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Chaetodipus hispidus.

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Chaetodipus hispidus (Baird, 1858)

Hispid Pocket Mouse

Perognathus hispidus Baird, 1858:421. Type locality "Charco Escondido [Tamaulipas], Mexico, (24 leagues W. of Matamoros)."

Perognathus paradoxus Merriam, 1889:24. Type locality "Trego County, Kansas."

Perognathus latirostris Rhoads, 1894:185. Type locality "Rocky Mountains."

Perognathus conditi Allen, 1894:318. Type locality "San Bernardino Ranch, southeastern corner of Cochise Co., Arizona."

Chaetodipus hispidus, Hafner and Hafner, 1983:24. Elevation of subgenus to generic status.

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciurognathi, Infraorder Myomorpha, Superfamily Geomyoidea, Family Heteromyidae, Subfamily Perognathinae, Genus *Chaetodipus*. Four subspecies recognized by Glass (1947) and Hall (1981) are as follows:

C. h. hispidus Baird, 1858:421, see above.

C. h. paradoxus Merriam, 1889:24, see above (*latirostris* Rhoads, *conditi* Allen are synonyms).

C. h. spilotus Merriam, 1889:25. Type locality "Gainesville, Cook [Cooke] County, Texas." (*maximus* Elliot is a synonym).

C. h. zacatecae Osgood, 1900:45. Type locality "Valparaiso, Zacatecas, Mexico."

Hoffmeister (1986) and Hoffmeister and Goodpaster (1954) recognized *C. hispidus conditi* Allen as a separate subspecies.

DIAGNOSIS. *Chaetodipus hispidus* (Fig. 1) is larger (total length usually >180 mm and length of hind foot usually >22 mm) than most of the pocket mice with which it occurs; total length in *Perognathus amplus*, *P. fasciatus*, *P. flavus*, and *P. flavescens* is <170 mm and length of hind foot is <22 mm. *C. hispidus* differs from other *Chaetodipus* in having a noncrested tail equal to or shorter than the length of the head and body. Total length in *C. intermedius* usually is <180 mm and length of hind foot is <22 mm. The dorsal fur of *C. hispidus* is coarser, with more buff to ochraceous tones than that of the grayer *C. baileyi*. The conspicuous buff to ochraceous lateral stripe in *C. hispidus* is lacking in *C. baileyi* and *C. penicillatus*. The skull of *C. hispidus* has a conspicuous supraorbital bead, and the auditory bullae are less inflated than in other pocket mice with which it occurs. The similarly sized *Liomys irroratus* has coarser pelage, is dark gray dorsally, and lacks the grooved upper incisors of pocket mice. The baculum and glans penis of *C. hispidus* are distinctive; in particular, the trifid head of the baculum is unlike that of any other heteromyid (Burt, 1936; Hafner and Hafner, 1983).

GENERAL CHARACTERS. The pelage is harsh; upper parts ochraceous mixed with black, venter whitish. In some regions the dorsal pelage has an olive tone (Schmidly, 1977). The tail is well haired, but not crested, with a black dorsal stripe, buffy sides, and white underside. Means and ranges (in parentheses) of external and skull measurements (in mm) of 10 adult *C. h. paradoxus* from western Nebraska were: total length, 220.0 (203 to 237); length of tail, 106.6 (93 to 114); length of hind foot, 26.4 (23.5 to 29.5); greatest length of skull, 32.0 (30.7 to 33.9; Jones et al., 1983). Mean body mass of seven individuals from this sample was 32.0 g. Means and ranges (in parentheses) of measurements (in mm) of 15 adult hispid pocket mice from the Hauchuca Mountains, Arizona, were: length of head and body, 96.9 (86 to 103); length of hind foot, 25.0 (23 to 28); occipitonasal length, 29.4 (28 to 30); greatest breadth at mastoids, 4.2 (4.0 to 4.4; Hoffmeister, 1986). The skull is large and robust (Fig. 2); the mastoids are relatively small and do not bulge posteriorly (Hall, 1981). The species grades from smaller in the south to larger in the north, and from lighter in the west to darker in the east (Blair, 1954). Dental formula is i 1/1, c 0/0, p 1/1, m 3/3, total 20, as in other pocket mice.

DISTRIBUTION. *Chaetodipus hispidus* ranges from North Dakota south through the Great Plains and Texas to central Tamaulipas, Mexico, northwest to southeastern Arizona (Fig. 3). *C. h. zacatecae* occurs as an apparently disjunct population in central Mexico from southern Coahuila and Durango to Hidalgo. Twelve specimens were taken from Camp Verde in central Arizona, 170 km from the nearest known record in southeastern Arizona, but there are no recent records from that area (Hoffmeister, 1986). The distributions of *C. h. hispidus*, *C. h. paradoxus*, and *C. h. spilotus* shown in Fig. 3 are essentially as determined by Glass (1947) in his review of the species. *C. h. zacatecae* apparently reaches its northern limit at the Rio Nazas in Durango (Peterson, 1976). Hoffmeister (1986) identified populations found in Arizona and Chihuahua as *C. h. conditi*.

FOSSIL RECORD. The earliest fossil record is from the late Irvingtonian (Yarmouthian interglacial period) Kanopolis fauna in Ellsworth Co., Kansas (Hibbard et al., 1978). *Perognathus rexroadensis* of the Blancan Blanco and Fox Canyon faunas of Texas and Kansas is the probable ancestor of *C. hispidus* (Kurtén and Anderson, 1980, based on Hibbard, 1950). Pleistocene fossils of *C. hispidus* are widespread over its present range and are indistinguishable from living subspecies (Dalquest, 1965; Dalquest and Stangl, 1984; Hibbard, 1952; Kennerly, 1956). Late Pleistocene or early Holocene remains have been found as far east as Jefferson Co., Missouri (Parmalee et al., 1969), but there are no records from north or east of the Missouri River (Hoffmann and Jones, 1970). Kennerly (1956) suggested fossils from the late Rancholabrean (Wisconsinan) Friesenhahn Cave fauna of southern Texas are those of *C. h. paradoxus* or *C. h. spilotus*, subspecies which now reach their southern limits in northern Texas. Dalquest and Roth (1970) found Pleistocene remains of *C. hispidus* in Tamaulipas, Mexico, between the present ranges of *C. h. hispidus* and *C. h. zacatecae*.

FORM. The hair of *C. hispidus* is average in length (7.8 to 9.1 mm) and width (0.07 to 0.10 mm) for *Chaetodipus*; the tip tapers gradually from a wide shaft and the base flares rapidly. A trough is present on the dorsal surface of the hair of all chaetodipines, but only two perognathines. This trough is especially deep and wide in *C. hispidus*. Medulla cells are fused and branched (Homan and Genoways, 1978).

A well-developed sebaceous glandular area, believed to function in olfactory communication, is present on the ventral surface of the tail. The gland is more developed in *Chaetodipus* than in *Perog-*

FIG. 1. Photograph of adult *Chaetodipus hispidus*, taken in Childress Co., Texas, 22 October 1987. Photograph by A. Shull, R. Wahl, and T. Best.

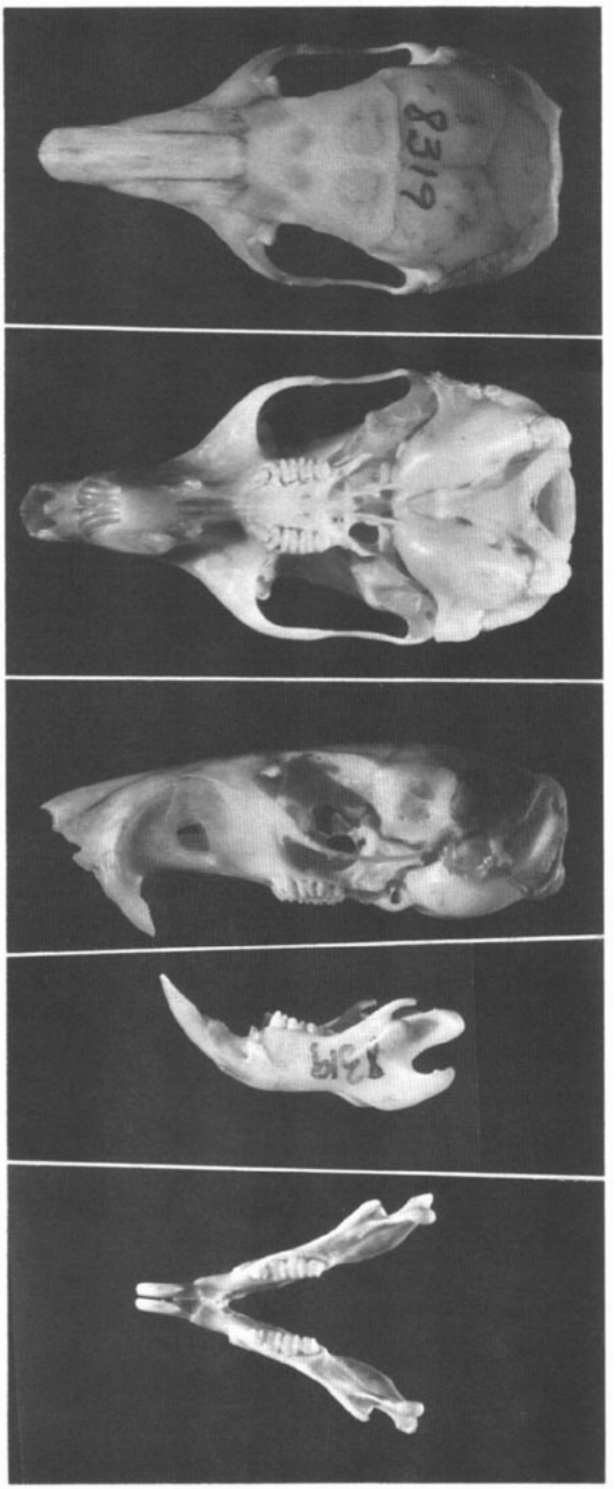

FIG. 2. Dorsal, ventral, and lateral views of cranium, and lateral and dorsal views of mandible of an adult female *Chaetodipus hispidus paradoxus* (Univ. Minnesota Museum of Natural History 8319) from Ford Co., Kansas. Greatest length of cranium is 32.0 mm.

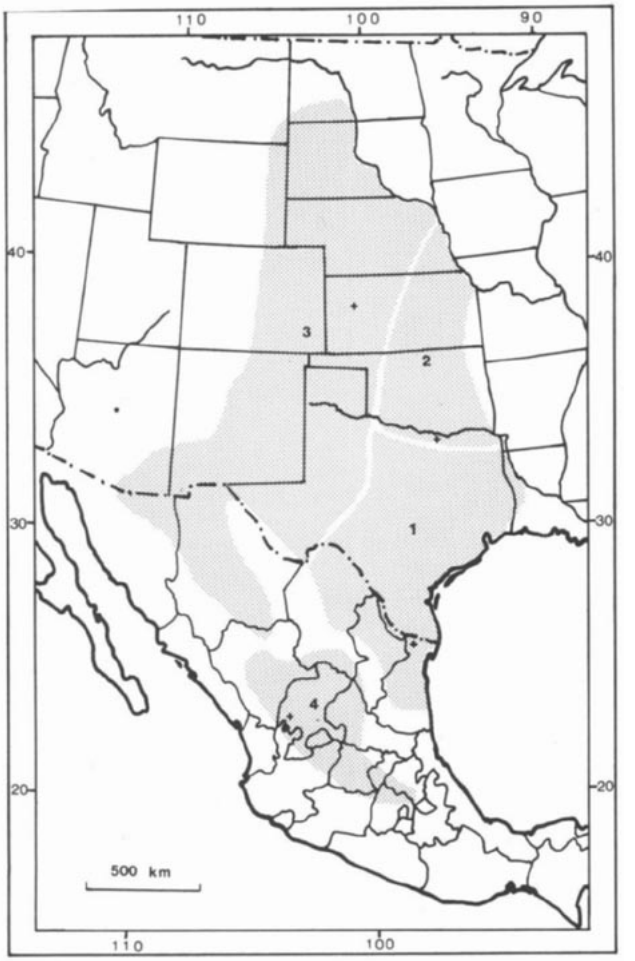

FIG. 3. Distribution of *Chaetodipus hispidus* and subspecies (Glass, 1947; Hall, 1981; Hoffmeister, 1986): 1, *C. h. hispidus*; 2, *C. h. spilotus*; 3, *C. h. paradoxus*; 4, *C. h. zacatecae* (+ indicates type locality). An isolated occurrence of *C. hispidus* in central Arizona is indicated with a dot.

nathus. Unlike other pocket mice, *C. hispidus* shows greater development of the gland in females than in males (Quay, 1965).

The teeth of *C. hispidus* have several distinguishing features. Unlike most other pocket mice, *C. h. paradoxus* has a posteromedian cuspule on the lower premolar in addition to the usual four cusps. The lower first and second molars of this subspecies also differ from those of most other pocket mice in showing a well-developed union of the lophs between the protoconid and the hypoconid (Wood, 1935). The deciduous lower premolar of *C. h. paradoxus* showed the greatest forward displacement of the anteroconid of any species studied by Wood (1935). The same tooth in *C. h. hispidus* is unusual in that the posterior cingulum gives rise to four small cuspules (Wood, 1935).

The sperm of *C. hispidus* is unlike that of any other pocket mice. The tail of the sperm is very long and the neck region is indiscernible (Hafner and Hafner, 1983).

FUNCTION. Normothermic minimal heart and respiratory rates are 250 beats/min and 50 breaths/min, respectively (Wang and Hudson, 1970). The basal metabolic rate, 1.25 to 1.28 cc O_2 g^{-1} h^{-1}, is 4 to 25% lower than the rate predicted on the basis of body mass (Morrison and Ryser, 1962; Wang and Hudson, 1970). A normothermic body temperature of 36.8 to 38.7°C is maintained at ambient temperatures of 5 to 34°C, but animals become hyperthermic at ambient temperatures above 34°C (Wang and Hudson, 1970). The latter authors found the thermal conductance to be 0.201 cc O_2 g^{-1} h^{-1}° C^{-1}, 26% higher than predicted on the basis of body mass.

As in other pocket mice, temperatures at which *C. hispidus* enters torpor vary with availability of food. Provided unlimited food and water, four of five individuals remained normothermic for 30 days at 5°C, but torpor was induced by food shortage at higher temperatures (Wang and Hudson, 1970). These authors found the body temperature in torpor to be 12 to 20.3°C with the heart rate falling to 6 to 14% and oxygen consumption to 3.5 to 13% of normothermic rates. They noted the lowest temperature from which individuals could be aroused is 8°C. The maximum spontaneous arousal rate is 0.47°C/min. During arousal, oxygen consumption is

twice the normothermic rate. Hudson (1967) found the "cut-out" temperature for an isolated heart to be 2.1°C, lower than in *Mus* and several species of *Peromyscus* tested.

In *C. hispidus*, the production of metabolic water equals evaporative water loss at a lower ambient temperature (16.0°C) than in other pocket mice studied (MacMillen and Hinds, 1983), indicating relatively low efficiency in regulating water. This observation is consistent with MacMillen and Hind's (1983) model predicting efficiency in regulating water as a negative function of body mass in pocket mice.

ONTOGENY AND REPRODUCTION. Jones et al. (1983) reported that in the northern Great Plains, adult females may bear two or more litters annually from spring through late summer. They also stated that number of young are reported to range from two to nine. Nothing has been published about growth and development.

ECOLOGY AND BEHAVIOR. The hispid pocket mouse inhabits a variety of dry, grassland habitats. Across much of its range it is most common in shortgrass and open bunchgrass prairie (Armstrong, 1972; Kaufman and Fleharty, 1974; Moulton et al., 1981; Schmidly, 1977). It occupies denser mid- to tall-grass prairie and areas of dense annual forbs in Arizona (Hoffmeister and Goodpaster, 1954; Rosenzweig and Winakur, 1969) and New Mexico (Findley et al., 1975). In parts of the Great Plains and Texas it often occurs in habitats with one or more of the following shrubs or trees: *Yucca*, ocotillo (*Fouquieria*), juniper (*Juniperus*), mesquite (*Prosopis juliflora*), and *Opuntia* (Jones et al., 1983; Schmidly, 1977). *C. hispidus* is tolerant of a wide variety of grassland vegetation and soil types in Texas and Oklahoma (Blair, 1938, 1939, 1954) and eastern Wyoming (Maxwell and Brown, 1968). Fleharty and Navo (1983) found it breeding at low densities in irrigated cornfields, but not in the surrounding sandsage (*Artemesia filifolia*) prairie of western Kansas. *C. hispidus* apparently is not dependent on sandy soils as are other plains pocket mice (Armstrong, 1972) and can be found in rocky or gravelly areas with heavy soils (Blair, 1937; Hoffmeister and Goodpaster, 1954).

The burrows of *C. hispidus* vary from simple tunnels, by immature animals, to branched tunnel systems with two or three entrances by older animals (Blair, 1937). Blair (1937) never found more than one individual in a burrow system. In northeastern Oklahoma, Blair (1938) found all burrows of *C. hispidus* under slabs of limestone and suggested that the distribution of the species might be limited in part by the availability of such slabs in this region.

In the mesquite plains of Texas, seeds composed 81% of the diet. The mice strongly selected certain seeds and diet changed with season. Major foods in winter were seeds of mesquite, sunflower (*Helianthus annuus*), cacti (*Mammillaria* and *Opuntia*), and sagebrush (*Artemisia ludoviciana*). In spring, the most common foods (by volume) were seeds and leaves of mesquite, blanket flower (*Gaillardia puchella*), *Opuntia* and bluestem (*Andropogon halli*), and insects. The diet overlapped considerably with that of coexisting *Dipodomys ordii*, but the two species were found in microhabitats with different soil types (Alcoze and Zimmerman, 1973). Blair (1937) found blanket flower and *Opuntia* to be the most frequently occurring foods in the burrows of hispid pocket mice in northeastern Oklahoma. Hispid pocket mice may store large quantities of seeds whenever they are available (Blair, 1937). Cheek-pouch volume is 1.42 cm^3, large enough to meet the daily energy requirements in one maximum seed load (Morton et al., 1980).

C. hispidus probably does not store fat for the winter, or hibernate (Blair, 1937). Even in the northern Great Plains, where hibernation would be most likely, Jones et al. (1983) believed *C. hispidus* subsisted through the winter on stores of seeds.

Predators of *C. hispidus* include carnivorous mammals, snakes, and owls. The western diamondback rattlesnake (*Crotalus atrox*) preys heavily on pocket mice; they ate more *C. hispidus* (by weight) than they ate any other species in Texas (Beavers, 1976). *C. hispidus* also was a major food item of great horned owls (*Bubo virginianus*) in Oklahoma (Tyler and Jensen, 1981).

Sixteen percent of the hispid pocket mice examined in the lower Rio Grande Valley, Texas, carried *Trypanosoma cruzi*, the protozoan that causes Chagas disease (Burkholder et al., 1980). These authors suggested that the mouse may be a resevoir for this protozoan. Borrelia-like spirochetes, but no trypanosomes, were present in blood of *C. hispidus* from southwestern Texas (Eads and Hightower, 1952). In New Mexico, Rail et al. (1969) found that hispid pocket mice carried few fleas; the one species found was *Thrassis fotus*, the flea that carries bubonic plague (*Franciscella pestis*). Plague-infested fleas were not found on the animals, however. Turner (1974) found one male infested by ticks (*Ixodes spinipalpis*) in western South Dakota.

Pocket mice generally are highly aggressive, solitary animals, and cannot be kept together in a small enclosure (Williams, 1968). However, Williams (1968) succeeded in keeping seven hispid pocket mice in a small cage for over a year. The mice tended to nest together even when separate nest boxes were provided. However, some males were aggressive, especially when food was restricted.

GENETICS. Diploid number of chromosomes is 34 and includes 3 pairs of large to medium metacentrics, 10 pairs of large to medium submetacentrics, 3 pairs of medium subtelocentrics, 1 large submetacentric X- and 1 small acrocentric Y-chromosome. The number of autosomal arms (fundamental number) is 64 (Patton, 1967*a*). Patton et al. (1981) examined electromorphic biochemical characters at 22 gene loci for most members of *Chaetodipus*. They found *C. hispidus* to be the most divergent member of the genus (although still clearly within *Chaetodipus*) and calculated a middle to late Miocene (18 mya) split of this species from the ancestral line.

REMARKS. There is some confusion about the type specimen described by Baird. Merriam (1889) accepted specimen No. 1696 (U.S. National Museum of Natural History) as the type for the species, though the skull was broken. He rejected Baird's second specimen, No. 1695 (USNM), stating it was possibly another species, and indicated that it was collected at Matamoras, Mexico. Osgood (1900) believed the broken skull of specimen No. 1696 (USNM) to be a composite of two individuals, possibly two species. He found specimen No. 1695 (USNM) to be "nearly perfect," however, and, based on that specimen, accepted the skin and posterior skull segment of specimen No. 1696 as the type specimen.

Hafner and Hafner (1983) elevated the subgenus *Chaetodipus* to 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 strongly supports the proposed elevation.

Hoffmeister (1986) did not accept *Chaetodipus* as a genus but proposed a new, monospecific subgenus, *Burtognathus*, for *C. hispidus* based mainly on its low chromosome number, lack of acrocentric chromosomes, unique baculum, and cranial features. Hoffmeister (1986) and Hoffmeister and Goodpaster (1954) recognized populations of *C. hispidus* from southeastern Arizona and Chihuahua as a separate subspecies, *C. h. conditi*, based on slightly smaller size, shorter and narrower skull, and longer tail relative to head and body than in *C. h. paradoxus* from the Great Plains.

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