Article

ZOOTAXA

A remarkable new species of the *magnus* species-group of *Cryptocellus* (Arachnida, Ricinulei) from Ecuador, with observations on the taxonomy of the New World genera

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Abstract

A new ricinuleid species, *Cryptocellus chimaera* **sp. nov.**, is described based on a male specimen from Northwest Ecuador (Esmeraldas, Reserva Ecológica Mache-Chindul, Estación Biológica Bilsa). This species is unique among all *Cryptocellus* in having very large longitudinal carapacial translucent areas together with a markedly incrassate femur of leg II. Representing only the second species of the order described from Ecuador, *C. chimaera* **sp. nov.** is assigned to the *magnus* species-group of *Cryptocellus* Westwood, 1874. *Cryptocellus chimaera* **sp. nov.** is remarkable, for its morphology resembles that of *Cryptocellus magnus* Ewing, 1929, especially with regard to the male copulatory apparatus, although both resemble *Pseudocellus* Platnick, 1980, due to the presence of diffuse longitudinal carapacial translucent areas. Along with the new species description, a comparative diagnosis and supplementary images are provided for *C. magnus*. Based on direct observations of some species belonging to the five species-groups of *Cryptocellus*, we discuss on the occurrence of different morphologies of carapacial translucent areas within the genus. We deem it important to continue the survey of morphological characters, especially within *Cryptocellus*, in order to increase our understanding of the species-groups and to unravel their relationships.

Key words: *Cryptocellus*, taxonomy, species-groups, carapacial translucent areas, Ecuador

Introduction

Ricinulei is the least diverse arachnid order, known from living and fossil species (Harvey 2002, 2003). The first high-level classification of ricinuleids, proposed by Selden (1992), placed fossil and extant species in separate suborders. Recent contributions and the discovery of *Primoricinuleus pugio* Wunderlich, 2015, from Cretaceous Burmese amber, yielded a different classification proposal (Wunderlich 2012, 2015). The suborder Primoricinulei Wunderlich, 2015, with family Primoricinuleidae Wunderlich, 2015, was erected for *P. pugio* on account of it presumably representing the sister taxon to all other ricinuleids (Wunderlich 2015). The remaining species were assigned to the suborder Posteriorricinulei Wunderlich, 2015, divided into Poliocheroidea Scudder, 1884 for fossil species and Ricinoidoidea Ewing, 1929 for extant species (Wunderlich 2015).

Ricinoidoidea contains one family, Ricinoididae Ewing, 1929 which encompasses 76 extant species (including the new species herein described) in three genera: *Cryptocellus* Westwood, 1874, known from Central and tropical South America, comprising 40 species; *Pseudocellus* Platnick, 1980, from southern U.S.A. (Texas) south to Panama and the Caribbean Islands, with 25 species (mostly from Mexico); and *Ricinoides* Ewing, 1929, from western and central African countries, with eleven species (Selden 1992; Harvey 2002, 2003; Tourinho & Azevedo

2007; Botero-Trujillo & Pérez 2008, 2009; Teruel & Armas 2008; Tourinho & Saturnino 2010; Tourinho *et al.* 2010, 2014; Valdez-Mondragón & Francke 2011, 2013; Pinto-da-Rocha & Andrade 2012; Botero-Trujillo 2014). Poliocheroidea is composed of 16 species in two families: Curculioididae Cockerell, 1916, with genera *Amarixys* Selden, 1992 and *Curculioides* Buckland, 1837, and Poliocheridae Scudder, 1884, with genera *Poliochera* Scudder, 1884 and *Terpsicroton* Selden, 1992 (Selden 1992; Harvey 2003; Wunderlich 2012).

Two extant genera were recognized as of the 1970's, *Cryptocellus* and *Ricinoides*. Platnick & Shadab (1977: 2) and Platnick (1980: 350) noted that the recognition of *Cryptocellus* (referring to species presently placed in *Cryptocellus* and *Pseudocellus*) was based on the absence of (morphological) features present in *Ricinoides*. The authors considered those to be specializations of the latter genus and postulated the possibility that *Cryptocellus* was paraphyletic. The original concept of *Cryptocellus* was later suggested paraphyletic based on nuclear and mitochondrial DNA markers (Murienne *et al.* 2013); shortly afterwards, however, its monophyly was supported from COI sequences and genomic data (Fernández & Giribet 2015).

Platnick (1980) was first to discuss the interrelationships inside the Ricinulei. He erected the genus *Pseudocellus* and transferred to it, from *Cryptocellus*, all the living North American, Cuban, and most of the Central American species. That work thus represents a substantial contribution that yielded the current definition of the American genera. Platnick (1980: 352) mentioned that "*the monophyly of* Cryptocellus*, as restricted above, is still questionable…*" Indeed, this genus has remained unsupported by putative synapomophies.

The notable morphological heterogeneity inside of *Cryptocellus* has led to its partitioning into five species-groups, each gathering species with similar morphologies. These are the *magnus*, *foedus* and *centralis* groups, proposed by N.I. Platnick and co-workers (Platnick & Shadab 1977, 1981a; Platnick & Paz 1979), and the *adisi* and *peckorum* groups, proposed by Tourinho & Saturnino (2010). Even though each group is supported by putative synapomorphies (Platnick & Shadab 1977, 1981a; Platnick & Paz 1979; Tourinho & Saturnino 2010), neither their monophyly nor their relationships have been thoroughly investigated.

In recent years, ricinuleids have received special attention and an important number of works, most of them taxonomic, have been published (e.g., Pinto-da-Rocha & Andrade 2012; Wunderlich 2012; Salvatierra *et al.* 2013; Valdéz-Mondragón & Francke 2013; Botero-Trujillo 2014; Teruel & Schramm 2014; Tourinho *et al.* 2014; García *et al.* 2015; Salvatierra & Tourinho 2016). In addition, two studies introduced the use of molecular data to investigate the interrelationships of the three genera, and postulated biogeographical hypotheses for the diversification of the group (Murienne *et al.* 2013; Fernández & Giribet 2015).

In the present contribution a new ricinuleid species is described from Ecuador, representing the second species of the order described from that country. Based on the male genital morphology, *Cryptocellus chimaera* **sp. nov.** is allocated to the *magnus* species-group, which now includes six species from northern tropical South America. Some observations on the taxonomy of New World ricinuleids are also included.

Material and methods

General terminology used in the species descriptions follows Platnick & Shadab (1977), except for male leg III, which follows Talarico *et al.* (2008a). The term carapacial translucent areas is preferred over others used in literature (e.g., eyes, ocelli, eye fields, ocular spots, pale areas, ocellar areas) as a general concept encompassing all others and in line with early works on the group (Platnick 1980; Platnick & Shadab 1976, 1981a, 1981b). As briefly discussed in part in this manuscript, the shape, size and degree of development of these areas is not the same across the whole order. Using narrower terms like ocelli or eyes would suggest some functioning of the structure; however, it has not been investigated whether or not carapacial translucent areas with different morphologies serve the same function in ricinuleids (e.g., image forming, light detection).

Specimens were examined with Leica M165 C and Leica S8AP0 stereomicroscopes. Photographs were taken with a Leica DFC 290 digital camera mounted on the Leica M165 C stereomicroscope and the extended focal range images composed with Helicon Focus 6.2.2 Pro software (http://www.heliconsoft.com/heliconsoft-products/helicon-focus/). Images were edited with Adobe Photoshop CS6. Measurements, in millimeters, were obtained following the methodology outlined by Cooke & Shadab (1973), using an ocular micrometer fitted to a Leitz Wetzlar stereomicroscope. The distribution map was produced using SimpleMappr (Shorthouse 2010).

Material examined

Specimens used in the present work belong to the following collections: American Museum of Natural History, New York, U.S.A. (AMNH); Colección Nacional de Arácnidos, Instituto de Biología, Universidad Nacional Autónoma de México, Mexico (CNAN); Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia (ICN); Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina (MACN); Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil (MCN); Instituto de Ciencias Biológicas, Escuela Politécnica Nacional, Quito, Ecuador (MEPN); Museu Paraense Emílio Goeldi, Belém, Brazil (MPEG); Museo Javeriano de Historia Natural 'Lorenzo Uribe S. J.', Pontificia Universidad Javeriana, Bogotá, Colombia (MPUJ); Museo de Zoología QCAZ, Pontificia Universidad Católica del Ecuador, Quito, Ecuador (PUCE).

Apart from material of the two species of the *magnus* group of *Cryptocellus* dealt with below, the following specimens were examined.

Cryptocellus becki Platnick & Shadab, 1977 (*foedus* group): BRAZIL: Amazonas, Manaus, Reserva Ducke, 06–09.viii.1992, A. D. Brescovit, 1 male (MCN-003); 14.iii.1987, A. A. Lise, 1 male (MCN-004); 18–25.ii.1992, A. D. Brescovit, 1 male (MCN-002); viii.1971, leg. Becker, 1 female (MACN).

Cryptocellus simonis Hansen & Sørensen, 1904 (*foedus* group): BRAZIL: Pará, Melgaço, Floresta Nacional de Caxiuanã, Estação Científica Ferreira Penna, triagem manual de serapilheira, 07–08.vi.2004, A. B. Bonaldo & cols., 1 male, 2 females (MCN-006). BRAZIL: Pará, Belém, Bosque Rodrigues Alves, 01º25'49.0" S 48º27'22.3" W, 25.x–01.xi.2001, J. A. P. Barreiros, 1 male, 1 female (MPEG[RIC]00037).

Cryptocellus platnicki Botero-Trujillo & Pérez, 2008 (*centralis* group): COLOMBIA: Chocó, Acandí, Capurganá, Jardín Botânico Del Darién, 90 m elev. 28.iii.2009, pitfall, P. Amaya, P. Correa, G. Sierra, 1 male (MPUJ-ENT 0014019). Chocó, Acandí, Capurganá, "camino a los ríos," 270 m elev., 07.xi.2008, A. Barrera, 1 female (MPUJ-ENT 0014020).

Cryptocellus sofiae Botero-Trujillo, 2014 (*adisi* group): COLOMBIA: Vichada, Cumaribo, El Tuparro Natural National Park, Administrative Center, 0.5º21'15.1" N 67º51'43.7" W, 80 m elev., 21.iii.2012, in litter sample from forest associated with rocky outcrop, D. A. Luna & C. Romero, 1 male (ICN-Ari-011), 1 female (ICN-Ari-012).

Cryptocellus peckorum Platnick & Shadab, 1977 (*peckorum* group): COLOMBIA: Amazonas, Leticia, Monilla Amena, Várzea, 70 m elev., 06.ix.2005, pitfall, G. Rodríguez, 1 female (MPUJ-ENT 0001752).

Cryptocellus sp. (*peckorum* group): ECUADOR: Fco. Orellana, Chiruisla, km 0.2, 00º36'50" S 75º52'34" W, primary forest, 218 m. elev., 08–13.xii.2005, Winkler trap, J. Vieira, 1 male, 1 female, 1 tritonymph (PUCE).

Pseudocellus pearsei (Chamberlin & Ivie, 1938): MEXICO: Yucatán, Grutas de Tzab Nah, Municipality Tecoh, 20º43'49" N 89º28'28" W, 23 m elev., 18.vii.2010, inside a cave, O. Francke & cols., 15 males, 20 females (CNAN-Rc00032).

Pseudocellus chankin Valdez-Mondragón & Francke, 2011: MEXICO: Chiapas, Cueva Kolem-chen "Cueva Grande", Reserva Chan-kin, Municipio Ocosingo, 16 º41'29" N 90º49'26" W, 144 m elev., inside a cave, 10.viii.2006, A. Valdez & cols., male holotype (CNAN-T0263).

Taxonomy

Family Ricinoididae Ewing, 1929

Genus *Cryptocellus* Westwood, 1874

Type species. *Cryptocellus foedus* Westwood, 1874, by monotypy.

The *magnus* species-group

Defined by Platnick & Paz (1979) for species with a straight and massive accessory piece of the male copulatory apparatus. The following species are included in this group: *Cryptocellus bordoni* (Dumitresco & Juvara-Bals, 1977) (Venezuela: Zulia); *Cryptocellus brignolii* Cokendolpher, 2000 (Suriname: Paramaribo); *Cryptocellus*

chimaera **sp. nov.** (Ecuador: Esmeraldas); *Cryptocellus magnus* Ewing, 1929 (Colombia: Magdalena); *Cryptocellus narino* Platnick & Paz, 1979 (Colombia: Antioquia, Boyacá, Tolima); *Cryptocellus pseudocellatus* Roewer, 1952 (Peru: Cajamarca).

Cryptocellus chimaera **sp. nov.**
(Figures 1–26, 47–48, 55)

Type material. *Holotype male (adult)* (MEPN 7813): ECUADOR: Esmeraldas, Reserva Ecológica Mache-Chindul, Estación Biológica Bilsa (aprox. 00º19'32'' to 00º22'48'' N; 79º45'05'' to 79º41'00'' W, 300–750 m), 'Bosque maduro', pitfall trap, 16.x.2007, R. Espinosa, coll. (80% ethanol-preserved). The specimen has the opisthosoma detached from the prosoma; left copulatory apparatus was dissected and stored in a microvial with the specimen.

Etymology. *Chimaera* is the Latin word for Χίμαιρα (ancient Greek), which refers to one of the fabulous creatures of Greek mythology whose body was a puzzle of body parts of different animals. It is used here as a noun in apposition, due the display in the new species of morphological features present in relatives of both New World genera.

Diagnosis. *Cryptocellus chimaera* **sp. nov.** is unique among species in the *magnus* group for which males are known in the very incrassate femur of leg II of male (Figs. 1, 15). The male of *C. pseudocellatus* has not yet been discovered; however, the female lacks cuticular pits on the cucullus (Platnick & Shadab 1977: 15) which are present in *C. chimaera* **sp. nov.** Large carapacial translucent areas, similar to those of *C. chimaera* **sp. nov.**, occur within the species-group at least in *C. magnus* (Figs. 35–36) and *C. bordoni* (see Salvatierra & Tourinho 2016: figs. 2a, 3a). The area occupied by these structures on the carapace is much larger in the new species (Fig. 2).

Comparisons. Based on the shape of the male copulatory apparatus, *Cryptocellus chimaera* **sp. nov.** most closely resembles *C. magnus*. Apart from the differences referred to above, *C. chimaera* **sp. nov.** can be readily recognized from *C. magnus* in several aspects, including: *i)* Tegument covered with bristle-like, translucent setae (Fig. 1); *ii)* cucullus with abundant pronounced surface tubercles on foremost two thirds (Figs. 2–3, 4); *iii)* opisthosoma ovate, with median plate of tergite XII clearly wider than long (Figs. 6, 8); *iv)* basal segment of pygidium with shallow notch on dorsal posterior border (Fig. 7); *v)* legs I and II with ventral tubercles from femur to metatarsus (Figs. 14–18); *vi)* leg IV noticeably more slender than leg III, such that the width of femur IV is approximately half that of femur III (Fig. 1); *vii)* tarsal process of the copulatory apparatus shallowly bifid (Fig. 26), with pronounced pro-ventral median ledge and array of distinct ventral longitudinal keels; L1 lobe shorter than L2 (Fig. 26); *viii)* accessory piece of the copulatory apparatus with pronounced ventral sub-basal widening (Fig. 20); L′ lobe subtly curved and thin (Figs. 23–24); apex with spiniform proventral process and without pro- or retrodorsal processes (Fig. 25); retrolateral surface with series of protruding carinae (Figs. 24–25). See the 'comparative diagnosis' section of *C. magnus* later in this paper for comparison.

Description. Male (holotype).

Coloration: Figs 1–3. Cucullus, carapace, sternal region and legs II reddish brown; pedipalps, legs I, III, IV, and dorsal surface of opisthosoma reddish; opisthosoma ventrally with a darkened rounded area, covering the central part of sternites XI, XII, and XIII anteriorly. Longitudinal carapacial translucent areas yellow, contrasting with the background color.

Setation: Figs. 1–18. Body and appendages entirely covered with fine, bristle-like, translucent setae, which are sparse in sternal region.

Carapace: Figs. 1–2, 47–48. Trapezoidal in shape, with lateral margins not parallel (narrowing anteriorly); anterior margin straight in dorsal aspect, slightly re-curved in frontal aspect; posterior margin gently re-curved; carapace longer than wide, widest at level between coxae II and III. Longitudinal translucent areas dorsally-directed in the lateral edges of carapace, without well-defined borders, covering between one third and half the length of the lateral margins, from level of coxae I to level between coxae II and III; translucent areas mostly covered with setae as rest of carapace, glabrous regions as narrow areas at the margin of carapace at level of coxae II. Carapace with symmetrical arrangement of tubercle-containing cuticular pits, as follows: about 17 pits along median longitudinal axis (posterior-most three pits larger); posterior margin with about six pits on each side of the midline (lateral two pairs wider); short oblique rows posterior to the translucent areas, each with about eight pits, the anteriormost pit which penetrates into the translucent areas; few additional isolated pits found between the

translucent areas and anterior to these. Carapace without any other pronounced depressions. Granules (apart from those of pits) only found in a row along posterior margin.

Cucullus: Fig. 4. Wider than long, noticeably widest anteriorly; with abundant strong surface tubercles on distal two thirds; with few tubercle-containing cuticular pits and devoid of furrows.

Chelicerae: Fig. 5. Movable finger twice the length of fixed finger and more robust; movable finger armed with one noticeably large sub-basal tooth and six small teeth progressively decreasing in size; fixed finger with five teeth, basal and distal ones slightly larger than three middle ones.

Sternal region: Fig. 3. Coxae I meeting tritosternum; coxae II–IV meeting entirely, progressively decreasing in length; II and III sub-rectangular, IV pear-shaped; coxae II with anterior and posterior margins parallel, each forming a straight line perpendicular to the median axis; suture lines of coxae III and IV each about half the length of that of coxae II (coxae II are larger). Cuticle with minute tubercles along coxal margins (more abundant on pedipalp coxae) and without cuticular pits.

Opisthosoma: Figs. 1, 8–10. Oblong truncate, longer than wide, widest at level of tergite XII. Median plates of tergites XI–XIII with paired antero-lateral depressions and lateral margins approximately parallel; median plate of tergites XI and XIII approximately as wide as long, that of XII clearly wider than long, that of X slit-like trapezoidal. Central region of tergite XI median plate only slightly elevated; tergite XIII median plate with rear corners pointy, protruding laterally. Dorsal and ventral surfaces with symmetrical arrangement of tubercle-containing cuticular pits, as follows: tergite XI median plate with eleven along anterior margin, five on posterior margin, four–five on lateral margins; tergite XII median plate with seven on anterior margin, five on posterior margin, four on each lateral margin; tergite XIII median plate with seven on anterior margin, three on each lateral margin. Internal margin of lateral plates of tergites X to XIII with one–two, six–seven, six–seven and five–seven pits, respectively. Lateral margins of ventral surface with a longitudinal row of pits consisting of one on each side of sternite X, six–seven on XI, seven–eight on XII, and ten on each side of XIII. Ventral pits also present on paired antero-lateral depressions of XI–XIII. Outside of the pits, minute tubercles only found on median plate of tergite X. Basal segment of pygidium with shallow notch on dorsal posterior border; ventral border without notch.

Pedipalps: Fig. 13. Without cuticular pits; with few tubercles on ventral surface of trochanters I and II. Femur dorsally convex, widened in basal half. Tibia longer than femur, with dorsal surface straight, slightly widened ventrally in basal third, and with array of shallow elongated tubercles [='elevated tubercles' of Salvatierra & Tourinho (2016)] on all surfaces in distal half. Movable claw about twice the length of fixed claw and more robust; fixed claw armed with minute teeth, movable claw toothless or feebly serrate (any teeth might have worn down).

Legs: Figs. 1, 11–12, 14–18. Without cuticular pits; leg segments with minute, inconspicuous granules in the very basal and distal boundaries facing the neighbouring segments. Leg II noticeably long and widened, especially on femur which very incrassate; other legs decrease in width in the order III, I, IV. Tibia of legs I and II with ventral notch, shallow on tibia I, more pronounced on tibia II. Legs I and II with ventral tubercles on femur, patella (on I only basally), tibia, and metatarsus, sparse and moderate in leg I, more abundant and sharp-tipped in leg II; the larger tubercles, found in femur and tibia of leg II, are mostly arranged in pro- and retroventral rows; legs III and IV devoid of tubercles. Leg I tarsus elevated, dorsally rounded, with claws sheltered in a cavity with disto-ventral opening; leg II distal tarsomere at least three times longer than the preceding tarsomeres, which are small and sub-equal in size and shape, with claws sheltered in a cavity with elongated ventral opening [like that of *Pseudocellus boneti* (Bolívar y Pieltain, 1942) see Talarico *et al.* 2006: fig. 3b]; leg III unmodified two tarsomeres sub-equal, slightly longer than the small tarsomeres of leg II; leg IV tarsomeres similar to those of leg II, except for terminal tarsomere which is at least twice longer than the preceding tarsomeres; terminal tarsomere of legs III and IV with distal dorsal and ventral V-shaped invaginations so the claws are exposed on either aspect. Leg III metatarsus not inflated, moderately excavated, with pro- and retrolateral subapical lobes; lamina cyathiformis longer than high, obtuse. Trochanter IV unmodified.

Copulatory apparatus: Figs. 11–12, 19–26. Tarsal process S-shaped on dorsal aspect, with moderate ipsilateral rotation; somewhat canoe-shaped on lateral aspect, with pronounced pro-ventral median ledge and array of distinct ventral longitudinal keels; dorsal pro- and retrolateral margins sinuous; apex shallowly bifid forming pro- (L2) and retrolateral (L1) lobes; L1 lobe rather horn-like, with irregular margins, shorter than L2. Accessory piece massive from base to apex, predominantly straight except for pronounced ventral sub-basal widening; apex with thin, dorsally-curved, retro-ventral hook-like lobe (L'), and spiniform pro-ventral process; L" lobe not differentiated; dorsal aspect of the accessory piece with longitudinal sperm transfer groove ending in distal opening, retrolateral aspect with series of longitudinal carinae, one of which is especially protruding.

FIGURES 1–3. *Cryptocellus chimaera* **sp. nov.** Male Holotype (MEPN 7813). 1, Habitus, dorsal view. 2, Carapace, dorsal view. 3, Prosoma, ventral view (sternal region).
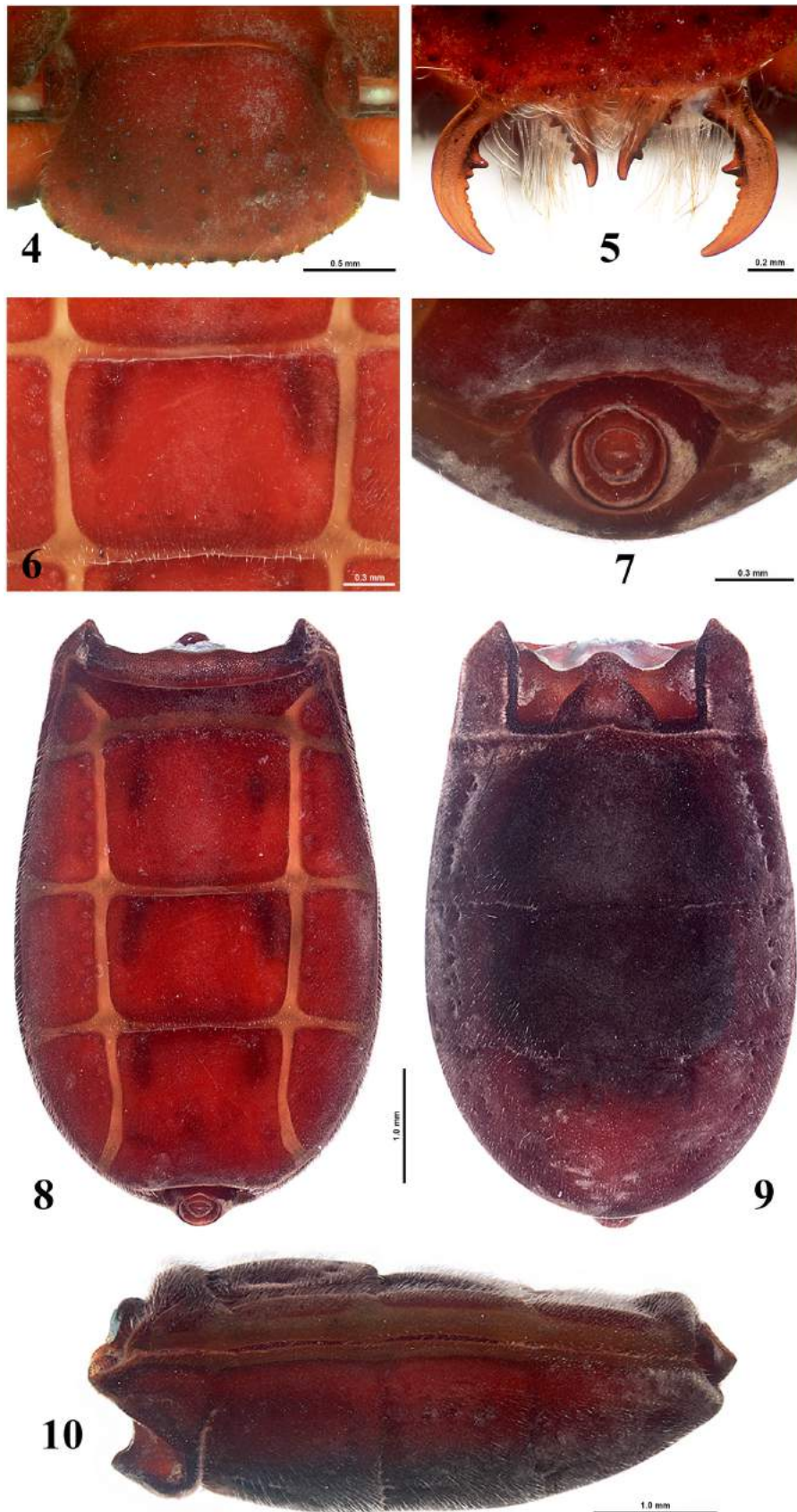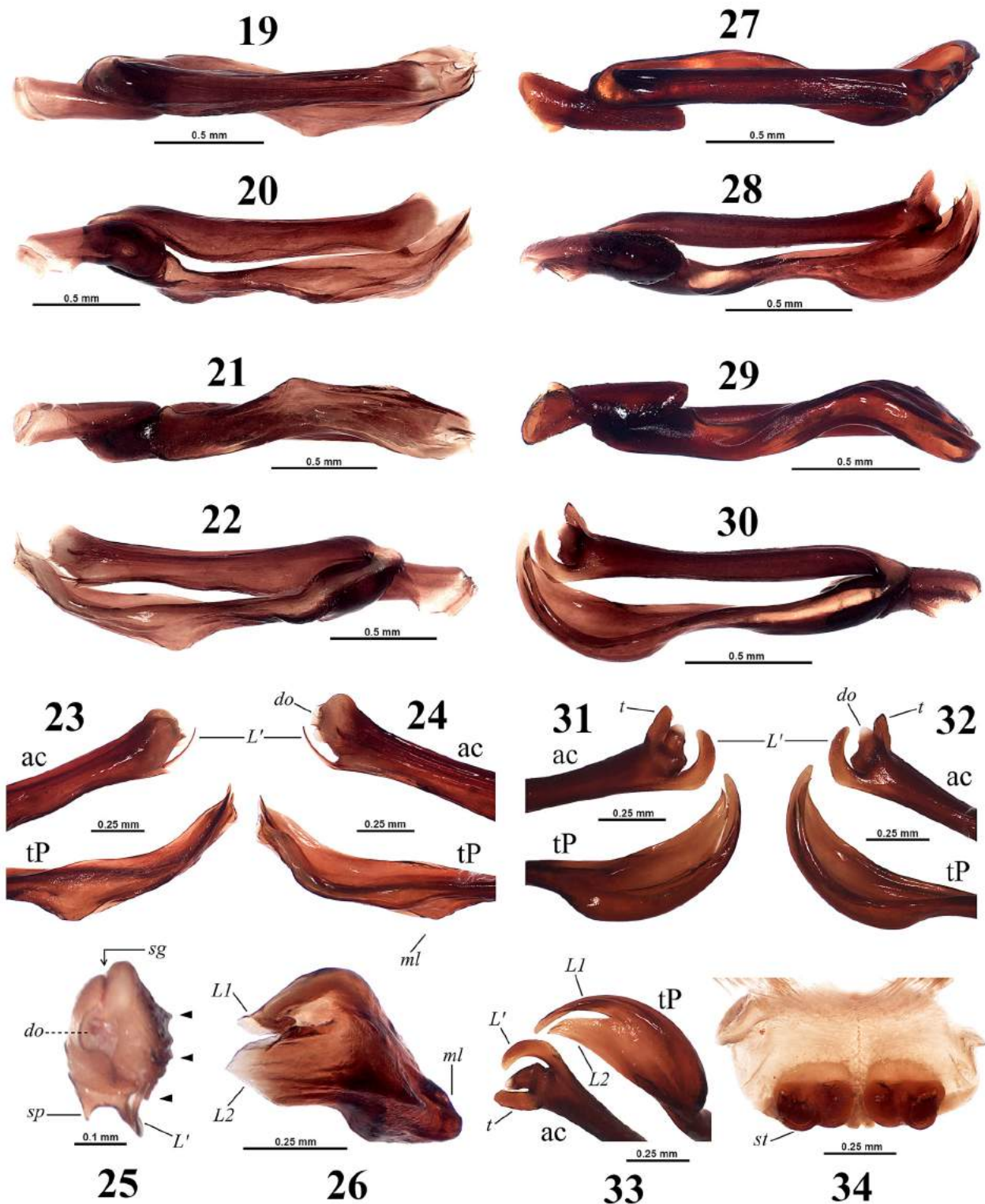
FIGURES 4–10. *Cryptocellus chimaera* **sp. nov.** Male Holotype (MEPN 7813). 4, Cucullus, frontal view. 5, Chelicerae, dorsal view. 6, Opisthosoma, median plate of tergite XII. 7, Opisthosoma, pygidium, posterior view. 8–10, Opisthosoma, dorsal, ventral and left lateral views, respectively.
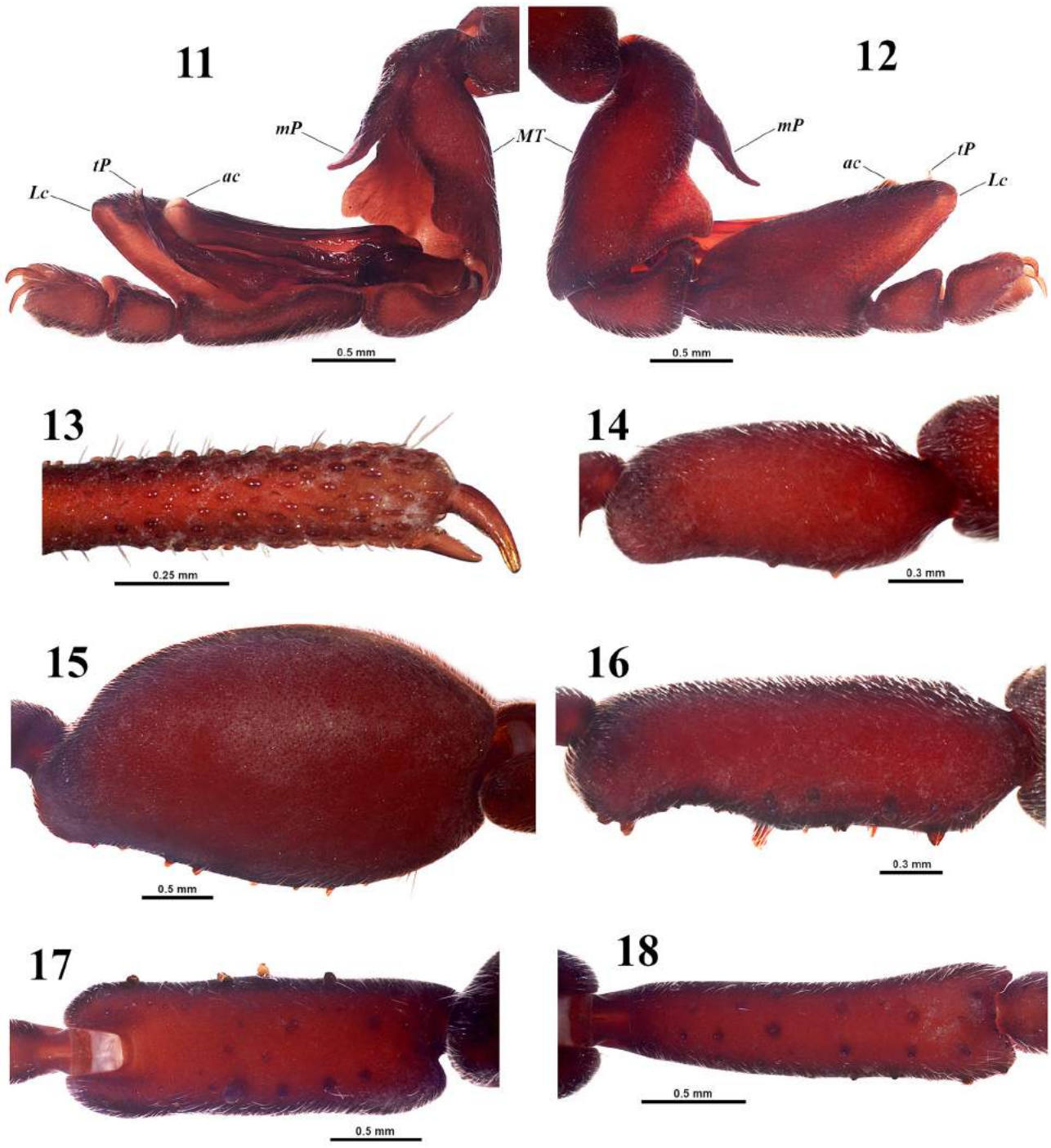
FIGURES 11–18. *Cryptocellus chimaera* **sp. nov.** Male Holotype (MEPN 7813). 11–12, Right leg III, prolateral and retrolateral views, respectively. 13, Left pedipalp tibia, movable (top) and fixed (bottom) claws. 14, Right leg I, tibia, prolateral view. 15, Right leg II, femur, prolateral view. 16–17, Right leg II, tibia, prolateral and ventral views, respectively. 18, Right leg II, metatarsus, ventral view. Abbreviations: *ac*, accessory piece; *Lc*, lamina cyathiformis; *mP*, metatarsal process; *MT*, metatarsus; *tP*, tarsal process.

Measurements of male (in mm). Body length, excluding pygidium 7.85; cucullus 1.13 long, greatest width 1.80; carapace 2.60 long, 2.33 wide at level between coxae II and III (where widest); opisthosoma 4.33 long (excluding pygidium), 3.07 wide at level of tergite XII (where widest); median plate of tergite XI 1.33 long, 1.60 wide (where widest); median plate of tergite XII 1.13 long, 1.60 wide; median plate of tergite XIII 1.33 long, 1.67 wide; suture line of coxae II 0.57 long, of coxae III 0.31 long; pedipalp femur 1.27 long, greatest depth 0.54; pedipalp tibia 1.87 long, greatest depth 0.26; femur I 1.47 long, greatest width 0.60; femur II 2.93 long, 1.47 greatest width, 1.87 greatest depth; femur III 0.80 width; femur IV 0.47 width.

FIGURES 19–34. *Cryptocellus chimaera* **sp. nov.** and *Cryptocellus magnus*, copulatory structures. 19–26, *Cryptocellus chimaera* **sp. nov.**. Male Holotype (MEPN 7813), left copulatory apparatus. 19–22, Dorsal, prolateral, ventral and retrolateral views, respectively. 23, Detail of distal half, prolateral view. 24, Idem, retrolateral view. 25, Accessory piece, apex, frontal view. 26, Tarsal process, ventro-frontal view. 27–33, *Cryptocellus magnus* Ewing, 1929. Male (AMNH), left copulatory apparatus. 27–30, Dorsal, prolateral, ventral and retrolateral views, respectively. 31–33, Detail of distal half on prolateral, retrolateral and ventro-frontal views, respectively. 34, *Cryptocellus magnus* Ewing, 1929. Female from San Pedro de La Sierra (AMNH), spermathecae. Abbreviations: *tP*, tarsal process; *ac*, accessory piece (retrolateral carinae indicated by arrowheads); *L'*, lobe of *ac*; *L1–L2*, lobes of *tP*; *sg*, sperm transfer groove; *do*, distal opening of *sg*; *sp*, spiniform process; *t*, prodorsal tubercle; *ml*, pro-ventral median ledge; *st*, spermatheca.

Female. Unknown.

Distribution. Known only from the type locality in Ecuador (Fig. 55).

Remarks. The type locality of *C. chimaera* **sp. nov.** (Bilsa Biological Station) is found in the lowlands west of the Andes, in North Western Ecuador. It is part of the Mache-Chindul Mointains, an area remarkable for its species diversity that has been proposed to be recognized as a Key Biodiversity Area (Ortega-Andrade *et al.* 2010).

Cryptocellus chimaera **sp. nov.**, which is probably endemic to a restricted area, is the second ricinuleid species described from Ecuador. The first species was *Cryptocellus leleupi* Cooreman, 1976, which Platnick & Paz (1979) regarded as a *nomen dubium* due that it had been described on the basis of a protonymph, thus lacking all the adult features used for the taxonomy of the group. The type locality of *C. leleupi* is "Oriente, Rio Negro," with approximate geographic coordinates 01°24'32" S 78°11'28" W in the eastern slopes of the Ecuadorian Andes, Tungurahua province. This is, some 200 km SE of the collection locality of *C. chimaera* **sp. nov.** and separated by the Andes (Fig. 55). Adult ricinuleids from this area have not been reported; therefore, *C. leleupi* is better retained as *nomen dubium* until such material becomes available and allows the recognition of the species. Different locality records of ricinuleids usually yield different species, and the likelihood that the holotypes of *C. leleupi* and *C. chimaera* **sp. nov.**, on different sides of the Andes, could be conspecific is negligible.

Cryptocellus magnus Ewing, 1929
(Figures 27–46, 55)

Cryptocellus magnus Ewing, 1929: 589–590, fig. 1.
Cryptocellus manni Ewing, 1929: 591–592, figs 2, 5, 8 (synonymised by Platnick and Shadab, 1976: 5).

Type material. Female holotype from COLOMBIA, Magdalena, Cincinati; in National Museum of Natural History (not examined).

Material examined. COLOMBIA: Magdalena, Villa Leonor, 1311 m elev., 12.iv.1975, J. A. Kochalka, 1 male, 1 female (AMNH). Magdalena, San Pedro de La Sierra, 960 m elev., 19.v.1975, J. A. Kochalka, 1 larva, 1 protonymph, 1 deutonymph, 2 tritonymphs, 1 female (AMNH).

Comparative diagnosis. *Cryptocellus magnus* can be readily recognized from *C. chimaera* **sp. nov.** in several aspects of the male morphology. *i)* Tegument covered with lanceolate, iridescent setae (Figs. 35, 39); *ii)* cucullus devoid of surface tubercles, surface granules restricted to anterior border (Fig. 38); *iii)* opisthosoma oblong elongate, with median plate of tergite XII approximately as long as wide (Fig. 39); *iv)* basal segment of pygidium without notch on either dorsal or ventral posterior borders; *v)* legs I and II without ventral tubercles; *vi)* femur of legs III and IV similar in width; *vii)* tarsal process of the copulatory apparatus deeply bifid, spoon-like without median ledge, with no distinct ventral keels; L1 lobe longer than L2 (Fig. 33); *viii)* accessory piece of the copulatory apparatus entirely straight, without sub-basal widening (Fig. 28); L' lobe strongly curved and markedly robust (Figs. 31–32); apex with spiniform retrodorsal process and pronounced prodorsal tubercle, without spiniform proventral process; retrolateral surface without conspicuous carinae (Figs. 31–33).

Distribution. Known only from Magdalena department, Colombia.

Measurements of male (in mm). Body length, excluding pygidium 8.38; cucullus 1.33 long, greatest width 2.07; carapace 2.73 long, 2.60 wide at level of leg III (where widest); opisthosoma 5.00 long (excluding pygidium), 3.07 wide at level of tergite XII (where widest); median plate of tergite XI 1.60 long, 1.73 wide (where widest); median plate of tergite XII 1.40 long, 1.47 wide; median plate of tergite XIII 1.73 long, 1.73 wide; suture line of coxae II 0.56 long, of coxae III 0.38 long; pedipalp femur 1.33 long, greatest depth 0.57; pedipalp tibia 1.93 long, greatest depth 0.26; femur I 1.53 long, greatest width 0.67; femur II 2.73 long, 0.80 greatest width, 1.00 greatest depth; femur III 0.87 width; femur IV 0.66 width.

Notes. *Cryptocellus magnus* was studied and described in detail by Platnick & Shadab (1976).

FIGURES 35–40. *Cryptocellus magnus* Ewing, 1929. Male and female from Villa Leonor (AMNH). 35, Male, carapace, dorsal view. 36, Female, carapace, dorsal view. 37, Male, prosoma, ventral view (sternal region). 38, Male, cucullus, frontal view. 39, Male, opisthosoma, dorsal view. 40, Female opisthosoma, dorsal view.

FIGURES 41–46. *Cryptocellus magnus* Ewing, 1929. Male (AMNH). 41–42, Right leg III, prolateral and retrolateral views, respectively. 43, Left pedipalp tibia, movable (top) and fixed (bottom) claws. 44, Right leg I, tibia, prolateral view. 45, Left leg II, femur, prolateral view. 46, Right leg II, tibia, prolateral view. Abbreviations: *ac*, accessory piece; *Lc*, lamina cyathiformis; *mP*, metatarsal process; *MT*, metatarsus; *tP*, tarsal process.

Discussion

Observations on the carapacial translucent areas of *Cryptocellus* and the relationships of *Cryptocellus chimaera* and *C. magnus.*

Cryptocellus is traditionally defined by the absence of an accessory tooth on the base of the cheliceral fixed finger (present only in *Ricinoides*), the median plate of tergite XII wider than long (as opposed to *Pseudocellus* where longer than wide), the dark color of adults (shared with *Ricinoides*; with some exceptions, e.g., *Cryptocellus sofiae*), and the dorsally invaginated distal margin of the terminal tarsomeres of legs III and IV (shared with *Pseudocellus*) (Platnick 1980, 2002). *Cryptocellus* has also been defined by the presence of small and laterally-directed translucent areas on carapace near the second legs; according to Platnick (1980: 351), these are also present in *Ricinoides* despite being overlooked in the literature. Although this definition provides *Cryptocellus* with a unique combination of features, none is unique to this genus but each is shared with either of the other extant genera. Therefore, without sufficient evidence to support the monophyly of *Cryptocellus* (referred to later in this paper), it seems premature to declare any of these as synapomorphic for the genus.

The carapacial translucent areas of *C. chimaera* **sp. nov.** are large, without well-defined borders, partially covered with setae, placed at level of coxae II, and perfectly visible on dorsal aspect (Figs. 47–48). According to our observations, those of *C. magnus* are similar in these respects although smaller (Figs. 35–36), and the same is true for *C. bordoni* (see Salvatierra & Tourinho (2016: figs. 2a, 3a). The translucent areas of these three species do not match those defined for the genus. Instead, they are similar to those of two *Pseudocellus* species which we examined, i.e., *Pseudocellus pearsei* and *P. chankin* (Figs. 51–54).
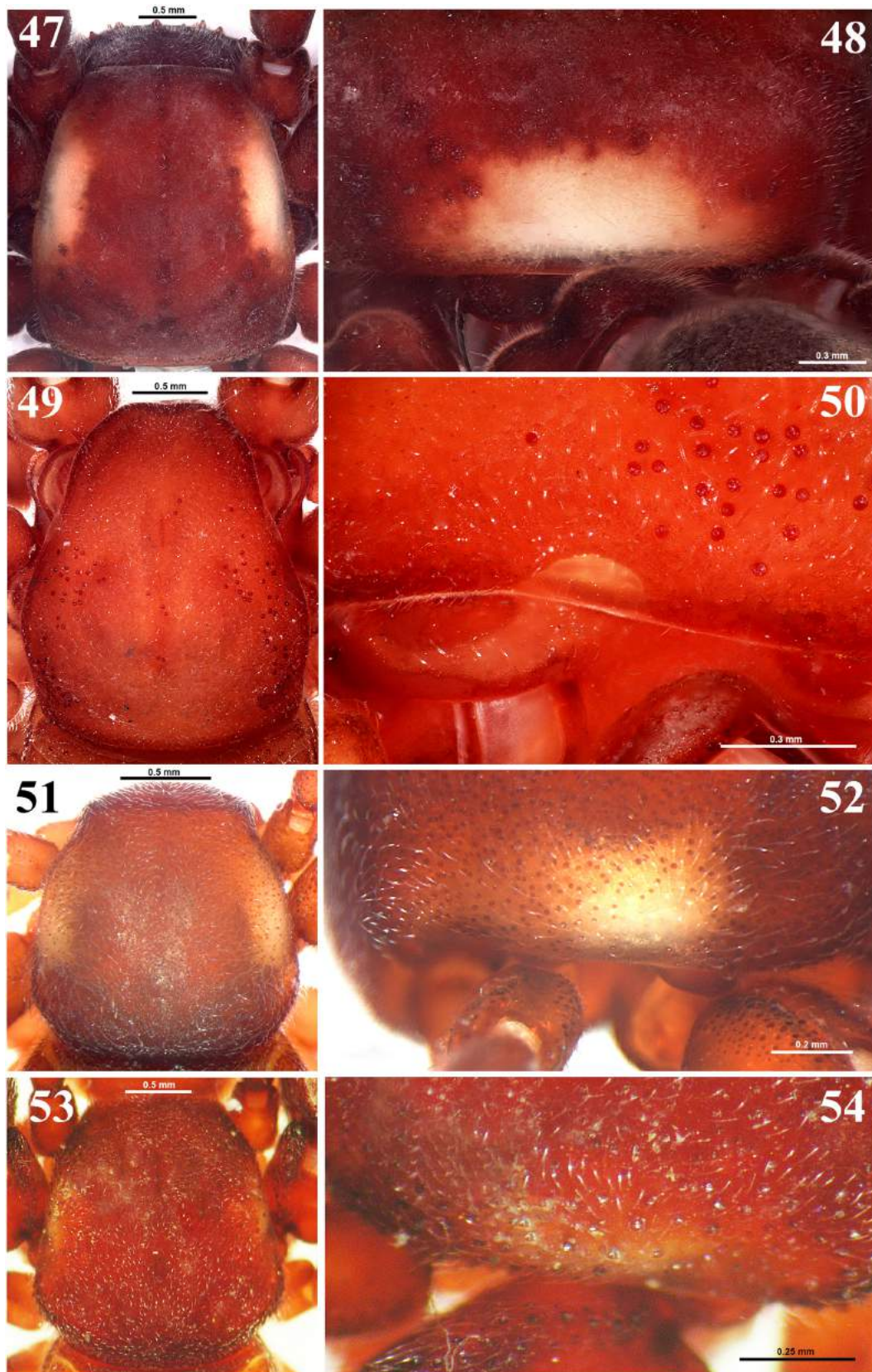
FIGURES 47–54. Translucent areas on carapace of males of the two American ricinuleid genera: carapace on dorsal view (left) and detail of area (right). 47–48, *Cryptocellus chimaera* **sp. nov.** Holotype (MEPN 7813). 49–50 *Cryptocellus becki* Platnick & Shadab, 1977. (MCN-002). 51–52, *Pseudocellus pearsei* (Chamberlin & Ivie, 1938). (CNAN-Rc00032). 53–54 *Pseudocellus chankin* Valdez-Mondragón and Francke, 2011. Holotype (CNAN-T0263).
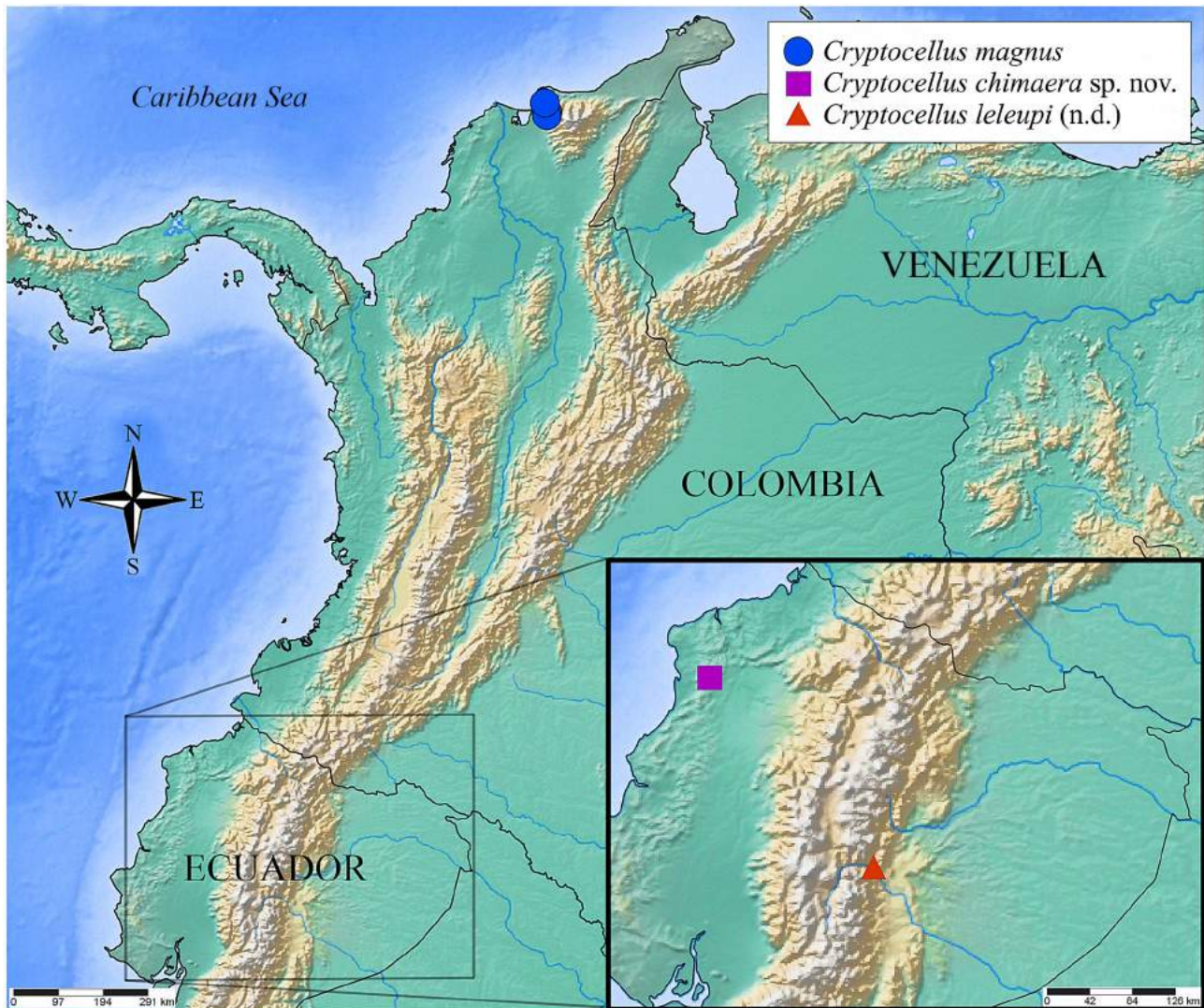
FIGURE 55. Map of Northwestern South America, plotting known locality records of *Cryptocellus chimaera* **sp. nov.**, *Cryptocellus magnus* Ewing, 1929 and *Cryptocellus leleupi* Cooreman, 1976 (*nomen dubium*).

The study of the carapacial translucent areas in species belonging to the other species-groups of *Cryptocellus* revealed additional morphological differences within the genus. In *C. becki* and *C. simonis* (*foedus* group), the areas are small, with well-defined borders, placed at level of posterior end of coxae I, shallow, and mainly visible on lateral aspect (Figs. 49–50). Though similar, those of *C. platnicki* (*centralis* group), *C. peckorum* and *Cryptocellus* sp. (*peckorum* group) are larger and elevated, clearly visible on either lateral or dorsal aspects, and placed approximately at the level between coxae I and II. In *C. sofiae* (*adisi* group), the corresponding areas are covered by polygonal setae, barely recognizable by an elevation of the cuticle at the level between coxae I and II, but otherwise undifferentiated.

This variation indicates that the concept of 'small and laterally-directed translucent areas' of *Cryptocellus* is not discrete enough as to properly define the genus, considering its current species composition. In place of that, such differences might be useful to further define the species-groups or clarify their relationships.

The large and diffuse translucent areas of *Pseudocellus* have been hypothesized to represent a stage in ocellar reduction and a synapomorphy for the genus (Platnick 1980). Based on this, and in the absence of a putative synapomorphy for *Cryptocellus* in *sensu lato* (the five species groups), it is possible that *C. chimaera* **sp. nov.** and *C. magnus* are closer to *Pseudocellus*. This hypothesis is not new at all. Platnick & Paz (1979: 3) noted that "*It is not yet possible to identify the sister taxon of the* magnus *group, or even to determine whether the* magnus *group is more closely related to the other South American or to Central America species.*"

Salvatierra & Tourinho (2016) revisited the morphology of *C. bordoni*, species for which Dumitresco &

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Juvara-Bals (1977) originally erected the genus *Heteroricinoides* that was synonymyzed with *Cryptocellus* only shortly afterwards (Platnick & Shadab 1977). Salvatierra & Tourinho (2016: 18) found understandable that *C. bordoni* was originally described as a new genus, and noted that the generic placement of *C. bordoni* remains unresolved. In light of the recent interest on the classification of ricinuleids and the additional knowledge that has been gathered for species in the *magnus* group since Platnick & Shadab (1977), it would be worthwhile to evaluate whether or not *Heteroricinoides* should be revalidated.

Until further research is done, *C. chimaera* **sp. nov.** is described in the same genus and allocated to the *magnus* species-group together with *C. magnus* and *C. bordoni*.

Final considerations.

Murienne *et al.* (2013) published the first molecular phylogeny of the extant ricinuleids using four nuclear and mitochondrial DNA markers. There, the monophyly of each of the genera was recovered and their relationships inferred as (*Cryptocellus* (*Pseudocellus* + *Ricinoides*)). Afterwards, Fernández & Giribet (2015) presented a phylogenomic study of ricinuleids whose resulting hypothesis strongly supported the inter-generic relationships first proposed by Selden (1992), i.e., (*Ricinoides* (*Pseudocellus* + *Cryptocellus*)). Both studies were novel in introducing molecular data to the phylogenetic reconstruction of ricinuleids, and because of using species as terminals in phylogenies of the group. Due to the broad taxonomic scope of these two studies, however, the taxon sampling was not sufficient for thoroughly addressing other questions such as the monophyly of each American genus or the relationships of the species-groups of *Cryptocellus*. These topics await a more thorough taxon sampling and would benefit from the inclusion of morphological characters.

Ricinuleids are, in general, difficult animals to collect. Thus, gathering diversity of species appropriately preserved for molecular studies, for which the specific identity (or species-group) is known, can be a difficult task. Meanwhile, it is possible that the morphology of *Cryptocellus* species has not been sufficiently investigated and that additional components of their morphology await discovery and/or in-depth exploration. For instance, setae, pits, pores and tubercles in the cuticle of ricinuleids are now prone to inclusion in phylogenetic analyses, thanks to a series of recent studies which have paid special attention to the integumentary structures (e.g., Talarico *et al.* 2006, 2008b; Salvatierra *et al.* 2013; Tourinho *et al.* 2014; Salvatierra & Tourinho 2016). We encourage continuing the character survey with the existing museum samples. This would facilitate the development of a morphology-based phylogeny wherein all the species-groups of *Cryptocellus*, along with several species of the other genera, can be represented.

The current species-group structure within *Cryptocellus* is primarily based on male features, restricting the usefulness of female specimens when the conspecific male is unknown. It is therefore important to look for morphological features that might allow recognizing female specimens of *Cryptocellus* as members of a given species-group. Apart from the value that this would bring for traditional taxonomists, this would shed light on whether or not the species-groups of *Cryptocellus* represent natural lineages, and facilitate the selection of taxa for further studies on phylogenetics or other subjects.

Acknowledgments

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