

Perognathus alticolus. By Troy L. Best

Published 2 June 1994 by The American Society of Mammalogists

Perognathus Wied, 1839

Perognathus Wied, 1839:368. Type species Perognathus fasciatus Wied, 1839.

**CONTEXT AND CONTENT.** Order Rodentia, Suborder Sciurognathi, Superfamily Geomyoidea, Family Heteromyidae, Subfamily Perognathinae, Genus Perognathus. The genus Perognathus is distinguished as follows: posterior one-third to one-half of sole of hind foot with sparse covering of short hairs; pelage relatively fine and soft, never with stiff, spine-like bristles on rump; no long, stiff, coarse hairs projecting across anterior margin of ear pinna; antitragus of ear pinna usually not lobed; mastoid bulla projecting posteriorly beyond the plane of the occiput; posteromedial border of mastoid bulla not projecting as a distinct indentation into the supraoccipital; interparietal width nearly always less than interorbital breadth (Williams et al., 1993). A key to the nine species of Perognathus follows (modified from Williams et al., 1993):

- 1 Antitragus of ear pinna lobed ..... 2
- Antitragus of ear pinna not lobed ..... 3
- 2 Inner surface of ear pinna with white or yellowish hairs; distal one-third of tail with blackish hairs dorsally; mastoid bulla forms small, sharp indentation in exoccipital; occurring only in southern California in the transverse ranges and the San Bernardino Mountains ..... *P. alticolus*
- Hairs of inner surface of ear pinna buffy rather than white or yellowish; distal one-third of tail with mix of sooty brown and black hairs dorsally; mastoid bulla with little or no indentation into exoccipital; occurring on the Columbia Plateau, in the Great Basin, and the eastern slopes of the Sierra Nevada ..... *P. parvus*
- 3 Length of tail averages less than length of head and body (a few individuals have tails longer than length of head and body); not occurring west of eastern Utah or westcentral Arizona, but found in Sonora along the Gulf of California coast ..... 4
- Length of tail averages greater than length of head and body (a few individuals have tails shorter than length of head and body); not occurring east of central Arizona and southcentral Utah ..... 9
- 4 Interparietal length <2.9 mm; length of tail <66 mm (average ≤60 mm); interorbital breadth average ≤4.7 mm and ranges <5.0 mm; width of interparietal <4.2 mm, average ≤3.6 mm ..... 5
- Interparietal length ≥2.9 mm; length of tail averages >60 mm; interorbital breadth ≥4.5 mm, average ≥4.8 mm; width of interparietal ≥3.15 mm, average ≥4.5 mm ..... 6
- 5 Length of tail averages ≥56 mm; interorbital breadth averages ≥4.5 mm; width of interparietals averages ≥3.3 mm; pelage sleek, not noticeably lax; dorsal color yellowish, tinged with blackish from black-tipped hairs; slight contrast between the darker mid-dorsal and paler dorsolateral color; pale postauricular spot relatively small ..... *P. merriami*
- Length of tail averages ≤55 mm; interorbital breadth averages ≤4.5 mm; width of interparietals averages ≤3.3 mm; pelage lax, not sleek in appearance; dorsal color buffy yellow, with a pinkish hue and a tinge of blackish from black-tipped hairs; dark mid-dorsal area contrasting markedly with paler dorsolateral color; pale postauricular spot relatively large ..... *P. flavus*
- 6 Occurring on the Great Plains, or in the northern Chihuahuan Desert region in southern Arizona and New Mexico, western Texas, and northern Chihuahua ..... 7

- Occurring on the intermountain plateaus and in the basins of southcentral and southwestern Wyoming, eastern Utah, southern and western Colorado, eastern Arizona, and New Mexico ..... 8
- 7 Dorsum yellowish with an olive-yellow (olivaceous) tone; length of interparietal generally <3.0 mm; length of head and body averaging >68 mm; not occurring south and east of western Nebraska on the Great Plains, nor in southeastern Colorado along the eastern front of the Rocky Mountains ..... *P. fasciatus*
- Dorsum yellowish with yellowish-orange tone; length of interparietal generally >3.0 mm; length of head and body averaging <66 mm; not occurring north and west of a line extending from about the east base of the Rocky Mountains in northern Colorado, to southcentral North Dakota ..... *P. flavescens*
- 8 Dorsum yellowish with an olive-yellow (olivaceous) tone; least interbullar distance (on dorsal surface of skull) averaging ≥4.3 mm; width of first upper molar ≤1.16 mm (average 1.10); not occurring south of the Uintah Basin of Utah and Colorado ..... *P. fasciatus*
- Dorsum yellowish with yellowish-orange tone; least interbullar distance averaging <4.0 mm, generally not >4.3 mm; width of first upper molar ≥1.13 (average 1.22); not occurring north of the Uintah Basin of Colorado and Utah ..... *P. flavescens*
- 9 Not occurring in California ..... 10
- Occurring in California ..... 11
- 10 Greatest length of skull generally <23.0 mm; frontonasal length averaging less than ca. 15 mm; length of hind foot ≤20 mm (average ≤19 mm) ..... *P. longimembris*
- Greatest length of skull generally >23.0 mm; frontonasal length averaging >15.1 mm; length of hind foot ≥19 mm (average >20 mm) ..... *P. amplus*
- 11 Occurring in central California in the San Joaquin and Sacramento valleys, north of the Tehachapi Mountains ..... *P. inornatus*
- Occurring in southern California from the Tehachapi Mountains southward ..... 12
- 12 Occipitonasal length of adults (permanent upper premolar with moderate to heavy wear) generally >22.5 mm ..... *P. inornatus*
- Occipitonasal length of adults (permanent upper premolar with moderate to heavy wear) generally <22.1 mm ..... *P. longimembris*

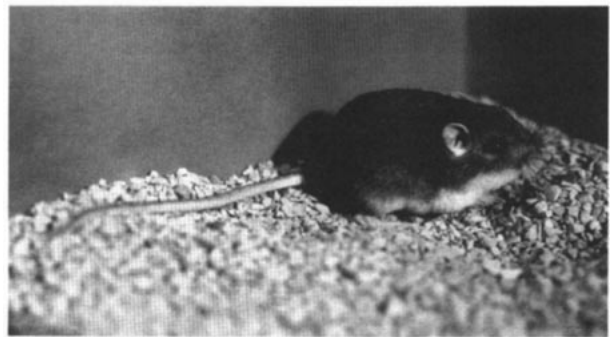


FIG. 1. Perognathus alticolus inexpectatus from Kern Co., California. Photograph courtesy of J. M. Sulentic.



FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Perognathus alticolus* from Squirrel Inn, 1,650 m, San Bernardino Mountains, San Bernardino Co., California (female, Museum of Vertebrate Zoology, University of California, Berkeley 31837). Greatest length of cranium is 21.8 mm. Photographs by T. H. Henry.

### *Perognathus alticolus* Rhoads, 1894

#### White-eared Pocket Mouse

*Perognathus alticolus* Rhoads, 1894:412. Type locality Squirrel Inn, near Little Bear Valley, 5,500 feet, San Bernardino Co. (Miller and Kellogg, 1955:367), "San Bernardino Mts., California."

*Perognathus alticola*: Osgood, 1900:9. Alternative spelling of name.

**CONTEXT AND CONTENT.** Context noted in generic summary above. Two subspecies of *P. alticolus* are recognized (Hall, 1981):

*P. a. alticolus* Rhoads, 1894:412, see above.

*P. a. inexpectatus* Huey, 1926:121. Type locality "14 miles west of Lebec, Kern County, California, altitude 6,000 feet."

**DIAGNOSIS.** *Perognathus alticolus* (Fig. 1) can be distinguished from *P. parvus* by its smaller average size, white or yellowish hairs on the inner surface of the pinna, a tail with more blackish

hairs on the distal one-third of the dorsal surface, and a more pronounced indentation of the mastoid bulla into the border of the exoccipital. *P. alticolus* can be distinguished from all other species of *Perognathus* by its lobed antitragus and more prominent crest on the distal portion of the tail (Williams et al., 1993). Cranially, *P. alticolus* may be distinguished from *P. flavescens* and *P. inornatus* by the well-defined separation of the auditory bullae ventrally. The lower premolar of *P. alticolus* is similar to that of *P. inornatus*, but the mastoids of *P. inornatus* are much larger than those of *P. alticolus*. *P. alticolus* is larger than *P. flavescens* and *P. inornatus*, less yellow than *P. flavescens*, and more lined with black than *P. inornatus* (Rhoads, 1894).

**GENERAL CHARACTERS.** The size of *P. alticolus* is medium-large for the genus (Best, 1993; Williams et al., 1993). The pelage is soft and full. Dorsally, the white-eared pocket mouse is yellowish brown and heavily lined with blackish (Rhoads, 1894); underparts are white (Hall, 1981). Bases of the dorsal hairs are plumbeous for 75% of their length (Rhoads, 1894). The lateral line usually is faintly expressed. The tail is bicolored or tricolored; dorsally the color of the tail is like the upperparts anteriorly, but shades to dusky or black at the tip, and it is white ventrally (Hall, 1981). The length of the tail is equal to or slightly longer than length of the head and body, and the tail is slightly crested for the distal one-third. The antitragus of the ear pinna is lobed and the inner side of the ear pinna has white or yellowish hairs. The auditory bullae are relatively small, the posterior borders of the mastoid bullae are about even with the most posterior part of the supraoccipital, and the mastoid bulla forms small indentations in the border of the exoccipital at the back of the skull (Fig. 2). The ascending branches of the supraoccipital are relatively broad and the interorbital region is broad. Compared with most subspecies of *P. parvus*, *P. alticolus* is small and its interparietal is compressed. The phallus and baculum are relatively short compared with *P. parvus*, and short, relative to length of head and body, for the genus (Williams et al., 1993).

Compared with *P. a. alticolus*, *P. a. inexpectatus* averages larger, has a darker, tricolored tail, and the black tip extends dorsally for at least one-half the length of the tail. In addition, the ears are dark, instead of pale as in *P. a. alticolus*, and more pointed (Huey, 1926). *P. a. inexpectatus* has a relatively small and square-shaped interparietal, whereas in *P. a. alticolus* the interparietal is relatively large and pentagon shaped (Sulentich, 1983). Average and range of measurements (in mm) of *P. a. alticolus* and *P. a. inexpectatus* (genders combined), respectively, are: total length, 155 (142-177), 155 (130-183); length of tail, 80 (70-95), 78 (61-97); length of hind foot, 21 (19-23), 21 (19-24); length of ear, 6 (5-6), 8 (7-9); greatest length of cranium, 24.1 (22.5-26.1), 23.9 (21.9-25.9); basiocranial length, 21.4 (20.0-25.3), 21.4 (20.4-23.0); greatest breadth of cranium, 12.3 (11.7-13.1), 12.6 (12.0-13.5); nasal length, 9.2 (8.2-11.0), 8.9 (7.3-9.9); maxillary length, 10.6 (8.0-13.9), 10.6 (10.0-11.4); least interorbital breadth, 5.7 (5.2-6.3), 5.4 (4.9-6.0); length of mandible, 12.8 (11.9-14.2), 12.8 (12.2-14.0); condylobasal length of cranium, 23.3 (20.9-25.2), 23.1 (21.1-25.3); length of maxillary toothrow, 3.5 (2.9-3.8), 3.2 (2.9-3.8); length of molar, 0.6 (0.4-0.8), 0.7 (0.5-0.8); width of molar, 1.1 (1.0-1.2), 1.1 (1.0-1.2); diameter of foramen magnum, 3.7 (3.3-4.1), 3.6 (3.0-4.1); separation of auditory bullae, 0.3 (0.0-0.6), 0.3 (0.1-0.8); greatest height of mastoid, 5.8 (4.9-6.6), 6.1 (5.4-6.7); greatest width of interparietal, 5.0 (4.5-5.7), 4.3 (3.4-5.4); greatest width of maxillary arch, 11.8 (10.8-13.0), 11.8 (10.4-13.0); greatest width of auditory bullae, 6.1 (5.6-6.6), 6.3 (5.4-6.9); posterior margin of the premaxillae and nasals, 0.5 (0.4-0.9), 0.5 (0.0-1.0); greatest height of mandible, 4.8 (4.0-5.5), 4.8 (4.3-5.2); constriction of occipital, 1.3 (1.0-1.5), 1.1 (0.8-1.3—Sulentich, 1983).

The white-eared pocket mouse is the most sexually dimorphic species of *Perognathus*. Males are significantly larger than females in total length, length of body, length of tail, length of hind foot, basal length of cranium, greatest length of cranium, spread of maxillary arch, interorbital width, nasal length, intermaxillary width, alveolar length, basioccipital length, greatest depth of cranium, greatest width of cranium, zygomatic width, and nasal width. Average measurements (in mm) of adult males and females, respectively, are: total length, 163.6, 149.5; length of body, 77.6, 72.5; length of tail, 86.0, 77.1; length of hind foot, 21.9, 20.7; length of ear, 5.9, 5.6; basal length of cranium, 15.3, 14.6; greatest length of cranium, 24.9, 23.8; maxillary arch spread, 12.0, 11.5; interorbital width,

6.1, 5.8; nasal length, 10.0, 9.2; intermaxillary width, 4.7, 4.6; alveolar length, 3.8, 3.7; lacrimal length, 1.6, 1.7; maxillary arch width, 1.2, 1.2; basioccipital length, 3.9, 3.7; greatest depth of cranium, 8.2, 8.0; greatest width of cranium, 12.9, 12.4; zygomatic width, 12.4, 11.8; nasal width, 2.6, 2.5 (Best, 1993).

**DISTRIBUTION.** The white-eared pocket mouse occupies arid shrub and forest communities in southcentral California, in the transverse ranges of Kern and Los Angeles counties, and the San Bernardino Mountains, San Bernardino Co. (Williams et al., 1993) at elevations  $\geq 1,500$  m (Grinnell, 1933; Stephens, 1906). *P. a. alticolus* is known only from arid Ponderosa pine (*Pinus ponderosa*) communities in the vicinity of Little Bear Valley and Strawberry Peak, San Bernardino Mountains, San Bernardino Co., California. *P. a. inexpectatus* occupies arid shrub-steppe communities in the Tehachapi Mountains of southcentral California, from the vicinity of Tehachapi Pass, Kern Co., on the northeast to the vicinity of Mount Pinos, Ventura Co., on the northwest, and Elizabeth and Quail lakes, Los Angeles Co., on the south (Fig. 3; Williams et al., 1993).

**FOSSIL RECORD.** The genus *Perognathus* is known from the Miocene (Wood, 1935). No fossils of *P. alticolus* are known.

**FORM AND FUNCTION.** As in all *Perognathus*, the dental formula of *P. alticolus* is  $i\ 1/1, c\ 0/0, p\ 1/1, m\ 3/3$ , total 20 (Ingles, 1965). *P. alticolus* has a medial, external supraoccipital crest. The crest extends dorsally from the superior margin of the foramen magnum, spreads laterally, and approaches the posterior border of the interparietal. The interparietal bone of *P. a. inexpectatus* is relatively square in shape, the lateral sides are straight and parallel, and the anterior side is rounded and extends slightly forward. In *P. a. alticolus*, the sides of the interparietal are relatively straight and spreading anteriorly (Sulentich, 1983).

The tip of the tail of *P. alticolus* is pectinate and is 102% of the length of head and body (Hatt, 1932). In *Perognathus*, specialized sebaceous caudal glands occur ca. 25–33% of the distance from the base to the tip of the tail and are restricted to the ventral surface. Compared with other species of *Perognathus*, however, the sebaceous glands associated with the hair follicles of the ventral surface of the tail in *P. alticolus* are not significantly enlarged or modified (Quay, 1965).

Average and range of measurements (in mm) of the phallus of *P. a. inexpectatus* are: total length of glans, 4.6 (4.4–4.7); proximal length of glans, 3.4 (3.3–3.5); distal diameter of glans, 1.2 (1.0–1.3); proximal diameter of glans, 1.3 (1.3–1.4); length of protractile tip, 1.5 (1.4–1.7); total length of baculum, 6.2 (6.2–6.3); diameter of middle of baculum, 0.4 (0.4–0.4); diameter of base of baculum, 1.1 (0.9–1.2); distal curvature of baculum,  $148^\circ$  ( $140$ – $160^\circ$ —Sulentich, 1983). Nothing is known about the ontogeny and reproduction of *P. alticolus*.

Average body temperatures (in  $^\circ\text{C}$ ) of *P. alticolus* at different ambient temperatures (in  $^\circ\text{C}$ ), respectively, are: 36.17, 2; 35.73, 7; 36.17, 12.5; 34.60, 17; 34.73, 22.5; 35.27, 27; 36.23, 32; 40.13, 37. Abdominal temperatures are significantly lower at ambient temperatures of 16 and 22.5 $^\circ\text{C}$  than at 2 and 32 $^\circ\text{C}$ . Death occurs within 1 h at ambient temperatures of 40 $^\circ\text{C}$  and at body temperatures  $>43^\circ\text{C}$  (Chew et al., 1967).

**ECOLOGY.** The white-eared pocket mouse lives among Ponderosa pines and on the dry floor of open pine forests where bracken ferns (*Pteridium aquilinum*) grow (Grinnell, 1933; Stephens, 1906). It also occupies grassy flats among scattered Ponderosa pines and occurs in Joshua tree (*Yucca brevifolia*) and pinyon-juniper (*Pinus-Juniperus*) woodland habitats. At lower elevations, it occurs in chaparral and coastal-sage communities and rangeland habitat composed mainly of introduced grasses. Much of its range is used as cattle range that supports a variety of introduced grasses (Sulentich, 1983). It also occurs in habitat dominated by *Salsola*, e.g., fallow grain fields (D. F. Williams, in litt.).

In captivity, *P. alticolus* ate rolled oats, sunflower seeds, and vegetable greens (Chew et al., 1967), but nothing is known of its natural diet. No parasites are known (Whitaker et al., 1993).

No specimens of *P. a. alticolus* have been obtained since 1934 (D. F. Williams, in litt.). *P. a. inexpectatus* also is uncommon. Apparently the entire distribution of *P. alticolus* is represented by allopatric populations (Sulentich, 1983). This species has been proposed for listing as a threatened and endangered species by the

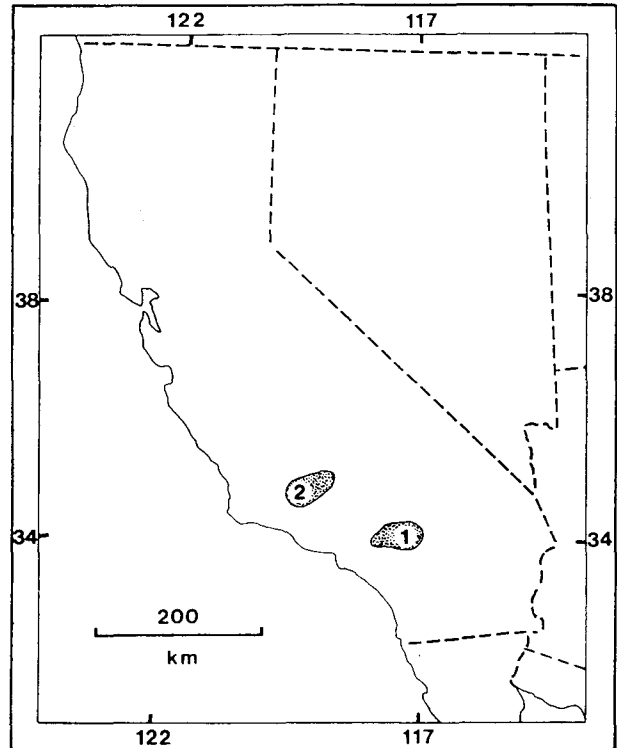


FIG. 3. Distribution of *Perognathus alticolus* in California: 1, *P. a. alticolus*; 2, *P. a. inexpectatus* (Hall, 1981).

United States Fish and Wildlife Service (Dunlop, 1989; Potter, 1982; Smith, 1985) and is considered endangered by the state of California (J. Gustafson, in litt.).

**GENETICS.** The karyotype of *P. a. alticolus* is not known (Sulentich, 1983). However for *P. a. inexpectatus*, the diploid number of chromosomes is 54 and the fundamental number is 74. There are 11 biarmed and 15 acrocentric autosomal pairs. The X chromosome is a large subtelocentric and the Y is a small acrocentric (Williams, 1978a). Based on an examination of 12 allozymes, *P. a. inexpectatus* is heterozygous for mannose phosphate isomerase (Sulentich, 1983).

**REMARKS.** *Perognathus alticolus* is closely related, and perhaps only subspecifically distinct from *P. parvus* (Williams et al., 1993). The *parvus* species group (*P. alticolus* and *P. parvus*) exhibits considerable diversity in chromosome structure (Williams, 1978a) and biochemical variation (Sulentich, 1983). However, in a phenetic analysis of morphologic characters, *P. alticolus* was not particularly similar to any other member of the genus (Best, 1993).

Based on qualitative characters of the interparietal bone and morphometric analysis, *P. a. inexpectatus* may be specifically distinct from *P. a. alticolus* (Sulentich, 1983). However, greater variation is present in size and proportions of the interparietals of *P. parvus* (e.g., those of *P. p. bullatus* are extremely compressed compared with those of adjacent populations of *P. p. clarus* in eastern Utah), and variation in size and shape of the interparietals in *P. flavescens* and *P. fasciatus* were shown to be strongly related to degree of bullar inflation and significantly correlated with degree of environmental aridity (Williams, 1978b; Williams and Genoways, 1979; Williams et al., 1993).

*Perognathus* is from the Greek *pera* meaning pouch and *gnathos* meaning jaw. The specific epithet *alticolus* is from the Latin *altus* meaning high and *colo* meaning to inhabit (Jaeger, 1955), possibly in reference to its mountain habitat (Williams et al., 1993).

I thank L. L. Thornton, A. M. Coffman, and other personnel in the Interlibrary Loan Department at Auburn University R. B. Draughon Library for assistance in obtaining articles from other institutions, and K. A. Howard for preparing Fig. 3. R. S. Lishak, R. E. Martin, J. O. Matson, D. F. Williams, and L. C. Wit critically evaluated an early draft of the manuscript. This is journal article no. 15-923264 of the Alabama Agricultural Experiment Station.

## LITERATURE CITED

- BEST, T. L. 1993. Patterns of morphologic and morphometric variation in heteromyid rodents. Pp. 197-235, in *Biology of the Heteromyidae* (H. H. Genoways and J. H. Brown, eds.). Special Publication, The American Society of Mammalogists, 10:1-719.
- CHEW, R. M., R. G. LINDBERG, AND P. HAYDEN. 1967. Temperature regulation in the little pocket mouse, *Perognathus longimembris*. *Comparative Biochemistry and Physiology*, 21: 487-505.
- DUNLOP, B. N. 1989. Endangered and threatened wildlife and plants; animal notice of review. *Federal Register*, 54(4):554-579.
- GRINNELL, J. 1933. Review of the Recent mammal fauna of California. University of California Publications in Zoology, 40: 71-234.
- HALL, E. R. 1981. The mammals of North America. Second ed. John Wiley & Sons, New York, 1:1-600 + 90.
- HATT, R. T. 1932. The vertebral columns of ricochetal rodents. *Bulletin of the American Museum of Natural History*, 63:599-738.
- HUEY, L. M. 1926. A new *Perognathus* from the vicinity of Mount Pinos, Kern County, California. *Proceedings of the Biological Society of Washington*, 39:121-122.
- INGLES, L. G. 1965. Mammals of the Pacific states: California, Oregon, and Washington. Stanford University Press, Stanford, California, 506 pp.
- JAEGER, E. C. 1955. A source-book of biological names and terms. Third ed. Charles C Thomas Publisher, Springfield, Illinois, 323 pp.
- MILLER, G. S., JR., AND R. KELLOGG. 1955. List of North American Recent mammals. *Bulletin of the United States National Museum*, 205:1-954.
- OSGOOD, W. H. 1900. Revision of the pocket mice of the genus *Perognathus*. *North American Fauna*, 18:1-73.
- POTTER, J. C. 1982. Endangered and threatened wildlife and plants; review of vertebrate wildlife for listing as endangered or threatened species. *Federal Register*, 47(251):58454-58460.
- QUAY, W. B. 1965. Variation and taxonomic significance in the sebaceous caudal glands of pocket mice (Rodentia: Heteromyidae). *The Southwestern Naturalist*, 10:282-287.
- RHOADS, S. N. 1894. Descriptions of new species of North American mammals with remarks on species of the genus *Perognathus*. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1893:404-412.
- SMITH, P. D. 1985. Endangered and threatened wildlife and plants; review of vertebrate wildlife. *Federal Register*, 50(181):37958-37967.
- STEPHENS, F. 1906. California mammals. The West Coast Publishing Co., San Diego, 351 pp.
- SULENTICH, J. M. 1983. The systematics and evolution of the *Perognathus parvus* species group in southern California (Rodentia: Heteromyidae). M.S. thesis, California State University, Long Beach, 85 pp.
- WHITAKER, J. O., JR., R. E. LEWIS, AND W. J. WRENN. 1993. Parasites. Pp. 386-478, in *Biology of the Heteromyidae* (H. H. Genoways and J. H. Brown, eds.). Special Publication, The American Society of Mammalogists, 10:1-719.
- WIED, MAXIMILIAN, PRINZEN ZU. 1839. Über einige Nager mit äusseren Backentaschen aus dem westlichen Nord-America. I. Über ein paar neue Gattungen der Nagethier mit äusseren Backentaschen. *Nova Acta Physico-Medica, Academiae Caesareae Leopoldino-Carolinae*, 19(1):367-374.
- WILLIAMS, D. F. 1978a. Karyological affinities of the species groups of silky pocket mice (Rodentia, Heteromyidae). *Journal of Mammalogy*, 59:599-612.
- . 1978b. Systematics and ecogeographic variation of the Apache pocket mouse (Rodentia: Heteromyidae). *Bulletin of Carnegie Museum of Natural History*, 10:1-57.
- WILLIAMS, D. F., AND H. H. GENOWAYS. 1979. A systematic review of the olive-backed pocket mouse, *Perognathus fasciatus* (Rodentia, Heteromyidae). *Annals of Carnegie Museum*, 48:73-102.
- WILLIAMS, D. F., H. H. GENOWAYS, AND J. K. BRAUN. 1993. Taxonomy. Pp. 38-196, in *Biology of the Heteromyidae* (H. H. Genoways and J. H. Brown, eds.). Special Publication, The American Society of Mammalogists, 10:1-719.
- WOOD, A. E. 1935. Evolution and relationships of the heteromyid rodents with new forms from the Tertiary of western North America. *Annals of Carnegie Museum*, 24:73-262.

Editors of this account were J. ALDEN LACKEY and KARL F. KOOPMAN. Managing editor was JOSEPH F. MERRITT.

T. L. BEST, DEPARTMENT OF ZOOLOGY AND WILDLIFE SCIENCE AND ALABAMA AGRICULTURAL EXPERIMENT STATION, 331 FUNCHESS HALL, AUBURN UNIVERSITY, ALABAMA 36849-5414.