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DISTRIBUTION AND VARIATION OF POCKET  
GOPHERS (GENUS GEOMYS) IN THE  
SOUTHWESTERN UNITED STATES

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The pocket gopher (Genus *Geomys*), often a destructive rodent when inhabiting farm and pasture lands, occurs over much of the United States and Mexico east of the Rocky Mountains. Its distribution and differentiation into geographic races is influenced by soil conditions and geographic features. Pocket gophers of this group are partial to sandy or friable soils. Black or clay soils are not a favorable habitat for them and these soils check their spread as frequently do large rivers.

Four species of this genus of pocket gophers occur in Texas; *Geomys breviceps* in the east, *Geomys lutescens* in the north, *Geomys personatus* in the lower Rio Grande Valley, and *Geomys arenarius* in the El Paso Valley.

Each of these four species has developed a number of varieties each occupying an area from which it is difficult or impossible for it to leave. In the main however their habitats are similar.

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# DISTRIBUTION AND VARIATION OF POCKET GOPHERS (GENUS *GEOMYS*) IN THE SOUTHWESTERN UNITED STATES

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Research Unit.†

Nearly half a century ago C. Hart Merriam (1895) published his revision of the genus *Geomys*, recognizing 8 subspecies of 5 species as occurring in the region covered by this study. Materials accumulated in the Texas Cooperative Wildlife Collection in the last few years have led the author to study anew the problem of the distribution and relationships of this genus in New Mexico, Texas, Oklahoma, Arkansas, and Louisiana.

In recognizing specific characters, Merriam (1895) placed considerable reliance on the shape and length of the jugal. Inasmuch as this bone is often so completely fused with the squamosal that the suture is obliterated, considerable difficulty is encountered in using this character. The length of the dorsolateral exposure of the jugal as compared with the width of the rostrum ventrad to the infraorbital foramina, however, is a character apparently more useful as it separates the genus into two groups: (1) *breviceps* and (2) *lutescens*, *personatus*, and *arenarius*. In group 1 the length of the dorsolateral exposure of the jugal is less than the width of the rostrum ventrad to the infraorbital canal; in group 2 it is more.

A character useful in distinguishing the species of group 2 is the ratio of the greatest width of the rostrum ( $r$ ) to the greatest length of the basioccipital ( $b$ ). In *personatus* and *arenarius* the ratio  $\frac{r}{b}$  averages less than 1; in *lutescens* it is 1. or more. *G. arenarius* can be distinguished from *G. personatus* by the presence in the former of a peculiar knob-like expansion of the distal end of the squamosal arm of the zygoma. This study indicates that *G. texensis* Merriam is a geographic race of the earlier named *G. breviceps*.

A useful and seemingly significant means of distinguishing geographic races of a single species is the comparison of mean "volumes" of the skulls. These figures are computed by averaging the products of the basilar length of Hensel times the zygomatic breadth times the palato-frontal depth. To insure valid data, it is imperative that one compare skulls of the same sex and the same age.

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The ranges of the four species found in the geographic area studied, are complementary; in no instance have two species been found in the same area. *G. arenarius* is restricted to the Upper Rio Grande Valley near El Paso and the Tularosa Basin, near Tularosa, New Mexico; *G. personatus* occurs in the lower Rio Grande plains from near Del Rio eastward to Padre Island; *G. lutescens* occupies the lighter soils of the first, second, and third plateaus of northwestern Texas, eastern New Mexico, and western Oklahoma; *G. breviceps* is found on the lower plains comprising the eastern parts of Texas and Oklahoma, most of Arkansas, and that part of Louisiana west of the Mississippi River.

All four species have a decided preference for the lighter, sandier soils. In fact, the heavy soils, if inhabited by pocket gophers at all, are inhabited by other genera, *Thomomys* and *Cratogeomys*. The close correlation between the distribution of *Geomys* and sandy soils is evident from an examination of figures 1 and 2.

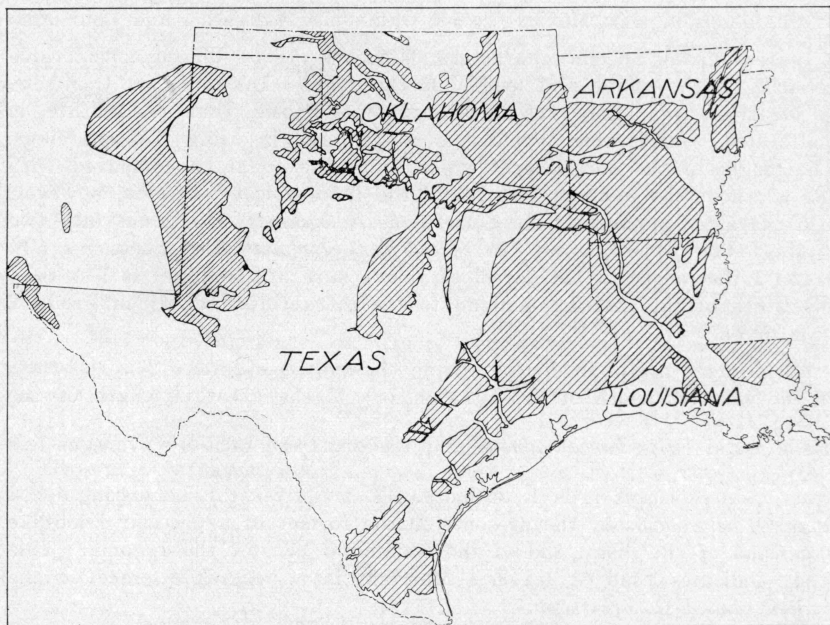


FIG. 1. Map showing the distribution of sandy soils in Texas, Louisiana, Arkansas, Oklahoma and New Mexico. (Modified from a soils map of these states by W. T. Carter). Compare with figure 2 showing the distribution of pocket gophers (Genus *Geomys*) in the same region.

This study is based upon nearly three years of field study by the author in Texas and Louisiana in which he examined more than 600 specimens and many field notes of other collectors. Unless otherwise stated, specimens listed as examined are in the Texas Cooperative Wildlife Collection, College Station, Texas. Additional material has been

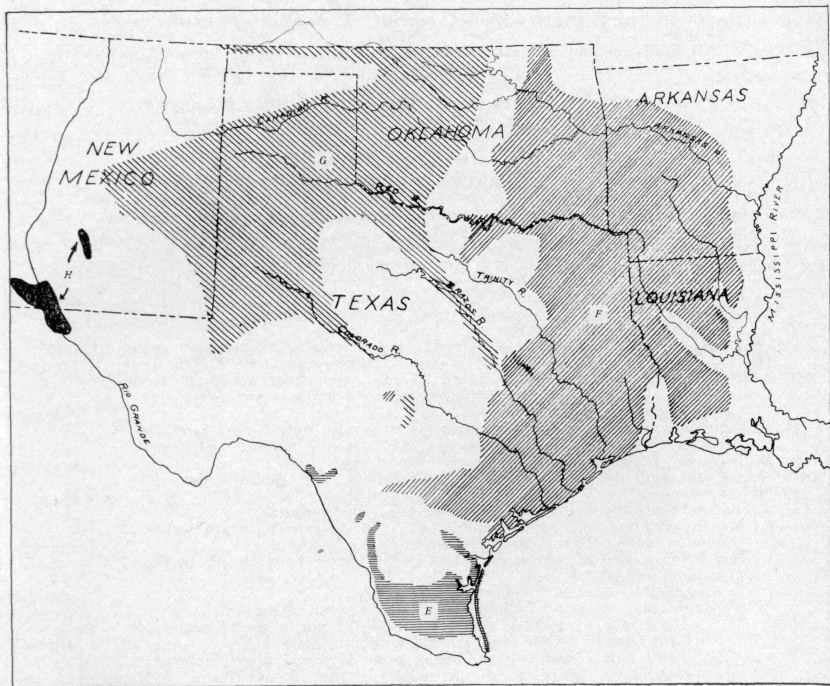


FIG. 2. Map showing the distribution of pocket gophers (Genus *Geomys*) in Texas, Louisiana, Arkansas, Oklahoma, and New Mexico. (E.) *Geomys personatus*, (F.) *Geomys breviceps*, (G.) *Geomys lutescens*, (H.) *Geomys arenarius*. Compare with figure 1 and note how well the distribution of the pocket gophers agrees with the distribution of sandy soils.

made available by George Willett from the collections of the Los Angeles Museum; by J. Kenneth Doult from collections in the Carnegie Museum; by George G. Goodwin from collections in the American Museum of Natural History; by Glover M. Allen from collections in the Museum of Comparative Zoology; by William H. Burt from collections in the Museum of Zoology, University of Michigan; by E. Raymond Hall from collections in the Museum of Vertebrate Zoology; by Hartley H. T. Jackson from the Biological Survey collections in the National Museum; and by George Lowery from collections in the Louisiana State University Museum.

#### KEY TO CERTAIN SPECIES OF GEOMYS

1. Dorsal exposure of jugal shorter than width of rostrum ventrad to infra-orbital openings.....*G. breviceps*
- 1<sup>1</sup>. Dorsal exposure of jugal longer than width of rostrum ventrad to infra-orbital openings.
2. Width of rostrum equal to or less than greatest length of basioccipital.
3. Squamosal arm of zygoma ending in prominent knob over middle of jugal.....*G. arenarius*
- 3<sup>1</sup>. Squamosal arm of zygoma lacking a prominent knob over middle of jugal.....*G. personatus*



21. Width of rostrum greater than greatest length of basioccipital.
4. Nasals distinctly hour-glass shaped, strongly constricted near middle.....*G. tuza\**
41. Nasals not hour-glass shaped, slightly, if at all, constricted near middle.
5. Hind foot of females usually 34 mm., or more, in length; premaxillary tongues terminating anterior to lacrimal processes.....*G. bursarius\**
51. Hind foot of females usually less than 33 mm.; premaxillary tongues terminating on line with, or posterior to, lacrimal processes.....*G. lutescens*

#### KEY TO THE RACES OF GEOMYS BREVICEPS

1. "Volume" of skull in females 11,000 cu. mm. or more (males 16,000 cu. mm., or more).
2. Zygomatic arches widely divergent anteriorly; hind foot of females averaging 27 mm. or more (29 mm. or more in males).
3. "Volume" of skull in females near 14,000 cu. mm.; body length averaging 231 mm.....*attwateri*
31. "Volume" of skull in females near 12,000 cu. mm.; body length averaging 221 mm. or less.
4. Hind foot (females) averaging 27 mm.; length of pterygoid from notch, 5 mm.; total length (females) averaging near 220 mm.....*terricola*
41. Hind foot (females) averaging 26 mm.; length of pterygoid from notch, 4.5 mm. or less; total length (females) averaging near 200 mm.....*ludemani*
21. Zygomatic arches rounding, not widely divergent anteriorly; hind foot in females averaging 26 mm. (males, 28 mm.); "volume" of female skulls near 11,000 cu. mm.....*breviceps*
11. "Volume" of skull in females less than 11,000 cu. mm. (males, less than 16,000 cu. mm.).
5. Prepalatal length† less than least length of basioccipital.
6. Maxillary plate of zygoma nearly at right angles to main axis of skull; breadth of rostrum (females) near 9 mm.;.....*brazensis*
61. Maxillary plate of zygoma curved posteriorly; breadth of rostrum (females) near 8.5 mm.
7. Zygomatic arches nearly parallel sided.....*dutcheri*
71. Zygomatic arches rounded, most wide-spread at middle.
8. Hind foot (females) averaging near 24 mm.; dorsal coloration light brown with distinct dark dorsal stripe.....*sagittalis*
8. Hind foot (females) averaging near 24 mm.; dorsal coloration rich dark, blackish brown, with distinct dorsal stripe.....*pratincola*
51. Prepalatal length greater than least length of basioccipital.
9. Hind foot 29.5 mm. (females); 33 mm. (males).....*texensis*
91. Hind foot near 26 mm. (females); 29 mm. (males).....*ammophilus*

#### GEOMYS BREVICEPS GROUP

Smallest in size of the genus *Geomys*, the species *Geomys breviceps* ranges widely over the lower plains country of Texas, Oklahoma, Arkansas and Louisiana. To the west, its range is roughly bounded by the Balcones Escarpment which marks the eastern edge of the first plateau; on the east it is bounded by the flood plains of the Mississippi River. Northward, the known range extends as far as Tulsa, Oklahoma, but, on the basis of known soil conditions, this species can be expected to occur in the sandy soils of Chautauqua County, Kansas. Southward it is bounded by the Gulf of Mexico and the Nueces River.

In this area of nearly 140 thousand square miles, the species is neither evenly nor continuously distributed. By preference, like other pocket gophers of this genus, it occurs almost exclusively in sandy soils; it rarely, if ever, is found in alluvial silts, clays, or stony soils. Therefore, numerous

\*Not herein discussed as these species do not occur within the region here under consideration.

†Distance from anterior edge of alveolus of Pm<sup>4</sup> to anterior edge of anterior palatine foramina.

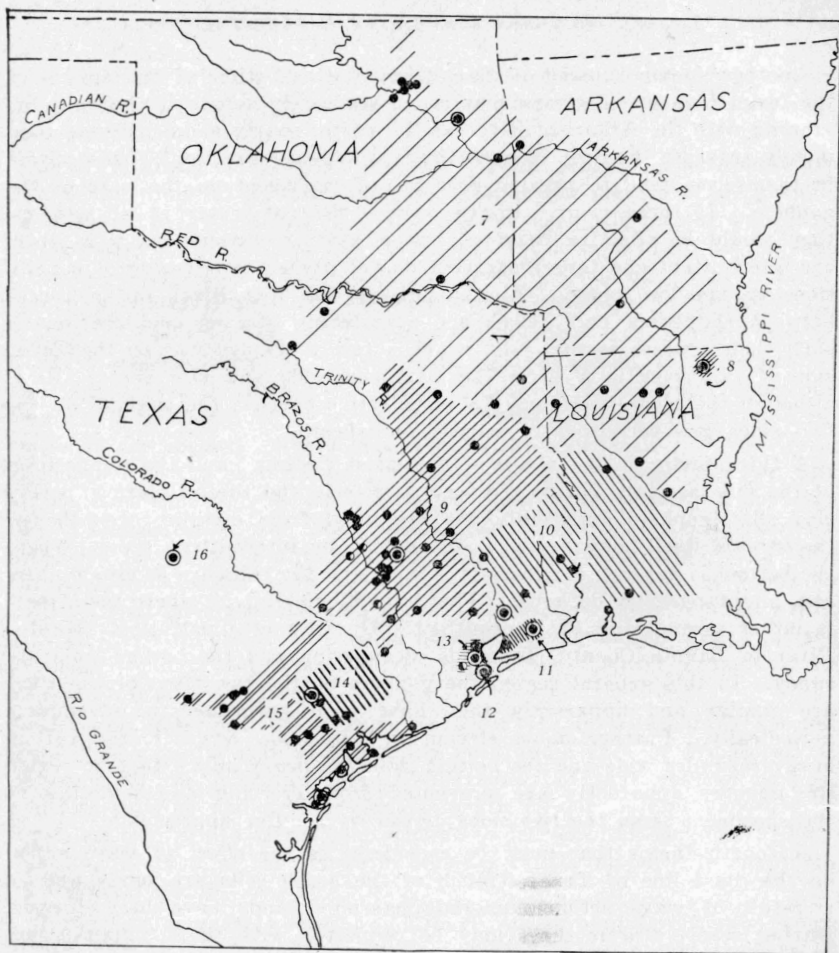


FIG. 3. Map showing the distribution of the races of *Geomys breviceps* in Texas, Louisiana, Arkansas, and Oklahoma. Solid dots indicate localities whence specimens have been examined; half solid circles indicate localities whence specimens have been recorded by other workers; solid dots within circles indicate type localities. (7) *Geomys breviceps dutcheri*, (8) *G. b. breviceps*, (9) *G. b. brazensis*, (10) *G. b. pratincolus*, (11) *G. b. ludemani*, (12) *G. b. terricolus*, (13) *G. b. sagittalis*, (14) *G. b. amophilus*, (15) *G. b. attwateri*, (16) *G. b. texensis*.

populations are more or less isolated on "islands" of sandy soils in "seas" of clay or silt deposits. This is particularly true in the coastal plains of Texas and Louisiana. Also, the species occurs on the sandy Gulf beaches in Texas and there, resulting from the combined action of wind and water on the coast line, populations often are completely or partially isolated by salt water. Tallys Island in Aransas County is an excellent example of complete isolation.



Another factor causing a discontinuous distribution of the species is the large number of rivers that cut transversely across its range. Beginning with the Arkansas River at the north, nearly a dozen rivers completely traverse the area in a northwest-southeast direction. These rivers in themselves tend to prevent freedom of movement on the part of the gophers. If these rivers carried a good flow of water at all seasons, they would be effective barriers, but at certain seasons many of them are intermittent and thus hinder but do not prevent a mingling of populations on the two sides. Others, such as the Red River in its course between Oklahoma and Texas, are meandering streams and continually shift their courses so that land which a few years ago was on the Texas side of the river is now on the Oklahoma side and *vice versa*. Here, although the river itself may be an effective barrier, the gophers on the two sides are permitted to mingle periodically.

A third factor is the width of the river "bottom" and the composition of the soil therein. Where the bottom is wide and the soils are of heavy clay silts, gophers apparently are prevented from crossing even though the stream itself may be of a meandering or intermittent type. Where the bottom is narrow, or where it is wide and the soils are sandy, gophers can, and apparently do, cross. This is particularly true where the stream is either meandering or intermittent. By way of illustration, the Red River in Fannin County, Texas, is meandering and the bottom soils are sandy. In this general region the gophers on the two sides of the river are similar and apparently they have been permitted to intermingle periodically. Farther down stream in Louisiana, however, the bottom is several miles wide and the bottom soils are heavy silts. In that region the gophers apparently are prevented from crossing and mingling as the specimens from the two sides of the river differ appreciably.

A fourth factor that must be considered is the effect of wave action on the coast line of Texas. Much of the beach soils are sandy and as a result of wave action numerous barrier islands have been formed. During severe storms these may be connected with the mainland; subsequent storms may convert them into islands again. Also, the mouths of some of the wider bays may be closed, converting the bay into a lake, and later the obstruction may be removed. This shifting of land may result in effective isolation of gophers, but in other instances it may be the means whereby the coastal populations are permitted to intermingle. The homogeneity of the now isolated populations on the sandy islands and peninsulas of the Texas coast suggests either that the populations do have an opportunity to intermingle or that they were homogeneous before they become isolated.

These factors complicate the picture of the relationships, distribution, and differentiation of the species. Even with more than three hundred specimens available, the writer has not been able to work out their relationships to his complete satisfaction. Too many gaps occur in the material. Next to nothing is known about the gophers of Arkansas outside the Arkansas River Valley; the same applies to Oklahoma.

The region in extreme Eastern Texas and Western Louisiana is almost *terra incognita*. The information derived from materials now available, however, merits placing it on record.

When Merriam (1895) revised the species *breviceps* he apparently evaded the problem of unraveling the complicated picture of geographic races found by recognizing only three races, each one on the periphery of the range of the species, and assigning all other specimens to the race *G. b. breviceps* Baird, stating that they were not typical. Bailey (1905) did much the same when he published on the mammals of Texas.

Each of the three races recognized by Merriam and Bailey, namely, *G. b. breviceps* Baird, *G. b. sagittalis* Merriam, and *G. b. attwateri* Merriam, proves to be isolated, either by wide areas of heavy clay soils or by a combination of heavy soils and river barriers, from the main range of the species. Mer Rouge, Louisiana, type locality of *breviceps*, happens to be the easternmost locality where this species is known and at the same time it is on an "island" of sand surrounded by heavy clay soils. Characters of the skull and the degree to which melanism has developed in the population strongly suggest that this colony has been effectively isolated for many generations. The area occupied by *sagittalis* is likewise effectively isolated, as is that of *attwateri*. Recently the writer (Davis, 1938) described as *G. b. brazensis* the population occupying the drainage basin of the Brazos River from Falls County, Texas, to the coastal prairie.

Although described by Merriam (1895:137) as a separate species, *Geomys texensis* is here treated as a geographic race of *breviceps*. It possesses all the important cranial characters of that species, namely, a heavy rostrum and a short jugal (length of dorsolateral exposure of jugal less than width of rostrum ventrad to infraorbital openings). Furthermore, the color of the pelage in *texensis* can be matched in specimens of *attwateri* and *brazensis*.

Further study reveals several additional centers of differentiation, some of which were recognized by Merriam (1895). The pocket gophers of the Arkansas River Valley differ noticeably from typical *breviceps* and, that population, along with the one occupying the Red River Valley from Cooke County, Texas, to Caddo Parish, Louisiana, seems to the author to merit recognition as a distinct geographic race.

A second center of differentiation is found in Victoria and De Witt counties, Texas, between the Colorado and Guadalupe rivers. These gophers resemble *attwateri* more closely than any other named race, but they are considerably smaller and differ in certain cranial features.

A third center is found at Texas City, Galveston County, where a relatively small sandy area is completely isolated from the known range of any other gopher by several miles of clay soils. Although geographically close to the range of *sagittalis*, the gophers at Texas City are much larger, more melanistic, differ in certain cranial characters and appear to be most like *attwateri*.

A fourth area is that between the Trinity and Red rivers in the piney woods section of southeastern Texas and southwestern Louisiana north of the coastal prairies. In this region the gophers are dark russet brown; they are small in size, and have small auditory bullae and other distinctive cranial characters.

A fifth center is found on the isolated sandy ridges on the coastal prairie of southeastern Texas east of Galveston Bay. These gophers are larger than those in the piney woods of southeastern Texas and they differ in certain cranial characters. In size of skull they approach specimens from Texas City and *attwateri*, but in size of body and external measurement they are smaller.

The race described by Bailey (1905:129) as *Geomys breviceps llanensis* in the author's opinion, is referable to another species, *Geomys lutescens*, and consequently is not discussed under *Geomys breviceps*.

The species *breviceps* is characteristic of the sandy lands of the Gulf Plains region west of the Mississippi River, and along with the red wolf (*Canis rufus*), the Texas otter (*Lutra canadensis texensis*), and the wood rat (*Neotima floridana*) may be considered as an indicator of that region.

To summarize: A critical study of more than 300 specimens of *Geomys breviceps* from Arkansas, Louisiana, Oklahoma, and Texas indicates the presence of at least ten geographic centers of differentiation in each of which the population samples are fairly homogeneous and different from those in other areas. From five of these areas the populations previously have been named; five new geographic races are here recognized.

In the following pages these races are discussed in order of geographic position—from north to south.

### ***Geomys breviceps dutcheri*, New subspecies Oklahoma Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 64591, U. S. National Museum (Biological Survey Collection); Fort Gibson, Muskogee County, Oklahoma; collected April 27, 1894, by Basil Hicks Dutcher, original no. 584.

**Distribution.**—Arkansas River Valley from Tulsa, Oklahoma, east at least as far as Benton, Arkansas, and south into northeastern Texas and northwestern Louisiana.

**Diagnosis.**—A small dark brown *breviceps* with narrow rostrum (8.5 mm. in females, 10 mm. in males); relatively smooth brain case, in females; small audital bullae; and short prepalatal length.

**Comparisons.**—Compared with *breviceps* (16 topotypes available): Skull smaller, "volume" 86 per cent that of *breviceps*; audital bullae smaller (4.5 mm. x 8 mm., as opposed to 5.5 x 8.8 mm.); distance from anterior edge of alveolus of Pm<sup>1</sup> to anterior edge of anterior palatine foramina (hereafter referred to as prepalatal length) less (5.5 mm., as opposed to 6.7 mm.); also, this measurement is less than the greatest width of the foramen magnum in *dutcheri*; greater, in *breviceps*. Compared with

*brazensis* (topotypes); Hind foot slightly longer (26 mm., as opposed to 25 mm.); rostrum narrower (8 mm., as opposed to 9 mm.), and relatively longer; dorsal outline of skull arched, rather than nearly flat or depressed in the infraorbital region.

**Remarks.**—The range of this race appears to coincide with the sandy areas in eastern Oklahoma, northeastern Texas, northern Louisiana east of the Red River, and along the Arkansas and Ouachita rivers in Arkansas. Apparently the Canadian River is not a serious barrier to the dispersal of pocket gophers. The Red River, on the other hand, appears to be no barrier in that portion of its course where it constitutes the boundary between Oklahoma and Texas. Here the sands come down to the first bottom, and, because the river is constantly changing its channel so that blocks of land once on the Oklahoma side of the river later are found on the Texas side and *vice versa*, the gophers could be expected to be the same on the two sides. In its course through Louisiana, however, the river and its wide flood plains, consisting of heavy silt soils, do constitute effective barriers to movements of the gophers.

The ranges of *dutcheri* and *breviceps* are clearly separated, *breviceps* being isolated on an "island" of sandy soil surrounded by heavy, nearly black, alluvial soils. The ranges of *dutcheri* and *brazensis*, however, are not clearly separated and intergradation occurs in the area between the Sabine and Trinity rivers. Both of these rivers seem to act as partial barriers to pocket gophers. This is easily understood when one considers that in the upper portions of these rivers the flood plains are usually narrow and in many places sandy soil, which pocket gophers prefer, constitute the banks of the river. Also, in summer these rivers are intermittent in their upper reaches, hence, they offer no serious obstacle to the dispersal of these rodents.

Throughout the range ascribed to *dutcheri* the population is not constant in all characters. Specimens from Mohawk Park, Oklahoma, are somewhat larger than those from Tulsa, Fort Gibson, and others within the general area; specimens from Shreveport and Minden, Louisiana, are more reddish in coloration. These variations probably reflect the relative state of isolation experienced at present by these populations. Basic cranial characters, however, are fairly constant through the entire range.

Merriam (1895:132) refers specimens from Ponca and Oklahoma City, Oklahoma, to *breviceps*. The author has examined these specimens and is of the opinion that they are of a different species, *Geomys lutescens*.

**Records of occurrence.**—Specimens examined, eighty-seven, as follows: **OKLAHOMA.** Tulsa County: Tulsa, 2 (Mus. Zool.); Garnett, 3 (Mus. Zool.); 8 mi. W Red Fork, 5 (U.S.N.M.); Mohawk Park, 8 (Mus. Zool.). Rogers County: near Garnett, 1 (Mus. Zool.). Muskogee County: Fort Gibson, 15 (U.S.N.M.). Sequoyah County: Redland, 3 (U.S.N.M.). Choctaw County: N side Red River, opposite Arthur, Texas, 4 (U.S.N.M.). **ARKANSAS.** Sebastian County: Fort Smith, 7 (U.S.N.M.). Saline County: Benton, 7 (U.S.N.M.). **TEXAS.** Cooke County: Gainesville, 2 (U.S.N.M.). Wise County: Decatur, 1 (U.S.N.M.). Marion County: Jefferson, 1 (U.S.N.M.). Gregg County: Longview, 4 (U.S.N.M.). **LOUISIANA.** Caddo Parish: 2 mi. S W Shreveport, 9; Keithville, 2 (L.S.U.). Webster Parish: 4 to 5 mi. E Minden, 7. Lincoln Parish: 4 mi. E Cloudrant, 1; Ruston, 1 (L.S.U.). Rapides Parish: Pineville, 2 (U.S.N.M.); Grant Parish: Fishville, 2 (L.S.U.). Additional record (Merriam, 1895:132): Camden, Ouachita County, Arkansas.

**Geomys breviceps breviceps Baird**  
**Louisiana Pocket Gopher**

**Type locality.**—Mer Rouge, Morehouse Parish, Louisiana.

**Distribution.**—Herein restricted to the sandy "island" in the immediate vicinity of Mer Rouge.

**Diagnosis.**—A grayish or blackish brown *breviceps*, with a distinct tendency to melanism (3 of 16 specimens available are nearly pure black); rostrum slender; prepalatal length greater than horizontal width of foramen magnum; auditory bullae relatively large (average 5.5 mm. x 6.6 mm.).

**Comparisons.**—Compared with *dutcheri*: See under account of same. Compared with *brazensis*: Rostrum slenderer and longer (ratio of breadth to length 50 as opposed to 69); prepalatal length averaging 20 per cent greater (6.7 mm., as opposed to 5.3 mm.).

**Remarks.**—Field work in the vicinity of Mer Rouge in the spring of 1939 revealed that pocket gophers occur only in the sandy areas south and west of the town. This sandy "island" is surrounded by low areas of heavy, clay soils in which no pocket gophers were found. Because of this it is inferred that the gophers in this vicinity are fairly effectively isolated. This inference is supported by the melanistic trend of the coat color, the great prepalatal length, and the large auditory bullae, characters not found consistently as yet in population samples from other localities.

**Records of occurrence.**—Specimens examined, seventeen, all from within a three mile radius of Mer Rouge.

**Geomys breviceps brazensis Davis**  
**Brazos Pocket Gopher**

**Type locality.**—Five miles east of Kurten, in Grimes County, Texas.

**Distribution.**—In general, the sandy, post oak country of Texas from the Sabine River in Kaufman and Panola counties, south and west to the Colorado River in Bastrop and Colorado counties.

**Diagnosis.**—A small, dark brown *breviceps* with usually a distinctly darker, nearly black, dorsal stripe; rostrum short and broad (ratio of breadth to length near 69); dorsal outline of skull distinctly flat or depressed in infraorbital region.

**Comparisons.**—For comparisons with *breviceps* and *dutcheri*, see accounts of same. Compared with *attwateri*: Smaller; premaxillae narrower; zygoma less divergent anteriorly; prepalatal length less, rather than greater, than horizontal width of foramen magnum. Compared with *sagittalis*: Slightly larger; rostrum relatively broader (ratio of breadth to length 69, as opposed to near 50); auditory bullae smaller.

**Remarks.**—Typical *brazensis* occurs largely in the sandy area between the Trinity and Brazos rivers. Those specimens from between the Trinity and Sabine rivers tend toward *dutcheri*. On the basis of relatively broad rostrum, however, they here are referred to *brazensis*. On the south side of the Brazos River, in Robertson County, for example, the author has



not been able to find a way in which the gophers differ from typical *brazensis* on the north side. Farther southward, at Bastrop, the gophers closely resemble *brazensis*, but are larger. Specimens from Huntsville, Hockley, and Huffman are lighter colored, that is, less blackish; those from Hockley and Huffman have a narrower rostrum, hence tending toward *sagittalis*.

Apparently the Colorado River is a much more effective barrier to pocket gophers than is any of the rivers farther east in Texas. At any rate, I have no evidence that *brazensis* is found on the south side of that river or that *attwateri* or *ammophilus* occurs on the north side. The heavy soils through which the Colorado runs for most of its distance after emerging from the hill country are in themselves barriers to gophers and aid in preventing frequent crossings of the river.

**Records of occurrence.**—Specimens examined, ninety-five, all from Texas, as follows: Kaufman County: Terrell, 7 (U.S.N.M.). Wood County: Mineola, 14 (U.S.N.M.). Panola County: 4 mi. N E Carthage, 4. Anderson County: Palestine, 5. (U.S.N.M.). Falls County: 1 mi. S E Reagan, 1; 2 mi. N W Bremond, 1. Robertson County: 1 mi. S Bremond, 3. Leon County: Marquez, 4 (U.S.N.M.); 13 mi. E Centerville, 4. Trinity County: 1 mi. N Trinity, 5. Walker County: 6 mi. S Huntsville, 2; 17 mi. W N W Huntsville, 2. Grimes County: 5 mi. E Kurten, 3. Brazos County: 2 mi. S Bryan, 1; 23 mi. N E Bryan, 4; College Station, 5; 4-6 mi. S College Station, 6; 3 mi. E Kurten, 2. Burleson County: 17 mi. E Caldwell, 5. Austin County: 2 mi. N E Bellville, 3. Bastrop County: 5 mi. E Bastrop, 6. Colorado County: Eagle Lake, 2. Harris County: 2.5 mi. N Hockley, 4; 4 mi. N Huffman, 2. Additional records (Merriam, 1895:132): Smith County: Troup; Robertson County: Hearne. Milam County: Milano. Washington County: Brenham.

### *Geomys breviceps attwateri* Merriam Attwater Pocket Gopher

**Type locality.**—Rockport, Aransas County, Texas.

**Distribution.**—The coastal sands of Texas from the Colorado River southwestward nearly to the Nueces River; inland south of the Guadalupe River at least as far as Moore, Frio County.

**Diagnosis.**—A relatively large *breviceps* with zygomata widely divergent anteriorly; rostrum relatively long and broad; premaxillae averaging 3.8 mm. in dorsal width in females, 4.0 mm. in males; dorsal coloration light russet brown.

**Comparisons.**—For comparison with *brazensis* see under account of same. Compared with *sagittalis*: Considerably larger; zygoma wide spreading anteriorly, rather than evenly rounded. Compared with *ammophilus*: See under account of same.

**Remarks.**—Although much of the soils of the coastal prairie are heavy Lake Charles and Victoria clays, numerous, often isolated, areas of sandy soils occur in which *attwateri* is found. The discontinuous distribution of sandy soils in the area results in a discontinuous distribution of pocket gophers. Often colonies are completely isolated on "islands" of sand surrounded by heavy clay soils. In spite of this, the pocket gophers in the range here assigned to *attwateri* are remarkably uniform as regards size, color, and cranial characters. Specimens from near San Antonio and Moore do not differ appreciably from those taken in the coastal sands.

The coastal sands between the Colorado and Nueces rivers are interrupted by a number of bays and bayous, suggesting that the populations of gophers at such localities as Matagorda, Aransas Refuge, and O'Connorsport are effectively isolated and hence potential geographic races. When one brings into account the manner of the formation of the off shore islands and the immediate beaches of the mainland by wave action, and the resulting changing nature of the coastline itself, it is not difficult to visualize that, through time, these populations might come into actual contact by expansion of their ranges onto newly created beaches and sand spits. This hypothesis may help to account for the homogeneous nature of the gophers from these coastal sands.

Additional specimens from south of San Antonio (Pleasanton, Campbellton, Moore) indicate that Allen's (1896:57) reference of 11 specimens of pocket gophers from 15 miles south of San Antonio to *Geomys texensis* is in error. All specimens that the author has examined from that general area are typical or nearly typical *attwateri*. Likewise, his reference (1894:171) of specimens from Aransas County to *Geomys personatus* resulted from misidentification. The last mentioned specimens were later (1895) described by Merriam as *Geomys breviceps attwateri*.

**Records of occurrence.**—Specimens examined, fifty-six, as follows: **Frio County:** 1 mi. N Moore, 3. **Atascosa County:** 2 mi. N Pleasanton, 7; 2 mi. N W Campbellton, 3. **Wilson County:** Calaveras, 20 mi. S San Antonio, 4 (U.S.N.M.). **Goliad County:** 8 mi. W Goliad, 8; 3 mi. E Goliad, 2. **Victoria County:** 3 mi. S W Victoria, 4. **Calhoun County:** 12 mi. S W Port Lavaca, 1 (L. A. Mus.); O'Connorsport, 3 (U.S.N.M.). **Matagorda County:** Matagorda, 8 (U.S.N.M.). **Aransas County:** 8 mi. S W Rockport, 5; Aransas Refuge, 10 mi. S E Austwell, 8. Additional records (Merriam, 1895:136): **Bexar County:** 18 mi. S San Antonio. **Aransas County:** Rockport; Tallys Island.

### ***Geomys breviceps ammophilus*, New subspecies Victoria Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 97010, U. S. National Museum (Biological Survey Collection); Cuero, De Witt County, Texas; collected April 26, 1899, by Vernon Bailey, original no. 6841.

**Distribution.**—Between the Colorado and Guadalupe rivers from the blackland prairies in northwestern De Witt, Lavaca, and Colorado counties southeastward to the Lake Charles clays near the gulf coast.

**Diagnosis.**—Similar to *attwateri* in general appearance and characters of the skull, but smaller; zygoma less divergent anteriorly.

**Comparisons.**—Compared with *attwateri*: Hind foot in females averaging 25.5 mm., rather than 27 mm.; "volume" of skull, nearly 30 per cent less (10,000 cu. mm., as opposed to 14,200 cu. mm. in females); nasals actually (12.3 mm., as opposed to 14.4 mm.) and relatively (38 per cent of basilar length of Hensel, rather than 41 per cent) shorter; zygoma less divergent anteriorly. Compared with *brazensis*, whose range borders it on the north: Similar in size, but coloration more grayish brown, dorsal "stripe" lacking; rostrum relatively narrower; zygoma divergent anteriorly, rather than bowed; auditory bullae about one-third again as large. Compared with *sagittalis*: Slightly larger; dorsal "stripe" lacking; zygoma divergent anteriorly, rather than bowed.



**Remarks.**—This race is most closely related to *attwateri*, differing from it chiefly in smaller size.

The range of *ammophilus* appears to be hemmed in on two sides by the Colorado and Guadalupe rivers. The first bottom flood plain of each river consists of heavy clay silts, hence, not a favorable habitat for pocket gophers. On the other two sides, roughly north and south, the heavy, black clay soils apparently act as barriers.

**Records of occurrence.**—Specimens examined, ten, as follows: **De Witt County:** Cuero, 4 (U.S.N.M.); 8 mi. S E Cuero, 1 (U.S.N.M.). **Victoria County:** Victoria, 2 (U.S.N.M.); Inez, 3 (U.S.N.M.).

***Geomys breviceps terricolus*, New subspecies**  
**Texas City Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 624, Texas Cooperative Wildlife Collection; one mile north of Texas City, Galveston County, Texas; collected January 16, 1938, by William B. Davis, original no. 2936.

**Distribution.**—Known only from the type locality.

**Diagnosis.**—A relatively large *breviceps* pocket gopher; hind foot in females averaging 27 mm.; prepalatal length equal to or less than shortest length of basioccipital; rostrum moderately wide (9.0 mm.); "volume" of skull near 13,000 cu. mm. in females.

**Comparisons.**—Compared with *sagittalis*, to which it is geographically nearest: Considerably larger, "volume" of skull 18 per cent greater; auditory bullae actually and relatively smaller; hind foot of females averaging 27 mm., rather than near 24 mm.; coloration darker, dorsal stripe less conspicuous. Compared with *attwateri*: Auditory bullae smaller, 5.2 mm. x 7.8 mm., as opposed to 6.5 mm. x 9.2 mm.; breadth of rostrum ventrad to infraorbital foramina 12 per cent less (4.0 mm., as opposed to 4.5 mm.); "volume" of skull 12 per cent less (12,000 cu. mm., as opposed to 14,000 cu. mm.). Compared with *ammophilus*: Larger, "volume" of skull 17 per cent greater; rostrum actually and relatively broader; prepalatal length equal to or less than least length of basioccipital; vertical width of zygoma at juncture of jugal and maxilla 25 per cent greater (2.1 mm., as opposed to 1.6 mm.).

**Remarks.**—This race is more closely related to *attwateri* and *ammophilus* than to its nearest geographic neighbor *sagittalis*. It appears to be completely isolated on a small tract of sandy soils in the immediate vicinity of Texas City and its range is separated from that of *sagittalis* by at least twenty miles of nearly black Lake Charles clay. From the nearest known locality whence *attwateri* has been taken it is separated by fully sixty miles of marshy or heavy clay soils.

Bailey (1905:128) reports the capture of 7 specimens of pocket gopher at Virginia Point. These probably are referable to *terricolus* rather than to *sagittalis* to which race he referred them.

**Records of occurrence.**—Specimens examined, 10, all from the type locality.

**Geomys breviceps sagittalis Merriam**  
**White-Throated Pocket Gopher**

**Type locality.**—Clear Creek, south end Harris County, Texas.

**Distribution.**—Along Clear Creek and in the sands along Galveston Bay north of Clear Creek.

**Diagnosis.**—A small, light brown *breviceps* with distinct dark dorsal stripe; hind foot of females averages near 24 mm.; rostrum relatively narrow; auditory bullae relatively large.

**Comparisons.**—Compared with *ammophilus* and *brazensis*: See under account of same. Compared with *pratincolus*: Zygomatic arches less wide spreading, maxillary plate more curved posteriorly; color of dorsum lighter brown; hind foot smaller (females average near 24 mm., rather than 26 mm.).

**Remarks.**—Apparently this race is limited to a relatively small area of sandy soil in southern Harris County and northern Galveston County. According to the information available, no gophers occur on the prairies between Clear Creek and Texas City, the type locality of *terricolus*. Also, pocket gophers apparently are absent from near Clear Creek northward across the black coastal prairie clays. The pocket gophers in northern Harris County are closer to, although not typical of, *brazensis*, to which race they herein are referred. To the east, the range of *sagittalis* is limited by Galveston Bay and the Trinity river, hence preventing any appreciable intermingling with *pratincolus*, which occurs on the east side of Galveston Bay.

**Records of occurrence.**—Specimens examined, nine, as follows: **Galveston County:** Clear Creek (probably near League City), 3 (U.S.N.M.). **Harris County:** 3 mi. N E Webster, 3; 3 mi. N La Porte, 3. Additional record (Merriam, 1895:134): **Galveston County:** Arcadia.

**Geomys breviceps pratincolus, New subspecies**  
**Coastal Prairie Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 1128, Texas Cooperative Wildlife Collection; two miles east of Liberty, Liberty County, Texas; collected November 24, 1939, by William B. Davis, original no. 3419.

**Distribution.**—The piney woods area of southeastern Texas east of the Trinity River and north of the coastal prairie, east as far as the Red River in Louisiana.

**Diagnosis.**—A relatively small *breviceps* with widely bowed zygomatic arches, short rostrum, and rich russet brown coloration, with nearly black dorsal stripe evident in most specimens.

**Comparisons.**—Compared with *brazensis*, to which it seems most closely related: Auditory bullae larger; rostrum proportionately narrower. Compared with *sagittalis*: Zygomatic arches more widely bowed; maxillary plate nearly at right angles to main axis of skull, rather than sloping backward; dorsal coloration darker brown, sides less brightly colored russet; hind foot larger.

**Remarks.**—This race is weakly differentiated from *brazensis*, differing chiefly in size of auditory bullae and breadth of rostrum, and assigned to it are certain non-typical specimens. Those from Livingston, and Kirbyville, Texas, and Provencal, Louisiana, are to be mentioned. The Livingston specimens are light golden brown in color and lack a dorsal stripe; the Kirbyville specimen has a much narrower skull, less bowed zygomatic arches, and narrower rostrum; those from Provencal have relatively longer rostra.

The differences between *brazensis* and *pratincolus* are not readily evident from external measurements and color. In the skulls, however, differences are readily noticed. The greater width, which usually increases posteriorly, of the rostrum and the less inflated bullae of *brazensis* are the chief differences.

**Records of occurrence.**—Specimens examined, thirty-nine, as follows: **TEXAS.** Polk County: 3 mi. W Livingston, 2. **Newton County:** Sabine River, 30 mi. S Newton, 2 (U.S.N.M.). **Jasper County:** Kirbyville, 1 (L.S.U. Mus.). **Liberty County:** 2 mi. E Liberty, 11. **Hardin County:** 13 mi. N E Sour Lake, 8 (U.S.N.M.). **LOUISIANA.** Natchitoches Parish: Provencal (within radius of 4 mi.), 8 (L.S.U. Mus.). **Jefferson Davis Parish:** Iowa Station, 6 (U.S.N.M.). **Cameron Parish:** Gum Cove, 15 mi. S Vinton, 1 (U.S.N.M.).

***Geomys breviceps ludemani*, New subspecies**  
**Ludeman Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 1135, Texas Cooperative Wildlife Collection; seven miles southwest of Fannett, Jefferson County, Texas; collected November 25, 1939, by William B. Davis, original no. 247 (of B. E. Ludeman).

**Distribution.**—Apparently restricted to a few isolated sand ridges in the southern parts of Jefferson and Chambers counties in extreme southeastern Texas.

**Diagnosis.**—A relatively small dark colored pocket gopher with large skull; "volume" of skull in females averages near 11,500 cu. mm.; pterygoidal processes short, measuring 4.5 mm. or less; hind foot in females near 26 mm.; prepalatal length greater than least length of basioccipital.

**Comparisons.**—Compared with *pratincolus*, which is geographically nearest and with which it doubtless intergrades: Skull larger; prepalatal length greater than least length of basioccipital, rather than equal to or less; pterygoidal processes from 10 to 20 per cent longer. Compared with *sagittalis*, from the opposite side of Galveston Bay: Zygoma more wide spread anteriorly; "volume" of skull (females) 11,500 cu. mm.; rather than near 10,000 cu. mm.; dorsal coloration averages darker. Compared with *terricolus* from Texas City: Smaller, total length of females averaging 202 mm., rather than 220 mm.; hind foot averages shorter, 26 mm., as opposed to 27 mm.; pterygoidal processes shorter.

**Remarks.**—In general shape of the skull *ludemani* resembles *terricolus*, that is, the zygomatic arches are wide spread anteriorly. In general



coloration, size, and length of pterygoid processes it is most closely related to *pratincolus*.

This race appears to be isolated on two sandy ridges that converge as they approach the Gulf. From the range of *pratincolus*, *ludemani* is separated by several miles of heavy coastal soils. From both *sagittalis* and *terricolus* it is separated by the Galveston Bay.

**Records of occurrence.**—Specimens examined, ten, as follows: Chambers County: Double Bayou, 10 mi. S Anahuac, 2. Jefferson County: 7 mi. S W Fannett, 8.

***Geomys breviceps texensis* Merriam**  
**Texas Pocket Gopher**

**Type locality.**—Mason, Mason County, Texas.

**Distribution.**—Known only from near the type locality.

**Diagnosis.**—A medium sized *breviceps* with large hind foot (females, 29.5 mm.; males, 33 mm.).

**Comparisons.**—Compared with *brazensis*: Larger; hind foot of females averaging 29.5 mm., rather than near 26 mm.; rostrum averaging longer and relatively narrower; prepalatal length near 6.7 mm., rather than 5.4 mm. Compared with *attwateri*: Similar in external measurements except in length of hind foot (*texensis* females, 29.5, males, 33; *attwateri* females, 27, males, 30.5); skulls averaging smaller ("volume" of *texensis* females, 8,200 cu. mm.; *attwateri* females, 14,200 cu. mm.); zygomatic arches less divergent anteriorly.

**Remarks.**—The author has studied carefully the characters used by Merriam (1895:137-138) in assigning *texensis* specific rank and finds that each one of them can be found in gophers in some part of the recognized range of *breviceps*. Even the character most relied upon by him—the relative length of the jugal and basioccipital—is found in gophers from several localities other than in Mason County. As is pointed out in the discussion of the *lutescens* group, *texensis* has a heavy, relatively wide rostrum and a short dorsal exposure of the jugal, a condition common to all the gophers herein referred to *breviceps* and not found in *lutescens* or *personatus*.

Specimens from Del Rio and Sycamore Creek that were referred by Merriam (1895) and Bailey (1905) to *texensis* appear to be more properly referred to *Geomys personatus* under which they are herein discussed. Likewise, specimens from 15 miles south of San Antonio that were referred by Allen (1896) to *texensis* are more properly referred to *attwateri*.

The race *texensis* is far removed geographically from the known general range of the species *breviceps*. Perhaps this isolation is more apparent than real for the writer has not explored the "Hill Country" of Texas for pocket gophers. Since the Llano River is tributary to the Colorado River, it seems probable that *breviceps* might be found in favorable localities in the territory between the ranges of *texensis* and *brazensis* or *attwateri*. Pocket gophers are known to occur at Fredericksburg in Gillespie County, but no specimens are available.

**Records of occurrence.**—Specimens examined, sixteen, all from near the type locality.

## GEOMYS ARENARIUS GROUP

Two races of this species occur at two widely separated localities, the Rio Grande Valley near El Paso and the Tularosa Basin in New Mexico. Apparently the occurrence of *arenarius* at Deming, New Mexico, marks the westernmost part of the range of *Geomys* in the United States.

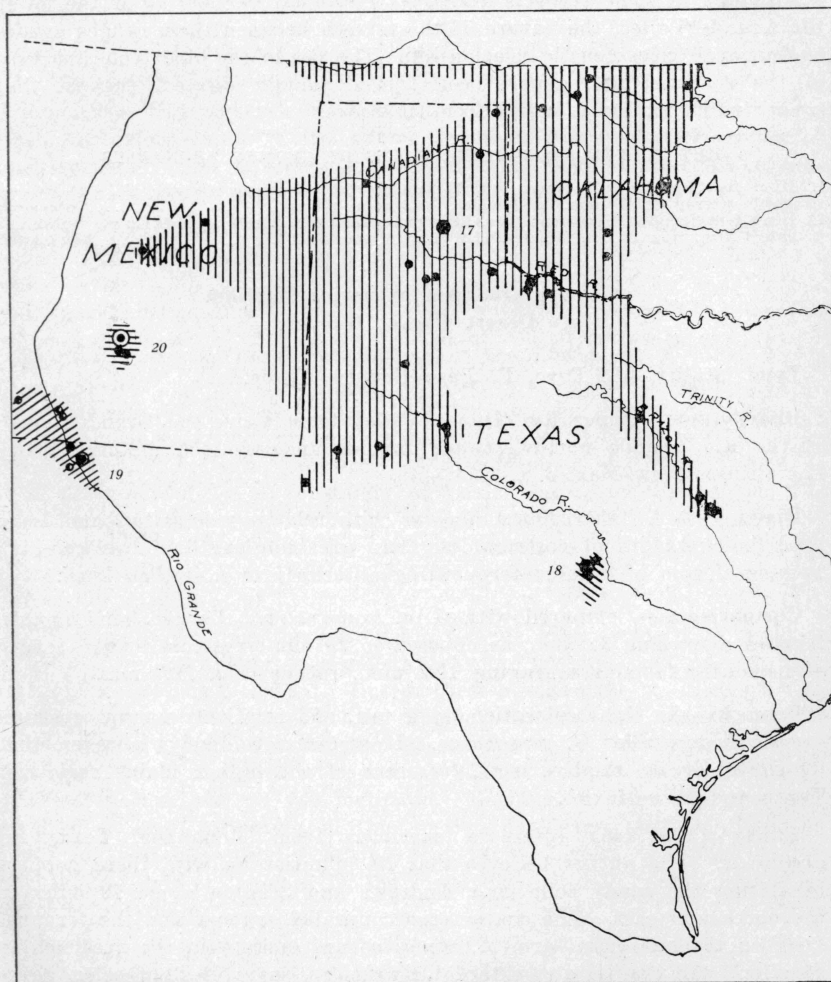


FIG. 4. Map showing the distribution of the races of two species of pocket gophers in western Texas, Oklahoma, and New Mexico. Solid dots indicate localities whence specimens have been examined; dots within circles indicate type localities. (17) *Geomys lutescens major*, (18) *G. lutescens llanensis*, (19) *Geomys arenarius arenarius*, (20) *G. arenarius brevirostris*.

As with other species of the genus, *arenarius* is partial to deep sandy soils; none has been found on the higher plateaus of trans-Pecos Texas where the soil usually is tight and of clay-loam texture. In such soils is the home of another genus, *Cratogeomys*, while a third genus, *Thomomys*, occupies the more friable soils in the foothills and mountains.

Although in some respects *arenarius* resembles *personatus* of the lower Rio Grande Valley, the nature of the terrain between their ranges argues against their close genetic relationship. The size of the hind foot, structure of the rostrum, and general color, even though diluted, suggest that *arenarius* is not far removed from *lutescens*.

#### KEY TO THE GEOGRAPHIC RACES OF GEOMYS ARENARIUS

1. Hind foot females 31-34 mm. (av. 32 mm.); rostrum longer (length of nasals averaging 15 mm. in females, 16.2 mm. males).....*arenarius*
- 1<sup>1</sup>. Hind foot females 27-32 mm. (av. 29 mm.); rostrum shorter (length of nasals averaging 12.7 in females, 15.0 mm. in males).....*brevirostris*

#### *Geomys arenarius arenarius* Merriam Desert Pocket Gopher

**Type locality.**—El Paso, El Paso County, Texas.

**Distribution.**—Upper Rio Grande Valley from above the Grand Canyon of the Rio Grande northwestward for an undetermined distance above Las Cruces, New Mexico.

**Diagnosis.**—A light colored *Geomys* with relatively long tail and large hind foot; breadth of rostrum less than greatest length of basioccipital; squamosal arm of zygoma terminating anteriorly in a swollen knob.

**Comparisons.**—Compared with *G. a. brevirostris*: Larger, hind foot in females averaging 32 mm., as opposed to 29 mm.; rostrum longer, length of nasals in females averaging 15.2 mm., rather than 12.7 mm.

**Remarks.**—In light coloration, long tail, and relatively narrow rostrum *arenarius* resembles *G. personatus*. It seems more likely, however, that its closest living relative is *G. lutescens* of the higher plains region of Texas and New Mexico.

Bailey (1931:245) refers a specimen from Monahans, Texas, to *arenarius*. The author believes that its affinities lie with those gophers inhabiting the sandy soils near Andrews and Stanton, some 70 miles to the north and east. The characteristic parallel zygoma and the terminal knob on the squamosal arm of *arenarius* are lacking in the specimen in question. All cranial and external characters, save for light color, agree with *G. lutescens major*, to which race the writer has referred it. This disposition is in full accord with the geography of the region.

**Records of occurrence.**—Specimens examined, seventeen, as follows: **TEXAS.** El Paso County: 2 mi. E El Paso 15; banks of Rio Grande, 15 mi. above El Paso, 2 (all 17 in Mus. Vert. Zool.). Additional records: **NEW MEXICO.** Dona Ana County: Las Cruces; Mesilla Park (Bailey, loc. cit.). Luna County: Deming (Merriam, 1895:140). **MEXICO.** Chihuahua: Juarez (Merriam, loc. cit.).

***Geomys arenarius brevirostris* Hall**  
**Tularosa Pocket Gopher**

**Type locality.**—East edge of white sand, 9 miles west of Tularosa, Tularosa-Hot Springs Road, Otero County, New Mexico.

**Distribution.**—Known only from the Tularosa Basin in Otero County, New Mexico.

**Diagnosis.**—According to Hall (1932:97), differs from *arenarius* from El Paso, Texas, in smaller size, shorter rostrum, and darker color.

**Remarks.**—The presence of *brevirostris* in the Tularosa Basin marks the northeastern limits of the known range of the species *G. arenarius* and strengthens the inference that the closest living relative of *Geomys arenarius* is *Geomys lutescens* of the high plains of Texas.

**Records of occurrence.**—Specimens examined, eight, as follows: 9 mi. W Tularosa, 5; 10 mi. S W Tularosa, 2; 12 mi. W Alamogordo, 1 (all Mus. Vert. Zool.).

**GEOMYS PERSONATUS GROUP**

The large *personatus* pocket gophers of the Lower Rio Grande Plains of Texas offer an illustration of the effects of isolation on a species. These gophers, restricted almost exclusively to the fine, deep sands between the Nueces River on the north and the Rio Grande on the south, occur in widely scattered localities. A discontinuous distribution such as this, accompanied by a constancy of basic characters throughout the group, suggests either a once nearly continuous distribution or the results of long continued attempts to seek out favorable less populated areas to relieve population pressure. On geologic grounds the latter explanation seems most logical.

Geologically speaking, the Lower Rio Grande Plains consist of a series of old beaches, paralleling in a general way the present coast line, varying in age from Eocene to Recent. One of these beaches, the so-called Carrizo Sands, begins at Carrizo Springs, Dimmit County, and extends north-eastwardly in a discontinuous strip across the state. Another, of Recent formation, is the series of wave-created islands, such as Padre, Mustang, and Matagorda, just off the mainland. Keeping in mind the processes involved in land formation in this section of Texas, that is, fluvial deposition and deposition resulting from wave action, the present distribution of pocket gophers in the lower Rio Grande plains is not so difficult to explain.

Obviously, the presence of pocket gophers on Padre and Mustang islands indicates a Recent connection of these sand barriers with the mainland in a section, such as Flour Bluff near Corpus Christi, that was already populated with gophers. The presence of *personatus* in the Carrizo Sands near Carrizo Springs can be explained by assuming an emigration along fluvial soils deposited along the Nueces River or by emigration "cross country" in the sandy soils between Laredo and the Nueces River west of Cotulla, LaSalle County. However, no pocket



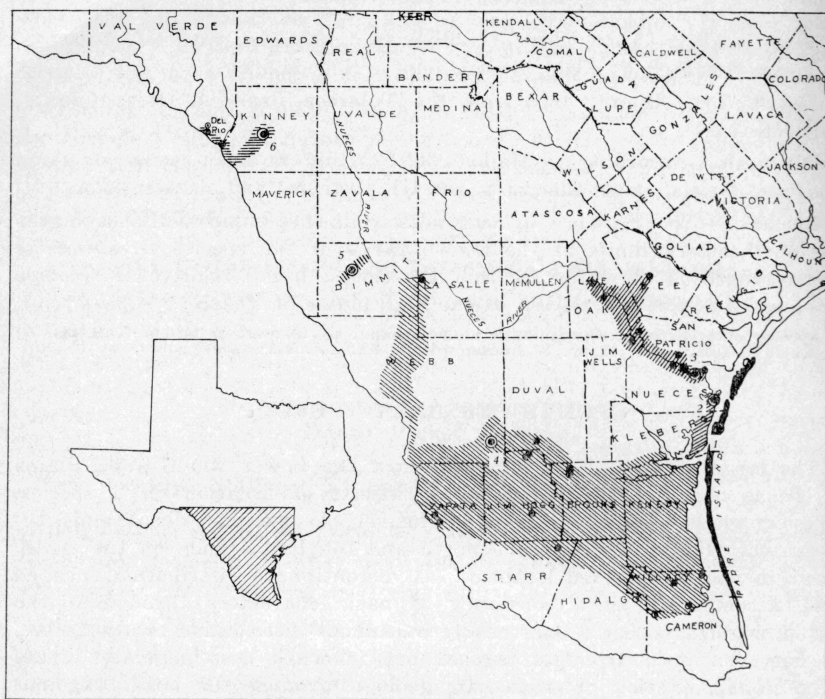


FIG. 5. Map showing the distribution of the races of *Geomys personatus* in the lower Rio Grande plains region of Texas. Solid dots indicate localities whence specimens have been recorded; dots within circles indicate the type localities. (1) *Geomys personatus personatus*, (2) *G. p. maritimus* (3) *G. p. fallax*, (4) *G. p. megapotamus*, (5) *G. p. minor*, (6) *G. p. fuscus*.

gophers now occur along a considerable section of this river above Three Rivers, Live Oak County, suggesting that the latter assumption is the more likely one. The presence of *personatus* at Brackettville, Sycamore Creek, and Del Rio probably resulted from an emigration along fluvial deposits near the Rio Grande. At present the main range of *personatus* borders the Rio Grande only in Zapata and Webb counties.

As previously stated, *Geomys personatus* is restricted to deep, sandy soils. It is entirely absent from the silt loams of the flood plains of the Rio Grande; likewise it is not found in the gravelly, stony, or clay soils that occur throughout much of the range of the species. These soils act as barriers and are effective in keeping scattered populations isolated.

The variation in size of *personatus* is striking. The individuals living in the newest, most recent sand deposits are largest, and as one progresses inland from Padre Island, the gophers become smaller, the smallest individuals being found at Carrizo Springs and Brackettville. That size might be correlated with the diggability of the soil is suggested by the following facts. The sands on Padre Island are fine and subject to dune

formation; the same is true on the mainland adjacent to the coast. In these areas the gophers are largest. The sands at Carrizo Springs are more compact and impregnated with silt. Here the gophers are smallest. Along the south side of the Nueces Bay gophers have been "forced" to utilize the only friable soils available, a sandy-clay loam. Here they are small, but at Sandia, a few miles up the Nueces River, where the soil consists of fairly deep, loose sand, they are considerably larger than those along the south side of Nueces Bay. By way of illustration, the average diameter of the burrows of pocket gophers at Flour Bluff is 108 mm.; that of gophers at Carrizo Springs, 65 mm.

This species of pocket gopher is typical of the Lower Rio Grande Plains biotic province, its distribution coinciding fairly well with the limits of that area, failing, of course, to occur in the harder, more compact soils. Along with such birds as the Texas Sparrow (*Arremonops rufivirgatus rufivirgatus*), the pyrrhuloxia (*Pyrrhuloxia sinuata texana*), and such mammals as the Texas opossum (*Didelphis mesamericana texensis*), and the small-toothed coyote (*Canis microdon*), *personatus* pocket gophers may be considered as an "indicator" of the province.

A critical study of 126 specimens of *G. personatus* from Texas indicates the presence of two groups as judged by the size of the skull and length of hind foot. The gophers occupying Mustang and Padre islands, the mainland adjacent to the shore near Flour Bluff, and the mainland in Duval, Brooks, Kenedy, Willacy, Jim Hogg, Starr, Zapata and Webb counties are relatively large animals with the hind foot 37 mm. or more in length. In this group, the populations on Mustang and Padre islands, and the mainland from Flour Bluff south to Baffin Bay, are isolated from the main range of the species. Correlated with this circumstance, each of these three areas, (1) Mustang and Padre islands, (2) the coastal sands, and (3) the deep sands in the hinterland, appears to constitute a center of differentiation.

The second group, comprised of isolated colonies near Brackettville, Carrizo Springs, and the lower course of the Nueces River, consists of small individuals, the hind foot seldom being more than 34 mm. in length. In this group, also, three centers of differentiation are evident.

To summarize: In the range of the species *Geomys personatus*, 6 centers of differentiation can be recognized, the population in each of which is fairly homogeneous and different from all the others. Of these populations, 2 have previously been named. In the following pages, descriptions and the distribution of these two are given; four races are described as new.

#### KEY TO THE GEOGRAPHIC RACES OF GEOMYS PERSONATUS

1. Hind foot of females averaging 34 mm., or more (males 5 per cent longer).
  2. Hind foot of females averaging 37 mm., or more.
    3. Total length of females averaging 280 mm. (males, 307 mm.).....*maritimus*
    3. Total length of females averaging 300 mm., or more (males, 321 mm.).....*personatus*
  2. Hind foot of females averaging near 34 mm.....*megapotamus*

- 1<sup>1</sup>. Hind foot of females averaging 32 mm., or less (males 3 per cent longer, or less).
- 4. Claw on fifth digit narrow vertically, and short; nasals extend posteriorly beyond anterior projections of frontals; color fuscous.....*fuscus*
  - 4. Claw on fifth digit broad vertically, and "chunky" in appearance; nasals end on a plane with, or in front of, anterior extensions of frontals.
  - 5. Hind foot of females near 30 mm.; dorsal coloration grayish.....*minor*
  - 5. Hind foot of females averaging near 32 mm.; dorsal coloration dark grayish brown.....*fallax*

***Geomys personatus personatus* True**  
**Padre Island Pocket Gopher**

**Type locality.**—Padre Island, off the coast of southern Texas.

**Distribution.**—Herein restricted to Padre and Mustang islands.

**Diagnosis.**—Largest animals of the *Geomys personatus* group. Total length of females averages 303 mm., of males, 321; mean "volume" of skulls of females, 24,000 cu. mm., of males, 35,000 cu. mm.; hind foot of females averages 39 mm.; of males, 41 mm.

**Comparisons.**—Largest of the *Geomys personatus* group. Needs comparison only with *maritimus* and *megapotamus* from which it differs in greater total length, longer tail, larger hind foot, and larger skull.

**Records of occurrence.**—Specimens examined, 10, from **Nueces County**: Mustang Island, 19 mi. S W Port Aransas. Additional record (Merriam, 1895:142) Padre Island (central and northern parts).

***Geomys personatus maritimus*, New subspecies**  
**Seaside Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 608, Texas Cooperative Wildlife Collection; Flour Bluff, eleven miles southeast of Corpus Christi, Nueces County; collected April 21, 1938, by William B. Davis, original no. 3059.

**Distribution.**—Beach sands from Flour Bluff south probably as far as Baffin Bay in Kleberg County.

**Diagnosis.**—Next to *G. p. personatus*, the largest of the *personatus* group; hind foot in females averages 37 mm.; in males, 41 mm.; average "volume" of skull in females near 18,000 cu. mm.; in males, near 30,000 cu. mm.

**Comparisons.**—This race needs critical comparison only with *G. p. personatus* from Padre and Mustang islands from which it differs in being smaller (total length males 307 mm., as opposed to 321; females 276, as opposed to 303); average "volume" of skull in males about 30,000 cu. mm., as opposed to 35,000 cu. mm.; females 18,000 cu. mm., as opposed to 24,000 cu. mm.; interpterygoid space V-shaped, rather than U-shaped; hind foot of females smaller, 37 mm., as opposed to 39 mm.

**Remarks.**—Apparently the range of this race is restricted to the narrow belt of beach sand extending from Corpus Christi Bay south to Baffin Bay. Its range is separated from that of *fallax* by hard, tight, black clay that is inimical to the activities of pocket gophers at least eleven miles from

*fallax* and a much greater distance from *megapotamus*. The close similarity of *maritimus* to the island-inhabiting *personatus* and the dissimilarity of the two adjacent mainland forms, *maritimus* and *fallax*, suggests that in the not remote past Padre and Mustang islands were connected with the mainland. On the other hand, *fallax* appears to have been isolated for a much longer period than has either *personatus* or *maritimus*.

A study of 32 burrow systems of this race revealed that the gophers burrowed at an average depth of 19 (8-24) inches. Burrows of females averaged 93 (70-115) mm. in diameter; those of males, 108 (100-120) mm. On the lower end of Mustang Island, however, where the *G. p. personatus* gophers are actually larger than the *maritimus* gophers are on the mainland at Flour Bluff, the animals burrowed at an average depth of only 10 (7-14) inches, and the burrows averaged smaller in diameter, 86 mm. for females, 95 mm. for males.

This discrepancy of the general principle that in pocket gophers the diameter of the burrow is directly proportional to the size of the animal can be explained by considering the nature of the soil. At Flour Bluff the animals were burrowing in fairly dry, loose sand, hence the greater depth and diameter of the burrow. In sand of this nature the gophers must experience some difficulty in maintaining a burrow system. On Mustang Island, on the other hand, the elevation of the land is so low and the water table so high that the gophers are forced to burrow only a short distance below the surface to avoid having their tunnels flooded. They seemed to burrow just at or above the water table, for water was found in many of the burrows. Also, the sand in this area is moist, hence more cohesive, and the gophers experience little caving of the tunnels, even at this shallow depth.

**Records of occurrence.**—Specimens examined, 19, all from the type locality.

### ***Geomys personatus megapotamus*, New subspecies** **Rio Grande Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 794, Texas Cooperative Wildlife Collection; from four miles southeast of Oilton, Webb County, Texas; collected November 25, 1938, by William B. Davis, original no. 3254.

**Distribution.**—Sandy sections of the lower Rio Grande plains in Webb, Duval, Brooks, Jim Hogg, Starr, Zapata, Kenedy, La Salle, and Willacy counties.

**Diagnosis.**—A medium sized member of the *Geomys personatus* group, smaller than *personatus* from Padre Island, and *maritimus* from the mainland; larger than *fallax*, *fuscus*, and *minor*; hind foot averages near 34 mm.

**Comparisons.**—Differs from both *personatus* and *maritimus* by its smaller size; hind foot in females averages 34 mm. in *megapotamus*, as compared with 39 mm. in *personatus* and 37 mm. in *maritimus* (males are 37, 41, and 40 respectively); differs from *fuscus*, *minor*, and *fallax* in larger size (hind foot in females 34, as opposed to near 30 and 32).



**Remarks.**—Of the races of *personatus*, *megapotamus* occupies by far the most extensive range. It has no present day connection with any of the other named races of the group except *minor* since unfavorable clay and stony soils hem it in on all sides. For example, from Laredo to Corpus Christi, no gophers occur along the highway until the deep red Duval-Webb sands are encountered near Oilton. This sand continues from Oilton to Realitos in Duval County at which place a heavy, dark clay is encountered. From this point on to near the Nueces River, pocket gopher mounds no longer occur. Nor do pocket gophers occur in the delta region of the lower Rio Grande Valley where the soil is composed largely of a dark, heavy silt. The correlation between texture of the soil and the presence or absence of pocket gophers of this group is so striking that, with the aid of a reliable soils map, one can predict with considerable accuracy where gophers will be found.

Intergradation between *megapotamus* and *minor* can be expected to occur along the Nueces River, but as yet no specimens are available that show this. The specimens from west of Cotulla are typical of *megapotamus* in all respects.

**Records of occurrence.**—Specimens examined, forty-four, as follows: **La Salle County:** S side Nueces River, 6 mi. W Cotulla, 4. **Duval County:** 3.5 mi. S W Realitos, 2. **Webb County:** 4 mi. S E Oilton, 7. **Zapata County:** 6 mi. N W Zapata, 1 (Carnegie Mus.); 10 mi. N W Zapata, 5. **Jim Hogg County:** 1 mi. N E Hebbbronville, 1; Hebbbronville, 4 (Los Angeles Mus.); 3 mi. N Agua Nueva, 2. **Brooks County:** Falfurrias, 6 (Los Angeles Mus.); 3 mi. S Falfurrias, 3. **Starr County:** 1 mi. S W Santa Elena, 1. **Willacy County:** 1 mi. E San Perlita, 5; 16 mi. E San Perlita, 3. Additional records (Merriam 1895:142): **Willacy County:** Sauz Rancho (near Santa Monica). **Cameron County:** near Santa Rosa. **Zapata County:** Carrizo (=Zapata).

### ***Geomys personatus fallax* Merriam** **Nueces Pocket Gopher**

**Type locality.**—South side of Nueces Bay, Nueces County, Texas.

**Distribution.**—South side of Nueces Bay and along both sides of the Nueces River from Corpus Christi and Edroy northwestward at least as far as Three Rivers, Live Oak County.

**Diagnosis.**—A relatively small, dark colored race of the *personatus* group. Except for *fuscus*, *fallax* is the darkest colored race of the species. Hind foot of females averages 32 mm.; males, 33 mm.

**Comparisons.**—Differs from *personatus*, *maritimus* and *megapotamus* in darker coloration and much smaller size; *fallax* has about half the bulk of *personatus* and *maritimus*, two-thirds the bulk of *megapotamus*. Differs from *minor* in darker more melanistic coloration, less inflated tympanic bullae, and more nearly "square" zygomatic arches anteriorly. Differs from *fuscus* in slightly larger size (hind foot 32 mm. or more, rather than 30 mm.); larger auditory bullae; nasals terminate in front of the anterior extensions of frontals, rather than even with or posterior to same.

**Remarks.**—Although usually found in fine deep sand, *fallax* occurs in a dark, sandy clay loam soil at Calallen and again on the south side of Nueces Bay near Corpus Christi. This is true also at Three Rivers, George West, Mathis, and Edroy. In fact the only place where we were

able to take *fallax* in the lighter colored sands was at Sandia. Seemingly correlated with the dark, nearly black, soil the color of *fallax* is the most nearly melanistic of all the races of *personatus*. That of *fuscus* is darker, but tends toward reddish brown, rather than blackish brown.

Our specimens indicate that the Nueces River has not constituted a serious barrier to pocket gophers. In fact, *fallax* is found wherever suitable sandy soil occurs on either side of that river below the town of Three Rivers. North of Three Rivers along the Atascosa River, tributary to the Nueces, *fallax* is replaced by another species, *Geomys breviceps*.

**Records of occurrence.**—Specimens examined, forty-two, as follows: **Live Oak County:** 5 mi. S Three Rivers, 6: 1.5 mi. S George West, 2. **Bee County:** Beeville, 1 (U.S.N.M.). **San Patricio County:** 1 mi. S W Mathis, 4; 4 mi. S E Edroy, 9. **Jim Wells County:** Sandia, 4. **Nueces County:** S side Nueces Bay, 6 mi. W Corpus Christi, 2; Calallen, 6 (Los Angeles Mus.); 1 mi. E Calallen, 8; Corpus Christi, 4 (Mus. Comp. Zool.). Additional records (Merriam, 1895:145): **Nueces County:** Nueces River, 10 miles from mouth [about 4 mi. W Calallen]; Las Mottes [this town is not shown on available maps].

### ***Geomys personatus minor*, New subspecies Carrizo Springs Pocket Gopher**

**Type.**—Female, adult, skin and skull; no. 787, Texas Cooperative Wildlife Collection; from Carrizo Springs, Dimmit County, Texas; collected November 24, 1938, by William B. Davis, original no. 3239.

**Distribution.**—Known only from the type locality.

**Diagnosis.**—One of the smallest of the known races of *Geomys personatus*. Color similar to that of *G. p. personatus*, but slightly darker; ventral coloration largely plumbeous, with patches of white along the mid-line. Skull similar to *G. p. fallax*, but smaller; skulls of adult males not much larger than those of adult females of *fallax*.

**Comparisons.**—Differs from *fallax*, to which it seemingly is most closely allied, in smaller size and lighter color; nasals acute posteriorly, rather than broad and blunt; mastoidal bullae more swollen and projecting farther posteriorly. Differs from *fuscus* in grayish rather than fuscous coloration; claw of fifth digit of manus nearly twice as large; nasals terminate on a plane with anterior projections of frontals, rather than posterior to same; audital bullae larger. Needs no comparison with other members of the group, all of which are appreciably larger.

**Remarks.**—At Carrizo Springs pocket gophers were found only in the sandy bottoms along Carrizo Creek. The soil above the creek bottom is comparatively hard, heavy, and unfavorable to the presence of pocket gophers. Since Carrizo Creek is tributary to the Nueces River, along which *megapotamus* occurs, intergradation between *minor* and *megapotamus* might be expected to occur some place along that river. Apparently *minor* is completely isolated at present, but its relationship to *megapotamus* suggests an earlier connection or an emigration along the Nueces River. In this area pocket gophers appear to be restricted to the fluvial deposits along the water courses and to the deep Carrizo Sands.

**Specimens examined.**—Five (one in Los Angeles Mus.), all from the type locality.

**Geomys personatus fuscus, New subspecies**  
**Del Rio Pocket Gopher**

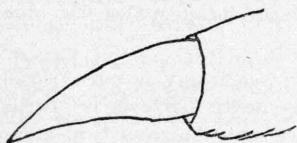
**Type.**—Female, adult, skin and skull; no. 12691/10985, American Museum of Natural History; Fort Clark [Brackettville], Kinney County, Texas; collected February 6, 1893, by Edgar A. Mearns, original no. 2274.

**Distribution.**—Along the water courses tributary to the Rio Grande in Val Verde and Kinney counties, Texas.

**Diagnosis.**—A small, fuscous colored *personatus* with a relatively small claw on the fifth digit of the manus; nasals extend posterior to anterior extensions of frontal processes.

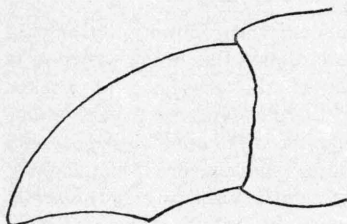
**Comparisons.**—Differs from all other known races of *personatus* in more fuscous coloration, smaller claw on fifth digit of manus, and relatively longer nasals. Differs from *personatus*, in much smaller size and darker coloration. Differs from *fallax* in actually and relatively longer nasals, narrower cranium and smaller audital bullae. Differs from *minor* in fuscous, rather than grayish brown, coloration and smaller audital bullae. Differs from *megapotamus* in smaller size (hind foot 30 mm., rather than 34 mm.); coloration fuscous, rather than grayish.

**Remarks.**—This race, like *minor* at Carrizo Springs, is isolated by regions of unfavorable soil from all the known races of *Geomys personatus*. Apparently the population reached the vicinity of Brackettville by emigrating in favorable years in fluvial soils along the Rio Grande and Las Moras Creek. Passage overland from the nearest known related population at Carrizo Springs is unlikely because of the rocky nature of the terrain. That this population has been isolated from the main center of distribution of the species for a considerable time is suggested by its many differences.



a

FIG. 6. Outline drawings of the claw on the fifth digit of the fore foot in (a) *Geomys personatus fuscus*, (b) *Geomys personatus minor*.



b



The specimens herein referred to this race have been referred by other workers, Bailey (1905), and Merriam (1895), to *Geomys texensis*, largely, I infer, on the basis of color. In cranial characters, however, these specimens are like *personatus*. That is, the length of the dorsal exposure of the jugal bone is longer than the distance between the two infraorbital openings, and the width of the rostrum is never greater than the greatest length of the basioccipital bone.

The reference of these pocket gophers to the *personatus* group rather than to *texensis* eliminates a difficulty encountered by Bailey and Merriam in explaining their geographical position in relation to that of *texensis*. Near Zapata, Zapata County, the sands inhabited by *personatus* extend along the creeks to the bank of the Rio Grande, hence, a pathway is open to their movement in favorable years along the narrow strip of fluvial deposits on the northeast bank of that river.

**Records of occurrence.**—Specimens examined, 6, as follows: **Kinney County:** Fort Clark (near Bracketville on Las Moras Creek), 4 (Amer. Mus.). **Val Verde County:** Rio Grande at Del Rio, 1; mouth of Sycamore Creek (boundary between Val Verde and Kinney counties), 1 (both in Biol. Surv. Coll.).

### GEOMYS LUTESCENS GROUP

In his revision of the pocket gophers, Merriam (1895:129) referred the *Geomys* of the plains of Texas to *Geomys lutescens*. Ten years later Bailey (1905:130), referred them to *Geomys breviceps llanensis*, which he described from Llano County, Texas, without stating reasons for transferring them to the species, *G. breviceps*.

Examination of topotypes and near topotypes of *G. lutescens*, and *G. breviceps*, convinces the writer that these two forms are specifically different. Comparison of *lutescens* with all the named races of *breviceps* reveals the following differences:

- | <i>lutescens</i>   |
|--|
| 1. Dorsal exposure of jugal longer than width of rostrum ventrad to infraorbital foramina. |
| 2. Hind foot usually more than 30 mm.  |

- | <i>breviceps</i>  |
|---|
| 1. Dorsal exposure of jugal shorter than width of rostrum ventrad to infraorbital foramina. |
| 2. Hind foot usually less than 30 mm.   |

The character of the jugal pointed out above as diagnostic of *breviceps* holds true in all the specimens of that species from Oklahoma, Louisiana, Texas, and Arkansas except for three specimens from Mer Rouge, Louisiana. Furthermore, it holds true for all available specimens of *texensis* (10), thus supporting the recommendation made earlier (Davis, 1938:488) that this hitherto supposed species be considered as one of the subspecies of *Geomys breviceps*.

All other *Geomys* occurring in Texas agree in having the dorsal exposure of the jugal longer than the width of the rostrum ventrad to the infraorbital openings. This indicates that *Geomys personatus*, *G. arenarius*, and *G. lutescens* might be more closely related to each other than either one is to *G. breviceps*. The race described by Bailey (1905) as *G. b. llanensis* differs from *breviceps* and agrees with *lutescens* in this character.

In other words, all the pocket gophers from the low coastal plains (less than 1,000 feet elevation) of Louisiana, Arkansas, Oklahoma, and Texas (except the Rio Grande plains which are occupied by *G. personatus*), agree among themselves and differ from the *Geomys* of the higher plains (except *texensis*) in the shorter length of the dorsolateral exposure of the jugal.

Study of the specimens assignable to *lutescens* reveals the presence of at least two geographic centers of differentiation in Texas, one of which, *llanensis*, appears to be completely isolated from the main range of the species. An account of this race and the description of one hitherto unrecognized race follow.

#### KEY TO THE GEOGRAPHIC RACES OF *GEOMYS LUTESCENS*

1. "Volume" of skull in females less than 13,000 cu. mm. (males less than 15,000 cu. mm.); auditory bullae small (distance from anteroventral edge of paroccipital process to hamulus of pterygoid in females 8 mm. or less)..... *llanensis*
- 1<sup>a</sup>. "Volume" of skull in females more than 13,000 cu. mm. (males more than 16,000 cu. mm.); auditory bullae large (distance from anteroventral edge of paroccipital process to hamulus of pterygoid in females more than 8 mm.)..... *major*

#### *Geomys lutescens llanensis* Bailey Llano Pocket Gopher

**Type locality.**—Llano, Llano County, Texas.

**Distribution.**—Restricted to the Central Basin of Texas.

**Diagnosis.**—A relatively small *lutescens* with dorsal outline of skull arched, small auditory bullae; alveolar length of maxillary tooth row less than 8 mm.

**Comparisons.**—See under account of *major*.

**Remarks.**—Examination of a soils map of Texas (Carter, 1931) reveals that the type locality of *llanensis* is on an island of Tishomingo-Pedernales soils which is surrounded by clay soils that apparently are uninhabited by *Geomys*. This would seem to indicate that *llanensis* is entirely restricted to the Central Basin of Texas and that it has no connection whatsoever with the *Geomys* of the lower plains country. Cranial characters substantiate this conclusion.

**Records of occurrence.**—Specimens examined, twenty-two, as follows: Llano County: Drier Creek, 7 mi. E Llano, 10; Oatman Creek, 3 mi. S Llano, 12.

#### *Geomys lutescens major*, New subspecies Plains Pocket Gopher

**Type.**—Female, adult, skin and skull; no. 819, Texas Cooperative Wildlife Collection; from eight miles west of Clarendon, Donley County, Texas; collected December 29, 1938, by Paul V. Jones, original no. 35.

**Distribution.**—The plains region of northwestern Texas, western Oklahoma, and eastern New Mexico.

**Diagnosis.**—Size large (see measurements). Color: Similar to *Geomys l. llanensis*; ventral coloration varying from whitish to nearly fuscous gray. Skull similar to *llanensis* but less arched; auditory bullae larger.

**Comparisons.**—Compared with *Geomys lutescens llanensis*: Larger; skull nearly flat-topped, rather than arched; auditory bullae larger, more inflated. Compared with *Geomys lutescens lutescens* (from Nebraska): Color much darker, that is more nearly liver brown; rostrum narrower.

**Remarks:**—Although available data indicate that the distribution of pocket gophers of the genus *Geomys* on the plains of northwestern Texas, western Oklahoma and eastern New Mexico is discontinuous, the constancy of cranial characters, particularly the relatively large auditory bullae and the nearly flat dorsal profile of the cranial part of the skull, seem to warrant grouping them as a single subspecies.

Variations, particularly in color, are present, however. Specimens from Woods County, Oklahoma, are brighter colored, that is more fuscous, than those from Texas; specimens from Briscoe County, Texas, are redder than those from the type locality. One specimen from Floyd County, Texas, is nearly fuscous. Two specimens from Hardeman County and seven from McLennan County, Texas, tend toward *breviceps* in the presence of a nearly black dorsal stripe.

**Records of occurrence.**—Specimens examined, one hundred-two, as follows: **NEW MEXICO.** **Guadalupe County:** Santa Rosa, 3 (Biol. Surv. Coll.). **Torrance County:** Mesa Jumanes (near Progresso), 1 (Biol. Surv. Coll.). **OKLAHOMA.** **Woodward County:** Woodward, 5 (Biol. Surv. Coll.). **Woods County:** Waynoka, 3 (Mus. Zool.); Alva, 1 (Biol. Surv. Coll.). **Comanche County:** Mt. Scott, 5 (Biol. Surv. Coll.); Lawton, 2 (Biol. Surv. Coll.). **Caddo County:** Apache, 3 (Biol. Surv. Coll.). **Oklahoma County:** Oklahoma City, 3 (Biol. Surv. Coll.). **Kay County:** Ponca Agency, 6 (Biol. Surv. Coll.). **TEXAS.** **Oldham County:** Tascosa, 5 (Biol. Surv. Coll.). **Hemphill County:** Canadian, 9 (5 in Biol. Surv. Coll.; 4 in Mus. Vert. Zool.). **Lipscomb County:** Lipscomb, 4 (Biol. Surv. Coll.). **Childress County:** Childress, 10 (Biol. Surv. Coll.). **Hardeman County:** 9 mi. S S W Chillicothe, 1; 3 mi. W Chillicothe, 1. **Donley County:** 1-11 mi. W Clarendon, 5. **Wilbarger County:** Vernon, 8 (Biol. Surv. Coll.). **Briscoe County:** 22 mi. E Tulia, 1 (Mus. Zool.); 6 mi. S Quitaque, 2 (Mus. Zool.). **Floyd County:** 6 mi. S and 9 mi. W Quitaque, 1 (Mus. Zool.). **Garza County:** 7 mi. W Post, 1 (Mus. Zool.). **Palo Pinto County:** Brazos, 2 (Biol. Surv. Coll.). **Mitchell County:** Colorado, 3 (Biol. Surv. Coll.). **Martin County:** Stanton, 9 (7 in Biol. Surv. Coll.). **Andrews County:** 14 mi. S Andrews, 1 (Mus. Zool.). **McLennan County:** 2 mi. S Waco, 1; 6 mi. S Waco, 6. **Ward County:** Monahans, 1 (Biol. Surv. Coll.).

## SUMMARY AND CONCLUSIONS

1. Four geographically varying species of *Geomys* occur west of the Mississippi River south of 37 degrees N latitude; these consist of twenty geographic races, ten of which are herein described as new.
2. The distribution of *Geomys* in the area studied is limited primarily by an edaphic factor—the presence of sandy soils. The heavy soils act as natural barriers.
3. Differentiation of geographic races is permitted by isolation effected either by heavy soils or rivers, or by the two in combination.
4. Meandering streams and rivers flowing through sandy soils are not effective barriers to pocket gophers in this region.

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Table 1. Average and extreme measurements, in millimeters, of adults in six races of *Geomys personatus* from the type localities

Race	Number Averaged and Sex	Total Length	Length of Tail	Length of Hindfoot	Basilar length of Hensel	Zygomatic Breadth	Mastoidal Breadth	Length of Nasals	Alveolar length of Maxillary Tooth Row	Palato-frontal Depth
personatus.....	2♀	303 (301-305)	103 (97-109)	39 (39-39)	45.1 (44.1-46.1)	31.9 (30.5-33.3)	29.8 (29.0-30.6)	19.2 (18.4-20.0)	11.0 (11.0-11.0)	19.5 (18.9-20.1)
maritimus.....	5♀	276 (260-285)	84 (75-93)	37.4 (36-39)	41.6 (40.3-42.7)	30.2 (28.4-32.4)	28.5 (26.8-30.0)	17.4 (16.7-18.7)	10.3 (10.0-10.6)	18.8 (17.6-19.4)
megapotamus.....	3♀	247 (241-250)	66 (59-67)	34 (31-35)	38.2 (37.6-38.9)	27.6 (27.0-28.6)	25.9 (25.7-26.2)	15.3 (15.1-15.5)	9.7 (9.7-9.7)	17.0 (16.6-17.4)
fallax.....	5♀	246 (235-258)	75 (68-80)	32 (31-33)	37.6 (37.0-38.0)	26.5 (26.1-26.9)	25.2 (25.1-25.7)	15.1 (14.4-15.6)	9.4 (9.1-9.6)	16.6 (16.2-17.0)
minor.....	1♀	225	75	30	31.8	22.5	21.6	12.8	8.8	14.0
fuscus.....	1♀	229	68	30	33.7	22.4	21.1	14.9	8.2	14.0
personatus.....	5♂	321 (310-326)	110 (93-121)	41 (39-42)	48.0 (46.4-49.7)	35.1 (33.2-37.5)	32.0 (30.3-33.4)	20.4 (19.6-22.0)	11.4 (10.5-12.0)	20.5 (19.7-21.0)
maritimus.....	3♂	307 (300-310)	95 (87-100)	40.7 (40-41)	46.5 (45.2-48.7)	32.9 (31.1-35.0)	30.6 (28.5-31.7)	19.9 (19.2-21.2)	11.4 (10.2-12.1)	20.4 (19.3-21.6)
megapotamus.....	2♂	291 (271-310)	86 (78-94)	37 (34-40)	44.2 (42.6-45.9)	32.1 (30.8-33.5)	30.5 (29.3-31.7)	18.6 (17.7-19.5)	10.4 (9.8-11.1)	19.2 (18.8-20.1)
fallax.....	5♂	269 (257-282)	87 (82-93)	33 (32-35)	42.5 (41.9-43.5)	31.0 (29.5-32.1)	28.6 (28.1-29.5)	17.6 (17.1-18.4)	9.6 (9.2-10.1)	17.9 (17.6-18.3)
minor.....	3♂	252 (248-259)	75 (74-75)	32 (31-33)	37.4 (35.8-38.4)	26.4 (25.4-27.4)	24.8 (24.1-25.3)	15.5 (14.8-16.3)	9.6 (9.3-9.8)	15.9 (15.5-16.2)
fuscus.....	1♂	250	72	30	37.4	26.6	24.8	16.6	7.9	16.2

Table 2. Average and extreme measurements, in millimeters, of adult females from near the type localities in ten races of *Geomys breviceps*

Race	Number Averaged	Total Length	Length of Tail	Length of Hindfoot	Basilar length of Hensel	Zygomatic Breadth	Mastoidal Breadth	Length of Nasals	Alveolar length of Maxillary Tooth Row	Palato-frontal Depth
breviceps.....	10	213 (198-226)	58 (53-64)	26 (25-27)	33.7 (31.9-36.2)	23.9 (21.5-25.5)	22.2 (20.3-22.8)	13.1 (11.3-14.3)	8.3 (7.9-8.9)	14.6 (13.2-15.4)
dutcheri.....	9	209 (192-223)	62 (58-66)	26 (25-28)	31.5 (30.3-32.6)	22.7 (21.9-23.5)	20.9 (20.2-21.6)	12.9 (12.0-14.2)	8.1 (7.8-8.9)	14.3 (13.8-14.7)
frazensis.....	5	205 (192-216)	62 (55-73)	25 (24-27)	31.5 (29.6-32.4)	23.8 (22.2-24.8)	21.6 (20.5-23.4)	12.0 (11.4-12.6)	8.2 (7.8-8.3)	13.9 (13.3-14.4)
saxittalis.....	5	205 (200-210)	62 (54-67)	24 (23-25)	31.5 (30.5-32.5)	22.9 (22.0-23.5)	21.2 (20.0-21.6)	12.6 (12.4-13.3)	8.1 (7.3-8.8)	14.4 (13.9-14.8)
terricolus.....	3	221 (223-222)	61 (60-63)	27 (25-28)	34.1 (32.9-35.1)	25.0 (23.8-25.9)	22.9 (22.5-23.4)	12.9 (13.5-14.3)	8.7 (8.2-9.4)	15.0 (14.7-15.3)
pratincolus.....	5	200 (187-208)	60 (52-67)	26 (25-27)	30.9 (30.4-31.7)	23.2 (23.0-24.1)	20.7 (20.3-21.3)	11.7 (10.5-12.5)	7.7 (7.4-8.0)	14.0 (13.8-14.5)
attwateri.....	7	231 (222-235)	63 (60-66)	27 (25-28)	35.2 (34.8-36.3)	25.6 (24.7-26.5)	23.4 (22.7-23.6)	14.4 (13.7-14.9)	9.0 (8.5-9.3)	15.8 (15.1-16.2)
ammophilus.....	3	202 (192-210)	62 (51-70)	26 (25-28)	31.7 (30.0-32.6)	22.6 (21.1-23.8)	21.1 (20.4-21.5)	12.3 (11.4-13.0)	8.3 (7.7-8.6)	14.0 (13.3-14.5)
texensis.....	8	222 (213-230)	62 (58-70)	29.5 (29-30)	30.6 (30.0-32.0)	21.1 (20.2-22.5)	19.3 (18.5-20.7)	11.0 (10.3-11.8)	6.1 (5.7-6.4)	12.4 (12.0-12.7)
ludemani.....	6	202 (190-209)	60 (55-64)	26 (25-27)	32.5 (30.3-33.6)	24.2 (22.7-25.8)	21.7 (20.6-22.6)	13.2 (12.3-14.4)	8.3 (7.8-8.6)	14.6 (13.6-15.1)

Table 3. Average and extreme measurements, in millimeters, of adult males from near the type localities in ten races of *Geomys breviceps*

Race	Number Averaged	Total Length	Length of Tail	Length of Hindfoot	Basilar length of Hensel	Zygomatic Breadth	Mastoidal Breadth	Length of Nasals	Alveolar length of Maxillary Tooth Row	Palato-frontal Depth
breviceps.....	6	232 (220-254)	68 (64-71)	28.1 (28-31)	37.2 (34.5-41.3)	27.1 (25.3-28.7)	23.9 (23.0-25.2)	15.1 (14.1-16.9)	8.7 (8.5-8.9)	15.8 (15.3-17.0)
dutcheri.....	5	235 (225-251)	67 (63-74)	28 (27-29)	36.1 (35.0-38.2)	26.9 (25.0-29.2)	23.6 (23.1-24.7)	16.3 (15.3-17.8)	9.0 (8.6-9.3)	15.8 (15.0-16.8)
brazensis.....	5	234 (228-243)	64 (60-70)	29 (28-30)	36.0 (35.0-37.2)	26.9 (26.2-27.5)	23.7 (22.9-24.6)	15.1 (14.0-16.5)	8.7 (7.8-9.5)	15.7 (14.9-16.7)
sagittalis.....	1	220	66	26	33.9	26.0	22.9	13.3	8.6	15.2
terricolus.....	2	239 (233-245)	65 (64-66)	29 (29-29)	38.0 (36.9-39.1)	28.3 (27.5-29.1)	24.5 (24.0-24.9)	15.9 (15.3-16.4)	8.8 (8.5-9.0)	16.5 (16.5-16.5)
pratincolus.....	3	229 (217-237)	70 (66-73)	29 (28-30)	36.0 (34.5-36.7)	27.8 (26.7-29.3)	23.4 (22.3-24.3)	14.4 (14.3-14.4)	8.2 (7.6-8.5)	15.8 (15.2-16.4)
attwateri.....	6	245 (233-260)	72 (65-79)	30.5 (29-32)	38.2 (35.1-40.0)	28.2 (24.5-29.9)	25.2 (23.6-27.7)	16.5 (14.4-17.7)	9.4 (8.8-9.9)	16.7 (15.6-17.5)
ammophilus.....	2	225 (220-230)	62 (57-66)	28 (27.5-28)	35.6 (34.6-36.5)	26.8 (26.7-26.8)	24.1 (23.7-24.5)	15.4 (15.3-15.5)	8.6 (8.2-9.0)	15.6 (14.8-16.3)
texensis.....	7	258 (250-272)	72 (63-80)	33 (31-35)	36.4 (34.8-38.0)	25.7 (24.4-27.5)	22.5 (21.8-23.5)	14.5 (13.1-15.8)	6.8 (6.3-7.5)	14.4 (13.7-15.2)
ludemani.....	1	226	70	30	37.7	29.6	24.5	16.2	8.5	16.0

Table 4. Average and extreme measurements, in millimeters, of two races each of *Geomys lutescens* and *Geomys arenarius*

Race	Number Averaged and Sex	Total Length	Length of Tail	Length of Hindfoot	Basilar length of Hensel	Zygomatic Breadth	Mastoidal Breadth	Length of Nasals	Alveolar length of Maxillary Tooth Row	Palato-frontal Depth
major.....	6 ♀	236 (229-240)	65 (54-75)	31 (29.5-32)	35.8 (33.6-37.0)	25.6 (24.0-26.6)	23.9 (21.7-25.0)	14.6 (13.4-15.5)	8.1 (7.3-8.6)	15.8 (15.2-16.3)
llanensis.....	9 ♀	232 (224-240)	62 (58-66)	29.5 (29-30)	33.0 (32.0-34.4)	23.2 (22.5-24.0)	21.2 (20.6-21.6)	13.5 (12.4-14.4)	7.2 (6.9-7.6)	14.6 (14.0-15.3)
major.....	5 ♂	256 (239-266)	78 (66-90)	30 *(29-31)	38.4 (36.6-40.5)	30.1 (28.5-32.5)	27.8 (26.6-30.0)	16.8 (16.2-17.8)	9.2 (8.3-9.9)	16.8 (16.1-18.0)
llanensis.....	8 ♂	254 (248-264)	70 (64-75)	31.5 (30-33)	36.9 (35.8-38.7)	27.4 (25.5-28.5)	23.6 (22.6-24.5)	16.1 (15.4-17.0)	7.5 (7.0-8.1)	15.8 (15.2-16.5)

<i>Geomys arenarius</i>										
arenarius.....	5 ♀	247 (239-254)	78 (73-84)	32 (31-34)	35.6 (34.5-37.3)	25.1 (24.3-26.5)	23.5 (22.8-24.2)	15.2 (14.1-16.5)	8.1 (7.6-8.5)	15.4 (15.1-16.0)
brevirostris.....	4 ♀	234 (227-247)	73 (60-80)	29 (27-32)	32.3 (30.2-34.9)	23.5 (21.9-25.0)	22.4 (20.8-24.0)	12.7 (11.6-14.1)	7.6 (7.3-7.8)	15.1 (14.6-16.0)
arenarius.....	3 ♂	262 (250-280)	82 (74-95)	33 (32-34)	37.2 (35.9-38.4)	26.7 (25.3-27.4)	24.9 (23.2-26.0)	16.2 (15.9-16.7)	8.6 (8.3-9.0)	15.7 (15.0-16.4)
brevirostris.....	4 ♂	252 (244-260)	77 (74-80)	31 (30-32)	35.8 (34.1-37.1)	25.9 (24.2-27.2)	24.2 (23.5-25.0)	15.0 (13.7-16.1)	7.9 (7.6-8.1)	16.0 (15.5-16.5)

\*Hindfoot of males from Stanton, Texas, measure up to 34 mm.