

Taxonomy of the genus *Cyrtogrammomma* Pocock, 1895 (Araneae, Mygalomorphae, Theraphosidae) with a description of a new species from Brazil

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Abstract

The genus *Cyrtogrammomma* Pocock, 1895 was proposed based on specimen samples from Monte Roraima, Guyana, and allocated in the family Barychelidae. However, the most recent cladistic analysis transferred *Cyrtogrammomma* to Theraphosidae. Herein, we amended the diagnosis and description of *C. monticola*, providing a redescription of the male, and new illustrations, including the description of a new cuticular structure consisting of thick and stiff setae on dorsal metatarsi I and II of females. Moreover, we diagnose, describe and illustrate a new species of *Cyrtogrammomma* from northeastern Brazil: *C. frevo* sp. nov. In addition, we provide an identification key, new distribution records of the genus in the states of Alagoas, Bahia, Pará, and Pernambuco, in Brazil, and the first record for the genus in caves.

Key Words

Atlantic Forest, Barychelidae, first record, *Trichopelma* Simon, 1888

Introduction

The genus *Cyrtogrammomma* consists of small theraphosids (12–14 mm) with an overall dark brown coloration, which build and live in silk-lined burrows in the soil, closed with a camouflaged operculum, which functions as a trapdoor. Originally, the monotypic genus *Cyrtogrammomma* was proposed based on a single female from Monte Roraima, Guyana (Pocock 1895). Years later, Pocock (1900), based on additional adult specimens of both sexes from the same locality of the holotype, described the male of *C. monticola* Pocock, 1895 and allocated the genus in the Barychelidae. Raven (1985) included the genus in the subfamily Barychelinae, due to the eyes' group shape (in three rows or the anterior lateral eyes on the carapace margin) and the apical segment of posterior lateral spinnerets in domed form, very short. *Cyrtogrammomma* currently comprises

two species: *C. monticola* Pocock, 1895 and *C. raveni* Mori & Bertani, 2020, recorded only in Guyana, northern South America (World Spider Catalog 2022).

The latest cladistic analysis, based on morphological characters and performed to understand the relationships of Theraphosidae, Barychelidae, and Paratropididae, supported the transfer of *Cyrtogrammomma* from Barychelidae to Theraphosidae (Mori and Bertani 2020). This analysis showed that *Cyrtogrammomma* is a monophyletic genus, sister group of *Trichopelma* Simon, 1888, well supported by the low number of maxillary and labial cuspules, anterior eyes row strongly procurved, leg I of the male with scopula on tarsus and part of metatarsus and tibial spur absent on males (Mori and Bertani 2020).

After the examination of the mygalomorph spiders from several collections, we redescribed *Cyrtogrammomma monticola* with new illustrations and the description of a

new cuticular structure and included the first record in a cave and notes on natural history for the genus. Additionally, we described a new species of *Cyrtogrammomma* from northeastern Brazil. Furthermore, an identification key and an updated map for the distribution of the species of the genus are presented.

Materials and methods

Taxonomic descriptions

Descriptions of the specimens were made under a Leica MZ6 stereo microscope. All measurements are in millimeters. Total body length includes carapace and abdomen without chelicerae and spinnerets. Length and width of carapace, eye tubercle, labium and sternum are the maximum values obtained. The length measurements of leg segments were obtained between joints in dorsal view. Terminology for number and disposition of spines follows Petrunkevitch (1925), with the modifications proposed by Bertani (2001).

Digital multifocal photos were taken with a Leica DFC500 digital camera attached to a Leica MZ16A stereoscopic microscope. Extended focal range images were composed with Leica Application Suite version 2.5.0. The specimens were prepared for scanning electronic microscopy (SEM) following Galleti-Lima and Guadanucci (2019). SEM photos were taken in the Scanning Electron Microscope FEI Quanta 250 SEM at the Laboratório de Biologia Celular of the Instituto Butantan.

The spermathecae were dissected and submitted to digestion of the non-chitinous tissue by Ultrazyme Enzymatic Cleaner for 24hrs, with a tablet diluted in 5 mL of distilled water. The internal structure was illustrated in a dorsal view. Male palpal bulb was removed from the cymbium and illustrated.

Geographic coordinates were obtained through information on the collections' original labels. For specimens collected in caves, coordinates were recorded near the main cave entrance using the Garmin GPSmap 60CSx. Localities from museum samples without coordinates, were georeferenced to the geographic center of the given locality using Google Maps. The geographic distribution of the species was mapped using the software ArcGIS 10.3 Desktop software (Esri 2007).

Institutional abbreviations (curators in parentheses)

- CAD** Coleção Aracnológica Diamantina, São Paulo, Brazil (J.P.L. Guadanucci);
IBSP Instituto Butantan, São Paulo, Brazil (A.D. Brescovit);
MPEG Museu Paraense Emílio Goeldi, Pará, Brazil. (A.B. Bonaldo);
NHM Natural History Museum, London, England (J. Beccaloni).

Morphological abbreviations

The following abbreviations are used in the text and figures: ap, apical; AME, anterior median eyes; ALE, anterior lateral eyes; d, dorsal; IRC, inferior reduced claw; p, prolateral; PC, preening combs; PL, prolateral lobe; PLE, posterior lateral eyes; PLS, posterior lateral spinnerets; PME, posterior median eyes; PMS, posterior median spinnerets; r, retrolateral; RL, retrolateral lobe; STC, superior tarsal claws; v, ventral.

Results

Taxonomy

Araneae Clerck, 1757

Theraphosidae Thorell, 1869

Genus *Cyrtogrammomma* Pocock, 1895

Cyrtogrammomma Pocock, 1895: 139.

Cyrtogrammomma — Simon, 1895: 1066; 1903: 912, 913. — Mello-Leitão 1923: 355. — Petrunkevitch 1928: 73. — Roewer 1942: 214. — Bonnet 1956: 1354. — Raven 1985: 111, 114. — Mori and Bertani 2020: 124–127.

Type species. *Cyrtogrammomma monticola* Pocock, 1895, by monotypy.

Diagnosis. *Cyrtogrammomma* can be distinguished by the short distal article of the PLS; anterior eye row strongly procurved with the anterior lateral eyes on the carapace margin; lack of tibial apophysis and cymbium elongated on males and few cupules on labium (3–15 cupules). *Cyrtogrammomma* resembles *Trichopelma* by short distal article of the PLS, male palpal bulb with pyriform aspect, and female spermatheca with two bilobed receptacles. The genus differs from *Trichopelma* by the absence of booklung combs, lack of tibial apophysis, and male cymbium lobes strongly pronounced, retrolateral lobe slightly longer than the prolateral lobe.

Description. See Mori and Bertani 2020.

Included species. *Cyrtogrammomma monticola* Pocock, 1895; *C. raveni* Mori & Bertani, 2020; *C. frevo* sp. nov.

Distribution. Brazil: states of Alagoas, Bahia, Pará, Pernambuco; Guyana: Kamakusa; Monte Roraima.

Cyrtogrammomma monticola Pocock, 1895

Figs 1–9

Cyrtogrammomma monticola Pocock, 1895: 139. — Pocock 1990: 66. — Simon 1895: 1066; 1903: 912, 913. — Mello-Leitão 1923: 355. — Petrunkevitch 1928: 73. — Roewer 1942: 214. — Bonnet 1956: 1354; — Raven 1985: 111, 114; — Mori and Bertani 2020: 125.

Type-material. *Holotype* ♀. GUYANA: Cuyuni-Mazaruni, Monte Roraima (8500ft), 5°13'N, 60°44'W, J. J. Quelch leg., (BM1895.3.20.2), not examined.



Figure 1. *Cyrtogrammomma monticola*, ♂, (BM1899.3.14.4-13). **A, B.** Habitus; **A.** Dorsal view; **B.** Ventral view; **C.** Eyes group, dorsal view; **D.** Labium and endites, ventral view; **E–H** Right cymbium; **E.** Dorsal view; **F.** Ventral view; **G.** Prolateral view; **H.** Retrolateral view. Abbreviations: PL = Prolateral lobe; RL = Retrolateral lobe. Scale bars: 2 mm (**A, B**); 1 mm (**C, D**); 0.5 mm (**E–H**).

Additional material examined. BRAZIL: Pará: 1 ♂ 3 ♀, Aveiro; Caverna Paraíso, 04°04'33.6"S, 55°27'32.4"W, 04-07.x.2020, R. Fonseca-Ferreira, R.L. Ferreira & M. Souza-Silva leg. (CAD 850 ♂, CAD851 ♀, CAD 852 ♀, IBSP 284610 ♀); 1 ♀; Rurópolis; Caverna das Mãos, 04°09'25.2"S, 55°04'19.2"W, R. Fonseca-Ferreira, R.L. Ferreira & M. Souza-Silva leg. (CAD 854); 1 ♀; Almeirim; 01°1'33.12220"S, 52°34'2.78573"W, 15.v.2005, T. Gardner & M.A. Ribeiro Júnior leg. (MPEG 7464). GUYANA: Cuyuni-Mazaruni, 2 ♂ 10 ♀, same data as the holotype (BM1899.3.14.4-13).

Amended diagnosis. Males of *Cyrtogrammomma monticola* resemble those of *C. frevo* sp. nov. by the palpal bulb with a straight embolus without keels (Figs 1G, H, 3F–H, 10H–J), but differ in the absence of “spoon-shaped” tip (Fig. 10H–L). Females can be distinguished from *C. frevo* sp. nov. by the spermathecae with long and straight ducts (Figs 2C, 4E), and from *C. raveni* by having several rounded lobes on the apex.

Redescription. Male. (CAD 850): Total length: 8.46. Carapace 6.02 long, 5.5 wide, thoracic striae distinct.

Caput raised. Fovea: 0.78 wide, straight. Clypeus absent. Eyes tubercle trapezoidal and slightly raised (Fig. 3D). Eight eyes on tubercle 1.02 long, 0.83 wide. Anterior eye row strongly procurved, posterior row straight (Fig. 3D). Eyes diameters and interdistances: AME 0.31, ALE 0.32, PME 0.08, PLE 0.21; ALE-ALE 0.52, ALE-AME 0.11, AME-PME 0.12, PME-PME 0.57, PLE-PME 0.05, AME-AME 0.15, ALE-PLE 0.27. Labium: ellipsoid, 0.5 long, 1.14 wide, having two rounded cupules on distal third (Fig. 3E). Chelicerae: 11 prolateral teeth and 14 tiny teeth on inner edge. Rastellum composed of weak and long setae, ca. 27 conical spines on promargin. Labiosternal groove shallow, flat, with pair of sigilla. Maxillae: 1.9 long, 1.12 wide, with ca. 15 cuspules in the inner corner. Heel reduced. Anterior lobe short, not projected (Fig. 3E). Sternum 3.11 long, 3.68 wide. Abdomen: Book lungs semi-circular, elliptical aperture, and book lungs combs absent (Fig. 3C). Palp (femur, patella, tibia, cymbium, total): 3.6, 2.05, 3.06, 1.73, 10.44. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 6.29, 2.98, 4.91, 4.52, 2.61, 21.31; II: 6.11, 3.01, 4.87, 4.85, 2.74, 16.71; III: 5.48,

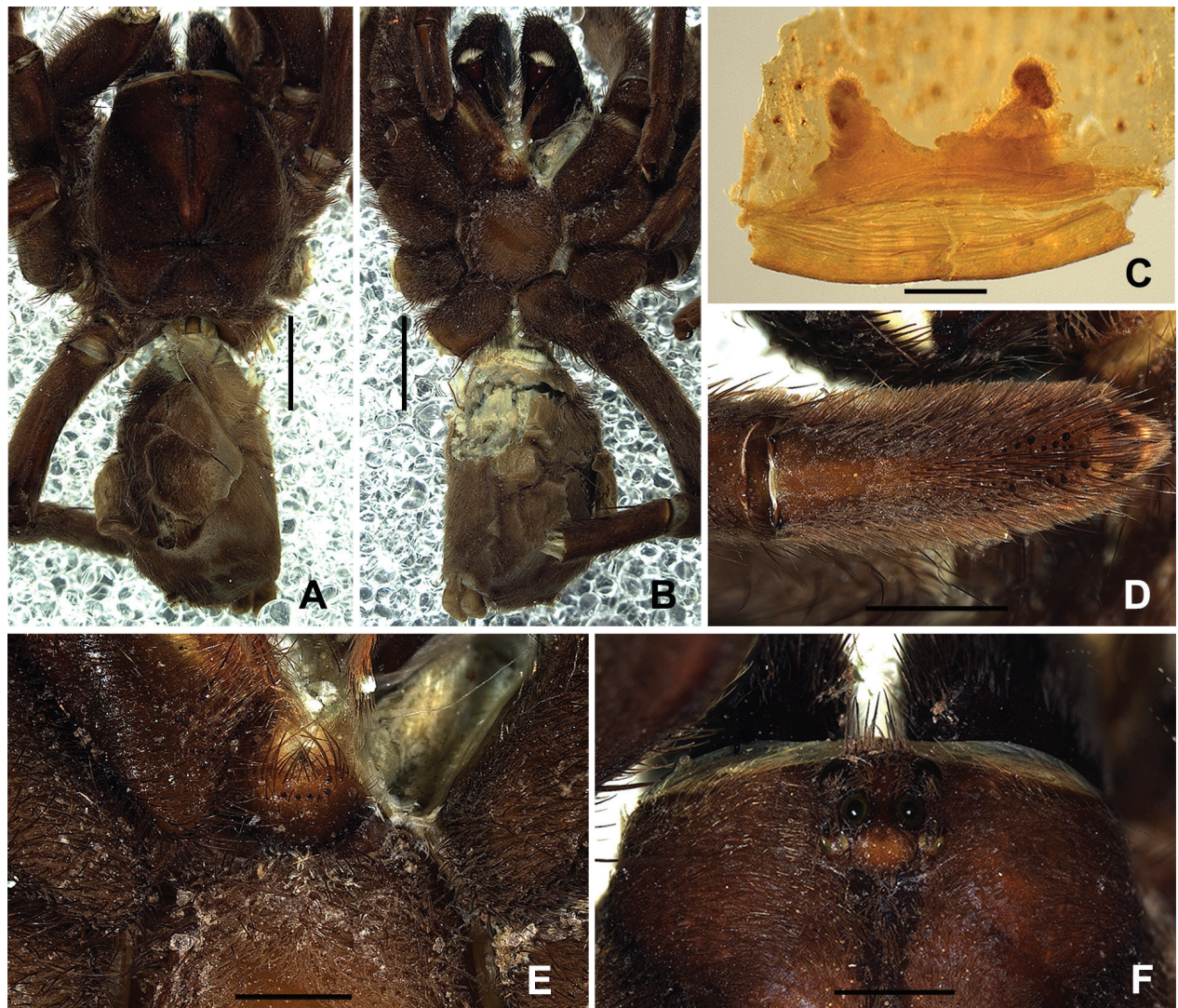


Figure 2. *Cyrtogrammomma monticola*, ♀, (BM1899.3.14.4-13). **A, B.** Habitus; **A.** Dorsal view; **B.** Ventral view; **C.** Spermathecae, dorsal view; **D.** Tarsus, dorsal view; **E.** Labium, ventral view; **F.** Eyes group, dorsal view. Scale bars: 2 mm (**A, B**); 0.2 mm (**C**); 1 mm (**D–F**).

2.4, 3.95, 5.42, 2.77, 20.02; IV: 7.5, 2.89, 6.26, 8.63, 3.18, 28.46. Spination: Leg I: femur p0-1-1-0-1-1, tibia v1-1-0-1-0-2ap, metatarsus v0-1-0; II: femur p0-1-1-0-1, tibia v0-1-1-0-2ap, metatarsus v1-0; III: femur p0-1, patella p0-1, tibia v0-1-2-0-1p-0-3ap, metatarsus v0-1-0-1-0-3ap, d0-1r-1p-0-1p-1-0-2-4ap; IV: femur d0-1, tibia v1r-0-1-0-1-1p-0-0-1p-1r-0-3ap, metatarsus v0-1-0-1-0-0-1p-0-3ap, d0-2-0-0-2-0-1-1. PC absent. Clavate trichobothria in two rows on distal half on all tarsi. Claws: IRC absent. STC bare. Scopula: Absent in all tibiae; Cymbium 1/3. Tarsi I–IV fully scopulate, metatarsi I–II all scopulate, III 1/2, IV 1/4 ap; tarsi I–II not divided, III–IV divided by a band of weak setae. Tibial apophysis absent.

Palp: Palpal bulb pyriform, subtegulum globose with four times longer embolus, triangular tip (Fig. 3F–H). Cymbium elongated with deep incision, prolateral and retrolateral lobe strongly projected (Fig. 3I–K).

Spinnerets: PMS 0.06. PLS: basal 0.64, median 0.35, apical 0.08. Apical segment domed (Fig. 3C).

Color pattern (preserved in alcohol): Carapace, chelicerae and legs light brown, femora darker. Car-

pace with yellowish setae. Ventrally yellowish brown. Abdomen dark brown, dorsal spotted pattern not visible. Spinnerets pale (Fig. 3A–C).

Female (CAD 851): Total length: 12.3. Carapace 7.05 long, 6.12 wide, thoracic striae distinct. Caput raised. Fovea: 1.1 wide, straight. Clypeus absent. Eyes tubercle trapezoidal and slightly raised. Eight eyes on tubercle 1.19 long, 1.48 wide. Anterior eye row strongly procurved, posterior row straight (Fig. 4C). Eyes' diameters and interdistances: AME 0.25, ALE 0.36, PME 0.13, PLE 0.31. ALE-ALE 0.7, ALE-AME 0.27, AME-PME 0.24, PME-PME 0.8, PLE-PME 0.7, AME-AME 0.28, ALE-PLE 0.33. Labium: trapezoidal, 1.04 long, 1.61 wide, having two cupules rounded on distal on third (Fig. 4B). Chelicerae: 8 prolateral teeth and 13 tiny on inner edge. Rastellum composed of long setae, ca. 27 conical spines on promagin. Labiosternal groove shallow, flat, with pair of sigilla. Maxillae: 3.34 long, 1.66 wide, with ca. 15 cuspules in the inner corner. Heel distinct. Anterior lobe short not projected. Sternum 4.5 long, 2.77 wide. Abdomen: Book lungs

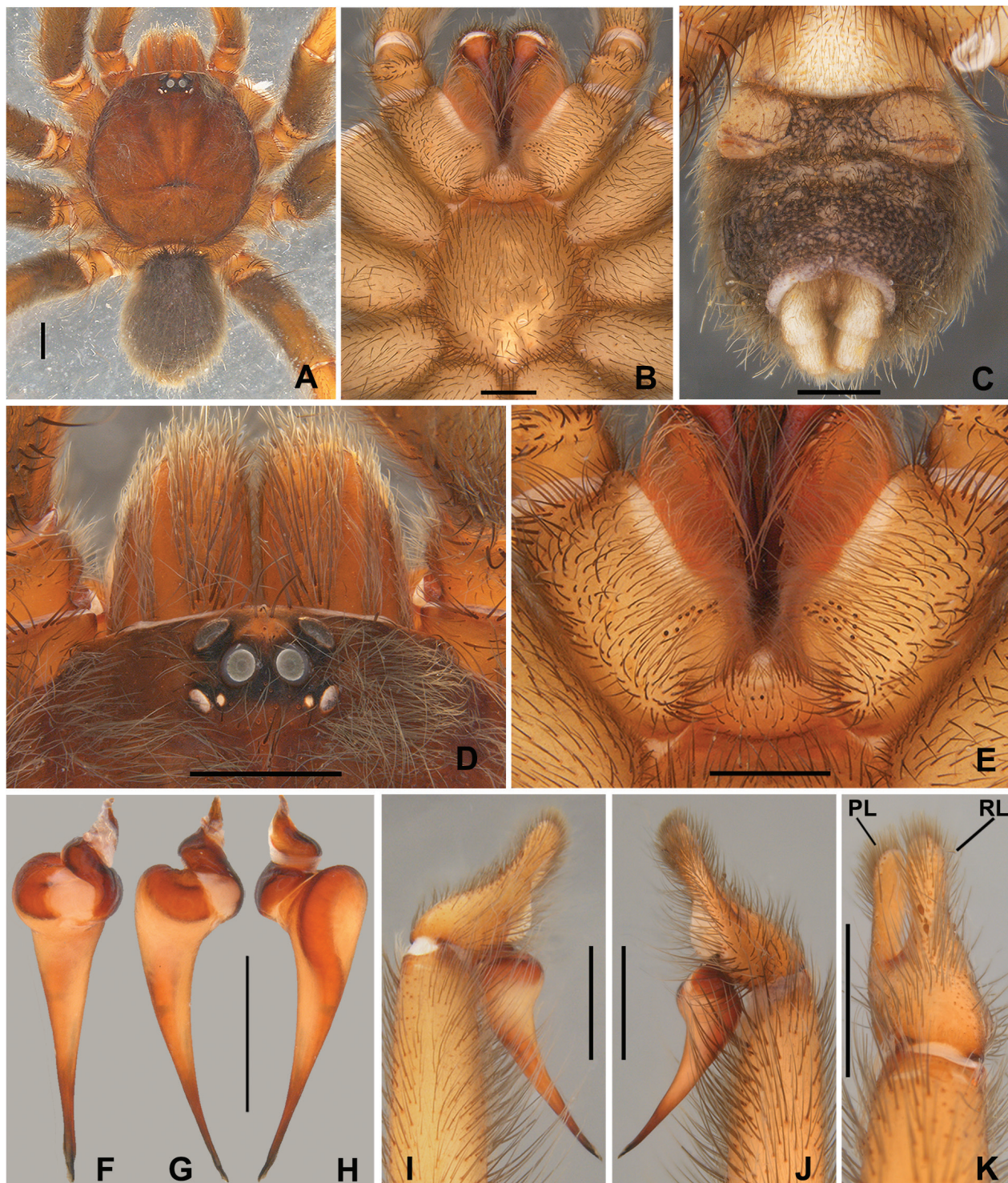


Figure 3. *Cyrtogrammomma monticola*, ♂, (CAD 850). **A.** Habitus, dorsal view; **B.** Prosoma, ventral view; **C.** Abdomen, ventral view; **D.** Eyes group, dorsal view; **E.** Labium and endites, ventral view; **F–H** Right male palpal bulb; **F.** Ventral view; **G.** Prolateral view; **H.** Retrolateral; **I–K** Cymbium: **I.** Prolateral view; **J.** Retrolateral view; **K.** Dorsal view. Abbreviations: PL = Prolateral lobe; RL = Retrolateral lobe. Scale bars: 1 mm (A–K).

semi-circular, elliptical aperture, and book lungs combs absent. Palp (femur, patella, tibia, cymbium, total): 4.41, 3.07, 2.95, 2.79, 13.22. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 5.76, 3.94, 3.52, 3.19, 1.96, 18.37; II: 5.87, 3.95, 3.82, 3.38, 1.92, 18.95; III: 5.47, 3.22, 3.37, 3.98, 1.85, 17.89; IV: 7.53, 3.91, 5.57, 7.32,

2.38, 26.71. Spination: palp: tibia v0-2-1-1-0-4ap. Leg I: femur p0-1; tibia v1-0-1-0-1ap; metatarsus v1-0-1ap; III: femur d0-1, patella v0-1-1ap, tibia v0-1-0-1-0-3ap, d0-2-2-0, metatarsus v0-1-1p-0-3ap, d0-1p-0-2-2; IV: femur d0-1, tibia v0-1-1-0-2-1p-0-1r-4ap, metatarsus v0-1-2d-0-1-0-1p-0-3ap, d0-1-0-2-1ap. PC absent.

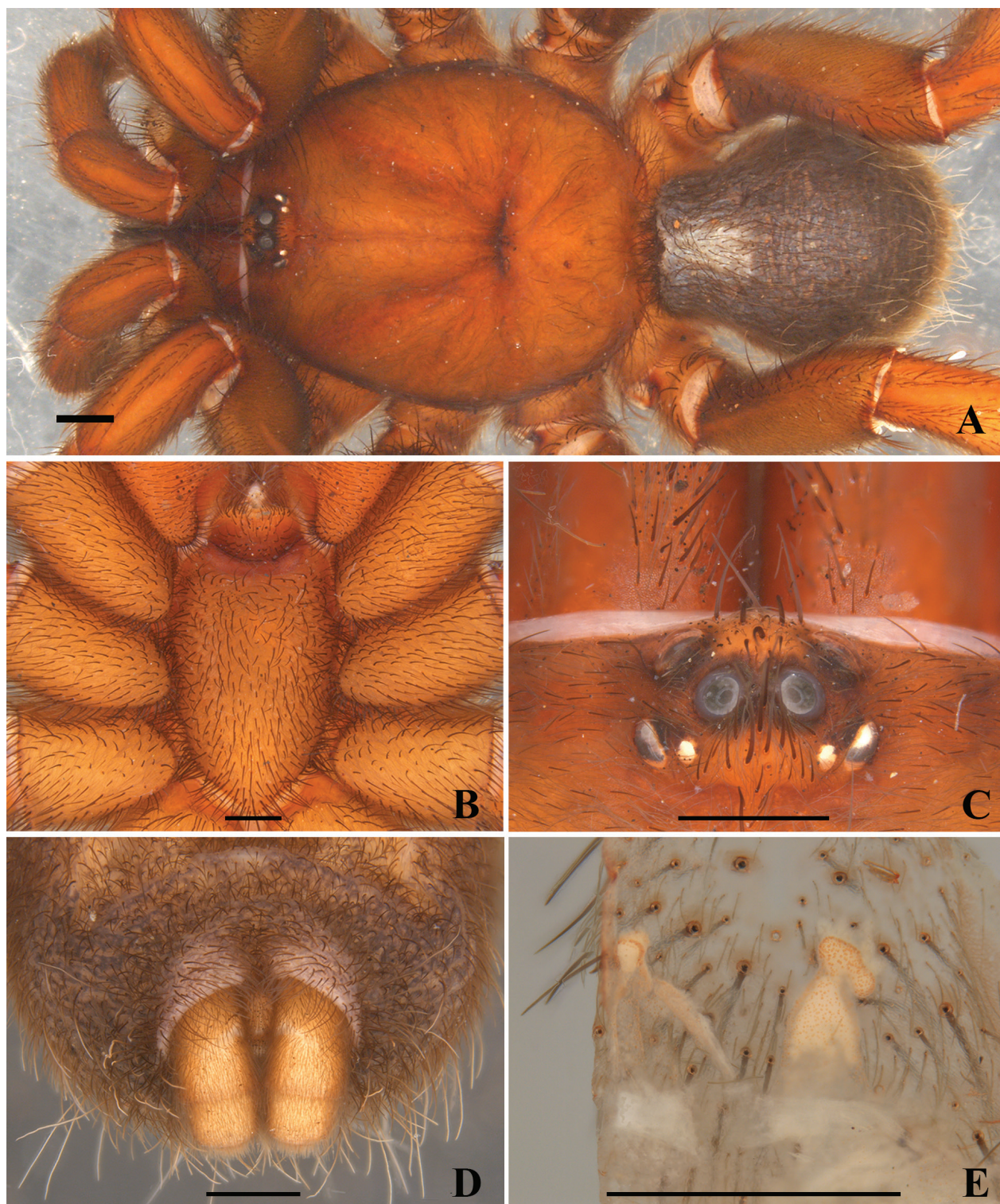


Figure 4. *Cyrtogrammomma monticola*, ♀, (CAD 851). **A.** Habitus, dorsal view; **B.** Sternum and labium, ventral view; **C.** Eyes group, dorsal view; **D.** Spinnerets, ventral view; **E.** Spermathecae, dorsal view. Scale: 1 mm (A–E).

Clavate trichobothria in two rows on distal half on all tarsi, 12 clavate trichobothria in each row. Matchstick type setae: dorso-prolateral on metatarsus I–II (Figs 8, 9). Claws: IRC absent. STC bare. Scopula: Absent in all tibiae; Tarsi I–IV fully scopulate, metatarsi I–II fully scopulate, III 1/3, IV 1/4; tarsi I–II not divided, III–IV divided by a band of setae. Spinnerets: PMS 0.06. PLS:

basal 1.09, median 0.46, apical 0.06. Apical segment domed (Fig. 4D).

Spermathecae: partially damaged. Two seminal receptacles; the ducts having a thickened basal half and narrow apical half, with strong constriction between the duct and the receptacles (Fig. 4E). Long and straight stalk with an apical globose lobe.



Figure 5. *Cyrtogrammomma monticola*, ♀, (CAD 852), live specimen from Gruta do Paraíso, Aveiro, Pará, Brazil, dorsal view. Photo: Wolf J Moeller.

Color pattern (preserved in alcohol): Carapace, chelicerae and legs reddish brown. Abdomen dark brown, dorsal spotted pattern not visible. Spinnerets pale (Fig. 4A).

Color pattern (live specimens): General appearance dark brown. Femora darker. Abdomen brown with a few whitish setae and light brown spots dorsally not conspicuous (Figs 5, 7).

Natural history. *C. monticola* spiders live in trap-door burrows, with a hinged lid, which is thin and soft (Fig. 6). The burrows can be found on ravines, and are usually camouflaged with moss, grains of sand and/or clay (Fig. 6A). Cave specimens were found in ravines and sediment banks deposited inside caves, including in aphotic regions, with their burrows usually close to each other.

Remarks. Mori and Bertani (2020) redescribed the genus based only on the holotype female and a new species from Kamakusa, Guyana. However, they did not dissect the spermathecae because of the poor condition of the specimen. This specimen was not found in the collection of the Natural History Museum (NHM) by one of the authors (HMOGF). However, examining the type-material cabinet of the NHM, we found additional specimens containing adults of both sexes used by Pocock (1900) to supplement the initial description of the male and some additional features of the females (BM1899.3.14.4-13),

which enabled us to illustrate the spermathecae for the first time, as well as the redescription of the male (Figs 1, 2). Due to the poor condition of the holotype, here we use recently collected specimens from Brazil that match the original description to add new measurement data. The male illustrated here appears to have a broken tip in the embolus (Fig. 1G, H).

Distribution. Brazil: Pará; Guyana: Cuyuni-Mazaruni and Kamakusa (Fig. 15).

***Cyrtogrammomma frevo* sp. nov.**

<http://zoobank.org/EB7C88DA-A43B-4146-8D34-57FC7E1B4489>

Figs 10–14

Type-material. Holotype ♂. BRAZIL: Alagoas: Murici, Estação Ecológica de Murici, 09°13'47"S, 35°50'10"W, 13–22.ix.1997, N.F.L.M. Hung leg. (IBSP 15220).

Paratypes: BRAZIL: Pernambuco: Jaqueira, Reserva Particular de Patrimônio Natural Frei Caneca, 8°42'41"S, 35°50'30"W, vii.2012, A. Costa leg., 1♀ (IBSP 165145); Alagoas: Murici, Estação Ecológica de Murici, 09°13'47"S, 35°50'10"W, 13–22.ix.1997, N.F.L.M. Hung leg. 1 ♂ (IBSP 15221); Bahia: Jandaíra, Mangue Seco, 11°33'50"S, 37°47'02"W, 1♀ (IBSP 131712).



Figure 6. *Cyrtogrammomma monticola*, ♀, (CAD 852). A, B Detail of the trapdoor of the specimen. A. Trapdoor camouflaged; red arrow points to the closed trapdoor; B. Trapdoor with the door open. Photos: Rafael Fonseca-Ferreira.



Figure 7. *Cyrtogrammomma monticola*, ♀, (CAD 852). **A, B** live specimen from Gruta do Paraíso, Aveiro, Pará, Brazil. **A.** live specimen, dorsal view; **B.** Detail of the metatarsus I and II, black arrows pointing to the matchstick setae. Photo: Wolf J Moeller.



Figure 8. *Cyrtogrammomma monticola*, ♀, (CAD 852). **A, B** Matchstick setae. **A.** tarsus and metatarsus leg I, prolateral view. **B.** tarsus and metatarsus leg I, dorsal view. Red arrows showing matchstick setae. Scale: 1 mm (**A, B**).

Additional material examined. BRAZIL: Bahia: 3♀, Jandaíra, Mangue Seco; 11°33'50"S, 37°47'02"W, (IBSP 131713, IBSP 131714, IBSP 131715); 1 juvenile, Camaçari, Praia de Barra do Jacuípe, 2012 (IBSP 248209); 5 juveniles; Salvador, Lauro Freitas, 12°53'38"S, 38°19'37"W, viii.2012, T.S. Melo leg. (IBSP 165156); 2♀, Jaguaripe, 13°6'46"S, 38°53'45"W; 2014, C.M.P. Leite leg. (IBSP 166186); 8♂, Pernambuco: Recife, Horto Dois Irmãos, 8°0'44.197"S, 34°56'45.991"W, vii–xi.2000, M. Perez leg. (IBSP 116561, 116562, 116563, 116564, 116565, 116566, 116567, IBSP 11668); 1♀ 3 juveniles, Sirinhaém, 8°35'27"S, 35°6'57"W, xii.2012–i.2013, R.V. Urbinati leg. (IBSP 165147).

Etymology. The species name is a noun in apposition derived from the typical dance of the Carnival of Pernambuco state.

Diagnosis. *Cyrtogrammomma frevo* sp. nov. can be recognized by the presence of a pattern of lateral stripes and central dots on the dorsal face of the abdomen (Figs 10A,

12A). Furthermore, it differs from *C. monticola* by having the PMS shorter (Fig. 11A, B) and from *C. raveni* by having a few cuspules (fewer than five) concentrated in the anterior half of the labium (see Mori and Bertani 2020, fig. 338). Males differ from *C. monticola* by the presence of a “spoon-shaped” tip on the embolus (Fig. 10H–L). Females can be distinguished by the spermathecae receptacle with short ducts (Fig. 12D).

Description. **Male** (holotype IBSP 15220). Total length: 8.6. Carapace 4.35 long, 3.8 wide, thoracic striae slightly distinct. Caput slightly raised. Fovea: 0.45 wide, straight. Clypeus absent. Eyes tubercle trapezoidal and slightly flat (Figs 10G, 11C). Eight eyes on tubercle 0.67 long, 0.7 wide. Anterior eye row strongly procurved, posterior row straight. Eyes' diameters and interdistances: AME 0.15, ALE 0.15, PME 0.1, PLE 0.17; ALE-ALE 0.27, ALE-AME 0.1, AME-PME 0.06, PME-PME 0.22, PLE-PME 0.04, AME-AME 0.12, ALE-PLE 0.27. Labium: ellipsoid, 0.3 long, 0.7 wide, having two rounded

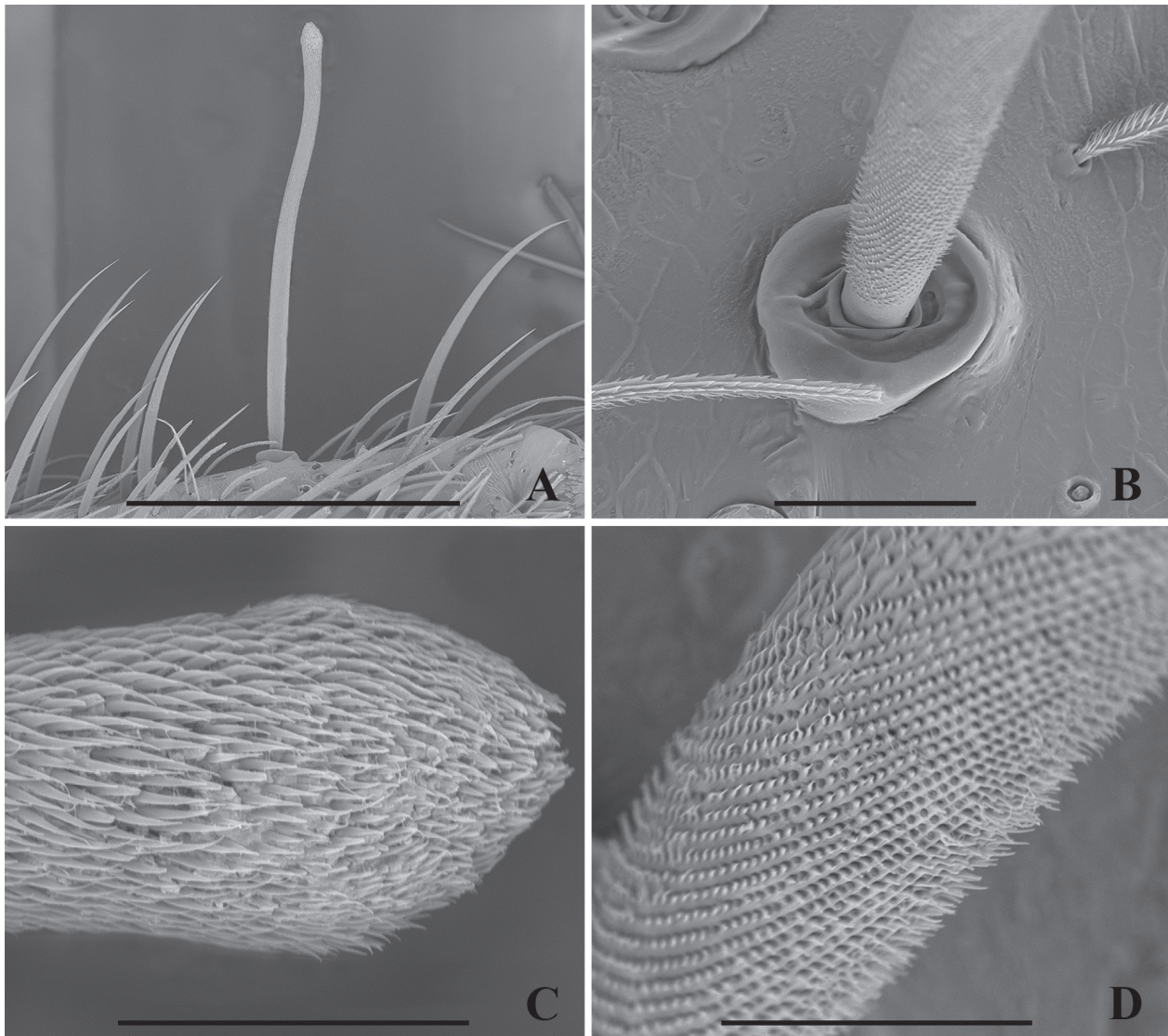


Figure 9. *Cyrtogrammomma monticola*, ♀, (CAD 852), SEM micrographies. **A** matchstick seta, prolateral view. **B**. socket detail, dorsal view. **C**. detail of the apex. **D**. detail of the stalk. Scale: 50 nm (**A**, **B**); 30 nm (**C**, **D**).

cupules on distal third (Fig. 10F). Chelicerae: 7 prolateral teeth and 12 tiny teeth on inner edge. Rastellum composed of weak and long setae, *ca.* 21 conical spines on promargin. Labiosternal groove shallow, flat, with pair of sigilla. Maxillae: 1.53 long, 0.7 wide, with *ca.* 9 cuspules in the inner corner. Heel reduced. Anterior lobe short, not projected (Fig. 10F). Sternum 1.89 long, 2.07 wide. Abdomen: Book lungs semi-circular, elliptical aperture, and book lungs combs absent. Palp (femur, patella, tibia, cymbium, total): 1.85, 1.2, 1.15, 1.25, 5.45. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 2.7, 2, 1.85, 1.6, 0.85, 9; II: 2.7, 1.85, 1.95, 1.75, 1.2, 9.45; III: 2.25, 1.55, 1.7, 2.1, 1.3, 8.9; IV: 3.25, 1.6, 2.5, 1.4, 3.25, 12. Spination: palp: tibia v0-1-1-1ap. Leg I: femur p0-0-1, patella v0-0-1ap, tibia v2-0-1-0-3ap, metatarsus v0-1; II: femur p0-0-1, patella v0-1ap, tibia v1-0-1-0-1ap, metatarsus v1-0; III: femur p0-1, patella v0-1ap, tibia v0-1-1p-0-2-1-3ap, metatarsus v0-1-1-0-1-0,d0-1-0-2-4ap; IV: femur d0-0-1, tibia v0-1-2-1p-0-1-1-0-1r-0-4, metatarsus v1p-

0-1r-0-1-0-1r-0-1-0, d0-1-0-0-1-4ap. PC absent. Clavate trichobothria non-plumose type with small barbs in two rows on distal half on all tarsus. Claws: IRC absent. STC on tarsus I–II without teeth, III with 3 teeth, IV with 2 teeth; palpal claw bare. Scopula: Absent in all tibiae; Tarsi I–IV fully scopulate, metatarsi I–II 3/4, III 2/3, IV 1/4 ap; tarsi I–II not divided, III–IV divided by a band of setae. Tibial apophysis absent (Fig. 11D).

Palp: Palpal bulb pyriform with a straight embolus and a “spoon-shaped” tip (Fig. 10H–L). Cymbium elongated with deep incision, prolateral and retrolateral lobe strongly projected (Figs 10C–E, 11E, F).

Spinnerets: PMS: 0.04. PLS: basal 0.52, median 0.2, apical 0.05. Apical segment domed (Fig. 11A, B).

Color pattern (preserved in alcohol): Carapace, chelicerae and legs brown, femora dark brown. Ventrally yellowish brown. Abdomen dorsal with 8 spots in the middle alternate with lateral stripes. Spinnerets pale (Fig. 10A, B).

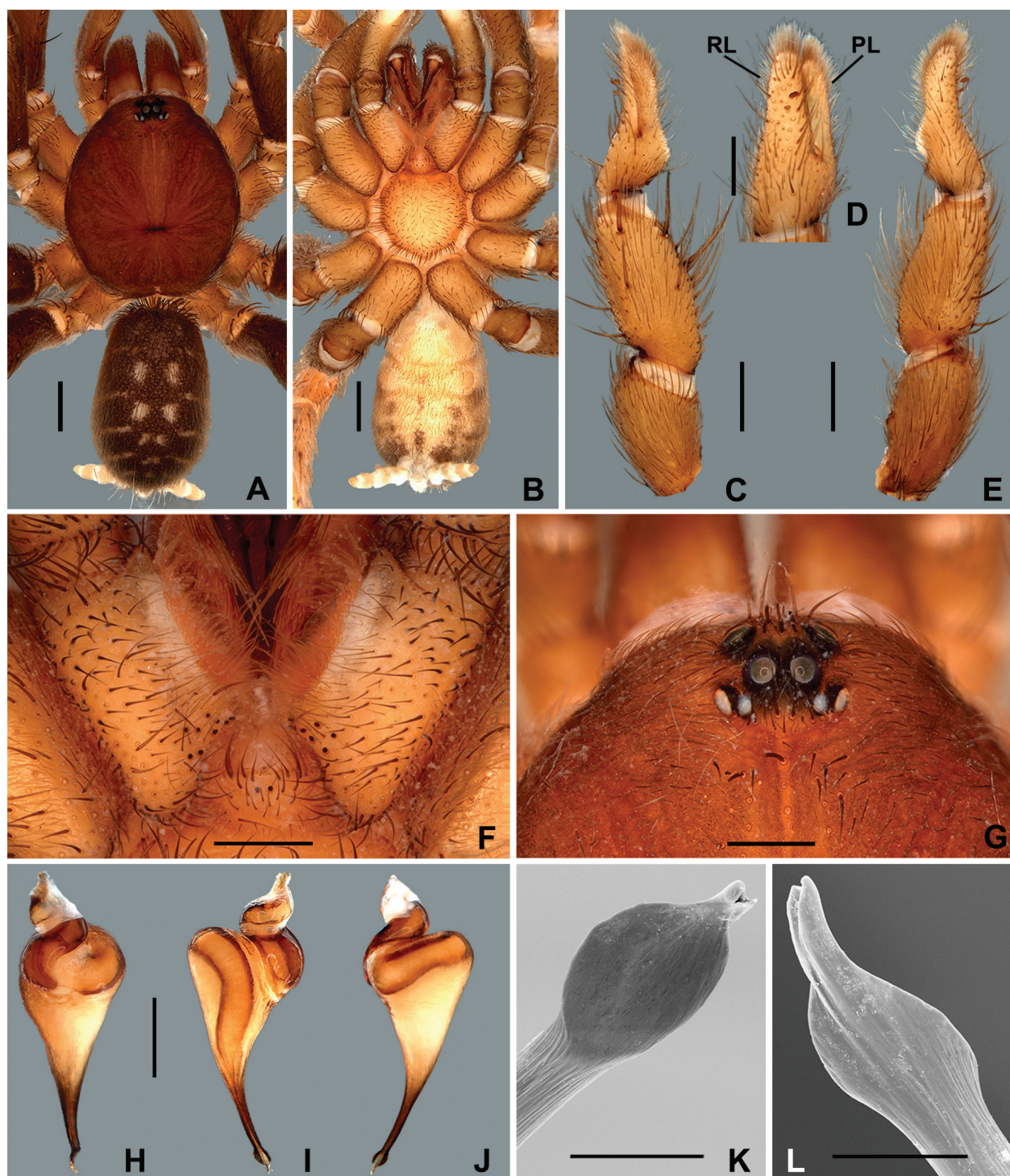


Figure 10. *Cyrtogrammomma frevo* sp. nov., ♂, holotype (IBSP 15220). **A, B.** Habitus: **A.** dorsal view; **B.** ventral view; **C.** Left pedipalp, prolateral view; **D.** Left cymbium, dorsal view; **E.** Left pedipalp, retrolateral view; **F.** Labium and endites, ventral view; **G.** Eyes group, dorsal view; **H–J** Male palpal bulb: **H.** Ventral view; **I.** Prolateral view; **J.** Retrolateral; **K, L.** Microphotographies of the apex of the palpal embolus: **K.** retrolateral view; **L.** prolateral view. Abbreviations: PL = Prolateral lobe; RL = Retrolateral lobe. Scale bars: 1 mm (**A, B**); 0.5 mm (**C–G**); 500 nm (**K, L**).

Female (Paratype IBSP 165145): Total length: 12.35. Carapace 5.1 long, 4.65 wide, thoracic striate distinct. Caput raised. Fovea: 0.57 wide, straight. Clypeus absent. Eyes tubercle trapezoidal and slightly flat (Fig. 12C). Eight eyes on tubercle 0.68 long, 0.8 wide. Anterior eye row strongly procurved, posterior row straight. Eyes'

diameters and interdistances: AME 0.17, ALE 0.15, PME 0.1, PLE 0.2; ALE-ALE 0.25, ALE-AME 0.1, AME-PME 0.07, PME-PME 0.22, PLE-PME 0.05, AME-AME 0.11, ALE-PLE 0.25. Labium: ellipsoid, 0.47 long, 0.85 wide, having two or three cupules rounded on distal on third (Figs 12B, 13C, D). Chelicerae: 8 prolateral teeth and

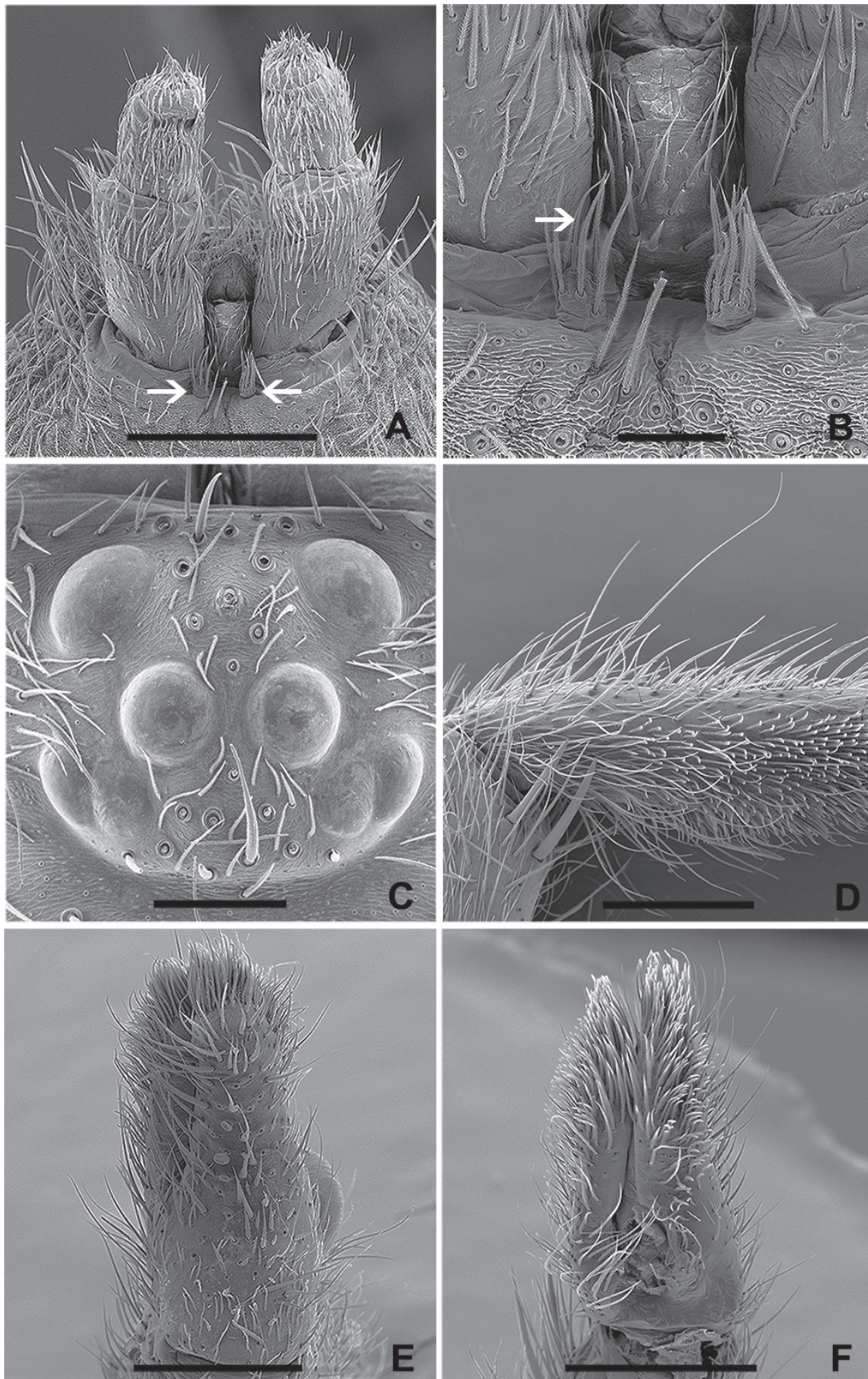


Figure 11. *Cyrtogrammomma frevo* sp. nov., ♂ (IBSP 15221), SEM micrographies. **A.** Spinnerets, black arrows pointing to the posterior median spinnerets, ventral view; **B.** Posterior Median Spinnerets in detail, black arrows pointing to the fusula, ventral view **C.** Eyes group; **D.** Tibia and metatarsus of the leg I, prolateral view; **E, F.** Cymbium; **E.** Dorsal view; **F.** Ventral view. Scale bars: 500 nm (**A**); 100 nm (**B**); 200 nm (**C**); 500 nm (**D–F**).



Figure 12. *Cyrtogrammomma frevo* sp. nov., ♀, paratype (IBSP 165145). **A.** Habitus, dorsal view; **B.** Sternum, labium and endites, ventral view; **C.** Eyes group, dorsal view; **D.** Spermathecae, dorsal view; **E.** Tarsus I, dorsal view. Scale bars: 1 mm (A); 0.5 mm (B, C, E); 0.2 mm (D).

13 tiny teeth on inner edge. Rastellum composed of long setae, *ca.* 22 conical spines on promargin. Labiosternal groove shallow, flat, with pair of sigilla. Maxillae: 1.7 long, 0.57 wide, with *ca.* 12 cuspules in the inner corner. Heel reduced. Anterior lobe short, not projected (Fig. 12B). Sternum 2.48 long, 2.88 wide. Abdomen: Book lungs semi-circular, elliptical aperture, and book lungs combs absent (Fig. 14B). Palp (femur, patella, tibia, cymbium, total): 1.85, 1.35, 1.25, 1.3, 5.75. Legs (femur, patella, tibia, metatarsus, tarsus, total): I: 2.8, 2.05, 1.9, 1.7,

1, 9.45; II: 2.75, 1.85, 1.85, 1.5, 1.3, 9.25; III: 2.4, 1.7, 1.8, 2.2, 1.2, 9.3; IV: 3.25, 1.65, 2.6, 3.25, 1.5, 12.25. Spination: palp: tibia v0-1ap. Leg I: tibia v0-1ap; femur p0-0-1, tibia v1-0-1ap; III: femur d0-1, patella v0-1-1ap, tibia v0-2-0-1p0-1, d1p-0-1-0-4ap, metatarsus v0-2-0-1r-1-0-1p-0-0-4ap; IV: femur d0-0-1, tibia v0-1-1-0-0-1p-1-1-0-3ap, metatarsus v0-1-2-0-1-1p-0-1r-0-4ap. PC absent. Tarsal organ located in the distal part of the tarsus, oval, slightly elevated on the distal part (Fig. 13B). Clavate trichobothria non-plumose type with small barbs in two rows

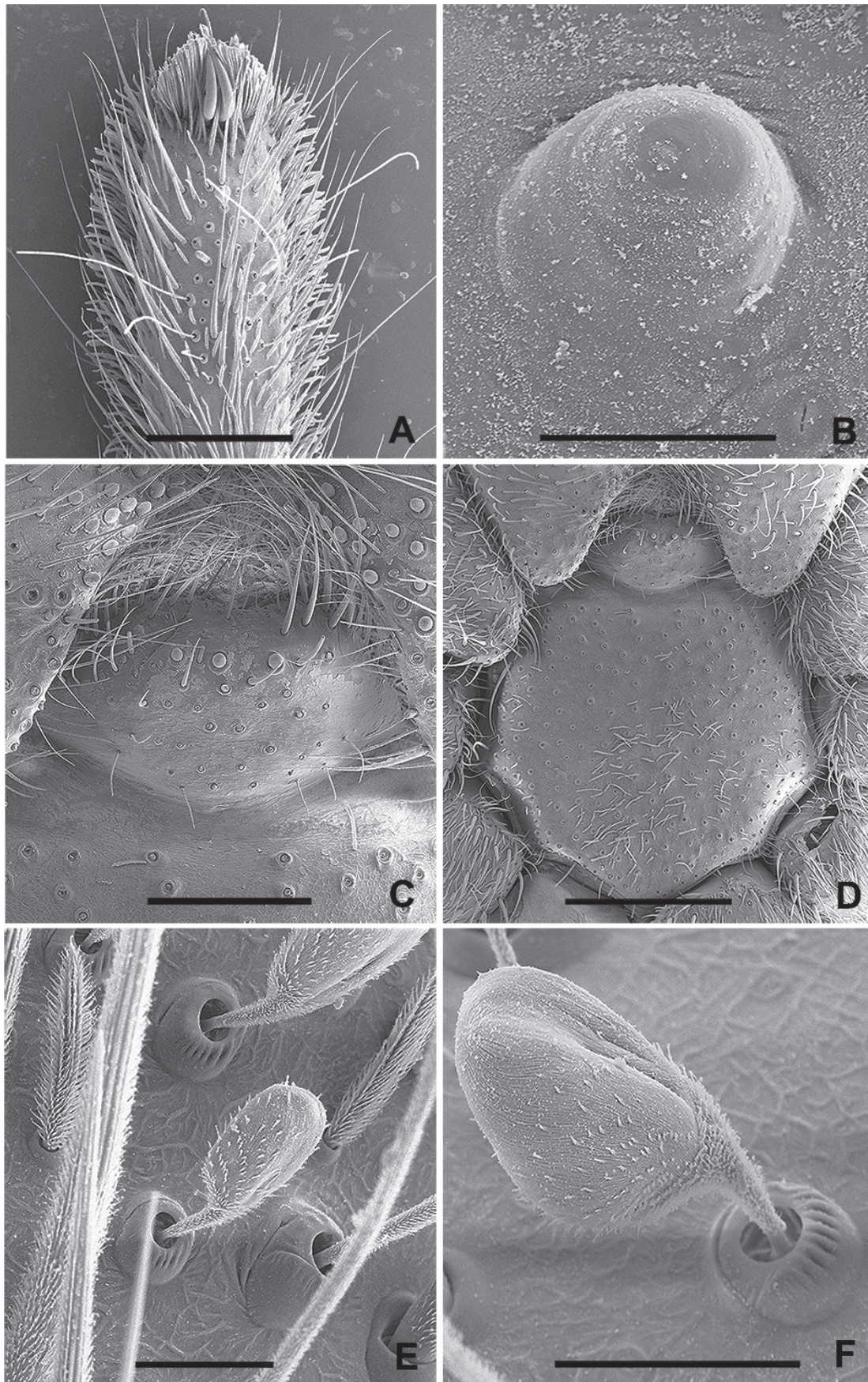


Figure 13. *Cyrtogrammomma frevo* sp. nov., ♀, (IBSP 131715), SEM micrographies. **A.** Tarsus of the leg I, dorsal view; **B.** Tarsal organ, dorsal view; **C.** Labium, ventral view; **D.** Sternum, ventral view; **E, F.** Clavate trichobothrium. Scale bars: 400 nm (**A**); 20 nm (**B**); 400 nm (**C**); 1 mm (**D**); 40 nm (**E**); 50 nm (**F**).

on distal half on all tarsi (Figs 12E, 13E, F). Claws: IRC absent. STC bare. Scopula: Absent in all tibiae; cymbium 1/3 scopulate. Tarsi I–IV fully scopulate, metatarsi I–II 3/4, III 2/3, IV 1/4 ap; tarsi I–II not divided, III–IV divided by a band of setae. Spinnerets: PMS: 0.02 PLS: basal 0.62, median 0.37, apical 0.25. Apical segment domed.

Spermathecae: wide base; short ducts with two globose lobes on apex of receptacles (Fig. 12D).

Color pattern (preserved in alcohol): Same as male (Fig. 12A).

Distribution. Brazil: states of Alagoas, Bahia and Pernambuco (Fig. 15).

Key to species of the *Cyrtogrammomma*

Males

- 1 Embolus 4 times longer than subtegulum (Fig. 1G, H); embolus tip triangular (Fig. 3F–H)..... *C. monticola*
- Embolus 2 times longer than subtegulum (Fig. 10H–J); embolus tip “spoon-shaped” (Fig. 10H–L). Pattern of stripes and dots on the abdomen (Fig. 10A) *C. frevo* sp. nov.

Females

- 1 Spermathecae with long and straight ducts (Figs 2C, 4E); abdomen without stripes and dots..... 2
- Spermathecae with short ducts (Fig. 12D); Pattern of stripes and dots on the abdomen (Fig. 12A) *C. frevo* sp. nov.
- 2 Spermathecae with two lobes on apex (Figs 2C, 4E); labium with 3–5 cuspules (Figs 2E, 4B)..... *C. monticola*
- Spermathecae with several rounded lobes on apex; labium with more than 5 cuspules (figs 338–340)..... *C. raveni*

Discussion

Historically, the sister group relationship of Theraphosidae and Barychelidae has always been well supported in morphological and molecular analysis (Raven 1985; Bond et al. 2012; Opatova et al. 2020). However, due to the lack of well-defined morphological characters, both families have their diagnoses superimposed, resulting in transfers of some genera mistakenly included in Barychelidae to Theraphosidae, as noted in the genus *Cyrtogrammomma*, which presents several homoplastic characters, such as the apical segment of PLS domed and the reduced anterior lobe of the maxilla (Mori and Bertani 2020). Thus, some traditional characters that diagnose Barychelidae are recognized as parallelism in basal families in Mygalomorphae (Raven 1985, 1994).

According to Mori and Bertani (2020), *Cyrtogrammomma* has the cymbium in triangular shape, with apex elongate, conical in dorsal view, and, with strong and long incision, which is also observed in *Trichopelma nitidum* Simon, 1888 (see figs 13–16 in Mori and Bertani 2020). However, the cymbium of *Cyrtogrammomma* is 3 times longer than that of *T. nitidum*, which could be regarded as an apomorphic character in future cladistic analysis (Figs 1E–H, 3I–K, 10C–E).

Only a few records of the genus were available for Guyana (*C. monticola* and *C. raveni*), however, in the present study we describe a new species from Atlantic Forest and the new records extend the distribution of the genus to this biome (Fig. 15).

Brazil has the best-studied cave fauna in South America and has a diverse hypogean arachnafauna (Trajano

and Bichuette 2010; Trajano 2019). However, records of mygalomorphs are usually associated with few specimens or small populations, mainly belonging to Theraphosidae and Dipluridae (Fonseca-Ferreira et al. 2017), in addition to some records of trapdoor spiders (Barychelidae and Pycnothelidae). Despite this, some caves have populations with dozens of individuals, as is the case with the spiders *Trechona diamantina* Guadanucci, Fonseca-Ferreira, Baptista & Pedroso, 2016 (Dipluridae), in a quartzite cave in the state of Minas Gerais (Guadanucci et al. 2016), where more than 100 individuals were recorded, including in the aphotic region (Guadanucci et al. 2014); the species *Guyruita metallophila* Fonseca-Ferreira, Zampaulo & Guadanucci, 2017 (Theraphosidae) in iron ore caves in the state of Pará (Fonseca-Ferreira et al. 2017) and unidentified small barychelids in sandstone caves in the region of Altamira, state of Pará (Trajano and Bichuette 2010).

Recently, two caves, 44 km apart, were sampled in the Brazilian state of Pará: Paraíso Cave, Aveiro (4°04'33.6"S, 55°27'32.4"W), and Mãos Cave, Rurópolis (4°09'25.2"S, 55°04'19.2"W). In these caves, which have very different physical characteristics, the first records of *Cyrtogrammomma* were made for subterranean environments. The Paraíso Cave is inserted in limestone lithology (Itaituba Formation – Tapajós Group) and despite having a small entrance, the cave develops over 5.8 km of mapped galleries, making it the largest cave in the Amazon region. Its interior, totally aphotic, presents heterogeneous environments, including rooms with collapsed blocks, sediment banks, and ravines, where several *Cyrtogrammomma* burrows (> 30) were found,

* Note: Male of *C. raveni* is unknown. Figure denoted “*fig.” refer to figures in Mori and Bertani (2020).

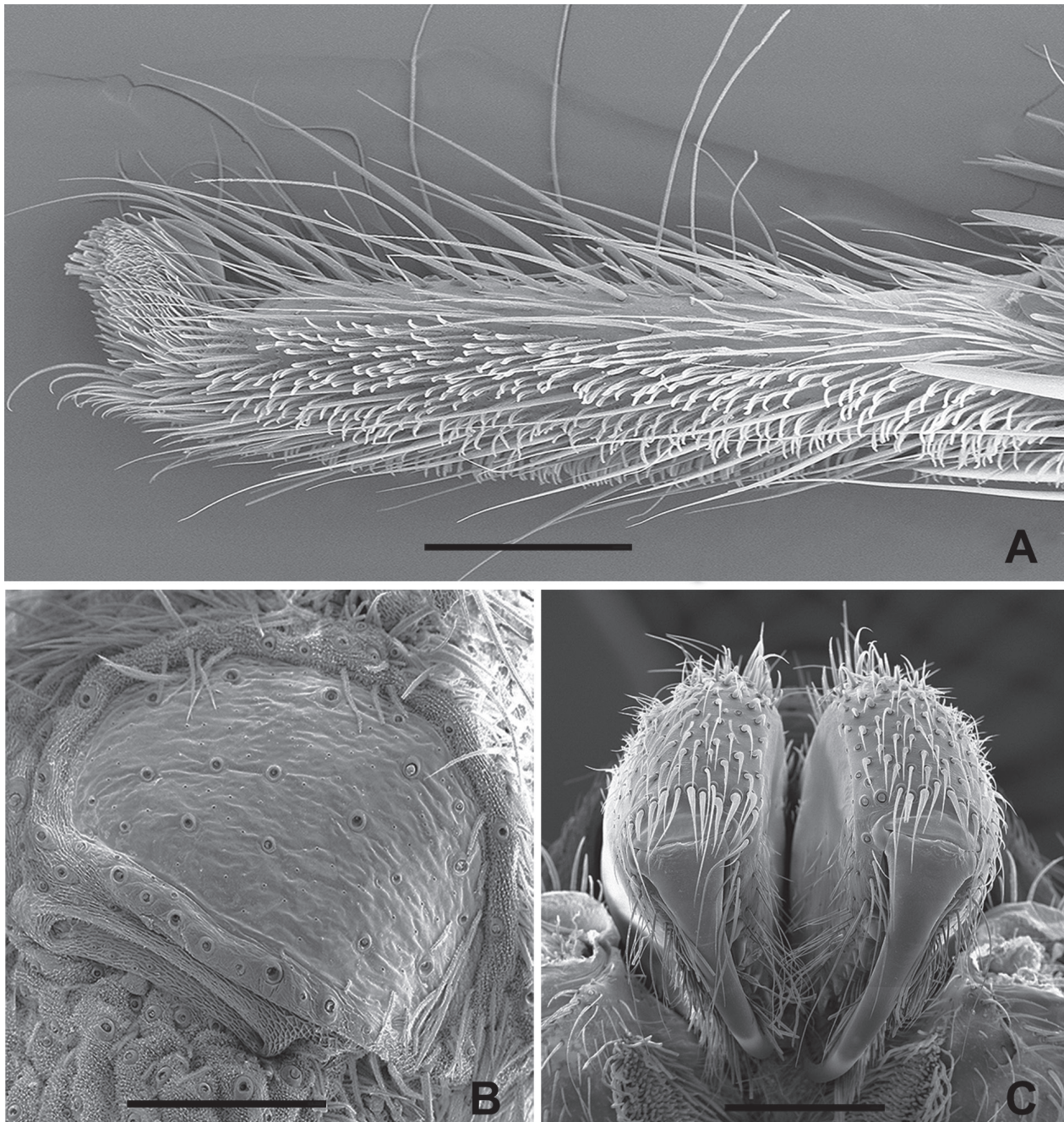


Figure 14. *Cyrtogrammomma frevo* sp. nov., ♀, (IBSP 131715), SEM micrographies. **A.** Tarsus of the leg I, prolateral view. **B.** Book lungs, ventral view; **C.** Chelicerae, ventral view. Scale bars: 400 nm (**A**); 300 nm (**B**); 500 nm (**C**).

some more than 1 km from the cave entrance, an unusual fact for trapdoor spiders. The specimens were found inside the cave on ravines, where its burrow was closed by a hinged lid and camouflaged with sand and clay (Fig. 6A). The Mãos Cave is inserted in the sandstone lithology (Maecuru Formation) and has a stream that runs throughout its interior. This cave has a wide entrance, and it develops up to about 1500 m, through a wide main gallery. A few *Cyrtogrammomma* burrows were found, scattered in ravines, mainly in the twilight zone of the cave. Currently, the state of Pará has sixteen species of mygalomorph spiders known for their caves (Pedroso and Baptista 2014; Fonseca-Ferreira et al. 2017).

Many groups of Mygalomorphae are diagnosed based on the possession of distinct setae on legs (Galleti-Lima and Guadanucci 2019). According to Ramírez (2014), a seta is a cuticular outgrowth articulated in a socket through an unsclerotized membrane. A small portion of leg cuticle may have many types of setae. Studies of cuticular features have received more attention over the years, where recent publications and unpublished surveys have yielded great diversity examined under SEM, which can reveal significant differences in well-known structures (e.g., stridulating setae, tufts, leg scopula, chemosensory setae (Guadanucci, Galleti-Lima and Indicatti 2020). In Ramírez (2014), different types of setae were differenti-

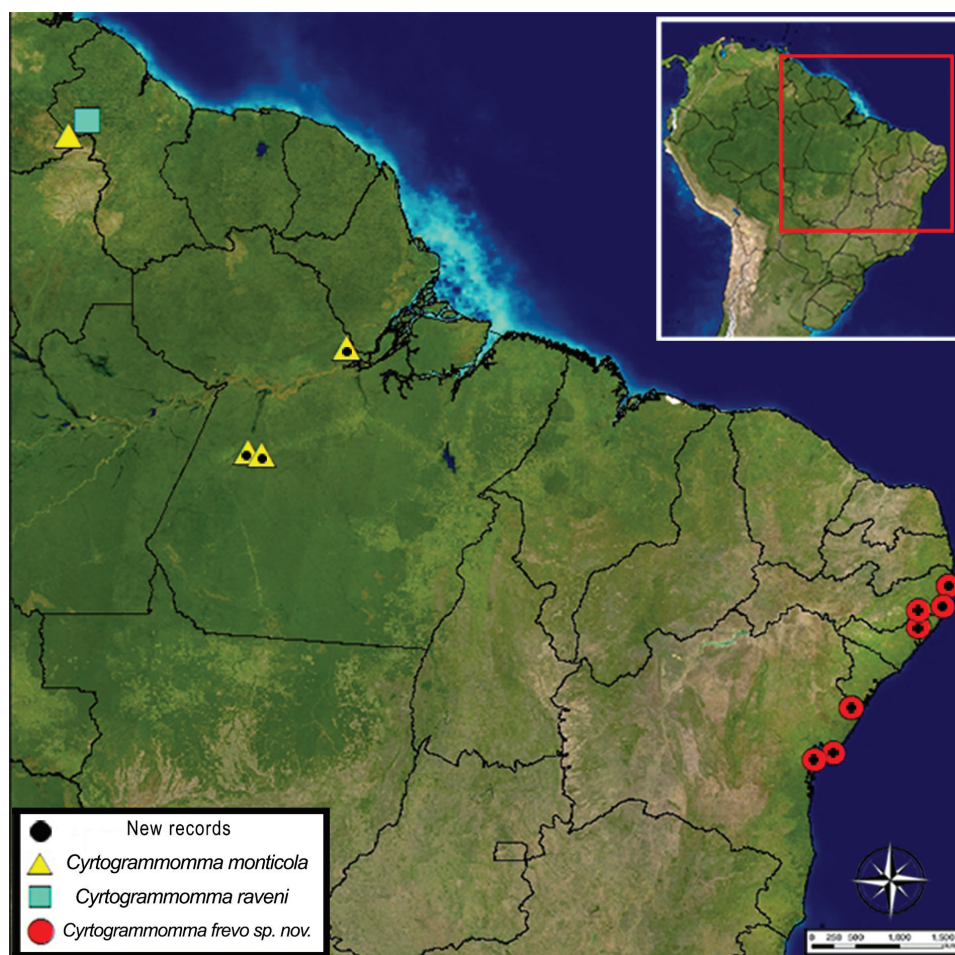


Figure 15. Distribution map of species of the genus *Cyrtogrammomma* Pocock, 1895.

ated based on morphology, function and position. Tactile hairs, which are referred to simply as “hairs”, are the most frequent and widespread kind of setae, and are structures with a curved shaft so that the tip is inclined toward the cuticle, and usually have barbs along its length.

Through detailed examination of females of *C. monticola* collected in Pará, Brazil, we recognized on metatarsi I–II a unique tactile seta (designated here as matchstick setae) on the dorso-prolateral distal portion (Figs 7–9). The matchstick seta is thick and stiff, with globose tip, and the surface covered with many thin barbs (Fig. 9C, D). The socket is elevated and matches those of other tactical hairs (Fig. 9B). In general, the tactile hairs are on the dorsal side of legs; they are long and some are upright, however their apexes are tapered (Fig. 8). It is very interesting that this seta has only been observed in *C. monticola*, without any mention in other congeners or in other trapdoor spiders, and it seems to be an autapomorphic character for this species.

Considering the stiffness and the ultramorphology of the seta, its position and presence on anterior legs, and the stance of trapdoor spiders’ legs when foraging, with legs I and II touching the rim of the burrow entrance and slightly lifting the lid, we suspect, hypothetically, that the matchstick setae could have the same tactile function, probably related to the opening of the burrow (operculum) or any

vibration that could be transmitted to the spider. Depending on the intensity of the vibration, it could indicate the approach of potential prey, the conspecific male or even a predator. Nonetheless, these hypotheses need to be tested with empirical observations.

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