

SYSTEMATIC REVISION OF  
THE GIANT VINEGARROONS OF THE  
*MASTIGOPROCTUS GIGANTEUS* COMPLEX  
(THELYPHONIDA: THELYPHONIDAE)  
OF NORTH AMERICA

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BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY

Number 418, 62 pp., 19 figures, 5 tables

Issued February 1, 2018

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## ABSTRACT

The North American vinegaroon, *Mastigoproctus giganteus* (Lucas, 1835), is demonstrated to comprise a complex of range-restricted species rather than a single widespread polymorphic species. Seven species are recognized based on morphological characters of the adult males, including the arrangement of spines on the prodorsal margin of the pedipalp trochanter, the position of the episoma on the carapace, the presence of a stridulatory organ on opposing surfaces of the chelicerae and the pedipalp coxa, the presence of a patch of setae on sternite V, and the shape and macrosculpture of the retrolateral surface of the pedipalp femur. The two currently recognized subspecies are elevated to species: *Mastigoproctus mexicanus* (Butler, 1872), stat. nov., and *Mastigoproctus scabrosus* (Pocock, 1902), stat. nov. *Mastigoproctus floridanus* (Lönnerberg, 1897) is revalidated from synonymy with *M. giganteus*. Redescriptions of *M. giganteus* and the other three species, based on both sexes, are provided, and three new species described: *Mastigoproctus cinteotl*, sp. nov., from Tamaulipas, Mexico; *Mastigoproctus tohono*, sp. nov., from Arizona and Sonora, Mexico; *Mastigoproctus vanderi*, sp. nov., from Sonora, Mexico. The present contribution raises the diversity of the Order Thelyphonida Latreille, 1804, in North America from one species to seven. Three species occur in the United States (one each in Arizona, Texas, and Florida), six species occur in Mexico, and two species occur in both countries.

KEYWORDS: Arachnida, Uropygi, whip scorpion, biodiversity

## INTRODUCTION

The arachnid Order Thelyphonida Latreille, 1804, commonly known as whip scorpions or vinegaroons, comprises a single family, Thelyphonidae Lucas, 1835, and four subfamilies: Hypoetmoninae Pocock, 1899; Mastigoproctinae Speijer, 1933; Thelyphoninae Lucas, 1835, and Typopeltinae Rowland and Cooke, 1973. Thelyphonida is among the smallest arachnid orders, comprising 15 extant genera and 121 species, as well as five extinct genera, for a total of 20 genera and 128 species worldwide (Harvey, 2013; Zhang, 2013). *Mastigoproctus* Pocock, 1894, is one of three genera in Mastigoproctinae and comprises 16 species and three subspecies endemic to the New World. Two species of *Mastigoproctus* occur in North America, *Mastigoproctus lacandonesis* Ballesteros and Francke, 2006, from southern Mexico, and *Mastigoproctus giganteus* (Lucas, 1835) (fig. 1), with two subspecies in addition to the nominotypical form: *Mastigoproctus giganteus mexicanus* (Butler, 1872) and *Mastigoproctus giganteus scabrosus* Pocock, 1902 (Ballesteros and Francke, 2006; Harvey, 2013). *Mastigoproctus giganteus* is widespread in central and northern Mexico and in Arizona, Texas, and Florida in

the southern United States (fig. 2). The habitats occupied by this species vary from pasturelands to pine/oak forest at altitudes ranging from 10–2440 m above sea level.

The taxonomic history of *M. giganteus* has involved a series of descriptions and synonymies over time. The species was originally described as *Thelyphonus giganteus* Lucas, 1835, and its type locality given simply as “Mexico.” *Thelyphonus excubitor* Girard, 1854, was subsequently described from Red River, “Louisiana,” and synonymized soon after with *T. giganteus* (Wood, 1863). Two more species were described subsequently: *Thelyphonus mexicanus* Butler, 1872, with type locality “Mexico,” and *Thelyphonus rufus* Butler, 1872, from an unknown locality. *Thelyphonus rufus* was synonymized with *T. giganteus* by Pocock (1894), who transferred *T. giganteus* to *Mastigoproctus*. The first subspecies of *M. giganteus*, *Mastigoproctus giganteus floridanus* Lönnerberg, 1897, with type locality “Florida,” described subsequently, was synonymized soon after with the nominotypical form (Kraepelin, 1899). Pocock (1902a) later reduced *T. mexicanus* to a subspecies of *M. giganteus*, *Mastigoproctus giganteus mexicanus* (Butler, 1872), and







added another subspecies, *Mastigoproctus giganteus scabrosus* Pocock, 1902, with type locality Playa Vicente, Oaxaca.

More than a century has passed since Pocock's (1902a) study of *M. giganteus*, and the validity of its synonyms and subspecies was not reassessed until now. After thorough revision of the holdings of several North American collections, morphological characters were identified that clearly separate various populations of *M. giganteus*, including the subspecies previously recognized by Lönnberg (1897) and Pocock (1902a), into distinct species, leading to the conclusion that *M. giganteus* is a complex of range-restricted species rather than a single widespread polymorphic species. In the present contribution, seven species are recognized based on morphological characters of the adult males. A detailed and comparative examination was conducted to identify diagnostic characters and detect variation possibly caused by wear, as previously reported by Haupt (1997, 2009) in the thelyphonid genus *Typopeltis* Pocock, 1894. Some characters, e.g., the shape and surface macrosculpture of the retrolateral surface of the pedipalp femur and the arrangement of spines on the prodorsal margin of the pedipalp trochanter, were first applied by Pocock (1902a) to diagnose the subspecies. Other characters, e.g., the position of the epistoma on the carapace or the presence of a patch of setae on sternites V–VII, demonstrated the importance of examining large series of specimens from multiple locations, to identify diagnostic characters that differ consistently among heterospecific populations and are invariant among conspecific populations. The absence of adequate series of material of both sexes alone accounts for the taxonomic confusion up to and including the time of Pocock's (1902a) study.

Consistent with the morphological differences identified, the distributional data presented herein revealed that morphologically diagnosable species are also geographically allopatric, each inhabiting a different biogeographical province (Morrone, 2006), and implying they are reproductively isolated and, hence, biological species. Few works have investigated courtship behavior in *M. giganteus*, but Punzo and Reeves (2001) reported differences in the behavior of *M. giganteus* populations from Florida and Texas, findings that corroborate their recognition as different species, presented herein.

Based on these discoveries, the two currently recognized subspecies are hereby elevated to species: *Mastigoproctus mexicanus* (Butler, 1872), stat. nov.; *Mastigoproctus scabrosus* (Pocock, 1902), stat. nov. *Mastigoproctus floridanus* (Lönnberg, 1897) is revalidated from synonymy with *M. giganteus*. Redescriptions of *M. giganteus* and the three species, based on both sexes, are provided, and three new species described: *Mastigoproctus cinteotl*, sp. nov., from Tamaulipas, Mexico; *Mastigoproctus tohono*, sp. nov., from Arizona and Sonora, Mexico; *Mastigoproctus vandevenderi*, sp. nov., from Sonora, Mexico.

The present contribution raises the diversity of the Order Thelyphonida in North America from one species to seven. Three species occur in the United States (one each in Arizona, Texas, and Florida), six species occur in Mexico, and two species occur in both countries. This contribution is not the last word, however. Morphological and DNA-sequence data from singletons and juvenile specimens have revealed the existence of additional species in Mexico, the recognition of which awaits the collection of adult males (Barrales-Alcalá et al., in prep.).

FIG. 1. Species of *Mastigoproctus* Pocock, 1894, habitus in life (A–D) and representative habitats (E–H). **A.** *M. vandevenderi*, sp. nov., ♂. **B.** *M. giganteus* (Lucas, 1835), ♀. **C.** *M. cinteotl*, sp. nov., ♂. **D.** *M. giganteus* (Lucas, 1835), ♂. **E.** Cuernavaca, Municipio Cuernavaca, Morelos, Mexico, habitat of *M. giganteus*. **F.** Cascada de Atoyac, Municipio Atoyac, Veracruz, Mexico, habitat of *M. scabrosus* (Pocock, 1902), stat. nov. **G.** El Cielo, Municipio Gómez Farías, Tamaulipas, Mexico, habitat of *M. cinteotl*, sp. nov. **H.** Puerto La Cruz, Municipio Yecora, Sonora, Mexico, habitat of *M. vandevenderi*. Photographs courtesy of Griselda Montiel (C, G) and Ricardo Paredes (E).

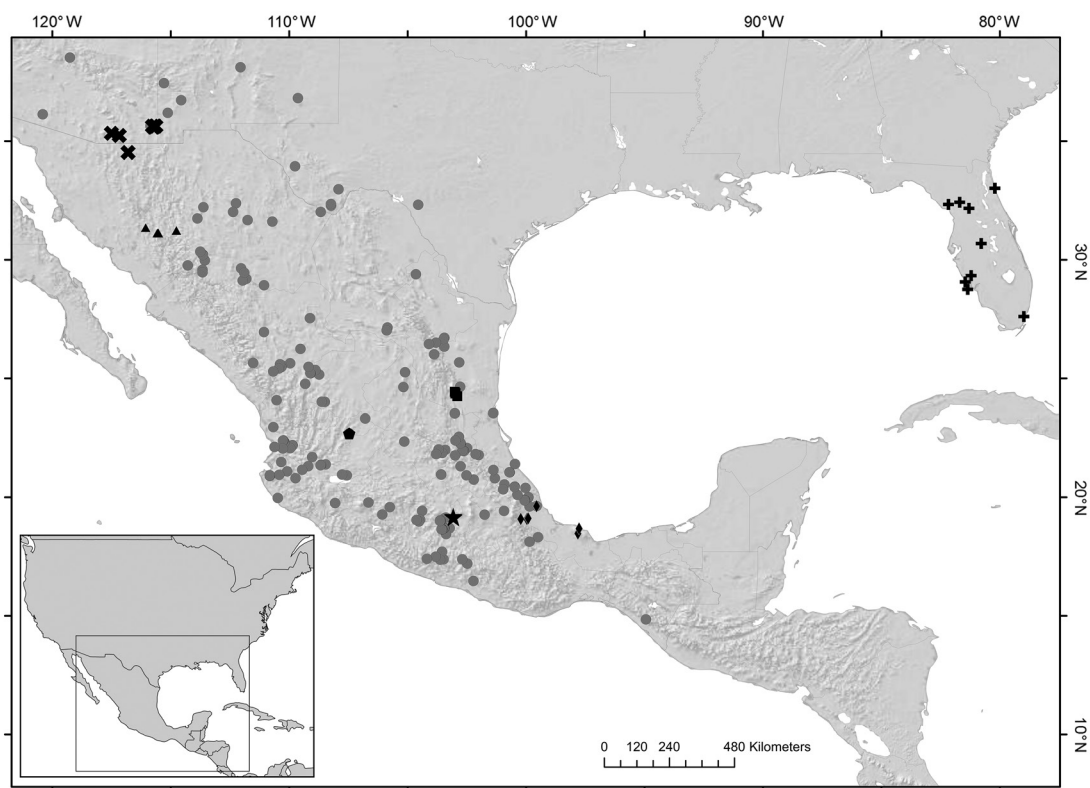


FIG. 2. Map of southwestern North America, plotting known localities of *Mastigoproctus* Pocock, 1894, from museum collections, databases, and the literature (gray circles), and species verified by examination of adult male specimens: *M. giganteus*, stat. nov. (black star); *M. floridanus* (Lönnberg, 1897), stat. nov. (black crosses); *M. mexicanus* (Butler, 1872), stat. nov. (black pentagon); *M. scabrosus* (Pocock, 1902), stat. nov. (black diamonds); *M. cinteotl*, sp. nov. (black squares); *M. tohono*, sp. nov. (black x's); *M. vandevederi*, sp. nov. (black triangles).

## MATERIAL AND METHODS

Material examined is deposited in the following collections: American Museum of Natural History (AMNH), New York; California Academy of Sciences (CAS), San Francisco; National Collection of Arachnids (CNAN), Institute of Biology, National Autonomous University of Mexico (IBUNAM), Mexico City; Anita Hoffmann Laboratory, Faculty of Science, National Autonomous University of Mexico (FCUNAM), Mexico City; Florida State Collection of Arthropods (FSCA), Gainesville.

Unfortunately, it was impossible to examine the type specimens of *M. giganteus*, which

appear to be lost (J.C. Huff, personal commun.). In the absence of type specimens, topotypes were the next point of reference. Due to the allopatric distributions of *Mastigoproctus* species, it was often possible to determine the identity of specimens when collection localities were listed in publications. One of the greatest difficulties encountered during the present study, however, was to identify the type localities of previously described taxa which, in many cases were ambiguous or nonexistent, e.g., the type locality of *M. giganteus* and *M. g. mexicanus*, reported as "Mexico." This problem was solved in part by detailed examination of the plates published by Lucas (1835), Butler (1872),

and Pocock (1902a), in which pedipalp shapes were faithfully represented, and comparison of those illustrations with specimens. In the case of *M. giganteus*, the morphotype in the illustrations of Lucas (1835) closely matches that occurring near Cuernavaca, Morelos, 80 km south of Mexico City, both places inhabited by humans prior to the arrival of the Spanish in 1519, and important population centers by the 19th century (Alvarez et al., 1973). Therefore, it may reasonably be deduced that the type locality of *M. giganteus* is located near Cuernavaca. Similarly, in the case of *M. mexicanus*, the only morphotypes that match the illustrations of Butler (1872) and Pocock (1902a) occur in Calvillo, Aguascalientes, and Yecora, Sonora. However, only Aguascalientes was inhabited by humans in the 19th century and readily accessible by road (Alvarez et al., 1973). Yecora was isolated and inaccessible in the mountains when the holotype of *M. mexicanus* was collected, i.e., before 1872.

The identification key, species diagnoses, and descriptions presented herein are based primarily on adult male specimens, which provide most of the diagnostic characters. Chelicerae were dissected using needles and forceps, and prepared for scanning electron microscopy (SEM) as described by Cruz-López and Francke (2016). Spermathecae were dissected using fine-tipped needles and scissors, removing as much adipose tissue as possible before placement into a 10% KOH solution for 24 hours at room temperature, followed by gently rinsing in distilled water. After cleaning, spermathecae were stained with chlorazol black stain, following Carayon (1969).

Morphological terminology and measurements follow Huff et al. (2008) and Huff and Prendini (2009). Measurements (millimeters) were taken with ULTRATECH digital Vernier calipers and an ocular micrometer attached to a Nikon SMZ660 stereomicroscope. Spines along the prodorsal margin of the pedipalp trochanter were numbered consecutively from proximal to distal (fig. 3). Vinegaroons often present setiferous tubercles; either raised knobs of cuticle in

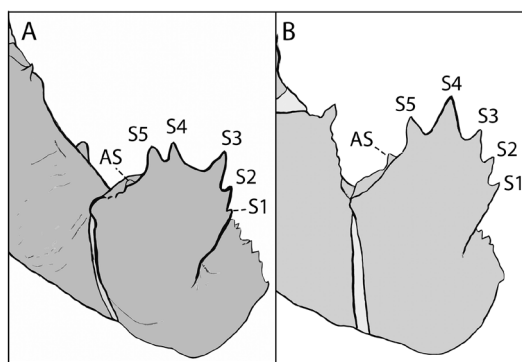


FIG. 3. *Mastigoproctus* Pocock, 1894, ♂ (A), ♀ (B), pedipalp trochanter, dorsal aspect, schematic illustration of spines along prodorsal margin. Abbreviations: AS: Accessory Spine; S1–S5: Spines 1–5, numbered from proximal to distal part of trochanter.

which a macroseta is inserted, or small semicircular ridges (cristula) on one side of the macrosetal insertions; therefore, subterminal accessory spines (AS) on the trochanter were noted only if not associated with macrosetae, i.e., if they were true spines and not setiferous tubercles.

Habitus, carapace, and pedipalp images were taken using a Nikon D5500 DSLR camera attached to a Firenze Mini Repro copy stand and prepared using Adobe Photoshop CS6. Scanning electron micrographs of chelicerae and pedipalp coxae were taken by accelerating voltages of 10–20 kV under high vacuum with a Hitachi SU1510 SEM at IBU-NAM. Images of chelicerae, pedipalp trochanters, and spermathecae were taken using an 8 megapixel Leica DFC490 digital camera attached to a Leica Z16 APO A stereomicroscope and prepared using Leica Application Suite Version 4.3.0 (Build: 600).

All locality records of sufficient accuracy were isolated from the material examined, published literature, the CNAN collections database, and GBIF (2017) to create a point-locality geographical dataset for mapping the distributionals of *Mastigoproctus* species. Records of *Mastigoproctus* species verified by examination of adult male specimens were plotted separately from other *Mastigoproctus* records. The distribution map was produced using ArcView GIS Version 10.4 (Environmental Systems



Research Institute, Redlands, CA), by superimposing point-locality records on spatial datasets depicting the topography and political boundaries of North America obtained from the U.S. Geological Survey ([http://goto.arcgisonline.com/maps/World\\_Shaded\\_Relief](http://goto.arcgisonline.com/maps/World_Shaded_Relief)).

## SYSTEMATICS

Family Thelyphonidae Lucas, 1835

Subfamily Mastigoproctinae Speijer, 1933

*Mastigoproctus* Pocock, 1894

Figures 1–20, tables 1–5

*Mastigoproctus* Pocock, 1894: 129, 130; Kraepelin, 1897: 36; Kraepelin, 1899: 223; Pocock, 1902a: 46; Shipley, 1909: 312; Hirst, 1912: 237; Hartline, 1923: 148, 149; Mello-Leitão, 1931: 25; Werner, 1935: 468; Takashima, 1947: 42; Snodgrass, 1948: 12, 27; Roewer, 1954: 57; Besch, 1969: 728; Weygoldt, 1972a: 23, 24, 29, 44, 45, 48; Rowland and Cooke, 1973: 68; Phillips, 1976: 397, 401, 403; Weygoldt, 1978: 145, 146, 154, 155; Valerio, 1981: 15; Mann, 1984: 149, 150; Legendre, 1985: 44; Haupt et al., 1988: 883; Weygoldt, 1988: 189, 190, 194; Ruppert and Barnes, 1994: 334; Barriel and Tassy, 1998: 199, fig. 3; Dunlop, 1998: 291, 293, 294; Proctor, 1998: 160; Armas and Maes, 1999: 14; Shultz, 1999: 92, 96, 104, 105, 109, 111; Armas, 2000: 2; Ax, 2000: 103, 390; Adis et al., 2002: 8; Armas, 2002: 42; Dunlop and Martill, 2002: 329; Harvey, 2002: 363; Rowland, 2002: 194, 195; Giribet, 2003: 558, fig. 1; Harvey, 2003: 65; Armas, 2004: 23, 24; Regier et al., 2005: 396, fig. 1; Viquez and Armas, 2005: 95, 96, 98; 2006: 37; Ballesteros and Francke, 2006: 156; Punzo, 2006: 266; Viquez and Armas, 2007: 39–42; Armas and Viquez, 2007: 508; Dunlop et al., 2007: 124, 125; Huff et al., 2008: 1, 2; Dunlop and Tetlie, 2008: 551; Giupponi and

De Vasconcelos, 2008: 18; Tetlie and Dunlop, 2008: 299; Teruel and Armas, 2008: 32; Armas et al., 2009: 4; Beccaloni, 2009: 113, 115–117, 124; Haupt, 2009: 15, 18; Villareal and Giupponi, 2009: 145, 146; Lukhtanov and Kuznetsova, 2010: 1117, fig. 2; Teruel, 2010: 193; McMonigle, 2013: 7, 10, 12, 16, 26, 28, 30, 31, 49–52, 55–57, 59, 65, 68, 77, 80–82, 85, 88, 89, 91, 94, 98, 99, 102, 106, 107, 112, figs. unnumbered, 4–6, 8, 9, 14, 27–29, 33, 34, 36, 37, 47, 49, 53, 54, 58, 60, 61, 66, 68, 79, 82–84, 86, 90, 91, 94, 97; Weygoldt and Huber, 2013: 348; Maquart et al., 2016: 79; Monjaraz-Ruedas et al., 2016: 120; Selden et al., 2016: 7; Chenyang and Huang, 2017: 101, 104.

**DIAGNOSIS:** *Mastigoproctus* differs from *Mayacentrum* Viquez and Armas, 2006, *Ravilops* Viquez and Armas, 2005, and *Thelyphonellus* Pocock, 1894, in the presence of a well-developed carina that extends from the lateral ocelli approximately two-thirds the length of the carapace toward the median ocular tubercle. *Mastigoproctus* differs further from *Thelyphonellus* in the presence of a pair of pygidial ommatoids, which are absent in the latter genera, and from *Ravilops* by the shape and macrosculpture of the pedipalps, which are elongate, punctate, and tuberculate in *Mastigoproctus*, but short and smooth in *Ravilops*. Additionally, *Mastigoproctus* differs from *Mayacentrum* in the structure of the tergites and sternites. Only the anterior tergites (I–III) are divided medially in *Mastigoproctus*, whereas all tergites are partially or completely divided in *Mayacentrum*, and sternites II and III are unmodified or with at most vague lateral swellings in the adult male of *Mastigoproctus*, whereas sternites II and III are distinctly bilobed in the adult male of *Mayacentrum*.

*Mastigoproctus* differs from *Mimoscorpius* Pocock, 1894, as follows. The pedipalp femur of the adult male bears a pair of teeth, one on the retroventral surface and one on the proventral surface, in *Mastigoproctus* whereas only one

tooth is present on the proventral surface in *Mimoscorpius*. The pedipalp tibia of the adult male is distinctly longer than wide in *Mastigoproctus* but almost as wide as long in *Mimoscorpius*. The tibiae of legs II–IV each possess a single ventrodistal spur in *Mastigoproctus* whereas two ventrodistal spurs are present in *Mimoscorpius*. The seminal receptacles are short, triangular, and posteriorly directed in *Mastigoproctus* but tubular and kidney shaped in *Mimoscorpius*.

*Mastigoproctus* differs from *Valeriphonus* Viquez and Armas, 2005, as follows. The tibiae of legs II–IV each possess a single ventrodistal spur in *Mastigoproctus* whereas a ventrodistal spur is present only on the tibia of leg IV in *Valeriphonus*. The pedipalp of *Mastigoproctus* is elongate and without a lobe on the retrolateral surface of the fixed finger, whereas the pedipalp of *Valeriphonus* is short and robust, with a pronounced lobe on the retrolateral surface of the fixed finger. The macrosetae comprising the stridulatory surface of the pedipalp coxa are randomly scattered in *Mastigoproctus* but evenly aligned in *Valeriphonus*.

#### KEY TO SPECIES OF THE *MASTIGOPROCTUS GIGANTEUS* COMPLEX

1. Chelicerae and pedipalp coxae, opposing surfaces with stridulatory organ (pars stridens and plectrum, respectively) (figs. 4A–D, F–H, 5A–D, F–H, 6A–D, F–H).....3
  - Chelicerae and pedipalp coxae, opposing surfaces without stridulatory organ (figs. 4E, 5E, 6E).....*M. scabrosus*, stat. nov.
2. Sternite V, medial surface with patch of fine macrosetae (♂); pedipalp trochanter, prodorsal margin with spines S3 and S4 subequal or variable in size, unequal, distance between them equal to or less than length of longest spine (figs. 7A, C, E, G, 8C, E); pedipalp femur and tibia, retrolateral surfaces tuberculate or punctate, femur retrolateral margin smooth or punctate, never cristulate (fig. 9A–B, D–E, G–H).....4
  - Sternite V, medial surface asetose (♂); pedipalp trochanter, prodorsal margin with spines S3 and S4 similar in size, both longer than distance between them (fig. 8A); pedipalp tibia and femur, retrolateral surfaces markedly punctate, femur retrolateral margin cristulate (fig. 9F).....*M. cinteotl*, sp. nov.
3. Carapace, epistoma visible in dorsal aspect (fig. 10A, B, E, F); pedipalp tibia, retrolateral surface tuberculate or punctate (fig. 9A, D, E, H).....5
  - Carapace, epistoma not visible in dorsal aspect (fig. 10H); pedipalp tibia, retrolateral surface markedly punctate (fig. 9G) .....*M. tohono*, sp. nov.
4. Pedipalp trochanter, prodorsal margin with five sharp spines (♂); pedipalp femur, retrolateral surface tuberculate or punctate.....6
  - Pedipalp trochanter, prodorsal margin with five spines, spine S4 short and blunt (♂); pedipalp femur, retrolateral surface punctate (fig. 9D).....*M. floridanus*, stat. nov.
5. Pedipalp femur, retrolateral surface with long digitiform tubercles, retrolateral margin not cristulate (♂) (fig. 9E, H).....7
  - Pedipalp femur, retrolateral surface markedly punctate, retrolateral margin cristulate (♂) (fig. 9A).....*M. giganteus*
6. Pedipalps densely setose; trochanter, prodorsal margin with spine S3 longer than others (♂), distance between S3 and S4 approximately equal to length of S3 (fig. 7E); femur, retrolateral surface with one macroseta at base of each tubercle (fig. 9E); carapace, anterior margin serrate, carinae present between anterior margin and median ocular tubercle (fig. 10B); spermatheca neck wide, seminal receptacles anteriorly directed (fig. 11E, F).....*M. mexicanus*, stat. nov.
  - Pedipalps sparsely setose; trochanter, prodorsal margin with spine S3 equal to or longer than S4, both longer than others (♂), distance between them equal to or greater than length of longest spine (fig. 8E); femur, retrolateral surface without macroseta at base of each tubercle (fig. 9H); carapace, anterior margin almost smooth, carinae between

anterior margin and median ocular tubercle absent (fig. 10D); spermatheca neck narrow, seminal receptacles posteriorly directed (fig. 12E, F).....*M. vandevenderi*, sp. nov.

*Mastigoproctus giganteus* (Lucas, 1835)

Figure 13A–D; table 1

*Thelyphonus giganteus* Lucas, 1835: unpaginated, pl. 8; Lamarck, 1838: 117; C.L. Koch, 1843: 21, 22, figs. 767, 768; Gervais, 1844: 12; C.L. Koch, 1850: 85; Wood, 1863: 374; Butler, 1872: 201; Marx, 1888: 42; 1892: 252–254; 1893: 54, 55.

*Thelyphonus excubitor* Girard, 1854: 236–238, pl. XVII, figs. 1–4 (synonymized by Wood, 1863: 374).

*Thelyphonus rufus* Butler, 1872: 205, 206, fig. 8 (synonymized by Pocock, 1894: 130).

*Thelyphonus* (?) *rufus*: Tarnani, 1890: 538.

*Thelyphonus* (?) *giganteus*: Tarnani, 1890: 538.

*Mastigoproctus giganteus*: Pocock, 1894: 130; Kraepelin, 1897: 37, 38, figs. 10b, 38b; Lönnberg, 1897: 190; Banks, 1898: 289; Kraepelin, 1899: 224 (part); Banks, 1900: 422 (part); Kraepelin, 1901: 263; Pocock, 1902a: 47, pl. X, figs. 1–4; 1902b: 170, figs. 40a, 41a, b; 1902c: figs. 2, 9; Werner, 1902: 606; Börner, 1904: 5, text figs. 9a, b, 19, 60, figs. 4, 6, 49, 50, 56–58, 61, 97; Tarnani, 1905: xi; Comstock, 1913: 19, fig. 14 (part); Petrunkevitch, 1913: pp. fig. 17; Patten, 1917: 251–275, figs. 1, 3, 4; Bradley, 1919: 435, 437, fig. 2; Barrows, 1925: 500, figs. 34, 35; Franganillo, 1930: 92 (misidentification); 1931: 48 (misidentification); Mello-Leitão, 1931: 27, fig. 11; Kästner, 1932: figs. 19, 37, 65; Werner, 1935: 468, figs. 21a, 27, 37, 42, 43, 52, 66, 75, 80, 97; Snodgrass, 1948: 11, 27–31, figs. 4a, 5b, 9a–h; Gertsch, 1949: 17; Millot, 1949a: fig. 49; 1949b: figs. 287, 290, 292a, b, 294a, b, 297a, b, 298, 299; Petrunkevitch, 1949: figs. 1, 2, 31, 33, 43–46, 49–52 (part); 1952: 5, fig. 1 (part); Henry, 1954: 2, 3, figs. 1, 2;

Petrunkevitch, 1955: figs. 33(2), 84(2); Janetschek, 1957: figs. 5, 6; Eisner et al., 1961: 272–297, figs. 1–22 (part); Savory, 1964: 166 (part); Waterhouse, and Gilby, 1964: 986; Roth and Eisner, 1962: 112, 115, 120; Kästner, 1965: fig. 514; Barr and Reddell, 1967: 259; Cloudsley-Thompson, 1968: 146–148; Kästner, 1968: 117, 119, figs. 10(1); Legendre, 1968: 36, fig. 27; Levi et al., 1968: 116, fig.; Peters, 1968: 337, fig. 1C; Besch, 1969: 730, fig. 6; Horne, 1969: 155–159; Weygoldt, 1969: 353, 356, fig. 8; Reddell, 1971: 28; Crawford, 1972: 531; Weygoldt, 1972a: 23, 29, 34, 45, figs. 3a–c, 6b, 7a–d, 13b; 1972b: figs. 5a–e, 6; Firstman, 1973: 5, 22, 23, figs. 14, 15; Rowland and Cooke, 1973: 68; Cutler and Richards, 1974: 1394; Weygoldt, 1975a: 311; 1975b: figs. 2a–e, 5a–c; Phillips, 1976: 397, 398, fig. 1; Ase, 1978: 238, 241, figs. 21–23; Yogi and Haupt, 1977: 53, 55; Cloudsley-Thompson, 1978: 186, 188; García Acosta, 1980: 43; Haupt et al., 1980: 205–213, figs. 1–8; Levi, 1982: 74, pl. 94; Courtens et al., 1983: 238; Homann, 1985: 70; Itokawa et al., 1985: 65, 66; Ahmed et al., 1986: 296, 301; Haupt et al., 1988: 883; Shultz, 1989: 11, figs. 1d, 5d, 9d, 15d; Codrington et al., 1990: 11; Crawford, 1990: 432–434, fig. 16.5; Meinwald, 1990: 27; Weygoldt, 1990: 84, 85, figs. 2C, 2E; Selden et al., 1991: 245, fig. 5; Shultz, 1992a: 148–150, figs. 1, 2; 1993: 335–365, figs. 1, 2a–c, 3a, b, 4a–d, 5a, b, 6, 7a, b, 8, 9a, b; Wheeler et al., 1993: 20; Dunlop, 1994: 267; Caycho, 1994: 171; Ruppert and Barnes, 1994: 633, 634, figs. 13–13; Meinwald and Eisner, 1995: 14, fig. 1C; Vázquez-Rojas, 1995: 35, 36; Wheeler, 1995: 324, table 1, figs. 2, 8a, 8b, 8c, 9; Vázquez-Rojas, 1996: 67–69; Wheeler, 1996: 5; Regier and Shultz, 1997: 905; Wheeler, 1997: 89; Farris and Källersjö, 1998: 165; Selden and Dunlop, 1998: 293, 294; Wheeler and Hayashi, 1998: 179; Shultz, 1999: 82, 88; Punzo, 2000: 385–387; Alberti, 2000: 213,



fig. 5a; Ax, 2000: 104, figs. 47b–g; Klompen, 2000: 808; Shultz, 2000: 403, 404; Coddington and Colwell, 2001: 211; Giribet et al., 2001: 158; Dunlop and Martill, 2002: 329, 332, figs. 5a, b; Giribet et al., 2002: 14; Weis and Melzer, 2012: 364, 365; Weygoldt, 2002: 466–468, fig. 634; Harvey, 2003: 66; Attygalle et al., 2004: 581; Haupt, 2004: 159, figs. 3a–d; Haupt and Müller, 2004: 579, 580; Giribet et al., 2005: 323; Punzo and Olsen, 2005: 206–211; Ballesteros and Francke, 2006: 156–161; Hassanin, 2006: 101, 103, 113; Punzo, 2006: 266–268; Dunlop et al., 2007: 125; Jones et al., 2007: 586, 588; Klompen et al., 2007: 940; Bourlat et al., 2008: 25; Huff et al., 2008: 1–9; Masta and Boore, 2008: 950, 953; Regier et al., 2008: 923; Schönhofer and Martens, 2008: 526; Beccaloni, 2009: 111, 117, 120, 122, 123, 125, 126, figs. unnumbered 112, 118; Carrel and Britt, 2009: 500–502, figs. 1–4; Haupt, 2009: 14–16, figs. 1, 4, 10; Kern and Mitchell, 2011: 2, 4, figs. 1–5 (part); Klimov and OConnor, 2009: 604, 605; Giribet et al., 2010: 413; Ferreira et al., 2011: 8, 10; Heethoff et al., 2011: 1041; Rehm et al., 2012: 3, 5, 11, fig. 1; Van den Borne et al., 2012: 447; Armas, 2013: 91–94; Hembree, 2013: 141–162 (part); Kropf, 2013: 43–56; Lamsdell, 2013: 1–27; Marchioro et al., 2013: 580–603; McMonigle, 2013: figs. unnumbered 69–76, 101 (part); Schmerge et al., 2013: 116–128; Borner et al., 2014: 79–87; Raguraman and Kannan, 2014: 173–205; Redmond, 2014: 120; Sharma and Giribet, 2014: 255; Sharma and Wheeler, 2014: 57; Sharma et al., 2014: 2964, 2966, 2980, fig. 11; Teruel and Rodriguez-Cabrera, 2014: 115–117; Ferreira, 2015: 3; Hils and Hembree, 2015: 1–62, fig. 4(3); Karasawa et al., 2015: 352–363; Nguyen and Hermansen, 2015: 81–94 (misidentification); Shear, 2015: 78–117; Wolff and Strausfeld, 2015: 38–44, fig. 2(1); Yamasaki et al., 2015: 18; Barrales-Alcalá et al., 2016: 26, 46, figs. 1A–D; Cabezas-Cruz et al., 2016: 303–319; Pinto dos

Santos et al., 2016: 1179–1193; Fernandez et al., 2016: 874, 877, fig. 2; Gomes and Palma, 2016: 3–19; Hembree, 2016: 262–297, figs. 2B, 4D, 7A–E; Klußmann-Fricke and Wirkner, 2016: 1084–1103; Lerma et al., 2016: 293–298; Miether and Dunlop, 2016: 103–119, fig. 5K; Monjaraz-Ruedas et al., 2016: 118–134, fig. 6A, B (part); Starrett et al., 2016; Watari and Komine, 2016: 49–54; Clouse et al., 2017: 2, 5–7, fig. 1d; Cruz-García et al., 2017: 705, 706; Gallant and Hochberg, 2017: 7, 8, 11, figs. 2, 3, 6; Nurhayati et al., 2017: 33, 35, 38; Sabroux et al., 2017: 5, 29; Grams et al., in press: 5, 8, 20, 33, figs. 1, 5, 9.

*Mastigoproctus giganteus giganteus*: Pocock, 1902c: 47; Harvey, 2003: 67; Barrales-Alcalá et al., 2016: 26, 46, fig. 2A–D.

TYPE MATERIAL: *Thelyphonus giganteus*: holotype ♀, Mexico (Museum National d'Histoire Naturelle, Paris) [not examined]. *Thelyphonus excubitor*: holotype ♀, Red River, "Louisiana" (Museum National d'Histoire Naturelle, Paris?) [not examined]. *Thelyphonus rufus*: holotype ♀ (Natural History Museum, London?) [not examined].

DIAGNOSIS: *Mastigoproctus giganteus* resembles *M. floridanus* and *M. tohono*, sp. nov., from which it differs as follows. The carapace epistoma is visible in dorsal aspect in *M. giganteus* but not in *M. tohono*. Spines S1–S5 on the prodorsal margin of the pedipalp trochanter of the adult male are all sharply pointed in *M. giganteus* whereas spines S4 and S5 are blunt in *M. floridanus* and *M. tohono*. The punctures on the retrolateral surface of the pedipalp femur are markedly cristulate, providing a rugose texture in *M. giganteus*, whereas the punctures are weakly cristulate in *M. tohono*, and not cristulate in *M. floridanus*.

DESCRIPTION: The following description is based on five males and four females.

*Total length*: Maximum length from anterior margin of carapace to posterior margin of opistho-

somal segment XII (pygidium) in adult specimens 60.1 mm (♂) and 62.4 mm (♀) (table 1).

*Color:* Carapace dark reddish brown, anterior and lateral margins dark brown. Tergites I–IX dark reddish brown, posterior and lateral margins darker. Sternite I dark reddish brown; II and III light brown; IV–IX and pygidium dark reddish brown. Flagellum brown, segments with reddish-brown macrosetae. Pedipalp trochanter, femur, patella, and tibia dark reddish brown, mesal surfaces with reddish macrosetae; patellar apophysis, fixed finger, and basitarsus blackish, with few reddish macrosetae. Legs I–IV reddish brown; II–IV coxae, ventral surfaces reddish brown.

*Carapace:* Epistoma visible in dorsal aspect. Pair of strongly developed carinae anterolaterally, extending from lateral ocelli to two-thirds the distance to median ocular tubercle (fig. 10A, E). Three pairs of lateral ocelli; anterior ocelli larger than median and posterior ocelli; anterior two pairs slightly separated from posterior pair by tubercle, distance between median and posterior ocelli three times distance between anterior and median ocelli. Median ocular tubercle smooth, situated in anterior 10% of carapace (table 1); distance between ocelli almost 1.5× ocular diameter. Carapace surfaces granular, with sclerotized crests mediolaterally. Posterior fovea present, distinct.

*Chelicerae:* Retrolateral surface with stridulatory surface (plectrum), comprising approximately 20 long, stout (ca. 13 times longer than wide), anteroventrally directed spiniform macrosetae (figs. 4A, B, 5A, B); mesal surface with few short, stout, anteroventrally directed spiniform macrosetae.

*Pedipalps:* Cuticle punctate with cristulae on retrolateral surface. Coxa, retrolateral surface punctate; ventral surface smooth; coxal apophysis with one terminal spine; prodorsal surface with long, retroventrally directed macrosetae inserted in cristulae, forming stridulatory surface (pars stridens) (fig. 6A, B). Trochanter longer than wide (♂), or subequal (♀); retrodorsal surface punctate and setose; prodorsal margin with five sharply pointed terminal spines (S1–S5) and

one subterminal accessory spine (AS), varying in size such that  $S3 \geq S4 > S5 > S2 > S1 > AS$  (♂; fig. 7A) or  $S4 > S5 \geq S3 > S2 > S1 \geq AS$  (♀; fig. 7B); space between S3 and S4 equal to or greater than length of S3 (♂) or equal to space between S4 and S5 (♀); prolateral surface with several spiniform tubercles and reddish setae (♂); proventral margin with two spines (♂). Femur laterally compressed (♂) or terete (♀), variable in length, two (♀) to three (♂) times longer than wide (table 1); prolateral surface with two spines, one prodorsal, short, sharply pointed, the other proventral, tubular, with sharp projection terminally, length one-quarter to one-sixth femur width (♂; fig. 9A) or short, sharply pointed, and situated apically (♀; fig. 9B); retrolateral surface rugose, with cristulae (♂) and punctate. Patella slightly shorter (♂) or longer (♀) than tibia (table 1); prolateral surface with reddish macrosetae and vestigial (♂) or distinct (♀) spine situated distally on proventral margin; one spine at base of patellar apophysis; retrolateral surface with cristulae proximally (♂) and punctate. Patellar apophysis elongated, almost one-quarter carapace length, punctate and slender (♂) or shorter and robust (♀); prolateral margin with row of blunt denticles; retrolateral margin smooth (♂) or denticulate (♀), with subterminal macrosetae. Tibia longer than wide, laterally compressed; prodorsal surface with sparse row of denticles; prolateral surface sparsely punctate, with reddish macrosetae; proventral margin with two spines distally; fixed finger, dorsal and ventral margins each with row of denticles. Basitarsus (movable finger), dorsal and ventral margins each with serrate row of denticles; prolateral surface with several reddish macrosetae; apex bifid (♂).

*Legs:* Surfaces setose. Leg I, basitarsal and telotarsal tarsomeres I–VII gradually decreasing in length, with tarsomere I longest, tarsomere VIII two-thirds length of tarsomere I. Legs I–III coxae, lateral surfaces and IV, dorsal surface each with setose spiniform tubercles. Legs II–IV trochanters, dorsal and lateral surfaces with setose spiniform tubercles; femora dorsal surfaces with setose spi-

TABLE 1

**Measurements (mm) of *Mastigoproctus giganteus* (Lucas, 1835)  
from Cuernavaca, Morelos, Mexico**

Material deposited in the National Collection of Arachnids (CNAN), Institute of Biology,  
National Autonomous University of Mexico, Mexico City.

Sex	♂					♀			
Collection	CNAN					CNAN			
Code	[Ur23]	[Ur69]	[Ur127]	[Ur139]	[RPL1606]	[Ur18]	[Ur73]	[Ur92]	[Ur84]
Total length	60.1	54.0	67.0	46.6	57.6	62.4	57.2	57.3	55.6
Pedipalp									
Trochanter length	6.8	5.6	8.2	5.6	4.3	5.3	6.3	5.0	5.0
Trochanter width	4.6	5.0	6.7	4.8	5.4	5.4	5.4	5.3	4.9
Femur length	15.1	12.4	18.0	10.5	12.5	9.4	9.4	8.8	8.7
Femur width	5.2	4.4	5.8	3.6	4.3	4.5	4.8	4.7	4.1
Ventromesal spine length	0.8	0.8	1.2	0.8	1.2	1.3	1.2	1.3	1.2
Ventromesal spine width	0.6	0.5	0.7	0.4	0.5	0.6	0.4	0.5	0.4
Patella length	9.9	7.9	11.6	6.9	8.4	6.4	6.1	5.5	5.8
Patella width	5.2	4.4	5.7	3.7	4.2	3.9	4.1	3.4	3.8
Patellar apophysis length	5.4	4.3	6.1	3.5	4.5	3.7	3.9	3.5	2.9
Patellar apophysis width	1.3	1.1	1.4	0.8	0.8	1.4	1.2	1.3	1.3
Tibia length	10.3	8.2	12.3	7.0	8.6	5.3	4.8	4.8	4.9
Tibia width	4.4	3.9	5.1	3.7	3.6	3.0	3.2	2.9	3.2
Carapace									
Total length	21.6	19.7	24.8	16.5	19.2	18.9	19.0	18.2	17.1
Total width at lateral ocelli	10.6	9.8	11.0	7.7	8.5	9.3	8.8	8.9	8.5
Total width at fovea	12.2	11.9	13.6	10.4	10.8	11.4	11.4	10.3	10.5
Median ocular tubercle distance	1.5	1.2	1.5	0.8	1.5	1.3	1.4	1.6	1.5
Ocular width	0.6	0.4	0.5	0.5	5.3	0.5	0.4	0.4	0.4
Distance betw. median ocelli	0.8	0.8	0.9	0.7	0.7	0.7	0.7	0.7	0.7
Leg I									
Coxa length	3.8	3.8	4.5	3.2	3.7	3.7	3.4	3.2	3.5
Trochanter length	3.0	3.7	3.9	2.5	3.1	3.2	2.9	2.4	2.9
Femur length	14.6	12.9	15.9	11.5	13.2	12.5	12.2	11.9	11.0
Patella length	19.0	16.4	19.8	15.3	18.0	15.4	15.6	15.0	14.1
Tibia length	18.7	16.6	19.8	16.4	18.0	16.0	15.6	15.1	14.8
Basitarsus–tarsus length	14.9	14.1	14.5	12.1	14.3	11.3	11.7	11.7	11.2
Leg IV									
Coxa length	7.9	7.4	8.0	6.3	6.7	7.6	7.5	7.1	7.3
Trochanter length	5.8	5.4	6.3	6.3	5.2	5.4	5.4	5.1	4.7
Femur length	16.6	14.5	17.6	13.6	15.5	15.4	13.9	13.8	13.6
Patella length	7.1	5.8	7.8	5.9	6.6	6.5	6.1	6.1	6.0
Tibia length	15.1	13.8	15.6	12.5	15.4	13.7	13.0	12.5	11.6
Basitarsus length	2.6	2.9	3.4	3.1	–	2.2	2.9	2.3	2.7
Tarsus length	7.6	7.1	7.7	6.7	–	6.7	5.7	7.0	6.4



niform tubercles, prolateral surfaces with setose spiniform tubercles, retrolateral surfaces smooth; tibiae each with one ventrodistal spur; basitarsi each with two ventrodistal spurs. Leg I tibia with two trichobothria distally; legs II–IV tibiae each with one trichobothrium distally.

*Opisthosoma*: Tergites granular; I–V each with median longitudinal suture, weak and restricted to posterior margin on I and II, extending anteriorly on III; X (first segment of pygidium) with distinct lateral longitudinal sutures (pleuron); XII with pair of oval ommatoids posterolaterally. Sternite II (genital) with pair of oblong (♂) or lanceolate (♀) depressions submedially, posterolateral surfaces inflated (♂) (fig. 13B) or flat (♀) (fig. 13D), and posterior margin protruding markedly (♂) or slightly (♀) posteriorly into median lobe which overlaps sclerotized area in space between sternites II and III (♀); III linear (♂) or with pronounced emargination (♀) anteriorly, posterior margin with (♂) or without (♀) weak median suture, and median bulge with patch of reddish macrosetae (♂); IV undivided longitudinally; V–VII each with (♂) or without (♀) patch of fine macrosetae medially; VIII–IX surfaces smooth, asetose. Spermathecae seminal receptacles rounded, posteriorly directed (fig. 11A, B); spermathecal neck short, wide; aperture of uterus curved, with medial notch; dorsal atrium circular in dorsal aspect.

*Sexual dimorphism*: Adult males present several characters that differ from the females and immature stages. The pedipalps of the male are relatively elongated, unlike the pedipalps of the female, which are shorter and more robust (fig. 9A, B). A wide gap is present between spines S3 and S4 on the prodorsal margin of the pedipalp trochanter (fig. 7A), and AS is absent in the male whereas all spines on the prodorsal margin are evenly spaced and AS is present in the female. The retroventral spine on the pedipalp femur is short and situated proximally in the male, whereas it is longer and situated terminally in the female. The patellar apophysis of the male is more slender and elongated than that of the female. The posterolateral surfaces of sternite II

are slightly inflated and the posteromedian margin protrudes markedly posteriorly in the male, whereas the posterolateral surfaces are flat, and the posteromedian margin protrudes slightly posteriorly in the female. Sternite III is linear anteriorly, its posteromedian margin protrudes slightly and bears a patch of macrosetae in the male, whereas sternite III is emarginate anteriorly, its posteromedian margin does not protrude, and a patch of macrosetae is absent in the female (fig. 13B, D).

**ADDITIONAL MATERIAL EXAMINED: MEXICO:** *Morelos*: Municipio Cuernavaca: Cuernavaca, 19.xi.2007, 1 ♂ (CNAN [Ur69]), 12. ix.1965, A. Manrique, 1 ♂ (CNAN [Ur23]), 28. ix.1997, M. Bravo, 1 ♀ (CNAN [Ur18]), 18. vii.2002, P. Berea, 2 ♀ (CNAN [Ur92, 115]), 2.x.2008, N. Chávez, 1 ♀ (CNAN [Ur73]), 1. xi.2011, N. Chávez, 1 ♂, 1 ♀, 2 juv. (CNAN [Ur127]); Cuernavaca, Santa María Ahuacatitlan suburb, 18°58'21.648"N 99°14'50.208"W, 1814 m, 1.viii.2013, R. Paredes, in house, 1 ♂ (CNAN [Ur139]), 24.ix.2015, R. Paredes, found dead in street, 1 ♂ (CNAN [RPL1606]); Cuernavaca, UAEM Campus, 15.xii.2015, 18°58'55.700"N 99°14'23.946"W, 1800 m, D. Barrales, R. Paredes, and A. Carlos, 5 juv. (CNAN [Ur178]).

**DISTRIBUTION**: Known from Cuernavaca in the state of Morelos, Mexico (fig. 2).

**NATURAL HISTORY**: *Mastigoproctus giganteus* inhabits tropical deciduous forest, at elevations between 1380–1800 m, with temperature range of 10°–34° C and mean annual precipitation of 1200 mm (fig. 1E). This species is commonly found under large rocks and rotten logs, just prior to and during the rainy season. Specimens collected behaved aggressively, displaying with the pedipalps spread and the flagellum elevated; they did not hesitate to spray their vinegary repellent.

**REMARKS**: *Thelyphonus excubitor* Girard, 1854, was described from a single female specimen of unknown provenance, although it was published in a report on the Expedition to the Red River in Louisiana Territory by Marcy et al. (1854). Wood (1863) synonymized *T. excubitor* with *M. giganteus*, where it has remained ever since. Louisiana

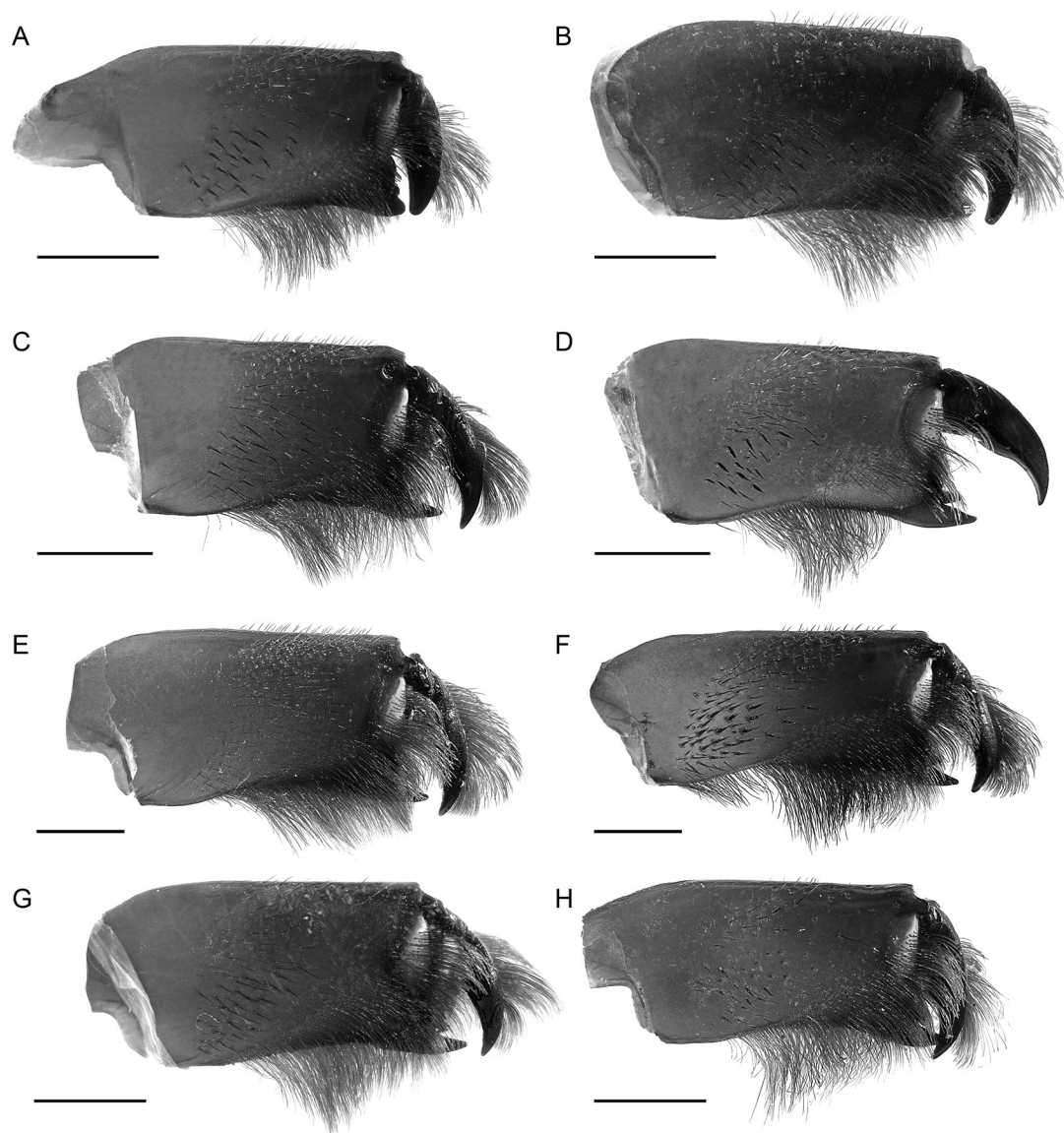


FIG. 4. *Mastigoproctus* Pocock, 1894, dextral chelicerae, retrolateral aspect, illustrating stridulatory organ (pectrum) (A–D, F–H). A, B. *M. giganteus* (Lucas, 1835), ♂ (CNAN [Ur23]) (A), ♀ (CNAN [Ur18]) (B). C. *M. floridanus* (Lönnberg, 1897), stat. nov., ♂ (FSCA [Th4]). D. *M. mexicanus* (Butler, 1872), stat. nov., ♂ (CNAN [Ur57]). E. *M. scabrosus* (Pocock, 1902), stat. nov., ♂ (CNAN [Ur176]). F. *M. cinteotl*, sp. nov., subad. ♂ paratype (CNAN T01040). G. *M. tohono*, sp. nov., paratype ♂ (AMNH). H. *M. vandevederi*, sp. nov., paratype ♂ (CNAN T1148). Scale bars = 2 mm.

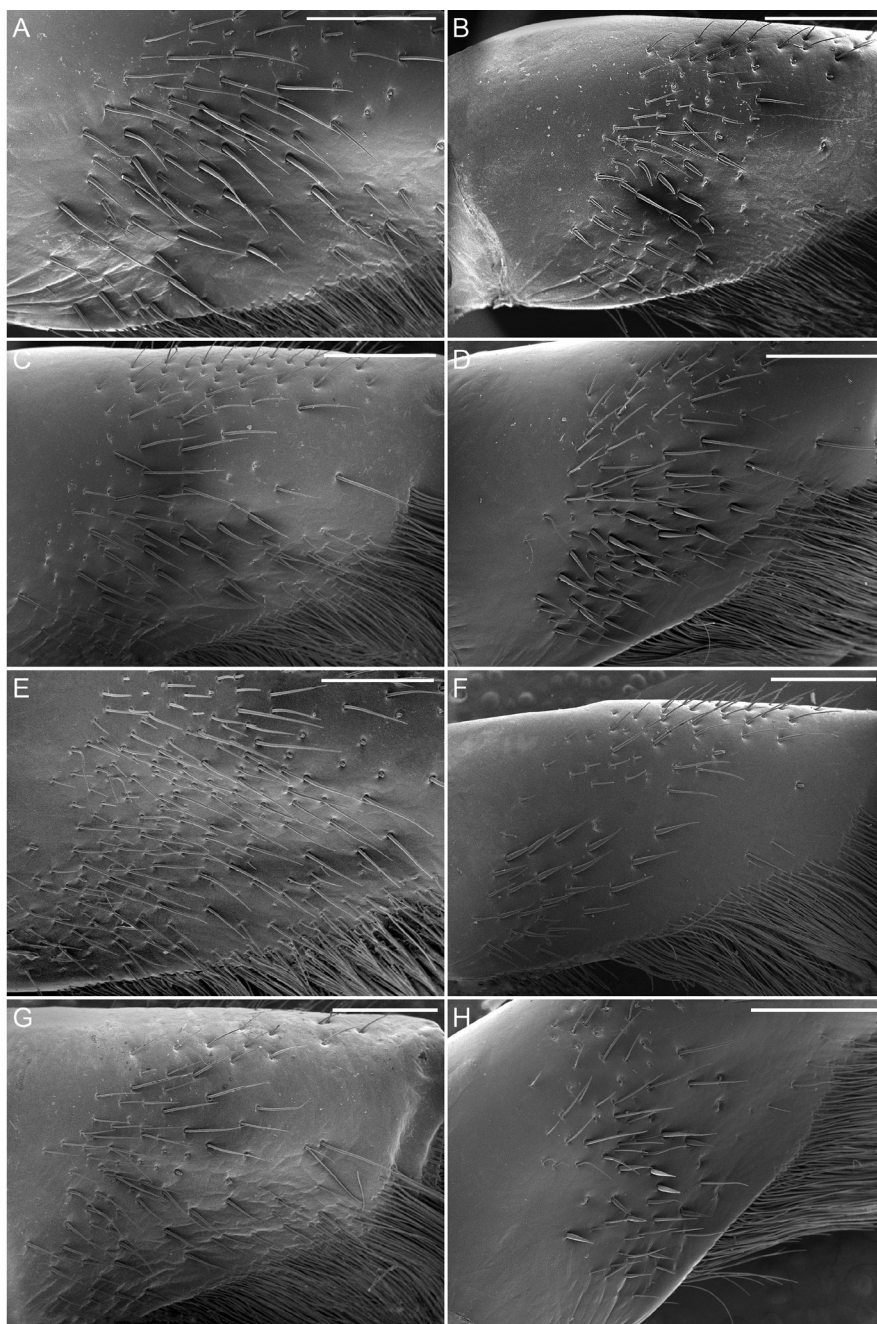


FIG. 5. *Mastigoproctus* Pocock, 1894, dextral chelicerae, retrolateral aspect, illustrating stridulatory organ (pectrum) (A–D, F–H) with scanning electron microscopy. A, B. *M. giganteus* (Lucas, 1835), ♂ (CNAN [Ur23]) (A), ♀ (CNAN [Ur18]) (B). C. *M. floridanus* (Lönnberg, 1897), stat. nov., ♂ (FSCA [Th4]). D. *M. mexicanus* (Butler, 1872), stat. nov., ♂ (CNAN [Ur57]). E. *M. scabrosus* (Pocock, 1902), stat. nov., ♂ (CNAN [Ur176]). F. *M. cinteotl*, sp. nov., subad. ♂ paratype (CNAN T01040). G. *M. tohono*, sp. nov., paratype ♂ (AMNH). H. *M. vandevederi*, sp. nov., paratype ♂ (CNAN T1148). Scale bars = 1 mm.



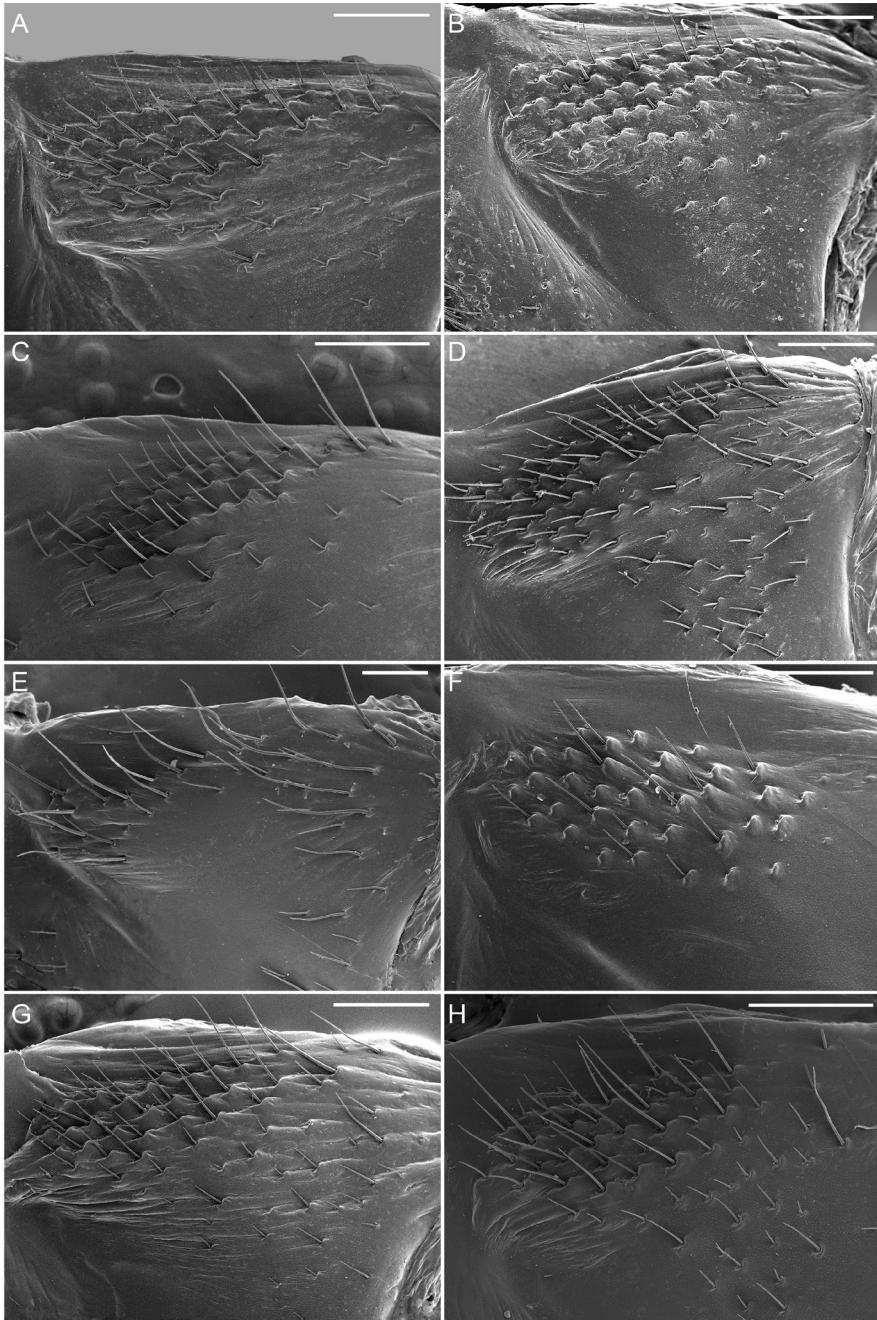


FIG. 6. *Mastigoproctus* Pocock, 1894, dextral pedipalp coxae, dorsomedial aspect, illustrating stridulatory organ (pars stridens) (A–D, F–H) with scanning electron microscopy. **A, B.** *M. giganteus* (Lucas, 1835), ♂ (CNAN [Ur23]) (A), ♀ (CNAN [Ur18]) (B). **C.** *M. floridanus* (Lönnberg, 1897), stat. nov., ♂ (FSCA). **D.** *M. mexicanus* (Butler, 1872), stat. nov., ♂ (CNAN [Ur57]). **E.** *M. scabrosus* (Pocock, 1902), stat. nov., ♂ (CNAN [Ur176]). **F.** *M. cinteotl*, sp. nov., subad. ♂ paratype (CNAN T01040). **G.** *M. tohono*, sp. nov., paratype ♂ (AMNH). **H.** *M. vandevederi*, sp. nov., paratype ♂ (CNAN T1148). Scale bars = 0.5 mm.



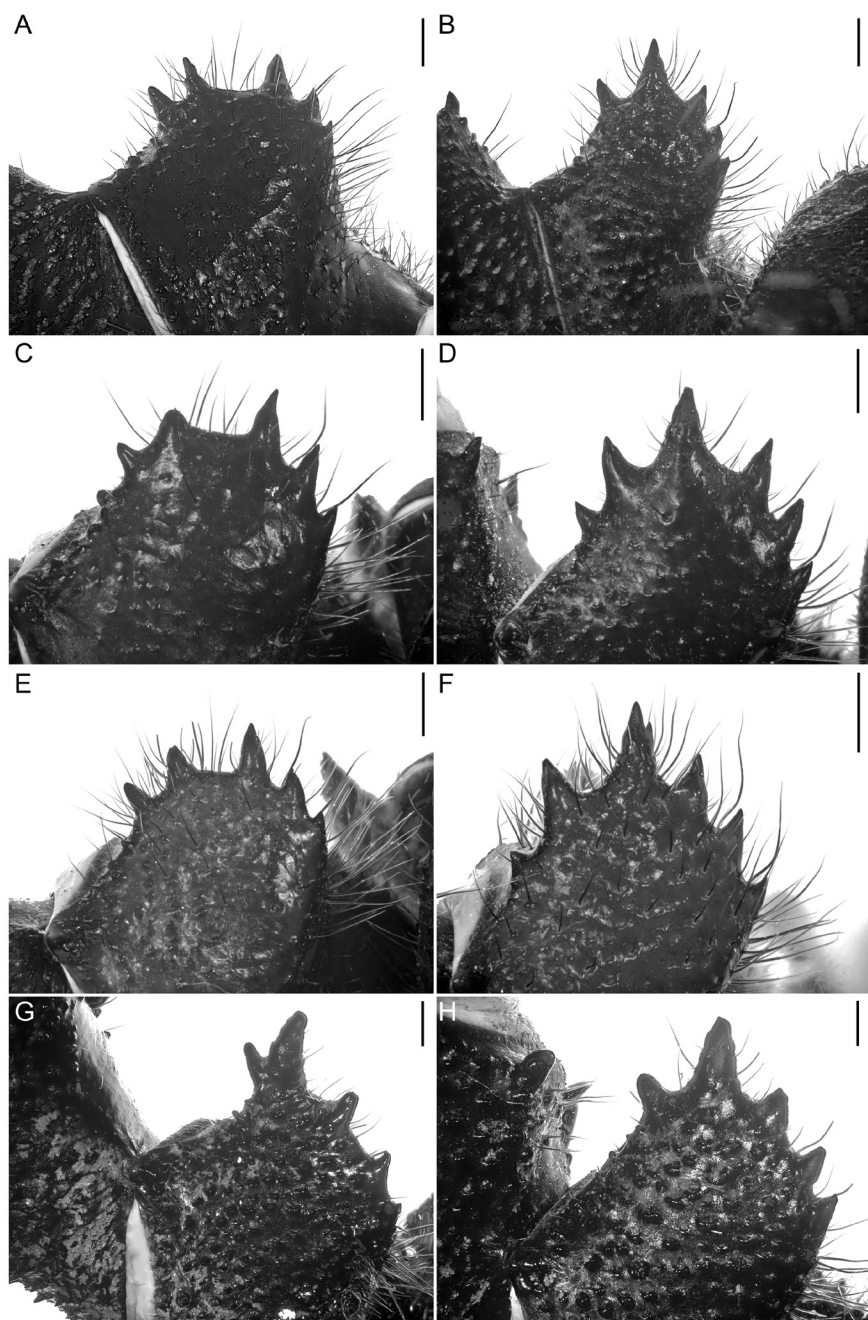


FIG. 7. *Mastigoproctus* Pocock, 1894, sinistral pedipalp trochanter, dorsal aspect, illustrating prodorsal spines in male (A, C, E, G) and female (B, D, F, H). A, B. *M. giganteus* (Lucas, 1835), ♂ (CNAN [Ur23]), ♀ (CNAN [Ur18]). C, D. *M. floridanus* (Lönnberg, 1897), stat. nov., ♂ (FSCA [Th4]), ♀ (FSCA [Th2]). E, F. *M. mexicanus* (Butler, 1872), stat. nov., ♂, ♀ (CNAN [Ur57]). G, H. *M. scabrosus* (Pocock, 1902), stat. nov., ♂ (CNAN [Ur176]), ♀ (CNAN [Ur175]). Scale bars = 2 mm.

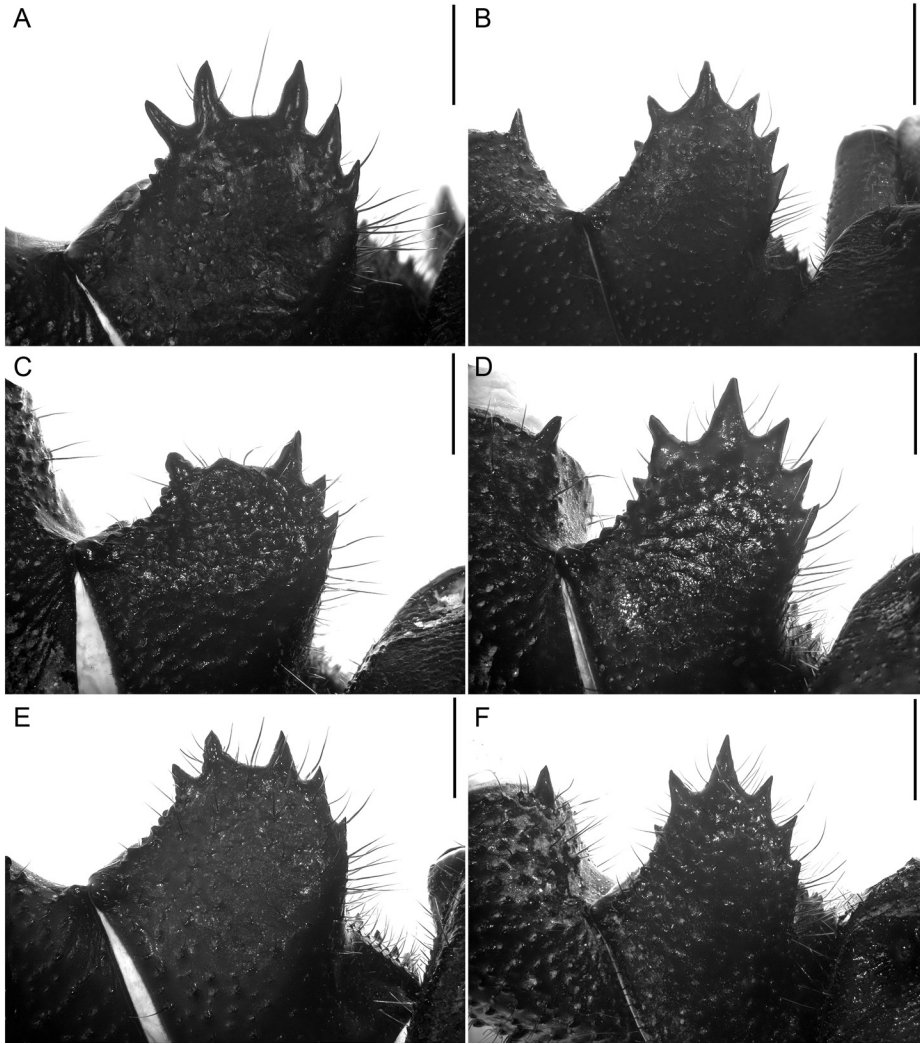


FIG. 8. *Mastigoproctus* Pocock, 1894, sinistral pedipalp trochanter, dorsal aspect, illustrating prodorsal spines in male (A, C, E) and female (B, D, F). A, B. *M. cinteotl*, sp. nov., holotype ♂ (CNAN T1149), paratype ♀ (AMNH). C, D. *M. tohono*, sp. nov., holotype ♂ (AMNH), paratype ♀ (CNAN T1151). E, F. *M. vandevederi*, sp. nov., holotype ♀ (CNAN T1146), paratype ♂ (CNAN T1147). Scale bars = 2 mm.

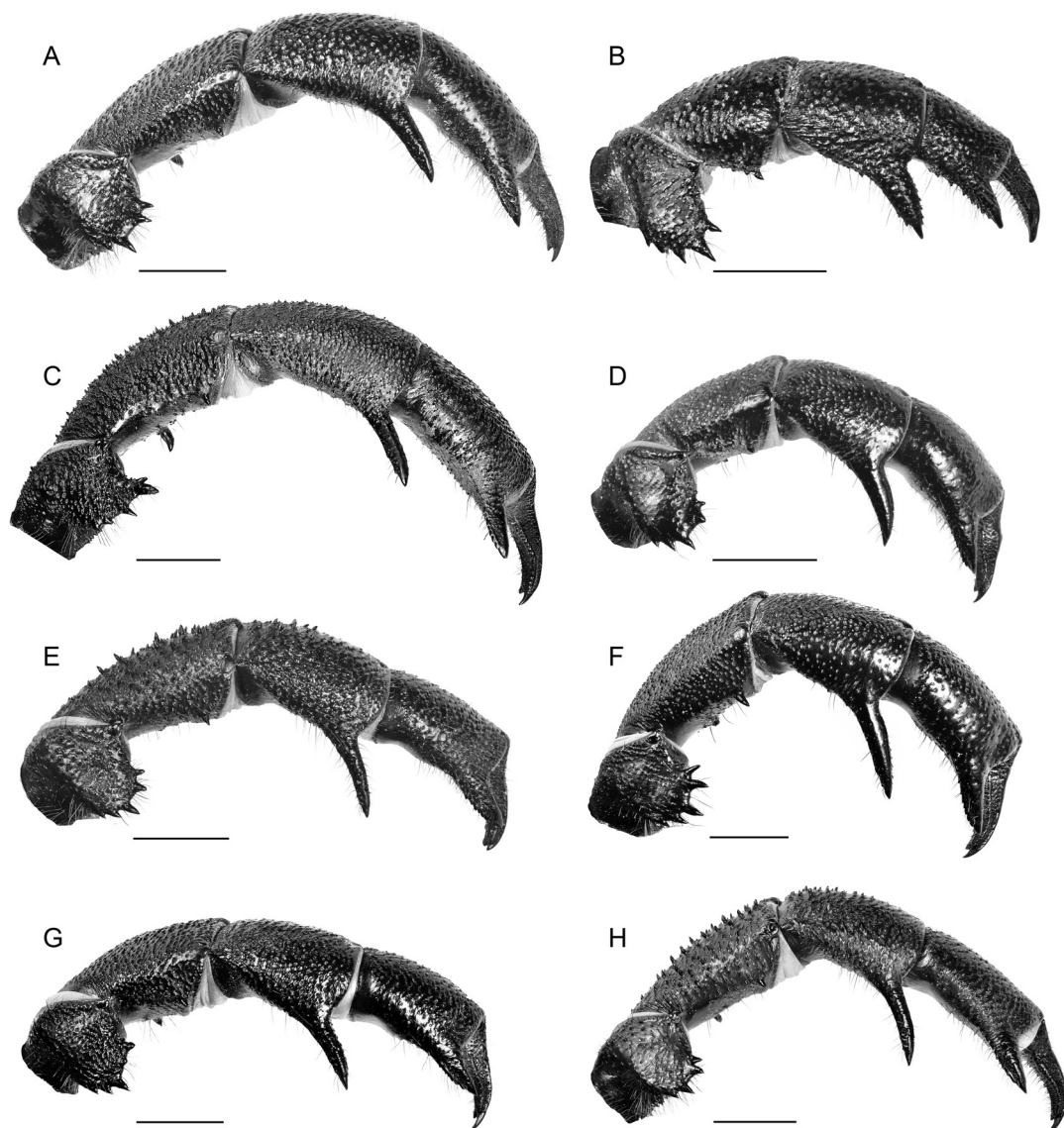


FIG. 9. *Mastigoproctus* Pocock, 1894, sinistral pedipalp, dorsal aspect. **A, B.** *M. giganteus* (Lucas, 1835), ♂ (CNAN [Ur23]) (**A**), ♀ (CNAN [Ur18]) (**B**). **C.** *M. scabrosus* (Pocock, 1902), stat. nov., ♂ (CNAN [Ur176]). **D.** *M. floridanus* (Lönnerberg, 1897), stat. nov., ♂ (FSCA). **E.** *M. mexicanus* (Butler, 1872), stat. nov., ♂ (CNAN [Ur57]). **F.** *M. cinteotl*, sp. nov., holotype ♂ (CNAN T1149). **G.** *M. tohono*, sp. nov., holotype ♂ (AMNH). **H.** *M. vandevederi*, sp. nov., holotype ♂ (CNAN T1146). Scale bars = 15 mm.



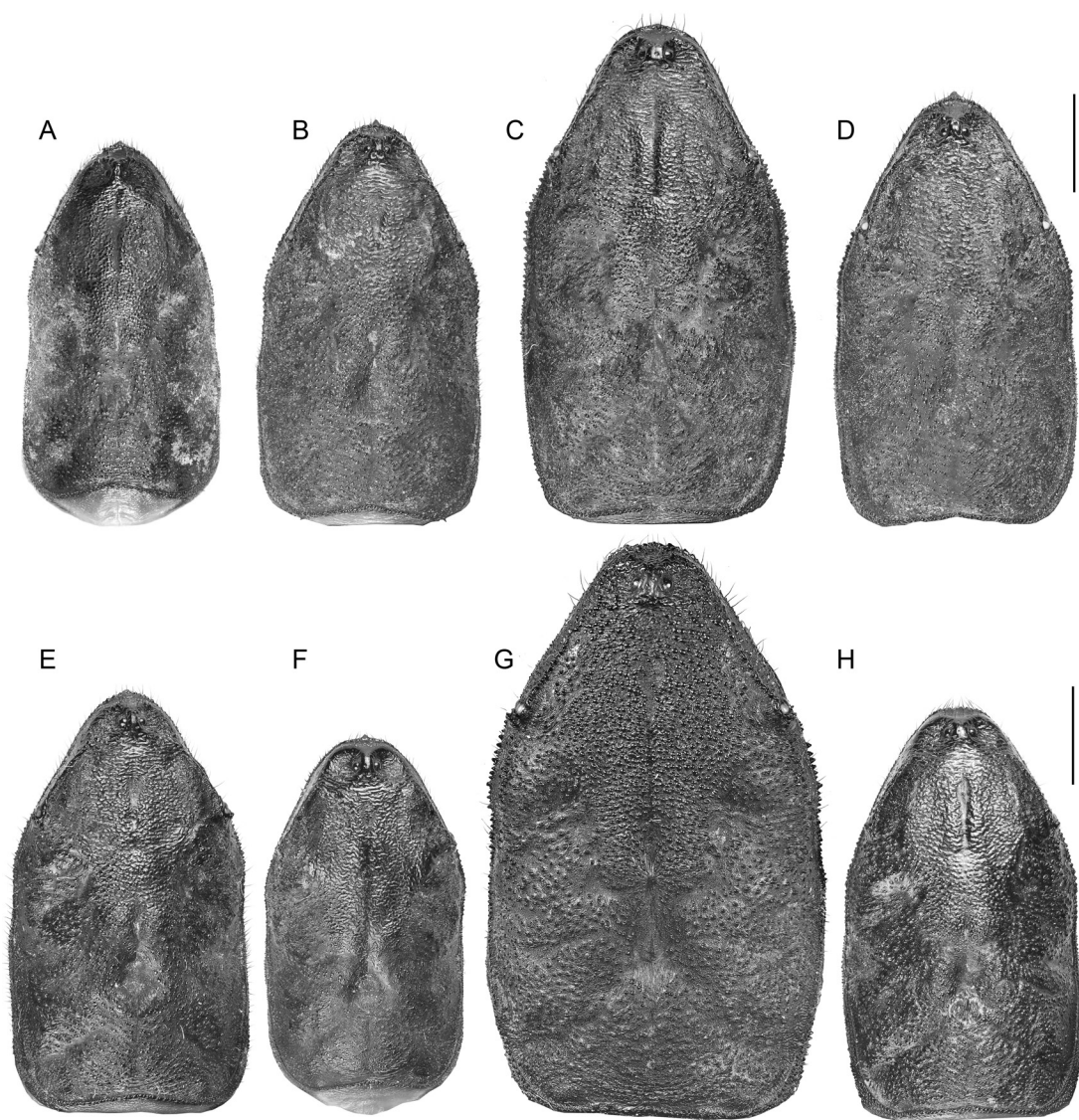


FIG. 10. *Mastigoproctus* Pocock, 1894, carapaces, dorsal aspect. **A, E.** *M. giganteus* (Lucas, 1835), ♀ (CNAN [Ur23]) (**A**), ♂ (CNAN [Ur18]) (**E**). **B.** *M. mexicanus* (Butler, 1872), stat. nov., ♂ (CNAN [Ur57]). **C.** *M. cinteotl*, sp. nov., holotype ♂ (CNAN T1149). **D.** *M. vandevederi*, sp. nov., holotype ♂ (CNAN T1146). **F.** *M. floridanus* (Lönnberg, 1897), stat. nov., ♂ (FSCA [Th4]). **G.** *M. scabrosus* (Pocock, 1902), stat. nov., ♂ (CNAN Ur176); **H.** *Mastigoproctus tohono*, sp. nov., holotype ♂ (AMNH). Scale bars = 5 mm.



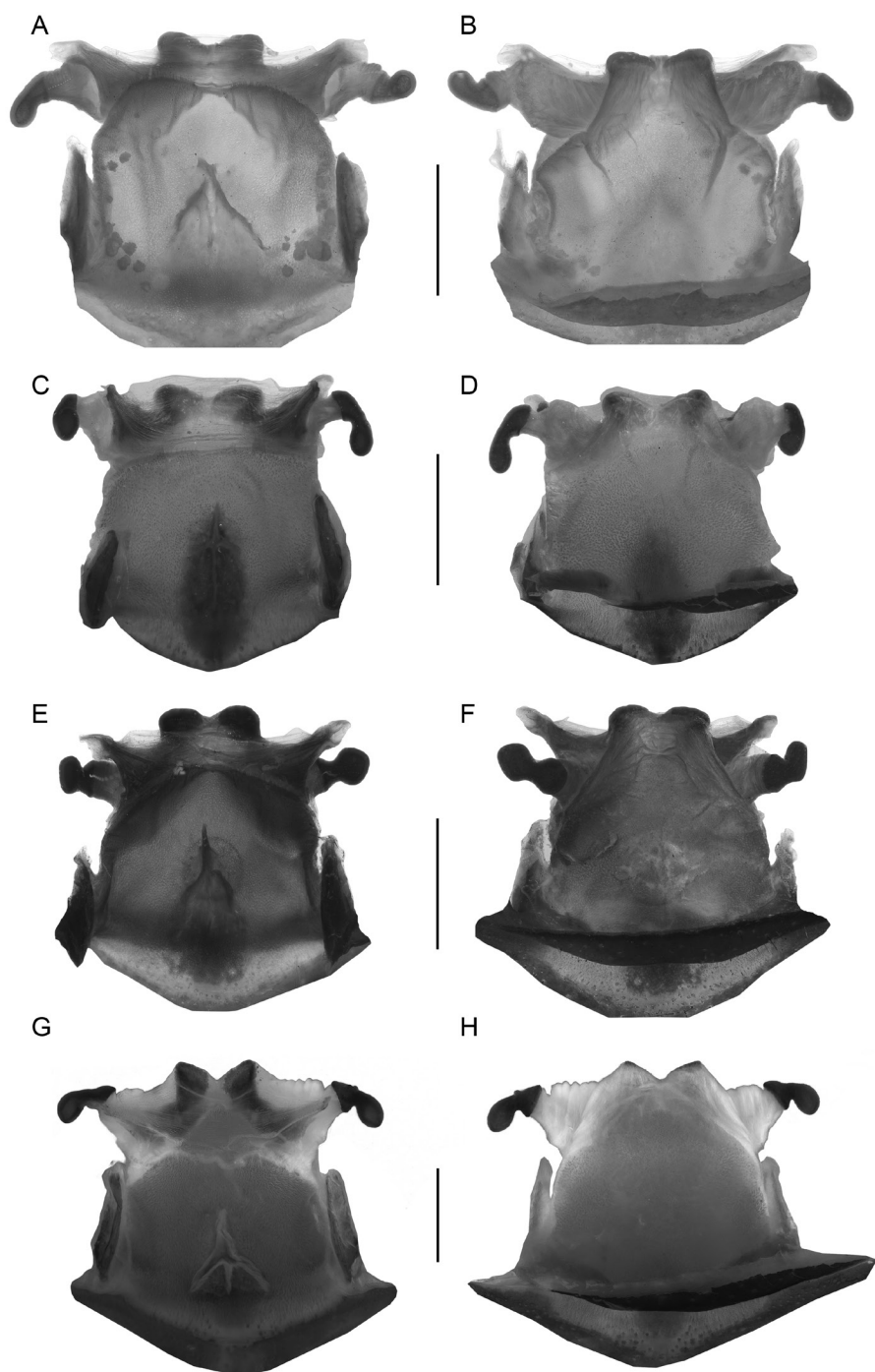


FIG. 11. *Mastigoproctus* Pocock, 1894, spermathecae, dorsal (A, C, E, G) and ventral (B, D, F, H) aspects. A, B. *M. giganteus* (Lucas, 1835), ♀ (CNAN [Ur18]). C, D. *M. floridanus* (Lönnberg, 1897), stat. nov., ♀ (FSCA [Th4]). E, F. *M. mexicanus* (Butler, 1872), stat. nov., ♀ (CNAN [Ur57]). G, H. *M. scabrosus* (Pocock, 1902), stat. nov., ♀ (CNAN [Ur175]). Scale bars = 2 mm.

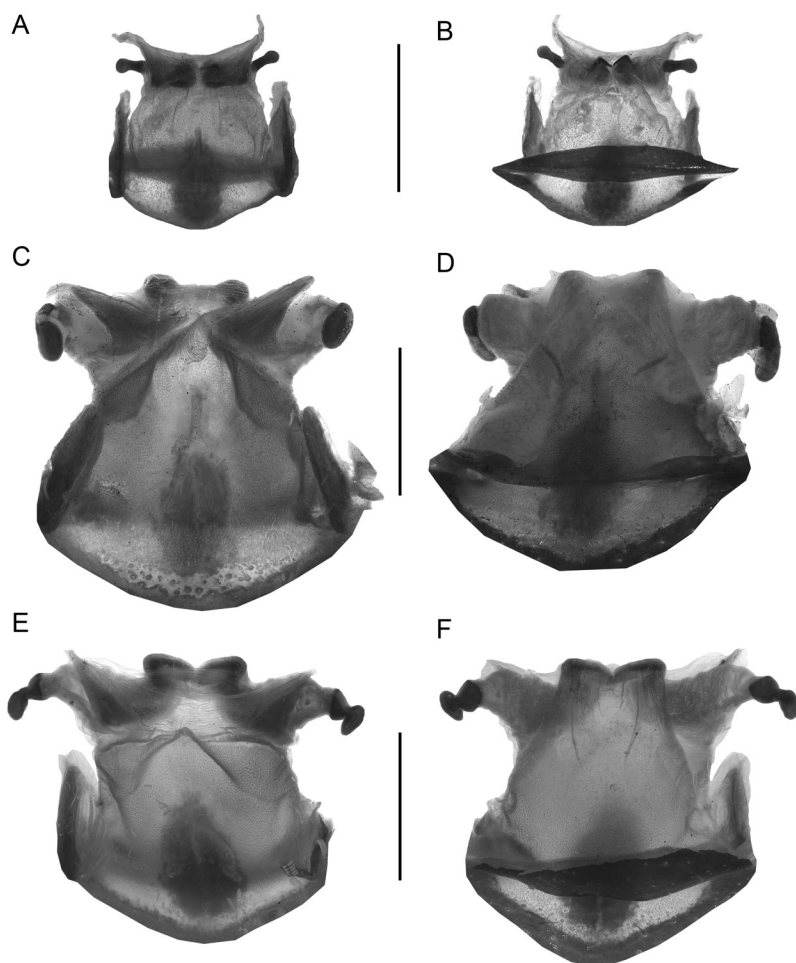


FIG. 12. *Mastigoproctus* Pocock, 1894, spermathecae, dorsal (A, C, E) and ventral (B, D, F) aspects. A, B. *Mastigoproctus cinteotl*, sp. nov., paratype ♀ (AMNH). C, D. *M. tohono*, sp. nov., paratype ♀ (AMNH). E, F. *M. vandevenderi*, sp. nov., paratype ♀ (CNAN T1147). Scale bars = 2 mm.

Territory encompassed most of present-day Louisiana, as well as Arkansas, Oklahoma, Texas, and eastern New Mexico. Some of the spiders collected during that expedition and described by Girard (1854) indicate the date and approximate location (e.g., 17 May, between Camps 2 and 3) such that is possible to estimate where the types originated. There are no such annotations in the case of *T. excubitor*, unfortunately. Furthermore, Girard (1854) did not confine himself to describing specimens collected during that expedition: (1) the holotype of *Scorpio boreus* Girard, 1854,

currently in *Paruroctonus* Werner, 1934, originated from the vicinity of the Great Salt Lake, Utah, and a smaller specimen originated from Eagle Pass, Texas, neither of which was visited during the Red River Expedition; (2) *Scorpio californicus* Girard, 1854, as the name indicates, was described from a specimen donated to the Smithsonian Institution from California; and (3) *Scorpio sayi* Girard, 1854, was described from a specimen from Pensacola, Florida. Thus, it is impossible to even narrow down the origin of *T. excubitor* to Louisiana Territory, as it may have come from

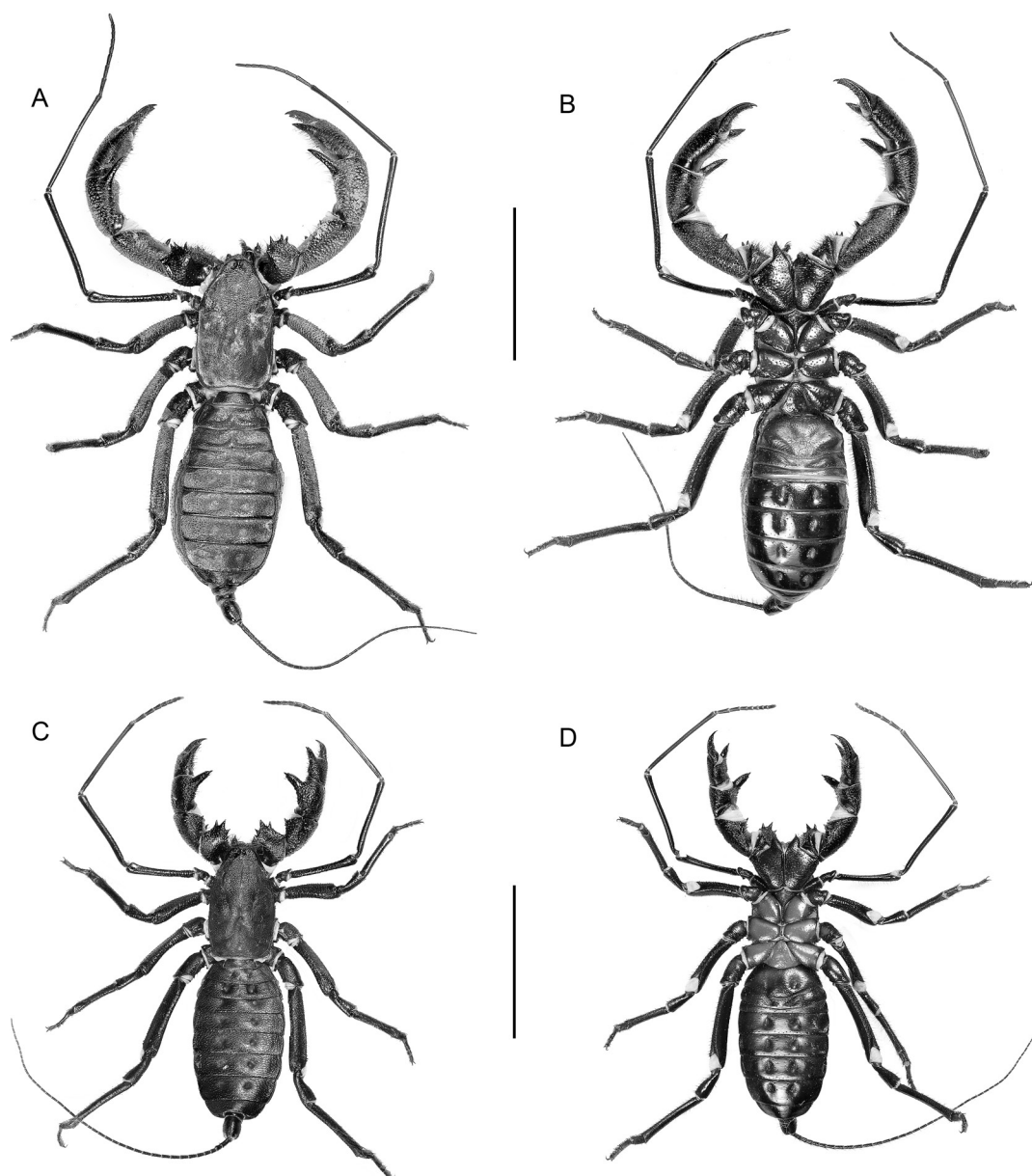


FIG. 13. *Mastigoproctus giganteus* (Lucas, 1835), habitus, dorsal (A, C) and ventral (B, D) aspect. A, B. ♂ (CNAN [Ur23]). C, D. ♀ (CNAN [Ur18]). Scale bars = 25 mm.

anywhere. It might be argued that *T. excubitor* should be removed from that synonymy and declared a nomen dubium. However, in the spirit of nomenclatural stability promoted by the International Code of Zoological Nomenclature, it seems prudent to retain it in synonymy with *M. giganteus*, where it has been for the last 155 years.

*Mastigoproctus floridanus* Lönnberg, 1897,  
stat. nov.

Figure 14A–D; table 2

*Mastigoproctus giganteus floridanus* Lönnberg, 1897: 189–191 (synonymized by Kraepelin, 1899: 224); McMonigle, 2013: fig. unnumbered, 100 (part).

*Mastigoproctus giganteus*: Kraepelin, 1899: 224; Banks, 1900: 422 (part); 1904: 143; Howard, 1919: 26; Ewing, 1928: 41–43, fig. 1; Savory, 1964: 166 (part); Muma, 1967: 21–23, fig. 16; Weygoldt, 1970: 1–7, figs. 1a, b, 2a–d, 3a–f, 4a–e; 1971: 137–141, figs. 1a, b, 2a, b, 3, 4, 5a–c, 6, pl. 1a–d, 11a–c, 111a–c; Browder, 1973: 161; Jespersen, 1978: 241, figs. 21–23; Coddington et al., 1990: 11 (part); Corey and Stout, 1990: 169, 170; Crawford, 1990: 434, fig. 16.5 (part); Folkerts et al., 1993: 161; Punzo, 2001: 35–39, figs. 3, 4; 2005a: 684–690; 2005b: 172, 173; Beccaloni, 2009: 111 (part); Carrel and Britt, 2009: 500–502, figs. 1–4 (part); Kern and Mitchell, 2011: 2, 4, figs. 1–5 (part).

TYPE MATERIAL: **U.S.A.**: *Florida*: holotype ♀? (Swedish Museum of Natural History, Stockholm) [not examined].

DIAGNOSIS: *Mastigoproctus floridanus* most closely resembles *M. giganteus*, from which it differs as follows. In the adult male of *M. floridanus*, spines S4 and S5 on the prodorsal margin of the pedipalp trochanter are blunt and a short, blunt subapical accessory spine (AS) is present whereas, in the adult male of *M. giganteus*, all spines on the prodorsal margin of the pedipalp trochanter are sharply pointed and an AS is absent.

*Mastigoproctus floridanus* also differs from *M. cinteotl*, sp. nov., and *M. tohono*, sp. nov., as follows. The carapace epistoma is visible in dorsal aspect in *M. floridanus* but not in *M. cinteotl* and *M. tohono*, and the lateral borders of the carapace are almost smooth in *M. floridanus* but strongly serrate in *M. tohono*. Spines S4 and S5 on the prodorsal margin of the pedipalp trochanter of the adult male are short and blunt in *M. floridanus* whereas S4 and S5 are longer and sharply pointed in *M. cinteotl*, and S4 is shorter in *M. tohono*.

DESCRIPTION: The following description is based on three males and two females.

*Total length*: Maximum length from anterior margin of carapace to posterior margin of opisthosomal segment XII (pygidium) in adult specimens 51.8 mm (♂) and 60.6 mm (♀) (table 2).

*Color*: Carapace dark reddish brown, anterior and lateral margins dark brown. Tergites I–IX dark reddish brown (♂) to reddish brown (♀), posterior and lateral borders darker. Sternites I and II light reddish brown mesally, margins reddish brown; III–IX and pygidium reddish brown (♀) to dark reddish brown (♂). Flagellum light reddish brown, segments with reddish-brown macrosetae. Pedipalp trochanter, femur, patella, and tibia dark reddish brown, mesal surfaces with few reddish macrosetae; patellar apophysis, fixed finger, and basitarsus blackish, with few reddish macrosetae. Legs I–IV reddish brown; II–IV coxae, ventral surfaces light reddish brown.

*Carapace*: Epistoma visible in dorsal aspect. Pair of strongly developed carinae anterolaterally, extending from lateral ocelli to two-thirds the distance to median ocular tubercle (fig. 10F). Three pairs of lateral ocelli with accessory translucent eyespot situated between anterior and posterior ocelli; anterior ocelli larger than median and posterior ocelli; anterior two pairs slightly separated from posterior pair by tubercle, distance between median and posterior ocelli 3× distance between anterior and median ocelli. Median ocular tubercle smooth, situated in anterior 10% of carapace (table 2); distance between ocelli almost 2× ocular diameter. Carapace sur-



TABLE 2

Measurements (mm) of *Mastigoproctus floridanus* (Lönnberg, 1897), stat. nov., from five counties in Florida, and *Mastigoproctus mexicanus* (Butler, 1872), stat. nov., from Aguascalientes, Mexico

Material deposited in the Florida State Collection of Arthropods (FSCA), Gainesville, and the National Collection of Arachnids (CNAN), Institute of Biology, National Autonomous University of Mexico, Mexico City.

Location	<i>Mastigoproctus floridanus</i>					<i>Mastigoproctus mexicanus</i>		
	Johns Co.	Levy Co.	Lee Co.	Marion Co.	Polk Co.			
Sex	♂			♀		♂	♀	
Collection	FSCA			FSCA		CNAN		
Code	[Th4]	[Th3]	[Th5]	[Th2]	[Th1]	[Ur57]	[Ur57]	[Ur57]
Total length	51.8	49.2	51.0	60.6	50.6	55.0	50.1	42.8
Pedipalp								
Trochanter length	6.0	7.1	5.2	5.4	6.0	7.2	6.6	5.4
Trochanter width	5.1	5.8	4.1	4.9	6.0	4.5	5.2	4.2
Femur length	10.6	11.8	10.6	9.3	9.6	12.1	8.6	8.1
Femur width	4.3	4.6	4.2	4.4	4.6	5.0	4.9	4.2
Ventromesal spine length	0.9	1.0	0.6	1.0	1.1	1.0	1.0	0.9
Ventromesal spine width	0.5	0.4	0.3	0.4	0.5	0.3	0.4	0.4
Patella length	6.9	7.6	6.8	5.9	6.0	8.4	5.6	5.0
Patella width	4.2	4.2	4.2	3.9	4.1	4.7	4.0	3.4
Patellar apophysis length	4.6	5.5	4.4	4.5	4.5	4.4	3.6	2.9
Patellar apophysis width	0.9	1.1	1.2	1.4	1.3	0.8	1.0	1.0
Tibia length	7.5	8.1	7.7	6.0	5.7	8.3	5.8	4.8
Tibia width	4.0	4.3	4.1	3.3	3.3	3.8	3.5	2.7
Carapace								
Total length	18.1	19.3	17.6	19.1	19.7	19.4	18.5	16.3
Total width at lateral ocelli	9.1	9.6	9.5	9.0	10.4	9.2	8.5	7.5
Total width at fovea	9.7	10.2	10.3	11.2	11.2	11.0	10.5	9.1
Median ocular tubercle distance	0.8	0.8	1.2	0.9	1.6	1.3	1.0	0.6
Ocular width	0.5	0.6	0.5	0.6	0.5	0.5	0.5	0.4
Distance betw. median ocelli	0.8	1.0	0.9	1.0	0.9	0.7	0.8	0.7
Leg I								
Coxa length	3.3	3.9	3.3	3.4	3.5	2.8	3.5	2.9
Trochanter length	2.7	3.4	2.8	2.8	2.8	2.8	2.6	2.7
Femur length	11.6	12.2	10.7	11.4	11.9	12.9	10.5	8.6
Patella length	14.9	16.0	13.6	15.2	15.4	17.5	14.8	13.6
Tibia length	15.0	15.5	13.7	14.3	15.4	17.0	14.8	12.9
Basitarsus–tarsus length	12.6	13.4	12.6	12.6	12.5	13.0	13.4	11.2
Leg IV								
Coxa length	6.3	6.6	5.5	6.9	6.8	6.2	6.9	5.3
Trochanter length	5.0	5.0	4.7	5.1	5.1	5.5	4.5	4.3
Femur length	12.9	13.8	16.7	14.0	13.4	13.8	13.2	10.2
Patella length	5.5	6.0	5.9	6.0	5.7	5.8	6.1	4.2
Tibia length	12.0	12.9	11.2	12.3	12.3	12.7	10.7	10.8
Basitarsus length	2.6	2.9	2.3	2.6	2.6	2.8	2.6	2.2
Tarsus length	6.2	5.7	5.8	7.1	6.1	6.1	5.7	5.1

faces rugose, tuberculate mediolaterally. Posterior fovea present, distinct.

*Chelicerae*: Retrolateral surface with stridulatory surface (plectrum), comprising approximately 20 long, stout (ca. 10× longer than wide), anteroventrally directed spiniform macrosetae (figs. 4C, 5C); mesal surface with few short, stout, anteroventrally directed spiniform macrosetae.

*Pedipalps*: Cuticle punctate. Coxa, retrolateral surface punctate; ventral surface smooth; coxal apophysis with one terminal spine; prodorsal surface with long, retroventrally directed macrosetae with cristulae, forming stridulatory surface (pars stridens) (fig. 6C). Trochanter longer than wide (♂), or subequal (♀); retrodorsal surface punctate and setose; prodorsal margin with five terminal spines (S1–S5) and one subterminal accessory spine (AS), S1–S3 sharply pointed; S4, S5, and AS blunt, varying in size such that  $S3 > S2 > S4 > S5 \geq S1 > AS$  (♂; fig. 7C) or  $S4 > S5 \geq S3 > S2 > S1 \geq AS$  (♀; fig. 7D); space between S3 and S4 equal to or greater than length of S3 (♂) or equal to space between S4 and S5 (♀); prolateral surface with several spiniform tubercles and reddish macrosetae (♂); proventral margin with two spines (♂). Femur laterally compressed (♂) or terete (♀),  $2.1\times$  (♀) to  $2.5\times$  (♂) longer than wide (table 2); prolateral surface with two spines, one prodorsal, short, sharply pointed, the other proventral, blunt, length one-quarter femur width (♂; fig. 9D) or short, sharply pointed, and situated apically (♀); retrolateral surface rugose, with sclerotized crests (♂) and punctate. Patella slightly shorter (♂) or longer (♀) than tibia (table 2); prolateral surface with reddish macrosetae, one vestigial (♂) or distinct (♀) spine situated distally on proventral margin and another vestigial spine situated two-thirds from proximal end of segment on proventral margin; one vestigial spine (♂) or two to three distinct spines (♀) at base of patellar apophysis; retrolateral surface sparsely punctate. Patellar apophysis elongated, almost one-quarter carapace length, smooth and slender (♂) or shorter and robust (♀); prolateral margin with row of blunt denticles; retrolateral margin smooth (♂) or denticulate (♀), with sub-

terminal macrosetae. Tibia longer than wide, laterally compressed; prodorsal surface with sparse row of denticles; prolateral surface sparsely punctate, with reddish macrosetae; proventral margin with two spines distally; fixed finger, dorsal and ventral margins each with row of denticles. Basitarsus (movable finger), dorsal and ventral margins each with serrate row of denticles; prolateral surface with several reddish macrosetae; apex bifid (♂).

*Legs*: Leg I, basitarsal and telotarsal tarsomeres I–VII gradually decreasing in length, with tarsomere I longest, tarsomere VIII two-thirds length of tarsomere I. Legs I–III coxae, lateral surfaces and IV, dorsal surface each with setose spiniform tubercles. Legs II–IV trochanters, dorsal surfaces with setose spiniform tubercles; femora dorsal surfaces with setose spiniform tubercles, prolateral surfaces granular, retrolateral surfaces smooth; tibiae each with one ventrodistal spur; basitarsi each with two ventrodistal spurs. Leg I tibia with two trichobothria distally; legs II–IV tibiae each with one trichobothrium distally.

*Opisthosoma*: Tergites granular; I, median longitudinal suture restricted to anterior margin; II and III, each with median longitudinal suture restricted to posterior margin; X (first segment of pygidium) with distinct lateral longitudinal sutures (pleuron); XII with lateral pair of lanceolate ommatoids posterolaterally. Sternite II (genital) with pair of oblong (♂) or lanceolate (♀) depressions submedially, posterolateral surfaces inflated (♂) or flat (♀), and posterior margin protruding markedly (♂) or slightly (♀) posteriorly into median lobe which overlaps sclerotized area in space between sternites II and III (♀); III divided longitudinally (♂) or undivided (♀), linear (♂) or with pronounced emargination (♀) anteriorly; posterior margin with (♂) or without (♀) median bulge with patch of reddish macrosetae; IV undivided longitudinally; V–VII each with (♂) or without (♀) patch of fine macrosetae medially; VIII–IX surfaces smooth, asetose. Spermathecae seminal receptacles rounded, anteriorly directed (fig. 11C, D); spermathecal neck short, wide; aperture of

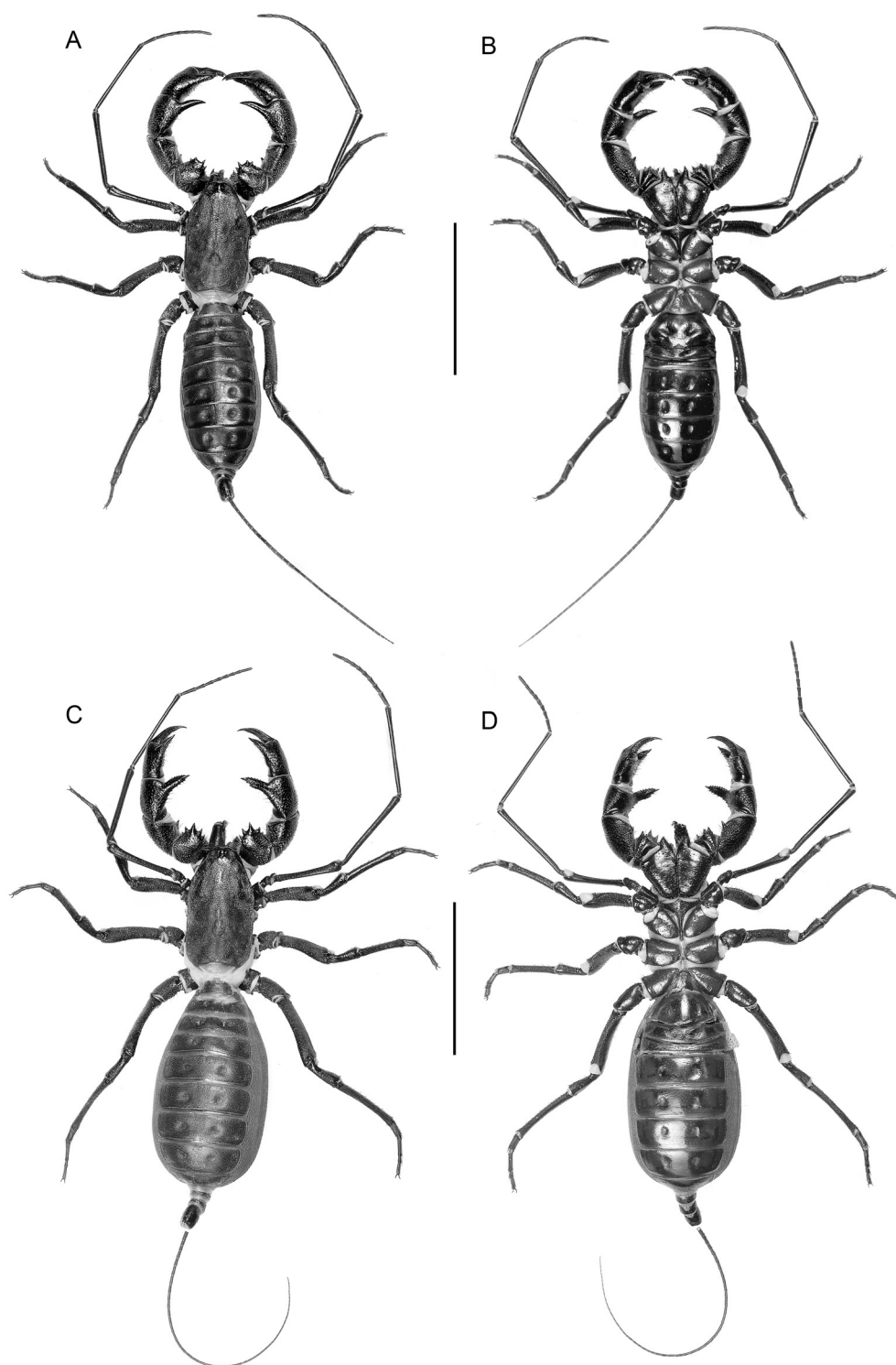


FIG. 14. *Mastigoproctus floridanus* (Lönnberg, 1897), stat. nov., habitus, dorsal (A, C) and ventral (B, D) aspect. A, B. ♂ (FSCA [Th4]). C, D. ♀ (FSCA [Th2]). Scale bars = 25 mm.

uterus curved, with medial notch; dorsal atrium pentagonal in dorsal aspect.

**Sexual dimorphism:** Adult males present several characters that differ from the females and immature stages. The pedipalps of the male are relatively elongated, unlike the pedipalps of the female, which are shorter and more robust (fig. 9D). Spines S4, S5, and AS on the prodorsal margin of the pedipalp trochanter are blunt, and a wide gap is present between S3 and S4 in the male (fig. 7C, D) whereas these spines are sharply pointed and a gap is absent between S3 and S4 in the female. The retroventral spine on the pedipalp femur is short and situated proximally in the male, whereas it is longer and situated terminally in the female. The patellar apophysis of the male is more slender and elongated than that of the female. The posterolateral surfaces of sternite II are slightly inflated and the posteromedian margin protrudes markedly posteriorly in the male, whereas the posterolateral surfaces are flat, and the posteromedian margin protrudes slightly posteriorly in the female. Sternite III is linear anteriorly, its posteromedian margin protrudes slightly and bears a patch of macrosetae in the male, whereas sternite III is emarginate anteriorly, its posteromedian margin does not protrude, and a patch of macrosetae is absent in the female (fig. 14B, D).

**ADDITIONAL MATERIAL EXAMINED: U.S.A.:** *Florida:* Johns Co.: St. Augustine, Anastasia Island, jct. SR 312 and SR 3 [29°51'08.92"N, 81°16'51.66"W], SE 1/4, Sec. 28, T 7 S, R 30 E, 1.vi.1981, K.A. Vliet, 1 ♂ (FSCA [Th4]). Lee Co.: Boca Grande [26°44'56.51"N 82°15'42.00"W], 12.ix.1974, E. Golby, 1 ♂ (FSCA [Th5]). Levy Co.: Bronson [29°26'49.91"N 82°38'31.14"W] 8.ix.2008, under bark, 1 ♂, 1 ♀ (AMNH); Wiliston [29°23'14.89"N 82°26'48.37"W], summer 1965, log pile, 1 ♂ (FSCA [Th3]). Marion Co.: Ocala [29°11'13.91"N 82°08'24.33"W], 28.ix.1963, D. Bucklen and E.A. Graham, in house, 1 ♀ (FSCA [Th2]). Polk Co.: Winter Haven [28°01'19.85"N 81°43'59.21"W], 20.xii.1954, M. Muma, under board on ground, 1 ♀ (FSCA [Th1]).

**DISTRIBUTION:** Known only from the state of Florida in the United States (fig. 2).

**NATURAL HISTORY:** *Mastigoproctus floridanus* inhabits subtropical scrub forest, at elevations between 10–100 m, with a temperature range of 4°–38° C and mean annual precipitation of 1500 mm. According to Lönnberg (1897) and Muma (1967), this species is often found under rotten logs and other debris on the surface of the ground and occasionally in houses.

*Mastigoproctus mexicanus* Butler, 1872,  
stat. nov.

Figure 15A–D; table 2

*Thelyphonus mexicanus* Butler, 1872: 201, fig. 1.

*Thelyphonus* (?) *mexicanus*: Tarnani, 1890: 538.

*Mastigoproctus giganteus mexicanus*: Pocock, 1902a: 48; Mello-Leitão, 1931: 27; Harvey, 2003: 67; Barrales-Alcalá et al., 2016: 26, 46 (part); McMonigle, 2013: 100, fig. unnumbered, 100 (part).

**TYPE MATERIAL: MEXICO:** holotype ♂ (Natural History Museum, London) [photographs examined].

**DIAGNOSIS:** *Mastigoproctus mexicanus* resembles *M. vandevederi*, sp. nov., from which it differs as follows. Adult *M. mexicanus* are densely setose and reddish in color whereas adult *M. vandevederi* are sparsely setose and brownish. Spine S3 is longer than the other spines on the prodorsal margin of the pedipalp trochanter of the adult male in *M. mexicanus* whereas spines S3 and S4 are equal in *M. vandevederi*. The tubercles on the retrolateral surface of the pedipalp femur are straight and digitiform in *M. mexicanus* but curved and cup shaped in *M. vandevederi*. The seminal receptacles of the spermathecae are swollen, obovate and anteriorly directed in *M. mexicanus* but narrow, triangular, and posteriorly directed in *M. vandevederi*.

**DESCRIPTION:** The following description is based on one male and two females.



*Total length:* Maximum length from anterior margin of carapace to posterior margin of opisthosomal segment XII (pygidium) in adult specimens 55.0 mm (♂) and 50.1 mm (♀) (table 2).

*Color:* Carapace reddish, anterior margin reddish brown, lateral margins dark reddish brown, median ocular tubercle dark reddish brown. Tergites I–IX reddish, posterior and lateral margins dark reddish. Sternites I and II reddish; III–IX and pygidium reddish brown. Pedipalp trochanter, femur, patella and tibia, dark reddish brown, mesal surfaces with several dark reddish macrosetae; patellar apophysis, fixed finger and basitarsus blackish, with reddish macrosetae. Legs I–IV reddish brown; II–IV coxae, ventral surfaces reddish.

*Carapace:* Epistoma visible in dorsal aspect. Pair of strongly developed carinae anterolaterally, extending from lateral ocelli to two-thirds the distance to median ocular tubercle (fig. 10B). Three pairs of lateral ocelli with accessory translucent eyespot situated between anterior and posterior ocelli; anterior ocelli almost equal to median and posterior ocelli; anterior two pairs slightly separated from posterior pair by tubercle, distance between median and posterior ocelli 6× distance between anterior and median ocelli. Median ocular tubercle smooth, situated in anterior 10% of carapace (table 2); distance between ocelli almost 1.5× ocular diameter. Carapace surfaces granular, tuberculate mediolaterally, and with sclerotized crests between median ocular tubercle and anterior margin. Posterior fovea present, distinct.

*Chelicerae:* Retrolateral surface with stridulatory surface (plectrum), comprising approximately 30 short, stout (ca. 7× or 8× longer than wide), anteroventrally directed spiniform macrosetae (figs. 4D, 5D); mesal surface with few short, stout, anteroventrally directed spiniform macrosetae.

*Pedipalps:* Cuticle punctate and tuberculate, with cristulae. Coxa, retrolateral surface with cristulae; ventral surface rugose; coxal apophysis with one terminal spine; prodorsal surface with long, retroventrally directed macrosetae inserted in cris-

tulae, forming stridulatory surface (pars stridens) (fig. 6D). Trochanter longer than wide (♂), or subequal (♀); retrodorsal surface tuberculate with long, straight cristulae (♂) or punctate (♀); prodorsal margin with five terminal spines (S1–S5) and one subterminal accessory spine (AS), varying in size such that  $S3 > S4 \geq S2 \geq S5 > S1 > AS$  (♂; fig. 7E) or  $S4 > S5 \geq S3 > S2 > S1 > AS$  (♀; fig. 7F); space between S4 and S3 subequal to length of S3 (♂) or subequal to space between S4 and S5 (♀); prolateral surface with several spiniform tubercles and reddish macrosetae (♂); proventral margin with two spines (♂). Femur laterally compressed (♂) or terete (♀),  $2\times$  (♀) to  $2.5\times$  (♂) longer than wide (table 2); prolateral surface with two spines, one prodorsal, short, sharply pointed, the other proventral, blunt, length one-fifth femur width (♂; fig. 9E) or short, sharply pointed, and apical (♀); retrolateral surface with sharply pointed digitiform tubercles (♂) or short tubercles proximally (♀). Patella slightly longer (♂) or shorter (♀) than tibia (table 2); prolateral surface with several reddish macrosetae, one spine (♂) or one to two spines (♀) situated distally on proventral margin; one vestigial (♂) or distinct (♀) spine at base of patellar apophysis; retrolateral surface tuberculate proximally. Patellar apophysis elongated, almost one-quarter carapace length, smooth and slender (♂) or shorter and robust (♀); prolateral margin with row of blunt, pointed denticles; retrolateral margin smooth (♂) or denticulate (♀), with subterminal macrosetae. Tibia laterally compressed; prodorsal surface with sparse row of denticles; prolateral surface sparsely punctate, with reddish macrosetae; proventral margin with two spines distally; fixed finger, dorsal and ventral margins each with row of denticles. Basitarsus (movable finger), dorsal and ventral margins each with serrate row of denticles; prolateral surface with several reddish macrosetae; apex bifid (♂).

*Legs:* Leg I, basitarsal and telotarsal tarsomeres I–VII gradually decreasing in length, with tarsomere I longest, tarsomere VIII four-fifths length of tarsomere I. Legs I–III coxae, lateral surfaces and IV, dorsal surface each with setose spiniform tubercles. Legs I–IV trochanters, dorsal and lateral sur-

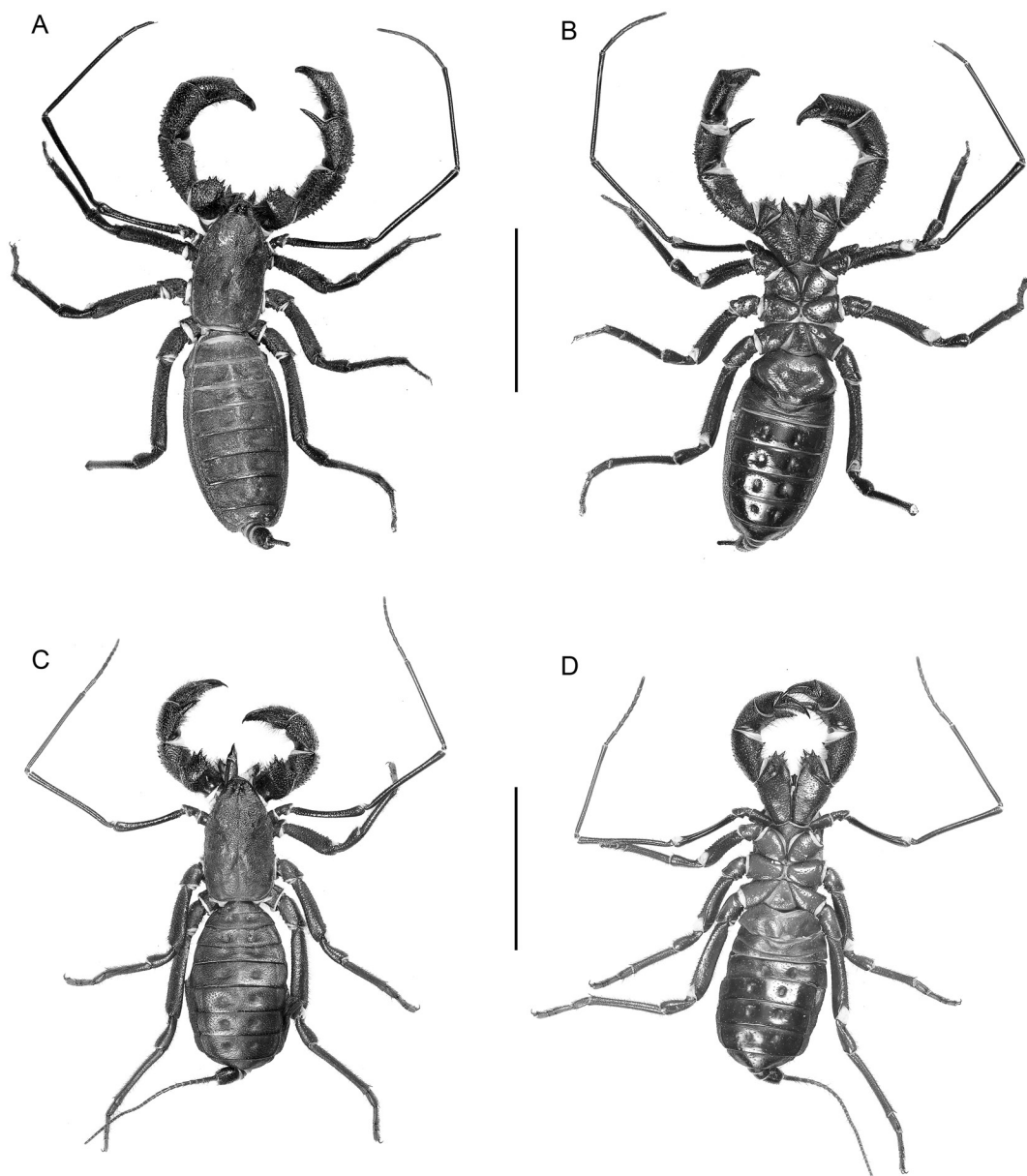


FIG. 15. *Mastigoproctus mexicanus* (Butler, 1872), stat. nov., habitus, dorsal (A, C) and ventral (B, D) aspect. A, B. ♂ (CNAN [Ur57]). C, D. ♀ (CNAN [Ur57]). Scale bars = 25 mm.

faces with setose spiniform tubercles; femora dorsal and ventral surfaces with setose spiniform tubercles, situated proximally on I, II–IV, retroventral surfaces each with setose spiniform tubercle terminally, with macroseta inserted subterminally; tibiae each with one ventrodistal spur; basitarsi each with two ventrodistal spurs. Leg I tibia with two trichobothria distally; legs II–IV tibiae each with one trichobothrium distally.

*Opisthosoma*: Tergites almost smooth with few dark macrosetae; I without median longitudinal suture; II with median longitudinal suture, extending from anterior margin to midsegment; tergites III–IX undivided; X (first segment of pygidium) with distinct lateral longitudinal sutures (pleuron); XII with pair of lateral, obovate ommatoids posterolaterally. Sternite II (genital) with pair of V-shaped (♂) or lanceolate (♀) depressions submedially, posterolateral surfaces inflated (♂) or flat (♀), and posterior margin protruding markedly (♂) or slightly (♀) posteriorly into median lobe, emarginate medially and overlapping sclerotized area in space between sternites II and III (♀); III divided longitudinally (♂) or undivided (♀), linear (♂) or with pronounced emargination (♀) anteriorly, posterior margin with (♂) or without (♀) median bulge with patch of reddish macrosetae; IV undivided longitudinally; V with (♂) or without (♀) patch of fine macrosetae medially; VI–VIII surfaces smooth, with few dark macrosetae (♂); IX surface smooth, asetose. Spermathecae seminal receptacles obovate, anteriorly directed (fig. 11E, F); spermathecal neck short, narrow; aperture of uterus curved, with medial notch; dorsal atrium pentagonal in dorsal aspect.

*Sexual dimorphism*: Adult males present several characters that differ from the females and immature stages. The pedipalps of the male are relatively elongated (fig. 9E), unlike the pedipalps of the female, which are shorter and more robust. A wider gap is present between spines S3 and S4 than between other spines on the prodorsal margin of the pedipalp trochanter in the male (fig. 7E, F) whereas all spines along the prodorsal margin are evenly spaced in the female. Long,

digitiform tubercles are present on the retrolateral surface of the femur in the male, whereas short tubercles and cristulae are present on the retrolateral surface of the female. The retroventral spine on the pedipalp femur is short and situated proximally in the male, whereas it is longer and situated distally in the female. The patellar apophysis is slender and elongated in the male, whereas it is short and stout in the female. The posterolateral surfaces of sternite II are slightly inflated in the male, but flat in the female. Sternite III is not emarginate anteriorly and its posterior margin exhibits a posteromedian bulge with a patch of macrosetae in the male, whereas sternite III is conspicuously emarginate anteriorly, its posteromedian margin does not protrude, and a patch of macrosetae is absent in the female (fig. 15B, D).

**ADDITIONAL MATERIAL EXAMINED: MEXICO:** *Aguascalientes*: Municipio Calvillo: 3 km E Presa Alamitos, 21°44'06.468"N 102°41'51.108"W, 2,440 m, 24.vii.2012, D. Barrales, G. Contreras, O. Francke, and A. Valdez, oak forest, 1 ♂, 1 ♀, 1 subad. ♂, 9 juv. (CNAN [Ur57]).

**DISTRIBUTION**: Known only from the vicinity of Presa Alamitos, in the municipality of Calvillo, Aguascalientes, Mexico (fig. 2).

**NATURAL HISTORY**: *Mastigoproctus mexicanus* inhabits oak forest, at elevations of 2000–2400 m, with a temperature range of 18°–22° C and mean annual precipitation of 660 mm. Specimens were collected under large rocks, and it was not unusual to find juveniles and adults together under the same shelter. The species is fairly abundant in the area. No aggressive behavior was observed.

*Mastigoproctus scabrosus* Pocock, 1902,  
stat. nov.

Figure 16A–D; table 3

*Mastigoproctus giganteus scabrosus* Pocock,  
1902a: 48; Mello-Leitão, 1931: 28; Harvey,  
2003: 67; Zárate-Gálvez and Chame-  
Vázquez, 2007: 393–395 (misidentification);  
McMonigle, 2013: 100, fig. unnumbered,

100 (part); Barrales-Alcalá et al., 2016: 26, 46, fig. 3A–D.

*Mastigoproctus giganteus scatrosus*: Franganillo, 1936: 147.

**TYPE MATERIAL:** **MEXICO:** *Oaxaca*: Holotype ♂ (Natural History Museum, London) [photographs examined].

**DIAGNOSIS:** *Mastigoproctus scabrosus*, stat. nov., is among the most conspicuous North American species of *Mastigoproctus* and may be distinguished from *M. mexicanus* and *M. vandevenderi*, sp. nov., both of which also exhibit tubercles on the retrolateral surface of the pedipalp femur, as follows. *Mastigoproctus scabrosus* is sparsely setose whereas *M. mexicanus* is densely setose. A cheliceral-coxal stridulatory organ is absent in *M. scabrosus*, but present in *M. mexicanus* and *M. vandevenderi*. Spines S4 and S5 on the prodorsal margin of pedipalp trochanter of the adult male are fused in *M. scabrosus*, but separated in *M. mexicanus* and *M. vandevenderi*. The terminal spiniform tubercle on the retroventral surfaces of the femora of legs II–IV is conical in *M. scabrosus* whereas it is more tubular (digitiform) in *M. vandevenderi* and *M. mexicanus*.

**DESCRIPTION:** The following description is based on three males and one female.

**Total length:** Maximum length from anterior margin of carapace to posterior margin of opisthosomal segment XII (pygidium) in adult specimens 73.7 mm (♂) and 64.2 mm (♀) (table 3).

**Color:** Carapace dark reddish brown, anterior margin blackish, lateral margins dark brown. Tergites I–IX dark reddish brown, posterior and lateral margins blackish. Sternites I and II reddish brown; III–IX and pygidium dark reddish brown. Flagellum dark brown, segments with reddish-brown macrosetae. Pedipalp trochanter, femur, patella, and tibia dark brown, mesal surfaces with few reddish macrosetae; patellar apophysis, fixed finger and basitarsus, blackish, with reddish macrosetae. Legs I–IV dark reddish brown; II–IV coxae, ventral surfaces reddish brown.

**Carapace:** Epistoma visible in dorsal aspect. Pair of strongly developed carinae anterolater-

ally, extending from lateral ocelli to two-thirds the distance to median ocular tubercle (fig. 10G). Three pairs of lateral ocelli with accessory translucent eyespot situated between anterior and posterior ocelli; anterior ocelli larger than median and posterior ocelli; anterior two pairs slightly separated from posterior pair by tubercle, distance between median and posterior ocelli 10× distance between anterior and median ocelli. Median ocular tubercle rugose, situated in anterior 10% of carapace (table 3); distance between ocelli almost 2× ocular diameter. Carapace surfaces densely granular, tuberculate mediolaterally. Posterior fovea present, distinct.

**Chelicerae:** Retrolateral surface without stridulatory surface; mesal surface with reddish macrosetae (figs. 4E, 5E).

**Pedipalps:** Cuticle punctate and tuberculate with cristulae. Coxa, retrolateral surface with cristulae; ventral surface rugose; coxal apophysis with one terminal spine; prodorsal surface smooth, with macrosetae (fig. 6E). Trochanter longer than wide; retrodorsal surface tuberculate; prodorsal margin with five terminal spines (S1–S5) and one subterminal accessory spine (AS), varying in size such that S4 > S3 > S2 > S5 ≥ S1 > AS (♂; fig. 7G) or S4 > S3 ≥ S5 ≥ S2 > S1 > AS (♀; fig. 7H); spaces between S2 and S3 equal to or greater than length of S2 and between S3 and S4 equal to or greater than length of S3 (♂; fig. 7G) or spines evenly spaced (♀); prolateral surface with several spiniform tubercles and reddish macrosetae (♂); proventral margin with two spines (♂). Femur laterally compressed (♂) or terete (♀), 2× (♀) to almost 3× (♂) longer than wide (table 3); prolateral surface with two spines, one prodorsal, short, blunt (♂) or sharply pointed (♀), the other proventral, sharply pointed, length almost one-third femur width (♂; fig. 9C) or short, sharply pointed, and situated apically (♀); retrolateral surface rugose, with short, blunt (♀) or long, sharply pointed (♂) tubercles. Patella slightly shorter (♂) or longer (♀) than tibia (table 3); prolateral surface with reddish macrosetae, one vestigial (♂) or distinct (♀) spine situated distally on proventral



TABLE 3

Measurements (mm) of *Mastigoproctus scabrosus* (Pocock, 1902), stat. nov., from Veracruz, Mexico

Material deposited in the California Academy of Sciences (CAS), San Francisco, the National Collection of Arachnids (CNAN), Institute of Biology, National Autonomous University of Mexico, Mexico City, and the Anita Hoffmann Laboratory, Faculty of Science, National Autonomous University of Mexico (FCUNAM), Mexico City.

Sex	♂				♀		
Collection	CAS		CNAN	FCUNAM	CNAN		
Code			[Ur176]		[Ur70]	[Ur174]	[Ur175]
Total length	64.2	73.0	73.9	69.5	73.7	75.0	64.2
Pedipalp							
Trochanter length	8.7	8.7	9.5	7.9	7.9	7.3	6.4
Trochanter width	5.4	7.1	5.4	5.9	6.7	4.5	4.3
Femur length	17.4	19.6	20.9	17.3	13.4	13.7	12.0
Femur width	5.8	7.2	7.5	6.4	6.7	7.1	6.0
Ventromesal spine length	2.1	2.0	2.4	2.1	1.5	2.0	1.4
Ventromesal spine width	0.7	0.9	0.8	0.8	0.4	0.9	0.6
Patella length	11.1	12.5	14.2	12.0	8.3	9.5	8.1
Patella width	5.4	7.1	6.8	6.5	5.7	5.9	5.1
Patellar apophysis length	5.2	6.6	6.6	5.8	4.5	5.0	4.8
Patellar apophysis width	1.1	1.3	1.5	1.3	1.4	1.5	1.4
Tibia length	11.9	12.7	14.5	12.2	7.5	7.8	6.8
Tibia width	5.4	5.8	6.2	5.6	5.8	4.8	4.0
Carapace							
Total length	23.9	27.9	29.7	27.2	25.5	27.4	24.8
Total width at lateral ocelli	12.3	12.8	14.3	13.6	9.8	13.5	12.1
Total width at fovea	13.7	15.9	17.5	14.9	15.0	16.0	14.5
Median ocular tubercle distance	1.5	1.2	1.9	1.4	1.6	1.4	1.5
Ocular width	0.6	0.5	0.7	0.6	0.7	0.7	0.6
Distance between median ocelli	1.1	1.3	1.3	1.1	1.1	1.2	1.1
Leg I							
Coxa length	4.3	5.0	5.0	4.9	4.5	5.0	4.7
Trochanter length	4.1	4.0	4.7	3.9	4.0	4.8	3.9
Femur length	15.7	20.1	20.8	17.9	15.5	18.5	16.5
Patella length	22.3	25.3	27.1	23.3	20.7	23.0	20.4
Tibia length	21.8	24.4	25.1	22.4	20.7	21.5	19.7
Basitarsus–tarsus length	17.5	18.8	20.1	18.0	15.6	16.0	16.8
Leg IV							
Coxa length	7.9	9.1	9.5	8.8	9.2	9.1	9.0
Trochanter length	6.8	8.7	9.0	7.3	7.4	9.7	8.4
Femur length	19.2	21.6	17.7	20.4	18.2	15.5	18.8
Patella length	7.8	9.2	8.5	9.1	8.7	8.2	8.1
Tibia length	18.6	20.9	15.9	19.9	17.0	12.1	16.2
Basitarsus length	3.6	3.9	3.1	4.4	3.5	2.9	3.2
Tarsus length	7.9	8.8	8.8	9.2	–	7.3	8.3

margin; one or two spines (♂) or one or three distinct spines (♀) at base of patellar apophysis; retrolateral surface with short tubercles (♂) or punctate (♀). Patellar apophysis elongated, almost one-quarter carapace length, smooth and slender (♂) or shorter and robust (♀); prolateral margin with row of blunt denticles; retrolateral margin smooth (♂) or denticulate (♀), with subterminal macrosetae. Tibia longer than wide, laterally compressed; prodorsal surface with sparse row of denticles; prolateral surface with cristulae and reddish macrosetae; proventral margin with two spines distally; fixed finger, dorsal and ventral margins each with row of denticles. Basitarsus (movable finger), dorsal and ventral margins each with serrate row of denticles; prolateral surface with several reddish macrosetae; apex bifid (♂).

**Legs:** Leg I, femur with sclerotized crests proximally; basitarsal and telotarsal tarsomeres I–VII gradually decreasing in length, with tarsomere I longest, tarsomere VIII two-thirds length of tarsomere I. Legs I–III coxae, lateral surfaces and IV, dorsal surface each with setose spiniform tubercles. Legs I–IV trochanters, dorsal and lateral surfaces with setose spiniform tubercles. Legs II–IV femora dorsal surfaces with setose spiniform tubercles, retroventral surfaces each with setose spiniform tubercle terminally, with macroseta inserted terminally, prolateral surfaces granular, retrolateral surfaces smooth; tibiae each with one ventrodiscal spur; basitarsi each with two ventrodiscal spurs. Leg I tibia with two trichobothria distally; legs II–IV tibiae each with one trichobothrium distally.

**Opisthosoma:** Tergites granular; I with median longitudinal suture; II with median longitudinal suture extending from anterior margin to midsegment; III with faint longitudinal suture; tergites IV–IX undivided; X (first segment of pygidium) with distinct lateral longitudinal sutures (pleuron); XII with pair of obovate ommatoids posterolaterally. Sternite II (genital) with pair of V-shaped (♂) or lanceolate (♀) depressions submedially, posterolateral surfaces inflated (♂) or flat (♀), and posterior margin protruding markedly (♂) or

slightly (♀) posteriorly into median lobe, emarginate medially and overlapping sclerotized area in space between sternites II and III (♀); III divided longitudinally (♂) or undivided (♀), linear (♂) or with pronounced emargination (♀) anteriorly, posteromedial margin with (♂) or without (♀) median bulge with patch of reddish macrosetae; IV divided longitudinally (♂) or undivided (♀); V with (♂) or without (♀) patch of fine macrosetae medially; VI–IX surfaces smooth, asetose. Spermathecae seminal receptacles rounded, anteriorly directed (fig. 11G, H); spermathecal neck short, narrow; aperture of uterus straight, with medial notch; dorsal atrium triangular in dorsal aspect.

**Sexual dimorphism:** Adult males present several characters that differ from the females and immature stages. The pedipalps of the male are relatively elongated (fig. 9C), unlike the pedipalps of the female, which are shorter and more robust. On the prodorsal margin of the pedipalp trochanter, two wide gaps are present between spines S2 and S3 and between spines S3 and S4, and spines S4 and S5 are fused in the male (figs. 7G, H, 9C), whereas all spines along the prodorsal margin are evenly spaced, and spines S4 and S5 are separated in the female. Long tubercles are present on the retrolateral surface of the femur in the male, whereas short tubercles and sclerotized crests are present on the retrolateral surface of the female. The retroventral spine on the pedipalp femur is short and situated proximally in the male, whereas it is longer and situated terminally in the female. The patellar apophysis of the male is more slender and elongated than that of the female. The posterolateral surfaces of sternite II are slightly inflated in the male but flat in the female. Sternite III is not emarginate anteriorly in the male, and exhibits a posteromedian bulge with a patch of macrosetae in the male, whereas sternite III is emarginate anteriorly, its posteromedian margin does not protrude, and a patch of macrosetae is absent in the female (fig. 16B, D).

**ADDITIONAL MATERIAL EXAMINED: MEXICO:** Veracruz: Municipio Atoyac: Atoyac, outside Cueva de Atoyac, 18°55'18.663"N 96°45'54.687"W,

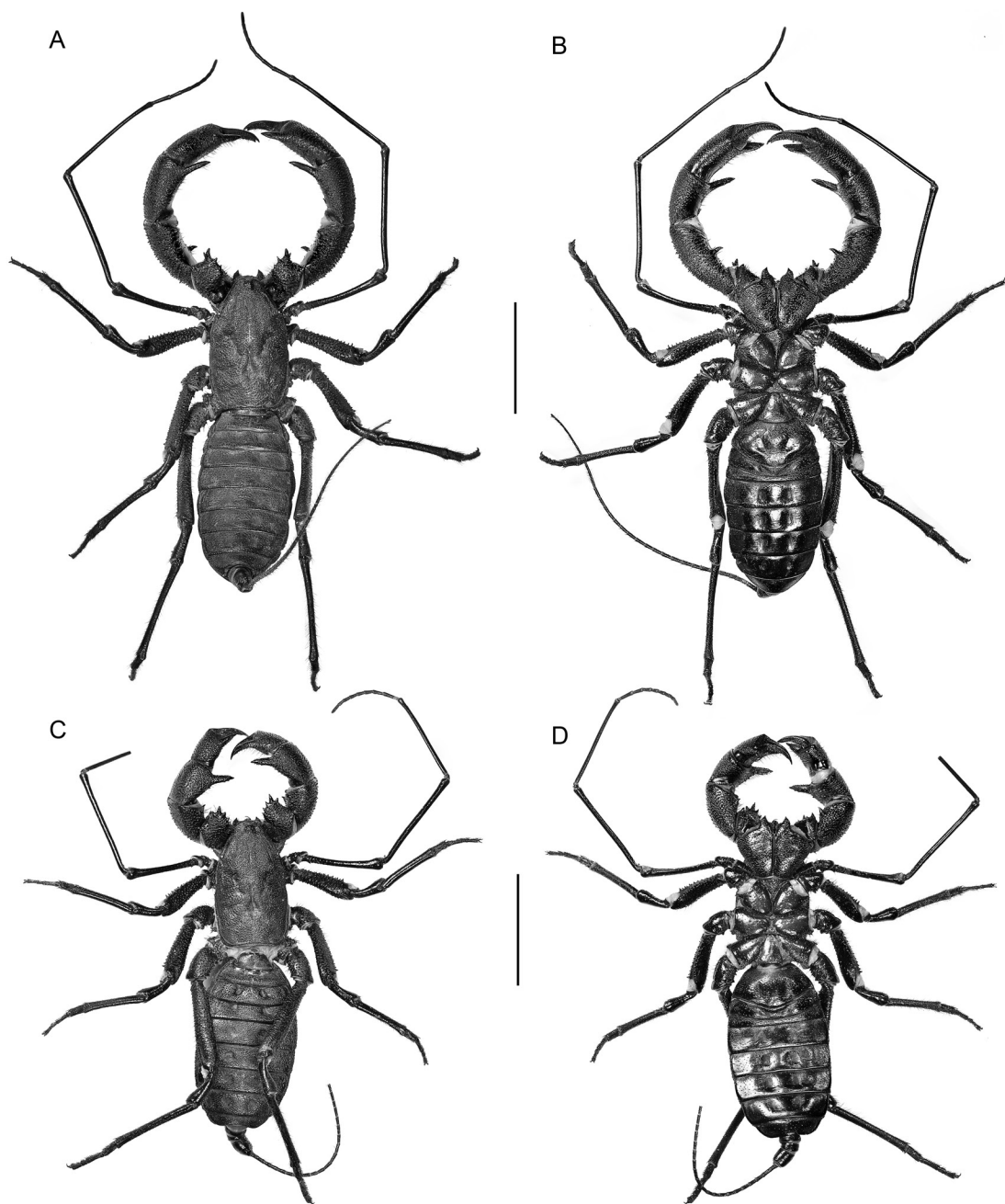


FIG. 16. *Mastigoproctus scabrosus* (Pocock, 1902), stat. nov., habitus, dorsal (A, C) and ventral (B, D) aspect. A, B. ♂ (CNAN [Ur176]). C, D. ♀ (CNAN [Ur175]). Scale bars = 25 mm.

500 m, 18.ii.2017, D. Barrales, G. Contreras, and R. Monjaraz, 1 juv. (CNAN [Ur169]); Atoyac, Rancho San Fermín, 18°54'04.593"N 96°48'19.760"W, 549 m, 18.iv.2017, A. Ramírez, 1 ♂ (CNAN [Ur176]), 18°54'27.226"N 96°48'40.734"W, 568 m, 18.v.2017, P. López, 1 ♀ (CNAN [Ur175]). Municipio Catemaco: Catemaco [18°25'17.02"N 95°06'47.40"W], 1964, W.F. Pyburn, 1 ♂ (CAS), viii.1965, A. Hoffmann, 1 ♂ (FCUNAM). Municipio Fortín de las Flores: Canyon near Fortín [18°54'00.72"N 97°00'37.53"W], 17.xii.1948, G. Rabago, 1 ♂ (CAS). Municipio Los Tuxtlas: San Andrés Tuxtla, Estación de Biología Tropical Los Tuxtlas, 18°35'05.64"N, 95°04'26.16"W, 148 m, 1.vi.2017, M. Madora, 1 ♀ (CNAN [Ur174]). Municipio Puente Nacional: Puente Nacional [19°19'46.56"N 96°28'57.65"W], viii.1947, 1 ♂ (AMNH), viii.2002, P. Berea, 1 ♀ (CNAN [Ur70]).

**DISTRIBUTION:** Known from the municipalities of Atoyac, Cordova, Los Tuxtlas, Playa Vicente and Puente Nacional, in the state of Veracruz, Mexico (fig. 2). Playa Vicente, in Veracruz, where the paratype was collected, is near the border with the state of Oaxaca, so the holotype, which is from an indefinite location in that state, may have originated in that general vicinity.

**NATURAL HISTORY:** *Mastigoproctus scabrosus* inhabits tropical deciduous forest and the tropical rainforest, at elevations of 50–800 m, with temperatures of 6°–35° C and mean annual precipitation of 72–1800 mm (fig. 1F). Specimens are active in the rainy season, becoming inactive during the dry season. Adults often hide in rotten logs, whereas juveniles are commonly found under large stones.

*Mastigoproctus cinteotl*, sp. nov.

Figure 17A–D; table 5

*Mastigoproctus giganteus*: Reddell and Mitchell, 1971a: 145, fig. 18; 1971b: 185; Reddell and Elliott, 1973: 183; Rowland and Reddell, 1976: 3, 4; Cokendolpher and Bryce, 1980: 18; Reddell, 1981: 124; Palacios et al., 2014–2015: 32.

**TYPE MATERIAL:** **MEXICO:** *Tamaulipas*: Municipio Gómez Farías: Holotype ♂ (CNAN T1149), subad. ♂ paratype (CNAN T01040), 1 km N Mirador Camino de Alta Cima, 23°03'12.78"N 99°10'45.32"W, 763 m. 20.iv.2016, J. Arreguín, G. Contreras, D. Guerrero, R. Monjaraz, G. Montiel and J. López; paratype ♂, paratype ♀ (AMNH), 8 mi. NW Gómez Farías, 1–5. vi.1964, J. Reddell, D. McKenzie, and L. Manire.

**ETYMOLOGY:** This new species is named after the Aztec god Cinteotl, responsible for providing the first corn seeds to their ancestors. The Mexican state of Tamaulipas was an important center for the domestication of corn (McClung de Tapia et al., 2001). The name is a noun in apposition.

**DIAGNOSIS:** *Mastigoproctus cinteotl*, sp. nov., resembles *M. giganteus* and *M. floridanus*, from which it differs as follows. Spines S3 and S4 on the prodorsal margin of the pedipalp trochanter are equal, and S4 and S5 are subequal in *M. cinteotl*, whereas S3 and S4 are unequal, and S5 shorter than S4, in *M. giganteus*; and S3 is longer than S4, and S4 and S5 subequal, in *M. floridanus*. The punctures on the retrolateral surface of the pedipalp femur are markedly cristulate, providing a rugose texture in *M. cinteotl*, whereas the punctures are weakly cristulate in *M. floridanus*. Sternite V is smooth in the adult male of *M. cinteotl*, but possesses a patch of fine macrosetae in *M. giganteus* and *M. floridanus*.

**DESCRIPTION:** The following description is based on two males and one female.

**Total length:** Maximum length from anterior margin of carapace to posterior margin of opisthosomal segment XII (pygidium) in adult specimens 65.8 mm (♂) and 53.9 mm (♀) (table 4).

**Color:** Carapace dark brown, anterior margin blackish. Tergites I–IX dark brown, posterior and lateral margins black. Sternites I–VIII dark reddish brown, lateral margins blackish. Sternite IX blackish, lateral and posterior margins black. Pygidium, dorsal and ventral surfaces dark reddish brown. Flagellum dark brown, segments with dark brown macrosetae. Pedipalp trochanter



TABLE 4

Measurements (mm) of type specimens of *Mastigoproctus cinteotl*, sp. nov., from Tamaulipas, Mexico, and *Mastigoproctus tohono*, sp. nov., from Arizona

Material deposited in the American Museum of Natural History (AMNH), New York, and the National Collection of Arachnids (CNAN), Institute of Biology, National Autonomous University of Mexico, Mexico City.

Type	<i>Mastigoproctus cinteotl</i>			<i>Mastigoproctus tohono</i>			
	Holotype	Paratype	Paratype	Holotype	Paratype	Paratype	Paratype
Sex	♂		♀	♂	♀		
Collection	CNAN	AMNH		AMNH			CNAN
Code	T1149						T1151
Total length	65.8	66.5	53.9	56.5	50.5	59.4	55.4
Pedipalp							
Trochanter length	4.4	4.2	4.9	5.8	5.2	5.4	5.9
Trochanter width	5.0	5.3	3.9	5.9	5.9	6.2	4.9
Femur length	16.1	15.3	8.1	12.1	9.1	10.3	10.1
Femur width	5.8	5.5	3.3	5.1	4.5	4.7	4.9
Ventromesal spine length	1.2	1.7	1.0	0.9	1.0	0.8	1.1
Ventromesal spine width	0.7	0.7	0.4	0.4	0.4	0.5	0.5
Patella length	10.2	9.9	5.3	8.0	5.8	6.1	6.2
Patella width	5.1	5.7	3.3	5.1	4.4	4.2	3.9
Patellar apophysis length	5.6	6.6	3.3	4.4	4.0	3.7	3.8
Patellar apophysis width	1.2	1.3	1.0	1.1	1.2	1.1	1.2
Tibia length	11.3	10.7	4.7	8.2	5.6	6.0	5.5
Tibia width	5.3	5.0	2.6	4.3	3.0	3.3	3.4
Carapace							
Total length	24.7	23.7	17.7	20.7	18.9	20.2	20.5
Total width at lateral ocelli	10.8	10.7	7.8	9.8	9.0	9.3	10.3
Total width at fovea	13.1	13.1	9.7	11.8	11.0	11.9	12.3
Median ocular tubercle distance	1.4	1.4	1.1	1.2	1.3	1.2	1.4
Ocular width	0.6	0.6	0.5	0.6	0.5	0.6	0.6
Distance between median ocelli	1.1	1.0	0.7	1.0	1.0	1.0	1.0
Leg I							
Coxa length	4.2	4.6	3.4	3.5	3.4	3.7	3.6
Trochanter length	3.7	4.1	3.0	2.8	2.8	3.1	2.7
Femur length	19.3	19.7	12.1	13.3	11.8	13.3	12.3
Patella length	25.3	25.2	15.4	18.4	14.3	16.4	16.7
Tibia length	23.1	23.2	15.4	17.8	15.4	15.7	16.7
Basitarsus–tarsus length	17.9	16.8	11.9	13.6	12.1	12.1	12.9
Leg IV							
Coxa length	8.9	8.1	6.6	6.8	6.5	7.7	7.2
Trochanter length	6.3	6.5	4.6	5.5	5.1	5.7	5.5
Femur length	19.9	18.7	13.3	15.1	14.1	15.1	14.7
Patella length	9.3	9.0	5.6	7.1	5.5	6.2	6.4
Tibia length	19.3	19.1	11.9	14.4	12.5	13.5	13.7
Basitarsus length	4.1	3.6	2.9	2.9	2.6	2.5	3.0
Tarsus length	8.7	8.1	6.6	7.1	6.9	6.7	8.9

dorsal and ventral surfaces dark brown, almost black, prolateral surface with reddish macrosetae. Pedipalp femur and patella dark brown, almost black, patellar apophysis black; tibia, dorsal and ventral surfaces dark brown, mesal surfaces with reddish macrosetae; fixed finger and basitarsus black. Leg I dark reddish brown; II–IV, coxae, ventral surfaces reddish brown, trochanter, femora, patellae, tibiae, basitarsi and telotarsi, dorsal and ventral surfaces dark reddish brown, lateral surfaces reddish brown.

*Carapace*: Epistoma visible in dorsal aspect. Pair of strongly developed carinae anterolaterally, extending from lateral ocelli to two-thirds the distance to median ocular tubercle (fig. 10C). Three pairs of lateral ocelli with accessory translucent eyespot situated between anterior and posterior ocelli; anterior ocelli larger than median and posterior ocelli; anterior two pairs slightly separated from posterior pair by tubercle, distance between median and posterior ocelli  $10\times$  distance between anterior and median ocelli. Median ocular tubercle smooth, situated in anterior 10% of carapace (table 4); distance between ocelli  $2\times$  ocular diameter. Carapace anterior and medial surfaces rugose, mediolateral surfaces tuberculate, other surfaces granular. Posterior fovea present, distinct.

*Chelicerae*: Retrolateral surface with stridulatory surface (plectrum), comprising approximately 20 short, stout (ca.  $8\times$  longer than wide), anteroventrally directed spiniform macrosetae (figs. 4F, 5F); mesal surface with few short, stout, anteroventrally directed spiniform macrosetae.

*Pedipalps*: Cuticle punctate with cristulae. Coxa, retrolateral surface rugose; ventral surface smooth and densely punctate; coxal apophysis with one terminal spine; prodorsal surface with long, proventrally directed macrosetae inserted in cristulae, forming stridulatory surface (pars stridens) (fig. 6F). Trochanter wider than long ( $\delta$ ) or longer than wide ( $\varphi$ ); retrodorsal surface with cristulae ( $\delta$ ), punctate; prodorsal margin with five terminal spines (S1–S5) and one subterminal accessory spine (AS), all sharply pointed, varying in size such that  $S3 \geq S4 \geq S5 > S2 > S1$

$> AS$  ( $\delta$ ; fig. 8A) or  $S4 > S5 \geq S3 \geq S2 > S1 \geq AS$  ( $\varphi$ ; fig. 8B); space between S3 and S4 equal to or greater than length of longest spine ( $\delta$ ) or equal to space between S4 and S5 ( $\varphi$ ); prolateral surface with several spiniform tubercles and reddish macrosetae ( $\delta$ ); proventral margin with two spines ( $\delta$ ). Femur laterally compressed ( $\delta$ ) or terete ( $\varphi$ ),  $2.5\times$  ( $\varphi$ ) to  $3\times$  ( $\delta$ ) longer than wide (table 4); prolateral surface with two spines, one prodorsal, short, sharply pointed, the other proventral, sharply pointed, length one-third to one-fifth femur width ( $\delta$ ; fig. 9F) or short, sharply pointed, and situated apically ( $\varphi$ ); retrolateral surface markedly punctate, with distinct cristulae ( $\delta$ ). Patella slightly shorter ( $\delta$ ) or longer ( $\varphi$ ) than tibia (table 4); prolateral surface with reddish macrosetae, one vestigial ( $\delta$ ) or distinct ( $\varphi$ ) spine situated distally on proventral margin; one short, blunt spine ( $\delta$ ) or one or two sharp spines ( $\varphi$ ) at base of patellar apophysis; retrolateral surface shallowly punctate. Patellar apophysis elongated, almost one-quarter carapace length, smooth and slender ( $\delta$ ) or shorter and robust ( $\varphi$ ); prolateral margin with row of blunt ( $\delta$ ) or sharply pointed ( $\varphi$ ) denticles; retrolateral margin smooth ( $\delta$ ) or sparsely denticulate ( $\varphi$ ), with subterminal macrosetae. Tibia laterally compressed ( $\delta$ ) or terete ( $\varphi$ ); prodorsal surface with sparse row of denticles; prolateral surface with reddish macrosetae; proventral margin with two spines distally; fixed finger, dorsal and ventral margins each with row of denticles. Basitarsus (movable finger), dorsal and ventral margins each with serrate row of denticles; prolateral surface with several reddish macrosetae; apex bifid ( $\delta$ ).

*Legs*: Leg I, basitarsal and telotarsal tarsomeres I–VII gradually decreasing in length, with tarsomere I longest, tarsomere VIII two-thirds length of tarsomere I. Legs I–III coxae, lateral surfaces and IV, dorsal surface each with setose spiniform tubercles. Legs II–IV trochanters, dorsal and lateral surfaces with setose spiniform tubercles. Legs I–IV femora dorsal surfaces with setose spiniform tubercles, situated proximally on I, II–IV, retroventral surfaces each with setose spiniform tuber-

cle terminally, with macroseta inserted terminally; lateral surfaces smooth; tibiae each with one ventrodistal spur; basitarsi each with two ventrodistal spurs. Leg I tibia with two trichobothria distally; legs II–IV tibiae each with one trichobothrium distally.

*Opisthosoma*: Tergites finely granular, more coarsely so along posterior margins; I with median longitudinal suture extending from midsegment to posterior margin; II with weak median longitudinal suture; III with median longitudinal suture extending from anterior margin to anterior third of segment; other tergites undivided; X (first segment of pygidium) with distinct lateral longitudinal sutures (pleuron); XII with pair of obovate ommatoids posterolaterally. Sternite II (genital) with pair of V-shaped (♂) or lanceolate (♀) depressions submedially, posterolateral surfaces inflated (♂) or flat (♀), and posteromedian margin protruding markedly (♂) or slightly (♀) posteriorly into median lobe, emarginate medially and overlapping sclerotized area in space between sternites II and III (♀); III divided longitudinally (♂) or undivided (♀), linear (♂) or with pronounced emargination (♀) anteriorly, posterior margin with (♂) or without (♀) patch of reddish macrosetae on posteromedian bulge; IV divided longitudinally (♂) or undivided (♀); V–IX surfaces smooth, asetose. Spermathecae seminal receptacles oblong, anteriorly directed (fig. 12A, B); spermathecal neck short, wide; aperture of uterus rounded, with medial notch; dorsal atrium triangular in dorsal aspect.

*Sexual dimorphism*: Adult males present several characters that differ from the females and immature stages. The pedipalps of the male are relatively elongated (fig. 9F), unlike the pedipalps of the female, which are shorter and more robust. A wider gap is present between spines S3 and S4 than between the other spines on the prodorsal margin of the pedipalp trochanter in the male, whereas all spines along the prodorsal margin are evenly spaced in the female (fig. 8A, B). The retrolateral surface of the pedipalp femur is punctate, with cristulae in the male (fig. 9F) but punc-

tate and smooth, without cristulae, in the female. The patellar apophysis of the male is more slender and elongated than that of the female. The posterolateral surfaces of sternite II are slightly inflated in the male, but flat in the female. Sternite III is not emarginate anteriorly and exhibits a posteromedian bulge with a patch of macrosetae in the male, whereas it is emarginate anteriorly, its posteromedian margin does not protrude, and a patch of macrosetae is absent in the female (fig. 17B, D).

**ADDITIONAL MATERIAL EXAMINED: MEXICO: Tamaulipas:** Municipio Gómez Farías: Altamira, 5.vii.1999, G. Montiel, 2 ♂ (CNAN [Ur43]); Reserva El Cielo, surroundings of Centro Interpretativo Ecológico, 23°03'56.52"N 99°10'08.220"W, 343 m, 22.iv.2016, J. Arreguín, et al., tropical semideciduous forest, 1 subad. ♂ (CNAN [Ur155]).

**DISTRIBUTION:** Known from the vicinity of El Cielo Protected Area in the municipality of Gómez Farías, Tamaulipas, Mexico (fig. 2). Populations from the Lower Rio Grande Valley in Texas, are probably conspecific based on one available sequence of the mitochondrial Cytochrome Oxidase I (COI) gene. Some specimens from western Texas, the Big Bend area, and southern New Mexico are probably not conspecific, but no adult males were available for examination.

**NATURAL HISTORY:** *Mastigoproctus cinteotl* inhabits the tropical semideciduous forest, at elevations of 300–800 m, with temperatures of 15°–27° C and mean annual precipitation of 670–3500 mm (fig. 2G). Specimens collected in April 2016 were found alone under large rocks and no juveniles were observed, suggesting that the breeding season occurs at another time of the year. Specimens were passive when collected, despite the warm temperatures. When handled, they sprayed a very aromatic secretion. Punzo and Reeves (2001) reported differences in the mating behavior of specimens identified as *Mastigoproctus giganteus* from Florida and Texas, reflecting differences between *M. floridanus* and this new species.

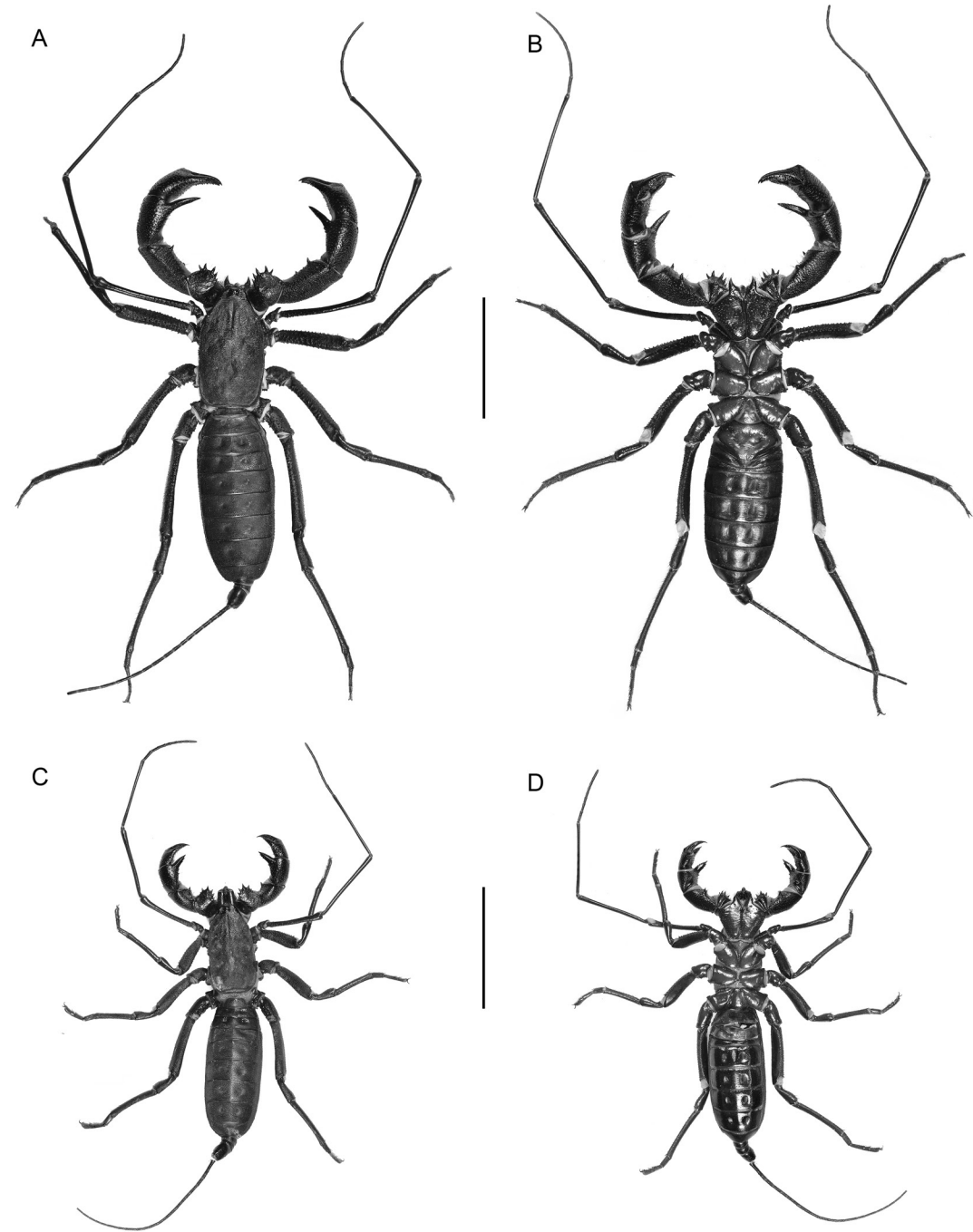


FIG. 17. *Mastigoproctus cinteotl*, sp. nov., habitus, dorsal (A, C) and ventral (B, D) aspect. A, B. Holotype ♂ (CNAN T1149). C, D. Paratype ♀ (AMNH). Scale bars = 25 mm.



*Mastigoproctus tohono*, sp. nov.

Figure 18A–D; table 4

*Mastigoproctus giganteus*: Wood, 1863: 374; Kraepelin, 1899: 224 (part); Banks, 1900: 422 (part); Comstock, 1913: 19, fig. 14; 1952: 5, fig. 1 (part); Eisner et al., 1961: 272–297, figs. 1–22; Savory, 1964: 166 (part); Lawrence, 1969: 125, 130; Ahearn, 1970: 339–351, figs. 1–6; Crawford and Cloudsley-Thompson, 1971: 99–106, fig. 1; Cloudsley-Thompson, 1975: 266, 273, 274; Muma, 1975: 262; Crawford, 1981: 21, 35, 36, 56, 59, 78, 86, 134, 137, 215, fig. 12c; Vasta and Marchalonis, 1983: 160, 161, 165; Vasta and Cohen, 1984: 334–340; Cloudsley-Thompson, 1986: 30; Barnes, 1987: 508, figs. 13–15, 16a, b; Coddington et al., 1990: 11 (part); Crawford, 1990: 434, fig. 16.5 (part); Shultz, 1991: 13–31, figs. 5c, 7–11; 1992b: 314–328, figs. 1a, 2, 3; 1993: 335–365, figs. 1, 2a–c, 3a, b, 4a–d, 5a, b, 6, 7a, b, 8, 9a, b; Schmidt et al., 2000: 443–450; Schmidt, 2003: 11; Punzo, 2007: 66–72; Becaloni, 2009: 111 (part); Carrel and Britt, 2009: 500–502, figs. 1–4 (part); Kern and Mitchell, 2011: 2, 4, figs. 1–5 (part); Hembree, 2013: 141–162 (part); McMonigle, 2013: 100, fig. unnumbered (part); Smith and Courter, 2015: 2603–2618, fig. 5; Monjaraz-Ruedas et al., 2016: 118–134, fig. 6A, B (part).

**TYPE MATERIAL: U.S.A.: Arizona:** Cochise Co.: Holotype ♂ (AMNH), Portal [31°54'48.23"N 109°08'39.67"W], 30.viii.1969, W.J. Gertsch; paratype ♀ (AMNH), Portal, 3.ix.1965, J. Jansen; 2 ♀ paratypes (AMNH, CNAN T1151), Southwestern Research Station, 5 mi. W Portal, [31°53'2.62"N 109°12'21.13"W], xi.1955, M.A. Cazier and E. Ordway.

**ETYMOLOGY:** This new species is named after the Tohono O'odham Native American people from southern Arizona and northern Sonora, Mexico, who have developed a deep relation-

ship with the environment. The name is a noun in apposition.

**DIAGNOSIS:** *Mastigoproctus tohono*, sp. nov., resembles *M. giganteus* and *M. floridanus*, from which it differs as follows. The carapace epistoma is not visible in dorsal aspect in *M. tohono*, but is visible in *M. giganteus* and *M. floridanus*. Spine S4 on prodorsal margin of the pedipalp trochanter of the adult male is blunt and shorter than the other spines on the prodorsal margin in *M. tohono*, whereas spine S4 is longer than spine S5 in *M. giganteus* and *M. floridanus*, and sharply pointed in *M. giganteus*. The punctures on the retrolateral surface of the pedipalp femur are weakly cristulate in *M. tohono*, but markedly cristulate in *M. giganteus* and not cristulate in *M. floridanus*.

**DESCRIPTION:** The following description is based on one male and three females.

**Total length:** Maximum length from anterior margin of carapace to posterior margin of opisthosomal segment XII (pygidium) in adult specimens 56.5 mm (♂) and 59.4 mm (♀) (table 4).

**Color:** Carapace dark reddish brown, with median lateral edges darker. Tergites I–IX reddish brown, lateral margins dark reddish brown. Sternites I–VIII reddish brown, lateral margins dark reddish brown. Sternite IX dark reddish brown. Pygidium, dorsal and ventral surfaces reddish brown. Flagellum reddish brown, segments with reddish macrosetae. Pedipalp trochanter, dorsal and ventral surfaces dark reddish brown, with reddish macrosetae anteriorly. Pedipalp femur and patella dark reddish brown, almost black, patellar apophysis black; tibia, dorsal and ventral surfaces dark reddish brown, mesal surfaces with reddish macrosetae; fixed finger and basitarsus black. Leg I, femur and patella dark reddish brown, tibia, basitarsus and telotarsus reddish brown; legs II–IV dark reddish brown.

**Carapace:** Epistoma not visible in dorsal aspect. Pair of strongly developed carinae anterolaterally, extending from lateral ocelli to two-thirds the distance to median ocular tubercle (fig. 10H). Three pairs of lateral ocelli with accessory translucent eyespot situated between ante-

rior and posterior ocelli; anterior ocelli larger than median and posterior ocelli; anterior two pairs slightly separated from posterior pair by tubercle, distance between median and posterior ocelli 6× distance between anterior and median ocelli. Median ocular tubercle smooth, situated in anterior 10% of carapace (table 4); distance between ocelli 2× ocular diameter. Carapace anterior and medial surfaces smooth, other surfaces granular. Posterior fovea present, distinct.

*Chelicerae*: Retrolateral surface with stridulatory surface (plectrum), comprising approximately 50 long, slender (ca. 15–25× longer than wide), anteroventrally directed macrosetae (figs. 4G, 5G); mesal surface with few long, stout, anteroventrally directed spiniform macrosetae.

*Pedipalps*: Cuticle punctate with cristulae. Coxa, retrolateral surface rugose; ventral surface smooth and punctate; coxal apophysis with one terminal spine; prodorsal surface with long, retroventrally directed macrosetae inserted in cristulae, forming stridulatory surface (pars stridens) (fig. 6G). Trochanter wider than long; retrodorsal surface punctate with short sclerotized cristulae (♂), punctate; prodorsal margin with five terminal spines (S1–S5) and one subterminal accessory spine (AS), all sharply pointed, except for S5 which is blunt (fig. 8C), varying in size such that  $S3 > S5 \geq S4 \geq S2 > S1 > AS$  (♂; fig. 8C) or  $S4 > S5 > S3 \geq S2 > S1 \geq AS$  (♀; fig. 8D); space between S3 and S4 equal to or greater than length of longest spine (♂) or subequal to space between S4 and S5 (♀); prolateral surface with several spiniform tubercles and reddish macrosetae (♂); proventral margin with two spines (♂). Femur laterally compressed (♂) or terete (♀), 2× (♀) to 2.3× (♂) longer than wide (table 4); prolateral surface with two spines, one prodorsal, short, sharply pointed, the other proventral, blunt, length one-fifth femur width (♂; fig. 9G) or short, sharply pointed, and situated apically (♀); retrolateral surface punctate, with short, distinct cristulae. Patella slightly shorter (♂) or longer (♀) than tibia (table 4); prolateral surface with few reddish macrosetae, one vestigial (♂) or distinct, sharp (♀) spine situated distally on proventral

margin; one vestigial (♂) or distinct, sharp (♀) spine at base of patellar apophysis; retrolateral surface punctate with short cristulae. Patellar apophysis elongated, almost one-fifth carapace length, smooth and slender (♂) or shorter and robust (♀); prolateral margin with row of blunt (♂) or sharply pointed (♀) denticles; retrolateral margin smooth (♂) or with two denticles (♀), with subterminal macrosetae. Tibia longer than wide, laterally compressed (♂) or terete (♀); prodorsal surface with few short denticles (♂) or longer, more pronounced row of denticles (♀); prolateral surface with several reddish macrosetae; proventral margin with two spines distally; fixed finger, dorsal and ventral margins each with row of denticles. Basitarsus (movable finger), dorsal and ventral margins each with serrate row of denticles; prolateral surface with several reddish macrosetae; apex bifid (♂).

*Legs*: Leg I, basitarsal and telotarsal tarsomeres I–VII gradually decreasing in length, with tarsomere I longest, tarsomere VIII two-thirds length of tarsomere I. Legs I–III coxae, lateral surfaces and IV, dorsal surface each with setose spiniform tubercles. Legs II–IV trochanters, dorsal and lateral surfaces with setose spiniform tubercles; femora dorsal surfaces with setose spiniform tubercles proximally, prolateral surfaces with setose spiniform tubercles, retrolateral surfaces smooth, retroventral surfaces each with setose spiniform tubercle terminally, with macroseta inserted terminally; tibiae each with one ventrodistal spur; basitarsi each with two ventrodistal spurs. Leg I tibia with two trichobothria distally; legs II–IV tibiae each with one trichobothrium distally.

*Opisthosoma*: Tergites finely granular, with row of coarse granules along posterior margins; I with median longitudinal suture restricted to anterior and posterior margins; II with median longitudinal suture extending from midsegment to posterior margin; III divided by median longitudinal suture; IV with median longitudinal suture extending from anterior margin to one-third length of segment; X (first segment of pygidium) with distinct lateral longitudinal

sutures (pleuron); XII with pair of oval ommatoids posterolaterally. Sternite II (genital) with semicircular depression medially (♂), pair of oblong (♂) or lanceolate (♀) depressions submedially, posterolateral surfaces inflated (♂) or flat (♀), and posterior margin protruding markedly (♂) or slightly (♀) into median lobe which overlaps sclerotized area in space between sternites II and III (♀); III divided longitudinally (♂) or undivided (♀), linear (♂) or with pronounced emargination (♀) anteriorly, posterior margin with (♂) or without (♀) median bulge with patch of reddish macrosetae (♂); IV divided longitudinally (♂) or undivided (♀); V with (♂) or without (♀) patch of fine macrosetae medially; VI–IX surfaces smooth, aetose. Spermathecae seminal receptacles triangular, posteriorly directed (fig. 12C, D); spermathecal neck short, narrow; aperture of uterus rounded, with medial notch; dorsal atrium pentagonal in dorsal aspect.

**Sexual dimorphism:** Adult males present several characters that differ from the females and immature stages. The pedipalps of the male are relatively elongated (fig. 9G), unlike the pedipalps of the female, which are shorter and more robust. A wide gap is present between spines S3 and S4 on the prodorsal margin of the pedipalp trochanter in the male, whereas S3 and S4 are evenly spaced in the female (fig. 8C, D). The retrolateral surface of the pedipalp femur is deeply punctate, with cristulae in the male (fig. 9G) but shallowly punctate, with weak cristulae, in the female. The patellar apophysis of the male is more slender and elongated than that of the female. The posterolateral surfaces of sternite II are slightly inflated, and a semicircular depression is present medially in the male, whereas the surfaces of sternite II are flat in the female. Sternite III is not emarginate anteriorly and exhibits a posteromedian bulge with a patch of macrosetae in the male, whereas it is emarginate anteriorly, its posteromedian margin does not protrude, and a patch of macrosetae is absent in the female (fig. 18B, D).

**ADDITIONAL MATERIAL EXAMINED: MEXICO:** Sonora: Municipio Cananea: Rincón del

Burro, 31°02'17.448"N 110°02'11.436"W, 1566 m, 26.viii.2014, D. Barrales, gallery forest, 2 juv. (CNAN [Ur135]). **U.S.A.:** Arizona: Cochise Co.: Portal [31°53'02.62"N 109°12'21.13"W], 3.ix.1965, J. Jensen, 1 ♂, 1 ♀, 1 subad. ♀ (AMNH), vii.1968, W.J. Gertsch, 1 ♂, 1 ♀ (AMNH), 30.viii.1969, W.L., 1 ♂ (AMNH), B. Tomberlin, Hatari Invertebrates, 3 ♂, 1 juv. (AMNH); Portal, Southwestern Research Station, 5 mi. W Portal, 5400 ft [31°53'02.31"N 109°12'21.79"W], xi.1962, V. Roth, 1 ♂ (AMNH), 16.viii.1985, T.W. Davies, 1 ♂ (CAS); S Pedro River on road from Tombstone to Ft. Huachuca [31°36'06.80"N 110°19'44.87"W], 7.vi.1952, A. Emerson, under bark of cottonwood, 1 ♂ (AMNH). Santa Cruz Co.: Elgin, 5000 ft [31°40'26.11"N 110°35'26.38"W], 23.vii.1970, K. Galvis, 1 ♀, 1 juv. (CAS).

**DISTRIBUTION:** *Mastigoproctus tohono* is recorded from northeastern Sonora, Mexico, and southern Arizona (fig. 2).

**NATURAL HISTORY:** This species inhabits the pastureland of Cananea, at an elevation of 1400–1600 m, with temperatures ranging from -2.4° to 42° C and mean annual precipitation of 545 mm. Specimens were collected under wood planks. Apparently, juveniles and adults excavate deep burrows in Arizona (J. Schmidt, personal commun.). They aestivate and hibernate in these burrows or under large boulders, emerging on the surface after the first rains. Along Cave Creek on the drive to the Southwestern Research Station, near Portal, specimens were fairly abundant after summer rains in the 1970s (O.F.F., personal obs.). Much research on vinegaroon biology was conducted with specimens of this new species (published under the name, *M. giganteus*). Eisner et al. (1961) studied the secretions of the abdominal glands of specimens collected at the Southwestern Research Station. Ahearn (1970) studied water relations and water loss using specimens from the Cave Creek area. Schmidt et al. (2000) studied the chemical composition of the pygidial gland secretions on specimens from Wilcox, Arizona.

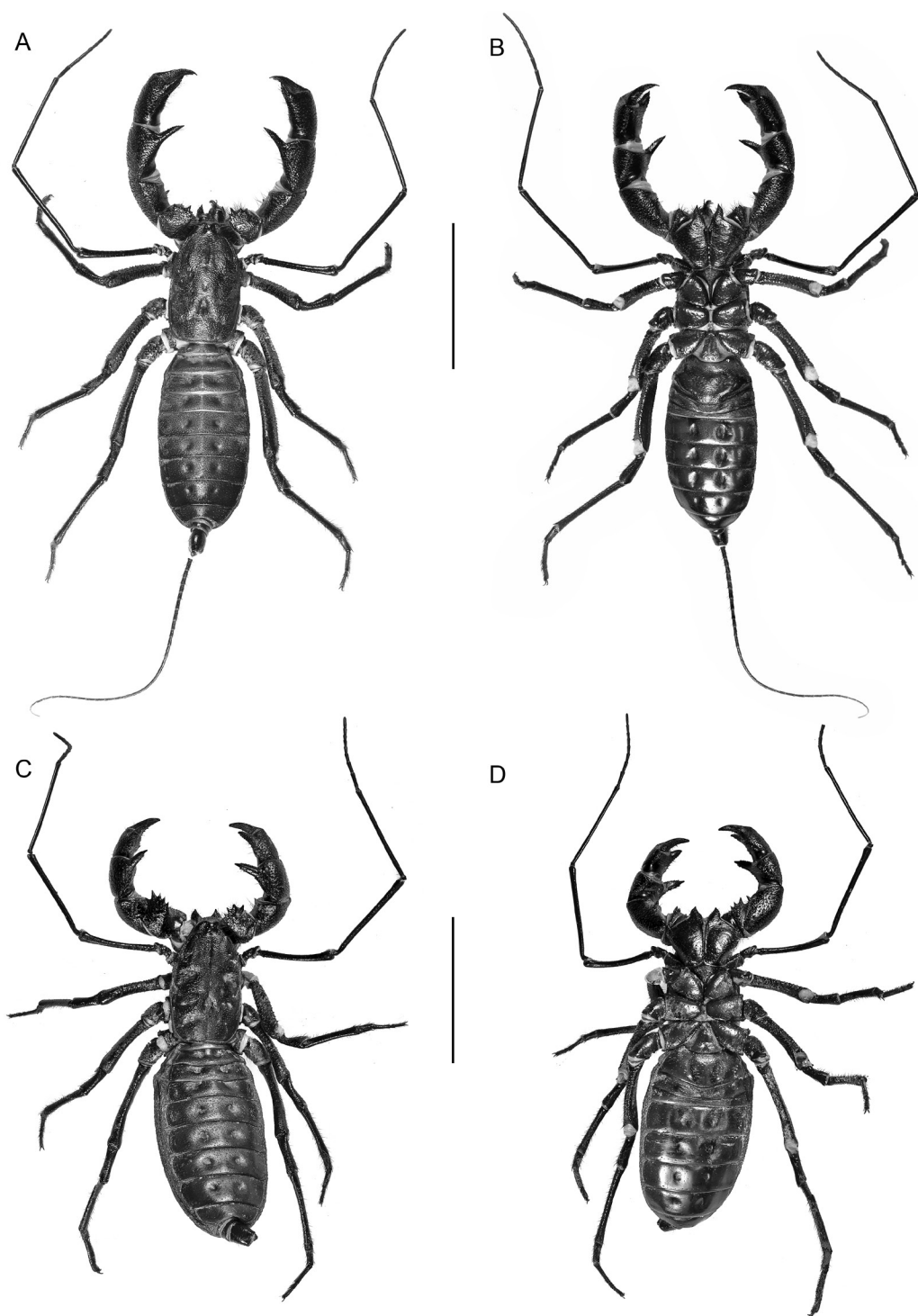


FIG. 18. *Mastigoproctus tohono*, sp. nov., habitus, dorsal (A, C) and ventral (B, D) aspect. A, B. Holotype ♂ (AMNH). C, D. Paratype ♀ (AMNH). Scale bars = 25 mm.



*Mastigoproctus vandevenderi*, sp. nov.

Figure 19A–D; table 5

**TYPE MATERIAL:** **MEXICO:** *Sonora:* Municipio Yecora: holotype ♂ (CNAN T1146), paratype ♂, paratype ♀ (CNAN T1147), paratype ♂, paratype ♀ (AMNH), paratype ♂ (CAS), Yecora, Puerto La Cruz road to Mesa del Campanero, 28°21'58.788"N 109°01'48.709"W, 2009 m, 19.viii.2016, D. Barrales and T. Lasso, mixed pine/oak forest; paratype ♂ (CNAN T1148), Yecora, Cabañas El Campanero, 28°22'14.53"N 109°01'42.28"W, 2018 m, 30.x.2014, G. Contreras and J. Mendoza, under rock; 2 ♂ paratypes (CAS), [Moctezuma], near 28.55°N 109.45°W, 18.ix.1982, V. Roth, pine forest.

**ETYMOLOGY:** This species is dedicated to Thomas van Devender, an ecologist and naturalist who has worked for many years on the flora and fauna of the state of Sonora and the southern part of the United States. Van Devender's contributions have helped biologists obtain a better understanding of the biota of northern Mexico.

**DIAGNOSIS:** *Mastigoproctus vandevenderi*, sp. nov., resembles *M. mexicanus*, from which it differs as follows. Adult *M. vandevenderi* are sparsely setose and brownish in color whereas adult *M. mexicanus* are densely setose and reddish. Spines S3 and S4 on the prodorsal margin of the pedipalp trochanter of the adult male are equal in *M. vandevenderi* whereas spine S3 is longer than the other spines in *M. mexicanus*. The tubercles on the retrolateral surface of the pedipalp femur are curved and cup shaped in *M. vandevenderi* but straight and digitiform in *M. mexicanus*. The seminal receptacles of the spermathecae are narrow, triangular, and posteriorly directed in *M. vandevenderi* but swollen, obovate and anteriorly directed in *M. mexicanus*.

**DESCRIPTION:** The following description is based on seven males and two females.

**Total length:** Maximum length from anterior margin of carapace to posterior margin of opisthosomal segment XII (pygidium) in adult specimens 59.7 mm (♂) and 45.1 mm (♀) (table 5).

**Color:** Carapace, dark reddish brown. Tergites I–IX dark reddish brown. Sternites I–III reddish brown, lateral margins dark reddish brown; IV–IX dark reddish brown, lateral margins dark brown. Pygidium, dorsal and ventral surfaces dark reddish brown. Flagellum reddish brown, segments with reddish macrosetae. Pedipalp trochanter, dorsal and ventral surfaces dark reddish brown, prolateral surface with reddish macrosetae; femur, patella, tibia, and basitarsus, dorsal and ventral surfaces dark reddish brown, mesal surfaces with reddish macrosetae. Leg I, coxa, trochanter and basitarsus reddish brown; femur, patella, and tibia dark reddish brown; II–IV coxae, ventral surfaces light reddish brown; trochanter, femora, patellae, and tibiae, dorsal surfaces reddish brown, ventral surfaces dark reddish brown; basitarsi and tarsi reddish brown.

**Carapace:** Epistoma visible in dorsal aspect. Pair of strongly developed carinae anterolaterally, extending from lateral ocelli to two-thirds the distance to median ocular tubercle (fig. 10D). Three pairs of lateral ocelli with accessory translucent eyespot situated between anterior and posterior ocelli; anterior ocelli larger than median and posterior ocelli; anterior two pairs slightly separated from posterior pair by tubercle, distance between median and posterior ocelli 4× distance between anterior and median ocelli. Median ocular tubercle smooth, situated in anterior 10% of carapace (table 5); distance between ocelli 1.5× ocular diameter. Carapace anterior and medial surfaces rugose, mediolateral and posterior surfaces densely granular. Posterior fovea present, distinct.

**Chelicerae:** Retrolateral surface with stridulatory surface (plectrum), comprising approximately 13 short, stout (ca. 5× longer than wide), anteroventrally directed spiniform macrosetae (figs. 4H, 5H); mesal surface with few short, stout, anteroventrally directed spiniform macrosetae.

**Pedipalps:** Cuticle tuberculate and punctate. Coxa, retrolateral and ventral surfaces rugose; coxal apophysis with one terminal spine; prodorsal surface with long, retroventrally

directed macrosetae inserted in cristulae, forming stridulatory surface (*pars stridens*) (fig. 6H). Trochanter longer than wide ( $\delta$ ) or subequal ( $\varphi$ ); retrodorsal surface with cristulae ( $\delta$ ) or punctate ( $\varphi$ ), and setose; prodorsal margin with five terminal spines (S1–S5) and one subterminal accessory spine (AS), all sharply pointed, except for AS which is blunt (fig. 8E), varying in size such that  $S3 \geq S4 > S5 > S2 > S1 > AS$  ( $\delta$ ; fig. 8E) or  $S4 > S5 \geq S3 > S2 > AS \geq S1$  ( $\varphi$ ; fig. 8F); space between S3 and S4 equal to or longer than length of longest spine ( $\delta$ ) or equal to space between S4 and S5 ( $\varphi$ ); prolateral surface with several spiniform tubercles and reddish macrosetae ( $\delta$ ); proventral margin with two spines ( $\delta$ ). Femur laterally compressed ( $\delta$ ) or terete ( $\varphi$ ), almost  $2\times$  ( $\varphi$ ) to  $2.5\times$  ( $\delta$ ) longer than wide (table 5); prolateral surface with two spines, one prodorsal, short, blunt ( $\delta$ ) or sharply pointed ( $\varphi$ ), the other proventral, blunt, rounded, length one-eighth femur width ( $\delta$ ; fig. 9H) or short, sharply pointed, and situated apically ( $\varphi$ ); retrolateral surface with digitiform tubercles (longer in  $\delta$ ). Patella slightly shorter ( $\delta$ ) or longer ( $\varphi$ ) than tibia (table 5); prolateral surface with reddish macrosetae, one vestigial ( $\delta$ ) or distinct, sharp ( $\varphi$ ) spine situated distally on proventral margin; one vestigial ( $\delta$ ) or distinct, sharp ( $\varphi$ ) spine at base of patellar apophysis; retrolateral surface tuberculate (tubercles larger and more numerous in  $\delta$ ). Patellar apophysis elongated, almost one-quarter carapace length, smooth and slender ( $\delta$ ) or shorter and robust ( $\varphi$ ); prolateral margin with row of blunt ( $\delta$ ) or sharply pointed ( $\varphi$ ) denticles; retrolateral margin smooth ( $\delta$ ) or with few denticles ( $\varphi$ ), with subterminal macrosetae. Tibia longer than wide, laterally compressed ( $\delta$ ) or terete ( $\varphi$ ); prodorsal surface with row of denticles; prolateral surface with several reddish macrosetae; proventral margin with two spines distally; retrolateral surface with few shorter macrosetae; fixed finger, dorsal and ventral margins each with row of denticles. Basitarsus (movable finger), dorsal and ventral margins each with ser-

rate row of denticles; prolateral surface with several reddish macrosetae; apex bifid ( $\delta$ ).

*Legs:* Leg I, basitarsal and telotarsal tarsomeres I–VII gradually decreasing in length, with tarsomere I longest, tarsomere VIII four-fifths length of tarsomere I. Legs I–III coxae, lateral surfaces and IV, dorsal and lateral surfaces each with setose spiniform tubercles. Legs I–IV trochanters, dorsal and lateral surfaces with setose spiniform tubercles; femora dorsal and ventral surfaces with setose spiniform tubercles, situated proximally on I, II, prolateral surface with setose spiniform tubercles, III and IV retrolateral surface smooth, prolateral and retrolateral surfaces smooth; II–IV retroventral surfaces each with setose spiniform tubercle terminally, with macroseta inserted terminally; tibiae each with one ventrodistal spur; basitarsi each with two ventrodistal spurs. Leg I tibia with two trichobothria distally; legs II–IV tibiae each with one trichobothrium distally.

*Opisthosoma:* Tergites finely granular; I divided by weak median longitudinal suture restricted to anterior and posterior margins; II with median longitudinal suture extending from midsegment to posterior margin; III with median longitudinal suture extending from anterior margin to one-third length of segment; X (first segment of pygidium) with distinct lateral longitudinal sutures (pleuron); XII with pair of oval ommatoids posterolaterally. Sternite II (genital) with pair of cup shaped ( $\delta$ ) or lanceolate ( $\varphi$ ) depressions submedially, posterolateral surfaces inflated ( $\delta$ ) or flat ( $\varphi$ ), and posteromedian margin protruding markedly ( $\delta$ ) or slightly ( $\varphi$ ) posteriorly into median lobe that overlaps sclerotized area in space between sternites II and III ( $\varphi$ ); III divided longitudinally ( $\delta$ ) or undivided ( $\varphi$ ), linear ( $\delta$ ) or with pronounced emargination ( $\varphi$ ) anteriorly, posterior margin with ( $\delta$ ) or without ( $\varphi$ ) median bulge with patch of reddish macrosetae ( $\delta$ ); IV with ( $\delta$ ) or without ( $\varphi$ ) median longitudinal suture extending from anterior margin to one-third length of segment; V with ( $\delta$ ) or without ( $\varphi$ ) patch of fine macrosetae medially; VI–IX surfaces smooth, asetose.

TABLE 5

Measurements (mm) of type specimens of *Mastigoproctus vandevenderi*, sp. nov., from Sonora, Mexico

Material deposited in the American Museum of Natural History (AMNH), New York, the California Academy of Sciences (CAS), San Francisco, and the National Collection of Arachnids (CNAN), Institute of Biology, National Autonomous University of Mexico, Mexico City. Abbreviation: dist. = distance.

Type	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype
Sex	♂							♀	
Collection	CNAN			AMNH	CAS			CNAN	AMNH
Code	T1146	T1147	T1148 [Ur145]					T1030 [Ur148]	
Total length	59.7	45.1	52.3	45.2	51.8	48.9	43.5	45.1	45.0
Pedipalp									
Trochanter length	6.4	4.6	4.6	4.2	5.3	5.5	4.2	5.2	5.1
Trochanter width	5.9	3.9	4.3	3.9	4.7	4.8	3.9	4.3	4.5
Femur length	18.0	9.8	11.7	9.4	10.3	11.8	9.2	7.8	8.1
Femur width	6.3	3.9	4.8	4.0	4.4	4.4	3.6	4.1	3.7
Ventromesal spine length	0.7	0.7	0.6	0.3	0.5	0.9	0.6	0.9	0.8
Ventromesal spine width	0.4	0.3	0.4	0.2	0.3	0.4	0.3	0.4	0.3
Patella length	11.7	6.1	7.9	6.3	7.2	7.2	5.4	5.6	5.3
Patella width	6.2	3.9	4.4	3.4	3.8	4.3	3.4	3.6	3.4
Patellar apophysis length	5.0	4.1	4.6	3.9	4.6	4.4	3.8	3.3	3.9
Patellar apophysis width	1.0	0.9	1.1	0.8	0.9	1.0	0.8	1.1	1.1
Tibia length	12.1	6.8	8.4	6.2	7.4	7.5	6.0	5.3	4.2
Tibia width	5.1	3.4	3.9	3.2	3.3	3.8	3.2	3.0	2.7
Carapace									
Total length	20.7	16.4	19.0	16.2	17.5	18.2	15.9	17.4	16.5
Total width at lateral ocelli	10.5	7.8	8.7	7.7	8.0	8.8	7.6	8.2	8.4
Total width at fovea	12.0	10.1	10.7	9.5	9.2	10.3	9.6	10.3	10.5
Median ocular tubercle dist.	1.5	1.2	1.2	1.0	1.2	1.0	1.1	1.2	1.1
Ocular width	0.5	0.5	0.5	0.4	0.5	0.5	0.4	0.4	0.4
Dist. betw. median ocelli	0.8	0.6	0.7	0.6	0.6	0.7	0.6	0.7	0.7
Leg I									
Coxa length	4.0	3.1	3.7	2.7	3.0	3.3	3.0	3.2	3.3
Trochanter length	3.4	3.0	2.9	2.4	2.7	3.0	2.4	2.8	2.1
Femur length	13.9	10.8	13.1	11.1	12.2	13.6	10.7	10.9	10.8
Patella length	18.2	13.9	17.3	14.9	16.6	17.5	14.7	13.7	14.6
Tibia length	18.4	12.9	17.3	14.8	16.5	16.9	13.8	13.6	13.3
Basitarsus-tarsus length	14.7	12.3	13.8	12.2	12.7	10.6	12.1	10.5	10.3
Leg IV									
Coxa length	7.5	5.9	6.9	5.3	6.3	6.2	6.0	6.3	5.5
Trochanter length	5.9	4.6	4.6	4.5	4.9	5.2	4.2	4.5	4.7
Femur length	14.9	12.8	14.3	12.8	13.3	14.0	12.6	12.9	12.0
Patella length	7.0	5.6	5.7	5.4	5.7	5.9	5.2	5.1	4.9
Tibia length	14.7	10.7	13.8	12.5	12.5	14.0	11.6	12.1	11.4
Basitarsus length	3.2	2.4	3.0	2.5	2.5	3.1	2.4	3.1	2.7
Tarsus length	6.7	5.8	6.7	5.7	6.2	5.8	5.1	6.2	5.9

Spermathecae seminal receptacles triangular, posteriorly directed (fig. 12E, F); spermathecal neck short, narrow, markedly constricted; aperture of uterus rounded, with medial notch; dorsal atrium pentagonal in dorsal aspect.

**Sexual dimorphism:** Adult males present several characters that differ from the females and immature stages. The pedipalps of the male are relatively elongated (fig. 9H), unlike the pedipalps of the female, which are shorter and more robust. A wide gap is present between spines S3 and S4 on the prodorsal margin of the pedipalp trochanter in the male, whereas S3 and S4 are evenly spaced in the female (fig. 8E, F). The tubercles on the retrolateral surface of the pedipalp femur are longer in the male than the female. The patellar apophysis of the male is more slender and elongated than that of the female. The posterolateral surfaces of sternite II are slightly inflated in the male, but flat in the female. Sternite III is not emarginate anteriorly and exhibits a posteromedian bulge with a patch of macrosetae in the male, whereas it is emarginate anteriorly, its posteromedian margin does not protrude, and a patch of macrosetae is absent in the female (fig. 19B, D). Sternite V exhibits a smooth patch of setae medially in the male, which is absent in the female.

**ADDITIONAL MATERIAL EXAMINED: MEXICO:** *Chihuahua:* Municipio Temósachic: Ocampo, highway Yecora to Basaseachi, 28°27'19.5"N 108°25'49.7"W, 1922 m, P. Berea Núñez, pine/oak forest, 1 ♀ (CNAN [Ur65]). *Sonora:* Municipio Yecora: Microondas Yecora, 28°22'24.5"N 109°02'03.9"W, 2200 m, 13.ix.1998, M. Balcazar L., 1 ♂ (CNAN [Ur11]); [Moctezuma], near 28.55°N 109.45°W, 18.ix.1982, V. Roth, pine forest, 3 juv. (CAS); Puerto La Cruz road to Mesa del Campanero, 28°21'58.788"N 109°01'48.709"W, 2009 m, 19.viii.2016, D. Barrales and T. Lasso, pine/oak forest, 9 juv. (CNAN [Ur179]); Yecora, N of Mesa del Campanero, Rancho La Palma, 28.371°N 109.065°W, 1499 m, 4.viii.2012, T.R. van Devender and R.A. Villa, 2 juv. (CNAN [Ur114]); Yecora, Puerto La Cruz,

28°21'57.8"N 109°01'48.592"W, 1925 m, 15.viii.2015, D. Barrales, 1 ♀, 1 juv. (CNAN [Ur148]).

**DISTRIBUTION:** Known from pine and pine/oak forests of the Sierra Madre Occidental in eastern Sonora and western Chihuahua, Mexico (fig. 2).

**NATURAL HISTORY:** *Mastigoproctus vandevenderi*, sp. nov., inhabits subhumid temperate pine/oak forest, at elevations between 1500 and 2000 m, with temperatures ranging from -14.5° to 38.5° C and mean annual precipitation of 1023 mm (fig. 1H). The largest adult series of this species was collected in the month of August, under large rocks and rotten logs. Juveniles of about the same size were observed sharing a refuge, presumably siblings that had not yet dispersed from the maternal nest. There was a notable absence of other arthropods under rocks within the area where the specimens were collected, perhaps reflecting the predatory behavior of this species. Adult males were aggressive when collected, attacking the forceps with the pedipalps. Males and females reacted similarly, spraying a strongly aromatic secretion.

## DISCUSSION

Based exclusively on morphological similarity, the seven species recognized in the present contribution appear to form three groups: *M. scabrosus* from southern Veracruz and eastern Oaxaca; a group comprising *M. mexicanus* from Aguascalientes and *M. vandevenderi* from southern Sonora; and a group comprising the remaining four species: *M. giganteus* from Morelos, *M. tohono* from southeastern Arizona and north-eastern Sonora, *M. cinteotl* from Tamaulipas and southern Texas, and *M. floridanus* from southern Florida. Although distinctly allopatric, species occurring in relatively close geographical proximity, or in similar habitats are not necessarily similar morphologically. For example, *M. scabrosus* inhabits tropical deciduous forest, whereas *M. tohono* inhabits the foothills of mountains in the Sonoran Desert, and *M. vandevenderi* inhab-



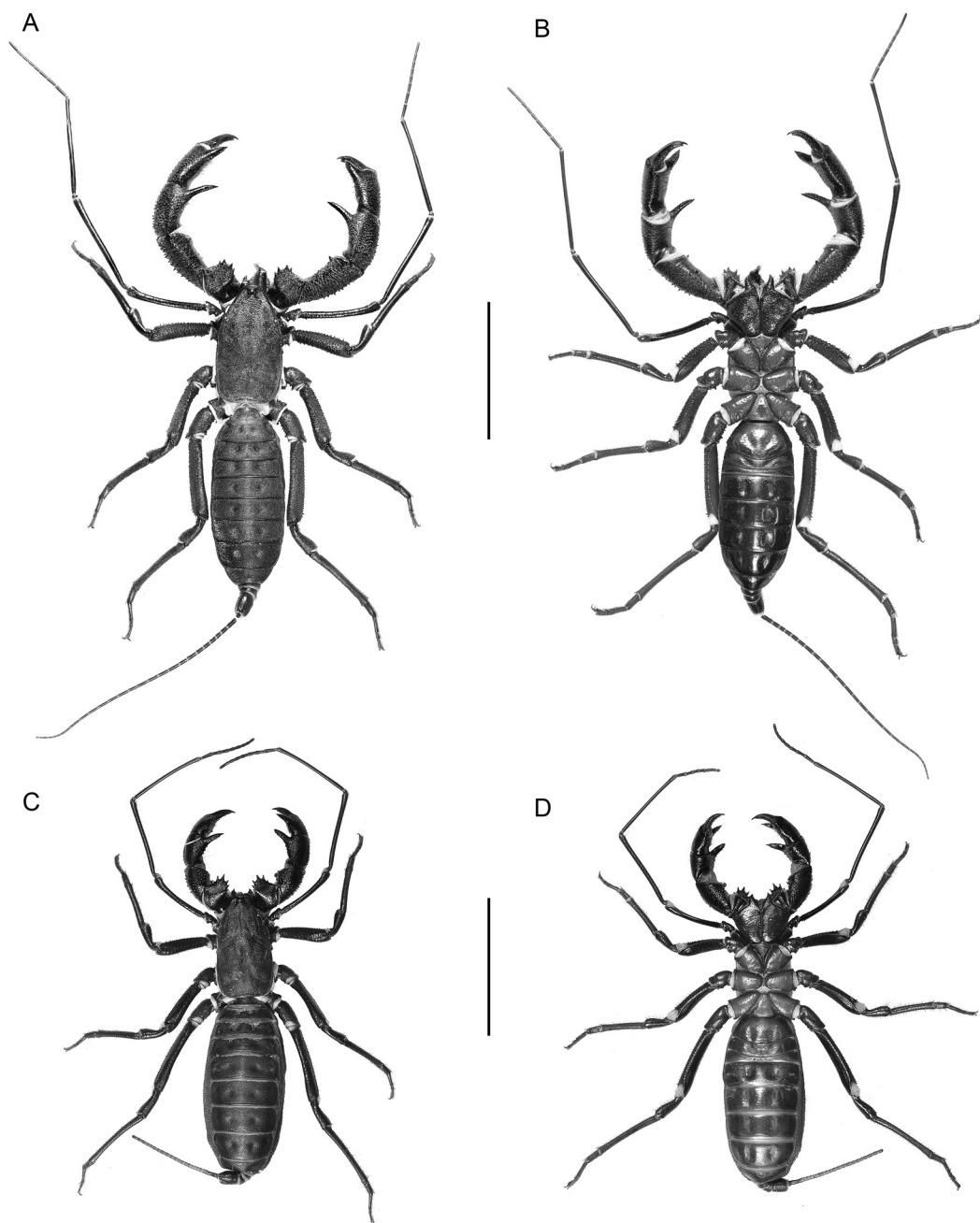


FIG. 19. *Mastigoproctus vandeversi*, sp. nov., habitus, dorsal (A, C) and ventral (B, D) aspect. A, B. Holotype ♂ (CNAN T1146). C, D. Paratype ♀ (CNAN T1147). Scale bars = 25 mm.

its pine forest. Their elevational distribution ranges from sea level in *M. floridanus* to 2200 m in *M. vandevederi*. A deeper understanding of their phylogenetic relationships is needed to unravel their evolutionary history.

Further work is also required to better understand the distributions and species limits of *Mastigoproctus*, both in Mexico and the United States. In the past, sightings of vinegarroons from North America were usually assigned to *M. giganteus*, a vast oversimplification. Many reported sightings were not verified due to the absence of specimens. For example, Cokendolpher and Bryce (1980) reported the first and, to date, only record of a vinegarroon from the U.S. state of Oklahoma, but the authors released the specimen soon after capture. A single specimen from the state of Utah is deposited at the AMNH, but due to the poor condition of the specimen, the limited data on the label, and the absence of other records from the state since the date of collection in 1929, it is probably spurious. Reports of *Mastigoproctus* from caves in several Mexican states (Palacios et al., 2014–2015) were also unaccompanied by specimens, preventing their identification. Numerous other locality records attributed to *M. giganteus* in the literature, in online databases, and in arachnological collections (fig. 2) cannot be reliably identified to species due to the absence of adult male specimens or the poor quality of the images. For example, the CNAN contains specimens of *Mastigoproctus* from 25 of the 32 states in Mexico, but only seven of these states are represented among the material included in the present contribution because most of the other material comprises females and immatures that cannot be reliably associated with (or separated from) the species recognized herein. DNA sequences from the COI gene are shedding some light on this problem. However, many of the specimens are decades old or fixed in 70% ethanol and other fluids, preventing the extraction of high molecular weight DNA. Efforts to revisit some of

these locations to collect fresh, appropriately fixed samples for DNA extraction are ongoing.

The recognition of seven species of *Mastigoproctus* in North America, from a range of different habitats, opens the door for future comparative studies on several aspects of their biology. For example, water relations were studied in *M. tohono*, from the Chihuahuan Desert of southeastern Arizona, by Ahearn (1971) and Crawford and Cloudsley-Thompson (1971); it would be interesting to examine the water retention mechanisms among species from more mesic climates such as *M. floridanus* and *M. scabrosus*. Eisner et al. (1961) analyzed the chemical composition of the defensive secretions of *M. tohono*, but nothing is known about the secretions of other species. Life history traits such as litter size and reproductive season have likewise been studied in only a few species, e.g., *M. tohono*. Punzo and Reeves (2001) noticed differences in courtship behavior between populations formerly regarded as *M. giganteus* from Texas compared with the courtship behavior of *M. floridanus* reported by Weygoldt (1971). The courtship behavior of other species will probably reveal further differences among them. This may also be true of their defense behavior; as *M. scabrosus* lacks a stridulatory apparatus, and the “rasp and file” apparatus of the other six species are morphologically different, each may potentially stridulate in a uniquely different manner.

Finally, a recent contribution recovered the genus *Mastigoproctus* paraphyletic with respect to *Mimoscorpio pugnator* (Butler, 1872) (Clouse et al., 2017: appendix S3). Only two exemplar species of *Mastigoproctus*, *M. floridanus* (as *M. giganteus*) and *M. lacandonensis* from Chiapas, Mexico, were included in the analysis, however. *Mastigoproctus* currently contains 22 valid species (Harvey, 2003, 2013), including several from the Caribbean islands and Central and South America. A more comprehensive taxon sample is required to test the hypothesis of paraphyly and establish a robust phylogenetic hypothesis for the group.

## ACKNOWLEDGMENTS

D.B.A. thanks the Posgrado en Ciencias Biológicas of UNAM and the CONACyT for a graduate school fellowship (number 416029), and the AMNH for a Collections Study grant to visit and examine the material deposited there. We thank Rodrigo Monjaraz-Ruedas, Gerardo Contreras-Félix, Laura Olguín-Pérez, Jesús Cruz-López, Jorge Mendoza-Marroquín, Daniela Candia-Ramírez, and Dariana Guerrero-Fuentes, graduate students at IBUNAM, and Griselda Montiel-Parra of the National Collection of Acari, IBUNAM, Andrea Jiménez Marín of the Molecular Biology Laboratory of the Department of Zoology, IBUNAM, and Alejandro Valdéz-Mondragon of the Arachnology Laboratory at the IBUNAM Regional Laboratory of Biodiversity and Plant Tissue Culture, Tlaxcala, for field assistance and advice during the development of this work; Lauren Esposito of the CAS, Ignacio Vázquez-Rojas of the FCUNAM, and G.B. Edwards and Paul Skelly of the FSCA, for the loan of material examined; Carlos Viquez for advice; Jeremy Huff for discussions regarding the *M. giganteus* complex and previous efforts to gather part of the material examined; Stuart Longhorn and Janet Beccaloni for assistance with information concerning type specimens in the Natural History Museum, London; Berenit Mendoza-Garfias, for assistance with SEM at the IBUNAM Electron Microscopy Laboratory; Susana Guzmán-Gómez for assistance with Leica equipment in the Laboratory of Microscopy and Photography of Biodiversity (II); Griselda Montiel-Parra and Ricardo Paredes-Leon (IBUNAM) for some of the photographs in figure 1; Steve Thurston (AMNH) for assistance with preparing the plates for this contribution; and two reviewers for revising a draft of the manuscript. Specimens recently collected for this work were obtained under Scientific Collector Permit FAUT-0175 from SEMARNAT to O.F.F. Some of the material examined was collected during National Science Foundation grants DEB 0413453 and DEB 0640219 to L.P.

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