MAMMALIAN SPECIES No. 764, pp. 1–4, 3 figs.

Peromyscus melanotis.

By Sergio Ticul Álvarez-Castañeda

Published 15 July 2005 by the American Society of Mammalogists

Peromyscus melanotis J. A. Allen and Chapman, 1897

Black-eared Mouse

Peromyscus melanotis J. A. Allen and Chapman, 1897:203. Type locality "Las Vigas, Vera Cruz [Veracruz], 8000 ft."

Peromyscus melanotis zamelas Osgood, 1909:59. Type locality "Colonia García, Chihuahua, 6700 ft."

Peromyscus cecilli Thomas, 1903:466. Type locality "Santa Barbara camp, southern slope of Mt. Orizaba [Pico de Orizaba], 12,500 ft. Puebla."

CONTEXT AND CONTENT. Order Rodentia, suborder Sciurognathi, family Muridae, subfamily Sigmodontinae, genus *Peromyscus* (Musser and Carleton 1993), subgenus *Peromyscus*. *Peromyscus melanotis* is monotypic (Hall 1981).

DIAGNOSIS. *Peromyscus melanotis* (Fig. 1) can be distinguished from all other Mexican species, except *P. maniculatus*, by its small size, short tail, and black preauricular hairs at anterior base of ear. Preauricular hairs usually form a black tuft (Hooper 1947), but tuft is very small in many specimens, so can be missed without careful attention.

Peromyscus melanotis and *P. maniculatus* are extremely similar morphologically, causing considerable taxonomic confusion (Avise et al. 1979). No measurement or characteristic can be used consistently to distinguish *P. maniculatus* from *P. melanotis* (Ramírez-Pulido 1969). In areas where *P. maniculatus labecula* and *P. melanotis* are sympatric, black tuft on *P. melanotis* is slightly smaller, braincase is broader and more rounded, interorbital space is narrow, prezygomatic notch is less prominent, auditory bulla is slightly smaller, and rostrum is decidedly longer and more slender than in *P. maniculatus labecula* (Osgood 1909).

GENERAL CHARACTERISTICS. The black-eared mouse is small in relation to other species of *Peromyscus*. Tail is sharply bicolored and very short, and pelage is usually very long and lax (Osgood 1909). Pelage is tawny ochraceous to paler yellow brown, varying from darker on upper parts to lighter on sides. Dorsum between shoulders and rump is mixed with dusky tawny and is darker than more lateral regions of trunk. Lower cheeks and narrow lateral line are tawny ochraceous. Orbital ring is very narrow and dusky. Ears are dusky brownish to black, with white edges. Whiskers have small dusky spot at base. Underparts, forefeet, and hind feet are white. Tail is well haired, slightly pencillate, and bicolored, with sooty brownish above and white below.

Summer pelage is similar but more intense in dusky areas than winter pelage (Allen and Chapman 1897; Osgood 1909). Winter-captured specimens from Coahuila are paler that those taken at same locality in warmer months (Baker 1956). Color of *P. melanotis* becomes lighter with age (Martínez-Coronel et al. 1991).

Adult females are larger than males (Martínez-Coronel et al. 1991). Mean ± *SD* measurements in millimeters, with range in parentheses, of 21 adult females (>2 years old) and 45 adult males, respectively, from La Malinche, Tlaxcala (Martínez-Coronel et al. 1991), are: total length, 155.9 ± 3.4 (140–170), 150.9 ± 2.0 (140–177); length of tail, 65.6 ± 2.4 (50–73), 63.3 ± 1.4 (49.0–75.0); length of hind foot, 20.1 ± 0.2 (18–22), 20.6 ± 0.3 (18.0–26.0); length of dry ear from crown, 17.7 ± 0.4 (15.9–20.0), 17.2 ± 0.2 (15.5–19.0); total length of skull, 26.5 ± 0.2 (25.8–27.5), 26.2 ± 0.1 (25.5–27.2); condylobasal length, 23.9 ± 0.2 (23.3–24.8), 23.6 ± 0.1 (22.9–24.6); zygomatic breadth, 13.3 ± 0.1 (12.7–13.0), 10.8 ± 0.1 (10.2–11.6); breadth of braincase, 12.0 ± 0.1 (11.5–12.4), 12.0 ± 0.1 (11.5–12.6); orbital constriction, 3.9 ± 0.0 (3.6–4.2), 3.9 ± 0.0 (3.7–4.2); length of nasals, 10.9 ± 0.1 (10.4–11.6), 10.8 ± 0.1 (10.2–11.6); alveolar length of maxillary toothrow, 3.7 ± 0.0 (3.5–3.9), 3.6 ± 0.0 (3.4–3.9). Dental formula is i 1/1, c 0/0, p 0/0, m 3/3, total 16 (Fig. 2).

Morphometric analysis of populations within the Transmexican Neovolcanic Range does not show significant geographic variation between populations (Martínez-Coronel et al. 1991).

DISTRIBUTION. *Peromyscus melanotis* is found throughout the pine–fir zone and intermixed grasslands in high mountains of Mexico, extending throughout the Neovolcanic Range and northward along the Sierra Madre Oriental and Sierra Madre Occidental (Bowers et al. 1973) to the upper mountainous elevations in southern Arizona (Fig. 3; Carleton 1989). *P. melanotis* is predicted to occur in isolated areas of the eastern Sonoran mountains (Caire 1997). No fossils are known.

FORM AND FUNCTION. Relative to other *Peromyscus*, sperm of *P. melanotis* have a slightly longer and broader head that is widest at the middle, tapering gradually to the base of the hook; base is narrow. Hook is strongly recurved and extends to dorsum from one-half to two-thirds of head length. Midpiece attachment varies from nearly central to highly eccentric. Mean ± *SE* measurements (in μm) of 10 sperm from 1 black-eared mouse are: length of head, 5.3 ± 0.07; width of head, 3.1 ± 0.08; length of midpiece, 16.7 ± 0.10; length of tail, 51.3 ± 0.71 (Linzey and Layne 1974). Sperm morphology of *P. melanotis* cannot be distinguished from that of *P. maniculatus* (Bowers et al. 1973).

Reproductive tract of male black-eared mice is similar to that of *P. maniculatus*, except that *P. melanotis* has 4 lateral ventral prostate ducts, exceeding the number in all examined specimens of *P. maniculatus*; both species have 2 medial ventral prostate ducts (Linzey and Layne 1969). The penile bulb is slightly bifurcated (Linzey and Layne 1969). Measurements (in mm) of 1 male reproductive tract are: length of testis, 8.0 by 5.7; length of vas deferens duct, 12.0; length of urethra, 21; ampullary gland, 2.5 by 3.0; vesicular gland, 9.7 by 3.3; anterior prostate, 5.5 by 2.0; dorsal prostate, 4.0 by 2.3; ventral prostate, 2.5 by 2.5; bulbourethral, 3.0 by 4.3 (Linzey and Layne 1969). Mean length of testes of 4 males captured in November was 7.2 mm (6.0–10.0 mm—Álvarez-Castañeda 1996).

Peromyscus melanotis has lower values of dopamine, norepinephrine, and serotonin in the cerebral cortex, midbrain, and cerebellum than does *P. maniculatus labecula* (Ortega-Corona et al. 1982).

Blood serum of *P. melanotis* is similar to that of *P. maniculatus*; in both species, transferrin (T) band is tall and quite wide; postalbumin (po.A) and globulin (G) bands are short, sloping away from T band in a symmetrical manner, but in *P. melanotis* globulin (G) band does not slope down as sharply as in *P. maniculatus*

FIG. 1. *Peromyscus melanotis* drawn by Oscar Armendaris from specimen 109410 (Museum of Vertebrate Zoology, University of California), from 8 miles NE Chalchicomula [Ciudad Serdan], 10,350 feet, Puebla, Mexico.

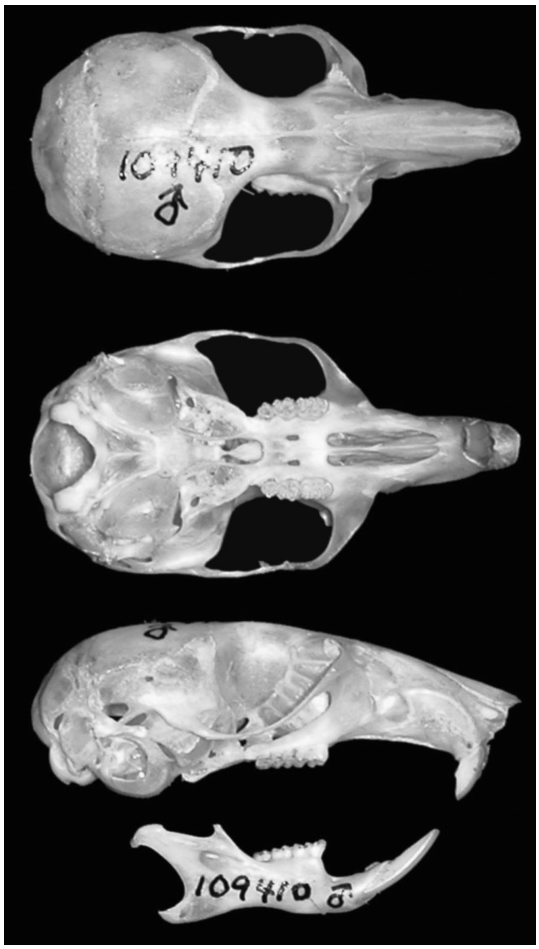

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Peromyscus melanotis* (adult, female, from 8 mi NE Chalchicomula [Ciudad Serdan], 10,350 feet, Puebla, Mexico, Museum of Vertebrate Zoology, University of California, 109410). Greatest length of cranium is 25.6 mm. Photograph by Sergio Ticul Álvarez-Castañeda.

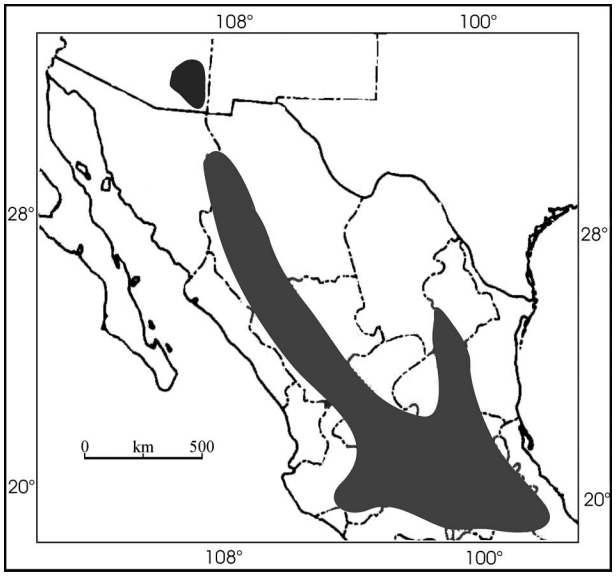

FIG. 3. Distribution of *Peromyscus melanotis* in México and United States, modified from Carleton (1989).

(Petersen 1968). The black-eared mouse has heterochromatin restricted to the centromeric regions (Robbins and Baker 1981).

ONTOGENY. Mean litter size of *Peromyscus melanotis* is 3.7–3.8 embryos (Baker 1956; Davis 1944), with a maximum of 5 embryos. Mean litter size at birth in captivity ranges from 3.5 (n = 23 litters) for black-eared mice from Durango, Mexico, to 3.8 (n = 17 litter) for mice from Distrito Federal (Bowers 1974). Pregnant females (mean number of embryos in parentheses, when available) have been recorded in January (3), April (4), May, July (3.5, range 1–5), August (5), and November (2—Álvarez-Castañeda 1996; Baker 1956; Davis 1944; Villa 1953); lactating females have been reported only in November (Álvarez-Castañeda 1996) and juveniles in June and July (Davis 1944).

One fertile cross between *P. melanotis* and *P. maniculatus* produced a litter of males, which were fertile when backcrossed to females of *P. maniculatus* (Clark 1966), but another similar mating failed to produce offspring. Of 137 interspecific crosses between *P. melanotis* and *P. maniculatus*, none produced offspring (Bowers 1974).

ECOLOGY AND BEHAVIOR. *Peromyscus melanotis* is not common in the type locality and is rare in the state of Veracruz (Hall and Dalquest 1963). The only specimens were in a canyon under logs, rocks, and clumps of zacaton grass (*Muhlenbergia macroura*—Hall and Dalquest 1963).

Peromyscus melanotis is found mainly in rocky habitats, areas with zacaton grass, marshes, and grassy and bushy areas in mesic deciduous and coniferous forests (Baker and Greer 1962; Davis 1944; Fa et al. 1996; Hooper 1968; Villa 1953). In the Transmexican Neovolcanic Range, *P. melanotis* is only present in high mountains with coniferous forest (Fa et al. 1990; Hall and Villa 1949). At lower altitudes, *P. melanotis* is replaced by *P. maniculatus labecula* (Fa et al. 1990). The 2 species are generally allopatric, but sometimes are found together (Ceballos and Galindo 1985) in ravines and clumps of grass where pine forests give way to open grassy plains. *P. maniculatus* and *P. melanotis* use similar types of plant cover. *P. melanotis* occurs predominantly in the fir and upper pine belts, slopes, and plains above tree line, and *P. maniculatus* is found in the lower parts of the fir and pine zones (Hooper 1957).

In Coahuila State, the black-eared mouse lives in the subalpine humid forest and adjacent areas of the montane mesic forest. No specimens were taken below 2,600 m or higher than 2,900 m (Baker 1956).

In the Chichinautzin Range portion of the Neovolcanic range, south of the Valley of Mexico, *P. melanotis* was the 2nd most abundant species, accounting for 28.1% of captures with a mean ± *SD* of 15.9 ± 6.4 mice/ha. The highest density was found in grasslands with 52.7 mice/ha, and density correlated negatively with altitude (Fa et al. 1990). Home range (mean ± *SD*) for the black-eared mouse at Sierra del Ajusco (3,000 m) is 420.8 ± 390.5 m² (n = 8—Fa et al. 1990). The geographic range of *P. melanotis* overlaps with that of *Liomys irroratus*, *Microtus mexicanus*, *Neotoma mexicana*, *Neotomodon alstoni*, *Peromyscus boylii*, *P. difficilis*, *P. maniculatus*, *P. truei*, *Reithrodontomys megalotis*, *Sorex vagrans*, *S. milleri*, and *Tamias bulleri* (Baker 1956; Baker and Greer 1962; Davis 1944; Davis and Russell 1953; Fa et al. 1996; Jiménez et al. 1999; Matson and Baker 1986; Villa 1953).

Black-eared mice emerge from their burrows after dark. Entrances are <2.5 cm in diameter and descend vertically into the ground. Twenty burrows of *P. melanotis* and *P. maniculatus* were found in 0.4 ha (Hall and Dalquest 1963).

The nest of 1 specimen in Veracruz was found between short grass tufts, under a rock 90 cm long and 60 cm wide. The nest was at the end of a 60-cm-long tunnel. The nest was oval, 7.5 cm long and 6.3 cm wide, and the roof was made of dry grass (Hall and Dalquest 1963).

Black-eared mice are omnivorous (Fa et al. 1990) but feed mostly on seeds and insects (Fa et al. 1996). *P. melanotis* can eat insects that contain cardenolides (ouabain, digoxin, and digitoxin), such as monarch butterflies (*Danaus plexippus*—Glendinning 1992). At the overwintering sites of monarch butterflies in Mexico, where black-eared mouse density ranges from 75 to 105 adults/ha, black-eared mice feed on an average of 40 monarchs per night, mainly those found on the ground, and they mainly eat the abdomen (Glendinning et al. 1988).

Microtus mexicanus is aggressively dominant over *P. melanotis* (Glendinning and Brower 1991), but *P. melanotis* is dominant

over *Neotomodon alstoni* (Fa et al. 1996). The black-eared mouse defends territories against other species in preferred microhabitats, but home-range overlap is low (Fa et al. 1996).

When tested for the Schweppes effect of quinine hydrochloride (QHCL), black-eared mice showed a low response to increased QHCL, hop extract, sucrose octaacetate, and tannic acid and high response to ouabain (Glendinning 1993).

Peromyscus melanotis has 5 of the 9 *Mys* retrovirus-like subfamilies (T2.5, T0.7, E1.8, E2.0, and PH1.56—Lee et al. 1996). Ectoparasites infecting *P. melanotis* include: Siphonaptera: *Atypholocera tancitari* (Barrera 1953), *Jellisonia klotsi*, *Peromyscopsylla hesperomys adelpha*, *Pleochaetis paramundus*, *P. sibynus jordani*, *Plusaetis aztecus*, *Rhadinopsylla fraternal*, *Strepsylla mina*, *Strepsylla* (Ayala-Barajas et al. 1988), *Ctenopthalmus haagi*, and *Pleochaetis mundus* (Whitaker 1968); Coleoptera: *Cryptophagus bolivari* (Barrera and Martínez 1968); Mesostigmata: *Androlaelaps circularis*, *A. debilis*, *A. fahrenholzi*, *Haemogamasus keegani*, and *Hirstionyssus breviseta* (Bassols 1981); and Trombicuidae: *Euschoengastia ampliseta* and *E. criceticola* (Loomis and Somerby 1966).

GENETICS. The karyotype of *P. melanotis* is 2n = 30 and FN = 62 (Bowers et al. 1973; Hsu and Arrighi 1968; Kreizinger and Shaw 1970) with a large submetacentric X chromosome and a medium-sized submetacentric Y chromosome. Pair 12 is biarmed acrocentric, but C-banded preparations distinguish the short arms (Greenbaum et al. 1978a). No polymorphism was detected with G- and C-banded karyotypes. The karyotype of *P. melanotis* is similar to the hypothetical primitive karyotype of the *P. maniculatus* complex (Bowers et al. 1973; Greenbaum and Baker 1978).

The complete cytochrome-*b* sequence of *P. melanotis* is similar to those of *P. keeni*, *P. maniculatus*, *P. polionotus*, and *P. sejugis* (Hogan et al. 1997). The patterns of variation of 25 allozymes for specimens of *P. melanotis* from the Distrito Federal are known (Roger and Engstrom 1992). Estimates of genetic variability, based on 21 genetic loci, show a heterozygosity per individual between 0.0 and 3.5 and polymorphism per population between 0.0 and 9.5 (Avise et al. 1979). Populations from Arizona were polymorphic in phosphoglucomutase (PGM-1, 0.73–0.27) and glutamate oxaloacetate transaminase (GOT-1, 0.88–0.12); those of the Distrito Federal were polymorphic in lactate dehydrogenase (LDH-1, 0.67–0.33) and hemoglobin (Hb, 0.34–0.33), and those of Veracruz were polymorphic in phosphoglucose isomerase (PGI-1, 0.83–0.17—Avise et al. 1979). Weighted mean heterozygosity was H = 2.6%, and mean genetic similarity among 4 populations was 0.917 (0.878–0.981—Avise et al. 1979).

REMARKS. *Peromyseus melanotis* derives from *P. maniculatus*; probably *P. melanotis* is a "peripheral insolate" of *P. maniculatus* ancestral stock (Blair 1950; Lawlor 1974). Electrophoretic analysis (Greenbaum et al. 1978b) supports an independent evolution of both species. *P. melanotis* derives from a pre-*maniculatus* stock, earlier than *P. oreas* and *P. polinotus* (Greenbaum et al. 1978b; Robbins and Baker 1981). Multivariate analysis indicated some convergence in morphometric characters, so specimens can be misclassified (Bowers et al. 1973). The specific name *melanotis* is derived from the Greek words *melano* black and *otis* ear.

Editing staff at CIBNOR improved the English text. Financial support was provided by Consejo Nacional de Ciencia y Tecnología (CONACYT grant 39467Q, SEMARNAP-2002-COL-019).

LITERATURE CITED

Allen, J. A., and F. M. Chapman. 1897. On a collection of mammals from Jalapa and Las Vigas, State of Vera Cruz, Mexico. American Museum of Natural History 9:197–268.

Álvarez-Castañeda, S. T. 1996. Los mamíferos del estado de Morelos. Centro de Investigaciones Biológicas del Noroeste, La Paz, Baja California Sur, México.

Avise, C. J., M. H. Smith, and R. K. Selander. 1979. Biochemical polymorphism and systematics in the genus *Peromyscus* VII. Geographic differentiation in members of the *truei* and *maniculatus* species group. Journal of Mammalogy 60:177–192.

Ayala-Barajas, R., J. C. Morales-Muciño, N. Wilson, J. E. Llorente-Bousquets, and H. E. Ponce-Ulloa. 1988. Catálogo de las pulgas (Insecta: Siphonaptera) en el museo de Zoología, Facultad de Ciencias Universidad Nacional Autónoma de México. Colección Alfredo Barrera. Serie Catálogos del Museo de Zoología "Alfonso Herrera" 1:1–102.

Baker, R. H. 1956. Mammals of Coahuila, Mexico. University of Kansas Publications, Museum of Natural History 9:125–335.

Baker, R. H., and J. K. Greer. 1962. Mammals of the Mexican state of Durango. Publications of the Museum, Michigan State University Biological series 2:29–154.

Barrera, A. 1953. Sinopsis de los sifonapteros de la Cuenca de Mexico (Ins., Siph). Anales de la Escuela Nacional de Ciencias Biológicas 7:155–245.

Barrera, A., and A. Martínez. 1968. Nuevo criptofágido mexicano: *Cryptophagus bolivari* nov. sp. (ins. Col.). Anales de la Escuela Nacional de Ciencias Biológicas 17:151–156.

Bassols, B. I. 1981. Catálogo de los ácaros Mesostigmata de mamíferos de México. Anales de la Escuela Nacional de Ciencias Biológicas 24:9–49.

Blair, W. F. 1950. Ecological factors in the speciation of *Peromyscus*. Evolution 4:253–275.

Bowers, J. H. 1974. Genetic compatibility of *Peromyscus maniculatus* and *Peromyscus melanotis*, as indicated by breeding studies and morphology. Journal of Mammalogy 55:720–737.

Bowers, J. H., R. J. Baker, and M. H. Smith. 1973. Chromosomal, electrophoretic, and breeding studies of selected populations of deer mice (*Peromyscus maniculatus*) and black-eared mice (*P. melanotis*). Evolution 27:378–386.

Caire, W. 1997. Annotated checklist of the recent land mammals of Sonora, Mexico. Pp. 69–80 in Life among the muses: papers in honor of James S. Findley (T. L. Yates, W. L. Gannon, and D. E. Wilson, eds.). Museum of Southwestern Biology, University of New Mexico, Albuquerque.

Carleton, M. D. 1989. Systematic and evolution. Pp. 7–141 in Advances in the study of *Peromyscus* (Rodentia) (G. L. Kirkland, Jr., and J. N. Layne, eds.). Texas Tech University, Lubbock.

Ceballos, G., and C. Galindo. 1985. Mamíferos de la cuenca de México. Limusa, México City, México.

Clark, D. L. 1966. Fertility of *Peromyscus maniculatus* × *Peromyscus melanotis* cross. Journal of Mammalogy 47:340.

Davis, W. B. 1944. Notes on Mexican mammals. Journal of Mammalogy 25:370–403.

Davis, W. B., and R. J. Russell. 1953. Aves y mamíferos del estado de Morelos. Revista de la Sociedad Mexicana de Historia Natural 14:77–147.

Fa, J. E., J. Lopez-Paniagua, F. J. Romero, J. L. Gomez, and J. C. Lopez. 1990. Influence of habitat characteristics on small mammals in a Mexican high-altitude grassland. Journal of Zoology (London) 221:275–292.

Fa, J. E., V. Sanchez-Cordero, and A. Mendez. 1996. Interspecific agonistic behavior in small mammals in a Mexican high-elevational grassland. Journal of Zoology (London) 239: 396–401.

Glendinning, J. I. 1992. Effectiveness of cardenolides as feeding deterrents of *Peromyscus* mice. Journal of Chemical Ecology 18:1559–1575.

Glendinning, J. I. 1993. Preference and aversion for deterrent chemicals in two species of *Peromyscus* mouse. Physiology and Behavior 54:141–150.

Glendinning, J. I., and L. P. Brower. 1991. Feeding and breeding responses of five mice species to overwintering aggregations of the monarch butterflies. Journal of Animal Ecology 59:1091–1112.

Glendinning, J. I., A. A. Mejia, and L. P. Brower. 1988. Behavioral and ecological interactions of foraging mice (*Peromyscus melanotis*) with overwintering monarch butterflies (*Danaus plexippus*) in Mexico. Oecologia 75:222–227.

Greenbaum, I. F., and R. J. Baker. 1978. Determination of the primitive karyotype for *Peromyscus*. Journal of Mammalogy 59:820–834.

Greenbaum, I. F., R. J. Baker, and J. H. Bowers. 1978a. Chromosomal homology and divergence between sibling species of deer mice: *Peromyscus maniculatus* and *P. melanotis* (Rodentia, Cricetidae). Evolution 32:334–341.

Greenbaum, I. F., R. J. Baker, and P. K. Ramsey. 1978b. Chromosomal evolution and the mode of speciation in three species of *Peromyscus*. Evolution 32:646–654.

Hall, E. R. 1981. The mammals of North America. Second edition. Volume 2. John Wiley & Sons, New York.

HALL, E. R., AND W. W. DALQUEST. 1963. The mammals of Veracruz. University of Kansas Publications, Museum of Natural History 14:165–362.

HALL, E. R., AND B. VILLA. 1949. An annotated checklist of the mammals of Michoacan, Mexico. University of Kansas Publications, Museum of Natural History 1:431–472.

HOGAN, K. M., S. K. DAVIS, AND I. F. GREENBAUM. 1997. Mitochondrial-DNA analysis of the systematic relationships within the *Peromyscus maniculatus* species group. Journal of Mammalogy 78:733–743.

HOOPER, E. T. 1947. Notes on Mexican mammals. Journal of Mammalogy 28:40–57.

HOOPER, E. T. 1957. Records of Mexican mammals. Occasional Papers of the Museum of Zoology, University of Michigan 589: 1–9.

HOOPER, E. T. 1968. Classification. Pp. 27–74 in Biology of *Peromyscus* (Rodentia) (J. A. King, ed.). Special Publication, The American Society of Mammalogists 2:1–593.

HSU, T. C., AND F. E. ARRIGHI. 1968. Chromosomes of *Peromyscus* (Rodentia, Cricetidae). I. Evolutionary trends in 20 species. Cytogenetics 7:417–446.

JIMÉNEZ, A., M. A. ZÚÑIGA, AND J. A. NIÑO. 1999. Mamíferos de Nuevo León, México. Universidad Autónoma de Nuevo León, Monterrey, México.

KREIZINGER, J. D., AND M. W. SHAW. 1970. Chromosomes of *Peromyscus* (Rodentia, Cricetidae). II. The Y chromosome of *Peromyscus maniculatus*. Cytogenetics 9:52–70.

LAWLOR, T. E. 1974. Chromosomal evolution in *Peromyscus*. Evolution 28:688–691.

LEE, R. N., J. C. JASKULA, R. A. VAN DEN BUSSCHE, R. J. BAKER, AND H. A. WICHMAN. 1996. Retrotransposon *Mys* was active during evolution of the *Peromyscus leucopus–maniculatus* complex. Journal of Molecular Evolution 42:44–51.

LINZEY, A. V., AND J. N. LAYNE. 1969. Comparative morphology of the male reproductive tract in the rodent genus *Peromyscus* (Muridae). American Museum Novitates 2355:1–47.

LINZEY, A. V., AND J. N. LAYNE. 1974. Comparative morphology of spermatozoa of the rodents genus *Peromyscus* (Muridae). American Museum Novitates 2532:1–20.

LOOMIS, R. B., AND R. E. SOMERBY. 1966. New species and new records of *Euschoengastia* (Acarina, Trombiculidae) from western Mexico. Bulletin of the South California Academy of Sciences 65:211–224.

MARTÍNEZ-CORONEL, M., J. RAMÍREZ-PULIDO, AND T. ÁLVAREZ. 1991. Variación intrapoblacional e interpoblacional de *Peromyscus melanotis* (Rodentia: Muridae) en el Eje Volcánico Transverso, México. Acta Zoológica Mexicana, nueva serie 47: 1–51.

MATSON, J. O., AND R. H. BAKER. 1986. Mammals of Zacatecas. Special Publications, The Museum, Texas Tech University 24: 1–88.

MUSSER, G. G., AND M. D. CARLETON. 1993. Family Muridae. Pp. 501–756 in Mammal species of the world: a taxonomic and geographic reference (D. E. Wilson and D. M. Reeder, eds.). Second edition. Smithsonian Institution Press, Washington, D.C.

ORTEGA-CORONA, B. G., A. MARTINEZ-GUERERO, N. ESPARZA-AVALOS, AND S. SANTILLAN-ALARCON. 1982. Comparative study of monoamine levels in discrete brain areas of five rodent species. Comparative Biochemistry and Physiology, C. Toxicology and Pharmacology 71:83–87.

OSGOOD, W. H. 1909. Revision of the mice of the American genus *Peromyscus*. North American Fauna 28:1–285.

PETERSEN, M. K. 1968. Electrophoretic blood-serum patterns in selected species of *Peromyscus*. American Midland Naturalist 79:130–148.

RAMÍREZ-PULIDO, J. 1969. Contribución al conocimiento de los mamíferos del Parque Nacional "Lagunas de Zempoala", Morelos, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 40:253–290.

ROBBINS, L. W., AND R. J. BAKER. 1981. An assessment of the nature of chromosomal rearrangements in 18 species of *Peromyscus* (Rodentia: Cricetidae). Cytogenetics and Cell Genetics 31:194–202.

ROGER, D. S., AND M. D. ENGSTROM. 1992. Evolutionary implications of allozymic variation in tropical *Peromyscus* of the *mexicanus* species group. Journal of Mammalogy 73:55–69.

VILLA, B. 1953. Mamíferos silvestres del Valle de México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México 23:269–492.

WHITAKER, J. O., JR. 1968. Parasites. Pp. 254–311 in Biology of *Peromyscus* (Rodentia) (J. A. King, ed.). Special Publication, American Society of Mammalogists 2:1–593.

Associate editors of this account were GAIL MICHENER and PAMELA OWEN. Editor was VIRGINIA HAYSSEN.

SERGIO TICUL ÁLVAREZ-CASTAÑEDA, CENTRO DE INVESTIGACIONES BIOLÓGICAS DEL NOROESTE, S. C., MAR BERMEJO 195. APARTADO POSTAL 128, LA PAZ, BAJA CALIFORNIA SUR, C.P. 23000, MEXICO.