MAMMALIAN SPECIES No. 297, pp. 1–5, 3 figs.

Chaetodipus baileyi.

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Published 15 January 1988 by The American Society of Mammalogists

Chaetodipus baileyi (Merriam, 1894)

Bailey's Pocket Mouse

Perognathus baileyi Merriam, 1894:262. Type locality "Magdalena, Sonora, Mexico."

Perognathus knekus Elliot, 1903:169. Type locality "Rosarito, San Pedro Martir mountains, Lower California, Mexico."

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

CONTEXT AND CONTENT. Order Rodentia, Suborder Myomorpha, Family Heteromyidae, Subfamily Perognathinae, Genus *Chaetodipus*. Eight subspecies recognized by Hall (1981) are as follows:

C. b. baileyi Merriam, 1894:262, see above.

C. b. rudinoris Elliot, 1903:167. Type locality "San Quintin, Lower California, Mexico" (*knekus* Elliot is a synonym).

C. b. insularis Townsend, 1912:122. Type locality "Tiburon Island," Gulf of California, Sonora.

C. b. domensis Goldman, 1928:204. Type locality "Castle Dome (at base of Castle Dome Peak), Arizona (altitude 1,400 ft.)." Castle Dome is in Yuma Co.

C. b. hueyi Nelson and Goldman, 1929:106. Type locality "San Felipe, northeastern Lower California, Mexico."

C. b. extimus Nelson and Goldman, 1930:223. Type locality "Tres Pachitas, 36 miles south of La Paz, Lower California, Mexico (altitude 700 ft.)."

C. b. fornicatus Burt, 1932:164. Type locality "Monserrate Island (latitude 25°38′ N., longitude 111°02′ W.), Gulf of California, Lower California, Mexico."

C. b. mesidios Huey, 1964:112. Type locality "San Borja Mission, near latitude 28°45′ N, Baja California, Mexico."

DIAGNOSIS. *Chaetodipus baileyi* (Fig. 1) is larger than most of the pocket mice with which it occurs. Total length is usually more than 200 mm, of which more than half is tail; length of hind foot is usually more than 26 mm. *Chaetodipus arenarius*, *C. intermedius*, and *C. pernix* usually are less than 180 mm in total length. *C. fallux* and *C. artus* usually are less than 200 mm with dorsal pelage brown, shading to black on the rump. *C. goldmani*, similar in size to *C. baileyi*, also is brown dorsally shading to black on the rump. *C. californicus* and *C. spinatus* have pronounced white spines on the rump, lacking in *C. baileyi*. The smaller *C. penicillatus*, broadly sympatric with *C. baileyi*, has a hind foot usually less than 26 mm in length. Interorbital breadth is less than interparietal breadth, whereas the two measurements are nearly equal in *C. baileyi* (Hall, 1981). *C. baileyi* differs from *C. hispidus* in having a strongly crested tail longer than head and body, a grayer dorsal coloration, and larger auditory bullae. *C. baileyi* lacks the conspicuous buff to ochraceous lateral stripe and supraorbital bead of *C. hispidus*. It differs from the slightly smaller *C. formosus*, with which it occurs in southern California and northern Baja California, in having yellowish hairs admixed with the grayish dorsal pelage, and in the presence of weak spines or black hairs on the rump (Ingles, 1947). Unlike most pocket mice, that have hooked or strongly curved bacula, or *C. hispidus*, that has a baculum with a trifid head, *C. baileyi* has a baculum that is long (10 to 11 mm), slender, and nearly straight. Only *C. formosus* has a similarly shaped baculum (Burt, 1936, 1960).

GENERAL DESCRIPTION. The pelage above is grayish, washed to a varying degree with yellow, and is somewhat harsh; underparts are whitish. Total length is 176 to 240 mm. Averages and ranges of external measurements (in mm) of 164 to 165 male and 209 to 211 female *C. b. baileyi*, respectively, are (Van de Graff, 1975): total length, 210.8 (206 to 240), 201.4 (176 to 228); length of tail, 114.0 (76 to 140), 109.2 (86 to 125); length of hind foot, 26.6 (24 to 38), 25.8 (21 to 29); length of ear, 9.5 (7 to 19), 9.2 (7 to 11). Average body mass of this sample is 28.2 g for males and 24.5 g for females. Ingles (1947) reported the range of measurements (in mm) for *C. baileyi* in California as total length, 200 to 231; length of tail, 110 to 136; length of hind foot, 26 to 28; length of ear, 9 to 11. Mean cranial measurements (in mm) for 122 males and 87 females, respectively, from Arizona and Sonora are: occipitonasal length, 30.3, 29.4 ($n = 83$); greatest breadth at mastoids, 15.9, 15.6; alveolar length of maxillary toothrow, 4.40 ($n = 119$), 4.35 (Hoffmeister, 1986). The tail is buff to gray above, whitish below, and strongly crested. The skull (Fig. 2) is large and robust; the mastoid side of the parietal is about equal in length to the frontal side (Hall, 1981). The interparietal is relatively large, around 6.8 mm wide (Ingles, 1947). The dental formula is i 1/1, c 0/0, p 1/1, m 3/3, total 20, as in other pocket mice.

DISTRIBUTION. The range (Fig. 3) is nearly coincidental with the Sonoran Desert (Sherbrooke, 1976). *C. baileyi* ranges from extreme southern California, across the southern half of Arizona to extreme southwestern New Mexico, south along the western half of Sonora to northern Sinaloa. It occupies almost the entire length of Baja California Peninsula, including several small coastal islands. Hoffmeister (1986) did not believe populations in eastern and western Arizona represent separate subspecies but rather extremes of a gradient in size and color. He included *C. b. domensis* Goldman in the subspecies *C. b. baileyi*.

FOSSIL RECORD. *Perognathus* has a well-documented fossil history extending back to the Miocene (Kurtén and Anderson, 1980). The fossil record has not yet been examined in light of the recent separation of *Chaetodipus* from *Perognathus*. Mead et al. (1983) found early Holocene fossils of *C. baileyi* in packrat (*Neotoma* sp.) middens near Picacho Peak in the lower Colorado River Valley near the northern limit of its present range in that area.

FORM. Homan and Genoways (1978) found the hair of *C. baileyi* to be relatively long and moderately wide for *Chaetodipus* with the tip tapering abruptly. A trough is present on the dorsal surface of the hair in all chaetodipines but in only two perognathines. In *C. baileyi* it is especially deep with high, sharply defined ridges. Medulla cells are flattened to oval. Quay (1965) found the sebaceous glandular area on the ventral surface of the tail in pocket mice to be more well developed in chaetodipines than in perognathines. The gland was somewhat developed in a specimen of Bailey's pocket mouse he examined. Flon et al. (1970) described the salivary glands as having relatively narrow convoluted granular tubules with a low content of both PAS-positive and xanthydrol-reactive granules.

Theoretical transmission of accoustical energy through the ear is 100%, high for the genus (Webster and Webster, 1975). Webster and Webster (1975) found the relative volume of the middle ear to

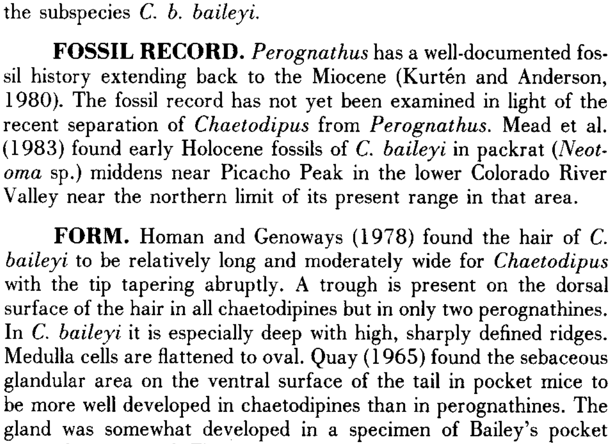

FIG. 1. Photograph of *Chaetodipus baileyi* from Castle Dome Mountains, Arizona. Photo by M. A. Chappell.

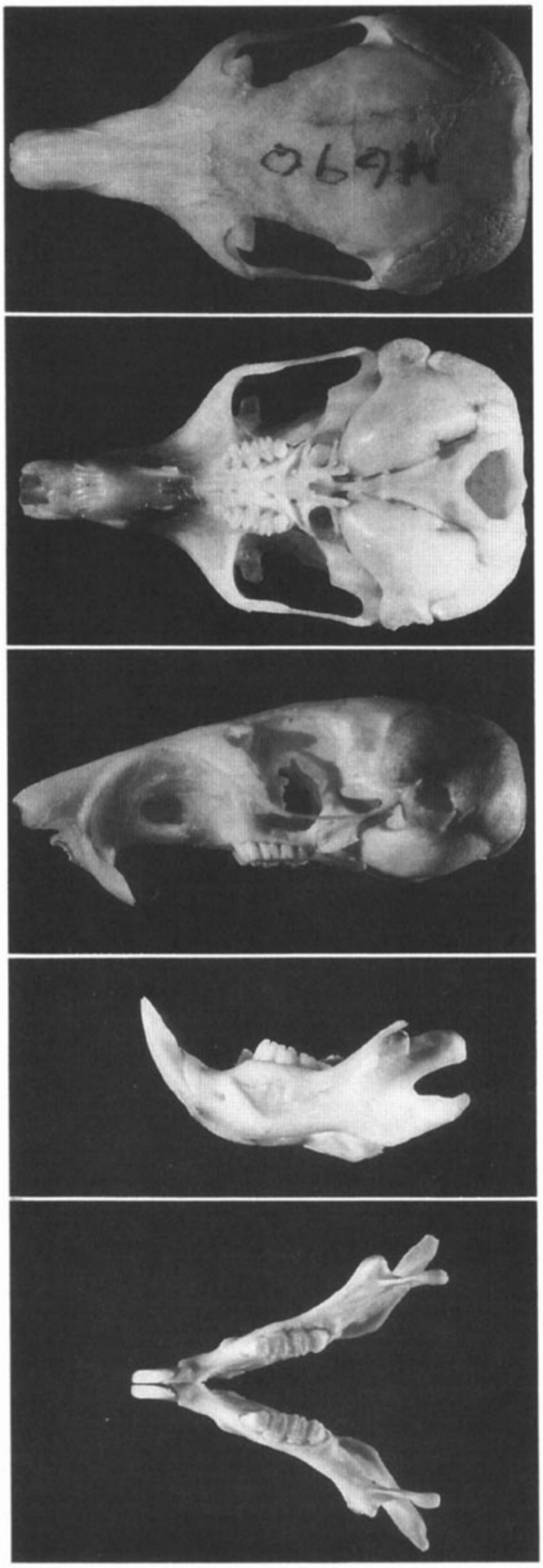

FIG. 2. Dorsal, ventral, and lateral views of cranium, and lateral and dorsal views of mandible of an adult female *C. b. baileyi* (MMNH 4690) from Pima Co., Arizona.

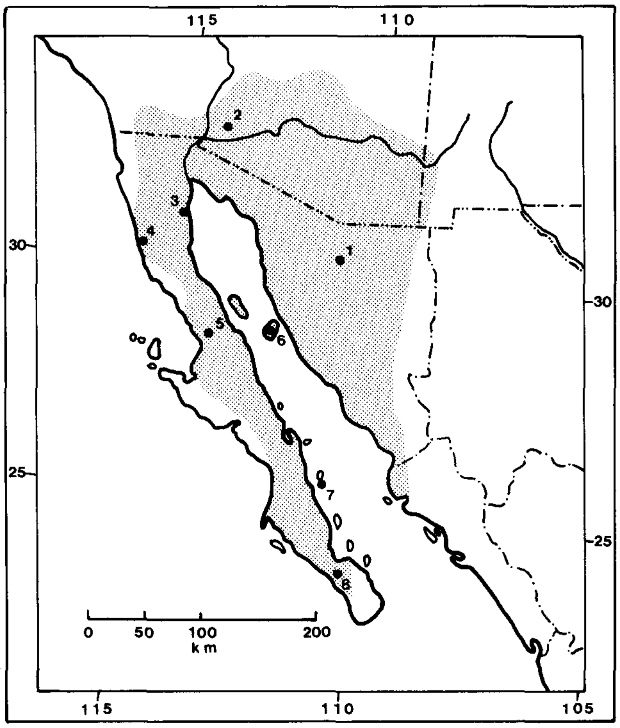

FIG. 3. Distribution of *C. baileyi* and type localities for subspecies: 1, *C. b. baileyi*; 2, *C. b. domensis*; 3, *C. b. hueyi*; 4, *C. b. rudinoris*; 5, *C. b. mesidios*; 6, *C. b. insularis*; 7, *C. b. fornicatus*; 8, *C. b. extimus*. Range limits are based on Hoffmeister (1986) for Arizona and Hall (1981) and published records for the rest of the range.

be 0.18, large for chaetodipines but smaller than in most perognathines. These authors believed large middle-ear volume enhances reception of low-frequency sound. Also, the size of the stapedial footplate is reduced, increasing the difference in area between it and the tympanic membrane. Large areal ratio also is thought to enhance reception of low-frequency sound. Webster and Webster (1977) described the inner ear structure as typical for the genus. In *Chaetodipus* the cochlea has 3 turns and is broad and squat with a sharply tapering apex. The helicotrema connecting the scala vestibuli and scala tympani is minute, only 0.004 mm² in cross section. Unlike in *Perognathus*, there is a narrow perilymphatic channel connecting the scala vestibuli and scala tympani.

Van de Graff (1975) found baculum length directly related to amount of spermatozoa, that was related to the age of the animal. The ratio of kidney mass to body mass in *C. baileyi* is 0.0040 to 0.0054, typical for rodents (Altschuler et al., 1979). As in the other species of *Chaetodipus* and *Perognathus* studied, the outer medulla is thickened, the papilla of the inner medulla are lengthened, and density of vasa recta in the medullary tissue is increased (Altschuler et al., 1979).

FUNCTION. Hayden and Lindberg (1970*b*) found the hemoglobin-oxygen affinity to be average for the genus; hemoglobin half-saturation value is 44. *C. baileyi* is capable of producing urine with high concentrations of urea and electrolytes. Schmidt-Nielsen et al. (1948*b*) found that on a diet of pure protein without water this species produced urine with urea concentrations of 3,000 to 4,000 mM, twice as concentrated as that of *Neotoma*. In addition, it had greater abilities to concentrate urine than *Dipodomys merriami* or *D. spectabilis* and lived on a diet of dry mesquite (*Prosopis velutina*) beans for at least 32 days. In another study, *C. baileyi* underwent a 20% increase in body mass on a diet of dry, nontoxic seeds and ate little succulent food even when available (Schmidt-Nielsen et al., 1948*a*). MacMillen and Hinds (1983) found that production of metabolic water equals evaporative water loss at a relatively high temperature of 20.8°C.

The major steroid produced by the adrenals is cortisol, whereas the major steroid produced by murid rodents is corticosterone (Ogunsua et al., 1971). Ogunsua et al. (1971) found that the adrenals of *C. baileyi* converted radioactive progesterone to aldosterone in amounts equaling the conversion to cortisol. In laboratory tests, Treiman and Levine (1969) showed that 11-hydroxycorticosteroid in the plasma was not elevated under stress in *C. baileyi* as it was in nonheteromyid species of wild mice. Two other steroids, 11-

deoxycorticosterone (DOC) and Reichstein's compound S, were elevated in the plasma under stress, however. Treiman and Levine (1969) postulated that *C. baileyi* has a relative deficiency of 11 *B*-hydroxylase, an enzyme that converts the steroids, DOC and compound S, to corticosterone and cortisol, respectively. They suggested that DOC may play a role in water and salt conservation. These authors also found evidence of a lack of response of the adrenals in *C. baileyi* to adrenocorticotrophic hormone (ACTH).

The metabolic-maintenance-rate curve (Chew et al., 1965), Y = 7.27 − 0.19X, was the lowest of six species of pocket mice studied (of which *C. baileyi* was the largest), and the least affected by ambient temperature. *C. baileyi*, with *C. formosus*, also had the lowest lower critical temperature (29.5°C) of the group. The lowest body temperature from which it can be aroused, 13.7°C, is relatively high (Hayden and Lindberg, 1970*a*). Most members of the genus *Perognathus* were able to arouse from temperatures below 10°C. However, Hayden and Lindberg (1970*a*) found evidence that Bailey's pocket mouse can maintain body temperatures well above the ambient while in torpor.

ONTOGENY AND REPRODUCTION. Van de Graff (1975) found that, as a group and individually, males tend to be in reproductive condition for longer periods each year than females. In his study in southeastern Arizona, 100% of males captured were fertile from February until September, 1972 and reproductively active males were captured in all months except January. No females were reproductively active until March 1971 and until June 1972. Males in reproductive condition averaged 5.4 g heavier than those that were not. In 1971, peak reproduction was in late spring with a secondary peak in late summer; in 1972, reproduction was delayed until late July and August, presumably because of drought. Lewis (1973) and Reynolds and Haskell (1949) also found reproductive peaks in spring and early autumn in southern Arizona. Young-of-the-year occasionally breed in late summer (Lewis, 1973; Van de Graff, 1975). Van de Graff (1975) found the number of placental scars averaged 3.6, and the number of embryos averaged 3.5.

Survivorship of 120 marked individuals in southwestern Arizona over an 11-month period during a drought year was only 7.5% (Paulson, 1981). Like other pocket mice, however, Bailey's pocket mouse has a relatively long life span. One individual lived in captivity for at least 3 years.

ECOLOGY AND BEHAVIOR. *Chaetodipus baileyi* occurs primarily in the Lower Sonoran Desert and Desert Grassland-Lower Sonoran Desert transition zone, often in ecotonal areas between rocky hillsides and desert flats (Ingles, 1947; Price, 1978*b*; Reichman, 1975). In Arizona, *C. baileyi* most frequently occurs with *Perognathus amplus*, *Chaetodipus penicillatus*, and *Dipodomys merriami*; many ecological studies have focused on relationships within this community. Bailey's pocket mouse is most abundant in areas with medium to large bushes or trees (M'Closkey, 1980; Price, 1978*b*; Rosenzweig and Winakur, 1969; Wondolleck, 1978). It also occurs on low desert flats, small sandy washes, and rocky hillsides (Bateman, 1967*a*; M'Closkey, 1978; Paulson, 1981; Rosenzweig and Winakur, 1969). Of the species with which it occurs, *C. penicillatus* uses the most similar microhabitats, also using areas under large bushes and trees (M'Closkey, 1982; Price, 1978*b*; Rosenzweig and Winakur, 1969). Bailey's pocket mouse sometimes uses areas with coarser, more gravelly soils than *C. penicillatus* (Bateman, 1967*a*; Hoagstrom, 1978; Wondolleck, 1978), but both species selected coarse, light soils over heavy or fine soils in laboratory experiments (Price and Waser, 1985). There is some evidence that *C. baileyi* excludes *D. merriami* in areas of coarse, gravelly substrate (Rosenzweig and Winakur, 1969; Wondolleck, 1978).

Coexistence by seed-size selection has been a debated topic for seed eating desert rodents (Brown, 1975; Brown and Lieberman, 1973; Lemen, 1978; M'Closkey, 1980; Price, 1983). In a laboratory study, Price (1983) found that, although median in size, *C. baileyi* selected larger seeds than the other species she studied. Differences between the species were not significant, however. M'Closkey (1980) found cheek pouches of free-ranging *C. baileyi* contained fewer, but larger, seeds than those of syntopic *P. amplus* and *D. merriami*. Unlike some other heteromyids studied, Bailey's pocket mouse does not select strongly for clump size or spacing of seeds (Price, 1978*a*; Price and Waser, 1985).

Meehan et al. (1977) found that intense grazing of the milkwort, *Polygala deserticum*, by *C. baileyi* and *C. fallux* in Baja California affected spatial distribution of the plant. *C. baileyi* is associated with jojoba (*Simmondsia chinensis*) in some areas (Bateman, 1967*a*; Rosenzweig and Winakur, 1969). *C. baileyi* apparently has a mechanism for detoxifying cyanogenic glucosides present in jojoba seeds. Sherbrooke (1976) found that of four species of coexisting heteromyids fed only jojoba seeds in captivity, only *C. baileyi* ate the seeds and lived (for as much as 2 weeks); the other species refused the seeds and lost weight rapidly. The ranges of jojoba and *C. baileyi* broadly overlap and Sherbrooke (1976) suggested a coevolutionary relationship between the species.

Chaetodipus baileyi is a dietary generalist, utilizing a variety of seeds, and varying amounts of insects and green vegetation (Reichman, 1974, 1975). In 2 years of field study, Reichman (1975) found the diet to be 84 to 89% seeds and 8.6 to 9.4% insects. Green vegetation composed a large part of the diet at certain times, as much as 40% in October 1971 (Reichman, 1974). Seeds of shrubs, especially cholla (*Opuntia*) and ocotillo (*Fouquieria*), composed 37 to 49% of the diet (Reichman, 1974). Stamp and Omhart (1978) found the diet to be 78 to 92% forb seeds and only 8 to 22% grass seeds. The volume of the cheek pouches (1.61 cm^3) is large enough to carry the daily energy requirements of an individual in one maximum seed load (Morton et al., 1980).

Individuals are active all year (Lewis, 1973; Paulson, 1981; Reynolds and Haskell, 1949) with peak activity in autumn and reduced winter activity after December (Reichman and Van de Graff, 1973). Laboratory experiments indicate *C. baileyi* is behaviorally dominant to *P. amplus* (Lewis, 1973).

In southeastern Arizona, capture rates ranged from 0.54/100 trapnights in summer 1976 to 10.14/100 trapnights in summer 1979 (M'Closkey, 1981). In southwestern Arizona, estimated densities reached 43.1 and 86.1 animals/ha by early July in 1979 in secondary and primary habitat, respectively. Eleven months later, densities were 2.2 and 44.1 animals/ha, respectively (Paulson, 1981). On a Lower Sonoran site in southeastern Arizona, densities in autumn ranged from 17.2 animals/ha to 52.4 animals/ha over several years (Olding and Cockrum, 1979).

GENETICS. The karyotype was described and illustrated by Patton (1967*a*). Diploid number is 46 and the number of autosomal arms (fundamental number) is 66 (Patton, 1972, 1977). The fundamental number is high for *Chaetodipus*, but the karyotype places the species well within the *Chaetodipus* group (Patton, 1967*a*). Electromorphic biochemical analysis of 22 gene loci in chaetodipines yielded further evidence of *C. baileyi's* position with *Chaetodipus* (Patton et al., 1981). Infraspecific geographic variation is pronounced. Populations east of the Colorado River differ from those in California and Baja California in exhibiting a high degree of polymorphism (Patton, 1972, 1977; Patton et al., 1981), largely related to an accumulation of supernumerary *B*-chromosomes in individuals. Populations in central and southern Sonora exhibit a higher degree of polymorphism (2N = 46 to 58) than those in Arizona (2N = 46 to 50) (Patton, 1972). Populations west of the Colorado River lack supernumerary chromosomes (Patton, 1972). At least 3 types of *B*-chromosomes have been distinguished based on size and C-band staining characteristics (Patton, 1977). The DNA of the supernumerary chromosomes is not qualitatively different from that of the A-chromosome set (Sherwood, 1983). *B*-chromosomes do not segregate randomly into secondary spermatocytes but have a tendency to accumulate (Patton, 1977). Young animals tend to have more supernumary chromosomes than adults, but the number of supernumeraries is stable in populations, suggesting a dynamic equilibrium maintained by natural selection (Sherwood, 1983). Interpopulation variation, caused by rearrangements (e.g., pericentric inversions) of chromosomes, also is present (Patton, 1972, 1977). There is only one published description of an albino, that from Pinal County, Arizona (Bateman, 1967*b*).

REMARKS. Hafner and Hafner (1983) elevated *Chaetodipus* to full generic status. Morphological (Burt, 1936; Hafner and Hafner, 1983; Homan and Genoways, 1978), karyological (Patton 1967*a*, 1967*b*; Williams, 1978), and biochemical (Hafner, 1982; Patton et al., 1981) evidence gives strong support for the elevation.

Mary V. Price supplied the photograph of *Chaetodipus baileyi* for Fig. 1.

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