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Peromyscus winkelmanni.

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***Peromyscus winkelmanni* Carleton, 1977**

Forest Mouse

Peromyscus winkelmanni Carleton, 1977:2. Type locality "6.3 mi (by road) WSW Dos Aguas, 8000 ft, Michoacan, Mexico."

CONTEXT AND CONTENT. Order Rodentia, suborder Sciurognathi, family Muridae, subfamily Sigmodontinae, genus *Peromyscus* (Musser and Carleton 1993), subgenus *Peromyscus*. *Peromyscus winkelmanni* (Fig. 1) is monotypic (Carleton 1989).

DIAGNOSIS. Skull of *P. winkelmanni* (Fig. 2) is similar in shape to those of *P. hylocetes* and *P. oaxacensis*, but *P. winkelmanni* is larger in all cranial measurements and has an interorbital bead and ridge. Bead is not as prominent as in *P. banderanus* and *P. megalops*, but is distinct and contrasting with sharply angled shelved interorbital region of *P. hylocetes* and *P. oaxacensis*. *P. winkelmanni* is larger in all cranial measurements than *P. boylii* and has interorbital bead or ridge.

Peromyscus winkelmanni lacks spines on lappets of glans penis, whereas in *P. boylii*, *P. levipes*, *P. madrensis*, *P. pectoralis*, and *P. simulus* spines extend onto lappets. Lower portion of glans surface is corrugated, a characteristic not present in other species of the *aztecus* or *boylii* assemblages (Bradley and Schmidly 1987).

GENERAL CHARACTERISTICS. Tail is approximately as long as head and body. Ears are smaller and darker than hind foot. Supraorbital border of skull is angled with wide interorbital span.

In the wet season (Carleton 1977) dorsum is tawny mixed with black with prominent black fur in the midback, which in some specimens is seen as a broad, poorly defined band. Lateral line is ocher. Cheeks, sides, and flanks are bright tan, almost cinnamon (Fig. 1). Transition between dorsal and ventral color is abrupt. Ventral fur is gray, tipped with white. Some specimens have an ocher pectoral spot. Tarsus of hind foot is dark. One-half of the metatarsal region has dusky fur, and the remainder is white. Tail has thin hair, darker on top than underneath (Carleton 1977).

Means and ranges of measurements (in mm) of 12 specimens from 8.0 km WSW Dos Aguas, 2,550 m, Guerrero, are (Carleton 1977): total length, 249.2 (235–265); length of tail, 129.1 (120–140); length of hind foot, 27.6 (27–29); length of skull, 32.4 (31.2–33.9); rostral length, 10.8 (10.1–11.6); zygomatic breadth, 16.2 (15.4–17.1); length of maxillary toothrow, 5.3 (5.1–5.6). Body mass in adults ranges from 53.0 to 54.5 g (Alvarez et al. 1987).

DISTRIBUTION. *Peromyscus winkelmanni* occurs in the Dos Aguas area of Michoacán, part of the transverse cordillera, and Filo de Caballo in the Sierra Madre del Sur of Guerrero, Mexico (Fig. 3; Carleton 1977; Smith et al. 1989). The range of the species is resticted to the wetter area on the west side of the Sierra Madre Occidental. No fossils are known.

FORM AND FUNCTION. *Peromyscus winkelmanni* has 3 pairs of mammae, 1 axillary pair and 2 inguinal pairs (Carleton 1977). Five juveniles were collected in July. Length of testis was 7.8 mm for 2 adult males and 6.0 mm for 1 juvenile in July (Alvarez et al. 1987).

Phallus is large, strongly vase-shaped, and lacking dorsal and ventral lappets. Glans penis is elongated (Carleton 1977), ca. one-third length of hind foot and ca. 4 times longer than wide. Surface of glans is covered with densely packed spines similar in size on dorsal and ventral sides. Spines are pointed at tip and overlap unevenly, and those on dorsum are less dense than those on venter (Bradley and Schmidly 1987). Conical spines become gradually smaller from attachment point of the prepuce toward the tip (Carleton 1977) and are the most divergent of the *boylii* assemblage (Bradley and Schmidly 1987). Baculum is rod-shaped with a triangular base 4–5 times wider than shaft, has a slight dorsoventral curve, is ca. 1.5 times longer than glans, and has a minute cartilaginous tip (Bradley and Schmidly 1987). Mean glans penis measurements in mm for 4 specimens from Dos Aguas, Michoacán, are: length of glans, 9.78; width of glans, 1.82; length of protractile tip, 2.63; length of baculum, 12.92 (Carleton 1977).

Discoglandular stomach contrasts with pouched stomach found in several species of *Peromyscus* (Carleton 1977).

Dental formula is i 1/1, c 0/0, p 0/0, m 3/3, total 16. Dentition is complex; accessory lophs and styles occur in both upper and lower molars (Carleton 1977); m1 and m2 with ectolophid and mesolophid (Álvarez et al. 1987).

ECOLOGY. *Peromyscus winkelmanni* is found in areas with large oaks, some >30 m in height, scattered among pines; in some places, oaks are dominant. Abundant pine and oak species in the area include *Pinus michoacana*, *P. lawsonii*, *P. prigglei*, *Quercus candicans*, and *Q. scytophylla*. Trees have thick mats of mosses and lichens and many epiphytes, including large bromeliads and orchids. Various herbs and saplings, mainly *Baccharis*, many rocks, and fallen trees (Carleton 1977; Duellman 1965) form the understory. The area is used for timber (Álvarez et al. 1987).

Other species collected with *P. winkelmanni* are *Peromyscus boylii* and *Reithrodontomys fulvescens*. The collection efficiency of *P. winkelmanni* in snap traps was 4.3–4.6% (Álvarez et al. 1987).

GENETICS. Karyotype of *P. winkelmanni* (FN = 70) includes a series of 12 large to small biarmed pairs of chromosomes and 11 pairs of large and small acrocentric autosomes. The most similar karyotype is that of *P. aztecus*, which differs by lacking 1 large biarmed pair and by having an additional pair of medium-size biarmed chromosomes (Smith et al. 1989).

Based on genetic variability at 19 gene loci, *P. winkelmanni* from Guerrero ($n = 2$) shows polymorphism in salivary amylase (0.50, 0.25, 0.25) and serum transferrin (0.25, 0.75), and those from Michoacán ($n = 63$) show polymorphism in salivary amylase (0.03, 0.74, 0.21, 0.02), phosphogluconate dehydrogenase (0.97, 0.03), carbonic anhydrase (0.87, 0.13), esterases (EST-1: 0.94, 0.06; EST-2: 0.28, 0.72; EST-5: 0.93, 0.07), phosphoglucomutase (0.99, 0.01), isocitrate dehydrogenase (0.52, 0.48), and lactate dehydrogenase (0.02, 0.98—Sullivan and Kilpatrick 1991).

FIG. 1. *Peromyscus winkelmanni* drawn by Oscar Armendaris from specimen 27156 of the Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacionale. Collected at 5 km S, 1 km W Dos Aguas, 2,450 m, Michoacán, Mexico.

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Peromyscus winkelmanni* (adult female from 5 km S, 1 km W Dos Aguas, 2,450 m, Michoacán, México, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacionale, 27156). Greatest length of cranium is 33.02 mm. Photograph by Sergio Ticul Álvarez-Castañeda.

Peromyscus winkelmanni has fixed derived alleles at the glutamate oxaloacetic and sorbitol dehydrogenase loci, whereas other species of the *aztecus* assemblage exhibit the primitive allele at these loci; a fixed-derived allele at the MOD-1 locus was exhibited in the population of Michocan and was absent in the rest of the *aztecus* species group (Sullivan and Kilpatrick 1991).

REMARKS. In the original description of the species (Carleton 1977), *P. winkelmanni* was included with *P. aztecus*, *P. evides*, *P. hylocetes*, and *P. oaxacensis* in the *aztecus* assemblage. In a subsequent revision of the *aztecus* assemblage, Carleton (1979) relegated *P. evides*, *P. hylocetes*, and *P. oaxacensis* to subspecific status of *P. aztecus* and recognized 3 species, *P. aztecus*, *P. spicilegus*, and *P. winkelmanni*. Morphological analysis of the glans penes indicates that *P. winkelmanii* can be considered in the *boylii* or *aztecus* assemblages depending on which species is used as an outgroup (Bradley and Schmidly 1987). Sullivan et al. (1991) used biochemical analyses to test Carleton's hypothesis of the content of the *aztecus* assemblage and concluded that the forms assigned to the *aztecus* assemblage formed a monophyletic unit. Sullivan and Kilpatrick (1991) concluded that *P. winkelmanni* is the basal taxon of the *aztecus* assemblage. In a karyological analysis, *P. winkelmanni* was a sister taxa of *P. aztecus* (Smith 1990), but the *aztecus* assemblage was not monophyletic and the affinities of the *aztecus-winkelmanni* clade were with *P. truei* rather than with *P. spicilegus* or taxa of the *P. boylii* assemblage. Kilpatrick (in litt.) considers that *P. winkelmanni* is a relic of the ancestral population that gave rise to the ancestral form of all of the other taxa of the *aztecus* assemblage. I tentatively place *P. winkelmanni* in the *aztecus* assemblage, as a basal member of the clade (Sullivan et al. 1997), following Carleton (1989).

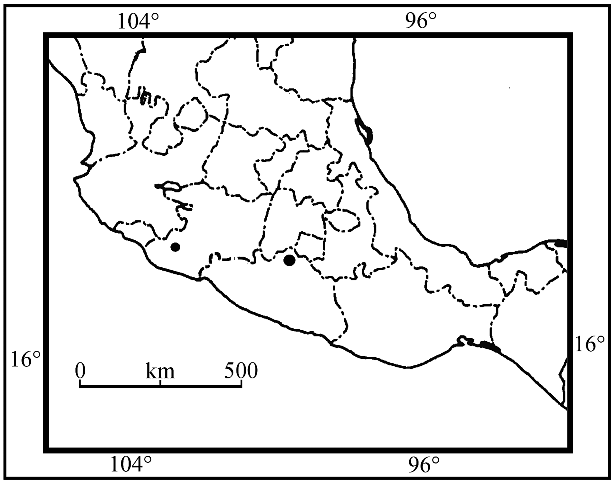

FIG. 3. Distribution of *Peromyscus winkelmanni* in south-central Mexico, taken from Carleton (1989).

Peromyscus winkelmanni is a species under special protection given by the Mexican government (Norma Oficial Mexicana 2002). Included in this category are species potentially at risk, but about which information is not available. The name *winkelmanni* honors John R. Winkelmann, who collected the original series (Carleton 1977).

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