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Cryptocellus armasi, a new troglomorphic hooded tick-spider from Venezuela (Arachnida: Ricinulei)

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Abstract

Ricinulei Thorell, 1876, or hooded tick-spiders, are among the least known arachnid orders. Represented by 88 species in the New World and 33 species in South America, only two ricinuleid species have been recorded from Venezuela, one of the Neotropical countries with the least known Ricinulei fauna. In the present contribution, *Cryptocellus armasi* **sp. nov.** is described and illustrated from male and female specimens collected inside Cueva de Toromo, a cave in the foothills of the Sierra de Perijá, in the state of Zulia, northwestern Venezuela. The new species, which belongs to the *magnus* species group, exhibits pronounced attenuation of the appendages. Based on this troglomorphism and hypogean habitat, the new species appears to be a troglobite, the first of its kind in *Cryptocellus* Westwood, 1874 and the first troglobitic ricinuleid from South America. This new species raises the number of extant ricinuleid species to 103 and the species of *Cryptocellus*, to 46. Thirty-four of these occur in South America and three in Venezuela. A map plotting the known distributions of the three Venezuelan species of Ricinulei is presented.

Key words: troglobite, troglobiont, taxonomy, Cueva de Toromo, Sierra de Perijá, Zulia

Resumen

Los Ricinulei Thorell, 1876, o arañas garrapata encapuchadas, se encuentran entre los órdenes de arácnidos menos conocidos. Representados por 88 especies en el Nuevo Mundo y 33 especies en América del Sur, solo dos especies de ricinúlidos han sido registradas en Venezuela, uno de los países neotropicales con la fauna de Ricinulei menos conocida. En el presente artículo, se describe e ilustra a *Cryptocellus armasi* **sp. nov.** a partir de ejemplares machos y hembras recolectados en la Cueva de Toromo, ubicada en las estribaciones de la Sierra de Perijá, en el Estado de Zulia, noroeste de Venezuela. La nueva especie, que pertenece al grupo *magnus*, exhibe una atenuación pronunciada de los apéndices. Con base en este troglomorfismo y su hábitat hipogeo, la nueva especie parece ser un troglobio, el primero de su tipo en *Cryptocellus* Westwood, 1874, y el primer ricinúlido troglobítico de América del Sur. Esta nueva especie eleva a 103 el número de especies de ricinúlidos existentes y a 46 el de *Cryptocellus*. Treinta y cuatro de ellas se encuentran en América del Sur y tres en Venezuela. Se presenta un mapa que muestra las distribuciones conocidas de las tres especies venezolanas de Ricinulei.

Palabras clave: troglobio, troglobionte, taxonomía, Cueva de Toromo, Sierra de Perijá, Zulia

Introduction

Ricinulei Thorell, 1876, or hooded tick-spiders, are among the least known arachnid orders. Although the cryptic habits and general rarity of Ricinulei in collections have resulted in them being understudied, compared with other, more conspicuous arachnid orders, the pace of species discovery and description has accelerated somewhat in recent years (Botero-Trujillo *et al.* 2021a). Since the start of the decade, twelve extant ricinuleid species were described from North, Central and South America, and Africa (Valdez-Mondragón *et al.* 2020; Valdez-Mondragón & Cortez-

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Roldán 2021; Valdez-Mondragón & Juárez-Sánchez 2021; Botero-Trujillo *et al.* 2021a, 2021b), in addition to two fossil species, one from the Pennsylvanian Energy Shale of Illinois, U.S.A. (Whalen & Selden 2021) and another from Burmese amber (Botero-Trujillo *et al.* 2022). Phylogenetic studies have also been conducted, by Benavides *et al.* (2021), using phylotranscriptomics and Sanger sequencing, and by Sato *et al.* (2024), using ultra-conserved elements.

In total, 104 extant ricinuleid species, 102 of which are considered valid, have been described and are classified into three genera: *Cryptocellus* Westwood, 1874, with 45 valid species (and one *nomen dubium*, *Cryptocellus emarginatus* Ewing, 1929) distributed across eleven countries, from Honduras to Brazil, at the outset of this study; *Pseudocellus* Platnick, 1980, with 41 valid species (and one *nomen dubium*, *Pseudocellus barberi* (Ewing, 1929)), distributed across eight countries from the southern U.S.A. to Panama, and the Caribbean islands of Cuba and Tobago; and *Ricinoides* Ewing, 1929, comprising 16 valid species, occurring in 14 countries of tropical west and central Africa (Botero-Trujillo *et al.* 2021a, 2021b; Valdez-Mondragón & Cortez-Roldán 2021; Valdez-Mondragón & Juárez-Sánchez 2021).

Many species of Ricinulei have been found inside caves. Several are restricted to caves and considered true troglobites. Most cave records concern species of *Pseudocellus*, the genus to which all troglobitic species currently belong. Some of these are markedly troglomorphic, showing modifications such as pronounced elongation of the legs and, in some cases, pale coloration and thin cuticle, e.g., *Pseudocellus krejcae* Cokendolpher & Enríquez, 2004, from Belize, *Pseudocellus permagnus* Armas, 2017, from Cuba, and *Pseudocellus oztotl* Valdez-Mondragón & Francke, 2011 and *Pseudocellus platnicki* Valdez-Mondragón & Francke, 2011, from Mexico (Cokendolpher & Enríquez 2004; Valdez-Mondragón & Francke 2011; Armas 2017). In contrast, only a few species of *Cryptocellus* have been collected inside caves, including *Cryptocellus bordoni* (Dumitresco & Juvara-Balş, 1977), from Venezuela, *Cryptocellus florezi* Platnick & García, 2008, from Colombia, and *Cryptocellus tarsilae* Pinto-da-Rocha & Bonaldo, 2007 and *Cryptocellus canga* Pinto-da-Rocha & Andrade, 2012, from Brazil (Dumitresco & Juvara-Balş 1977; Pinto-da-Rocha & Bonaldo 2007; Platnick & García 2008; Pinto-da-Rocha & Andrade 2012). Nevertheless, all these species of *Cryptocellus* lack troglomorphies and should therefore be regarded as troglophiles or trogloxenes. No species of *Ricinoides* have been recorded from caves.

The present contribution describes a new ricinuleid, *Cryptocellus armasi* **sp. nov.**, from male and female specimens collected inside Cueva de Toromo, a cave in the foothills of the Sierra de Perijá, in the state of Zulia, northwestern Venezuela. The new species belongs to the *magnus* species group, an assortment of putatively related South American species defined by Platnick and Paz (1979) and subsequently addressed by other authors (Tourinho & Saturnino 2010; Botero-Trujillo & Valdez-Mondragón 2016; Salvatierra & Tourinho 2016). This new species, the third ricinuleid recorded in Venezuela, exhibits pronounced attenuation of the appendages. Based on this troglomorphism and its hypogean habitat, the new species appears to be a troglobite, the first of its kind in *Cryptocellus* and the first troglobitic ricinuleid from South America. This new species raises the number of extant ricinuleid species to 103 and the species of *Cryptocellus*, to 46. Thirty-four of these occur in South America and three in Venezuela. A map plotting the known distributions of the three Venezuelan species of Ricinulei is presented.

Material and methods

The type material of the new species belongs to the Museo de Biología de La Universidad del Zulia (MBLUZ), Maracaibo, Venezuela, and is on long-term loan to the Invertebrate Zoology Collection (IZC) of the American Museum of Natural History (AMNH), New York, U.S.A.

Specimens were examined with Leica M165 C and Nikon SMZ1500 stereomicroscopes. Digital photomicrographs were taken with a Nikon DS-Ri2 camera adapted to a Nikon SMZ 18 stereomicroscope with a SHR Plan Apo 1x Objective, using NIS-Elements Imaging Software ver. 4.60, at the AMNH Microscopy and Imaging Facility. Line drawings were prepared using a camera lucida mounted on the Nikon SMZ1500 stereomicroscope. Measurements were recorded, following the methodology outlined by Botero-Trujillo *et al.* (2021b), using a calibrated ocular micrometer fitted to the Nikon SMZ 1500 stereomicroscope.

The description style follows Botero-Trujillo *et al.* (2021a, 2021b). Terminology for the copulatory apparatus follows Talarico *et al.* (2008) and Botero-Trujillo & Valdez-Mondragón (2016), except that the terms “fixed process” and “movable process” replace the terms “tarsal process” and “accessory piece,” respectively, following Cokendolpher (2000) and Botero-Trujillo *et al.* (2021b).

Locality records for the material examined were georeferenced using coordinates published by Botosaneanu & Viloria (1993). A distribution map was produced with QGIS Geographic Information System ver. 3.30 (http://www.qgis.org) using a digital elevation model, raster Hillshade conversion (with layers on azimuths 45° and 145°) and single band rendering (i.e., BrBg). The map presents distributional data for the three species of Ricinulei recorded in Venezuela.

Systematics

Family Ricinoididae Ewing, 1929

Genus *Cryptocellus* Westwood, 1874

Cryptocellus armasi sp. nov.

Figures 1–7; Table 1

Type material. VENEZUELA: *Zulia*: Municipio: Machiques de Perijá, Sierra de Perijá, Hacienda Medellín, Cueva de Toromo [10°03'20"N 72°40'00"W, ca. 260 m], galería n. 1, in bat guano, 18.viii.1997, A. Rincón, L. Cáceres & Y. Vargas, 2 ♂, 4 ♀ syntypes (MBLUZ/AMNH IZC 325115). Large body parts are stored in three vials and small body parts in four microvials. The fragments of males and females, stored separately, are labeled by sex. One vial and one microvial contain pieces that cannot be assigned to either sex.

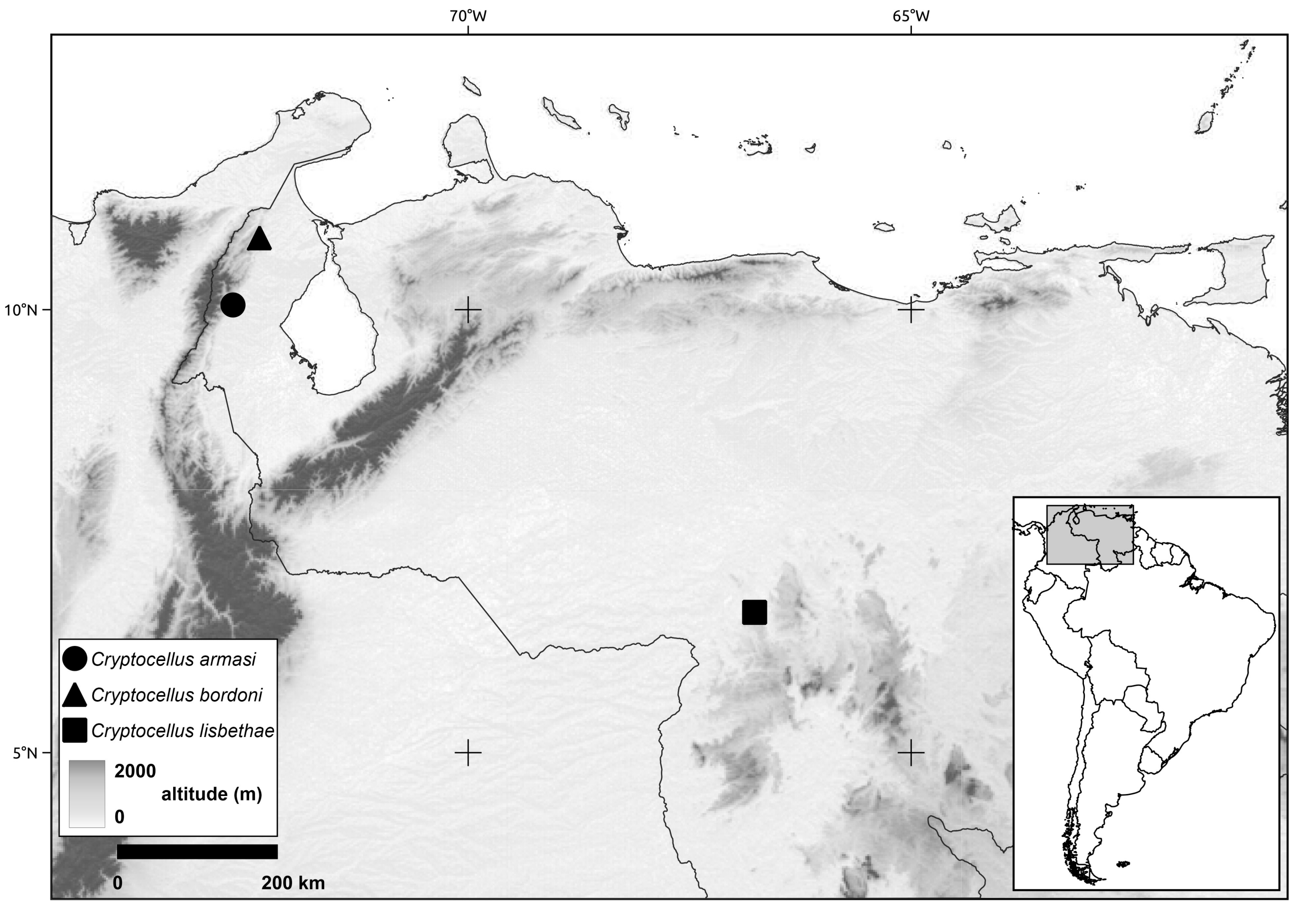

FIGURE 1. Map of northwestern South America, plotting the known distribution of *Cryptocellus armasi* **sp. nov.**, and the two other ricinuleid species recorded in Venezuela, *Cryptocellus bordoni* (Dumitresco & Juvara-Balş, 1977) and *Cryptocellus lisbethae* González-Sponga, 1998.

FIGURE 2. *Cryptocellus armasi* **sp. nov.**, syntype ♂ (MBLUZ/AMNH IZC 325115). **A.** Carapace, dorsal aspect. **B.** Cucullus, anterior aspect. **C–E.** Opisthosoma, dorsal (**C**), lateral (**D**), and ventral (**E**) aspects. Scale bars = 0.5 mm.

The type material comprises the desiccated fragments of six individuals, all of which were originally in the same vial. The hardness of the ricinuleid cuticle enabled every structure (somatic and sexual) to remain intact. Study of the fragments revealed that the series comprises two adult males and four adult females. However, due to the pronounced appendage attenuation and absence of sexual dimorphism in the leg segments, it was impossible to assign every fragment (e.g., leg tarsal segments) to a male or female specimen and to reassemble any single individual as the holotype of the new species. Taking into consideration that (1) all the specimens were part of the same collection event inside a single cave, (2) all specimens comprising the series are conspecific, and (3) the individual specimens cannot be fully reassembled from the available fragments, a decision was taken to consider all six specimens as syntypes, according to the ICZN (1999) "specimens of a type series that collectively constitute the name-bearing type."

FIGURE 3. *Cryptocellus armasi* **sp. nov.**, syntype ♀ (MBLUZ/AMNH IZC 325115). **A.** Carapace, dorsal aspect. **B.** Cucullus, anterior aspect. **C, D.** Opisthosoma, dorsal (**C**) and ventral (**D**) aspects. Scale bars = 0.5 mm.

Diagnosis. *Cryptocellus armasi* **sp. nov.** is one of only two species of the *magnus* species group that are associated with caves, the other being *C. bordoni*. Whereas *C. bordoni* "does not possess troglomorphic characters (… very elongated and thin appendages …)" (Salvatierra & Tourinho 2016: 12) and there is no indication of troglomorphies in its original description (Dumitresco & Juvara-Balş 1977), *C. armasi* exhibits a narrow opisthosoma (Figs. 2C–E, 3C, D) and pronounced attenuation of the appendages, with very long, slender legs (Fig. 4C–F) (e.g., leg II femur W:L = 1:8.1 [♂], 1:8.6 [♀]; carapace L:femur II L = 1:1.7 [♂]), and no apparent sexual dimorphism in the size of the leg segments, unlike other species of the *magnus* group. These characters, presumed to be associated to a troglobitic lifestyle, readily distinguish the new species from its closest relatives, *C. bordoni* (carapace L:femur II L = 1:1.5 [♂]), *Cryptocellus brignolii* Cokendolpher, 2000 (carapace L:femur II L = 1:1.1 [♂]), *Cryptocellus chimaera* Botero-Trujillo & Valdez-Mondragón, 2016 (carapace L:femur II L = 1:1.1 [♂]), *Cryptocellus magnus* Ewing, 1929 (carapace L:femur II L = 1:1.0 [♂]), *Cryptocellus narino* Platnick & Paz, 1979 (carapace L:femur II

L = 1:1.2 [♂]), and *Cryptocellus pseudocellatus* Roewer, 1952 (male is unknown, but female illustrated by Roewer (1952: 47, fig. 4)).

Cryptocellus armasi also differs from *C. bordoni*, the most geographically proximate congener, in the shape of the male copulatory apparatus. The movable process of the apparatus is linear in lateral aspect, its dorsal and ventral surfaces parallel along its entire length (Figs. 6A, B, 7A, B), in *C. armasi*, unlike *C. bordoni*, in which the distal region of the movable process is curved dorsally and equipped with a large, proventral subdistal protrusion (Dumitresco & Juvara-Balş 1977: 168, 169, figs. 9A–C, 10A, B; Salvatierra & Tourinho 2016: 18, fig. 17A), structures that, in combination, create a "hammer-like" appearance. Additionally, the apex of the movable process bears a leaflike projection prodorsally (relative to the sperm transfer groove) and its *L′* lobe is shorter and hook-shaped (Figs. 6A, E–G, 7A, B, F, G) in *C. armasi*, whereas there is no such leaflike projection and the *L′* lobe is longer and sublinear in *C. bordoni* (Dumitresco & Juvara-Balş 1977: 168, 169, figs. 9A–C, 10A–C; Salvatierra & Tourinho 2016: 18, fig. 17A–C). The copulatory apparatus of the two species also differs in the morphology of the fixed process, notably the shape of its distal region in lateral aspect, being more linear and with the ventral surface slightly angular, in *C. armasi* (Figs. 6A, B, 7A, B, D, E), but curved dorsally and with the ventral surface arcuate, in *C. bordoni* (Dumitresco & Juvara-Balş 1977: 168, 169, figs. 9A–C, 10A; Salvatierra & Tourinho 2016: 6, fig. 5C, D).

Etymology. The species name (noun in the genitive case) is a eponym honoring Dr. Luis F. de Armas, formerly of the Instituto de Ecología y Sistemática, La Habana, Cuba, on the occasion of his 80th birthday and in recognition to his contributions to the knowledge of troglobitic arachnids, including ricinuleids.

Description. Based on the syntypes (MBLUZ/AMNH IZC 325115).

Measurements: Total length, 7.49 mm (♂), 7.29 mm (♀) (Table 1).

TABLE 1. Measurements (mm) for syntypes (MBLUZ/AMNH IZC 325115) of *Cryptocellus armasi* **sp. nov.** Abbreviations: L, length; W, width; H, height. Notes: [1]excludes pygidium and cucullus; [2]maximum width; [3]maximum height; [4]midline.

	Syntype ♂	Syntype ♀
Total Body L[1]	7.49	7.29
Cucullus L	1.10	1.14
Cucullus W[2]	1.70	1.76
Carapace L	2.15	2.24
Carapace W[2]	2.04	2.17
Opisthosoma L[1]	5.34	5.05
Opisthosoma L[2]	2.62	2.75
Median plate XI L	1.63	1.51
Median plate XI W[2]	1.38	1.57
Median plate XII L	1.55	1.51
Median plate XII W[2]	1.33	1.57
Median plate XIII L	1.76	1.72
Median plate XIII W[2]	1.14	1.38
Pedipalp Femur L	1.38	1.48
Pedipalp Femur H[3]	0.45	0.49
Pedipalp Tibia L	2.04	2.13
Pedipalp Tibia H[4]	0.17	0.17
Leg I Coxa L	1.01	1.12
Leg I Trochanter L	0.77	0.71
Leg I Femur L	1.94	1.94
Leg I Femur W[4]	0.39	0.39
Leg I Femur H[4]	0.43	0.43

......continued on the next page

TABLE 1. (Continued)

	Syntype ♂	Syntype ♀
Leg I Patella L	1.05	1.03
Leg I Tibia L	1.16	1.12
Leg I Metatarsus L	1.72	1.66
Leg I Tarsus L	0.75	0.69
Leg II Coxa L	1.42	1.42
Leg II Trochanter L	1.18	1.08
Leg II Femur L	3.66	4.02
Leg II Femur W[4]	0.45	0.47
Leg II Femur H[4]	0.52	0.52
Leg II Patella L	1.66	1.68
Leg II Tibia L	2.86	2.97
Leg II Metatarsus L	2.90	3.01
Leg III Coxa L	1.18	1.14
Leg III Trochanter 1 L	0.84	0.75
Leg III Trochanter 2 L	0.97	0.90
Leg III Femur L	2.26	2.26
Leg III Femur W[4]	0.43	0.41
Leg III Femur H[4]	0.47	0.43
Leg III Patella L	1.12	1.08
Leg III Tibia L	1.18	1.27
Leg III Metatarsus L	1.38	1.51
Leg IV Coxa L	-	1.03
Leg IV Trochanter 1 L	-	0.86
Leg IV Trochanter 2 L	-	0.90
Leg IV Femur L	-	2.58
Leg IV Femur W[4]	-	0.34
Leg IV Femur H[4]	-	0.41
Leg IV Patella L	-	1.18
Leg IV Tibia L	-	1.35
Leg IV Metatarsus L	-	1.68

Coloration (of desiccated fragments): Soma and appendages reddish brown (Figs. 1–5). Carapace dorsolateral translucent areas yellow (Figs. 2A, 3A). Opisthosomal tergal and pleural membranes yellow, hyaline. Cheliceral manus yellowish; fingers and finger dentition dark red.

Setation: Soma and appendages covered with short to slightly elongate, translucent, bristle-like setae (Figs. 1–5). Polygonal setae absent.

Tegument surface macrosculpture: Tegument with bilaterally symmetric rows of oval or rounded, granule-containing cuticular pits arranged as follows: on cucullus, along three partial longitudinal rows (median and paired lateral rows; Figs. 2B, 3B); on carapace, along pair of anterolateral longitudinal rows, pair of submedian oblique rows, pair of posterosubmedian oblique rows, pair of posterolateral longitudinal rows, pair of posteromarginal transverse rows, and median longitudinal row (Figs. 2A, 3A); on opisthosomal tergites XI–XIII, in rows along margins of median sclerites and along contiguous lateral margin of lateral sclerites (Figs. 2C, 3C); on opisthosomal sternites, in longitudinal rows along lateral margins (Figs. 2E, 3D). Carapace and opisthosoma predominantly smooth, except for pits. Cucullus, anterior surface coarsely granular ventrally, especially in male (Figs. 2B, 3B). Coxosternal region and legs granular (Fig. 4C–F). Opisthosoma, tergal and pleural membranes smooth. Pedipalp femur predominantly smooth, except ventral surface granular proximally (Fig. 4A); tibia smooth proximally, with elevated oval tubercles in distal half to two-thirds (Fig. 4A, B).

Carapace: Carapace trapezoidal, longer than wide (Table 1), broadest between coxae of legs II and III; lateral margins curved, converging anteriorly (Figs. 2A, 3A); anterior margin linear in dorsal aspect, sublinear in frontal aspect; posterior margin procurved; dorsolateral translucent areas oval, without well-defined borders, aligned with intersection between coxae of legs I and II.

Cucullus: Cucullus broadened laterally, wider than long (Table 1); ventrolateral margins rounded (Figs. 2B, 3B); ventral margin predominantly linear in anterior aspect, with shallow median concavity in ventral aspect.

Chelicerae: Movable finger longer than fixed finger, not widened; mucron apex acute; tooth row comprising approximately seven small teeth and one markedly larger, proximal tooth. Fixed finger tooth row comprising approximately five small to medium-sized teeth.

Coxosternal region: Tritosternum large, forming diamond-shaped shield, abutting coxae of legs I; coxae of legs II–IV each abutting one another medially along entire length, except for coxae of legs II, separated anteriorly by tritosternum; coxae of legs II, anterior and posterior margins perpendicular to median axis, not forming angle medially; coxae of legs II–IV progressively decreasing in length (Table 1); suture between coxae of legs III shorter than suture between coxae of legs II and, to lesser extent, coxae of legs IV.

Opisthosoma: Opisthosoma elongate oval, longer than wide (Table 1), broadest at tergite XII (Figs. 2C, 3C). Tergites X–XIII each comprising median and lateral sclerites; median sclerites of tergites XI–XIII each with paired, shallow submedian depressions, lateral margins subparallel on XI, subparallel (♂) or slightly converging posteriorly (♀) on XII and XIII; of tergites XI and XII longer than wide (♂) or slightly wider than long (♀); of XIII longer than wide (Table 1). Sternites XI–XIII each with paired submedian depressions as tergites (Figs. 2E, 3D). Pygidium basal segment, posterior margin with small V-shaped notch ventrally, slightly emarginate dorsally (Figs. 2C–E, 3C, D).

Pedipalps: Femur robust (Table 1), dorsal surface convex (Fig. 4A). Tibia longer than femur (Table 1), entirely linear, slightly to moderately swollen proximally, rest of segment narrower in dorsal aspect and, to lesser extent, lateral aspect (Fig. 4A, B). Movable finger longer than fixed finger.

Legs: All legs very long and narrow (Fig. 4C–F); leg II longest (Table 1); legs I–IV similar in width, no segments swollen (Table 1). Legs unmodified except in association with male copulatory apparatus. Leg III (♂) metatarsus with moderate concavity dorsodistally (Fig. 5A); retrodorsal margin markedly angular submedially (Fig. 5B); metatarsal process situated proximally near tibia, tapering, apex dorsoventrally compressed and curving retrolaterally; *lamina cyathiformis* slightly deeper than long, with rounded apex (Fig. 5C).

Male copulatory apparatus: Fixed process, distal half prominent ventrally in lateral aspect (Figs. 6A, B, 7A, E); apex deeply incised longitudinally, forming pro- (*L*2) and retrolateral (*L*1) lobes (Figs. 6E, F, 7C–E), each on opposite sides of fixed process (relative to dorsal longitudinal sulcus). Movable process slightly shorter than fixed process, robust, rigid, and linear, margins parallel (Figs. 6A–C, E, G, 7A, B, F–H); apex bifurcate, producing dorsally curved, hook-shaped lobe (*L′*); apex with obliquely oriented, leaflike projection prodorsally, adjacent to termination of sperm transfer groove into distal opening.

Female spermathecae: Spermathecae heavily sclerotized, approximately as deep as wide (Fig. 7I); adjacent but separated; external morphology bilaterally symmetric, internal cavity not visible. Anterior genital lip subtrapezoidal; posterior genital lip missing.

Distribution. *Cryptocellus armasi* is known only from the type locality in the Municipio of Machiques de Perijá in the state of Zulia, northwestern Venezuela (Fig. 1).

Natural history. Cueva de Toromo is situated in the Parque Ecoturístico Cueva de Toromo, on a tributary of the Río Atapsi (a.k.a., Río Negro), its entrance located at 10°03’20”N 72°40’00”W (Botosaneanu & Viloria 1993). The cave is 1120 m in length (horizontal, accessible portion), its length traversed by a stream, and contains labyrinths, waterholes, and waterfalls (Botosaneanu & Viloria 1993; SVE 1993; FAA 2024). It develops in limestones of the Cogollo Group (Early Cretaceous), its soils comprising gravel, sand and compact rock (SVE 1993). A stygobite isopod, a styglophile crab, a depigmented micro-/anophthalmus fish, and another stygoxene fish have been recorded in the cave (Botosaneanu & Viloria 1993).

The habitat and habitus of *C. armasi* are consistent with the troglobitic ecomorphotype. Considering that *C. armasi* is known only from inside a cave (it is unknown whether the ecosystem outside the cave has been sampled for ricinuleids), the marked elongation of its appendages is presumed to be the result of adaptation to life in the subterranean environment.

FIGURE 4. *Cryptocellus armasi* **sp. nov.**, syntype ♂ (MBLUZ/AMNH IZC 325115). **A, B.** Pedipalp, prolateral aspect (fixed finger missing) (**A**) and closeup of distal half of tibia (**B**). **C.** Leg I tibia, prolateral aspect. **D–F.** Leg II femur, prolateral aspect (**D**), tibia, prolateral aspect (**E**), and metatarsus, prolateral aspect (**F**). Scale bars = 0.5 mm (**A–C**), 1 mm (**D–F**).

FIGURE 5. *Cryptocellus armasi* **sp. nov.**, syntype ♂ (MBLUZ/AMNH IZC 325115). **A, B.** Leg III metatarsus, prolateral (**A**) and retrolateral (**B**) aspects. **C.** Leg III, second (modified) tarsomere and *lamina cyathiformis*, prolateral aspect. Scale bars = 0.5 mm.

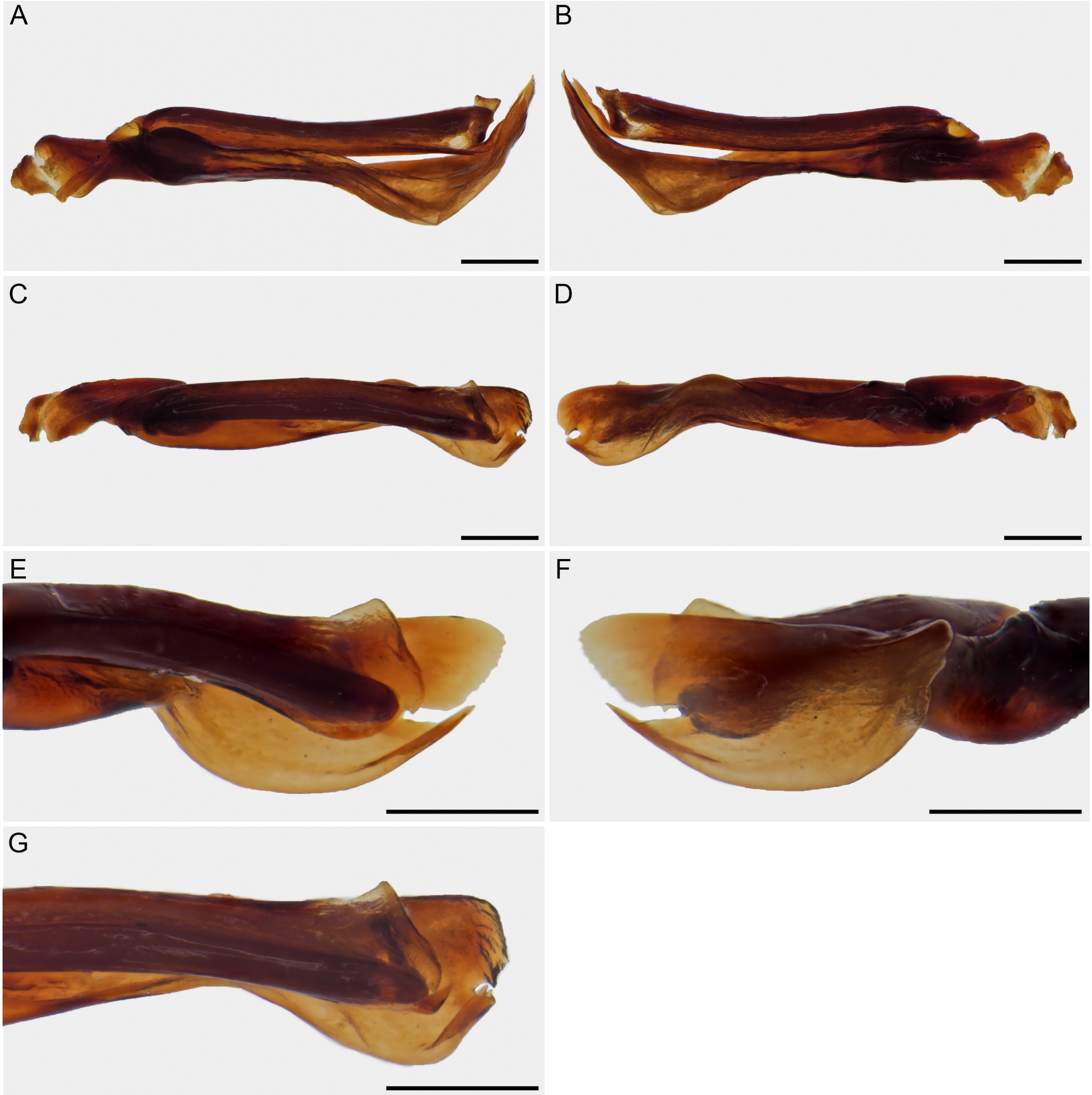

FIGURE 6. *Cryptocellus armasi* **sp. nov.**, syntype ♂ (MBLUZ/AMNH IZC 325115), dextral copulatory apparatus. **A.** Retrolateral aspect. **B.** Prolateral aspect. **C.** Dorsal aspect. **D.** Ventral aspect. **E.** Distal part, dorsal aspect, inclined. **F.** Distal part, ventral aspect, inclined. **G.** Closeup of distal part, dorsal aspect (similar to **C**). Scale bars = 0.25 mm.

The fact that the new species was collected in bat guano is noteworthy because, according to A. Pérez González (pers. comm.), troglophilic ricinuleids are more frequently associated with that substrate than troglobitic ricinuleids. This raises the possibility that *C. armasi* could be a troglophile rather than a troglobite. New collections are needed to shed light on this question.

Conservation status. The type material of *C. armasi* was collected almost three decades ago and no other material of this species is known to exist in biological collections. Based on satellite images from Google Earth Pro (2024) and its historical imagery functionality, the area where the cave is located seems to have aridified in recent years. The conservation status of Cueva de Toromo is unknown, as is the status of *C. armasi*. However, the stygobite isopod described from this cave, *Zulialana coalescens* Botosaneanu & Viloria, 1993, is considered vulnerable (Viloria 2015). Therefore, considering the restricted geographical distribution of the troglobite ricinuleid,

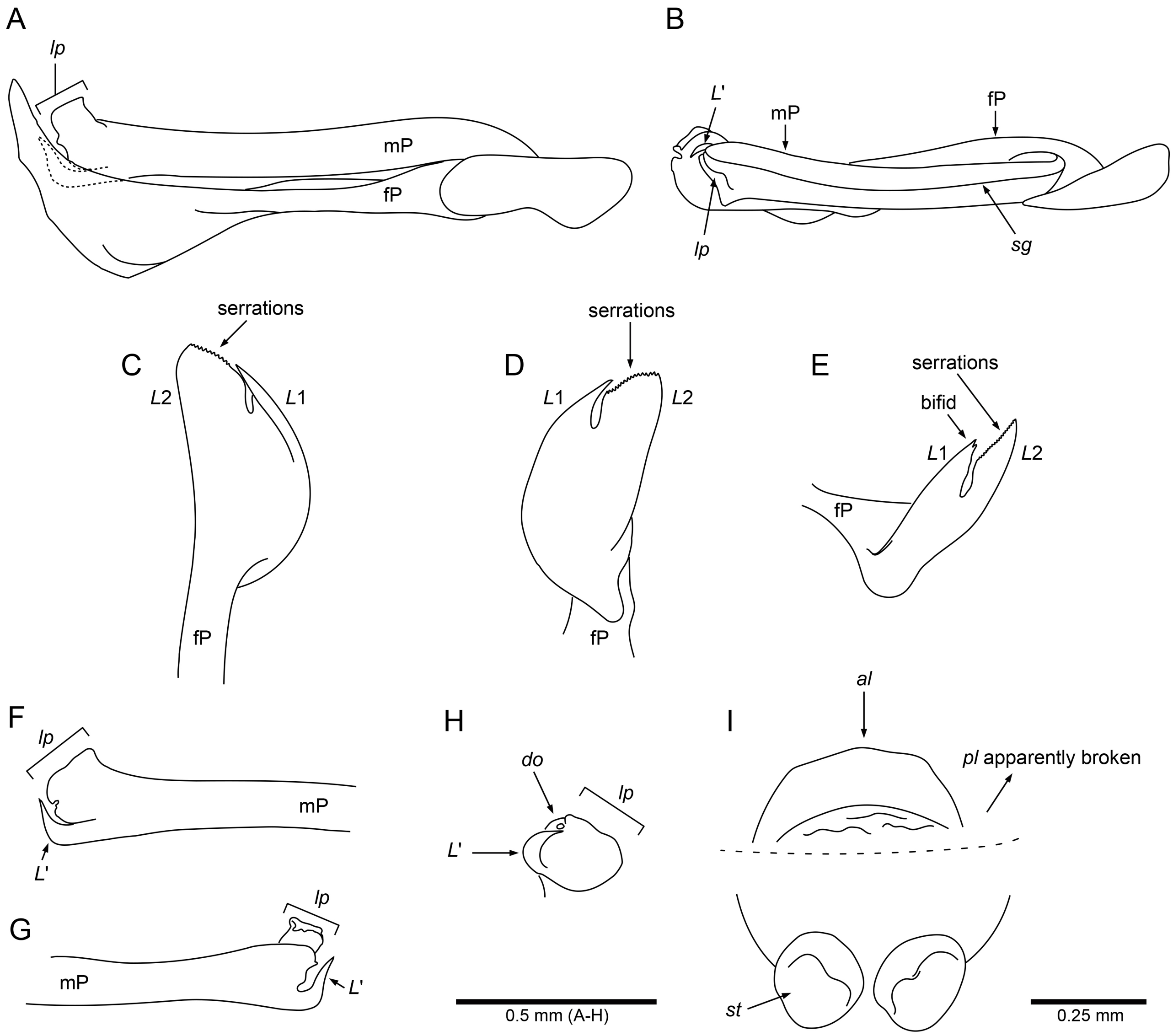

FIGURE 7. *Cryptocellus armasi* **sp. nov. A–H.** Syntype ♂ (MBLUZ/AMNH IZC 325115), dextral copulatory apparatus. **A.** Prolateral aspect. **B.** Dorsal aspect. **C–E.** Distal part of fixed process, dorsal (**C**), ventral (**D**), and retroventral (**E**) aspects, inclined. **F, G.** Distal part of movable process, ventral (**F**) and retrolateral (**G**) aspects. **H.** Movable process, apex, frontal aspect. **I.** Syntype ♀ (MBLUZ/AMNH IZC 325115), spermathecae, posterior aspect. Abbreviations: *al*, anterior genital lip; *do*, distal opening of *sg*; fP, fixed process; *lp*, leaflike projection; mP, movable process; *pl*, posterior genital lip; *sg*, sperm transfer groove; *st*, spermatheca. Scale bars (as indicated).

C. armasi, the inherent sensitivity of troglobites to habitat transformation, and the fact that Cueva de Toromo to which this species appears to be endemic, is exposed to ecotourism (FAA 2024), this species may also be threatened. Efforts dedicated to determining whether *C. armasi* remains extant and, if so, to protect its population and habitat, should be prioritized.

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