MAMMALIAN SPECIES No. 384, pp. 1–4, 3 figs.

Chaetodipus arenarius.

By James Alden Lackey

Published 6 November 1991 by The American Society of Mammalogists

Chaetodipus arenarius (Merriam, 1894)

Sand Pocket Mouse

Perognathus arenarius Merriam, 1894:461. Type locality "San Jorge, near Comondu, Lower [Baja] California [Mexico]."

Perognathus helleri Elliot, 1903:166. Type locality "San Quentin [Quintin], Lower [Baja] California, Mexico."

C[haetodipus]. arenarius: Hafner and Hafner, 1983:24. Elevation of subgenus to generic status.

CONTEXT AND CONTENT. Order Rodentia, Family Heteromyidae, Subfamily Perognathinae. The genus *Chaetodipus* contains 14 species. Eleven subspecies of *C. arenarius* are recognized (Hall, 1981; Huey, 1964):

C. a. albescens (Huey, 1926:67). Type locality "San Felipe, Lower [Baja] California, [lat. 31°02′N, long. 114°50′W; Bond, 1969] Mexico."

C. a. albulus (Nelson and Goldman, 1923:159). Type locality "Magdalena Island, Lower [Baja] California, Mexico." Originally described as a subspecies of *C. penicillatus*; referred to *C. arenarius* by Huey (1926).

C. a. ambiguus (Nelson and Goldman, 1929:108). Type locality "Yubay, 30 miles southeast of Calamahue, Lower [Baja] California, Mexico (altitude 2,000 feet)."

C. a. ammophilus (Osgood, 1907:20). Type locality "Margarita Island, Lower [Baja] California, Mexico." Originally described as a subspecies of *C. penicillatus*; referred to *C. arenarius* by Huey (1926).

C. a. arenarius (Merriam, 1894:461), see above.

C. a. helleri (Elliot, 1903:160), see above; referred to *C. arenarius* by Huey (1926).

C. a. mexicalis (Huey, 1939:57). Type locality "Los Muertos Canyon fan, in palo verde ironwood association, at Gaskill's Tank, near Laguna Salada, Lower [Baja] California, Mexico, lat. 32°27′ north, long. 115°53′ west."

C. a. paralios (Huey, 1964:113). Type locality "Barril (28°20′N), on the Gulf of California, Baja California, Mexico [long. 112°50′W; Bond, 1969]."

C. a. sabulosus (Huey, 1964:114). Type locality "mainland on south side of Scammon's Lagoon, Baja California, Mexico [near lat. 27°40′N, long, 114°05′W; Bond, 1969]."

C. a. siccus (Osgood, 1907:20). Type locality "Ceralbo [Cerralvo] Island, Lower [Baja] California, Mexico." Originally described as a subspecies of *C. penicillatus*; referred to *C. arenarius* by Nelson and Goldman (1929).

C. a. sublucidus (Nelson and Goldman, 1929:109). Type locality "La Paz, Lower [Baja] California, Mexico."

DIAGNOSIS. Hafner and Hafner (1983) elevated *Chaetodipus* from subgeneric to generic level, and provided a diagnosis for the genus. From other members of *Chaetodipus*, *C. arenarius* (Fig. 1) is distinguished by the following combination of characters (measurements in mm); lack of distinct spines or bristles on rump; total length <200; crested tail; tail longer than head and body; skull (Fig. 2) without supraorbital bead; interorbital breadth >5.8 and >39% of basilar length (Hall, 1981). The following diagnoses pertain to species of *Chaetodipus* and *Perognathus* found in Baja California. The morphology of *C. arenarius* is similar in many aspects to that of *C. penicillatus*, but the geographic ranges of these two species overlap only in extreme northeastern Baja California, and perhaps only in the vicinity of San Felipe. There is overlap in body size between *C. arenarius* and *C. penicillatus* (*C. arenarius* averages smaller), neither has rump spines, and both have crested tails. *C. penicillatus*, however, has a yellowish or yellowish-brown dorsum, in contrast to the uniform smoke gray of *C. arenarius albescens*, the subspecies inhabiting the San Felipe region (Huey, 1926; Osgood, 1900). Nelson and Goldman (1929:107) further differentiated the two species by skull characters: skull [of *C. arenarius*] less flattened, the braincase more inflated and higher arched; upper part of foramen magnum normally forming a distinct embayment, constricted by projecting lateral angles of the margin (foramen magnum more evenly rounded in *C. penicillatus*); coronoid process more slender and curving strongly backward, not rising so steeply or so high above level of condyle as usual in *C. penicillatus*. *C. arenarius* is smaller than *C. baileyi*, with which it is broadly sympatric; total length of *C. baileyi* is 200 or more, and length of hindfoot 26 or more, whereas in *C. arenarius* those dimensions are less (Hall, 1981). Compared with *C. formosus* in the region where these two species are sympatric, *C. arenarius* is smaller (only a slight overlap in total length between adult *C. arenarius* and juvenile *C. formosus*), the tail of *C. arenarius* is much less crested, and the dorsum of *C. arenarius* is pale gray or brownish, whereas the dorsum of *C. formosus* is darker gray. The two species apparently are segregated ecologically, with *C. arenarius* found only in areas of sandy soil, and *C. formosus* in rocky hillsides (Huey, 1964). *C. arenarius* is easily distinguished from *C. spinatus* owing to the presence of bristles on the rump of the latter species. In the Cape region, *C. arenarius* is sympatric with *C. dalquesti*, a species whose status has been questioned by Hafner and Hafner (1983). According to Roth (1976), *C. arenarius* averages smaller than *C. dalquesti* for a variety of measures, including total length, length of tail, and length of hind foot, but there is considerable overlap. The ear is shorter in *C. arenarius*, 7–8 compared with 8–10 in *C. dalquesti*; ears uniformly pale colored in *C. arenarius*, rather than having a broad black margin; tail of *C. arenarius* not distinctly crested, and of a paler color; rump spines present in *C. dalquesti*. In northern Baja California, *C. arenarius* can be distinguished from *C. fallax* and *C. californicus* by the presence of rump spines in the latter two species. *C. anthonyi* inhabits Cedros Island off the western coast and is not sympatric with *C. arenarius*; *C. anthonyi* has rump spines. The only other pocket mouse in Baja California is *Perognathus longimembris*, which has a total length of 131–140, and a length of hind foot of 18.5 (preceding measurements from three specimens from northwestern Sonora, Mexico; Osgood, 1907). *P. longimembris* has a soft-silky pelage, a short (3–7) terminal tuft on its tail, an interparietal that is about 3.5 wide, compared to 5.8 or more in *C. arenarius*, and an occiput that is not deeply indented laterally by the mastoids (Ingles, 1965).

GENERAL CHARACTERS. The length of the hind foot is 30% of head and body length, and the length of the tail is 100% of head and body length (Hatt, 1932). Mean measurements (in mm)

FIG. 1. Photograph of *Chaetodipus arenarius arenarius* from 13 km SW Santa Rita, Baja California Sur, Mexico. Photograph by T. L. Best.

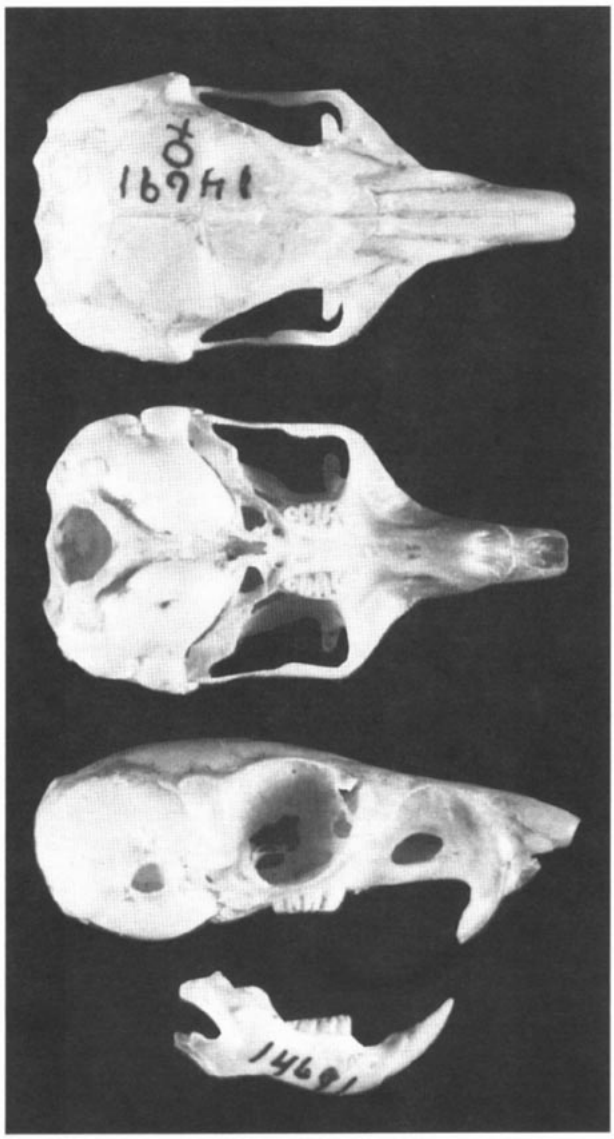

FIG. 2. Dorsal, ventral, and lateral views of the skull, and lateral view of the mandible of an adult female *Chaetodipus arenarius arenarius* (San Diego Natural History Museum 14691) from Santo Domingo, Baja California, Mexico. Greatest length of skull is 24.3 mm. Photograph by J. Ford.

of 20 adult males and 20 adult females from throughout the range of the species, respectively, are: total length, 156, 152; length of body, 70, 67; length of tail, 86, 85; length of hind foot, 21, 21; length of ear, 8, 8; basal length of cranium, 13.9, 13.6; greatest length of cranium, 22.9, 22.4; maxillary arch spread, 11.0, 10.5; interorbital width, 6.1, 5.9; nasal length, 8.8, 8.7; intermaxillary width, 4.3, 4.3; alveolar length, 3.3, 3.3; basicranial length, 1.6, 1.5; maxillary arch width, 1.3, 1.2; basioccipital length, 3.3, 3.1; greatest depth of cranium, 7.6, 7.5; greatest width cranium, 12.1, 11.8; zygomatic width, 11.5, 11.1; nasal width, 2.5, 2.4. Males are significantly larger than females in six of 19 characters: greatest length of skull, maxillary arch spread, maxillary arch width, basioccipital length, zygomatic width, and nasal width. Sexual dimorphism in 13 other species of *Chaetodipus* occurred in 0–12 characters per species, with an average of 4.4 (Best, in press).

The pelage is soft, semi-silky (Huey, 1926), and has no bristles other than occasionally a few weak rump bristles (Osgood, 1907). The dorsum varies from pale gray or pale buff in subspecies such as *C. a. albescens*, *C. a. albulus*, and *C. a. paralios*, to drab brown in *C. a. arenarius*, to dark brown in *C. a. helleri*; often there are brown- or black-tipped hairs in the dorsum of darker populations, yielding a slightly grizzled appearance. In some populations the color of the dorsum is paler on the sides, blending into the white of the under parts. The tail is bicolored, with the upper stripe varying from tan to dark brown in concert with the color of the dorsum. Underparts, feet, and underside of the tail are white or creamy, except in *C. a. helleri* in which the feet are pale gray. A buffy lateral stripe between the colors of the upper and under parts is distinct only in *C. a. helleri* and in darkly colored populations of *C. a. arenarius*; in other subspecies the stripe is faint, variable in expression, or absent. The ears are dusky. There is a minute patch of white hairs at the base of the ear in *C. a. arenarius* (Merriam, 1894); the patch also is present in *C. a. albescens* and *C. a. helleri*. There are two color phases for *C. a. siccus*, gray and buffy (Osgood, 1907).

The skull of *C. arenarius* is short and broad, and the braincase is vaulted, although varying in this respect among subspecies. The zygomatic arch is slender and lies parallel to the main axis of the skull. The interparietal is more than twice as wide as long, and is strap-shaped or pentagonal. The nasals are slender. The lower premolar is larger than the last molar (Hall, 1981; Merriam, 1894).

DISTRIBUTION. The geographic range of *C. arenarius* (Fig. 3) lies entirely within Baja California, Mexico, encompassing the entire peninsula except for the Pacific coastal region north of San Quintin, the adjacent Sierra Juarez and Sierra de San Pedro Martir in the northcentral part of the peninsula, and most of the southeastern area bordering the Gulf of California. Inland regions, particularly in the southern one-half of the peninsula, have received little attention by mammalogists; there are, for example, no published locality records of *C. a. arenarius* within the northern 150 km of the range of this subspecies as depicted by Hall (1981). This species also is found on several islands off the eastern and western coasts of the southern region of the peninsula. The altitudinal range of *C. arenarius* extends upward to approximately 600 m in central Baja California (Nelson and Goldman, 1929). Two isolated subspecies in southern Baja California are of biogeographic interest: *C. a. sublucidus*, found only in the immediate region of La Paz Bay, and *C. a. siccus*, on Cerralvo Island. The geographic range of the La Paz population is restricted by unfavorable habitat, and apparently there is no population of *C. arenarius* on the mainland opposite Cerralvo Island (Banks, 1964; Hall, 1981; Nelson and Goldman, 1929). There is no fossil record for this species.

FORM AND FUNCTION. The baculum of *C. arenarius* has an enlarged basal region, usually laterally compressed. The baculum is sigmoid, having a ventral curvature immediately distal to the base, a gradual dorsal curvature and, distally, a sharp ventral curvature. The curvature at the distal end is less acute in *C. arenarius* than in various other species of *Chaetodipus*, and resembles that of *C. penicillatus* and *C. californicus*. The shaft tapers from base to distal end. The length of the baculum in three subspecies of *C. arenarius* averaged 9.1–9.9 mm, the base was 0.52–0.81 mm high, and 0.49–0.74 mm wide (Burt, 1936).

The middle-ear volume of *C. arenarius* averaged 0.09 cm^3 in two specimens; among 13 other species of *Chaetodipus* and *Perognathus* only *C. baileyi*, larger in body size than *C. arenarius*, had a larger absolute volume, 0.11 cm^3. Relative middle ear volume (cube root of middle-ear volume divided by occipitonasal length) in *C. arenarius* was 0.23, larger than that in the 13 other species of pocket mice examined, with the exception of *P. flavus*. The cochlea of *C. arenarius*, like that in all pocket mice examined, had three turns, whereas in three other genera of Heteromyidae (*Dipodomys*, *Microdipodops*, and *Liomys*), there were 3.5 turns (Webster and Webster, 1975, 1977).

Two 5-mm embryos were found in a specimen of *C. a. siccus* collected on 25 March on Cerralvo Island (Banks, 1964). Nothing else is known about the ontogeny and reproduction of *C. arenarius*.

ECOLOGY. There is a close association between *C. arenarius* and sandy soils. In northern Baja California the type locality of *C. a. mexicalis* includes sandy ground (Huey, 1964). At San Felipe, on the Gulf of Mexico, the habitats of the *C. a. arenarius* population in that area are sandy areas bordering San Felipe Bay (Huey, 1926). In northwestern Baja California, the habitat of *C. a. helleri* is sandy areas on the San Quintin plain (Huey, 1964). Farther south, in the vicinity of El Arco and San Ignacio, *C. a. ambiguus* is found in an extremely arid region in habitats characterized by soil consisting almost entirely of sand and by sparse vegetation (Alvarez, 1958). In the Cape region, the habitats of *C. a. sublucidus* are sandy sections of the desert basin in the La Paz region (Huey, 1964). On

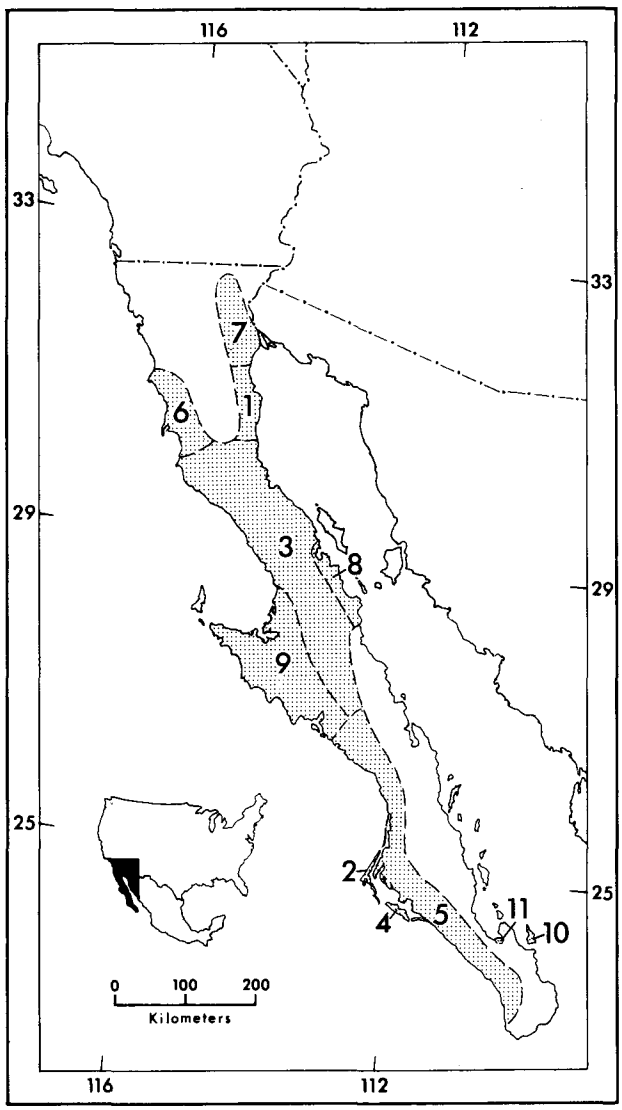

FIG. 3. Geographic distribution of *Chaetodipus arenarius* (Hall, 1981). 1, *C. a. albescens*; 2, *C. a. albulus*; 3, *C. a. ambiguus*; 4, *C. a. ammophilus*; 5, *C. a. arenarius*; 6, *C. a. helleri*, 7, *C. a. mexicalis*; 8, *C. a. paralios*; 9, *C. a. sabulosus*; 10, *C. a. siccus*; 11, *C. a. sublucidus*. Illustration by M. C. Blake.

Cerralvo Island, off the eastern coast of the Cape region, *C. a. siccus* was abundant on the flat, sandy southwestern portion of the island, but less common on slopes and ridges. Mounds and burrows of this species on Cerralvo Island were found far up arroyos having a sandy floor, suggesting sandy soil is a more significant aspect of the habitat than is a flat, open environment (Banks, 1964).

The only known predator of *C. arenarius* is the barn owl, *Tyto alba*. A skull of *C. arenarius* was found in a regurgitated pellet at San Ignacio, Baja California (Lopez-Forment C. and Urbano V., 1977).

The only recorded parasite of *C. arenarius* is a mite, *Ischryopoda spiniger*, found at Estero Salinas, Bahia de la Magdalena, adjacent to Magdalena Island (Hoffmann et al., 1972).

GENETICS. In a sample of 26 loci in 18 specimens from San Felipe, the mean number of alleles per locus was 1.115, the mean proportion of loci polymorphic per population was 0.115, and the mean proportion of loci heterozygous per individual was 0.041. *C. arenarius* was polymorphic in 11.5% of the 26 loci examined; average heterozygosity per individual was 4.1%. For all 13 species of *Chaetodipus* investigated, average polymorphism per population was 14.5%, and average heterozygosity per individual was 4.84% (Patton et al., 1981).

REMARKS. Osgood (1907) apparently was the first to use the vernacular name little desert pocket mouse for *C. arenarius*; this name subsequently was employed by Hall (1981). Banks (1964) used the name desert pocket mouse, in reference to *C. a. siccus*. In view of the use of similar or identical names for other species of pocket mice, for example, little pocket mouse for *P. longimembris* (Hall, 1981) and desert pocket mouse for *C. penicillatus* (Jones et al., 1986), I suggest the use of sand pocket mouse, a name employed by Huey (1964), because the specific epithet and three subspecific epithets of this species refer to this major aspect of the habitat of all populations of this species.

I thank A. M. Rea, San Diego Natural History Museum, for the loan of specimens of *C. arenarius*. E. C. Oaks provided comments on an earlier draft.

LITERATURE CITED

ALVAREZ, T. 1958. Roedores colectados en el Territorio de la Baja California. Acta Zoologica Mexicana, 2:1–7.

BANKS, R. C. 1964. The mammals of Cerralvo Island, Baja California. Transactions of the San Diego Society of Natural History, 13:397–404.

BEST, T. L. In press. Patterns of morphologic and morphometric variation in heteromyid rodents. *In* Biology of the Heteromyidae (H. H. Genoways and J. H. Brown, eds.). Special Publication, The American Society of Mammalogists, 10.

BOND, S. I. 1969. Type specimens of mammals in the San Diego Natural History Museum. Transactions of the San Diego Society of Natural History, 15:252–263.

BURT, W. H. 1936. A study of the baculum in the genera Perognathus and Dipodomys. Journal of Mammalogy, 17:145–156.

ELLIOT, D. G. 1903. Descriptions of apparently new species and subspecies of mammals from California, Oregon, the Kenai Peninsula, Alaska, and Lower California, Mexico. Field Columbian Museum Publications 74, Zoology Series, 3:153–173.

HAFNER, J. C., AND M. S. HAFNER. 1983. Evolutionary relationships of heteromyid rodents. Great Basin Naturalist Memoirs, 7:3–29.

HALL, E. R. 1981. The mammals of North America. Second ed. John Wiley and 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.

HOFFMANN, A., I. BASSOLS DE BARRERA, AND C. MENDEZ. 1972. Nuevos hallazgos de acaros en Mexico. Revista de la Sociedad Mexicana de Historia Natural, 33:151–159.

HUEY, L. M. 1926. The description of a new subspecies of Perognathus from Lower California with a short discussion of the taxonomic position of other peninsular members of this genus. Proceedings of the Biological Society of Washington, 39:67–70.

———. 1939. A new Perognathus arenarius from near the U.S.-Mexican boundary in Lower California. Transactions of the San Diego Society of Natural History, 9:57–58.

———. 1964. The mammals of Baja California, Mexico. Transactions of the San Diego Society of Natural History, 13:85–168.

INGLES, L. G. 1965. Mammals of the Pacific States. California, Oregon, and Washington. Stanford University Press, Stanford, California, 506 pp.

JONES, J. K., JR., D. C. CARTER, H. H. GENOWAYS, R. S. HOFFMANN, D. W. RICE, AND C. JONES. 1986. Revised checklist of North American mammals north of Mexico, 1986. Occasional Papers, The Museum, Texas Tech University, 107:1–22.

LOPEZ-FORMENT C., W., AND G. URBANO V. 1977. Restos de pequenos mamiferos recuperados en regurgitaciones de lechuza, *Tyto alba*, en Mexico. Anales del Instituto de Biologia, Universidad Nacional Autonoma de Mexico, Serie Zoologica, 48:231–242.

MERRIAM, C. H. 1894. Descriptions of four new pocket mice from Lower California, collected by Walter E. Bryant. Proceedings of the California Academy of Sciences, series 2, 4:457–462.

NELSON, E. W., AND E. A. GOLDMAN. 1923. A new pocket mouse from Lower California. Proceedings of the Biological Society of Washington, 36:159–160.

———. 1929. Six new pocket mice from Lower California and

notes on the status of several described species. Proceedings of the Biological Society of Washington, 42:103–112.

OSGOOD, W. H. 1900. Revision of the pocket mice of the genus Perognathus. North American Fauna, 18:1–73.

———. 1907. Four new pocket mice. Proceedings of the Biological Society of Washington, 20:19–22.

PATTON, J. L., S. W. SHERWOOD, AND S. Y. YANG. 1981. Biochemical systematics of chaetodipine pocket mice, genus *Perognathus*. Journal of Mammalogy, 62:477–492.

ROTH, E. L. 1976. A new species of pocket mouse (*Perognathus*: Heteromyidae) from the cape region of Baja California Sur, Mexico. Journal of Mammalogy, 57:562–566.

WEBSTER, D. B., AND M. WEBSTER. 1975. Auditory systems of Heteromyidae: functional morphology and evolution of the middle ear. Journal of Morphology, 146:343–376.

———. 1977. Auditory systems of Heteromyidae: cochlear diversity. Journal of Morphology, 152:153–170.

Editors of this account were TROY L. BEST and KARL F. KOOPMAN. Managing editor was DON E. WILSON.

J. A. LACKEY, DEPARTMENT OF BIOLOGY, STATE UNIVERSITY OF NEW YORK, OSWEGO 13126.