 1940; Klauber, 1972; Campbell and Lamar, 1989; Gloyd and Conant, 1991), the systematic status of several taxa remains questionable. We herein attempt to resolve some of these problems. Terminology follows Klauber (1972); the method of counting scales is that of Dowling (1951).

We argue that recognition of certain Neotropical genera (*Bothriechis* and *Bothriopsis*) accurately reflects our knowledge of natural groups and adheres to modern systematic practice. Conversely, the evidence that the genus *Bothrops* as presently comprised is monophyletic is less compelling. The name *Bothrops*, contrary to the views of several recent authors (for example, Schätti *et al.*, 1990, and Shätti and Kramer, 1991), is masculine in gender (Smith and Larsen, 1974; Internat. Code Zool. Nomenclature, 1985, art. 30a, ii). The variation and generic allocation of *Bothrops albocarinatus* Shreve (1934) are discussed and its distribution is redefined to include south-central Colombia. We discuss the reasons for our distinction between *Bothrops asper* and *B. atrox* (Campbell and Lamar, 1989), and suggest that possibly several additional unrecognized species may be present in the *asper-atrox* complex. *Bothrops microphthalmus colombianus* Rendahl and Vestergren (1940) is elevated to specific status. *Bothrops roedingeri* Mertens (1942) and *Trigonocephalus xanthogrammus* Cope (1868) are placed, respectively, in the synonymies of *Bothrops pictus* (Tschudi,

1845) and *B. asper* (Garman, 1884). *Bothrops campbelli*, *B. osbornei*, and *Bothriechis mahnerti* are referred to the synonymy of previously described species, which are herein redescribed with amplified distributions. Finally, a new genus is proposed for three species of high-montane Middle American pitvipers that appear to form a natural group.

## The Genera *Bothriechis*, *Bothriopsis*, and *Bothrops*

The genus *Bothriechis* Peters (1860) was recognized by Campbell and Lamar (1989) for seven species of arboreal pitvipers, most of which are confined to wet montane habitats in southern México and Central America, but with one species ranging into northwestern South America in lowland as well as lower montane habitats. The generic arrangement recognizing both *Bothriechis* and *Bothriopsis*, as well as *Ophryacus*, was first proposed by Burger (1971) in an unpublished doctoral dissertation. Subsequently, Burger's identification keys to these genera were published by Pérez-Higareda *et al.* (1985).

Shätti *et al.* (1990) suggested that the genera *Bothriechis* and *Bothriopsis*, as recognized by Campbell and Lamar (1989), appeared to be artificial groups, and that *Bothrops* (*sensu* Burger, 1971) "probably represents a monophyletic group." Cadle (1992) voiced the opinion that he "preferred to err on the side of conservatism" and suggested that *Bothrops* (*sensu lato*) be retained. We hardly would agree that recognition of a paraphyletic taxon could be called conservative. We hypothesize that *Bothriechis* and *Bothriopsis* represent monophyletic groups, whereas the diverse, widespread genus *Bothrops* may be paraphyletic.

Shätti *et al.* (1990), on the basis of newly collected material, confirmed the suggestion of Campbell and Lamar (1989:172) that *Bothriopsis albocarinata* and *B. alticola* are conspecific, with *albocarinata* having priority, but they placed *albocarinata* in the genus *Bothriechis*. Shätti and Kramer (1991) also described *Bothriechis mahnerti*, which they mistakenly thought was a novel taxon, but what in actuality is *Bothriopsis punctata* (see discussion below of the taxonomic status of *Bothrops osbornei* and *Bothriechis mahnerti*). We take this opportunity to point out that the distribution of *Bothriopsis albocarinata* is not restricted to Ecuador as delimited by Shätti *et al.* (1990) and that this species ranges at least as far north as south-central Colombia (UV 10561). This specimen is noteworthy in that it is one of the largest known (649 mm snout-vent, 764 mm total length), is significantly

darker in overall pattern than typical specimens, and lacks distinctive pale keels on the dorsal scales. Two additional specimens from Pastaza, Ecuador (GNM 3765 from Chambira, Río Bobonaza, and GNM 3766 from the Río Conambo) are typical in most respects, except GNM 3765 possesses 23 dorsal scale rows at midbody rather than 19 to 21.

Shätti *et al.* (1991) suggested that five species, which they placed in the genus *Bothriechis*, were closely related: *schlegelii*, *bilineata*, *punctata*, *taeniata*, and *albocarinata*. The only evidence these authors gave for this purportedly close relationship was that all of these species have a prehensile tail. In lieu of additional evidence, a prehensile tail might be considered a homologous character uniting Middle American and South American groups of arboreal pitvipers. However, when the preponderance of evidence is considered (summarized by Campbell and Lamar, 1989), it appears more likely that a prehensile tail is convergent in these two groups.

Characters distinguishing *Bothriechis* from *Bothriopsis* given by Campbell and Lamar (1989) and cited by Shätti *et al.* (1990) include hemipenis shape (subcylindrical or tapered with papillate calyces as opposed to attenuated with a calyculate distal half), number of hemipenial spines (10 to 24 as opposed to 30 to 40), and subcaudal condition (entire as opposed to divided). Other characters defining these genera given by Burger (1971) and cited by Shätti et al. (1990) include the shape of the ectopterygoid (broad and slightly curved without truncate dorsolateral projections as opposed to lacking anterior dorsolateral projections) and palatine (triangular with apex near or posterior to mid-palatine in *Bothriechis* and variable in *Bothriopsis*), and the nature of scale ornamentation on the distal portion of the tail (first and second rows of scales on distal one-third of tail strongly keeled as opposed to unmodified). Shätti *et al.* (1990) questioned the validity of these characters, although they apparently did not examine skeletal material or even external features of comparative material. Paradoxically, after indicating support for the value of the hemipenis as a character to distinguish phylogenetic groups among New World pitvipers, Shätti *et al.* (1990:884) discussed some of the differences between *Bothriechis* and *Bothriopsis*, yet they chose to ignore these differences in their generic designations (Schätti *et al.*, 1990; Schätti and Kramer, 1991). Schätti *et al.* (1990:884) did not explain their rationale while casting aspersions on the observations of others by unfounded statements such as "likely due to a limited number of preparations in a

few species" and "is a poor character" and "differences . . . are at best gradual." Unfortunately, while these authors were eager to offer their taxonomic opinions, they were less forthcoming with any real evidence.

Crother *et al.* (1992) examined the phylogenetic relationships of the seven species of *Bothriechis* recognized by Campbell and Lamar (1989). Independent analyses of biochemical and morphological characters each yielded a single most parsimonious cladogram. The combined data yielded two equally parsimonious trees that had topologies similar to those trees derived independently by use of morphology and allozymes. Werman (1992), also using biochemical and anatomical characters, identified a monophyletic lineage containing Middle American pitvipers (*schlegelii*, *lateralis*, *nigroviridis*). Crother *et al.* (1992) and Werman (1992) independently identified the Mexican *Ophryacus undulatus* as the sister taxon of *Bothriechis*.

Recently, the issue of gender involving names of New World pitvipers has again become confused in the literature (Wilson and Meyer, 1985; Villa *et al.*, 1988; Schätti *et al.*, 1990; Schätti and Kramer, 1991). The gender of *Bothrops* is masculine (Internat. Code Zool. Nomenclature, 1985, chapter 7, article 30(a)ii; Smith and Larsen, 1974; Campbell, 1987; Campbell and Lamar, 1989; Lamar, 1990), whereas the gender of *Bothriopsis* is feminine (Internat. Code Zool. Nomenclature, 1985, Article 30, A.); *Bothriechis* is masculine for the same reasons. The genus *Porthidium*, although neuter, does not require a change in the name *hyoprora* (*contra* Schätti and Kramer, 1991), which is a noun in apposition.

## The *Bothrops asper-atrox* Problem

The systematics of the *Bothrops asper-atrox* complex has been controversial for more than a century. Schätti and Kramer (1991:9) stated that "based on morphological evidence from Ecuadorian specimens at hand, we consider *Bothrops aspera* [*sic*] (Garman) and *B. atrox* (L.) to be conspecific." Unquestionably, the wide range of variation in nearly every external character renders difficult the task of separating these taxa. We have examined several hundred specimens during the course of related work in the Neotropics, and suggest that a multi-species complex may be involved, including cryptic species, discordant variation (both morphologically and biochemically), and multiple zones of contact. We suggested (Campbell and Lamar, 1989) that western

Venezuela may be an important area in the history of the *atrox-asper* complex, and recent investigations (Markezich and Taphorn, personal communication) do not refute the notion that secondary contact has occurred there.

There is reason to suspect that the genus *Bothrops* as currently recognized may be paraphyletic. There are few unifying characteristics among members of this group and the disparate morphologies would suggest the presence of a number of monophyletic species groups, some of which may be more closely related to *Bothriopsis* than to *Bothrops*.

## The Taxonomic Status of *Bothrops microphthalmus colombianus*

Rendahl and Vestergren (1940) described *Bothrops microphthalmus colombianus* from two specimens from western Colombia. Why these authors thought the affinities of *colombianus* were with *B. microphthalmus* was not stated, but they noted (p. 15): "This new subspecies differs from typical *B. microphthalmus* in a higher number of scale rows, a different colouration and in a somewhat larger number of ventrals." We have examined three specimens of this rare snake, including the male holotype (NRM 23114), female paratype (NRM 33114), and an additional adult female (UTA R-25949). We have also examined several specimens of *microphthalmus* from Amazonian Perú (FMNH—see appendix) and find that *colombianus* differs from *microphthalmus* in other salient characters (Table 1).

*Bothrops microphthalmus* differs from *B. colombianus* in having a strongly proboscidiform snout (as opposed to blunt), in having a transverse suture above the eye that partially divides the supraocular scale, in having fewer ventrals (146 to 168 as opposed to 162 to 172), in having 21 to 23 midbody dorsal scale rows (as opposed to 25), and in being much smaller (adults usually less than 700 mm in total length, maximum known 941, as opposed to at least 1360 mm). The dorsal scales in *Bothrops colombianus* are strongly tuberculate and *Lachesis*-like, whereas in *B. microphthalmus* there is a keel present, but this is not raised into a tubercle.

These species are effectively isolated from each other by the higher elevations of the Andes. *Bothrops microphthalmus* is restricted to the Amazonian slopes of Colombia, Ecuador, Perú, and perhaps northern Bolivia (Nicéforo-María, 1975; Campbell and Lamar, 1989), and *B.*

FIG. 1.—*Bothrops colombianus*. Cerro Munchique, 1200 m., Cauca, Colombia. Photograph by Mats Höggren.

FIG. 2.—*Bothrops colombianus*. Variation in two juveniles from El Tambo, Cerro Munchique, 1500-2000 m., Cauca, Colombia. Photograph by Martin Carlson.

*colombianus* (Figs. 1-2) is known only from the Pacific versant of Colombia. The northernmost record for *B. colombianus* (Yarumal, Antioquia, Colombia) has been called into question (Nicéforo-María,

TABLE 1.—Variation of selected scale characteristics in *Bothrops colombianus* and *B. microphthalmus*. Slashes denote right/left. Adapted, in part, from Nicéforo-María (1975).

| Species | Sex | Inter-supraoculars | Supra-labials | Infra-labials | Ventrals | Subcaudals | Midbody dorsal scale rows |
|---|---|---|---|---|---|---|---|
| | | | *Bothrops colombianus* | | | | |
| NHRM 23114 (type) | ♂ | 8 | 8/8 | 10/10 | 162 | 54* | 25 |
| NHRM 33114 | ♀ | 10 | 8/8 | 10/10 | 172 | 51 | 25 |
| UTA R-25949 | ♀ | 6 | 9/9 | 10/10 | 169 | 53 | 25 |
| MLS 1832 | ♀ | 7 | 8/8 | —— | 172 | 51 | 25 |
| | | | *Bothrops microphthalmus* | | | | |
| FMNH 5580 | ♂ | 7 | 7/7 | 9/9 | 153 | 54 | 23 |
| FMNH 40242 | ♂ | 6 | 7/8 | 10/9 | 155 | 56 | 21 |
| FMNH 63740 | ♀ | 5 | 7/7 | 10/9 | 146 | 44 | 23 |
| MLS 1632 | ♂ | 6 | 7/7 | 10/10 | 161 | 49 | 23 |
| MLS 1633 | ♂ | 5 | 7/7 | 8/8 | 154 | 53 | 23 |
| MLS 1634 | ♀ | 8 | 7/7 | 10/10 | 168 | 48 | 23 |
| MLS 1635 | ♀ | 6 | 7/7 | 9/9 | 165 | 47 | 23 |
| MLS 1636 | ♀ | 6 | 8/7 | 9/9 | 164 | 44 | 23 |

*Tip of tail missing, representing perhaps two or three subcaudals.

1964; S. Ayerbe, personal communication). The species probably occurs in northwestern Ecuador although we are unaware of specimens from that area. Little is known of its natural history, but it is said to be a sedentary forest dweller (S. Ayerbe, personal communication). Interestingly, there exists considerable anecdotal information suggesting that *B. colombianus* is an egg layer and egg brooder (S. Ayerbe, personal communication).

In view of the differences between these species, we propose that *Bothrops microphthalmus colombianus* Rendahl and Vestergren be considered a distinct species, *Bothrops colombianus*.

## Taxonomic Status of *Bothrops roedingeri*

*Bothrops roedingeri* was described from two specimens by Mertens (1942) from Hacienda Huayuri, near Nazca, Departamento de Ica, Perú; this locality lies in the coastal desert region of western South America. In the original description of *B. roedingeri*, Mertens (1942) hypothesized that this species was most closely related to *B. ammodytoides*, a species occurring east of the Andes, more than 1500 kilometers to the southeast of the type locality of *B. roedingeri*, in subtropical savannas, steppes, and perhaps temperate broadleaf evergreen forest. As pointed out by Campbell and Lamar (1989), Mertens (1942) made no mention of *B. pictus* in his diagnosis of *B. roedingeri*, and *B. pictus* was curiously absent from the collection on which he reported. *Bothrops pictus* is a relatively widespread but poorly known species, with a distributional range that overlaps the range of *B. roedingeri* (Campbell and Lamar, 1989) in the desert coastal region of Perú. A comparison of the features reported for *B. roedingeri* (Mertens, 1942) with those given for *B. pictus* (Campbell and Lamar, 1989) reveals that the two species are practically indistinguishable. The only character purportedly separating the two taxa is the number of ventrals, 152 to 173 in *B. pictus* and 179 to 185 in *B. roedingeri* (Campbell and Lamar, 1989:222). However, these ranges of variation are based on small sample sizes and, on the basis of the meager material at hand, we suspect clinal variation in the number of ventrals in *B. pictus*, with a higher number in the south. We propose that *B. roedingeri* Mertens be relegated to the synonymy of *B. pictus* (Tschudi).

## Taxonomic Status of *Bothrops xanthogrammus*

*Bothrops xanthogrammus* was described by Cope (1868) from Pallatanga, Departamento de Chimborazo, Ecuador. This locality lies at about 1500 meters on the Pacific versant. *Bothrops xanthogrammus* is known with certainty only from the type locality and the type material. Its purported existence in Colombia can be traced to the belief that *Bothrops quadriscutatus* Posada-Arango (1889*a*) is synonymous with *B. xanthogrammus* (Peters and Orejas-Miranda, 1970). Quintini (1927) and Milá de la Roca (1932) cited *B. xanthogrammus* for Venezuela based on spurious evidence. The specific status of *B. xanthogrammus* was challenged (Campbell and Lamar, 1989), although some investigators still consider it to be a valid species (Schätti and Kramer, 1991).

We have examined a syntype of *Bothrops xanthogrammus* (ANSP 9978) and find that this specimen is indistinguishable from *B. asper* Garman (1884), which also occurs in the region. A detailed description of the holotype is given by Campbell and Lamar (1989:226, figs. 247-248). The only character that purportedly separates this taxon from *B. asper* is the presence of smooth rather than keeled supracephalic scales. However, the head of ANSP 9978 is now missing, making verification of this feature impossible; nevertheless, smooth supracephalic scales may occur adventitiously as occasionally demonstrated in specimens of *B. asper* and *B. atrox* from widespread localities. Portions of a disarticulated skull of *B. xanthogrammus* (ANSP 9978) reveal no notable differences between *xanthogrammus* and *asper*. The frontals are 7.2 mm long and 4.7 mm wide, the supratemporal is 8.2 mm in length, both the left and right dentaries have 18 teeth, the left pterygoid has 17 teeth, and the left palatine bears three teeth.

Cope (1868) referred to a "holotype" but stated that he had two specimens. Subsequently, Malnate (1971) indicated ANSP 9978 to be the holotype. This specimen and USNM 6717 were probably the two specimens used by Cope in his description (R. I. Crombie, personal communication). The USNM specimen cannot be located; thus ANSP 9978 must be regarded as the remaining syntype. A specimen from the type locality and resembling Cope's description of *B. xanthogrammus* is clearly *Bothrops asper* (Fig. 3).

We recommend that *B. xanthogrammus* (Cope, 1868) be placed in the synonymy of *B. asper* (Garman, 1884). An abbreviated history of the name is:

FIG. 3.—*Bothrops asper*. Pallatanga, Chimborazo, Ecuador. Photograph by Ulrich Kuch.

*Trigonocephalus xanthogrammus* Cope, 1868, Proc. Acad. Nat. Sci. Philadelphia, 20:110.

*Lachesis xanthogrammus*, Boulenger, 1896, Cat. snakes British Mus., 3:543.

*Bothrops xanthogrammus*, Amaral, 1930*b* [dated 1929], Mem. Inst. Butantan, 4:241.

*Bothrops xantogrammus* [*sic*], Hoge, 1966 [dated 1965], Mem. Inst. Butantan, 32:135.

*Bothrops xanthogrammus*, Peters and Orejas-Miranda, 1970, Bull. U.S. Nat. Mus. 297(1):55.

## THE TAXONOMIC STATUS OF *BOTHROPS CAMPBELLI*

Studies dealing with geographic variation among Neotropical pitvipers are almost nonexistent, and many species are known only from scant reports, some of which were based on only a few specimens, or in which a series from a single locality was treated. Recent investigations in Ecuador have resulted in the descriptions of several species of pitvipers (Freire-Lascano, 1991; Schätti and Kramer, 1991), the redescription of another (Schätti *et al.*, 1990), and a novel generic arrangement (Schätti *et al.*, 1990). The species described as new by these authors are referable to two previously poorly known taxa, which merit redescription and discussion.

A specimen referable to *Bothrops pulcher* (Peters, 1863) recently was described as *Bothrops campbelli* (Fig. 4) by Freire-Lascano (1991). Inasmuch as *B. pulcher* is poorly represented in museum collections, we offer a description based on 22 specimens and a comparison with *B. campbelli*. Unfortunately, we were unable to examine type material of *B. pulcher*.

*Diagnosis of* Bothrops pulcher.— A moderately stout, terrestrial lancehead resembling *Bothrops asper* in some aspects of coloration and scutellation, but possessing larger snout scales (only two anterior and two posterior intercanthals, measured transversely) and fewer ventrals (139 to 174 as opposed to 161 to 240). *Bothrops pulcher* differs from *B. andianus* by possessing a banded body pattern lateral triangles in *andianus*), a faintly visible or nonexistent postocular stripe (well defined in *andianus*), and fewer intercanthals. *Bothrops pulcher* is more robust than *B. andianus*, with a comparatively shorter and broader head.

*Description.*— The rostral is approximately as high as wide, almost square, and contacted dorsally by one or two apical scales that divide the internasals. The canthal is slightly longer than wide and one and a half to two times as wide as the internasal. An anterior and posterior pair of enlarged intercanthals with low oblique keels are present. There are two to five postcanthals; two to seven intersupraoculars (usually four or fewer), with low keels; and 25 scale rows between the right and left rictus, all but lowest strongly keeled. The supraloreal is approximately twice as long as high; the infraloreal is nearly square; the one to three prefoveals are small and separate the posterior nasal from the lacunolabial; and the postfoveal broadly contacts the third supralabial and is not fused to lower preocular. The middle preocular is not fused to the supralacunal, and the lower preocular is about half the size of the middle preocular, with both scales entering the orbit. The subocular and postocular are usually entire and the oculabials are in one or two rows. There are seven to eight supralabials (second fused with prelacunal); eight to 10 infralabials, with the first three or four in contact with the chinshields; and three median gulars. Tiny tubercular mechanoreceptors (*sensu* Jackson and Sharawy, 1980) are scattered on the scale surfaces of head and chin, especially labials. The dorsal scales have raised, tubercular keels that do not reach the apices. Dorsal scales are arranged in 20 to 25 rows anteriorly, 20 to 25 rows at midbody, and 16 to 21 rows posteriorly. There are 139 to 174 ventrals, an

FIG. 4.—*Bothrops campbelli* [= *B. pulcher*]. Top: topotype (INHMT 2455), from Huagal-Sacramento, Cantón Pallatanga, 1500-2000 m., Chimborazo, Ecuador. Bottom: holotype (INHMT 1956). Photographs by Ulrich Kuch.

undivided anal, and 44 to 64 divided subcaudals. The terminal caudal scute is nearly straight, obtusely rounded, and equivalent in length to the preceding three to three and a half subcaudals, with dorsal capping scales extending to near the end and fusing with the terminal subcaudal distally.

The head and body are brown to grayish brown (sometimes pinkish gray or tan in juveniles) dorsally, with or without about 20 brown, black-margined crossbands (four to seven dorsal scales in length) some of which may be disrupted at the vertebral line. Paler interspaces are one to four dorsal scales in length (half scale on tail), being longest middorsally and most pronounced posteriorly. The last caudal interspace sometimes forms a ventrocaudal stripe. There is a ventrolateral series of small black spots on the first two rows of dorsal scales and extending onto the adjacent ventrals. A dark brown postocular stripe encroaches most of the two posterior supralabials and passes the oral rictus, terminating on the first row of dorsals. This stripe frequently merges with the dorsal head color; it is subtended by a pale line, which is often most visible on (and beneath) the neck. Indistinct brown nuchal spots are occasionally evident. In some specimens, the sides of the head are pale, revealing a darker brown subocular spot with concentric black-and-white margins. Black-bordered brown or white spots occur on the chinshields and infralabials; otherwise the chin is yellow and finely stippled with brown or rust. The venter is yellow, tan, or reddish brown, evenly mottled and stippled with dark brown, except for the chin, throat, and subcaudal surface, all of which are more sparsely pigmented. The edges of the ventrals are encroached by ventrolateral black spots. This species reaches at least 906 mm total length.

*Distribution.*—This species occurs from lowlands to at least 2500 meters along the Pacific slopes of the Andes from the Departamento Valle del Cauca, Colombia, south to at least Provincia El Oro, Ecuador. There are unverified reports from the Colombian Chocó, and from the Amazonian versant of the Ecuadorian Andes (the latter locality is unlikely). The type locality, Quito, is unsuitable habitat, and we suspect the specimen came from a nearby but less elevated area.

*Discussion.*—Most specimens of *B. pulcher* in museums are from the northern extreme of the range, in the lowlands of the Departamento Valle del Cauca, Colombia. These specimens possess a lower number of ventrals (143 to 150), reduced tubercular dorsal keels, and a slightly

paler color than those from farther south. A female specimen from "south of [La] Chonta," El Oro Province, Ecuador (AMNH 22094), has the highest number of anterior rows of dorsal scales (25) and ventrals (174) known for this species. It also represents the southernmost known locality for *B. pulcher*. The type specimen of *Bothrops campbelli* is a large male (although Freire-Lascano, 1991, referred to it as "young"). Its scutellation (three preloreals, one supraloreal, one row of scales prevent contact with infraoculars, 12 scales surround each supraocular, keels most pronounced middorsally, 160 ventrals, undivided anal, 50/50 divided subcaudals, 7/7 supralabials, 9/9 infralabials, five inter-supraoculars, 21/21/19 dorsal scale rows) falls within the range of variation known for *B. pulcher*. The "preloreals" are prefoveals.

Freire-Lascano described the color of *B. campbelli* as follows [translated from Spanish]: venter black speckled with yellow spots; dorsum and head entirely black; rostral normal, without postocular line; a postinfralabial line, of yellow color, and covering 14 scales; some infralabials and gulars with yellow spots dorsally. Again, nothing differs substantially from that which is known for *B. pulcher* although his specimen is rather dark, but this is a common occurrence in *Bothrops*. A small specimen from Las Pampas, Cotopaxi (see fig. 242 in Camp- bell and Lamar, 1989), is noticeably dark as a result of preservation. We observed a live adult from Las Pampas, and it was dark reddish gray dorsally; a juvenile (Fig. 5) from the same locality was pale gray and brown. A topotypic specimen (KU 218462) identified by Freire-Lascano as "*Bothrops osbornei*" is a typical juvenile *B. pulcher*. *Bothrops campbelli*, in scutellation, pattern, appearance, and distribution, is in strong agreement with *B. pulcher*. The name "serpiente boca de sapo," cited for *B. campbelli* is used in Las Pampas for *B. pulcher* (G. Onore, personal communication). Clearly, *Bothrops campbelli* Freire-Lascano (1991) is a subjective junior synonym of *Bothrops pulcher* (Peters). An abbreviated synonymy for *B. pulcher* is:

*Trigonocephalus pulcher* Peters, 1863, Monatsber. Preuss. Akad. Wiss. Berlin, p. 672. Quito, Ecuador (ZMB 3868, three syntypes).

*Lachesis pulcher* ,Boulenger, 1896, Cat. snakes British Mus., 3:539.

*Bothrops pulchra*, Amaral, 1923, Proc. New England Zool. Club, 8:104; Peters, 1960, Bull. Mus. Comp. Zool., 122:510.

*Bothrops pulcher* , Peters and Orejas-Miranda, 1970, Bull. U.S. Nat. Mus., 297(1):54.

*Bothrops pulcher* , Campbell and Lamar, 1989, Venom. Rept. Latin America, pp. 185, 221.

FIG. 5.—*Bothrops pulcher*. Juvenile from Las Pampas, Cotopaxi, Ecuador. Photograph by J. Anhalzer, courtesy Jean-Marc Touzet.

*Bothrops campbelli* Freire-Lascano, 1991, Publ. Trab. Cient. Ecuador, Univ. Téc. Machala (Ecuador), p. 1 (unnumbered). Recinto, Huagal-Sacramento, Cantón Pallatanga, Provincia de Chimborazo, Ecuador; 1500 to 2000 meters elevation; Muestrario Herpetológico del Instituto Nacional de Higiene (Guayaquil, Ecuador), example no. 1956.

## THE TAXONOMIC STATUS OF *BOTHROPS OSBORNEI* AND *BOTHRIECHIS MAHNERTI*

Specimens referable to *Bothriopsis punctata* (García) were described recently as *Bothrops osbornei* Freire-Lascano (1991) (Fig. 6), and *Bothriechis mahnerti* Schätti and Kramer 1991 (Fig. 7). Owing to its relative obscurity it seems worthwhile to redescribe and discuss *Bothriopsis punctata* (García).

*Diagnosis*.— A large, semiarboreal, forest pitviper; olive gray to yellowish in dorsal ground color, with 14 to 22 pairs of brown, pale-centered vertebral blotches, dorsally fused or not. These blotches are offset or fused with lateral blotches, creating a spotted, semibanded, or banded appearance. The top of head has symmetrical dark brown markings and there are 175 to 213 ventrals, 66 to 95 paired subcaudals, 22 to 29 midbody dorsal scale rows, and six to nine intersupraoculars. This species is similar to *Bothriopsis taeniata* (Wagler) in overall pat-

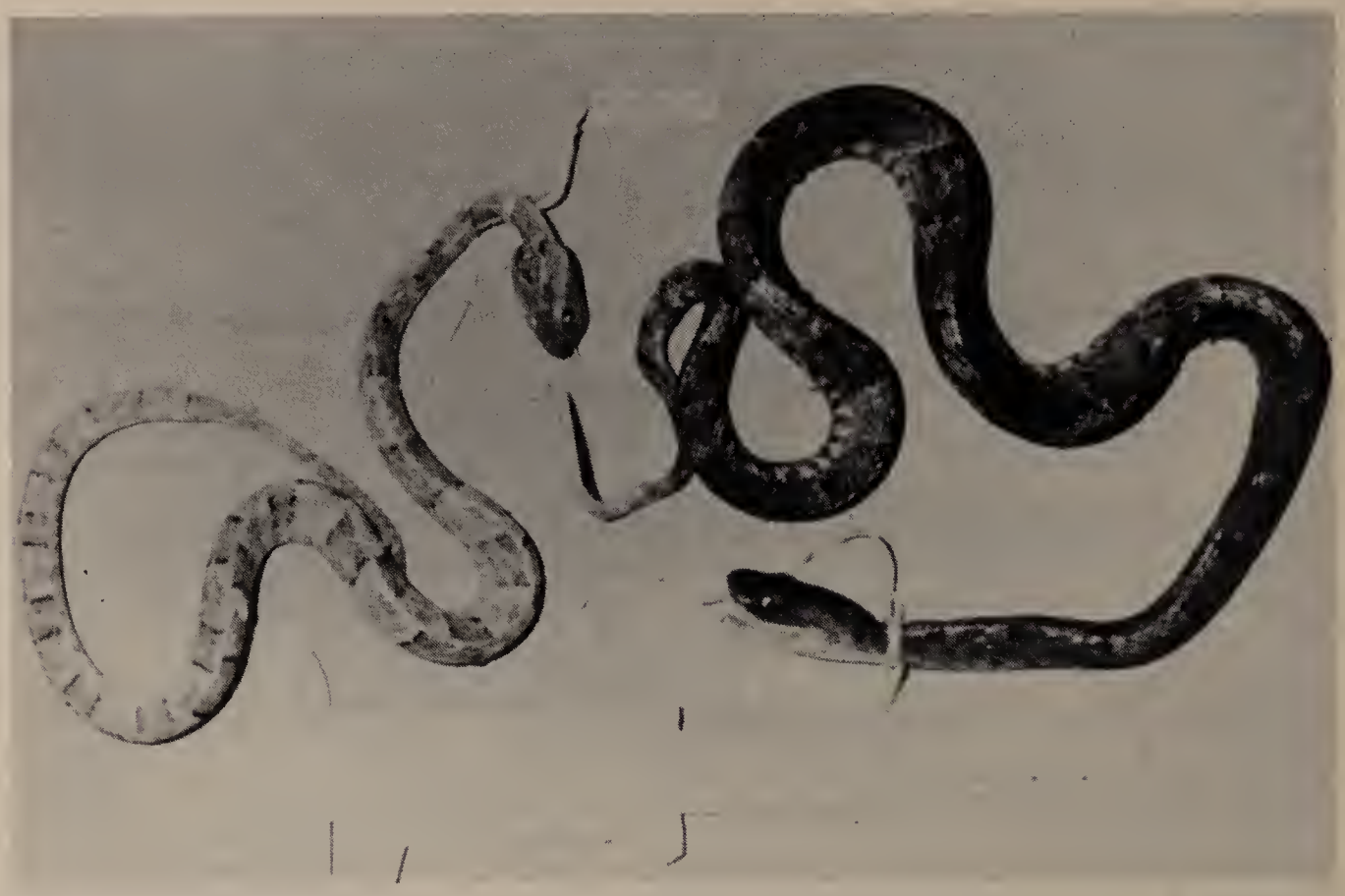

FIG. 6.—*Bothrops osbornei* [= *Bothriopsis punctata*]. Holotype (INHMT 1924) at left and paratype (INHMT 22340) at right. Photographs by Ulrich Kuch.

tern but the latter possesses more body bands, more ventrals, and mostly unpaired subcaudals. The ranges of the two species are separated by the Andes Mountains.

*Description.*—The rostral is about one and a half or more times higher than wide and contacts the internasal and first supralabial about equally. The internasals are large, in broad contact anteriorly, sometimes divided dorsally by a small apical scale, and overlap the *canthus rostralis*. The canthals are slightly longer and considerably wider than the internasals. There are two to three transverse rows of intercanthals, which usually contain some enlarged scales, but occasionally include granular scales. The supraoculars are two to two and a half times longer than wide, one-half to one-third the width of the cranium, and with the inner margin often quite irregular. There are six to nine keeled intersupraoculars and 24 to 28 scales between right and left rictus, all but the lowermost strongly keeled. The prenasal is higher and twice as long as the postnasal, with the posteroventral projection of the prenasal contacting the prefoveal, and separating the postnasal from the supralabials. There is a single prefoveal and subloreal, the latter separating the postnasal from the prelacunal. The loreal is irregularly quadrangular and slightly longer than high; the middle preocular enters the orbit broadly, is half as long and three-fourths as high as the upper

FIG. 7.—*Bothriechis mahnerti* [ = *Bothriopsis punctata*]. Holotype (MHNG 2459.47) from Las Pampas, approximately 2000 m., Cotopaxi, Ecuador. Photograph by Giovanni Onore.

preocular; and the lower preocular is smaller, triangular in shape, and usually excluded from orbit. The middle and lower preocular are not fused to the supralacunal and infralacunal, respectively, the subocular is single, and there are two to three postoculars. The interoculabials are in one to two rows. There are six to nine supralabials, with the first pair in broad contact behind mental and the second fused with the prelacunal, and nine to 13 infralabials, with the anterior three pairs in contact with chinshields. There are four to five median gulars. The dorsal scales are distinctly keeled except for the paraventrals, which have low, incomplete, and slightly oblique keels. The paraventrals are greatly enlarged and the scales of the second row are slightly enlarged. There are 22 to 29 dorsal scale rows anteriorly, 22 to 29 scale rows at midbody, and 19 to 23 scale rows posteriorly. There are 175 to 213 ventrals; 67 to 95 divided subcaudals; and the terminal caudal spine is compressed laterally, equivalent in length to the two and a half to three and a half preceding subcaudals, with a blunt and slightly upturned end and six subtending scales, none of which is as differentiated dorsal capping scales.

The head is greenish tan or gray dorsally. A dark brown or black postocular stripe is two scales wide, often paler medially, occasionally bordered narrowly in bright yellow or brown, and extends from the postoculars to, or slightly beyond, the rictus, crossing the dorsal part of the penultimate and posterodorsal half of the last supralabial. Similarly colored nuchal spots converge anteriorly and terminate separately over the occiput. The parietal stripes converge anteriorly, joining between the eyes into a "Y," and sometimes merging with the occipital marks to form an irregular ocellus. Dark pigment is scattered along various scale sutures, and is especially evident as narrow bars on supra- and infralabials. The supralabials are tan and the iris is gold, with or without bronze reticulations medially. The body is yellowish tan (especially in juveniles), greenish gray (especially large adults or specimens from northern part of range), or brown dorsally. There are 14 to 22 pairs of narrow dark brown crossbands, which are two to three dorsal scales in length. The crossbands are outlined and stippled with black, but otherwise are nearly as pale as the ground color. Individual crossbands of an individual pair are separated by interspaces of two to three dorsal scales, while pairs are separated from one another by interspaces of six to nine dorsal scales in length. Each crossband is constricted or interrupted midlaterally and middorsally, thus appearing as a chain of four rounded spots. The interspaces are outlined with yellow and sparsely stippled with black and brown.

The pairs of caudal crossbands are less distinctly outlined, with five to seven crossbands on the proximal two-thirds of the tail. The distal one-third of the tail is uniform pale pink, yellowish white, or soft gray, sometimes with faint bands near the tip. The tail is palest in juveniles, but often discernibly pale in adults. The throat is pale tan to yellow, immaculate or with fine dark brown or black stippling which increases posteriorly across the venter. A ventrolateral series of small dark spots (one and a half to two scales long), are spaced along paraventrals and edges of ventrals about one scale apart, and the posterior half of the belly of adults tends to be predominantly black (grayish tan in juveniles), either peppered with brown or irregularly spotted with yellow. There are ventrolateral dark spots that merge posteriorly with the dark venter in many specimens. The subcaudal surface becomes increasingly mottled with yellow posteriorly, and its distal one-third to two-fifths is usually immaculate yellow (especially in juveniles) to soft gray. Dark pigment increases overall in adults and in northern populations;

FIG. 8.—*Bothriopsis punctata* (UTA R-30284). Specimen from near Tumbés, Peru. Photograph by Gerald Marzec.

juveniles tend to be pale, with markings more distinctly delineated, especially on the dorsum of the head. Large females attain at least 1260 mm in total length, and there is anecdotal evidence of specimens approaching two meters (S. Ayerbe, personal communication).

*Distribution.*—Panamá south to near the Ecuador-Perú border, along the Pacific coast and adjacent Andean slopes, from near sea level to at least 2000 meters. The northernmost record is from Cañas, Darién, Panamá (type locality of *Bothrops leptura*). The species is uncommon in collections, and frequently misidentified as either *Bothrops asper* or *B. atrox*; thus its southern distributional limit was for many years considered to be in northwest Ecuador (Provincia Esmeraldas). However, the *Bothriechis mahnerti* type series extends the range southward through Pichincha to northern Cotopaxi, the *Bothrops osbornei* series is from Chimborazo, and a specimen (UTA R-30284) (Fig. 8) exists from a moist forest remnant near Tumbes, along the Ecuador-Perú border. The latter locality, while unusual for moist-forest species, is not without precedent: specimens of *Bothrops pulcher, Bothriechis schlegelii,*

and *Micrurus ancoralis* have been taken nearby. We suspect the population is relictual. Schätti and Kramer (1991) speculated that a specimen of *B. mahnerti* reportedly from Coca, Napo, in Amazonian Ecuador, has erroneous locality data. Most certainly either the record is in error or the specimen is referable to the superficially similar *Bothriopsis taeniata*, which does occur there.

*Discussion.—Bothrops osbornei* was described on the basis of four specimens. The scutellation of these specimens (182 to 198 ventrals, undivided anal, 66 to 69 divided subcaudals, 7/7 supralabials, 10 to 13 infralabials, seven intersupraoculars, 25/25 to 26/21 dorsal scale rows) falls within the range of variation cited herein for *Bothriopsis punctata*, although the subcaudals are at the lower extreme.

Freire-Lascano (1991) described the coloration of *Bothrops osbornei* as follows [translated from Spanish]: the dorsum consists of dark transverse bands over a pale brown (juveniles) or blackish gray (adults) ground color. Venter totally spotted with black . . . a dark postocular band that reaches the first [last] infralabial is present. Unfortunately, the color description is too rudimentary for close comparison with *B. punctata*; however no discrepancies are evident, and Freire-Lascano (1991) noted correctly the ontogenetic trend towards a darker ground color (see Fig. 6).

The legitimacy of the Freire-Lascano (1991) publication could be challenged under chapter 3, articles 8(d) and 9(3) of the International Code of Zoological Nomenclature, but the point is moot owing to the invalidity of his taxa and of *Bothriechis mahnerti*.

Shortly after Freire-Lascano's (1991) publication, Schätti and Kramer (1991) described *Bothriechis mahnerti* (Fig. 7) based on a series of six juvenile and subadult specimens (largest snake, 685 mm) from Las Pampas (Cotopaxi), and Santo Domingo de los Colorados (Pichincha). Variation in the *B. mahnerti* type series was cited as follows: ventrals 175 to 188; anal undivided; subcaudals 67 to 72 (divided); supralabials six to eight (second forming lacunolabial); infralabials nine to 12; intersupraoculars six to eight; midbody dorsal scale rows 25 to 27.

Schätti and Kramer's detailed color description can be compared with Freire-Lascano's (1991) abbreviated description of *Bothrops osbornei*, and there is no significant discrepancy. In comparison with known variation in *Bothriopsis punctata*, the *Bothriechis mahnerti* series includes the lowest number of ventrals (175). However, these

numbers are approached closely by those of other specimens, including some from the northern end of the range. The figure illustrating the holotype of *B. mahnerti* (Schätti and Kramer, 1991:fig. 1) shows the middle preocular to be fused with the supralacunal, an atypical condition. The same figure shows a single postocular, although the authors stated that two are present. The specimen from the Ecuador-Perú border area (UTA R-30284) possesses scutellational features that place it within the range cited for *Bothriechis mahnerti*—181 ventrals, anal undivided, 71 divided subcaudals, seven supralabials (second forming lacunolabial), nine to 10 infralabials, seven intersupraoculars, and 25 midbody dorsal scale rows. It is a juvenile female, nearly identical in size to the *B. mahnerti* holotype (366 mm as opposed to 368 mm), with an umbilical scar beginning on ventral 163.

Both *Bothrops osbornei* and *Bothriechis mahnerti* are indistinguishable from, and junior subjective synonyms of, *Bothriopsis punctata*. Schätti and Kramer (1991) apparently placed heavy reliance on the description by García (1896), and acknowledged, but failed to comprehend, the importance of the similarity of their taxon to *B. punctata*. Moreover, they noticed, but ignored, the darker color of the only non-juvenile (a subadult female, MHNG 2250.21) in their series; this specimen is also from a locality to the north of other material examined by them. Schätti and Kramer called into question the identification of a specimen of "*punctatus*" [*sic*] figured by Campbell and Lamar (1989:fig. 157), citing its variance from García's description and its resemblance to *Bothriechis mahnerti*. They were correct on both points: García dealt inadequately with a single specimen of which the latter is a synonym. A juvenile snake from Valle, Colombia (Fig. 9), shows a darker overall pattern typical of specimens from the northern part of the range.

Inasmuch as Schätti and Kramer (1991) cited no specimens of *B. punctata* as having been examined by them nor, for that matter, did they provide the rationale behind their counting and descriptive methods, it appears that they were unfamiliar with *B. punctata*. Schätti and Kramer (1991:14) further stated: "There is but a single species of arboreal pitvipers [*sic*] from west of the Andes resembling *Bothriechis mahnerti*, i.e. *B. peruvianus* (Boulenger)." They apparently based this conjecture on the fact that the specimen figured in Campbell and Lamar (1989) shows pronounced dorsal crossbars. There are similarities between the two, as both are members of the genus *Bothriopsis*, but *B.*

FIG. 9.—*Bothriopsis punctata*. Juvenile from Valle, Colombia. Photograph by Fernando Castro, courtesy of Santiago Ayerbe.

*peruviana* does not occur west of the Andes (Campbell and Lamar, 1989) and it is arguably closer to *Bothriopsis albocarinata* (Shreve), an Amazonian species recently redescribed by the same authors (Schätti *et al.*, 1990). That *B. campbelli*, *B. osbornei*, and *B. mahnerti* were described is illustrative of the need for caution owing to our lack of knowledge regarding geographic, individual, and ontogenetic variation in Neotropical snakes.

Although the type description of *Lachesis punctatus* García, 1896, is brief and the author failed to designate a type specimen, the color illustration is clearly representative, albeit of a spotted rather than banded specimen. On the basis of a specimen from eastern Panamá, Amaral (1923) described the species as *Bothrops leptura*. Nicéforo-María (1929*a*, 1929*b*) pointed to the priority of *Lachesis punctatus* and discussed some of the problems associated with García's (1896) nomenclature. Subsequently, Amaral (1930*a*) recognized the priority of *Lachesis monticelli* Peracca, 1910, although he refused to accept García's taxon. Recent investigators (Dunn, 1944; Petèrs, 1960; Peters and Orejas-Miranda, 1970; Campbell and Lamar, 1989) have recognized *Lachesis punctatus* García. The species *Thanatophis montanus* Posada-Arango (1889*a*), subsequently placed by the same author in the genus *Thanatos* (Posada-Arango, 1889*b*), has been considered by most workers to be synonymous with *Bothriopsis taeniata*, owing to the undivided condition of the subcaudals. However, the type locality of *T. montanus* in the mountains of Antioquia (Colombia) lies within the range of *B. punctata*. We regard the status of *Thanatophis montanus*

Posada-Arango (1889*a*) as unresolved. The abbreviated synonymy for *Bothriopsis punctata* is:

*Lachesis punctatus* García, 1896; Los ofídios venenosos del Cauca, p. 30, pl. 8 (las montañas del Dagua =mountains of Dagua River, Valle del Cauca, Colombia). No type specimen designated.

*Lachesis monticelli* Peracca 1910, Ann. Mus. Zool. Anat. Comp. Univ. Napoli, 3(12): 2 ("America tropicale?"). Holotype: UNZM, a female, destroyed during World War II.

*Bothrops leptura* Amaral, 1923, Proc. New England Zool. Club, 8:102 (USNM 50110; "Cana, eastern Panama" [= Cañas, Darién, Panamá).

*Bothrops monticelli*, Amaral, 1930*a* [1929], Mem. Inst. Butantan, 4:59.

*Bothrops punctatus* , Dunn, 1944, Caldasia, 3:215.

*Bothrops osbornei* Freire-Lascano, 1991, Univ. Técnica de Machala (Ecuador), p. 2 (unnumbered); example no. 1924 [Muestrario Herpetológico del Instituto Nacional de Higiene, Guayaquil, Ecuador]; Sacramento—Cantón Pallatanga, Provincia del Chimborazo [Ecuador]. The type is a juvenile female.

*Bothriechis mahnerti* Schätti and Kramer, 1991, Rev. Suisse Zool., 98:10 (MHNG 2459.47; Las Pampas, N Cotopaxi [Ecuador]). The holotype is a subadult male.

## The Genus *Porthidium* (*sensu lato*)

The morphologically and ecologically diverse pitviper fauna of Middle America has only recently begun to be treated in an adequate systematic fashion. Exclusive of the rattlesnakes, bushmaster, and members of the genus *Agkistrodon*, New World species of pitvipers traditionally have been placed collectively in the genus *Bothrops* (see Hoge, 1966, and Peters and Orejas-Miranda, 1970) or in *Trimeresurus* (Smith, 1941). More recently, generic partitioning of this wide array of pitvipers has occurred (Burger, 1971, 1985; Campbell and Lamar, 1989). The monophyletic clade of Middle American arboreal pitvipers were placed in *Bothriechis* (Burger, 1971; Campbell and Lamar, 1989; Crother *et al.*, 1992; Werman, 1992), and the well differentiated sister taxon of *Bothriechis* was recognized as the monotypic *Ophryacus undulatus* (Campbell and Lamar, 1989; Crother *et al.*, 1992; Werman, 1992).

Campbell and Lamar (1989) pointed out that *Porthidium*, as recognized by them, contained several distinct lineages, the relationships of which were unknown. One of these lineages contains the hog-nosed pitvipers, and because the type species of *Porthidium* Cope (1871) is *Trigonocephalus lansbergii* Schlegel (1841), the name *Porthidium* has

priority for this group. The genus *Atropoides* was proposed recently (Werman, 1992) to accommodate the lineage containing the jumping pitvipers (*nummifer*, *olmec*, and *picadoi*).

Three species (*barbouri*, *godmani*, and *tzotzilorum*) were placed in the "montane pitviper" lineage of *Porthidium* by Campbell and Lamar (1989). These species appear to be closely related to each other (Campbell, 1985, 1988), but their relationship to other groups of pitvipers remains unclear. Preliminary biochemical evidence suggests that they may constitute a basal clade of New World pitvipers (Campbell and Whitmore, 1989; Werman, 1992). These distinctive snakes occur in montane habitats at relatively high elevations (1500 to more than 3000 meters) from southern México (Guerrero) through Central America to Panamá. They do not appear to be closely related to either the hog-nosed or jumping pitvipers. We propose for these snakes a new generic name as follows:

## *Cerrophidion*, new genus

*Type species.*— *Bothriechis Godmanni* Günther, 1863, by present designation. [The spelling provided by Günther, 1895:190, pl. 57, fig. A, should be followed by indication.]

*Diagnosis and definition.*— Small, moderately stout, terrestrial pitvipers lacking a strongly prehensile tail, rarely exceeding 700 mm in total length, having a pattern of dorsal blotches often fused into a zigzag pattern and of smaller lateral blotches, and a ground color of some shade of brown, gray, or orange.

The snout is not elevated and the rostral scale is broader than high; scales in the frontal and parietal areas are enlarged (sometimes into plates) and often irregular (Fig. 10). The number of intersupraocular scales varies from one in some *C. barbouri* to seven in some *C. godmani*. There are 120 to 148 ventrals, 22 to 36 undivided subcaudals, and 17 to 25 dorsal scale rows at midbody. These snakes also are characterized by having a hyoid skeleton with relatively long branchials (second ceratobranchials according to some authors), and in having the basal portion of the pterygoid as long as, or longer than, the ectopterygoid (Burger, 1971).

The hemipenes bear 12 to 40 large spines on the proximal third of each lobe; the remainder of the lobe is covered by calyces that have spinulate or papillate micro-ornamentation. Below the level of the

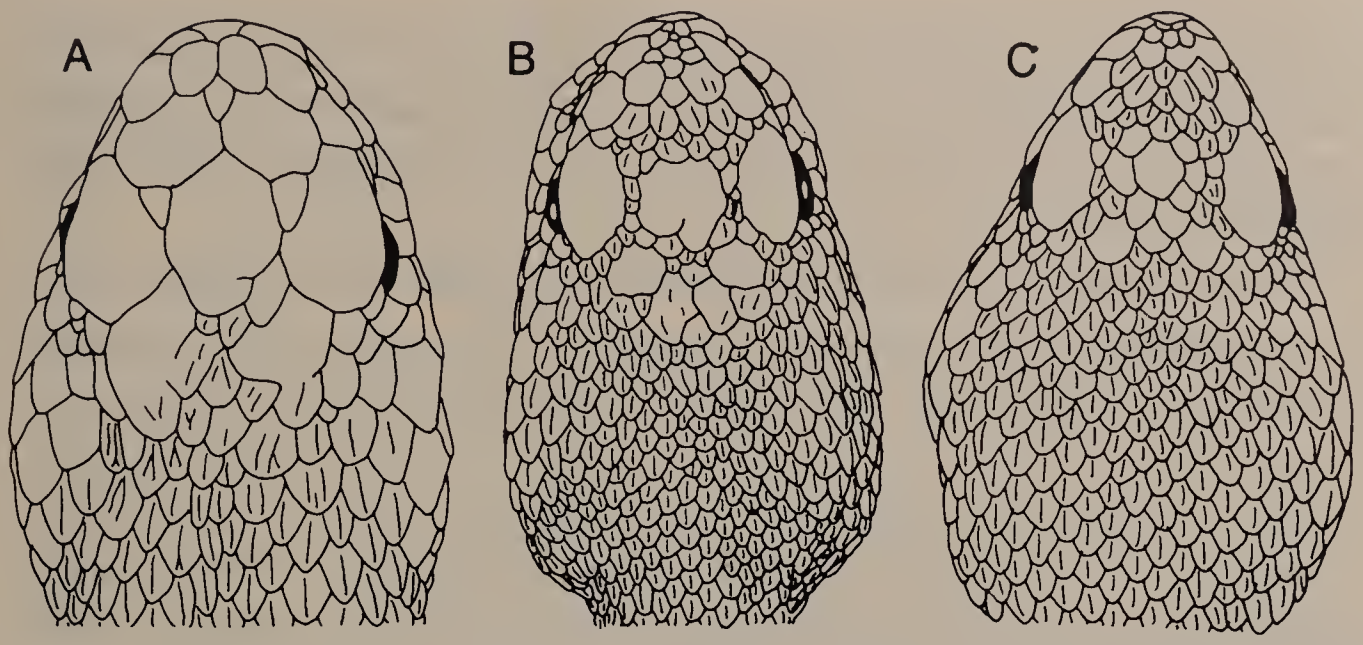


FIG. 10.—Variation in the dorsal head scales in members of the genus *Cerrophidion*. (A) *Cerrophidion barbouri*—0.8 km. N Puerto del Gallo, Guerrero, México, 2896 m.; UTA R-4450 (from Campbell, 1985:14, fig. 5B). (B) *Cerrophidion tzotzilorum*—10.9 km. ESE San Cristóbal de Las Casas, Chiapas, México, 2320 m.; UTA R-9641—holotype (from Campbell, 1985:50, fig. 2B). (C) *Cerrophidion godmani*—San Jorge Muxbal, Guatemala, Guatemala, ca. 1850 m.; UTA R-6185 (from Campbell and Solórzano, 1992:236, fig. 9B).

crotch, the organ is mostly naked, except for a few small spines that are concentrated on the lateral surfaces.

Pitvipers occurring in the Neotropics with which these snakes have sometimes been allied include species in the genus *Bothrops*, members of which differ from *Cerrophidion* in attaining a larger size, almost always more than a meter in total length, in usually having a higher number of ventrals and subcaudals, and in having divided subcaudals. Members of the genus *Bothriechis* usually have a green ground color, are arboreal with a strongly prehensile tail and attenuate, laterally compressed body, and usually have a higher number of ventrals (137 to 175) and subcaudals (42 to 72). The monotypic *Ophryacus undulatus* has scales over the eyes raised into a "horn," the supraocular region and crown are covered by small, keeled scales with 10 to 20 intersupraoculars between the elongated supraocular spines, and there are more ventrals (157 to 171) and usually more subcaudals (37 to 57), which are divided. In species of *Atropoides*, the body is exceedingly robust; the intersupraoculars are scalelike and more numerous (seven to 12), and are not enlarged into plates; and the supraoculars are reduced in size and longitudinally narrow or fragmented into small scales. Species of *Porthidium* (*sensu stricto*) differ from *Cerrophidion* in having a distinctly elevated canthus with a rostral that is higher than

broad; in having hemipenial lobes that terminate in a naked apical disc, in the center of which is a large papilla; and in usually having a pattern consisting of a pale middorsal line that is offset laterally by small, staggered blotches.

Other genera of New World pitvipers may be distinguished from *Cerrophidion* by the following features. The rattlesnakes (genera *Crotalus* and *Sistrurus*) have a rattle on the tip of the tail; *Agkistrodon* has a pattern of broad crossbands and larger supracephalic plates, usually arranged in a nine-plate, colubridlike pattern; *Lachesis* reaches a huge size (more than three meters), lays eggs, has the second supralabial fused with the prelacunal, and the distal subcaudals are divided into four or five rows of small spinelike scales; and *Bothriopsis* is arboreal with an attenuate body and strongly prehensile tail, a higher number of ventrals (153 to 254), and usually more subcaudals (41 to 91), most of which are usually divided.

*Content.*—The genus *Cerrophidion* contains three species: *barbouri* restricted to the Sierra Madre del Sur in Guerrero, México; *tzotzilorum* occurring in the highlands of Chiapas, México; and *godmani* disjunctly distributed from the highlands of southeastern Oaxaca, México, through Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica to western Panamá.

*Etymology.*—Derived from the Spanish *Cerro*, meaning mountain in allusion to the habitat of these snakes, and from the Greek *ophidion*, meaning a small snake.

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## Appendix 1

Selected localities and referred specimens. For museum acronyms see Leviton *et al.* (1985).

*Bothriopsis albocarinata.*—Colombia. *Putumayo*: 35 km. from Mocoa, on road between Verde and Yolo (UV 10561). Ecuador. *Loja/Zamora-Chinchipe*: 5 km. E Loja, 9200 feet (holotype of *Bothrops alticola*, BM 1946.1.19.26). *Pastaza*: Río Pastaza (holotype of *Bothrops albocarinata*, MCZ 36989); Chambira, Río Bobonaza (GNM 3765); Río Conambo (GNM 3766). *Tungurahua*: Río Negro, 1260 m. (KU 121347-48). See Schätti *et al.* (1990) for additional specimens from Ecuador.

*Bothrops asper.*—Ecuador. *Chimborazo*: Pallatanga (syntypes of *B. xanthogrammus*, ANSP 9978 and USNM 6717—the latter specimen is now lost).

*Bothrops microphthalmus.*—Colombia. *Boyacá*: Miraflores (Puente de Rusa), 1432 m. (ICN 1533). Peru. *Madre de Dios*, Candama (FMNH 40242). *Huánuco*: valley of the Chinchao, Buena Vista (FMNH 5580); no specific locality (FMNH 63740).

*Bothrops pictus.*—Peru. *Ancash*: Chimbote (FMNH 5662-64). *Arequipa*: Majes Valley (FMNH 3991, Univ. Arequipa no. 7). *Ica*: Hacienda Huayuri (holotype and paratype of *Bothrops roedingeri.* SMF 6017-18). *Lima*: Chosica (MCZ 45716); Lima (MCZ 3573); "mountain uplands" (lectotype and paralectotype, MHNN 6-7, designated by Schätti, 1986).

*Bothrops pulcher.*—Colombia. *Valle del Cauca*: km. 13 on road from Buenaventura to Río Calima (FMNH 165586); road from Buenaventura to Río Calima (FMNH 165587-93); Río Calima, 7 km. from lumber camp (Campamento "Cartón de Colombia") (FMNH 165594-96); Río Raposo, Virology Field Station (USNM 151708, 154051)—not examined; Caimancito, south of Buenaventura, on bank of Río Cajambre (UTA R-21689). Ecuador: *Cotopaxi*: Las Pampas (Basel Museum Field Series-unnumbered). *Chimborazo*: Pallatanga (no. 1956, holotype of *B. campbelli*—Muestrario Herpetológico del Instituto Nacional de Higiene-Guayaquil), KU 218462 (topotype). *El Oro*: south of [La] Chonta, AMNH 22094.

*Imbabura*: Intag [=Intac] (BM specimen). *Pichincha*: "Quito" (ZMB 3868, three syntypes).

*Bothriopsis punctata.*—Panama: *Darién*: Cañas (USNM 50110, holotype of *Bothrops leptura*). Colombia: *Antioquia*: Pantanos (Inst. Nacional de Salud, Bogotá). *Caldas*: Santa Cecilia, Pueblo Rico FMNH 55888-94. *Valle del Cauca*: mountains of [Río] Dagua (type locality for *Lachesis punctatus*); Río Calima, Quebrada de la Brea (USNM 124258); Río Raposo, Virology field Station (USNM 126374, 151706); between Buenaventura and Río Calima (FMNH 165384-85); Río Calima, 7 km. from lumber camp [Campamento "Cartón de Colombia] (FMNH 165386). *Chocó*: no other data (UTA R-7264); Río San Juan (USNM 72355); between Andagoya and Condoto (USNM 121059-60); between Palestina and Cucurrupí (Río San Juan) (CAS 119921); Caño Docordó (CAS 119594). Ecuador: *no specific locality* (USNM 20629-30). *Chimborazo*: Sacramento—Cantón Pallatanga (no. 1924, holotype of *Bothrops osbornei*, nos. 1925 and 2186 from same series); vía a Huagal, Cantón Pallatanga: (no. 2234, Muestrario Herpetológico del Instituto Nacional de Higiene-Guayaquil). *Cotopaxi*: Las Pampas (MHNG 2459.47, holotype of *Bothriechis mahnerti*, MHNG 2459.44-46 and 2459.48). *Pichincha*: Río Blanco (USNM 165286); Santo Domingo de los Colorados (MHNG 2250.21).

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