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

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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.

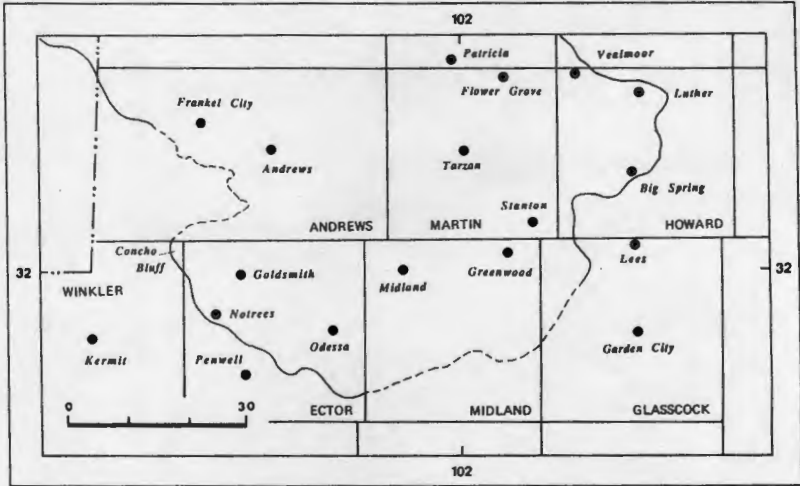


FIG. 1.—Map of southern end of Kansan Biotic Province in Texas showing seven-county study area, outline of provincial boundary, and location of place-names used in text. Scale at lower left is in miles.

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 snow fall	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 Management 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.

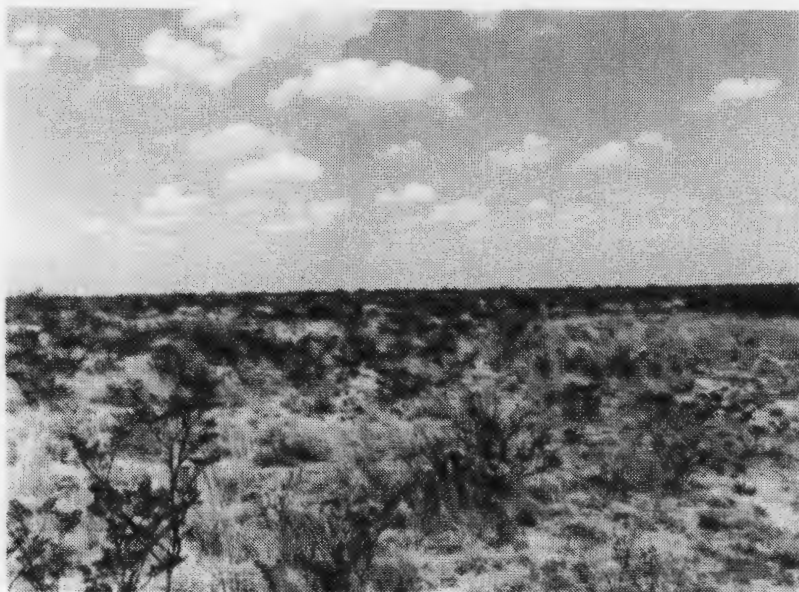


FIG. 4.—Creosote-mesquite grassland atop Concho Bluff, Winkler County, Texas.



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.

***Dasyus 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 utilized 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. knoxjonesi* 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, 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. tooththrow
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 mi. 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 x 10 (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).

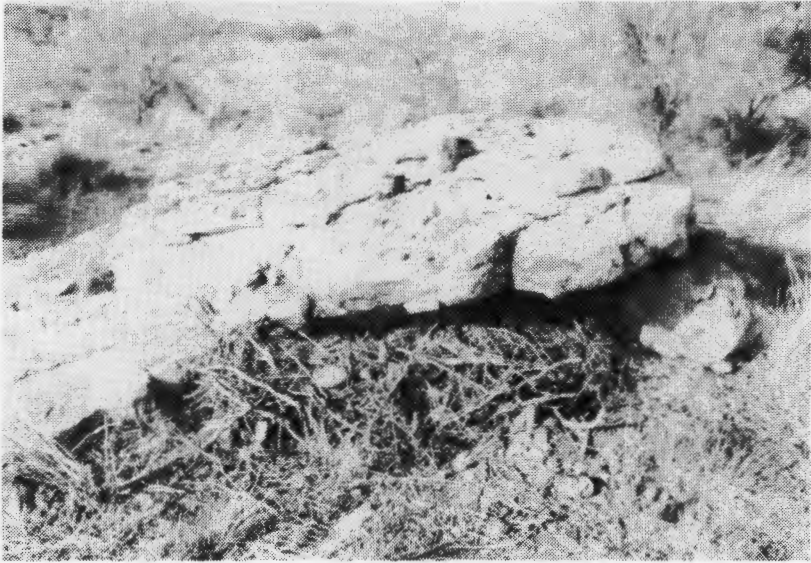


FIG. 8.—*Neotoma albigula* nest under rock near break of Llano Estacado, Ector County, Texas.

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) and 1.5 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) \pm 37.2, 1172.8 (1041-1283) \pm 67.9; 398.0 (343-432) \pm 25.8, 378.4 (305-432) \pm 36.5; 159.1 (152-178) \pm 10.9, 156.0 (133-178) \pm 10.9; 11.1 (8.5-13.4) \pm 1.4, 10.9 (7.9-13.4, one pregnant with five small fetuses) \pm 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 assignable 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, on 14 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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