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Perognathus merriami.

By Troy L. Best and Marian P. Skupski

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Perognathus merriami J. A. Allen, 1892

Merriam's Pocket Mouse

Perognathus merriami J. A. Allen, 1892:45. Type locality "Brownsville [Cameron Co.—Elliot, 1905:302], Texas."

Perognathus mearnsi J. A. Allen, 1896*b*:237. Type locality "Watson's Ranch, 15 miles southwest of San Antonio [Bexar Co.—Miller, 1912:261], Texas."

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciurognathi, Superfamily Geomyoidea, Family Heteromyidae, Subfamily Perognathinae, Genus *Perognathus*. There are nine species of *Perognathus* (Best, 1994; Williams et al., 1993). Two subspecies of *P. merriami* are recognized (Hall, 1981; Lee and Engstrom, 1991):

P. m. gilvus Osgood, 1900:22. Type locality "Eddy [now Carlsbad, Eddy Co.—Bailey, 1931:279], N. Mex."

P. m. merriami J. A. Allen, 1892:45, see above (*mearnsi* J. A. Allen is a synonym).

DIAGNOSIS. The ranges of *P. merriami* and *P. flavus* overlap in southeastern New Mexico and western Texas (Bailey, 1905; Osgood, 1900). *P. merriami* (Fig. 1) resembles *P. flavus* more than any other species of *Perognathus*; these taxa may hybridize at a few localities. Compared with *P. flavus*, *P. merriami* has: shorter and coarser pelage; paler, less-contrasting mid-dorsal color with a yellowish or yellowish-orange rather than pinkish hue; smaller postauricular spots; smaller, less-inflated auditory bullae; greater interorbital and interparietal widths; narrower P4 (Williams et al., 1993); greater nasal projection and nasal length; lesser transdental width; greater translacrimal width; shorter ears; greater length of head and body, length of tail, and length of hind foot. Relative to greatest length of skull, *P. merriami* has shorter maxillary toothrows and bullae, longer and more projecting nasals, lesser transdental width, and greater interorbital breadth (Anderson, 1972). No single set of characters will distinguish all *P. merriami* from all *P. flavus*. Comparisons of individuals from areas of sympatry show *P. m. gilvus* and *P. f. flavus*, respectively, to average: ratio of bullar length to occipitonasal length, 0.359, 0.388; ratio of length of tail to total length, 0.488, 0.452; distance across mastoid bullae, 11.44, 11.93 mm; width of P4, 0.82, 0.90 mm (Williams et al., 1993).

In part of its range, *P. merriami* is sympatric with *P. flavescens*. The general shape of the skull of *P. merriami* (Fig. 2) is similar to that of *P. flavescens*, but it is more angular and smaller. The rostrum of *P. merriami* is much heavier, the maxillary branches of the zygomatic arches often are squarely bent, the zygomatic arches are nearly parallel, and the interparietal is more nearly quadrate than in *P. flavescens* (but much wider than in *P. flavus*). Compared with *P. flavescens*, *P. merriami* is smaller, has a shorter tail, the interparietals are not as wide (Williams et al., 1993), it has shorter bullae, narrower palate, lesser transdental breadth, lesser occipitobullar, occipitomaxillary, and occipitonasal lengths, and lesser translacrimal breadth and dorsal transbullar breadth of skull. Relative to greatest length of skull, *P. merriami* has shorter bullae, lesser palatal width, lesser transdental width, lesser occipitobullar length, and lesser occipitomaxillary length than *P. flavescens* (Anderson, 1972).

GENERAL CHARACTERS. Merriam's pocket mouse is a small, silky-haired pocket mouse (Davis, 1974). The pelage is smooth (Schmidly, 1983), and when pressed down it almost appears oily (Dalquest and Horner, 1984). The dorsal color is yellowish or yellowish-orange, with a slight blackish tinge (Williams et al., 1993) produced by black tips on the longer hairs (Dalquest and Horner, 1984). There is little contrast between mid-dorsal and dorsolateral areas (Williams et al., 1993). Ventrally, including forelegs and feet, pelage usually is white to the base of the hairs (Merriam, 1889), but may be a rich creamy color (Dalquest and Horner, 1984). The ears have a white spot on the interior margin (Merriam, 1889). The buffy postauricular spot is small (Williams et al., 1993) and the subauricular spot is white (Davis, 1974). There is a pale ring around each eye (Merriam, 1889); the tail is darker above than below (Davis, 1974). The transverse nose stripes are prominent and black. The color of *P. m. gilvus* is paler, more yellowish, and the pelage is softer than in *P. m. merriami* (Osgood, 1900). At Black Gap, Brewster Co., Texas, *P. merriami* from areas with lava rock did not appear darker than those from pale limestone soils (Tamsitt, 1954).

In southern Texas, *P. merriami* is small and dark. In western Texas, Merriam's pocket mouse is moderate in size and long-tailed with large auditory bullae, large mastoids, and is pale. In northern Texas, *P. merriami* is large-bodied, short-tailed, has a large interparietal, and is moderately pale. Generally, variation among distant populations is greater than among populations in closer proximity (Al-Uthman, 1952).

Average measurements (in mm), ratios, and color of *P. m. gilvus* and *P. m. merriami*, respectively, are: total length, 116.43, 113.93; length of tail, 56.83, 55.77; length of hind foot, 16.67, 16.07; ratio of length of tail to total length, 0.49, 0.49; ratio of length of hind foot to total length, 0.14, 0.14; occipitonasal length, 20.40, 20.14; frontonasal length, 13.72, 13.70; nasal length, 7.38, 7.34; length of maxillary toothrow, 3.06, 2.99; mastoid breadth, 11.44, 11.28; width of interparietal, 3.32, 3.53; length of interparietal, 2.49, 2.47; bullar length, 7.32, 7.12; least interorbital constriction, 4.71, 4.61; ratio of nasal length to occipitonasal length, 0.36, 0.36; ratio of mastoid breadth to occipitonasal length, 0.56, 0.56; ratio of bullar length to occipitonasal length, 0.36, 0.35; ratio of length of maxillary toothrow to occipitonasal length, 0.15, 0.15; ratio of interparietal width to mastoid breadth, 0.29, 0.31; background color (color of dorsal underfur scored from 1—pale pinkish to 5—bright yellowish-orange), 3.21, 4.19; postauricular patch (degree of development of postauricular patches scored from 1—none to 5—large), 2.76, 2.05; lateral line (degree of development of lateral line scored from 1—indistinct to 3—distinct), 1.50, 2.42; dorsal black (color of dorsal guard hairs scored from 1—pale to 5—dark), 2.93, 3.63; silkiness (softness of pelage scored from 2—silky to 4—harsh), 2.79, 3.56 (Wilson, 1973). Mass is 7–9 g in Texas (Davis, 1974; Davis and Robertson, 1944), 7–10 g in Tamaulipas (Alvarez, 1963), and 7.3 g (range, 6.2–7.9) for males and

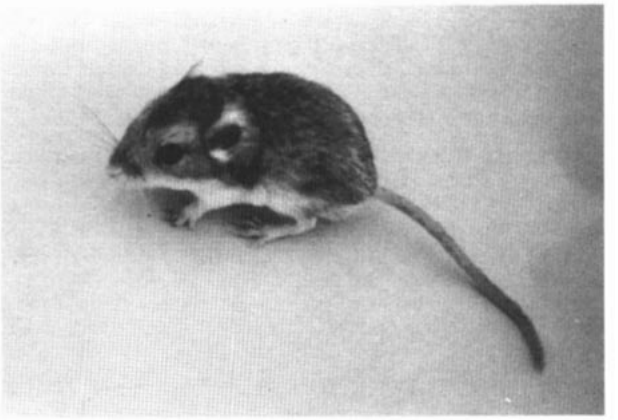

FIG. 1. A *Perognathus merriami gilvus* from San Angelo, Tom Green Co., Texas. Photograph courtesy of T. E. Lee, Jr.

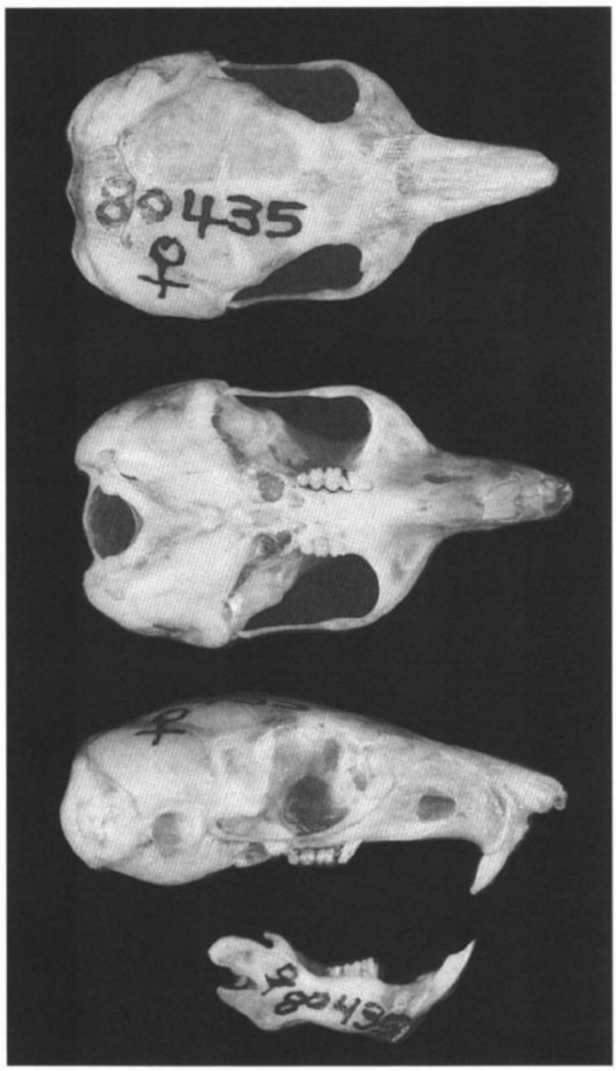

FIG. 2. Dorsal, ventral, and lateral views of the cranium and lateral view of the mandible of *Perognathus m. merriami* from Del Rio, Val Verde Co., Texas (female, University of Kansas Museum of Natural History 80435). Greatest length of cranium is 19.9 mm. Photographs by T. H. Henry.

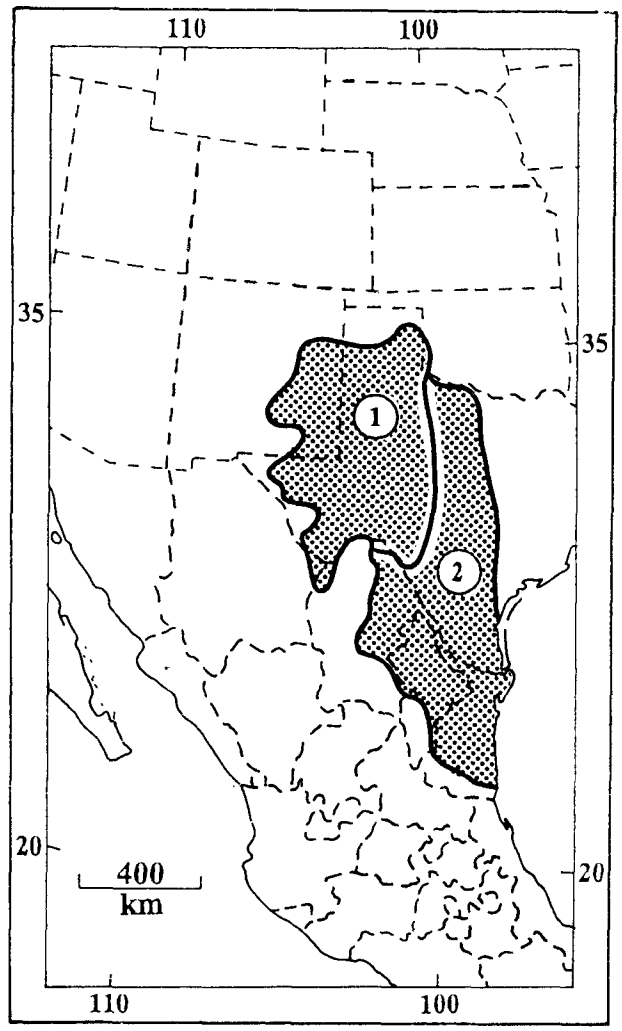

FIG. 3. Distribution of *Perognathus merriami* in central North America (modified from Hall, 1981): 1, *P. m. gilvus*; 2, *P. m. merriami*.

6.4 g (range, 5.6–7.6) for nonpregnant females in Coahuila (Baker, 1956).

DISTRIBUTION. Merriam's pocket mouse occupies the subtropical region of southern Texas and northeastern Mexico, and the lower Sonoran life zone of westcentral Texas and southeastern New Mexico (Miller, 1912). Its range (Fig. 3) extends from northern New Mexico, western Oklahoma, and Texas southward through Tamaulipas (Hall, 1981). Populations in Coahuila are separated by the Sierra del Carmen-Sierra Madre Oriental Axis (Baker, 1956).

FOSSIL RECORD. The genus *Perognathus* is known from the Miocene (Wood, 1935). Remains of *P. merriami* have been recovered from Pleistocene sediments in Texas: Fowlkes Cave, Culberson Co. (Dalquest and Stangl, 1986); Schulze Cave, Edwards Co. (Dalquest et al., 1969); near Saint Jo, Montague Co. (Dalquest and Hibbard, 1965); Groesbeck Creek, Hardeman Co. (Dalquest, 1965); Lake Kickapoo, Archer Co. (Kitchens, 1988); Longhorn Cavern, Burnet Co. (Semken, 1961); and New Mexico: Muskox Cave, Eddy Co. (Logan, 1981; listed as *P. flavus* by Harris, 1985).

FORM AND FUNCTION. Hair of the dorsum is short (average is 5.4 mm in length; range, 5.2–5.5) and the narrowest (range, 0.020–0.040 mm in width) of the genus. The base of dorsal guard hairs usually is curved, the shaft is not distinct from the base, and the tip tapers rather abruptly. The hair is oval in cross section, but more rounded than in *P. flavescens*. The medulla has three oval to round cells in irregular rows (Homan and Genoways, 1978).

Merriam's pocket mouse retains winter pelage through spring and summer, which in June and early July often becomes so worn that the plumbeous bases of hairs are exposed. In late July and August, summer molt takes place; this is the only annual molt. New hair comes in rapidly and evenly, progressing from the head backward until completed; this bright pelage is most evident in September and October (Osgood, 1900). *P. merriami* does not have a distinct dorsal molt line until after the head region has molted (Porter, 1962). Because the pelage is not as worn, late autumn and winter pelage appears heavier, softer, and paler than summer pelage. Thus, changes after the one annual molt are the result of wear (Osgood, 1900).

The ears are small, orbicular (Osgood, 1900), and there is no antitragal lobe (Merriam, 1889). The hind foot is 27% of length of head and body (Hatt, 1932), and the proximal one-half of the sole of the hind foot is haired (Osgood, 1900). The tail is unhaired at the tip (Hatt, 1932), scantily haired elsewhere (Osgood, 1900), and is not crested or penicillate (Merriam, 1889). Length of head and body seldom is >62 mm, and the ratio of length of tail to length of head and body averages 0.82–0.95 (Williams et al., 1993). Males are larger than females in length of body (Porter, 1962).

As in all *Perognathus*, the dental formula is i 1/1, c 0/0, p 1/1, m 3/3, total 20 (Hall, 1981). The first lower molar is largest and the second and third are successively smaller (Merriam, 1889). The front of the lower incisors is smooth (Schmidly, 1983), but the upper incisors are grooved medially.

The skull is small (Merriam, 1889), and the mastoids reach the dorsal surface of the cranium, scarcely compress the interpa-

rietal, and project posterior to the occipital (Webster, 1968). The transverse interparietal dimension is less than interorbital breadth and the bullae meet or nearly meet anteroventrally (Anderson, 1972). The interparietal is small with the anterior angles rounded. The auditory bullae meet below the basisphenoid. The mastoid border of the parietal is the longest (Merriam, 1889), and there is a long lateral process extending from the parietal to a point between the squamosal and mastoid (Wood, 1935). The rostrum is proportionately broad and short (Williams et al., 1993).

The middle ear has the following dimensions (in mm unless otherwise indicated): volume, 0.06 cm^3; relative volume, 0.22 cm^3; diameter of tympanic membrane, 2.81; length of stapes footplate, 0.64; width of stapes footplate, 0.35; length of malleus, 1.65; length of incus, 0.61 (Webster and Webster, 1975). The cochlea forms a prominent bulge in the roof of the hypotympanic portion of the middle-ear cavity. The bony walls encapsulating the cochlea are so thin that each of its turns is discernible. The cochlea has three turns, is broad and squat, and has a tapering apex. The organ of Corti and the basilar membrane extend into the vestibule. The scala vestibuli is thus part of the vestibule at the beginning of the basal turn. The basal end of the basilar membrane lies near the round-window membrane; the cross-sectional area of the scala tympani at this point is small. The scala tympani narrows to 0.026 mm^2 by the beginning of the second turn and to 0.013 mm^2 at the beginning of the third turn, then dilates to 0.023 mm^2 at the apex. The helicotrema, connecting scala vestibuli and scala tympani, extends less than one-quarter turn and has an area of 0.009 mm^2. Cross-sectional area of the scala media decreases 1.4-fold for the first half-turn to the apex. The basilar membrane has a thin zona tecta in all turns. Its zona pectinata extends from the outer pillar to the spiral ligament and contains a large hyaline mass enclosed by basilar membrane fibers passing above and below it. The basilar membrane is narrowest at the beginning of the basal turn, measuring ca. 100 μm from osseous spiral lamina to spiral ligament. Width of the basilar membrane increases and reaches its maximum of ca. 150 μm at the end of the first turn and decreases in the upper two turns (Webster and Webster, 1980).

The sebaceous caudal glands are small and unmodified. The paired or bilobate sebaceous glands opening into each hair follicle are relatively small (Quay, 1965).

Perognathus merriami becomes torpid at air temperatures <10°C (Cade, 1964). Upon exposure to a cold night, it goes into torpor. When captured in traps on a cold night, Merriam's pocket mouse may appear dead in the morning, but when warmed it will soon recover (Allen, 1896*a*). *P. merriami* becomes less active and is dormant at times during winter when weather conditions are harsh (Porter, 1962; Schmidly, 1983); it may (Porter, 1962) or may not (Bailey, 1905) hibernate in Texas.

Merriam's pocket mouse does not drink water (Dalquest and Horner, 1984), but it derives water from vegetation and insects it eats. *P. merriami* excretes a concentrated urine and survives without access to surface moisture (Schmidly, 1983).

A *P. merriami* entered a puddle of water ca. 3 m in diameter and swam for a distance of ca. 1.2 m. It entered voluntarily and swam relatively high in the water (Davis, 1942). Swimming is characterized by vigorous leg action and a rapid, jerking motion of the body. When in water, Merriam's pocket mouse lacks smooth coordination between front and hind limbs, but is able to float for extended periods. Average duration of swimming is 94 s (range, 56–158), but *P. merriami* is not as adept a swimmer as *P. flavus* (Schmidly and Packard, 1967). Narrow permanent streams probably do not constitute physical barriers to movements of this pocket mouse (Davis, 1942).

The basal end of the baculum is large. From the base, the shaft arches upward, then downward and up again at the tip. Average and range of measurements (in mm) are: total length, 5.7 (5.2–6.1); height of base, 0.9 (0.8–1.0—Burt, 1960).

ONTOGENY AND REPRODUCTION. The small size of *P. merriami* precludes using perforate vaginae or vaginal plugs to assess reproductive activity (Chapman and Packard, 1974). In Texas, the breeding season appears to extend from April to November (Davis, 1974), but not into winter months (Chapman and Packard, 1974); two nursing young were present on 18 May (Allen, 1896*a*). In Coahuila, a female had four embryos on 12 June, and nonpregnant females were present in March and April (Baker, 1956).

In Texas, each litter contains three to six young (Davis, 1974). There usually are three or four young born in late spring, and more than one litter may be born in a summer (Dalquest and Horner, 1984). One female caught in June and again in September was pregnant both times; she was lactating in July (Chapman and Packard, 1974).

Young Merriam's pocket mice that were 70% of adult size were present in western Texas on 26 July (Davis and Robertson, 1944), and others were recorded in June and late November (Davis, 1974). Young that are <50% grown may be captured in traps baited with oatmeal or nut meats (Dalquest and Horner, 1984).

Young are markedly different from adults (Allen, 1896*b*). Juvenile pelage is characterized by a soft, silky texture, and absence of the black-tipped dorsal hairs of adults (Chapman and Packard, 1974). Nursing young are dusky gray to grayish brown with varying amounts of black. The ear spot is pale buff to pale fulvous, the eye ring is bright buff to pale fulvous, and there is a narrow, sharply defined lateral line that is bright ochraceous. The ventral surface is white and the tail is darker than in adults. Two-thirds grown young are similar, but paler and more grayish above (Allen, 1896*a*, 1896*b*; Davis, 1974).

Juvenile males that molt into adult pelage may be capable of reproducing before reaching adult mass. Although these males have spermatozoa, no juvenile females become pregnant or have placental scars (Porter, 1962).

In the Big Bend region, annual population turnover was 84%. In the Black Gap area, turnover was 75% (Davis, 1974). In captivity, Merriam's pocket mice have lived 4 years on a diet of seeds and no water (Allen, 1898). In nature, maximum life span is 22–33 months (Davis, 1974).

ECOLOGY. Merriam's pocket mouse shows no preference for soil type and occurs on soils ranging from compact clays and caliche to deep sands (Blair, 1952). In Oklahoma, it occurs in barren and eroded situations (Martin and Preston, 1970). In Texas, *P. merriami* is present in semi-sandy habitats (Davis and Robertson, 1944), sandy dunes, rocky hillsides (Dalquest and Stangl, 1986), and sandy or gravelly soil (Dalquest and Horner, 1984). It appears not to inhabit river bottoms or sandy washes that are subject to flooding (Judd, 1967). Merriam's pocket mouse can be found along ridges of earth left when bulldozers scrape the earth of mesquite (*Prosopis*) pastures for firebreaks (Dalquest and Horner, 1984), and on cultivated lands, particularly fallow fields. It often is turned up by plows in spring and summer (Allen, 1896*a*). *P. merriami* also occurs in the creosotebush–lechuguilla–prickly pear (*Larrea–Agave–Opuntia*) association where igneous pebbles form desert pavement. In Texas, rocky soils do not seem to be barriers (Judd, 1967), but heavy rocky soils are barriers to this species in Coahuila (Baker, 1956). In the Big Bend region, steep slopes do not restrict distribution or abundance, providing other aspects of its habitat are suitable. Merriam's pocket mouse is most abundant on slopes with a gradient of 5–10%. Here it reaches its maximum abundance on deep soils containing clays (sandy clay loams). *P. merriami* often is found on desert-pavement soils containing at least 50% rocks by weight; rocks rarely are ≥7.5 cm in diameter (Porter, 1962).

Perognathus merriami occurs in shortgrass prairies and desert scrubland over most of its range (Dalquest and Horner, 1984), and it is most common in open and arid brushlands (Blair, 1952). In Texas, upper distributional limits are imposed by pine–oak–juniper (*Pinus–Quercus–Juniperus*) woodlands (Porter, 1962), but Merriam's pocket mouse is present on upland slopes, floodplains, rocky canyons, lava, and cliffs (Tamsitt, 1954). It is found most abundantly in areas where plant density is intermediate, if understory plants are <30–50 cm in height. Height of groundcover is important; tall, dense groundcover seems to restrict its movements, whereas short groundcover (≤15 cm) does not (Porter, 1962). In northern Texas, *P. merriami* occurs in a variety of habitats, but is most common in well-grazed or overgrazed pastures with mesquite; one was observed on a close-cropped lawn of a golf course (Dalquest and Horner, 1984). In New Mexico, Merriam's pocket mouse inhabits low stony mesas, open prairie, and areas with low mesquite bushes at edges of valleys (Bailey, 1931). In Tamaulipas, it occurs in semi-arid habitats with mesquite and grasses, and is abundant in open fields surrounded by brush (Alvarez, 1963). In Coahuila, *P. merriami* lives in deep sand along the Río Grande, on and adjacent to fallow, formerly irrigated, fields, in grass among clumps of prickly pear and mesquite, and along mesquite-bordered arroyos (Baker, 1956).

Perognathus merriami also occurs in habitats containing ju-

niper savannah, creosotebush (*Larrea tridentata*), salt cedar (*Tamarix gallica*), and walnut-desert willow (*Juglans rupestris-Chilopsis linearis*) associations (Hermann, 1950). Depending upon geographic area, plants in its habitat include tarbush (*Flourensia cernua*), mariola (*Parthenium incanum*), fluff grass (*Tridens pulchellus*), lechuguilla (*Agave lechuguilla*—Porter, 1962), catclaw (*Acacia greggii*), tabosagrass (*Hilaria mutica*), narrow-leafed yucca (*Yucca elata*), tassajillo (*Opuntia leptocaulis*), allthorn (*Koberlinia spinosa*), barberry (*Berberis trifoliolata*), small-leaved sumac (*Schmaltzia microphylla*), black grama (*Bouteloua eriopoda*—York, 1949), broomweed (*Xanthocephalum texanum*), greenbrier (*Smilax*—Blair, 1954), ocotillo (*Fouquieria splendens*), sotol (*Dasylirion leiophyllum*), persimmon (*Diospyros virginiana*), prickly pear (Tamsitt, 1954), huisache (*Acacia vernicosa*), yucca (*Yucca*—Blair and Miller, 1949), common mesquite (*Prosopis juliflora*), honey mesquite (*P. glandulosa*), small-leafed buckthorn (*Microrhamnus ericoides*), brasil tree (*Condalia spathulata*), mariola, silver-leaf nightshade (*Solanum elaeagnifolium*), common ragweed (*Ambrosia artemisiifolia*), false grama (*Cathesticum erectum*), Wright's threeawn (*Aristida wrightii*), hedgehog cactus (*Echinocereus*), pincushion cactus (*Neomamillaria denudata*), mazinnia (*Mazinnia spathulata*), slim tridens (*Tridens muticus*), shaefferia (*Shaefferia cuneifolia*), bush muhly (*Muhlenbergia porteri*), hairy grama (*Bouteloua hirsuta*), three-awn (*Aristida*), bluestem (*Andropogon*), panic grass (*Panicum*), small-leafed buckthorn, allthorn, Mormon tea (*Ephedra*), ratany (*Krameria parviflora*), Torrey yucca (*Yucca torreyi*), white brush (*Aloysia ligustrinum*), chittam (*Bumelia angustifolia*), red grama (*Bouteloua trifida*), coyotillo (*Karwinskia humboldtiana*), dog's ear (*Coldenia canescens*), parthenium (*Parthenium lyartum*), cenizio (*Leucophyllum texanum*), guayacan (*Porliera angustifolia*), wild lime (*Fagara fagara*), lantana (*Lantana horrida*), wild olive (*Cordia boissieri*), osmia (*Osmia conyzoides*), red brush (*Lippia graveoleus*), three-leaved sumac (*Schmaltzia trilobata*), sagebrush (*Artemisia filifolia*), buffalograss (*Buchloe dactyloides*), Colorado bluestem (*Agropyron smithii*), false buffalograss (*Munroa squarrosa*), wire grass (*Aristida glauca*—Al-Uthman, 1952), Texas prickly pear (*Opuntia lindheimeri*), plantain (*Plantago*), little bluestem (*Andropogon scoparius*), purple threeawn (*Aristida purpurea*), sandbur (*Cenchrus incertus*—Chapman and Packard, 1974), and Bermudagrass (*Cynodon dactylon*—Davis, 1974).

Shallow burrows sometimes are dug under rocks or fallen mesquite logs, with the rock or log forming the roof of the short burrow and a pocket-like terminal chamber (Dalquest and Horner, 1984). Some burrows are found in nearly vertical banks left by road graders along highway right-of-ways. One den consisted of three tunnels, 30–45 cm in length, that converged under a flat rock to a nest chamber. *P. merriami* also uses abandoned burrows of pocket gophers (Geomyidae—Davis, 1974). However, burrows of *P. merriami* characteristically (93.2%) are located at the base of a clump of grass or other vegetation. The root system of these plants probably adds stability to the burrow entrance. Diameter of the entrance at ground level is ca. 2–3 cm. Excavated soil is scattered away from the entrance so that the burrow is well camouflaged. During the day, entrances to occupied burrows are plugged with 2.5–5.0 cm of loosely packed soil, not extending to ground level. Unoccupied burrows usually are plugged externally so that the plug is even with the ground (Chapman and Packard, 1974).

Perognathus merriami maintains and uses several burrows within the home range. These burrows form a spherical pattern well within the range of an individual and may be for home or refuge; males maintain six or seven burrows and females about five. *P. merriami* usually spends more time in the home burrow. Home burrows may have two or more entrances and are similar in construction for both sexes, except females build more elaborate nests. The refuge burrow generally is a blind tunnel used for storing food, for refuge, or for temporary shelter. These burrows may be actively maintained. When released from traps, *P. merriami* will go into its home or escape burrows, not into burrows of other Merriam's pocket mice or other small mammals. An average tunnel in a home burrow descends almost vertically for 15–20 cm from the entrance, then lessens in grade until reaching a depth of 45–60 cm. Many burrows have blind side tunnels used for deposition of fecal pellets. Home burrows usually possess enlarged (7.6–15.2 cm diameter) nest chambers. Seeds and other food material are stored around the edges of this chamber and nesting material is lodged against one wall. Nests are made of dried grass, seed husks, and finely broken weed twigs. There may be separate food chambers, which are enlarged, blind, branches from the main tunnel (Chapman and Packard, 1974).

Perognathus merriami is able to dig burrows in sandy, loam, or clay soils. Burrows are more extensive in loam soil than in clay or sandy soils and are constructed by digging with the front feet; hind feet are used to propel the mound of soil under the body further away. Completed burrows are S-shaped with a center opening, and 3.8 cm deep. In loam soils, burrows are more extensive, with blind ends, enlarged areas for nesting or food, and some interconnecting runways. In dried clay-loam soils with ca. 1.3-cm crust, Merriam's pocket mouse cannot dig with the forefeet; instead, the crusty surface is chewed through, and digging proceeds as usual (Denyes, 1954).

In Texas, a number of burrows had juniper seeds or empty shells from which the kernel had been eaten out through a small hole in one end. In some instances, these seeds must have been carried a distance of 50–100 m. In one den under a flat rock, there was a mass of fresh juniper seeds cleaned of outer pulp. In another burrow, old moldy corn and bits of rubbish mixed with fresh earth were brought out, a little each night as if in a general house cleaning, indicating that various seeds and grains are stored in times of abundance (Bailey, 1905).

Food primarily consists of seeds, but a small amount of green vegetation and insects may be consumed. Seeds are opened in burrows and hulls accumulate in mats on the floor of some chambers. Floors of such chambers may be covered with hulls of seeds to a depth of 1.3 cm. Nests sometimes are placed in chambers sheltered by a rock or log (Dalquest and Horner, 1984).

In northcentral Texas, cheekpouch contents of *P. merriami* indicated it gathered the same foods as *Dipodomys elator*. Foods included oats (*Avena sativa*), cultivated sorghum (*Sorghum bicolor*), Johnsongrass (*S. halepense*), sandbur, panic grass, bristlegrass (*Setaria*), purple three-awn, wild barley (*Hordeum pusillum*), pin clover (*Erodium circutarium*), broomweed, buffalobur (*Solanum rostratum*), Texas stickseed (*Lappula texana*), prairie verbena (*Verbena bipinnitifida*), spreading bladderpod (*Lesquerella gracilis*), prickly pear, lazy daisy (*Aphanostephus*), honey mesquite, insect parts, soil, and small rocks (Chapman, 1972). In southern Texas, cheekpouches contained (in decreasing order of occurrence) sandbur, honey mesquite, tassajillo, phlox (*Phlox drummondi*), gaura (*Gaura odorata*), plains coreopsis (*Coreopsis cardaminefolia*), peppergrass (*Lepidium austrinum*), little bluestem, windmillgrass (*Chloris andropogonoides*), Texas bromegrass (*Bromus texensis*), and Texas grama (*Bouteloua texensis*—Chapman and Packard, 1974). Other foods are seeds of creosotebush, prickly pear, croton (*Croton*—Judd, 1967), poverty weed (*Baccharis*—Bailey, 1905), and Bermudagrass (Davis, 1974). Merriam's pocket mouse is too small to have serious effects on crops, but some wheat (*Triticum aestivum*) may be taken after harvest (Dalquest and Horner, 1984). In captivity, it eats birdseed, guinea pig chow, lettuce (Martin, 1977), millet seeds (Davis, 1974), bread, corn, oats, and bran (Allen, 1896*a*). *P. merriami* can survive for months or years without water (Allen, 1898; Davis, 1974).

The sex ratio usually is ca. 1:1 (Chapman and Packard, 1974), but the number of active males may exceed the number of females because of hibernation by females. In parts of western Texas, the numbers of *P. merriami* do not fluctuate greatly (Porter, 1962), but in other areas of its range it is extremely variable in abundance (Dalquest and Horner, 1984) and may be the most abundant mammal (Hermann, 1950). In the Tamaulipan province of Texas, *P. merriami* was second only to *Peromyscus leucopus* in abundance (Blair, 1952). Most (60–80%) annual mortality occurs from July to December (Porter, 1962). Merriam's pocket mouse is most abundant in summer and autumn, but rarely is active in winter, especially in January. Larger populations in summer and autumn likely result from the addition of juveniles (Chapman and Packard, 1974). Density in one area of Texas was 3.2/ha; males were 1.5/ha and females were 1.7/ha (York, 1949). At another site in Texas, density ranged from 2.68 to 10.20/ha through the year, excluding January when none was observed. However, when subadults and transient mice are removed from these numbers, density is ca. 5/ha through the year (Chapman and Packard, 1974). Traps placed at intervals of 10–12 m give a better estimate of population size than traps placed ca. 20 m apart (Porter, 1962).

The small home ranges (Schmidly, 1983) of *P. merriami* do not overlap, indicating territoriality (Chapman and Packard, 1974). Adult females show a stronger tendency toward territoriality than adult males (Porter, 1962).

In Texas, the home range of one *P. merriami* was 2.16 ha, and that of another 0.18 ha. The average size of the home range of males was 0.59 ha, and for females 1.56 ha (York, 1949). In Oklahoma, a female had a home range of 0.03 ha, and travelled a

maximum distance of 57 m (Martin and Preston, 1970). Average and range of linear movements (in m) for adult males, subadult males, adult females, and subadult females, respectively, are: winter–spring, 30.3 (21.3–37.5), 35.4 (21.3–45.0), 25.8 (15.0–37.5), 27.9 (15.0–37.5); summer–autumn, 34.8 (15.0–45.0), 36.6 (21.3–45.0), 27.9 (21.3–37.5), 27.9 (15.0–45.0). Males move greater distances than do females. Subadult males travel farther than other sex and age categories. Subadults of both sexes travel greater average distances between capture sites than do adults, and may disperse into marginal areas to a greater extent than adults. Adults move greater distances in summer and autumn (Chapman and Packard, 1974).

Merriam's pocket mouse is less attracted than most other small rodents to snap traps baited with chewed rolled oats or other foods. This wariness probably accounts for the small number of specimens captured in traps, but it can be captured by hand by spotting them with a headlight at night (Baker, 1956). *P. merriami* readily enters Sherman live-traps (Dalquest and Stangl, 1986), and may learn to rely on the bait of traps as a source of food (York, 1949), but it is difficult to capture in traps (Chapman and Packard, 1974). *P. merriami* makes an interesting pet when kept in a container with sandy soil. The sand should be dampened from time to time, and small seeds added daily (Dalquest and Horner, 1984).

In southwestern Texas, *P. merriami* is sympatric with *Chaetodipus penicillatus*, *C. nelsoni* (Porter, 1962), and *Dipodomys merriami*. Apparently, dens are not shared by *P. merriami* and *D. merriami* (York, 1949), but one *P. merriami* lived in a cage with a *Chaetodipus hispidus* for several months (Allen, 1896*a*). When placed into an artificial pocket gopher burrow, *P. merriami* avoided the gophers easily (Hickman, 1977).

Onychomys leucogaster eats Merriam's pocket mice that have been captured in traps, suggesting *O. leucogaster* may prey upon *P. merriami* when insect food is in short supply (Chapman and Packard, 1974). Other predators of *P. merriami* include gray foxes (*Urocyon cinereoargenteus*), barn owls (*Tyto alba*), screech owls (*Speotyto cunicularia*), burrowing owls (*Asio otus*—Dalquest and Horner, 1984), and loggerhead shrikes (*Lanius ludovicianus*—Chapman and Casto, 1972). In southern Texas, the herbicide picloram may have a short-term effect on populations of *P. merriami* (Harris, 1989).

Endoparasites include the coccidian *Eimeria reedi* (Ford et al., 1990). Ectoparasites include the mites *Euschoengastia decipiens*, *Geomylichus perognathi*, *Androlaelaps fahrenholzi* (Thomas et al., 1990), *A. grandiculatus* (Eads, 1951), *Hexidionis breviseta* (Loomis and Crossley, 1963; Whitaker, 1993), *H. allredi*, *H. harveyi*, *Kayella lacerta*, *Leptotrombidium panamense*, *Parasecia gurneyi*, *Pseudoschoengastia farneri*, *Hyponeocula arenicola* (Whitaker, 1993), *Euschoengastoides hoplai* (Loomis and Crossley, 1963), and *Otorhinophila baccusi* (Loomis and Wrenn, 1973), the louse *Fahrenholzia boleni* (McDaniel, 1968), and the fleas *Meringis agilis* (Eads et al., 1987), *M. dipodomys*, *M. rectus* (Graves et al., 1974), and *Orchopeas leucopus* (Hedeen, 1953).

BEHAVIOR. *Perognathus merriami* is nocturnal, but it may be active outside its burrow in daylight hours. Merriam's pocket mouse spends much of the daylight hours sleeping, burrowing, and modifying older tunnels (Dalquest and Horner, 1984).

Merriam's pocket mouse can be startled by digging into the main burrow or by stamping on the ground. It may dart out of one of the burrow openings, or break through a thin crust of earth that covers a concealed exit and after a leap or two will sit trembling and blinking in the light of day. Evidently, light hurts its eyes and after blinking for awhile it closes them. Adults are not so readily driven out of dens as juveniles (Bailey, 1905).

When first captured *P. merriami* struggles to escape, but does not bite. After being held gently for a few minutes it seems to lose its fear, and will sit on the open hand, blinking in the glare of daylight. At a sudden motion, Merriam's pocket mouse bounds away in long leaps, but soon stops under a weed or bush. While sitting motionless, it can be recaptured by approaching cautiously and covering it with an open hand (Bailey, 1905).

Up to six *P. merriami* have been kept in the same cage for ca. 1 year (Davis, 1974). In captivity, when 30–60 g of mixed seeds is supplied at one time, *P. merriami* either works until all is cached in its underground burrow, or it sorts the seeds and makes separate deposits aboveground of each kind in different corners of the cage (Allen, 1898).

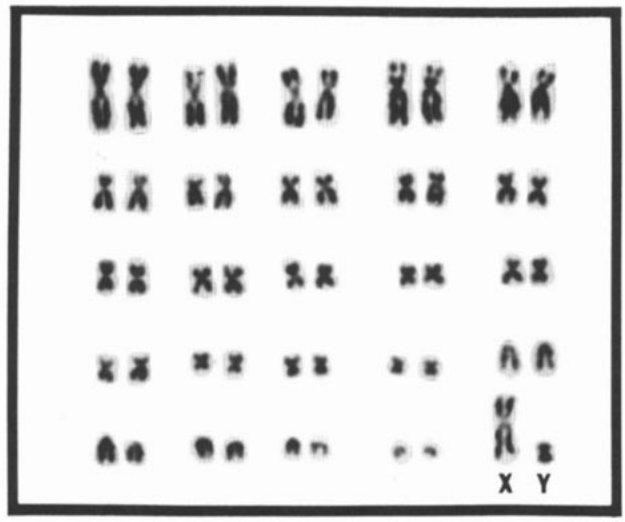

FIG. 4. Karyotype of a male *Perognathus merriami gilvus* from near San Angelo, Tom Green Co., Texas. Photograph courtesy of T. E. Lee, Jr.

Usually, *P. merriami* emits no sound. However, it can produce a high, metallic squeak (Bailey, 1905; Davis, 1974).

GENETICS. Standard, C-banded, and G-banded karyotypes of *P. merriami* (Fig. 4) and *P. flavus* from many localities in New Mexico and Texas appear identical (Lee and Engstrom, 1991). The diploid number of chromosomes is 50, the fundamental number is 86, there are 19 pair of biarmed and 5 pair of uniarmed autosomes, the X chromosome is submetacentric, and the Y is metacentric (Patton, 1967).

Of 28 allozymes examined, 23 were variable and 5 were monomorphic. There were no fixed differences among samples from across New Mexico and Texas. However, pronounced frequency differences occurred at five loci between samples referable to *P. f. flavus* and those assignable to *P. m. gilvus* and *P. m. merriami* (purine nucleoside phosphorylase, phosphogluconate dehydrogenase, esterase, lactate dehydrogenase, superoxide dismutase-1). Generally, these two distinctive allelic complements correspond to the boundary between *P. flavus* and *P. merriami* (Lee and Engstrom, 1991).

REMARKS. The morphologic similarity of *P. merriami* and *P. flavus* has been noted (e.g., Bailey, 1931; Blair and Miller, 1949; Davis, 1974; Osgood, 1900). Merriam (1889) even used a specimen of *P. merriami* from Mason, Mason Co., Texas, as the basis of his description of *P. flavus* (Osgood, 1900). Based on external, cranial, and pelage characters, *P. merriami* has been considered conspecific with *P. flavus* (Wilson, 1973), and behavioral data support their conspecific status (Martin, 1977). However, based on allozymes, *P. merriami* and *P. flavus* are now considered separate species. The distribution of *P. m. gilvus* is intermediate to the main range of *P. f. flavus* and *P. m. merriami*, and is in many ways structurally intermediate to *P. m. merriami* and *P. f. flavus*, giving the impression that the two taxa broadly hybridize. Genic analysis, however, shows distinct genotypes for *P. m. gilvus* and *P. f. flavus* from several localities of sympatry, and only a few possible hybrids from one locality in southeastern New Mexico (Lee and Engstrom, 1991).

The *flavus* group of pocket mice (*P. flavus*, *P. merriami*) is closely related to the *longimembris* group (*P. amplus*, *P. longimembris*, *P. inornatus*—Williams, 1978). *Perognathus* is from the Greek *pera* meaning pouch and *gnathos* meaning jaw. The specific epithet *merriami* honors C. Hart Merriam, Chief of the United States Biological Survey, 1885–1910 (Jaeger, 1955).

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T. L. BEST, DEPARTMENT OF ZOOLOGY AND WILDLIFE SCIENCE AND ALABAMA AGRICULTURAL EXPERIMENT STATION, 331 FUNCHESS HALL, AUBURN UNIVERSITY, ALABAMA 36849-5414; M. P. SKUPSKI, DEPARTMENT OF BIOLOGY, UNIVERSITY OF NEW MEXICO, ALBUQUERQUE 87131.