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SHREWS (EULYPOTYPHLA: SORICIDAE) OF MEXICO

Leslie N. Carraway¹

ABSTRACT.—Examination of published records, and morphometric and morphologic analyses of 3398 museum specimens, revealed that 4 genera including 30 monotypic and 5 polytypic species of shrews (Soricidae) occur in Mexico. Of these, 2 new species were named and 2 subspecies were heretofore unrecognized, 3 were reclassified, and 1 was elevated to species level. *Cryptotis goldmani machetes*, previously subsumed into *C. g. goldmani*, was reelevated based on ventral pelage color. *Sorex veraepacis mutabilis* contained 2 morphotypes, 1 of which matched that of the holotype; however, the 2nd morphotype not only did not match that of the subspecific holotype, but also has a sympatric distribution. Thus, specimens of the 2nd morphotype are referred to a new species: ***Sorex ixtlanensis***. *Sorex saussurei* formerly contained 4 subspecies of which the nominal *S. s. saussurei* contained 3 morphotypes based on position of the median tines of the I1s. Specimens of 1 morphotype match the holotype, have a distribution limited to the Transvolcanic Belt, and are referred to the now monotypic *S. saussurei*. Specimens of the 2nd morphotype, herein referred to a new species ***Sorex mediopua***, also are limited to the Transvolcanic Belt and can be found at many of the same localities as those of *S. saussurei*. Specimens of the 3rd morphotype, not only include a portion of the specimens formerly included in *S. s. saussurei*, but all those previously referred to the other 3 subspecies of *S. saussurei*: *crisobalensis*, *oaxacae*, and *veraecrucis*. Based on priority, *veraecrucis* is elevated to specific status with *crisobalensis* and *oaxacae* as subspecies. The specimens formerly contained within *S. s. saussurei* are referred to a new subspecies: ***Sorex veraecrucis altoensis***. *Sorex veraecrucis* now has the broadest distribution of any taxon of shrews in Mexico.

Key words: shrews, Soricidae, Mexico, *Eulypotyphla*, *Cryptotis*, *Notiosorex*, *Megasorex*, *Sorex*.

RESUMEN.—El examen de los registros publicados y los análisis de morfométricos y morfológicos de 3398 especímenes de museo, revelaron que cuatro géneros, incluyendo 30 especies monotípicas y cinco politípicas de musarañas (Soricidae), ocurren en México. De éstas, dos especies nuevas fueron nombradas y dos subespecies dejaron de ser reconocidas a partir de ahora, tres fueron reclasificadas y una fue elevada al nivel de especie. *Cryptotis goldmani*, previamente considerada la subespecie nominal, fue restablecida con base en el color del pelaje ventral. En *Sorex veraepacis mutabilis* se encontraron dos morfotipos, uno de los cuales correspondía con el holotipo subespecífico, mientras que el otro además de ser diferente, mostraba distribución simpátrica. Por ende, los especímenes este morfotipo son referidos a la nueva especie, ***Sorex ixtlanensis***. Originalmente, *Sorex saussurei* estaba representada por cuatro subespecies de las cuales la nominal, *S. s. saussurei*, incluía tres morfotipos, con base en la posición de las cúspides accesorias mediales de los I1. Los especímenes de uno de los morfotipos corresponden con el holotipo, tienen una distribución limitada al Eje Volcánico Transversal y son referidas a *S. saussurei*, ahora considerada monotípica. Los especímenes del segundo morfotipo, considerados aquí dentro de la nueva especie ***Sorex mediopua***, también se limitan al Eje Volcánico Transversal y pueden ser encontrados en varias de las mismas localidades de los ejemplares de *S. saussurei*. Los especímenes del tercer morfotipo no solo incluyen una porción de los ejemplares inicialmente incluidos en *S. s. saussurei*, sino a todos los que previamente eran referidos a las otras tres subespecies de *S. saussurei*: *crisobalensis*, *oaxacae* y *veraecrucis*. Por prioridad, *veraecrucis* es elevada al nivel específico, quedando *crisobalensis* y *oaxacae* como subespecies. Los especímenes inicialmente asignados dentro de *S. s. saussurei* son referidos a la nueva subespecie, ***Sorex veraecrucis altoensis***. *S. veraecrucis* tiene ahora la distribución más extensa entre todos los taxa de musarañas en México.

Palabras clave: musarañas, *Eulypotyphla*, México, *Cryptotis*, *Notiosorex*, *Megasorex*, *Sorex*.

Biologists working in Mexico have an extensive history of conducting research on mammals, particularly bats, rodents, carnivores, and artiodactyls (Villa-R. 1966, Ramírez-Pulido et al. 1983, 1986, 2000, Ramírez-Pulido and Castro-Campillo 1990, 1994, Cervantes 1991, Villa-R. and Cervantes 2003). However, research on

shrews (Soricidae) has been sorely neglected. The 1st publication to refer to a soricid (*Cryptotis parva berlandieri*) from Mexico (Mata-moros, Tamaulipas) was in 1857 (Baird 1857). Since that time, >2900 articles have been published in which mammals from Mexico were mentioned, of which only about 229 contained

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information on soricids up to the year 2000 (Ramírez-Pulido et al. 1983, 1986, 2000, Ramírez-Pulido and Castro-Campillo 1990, 1994) and at least 16 more since 2000. Although Choate (1970) provided a taxonomic review of *Cryptotis* and Hall and Kelson (1959) and Hall (1981) included all taxa distributed in Mexico, most of these were either faunal lists or original descriptions. However, several of the publications were morphometric studies on a limited number of species from restricted geographic areas or genetic evaluations of a few species. Perhaps the reason behind the low number of more expansive publications has been the difficulty in obtaining specimens and in identifying those few specimens researchers collected as incidentals when trapping rodents. Even now, some taxa (e.g., *Cryptotis griseiventris*, *C. mayensis*, *C. parva soricina*, and *Notiosorex crawfordi*) in Mexico are best known from their remains found in owl (Order Strigiformes) pellets rather than direct collection of specimens of these taxa by trapping.

The flora and fauna of Mexico have been greatly impacted by the climatic effects of not only an ocean abutting the long west coast and the Gulf of Mexico along the east coast, but also by 2 dramatic geological features (Fig. 1). First, the Transvolcanic Belt, containing numerous mountains (elevations range from 2000 m to >4000 m) oriented northwest to southeast (bounded by latitude 19°N and 20°N and longitude 96°E and 105°E), transects the country from the Volcán San Juan, Nayarit, and Volcán de Colima, Colima, on the west coast to Cerro Cofre de Perote and Volcán Pico de Orizaba near the east coast and Sierra de Los Tuxtlas on the east coast of Veracruz (Baker 1971, Fa 1989, Ceballos and Navarro L. 1991, Armstrong 1996). Second, the Isthmus de Tehuantepec, located in southern Veracruz and Oaxaca, is involved intimately in the creation of fairly distinct faunas and floras to the north and west and to the south of the isthmus (Miranda and Sharp 1950, Stuart 1954, Toledo 1982, Peterson et al. 1999, Carleton et al. 2002, Villa-R. and Cervantes 2003). Additionally, several other mountain ranges, including Sierra Madre Oriental in the northeast (from Nuevo León to Hidalgo), Sierra Madre Occidental in the northwest (from Chihuahua to northeastern Jalisco), Sierra Madre del Sur in the southwest (from western Jalisco to Oaxaca), Sierra Madre de

Chiapas (along the southern coast of Chiapas), and Sierra del Norte de Chiapas (in northern Chiapas) produce significant rainshadow effects and many isolated habitat types.

Biotic regions (Fig. 2) of Mexico include low- and high-elevation tropical cloud and rain forests, low-elevation scrub woodlands, low- and high-elevation deserts, and numerous 3660+ m mountains with fairly isolated habitats above treeline that contain relictual vertebrate populations (Smith 1941, Moore 1945, Goldman and Moore 1946, Goldman 1951, Barrera 1962, Rzedowski 1986, Fa 1989, Álvarez and Lachica 1991, Campbell 1999, Morrone et al. 1999, Ceballos et al. 2002a, Villa-R. and Cervantes 2003). The Baja California peninsula itself has 3 distinct physiographic regions (Rzedowski 1986, Álvarez-Castañeda et al. 1995, Villa-R. and Cervantes 2003): Biotic Province California north of 30°30'N, Biotic Province Baja California Sur south of 27°N, and in between the Biotic Province Desierto del Vizcaíno. Biotic Province California contains the montane biotic district San Pedro Mártir to the east and the coastal plain biotic district San Diego. Biotic Province Desierto del Vizcaíno (= central desert of Baja California) contains the biotic district Baja California Central characterized by the Desierto de Vizcaíno and the biotic district Desierto de Colorado to the east. The Desierto de Vizcaíno, combined with the mountainous region to its east, creates a sharp delineation of the mammalian fauna into northern and southern units (Huey 1964). And, Biotic Province Baja California Sur contains the mountainous biotic district Sierra de la Giganta, which dominates the northern section of the Province, and the biotic district Cabo which includes the area south of La Paz. Factors that contribute to the extraordinary array of ecosystems and physiographic regions in Mexico include being located primarily within the tropics (but containing strong influences from temperate and subtropical faunas and floras extending from the north and from Central America, respectively), elevations from sea level to >5700 m, volcanism, precipitation ranging from <500 mm to >7000 mm per year (depending upon latitude and rainshadow effects), and the disjoining of faunal and floral systems because of post-Pleistocene climatic changes.

Four genera (*Cryptotis*, *Megasorex*, *Notiosorex*, *Sorex*) of soricids included in 3 tribes (Blarinini, Notiosoricini, Soricini) occur in

Fig. 1. Physiogeographic features providing the greatest impact on the flora and fauna of Mexico.

Fig. 2. Biotic provinces of Mexico (J. Ramírez-Pulido *in litt.* 2006, used with permission, modified from CONABIO map at <http://conabioweb.conabio.gob.mx/metacarto>).

Mexico. In 1983, 22 species and 36 taxa (species + nominal subspecies) were recognized (Ramírez-Pulido et al. 1983); in 1996, 21 species and 35 taxa (Ramírez-Pulido et al. 1996); in 2000, 27 species and 32 taxa (Ramírez-Pulido et al. 2000); and in 2003, 21 species (Villa-R. and Cervantes 2003). Official status (Norma Oficial Mexicana 2002) of shrews in Mexico is difficult to judge because it may be a reflection of their numbers, or it may be related to the paucity of available specimens for some taxa. Currently, 21 taxa (47.7%) have been afforded protected status, 3 (6.8%) threatened status, and 1 (2.3%) is considered endangered; thus, 56.8% ($n = 25$ of 44 taxa) of the soricid fauna of Mexico is provided official standing by the Mexican government (Norma Oficial Mexicana 2002).

Shrews are distributed within all physiographic regions from sea-level deserts of the Baja California peninsula and low-canopy scrub trees of the Yucatán Peninsula to the high reaches of the Sierra Madre Occidental and Sierra Madre Oriental. Holdings in museums throughout Mexico and the United States give the impression of there being "hot spots" for the occurrence of shrews and areas utterly depauperate of shrews; however, in part, this impression likely is a reflection of collection effort. The purpose of this study is to provide an overview of the soricids of Mexico with updated taxonomy; summaries of distribution, ecology and natural history; and a key to the taxa to encourage the study of this old (Pruitt 1957, van Zyll de Jong 1983, Harris 1998), unique, and interesting group of mammals.

METHODS

Within the genera *Cryptotis*, *Megasorex*, *Notiosorex*, and *Sorex*, I examined 3398 specimens from throughout Mexico. Only 2 specimens of *Notiosorex cockrumi* from Mexico were included in Baker et al. (2003); however, they did include 16 other *N. cockrumi* from the United States that were positively identified to species based on genetics. These latter specimens were included to verify identifying characteristics of the skull and mandible.

For all specimens examined, states for 27 qualitative characters (see Appendix for definitions) were evaluated and recorded. Eleven cranial and 25 mandibular characters were recorded for each of 715 specimens (Fig. 3).

Greatest length of skull and cranial breadth were measured with Mitutoyo Digimatic calipers to the nearest 0.01 mm. All other quantitative skull characters recorded were measured by use of an ocular micrometer (10 lines = 1 mm) or ocular protractor (in degrees) mounted in a Bausch and Lomb binocular microscope. Total length, length of tail, and length of hind foot were recorded from specimen tags; length of head and body was determined as total length minus tail length. Length of claw on the middle digit of the manus was measured in ocular micrometer lines. All values reported in text are in millimeters or degrees. Statgraphics Plus 5.1 Enterprise Edition was used for all statistical analyses.

Terminology for tooth morphology and nomenclature follows that of Butler et al. (1989), Choate (1970), Dannelid (1989), Hall (1981), and Hershkovitz (1971). Dentary teeth are referred to as i1, c1, p4, m1, m2, and m3. Teeth in the upper jaw are referred to as I1, U1, U2, U3, U4, U5, P4, M1, M2, and M3. The U1–U5 refer to a sequence of unicuspid teeth that vary in number depending on the taxonomic group. Although *Cryptotis* shrews possess a cusplet on U1–U3, these teeth still are referred to as unicuspid. For dimensions in which tooth designations are separated by a dash (e.g., U1–M3), the specified teeth were measured as a unit from most anterior point to most posterior point. For dimensions in which tooth designations are separated by a plus (+), the length of each tooth was measured individually and the values summed. This distinction is necessary, as unlike the teeth of most mammals, soricid teeth overlap one another to a considerable extent (Carraway 1995).

The following Key to the Shrews of Mexico is dichotomous. Because some taxa are composed of geographic populations of disparate sizes it is possible for a taxon to be identified in more than 1 couplet. Characters contained within parentheses are useful for distinguishing the taxon from other taxa not in direct line in the Key. Characteristics of the curly overhairs were obtained from Ducommun et al. (1994).

In taxon accounts, synonymies contain the original taxonomic designation, new name combinations, and junior synonyms. Diagnosis sections include a combination of features that distinguish the taxon from all others. In Ecology sections, descriptions of occupied habitats are presented at the same level of precision as

Fig. 3. Camera-lucida tracings of a *Notiosorex* skull and mandible (1–17) and *Sorex* tooththrows (18–30) to illustrate quantitative characters (numerals) measured and 4 anatomical features (letters) examined. Key to characters: (1) condylobasal length, (2) maxillary breadth, (3) least interorbital breadth, (4) cranial breadth, (5) breadth of zygomatic plate, (6) breadth across M2–M2, (7) length of P4–M3, (8) palatal length, (9) length of unicuspid tooththrow, (10) length of U1–M3, (11) length of mandible to anterior tip of i1, (12) length of coronoid–posterior point of upper condylar facet, (13) height of coronoid process, (14) height of coronoid valley, (15) height of articular condyle, (16) length of mandible, (17) length of coronoid–ventral point of lower condylar facet, (18) length of c1–m3, (19) length of c1, (20) length of p4, (21) length of m1, (22) length of m2, (23) length of m3, (24) length from upper articular condyle to posterior edge of m3, (25) angle of coronoid process from horizontal plane of dentary, (26) angle of i1 from horizontal plane of dentary, (27) depth of dentary at m1, (28) width of c1, (29) width of p4, (30) width of m1, (31) width of m2, and (32) width of m3. Anatomical features are: (a) zygomatic process, (b) roof of glenoid fossa, (c) paroccipital process, and (d–d') relationship of anterior edge of m1 and posterior edge of i1. Scale bar in center with characters 1–17 equals 5 mm. Scale bar with characters 18–32 equals 1 mm.

occurred in the cited literature. Also, current names of mammalian associates follows Ceballos et al. (2002b) and Ramírez-Pulido et al. (1996); thus, names appearing in cited literature may differ from names presented herein. In accounts without a Status section, the taxon carries no level of consideration according to

Norma Oficial Mexicana (2002). In lists of specimens examined, specimens are ordered alphabetically by state and major geographic point in specific locality of collection site, and museum acronym and catalog number. A small percentage of specimens were not cataloged at the time they were examined; they are referred to

by the museum acronym followed by the original collector's number including 1 or more letters as a prefix. A "T" immediately following a number in lists of specimens examined indicates a type specimen. A superscript pound symbol (#) immediately following a number in lists of specimens examined indicates that the specimen was measured. A superscript asterisk (*) following a collection locality indicates that the geographic location could not be determined; therefore, it was not plotted on a distribution map. A superscript star (☆) following a collection locality indicates an extralimital Pleistocene fossil locality. Information provided in brackets in lists of specimens examined was added to provide clarity for collection localities that are difficult to find. Some specimens noted in the published literature were not available for examination; they are listed in the Additional Specimens section of species accounts.

Except for new species, all species accounts are in alphabetical order within their tribe. Two new species and 2 subspecies previously unrecognized, 3 reclassified, and 1 elevated to species rank are described within the genus *Sorex*; their accounts appear at the beginning of Species Accounts for Tribe Soricini.

On distribution maps, symbols for localities include all specimens for which the collection locality is within the diameter of the symbol. An open star (☆) indicates an extralimital Pleistocene fossil locality. Distribution maps were produced with ArcView 3.2. Latitudes and longitudes used for plotting specimen collection localities and those listed with type localities in synonymies were obtained or calculated from values on specimen tags and in the internet databases Biogeomancer, USGS Geographic Names Information System (GNIS), Calle World Index, and the GeorefCalculator

of the MANIS project at the Museum of Vertebrate Zoology, University of California Berkeley. Also, J. Ramírez-Pulido provided latitudes and longitudes for a number of localities at which *Cryptotis* had been collected.

TAXONOMY

For the purposes of this monograph, a species of mammal is composed of 1 or more populations of actually or potentially interbreeding individuals genetically (i.e., reproductively) isolated from other such populations. Thus, individuals within a species possess "... a lineage with [a] separate and unitary evolutionary role" from individuals within other species (Simpson 1961:147, Mayr 1963, Wiley 1978). One or more populations are considered a distinct evolutionary unit (i.e., species) if individuals within the population(s) possess an array of morphologic, genetic, or behavioral similarities distinct from other such evolutionary units (Wiley 1978, Mayr 1982, Wright 1982). Species may have sympatric distributions.

A species may contain distinct geographic variants (= subspecies) with allopatric, parapatric, or interdigitating distributions. These variants are adapted to local environmental conditions. When individuals of the different subspecies come into contact with one another interbreeding occurs (Goldschmidt 1982, Wright 1982). The 1 or more characters that define each subspecies will be within the limits of the array of the morphologic, genetic, or behavioral similarities that characterize the species to which it belongs (Mayr 1963).

KEY TO THE SHREWS OF MEXICO

1. Tail long, $\geq 40\%$ of length of head and body; II with median tine (Figs. 4–7); 5 unicuspid in

Figs. 4–7. IIs of *Sorex* illustrating relative position of anteriomedial tines relative to pigmentation: 4, tine located above pigment on body of IIs; 5, tine located well-above pigment on body of IIs; 6, tine located at interface of pigment on body of IIs; 7, tine located well within pigment on body of IIs.

upper toothrow (Fig. 8); in labial view, alveolus of i1 not extending posteriorly beneath paraconid of m1 (Fig. 10); (all teeth pigmented); (U1–U3 with no 2nd cusp); (no locking mechanism present in upper glenoid furrow); (area between condylar processes not emarginate, i.e., breadth of interarticular area equal to that of superior condylar facet, Fig. 14); (curly over-

hairs with “deep grooves with a central ridge” and “a superimposition of 2 rather elongated notches” [Ducommun et al. 1994:635]) 24 (Tribe Soricini: *Sorex*)

— Tail short, $\leq 33\%$ of head and body length; I1 without median tine; 3 or 4 unicusps (Fig. 9) present in upper toothrow; in labial view,

Figs. 8–17. Diagnostic characters of the skull and mandible for *Cryptotis*, *Megasorex*, *Notiosorex*, and *Sorex*. Right side of rostra (labial) illustrating differences in number of unicusps in upper toothrow: 8, 5 unicusps as for *Sorex*; 9, 3 unicusps as for *Cryptotis*, *Megasorex*, *Notiosorex*. 10–13, Dentaries (labial) illustrating relationship of posterior point of alveolus of i1 and anterior point of m1 and degree of pigmentation of mandibular teeth: 10, alveolus of i1 not extending posteriorly beneath paraconid of m1, all teeth pigmented (*Sorex*, USNM 88014); 11, alveolus of i1 extending posteriorly beneath at least part of paraconid of m1, all teeth pigmented (*Cryptotis*, USNM 68338); 12, alveolus of i1 extending posteriorly beneath at least part of paraconid of m1, light pigment on i1, c1, and p1 (*Notiosorex*, USNM 146693); 13, alveolus of i1 not extending posteriorly beneath paraconid of m1, all teeth unpigmented (*Megasorex*, USNM 511264). Scale bar for Figs. 10–13 equals 1 mm. 14–17, Condylar processes (posterior) illustrating differences in shape: 14, area between condylar processes not emarginate, i.e., breadth of interarticular area equal to that of superior condylar facet (*Sorex*); 15, area between condylar processes shallowly emarginate, i.e., breadth of interarticular area approximately equal to that of superior condylar process (*Cryptotis*); 16, area between condylar processes deeply emarginate, i.e., breadth of interarticular area markedly less than that of superior condylar process (*Notiosorex*); 17, same as for *Notiosorex* (*Megasorex*).

- alveolus of i1 extending posteriorly beneath at least part of paraconid of m1 (Figs. 11–12; except in *Megasorex*, Fig. 13) 2
2. Three unicuspid (Fig. 9, U1–U3) present in upper toothrow; U1–U3 with no 2nd cusp; area between condylar processes deeply emarginate, i.e., breadth of interarticular area markedly less than that of superior condylar process (Figs. 16–17); not all teeth pigmented (Figs. 12–13); locking mechanism present in upper glenoid furrow that holds the upper condylar facet in place; shield of curly overhairs having a smooth structure “with, at most, shallow U-shaped notches” (Ducommun et al. 1994:623) 3 (Tribe Notiosoricini: *Megasorex*, *Notiosorex*)
- Three or 4 unicuspid (U1–U3 [Fig. 9] or U1–U4) present in upper toothrow; U1–U3 with 2nd cusp; area between condylar processes shallowly emarginate, i.e., breadth of interarticular area approximately equal to that of superior condylar process (Fig. 15); all teeth pigmented (Fig. 11); no locking mechanism present in upper glenoid furrow; shield of curly overhairs has 2 or 3 rows of parallel C-shaped notches that form a central ridge with 2 rather short notches often superimposed 7 (Tribe Blarinini: *Cryptotis*)
3. Total length 110–140 mm; head and body large, 81–87 mm long; skull robust; all teeth unpigmented (Fig. 13); tail 38–50 mm long and slightly bicolored; curly overhairs have a single series of superficial notches in the smooth shield *Megasorex gigas*
- Total length 78–100 mm; head and body small, 50–74 mm long; skull not robust; light pigment on I1, U1–U3, and sometimes P4, i1, c1, and p1 (Fig. 12); tail 19–35 mm long and unicolored the same as the dorsal pelage; curly overhairs have a single series of slightly indented notches on the smooth shield 4 (*Notiosorex*)
4. Pelage on dorsum and venter has a silvery wash; roof of glenoid fossa not extending laterally from cranium when skull viewed from dorsal aspect (Fig. 18); (can be distinguished from *N. cockrumi* and *N. crawfordi* by condylobasal length ≥ 16.97 mm); (can be distinguished from *N. cockrumi* by breadth across M2–M2 usually 4.9–5.1 mm, length of c1–m3 usually 5.0–5.1 mm); (can be distinguished from *N. evotis* by length of upper unicuspid toothrow ≥ 2.0 mm, height of coronoid process 4.0–4.1 mm, length of coronoid process–posterior point of upper condylar facet 3.7–3.8 mm, and length of coronoid process–ventral point of lower condylar facet 3.3–3.4 mm) *Notiosorex villai*
- Hairs on dorsal pelage white medially with very dark grayish brown tips; hairs on venter white on distal half; roof of glenoid fossa extending laterally from cranium when skull viewed from dorsal aspect (Fig. 19) 5
5. Breadth of zygomatic plate 2.1–2.4 mm; a combination of height of coronoid process usually ≥ 4.5 mm and cranial breadth usually ≥ 8.2 mm; (can be distinguished from *N. cockrumi* by condylobasal length 16.5–18.4 mm, breadth across M2–M2 usually 5.1–5.4 mm, length of c1–m3 usually 4.9–5.3 mm, height of coronoid process usually 4.3–5.0 mm, height of articular condyle 3.0–3.5 mm) *Notiosorex evotis*
- Breadth of zygomatic plate 1.7–2.1 mm; a combination of height of coronoid process ≤ 4.4 mm and cranial breadth usually ≤ 8.5 mm 6

Figs. 18–19. Skulls (right dorsal) of *Notiosorex* illustrating differences in roof of glenoid fossa: 18, not extending laterally from cranium when viewed from dorsal aspect (*N. villai*, KU 54932); 19, extending laterally from cranium when viewed from dorsal aspect (*N. crawfordi*, KU 145262). Scale bar equals 5 mm.

Figs. 20–23. Rostra (right labial) illustrating differences in shape of zygomatic processes and position of zygomatic processes relative to M2 and M3: 20, process elliptic, extends posteriorly and ventrolaterally to below level of occlusal surface (*C. g. goldmani*, USNM 68547); 21, process bulbous and flared laterally, extends ventrolaterally to below level of occlusal surface of molars (*C. peregrina*, USNM 68338); 22, process sharply pointed, extends dorsolaterally at level of alveoli (*C. merriami*, USNM 77020); 23, process bulbous, extends posteriorly and ventrolaterally to below level of occlusal surface (*C. magna*, USNM 68565). Scale bar equals 1 mm.

- 6. Total length 78–86 mm; length of claw on middle digit of manus 1.0–1.2 mm and 1.28%–1.52% of total length *Notiosorex cockrumi*
- Total length usually 84–100 mm, most individuals are >88 mm; length of claw on middle digit of manus 1.0–1.2 mm and 1.57%–1.82% of total length *Notiosorex crawfordi*
- 7. U4 completely visible in lateral view; (tail slightly bicolored) 8
- U4 partially obscured or not visible in lateral view or missing 10
- 8. Cranial breadth 9.7–10.7 mm; least interorbital breadth 4.5–4.8 mm; length of claw on middle digit of manus 2.7–3.0 mm and 2.5%–3.1% of total length; zygomatic processes bulbous (Fig. 21); (palatilar length 7.8–8.5 mm); (zygomatic processes flare laterally [Fig. 21]); (length of coronoid–ventral point of lower condylar facet 3.7–4.2 mm); (length of coronoid–posterior point of upper condylar facet 3.5–3.8 mm); (length of m2 1.5–1.6 mm); (i1 with 2 denticles and deep interdenticular spaces [Fig. 24]); (pelage on dorsum dark blackish brown with interspersed whitish hairs); (pelage on venter slightly paler than that of dorsum) *Cryptotis peregrina*
- Cranial breadth ≤ 9.6 mm; least interorbital breadth <4.4 mm; length of claw on middle digit of manus 1.0–1.8 mm and $\leq 2.5\%$ of total length; zygomatic processes sharply pointed (Fig. 22) 9
- 9. Pelage on dorsum dark gray; pelage on venter slightly lighter gray; length of claw on middle digit of manus 1.5–1.6 mm and 1.2%–1.6% of total length; palatilar length 7.7–8.5 mm; length of U1–M3 ≥ 7.0 mm; zygomatic processes extend dorsolaterally at level of alveoli of M2 and M3 (Fig. 22); height of coronoid process 4.8–5.3 mm; height of coronoid valley ≥ 2.4 mm; length of coronoid–ventral point of lower condylar facet, 4.3–4.9 mm; i1 with 2 denticles and deep interdenticular spaces (Fig. 24); (breadth across M2–M2 7.0–7.5 mm); (length m2 1.3–1.5 mm) *Cryptotis mayensis*

Figs. 24–27. Views of i1s illustrating denticles (a and a'), differences in interdenticular spaces (b and b'), and degree of pigmentation at anteromedial edge (c and c'); 24, deep spaces (labial); 25, shallow spaces (labial); 26, long strip of pigment present at edge (lingual); 27, long strip of pigment not present at edge (lingual). Scale bar equals 1 mm.

- Pelage on dorsum light to medium brown; hairs on venter white distally; length of claw on middle digit of manus 1.0–1.8 mm and 1.4%–2.4% of total length; palatilar length 6.5–7.0 mm; length of U1–M3 <7.0 mm; zygomatic processes extend posteriorly and ventrolaterally to below occlusal surface of teeth (Fig. 20); height of coronoid process 3.5–4.2 mm; height of coronoid valley 2.0 mm; length of coronoid–ventral point of lower condylar facet 3.4–3.9 mm; i1 with 3 denticles and very shallow interdenticular spaces (Fig. 25); (length of coronoid–posterior point of upper condylar facet 4.1–4.7 mm); (length m2 1.2–1.4 mm) *Cryptotis parva berlandieri*
- 10. Largest *Cryptotis*; total length >123 mm; length of tail >40 mm; condylobasal length >22 mm; palatilar length >9.4 mm; length of U1–M3, >8.4 mm; length of unicuspid tooththrow >2.9 mm; maxillary breadth >7 mm; height of coronoid process >5.5 mm; hairs on tail uniformly same dark brown as dorsal pelage; (length of claw on middle digit of manus 1.8%–2.4% of total length); (pelage on dorsum dark brown); (pelage on venter slightly paler than that of dorsum); (zygomatic processes extend posteriorly and ventrolaterally to below occlusal surface of teeth and bulbous [Fig. 23]); (i1 with 3 denticles and deep interdenticular spaces [Fig. 24]) *Cryptotis magna*
- Small- to medium-sized *Cryptotis*; total length <123 mm; length of tail <40 mm; condylobasal length usually <21 mm; palatilar length <9.4 mm; length of U1–M3 <8.4 mm; length of unicuspid tooththrow <2.9 mm; maxillary breadth <7 mm; height of coronoid process usually <5.0 mm; tail slightly bicolored 11
- 11. Palatilar length ≤ 7.2 mm; cranial breadth ≤ 8.8 mm; least interorbital breadth ≤ 4.4 mm; length of tail usually <24 mm; i1 with 3 denticles and very shallow interdenticular spaces (Fig. 25); (zygomatic processes extend posteriorly and ventrolaterally to below occlusal surface of teeth [Fig. 20] and sharply pointed) 12
- Palatilar length >7.2 mm; cranial breadth >8.8 mm; least interorbital breadth >4.4 mm; length of tail usually >26 mm; i1 with 2 denticles and interdenticular spaces usually deep (Fig. 24) 14
- 12. Pelage on dorsum light to medium brown; hairs on venter white distally; (length of claw on middle digit of manus 1.0–1.8 mm and 1.4%–2.4% of total length); (condylobasal length usually 15.2–16.5 mm and length of m3 + width m1 + width m2 + width m3 usually 3.8–4.5 mm) *Cryptotis parva berlandieri*
- Pelage on dorsum medium to dark brown; pelage on venter light brown; (length of claw on middle digit of manus 1.2–2.0 mm and 1.6%–2.2% of total length) 13
- 13. Breadth across M2–M2 4.8–5.5 mm; (condylobasal length usually 16.4–17.6 mm); (length of U1–M3 5.7–6.8 mm); (length of mandible 6.4–8.5 mm); (length of mandibular tooththrow 4.1–5.3 mm); (length from upper articular condyle to posterior edge of m3 3.4–4.6 mm); (height of coronoid valley usually 2.0–2.6 mm); (height of articular condyle 2.8–3.6 mm); (length of m3 + width m1 + width m2 + width m3 usually 4.3–5.1 mm) *Cryptotis parva pueblensis*
- Breadth across M2–M2 3.1–4.1 mm; (condylobasal length usually 16.1–17.7 mm and length of m3 + width m1 + width m2 + width m3 usually 3.6–4.8 mm) *Cryptotis parva soricina*
- 14. Condylobasal length >21.0 mm; cranial breadth >11.0 mm; length of U1–M3 >8.0 mm; (length

- of claw on middle digit of manus 3.7 mm and ca. 3.4% of total length); (pelage on dorsum dark brown); (pelage on venter slighter paler than that of dorsum with a silvery shine); (zygomatic processes extend posteriorly and ventrolaterally to below occlusal surface of teeth [Fig. 20] and sharply pointed); (breadth across M2–M2 6.6 mm); (length of mandible 10.0–11.0 mm); (length of mandibular tooththrow 6.5–6.8 mm); (height of coronoid process 4.7–4.8 mm); (height of articular condyle 4.0–4.3 mm); (height of coronoid valley 3.0–3.1 mm); (length from upper articular condyle to posterior edge of m3 5.4–6.0 mm) *Cryptotis goodwini*
- Condylbasal length ≤ 20.7 mm; cranial breadth usually < 10.6 mm; length of U1–M3 ≤ 8.0 mm 15
15. Palatilar length usually < 8.1 mm and maxillary breadth < 6.4 mm 16
- Palatilar length usually > 8.1 mm and maxillary breadth > 5.9 mm 18
16. Hairs on dorsum dark silvery gray for proximal half, with a white band medially and a dark reddish brown tip; hairs on venter dark silvery gray proximally with a blond tip; (condylbasal length 18.74–18.96 mm); (cranial breadth 8.9–9.3 mm); (breadth across M2–M2 5.5–5.8 mm); (zygomatic processes sharply pointed and extend posteriorly and ventrolaterally to below occlusal surface of teeth); (length of mandible 8.3–8.8 mm); (length of mandibular tooththrow 5.4–5.5 mm); (height of coronoid process 3.8–4.0 mm); (height of articular condyle 3.5–3.7 mm); (height of coronoid valley 2.6–2.8 mm); (length from upper articular condyle to posterior edge of m3 4.6–5.0 mm). *Cryptotis tropicalis*
- Pelage on dorsum dark brown; hairs on venter dark silvery gray proximally with a dark brown or white tip 17
17. Hairs of venter dark brown tipped; zygomatic processes bulbous and flare laterally and usually project posteriorly to the posterior edge of M3 or beyond (Fig. 28); (length of claw on middle digit of manus 1.9–2.9 mm and 2.0%–2.7% of total length); (condylbasal length 17.7–19.8 mm); (cranial breadth 9.3–10.5 mm) *Cryptotis mexicana*
- Hairs of venter white tipped; zygomatic processes project ventrally almost “hugging” the labial edge of where M2 and M3 abut and always project posteriorly only to the midpoint of M3 (Fig. 29); (length of claw on middle digit of manus 2.1–2.6 mm and 2.0%–2.5% of total length); (condylbasal length 17.2–19.6 mm); (cranial breadth 8.7–10.3 mm) *Cryptotis obscura*
18. Pelage on dorsum medium or dark gray; 3 (Fig. 9) or 4 unicusps present in upper tooththrow 19
- Pelage on dorsum medium or dark brown; 4 unicusps present in upper tooththrow; (zygomatic processes extend posteriorly and ventrolaterally to below occlusal surface of teeth [Fig. 23]) 21

Figs. 28–29. Ventral view of *Cryptotis* illustrating relationship of length of zygomatic processes (a) relative to M3 (a’): 28, processes project to posterior edge of M3 or beyond, (*C. mexicana*, USNM 68528); 29, processes project posteriorly only to the midpoint of M3, (*C. obscura*, USNM 81116). Scale bar equals 1 mm.

19. Pelage on dorsum very dark gray with a silvery wash distally giving a frosted appearance; 3 (Fig. 9) or 4 upper unicuspid present; (condylobasal length, 17.94–19.49 mm); (palatilar length 7.4–8.6 mm); (breadth across M2–M2 5.0–5.9 mm); (zygomatic processes extend posteriorly and ventrolaterally to below occlusal surface of teeth [Fig. 20] and sharply pointed); (length of c1–m3 usually 5.8–6.0 mm); (height of articular condyle 3.6–3.8 mm); (very small “bump” in bottom of deepest interdenticular space [Fig. 24]); (length of claw on middle digit of manus 1.9–2.0 mm and ca. 2.0% of total length) *Cryptotis phillipsi*
- Pelage on dorsum uniformly medium or dark blackish or brownish gray with no silvery wash; 4 upper unicuspid always present 20
20. Pelage on dorsum medium blackish gray and venter pale gray; condylobasal length <20 mm; palatilar length 7.5–8.2 mm; zygomatic processes extend dorsolaterally at level of alveoli of M2 and M3 (Fig. 22); length of mandible 7.9–8.3 mm; length of c1–m3 5.1–5.5 mm; height of articular condyle 3.2–3.5 mm; length of claw on middle digit of manus 1.5 mm and ca. 1.5% of total length; i1 with deep interdenticular spaces (Fig. 24); (breadth across M2–M2, 5.0–5.5 mm); (length of mandible 7.9–8.3 mm); (length from upper articular condyle to posterior edge of m3 4.3 mm); (height of coronoid valley 2.4–2.6 mm); (height of the articular condyle 3.2–3.5 mm); (length of coronoid–ventral point of lower condylar facet 3.7–4.3 mm); (length of coronoid–posterior point of upper condylar facet, 3.5–4.0 mm) *Cryptotis merriami*
- Pelage uniformly dark brownish gray on dorsum and venter; condylobasal length ≥ 20 mm; palatilar length 8.5–9.5 mm; zygomatic processes are medium-large to elliptic and extend posteriorly and ventrolaterally to halfway of level of occlusal surface of teeth (Fig. 23); length of mandible 9.0–9.5 mm; length of c1–m3 usually 5.7–6.1 mm; height of articular condyle 3.6–4.2 mm; length of claw on middle digit of manus 2.5–3.2 mm and ca. 2.3%–2.9% of total length; i1 with moderately deep interdenticular spaces (Fig. 24); (length of U1–M3 7.4–8.0 mm); (length of unicuspid toothrow 2.5–3.0 mm); (breadth across M2–M2 usually 5.1–5.7 mm) *Cryptotis griseoventris*
21. Pelage on dorsum medium brown; hairs on venter white tipped; zygomatic processes sharply pointed (Fig. 22); (length of claw on middle digit of manus 3.0–4.4 mm and 2.9%–4.3% of total length); (condylobasal length 19.39–20.72 mm); (cranial breadth 9.43–10.51 mm); (breadth across M2–M2 usually <5.8 mm) *Cryptotis alticola*
- Pelage on dorsum dark brown; hairs on venter with or without a light-colored tip; zygomatic processes elliptic (Fig. 20); (condylobasal length 18.7–20.7 mm); (cranial breadth 9.8–10.9 mm); (breadth across M2–M2 5.2–5.8 mm) 22
22. Pelage on venter only slightly paler brown than that of dorsum; length of claw on middle digit of manus 2.4–2.8 mm and $\leq 2.8\%$ of total length *Cryptotis nelsoni*
- Pelage on venter much paler than that of dorsum; length of claw on middle digit of manus usually 2.8–3.8 mm and $\geq 2.9\%$ of total length 23
23. Hairs on venter white tipped; length of claw on middle digit of manus 2.8–3.5 mm and 2.6%–3.8% of total length . . . *Cryptotis goldmani goldmani*
- Hairs on venter blond tipped; length of claw on middle digit of manus usually 3.6–3.8 mm and 3.0%–3.5% of total length *Cryptotis goldmani machetes*
24. U3 $\geq$ U4 in lateral view (Fig. 30); (i1 with long strip of pigment present on anteromedial edge [Fig. 26]) 25
- U3 < U4 in lateral view (Fig. 31) 27
25. Total length ≥ 120 mm; length of tail >50 mm; length of hind foot >13 mm; condylobasal length >18 mm; cranial breadth >8.3 mm; maxillary breadth ≥ 5.5 mm; length of U1–M3 ≥ 7.0 mm; length of unicuspid toothrow >2.5 mm; I1 with median tine above pigment (Fig. 4); i1 with 3 denticles, shallow interdenticular

Figs. 30–31. Rostra (right labial) of *Sorex* illustrating relationship of size differences of U3 and U4: 30, U3 $\geq$ U4 in lateral view; 31, U3 < U4 in lateral view.

- spaces (Fig. 25), and pigment in 2 sections; pelage color of body and tail uniformly very dark brown *Sorex sclateri*
- Total length <115 mm; length of tail <50 mm; length of hind foot ≤ 13 mm; condylobasal length <18 mm; cranial breadth ≤ 8.1 mm; maxillary breadth <5.4 mm; length of U1–M3 ≤ 6.5 mm; length of unicuspid toothrow <2.5 mm; I1 with median tine within pigment (Fig. 7); i1 with 2 denticles, shallow or deep interdenticular spaces (Figs. 24–25), and pigment in 1 section; hairs of pelage dark gray proximally on dorsum and venter; hairs on venter with a light-colored tip; hairs on tail markedly bicolored with medium brown dorsally and white ventrally 26
26. Deep interdenticular spaces on i1 (Fig. 24); hairs on dorsum with a wide, blond band medially and a narrow, dark brown tip giving the pelage an overall medium brown appearance; hairs on venter white tipped *Sorex arizonae*
- Shallow interdenticular spaces on i1 (Fig. 25); hairs on dorsum with a narrow, blond band medially and a narrow, dark brown tip giving the pelage an overall medium-dark brown appearance; hairs on venter blond tipped; (condylobasal length >16 mm); (maxillary breadth >5 mm); (least interorbital breadth >3.5 mm) *Sorex emarginatus*
27. Condylobasal length <17.9 mm 28
- Condylobasal length ≥ 17.9 mm; (length of U1–M3 ≥ 6.5 mm) 37
28. I1 with median tine usually above pigment (Figs. 4–5); (pigment of tine always separate from pigment on body of I1 [Figs. 4–5]) 29
- I1 with median tine within pigment (Fig. 7); (i1 with long strip of pigment present at antero-medial edge [Fig. 26]) 31
29. Cranial breadth >8.7 mm; maxillary breadth >5.5 mm; least interorbital breadth >4 mm; pigment on teeth pale orangish yellow; pigment on i1 in 1 section and no long strip of pigment present at anteromedial edge (Fig. 27); mental foramen located beneath center of m1; pelage uniformly reddish brown on dorsum, venter, and dorsal surface of tail; hips and rump with guard hairs extending 1 mm beyond dorsal pelage; hairs on tail slightly bicolored reddish brown dorsally *Sorex stizodon*
- Cranial breadth <8.5 mm; maxillary breadth <5.5 mm; least interorbital breadth <4 mm; pigment on teeth dark red; pigment on i1 in 1 or 2 sections, but includes denticles, and a long strip of pigment present at anteromedial edge (Figs. 24, 26); mental foramen located beneath anterior portion of m1; hairs on dorsum dark gray proximally, blond medially, and dark brown distally; pelage on venter variable, but different from dorsum; hips and rump with guard hairs extending 1.75–2.5 mm beyond dorsal pelage; tail usually sharply bicolored with dark brown hairs dorsally 30
30. Maxillary breadth >5 mm; U5 large; i1 with 2 denticles (Fig. 24) and pigment in 1 section; hairs on dorsum light reddish white medially with a short, dark brown tip; hips and rump with guard hairs uniformly dark except for scattered white ones present on sides; hairs on venter light red tipped *Sorex oreopolus*
- Maxillary breadth <5 mm; U5 very small; i1 with 3 denticles (Fig. 24) and pigment in 2 sections; hairs on dorsum white medially with a long, dark brown tip; hips and rump with guard hairs dark for proximal half and silver for distal half; some scattered, all-dark guard hairs present in lumbar region; hairs on venter white tipped *Sorex orizabae*
31. Geographic distribution on Baja California peninsula; (i1 with pigment in 1 section) 32
- Geographic distribution not including Baja California peninsula 34
32. Cranial breadth <7.5 mm; maxillary breadth ≤ 4.6 mm; head of coronoid processes straight; (geographic distribution restricted to Baja California) *Sorex ornatus juncensis*
- Cranial breadth ≥ 7.7 mm; maxillary breadth ≥ 4.6 mm; head of coronoid processes tipped anteriorly 33
33. Pelage on venter pale brown; hips and rump with black guard hairs extending 2 mm beyond dorsal pelage; hairs on tail light grayish brown; geographic distribution restricted to Baja California Sur *Sorex ornatus lagunae*
- Hairs on venter white tipped; hips and rump with light brown guard hairs extending 2 mm beyond dorsal pelage; tail strongly bicolored; geographic distribution restricted to Baja California *Sorex ornatus ornatus*
34. Maxillary breadth >4.95 mm; i1 with 2 denticles and shallow interdenticular spaces (Fig. 25); (i1 with pigment in 1 section) 35
- Maxillary breadth ≤ 4.95 mm; i1 with 3 denticles and deep interdenticular spaces (Fig. 24); (dorsal pelage light brown); (hips and rump with dark brown guard hairs extending 0.33 mm beyond dorsal pelage); (hairs on venter medium-dark gray proximal two-thirds and white distal one-third) 36
35. Hairs on dorsum light red medially with a dark brown tip; hips and rump with dark brown guard hairs extending 0.75 mm beyond dorsal pelage; hairs on venter dark gray proximal two-thirds and blond distal one-third; tail is distinctly bicolored *Sorex ventralis*

- Hairs on dorsum blond medially with a medium or dark brown tip; hips and rump with medium brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage; hairs on venter medium silvery gray proximal two-thirds and white distal one-third; tail may be uniform in color of dorsum or slightly bicolored *Sorex saussurei*
- 36. Maxillary breadth <4.5 mm; breadth across M2–M2 <4 mm; length of U1–M3 <4 mm; length of c1–m3 <4.5 mm; height of coronoid process <3.5 mm; angle of i1 from horizontal of mandibular ramus usually $\leq 5^\circ$; i1 with pigment in 3 sections; (condylobasal length <16 mm); (least interorbital breadth <3.5 mm) . . . *Sorex milleri*
- Maxillary breadth >4.5 mm; breadth across M2–M2 >4 mm; length of U1–M3 >4 mm; length of c1–m3 ≥ 4.9 mm; height of coronoid process >3.5 mm; angle of i1 from horizontal of mandibular ramus $\geq 8^\circ$; i1 with pigment in 1 section *Sorex monticolus*
- 37. Tail slightly bicolored; (I1 with median tine above pigment [Figs. 4–5]); (angle of i1 from horizontal ramus of dentary 5°); (i1 with 3 denticles [Fig. 24] and no long strip of pigment present at anteromedial edge [Fig. 27]); (hairs on dorsum medium silver gray for proximal two-thirds, blond for medial one-sixth, and dark brown for distal one-sixth giving pelage an overall dark brown appearance); (hairs on venter medium silvery gray for proximal two-thirds and medium-dark brown for distal one-third resulting in venter being only slightly paler than dorsum in overall appearance) *Sorex veraepacis chiapensis*
- Hairs on tail uniform in color of dorsal pelage . . . 38
- 38. Overall, large *Sorex*; condylobasal length >19 mm; cranial breadth >9.6 mm; i1 with 3 denticles (Figs. 24–25) and no long strip of pigment present at anteromedial edge (Fig. 27); (I1 with median tine above or within pigment [Figs. 4–7]) 39
- Small- to medium-sized *Sorex*; condylobasal length <19 mm; cranial breadth usually <9.6 mm; i1 with 2 or 3 denticles (Figs. 24–25) and a long strip of pigment may or may not be present at anteromedial edge (Figs. 26–27) 40
- 39. Pelage on dorsum very dark brown; pelage on venter only slightly paler than dorsum; hips and rump with dark brown guard hairs extending 1.5–1.8 mm beyond dorsal pelage; I1 with median tine above pigment (Figs. 4–5) *Sorex macrodon*
- Hairs on dorsum reddish blond medially with a dark brown tip; pelage on venter light reddish brown; hips and rump with pale reddish blond and dark brown guard hairs extending 2.2–2.8 mm beyond dorsal pelage; I1 with median tine within pigment (Fig. 7) . . . *Sorex veraepacis mutabilis*
- 40. Cranial breadth >9 mm 41
- Cranial breadth <9 mm 42
- 41. I1 with median tine at interface of unpigmented and pigmented areas (Fig. 6); (i1 with deep interdenticular spaces [Fig. 24]) *Sorex mediopua*
- I1 with median tine above pigment (Figs. 4–5) . . . 43
- 42. Hairs on dorsum reddish blond medially with a dark brown tip; hips and rump with pale reddish blond and dark brown guard hairs extending 2.2–2.8 mm beyond dorsal pelage; hairs on venter with light reddish brown tips; i1 with 3 denticles (Fig. 24); angle of i1 from horizontal ramus of dentary <6° *Sorex ixtilanensis*
- Hairs on dorsum dark gray for proximal three-fourths, light brown for medial one-eighth, and dark brown for distal one-eighth giving pelage an overall medium-dark reddish brown appearance; hips and rump with light brown guard hairs extending 1.7 mm beyond dorsal pelage; hairs on venter with white tips; i1 with 2 denticles (Fig. 24); angle of i1 from horizontal ramus of dentary 10° *Sorex veraecrucis oaxacae*
- 43. Length of tail >50 mm; (length of hind foot ≥ 14 mm); (cranial breadth ≥ 8.6 mm); (i1 with shallow interdenticular spaces [Fig. 25] and pigment in 1 section) *Sorex veraecrucis veraecrucis*
- Length of tail <50 mm 44
- 44. Length of hind foot ≥ 14 mm; cranial breadth ≥ 8.6 mm; i1 with shallow interdenticular spaces (Fig. 25) and pigment in 1 section; hips and rump with guard hairs extending 1.0–1.5 mm beyond dorsal pelage; (length of U1–M3 <6.9 mm) *Sorex veraecrucis altoensis*
- Length of hind foot <14 mm; cranial breadth <8.6 mm; i1 with deep interdenticular spaces (Fig. 24) and pigment in 2 sections; hips and rump with guard hairs extending 1.9 mm beyond dorsal pelage *Sorex veraecrucis cristobalensis*

SPECIES ACCOUNTS

TRIBE BLARININI (*Cryptotis*)

DIAGNOSIS.—Shrews of the tribe Blarinini are unique in having the labial ridge of the anteroposteriorly directed groove in the 2nd cusp of the I1 always pigmented and the lingual ridge usually pigmented. A tiny cusplet is located on the lingual side of each U1–U3. Also, the area between the condylar processes is shallowly emarginate, i.e., the breadth of the interarticular area is approximately equal to

that of the superior condylar process (Fig. 15; Carraway 1995). Further, Blarinini can be distinguished from Notiosoricini by the shield of the curly overhairs having a "... central ridge resulting from [2 or 3] rows of parallel C-shaped notches" with "... a superimposition of often two rather short notches" (Ducommun et al. 1994:630), no locking mechanism present in the upper glenoid furrow to hold the mandible in place (Carraway 2005), and dark pigment present on all teeth. Additionally, it can be distinguished from Soricini by a short tail $\leq 33\%$ of length of head and body, I1 with no median tine, 2nd cusp of I1 with an antero-posteriorly directed groove, and, in labial view, alveolus of i1 extending posteriorly beneath the paraconid of m1 in the mandible (Fig. 11).

GENERAL CHARACTERISTICS.—Pelage color of shrews in the tribe Blarinini ranges from light- to dark-colored gray or brown. The shrews range in size from the small *Cryptotis parva* to the large *Cryptotis magna*.

REMARKS.—The tribe Blarinini includes 2 extant genera, *Cryptotis* and *Blarina*, of which only *Cryptotis* is distributed in Mexico.

Cryptotis

ETYMOLOGY.—The generic name *Cryptotis* is derived from the Greek *kryptos* 'hidden' and *otos* 'ear'.

DIAGNOSIS.—In addition to the diagnostic characters presented for the tribe Blarinini, on the mandible of *Cryptotis*, the lower glenoid facet, which is displaced anteriorly to the upper glenoid facet, is partially visible in labial view. Also, the condyloid processes are slightly deflected labially. On the skull, the upper glenoid furrow is rotated 10° from the horizontal of the skull (Carraway 2005).

GENERAL CHARACTERISTICS.—All species in the genus *Cryptotis* have red-tipped teeth. Pelage colors range from medium to dark and condylobasal length ranges from 15.2 to 23.6 mm. Usually, 30 pigmented teeth, including 4 unicuspid teeth on each side of the upper jaw, are present. Occasionally, only 3 upper unicuspid teeth (Fig. 9) are present; thus, the total number of teeth would be 28. Usually, i1 with pigment in 1 section.

SYSTEMATICS.—With exception of *Cryptotis magna*, members of the genus *Cryptotis* distributed within Mexico have been divided into

the *C. mexicana*-group, the *C. parva*-group, and the *C. nigrescens*-group (Choate 1970, Woodman and Timm 1993, Woodman 2005). The first contains the species *mexicana*, *obscura*, *nelsoni*, *peregrina*, *phillipsi*, and the subgroup *C. goldmani* that contains the species *alticola*, *griseoventris*, *goldmani*, and *goodwini*. The second contains the species *parva* and *tropicalis*. The *mexicana*- and *parva*-groups are distributed primarily west of the Isthmus de Tehuantepec northward. The 3rd group, distributed primarily in Central America east of the Isthmus, contains several species of which only *mayensis* and *merriami* are distributed partly in southern Mexico. The relict species *C. magna* is not closely related to any extant species of *Cryptotis* (Choate 1970).

Relative to taxa in other *Cryptotis* species-groups, within the *mexicana*- and *goldmani*-groups, the forelimbs exhibit structural modifications in which the forefeet are broader and the foreclaws longer, with members of the latter group exhibiting the greatest enlargement (Woodman and Timm 1999, 2000). Additionally, structural modifications of the humerus considered diagnostic for members of these 2 species-groups were reported. It was noted that the forefeet of species within the *parva*-group did not exhibit any of these forelimb or forefoot modifications. Research into the nature of the structural modifications of the forefeet by use of a digital X-ray system illustrated how the enlargement of the forefeet occurred relative to each of the bones in the manus (Woodman and Morgan 2005). Research reported by these investigators supported the species-groups first proposed by Choate (1970). Herein, in Diagnosis and General Characteristics sections, I refer to members of the *mexicana*- and *goldmani*-groups as the long-clawed shrews and members of the *parva*-group as the short-clawed shrews.

Based on geographic areas containing the greatest number of species and subspecies with the greatest differentiation, and geographic distributions of species containing the most advanced characteristics, Choate (1970) stated that all of the primary and secondary species-groups within modern *Cryptotis* originated in and dispersed from southern Mexico. Furthermore, he stated that the *mexicana*-, *goldmani*-, and *parva*-groups originated west of the Isthmus de Tehuantepec and the *nigrescens*-group

originated east of the Isthmus. Thus, the Isthmus de Tehuantepec made a significant contribution to speciation in these groups by acting initially as a barrier to their movements. Subsequently, as climate and vegetation in the region of the Isthmus changed in the late Pleistocene, secondary movements of animals moving eastward or westward of the Isthmus allowed for further speciation to take place within these groups. However, presently, the 250-m-high Isthmus is a dry lowland that certainly would inhibit, if not eliminate, the movements of any soricids across the Isthmus. Woodman and Timm's (1999) findings support these conclusions.

DISTRIBUTION.—Shrews of the genus *Cryptotis* are distributed throughout much of the eastern United States and southward through the northeastern and all of the southern half of Mexico.

ADDITIONAL REFERENCES.—Ayala-Barajas et al. (1988), Brennan (1960:487), Traub and Berrera (1966:127–128, 138–139), Villa-R. and Cervantes (2003:27, 55), Whitaker and Morales-Malacara (2005:547, 623, 630), Woodman (2002:251).

REMARKS.—Choate (1970:211, fig. 3) described a “. . . reduction and specialization of the ectoloph of the 3rd upper molar in *Cryptotis*” from *C. magna* through *C. mexicana*, *C. parva pueblensis*, *C. alticola*, to *C. goodwini*. Upon examination of a series of specimens for each of these taxa, I found this character to be variable in its appearance within each taxon and not as clearly defined as Choate (1970) indicated.

Cryptotis alticola (Merriam, 1895a)—
Popocatepetl Shrew

Blarina alticola Merriam, 1895a:27. Type locality “Volcán Popocatepetl, 11,500 ft., México,” latitude 19.05°N, longitude 98.63°W.

Cryptotis alticola: Miller, 1912:27.

Cryptotis euryrhynchis: Genoways and Choate, 1967:203. Type specimen KU 107143, ♂, young adult, skin and skull with cranium crushed. Type locality “Volcan de Fuego, 9800 ft., Jalisco.”

Cryptotis goldmani alticola: Choate, 1970:245.

HOLOTYPE.—USNM 52047, ♂, adult, skin and skull.

ETYMOLOGY.—The specific name is in reference to the holotype being collected at a high elevation on Volcán Popocatepetl.

DIAGNOSIS.—*Cryptotis alticola* can be distinguished from *C. parva* and *C. obscura* by

greater condylobasal length 19.3–21.1 mm, and greater length (actual and relative) of claw on the middle digit of the manus 3.0–4.4 mm (2.9%–4.3% of total length). Further, *C. alticola* differs from *C. parva* by il with 2 denticles and deep interdenticular spaces (Fig. 24) and from *C. obscura* and *C. goldmani* by medium brown dorsal pelage and sharply pointed zygomatic processes (Fig. 22).

GENERAL CHARACTERISTICS.—*Cryptotis alticola* has a medium brown dorsal pelage, hairs on venter dark gray proximally with a white tip, and hairs on tail colored the same as the body. U4 is partially obscured or not visible in lateral view. The zygomatic processes extend posteriorly and ventrolaterally to below the occlusal surface of the teeth.

DISTRIBUTION.—An endemic to Mexico, *C. alticola* is known from portions of about an 18,000 km² area in Colima, Distrito Federal, Hidalgo, Jalisco, México, Michoacán, Morelos, and Puebla from 2460 to 4400 m elevation (Fig. 32; Fa 1989, Flores Vilella and Gerez 1994).

ECOLOGY.—*Cryptotis alticola* occurs at high elevations, usually in forests (Choate 1970). In Distrito Federal and Estado de México, *C. alticola* has been collected in a wet sedge and bunchgrass meadow in moss-lined *Microtus* runways (Davis 1944, Hooper 1957) and is common in temperate forests of pine, sacred fir, oak, and álamos (= ailes) with muhly bunchgrass (*Muhlenbergia macroura*; Ceballos González and Galindo Leal 1984). In Michoacán, this species occurs in disturbed pine–sacred fir (*Abies religiosa*) forests with a shrubby undergrowth of *Baccharis* (Álvarez and Sánchez-Casas 1997), and in pine–oak–fir forests with an undergrowth of muhly grass (Choate 1970). No reproductive information is available in the published literature.

Known mammalian associates include *Microtus mexicanus*, *Neotomodon alstoni*, *Peromyscus aztecus*, *P. difficilis*, *P. melanotis*, *Reithrodontomys chrysopsis*, *R. megalotis*, *R. sumichrasti*, *Sorex oreopolus*, and *S. saussurei* (Davis 1944, Fa et al. 1990, Ramírez-Pulido et al. 2004).

STATUS.—*Cryptotis alticola* is listed as protected under *C. goldmani alticola* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Alston (1879–1882:182), Álvarez et al. (1997:12–13), Barrera (1968:58–60, 64, 66, 98), Escalante et al. (2003:575), Goldman (1951:385, 398), Jones and Genoways (1969:130), Miller (1912:27), Miller and

Fig. 32. Distribution of 5 species of *Cryptotis* including 2 subspecies of *Cryptotis goldmani* in Mexico. Taxa are indicated by symbols in key.

Rehn (1901:248), Poole and Schantz (1942: 175), Ramírez-Pulido et al. (2000:152), Villa-R. (1953: 177), Villa-R. and Cervantes (2003:91), Whitaker and Morales-Malacara (2005:652), Woodman and Timm (1999:5), Woodman (2005: 524, 526–528, 534).

SPECIMENS EXAMINED ($n = 1467$; 29 measured).—**Colima:** Volcán de Fuego (LACM 29058). **Distrito Federal:** Ajusco, 11,000 ft (USNM 50763#); Cañón de Contreras, 10,200 ft (UMMZ 94597#); Cerro Santa Rosa, Contreras, 3200 m (CNMA 951); Parque Nacional “Desierto de los Leones,” 19°18'12"N, 99°18'24"W, 2870 m (UAMI 13208–14611, 14619); 0.85 km N, 3.5 km W Ecuanil, Cerro del Ajusco, 19°13'37"N, 99°15'37"W, 3180 m (UAMI 13210–13212); Santa Rosa, 3000 m (UMMZ 93367#). **Hidalgo:** 8 km N Tlanchinol, 1060 m (UAMI 14606–14607); 5 km N, 3 km E Tlanchinol, 21°01'23"N, 98°37'59"W, 1590 m (UAMI 14604–14605); 8 km N, 10 km E Tlanchinol, 1290 m (UAMI 14608–14609); 1.5 km S, 3.8 km W Tlanchinol, 20°57'53"N, 98°40'52"W, 1470 m (UAMI 13206); 2 km S, 3 km W Tlanchinol, 20°57'53"N, 98°40'52"W, 1470 m (UAMI 13207); 3 km S, 1 km W Tlanchinol, 1300 m (UAMI 14599–14603). **Jalisco:**

20 mi SE Autlán, 9000 ft (KU 111385#–111387#); Nevado de Colima, 10,800 ft (USNM 375689#–375690#); 12 mi SW Ciudad Guzmán, 10,000 ft (KU 112039#–112041#); Volcán de Fuego, 9800 ft (KU 107143). **México:** 3 mi S Bosencheve, Refugio San Cayetano, 8200 ft (UMMZ 102713); Lagunas de Zempoala, 9100 ft (USNM 329424#–329426#); 45 km ESE México City, Monte Río Frío (TCWC 1927#); Mt. Popocatepetl (USNM 52043#, 52045#–52046#, 52047T#); Salazar (USNM 50757#–50759#); 12 km S San Juan de las Huertas, 3850 m (CB 22675); N slope Volcán Toluca, 11,500 ft (USNM 55896#); 15.5 km S, 7 km W Zinacantepec, 3470 m (CB 19357). **Michoacán:** ca. 12 mi W Cd. Hidalgo, 9150 ft (KU 66280#); 17.5 km NW Ciudad Hidalgo, 2980 m (CB 26210); Mt. Tancítaro (USNM 125897#–125899#); Sierra Patamba, 9000 ft (KU 62311#). **Morelos:** Parque Nacional Lagunas de Zempoala, 2.3 km N, 6.8 km W Huitzilac, 2800 m (CB 40792). **Puebla:** Chignautla, [18°48'07"N, 97°23'30"W], 1910 m (UAMI 1455); Honey, 1990 m (UMMZ 89757–89758); 1.5 km SE Quimixtlán, [18°15'15"N, 97°05'15"W], 1810 m (UAMI 3725#); 10 km W San Martín, Texmelucan (C.E.E. San Juan Tetela), 3300 m

(CNMA 26548); 10 km W San Martín, Texmelucan (C.E.E. San Juan Tetela), 3400 m (CNMA 26545–26547); 10 km W San Martín, Texmelucan (C.E.E. San Juan Tetela), 3900 m (CNMA 26544); Tlatlauquitepec, [19°50'08"N, 97°29'09"W], 1910 m (UAMI 1221).

Cryptotis goldmani (Merriam, 1895a)—
Goldman's Small-eared Shrew

ETYMOLOGY.—The specific name is a patronymic honoring Dr. Edward Alphonso Goldman for his landmark work on the mammals of Mexico.

DIAGNOSIS.—*Cryptotis goldmani* can be distinguished from sympatric *Cryptotis* by greater length (actual and relative) of claw on the middle digit of the manus 2.8–3.8 mm (2.7%–3.8% of total length). Further, *C. goldmani* differs from *C. griseoventris* by light-tipped hairs on venter and i1 with deep interdenticular spaces; from *C. alticola* by dark brown dorsal pelage and elliptic zygomatic processes (Fig. 20); from *C. parva* by greater condylobasal length 18.7–20.7 mm, and i1 with 2 denticles and deep interdenticular spaces (Fig. 24); from *C. mayensis* and *C. peregrina* by U4 partially obscured or not visible in lateral view; and from *C. magna* by condylobasal length <21.0 mm and i1 with 2 denticles.

GENERAL CHARACTERISTICS.—*Cryptotis goldmani* has hairs of venter dark gray proximally with light-colored tips. It has a slightly bicolored tail. Individuals comprising populations of *C. goldmani* in Oaxaca and Guerrero have distinctive venter colors; therefore, I consider them distinct subspecies. All *C. goldmani* are considered members of the long-clawed *Cryptotis* of Mexico with the claw on the middle digit of the manus 3.2–3.8 mm (2.9%–3.6% of total length) for *C. g. machetes* and 2.7–3.5 mm (2.5%–3.8% of total length) for *C. g. goldmani*, respectively. The zygomatic processes extend posteriorly and ventrolaterally to below the occlusal surface of the teeth.

DISTRIBUTION.—An endemic to Mexico, *C. goldmani* is known from Guerrero and Oaxaca and possibly from far western Chiapas (Fig. 32; Fa and Morales 1993, Espinoza Medinilla et al. 2002).

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:53), Escalante et al. (2003:575), Flores Vilella and Gerez (1994:330), Villa-R. and Cervantes (2003:94), Whitaker and Morales-

Malacara (2005:652), Woodman (2005:523–530, 534).

Cryptotis goldmani goldmani
(Merriam, 1895a)

Blarina mexicana goldmani Merriam, 1895a:25. Type locality "Mts. near Chilpancingo, [10,000 ft.] Guerrero," latitude 17.51°N, longitude 99.54°W.

Cryptotis mexicana goldmani: Miller, 1912:27.

Cryptotis guerrensis Jackson 1933:80. Type specimen USNM 126895, ♀, skin and skull. Type locality "Omiteme [sic], Guerrero."

Cryptotis goldmani goldmani: Choate, 1970:247.

HOLOTYPE.—USNM 70244, ♂, young adult, skin and skull.

ETYMOLOGY.—The subspecific name is a patronymic honoring Dr. Edward Alphonso Goldman for his landmark work on the mammals of Mexico.

DIAGNOSIS.—*Cryptotis g. goldmani* can be distinguished from *C. g. machetes* by a venter pelage with white-tipped hairs.

DISTRIBUTION.—An endemic to Mexico, *C. g. goldmani* is known only from the Omiltemi area of Guerrero from ca. 1550 to 3000 m elevation (Fig. 32).

ECOLOGY.—*Cryptotis g. goldmani* occurs in high elevation fir forests characterized by a deep humus layer overlain with a considerable leaf layer (Davis and Lukens 1958) down into cloud forests (Choate 1970). In soft humus, burrows are constructed at depths to 10 cm and most commonly are associated with edges of logs. Also, according to specimen tags (TCWC 5573–5574), it occurs under rotting logs in dense woods of pine-oak forest. No reproductive information was found in published literature. No mammalian associates were found in published literature; however, P.L. Clifton (KU field notes and catalog 1964—reported by Woodman and Timm [1999]) did report collecting *Peromyscus aztecus*, *P. megalo-*
lops, and a *Reithrodontomys* species in the same habitat.

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12–13), Barrera (1958:90), Fa and Morales (1991:207), Goldman (1951:335, 398), Goodwin (1969:40), Jackson (1933:80), Jiménez Almaraz et al. (1993:523), León P. and Romo V. (1991:16), Lyon and Osgood (1909:238), Miller and Rehn (1901:248), Poole and Schantz (1942: 176–178), Ramírez-Pulido et al. (1983:15; 2000:153).

REMARKS.—Specimens of *C. g. goldmani* originally were referred to as either *C. g. goldmani* or *Cryptotis guerrerensis*. Both holotypes have a venter pelage composed of white-tipped hairs.

SPECIMENS EXAMINED ($n = 46$; 17 measured).—**Guerrero:** Camino a Chayotillo, Mpio. Chilpancingo, Omiltemi (MZFC 3483–3485, 3486#, 3487–3494); Mts. near Chilpancingo (USNM 70244T#); Mts. near Chilpancingo, 9600 ft (USNM 70245#); Mts. near Chilpancingo, 9700 ft (USNM 70243#); Mts. near Chilpancingo, 9800 ft (USNM 70247#); El Iris, Mpio. Tlacotepec, 2300 m (MZFC 3481–3482); 7 mi SW Filo de Caballo [= Puerto General Nicolás Bravo], 8200 ft (TCWC 41948#, 41949); Las Trincheras, Omiltemi, Mpio. Chilpancingo (MZFC 3480); Los Retrocesos, Mpio. Atoyac de Álvarez, 1550 m (MZFC 3485); Omiltemi, 2450 m (CNMA 29471, 32006; LACM 74156–74159; USNM 126897, 127500); Omiltemi, 7300 ft (KU 98725#–98727#; USNM 126895T#, 126896#, 126947#, 127506#); Omiltemi, Mpio. Chilpancingo, 2268 m (CNMA 40201); 2 mi W Omiltemi, 7900 ft (TCWC 5665, 5573#–5574#, 5575); 3 mi W Omiltemi, 8200 ft (MVZ 113491#); 0.5 km NW Omiltemi, Mpio. Chilpancingo, 2198 m (CNMA 40200); 3 mi NW Omiltemi, 2300 m (USNM 329427#); Retrocesos, Mpio. Atoyac (MZFC 3486).

ADDITIONAL SPECIMENS.—**Guerrero:** S slope Cerro Teotepec, 3150 m (UMMZ 114710—Woodman and Timm 1999).

Cryptotis goldmani machetes
(Merriam, 1895a)

Blarina mexicana machetes Merriam, 1895a:26. Type locality “Mts. near Ozolotepec, Oaxaca,” latitude 16.09°N, longitude 96.31°W.

Blarina fossor: Merriam, 1895a:28. Type specimen USNM 68545, ♀, skin and skull. Type locality “Mt. Zempoaltepec, Oaxaca.”

Cryptotis frontalis Miller, 1911:222. Type specimen USNM 123429, sex unknown, skull cleaned, skin in alcohol. Type locality “Tehuantepec, Oaxaca.”

Cryptotis mexicana machetes: Miller, 1912:27 (in part).

Cryptotis fossor: Miller, 1912:28.

Cryptotis m. mexicana: Jones and Genoways, 1967:321 (in part).

Cryptotis goldmani goldmani: Choate, 1970:247 (in part).

HOLOTYPE.—USNM 71456, ♀, young adult, skull.

ETYMOLOGY.—The subspecific name is derived from the Greek *machetes* ‘a fighter’.

DIAGNOSIS.—*Cryptotis g. machetes* can be distinguished from *C. g. goldmani* by a venter pelage with blond-tipped hairs.

DISTRIBUTION.—An endemic to Mexico, *C. g. machetes* is known primarily from Oaxaca from 2250 to 3200 m elevation (Fig. 32). One record from La Reserva de la Biosfera La Sepultura, Chiapas (Espinoza Medinilla et al. 2002) is mentioned, but could not be confirmed.

ECOLOGY.—*Cryptotis g. machetes* occurs in areas with damp leaf litter and humus along streams with moss-covered rotting logs overgrown with dense herbaceous vegetation, ferns, and shrubs with an overhead open-canopy of oaks and other deciduous trees (Musser 1964). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis peregrina*, *C. phillipsi*, *Microtus mexicanus*, *Oryzomys chapmani*, *Peromyscus megalops*, *Reithrodontomys mexicanus*, *Rattus* sp., *Sorex veraecrucis oaxacae*, and *S. veraepacis mutabilis* (P.B. Robertson KU field notes and catalog 1970—reported by Woodman and Timm 1999; Schaldach 1966).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12–13), Briones-Salas and Sánchez-Cordero (2004:436), Goldman (1951:398), Goodwin (1969:40–41, 43), Lyon and Osgood (1909:238), Miller and Rehn (1901:248–249), Poole and Schantz (1942:176, 178), Ramírez-Pulido et al. (1983:15; 2000:153), Villa-R. (1953:177), Villa-R. and Cervantes (2003:96).

REMARKS.—Specimens of *C. g. machetes* originally were referred to as either *C. fossor*, *C. frontalis*, or *C. mexicana machetes*. All 3 holotypes have a venter pelage composed of blond-tipped hairs.

SPECIMENS EXAMINED ($n = 17$; 10 measured).—**Oaxaca:** Cerro Zempoaltepec, 4.5 km N Santa María Yacochi, Mpio. Tehuantepec, 2450 m (CNMA 33601–33602); Distrito Ixtlán, Comaltepec, Vista Hermosa (KU 143749#); Mt. Zempoaltepec (USNM 68531#, 68542, 68545T#, 68547#, 71454–71455, 71459–71460); Mts. near Ozolotepec (USNM 71456T#, 71457#–71458#); Campamento Río Molino, 2300 m (KU 124278#, 124301#); near Tehuantepec (USNM 123429T#).

ADDITIONAL SPECIMENS.—**Chiapas:** La Reserva de la Biosfera La Sepultura (Espinoza Medinilla et al. 2002). **Oaxaca:** Puerto Ángel Rd., lumber camp, km 158, 8375 ft (CAS

15477—Woodman and Timm 1999); Mixteguilla, ca. 500 ft (2 AMNH), San Juan Ozolotepec, ca. 7500 ft (1 AMNH), San Miguel Suchitepec, ca. 9000 ft (2 AMNH—Choate 1970); near Tehuantepec City (Villa-R. 1953).

Cryptotis goodwini Jackson, 1933—
Goodwin's Small-eared Shrew

Cryptotis goodwini Jackson, 1933:81. Type locality "Calel, 10,200 ft, Guatemala," latitude 15.07°N, longitude 91.57°W.

Cryptotis nigrescens: Burt and Stirton, 1961:21 (in part).
C[ryptotis]. goodwini Musser, 1964:7.

HOLOTYPE.—USNM 77074, ♂, adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Dr. George G. Goodwin for his work on mammals of Latin America.

DIAGNOSIS.—*Cryptotis goodwini* can be distinguished from sympatric *Cryptotis* by condylobasal length ≥ 21.0 mm and greater length (actual and relative) of claw on the middle digit of the manus 3.7 mm (3.4% of total length). Further, *C. goodwini* differs from *C. griseoventris* by i1 with deep interdenticular spaces (Fig. 24), height of coronoid process 4.7–4.8 mm, length from upper articular condyle to posterior edge of m3 5.4–6.0 mm, and length of coronoid–posterior point of upper condylar facet 4.0–4.7 mm; and from *C. griseoventris* and *C. mexicana* by sharply pointed zygomatic processes (Fig. 20). Also, *C. goodwini* differs from *C. tropicalis* by its overall larger size: condylobasal length 21.0–22.8 mm, palatilar length 9.3 mm, maxillary breadth 7.2 mm, length of U1–M3 8.0 mm, length of unicuspid tooththrow 3.1 mm, breadth across M2–M2 6.6 mm, length of mandible 10.0–11.0 mm, length of mandibular tooththrow 6.5–6.8 mm, height of coronoid process 4.7–4.8 mm, height of articular condyle 4.0–4.3 mm, height of coronoid valley 3.0–3.1 mm, and length from upper articular condyle to posterior edge of m3 5.4–6.0 mm.

GENERAL CHARACTERISTICS.—*Cryptotis goodwini* has a dark brown dorsal pelage, paler brown venter with a silvery shine, and a slightly bicolored tail. Of the long-clawed *Cryptotis* of Mexico, *C. goodwini* has a medium-length claw (3.7 mm long, 3.4% of total length) on the middle digit of the manus. U4 is partially obscured or not visible in lateral view. The zygomatic processes extend posteriorly and ventrolaterally to below the occlusal

surface of the teeth (Fig. 21). The i1 has 2 denticles (Fig. 24).

DISTRIBUTION.—*Cryptotis goodwini* occurs within Nuclear Central America from Chiapas south into Honduras from 900 to 3400 m elevation (Fig. 32; Woodman and Timm 1999).

ECOLOGY.—*Cryptotis goodwini* occurs in tropical, humid montane forests of pine, pine-oak, and mixed forests including cypress, particularly along the continental slope of the Gulf of Mexico of the Sierra Madre de Chiapas (Hutterer 1980, Horvath et al. 1999–2000, Escalante et al. 2003). Habitats include an abundance of grass and moss groundcover. In the Reserva Ecológica El Triunfo (2000 m), Chiapas, *C. goodwini* occurs in montane cloud forests dominated by *Cedrela mexicana*, *Matudaea trinervia*, and *Quercus* sp. (including *Q. crispifolia*—Medellín 1988). At its most northern known point of occurrence, *C. goodwini* was found along an arroyo with semiflat terrain surrounded on either side by sharply sloping montane peaks (Horvath et al. 1999–2000). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis parva pueblensis*, *Heteromys goldmani*, *Marmosa mexicana*, *Nyctomys sumichrasti*, *Oryzomys couesi*, *O. alfaroi*, *Peromyscus aztecus oaxacensis*, *P. boylii*, *P. guatemalensis*, *P. mexicanus*, *Reithrodontomys megalotis*, *R. mexicanus*, *Sorex veraecrucis cristobalensis*, and *S. veraepacis chiapensis* (Hutterer 1980, Medellín 1988, Espinoza Medinilla et al. 1998, Horvath et al. 1999–2000).

ADDITIONAL REFERENCES.—Aranda and March (1987:143), Arita and Ceballos (1997:53), Poole and Schantz (1942:176), Ramírez-Pulido et al. (1983:15; 2000:153), Whitaker and Morales-Malacara (2005:652), Woodman (2005:523–530, 534).

SPECIMENS EXAMINED ($n = 2$; 2 measured).—**Chiapas:** 17 km SE Finca La Prusia [= Reserva de la Biosfera El Triunfo], Mpio. Jaltenango, 2000 m (CNMA 22784#). **Guatemala:** Calel (USNM 77074T#).

ADDITIONAL SPECIMENS.—**Chiapas:** 31 km S, 24 km W La Independencia, Municipio de La Concordia, 15°47'25"N, 93°03'52"W, 1240 m (ECOSUR 986 [Colección Mastozoológica, El Colegio de la Frontera Sur, San Cristóbal de Las Casas, Chiapas]—Horvath et al. 1999–2000); near Catarina, Sierra Madre de Chiapas,

1500 m (ZFMK [Museum Alexander Koenig, Bonn, Germany] 63.484).

Cryptotis griseoventris Jackson,
1933—Dark Mexican Shrew

Cryptotis griseoventris Jackson, 1933:80. Type locality "San Cristobal, Chiapas [= San Cristóbal de las Casas, 9500 ft]," latitude 16.75°N, longitude 92.63°W.

Cryptotis goldmani goldmani: Choate, 1970:247 (in part).

HOLOTYPE.—USNM 75894, ♂, young adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Middle Latin *griseus* 'gray' in reference to the uniformly very dark gray venter and the Latin *ventris* 'belly'.

DIAGNOSIS.—*Cryptotis griseoventris* can be distinguished from sympatric *Cryptotis* by a uniformly dark brownish-gray venter pelage, i1 with moderately deep interdenticular spaces (Fig. 24), and condylobasal length 19.4–20.7 mm. Further, *C. griseoventris* differs from *C. merriami* by greater length (actual and relative) of claw on the middle digit of the manus, 2.5–3.2 mm (2.3%–2.9% of total length), palatilar length ≥ 8.3 mm, length of mandible ≥ 9.0 mm, length from upper articular condyle to posterior edge of m3 4.8–5.2 mm, and zygomatic processes medium-large to elliptic (Fig. 23) that extend posteriorly and ventrolaterally to halfway to level of occlusal surface of teeth; from *C. parva* and *C. tropicalis* by medium-large to elliptic zygomatic processes; and from *C. goodwini* by length of claw on the middle digit of the manus < 3.5 mm, height of coronoid process usually 4.1–4.3 mm, length from upper articular condyle to posterior edge of m3 4.8–5.2 mm, and length of coronoid-posterior point of upper condylar facet usually 3.4–3.8 mm. Additionally, *C. griseoventris* can be distinguished from *C. tropicalis* by palatilar length 8.5–9.5 mm, maxillary breadth 5.9–6.4 mm, length of U1–M3 7.4–8.0 mm, length of unicuspid toothrow 2.5–3.0 mm, and length of mandibular toothrow usually 5.7–6.1 mm.

GENERAL CHARACTERISTICS.—*Cryptotis griseoventris* has a very dark brownish gray dorsal pelage and slightly bicolored tail. U4 is partially obscured or not visible in lateral view. The i1 has 2 denticles (Fig. 24).

DISTRIBUTION.—*Cryptotis griseoventris* occurs within Nuclear Central America from Chiapas south into Guatemala to at least 2600 m elevation (Fig. 32; Woodman and Timm 1999, Escobedo-Morales et al. 2006).

ECOLOGY.—*Cryptotis griseoventris* occurs in the Chiapan Highlands in high elevation pine- and fir-dominated forests with frosty nights and in oak-dominated cloud forest (Goldman 1951). No reproductive information or mammalian associates were found in published literature.

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Álvarez del Toro (1977:20), Ramírez-Pulido et al. (2000:153), Villa-R. (1953:177), Whitaker and Morales-Malacara (2005:652), Woodman (2005:524, 526–530, 534).

SPECIMENS EXAMINED ($n = 16$; 15 measured).—**Chiapas:** San Cristóbal [= San Cristóbal de Las Casas] (USNM 75886#–75893#, 75894T#, 75895); Mpio. Ocosingo, Yaxchilán (MZFC AEM177#, AEM265#); Volcán Kagchiná, ca. 3.5 km N Las Margaritas, 4900 ft (MHP 8779# [4 specimens from owl pellets]).

ADDITIONAL SPECIMENS.—**Chiapas:** 6 mi SE San Cristóbal Las Casas (MCZ [Museum of Comparative Zoology, Harvard University] 48061—Woodman and Timm 1999).

Cryptotis magna (Merriam,
1895a)—Big Small-eared Shrew,
Big Mexican Shrew

Blarina magna Merriam, 1895a:28. Type locality "Totontepec, 6,800 ft, Oaxaca," latitude 17.22°N, longitude 95.98°W.

Cryptotis magna: Miller, 1912:28.

HOLOTYPE.—USNM 68575, ♂, old adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Latin *magnus* 'great' in reference to its large size.

DIAGNOSIS.—*Cryptotis magna* can be distinguished from sympatric *Cryptotis* by hairs on tail uniformly dark brown, i1 with 3 denticles (Fig. 24), and greater overall size: total length > 123 mm, length of tail > 40 mm, and condylobasal length 21.6–23.6 mm.

GENERAL CHARACTERISTICS.—*Cryptotis magna* is a dark brown shrew with the venter only slightly paler than the dorsal pelage. Length of claw (2.4–3.3 mm) on the middle digit of the manus is intermediate in length among *Cryptotis*; however, relative to total length the claw is short (1.9%–2.4% of total length). U4 is partially obscured or not visible in lateral view. The zygomatic processes are bulbous and extend posteriorly and ventrolaterally to below the occlusal surface of the

Fig. 33. Distribution of *Cryptotis magna* and 3 subspecies of *C. parva* in Mexico. Taxa are indicated by symbols in key. Collection site of a fossil *C. p. berlandieri* is indicated by an open star (☆).

teeth (Fig. 23). The i1 has deep interdenticular spaces (Fig. 24).

DISTRIBUTION.—An endemic to Mexico, *C. magna* is known only from Oaxaca from ca. 1500 to 2850 m elevation (Fig. 33; Choate 1970, Ramírez-Pulido and Britton 1981, Fa and Morales 1993, Flores Villela and Gerez 1994, Illoldi-Rangel et al. 2004).

ECOLOGY.—*Cryptotis magna* occurs within the ecosystem referred to as the Humid Upper Tropical Subzone (Goldman 1951) characterized by wet, dense herbaceous cover located in dense, cool cloud forests of pine-oak or oak with scattered conifers, and abundant philodendrons and tree ferns (Musser 1964, Jones and Genoways 1967, Goodwin 1969, Choate 1970, Rickart 1977). As of 2005, only 72.48% of habitat considered suitable for *C. magna* habitation (i.e., habitat unmodified for agriculture or urban development) still existed (Sánchez-Cordero et al. 2005).

A pregnant female (KU 124282) with 3 embryos (uterine swellings 2 mm) was collected 18 May 1970.

Known mammalian associates include *Cryptotis m. mexicana*, *Habromys chinanteco*, *H. lepturus*, *Heteromys desmarestianus lepturus*,

Megadontomys cryophilus, *Microtus mexicanus*, *M. oaxacensis*, *Oryzomys alfaroi*, *O. chapmani*, *Peromyscus boylii*, *P. furvus*, *P. melanocarpus*, *P. mexicanus*, *Reithrodontomys mexicanus*, *R. microdon albilabris*, *Sorex veraecrucis oaxacae*, and *S. veraepacis mutabilis* (Musser 1964, Jones and Genoways 1967, Robertson and Rickart 1975, Rickart 1977, Ramírez-Pulido et al. 2004).

STATUS.—*Cryptotis magna* is listed as a protected species (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12), Arita and Ceballos (1997:53), Briones-Salas and Sánchez-Cordero (2004:436), Ceballos and Navarro L. (1991:178), Escalante et al. (2003:575), Lyon and Osgood (1909:238), Miller and Rehn (1901:249), Poole and Schantz (1942:177), Ramírez-Pulido et al. (1983:15; 2000:153), Villa-R. and Cervantes (2003:91), Whitaker and Morales-Malacara (2005:652), Woodman (2005:523–530, 534), Woodman and Timm (1993:9, 15, 19, 23, 26, 29).

SPECIMENS EXAMINED ($n = 62$; 40 measured).—**Oaxaca:** N slope Cerro Pelón, 31.6 km (by road) S Vista Hermosa, 2650 m (KU 124290#); Cerro Zempoaltepetl, 4.5 km N Santa María Yacoohi, Mpio. Tlaxiaco, 2450 m

(CNMA 33609); Comedor La Cabana (km 134 Tuxtepec, Oaxaca) y 13 km W Atepec, Mpio. Atepec, 2820 m (FMNH 141789#); La Esperanza, [17°36'34"N, 96°12'28"W], 1430 m (UAMI 10152#); 1 km N La Esperanza, Mpio. Santiago Comaltepec, 1525 m (CNMA 29437); 2.5 km N, 1 km E La Esperanza, 17°35'12"N, 96°23'29"W, 1850 m (UAMI 13212#–13213#); 11 km SW La Esperanza, camino lodoso hacia San Isidro, Mpio. Santiago Comaltepec, 2000 m (CNMA 29438#, 29439, 29441–29443, 29444#–29445#, 29446, 29447#–29448#, 29449–29455, 29456#–29460#, 29461, 29463, 24965; FMNH 141790#); Distrito Ixtlán, 16 mi WSW La Esperanza (TCWC 41950#–41952#); Llano de las Flores, 2900 m (KU 121407#–121409#); Llano de las Flores, km 132 Tuxtepec-Oaxaca, Mpio. Atepec, 2750 m (CNMA 29823); 13 mi NE (Tuxtepec road) Llano de las Flores, near Cerro Pelón, 9200 ft (UMMZ 112573#); 27.5 km (by road) NNE Llano de Las Flores, Hwy 175 (CNMA 29468–29469; LACM 74164–74165); 1.3 mi S Llano de las Flores (MZFC 5781#); Mt. Zempoaltepec, 8000 ft (USNM 68565#); Totontepec, 6800 ft (USNM 68575T#); Vista Hermosa, 1600 m (KU 99539#); Vista Hermosa, 5200 ft (KU 99540#); 2.3 km (by road) S Vista Hermosa, 1560 m (KU 136577#); 3.5 km (by road) N Vista Hermosa, 1360 m (KU 121659#); 12 km (by road) S Vista Hermosa, 1920 m (KU 124282#, 124285#–124287#); 28.6 km (by road) S Vista Hermosa, 2350 m (KU 124289#); 3.5 mi SSW Vista Hermosa, 6200 ft (KU 99541#); 21 km (by road) S Vista Hermosa, 2080 m (KU 136576#); 6.5 mi SSW Vista Hermosa, 7100 ft (KU 99542#); 6.5 mi SSW Vista Hermosa, 7100 ft (KU 99544#); 12 mi SSW Vista Hermosa, 9300 ft (KU 99545#).

ADDITIONAL SPECIMENS.—**Oaxaca:** S slope Cerro Pelón, 9200 ft (Musser 1964); 10.5 km S Vista Hermosa, 1850 m (Robertson and Rickart 1975).

Cryptotis mayensis (Merriam, 1901)—
Maya Small-eared Shrew

Blarina mayensis Merriam, 1901, 3:559. Type locality "Ruina Maya de Chichén-Itzá, Yucatán," latitude 20.67°N, longitude 88.57°W.

Cryptotis mayensis: Miller, 1912:26.

Blarina mexicana: Gaumer, 1917:249 (in part).

Cryptotis micrura: Murie, 1935:17 (in part).

Cryptotis nigrescens mayensis: Choate, 1970:275.

HOLOTYPE.—USNM 108087, ♀, subadult, skin and skull.

ETYMOLOGY.—The specific name is in reference to the Mayan culture.

DIAGNOSIS.—*Cryptotis mayensis* can be distinguished from sympatric *Cryptotis* by dark gray dorsal pelage and U4 completely visible in lateral view. Further, *C. mayensis* differs from sympatric *Cryptotis*, except *C. merriami*, by zygomatic processes that extend dorsolaterally at the level of the alveoli of M2 and M3 (Fig. 22) as for *Sorex*; from *C. goldmani* by length of claw on the middle digit of the manus 1.5–1.6 mm (1.2%–1.6% of total length), cranial breadth ≤ 9.6 mm, and sharply pointed zygomatic processes (Fig. 22); and from *C. tropicalis* by breadth across M2–M2 5.0–5.3 mm.

GENERAL CHARACTERISTICS.—*Cryptotis mayensis* has a venter slightly paler gray than the dorsal pelage and hairs on tail colored as for venter. Condylbasal length is 18.95 mm for the holotype. The i1 has 2 denticles and deep interdenticular spaces (Fig. 24).

DISTRIBUTION.—*Cryptotis mayensis* is known from Campeche, Quintana Roo, and Yucatán of the Yucatán Peninsula in lowland areas <100 m elevation and from owl pellets in the Balsas Basin, Guerrero (Fig. 32; Choate 1970; Flores Villela and Gerez 1994). Choate (1970:277) postulated 3 explanations for the disjunct distribution of this species. First is that the specimens from Guerrero represent a subspecies distinct from *C. mayensis* on the Yucatán Peninsula. Woodman and Timm (1993:11) examined the morphology of these 2 groups of specimens by use of multivariate analyses and were unable to determine even minor differences between specimens of *C. mayensis* from Guerrero and the Yucatán Peninsula. My comparisons of morphological data between these 2 groups of specimens concur with their results. Second, in the Pleistocene-Holocene *C. mayensis* was "... represented by populations inhabiting low, arid regions ranging continuously from the Balsas Basin along valleys and plains across the mountains of Oaxaca, and finally to the Yucatán Peninsula" many of which have been eliminated over time due to changes in climate and vegetation (Choate 1970:277). And, third, that populations of *C. mayensis* currently occur "... throughout the Balsas Basin, along the relatively arid Pacific coast of México southeast of the mouth of the Río Balsas, thence across the isthmus to the Gulf coastal

plains, and finally to the Yucatan Peninsula" (Choate 1970: 277). Choate (1970) then hypothesized that the lack of intervening populations between Guerrero and the Yucatán Peninsula simply results from a lack of collection effort. Refer to Woodman and Timm (1993) for further discussion of these hypotheses.

ECOLOGY.—Within the Yucatán Peninsula, *C. mayensis* is the only shrew to be found in the "seasonally dry" lowlands (Choate 1970, Woodman 1995:223). It is considered a species characteristic of the Peninsula de Yucatán tropical dry forest characterized by arid, lowland tropical deciduous forests (Escalante et al. 2003). In Campeche it occurs in "mature, transitional deciduous-evergreen forest[s]" (Dowler and Engstrom 1988:161) "dominated by escoba palms (*Cryosophila*) and *Sabal* palms" (Woodman and Timm 1993:10). In Yucatán, a number of specimens have been found in owl pellets (Hatt 1938) or mummified in Mayan ruins (Álvarez and Martínez Guerrero 1967). One specimen was collected in "... mixed grass and dense weeds ..." near the Mérida airport (Jones et al. 1974). In Quintana Roo, *C. mayensis* was collected "... along side of a road in tropical rain forest, opposite a cornfield ..." (Álvarez and Martínez Guerrero 1967:205). No reproductive information was found in published literature.

Known mammalian associates include *Grisson canaster*, *Heteromys gaumeri*, *Marmosa mexicana mayensis*, *Mus musculus*, *Oryzomys melanotis*, *Ototylomys hatti*, *O. phyllotis*, and *Peromyscus yucatanicus* (Hatt 1938, Jones et al. 1974, Dowler and Engstrom 1988).

STATUS.—*Cryptotis mayensis* is listed as protected under *C. nigrescens mayensis* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12), Arita and Ceballos (1997:53), Barrera (1968:56), Hall (1981:63), Hall and Kelson (1959:61), Hatt (1953:59), Hershkovitz (1951:552), Lyon and Osgood (1909:238), Miller (1912:26–27), Poole and Schantz (1942:177), Ramírez-Pulido and Sánchez-Hernández (1972:108), Ramírez-Pulido et al. (1983:15; 2000:153), Villa-R. (1948:498), Villa-R. and Cervantes (2003:98), Whitaker and Morales-Malacara (2005:652), Woodman (2005:524).

SPECIMENS EXAMINED ($n = 65$; 8 measured).—**Campeche:** 60 km SE Dzibalchén (19°10'N, 89°20'W) (ASNHC 6071#); 7.5 km

W Escárcega (ASNHC 1286#); La Tuxpana, Champotón [= La Tuxpeña; a small port located ca. 30 mi. SW Campeche] (USNM 170862#). **Guerrero** (all specimens from owl pellets): Cueva del Cañón del Zopilote, 13 km S Puente Mezcala, 650 m (CNMA 11031–11043); 13 km S Puente Mezcala, 720 m (CNMA 12666–12692 [12666–12691 consist of rostral regions, 12692 consists of 5 left mandibles and 8 right mandibles]). **Quintana Roo:** 2 km SE Laguna Chichancanab [= Chickannaab] (CB 1240); 6 km S, 1.5 km W Tres Garantías (ASNHC 6441#). **Yucatán:** Chichen-Itzá, ca. 75 ft (USNM 108087T#); 6 km S Mérida (KU 91463#); SW de Dzilán de Bravo, Mpio. Dzilán de Bravo, 500 m (CNMA 23796–23801); 13 km W Peto (KU 143892#); Tzucacab, R. Hobonil, km 6 carr. Tzucacab-Catmís, 2 km SW, 20°00'55"N, 89°02'25"W (COZORE-Y 460–461, 500); Xbac (USNM 173000#).

ADDITIONAL SPECIMENS.—**Yucatán:** Actun Spukil[☆], ca. 200 ft (AMNH); SW Dzilam de Bravo (Woodman and Timm 1993); 2.5 km NW Dzityá (6 CNMA—Woodman and Timm 1993); Mayan ruins at Uxmal (Laboratorio de Paleozoología, Departamento de Prehistoria, INAH 410–411, 1 mummified shrew and 18 right and 17 left mandibular rami—Álvarez and Martínez Guerrero [1967]); Buctzotz, Calotmul, Izamal, Nabalám, Cenotillo, Temax, Tzalam, and Valladolid (Gaumer 1917).

Cryptotis merriami Choate, 1970— Merriam's Small-eared Shrew

Cryptotis nigrescens: Goodwin, 1942:117 (in part).

Cryptotis nigrescens merriami Choate, 1970:227. Type locality "Jacaltenango, 5400 ft, Huehuetenango, Guatemala," latitude 15.67°N, longitude 91.73°W.

Cryptotis nigrescens nigrescens: Choate, 1970:279 (in part).

Cryptotis merriami: Woodman and Timm, 1993:14. Type locality "Irazu Rangen (= Volcán de Irazu), Costa Rica."

HOLOTYPE.—USNM 77050, ♀, adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Dr. Clinton Hart Merriam who was the first to describe the shrews now referred to the genus *Cryptotis* (Choate 1970).

DIAGNOSIS.—*Cryptotis merriami* can be distinguished from sympatric *Cryptotis*, except *C. mayensis*, by zygomatic processes that extend dorsolaterally at the level of the alveoli of M2 and M3 (Fig. 22) as for *Sorex*; it can be distinguished from *C. mayensis* by U4 partially obscured or not visible in lateral view. Further,

Fig. 34. Distribution of 7 species of *Cryptotis* in Mexico. Taxa are indicated by symbols in key.

C. merriami differs from *C. goodwini*, *C. griseoventris*, *C. mexicana*, and *C. tropicalis* by pale gray venter pelage; from *C. mexicana* by sharply pointed zygomatic processes (Fig. 22); from *C. goodwini* and *C. griseoventris* by condylobasal length <20.0 mm, length from upper articular condyle–posterior edge of m3 4.3 mm ($n = 1$), and length of the claw on the middle digit of the manus <2.0 mm (1.5% of total length); and from *C. griseoventris* by palatilar length ≤ 8.2 mm, length of mandible <8.5 mm, and i1 with deep interdenticular spaces (Fig. 24). Additionally, *C. merriami* can be distinguished from *C. parva pueblensis* by i1 with 2 denticles and deep interdenticular spaces (Fig. 24), and greater length, but not width, of skull: condylobasal length 18.8–19.8 mm, palatilar length 7.5–8.2 mm, and length of U1–M3 7.0–7.1 mm. With the exception of having a taller height of the condylar process (4.1–4.7 mm), overall, the mandible of *C. merriami* is smaller than for *C. tropicalis*: breadth across M2–M2 5.0–5.5 mm, length of mandible 7.9–8.3 mm, length from upper articular condyle to posterior edge of m3 4.3 mm ($n = 1$), height of coronoid valley 2.4–2.6 mm, height of the articular condyle 3.2–3.5 mm, length of coronoid–ventral point of lower condylar facet 3.7–4.3 mm, and length

of coronoid–posterior point of upper condylar facet 3.5–4.0 mm.

GENERAL CHARACTERISTICS.—*Cryptotis merriami* has a medium blackish gray dorsal pelage, pale gray venter, and tail slightly bicolored as for the body.

DISTRIBUTION.—*Cryptotis merriami* occurs within Nuclear Central America from the Mesa Central of Chiapas south throughout Central America from 975 to 1650 m elevation (Fig. 34; Flores Villela and Gerez 1994, Woodman and Timm 1993).

ECOLOGY.—Habitats in the Mesa Central biotic province of Chiapas were described as being dry with scrubby, thin pine-oak forest over high, porous limestone ridges with intervening valleys where corn and wheat are grown (Goldman 1951). Whether these habitats represent those occupied by *C. merriami* is unknown. However, throughout Central America, Merriam's small-eared shrews occur in highland areas (975–1650 m) “. . . in evergreen, broadleaf and pine-oak forest and cultivated areas near forest” (Reid 1997:67). No reproductive information or mammalian associates were found in published literature.

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:53), Hall (1981:63), Ramírez-Pulido

et al. (1983:15), Whitaker and Morales-Malacara (2005:652), Woodman (2005:525).

SPECIMENS EXAMINED ($n = 1$; 1 measured).—**Guatemala:** Jacaltenango, 5400 ft (USNM 77050T#).

ADDITIONAL SPECIMENS.—**Chiapas:** Templo Olvidado, Palenque (4 left and right mandibles and 1 premaxilla excavated from cave deposits—Ocaña Marin 1997); Volcán Kagchiná, ca. 4900 ft (6 specimens) and Cueva Los Llanos, ca. 4900 ft (3 specimens—Choate 1970:279).

Cryptotis mexicana (Coues, 1877)—
Mexican Small-eared Shrew

Blarina [*Soriciscus*] *mexicana* Coues, 1877:652. Type locality "Jalapa [= Xalapa], Veracruz," latitude 19.51°N, longitude 96.91°W.

Blarina mexicana: True, 1884:606.

Cryptotis mexicana: Miller, 1911:221.

Cryptotis mexicana mexicana Miller, 1912:26.

HOLOTYPE.—USNM 3525/4438, sex unknown, subadult, skin and skull.

ETYMOLOGY.—The specific name is derived from the country of Mexico from which the holotype was collected.

DIAGNOSIS.—*Cryptotis mexicana* can be distinguished from *C. peregrina* by U4 partially obscured or not visible in lateral view and palatilar length ≤ 8.1 mm and from *C. nelsoni* and *C. obscura* by a dark brown dorsal pelage, dark-tipped hairs on venter, and a slightly bicolored tail. Further, *C. mexicana* differs from *C. nelsoni* by maxillary breadth < 6.4 mm; from *C. obscura* by zygomatic processes extending posteriorly and ventrolaterally to below occlusal surface of teeth (Fig. 28); from *C. parva* by condylobasal length 17.7–19.9 mm and i1 with 2 denticles and deep interdenticular spaces (Fig. 24); from *C. goldmani* by length of claw on the middle digit of the manus 1.9–2.9 mm (2.0%–2.7% of total length), palatilar length ≤ 8.1 mm, and maxillary breadth < 6.4 mm; and from *C. phillipsi* by palatilar length ≤ 8.1 mm.

GENERAL CHARACTERISTICS.—*Cryptotis mexicana* has bulbous zygomatic processes (Fig. 28). The zygomatic plate is 1.7–2.3 mm wide.

DISTRIBUTION.—An endemic to Mexico, *C. mexicana* is known from portions of about a 34,000-km² area in Chiapas, Hidalgo, Oaxaca, Puebla, and Veracruz (Fig. 34; Ramírez-Pulido and Britton 1981, Fa 1989, Fa and Morales 1993, Flores Vilella and Gerez 1994).

ECOLOGY.—In Puebla, *C. mexicana* was found in beech-sweetgum cloud forest beneath

undergrowth near moving water (Heaney and Birney 1977). In Veracruz, Mexican small-eared shrews occur from at least 518 to 2600 m in a wide variety of habitats from succulent vegetation along streams where the soil is soft and wet, in maguey hedges (= cercas) that divide cornfields, in "... deep moss in a small, cold valley in ... pine forest ...", patches of wild bananas, to overgrown hillsides covered with dense, dry brush (Hall and Dalquest 1963:206). As of 2005, only 57.57% of habitat considered suitable for *C. mexicana* habitation (i.e., habitat unmodified for agriculture or urban development) still existed (Sánchez-Cordero et al. 2005). Nine lactating females (KU 29525, 29529, 29531, 29534, 29542–29543, 29545, 29548, 29562) were collected 7–20 October 1948 in Veracruz. A pregnant female (KU 29576) with 3 embryos (uterine swellings 5 mm) was collected 2 December 1948 in Veracruz (Hall and Dalquest 1963).

Known mammalian associates in Oaxaca include *Cryptotis magna*, *Habromys chinanteco*, *H. lepturus*, *Heteromys desmarestianus lepturus*, *Megadontomys cryophilus*, *Microtus mexicanus*, *M. oaxacensis*, *Oryzomys alfaroi*, *O. chapmani caudatus*, *Peromyscus boylii*, *P. melanocarpus*, *P. mexicanus*, *Reithrodontomys mexicanus*, *R. microdon albilabris*, *Sorex veraecrucis*, and *S. veraepacis mutabilis* (Musser 1964, Jones and Genoways 1967, Robertson and Rickart 1975, Rickart 1977). Mammalian associates in Puebla include *Liomys irroratus*, *Microtus mexicanus*, *M. quasiater*, *Oligoryzomys fulvescens*, *Oryzomys chapmani*, *Peromyscus aztecus*, *P. leucopus*, *P. maniculatus*, and *P. melanotis* (Heaney and Birney 1977, Ramírez-Pulido et al. 2004). Mammalian associates in Veracruz include *Marmosa mexicana*, *Microtus mexicanus*, *M. quasiater*, *Oligoryzomys fulvescens*, *Oryzomys alfaroi*, *O. chapmani*, *O. couesi*, *Peromyscus aztecus*, *P. beatae*, *P. furvus*, *P. leucopus*, *P. levipes*, *P. melanotis*, *Reithrodontomys fulvescens*, *R. sumichrasti*, *R. megalotis*, *Sorex macrodon*, *S. veraecrucis*, and *Sylvilagus cunicularius* (Hall and Dalquest 1963, Prieto Bosch and Sánchez-Cordero 1993, Ramírez-Pulido et al. 2004).

ADDITIONAL REFERENCES.—Alston (1879–1882:57), Alvarado (1915:20), Aranda and March (1987:143), Arita and Ceballos (1997:53), Barrera (1968:56), Briones-Salas and Sánchez-Cordero (2004:436), Choate (1970:234–235, 237, 239; 1973:1–2), Coates-Estrada and Estrada

(1986:34), Díaz de León (1905:26), Escalante et al. (2003:567–568, 575), Fa and Morales (1991:207), Findley (1953:637), Goldman (1951:348), Goodwin (1954a:1; 1969:39, 41, 43), Hall (1981:58), Hall and Kelson (1959:60), Herrera (1890:300; 1897:70; 1898:39), Koopman and Martin (1959:4), Lukoschus et al. (1977), Lyon and Osgood (1909:239), Merriam (1895a:24, 28), Miller and Rehn (1901:248), Musser (1964:6), Padilla-G. and Pineda-L. (1997:63), Poole and Schantz (1942:177), Prieto Bosch and Sánchez-Cordero (1993:45), Ramírez-Pulido et al. (1983:15; 2000:153), Schaldach (1966:288–289), Villa-R. and Cervantes (2003:94), Whitaker and Morales-Malacara (2005:547), Woodman (2005:523–530, 534, 612), Woodman and Timm (1999:25).

REMARKS.—Latitude and longitude in brackets in Specimens Examined are from Ramírez-Pulido et al. (2004).

SPECIMENS EXAMINED ($n = 305$; 88 measured).—**Chiapas:** 3 mi E Pueblo Nuevo Solistahuacán, [17°06'N, 92°53'W], 7000 ft (KU 83942#). **Hidalgo:** Molango (UMMZ 96925); Zacualtipán, 1800 m (UMMZ 96920–96924). **Oaxaca:** near Cajones (USNM 68560#, 68561); near Campamento Río Molino (Hwy 175), 7300 ft (UMMZ 112572); Cerro San Felipe (USNM 68294#, 68296#, 68299#–68303#, 68305#, 68306, 68308–68314, 68361, 68520); Cerro San Felipe, 6 km (by road) W La Cumbre, 2670 m (KU 121658#, 124293); Cerro “El Soplador,” 3 km NNW Choapan, 1200 m (CB 38588); NE slope Cerro Pelón, 2620 m (KU 120302#); Cerro Zempoaltepec, 4.5 km N Santa María Yacochi, Mpio. Tahuitontepec, 2450 m (CNMA 29986–29989, 29991–29992, 33600–33606, 35260–35261); Cerro Zempoaltepec, 5 km N Santa María Yacochi, Mpio. Tahuitontepec, 2450 m (CNMA 34859); Cerro Zempoaltepec, 3.5 km E Santa María Yacochi, Mpio. Tahuitontepec, 2450 m (CNMA 29990); Cuicatlán, Carr. Santa María Papalo Peña Verde (MZFC CAS289); 5 km N, 1 km W Huautla, 18°10'07"N, 96°50'33"W, 1120 m (UAMI 13214); 12 mi N Ixtlán de Juárez, Llano de las Flores, 9200 ft (UMMZ 109406#–109408#); 2 km (by road) W Los Cumbre, 2900 m (KU 121414); 1 km N La Esperanza, Mpio. Santiago Comaltepec, 1525 m (CNMA 29425); 11 km SW La Esperanza, camino lodoso hacia San Isidro, Mpio. Santiago Comaltepec, 2000 m (CNMA 29426–29433, 29435, 29464); 17 km SE La Esperanza, camino lodoso hacia San

Isidro, Mpio. Santiago Comaltepec, 2100 m (CNMA 29434); Distrito Ixtlán, 16 mi WSW La Esperanza (TCWC 41953#); Llano de las Flores, 2800 m (KU 120303, 121410–121411, 121412#, 121413); Llano de las Flores, 3150 m (KU 91465); N. Llano de las Flores, 9500 ft (UMMZ 112569#–112570#); 11 mi (Tuxtepec road) NE Llano de las Flores, 9100 ft (UMMZ 112571); 27.5 km (by road) NNE Llano de las Flores, Hwy 175 (CNMA 29470; LACM 74168–74173); 0.4 mi S Llano de las Flores, 9200 ft (TCWC 45106); Mt. Zempoaltepec (USNM 68521–68522, 68523#–68528#, 68529–68530, 68532#–68536#, 68538–68539, 68540#–68541#, 68543–68544, 68546, 68548, 68549#); 1.5 km carr. Puerto de la Soledad, San Bernardino, San Fco. Huehuetlán, Teotitlán F.M., 2250 m (CNMA 38638); Reyes (USNM 69604#–69606#, 69607#, 69608, 69609#, 69610, 69611#, 69612–69614, 69615#, 69733); 15 km N Tlaxcala, 2865 m (UAMI 2941–2949); Totontepec (USNM 68550#, 68551–68552, 68553#, 68556, 68557#–68559#); 3 km SE Totontepec, Mpio. Totontepec, 1800 m (CNMA 29973); Vista Hermosa, 1500 m (KU 91464#); 5 km N, 1 km E Zacapoaxtla, [19°54'32"N, 97°33'00"W], 1620 m (UAMI 2950). **Puebla:** 2.6 km NE Aire Libre, Mpio. Teziutlán, 19°53'44"N, 97°24'02"E, 1710 m (UAMI 13216–13218); 3 km S Atacpan, [19°48'32"N, 97°33'40"W], 2140 m (UAMI 1857); Chignautla, [19°48'07"N, 97°23'30"W], 2060 m (UAMI 2936); 4 km W Cuetzalán, [20°02'20"N, 97°34'00"W], 900 m (UAMI 9417); Honey, 1900 m (UMMZ 89757); Huauchinango, [20°11'N, 98°03'N], 5000 ft (UMMZ 91416#; USNM 92702#–92703#, 92704, 92705#–92709#, 92710–92711, 92712#, 92713–92714, 92715#–92717#, 92772); 3 km NE San Juan Acateno, 19°53'49"N, 97°21'41"W, 850 m (UAMI 13219); 3 km NE San Juan Acateno, 19°53'49"N, 97°21'41"W, 1560 m (UAMI 13220); 15 km N Tlaxco, Tlaxcala, [19°42'37"N, 98°04'54"W], 2865 m (UAMI 2937–2940); 6 km N Villa Juárez (CB 672); Xocoyolo (Hwy 21), 4300 ft (UMMZ 112564#–112565#); 4 km S, 2.4 km W Zacapuaxtla, 2120 m (CB 11629); 2 mi NW Zacapoaxtla (Hwy 21), 4900 ft (UMMZ 112566#–112567#). **Veracruz:** 2 km NW Acajete, 2200 m (CB 4625–4626); 2.6 mi W Banderillas, ca. 5000 ft (UMMZ 113138); 1.5 km SE Banderillas, [19°34'35"N, 96°54'35"W], 1590 m (UAMI 9158–9160, 11584); Coscomatepec, 5000 ft

(KU 29575–29577); 3 km N, 3.5 km E Coscomatepec, 19°06'02"N, 97°01'57"W, 1380 m (UAMI 13221–13226); 5.5 km N, 6 km E Coscomatepec, 19°05'37"N, 97°01'32"W, 1560 m (UAMI 13227); Huatusco, 5000 ft (KU 29572–29574); 5 km N Huatusco, [19°10'51"N, 96°57'34"W], 1320 m (UAMI 9161–9162); Jaracingo, 6000 ft (UMMZ 91149#); 2 km N, 2 km W Jilotepec, 19°38'26"N, 96°57'30"W (UAMI 13229); La Joya (CNMA 919); La Joya (Hwy 145), 6600 ft (UMMZ 112568#); Las Animas, Xalapa (CB 38561–38564, 39641–39646); Las Vigas, 8500 ft (KU 29524–29540, 29542–29565, 29566#–29568#, USNM 54442#, 55061#); 5 mi E Las Vigas (TCWC 44502#); 5 km W Naolinco, Mpio. Naolinco, 1650 m (CNMA 35264); Orizaba (USNM 58279#, 58281#–58282#); 3.1 km S Puerto del Aire, ca. 2300 m (MVZ 163012#); 18 km NW Teocelo, Mpio. Ixhuacán, 19°24'17"N, 99°00'08"W, 1300 m (CNMA 35265); 4 km W Tlapacoyan, 1700 ft (KU 23412–23414); Xalapa (USNM 3525/4438T#); Xico [= Jico] (USNM 55063–55064, 55066#, 55069#–55071#, 55074#–55076#, 55077, 55082#, 55084, 55087#–55089#, 55090–55092, 55094#, 55095, 55096#, 55097–55099, 58276–58278, 58280, 58283); 1 km N, 3 km W Zongolica, 18°41'05"N, 97°03'12"W, 1830 m (UAMI 13231); 4 km N, 8 km W Zongolica, 18°42'03"N, 97°03'57"W, 1860 m (UAMI 13232); 14 km SE (por carr.) Zongolica, Mpio. Zongolica, 1850 m (CNMA 34212).

ADDITIONAL SPECIMENS.—**Oaxaca:** 7 mi N Ixtlán de Juárez, 10,000 ft (CAS) and 8 km NW Colonia "Rodolfo Figueroa" [sic] (= Rodolfo Figueroa), 5500 ft (CAS—Ramírez-Pulido et al. 2004). **Puebla:** 12.1 km (by road) NE Teziutlán, 19°52'N, 97°20'W (BMNH [J.F. Bell Museum of Natural History] 6875—Heaney and Birney 1977). **Veracruz:** San José de los Molinos (Prieto Bosch and Sánchez-Cordero 1993); Teocelo, 5000 ft (1 MCZ [Museum of Comparative Zoology, Harvard University]—Ramírez-Pulido et al. 2004).

Cryptotis nelsoni (Merriam, 1895a)—
Nelson's Shrew

Blarina nelsoni Merriam, 1895a:26. Type locality "Volcán Tuxtla, 4,800 ft, Veracruz," latitude 18.55°N, longitude 95.22°W.

Cryptotis nelsoni: Miller, 1912:27.

Cryptotis mexicana nelsoni: Choate, 1970:234.

HOLOTYPE.—USNM 65437, ♀, young adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Mr. Edward W. Nelson, collector of the holotype and paratypes.

DIAGNOSIS.—*Cryptotis nelsoni* can be distinguished from sympatric *Cryptotis* by a uniformly dark brown body and tail. Further, *C. nelsoni* differs from *C. parva* by its much greater size; from *C. mexicana*, *C. obscura*, and *C. peregrina* by maxillary breadth ≥ 6.5 mm; from *C. obscura* and *C. peregrina* by least interorbital breadth 4.8–5.1 mm; from *C. peregrina* by U4 partially obscured or not visible in lateral view; and from *C. alticola* by palatilar length 7.9–8.4 mm and length of claw on the middle digit of the manus 2.4–2.8 mm (2.4%–2.8% of total length).

GENERAL CHARACTERISTICS.—*Cryptotis nelsoni* is the largest of the "*C. mexicana* group" with condylobasal length 19.2–20.2 mm, length of U1–M3 7.2–7.8 mm, breadth across M2–M2 5.3–5.8 mm, and breadth of zygomatic plate 1.8–2.2 mm. The zygomatic processes are elliptic (Fig. 20) and extend posteriorly and ventrolaterally to below the occlusal surface of the teeth (Fig. 23). The i1 has 2 denticles and deep interdenticular spaces (Fig. 24).

DISTRIBUTION.—An endemic to Mexico, *C. nelsoni* is known only from the type locality in Veracruz (Fig. 34).

ECOLOGY.—The type locality is located on the side of the extinct Volcán Tuxtla (= Volcán de San Martín), within the Upper Humid Tropical forest. Nelson's shrews were considered common from ca. 1463 m to the summit at 1650 m. At time of collection, the area from ca. 1463 to 1525 m was vegetated with dense virgin forest containing "... Spanish cedars, wild figs, and others [trees] of large size" (Goldman 1951:283). Above 1525 m, the habitat was characterized by "... thickets of bushes, patches of orchids, and mosses ..." (Goldman 1951:283). No reproductive information or mammalian associates were found in published literature.

STATUS.—*Cryptotis nelsoni* is listed as protected under *C. mexicana nelsoni* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12), Hall and Dalquest (1963:206), Miller and Rehn (1901:248), Poole and Schantz (1942:178), Ramírez-Pulido et al. (1983:15), Whitaker and Morales-Malacara (2005:652), Woodman (2005:524, 526–529, 534), Woodman and Timm (1999:25).

SPECIMENS EXAMINED ($n = 8$; 5 measured).—**Veracruz:** Volcán Tuxtla [= Volcán de San Martín], 4800 ft (USNM 65429#–65430#, 65431, 65432#, 65433, 65435#, 65436, 65437T#).

Cryptotis obscura (Merriam, 1895a)—
Grizzled Shrew

Blarina obscura Merriam, 1895a:23. Type locality “Tulancingo, 8,500 ft, Hidalgo,” latitude 20.08°N, longitude 98.37°W.

Cryptotis obscura: Miller, 1912:26.

Cryptotis mexicana madrea Goodwin (1954b:1). Type specimen AMNH 147901, ♂, adult, skin and skull. Type locality “Rancho del Cielo, 5 mi NW Gómez Farías, Tamaulipas.”

Cryptotis mexicana obscura: Choate, 1970:235.

HOLOTYPE.—USNM 55634, ♀, young adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Latin *obscurus* ‘dusky’.

DIAGNOSIS.—*Cryptotis obscura* can be distinguished from other *Cryptotis* by the grizzled appearance of the dorsal pelage and by zygomatic processes that project ventrally almost “hugging” the labial edge of where M2 and M3 abut and always project posteriorly only to the midpoint of M3 (Fig. 29). Further, *C. obscura* differs from *C. nelsoni* by condylo-basal length 17.5–19.0 mm, maxillary breadth 5.6–6.3 mm, least interorbital breadth 4.3–4.8 mm, length of U1–M3 usually 6.0–7.1 mm, length of unicuspid tooththrow 1.9–2.3 mm, and breadth across M2–M2 usually 4.5–5.1 mm.

GENERAL CHARACTERISTICS.—*Cryptotis obscura* has hairs on the dorsum dark silvery gray for the proximal two-thirds and brown for the distal one-third. Hairs on the venter are light silvery gray for the proximal three-fourths and silver for the distal one-fourth. Thus, *C. obscura* has an overall lighter appearance than do other taxa of the “*C. mexicana* group.” The tail is slightly bicolored. The length of the claw on the middle digit of the manus (2.1–2.6 mm) is near the lower end of the intermediate-length claws for *Cryptotis* (2.0%–2.5% of total length) in Mexico. U4 is partially obscured or not visible in lateral view. The zygomatic plate is 1.7–2.0 mm wide. The zygomatic processes are bulbous (Fig. 29). The i1 has 2 denticles and deep interdenticular spaces (Fig. 24).

DISTRIBUTION.—An endemic to Mexico, *C. obscura* is known from portions of about an 18,000-km² area in Hidalgo, México, Queré-

taro, San Luis Potosí, Tamaulipas, and Veracruz from ca. 1040 to 2500 m elevation (Fig. 34; Fa 1989, Flores Villela and Gerez 1994).

ECOLOGY.—Grizzled shrews usually occur from ca. 1150 m to 2500 m within the ecosystem referred to as the Humid Upper Tropical Subzone (Goldman 1951) characterized by wet, dense herbaceous cover located in dense cloud forests of pine-oak or oak with scattered conifers, and abundant philodendrons and tree ferns (Martin 1955, Choate 1970). In Veracruz, grizzled shrews occur among deciduous trees with heavy leaf litter (Hall and Dalquest 1963). In Tamaulipas, they occur in overgrown ditches and in stone walls along agricultural fields (Álvarez 1963; specimen tags for UMMZ 107889–107890).

Two females (TTU 24182 and 24184), each with 2 embryos (crown-rump length 9 mm and 5.2 mm, respectively) were collected on 15 August 1973 in Hidalgo. Another female (TTU 24179) with 3 embryos (crown-rump length 10 mm) was collected on 27 July 1973 in Hidalgo.

Known mammalian associates possibly include *Enchisthenes hartii*, *Leopardus wiedii glaucula*, *Glaucomys volans*, *Lasiurus cinereus*, *Marmosa mexicana*, *Oryzomys alfaroi*, *Reithrodontomys megalotis*, *R. mexicanus*, and *Sylvilagus brasiliensis truei* (Martin 1955). Mammalian associates in Tamaulipas include *Baiomys taylori*; in San Luis Potosí they include *Liomys irroratus*, *Microtus quasiater*, *Oryzomys couesi*, *O. chapmani*, *Peromyscus furvus*, *P. leucopus*, and *P. levipes*; and in Hidalgo they include *Microtus quasiater*, *Oryzomys chapmani*, *O. couesi*, *Oligoryzomys fulvescens*, *Peromyscus aztecus*, *P. difficilis*, *P. furvus*, *Reithrodontomys fulvescens*, and *Sigmodon hispidus* (Ramírez-Pulido et al. 2004).

STATUS.—*Cryptotis obscura* is listed as protected under *C. mexicana obscura* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12), Choate (1973:2), Escalante et al. (2003:575), Findley (1953:637), Goodwin (1954b:4), Jones et al. (1983:379), Koopman and Martin (1959:4), Lawrence (1993:24), León P. and Romo V. (1991:16), Miller and Rehn (1901:247–248), Poole and Schantz (1942:178), Ramírez-Pulido et al. (1983:15), Villa-R. and Cervantes (2003:91), Whitaker and Morales-Malacara (2005:652), Woodman (2005:524–530, 534), Woodman and Timm (1999:25).

REMARKS.—Latitude and longitude in brackets in Specimens Examined are from Ramírez-Pulido et al. (2004).

SPECIMENS EXAMINED ($n = 109$; 24 measured).—**Hidalgo:** 2 km N Chapulhuacan, 21°10'10"N, 98°54'02"W, 900 m (UAMI 13233); Encarnación (USNM 81125#–81126#, 81127, 81131, 81132#–81134#); Lago Tejocotal (11 km E Acaxochitlán), 2250 m (KU 81770#); Molango (UMMZ 96925); 1 km S, 3.5 km W Otongo, 20°58'15"N, 98°43'56"W, 1040 m (UAMI 13234–13235); 13 km WSW Tehuetlán, 1500 m (TTU 15454); Tenango de Doria, 5200 ft (UMMZ 112562#–112563#); 3.5 km SE Tanguistengo, [20°48'23"N, 98°37'35"W], 1350 m (UAMI 11579); 1 km N, 3 km E Tlanchinol, ca. 1500 m (TTU 24178–24179); 4 km NE Tlanchinol, 1470 m (CB 39727–39733); Tulancingo (USNM 55633#, 55634T#); Zacualtipán, 1800 m (UMMZ 96918–96924); Zacualtipán, 1900 m (UMMZ 96917#); 1.8 mi N Zacualtipán [2100–2200 m] (TTU 15455); 4 km N Zacualtipán, 2200 m (TTU 24180–24181); 5 km E Zacualtipán, 2100 m (TTU 24182–24184). **México:** Estación Experimental de Fauna Silvestre "Ing. Luis Macías Arelleno" (San Cayetano), Mpio. Villa de Allende, 2500 m (CNMA 34779). **Querétaro:** Amoles (UMMZ 96307–96308); Pinal de Amoles, 2460 m (CB 27383–27390; USNM 81115, 81116#–81119#, 81123–81124, 81129#, 81147); 1 km S Pinal de Amoles (MZFC 637–648); 4 km SW Pinal de Amoles, Mpio. Pinal de Amoles, 2550 m (CNMA 29106, 29332). **San Luis Potosí:** Apetzco, 0.5 km N, 2 km W Xilitla, [21°23'35"N, 99°01'35"W], 830 m (UAMI 11580#); 11 km S, 8 km W Xilitla, [21°17'19"N, 98°55'52"W], 1160 m (UAMI 11581#). **Tamaulipas:** "El Cielo," 8 km NW Gómez Farías, [23°00'30"N, 99°02'30"W], 1150 m (UAMI 11168, 11169#–11170#, 11171–11172, 11173#, 11174–11193); Rancho del Cielo, 5 mi NW Gómez Farías, 3500 ft (AMNH 147901#, from owl pellets); UMMZ 107889–107890; Reserva de la Biosfera "El Cielo," [23°00'33"N, 99°02'30"W], 1140 m (UAMI 11582, 11583#). **Veracruz:** Zacualpan, 6000 ft (KU 82841#).

ADDITIONAL SPECIMENS.—**Hidalgo:** 1 km S, 6 km W Otongo, [20°57'53"N, 98°42'21"W], 1170 m (UAMI 13235). **Tamaulipas:** Aserradero del Infiernillo, 11 km W Gómez Farías and 10 km NNW Aserradero del Paraíso [13 km NNW Chamal], ca. 1300 m (6 crania and 4 rami from owl pellets—Goodwin 1954b:4).

Cryptotis parva—Least Shrew

ETYMOLOGY.—The specific name is derived from the Latin *parvus* 'little or small'.

DIAGNOSIS.—Overall, *C. parva* is the smallest *Cryptotis* in any habitat where it occurs, with a combination of condylobasal length <18 mm, cranial breadth <9 mm, and length of mandible ≤ 8.5 mm. Further, it can be distinguished from other *Cryptotis* by i1 with 3 denticles and very shallow interdenticular spaces (Fig. 25).

GENERAL CHARACTERISTICS.—Within *C. parva*, usually the U4 is partially obscured or not visible in lateral view; however, among *C. p. berlandieri* some specimens have the U4 completely visible. The zygomatic processes extend posteriorly and ventrolaterally to below the occlusal surface of the teeth (Fig. 23) and are sharply pointed. It is a light to dark brown shrew with a venter paler than the dorsal pelage. Length of the claw on the middle digit of the manus for all subspecies of *C. parva* is ≤ 2.0 mm, placing them well within the group of short-clawed *Cryptotis* in Mexico.

DISTRIBUTION.—Currently, *C. parva* is distributed throughout most of eastern United States and in Mexico from Coahuila, west to Nayarit, and south through Chiapas (Fig. 33; Hall 1981). An extralimital late-Pleistocene fossil of *C. p. berlandieri* was found in Chihuahua (Messing 1986). In Mexico, it occurs from sea level to 2750 m elevation.

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:53), Armstrong (1996:274), Barrera (1968:57, 60), Escalante et al. (2003:575), Fa and Morales (1991:207), Findley and Caire (1977:136), Villa-R. and Cervantes (2003:31), Whitaker and Morales-Malacara (2005:652), Woodman (2005:524, 534).

Cryptotis parva berlandieri (Baird, 1857)

Blarina berlandieri Baird, 1857:53. Type locality "Matamoros, Tamaulipas," latitude 25.91°N, longitude 97.5°W.

Blarina parva: Merriam, 1895a:17.

B[larina]. b[revicauda]. berlandieri: Elliot, 1903a, 3:149.

Blarina pergracilis: Elliot, 1903a:149. Type locality "Ocotlán, Jalisco."

Cryptotis pergracilis macer Miller, 1911:223. Type specimen USNM 15565/38494, sex unknown, subadult, skull cleaned but cranium heavily damaged, skin in alcohol. Type locality "Guanajuato, Guanajuato."

Cryptotis pergracilis pergracilis Miller, 1911:223.

Cryptotis berlandieri: Miller, 1912:25.

Cryptotis pergracilis macra Miller, 1924:31.

Cryptotis pergracilis nayaritensis Jackson, 1933:79. Type specimen USNM 88015, ♂, subadult, skin and skull. Type locality "Tepic, altitude 3000 feet, Nayarit."
Cryptotis parva berlandieri: Davis, 1944:413.

HOLOTYPE.—USNM 2159, sex unknown, subadult, skull cleaned but sunken all over and a bit shriveled, probably result of fluid preservation; skin in alcohol.

ETYMOLOGY.—The subspecific name is a patronymic honoring Jean Luis Berlandier, "a Belgian who for some years was in the service of the Mexican government" (Jaeger 1978:308).

DIAGNOSIS.—*Cryptotis p. berlandieri* can be distinguished from *C. p. pueblensis* and *C. p. soricina* by a light to medium brown dorsal pelage, venter hairs medium silvery gray proximally with white tips, breadth across M2–M2 4.1–4.9 mm, and from both by a combination of condylobasal length usually 15.2–16.5 mm and length m3 + width m1 + width m2 + width m3 usually 3.8–4.5 mm.

GENERAL CHARACTERISTICS.—*Cryptotis p. berlandieri* is the smallest of the *C. parva* (condylobasal length 15.2–16.9 mm), thus the smallest *Cryptotis* in Mexico. It has a tail bicolored as for the body. Length of the claw on the middle digit of the manus (1.0–1.8 mm) is among the shortest of the short-clawed *Cryptotis* (1.4%–2.4% of total length) in Mexico. Within *C. p. berlandieri* the visibility of U4 is variable, ranging from not visible, partially obscured, to completely visible in lateral view.

DISTRIBUTION.—*Cryptotis p. berlandieri* is known from southern Texas and Coahuila, Guanajuato, Jalisco, Michoacán, Nayarit, Nuevo León, San Luis Potosí, and Tamaulipas from sea level to ca. 2750 m elevation (Fig. 33; Hall 1981). An extralimital late-Pleistocene fossil is known from Jiménez Cave, Chihuahua (Fig. 33; Messing 1986).

ECOLOGY.—*Cryptotis p. berlandieri* occurs in a broad range of ecology types from rocky grass fields near large marshes (from specimen labels) to mesic woodlands (Moreno-Valdez 1998), tropical deciduous forests (Orduña Trejo et al. 1999–2000), humid tropical forests (Goodwin 1954b), fish hatcheries (Hall and Villa-R. 1949), horse pastures, and fields cultivated with grain (Álvarez and Sánchez-Cases 1997, Moreno-Valdez 1998).

In Michoacán, a female (UMMZ 93144) collected on 26 May 1948 had 6 embryos (uterine swellings 3 mm—Choate 1970). In Tamaulipas, a female (KU 54924) collected on

5 July 1953 contained 3 embryos (uterine swellings 5 mm—Álvarez 1963). A female collected on 6 June 1953 (KU 54923) was lactating (Choate 1970) and another (AMNH 164872) was collected with a nest containing 4 young on 22 April 1953 (Choate 1970).

Known mammalian associates include *Baiomys taylori*, *Liomys irroratus*, *Neotoma mexicana*, *Notiosorex evotis*, *N. villai*, *Oryzomys palustris*, *Peromyscus maniculatus*, *P. melanophrys*, *Reithrodontomys fulvescens*, *R. megalotis*, and *Sigmodon mascotensis* (Schmidly and Hendricks 1984, Hernández-Chávez 1997). Barn Owls (*Tyto alba*) are known to prey upon *C. p. berlandieri* (Hernández-Chávez 1997).

ADDITIONAL REFERENCES.—Alston (1879–1882:207), Alvarado (1915:20), Álvarez et al. (1997:12), Baird (1857:53), Baker and Alcorn (1953:116), Booth (1957:9), Dalquest (1953:22), Dalquest and Roth (1970:221), Díaz de León (1905:26–27), Findley (1955b:615), Goldman (1951:370, 426), Hafner and Shuster (1996:536), Hall and Dalquest (1963:207), Hall and Kelson (1959:56–57), Hall and Villa-R. (1950:165), Hooper (1961:121), Jiménez Guzmán et al. (1997:133; 1999:33), Lyon and Osgood (1909:237), Maldonado (1999:47–48), Merriam (1895a:20, 22), Miller and Rehn (1901:247), Poole and Schantz (1942:175, 178–179), Ramírez-Pulido et al. (1983:16), Raun (1965:214), Twente and Baker (1951:120), Villa-R. and Cervantes (2003:86), Whitaker (1974:1).

SPECIMENS EXAMINED ($n = 59$; 22 measured).—**Coahuila:** 4.5 mi SW Guadalupe Victoria, 100 m from Gómez Farías (TCWC 34304#). **Guanajuato:** near Guanajuato (USNM 15565/38494T#). **Jalisco:** Huascato (CB 76); 3.5 mi N Mascota, 6150 ft (KU 105408#); Ocotlán (USNM 120150#, 120151, 120152#); 1 mi S Ocotlán, 5000 ft (KU 30822#–30824#); 16 mi NE Tamazula, 5000 ft (TCWC 6623#). **Michoacán:** Colonia Ibarra, Pátzcuaro, Mpio. Pátzcuaro (CNMA 23, 4163; MVZ 100075); 1 km S Cumuato (LACM 12264); La Palma (LACM 12261–12263); 2 mi E La Palma, Cerrito Loco, SE side Lago Chapala (KU 143711#); 12 km W Morelia, Mpio. Morelia (CNMA 8564–8567); 3 mi E Pátzcuaro (UMMZ 93144#); 7 km NNW de Quiroga (CNMA 7806–7808); 9 km N, 14 km E Sahuayo, 1500 m (CB 26203–26208); Sierra Baralosa, 1.5 hours (by mule) NE Rancho Baralosa, 8900 ft (UMMZ 102657#); 2 km S, 1 km W Tanhuato, 1510 m (CB 26196–26202). **Nayarit:** Tepic, 3000 ft

(USNM 88015T[#]). **Nuevo León:** Presa La Boca, 4 km E Corretero Santiago, [25°11'05"N, 100°09'10"W] (UAMI 9156[#]). **San Luis Potosí:** Rancho El Estribo, 10 km S Naranjo, Mpio. Ciudad del Maíz, 330 m (CNMA 21992–21993); 1 km S Río Verde, 1030 m (CB 30731). **Tamaulipas:** 1 mi S Altamira (KU 54924[#]–54928[#], 54931[#]); 22 mi N Ciudad Victoria, Río Corona (TCWC 26352[#]); Matamoros (USNM 1793/642, 1794/693, 2159T, 116510); Rancho del Cielo, 5 mi NW Gómez Farías (AMNH 147901); San Carlos Mts., 0.3 mi SW Rancho Carricitos, ca. 1900 ft (TCWC 30491[#]).

ADDITIONAL SPECIMENS.—**Chihuahua:** Jiménez Cave[☆] (1 right mandible late-Pleistocene fossil, UTEP [University of Texas at El Paso] 91-484—Messing 1986). **Coahuila:** 10 mi NE Melchor Múzquiz (Hall 1981). **Nuevo León:** Mpio. Guadalupe, Guadalupe (UANL [Universidad Autónoma de Nuevo León Colección de Mamíferos] 682); Mpio. Juárez, Rancho El Fraude, 2 km W Juárez (UANL 2721); and Mpio. Santiago, Colonia Pescadores, El Cercado (UANL 3892–3894, 3896); Cueva La Boca (UANL 3897); Los Atascosos, 4 km W El Cercado (UANL 3895); 7.2 km N, 3.2 km W Monterrey (UIMNH [University of Illinois, Museum of Natural History] 42797—Hoffmeister 1977); Presa La Boca (UANL 11–16, 199); San Francisco (UANL 10); and San Pedro (UANL 3898) (Jiménez Guzmán et al. 1996, 1999). **Tamaulipas:** Aserradero del Paraíso, 13 km NNW Chamal, 431 m (1 cranium and mandible from owl pellet AMNH—Goodwin 1954b); Aserradero del Paraíso, 13 km NNW Chamal, 420 m (1 rostrum and 2 mandibles from owl pellets—Koopman and Martin 1959).

Cryptotis parva pueblensis
(Tomes, 1862)

Sorex micrurus Tomes, 1862, 1861:279 (in part).

Blarina pergracilis Elliot, 1903a:149.

Cryptotis pergracilis pueblensis: Jackson, 1933:79. Type locality "Huauchinango, 5,000 ft, Puebla," latitude 20.18°N, longitude 98.05°W.

Cryptotis pergracilis pueblensis Dalquest, 1953:22.

Cryptotis celatus: Goodwin, 1956:1. Type specimen AMNH 145838, ♂, subadult, skin and skull. Type locality "Tehuantepec, Las Cuevas, Oaxaca."

Cryptotis parva pueblensis: Choate, 1970:264.

HOLOTYPE.—USNM 92720, ♂, adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the state of Puebla from which the holotype was collected.

DIAGNOSIS.—*Cryptotis p. pueblensis* can be distinguished from *C. p. berlandieri* by a light brown venter and from *C. p. soricina* by breadth across M2–M2 4.8–5.5 mm. Additionally, it differs from *C. p. berlandieri* and *C. p. soricina* by a combination of condylobasal length usually 16.4–17.6 mm and length m3 + width m1 + width m2 + width m3 usually 4.3–5.1 mm. Further, *C. p. pueblensis* differs from *C. merriami* by lesser length, but not width, of skull: condylobasal length usually 16.4–17.6 mm, palatilar length 6.7–7.3 mm, and length of U1–M3 5.7–6.8 mm.

Additionally, *C. parva pueblensis* can be distinguished from *C. tropicalis* by hairs on venter pale to medium brown and by its overall smaller size: condylobasal length 16.4–17.6 mm, palatilar length 6.7–7.3 mm, length of U1–M3 5.7–6.8 mm, breadth across M2–M2 4.8–5.5 mm, length of mandible 6.4–8.5 mm, length of mandibular tooththrow 4.1–5.3 mm, length from upper articular condyle to posterior edge of m3 3.4–4.6 mm, height of coronoid valley usually 2.0–2.6 mm, height of articular condyle 2.8–3.6 mm, length of coronoid–ventral point of lower condylar facet usually 3.4–4.2 mm, and length of coronoid–posterior point of upper condylar facet usually 3.1–3.8 mm.

GENERAL CHARACTERISTICS.—*Cryptotis p. pueblensis* has a medium to dark brown dorsal pelage and a slightly bicolored tail. Length of claw on the middle digit of the manus of 1.2–2.0 mm (1.6%–2.2% of total length) places *C. p. pueblensis* within the group of short-clawed *Cryptotis* in Mexico.

DISTRIBUTION.—An endemic to Mexico, *C. p. pueblensis* is known from Chiapas, Hidalgo, Oaxaca, Puebla, San Luis Potosí, Tabasco, and Veracruz from 30 to 2300 m elevation (Fig. 33; Hall 1981).

ECOLOGY.—Usually, *C. p. pueblensis* occurs at middle elevations in rocky outcrops associated with moist meadows, saw-grass (cf. *Cladium jamaicense*) or dense brush, elephant's ear with other succulent vegetation near a stream, and rock walls overgrown with grass and brush between fields of coffee (Hall and Dalquest 1963, Choate 1970). However, it also occurs on sandy banks along rivers (Davis 1944) and in the arid coastal plain on dry, hard ground vegetated with thorny bushes and sparse grasses.

In Oaxaca, a female (CAS 14311) collected on 10 August 1965 was lactating (Choate 1970).

In Veracruz, a recently lactating female was collected on 28 October 1947 (Hall and Dalquest 1963). Known mammalian associates include *Baiomys musculus*, *Cryptotis goodwini*, *Microtus quasiater*, *Peromyscus leucopus*, *P. mexicanus*, *Reithrodontomys fulvescens*, *Sigmodon hispidus*, *Sorex veraecrucis cristobalensis*, and *S. veraepacis chiapensis* (Hall and Dalquest 1963, Espinoza Medinilla et al. 1998). King snakes (*Lampropeltis polyzona*) are known to prey upon *C. p. pueblensis* (Hall and Dalquest 1963).

ADDITIONAL REFERENCES.—Álvarez et al. (1984:14; 1997:12–13), Aranda and March (1987:143), Briones-Salas and Sánchez-Cordero (2004:436), Coates-Estrada and Estrada (1986:34), Goodwin (1954b:3–4; 1956:1–2; 1969:41), Hall and Kelson (1959:63), Hooper (1947:43), Horvath et al. (2001:22), Lawrence (1993:24), León P. and Romo V. (1991:16), Merriam (1895a:22), Naranjo and Espinoza Medinilla (2001:65), Ramírez-Pulido et al. (1983:16), Villa-R. and Cervantes (2003:91), Whitaker (1974:1).

SPECIMENS EXAMINED ($n = 90$; 27 measured).—**Chiapas:** 25 km S, 21 km W Comitán, 500 m (CB 6861); Huixtla (CNMA 8010); 23.6 mi NW Huixtla, 400 ft (TCWC 34980#); 16 mi NE San Cristóbal (MVZ 141669–141671); Mohasik, Tenejapa, 20 mi NE San Cristóbal, 5000 ft (MVZ 141668); Prusia, 1000 m (UMMZ 88194#); 1 mi S Pueblo Nuevo Solistahuacán, [17°06'N, 92°53'W], 5700 ft (KU 83943#); Distrito Soconusco, Finca Esperanza, 145 m (UMMZ 79530#); Valle de Comitán (USNM 77019#); Villa Flores, 600 m (UMMZ 96926); Yajalon (USNM 75895#). **Hidalgo:** Pisaflores, [21°12'02"N, 99°00'22"W], 310 m (UAMI 11585#). **Oaxaca:** Choápan (USNM 68555); 2 km carret. Huautla-San José Tenango (CNMA 38639); 27 km (by road) S Juchatengo, 1850 m (KU 121662#); Juquila (USNM 71265, 71447–71451, 132481); Pluma (USNM 71452#–71453#); km 178 Puerto Ángel Rd., Río Jalatengo Camp, 4275 ft (CAS 14074); 5 km NW Puerto de la Soledad, Teotitlán, Mpio. Huehuetlán, 1900 m (CNMA 38277); 4.5 km N Santa María de Albarradas (KU 143596); 3.5 km SW Sebastián Jilotepec, Mpio. Santa Ana Tavela, 2300 m (CNMA 39359); 10 km SW Sebastián Jilotepec, Mpio. Santa Ana Tavela, 1100 m (CNMA 39360); 20 mi S, 5 mi E Sola de Vega, 4800 ft (KU 99547); Tehuantepec, Las Cuevas (AMNH 145838#); Tuxtepec (USNM

65425#). **Puebla:** Huauchinango, [20°11'N, 98°03'N], 5000 ft (UMMZ 91415; USNM 92718–92719, 92720T#, 92721#); Rancho “Las Margaritas,” 9 km N Hueytamalco, 600 m (UAMI 10699); Rancho “Las Margaritas,” 9 km NW Hueytamalco, [20°01'45"N, 97°15'45"W], 600 m (UAMI 1220, 2482–2485); Metlaltoyuca, 800 ft (USNM 93106); 4 km SW Piedras Negras, [20°27'15"N, 97°47'30"W], 190 m (UAMI 4602); 4 km W San José Acateno, [20°07'40"N, 97°13'25"W], 200 m (UAMI 2263); Santiago Yancuictlalpan, [20°03'28"N, 97°27'00"W], 950 m (UAMI 3726); 2 km S Tlacuilotepec, [20°18'32"N, 98°03'22"W], 1200 m (UAMI 5680); Villa Juárez, 3300 ft (CB 457); 5.5 km N Zacapoaxtla, [19°55'00"N, 97°35'25"W], 1400 m (UAMI 11586–11587). **San Luis Potosí:** Apetzco, 0.5 km N, 2 km W Xilitla, [21°23'35"N, 99°01'35"W], 830 m (UAMI 11588); 1 km N Xilitla, [21°12'02"N, 99°00'22"W], 550 m (UAMI 11589). **Tabasco:** 11 mi. N Balancán (LSU 8882#). **Veracruz:** Boca del Río, 10 ft (TCWC 2765#); 7 km W El Brinco, 800 ft (KU 29522); Catemaco (USNM 65426); Cerro Egega [sic], Los Tuxtlas (MZFC 688); 7 km NNW Cerro Gordo, 1500 ft (KU 23415#, 23416, 23417#); 3 km N, 1 km W Coatepec, [19°26'25"N, 96°56'10"W], 1350 m (UAMI 9163); Cuatatolapan, under driftwood along S bank Río San Juan near railroad bridge (TCWC 23576#); 1.5 km N, 3 km W Huatusco, [19°11'11"N, 96°59'14"W], 1370 m (UAMI 9164); 5.5 km N, 0.5 km E Huatusco, 19°10'51"N, 96°57'34"W, 1200 m (UAMI 13236); 1.5 mi N Xalapa, 4500 ft (UMMZ 94598); Las Animas, Xalapa (CB 38560, 39643); 1 km E Mecayucán, 200 ft (KU 23418); Orizaba, 4000–4200 ft (USNM 38472/8576, 58274#–58275#, 58284–58286); Potrero Viejo, 1700 ft (KU 12629); Sihuapan, 5 km E San Andrés Tuxtla, Sierra de las Tuxtlas, 450 m (CNMA 13913); Teocelo, 4500 ft (KU 29521#, 29523); 5 km N Xalapa, 4500 ft (KU 19094#); Xico [= Jico] (USNM 55062#, 55065#, 55078–55079, 55080#, 55081, 55085, 55086#).

ADDITIONAL SPECIMENS.—**San Luis Potosí:** 2 km SW Huichihuayán, 21°28'N, 98°57'W, ca. 400 ft (LSU 4784); 10 km E Platanito, 22°29'N, 99°26'W, ca. 3500 ft (LSU 4781–4783); Xilitla, 21°23'N, 99°01'W, ca. 2200 ft (LSU 2777); above [= 3 km NW] Xilitla at Apetzco (LSU 2778–2779); and rd. junction, Pan-American Hwy and Xilitla Rd (= 15 km

NE Xilitla) LSU 2776—Dalquest 1953); 2 mi (by road) E Xilitla, ca. 3000 ft (UMMZ 113557—Choate 1970). **Veracruz:** Mirador*, 3800 ft (presented in Choate 1970:266 as 3 specimens from USNM; however, no soricid from this locality is housed in the USNM mammal collection).

Cryptotis parva soricina
(Merriam, 1895a)

Blarina soricina Merriam, 1895a:22. Type locality "Tlalpan, 10 mi S Ciudad de México, Distrito Federal, 7,600 ft," latitude 19.26°N, longitude 99.15°W.

C[ryptotis]. Soricina: Miller, 1911:221.

Cryptotis soricina Miller, 1924:32.

Cryptotis parva soricina: Choate, 1970:267.

HOLOTYPE.—USNM 50762, ♂, adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the Latin *soricinus* 'of a shrew'.

DIAGNOSIS.—*Cryptotis p. soricina* can be distinguished from *C. p. berlandieri* by a light brown venter and from *C. p. pueblensis* by breadth across M2–M2 3.8–4.1 mm, and from both by a combination of condylobasal length 16.1–17.7 mm and length m3 + width m1 + width m2 + width m3 usually 3.6–4.8 mm.

GENERAL CHARACTERISTICS.—*Cryptotis p. soricina* has a dark brown dorsal pelage and a slightly bicolored tail. Length of claw on the middle digit of the manus of 2.0 mm (2.2% of total length) places *C. p. soricina* within the group of short-clawed *Cryptotis* in Mexico. Condylobasal length ranges from 16.1 to 17.7 mm.

DISTRIBUTION.—An endemic to Mexico, *C. p. soricina* is known from portions of about a 32,000-km² area in Distrito Federal and México (Fig. 33; Fa 1989).

ECOLOGY.—Throughout its distribution in the Valley of Mexico, *C. p. soricina* occurs primarily in livestock pastures with the 1 qualification seeming to be the presence of dense herbaceous plants to provide sufficient cover (Ceballos González and Galindo Leal 1984). However, Cervantes et al. (1995) reported *C. p. soricina* from a pine (*Pinus*) and mixed pine-oak (*Quercus*) habitat at 6.3 km E San José Villa de Allende, Estado de México. Villa-R. (1953) reported a lactating female with 4 embryos; no date of collection was provided. Known mammalian associates include *Sorex saussurei* (Cervantes et al. 1995). Barn-owls (*Tyto alba pratincola*) are known to prey upon *C. p. soricina* (López-Forment C. 1997).

STATUS.—*Cryptotis p. soricina* is listed as a protected subspecies (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Alvarado (1915:20), Chávez and Ceballos (1998:121), Goldman (1951:384, 432), Herrera (1890:305; 1895:21; 1897:70), López-Forment and Urbano-V. (1977:235), Miller (1912:26), Miller and Rehn (1901:247), Poole and Schantz (1942:179), Ramírez-Pulido et al. (1983:16), Villa-R. (1952:319–320; 1953:177), Whitaker (1974:1).

SPECIMENS EXAMINED ($n = 91$; 12 measured).—**Distrito Federal:** Canal de Cuernavaca, Xochimilco (UAMI 5#); Canal de Japón, Xochimilco (CB 29010); Tlalpán, 10 mi S Ciudad de México, [19°18'10"N, 98°57'00"W], 7600 ft (USNM 50760#, 50762T#); Universidad Femenina, Bosque Chapultepec, 7400 ft (CNMA 439). **México:** Ex-Lago de Texcoco, 4 km S, 12 km W Texcoco, [19°29'42"N, 99°00'00"W], 2250 m (UAMI 9711, 9712#, 9713–9714, 9715#, 9716–9728, 9729#, 9730–9732, 9733#, 9734, 9735#, 9736, 9737#, 9738–9740, 9741#–9743#, 9744–9793); Los Reyes Iztacala, Mpio. Tlalnepantla (CNMA 19663); 3 km S Tlapacoya, 2250 m (CB 3955–3956).

ADDITIONAL SPECIMENS.—**Distrito Federal:** 4 km SW Santiago Tepalcatlalpán, Delegación Xochimilco, 2350 m (54 individuals from owl pellets—López-Forment C. 1997); and Tlapacoyan, ca. 7200 ft (58 CB—Choate 1970). **México:** 9 km N Valle de Bravo, 2370 m (LSU 34413); 1 km S San Juan Zitlaltepec, ca. 4100 ft (1 CB—Choate 1970).

Cryptotis peregrina (Merriam, 1895a)—
Mexican Mountain Shrew

Blarina mexicana peregrina Merriam, 1895a:24. Type locality "Mts. near 15 mi W Oaxaca, 9,500 ft., Oaxaca," latitude 16.89°N, longitude 96.88°W.

C[ryptotis]. mexicana peregrina: Miller, 1911:222 (in part).

Cryptotis mexicana peregrina Miller, 1912:26 (in part).

Cryptotis mexicana machetes Miller, 1912:27 (in part).

Notiosorex [Xenosorex] phillipsii: Schaldach, 1966:289 (in part).

Notiosorex phillipsii: Schaldach, 1966:289 (in part).

Cryptotis peregrina: Woodman and Timm, 1999:1.

HOLOTYPE.—USNM 68317, ♂, adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Latin *peregrinus* 'strange or foreign'.

DIAGNOSIS.—*Cryptotis peregrina* can be distinguished from sympatric species of *Cryptotis* by U4 completely visible in lateral view and a narrow zygomatic plate (1.3–1.7 mm). Further,

C. peregrina differs from *C. obscura*, *C. parva*, and *C. phillipsi* by length of claw on the middle digit of the manus 2.7–3.0 mm (2.5%–3.1% of total length); and from *C. parva* by much greater overall size and il with 2 denticles and deep interdenticular spaces (Fig. 24).

GENERAL CHARACTERISTICS.—*Cryptotis peregrina* has a dark brown dorsal pelage, slightly paler ventral pelage, and a slightly bicolored tail. Condylbasal length ranges from 18.4 to 19.9 mm. The zygomatic processes are bulbous and extend posteriorly and ventrolaterally to below occlusal surface of teeth (Fig. 21).

DISTRIBUTION.—An endemic to Mexico, *C. peregrina* is known only from a limited area in Oaxaca. Goldman (1951:218) corrected the type locality to “Mts. near 15 mi due southwest of Oaxaca and just pass Santa Inéz” (Fig. 34; Woodman and Timm 2000). The mountains were identified as the Sierra de Cuatro Venados by Binford (1989).

ECOLOGY.—The type locality of *C. peregrina* is “. . . a wet meadow at 9,300 [sic] feet on the west slope known as Nevería Herrera” located within cloud forest (Goldman 1951:218; Choate 1970). No reproductive information or mammalian associates were found in published literature.

STATUS.—*Cryptotis peregrina* is listed as protected under *C. mexicana peregrina* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12), Briones-Salas and Sánchez-Cordero (2004:436), Choate (1969:469; 1973:2), Goodwin (1969:40), Miller and Rehn (1901:248), Musser (1964:6), Poole and Schantz (1942:178), Ramírez-Pulido et al. (1983:15), Schaldach (1966:289), Villa-R. (1953:177), Whitaker and Morales-Malacara (2005:652), Woodman (2005: 524, 526–529, 534), Woodman and Timm (1999:25).

SPECIMENS EXAMINED ($n = 12$; 12 measured).—Oaxaca: [mountains] 15 mi [S]W Oaxaca, 9500 ft (USNM 68316#, 68317T#, 68321#, 68323#, 68325#, 68328#–68330#, 68332#–68333#, 68338#); 2 km NE San Andrés Chicahuastla [= Chicahuastla], 2300 m (UMMZ 113888#).

ADDITIONAL SPECIMENS.—Oaxaca: N of La Muralla, [16°58'N, 97°56'W], top of Cerro Yucuninó [= Cerro Yucuyacua, 17°06'N, 97°40'W], Tlaxiaco [= Santa María Asunción Tlaxiaco, 17°16'N, 97°41'W], 10,500+ ft (all 3 localities as reported on specimen tag of AMNH

149965—Woodman and Timm 2000); near Oaxaca City (Villa-R. 1953).

Cryptotis phillipsi (Schaldach, 1966)—
Phillips' Shrew

[*Cryptotis*]. *mexicana peregrina*: Miller, 1911:222 (in part).
Cryptotis mexicana peregrina Miller, 1912:26 (in part).

Notiosorex (Xenosorex) phillipsi: Schaldach, 1966:289 (in part). Type locality “Río Molino, (3 kilometers S.W. San Miguel Suchixtepec, altitude) 2250 m, S. Oaxaca,” latitude 16.06°N, longitude 96.49°W.

Notiosorex phillipsi Schaldach, 1966:289.

Cryptotis phillipsi: Woodman and Timm, 2000:351.

HOLOTYPE.—CNMA 8445, ♀, adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Allan R. Phillips who studied the avian fauna of Mexico.

DIAGNOSIS.—*Cryptotis phillipsi* can be distinguished from all sympatric *Cryptotis* by il with a very small “bump” located in bottom of deepest interdenticular space. Further, *C. phillipsi* differs from *C. goldmani*, *C. nelsoni*, *C. obscura*, and *C. peregrina* by length of claw on the middle digit of the manus 1.9–2.0 mm (2.0% of total length); from *C. mexicana* and *C. obscura* by palatilar length usually 8.0–8.8 mm and breadth across M2–M2 usually 5.5–5.9 mm; from *C. obscura* by length of U1–M3 7.3–8.0 mm; and from *C. peregrina* by U4 (when present) partially obscured or not visible in lateral view and breadth across M2–M2 usually 5.5–5.9 mm.

GENERAL CHARACTERISTICS.—*Cryptotis phillipsi* has a very dark gray dorsal pelage with a silvery wash giving a frosted appearance. Hairs on venter are slightly paler than those of the dorsum with silvery medium gray for the proximal three-fourths and silver for the distal one-fourth. Hairs on tail are uniformly very dark gray as for the dorsal pelage. Condylbasal length ranges from 17.9 to 20.4 mm. The zygomatic plate usually is 1.9–2.2 mm wide. The il has 2 denticles and deep interdenticular spaces. Zygomatic processes extend posteriorly and ventrolaterally to below occlusal surface of teeth (Fig. 23) and are sharply pointed.

DISTRIBUTION.—An endemic to Mexico, *C. phillipsi* is known only from Oaxaca from ca. 1060 to 2600 m elevation (Fig. 34; Woodman and Timm 2000).

ECOLOGY.—The type locality of *C. phillipsi* is located at the upper reaches of cloud forest. The locality occurs in a humid, shaded valley

with numerous small streams "... lined with willows and alders ... choked with a dense, lush ground cover of ferns, vines, and flowering shrubs" and the ground "... covered with dense mosses and deep humus" with pines and immense oaks on the ridges and slopes of the valley (Schaldach 1966:287). The area of Río Guajolote, on the Pacific side of the southern coast range of Oaxaca, is characterized as having a more complete cloud forest ecosystem with more dense vegetation and a nearly impassable river valley with an abundance of blackberry (*Rubus*) brambles. Another collection locality at the Río Jalatengo is considered to be at the lower limits of cloud forest, with pine trees, large blackberry thickets, and a ground cover "... more lowland tropical in character" (Schaldach 1966:287). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis goldmani machetes*, *Sorex veraecrucis oaxacae*, and *S. veraepacis mutabilis* (Schaldach 1966).

STATUS.—*Cryptotis phillipsi* is listed as protected under *C. mexicana peregrina* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:12), Whitaker and Morales-Malacara (2005:652), Woodman (2005:524, 526–530, 534).

SPECIMENS EXAMINED ($n = 8$; 6 measured).—**Oaxaca:** Campamento Río Molino, 2300 m (KU 121661#, 124298#); Las Vigas, 8500 ft (KU 29541#); Río Guajolote, 2000 m (KU 114226#); Río Molino, 3 km SW San Miguel Suchixtepec, [km 153], 2250 m (CNMA 8445T#, 8446–8447); 20 mi S, 5 mi E Sola de Vega [= San Miguel Sola de Vega, 16°31'N, 96°59'W], 4800 ft (KU 98728#).

ADDITIONAL SPECIMENS.—**Oaxaca:** La Cima, Puerto Escondido Rd., km 184.5, [16°12'N, 97°07'W], 5750 ft (CAS 15473); Lovene, [16°02'N, 96°12'W], Miahuatlán (AMNH 178739); Puerto Ángel Rd. (MZFC 27517); Puerto Ángel Rd., km 153, [16°04'N, 96°28'W], 7100 ft (CAS 14068); Puerto Ángel Rd., Río Jalatengo Camp, km 178, 4275 ft (CAS 14069, 14071–14072, 15475; MZFC 27518); Puerto Ángel Rd., km 195, 3475 ft (MZFC 26551); Puerto Escondido Rd., km 193, [16°10'N, 97°07'W], 4200 ft (CAS 15474); San Miguel Suchixtepec, [16°05'N, 96°28'W], Miahuatlán District (AMNH 214806–214808); Sinai [Finca

Sinai, 16°07'N, 97°08'W], 10 km [by trail] E Nopala [Santo Reyes Nopala], 7200 ft (CAS 14940—Woodman and Timm 2000).

Cryptotis tropicalis (Merriam 1895a)—
Tropical Shrew

Corsira tropicalis Gray, 1843:79 (*nomen nudum*).

Sorex micrurus: Tomes, 1862, 1861:279 (in part). Type locality "Cobán cerca de los 4,400 ft, Alta Verapaz, Guatemala," latitude 15.48°N, longitude 90.37°W.

Blarina tropicalis: Merriam, 1895a:21.

C[ryptotis]. tropicalis: Miller, 1911:221.

Cryptotis micrura: Miller, 1924:32.

Cryptotis parva tropicalis: Choate, 1970:268.

Cryptotis tropicalis Handley and Choate, 1970:200.

LECTOTYPE.—British Museum (Natural History) no. 7.1.1.33, probably ♂, subadult, skin with some damage, associated skull probably a misidentified *C. merriami* (Woodman *in litt.*).

ETYMOLOGY.—The specific name is related to the affinity of this taxon to the tropical physiographic provinces of Chiapas and Central America.

DIAGNOSIS.—*Cryptotis tropicalis* can be distinguished from *C. goodwini* by its overall smaller size: condylobasal length 18.7–18.9 mm, palatilar length 7.7–7.9 mm, maxillary breadth 5.4–5.6 mm, length of U1–M3 6.7–7.2 mm, length of unicuspid tooththrow 2.2–2.6 mm, breadth across M2–M2 5.5–5.8 mm, length of mandible 8.3–8.8 mm, length of mandibular tooththrow 5.4–5.5 mm, height of coronoid process 3.8–4.0 mm, height of articular condyle 3.5–3.7 mm, height of coronoid valley 2.6–2.8 mm, and length from upper articular condyle to posterior edge of m3 4.6–5.0 mm.

With the exception of having a shorter height of the condylar process (3.9–4.0 mm), overall, the mandible of *C. tropicalis* is larger than for *C. merriami*: breadth across M2–M2 5.5–5.8 mm, length of mandible 8.3–8.8 mm, length from upper articular condyle to posterior edge of m3 4.6–5.0 mm, height of coronoid valley 2.6–2.8 mm, height of articular condyle 3.5–3.7 mm, length of coronoid–ventral point of lower condylar facet 4.3–4.5 mm, and length of coronoid–posterior point of upper condylar facet 4.1–4.3 mm. Additionally, *C. tropicalis* can be distinguished from *C. parva pueblensis* by hairs on venter blond tipped, i1 with 2 denticles and deep interdenticular spaces (Fig. 24), and by its overall larger size: condylobasal length 18.7–18.9 mm, palatilar length 7.7–7.9 mm, length of U1–M3 6.7–7.2 mm, breadth across M2–M2 5.5–5.8 mm, length of

unicuspid toothrow 2.2–2.6 mm, length of mandible 8.3–8.8 mm, length of mandibular toothrow 5.4–5.5 mm, length from upper articular condyle to posterior edge of m3 4.6–5.0 mm, height of coronoid valley usually 2.6–2.8 mm, height of articular condyle 3.5–3.7 mm, length of coronoid–ventral point of lower condylar facet usually 4.3–4.5 mm, and length of coronoid–posterior point of upper condylar facet usually 4.1–4.3 mm.

Further, *C. tropicalis* can be distinguished from *C. griseoventris* by sharply pointed zygomatic processes (Fig. 22) and i1 with deep interdenticular spaces (Fig. 24), condylobasal length 18.7–18.9 mm, palatilar length 7.7–7.9 mm, maxillary breadth 5.4–5.6 mm, length of U1–M3 6.7–7.2 mm, length of unicuspid toothrow 2.2–2.6 mm, and length of mandibular toothrow 5.4–5.5 mm. Also, it differs from *C. mayensis* and *C. mexicana* by breadth across M2–M2 5.5–5.8 mm; from *C. mayensis* by U4 partially obscured or not visible in lateral view; and from *C. mexicana* by sharply pointed zygomatic processes.

GENERAL CHARACTERISTICS.—*Cryptotis tropicalis* has hairs of dorsal pelage dark silvery gray for proximal half, with white band medially, and dark reddish brown tips. Hairs on venter are dark silvery gray proximally with blond tips. The tail is slightly bicolored. The zygomatic processes extending posteriorly and ventrolaterally to below occlusal surface of teeth (Fig. 23).

DISTRIBUTION.—*Cryptotis tropicalis* occurs within Nuclear Central America from the eastern highlands of Chiapas south into the highlands of Belize, Guatemala, and Honduras (Fig. 34; Choate 1970, Hall 1981).

ECOLOGY.—*Cryptotis tropicalis* occurs in tropical rainforests of the high plains and inland slopes of the Sierra Madre (Hooper 1947, Choate 1970, Álvarez del Toro 1977). No reproductive information or mammalian associates were found in published literature.

STATUS.—*Cryptotis tropicalis* is listed as protected under *C. parva tropicalis* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Choate (1970: 268–270), Ramírez-Pulido et al. (1983:7), Whitaker (1974:1), Woodman and Croft (2005:20–21, 30).

SPECIMENS EXAMINED ($n = 14$; 3 measured).—**Chiapas:** Finca Prusia, Mpio. La Libertad,

1110 m (CNMA 18#, 170#); La Trinitaria, Mpio. La Trinitaria (CNMA 36461–36471); Unión Juárez, Volcán Tacaná (CNMA 9063#).

ADDITIONAL SPECIMENS.—Liquidambar (SMF [Gerhard Storch private collection] 11477a—Woodman and Croft 2005).

TRIBE NOTIOSORICINI (*Megasorex* and *Notiosorex*)

DIAGNOSIS.—Shrews of the tribe Notiosoricini are unique in having a locking mechanism present in the upper glenoid furrow that holds the upper condylar facet in place (Carraway 2005); unpigmented labial and lingual ridges along the anteroposteriorly directed groove in the 2nd cusp of I1; no pigment on teeth or some teeth only lightly pigmented (Fig. 12); and area between condylar processes deeply emarginate, i.e., breadth of interarticular area markedly less than that of superior condylar process (Fig. 16; Carraway 1995). Further, *Megasorex* and *Notiosorex* shrews differ from soricini shrews by the shield of the curly overhairs having a smooth structure “with, at most, shallow U-shaped notches” (Ducommun et al. 1994:623); a short tail $\leq 33\%$ of length of head and body; 28 teeth, some of which may be pigmented; 3 unicuspid teeth on each side of upper jaw; and I1 with no median tine. Furthermore, on the skull, upper glenoid furrow is rotated 30° from horizontal of the skull (Carraway 2005).

GENERAL CHARACTERISTICS.—Notiosoricini shrews are light to dark gray colored and range in size from the small *Notiosorex crawfordi* to the large *Megasorex gigas*.

Megasorex gigas (Merriam, 1897)— Musaraña del Desierto, Mexican Giant Shrew, or Merriam’s Desert Shrew

Notiosorex gigas Merriam, 1897:227. Type locality “Mts. near Milpillas, cerca de San Sebastián, Jalisco,” latitude 22.12°N , longitude 104.11°W .

(*Notiosorex*) *gigas* Trouessart, 1898:1286.

Megasorex gigas: Hibbard, 1950:128.

HOLOTYPE.—USNM 88012, ♀, adult, skin and skull.

ETYMOLOGY.—The generic name is derived from the Greek *megas* ‘great’. The specific name is derived from the Latin *soricinus* ‘of a shrew’.

Fig. 35. Distribution of *Megasorex gigas* and 4 species of *Notiosorex* in Mexico. Taxa are indicated by symbols in key. Collection sites of fossil *N. crawfordi* are indicated by an open star (☆).

DIAGNOSIS.—*Megasorex* shrews can be distinguished from other shrews by a combination of large size, all teeth unpigmented (Fig. 13), and in labial view, alveolus of i1 does not extend posteriorly beneath at least part of paraconid of m1 (Fig. 13). Also, the curly overhairs have a single series of superficial notches in the smooth shield (Ducommun et al. 1994: 635). Additionally, it can be distinguished from *Notiosorex* by “the lower glenoid furrow [of the skull] being fused more laterally to the alisphenoid, thus the alisphenoid does not serve as a ridge on the lingual side of the ovale groove. The result is a continuous, smooth line along the anterior edge of the lower glenoid furrow to the labial edge of the alisphenoid” (Carraway 2005:79).

GENERAL CHARACTERISTICS.—*Megasorex gigas* has a light gray–lightish brown dorsal pelage, ventral pelage with white-tipped hairs, and a slightly bicolored tail. It is a large shrew with a head and body length 81–87 mm and a robust skull.

DISTRIBUTION.—An endemic to Mexico, *M. gigas* is known from portions of about a 44,400-km² area in Colima, Guerrero, Jalisco, Michoacán, and Nayarit from at least 80 to 1800 m

elevation (Fig. 35; Armstrong and Jones 1972a, Ramírez-Pulido and Britton 1981, Fa 1989, Fa and Morales 1993, Flores Villela and Gerez 1994, Téllez-Girón et al. 1997).

ECOLOGY.—Although few specimens of *M. gigas* are known, they usually have been captured in riparian areas characterized by moist banks with logs, rocks, and boulders in humid tropical deciduous forests (Merriam 1897, Davis 1957, Davis and Lukens 1958, Winkelmann 1962, Jones 1966, Webb et al. 1981). In Colima, *M. gigas* also occurs in mesophyletic forests (Téllez-Girón et al. 1997) and in stone walls at the edge of corn fields (specimen tag of LACM 13568). In Nayarit, *M. gigas* occurs in moist or xeric areas with an abundance of lava rocks (Fisher and Bogan 1977). As of 2005, in Oaxaca only 67.59% of habitat considered suitable for *M. gigas* habitation (i.e., habitat unmodified for agriculture or urban development) still existed (Sánchez-Cordero et al. 2005).

A lactating female (KU 99538) was collected 14 June 1964. Known mammalian associates include *Hodomys alleni*, *Liomys pictus*, *Osgoodomys banderanus*, *Peromyscus aztecus evides*, *P.*

maniculatus, *P. spicilegus*, and *Reithrodontomys fulvescens* (Winkelman 1962, Téllez-Girón et al. 1997).

STATUS.—*Megasorex gigas* is listed as a threatened species (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Arita and Ceballos (1997:53), Briones-Salas and Sánchez-Cordero (2004:436), Chávez and Ceballos (1998:118), Escalante et al. (2003: 575), Fa and Morales (1991:207), Goldman (1951:335), Goodwin (1969:43), Hall (1981:65), Hall and Kelson (1959:65), Kasper and Jones (1977:155), López-Forment and Urbano-V. (1977:235), Lyon and Osgood (1909:240), Maldonado (1999:46–47), Miller (1912:28), Miller and Rehn (1901:245), Orr (1963:424), Poole and Schantz (1942:181), Ramírez-Pulido and Sánchez-H. (1972:108), Ramírez-Pulido et al. (1983:16), Repenning (1967:56), Villa-R. and Cervantes (2003:91), Whitaker and Morales-Malacara (2005:652).

SPECIMENS EXAMINED ($n = 53$; 35 measured).—**Colima:** 14 mi N Colima, 4200 ft (LACM 55132#–55133#); 3 mi NE Colima (LACM 13568); 5 mi NE La Cofradía [= Cofradía de Suchitlán], 3700 ft (LACM 55074–55077); 7 mi NE La Cofradía (LACM 55079#–55081#, 55083#, 55084); Los Llanitos, 5900 ft (LACM 29059–29060); Mixcuatle [= Miscoate] (LACM 33815). **Guerrero:** Acahuizotla, 2800 ft (TCWC 5828#–5831#); 2 km SE Acahuizotla, in canyon below village, 2500 ft (TCWC 5644#); 2 km SE Acahuizotla, 2800 ft (TCWC 5824#–5827#); 5 km N Agua del Obispo (KU 99537#); 14 mi S Chilpancingo, 3500 ft (CAS 12246); Texcalzitle, 6 km NNW Teloloapan (CNMA 9064#). **Jalisco:** 4 mi SW Puerto Valarta, 20 ft (KU 111388#); San Sebastián (USNM 88010#, 88011, 88012T#). **Michoacán:** 6 km NE (por carr.) Aguila “Los Teriamaster” (CNMA 26553); 2 km W Cerro Colorado, 1113 m (UAMI TK45530–TK45531); Coalcoman, 1800 m (CNMA 876; UAMI TK45891); 7 mi E (by road) Dos Aguas, 5600 ft (UMMZ 110522–110523); 11 mi E (by road) Dos Aguas (UMMZ 110520#–110521#); Los Reyes (USNM 125896#); 18°49.493'N, 103°05.478'W (UAMI TK45891#); 19°19.23'N, 100°29.5'W (UAMI TK45530#–TK45531#). **Nayarit:** 7.3 mi ESE Amatlán de Cañas, 5000 ft (KU 98879#); 3 mi N Coapán (USNM 511264#); 3.5 mi W (by road) Venustiano Carranza, 2900 ft (CMNH 79264#); 3.7 mi SW Venustiano Carranza

(TCWC 41954#–41955#); 4 mi SW Venustiano Carranza (TCWC 41956#–41959#).

ADDITIONAL SPECIMENS.—**Colima:** El Rancho “El Jabalí,” 7 km N Cofradía de Suchitlán, Municipio de Comala, in the foothills of Volcán de Colima, 19°26'N, 103°49'W, 1460 m (2 specimens—Téllez-Girón et al. 1997). **Jalisco:** La Estación de Biología “Chamela,” Mpio. La Huerta, in the Planicie Costera, ca. 19°32'N, 105°02'W, 80 m (3 specimens—Téllez-Girón et al. 1997). **Nayarit:** Mineral de Tigre, 6 mi E Huajicori, 1340 ft (MSUM 17086); and 9 mi WSW Compostela, 2000 ft (MSUM 16102; Fisher and Bogan 1977).

Notiosorex

ETYMOLOGY.—The generic name *Notiosorex* is derived from the Greek *notios* ‘southern’ and the Latin *sorcinus* ‘of a shrew’.

DIAGNOSIS.—*Notiosorex* shrews can be distinguished from other genera of shrews by a combination of small size; teeth with only light pigment on I1, U1–U3, and sometimes P4, i1, c1, and p1 (Fig. 12); and in labial view, the alveolus i1 extending posteriorly beneath at least part of paraconid of m1 (Fig. 12). Also, the curly overhairs have a single series of slightly indented notches on the smooth shield (Ducommun et al. 1994:635). Additionally, they can be distinguished from *Megasorex* by “the labial edge of the alisphenoid forming a ridge that constitutes a portion of the side of the ovale groove” (Carraway 2005:79).

GENERAL CHARACTERISTICS.—All *Notiosorex* have a medium to dark gray dorsal pelage, ventral pelage with pale-tipped hairs, and hairs on tail colored uniformly the color of the dorsal pelage.

TAXONOMY.—Four species of *Notiosorex* are recognized: *cockrumi*, *crawfordi*, *evotis*, and *villai*. The possibility of a fifth species of *Notiosorex*, currently residing on the Baja California peninsula, has been suggested by McAliley et al. (in press) and Ohdachi et al. (2006).

DISTRIBUTION.—Shrews of the genus *Notiosorex* are distributed throughout the southwestern United States, southward through most of the northern two-thirds of Mexico (Fig. 35).

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:53), Villa-R. and Cervantes (2003:27, 55, 77).

REMARKS.—*Notiosorex* shrews are notoriously difficult to capture in traps (Baker 1956,

Fig. 36. Discriminant-function plot of *Notiosorex crawfordi* ($n = 34$; solid bars) and *N. cockrumi* ($n = 15$; open bars) based on 26 quantitative variables. Discriminant-function axis I ($\chi^2 = 46.17$, $df = 26$, $P = 0.0087$) accounted for 100% of variation present between the 2 taxa. With 98% (1 *N. crawfordi* was misclassified at the 51% level) of 49 specimens correctly classified into their *a priori* groups 2 distinct clusters were formed. Specimens have longer and wider skulls and mandibles from *N. crawfordi* on the left to *N. cockrumi* on the right.

Clark and Yensen 1983). However, in regions where species of this genus are known to occur, large numbers of specimens commonly are found in pellets (Lindstedt 1980) regurgitated by barn owls (*Tyto alba*) and great horned owls (*Bubo virginianus*). Thus, the most expeditious approach to ascertaining the occurrence of these shrews is through examination of owl pellets.

One specimen of *Notiosorex crawfordi* from the Wisconsin-aged site of Cueva de Abra, Tamaulipas, was reported (Dalquest and Roth 1970). This locality is located within the distribution of *N. villai* (Fig. 35); unfortunately, as the specimen has been misplaced, it was unavailable for examination to confirm its identity.

Notiosorex cockrumi

Baker, O'Neill, and McAliley, 2003—
Cockrum's Gray Shrew

Notiosorex cockrumi Baker, O'Neill, and McAliley, 2003:2.

Type locality "Arizona, Cochise County, Leslie Canyon National Wildlife Refuge, T21S, R28E, Section NE 1/4 20, elevation 4460 m," latitude 31.60°N, longitude 109.53°W.

HOLOTYPE.—TTU 100000; sex unknown; subadult; skin, skull, and postcranial skeleton;

frozen tissues TK49918 deposited in the Natural Science Research Laboratory, Texas Tech University.

ETYMOLOGY.—The specific name is a patronymic honoring "... Dr. E. Lendell Cockrum for his lifetime of research on mammals and for his commitment to the education of students in Mammalogy and General Biology" (Baker et al. 2003:9).

DIAGNOSIS.—Originally, *N. cockrumi* was distinguished from *N. crawfordi* by 232 fixed or polymorphic position differences in the mitochondrial cytochrome *b* gene and 30 fixed or polymorphic site differences in Intron 7 of the nuclear gene beta fibrinogen (Baker et al. 2003, www.nsrll.ttu.edu/publicat.html). However, qualitative and quantitative characteristics also distinguish *N. cockrumi* from other species of *Notiosorex*. It has the shortest actual length of claw on the middle digit of the manus (1.0–1.2 mm) of species within *Notiosorex*; relative to total length, the claw also is much shorter (1.28%–1.52%) than for *N. crawfordi*. Unlike *N. evotis*, it has an extension of the roof of the glenoid fossa that forms a prominent ridge on the lateral side of the cranium (Fig. 19). Intermediate in size between *N. crawfordi* and *N. evotis*, *N. cockrumi* can be distinguished from *N. crawfordi* and *N. villai*

by total length 78–86 mm; from *N. evotis* and *N. villai* by condylobasal length usually 15.76–16.51 mm, breadth across M2–M2 usually 4.6–4.9 mm, and length of c1–m3 usually 4.6–4.8 mm. Further, *N. cockrumi* can be separated from *N. evotis* by cranial breadth usually 8.2–9.0 mm, height of coronoid process usually 4.0–4.3 mm, and height of articular condyle 2.7–3.0 mm.

Based on a discriminant analysis (Fig. 36), all specimens of *N. cockrumi* can be distinguished from *N. crawfordi* by application of the following discriminant-function equation: discriminant score = $0.7261(\text{condylobasal length}) - 5.48432(\text{least interorbital breadth}) + 7.3084(\text{maxillary breadth}) + 2.8817(\text{cranial breadth}) - 1.6454(\text{breadth across M2–M2}) + 4.5887(\text{length of unicuspid toothrow}) - 0.7162(\text{length of P4–M3}) - 2.013(\text{length of U1–M3}) + 1.5453(\text{length of mandible}) - 11.3988(\text{length of c1–m3}) - 6.2236(\text{length from upper articular condyle to posterior edge of m3}) + 2.1833(\text{height of articular condyle}) + 4.9899(\text{height of coronoid valley}) - 5.8256(\text{height of coronoid process}) - 5.0594(\text{depth of mandible at m2}) + 6.8252(\text{length of coronoid–posterior point of upper condylar facet}) - 3.1701(\text{length of coronoid–ventral point of lower condylar facet}) + 20.0286(\text{length of c1}) - 1.4169(\text{length of p4}) + 5.1313(\text{length of m2}) - 23.6296(\text{length of m3}) - 2.5635(\text{width of c1}) + 8.6846(\text{width of p4}) - 18.6706(\text{width of m1}) - 3.8984(\text{width of m2}) + 19.2577(\text{width of m3}) + 34.6748. Individuals with a score >1.0 are referable to *N. cockrumi*; those with a score <1.0 are referable to *N. crawfordi*.$

GENERAL CHARACTERISTICS.—In winter, hairs of the dorsal pelage have a wide band of very dark grayish brown proximally, a narrow band of pinkish white medially, and a narrow band of very dark grayish brown distally; hairs on venter have a narrow band of gray proximally and a wide band of white distally. Hairs on tail are dark grayish brown.

DISTRIBUTION.—*Notiosorex cockrumi* is distributed from southern Arizona southward into central Sonora (Fig. 35; Baker et al. 2003).

ECOLOGY.—As recorded by the collector, habitat of the type locality is “. . . riparian overstory of Arizona walnut and ash. Mesquite grassland dominated by giant sacaton . . .” (*Sporobolus wrightii*—Baker et al. 2003:2). No reproductive information was found in pub-

lished literature. In Arizona, known mammalian associates include *Notiosorex crawfordi* (Baker et al. 2003).

SPECIMENS EXAMINED ($n = 18$; 15 measured).—MEXICO: **Sonora:** 14.6 mi E Mazocahui (MVZ 148830#); 4.1 mi NW (by road) Nacori Chico (MVZ 148831). UNITED STATES: **Arizona:** Cochise Co., Leslie Canyon National Wildlife Reserve, T21S, R28E, NE1/4 Sec. 20, 4660 m (TTU 82981#–82984#, 82986#–82987#, 82991, 82993, 82994#, 82996#, 82998#, 83502#–83505#, 100000T#).

Notiosorex crawfordi (Coues, 1877)—
Crawford's Gray Shrew
or Desert Shrew

Sorex (*Notiosorex*) *crawfordi* Coues, 1877:651. Type locality “Fort Bliss, El Paso Co., Texas,” latitude 31.8°N, longitude 106.4°W.

Notiosorex crawfordi: (Coues, 1877:652).

Notiosorex crawfordi Carraway and Timm, 2000:311.

HOLOTYPE.—USNM 2653/4437, sex unknown, adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring S.W. Crawford, collector of the holotype.

DIAGNOSIS.—*Notiosorex crawfordi* has the smallest cranium of the genus. An extension of the roof of the glenoid fossa forms a prominent ridge on the lateral side of the cranium (Fig. 19), small paroccipital processes lie against the exoccipitals (Fig. 37), and the coronoid processes are slender relative to their height (Carraway and Timm 2000). *Notiosorex crawfordi* can be distinguished from *N. cockrumi* by total length usually 84–100 mm (most are >88 mm) and length of claw on the middle digit of the manus 1.3–1.6 mm (1.57%–1.82% of total length). Further, 98% of *N. crawfordi* can be separated from *N. cockrumi* by application of the discriminant-function equation presented in the Diagnosis section of the previous species account.

Breadth of the zygomatic plate (1.7–2.0 mm, 10%–13% of condylobasal length) is intermediate between *N. evotis* (2.1–2.4 mm, 13%–15%) and *N. villai* (1.7 mm, 8%). Based on a discriminant analysis (Fig. 40), 100% of specimens of *N. crawfordi* can be distinguished from *N. evotis* by application of the following discriminant-function equation: discriminant score = $-2.8891(\text{condylobasal length}) - 4.5459(\text{maxillary breadth}) + 1.8064(\text{length of P4–M3}) + 2.2555(\text{breadth across M2–M2}) - 1.6672(\text{height$

Figs. 37–39. Right side of cranium of *Notiosorex* illustrating differences in position of paroccipital process relative to exoccipital in lateral view: 37, small process lying against, but not extending to ventral edge of exoccipital (*N. crawfordi*, KU 145262); 38, low-set process extending at an oblique angle from skull (*N. evotis*, KU 89214); 39, small process lying against and extending to ventral edge of exoccipital (*N. villai*, KU 54932).

Fig. 40. Discriminant-function plot of *Notiosorex crawfordi* ($n = 35$, solid bars) and *N. evotis* ($n = 12$, open bars) based on 12 quantitative variables. Discriminant-function axis I ($\chi^2 = 70.50$, $df = 12$, $P = 0.0000$) accounted for 100% of variation present between the 2 taxa. With 100% of 47 specimens correctly classified into their *a priori* groups 2 distinct clusters were formed. Specimens have longer and wider skulls and mandibles from *N. crawfordi* on the left to *N. evotis* on the right.

of coronoid process) – 2.1978(length of mandible) – 5.1098(length of c1–m3) + 5.9763(depth of mandible at m2) – 1.1425(length of coronoid–posterior point of upper condylar facet) + 10.5753(length from upper articular condyle to posterior edge of m3) + 11.2101(width of m1) + 7.9573(length of c1–m3) – 9.0614. Individuals with a score <1.1 are referable to *N. crawfordi*; those with a score >1.9 are referable to *N. evotis*.

GENERAL CHARACTERISTICS.—During summer, *N. crawfordi* has hairs of the dorsal pelage with a wide band of dark gray proximally and a narrow band of very dark grayish brown dis-

tally; hairs on venter have equal-width bands of very dark gray proximally and pinkish white distally (Carraway and Timm 2000). During winter, hairs of the dorsal pelage have a wide band of very dark grayish brown proximally, a narrow band of pinkish white medially, and a narrow band of very dark grayish brown distally; hairs on venter have a narrow band of gray proximally and a wide band of white distally. Hairs on tail are dark grayish brown.

DISTRIBUTION.—*Notiosorex crawfordi* occurs throughout the southwestern United States and in Mexico in Baja California Peninsula, Chihuahua, Coahuila, Durango, Hidalgo, Jalisco,

Nuevo León, San Luis Potosí, Sinaloa, Sonora, and Zacatecas (Fig. 35; Rodríguez Vela 1999, Carraway and Timm 2000, Álvarez and González-Ruiz 2001). One insular record is documented from San Martin Island. Occurrences of *N. crawfordi* range from low elevations on the Baja California Peninsula and Sinaloa to at least 2317 m in the Sierra Moroni of Zacatecas.

ECOLOGY.—*Notiosorex crawfordi* occurs in a wide variety of ecosystems from dry areas with vegetation dominated by *Larrea tridentata*, *Ambrosia chenopodiifolia*, *A. dumosa*, *Opuntia echinocarpa*, *Idra columnaris*, and *Pachycereus pringlei* (Yensen and Clark 1986); a mixed desert-shrub and mesquite-grassland ecotone (Baker 1962, Petersen and Petersen 1979); desert with vegetation dominated by lechuguilla, algerita, catclaw, prickly pear, and barrel cactus (Dalby and Baker 1967); sandy flats (Fisher 1941, Yensen and Clark 1986); near "... a mesquite tree on a moist mud flat ..." (Armstrong and Jones 1971:751); pine-oak forest (Álvarez 1963); to a *Neotoma lepida* stick nest (Ryckman et al. 1965). Delgadillo Villalobos et al. (2005) found *N. crawfordi* on Maderas del Carmen, Coahuila, from 1000 m in the desert to 1415 m in grasslands interspersed with beaked yucca (*Yucca rostrata*), sotol (*Dasylirion leiophyllum*), and junipers (*Juniperus* sp.). The wide range of habitats occupied by Crawford's gray shrews is possible because of their unique physiological adaptations for very dry environments (Lindstedt 1980) and the smooth structure of the shield of their curly overhairs (Ducommun et al. 1994). A lactating female was collected in October 1980 in Baja California Sur (Woloszyn and Woloszyn 1982).

Known mammalian associates include *Perognathus flavus* and *P. penicillatus* in Coahuila (Baker 1953) and *Neotoma lepida*, *Peromyscus eva*, *P. truei*, and *Sorex ornatus lagunae* in Baja California Sur (Maldonado 1999). An examination of Barn Owl (*Tyto alba*) pellets found at 2 mi W Miñaca, western Chihuahua, showed *N. crawfordi* in association with *Baiomys taylori*, *Dipodomys ordii*, *Microtus mexicanus*, *Neotoma mexicana*, *Onychomys torridus*, *Perognathus flavus*, *Peromyscus* sp., *Reithrodontomys* sp., *Signodon* sp., and *Thomomys umbrinus* (Anderson and Long 1961). *Lepus californicus*, *L. callosus*, *Mus musculus*, *Peromyscus boylii*, *P. maniculatus*, *P. polius*, *P. truei*, *Reithrodonto-*

mys fulvescens, *R. megalotis*, *Rattus rattus*, *Signodon fulviventer minimus*, *S. ochrognathus*, *Spermophilus variegatus*, *Sylvilagus auduboni*, and *S. floridanus* also occurred in the area. In another study of a small mammal community in northern Durango, Petersen and Petersen (1979) found remains of *N. crawfordi* in addition to those of *Baiomys taylori*, *Dipodomys merriami*, *D. nelsoni*, *D. ordii*, *Lepus californicus*, *Liomys irroratus*, *Neotoma albigula*, *N. goldmani*, *Onychomys torridus*, *Perognathus flavus*, *P. hispidus*, *P. nelsoni*, *Peromyscus maniculatus*, *P. melanophrys*, *P. pectoralis*, *P. truei*, *Reithrodontomys megalotis*, *R. fulvescens*, *Signodon fulviventer*, *S. hispidus*, *S. ochrognathus*, and *Sylvilagus audubonii* in Barn Owl and Great Horned Owl (*Bubo virginianus*) pellets. Baker (1962) trapped many of these species in the same area as *N. crawfordi*. Also, Petersen and Petersen (1979) were able to trap or observe *Lepus callosus*, *Cratogeomys castanops*, *Spermophilus spilosoma*, *S. variegatus*, *Thomomys umbrinus*, and 3 species of bats (not named). In addition to these taxa, Baker (1966) also found *Perognathus nelsoni* in association with *N. crawfordi* in Durango. In Nuevo León, *N. crawfordi* was found in association with *Perognathus nelsoni* and *Peromyscus pectoralis* (Dalby and Baker 1967); with *Canis latrans*, *Lepus californicus*, *Odocoileus virginianus*, *Pecari tajacu*, *Procyon lotor*, *Spermophilus* sp., *Sylvilagus floridanus*, *Tadarida brasiliensis mexicana*, and *Taxidea taxus* (Rodríguez Vela 1999); and with *Chaetodipus n. nelsoni* and *Peromyscus pectoralis collinus* (Jiménez Guzmán et al. 1999).

STATUS.—*Notiosorex crawfordi* is listed as a threatened species (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Anderson (1972:233), Anderson and Ogilvie (1957:34), Armstrong (1996:276), Armstrong and Jones (1972b:2), Baker (1953:253; 1962:283), Baker and Alcorn (1953:116), Bradshaw and Hayward (1960:282), Brennan and Goff (1977:912), Caire (1997:71), Clark and Yensen (1983:439), Cockrum and Bradshaw (1963:3), Dalquest and Roth (1970:221), Escalante et al. (2003:575), Findley (1955b:616), Findley and Caire (1977:132), Fisher and Bogan (1977:827), Grenot and Serrano (1981:91), Hall and Kelson (1959:64), Hernández Chávez (1997:163), Hooper (1961:120), Huey (1964:92), Jiménez Guzmán

et al. (1997:133; 1999:33–34), Jones et al. (1962:147), Kasper and Jones (1977:155), Lukoschus et al. (1977), Lyon and Osgood (1909:240), Merriam (1895a:32–33), Packard (1977:142, 148, 150), Petersen (1976:139; 1979:1–8; 1980:123), Poole and Schantz (1942:181), Ramírez-Pulido et al. (1983:16), Schmidly (1977:165), Schmidly and Hendricks (1984:22), Schultz et al. (1970:148), True (1884:606), Twente and Baker (1951:120–121), Villa-R. and Cervantes (2003:87), Whitaker and Morales-Malacara (2005:547–548, 612, 626).

SPECIMENS EXAMINED ($n = 60$; 5 measured).—**Baja California:** 9 mi N (Hwy 1) Cataviña (MVZ 155507, 159725); 9 mi N Cataviña (MVZ 159725); El Crucero, 29°16'N, 114°09'W, 610 m (CNMA 18839); 10 mi SE (Hwy 1) El Rosario (MVZ 154748, 155508, 159726); 9.2 mi S (Méx. Hwy 1) Rosarito (MVZ 163717); San Martin Island, 300 yd inland from Hassler's Cave (MVZ 136207); San Quintin (CAS 52; USNM 139592–139593); 14 mi S San Quintin, Playa El Socorro, along mouth of El Socorro River (LACM 90999, 91027–91030, 91076); Santo Tomás (USNM 137142). **Baja California Sur:** Cabo San Lucas (LACM 8429); Santa Anita (USNM 74550–74551, 79088–79092, 146693, 146933–146934, 146936, 147352, 147421); Todos Santos, Sierra de la Laguna, Laguna Chica (LACM 90998). **Chihuahua:** 3.5 mi ESE Los Lamentos (KU 76488); 2 mi W Minaca (KU 109475). **Coahuila:** 3 mi NW Cuatro Ciénegas (KU 51571–51572); El Gorrión Hwy 54, km marker 80 (TTU 9728); Sabinas (USNM 277621). **Durango:** 2 km SE Atotónilco, 6680 ft (MSUM 13887–13888); 4.8 km SE Atotónilco, 6680 ft (MSUM 13889–13890); 7 mi NNE Boquilla, 6400 ft (MSUM 10260); 28 km N, 18 km E Ceballos (UAMI 801, 1222, 1607, 1859–1861); km 1134, Hwy 45* (TTU 6284[#]). **Hidalgo:** 11 km S, 1 km W Zacualtipán, ca. 1700 m (TTU 24185[#]). **Nuevo León:** 3 mi SW Galeana, 5100 ft (MSUM 11238). **San Luis Potosí:** 21.4 km S Matehuala (CB 14187). **Sinaloa:** 5 mi WNW El Carrizo (KU 105409); El Fuerte (KU 75184[#]); Mazatlán (MZFC uncataloged mummy). **Sonora:** Río Alamos (TTU 6323[#]). **Zacatecas:** Plateado (USNM 90845[#]).

ADDITIONAL SPECIMENS.—**Chihuahua:** Jiménez Cave[☆] (late Pleistocene fossil, UTEP [University of Texas at El Paso]—Messing 1986). **Coahuila:** Cuadro Pelota, 29°56'94"N [sic], 102°35'14"W, Maderas del Carmen (Del-

gadillo Villalobos et al. 2005). **Durango:** Atotónilco de Campa, 24°38'N, 103°42'W, 2037 m (44 specimens from owl pellets and 4 trapped specimens in private collection of M.K. Petersen). **Hidalgo:** Grutas de Xoxaí, 6 km N Lagunilla, 1870 m (4 specimens from owl pellets—Álvarez and González-Ruiz 2001). **Jalisco:** La Unión, 28 km S Lagos de Moreno (Álvarez and González-Ruiz 2001). **Nuevo León:** Rancho Peñitas, 23.7 km N, 19 km E Sabinas Hidalgo, 26°58'27"N, 99°36'42"E, 100 m (Rodríguez Vela 1999). **San Luis Potosí:** Cueva la Presita, 21.4 km S Matehuala, 1540 m (Álvarez and González-Ruiz 2001). **Sonora:** 1 mi W Maytoarena (35 specimens from owl pellets—Cockrum and Bradshaw 1963). **Zacatecas:** Muni, Panuco, 23°05'15"N, 102°31'20"W, 2150 m[☆] (late Pleistocene fossil; Jau-Mexia et al. 2000).

Notiosorex evotis (Coues, 1877)—
Large-eared Gray Shrew

Sorex (*Notiosorex*) *evotis* Coues, 1877:652. Type locality "Mazatlan, [Sinaloa,] México," latitude 23.21°N, longitude 106.42°W.

Sorex evotis Alston, 1879:55.

Notiosorex crawfordi evotis: Merriam, 1895a:34.

Notiosorex evotis: Jones et al. (1962:148).

Notiosorex evotis Carraway and Timm, 2000:310.

HOLOTYPE.—USNM 9066, sex unknown, adult, skin only, skull lost.

ETYMOLOGY.—The specific name is derived from the Greek *ev* 'good' and *otos* 'ear', possibly in reference to its "extremely large" ears (Coues 1877:652).

DIAGNOSIS.—*Notiosorex evotis* is the largest member of the genus. An extension of the roof of the glenoid fossa forms a prominent ridge on the lateral side of the cranium (Fig. 19), low-set paroccipital processes extend at an oblique angle from the cranium (Fig. 38), and the coronoid processes are broad relative to their height (Carraway and Timm 2000). The zygomatic plate is broader, both actually (2.1–2.4 mm) and relatively (13%–15% of condylobasal length) than in either *N. crawfordi* (1.7–2.0 mm; 10%–13%) or *N. villai* (1.7 mm; 8%). Based on a discriminant analysis (Fig. 41), 100% of specimens of *N. evotis* can be distinguished from *N. cockrumi* and *N. crawfordi* by application of the following discriminant-function equation: discriminant score = -0.0366 (condylobasal length) $- 5.6519$ (maxillary breadth) $- 0.969577$ (length of P4–M3) $+ 5.7709$ (breadth across M2–M2) $+ 3.03648$

Fig. 41. Discriminant-function plot of *Notiosorex crawfordi* and *N. cockrumi* ($n = 49$, solid bars) and *N. evotis* ($n = 12$, open bars) based on 16 quantitative variables. Discriminant-function axis I ($\chi^2 = 126.44$, $df = 32$, $P = 0.0000$) accounted for 100% of variation present between the 2 groups. With 100% of 61 specimens correctly classified into their *a priori* groups 2 distinct clusters were formed. Specimens have longer and wider skulls and mandibles from *N. crawfordi* and *N. cockrumi* on the left to *N. evotis* on the right.

(length of mandible) $- 0.3578$ (length of unicuspid toothrow) $+ 7.0882$ (depth of mandible at m2) $- 1.760$ (length of coronoid-posterior point of upper condylar facet) $- 4.0089$ (height of coronoid process) $- 1.02538$ (cranial breadth) $+ 6.8008$ (height of coronoid valley) $+ 3.3035$ (length of coronoid-ventral point of lower condylar facet) $+ 1.3115$ (width of m1) $+ 4.0019$ (width of m2) $- 1.3568$ (length of m2) $+ 10.1395$ (length of m3) $- 33.5317$. Individuals with a score >2.4 are referable to *N. evotis*; those with a score <1.6 are referable to *N. cockrumi* or *N. crawfordi*. Further, *N. evotis* can be distinguished from *N. cockrumi* by cranial breadth usually 8.2–9.0 mm and height of articular condyle 3.0–3.7 mm.

GENERAL CHARACTERISTICS.—During summer, *N. evotis* has hairs on the dorsum with a wide band of dark gray proximally, a narrow band of pinkish white medially, and a narrow band of very dark grayish brown distally; hairs on venter have a narrow band of very dark gray proximally and a wide band of pinkish white distally (Carraway and Timm 2000). During winter, hairs on the dorsum have a narrow band of very dark gray proximally and a wide band of grayish brown distally; hairs on venter have a narrow band of dark gray proximally and a wide band of light yellowish

brown distally. Hairs on tail are very dark grayish brown.

DISTRIBUTION.—An endemic to Mexico, *N. evotis* is known from Jalisco, Michoacán, Nayarit, and Sinaloa (Fig. 35; Carraway and Timm 2000).

ECOLOGY.—*Notiosorex evotis* occurs from a 3-m elevation along the Pacific coast to 550 m in the Sierra Madre Occidental of Sinaloa. It is known from a wide variety of ecosystems including those characterized by fallow fields bordered by scattered cacti, thornbush, and mesquite (Armstrong and Jones 1971, Schlitter 1973, Escalante et al. 2003) communities that “. . . consist . . . mostly of dry, dense weeds and short, thorny shrub . . .” with few trees and “. . . in low weeds near thorn bush [*sic*] . . .” (Jones et al. 1962:148–149); and “. . . in damp spots under rocky ledges . . .” (Fisher and Bogan 1977:826).

A female (KU 90581), collected 27 July 1962 in Sinaloa contained 5 embryos (crown-rump length, 10 mm) and had prominent mammae (Armstrong and Jones 1971).

Known mammalian associates in Sinaloa include *Chaetodipus pernix*, *Liomys pictus*, *Mus musculus*, and *Sigmodon hispidus* (Jones et al. 1962). Known mammalian associates in Michoacán include *Baiomys taylori*, *Cryptotis parva berlandieri*, *Liomys irroratus*, *Neotoma*

mexicana, *Oryzomys palustris*, *Peromyscus maniculatus*, *P. melanophrys*, *Reithrodontomys fulvescens*, *R. megalotis*, and *Sigmodon mascoensis* (Hernández-Chávez 1997).

STATUS.—*Notiosorex evotis* is listed as threatened under *N. crawfordi evotis* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Alvarado (1915:20), Álvarez (1963:397), Álvarez et al. (1997:12), Armstrong and Jones (1972b:2), Dalquest and Roth (1970:221), Findley (1955b:616), Fisher (1941:266), Herrera (1897:70), Hooper (1961:12), Jones et al. (1962:147–148), Lyon and Osgood (1909:240), Maldonado (1999:45–46), Matson and Baker (1986:29), Miller (1912:28), Miller and Rehn (1901:245), Poole and Schantz (1942:181), Ramírez-Pulido et al. (1983:16), Whitaker and Morales-Malacara (2005:652).

SPECIMENS EXAMINED ($n = 43$; 19 measured).—**Jalisco**: area of Chapala and Ajijic (K. Wilkins private collection, 3 specimens from containers on roadsides); 13 mi S, 15 mi W Guadalajara (KU 33318); 21 mi SW Guadalajara (KU 42583–42585); La Unión, 28 km S Lagos (CB 2410). **Michoacán**: 2 mi E La Palma, SE side of Lago de Chapala (KU 42586–42588). **Nayarit**: 31 km S, 44.3 km W Compostela (CB 18864); El Refilion (USNM 508358); Tepic (USNM 314064). **Sinaloa**: 20 km N, 5 km E Badiraguato (KU 96419#); Hwy 15, 0.25 mi S Sonora line, El Carrizo, 50 ft (UMMZ 109403); 5 mi WNW El Carrizo (KU 105409#); Laguna, 17 mi SW Choix, 500 ft (KU 89215#); 16 km NNE Choix, 1700 ft (KU 89210#–89211#, 89212, 89213#); 1 mi SE El Cajón, 1800 ft (KU 100319#); 15 mi SE Escuinapa (MSUM 5691); Isla Palmito del Verde, 6 mi NNW Teacapan (KU 98880#); Laguna, 17 mi SW Choix, 500 ft (KU 89214#, 89215–89216); Mazatlán (KU 85533#–85536#, USNM 9066T); 1 mi N Mazatlán, 25 ft (MSUM 8149); 3 mi SW Pánuco (CNMA 26554); Rosario, 500 ft (KU 90581#); 10 km S, 38 km E Sinaloa (KU 125475, 125476#–125479#); 44 km ENE Sinaloa, 600 ft (KU 89998#); on Hwy 15, 0.25 mi S Sonora line (UMMZ 109403).

Notiosorex villai Carraway and Timm, 2000—
Villa's gray shrew

Notiosorex crawfordi Findley, 1955b:616 (in part).

Notiosorex villai: Carraway and Timm, 2000:307. Type locality "Jaumave, Tamaulipas, Mexico, 2400 ft." Álvarez (1963:386) recorded the latitude and longitude of Jaumave as 23°34'N, 99°23'W.

HOLOTYPE.—KU 54932, ♀, adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Dr. Bernardo Villa-Ramírez father of Mexican mammalogy.

DIAGNOSIS.—*Notiosorex villai* is intermediate in size between *N. crawfordi* and *N. evotis*. The cranium lacks a prominent ridge on the lateral side (Fig. 18), the paroccipital processes lie against the exoccipitals (Fig. 39), and the coronoid processes are slender relative to their height (Carraway and Timm 2000). The zygomatic plate is narrower, both actually (1.7 mm) and relatively (8% of condylobasal length) than in most *N. crawfordi* (1.7–2.0 mm, 10%–13%) or all *N. evotis* (2.1–2.4 mm, 13%–15%). *N. villai* can be distinguished from *N. cockrumi* by condylobasal length ≥ 16.97 mm, breadth across M2–M2 usually 4.9–5.1 mm, and length of c1–m3 usually 5.0–5.1 mm.

GENERAL CHARACTERISTICS.—During summer, *N. villai* has hairs on the dorsum with a wide band of dark gray proximally and a narrow band of silvery gray distally; hairs on venter have a narrow band of dark gray proximally and a wide band of silvery gray distally (Carraway and Timm 2000). During winter, hairs on the dorsum have a wide band of very dark gray proximally, a narrow band of pinkish white medially, and a narrow band of very dark grayish brown distally; hairs on venter have a narrow band of very dark gray proximally and a wide band of pinkish white distally. Hairs on tail are very dark grayish brown.

DISTRIBUTION.—An endemic to Mexico, *N. villai* is known only from 3 localities in southwestern Tamaulipas (Fig. 35; Carraway and Timm 2000).

ECOLOGY.—*Notiosorex villai* has been collected only in isolated mountain valleys within the ecotone characterized by "low meseta-like folded mountains" characterized by "closely spaced ridges" (Álvarez 1963; Baker 1971:fig. 16; Ferrusquía-Villafranca 1993:33). The vegetation surrounding Jaumave was pine-oak forest, that of Palmillas tropical forest, and near Rancho Carricitos riparian (Carraway and Timm 2000). The broad range of ecological types represented within the 3 localities at which *N. villai* has been collected suggests that examination of owl pellets and more extensive pitfall trapping in adjacent regions probably will reveal a wider distribution. Two lactating females

(KU 54932 and 54933) were collected in July 1953 (Álvarez 1963).

Known mammalian associates include *Antrozous pallidus*, *Baiomys taylori*, *Bassariscus astutus*, *Cryptotis parva berlandieri*, *Desmodus rotundus*, *Lasiurus borealis*, *L. cinereus*, *Liomys irroratus*, *Mephitis macroura*, *M. mephitis*, *Mormoops megalophylla*, *Mus musculus*, *Mustela frenata*, *Myotis californicus*, *Onychomys arenicola*, *Oryzomys couesi*, *Peromyscus boylii*, *P. leucopus*, *P. pectoralis*, *Reithrodontomys fulvescens*, *Sciurus alleni*, *S. aureogaster*, *Sigmodon hispidus*, and *Tadarida brasiliensis* (G.H. Heinrich in litt., Schmidly and Hendricks 1984).

STATUS.—Presently, *N. villai* is known only from 2 isolated mountain valleys; thus, probably it should be considered at least protected until more is known of its distribution.

ADDITIONAL REFERENCES.—Ramírez-Pulido et al. (1983:16), Whitaker and Morales-Malacara (2005:652).

SPECIMENS EXAMINED ($n = 3$; 2 measured).—**Tamaulipas:** Jaumave, 2400 ft (KU 54932T#); Palmillas, [23°18'N, 99°33'W], 4400 ft (KU 54933); 0.3 mi SW Rancho Carricitos, San Carlos Mts., 1900 ft (TCWC 30492#).

TRIBE SORICINI (SOREX)

ETYMOLOGY.—The generic name *Sorex* is derived from the Latin *soricinus* 'of a shrew'.

DIAGNOSIS.—Soricin shrews are unique in having a long tail $\geq 40\%$ of length of head and body; 32 pigmented teeth; 5 unicuspid teeth on each side of upper jaw (Fig. 8; Lira et al. 1994:28, fig. 11.31); I1 with median tine; no groove in 2nd cusp of I1; in labial view, alveolus of i1 not extending posteriorly beneath the paraconid of m1 in the mandible (Fig. 10); and area between condylar processes not emarginate, i.e., the breadth of interarticular area equal to that of superior condylar process (Fig. 14; Carraway 1995). Further, soricin shrews differ from notiosoricin shrews by curly overhairs with "deep grooves with a central ridge" and "a superimposition of 2 rather elongated notches" (Ducommun et al. 1994:635), no locking mechanism present in the upper glenoid furrow to hold the mandible in place (Carraway 2005); all teeth pigmented (Fig. 10); and on the skull, the upper glenoid furrow is rotated 10° from the horizontal of the skull (Carraway 2005).

GENERAL CHARACTERISTICS.—Soricin shrews have light- to dark-colored pelage in grays, browns, and reds in various combinations. They range in size from the small *S. o. ornatus* to the large *S. macrodon* and *S. sclateri*.

TAXONOMY.—I noted that, among specimens initially identified as *Sorex veraepacis*, individuals of *S. v. chiapensis* have median tines located above the pigment on the body of the I1s just as for the holotype. However, within *S. v. mutabilis*, 1 group of specimens had median tines located well within the pigment on the I1s just as for the holotype (Fig. 7) and a 2nd group had median tines located above the pigment on the body of the I1s and pigment on the i1s in 1 section (Fig. 5). Three *a priori* groups were defined by these qualitative characters. A multigroup discriminant function analysis of these 3 *a priori* groups, based on 30 quantitative characters, resulted in 3 morphometrically distinct groups whose memberships corresponded to the *a priori* groups established with qualitative characters (Fig. 42). Plotting of collection localities for specimens within these 3 groups showed overlapping geographic distributions for the 2 groups within *S. v. mutabilis*. Therefore, herein I refer the specimens unlike the holotype for *S. v. mutabilis* to the new species *Sorex ixatlanensis*.

Sorex s. saussurei is composed of 3 similar morphotypes. A multigroup discriminant function analysis of these *a priori* groups, based on 30 quantitative characters, resulted in 3 morphometrically distinct groups whose memberships corresponded to the *a priori* groups established with qualitative characters (Fig. 43). The most easily seen difference among the 3 is that the I1s of the 1st form have a large, well-pigmented median tine located well within the pigment on the body of the I1s. The 2nd form has a well-pigmented median tine located at the interface of the unpigmented and pigmented areas of the I1s. And, the I1s of the 3rd form have a very small, usually unpigmented or only slightly pigmented median tine located above the pigment on the body of the I1s; there is always a gap between any pigment on the tine and the pigment on the body of the I1s. Individuals with any 2 of the 3 morphological forms can be found at a single geographic locality (Figs. 44–45). Specimens of the 1st form match the tine morphology of the nominal holotype, thus herein are

Fig. 42. Discriminant-function plot of *Sorex ixtlanensis* ($n = 24$; closed triangles), *Sorex veraepacis chiapensis* ($n = 9$; open circles with dots), and *S. v. mutabilis* ($n = 18$; open triangles) based on 30 quantitative variables. Plus (+) symbols represent group centroids. Discriminant-function axis I ($\chi^2 = 140.03$, $df = 60$, $P = 0.0000$) accounted for 55.06% and discriminant-function axis II ($\chi^2 = 67.03$, $df = 29$, $P = 0.0001$) 44.94% of variation present among the 3 taxa. Taxa have shorter skulls and mandibles from *S. ixtlanensis* to *S. v. mutabilis* to *S. v. chiapensis*. However, they have narrower skulls from *S. v. chiapensis* to *S. ixtlanensis* to *S. v. mutabilis*.

referred to the species *Sorex saussurei*. Specimens of the 2nd form, a portion of *S. s. saussurei*, herein are referred to the new species *Sorex mediopua*. Specimens of the 3rd form including *S. s. cristobalensis*, *S. s. oaxacae*, *S. s. veraecrucis*, and a portion of *S. s. saussurei* are herein referred to the newly elevated species *Sorex veraecrucis* that possesses page priority over *cristobalensis* or *oaxacae*. The portion of *S. s. saussurei* of the 3rd form is referred to the new subspecies *Sorex veraecrucis altoensis*.

SYSTEMATICS.—In 1842 DeKay designated *Otisorex* as a genus for a form of shrew in the eastern United States; subsequently, it was considered a synonym of the genus *Sorex* (Miller 1895). In 1857, Baird listed 3 genera of shrews within the subfamily Soricinae of which 1 was *Sorex*. He did not designate any subdivisions within *Sorex*; however, he did mention that whereas for most of the species the U3 (e.g., 3rd upper unicuspid) was $\geq U4$ (e.g., 4th upper

unicuspid), a few species had the opposite arrangement. In a footnote (p. 40) to a paper on the history of eastern [United States] shrews, Miller (1895) mentioned sending a specimen to DeKay for identification. In DeKay's reply, the specimen was regarded as belonging to the subgenus *Otisorex*. However, neither DeKay nor Miller provided a description of *Otisorex* as a subgenus; thus it was not accepted into the formal taxonomic literature as a proper designation. Following Miller's paper, Merriam (1895b) provided a synopsis of 41 taxa of *Sorex* that he placed into 4 subgenera of which all 7 taxa of *Sorex* then known from Mexico were placed within the subgenus *Sorex*. Jackson, in a 1928 review of American long-tailed shrews, recognized the same subgenera as Merriam and listed the 17 known taxa of *Sorex* from Mexico within the subgenus *Sorex*.

Finally, Findley (1955a) sorted the species of *Sorex* into 2 subdivisions or subgenera: *Otisorex*, with primarily a Nearctic distribution,

Fig. 43. Discriminant-function plot of *Sorex mediopua* ($n = 15$; closed circles), *S. saussurei* ($n = 24$; open circles), and *S. veraecrucis* ($n = 57$; open squares) based on 29 quantitative variables and 3 external measurements. Plus (+) symbols represent group centroids. Discriminant-function axis I ($\chi^2 = 155.10$, $df = 64$, $P = 0.0000$) accounted for 58.68% and discriminant function axis II ($\chi^2 = 68.98$, $df = 31$, $P = 0.0001$) 41.32% of variation present among the 3 taxa. Taxa have narrower and shorter skulls and mandibles from *S. mediopua* to *S. veraecrucis* to *S. saussurei*.

and *Sorex*, with primarily a Palearctic distribution. Taxa within *Otisorex* were described as having the following characteristics: $U3 < U4$, presence of secondary cuspules on the U's, presence of a complete pigmented ridge on the unicuspid extending medially from the tips of the teeth to the cingula, and usually no postmandibular foramen. Taxa placed within the subgenus *Sorex* were defined as having the $U3 \geq U4$, absence of secondary cuspules on the U's, no pigmented ridge on U's, and usually possessing a well-developed postmandibular foramen. Examination of larger numbers of specimens has shown that the states for the last 2 characters are more variable than previously thought (Carraway 1987, George 1988, Junge and Hoffmann 1981). Also, the amount of pigmentation present is negatively correlated with the age of the animal, e.g., the older the animal, the greater the wear of the U's and the less pigment that remains present. Thus, for old animals, this character cannot be used.

Despite the amount of effort expended to determine the phylogenetic relationship between members of the subgenera *Otisorex* and *Sorex*, some disagreements as to placement of species within subgenera of *Sorex* still exist (George 1988, Stewart and Baker 1994, Ruedi 1998, Ohdachi 2006). Solutions to the disagreements will require more detailed genetic and morphologic analyses with more complete data sets containing species from throughout the Holarctic (Junge and Hoffmann 1981, George 1988, Hausser et al. 1998, Ruedi 1998).

Based on the characters previously mentioned, herein, the species *S. arizonae*, *S. emarginatus*, *S. saussurei*, *S. sclateri*, *S. stizodon*, and *S. ventralis* are considered to belong to the subgenus *Sorex* (Diersing and Hoffmeister 1977). All remaining species of the genus *Sorex* distributed within Mexico are considered to belong to the subgenus *Otisorex*.

In addition to species of *Sorex* being sorted into subgenera, they also have been sorted into species-groups that carry no taxonomic

Figs. 44–45. Distribution of 5 species of *Sorex* in Mexico: 44, 4 species of *Sorex* including 2 subspecies of *S. veraepacis* and specimens that are either *S. ixtlanensis* or *S. veraepacis mutabilis*; 45, 4 subspecies of *S. veraecrucis*. Taxa are indicated by symbols in key.

standing and are merely informal groupings designed to provide order for collected data. These abstract groups have been based on morphological, chromosomal, and genetic data by a variety of researchers (Jackson 1928, Findley 1955a, Hennings and Hoffmann 1977, Junge and Hoffmann 1981, van Zyll de Jong 1983, Cook et al. 2001, Demboski and Cook 2001) and are supposed to signify that taxa within the groups are thought to be more closely related to one another than they are to taxa within other groups. However, the groupings formed by the different datasets often conflict (Zima et al. 1998, Demboski and Cook 2001), and some species do not fit into any of the groupings, so are placed in their own monotypic group (Jackson 1928, Junge and Hoffmann 1981, George 1988). Thus, herein, no species groups are recognized.

ADDITIONAL REFERENCES.—Aranda et al. (1995:89–99), Ayala-Barajas et al. (1988), Barrera (1968:68), Hopkins and Rothschild (1966), Villa-R. and Cervantes (2003:27), Whitaker and Morales-Malacara (2005:548, 617, 623, 643, 645).

***Sorex ixtlanensis* new species**
(Figs. 44, 46–50)
Ixtlan Shrew

Sorex saussurei caudatus: Merriam, 1895b:84.

Sorex saussurei mutabilis: Merriam, 1898:782.

Sorex veraepacis mutabilis: Jackson, 1925:130 (in part).

HOLOTYPE.—KU 124320, ♂, young adult, skin and skull. Collector P.B. Robertson, original number 1264, collected 11 May 1970, testis 10 × 6 mm, external measurements 144–67–15–x–8.0 g

TYPE LOCALITY.—“N slope Cerro Pélón, 31.6 kms. S (by road) Vista Hermosa, 2650 m., Oaxaca,” latitude 17.36°N, longitude 95.25°W.

ETYMOLOGY.—The specific name *ixtlanensis* was chosen because the majority of specimens of this taxon have been collected within the Distrito Ixtlán, Oaxaca. Pronunciation of the specific name is 'ikt 'lan, "en(t)sås.

DIAGNOSIS.—*Sorex ixtlanensis* can be distinguished from *S. veraepacis* by i1s with a long strip of pigment present at the anteromedial edge (Fig. 26) and generally larger size of mandible: length of coronoid–ventral point of lower condylar facet 3.7–4.2 mm, length of mandible usually 8.2–9.4 mm, length of c1–m3 5.5–5.9 mm, length from upper articular con-

dyle to posterior edge of m3 3.9–4.3 mm, and height of articular condyle 2.8–3.3 mm. Further, it differs from *S. veraepacis chiapensis* by hairs on dorsum reddish blond medially with dark brown tips, pelage on venter light reddish brown, hairs on tail uniform in color of dorsum, hips and rump with pale reddish brown and dark brown guard hairs extending 2.2–2.8 mm beyond dorsal pelage, and breadth between M2–M2 usually 4.5–5.3 mm. Also, it can be distinguished from *S. veraepacis mutabilis* by median tines located above the pigment on the body of the I1s (Figs. 5, 50) and i1s with pigment in 1 section.

Additionally, *S. ixtlanensis* differs from *S. veraecrucis* by hairs on dorsum reddish blond medially with a dark brown tip, hips and rump with pale reddish blond and brown guard hairs extending 2.2–2.8 mm beyond the dorsal pelage, hairs on venter with light reddish brown tips, and i1 with 3 denticles (Fig. 24). Also, it can be distinguished from *S. veraecrucis oaxacae* by the angle of i1 < 6° from the horizontal ramus of the dentary, and by its generally longer skull and mandible: condylobasal length usually 18.24–19.71 mm, palatilar length 7.8–8.6 mm, length of unicuspid toothrow usually 2.5–2.8 mm, length of mandible usually 8.2–9.4 mm, and length of mandibular toothrow usually 5.5–5.9 mm. It can be distinguished from *S. v. veraecrucis* and *S. v. altoensis* by cranial breadth > 9 mm and i1 with deep interdenticular spaces (Fig. 24).

Further, it differs from *S. macrodon* by hairs on tail reddish blond with dark tips and least interorbital breadth 3.6–4.4 mm; from *S. saussurei* by hairs on dorsum dark brown tipped and ventral pelage slightly paler than that of the dorsum, cranial breadth 8.65–10.38 mm, and i1 with 3 denticles (Fig. 24); and from *S. sclateri* by pelage on dorsum dark brown with a slightly paler venter, U3 < U4 (Fig. 31), i1 with deep interdenticular spaces (Fig. 24) and pigment in 1 section, length of tail 45–51 mm, and height of coronoid valley usually 2.0–2.3 mm. Also, it can be distinguished from *S. stizodon* by hips and rump with dark brown guard hairs extending 2.2–2.8 mm beyond dorsal pelage, hairs on dorsum dark brown tipped with a slightly paler venter and slightly bicolored tail, U3 < U4 (Fig. 31), i1 with deep interdenticular spaces (Fig. 24), and generally larger size: total length 117–135 mm, length of

Figs. 46–50. Camera-lucida tracings of an adult male *Sorex ixtlanensis* (KU 124320) from the north slope of Cerro Pélón, 31.6 km S (by road) Vista Hermosa, 2650 m, Oaxaca: 46, dorsal; 47, lateral; and 48, ventral views of skull; 49, lateral view of labial side of left mandible; and 50, anterior view of I1s. Scale bars equal 1 mm. All views are of holotype.

tail 45–61 mm, condylobasal length 18.24–19.71 mm, palatilar length 7.8–8.6 mm, length of U1–M3 6.8–7.7 mm, cranial breadth 8.65–10.38 mm, length of unicuspid tooththrow 2.5–2.8 mm, length of mandible usually 8.2–9.4 mm, length of c1–m3 5.5–5.9 mm, and shorter height of coronoid valley 2.0–2.3 mm. Further, it differs from *S. ventralis* by hairs on dorsum reddish blond medially with dark tips, pelage on venter light reddish brown, hairs on tail uniformly colored as for the dorsum, i1 with 3 denticles and deep interdenticular spaces (Fig. 24), and generally larger size: palatilar length 7.8–8.6 mm, length of U1–M3 6.8–7.7 mm, length of unicuspid tooththrow 2.5–2.8 mm, length of c1–m3 usually 5.5–5.9 mm, and length of coronoid–posterior point of upper condylar facet usually 3.5–4.0 mm.

DISTRIBUTION.—An endemic to Mexico, *S. ixtlanensis* is known from Guerrero and Oaxaca from 1920 m to ≥ 3000 m elevation (Fig. 44).

ECOLOGY.—*Sorex ixtlanensis* occurs at high elevations in the Canadian Zone (Goldman 1951) in either pine-fir or pine-oak forests with shady areas with a deep layer of humus overlain with a deep layer of leaves (Davis and Lukens 1958, Musser 1964). No reproductive information or mammalian associates were found in published literature.

ADDITIONAL REFERENCES.—Villa-R. and Cervantes (2003:94).

SPECIMENS EXAMINED ($n = 58$; 36 measured).—**Guerrero:** 7 mi SW Filo de Caballo [= Puerto General Nicolás Bravo], 8200 ft (TCWC 41961#–41963#); 10 mi SW Filo de Caballo [= Puerto General Nicolás Bravo], 8200 ft (TCWC 41964#); 5 mi SW Mazatlán, ca. 8000 ft (TCWC 5284#); Omiltemi (ASNHC 3506#–3510#); Omiltemi, 2450 m (ASNHC 3511#–3512#; LACM 74180–74181, 74188); Omiltemi, 2600–2800 m (ASNHC 3513#–3514#; LACM 74182–74183, 74184#, 74185, 74189#, 74191#); 2 mi W Omiltemi, 7800 ft (TCWC 5667#); near Puerto Chico, 6.3 km (by road) SW Casa Verde (20 mi N Chilpancingo on Hwy 95), 8400 ft (UMMZ 112578#). **Oaxaca:** near Campamento Río Molino (Hwy 175), 7300 ft (UMMZ 112574#); NE slope Cerro Pelón, 2620 m (KU 120304#); N slope Cerro Pelón, 31.6 km (by road) S Vista Hermosa, 2650 m (KU 124307#–124308#, 124320T#); NW slope Cerro Zempoaltepetl, 3000 m (KU 124328#); Distrito Ixtlán, 16 mi

WSW La Esperanza (TCWC 41965#–41971#); N. Llano de las Flores, 9200 ft (UMMZ 112575#); 27.5 km (by road) NNE Llano de las Flores, Hwy 175 (ASNHC 3500#–3505#; LACM 74192, 74193#); 2 km NW San Andrés Chicahuastla, 2300 m (UMMZ 113889–113891); 12 km (by road) S Vista Hermosa, 1920 m (KU 124312, 124313#, 124315#); 16.8 km (by road) S Vista Hermosa, 2030 m (KU 121655); 21 km (by road) S Vista Hermosa (KU 136575#); 28.6 km (by road) S Vista Hermosa, 2350 m (KU 121656#); 6.5 mi SSW Vista Hermosa, 7100 ft (KU 99548–99549).

Sorex mediopua new species

(Figs. 44, 51–55)

Jalisco Shrew

Sorex saussurei saussurei: Miller, 1912:19 (in part).

HOLOTYPE.—KU 112032, ♀, adult, skin and skull. Collector Percy L. Clifton, original number 12743, collected 9 June 1967, external measurements 119-46-13-8-x g.

TYPE LOCALITY.—“12 mi SW Cd. Guzmán, 10000 ft., Jalisco,” latitude 19.56°N, longitude 103.61°W.

ETYMOLOGY.—The specific name is derived from the Spanish *medio* ‘middle or interface’ and the Spanish *púa* ‘tine’. It is used as a noun in apposition to the masculine *Sorex*.

DIAGNOSIS.—*Sorex mediopua* can be distinguished from *S. oreopolus*, *S. orizabae*, *S. saussurei*, *S. veraecrucis altoensis*, and *S. ventralis* by a medium to large heavily pigmented median tine located at the interface of the unpigmented and pigmented areas of the I1s (Figs. 6, 55) and tail uniform in color. Further, it can be distinguished from *S. oreopolus*, *S. orizabae*, and *S. ventralis* by its overall larger size: breadth across M2–M2 4.7–5.1 mm, length of mandible 7.7–9.2 mm, length of c1–m3 5.2–5.6 mm, and length of coronoid–posterior point of upper condylar facet 3.3–3.9 mm. Additionally, *S. mediopua* differs from *S. oreopolus* and *S. orizabae* by i1s with shallow interdenticular spaces (Fig. 25) and the following cranial and mandibular characters: maxillary breadth 5.3–5.7 mm, least interorbital breadth 3.6–4.1 mm, cranial breadth 8.3–9.4 mm, height of coronoid process 3.8–4.3 mm, height of coronoid valley 1.9–2.3 mm, height of articular condyle 2.6–3.2 mm, depth of mandible 1.0–1.3 mm, length of coronoid–ventral

Figs. 51–55. Camera-lucida tracings of an adult female *Sorex mediopua* (KU 112032) from 12 mi SW Ciudad Guzmán, 10,000 ft, Jalisco: 51, dorsal; 52, lateral; and 53, ventral views of skull; 54, lateral view of labial side of left mandible; and 55, anterior view of I1s. Scale bars equal 1 mm. All views are of holotype.

point of lower condylar facet 3.6–4.1 mm. *Sorex mediopua* also can be distinguished from *S. orizabae* by i1s with 2 denticles (Fig. 25), total length 102–120 mm, and palatilar length 7.3–8.5 mm; and from *S. ventralis* by palatilar length 7.3–8.5 mm, length of U1–M3 6.5–7.2 mm, and length of unicuspid tooththrow 2.2–2.5 mm.

GENERAL CHARACTERISTICS.—*Sorex mediopua* has hairs on dorsum with a medium silvery gray band proximally, either a white or blond band medially, and dark brown tips giving an overall medium brown appearance. Hairs on venter are medium silvery gray proximally with blond tips paler than for *S. veraecrucis altoensis*. U3 < U4 (Fig. 31). The i1 has pigment in 1 section and a long strip of pigment at the anteriomedial edge (Fig. 26).

DISTRIBUTION.—An endemic to Mexico, *S. mediopua* is known from Guerrero, Jalisco, México, and Michoacán from ca. 1875 to 3048 m elevation (Fig. 44).

ECOLOGY.—*Sorex mediopua* occurs at higher elevations in the Transvolcanic Belt in pine-oak-juniper woodlands, in yellow pine-alder woodlands, or in moist montane canyons with pine-oak or Douglas-fir-juniper woodlands with shrubby understories of *Bacheria* and *Senecio* in areas with a deep humus layer overlain with a layer of leaves or needles (Baker 1956, Davis and Lukens 1958, Baker and Greer 1962). No reproductive information was found in published literature.

Known mammalian associates include *Microtus mexicanus*, *Neotamias dorsalis*, *Reithrodontomys sumichrasti*, and *Sorex milleri* (Baker 1956, Davis and Lukens 1958).

SPECIMENS EXAMINED ($n = 38$; 18 measured).—**Guerrero:** Mts. near Chilpancingo (USNM 70252#–70253#). **Jalisco:** 20 mi SE Autlán, 9000 ft (KU 111369–111370, 111371#–111375#, 111376, 111378–111384); 12 mi SW Ciudad Guzmán, 10,000 ft (KU 112031#, 112032T#, 112033, 112034#, 112035#, 112037); 3.5 mi N Mascota, 6150 ft (KU 105407); 15 mi S, 9 mi E Talpa de Allende, 6900 ft (KU 98718–98719, 98720#, 98721, 98722#); Volcán de Fuego, 9800 ft (KU 107138#, 107142, 108597–108599, 112038#). **México:** 10 mi N, 6 mi E Valle de Bravo, 7460 ft (KU 62312#). **Michoacán:** ca. 12 mi W Ciudad Hidalgo, 9150 ft (KU 66279#). **Morelos:** Lagunas de Zempoala, near Ojo de Agua (USNM 329417#).

Sorex veraecrucis
Veracruz Shrew

ETYMOLOGY.—The specific name is derived from the state of Veracruz from which the holotype was collected.

DIAGNOSIS.—*Sorex veraecrucis* can be distinguished from *S. ixtlanensis* by hairs on dorsum overall medium brown, hips and rump with pale dark brown guard hairs extending 1.0–1.9 mm beyond the dorsal pelage, hairs on venter with blond or white tips, and i1 with 2 denticles (Figs. 24–25), the angle of i1 > 6° from the horizontal ramus of the dentary, and by its generally shorter skull and mandible: condylobasal length usually 17.86–18.41 mm, length of unicuspid tooththrow usually 2.3–2.6 mm, and length of mandibular tooththrow usually 5.0–5.4 mm. Also, it can be distinguished from *S. mediopua* and *S. saussurei* by a very small, usually unpigmented or only slightly pigmented median tine located high above the pigment on the body of the I1s (Fig. 4); and from *S. saussurei* by a tail with uniform coloration same as for dorsum. It differs from *S. arizonae*, *S. emarginatus*, *S. macrodon*, *S. milleri*, *S. monticolus*, and *S. orizabae* by condylobasal length 17.86–18.41 mm and cranial breadth 8.5–9.2 mm. Additionally, *S. veraecrucis* differs from *S. arizonae* and *S. emarginatus* by U3 < U4 (Fig. 31), palatilar length 7.3–8.4 mm, length of hind foot 12–16 mm, and tail usually uniform in color; and from *S. macrodon* by i1 with a long strip of pigment present at anteromedial edge (Fig. 26), hairs of venter with light-colored tips, and smaller size: length of U1–M3 6.5–7.0 mm, maxillary breadth 5.0–5.6 mm, breadth across M2–M2 4.5–5.1 mm, and length of c1–m3 5.0–5.8 mm. Further, it can be distinguished from *S. milleri* by i1 with 2 denticles (Figs. 24–25) and 1 or 2 sections of pigment, and larger size: palatilar length 7.3–8.4 mm, maxillary breadth usually 5.0–5.6 mm, least interorbital breadth usually 3.6–4.6 mm, breadth across M2–M2 usually 4.5–5.1 mm, length of c1–m3 5.0–5.8 mm, height of coronoid process 3.8–4.3 mm, length of coronoid–ventral point of lower condylar facet 3.6–4.0 mm, and length of coronoid–posterior point of upper condylar facet 3.4–3.8 mm; from *S. monticolus* by hips and rump with light to dark brown, clear-tipped guard hairs extending 1.0–1.9 mm beyond dorsal pelage, pelage on dorsum medium brown, i1 with 2 denticles

(Figs. 24–25), and length of mandible 7.6–8.8 mm; and from *S. oreopolus* by tail usually uniform in color and least interorbital breadth 3.6–4.6 mm. Also, it differs from *S. orizabae* by hips and rump with light to dark brown, clear-tipped guard hairs extending 1.0–1.9 mm beyond dorsal pelage, tail usually uniform in color, i1 with 2 denticles, and generally larger size: palatilar length 7.3–8.4 mm, length of mandible usually 7.6–8.8 mm, length of c1–m3 usually 5.0–5.8 mm, and length of coronoid–posterior point of upper condylar facet usually 3.4–3.8 mm. *Sorex veraecrucis* can be distinguished from *S. sclateri* and *S. stizodon* by i1 with 2 denticles (Figs. 24–25), pelage on dorsum overall medium brown and hairs on venter with light-colored tips, and condylobasal length 17.86–18.41 mm; additionally from *S. sclateri* by $U3 < U4$ (Fig. 31); from *S. ventralis* by I1 with median line above pigment (Fig. 4), length of U1–M3 6.5–7.0 mm, length of c1–m3 5.0–5.8 mm, length of coronoid–posterior point of upper condylar facet 3.4–3.8 mm, hips and rump with medium or dark brown, clear-tipped guard hairs extending 1.0–1.9 mm beyond dorsal pelage; and from *S. veraepacis* by dorsal pelage overall medium brown and ventral pelage with light-colored tips, cranial breadth 8.5–9.2 mm, breadth of zygomatic plate 1.2–1.5 mm, and i1 with a long strip of pigment present at anteromedial edge (Fig. 26).

GENERAL CHARACTERISTICS.—The i1 with depth of interdenticular spaces and number of sections of pigment variable. The tail is uniformly the color of the dorsum for most specimens of *S. veraecrucis*; however, some have a slightly bicolored tail.

DISTRIBUTION.—*Sorex veraecrucis* is the most widely distributed soricid in Mexico occurring from Coahuila southward into Chiapas from Pacific to Atlantic coasts at elevations ranging from 1600 m to ≥ 3650 m (Fig. 45; Hall 1981, Flores Vilella and Gerez 1994).

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:54), Findley and Caire (1977:132), Packard (1977:142, 146, 148, 151), Schmidly (1977:165, 171, 173, 180).

Sorex veraecrucis veraecrucis
Jackson, 1925

Sorex saussurei veraecrucis: Jackson, 1925:128. Type locality "Xico, 6,000 ft, Veracruz," latitude 19.42°N, longitude 97.0°W.

HOLOTYPE.—USNM 55106, ♀, adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the state of Veracruz from which the holotype was collected.

DIAGNOSIS.—*Sorex v. veraecrucis* differs from all other subspecies of *S. veraecrucis* by length of tail usually 50–62 mm. Additionally, it can be distinguished from *S. v. cristobalensis* and *S. v. oaxacae* by i1 with shallow interdenticular spaces (Fig. 25) and pigment in 1 section, hips and rump with dark brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage and from *S. v. cristobalensis* by hairs on venter blond- or white-tipped.

In addition to diagnostic characters listed for the species, *S. v. veraecrucis* also can be distinguished from *S. oreopolus* and *S. veraepacis* by hips and rump with dark brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage. Further, *S. v. veraecrucis* differs from *S. oreopolus* by hairs on venter blond- or white-tipped, length of tail usually 50–62 mm, i1 with shallow interdenticular spaces (Fig. 25), length of c1–m3 5.0–5.4 mm, height of coronoid valley 2.0–2.3 mm, and height of articular condyle 2.8–3.2 mm; from *S. orizabae* by pelage on dorsum overall medium brown, i1 with shallow interdenticular spaces (Fig. 25) and pigment in 1 section, height of coronoid process 3.8–4.3 mm, height of coronoid valley 2.0–2.3 mm, height of articular condyle 2.8–3.2 mm, and length of coronoid–ventral point of lower condylar facet 3.4–3.8 mm; from *S. ventralis* by tail uniform in color, length of tail usually 50–60 mm, length of unicuspid tooththrow usually 2.3–2.6 mm, breadth across M2–M2 4.5–4.9 mm, length of mandible usually 7.6–8.8 mm, height of coronoid valley 2.0–2.3 mm, and height of articular condyle 2.8–3.2 mm; and from *S. veraepacis* by hairs on venter blond- or white-tipped and i1 with shallow interdenticular spaces (Fig. 25).

GENERAL CHARACTERISTICS.—*Sorex v. veraecrucis* has hairs on the dorsum with medium silvery gray band proximally, either a white or blond band medially, and dark brown tips giving an overall medium brown appearance. Hairs on venter are medium silvery gray proximally with either blond or white tips.

DISTRIBUTION.—An endemic to Mexico, *S. v. veraecrucis* is known from Oaxaca, Puebla, and Veracruz from 1800 to 2860 m elevation (Fig. 45; Goodwin 1969, Hall 1981).

ECOLOGY.—According to Jackson (1928:156–157), *S. v. veraecrucis* “. . . is confined principally to the higher parts of the Atlantic drainage from central Vera Cruz [sic] and Puebla south to northeastern Oaxaca. . . .” In Veracruz, *S. v. veraecrucis* occurs in moist habitats with short grass (76 mm high), “. . . low ferns, bracken moss, and liverworts. . . .” with nearby cold streams, in maguey hedges (= cercas) that divide cornfields, in damp moss in the bottoms of valleys in pine forests, and damp areas under the cover of low lava overhangs (Hall and Dalquest 1963:205). Remarks on specimen labels indicate it can be found in a range of habitat types including dry woods (CNMA 39361), pine-oak woodlands (MZFC 138), and rainforest (CNMA 29413). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis mexicana*, *Microtus mexicanus*, *Neotoma mexicana torquata*, *Peromyscus boylii*, *P. melanotis*, and *Sorex macrodon* (Hall and Dalquest 1963).

STATUS.—*Sorex v. veraecrucis* is listed as protected under *S. saussurei veraecrucis* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Briones-Salas and Sánchez-Cordero (2004:436), Hall and Kelson (1959:48–49), Poole and Schantz (1942:194), Prieto Bosch and Sánchez-Cordero (1993:459), Ramírez-Pulido et al. (1983:17).

SPECIMENS EXAMINED ($n = 75$; 24 measured).—**Oaxaca:** Cerro Piedra larga, Agua Fría, 11 km SW de San Sebastián Jilotepec (MZFC 138); Cerro Zempoaltepec, 4.5 km N Santa María Yacachi, Mpio. Tahuitontepec, 2450 m (CNMA 30006–30010, 33608); Cuicatlán, Carr. Santa María Papalo, Peña Verde, 17°50'49"N, 96°45'48"W, 2220 m (MZFC CAS277); 11 km SW La Esperanza, camino lodoso hacia, San Isidro Mpio. Santiago, Comaltepec, 2000 m (CNMA 29413–29424, 33759–33761); 1.3 mi S Llano de las Flores (MZFC 5768); 27.5 km NNE (by road) Llano de las Flores on Hwy 175 (CNMA 29477–29479; LACM 74174, 74177–74179); 3 km W Santa María Yucuhiti, Mpio. Santa María Yucuhiti, 2040 m (CNMA 39372); Mt. Zempoaltepec (USNM 68566#, 68570#); Oaxaca (USNM 69601); 3 km N Peña Verde, Mpio. Santa María Papalo, 2220 m (CNMA 39366–39369); km 7 Carretera Puente de Fierro, Santa María Chilchotla, Mpio. Huautla de Jiménez (CNMA 35316); 6 km SE

Puerta de Fierro, Mpio. Huautla de Jiménez (CNMA 39371); Reyes (USNM 69593#, 69599#, 69603#); 2.5 km SW San Sebastián Jilotepec, Mpio. Santa Ana Tavela, 2500 m (CNMA 39361–39363); 3.5 km SW San Sebastián Jilotepec, Mpio. Santa Ana Tavela, 2300 m (CNMA 39364–39365); 14 km SE Tlahuitoltepec, Mpio. Tlahuitoltepec, 2700 m (CNMA 29878). **Puebla:** Mt. Orizaba (USNM 53629#). **Veracruz:** 3 km W Acultzingo, 7000 ft (KU 23411#); 6 km SSE Altotonga, 9000 ft (KU 19093#); Banderillas, 6 km NW Xalapa, 1500 m (CNMA 34213); Las Vigas (USNM 54441#); Las Vigas, 8500 ft (KU 29510#–29520#); 1 km W Las Vigas, 8500 ft (KU 29509#); 2 km N Nueva Vaqueria, 2690 m (CB 29828); 5 km E Perote, 2860 m (CB 13610); 3.1 km S (por camino) Puerto del Aire, Mpio. Acultzingo, 1300 m (CNMA 34214); Xico [= Jico], 6000–6500 ft (USNM 55102#, 55103–55104, 55105#, 55106T#).

Sorex veraecrucis altoensis
new subspecies
(Figs. 45, 56–60)

Sorex saussurei saussurei: Miller, 1912:19 (in part).

HOLOTYPE.—KU 107135, ♀, young adult, skin and skull. Collector Percy L. Clifton, original number 11037, collected 8 July 1966, external measurements 113-44-14-9.5-x g.

TYPE LOCALITY.—“Volcán de Fuego, 9800 ft., Jalisco,” latitude 19.55°N, longitude 103.63°W.

ETYMOLOGY.—The subspecific name is related to this taxon being distributed at high elevations.

DIAGNOSIS.—*Sorex v. altoensis* differs from *S. v. cristobalensis* by il with shallow interdenticular spaces (Fig. 25) and pigment in 1 section, hips and rump with dark brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage, hairs on venter blond- or white-tipped; from *S. v. oaxacae* by ils with shallow interdenticular spaces, hips and rump with dark brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage; and from *S. v. veraecrucis* by length of tail 38–51 mm.

In addition to diagnostic characters listed for the species, *S. v. altoensis* differs from *S. milleri*, *S. oreopolus*, *S. orizabae*, and *S. monticolus* by tail a uniform color as for the dorsum. Further, it differs from *S. milleri* and *S. oreopolus* by il with shallow interdenticular spaces (Fig. 25) and hips and rump with dark brown guard hairs extending 1.0–1.5 mm

Figs. 56–60. Camera-lucida tracings of an adult female *Sorex veraecrucis altoensis* (KU 107135) from Volcán de Fuego, 9800 ft, Jalisco: 56, dorsal; 57, lateral; and 58, ventral views of skull; 59, lateral view of labial side of left mandible; and 60, anterior view of I1s. Scale bars equal 1 mm. All views are of holotype.

beyond dorsal pelage; from *S. monticolus* by palatilar length usually 7.3–8.3 mm, maxillary breadth 4.97–5.7 mm, and least interorbital breadth 3.7–4.1 mm; and from *S. orizabae* by i1 with shallow interdenticular spaces (Fig. 25) and pigment in 1 section. Also, *S. v. altoensis* differs from *S. oreopolus* by hairs on venter blond- or white-tipped. Further, it can be distinguished from *S. macrodon* by condylobasal length 17.54–18.61 mm, cranial breadth 8.32–9.36 mm, i1 with shallow interdenticular spaces (Fig. 25), and length of c1–m3 4.9–5.6 mm.

GENERAL CHARACTERISTICS.—*Sorex v. altoensis* has hairs on dorsum with medium silvery gray band proximally, either a white or blond band medially, and dark brown tips giving an overall medium brown appearance. Hairs on venter are medium silvery gray proximally with blond tips.

DISTRIBUTION.—*Sorex v. altoensis*, the most widely distributed subspecies of *S. veraecrucis*, occurs in Coahuila, Colima, Distrito Federal, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, México, Michoacán, Morelos, Nuevo León, Oaxaca, Puebla, Querétaro, and Tamaulipas from ca. 2100 m to ≥ 3650 m elevation (Fig. 45; Hall 1981).

ECOLOGY.—Generally, *S. v. altoensis* occurs at higher elevations in pine-oak-juniper woodlands, in yellow pine-alder woodlands, or in moist montane canyons with pine-oak or Douglas-fir-juniper woodlands with shrubby understories of *Bacheria* and *Senecio* in areas with a deep humus layer overlain with a layer of leaves or needles, but it also occurs in high elevation agricultural fields planted to oats or corn and in “. . . tall sacaton grasses in rocky situations near water” (Davis 1944:376, Hall and Villa-R. 1949, Villa-R. 1952, Davis and Russell 1954, Davis and Lukens 1958, Baker and Greer 1962, Cervantes et al. 1995, Álvarez and Sánchez-Casas 1997, Orduña Trejo et al. 1999–2000).

A female with 2 embryos (crown-rump length 13 mm) was collected in August (year not reported) in Michoacán (Álvarez and Sánchez-Casas 1997).

Known mammalian associates include *Cryptotis parva soricina*, *Microtus mexicanus*, *Peromyscus difficilis*, *P. levipes ambiguus*, *P. melanotis*, *Reithrodontomys megalotis*, *R. sumichrasti*, *Sorex milleri*, *S. orizabae*, and *Tamias bulleri* (Davis and Russell 1954, Baker 1956, Davis and Lukens 1958, Cervantes et al. 1995, Jiménez Guzmán et al. 1999).

ADDITIONAL REFERENCES.—Álvarez (1963:396), Álvarez et al. (1997:13), Álvarez-Castañeda (1996:52), Barrera (1953:204, 224), Basols (1981:18), Ceballos González and Galindo Leal (1984:53–54), Díaz de León (1905:26), Diersing and Hoffmeister (1977:332), Findley (1953:636), Goldman (1951:392, 398, 402), Goodwin (1969:38–39), Hall and Villa-R. (1950:165), Hoffmann (1951:99; 1952:91; 1990:72, 97, 168; 1993:20), Hooper (1946:394; 1947:43; 1955:7), Jackson (1925:128; 1928:156–157), Jiménez Almaraz et al. (1993:524), Jiménez Guzmán et al. (1997:133), Junge and Hoffmann (1981:44), Lyon and Osgood (1909:248), Mass et al. (1981:55), Merriam (1895b:83–84), Miller and Rehn (1901:241), Musser (1964:6), Poole and Schantz (1942:193), Prieto Bosch and Sánchez-Cordero (1993:459), Ramírez-Pulido (1969:265), Ramírez-Pulido et al. (1983:17), Rickart (1977:3), Schaldach (1966:288), Traub (1950:83), Villa-R. (1952:317; 1953:177), Villa-R. and Cervantes (2003:91, 94), Webb and Baker (1969:143), Whitaker et al. (1991:114).

REMARKS.—Presently, the primary means of distinguishing *Sorex veraecrucis* and *Sorex saussurei* is the morphological condition of the median tines on the I1s. Some specimens had worn, broken, or missing I1s, thus could not be positively classified into either of these species. These specimens are listed under “Specimens examined of unknown tine morphology.”

SPECIMENS EXAMINED ($n = 157$; 38 measured).—**Coahuila:** Sierra Guadalupe (USNM 117002#, 117003). **Colima:** 7.5 km N, 4 km W Queseria, 1820 m (CB 29113); Volcán de Fuego, 8800 ft (LACM 29069, 29083–29089, 29091); Volcán de Fuego, 9000 ft (LACM 37704–37705, 37709, 37711–37713). **Distrito Federal:** 0.85 km N, 3.5 km W Ecuani, Cerro del Ajusco, 19°13'37"N, 99°15'37"W, 3180 m (UAMI 14662, 14670); Instituto de Biología, Ciudad Universitaria, Delegación Coyoacán, 2240 m (CNMA 38637); Jardines del Pedregal de San Ángel (CNMA 9059); Parque Nacional “Desierto de los Leones,” 19°18'12"N, 99°18'24"W, 2870 m (UAMI 14616, 14645, 14647, 14656); C. Zacayuca, 3 mi N Tlalpan (CNMA 790). **Durango:** 1.5 mi NW Mil Díaz, 3 mi NW El Salto (MVZ 122943–122945); 12 mi E Revolvercarderos, 8100 ft (USNM 375687#); 1.5 mi W San Luis, 8000 ft (UMMZ 99979#–99981#). **Guanajuato:** Santa Rosa (USNM 81616#). **Guerrero:** 4 mi SW Filo de Caballo

[= Puerto General Nicolás Bravo] (TCWC 45109); Omiltemi (USNM 127504); 2 mi W Omiltemi, 7800 ft (TCWC 5666); 2 mi. W Omiltemi, ca. 7900 ft (TCWC 5572#); 4 km W Omiltemi, 2480 m (CB 36423). **Hidalgo:** Encarnación, 8500 ft (USNM 81135); Encarnación, 9000 ft (USNM 81130#); Lagunita (CNMA 26550). **Jalisco:** 1 km S, 13 km W Atenquique, 2460 m (CB 29112); N slope Cerro Nevado de Colima, 8500 ft (LACM 10858–10860, 10864); 2 km S, 6 km E El Jazmín (CB 29111); NE slope Cerro Nevado de Colima, 2750 m (UMMZ 113892–113893); Cerro Nevado de Colima (USNM 375683–375686, 375688#); NW slope Cerro Nevado de Colima, 0.5 mi E El Isote, 8000 ft (UMMZ 94594); NW slope Cerro Nevado de Colima, 0.5 mi E El Isote, 8800 ft (UMMZ 94589#); NW slope Cerro Nevado de Colima, 9500 ft (UMMZ 94590–94593); 12 mi SW Ciudad Guzman, 10,000 ft (KU 112036#); San Sebastián (USNM 88013#); Volcán de Fuego, 9800 ft (KU 107132#–107133#, 107135#–107137#, 107139#). **México:** 1.5 km N, 5.5 km E Ecatingo, 2970 m (CB 28916); Lagunas de Zempoala (USNM 329410, 329411#–329412#, 329413–329416); Mt. Popocatepetl (USNM 52041–52042); 1.5 km N, 4 km E Nejapa, 2940 m (CB 8722); 1.6 km N, 6.4 km E Nejapa, 3200 m (CB 10137); Mpio. Ocuilán de Arteaga, km 14 Currek, Ocuilán-Cuernavaca (MZFC 5687–5688, 5690); 5.5 km E San Pedro Nejapa [= Nexapa], 3250 m (CB 757); 2.2 km N, 6.5 km E San Pedro Nejapa, 3490 m (CB 21845); Salazar, [19°18'N, 99°23'W] (USNM 50772#, 50775); 4 km S, 8.5 km E San Pedro Nejapa, 3500 m (CB 10138); 10 km N, 12.4 km E Temascaltepec, 2450 m (CB 21461); N slope Volcán Toluca (USNM 55899). **Michoacán:** 2 km SW Angahuán, San Juan Paricutín, 2250 m (CB 30315); Cerro de San Andrés, 7300 ft, 15 mi ESE Morelia (MVZ 109356); Cerro Tancítaro, 9600 ft (FMNH 52138#); 9.5 km S, 2 km E Epitacio Huerta [in Querétaro], 2510 m (CB 25317–25318); Mt. Tancítaro (USNM 125888#, 125889–125892, 125894); Mt. Tancítaro, 7800 ft (FMNH 52131#, 52141#); Nahuatzen (USNM 50765, 50766#, 50769, 50771); 3.3 km S, 4.1 km W Nahuatzen (CB 13208); 7.3 km SE Nahuatzen (CB 11766); Patamban (USNM 125685#); 2.5 km S, 2 km E Pátzcuaro, 2270 m (CB 26209); 9 km N, 10 km W Nuevo San Juan Parangaricuimicuaro, 2250 m (CB 30316); Patamban (USNM 125685);

Pátzcuaro (FMNH 8688#); 4 mi S Pátzcuaro, 7800 ft (MVZ 100076–100077); 5 mi S Pátzcuaro, near road to Tacámbaro (UMMZ 93146). **Morelos:** Barranca de Atzompa (CB 10); 6.5 km N, 1 km E Hueyapan, 2680 m (CB 28917); Joya de Atexapa, Parque Nacional Lagunas de Zempoala, 2825 m (CNMA 1356); Joya de Atexapa, Parque Nacional Lagunas de Zempoala, 3000 m (CNMA 1345–1347, 1350, 1354); Lagunas de Zempoala, near Ojo de Agua (USNM 329418#–329420#); km 11 carr., Huitzilac, Parque Nacional Lagunas de Zempoala (CNMA 1352, 1355); Parque Nacional Lagunas de Zempoala, 2.3 km N, 6.8 km W Huitzilac, 2800 m (CB 49790–40791); Laguna Beca, Parque Nacional Lagunas de Zempoala, 2840 m (CNMA 9759); Laguna Beca, Parque Nacional Lagunas de Zempoala, 2860 m (CNMA 9760); Tetela del Volcán (USNM 52040); 2 km SE Tezoyo, 2250 m (CB 8041); 10 km SW Tres Cumbres, 10,000 ft (TCWC 4507#); 10.3 km NE Tres Marías (CB 36834). **Nuevo León:** E slope Cerro Potosí (USNM 392125#). **Oaxaca:** 12 mi N Ixtlán de Juárez (TCWC 47489); 1.5 mi N Llano de las Flores (TCWC 45110#); Tamazulapam (USNM 70249#, 70250–70251, 70299). **Puebla:** 7 mi SE Chignahuapan, 8300 ft (TCWC 48482); 7.3 mi by road SW Huauchinango, 6800 ft (UMMZ 110519). **Querétaro:** Pinal de Amoles (USNM 81120#–81122#, 81128). **Tamaulipas:** Miquihuana (USNM 93925#, 93926–93928).

SPECIMENS EXAMINED WITH UNKNOWN TIME MORPHOLOGY (i.e., IIs worn, broken, or missing; $n = 19$; 9 measured).—**Colima:** Volcán de Fuego, 8800 ft (LACM 29066, 29079, 29090). **Jalisco:** 12 mi S Ahaucapán, Sierra de Autlán (LACM 10856); N slope Cerro Nevado de Colima, 8500 ft (LACM 10861); 12.5 mi. SW (by road) Talpa de Allende, 4200 ft (CMNH 79263#, TCWC 41960#). **México:** 3 mi S Bosoncheve, Refugio San Cayetano, 8200 ft (UMMZ 102712); 8 km NW Villa Victoria, 2400 m (CB 1972). **Michoacán:** Cerro Tancítaro, 7800 ft (FMNH 52140#); Mt. Tancítaro, 7800 ft (FMNH 52132#–52136#); Mt. Tancítaro, 9500 ft (FMNH 52137#). **Morelos:** 45 km SW México City, 9400 ft (TCWC 2763). **Nuevo León:** Cerro El Potosí, Galeana, 3140 m and Fraccionamiento Campestre Villa Montaña, San Pedro Garza García (Jiménez Guzmán et al. 1999). **Puebla:** 7.3 mi by road SW Huauchinango, 6800 ft (UMMZ 110518).

Sorex veraecrucis cristobalensis
Jackson, 1925

Sorex saussurei cristobalensis: Jackson, 1925:129. Type locality "San Cristóbal, 8,400 ft, Chiapas," latitude 16.75°N, longitude 92.63°W.

HOLOTYPE.—USNM 75883, ♀, adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the type locality 'San Cristóbal', Chiapas.

DIAGNOSIS.—*Sorex v. cristobalensis* differs from all other subspecies of *S. veraecrucis* by hairs on venter light reddish brown tipped and hips and rump with light brown clear-tipped guard hairs extending 1.7 mm beyond dorsal pelage. Also, it can be distinguished from *S. v. oaxacae* by condylobasal length 18.29 mm; from *S. v. altoensis* and *S. v. veraecrucis* by i1 with deep interdenticular spaces (Fig. 24) and pigment in 2 sections; and from *S. v. veraecrucis* by length of tail ≥ 46.5 mm.

In addition to diagnostic characters listed for the species, *S. v. cristobalensis* also can be distinguished from *S. veraepacis chiapensis* by least interorbital breadth 3.9 mm, cranial breadth 8.5 mm, i1 with pigment in 2 sections, hips and rump with light brown, clear-tipped guard hairs extending 1.7 mm beyond dorsal pelage, and tail uniform in color; and from *S. sclateri* by i1s with deep interdenticular spaces (Fig. 24) and generally smaller size: total length 116 mm, length of tail 46.5 mm, length of hind foot 13.5 mm, length of mandible 7.9 mm, length from upper articular condyle to posterior edge of m3 3.8 mm, and height of coronoid valley 2.0 mm. Further, it differs from *S. stizodon* by i1 with pigment in 2 sections, deep interdenticular spaces (Fig. 24), and a long strip of pigment present at anteromedial edge (Fig. 26); hips and rump with light brown, clear-tipped guard hairs extending 1.7 mm beyond dorsal pelage; and it is generally longer: total length 116 mm, length of tail 46.5 mm, palatilar length 7.9 mm, length of U1–M3 6.9 mm, length of mandible 7.9 mm, length of c1–m3 5.4 mm, length from upper articular condyle to posterior edge of m3 3.8 mm, and height of coronoid valley 2.0 mm, but also, has a generally narrower skull: maxillary breadth 5.4 mm, least interorbital breadth 3.9 mm, and cranial breadth 8.5 mm.

GENERAL CHARACTERISTICS.—*Sorex v. cristobalensis* has hairs on the dorsum light brown medially and dark brown distally, giving an

overall medium brown appearance.

DISTRIBUTION.—An endemic to Mexico, *S. v. cristobalensis* is known only from 3 localities in Chiapas (Fig. 45; Hall 1981).

ECOLOGY.—*Sorex v. cristobalensis* occurs at high elevations (Álvarez del Toro 1977) in the Transition Zone of Chiapas between the Upper Austral Zone and the Canadian Zone (Goldman 1951). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis goodwini* and *Sorex veraepacis chiapensis* (Espinoza Medinilla et al. 1998).

STATUS.—*Sorex v. cristobalensis* is listed as protected under *S. saussurei cristobalensis* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:14), Aranda and March (1987:143), Junge and Hoffmann (1981:45), Poole and Schantz (1942:193), Ramírez-Pulido et al. (1983:17), Villa-R. and Cervantes (2003:97).

SPECIMENS EXAMINED ($n = 3$; 3 measured).—**Chiapas:** El Triunfo, 10 km SSE Finca Prusia, ca. 1900 m (LACM 74152#); 9 mi SE Tonalá (to vicinity of Finca Ocuilapa), then approximately 10 mi (by trail) NE of that point (LACM 18709#); San Cristóbal, 8400 ft (USNM 75883T#).

Sorex veraecrucis oaxacae
Jackson, 1925

Sorex saussurei oaxacae Jackson, 1925:128. Type locality "Mts. near Ozolotepec, [10,000 ft.] Oaxaca," latitude 16.09°N, longitude 96.31°W.

HOLOTYPE.—USNM 71467, ♀, adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the state of Oaxaca from which the holotype was collected.

DIAGNOSIS.—*Sorex v. oaxacae* differs from all other subspecies of *S. veraecrucis* by hips and rump with dark brown, clear-tipped guard hairs extending 1.9 mm beyond dorsal pelage. Additionally, it can be distinguished from *S. v. cristobalensis* by condylobasal length 17.86–18.15 mm, i1 with pigment in 1 section, and hairs on venter white tipped; and from *S. v. altoensis* and *S. v. veraecrucis* by i1 with deep interdenticular spaces (Fig. 24).

In addition to diagnostic characters listed for the species, *S. v. oaxacae* also can be distinguished from *S. ventralis* by I1 with a median tine above pigment (Fig. 4), i1 with deep interdenticular spaces (Fig. 24), hairs on venter white tipped, and hairs of tail uniformly

medium brown as for dorsal pelage; and from *S. veraepacis mutabilis* by hips and rump with dark brown, clear-tipped guard hairs extending 1.9 mm beyond dorsal pelage.

GENERAL CHARACTERISTICS.—*Sorex v. oaxacae* has a medium brown dorsal pelage.

DISTRIBUTION.—An endemic to Mexico, *S. v. oaxacae* is known only from Oaxaca from 1600 to 3000 m elevation (Fig. 45; Goodwin 1969).

ECOLOGY.—*Sorex v. oaxacae* occurs along moist, moss-covered rock outcrops surrounded with dense herbaceous vegetation containing large amounts of ferns with a shrubby overstory (Musser 1964, Webb and Baker 1969). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis goldmani machetes*, *C. magna*, *C. m. mexicana*, *C. phillipsii*, *Habromys chinanteco*, *H. lepturus*, *Heteromys desmarestianus lepturus*, *Megadontomys cryophilus*, *Microtus mexicanus*, *M. oaxacensis*, *Oryzomys alfaroi*, *O. caudatus*, *Peromyscus boylii*, *P. megalops*, *P. melanocarpus*, *P. mexicanus*, *Reithrodontomys mexicanus*, *R. microdon*, and *Sorex veraepacis mutabilis* (Musser 1964, Schaldach 1966, Jones and Genoways 1967, Robertson and Rickart 1975, Rickart 1977).

STATUS.—*Sorex v. oaxacae* is listed as protected under *S. saussurei oaxacae* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:14), Briones-Salas and Sánchez-Cordero (2004:436), Poole and Schantz (1942:193), Ramírez-Pulido et al. (1983:17), Villa-R. (1953:177).

SPECIMENS EXAMINED ($n = 10$; 7 measured).—**Oaxaca:** Juquila, 5 road mi NW Santa Rosa (UMMZ 117851[#]); Mts. near Ozolotepec, 10,000 ft (USNM 71467T[#]); Río Molino, 2250 m (CNMA 8440–8441); Campamento Río Molino, 2300 m (KU 124310[#]); near Campamento Río Molino (Hwy 175), 7300 ft (UMMZ 112576[#]–112577[#]); 3 mi S Suchixtepec, 7100 ft (TCWC 47490); Vista Hermosa, 1600 m (KU 99550[#]); 4.5 km (by road) S Vista Hermosa, 1620 m (KU 121654[#]).

Sorex arizonae
Diersing and Hoffmeister, 1977—
Arizona Shrew

Sorex arizonae Diersing and Hoffmeister, 1977:329. Type locality "extreme upper end of Miller Canyon, 10 mi

S, 4.75 mi E Fort Huachuca, Cochise Co., Arizona," latitude 31.43°N, longitude 110.24°W.

HOLOTYPE.—UI 3809, ♀, age unknown, skin and skull.

ETYMOLOGY.—The specific name was derived from the state of Arizona from which the holotype was collected.

DIAGNOSIS.—*Sorex arizonae* can be distinguished from *S. emarginatus* by condylobasal length 16.25 mm, i1 with deep interdenticular spaces (Fig. 24), length from upper articular condyle to posterior edge of m3 3.6 mm, and height of articular condyle 2.8 mm; from *S. monticolus* by palatilar length 7.2 mm, maxillary breadth 5.1 mm, i1 with 2 denticles, and hips and rump with light brown, clear-tipped guard hairs extending 1.1 mm beyond dorsal pelage; and from *S. veraecrucis altoensis* by $U3 \geq U4$ (Fig. 30), I1 with median tine always within pigment (Fig. 7), length of hind foot 11 mm, condylobasal length 16.25 mm, palatilar length 7.2 mm, cranial breadth 7.99 mm, and i1 with deep interdenticular spaces (Fig. 24). Further, *S. arizonae* differs from *S. milleri* by hips and rump with light brown, clear-tipped guard hairs extending 1.1 mm beyond dorsal pelage, $U3 \geq U4$ (Fig. 30), i1 with 2 denticles and pigment in 1 section, and greater size: condylobasal length 16.25 mm, palatilar length 7.2 mm, length of U1–M3 6.4 mm, maxillary breadth 5.1 mm, least interorbital breadth 3.7 mm, breadth across M2–M2 4.6 mm, length of c1–m3 4.9 mm, length from upper articular condyle to posterior edge of m3 3.6 mm, height of coronoid process 3.7 mm, height of articular condyle 2.8 mm, and length of coronoid–ventral point of lower condylar facet 3.3 mm.

GENERAL CHARACTERISTICS.—*Sorex arizonae* has hairs on dorsum with wide blond band medially and narrow dark brown tips giving an overall medium brown appearance; hairs on venter are white tipped. The tail is bicolored. The skull is delicate in structure. A long strip of pigment is present at anteromedial edge of i1 (Fig. 26).

DISTRIBUTION.—*Sorex arizonae* occurs in Arizona, New Mexico, and Chihuahua (Fig. 63; Diersing and Hoffmeister 1977, Caire et al. 1978, Conway and Schmitt 1978).

ECOLOGY.—The only known Mexican specimen was collected at 2591 m on a north-facing slope with *Pinus*, *Arbutus*, *Juniperus*, and *Quercus* in a scattered rocky outcrop in the Sonoran Desert (Caire et al. 1978, Escalante

Figs. 61–63. Distribution of 11 species of *Sorex* in Mexico: 61, *S. oreopolus*; 62, *S. orizabae*; 63, nine species of *Sorex* including 3 subspecies of *S. ornatus*. Taxa are indicated by symbols in key.

et al. 2003). No reproductive information was found in published literature.

Known mammalian associates include *Neotoma mexicana*, *Peromyscus boylii*, *P. truei*, and *Thomomys umbrinus* (Caire et al. 1978, Conway and Schmitt 1978).

STATUS.—*Sorex arizonae* is listed as an endangered species by the Mexican government (Norma Oficial Mexicana 2002) and as vulnerable by the IUCN/CITES (Ceballos et al. 2002b).

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:53), Armstrong (1996:272), Caire (1997:71), Ceballos and Navarro L. (1991:180), Ramírez-Pulido et al. (1983:16), Villa R. and Cervantes (2003:45), Whitaker and Morales-Malacara (2005:652).

SPECIMEN EXAMINED ($n = 1$; 1 measured).—**Chihuahua:** ca. 60 km W (by road) Tomochic, 2591 m (UCO 524#).

Sorex emarginatus Jackson, 1925—
Zacatecas Shrew or Sierra Madre
Long-tailed Shrew

Sorex emarginatus Jackson, 1925:129. Type locality "Sierra Madre cerca de Bolaños, 7,600 ft, Jalisco," latitude 21.68°N, longitude 103.78°W.

Sorex oreopolus emarginatus: Findley, 1955b:616.

HOLOTYPE.—USNM 90847, sex unknown, young adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Latin *emarginatus* 'without a hem or border'.

DIAGNOSIS.—*Sorex emarginatus* can be distinguished from *S. arizonae* by condylobasal length 16.28–16.79 mm, i1 with shallow interdenticular spaces (Fig. 25), length from upper articular condyle to posterior edge of m3 3.2–3.3 mm, and height of articular condyle 2.5–2.6 mm; and from *S. monticolus* by $U3 \geq U4$ (Fig. 30), i1 with 2 denticles, and hips and rump with medium brown, clear-tipped guard hairs extending 1.2–1.4 mm beyond dorsal pelage. Further, it differs from *S. oreopolus* by $U3 \geq U4$ (Fig. 30), I1 with median tine within pigment (Fig. 7), condylobasal length 16.28–16.79 mm, and hips and rump with medium brown, clear-tipped guard hairs extending 1.2–1.4 mm beyond the dorsal pelage and from *S. veraecrucis altoensis* by $U3 \geq U4$ (Fig. 30), I1 with median tine always within pigment (Fig. 7), condylobasal length 16.28–16.79 mm, palatal length 6.5–7.2 mm, and cranial breadth 7.8–8.1 mm.

GENERAL CHARACTERISTICS.—*Sorex emarginatus* has hairs on dorsum with a narrow blond band medially and narrow dark brown tips giving an overall medium dark brown appearance; hairs on venter are blond-tipped. The tail is markedly bicolored. The i1 has pigment in 1 section and a long strip of pigment present at anteromedial edge (Fig. 26).

DISTRIBUTION.—An endemic to Mexico, *S. emarginatus* is known from portions of about a 23,200-km² area in Durango, Jalisco, and Zacatecas (Fig. 63; Álvarez and Polaco 1984, Fa 1989, Fa and Morales 1993, Flores Villela and Gerez 1994).

ECOLOGY.—In Durango, *S. emarginatus* occurs in mesic valleys of the Transition Zone (Goldman 1951) vegetated with pine (*Pinus* sp.) forests or mixed pine-oak forests to ≥ 2450 m (Baker and Greer 1962, Álvarez and Polaco 1984). In Zacatecas, it occurs in the highlands in moist, pine-oak forests and "... in wet, oak-leaf ground cover piled near the base of a streamside rock wall in open montane oak-manzanita-juniper-madrone forest ..." (Matson and Baker 1986:28).

On 15 July (year not reported) a lactating female was collected in Durango (Baker and Greer 1962). On 4 August 1975 a lactating female was collected in Zacatecas (Matson and Baker 1986).

Known mammalian associates include *Peromyscus melanotis* and *P. boylii* (Baker and Greer 1962). Garter snakes (*Thamnophis elegans*) are known to prey upon *S. emarginatus* (Matson and Baker 1986).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Arita and Ceballos (1997:53), Armstrong (1996:272), Diersing and Hoffmeister (1977:321), Escalante et al. (2003:575), Fa and Morales (1991:207), Hall (1981:50), Jackson (1928:160), Junge and Hoffmann (1981:45), López-Vidal and Álvarez (1993:188), Poole and Schantz (1942:185), Villa-R. (1953:177), Webb and Baker (1962:330), Whitaker and Morales-Malacara (2005:652).

REMARKS.—Specimens from Cerro Potosí, Mpio. Galeana, Nuevo León, reported by Koestner (1941) to be *S. emarginatus* actually are *S. milleri*.

SPECIMENS EXAMINED ($n = 6$; 5 measured).—**Durango:** 7 mi SW Las Adjuntas, 8900 ft (KU 54346#). **Jalisco:** 1 km SW La Peña (CB 14233); Sierra Madre cerca de Bolaños, 7600 ft (USNM 90847T#). **Zacatecas:** 26 km NW

Jalpa, 2460 m (TTU 41744#); Plateado, 7600 ft (USNM 90846#); Plateado, 8500 ft (USNM 90844#).

ADDITIONAL SPECIMENS.—**Zacatecas:** 10 km W San Juan Capistrano, 2900 m (Matson and Baker 1986).

Sorex macrodon Merriam, 1895b—
Large-toothed Shrew

Sorex macrodon Merriam, 1895b:82. Type locality "Orizaba, 4,200 ft, Veracruz," latitude 18.85°N, longitude 97.08°W.

HOLOTYPE.—USNM 58272, ♂, young adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Greek *makros* 'long or large' and the Greek *odontos* 'tooth'.

DIAGNOSIS.—*Sorex macrodon* can be distinguished from sympatric *Sorex* by a zygomatic plate 1.8–2.3 mm, maxillary breadth 5.7–6.0 mm, breadth across M2–M2 5.2–5.4 mm, and hips and rump with dark brown guard hairs extending 1.5–1.8 mm beyond dorsal pelage. Further, it differs from *S. oreopolus*, *S. orizabae*, and *S. ventralis* by total length 126–131 mm, length of tail 50–54 mm, condylobasal length 19.1–19.9 mm, palatilar length 8.0–8.6 mm, length of U1–M3 7.3–7.7 mm, least interorbital breadth 4.3–4.6 mm, cranial breadth 9.7–10.1 mm, i1 with no long strip of pigment present at anteromedial edge (Fig. 27), length of mandible 8.2–9.8 mm, length of c1–m3 5.6–5.9 mm, hairs on venter without light-colored tips, and hairs on tail uniformly very dark brown. Additionally, *S. macrodon* can be distinguished from *S. oreopolus* by i1 with 3 denticles (Fig. 24); from *S. orizabae* by i1 with pigment in 1 section; and from *S. ventralis* by I1 with median tine above pigment (Fig. 4) and i1 with 3 denticles and deep interdenticular spaces (Fig. 24). *Sorex macrodon* differs from *S. saussurei* and *S. veraecrucis altoensis* by condylobasal length 19.1–19.9 mm; length of U1–M3 7.3–7.7 mm; cranial breadth 9.7–10.1 mm; I1 with median tine always above pigment; i1 with 3 denticles, deep interdenticular spaces (Fig. 24), and no long strip of pigment present at anteromedial edge (Fig. 27); length of c1–m3 5.6–5.9 mm; hairs on venter without light-colored tips; and hairs on tail always uniformly very dark brown. *Sorex macrodon* can be distinguished from *S. veraepacis* by I1 with median tine always above pigment (Fig. 7), i1

with pigment always in 1 section, and hairs on tail uniformly very dark brown.

GENERAL CHARACTERISTICS.—Generally, *S. macrodon* is the largest *Sorex* in any habitat in which it occurs. It has a very dark brown dorsum and a venter only slightly paler than the dorsum. U3 < U4 (Fig. 31).

DISTRIBUTION.—An endemic to Mexico, *S. macrodon* is known from portions of about a 6400-km² area in Oaxaca, Puebla, and Veracruz (Fig. 63; Hall 1981, Ramírez-Pulido and Britton 1981, Fa 1989, Fa and Morales 1993, Flores Villela and Gerez 1994).

ECOLOGY.—In Puebla, *S. macrodon* was found in beech-sweetgum cloud forest beneath undergrowth near moving water (Heaney and Birney 1977). In Veracruz, it occurs in the Humid Upper Tropical Subzone (Goldman 1951) "... in dense, woody bushes along the mossy bank of a tiny stream ... in cloud brushland ... " (Hall and Dalquest 1963:204). However, it is considered to be most common from 1650 to 2000 m on bare ground under logs or large rocks in dense, damp oak forests (Jackson 1928). As of 2005, only 15.95% of habitat considered suitable for *S. macrodon* habitation (i.e., habitat unmodified for agriculture or urban development) still existed (Sánchez-Cordero et al. 2005). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis mexicana*, *Liomys irroratus*, *Megadontomys thomasi*, *Microtus mexicanus*, *Oryzomys alfaroi*, *Peromyscus furvus*, *Plecotus mexicanus*, and *Sorex v. veraecrucis* (Hall and Dalquest 1963, Heaney and Birney 1977, Prieto Bosch and Sánchez-Cordero 1993).

STATUS.—*Sorex macrodon* is listed as a protected species (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Arita and Ceballos (1997:54), Barrera (1968:56), Ceballos and Navarro L. (1991:178), Escalante et al. (2003:575), Fa and Morales (1991:206), Hall and Kelson (1959:37), Junge and Hoffmann (1981:43), Lyon and Osgood (1909:245), Miller (1912:19), Miller and Rehn (1901:240), Poole and Schantz (1942:188), Ramírez-Pulido et al. (1983:17), Whitaker and Morales-Malacara (2005:652).

SPECIMENS EXAMINED ($n = 9$; 5 measured).—**Oaxaca:** 2.3 km (by road) S Vista Hermosa (KU 136573#); 4.5 km (by road) S Vista Hermosa, 1620 m (KU 121657#). **Veracruz:** Xico

[= Jico] (USNM 55100, 55101#, 55107#); Orizaba, 4200 ft (USNM 58270–58271, 58272T#, 58273).

ADDITIONAL SPECIMENS.—**Puebla:** 12.1 km (by road) NE Teziutlán, 19°52'N, 97°20'W (BMNH [J.F. Bell Museum of Natural History] 6876–6877; Heaney and Birney 1977). **Veracruz:** 3 km W Acultzingo, 7000 ft ($n = 3$) and Las Vigas, 8500 ft ($n = 1$; Hall and Dalquest 1963); Cofre de Perote (Prieto Bosch and Sánchez-Cordero 1993).

Sorex milleri Jackson, 1947—
Mount Carmen Shrew

Sorex milleri Jackson, 1947:131. Type locality “Sierra del Carmen, [Campo Madera, 8000 ft.] Coahuila,” latitude 29.0°N, longitude 102.34°W.

HOLOTYPE.—USNM 274950, ♀(?), adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Mr. F.W. Miller collector of the holotype.

DIAGNOSIS.—*Sorex milleri* can be distinguished from *S. veraecrucis altoensis* by I1 with median tine always within pigment (Fig. 7); i1 with 3 denticles, deep interdenticular spaces (Fig. 24), and pigment in 3 sections; and hips and rump with dark brown guard hairs extending 0.33 mm beyond dorsal pelage. Also it differs by its smaller size: condylobasal length 14.73–16.08 mm, palatilar length 6.1–6.8 mm, maxillary breadth usually 4.0–4.4 mm, least interorbital breadth usually 2.7–3.2 mm, cranial breadth 7.31–8.0 mm, breadth across M2–M2 usually 3.6–3.9 mm, length of c1–m3 3.8–4.5 mm, height of coronoid process 2.8–3.3 mm, length of coronoid–ventral point of lower condylar facet 2.7–3.1 mm, and length of coronoid–posterior point of upper condylar facet 2.7–3.1 mm.

GENERAL CHARACTERISTICS.—*Sorex milleri* has a light brown dorsum, venter hairs white tipped, and a bicolored tail. The skull is small and delicate in structure, U3 < U4 (Fig. 31), and i1 has a long strip of pigment present at antero-medial edge (Fig. 26).

DISTRIBUTION.—An endemic to Mexico, *S. milleri* is known from Coahuila and Nuevo León (Fig. 63; Baker 1956, Ramírez-Pulido and Britton 1981, Fa and Morales 1993, Flores Villela and Gerez 1994, Jiménez Guzmán et al. 1997).

ECOLOGY.—This species occurs at high elevations, to ca. 3700 m, in Douglas-fir–pine–aspen and scrub piñon pine woodlands along

logs in moist shaded areas with ground litter in the Sierra Madre Oriental (Koestner 1941, Baker 1956). Delgadillo Villalobos et al. (2005: 94) found an active nest at 2400 m at Cuadro Pelota, Madreas del Carmen, Coahuila, located in a forest opening “. . . at the entrance of a Botta’s pocket gopher (*Thomomys bottae*) burrow under a rotting log 25 cm in diameter . . .” surrounded by mesic montane forest. The “ground cover consisted of grasses, including poverty oat grass (*Danthonia spicata*), tobosa grass (*Hilaria mutica*), bull muhly (*Muhlenbergia emersleyi*), and Pringle needlegrass (*Piptochaetium pringlei*), with scattered pines, Douglas-fir, and silverleaf oak (*Quercus hypoleucoides*).” They found 8 additional nests in a similar habitat type at Mesa Bonita (23°00'67"N, 102°36'76"W, 2700 m), 12 km N Cuatro Pelota. The cup-like nests were 10 cm in outside diameter, had an entrance hole 19 mm in diameter and always were located in old Botta’s pocket gopher tunnels under rotting logs. They were composed of a loose mass of grass blades with pine needles, bits of bark, and oak leaves located at the bottom; 1 nest contained several small feathers (Delgadillo Villalobos et al. 2005). As of 2005, in Veracruz only 82.70% of habitat considered suitable for *S. milleri* habitation (i.e., habitat unmodified for agriculture or urban development) still existed (Sánchez-Cordero et al. 2005).

A lactating female was collected on 7 July 1955 in Coahuila (Baker 1956). A nest containing 1 female adult and 6 young was found in October 2003 at Cuadro Pelota, Maderas del Carmen, Coahuila (Delgadillo Villalobos et al. 2005). A female with enlarged mammae was collected 6 July 1938 in Nuevo León (Koestner 1941).

Known mammalian associates include *Microtus mexicanus*, *Peromyscus boylii*, *P. melanotis*, *Reithrodontomys megalotis*, *Sigmodon o. ochrog-nathus*, and *Thomomys bottae* (Baker 1956, Jiménez Guzmán et al. 1999, Delgadillo Villalobos et al. 2005).

STATUS.—*Sorex milleri* is listed as a protected species by the Mexican government (Norma Oficial Mexicana 2002) and as vulnerable by the IUCN/CITES (Ceballos et al. 2002b).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Arita and Ceballos (1997:54), Armstrong (1996:272), Escalante et al. (2003:567–569, 575), Findley (1955b:617), Findley and Caire (1977:132, 136), Junge and Hoffmann

(1981:43), Koestner (1944:228), Ramírez-Pulido et al. (1983:17), Schmidly (1977:165), Tipton and Méndez (1968:189, 195, 204), van Zyll de Jong and Kirkland (1989:110), Villa-R. and Cervantes (2003:85), Whitaker and Morales-Malacara (2005:548, 643, 645).

REMARKS.—Specimen BYU 7014, collected at Chihuahua, Chihuahua, was originally reported as a *S. milleri* (López-Wilchis and López Jardines 2000). It is actually a *S. monticolus*.

SPECIMENS EXAMINED ($n = 34$; 26 measured).—**Coahuila:** 13 mi E San Antonio de las Alazanas, [Sierra Madre Oriental], 9950 ft (KU 67279#–67282#, 67284#, 67287#, 67290#, 67293#–67295#, 67297#, 67299#, 67301#); Sierra del Carmen (USNM 274950T#); Sierra del Carmen, Madero Camp (USNM 274951#). **Nuevo León:** Cerro Potosí near La Jolla Galeana (FMNH 48227#, 48229#–48230#); E slope Cerro Potosí, 50 yd S microwave tower, 10,500 ft (CNMA 26549); E slope Cerro Potosí, 10,425 ft (USNM 392121#); E slope Cerro Potosí, 10,500 ft (USNM 392118#); E slope Cerro Potosí, 10,600 ft (USNM 392124#); E slope Cerro Potosí, 12,000 ft (USNM 392116#); El Potosí, 19 km N Galeana, 9500 ft (USNM 329403, 329404#–329407#, 329408, 392117, 392119–392120, 392122–392123).

ADDITIONAL SPECIMENS.—**Coahuila:** Cuadro Pelota, 29°56'94"N [sic], 102°35'14"W, Maderas del Carmen (Delgadillo Villalobos et al. 2005). **Nuevo León:** Bustamante and Monterrey (Jiménez Guzmán et al. 1996).

Sorex monticolus Merriam, 1890—
Dusky Shrew, Mountain Shrew,
or Montane Shrew

Sorex monticolus Merriam, 1890:43. Type locality "San Francisco Mountains, 3,500 m (11,500 ft), Coconino Co., Arizona," latitude 33.70°N, longitude 108.96°W.

Sorex vagrans monticola: Merriam, 1895b:69.

Sorex durangae Jackson, 1925:127. Type specimen USNM 94540, ♂, adult, skin and skull. Type locality "El Salto, Durango," latitude 23.76°N, longitude 105.37°W.

Sorex melanogenys Hall, 1932:260.

Sorex m[onticolus]. monticolus Hennings and Hoffmann, 1977:12.

HOLOTYPE.—USNM 17599/24535, ♂, adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Latin *monticolus* 'a mountain' in reference to areas where it usually is collected.

DIAGNOSIS.—*Sorex monticolus* can be distinguished from *S. arizonae*, *S. emarginatus*, and *S. veraecrucis altoensis* by hips and rump

with dark brown guard hairs extending 0.33 mm beyond dorsal pelage and i1 with 3 denticles (Fig. 24). Further, *S. monticolus* differs from *S. arizonae* by $U3 < U4$ (Fig. 31), palatilar length usually 6.7–7.0 mm, and maxillary breadth 4.7–4.9 mm; from *S. emarginatus* by pelage on dorsum light brown and hairs on venter white tipped, $U3 < U4$ (Fig. 31), and i1 with deep interdenticular spaces (Fig. 24); and from *S. veraecrucis altoensis* by pelage on dorsum light brown, i1 with deep interdenticular spaces (Fig. 24), and smaller size: condylobasal length 16.38–17.16 mm, palatilar length usually 6.7–7.0 mm, cranial breadth usually 7.78–8.39 mm, and length of mandible 6.8–7.3 mm.

GENERAL CHARACTERISTICS.—*Sorex monticolus* has a bicolored tail. The skull is of intermediate size, I1 has a median tine well within the pigment (Fig. 7), and i1 has pigment in 1 section and a long strip of pigment present at anteromedial edge (Fig. 26).

DISTRIBUTION.—*Sorex monticolus* is distributed throughout montane regions of Canada and the United States southward into Chihuahua and Durango, Mexico (Fig. 63; Alexander 1996).

ECOLOGY.—In Chihuahua, *S. monticolus* has been collected in pine forest habitat above 2000 m (Anderson 1972). In Durango, montane shrews occur in the Transition Zone (Goldman 1951) in moss-lined runways on the walls of moist canyons surrounding Douglas-fir-juniper woodlands and along logs on grazed, dry hill-sides vegetated with a pine-oak-madroño woodland (Hooper 1955, Baker and Greer 1962).

A lactating female was collected on 21 July (year not reported) in Durango (Baker and Greer 1962). Known mammalian associates include *Neotoma mexicana* and *Peromyscus boylii* (Baker and Greer 1962).

STATUS.—*Sorex monticolus* is listed as protected under *S. vagrans monticola* (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Arita and Ceballos (1997:54), Armstrong (1996:273), Caire (1997:71), Diersing and Hoffmeister (1977:332), Escalante et al. (2003:575), Findley (1955b:617), Gardner (1965:101), Poole and Schantz (1942:185), Ramírez-Pulido et al. (1983:17), Villa-R. (1953:177), Villa-R. and Cervantes (2003:82), Webb and Baker (1984:246), Whitaker and Morales-Malacara (2005:652).

SPECIMENS EXAMINED ($n = 12$; 10 measured).—MEXICO: **Chihuahua**: Chuhuichupa (BYU 7014#); near Guadalupe y Calvo, Sierra Madre, 7000–9000 ft (USNM 95322#–95324#, 95325, 95326#); E side Mt. Mohinora, 10,000 ft (MLZ 218#–219#); Río Verde (on Parral-Guadalupe y Calvo Rd.) (LACM 13875). DURANGO: El Salto (USNM 94539#, 94540T#). UNITED STATES: **Arizona**: Greenlee Co.: San Francisco Mts., 11,000 ft (USNM 17599T#).

Sorex oreopolus Merriam, 1892—
Volcano Shrew or Mexican
Long-tailed Shrew

Sorex oreopolus Merriam, 1892:173. Type locality “Falda norte de la Sierra Nevada de Colima, ca. 10,000 ft, Jalisco,” latitude 19.55°N, longitude 103.63°W.

Sorex oreopolus [i. *oreopolus* Hall and Kelson, 1959:49.

Sorex oreopolus orizabae Álvarez-Castañeda, 1996:51 (in part).

HOLOTYPE.—USNM 33663/45698, ♂, adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Greek *oreos* ‘a mountain’ and the Latin *polus* ‘pivot or axis’ probably in reference to its distribution within the Transvolcanic Belt.

DIAGNOSIS.—*Sorex oreopolus* can be distinguished from *S. macrodon* by i1 with 2 denticles (Fig. 24) and a long strip of pigment present at anteromedial edge (Fig. 26), hairs on venter light red tipped, tail bicolored, and overall smaller size: total length 90–117 mm, length of tail 37–43 mm, condylobasal length 16.86–18.55 mm, palatilar length 6.0–7.9 mm, length of U1–M3 5.3–7.1 mm, breadth of zygomatic plate 1.0–1.4 mm, maxillary breadth 4.8–5.6 mm, least interorbital breadth 3.4–3.5 mm, cranial breadth 7.8–9.1 mm, breadth across M2–M2 3.6–4.8 mm, length of mandible 7.3–7.7 mm, length of c1–m3 4.8–5.0 mm, length from upper articular condyle to posterior edge of m3 3.4–3.7 mm, height of coronoid process 3.3–3.9 mm, height of coronoid valley 1.6–1.9 mm, height of articular condyle 2.5–2.7 mm, and depth of mandible 0.9–1.0 mm. Further, *S. oreopolus* differs from *S. orizabae* by hairs on venter light red tipped, i1 with 2 denticles (Fig. 24) and pigment in 1 section, length of mandible usually 7.3–7.7 mm and from *S. saussurei* and *S. ventralis* by I1 with median tine always above pigment (Fig. 4), least interorbital breadth 3.4–3.5 mm, i1 with deep interdenticular spaces (Fig. 24), hips and rump

with dark brown, clear-tipped guard hairs extending 1.75–2.5 mm beyond dorsal pelage, and hairs on venter light red tipped.

GENERAL CHARACTERISTICS.—*Sorex oreopolus* has hairs on the dorsum with a pale reddish white band medially and short dark brown tips and venter hairs dark gray proximally with light red tips. The skull is of intermediate size and $U3 < U4$ (Fig. 31).

DISTRIBUTION.—An endemic of Mexico, *S. oreopolus* is known from portions of about a 34,400-km² area in Distrito Federal, Jalisco, México, Morelos, Puebla, and Tlaxcala (Fig. 61; Hall 1981, Ramírez-Pulido and Britton 1981, Fa and Morales 1993, Flores Villela and Gerez 1994).

ECOLOGY.—*Sorex oreopolus* occurs in a wide range of ecological zones, from Canadian through Transition to Hudsonian (Goldman 1951). The volcano shrew occurs in moist fir-pine-oak forests at ca. 2500 m (Hooper 1955, Álvarez-Castañeda 1996) and in high-altitude tussock grasslands dominated by *Festuca amplissima*, *F. tolucensis*, *Muhlenbergia macroura*, and *M. quadridentata* with understories of the forbes *Alchemilla sebalidiaefolia*, *Bidens diversifolia*, *Eupatorium* sp., *Geranium* sp., and *Gnaphalium* sp. (Fa and Sánchez-Cordero 1993). No reproductive information was found in published literature.

Known mammalian associates in Jalisco include *Peromyscus spicilegus* (Hooper 1955). In Morelos they include *Neotoma mexicana*, *Neotomodon alstoni*, *Peromyscus difficilis*, *P. maniculatus*, *P. melanotis*, *P. truei*, *Reithrodontomys chrysopsis*, and *R. megalotis* (Fa et al. 1990, Fa and Sánchez-Cordero 1993).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:14), Arita and Ceballos (1997:54), Armstrong (1996:276), Barrera (1968:57), Chávez and Ceballos (1998:127), Davis (1944:375), Davis and Russell (1953:122), Díaz de León (1905:25), Escalante et al. (2003:575), Fa and Morales (1991:207), Findley (1955a:52), Hennings and Hoffmann (1977:32), Jackson (1925:129; 1928:160, 162), Junge and Hoffmann (1981:43–44), Lyon and Osgood (1909:247), Mass et al. (1981:56), Merriam (1895b:71), Miller (1912:17), Miller and Rehn (1901:239), Poole and Schantz (1942:191), Ramírez-Pulido (1969:266), Ramírez-Pulido et al. (1983:17), Villa-R. and Cervantes (2003:91), Whitaker and Morales-Malacara (2005:652).

REMARKS.—In July 2003, Cerro Nevado de Colima (= Volcán de Colima) erupted. It is unknown if specimens still could be found on its north slope at the type locality.

SPECIMENS EXAMINED ($n = 18$; 7 measured). —**Distrito Federal:** 0.85 km N, 3.5 km W Ecuanil, Cerro del Ajusco, 19°13'37"N, 99°15'37"W, 3180 m (UAMI 13245#, 13247, 15096#, UAMI JPR3982); Parque Nacional "Desierto de los Leones," 19°18'12"N, 99°18'24"W, 2870 m (UAMI 14613#); 5 km SW Parrés, Tlalpán (CNMA 19591); Parres, Estación de Ferrocarril "La Cima" Carretera Federal México, Cuernavaca, Tlalapan (CNMA 31955#). **Jalisco:** Falda norte de la Cerro Nevado de Colima (USNM 33663/45698T#, 33665/45700); 1 mi N summit Nevado de Colima, 12,300 ft (UMMZ 94595#). **México:** Zoquiapan, 15 km SW Río Frío (UAMI 1223). **Morelos:** Cerro Cruz del Marquez, 2440 m (CNMA 440); Huitzilac, Lagunas de Zempoala (CNMA 1351#); Joya de Atexcapa, Zempoala, 3000 m (CNMA 1348–1349); Parque Lagunas de Zempoala, Atzampa, 2825 m (CNMA 15339). **Puebla:** Estación Experimental Tetela, 10 km W Tetela, 3600 m (UAMI 7959). **Tlaxcala:** 6 km S, 12 km W Huamantla, 3220 m (UAMI 6686).

ADDITIONAL SPECIMENS.—**Jalisco:** Volcán de Fuego, 13,000 ft (Allen 1906).

Sorex orizabae Merriam, 1895b—
Orizaba Shrew

Sorex orizabae Merriam, 1895b:71. Type locality "Falda oeste del Pico de Orizaba, 9,500 ft, Puebla," latitude 19.02°N, longitude 97.27°W.

Sorex vagrans orizabae: Jackson, 1928:113.

HOLOTYPE.—USNM 53633, ♀, adult, skin and posterior half of skull and mandibles.

ETYMOLOGY.—The specific name is derived from the type locality 'Pico de Orizaba', Puebla.

DIAGNOSIS.—*Sorex orizabae* can be distinguished from *S. macrodon* by i1 with pigment in 2 sections and a long strip of pigment present at anteromedial edge (Fig. 26), hairs on venter white tipped, tail bicolored, and overall smaller size: total length usually 92–108 mm, length of tail 33–43 mm, length of hind foot usually 12–14 mm, condylobasal length usually 16.29–17.29 mm, palatilar length 6.4–7.0 mm, length of U1–M3 5.9–7.0 mm, breadth of zygomatic plate usually 1.0–1.6 mm, maxillary breadth usually 4.6–5.3 mm, least interorbital breadth 3.0–3.8 mm, cranial breadth usually 7.68–8.58 mm, breadth across M2–M2 usually

4.1–4.8 mm, length of mandible usually 6.5–7.1 mm, length of c1–m3 usually 4.3–4.9 mm, height of coronoid process 3.3–3.8 mm, height of coronoid valley usually 1.7–1.9 mm, height of articular condyle usually 2.3–2.7 mm, and depth of mandible 0.9–1.1 mm. Further, *S. orizabae* differs from *S. oreopolus* by hairs on venter white tipped, i1 with 3 denticles (Fig. 24) and pigment in 2 sections, and length of mandible usually 6.5–7.1 mm; and from *S. ventralis* by I1 with median tine above pigment (Fig. 4), i1 with 3 denticles and deep interdenticular spaces (Fig. 24), hips and rump with medium or dark brown, clear-tipped guard hairs extending 1.75–2.5 mm beyond dorsal pelage, and hairs on venter white tipped. Also, *S. orizabae* can be distinguished from *S. saussurei* by hips and rump with medium or dark brown, clear-tipped guard hairs extending 1.75–2.5 mm beyond dorsal pelage, tail always bicolored, i1 with 3 denticles and deep interdenticular spaces (Fig. 24), and generally smaller size: condylobasal length usually 16.29–17.29 mm, palatilar length 6.4–7.0 mm, cranial breadth usually 7.68–8.58 mm, length of mandible usually 6.5–7.1 mm, length of c1–m3 usually 4.3–4.9 mm, and length of coronoid–posterior point of upper condylar facet usually 2.9–3.2 mm.

GENERAL CHARACTERISTICS.—*Sorex orizabae* has hairs on dorsum with a white band medially and long, dark brown tips giving an overall grizzled appearance to the dorsum; venter hairs are colored dark gray proximally with white tips. The skull is of intermediate size and U3 < U4 (Fig. 31).

DISTRIBUTION.—An endemic to Mexico, *S. orizabae* is known from portions of about a 42,000-km² area in Distrito Federal, México, Michoacán, Morelos, Puebla, Tlaxcala, and Veracruz (Fig. 62; Fa 1989).

ECOLOGY.—Throughout its distribution, the Orizaba shrew can be found only at high elevations in montane valleys (within the Canadian and Hudsonian zones of Goldman [1951]) bordering boreal pine forests with understories of the muhly bunchgrass and in talus slopes far above timberline (Ceballos González and Galindo Leal 1984, Álvarez-Castañeda 1996) or in understories of tall clumps of sacaton grass (prob. *Sporobolus wrightii*) in boreal pine-forests with nearby running water (Davis 1944, Davis and Russell 1954; specimen tag for TCWC 2760). No reproductive information was found in published literature.

Known mammalian associates include *Mephitis m. macroura*, *Microtus m. mexicanus*, *Neotomodon a. alstoni*, *Peromyscus maniculatus fulvus*, *P. m. labecula*, *P. melanotis*, *Reithrodontomys megalotis saturatus*, *Sorex saussurei*, *Tadarida mexicana*, and *Thomomys umbrinus peregrinus* (Davis and Russell 1953, 1954). Red-tailed hawks (*Buteo jamaicensis calurus*) are known to prey upon Orizaba shrews (Davis 1944).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:14), Barrera (1968:58, 60), Findley (1955a:52), Hall (1981:36), Hall and Dalquest (1963:204), Hall and Kelson (1959:33), Hennings and Hoffmann (1977:8, 32), Junge and Hoffmann (1981:43–44), Miller (1912:15), Miller and Rehn (1901:238), Poole and Schantz (1942:191), Ramírez-Pulido et al. (1983:18; 2000:157).

SPECIMENS EXAMINED ($n = 44$; 21 measured).—**Distrito Federal**: 7 km NW Ajusco, 3260 m (CB 5316). **México**: Cuesta del Carmen, 3 km N, 1 km W Lengua de Vaca, 2760 m (CB 24685); 86 km SE México City, N slope Mt. Popocatepetl, 13,500 ft (TCWC 2760#); 55 km ESE México City, Monte Río Frío, 10,500 ft (TCWC 2759#); Nevado de Toluca, 5 mi S Raicer (USNM 329422#); NE slope Nevado de Toluca, [19°08'N, 99°44'W], 13,700 ft (KU 62313#); 3 km S, 4 km W Río Frío, 3250 m (CB 2599, 4988); 1.5 km S, 5 km E San Rafael, 3000 m (CB 19226); 11 km N, 3 km W Tlmacas, 3860 m (CB 8723); Nevado de Toluca, 16 mi SSW Toluca (USNM 329400–329402, 329423); Salazar (USNM 50773–50774); 3 km SW Valle de Bravo, 2060 m (CB 24684); N slope Volcán Toluca (USNM 55897#–55898#, 55900#). **Michoacán**: Mt. Tancitaro (USNM 125885–125887); Nahuatzen (USNM 50764#, 50767#, 50770#); Patamban (USNM 125686#); 10 km S (by road) Pátzcuaro, 19°27'35"N, 101°36'27.3W, 2200 m (BYU 15994#–15995#). **Morelos**: 42 km S carretera a Cuernavaca (TTU 41101); Lagunas de Zempoala, 3000 m (CB 948); 5 km N Tres Cumbres, 10,200 ft (TCWC 4505#–4506#). **Puebla**: falda oeste del Pico de Orizaba, 9500 ft (USNM 53628, 53630, 53631#, 53632, 53633T#, 53634#). **Tlaxcala**: 10 km S Huamantla, ca. 2440 m (TTU 25341); Cerro de la Malinche, 0.3 mi S Micro-Ondas (TCWC 47486); Mt. Malinche (USNM 54438#–54439#). **Veracruz**: Cofre de Perote (USNM 54440#).

ADDITIONAL SPECIMENS.—**México**: N slope Mt. Popocatepetl, 13,500 ft (1 TCWC—Davis 1944).

Sorex ornatus— Ornate Shrew or Tule Shrew

ETYMOLOGY.—The specific name is derived from the Latin *ornatus* 'decorated or adorned'.

DIAGNOSIS.—Ornate shrews are among the smallest shrews in Mexico: condylobasal length 15.60–17.27 mm, maxillary breadth 4.5–5.1 mm, least interorbital breadth usually 3.0–3.6 mm, and length from upper articular condyle to posterior edge of m3 3.1–3.7 mm. Also, the I1 has a median tine within pigment (Fig. 7); U3 < U4 (Fig. 31); and i1 with 3 denticles, deep interdenticular spaces (Fig. 24), pigment in 1 section, and a long strip of pigment present at anteromedial edge (Fig. 26). *Sorex ornatus* has light brown dorsal pelage with either gray or red overtones and a venter pelage always lighter than that of the dorsum.

DISTRIBUTION.—*Sorex ornatus* is distributed in California and the Baja California Peninsula (Fig. 63; Hall 1981, Flores Villela and Gerez 1994).

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:54), Escalante et al. (2003:575), Maldonado et al. (2001:127–147), Villa-R. and Cervantes (2003:65, 77), Whitaker and Morales-Malacara (2005:652).

Sorex ornatus juncensis Nelson and Goldman, 1909

Sorex californicus juncensis Nelson and Goldman, 1909:27.

Type locality "Socorro, 15 mi S San Quintín, Lower California [Baja California], Mexico," latitude 31.07°N, longitude 115.68°W.

Sorex juncensis: Jackson, 1928:172.

Sorex ornatus juncensis: Junge and Hoffmann, 1981:34.

HOLOTYPE.—USNM 139594, ♀(?), young adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the Latin *juncus* 'made of rushes' in reference to the ecology of the type locality at the time the holotype was collected.

DIAGNOSIS.—*Sorex o. juncensis* can be distinguished from *S. o. lagunae* and *S. o. ornatus* by a light reddish brown dorsum, blond venter, a slightly bicolored tail, hips and rump with dark brown guard hairs extending 2 mm beyond dorsal pelage, and smaller size: condylobasal length 15.6 mm, cranial breadth 7.46 mm, length of unicuspid tooththrow 1.9–2.0 mm, and length of mandible 6.2–6.5 mm.

DISTRIBUTION.—An endemic to Mexico, *S. o. juncensis* is known only from 2 localities in Baja California (Fig. 63; Ramírez-Pulido and Britton 1981).

ECOLOGY.—*Sorex o. juncensis* is known only from the El Socorro marsh. No reproductive information or mammalian associates were found in published literature.

STATUS.—Officially, *S. o. juncensis* is listed as protected under *S. juncensis* (Norma Oficial Mexicana 2002). However, in the 1940s Huey (1964) and in 1991 Maldonado (1999) attempted to trap *S. o. juncensis* in the marsh, but were unsuccessful. Maldonado further noted that the marsh was essentially dry in 1991 and being impacted by housing construction. Thus, in all likelihood this subspecies is extinct.

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Ceballos and Navarro L. (1991:178), Escalante et al. (2003:575, 578), Junge and Hoffmann (1981:34), Owen and Hoffmann (1983:2), Poole and Schantz (1942:184), Ramírez-Pulido et al. (1983:16).

SPECIMENS EXAMINED ($n = 4$; 2 measured).—**Baja California:** San Quintín (FMNH 10843, 10845); Socorro (USNM 147400#); Socorro, 15 mi S San Quintín (USNM 139594T#).

Sorex ornatus lagunae
Nelson and Goldman, 1909

Sorex lagunae Nelson and Goldman, 1909:27. Type locality "La Laguna, Sierra Laguna, Lower California [= Baja California Sur], (5,500 ft)," latitude 23.09°N, longitude 109.61°W.

Sorex ornatus lagunae: Jackson, 1928:169.

HOLOTYPE.—USNM 147119, ♀, adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the type locality of 'La Laguna' from which the holotype was collected.

DIAGNOSIS.—*Sorex o. lagunae* can be distinguished from *S. o. juncensis* by a light grayish brown dorsum, pale brown venter; hairs on tail light grayish brown, hips and rump with black guard hairs extending 2 mm beyond dorsal pelage, condylobasal length 15.77–16.35 mm, cranial breadth 7.7–8.3 mm, length of unicuspid toothrow 1.9–2.1 mm, and length of mandible 6.7–7.2 mm; and from *S. o. ornatus* by a pale brown venter; hairs on tail light grayish brown, and hips and rump with black guard hairs extending 2 mm beyond dorsal pelage.

DISTRIBUTION.—An endemic to Mexico, *S. o. lagunae* is known only from 3 localities in Baja California Sur (Fig. 63).

ECOLOGY.—*Sorex o. lagunae* occurs in crevices along moss-covered rocky stream banks in montane valleys vegetated with a

mixed pine (*Pinus cembroides*)–oak (*Quercus devia*, *Q. tuberculata*) forest within the Upper Austral Zone (Goldman 1951).

A female collected in May 1991 had 5 "well-developed" embryos (Maldonado 1999:43). Known mammalian associates include *Neotoma lepida*, *Notiosorex crawfordi*, *Peromyscus eva*, and *P. truei* (Maldonado 1999).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Galina Tessaro et al. (1988:211), Huey (1964:91), Junge and Hoffmann (1981:34), Miller (1912:18; 1924:20, 24–25), Owen and Hoffmann (1983:2), Poole and Schantz (1942:187), Ramírez-Pulido et al. (1983:17), Woloszyn and Woloszyn (1982:44), Woloszyn et al. (1985:158).

SPECIMENS EXAMINED ($n = 13$; 12 measured).—**Baja California Sur:** La Laguna, Sierra de la Laguna, 5500 ft (USNM 147119T#); La Laguna, Sierra de La Laguna, 6200 ft (MVZ 109921); Todos Santos, Sierra de la Laguna, Laguna Chica (LACM 91000#–91010#).

Sorex ornatus ornatus
Merriam, 1895b

Sorex ornatus Merriam, 1895b:79. Type locality head "San Emigdio Canyon, Mt. Piños, 5,500 ft, Kern Co., California," latitude 34.98°N, longitude 119.18°W.

Sorex oreinus Elliot, 1903c:172. Type locality "Aguaje de las Fresas, Sierra San Pedro Mártir, Baja California, 6,000 ft."

Sorex orinus: Elliot, 1903b:228. Spelling corrected from Elliot (1903c).

Sorex orinomus: Elliot, 1907:472.

Sorex ornatus ornatus: Jackson, 1928:169.

HOLOTYPE.—USNM 31333/43198, ♂, adult, skin and skull with part of cranium missing.

ETYMOLOGY.—The subspecific name is derived from the Latin *ornatus* 'decorated or adorned'.

DIAGNOSIS.—*Sorex o. ornatus* can be distinguished from *S. o. juncensis* and *S. o. lagunae* by hairs on venter white tipped, a strongly bicolored tail, and hips and rump with light brown guard hairs with white tips extending 2 mm beyond dorsal pelage. Further, *S. o. ornatus* differs from *S. o. juncensis* by a light grayish-brown dorsum and overall larger size: condylobasal length 15.8–17.27 mm, maxillary breadth 4.6–5.1 mm, cranial breadth 7.9–8.5 mm, length of unicuspid toothrow 2.0–2.3 mm, breadth across M2–M2 4.2–4.6 mm, and length of mandible 6.6–7.4 mm.

DISTRIBUTION.—An endemic to Mexico, *S. o. ornatus* is known from Baja California north of 30°N latitude (Fig. 63).

ECOLOGY.—This subspecies occurs from sea level in coastal salt marshes, moist meadows, and along the waterline of streams and ponds to ca. 2080 m on the Sierra San Pedro Martir in riparian and palustrine ecosystems (Elliot 1903b, Huey 1964, Maldonado 1999). No reproductive information or mammalian associates were found in published literature.

STATUS.—*Sorex o. ornatus* is listed as a protected subspecies (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Banks (1967:224), Goldman (1951:385), Ramírez-Pulido et al. (1983:17).

SPECIMENS EXAMINED ($n = 35$; 19 measured).—MEXICO: **Baja California**: 2 mi W El Rosario, along the mouth of the El Rosario River (LACM 91031–91035); 1 mi E El Rosario, 200 ft (MVZ 50220); San Quintín (FMNH 10843#–10845#); San Ramón, mouth of Santo Domingo River (MVZ 35394#, 35395); San Telmo, 600 ft (MVZ 35396#–35405#, UMMZ 79586#–79587#); San Telmo marshes near ocean (UMMZ 79588); Sierra San Pedro Martir, La Cieneguita de Soto, 3 km W park entrance (LACM 91068); Sierra San Pedro Martir, park entrance, La Corona de Abajo, 6825 ft (LACM 91056–91058, 91059#–91060#, 91070–91073). UNITED STATES: **California**: Kern Co.: head San Emigdio Canyon (USNM 31333T#).

ADDITIONAL SPECIMENS.—**Baja California**: Aguaje de Las Fresas, San Pedro Martir Mts. ($n = 1$; Elliot 1903b).

Sorex saussurei
Merriam, 1892

Sorex saussurei Merriam, 1892:173. Type locality reported as Falda Norte Sierra Nevado de Colima, ca. 8000 ft, Jalisco; however, the Type specimen tag has "Sierra Nevado, Jalisco," latitude 19.55°N, longitude 103.63°W. *Sorex saussurei saussurei*: Miller, 1912:19 (in part).

HOLOTYPE.—USNM 33667/45702, ♀, adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Theodore de Saussure and H.B. de Saussure who wrote extensively on botany.

DIAGNOSIS.—*Sorex saussurei* can be distinguished from *S. mediopua* and *S. veraecrucis altoensis* by a large, well-pigmented median tine located well within the pigment on the body of the I1s (Fig. 7); from *S. milleri* and *S. oreopolus* by i1 with shallow interdenticular spaces (Fig. 25) and hips and rump with dark

brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage; from *S. monticolus* by palatilar length usually 7.2–8.2 mm, maxillary breadth 5.1–5.7 mm, and least interorbital breadth 3.6–4.2 mm; and from *S. orizabae* by i1 with 2 denticles, shallow interdenticular spaces (Fig. 25), and pigment in 1 section. Additionally, *S. saussurei* differs from *S. oreopolus* by hairs on venter blond- or white-tipped. Further, *S. saussurei* differs from *S. v. cristobalensis* by i1 with shallow interdenticular spaces (Fig. 25) and pigment in 1 section, hips and rump with dark brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage, and hairs on venter blond- or white-tipped; from *S. v. oaxacae* by i1s with shallow interdenticular spaces (Fig. 25), and hips and rump with dark brown guard hairs extending 1.0–1.5 mm beyond dorsal pelage; and from *S. v. veraecrucis* by length of tail 41–51 mm. Finally, it can be distinguished from *S. macrodon* by condylobasal length 17.46–18.64 mm; length of U1–M3 6.4–7.2 mm; cranial breadth 8.29–9.3 mm; I1 with median tine always within pigment (Fig. 7); i1 with 2 denticles, shallow interdenticular spaces (Fig. 25), and a long strip of pigment present at anteromedial edge (Fig. 26); length of c1–m3 5.0–5.4 mm; hairs on venter with blond or white tips; and hairs on tail uniform in color or slightly bicolored.

GENERAL CHARACTERISTICS.—*Sorex saussurei* has hairs on the dorsum with medium silvery gray band proximally, either a white or blond band medially, and dark brown tips giving an overall medium brown appearance. Venter hairs are medium silvery gray proximally with blond or white tips. The tail is slightly bicolored.

DISTRIBUTION.—*Sorex saussurei* occurs in Colima, Distrito Federal, Jalisco, México, Michoacán, Morelos, and Puebla from ca. 2100 m to ≥ 3650 m elevation (Fig. 48; Hall 1981).

ECOLOGY.—Generally, *S. saussurei* occurs at higher elevations in pine-oak-juniper woodlands, in yellow pine-alder woodlands, or in moist montane canyons with pine-oak or Douglas-fir-juniper woodlands with shrubby understories of *Bacheria* and *Senecio* in areas with a deep humus layer overlain with a layer of leaves or needles, but it also occurs in high elevation agricultural fields planted to oats or corn and in ". . . tall sacaton grasses in rocky situations near water" (Davis 1944:376, Hall and Villa-R. 1949, Villa-R. 1952, Davis and

Russell 1954, Cervantes et al. 1995, Álvarez and Sánchez-Casas 1997, Orduña Trejo et al. 1999–2000). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis parva soricina*, *Microtus mexicanus*, *Neotamias dorsalis*, *Neotomodon alstoni*, *Peromyscus difficilis*, *P. melanotis*, *Reithrodontomys megalotis*, *R. sumichrasti*, and *Sorex orizabae* (Davis and Russell 1954, Cervantes et al. 1995, Orduña Trejo et al. 1999–2000).

ADDITIONAL REFERENCES.—Álvarez (1963:396), Álvarez et al. (1997:13), Álvarez-Castañeda (1996:52), Armstrong (1996:276), Ayala-Barajas et al. (1988), Barrera (1953:204, 224; 1968:57–58, 64–66, 68, 91, 98), Bassols (1981:18), Basurto (1973), Ceballos González and Galindo Leal (1984:53–54), Díaz de León (1905:26), Diersing and Hoffmeister (1977:332), Escalante et al. (2003:575), Findley (1953:636), Goldman (1951:392, 398, 402), Goodwin (1969:38–39), Hall and Villa-R. (1950:165), Hoffmann (1951:99; 1952:91; 1990:72, 97, 168; 1993:20), Hooper (1946:394; 1947:43; 1955:7), Jackson (1925:128; 1928:156–157), Jiménez Almaraz et al. (1993:524), Jiménez Guzmán et al. (1997:133), Junge and Hoffmann (1981:44), Lyon and Osgood (1909:248), Mass et al. (1981:55), Merriam (1895b:83–84), Miller and Rehn (1901:241), Musser (1964:6), Poole and Schantz (1942:193), Prieto Bosch and Sánchez-Cordero (1993:459), Ramírez-Pulido (1969:265), Ramírez-Pulido et al. (1983:17), Rickart (1977:3), Schalldach (1966:288), Traub (1950:83), Villa-R. (1952:317; 1953:177), Villa-R. and Cervantes (2003:91, 94), Webb and Baker (1969:143), Whitaker and Morales-Malacara (2005:545, 548, 622–624, 626, 628–630, 643, 645), Whitaker et al. (1991:114).

REMARKS.—In July 2003, Cerro Nevado de Colima (= Volcán de Colima) erupted. It is unknown if specimens still could be found on its north slope at the type locality.

SPECIMENS EXAMINED ($n = 143$; 18 measured).—**Colima:** 7 mi NE La Cofradía [= Confradía de Suchitlán] (LACM 55078, 55082); Volcán de Fuego, 8800 ft (LACM 29061–29065, 29067–29068, 29070–29078, 29080–29082); Volcán de Fuego, 9000 ft (LACM 37706–37708, 37710, 37714–37715). **Distrito Federal:** Cañón de Contreras, 2600 m (UMMZ 88640#); Cañón de Contreras, 2900 m (UMMZ 91902#–91903#, 94586#); Parque Nacional “Desierto de los Leones,” 19°18′12″N, 99°18′24″W, 2870 m

(UAMI 13237, 13239–13244, 14614–14615, 14617–14618, 14620–14658); 0.85 km N, 3.5 km W Ecuamil, Cerro del Ajusco, 19°13′37″N, 99°15′37″W, 3180 m (UAMI 13246, 13248–13249, 14659–14682); El Zarco (CB 581); Pedregal, San Gerónimo, 2400 m (UMMZ 88639#); Portilla de Santa Rosa, 3100 m (UMMZ 88635#); San Bartholomé, 2500 m (UMMZ 88636#); San Mathens, Boca de la Loma, 2800 m (UMMZ 88638#); Santa Rosa, 2500 m (UMMZ 91606#). **Jalisco:** 12 mi S Ahuacapan, Sierra de Autlán (LACM 10857); Volcán Nevado (USNM 33667T#); Cerro Nevado de Colima (UMMZ 96275; USNM 33666/45701#); N slope Cerro Nevado de Colima (LACM 10862–10863); San Sebastián (USNM 88014#); Volcán de Fuego, 9800 ft (KU 107140#). **México:** 1 km E Calpulhuac [= San Mateo Calpulhuac], 2600 m (CB 22672–22673); Cerro Ayaqueue, Mpio. Juchitepec, km 33 carretera Xochiuiltco-Oaxtepec (UAMI 5681); 11 km N, 2.5 km W Coatepec de Harinas, 2870 m (CB 22647, 29013); Estación Experimental Forestal y de la Fauna “Ing. Luis Macías Arellano,” Sedue, Mpio. Villa de Allende, 2500 m (UAMI 10510–10511); Ixtapaluca (CB 2859); Río Frío, 3100 m (CB 36281); Zoquiapan, 15 km SW Río Frío (UAMI 803). **Michoacán:** 10 mi NW Hidalgo, Cerro San Andrés, 9400 ft (UMMZ 94587–94588); Nahuatzen (USNM 50768#); 5 mi S Pátzcuaro (UMMZ 93145); 9 km S Pátzcuaro on Hwy to Tacámbaro, 8000 ft (UMMZ 95702); Sierra Patamba, 9000 ft (KU 62309#). **Morelos:** 2 mi W Huitzilac, 10,000 ft (TCWC 4508); 45 km SW México City, 7800 ft (TCWC 2762#, 2764). **Puebla:** Huauchinango, [20°11′N, 98°03′N] (USNM 92722#); Río Otlati, 15 km NW San Martín, 8700 ft (TCWC 2761#).

Sorex sclateri Merriam, 1897—
Sclater’s Shrew

Sorex sclateri Merriam, 1897:228. Type locality “Tumbalá, 5,000 ft, Chiapas,” latitude 17.3°N, longitude 92.32°W. (*Sorex*) *Sclateri* Trouessart, 1898:1287.

HOLOTYPE.—USNM 75872, ♀, adult, skin and skull.

ETYMOLOGY.—The specific name is a patronymic honoring Dr. Philip Lutley Sclater secretary of the Zoölogical Society of London in 1897.

DIAGNOSIS.—*Sorex sclateri* can be distinguished from *S. s. cristobalensis*, *S. stizodon*, and *S. veraepacis* by hips and rump with black guard hairs extending 1.7–1.9 mm beyond

dorsal pelage. Further, *S. sclateri* differs from *S. s. cristobalensis* by i1 with 3 denticles and shallow interdenticular spaces (Fig. 25), and generally larger size: total length 120–126 mm, length of tail 52–53 mm, length of hind foot 15.5–16.0 mm, length of mandible 8.1–8.9 mm, length from upper articular condyle to posterior edge of m3 4.0–4.9 mm, and height of coronoid valley usually 2.2–2.5 mm. Additionally, it differs from *S. stizodon* by pelage of dorsum and venter uniformly dark brown, U3 $\geq$ U4 (Fig. 30), i1 with pigment in 2 sections and a long strip of pigment present at anteromedial edge (Fig. 26), length of mandible 8.1–8.9 mm, length of c1–m3 5.5–5.8 mm, and length from upper articular condyle to posterior edge of m3 4.0–4.9 mm. Also, it can be distinguished from *S. veraepacis* by pelage of dorsum and venter uniformly dark brown; U3 $\geq$ U4 (Fig. 30); i1 with shallow interdenticular spaces (Fig. 25), pigment in 2 sections, and a long strip of pigment present at anteromedial edge (Fig. 26); and larger size: length of tail 52–53 mm, cranial breadth 8.4–9.3 mm, length of mandible 8.1–8.9 mm, length of c1–m3 5.5–5.8 mm, length from upper articular condyle to posterior edge of m3 4.0–4.9 mm, height of coronoid valley usually 2.2–2.5 mm, height of articular condyle 2.8–3.1 mm, depth of mandible 1.1–1.2 mm, and length of coronoid–ventral point of lower condylar facet 3.8–4.2 mm.

GENERAL CHARACTERISTICS.—*Sorex sclateri* is among the largest *Sorex* in Mexico with a condylobasal length 18.45–19.95 mm. Median tine on I1 is above the pigment (Fig. 4). Sclater's shrews have hairs on tail uniformly dark brown.

DISTRIBUTION.—An endemic to Mexico, *S. sclateri* is known only from 2 localities in Chiapas (Fig. 63; Ramírez-Pulido and Britton 1981, Fa and Morales 1993, Flores Villela and Gerez 1994).

ECOLOGY.—The type locality is located within the ecosystem referred to as the Humid Upper Tropical Subzone by Goldman (1951) or Los Altos de Chiapas tropical montane cloud forest by Escalante et al. (2003) characterized by high elevation cloud-forest. Both localities from which specimens of *S. sclateri* have been collected are within the conifer and oak (*Quercus*) forest zone of Rzedowski (1986: fig. 179). No reproductive information or mammalian associates were found in published literature.

STATUS.—*Sorex sclateri* is listed as a protected species by the Mexican government (Norma Oficial Mexicana 2002) and as endangered by the IUCN/CITES (Ceballos et al. 2002b).

ADDITIONAL REFERENCES.—Álvarez del Toro (1952:229; 1977:20), Álvarez et al. (1984:13; 1997:14), Aranda and March (1987:143), Arita and Ceballos (1997:54), Ceballos and Navarro L. (1991:178), Junge and Hoffmann (1981:45), Lyon and Osgood (1909:248), Miller and Rehn (1901:241), Poole and Schantz (1942:194), Ramírez-Pulido et al. (1983:17), Villa-R. and Cervantes (2003:97), Whitaker and Morales-Malacara (2005:652).

SPECIMENS EXAMINED ($n = 5$; 5 measured).—**Chiapas:** San Antonio Buenavista (CB 2860#); Tumbala, 5000 ft (USNM 75871#, 75872T#, 75873#–75874#).

Sorex stizodon Merriam, 1895b—
San Cristóbal Shrew or
Pale-toothed Shrew

Sorex stizodon Merriam, 1895b:98. Type locality "San Cristóbal, 9,000 ft, Chiapas," latitude 16.75°N, longitude 92.63°W.

HOLOTYPE.—USNM 75885, ♀, adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Greek *stizo* 'to prick or puncture'.

DIAGNOSIS.—*Sorex stizodon* can be distinguished from *S. sclateri*, *S. v. cristobalensis*, and *S. veraepacis* by hips and rump with black guard hairs extending 1 mm beyond dorsal pelage and U3 < U4 (Fig. 30). Further, *S. stizodon* differs from *S. sclateri* by pelage of dorsum and venter uniformly reddish brown, i1 with pigment in 1 section and no long strip of pigment present at anteromedial edge (Fig. 27), and smaller size: length of mandible 7.3 mm, length of c1–m3 5.0 mm, and length from upper articular condyle to posterior edge of m3 3.7 mm. Additionally, it differs from *S. v. cristobalensis* by i1 with pigment in 1 section, shallow interdenticular spaces (Fig. 25), and no long strip of pigment present at anteromedial edge (Fig. 27); and generally shorter: total length 107 mm, length of tail 41 mm, palatilar length 7.1 mm, length of U1–M3 6.2 mm, length of mandible 7.3 mm, length of c1–m3 5.0 mm, length from upper articular condyle to posterior edge of m3 3.7 mm, and height of coronoid valley 2.3 mm; but also, generally a

wider skull: maxillary breadth 5.6 mm, least interorbital breadth 4.1 mm, and cranial breadth 8.8 mm. Also, it can be distinguished from *S. veraepacis* by i1 with shallow interdenticular spaces; pelage of dorsum, venter, and hairs on tail uniformly reddish brown; and generally smaller size: total length 107 mm, length of tail 41 mm, condylobasal length 17.4 mm, palatilar length 7.1 mm, length of U1–M3 6.2 mm, cranial breadth 8.8 mm, length of unicuspid toothrow 2.3 mm, breadth across M2–M2 4.7 mm, length of mandible 7.3 mm, and length of c1–m3 5.0 mm; and greater size for height of coronoid valley 2.3 mm and height of articular condyle 3.0 mm.

GENERAL CHARACTERISTICS.—The holotype of *S. stizodon* has a skull of intermediate size, I1 with median tine above pigment (Fig. 4), and i1 with 3 denticles (Fig. 24).

DISTRIBUTION.—An endemic to Mexico, *S. stizodon* is known only from the type locality and Reserva Ecológica Huitepec in Chiapas (Fig. 63; Ramírez-Pulido and Britton 1981, Fa and Morales 1993, Flores Villela and Gerez 1994, Naranjo and Espinoza Medinilla 2001).

ECOLOGY.—The type locality of *S. stizodon* is at high elevation in the Canadian Zone "... characterized by dominant stands of fir (*Abies religiosa*), Douglas fir (*Pseudotsuga mucronata*), pine (*Pinus ayacahuite*) . . ." with lesser numbers of other trees and shrubs (Goldman 1951:397, Álvarez de Toro 1977). *Sorex stizodon* occurs in oak-pine woodlands on the Reserva Ecológica Huitepec (Naranjo and Espinoza Medinilla 2001). No reproductive information or mammalian associates were found in published literature.

STATUS.—*Sorex stizodon* is listed as a protected species by the Mexican government (Norma Oficial Mexicana 2002) and as endangered by the IUCN/CITES (Ceballos et al. 2002b).

ADDITIONAL REFERENCES.—Álvarez de Toro (1952:229), Álvarez et al. (1997:14), Aranda and March (1987:143), Arita and Ceballos (1997:54), Ceballos and Navarro L. (1991:178), Escalante et al. (2003:570, 575), Junge and Hoffmann (1981:45), Lyon and Osgood (1909:249), Miller and Rehn (1901:241), Poole and Schantz (1942:194), Ramírez-Pulido et al. (1983:18), Villa-R. (1953:177), Villa-R. and Cervantes (2003:97), Whitaker and Morales-Malacara (2005:652).

SPECIMEN EXAMINED ($n = 1$; 1 measured).

—**Chiapas:** San Cristóbal, 9000 ft (USNM 75885T#).

ADDITIONAL SPECIMENS.—**Chiapas:** Reserva Ecológica Huitepec, Mpio. San Cristóbal de las Casas (Naranjo and Espinoza Medinilla 2001).

Sorex ventralis Merriam, 1895b—

Chestnut-bellied Shrew or

San Felipe Long-tailed Shrew

Sorex obscurus ventralis Merriam, 1895b:75. Type locality "Cerro San Felipe, [10000 ft.] Oaxaca," latitude 16.28°N, longitude 97.74°W.

Sorex ventralis: Elliot, 1903a:148.

Sorex oreopolus ventralis: Findley, 1955b:617.

HOLOTYPE.—USNM 68342, ♂, adult, skin and skull.

ETYMOLOGY.—The specific name is derived from the Latin *ventralis* 'of or belonging to the belly'.

DIAGNOSIS.—*Sorex ventralis* can be distinguished from *S. macrodon*, *S. oreopolus*, *S. orizabae*, *S. saussurei*, and *S. veraepacis* by hips and rump with dark brown guard hairs extending 0.75 mm beyond dorsal pelage and i1 with shallow interdenticular spaces (Fig. 25). Additionally, *S. ventralis* differs from *S. macrodon*, *S. oreopolus*, *S. orizabae*, and *S. veraepacis* by hairs of venter blond tipped. Further, *S. ventralis* can be distinguished from *S. macrodon* by i1 with long strip of pigment present at anteromedial edge (Fig. 26), tail bicolored, and generally smaller size: length of tail usually 37–46 mm, condylobasal length usually 16.5–18.23 mm, length of U1–M3 5.5–6.4 mm, least interorbital breadth 3.6–4.1 mm, cranial breadth usually 8.4–8.9 mm, length of mandible usually 6.9–7.4 mm, and length of c1–m3 usually 4.2–4.9 mm; from *S. oreopolus* by I1 with median tine within pigment (Fig. 7) and least interorbital breadth 3.6–4.1 mm; from *S. orizabae* by I1 with median tine within pigment (Fig. 7) and i1 with 2 denticles (Fig. 25); and from *S. saussurei* by I1 with median tine within pigment (Fig. 7), length of U1–M3 5.5–6.4 mm, length of c1–m3 usually 4.2–4.9 mm, and length of coronoid–posterior point of upper condylar facet usually 3.0–3.3 mm. Additionally, it differs from *S. veraepacis* by hairs on dorsum dark brown tipped, tail bicolored, i1 with 2 denticles (Fig. 25) and a long strip of pigment present at anteromedial edge

(Fig. 26), and generally smaller size: palatilar length 6.1–7.5 mm, length of U1–M3 5.5–6.4 mm, cranial breadth usually 8.4–8.9 mm, length of unicuspid toothrow 1.9–2.3 mm, length of c1–m3 usually 4.2–4.9 mm, and length of coronoid–posterior point of upper condylar facet usually 3.0–3.3 mm.

GENERAL CHARACTERISTICS.—*Sorex ventralis* has hairs on dorsum light red medially with dark brown tips. The tail is colored as for the body. *Sorex ventralis* has a skull of intermediate size (condylobasal length 16.5–18.23 mm) with U3 < U4 (Fig. 30), and i1 with pigment in 1 section.

DISTRIBUTION.—An endemic to Mexico, *S. ventralis* is known from portions of about a 39,600-km² area in Distrito Federal, México, Oaxaca, Puebla, and Tlaxcala (Fig. 63; Fa 1989, Fa and Morales 1993, Flores Villela and Gerez 1994).

ECOLOGY.—*Sorex ventralis* occurs in temperate montane regions of the Distrito Federal and Estado de México vegetated with pine, sacred fir, and oak forests, and in meadows neighboring the forests (Ceballos González and Galindo Leal 1984). In Oaxaca, it occurs at high elevations in the Canadian Zone (Goldman 1951) “. . . in the ecotone between a meadow and a wet, mature forest of oak, pine and fir” (Hooper 1961:120). No reproductive information was found in published literature. Known mammalian associates in Oaxaca include *Habromys lepturus*, *Peromyscus aztecus oaxacensis*, and *P. boylei* (Hooper 1961).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:13), Arita and Ceballos (1997:54), Briones-Salas and Sánchez-Cordero (2004:436), Diersing and Hoffmeister (1977:332), Elliot (1907:469), Escalante et al. (2003:575), Fa and Morales (1991:207), Findley (1955a:52), Goodwin (1969:39), Hennings and Hoffmann (1977:32), Jackson (1928:160–162), Junge and Hoffmann (1981:44–45), Lyon and Osgood (1909:251), Mass et al. (1981:56), Merriam (1895b:171), Miller (1912:16), Miller and Rehn (1901:238), Poole and Schantz (1942:190), Ramírez-Pulido et al. (1983:18), Villa-R. (1953:177), Villa-R. and Cervantes (2003:91, 94), Whitaker and Morales-Malacara (2005:652).

SPECIMENS EXAMINED ($n = 93$; 24 measured).—**Distrito Federal:** 1.6 km E, 800 m S Acopilco, 3000 m (CB 2389–2391); Cerro del Ajusco, Tlalpán, 3900 m (UAMI 16479–16481);

5 km S, 7 km W Contreras, 3300 m (CB 2344–2345); 0.85 km N, 3.5 km W Ecuani, Cerro del Ajusco, 19°13'37"N, 99°15'37"W, 3180 m (UAMI JPR3965, JPR3983); Parque Nacional “Desierto de Los Leones,” 19°18'12"N, 99°18'24"W, 2870 m (UAMI 14683#–14685#, UAMI JPR3979–JPR3980); 5 km SW Parres (CB 1490); Pedregal de San Ángel C.U. (CB 5229). **México:** 2.5 km N, 4 km E Cabeza Iztacihuatl, 3700 m (CB 2024–2025); 2.5 km N, 4.5 km E Cabeza Iztacihuatl, 3600 m (CB 2026); 2 km E Cahuacán, 2540 m (UAMI 2702); 3 mi W Río Frío, 10,400 ft (CAS 12241); W slope Volcán Nevado de Toluca, 12,200 ft (UMMZ 94596#); Zoquiapan, 15 km S Río Frío, 3110 m (UAMI 802#, 2703#). **Oaxaca:** near Cajones (USNM 68554, 68583#); Cerro San Felipe (USNM 68340–68341, 68342T#, 68343#, 68346, 68347#); Cuicatlan, Carr. Santa María Pápalo, Peña Verde, 17°50'49"N, 96°45'48"W, 2220 m (MZFC CAS283); 12 mi N Ixtlán de Juárez, Llano de las Flores, 9200 ft (UMMZ 109404#, 109405); 0.9 mi N Llano de las Flores (TCWC 45107#–45108#, 45109, 47487–47488); 1.5 mi N Llano de las Flores (TCWC 45110); 15 mi W Oaxaca (USNM 68351#–68352#, 68353–68354, 68355#, 68357, 68358#–68359#, 68360, 68362); Mts. near Ozolotepec (USNM 71461#, 71462, 71465#). **Puebla:** Honey, 1990 m (UMMZ 89756); Huauclhinango, [20°11'N, 98°03'N] (USNM 92723#–92724#); 3 km SE Paredón (CB 8039–8040); 10 km W San Martín Texmelucan, 3100 m (CNMA 26514–26528, 26542); 10 km W San Martín Texmelucan, 3900 m (CNMA 26540#); 10 km W San Martín Texmelucan, 3300 m (CNMA 13502, 26543); 10 km W San Martín Texmelucan, 3330 m (CNMA 26543); 10 km W San Martín Texmelucan, 3400 m (CNMA 26532, 26535–26538); 10 km W San Martín Texmelucan, 3900 m (CNMA 26529–26531, 26533–26534, 26539–26540). **Tlaxcala:** 3 km SE San Antonio Techalote, 2600 m (UAMI 3727#).

Sorex veraepacis—
Verapaz Shrew

ETYMOLOGY.—The specific name is derived from the Departamento de Verapaz, Guatemala, within which the holotype was collected.

DIAGNOSIS.—*Sorex veraepacis* differs from *S. ixtlanensis* by i1s with no long strip of pigment present at the anteromedial edge (Fig. 27) and generally smaller size of mandible:

length of coronoid–ventral point of lower condylar facet 3.3–3.7 mm, length of mandible usually 7.1–8.3 mm, length of c1–m3 4.9–5.6 mm, length from upper articular condyle to posterior edge of m3 3.5–4.0 mm, and height of articular condyle 2.3–2.9 mm. Further, it can be distinguished from *S. macrodon* by hairs on tail reddish blond with dark tips; from *S. saussurei* by dorsal pelage dark brown tipped and ventral pelage slightly paler than dorsum, cranial breadth 9.1–10.3 mm, and i1 with 3 denticles (Fig. 24) and no long strip of pigment present at anteromedial edge (Fig. 27). Additionally, it differs from *S. sclateri* by pelage of dorsum dark brown with a slightly paler venter; $U3 < U4$ (Fig. 31); i1 with deep interdenticular spaces (Fig. 24), pigment in 1 section, and no long strip of pigment present at anteromedial edge (Fig. 27); and smaller size: length of tail 46–51 mm, cranial breadth 9.25–9.71 mm, length of mandible usually 7.8–8.0 mm, length of c1–m3 5.4–5.5 mm, length from upper articular condyle to posterior edge of m3 3.7–4.0 mm, height of coronoid valley 1.9–2.0 mm, height of articular condyle 2.5–2.8 mm, depth of mandible 0.9–1.1 mm, and length of coronoid–ventral point of lower condylar facet usually 3.5–3.7 mm. Also, it differs from *S. stizodon* by hips and rump with dark brown guard hairs extending ≥ 1.0 mm beyond dorsal pelage, pelage of dorsum dark brown with a slightly paler venter and slightly bicolored tail, $U3 < U4$ (Fig. 31), i1 with deep interdenticular spaces (Fig. 24), and generally larger size: total length 117–125 mm, length of tail 46–51 mm, condylobasal length 18.4–18.8 mm, palatilar length 7.6–8.0 mm, length of U1–M3 6.9–7.2 mm, cranial breadth 9.25–9.71 mm, length of unicuspid tooththrow 2.5–2.8 mm, breadth across M2–M2 4.8–5.1 mm, length of mandible 7.8–8.0 mm, length of c1–m3 5.4–5.5 mm, and smaller size for height of coronoid valley 1.9–2.0 mm and height of articular condyle 2.5–2.8 mm. Further, it can be distinguished from *S. ventralis* by hairs of dorsum reddish blond medially with dark tips; pelage of venter light reddish brown; hairs on tail uniformly colored as for dorsum; i1 with 3 denticles, deep interdenticular spaces, and no long strip of pigment present at anteromedial edge (Fig. 27); and generally larger size: palatilar length usually 7.4–8.4 mm, length of U1–M3 usually 6.7–7.6 mm, cranial breadth usually 9.1–10.3

mm, length of unicuspid tooththrow 2.3–2.8 mm, length of c1–m3 usually 4.9–5.9 mm, and length of coronoid–posterior point of upper condylar facet usually 3.3–4.0 mm.

GENERAL CHARACTERISTICS.—*Sorex veraepacis* is a medium-sized shrew with placement of median tine relative to pigment on body of I1 variable (Figs. 4, 7) and i1 with number of sections of pigment variable. Pelage color ranges from a generally dark brown dorsum with a slightly paler venter to a reddish dark brown dorsum with a light reddish brown venter.

DISTRIBUTION.—*Sorex veraepacis* occurs from Guerrero, through Oaxaca, into Chiapas from ca. 1218 to 2900 m elevation (Fig. 48; Flores Vilella and Gerez 1994).

ECOLOGY.—As of 2005, only 75.84% of habitat considered suitable for *S. veraepacis* habitation (i.e., habitat unmodified for agriculture or urban development) still existed (Sánchez-Cordero et al. 2005). No reproductive information or mammalian associates were found in published literature.

ADDITIONAL REFERENCES.—Arita and Ceballos (1997:54), Escalante et al. (2003:575), Whitaker and Morales-Malacara (2005:548, 641, 645).

Sorex veraepacis chiapensis

Jackson, 1925

Sorex veraepacis chiapensis Jackson, 1925:129. Type locality "San Cristóbal, 9500 ft, Chiapas," latitude 16.75°N, longitude 92.63°W.

HOLOTYPE.—USNM 75877, ♀, adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the state of Chiapas from which the holotype was collected.

DIAGNOSIS.—*Sorex v. chiapensis* can be distinguished from *S. v. mutabilis* by median tine located above the pigment on the I1 (Fig. 4), i1 with pigment in 1 section, pelage of dorsum overall dark brown, pelage of venter slightly paler, a slightly bicolored tail, hips and rump with dark brown guard hairs extending 1.0–1.3 mm beyond the dorsal pelage, and breadth across M2–M2 4.8–5.1 mm.

GENERAL CHARACTERISTICS.—*Sorex v. chiapensis* has hairs on dorsum with medium silvery gray for the proximal two-thirds, blond for the medial one-sixth, and dark brown for the distal one-sixth giving an overall dark brown appearance. Hairs on venter are medium silvery gray for the proximal two-thirds and

medium-dark brown for the distal one-third resulting in the venter being only slightly paler than the dorsum in overall appearance.

DISTRIBUTION.—An endemic to Mexico, *Sorex v. chiapensis* is known only from Chiapas (Fig. 48).

ECOLOGY.—*Sorex v. chiapensis* occurs at high elevation in the Canadian Zone "... characterized by dominant stands of fir (*Abies religiosa*), Douglas fir (*Pseudotsuga mucronata*), [and] pine (*Pinus ayacahuite*) . . ." with lesser numbers of other trees, shrubs, *Salvia*, and grasses (UMMZ 93740; Goldman 1951:397). In the Reserva Ecológica El Triunfo (2000 m) *S. v. chiapensis* occurs in montane cloud forests dominated by *Cedrela mexicana*, *Matudaea trinervia*, and *Quercus* sp. (including *Q. crispifolia*—Medellín 1988). No reproductive information was found in published literature.

Known mammalian associates include *Cryptotis goodwini*, *Heteromys desmarestianus goldmani*, *Nyctomys sumichrasti*, *Peromyscus aztecus oaxacensis*, *P. guatemalensis*, *Reithrodontomys megalotis*, *R. mexicanus*, and *Sorex veraecrucis cristobalensis* (Medellín 1988, Espinoza Medinilla et al. 1998). *Sorex v. chiapensis* is known to be preyed upon by false vampire bat (*Chrotopterus auritus*; Medellín 1988).

STATUS.—*Sorex v. chiapensis* is listed as a protected subspecies (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez del Toro (1977:20), Álvarez et al. (1997:14), Aranda and March (1987:143), Poole and Schantz (1942:197), Ramírez-Pulido et al. (1983:18), Villa-R. (1953:177), Villa-R. and Cervantes (2003:97).

SPECIMENS EXAMINED ($n = 14$; 9 measured).—**Chiapas:** "El Triunfo," 7 km SSW Finca "La Prusia" (CNMA 19114#); "El Triunfo," 10 km SSE Finca "La Prusia," ca. 1900 m (LACM 74153–74154); Mpio. Jitotol, 10 km NNW Jitotol, 1690 m (CNMA 24624#); Pinabete (USNM 77685); San Cristóbal, 9500 ft (UMMZ 93740#; USNM 75876, 75877T#, 75878#–75880#, 75881, 75882#, 75884#).

Sorex veraepacis mutabilis
Merriam, 1895b

Sorex saussurei caudatus Merriam, 1895b:84. Type locality "Los Reyes (Cerca de Cuicatlán), 10,200 ft, Oaxaca," latitude 17.22°N, longitude 96.83°W.

Sorex saussurei mutabilis: Merriam, 1898:782. Name change from *S. s. caudatus*.

Sorex veraepacis mutabilis: Jackson, 1925:130.

HOLOTYPE.—USNM 69600, ♀, young adult, skin and skull.

ETYMOLOGY.—The subspecific name is derived from the Latin *mutabilis* 'changeable'.

DIAGNOSIS.—*Sorex v. mutabilis* can be distinguished from *S. v. chiapensis* by median tine well within pigment on I1 (Fig. 7), i1 with pigment in 3 sections, hairs on dorsum reddish blond medially with dark brown tips, hairs on venter light reddish brown, hairs on tail uniform in color of dorsum, hips and rump with pale reddish brown and dark brown guard hairs extend 2.2–2.8 mm beyond dorsal pelage, and breadth between M2–M2 usually 4.5–4.8 mm.

GENERAL CHARACTERISTICS.—*Sorex v. mutabilis* has hairs on dorsum reddish blond medially with dark brown tips, hairs on venter light reddish brown, and tail uniform in color of dorsum.

DISTRIBUTION.—An endemic to Mexico, *S. v. mutabilis* is known from Guerrero and Oaxaca (Fig. 48).

ECOLOGY.—*Sorex v. mutabilis* occurs at high elevations in the Canadian Zone (Goldman 1951) in shady areas of either pine-fir or pine-oak forests with a deep layer of humus overlain with a deep layer of leaves (Davis and Lukens 1958, Musser 1964). No reproductive information was found in published literature.

Known mammalian associates in Oaxaca include *Cryptotis goldmani machetes*, *C. magna*, *C. m. mexicana*, *C. phillipsi*, *Heteromys lepturus*, *Microtus mexicanus*, *M. oaxacensis*, *Oryzomys alfaroi*, *O. caudatus*, *Peromyscus boylii*, *P. chinanteco*, *P. lepturus*, *P. melanocarpus*, *P. mexicanus*, *P. thomasi cryophilus*, *Reithrodontomys mexicanus*, *R. microdon albilabris*, and *Sorex veraecrucis oaxacae* (Musser 1964, Schaldach 1966, Jones and Genoways 1967, Robertson and Rickart 1975, Rickart 1977).

STATUS.—*Sorex v. mutabilis* is listed as a protected subspecies (Norma Oficial Mexicana 2002).

ADDITIONAL REFERENCES.—Álvarez et al. (1997:14), Briones-Salas and Sánchez-Cordero (2004:436), Goodwin (1969:34), Jackson (1928:151–152, 157), Jiménez Almaraz et al. (1993:524), Junge and Hoffmann (1981:43–45), León P. and Romo V. (1991:17), Lyon and Osgood (1909:242), Miller and Rehn (1901:241), Ponce-Ulloa and Llorente Bousquets (1993:33), Poole and Schantz (1942:193), Ramírez-Pulido et al. (1983:18), Villa-R. (1953:177), Villa-R. and Cervantes (2003:94).

SPECIMENS EXAMINED ($n = 25$; 12 measured).—**Guerrero**: 3 mi NW Omiltemi, 2300 m (USNM 329421#). **Oaxaca**: Cerro San Felipe (USNM 68344#, 68348, 68349#–68350#); 5 km N, 1 km W Huautla, 18°10'07"N, 96°50'33"W, 1120 m (UAMI 13251#); Mt. Zempoaltepec (USNM 68339#, 68562#, 68564#, 68567#, 68568–68569, 65871–65874); Mts. near Ozolotepec (USNM 71463–71464, 71466); Reyes (USNM 69594, 69596, 69597#–69598#, 69600T#, 69602).

SPECIMENS EXAMINED THAT COULD NOT BE IDENTIFIED as either *S. v. mutabilis* or *S. ixtlanensis* ($n = 32$; 6 measured).—**Guerrero**: Agua Fría, 22 km SW Yextla, 2600 m (CB 382); Cañada "La Perra," Omiltemi, Mpio. Chilpancingo (MZFC 3487); El Iris, Mpio. Tlacotepec, 2300 m (MZFC 3494–3495); La Golondrina* (MZFC 3493); Omiltemi (CB 624; CNMA 29472–29475; MZFC 3488, 3490–3492; USNM 127505); 700 m W Omiltemi (MZFC 3489); 0.5 km WNW Omiltemi, Mpio. Chilpancingo, 2216 m (CNMA 40202–40204); 8 mi W Omiltemi, 8200 ft (MVZ 113488). **Oaxaca**: La Esperanza, 1430 m (UAMI 10151#); 5 km S, 3 km W La Esperanza, 17°35'38"N, 96°24'19"W, 1950 m (UAMI 13250#); Río Molino (CNMA 8442–8443); Totontepec (USNM 65876#, 65877, 65878#–65880#, 65881–65882). **Veracruz**: Teocelo, 1218 m (CNMA 920).

CONCLUSIONS

Morphometric and morphologic characters applied herein to 3398 specimens of soricids enabled me to distinguish 44 taxa (included in 30 monotypic and 5 polytypic species) as occurring in Mexico. Of these, 2 new species were named; 2 subspecies were heretofore unrecognized, 3 were reclassified, and 1 was elevated to species level. Based on the recorded characters it was possible to devise a key for the identification of all 44 taxa. Of these taxa, 70.45% ($n = 31$) are endemic and 43.18% ($n = 19$) have most of their distributions within the zone between the Transvolcanic Belt and the Isthmus de Tehuantepec (Fa 1989, Fa and Morales 1993, Ceballos et al. 2002a). Another 15.91% ($n = 7$) are restricted to south of the Isthmus de Tehuantepec in Nuclear Central America. The basis for the high level of species richness (56.82%, $n = 25$) for the southern one-third of Mexico, from the Transvolcanic Belt southward, is related to the

complex geologic (Ferrusquía-Villafrance 1993) and zoogeographic history of the region with its accompanying complex climatic and floristic associations (Wetmore 1943, Toledo 1982, Campbell 1999). Within the northern two-thirds of Mexico, a region of comparatively simple geologic and zoogeographic history, only 34.09% ($n = 15$) of Mexico's soricids occur with only 29.55% ($n = 13$) having their distributions restricted to north of the Transvolcanic Belt. Furthermore, 27.27% ($n = 12$) of the soricid taxa of Mexico should be considered micro-endemics; e.g., they are known only from an extremely restricted habitat type, high elevations, or the type locality.

Although for many taxa little is known regarding their natural history (e.g., ecology, reproduction, mammalian associates, and predators), some habitat relationships are evident from data associated with specimens in systematics collections. Some taxa evidently require specific habitat components; e.g., all specimens examined of *C. peregrina* were collected in wet meadows within cloud forest and *S. ixtlanensis* was collected only in deep humus under forests containing pines. Others, such as *C. alticola*, have less strict requirements in that all specimens were collected in high-elevation temperate forests containing some pines. Finally, still others, such as *C. parva berlandieri* and *S. veraecrucis*, seemingly can occupy almost any habitat type.

The high level of restricted distributions and the specific habitat requirements of many soricid taxa within Mexico, coupled with potential anthropogenic effects on climate and habitats, suggest that continued existence of these taxa may be precarious (Dirzo and Garcia 1992, Sánchez-Cordero et al. 2005). Future research should include a comparison of environmental characteristics (e.g., elevation, vegetation, climate, and geology) at localities where specimens of the various taxa of soricids were collected with those of unsampled areas to ascertain sites for further examination. This information will delimit areas of highest probability for finding taxa, herein considered to be endemic or microendemic, beyond their presently known ranges (Peterson et al. 2000, 2002). Such also will provide governmental agencies with necessary information to decide which taxa should be afforded some level of protection and the level of protection required (Peterson et al.

1993, 2002, Sánchez-Cordero 2001, Briones-Salas and Sánchez-Cordero 2004, Ortega-Huerta and Peterson 2004).

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LITERATURE CITED

- ALEXANDER, L.F. 1996. A morphometric analysis of geographic variation within *Sorex monticolus* (Insectivora: Soricidae). University of Kansas Natural History Museum, Miscellaneous Publication 88:1–54.
- ALLEN, J.A. 1906. Mammals from the states of Sinaloa and Jalisco, Mexico, collected by J.H. Batty during 1904 and 1905. *Bulletin of the American Museum of Natural History* 22:191–262.
- ALSTON, E.R. 1879–1882. *Biologia Centrali-Americana. Mammalia*. Taylor and Francis, Red Lion Court, Fleet Street 1:1–220.
- ALVARADO, R. 1915. Sinonimia vulgar y científica de los mamíferos mexicanos. *Boletín Dirección de Estudios Biológicos* 1:11–41.
- ÁLVAREZ, T. 1963. The recent mammals of Tamaulipas, Mexico. University of Kansas Publications, Museum of Natural History 14:363–473.
- ÁLVAREZ, T., S.T. ÁLVAREZ-CASTAÑEDA, AND M. GONZÁLEZ-ESCAMILLA. 1997. Localidades típicas de mamíferos terrestres en México. Centro de Investigaciones Biológicas del Noroeste, S. C. y Escuela Nacional de Ciencias Biológicas.
- ÁLVAREZ, T., P. DOMÍNGUEZ, AND J. ARROYO-C. 1984. Mamíferos de la Angostura, región central de Chiapas.

- Instituto Nacional de Antropología e Historia, Departamento de Prehistoria, Cuaderno de Trabajo 24:1-89.
- ÁLVAREZ, T., AND N. GONZÁLEZ-RUIZ. 2001. Nuevos registros de *Notiosorex crawfordi* (Insectivora: Soricidae) para México. *Acta Zoológica Mexicana*, nueva serie 84:175-177.
- ÁLVAREZ, T., AND F. DE LACHIA. 1991. Zoogeografía de los vertebrados de México. *Sistemas Técnicos de Edición*, S.A. de C.V. Tlalpan, México.
- ÁLVAREZ, T., AND A. MARTÍNEZ GUERRERO. 1967. New records of *Cryptotis mayensis* from the Yucatan Peninsula, Mexico. *Southwestern Naturalist* 12:204-205.
- ÁLVAREZ, T., AND O. POLACO. 1984. Estudio de los mamíferos capturados en la Michilia, Durango, México. *Anales de la Escuela Nacional de Ciencias Biológicas, México* 28:99-148.
- ÁLVAREZ, T., AND N. SÁNCHEZ-CASAS. 1997. Contribución al conocimiento de los mamíferos, excepto Chiroptera y Rodentia, de Michoacán, México. *Anales de la Escuela Nacional de Ciencias Biológicas, México* 42:47-74.
- ÁLVAREZ-CASTAÑEDA, S.T. 1996. Los mamíferos del Estado de Morelos. *Centro de Investigaciones Biológicas del Noreste, S.C.*
- ÁLVAREZ-CASTAÑEDA, S.T., C.A. SALINAS-ZAVALA, AND R. DE LACHICA. 1995. Analysis biogeográfico del noreste de México con énfasis en la variación climática y mastozoológica. *Acta Anales de la Escuela Nacional Mexicana*, nueva serie 66:59-86.
- ÁLVAREZ DEL TORO, M. 1952. Los animales silvestres de Chiapas. *Ediciones del Gobierno del Estado. Tuxtla Gutiérrez, Chiapas, México.*
- . 1977. Los mamíferos de Chiapas. *Universidad Autónoma de Chiapas, Tuxtla Gutiérrez, Chiapas, México.*
- ANDERSON, S. 1972. Mammals of Chihuahua, taxonomy and distribution. *Bulletin of the American Museum of Natural History* 148:149-410.
- ANDERSON, S., AND C.A. LONG. 1961. Small mammals in pellets of barn owls from Miñaca, Chihuahua. *American Museum Novitates* 2052:1-4.
- ANDERSON, S., AND P.W. OGILVIE. 1957. Vertebrates found in owl-pellets from northeastern Chihuahua. *Southwestern Naturalist* 2:33-37.
- ARANDA, M., N. LÓPEZ-RIVERA, AND L. LÓPEZ DE BUEN. 1995. Hábitos alimentarios del coyote (*Canis latrans*) en la Sierra del Ajusco, México. *Acta Zoológica Mexicana*, nueva serie 65:89-99.
- ARANDA, M., AND I. MARCH. 1987. Guía de los mamíferos silvestres de Chiapas. *Instituto Nacional de Investigaciones Sobre Recursos Bioticos, Programa para Estudios en Conservación Tropical, Universidad de Florida.*
- ARITA, H.T., AND G. CEBALLOS. 1997. Los mamíferos de México: distribución y estado de conservación. *Revista Mexicana de Mastozoolología* 2:33-71.
- ARMSTRONG, D.M. 1996. Northern limits of mammals of the northern interior Mexico. Pages 261-283 in H.H. Genoways and R.J. Baker, editors, *Contributions in mammalogy: a memorial volume honoring Dr. J. Knox Jones, Jr.* Museum of Texas Tech University, Lubbock.
- ARMSTRONG, D.M., AND J.K. JONES, JR. 1971. Mammals from the Mexican state of Sinaloa. I. Marsupialia, Insectivora, Edentata, Lagomorpha. *Journal of Mammalogy* 52:747-757.
- . 1972a. *Megasorex gigas*. *Mammalian Species* 16:1-2.
- . 1972b. *Notiosorex crawfordi*. *Mammalian Species* 17:1-5.
- AYALA-BARAJAS, R., J.C. MORALES-MUNCIÑO, N. WILSON, J.E. LLORENTE-BOUSQUETS, AND H.E. PONCE-ULLOA. 1988. Catálogo de las Pulgas (Insecta; Siphonaptera) en el Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México 1: Colección Alfredo Barrera. *Serie Catálogos del Museo de Zoología "Alfonso L. Herrera"* Catálogo no. 1:1-102.
- BAIRD, S.F. 1857. Mammals. In: *Reports of explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean*. Beverly Tucker, printer, Washington, DC. 8(1):1-757 + 43 plates.
- BAKER, C.L. 1971. Geologic reconnaissance of the eastern Cordillera of Mexico. *Geological Society of America Special Paper* 131:1-83 + 18 plates + 1 map.
- BAKER, R.H. 1953. Mammals from owl pellets taken on Coahuila, Mexico. *Kansas Academy of Science* 56:253-254.
- . 1956. *Mammals of Coahuila, Mexico*. University of Kansas Publication, Museum of Natural History 9:125-335.
- . 1962. Additional records of *Notiosorex crawfordi* from Mexico. *Journal of Mammalogy* 47:344-345.
- . 1966. Further notes on the mammals of Durango, Mexico. *Journal of Mammalogy* 47:344-345.
- BAKER, R.H., AND A.A. ALCORN. 1953. Shrews from Michoacan, Mexico, found in barn owl pellets. *Journal of Mammalogy* 34:116.
- BAKER, R.H., AND J.K. GREER. 1962. Mammals of the Mexican state of Durango. *Publications of the Museum of Michigan State University, Biology Series* 2:29-154.
- BAKER, R.J., M.B. O'NEILL, AND L.R. MCALILEY. 2003. A new species of desert shrew, *Notiosorex*, based on nuclear and mitochondrial sequence data. *Occasional Papers, Museum of Texas Tech University* 222:1-12.
- BANKS, R.C. 1967. Birds and mammals of La Laguna, Baja California. *Transactions of the San Diego Society of Natural History* 14:205-232.
- BARRERA, A. 1953. Sinopsis de los sifonápteros de la Cuenca de México (Ins., Siph.). *Anales de la Escuela Nacional de Ciencias Biológicas, México* 7:155-245.
- . 1958. Insectos parásitos de mamíferos salvajes de Omiltemi, Gro., y descripción de un nuevo sifonáptero: *Pleochaetis soberoni* nov. sp. *Anales de la Escuela Nacional de Ciencias Biológicas, México* 9:89-96.
- . 1962. La Península de Yucatán como provincia biótica. *Revista de la Sociedad Mexicana de Historia Natural* 23:71-105.
- . 1968. Distribución cliserial de los Siphonaptera del Volcán Popocatepetl, su interpretación biogeográfica. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Seria Zoología* 39:35-100.
- BASSOLS, DE B.E. 1981. Catálogo de los ácaros Mesostigmata de mamíferos de México. *Anales de la Escuela Nacional de Ciencias Biológicas, México* 24:9-49.
- BASURTO, L.A. 1973. Contribución al estudio de los Mióbidos de México (Acarina, Myobiidae). *Ciencia* 28:99-105.
- BINFORD, L.C. 1989. A distributional survey of the birds of the Mexican state of Oaxaca. *Ornithological Monographs* 43:1-418.
- BOOTH, E.G. 1957. Mammals collected in Mexico from 1951 to 1956 by the Walla Walla College Museum of

- Natural History. Walla Walla College Publications, Department of Biological Sciences and Biological Station 20:1–19.
- BRADSHAW, G. VAN R., AND B.J. HAYWARD. 1960. Mammal skulls recovered from owl pellets in Sonora, Mexico. *Journal of Mammalogy* 41:282–283.
- BRENNAN, J.M. 1960. Eight new species of *Pseudoschoengastia* from Mexico and Panama with a revised key to the species (Acarina, Trombiculidae). *Acarologia* 2:480–492.
- BRENNAN, J.M., AND M.L. GOFF. 1977. The neotropical genus *Hoffmannina*: four new species and other records from Mexico, Panama and Venezuela (Acarina: Trombiculidae). *Journal of Parasitology* 63:908–914.
- BRIONES-SALAS, M., AND V. SÁNCHEZ-CORDERO. 2004. Mamíferos. Pages 423–447 in A.J. García-Mendoza, M.J. Ordoñez, and M. Briones-Salas, editors, Biodiversidad de Oaxaca. Instituto de Biología, UNAM-Fondo Oaxaqueño para la Conservación de la Naturaleza–World Wildlife Fund, México.
- BURT, W.H., AND R.A. STIRTON. 1961. The mammals of El Salvador. Miscellaneous Publications. Museum of Zoology, University of Michigan 117:1–69.
- BUTLER, P.M., R.S. THORPE, AND M. GREENWOOD. 1989. Interspecific relations of African crocidurine shrews (Mammalia: Soricidae) based on multivariate analysis of mandibular data. *Zoological Journal of the Linnean Society* 96:373–412.
- CAIRE, W. 1997. Annotated checklist of the Recent land mammals of Sonora, Mexico. Pages 69–80 in T.L. Yates, W.L. Gannon, and D.E. Wilson, editors, Life among the muses: papers in honor of James S. Findley. Museum of Southwestern Biology, University of New Mexico, Albuquerque.
- CAIRE, W., J.E. VAUGHAN, AND V.E. DIERSING. 1978. First records of *Sorex arizonae* (Insectivora: Soricidae) from México. *Southwestern Naturalist* 23:532–533.
- CAMPBELL, J.A. 1999. Distribution patterns of amphibians in Middle America. Pages 111–210 in W.E. Duellman, editor, Patterns of distribution of amphibians: a global perspective. Johns Hopkins University Press, Baltimore, MD.
- CARLETON, M.D., O. SÁNCHEZ, AND G. URBANO. 2002. A new species of *Habromys* (Muroidea: Neotominae) from México, with generic review of species definitions and remarks on diversity patterns among Mesoamerican small mammals restricted to humid montane forests. *Proceedings of the Biological Society of Washington* 115:488–533.
- CARRAWAY, L.N. 1987. Analysis of characters for distinguishing *Sorex trowbridgii* from sympatric *S. vagrans*. *Murrelet* 68:29–30.
- . 1995. A key to Recent Soricidae of the western United States and Canada based primarily on dentaries. *Occasional Papers of the Natural History Museum, University of Kansas* 175:1–49.
- . 2005. Comparative osteology of the glenoid fossa and condyloid process in North American Soricinae shrews (Soricomorpha: Soricidae). Pages 75–83 in V. Sánchez-Cordero and R.A. Medellín, editors, Contribuciones Mastozoológicas en Homenaje a Bernardo Villa. Instituto de Biología e Instituto de Ecología, Universidad Nacional Autónoma de México, México City, México.
- CARRAWAY, L.N., AND R.M. TIMM. 2000. Revision of the extant taxa of the genus *Notiosorex* (Mammalia: Insectivora: Soricidae). *Proceedings of the Biological Society of Washington* 113:302–318.
- CEBALLOS, G., J. ARROYO-CABRALES, AND R.A. MEDELLÍN. 2002a. Mamíferos de México. Pages 377–413 in G. Ceballos and J.A. Simonetti, editors, Diversidad y conservación de los mamíferos neotropicales. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad e Instituto de Ecología Universidad Nacional Autónoma de México.
- . 2002b. The mammals of México: composition, distribution, and conservation status. *Occasional Papers, Museum of Texas Tech University* 218:1–27.
- CEBALLOS, G., AND D. NAVARRO L. 1991. Diversity and conservation of Mexican mammals. Pages 167–198 in M.A. Mares and D.J. Schmidly, editors, Latin American mammalogy: history, biodiversity, and conservation. University of Oklahoma Press, Norman.
- CEBALLOS GONZÁLEZ, G., AND C. GALINDO LEAL. 1984. Mamíferos silvestres de la Cuenca de México. Instituto de Ecología y Museo de Historia Natural de la Ciudad de México, Editorial Limusa, México, D.F.
- CERVANTES, F.A. 1991. Contribuciones mastozoológicas en Homenaje al Dr. Bernardo Villa Ramírez. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Anales de la Escuela Nacional* 62:151–382.
- CERVANTES, F.A., G. MATAMOROS, AND I. MARTÍNEZ MATEOS. 1995. Mamíferos silvestres de la Unidad de Evaluación y Monitoreo de la Biodiversidad “Ing. Luis Macías Arellano,” San Cayetano, Estado de México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Anales de la Escuela Nacional* 66:233–239.
- CHÁVEZ, C., AND G. CEBALLOS. 1998. Diversidad y estado de conservación de los mamíferos del Estado de México. *Revista Mexicana de Mastozología* 3:113–134.
- CHOATE, J.R. 1969. Taxonomic status of the shrew, *Notiosorex (Xenosorex) phillipsii* Schaldach, 1966 (Mammalia: Insectivora). *Proceedings of the Biological Society of Washington* 82:469–476.
- . 1970. Systematics and zoogeography of Middle American shrews of the genus *Cryptotis*. University of Kansas Publications, Museum of Natural History 19:195–317.
- . 1973. *Cryptotis mexicana*. *Mammalian Species* 28:1–3.
- CLARK, W.H., AND E. YENSEN. 1983. Nuevo registro de la musaraña desertícola *Notiosorex crawfordi* (Coues), del desierto central de Baja California, México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 53:439–441.
- COATES-ESTRADA, R., AND A. ESTRADA. 1986. Manual de identificación de Campo de los Mamíferos de la Estación de Biología “Los Tuxtlas.” Instituto de Biología, Universidad Nacional Autónoma de México.
- COCKRUM, E.L., AND G. VAN R. BRADSHAW. 1963. Notes on mammals from Sonora, Mexico. *American Museum Novitates* 2138:1–9.
- CONWAY, M.C., AND C.G. SCHMITT. 1978. Record of the Arizona shrew (*Sorex arizonae*) from New Mexico. *Journal of Mammalogy* 59:631.
- COOK, J.A., A.L. BIDLACK, C.J. CONROY, J.R. DEMBOSKI, M.A. FLEMING, A.M. RUNCK, K.D. STONE, AND S.O. MACDONALD. 2001. A phylogeographic perspective on endemism in the Alexander Archipelago of southeast Alaska. *Biological Conservation* 97:215–227.

- COUES, E. 1877. Precursory notes on American insectivorous mammals, with descriptions of new species. Bulletin of the United States Geologic and Geographical Survey of the Territories 3:631–653.
- DALBY, P.L., AND R.H. BAKER. 1967. Crawford's desert shrew first reported from Nuevo Leon. Southwestern Naturalist 12:195–196.
- DALQUEST, W.W. 1953. Mammals of the Mexican state of San Luis Potosi. Louisiana State University, Biological Science Series 1:1–229.
- DALQUEST, W.W., AND E. ROTH. 1970. Late Pleistocene mammals from a cave in Tamaulipas, Mexico. Southwestern Naturalist 15:217–230.
- DANNELID, E. 1989. Medial tines on the upper incisors and other dental features used as identification characters in European shrews of the genus *Sorex* (Mammalia, Soricidae). Zeitschrift für Säugetierkunde 54: 205–214.
- DAVIS, W.B. 1944. Notes on Mexican mammals. Journal of Mammalogy 25:370–403.
- . 1957. Notes on the Mexican shrew *Megasorex gigas* (Merriam). Southwestern Naturalist 2:174–175.
- DAVIS, W.B., AND P.W. LUKENS, JR. 1958. Mammals of the Mexican state of Guerrero, exclusive of Chiroptera and Rodentia. Journal of Mammalogy 39:347–367.
- DAVIS, W.B., AND R.J. RUSSELL, JR. 1953. Aves y mamíferos de estado de Morelos. Revista del la Sociedad Mexicana de Historia Natural 14:77–147.
- . 1954. Mammals of the Mexican state of Morelos. Journal of Mammalogy 35:63–80.
- DEKAY, J.E. 1842. Zoology of New-York, or the New-York fauna. Part 1. Mammalia. W. & A. White & J. Visscher, Albany, New York. 146 pp. + 33 plates.
- DELGADILLO VILLALOBOS, J.A., B.R. MCKINNEY, F. HEREDIA PINEDA, AND S. GIBERT ISEHN. 2005. Nest record of *Sorex milleri* from Maderas del Carmen, México. Southwestern Naturalist 50:94–95.
- DEMBOSKI, J.R., AND J.A. COOK. 2001. Phylogeography of the dusky shrew, *Sorex monticolus* (Insectivora, Soricidae): insight into deep and shallow history in northwestern North America. Molecular Ecology 10:1227–1240.
- DÍAZ DE LEÓN. 1905. Catálogo de los mamíferos de la República Mexicana. Imprenta Ricardo Rodríguez R. Aguascalientes.
- DIERSING, V.E., AND D.F. HOFFMEISTER. 1977. Revision of the shrews *Sorex merriami* and a description of a new species of the subgenus *Sorex*. Journal of Mammalogy 58:321–333.
- DIRZO, R., AND M.C. GARCIA. 1992. Rates of deforestation in Los Tuxtlas, a neotropical area in southeast Mexico. Conservation Biology 6:84–90.
- DOWLER, R.C., AND M.D. ENGSTROM. 1988. Distributional records of mammals from the southwestern Yucatan peninsula of Mexico. Annals of the Carnegie Museum 57:159–166.
- DUCOMMUN, M.-A., JEANMAIRE-BESANÇON, F., AND P. VOGEL. 1994. Shield morphology of curly overhair in 22 genera of Soricidae (Insectivora, Mammalia). Revue Suisse de Zoologie 101:623–643.
- ELLIOT, D.G. 1903a. A list of a collection of Mexican mammals with a description of some apparently new forms. Field Columbian Museum, Zoology Series 3: 141–149.
- . 1903b. A list of mammals collected by Edmund Heller, in the San Pedro Martir and Hanson Laguna mountains and the accompanying coast regions of Lower California, with descriptions of apparently new species. Field Columbian Museum, Zoology Series 3:199–232.
- . 1903c. Descriptions of apparently new species and subspecies of mammals from California, Oregon, the Kenai Peninsula, Alaska, and lower California, Mexico. Field Columbian Museum, Zoology Series 3:153–173.
- . 1907. A catalogue of the collection of mammals in the Field Columbian Museum. Field Columbian Museum, Zoology Series 8:1–694.
- ESCALANTE, T., D. ESPINOSA, AND J.J. MORRONE. 2003. Using parsimony analysis of endemism to analyze the distribution of Mexican land mammals. Southwestern Naturalist 48:563–578.
- ESCOBEDO-MORALES, L.A., L. LEÓN-PANIAGUA, J. ARROYO-CABRALES, AND F. GREENAWAY. 2006. Distributional records for mammals from Chiapas, Mexico. Southwestern Naturalist 51:269–272.
- ESPINOZA MEDINILLA, E., A. ANZURES DADDA, AND E. CRUZ ALDAN. 1998. Mamíferos de la Reserva de la Biosfera El Triunfo, Chiapas. Revista Mexicana de Mastozoología 3:79–94.
- ESPINOZA MEDINILLA, E., E. CRUZ, I. LIRA, AND I. SÁNCHEZ. 2002. Mamíferos de La Reserva de La Biosfera La Sepultura, Chiapas, México. Revista Mexicana de Mastozoología 6:42–59.
- FA, J.E. 1989. Conservation-motivated analysis of mammalian biogeography in the Trans-Mexican Neovolcanic Belt. National Geographic Research 5:296–316.
- FA, J.E., J. LÓPEZ-PANIAGUA, F.J. ROMERO, J.L. GÓMEZ, AND J.C. LÓPEZ. 1990. Influence of habitat characteristics on small mammals in a Mexican high-altitude grassland. Journal of Zoology, London 221: 275–292.
- FA, J.E., AND L.M. MORALES. 1991. Mammals and protected areas in the Trans-Mexican Neovolcanic Belt. Pages 199–226 in M.A. Mares and D.J. Schmidly, editors, Latin American mammalogy: history, biodiversity, and conservation. University of Oklahoma Press, Norman.
- . 1993. Patterns of mammalian diversity in Mexico. Pages 319–361 in T.P. Ramamoorthy, R. Bye, A. Lot, and J. Fa, editors, Biological diversity of Mexico: origins and distribution. Oxford University Press, New York.
- FA, J.E., AND V. SÁNCHEZ-CORDERO. 1993. Small mammal population responses to fire in a Mexican high-altitude grassland. Journal of Zoology, London 230: 343–347.
- FERRUSQUÍA-VILLAFRANCA, I. 1993. Geology of Mexico: a synopsis. Pages 3–107 in T.P. Ramamoorthy, R. Bye, A. Lot, and J. Fa, editors, Biological diversity of Mexico: origins and distribution. Oxford University Press, New York.
- FINDLEY, J.S. 1953. Pleistocene Soricidae from San Josecito Cave, Nuevo Leon, Mexico. University of Kansas Publications, Museum of Natural History 5:633–639.
- . 1955a. Speciation of the wandering shrew. University of Kansas Publications, Museum of Natural History 9:1–68.
- . 1955b. Taxonomy and distribution of some American shrews. University of Kansas Publications, Museum of Natural History 7:613–618.
- FINDLEY, J.S., AND W. CAIRE. 1977. The status of mammals in the northern region of the Chihuahuan Desert.

- Pages 127–139 in R.H. Wauer and D.H. Riskind, editors, Transactions of the symposium on the biological resources of the Chihuahuan Desert region: United States and Mexico. U.S. Department of the Interior, National Park Service Transactions and Proceedings Series 3:1–658.
- FISHER, H.I. 1941. Notes on shrews of the genus *Notiosorex*. Journal of Mammalogy 22:263–269.
- FISHER, R.D., AND M.A. BOGAN. 1977. Distributional notes in *Notiosorex* and *Megasorex* in western Mexico. Proceedings of the Biological Society of Washington 90:826–828.
- FLORES VILLELA, O., AND P. GEREZ. 1994. Biodiversidad y conservación en México: vertebrados, vegetación y uso del suelo. Segunda ed. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad y Universidad Nacional Autónoma de México, México, D.F.
- GALINA TESSARO, P., S. ÁLVAREZ-CÁRDENAS, A. GONZÁLEZ-ROMERO, AND S. GALLINA. 1988. Mastofauna. Pages 209–228 in L. Arriaga and A. Ortega, editors, La Sierra de La Laguna de Baja California Sur, Centro de Investigaciones Biológicas de Baja California Sur, A.C. La Paz, Baja California Sur, México 1:1–237.
- GARDNER, A.L. 1965. New bat records from the Mexican state of Durango. Proceedings of the Western Foundation of Vertebrate Zoology 1:101–106.
- GAUMER, G.F. 1917. Monografía de los mamíferos de Yucatán. Departamento de Talleres Gráficos de la Secretaría de Fomento, México.
- GENOWAYS, H.H., AND J.R. CHOATE. 1967. A new species of shrew (genus *Cryptotis*) from Jalisco, Mexico (Mammalia; Insectivora). Proceedings of the Biological Society of Washington 80:203–206.
- GEORGE, S.B. 1988. Systematics, historical biogeography, and evolution of the genus *Sorex*. Journal of Mammalogy 69:443–461.
- GOLDMAN, E.A. 1951. Biological investigations in México. Smithsonian Miscellaneous Collections 115:1–476.
- GOLDMAN, E.A., AND R.T. MOORE. 1946. The biotic provinces of Mexico. Journal of Mammalogy 26:347–360.
- GOLDSCHMIDT, R. 1982. The material basis of evolution. Yale University Press, New Haven, CT.
- GOODWIN, G.G. 1942. Mammals of Honduras. Bulletin of the American Museum of Natural History 79:107–195.
- _____. 1954a. A new short-tailed shrew and a new free-tailed bat from Tamaulipas, Mexico. American Museum Novitates 1670:1–3.
- _____. 1954b. Mammals from Mexico collected by Marian Martin for the American Museum of Natural History. American Museum Novitates 1689:1–16.
- _____. 1956. Seven new mammals from México. American Museum Novitates 1791:1–10.
- _____. 1969. Mammals from the state of Oaxaca, Mexico, in the American Museum of Natural History. Bulletin of the American Museum of Natural History 141:1–269.
- GRAY, J.E. 1843. [Various species of Mammalia from Coban, Central America]. Proceedings of the Zoological Society of London 1843:79.
- GRENOT, C., AND V. SERRANO. 1981. Ecological organization of small mammal communities at the Bolson de Mapimi (Mexico). Pages 89–100 in R. Barbault and G. Halffter, editors, Ecology of the Chihuahuan Desert. Organization of some vertebrate communities. Instituto de Ecología, A.C., México 8:1–167.
- HAFNER, D.J., AND C.J. SHUSTER. 1996. Historical biogeography of western peripheral isolates of the least shrew, *Cryptotis parva*. Journal of Mammalogy 77:536–545.
- HALL, E.R. 1932. A new shrew of the *Sorex merriami* group from Arizona. Journal of Mammalogy 13:259–262 + 1 plate.
- _____. 1981. The mammals of North America. 2nd edition. John Wiley & Sons, New York 1:1–600 + 90.
- HALL, E.R., AND W.W. DALQUEST. 1963. The mammals of Veracruz. University of Kansas Publications, Museum of Natural History 14:165–362.
- HALL, E.R., AND K.R. KELSON. 1959. The mammals of North America. The Ronald Press Co., New York 1:1–546 + 79.
- HALL, E.R., AND B. VILLA-R. 1949. An annotated check list of the mammals of Michoacán, México. University of Kansas Publications, Museum of Natural History 1:431–472.
- _____. 1950. Lista anotada de los mamíferos de Michoacán, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México 21:159–214.
- HANDLEY, C.O., JR., AND J.R. CHOATE. 1970. The correct name for the least short-tailed shrew (*Cryptotis parva*) of Guatemala (Mammalia: Insectivora). Proceedings of the Biological Society of Washington 83:195–202.
- HARRIS, A.H. 1998. Fossil history of shrews in North America. Pages 133–156 in J.M. Wójcik and M. Wolsan, editors, Evolution of shrews. Mammal Research Institute, Polish Academy of Sciences, Białowieża.
- HATT, R.T. 1938. Notes concerning mammals collected in Yucatan. Journal of Mammalogy 19:333–337.
- _____. 1953. The mammals. Pages 45–77 in R.T. Hatt, H.I. Fisher, D.A. Langebartel, and G.W. Brainerd, editors, Faunal and archeological researches in Yucatan Caves. Cranbrook Institute of Science Bulletin 33:1–119.
- HAUSSER, J., L. FUMAGALLI, AND P. TABERLET. 1998. Mitochondrial DNA evolution in shrews. Pages 295–308 in J.M. Wójcik and M. Wolsan, editors, Evolution of shrews. Mammal Research Institute, Polish Academy of Sciences, Białowieża.
- HEANEY, L.R., AND E.C. BIRNEY. 1977. Distribution and natural history notes on some mammals from Puebla, Mexico. Southwestern Naturalist 21:543–545.
- HENNINGS, D., AND R.S. HOFFMANN. 1977. A review of the taxonomy of the *Sorex vagrans* species complex from western North America. Occasional Papers. Museum of Natural History, University of Kansas 68:1–35.
- HERNÁNDEZ-CHÁVEZ, J.J. 1997. La alimentación de *Tyto alba* en la Ciénaga de Chapala, Michoacán, México. Pages 157–174 in J. Arroyo Cabrales and O.J. Polaco, coordinators, Homenaje al profesor Ticul Álvarez. Instituto Nacional de Antropología e Historia, Colección Científica, México, D.F.
- HERRERA, A. 1890. Notas acerca de los vertebrados del Valle de México. La Naturaleza, 2a. serie 1:299–342.
- _____. 1895. Catálogo de la colección de mamíferos del Museo Nacional. Imprenta Museo Nacional, 2a. Ed. 1:1–42.
- _____. 1897. Primatos, carnívoros e insectívoros de México. Anales de Museo de Nacional Mexico, Ep. 1a. 4: 63–70.

- _____. 1898. Catálogo de la colección de mamíferos del Museo Nacional. Imprenta Museo Nacional, Ep. 3a 1:1–73.
- HERSHKOVITZ, P. 1951. Mammals of British Honduras, Mexico, Jamaica and Haiti. *Fieldiana-Zoology* 31: 547–569.
- _____. 1971. Basic crown patterns and cusp homologies of mammalian teeth. Pages 95–150 in A.A. Dahlberg, editor, *Dental morphology and evolution*. University of Chicago Press, Chicago.
- HIBBARD, C.W. 1950. Mammals of the Rexroad formation from Fox Canyon, Meade County, Kansas. *Contributions to the Museum of Paleontology, University of Michigan* 8:113–192.
- HOFFMANN, A. 1951. Contribuciones al conocimiento de los trombicúlidos mexicanos. 4a. parte. *Ciencia, México* 11:97–103.
- _____. 1952. Contribución al conocimiento de los trombicúlidos mexicanos. 5a. parte. *Ciencia, México* 12: 87–94.
- _____. 1990. Los trombicúlidos de México (Acarida: Trombiculidae). Instituto de Biología, Universidad Nacional Autónoma México, Publicaciones Especiales 2:1–275.
- _____. 1993. Las colecciones de artrópodos de A. Hoffmann. Instituto de Biología, Universidad Nacional Autónoma México, Cuadernos 19:1–43.
- HOFFMEISTER, D.F. 1977. Noteworthy range extensions of mammals in northern Mexico and Arizona. *Southwestern Naturalist* 22:150–151.
- HOOPER, E.T. 1946. Extra teeth in a shrew. *Journal of Mammalogy* 27:394.
- _____. 1947. Notes on Mexican mammals. *Journal of Mammalogy* 28:40–57.
- _____. 1955. Notes on mammals of western Mexico. *Occasional Papers of the Museum of Zoology, University of Michigan* 565:1–26.
- _____. 1957. Records of Mexican mammals. *Occasional Papers of the Museum of Zoology, University of Michigan* 586:1–9.
- _____. 1961. Notes on mammals from western and southern Mexico. *Journal of Mammalogy* 42:120–122.
- HOPKINS, G.H.E., AND M. ROTHSCHILD. 1966. An illustrated catalogue of the Rothschild Collection of Fleas (Siphonaptera) in the British Museum (Natural History). Vol. 4 Hystriechopsyllidae. British Museum (Natural History), London.
- HORVATH, A., R. VIDAL-LOPEZ, AND A. MUÑOZ-ALONSO. 1999–2000. Nueva localidad para la distribución en México de *Cryptotis goodwini* (Insectivora: Soricidae). *Revista Mexicana de Mastozoología* 4:117–119.
- HORVATH, A., R. VIDAL-LOPEZ, AND R. SARMIENTO-AGUILAR. 2001 [2003]. Mamíferos del Parque Nacional Lagunas de Montebello, Chiapas, México. *Revista Mexicana de Mastozoología* 5:6–26.
- HUEY, J.M. 1964. The mammals of Baja California, Mexico. *Transactions of the San Diego Society of Natural History* 13:85–165.
- HUTTERER, R. 1980. A record of Goodwin's shrew, *Cryptotis goodwini*, from Mexico. *Mammalia* 44:413.
- ILLOLDI-RANGEL, P., V. SÁNCHEZ-CORDERO, AND A.T. PETERSON. 2004. Predicting distributions of Mexican mammals using ecological niche modeling. *Journal of Mammalogy* 85:658–662.
- JACKSON, H.H.T. 1925. Preliminary descriptions of seven shrews of the genus *Sorex*. *Proceedings of the Biological Society of Washington* 38:127–130.
- _____. 1928. A taxonomic review of the American long-tailed shrews (genera *Sorex* and *Microsorex*). *North American Fauna* 51:1–238.
- _____. 1933. Five new shrews of the genus *Cryptotis* from Mexico and Guatemala. *Proceedings of the Biological Society of Washington* 46:79–82.
- _____. 1947. A new shrew (genus *Sorex*) from Coahuila. *Proceedings of the Biological Society of Washington* 60:131–132.
- JAEGER, E.C. 1978. A source-book of biological names and terms. 3rd edition, 6th printing. Charles C Thomas, Publisher, Springfield, IL.
- JAU-MEXIA, N., O.J. POLACO, AND J. ARROYO-CABRALES. 2000. New mammals for the Pleistocene of Zacatecas, Mexico. *Current Research in the Pleistocene* 17: 124–125.
- JIMÉNEZ ALMARAZ, T., J. JUAREZ GOMEZ, AND L. LEÓN PANIAGUA. 1993. 15: Mamíferos. Pages 503–549 in I. Luna Vega and J. Llorente Bousquets, editors, *Historia Natural del parque Ecológico Estatal, Omiltemi, Chilpancingo, Guerrero, México*. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad y Universidad Nacional Autónoma de México.
- JIMÉNEZ GUZMÁN, A., J.A. NIÑO RAMÍREZ, AND M.A. ZÚÑIGA RAMOS. 1996. Estado actual de la Colección de Mamíferos, Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León, México. *Publicaciones Biológicas, Facultad de Ciencias Biológicas, Universidad Autónoma Nuevo León, México, Suplemento* 3:1–30.
- JIMÉNEZ GUZMÁN, A., M.A. ZÚÑIGA RAMOS, AND J.A. NIÑO RAMÍREZ. 1997. Lista anotada de mamíferos de Nuevo León, México. *Revista Mexicana de Mastozoología* 2:132–141.
- _____. 1999. Mamíferos de Nuevo León, México. Universidad Autónoma de Nuevo León, México.
- JONES, J.K., JR. 1966. Recent records of the shrew, *Megasorex gigas* (Merriam), from western Mexico. *American Midland Naturalist* 75:249–250.
- JONES, J.K., JR., T. ÁLVAREZ, AND M.R. LEE. 1962. Noteworthy mammals from Sinaloa, Mexico. University of Kansas Publications, Museum of Natural History 14:145–159.
- JONES, J.K., JR., D.C. CARTER, AND W.D. WEBSTER. 1983. Records of mammals from Hidalgo, Mexico. *Southwestern Naturalist* 28:378–380.
- JONES, J.K., JR., AND H.H. GENOWAYS. 1967. Notes on the Oaxacan vole, *Microtus oaxacensis* Goodwin, 1966. *Journal of Mammalogy* 48:320–321.
- _____. 1969. Holotypes of Recent mammals in the Museum of Natural History, The University of Kansas. Pages 129–149 in J.K. Jones, Jr., editor, *Contributions in Mammalogy*. Miscellaneous Publications. Museum of Natural History, University of Kansas 51:1–428.
- JONES, J.K., JR., H.H. GENOWAYS, AND J.D. SMITH. 1974. Annotated checklist of mammals of the Yucatan Peninsula, Mexico. III. Marsupialia, Insectivora, Primates, Edentata, Lagomorpha. *Occasional Papers, Museum of Texas Tech University* 23:1–12.
- JUNGE, J.A., AND R.S. HOFFMANN. 1981. An annotated key to the long-tailed shrews (genus *Sorex*) of the United States and Canada, with notes on Middle America. *Occasional Papers of the Museum of Natural History, University of Kansas* 94:1–48.

- KASPER, T.C., AND J.K. JONES, JR. 1977. The desert shrew, *Notiosorex crawfordi*, in Hidalgo, Mexico. Southwestern Naturalist 22:155–156.
- KOESTNER, E.J. 1941. An annotated list of mammals collected in Nuevo Leon, Mexico, in 1938. Great Basin Naturalist 2:9–15.
- . 1944. Populations of small mammals on Cerro Potosi, Nuevo Leon, Mexico. Journal of Mammalogy 25:284–289.
- KOOPMAN, K.F., AND P.S. MARTIN. 1959. Subfossil mammals from the Gomez Faris region and the tropical gradient of eastern Mexico. Journal of Mammalogy 40:1–12.
- LAWRENCE, M.A. 1993. Catalog of recent mammal types in the American Museum of Natural History. Bulletin of the American Museum of Natural History 217:1–200.
- LEÓN P, L., AND E. ROMO V. 1991. Catálogo de mamíferos (Vertebrata: Mammalia). Serie Catálogos del Museo de Zoología "Alfonso L. Herrera." Facultad de Ciencias, Universidad Nacional Autónoma de México, Catálogo 2:1–68.
- LINDSTEDT, S.L. 1980. Energetics and water economy of the smallest desert mammal. Physiological Zoology 53:82–97.
- LIRA, I.E., C. MÜDESPACHER, AND B. GARCÍA GÜIDO. 1994. Theria diccionario de mamíferos. A.G.T., editor. S.A., México, D.F.
- LÓPEZ-FORMENT C., W. 1997. Algunas notas faunísticas del estudio de regurgitaciones de lechuza *Tyto alba*, en el sur del Valle de México. Pages 175–181 in J. Arroyo Cabres and O.J. Polaco, coordinators, Homenaje al profesor Ticul Álvarez. Instituto Nacional de Antropología e Historia, Colección Científica, México, D.F.
- LÓPEZ-FORMENT C., W., AND G. URBANO-V. 1977. Restos de pequeños mamíferos recuperados en regurgitaciones de lechuza, *Tyto alba* en México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 48:231–242.
- LÓPEZ-VIDAL, J.C., AND T. ÁLVAREZ. 1993. Biología de la rata montera, *Neotoma mexicana*, en la Michilía, Durango, México. Pages 185–195 in R.A. Medellín and G. Ceballos, editors, Avances en el estudio de los mamíferos de México. Asociación Mexicana de Mastozoología, A.C., Publicaciones Especiales 1:1–464.
- LÓPEZ-WILCHIS, R., AND J. LÓPEZ JARDINES. 2000. Los mamíferos de México depositados en colecciones de Estados Unidos y Canada. Universidad Autonoma Metropolitana Unidad Iztapalapa, México, D.F. 3: 1–421.
- LUKOSCHUS, F.S., P.H. GERRITS, AND A. FAIN. 1977. Three new species of genus *Orycterxenus* Zachvatkin 1941 (Acarina: Sarcophagidae). Senckenbergiana Biologica 58:83–91.
- LYON, M.W., AND W.H. OSGOOD. 1909. Catalogue of the type-specimens of mammals in the United States National Museum, including the Biological Survey Collection. Bulletin of the United States National Museum 62:1–325.
- MALDONADO, J.E. 1999. Family Soricidae. Pages 39–52 in S.T. Álvarez-Castañeda and J.L. Patton, editors, Mamíferos del noroeste de México. Centro de Investigaciones Biológicas del Noroeste, S.C.
- MALDONADO, J.E., C. VILÁ, AND R.K. WAYNE. 2001. Tripartite genetic subdivisions in the ornate shrew (*Sorex ornatus*). Molecular Ecology 10:127–147.
- MARTIN, P.S. 1955. Zonal distribution of vertebrates in a Mexican cloud forest. American Naturalist 89:347–361.
- MASS, J., R. PATRON, A. SUAREZ, S. BLANCO, G. CEBALLOS, C. GALINDO, AND A. PESCADOR. 1981. Ecología de la Estación Experimental Zoquiapan (descripción general, vegetación & fauna). Universidad Autónoma Chapingo, Dirección de Difusión Cultural, Departamento de Bosques, México, Colección Cuadernos Universitarios 2:1–114.
- MATSON, J.O., AND R.H. BAKER. 1986. Mammals of Zacatecas. Special Publication of The Museum, Texas Tech University 24:1–88.
- MAYR, E. 1963. Speciation and systematics. Pages 281–298 in G.L. Jepsen, E. Mayr, and G.G. Simpson, editors, Genetics, paleontology, and evolution. Atheneum, New York.
- . 1982. The growth of biological thought: diversity, evolution, and inheritance. Belknap Press of Harvard University Press, Cambridge, MA.
- MCALEILEY, L.R., M.B. O'NEILL, AND R.J. BAKER. In press. Molecular evidence for genetic subdivisions in the desert shrew, *Notiosorex crawfordi*. Southwestern Naturalist.
- MEDELLÍN, R.A. 1988. Prey of *Chrotopterus auritus*, with notes on feeding behavior. Journal of Mammalogy 69:841–844.
- MERRIAM, C.H. 1890. Annotated list of mammals of the San Francisco Mountain plateau and desert of the Little Colorado in Arizona, with notes on their vertical distribution, and descriptions of new species. North American Fauna 3:43–86.
- . 1892. Descriptions of nine new mammals collected by E.W. Nelson, in the states of Colima and Jalisco, Mexico. Proceedings of the Biological Society of Washington 7:164–174.
- . 1895a. Revision of the shrews of the American genera *Blarina* and *Notiosorex*. North American Fauna 10:1–34.
- . 1895b. Synopsis of the American shrews of the genus *Sorex*. North American Fauna 10:57–124.
- . 1897. Descriptions of five new shrews from Mexico, Guatemala, and Colombia. Proceedings of the Biological Society of Washington 11:227–230.
- . 1898. New names for *Spermophilus brevicaudus*, *Canis pallidus* and *Sorex caudatus* Merriam. Science (N.S.) 8:782.
- . 1901. Seven new mammals from Mexico, including a new genus of rodents. Proceedings of the Washington Academy of Science 3:559–563.
- MESSING, H.J. 1986. A late Pleistocene–Holocene fauna from Chihuahua, Mexico. Southwestern Naturalist 31:277–288.
- MILLER, G.S., JR. 1895. The long-tailed shrews of the eastern United States. North American Fauna 10:35–56.
- . 1911. Three new shrews of the genus *Cryptotis*. Proceedings of the Biological Society of Washington, 24:221–224.
- . 1912. List of North American land mammals in the United States National Museum, 1911. Bulletin of the United States National Museum 79:1–455.
- . 1924. List of North American Recent mammals, 1923. Bulletin of the United States National Museum 128:1–673.

- MILLER, G.S., JR., AND J.A.G. REHN. 1901. Systematic results of the study of North American land mammals to the close of the year 1900. *Proceedings of the Boston Society of Natural History* 30:1–352.
- MIRANDA, F., AND A.J. SHARE. 1950. Characteristics of the vegetation in certain temperate regions of eastern Mexico. *Ecology* 31:313–333.
- MOORE, R.T. 1945. The Transverse Volcanic Biotic Province of Central Mexico and its relationship to adjacent provinces. *Transactions of the San Diego Society of Natural History* 10:217–236.
- MORENO-VALDÉZ, A. 1998. Mamíferos del Cañón de Huajuco, Municipio de Santiago, Nuevo León, México. *Revista Mexicana de Mastozoología* 3:5–25.
- MORRONE, J.J., D. ESPINOSA ORGANISTA, C. AGUILAR ZÚÑIGA, AND J. LLORENTE BOUSQUETS. 1999. Preliminary classification of the Mexican biogeographic provinces: a parsimony analysis of endemism based on plant, insect, and bird taxa. *Southwestern Naturalist* 44:507–514.
- MURIE, A. 1935. Mammals from Guatemala and British Honduras. *Miscellaneous Publications. Museum of Zoology, University of Michigan* 26:1–30 + 1 plate + 1 map.
- MUSSER, G.G. 1964. Notes on geographic distribution, habitat, and taxonomy of some Mexican mammals. *Occasional Papers of the Museum of Zoology, University of Michigan* 636:1–22.
- NARANJO, E.J., AND E. ESPINOZA MEDINILLA. 2001 [2003]. Los mamíferos de la Reserva Ecológica Huixtla, Chiapas, México. *Revista Mexicana de Mastozoología* 5:58–67.
- NELSON, E.W., AND E.A. GOLDMAN. 1909. Eleven new mammals from lower California. *Proceedings of the Biological Society of Washington* 22:23–28.
- NORMA OFICIAL MEXICANA. 2002. Norma Oficial Mexicana NOM-059-ECOL-2001. Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. *Diario Oficial de la Federación* del 6 de marzo de 2002.
- OCAÑA MARIN, A. 1997. El estudio de los mamíferos del Templo Olvidado, Palenque, Chiapas. Pages 239–252 in J. Arroyo Cabreles and O.J. Polaco, coordinators, *Homenaje al profesor Ticul Álvarez*. Instituto Nacional de Antropología e Historia, Colección Científica, México, D.F.
- OHDAHI, S.D., M. HASEGAWA, M.A. IWASA, P. VOGEL, T. OSHIDA, L.-K. LIN, AND H. ABE. 2006. Molecular phylogenetics of soricid shrews (Mammalia) based on mitochondrial Cytochrome *b* gene sequences: with special reference to the Soricidae. *Journal of Zoology* 270:177–191.
- ORDUÑA TREJO, C., A. CASTRO-CAMPILLO, AND J. RAMÍREZ-PULIDO. 1999–2000. Mammals from the Tarascan Plateau, Michoacán, México. *Revista Mexicana de Mastozoología* 4:55–70.
- ORR, R.T. 1963. An extension of the range of Merriam's desert shrew. *Journal of Mammalogy* 44:424.
- ORTEGA-HUERTA, M., AND A.T. PETERSEN. 2004. Modeling spatial patterns of biodiversity for conservation prioritization in north-eastern Mexico. *Biodiversity Research* 10:39–54.
- OWEN, J.G., AND R.S. HOFFMANN. 1983. *Sorex ornatus*. *Mammalian Species* 212:1–5.
- PACKARD, R.L. 1977. Mammals of the southern Chihuahuan Desert: an inventory. Pages 141–153 in R.H. Wauer and D.H. Riskind, editors, *Transactions of the symposium on the biological resources of the Chihuahuan Desert region: United States and Mexico*. U.S. Department of the Interior, National Park Service Transactions and Proceedings Series 3:1–658.
- PADILLA-G., U., AND P. PINEDA-L. 1997. Vertebrados del estado de Querétaro. Universidad Autónoma de Querétaro, Querétaro, México.
- PETERSEN, M.K. 1976. Noteworthy range extensions of some mammals in Durango, Mexico. *Southwestern Naturalist* 21:139–142.
- . 1979. Some morphometric observations on *Notiosorex crawfordi* from Durango, México. *Occasional Papers Zoologicas of Michael K. Petersen* 1:1–9.
- . 1980. A comparison of small mammal populations sampled by pit-fall and live-traps in Durango, Mexico. *Southwestern Naturalist* 25:122–124.
- PETERSEN, M.K., AND M.K. PETERSEN. 1979. A temporal comparison of owl pellet contents with small mammal population levels in Durango, México. *Occasional Papers Zoologicas of Michael K. Petersen* 4:1–27.
- PETERSON, A.T., S.L. EGBERT, V. SÁNCHEZ-CORDERO, AND K.P. PRICE. 2000. Geographic analysis of conservation priority: endemic birds and mammals in Veracruz, Mexico. *Biological Conservation* 93:85–94.
- PETERSON, A.T., O.A. FLORES-VILLELA, L.S. LEÓN-PANIAGUA, J.E. LLORENTE-BOUSQUETS, M.A. LUIS-MARTINEZ, A.G. NAVARRO-SIGÜENZA, M.G. TORRES-CHÁVEZ, AND I. VARGAS-FERNÁNDEZ. 1993. Conservation priorities in Mexico: moving up in the world. *Biodiversity Letters* 1:33–38.
- PETERSON, A.T., M.A. ORTEGA-HUERTA, J. BARTLEY, V. SÁNCHEZ-CORDERO, J. SORBERÓN, R.H. BUDDEMEIER, AND D.R.B. STOCKWELL. 2002. Future projections for Mexican faunas under global climate change scenarios. *Nature* 416:626–629.
- PETERSON, A.T., J. SORBERÓN, AND V. SÁNCHEZ-CORDERO. 1999. Conservatism of ecological niches in evolutionary time. *Science* 285:1265–1267.
- PONCE-ULLOA, H.E., AND J.E. LLORENTE BOUSQUETS. 1993. Distribución de Siphonaptera (Arthropoda, Insecta) en la Sierra de Atoyac de Álvarez, Guerrero, México. *Instituto de Biología, Universidad Nacional Autónoma México, Publicaciones Especiales* 11:1–77.
- POOLE, A.J., AND V.S. SCHANTZ. 1942. Catalog of the type specimens of mammals in the United States National Museum, including the Biological Surveys collection. *Bulletin of the United States National Museum* 178:1–705.
- PRIETO BOSCH, M., AND V. SÁNCHEZ-CORDERO. 1993. Sistemas de información geográficos: un caso de estudio en Veracruz. Pages 455–464 in R.A. Medellín and G. Ceballos, editors, *Avances en el estudio de los mamíferos de México*. Asociación Mexicana de Mastozoología, A.C., Publicaciones Especiales 1:1–464.
- PRUITT, W.O., JR. 1957. A survey of the mammalian family Soricidae (Shrews). *Säugetierkundliche Mitteilungen* 5:18–27.
- RAMÍREZ-PULIDO, J. 1969. Contribución al estudio de los mamíferos del Parque Nacional "Lagunas de Zempoala," Morelos, México. *Anales Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 40:253–290.

- RAMÍREZ-PULIDO, J., AND M.C. BRITTON. 1981. An historical synthesis of Mexican mammalian taxonomy. *Proceedings of the Biological Society of Washington* 94:1–17.
- RAMÍREZ-PULIDO, J., M.C. BRITTON, A. PERDOMO, AND A. CASTRO. 1986. *Guía de los mamíferos de México. Referencias hasta 1983*. Universidad Autónoma Metropolitana. Unidad Iztapalapa, México.
- RAMÍREZ-PULIDO, J., A. CASTILLO-MORALES, A. SALAME-MÉNDEZ, AND A. CASTRO-CAMPILLO. 2004. Características morfológicas y morfométricas de cinco especies de *Cryptotis* (Mammalia: Soricomorpha). *Acta Zoológica Mexicana* 20:9–37.
- RAMÍREZ-PULIDO, J., AND A. CASTRO-CAMPILLO. 1990. *Bibliografía reciente de los mamíferos de México: 1984/1988*. Universidad Autónoma Metropolitana. Unidad Iztapalapa, México.
- . 1994. *Bibliografía reciente de los mamíferos de México: 1989/1993*. Universidad Autónoma Metropolitana. Unidad Iztapalapa, México.
- RAMÍREZ-PULIDO, J., A. CASTRO-CAMPILLO, M.A. ARMELLA, AND A. SALAME-MÉNDEZ. 2000. *Bibliografía reciente de los mamíferos de México 1994–2000*. Universidad Autónoma Metropolitana Unidad Iztapalapa, México, D.F.
- RAMÍREZ-PULIDO, J., A. CASTRO-CAMPILLO, J. ARROYO-CABRALES, AND F.A. CERVANTES. 1996. Lista taxonómica de los mamíferos terrestres de México: A taxonomic list of the terrestrial mammals of Mexico. *Occasional Papers, Museum of Texas Tech University* 158:1–62.
- RAMÍREZ-PULIDO, J., R. LÓPEZ-WILCHIS, C. MÜDESPACHER ZIEHL, AND I.E. LIRA. 1983. *Lista y bibliografía Reciente de los mamíferos de México*. Universidad Autónoma Metropolitana Unidad Iztapalapa, México, D.F.
- RAMÍREZ-PULIDO, J., AND C. SANCHEZ-HERNANDEZ. 1972. Regurgitaciones de lechuza, procedentes de la cueva del Cañón del Zopilote, Guerrero, México. *Revista de la Sociedad Mexicana de Historia Natural* 33:107–112.
- RAUN, G.G. 1965. *Cryptotis parva* from Coahuila, Mexico and comments on the taxonomy of least shrews in Texas. *Southwestern Naturalist* 10:214–218.
- REID, F.A. 1997. *A field guide to the mammals of Central America and southeast Mexico*. Oxford University Press, New York.
- REPPENING, C.A. 1967. Subfamilies and genera of the Soricidae. *Geological Survey Professional Papers* 565: 1–74.
- RICKART, E.A. 1977. Reproduction, growth and development in two species of cloud forest *Peromyscus* from southern Mexico. *Occasional Papers of the Museum of Natural History, University of Kansas* 67:1–22.
- ROBERTSON, P.B., AND E.A. RICKART. 1975. *Cryptotis magna*. *Mammalian Species* 61:1–2.
- RODRÍGUEZ VELA, H. 1999. *Notiosorex crawfordi* (Coues, 1877) en el matorral desértico de Nuevo León, México. *Vertebrata Mexicana* 5:5–8.
- RUEDI, M. 1998. Protein evolution in shrews. Pages 269–294 in J.M. Wójcik and M. Wolsan, editors, *Evolution of shrews*. Mammal Research Institute, Polish Academy of Sciences, Białowieża.
- RYCKMAN, R.E., D.L. FOLKES, L.E. OLSEN, P.L. ROBB, AND A.E. RYCKMAN. 1965. Epizootiology of *Trypanosoma cruzi* in southwestern North America. *Journal of Medical Entomology* 2:87–108.
- RZEDOWSKI, J. 1986. *Vegetación de México*. Editorial Limusa, Mexico, D.F.
- SÁNCHEZ-CORDERO, V. 2001. Elevation gradients of diversity for rodents and bats in Oaxaca, Mexico. *Global Ecology and Biogeography* 10:63–76.
- SÁNCHEZ-CORDERO, V., P. ILLOLDI-RANGEL, M. LINAJE, S. SARKAR, AND A.T. PETERSON. 2005. Deforestation and extant distributions of Mexican endemic mammals. *Biological Conservation* 126:465–473.
- SCHALDACH, W.J., JR. 1966. New forms of mammals from southern Oaxaca, Mexico, with notes on some mammals of the coastal range. *Säugetierkundliche Mitteilungen* 14:286–297.
- SCHLITTER, D.A. 1973. *Notiosorex crawfordi evotis* from Nayarit. *Southwestern Naturalist* 17:423.
- SCHMIDLX, D.J. 1977. Factors governing the distribution of mammals in the Chihuahuan Desert region. Pages 163–192 in R.H. Wauer and D.H. Riskind, editors, *Transactions of the symposium on the biological resources of the Chihuahuan Desert region: United States and Mexico*. U.S. Department of the Interior, National Park Service Transactions and Proceedings Series 3:1–658.
- SCHMIDLX, D.J., AND F.S. HENDRICKS. 1984. Mammals of the San Carlos Mountains of Tamaulipas, Mexico. Pages 15–69 in R.E. Martin and B.R. Chapman, editors, *Contributions in mammalogy in honor of Robert L. Packard*. Special Publication of the Museum, Texas Tech University 22:1–234.
- SCHULZ, T.A., F.J. RADOVSKY, AND P.D. BUDWISER. 1970. First insular record of *Notiosorex crawfordi*, with notes on other mammals of San Martin Island, Baja California, Mexico. *Journal of Mammalogy* 51:148–150.
- SIMPSON, G.G. 1961. *Principles of animal taxonomy*. Columbia University Press, New York.
- SMITH, H.M. 1941. Las provincias bióticas de México, según la distribución geográfica de las lagartijas del género *Sceloporus*. *Anales de la Escuela Nacional de Ciencias Biológicas, México* 2:103–111.
- STEWART, D.T., AND A.J. BAKER. 1994. Evolution of mtDNA D-loop sequences and their use in phylogenetic studies of shrews in the subgenus *Otisorex* (Sorex: Soricidae: Insectivora). *Molecular Phylogenetics and Evolution* 3:38–46.
- STUART, L.C. 1954. A description of a subhumid corridor across northern Central America, with comments on its herptofaunal indicators. *Contributions from the Laboratory of Vertebrate Biology* 65:1–26.
- TÉLLEZ-GIRÓN, G., A. MENDOZA-DURÁN, AND G. CEBALLOS. 1997. Registros notables de mamíferos del oeste de México. *Revista Mexicana de Mastozoología* 2: 97–100.
- TIPTON, J.V., AND E. MENDEZ. 1968. New species of fleas (Siphonaptera) from Cerro Potosí, Mexico. With notes on ecology and host parasite relationships. *Pacific Insects* 10:177–214.
- TOLEDO, V.M. 1982. Pleistocene changes of vegetation in tropical Mexico. Pages 93–111 in G.T. Prance, editor, *Biological diversification in the tropics*. Columbia University Press, New York.
- TOMES, J. 1862. Report of a collection of mammals made by Osbert Salvin, Esq., F.Z.S., at Deuñas, Guatemala; with notes on some of the species, by Mr. Fraser. *Proceedings of the Zoological Society of London* 1861:278–288.

- TRAUB, R. 1950. Siphonaptera from Central America and Mexico: a morphological study of the Aedeagus with descriptions of new genera and species. *Fieldiana: Zoology* 31:117–130.
- TRAUB, R., AND A. BARRERA. 1966. New species of *Ctenophthalmus* from Mexico, with notes on the ctenidia of shrew-fleas (Siphonaptera) as examples of convergent evolution. *Journal of Medical Entomology* 3: 127–145.
- TROUESSART, E.L. 1898. *Catalogus mammalium tam viventium quam fossilium*. Nova Editio (Prima Completa), R. Friedländer & Sohn, Berolini 2:665–1479.
- TRUE, F.W. 1884. Provisional plan for a collection of mammals to be exhibited at the World's Industrial and Cotton Centennial Exposition of 1884–1885, at New Orleans. *Proceedings of the United States National Museum* 29:1–27.
- TWENTE, J.W., AND R.H. BAKER. 1951. New records of mammals from Jalisco, Mexico, from barn owl pellets. *Journal of Mammalogy* 32:120–121.
- VAN ZYLL DE JONG, C.G. 1983. Handbook of Canadian mammals. I. Marsupials and insectivores. National Museum of Natural Sciences, National Museums of Canada.
- VAN ZYLL DE JONG, C.G., AND G.L. KIRKLAND, JR. 1989. A morphometric analysis of the *Sorex cinereus* group in central and eastern North America. *Journal of Mammalogy* 70:110–122.
- VILLA-R., B. 1948. Mamíferos del Soconusco, Chiapas. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México* 19:485–528.
- . 1952 [1953]. Mamíferos silvestres del Valle de Mexico. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México* 23:269–492 + 14 plates.
- . 1953. Mamíferos. Pages 175–200 in E. Beltrán, editor, *Vida silvestre y recursos naturales a lo largo de la Carretera Panamericana*. Instituto Mexicano de Recursos Naturales Renovables.
- . 1966 [1967]. Los murciélagos de Mexico. *Universidad Nacional Autónoma de México, Instituto de Biología, México*.
- VILLA-R., B., AND F.A. CERVANTES. 2003. Los mamíferos de México. Instituto de Biología, Universidad de Nacional Autónoma de México y Grupo Editorial Iberoamerica, S.A. de C.V., México, D.F.
- WEBB, R.G., AND R.H. BAKER. 1962. Terrestrial vertebrates of the Pueblo Nuevo Leon area of southwestern Durango, Mexico. *American Midland Naturalist* 68:325–333.
- . 1969. Vertebrados terrestres del suroeste de Oaxaca. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 40: 139–151.
- . 1984. Terrestrial vertebrates of Cerro Mohinora Region, Chihuahua, Mexico. *Southwestern Naturalist* 29:243–246.
- WEBB, R.G., A. MARTINEZ, AND R.H. BAKER. 1981. Algunos anfibios, reptiles y mamíferos del Mineral del Tigre, Nayarit. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 51:699–702.
- WETMORE, A. 1943. The birds of southern Veracruz, Mexico. *Proceedings of the United States National Museum* 93:215–340.
- WHITAKER, J.O., JR. 1974. *Cryptotis parva*. *Mammalian Species* 43:1–8.
- WHITAKER, J.O., JR., J.L. GLENDINNING, AND W.J. WRENN. 1991. Ectoparasites of *Sorex saussurei* (Saussure's shrew) from Michoacan, Mexico. *Southwestern Naturalist* 35:114–115.
- WHITAKER, J.O., JR., AND J.B. MORALES-MALACARA. 2005. Ectoparasites and other associates (Ectodytes) of mammals of Mexico. Pages 535–666 in V. Sánchez-Cordero and R.A. Medellín, editors, *Contribuciones Mastozoológicas en Homenaje a Bernardo Villa*. Instituto de Biología e Instituto de Ecología, Universidad Nacional Autónoma de México, México City, México.
- WILEY, E.O. 1978. The evolutionary species concept reconsidered. *Systematic Zoology* 27:17–26.
- WINKELMANN, J.R. 1962. Mammal records from Guerrero and Michoacan, Mexico. *Journal of Mammalogy* 43: 108–109.
- WOLOSZYN, D., J.C. GUEMEZ, AND B.W. WOLOSZYN. 1985. New locality record of La Laguna Mountain shrew, *Sorex ornatus lagunae* Nelson and Goldman, 1909 in Cape Region of Baja California, Mexico. *Acta Theriologica* 30:157–160.
- WOLOSZYN, D., AND B.W. WOLOSZYN. 1982. Los mamíferos de la Sierra de La Laguna, Baja California Sur. Consejo Nacional de Ciencia y Tecnología, México, D.F.
- WOODMAN, N. 1995. Morphological variation between Pleistocene and Recent samples of *Cryptotis* (Insectivora: Soricidae) from the Yucatan Peninsula, Mexico. *Journal of Mammalogy* 76:223–231.
- . 2002. A new species of small-eared shrew from Columbia and Venezuela (Mammalia: Soricomorpha: Soricidae: genus *Cryptotis*). *Proceedings of the Biological Society of Washington* 115:249–272.
- . 2005. Evolution and biogeography of Mexican small-eared shrews of the *Cryptotis mexicana*-group (Insectivora: Soricidae). Pages 523–534 in V. Sánchez-Cordero and R.A. Medellín, editors, *Contribuciones Mastozoológicas en Homenaje a Bernardo Villa*. Instituto de Biología e Instituto de Ecología, Universidad Nacional Autónoma de México, México City, México.
- WOODMAN, N., AND D.A. CROFT. 2005. Fossil shrews from Honduras and their significance for Late Glacial evolution in body size (Mammalia: Soricidae: *Cryptotis*). *Fieldiana, Geology, New Series* 51:1–30.
- WOODMAN, N., AND J.J.P. MORGAN. 2005. Skeletal morphology of the forefoot in shrews (Mammalia: Soricidae) of the genus *Cryptotis*, as revealed by digital X-rays. *Journal of Morphology* 266:60–73.
- WOODMAN, N., AND R.M. TIMM. 1993. Intraspecific and interspecific variation in the *Cryptotis nigrescens* species complex of small-eared shrews (Insectivora: Soricidae), with the description of a new species from Colombia. *Fieldiana: Zoology, New Series* 74:1–30.
- . 1999. Geographic variation and evolutionary relationships among broad-clawed shrews of the *Cryptotis goldmani*-group (Mammalia: Insectivora: Soricidae). *Fieldiana: Zoology, New Series* 91:1–35.
- . 2000. Taxonomy and evolutionary relationships of Phillips' small-eared shrew, *Cryptotis phillipsii* (Schalldach, 1966), from Oaxaca, Mexico (Mammalia, Insectivora: Soricidae). *Proceedings of the Biological Society of Washington* 113:339–355.

- WRIGHT, S. 1982. Character change, speciation, and the higher taxa. *Evolution* 36:427–443.
- YENSEN, E., AND W.H. CLARK. 1986. Records of desert shrews (*Notiosorex crawfordi*) from Baja California, Mexico. *Southwestern Naturalist* 31:529–530.
- ZIMA, J., L. LUKÁČOVÁ, AND M. MACHOLÁN. 1998. Chromosomal evolution in shrews. Pages 175–218 in J.M. Wójcik and M. Wolsan, editors, *Evolution of shrews*. Mammal Research Institute, Polish Academy of Sciences, Białowieża.

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APPENDIX. Twenty-seven qualitative characters examined and recorded for 3398 specimens representing all 44 taxa of shrews in Mexico.

CRANIUM AND MANDIBLES

1. Pigmentation of teeth—on which teeth pigmentation is present (Figs. 10–13)
2. Color of pigmentation—pale, light, dark, orangish yellow, or red

CRANIUM

3. Median tine on I1—presence (Figs. 4–7) or absence
4. Position of median tine relative to pigment on I1—above (Figs. 4–5), at (Fig. 6), or within (Fig. 7) pigment on body of tooth
5. Groove in 2nd cusp of I1—presence or absence
6. Number of unicuspid (= U)—3 (Fig. 9), 4, or 5 (Fig. 8)
7. Position of U4 in lateral view—completely visible, partially obscured, or not visible
8. Size of U3 relative to U4— $U3 \geq U4$ (Fig. 30) or $U3 < U4$ (Fig. 31)
9. Size of U5 relative to U4—smaller or larger
10. Position of zygomatic processes (Figs. 20–23)—flare laterally, project ventrally, extend posteriorly, or extend dorsoventrally
11. Condition of zygomatic processes (Figs. 20–23)—sharply pointed, medium-large, bulbous, or elliptic
12. Locking mechanism in upper glenoid furrow—presence or absence
13. Roof of glenoid fossa—extending (Fig. 19) or not extending (Fig. 18) laterally from cranium when skull viewed from dorsal aspect
14. Paroccipital processes (Fig. 3c) relative to exoccipitals—lie against (Figs. 37, 39) or extend from (Fig. 38)

MANDIBLES

15. Condition of interarticular area relative to superior condylar facet—not emarginate (Fig. 14), shallowly emarginate (Fig. 15), or deeply emarginate (Figs. 16–17)
16. Position of alveolus of i1 relative to m1 (Fig. 3d–3d')—extending (Figs. 11–12) or not extending (Figs. 10, 13) posteriorly beneath paraconid of m1
17. Long strip of pigment at anteromedial edge of i1—presence (Fig. 26) or absence (Fig. 27)
18. Number of denticles (Figs. 24–25) on i1—1, 2, or 3
19. Depth of interdenticular spaces on i1—shallow (Fig. 25), moderate, or deep (Fig. 24)
20. Number of sections of pigment on i1—1, 2, or 3
21. Angle of coronoid processes—straight or tipped anteriorly relative to horizontal plane of mandible
22. Size of coronoid processes relative to height—slender or broad
23. Position of mental foramen relative to m1—anterior, center, or posterior

PELAGE

24. Guard hairs on hips and rump—length and color
 25. Hairs of dorsal pelage—color of bands and proportion of each
 26. Hairs of ventral pelage—color of bands and proportion of each
 27. Color of tail—bicolored or uniform
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