

A NEW SUBSPECIES OF SAND POCKET MOUSE
Chaetodipus arenarius (RODENTIA: HETEROMYIDAE)
FROM BAJA CALIFORNIA SUR, MEXICO

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RESUMEN.- Se describe una nueva subespecie de *Chaetodipus arenarius* en Baja California, México, cuya distribución se restringe a una pequeña área situada en el suroeste de la Bahía de La Paz, Baja California Sur. El pelaje y la morfología craneal de ejemplares obtenidos en esa zona, se compararon con los de individuos de las subespecies geográficamente más cercanas, *C. a. siccus* y *C. a. sublucidus*. Asimismo, se desarrollaron análisis de varianza seguidos de la prueba de Newmann-Keuls para comparar cuatro medidas somáticas y nueve craneales entre las tres poblaciones. La variación entre los taxa se examinó mediante un análisis de componentes principales. Estas pruebas demostraron que la nueva subespecie presenta un tamaño significativamente menor ($P < 0.05$) en dos de las medidas somáticas y en ocho medidas craneales.

Palabras clave: *Chaetodipus*, Península de Baja California, nueva subespecie, mamíferos, Rodentia, México.

ABSTRACT.- A new subspecies of *Chaetodipus arenarius* from the peninsula of Baja California, Mexico, is described. The subspecies has restricted distribution in a southwestern area near the Bahía de La Paz, Baja California Sur. Pelage and skull morphology of specimens taken from this location were compared to those of individuals of geographical closest subspecies, *C. a. siccus* and *C. a. sublucidus*. An analysis of variance, followed by Newmann-Keuls tests, were used to compare four somatic and nine skull measurements among the three populations. Variation among taxa was examined using a principal components analysis. Results showed that the new subspecies is significantly smaller ($P < 0.05$) in two somatic and eight skull measurements.

Key words: *Chaetodipus*, Baja California Peninsula, new subspecies, mammals, Rodentia, Mexico.

INTRODUCTION

The genus *Chaetodipus* has 14 species, seven of which are present in the Baja California Peninsula (Patton and Álvarez-Castañeda 1999), including the endemic *Chaetodipus arenarius* with 11 recognized subspecies (Williams *et al.* 1993, Lackey 1991). It can be distinguished from other *Chaetodipus* species by its moderately small size, a crested tail that is longer than the head and body, small ears, a relatively soft pelage, and usually lack of stiff bristles or spines. Its range includes the mainland of the peninsula and three islands: Isla Cerralvo, Isla Margarita, and Isla Magdalena (Patton and Álvarez-Castañeda 1999,

Huey 1964). The species can be found from sea level to 600 m in the central part of the peninsula (Nelson and Goldman 1929).

During a mammal survey of the entire Baja California peninsula in 1993, a large series of *C. arenarius* was collected at El Mogote (Fig. 1). The site is a large sand barrier bar with dunes, 17 km long, that forms the coastal lagoon of Ensenada de La Paz, in the southern part of the Bahía de La Paz. This coastal habitat has sparse vegetation and the dominant species in flat areas are annual plants (*Marina* sp.) and some scrubs and cacti (*Jatropha cuneata*, *Bursera microphylla*, and *Opuntia cholla*).

In order to properly assign them to a subspecies, specimens from El Mogote were compared with individuals belonging to the most nearby subspecies (Fig. 1): *C. a. subblucidus* from the south coastal plain of Bahía de La Paz and *C. a. siccus*, from Cerralvo Island. Pelage coloration of specimens was compared using Mussell color charts (1975) and the names and codes follow the terminology charts. For quantitative analyses, the age of the specimens was determined by the occlusal molar pattern, modified from Genoways (1973). Thirteen measurements (four somatic, nine cranial) were taken *sensu* Best (1978) from specimens of the three populations (Table 1). This author (Best 1993) recorded secondary sexual dimorphism for five cranial characters in one population; since none of these were significantly different between sexes in the three examined populations, data were pooled together. Analyses of variance (ANOVA) followed by the *post-hoc* comparison Newmann-Keuls test, were used to find significant differences ($\alpha \leq 0.05$) among populations. A principal components analysis was run to explore the location of each population in the hyperspace (Fig.2).

Specimens from El Mogote were significantly smaller in seven and ten measurements compared to *C. a. subblucidus* and *C. a. siccus*, respectively (Table 1). The first three principal components explained 72 % of phenotypic variation. Upper and lower lengths of teeth rows were most important in PC I, length of tail and total length in PC II, and interparietal length in PC III. The bi-plot of PC I and PC II (Fig. 2) clearly shows that only populations two and three overlap. In summary, all these morphological differences appear sufficient to recognize the population from El Mogote as a new subspecies. Specimens have all the characteristics of *C. arenarius*, but are consistently smaller, paler, and with morphological skull differences from those of other nearby areas; therefore, we consider these differences sufficient to assign them to the new subspecies:

***Chaetodipus arenarius ramirezpulidoi*, new subspecies**

Holotype

Adult male, cranium, and dry skin, Collection of Mammals of the Centro de Investigaciones Biológicas del Noroeste (CIB) 162, collected on September 9, 1993; original preparation number, Sergio Ticul Álvarez Castañeda 1608. The skull is intact and in excellent condition (Fig. 3), but the right pinna of the

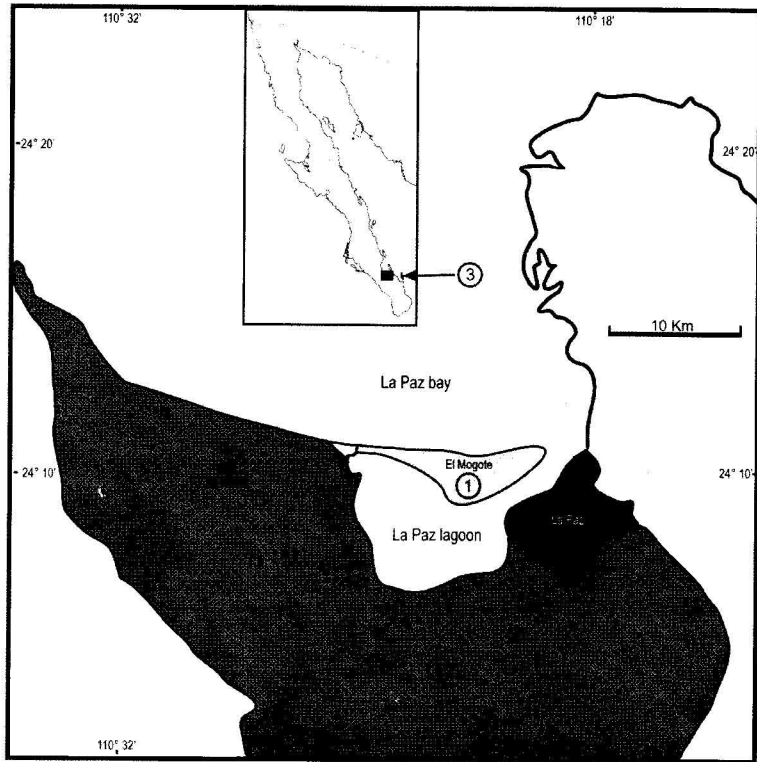


Figure 1.- Distribution of three subspecies of *Chaetodipus arenarius* in the vicinity of La Paz, Baja California Sur, Mexico. (1) *C. a. ramirezpulidoi*; (2) *C. a. sublucidus*, and (3) *C. a. siccus*.

skin has a slight tear.

Type locality. El Mogote, 5 km N, 9 km W La Paz, Baja California Sur, México 7 msnm (24° 10' 110° 21').

Diagnosis

Smaller than *Chaetodipus a. sublucidus* and *C. a. siccus*; dorsum pale reddish brown, mixed reddish brown, and dark reddish brown, without pale gray hairs on the central part of the back; sides pale brown; small patch and a ring around the eye of pinkish-white hairs; upper lips white, contrasting to all other coloration; underparts, feet, and underside of the tail white; skull small; braincase slightly inflated, moderately arched; rostrum cylindrical and short; bulla small (Fig. 3).

Paratypes (72). Baja California Sur: El Mogote, 5 km N, 9 km W La Paz, 7 msnm (CIB 158--161, 163--227, 1910--1912).

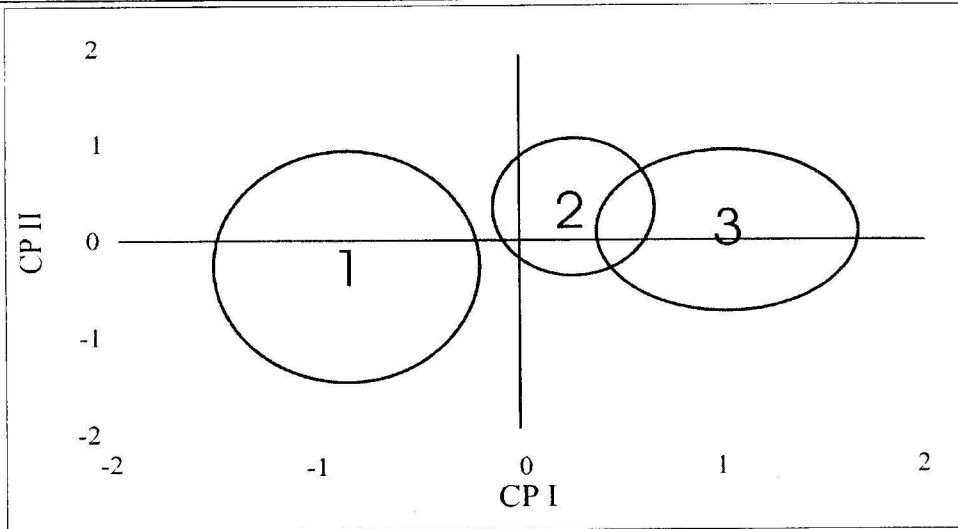


Figure 2. Average \pm standard deviation clusters in the first two Principal Components (CP) of three populations of *Chaetodipus arenarius*: (1) Populations from El Mogote, (2) *C. a. subclucidus*, (3) *C. a. siccus*. Clusters were constructed using specimens taken from each population.

Distribution

Found only at El Mogote (Fig. 1), a sand barrier bar located a few kilometers offshore from the southern coast of the Bahía de La Paz and connected to the mainland about 10 km north of El Comitan. This area is the northern border of the coastal lagoon Ensenada de La Paz, in the southwestern part of the Bahía de La Paz, Baja California Sur, Mexico.

Description and Comparisons

Description of holotype

Adult male of medium size; tail longer than head and body (60 %). Pelage soft, semi-silky, without distinct spines or bristles on rump, but occasionally a few weak bristles. Dorsum pale reddish brown (5YR 6/4), mixed reddish brown (5YR 5/4), and dark reddish brown (5YR 3/2); without pale gray; the middle part of the back to the head is darker; lateral stripe not distinct; sides paler than dorsum; with a small patch and a ring around the eye of pinkish-white hairs (5YR 8/2); ears pink (7.5YR 8/4), with the edge darker. Cheek, throat, and underparts white (5YR 9/1); feet white (7.5YR 8/1); back part of the tail dark grayish brown (10YR 3/2) and crested. Skull small; nasals cylindrical; broad zygomatic arch nearly

parallel; lachrymal process well-developed; interparietal more than twice as wide as long; bulla wider than long (Fig. 3). These characteristics generally apply to the paratypes. Measurements (mm) of the holotype and the paratypes are given in Table 1.

Comparisons

Chaetodipus arenarius ramirezpulidoi can be distinguished from both *C. a. siccus* and *C. a. sublucidus*, the most geographically adjacent subspecies (Table 1, Fig. 2), by its significantly ($P < 0.05$) smaller dimensions in total length, length of ear, occipito-nasal length, interorbital width, braincase width, length of upper tooth row, and length of lower tooth row. Also, it is smaller than *C. a. siccus* in zygomatic, interparietal length, and mandibular length.

Dorsal coloration in *C. a. ramirezpulidoi* is pale reddish brown in contrast with *C. a. sublucidus*, which is darker, with pale gray, and with *C. a. siccus*, which has two phases, one gray and the other buffy with a red tone.

Table 1.— Mean, standard deviation, and range (mm) of holotype and adult paratypes of *Chaetodipus arenarius ramirezpulidoi* (n = 33), and adult specimens of *C. a. siccus* (n = 18) and *C. a. sublucidus* (n = 35). For *C. a. siccus* and *C. a. sublucidus*, significant results of the Newmann-Keuls test, as compared with *C. a. ramirezpulidoi*, are indicated (* $P < 0.05$; ** $P < 0.01$).

Measurements	<i>C. a. ramirezpulidoi</i>		<i>C. a. siccus</i>	<i>C. a. sublucidus</i>
	Holotype	Paratypes		
Total length	157.0	144.5 ± 17.7 110-167	168 ± 12.5** 129-188	163.1 ± 9.2** 143-178
Length of tail	90.0	78.7 ± 15.9 41-98	87.0 ± 15.0 48-105	88.5 ± 9.7 67-103
Length of hind foot	22.0	22.5 ± 1.3 21-28	22.8 ± 1.3 21-25	23.3 ± 0.8 22-24
Length of ear	8.0	7.6 ± 0.6 7-9	8.7 ± 1.2** 7-10	8.4 ± 0.6* 7-9
Occipitonasal length	22.6	22.9 ± 0.7 21.9-23.7	25.2 ± 0.9** 23-26.4	24.8 ± 0.7** 23.4-25.7
Zygomatic width	10.6	10.9 ± 0.6 10.0-11.6	12.0 ± 0.5** 10.7-12.5	11.5 ± 0.4 10.6-12.6
Interorbital width	5.8	5.2 ± 0.3 5.4-6.1	6.3 ± 0.2** 5.8-6.6	6.3 ± 0.3** 5.9-6.9
Braincase width	12.0	11.8 ± 0.4 11.2-12.4	13.0 ± 0.4** 12.2-13.8	12.9 ± 0.3** 12.4-13.6
Length of upper toothrow	3.6	3.3 ± 0.3 3.4-4.8	3.7 ± 0.1** 3.4-4	3.5 ± 0.1** 3.1-3.7
Length of lower toothrow	2.7	2.9 ± 0.2 2.5-3.3	3.4 ± 0.1** 3.1-3.6	3.1 ± 0.1** 2.9-3.4
Interparietal width	6.9	6.8 ± 0.5 6.2-7.5	7.0 ± 0.3 6.3-7.8	6.9 ± 0.6 6.1-7.9
Interparietal length	3.1	3.6 ± 0.4 3.1-4.1	3.3 ± 0.1** 3-3.5	3.6 ± 0.3 3.2-4.2
Mandibular length	10.2	9.7 ± 0.5 8.8-10.3	10.5 ± 0.4* 9.6-11.3	10.3 ± 0.4 8.2-10.8

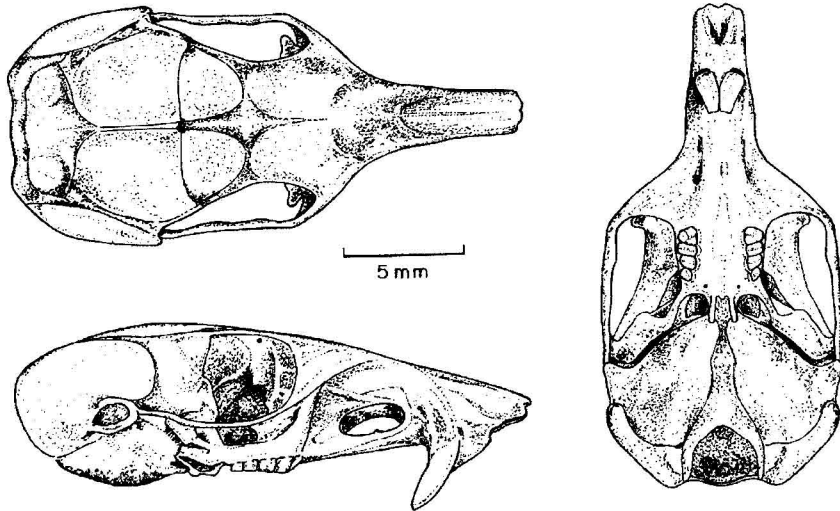


Figure 3.- Dorsal, lateral, and ventral views of the skull of the holotype of *Chaetodipus arenarius ramirezpulidoi*, an adult male (CIB 162).

In comparison with *C. a. sublucidus*, *C. a. ramirezpulidoi* has the central part of the dorsum darker, with gray. Some specimens of *C. a. sublucidus* are dark, mainly on the back and upper part of the head, with grayer sides, in contrast to *C. a. ramirezpulidoi* on which the dorsum is pale light reddish brown and some specimens are pale, with little contrast between the lateral line and the dorsum. In *C. a. sublucidus*, the small patch and ring around the eye are not clearly defined, but are strongly contrasting in *C. a. ramirezpulidoi*. Underparts, feet, and underside of tail are dull white to pale gray versus the pure white of *C. a. ramirezpulidoi*. The skull of *C. a. sublucidus* has an arched braincase, a short, less cylindrical rostrum, and less inflated bulla. In *C. a. ramirezpulidoi*, the braincase is less arched; rostrum longer, and the bulla are more cylindrical and inflated.

In comparison with *C. a. siccus*, color of *C. a. ramirezpulidoi* is grayer or buffy with red tones and the small patch and ring around the eye are not contrasting. Underparts, feet, and underside of tail are white to white-cinnamon. With regards the skull, the rostrum is shorter, nasals extend below the frontals, and the bullae are larger.

Remarks

Nelson and Goldman (1929) recorded *C. a. sublucidus* only from nearly flat areas along the southern coast of Bahía de La Paz, characterized by sarcocaula scrub vegetation and mainly sandy soils. The most representative plants of the area are included within the families of Euphorbiaceae, Cactaceae, and Leguminosae (León de la Luz et al. 1996).

Chaetodipus a. ramirezpulidoi was collected in the coastal dune zone of El Mogote, northwest of the city of La Paz, Baja California Sur, Mexico (Fig. 1). The most representative plant species on the sandbar barrier are *Abronia maritima*, *Amaranthus watsonii*, *Jouvea pilosa*, *Haplopappus sonorensis*, and *Jatropha cinerea* (J. L. León de la Luz, pers. comm.). The soil is pure sand with moving dunes.

Of eight females collected in May, one had three embryos and the others were lactating. Those collected in September had scars in the uterus. In November, we collected juveniles. Average length of testes in mature males were 8.16 mm in May, and 6.53 mm in September.

In November, most specimens of *C. a. ramirezpulidoi* have yellow-ochre underparts, but this coloration was an effect of the abundance of *Marina maritima* and *M. chrysostris* on El Mogote, which have a pigment that tints the underparts of the mice.

Other small mammals collected at El Mogote were *Dipodomys merriami* and *Peromyscus maniculatus*; both species comprised 3 % of the captured specimens. For *C. a. ramirezpulidoi*, trap success was approximately 15 %.

Etymology

The new subspecies is named in honor of José Ramírez-Pulido for his professional contributions to Mexican mammalogy and in acknowledgment of his support to the authors at different times in their own professional development.

Conservation Status

Ramírez-Pulido's Pocket Mouse is restricted to the sandy coastal barrier bar, locally known as "El Mogote" (1540 ha), that divides the lagoon of La Paz from the bay of La Paz. Starting in 2004, part of the pristine El Mogote will be developed for touristic, recreational and residential uses, especially the eastern tip (504 ha). In the general development plan, only 52 km² are to remain under natural conditions; however, there may be serious threats from non native species (cats, dogs, and house mice) associated with urban development. For this reason, we strongly recommend that this subspecific population be considered for inclusion in the list of endangered species within the Mexican Official Norm (NOM-059).

Specimens Examined

C. a. ramirezpulidoi (73). El Mogote, 5 km N, 9 km W La Paz. (73 CIB). *C. a. siccus* (29). Isla Cerralvo, Punta Viejos (5 CNMA); Isla Cerralvo Punta SW (6 CNMA); Isla Cerralvo (5 CNMA, 7 CIB, 1 USNM); Isla Cerralvo, SE de la playa, 500 m (5 CNMA). *C. a. sublucidus* (129). 11 km N La Paz (1 CIB) 11 km N El Centenario (15 CIB); 5 km N Ejido El Centenario (6 CIB) La Paz (1 USNM), km 23, Carretera San Juan de La Costa (1 CIB); 27 km W La Paz (3 CIB); Brisamar, 25 km W La Paz (49 CIB);

El Comitán, 17.5 km W La Paz (40 CIB); 12 km W La Paz (12 CIB); 9 km W La Paz (1 CIB).

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DEDICATORIA

Dedicamos este trabajo con gran afecto al Dr. Ramírez Pulido como un reconocimiento a su labor académica dentro del campo mastozoológico. Su trayectoria ha sido ejemplo e inspiración para las nuevas generaciones que hemos tenido la fortuna de aprender de su experiencia, colaborar con él y, sobre todo, contar con su amistad.

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