

DISTRIBUTION AND NATURAL HISTORY OF SCHMIDLY'S DEERMOUSE (*PEROMYSCUS SCHMIDLYI*)

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ABSTRACT—We present the geographic range expansion of *Peromyscus schmidlyi* to the north (430 km). The two new localities represent the first record for the state of Sonora. These records show that *P. schmidlyi* may be present throughout the Sierra Madre Occidental. *P. schmidlyi* could have a similar range to the other endemic species of this region, such as *Spermophilus madrensis*, *Sciurus nayaritensis*, and *Nelsonia neotomodon*.

RESUMEN—Se presenta una expansión de la distribución geográfica de *Peromyscus schmidlyi* en 430 km hacia el norte. Las dos nuevas localidades son el primer registro para el estado de Sonora. Estos registros muestran que *P. schmidlyi* puede estar presente en la Sierra Madre Occidental. Es posible que *P. schmidlyi* tenga una distribución geográfica similar a la de otras especies endémicas en esta región, como *Spermophilus madrensis*, *Sciurus nayaritensis* y *Nelsonia neotomodon*.

Schmidly's deer mouse (*Peromyscus schmidlyi*) is an endemic species restricted to the states of Durango and Sinaloa, Mexico (Bradley et al., 2004). Basic aspects of its biology, reproduction, size variation, habitat, and the real or potential geographical distribution are not well known. Moreover, knowledge of this species is hindered as there are no reported diagnostic morphological differences to separate *P. schmidlyi* from other species of the *boylii* species group occurring in western Mexico. As such, *P. schmidlyi* can only be recognized using karyotypic or molecular (i.e., cytochrome-*b* sequence) analyses. Our goal is to increase the information on the distribution and natural history of *P. schmidlyi* based on the discovery of new specimens from Sonora, Mexico.

In October 2004, many localities from Sonora were visited as a result of a survey in relation to the *boylii* species group in the northwestern part of Mexico. New specimens of *P. schmidlyi* were collected in two localities from which *P. spicilegus* previously was recorded (Caire, 1978; Bradley et

al., 1996). We established eight transects, each with 40 Sherman live traps baited with rolled oats. Trap sites were placed in suitable habitats for *Peromyscus*, primarily pine (*Pinus*) or oak (*Quercus*) trees and beneath pointleaf manzanita (*Arctostaphylos pungens*). Specimens were prepared in the conventional manner (Hall, 1981), and housed in the mammal collection of the Centro de Investigaciones Biológicas del Noroeste (CIB). Eight specimens of Schmidly's deer mouse were captured, seven (10848, 10849, 10885–10889 CIB) at 0.8 km N, 1.4 km E Yécora, 1,550 m (28°22'38" N, 108°54'32" W), and one (10850 CIB) at Los Vallecitos, 2 km N, 11.5 km E Yécora, 1,430 m (28°23'00" N, 08°48'22" W; Fig. 1).

Mitochondrial DNA of five specimens was extracted from liver tissue using Chelex® (Walsh et al., 1991). We amplified the first 800 bp of cytochrome-*b*, beginning with the ATG start codon, used primer pairs (MVZ05 5'-CGAAGCTT-GATATGAAAAACCATCGTTG and MVZ16 5'-

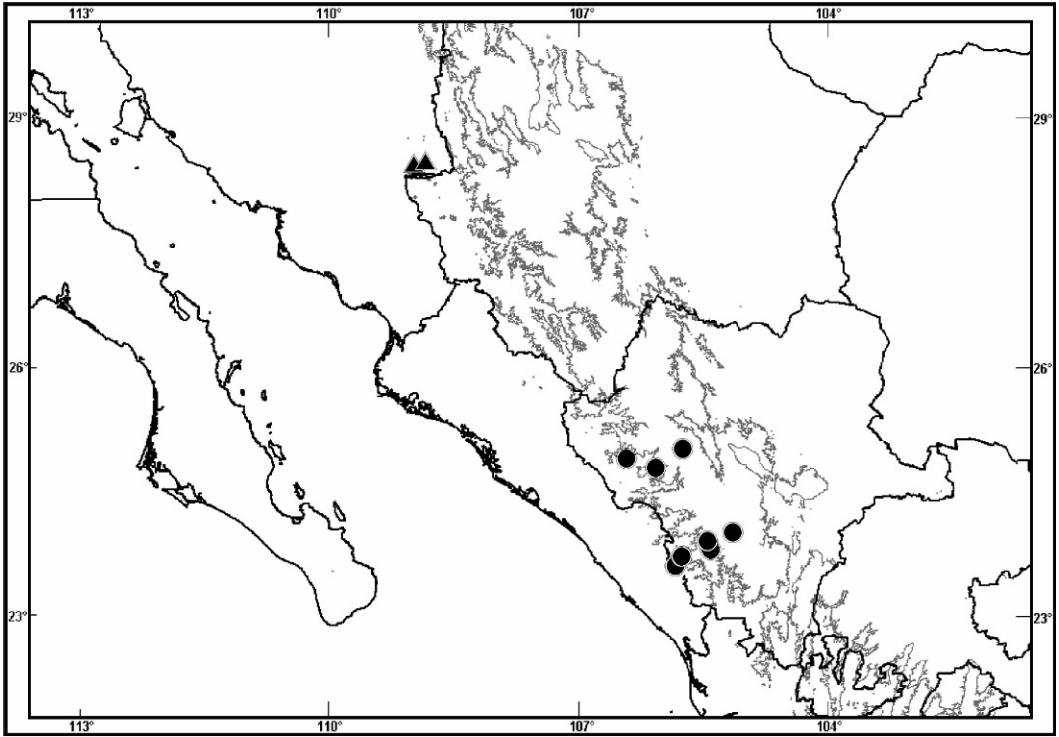


FIG. 1—Geographic distribution of *Peromyscus schmidlyi*. Circles indicate previous localities (Bradley et al., 2004) and the triangles represent the new record in Sonora, Mexico; contour lines are 2,000 m.

AAATAGGARTATCA YCTGGTTTRAT; Smith, 1998). The polymerase chain reaction was used to amplify fragments of cytochrome *b* gene under the following parameters: 3 min of initial denaturation at 94°C followed by 37 cycles of 94°C denaturation (45 s), 50°C annealing (1 min), and 72°C extension (1 min). Template DNA was cycle-sequenced with primers MVZ05 using an ABI 3730xl DNA analyzer, following the manufacturer’s protocol. Sequences were aligned using Sequencher version 4.1 software (Gene Codes Corp., Ann Arbor, Michigan). Sequences of these specimens are 99% similar to those recorded for *P. schmidlyi* in GenBank (Altschul et al., 1997; Bradley et al., 2004). Five sequences of the specimens (10885–10889) have different haplotypes. The percentage of differences among those samples sequenced by us is <1%. Our sequences (EU 234536–EU234540) differ from *P. schmidlyi* sequences in Genbank (AY322524, AY322523) by 1.02%, and from sequences of *P. boylii rowleyi* (AF121925, AF155413) and *P. spicilegus* (AY322512) by 7.91 and 11.43%, respectively.

External and cranial measurements (mean \pm SD and range in millimeters) of the eight

specimens from Sonora of *P. schmidlyi* are: total length, 179.5 \pm 14.76 (175–205); length of tail, 86.0 \pm 8.57 (72–102); length of hind foot, 19.4 \pm 1.06 (19–21); length of ear, 19.5 \pm 0.93 (18–21); length of skull, 26.2 \pm 1.22 (24.2–28.8); zygomatic breadth, 12.9 \pm 0.43 (12.4–13.6); breadth of braincase, 12.1 \pm 0.30 (11.6–12.5); depth of cranium, 9.4 \pm 0.27 (9.0–9.7); interorbital breadth, 4.2 \pm 0.15 (4.1–4.4); breadth of rostrum, 4.2 \pm 0.20 (3.9–4.5); length of rostrum, 10.4 \pm 0.62 (9.3–11.2); length of palate, 4.0 \pm 0.33 (3.7–4.6); length of molar toothrow, 4.2 \pm 0.19 (4.0–4.6); length of incisive foramen, 4.9 \pm 0.38 (4.6–5.3); breadth of zygomatic plate, 1.9 \pm 0.32 (1.2–2.2).

Averages of cranial measurements of specimens from Sonora are smaller than those from the type specimens, with the exception of lengths of rostrum and molar toothrow (Bradley et al., 2004). The three females were pregnant, each had two embryos (total length, 20 and 17, 16 and 16, 8 and 8 mm); three males had scrotal testes (total length, 15, 12, 11 mm). No data are available for the other two specimens.

The two localities in which *P. schmidlyi* was collected were geographically proximal. However, they have differences in vegetation composition. (1) 0.8 km N, 1.4 km E Yécora has a slope of 15°, with oak-juniper forest. The dominant species in the upper layer were pointleaf manzanita, kittle lemonhead (*Coreocarpus arizonicus*), one-seeded juniper (*Juniperus monosperma*), Apache pine (*Pinus engelmannii*), ponderosa pine (*Pinus ponderosa*), yécora pine (*Pinus yecorensis*), Arizona white oak (*Quercus arizonica*), sípuri (*Quercus durifolia*), silverleaf oak (*Quercus hypoleucoides*). Annuals were six-week threeawn (*Aristida absensionis*), spidergrass (*Aristida temipes*), common oats (*Avena sativa*), and needle grama (*Bouteloua aristroides*). (2) Los Vallecitos, 2 km N, 11.5 km E Yécora, has a slope of nearly 3°, with oak-pine forest. Dominant species in the upper layer were pointleaf manzanita, Apache pine, Arizona white oak, and silverleaf oak. Annuals were six-week threeawn and spidergrass. In both localities, no other species of rodent was collected in the same trap line in which we found *P. schmidlyi*.

These two localities represent the first record of *P. schmidlyi* from the state of Sonora increasing the geographic range for the species 430 km to the northwest. Also, the Sonoran record indicates that the geographical distribution of *P. schmidlyi* may extend throughout the Sierra Madre Occidental. For this reason, it also is probable that besides Durango, eastern Sinaloa, and Sonora, *P. schmidlyi* could continue its range to the western part of Chihuahua, northeastern Nayarit, northwestern Zacatecas, and northern Jalisco (Fig. 1). Endemic species of the Sierra Madre Occidental are few, but *P. schmidlyi* could have a similar range to the other endemic species of this region, such as *Spermophilus madrensis*, *Sciurus nayaritensis*, and *Nelsonia neotomodon* (Hall, 1981).

The karyotype of *P. schmidlyi* demonstrates its monophyletic origin (FN = 54–56), because no hybridization or introgression evidences were found (Bradley et al., 2004). Thus, it is possible that the cytotypes extend throughout the Sierra Madre Occidental, similar to the distribution proposed in this study.

As mentioned, *P. schmidlyi* occupies both sides (east and west) of the Sierra Madre Occidental, while *P. spicilegus* occupies only the western slope and *P. boylii rowleyi* only the eastern slope. *P. b. rowleyi* occurs at the base of the western slope of the Sierra Madre Occidental in Sonora. The three species occur in the pine-oak forest, the

last two only in part (Hooper, 1955; Baker and Greer, 1962; Anderson, 1972; Bradley et al., 2004). Thus, *P. schmidlyi* may occur in the same localities as *P. spicilegus* and *P. b. rowleyi* (Bradley et al., 2004), although it has not been determined if *P. schmidlyi* occurs in the same microhabitats. However, identification of species in this region is hindered by coexistence of two or more species of the *boylii* group in the Sierra Madre Occidental, and by the subtle differences among species.

Peromyscus schmidlyi is more similar to *P. levipes* than to any other species of the *boylii* species group, but they are not sympatric. However, morphological differences with other potentially sympatric species are complex. According to Bradley et al. (2004), *P. schmidlyi* is larger and darker compared to *P. boylii*, the orbital region is hourglass and not angular as compared with *P. spicilegus*, but in larger samples, this difference is not clear. Before the description of *P. schmidlyi*, the systematics of the *Peromyscus* in the Sierra Madre Occidental was confusing. Hooper (1955) found more than two morphological groups; later Baker and Greer (1962) carried out a detailed analysis with one east-west transect. They detected great variation in color, size, and forms of the supraorbital border of the skull. Anderson (1972) proposed two morphological groups in the Sierra Madre Occidental (*P. b. rowleyi* and *P. b. spicilegus*), but recognized the large amount of variation. In all the cases, Hooper (1955), Baker and Greer (1962), and Anderson (1972) considered intergradual groups of the *boylii* group and even interbreeding populations. The description of *P. schmidlyi* provided order to the confusion in the *boylii* group in the Sierra Madre Occidental. *P. spicilegus* occupies the western side, *P. schmidlyi* the central highlands, and *P. boylii* the eastern side. However, we can make some additional conclusions. Due to problems in identification, morphological studies of *P. schmidlyi* should be supplemented with karyotype analysis or DNA (cytochrome-*b*), and there is the possibility that Anderson (1972), Hooper (1955), and Baker and Greer (1962) could have include specimens of *P. schmidlyi*. Therefore, information currently known for *P. boylii rowleyi* and *P. spicilegus* could be mixed with ecology and biological information for *P. schmidlyi*.

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