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The genus *Ctenorillo* Verhoeff, 1942 (Oniscidea, Armadillidae) from Colombia: new records, new species, and conservation comments

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Abstract: The Armadillidae are the most diverse family within the Oniscidea, widely distributed around the world. To date, only seven species of the family are known from Colombia. After the examination of a collection from the Colombian departments of Atlántico, Bolívar, Cesar, Magdalena, Risaralda, Santander, and Sucre, eight species were recognized as belonging to the genus *Ctenorillo*, of which six are considered to be new to Science: *C. binomio* n. sp., *C. humboldti* n. sp., *C. mincaensis* n. sp., *C. orientalis* n. sp., *C. papagayoensis* n. sp., and *C. tayrona* n. sp. Moreover, the distribution knowledge of *C. dazai* and *C. tuberosus* has expanded. *Ctenorillo* species in Colombia are predominantly distributed in Tropical Dry Forest areas, which is one of the most endangered ecosystems in the world. Considering the new taxa presented here, allied with other Oniscidea groups, there is an urgent need to raise the awareness level regarding the conservation status of this ecosystem in the country.

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Key words: neotropical; terrestrial isopods; new species; Tropical Dry Forest.

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Introduction

Terrestrial isopods (Oniscidea) are the unique crustacean lineage completely adapted to terrestrial habitats (Schmalfuss 2003; Hornung 2011; Richardson and Araujo 2015; Taiti 2018a). To date, the group comprises more than 4,000 species in more than 500 genera in 38 or 39 families distributed in almost all types of habitats (Sfenthourakis and Taiti 2015; Lins et al. 2017; Dimitriou et al. 2019; Campos-Filho and Taiti 2021).

The family Armadillidae holds the highest diversity, including ca. 650 species in 80 genera widely distributed in Neotropical, Afrotropical, Oriental, and Australian regions (Taiti et al. 1998; Schmalfuss 2003; Sfenthourakis and Taiti 2015; López-Orozco et al. 2022; Boyko et al. 2023a). The family has a great morphological diversity (Schmalfuss & Ferrara 1983; Schmalfuss 1985, 1996; Taiti et al. 1998; Taiti 2014), and most of its representatives have the ability to roll up into a ball (Schmalfuss 1984).

To date, in the Neotropics, only eight genera have been recorded so far, *Acanthoniscus* Gosse, 1851, *Ctenorillo* Verhoeff, 1942, *Cubaris* Brandt, 1833, *Diploexochus* Brandt, 1833, *Gabunillo* Schmalfuss & Ferrara, 1983, *Pseudodiploexochus* Lewis, 1998, *Synarmadillo* Dollfus, 1891, and *Venezillo* Verhoeff, 1928 (Pearse 1915; Schmidt 2001; Campos-Filho et al. 2014, 2017, 2018; Carpio-Díaz et al. 2018; Rodríguez-Cabrera and Armas 2023).

In Colombia, only seven species of Armadillidae are known, i. e., *Ctenorillo dazai* Carpio-Díaz, López-Orozco & Campos-Filho, 2018, *C. tuberosus* (Budde-Lund, 1904), *Synarmadillo ruthveni* (Pearse, 1915), *Venezillo brevispinis* (Pearse, 1915), *V. gigas* (Miers, 1877), *V. grenadensis* (Budde-Lund, 1893), and *V. vincentis* (Budde-Lund, 1904) (Richardson 1912; Pearse 1915; Carpio-Díaz et al. 2018; Campos-Filho et al. 2017; López-Orozco et al. 2022). It is worth mentioning that Van Name (1936) and Vandel (1972) recorded the pantropical species *Cubaris murina* Brandt, 1833 from the country, but both authors did not provide the localities where the specimens were collected, and therefore, these records are considered doubtful.

In the present work six new species of the genus *Ctenorillo* are described, i.e., *Ctenorillo binomio* n. sp. from the department of Bolívar, *Ctenorillo humboldti* n. sp. from the department of Risaralda, *Ctenorillo mincaensis* n. sp. and *Ctenorillo tayrona* n. sp. from the department of Magdalena, *Ctenorillo orientalis* n. sp. from the department of Cesar, and *Ctenorillo papagayoensis* n. sp. from the department of Santander. In addition, *C. dazai* and *C. tuberosus* have the knowledge on their distribution expanded.

Material and Methods

Specimens were preserved in ethanol 75%. The identifications are based on morphological characters with the use of micropreparations in Hoyer's medium (Anderson 1954). The illustrations were made with the aid of a camera lucida mounted on Wild M3 and M20 microscopes. The final illustrations were prepared using the software GIMP (v. 2.8) with the method proposed by Montesanto (2015, 2016). The respiratory structures were classified as in Paoli et al. (2002). The maps were constructed with the ArcMap (v. 10) software with the layers as in Morrone et al. (2022).

The material examined is deposited in the Collection of the Universidad de Cartagena, Cartagena (CBUDC-CRU), Collection of Terrestrial Invertebrates of the Instituto Alexander von Humboldt, Villa de Leyva (IAvH-I), and Collection of the Instituto de Ciencias Naturales, Nacional University of Colombia, Bogotá, Colombia (ICN-CR-is).

Systematic account

Family Armadillidae Brandt, 1831
Genus *Ctenorillo* Verhoeff, 1942

Type species: *Ctenorillo buddelundi* Verhoeff, 1942 [= *Ctenorillo regulus* (Van Name, 1920)], by monotypy (see Schmidt and Leistikow 2004).

Remarks

To date, the genus *Ctenorillo* Verhoeff, 1942 comprises 15 species: *C. ausseli* Dollfus, 1893 from the Canary Islands; *C. bananae* (Van Name, 1920) from Angola, Cameroon and Congo; *C. dazai* from Colombia; *C. fagei* (Paulian de Félice, 1941) from Ivory Coast; *C. ferrarai* Campos-Filho, Araujo & Taiti, 2014 from Brazil; *C. gabunensis* (Schmalfuss & Ferrara, 1983) from Gabon; *C. guinensis* (Schmalfuss & Ferrara, 1983) from Guinea; *C. kenyensis* Schmölzer, 1974 from Tanzania and Uganda; *C. legai* (Arcangeli, 1941) from Ethiopia; *C. meyeri* Taiti, 2018 from South Africa; *C. mineri* (Van Name, 1936) from Guyana and Venezuela; *C. parituberculatus* (Taiti & Ferrara, 1987) from Malawi; *C. regulus* (Van Name, 1920) from Kenya, Somalia, Uganda and Zaire; *C. strinatii* (Schmalfuss & Ferrara, 1983) from Congo; and *C. tuberosus* (Budde-Lund, 1904) from Brazil and Haiti (Boyko et al. 2023b).

The genus was recently redefined by Carpio-Díaz et al. (2018). As mentioned by Campos-Filho et al. (2014) and Taiti (2018b), the best taxonomic characteristics to distinguish the species of the genus are the number and arrangement of the dorsal tubercles and bosses of the cephalon, pereon, and pleon.

Ctenorillo dazai Carpio-Díaz, López-Orozco & Campos-Filho, 2018

Figure 1

Ctenorillo dazai Carpio-Díaz et al. 2018: 311, figs 5, 51-74.

Material examined

Colombia: **Atlántico**, 2 ♂♂, 1 ♀ (CUDC-CRU 410), Luruaco, Arroyo de Piedra, around La Mojana cave (outside), 10°37’38.15”N 75°6’35.89”W, 25 March 2017, leg. C.M. López-Orozco and R. Borja-Arrieta; **Bolívar**, 9 ♂♂, 9 ♀♀ (CBUDC-CRU 334), Cartagena de Indias, Barú, Calablanca, 10°9’20.62”N 75°40′44.39″W, 5 October 2017, leg. L.D. Luna; 1 ♂, 2 ♀♀ (CBUDC-CRU 335), San Jacinto, Brasilar, 9°54’33”N 75°11’6”W, 20 October 2018, leg. W. Zapata and M. Carrillo; 2 ♂♂, 2 ♀♀ (CBUDC-CRU 336), Turbaco, Cañaveral, 10°22’7.1”N 75°21’30.5”W, 15 October 2018, leg. W. Zapata and M. Carrillo; **Sucre**, 1 ♀ (CBUDC-CRU 409), Chalán, Reserva Natural Altamira, 9°35’22.46”N 75°20’41.76”W, 16 July 2018, leg. C.M. López-Orozco and R. Borja-Arrieta; 2 ♀♀ (CBUDC-CRU 377), Tolúviejo, La Piche, Campo Aventura Roca Madre, 9°30’51.5”N 75°23’37.3”W, 13 July 2018, leg. C.M. López-Orozco and R. Borja-Arrieta; 1 ♀ (CBUDC-CRU 378), 1 ♀ (CBUDC-CRU 379), same locality and collectors as previous, 14 July 2018.

Distribution

This species was previously recorded from the Botanical Garden Guillermo Piñeres (Tropical Dry Forest area - TDF), Turbaco, North of Bolívar, Colombian Caribbean (Carpio-Díaz et al. 2018). The present records extend the knowledge of its distribution to the departments of Atlántico and Sucre (Montes de María). The localities where the specimens were collected are placed in TDF areas (see Figure 1).

Ctenorillo tuberosus (Budde-Lund, 1904)

Figure 1

Armadillo tuberosus Budde-Lund, 1904: 109, pl. X figs 1-4.
Ctenorillo tuberosus; López-Orozco et al. 2022: 38, fig. 2L.

Material examined

Colombia: **Bolívar**, 3 ♀♀ (CUDC-CRU 56), Cartagena de Indias, Cerro de la Popa, Salto del Cabrón, 10°25'9.03"N 75°31'33.37"W, 13 July 2017, leg. C.M. López-Orozco.

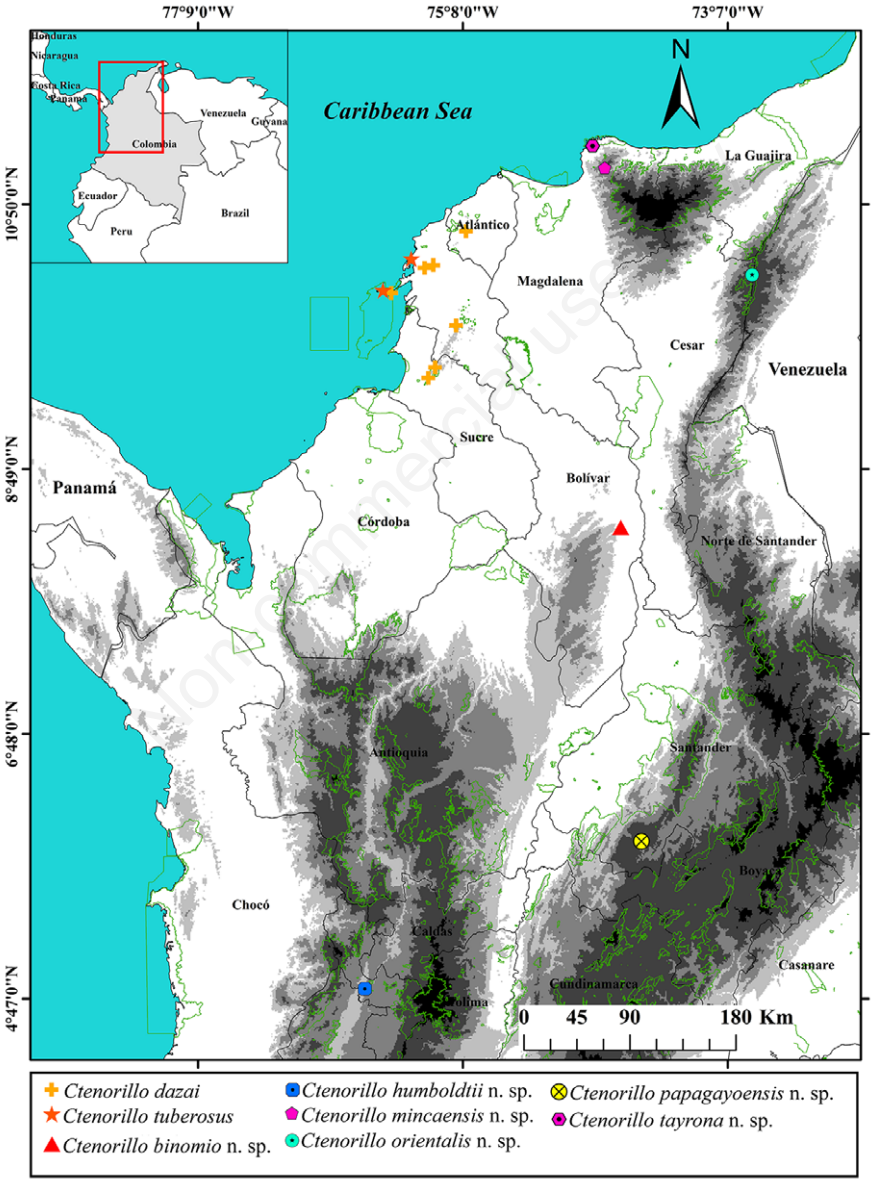

Figure 1. Map of *Ctenorillo* species from Colombia. Light to dark gray areas= Andean Cordillera; Light green areas= Tropical Dry Forest; Dark green lines= Colombian conservation units.

Distribution

Brazil, Colombia, and Haiti (Schmalfuss 2003; Campos-Filho et al. 2017; López-Orozco et al. 2022). This species has been recorded in the Colombian Caribbean from Isla Grande, department of Bolívar (López-Orozco et al. 2022). The present work extends the knowledge of its distribution to the continental part of the Colombian Caribbean (see Figure 1).

Ctenorillo binomio **Carpio-Díaz, Bichuette & Campos-Filho n. sp.**

Figures 1-4

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Material examined

Colombia: Holotype ♂ (parts in micropreparations) (CBUDC-CRU 412), **Bolívar**, Morales, Arcadia, San Miguel cave, 8°22'21.22"N 73°55'54.17"W, 20 April 2018, leg. C.M. López-Orozco and R. Borja-Arrieta. Paratype*:* 1 ♀ (parts in micropreparations) (CBUDC-CRU 337), same data as holotype.

Description

Maximum length: male and female 5 mm. Color dark gray. Dorsum covered with small triangular tubercles, arranged as follows (Figure 2A,B): cephalon with 10 tubercles in three rows, anterior and middle rows with two tubercles each, posterior row with six tubercles; pereonite 1 with four tubercles on anterior row, 12 tubercles on middle arranged in two rows of six tubercles each, and five tubercles on posterior row; pereonites 2-6 with eight tubercles on anterior row, and nine tubercles on posterior row; pereonite 7 with six tubercles on anterior row, and nine tubercles on posterior row; pleonites 3 and 4 with four tubercles, pleonite 5 and telson with two tubercles each. Dorsal surface with short triangular scale-setae (Figure 2C). Pereonites 1-7 with one line of noduli laterales per side inserted on postero-lateral surface of second outer tubercle. Cephalon (Figure 2D-F) with frontal shield rectangular, slightly protruding above vertex, and slightly bent over vertex; eyes of 12 ommatidia. Pereonite 1 epimera slightly grooved on lateral margin for about half length, inner lobe of schisma rounded, not extending beyond posterior margins of outer lobe; pereonites 2-4 epimera rectangular, pereonite 2 with ventral lobe subtriangular, distal margin rounded, not extending beyond posterior margin of epimera (Figure 2A,F,G). Pleonites 3-5 epimera rectangular (Figure 2H,I). Telson (Figure 2H) hourglass-shaped, proximal part broader than distal part, slightly convex distal margins. Antennula (Figure 2J) of three articles, proximal and distal articles subequal in length, distal article bearing seven apical aesthetascs. Antenna (Figure 2K) short and stout, not surpassing posterior margin of cephalon when extended backwards; flagellum of two articles, distal article about three times as long as proximal article, bearing two lateral aesthetascs; apical organ short. Mandibles with molar penicil semi-dichotomized bearing several plumose branches, left mandible (Figure 3A) with 2+1 penicils, right mandible (Figure 3B) with 1+1 penicils. Maxillula (Figure 3C) inner branch distal margin rounded bearing two long penicils; outer branch composed of 4+5 simple teeth. Maxilla (Figure 3D) bilobate, inner lobe covered with thick setae; outer lobe about three times as wide as inner lobe covered with thin setae. Maxilliped (Figure 3E) basis rectangular bearing sparse setae; palp proximal article with two distinct setae; endite subrectagular, medial seta strong, distal margin with two hook-like setae. Pereopod 1 carpus with antennal grooming brush transverse, and distal setae apically cleft; dactylus with ungual and dactylar seta simple. Uropod (Figure 3F) protopod trapezoidal, flattened,

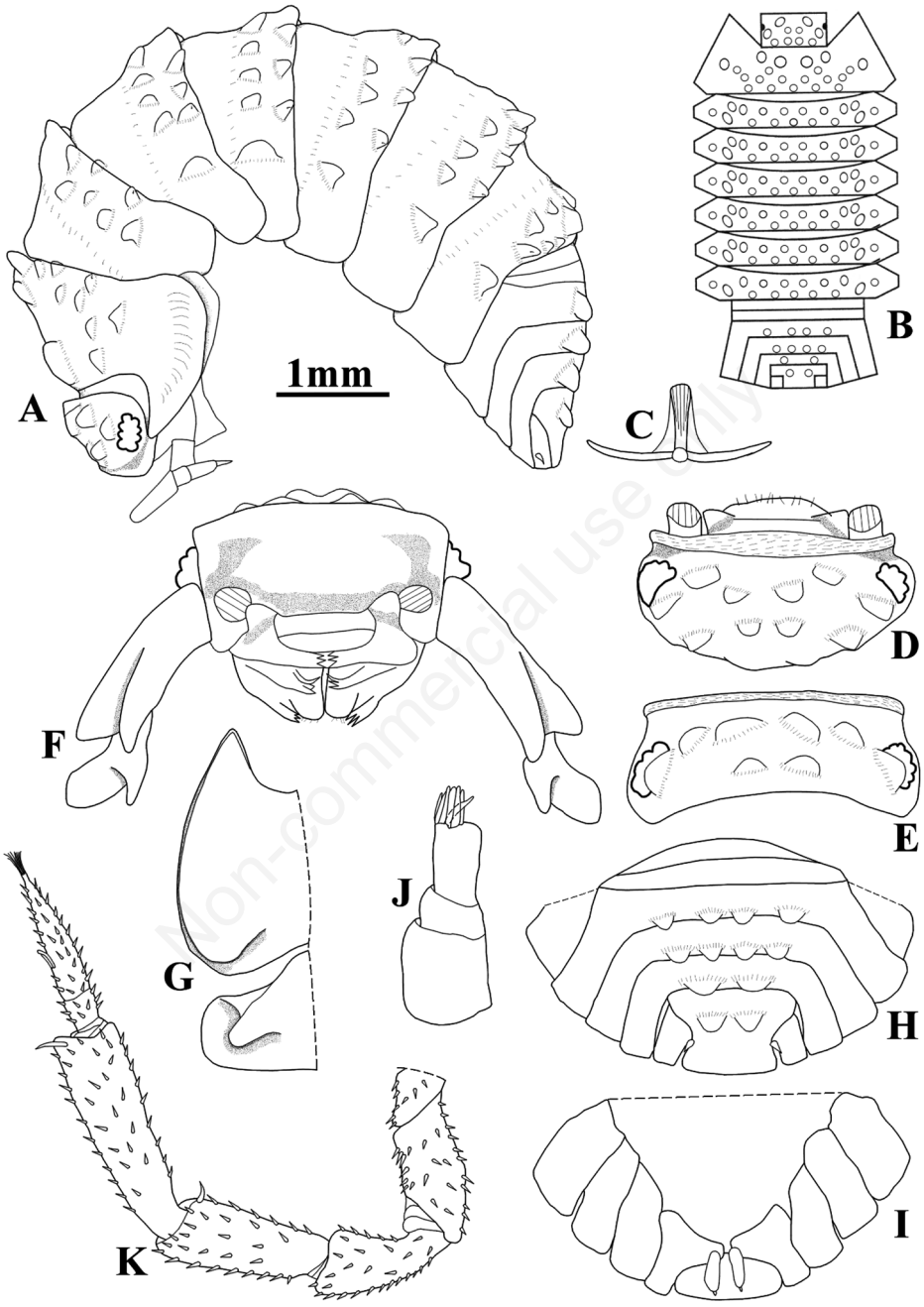

Figure 2. *Ctenorillo binomio* Carpio-Díaz, Bichuette & Campos-Filho n. sp., ♀: A, habitus, lateral view; B, dorsal tubercles scheme; C, dorsal scale-seta; D, cephalon, dorsal view; E, cephalon, posterior view; F, cephalon and pereonites 1 and 2, frontal view; G, pereonites 1 and 2 epimera, ventral view; H, pleon, telson, and uropods, dorsal view; I, pleonites 3-5, telson, and uropods, ventral view; J, antennula; K, antenna.

basal part enlarged, medial margin slightly concave; exopod short, inserted dorsally on distinct lobe near medial margin; endopod inner margin bearing fringe of setae. Pleopods 1-5 exopods with monospiracular lungs.

Male: Pereopod 1 and 7 (Figure 4A,B) with no particular modifications. Genital papilla as in Figure 4C. Pleopod 1 (Figure 4C) exopod subtriangular, slightly wider than long, outer margin slightly crenulate bearing five short setae; endopod three times as long as exopod, distal part tapering, and slightly bent outwards. Pleopod 2 (Figure 4D) exopod triangular, outer margin concave bearing eight short setae; endopod flagelliform longer than exopod. Pleopod 3 and 4 exopods as in Figure 4E and F, respectively. Pleopod 5 exopod (Figure 4G) rhomboid, outer margin slightly concave bearing many setae.

Etymology

The new species is named after the Vallenata music group "Binomio de Oro", dedicated to its singer and founder Rafael Orozco.

Remarks

In the arrangement of the dorsal tubercles of the pleon, *Ctenorillo binomio* n. sp. is similar to *C. gabunensis* and *C. tuberosus*; however, it can be distinguished in the shape, number and arrangement of the dorsal tubercles of the cephalon and pereon (see Schmalfuss

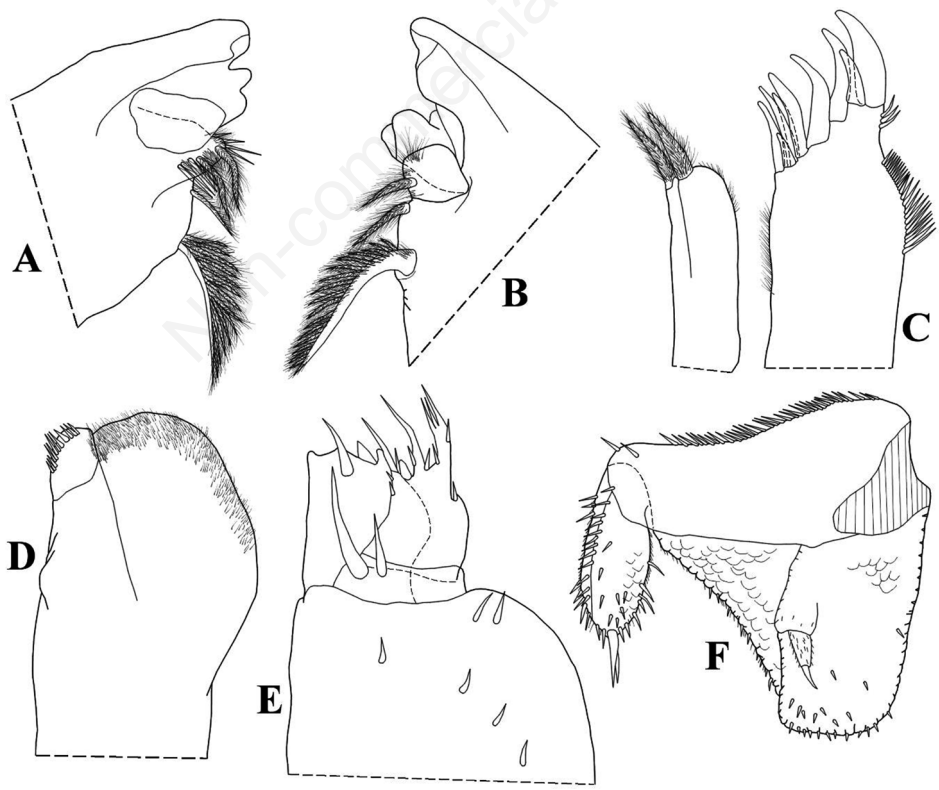

Figure 3. *Ctenorillo binomio* Carpio-Díaz, Bichuette & Campos-Filho n. sp., ♀: A, left mandible; B, right mandible; C, maxillula; D, maxilla; E, maxilliped; F, uropod.

and Ferrara 1983; Campos-Filho et al. 2017). Moreover, in comparison with the other Neotropical species, it differs in having the cephalon with 10 tubercles (vs. 12 in *C. dazai* and *C. mineri*; 14 in *C. ferrarai*), pereonite 1 with 21 tubercles (vs. 23 in *C. dazai*; 22 in

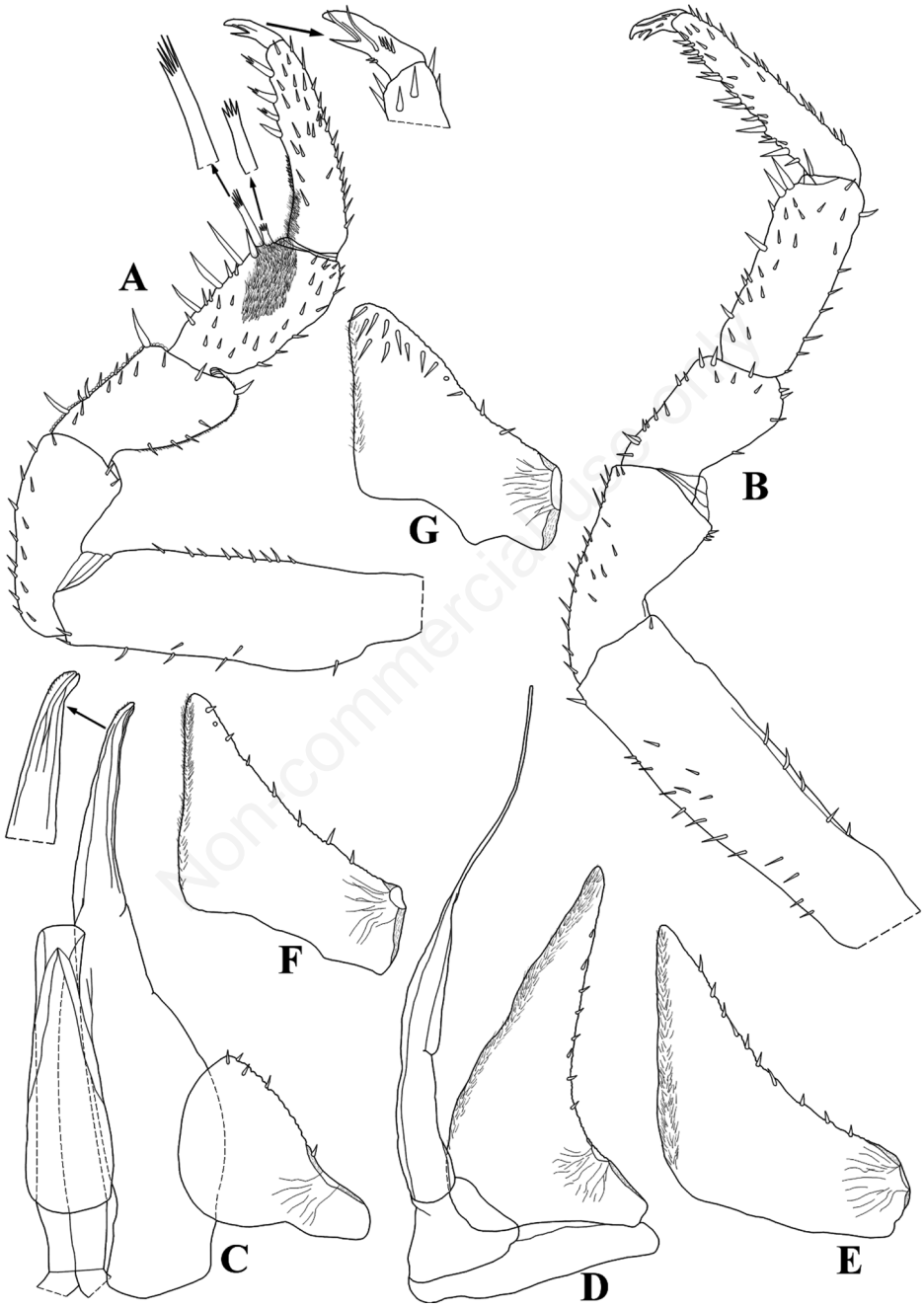

Figure 4. *Ctenorillo binomio* Carpio-Díaz, Bichuette & Campos-Filho n. sp., ♂: A, pereopod 1; B, pereopod 7; C, pleopod 1 and genital papilla; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

C. ferrarai), pereonites 2-6 with 17 tubercles and pereonite 7 with 15 tubercles (vs. pereonites 2-7 with 15 tubercles in *C. dazai*; pereonites 2-7 with 12 tubercles in *C. ferrarai*), pleonites 3-5 composed of 4+4+2 tubercles (vs. 3+3+3 in *C. dazai*; 4+4+4 in *C. ferrarai* and *C. mineri*); antennula with seven aesthetascs (vs. six in *C. dazai*; eight in *C. ferrarai*), uropod exopod short inserted bellow the dorsal lobe (vs. tiny and inserted above the dorsal lobe in *C. dazai* and *C. ferrarai*), and male pleopod 1 exopod with the distal-medial part broad (vs. triangular in *C. dazai* and *C. ferrarai*) (see Vandel 1952; Campos-Filho et al. 2014; Carpio-Díaz et al. 2018).

***Ctenorillo humboldti* Carpio-Díaz, López-Orozco & Campos-Filho n. sp.**

Figures 1,5-7

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Material examined

Colombia: Holotype ♂ (IAvH-I-508), **Risaralda**, Pereira, Vereda Los Cerritos - Hacienda Alejandría, 4°51'27"N 75°52'49"W, 1000 m a.s.l., November 2004, leg. M. Bustamante. Paratype: 1 ♂ (parts in micropreparations) (IAvH-I-508), same data as holotype.

Description

Maximum length: 4 mm. Color brown; upper portion of tubercles, anterior corner of pereonite 1 epimera, pereonites 2-7 and pleonites 3-5 epimera depigmented. Dorsum covered with triangular tubercles, arranged as follows (Figure 5A,B): vertex of cephalon with eight tubercles in three rows, anterior and posterior rows with two tubercles each, middle row with four tubercles; pereonite 1 with four tubercles on anterior row, six tubercles on middle, and two tubercles on posterior row; pereonites 2-7 with six tubercles on anterior row, and two tubercles on posterior row; pleonites 3-5 without tubercles; telson with two tubercles. Dorsal surface with short triangular scale-setae (Figure 5C). Pereonites 1-7 epimera with one line of noduli laterales per side inserted on postero-lateral surface of second outer tubercle. Cephalon (Figure 5D-F) with frontal shield rectangular, slightly protruding above vertex, and slightly bent over vertex; eyes of 18 ommatidia. Pereonite 1 epimera grooved on lateral margins for about two thirds of length, inner lobe of schisma rounded, not extending beyond posterior margin of outer lobe; pereonites 2-7 epimera rectangular, pereonite 2 with ventral lobe subtriangular, distal margin rounded, not extending beyond posterior margin of epimera (Figure 5A,F-H). Pleonites 3-5 epimera rectangular (Figure 5I,J). Telson (Figure 5I) hourglass-shaped, proximal part broader than distal part, straight distal margin. Antennula (Figure 5K) of three articles, proximal and distal articles subequal in length, distal article bearing seven aesthetascs. Antenna (Figure 5L) short and stout, slightly surpassing posterior margin of cephalon when extended backwards; flagellum of two articles, distal article about twice as long as proximal article, bearing two lateral aesthetascs; apical organ short. Buccal pieces (Figure 6A-E) as in *Ctenorillo binomio* n. sp. Pereopod 1 carpus with antennal grooming brush transverse, and distal setae apically cleft; dactylus with ungual and dactylar seta simple. Uropod (Figure 6F) protopod trapezoidal, flattened, basal part enlarged, medial margin concave; exopod short, inserted dorsally below distinct lobe near median margin; endopod inner and outer margins bearing fringe of setae. Pleopods 1-5 exopods with monospiracular lungs.

Male: Pereopod 1 and 7 (Figure 7A,B) with no particular modifications. Genital papilla as in Figure 7C. Pleopod 1 (Figure 7D) exopod triangular, as long as wide, outer margin

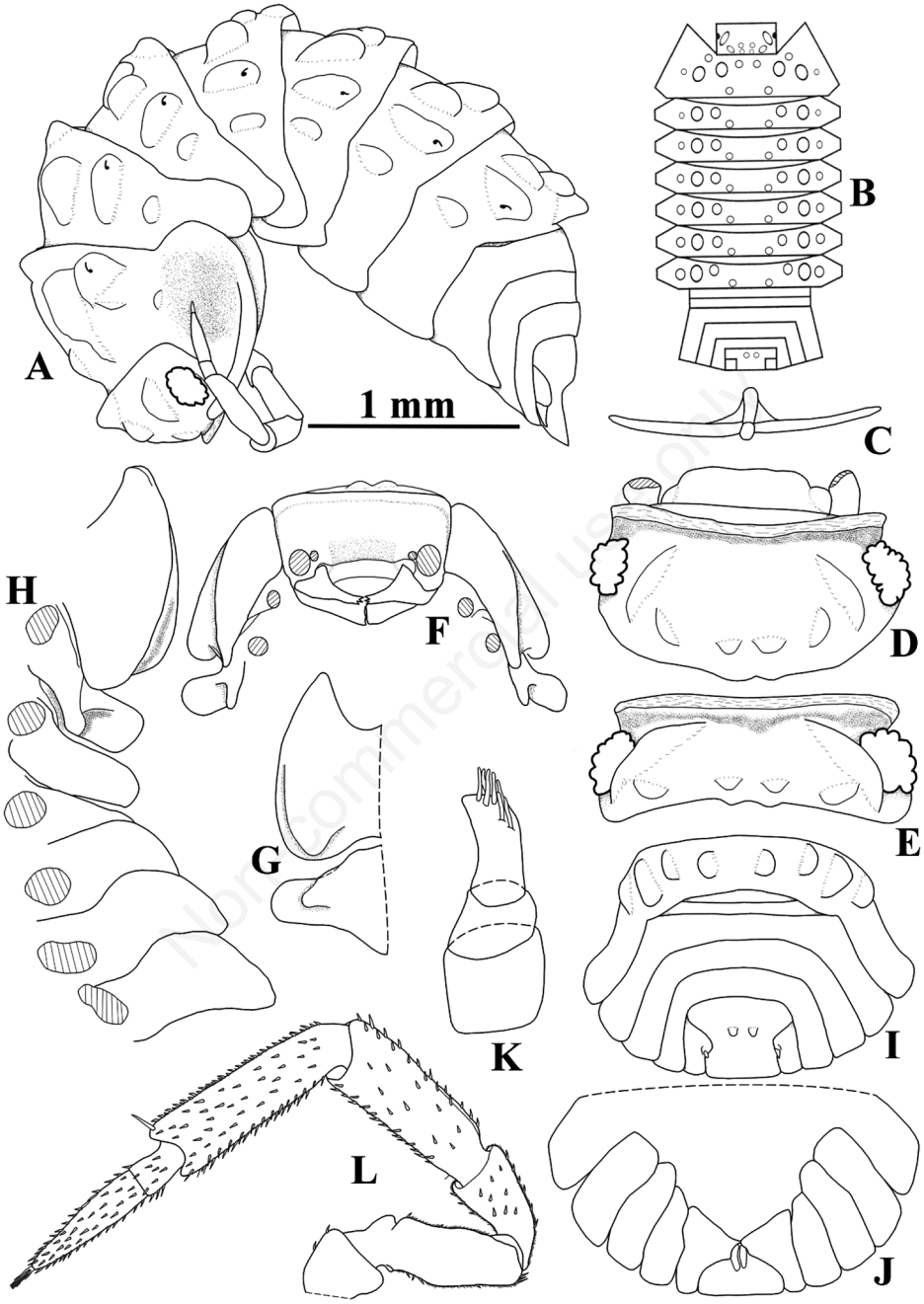

Figure 5. *Ctenorillo humboldti* Carpio-Díaz, López-Orozco & Campos-Filho n. sp., ♂: A, habitus, lateral view; B, dorsal tubercles scheme; C, dorsal scale-seta; D, cephalon, dorsal view; E, cephalon, posterior view; F, cephalon and pereonites 1 and 2, frontal view; G, pereonites 1 and 2 epimera, ventral view; H, pereonites 1-7 epimera, ventral view; I, pereonite 7, pleon, telson, and uropods, dorsal view; J, pereonite 7, pleonites 3-5, telson and uropods, ventral view; K, antennula; L, antenna.

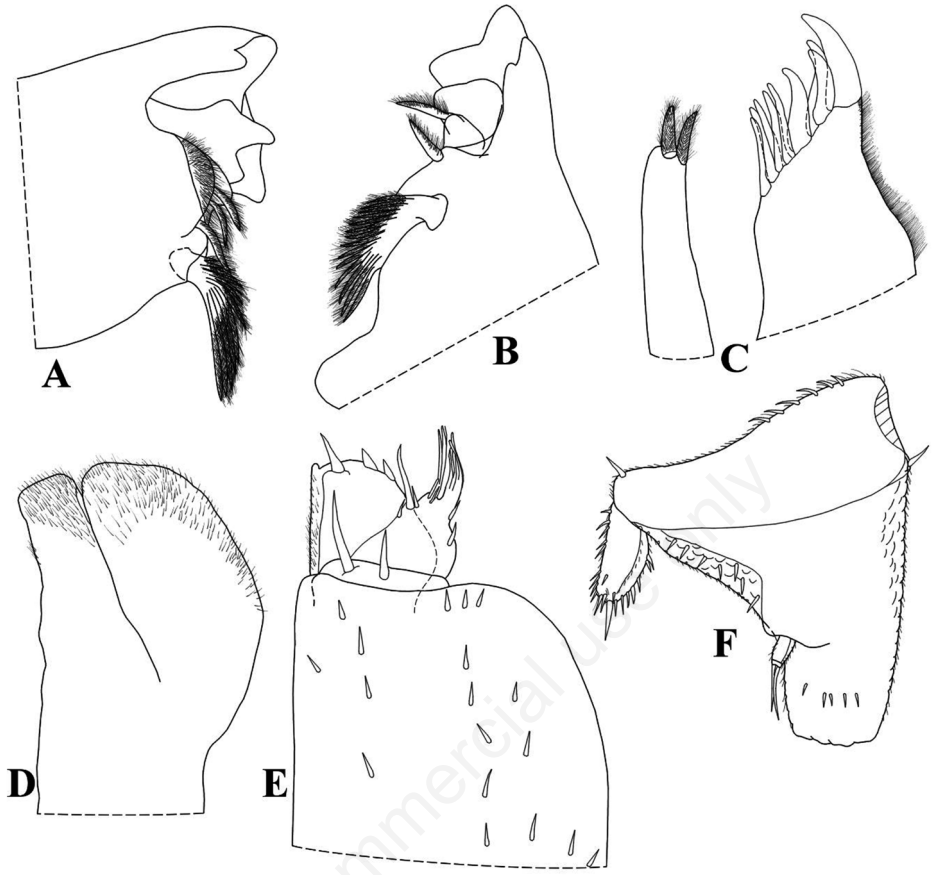

Figure 6. *Ctenorillo humboldti* Carpio-Díaz, López-Orozco & Campos-Filho n. sp., ♂: A, left mandible; B, right mandible; C, maxillula; D, maxilla; E, maxilliped; F, uropod.

slightly concave, inner and outer margins bearing many short setae; endopod about three times as long as exopod, distal part tapering. Pleopod 2 (Figure 7E) exopod triangular, outer margin concave bearing many short setae; endopod flagelliform longer than exopod. Pleopod 3 and 4 exopods as in Figure 7F and G, respectively. Pleopod 5 exopod (Figure 7H) rhomboid, outer margin slightly sinuous bearing many short setae.

Etymology

The new species is named after the German naturalist and explorer Friedrich Wilhelm Heinrich Alexander von Humboldt, also known as Baron von Humboldt, famous for his biogeographic expeditions to South America.

Remarks

In the absence of the dorsal tubercles of the pleon, *Ctenorillo humboldti* n. sp. is similar to *C. strinatii*, from which it can de distinguished by the shape, number and arrangement of the dorsal tubercles of the cephalon and pereon, and shape of the male pleopod 1 exopod (see Schmalfuss and Ferrara 1983). Moreover, it differs from the Neotropical species in

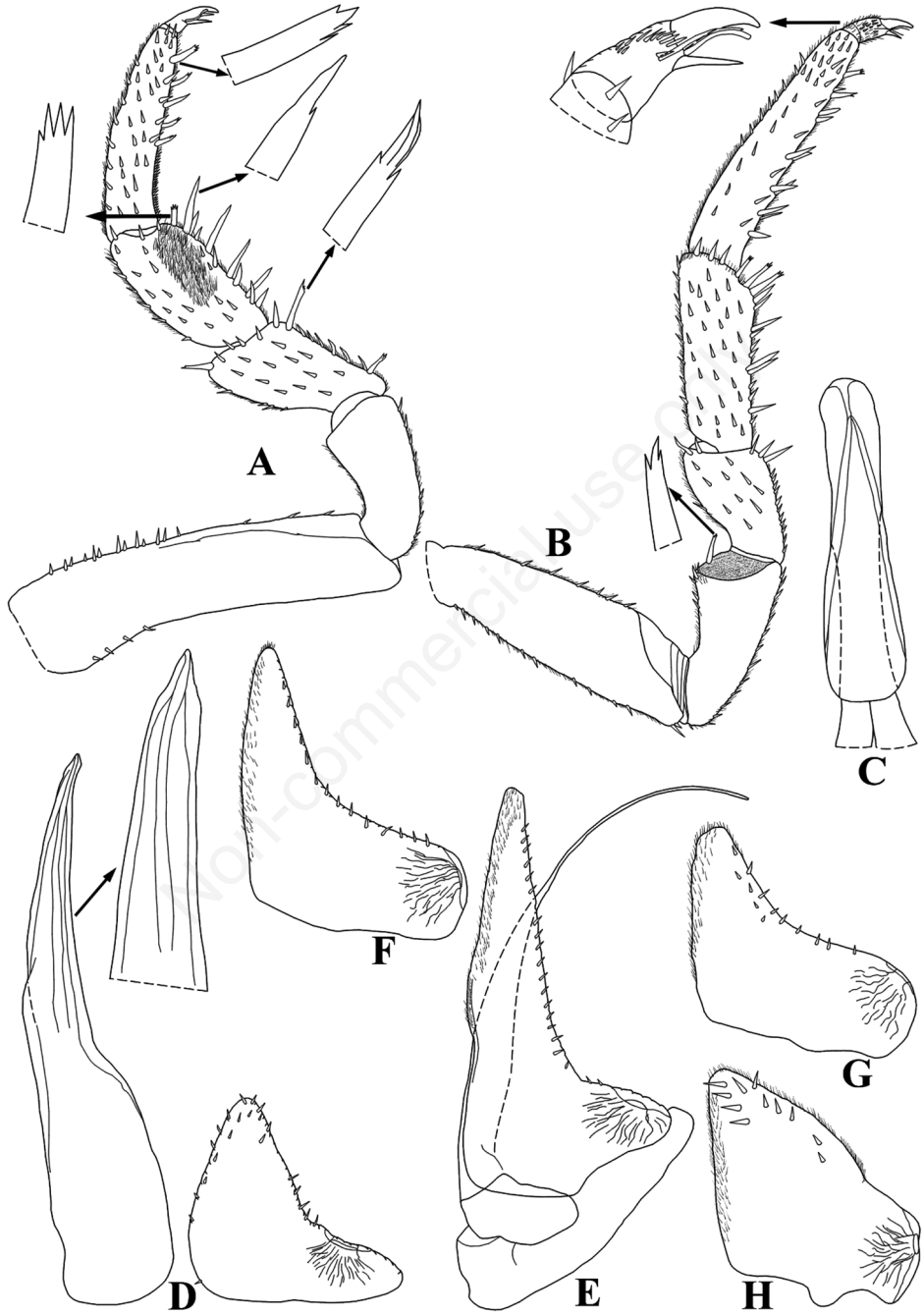

Figure 7. *Ctenorillo humboldti* Carpio-Díaz, López-Orozco & Campos-Filho n. sp., ♂: A, pereopod 1; B, pereopod 7; C, genital papilla; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

the cephalon with eight tubercles, pereonite 1 with 12 tubercles, pereonites 2-7 with eight tubercles, pleonites 3-5 smooth, antennula with seven aesthestascs, uropod exopod short inserted below the dorsal median lobe, and the male pleopod 1 exopod with outer margin concave (see previous remarks). *Ctenorillo humboldti* n. sp. also differs from *C. binomio* n. sp., in the number and arrangement of the dorsal tubercles of the cephalon and pereon, pleonites 3-5 smooth and shape of the male pleopod 1 exopod.

Ctenorillo mincaensis **López-Orozco, Carpio-Díaz & Campos-Filho n. sp.**

Figures 1,8-10

urn:lsid:zoobank.org:act:B17E5F29-CCA8-4EC6-B345-A2EE96C30064

Material examined

Colombia: Holotype ♂ (CBUDC-CRU 411), **Magdalena**, Santa Marta, Minca, Betoma 11°6′42.26″N 74°3′13.98″W, 20 February 2018, leg. F. Cala. Paratypes: 1 ♂, 1 ♀ (parts in micropreparations) (CBUDC-CRU 347), same data as holotype; 13 ♂♂, 27 ♀♀ (CBUDC-CRU 348), same locality and collector as holotype, 21 February 2018.

Description

Maximum length: male 4 mm, female 6 mm. Color dark brown with typical pale muscular insertions; pereonites 1-7 median portion and epimera more pigmented; upper portion of dorsal tubercles depigmented. Dorsum covered with short triangular and elongated tubercles, arranged as follows (Figure 8A,B): vertex of cephalon with 12 tubercles in three rows, anterior row with four tubercles, middle row with two tubercles, posterior row with six tubercles; pereonite 1 with six tubercles on anterior row, 12 tubercles on middle, and three tubercles on posterior row; pereonites 2-6 with two tubercles on anterior row, ten tubercles on middle row, and three tubercles on posterior row; pereonite 7 with two tubercles on anterior row, six tubercles on middle, and three tubercles on posterior row; pleonite 3 with four small tubercles, pleonites 4 and 5 and telson with two tubercles each, more prominent on telson. Dorsal surface with short triangular scale-setae (Figure 8C). Pereonites 1-7 with one line of noduli laterales per side. Cephalon (Figure 8D-F) with frontal shield rectangular, not protruding above vertex, and slightly bent over vertex; eyes of 16 ommatidia. Pereonite 1 epimera grooved on lateral margin, inner lobe of schisma rounded, not extending beyond posterior margin of outer lobe; pereonites 2 and 3 epimera subrectangular, 4-7 rectangular; pereonite 2 with ventral lobe subtriangular, distal margin rounded, not extending beyond posterior margin of epimera (Figure 8A,F,G). Pleonites 3-5 epimera rectangular (Figure 8H, I). Telson (Figure 8H) hourglass-shaped, proximal part broader than distal part, straight distal margin. Antennula (Figure 8J) of three articles, proximal and distal articles subequal in length, distal article bearing six to seven aesthetascs inserted apically. Antenna (Figure 8K) short and stout, not surpassing posterior margin of cephalon when extended backwards; flagellum of two articles, distal article three times as long as proximal article, bearing two lateral aesthetascs; apical organ short. Buccal pieces (Figure 9A-E) as in *Ctenorillo binomio* n. sp. Pereopod 1 carpus with antennal grooming brush transverse, and distal setae apically cleft; dactylus with ungual and dactylar seta simple. Uropod (Figure 9F) protopod trapezoidal, flattened, basal part enlarged, medial margin concave; exopod tiny, inserted dorsally on distinct lobe near median margin; endopod inner margin bearing fringe of setae. Pleopods 1-5 exopods with monospiracular lungs.

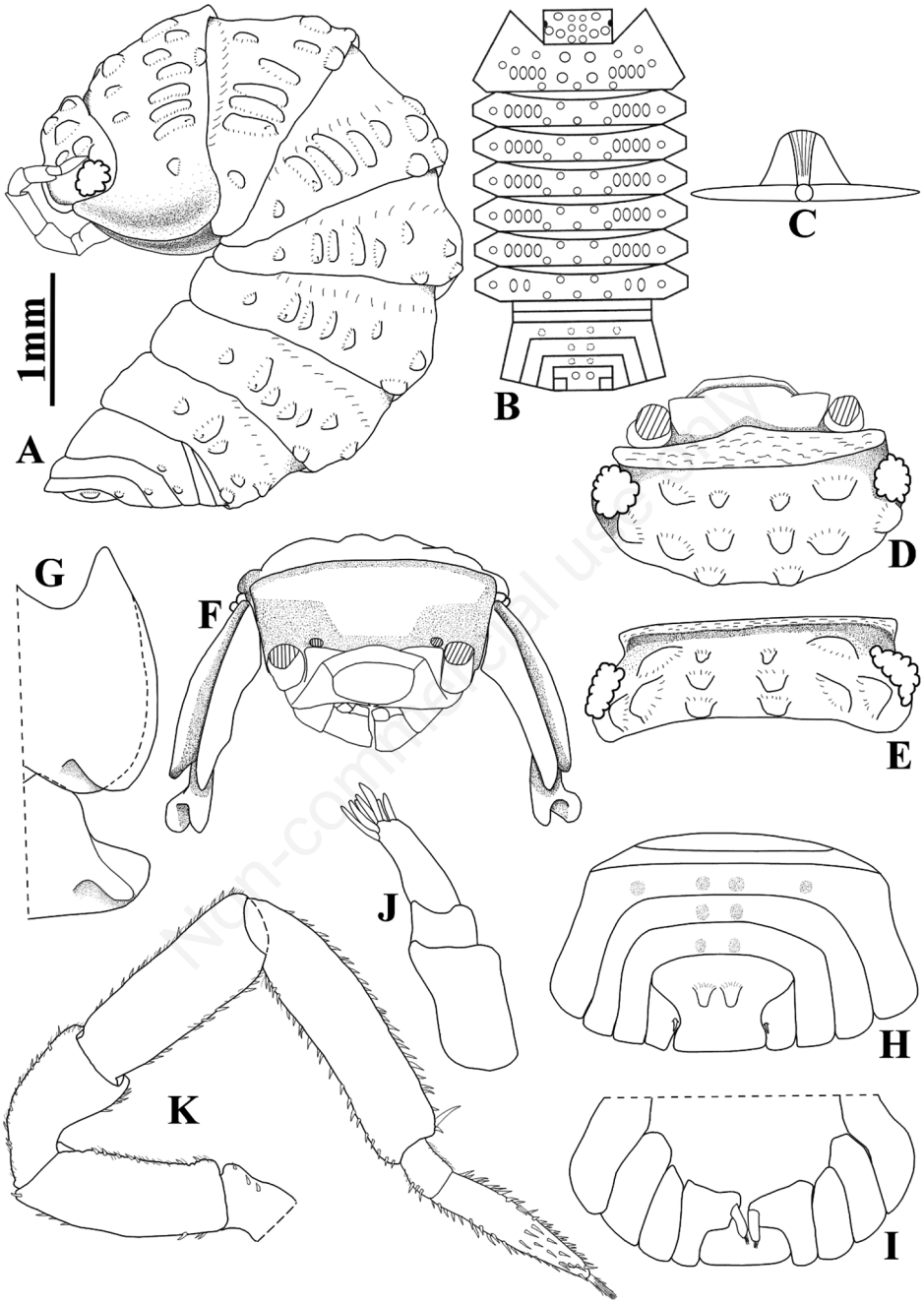

Figure 8. *Ctenorillo mincaensis* López-Orozco, Carpio-Díaz & Campos-Filho n. sp., ♀: A, habitus, lateral view; B, dorsal tubercles scheme; C, dorsal scale-seta; D, cephalon, dorsal view; E, cephalon, posterior view; F, cephalon and pereonites 1 and 2, frontal view; G, pereonites 1 and 2 epimera, ventral view; H, pleon, telson, and uropods, dorsal view; I, pleonites 3-5, telson, and uropods, ventral view; J, antennula; K, antenna.

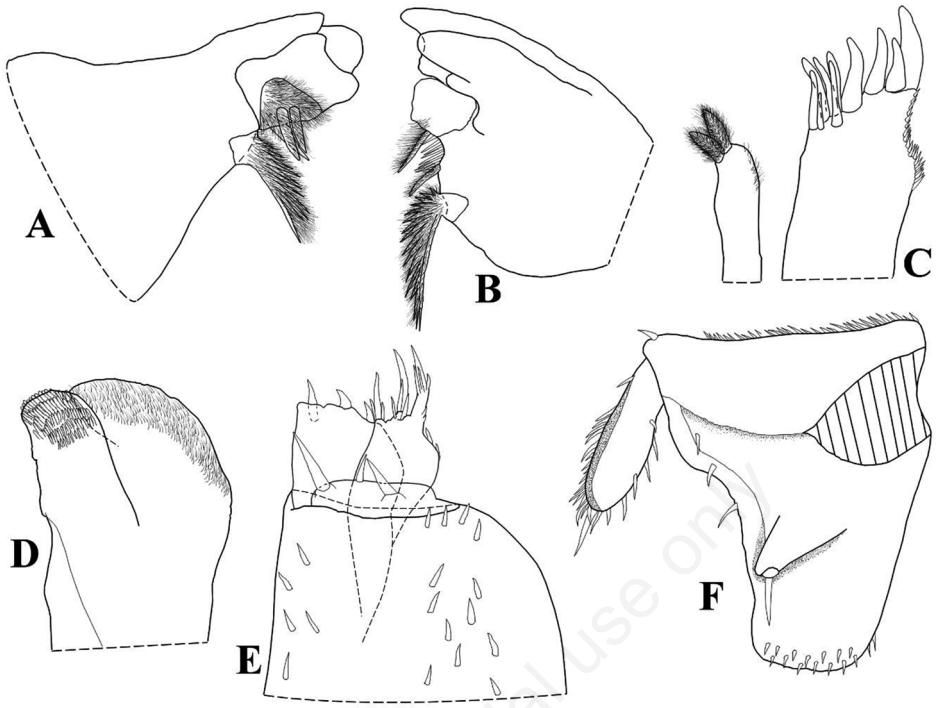

Figure 9. *Ctenorillo mincaensis* López-Orozco, Carpio-Díaz & Campos-Filho n. sp., ♀: A, left mandible; B, right mandible; C, maxillula; D, maxilla; E, maxilliped; F, uropod.

Male: Pereopod 1 and 7 (Figure 10A,B) with no particular modifications. Genital papilla as in Figure 10C. Pleopod 1 (Figure 10C) exopod triangular, wider than long, outer margin slightly concave, outer and inner margins bearing many short setae; endopod more than twice as long as exopod, distal part tapering bearing short median setae. Pleopod 2 (Figure 10D) exopod triangular, outer margin concave bearing many short setae; endopod distinctly longer than exopod. Pleopod 3 and 4 exopods as in Figure 10E,F, respectively. Pleopod 5 exopod (Figure 10G) rhomboid, outer margin almost straight bearing many short setae.

Etymology

The new species is named after the locality where the specimens were collected: Minca.

Remarks

In the arrangement of the dorsal tubercles of the pleon, i.e., pleonite 3 with four tubercles, pleonites 4 and 5 and telson with two tubercles, *Ctenorillo mincaensis* n. sp. resembles *C. guinensis*, from which it can easily be distinguished by the shape and arrangement of the dorsal tubercles of the cephalon and pereon, and shape of the male pleopod 1 (see Schmalfuss and Ferrara 1983). Moreover, it differs from the Neotropical species in the cephalon with 12 tubercles, pereonite 1 with 21 tubercles, pereonites 2-6 with 15 tubercles and pereonite 7 with 11 tubercles, pleonites 3-5 with 4+2+2 tubercles, male pleopod 1 exopod with outer margin concave in the middle (see *C. binomio* n. sp. remarks). *Ctenorillo mincaensis* n. sp. also differs from the previous new species in the shape, number and arrangement of the dorsal tubercles of the cephalon, pereon and pleon, and shape of the male pleopod 1 exopod.

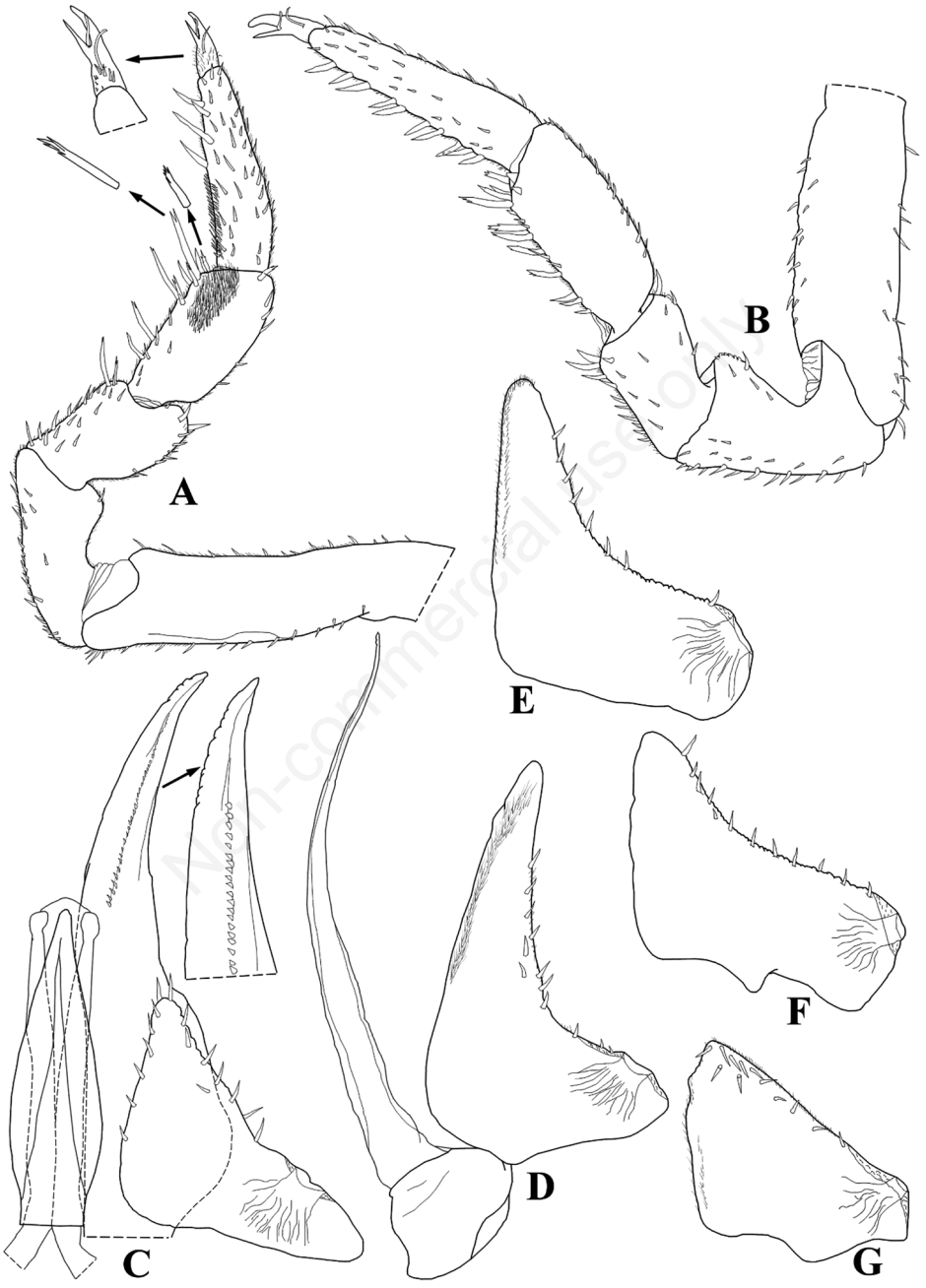

Figure 10. *Ctenorillo mincaensis* López-Orozco, Carpio-Díaz & Campos-Filho n. sp., ♂: A, pereopod 1; B, pereopod 7; C, pleopod 1 and genital papilla; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

***Ctenorillo orientalis* Carpio-Díaz, Taiti & López-Orozco n. sp.**

Figures 1,11-13

urn:lsid:zoobank.org:act:69228A54-95F1-4E38-9698-4C3F5705ECEC

Material examined

Colombia: Holotype ♀ (CUDC-CRU 57), **Cesar**, Manaure, San José de Oriente, Serranía de Perijá, 10°17'40.4"N 72°55'52.1"W, 13 August 2015, leg. C.M. López-Orozco and Y. Herrera-Medina. Paratypes*:* 1 ♀ (parts in micropreparations) (CUDC-CRU 355), 5 ♀♀ (CUDC-CRU 356), same data as holotype.

Description

Maximum length: 4.5 mm. Color brown; antennae and pereopods strongly pigmented; pereonites 1-7 and pleon with median and paramedian portions depigmented; pereonite 1 epimera anterior and posterior corners depigmented; pereonites 2-7 epimera lateral margins with large depigmented spot. Dorsum covered with short triangular tubercles, arranged as follows (Figure 11A,B): vertex of cephalon with 16 tubercles in three rows, anterior row with six tubercles, middle row with four tubercles, posterior row with six tubercles; pereonite 1 with four tubercles on anterior row, 14 tubercles on middle row, and seven tubercles on posterior row; pereonites 2-7 with eight tubercles on anterior row, nine tubercles on posterior row; pleonites 3 and 4 with four tubercles, pleonite 5 and telson with two tubercles each. Dorsal surface with semi-circular scale-setae (Figure 11C). Pereonites 1-7 epimera with one line of noduli laterales per side inserted on antero-lateral surface of second outer tubercle. Cephalon (Figure 11D-F) with frontal shield rectangular, slightly protruding above vertex, and slightly bent over vertex; eyes of 17-19 ommatidia. Pereonite 1 epimera grooved on lateral margins, for about one quarter of length, inner lobe of schisma rounded, not extending beyond posterior margin of outer lobe; pereonites 2 epimera subtriangular, 3-7 rectangular; pereonite 2 with ventral lobe subrectangular, distal margin rounded, not extending beyond posterior margin of epimera (Figure 11A,F,G). Pleonites 3-5 epimera rectangular (Figure 11H,I). Telson (Figure 11H) hourglass-shaped, proximal part broader than distal part, slightly convex distal margin. Antennula (Figure 11J) of three articles, proximal and distal articles subequal in length, distal article bearing five subapical aesthetascs. Antenna (Figure 11K) short and stout, slightly surpassing posterior margin of cephalon when extended backwards; flagellum of two articles, distal article three times as long as proximal article, and bearing two lateral aesthetascs; apical organ short. Buccal pieces (Figure 12A-E) as in *Ctenorillo binomio* n. sp. Pereopods 1-7 (Figure 13A,B) with no particular modifications; pereopod 1 carpus with antennal grooming brush transverse, distal setae apically cleft; dactylus with ungual and dactylar seta simple. Uropod (Figure 12F) protopod trapezoidal, flattened, basal part enlarged, medial margin slightly concave; exopod short, inserted dorsally below distinct lobe near medial margin; endopod inner and outer margins bearing fringe of setae. Pleopods 1-5 exopods with monospiracular lungs. Pleopod 1 exopod (Figure 13C) twice as wide as long, distal margin almost straight. Pleopod 2 exopod (Figure 13D) subtriangular, outer margin concave bearing many short setae. Pleopod 3 and 4 exopods (Figure 10E,F) subrectangular, distal margin slightly concave and bearing many short setae. Pleopod 5 exopod (Figure 13G) rhomboid, outer margin almost straight bearing many short setae.

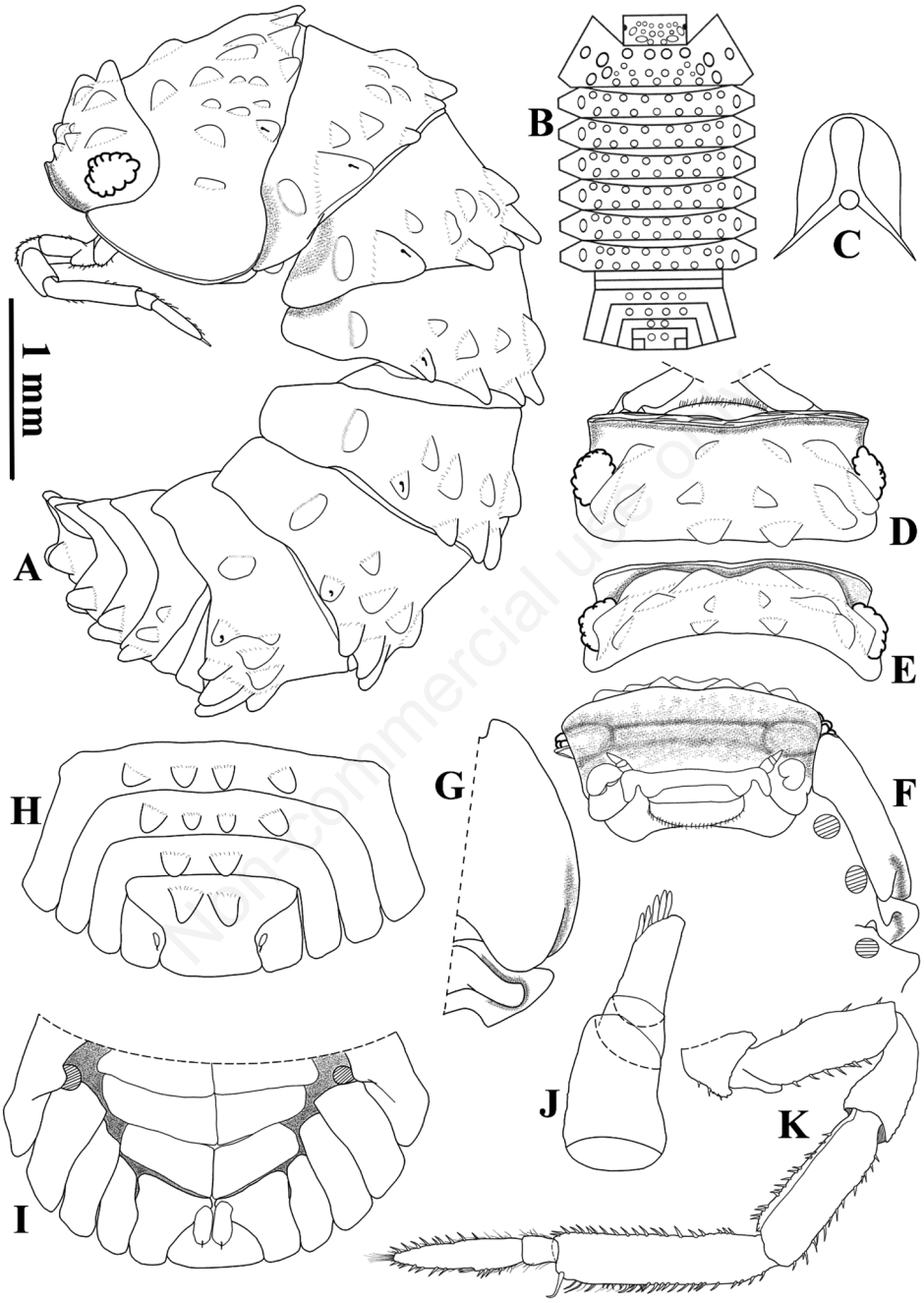

Figure 11. *Ctenorillo orientalis* Carpio-Díaz, Taiti & López-Orozco n. sp., ♀: A, habitus, lateral view; B, dorsal tubercles scheme; C, dorsal scale-seta; D, cephalon, dorsal view; E, cephalon, posterior view; F, cephalon and pereonites 1-3, frontal view; G, pereonites 1 and 2 epimera, ventral view; H, pleonites 3-5, telson, and uropods, dorsal view; I, pereonite 7, pleonites 3-5, telson, and uropods, ventral view; J, antennula; K, antenna.

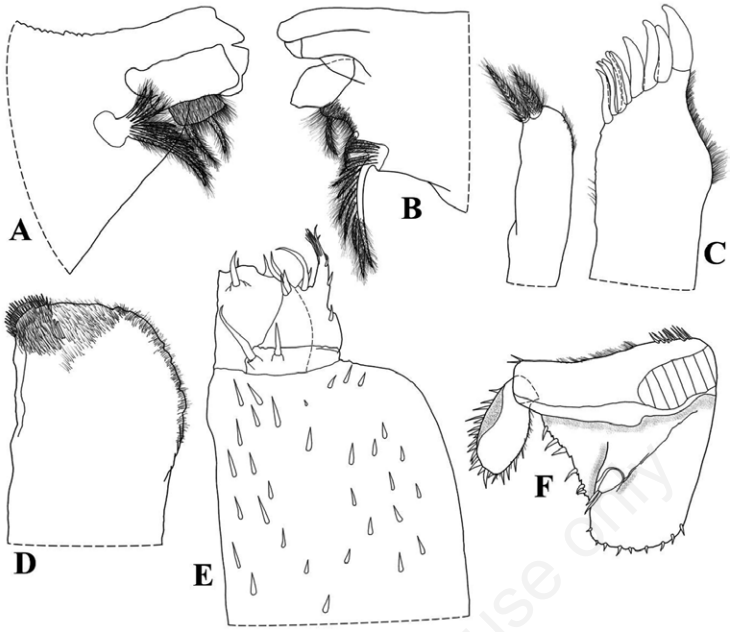

Figure 12. *Ctenorillo orientalis* Carpio-Díaz, Taiti & López-Orozco n. sp., ♀: A, left mandible; B, right mandible; C, maxillula; D, maxilla; E, maxilliped; F, uropod.

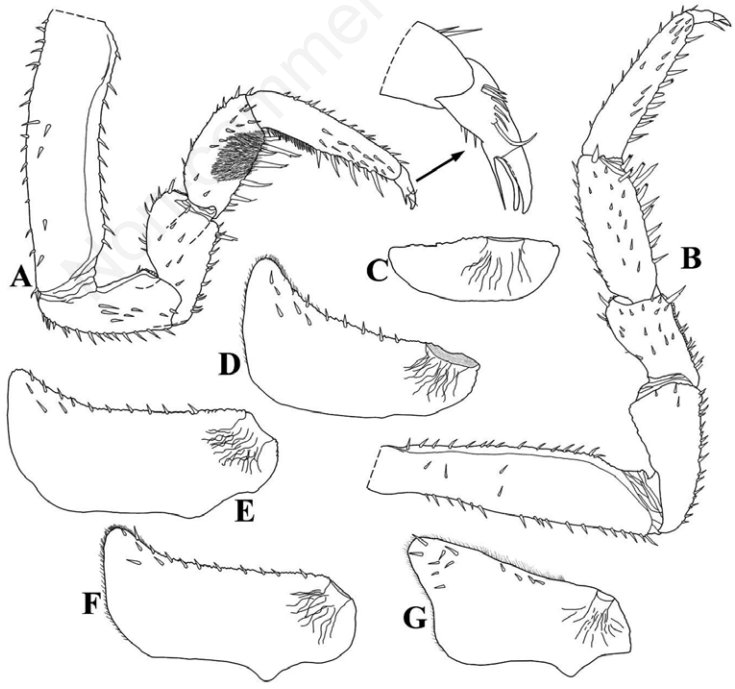

Figure 13. *Ctenorillo orientalis* Carpio-Díaz, Taiti & López-Orozco n. sp., ♀: A, pereopod 1; B, pereopod 7; C, pleopod 1 exopod; D, pleopod 2 exopod; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

Etymology

The new species name refers to the geographical location of the locality where the specimens were collected: Cordillera Oriental de Colombia.

Remarks

Despite the absence of male specimens, *Ctenorillo orientalis* n. sp. exhibits a unique arrangement of the dorsal tubercles of the cephalon and pereon. In the arrangement of the dorsal tubercles of the pleon, the new species is similar to *C. gabunensis*, *C. tuberosus* and *C. binomio* n. sp.. It can de distinguished by the shape, number and arrangement of the dorsal tubercles of cephalon and pereon (see Schmalfuss and Ferrara 1983; Campos-Filho et al. 2017).

***Ctenorillo papagayoensis* Carpio-Díaz, Borja-Arrieta & Campos-Filho n. sp.**

Figures 1,14-16

urn:lsid:zoobank.org:act:11B0915D-7619-4C61-AF01-C3B62C6A8680

Material examined

Colombia: Holotype ♂ (parts in micropreparations) (ICN-CR-is 72), **Santander**, Bolívar, Los Papagayos cave, 5°58'47.65"N 73°46'24.44"W, 22 June 2008, leg. D. Casallas and M. Hoyos. Paratypes*:* 1 ♂, 1 ♀ (parts in micropreparations) (ICN-CR-is 72), same data as holotype.

Description

Maximum length: male 5 mm, female 5.5 mm. Color brown with typical pale muscular insertions; pereonites 1-7 median portion and epimera, and pleon strongly pigmented. Dorsum covered with short rounded tubercles, arranged as follows (Figure 14A,B): vertex of cephalon with 12 tubercles in three rows, anterior row with four tubercles, middle row with two tubercles, posterior row with six tubercles; pereonite 1 with four tubercles on anterior row, six tubercles on middle row, and two tubercles on posterior row; pereonites 2-7 with two tubercles on anterior row, six tubercles on posterior row; pleonites 3-5 plus telson smooth. Dorsal surface with short triangular scale-setae (Figure 14C). Pereonites 1-7 epimera with one line of noduli laterales per side inserted on postero-lateral surface of second outer tubercle. Cephalon (Figure 14D-F) with frontal shield rectangular, not protruding above vertex, and slightly bent over vertex; eyes of 16 ommatidia. Pereonite 1 epimera grooved on lateral margins for about two thirds of length, inner lobe of schisma rounded, not extending beyond posterior margin of outer lobe; pereonites 2-7 rectangular; pereonite 2 with ventral lobe subtriangular, distal margin rounded, not extending beyond posterior margin of epimera (Figure 14A,F,G). Pleonites 3-5 epimera rectangular (Figure 14H,I). Telson (Figure 14H) hourglass-shaped, proximal part broader than distal part, straight distal margin. Antennula (Figure 14J) of three articles, proximal and distal articles subequal in length, distal article bearing five apical aesthetascs. Buccal pieces (Figure 15A-E) as in *Ctenorillo binomio* n. sp. Pereopod 1 carpus with antennal grooming brush transverse, distal setae apically cleft; dactylus with ungual and dactylar seta simple. Uropod (Figure 15F) protopod trapezoidal, flattened, basal part enlarged, medial margin concave; exopod

short, inserted dorsally below distinct lobe near median margin. Pleopods 1-5 exopods with monospiracular lungs.

Male: Pereopod 1 (Figure 16A) with no particular modifications. Pereopod 7 (Figure

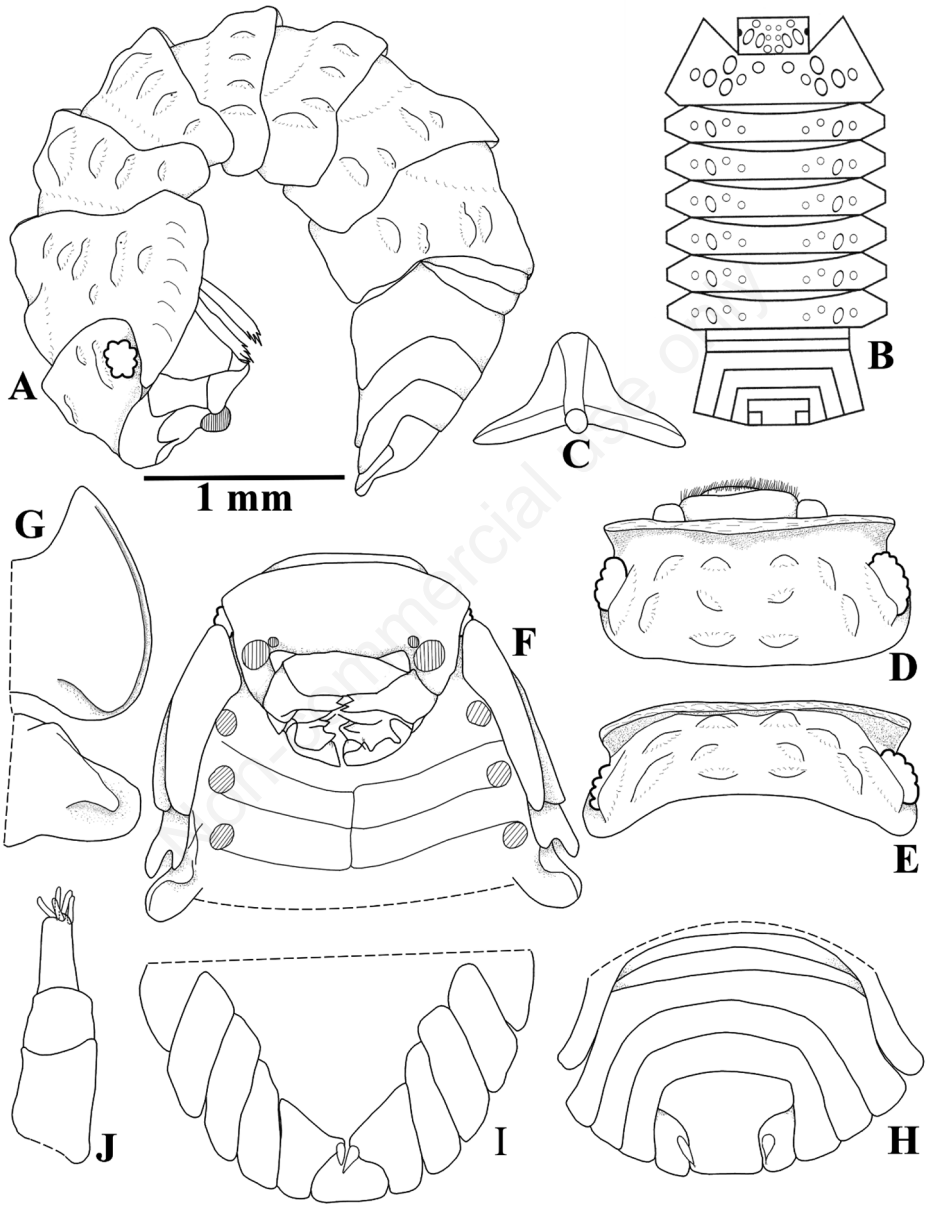

Figure 14. *Ctenorillo papagayoensis* Carpio-Díaz, Borja-Arrieta & Campos-Filho n. sp., ♀: A, habitus, lateral view; B, dorsal tubercles scheme; C, dorsal scale-seta; D, cephalon, dorsal view; E, cephalon, posterior view; F, cephalon and pereonites 1-3, frontal view; G, pereonites 1 and 2 epimera, ventral view; H, pereonite 7, pleon, telson, and uropods, dorsal view; I, pereonite 7, pleonites 3-5, telson, and uropods, ventral view; J, antennula; K, antenna.

16B) ischium with rostral surface slightly depressed distally. Genital papilla as in Figure 16C. Pleopod 1 (Figure 16D) exopod triangular, longer than wide, outer margin slightly concave, outer and inner margins bearing many short setae; endopod twice as long as exopod, distal part tapering bearing short setae on medial margin. Pleopod 2 (Figure 16E) exopod triangular, outer margin concave bearing many short setae. Pleopod 3 and 4 exopods as in Figure 16F,G, respectively. Pleopod 5 exopod (Figure 16H) triangular, outer margin almost straight bearing many short setae.

Etymology

The new species is named after of the locality where the specimens were collected: Los Papagayos cave.

Remarks

Ctenorillo papagayoensis sp nov. differs from all other species of the genus in the absence of tubercles on pleon and telson, and in the number and arrangement of the dorsal tubercles of the cephalon and pereon.

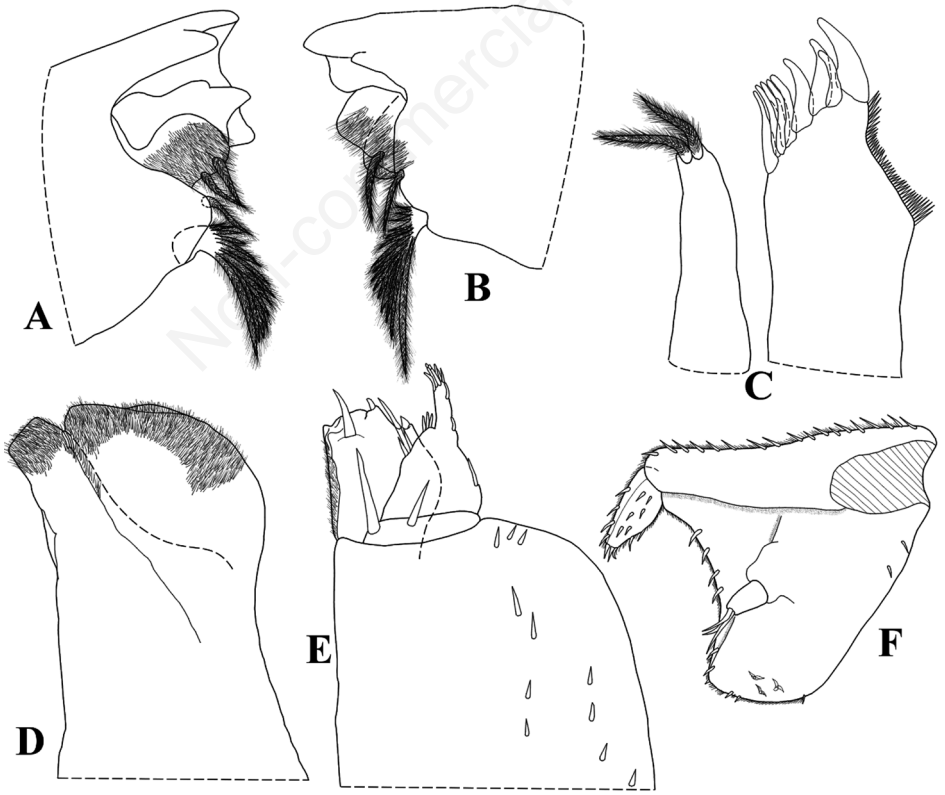

Figure 15. *Ctenorillo papagayoensis* Carpio-Díaz, Borja-Arrieta & Campos-Filho n. sp., ♀: A, left mandible; B, right mandible; C, maxillula; D, maxilla; E, maxilliped; F, uropod.

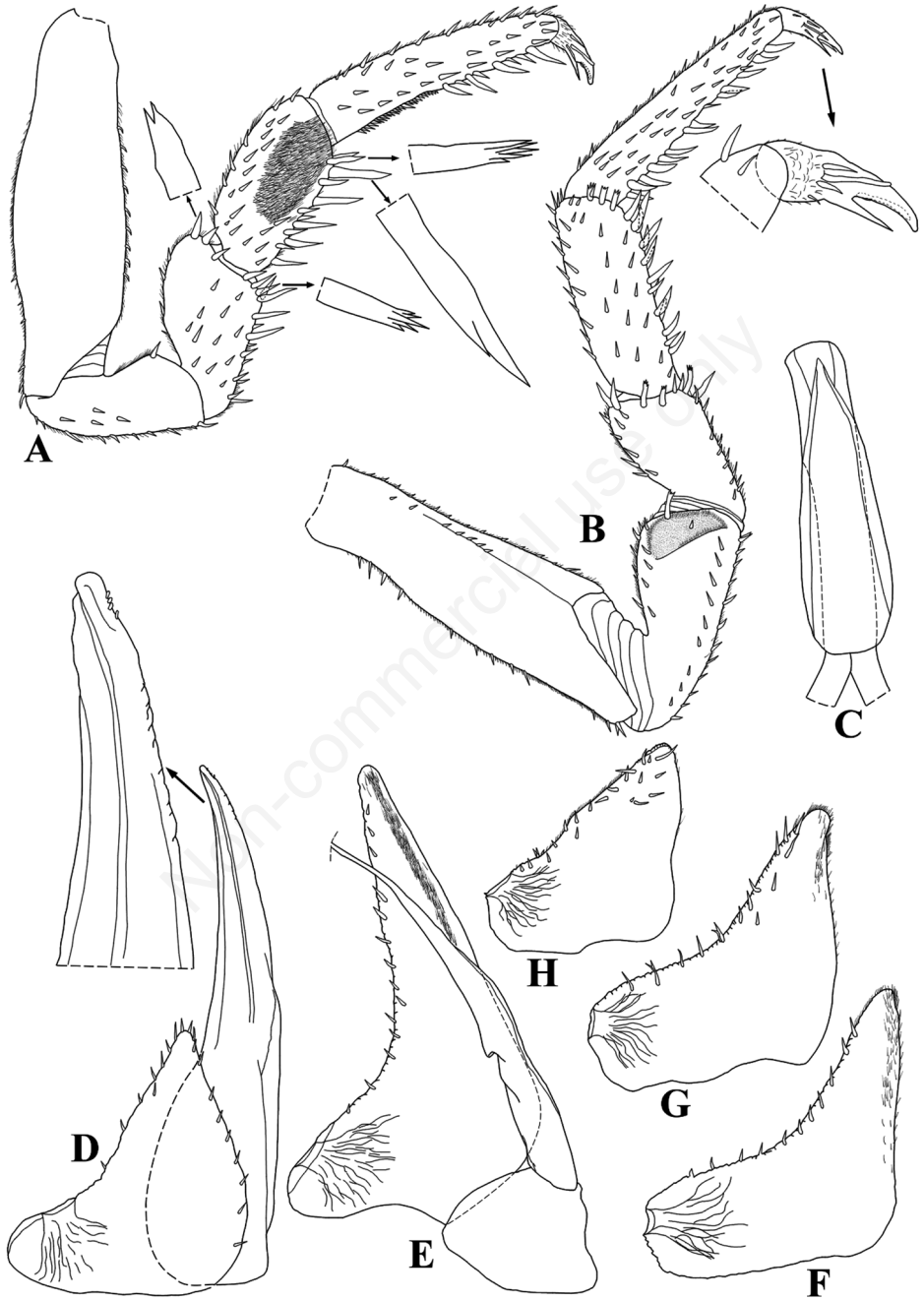

Figure 16. *Ctenorillo papagayoensis* Carpio-Díaz, Borja-Arrieta & Campos-Filho n. sp., ♂: A, pereopod 1; B, pereopod 7; C, genital papilla; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

***Ctenorillo tayrona* López-Orozco, Borja-Arrieta & Campos-Filho n. sp.**

Figures 1,17,18

urn:lsid:zoobank.org:act:8273CDBA-B15E-44B7-8111-4BAF1D8ED435

Material examined

Colombia: Holotype ♀ (parts in micropreparations) (CBUDC-CRU 342), **Magdalena**, Santa Marta, Sierra Nevada de Santa Marta, Sector Bahía Concha, 11°17'32.28"N 74°9'12.8"W, 16 August 2018, leg. C.M. López-Orozco and R. Borja-Arrieta.

Description

Length: 2.5 mm. Color brown with typical pale muscular insertions; entire body strongly pigmented. Dorsum covered with short rounded tubercles, arranged as follows (Figure 17A,B): vertex of cephalon with ten tubercles in three rows, anterior row with four tubercles, middle row with two tubercles, posterior row with four tubercles; pereonite 1 with four tubercles on anterior row, eight tubercles on middle, and seven tubercles on posterior row; pereonites 2-7 with six tubercles on anterior row, and nine tubercles on posterior row; pleon smooth, telson with two median tubercles. Dorsal surface with short triangular scale-setae (Figure 17C). Pereonites 1-7 epimera with one line of noduli laterales per side inserted on postero-lateral surface of second outer tubercle. Cephalon (Figure 17D-F) with frontal shield rectangular, not protruding above vertex; eyes of eight ommatidia. Pereonite 1 epimera grooved on lateral margins, inner lobe of schisma rounded, slightly extending beyond posterior margin of outer lobe; pereonites 2 and 3 epimera subtriangular, outer margin rounded, epimera 4-7 rectangular; pereonite 2 with ventral lobe subtriangular, distal margin rounded, slightly extending beyond posterior margin of outer lobe (Figure 17A,F,G). Pleonites 3-5 epimera rectangular (Figure 17H,I). Telson (Figure 17H) hourglass-shaped, proximal part broader than distal part, straight distal margin. Antennula (Figure 17J) of three articles, proximal and distal articles subequal in length, distal article bearing three apical aesthetascs. Buccal pieces (Figure 18A-E) as in *Ctenorillo binomio* n. sp. Uropod (Figures 17I, 18F) protopod trapezoidal, flattened, basal part enlarged, medial margin straight; exopod tiny, inserted dorsally below distinct lobe near median margin. Pereopods 1 and 7 (Figure 18G,H) with no particular modifications; pereopod 1 carpus with antennal grooming brush transverse, and distal setae apically cleft; dactylus with ungual and dactylar seta simple. Pleopods 1-5 exopods with monospiracular lungs.

Etymology

The new species is named after the Tayrona people, an indigenous group that inhabited areas of the Sierra Nevada de Santa Marta.

Remarks

In the absence of the dorsal tubercles of the pleon, *Ctenorillo tayrona* n. sp. is similar to *C. strinatii* and *C. humboldti* n. sp. It can de distinguished by the shape, number and

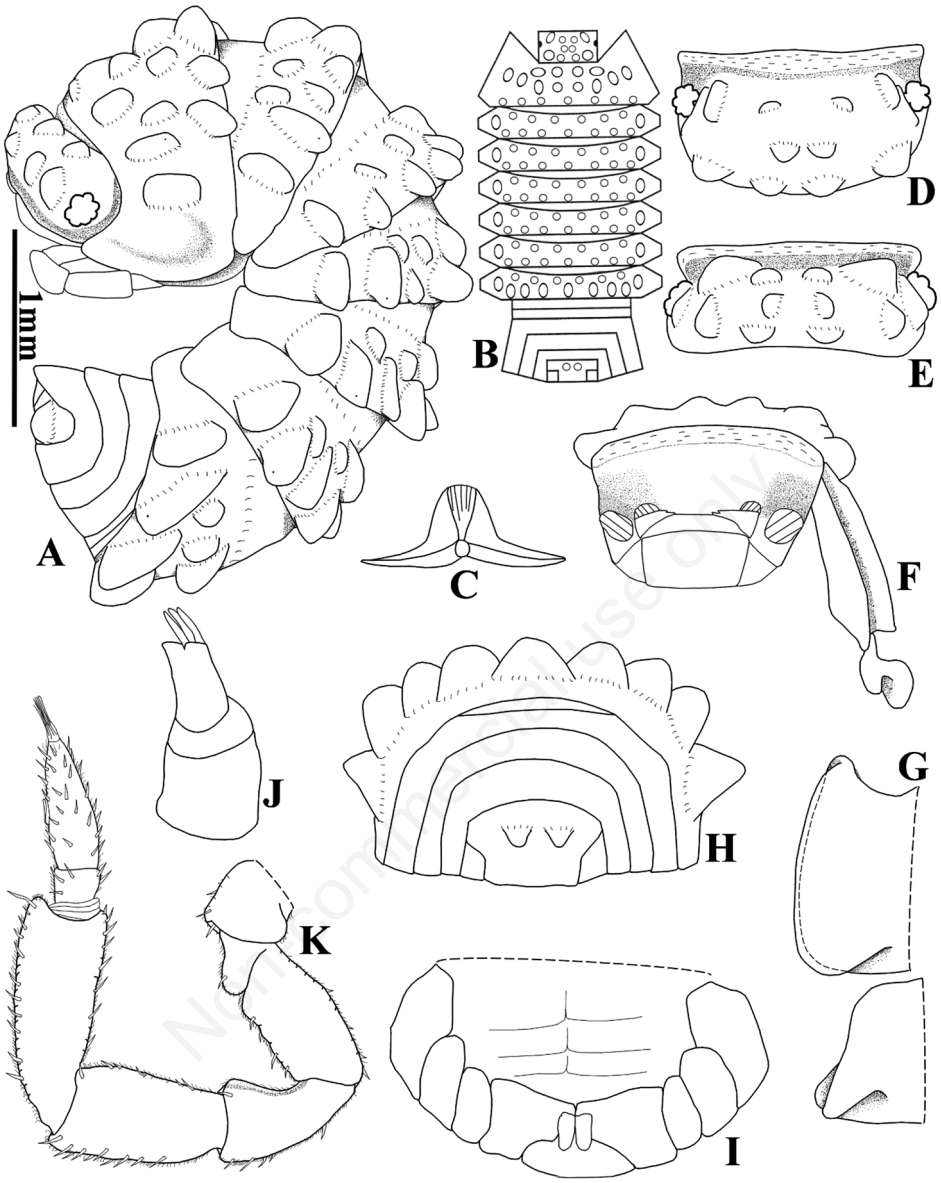

Figure 17. *Ctenorillo tayrona* López-Orozco, Borja-Arrieta & Campos-Filho n. sp., ♀: A, habitus, lateral view; B, dorsal tubercles scheme; C, dorsal scale-seta; D, cephalon, dorsal view; E, cephalon, posterior view; F, cephalon and pereonites 1 and 2, frontal view; G, pereonites 1 and 2 epimera, ventral view; H, pereonite 7, pleon, telson, and uropods, dorsal view; I, pleonites 3-5, telson, and uropods, ventral view; J, antennula; K, antenna.

arrangement of the dorsal tubercles of the cephalon and pereon (see Schmalfuss and Ferrara 1983). In the comparison with the Neotropical species, it differs in having the cephalon with 10 tubercles, pereonite 1 with 19 tubercles, pereonites 2-7 with 15 tubercles, and antennula with three aesthetascs.

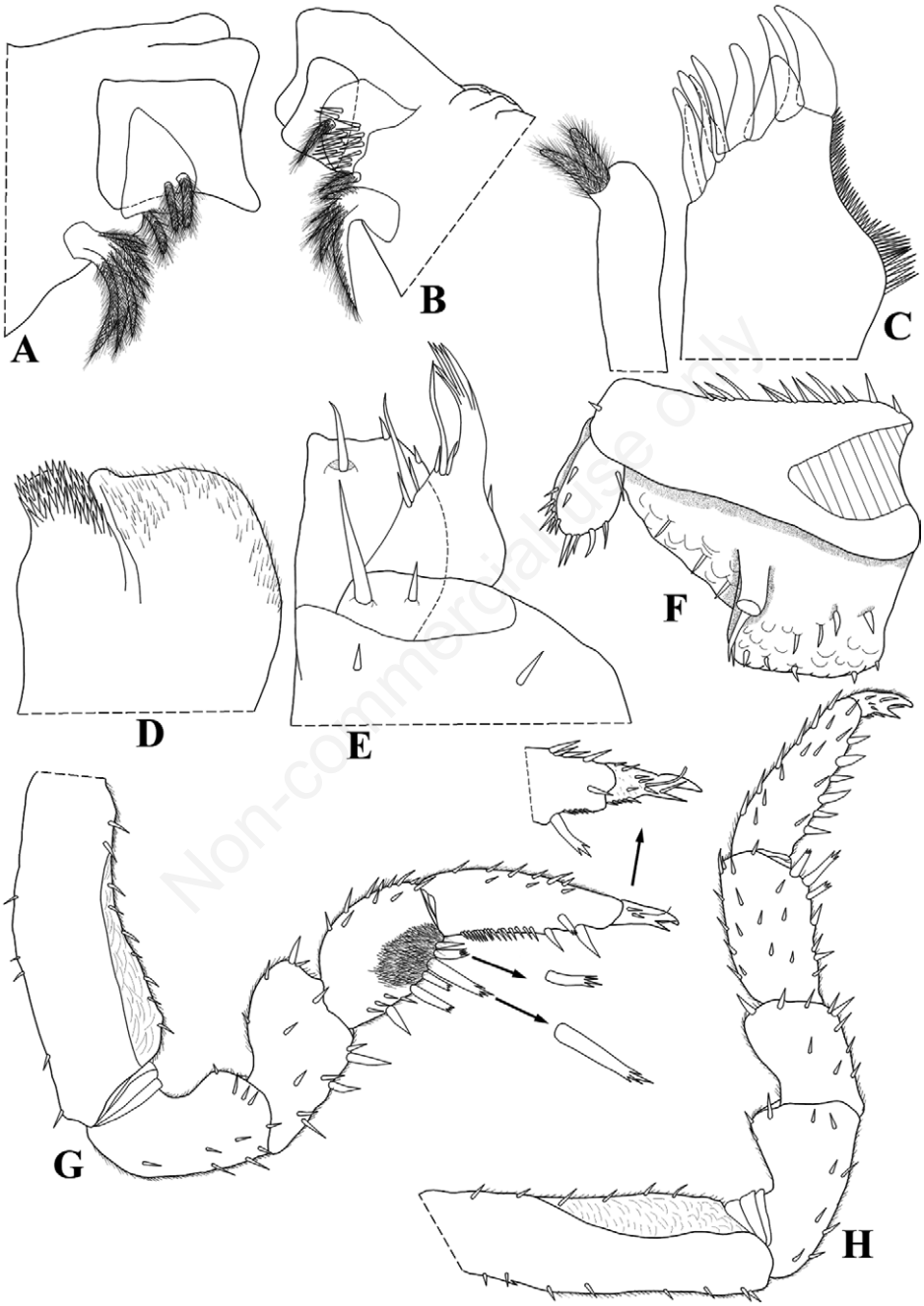

Figure 18. *Ctenorillo tayrona* López-Orozco, Borja-Arrieta & Campos-Filho n. sp., ♀: A, left mandible; B, right mandible; C, maxillula; D, maxilla; E, maxilliped; F, uropod; G, pereopod 1; H, pereopod 7.

Discussion

To date, 46 species of Armadillidae are known from South America, distributed as follows, 20 from Brazil, one from Chile, seven from Colombia, five from Paraguay, and 13 from Venezuela (Schultz 1995; Schmidt 2001; Pérez-Schultheiss 2009; Schmalfuss 2003; Campos-filho et al. 2018, 2023; Cardoso et al. 2023). The present work considerably increases the biodiversity of the Armadillidae for Colombia, from seven to 13 species. In addition, it represents the first record of terrestrial isopods for the departments of Atlántico, Risaralda, and Santander. Despite the number of species described here, this work also suggests the need of more surveys in other regions of the country where the knowledge of the group is poorly known, such as Andina, Pacifico, Amazonia, Sucre, and Orinoquía.

The members of the Armadillidae are mainly distributed in lower altitudes of the Colombian Caribbean, mostly associated with TDF areas (Figure 1), one of the most threatened ecosystems in the world (Janzen 1988; Etter 1993; García et al. 2014). In the Neotropical region, the TDF areas show a disjointed distribution, and hold high levels of endemic taxa (Olson et al. 2001; Lamoreux et al. 2006; Pennington et al. 2006; Morrone 2014; Banda-R et al. 2016). In Colombia, only 5% of this ecosystem is protected through the National System of Protected Areas. Considering the number of new taxa proposed here, allied with other studies of Oniscidea for the country, there is an evident need to raise the level of awareness of this ecosystem in order to propose strategic areas for conservation efforts.

Regarding the Neotropical regionalization proposed by Morrone et al. (2022), Colombia holds nine provinces in three main biogeographic regions, the Pacific domain in the north, the South American Transition domain as a corridor in the center, and Boreal Brazilian domain in the south. Most of the records of the *Ctenorillo* species are in the Pacific domain, especially in Magdalena province, and one record in the Transition domain, Páramo province. In Colombian Caribbean four regions were recognized: 1, Península de La Guajira; 2, Sierra Nevada de Santa Marta; 3, Serranía de San Jacinto; and 4, Serranía del Perijá.

Colombia holds a high diversity of ecosystems, fauna and flora, due to its latitudinal extension as well as its complex geological history (Morrone and Lopretto 2001; Hooghiemstra et al. 2006; Guerrero et al. 2008; Cardona et al. 2010; Llorente-Bousquets and LeCrom 2013; Solari et al. 2013; López-O. et al. 2014; Morrone 2014; Campos and Lasso 2015; González-Orozco 2021). It is clear that with more surveys along its territory, the biodiversity of Armadillidae, as well as of other Oniscidea members, will increase, as is common in tropical countries. It will be very interesting, using also molecular approaches (see for instance López-Orozco et al. 2022) to check whether the distribution of the Oniscidea in Colombia reflects the geological history of the country. Therefore, it is of fundamental importance to support the human capacity of taxonomists, ecologists and molecular biologists, with more financial support to conduct more studies on the group within the country.

Authors' contributions

YMC-D conceived the study, collected the material, sorted the collections, drew the first drafts, and contributed to the final illustrations; CML-O collected the material, sorted the collections, drew the first drafts, and contributed to the final illustrations; RLB-A, MG-E collected the material, sorted the collections, contributed in the final illustrations; ISC-

F, SS, and ST assisted in species recognition and description, and financial support; AB, JCNM, MEB, GRNS project development and financial support, and all authors wrote and revised the text. All the authors have read and approved the final version of the manuscript and agreed to be held accountable for all aspects of the work.

Conflict of interest

The authors declare no potential conflict of interest.

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Availability of data and materials

All data generated or analyzed during this study are included in the published article.

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