MAMMALIAN SPECIES No. 161, pp. 1–5, 5 figs.

Peromyscus truei.

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Published 3 December 1981 by The American Society of Mammalogists

Peromyscus truei (Shufeldt, 1885)

Pinyon Mouse

Hesperomys truei Shufeldt, 1885:407. Type locality Fort Wingate, McKinley Co., New Mexico.
Hesperomys megalotis Merriam, 1890:63. Type locality Black Tank, Little Colorado Desert, Coconino Co., Arizona.
Sitomys martirensis Allen, 1893:187. Type locality Sierra San Pedro Mártir, 7,000 ft., Baja California.
Sitomys gilberti Allen, 1893:188. Type locality Bear Valley, San Benito Co., California.
P[eromyscus]. Truei, Thomas, 1894:365. First use of name combination.
Peromyscus dyselius Elliot, 1898:207. Type locality Portola, San Mateo Co., California.
Peromyscus gratus Merriam, 1898:123. Type locality Tlalpan, Distrito Federal, Mexico.
Peromyscus pavidus Elliot, 1903*a*:142. Type locality Pátzcuaro, Michoacán.
Peromyscus sagax Elliot, 1903*a*:142. Type locality La Palma, Michoacán.
Peromyscus hemionotis Elliot, 1903*b*:157. Type locality Rosarito Divide, Sierra San Pedro Mártir, Baja California.
Peromyscus montipinoris Elliot, 1904:264. Type locality Lockwood Valley, near Mt. Pinos, Ventura Co., California.
Peromyscus lasius Elliot, 1904:265. Type locality Hannopee Canyon, 7,500 ft., Panamint Mts., Inyo Co., California.
Peromyscus zelotes Osgood, 1904:67. Type locality Queréndaro, Michoacán.
Peromyscus comanche Blair, 1943:7. Type locality Tule Canyon, Briscoe Co., Texas.

CONTEXT AND CONTENT. Order Rodentia, Family Cricetidae, Subfamily Cricetinae, Genus *Peromyscus*, Subgenus *Peromyscus*, Species-group *truei*. Currently, 15 subspecies may be recognized.

P. t. chlorus Hoffmeister, 1941:131. Type locality Lost Horse Mine, S end Little San Bernardino Mts., Riverside Co., California.
P. t. comanche Blair, 1943:7, see above. See Schmidly (1973:269) for the basis of this combination.
P. t. dyselius Elliot, 1898:207, see above.
P. t. erasmus Finley, 1952:265. Type locality 8 mi. NE Durango, 6,200 ft., Durango. Regarded as synonym of *gentilis* by Baker (1960:321).
P. t. gentilis Osgood, 1904:61. Type locality Lagos, Jalisco.
P. t. gilberti (Allen, 1893:188), see above.
P. t. gratus Merriam, 1898:123, see above (*sagax* Elliot, *pavidus* Elliot, and *zelotes* Osgood are synonyms).
P. t. lagunae Osgood (1909:172). Type locality La Laguna, Sierra Laguna, Baja California.
P. t. martirensis (Allen, 1893:187), see above (*hemionotis* Elliot a synonym).
P. t. montipinoris Elliot, 1904:264, see above.
P. t. nevadensis Hall and Hoffmeister, 1940:401. Type locality ½ mi. W Debbs Creek, 6,000 ft., Pilot Peak, Elko Co., Nevada.
P. t. preblei Bailey, 1936:188. Type locality Crooked River, 20 mi. SE [=12 mi. S, 6 mi. E] Prineville, Crook Co., Oregon.
P. t. sequoiensis Hoffmeister, 1941:129. Type locality 1 mi. W Guerneville, Sonoma Co., California.
P. t. truei (Shufeldt, 1885:407), see above (*lasius* Elliot and *megalotis* Merriam are synonyms).
P. t. zapotecae Hooper, 1957:6. Type locality 1 mi. E Tlacolula, 5,700 ft., Oaxaca.

DIAGNOSIS. Mice of the species *P. truei* have relatively and actually large ears, with the ear measured from the notch equal to or longer than the hind foot in most populations. Total length averages about 190 to 200 mm. The tail is longer than the head and body in populations west of the Sierra Nevadas, Baja California, and mainland Mexico; the tail is shorter than the body in most United States populations east of the Sierra Nevadas and Cascade Mountains. The hindfoot in most populations is 22 mm or more in length. The skull (Fig. 1) is of medium size but the auditory bullae are large and well inflated. The upper cheek-teeth have the characteristic features of the subgenus *Peromyscus*, with a well-developed mesoloph in the upper first and second molars.

Peromyscus truei is most often confused with *Peromyscus boylii*, *P. difficilis*, *P. leucopus*, *P. californicus*, and *P. bullatus*. *P. truei* differs from *P. boylii* in having an ear that is as long as or longer than the hindfoot, rather than only about 70 to 80% of the length of the hindfoot, tail that is more heavily haired and with less pronounced annulations, auditory bullae that are more inflated, and chromosomes that differ in the number of kinds.

Peromyscus truei can be differentiated from *P. difficilis* by a combination of color features. In *P. difficilis*, the coloration of the dorsum in adults often is grayish-black, somewhat similar to the juvenile pelage, the color along the lateral line has very little ochraceous color, and the top of the head in adults is often gray-

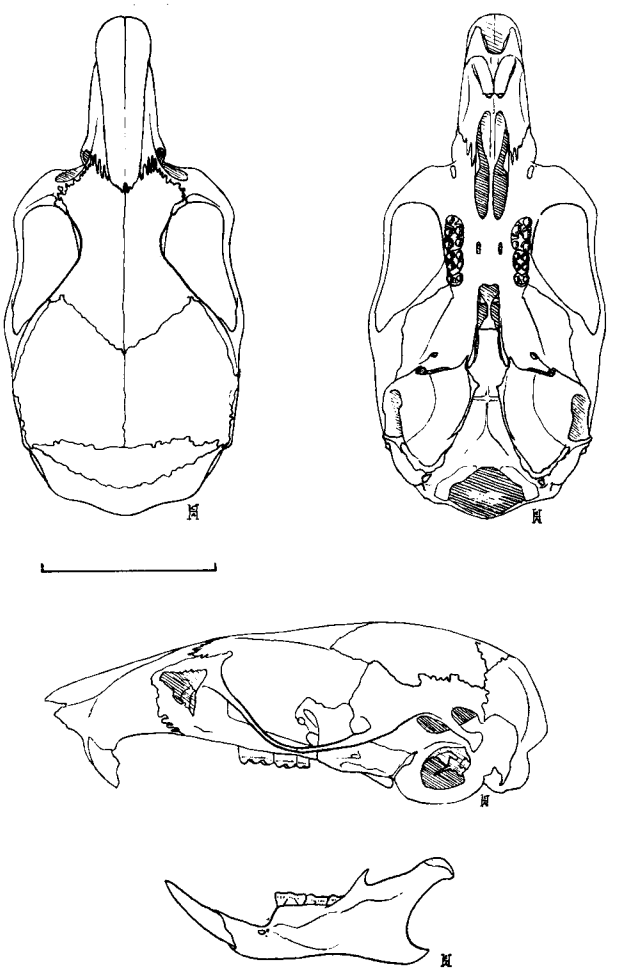

FIGURE 1. Dorsal, ventral, and lateral views of cranium and lateral view of left ramus of *Peromyscus truei truei*, MVZ 68476, male, 0.5 mi. W Debbs Creek, Elko Co., Nevada (from Hoffmeister, 1944). Scale represents 10 mm.

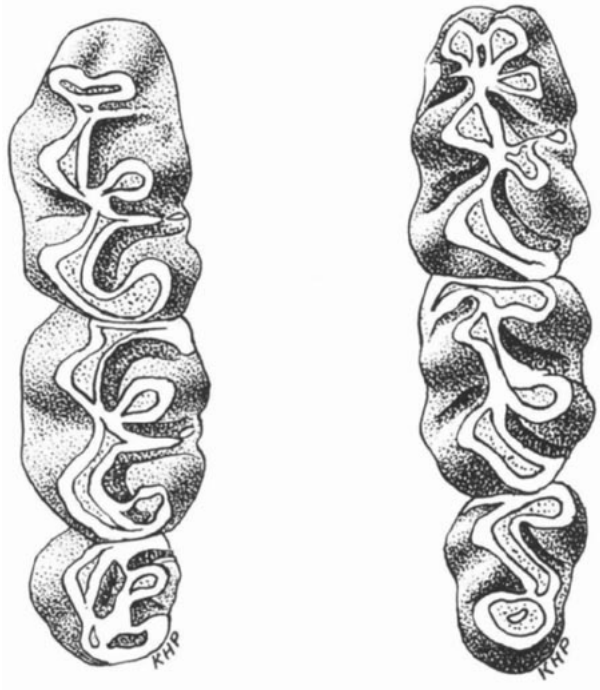

FIGURE 2. Occlusal view of upper (left) and lower (right) molariform teeth of *Peromyscus truei* (from Hoffmeister, 1951).

ish. In addition, in *P. truei*, the auditory bullae are relatively more inflated, the toothrow is shorter, and chromosomes differ in the number of kinds. In Mexico, the skull of *P. truei* is noticeably smaller.

Peromyscus truei occurs with *P. californicus* in parts of its range and differs from it in overall smaller size, shorter hindfoot, smaller skull and shorter toothrow, presence rather than absence of mesolophs of the first and second upper molars, and in differences in the number of kinds of chromosomes.

Peromyscus truei usually does not occupy the same areas as *P. leucopus*, but where it does *P. truei* is larger, especially the ear and the tail, the tail is more heavily haired at the tip, the skull is larger, the auditory bullae are much more inflated, and the zygomatic arches are less strongly bowed outward.

Peromyscus truei differs from *P. bullatus* of Vera Cruz in smaller ears (less rather than more than 24 mm), auditory bullae less inflated, and hindfoot shorter (24 mm or less rather than usually more).

GENERAL CHARACTERS. Pinyon mice are large-eared, medium-sized mice. Color varies from a pale yellowish-brown (*P. t. chlorus*) to brownish black (*P. t. dyselius* and *gratus*) and the fur is long and silky. The dorsal tail stripe is slightly darker than the back. The tail is covered with short hairs except at the tip where longer hairs project. An ochraceous pectoral spot may be present or absent. The dorsum of the hindfeet is white or dusky. Greatest length of skull in adults is usually between 27.0 and 30.0 mm and alveolar length of the maxillary toothrow between 4.2 and 4.5 mm. The braincase is large and vaulted and the zygomatic arches are weak, do not bulge laterally, and converge anteriorly. A mesoloph is present in M1 and M2. In m1 and m2 a remnant of a mesolophid or a mesostylid or what Schmidly (1973) calls an entolophulid and ectostylid, respectively, may occasionally be present. The cheekteeth are illustrated in Fig. 2.

Three groups of populations of pinyon mice each have certain characteristics separating them, one from another. In one group (*P. t. gilberti, sequoiensis, dyselius, montipinoris, chlorus, martirensis,* and *lagunae*) (see Fig. 3), the tail is longer than the body, the ear relative to the length of the hindfoot is small, and the inflation of the auditory bullae is not so great as in the next group. Selected measurements (mm) of a population from Kern County, California, are: length of tail, 106; length of body, 99; length of hindfoot, 23.9; length of ear, measured dry from the notch, 23.4; greatest length of skull, 29.1; breadth of braincase, 13.3. In a second group consisting of those populations east of the Sierra Nevada—Cascade axis and north of Mexico (*P. t. truei, nevadensis,* and *preblei*) (see Fig. 4), the tail is shorter than the body, the ear relative to the length of the hindfoot is large, and the inflation of the auditory bullae is great. Selected measurements (mm) of a population for this group from Valencia County, New Mexico, are: length of tail, 88; length of body, 100; length of hindfoot, 23.1; length of ear measured dry from the notch, 23.7; greatest length of skull, 28.5; breadth of braincase, 13.1. The subspecies *P. t. comanche* should fit in group two on a geographical basis, but the tail is longer than the body (102.7 to 95.1, respectively) and the ear relative to the hindfoot is short (measured in the flesh, 21.9 to 23.2, respectively) (Schmidly, 1973). In the third group, consisting of populations in mainland Mexico (*P. t. gentilis, gratus, erasmus,* and *zapotecae*), the tail is longer than the body, the ear is small relative to the hindfoot, and auditory bullae not greatly inflated. Selected measurements (mm) of a population from Tlalpan, Federal District, Mexico, are: length of tail, 106; length of body, 94; length of hindfoot, 22.6; length of ear measured dry from the notch, 19.9; greatest length of skull, 27.3; breadth of braincse, 13.0. The fundamental number of the chromosomes of group 3 is 54; FN is 62 in the other groups (Zimmerman et al., 1975).

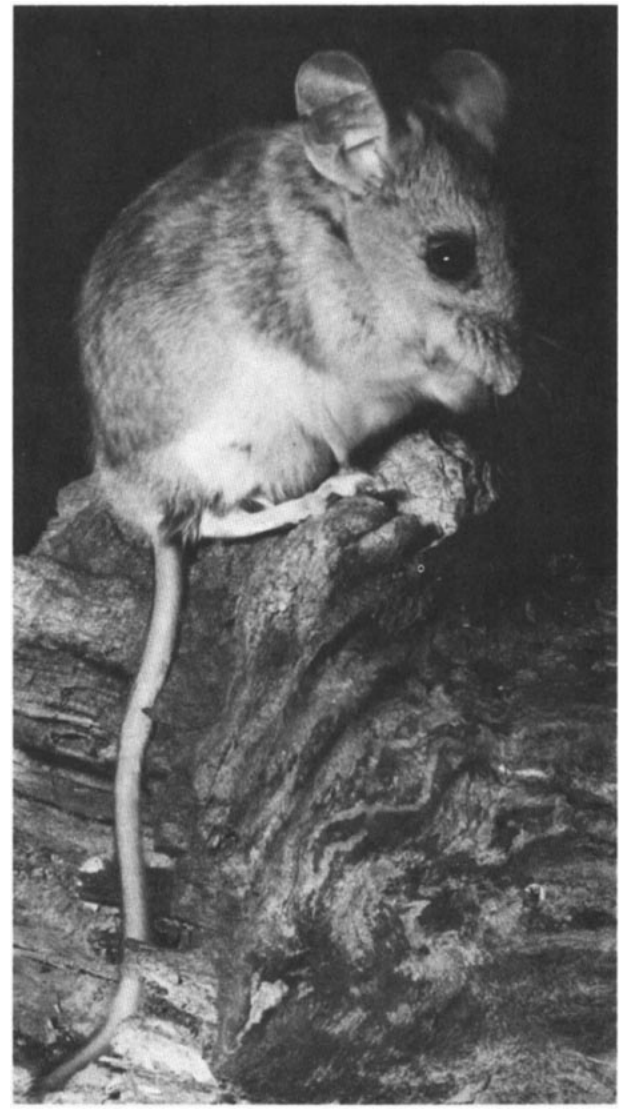

FIGURE 3. Small-eared, long-tailed *Peromyscus truei gilberti* from Madera County, California (photograph by Woodrow W. Goodpaster).

DISTRIBUTION. The range of *P. truei* is shown in Fig. 5. The species occurs in southwestern United States from central Oregon and southern Wyoming on the north, from eastern Colorado, the panhandle of Texas, and western Oklahoma on the east, to the Pacific Ocean on the west. In mainland Mexico, it occurs along the Sierra Madre south to Oaxaca and in Baja Cal-

FIGURE 4. Large-eared, short-tailed *Peromyscus truei truei* from Santa Fe County, New Mexico (photograph by Woodrow W. Goodpaster).

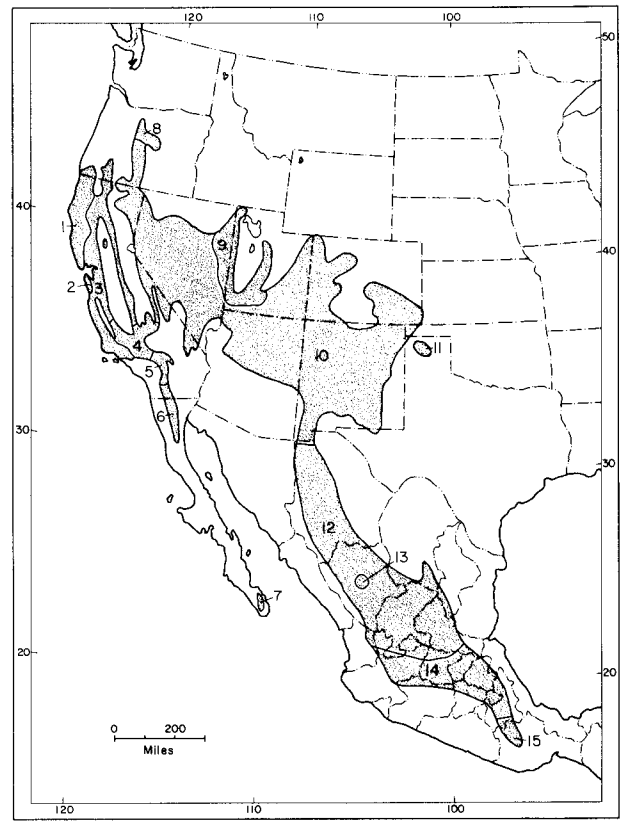

FIGURE 5. Geographic distribution of *Peromyscus truei*. Subspecies are: 1. *P. t. sequoiensis*; 2, *P. t. dyselius*; 3, *P. t. gilberti*; 4, *P. t. montipinoris*; 5, *P. t. chlorus*; 6, *P. t. martirensis*; 7, *P. t. lagunae*; 8, *P. t. preblei*; 9, *P. t. nevadensis*; 10, *P. t. truei*; 11, *P. t. comanche*; 12, *P. t. gentilis*; 13, *P. t. erasmus*; 14, *P. t. gratus*; 15, *P. t. zapotecae*.

ifornia, in the Sierra San Pedro Martir and the Sierra Laguna. In much of its range, the presence of pinyon mice is dependent upon the presence of rocks or rocky slopes and upon the presence of pinyon-juniper or chaparral. Details of distribution can be found as follows: Hoffmeister (1951) overall up to 1950, Armstrong (1972) for Colorado, Findley et al. (1975) for New Mexico, Baker (1956) for Coahuila, Baker and Greer (1962) for Durango, Dalquest (1953) for San Luis Potosi, Anderson (1972) for Chihuahua, Hooper (1957) for Puebla and Oaxaca. The habitats occupied within this range are discussed in ECOLOGY.

FORM. Vibrissae are as follows: buccal mystacial numerous with the longest about one-third to one-half the length of the body. Submentals absent or so reduced as to be but slightly, if any, longer than the surrounding hairs. Superciliaries two in number of unequal length, the longer extending at least to the middle of the ear, the shorter extending to the notch of the ear. A single pair of genal vibrissae extend to about the tragus of the ear. Usually there are about 6 carpal vibrissae. Ear is large and expanded, arising from a tubular base, with craniad edge overfolded. Tragus is only slightly indicated. The manus has 5 pads with the thenar pad absent or fused with interdigital pad 1. The pollex is rudimentary and with a nail in contrast to the other digits with well-developed claws. The pes has six pads on the sole, with the hypothenar the smallest. Digit 3 is the longest, being about one-third the length of the pes. Mammary glands consist of two pairs located inguinally and one pair located pectorally.

The cranial foramina are much as figured by Klingener (1968). M1 and M2 each possess a mesoloph and mesostyle (for terminology, see illustration of Hoffmeister, 1951); the mesoloph may extend toward the cingulum and join the mesostyle. In less than 1%, the mesoloph may be absent but the mesostyle is usually still present. The anterocone (upper) and anteroconid of the first molars are divided by an anterior groove. There are 13 pairs of ribs of which 7 pairs are true ribs. The number of caudal vertebrae is 30 to 32.

The glans penis, as described by Hooper (1958), is "a spiny, elongate rod, flared slightly distally, with a nonspinous terminal segment . . . . Spines occur over most of the glans except on the basal portion and on that part distal to the two dorsal lappets and the ventral lip. The conical, nonspinous tip is slightly protractile . . . The distal cartilaginous cap [of the baculum] is minute."

Molt was described and figured by Hoffmeister (1951) and was discussed by McCabe and Blanchard (1950) and Douglas (1969).

FUNCTION. When studying the water stress of free-living and laboratory pinyon mice from California, Bradford (1974) found that, when subjected to increasing water stress, osmotic concentrations of urine increased, feces became drier, and body-water turnover rates decreased. Under severest water stress, with the minimum water available for survival, diurnal torpor occurred and apparently caused a decline in urine concentration and an increase in fecal water content during the daytime. In midsummer, urine osmotic concentrations and fecal water contents of field-caught mice had values similar to those of laboratory mice under severe water stress. Some tests that Douglas (1969) ran indicated that the amount of water consumed by pinyon mice was correlated with the protein-content of the diet, with the higher the protein intake, the more water consumed. Douglas (1969) thought that in southwestern Colorado, drought could reduce the water content of the vegetation to such a level that pregnant or lactating females find it difficult, if not impossible, to raise litters successfully. He also thought that a mouse eating 10 g of plant material containing 50% moisture would obtain 5 g of food and 5 g of water, both of which would exceed the minimum daily needs for non-pregnant adults.

ONTOGENY AND REPRODUCTION. In southwestern Colorado, breeding occurs from April through September (Douglas, 1969), and in Arizona, from mid-February to mid-November. In California, the average number of young per litter in the wild was 3.5, and in captivity 3.3 (McCabe and Blanchard, 1950). In southwestern Colorado, the number of embryos was 4.0 (SD ± 0.91), with a range of 3 to 6 (Douglas, 1969). Douglas' study of male reproductive capabilities indicated that all males did not reach breeding condition at the same time of the year. Juveniles had scrotal testes at the time the postjuvenal molt was beginning; they are not able to impregnate females unless the testes are scrotal.

McCabe and Blanchard (1950) and Hoffmeister (1951) gave detailed descriptions of newborn and developing young of *Peromyscus truei gilberti* and Douglas (1969) described young of *P. t. truei*. At birth, young are hairless and eyes and ears closed. During week 1, young of *P. t. truei* squeak loudly. In *P. t. gilberti* they do not squeak until one week old. Between the 16th and 21st day eyes open and ears unfold and open. The body is haired by the 14th day in *P. t. truei*. Douglas (1969) said that his animals nursed for the first month but McCabe and Blanchard (1950) said

that females were without milk in the 4th week after parturition, although the young still attempted to nurse. Postjuvenal molt is discernible by week 7. This molt is complete, or nearly so, by week 10 or 11. Hoffmeister (1951), for *P. t. gilberti*, and Douglas (1969), for *P. t. truei*, showed changes in external size with increasing age. Hoffmeister (1951) also discussed changes in the skull with increasing age. Probably at least 88% of growth occurs during the first 35 days; by about day 100, 99%. Cranial elements housing the brain increase least in early postembryonic development; the greatest increase is in the rostral part of the skull.

Longevity is short. Douglas (1969) found that only 2 to 3% of the adults live long enough to breed in consecutive breeding seasons. If I interpret McCabe and Blanchard (1950) correctly, they suggested that only 20% of the young that are out of the nest and feeding for themselves may complete a year of life.

ECOLOGY. In the United States east of the Sierra Nevada-Cascade axis, pinyon mice are most commonly found "in the piñon belt in close association with piñons or junipers, particularly where these trees grow among rocks or on rocky slopes. No other species of *Peromyscus*, or any other small rodent, is as exclusively confined to the piñon-juniper belt, or occurs as abundantly in it as does *P. t. truei*" (Hoffmeister, 1951). In central Oregon, where pinyons are not present, these mice live in rocky outcrops among junipers and sage. In Texas, these mice "occupy a restricted range along the rocky, cedar [juniper]-covered slopes at the northwestern corner of the 'Break of the Plains' in western Texas. Locally this species is restricted to rocky situations in cedar forests on the canyon slopes and floors" (Schmidly, 1973). There are exceptions to the occurrence of *P. truei* in pinyon-juniper. They have been taken in yellow pine forests, in the bristle-cone pine belt, and in a cottonwood-sagebrush riparian situation.

West of the Sierra Nevada-Cascade axis, pinyon mice are found in a variety of habitats. In California, Hoffmeister (1964) pointed out the concordance of these mice and the Upper Sonoran Life-zone and the coastal redwood belt. In much of California, *P. truei* is closely associated with chaparral on canyon sides, even if the chaparral is among stands of live oaks, eucalyptus, or pine (McCabe and Blanchard, 1950). In the coastal redwood belt, these mice are associated with redwoods, Douglas fir, California laurel, blackberry, madrone, and poison oak (Hoffmeister, 1951). In the desert localities in southern California, pinyon mice are found among pinyons, junipers, Joshua trees, sometimes in chaparral, and even in desert scrub, including sagebrush. In Baja California, these mice are found in pinyon, sometimes in association with junipers and scrub oak.

In mainland Mexico, pinyon mice occupy a variety of habitats. In Oaxaca, they live on the broken faces of limestone cliffs and among boulders at the base, with a sparse vegetative cover of cactus, mesquite, and grasses (Hooper, 1957). In the Distrito Federal, they occupy rocky lava beds that are fissured and broken and partly grown up with sacaton and groundsel. In San Luis Potosi, pinyon mice are found at the bases of rocky slopes, often in dense growths of prickly pear and yucca (Dalquest, 1953); in Durango they live in rocky areas from the Douglas-fir-aspen belt to the rocky arroyos bordering grassy plains (Baker and Greer, 1962). In Coahuila, these mice live in rocky situations where juniper, pinyon, and yucca provide the principal vegetative cover but they are also found in juniper-cactus, pinyon-juniper and yellow pine, and yucca-mesquite associations (Baker, 1956).

The home range for these mice in southwestern Colorado (Douglas, 1969) had a mean of 14,427 m^2 (SD ± 5,878 m^2) for males and 12,395 (±5,354) for females, using the inclusive boundary-strip method of calculations. If the exclusive boundary-strip method is used, the mean home range for males is 10,465 m^2 (±4,043) and for females 8,290 (±2,688). On the average, these mice travelled 52 m between captures for adult males and 49 m for adult females. It is difficult to convert the home range figures into density per hectare because parts of any hectare may be ecologically unsuitable for these mice.

The stomach contents of 16 mice taken in midsummer in Monterey County, California, consisted primarily of insects and some spiders; one contained 60% mammal remains (Bradford, 1974). These mice were not feeding on seeds and leaves of chamise although they lived in chamise chaparral. By late summer, the diet was predominantly acorn mast. Douglas (1969) listed plants eaten or not eaten by captive pinyon mice from southwestern Colorado. He also noted a number of plants that could be identified in the stomach of wild-taken pinyon mice. Douglas felt that the winter staple must be juniper seeds in this part of Colorado, since juniper berries remain on the branches throughout winter.

GENETICS. The diploid number of chromosomes is 48 and the karyotype consists of 5 pairs of medium to large biarmed autosomes, 3 pairs of small biarmed autosomes, 15 pairs of small to large acrocentric autosomes, and subtelocentric X and small acrocentric Y chromosomes in most populations. Three specimens from Coahuila were reported by Lee et al. (1972) to be like an illustration of Hsu and Arrighi (1968:Fig. 4*a*), and thus would have 2 pairs of medium to large biarmed autosomes, 2 pairs of small biarmed autosomes, and 19 pairs of acrocentric autosomes. Fifteen loci were examined for the electrophoretic patterns of 13 proteins by Zimmerman et al. (1975) for four samples of *P. truei*: Arizona-Utah, New Mexico, Chihuahua, and Durango. Biochemical characters of mice from Grant County, New Mexico, and the sample consisting of mice from 3 mi. SE Santa Barbara and 9 mi. SSE Celulosa, Chihuahua (localities 14 and 15 of Zimmerman et al., 1975) were distinct from the northern populations but no mention was made of the sample to the south in Durango (Zimmerman et al., 1975).

REMARKS. *Peromyscus truei* is the nominal species of the *truei* group of large-eared mice, which group includes also *P. difficilis* and *P. bullatus*. Since the species was revised (Hoffmeister, 1951), three subspecies have been added (*comanche*, *erasmus*, *zapotecae*). The form *comanche* has had a varied history, being regarded as a distinct species, as a subspecies of *P. boylii*, and as a subspecies of *P. truei*.

Pinyon mice in areas of open country, as in the pinyon-juniper-rock association, have short tails, large ears, and large bullae. The large ears and bullae may be adaptations for detecting predators at the greatest possible distance. In areas of dense cover, pinyon mice have long tails, short ears, small bullae, and long hindfeet. In such places, detection of potential predators at great distances may not be as important as rapid movements through brush which movement is facilitated by long tails and long, broad hindfeet.

Hoffmeister (1951) pointed out that there are clinal changes from the interior coastward (east to west) and southward in decreasing size of the body, increasing length of the tail, decreasing size of the ears, decreasing length of the hindfeet, and decreasing size of the skull.

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