

Research article

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Revision of the troglomorphic genus *Troglostygnopsis* Šilhavý, 1974 (Opiliones, Laniatores, Stygnopsidae)

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Abstract. In the present paper, we have made a taxonomic revision of the previously monotypic genus *Troglostygnopsis* Šilhavý, 1974. Based on the revision of diverse material, the genus is rediagnosed and the type species, *Troglostygnopsis anophthalma* Šilhavý, 1974 is redescribed. The new species *Troglostygnopsis kalebi* sp. nov. is described from specimens collected in a cave in Chiapas, Mexico, and this species is compared with *T. anophthalma*. A final discussion on some troglobitic genera of Stygnopsidae is addressed.

Keywords. Caves, Gonyleptoidea, Mexico, new species, taxonomy.

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Introduction

As part of his revision of Mexican cavernicolous Laniatores, Šilhavý (1974) described the subfamily Troglostygnopsinae Šilhavý, 1974 in Stygnopsidae Sørensen, 1932. According to Šilhavý, this subfamily differs from Stygnopsinae in having the first distitarsus with more than two segments. In the same work, Šilhavý described the genus *Troglostygnopsis* Šilhavý, 1974 as the only member of Troglostygnopsinae. This genus was diagnosed as true troglobitic animals with ocularium reduced, eyeless, mesotergal areas unarmed, scutum with lateral projections between third and fourth areas, sometimes on posterior corners

of scutum, chelicerae large, pedipalps long and armed with large spines, and distitarsi I and II with more than two segments. Šilhavý (1974) assigned two troglomorphic eyeless species to *Troglostygnopsis*: *T. anophthalma* Šilhavý, 1974 (type species) and *T. inops* (Goodnight & Goodnight, 1971), this last formerly assigned to *Hoplobunus* Banks, 1900. Later, Kury (2003) considered Troglostygnopsinae was proposed on troglomorphic autapomorphies; therefore, Kury and contemporaneous authors did not consider the subfamilial criterion of Šilhavý, keeping this subfamily as a junior synonym of Stygnopsinae (Reddell 1981; Kury & Cokendolpher 2000; Kury 2003; Mendes & Kury 2007).

During their taxonomic revision of selected stygnopsid genera, Cruz-López & Francke (2013b) noticed that male genitalia of *Paramitraceras* Pickard-Cambridge, 1905, *Philora* Goodnight & Goodnight, 1954 and *Troglostygnopsis* share similarities in the shape of the apical portion of penises and setal arrangement. In this regard, Cruz-López & Francke considered that these similarities could be due to common ancestry. Later, Cruz-López & Francke (2015) proposed a morphological-based phylogenetic hypothesis of the genus *Karos* Goodnight & Goodnight, 1944 and obtained two main results regarding *Troglostygnopsis*. First, this genus was recovered as polyphyletic, so they proposed the genus *Mictlana* Cruz-López & Francke, 2015 and transferred *T. inops* to it. Second, *T. anophthalma* together with *Paramitraceras* and *Philora* form a clade, supported by morphological characters of the male genitalia. In a broad sense, Cruz-López & Francke (2017) proposed a total evidence phylogeny of the family Stygnopsidae, including the largest number of taxa available to date. In that paper, two undetermined *Troglostygnopsis* were recovered as monophyletic, being the sister group of *Sbordonia* Šilhavý, 1977 in the subfamily Stygnopsinae, corroborating the monophyly of the genus.

Recently, Aguiñaga & Cruz-López (2019), Cruz-López *et al.* (2019) and Cruz-López & Francke (2020) have continued with the revisions of some genera of the family, especially those with troglomorphic traits. As a complement of the systematics of Stygnopsidae, here we present a taxonomic revision of *Troglostygnopsis*, rediagnosing the genus, redescribing *T. anophthalma*, and describing the new species *Troglostygnopsis kalebi* sp. nov., from caves in Chiapas, Mexico.

Material and methods

The material examined is deposited in the Colección Nacional de Arácnidos (CNAN), UNAM, Mexico and the American Museum of Natural History (AMNH), New York, USA. Color photographs were taken with an AxioCam Mrc5 camera attached to a Carl Zeiss V16 stereoscope. Drawings were made in Photoshop CS5 using assembled photographs to delineate the main structures. SEM photos were taken using a Hitachi S-2460N Scanning Electronic Microscope. Color photographs and SEM images were taken at the Instituto de Biología, as part of the Laboratorio Nacional de Biodiversidad (LaNaBio network) in the same institute. All images and schemes were edited using Photoshop. Nomenclature of the scutum shape is according to Kury & Medrano (2016). The relative size of chelicera with respect to the body, and the ratio between the length of scutum and the length of cheliceral hand was taken according to Cruz-López & Francke (2013a). Nomenclature of the main setiferous tubercles of pedipalpal tibia follows Acosta *et al.* (2007), with modifications for the family proposed in Aguiñaga & Cruz-López (2019). The macrosetal groups on the penis are named in accordance with Kury & Villarreal (2015), with modifications proposed by Cruz-López & Francke (2019b). Measurements are in mm.

Abbreviations for morphological terms

MS = macrosetae of penis, arranged in five groups (A–E)

SST = spiniform setiferous tubercle on pedipalpal tibia, named from the base to the apical portion (1–3)

Institutional abbreviations

AMCS = Association for Mexican Cave Studies

AMNH = American Museum of Natural History, New York, USA
CNAN = Colección Nacional de Arácnidos, UNAM, Mexico
MCZR = Museo Civico di Zoologia Roma, Rome, Italy

Results

Taxonomy

Class Arachnida Lamarck, 1801
Order Opiliones Sundevall, 1833
Suborder Laniatores Thorell, 1876
Infraorder Grassatores Kury, 2002
Superfamily Gonyleptoidea Sundevall, 1833
Family Stygnopsidae, Sørensen, 1932
Subfamily Stygnopsinae Sørensen, 1932

Genus *Troglostygnopsis* Šilhavý, 1974

Troglostygnopsis Šilhavý, 1974: 182. (type species: *Troglostygnopsis anophthalma* Šilhavý, 1974, by original designation).

Troglostygnopsis – Reddel 1981: 165. — Kury & Cokendolpher 2000: 149. — Kury 2003: 240. — Cruz-López & Francke 2013b: 300; 2015: 828; 2016: 328; 2017: 320; 2018: 1047; 2019b: 226; 2020: 433. — Aguiñaga & Cruz-López 2019: 10. — Cruz-López *et al.* 2019: 286.

Emended diagnosis

Troglomorphic members of Stygnopsinae, eyeless, similar condition as *Mexotroglinus* Šilhavý, 1977, *Toojah* Cruz-López, in press, *Chiniquipellobunus madlae* (Goodnight & Goodnight, 1967) and *Serrobunus paulbryanti* Aguiñaga & Cruz-López, 2019. *Troglostygnopsis* has clear lateral areas on scutum, similar to *Panzosus* Roewer, 1949, *Paramitraceras*, *Philora*, *Sbordonia* and *Toojah*; however, *Troglostygnopsis* can be distinguished from other eyeless genera with lateral projections on scutum by the presence of a dorsal row of large spiniform tubercles on pedipalpal femur; in fact, no other genus of the family whether troglobitic or epigeal has this protruding row. Male genitalia have the *Paramitraceras*-pattern sensu Cruz-López & Francke (2013b): pars distalis tubular, with an apical depression where the follis arises, with many pairs of acute MS C on lateral sides, many pairs of spatulate MS A+B at the base and laterally on the pars distalis, two pairs of MS E, E1 small and in the middle of ventral side, E2 long and external to E1, and one or two pairs of MS D, near the base of follis. *Troglostygnopsis* can be differentiated from those genera with male genitalia with this pattern (*Paramitraceras*, *Panzosus*, *Philora* and *Sbordonia*) as follows: ocularium not pointing forward, pedipalps strongly armed with long spiniform setiferous tubercles, and males without glandular ventral tubercles on stigmatic area (in this last character similar to *Sbordonia armigera* Šilhavý, 1977).

Included species

Troglostygnopsis anophthalma Šilhavý, 1974 (type species) and *Troglostygnopsis kalebi* sp. nov.

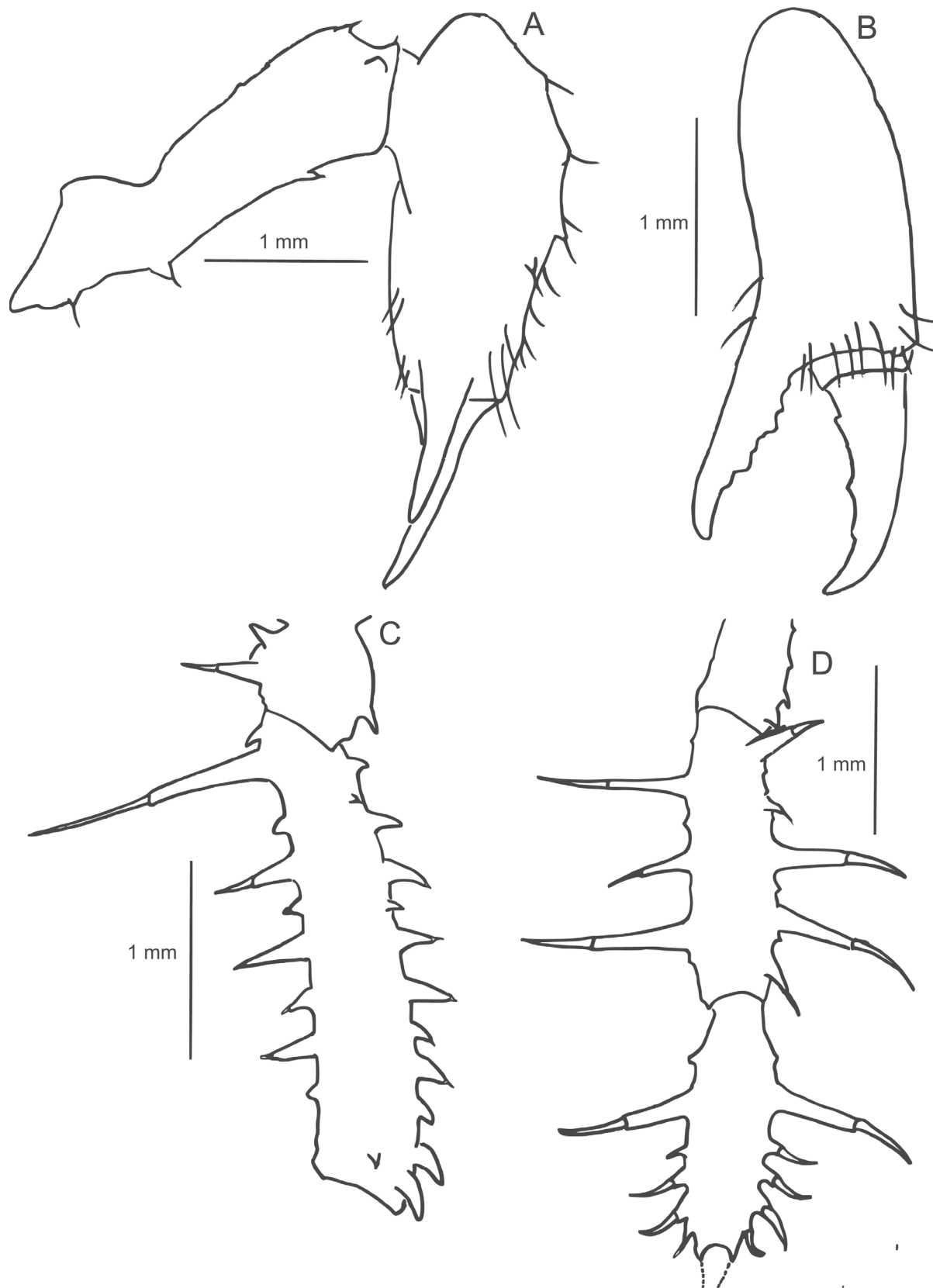


Fig. 1. *Troglostygnopsis anophthalma* Šilhavý, 1974, ♂, topotype (AMNH). A. Chelicera, mesal view. B. Chelicera, frontal view. C. Pedipalpal femur, mesal view. D. Pedipalpal tibia and tarsus, ventral view.

Troglostygnopsis anophthalma Šilhavý, 1974

Figs 1–3

Troglostygnopsis anophthalma Šilhavý, 1974: 182.

Troglostygnopsis anophthalma – Sbordonì *et al.* 1974: 32 (nomen nudum). — Reddell 1981: 165. — Rambla & Juberthie 1994: 221. — Kury & Cokendolpher 2000: 149. — Kury 2003: 240. — Cruz-López & Francke 2013b: 303; 2015: 829; 2016: 328; 2020: 435. — Aguiñaga & Cruz-López 2019: 10.

Diagnosis

Movable finger of chelicera with three teeth (Fig. 1B), small and wide. Tubercles of leg IV small and scattered; patella with few, small tubercles (Fig. 2B). Penis with one pair of MS D, MS E1 below the level of E2 (Fig 3).

Type material (not examined)

Holotype

MEXICO • ♂; Chiapas, San Cristóbal de las Casas, Grutas de Rancho Nuevo; 2,275 m a.s.l.; 25 Feb. 1971; R. Argano leg.; MCZR.

Allotype

MEXICO • ♀; same collection data as for holotype; MCZR.

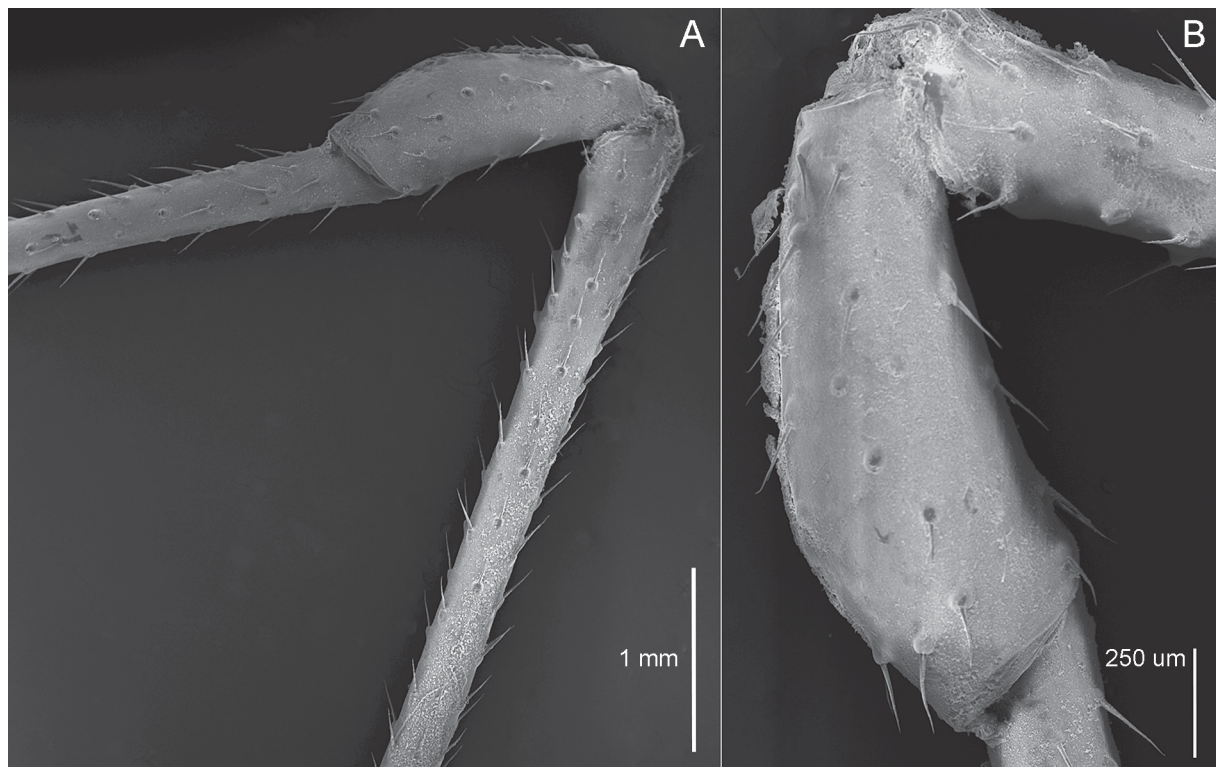


Fig. 2. *Troglostygnopsis anophthalma* Šilhavý, 1974, ♂, topotype (AMNH). **A.** Apical femur, patella and basal tibia IV. **B.** Patella IV.

Material examined

Topotype

MEXICO • 1 ♂, Chiapas, San Cristóbal de las Casas, Grutas de San Cristóbal [= Grutas de Rancho Nuevo]; 16°44'12" N, 92°38'18" W; 20 Jan. 1980; V. Roth leg.; AMNH.

Preliminary considerations

The holotype was not examined; however, according to several caves studies and maps collected by the Association for Mexican Cave Studies (AMCS, information available at: <http://www.mexicancaves.org/>) we know that Grutas de Rancho Nuevo are the same as Grutas de San Cristobal; therefore, the male examined here is considered a topotype. This specimen is poorly preserved, without almost all legs, incomplete scutum and broken body. In the present work, we could only illustrate the chelicera, pedipalp, ornamentation of femur and patella IV, and male genitalia in detail. Fortunately, these structures are enough to recognize and diagnose this species. Additionally, Šilhavý (1974) made excellent drawings of dorsal and lateral view of the holotype, which are very clear and informative for taxonomic purposes. Finally, Šilhavý (1974), based on immature stages, mentioned two additional records for *T. anophthalma* from Cueva de la Golondrina and Cueva del Nacimiento del Río San Antonio, both in Bochil, Chiapas. Due to the specificity in cave habitats in these species, it is necessary to collect adults from those caves to corroborate if they are conspecific with *T. anophthalma* or represent undescribed species.

Redescription

Male

MEASUREMENTS. Scutum length: 4.9, scutum width: 4.1.

CHELICERA (Fig. 1A–B). Scutum/cheliceral hand ratio: 1.37. Basichelicerite long, with diffuse bulla. Cheliceral hand slightly swollen, fixed finger with six teeth distributed evenly throughout, middle one

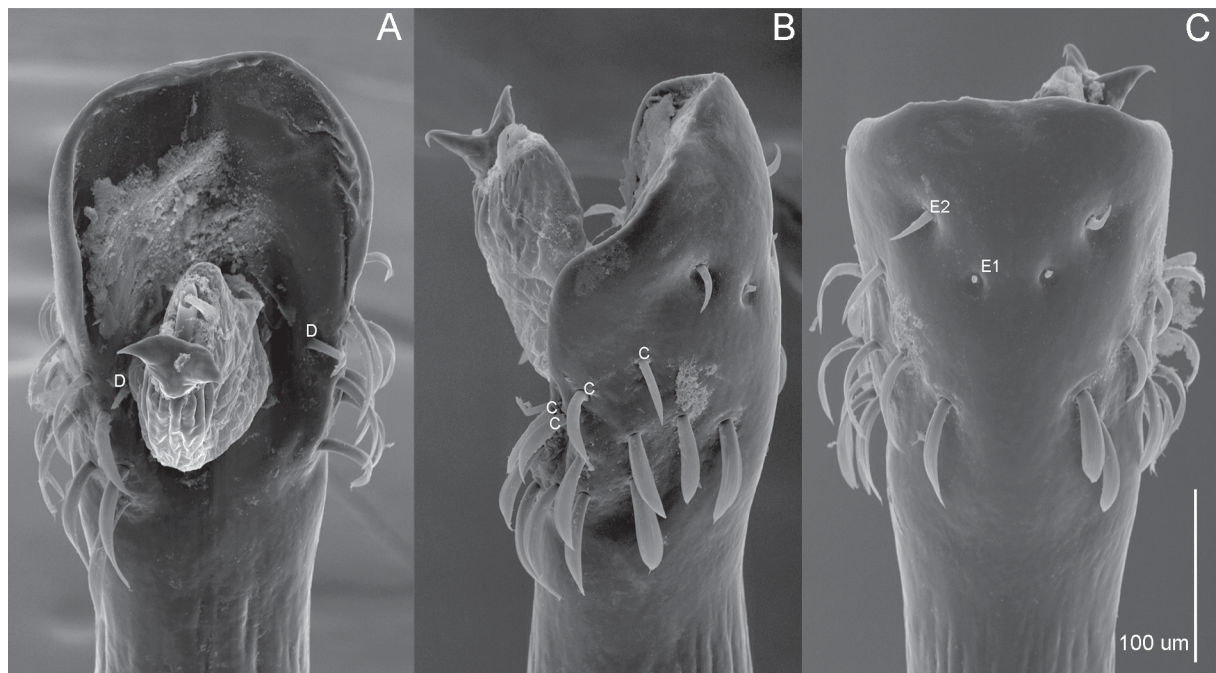


Fig. 3. *Troglostygnopsis anophthalma* Šilhavý, 1974, ♂, topotype (AMNH), penis. A. Dorsal view. B. Lateral view. C. Ventral view. Scale bar in C applicable to all figures.

biggest; movable finger with three scattered teeth, basalmost and middle ones small and triangular, distal one diffuse.

PEDIPALPS (Fig. 1C–D). Measurements: 2.30/1.00/1.75/1.80/1.00. Trochanter globose, with three ventral spiniform tubercles, apical one very large, dorsally with one spiniform tubercle. Femur slightly compressed laterally, with one ventral and one dorsal row of large spiniform tubercles pointing distally, these tubercles uniformly distributed throughout femur, ventral basalmost one most prominent. Patella with few small spiniform tubercles. Tibia with long armature, with relative sizes of three major tubercles (SST) on mesal side $1 = 3 > 2$, and on ectal margin $3 = 2 > 1$, on this segment two small setiferous tubercles between SST 1 and 2, and at apical end of the margin. Tarsus with six major tubercles on mesal side ($2 > 4 = 5 > 6 > 1 = 3$) and five on ectal side ($1 > 4 > 2 = 3 = 5$).

LEGS (Fig. 2). All segments very long and slender, femur IV longer than scutum. Ornamentation of femur IV composed of small and scattered tubercles forming longitudinal rows, patella covered with few small tubercles.

PENIS (Fig. 3). Pars distalis with an apical concavity, lateral and apical margins softly rolled dorsally. Follis rugose, apices of dorsal bilobular projection long and pointed. One pair of small MS D lateral to base of follis, near to lateral margins of pars distalis. Four pairs of acute MS C forming two irregular rows on lateral sides. MS A+B formed by many spatulate setae, on latero-basal portion of pars distalis, some of them on ventral side. MS E composed of two pairs, MS E1 markedly below level of E2.

Female

Not examined.

Distribution

Known only from the type locality.

***Troglostygnopsis kalebi* sp. nov.**

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Figs 4–7

Troglostygnopsis sp. CNANOp0050 Cruz-López & Francke 2017: 318.

Diagnosis

Movable finger of chelicera with two teeth, low and wide (Fig. 5B). Tubercles of leg IV large and very close each other, patella with many of these tubercles (Fig. 6B). Penis with two pairs of MS D, MS E1 just above the level of E2.

Etymology

Patronymic honoring our colleague and friend Kaleb Zárate, an enthusiastic speleologist who has helped us collecting troglomorphic arachnids during several expeditions in southeastern Mexico.

Material examined

Holotype

MEXICO • ♂; Chiapas, Las Rosas, Cueva del Ciprés; 16°18'2" N, 92°19'5" W; 17 Jun. 2011; O. Francke, J. Cruz-López, R. Monjaraz-Ruedas, G. Contreras and K. Zárate leg.; CNAN-T0850.

Paratypes

MEXICO • 1 ♂, 1 ♀; same collection data as for holotype; male is a DNA voucher CNANOp0050; CNAN-T0851.

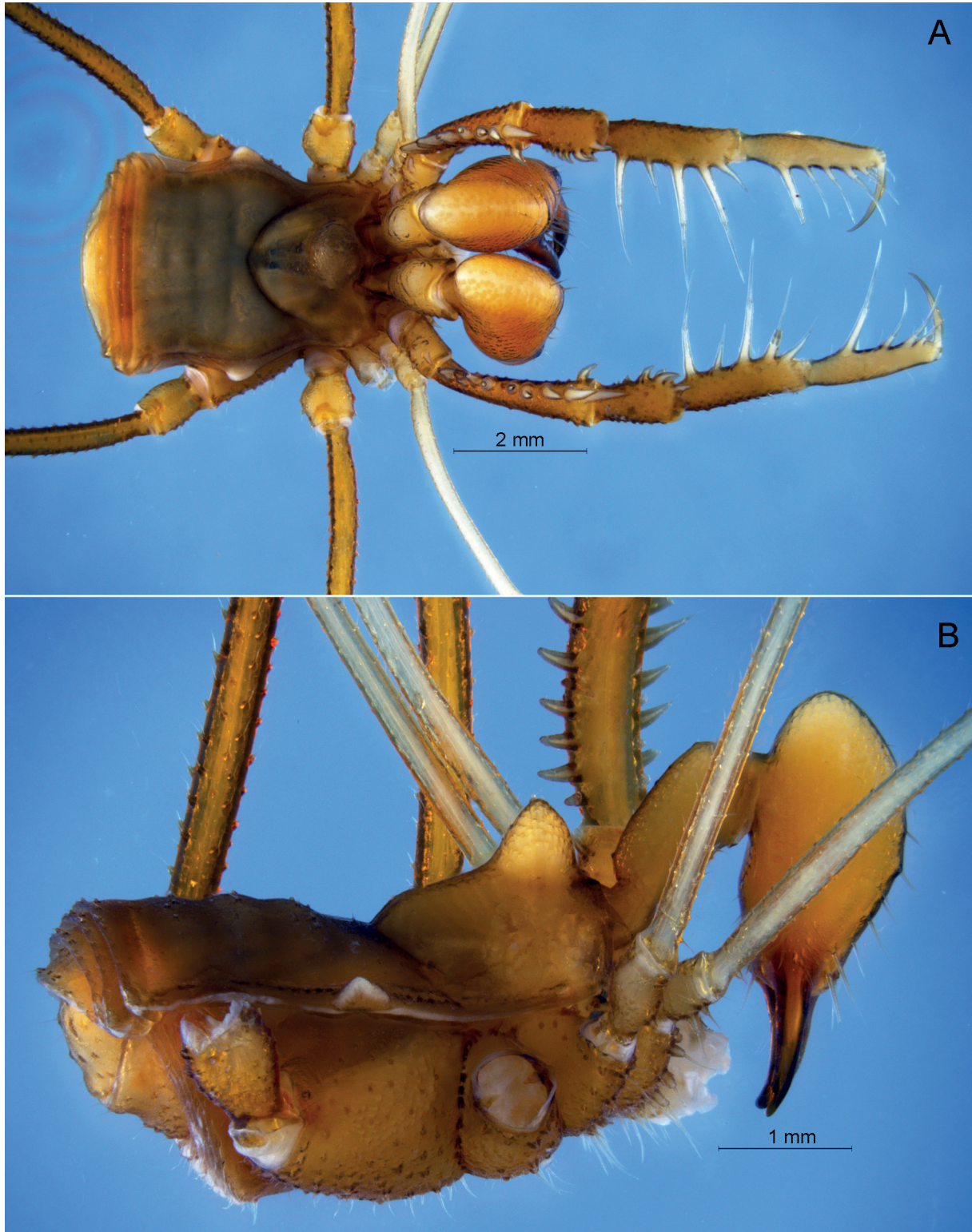


Fig. 4. *Troglostygnopsis kalebi* sp. nov., ♂, holotype (CNAN-T0850). **A.** Dorsal view. **B.** Lateral view.

Description

Male (based on the holotype)

MEASUREMENTS. Scutum length: 5.0, scutum width: 4.2.

BODY (Fig. 4). Scutum type zeta ‘ ζ ’, with both constrictions marked, specially C1, which marks the limits between prosoma and opisthosoma. Lateral margins of the scutum projected in lateral clear areas,

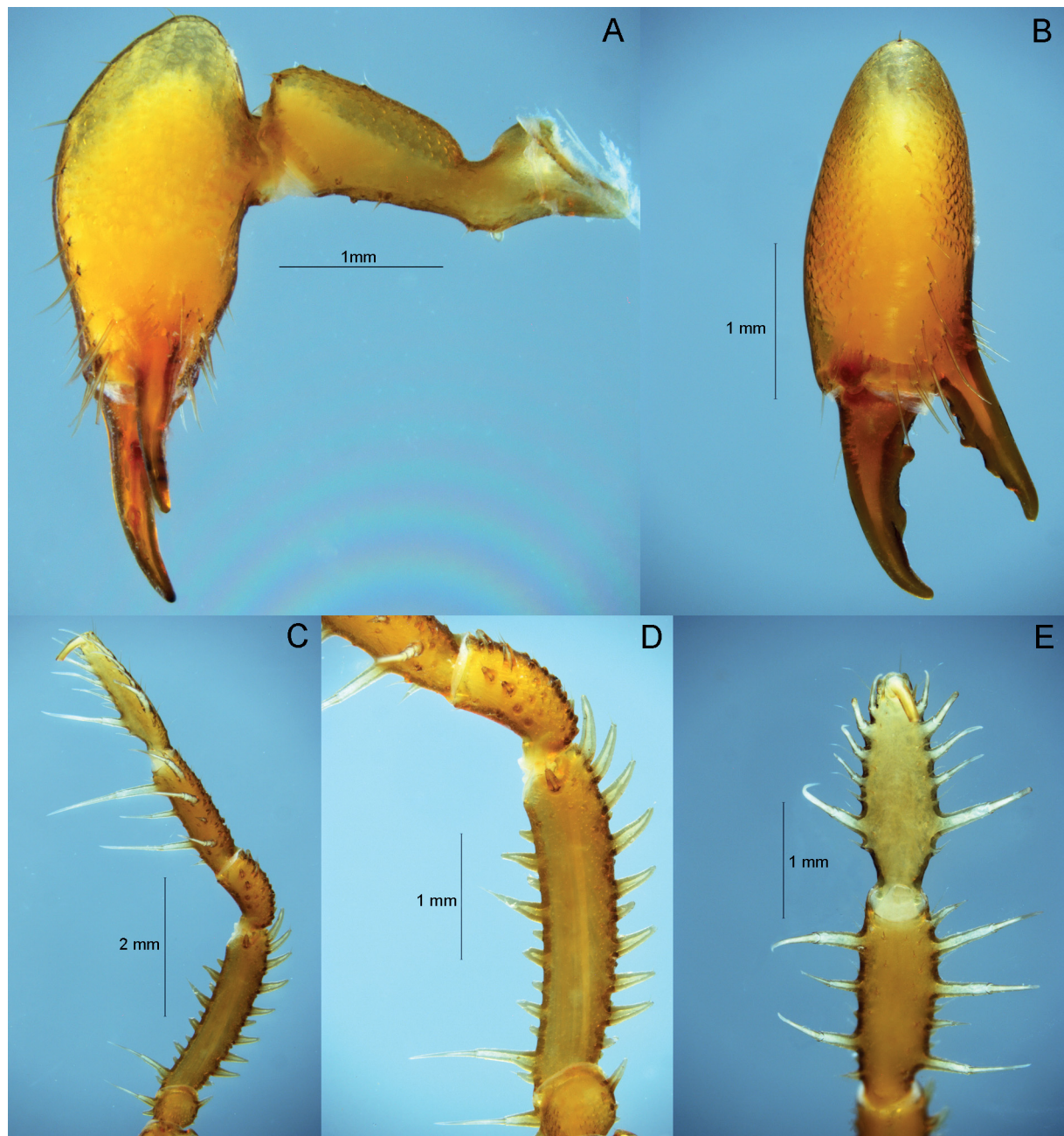


Fig. 5. *Troglstygnopsis kalebi* sp. nov., ♂, holotype (CNAN-T0850). **A.** Chelicera, mesal view. **B.** Chelicera, frontal view. **C.** Pedipalp, mesal view. **D.** Pedipalpal femur, mesal view. **E.** Pedipalpal tibia and tarsus, ventral view.

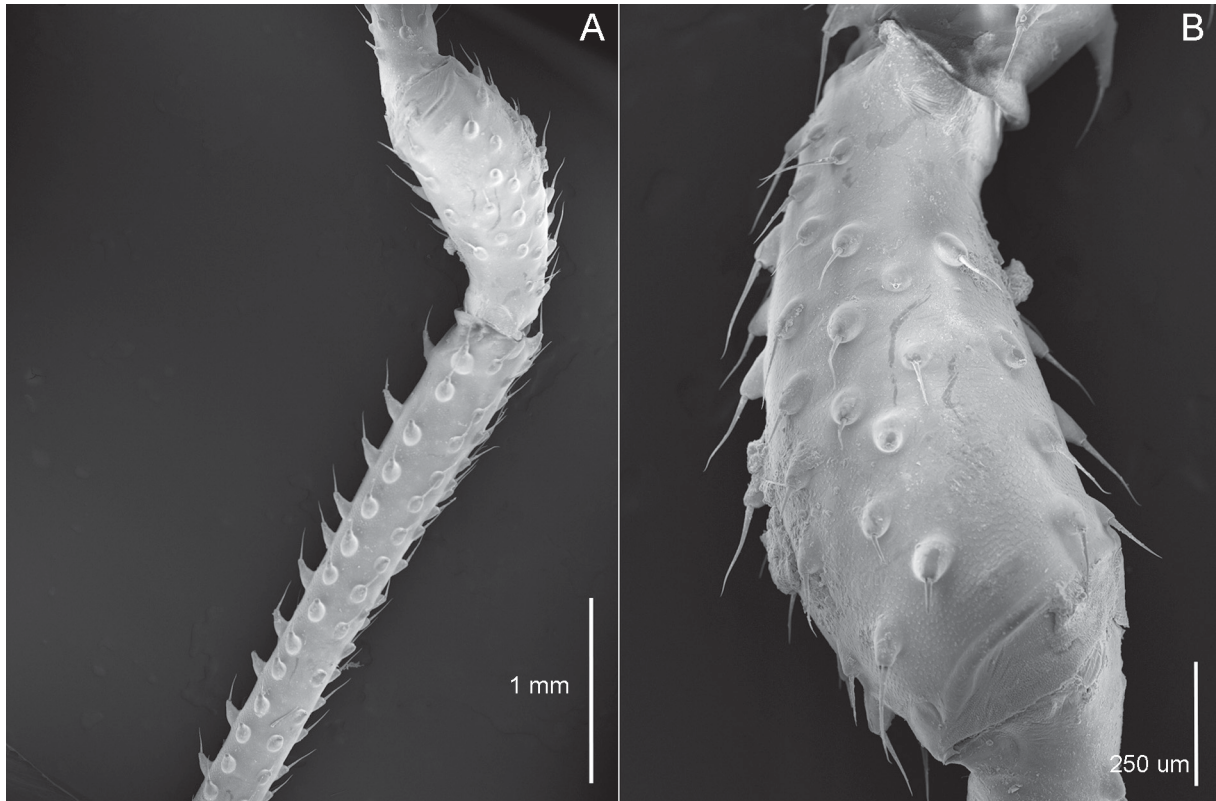


Fig. 6. *Troglostygnopsis kalebi* sp. nov., ♂, holotype (CNAN-T0850). **A.** Apical femur, patella and basal tibia IV. **B.** Patella IV.

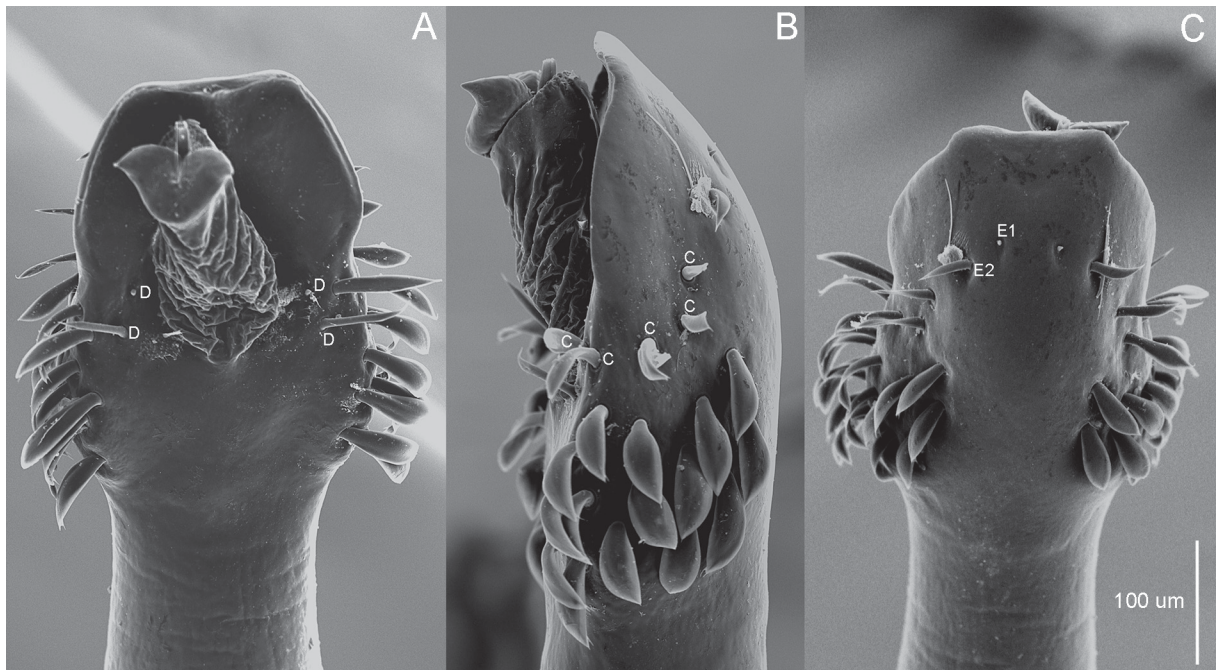


Fig. 7. *Troglostygnopsis kalebi* sp. nov., ♂, holotype (CNAN-T0850), penis. **A.** Dorsal view. **B.** Lateral view. **C.** Ventral view. Scale bar in C applicable to all figures.

large and rounded. Entire dorsum smooth, with few small tubercles in middle of each mesotergal area. Ocularium at the frontal margin of the prosoma, acute, without eyes.

CHELICERA (Fig. 5A–B). Scutum/cheliceral hand ratio: 1.29. Basichelicerite large and smooth, with few small tubercles on ventral and apical regions. Cheliceral hand slightly widened but not swollen. Fixed finger with four teeth distributed evenly throughout, central triangular-shaped. Movable finger with two teeth, one basal and one subterminal, basalmost rounded.

PEDIPALPS (Fig. 5C–E). Measurements: 2.31/1.10/1.80/1.80/1.10. Trochanter globose, with long spiniform setiferous tubercles on ventral and dorsal faces. Femur compressed laterally, armed with dorsal and ventral row of about 10 very large spiniform setiferous tubercles. Additionally, femur with mesal apical spiniform tubercle, near patella. Patella covered with spiniform tubercles on dorsal and mesal faces. Tibia with large main armature, relative sizes of SST on mesal side $1 = 3 > 2$, and on ectal margin $3 = 2 = 1$. Also on tibia three very small tubercles between SST 1, SST 2 and SST 3 on mesal side, and four small ones between SST 1 and SST 2, one between SST2 and SST 3, and one apically. Tarsus with six major tubercles on mesal side ($1 > 2 > 3 > 4 > 5 > 6$) and six on ectal side ($1 > 2 > 3 > 4 > 5$).

LEGS (Fig. 6). All segments long and slender, legs I–III without armature, ornate only with few disperse small tubercles. Ornamentation of femur IV formed by rounded and acuminate tubercles, which form longitudinal rows along entire femur, patella covered with many tubercles.

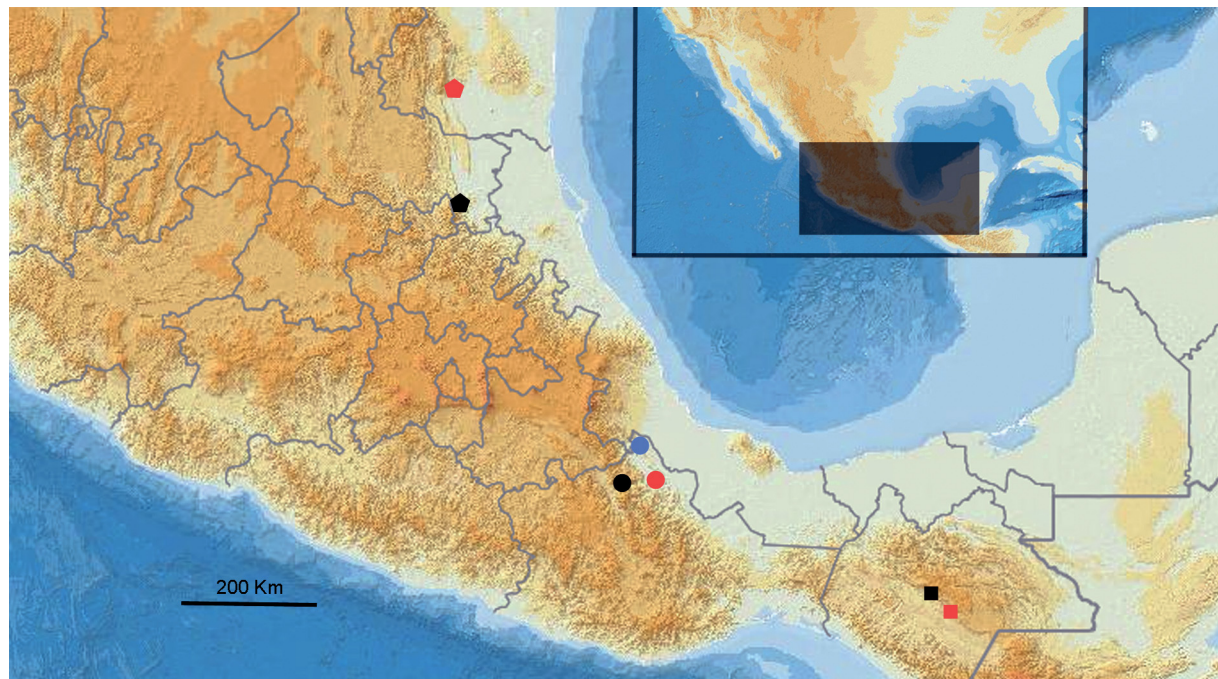


Fig. 8. Distribution of selected troglitic genera of Stygnopsidae Sørensen, 1932. Squares are distribution of *Troglstygnopsis* Šilhavý, 1974: black = *T. anophthalma* Šilhavý, 1974; red = *T. kalebi* sp. nov. Circles show distribution of *Brujita* Cruz-López, in press, *Toojah* Cruz-López, in press and the dubious record for *Mictlana inops* (Goodnight & Goodnight, 1971) reported by Goodnight & Goodnight (1973): black = *B. chapulapa* Cruz-López, in press; red = *T. cimutaa* Cruz-López, in press; blue = *M. inops*?. Pentagons are the distribution of *Mictlana* Cruz-López & Francke, 2015: black = *M. plana* (Goodnight & Goodnight, 1973); red = *M. inops*.

PENIS (Fig. 7). Pars distalis wide, spoon-shaped. Follis multifolded, apices of dorsal bilobular projection acute, stylus arises from inside. Two pairs of MS D, lateral to base of follis, one pair very small and other formed by large acute MS. Five to six pairs of acute MS C forming curved rows on lateral sides. MS A+B formed by 16–17 spatulate setae, latero-basally to pars distalis. MS E composed of two pairs, MS E1 just above level of E2.

Female

Very similar to male, without remarkable sexual dimorphism.

Distribution

Known only from the type locality.

Discussion

Goodnight & Goodnight (1971, 1973), described and assigned six cave-dwelling harvestmen species to the genus *Hoplobunus*, based on their reductionist classification scheme which they previously proposed in Goodnight & Goodnight (1953). Goodnight & Goodnight (1971) described *Mictlana inops* (as *Hoplobunus inops*) from Sotano de la Joya, in Tamaulipas State, northern Mexico (Fig. 8). This species was easily separated from other species of *Hoplobunus* by “general adaptation to a cave life”, according to them. Subsequently, Goodnight & Goodnight (1973) reported some new records for *M. inops*; surprisingly, one of these is in Cueva del Nacimiento del Río San Antonio, Acatlán, Oaxaca State, southern Mexico, about 560 km south of those records near the type locality (Fig. 8). This record was supported by the Goodnights’ conception of species highly being variable in morphology with very wide geographical distributions. Many years later, this record was corroborated as an undescribed troglomorphic species by Reddell (1981) and Kury (2003). Complementarily, the way that Goodnight & Goodnight delimited species has been refuted, especially for some Mexican harvestmen (e.g., Cruz-López & Francke 2015, 2019a).

Recent studies have shown that some harvestmen species exhibit very short-range distributions, sometimes covering a few kilometers, or in the case of troglobitic species, only a cave or one cave system (Ubick & Ozimec 2005; Jay *et al.* 2016; Cruz-López *et al.* 2019). Troglobitic genera of the family Stygnopsidae, reflecting micro-endemic distributions, are the following: *Brujita* Cruz-López, in press, *Iztlina* Cruz-López & Francke, 2017, *Mexotroglinus* Šilhavý, 1977, *Minisge* Cruz-López *et al.*, 2019, *Tonalteca* Cruz-López & Francke, 2017 and *Toojah* Cruz-López, in press, each restricted to a specific cave system.

The Northern portion of Oaxaca is characterized by the presence of numerous karstic caves, the most remarkable being the Huautla Cave System (HCS) (Steele & Smith 2019). In this area, seven troglomorphic stygnopsids have been reported, and remarkably, both species of *Minisge* inhabit HCS sympatrically but at different depths (Cruz-López *et al.* 2019). Also, in this region of Oaxaca State, the locality of the false record of *M. inops* from Acatlán is about 66 km away from the type locality of *Brujita chapulapa* Cruz-López, in press, a troglomorphic species somewhat similar to *Mictlana*. A further revision of this specimen or additional specimens from the same locality would clarify its identity.

Additionally, the troglobitic genera *Brujita*, *Mictlana* (both in Karosinae), *Toojah* and *Troglostygnopsis* (both in Stygnopsinae) resemble each other externally very much, mainly by the presence of clear lateral projections in the middle scutum. This last character may perhaps have been the reason why Goodnight & Goodnight misidentified the troglobitic stygnopsid from northern Oaxaca as *M. inops*. Cruz-López (in press) discussed the synapomorphies for both subfamilies, as well as other diagnostic characters used for the recognition of several taxa among the subfamilies. In this way, the shape of

mesotergal sulci (sometimes only visible using an SEM), cheliceral dentition, cheliceral comb, armature of pedipalpal femur and patella, and arrangement of MS on the penis are enough for the recognition of all genera in the family.

Regarding *Troglostygnopsis*, both species are restricted to the central portion of Chiapas State, with both type localities separated by about 56 km. This genus, like the rest of the other troglobitic genera, shows a short-range endemic distribution (Fig. 8). Also, cheliceral dentition, pedipalpal armature, leg IV ornamentation, and male genitalia are more reliable characters than the tarsal count and presence of lateral clear areas, as Goodnight & Goodnight and Šilhavý have proposed. Also, based on the phylogenetic hypothesis of Stygnopsidae, lateral clear areas are homoplastic character (Cruz-López & Francke 2017). In conclusion, troglobitic genera with these structures show very restricted distribution ranges, *Mictlana* in northern Mexico, in the states of Tamaulipas and San Luis Potosí; *Brujita* and *Toojah* in northern Oaxaca, and *Troglostygnopsis* restricted to the central portion of Chiapas (Fig. 8).

Acknowledgments

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