

## FAMILY HETEROMYIDAE

*James L. Patton and Sergio Ticol Alvarez-Castañeda*

### Subfamily Perognathinae Coues

These are small to medium sized mice, ranging from 100 to 230 mm in total length and from 5 to 60 g in weight. The body form is quadrupedal and rather "mouse" like. They are scansorial to quasi-ricochetal in locomotion, but all four feet contact the ground with each stride; rapid movement is by an erratic quadrupedal bound, not a bipedal hop (Bartholomew and Cary, 1954). The hind feet and legs are typically longer than murid rodents, the pes has five clawed digits and a naked or only partly haired sole. Body hairs are of two types, straight and relatively long overhairs and a thin underfur of short and often strongly curved hairs. The upper incisors are grooved, there are four cheek-teeth as with all heteromyids, and the molars are brachydont, rooted, and sexta tuberculate, wearing into a horse-shoe shaped bilophodont condition before becoming obliterated with advanced age. Cranially, the squamosal is in broad contact with the parietal on the dorsal surface of the skull; the anterior zygomatic root is not greatly enlarged on joining the lacrimal; there is a large orbital non-ossification usually including the ethmoid foramen; the incisive foramen is small; the auditory bullae are greatly expanded, with the mastoid portion visible in dorsal view; and the inflated interior of the mastoid and tympanic bullae are filled with spongy trabeculae. A stapedius muscle is lacking in the middle ear. The cervical vertebrae are all independent. The baculum is relatively long and slender with a swollen base and typically an upturned tip (straight in some species and tridigitate in *C. hispidus*). Details of descriptive morphology can be found in Burt (1936), Brylski (1993), Hafner and Hafner (1983), Homan and Genoways (1978), Merriam (1889), Osgood (1900), Ryan (1989), Wahlert (1985), Webster and Webster (1975), and Wood (1935).

There are two groups of Recent pocket mice within the subfamily, commonly known as the silky (*Perognathus*) and spiny (*Chaetodipus*) pocket mice. These two groups were long considered as subgenera of the single genus *Perognathus* (Merriam, 1889; Osgood, 1900; Hall, 1981), but Hafner and Hafner (1983) provided reasons for their separation at the generic level. This recommendation has been followed by most recent treatments (e.g., Patton, 1993; Williams, *et al.*, 1993), and will be followed here. The two genera can be distinguished as follows (modified from Williams *et al.*, 1993).

*Chaetodipus* - Sole of hind foot naked; pelage relatively coarse, often with stiff, spine-like bristles on rump; stiff, coarse hairs usually project across anterior margins of ear pinna; antitragus of ear pinna lobed; tail always longer than head and body and usually both crested and penicillate; mastoid bulla usually not projecting posteriorly beyond plane of occiput; postero-medial border of mastoid bulla usually projecting as a distinct indentation into the supraoccipital; interparietal

width equal to or greater than interorbital breadth; vesicular glands of males short, globular in shape, and yellow- to gray-colored (pinkish and granular in fresh specimens).

*Perognathus* - 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 usually not lobed; tail equal to or only slightly longer than head and body, never crested and usually not penicillate; mastoid bulla projecting posteriorly beyond the plane of the occiput; postero-medial border of mastoid bulla not projecting as a distinct indentation into the supraoccipital; interparietal width nearly always less than interorbital breadth; vesicular glands of males elongated, tube-like, "J"-shaped, and translucent.

### Genus *Chaetodipus*

1889. *Chaetodipus* Merriam, N. Amer. Fauna, 1:5, 25 October.

Type species. *Perognathus* [*Chaetodipus*] *spinatus* Merriam, 1889, N. Amer. Fauna, 1:5.

Diagnosis. Characteristics as for genus except baculum tapers to a simple, nonlobed tip; no supraorbital bead or ridge on frontal; squamosal portion of zygomatic arch firmly attached to meatal part of auditory bulla; supraoccipital forms indentation into mastoid bulla; diploid number of chromosomes, in so far as is known, 36 to 56.

Comparisons. See accounts of *Burtognathus* and *Perognathus* for comparison with those taxa.

Remarks. The subgenus *Chaetodipus* as applied here differs from the subgenus of Merriam (1889) as it was applied by him and subsequent authorities except Hoffmeister (1986).

### Species Accounts

#### *Chaetodipus arenarius arenarius* (Merriam)

1894. *Perognathus arenarius* Merriam, Proc. Calif. Acad. Sci., ser. 2, 4:461.

1976. *Perognathus dalquesti*, Roth, J. Mam., 57:562.

1983. *Chaetodipus arenarius arenarius*, Hafner and Hafner, Great Basin Nat. Mem., 7:25

Type locality. From San Jorge, near Comondu, Baja California Sur, Mexico.

Range. Limited to the sandy soils on the Baja California Peninsula, from near the international boundary in northeastern Baja California southward to near the southern cape in Baja California Sur; not known from the eastern Gulf slope from about El Barril, Baja California, south to near La Paz, Baja California Sur; and Sierra de las Cacachilas and Isla Cerralvo in the southern Gulf of California (see Huey, 1964; Hall, 1981; Lackey, 1991a). *C. a. arenarius* occurs on sandy soils from near the cape region northward to the southern part of the Vizcaino Desert on the Pacific coast of Baja California Sur.

Recorded localities. **BAJA CALIFORNIA SUR:** San Jorge, near Comondu (Merriam, 1894). Tres Pachitas; Todos Santos-Pescadero (Banks, 1964).

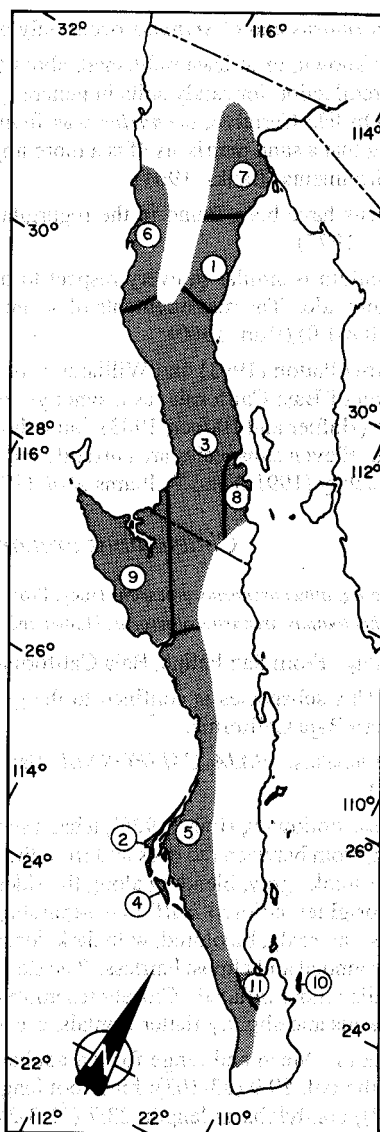
Description. This is a moderately small species within the genus, with a crested tail that is longer than the head and body and small ears. The pelage is relatively soft and usually lacks stiff bristles or spines. The dorsal color is a pale light gray or yellowish gray; there is no clearly developed buff lateral stripe. The length of the head and body averages about 70; the length of the tail ranges about 85; and the ear around 8 (Best, 1993). The skull is short and broad, with a somewhat vaulted

braincase, slender and parallel zygomatic arches, an interparietal more than twice as broad as it is long and strapshaped to slightly pentagonal, and slender nasals (see Lackey, 1991a).

**Measurements.** The means and ranges of 12 females (Banks, 1964) are: total length, 168.3 (155-180); length of tail, 90.5 (80-96); greatest length of skull, 24.8 (23.7-25.5); basilar length, 18.6 (17.4-19.4); frontonasal length, 16.9 (16.5-17.4); mastoid width, 13.2 (12.7-13.6).

**Remarks.** Detailed comparisons of *C. arenarius* with other species of pocket mice from the Baja California peninsula can be found in Lackey (1991a). This species is one of those within the genus that generally lacks any spines on the rump, and can be readily distinguished by this feature alone from others within its range (namely, *C. spinatus*, *C. californicus*, and *C. fallax*), as well as by smaller size and a much paler pelage color. It is sympatric, or nearly so, with three other relatively soft-haired species that also generally lack spines, namely *C. baileyi*, *C. formosus*, and *C. penicillatus*. From *C. baileyi*, *C. arenarius* differs by its much smaller size (hind foot 25 mm versus 26 mm; Williams *et al.*, 1993); from *C. formosus* by its generally smaller size and shorter ear (9 mm versus 9 mm), less well-developed crest on the tail, much less inflated bullae, and light yellow-gray as opposed to darker gray coloration; and from *C. penicillatus* by its smaller size, more annulated appearing tail, and broader skull, and grayish instead of yellow-brown coloration.

In northeastern Baja California where all four species that lack rump spines, as well as *C. spinatus*, are sympatric, or nearly so, *C. arenarius* and *C. penicillatus* are confined to very sandy soils, *C. baileyi* extends from sandy to stony pavements,



Localization of *Chaetodipus arenarius*:

- |                           |                              |
|---------------------------|------------------------------|
| 1. <i>C. a. albescens</i> | 2. <i>C. a. albulus</i>      |
| 3. <i>C. a. ambiguus</i>  | 4. <i>C. a. amophilus</i>    |
| 5. <i>C. a. arenarius</i> | 6. <i>C. a. helleri</i>      |
| 7. <i>C. a. mexicalis</i> | 8. <i>C. a. paralius</i>     |
| 9. <i>C. a. sabulosus</i> | 10. <i>C. a. siccus</i>      |
|                           | 11. <i>C. a. subluceidus</i> |

while *C. formosus* and *C. spinatus* occur only on rocky slopes.

Little is known, or at least published, about the ecology and life history of this species, other than its predilection for sandy soils in generally flat and arid desert scrub communities (Lackey, 1991a). On Isla Cerralvo, *arenarius* was found in patches of sandy soil well up into arroyos, suggesting that a sand matrix itself is a more important determinant of local distribution than flat, open environments (Banks, 1964).

Specimens have been found in the regurgitated pellets of barn owls (Lopez-Forment C. and Urbano V., 1977).

The baculum is similar in every respect to that of *penicillatus*, except that the base is slightly higher than wide. The measurements of seven specimens are: length 10.5 (9.7-12.1); height of base 0.9 (0.8-1.0) (Burt, 1960).

We follow Patton (1993) and Williams *et al.* (1993) in regarding *C. dalquesti* Roth, from the cape region of Baja California, as a synonym of *C. a. arenarius*. The two forms have the same karyotype (Hafner and Hafner, 1983), but a thorough analysis of their relationships has yet to be published. Eleven subspecies are currently recognized, as mapped. The synopsis presented here follows Lackey (1991a) and Williams *et al.* (1993).

### *Chaetodipus arenarius albescens* (Huey)

1926. *Perognathus arenarius albescens* Huey, Proc. Biol. Soc. Washington, 39:67.

1983. *Chaetodipus arenarius albescens*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Felipe, Baja California, Mexico.

Range. This subspecies is confined to the gulf coastal region in the vicinity of San Felipe in northeastern Baja California.

Recorded localities. **BAJA CALIFORNIA:** San Felipe (Huey, 1926; Patton *et al.*, 1981 as *C. arenarius*).

Description. Following Huey (1926), it has a semi-silky pelage of extremely light color; the dorsal coloration, from between the eyes and from the level of the back of the ears to the base of the tail, is uniform smoke gray, blending along the sides to the white underparts; some specimens have a definite, brighter colored buff line separating the entire darker upperparts from the white underparts; tail scaly, bicolored, with dark dorsal stripe, and slight terminal brush of longer hairs; ears well rounded and almost hairless. The skull is similar to that of *C. arenarius*, but squarer and aural bullae more inflated. Closely resembles *C. a. helleri*, except that it is larger, has slightly broader nasals and slightly flatter frontals, especially between the lachrymal bones.

Measurements. Mean and range for ten adults (Huey, 1926) are: total length, 165.3 (155-182); length of the tail, 89.9 (83-103); hind foot length, 21.6 (20-23); ear length, 5 (all); weight, 15.1 (10.9-19.8); condylobasal length, 23.7 (23.3-24.8); width of bullae, 12.3 (11.8-12.7); length of maxillary toothrow, 3.1 (3.0-3.4); length of the nasals, 9.1 (8.4-9.7); interorbital constriction, 6.1 (6.0-6.5).

Remarks. No information about the natural history is known

### *Chaetodipus arenarius albulus* (Nelson and Goldman)

1923. *Perognathus penicillatus albulus* Nelson and Goldman, Proc. Biol. Soc. Washington, 36:159.

1983. *Chaetodipus arenarius albulus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Magdalena Island, Baja California Sur, Mexico.

Range. Known only from Isla Magdalena, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: Magdalena Island (Nelson and Goldman, 1923; Huey, 1926). Magdalena Bay (Anthony, 1925). Estero Salinas (Alvarez, 1960).

Description. Following Nelson and Goldman (1923), this is a small and unusually light-colored form, most closely allied to *C. a. arenarius*, but upperparts decidedly paler, the buff element much less obscured by dusky hairs. The colors of the type are: upper parts in general near light buff, palest on cheeks, shoulders, sides, and outer surface of hind limbs, finely and rather inconspicuously mixed or lined with brownish black on top of head and over back; underparts, fore limbs, and hind feet white; tail light brownish above, whitish below. The skull closely resembles that of *C. a. arenarius*, but averages smaller, less massive. It is also similar to that of *C. a. ammophilus*, but decidedly smaller with relatively weaker zygomatic arches.

Measurements. Means and ranges of nine adults (Nelson and Goldman, 1923) are: total length, 156 (147-164); length of tail, 86 (79-98); hind foot length, 23.2 (21-23). The measurement of the skull of the type are: greatest length, 22.8; mastoid width, 12; zygomatic width, 11.2; interorbital breadth, 6.1; length of maxillary toothrow, 3.4; interparietal, 7 x 3.4; length of nasals, 8.7; zygomatic width, 11.2.

Remarks. The pallid coloration of this pocket mouse appears to be associated with that of the shifting sand dunes it inhabits. It appears to be restricted to Magdalena Island, but is evidently very closely allied to the darker form which occurs on the adjacent mainland (Nelson and Goldman, 1929). The Estero Salinas is on the peninsula in front of Isla Magdalena (Alvarez, 1960). This subspecies is considered threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus arenarius ambiguus* (Nelson and Goldman)

1929. *Perognathus arenarius ambiguus* Nelson and Goldman, Proc. Biol. Soc. Washington, 42:108.

1983. *Chaetodipus arenarius ambiguus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Yubay, 30 mi SE Calamahue, 2,000 ft, Baja California.

Range. This subspecies extends from near Chapala southward to the middle of the Vizcaino Desert in Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: Calamahue; Calamahue Canyon (mouth); La Lomita Maria; Pozo Altamirano; Pozo San Augustin (20 miles east of San Fernando); Punta Prieta; Rancho Mesquital (33 miles west of Calmalli); San Andres; San Fernando; San Ignacio (20 miles west); Santo Domingo; San Francisquito; Santa Clara Mountains; Santa Rosalia Bay; Scammon's Lagoon (south side); Turtle Bay (or San Bartolome); Yubay, 30 mi SE Calamahue, 2000 ft (Nelson and Goldman, 1929). 25 mi N Punta Prieta (Villa, 1941). Between El Arco and San Ignacio (Alvarez, 1960). San Fernando; Pozo San Augustin, 20 mi E San Fernando; Mouth Calamahue Canyon; Pozo Altamirano, 20 mi San Ignacio; San Andres; 25 mi N Punta Prieta (Hall, 1981).

Description. Following Nelson and Goldman (1929), it is similar to *C. a. arenarius*, but smaller and paler colored. The color of the type is light buff upper parts, obscured by overlying black-tipped hairs; buff lateral line absent; under parts, fore-limbs and hind feet white; tail brownish above, white below. The skull is similar in general to that of *C. a. arenarius* and *C. a. albescens* but averages smaller, with relatively smaller mastoid and auditory bullae. These differences most noticeable particularly in comparison to *C. a. arenarius*.

Measurements. The means and ranges of five specimens (Nelson and Goldman, 1929) are: total length, 163 (157-167); length of tail, 92 (88-96); hind foot length, 22 (22-23.5). The measurements of the skull of the type are; greatest length, 22.6; greatest breadth, 12; interorbital breadth, 6.2; length of maxillary tooththrow, 3.2; interparietal, 5.8 x 2.8; length of nasals, 8.3; width of nasals, 2.3.

Remarks. *Chaetodipus arenarius ambiguus* is slightly larger than *C. a. helleri* with decidedly paler coloration. Rather closely resembling *C. a. albescens*, but color usually distinctly darker. Buff lateral line absent or faint. The skull differs from that of *C. a. helleri* mainly in larger average size (Nelson and Goldman, 1929).

This subspecies occupies the central section from San Fernando south to the Vizcaino Desert, the region of perhaps the most extreme aridity in Baja California (Nelson and Goldman, 1929).

### *Chaetodipus arenarius ammophilus* (Osgood)

1907. *Perognathus penicillatus ammophilus* Osgood, Proc. Biol. Soc. Washington, 20:20.

1983. *Chaetodipus arenarius ammophilus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Santa Margarita Island, Baja California Sur, Mexico.

Range. Known only from its type locality of Santa Margarita Island, off the western coast of Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: Santa Margarita Island (Osgood, 1907b).

Description. Following (Osgood, 1907b), the size is nearly equal to *C. a. siccus*; color paler; mastoids smaller. Size decidedly greater than *C. a. arenarius*; color averaging paler; skull larger and heavier; mastoids relatively smaller. The coloration is much as *arenarius* but averaging paler; paler than in *C. a. siccus*, and not exhibiting a gray phase. General effect of upperparts drab; basal part of hairs of upperparts pale gray slightly tinged with fawn; no obvious lateral line; underparts creamy. The skull is similar in general to that of *C. a. siccus*, but mastoids smaller; larger and heavier and with relatively smaller mastoids than that of *C. a. arenarius*.

Measurements. The means and range of nine topotypes (Osgood, 1907b) are: total length, 181 (171-188); length of tail, 105 (100-113); hind foot length, 94 (23.5-25.55). Skull of the type: greatest length, 26.1; basilar length, 18; mastoid width, 13.2; zygomatic width, 13.1; interorbital constriction, 6.6; nasals, 9.4; interparietal, 7.3 x 3.8; diastema, 6.4; maxillary tooththrow, 3.8.

Remarks. This form may be distinguished from both *C. a. arenarius* and *C. a. siccus* by its relatively small mastoids. Specimens from Isla Magdalena, which lies near Isla Margarita, represent the subspecies *C. a. albulus* and do not approach *C. a. ammophilus* in size or cranial characters, although both subspecies are rather pale. This subspecies is considered threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus arenarius helleri* (Elliot)

1903. *Perognathus helleri* Elliot, Field Columbian Mus., Publ. 74, Zool. Ser., 3:166.

1983. *Chaetodipus arenarius helleri*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Quintin [San Quintin], Baja California, Mexico.

Range. This race is known only from the San Quintin Plain on the northwestern Pacific coast.

Recorded localities. *BAJA CALIFORNIA*: San Quintin (Elliot, 1903). West Side of the San Quintin Bay (Anthony, 1925). San Quintin and vicinity (Huey, 1926). N San Quintin (Villa, 1941).

Description. Following Elliot (1903), in size it is similar to *C. a. arenarius*; the color above is mixed black and dark buff, giving a dark yellowish-brown appearance to the upper parts, very different from the pale buff-drab of *C. a. arenarius*. Distinct bright buff lateral line from nose to rump; under parts pure white; tail above dark brown, almost dusky; beneath pure white pencil like upper part dusky; hands and feet gray, ears dark brown. The skull has shorter nasals, broader rostrum, wider interorbital space, brain case broader, mastoids less prominent, and smaller and more anteriorly pointed bullae.

Measurements. The mean and ranges for 15 specimens (Elliot, 1903) are: total length, 159; length of tail, 83; hind foot length, 20.5; ear length, 8; occipitonasal length, 23.0; basilar length of Hensel, 14.0; interorbital breadth, 6.0; length of maxillary toothrow, 3.0; width across mastoid bullae, 11.5; length of nasals, 7.5; width of rostrum, 4.0; zygomatic breadth, 11.5; greatest width of brain case, 10.5; palatal arch to alveoli of incisors, 8.5.

Remarks. *C. a. helleri* and *C. a. albescens* from San Felipe are totally different in color and are separated from each other by the San Pedro Martir mountains, 10,000 feet high, and the two coastal ranges (Elliot, 1903).

### *Chaetodipus arenarius mexicalis* (Huey)

1939. *Perognathus arenarius mexicalis* Huey, Trans. San Diego Soc. Nat. Hist., 9:57.

1983. *Chaetodipus arenarius mexicalis*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From the Los Muertos Canyon fan at Gaskill's Tank, near Laguna Salada, 32° 27' LN, 115° 53' LW, Baja California, Mexico.

Range. Found on sandy ground on the western side of Laguna Salada (Huey, 1964).

Recorded localities. *BAJA CALIFORNIA*: Los Muertos Canyon fan at Gaskill's Tank, near Laguna Salada (Huey, 1939). De Mara's Well, Laguna Salada (Hall, 1981).

Description. Resembles *C. a. albescens*, considered by Huey (1939) to be its closest relative structurally and geographically, but is darker dorsally and either lacks, or has only a very faint buffy lateral line. Cranially, this race has a basally broader and slightly heavier rostrum as well as slightly more inflated bullae than *albescens*. Its dorsal color is closest to that of *C. a. ambiguus* from the central part of the peninsula.

Measurements. Measurements of the type include: total length, 176; length of tail, 102; hind foot length, 23; ear length (crown), 5; greatest length of skull, 23.7; interorbital breadth, 6.1; length of maxillary toothrow, 3.2; width across mastoid bullae, 12.0; length of nasals, 8.5 (from Williams *et al.*, 1993).

Remarks. According to Huey (1939a), this subspecies may range northward into the state of California, although the species has not been taken in the United States.

### *Chaetodipus arenarius paralius* (Huey)

1964. *Perognathus arenarius paralius* Huey, Trans. San Diego Soc. Nat. Hist., 13:113.

1983. *Chaetodipus arenarius paralius*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From [El] Barril, 28° 20' LN, on the Gulf of California, Baja California, Mexico.

Range. This race occurs on the gulf coast from near Bahia Los Angeles southward to the vicinity of the type locality at El Barril, Baja California.

Recorded localities. *BAJA CALIFORNIA*: [El] Barril, San Francisquito Bay; Los Flores; Los Angeles Bay (not typical) (Huey, 1964).

Description. Following Huey (1964), this race is extremely pale, almost white with a tinge of brown over the lightly grizzled dorsal area. The side stripes are obscure or missing on some specimens and the tail stripe is notably pale. The skull of *C. a. paralius* is large and is flat across the brain case.

Measurements. The measurements of the type (Banks, 1964) are: total length, 150; length of tail, 81; hind foot length, 22; ear length (crown), 5; greatest length of skull, 24.0; interorbital constriction, 6.3; length of nasals, 8.9; length of maxillary tooththrow, 2.9.

Remarks. *Chaetodipus arenarius paralius* differs from *C. a. albescens* in being slightly larger and in having a brownish cast to its dorsal pelage. The tail stripe is notably pale and the brownish side stripes found on the darker subspecies of this species are obscure or missing on most specimens of *C. a. paralius*. From *C. a. ambiguus* in being decidedly paler, and little comparison is required to separate specimens. Compared with *C. a. subluclidus*, it is pale and appears to be nearly white. Cranially, *C. a. paralius* differs from all three in the main larger and the braincase is more nearly flat (Banks, 1964). Only the measurements of the type have been published.

### *Chaetodipus arenarius sabulosus* (Huey)

1964. *Perognathus arenarius sabulosus* Huey, Trans. San Diego Soc. Nat. Hist., 13:114.

1983. *Chaetodipus arenarius sabulosus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From the mainland on S side Scammon's Lagoon, Baja California Sur, Mexico.

Range. The race is distributed from Bahia Santa Rosalia southward through the western Vizcaino Desert to the vicinity of Laguna San Ignacio.

Recorded localities. *BAJA CALIFORNIA SUR*: Mainland on S side Scammon's Lagoon (Huey, 1964). Santa Rosalia Bay; Norther part of San Ignacio Lagoon; Turtle bay (Hall, 1981).

Description. Following Huey (1964), it is pallid in color on the face, sides of head, and body. Dorsally, the pelage is slightly grizzled. The median side stripe is light brown and very faintly marked, as is the upper side of the tail. The skull is dome-like across the brain case and has a compressed appearance when viewed dorsally.

Measurements. The measurements of the type (Huey, 1964) are: total length, 165; length of tail, 91; hind foot length, 21; ear length, 5; greatest length of skull, 23.5; interorbital breadth, 6.1; length of maxillary tooththrow, 2.9; width across mastoid bullae, 12.3; length of nasals, 8.8.

Remarks. Compared with *C. a. ambiguus*, *C. a. sabulosus* is paler in color and has a narrower, dome-shaped skull. Compared with *C. a. arenarius*, it is paler in overall color, is less grizzled dorsally and the side stripes and stripe on top of the tail are paler and less heavily marked. The skull is more dome-shaped and not as broad across the bullae (Huey, 1964). Only the measurements of the type are published.

### *Chaetodipus arenarius siccus* (Osgood)

1907. *Perognathus penicillatus siccus* Osgood, Proc. Biol. Soc. Washington, 20:20.

1983. *Chaetodipus arenarius siccus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.



Type locality. From Cerralvo [Cerralvo] Island, Baja California Sur, Mexico.

Range. Known only from its type locality of Isla Cerralvo in the Gulf of California, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: Cerralvo Island (Osgood, 1907b; Banks, 1964; Servin *et al.*, 1992).

Description. Following Osgood (1907b), the size is decidedly larger than in *C. a. arenarius*, very weak rump bristles rarely present; color dimorphic, buff phase slightly darker than in *arenarius*, gray phase decidedly different; skull large and heavy; mastoids rather large. The color is practically as in *arenarius* but averaging slightly darker; general effect of upperparts buff fawn; lateral line narrow, pinkish buff; underparts creamy. The skull is similar to that of *C. a. arenarius* but decidedly larger and heavier; mastoids rather large; ascending branches of supraoccipital broad; similar to that of *C. a. ammophilus* but averaging larger with relatively large mastoids.

Measurements. The means and ranges of external measurements of ten topotypes (Osgood, 1907b) are: total length, 175 (165-187); length of tail, 98 (92-102); hind foot length 24.5 (23.5-26). Skulls of type and one topotype: greatest length 25.9; 26.9; basilar length, 17.7; 18.9; mastoid width 13.8; 13.8; zygomatic width, 12.6; 13; interorbital constriction, 6.6; 6.6; nasals, 8.9; 9.6; interparietal, 7.2 x 3.1; 7.5 x 3.8; diastema 6; 6.7; maxillary toothrow, 4; 3.9.

Remarks. This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus arenarius sublucidus* (Nelson and Goldman)

1929. *Perognathus arenarius sublucidus* Nelson and Goldman, Proc. Biol. Soc. Washington, 42:109.

1983. *Chaetodipus arenarius sublucidus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. La Paz, Baja California [Sur].

Range. Known from sandy areas near the vicinity of La Paz, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: La Paz (Nelson and Goldman, 1929). 17 km NE La Paz (Servin *et al.*, 1994).

Description. Following Nelson and Goldman (1929), its closely allied to *C. a. albulus*, but darker in color, the general tone of upper parts tending toward ochraceous-tawny instead of light ochraceous-buff. Similar in general to *C. a. arenarius*, but averaging smaller and decidedly paler, the upper parts much less heavily overlaid with black; skull differing in detail. The color of the type is upper parts near light ochraceous-tawny, finely and inconspicuously overlaid with brownish black; buff lateral line absent; under parts, entire forearms and hind feet white; tail scantily haired, light brownish above, whitish below. The skull is about as in *C. a. albulus*, of Magdalena Island. Compared with that of *C. a. arenarius*, the skull averages smaller, and relatively narrower with relatively smaller, less inflated mastoid and auditory bullae.

Measurements. Means and ranges for external measurements of ten adult topotypes (Nelson and Goldman, 1929) are: total length, 157 (151-166); length of tail, 87.7 (83-95); hind foot length, 21.6 (21-22). The measurements of the skull of the type are: greatest length, 24.8; greatest breadth, 12.6; interorbital breadth, 6.3; length of maxillary toothrow, 3.2; width across mastoid bullae, 12.6; interparietal, 6.4 x 3.7; length of nasals, 9.4; width of nasals, 2.3.

Remarks. This subspecies has an unusually limited but well defined range, covering the very arid desert of the small sloping basin a few miles in extent, lying about the southern and southwestern

part of Bahía La Paz. To the north and south its range is limited by mountainous areas and to the west by the divide between the drainage to the Gulf and to the Pacific (Nelson and Goldman, 1929). The most important environmental variable governing the presence of this subspecies is sandy soil (Cortes-Calva and Alvarez-Castañeda, 1997).

### *Chaetodipus artus* (Osgood)

1900. *Perognathus artus* Osgood, N. Amer. Fauna, 18:55.

1983. *Chaetodipus artus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

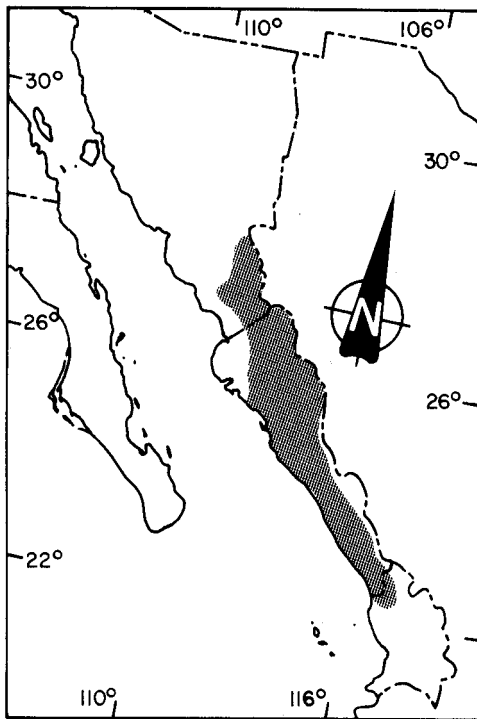
Type locality. From Batopilas, Chihuahua, Mexico.

Range. This species is known from southeastern Sonora south throughout Sinaloa, except the coastal area of northwestern Sinaloa, the canyon bottoms of southeastern Chihuahua and western Durango, and northern Nayarit. It has an apparent dendritic distribution, following stream courses in much of southeastern Sonora into the barranca bottoms of western Chihuahua and Durango where tropical deciduous vegetation grows (Anderson, 1972; Baker and Greer, 1962), but is more broadly distributed in the hill country of Sinaloa and Nayarit.

Recorded localities. *NAYARIT*: San Ignacio (Wilson, 1985). *SINALOA*: 35 mi (52 km) N Culiacan (Ingles, 1959). Rancho Rosalita, 26 mi NE Choix; 4 mi NE Terrero; 1 mi S Pericos; 12 mi N Culiacan; 32 mi SSE Culiacan; 6 mi N, 0.5 mi E El Dorado; El Dorado (Hall and Ogilvie, 1960). San Lorenzo (Patton *et al.*, 1981). *SONORA*: Guirocoba (Burt, 1938). Carimechi; Rio "Cuchahaque", 11.3 mi E Alamos; 9 mi SE Alamos, 1000 ft (Burt and Hooper, 1941). Alamos (Patton *et al.*, 1981).

Description. This is a moderately sized pocket mouse, total length about 190, with a long, crested and penicillate tail approximately 95 in length, a moderate sized hind foot (23-24 long), and long ears, averaging about 11 in height. The skull is relatively long (27) and narrow (mastoid breadth, 13), with a relatively long and attenuate rostrum, very small and rugose mastoid bullae, and thus an especially wide interparietal. General description can be found in Best and Lackey (1992a).

Measurements. The mean and range (in mm) of 14 specimens from Chihuahua (Anderson, 1972) are: total length, 177.1 (160-200); length of tail, 94.6 (73-110); hind foot length, 22.6 (21-24); ear length, 11.0 (10-12); weight, 19.3 (13.1-27.5); occipitonasal length, 25.7 (24.9-26.9); occipitobullar length, 6.8 (6.3-7.2); occipitomaxillary length, 15.9 (15.6-16.6); anterior zygomatic



Localization of *Chaetodipus artus*.

breadth, 12.2 (11.3-12.8); posterior zygomatic breadth, 12.5, (11.9-13.2); interorbital bread, 6.1 (5.5-6.8); anteroposterior interparietal dimension, 3.3 (2.4-3.8); lateral interparietal dimension 7.6 (6.9-8.3).

Remarks. Externally similar to sympatric *C. goldmani*, this species can be distinguished by its slightly smaller size, darker dorsal coloration, less hairy tail, less prominent rump spines, and broader dorsal tail stripe. It has a slightly shorter and narrower skull with less inflated and more rugose mastoid bullae with a strongly marked transverse ridge; smaller tympanic bullae; wider supraoccipital; ascending processes of premaxillae extend posterior to nasals a distance greater than the least breadth of one nasal bone; and deeper palatal pits among other characters (see Anderson, 1964). The range of *artus* overlaps with that of *C. pernix* from central Sinaloa south into northern Nayarit. These two species are readily distinguished by differences in size (large in *artus*, smaller in *pernix*) and presence (*artus*) or absence (*pernix*) of visible rump spines. In southern Sonora, *artus* is smaller than close-by but nonsympatric *baileyi* and larger than *penicillatus* and *pernix*, and differs from all three by its darker coloration and presence of rump spines. This species has less inflated and more rugose mastoid bullae than any other pocket mouse in the northern Mexican states of Sonora, Sinaloa, and Nayarit.

This is the only species in the genus which is not found even in part of its range in one or more sections of the Sonoran Desert, as defined by Shreve and Wiggins (1964). Rather, *artus* is an inhabitant of the more mesic and interior short-tree, or tropical deciduous forest along the western base of the Sierra Madre Occidental. At sites where it is sympatric with *C. goldmani*, *artus* is more typically confined to the more mesic microhabitats, especially within the riparian communities along stream courses (Patton, 1969a). It and *C. pernix* can be sympatric throughout most of Sinaloa, but the latter is usually found in softer, looser soils. No detailed analysis of habitat associations between this pair of taxa has as yet been made.

There are no published accounts on the population biology, life history, demographic, or other ecological variables of *C. artus*. Pregnant females in the Museum of Vertebrate Zoology collections were taken in the months of May and July; litter size varied from 2 to 5.

Hall and Ogilvie (1960) suggested *C. artus* was conspecific with *C. goldmani*, but Anderson (1964) and Patton (1969a) showed the two are in fact sympatric over a broad area in southeastern Sonora and northeastern Sinaloa. No subspecies have been formally recognized in the literature, but no analysis of geographic variation has as yet been undertaken.

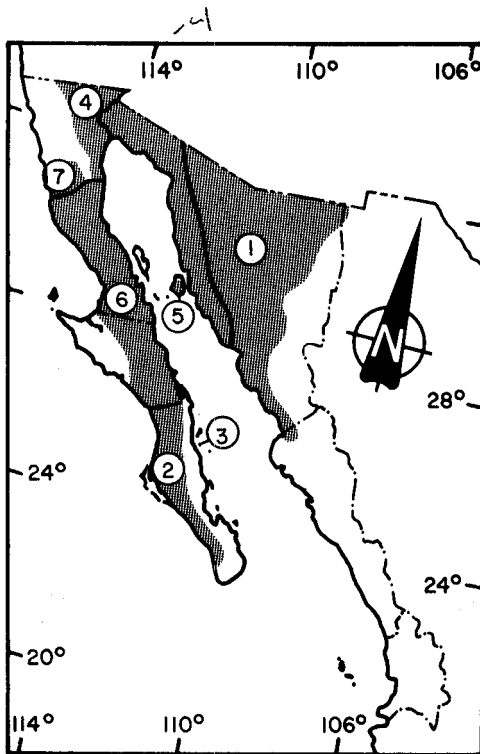
### *Chaetodipus baileyi baileyi* (Merriam)

1894. *Perognathus baileyi* Merriam, Proc. Acad. Nat. Sci. Philadelphia, 46:262.

1893. *Chaetodipus baileyi baileyi*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Magdalena, Sonora, Mexico.

Range. Nearly coincidental with the Sonoran Desert (as defined by Shreve and Wiggins, 1964), *C. baileyi* ranges from southeastern California across southern Arizona to extreme southwestern New Mexico, and hence south along the western half of Sonora to northwestern Sinaloa, and down nearly the entire length of the Baja California Peninsula, excluding the cape region, and is present on several islands in the Gulf of California. The species distribution has been mapped in detail for Arizona (Hoffmeister, 1986) and New Mexico (Findley *et al.*, 1975), and a generalized range map can be found in Paulson (1988a). The subspecies *C. b. baileyi* ranges from the Colorado river in southwestern Arizona, the southern edge of the Mogollon Plateau in central Arizona, and southwestern New Mexico southward into the foothills of the Sierra Madre Occidental and the



Localization of *Chaetodipus baileyi*:

- |                            |                           |
|----------------------------|---------------------------|
| 1. <i>C. b. baileyi</i>    | 2. <i>C. b. extimus</i>   |
| 3. <i>C. b. fornicatus</i> | 4. <i>C. b. hueyi</i>     |
| 5. <i>C. b. insularis</i>  | 6. <i>C. b. mesidios</i>  |
|                            | 7. <i>C. b. rudinoris</i> |

coastal plain of Sonora to northern Sinaloa (Hall, 1981; Hoffmeister, 1986; Patton and Jones, 1972).

Recorded localities. *SINALOA*: 1 mi S, 6 mi E El Carrizo; 42.1 km N Los Mochis (Patton and Jones, 1972). *SONORA*: Alamo Wash (35 mi NE Magdalena); Ures; Hermosillo; Bahia San Carlos; San Jose de Guaymas; Obregon (Burt, 1938). Puerto Libertad; Bahia San Carlos (Cockrum and Bradshaw, 1963). Pinacate; Carbo; Bahia Kino; Guaymas; Vicam; Navojoa (Patton, 1972). Navojoa (Patton and Jones, 1972). Bacadehuachic; Bacerac; Huasabas; Moctezuma; Tepache; Rebeico; Tonichi; Mazatlan; Hermosillo; Pitahaya; Coyotes; Navojoa; Desemboque; Pinacate (Patton *et al.*, 1981 as *C. baileyi*).

Description *Chaetodipus baileyi* is one of the largest species in the genus, with a total length usually more than 200 and a hind foot usually greater than 26 (see comparative measurements in Best, 1993). It lacks stiff rump spines, has a soft yellowish gray-brown dorsal pelage color and a self-colored white venter. The ears are moderately large, usually greater than 9 mm; the tail is long, strongly crested, and buff to gray above, whitish below. The skull is large and robust; the mastoid portion of the auditory bullae is moderately inflated; the interorbital region is wider than the width of the interparietal; and

the tooth row is long, averaging more than 4 mm.

Measurements. Average measurements of 13 female specimens from southern Arizona (Hoffmeister, 1986) are: body length, 91.9; hind foot length, 27.8; occipito-nasal length, 29.6; fronto-nasal length, 19.7; length of nasals, 11.5; interorbital breadth, 7.1; mastoid breadth, 15.6; zygomatic breadth, 13.8; length mastoid bullae, 9.7; maxillary toothrow length, 4.3; width of interparietal, 6.5; length of interparietal, 4.0; distance between stylomastoid foramen, 12.3.

Remarks. This species can readily be distinguished from all sympatric or near-sympatric chaetodipine pocket mice by the combination of its large size and lack of evident stiff rump spines. Confusion is really only possible between *baileyi* and *C. penicillatus* in Arizona and Sonora, or between *baileyi* and *C. formosus* in eastern California and Baja California. All three species lack rump spines, but, again, *baileyi* is significantly larger in most dimensions of the body and skull. It is much larger than sympatric *C. pernix* (in Sonora and Sinaloa) and *C. arenarius* (in Baja California), the other two species that lack rump spines. It is nearly the same size as *C. hispidus* in southeastern Arizona, but differs by its long and crested tail and grayish, instead of yellowish brown dorsal coloration. From all other species (*C. californicus*, *C. fallax*, *C. spinatus* in southern

California and Baja California; *C. intermedius* in Arizona and Sonora; and *C. goldmani* in Sonora and northern Sinaloa), *baileyi* can be readily distinguished by its lack of rump spines and larger body size.

*Chaetodipus baileyi* is characteristic of Lower Sonoran vegetation, where it can be found sympatric, or nearly so, with a wide range of other pocket mice, including *C. pernix*, *C. goldmani*, and *C. penicillatus* in southern and eastern Sonora; with *C. penicillatus* and *C. intermedius* in southern Arizona and northwestern Sonora; and with *C. formosus*, *C. penicillatus*, *C. spinatus*, and *C. arenarius* in Baja California. This species, in general, prefers the rock-strewn pavements of desert bajadas where the soil matrix is soft alluvium, in the ecotonal area between rocky hill sides and desert flats (Bateman, 1967; Rosensweig and Winakur, 1969; Wondolleck, 1978). Thus, it is typically segregated by habitat from the sand-dwelling *arenarius*, *penicillatus*, or *pernix*, and *saxicolous*, *spinatus*, *fallax*, *formosus*, and *intermedius*, although local overlap can be found. It occurs in the same microhabitats as *goldmani* in the thornscrub of eastern Sonora. Much of the range of this species is coincidental with joboba, the Sonoran Desert endemic shrub *Simonsia chinensis* (Sherbrooke, 1976).

Bailey's pocket mouse has been included in several ecological studies on the dynamics of desert communities, beginning with the early work of Rosensweig and Winakur (1969) and extending through the studies of Price (1978; 1983), M'Closky (1978; 1980), and Reichman (1975). In laboratory experiments, *baileyi* selects larger seeds than congeners (Price, 1983), and cheek-pouch contents contain fewer, but larger seeds (M'Closky, 1980) than other sympatric heteromyids. In general, this species is a dietary generalist, feeding on a variety of seeds but also varying amounts of insects and green plant materials (Reichman, 1975). It is the only desert rodent known that can metabolize the waxy oils of joboba seeds (Sherbrooke, 1976). The volume of the cheek pouches is sufficiently large to enable an individual to carry its daily energy requirements at one time (Morton *et al.*, 1980). Individuals are active year-round (Reynolds and Haskell, 1949), with seasonal peaks in activity during autumn and lows during winter months (Reichman and Van de Graff, 1973). Males are typically in breeding condition for a longer period than females, with peak reproduction in late spring followed by a second short season in late summer (Reynolds and Haskell, 1949). Young-of-the-year born in spring can breed that summer. The average litter size is 3.5 (Paulson, 1988a).

Local populations can be quite dense under favorable conditions, with trap success rates as high as 10% and densities ranging between 17 and 86 individual per hectare reported (M'Closky, 1980; Olding and Cockrum, 1979).

The baculum of this species is relatively small for the size of the animal. It is a simple spicule similar to that in *formosus*. The shaft is nearly straight and the basal end is slightly enlarged. The measurements from 15 specimens are: length 9.2 (8.5-11.0); height of base 0.64 (0.5-0.8) (Burt, 1960).

This species has no close relatives within the genus, at least based on protein electrophoretic comparisons (Patton *et al.*, 1981). Eight subspecies are usually recognized in the literature (Hall, 1981; Paulson, 1988a; Patton, 1993; Williams *et al.*, 1993), all of which occur in, or are confined to, the northwestern Mexican states of Sinaloa, Sonora, Baja California, and Baja California Sur. Hoffmeister (1986) considered *domensis* to be indistinguishable from *baileyi*; Goldman (1928) noted that *domensis* mainly differed from *baileyi* in its more pale-colored upper parts.

*Chaetodipus baileyi extimus* (Nelson and Goldman)

1930. *Perognathus baileyi extimus* Nelson and Goldman, J. Washington Acad. Sci., 20:223.

1983. *Chaetodipus baileyi extimus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Tres Pachitas, 700 ft, 36 mi S La Paz, Baja California Sur, Mexico.

Range. Known from southern and southwestern Baja California Sur from the type locality of Tres Pachitas, 36 mi S La Paz, north to Comondu, Matancita, and San Jorge (Hall, 1981).

Recorded localities. **BAJA CALIFORNIA SUR:** Pichilingue Bay (Towsend, 1912). Calamahue; Calmalli; Comondu; Matancita; Onyx; Punta Prieta; San Bruno; San Francisquito; San Ignacio; San Ignacio (20 miles west); San Jorge; Santa Rosalia (10 miles west); Tres Pachitas (Nelson and Goldman, 1930). Magdalena desert, Santo Domingo region (Alvarez, 1958). Comondu; Matancitas; San Jorge (Hall, 1981).

Description. Following Nelson and Goldman (1930), they are a light, buff subspecies with nearly pure white forearms and grayish ears. The color of the type is: upper parts near pinkish buff, the top of head and dorsum moderately overlaid with black-tipped hairs, becoming thinner and less conspicuous on sides; a narrow, buff lateral line present; under parts, fore limbs and hind feet white; ears thinly clothed with fine grayish hairs; tail above grayish-brown near base, becoming purer brown toward tip, dull white below. The skull is closely resembles that of *C. b. rudinoris*, but braincase narrower, the narrowing mainly in the parietals and interparietal; mastoids and auditory bullae rather small, but closely approaching those of *rudinoris*.

Measurements. The means and range of six specimens (Burt, 1932) are: total length, 201 (188-223); tail vertebrae, 111 (103-124); hind foot, 25 (24-27); greatest length of skull, 29.3 (28.5-30.9); basal length (groove on incisor to condyle), 24.9 (24.2-26.7); greatest mastoid breadth, 15.2 (14.7-15.8); length of mastoids, 9.5 (9.3-10.2); interorbital constriction, 6.9 (6.8-7.0); length of nasals, 11.6 (10.1-12.5); interparietal length, 4.0 (3.7-4.3); interparietal width, 6.1 (5.8-6.3); length of maxillary tooth row, 4.1 (4.0-4.4).

Remarks. *C. baileyi extimus* is similar to *C. b. rudinoris*, but lighter more buff, the upper parts in general less overlaid with black; sides decidedly lighter; outsides of forearms white, or nearly pure white, instead of distinctly suffused with plumbeous ears clothed with grayish, instead of dusky hairs, and tail grayer above near base (Nelson and Goldman, 1930).

Alvarez (1958) collected this subspecies in a dense shrub, very moist area. Cortes-Calva and Alvarez-Castañeda (1997) determined a relationship between the presence of the species and the vegetative cover, concluding the most important variable for the area near Bahía de La Paz is the space between plants, and the species are mainly present in modified areas.

*Chaetodipus baileyi fornicatus* (Burt)

1932. *Perognathus baileyi fornicatus* Burt, Trans. San Diego Soc. Nat. Hist., 7:164.

1983. *Chaetodipus baileyi fornicatus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Monserrate Island, 25° 38' LN, 111° 02' LW, Gulf of California, Baja California [Sur], Mexico.

Range. Known only from the type locality of Isla Montserrat in the Gulf of California.

Recorded localities. **BAJA CALIFORNIA SUR:** Montserrat Island (Burt, 1932).

Description. Following Burt (1932), the specimens are a dark-colored insular race, differing from the mainland race *C. b. extimus* in distinctly darker coloration with less cinnamon overwash, in

having a more highly arched skull (antero-posteriorly), smaller, less inflated mastoids, smaller auditory bullae, and broader, heavier jugals. The interparietal is also longer and narrower without a distinct fifth anterior angle.

Measurements. The means and ranges of 10 specimens (Burt, 1932) are: total length, 192 (179-202); length of tail, 102 (94-109); hind foot length, 26 (25-27); greatest length of skull, 25.8 (27.9-29.1); basal length (groove on incisor to condyle), 23.1 (23.4-24.6); greatest mastoid breadth, 14.3 (14.1-14.5); length of mastoids, 8.9 (8.3-9.2); interorbital constriction, 6.5 (6.3-6.9); length of nasals, 10.9 (10.1-11.4); interparietal length, 3.6 (3.4-3.9); interparietal width, 6.4 (6.1-6.6); length of maxillary tooth row, 4.3 (4.0-4.4).

Remarks. This insular race with its dark coloration and small mastoids is set off sharply from all other races of the *Chaetodipus baileyi* (Burt, 1932). The holotype is now housed in the Dickey Collection at the University of California at Los Angeles (Williams *et al.*, 1993).

No specimens have been taken on Isla Montserrat during the past three years (Alvarez-Castañeda *in litt.*). This subspecies is considered rare by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus baileyi hueyi* (Nelson and Goldman)

1929. *Perognathus baileyi hueyi* Nelson and Goldman, Proc. Biol. Soc. Washington, 42:106.

1983. *Chaetodipus baileyi hueyi*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Felipe, northeastern Baja California, Mexico.

Recorded localities. *BAJA CALIFORNIA*: El Mayor; El Mayor (13 miles north); San Felipe (Nelson and Goldman, 1929). San Felipe (Patton, 1972). San Felipe; Punta Prieta; Mission San Fernando (Patton *et al.*, 1981 as *C. baileyi*).

Description. Following Nelson and Goldman (1929), this subspecies is similar to *C. b. baileyi* and *C. b. rudinoris*, but general color of upper parts decidedly paler, more ashy, the dusky element less developed than in either. The color of the type is ashy gray with a light buff suffusion on the upper parts, the head and dorsal area finely and rather inconspicuously lined with black; a faint buff lateral line present; under parts, fore limbs and hind feet white; ears scantily clothed with fine whitish hairs; tail light brownish above, white below. The skull closely resembles that of *C. b. rudinoris* but mastoid and auditory bullae are larger, as in *C. b. baileyi*. It differs from *C. b. baileyi* in narrower rostrum, greater posterior extension of premaxillae beyond nasals, and in slenderness of ascending branches of supraoccipital.

Measurements. The measurements of the type given by Nelson and Goldman (1929) are: total length, 196; length of tail, 106; hind foot length, 24; greatest length of skull, 27.5; interorbital breadth, 6.4; length of maxillary toothrow, 3.7; width across mastoid bullae, 14.3; length of interparietal, 4.4; width of interparietals, 5.7; length of nasals, 10.5; width of nasals, 2.5; zygomatic breadth, 14.5.

Range. Distributed from southeastern California west of the Colorado River into northeastern Baja California as far south as the type locality at San Felipe on the gulf coast.

Remarks. Like various other pocket mice from the vicinity of San Felipe, this subspecies is distinguished by extremely pale coloration. Although the type is barely mature, as indicated by lack of wear on the molars, the condition of the mammae shows that young had been suckled (Nelson and Goldman, 1929).

*Chaetodipus baileyi insularis* (Townsend)

1912. *Perognathus baileyi insularis* Townsend, Bull. Amer. Mus. Nat. Hist., 31:122.

1983. *Chaetodipus baileyi insularis*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Tiburon Island, Gulf of California, Sonora, Mexico.

Recorded localities. *SONORA*: Tiburon Island (Townsend, 1912; Patton, 1972).

Description. Following Townsend (1912), they are in size and color about the same as *C. penicillatus pricei*. Skull in general rather narrow; rostrum and nasals narrow; interparietal large; ascending branches of supraoccipital narrow; and maxillary arm of zygoma weak.

Measurements. The means and extremes of eight specimens (Burt, 1932) are: total length, 202 (185-211); length of tail, 115 (103-123); hind foot length, 26 (24-27); greatest length of skull, 28.2 (27.2-29.3); basal length (groove on incisor to condyle), 23.6 (22.7-24.5); greatest mastoid breadth, 14.4 (13.8-15.1); length of mastoids, 9.4 (9.2-9.7); interorbital constriction, 6.7 (6.2-7.1); length of nasals, 10.9 (10.6-12.0); interparietal length, 4.1 (3.5-4.4); interparietal width, 6.7 (6.4-7.0); length of maxillary tooth row, 4.0 (3.8-4.2).

Range. Known only from the type locality on Isla Tiburon, off the Sonoran coast in the Gulf of California.

Remarks. This subspecies is considered rare by the Mexican Government (NOM-059-ECOL-1994).

*Chaetodipus baileyi mesidios* (Huey)

1964. *Perognathus baileyi mesidios* Huey, Trans. San Diego Soc. Nat. Hist., 13:112.

1983. *Chaetodipus baileyi mesidios*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Borja Mission, near 28° 45' LN, Baja California, Mexico.

Range. Found in the mid portions of the Baja California peninsula, this subspecies ranges south from Catavina to Bahia Concepcion.

Recorded localities. *BAJA CALIFORNIA*: San Borja Mission (Huey, 1964). Onyx; Calamahue; Isla Smith; San Bruno Concepcion Bay; Punta Prieta (Hall, 1981).

Description. Following Huey (1964), this subspecies is recognizable by its silky, grizzled dorsal pelage with a darker buff median line and long tail thickly haired over the outer half of its length. Its skull is broad and flat across the parietals with swollen audital bullae.

Measurements. The measurements of the type (Huey, 1964): total length, 212; length of tail, 121; hind foot length, 25; ear length (crown), 6; greatest length of skull, 29.7; interorbital breadth, 7.0; length of maxillary toothrow, 4.1; width across mastoid bullae, 15.6; length of nasals, 7.0.

Remarks. Compared with *C. baileyi extimus*, *C. b. mesidios* has more grizzled dorsal pelage with darker colored sides and brighter, broader median buff stripes. The skull is more nearly flat and broader and has slightly more swollen, less truncated audital bullae. Compared with *C. b. hueyi*, it has darker and more grizzled pelage dorsally. The skull is not so broad and is slightly more rounded and not so flattened in profile. Compared with *C. b. rudinoris* is lighter in dorsal pelage color. The skull has less inflated bullae with slightly more slender nasals (Huey, 1964). Only measurements of the type have been published.



*Chaetodipus baileyi rudinoris* (Elliot)

1903. *Perognathus baileyi rudinoris* Elliot, Field Columbian Mus., Publ. 74, Zool. Ser., 3:167.

1983. *Chaetodipus baileyi rudinoris*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Quentin [San Quintin], Baja California, Mexico.

Range. Distributed from the coastal plain near San Quintin and foothill slopes of the southern end of the Sierra San Pedro Martir south to the region of El Marmol and Mission San Fernando (Huey, 1964).

Recorded localities. *BAJA CALIFORNIA*: San Quintin (Elliot, 1903). Rosarito (Hall, 1981).

Description. Following Elliot (1903), it is similar to *C. b. baileyi* but darker, with very slender nasals, mastoids larger, upper incisors more slender. The upper parts and sides pale buff finely lined with black, darkest on head; sides of nose, cheeks and line above eyes pale yellowish buff lined with black; ochraceous lateral line from lips to thighs; under parts pure white; tail above and pencil dark brown. beneath yellowish-white; hands and feet grayish white.

Measurements. Measurements of the type (Elliot, 1903): total length, 232; length of tail, 128; hind foot length, 27; ear length, 11.5; occipitonasal length, 31.0; basal length of Hensel, 22.0; interorbital breadth, 6.5; length of maxillary toothrow, 4.0; width across mastoid bullae, 15.0; width of interparietals, 6.5; length of nasals, 10.0; width of nasals (anterior), 3; width of rostrum, 4.0; zygomatic breadth, 16.0; distance from palatal arch to alveolus of incisor, 12.0; greatest width of basioccipital between bullae, 5.0.

Remarks. This subspecies while darker than typical *C. baileyi* is remarkable for its very slender nasals, by which it can be distinguished from any other known form (Elliot, 1903). Except for the holotypes of *C. b. rudinoris* and *knekus* (Elliot, 1903; considered a synonym of *rudinoris*) no measurements have been published (Williams *et al.*, 1993).

*Chaetodipus californicus* (Merriam)

1889. *Perognathus californicus* Merriam, N. Amer. Fauna, 1:26.

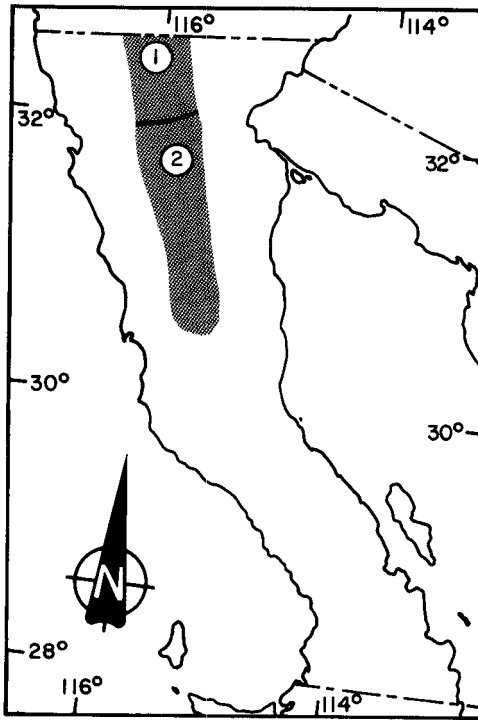
1983. *Chaetodipus californicus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Berkeley, Alameda Co., California.

Range. Chaparral (Upper Sonoran), oak grassland, and coastal shrub communities of California and northern Baja California, ranging from the San Francisco Bay area southward in the coastal ranges west of the Central Valley to the Sierra San Pedro Martir, Baja California, and from Placer Co. on the western slope of the Sierra Nevada through the Transverse ranges in southern California.

Description. This is among the largest species in the genus, along with *C. baileyi* and *C. hispidus* (see Best, 1993, for comparative measurements). It is characterized by a relatively long, strongly crested and penicillate tail; numerous stiff spines on the rump, sometimes extending onto the sides; relatively long and square-tipped ear pinna; and relatively small mastoid bullae with a broad interparietal. The ratio of the length of the tail to head and body ranges from about 1.15 to 1.55; the ear is more than 10 mm in length (from the notch); and the width of the interparietal is usually greater than 8.1 mm. This species is typically dark, grizzled, reddish-brown, with a sharply evident buff-colored lateral line separating the dorsal pelage from the self-color white venter.

Remarks. This species is generally similar in most respects to other medium to large-sized members of the genus with distinct spines on the rump, but it needs comparison here only with its sympatric, or near-sympatric congeners, *C. fallax* and *C. spinatus*. From *fallax*, it can be



Localization of *Chaetodipus californicus*.  
 1. *C. c. femoralis*                      2. *C. c. mesopolius*

distinguished, however, by its longer (more than 10 mm) and somewhat squared-topped (as opposed to rounded) ears, slightly larger size, relatively longer tail, and broader interparietal. These also differ in general habitat, with *californicus* typically found in Upper Sonoran (primarily chaparral) and *fallax* in Lower Sonora (primarily desert scrub) habitats. From *C. spinatus*, the range of which it might contact in the extreme southeastern part of its distribution, *californicus* differs by having fewer spines, particularly absent in the shoulder region, a darker and more brownish as opposed to lighter and more yellowish-gray dorsal pelage, a conspicuous stripe of buff-colored hair on the sides, a relatively longer tail, a longer ear, and wider interparietals.

Occurs primarily on hard-pan soils. Its range overlaps with that of *C. fallax*, which is usually found at lower elevations in coastal sage or desert scrub (Lower Sonoran) communities. For example, in the San Gabriel Mountains in southern California, Vaughan (1954) records *fallax* from the coastal sage scrub association on the south slope of the range, with an elevational range extending to about 2000 feet, but *californicus* in the chaparral association above this elevation.

As is true for most pocket mice, the diet of this species is mostly seeds, supplemented with insects and green vegetation particularly during periods of water stress. They typically undergo a pattern of daily torpor, but are active year-round and do not hibernate. They dig burrows, and are typically solitary, but local densities can be reasonably high, equal to those of any other species in the genus. Young are born in the spring and early summer, with litter size usually about four and with one to two litters per year. As with most pocket mice, gestation is about 21 to 28 days.

The baculum of this species is long, with a proximal bulb and a shaft which curves gradually upward to near the end where the distal tip has an abrupt upward turn. Measurements of four adults are: length 11.4 (11.1-11.6); height of base 0.92 (0.9-1.0) (Burt, 1960).

Most accounts (e.g., Hall, 1981; Williams *et al.*, 1993) list seven subspecies in addition to the dominant form, with two occurring in northwestern Mexico. The species has never been reviewed, however, and the extent to which these races represent biologically meaningful entities remains unknown. The two races in Baja California include (following Huey, 1964; Hall, 1981).

*Chaetodipus californicus femoralis* (J. A. Allen)

1891. *Perognathus (Chaetodipus) femoralis* J. A. Allen, Bull. Amer. Mus. Nat. Hist., 3:281.

1983. *Chaetodipus californicus femoralis*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Dulzura, San Diego Co., California.

Recorded localities. **BAJA CALIFORNIA**: Hanson Lagoon; Hanson laguna Mts. (Hall, 1981).

Description. Following Allen (1891), above prevailing tint blackish, faintly suffused with pale grayish buff, more pronounced on the sides, and bounded below by a broad lateral line of dull orange buff. The pelage of the whole dorsal surface consists of coarse hairs and bristles without underfur; bristly hairs are pale grayish plumbeous basally, subapically broadly ringed with pale buff and tipped with black; they are mixed with coarse grooved spines, some of which are wholly black and others wholly pale buff. Below, whole fore limbs, and inner surface of the hind limbs nearly to the tarsus, white; no light eye-ring; no light spots at base of ears; outer surface of hind limbs blackish to the feet, with long conspicuous yellowish white bristles on the thighs; upper surface of the hind feet grayish white; tail sharply bicolor, blackish above and at the tip, grayish white below.

Measurements. The measurements of 20 specimens (Benson, 1930) are: total length, 216 (201-227); length of tail, 124 (105-143); hind foot length, 27 (25-28); ear length, 10 (9-11); greatest length of skull, 28.3 (26.8-29.1); fronto-nasal length, 18.6 (17.7-19.3); length of nasals, 10.7 (10.1-11.5); great width across mastoid, 14.0 (13.7-14.2); interorbital breadth, 6.9 (6.5-7.2); length of maxillary tooththrow, 4.1 (3.9-4.4).

Range. This subspecies occupies chaparral communities on the Pacific Slope of San Diego Co., ranging southward along the Peninsular Ranges into Baja California through the Sierra de Juarez and northwestern slopes of the Sierra San Pedro Martir.

Remarks. Data about the biology and ecology of the subspecies are unknown

*Chaetodipus californicus mesopolius* (Elliot)

1903. *Perognathus femoralis mesopolius* Elliot, Field Columbian Mus., Publ. 74, Zool. Ser., 3:168.

1983. *Chaetodipus californicus mesopolius*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Penon [Piñon], 5,000 ft, San Pedro Martir Mountains, Baja California, Mexico.

Range. It is only known from the Sierra San Pedro Martir.

Recorded localities. **BAJA CALIFORNIA**: Piñon, 5,000 ft, San Pedro Martir Mountains (Elliot, 1903). Agua de las Fresas; Santa Eulalia; Santa Rosa (Hall, 1981).

Description. Following Elliot (1903), this form is large in size, ear large, hind foot and tail long, similar to *C. femoralis* in color but grayer, lacking the bistre color so characteristic of that subspecies. Skull with greater interorbital constriction and somewhat less mastoid breadth. The color above is pale gray and light buff lined with black; nose and side of face pale buff lined sparingly with black; sides grayer than upper parts; lateral line light buff; under parts, hands and feet pure white; tail and pencil dusky above, white beneath; ears light brown.

Measurements. The measurements of the type (Elliot, 1903) are: total length, 232; length of tail, 136; hind foot length, 27; ear length, 14; occipitonasal length, 27.0; basilar length of Hensel, 18.0; interorbital breadth, 6.0; width across mastoid bullae, 13.0; length of nasals, 10.0; width of nasals

(anterior), 3.0; posterior width of nasals, 2.0; width of rostrum, 5; zygomatic breadth, 13.0; distance from palatal arch to alveolus of incisor, 10.0.

Remarks. This form was distinguished from *C. c. femoralis* primarily based on its grayer color, which, in *Chaetodipus*, generally suggests an animal in juvenile pelage (see Williams *et al.*, 1993). It appears to be restricted to the San Pedro Martir range, which is separated from the Laguna Hanson mountains on the north by an approximately fifty-mile stretch of broken hills and mesas, and a strip of desert, the elevation of this tract ranging from 3,000 to 6,000 feet. In the Laguna Hanson mountains *C. c. femoralis* was taken (Elliot, 1903).

### *Chaetodipus fallax fallax* (Merriam)

1889. *Perognathus fallax* Merriam, N. Amer. Fauna, 1:19.

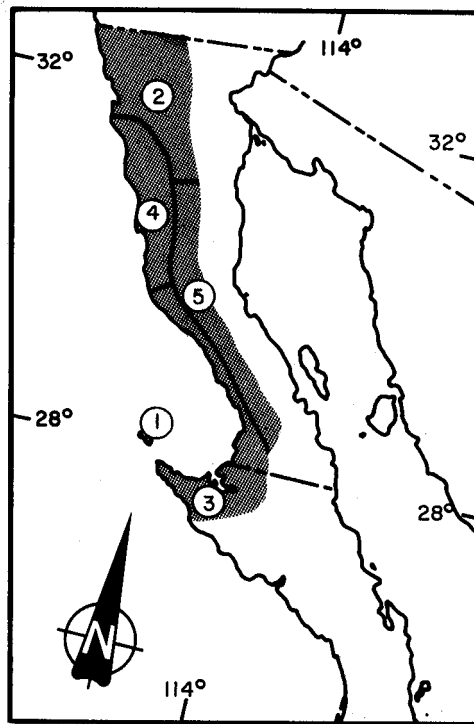
1983. *Chaetodipus fallax fallax*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Bernardino [Reche Canyon, 3 mi SE Colton, 1,250 ft], San Bernardino Co., California.

Range. This species has one of the smallest ranges of any member of the genus. It is limited to southern California, from the north side of the Transverse Ranges, south through northwestern Baja California along the Pacific coast to Bahia San Bartolome, including Isla Cedros (Lackey, 1996; Williams *et al.*, 1993). *C. f. fallax* is distributed from the southern slopes of the San Gabriel and San Bernardino mountains in southern California, south through the coastal sage zone into northern Baja California, from Jacumba west to the Pacific Ocean and south to El Valle de la Trinidad and to Ensenada, mainly on the western slopes of the Sierra Juarez and more coastal hills.

Recorded localities. **BAJA CALIFORNIA:** Ensenada; Cañada del rio San Diego, cerca de Tijuana; Sangre de Cristo (Villa, 1941). El Valle de las Palmas; N side of Descanso Bay; Ensenada; 6 mi E Ensenada; Boundary S Jacumba, California; Sangre de Cristo; El Valle de la Trinidad (not typical); summit of San Matias Pass (not typical) (Huey, 1960b).

Description: This is a medium-sized pocket mouse with relatively short and rounded ears (less than 9 mm), distinct spines are present on the rump and flanks, the tail is long and both crested and penicillate, and the dorsal coloration ranges from a rich brown in specimens from along the coast to light grayish-brown at inland localities on



Localization of *Chaetodipus fallax*:

- |                          |                               |
|--------------------------|-------------------------------|
| 1. <i>C. f. anthonyi</i> | 2. <i>C. f. fallax</i>        |
| 3. <i>C. f. inopinus</i> | 4. <i>C. f. majusculus</i>    |
|                          | 5. <i>C. f. xerotrophicus</i> |

the margins of the desert. A buff-colored lateral line is present, and the underparts are self-colored white or creamy white. The cranium is arched, the interparietal is wide with a conspicuously obtuse anterior angle, the mastoids are relatively large, the rostrum is attenuated and narrow, and the nasofrontal suture is slightly or not at all emarginate. The total length averages about 190 mm, tail about 105 mm, greatest skull length about 26.6 mm, and maxillary tooth row length about 4 mm.

**Measurements.** Osgood (1900) gave average external measurements for six individuals and average cranial measurements for three individuals from the type locality, as follows: total length, 192; length of tail, 110; hind foot length (dry), 23; ear length (crown, dry), 9; occipitonasal length, 26.0; basilar length of Hensel, 18.0; width across mastoid bullae, 12.9; length of interparietal, 3.8; width of interparietal, 7.8; interorbital width, 6.6; length of nasals, 6.0.

**Remarks.** This species really only needs comparison with *C. californicus*, with which it might be locally sympatric. As noted under the account of that species, *californicus* is distinctly larger in size, with longer and obviously more square-topped as opposed to rounded ears. The two also differ in primary habitat (see below), but otherwise are quite similar. Compared to other pocket mice which may be sympatric or nearly so, the rump spines of *fallax* will differentiate it from *arenarius*, *baileyi*, and *formosus*, as will its buff lateral line. The rump spines of *fallax* are not nearly as well developed as in *spinatus*, where they extend onto the shoulders.

In the laboratory under a range of controlled conditions, this species will select substrates characterized by coarse, light soil (Price and Longland, 1989), similar to the conditions under which they are typically found in nature. Their habitat ranges from rocky areas within shrub communities both on desert slopes and the coast. The typical habitat along the Pacific is coastal sage scrub vegetation (Price and Kramer, 1984; Price and Waser, 1984). In the La Puerta Valley in southeastern San Diego County, California, *fallax* was collected with six other species of pocket mice, five *Chaetodipus* (*baileyi*, *californicus*, *formosus*, *penicillatus*, and *spinatus*) as well as *Perognathus longimembris*, perhaps the richest assemblage of pocket mice anywhere (von Bloeker, 1932). It occupies typically more xeric and open habitats at elevations below that of *californicus*, the stony soils above the sandy desert fans where *C. penicillatus* and *P. longimembris* are likely to be found, but the same types of soils in which *C. baileyi*, *C. formosus*, and *C. spinatus* occur. No studies have been made on how these species partition their habitat in areas of sympatry.

Like many other pocket mice and kangaroo rats (but certainly not all), the San Diego pocket mouse can persist on a diet of dry seeds and no free water, without losing weight (MacMillen, 1964). Urine concentrating ability has been examined by MacMillen and Hinds (1983), resting metabolism by Hinds and MacMillen (1985), and general metabolic rates as a function of habitat by Hulbert *et al.* (1985). Mice can be active above ground throughout the year, but long-term trapping data in the San Gabriel Mountains of southern California (Vaughan, 1954) indicate that they are not active on nights when the temperature fell below 5° C. Thus, the species might remain underground for weeks at a time during prolonged cold weather. Reproduction apparently occurs primarily in late winter and spring, but a second peak has been noted in the fall at some localities (MacMillen, 1964; Vaughan, 1954). Its diet consists mostly of seeds, like other pocket mice, but the species may be an effective herbivore under some conditions; Meehan *et al.* (1977) report that *C. fallax* and *C. baileyi* were responsible for extensive cropping of leaves and shoots of herbaceous perennials. Vaughan (1954) also reported that *fallax* consumed *Opuntia* pads, although this activity has been debated (MacMillen, 1964). Home range sizes have been measured at 0.3 ha, with no difference in size as well as little overlap between the sexes (MacMillen, 1964). Maximum

densities have been measured at 52 mice per hectare during the spring months, with average longevity of marked individuals only about 5 months (Ryan, 1968; McClenaghan, 1983).

Hall (1981), following Huey (1964), considers *C. anthonyi* as a species separate from *C. fallax*, but most subsequent authors view it only as a subspecies (Patton, 1993; Williams *et al.*, 1993; Lackey, 1996). It has the same karyotype as does *fallax* sampled throughout its range (Patton, 1970). In addition to *anthonyi*, there are five other subspecies currently recognized for this species, four of which occur along the Baja California peninsula (see Huey, 1960b). The only subspecies not in Baja California (*pallidus* Mearns, E.A. 1901. Proc. Biol. Soc. Wash., 14:135) is distributed along the desert slopes of the Transverse and Peninsular ranges in southern California, with a type locality of Mountain Spring, half-way up the east slope of the Coast Range Mountains, on the Mexican Boundary Line, in San Diego County, California. While it has not been recorded in Mexico, it may extend south along the eastern slope of the Sierra Juarez. Huey (1960b), however, failed to find the species at places on the desert slopes of the Sierra Juarez where he expected it.

### *Chaetodipus fallax anthonyi* (Osgood)

1900. *Perognathus anthonyi* Osgood, N. Amer. Fauna, 18:56.

1983. *Chaetodipus fallax anthonyi*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From South Bay, Cerros [Cedros] Island, Baja California, Mexico.

Range. Known only from Isla Cedros, Pacific Ocean, Baja California.

Recorded localities. **BAJA CALIFORNIA:** Isla Cedros (Osgood, 1900).

Description. Color above grayish fawn mixed with black; lateral line brownish fawn, poorly defined; ears dusky; white subauricular spot present; tail dusky above, whitish below. Skull similar to *C. f. fallax* but cranium less arched; rostrum heavier; mastoids smaller; interparietal smaller and shorter; zygomatic breadth greater anteriorly.

Measurements. The measurements of the holotype (Osgood, 1900): total length, 168; length of tail, 92; hind foot length, 23.5; occipitonasal length, 25.4; basilar length of Hensel, 17.4; interorbital breadth, 6.0; width across mastoid bullae, 12.9; length of interparietal, 2.6; width of interparietals, 5.8; length of nasals, 10.2.

Remarks. *C. fallax anthonyi* is characterized as being smaller than typical *fallax*, but is similar in size to *C. f. inopinus*, the subspecies on the mainland opposite Cedros Island.

### *Chaetodipus fallax inopinus* (Nelson and Goldman)

1929. *Perognathus fallax inopinus* Nelson and Goldman, Proc. Biol. Soc. Washington, 42:110.

1983. *Chaetodipus fallax inopinus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Turtle Bay [Bahia Tortugas; also known as Bahia San Bartolome], Baja California Sur, Mexico.

Range. This race occurs on the narrow coastal strip from the mouth of the Rio Santa Catarina in Baja California south to the type locality at Bahia Tortugas [San Bartolome], Baja California Sur.

Recorded localities. **BAJA CALIFORNIA SUR:** San Bartolome Bay (Towsend, 1912). Bahia Tortugas (Nelson and Goldman, 1929). Santa Catalina Landing; Santa Rosalia Bay (Huey, 1960b).

Description. Following Nelson and Goldman (1929), it is closely allied to *C. f. fallax* and *C. f. pallidus*, but smaller and upper parts more rufescent than usual in either; skull differing in smaller size and structural details. The color of the type is lighter in upper parts near ochraceous-buff, but slightly more tawny, this color purest along lateral line, but much obscured on head and back by overlying black-tipped hairs, the combination producing a brownish tawny effect; under parts and feet white; outer sides of forearms faintly tinged with buff; tail blackish above, white below. The skull is similar to those of *C. f. fallax* and *C. f. pallidus*, but smaller, less massive; rostrum relatively more slender; dentition lighter; incisors narrower; molariform tooththrows relatively shorter; auditory bullae relatively rather large.

Measurements. Total length, 180; length of tail, 104; hind foot length (dry), 23; greatest length of skull, 25.5; interorbital breadth, 6.2; length of maxillary tooththrow, 3.5; width across mastoid bullae, 13.2; length of interparietal, 4.3; width of interparietals, 6.6; length of nasals (median line), 9.3; width of nasals, 2.5.

Remarks. Compared with that of *C. anthonyi* in general, this subspecies is similar but more ruddy in color and has quite distinctive cranial characteristics. Rump spines present as usual in the species. The skull is broader posteriorly, with zygomata narrower, more convergent anteriorly, the sides, therefore, less nearly parallel; interorbital space broader; interparietal larger; audital bullae larger, more inflated (Nelson and Goldman, 1929).

Other than those of the holotype, there are no published measurements for *inopinus*.

### *Chaetodipus fallax majusculus* (Huey)

1960. *Perognathus fallax majusculus* Huey, Trans. San Diego Soc. Nat. Hist., 12:418.

1983. *Chaetodipus fallax majusculus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Quintin, Baja California, Mexico.

Range. This is another coastal race, ranging from its type locality at Bahia San Quintin, Baja California south to El Rosario and northeast to Las Cabras.

Recorded localities. **BAJA CALIFORNIA:** 3 mi S San Telmo; Las Cabras; Santo Domingo (30° 47' LN); 1 mi S San Ramon; S San Ramon; north end of San Quintin; 10 mi SE San Quintin; Santa Maria, near San Quintin; 5 mi E San Quintin; 1 mi E El Rosario; 4 mi E El Rosario; 10 mi E El Rosario; mouth of Canyon San Juan de Dios; Aguita (not typical) (Huey, 1960b). Las Cabras; 10 mi E El Rosario (Hall, 1981).

Description. Following Huey (1960b), this race is darker in dorsal coloration than any other member of the species, clearly so when a series of specimens is examined. It has a very robust body with a relatively shorter tail that is brightly bicolored and well tufted. An unusually large number of spine-like white bristle hairs are present over the posterior part of the body.

Measurements. The measurements of the type (Huey, 1960b) are: total length, 191; length of tail, 105; hind foot length, 24; ear length, 6; greatest length of skull, 26.7; interorbital breadth, 6.9; length of maxillary tooththrow, 3.6; width across mastoid bullae, 14.7; length of nasals, 9.8.

Remarks. No measurements have been published for specimens other than the holotype.

### *Chaetodipus fallax xerotrophicus* (Huey)

1960. *Perognathus fallax xerotrophicus* Huey, Trans. San Diego Soc. Nat. Hist., 12:419.

1983. *Chaetodipus fallax xerotrophicus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From 2 mi NE Chapala, Baja California, Mexico.

Range. Distributed inland of the coastal races *inopinus* and *majusculus*, in the foothills of the Sierra San Pedro Martir, Sierra San Miguel, and Sierra de San Borja.

Recorded localities. **BAJA CALIFORNIA:** Matome; San Agustin; Rancho Ramona, 7 mi N Santa Catalina; San Andreas (*sic*); 25 mi N Punta Prieta; San Fernando Mission (Hall and Kelson, 1959). San Fernando Mission; 5 mi SE San Fernando; San Agustin; Rancho Ramona, 7 mi N Santa Catarina; Onyx; 3 mi S El Marmol; 13 mi NW Chapala; 2 mi NE Chapala; 25 mi N Punta Prieta; San Andreas (not typical) (Huey, 1960b). Punta Prieta; Mision San Fernando (Patton *et al.*, 1981 as *C. fallax*).

Description. Following Huey (1960b) this race, in dorsal view of the series, is slightly paler than *C. f. majusculus*, but is decidedly darker than the coastal form, *C. f. inopinus*, and *C. f. pallidus*, the race that inhabits the California desert. *C. f. xerotrophicus* is similar to but has a smaller body size than the nominate race, *C. f. pallidus* and *C. f. majusculus*, and larger than *C. f. inopinus*, and differs from them all by having a longer tail. The skull of *C. f. xerotrophicus* can be differentiated from *C. f. majusculus* in being lighter-boned, with less inflated bullae, and a smaller braincase, with a flatter, less-curved profile and more slender rostrum. From *C. f. inopinus*, *xerotrophicus* is more heavily boned and larger in size.

Measurements. The measurements of the type (Huey, 1960b) are: total length, 210; length of tail, 127; hind foot length, 24; ear length, 6; greatest length of skull, 26.8; interorbital breadth, 6.2; length of maxillary toothrow, 3.7; width across mastoid bullae, 14.0; length of nasals, 10.4.

Remarks. No measurements other than those of the holotype, are available.

### *Chaetodipus formosus* (Merriam)

1889. *Perognathus formosus* Merriam, N. Amer. Fauna, 1:17.

1983. *Chaetodipus formosus formosus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From St. George, Washington Co., Utah.

Range. The Long-tailed pocket mouse is distributed throughout the southern Great Basin, Mojave, and Colorado sections of the Sonoran Desert, from western and southern Utah, northwestern Arizona north of the Grand Canyon, western and southern Nevada, eastern and southeastern California, and eastern Baja California south to El Barril (Huey, 1964; Williams *et al.*, 1993).

Description. This is a medium-sized mouse, with a total length about 190 mm, tail length of 105 mm, and hind foot length of 24 mm. The tail is long and with a very well developed crest; the mastoids are enlarged, projecting beyond the plane of the occiput. Proportionally, this is one of the longest-tailed species in the genus, with the tail between 125 and 130 percent of the head and body length.

Remarks. This species can be found sympatric, or nearly so, with *C. arenarius*, *C. baileyi*, *C. fallax*, *C. penicillatus*, and *C. spinatus* in southeastern California and adjacent northeastern Baja California. It can be distinguished from all of these species by its moderately well-inflated auditory bullae, particularly the mastoid portion that extends posteriorly to the occiput. Externally, it differs from *fallax* and *spinatus* by the lack of rump spines; and from *arenarius* by its larger size, proportionately longer and more crested tail, and gray as opposed to pale yellowish dorsal color. This species is most similar to *baileyi* and *penicillatus*, differing from the former by being smaller in all body measurements and with grayish as opposed to yellowish gray dorsal color, and



from the latter by its longer and more strongly crested tail, as well as by bullar expansion. *C. formosus* and *C. baileyi* are unique among chaetodipine pocket mice in having a nearly straight bacula without an upturned tip (Burt, 1960).

Individuals of this species generally prefer rocky soils, often on rocky slopes or at the base of cliffs, within a desert scrub habitat association. They are found on lava flows in many areas within their range, on rocky or gravelly soils of dry stream beds, and on desert pavements with marble-sized rocks (Hall, 1946; Hoffmeister, 1986). Thus, Long-tailed pocket mice are likely to overlap in habitat with *C. spinatus* and perhaps *C. fallax* in Baja California, but can be readily distinguished from these two species by the lack of rump spines.

As with most species of pocket mice, this one is also primarily a seed-eater, supplementing their diets seasonally with flowers and leaves, fruits, and sometimes insects. Smith and Jorgensen (1975) record the breeding season as beginning in the spring and continuing through summer. The litter size averages over five young, with a range of two to six. Young of the year may become reproductively active, but breeding is usually confined to animals which are at least 12 or more months old. The species has been collected in the winter, suggesting that it does not hibernate (Hoffmeister, 1986).

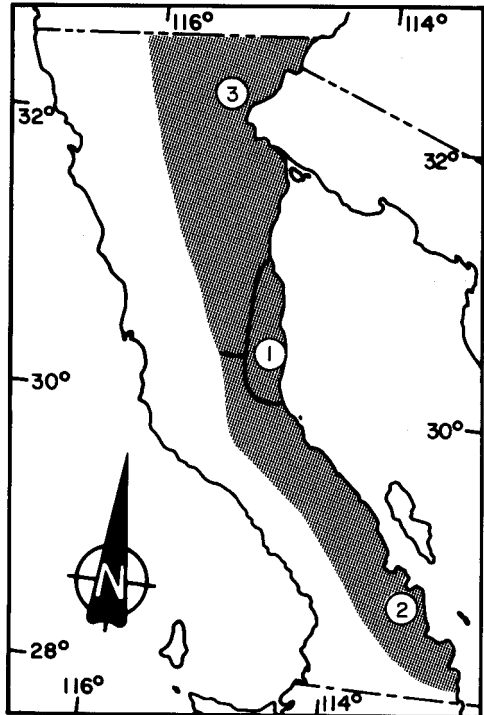
This species was traditionally placed in the subgenus *Perognathus* (Osgood, 1900; Hall, 1981), largely because of its relatively well-inflated auditory bullae despite possession of external features (such as elongated crested tail, hispid pelage, and naked soles of the hind feet) more typical of *Chaetodipus*. Protein electromorphic data clearly align *formosus* with *Chaetodipus* (Patton *et al.*, 1981), and all recent authors have included it within this genus (*e.g.*, Hafner and Hafner, 1983; Patton, 1993; Williams *et al.*, 1993). Nine subspecies are listed in Hall (1981) and Williams *et al.* (1993), three of which occur within the Baja California peninsula (Huey, 1964).

### *Chaetodipus formosus cinerascens* (Nelson and Goldman)

1929. *Perognathus formosus cinerascens* Nelson and Goldman, Proc. Biol. Soc. Washington, 42:105.

1983. *Chaetodipus formosus cinerascens*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Felipe, northeastern Baja California, Mexico.



Localization of *Chaetodipus formosus*:  
 1. *C. f. cinerascens*      2. *C. f. infolatus*  
 3. *C. f. mesembrinus*

Range. Known from the arid rocky hills in the gulf coastal desert in the vicinity of the type locality at San Felipe, Baja California, Mexico. Its southern limits along the coast are unknown (Huey, 1964).

Recorded localities. *BAJA CALIFORNIA*: San Felipe (Nelson and Goldman, 1929). San Felipe; NE El Marmol (Huey, 1954).

Description. Following Nelson and Goldman (1929), this is a small and extremely pallid subspecies closely allied to *C. f. mesembrinus*, but distinguished by ashy gray coloration of upperparts, with scarcely a trace of the dull buff-brownish suffusion present in *mesembrinus*. The upper parts coloration of the type is light ash-gray, finely and rather inconspicuously mixed with black owing to overlying black-tipped hairs which are most numerous along median line on head and over back; under parts, including lips, lower part of cheeks, entire fore limbs and hind feet white; tail light brownish above, becoming darker toward tip; white below. The skull is very similar to that of *C. f. mesembrinus*, but smaller; rostrum and nasals very slender and the interorbital region apparently narrower.

Measurements. Total length, 155; length of tail, 75; hind foot length, 22.8; weight, 15.8 g; greatest length of skull, 24.3; interorbital breadth, 6.1; length of maxillary toothrow, 3.4; width across mastoid bullae, 13.6; length of interparietal, 3.5; width of interparietals, 5.0; length of nasals, 9.3; width of nasals, 2.2.

Remarks. Most of the mammals of the region of San Felipe are very light in color, and this subspecies follows the same general rule. This is a region of extreme aridity and continuous intense sunshine. Because the soil is a light color, even where the surface is not covered with whitish drifting sand, the pale color of the mammals is undoubtedly caused by environmental influences (Nelson and Goldman, 1929). No additional measurements for *cinerascens* other than for the holotype have been published.

### *Chaetodipus formosus infolatus* (Huey)

1954. *Perognathus formosus infolatus* Huey, Trans. San Diego Soc. Nat. Hist., 12:1.

1983. *Chaetodipus formosus infolatus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From 7 mi W San Francisquito Bay, 28° 30' LN, Gulf of California, Baja California, Mexico.

Range. Distributed along the central gulf coast south of the range of *cinerascens*, from El Marmol to El Barril.

Recorded localities. *BAJA CALIFORNIA*: 7 mi W San Francisquito Bay; [El] Barril; 3 miles S El Marmol; 3 miles W El Marmol (Huey, 1954).

Description. Following Huey (1954), in color, *C. f. infolatus* is the most pallid, dorsally, of all the known races of *Chaetodipus formosus*. In this characteristic, it even exceeds the pallor of the ashen-colored *C. f. cinerascens* that inhabits the extremely arid, stony areas northward near San Felipe, Baja California, Mexico. It is larger in size than *C. f. cinerascens* and has a proportionately larger cranium with larger, more inflated mastoid bullae.

Measurements. The only published measurements are those from the type: total length, 187; length of tail, 104; hind foot length, 25; ear length (crown), 6; occipitonasal length, 27.5; interorbital breadth, 6.6; length of maxillary toothrow, 3.8; width across mastoid bullae, 14.6; length of nasals, 10.2.

Remarks. No data about the ecology and biology of the subspecies are known.

*Chaetodipus formosus mesembrinus* (Elliot)

1904. *Perognathus mesembrinus* Elliot, Field Columbian Mus., Publ. 87, Zool. Ser., 3:251.

1983. *Chaetodipus formosus mesembrinus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Palm Springs, Riverside Co., California.

Range. This form occurs throughout the desert area of southern California south to the southern end of Laguna Salada in northern Baja California.

Recorded localities. *BAJA CALIFORNIA*: Matome (Hall, 1981).

Description. This is a small, pale desert form. The upper parts and thighs mixed drab gray and buff; no lateral line; lips, entire under parts, forelegs, fore and hind feet white; tail above and pencil brownish drab, beneath whitish; ears dark brown, bases covered with tufts of drab gray. The skull is shorter than typical *C. formosus*, but equally broad and with the same large mastoid bullae but which project further posterior to the occiput.

Measurements. Measurements taken from Williams *et al.* (1993): total length, 195; length of tail, 114; hind foot length, 23; ear length, 11; total length of skull, 21; basilar length of Hensel, 18; interorbital breadth, 7.0; length of maxillary toothrow, 4.0; length of mastoid bulla, 9.0; width across mastoid bullae, 14.0; length of nasals, 9.4; zygomatic breadth, 13.0; greatest parietal width, 10.5; palatal length, 10.0; length of mandible, 12.5; length of mandibular toothrow, 3.5.

Remarks. No other published measurements for *mesembrinus* are known. Length of skull given by Elliot (1904) suggests either an error in measuring or recording, or a juvenile specimen (Williams, *et al.*, 1993).

*Chaetodipus goldmani* (Osgood)

1900. *Perognathus goldmani* Osgood, N. Amer. Fauna, 18:54.

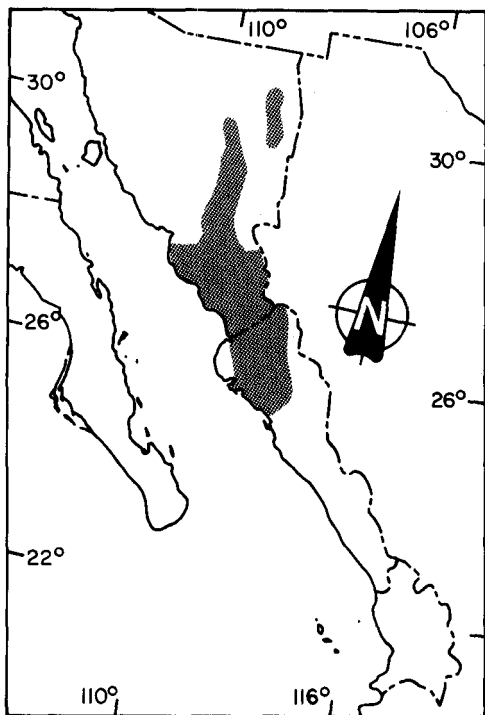
1983. *Chaetodipus goldmani*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Sinaloa, Sinaloa, Mexico.

Range. Known from the coastal plain from northern Sinaloa inland through the Rio Sinaloa and Rio Fuerte valleys, north into Sonora along the coast as far as Ciudad Obregon and inland into the foothills of the Sierra de Alamos and Sierra Madre Occidental throughout the Rio Mayo (to extreme western Chihuahua) and Rio Yaqui drainages, including the Rio Moctezuma. An isolated population is known from northeastern Sonora, from near Huachinera in the upper Rio Bavispe drainage south to Nacori Chico, but the species is apparently absent from the middle and lower sections of this effluent of the Rio Yaqui (see Patton, 1969a; Lackey and Best, 1992).

Recorded localities. *SINALOA*: Sinaloa (Osgood, 1900). 2.5 mi N El Fuerte; 10 mi NNW Los Mochis (Hall and Ogilvie, 1960). El Carrizo; El Fuerte; San Blas (Patton *et al.*, 1981). *SONORA*: Alamos; Camoa (Osgood, 1900). Tesia; Chinobampo (Burt, 1938). Rio Mayo, near Carimechi (Burt and Hooper, 1941). Aduana; Alamos (Ingles, 1959). 1 mi E Buena Vista, on Rio Yaqui reservoir, 1000 ft; Camoa; Tesia; Alamos; 4.5 mi SE Alamos, 1000 ft; Chinobampo; 3 mi NNW Bacarachi (Bacavachi) (Hall and Ogilvie, 1960). Rio Cuchujaqui; 0.5 mi N La Aduana; 6.7 mi N, 17.3 mi E Navajoa [Navojoa] (Cockrum and Bradshaw, 1963). Alamos; SE Alamos; Esperanza; Navojoa; N Navojoa; Nuri; Rebeico; Tonichi; El Novillo; Moctezuma; Bacanora; Sahuaripa; Nacori Chico; NE Nacori Chico; El Coyote; Aribabi (Patton *et al.*, 1981).

Description. This is a medium-to large-sized species, nearing 200 mm in total length, a tail of over 100 mm on average, and a hind foot over 24 mm on average. The pelage is hispid and moderately



Localization of *Chaetodipus goldmani*.

developed rump spines are present. Dorsal coloration is a dark grayish-brown sprinkled with an admixture of black. A lateral line of pinkish buff is apparent. Melanistic animals can be found on the malpais south of Moctezuma in north-central Sonora (Findley, 1967). The ears are blackish and long, averaging over 11 mm, with a prominent antitragal lobe that is wider at the base than the apex. The tail is sharply bicolored, blackish above and white below, and moderately crested and penicillate. The skull is heavy, with relatively uninflated mastoid portions of the auditory bullae and a stout rostrum. Greatest skull length averages 27 mm, cranial width about 13.5 mm, and maxillary tooth row length slightly less than 4 mm. Summary measurements for external and cranial dimensions can be found in Straney and Patton (1980) and Best (1993).

**Measurements.** The mean and range of a five specimens from Chihuahua (Anderson, 1972) are: Total length, 182.4 (170-192); length of tail, 96.6 (87-102); hind foot length, 24.3 (23-25); ear length, 9.8 (9-10); weight, 21.4 (19-23); occipitonasal length, 26.5 (25.8-27.1); occipitobullar length, 7.5 (7.3-7.6); occipitomaxillary length, 16.2 (16.0-16.5); anterior zygomatic breadth, 12.8 (12.6-13.1); posterior zygomatic breadth, 13.1, (12.7-13.7); interorbital bread, 6.1 (5.7-6.4); anteroposterior interparietal dimension, 3.6 (3.3-3.8); lateral interparietal dimension 7.3 (6.9-7.6).

**Remarks.** This species is sympatric, or nearly so, with *C. penicillatus* and *C. baileyi* in the northern part of its range, with *C. penicillatus*, *C. baileyi*, and *C. pernix* along the coastal plain of southern Sonora, and with *C. artus* in the interior foothills of southeastern Sonora and northeastern Sinaloa. It can be readily distinguished from the first three species by the presence of rump spines, its darker, grizzled brownish pelage streaked with black, and its larger ears. It is slightly smaller than *baileyi*, but larger than either *penicillatus* or *pernix*. Anderson (1964) details distinctions between *goldmani* and *artus* in areas of sympatry. Characters differentiating these two species are described above under the latter species.

This species occurs from thornscrub habitats along the coast of Sinaloa and Sonora into short-tree forest to the east in the Sierra Madread foothills. In the Rio Yaqui drainage, the species is found in the Foothills of Sonora section of the Sonoran Desert (Shreve and Wiggins, 1964), habitat dominated by organ pipe and hecho columnar cactus, tree ocotillos, and mesquite. In the upper Rio Bavispe drainage, *goldmani* is found in the lower montane woodlands and riparian habitats. It occurs in a wide variety of soil types, usually in hard soils composed of fine silt grains, but also on rocky hillsides. In coastal areas where it is sympatric with *penicillatus* and *pernix*,

*goldmani* is more common on rocky slopes and the other two on flatter, sandier bottomlands. In interior regions of the central Rio Yaqui basin, *goldmani* is found on rocky slopes and hard soils, again *penicillatus* in looser, sandier soils, and *baileyi* on stony bajadas. In short-tree forest habitats, *goldmani* is found in the xeric areas away from the more mesic stream sides where *artus* is common (Patton, 1969a).

Little has been published regarding the population biology of this species, except habitat range (e.g., Burt and Hooper, 1941; Patton, 1969a; summarized in Lackey and Best, 1992). Pregnant or lactating females are recorded from the months of April through August (specimens in the Museum of Vertebrate Zoology collections), suggesting breeding proceeds following the winter rains and continues with the summer monsoon season. Scar or embryo counts from these specimens ranged from two to four.

The baculum is a fairly large, sigmoid-shaped bone with slightly enlarged basal end and an upturned distal end which forms approximately a right angle with the shaft. The base is slightly higher than wide. The measurements of five specimens are: length 13.5 (13.2-14.1); height of base 0.96 (0.9-1.1) (Burt, 1960).

There are no described races of this species, although its range is divided into six distinct and contiguously allopatric chromosome races (Patton, 1969a). In southern Sonora and northern Sinaloa, these races are geographically bounded by the major river courses in the region, the Rio Mayo, Rio Fuerte, and Rio Cuchijaqui. Chromosomal hybrids are known between two of the races in southeastern Sonora and adjacent Sinaloa. Populations belonging to the northern and southern races are largest, with geographically intermediate populations of smaller size. Straney and Patton (1980) examine geographic variation in external and cranial dimensions, and relate that variation to both phylogenetic and environmental determinants. Variation in protein electromorphic loci was examined by Patton *et al.* (1981).

### *Chaetodipus hispidus* Baird

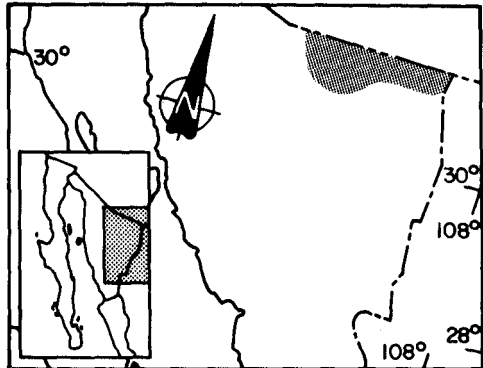
1858. *Perognathus hispidus* Baird, S. F. 1857 [1858]. Reports of Explorations and Surveys....., 8(1):421.

1983. *Chaetodipus hispidus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. Charco Escondido [Tamaulipas], Mexico (24 leagues W of Matamoros).

Range. This species ranges from North Dakota in the United States through the Great Plains southeast to central Tamaulipas, Mexico, and southwest into New Mexico, southeastern Arizona, northeastern Sonora, and adjacent Chihuahua. There is an apparently disjunct population in central Mexico from southern Coahuila and Durango to Hidalgo (Paulson, 1988b).

Description. One of the larger species of chaetodipine pocket mice, *C. hispidus* has a total length usually longer than 200 mm, a tail length about equal to or slightly shorter than head and body length, and a hind foot length averaging more than 25 mm (Paulson, 1988b; Best, 1993). The tail is unique among chaetodipine pocket



Localization of *Chaetodipus hispidus*.

mice in lacking a crest. The pelage is coarse, dorsally mixed ochraceous and blackish, with a distinct ochraceous lateral band, and white venter. The skull is large and robust, interorbitally broad, supraorbital beads are evident, and the mastoids are relatively small and do not extend posteriorly. The baculum is straight but has a unique tridigitate tip.

Remarks. This species is the most distinctive in the genus, and can be distinguished from any other pocket mouse by the combination of generally bright ochraceous, as opposed to grayish or brownish, dorsal coloration, relatively small and uninflated mastoid bullae, and relatively short, noncrested tail.

This species is common in short-grass and open bunch-grass prairie and scrub habitats of the western and central Great Plains and desert grasslands, extending south through similar habitats throughout the Mexican Plateau. It enters tropical deciduous forest on the coastal slopes of Tamaulipas. It can be found on a variety of soil substrates, ranging from rocky or gravelly areas that are dense to alluvial sandy soils. In southeastern Arizona, Hispid pocket mice can be found sympatrically with the Desert pocket mouse, *C. penicillatus*, in the alluvial base and valley floors (Hoffmeister and Goodpaster, 1954; Hoffmeister, 1986).

These are primarily seed eaters, with the diet shifting seasonally depending upon availability, although some green plant material may be taken. They cache large quantities of seeds, which form winter food stores as this species does not store fat reserves nor hibernate. Individuals are aggressive and solitary, inhabiting self-dug borrow systems. Females may produce two litters in a season, which extends from spring through late summer, with litter sizes reported to range from 2 to 9. MacMillen and Hinds (1983) note that Hispid pocket mice are less efficient in regulating water balance than other species in the genus.

Hoffmeister (1986) erected the subgenus *Burtognathus* to contain *C. hispidus* as its sole member, diagnosed on the basis of its distinct bacular morphology, all biarmed autosomal chromosome complement, presence of a supraorbital ridge or bead, squamosal portion of the zygomatic arches usually free of the auditory bullae, and of supraoccipital indentation into the mastoids. Glass (1947) reviewed the species, noting a general size cline from north to south. In his revision of the species, he recognized four subspecies, recording *C. h. paradoxus* (Merriam, 1889) from southern New Mexico, southern Arizona, and northern Chihuahua. Anderson (1972) also allocated Chihuahuan specimens to this subspecies, but Hoffmeister (1986) and Hoffmeister and Goodpaster (1954) regarded the samples from southern Arizona as distinct, allocating these to *C. h. conditi* (J. A. Allen). Hispid pocket mice in Sonora (vicinity of Cananea, records in the Museum of Vertebrate Zoology) undoubtedly belong to this taxon, regardless of whether it is considered distinct from, or synonymous with, *paradoxus*. The type locality of *conditi* is San Bernardino Ranch [17 mi E Douglas], Cochise Co., Arizona, just north of the international border from Sonora.

### *Chaetodipus intermedius intermedius* (Merriam)

1889. *Perognathus intermedius* Merriam, N. Amer. Fauna, 1:18.

1983. *Chaetodipus intermedius*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Mud Spring, Mohave Co., Arizona.

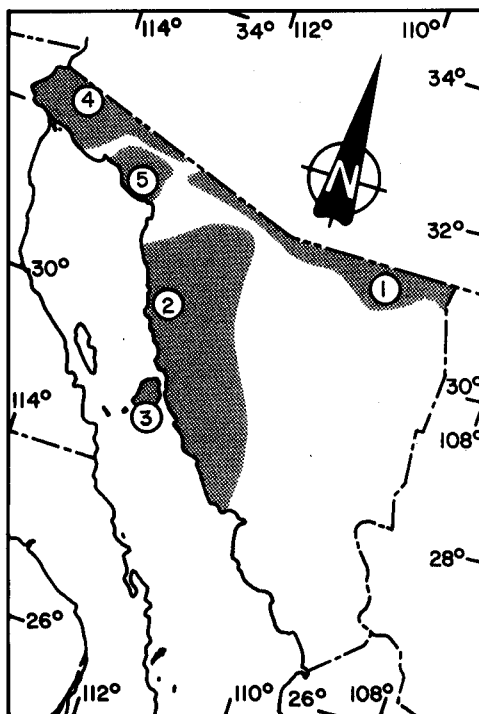
Range. Broadly distributed in rocky habitats in the Sonoran and Chihuahuan deserts of the southwestern United States (southern Utah, Arizona, New Mexico, and trans-Pecos Texas) into northern Mexico (western and northern Sonora and northern and central Chihuahua) (see Hoffmeister, 1986; Williams *et al.*, 1993). Hoffmeister (1986) records *C. i. intermedius* along the

Sonoran border in southern Arizona, from east of Sonoita to the southern end of the Huachuca Mountains. While no records are known from adjacent parts of Sonora along this section of the international border, Rock pocket mice certainly occur there.

**Description.** The Rock pocket mouse is a small to medium sized member of the genus (total length about 170 to 175 mm; tail length about 95 mm; hind foot length 20-23 mm; and skull length about 24 to 25 mm). Rump spines are present, but are often difficult to detect. The anterior edge of the interparietal is 'strap-shaped' (nearly straight), not angled forward. The supraoccipital forms a sharp-angled wedge between the interparietal and mastoid bulla. The bullae are moderately inflated, almost extending posteriorly to the plane of the occiput. The rostrum is relatively narrow. The tail is crested with a terminal tuft and bicolored. The dorsal color is darkish, varying from grayish buff to dark brownish-black and black in specimens from malpais habitats.

**Remarks.** This species might be sympatric, or nearly so, with at least four other species in the genus, namely *baileyi*, *hispidus*, and *penicillatus*. It can be readily distinguished from any of these species by the presence of rump spines, but these are not as well developed and obvious as in species such as *fallax*, *goldmani*, and *spinatus*, so care must be taken. It is much smaller than both *baileyi* and *hispidus* in nearly all external and cranial dimensions, has a crested tail which *hispidus* lacks, and has much smaller bullae than *baileyi*. The Rock pocket mouse is not sympatric with *formosus* (the two occur on opposite sides of the Colorado River in Arizona and California), but can be distinguished from this species by its rump spines and much less inflated mastoid bullae. It is most easily confused with the Desert pocket mouse, *C. penicillatus*, but can be separated from it by the rump spine, smaller hind foot (usually less than 23 mm rather than more), interparietal with a straight rather than angled suture along the anterior face, and thus not pentagonal or five-sided; wedge-shaped as opposed to truncate bullae; and narrower rostrum. The two also differ in habitat (see below). The range of *intermedius* approaches that of *goldmani* in Sonora, but there are no known areas of sympatry. The two can be distinguished by size, with *goldmani* larger; by color, with *goldmani* darker and more brownish; and by its weaker and less obvious, but still present, rump spines.

*Chaetodipus intermedius* is strongly restricted to rocks and rocky habitats, mostly on steep slopes with sparse desert shrub cover in rocky ravines or bajadas. The species is very characteristic of and essentially limited to the Sonoran Desert and, in Mexico, to the Lower Colorado, Plains of



Localization of *Chaetodipus intermedius*:

- |                             |                             |
|-----------------------------|-----------------------------|
| 1. <i>C. i. intermedius</i> | 2. <i>C. i. lithophilus</i> |
| 3. <i>C. i. minimus</i>     | 4. <i>C. i. phasma</i>      |
|                             | 5. <i>C. i. pinacate</i>    |

Sonora, and Central Gulf Coast sections. Individuals are never found in broad expanses of sand. In this respect, Rock pocket mice are always segregated by substrate differences from sympatric Desert pocket mice. The close association with rocky substrates is reflected in the range of coloration, where individuals on lava flows in New Mexico, Arizona, and Sonora are characteristically black, or a very dark brownish-black, closely matching the color of the substrate. In Sonora, black individuals are well known from the Pinacate malpais in the extreme northwestern part of the state. Light colored subspecies are also known, in areas where the rocky substrates are pale, such as within the light-colored rocks around Tinajas Altas, on the border between Arizona and Sonora.

Like most species in the genus, the Rock pocket mouse breeds in the late spring and early summer over most of its range, with an average of about 4 young per litter (range in Arizona of 1 to 7; Hoffmeister, 1986). Population densities have been recorded to range from less than 10 to nearly sixty individuals per hectare (Ruffner *et al.*, 1978). The diet is almost exclusively comprised of seeds, supplemented with insects and optuntia; little if any green vegetation has been recorded (Reichman, 1975).

Hall (1981) and Williams *et al.* (1993) list 12 subspecies within *C. intermedius*, four of which have been mapped with known localities in Sonora, and a fifth that probably extends into the state.

### *Chaetodipus intermedius lithophilus* (Huey)

1937. *Perognathus intermedius lithophilus* Huey, Trans. San Diego Soc. Nat. Hist., 8:355.

1983. *Chaetodipus intermedius lithophilus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Porto [Puerto] Libertad, summit of rocky hill 1.5 mi NNW fresh water spring on beach, Sonora, Mexico.

Range. This race occurs along the gulf coast from about Puerto Penasco south to Bahia San Carlos, and east in the coastal plain as far inland as Caborca and near Hermosillo.

Recorded localities. SONORA: Puerto Libertad, summit of rocky hill 1.5 mi NNW fresh water spring on beach (Huey, 1937). Hermosillo; Punta Chueca (Patton *et al.*, 1981, as *C. intermedius*).

Description. Following Huey (1937), it is darker and more grayish dorsally than either *C. i. intermedius* or *C. i. phasma* and lacks the pinkish cast found in these two northern races. In size *lithophilus* resembles *phasma* and is slightly smaller than *intermedius*. Cranially, the mastoid bullae are less extended and the posterior part of the skull is slightly more arched and deeper than in either of the other two mentioned forms.

Measurements. The means and ranges of eight specimens (Huey, 1937) are: total length, 166.8 (162-170); length of tail, 91.7 (82-97); hind foot length, 20.1 (19-21); ear length, 5; occipitonasal length, 23.3; occipitonasal length, 23.3 (22.4-24.2); interorbital breadth, 6.0 (5.9-6.2); length of maxillary toothrow, 3.2 (3.1-3.4); width across mastoid bullae, 12.6 (12.2-12.9); length of nasals, 9.0 (8.8-9.3).

Remarks. No data about the biology and ecology of the subspecies are known.

### *Chaetodipus intermedius minimus* (Burt)

1932. *Perognathus penicillatus minimus* Burt, Trans. San Diego Soc. Nat. Hist., 7:164.

1983. *Chaetodipus intermedius minimus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.



Type locality. From Turner's Island, 28 43' LN, 112 19' LW, Gulf of California, Sonora, Mexico.

Range. Known only from the type locality.

Recorded localities. *SONORA*: Turner's Island (Burt, 1932)

Description. This is a small, dark-colored race which Burt (1932) erroneously placed in the *Chaetodipus penicillatus* group. Coloration of upperparts blackish-brown interspersed with light pinkish-cinnamon; base of hairs plumbeous; dorsal surface of tail pale bister; ventral surface soiled yellowish-white; lateral line present, but indistinct. Skull small with small mastoids and auditory bullae.

Measurements. The measurement of the type and only specimen collected by Burt (1932) are: total length, 162; tail vertebrae, 67; hind foot, 20; greatest length of skull, 23.9; basal length (groove on incisor to condyle), 19.5; greatest mastoid breadth, 12.5; length of mastoids, 7.1; interorbital constriction, 6.2; length of nasals, 9.2; interparietal length, 3.6; interparietal width, 7.1; length of maxillary tooth row, 3.5.

Remarks. Originally described as a subspecies of *C. penicillatus*, Hoffmeister (1974) showed this form, known only from Isla Datil (Turner's Island) off the southeastern tip of Isla Tiburon in the Gulf of California, is correctly allocated to *intermedius*. The holotype is in the Dickey Collection of the University of California at Los Angeles collection (Williams *et al.*, 1993).

Burt (1932) said that one specimen of *minus* was taken in sandy soil. He considered the specimen collected distinct in skin and skull characteristics from any large series of *C. penicillatus seri* from nearby Isla Tiburon. This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus intermedius phasma* (Goldman)

1918. *Perognathus intermedius phasma* Goldman, Proc. Biol. Soc. Washington, 31:22.

1983. *Chaetodipus intermedius phasma*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Tinajas Atlas, 1,400 ft, Gila Mountains, Yuma Co., Arizona.

Range. This race extends over the Colorado Desert section of the Sonoran Desert in southwestern Arizona into adjacent northwestern Sonora.

Recorded localities. *SONORA*: Papago Tanks, Sierra Pinacate (Blossom, 1933). Papago Tanks; 40 mi W Sonoyta [Sonoita] (Burt, 1938). Pinacate (Patton *et al.*, 1981, as *C. intermedius*).

Description. A small and pale race, upper parts between light buff and pale ochraceous-buff, purest on cheeks, sides, and across hips, the top of head and back with thinly overlying dusky-tipped hairs; under parts, limbs, and feet white; tail brownish above, white below, except penciled tip which is brownish all around. Skull similar to, but smaller than, that of *C. i. intermedius*.

Measurements. Hoffmeister (1986) gave statistics for four samples of *phasma* from Arizona. Measurements of the holotype are (from Williams *et al.*, 1993): total length, 165; length of tail, 97; hind foot length, 20.5; greatest length of skull, 23.0; interorbital breadth, 5.8; length of maxillary toothrow, 3.4; width across mastoid bullae, 12.3; length of interparietal, 2.6; width of interparietal, 6.1; length of nasals, 8.5.

Remarks. *C. i. pinacate* (Blossom, 1933) is a melanistic race that inhabits the Pinacate Lava Flows in northwestern Sonora. However, Hoffmeister (1986) found that it does not differ in external or

cranial measurements from neighboring *phasma* from lighter colored soils, and Williams *et al.* (1993) formally synonymized it with *phasma*.

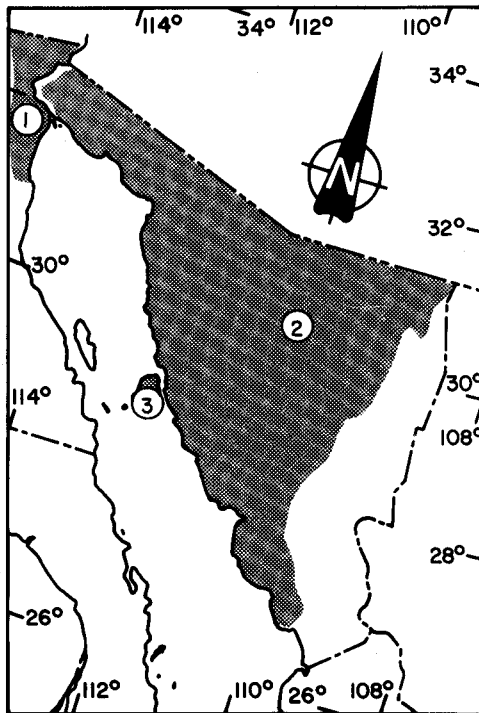
### *Chaetodipus penicillatus* (Woodhouse)

1852. *Perognathus penecillatus* [sic] Woodhouse, Proc. Acad. Nat. Sci. Philadelphia, 6:200.

1983. *Chaetodipus penicillatus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. San Francisco Mountains, New Mexico (later thought to be northeast side of San Francisco Mountains, Coconino Co., Arizona); fixed as 1 mi SW Parker, Yuma Co., Arizona by Hoffmeister and Lee (1967).

Range. This species is known from Chihuahuan, Sonoran, and Mojave desert regions of the southwestern United States and adjacent Mexico. It ranges from Death Valley in southeastern California to northeastern Baja California, eastward and southward through southern Nevada to extreme southwestern Utah, central and southern Arizona south of the Mogollon Rim, the coastal regions of Sonora to the lower Rio Mayo, southern New Mexico, the Trans-Pecos region of Texas, and the desert portions of the Mexican Plateau in the states of Chihuahua, Coahuila, Nuevo Leon, western Tamaulipas, Zacatecas, San Luis Potosi, and Durango (Hoffmeister and Lee, 1967; Williams *et al.*, 1993). Those subspecies east of the Continental Divide near the Arizona-New Mexico border (*eremicus* and *atrodorsalis*) were recently elevated to specific status by Lee *et al.* (1996), under the name *C. eremicus* (Mearns), based on differences in karyotype (Patton, 1970), nuclear genes (Patton *et al.*, 1981), and mitochondrial DNA (Lee *et al.*, 1996).



Localization of *Chaetodipus penicillatus*:

1. *C. p. angustirostris*      2. *C. p. pricei*  
3. *C. p. seri*

Description. This is a medium-sized species, with a relatively long (usually 10 to 20 mm longer than head and body) and crested tail, short ears, no spines on the rump, and a comparatively faint or even absent buff lateral stripe. The total length ranges from about 165 to 190 mm, the tail from 88 to 101 mm, and the ear typically 8 mm or less (Williams *et al.*, 1993; Best, 1993). The proximal two-thirds of the tail is relatively sparsely haired, with a distinctly annulated pattern. The skull is characterized by the anterior extension of the supraoccipital between the interparietal and mastoid relatively broad, strap-like, and squared at the anterior end, a pentagonal (as opposed to strap-shaped) interparietal, and relatively uninflated mastoid bullae. The dorsal coloration is grayish- or pinkish-brown mixed with black and dark browns; the tail has a distinct dorsal stripe.

Remarks. The Desert pocket mouse may be distinguished readily from sympatric *C. baileyi* by its much smaller size and much less inflated auditory bullae, and from sympatric *C. goldmani* and near-sympatric *C. artus* by its smaller size, grayer overall color, and lack of rump spines. However, it is quite similar in general appearance to, and thus often difficult to differentiate from, other small to medium-sized chaetodipine pocket mice, particularly with *C. arenarius*, *C. formosus*, *C. intermedius*, and *C. pernix* with which it can be sympatric in various parts of its range. The combination of lack of rump spines, pentagonal as opposed to strap-shaped interparietal, and less-inflated mastoid bullae distinguish *penicillatus* from *intermedius*. From *arenarius*, *penicillatus* differs by grayer as opposed to yellowish color, larger size, more annulated appearing tail in life, and narrower skull; from *formosus* by less developed crest on the tail and much less-inflated mastoid bullae, which do not extend posterior of the occiput; and from *pernix* by a generally larger size, lack of a buff lateral stripe, a somewhat more crested tail, wider interorbital region, and larger mastoid bullae (see Williams *et al.*, 1993, and references therein). However, small-bodied samples from east-central Sonora, allocated to *pernix* by Burt (1938) are, in fact, *penicillatus* based on chromosomal and biochemical characters (Patton, *et al.*, 1981), so the size differences between these two species are only useful in areas of sympatry or near-sympatry along the coastal regions of southern Sonora. These two species are also known to hybridize naturally near Vicam, in the coastal plain north of Ciudad Obregon (Patton and Soule, 1967).

As restricted by Lee *et al.* (1996), the Desert pocket mouse occurs exclusively within the Sonoran Desert in sandy or silty soils on desert valley floors, although in a wide range of desert scrub habitat associations. It does not overlap in habitat with sympatric *intermedius* nor largely with *baileyi* (see accounts, above), but can occur in the same soils sympatrically with both *arenarius*, where these two overlap in extreme northeastern Baja California near San Felipe, and *pernix* in coastal southern Sonora. If, and how, overlap between these two pairs is maintained is unknown.

Desert pocket mice breed in late spring and summer, from the months of April to August. Litter sizes range from 2 to 8, with a mean near 5; the gestation period is about 26 days. Diets are almost exclusively seeds, supplemented with other plant parts. The species can reach relatively high densities, with more than 50 individuals per hectare (Hoffmeister, 1986).

The baculum has a base near circular in cross section; the shaft forms a long sigmoid shape in lateral view and tapers gradually from the slightly enlarge base to a pointed upturned tip; it is similar to *goldmani*. The measurement of 27 specimens are: length 11 (9.0-12.9); height of base 0.8 (0.5-1.3) (Burt, 1960).

The most recent revision based on geographic trends in morphology is by Hoffmeister and Lee (1967). Excluding two subspecies now allocated to the Chihuahuan Desert *C. eremicus* (see Lee *et al.*, 1996), there are six subspecies recognized for the Desert pocket mouse, three of which occur in Mexico.

### *Chaetodipus penicillatus angustirostris* (Osgood)

1900. *Perognathus penicillatus angustirostris* Osgood, N. Amer. Fauna, 18:47.

1983. *Chaetodipus penicillatus angustirostris*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Carriso [Carrizo] Creek, Colorado Desert, Imperial Co., California.

Range. Distributed in the southern Mojave Desert of eastern California south through the Colorado Section of the Sonoran Desert to the vicinity of San Felipe on the northeastern Gulf coast of Baja California.

Recorded localities. *BAJA CALIFORNIA*: Monte del Coyote, near Jacumba; Valle la Puerta (Villa, 1941). San Felipe; Buena Vista Camp (Hall and Kelson, 1959). San Felipe (Patton *et al.*, 1981 as *C. penicillatus*).

Description. Following Osgood (1900) are: similar to *P. penicillatus*, but smaller; color about the same; skull lighter and with longer and more slender rostrum; nasals ascending premaxilar long and narrow, much more slender than in *penicillatus*; interparietal averaging larger and more angular.

Measurements. Total length, 191; length of tail, 105; hind foot length (dry), 24.4; greatest length of skull, 27.1; width across bullae, 13.3; breadth across maxillary arches, 12.9; nasal length, 11.1; interorbital breadth, 6.4.

Remarks. Length of foot (dry) listed on the tag of the holotype was 23.9 mm. Based on chromosomal (Patton, 1969b) and nuclear allozyme genes (Patton *et al.*, 1981), the western Arizonan population of *C. p. penicillatus* probably should be allied with *angustirostris* rather than with populations of *penicillatus* from central Arizona.

### *Chaetodipus penicillatus pricei* (J. A. Allen)

1894. *Perognathus pricei* J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:318.

1983. *Chaetodipus penicillatus pricei*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Oposura [Moctezuma], Sonora, Mexico.

Range. This race occurs from southern Arizona and extreme southwestern New Mexico south along the coastal plains of Sonora at least to Navojoa in the lower Rio Mayo and east throughout most of the Rio Yaqui drainage.

Recorded localities. *SONORA*: Batamotal (Hall and Kelson, 1959). North shore of Bocochoibampo Bay (Cockrum and Bradshaw, 1963). Hermosillo; Magdalena; Ortiz; Quitobaquita; Sonora; Sonoyta [Sonoita] (Osgood, 1900). 8.5 mi NE Colonia Oaxaca; 1 mi N Huachinera (Patton and Soule, 1967). Hermosillo; Baserac; Suaqui Grande; Tecoripa; Mazatan; Tonichi; Guasimas; Pitahaya; Vicam; Coyotes; Desemboque; Pinacate (Patton *et al.*, 1981, as *C. penicillatus*). 2 mi N Bahia Kino (Hall, 1981).

Description. A subspecies of medium to small size; tail of medium length; hind foot short; total length medium (usually between 170 and 180); skull small; occipitonasal length short; nasals short; interorbital constriction narrow; toothrow short; mastoid breadth great relative to length of skull. Color dark in most populations, with specimens from northwestern Sonora and adjacent Arizona pale; ground color light grey-grown with admixture of dark hairs; lateral line prominent; postauricular patch absent or not prominent (see Hoffmeister and Lee, 1967).

Measurements. Total length, 157; length of tail, 90; hind foot length, 23; ear length, 7.5; greatest length of skull, 23.0; basilar length, 18; interorbital breadth, 5.5; length of maxillary toothrow, 3.5; width across mastoid bullae, 11.5; length of interparietal, 4.0; width of interparietals, 8.0; length of nasals, 7.7; zygomatic breadth, 11.5; length of rostrum, 9.6.

Remarks. This is a small subspecies, both externally and cranially, being especially small in occipitonasal length, length of nasals, and interorbital breadth. See Hoffmeister and Lee (1967) for a discussion of areas of integration as well as differentiation between *C. p. pricei* and *C. p. penicillatus*.

*Chaetodipus penicillatus seri* (Nelson)

1912. *Perognathus penicillatus goldmani* Townsend, Bull. Amer. Mus. Nat. Hist., 31:122.

1912. *Perognathus penicillatus seri* Nelson, Proc. Biol. Soc. Washington, 25:116. Renaming of *goldmani* Townsend, 1912.

1983. *Chaetodipus penicillatus seri*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. from Tiburon Island, Gulf of California, Sonora, Mexico.

Range. Known only from Isla Tiburon in the east-central part of the Gulf of California.

Recorded localities. *SONORA*: Tiburon Island (Townsend, 1912). Petrel Bay (Burt, 1938).

Description. A subspecies of small size; short nasals, narrow interorbital region; and short toothrow. Color light; ground color light pinkish cinnamon; postauricular patch not conspicuous (see Hoffmeister and Lee, 1967).

Measurements. The means and ranges of 18 specimens (Burt, 1932) are: total length, 171 (161-195); length of tail, 98 (92-106); hind foot length, 23 (22-24); greatest length of skull, 24.3 (23.1-25.6); basal length (groove on incisor to condyle), 20.2 (19.3-21.0); greatest mastoid breadth, 13.1 (12.1-13.0); length of mastoids, 7.8 (7.4-8.1); interorbital constriction, 5.9 (5.5-6.3); length of nasals, 9.0 (8.4-9.7); interparietal length, 3.5 (2.9-4.0); interparietal width, 6.6 (6.0-7.2); length of maxillary tooth row, 3.5 (3.3-3.8).

Remarks. This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

*Chaetodipus pernix pernix* (J. A. Allen)

1898. *Perognathus pernix* J. A. Allen, Bull. Amer. Mus. Nat. Hist., 10:149.

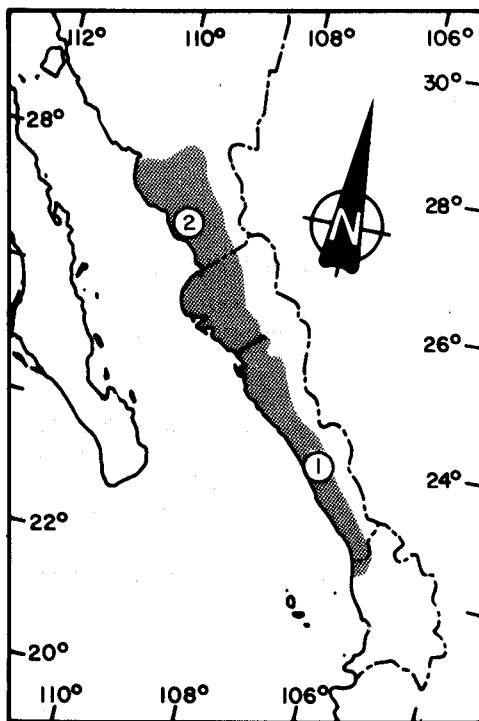
1983. *Chaetodipus pernix perni*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Rosario, Sinaloa, Mexico.

Range. The species *C. pernix* occurs from the coastal plain of southern Sonora south to northern Nayarit (Best and Lackey, 1992b; Williams *et al.*, 1993). The northern-most location is Presa Alvaro Obregon, on the Rio Yaqui north of Ciudad Obregon, and the southern-most is at Playa Novilleros on the coastal strand in northwestern Nayarit (records in the Museum of Vertebrate Zoology). *C. p. pernix* is distributed from north-central Sinaloa, near Pericos, to extreme northwestern Nayarit. Specimens recorded by Burt (1938) from Tecoripa in central Sonora are of *C. penicillatus*, not *pernix* (see account for *penicillatus*, above).

Description. This is a small-bodied member of the genus, with a long and thinly haired, but crested tail, medium-sized ears, and dark and slightly hispid pelage. Specimens from the northern part of the range in Sonora (subspecies *rostratus*) are paler and larger than those from the southern part (subspecies *pernix*). The skull is small, narrow, and elongate, with small mastoids, a constricted interorbital region, broad interparietal, broad nasals, and small cheek teeth (Best and Lackey, 1992b).

Recorded localities. *NAYARIT*: Playa Novilleros; Acaponeta (Hall, 1981). *SINALOA*: Rosario (J. A. Allen, 1898). Chele (Hooper, 1955). 6 mi NE Ciudad de Mazatlan (Ingles, 1959). Pericos (Patton *et al.*, 1981 como *C. pernix*). Hacienda Island, a few miles W Escuinapa; Altata (Hall, 1981). *SONORA*: Aduana (Ingles, 1959). Esperanza; Coyotes; Navojoa; Pitahaya; Vicam (Patton *et al.*, 1981, as *C. pernix*).



Localization of *Chaetodipus pernix*:  
 1. *C. p. pernix*      2. *C. p. rostratus*

Measurements. Osgood (1900) gave average measurements for three specimens from the type locality as: total length, 175; length of tail, 97; hind foot length, 22.3; occipitonasal length, 24.4; basilar length of Hensel, 17.4; interorbital breadth, 5.4; width across mastoids, 12.2; length of nasals, 9.2; length of interparietal, 3.3; width of interparietal, 7.2.

Remarks. This species is sympatric with four others in the genus. It differs readily from *C. baileyi* by its much smaller size, much less well-inflated mastoid bullae, and much darker dorsal coloration. From both *C. artus* and *C. goldmani*, *pernix* differs by its smaller size and lack of rump spines. It is quite similar to *C. penicillatus*, but can be distinguished in areas of sympatry in southern Sonora by the characteristics listed above under that species.

This species occupies thornscrub habitats along the coast of southern Sonora and northern Sinaloa, grading into tropical deciduous, short-tree forest inland in this region, as well as throughout central and southern Sinaloa and northern Nayarit. It has been collected along the edges of agricultural fields adjacent to the coastal dunes at Playa Novilleros in extreme northwestern Nayarit. Throughout its range, the Sinaloan pocket

mouse prefers sandy or silty soils. Where sympatric with *C. goldmani* in Sonora, the latter occupies rockier soils and steeper slopes. It is truly syntopic with *C. penicillatus* in the alluvial soils of the lower Rio Yaqui and Rio Mayo valleys.

This is a little studied mouse. It is granivorous, as are other members of the genus. Reproduction apparently occurs in the late spring and summer, based on data from specimens in the Museum of Vertebrate Zoology collections. Hooper (1955) collected two pregnant females in April. Litter sizes range from 2 to 5.

The base of the baculum is higher than wider and the distal end curves upward sharply. It differs from *goldmani* chiefly in being smaller. The length of one specimen is 11.1; height of base 1.0 (Burt, 1960).

There are two races currently recognized. These differ substantially in diploid number (*rostratus*,  $2n=52$  versus *pernix*,  $2n=36$  or  $38$ ; Patton, 1967; 1970) but share close genetic similarity based on allozymes (Patton *et al.*, 1981).

### *Chaetodipus pernix rostratus* (Osgood)

1900. *Perognathus pernix rostratus* Osgood, N. Amer. Fauna, 18:51.

1983. *Chaetodipus pernix rostratus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Camoa, Rio Mayo, Sonora, Mexico.

Range. This race occurs from the lower Rio Yaqui valley south throughout coastal Sonora and Sinaloa to south of Guamuchil.

Recorded localities. *SINALOA*: San Rafael, 10 mi N Guamuchil; San Miguel Zapote; Rio Fuerte (Patton and Soule, 1967). *SONORA*: Camoa, Rio Mayo (Osgood, 1900). Obregon; Tesia (Burt, 1938). Guiracoba (Hall, 1981). Vicam (Patton and Soule, 1967). Specimens recorded by Burt (1938) from Tecoripa belong to *C. penicillatus*, not *C. pernix* (see above).

Description. External size and proportions similar to *C. p. pernix*, but skull quite different. Upper parts slightly lighter and grayer than *pernix*; general color broccoli brown rather than hair-brown; facial area distinctly paler than back and sides; lateral line pinkish buff; lower parts soiled white. Skull shorter and broader than that of *pernix*; rostrum very heavy; nasals, premaxillae, and premaxillary branches of zygomata all distinctly heavy; interparietal, mastoids, and auditory bullae similar to that of *pernix*.

Measurements. Osgood (1900) listed average measurements of topotypes as (4 individuals for external and 3 individuals for cranial measurements): total length, 161; length of tail, 88; hind foot length, 22.5; occipitonasal length, 22.7; basilar length of Hensel, 16.5; width across mastoids, 11.7; length of nasals, 8.6; least interorbital breadth, 5.5; length of interparietal, 3.4; width of interparietal, 5.5.

Remarks. Chromosomal complement ( $2n=52$ ) quite different from that of *C. p. pernix* ( $2n=36-38$ ; Patton, 1970). This subspecies is known to hybridize with *C. penicillatus* on the coastal plain near Vicam, Sonora (Patton and Soule, 1967).

### *Chaetodipus spinatus spinatus* (Merriam)

1889. *Perognathus spinatus* Merriam, N. Amer. Fauna, 1:21.

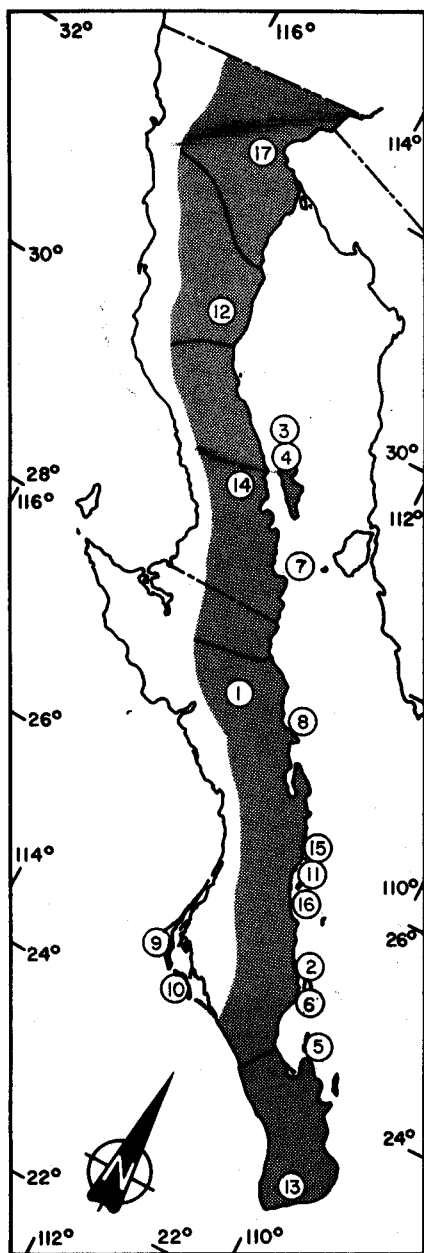
1983. *Chaetodipus spinatus spinatus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From lower Colorado River, 25 mi below [S] the Needles, San Bernardino Co., California.

Range. The Colorado Desert of southeastern California and the Baja California peninsula; ranges from extreme southern tip of Nevada south along the Colorado River, and from the Coachella and Imperial valleys in California, southward into Baja California to Cabo San Lucas. It has not been recorded from the cooler and moister Pacific coast of Baja California north of the Sierra de la Laguna in the cape region, including the Magdalena Plain, but it is found on Magdalena and Margarita islands off of the Pacific coast of Baja California Sur. It is also known from many of the islands along the gulf coast of the Baja California peninsula (Mejia, Angel de la Guardia, San Lorenzo, San Marcos, Coronados, Carmen, Danzante, San Jose, San Francisco, and Espiritu Santo; see Hall, 1981; Huey, 1964). The nominal subspecies *C. s. spinatus* is distributed along the western side of the Colorado River from extreme southern Nevada south through southeastern California and northeastern Baja California to the vicinity of San Felipe on the Gulf of California.

Recorded localities. *BAJA CALIFORNIA*: San Felipe (Huey, 1960a). Cocopah Mts. (Hall, 1981).

Description. This is a medium to medium-large species with a long, crested tail, small ear pinnae, very pronounced spines on the rump and often extending on the flanks to the shoulder region, and usually without a lateral buff stripe. The skull is comparatively flat dorsally, rather narrow, with small mastoid bullae and thus moderately wide interparietals. The upper parts are a drab gray-brown, with the hairs plumbeous basally, pale tan subterminally, and often black-tipped.



This species averages nearly 200 mm in total length, with the tail 115 mm, hind foot 24 mm, and skull length about 26 mm.

Measurements. Means for five (Huey, 1930; 1960a) are: total length, 184.8; length of tail, 106.4; hind foot length, 22.2; ear length, 5.0; great length of skull, 24.4; with across bullae, 12.2; interorbital constriction, 6.2; length of nasals, 9.2; length of maxilar tooththrow, 3.5.

Remarks. Spiny pocket mice may be sympatric with *C. arenarius*, *C. baileyi*, *C. fallax*, *C. formosus*, or *C. penicillatus*, and near-sympatric with *C. californicus*. The species is readily distinguished from any other by its very distinctive and well-developed spines on the rump and flanks, except *californicus* and *fallax*. Its spines are typically even more developed than are those of *californicus* and *fallax*, but *spinatus* also differs from these two generally by the lack of a buff lateral stripe. These, and other characteristics, are noted in individual accounts above.

*C. spinatus* is typically found on rocky, desert slopes and other rocky soils in low elevation desert shrub communities. It shares this habitat with *C. fallax* and *C. formosus* in northeastern Baja California and adjacent California, and can overlap with *C. baileyi* in hard-pan and stony soils of the lower slopes, but it is absolutely segregated by habitat from sandy soil occupants, such as *C. arenarius* and *C. penicillatus*.

Lackey (1991b) summarizes the sparse information available on the ecology and life

Localization of *Chaetodipus spinatus*:

- |                             |                              |
|-----------------------------|------------------------------|
| 1. <i>C. s. broccus</i>     | 2. <i>C. s. bryanti</i>      |
| 3. <i>C. s. evermanni</i>   | 4. <i>C. s. guardiaei</i>    |
| 5. <i>C. s. lambi</i>       | 6. <i>C. s. latijugualis</i> |
| 7. <i>C. s. lorenzi</i>     | 8. <i>C. s. macrosensis</i>  |
| 9. <i>C. s. magdalenae</i>  | 10. <i>C. s. margaritae</i>  |
| 11. <i>C. s. occultus</i>   | 12. <i>C. s. oribates</i>    |
| 13. <i>C. s. peninsulae</i> | 14. <i>C. s. prietae</i>     |
| 15. <i>C. s. pullus</i>     | 16. <i>C. s. seorsus</i>     |
|                             | 17. <i>C. s. spinatus</i>    |



history of this species. Most information deals with habitat range (recorded above); there have been no studies of population dynamics, seasonal variation in activity, reproduction, or other attributes.

The baculum has a slightly enlarged basal end that is nearly circular across section and entire bone is sigmoid in shape in lateral outline. Measurements of 51 specimens are: length 10.9 (9.3-13.0); height of base 0.68 (0.4-0.9) (Burt, 1960).

Eighteen subspecies are currently recognized for the Spiny pocket mouse, of which 17 occur in Mexico (Hall, 1981; Lackey, 1991b; Williams *et al.*, 1993). Most are known only from islands either in the Gulf of California or off the southern Pacific coast of Baja California Sur.

### *Chaetodipus spinatus broccus* (Huey)

1960. *Perognathus spinatus broccus* Huey, Trans. San Diego Soc. Nat. Hist., 12:410.

1983. *Chaetodipus spinatus broccus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Ignacio, 27° 17' LN, Baja California Sur, Mexico.

Range. This race occurs over the northern three-fourths of the peninsula in Baja California Sur, generally on the slopes of the Sierra de la Giganta.

Recorded localities. **BAJA CALIFORNIA SUR**: Llano de San Bruno; 12 mi S Mulege, Concepcion Bay; Canipolo; Comondu (Huey, 1960a). Loreto (Bassols, 1981). Llanos de San Bruno; 12 mi S Mulege, Concepcion Bay; Comondu (Hall, 1981).

Description. Following Huey (1960a), it differs from *C. s. prietae* in its larger size and proportionately longer tail. The skull is flatter and less rounded. The most pronounced character, for which the race is named, is a well developed pointed projection on the underside of the zygomatic arch where the jugal joins the maxilla.

Measurements. Means of five males from the type locality (Huey, 1960a) are: total length, 196; length of tail, 112.2; hind foot length, 21.4; ear length, 5.2; greatest length of skull, 25.6; interorbital breadth, 6.4; length of maxillary toothrow, 3.3; width across mastoid bullae, 12.7; length of nasals, 9.8.

Remarks. Compared with *C. s. penirsulae*, *C. s. broccus* is smaller, with smaller ears and smaller skull. The pointed projection on the zygomatic arch, however, is larger and more prominently developed (Huey, 1960a).

### *Chaetodipus spinatus bryanti* (Merriam)

1894. *Perognathus bryanti* Merriam, Proc. California Acad. Sci., ser. 2, 4:458.

1983. *Chaetodipus spinatus bryanti*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Jose Island, Gulf of California, Baja California [Sur].

Range. Known only from Isla San Jose, Gulf of California, Baja California Sur.

Recorded localities. **BAJA CALIFORNIA SUR**: San Jose Island (Merriam, 1894; Townsend, 1912).

Description. This is a large member of the *spinatus* group, with a distinctly long and more heavily crested tail than other members; the ears are longer and darker; the whiskers longer and heavier, reaching the middle of the back; and the pelage is coarser and more spiny. Coloration of the upper parts is drab gray, becoming brownish on the back in old pelage, abundantly lined with black hairs; the under parts, fore and hind feet and fore legs are white; there is no lateral stripe; the tail is

bicolored, dusky above, white beneath. The skull is similar to that of the nominate subspecies, but very much larger (total length 27 instead of 23); interparietal more than twice as broad as long, strap-shaped or very broadly and flatly pentagonal. Compared with *C. s. peninsulae* from the adjacent mainland, the skull is narrower and slightly smaller, but the cranial differences are slight.

Measurements. The means and ranges for 23 specimens (Burt, 1932) are: total length, 190 (167-196); length of tail, 113 (88-125); hind foot length, 24 (23-25); greatest length of skull, 25.5 (24.1-26.7); basal length (groove on incisor to condyle), 21.0 (19.8-22.0); greatest mastoid breadth, 12.7 (12.2-13.5); length of mastoids, 7.7 (7.1-8.2); interorbital constriction, 6.7 (6.3-7.4); length of nasals, 10.1 (9.2-11.4); interparietal length, 3.9 (3.4-4.4); interparietal width, 7.7 (6.9-8.4); length of maxillary tooth row, 3.6 (3.4-3.9).

Remarks. This is the largest taxon of the *spinatus* group. It is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus evermanni* (Nelson and Goldman)

1929. *Perognathus evermanni* Nelson and Goldman, Proc. Biol. Soc. Washington, 42:111.

1983. *Chaetodipus spinatus evermanni*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Mejia Island, near north end of Angel de la Guardia [= Guardia] Island, Gulf of California, Baja California.

Range. Known only from Isla Mejia, near the north end of Isla Angel de la Guardia, Gulf of California, Baja California.

Recorded localities. **BAJA CALIFORNIA:** Mejia Island (Nelson and Goldman, 1929; Banks, 1967; Gill, 1981).

Description. Following Nelson and Goldman (1929), this is a small species of the *Chaetodipus spinatus* group, resembling typical *spinatus* externally but underlying plumbeous area of pelage darker and more sharply defined; delicate structure of cranium, especially attenuation of nasals and narrowness of frontal and parietal regions, quite distinctive. Rump bristles present, and tail with an elongated terminal tuft as in *spinatus*. The color of the type has light ochraceous buff upper parts, darkened by overlying black tipped hairs with sharply defined plumbeous under color showing through, the result being a dull, grizzled, grayish-brown general tone; under parts, forelimbs, and hind feet white; tail brownish above, white below. The skull is in general similar to that of *C. s. spinatus*, but smaller, relatively narrower, and lighter in structure; braincase narrower and proportionately more arched above, nasals much narrower, more tapering, their width near posterior ends exceeded by that of ascending branches of premaxillae (nasals broader than premaxillae posteriorly in *C. s. spinatus*), the ends with a deep emargination between them; interorbital space narrower; mastoid and audital bullae smaller, dentition about as in *spinatus*.

Measurements. The means and ranges for 27 specimens (Banks, 1967) are: total length, 151 (144-155); tail vertebrae, 79 (76-82); hind foot, 21 (20-21); greatest length of skull, 23.9 (23.2-24.8); basal length (groove on incisor to condyle), 19.8 (19.4-20.4); greatest mastoid breadth, 11.8 (11.7-11.9); length of mastoids, 6.7 (6.6-6.8); interorbital constriction, 5.8 (5.8-5.9); length of nasals, 9.3 (8.8-9.4); interparietal length, 3.3 (3.1-3.5); interparietal width, 7.4 (7.3-7.5); length of maxillary tooth row, 3.5 (3.4-3.6).

Remarks. *Chaetodipus spinatus evermanni* differs so strongly from the widely ranging mainland form that specific recognition may be warranted. Its small island habitat has been described as rough and volcanic, cut by steep, rocky canyons (Nelson and Goldman, 1929). This subspecies

is probably extinct by the introduction of non native species. Is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus guardiae* (Burt)

1932. *Perognathus spinatus guardiae* Burt, Trans. San Diego Soc. Nat. Hist., 7:165.

1983. *Chaetodipus spinatus guardiae*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Puerto Refugio, north end Angel de la Guardia [Guarda] Island, 30 ft, Gulf of California, Baja California, Mexico.

Range. Occurs only on Isla Angel de la Guardia, with the type locality at Puerto Refugio, on the north end of the island.

Recorded localities. **BAJA CALIFORNIA:** Angel de la Guardia Island (Burt, 1932; Banks, 1967; Gill, 1981).

Description. Following Burt (1932), it is a small-sized, light-colored race of the *Chaetodipus spinatus* group, resembling *C. s. evermanni* from Mejia Island to the north, but somewhat larger and more pallid in coloration. It is the palest member of the *spinatus* group known from the islands of the gulf. The lateral line is less distinct than in *evermanni*; rump spines are present, but not conspicuous; tail tuft less prominent than in most races of *spinatus*. Skull similar to that of *evermanni*, but interpterygoid space wider and pterygoids less flattened when viewed ventrally; interparietal averages smaller. This race differs from specimens taken at Concepcion Bay on the mainland of Baja California chiefly in smaller size and paler coloration.

Measurements. The means and extremes for 36 specimens (Burt, 1932) are: total length, 161 (140-175); length of tail, 87 (75-96); hind foot length, 22.5 (20-23); greatest length of skull, 24.6 (23.3-26.2); basal length (groove on incisor to condyle), 20.2 (18.8-21.4); greatest mastoid breadth, 12.1 (11.3-12.7); length of mastoids, 6.9 (6.4-7.3); interorbital constriction, 6.0 (5.6-6.5); length of nasals, 9.8 (8.6-10.6); interparietal length, 3.0 (2.6-3.5); interparietal width, 7.1 (6.4-7.6); length of maxillary tooth row, 3.7 (3.5-4.1).

Remarks. Burt (1932) considers that the channel separating Angel de la Guardia Island from Mejia Island, about 150 yards wide, to be an effective barrier isolating the two races. The holotype is now in the Dickey Collection at the University of California at Los Angeles. This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus lambi* (Benson)

1930. *Perognathus spinatus lambi* Benson, Univ. California Publ. Zool., 32:452.

1983. *Chaetodipus spinatus lambi*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Gabriel, Espiritu Santo Island, Gulf of California, Baja California Sur, Mexico.

Range. Known only from Isla Espiritu Santo, Gulf of California, Baja California Sur

Recorded localities. **BAJA CALIFORNIA SUR:** Espiritu Santo Island (Benson, 1930).

Description. Following Benson (1930), it is a small pocket mouse that can be distinguished from *C. s. peninsulae* and *C. s. bryanti* by smaller size of head and body, smaller, narrower, more delicate skull, and much smaller mastoids. The color is about as in *peninsulae*. The colors of the type are: upper parts in general light pinkish cinnamon heavily lined with bister; underparts, fore limbs, and feet, white, faintly washed with cream color; tail white beneath, bister above, lightest at pencil;

most dorsal hairs tipped with bister, each with a subterminal band of light pinkish-cinnamon, and light quaker-drab base. Some dorsal hairs are longer and lack the subterminal band. These and the dark tips of the other hairs produce the lined appearance of the pelage. Spines are white. The skull, compared with *peninsulae*, is smaller, narrower, more delicate; zygomatic processes of maxillae narrower and forming more acute angle with rostrum; rostrum more slender; mastoids much less inflated.

Measurements. The means and ranges for eight adults (Burt, 1932) are: total length, 175 (163-187); length of tail, 99 (89-107); hind foot length, 23 (22-24); greatest length of skull, 25.7 (25.1-26.6); basal length (groove on incisor to condyle), 21.1 (20.6-21.5); greatest mastoid breadth, 12.2 (11.9-12.7); length of mastoids, 7.0 (6.6-7.2); interorbital constriction, 6.8 (6.2-7.1); length of nasals, 10.2 (9.8-11.0); interparietal length, 3.2 (3.1-3.3); interparietal width, 7.5 (7.1-8.0); length of maxillary tooth row, 3.7 (3.4-3.9).

Remarks. Some specimens of *C. s. lambi* overlap in characteristics with those of *C. s. peninsulae*. However, all exhibit a more brownish tinge than most specimens of *peninsulae* and the hair is slightly less coarse. This race is darker than *C. s. occultus*, *C. s. bryanti*, and *C. s. margaritae*. The skull equal in size to that of *C. s. spinatus* but more slender, more delicate, and with smaller mastoids. The skull is also equal in size, but flatter than, that of *occultus*. Compared with *magdalenae* and *margaritae*, the skull is smaller (basilar length of Hensel in four specimens averages 16.8 mm) (Benson, 1930).

All the insular races of the *spinatus* group, except *bryanti* of San Jose Island, are characterized as having smaller mastoids than the mainland races (Benson, 1930). Cortes-Calva and Alvarez-Castañeda (1997) found that this subspecies has its main distribution in canyon bottoms on Isla Espiritu Santo. This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus latijugularis* (Burt)

1932. *Perognathus spinatus latijugularis* Burt, Trans. San Diego Soc. Nat. Hist., 7:168.

1983. *Chaetodipus spinatus latijugularis*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Francisco Island, 24° 50' LN, 110° 34' LW, Gulf of California, Baja California [Sur], Mexico.

Range. Known only from Isla San Francisco, Gulf of California, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: San Francisco Island (Burt, 1932).

Description. Following Burt (1932), this is a medium-sized and dark-colored form, with wide, flat jugals. The lateral line is indistinct. Skull medium-sized; nasals usually tapering toward posterior termination that is rarely emarginate; interparietal convex on anterior border, but without a distinct fifth angle; supraorbital ridges trenchant; jugals broad, short, and flattened dorso-ventrally; zygomatic processes of maxillary and squamosal heavy and approaching one another in center of arch; mastoids and auditory bullae medium, relative size about as in *C. s. bryanti*.

Measurements. The means and ranges of nine specimens (Burt, 1932) are: total length, 179 (170-188); length of tail, 106 (100-110); hind foot length, 22 (22-22); greatest length of skull, 25.5 (24.2-26.8); basal length (groove on incisor to condyle), 21.1 (20.4-22.0); greatest mastoid breadth, 12.6 (12.2-12.9); length of mastoids, 7.5 (7.2-7.8); interorbital constriction, 6.7 (6.5-7.0);

length of nasals, 9.5 (9.0-10.3); interparietal length, 3.6 (3.5-3.7); interparietal width, 7.3 (6.9-7.5); length of maxillary tooth row, 3.9 (3.6-4.0).

Remarks. *Chaetodipus spinatus latijugularis* differs from *C. s. bryanti* from San Jose Island in smaller size, distinctly darker coloration without the yellowish admixture on upperparts, non-emargine nasals at posterior termination, heavier jugals, and interparietal strap-shaped as opposed to pentagonal. This subspecies differs from *C. s. lambi* from Espiritu Santo Island in the length of interparietal, and posteriorly tapering nasals; and from *C. s. peninsulae* in darker coloration and heavier jugals. *C. s. latijugularis* is set off sharply from *bryanti* to the north, *lambi* to the south, and *peninsulae* to the west by its darker coloration and broad, flattened jugals. It approaches *pullus* in coloration (Burt, 1932). This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus lorenzi* (Banks)

1967. *Perognathus spinatus lorenzi* Banks, Proc. Biol. Soc. Washington, 80:101.

1983. *Chaetodipus spinatus lorenzi*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From South San Lorenzo Island, 28° 36' LN, 112° 51' LW, Gulf of California, Baja California, Mexico.

Range. Known only from Isla San Lorenzo, Gulf of California, Baja California.

Recorded localities. **BAJA CALIFORNIA:** South San Lorenzo Island; North San Lorenzo Island (Banks, 1967).

Description. Following Banks (1967), it is similar in size to *C. s. guardia*, but darker in color and with a shorter, shallower skull; lighter in color and much smaller than *C. s. prietae*; and somewhat larger than *C. s. evermanni*, brownish rather than gray in overall coloration. This race is distinguished from all these populations by the extremely dark dorsal tail stripe and by the shorter, shallower skull.

Measurements. Means and ranges for 20 specimens (Banks, 1967) are: total length, 152.9 (142-160); length of tail, 77.7 (68-86); greatest length of skull, 23.8 (23.0-24.6); skull width, 11.7 (11.3-12.0); skull depth, 8.0 (7.7-8.4); length of nasals, 9.1 (8.7-9.7).

Remarks. South San Lorenzo Island is listed on recent Mexican maps as Isla San Lorenzo; North San Lorenzo Island (28° 42' LN, 112° 57' LW) is also known as Isla Las Animas. This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus magdalenae* (Osgood)

1907. *Perognathus spinatus magdalenae* Osgood, Proc. Biol. Soc. Washington, 20:21.

1983. *Chaetodipus spinatus magdalenae*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Magdalena Island, Pacific Ocean, Baja California [Sur], Mexico.

Range. Known only from Isla Magdalena, Baja California Sur.

Recorded localities. **BAJA CALIFORNIA SUR:** Magdalena Island (Osgood, 1907b).

Description. Following Osgood (1907b), size and color nearly as in *C. s. peninsulae*; mastoids smaller; rostrum lightly longer. Mastoids as in *C. s. margaritae*; size smaller; rostrum longer and broader. The coloration is very similar to that of *peninsulae* and *margaritae*, but somewhat more deeply vinaceous; upperparts fawn mixed with dusky, chiefly viewed as fine lines; lateral line very

narrow, fawn colored; underparts creamy white. The skull size about as in *peninsulae*; mastoids smaller; rostrum slightly longer; mastoids as in *margaritae*; rostrum nasals, and skull throughout more elongate.

Measurements. Means and range for ten topotypes (Osgood, 1907b) are: total length, 194 (188-200); length of tail, 115 (110-122); hind foot length, 24 (23.5-25). Skulls of type and one topotype, respectively: greatest length, 26.4, 26.8; basilar length, 17.9, 18; mastoid width, 12.6, 12.7; zygomatic width, 12.8, 12.7; interorbital constriction, 6.9, 6.7; nasals, 10.5, 10.6; interparietal, 8.1 x 3.6, 7.5 x 3.3; diastema, 6, 6.5; maxillary toothrow, 4.3, 4.

Remarks. No ecological data are known

### *Chaetodipus spinatus macrosensis* (Burt)

1932. *Perognathus spinatus macrosensis* Burt, Trans. San Diego Soc. Nat. Hist., 7:166.

1983. *Chaetodipus spinatus macrosensis*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Marcos Island, 27° 13' LN, 112° 05' LW, Gulf of California, Baja California Sur, Mexico.

Range. Known only from Isla San Marcos, Gulf of California, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: San Marcos Island (Burt, 1932).

Description. Following Burt (1932), this is a small, dark-colored race of *Chaetodipus spinatus*, approaching in external characters specimens from Concepcion Bay, Baja California, but differing from them in smaller size; relatively longer tail; relatively longer nasals; smaller interparietal, and paler coloration. Lateral line present but indistinct; median rump spines black-tipped, lateral ones white. Skull small; nasals relatively long, straight sided for posterior one-half; mastoids and auditory bullae small.

Measurements. The means and ranges for 17 topotypes (Burt, 1932) are: total length, 168 (150-178); length of tail, 97 (88-103); hind foot length, 21 (21-22); greatest length of skull, 24.4 (22.2-25.5); basal length (groove on incisor to condyle), 20.0 (18.5-20.5); greatest mastoid breadth, 11.9 (11.4-12.5); length of mastoids, 7.0 (6.4-7.5); interorbital constriction, 6.1 (5.6-6.4); length of nasals, 9.3 (8.2-10.0); interparietal length, 3.6 (3.4-3.8); interparietal width, 7.1 (6.7-7.5); length of maxillary tooth row, 3.6 (3.4-3.8).

Remarks. This race differs from *guardiae* chiefly in darker coloration and relatively longer tail (Burt, 1932). The holotype is the Dickey Collection at the University of California at Los Angeles. This subspecies is considered threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus margaritae* (Merriam)

1894. *Perognathus margaritae* Merriam, Proc. California Acad. Sci., ser. 2,4:459.

1983. *Chaetodipus spinatus margaritae*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Santa Margarita Island, Pacific Ocean, Baja California [Sur], Mexico.

Recorded localities. *BAJA CALIFORNIA SUR*: Santa Margarita Island (Merriam, 1894).

Description. The color of the upper parts varies from drab-gray on the sides to grizzled black and yellowish-brown on the back, the latter due to a coarse admixture of black hairs; under parts and feet are white; tail is bicolored, dusky above and whitish beneath. The skull is similar to that of the nominate subspecies, but slightly longer, more arched and relatively narrower posteriorly; the

interparietal is broadest in the middle instead of anteriorly, with the parieto-occipital suture opposite middle, instead of anterior corner; lacrymals decidedly larger; posterior ends of nasals and premaxillary together forming a deep emargination.

Measurements. Merriam (1894) gave external measurements of two specimens (measured fresh); no other data on measurements are available for *margaritae*: [external measurements from dry skin] total length, 170; length of tail, 102; hind foot length, 22.5; ear length (anterior base), 8.5; occipitonasal length, 25.9; basilar length of Hensel, 18.0; interorbital breadth, 6.5; width across mastoid bullae, 12.0; length of interparietal, 3.7; width of interparietals, 8.0; length of nasals, 10.3.

Range. Known only from Isla Santa Margarita, Pacific Ocean, Baja California Sur.

Remarks. This subspecies is considered as threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus occultus* (Nelson)

1912. *Perognathus spinatus nelsoni* Townsend, Bull. Amer. Mus. Nat. Hist., 31:122.

1912. *Perognathus spinatus occultus* Nelson, Proc. Biol. Soc. Washington, 25:116. Renaming of *nelsoni* Townsend, 1912.

1983. *Chaetodipus spinatus occultus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Carmen Island, Gulf of California, Baja California [Sur], Mexico.

Range. Known only from Isla del Carmen, Gulf of California, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: Carmen Island (Townsend, 1912).

Description. Compared with *C. spinatus peninsulae*, the color is gray and lacks the drab-brown effect seen in *peninsulae*; general size similar, but tail slightly shorter, decidedly shorter than in *bryanti* (Townsend, 1912).

Measurements. Burt (1932) listed means and ranges for five specimens as: total length, 182 (168-205); length of tail, 100 (90-115); hind foot length, 22 (21-23); greatest length of skull, 25.5 (23.3-27.3); basal length, 20.9 (19.1-22.4); greatest mastoid breadth, 12.6 (11.7-13.0); length of maxilar toothrow, 39 (3.6-4.0); nasal length, 9.8 (8.9-10.5); interorbital breadth, 6.5 (6.1-6.8).

Remarks. *C. s. occultus* (Nelson, 1912) is a renaming of *C. s. nelsoni* Townsend (1912). This subspecies is considered threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus oribates* (Huey)

1960. *Perognathus spinatus oribates* Huey, Trans. San Diego Soc. Nat. Hist., 12:409.

1983. *Chaetodipus spinatus oribates*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Fernando Mission, 30° LN, Baja California, Mexico.

Range. Rocky slopes of the Sierra San Pedro Martir and the Sierra San Miguel southward to the vicinity of La Ramona, northeast of Santa Catarina, in Baja California.

Recorded localities. *BAJA CALIFORNIA*: Las Cabras; Parral; Matome (Hall and Kelson, as *C. s. spinatus*). San Fernando Mission; Rancho Ramona, 8 mi N Santa Catarina; Las Cabras (Huey, 1960a). Rancho Ramona, 8 mi N Catalina (Hall, 1981).

Description. Following (Huey, 1960a), this race is recognizable by its very spiny and grizzled, blackish dorsal pelage, darker than in other races, and its small body, having a proportionately

long, well tufted, and bicolored tail; underparts and feet are white, with little or no blending of color on the sides.

Measurements. The averages of three specimens (Huey, 1960a) are: total length, 190.4; length of tail, 110.4; hind foot length, 22.0; ear length, 5.0; greatest length of skull, 24.6; interorbital breadth, 6.3; length of maxillary tooththrow, 3.4; width across mastoid bullae, 12.7; length of nasals, 9.3.

Remarks. Compared with *C. spinatus rufescens*, *C. s. oribates* is much darker in dorsal pelage color, with a skull slightly heavier-boned in most dimensions. Compared with *C. s. prietae*, *oribates* is slightly darker and more grizzled, with a proportionately longer tail. The skull of *oribates*, when compared with the skulls of both of these races, is rounder as seen either from the side or from the rear, and has heavier maxillary arches and nasals; the bullae also are more rounded and inflated (Huey, 1960a).

Huey (1960a) encountered individuals of this subspecies on rocky terrain from the western foothills bordering Llano de San Agustin, at 30° LN.

### *Chaetodipus spinatus peninsulae* (Merriam)

1894. *Perognathus spinatus peninsulae* Merriam, Proc. California Acad. Sci., ser. 2, 4:460.

1983. *Chaetodipus spinatus peninsulae*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From San Jose del Cabo, Baja California Sur, Mexico.

Range. Occurs throughout the cape region of Baja California Sur from approximately the level of Bahia de la Paz to the southern tip.

Recorded localities. **BAJA CALIFORNIA SUR:** Cape San Lucas; San Jose del Cabo; Pichililigue Bay; Miraflores; San Bernado Mountains (Townsend, 1912). La Paz, Mesa, 19 mi N La Paz; 7 mi NW San Bartolo; Miraflores; Los Barriles; 9 mi NE Cape San Lucas; San Jose del Cabo; Cape San Lucas (Huey, 1960a).

Description. Larger than the nominate subspecies, with much larger ears, and coarser pelage; well developed rump spines; tail slender and sparsely crested. Coloration of upper parts drab-gray heavily lined with black hairs, becoming brownish in worn pelage; under parts and feet white; tail bicolored, dusky above and white below. Skull large and flat, with angles of the interparietal usually rounded.

Measurements. Means of 12 specimens (Huey, 1930) are: total length, 195.2; length of tail, 111.7; hind foot length, 21.3; ear length, 5.1; condilobasal length, 25.5; width across bullae, 12.3; nasal length, 9.9; interorbital breadth, 6.5; length of maxillary tooththrow, 3.4.

Remarks. Merriam (1894) regarded this form to be sufficiently distinct from typical *spinatus* to be recognized as a separate species, were it not for intermediate specimens from the middle part of the Baja California peninsula. Cortes-Calva and Alvarez-Castañeda (1997) examined the ecology of this race, concluding that soil type was the most important variable determining its presence in the area near Bahia de La Paz.

### *Chaetodipus spinatus prietae* (Huey)

1930. *Perognathus spinatus prietae* Huey, Trans. San Diego Soc. Nat. Hist., 6:232.

1983. *Chaetodipus spinatus prietae*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From 25 mi N Punta Prieta, 29° 24' LN, 114° 24' LW, Baja California, Mexico.



Range. Distributed throughout the central part of the Baja California peninsula, from near San Agustin, Baja California, south to near Mision Santa Gertrudis, inland, and El Barril on the Gulf coast, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA*: 25 mi N Punta Prieta; San Agustin; Catavina (Huey, 1930). San Agustin (Hall and Kelson, 1959). Cataviña (not typical); 25 mi N Punta Prieta; San Borjas Mission; 12 mi E El Arco; Santa Gertrudis Mission; [El] Barril (Huey, 1960a). 25 mi N Punta Prieta; [El] Barril (Banks, 1967). Cataviña; El Barril; Santa Gertrudis Mission; San Borja Mision; 12 mi E El Arco (Hall, 1981).

Description. Following Huey (1930), compared with *spinatus*, larger both in body and cranial measurements. In color it is much darker, with a gray cast as in *spinatus*, grizzled somewhat like *peninsulae*. The skull of *prietae* is more nearly like *peninsulae* in several characteristics, though it has a rounder brain case, approaching that of *spinatus*. However, the interparietals are flat, as in *peninsulae*.

Measurements. Means and ranges of measurements of eight females and ten males (Banks, 1967) are: total length, 174.9 (165-186); 186.6 (179-195); length of tail, 99.6 (91-108); 108 (105-112). The measurement of the skull (males and females) from 22 specimens are: greatest length, 24.6 (23.8-25.8); skull width, 12.6 (12.1-13.1); skull depth, 8.3 (7.7-8.6); length of nasals, 9.3 (8.5-10.3).

Remarks. Compared to *C. s. peninsulae*, *prietae* is grayish rather than brown in color and not so heavily grizzled (Huey, 1930).

### *Chaetodipus spinatus pullus* (Burt)

1932. *Perognathus spinatus pullus* Burt, Trans. San Diego Soc. Nat. Hist., 7:166.

1983. *Chaetodipus spinatus pullus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Coronados Island, 26° 06' LN, 111° 18' LW, Gulf of California, Baja California Sur, Mexico.

Range. Found only on Isla Coronados, Gulf of California, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: Coronados Island (Burt, 1932).

Description. Following Burt (1932), this is a medium-sized, dark-colored race of the *Chaetodipus spinatus* group. It is set off sharply from *C. s. occultus* from Isla Carmen, its nearest island neighbor, by distinctly darker coloration of upperparts (less yellowish), slightly larger size, longer tail, lighter dentition, longer nasals, and more inflated audital bullae.

Measurements. The means and ranges for seven specimens (Burt, 1932) are: total length, 183 (170-192); length of tail, 104 (96-111); hind foot length, 23 (22-23); greatest length of skull, 25.8 (25.1-26.5); basal length (groove on incisor to condyle), 21.3 (20.5-22.2); greatest mastoid breadth, 12.7 (12.6-12.9); length of mastoids, 7.3 (6.9-7.6); interorbital constriction, 6.4 (6.2-6.5); length of nasals, 10.3 (9.9-10.8); interparietal length, 3.9 (3.7-4.1); interparietal width, 7.8 (7.6-8.0); length of maxillary tooth row, 3.5 (3.4-3.7).

Remarks. *Chaetodipus spinatus pullus* differs from *C. s. broccus* taken on the peninsula at Concepcion Bay in larger size, slightly paler coloration without the yellowish lateral lines (white of underparts meets the dark upperparts abruptly), and more prominent tuft on end of tail (Burt, 1932). *C. s. pullus* is closer to *C. s. occultus* from nearby Isla Carmen in skull characteristics and in having the pronounced tuft on the terminal portion of the tail (Burt, 1932). The holotype is the Dickey Collection at the University of California at Los Angeles (Williams *et al.*, 1993).

Isla Coronados is a small volcanic island about 1.75 miles long, north to south, and between 1 and 1.5 miles wide. It is 1.5 miles from the mainland at the nearest point. There is a low sand spit on the southwest side of the island, otherwise it is rough and covered with dark brown (nearly black in some places) lava. The dark color of the pocket mice thus matches with the dark background of the island (Burt, 1932). This subspecies is considered threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Chaetodipus spinatus serosus* (Burt)

1932. *Perognathus spinatus serosus* Burt, Trans. San Diego Soc. Nat. Hist., 7:167.

1983. *Chaetodipus spinatus serosus*, Hafner and Hafner, Great Basin Nat. Mem., 7:25.

Type locality. From Danzante Island [Isla Danzante Primero], 25° 47' LN, 111° 11' LW, Gulf of California, Baja California Sur, Mexico.

Range. Occurs only on Isla Danzante Primero, Gulf of California, Baja California Sur.

Recorded localities. *BAJA CALIFORNIA SUR*: Danzante Island (Burt, 1932).

Description. Following Burt (1932), this is a medium-size, dark-colored race, intermediate in color between *C. s. occultus* from Carmen Island and *C. s. pullus* from Coronados Island.

Measurements. The means and ranges of seven specimens (Burt, 1932) are: total length, 181 (167-196); length of tail, 103 (98-111); hind foot length, 23 (22-24); greatest length of skull, 25.1 (24.5-25.7); basal length (groove on incisor to condyle), 21.0 (20.4-21.4); greatest mastoid breadth, 12.3 (12.0-12.4); length of mastoids, 7.2 (7.0-7.4); interorbital constriction, 6.5 (6.3-7.1); length of nasals, 9.8 (9.0-10.6); interparietal length, 3.6 (3.5-3.6); interparietal width, 7.3 (6.9-7.6); length of maxillary tooth row, 3.7 (3.6-3.8).

Remarks. *Chaetodipus spinatus serosus* differs from *C. s. occultus* chiefly in darker coloration and in having more rounded auditory bullae and smaller mastoids; from *C. s. pullus* in somewhat paler coloration with more of the yellowish admixture of upperparts, and in shorter nasals and smaller interparietal; from *C. s. bryanti* in smaller size, relatively shorter tail, and darker coloration; and from *C. s. peninsulae* in darker coloration, more rounded and more highly arched skull with nasals more deeply emarginate at posterior termination, and in smaller mastoids (Burt, 1932). The holotype is the Dickey Collection of the University of California at Los Angeles.

Danzante is a small island only 1.5 miles from the mainland and about the same distance from Isla Carmen. The specimens on which the above description is based were taken along a small beach on the southwest side of the island (Burt, 1932). This subspecies is considered threatened by the Mexican Government (NOM-059-ECOL-1994).

### Genus *Perognathus*

1839. *Perognathus* Wied, Nova Acta Phys.-Med. Acad. Caesar. Leop.-Carol., 19(1):368.

Type Species. *Perognathus fasciatus* Wied, 1839, Nova Acta Phys.-Med. Acad. Caesar. Leop.-Carol., 19(1):368.

Diagnosis. Size small, total length from about 100 to 200 mm, weight from about 5 to 30 g; body form quadrupedal and scansorial; hind limbs longer than forelimbs; tail relatively short, length usually averaging less to slightly more than length of head and body; tail without prominent distal, dorsal crest or terminal tuft of hairs, although several species have a slight crest and terminal tuft (pencil); tail some shade of brown or buff above, whitish below; proximal one-fourth to one-half

of sole of hind foot with sparse covering of short hairs; ear pinna short and rounded, and without a lobed antitragus except in *P. parvus* and *P. alticola*; antero-lateral edge of ear pinna without covering of long, coarse hairs; generally a contrasting, light buff area on the head around ear pinna (postauricular patch), and a small, whitish spot below the external auditory meatus; dorsal surfaces generally some shade of buff or brownish, usually tinged with black; usually a clear, buff lateral stripe without blackish tinge; undersides usually whitish; in general, hairs relatively short, soft, and oval to flattened in cross section; hairs lack dorsal trough except, in so far as is known, *P. amplus*; longer, stiff, spine-like hairs never present in pelage of dorsal and lateral surfaces; mastoid bullae usually extending beyond the plane of the occiput; tympanic bullae nearly meeting anteriorly on the ventral surface of the skull; exoccipital without strong lateral indentations of mastoid bullae; interparietals compressed and narrower than interorbital breadth; phallus relatively short in length; soft tissue of phallus extends about two-thirds of the length of the baculum; phallus lacks external spines but has urethral lappets; baculum relatively short in length, with swollen, bulbous proximal end and slender, slightly upturned distal end; vesicular glands of male reproductive system elongated and tube-like with hooked end and translucent; head of spermatozoa approximating a triangle, with rounded vertices; tendon at origin of *M. rectus femoris* fan-shaped (Hafner and Hafner, 1983; Hall, 1981; Homan and Genoways, 1978; Ryan, 1989; Wood, 1935).

Remarks. This diagnosis is based on recent species. The genus *Perognathus* includes as synonyms *Cricetodipus* Peale, 1848 (type species *C. parvus*), a name that also was subsequently applied, for a time, to some species of *Dipodomys*; *Abromys* Gray, 1868 (type species *A. lordi*, a synonym of *P. parvus*), and *Otognosis* Coues, 1875 (type species *O. longimembris*). Considerable taxonomic confusion arose as a result of S. F. Baird, E. Coues, J. E. Gray, T. R. Peale, and others misapplying the names *Perognathus fasciatus*, *Perognathus hispidus*, *Abromys lordi*, and *Cricetodipus parvus*. Merriam (1889) and Osgood (1900) were largely responsible for clarifying the nomenclature and stabilizing the taxonomy of pocket mice. As conceived herein, the genus *Perognathus* does not include the hispid-haired species of *Chaetodipus* nor *Perognathus formosus* Merriam, which has been shown to be a species of *Chaetodipus* (Homan and Genoways, 1978; Patton *et al.*, 1981).

Most of the structural characteristics that are of value in distinguishing species are related to size, proportions, and color, all of which exhibit considerable individual and geographic variation, making identification keys based on skins and skulls cumbersome.

### *Perognathus amplus amplus* Osgood, 1900

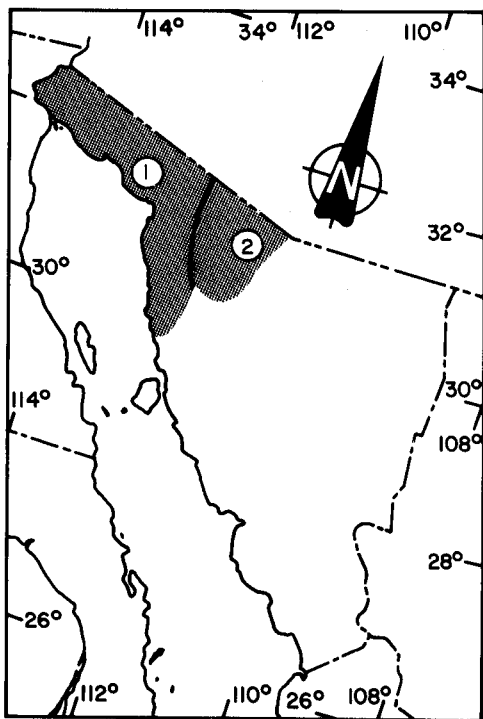
1900. *Perognathus amplus* Osgood, N. Amer. Fauna, 18:32.

Type locality. From Fort Verde, Yavapai Co., Arizona.

Range. This species occurs apparently as a series of disjunct populations from central and southwestern Arizona southward into northwestern Sonora. The range in Arizona is mapped by Hoffmeister (1986). *P. a. amplus* is distributed from central and southwestern Arizona south into northwestern Sonora along the coast, as far south as Puerto Libertad.

Recorded localities. SONORA: Pagago Tanks, 2 mi WNW Puerto Libertad (Hall, 1981).

Description. This is a medium-sized species of the genus with a relatively long tail, large hind feet, inflated mastoid bullae, and a compressed interparietal. Both head and body and tail length range between 70 and 90 mm, with the ratio between these dimensions varying from 0.88 to 1.33 (Williams *et al.*, 1993). The length of the hind foot is generally 20 mm or longer. Dorsal color



Localization of *Perognathus amplus*:  
 1. *P. a. amplus*      2. *P. a. taylora*

is variable, but usually orangeish tan sprinkled with black, with individuals on dark lava substrates sometimes almost black. There is a light-colored postauricular patch present, but it is not especially conspicuous. The subspecies *P. a. amplus* is the largest of the group (Hoffmeister, 1986).

**Measurements.** Mean and range of 23 adults from southwestern Arizona (Hoffmeister, 1986) are: body length, 74.3 (66-75); hind foot length, 20.1 (17.9-21.0); occipitonasal length, 23.6 (22.1-24.8); fronto-nasal length, 15.8 (14.5-16.7); nasal length, 9.1 (8.2-10.0); interorbital breadth, 5.1 (4.7-5.5); mastoid breadth, 14.0 (13.0-14.8); zygomatic breadth, 12.0 (10.8-13.0); length of mastoid bullae, 9.2 (8.8-9.6); maxillary tooththrow length, 3.6 (3.4-3.8); width of interparietal, 3.0 (2.3-3.8); length of interparietal, 2.8 (2.3-3.2); distance between stylomastoid foramen, 11.8 (11.2-12.2).

**Remarks.** We follow Hoffmeister (1986) in regarding *rotundus* Goldman (1932) to be a junior synonym of the nominate subspecies. As a species, this pocket mouse is most similar to *P. longimembris*, and is readily confused with that species. No single character of skin or skull is known that will distinguish all individuals of either species. Williams *et al.*

(1993) note that *amplus* differs from *longimembris* in larger average size and in having a wider upper premolar; greatest length of skull generally exceeds 23.2 mm in *amplus*, usually less than 23.1 in *longimembris*; and hind foot length usually 20 mm or more versus 19.5 or less. Hoffmeister (1986) provides detailed comparisons between these two species in Arizona. In areas adjacent to the international boundary with Sonora, the two species can be distinguished as follows: length of tooththrow (*amplus*, 3.4 mm or greater; *longimembris*, 3.1 mm or less), occipitonasal length (*amplus*, 22.0 mm or greater; *longimembris*, 21.4 mm or less); mastoidal breadth (*amplus*, 12.9 mm; *longimembris*, mm); length of body (*amplus*, 65 mm or greater; *longimembris*, 64 mm or less); and height of skull (*amplus*, 8.6 mm on average; *longimembris*, 7.6 mm on average). It is potentially sympatric with *P. flavus* southwest of Caborca in northwestern Sonora, but can be readily distinguished from this species by its larger overall size and both absolutely and proportionally longer and slightly penicillate tail.

This species inhabits Mojave and Sonoran desert scrub communities and parts of the Great Basin desert scrub (along the Little Colorado River in northern Arizona). In the southern part of the range, it is most commonly found in mesquite or creosote bush, cactus, and palo verde communities, usually in soft or sandy soils of flat desert plains and valley floors (Hoffmeister, 1986; Reichman, 1975).

These are granivorous specialists, with diets minimally supplemented with green plant materials and, sometimes, insects (Reichman, 1975). Breeding apparently begins in late winter and extends into the early summer, coincidental with the winter rainy season. Mean litter size has been reported at 3.35 young, with a range of 1 to 5 (Smith and Jorgensen, 1975). They apparently enter prolonged torpor during winter months and are not active above ground for extended periods of time (Reichman and Van de Graff, 1973).

The baculum is the typical for members of this group; the base is wider than high and the sharp tapers gradually from the bulbous base to the pointed tip. It is 7.1 long and the base 0.7 wide (Burt, 1960).

Four subspecies are currently recognized for the species (Williams *et al.*, 1993), two of which occur in the state of Sonora.

### *Perognathus amplus taylori* Goldman

1932. *Perognathus amplus taylori* Goldman, Jour. Washington Acad. Sci., 22:488.

Type localities. From Santa Rita Range Reserve (near Northeast Station), 35 mi S Tucson, about 4,000 ft, Pima Co., Arizona.

Range. This race is found to the east of *amplus*, in south-central Arizona, extending south into northwestern Sonora from Sonoita to the vicinity of Caborca (see Hoffmeister, 1986).

Recorded localities. SONORA: 13 mi W Caborca (Hoffmeister, 1986).

Description. This is the smallest subspecies of *P. amplus*, characterized by short body and tail, short hind feet, small skull, short tooththrow, relatively long bullae, and pinkish buff color.

Measurements. Goldman (1932) gave averages and ranges of measurements for 10 adult topotypes; Hoffmeister (1986) gave statistics for measurements of samples of 26 individuals from south of Tucson, Arizona, as: body length, 68.1 (58-79); hind foot length, 20.1 (19.0-22.0); occipitonasal length, 22.7 (21.5-23.5); fronto-nasal length, 15.2 (14.2-15.8); nasal length, 8.5 (7.9-8.8); interorbital breadth, 5.2 (4.8-5.7); mastoid breadth, 13.5 (12.9-14.2); zygomatic breadth, 11.7 (11.1-12.4); length of mastoid bulla, 9.0 (8.4-9.4); maxillary tooththrow length, 3.3 (3.1-3.5); width of interparietal, 3.3 (3.0-3.7); length of interparietal, 3.0 (2.5-3.3); distance between stylomastoid foramen, 11.6 (11.2-12.3).

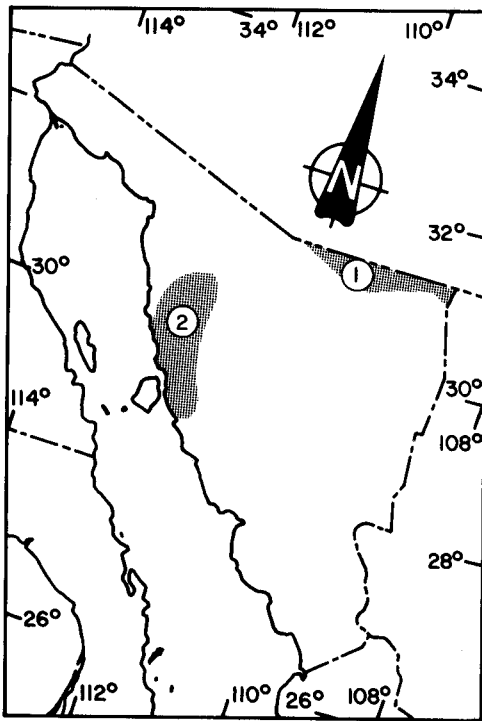
Remarks. Hoffmeister (1986) examined four specimens from near Caborca, Sonora, stating that their small size certainly excluded them from belonging to the nominate subspecies, and allocated them to *taylori* although noting that they were smaller in size than typical of this subspecies.

### *Perognathus flavus flavus* Baird

1855. *Perognathus* [sic] *flavus* Baird, Proc. Acad. Nat. Sci. Philadelphia, 7:332.

Type localities. From El Paso, El Paso Co., Texas;

Range. Widely distributed throughout most of west-central and southwestern Great Plains and intermountain basins of the United States and the Central Plateau of Mexico, with a disjunct population on the central coastal plain of Sonora in the lower Rio Sonora drainage. The species also occurs in the extreme northeastern section of Sonora adjacent to the international border, with records from near Cananea (Museum of Vertebrate Zoology). *P. f. flavus* is a broadly distributed taxon occurring through the desert grasslands of west Texas, New Mexico, southeastern Arizona, and south throughout most of Chihuahua into north-central Durango.



Localization of *Perognathus flavus*:

1. *P. f. flavus*                      2. *P. f. sonoriensis*

interorbital breadth, 4.4 (4.1-4.8); mastoid breadth, 12.0 (11.4-12.7); zygomatic breadth, 10.3 (9.8-10.8); length of mastoid bulla, 7.9 (7.4-8.3); maxillary toothrow length, 3.0 (2.8-3.2); width of interparietal, 3.1 (2.4-3.7); length of interparietal, 2.4 (2.0-2.6); distance between stylomastoid foramen, 10.4 (9.7-10.9).

**Remarks.** This species can be easily distinguished from the other two members of the genus occurring in northwestern Mexico (*amplus* and *longimembris*) by its smaller size and short tail, more conspicuous and pale-colored post-auricular patch, and smaller skull with proportionately larger mastoid bullae.

Silky pocket mice occur in sparse desert scrub and dessert grasslands habitats, ranging through Lower and Upper Sonoran communities to an elevation maximum of nearly 2,500 meters. They can be found in both sandy and pebbly soils, but seem to prefer less compacted soils. A complete synopsis of published habitat characteristics can be found in Best and Skupski (1994).

As is true of all pocket mice, *P. flavus* is primarily a granivore, feeding on the seeds of a wide variety of perennial and annual species. It nests in self-constructed burrows, often in abandoned earthen mounds of pocket gophers, with a complex of tunnels reaching depths of 35 cm. Their burrows may contain large caches of seeds. Reproduction typically occurs in spring and summer, but may begin as early as late winter and extend into fall. Females may reach reproductive maturity before year, and may have two reproductive peaks in a given year, although one is perhaps more

Recorded localities. There are no published records of this subspecies in northwestern Mexico, but specimens from the following localities are in the collections of the Museum of Vertebrate Zoology: SONORA: 5 mi N Cananea; La Saucedá, 15 mi NNE Cananea; 2.3 mi S Santa Cruz.

**Description.** This is a diminutive pocket mouse, averaging only about 7 grams in weight, with a head and body length about 60 mm or less, short tail (averaging 85% of head and body length), tapering to a blunt tip without a terminal pencil of hairs. It has a very soft pelage, hence its common name, but no more soft than many other members of the genus. The upperparts are finely lined with black on ochraceous buff; the dorsal color is heavily overlain with blackish-tipped hairs, contrasting with the clear buff postauricular patch and the narrow buff lateral line; the underparts are pure white.

**Measurements.** Mean and ranges of 14 specimens from southeastern Arizona (from Hoffmeister, 1986) are: body length, 57.0 (53-63); length of tail, 47.8 (40-51); hind foot length, 16.5 (16-18); occipitonasal length, 20.0 (19.4-20.4); fronto-nasal length, 13.0 (12.6-13.4); nasal length, 7.2 (6.9-7.7);

common. Average litter size is 3 to 4, with a range from one to six. Gestation is three to four weeks. This species can fluctuate greatly in population numbers seasonally as well as from year to year. A more thorough description of its natural history, including complete reference list, can be found in Best and Skupski (1994).

The baculum has a large bulbous basal end, is wider than high; the shaft curves up in the middle and again at the distal end. Measurements of six specimens are: length 6.8 (6.3-7.2); height of base 1.1 (1.0-1.2) (Burt, 1960).

There are 14 recognized subspecies of Silky pocket mice (Best and Skupski, 1994; Hall, 1981; Williams *et al.*, 1993), two of which occur in the state of Sonora.

### *Perognathus flavus sonoriensis* Nelson and Goldman

1934. *Perognathus flavus sonoriensis* Nelson and Goldman, Jour. Washington Acad. Sci., 24:267.

Type locality. From Costa Rica Ranch, lower Rio Sonora, Sonora, Mexico.

Range. Known from along the coast of Sonora from Las Alesnas, southwest of Caborca south as far as near Empalme.

Recorded localities. SONORA: Costa Rica Ranch (Nelson and Goldman, 1934). 3 mi S Maytorena (Cockrum and Bradshaw, 1963). 10 mi N Empalme (Bradshaw and Hayward, 1960).

Description. Following Nelson and Goldman (1934), this race is closely allied to *Perognathus flavus flavus*, but upper parts less heavily overlaid with black, owing to shortening of dark tips of hairs; ears less blackish; black facial markings obsolescent; hind foot apparently shorter; cranial details distinctive. The color of the type includes a near pinkish buff upper parts finely mixed or overlaid with black, the dark hairs most numerous on top of head and over back: lateral line rich pinkish buff, broad and distinct from cheeks to thighs, with a narrow downward extension reaching to near forearm; under parts and limbs white; muzzle white; dark. V-shaped, facial marking narrow and indistinct; ears lined internally with mixed grayish and brownish hairs; tail dull whitish, nearly unicolor. The skull is very similar to that of typical *flavus*, but rostrum and nasals shorter, zygomata more widely spreading anteriorly, and molariform teeth smaller.

Measurements. hind foot length, 15; occipitonasal length, 19.3; interorbital breadth, 4.2; length of maxillary tooththrow, 2.8; width across mastoid bullae, 11.7; length of interparietal, 3.0; width of interparietals, 3.2; length of nasals, 6.5; width of nasals, 2.0; zygomatic breadth (posteriorly), 10.3.

Remarks. No other published information is available.

### *Perognathus longimembris* (Coues)

1875. *O[tognosis]. longimembris* Coues, Proc. Acad. Nat. Sci. Philadelphia, 27:305

Type localities. From Fort Tejon, Tehachapi Mountains, Kern Co., California.

Range. Distributed throughout the Great Basin, Mojave, and western sections of the Sonoran Desert, southward from southeastern Oregon, extreme southwestern Idaho, and western Utah through Nevada, eastern California, and western Arizona, and extending into northern Baja California and around the northern margins of the Gulf of California in Sonora. An apparently disjunct population occurs in the vicinity of Bahia Kino on the central Sonoran coast (see Hall, 1981; Hoffmeister, 1986; Williams *et al.*, 1993).

**Description.** This is a small-bodied species with a relatively long, slightly penicillate tail, with medium-sized interparietals, and a narrow upper premolar. The ratio of the length of tail to head and body nearly always exceeds 1.03, ranging to about 1.40; the hind foot is relatively short, ranging from 15 to 20 mm; the mean occipitonasal length is always less than 22.0 mm, with only rare individuals exceeding this length; and the width of the upper premolar varies from about 0.75 to 0.95 mm (see Hoffmeister, 1986; Williams *et al.*, 1993).

**Remarks.** Features that distinguish this species from its close relative, *P. amplus*, are given in the account of that species; see also details given in Hoffmeister (1986). Little pocket mice are potentially sympatric with the Silky pocket mouse on the central Sonoran coast in the general area of Bahia Kino. These two are readily distinguished by differences in body size (*longimembris* is larger), degree of mastoid bullar inflation (*longimembris* less inflated), and absolute and relative tail length (*longimembris* longer).

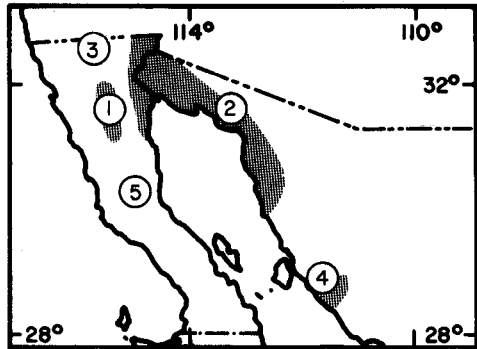
Little pocket mice live on and in sandy or gravelly soils, often in terrain that is rolling or broken by ravines and rocks. They range in general habitat from Great Basin, Mojave, and Sonoran desert scrub communities.

The species can be very common locally, with densities estimated at more than one hundred per hectare in Nevada (Hall, 1946). However, individuals are only seasonally active, being absent above ground, and presumably hibernating, during the winter (O'Farrell, 1974; Bartholomew and Cade, 1957). Reproduction occurs during the spring and early summer; the mean litter size has been reported as 4.6, with a range of 2 to 6 (Hoffmeister, 1986). As with other pocket mice, these feed primarily on seeds.

The baculum has a the bulbous proximal end varies from being wider than high to higher than wide. The bone in this species is the smallest of those represented in northwestern Mexico. Measurements from 13 specimens are: length 5.2 (4.1-6.6); height of base 0.5 (0.4-0.8) (Burt, 1960).

Sixteen subspecies are recognized (Hall, 1981; Williams *et al.*, 1993), six of which occur in the states of Baja California and Sonora. A seventh subspecies, *P. l. pacificus* (Mearns, E. A. 1898. Bull. Amer. Mus. Nat. Hist., 10:299, with type locality on the shore of the Pacific Ocean at International Boundary marker 258, San Diego Co., California), undoubtedly extends into Baja California on the coastal strand in the vicinity of Tijuana.

Specimens from the north of the Transverse ranges in west-central California, assigned to this species (Hall, 1981), are *P. inornatus*. The northern distributional limits of *P. longimembris longimembris* are not known. The type locality is in a position where either or both *P. longimembris* and *P. inornatus neglectus* may occur, but no pocket mice have been taken from there in this century. The holotype may not have come from Ft. Tejon, but rather from somewhere



Localization of *Perognathus longimembris*:

- |                                 |                            |
|---------------------------------|----------------------------|
| 1. <i>P. l. aestivus</i>        | 2. <i>P. l. bombycinus</i> |
| 3. <i>P. l. internationalis</i> | 4. <i>P. l. kinoensis</i>  |
|                                 | 5. <i>P. l. venustus</i>   |



in the surrounding country, perhaps the Mojave Desert side of the Transverse ranges (Osgood, 1918).

### *Perognathus longimembris aestivus* Huey

1928. *Perognathus longimembris aestivus* Huey, Trans. San Diego Soc. Nat. Hist., 5:87.

Type locality. From Sangre de Cristo, Valle San Rafael on western base of Sierra Juarez, 31° 52' LN, 116° 06' LW, Baja California, Mexico.

Range. Known from the western base of the Sierra Juarez, from near the type locality at Sangre de Cristo, Valle San Rafael, south to El Valle de la Trinidad (Huey, 1964).

Recorded localities. **BAJA CALIFORNIA:** Sangre de Cristo, Valle San Rafael on western base of Sierra Juarez; Valle de la Trinidad, (Huey, 1928). Sangre de Cristo (Huey, 1930; Villa, 1941).

Description. Compared with *C. l. panamintinus*, this form is slightly brighter in color with fewer black-tipped hairs dorsally. The pearl grey of the base of the pelage extends well down the back toward the rump. This character is variable, however, and, in some cases, covers the entire back. The most prominent characters of this form are cranial, contrasting sharply with the corresponding characters of other members of the *longimembris* group. The mastoid bullae are large and inflated, giving a much greater width to the skull posteriorly and compressing the interparietal into an almost equal-sided pentagon. The auditory bullae are also larger and give the skull a deeper appearance (Huey, 1928).

Measurements. Huey (1939a) listed measurements for five males and three females: total length, 142.3 (130-148); length of tail, 77.4 (68-83); hind foot length, 19.1 (17-20); greatest length of skull, 22.7 (22.0-23.2); interorbital breadth, 5.2 (4.8-5.7); width across mastoid bullae, 13.1 (12.8-13.5); length of nasals, 8.1 (8.0-8.5).

Remarks. Like other populations of *P. longimembris* from the southwestern part of its range, the mastoid bullae are greatly inflated; whether *aestivus* is distinct from adjacent subspecies is equivocal, however (Williams *et al.*, 1993).

### *Perognathus longimembris bombycinus* Osgood

1907. *Perognathus longimembris bombycinus* Osgood, Proc. Biol. Soc. Washington, 20:19

Type locality. From Yuma, Yuma Co., Arizona.

Range. This race is distributed along the lower Colorado River Valley in southeastern California and southwestern Arizona south around the northern end of the Gulf of California in northwestern Sonora (south to Puerto Libertad and inland to Bamora and near Caborca) and northeastern Baja California (from near Mexicali south to San Felipe).

Recorded localities. **BAJA CALIFORNIA:** San Felipe (Huey, 1939b). **SONORA:** Pinacate Lava flows (Patton, 1967). Colonia Lerdo (Hall, 1981).

Description. This is a small-sized race of *P. longimembris*; hind feet are short; skull is short, narrow, flattened; toothrow is short; interparietal is only slightly wider than long; interorbital breadth is usually less than 5.0 mm; depth of skull is usually 7.8 mm or less.

Measurements. Hoffmeister (1986) records means and ranges from 13 specimens from southwestern Arizona as: body length, 59.0 (53.5-65.0), hind foot length, 18.2 (17-19); occipitonasal length, 20.3 (19.0-21.2); fronto-nasal length, 13.7 (12.8-14.3); nasal length, 7.5

(6.9-8.0); interorbital breadth, 4.7 (4.4-4.9); mastoid breadth, 12.0 (11.5-12.6); zygomatic breadth, 9.9 (9.2-10.4); length of mastoid bulla, 8.5 (8.1-8.9); maxillary toothrow length, 2.9 (2.7-3.0); width of interparietal, 2.7 (2.4-3.5); length of interparietal, 2.5 (2.3-2.7); breadth across stylomastoid foramen, 10.7 (10.1-11.3).

Remarks. Hoffmeister (1986) suggests that *P. l. kinoensis* Huey (1935) is indistinguishable from *bombycinus*.

### *Perognathus longimembris internationalis* Huey

1939. *Perognathus longimembris internationalis* Huey, Trans. San Diego Soc. Nat. Hist., 9:47.

Type locality. From the Baja California side of the International Boundary at Jacumba, San Diego Co., California.

Range. Known from the San Felipe and La Puerta valleys in San Diego Co., California, to adjacent northern Baja California at the type locality in the Jacumba Valley.

Recorded localities. **BAJA CALIFORNIA:** Baja California side of the International Boundary at Jacumba, San Diego Co., California (Huey, 1939b).

Description. Following Huey (1939b), individual specimens of *P. l. internationalis* resemble, in general color, specimens of *C. l. brevinasus* and *C. l. longimembris*, whose ranges are to the north, and *C. l. aestivus*. Taken in series, however, *internationalis* has a brighter tone, with the buff coloration of the under pelage a clearer, warmer color tone. The skull of *internationalis* has longer, broader nasals, and is broader posteriorly, especially across the tympanic bullae, than that of either *brevinasus* or *longimembris*. In comparison with *aestivus*, *internationalis* lacks the extremely broadened tympanic bullae, being intermediate in this respect between the rather narrow-skulled *brevinasus* and *longimembris* and the extremely broadened *aestivus*. It differs from *aestivus* more notably in having much less inflated auditory bullae and a more rounded brain case.

Measurements. Huey (1939b) gave measurements for five adults of each sex: total length, 141; length of tail, 78; hind foot length, 19; ear length (crown), 5; greatest length of skull, 21.9; interorbital breadth, 5.2; length of maxillary toothrow, 3.1; width across mastoid bullae, 12.6; length of nasals, 7.5.

Remarks. This subspecies seems to represent a form structurally intermediate between the coastal basin subspecies, *brevinasus* and *pacificus*, and the inland desert forms, *bangsi* and *aestivus*, a situation to be expected on the basis of its intermediate geographic position. Subspecies recognition is equivocal (Williams *et al.*, 1993).

### *Perognathus longimembris kinoensis* Huey, 1935

1935. *Perognathus longimembris kinoensis* Huey, Trans. San Diego Soc. Nat. Hist., 8:73.

Type locality. From Bahia Kino (northern end of the sand dune peninsula that borders the bay and forms the northern arm of the estuary), Sonora, Mexico.

Range. Known from the type locality at Bahia Kino eastward up the valley of the Rio Sonora to west of Hermosillo and south along the coast to Estero Tastioto.

Recorded localities. **SONORA:** Bahia Kino (northern end of the sand dune peninsula that borders the bay and forms the northern arm of the estuary) (Huey, 1935).

Description. Following (Huey, 1935), this race is darker than *P. l. bombycinus* its nearest relative. The most prominent characters of this form are cranial, and compared with *bombycinus*, the skull of *kinoensis* is more rounded and narrower across the bullae. The interparietal is almost square in shape, and the nasals are longer and more attenuated.

Measurements. Total length, 135; length of tail, 80; hind foot length, 17; ear length (crown), 4; greatest length of skull, 20.7; interorbital breadth, 4.6; length of maxillary toothrow, 2.6; width across mastoid bullae, 11.4; length of nasals, 7.2.

Remarks. Like other *Perognathus* living in relatively humid environments, the bullae are less inflated and the posterior cranial region less constricted than populations from arid environments. This subspecies appears to be little differentiated from *bombycinus* from farther north, and is thus likely a junior synonym (see Hoffmeister, 1986).

### *Perognathus longimembris venustus* Huey

1930. *Perognathus longimembris venustus* Huey, Trans. San Diego Soc. Nat. Hist., 6:233.

Type locality. From San Agustin, 30° LN, 115° LW, Baja California, Mexico.

Range. Known only from the type locality at San Agustin, Baja California.

Recorded localities. *BAJA CALIFORNIA*: San Agustin (Huey, 1930).

Description. Compared with *P. l. aestivus*, this race is much darker in color and has a decidedly bicolored tail, the black tail-stripe running the full caudal length, terminating with a black tip. The pinna is also covered with black hairs. Cranially, *P. l. venustus* has a longer tooth row, and the frontals are slightly higher and rounder. This latter character does not seem to bear relation to age. The mastoid bullae are more rounded and do not extend as far posteriorly, while the auditory bullae are more attenuated and not as heavily inflated basally (Huey, 1930).

Measurements. Huey (1939a) gave measurements for three specimens: total length, 135.3 (130-140); length of tail, 76.3 (75-78); hind foot length, 19; greatest length of skull, 21.9 (21.7-22.4); interorbital breadth, 5.1 (5.0-5.4); width across mastoid bullae, 12.5 (12.4-12.7); length of nasals, 7.7 (7.2-8.0).

Remarks. There are few, if any, significant differences in the measurements listed by Huey (1939a) for *venustus* and *aestivus*, leaving only the "much darker color" of the former as apparently diagnostic, a situation that may not warrant taxonomic separation (see Williams *et al.*, 1993).

## Subfamily Dipodomysinae Coues

Two Recent genera are usually placed within this subfamily, the kangaroo rats (*Dipodomys*) and kangaroo mice (*Microdipodops*). Only the kangaroo rats extend into northwestern Mexico, as the kangaroo mice are limited in their distribution to the Great Basin Desert of the western United States. The body size ranges from small to large, with weights from 10 to about 170 g. The body form is ricochetal, with elongated hind limbs and shortened, slender forelimbs; the tail exceeds the head and body length; and the soles of the hind feet are covered with dense hair; the body hair is long, smooth, soft to the touch. The upper incisors are deeply grooved, the molars hypsodont and ever-growing, or nearly so in *Dipodomys*. The auditory bullae are enormously inflated, with the mastoid portion expanded dorsally and extending posteriorly well beyond the occipital plane; the interior is hollow, without a spongy network of trabeculae, as in other genera in the family.

## *Dipodomys*

1841. *Dipodomys* Gray, Ann. Mag. Nat. Hist., ser. 1, 7:521, August.

Type Species. *Dipodomys phillipsii* Gray, 1841, Ann. Mag. Nat. Hist., ser. 1, 7:521, August.

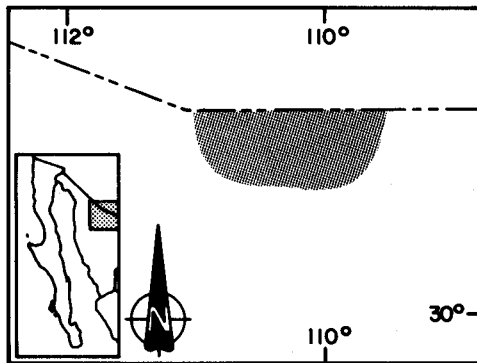
Diagnosis. General form ricochetel, with elongated hind limbs, short forelimbs, short neck with compressed and partially fused cervical vertebrae, and with tail usually longer than head and body, crested and penicillate. First digit of hindfoot vestigial or absent externally; underparts, foreleg, forefoot, dorsal surface of hind foot, upper lip, spot above eye, and spot behind ear white; white stripe across flank, extending to base of tail; base of tail white all around; white stripes extend along sides of tail from base to near tip; dorsal side of tail dark, and ventral side usually so; upper parts some shade of buff or brown; large sebaceous gland on back between shoulders; cheek teeth hypsodont, with molars evergrowing, or nearly so; auditory bullae huge, with mastoid portion expanded dorsally to restrict size of interparietal and extending posteriorly well beyond the occipital plane; baculum moderate in length and with strongly upturned tip and swollen base (see Hafner and Hafner, 1983; Wahler, 1985; Williams et al., 1993; and Wood, 1935).

### *Dipodomys ordii ordii* Woodhouse

1853. *Dipodomys*. *ordii* Woodhouse, Proc. Acad. Nat. Sci. Philadelphia, 6:224.

Type locality. Neotype. El Paso, El Paso Co., Texas (designated by Merriam, 1890:45, as the "Duplicate type").

Range. From southeastern Washington southward through the Great Basin, and from southwestern Saskatchewan and southeastern Alberta southward through the western Great Plains to western Texas through Hidalgo (Baumgardner and Schmidly, 1981; Hall, 1981; Setzer, 1949). *D. o. ordii* of southeastern Arizona, southern New Mexico, northern Chihuahua, and northeastern Sonora (Hall, 1981).



Geographic range of *Dipodomys ordii ordii*.

Recorded localities. *SONORA*: Santa Cruz; Alamo Wash, 35 mi NW Magdalena (Baird, 1857). Fronteras (Allen, 1895). Alamo Wash; 35 mi NW Magdalena (Burt, 1938). Nogales; Santa Cruz; 5 mi Cananea; Alamo Wash; 35 mi NW Magdalena (Setzer, 1949).

Description. A small to medium-sized kangaroo rat; five toes on the hind feet; relatively short tail and ears; maxillary arch relatively slender; rostrum comparatively short. The ratio of lengths of tail to head and body normally averages between about 1.16 and 1.26 and the width of the skull across the bullae ranges between about 22.3 and 26.3 (Grinnell, 1922; Setzer, 1949).

Measurements. The means and range for 14 specimens from Chihuahua (Anderson, 1972) are: Total length, 237.8 (221-252); length of tail, 129.9 (110-141); hind foot length, 37.4 (36-39); ear length, 13.5 (12-15); greatest length of skull, 37.9 (36.3-38.9); basilar length of skull, 23.4 (23.0-24.5); great breadth across bullae, 24.1 (23.8-24.8); breadth across maxillary processes, 20.5 (19.3-20.9); breadth of rostrum, 3.7 (3.4-4.1); length of nasal, 13.8 (13.0-15.5); interorbital breadth, 13.1 (12.5-13.9).

Remarks. In New Mexico and Texas, *D. ordii* is found in *Yucca*, *Prosopis*, *Artemisia*, *Quercus havardi*, and *Gutieriza sarothrae* (Dice, 1930; Garner, 1974; Best and Hoditschek, 1986). Gestation is 28 to 32 days (Day *et al.*, 1956; Duke, 1944). Number of embryos ranges from 1 to 6 with a mean of 3.5 (Hall, 1946). There may be two litters each year (Alcorn, 1941). The baculum is similar in every respect to that of *herrmanni* (Burt, 1960). *Dipodomys ordii* has a diploid number of 72 chromosomes with all autosomes biarmed, of which 4 pairs are metacentric, 26 pairs are submetacentric, and 5 pairs are subtelocentric. The X chromosome is submetacentric and the Y chromosome is acrocentric to subtelocentric (Stock, 1974; Patton and Rogers, 1993a).

### *Dipodomys gravipes* Huey

1925. *Dipodomys gravipes* Huey, Proc. Biol. Soc. Washington, 38:83.

Type locality. 2 mi W Santo Domingo Mission, Baja California, Mexico, 30° 45' LN, 115° 58' LW

Range. *Dipodomys gravipes* is known from the San Quintin Valley in Baja California, from near San Telmo south of El Rosario.

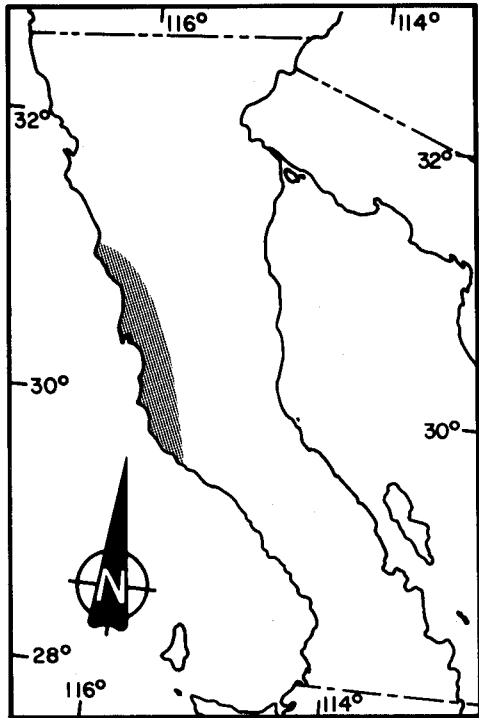
Recorded localities. **BAJA CALIFORNIA:** 2 mi W Santo Domingo Mission (Huey, 1925). 3 mi S San Telmo; 2 mi W Santo Domingo Mission; mouth of Agua Chiquitin Canyon; Santa Maria near San Quintin; 1 mi S San Ramon (Huey, 1957).

Description. The San Quintin kangaroo rat has five toes on the hind feet, is medium large in size with a small ear pinna, and has a thick tail of medium length; the skull is relatively wide; width across the maxillary arches averaging more than 54.8% of the greatest length of skull; maxillary root of the zygomatic arch has a sharp posteroexternal angle (Williams *et al.*, 1993).

Measurements. The mean and range of 56 males (Best, 1993b) are: total length, 306.8; length of tail, 176.1; hind foot length, 44.8; ear length, 13.3; greatest length of skull, 41.6; interorbital width, 10.9; length of nasals, 4.0; breadth across maxillary arches, 6.1; greatest

width, 26.0. The mean and range of 54 females (Best, 1993) are: total length, 300.0; length of tail, 173.2; length of hind foot, 44.1; length of ear, 13.5; greatest length of skull, 40.6; interorbital width, 10.8; length of nasals, 3.9; breadth across maxillary arches, 6.1; greatest width, 25.7.

Remarks. *Dipodomys gravipes* is larger than *D. merriami* and *D. simulans*. It can be distinguished from the former by having five toes on the hind feet; in comparison to *D. simulans*, *D. gravipes* has shorter ears, longer hind feet, larger body size, and a tail that is thicker, paler, and less sharply



Geographic range of *Dipodomys gravipes*.

bicolored (Best and Lackey, 1985); the head is wider, which is apparent externally as well as being reflected in measures of cranial width.

Best and Lackey (1985) reviewed the relationships of *D. gravipes* to other species of *Dipodomys*. Alvarez-Castañeda *et al.* (1995) consider it a key species in the province San Diegina in their study of zoogeography of Northwestern Mexico. This species is considered as endangered by the Mexican Government (NOM-059-ECOL-1994).

### *Dipodomys simulans simulans* (Merriam)

1904. *Perodipus streaton simulans* Merriam, Proc. Biol. Soc. Washington, 17:144.

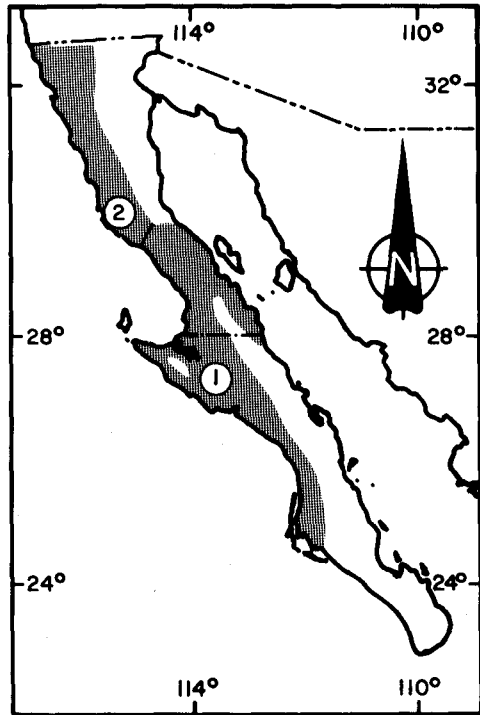
1993. *Dipodomys simulans simulans*, Williams, Genoways and Braun, Biol. of Heteromyidae. Amer. Soc. Mamm., Spc. Publ., 10:86

Type locality. Dulzura, San Diego Co., California.

Range. The species is found from the Los Angeles Basin and San Jacinto mountains of southern California, southward in Baja California to the vicinity of Bahia Almejas, Baja California Sur. *Dipodomys simulans simulans* ranges from southern California southward Baja California near Santa Catarina, including the slopes of the Sierra Juarez and Sierra San Pedro Martir.

Recorded localities. **BAJA CALIFORNIA:** 2 mi W Mision Santo Domingo; Las Cabras; San Jose (Huey, 1925). El Rayo; Sierra Juarez; Valle de la Trinidad; El Rosario (Villa, 1941). Just south of the International boundary near Jacumba, California; 3 mi NW Neji; Tres Picos Mine, Near Juarez; Rosarito Beach; N side Descanso Bay; Ensenada; 14 mi S Ensenada; Santo Thomas; Laguna Hanson; 1 mi E Laguna Hanson; El Rayo, Sierra Juarez; Sangre de Cristo; El Valle de la Trinidad, extreme western end; El Valle de la Trinidad. Aguaito Spring; Summit of San Mat'as Pass, Diablito spring; La Grulla, Sierra San Pedro Martir; 8 mi N Santa Catalina (Rancho La Ramona); 7 mi N Santa Catalina; 4 mi N Santa Catalina landing; (Huey, 1951). Ensenada; Valladares; Rosarito; Rosarito Divide (Hall and Kelson, 1952). 14 mi N Laguna Hanson; Valle de la Trinidad; Sierra Juarez; El Rosario (Alvarez, 1960).

Description. A medium-sized kangaroo rat with five toes on the hind feet, moderately long ear pinnae, relatively narrow breadth across the maxillary arches, and 60 chromosomes. Length of head and body averages about 115 mm and length of hind foot averages less than 42 mm; greatest length of skull averages less than 39.5 mm and maxillary breadth averages less than 21.0 mm.



Geographic range of *Dipodomys simulans*:

Measurements. Of the holotype following Williams *et al.* (1993) are: total length, 280; length of tail, 165; hind foot length, 40; greatest length of skull, 38.00; width across bullae, 24.40; breadth across maxillary arches, 20.15; nasal length, 13.30; interorbital breadth, 12.65.

Remarks. *Dipodomys simulans* may be distinguished from *D. gravipes* by the narrower breadth across the maxillary arches, smaller hind feet, and larger ears (Williams *et al.*, 1993).

Huey (1951) treated *D. peninsularis* as a species, and Best (1978) listed it as a subspecies of *D. agilis*. Huey (1962) considered *D. antiquarius*, from Sierra Borja, Baja California, to be closest to *D. stephensi*, but Lackey (1967) could find no significant differences between samples of *D. antiquarius* and *D. peninsularis*. Stock (1974) postulated *D. antiquarius* was a subspecies of *D. agilis* (now *simulans*).

Grinnell (1922) and Huey (1951) noted only slight and inconsistent differences in specimens of *D. a. agilis* and *D. simulans*. Best (1978) considered that *D. paralius* was indistinguishable from *D. a. plectilis*. Morphometric analyses (Best, 1981a, 1983) did not show little differentiation among *D. a. martirensis*, *D. a. plectilis*, and *D. simulans*, so all the subspecies of *D. agilis* and *D. paralius* are under *D. simulans simulans* (see Williams *et al.*, 1993; Sullivan and Best, 1997).

*Dipodomys simulans* has the densest population of any form of *Dipodomys* in northern Baja California. No specimen yet examined lacks the fifth toe or hallux, which is occasionally revealed in some Californian species of *Dipodomys* (Huey, 1951).

The baculum is slightly smaller than others with the large, bulbous basal ends. Measurements of eight specimens are: length, 9.7 (9.0-10.3); height of base 1.6 (1.3-1.9); width of base, 1.3 (1.1-1.4) (Burt, 1960).

### *Dipodomys simulans peninsularis* (Merriam)

1907. *Perodipus simulans peninsularis* Merriam, Proc. Biol. Soc. Washington, 20:79.

Type locality. Santo Domingo [Landing], 28° 51' LN, 114° LW, Baja California.

Range. Occurs in the central and southern portions of the Baja California Peninsula, from the vicinity of San Fernando Mission, Baja California southward to the vicinity of Magdalena and Almejas bays, near 24° 30' LN.

Recorded localities. **BAJA CALIFORNIA:** La Lomita Maria; Mesquiteal; 11 mi S Punta Prieta (Huey, 1957). **BAJA CALIFORNIA SUR:** Santo Domingo [Landing] (Merriam, 1907). Calmalli (Villa, 1941). Santo Domingo Landing; 5 mi W El Ca-on; Calmalli; 4 mi E El Arco; 5 mi E El Arco; 12 mi E El Arco, Rancho Mira Flores; Santa Gertrudis Mission; Rancho Union, 15 mi E Calmalli; 1 mi E Rancho Lagunitas; Pozo Altimirano; Campo Los Angeles; San Ignacio; 18 mi E San Ignacio; 10 mi W Santa Rosalia, Valle del Yaqui; Santa Teresa Bay, Gulf of California; 7 mi W San Francisquito Bay; San Jorge; Santo Domingo 25° 30' LN; 7 mi N el refugio; 9 mi S El refugio; Matancito [Matancitas] (Huey, 1957). Calmalli (Alvarez, 1960).

Description. Similar in general to *simulans* but considerably larger, tail crest more strongly developed, and pelage more silky (Merriam, 1907). Ground color paler buff only lightly lined with dark hairs; nose patch small and not connected with whisker-masks. Skull like that of *simulans* but maxillary arch slightly narrower, with angle less pronounced; mastoids slightly larger and deeper; interparietal area narrower.

Measurements. The mean and range of three male topotypes (Huey, 1951) are: total length, 291 (285-302); length of tail, 196.3 (170-189); hind foot length, 42.0 (42-42); greatest length of skull, 40.3 (39.7-41.0); width across bullae, 25.3 (24.8-26.1); breadth across maxillary arches, 20.6

(20.1-20.9); nasal length, 13.9 (13.7-14.1); width of maxillary arch at middle, 4.7 (4.6-4.9). The mean and range of three females topotypes (Huey, 1951) are: total length, 281.0 (274-287); length of tail, 167.3 (162-173); length of hind foot, 41.3 (40-42); greatest length of skull, 39.6 (39.3-39.9); width across bullae, 25.5 (25.3-25.7); breadth across maxillary arches, 21.5 (21.1-21.8); nasal length, 13.8 (13.8-14.0); width of maxillary arch at middle, 4.9 (4.5-5.3).

Remarks. Best (1978) regarded *D. antiquaris* as indistinguishable from *D. p. pedionomus*, and *D. peninsularis* was not specifically distinct from *D. simulans*, and considered *pedionomus*, *eremoecus*, and *australis* as subspecies of *D. simulans*. Subsequently, Best (1983) showed a close similarity between *Dipodomys p. peninsularis*, and *D. p. australis*, whose geographic ranges are contiguous. Williams *et al.* (1993) include these three subspecies of *D. peninsularis* and *D. anticuaris* as junior synonyms of *D. simulans peninsularis*, while Sullivan and Best (1997) list all these as synonym of *D. s. simulans*.

### *Dipodomys spectabilis* Merriam

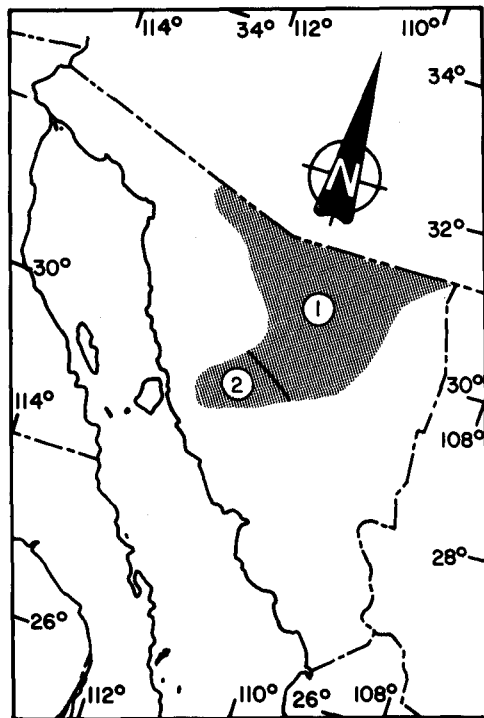
1890. *Dipodomys spectabilis* Merriam, N. Amer. Fauna, 4:46.

Type locality. Dos Cabezas, Cochise Country, Arizona.

Range. This species occurs south-central Arizona and northern Sonora, eastward to Trans-Pecos Texas, extending north in Arizona to the Four Corners Region and south through New Mexico to northeastern Durango. A disjunct population occurs south of the range of *D. nelsoni* in east-central Zacatecas, northeastern Aguascalientes, and western San Luis Potosi (Williams *et al.*, 1993).

Description. One of the largest species of kangaroo rats, with four toes on the hind feet and with a tail terminating in a large, white tuft of hairs (tuft exceeds 25 mm in length, typically about 40 mm) bordered proximally by a band of black hairs; lateral white stripes of tail present only on about the proximal half; underside of tail, proximal to white tuft, dark colored; head and body length averaging from about 128 to 150 mm; the auditory bullae relatively large and inflated; skull relatively wide across the maxillary arches (breadth averaging from about 25.0 to 26.3) (Williams *et al.*, 1993).

Remarks. *Dipodomys spectabilis* is most similar in size and appearance to *D. nelsoni*; see the account of the latter species for diagnostic characters. It is also similar in size to the four-toed species, *D. deserti*, from which *D. spectabilis*



Geographic range of *Dipodomys spectabilis*:  
1. *D. s. perblandus* 2. *D. s. intermedius*



can be distinguished by the prominent black border to the white tail tuft, the dark underside to its tail, generally smaller hind feet (usually averaging from 47 to 52 in *spectabilis* and from 52 to 53.5 in *deserti*), and a less inflated skull with a wider interorbital region and wider breadth across the maxillary arches (Nader, 1978; Williams *et al.*, 1993).

*Dipodomys spectabilis* are conspicuously sexually dimorphic, with males significantly larger in several characteristics (Best, 1988, 1993).

The baculum of *Dipodomys spectabilis* is the largest in the genus (Best and Schnell, 1974). The bulbous basal end is sculptured in old animals, and is higher than wide. From the basal end, the shaft tapers gradually to the pointed tip, upturned at approximately a right angle to the nearly straight shaft (Burt, 1960). Bacula average 16.7 long, 2.3 wide at the base, and 2.6 high at the base (Best and Schnell, 1974).

The different subspecies of *Dipodomys spectabilis* have  $2n = 72$  chromosomes, but differ in both autosomal and sex chromosomes morphology (Stock, 1974). *D. s. spectabilis* has 35 acrocentric chromosomes and a fundamental number of 70.

### *Dipodomys spectabilis intermedius* Nader

1965. *Dipodomys spectabilis intermedius* Nader, Proc. Biol. Soc. Washington, 78:50.

Type locality. 16.7 mi SW Bamori, about 1,900 ft, Sonora, Mexico.

Range. West central Sonora, Mexico, from Querobabi on the north, southward to Carbo and westward to about 17 mi southwest of Bamori (Nader, 1978).

Recorded localities. SONORA: 16.7 mi SW Bamori, 1900 ft; 5 mi W Querobabi; 45 mi N Hermosillo, 2100 ft (Nader, 1965).

Description. Following Nader (1965), this is a small subspecies of *Dipodomys spectabilis* averaging in total length 318.5 to 325.0; tail length, 184.9 to 188.8; ear length about 16.6; distal white tip of the tail short, averaging 20.0 to 21.0; light in weight, averaging 98.9 to 106.1 grams. Upper parts are light ochraceous-buff mixed with pinkish buff; sides with more evident pinkish buff; arietiform markings dusky; plantar stripes light brown; dorsal and ventral tail stripes darkish; subterminal band at end of tail blackish; tuft of hairs at base of tail ventrally grayish.

The skull is of small size; greatest length averaging 43.0 to 43.2; basal length averaging 31.0; breadth across maxillary arches small; posterolateral edge of maxillary arches slightly flared; rostrum narrow; auditory bullae small; greatest breadth across bullae averaging 27.0 to 27.7; supraoccipital and interparietal narrow; least width of supraoccipital averaging 1.7 to 2.0; narrow across exoccipitals; external openings of auditory meatuses oval; incisor usually small; mandible small, mandibular length averaging 17.9 to 18.0. Also see measurements.

Measurements. Mean and extremes of seven specimens from the type locality (Nader, 1965) are: Total length, 325.0 (314.0-330.0); tail length, 184.9 (174.0-195.0); length of white tip of tail, 20.0 (13.0-25.0); hind foot length, 47.6 (46.0-49.0); body length, 137.3 (130.0-146.0); greatest length of skull, 43.05 (42.1-44.2); basal length, 31.04 (30.5-31.8); length of nasals, 15.7 (15.2-16.8); greatest breadth across bullae, 27.7 (27.2-28.7); rostral width, 4.3 (4.1-4.4); bullar depth, 14.4 (14.2-15.2); alveolar length of maxillary tooth row, 5.9 (5.3-6.3); least width of supraoccipital, 1.75 (1.4-2.2); breadth across exoccipitals, 13.14 (12.7-13.4); mandibular length, 17.9 (17.3-18.5); weight (grams), 98.8 (94.9-105.7).

Remarks. *Dipodomys spectabilis intermedius* is a small, pinkish buff subspecies, with a short white tip on the tail. It is closely related to *D. s. perblandus*. Because the former subspecies is

intermediate morphologically between *D. s. perblandus* and *D. nelsoni*, the name *intermedius* seems appropriate. *D. s. intermedius* does not represent the terminus of clinal variation within the range of measurements of *D. s. perblandus*. *D. s. intermedius* is more pinkish; slightly smaller in many body and skull measurements of *D. s. perblandus* (Nader, 1965).

*Dipodomys spectabilis intermedius* intergrades with *D. s. perblandus* in central Sonora. One adult from 5 mi W Querobabi which is referred herein to *D. s. intermedius*, has a wide interparietal, wide supraoccipital, and small round openings of the external auditory meatuses, similar to those of *D. s. perblandus*.

Variations within *D. s. intermedius* include the following: one of five adults from 45 mi N Hermosillo has the breadth across the maxillary arches and the greatest breadth across the bullae slightly larger than the typical. In two of seven adults from 16.7 mi SW Bamori, the least width of the supraoccipital approaches that of *D. s. perblandus* (Huey, 1957).

Specimens from 45 mi N Hermosillo were found associated with grass and palo fierro or ironwood (*Olneya tesota*) and those from 16.7 mi SW Bamori were found associated with grass, creosote (*Larrea* sp.), and palo verde (*Cercidium* sp.). Similar habitat to that from which specimens of *D. s. intermedius* have been taken is available in areas nearby, and future collecting will probably show that this subspecies has a wider geographic range. The limited number of specimens available from Sonora probably reflects the difficulty of access for collecting in much of this region (Huey, 1957).

### *Dipodomys spectabilis perblandus* Goldman

1933. *Dipodomys spectabilis perblandus* Goldman, Jour. Washington Acad. Sci., 23:466.

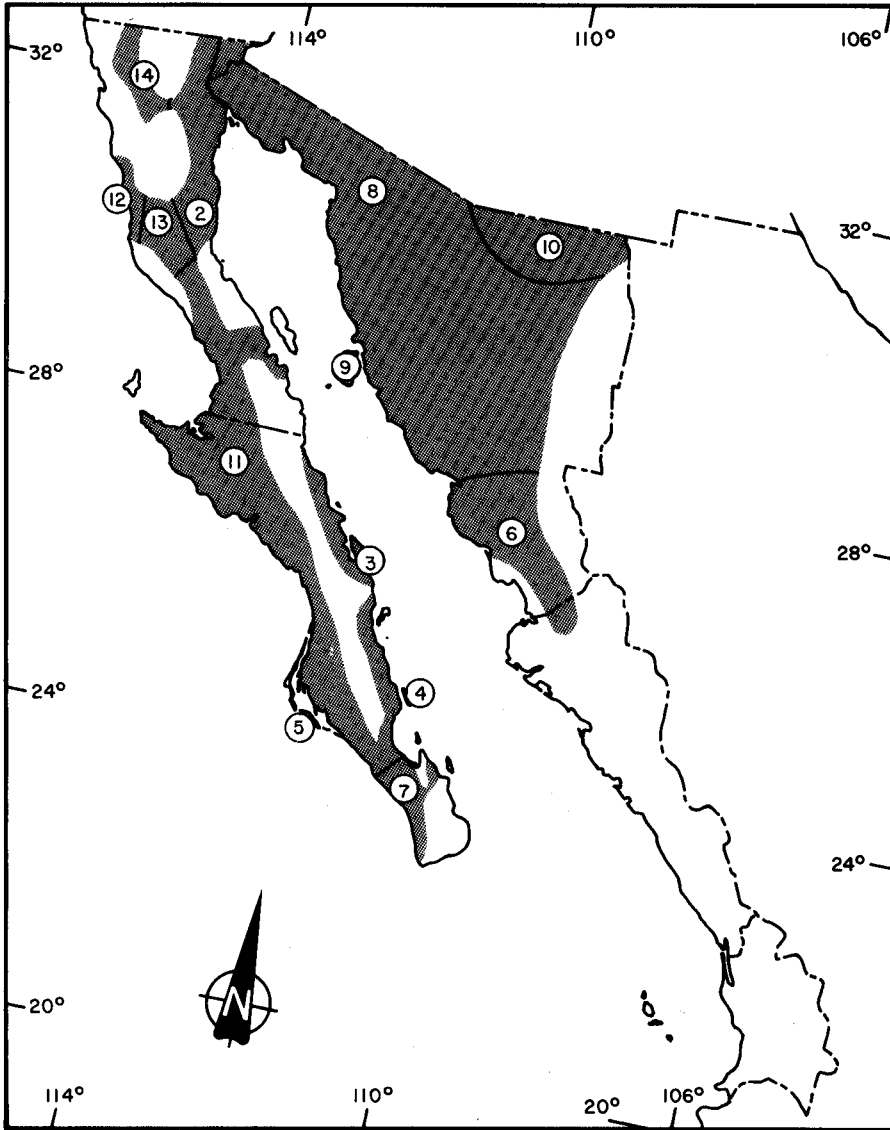
Type locality. Calabasas, about 3,500 ft, Santa Cruz Co., Arizona.

Range. Found in south central Arizona southward to north central Sonora.

Recorded localities. SONORA: Cerro Blanco (Elliot, 1907). 2 mi S Sasabe (Dice y Blossom, 1937). Noria; 2 mi S Sasabe (Burt, 1938). Magdalena (Goldman, 1933). Ebano (Villa, 1941). La Sauceda, 15 mi NNE Cananea; 9 mi N Cananea (Alvarez, 1960). Pozo de San Emeterio, 8.5 mi N Quitovac; Cerro Blanco; Magdalena; Llano; 20 mi S Santa Ana ca. 2,600 ft (Nader, 1978).

Description. Following Goldman (1933), this subspecies is closely allied to *Dipodomys spectabilis spectabilis* from southeastern Arizona, but smaller and paler, the upper parts more thinly mixed with black; black facial mask less distinct; tail less extensively tipped with white cranial characters, also distinctive. The color of the type (fresh pelage) is: upper parts in general light ochraceous buff, purest on cheeks, shoulders, sides, and outer surfaces of thighs, the top of head and back thinly mixed with black; under parts, postauricular and supraorbital spots, fore limbs, hind feet above, hip stripes, and tail at extreme base all around pure white; tail beyond base black mixed with gray above and below, becoming nearly black in a subterminal zone all around, abruptly interrupted by pure white tip 40 millimeters in length, the sides white along lines narrowing gradually and disappearing in the subterminal area mentioned; soles of hind feet brownish; ears whitish externally, except anterior fold which is dusky, thinly clothed internally with minute black hairs. The skull is similar to that of *D. s. spectabilis*, but decidedly smaller; mastoids relatively smaller; interparietal and supraoccipital usually relatively broader at constriction between mastoids; dentition lighter, the incisors and molariform teeth distinctly narrower.

Measurements. Nader (1978) Total length, 326.6 (315-335); length of tail, 193.6 (184-204); hind foot length, 48.3 (47-50); greatest length of skull, 44.6 (43.0-45.3); width across bullae, 28.1



Geographic range of *Dipodomys merriami*:

- |                            |                               |                                |                               |
|----------------------------|-------------------------------|--------------------------------|-------------------------------|
| 1. <i>D. m. annulus</i>    | 2. <i>D. m. arenivagus</i>    | 3. <i>D. m. brunensis</i>      | 4. <i>D. m. insularis</i>     |
| 5. <i>D. m. margaritae</i> | 6. <i>D. m. mayensis</i>      | 7. <i>D. m. melanurus</i>      | 8. <i>D. m. merriami</i>      |
| 9. <i>D. m. mitchelli</i>  | 10. <i>D. m. olivaceus</i>    | 11. <i>D. m. platyeephalus</i> | 12. <i>D. m. quintinensis</i> |
|                            | 13. <i>D. m. semiparalius</i> | 14. <i>D. m. trinidadensis</i> |                               |

(27.7-28.6); length of nasals, 16.1 (15.0-16.8); breadth across maxillary arches, 25.7 (25.3-25.9); interorbital breadth, 14.6 (14.0-15.3); alveolar length of maxillary toothrow, 5.9 (5.6-6.2); rostral breadth. 4.6 (4.3-4.7).

Remarks. *Dipodomys spectabilis perblandus* is a well marked subspecies, although not far removed geographically from *D. s. spectabilis*. It occupies the desert area west of the range of *D. s. spectabilis*, which is typical of the higher plateau region of southeastern Arizona (Goldman, 1933). In northern Sonora, they live in habitat dominated by *Prosopis* under which there is grass, mostly *Aristida* and *Bouteloua* (Dice and Blossom, 1937).

*D. s. perblandus* has  $2n = 72$  with 12 submetacentric chromosomes, 31 acrocentric chromosomes, and a fundamental number of 78 (Stock, 1974).

### *Dipodomys merriami merriami* Mearns

1890. *Dipodomys merriami* Mearns, Bull. Amer. Mus. Nat. Hist., 2:290.

Type locality. New River, between Phoenix and Prescott, Maricopa Co., Arizona.

Range. The species is widely distributed from northwestern Nevada southward to the Baja California Peninsula, Sonora through Aguascalientes (Hall, 1981). *D. m. merriami* occurs from northwestern Nevada, southward through the Rio Yaqui Valley in southern Sonora (Lidicker, 1960).

Recorded localities. **BAJA CALIFORNIA:** Imperial canal, 11 mi E Mexicali; Seven Wells; E side Cocopah Mtns, 21 mi SSE Mexicali, 100 ft; Domos arenosas, 15 mi W Yuma; 1 mi S U. S. Mexican boundary, 10 mi W Pilot Knob; Alamos River, 20 mi SW Pilot Knob, 50 ft; Colorado River, 20 mi S Pilot Knob; Colorado River, lat 32° 15' N (Lidicker, 1960).

**SONORA:** Ortiz; Guaymas (Merriam, 1893). Cerro Blanco (Elliot, 1907). 3 mi S Hermosillo; Costa Rica (45 mi SW Hermosillo); Ures; San Jose de Guaymas (Burt, 1938). Costa Rica (Villa, 1941). 5 mi N Guaymas; 80 mi N Hermosillo; 11 mi N Cd. Obregon (Booth, 1957). 5 mi W Alamos (Ingles, 1958). Paso MacDougal, Pinacate region; Sierra Pinacate, 40 mi W Sonoyta [Sonoita]; Papago Tanks, Pinacate Mtns; between Sonoyta and Papago tankls, Altar Province; 0.5 mi S Crater Elegante, 34 mi S Sonoyta [Sonoita], 900 ft; Batamote, Rio Sonoyta [Sonoita], 30 mi SW Sonoyta [Sonoita]; 3 mi NE Tinajas de los Papagos, Sierra del Pinacate; Tinajas de los Papagos, Sierra del Pinacate; 2 mi S Sierra Blanca, 16 mi E Punta Peñascosa; 1 mi NNE Punta Peñascosa; 1 mi NE Punta Peñascosa; Cerro La Cholla, 6 mi WNW Punta Peñascosa, 50 ft; Pozo de Cipriano, 10 mi WSW Sonoyta [Sonoita]; 0.5 mi NE Sonoyta [Sonoita]; Pozo de San Emeterio, 8.5 mi N Quitovac; 5 mi S Sasabe, on New Altar Rd, 1400 ft; 16.7 mi (by rd) n caborca, 450 ft; 2 mi E Pitiquito; 1 mi W Altar, ca 900 ft; 1.6 mi SW Alesnas, 20 mi WSW Caborca, 1900 ft; 13 mi SW Caborca; 3 mi N Puerto de Lobos, 200 ft; Cerro del Viejo, Altar Province; 16.7 mi SW Bamori, 1900 ft; 9 mi SSW Yaqui; Punta Cirio, 5 mi S Puerto Libertad, 20 ft; Llano; 20 mi S Santa Ana; 5 mi N Cornelio; Puerto Gonzalitos, 33.4 mi S Santa Ana, 2700 ft; Poza; 56 mi N Hermosillo (by highway); 45 mi N Hermosillo; 30 mi N Hermosillo (by highway); 14 mi N Hermosillo, 1100 ft; San Jose de Gracia, 20 mi NE Hermosillo, 1150 ft; 11.9 mi N Hermosillo; 1 mi N Batue, Rio Moctezumac; 10 mi SE Punta Arena, 75 mi W Hermosillo, 10 ft; Sierra Seri, 9 mi W San Javier, 70 mi W Hermosillo; Puerto Kino, 20 ft; Costa Rica Ranch, 45 mi SW Hermosillo; 11.3 mi W Hermosillo, 650 ft; Hermosillo; 3 mi S Hermosillo; 5 mi S Hermosillo, 1100 ft; 15 mi S Hermosillo; 5 mi NE Tastiota; Ortiz; 0.5 mi NW San Jose de Guaymas, 25 ft; 1 mi E San Jose de Guaymas; 50 ft; Batamotal; 7/10 mi SW Poza, 8 mi NW Guaymas; 2.5 mi WSW Guaymas, 15 ft; 2 mi W Guaymas, 25 ft; 4 mi SE Empalme; Guasimas, 15 ft; Pitahaya, 40 km SE Empalme,

100 ft; Sotello ranch, Altar province (Lidicker, 1960). 6 mi E Agua Prieta; 3 mi S Hermosillo; Rancho Costa Rica, 45 mi SW Hermosillo (Alvarez, 1960).

Description. A small-sized kangaroo rat (head and body length averages less than about 105 mm and greatest length of skull averages less than 37 mm in all populations; Lidicker, 1960) with four toes on the relatively slender hind feet, and with a tail terminating in a crest and tuft of dusky or blackish-brown hairs; mastoid bullae usually relatively more inflated and rostrum narrower than in most other species; rostrum not decidedly shortened and face not noticeably narrower than most other species.

Measurements. Following Lidicker (1960) are: body length about, 100; total length, 240-250; hind foot length, 37-38; cranial length averages about, 35.5; maxillary breadth usually, 19.0-19.5; least interorbital breadth average 12.5 to 13; greatest breadth average 22.5-23.0; nasal length 13.0-13.5; basal length usually 24 or more.

Remarks. *Dipodomys merriami* is most similar in size and appearance to the other small-sized, four-toed species, *D. nitratoides*; all other four-toed species are considerably larger and most have a prominent tuft of white hairs at the tip of the tail. *D. merriami* differs from *D. nitratoides* in generally being larger in size, and in having a longer and wider rostrum (nasal length usually averages greater than 13.1 in *D. merriami* and less than 12.3 mm in *D. nitratoides*; Hoffmann, 1975; Lidicker, 1960).

Mearns (1890) listed it as 281 mm, the difference apparently being that Mearns measured to the end of the hairs on the tail.

Hall (1981) treated *Dipodomys margaritae* as a species distinct from *D. merriami*, although Lidicker (1960) considered it to be a subspecies of *D. merriami*; we concur with Lidicker. Lidicker (1960) provided measurements for each of the subspecies of *D. merriami*.

The baculum is relative long. The moderately enlarged basal end tapers gradually into the shaft which has a slight ventral curvature rather than a dorsal one near the distal end. The tip does not curve dorsally at as acute an angle. The basal end is slightly, if any, higher than wide. Measurements of 51 specimens are: length 10.8 (9.3-11.7; height of base, 1.2 (1.0-1.7); width of base, 1.06 (0.8-1.3).

### *Dipodomys merriami annulus* Huey

1951. *Dipodomys merriami annulus* Huey, Trans. San Diego Soc. Nat. Hist., 11:224.

Type locality. El Barril, Gulf of California, 28 20' LN, 112 50' LW, Baja California, Mexico.

Range. From near Bahia Los Angeles to Bahia Santa Teresa (Huey, 1951).

Recorded localities. BAJA CALIFORNIA: El Barril; Bahia Santa Teresa; Bahia San Francisco; 7 mi W Bahia San Francisco; Los [las] Flores, cerca de Bahia [de] los Angeles (Huey, 1951). Bahia de los Angeles (Booth, 1957). Los [Las] Flores, Bahia de Los Angeles; 7 mi W San Francisquito bay; San Francisquito bay; [El] Barril; San Borja Mission; Santa Teresa Bay (Lidicker, 1960).

Description. Following Huey (1951), compared with *Dipodomys merriami platycephalus*, *D. m. annulus* is nearly equal in size, but is paler dorsally and has a darker crest on its bicolored tail. In color tone, *D. m. annulus* resembles *D. m. arenivagus* but is several shades darker. Here the resemblance ends, for *annulus* is larger and has the black tail of the Cape district races. Compared with *Dipodomys m. brunensis*, *D. m. annulus* is more pallid and has a bicolored tail. In fact, as the name implies, it is the connecting link in the two racial chains, and has dominant characteristics of both. The skull of *D. m. annulus*, compared with that of *D. m. platycephalus*, is similar in size,

but has more inflated mastoid bullae and several other minor unmeasurable characteristics, such as very sharply angled zygomatic arches and truncated auditory bullae, which sets *annulus* apart from either *platycephalus* or *brunensis*.

Measurements. The mean and range of five males (Huey, 1951) are: total length, 248.2 (244-252); length of tail, 145.6 (140-150); hind foot length, 39.4 (38-40); greatest length of skull, 36.4 (35.3-37.2); width across bullae, 23.4 (22.3-24.3); spread of maxillary arches, 20.2 (19.5-21.1); great length of nasals; 13.5 (13.0-14.0); width of maxillary arch at middle, 5.3 (5.2-6.0). The mean and range of five females (Huey, 1951) are: total length, 250.2 (250-251); length of tail, 149.8 (148-151); length of hind foot, 38.4 (37-40); greatest length of skull, 36.4 (35.9-37.0); width across bullae, 23.4 (22.9-23.9); spread of maxillary arches, 20.2 (19.0-21.0); great length of nasals, 13.5 (13.0-14.1); width of maxillary arch at middle, 5.3 (5.0-5.5).

Remarks. Huey (1951) mentions the type locality of the darker *D. m. platycephalus* on the Pacific slope is less than 40 miles and almost directly west of Barril, so the presence of this pallid race so near reflects the decidedly arid character of this Gulf coast region, and is further evidence of the differentiating influence of the elements within short distances along the climatically variable peninsula.

### *Dipodomys merriami arenivagus* Elliot

1904. *Dipodomys m[erriami]. arenivagus* Elliot, Field Columbian Mus., Publ. 87, Zool. Ser., 3:249.

Type locality. San Felipe, Baja California, Mexico.

Range. From south of the U. S. border and west of the Colorado River Delta, southward to San Felipe and east of the Sierra San Pedro Martir and Sierra Juarez, Baja California (Huey, 1951).

Recorded localities. **BAJA CALIFORNIA:** San Felipe (Elliot, 1904; Villa, 1941). San Felipe; 5 mi N San Felipe; 30 mi N San Felipe; 40 mi N San Felipe; De Mara's Well, Western side Laguna Salada; Gaskill's Tank, east base Sierra Juarez (Huey, 1951). 6 mi S, 33 mi E Mountain Springs (Calif); Las Palmas Canyon, W side Laguna Salada, 15 mi S north end, 200 ft; De Mara's Well, W side Laguna Salada; Signal Mountain; SE base Signal Mtn; Cerro Centinela, 13 mi WSW Mexicali, 300 ft; 13 mi N El Mayor; 40 mi N San Felipe; 30 mi N San Felipe; San Felipe; mouth El Cajon Canyon, base San Pedro Martir Mtns, 2,300 ft; La Bocana de la Canon de Santa Maria, 10 mi E Mission de Santa Maria; 15 mi NW Calamahue Mission, 1,600 ft; Puerto de Calamahue; (Iaskill's Tank, Los Muertos Canyon Fan, near Laguna Salada; 40 mi N San Felipe; 5 mi N San Felipe; San Felipe; Canyon Esperanza; Valley E base San Pedro Martir Mtns. (Lidicker, 1960). San Felipe; 58 km SE, 23 km W San Felipe (Alvarez, 1960).

Description. Following (Lidicker, 1960), the color is extremely pale pinkish buff, dusky tips of hairs absent; arietiform markings extremely pale or absent; dorsal tail stripe and caudal pencil very light brown; ventral tail stripe either entirely gone, remaining only as a distal remnant, or present as a pale, thin streak; plantar stripes either completely absent, greatly reduced, or pale, thin, and sometimes reddish; supraoccipital spot usually prominent; cheeks generally pure white all the way to orbit.

Measurements. The mean and range of five males (Huey, 1951) are: total length, 246 (235-256); length of tail, 146.6 (140-155); hind foot length, 38.2 (37-39); greatest length of skull, 35.8 (35.0-36.7); width across bullae, 23.3 (22.8-23.7); spread of maxillary arches, 19.2 (18.6-19.6); great length of nasals, 12.7 (12.2-13.4); width of maxillary arch at middle, 5.0 (4.6-5.2). The mean and range of five females (Huey, 1951) are: Total length, 242.0 (233-253); length of tail, 141.6

(132-151); length of hind foot, 37.2 (36-39); greatest length of skull, 35.7 (34.7-37.0); width across bullae, 22.9 (22.6-23.8); spread of maxillary arches, 19.0 (18.1-19.7); great length of nasals, 13.0 (12.0-13.8); width of maxillary arch at middle, 4.9 (4.7-5.0).

Remarks. Lidicker (1960) considers this subspecies as the most specialized of the entire species, because it lives in some of the driest and hottest deserts of North America.

### *Dipodomys merriami brunensis* Huey

1951. *Dipodomys merriami brunensis* Huey, Trans. San Diego Soc. Nat. Hist., 11:225.

Type locality. Llano de San Bruno, Baja California [Sur], Mexico.

Range. From near El Valle de Yaqui, about 12 km NW Santa Rosalia, southward to the southern end of Bahia Concepcion, Baja California (Huey, 1951).

Recorded localities. **BAJA CALIFORNIA SUR:** Cape San Lucas; San Jose del Cabo; Santa Anita; 7 miles south of Miraflores; Agua Caliente; La Paz, 15; Tres Pachitas (Huey, 1951). 10 mi W Santa Rosalia, Valle del Yaqui; Llano de San Bruno; Mulege; Bahia Concepcion, 13 mi SE Mulege, 10 ft; S end Bahia Concepcion; Santa Rosalia, SE end Bahia Concepcion, 25 ft; Canipoli; El Valle del Yaqui, NW of Santa Rosalia; San Bruno; Llano de San Bruno (Lidicker, 1960). Arroyo Leon, near Loreto (Alvarez, 1960).

Description. Following (Huey, 1951) this subspecies closely resembles *D. m. platycephalus* in size, its nearest geographic relative. In dorsal coloration it is darker, in general color tone tending toward *Dipodomys merriami melanurus* of the extreme Cape region. The tail tuft color is blacker than that of *platycephalus*. Both the mastoid and tympanic bullae are larger and more inflated.

The mastoid bulla of the skull of *D. m. brunensis* is more inflated than that of *D. m. melanurus*, and a number of the specimens have smaller ears. This ear characteristic in *Dipodomys*, specially when the whole genus is considered, is directly related to the inflation or deflation of the mastoid bullae. As a general rule, the species having large inflated mastoids have smaller external pinna than do those whose mastoid bullae are moderate in size. In *Dipodomys merriami*, this characteristic is too variable and has too little racial stability to warrant its use as a means to differentiate between races.

Measurements. The mean and range of five males (Huey, 1951) are: total length, 251.4 (245-258); length of tail, 154.6 (146-168); hind foot length, 38.0 (37-39); greatest length of skull, 37.0 (36.3-37.6); width across bullae, 23.9 (23.5-24.5); spread of maxillary arches, 20.1 (19.4-20.6); great length of nasals, 13.7 (13.3-14.2); width of maxillary arch at middle, 5.0 (4.5-5.3). The measurements of 2 skins and one skull of females (Huey, 1951) are: total length, 248, 250; length of tail, 151, 151; length of hind foot, 38, 40; greatest length of skull, 37.1; width across bullae, 23.0; spread of maxillary arches, 20.0; great length of nasals, 13.8; width of maxillary arch at middle, 5.0.

Remarks. Compared with *D. m. melanurus*, *brunensis* has the same color tone, but is lighter and has a lighter colored tail. The difference in dorsal color is attributable to the climatic influences shown in the ranges of the two races. Both *brunensis* and *melanurus* occupy sections of the peninsula that are climatically different than the region occupied by their relatives to the north and west.

*Dipodomys merriami insularis* Merriam

1907. *Dipodomys insularis* Merriam, Proc. Biol. Soc. Washinton. 20:77.

Type locality. San Jose Island, Gulf of California, Baja California [Sur], Mexico.

Range. Only known of San Jose Island, Gulf of California.

Recorded localities. *BAJA CALIFORNIA*: San Jose Island (Townsend, 1912). Southwest side; Southeast end San Jose Island (Huey, 1951). San Jose Island; Southwest side San Jose Island; S end San Jose Island; Southeast end San Jose Island (Lidicker, 1960).

Description. Following Merriam (1907), the size is small; color pale pinkish buff only lightly lined with dark hairs; nose and whisker patches only faintly developed. The ground color is pinkish buff with vinaceous tinge on rump and flanks, as in *D. margaritae*. The skull is small but rather broad, with very broad maxillary arches. Compared with *D. m. platycephalus* the skull is smaller; frontoparietal shield much narrower; and mastoid bullae decidedly smaller.

Measurements. Mean measurements of 9 adult males and 16 adult females (Best and Thomas, 1991) are: total length, 258.2 and 243.9; length of body, 108.2 and 97.3; length of tail, 150.0 and 146.6; hind foot length, 40.1 and 38.4; ear length, 13.0 and 13.5; basal length of cranium, 20.8 and 20.7; greatest length of cranium, 36.4 and 36.0; maxillary arch spread, 20.7 and 20.9; interorbital width, 11.1 and 11.2; nasal length, 13.4 and 13.7; intermaxillary width, 7.4 and 7.2; alveolar length, 4.9 and 4.6; lacrimal length, 3.5 and 3.6; maxillary arch width, 5.7 and 5.7; basioccipital length, 4.7 and 4.7; greatest depth of cranium, 11.6 and 11.5; greatest width of cranium, 22.8 and 22.7; zygomatic width, 17.8 and 17.6; and nasal width, 3.6 and 3.5.

Remarks. Often regarded as a separate species (e.g., Huey, 1964), we follow Williams *et al.* (1993) in treating *insularis* as one a subspecies amid the chain of mainland races of *D. merriami*. In certain basic characters, however, such as the shape of the bullae, which are smaller than those of the mainland races, and the correspondingly large ears, general pelage color, and robust appearance, it contrasts so strongly with the geographically nearest mainland relative *D. m. brunensis*, that integration cannot be assumed (Huey, 1951). Lidicker (1960) included samples of *D. insularis* in his analysis of geographic variation in *D. merriami* because of the possibility that it might prove to be a subspecies of the latter species. He retained specific rank for *D. insularis*, however, because of its greater structural divergence from the norm among samples of all subspecies of *D. merriami*. Best and Janecek (1992) found that *D. insularis* was significantly different in several morphological traits from samples of *D. merriami* from the mainland, but they classified it as a subspecies of *D. merriami* based on allozymic similarities.

Compared with *D. m. melanurus* from the mainland of the Cape region: color very much paler and of different tone; crested part of tail paler and less strongly crested; ears larger. Compared with *D. m. platycephalus*: general color paler; tail crest browner. The young are decidedly paler than young of *D. m. platycephalus* (Merriam, 1907).

The vegetation of Isla San Jose is most plentiful in the canyons and drainages and the rocky higher slopes are extremely barren (Nelson, 1922). Best and Thomas (1991) collected specimens in open habitat about 100 m from the beach, in an area with a vegetative cover of 65%. The remaining 35% was bare ground with desert pavement.

Lidicker (1960) found considerable sexual dimorphism, with males being larger than females; he provided external and cranial measurements for samples of males and females. No embryos were present in an adult female collected in May, but the presence of a subadult female collected in that month indicated young may be born in late February or March (Best and Thomas, 1991).



The measurement of the baculum of an adult and a subadult male, respectively, are: length, 12.4, 10.7; height of base, 1.4, 1.4; and width of base, 1.2, 1.3 (Best and Thomas, 1991). This subspecies is considered threatened by the Mexican Government (NOM-059-ECOL-1994).

### *Dipodomys merriami margaritae* Merriam

1907. *Dipodomys margaritae* Merriam Proc. Biol. Soc. Washington, 20:76.

Type locality. [Santa] Margarita Island, Baja California Sur, Mexico.

Range. Occurs only on Santa Margarita Island off the Pacific Coast, Baja California Sur.

Recorded localities. **BAJA CALIFORNIA:** Santa Margarita Island (Huey, 1951; Lidicker, 1960).

Description. Following Merriam (1907), it is of very small size (nearly as small as *D. nitratoides exilis*); color pale pinkish buff almost ochraceous buff, moderately lined with dark hairs. Tail crest small and weak; ventral stripe continuous; lateral white stripes reaching nearly to tip of vertebrae. Ground color similar to *D. m. arenivagus* but less pure obscured by intermixture of dark hairs. The skull is very small and light with slender rostrum and nasals; remarkably small bullae; rather broad frontoparietal shield and intermated rather squarely spreading (but short) anterior arm of zygomatic broad and strongly angled maxillary arch. Skull short, same size as *D. m. parvus*, from which it differs markedly in smaller and less inflated mastoid bullae (especially the rear section which does not project so far posteriorly), and less conspicuously in longer nasals, longer (and slightly broader) maxillary arches, which stand out more squarely. Both have rather broad frontoparietal shields and interparietals, and clearly belong to same group although they differ greatly in color.

Measurements. Mean measurements of three adult males and one adult female (Best, 1992) are: total length, 238.7, 247.0; length of body, 91.3, 97.0; length of tail, 147.3, 150.0; hind foot length, 38.0, 39.0; ear length, 13.0, -; basal length of cranium, 19.8, 19.6; greatest length of cranium, 35.0, 34.6; maxillary arch spread, 19.4, 19.3; interorbital width, 11.2, 11.0; nasal length, 13.2, 12.9; intermaxillary width, 7.0, 7.0; alveolar length, 4.9, 4.8; lacrimal length, 3.3, 3.2; maxillary arch width, 5.3, 4.9; basioccipital length, 4.6, 4.4; greatest depth of cranium, 11.4, 11.7; greatest width of cranium, 21.9, 21.5; zygomatic width, 17.6, 17.5; nasal width, 3.3, 3.0.

Remarks. *D. m. margaritae* requires comparison with only *D. m. parvus*, its small size (skull 33.5 x 22) alone being sufficient to distinguish it from all others except *D. nitratoides exilis*, and its bullae are smaller even than those of *D. n. exilis* (Merriam, 1907).

The range of variation shown by the limited available material of this species stands well beyond that shown by a good series from the nearby mainland. The bullae are much smaller and less inflated and the pelage is decidedly pale, as is the tail tuft. The ratio of tail to body length is smaller than that of the nearby mainland species. There seems to be no valid reason to reduce either this species or *D. insularis* a subspecies, for there is no evidence of intergradation (Huey, 1951).

Lidicker (1960), in his analysis of geographic variation in *D. merriami*, concluded that *D. margaritae* did not warrant specific status and assigned it as a subspecies of *D. merriami*, an opinion with which Huey (1964) disagreed. Hall (1981) listed *D. margaritae* as a species without reference to Huey (1964) or Lidicker (1960). We believe Lidicker's (1960) conclusions are based on the most comprehensive analysis, and concur with his assignment of *D. margaritae* as a subspecies of *D. merriami*. Huey (1951) and Lidicker (1960) listed measurements for samples of this subspecies.

Santa Margarita Island is desertlike in character with sparse vegetation. The low area in the middle contains more abundant vegetation. Among the most notable species are *Pachycereus calvus* and *P. pectenaboriginum*, *Machaerocereus gummosus*, *Lemaireocereus thurberi*, *Fouquieria peninsularis*, *Jatropha canescens*, and *Pedilanthus macrocarpus* (Nelson, 1922).

*Dipodomys margaritae* apparently is not common on Santa Margarita Island and probably is restricted in its distribution to the lowland area between the northern and southern mountain ranges. One specimen was captured during 80 trap-nights in July 1986 and none were captured during 440 trap-nights in September 1990 (Best, 1992).

The baculum of an immature specimen was 9.8 mm in length 1.5 mm in height of base, and 1.0 mm in width of base (Best, 1992).

This subspecies is considered endangered by the Mexican Government (NOM-059-ECOL-1994).

### *Dipodomys merriami mayensis* Goldman

1928. *Dipodomys merriami mayensis* Goldman, Proc. Biol. Soc. Washington, 41:141.

Type locality. Alamos, Sonora, Mexico.

Range. From Rio Yaqui Valley of southern Sonora southward to extreme northern Sinaloa (Lidicker, 1960).

Recorded localities. *SINALOA*: 1 mi NE El Fuerte (Lidicker, 1960). *SONORA*: Camoa (Goldman, 1928). Alamos; Camoa (Goldman, 1937). Guirocoba; Chinobampo; Tesia; Camoa (Burt, 1938). 1 mi S Vicam, 200 ft; 6 mi NNW Ciudad Obregon; 1 mi N Ciudad Obregon, 200 ft; Los Medanos, 30 mi SW Obregon; 25 mi NW Navojoa; 22.5 mi NW Navojoa; Camoa, Rio Mayo; 3 mi NNW Bacavachi, 100 ft; 12 mi WNW Alamos; 10 mi WNW Alamos; 3 mi W Alamos, 1200 ft; 1 mi NW Alamos, 1500 ft; 1 mi W Alamos; W side Alamos; Alamos; 33 mi SSE Navojoa (Lidicker, 1960). Camoa, Rio Mayo; 15 mi W Alamos (Alvarez, 1960).

Description. Following Goldman (1937), this is a rather dark-colored form, most closely allied to *Dipodomys merriami merriami*, but upper parts darker, tail blacker; skull differing most prominently in greater expansion of maxillary arches. Hind foot with four toes as usual in the species. The coloration of the type (fresh pelage) is: upper parts in general near cinnamon buff of Ridgway, moderately mixed with black, the dark hairs giving a finely lined appearance, especially on top of head and over back; under parts, fore limbs, hind feet above, supraorbital and postauricular spots, usual hip stripes and tail at extreme base all around pure white; tail beyond extreme base slightly blackish along upper and lower median stripes to near tip where the lengthening hairs are blackish all around, the sides white passing gradually into dusky subterminally, the lighter under color persisting to extreme tip; outer sides of ankles and soles of hind feet distinctly blackish; dark facial markings rather broad and conspicuous. The skull is similar to that of *D. m. merriami*, but maxillary arches broader, the lateral angles more everted and hook-like; rostrum slightly heavier, the nasals slightly broader anteriorly than usual in *D. merriami*; mastoid and auditory bullae about the same. Resembling that of *D. m. melanurus* in development of maxillary arches, but mastoid and auditory bullae decidedly smaller.

Measurements. Following Lidicker (1960) are: length of tail averaging less than 145; greatest length of skull averaging only little more than, 35.0; and 22.3 in greatest breadth.

Remarks. While this kangaroo rat is closely allied to the widely ranging typical subspecies, it is easily distinguished by the rather well-marked combination of color and cranial characteristics

listed above. It somewhat resembles *D. m. melanurus* of Baja California Sur, but is darker and cranial distinctions have been mentioned (Goldman, 1937).

### *Dipodomys merriami melanurus* Merriam

1894. *Dipodomys merriami melanurus* Merriam, Proc. California Acad. Sci., Ser. 2, 3:345.

Type locality. San Jose del Cabo, Baja California Sur, Mexico.

Range. From near San Jorge on the north end of the Magdalena Plain, southward through the Cape region of Baja California Sur (Lidicker, 1960).

Recorded localities. **BAJA CALIFORNIA SUR:** Miraflores (Townsend, 1912). 9 mi S El Refugio, Magdalena Plain; Buena Vista, Magdalena Plain; Matancitas, Magdalena Plain; Santo Domingo (25° 30' LN), Magdalena Plain; San Jorge; Cape San Lucas; San Jose del Cabo; Santa Anita; 7 mi S Miraflores; Agua Caliente; La Paz; Tres Pachitas (Huey, 1951). San Jorge (25° 44' LN, 112° 07' LW), 5 ft; Buena Vista, Magdalena Plain; Santo Domingo (25° 31' LN) Santo Domingo (25° 30' LN); Matancita; near El Refugio; 24.3 mi by road SE El Refugio, 24° 33' LN, 111° 35' LW, 100 ft; La Paz; 1 mi S La Paz; 2 mi SW La Paz; Muertos Bay, 24 LN; Agua Caliente, 800 ft; Todos Santos; Miraflores; 7 mi S Miraflores; 6 mi N San Jose del Cabo; San Jose del Cabo; Cape San Lucas (Lidicker, 1960).

Description. Following Merriam (1894), this subspecies is similar to *D. merriami* but smaller and with the terminal third of the tail abruptly blackish. The coloration of the upper parts is pale ochraceous-buff mixed rather sparingly with black-tipped hairs; crescents at base of whiskers small; face and supraorbital spot white; not dusky on ankle; upper and lower tail-stripes continuous to tip, meeting considerably anterior to end of vertebrae, the crested penicillate part blackish.

Measurements. The mean and range of five males (Huey, 1951) are: total length, 252 (248-257); length of tail, 150.4 (144-160); hind foot length, 37.0 (36-38); greatest length of skull, 36.6 (35.9-37.8); width across bullae, 23.4 (22.9-24.0); spread of maxillary arches, 20.0 (19.4-21.3); great length of nasals, 13.1 (12.5-13.8); width of maxillary arch at middle, 5.3 (5.0-5.8). The mean of five females (Huey, 1951) are: total length, 245.0; length of tail, 147.2; length of hind foot, 37.4; greatest length of skull, 35.4; width across bullae, 22.6; spread of maxillary arches, 19.9; great length of nasals, 12.5; width of maxillary arch at middle, 5.2.

Remarks. The holotype was destroyed in the San Francisco earthquake and fire of 1906. After the fire, a new catalog was started; thus, CAS 539 now represents a different specimen. Lidicker (1960) synonymized *D. m. llanoensis* with *D. m. melanurus*, because the former exhibited intermediate characteristics between typical *D. m. melanurus* to the south and *D. m. platycephalus* to the north. Huey (1964) retained *D. m. llanoensis* "as a means of cataloging the geographic variation shown by the specimens." Hall (1981) cited Huey (1964) as his reason for recognizing *D. m. llanoensis*. We concur with Lidicker (1960).

### *Dipodomys merriami mitchelli* Mearns

1897. *Dipodomys mitchelli* Mearns, Proc. U.S. Natl. Mus., 19:719, 30 July.

Type locality. Tiburon Island, Gulf of California, Sonora, Mexico.

Range. Known only from Tiburon Island, Gulf of California, Sonora (Hall, 1981).

Recorded localities. **SONORA:** Tiburon Island (Mearns, 1897; Townsend, 1912). E side Tiburon Island; Bahia Santa Rosa, E side Tiburon Island; Ensenada del Perro, S end Tiburon Island;

Tiburon Island (Lidicker, 1960) Ensenada de Los Perros, S Isla Tiburon; Bahia Santa Rosa, E Isla Tiburon (Alvarez, 1960).

Description. Following Mearns (1897) is similar to *Dipodomys merriami simiolus*, but slightly smaller, with much shorter ears and stronger coloration; tail much heavily coated than that of the corresponding mainland; darker band on upper and under surfaces black; ears more densely clothed than in *D. m. simiolus*, and are almost black instead of buffy white; dark stripe on the under side of the hind foot intensely black; under pelage having darker slate color.

Measurements. Following Mearns (1897) are: length of tail, 140; hind foot length, 38.5; greatest length of skull, 36.5; width across bullae, 22.5; length of nasals, 13.3.

Remarks. Mearns (1897) made a comparison with *D. m. melanurus* of Baja California and consider that they are very different.

### *Dipodomys merriami olivaceus* Swarth

1929. *Dipodomys merriami olivaceus* Swarth, Proc. California Acad. Sci., ser. 4, 18:356.

Type locality. Fairbank, Cochise Co., Arizona.

Range. From southeastern Arizona and western New Mexico southward around the northern end of the Sierra Madre Occidental into northeastern Sonora on the west and central Chihuahua on the east (Willson *et al.*, 1993).

Recorded localities. SONORA: La Mision, 2 mi W Magdalena; Magdalena; 6 mi E Agua Prieta, 4,100 ft; 30 km S Agua Prieta on R.R. (Lidicker, 1960).

Description. Following Lidicker (1960) are dark, often with an olivaceous cast; arietoform marking very dark and prominent; tailstripes broad and medium to dark brown; plantars dark brown and extended to the es; peneilsvery dark.

Measurements. The mean and range of 18 specimens from Chihuahua (Anderson, 1972) are: total length, 241.9 (195-273); length of tail, 144.2 (125-163); hind foot length, 37.4 (30.7-41); ear length, 12.6 (10-15). Anderson (1972) does not give the skull measurements.

### *Dipodomys merriami platycephalus* Merriam, 1907

1907. *Dipodomys platycephalus* Merriam, Proc. Biol. Soc. Washington, 20:76.

Type locality. Calmalli, Baja California, Mexico.

Range. From the southern end of the Sierra San Pedro Martir and San Fernando, southward to about 26° 15' LN, including the entire Vizcaino Desert, but not extending to the Gulf coastal regions (Lidicker, 1960; Williams *et al.*, 1993).

Recorded localities. BAJA CALIFORNIA: Mezquital: Campo los Angeles: Santa Rosalia; Punta Prieta (Villa, 1941). Santo Domingo (28° 12' LN, 115° 04' LW); South side of Scammon's lagoon (Huey, 1927). San Francisquito; mouth of Calamahue Canyon; Ubai (=Yubay), 30 mi S Calamahue; San Borjas Mision; Santa Rosalia Bay, La Lomita Maria (Miller's Landing), Santo Domingo Landing (28° 15' LN); mainland on south side of Scammon's Lagoon; Mesquital; 5 mi W El Cañon (10 mi W Calmalli); Calmalli; 4 mi E El Arco; Pozo Altamirano; Campo los Angeles; 1 mi E Rancho Lagunitas (Huey, 1951). 3 mi W El Marmol; San Agustin; 5 mi S El Marmol; 12.5 mi by road S El Marmol; San Fernando; Rancho Ramona, 8 mi n Santa Catarina; 7 mi N Santa Catarina; Santa Catarina landing; Cataviña; 13 mi NW Chapala; 2 mi NW Chapala; 25 mi

N Punta Prieta; 24 mi NW Punta Prieta, 2,000 ft; Punta Prieta; Valle de Agua Amarga (15 mi W Bahia de Los Angeles); San Andres; 11 mi S Punta Prieta; Santa Rosalia Bay; Santo Domingo landing; Mesquital; 10 mi SE Mesquital, 400 ft; Calmalli. (Lidicker, 1960). El Mesquital: Campo Los Angeles; Santa Rosalia; Punta Prieta (Alvarez, 1960). *BAJA CALIFORNIA SUR*: Turtle Bay; 1 mi SE Cabo Tortola, 27° 38' LN; S Scammon's Lagoon (mainland): Campo Los Angeles; Punta Abreojos (Lidicker, 1960).

Description. Following Merriam (1907) in the original description, this subspecies is externally similar to *D. merriami simiolus* but the skull is different. The ground color is ochraceous buff moderately lined with dark hairs; ankle same color (not dusky). The skull in general is like that of *D. m. merriami*, but extraordinarily broad; maxillary arches of zygomata broadly and squarely spreading (as in *Perodipus streatori* [= *D. heermanni*]) fronto-parietal shield exceedingly broad; interparietal area broad; mastoid bullae normal.

Measurements. The mean and range of five males (Huey, 1951) are: total length, 250.2 (245-261); length of tail, 148.4 (140-155); hind foot length, 37.4 (36-38); greatest length of skull, 36.4 (35.3-37.5); width across bullae, 23.2 (22.6-23.9); spread of maxillary arches, 20.0 (19.9-20.3); great length of nasals, 13.0 (12.7-13.9); width of maxillary arch at middle, 5.1 (4.8-5.6). The mean and range of five females (Huey, 1951) are: total length, 247 (238-257); length of tail, 145.4 (140-150); hind foot length, 37.4 (37-38); greatest length of skull, 36.5 (34.7-37.6); width across bullae, 23.1 (22.7-23.7); spread of maxillary arches, 20.1 (19.4-21.1); great length of nasals, 13.4 (12.5-14.5); width of maxillary arch at middle, 5.3 (5.0-5.5).

Remarks. Lidicker (1960) synonymized *semipallidus* with *platycephalus* because he found them to be intergrades between *quintinensis* and *platycephalus*. Huey (1951, 1964) distinguished *semipallidus* entirely on the basis of slightly darker coloration, which Lidicker (1960) did not consider worthy of subspecific recognition. Hall (1981) retained *semipallidus* for reasons not stated. We concur with Lidicker (1960) that the slight and inconsistent differences in color attributed to *semipallidus* by Huey (1951, 1964) do not merit recognition as a separate subspecies.

### *Dipodomys merriami quintinensis* Huey

1951. *Dipodomys merriami quintinensis* Huey, Trans. San Diego Soc. Nat. Hist., 11:222.

Type locality. 5 mi E San Quintin, Baja California Mexico.

Range. Occurs on the San Quintin Plain along the Pacific coast, from near Santo Domingo southward to the region of El Rosario, Baja California.

Recorded localities. *BAJA CALIFORNIA*: Santo Domingo; San Quintin (Villa, 1941; Alvarez, 1960). Santo Domingo (30° LN); 1 mi S San Ramon; north end San Quintin Plain; San Quintin; Santa Maria near San Quintin; 5 mi E San Quintin; mouth of agua Chiquita Canyon; 7 mi SE San Quintin; 3 mi E El Rosario; 8 mi E El Rosario (Huey, 1951). N end San Quintin Plain; San Ramon, mouth Santo Domingo River; 1 mi San Ramon; Santo Domingo; Arroyo Nuevo York, 15 mi S Santo Domingo; near San Quintin: San Quintin; Agua Chiquita, 4 mi E San Quintin; 10 mi E San Quintin; Santa Maria, near San Quintin; 10 mi E El Rosario, 600 ft (Lidicker, 1960).

Description. The pelage color of *D. m. quintinensis*, when viewed in series, is darker than in *D. m. parvus*, with which it is most similar. This form furnishes a good demonstration of the need for large series to establish color values in species that show considerable variation in this respect. Compared with *D. m. parvus*, *D. m. quintinensis* averages larger; its tail tuft is lighter in density of black, and it has a larger ear. It differs from *D. m. trinidadensis* in being darker and in having

a slightly smaller skull. Compared with *D. m. semipallidus*, its intergrading relative and apparent ancestor to the southward, *D. m. quintinensis* is darker, both in pelage color and in tail tuft. In both body size and skull size it is smaller than *D. m. semipallidus*. Its differentiation, like that of *D. m. trinidadensis*, seems to have involved a reduction in size.

Measurements. The mean and range of five males (Huey, 1951) are: total length, 241.2 (235-246); length of tail, 144 (140-148); hind foot length, 36.4 (35-39); greatest length of skull, 35.0 (33.6-36.5); width across bullae, 22.3 (21.7-22.7); spread of maxillary arches, 19.2 (18.8-20.1); great length of nasals, 12.8 (12.5-13.4); width of maxillary arch at middle, 4.8 (4.5-5.1). The mean and range of five females (Huey, 1951) are: total length, 242.0 (231-250); length of tail, 140.8 (134-148); length of hind foot, 35.8 (35-37); greatest length of skull, 34.9 (33.3-36.3); width across bullae, 22.6 (21.2-23.1); spread of maxillary arches, 19.2 (18.7-19.9); great length of nasals, 12.2 (11.8-12.8); width of maxillary arch at middle, 5.0.

Remarks. This form, like *D. m. parvus* and *D. m. trinidadensis*, provides another example of parallel development. All three branch separately from a desert stock line, with no known interconnecting links of relationship along the Pacific Slope. In other words, each appeared to be separate invaders into an as yet completely unoccupied region of different climatic conditions. The effect of the change in climate is recorded in their degree and pattern of differentiation. It is likely that parallel correlations between meteorological data taken in the three localities for an adequate period and subspecies differences would indicate a strong relationship between gradients in climate and morphology.

### *Dipodomys merriami trinidadensis* Huey

1951. *Dipodomys merriami trinidadensis* Huey, Trans. San Diego Soc. Nat. Hist., 11:220.

Type locality. Aguajito Spring, El Valle de la Trinidad, Baja California, Mexico.

Range. Lidicker (1960) outlined a discontinuous range from the Jacumba Valley and Mountain Springs region of California, southward to El Valle de la Trinidad along the western border of the Sierra Juarez, Baja California, Mexico.

Recorded localities. **BAJA CALIFORNIA:** San Francisco Bay (Townsend, 1912). Sangre de Cristo (Villa, 1941; Alvarez, 1960). Sangre de Cristo; El Valle de la Trinidad; summit of San Matias Pass, Diablito spring (Huey, 1951). N end of San Quintin plain; San Ramon, mouth Santo Domingo River; International boundary at Jacumba; Valle La Puerta, near boundary; Sangre de Cristo [Valle en la San Rafael]; El valle de la Trinidad, Aguajito Spring; El Valle de la Trinidad, 2,500 ft; summit San Matias Pass, near Diablito Spring (Lidicker, 1960).

Description. Compared with *D. m. arenivagus*, *D. m. trinidadensis* is darker in dorsal color, more closely resembling *D. m. parvus* and showing distinctly the effect on coloration of the Pacific slope environmental condition. The tail of *D. m. trinidadensis* is heavily striped above and below, with a greater area covered by the darker dorsal and ventral stripes than by the white sides stripes. This is in sharp contrast to the relative area covered by ventral and dorsal stripes on the tail of *D. m. arenivagus*, in some specimens of which the ventral stripe is almost lacking. *D. m. trinidadensis* is smaller than *D. m. arenivagus* and larger than *D. m. parvus*.

Cranially, the relationship with its desert relative is apparent, as there is a wide gap in general shape of the skull between *D. m. trinidadensis* and *D. m. parvus*. This is shown in a limited degree by the measurements, though the contour of the skull and the inflation of the bullae do not lend themselves well to measurements. Compared with *D. m. arenivagus*, *D. m. trinidadensis* has a

more elongated skull, because of the more compressed mastoid bullae. The auditory bullae are larger, more inflated, and less trumpet-shaped.

Measurements. The mean and range of five males (Huey, 1951) are: total length, 241.8 (234-255); length of tail, 143.8 (138-154); hind foot length, 37.4 (36-38); greatest length of skull, 35.5 (35.4-35.9); width across bullae, 22.5 (22.1-23.1); spread of maxillary arches, 18.9 (18.4-19.5); great length of nasals, 12.6 (12.4-12.9); width of maxillary arch at middle, 4.8 (4.7-5.0). The mean and range of five females (Huey, 1951) are: total length, 240.8 (238-248); length of tail, 142.6 (140-145); length of hind foot, 37.0 (36-38); greatest length of skull, 35.6 (35.0-36.7); width across bullae, 22.6 (22.2-23.4); spread of maxillary arches, 18.7 (18.4-19.1); great length of nasals, 12.8 (12.6-13.4); width of maxillary arch at middle, 4.6 (4.3-5.2).

Remarks. Lidicker (1960) discussed the possibility that *D. m. trinidadensis* was polyphyletic, and that the diagnostic characters exhibited by the disjunct populations were examples of convergence. A more likely hypothesis, according to Lidicker (1960), is that the populations are relicts of a formerly more widely-distributed population. The northern populations of this taxon was classified as *D. m. simiolus* by Grinnell (1922). Huey (1951) listed means and ranges of measurements for samples of males and females from Baja California.

### *Dipodomys deserti deserti* Stephens

1887. *Dipodomys deserti* Stephens, Amer. Nat., 21:42.

Type locality. Mojave River [3 or 4 miles from, and opposite Hesperia], San Bernardino Co., California.

Range. The species can be found from southwestern Utah, southerward to northwestern Sonora, and northeastern Baja California (Nader, 1978). *D. d. deserti* from southeastern Utah, western Arizona, northwestern Sonora, northeastern Baja California (Williams *et al.*, 1993).

Recorded localities. **BAJA CALIFORNIA:** San Felipe (Villa, 1941). 40 mi N San Felipe; 30 mi N San Felipe; San Felipe; De Mara's Well on western side of Laguna Salada, 35 mi below international boundary. 61 km NE, 3.4 km W San Felipe; 56 km S San Felipe (Alvarez, 1960). **SONORA:** El Doctor (Burt, 1938). Rancho Noche Buena Viejo, 120 mi SE, 12 km N Sonoita [Sonoita]; 1 mi NNE Punta Peñasco (Alvarez, 1960).

Description. A large kangaroo rat with four-toed hind feet; tail with ventral coloration the same as or only slightly darker than the lateral light stripes, and with no dark band proximal to the white, distal tuft; skull with greatly inflated auditory bullae; interparietal usually absent in dorsal view in adult specimens; supraoccipital so compressed as to be barely visible dorsally (1 mm or less) (Williams *et al.*, 1993). *D. deserti* has the flattest skull of any member of the genus (Merriam, 1890)

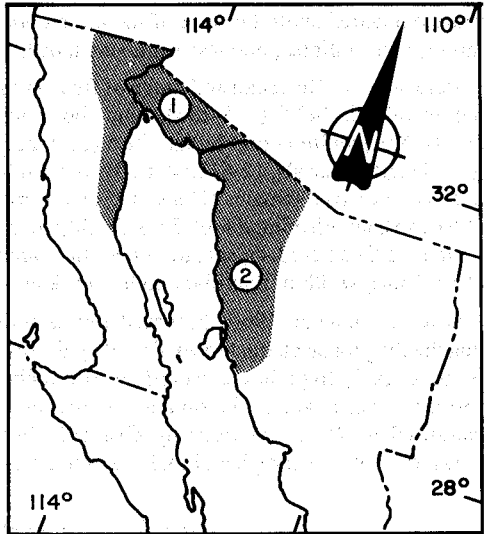
Measurements. From Nader (1978) are: total length, 342.0 (313-376); length of tail, 206.3 (187-229); hind foot length, 53.5 (51-56); greatest length of skull, 45.5 (44.5-46.5); width across bullae, 30.2 (28.9-31.4); length of nasals, 16.8 (16.1-17.5); breadth across maxillary arches, 23.3 (22.1-25.0); interorbital breadth, 13.7 (13.2-14.5); length of alveolar maxillary tooththrow, 6.2 (5.8-6.5); length of alveolar mandibular tooththrow, 6.0 (5.7-6.2).

Remarks. *Dipodomys deserti* can be distinguished from all other species by its large size, absence of a vestigial fifth toe on the hind feet, and usual absence of a darker ventral stripe on the tail. *D. deserti* can be differentiated from *D. spectabilis* by its lack of a dark-colored band of hairs bordering the white tail tuft, generally smaller hind feet, and a flatter skull, with a broader

interorbital region and greater breadth across the maxillary arches (Hall, 1981; Nader, 1978; Williams *et al.*, 1993).

The desert kangaroo rat is adapted to live in the lowest, hottest, and most arid regions of North American deserts (Nader, 1978). It is associated with loose sandy soils dominated by *Larrea* or *Prosopis* (Williams *et al.*, 1993). The gestation period is 29 to 32 days (Butterworth, 1961) and the number of embryos ranges from one to six with a mean of 3.43 and a mode of 3.0. One or possibly two litters (February and May) are produced each year (Nader, 1978). Reproductive activity begins early in January and continues through early July (Best, *et al.*, 1989).

The fundamental number of chromosome is 108. There are 3 metacentric chromosomes, 16 submetacentrics, 4 subtelocentrics, 8 acrocentrics and telocentrics, the X chromosome is submetacentric, and the Y is acrocentric-subtelocentric (Stöck, 1974).



Geographic range of *Dipodomys deserti*:

1. *D. d. deserti*

2. *D. d. sonoriensis*

### *Dipodomys deserti sonoriensis* Goldman

1923. *Dipodomys deserti sonoriensis* Goldman, Proc. Biol. Soc. Washington, 36:139.

Type locality. La Libertad Ranch, 30 mi E Sierra Seri, Sonora, Mexico.

Range. Found on the coastal plain of west central Sonora.

Recorded localities. SONORA: La Libertad Ranch, 30 mi E Sierra Seri (Goldman, 1923). Rancho Costa Rica (Burt, 1938). Hermosillo (Villa, 1941). Rancho Dolores, 7 mi ESE Rancho Libertad, 47 mi W Hermosillo; Hermosillo (Alvarez, 1960).

Description. General characters closely allied to *Dipodomys deserti deserti*, but general color of upper parts decidedly darker, more heavily overlaid with black, the buffy element of a vinaceous instead of ochraceous tone. Skull differing in detail, especially the weaker development of the maxillary arches and jugals (Goldman, 1923). The characteristics of the type (Goldman, 1923) are: upperparts in general light vinaceous-buff, rather heavily overlaid or mixed with black, especially on rump; nose, area at base of vibrissae, and orbital rings distinctly blackish; under parts, fore limbs, hip stripes, hind feet above, and sides of tail white as usual in the species; tail blackish above (tip missing in type), a narrow dusky median line below. The skull closely resembles that of *D. d. deserti*, but maxillary arches weaker; lacrymals larger, their extension along posterior border of maxillary arches equalling about one-half the distance to outer angle (extension distinctly less than one-half this distance in *D. d. deserti*); jugals more slender; squamosal (as viewed from above) less broadly articulating with parietal; mastoid bullae more fully inflated along line of contact with parietals.



Measurements. From Nader (1978) are: total length, 362.0 (345-385); length of tail, 210.7 (198-231); hind foot length, 52.0 (52-55); greatest length of skull, 46.7 (45.6-47.8); width across bullae, 31.1 (30.3-32.1); length of nasals, 17.4 (16.2-18.6); breadth across maxillary arches, 24.6 (23.3-25.9); interorbital breadth, 14.9 (14.2-15.7); length of alveolar maxillary toothrow, 6.0 (5.6-6.4); length of alveolar mandibular toothrow, 6.1 (5.7-6.5).

Remarks. Specimens from parts of southwestern Arizona are somewhat darker in color in upper parts than typical *Dipodomys deserti*, and apparently grade toward the form described here. *D. d. sonoriensis* probably has an extensive range over the sandy plains of northwestern Sonora (Goldman, 1923). *D. d. sonoriensis* is the largest subspecies and the darkest colored, being "nearly blackish" (Nader, 1978).

## Subfamily Heteromyinae Coues

Members of this subfamily are medium to large-sized mice, ranging from 180 to 360 mm in total length; the body form is quadrupedal and generally mouse- or rat-like; the tail is neither tufted nor crested, naked in appearance with annular rows of scales usually visible; locomotion is scansorial, with a bounding, quasi-richochetal movement at fast pace; the hind limbs are larger than the forelimbs; the pes has five clawed digits; the sole may be naked or clothed with fine hairs; the pelage is stiff or hispid, with body hairs of three types (straight, relatively long and widened overhairs; wide, troughed overhairs; and a thin underfur of slightly wavy hairs; the anterior face of the upper incisor is smooth or may have a shallow groove; the molars are progressively hypsodont, rooted, and tuberculate; the enamel cusp pattern is lost to wear early in life; lophs of P4 unite first at lingual then at labial sides, surrounding a central basin in a majority of species; the squamosal is in broad contact with the parietal on the dorsal surface of the skull and is not perforated by the auditory bullae; the orbital walls are completely ossified; two pterygoid fossae are present; the auditory bullae are moderately expanded, with their inflated interior filled with spongy trabeculae; the mastoid bullae do not extend onto the dorsal surface of the skull nor project posteriorly of the occipital plane. These are the most murine-like members of the family, and are, in many ways, more similar structurally to ancestral heteromyids and geomysids than they are to living heteromyids (see Wood, 1935). Further details of body form can be found in the accounts of Genoways (1973), Wahlert (1985), Brylski (1993), and Hafner (1993). A complete list of recent taxa included in the subfamily can be found in Patton (1993) and Williams *et al.* (1993); the latter includes keys to the two extant genera and their included species. Only one species in the genus *Liomys* occurs northwestern Mexico.

## Genus *Liomys* Merriam, 1902

1902. *Liomys* Merriam, Proc. Biol. Soc. Wash., 15:44

Type species. *Heteromys alleni* [= *Liomys irroratus alleni*] Coues, 1881, Bull. Mus. Comp. Zool., 8:187.

Comments. Generally referred to as spiny pocket mice, a common name also shared with *Chaetodipus* among the heteromyids of northwestern Mexico, members of this genus are typically much larger with much stiffer pelage, lack distinct rump spines but have stiff hairs throughout, have much smaller and less inflated bullae with no dorsal mastoid inflation, an essentially naked and noncrested tail, naked soles on the hind feet, and rather hypsodont cheek teeth that wear flat early in life. The genus was revised by Genoways (1973). Only the single species *Liomys pictus*

(Thomas, 1893) is found in the northwestern Mexican states of Nayarit, Sinaloa and Sonora. However, *L. irroratus* occurs in Jalisco where its distribution approaches the border between that state and Nayarit (Genoways, 1973). In his revision of the genus, Genoways (1973) recognized four subspecies of *L. pictus*, two of which occur within northwestern Mexico: *L. p. pictus* (Thomas) and *L. p. hispidus* (J. A. Allen).

### *Liomys pictus pictus* (Thomas, 1893)

1893. *Heteromys pictus* Thomas, Ann. Mag. Nat. Hist., ser. 6, 12:233

1911. *Liomys pictus*, Goldman, N. Amer. Fauna, 34:33.

Type locality. From Mineral San Sebastian, 4300 ft, Jalisco..

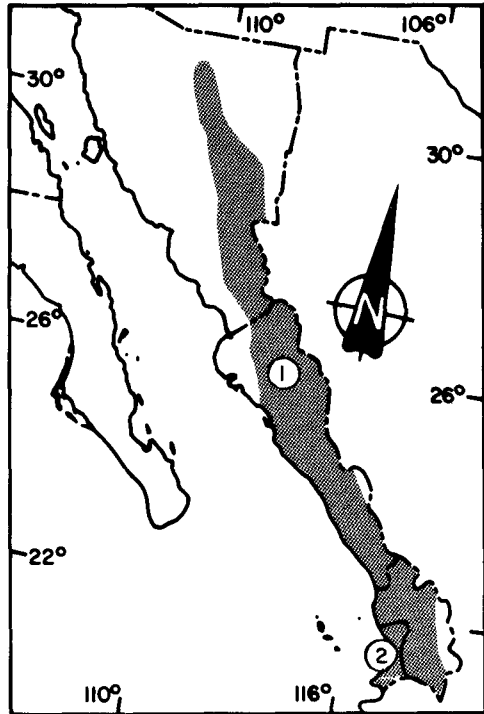
Range. This subspecies occurs along the west coast of Mexico from extreme southwestern Nayarit, Jalisco, Colima, Michoacan, Guerrero, Oaxaca, Chiapas, into northwestern Guatemala, and across the Isthmus of Tehuantepec into southern Veracruz (Genoways, 1973; McGhee and Genoways, 1978).

Recorded localities. *NAYARIT*: Compostela; Navarrete; Santiago (Goldman, 1911). 10 mi E San Blas, 5 mi S Las Varas (Hall, 1981).

Description. A medium to small-sized member of the genus, reddish brown above, with a ochraceous lateral stripe, and white below. The sole of the hind feet is finely haired. The pelage is hispid, with stiff spines intermingled with slender soft hairs. The total length averages 240 mm, tail length 124 mm, and hind foot length 29 mm. The cranium is relatively narrow in comparison with its length.

Measurements. The mean and range of five topotypes (Goldman, 1911) are: total length, 251 (232-260); length of tail, 136 (117-146); hind foot length, 29.4 (27.5-31); greatest length of the skull, 31.9 (30.9-33); zygomatic breadth, 14.3 (14.1-15); interorbital constriction, 7.5 (7.2-7.8); length of nasals, 13.3 (13.2-13.6); width of braincase, 13.8 (13.2-14); alveolar length of upper molar series, 4.9 (4.6-5).

Remarks. This taxon is readily distinguished from any other sympatric heteromyid in northwestern Mexico by virtue of its distinct murine-like body form, large size, naked and noncrested tail, harsh and rather spiny pelage, and skull without dorsal expansion of the mastoid bullae. This is the only species of the genus in northwestern Mexico, although the range of *L. irroratus* approaches the geographic limits of this region near the Nayarit border in Jalisco (Genoways, 1973). In areas of sympatry, *pictus* can be distinguished from *irroratus* by its smaller



Localization of *Liomys pictus*:  
1. *L. p. hispidus*      2. *L. p. pictus*

external and cranial size; presence of a loph connection between the entostyle to the hypocone in the upper permanent premolar; a ventral keel on the baculum; narrow as opposed to broad pterygoid wings; and reddish-brown dorsal color with an ochraceous lateral stripe rather than grayish-brown with a pale pinkish to buff lateral stripe (see Genoways, 1973).

Little is known of the ecology and population biology of Painted spiny pocket mice. They are regarded as solitary, aggressive, and nocturnal. Breeding has been recorded in every month except January and October at various localities throughout the range, but the season in northwestern Mexico is most likely to coincide with spring through fall. Litter sizes have been reported from one to six, with a modal number of four. Available information is summarized by McGhee and Genoways (1978).

The baculum has a basal bulbous end which is usually higher than wide and tapers gradually into a slightly upcurved shaft. Subterminally, just before the tip turns upward, the shaft is flattened dorsoventrally, but immediately following, it is flattened laterally to form a ventral keel on the upturned tip. Measurements of 26 specimens are: length 8.8 (8.0-10.0); height of base, 1.3 (0.9-1.7); width of base 1.1 (0.8-1.5) (Burt, 1960).

### *Liomys pictus hispidus* (J. A. Allen)

1897. *Beteromys hispidus* J. A. Allen, Bull. Amer. Mus. Nat. Hist., 9:56.

Type locality. From Rancho El Colomo, Compostela, Nayarit.

Range. This race has an extremely large range, with a distribution from Jalisco through Nayarit northward throughout Sinaloa to eastern and central Sonora south of Nogales, and inland into the canyon bottoms of western Chihuahua and Durango..

Recorded localities. *NAYARIT*: Acaponeta; Amatlan; Ojo de agua (near Amatlan); Pedro Pablo; Rancho Palo Amarillo (Near Amatlan); Tepic (Goldman, 1911). 3.5 mi E San Blas (Hooper, 1955). 4 mi NE San Blas (Hooper, 1957). Acaponeta; Amatlan; 7 mi ESE Amatlan de Cañas, 4750 ft; 7 3/10 mi ESE Amatlan de Cañas, 5000 ft; 7 1/2 mi ESE Amatlan de Cañas, 5,000 ft; Compostela, Rancho El Colomo; 2 m i S Compostela, 2900 ft; Huajicori, Rio de Bajar; 3 mi SE Huajicori; 5 mi SE Huajicori; 1 mi E Ixtlan del Rio 3700 ft; 1/2 mi W Jalisco-Nayarit border on Mexican Hwy 15; La Cuchara, approximately 40 mi E Acaponeta; Ojo de Agua, near Amatlan; Pedro Pablo; Plataneros, 10 mi E Ruiz; Playa Novilleros; 3 km S Playa Novilleros; Rancho Palo Amarillo, near Amatlan; 2 mi SW Rosamorada; 17 mi E San Blas; 29 km E San Blas, 50 m; 1 mi SW San Jose del Conde, 3000 ft; 1 1/2 km N San Miguel; 4 mi N Santa Isabel, 3800 ft; 2 mi N Santa Isabel, 3800 ft; 2 mi WNW Tepic, 3200 ft; Tepic; 20 mi SE Tepic, 3500 ft; 17 km SE Tuxpan, 480 ft (Genoways, 1973). Highway Tepic-San Blas (Bassols, 1981). *SINALOA*: Culiacan; Sierra de Choix (50 mi NE Choix); Sinaloa; Escuinapa; Mazatlan; Plomosa; Rosario (Goldman, 1911). Copala (Reeder, 1953). Chele (Hooper, 1955). 4 mi NW Agua Nueva, 50 ft; 20 km N, 5 km E Badiraguato, 1800 ft; 1 1/2 mi N Badiraguato, 750 ft; 1 mi SE Camino Real, 400 ft; Chele, 15 mi N Rosario, 300 ft; 18 km NNE Choix; 16 km NNE Choix, 1700 ft; 1 mi N Comanito; 1/2 mi S Concepcion, 250 ft; 1 1/2 mi E Concordia, 250 ft; 3 mi NE Copala, 2500 ft; 1 mi N Copala, 3200 ft; Copala, 1600 ft; 5 mi SW Copala, 750 ft; Cosala, 1300 ft; 6 mi E Cosala, 1500 ft; 2 mi E Costa Rica, 100 ft; 16 mi NW Culiacan; 12 mi N Culiacan, 400 ft; Culiacan; 32 mi SSE Culiacan; 1 mi S El Cajon, 1800; El Dorado; 2 km S El Dorado, 20 ft; 6 km NE El Fuerte, 150 m; 3 mi NE El Fuerte, 200 ft; 6 km E El Fuerte, 400 ft; Elota; 2 mi NW Escuinapa, 500 ft; Escuinapa; 15 mi SE Escuinapa; 27 mi SE Guamuchil on Mexican highway; 24 km S Guasave, 20 ft; Hacienda San Jose, 21 mi NE Rosario, 350 ft; Isla Palmito de la Virgen, 15 ft; Isla Palmito del Verde (middle);

Isla Palmito del Verde (S end); km marker 1206 on Mexican Hwy 15; 6 mi W La Concha, 10 ft; La Cruz, 30 ft; Laguna, 17 km SW Choix, 500 ft; 7 3/10 km SW Matatan, 500 ft; 7 1/2 km SW Matatan, 500 ft; 20 mi N Mazatlan; 9 mi N Mazatlan; 10 km N Mazatlan; 5 mi NW Mazatlan; 4 mi N Mazatlan; 3 mi NNW Mazatlan, 25 ft; 1 mi N Mazatlan, 25 ft; Mazatlan; 5 mi WSW Mazatlan; Panuco, 22 km NE Concordia; 23 km W Pericos, 200 ft; 1 mi S Pericos; Piaxtla, 100 ft; Plomosas; 2 mi SW Plomosas, 3050 ft; 12 mi NE Presa Sanalona, 600 ft; 11 mi ENE Presa Sanalona, 500 ft; Puerta de Canoa, 11 mi N, 2 1/2 mi E Mazatlan; W side Rio Chametla, 1 mi NE Rosario; Rosario; 4 mi SW Rosario; 5 mi SSE Rosario, 100 ft; San Juan, 8 mi SE San Ignacio; San Ignacio, 700 ft; 5 km SW San Ignacio, 200 m; 1 km NE Santa Lucila, 3700 ft; Santa Lucila, 3600 ft; 1 mi E Santa Lucila, 4200 ft; 2 mi SW Santa Luda, 3750 ft; 44 km ENE Sinaloa, 600 ft; 8 km N, 22 km E Sinaloa, 400 ft; Sinaloa; 1 mi E Sinaloa, 180 ft; 10 km S, 38 km E Sinaloa, 800 ft; 6 mi NNW Teacapan; Teacapan, Isla Palmito del Verde; 13 km NNE Vaca, 1300 ft; 34 mi NE Villa Union on Mexican Hwy 40; 8 km N Villa Union, 450 ft; 2 mi W Villa Union; 18 mi SE Villa Union, 300 ft (Genoways, 1973). SONORA: Alamos; near Alamos; Camoa (Goldman, 1911). Guirocoba; Chinobampo; Tesia; Tecoripa; Ures (Burt, 1938). Alamos, 54 km E Navajoa, 1000 ft; 1 mi NW Alamos, 1500 ft; Alamos; 1 mi E Alamos; 9 mi SE Alamos; Camoa, Rio Mayo; Chinobampo; Guirocoba; 2 mi E Guirocoba; La Estancia, 6 mi N Nacori, 2150 ft; Las Delicias [+1/4 mi E of plaza], Alamos; Matape, 105 km E Hermosillo 2300 ft; 23 mi S, 5 mi E Nogales, 3200 ft; Rio Alamos; Rio Cuchahaqui; E bank Rio Yaqui; 1 mi S El Novillo; Tecoripa; Tesia (Genoways, 1973).

Measurements. Greatest length of skull, 30.5; interorbital constriction, 7.1; mastoid breadth, 13.9; length of nasals, 12:3; length of rostrum, 13.4; length of maxillary toothrow, 5.0.

Remarks. The subspecies name *hispidus* applies to populations along the northwestern coast of Mexico that vary in a clinal fashion from medium-sized individuals in Sonora and northern Sinaloa to relatively small individuals in northern Nayarit. In the vicinity of San Blas, Nayarit, *hispidus* intergrades with *pictus* from coastal areas to the south. Specimens from the vicinity of Tepic, Nayarit, and southeastward through Nayarit to just south of Guadalajara, Jalisco, are intermediate in size between *pictus* to the west and *hispidus* to the north, but possess cranial characters that ally them with *hispidus*.

This race occurs in silty to hard-pan soils of the Sonoran Foothills section of the Sonoran Desert, in north-central Sonora, south in tropical deciduous, or short-tree forest in southern Sonora, Sinaloa, and Nayarit. Burt (1938) trapped it in cultivated fields at Tecoripa and at Ures, and at Tesia they were common along the second bottom of the river. It is more common in mesic habitats, such as riparian communities, than in drier zones (Genoways, 1973). It is the most tropical heteromyid in northwestern Mexico, although its distribution in this area is closely coincidental with the combined ranges of *C. artus*, *C. goldmani*, and *C. pernix*, except for its absence along the coastal lowlands of southern Sonora and northwestern Sinaloa. Painted spiny pocket mice have been taken sympatrically with each of these three species of *Chaetodipus*.

Bassols (1981) recorded *Androlaelaps casalis*, *Steptolaelaps liomydis*, and *Hypoaspis* from Nayarit. Genoways (1973) includes both *sonorana* Merriam (type locality of Alamos, Sonora) and *escuinapae* J. A. Allen (type locality at Esquinapa, Sinaloa) as synonyms.

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