

Chaetodipus penicillatus. By Stacy J. Mantooth and Troy L. Best

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***Chaetodipus penicillatus* (Woodhouse, 1852)**

Desert Pocket Mouse

Perognathus penicillatus Woodhouse, 1852:200. "San Francisco Mountains, New Mexico." Restricted to "1 mile SW Parker, Yuma Co., Arizona" by Hoffmeister and Lee (1967:368).

Perognathus penicillatus Woodhouse, 1853:49. Corrected spelling of *Perognathus penicillatus* Woodhouse, 1852.

Perognathus penicillatus True, 1884:599. Incorrect subsequent spelling of *Perognathus penicillatus* Woodhouse, 1852.

Perognathus (Chaetodipus) stephensi Merriam, 1894:267. Type locality "Mesquite Valley, NW arm of Death Valley, Inyo Co., California."

Perognathus pricei J. A. Allen, 1894:318. Type locality "Oposura, Sonora," Mexico.

Perognathus penicillatus goldmani Townsend, 1912:122. Type locality "Tiburon Island, Gulf of California, Sonora;" preoccupied by *Perognathus goldmani* Osgood, 1900.

Perognathus penicillatus seorsus Goldman, 1939b:257. Type locality "sand flat along Virgin River, 7 miles above Bunker-ville, Clark Co., Nevada;" preoccupied by *Perognathus spinatus seorsus* Burt, 1932.

Chaetodipus penicillatus: Hafner and Hafner, 1983. First use of current name combination.

CONTEXT AND CONTENT. Order Rodentia, suborder Sciuromorphi, superfamily Geomyoidea, family Heteromyidae, subfamily Perognathinae, genus *Chaetodipus*, subgenus *Chaetodipus* (Williams et al. 1993). Keys to 14 species and 2 subgenera of *Chaetodipus* are available (Best 1993a; Williams et al. 1993). Six subspecies of *C. penicillatus* are recognized (Hall 1981; Osgood 1900):

C. p. angustirostris (Osgood, 1900:47). Type locality "Carrizo Creek, Colorado Desert, Imperial Co., California."

C. p. penicillatus (Woodhouse, 1852:200), see above.

C. p. pricei (J. A. Allen, 1894:318), see above.

C. p. seri (Nelson, 1912:116), see above, replacement name for *Perognathus penicillatus goldmani* Townsend, 1912.

C. p. sobrinus (Goldman, 1939a:34), see above, replacement name for *Perognathus penicillatus seorsus* Goldman, 1939b.

C. p. stephensi (Merriam, 1894:267), see above.

DIAGNOSIS. *Chaetodipus penicillatus* (Fig. 1) is much larger than *C. intermedius*, a sympatric congener, and *C. penicillatus* also has a noticeable crest of hairs on tail and a prominent buffy lateral stripe (Williams et al. 1993). The interparietal of *C. penicillatus* is pentagonal with all angles somewhat rounded and does not contact mastoid bullae, whereas that of *C. intermedius* contacts mastoid bullae (Hall 1981). Pinnae of *C. penicillatus* have sparse hair and are relatively short and round compared to those of congeners.

GENERAL CHARACTERS. *Chaetodipus penicillatus* is a medium-sized heteromyid with a long, crested, mostly naked, tufted tail. Tail and tuft are dusky dorsally, and portion of tail proximal to tuft is white ventrally. Ventral pelage is yellowish brown to yellowish gray and dorsal pelage is white or buff with an obscure or absent lateral line (Hall 1981; Osgood 1900; Woodhouse 1852). Rump spines are absent. Forelimbs have 4 well-developed toes and a thumb, whereas hind limbs have 5 toes; palms of front feet and soles of hind feet are naked (Woodhouse 1852).

Skull (Fig. 2) is moderately sized and head is not easy to distinguish from neck. Rostrum is robust and high. Anterior extension of supraoccipital between interparietal and mastoid is comparatively broad and squared whereas interparietal is more round-

ed, especially posterior angles. Mastoid bullae are somewhat small and auditory bullae are widely separated anteriorly. Mastoid side of parietal equals squamosal side. Parietals are somewhat flattened with mastoid side of parietal same as squamosal side. Lower pre-molar is larger than last molar (Hall 1981; Merriam 1889; Osgood 1900; Woodhouse 1852).

Average external and cranial measurements (in mm) of adult males ($n = 20$) and females ($n = 20$), respectively, are: total length, 167.7, 167.3; length of head and body, 76.6, 75.8; length of tail, 91.1, 91.5; length of hind foot, 21.6, 23.1; length of ear, 8.2, 8.5; basal length of cranium, 15.1, 15.0; greatest length of cranium, 24.2, 24.3; spread of maxillary arch, 11.1, 11.2; interorbital width, 5.8, 5.9; nasal length, 9.1, 9.2; intermaxillary width, 4.4, 4.4; alveolar length, 3.5, 3.6; lacrimal length, 1.7, 1.7; width of maxillary arch, 1.3, 1.4; basioccipital length, 3.9, 3.9; greatest depth of cranium, 8.0, 7.9; greatest width of cranium, 12.5, 12.5; zygomatic width, 12.3, 12.2; nasal width, 2.9, 2.8 (Best 1993b). Body mass averages 16.89 g for both sexes. Males have an average body mass (in g) of 16.75; 16.88 for reproductive males and 16.23 for non-reproductive males. Females have an average body mass (in g) of 17.04; 18.12 for lactating females, 17.85 for pregnant females, and 15.91 for nonreproductive females (Van de Graaff 1975). Males are usually larger than females (Hall 1946; Hoffmeister and Lee 1967), but 1 study noted a significant difference only in length of hind foot (Best 1993a). Insular populations in the Gulf of California exhibit an overall reduction in size (Lawlor 1982).

DISTRIBUTION. *Chaetodipus penicillatus* occurs in deserts and arid regions of southwestern North America (Fig. 3), coincident with creosote bush communities. Northern boundary extends from southeastern California to southwestern edge of New Mexico and northward in Arizona to extreme southern Nevada and Utah. Southern boundary extends from northeastern Baja California into northern two-thirds of Sonora, Mexico (Hall 1981; Williams et al. 1993). Elevational range is 36–1,585 m (Lowe 1964).

FOSSIL RECORD. *Chaetodipus penicillatus* occurs in a late Pleistocene assemblage in Dove Spring Lignites, Kern County, California (Whistler 1990). *C. penicillatus* also occurs in a Holocene deposit found in Quien Sabe Cave, San Bernardino County, California (Whistler 1991).

FORM AND FUNCTION. Pelage of individuals in volcanic Pinacate Mountains, where a layer of black dust covers sandy soils, is much darker than pelage of individuals from other populations (Dice and Blossom 1937). A melanistic individual of *C. p. angustirostris* was reported from California, with a tuft of white hair along



FIG. 1. Adult *Chaetodipus penicillatus pricei* from Santa Rita Experimental Range, Pima County, Arizona. Photograph by T. L. Best.



FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult male *Chaetodipus penicillatus* from Virgin River, 6.4 km S Littlefield, Mojave County, Arizona (T. L. Best 4084). Greatest length of skull is 28.2 mm.

shaft of tail that was attributed to damage to underlying caudal vertebrae (Howell 1923).

Dental formula is $i\ 1/1, c\ 0/0, p\ 1/1, m\ 3/3$, total 20 (Brylski 1993). Teeth exhibit simple lophodont dentition with enamel restricted to anterior and posterior surfaces (Nikolai and Bramble 1983). Baculum has an enlarged, slightly laterally compressed base leading to a long and slender shaft that gently tapers to a pointed tip. Distal end of baculum is ventrally curved, forming a 90° angle (Burt 1936, 1960). Length and shape of bacula vary according to age and reproductive condition (Van de Graaff 1975). Bacula of juveniles and subadults lack sigmoid appearance found in adult males and show extensive dorsal curvature. Bacula averaged 7.65 mm for juveniles ($n = 3$) and 9.01 mm for subadults ($n = 14$ —Van de Graaff 1975) captured in Pima County, Arizona. A separate study (Burt 1936) reported a mean bacular length of 12.58 mm ($n = 3$). Length of baculum correlates with fertility (amount of spermatozoa); males with relatively more spermatozoa have longer bacula (Van de Graaff 1975).

Hairs are relatively long (8.5 mm) and wide (0.08–0.10 mm) with a wide shaft and abrupt tip. Dorsal surface of hairs exhibits shallow, but wide, troughs, and medulla of shaft is 5–7 fused cells across (Homan and Genoways 1978). A specialized sebaceous caudal gland is located ventrally and distal to base of tail (Quay 1965).

Mastoids do not reach dorsal surface of skull and bullae are slightly inflated. Middle ear is composed of cancellous bone, with

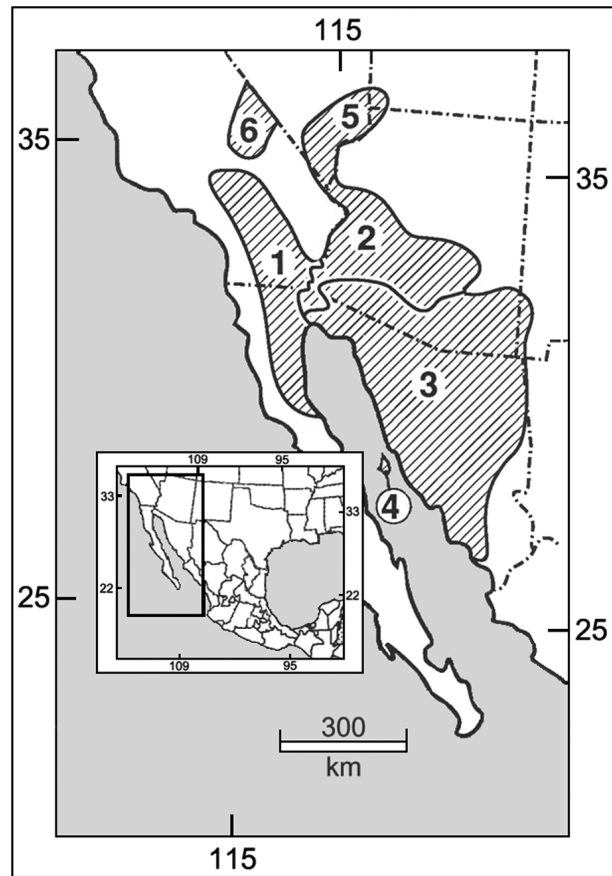


FIG. 3. Geographic distribution of *Chaetodipus penicillatus* (modified from Hall 1981). Subspecies are: 1, *C. p. angustirostris*; 2, *C. p. penicillatus*; 3, *C. p. pricei*; 4, *C. p. seri*; 5, *C. p. sobrinus*; 6, *C. p. stephensi*.

a large cavity ventral to cochlea and modifications in Hensen's cells and zona pectinata of the cochlea within the middle ear (Webster 1968). Volume of middle ear is 0.04 ml and diameter of tympanic membrane is 2.77 mm. Stapes footplate, which is convex and bulgates below, is 0.66 by 0.33 mm, does not possess a stapedia process, and has a small and slightly ossified intercrural canal. Malleus and incus are securely attached to each another and are 1.55 and 0.67 mm in length, respectively. Malleus has a large and obtusely rounded head, lacks a processus cephalicus, and has a small and delicate processus gracilis. Large, rounded incus has a process brevis that is two-thirds as long as stapedia process and both extend outward at right angles; sylvian apophysis is absent (Cockerell et al. 1914; Webster and Webster 1975).

Basal metabolic rate, in terms of oxygen consumption, is $1.38\ \text{ml}\ \text{g}^{-1}\ \text{h}^{-1}$. Lower limit of thermal neutrality is 31.7°C (Brower 1970). Under conditions of low humidity and moderate temperatures with no exogenous water, average maximum urine concentration is 4,684 mOsm/l (Grubbs 1974); concentrations have been recorded as high as 6,048 and 7,500 mOsm/l (Altschuler et al. 1979; Lindstedt and Braun 1978). Glomerular volume ($2.5\text{--}16.0 \times 10^3\ \mu\text{m}^3$) and length of proximal tubule (3.3–10.4 mm) exceed those of other rodents (Lindstedt and Braun 1978). Mean ($\pm SE$) glomerular filtration rate has been reported as $475 \pm 73\ \mu\text{l}\ \text{min}^{-1}\ \text{g}\ \text{kidney}\ \text{weight}^{-1}$ and urine osmolality as $1,154 \pm 197\ \text{mOsm/l}$ water. Single glomerular filtration rate does not differ between proximal and distal tubules; 43 and $48\ \text{nl}\ \text{min}^{-1}\ \text{g}\ \text{kidney}\ \text{mass}^{-1}$, respectively (Braun et al. 1981). Juxtamedullary nephrons are 1.5–1.6 times larger in diameter than either superficial or midcortical nephrons (Altschuler et al. 1979). A greater portion of renal blood flow moves through these larger nephrons (1.6 times as much as superficial nephrons), which also exhibit longer loops of Henle (Jamison and Kriz 1982). Superficial nephrons have a thin loop of Henle located in vascular bundles of outer medulla with a simple epithelium (mean $\pm SE$, $0.4 \pm 0.6\ \mu\text{m}$ thick), whereas a majority of midcort-

ical and juxtamedullary nephrons have a relatively thick epithelia ($1.7 \pm 0.6 \mu\text{m}$ thick—Nagle et al. 1981). Because papillae extend farther into ureter, outer and inner medullary thickness (16.8 mm) is large (Altschuler et al. 1979; Lindstedt and Braun 1978). Kidneys do not contain unique types of medullary epithelia (Nagle et al. 1981). Thus, *C. penicillatus* has a theoretical urine-concentrating ability $> 10,000 \text{ mOsm/l}$ water (Sperber 1944). Water balance is thermally dependent (MacMillen and Hinds 1983), as reflected in rates of water turnover (decreasing water turnover with increasing temperature) and urine concentration (increasing concentration with increasing temperature—Grubbs 1974). Turnover of tritiated water (k) is inversely related to body weight ($k = 2.60 (\text{weight}^{-1.13})$) and ambient temperatures ($k = 0.21 - 0.0049 (\text{ambient temperature})$). Water turnover is independent of protein content of diet but urine osmolarity increased with increasing protein ($\bar{X} = 4,685 \text{ mOsm/l} \pm 172 \text{ SE}$ —Grubbs 1980).

Internal carotid and vertebral arteries supply brain and stapled artery supplies dura mater, orbit, and both jaws via 3 branches (Bugge 1971). During biosynthesis of steroids in adrenal glands with an average mass of 2.4 mg/gland, cortisol, aldosterone, and 18-hydroxycorticosterone are formed as major end products from endogenous sources (Ogunsua et al. 1971). Within pancreatic islets, alpha cells are centrally located with some partly scattered cords of alpha cells among beta cells. Ratio of alpha to beta cells is relatively high and similar throughout pancreas (Quay 1960). Submandibular salivary glands contain convoluted granular tubules with dilated ducts with a diameter of 40.5–86 μm and columnar cells 16–19 μm in height. Parotid glands contain nondistinct, short, and narrow intercalated ducts with squamous to low cuboidal cells (Flon et al. 1969).

Mean ($\pm \text{SE}$) endocranial volume is $0.44 \pm 0.3 \text{ ml}$, with an encephalization quotient of 1.00 based on overall mammalian body mass, and 0.91 based on body mass of only geomyoids (Hafner and Hafner 1984).

ONTOGENY AND REPRODUCTION. Peak reproductive activity of males occurs during summer. In June, $>95\%$ of males were capable of reproduction; reproductive activity begins to decrease in August until few fertile males are present by late autumn. Most reproductive activity in females occurs during June–October (Van de Graaff 1975). No reproductively active females were recorded during October–May, although fertile males were recorded at this time (Van de Graaff 1975; Vaughan 1976).

Estrus lasts a few h and gestation is 23–26 days (Eisenberg and Isaac 1963; Wilken and Ostwald 1968). During estrus, interspecific aggression and territoriality decrease (Wilken and Ostwald 1968). After copulation and successful fertilization, vaginal plugs form from the lining of genital tract. Vaginal plugs average 10.55 mm in length ($n = 3$) with a thicker distal end that tapers to a bulblike proximal end, closest to the cervix (Van de Graaff 1975). Average litter size in the wild is 3.38 (Van de Graaff 1975) and in the laboratory is 4.9 (range, 3–7—Wilken and Ostwald 1968). Incisors appear 9 days after birth, eyes open on day 14, and ears open no sooner than day 14 (Eisenberg and Isaac 1963).

ECOLOGY AND BEHAVIOR. Individuals are solitary with nonoverlapping home ranges (Jones 1985). Population density is 0–8.5 individuals/ha (Vaughan 1976). Average size of home range was 855 m^2 (Vaughan 1976) and 1,214–2,430 m^2 (Reynolds and Haskell 1949).

Activity increases primarily during mornings in late spring and early summer, and decreases during hottest and driest parts of the year (Hoagstrom 1978; Van de Graaff 1975). In southern Arizona, no activity was observed from December to February. Overall activity decreases during winter, with few individuals captured from November to April (Bateman 1967; Van de Graaff 1975; Vaughan 1976). Seasonal dormancy occurs (Arnold 1942; Reynolds and Haskell 1949) and individuals readily enter short bouts of torpor during energetic emergencies (French 1993). Spontaneous torpor occurs in captive animals when air temperature reaches 10–15°C and death occurs at 5°C (Bartholomew and Cade 1957; Brower 1970; Brower and Cade 1971). Functional hypoxia-induced torpor occurs when body temperature reaches 9.9°C (Hayden and Lindberg 1970). Phase of moon and amount of moonlight can significantly affect foraging patterns, causing individuals to alter microhabitat use during periods of bright moonlight (Meyer and Valone 1999; Price et

al. 1984), and minimum ambient temperature significantly affects foraging effort (Meyer and Valone 1999).

The desert pocket mouse is relatively rare near its type locality because this area is near the edge of its range; it is more common along northern portions of the Colorado River (Stephens 1906). In Sonora, *C. penicillatus* is among the most often-encountered species of pocket mouse, indicating a relatively high abundance (Caire 1978), and it is prominent in the Lower Austral Zone of Mexico (Goldman 1951). *C. penicillatus* displays a strong affinity for areas with creosotebush (*Larrea*) and saltbush (*Atriplex*) and its geographic range approximates that of the *Larrea–Atriplex* complex in the Lower Sonoran life zone (Hoffmeister and Lee 1967; Warren 1979). *C. penicillatus* also occurs in association with *Acacia*, *Bouteloua*, *Flourensia*, *Fouquieria*, *Opuntia*, *Prosopis*, and *Yucca*. Foraging occurs mostly under large bushes (Price 1984; Wondolleck 1975, 1978) and in dense grasses (Reynolds and Haskell 1949), although dense vegetation is not a requirement (Caire 1978). Activity of *C. penicillatus* is positively correlated with ground cover (Wandolleck 1975; Warren 1979). Burrows occur below mesquite (*Prosopis*) and creosote bushes (*Larrea*) and in bare areas (Bailey 1931; Ingles 1959). *C. penicillatus* usually occurs on mostly level terrain with fine, sandy, or light gravelly soils (Bailey 1931; Bateman 1967; Caire 1978; Drabek 1967; Findley et al. 1975; Grinnell 1914, 1933; Hoffmeister and Durham 1971; Vaughan 1976; Warren 1979). *C. penicillatus* may occur on coarser soils (Rosenzweig and Winakur 1969). On Isla Tiburón in the Gulf of California, the species was present on gently sloping hills and flat areas where soils consisted of sand and gravel (Burt 1938).

Seeds of catclaw (*Acacia*), creosotebush, dates (*Zizyphus*), and mesquite have been found in cheek pouches (Arnold 1942; Bond 1945). Other seeds, taken from cheek pouches, include *Erodium cicutarium*, a common desert annual, *Opuntia engelmannii*, a succulent (Inouye 1981; McCloskey 1983), annual grasses (*Aristida adscensionis* and *Bouteloua aristidoidea*), perennial grasses (*Aristida ternipes*, *Heteropogon contortus*, *Pappophorum wrightii*, *Ristida hamulosa*, *Setaria macrostachya*, and *Trichachne californica*), grass culms, annual forbs (*Boerhaavia terrestris*, *Euphorbia*, *Kallstroemia grandiflora*, and *Lotus humistratus*), perennial forbs (*Boerhaavia caribaea*, *Ditaxis neomexicana*, and *Sida diffusa*), and several shrubs (*Acacia*, *Opuntia engelmannii*, *O. fulgida*, and *Prosopis juliflora*—Reynolds and Haskell 1949). Potentially toxic jojoba (*Simmondsia chinensis*) seeds are refused in captivity, even when facing starvation (Sherbrooke 1976). Insect matter from beetles and bees has been found in cheek pouches of immature individuals (Arnold 1942). Foraging activity fluctuates with availability of seeds of various plants, and individuals collect a limited variety of seeds during a specific period of time (Eisenberg 1963; McCloskey 1983). Normally a ground forager, *C. penicillatus* will climb vegetation to collect food (Reichman and Price 1993; Rosenzweig et al. 1975). Rates to harvest seeds increase with increasing density of seeds and decrease with increasing size of soil particles and density of seeds (Price and Heinz 1984). Selection of seeds is inversely proportional to amount of time to find a seed (Smigel and Rosenzweig 1974).

Chaetodipus penicillatus is sympatric with *Dipodomys deserti*, *D. merriami*, *Mus musculus*, *Neotoma albigula*, *Notiosorex crawfordi*, *Onychomys torridus*, *Perognathus baileyi*, *P. amplus*, *P. intermedius*, *Peromyscus eremicus*, *Reithrodontomys megalotis*, *Sigmodon hispidus*, *Spermophilus harrisi*, and *Spermophilus tereticaudus* (Hoagstrom 1978; Hoffmeister and Durham 1971; Hoffmeister and Goodpaster 1962; Reynolds 1958; Van de Graaff 1975). Although similar morphologically, *C. baileyi* does not occur sympatrically because of different habitat requirements (Rosenzweig and Winakur 1969). *Chaetodipus intermedius* and *C. penicillatus* usually do not occupy the same habitat, but were sympatric near volcanic boulders on exposed lava in northwestern Sonora, Mexico (Dice and Blossom 1937). Coyotes (*Canis latrans*) are predators (Short 1979).

Two species of fungi, *Coccidioides immitis* and *Haplosporangium parvum*, are parasitic on *C. penicillatus* (Ashburn and Emmons 1942; Emmons 1942; Emmons and Ashburn 1942). The protozoan *Eimeria penicillati* (Sporozoa) was described from the intestinal tract (Ivens et al. 1958); additional coccidian endoparasites include *Eimeria merriami* and *E. reedi* (Ford et al. 1990). Other endoparasites include several species of nematodes, *Protospirura anodon*, *P. tetradon*, *Trichuris perognathi*, *T. minuta*, and

Wellcomia longejector (Arnold 1942; Chandler 1946; Hannum 1943). *Microfilaria* has been found in blood (Wood 1952).

Ectoparasites include 5 species of mites: *Geomylichus brevispinosus*, *G. multistriatus*, *G. texanus* (Linthorpeidae—Fain et al. 1978, 1988), *Ischyropoda spiniger* (Laelapidae—Keegan, 1951), and *Neolabidophorus verrucosus* (Glycyphagidae—Furman 1955). Several species of chiggers, parasitic larvae of mites of the family Trombiculidae, have been found, including *Dermadelema furmani* (Pomeroy and Loomis 1984), *Euschoengastoides arizonae*, *E. hoplai*, *E. imperfectus*, *E. loomisi*, *E. neotomae*, *E. ryckmani*, *E. tanigoshii*, *E. timidus*, *E. webbi*, *Hexidionis allredi*, *H. harveyi*, *H. navojoae*, *Hyponeocula arenicola*, *H. deserticola*, *H. imitator*, *H. rugosa*, *Kayella lacerta*, *Leptotrombidium panamense*, *Otorhinophila baccusi*, *O. desertorum*, *O. intrasola*, *O. parvisola*, *O. sola*, *O. xerophila*, and *Pseudoschoengastia* (Loomis 1971; Loomis and Crossley 1963; Loomis and Wrenn 1973; Lucas and Loomis 1968; Tanigoshi and Loomis 1974; Wrenn and Loomis 1967). One species of flea, *Meringis agilis*, has been reported (Eads 1960). The sucking louse *Fahrenholzia pinnata*, a member of a heteromyid-specific genus of lice, occurs on *C. penicillatus* (Morlan and Hoff 1957).

In captivity, sand placed within cages is essential to maintain health (Spiller and Ostwald 1968). Individuals must be caged separately because interspecific aggression can lead to severe injury and death. Captive females usually remain in anestrus or experience irregular periods of estrus; complete or partial contact with males can initiate estrus (Ostwald et al. 1972; Wilkin and Ostwald 1968). Aseasonal, constant photoperiods, coupled with partial contact with males, also may initiate estrus (Ostwald et al. 1972). A semipurified diet designed to address dietary needs of *C. penicillatus* has been developed; this diet includes high ratios of potassium to sodium and magnesium to calcium, and replacement of inorganic phosphates by organic phosphates, including calcium, magnesium, and sodium salts of glycerophosphates. This diet is adequate to maintain adult mice, but lacks a source of water required by weanlings (Spiller and Ostwald 1968).

GENETICS. Diploid number of chromosomes is 46, with fundamental numbers of 48 and 54, depending on subspecies: *C. p. penicillatus*, 54; *C. p. angustirostris*, 54; *C. p. pricei*, 48; and *C. p. seri*, 48 (Patton 1970). Two autosomal pairs are biarmed (1 metacentric and 1 submetacentric) and the remaining 20 autosomal pairs are acrocentric, including 1 pair of microchromosomes. X chromosome is submetacentric and Y chromosome is acrocentric (Patton and Soule 1967).

Three karyologic races within this species differ in number of autosomal arms, but not diploid number of chromosomes; these races do not correspond to recognized subspecies (Patton 1969b). One race is consistent with *C. p. pricei* and populations in eastern Arizona of *C. p. penicillatus*. A 2nd race is consistent with *C. eremicus* and *C. eremicus atrodorsalis* (formerly recognized as subspecies of *C. penicillatus*) in the Chihuahuan Desert. The 3rd chromosomal race is consistent with *C. p. angustirostris* and western Arizona populations of *C. p. penicillatus* (Patton 1965, 1967, 1969a, 1970). *C. eremicus* was elevated to specific status based on DNA sequence analysis and contains 2 subspecies: *C. e. eremicus* and *C. e. atrodorsalis*, based on geographic, morphologic, and chromosomal data (Hoffmeister and Lee 1967; Lee et al. 1996; Patton 1969b, 1970).

Of 179 individuals sampled from 22 populations of *C. penicillatus*, an average of 1.603 alleles/locus were found, with 0.167 loci polymorphic per population (Patton et al. 1981). Proportion of heterozygous loci per individual averaged 0.047 (Patton et al. 1981). *C. penicillatus pricei* and *C. pernix rostratus* hybridize under natural conditions. Only 2 F₁ hybrids were reported from >200 individuals examined, indicating that hybridization is rare and the 2 species retain their genetic identity (Patton and Soule 1967). Considerable genetic intergradation occurs between populations of *C. p. penicillatus* and *C. p. pricei* in southern Arizona, although outside this zone they are distinguishable genetic units (McKnight 1989).

REMARKS. *Chaetodipus* is from the Greek *chaeta* referring to bristlelike hairs, *dis* meaning 2, and *pous*, alluding to feet. The specific epithet *penicillatus* is from the Latin *penicillus* meaning having the form of a pencil and ending with a tuft of fine hairs, like a paintbrush (Stangl et al. 1993). Additional common names

are tuft-tailed pocket mouse (Coues and Yarrow 1875; Stephens 1906) and sand pocket mouse (Arnold 1942).

K. A. Howard prepared Fig. 3 and all figures were greatly improved by modifications made by L. F. Alexander. This manuscript is a contribution from the Center for Aridlands Biodiversity Research and Education (CABRE) at the University of Nevada, Las Vegas.

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Associate Editors were KRISTOFER HELGEN, BETTY MCGUIRE, and PAMELA R. OWEN. Editor was VIRGINIA HAYSSEN.

S. J. MANTOOTH, DEPARTMENT OF BIOLOGICAL SCIENCES, UNIVERSITY OF NEVADA LAS VEGAS, 4505 MARYLAND PARKWAY, LAS VEGAS, NEVADA 89154-4004, USA. T. L. BEST, DEPARTMENT OF BIOLOGICAL SCIENCES AND ALABAMA AGRICULTURAL EXPERIMENT STATION, 331 FUNCHESS HALL, AUBURN UNIVERSITY, ALABAMA 36849-5414, USA.