Villarreal M et al. Zoological Studies (2015) 54:45
DOI 10.1186/s40555-015-0117-8

Zoological Studies
a SpringerOpen Journal

RESEARCH Open Access

The poorly known genus *Ventrifurca* Roewer, 1913 revisited (Opiliones: Cranaidae)

Osvaldo Villarreal M[1*], Adriano B Kury[1] and Ricardo Pinto-da-Rocha[2]

Abstract

Background: The distinction of genera in Cranaidae (as in many other Gonyleptoidea) is traditionally made on the basis of a combination of armature of scutal areas, tarsomere counts, and some secondary sexual structures (which may vary among males). This historically led to the creation of non-natural groups of species as meaningless genera. Here some nominal genera of Cranaidae are addressed, and this paucity of diagnostic characters is alleviated with more detailed diagnoses and descriptions.

Results: The poorly known genus *Ventrifurca* Roewer, 1913, hitherto monotypic, is revisited. The genera *Microcranaus* Roewer, 1913 (with three species), *Cayabeus* Roewer, 1932 (monotypic), and *Angistrius* (monotypic) are here proposed as junior subjective synonyms of *Ventrifurca*. Both type species of *Microcranaus* and *Cayabeus* are considered junior subjective synonyms of *Ventrifurca albipustulata*; thus, *Cayabeus perlatus* Roewer, 1932 and *Microcranaus pustulatus* Roewer, 1913 = *Ventrifurca albipustulata* Roewer, 1913. *Ventrifurca abnormis* comb. nov. is proposed for *Angistrius abnormis* Roewer, 1932. *Rhopalocranaus dybasi* Goodnight & Goodnight, 1947, currently *Neocranaus dybasi*, is transferred to *Ventrifurca*, and the new combination *Ventrifurca dybasi* comb. nov. is herein proposed for it. *Ventrifurca albipustulata* is redescribed, and for the first time, the male genitalia is described and illustrated, and SEM pictures are offered. The new species *Ventrifurca caffeinica* sp. nov. is described from Quindío department, Colombia. A new diagnosis to *Ventrifurca* is proposed. The relationships of *Ventrifurca* are discussed. The remaining two species of *Microcranaus* are transferred to the family Manaosbiidae: (1) *Microcranaus columbianus* newly combined as *Rhopalocranaus columbianus* (Roewer, 1963) and (2) *Microcranaus gracilis* newly combined as *Camelianus gracilis* (Roewer, 1913). New diagnoses are given for both species.

Conclusions: A non-monotypic genus of Andean Cranaidae is defined, associated with a well-defined geographic region, and unloaded of extraneous species which belong to another family. Recognition of variation in heteromorphic males reveals past errors of assignment when only limited samples were available for study.

Background

The family Cranaidae is a group of mainly Andean-Amazonian harvestmen, only recognized in the end of the twentieth century (Kury 1994) and whose diversity is underestimated. Its taxonomy is unsatisfactory and plagued by many monotypic and poorly known genera. The monophyly of this taxon has been recovered in some phylogenetic studies (Orrico and Kury 2009; Sharma and Giribet 2011; Pinto-da-Rocha et al. 2014). Nevertheless, a molecular study by Pinto-da-Rocha et al. (2014) considered it as a member of the Gonyleptidae. However, because Orrico and Kury (2009) found that of the four traditional subfamilies of cranaids, two are microdiverse and the other two are paraphyletic, they proposed to abandon the use of subfamilies at least as currently defined. On the other hand, Kury (2012b) proposed the inclusion of Zamorinae as a fifth subfamily wich, posteriorly was transferred to Nomoclastidae by Kury & Villarreal (2015). In view of this uncertainty in recent literature, the use of subfamilies in Cranaidae is meant here only for convenience of reference of traditional assemblages of species. A phylogenetic analysis project to understand the internal and external relationships of Cranaidae/Cranainae is ongoing by the first author. Cranaidae (as a family) is used here as a neutral term.

Recently, some works have been published addressing varied taxonomy and systematic issues in the family,

* Correspondence: osvaldovillarreal@gmail.com
[1]Departamento de Invertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, São Cristóvão, 20.940-040 Rio de Janeiro, RJ, Brazil
Full list of author information is available at the end of the article

primarily three systematic works, two papers focusing on the relationship of the genus *Phareicranaus* Roewer, 1913 (Pinto-da-Rocha and Kury 2003; Pinto-da-Rocha and Bonaldo 2011) and another focused on testing the monophyly of Stygnicranainae (Orrico and Kury 2009). Subsequently, some contributions on the alpha taxonomy of Cranaidae were published, either as (1) transfer of taxa from other families to Cranaidae (Pinto-da-Rocha and Hara 2009; Pinto-da-Rocha et al. 2012), (2) description of new taxa (Kury 2012a, b), (3) detection of 'false cranaids' (Villarreal and Kury 2012), or (4) synonymy or revalidation and redescription of some genera (Hara et al. 2014). Those contributions tried to clarify the definition of the genera composing this family, but the taxonomy of cranaids is still confused and most genera are poorly known.

In this paper, the genus *Ventrifurca* Roewer, 1913 is revisited, its type species is redescribed, a new species is described from Quindío department, Colombia, and a new generic diagnosis is offered. *Cayabeus* Roewer, 1932 and *Microcranaus* Roewer, 1913 are considered junior subjective synonyms of *Ventrifurca*. Two spurious species of *Microcranaus* are transferred to Manaosbiidae. Comments about the relationships of the genus *Ventrifurca* within the family are presented, and a diagnostic character in the genital macrosetae is detected for a group of cranaid genera.

Historical background

Roewer (1913b: 349) described the new subfamily Cranainae in Gonyleptidae with some old and many new genera and species. Of relevance here, he described the following as new: (1) the genus *Microcranaus*, based on two new species - *Microcranaus pustulatus* from 'Ecuador: Cachab' and *Microcranaus gracilis* from 'Surinam: Saramacca'. He designated *Microcranaus pustulatus* Roewer, 1913 as type species of the genus; (2) the monotypic genus *Ventrifurca* based on the new species *Ventrifurca albipustulata* from 'Columbien: Camelia'; and (3) the genus *Rhopalocranaus* with four new South American species, designating as type species *Rhopalocranaus marginatus* Roewer, 1913.

Posteriorly, Roewer (1932: 337 and 346) described in Gonyleptidae Cranainae two new monotypic genera - *Cayabeus*, based on the new species *Cayabeus perlatus* from 'Ecuador (Cayabé)', which is a misspelling of the town Cayambe (Pichincha), and *Angistrius*, based on the new species *Angistrius abnormis* from Alausi.

Goodnight and Goodnight (1947: 40) described in the wastebasket genus *Rhopalocranaus* (then in Gonyleptidae Cranainae) the new species *Rhopalocranaus dybasi* from 'mountains west of Cali, Department of Cauca, Colombia'. Soares and Soares (1948: 593, 609) perpetrated an unlucky synonymy, seemingly based on nothing: (1) *Rhopalocranaus* Roewer, 1913 = *Cranaus* Simon, 1879.

Kury (1997: 4) transferred *Rhopalocranaus* to Manaosbiidae. Kury (2003) in his catalog of New World Laniatores proposed many changes and updates, among which are the following: (1) updated and completed details of locality records of old literature and (2) transferred *Rhopalocranaus dybasi* to *Neocranaus* Roewer, 1913, creating the new combination *Neocranaus dybasi* (Goodnight and Goodnight, 1947).

Methods

The standard of description and morphological nomenclature follows Villarreal and Kury (2012) and Kury (2012a, b) and outlines of the dorsal scutum as described in Kury et al. (2007). MS = macrosetae of penis ventral plate. Other abbreviations used: CL = carapace length, CW = carapace width, AL = abdominal scutum length, AW = abdominal scutum width, DSL = dorsal scutum length, Tr = trochanter, Fe = femur, Pa = patella, Ti = tibia, Mt = metatarsus, Ta = tarsus. All measurements are in mm unless otherwise noted. Abbreviations of the repositories cited are FMNH (Field Museum of Natural History, Chicago), IAvH (Instituto Alexander von Humboldt, Colombia), MNHN (Muséum National d'Histoire Naturelle, Paris), MNRJ (Museu Nacional, Rio de Janeiro), QCAZ (Museo de Zoologia, Pontificia Universidad Católica de Quito), and SMF (Senckenberg Museum, Frankfurt). The A-E system of naming the macrosetae of ventral plate follows Kury and Villarreal (2015).

Results

In the following list, literature entries are not exhaustive (these can be found in Kury 2003), but rather restricted to the critical contributions.

Cranaidae Roewer, 1913

Ventrifurca Roewer, 1913

Ventrifurca Roewer, 1913b: 382; Kury, 2003: 100 (type species *Ventrifurca albipustulata* Roewer, 1913, by monotypy).

Microcranaus Roewer, 1913b: 352; Soares and Soares, 1948: 608; Kury, 2003: 95 (type *Microcranaus pustulatus* Roewer, 1913, by original designation). Syn. nov.

Cayabeus Roewer, 1932: 337; Kury, 2003: 91 (type species *Cayabeus perlatus* Roewer, 1932, by monotypy). Syn. nov.

Angistrius Roewer 1932: 346; Kury 2003: 90 [type species: *Angistrius abnormis* Roewer, 1932, by monotypy]. Syn. nov.

Diagnosis. Dorsal scutum type beta, elongate pyriform in dorsal view (Figures 1A, 2A, and 3A). Dorsal scutum sexually dimorphic in lateral view, in males frontal hump higher, reaching eye height and abdominal scutum flat, resulting in spine of area III erect (in females frontal

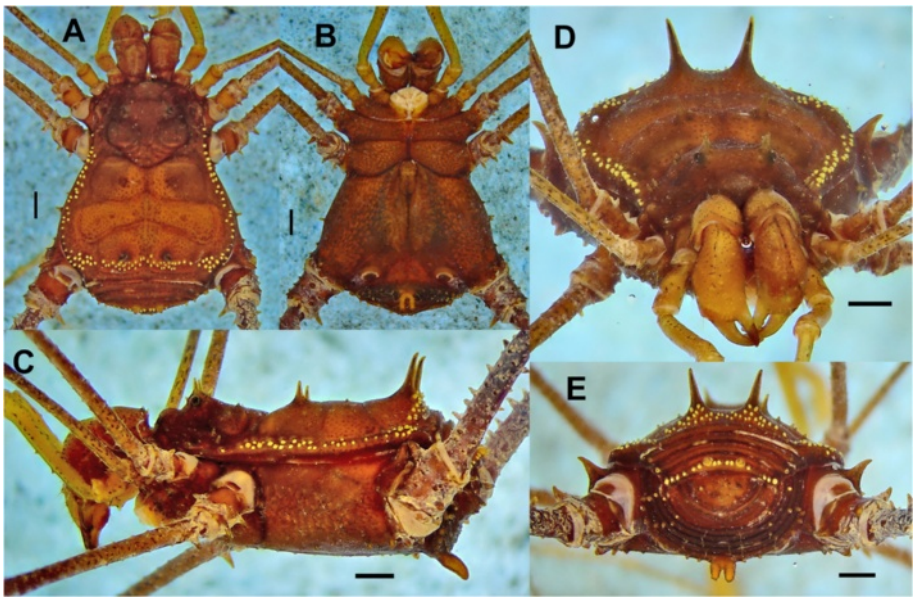

Figure 1 *Ventrifurca albipustulata* (MNRJ 19197) male. **(A)** Habitus, dorsal view. **(B)** Ventral view. **(C)** Lateral view. **(D)** Dorsofrontal view. **(E)** Posterior view. Scale bars = 1 mm.

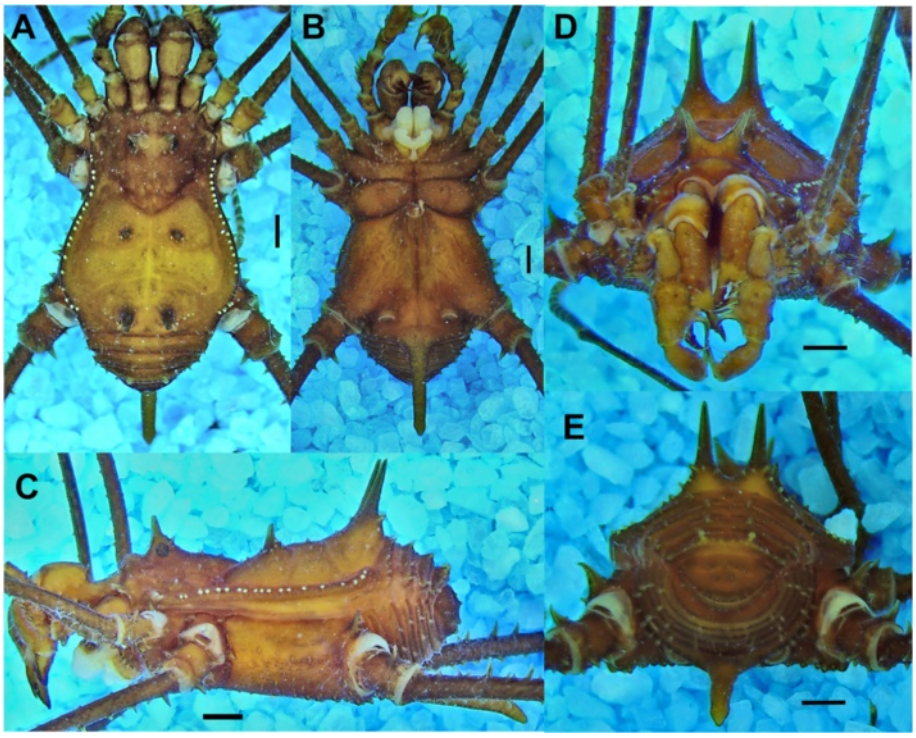

Figure 2 *Ventrifurca caffeinica* sp. nov. (MNRJ 8351) male holotype. **(A)**. Habitus, dorsal view. **(B)** Ventral view. **(C)** Lateral view. **(D)** Frontal view. **(E)** Posterior view. Scale bars = 1 mm.

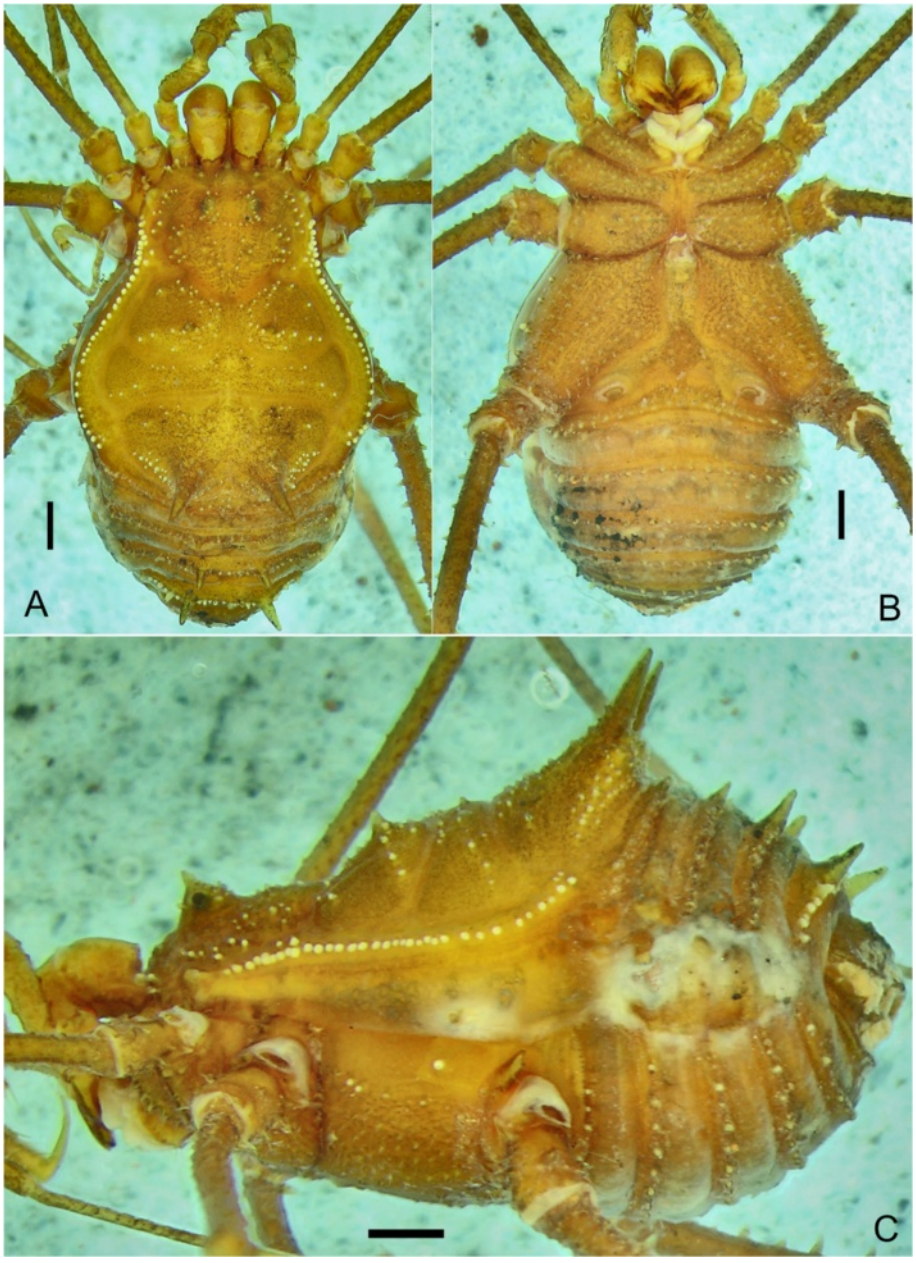

Figure 3 *Ventrifurca dybasi* (FMNH-INS 000 011 250) female holotype. **(A)** Habitus dorsal view. **(B)** Ventral view. **(C)** Lateral view. Scale bars = 1 mm.

hump is very low and abdominal scutum is bulged, resulting in spines of area III inclined backwards) (e.g., Figure 4E,F). Mesotergum divided into 3 well-marked areas, area I divided into left and right halves by longitudinal straight groove (Figures 1A, 2A, 5A and 6A). Mesotergum smooth with a pair of high spines on area I (higher in males), a row of granules on II and a pair of very high spines on area III (Figures 1A, 2A,C,D, 5A and 6A). Lateral margin of scutum with irregular rows of yellow tubercles, extending (completely or not) onto posterior border of area III (Figures 1A,C,D,E, 2A,C,D, 3A,C and 7A,C,E). Free tergite III with a pair of lighter spines, larger in females (Figures 5A,B and 6A,E). Stigmatic area of males with variably developed process on the medial zone of the posterior border, from 2 small buttons to 2 conspicuous parallel processes fused at base or isolated (Figures 1B,E and 5C,E) or a large cylindrical process (Figures 2B,C and 6A,D,F). Stigmatic area sexually dimorphic, shorter in females, elongate in males. Pedipalpi slightly elongated with femur and patella cylindrical and unarmed, tibia enlarged with few ventrolateral spiniform tubercles (Figure 8D,E) or with little tubercles

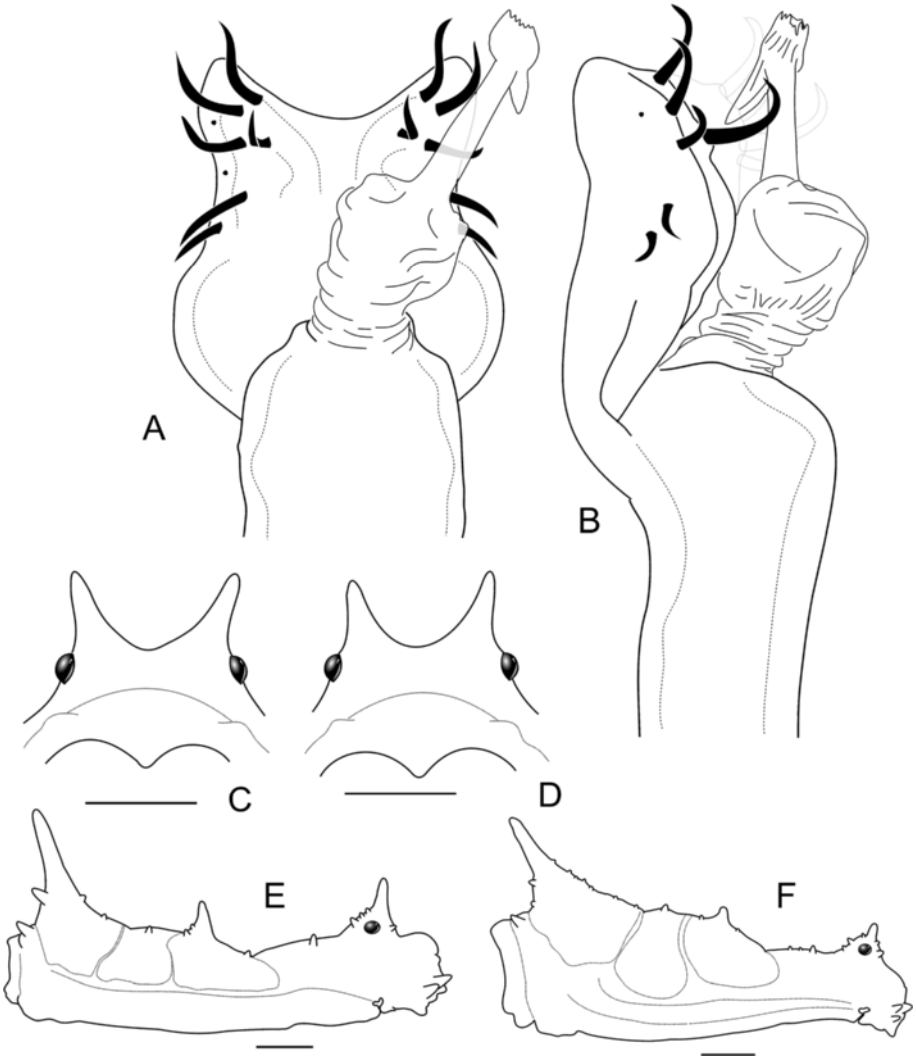

Figure 4 *Ventrifurca caffeinica* sp. nov. (MNRJ 8351) male holotype. Apical portion of the penis: **(A)** Dorsal view. **(B)** Lateral view. **(C-D)** Intraspecific variation on the ocularium of the males (MNRJ 8351 and MNRJ 7038) in frontal view. Sexual dimorphism in dorsal scutum. **(E)** Male. **(F)** Female. Scale bars = 1 mm.

but with strong sexual dimorphism (Figure 9A,B,C,I,J). Leg IV of males armed with many spiniform tubercles. Femur proximally armed with four longitudinal rows of spiniform tubercles, distally with 1 retrolateral ventrally curved tubercle, 1 retrodorsal distal and 1 conspicuous retrolateral subdistal tubercle (Figure 8F,G). Penis. Ventral plate of penis in the same direction of the longitudinal axis of the penis, trapezoid and guitar shaped, with distal border concave and laterodistal corner rounded (Figures 4A,B, 10A,B,C, 11A,C and 12A,B,C). Stylus surpassing ventral plate, without dorsal process, with little stylar caps (Figures 11C,D,E and 12C,D,E). Ventral plate chaetotaxy: laterodistal group (MS C group), with 3 curved setae grouped together on the distal corner of the plate (Figures 10A, 11A, and 12A,B,C); dorsomedial setae (MS D) (largest among those of ventral plate), represented only by 1 pair of large and curved setae pointing distally, located near of the medial line of the plate, close to distal group (Figures 4B, 10A,B, 11A,B, and 12A); lateroproximal group (MS A) placed medially conformed by a pair separated from the rest by a gap (MS B absent) (Figures 4A,B, 10A,B, 11A,B,C, and 12B). Lateroventral group (MS E) conformed by two pairs of short and rounded setae located on the laterodistal keel of ventral plate (VP; Figures 4A,B, 10A,B, and 12B).

Included species (Figure 13). (1) *Ventrifurca abnormis* (Goodnight and Goodnight, 1947) comb. nov. - Ecuador, Chimborazo (Northwestern Andean montane forests NT0145); (2) *Ventrifurca albipustulata* Roewer, 1913 - Ecuador, Esmeraldas; Pichincha (Northwestern Andean montane forests NT0145 and Western Ecuador moist forests NT0178); (3) *Ventrifurca dybasi* (Goodnight and

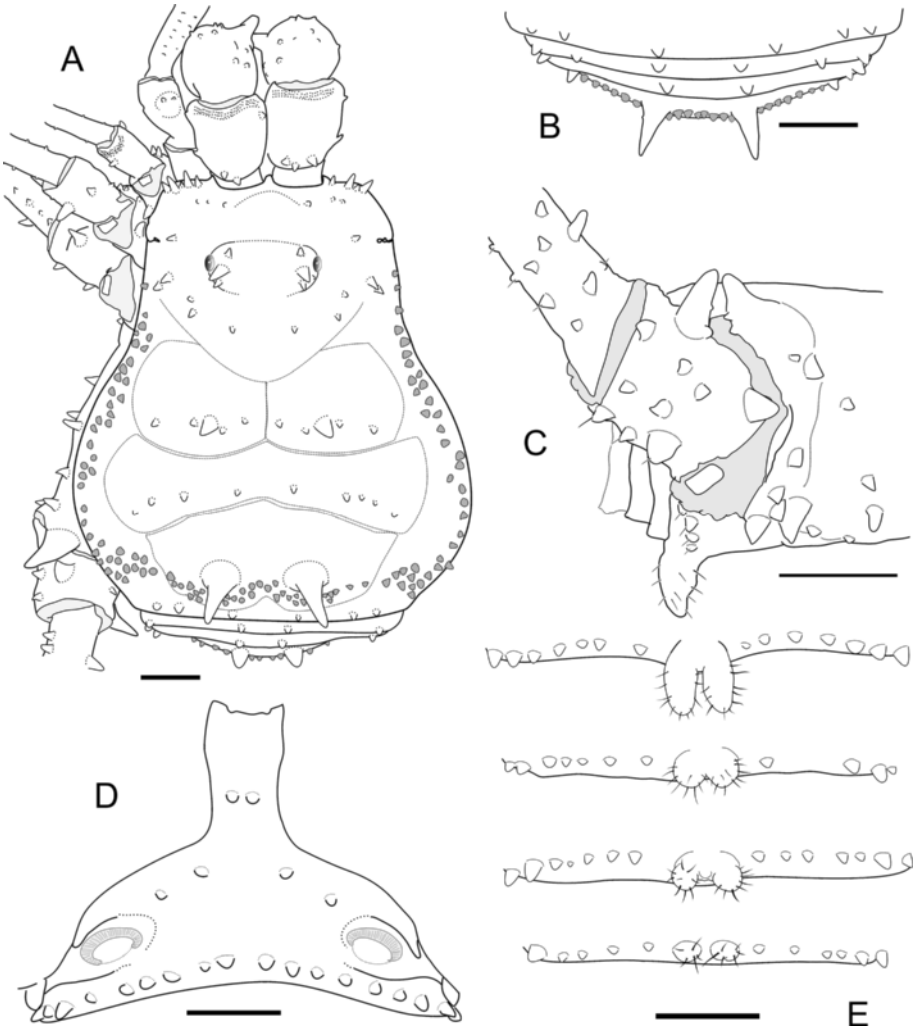

Figure 5 *Ventrifurca albipustulata* (MNRJ 19197). **(A)**. Habitus, dorsal view (male). **(B)** Free tergites, dorsal view (female). **(C)** Coxa and trochanter IV in lateral view (male). **(D)** Stigmatic area, ventral view (female). **(E)** Variation of posterior border of the stigmatic area in ventral view (males). Scale bars = 1 mm.

Goodnight, 1947) comb. nov. - Colombia, Valle del Cauca (Cauca Valley montane forests NT0109), and (4) *Ventrifurca caffeinica* sp. nov. - Quindío (Cauca Valley montane forests NT0109).

Ventrifurca abnormis (Goodnight and Goodnight, 1947) comb. nov.

Figures 13 and 14

Angistrius abnormis Roewer 1932: 346, figs. 63-64; Kury 2003: 90.

Type data

♂ holotype (SMF RII 261/5), from Ecuador, Chimborazo, Alausi, WWF ecoregion NT0145 (Northwestern Andean montane forests).

Diagnosis

Lateral and posterior rows of yellow granules of scutum continuous all along, but with 2 clusters at scutal groove and on the lateral margins of area III. Free tergite III with scattered yellow granules. Scutal area I with contrasting yellow tubercles in the middle and posteriorly. Ocularium, carapace, scutal area II with yellow tubercles (Figure 14A). Basichelicerite short. Pedipalpal femur ectally unarmed (Figure 14B). Stigmatic area on males with robust uniramous median apophysis (Figure 14B,C). Ratio Fe IV of ♂/scutum = 2.3.

Ventrifurca albipustulata Roewer, 1913

Figures 1, 5, 7, 8, 10, 11, and 13; Tables 1 and 2

Ventrifurca albipustulata Roewer, 1913b: 383, figs. 149-150; Kury, 2003: 100.

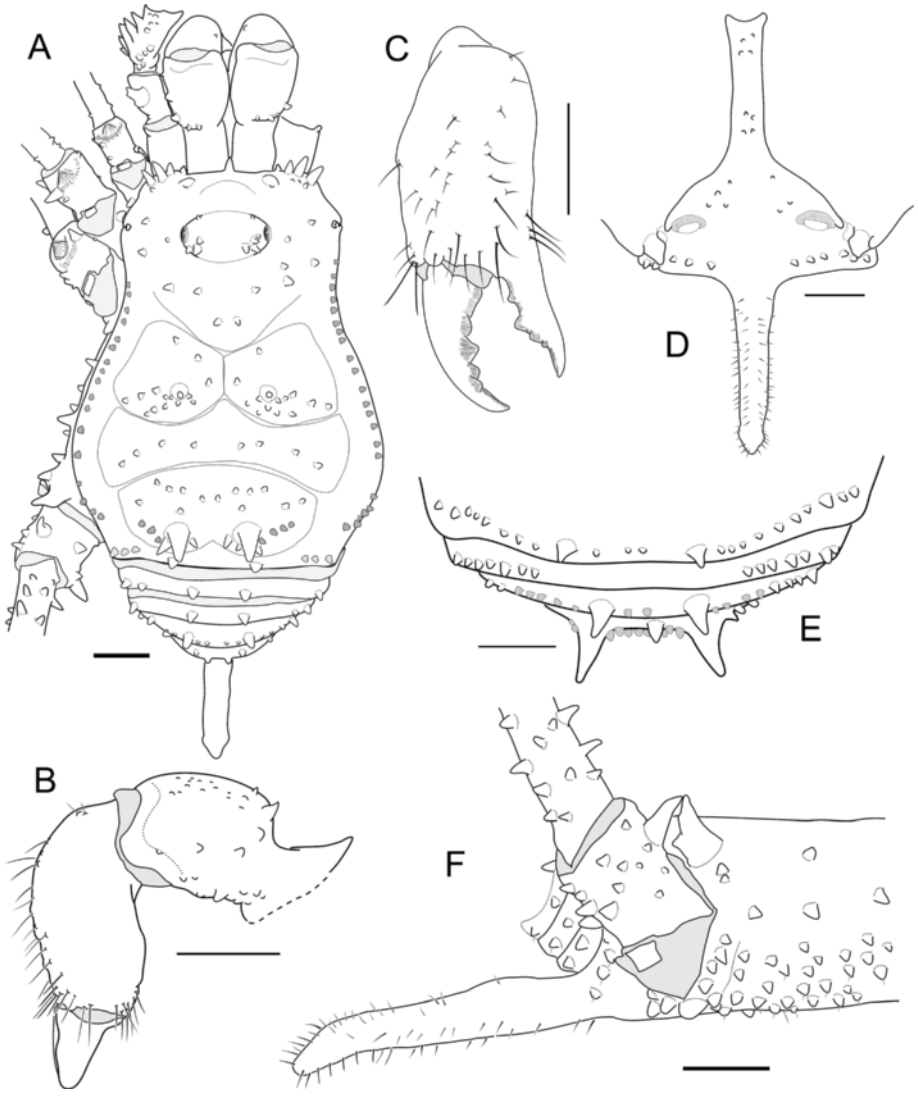

Figure 6 *Ventrifurca caffeinica* sp. nov. **(A)** Habitus, dorsal view (male holotype). **(B)** Left Ch, ectal view. **(C)** Left Ch, frontal view. **(D)** Stigmatic area, ventral view (male holotype). **(E)** Free tergites in dorsal view (female MNRJ 19387). **(F)** Cx-Tr IV and apophysis of stigmatic area, lateral view (male holotype). Scale bars = 1 mm.

Microcranaus pustulatus Roewer, 1913b: 353, fig. 137; Kury, 2003: 93. Syn. nov.

Cayabeus perlatus Roewer, 1932: 337, fig. 53; Kury, 2003: 91. Syn. nov.

Type data

(1) 1 ♂ 1 ♀ syntypes of *Ventrifurca albipustulata* (SMF RI 846, photographed, Roewer cited only 1 male 'type', but the type series consists of 1 male and 1 female) from 'Columbien' without further locality data, while the publication has 'Columbien Camelia' and Kury (2003) extrapolated 'Cafetal Camelia, Antioquia' based on the locality of Swiss Führmann and Mayor 1910 Expedition. Roewer studied the material from this expedition in other contributions, but there is no evidence that this specific material is prevenient from that. There are many places called 'La Camelia' in Colombia, and we do not have evidence to pinpoint one as the type locality, especially because the actual label bears nothing further than 'Colombia'. (2) ♂ holotype of *Microcranaus pustulatus* (SMF RI 851, photographed), from Ecuador, 'Cachab'. There is a Cachabé railway station of collecting by Rosenberg of BMNH, in the Esmeraldas Province at 500 ft. This must correspond to Esmeraldas, San Javier de Cachaví, ca. 138 m, 1.06611/−78.77722, WWF ecoregion NT0178 (Western Ecuador moist forests). There is a railway station on the Cachabí River at 150 m, Esmeraldas, currently known as Urbina, very close to San Javier. Kury (2003) interpolated 'Carchí Province' Cachabí River, but these localities are more to the west, already in the

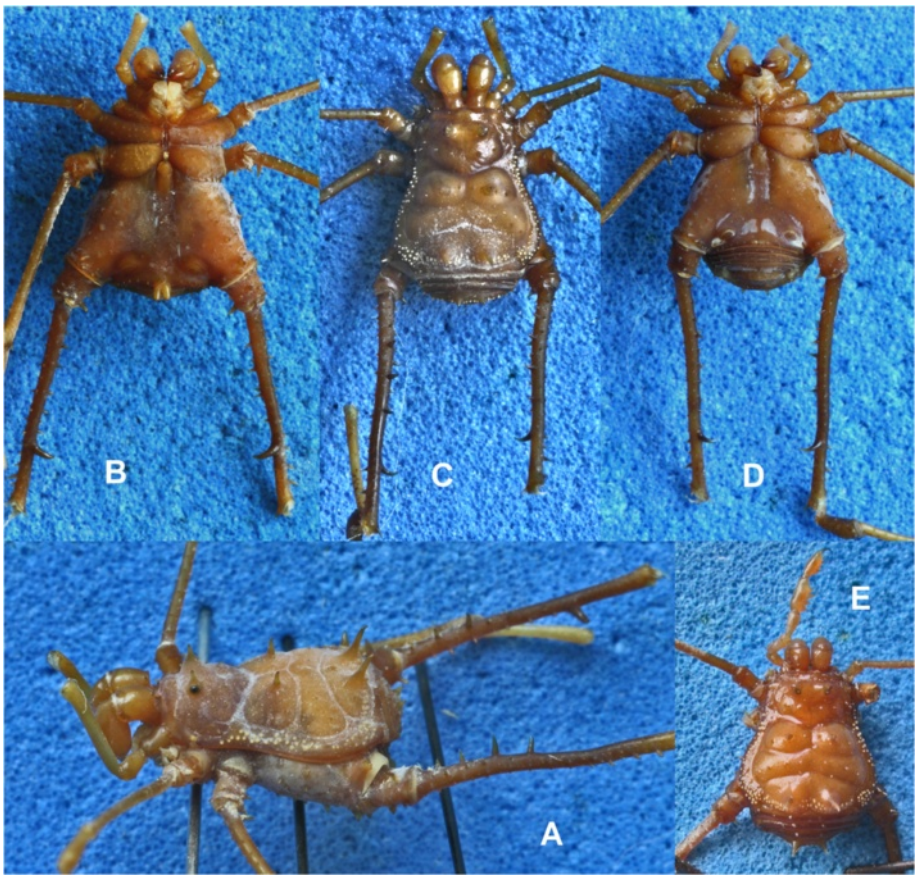

Figure 7 Type material of nominal species here synonymized under *Ventrifurca albipustulata*. *Ventrifurca albipustulata* (SMF RI 846) male syntype: **(A)** Habitus, dorsolateral view. **(B)** Same, ventral view. *Microcranaus pustulatus* (SMF RI 851) male holotype: **(C)** Habitus, dorsal view. **D**. Habitus, ventral view. *Cayabeus perlatus* (MNHN Coll. Simon 20319) female syntype: **(E)** Habitus, dorsal view.

Esmeraldas province. (3) 2 ♀ [wrongly reported as ♂] syntypes of *Cayabeus perlatus* (SMF RI 1423 and MNHN Coll. Simon 20319, Roewer number 5377, both photographed), Ecuador, Pichincha, Cayambe [misspelled as 'Cayabé'], WWF ecoregion NT0145 (Northwestern Andean montane forests).

Other material examined

4 ♂ 1 ♀ (MNRJ 19197) Ecuador, Esmeraldas, Chuchuvi, Cumbres Andinas, N 00.88404°, W 078.51437°, alt: 742 m, 16.iii.2011, leg. A Chagas, A Giupponi, A Kury and M Vega, WWF ecoregion NT0145 (Northwestern Andean montane forests). 1 ♂ (QCAZ AK 0262), same data. 1 ♂ 1 ♀ (MNRJ 19386) Ecuador, Esmeraldas, Tundaloma Lodge, near Calderón. N 01.18277°; W 078.75259°. Alt. 55 m. 8-9.ii.2014, leg. A Kury and A Giupponi, WWF ecoregion NT0178 (Western Ecuador moist forests).

Diagnosis

Lateral and posterior rows of yellow granules of scutum irregularly doubled or tripled and continuous all along. Free tergite III with row of yellow granules along its extension. Scutal area I without contrasting yellow tubercles. Ocularium, carapace, scutal area II without yellow tubercles (Figures 1A,C and 5A). Basichelicerite short. Pedipalpal femur ectally unarmed (Figure 8D, J). Stigmatic area on males with short bifurcated median apophysis, which may be extremely reduced (Figures 1B,C,E, 5C,E, and 7B,D). Ratio Fe IV of ♂/scutum = 1.4. Stylar cap short (Figure 11E).

Redescription (♂ MNRJ 19197)

Body and appendage measurements are in Table 2.

Dorsum. Dorsal scutum type beta without conspicuous coda (convergent-sided terminal area) (Figures 1A and 5A). Scutum rather flattened in lateral view (Figure 1C,D,E). Abdominal scutum widest at groove III level; lateral margin of dorsal scutum with yellow rounded tubercles from carapace to area III, following outline of scutum (Figure 5A). Ocularium without median depression, armed with a paramedian pair of acuminate tubercles set widely apart (Figure 1D) and some small tubercles. Mesotergum well delimited, divided into 3 well-marked areas: area I divided into left and right halves by longitudinal straight groove,

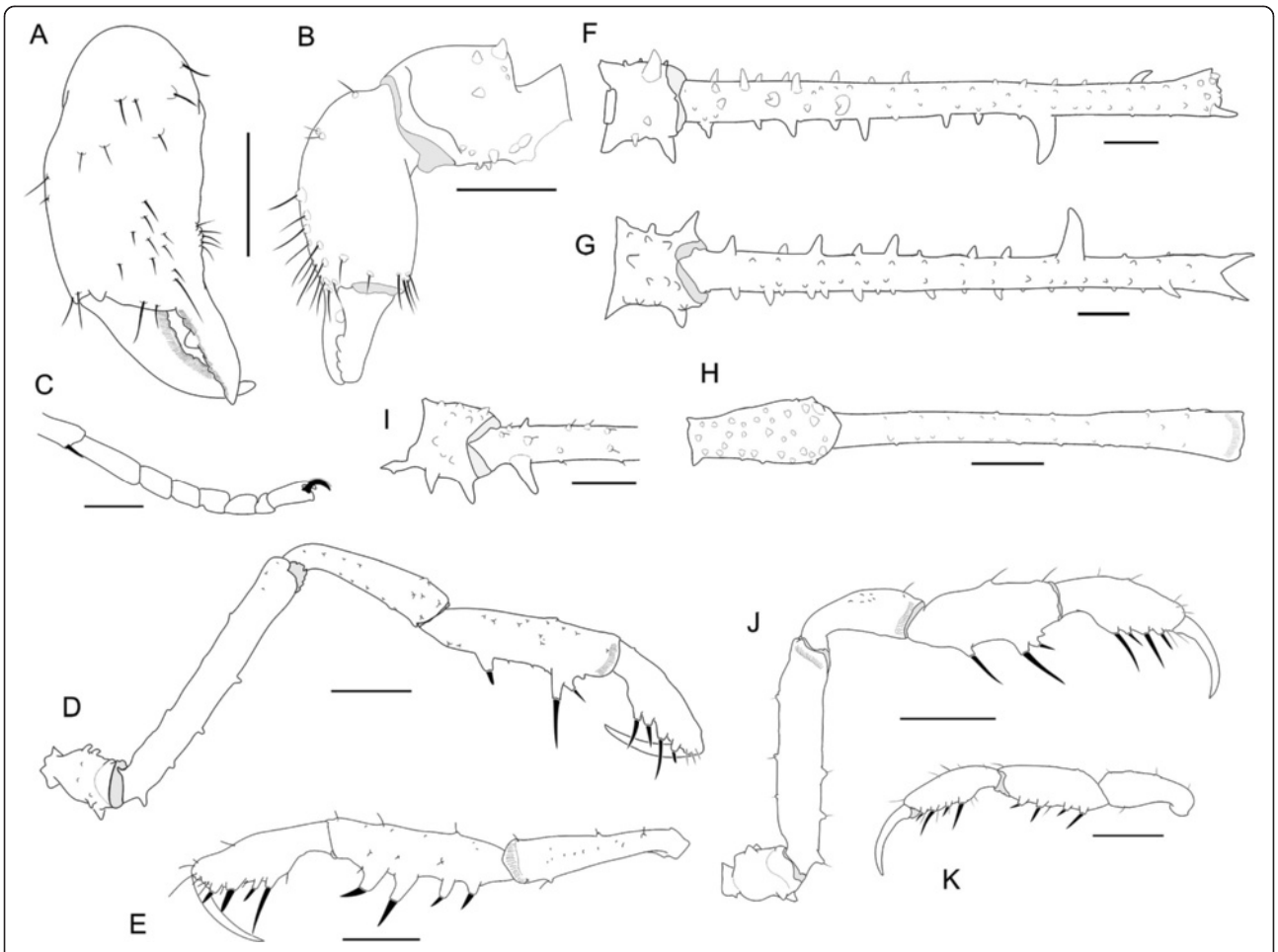

Figure 8 *Ventrifurca albipustulata* (MNRJ 19197) male. **(A)** Right chelicera, frontal view. **(B)** Left chelicera, ectal view. **(C)** Right Ta IV, retrolateral view. **(D)** Right Pp, ectal view. **(E)** Right Pp, dorsomesal view. **(F)** Right Tr and Fe IV, dorsal view. **(G)** Same, ventral view. **(H)** Right Pa and Ti IV, dorsal view. **(I)** Left Tr and base of Fe III, ventral view. Female: **(J)** Right Pp, ectal view. **(K)** Right Pp, dorsomesal view. Scale bars = 1 mm.

and with 1 conspicuous spine on each side and four little granules (Figure 5A); area II penetrating subtly into area I, with a median transverse row of small tubercles; area III with a pair of paramedian acuminate erect high subparallel spines, located near posterior margin, posterior half of this area densely covered with yellow and rounded tubercles (Figures 1A and 5A). Posterior border of scutum straight, armed with a row of granules. Free tergites I-II with a pair of paramedian granules and 1 slightly larger laterodistal on each side, contrasting yellow; free tergite III armed with a posterior row of 16 yellow conspicuous tubercles, the paramedian pair much stouter and concolorous with background (Figure 1A,E).

Venter. Stigmatic area with 3 pairs of tiny granules aligned in two longitudinal and divergent rows and 2 enlarged parallel apophyses (formed by multiple tubercles fused) with common base and rounded apex on the medial area of the posterior border (Figures 1B and 5D,E).

Chelicera (Figure 8A,B). Chelicera slightly swollen, bulla with a group of 2 to 3 proximal and 1 ectoproximal tubercles; hand enlarged, with some frontal tubercles and a patch of about 5 to 6 mesal setiferous tubercles. Fixed finger with a dentate lamella and 1 conspicuous tooth on the proximal half.

Pedipalpi (Figure 8D,E). Femur, patella and tibia elongate; trochanter with 2 dorsal tubercle, 2 minute dorsodistal granules; ventrally with 2 tubercles. Femur cylindrical with a discrete row of ventral spaced granules, about 40% DSL. Patella unarmed, slightly swollen distally, about 1/4 of DSL. Tibia cylindrical, about 1/4 of DSL, ectal with 3 spines (iIi) and mesal with four (iiII). Tarsus without coarse dorsal granulation, ectal with 4 spines (IiIi) and mesal with 4 spines (IiIi).

Legs (Figure 8 C,F,G,H,I). Trochanter II with conspicuous dorsal tubercle, 2 retroventral and another retrodorsal. Trochanter III with 3 prolateral tubercles, 1 prodorsal and 1 retrodorsal and 2 large retrolateral and 2 proventral and retroventral. Trochanter IV with 1 large prodorsal tubercle, 2 retrolateral tuber-cles, distal 1 much larger, 1 ventral blunt tubercle. Femora I-III straight, with numerous rows of granules. Femur III

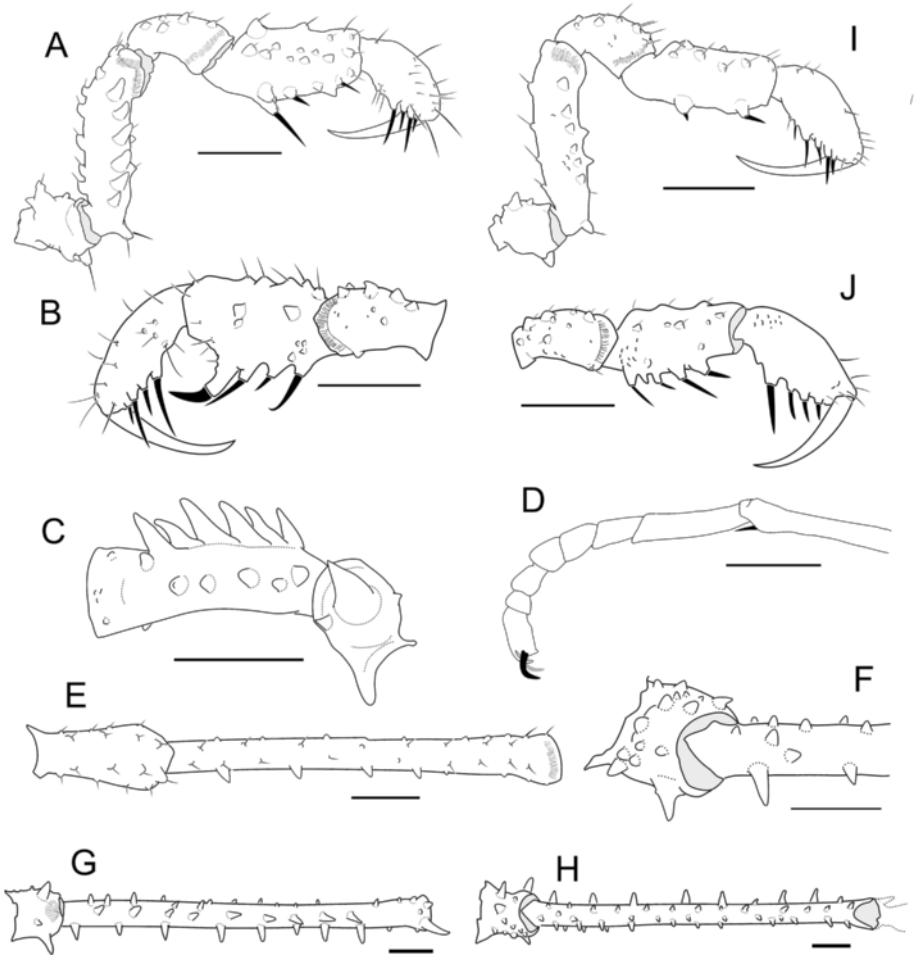

Figure 9 *Ventrifurca caffeinica* sp. nov. male and female. Male holotype (MNRJ 8351): **(A)** Right Pp, ectal view. **(B)** Right Pp, mesodorsal view. **(C)** Right Tr and Fe of Pp, dorsal view. **(D)** Right Ta IV, prolateral view. **(E)** Pa-Ti IV, dorsal view. **(F)** Tr- basal Fe III, ventral view. **(G)** Tr-Fe IV, dorsal view. **(H)** Same, ventral view. Female paratype (MNRJ 19387): **(I)** Right Pp, ectal view. **(J)** Left Pp, mesodorsal view. Scale bars = 1 mm.

furthermore with 1 retrodorsal distal spine and 1 proximal retroventral tubercle. Femur IV slightly sinuous with 6 longitudinal rows of granules; retrodorsal row with 3 larger proximal and 1 distal; those of both ventral rows very small; retroventral row with 1 curved subdistal spines and proventral row with a large curved perpendicular spine. Ratio Fe IV/scutum = 1.4. Tarsal counts in Table 1.

Genitalia (Figures 10 and 11). Ventral plate (VP) subrectangular with mid-constriction and apical parabolic concavity. Ventral surface of VP with 2 lung-shaped fields of needle microsetae each with a distal patch of asparagus-like microsetae. All macrosetae (MS) displaced to distal. Set MS A-B composed of 2 pairs or short lateral setae. 3 to 4 pairs of short curved MS C with helycoidal apex. MS D: 1 pair, strongly displaced to dorsal and curved apically. MS E: 2 pairs, very small, located on laterodistal flange, between groups A and C. Glans sac columnar elongate. Stylus substraight, without processes. Capellum formed by fused dorsal and ventral stylar caps with a pair of acuminate lateral prongs and short acuminate mid prong.

Variation (Figure 5E). The apophyses of stigmatic area may be either isolated or fused at base, as well as buttons or longer finger-like projections, with combinations between these.

Female. Similar to the males. Differential characters are as follows: without frontal hump and abdominal areas high giving the body a non-flattened appearance; spines of the abdominal area I and ocularium short. Paramedian tubercles of free tergite III larger than the males (Figure 5B). Stigmatic area short (non-elongated) without posterior process (Figure 5D). Chelicera not swollen. Pedipalpi sexually dimorphic, slightly elongated, with spines on the tibia and tarsus smaller than the male (Figure 8J,K). Legs with the longitudinal row of tubercles less conspicuous, without none dorsal or lateral tubercle conspicuously greater.

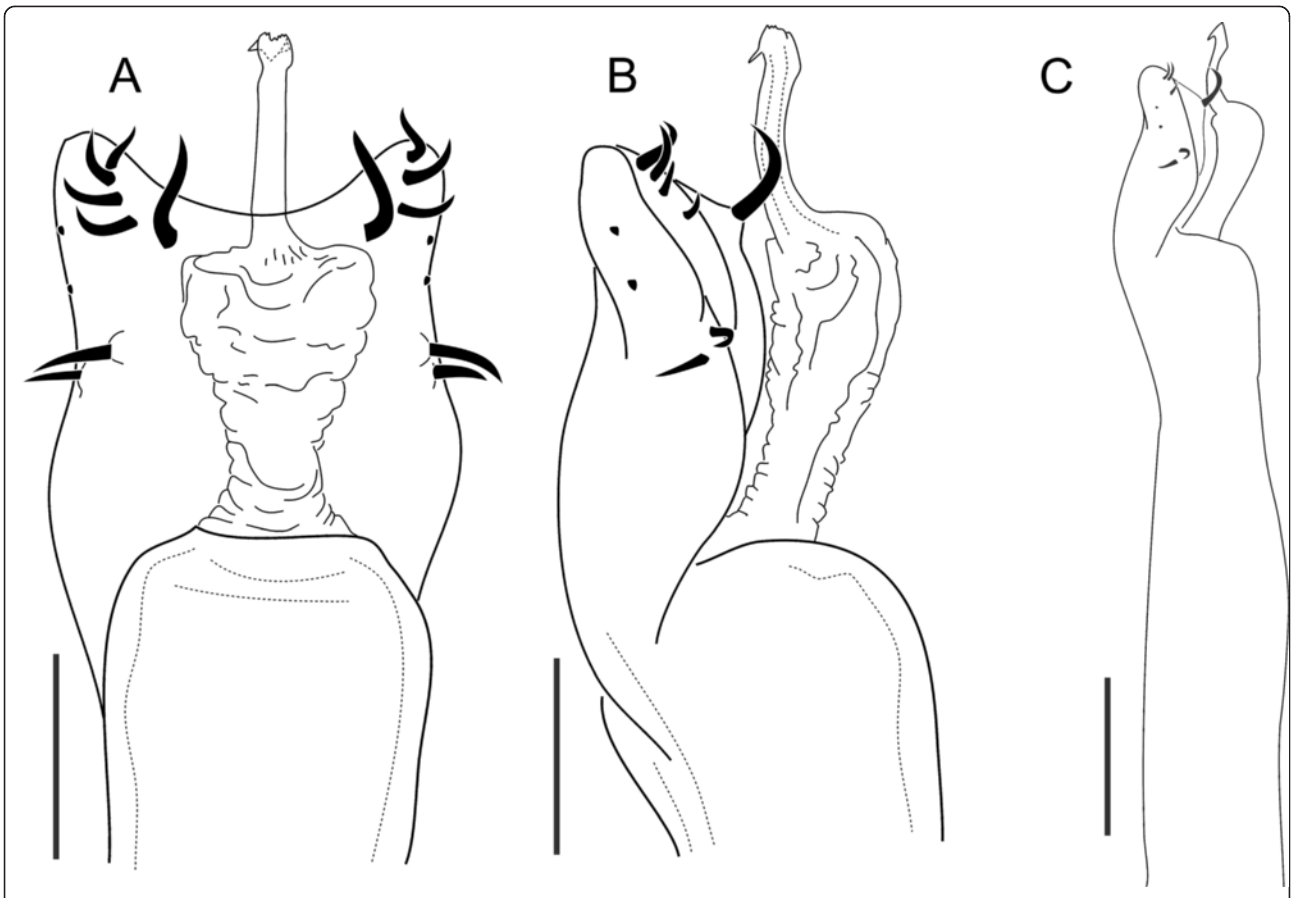

Figure 10 *Ventrifurca albipustulata* (MNRJ 19197). Distal portion of the penis: **(A)** Dorsal view. **(B)** Lateral view. **(C)** Apical half of the penis, lateral view. Scale bars (A, B) = 0.01 and (C) = 0.1 mm.

***Ventrifurca caffeinica* sp. nov.**
Figures 2, 4, 6, 12, and 13; Tables 2 and 3

Etymology
Species name is a neo-Latin adjective from the substance caffeine, referring to the international fame of Quindío department as a coffee producer.

Type data
Holotype: ♂ (MNRJ 8351) Colombia, Quindío, Filandia, b. Palacio, v. Biscocho 1,700 m 30.xi.2002 leg. L Mendoza. Paratypes: 1 ♂ (MNRJ 7038) Colombia, Quindío, Bosque de Bremen, Filandia x.1996 leg. C Rodríguez; 1 ♂ (IAvH 300053) Colombia, Quindío, Municipio. Filandia, Vda. Cruces, Finca Bosquinza, 1,900 m 4°42′15″ N 75°37′57″ W 04.vi.2002 Plantación de pino 6 leg. G Jiménez & MF Reina; 1 ♀ (MNRJ 19387) Colombia, Quindío, b. Silencio ix.1998 leg. G Ramírez.

Diagnosis
Lateral and posterior rows of yellow granules of scutum as a single line and interrupted posteriorly with only a few granules behind spines of area III. Free tergite III without row of yellow granules. Scutal area I with only a few contrasting yellow tubercles around paramedian spines. Ocularium, carapace, scutal area II without yellow tubercles (Figures 2A,C and 6A). Basichelicerite robust and long (Figures 2A and 6A). Pedipalpal femur with ectal row of stout spines (Figure 9A,I). Stigmatic area on males with very long cylindrical uniramous median acuminate apophysis (Figures 2B,E and 6A,D,F). Ratio Fe IV of ♂/scutum = 1.4. Stylar cap much elongate (Figure 12C,D,E).

Body and appendage measurements are in Table 2.

Dorsum
Dorsal scutum type beta elongate without conspicuous coda (convergent-sided terminal area) (Figures 2A and 6A). Scutum rather flattened in lateral view, excepted for base of spines of area III (Figure 2C). Abdominal scutum widest at groove III level; lateral margin of dorsal scutum with yellow rounded tubercles from carapace to area III, following outline of scutum as a discontinuous row (Figures 2A and 6A). Ocularium without median

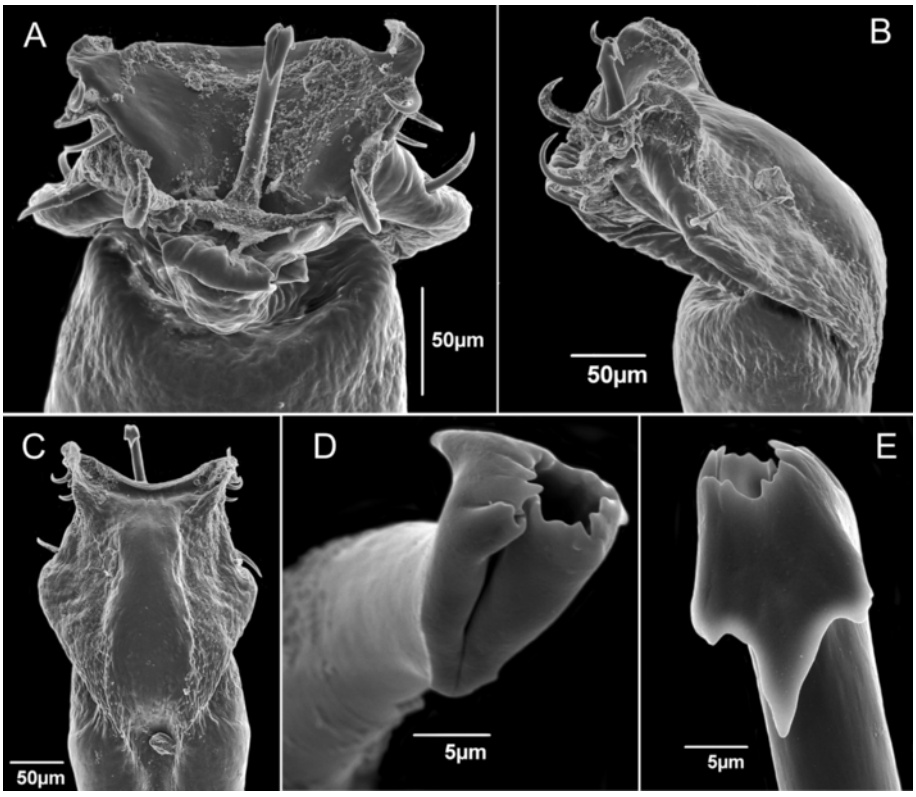

Figure 11 *Ventrifurca albipustulata* (MNRJ 19197). Penis, distal part. **(A)** Dorsoapical view. **(B)** Lateral view. **(C)** Ventral view. **(D)** Stylar caps, dorsoapical view. **(E)** Stylar caps, ventral view.

depression, armed with a paramedian pair of acuminate tubercles set widely apart (Figures 2D and 4C, D) and some small tubercles. Mesotergum well delimited, divided into 3 well-marked areas: area I divided into left and right halves by longitudinal straight groove, and with 1 conspicuous spine on each side and 14 little granules of which a few are contrasting yellow (Figure 6A); area II penetrating subtly into area I, with a median transverse row of small tubercles; area III with a pair of paramedian acuminate erect high subparallel spines, located near posterior margin, each with 2 to 3 accessory spines; posterior half of this area with a row of yellow tubercles (Figures 2A and 6A). Posterior border of scutum straight, armed with 3 yellow granules each side plus a pair of paramedian larger ones. Free tergites I-II with a pair of paramedian granules and 1 to 2 smaller laterodistal on each side; free tergite III armed with a posterior row of 13 tubercles, the paramedian pair much stouter (Figure 6A).

Venter

Stigmatic area with 2 groups of tiny anterior granules; 2 clusters of granules near of stigmata and 5 to 6 large granules each side of the posterior border. Posteroventral process cylindrical and large, located on the medial area of the posterior border (Figures 2B,C and 6D,F).

Chelicera (Figure 6A,B,C)

Chelicera slightly swollen, bulla with 2 proximal and 1 to 2 ectoproximal tubercles; hand enlarged, with some frontal tubercles arranged in 2 rows and a patch of about 3 mesal setiferous tubercles. Fixed finger with a dentate lamella and 1 conspicuous tooth on the proximal half.

Pedipalpus (Figure 9A,B,C)

Trochanter with 2 dorsal tubercles, 2 minute dorsodistal granules; ventrally with 2 tubercles. Femur cylindrical, slightly elongated, armed with longitudinal rows of tubercles, the dorsal and mesal rows are larger, and with a ventroproximal large tubercle; patella and tibia normal (not unusually elongated as in other members of the genus); patella curved, with some dorsal granules; tibia dorsally granulated, ectal with 3 spines (Iii) and mesal with four (IiII), the most distal curved and strong; tarsus without coarse granulation, ectal with 4 spines (IiIi) and mesal with 4 spines (IiIi).

Legs (Figure 9D,E,F,G,H)

Trochanter II with 2 + 1 + 2 ventral (3 rows, middle larger), 1 prodorsal distal, 2 retrodorsal (distal larger), 2 retrolateral, 1 retroventral tubercles. Trochanter III with 2 + 1 + 2 ventral (3 rows, middle larger), 2 proventral, 2 retroventral,

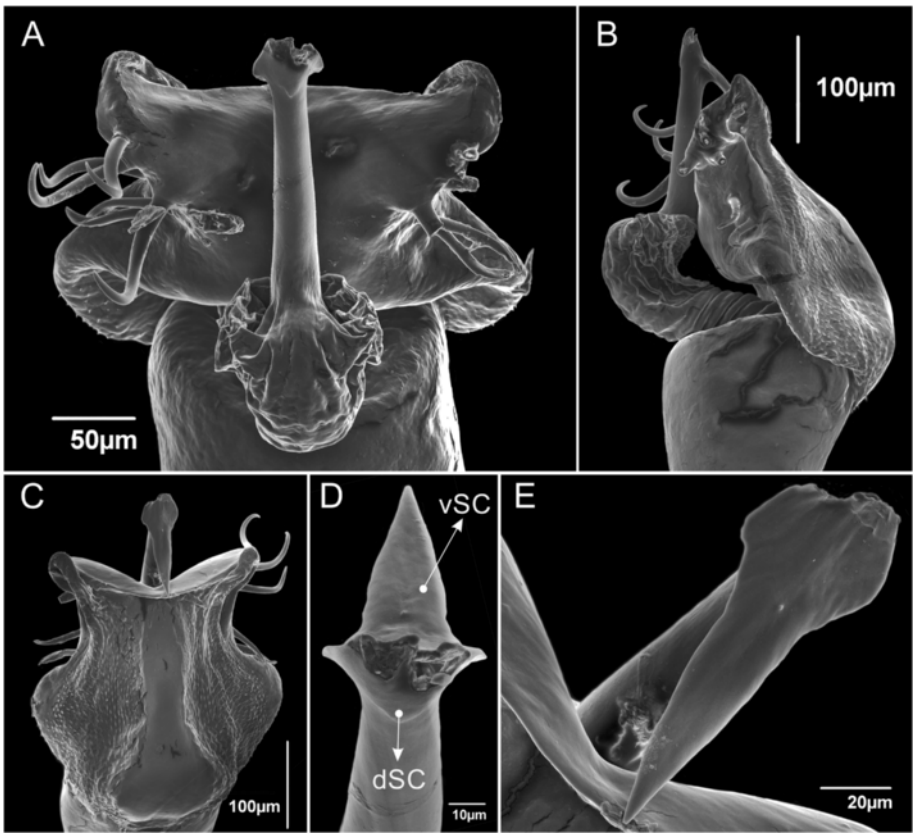

Figure 12 *Ventrifurca caffeinica* sp. nov. (MNRJ 7038). Penis, distal part. **(A)** Dorsoapical view. **(B)** Lateral view. **(C)** Ventral view. **(D)** Stylar caps, dorsoapical view. **(E)** Stylar caps, ventral view. vSC: ventral stylar cap; dSC: dorsal stylar cap.

2 (1 much larger) retrolateral, 2 prodorsal, 2 (distal larger) retrodorsal and 2 small prolateral tubercles. Trochanter IV with 2 + 1 + 2 ventral (3 rows, middle larger), 1 large prodorsal, 3 retrodorsal clustered, 2 small prolateral, 2 retrolateral distal 1 much larger, tubercles. Femora I-III straight, with numerous rows of granules. Femur III furthermore with 1 retrolateral proximal and 1 retrodorsal distal tubercles. Femur IV straight, with 6 longitudinal rows of granules; ones in retrolateral row larger, 1 retrodorsal distal tubercle. Tibia I-IV straight, with numerous rows of granules. Tibia IV with a retrolateral row of tubercules. Ratio Fe IV/scutum = 1.4. Tarsal counts in Table 3.

Genitalia (Figures 4A, B and 12)

Ventral plate (VP) subrectangular with deep mid-constriction and apical parabolic concavity. Ventral surface of VP with 2 lung-shaped fields of needle microsetae each with a distal patch of asparagus-like microsetae. All macrosetae (MS) displaced to distal. Set MS A-B composed of 2 pairs or short lateral setae. 3 pairs of short curved MS C with helycoidal apex. MS D: 1 pair, strongly displaced to dorsal and curved apically. MS E: 2 pairs, very small, located on laterodistal flange, ventrally at group C. Glans sac columnar elongate. Stylus straight, without processes. Capellum formed by marginally fused dorsal and ventral stylar caps with pair of acuminate lateral prongs and very stout acuminate mid prong.

Variation

There are only two beta males in the lots examined; one of them has apophyses of stigmatic area reduced. Spines of the ocularium can be subparallel or slightly divergent in frontal view.

Female

Similar to the males. Differential characters are as follows: without frontal hump and abdominal areas high, giving the body a non-flattened appearance; spines of the abdominal area I and ocularium short (Figure 4E,F). Paramedian tubercles of free tergite III larger than in the males (Figures 6E). Stigmatic area short (non-elongated) without posterior process. Chelicera not swollen. Pedipalpi sexually dimorphic, with tubercles smaller than in the male (Figures 9I, J), and more distal ectal spine of the tibia straight and normal. Legs with the longitudinal row of tubercles less conspicuous.

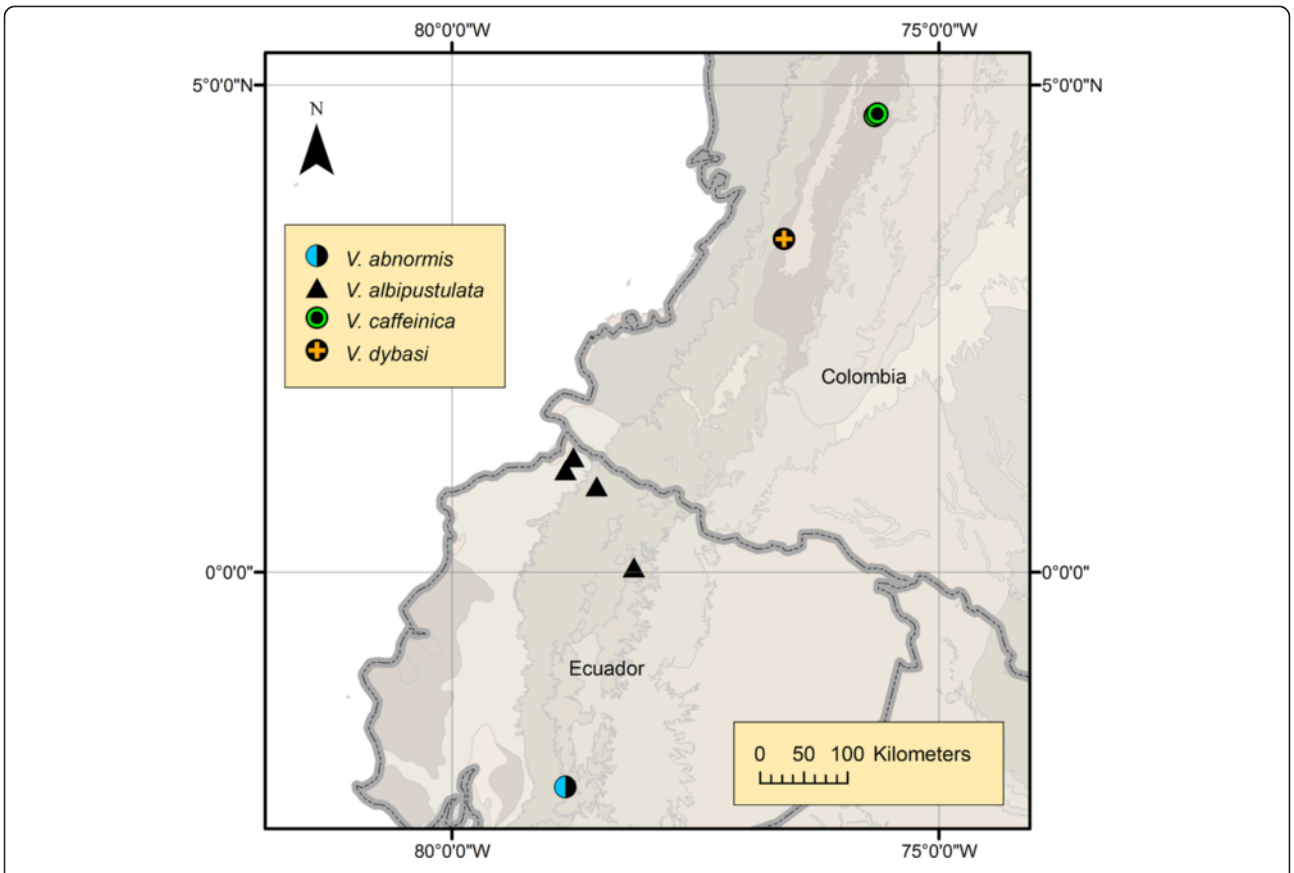

Figure 13 Northwestern South America, showing the distribution of the species of *Ventrifurca*. Shaded areas in the background are the WWF ecoregions.

***Ventrifurca dybasi* (Goodnight and Goodnight, 1947) comb. nov.**

Figure 3A,B,C

Rhopalocranaus dybasi Goodnight and Goodnight, 1947: 40, fig. 20.

Neocranaus dybasi: Kury 2003: 95.

Type data

♀ holotype (FMNH), from Colombia, Valle del Cauca, Mountains W Cali, WWF ecoregion NT0109 (Cauca Valley montane forests). Examined.

Diagnosis (Figure 3)

Lateral and posterior rows of yellow granules of scutum as a single line (excepted at carapace where they are clustered) and interrupted posteriorly with numerous granules postero-lateral on area III. Free tergite III with row of yellow granules along its extension. Scutal area I with an arch of yellow tubercles interrupted in laterals. Ocularium, carapace, scutal area II with scattered yellow tubercles. Pedipalpal femur with ectal row of stout spines.

Manaosbiidae Roewer, 1943.

***Rhopalocranaus columbianus* (Roewer, 1963) comb. nov., new familial assignment**

Figure 15A,C,D

Microcranaus columbianus Roewer, 1963: 64, figs 34-35; Kury 2003: 95.

Type data

♂ holotype 1 ♂ 2 ♀ paratypes (SMF 12707), from Colombia, Cauca, Monterredondo (03°13′N - 76°12′W), 1,400 m.

Diagnosis

Chelicerae, pedipalpi and legs yellowish brown, dorsal scutum dark brown. Scutal areas higher than ocularium in lateral view; ocularium with 2 high and acuminate tubercles; area I, III with a pair of high and acute tubercles. Free tergites I-III each with a pair of paramedian tubercles (higher on III). Penis: ventral plate in the same direction of the penis main axis, subrectangular in dorsal view, with lateral margins slightly divergent and the distal border slightly concave. Chaetotaxy: with only 2 pairs of macrosetae (MS) A, straight or slightly curved, cylindrical and acuminated, with a gap between MS A1-A2. One pair distally positioned, near to laterodistal corner

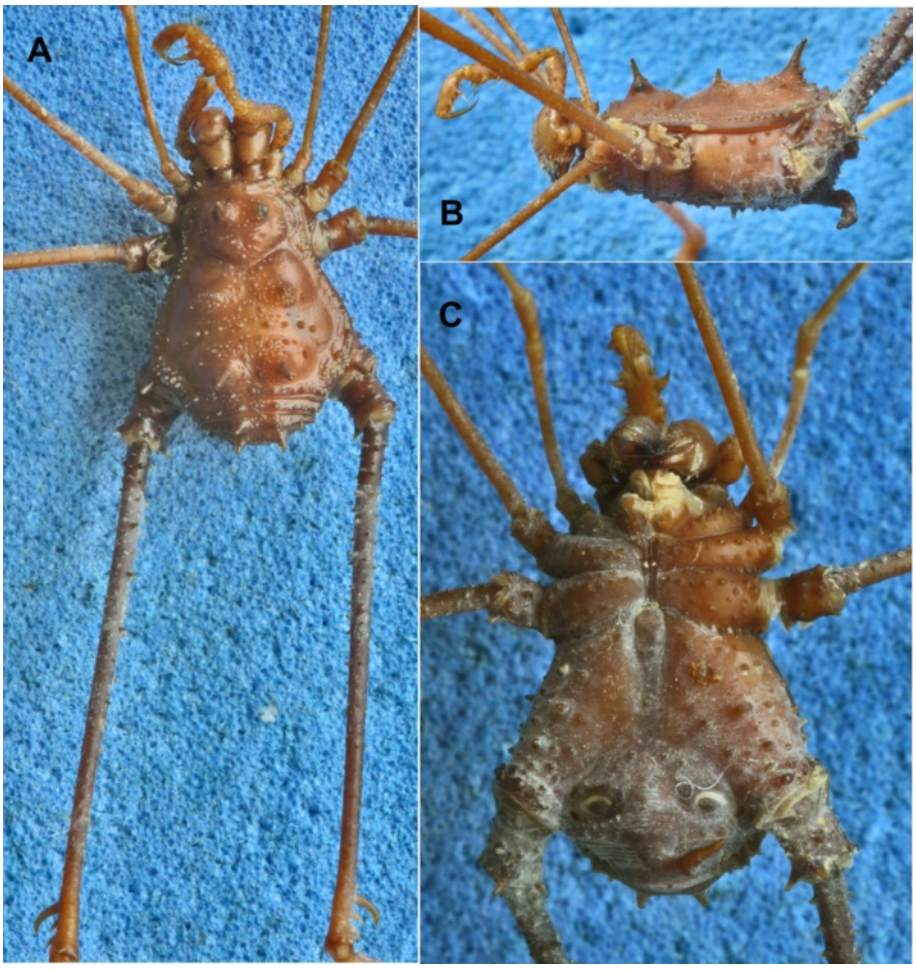

Figure 14 *Ventrifurca abnormis* male holotype (SMF RII 261/5). **(A)** Habitus, dorsal view. **(B)** Habitus, lateral view. **(C)** Habitus, ventral view.

of VP, the other 1 pair, basally positioned, together but dorsally to MS B. Macrosetae C with 3 pairs of curved and long setae distally located (the basal most slightly separate from the distal pair). MS D with only 1 pair of short setae, located dorsally to MS C. MS group by MS E group composed by 2 pairs reduced and rounded setae. Stylus with globose glans, apex straight and cylindrical, without stylar caps or other structures. Male basitarsus I moderately spindled and undivided.

Table 1 Tarsal formula of *Ventrifurca albipustulata* (numerals in parentheses represent number of distitarsomeres)

		I	II	III	IV
MNRJ 19197	♂	?/7(3)	14(3)	7	7
MNRJ 19197	♂	7(3)	14-16(3)	7	7
MNRJ 19197	♂	7(3)	16(3)	7	7
MNRJ 19197	♂	7-8(3)	15-16(3)	7	7
MNRJ 19197	♀	7(3)	14(3)	7	7
QCAZ AK 0262	♂	7(3)	14(3)	7	7

Camelianus gracilis (Roewer, 1913) comb. nov., new familial assignment

Figure 15B.

Microcranaus gracilis Roewer, 1913b: 355, fig. 138.
'*Microcranaus*' *gracilis*: Kury, 2003: 206.

Type data

♀ holotype [wrongly reported as male] (SMF RI-849), from Surinam, Saramacca.

Diagnosis (based on female holotype)

Body russet, scutum, tergites and sternites darker, mottled in black. Appendages pale yellow with loose black reticle (according to Roewer 1913b). Dorsum. Anterior margin of carapace with three tubercles each side. Ocularium with 2 conical dorsal tubercles (about size of eye), 2 anterior tubercles, 2 posterior tubercles. Carapace with 3 to 4 tubercles behind each side of ocularium. Lateral margin with four tubercles near coxa III. Area I with a large apophysis with rounded apex, surrounded by 6 tubercles, 3 tubercles each side; II with 2 to 3

Table 2 *Ventrifurca* spp. body and appendage measurements, expressed in millimeters

	V. albipustulata		*V. caffeinica*	
	♂ (MNRJ 19197)	♀ (MNRJ 19197)	♂ (MNRJ 8351)	♀ (MNRJ 19387)
CL	3.4	2.6	3.5	3.0
CW	3.8	3.5	3.8	3.9
AL	4.2	3.7	4.2	4.1
AW	6.5	3.7	6.4	6.5
IOD	1.7	1.3	1.7	1.2
BaCh	1.6	1.2	1.6	1.4
FePp	2.5	1.8	3.2	2.0
PaPp	1.7	1.2	1.8	1.1
TiPp	1.9	1.3	1.9	1.2
Fe I	5.0	4.2	5.3	3.5
Fe II	9.9	9.9	11.7	-
Fe III	7.1	6.5	8.2	5.9
Fe IV	9.1	8.8	10.2	7.4
Ti I	2.8	2.6	3.5	2.6
Ti II	6.8	6.7	8.1	-
Ti III	3.8	3.3	3.9	3.2
Ti IV	5.8	4.8	5.8	4.6

tubercles each side; III with 2 divergent pointed apophyses, directed backwards, with 2 tubercles each side. Posterior margin with 8 tubercles. Free tergites I with 14 tubercles, 1 pair higher (about eye high); II with 4 to 5 tubercles each side, with a pair of wide and pointed tubercles (larger than tergite width), 2 tubercles between largest ones; III with 10 tubercles, 3 of them larger. Anal operculum with 10 tubercles. Cheliceral segment I with 7 tubercles on lateral margin of bulla. Tarsal formula: 6(3); 11(3); 6; 6. Male unknown.

Discussion and conclusions

Rationale of the synonymies

Roewer (1913a, b, 1932), as typical of his system, used supposed differences (some of them known to be irrelevant, see for example de Piza 1940: 313 ff.; de Piza 1942: 403 ff.; Ringuelet 1959: 188) in the armature of the scutal areas and of the free tergites to separate these genera, recognizing three categories ('spine', 'small spine', and 'tubercle'). Furthermore, *Ventrifurca* was isolated from the other two genera by having a short bifurcate projection on stigmatic area, and *Microcranaus* isolated by having tarsus I, III, and IV hexamerous instead of heptamerous. In our sample of *V. albipustulata* (six specimens), tarsomere range is 7-8/14-16/7/7; curiously none has 6 tarsomeres on leg I. The tarsomere count, said by Roewer (inspired in Sørensen) and followers to be fairly constant (Sørensen 1902: 3; Roewer 1913a: 5; Goodnight and Goodnight 1953: 36), has later proven to be variable, and 5 versus 6 or 6 versus 7 tarsomeres were already found in many species (e.g., Soares 1943: 223; de Mello-Leitão 1949: 3; Muñoz-Cuevas 1973: 230). The paired apophyses of the stigmatic area would be the most significant feature to diagnose *Ventrifurca*. However, this feature is herein demonstrated to be variable intraspecifically, which led different male specimens to be described as different genera (see 'variation' above and Figure 5E).

Table 3 Tarsal formula of *Ventrifurca caffeinica* sp. nov.

		I	II	III	IV
MNRJ 8351	♂	7-6(3)	11-12(3)	7	7
MNRJ 7038	♂	?-6(3)	?	6-7	7
IAvH 300053	♂	6(3)	?	7	?-7
MNRJ 19387	♀	6(3)	12(3)	7	7

Interchange of species to and from *Ventrifurca*/*Rhopalocranaus*

It is not unusual, in works done under the Roewerian paradigm, to join completely unrelated species which happen to coincide in tarsal counts and area armature. *M. columbianus* has been originally included in *Microcranaus* under such constraints. However, examination of the type material by one of us, including male genitalia, led to its placement in Manaosbiidae, where it fits in *Rhopalocranaus* by the shape of the ventral plate of the penis, pattern of their macrosetae, and ornamentation of the dorsal scutum and ocularium (a review of Manaosbiidae by RPR is in course). On the other hand, following the same reasoning of Roewer, Goodnight and Goodnight (1947) discovered a species here included in *Ventrifurca* after revision of the holotype, but described it under the then amorphous assemblage *Rhopalocranaus*, namely *R. dybasi*. Only much later, Kury (1997) transferred *Rhopalocranaus* from Cranainae to Manaosbiidae. However, as demonstrated above, *R. dybasi*, even known only by the female, is a Cranaidae and matches the present diagnosis of *Ventrifurca*.

Distribution of *Ventrifurca*

The distribution of cranaid species is primarily associated with the Andean and Amazonian forest. It is currently difficult to find any pattern of distribution of the genera in this family due to (1) the unsatisfactory taxonomy with many monotypic/meaningless genera, (2) species known from only one locality, and (3) poorly studied collections in the Andean region. A few comments can be made on two monophyletic groups: (1) the 'longipalp cranaids' (formerly Stygnicranainae) which are distributed in the south of Colombia and north of Ecuador associated to Northwestern Andean montane

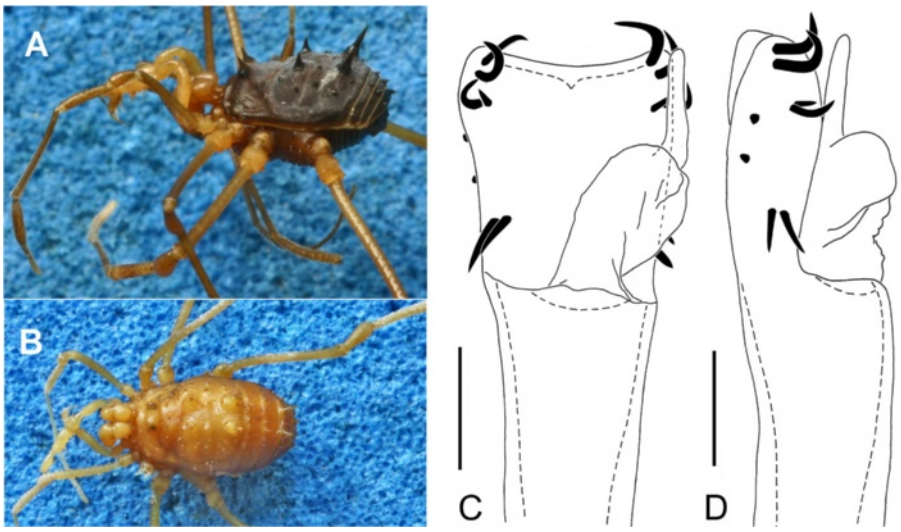

Figure 15 Species of Manaosbiidae transferred here from *Microcranaus*. *Rhopalocranaus columbianus* (SMF 12707) male holotype: **(A)** Habitus, lateral view. *Camelianus gracilis* (SMF RI-849) female holotype: **(B)** dorsal view. *Rhopalocranaus columbianus*. Distal portion of the penis. **(C)** Dorsal view. **(D)** Lateral view. Scale bars (C-D) = 0.1 mm.

forests (Orrico and Kury 2009) and (2) the genus *Phareicranaus* which has some species groups (Villarreal, unpublished data), one of them associated to north of south America (Venezuela, Panama and Trinidad) and another well distributed in the Amazonian Basin (Brazil, Ecuador, Peru).

Although only three species of *Ventrifurca* are known, this could be a more diverse genus and seems to be restricted to the western range of the Colombian Andes and Ecuador, from north of Ecuador about 700 km north into northwestern Colombia. Reliable records of *Ventrifurca* species are only from WWF ecoregions NT0109 and NT0145, both belonging to the larger region Northern Andean montane forests. This corresponds to Morrone's (2014) Cauca Province. On the other hand, the type locality of *Microcranaus pustulatus*, the 'Cachab' - which is here interpreted as Río Cachabí, at much lower altitude, already in the Choco-Darien moist forests region (matching Morrone's Western Ecuador Province) - might be inaccurate, so *Ventrifurca* can be said to be safely recorded only from Northern Andean montane forest. Another interpretation is that the original locality report is accurate, and *Ventrifurca* is much wider spread than we think, descending into the Pacific lowland forest. Only further collecting expeditions will allow putting those hypotheses to test.

Relationships of *Ventrifurca*

A great number of Cranaidae (e.g., *Phalangodus*, *Phareicranaus* in part, *Carsevennia* Roewer, 1913, *Heterocranaus* Roewer, 1913, *Yania* Roewer, 1919) has short, compact pedipalpi, with femur strongly convex dorsally and spined mainly on the males. But a more slender, sexually dimorphic pedipalpus, slightly elongate in males of *V. albipustulata*, hints to some relationship with the three genera of 'longipalp cranaids' which are thought to constitute a clade (see illustrations of all in Orrico and Kury 2009). In *Tryferos*, the pedipalpus of the male is immensely elongate (femur to tibia) and femur unarmed while the female has regular podomeres. *Agathocranaus* is known only from a male, but podomeres are only moderately long. Of special interest in *Agathocranaus* is the circular/elliptical transverse section of tarsus (instead of hemispherical). This feature is consistently associated with elongate pedipalpi and is known in Biantidae, Epedanidae, Stygnidae (Kury and Pérez-G 2007; Pinto-da-Rocha 1997; Kury 2008, 2009), and some Gonyleptidae (Caelopyginae, Sodreaninae, and Progonyleptoidellinae) (Pinto-da-Rocha 2002; Pinto-da-Rocha and Bragagnolo 2011). *Stygnicranaus* appears to represent a step further in the evolution of 'longipalpness,' because it has the same tarsal conformation as *Agathocranaus*, but with greater elongation of Fe-Ti both in males and in females. Even if *Ventrifurca caffeinica* sp. nov. is an exception, frequently species with ornamentation on the posterior edge of the stigmatic area have at least males if not both sexes with elongation of leastwise one of the segments of the pedipalpus, e.g., *Angistrisoma atrolutea* Roewer, 1932, *A. fuscum* Roewer, 1932, *Angistrius abnormis* Roewer, 1932, *Ventripila marginata* Roewer, 1917, and *Ventrisudis mira* Roewer, 1963.

The guitar-shaped penis ventral plate, the distal concentration of macrosetae, and the presence of a stylar cap (thus called by Kury 2012a, also *capellum* in Orrico and Kury 2009), all present in *Ventrifurca*, are quite widespread in some Cranaidae genera (e.g., *Heterocranaus*, *Chiriboga*, and *Metacranaus* in Pinto-da-Rocha and Bonaldo 2011;

Zannicranaus in Kury 2012a). More strikingly similar is the greatly medially shifted pair of dorsal macrosetae present in *Stygnicranaus* and *Metacranaus*. As male genital morphology is largely unknown in Cranaidae, the evolution of their features is hitherto only poorly understood, a scenario that is gradually changing with focused work on this family.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
OVM led the execution of the project, prepared most photographs and drawings, and wrote the bulk of the text, including diagnoses and descriptions of the species and some of the discussion. ABK conceived the initial, much narrower, idea of the paper, discovered synonymies, traveled to Ecuador where he collected *Ventrifurca* specimens, arranged loan of Chicago type specimens, edited images, created the map, checked descriptions and diagnoses, and redacted the historical background and most of the discussion. RPR traveled to France and Germany in order to study type material of Roewer's species and produced pictures of them, drafted the genitalia of Manaosbiidae, and placed the non-Cranaidae in genera. All authors intensively discussed all parts of the text, genera and species delimitation, and image organization, and all read and approved the final manuscript.

Acknowledgements
This study is co-funded by grants CNPq (477502/2012-1 and 504327/2012-7) and FAPERJ (E-26/111.431/2012 and E-26/111.705/2012) to ABK, CAPES (PEC-PG 5900115) to OVM, and FAPESP (2009/17206-5; BIOTA, 2013/50297-0), NSF (DOB 1343578), and NASA to RPR. We would like to thank Peter Jäger (SMF) for the hospitality in Frankfurt to RPR, Mark Judson and Elise-Anne Leguin (MNHN) idem in Paris, Claudia Medina (IAvH) for hospitality to ABK in Villa de Leyva, Petra Sierwald (FMNH) for sending type material, and Álvaro Barragán and Mauricio Vega (QCAZ) for helping out in ABK's expedition to Ecuador. Maria Cleide de Mendonça (MNRJ) provided optical facilities.

Author details
[1]Departamento de Invertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, São Cristóvão, 20.940-040 Rio de Janeiro, RJ, Brazil. [2]Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, Caixa Postal 11461, 05422-970 São Paulo, SP, Brazil.

Received: 22 September 2014 Accepted: 29 April 2015
Published online: 07 June 2015

References
Goodnight CJ, Goodnight ML (1947) Phalangida from tropical America. Fieldiana Zool 32(1):1–58
Goodnight CJ, Goodnight ML (1953) The opilionid fauna of Chiapas, Mexico, and adjacent areas (Arachnoidea, Opiliones). Am Mus Novit 1610:1–81
Hara MR, Pinto-da-Rocha R, Villarreal MO (2014) Revision of the cranaid genera *Phalangodus*, *Iquitosa* and *Aguaytiella* (Opiliones: Laniatores: Gonyleptoidea). Zootaxa 3814(4):567–580
Kury AB (1994) The genus *Yania* and other presumed Tricommatidae from South American highlands (Opiliones, Cranaidae, Prostygninae). Revue Arachnologique 10(7):137–145
Kury AB (1997) The genera *Saramacia* Roewer and *Syncranaus* Roewer, with notes on the status of the Manaosbiidae (Opiliones, Laniatores). Bol Mus Nac Rio de J (Nov Ser) (Zool) 374:1–22
Kury AB (2003) Annotated catalogue of the Laniatores of the New World (Arachnida, Opiliones). Rev Iber Aracnol Vol Especial Monográfico 1:1–337
Kury AB (2008) On the systematic position of *Dino* Loman and *Toccolus* Roewer (Opiliones, Laniatores, Epedanidae), with the description of a new species from western Java, Indonesia. Zootaxa 1932:61–68
Kury AB (2009) A new genus of Stygninae from a relictual rainforest in Ceará, northeastern Brazil (Opiliones, Laniatores, Stygnidae). Zootaxa 2057:63–68
Kury AB (2012a) A new genus of Cranaidae from Ecuador (Opiliones: Laniatores). Zootaxa 3314:31–44
Kury AB (2012b) First report of the male of *Zamora granulata* Roewer 1928, with implications on the higher taxonomy of the Zamorinae (Opiliones, Laniatores, Cranaidae). Zootaxa 3546:29–42
Kury AB, Pérez-G, A (2007). Biantidae Thorell, 1889. Pp 176-179. In: Pinto-da-Rocha, R., G. Machado & G. Giribet (eds.). Harvestmen: the biology of the Opiliones. Harvard University Press, Cambridge and London. x + 597 pages
Kury AB, Villarreal-M O, Costa CS (2007) Redescription of the type species of *Cynorta* Koch, 1839 (Arachnida, Opiliones, Cosmetidae). J Arachnol 35(2):325–333
Kury AB, Villarreal MO (2015) The prickly blade mapped: establishing homologies and a chaetotaxy for macrosetae of penis ventral plate in Gonyleptoidea (Arachnida, Opiliones, Laniatores). Zool J Linnean Soc 174:1–46.
de Mello-Leitão CF (1949) Famílias, subfamília, espécies generos novos de opiliões e notas de sinonimia. Bol Mus Nac Rio de J (Nov Ser) (Zool) 94:1–33
Morrone JJ (2014) Biogeographical regionalisation of the Neotropical region. Zootaxa 3782(1):001–110, http://dx.doi.org/10.11646/zootaxa.3782.1.1
Muñoz-Cuevas A (1973) Sur les caractères génériques de la familie des Gonyleptidae (Arachnida, Opilions, Laniatores). Bull Mus Nat Hist Nat (3) 87(113):225–234
Orrico VGD, Kury AB (2009) A cladistic analysis of the Stygnicranainae Roewer, 1913 (Arachnida, Opiliones, Cranaidae) – where do longipalp cranaids belong? Zool J Linnean Soc 157:470–494
Pinto-da-Rocha R (1997) Systematic review of the Neotropical family Stygnidae (Opiliones, Laniatores, Gonyleptoidea). Arq Zool 33(4):163–342
Pinto-da-Rocha R (2002) Systematic review and cladistic analysis of the Caelopyginae (Opiliones, Gonyleptidae). Arq Zool 36(4):357–464
Pinto-da-Rocha R, Bonaldo AB (2011) Species relationships in the Neotropical genus *Phareicranaus* Roewer 1913 (Opiliones: Cranaidae): two new species and new data from penial morphology. Zootaxa 3135:1–34
Pinto-da-Rocha R, Bragagnolo C (2011) Systematic revision and cladistic analysis of the Brazilian subfamily Sodreaninae (Opiliones: Gonyleptidae). Invertebr Syst 24 ["2010"]:509–538
Pinto-da-Rocha R, Hara MR (2009) New familial assignments for three species of Neotropical harvestmen based on cladistic analysis (Arachnida: Opiliones: Laniatores). Zootaxa 2241:33–46
Pinto-da-Rocha R, Kury AB (2003) Phylogenetic analysis of *Santinezia* with description of five new species (Opiliones, Laniatores, Cranaidae). J Arachnol 31(2):173–208
Pinto-da-Rocha R, Benedetti AR, Vasconcelos EG, Hara MR (2012) New systematics assignments in Gonyleptoidea (Arachnida, Opiliones, Laniatores). Zookeys 198:25–68
Pinto-da-Rocha R, Bragagnolo C, Marques FPLM, Antunes M Jr (2014) Phylogeny of harvestmen family Gonyleptidae inferred from a multilocus approach (Arachnida: Opiliones). Cladistics 30:519–539. doi:10.1111/cla.12065
de Piza ST Jr (1940) Breves considerações em torno de alguns nóvos Gonyléptidas do Brasil. Rev Agric 15(7–8):312–324
de Piza ST Jr (1942) A respeito da sistemática de alguns opiliões. Rev Bras Biol 2(4):403–416
Ringuelet RA (1959) Los arácnidos Argentinos del orden Opiliones. Rev Mus Argent Cienc Nat Bernardino Rivadavia 5(2):127–439, figs 1–62, plates 1–20
Roewer CF (1913a) Die Familie der Gonyleptiden der Opiliones-Laniatores. Arch Naturgesch (Abt A Original-Arbeiten) 79(4): 1–256, pl. 1a.
Roewer CF (1913b) Die Familie der Gonyleptiden de Opiliones - Laniatores. [part 2]. Arch Naturgesch (Abt A Original-Arbeiten) 79(5): 257–472, pl. 2
Roewer CF (1932) Weitere Weberknechte VII (7. Ergänzung der: "Weberknechte der Erde", 1923) (Cranainae). Arch Naturgesch (NF) 1(2):275–350
Roewer CF (1963) Opiliones aus Peru und Colombien. [Arachnida Arthrogastra aus Peru V]. Senckenb Biol 44(1):5–72
Sharma PP, Giribet G (2011) The evolutionary and biogeographic history of the armoured harvestmen – Laniatores phylogeny based on ten molecular markers, with the description of two new families of Opiliones (Arachnida). Invertebr Syst 25:106–145
Simon E (1879) Essai d'une classification des Opiliones Mecostethi. Remarques synonymiques et descriptions d'espèces nouvelles. Première partie. Annales de la Société Entomologique de Belgique, 22: 183–241.
Soares BAM (1943) Notas sobre opiliões II. Pap Avulsos Dep Zool (Sao Paulo) 3(15):221–227
Soares BAM, Soares HEM (1948) Monografia dos gêneros de opiliões neotrópicos I. Pap Avulsos Dep Zool (Sao Paulo) 5(9):553–636
Sørensen WE (1902) Gonyleptiden (Opiliones, Laniatores). Ergebnisse der Hamburger Magalhaensischen Sammelreise 6(5):1–36
Villarreal MO, Kury AB (2012) *Licornus* Roewer, 1932: newly transferred to Ampycinae and first record of the family Gonyleptidae (Opiliones: Laniatores) from Venezuela. Zootaxa 3544:71–78