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New species of *Rivudiva* Lugo-Ortiz & McCafferty (Ephemeroptera: Baetidae) with comments on *R. minantenna* Lugo-Ortiz & McCafferty and *R. trichobasis* Lugo-Ortiz & McCafferty

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Abstract

Based on nymphs collected in Espírito Santo and Amazonas, Southeastern and Northern Brazil, two new species of the genus *Rivudiva* Lugo-Ortiz & McCafferty, 1998 (Ephemeroptera: Baetidae) are described. *Rivudiva inma* sp. nov. shares several characteristics with *R. minantenna* Lugo-Ortiz & McCafferty, 1998, but can be distinguished by details of leg setation, such as length and shape of robust setae and presence of setae on trochanter. *Rivudiva oonirikoperi sp.* nov. is more similar to *R. trichobasis* Lugo-Ortiz & McCafferty, 1998, but can be separated by the absence of setae on scape and pedicel, shape of distal margin of labrum, and length of maxillary palp. New diagnoses and illustrations are provided for *R. minantenna* and *R. trichobasis*, as well as a key to the known nymphs of *Rivudiva* species.

Keywords: Taxonomy, Neotropics, Atlantic Forest, Amazon, key

Introduction

The genus *Rivudiva* was erected by Lugo-Ortiz & McCafferty (1998) in order to include two species of Baetidae (Ephemeroptera) with conspicuous long setae on the femora of all legs. These species were described exclusively from southern Brazil and Paraguay, but in recent years several authors have provided subsequent data.

Orth *et al.* (2000), Salles *et al.* (2004), Falcão *et al*. (2011), Boldrini *et al.* (2012), and Boldrini & Cruz (2014) expanded the distributional range of the genus. Respectively, these authors provided new records from French Guiana (*Rivudiva* sp.), Rio de Janeiro (*R. minantenna* Lugo-Ortiz & McCafferty, 1998), Roraima (*R. trichobasis* Lugo-Ortiz & McCafferty, 1998), Maranhão (*R. trichobasis*), and Rondônia (*R. trichobasis*). After rearing nymphs assigned to *R. minantenna* from Espírito Santo, Salles & Nascimento (2009) described the adults of the genus for the first time. Based on that description, and on the presence of a spine-like protuberance on the distal margin of the subgenital plate, they have also transferred two species known exclusively at the adult stage to that genus, namely *R. venezuelensis* (Traver, 1943) from Venezuela and *R. covaloae* (Traver, 1971) from Uruguay. And finally, Cruz *et al.* (2011) described the adults of *R. trichobasis* based on reared material from Amazonas.

To date, the genus presents a wide and disjunct distribution restricted to South America and comprises the following species: *R. minantenna* (type-species, known from nymph and male imago); *R. trichobasis* (nymph and male imago); *R. covaloae* (male imago); and *R. venezuelensis* (male imago).

Based on a phylogenetic analysis, *Rivudiva* was recovered as the sister group of *Varipes* Lugo-Ortiz & McCafferty, 1998 and both genera were closely related to *Apobaetis* Day, 1955 (Nieto 2010). A recent cladistics analysis

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(Cruz *et al.* 2018), however recovered *Rivudiva* as a sister group of *Adebrotus* Lugo-Ortiz & McCafferty, 1995, *Callibaetoides* Cruz, Salles & Hamada, 2013, *Callibaetis* Eaton, 1881, *Waltzohyphius* McCafferty & Lugo-Ortiz, 1995 (in Lugo-Ortiz & McCafferty, 1995), *Apobaetis*, and *Paracloeodes* Day, 1955.

During the course of studies on the mayfly fauna from Espírito Santo, Brazil, three species of *Rivudiva* were found: the one assigned to *R. minantenna* by Salles & Nascimento (2009), another one closely related to that species, and a last one related to *R. trichobasis*. Additionally, one of us also found a new species from the Amazonas. The correct specific assignment of the specimens from Espírito Santo, however, proved to be a difficult task based on the original description provided by Lugo-Ortiz & McCafferty (1998), especially in the case of the species related to *R. minantenna*. In order to elucidate their identities we review most of the specimens historically attributed to *Rivudiva* from Brazil, including paratypes of *R. minantenna* and *R. trichobasis*. Based on that, we present herein the description of two new species, new diagnoses and illustrations for *R. minantenna* and *R. trichobasis*, and a key to the four species known at the nymphal stage.

Material and methods

Pictures of habitus of preserved specimens and slides were taken using a cellphone adapted for use with a stereomicroscope and microscope. Living specimens were photographed in the field, in a small acrylic aquarium, with a Nikon D800, a 105 mm objective and a Nikon macro flash. Line drawings were made on Adobe Illustrator CC® according to Coleman (2003, 2006), and were based on photographs or drawings made with the aid of a camera lucida. SEM photographs were taken with a JEOL 35 CF scanning electron microscope. The free software QGIS, Geographic Information System (http://qgis.org) was used to make the distribution map of the species.

The examined material is housed in the following institutions: Museu de Entomologia (UFVB), Viçosa, Brazil; Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil; and Instituto de Biodiversidad Neotropical (IBN), Tucumán, Argentina. Permanent slides of the material housed in UFVB or INPA were prepared using Euparal® as mounting media, those housed in IBN using Canada Balsam. When describing fore legs, ratios of femur, tarsus and tarsal claw are presented in relation to tibia. Actual length of tibia in millimeters is presented between parentheses.

Results

Rivudiva Lugo-Ortiz & McCafferty, 1998

Diagnosis

Nymph. 1) maxillary palp long and robust, segment I almost as long as length of galea-lacinia or even longer, and segment II with short pointed distal projection (Figs 5, 15, 24); 2) ventral canine of maxilla laterally expanded (Figs 26–27); 3) lingua sub-quadrangular, apex with tuft of setae (Figs 4, 14); 4) glossa oblong, with conspicuous stout setae on inner or distal margin (Figs 6, 16); 5) segment II of labial palp with rounded inner medial protuberance, segment III conical (Figs 6, 16); 6) femora with distinct robust, usually long setae on outer margin, inner margin, and on a longitudinal row on dorsal and ventral surface (Figs 7, 17, 19, 30–33); 7) tarsal claws with two rows of denticles (Figs 8, 18, 34, 35); 8) hind wing pads present or absent.

Imago. 1) marginal intercalaries of fore wing double; 2) hindwings present or absent, when present with two longitudinal veins and with costal projection pointed, placed in the basal fourth of anterior margin; 3) forceps with distal segment long, about 2× as long as wide; 4) fusion of first and second segment of forceps on basal third; 5) distal margin of subgenital plate with shallow emargination or with small pointed projection.

Distribution. Neotropical, until now restricted to South America in the following countries: Brazil, French Guiana, Paraguay, and Venezuela.

Key to the species in the nymphal stage

1. Abdominal sterna with robust, apically pointed setae (Figs 36–37); hind wing pads absent 2
1'. Abdominal sterna with simple setae; hind wing pads present 3

2(1). Scape and pedicel with apically pointed setae (Fig. 28); fore tarsus without long setae . . . . . *R. trichobasis*
2'. Scape and pedicel without apically pointed setae; fore tarsus with long setae . . . . . *R. oonirikoperi*, sp. nov.

3(1'). Setae on dorsum of fore femur long (as long as maximum width of femur) and apically pointed (Fig. 32). . . . . *R. minantenna*
3'. Setae on dorsum of fore femur short (at most ⅓ maximum width of femur) and apically blunt (Figs 7, 30, 31) . . . . . *R. inma*, sp. nov.

Rivudiva inma **Salles & Nieto, sp. nov.**

Rivudiva minantenna (misidentification): Salles & Nascimento (2009: 233); Salles *et al.* (2010: 303).

Material examined. Holotype (male adult with corresponding exuviae): BRAZIL, Espírito Santo state, Santa Teresa, Capitel de Santo Antônio, S 19°52'33" W 40°31'50", 720 m.a.s.l., 19.ii.2009, FF Salles leg. (UFVB, #EP000150). Paratypes: same data as holotype, 2 nymphs (IBN); same data as holotype, except for 20.ii.2009, 14 nymphs (UFVB, 1 used for SEM images, #EP000151); same data as holotype, except 26.x.2008, 4 nymphs (UFVB, #EP000152).

Diagnosis

Nymph. 1) antenna without spine-like setae on scape and pedicel ; 2) distal margin of labrum with deep, wide, medial emargination (Figs 1, 22); 3) dorsal surface of labrum with regular row of setae, plus few additional setae (Figs 1, 22); 4) tuft on apex of lingua formed by long simple setae (Fig. 4); 5) maxillary palp segment II apically rounded and with a nipple-like projection (Figs 5, 24); 6) glossa with base ventrally expanded, apex obliquely truncate and with dorsal thick setae distomedially (Fig. 6); 7) hind wing pads present; 8) trochanter with robust, short and apically pointed setae (Fig. 7); 9) outer dorsal row, medial dorsal row and inner dorsal row of femora with robust blunt setae, those of outer row at most 1/3 maximum width of femur (Figs 7, 30–31); 10) abdominal sterna without robust apically pointed setae; 11) paraproct with around 15 marginal spines (Fig. 10).

Imago. 1) dorsal portion of turbinate eyes with inner margins parallel (Fig. 1 of Salles & Nascimento 2009); 2) length of forewing about 2.7× width; 3) hind wings present (fig. 5 of Salles & Nascimento 2009); 4) forceps segment III oblong, 2× as long as wide (fig. 6 of Salles & Nascimento 2009); 6) posterior margin of subgenital plate with a medial pointed projection (fig. 6 of Salles & Nascimento 2009).

Description

Nymph. Lengths: body, 5.2 mm; antennae, 1.8 mm.

Head. Coloration: pale yellow. Antenna pale yellow. Compound eyes pale yellow. Antenna. Scape and pedicel without spine-like setae. Labrum (Figs 1, 22). Rectangular, broader than long; length about 0.6x maximum width; distal margin with wide medial emargination; anterolateral and distal margins with bifid and pectinate setae; dorsal surface near distal margin with somewhat regular row of several simple setae. Left mandible (Fig. 2). Incisors cleft in two sets; outer and inner set of incisors respectively with 4 + 2 denticles; prostheca robust; margin between prostheca and mola straight; tuft of spine-like setae at base of mola present; subtriangular process wide; denticles of mola constricted; lateral margins convex. Right mandible (Fig. 3). Incisors deeply cleft in two sets; outer and inner set of incisors respectively with 3 + 3 denticles; prostheca bifurcated at middle and pectinate; margin between prostheca and mola straight; tuft of spine-like setae at base of mola present; denticles of mola not constricted; apex of mola with two simple setae; lateral margins convex. Hypopharynx (Fig. 4). Lingua subequal to superlingua, subquadrangular with a distomedial pointed projection covered by tuft of long simple setae; superlingua with angulate

FIGURES 1–6. *Rivudiva inma*, sp. nov., nymph: (1) Labrum; (2) Left mandible; (3) Right mandible; (4) Hypopharynx; (5) Maxilla; (6) Labium (left = ventral surface, right = dorsal surface).

FIGURES 7–10. *Rivudiva inma*, sp. nov., nymph. (7) Fore leg; (8) Tarsal claw; (9) Posterior margin of tergum IV; (10) Paraproct.

outer margin; short, thin, simple setae scattered over distal margin of lingua and superlingua. Maxilla (Figs 5, 24–25). Maxillary palp 1.5× longer than galea-lacinia; segment II and III combined 0.8× the length of segment I, apex with inner nipple-like projection; maxillary palp with fine and simple setae scattered over surface. Labium (Fig. 6). Glossa oblong, basally expanded, narrowing apically and subequal to paraglossa; apex with eight short spine-like setae; outer margin bare; inner margin with row of thick setae on apical 2/3; ventral surface covered by thin long setae. Paraglossa curved inward, but with distinct apical margin; apex with three rows of robust long spine-like setae; outer margin with long thin setae on distal 1/2. Labial palp with segment I subequal in length to segments II and III combined; segment II with rounded medial protuberance, outer margin and distomedial protuberance covered with thin, long and simple setae; segment III conical, length 0.7× width, covered by thin simple setae on outer margin, dorsal surface with robust spine-like setae near outer margin.

Thorax. Pale yellow. Hind wing pads present. Legs pale yellow. Foreleg (Figs 7, 30–31). Ratio of foreleg 1.2:(1):0.9:0.3. Fore femur. Length about 2.7× maximum width; outer and inner margins with short to elongate clavate setae, anterior and posterior surface covered with longitudinal row of clavate robust setae; length of setae on outer margin at most 1/3 maximum width of femur. Tibia. Dorsally bare; inner margin with a row of spine-like setae increasing in length toward apex. Tarsus. Inner margin with a row of spine-like setae. Tarsal claws as in Figs 8 and 34. Mid and hind leg. Femora narrower than fore femora; setae on anterior surface of femora longer than in fore femur; setae on posterior surface longer and pointed. Tibiae and tarsi with one row of short spine-like setae.

Abdomen. Pale yellow, terga II–III and VI yellowish brown, anterior margins of segments II-VI brownish (Figs 38–39). Tergal surface covered by pores and short spine-like setae; posterior margin with contiguous spination (Fig. 9). Sterna pale yellow, bare. Gills whitish. Paraproct (Fig. 10) with around 15 marginal spines. Cercus and terminal filament without large lateral spines.

Imago. Adequately characterized by Salles & Nascimento (2009), although incorrectly associated to *R. minantenna*.

Etymology. After the Instituto Nacional da Mata Atlântica (INMA), the Brazilian National Institute of the Atlantic Forest. INMA is located in the city of Santa Teresa, locality of the new species, and one of the institute's most important mission is the conservation of the Atlantic Forest and, therefore, of the new species.

Comments. Specimens of this species have been incorrectly assigned to *R. minantenna* by Salles & Nascimento (2009) due to several characteristics shared by them (see discussion for more details). The adults of the new species differ from the adults of *R. covaloae*, the other species with hind wings, by the shape of the distal margin of the subgenital plate. In *R. covaloae* the medial spine lies in a concavity of this margin (see fig. 2 of Traver 1971), while in the new species the distal margin is convex (see fig. 6 of Salles & Nascimento 2009).

Distribution. Southeastern Brazil, Espírito Santo (Fig. 41).

Biology. Nymphs of the new species were found inhabiting the sandy substrates of few streams in Augusto Ruschi Biological Reserve, Espírito Santo, or in adjacent areas. They are difficult to collect due to an apparently low abundance and/or to an apparently patchy distribution in the extensive sandy areas of these streams. Besides, the color pattern of the nymphs generates a remarkable camouflage with its habitat (see fig. 8 of Salles & Nascimento 2009).

Rivudiva oonirikoperi **Cruz, sp. nov.**

Material examined. Holotype (male nymph on slide): BRAZIL, Amazonas state, São Gabriel da Cachoeira, stream on BR 307 Km 13, 00º04'44.6"S/067º00'15.9"W, 26.viii.2011, P.V. Cruz, A.S. Fernandes and E. Reis cols. (INPA). Paratype: one nymph, same data as holotype (INPA).

Diagnosis

Nymph. 1) antenna without spine-like setae on scape and pedicel; 2) distal margin of labrum without medial emargination (Fig. 11); 3) outer margin of mandibular incisors with spine-like process (Figs 12–13); 4) tuft on apex of lingua formed by short simple setae (Fig. 14); 5) maxillary palp long, 2.1× the length of galea-lacinia (Fig. 15); 6) glossa subelliptical, not expanded at base (Fig. 16); 7) medial protuberance of labial palp segment II strongly projected medially (Fig. 16); 8) hind wing pads absent; 9) inner margin and anterior surface of fore tarsus with robust long spine-like setae (Fig. 17); 10) paraproct with three marginal spines, posterolateral extension without spines (Fig. 20).

Imago. Unknown.

Description

Nymph. Lengths: body, 3.2 mm; cercus, 1.6 mm.

Head. Coloration: Pale yellow. Antenna white. Compound eyes light orange. Antenna. Scape and pedicel without spine-like setae; flagellum with minute spines and thin setae on apex of each segment. Labrum (Fig. 11). Rectangular, length about 0.5x maximum width; distal margin without medial emargination, anterolateral and distal margin with robust bifid setae; dorsal surface near distal margin with two rows of thin simple setae; ventral surface with anterolateral robust bifid setae. Left mandible (Fig. 12). Incisors cleft in two sets; outer and inner set of incisors respectively with 3 + 3 denticles, outer incisor with spine-like process; prostheca robust and bifid at base, internal lobe slender, external lobe robust; margin between prostheca and mola straight; tuft of spine-like setae at base of mola absent; subtriangular process wide; denticles of mola not constricted; lateral margins convex. Right mandible (Fig. 13). Incisors cleft in two sets; outer and inner set of incisors respectively with 2 + 2 denticles and an outer spine-like process; prostheca stout, bifurcated at apex, inner lobe longer and pectinate; margin between prostheca and mola straight; tuft of spine-like setae at base of mola present; denticles of mola not constricted; apex of mola with two simple setae; lateral margins convex. Hypopharynx (Fig. 14). Lingua longer than superlingua, sub-quadrangular with a distomedial pointed projection covered by tuft of simple setae; superlingua with rounded outer margin; short, thin, simple setae scattered over distal margin of lingua and superlingua. Maxilla (Fig. 15). Maxillary palp long, 2.1× length of galea-lacinia; segment II 0.8× the length of segment I, apex with inner lobe; maxillary palp with thin simple setae scattered over surface; canines slender, dentisetae similar to canines. Labium (Fig. 16). Glossa sub-elliptical, basally broad, narrowing apically and shorter than paraglossa; inner margin with row of spine-like setae on apical half; ventral surface covered by thin setae. Paraglossa curved inward; apex with two rows of robust and long spine-like setae; outer margin bare; dorsal surface with many long spine-like setae. Labial palp with segment I 0.9× the length of segments II and III combined; medial protuberance of segment II strongly projected medially , outer margin and distomedial protuberance covered by thin, long simple setae; segment III conical, length 1.1× width, covered by thin simple setae on outer margin, ventral surface with robust spine-like setae near outer margin.

Thorax. Mesothorax with two large brown marks (Fig. 21). Hind wing pads absent. Foreleg (Fig. 17). Femur, tibia and tarsus light yellow. Ratio of foreleg 1.1:(1):0.6:0.17. Forefemur. Length about 2.6× maximum width; dorsal margin, anterior and posterior surface covered by robust long spine-like setae. Tibia. Dorsally bare; inner margin and anterior surface with few robust long spine-like setae. Tarsus. Ventral margin and anterior surface with robust long spine-like setae. Tarsal claws (Fig. 18) 0.3× the length of tarsus, with two rows of conical denticles. Mid and hind leg (Fig. 19). Anterior surface of tibiae and tarsi without robust long setae; ventral margin of tibiae and tarsi with one row of short blunt setae.

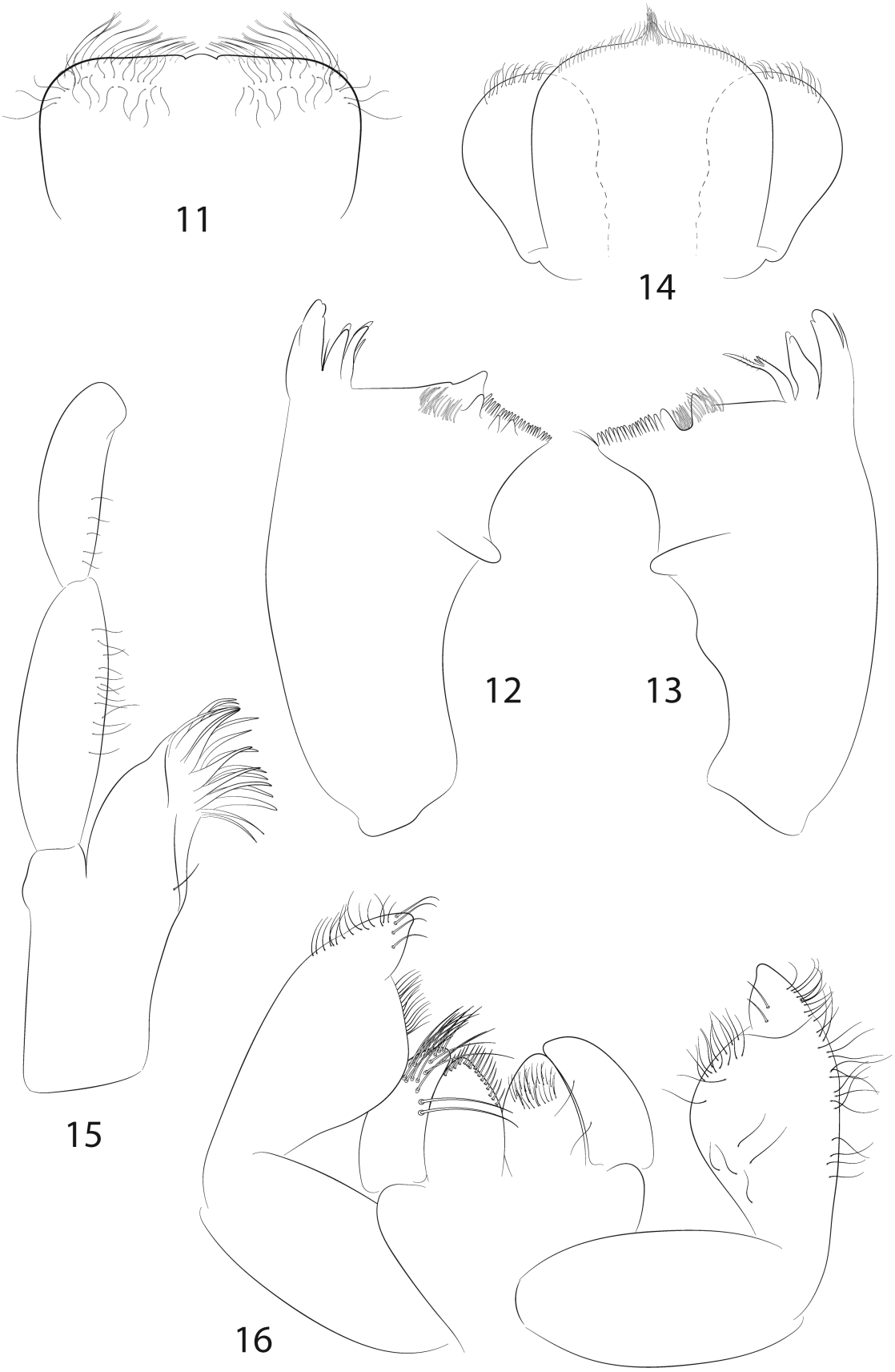
Abdomen. Terga pale yellow, I and II with two large brown marks (Fig. 21); surface covered by pores and short spine-like setae as in fig. 37; posterior margin smooth. Sterna white. Gills missing. Paraproct (Fig. 20) with three marginal spines, posterolateral extension without spines. Cerci with lateral spines on every segment. Terminal filament without spines.

Etymology. Õonirikoperi is a word in Baniwa language, from Baniwa indigenous ethnicity, a group of Native American inhabiting the area where the species was collected. This word is attributed to any specimen of Ephemeroptera. However, its literal meaning is "a being [malevolent] that walk inside the water". The name is in apposition.

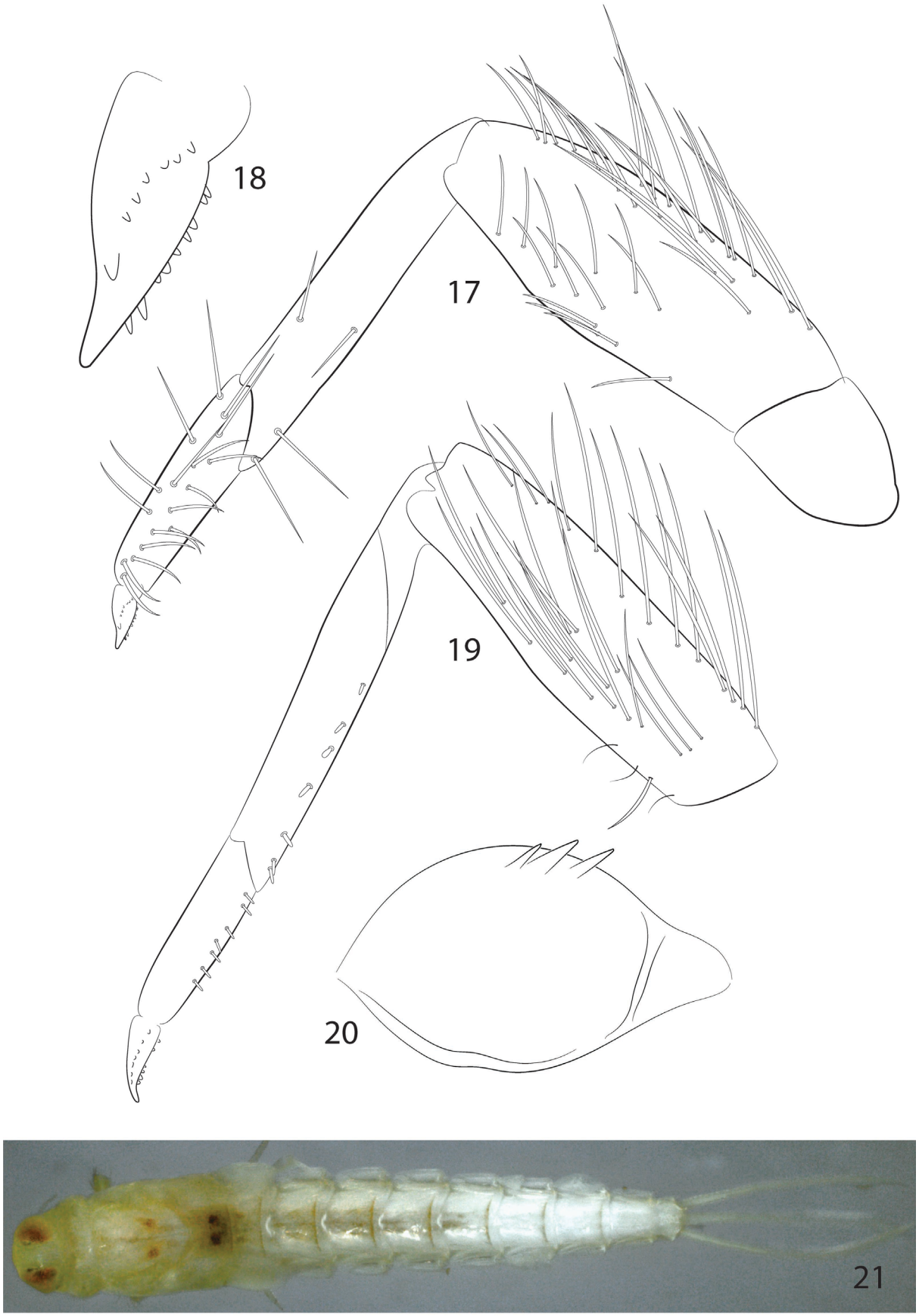
Comments. *Rivudiva venezuelensis* (Traver, 1943) was described based solely on male and female imagos from Venezuela and since then no other material has been assigned to it. Given the absence of hind wings in this species and in R. *oonirikoperi*, sp. nov., there is a possibility that this new species is in fact the nymphal stage, and thus represents a junior synonym of *R. venezuelensis*. Obtaining additional material from both species, including nymphs and reared adults, would be the best solution to solve this doubt.

Distribution. Brazil, Amazonas, São Gabriel da Cachoeira (Fig. 41).

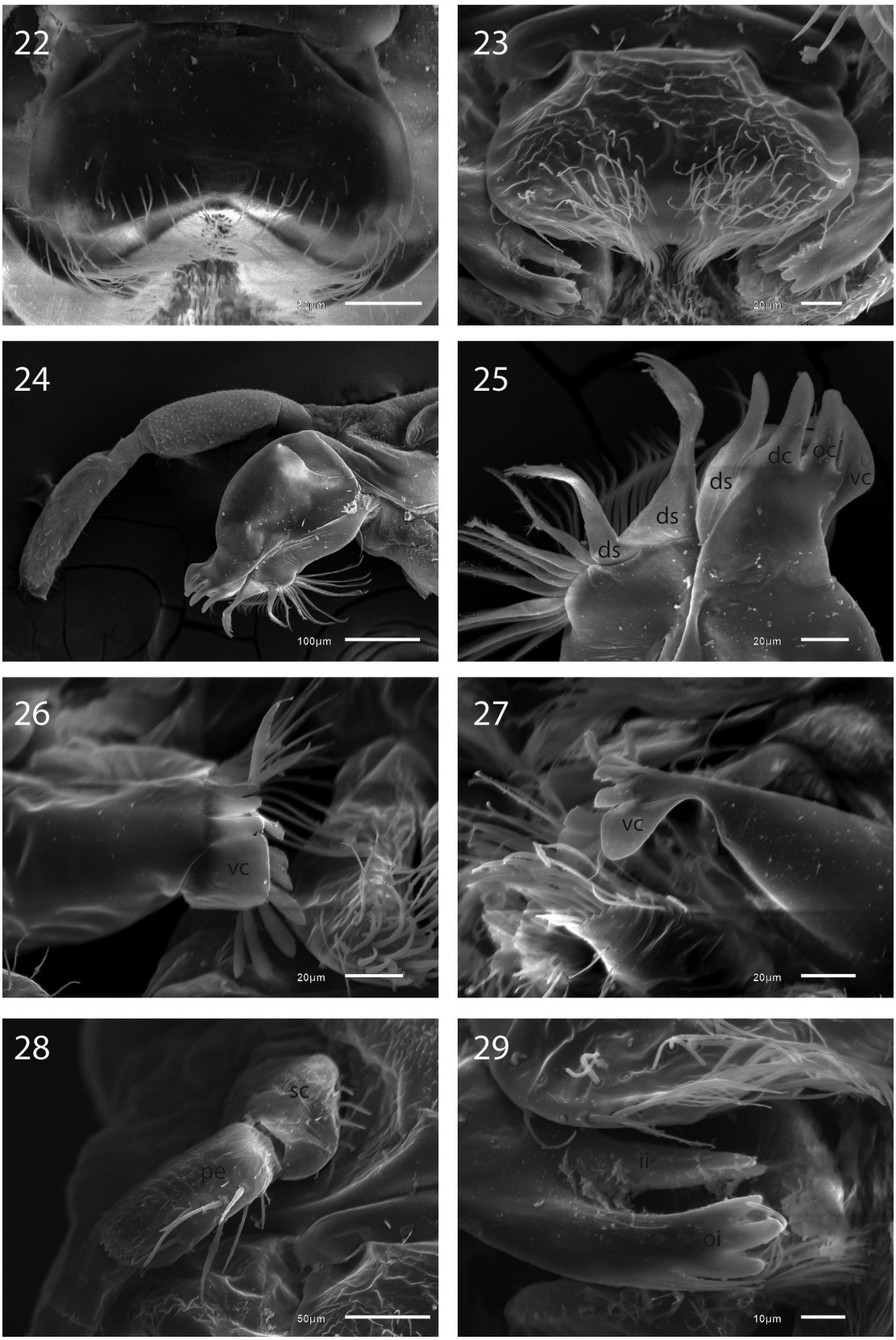
Biology. Nymphs were collected on sand in a small (90 cm width) and well preserved stream with low water flow.



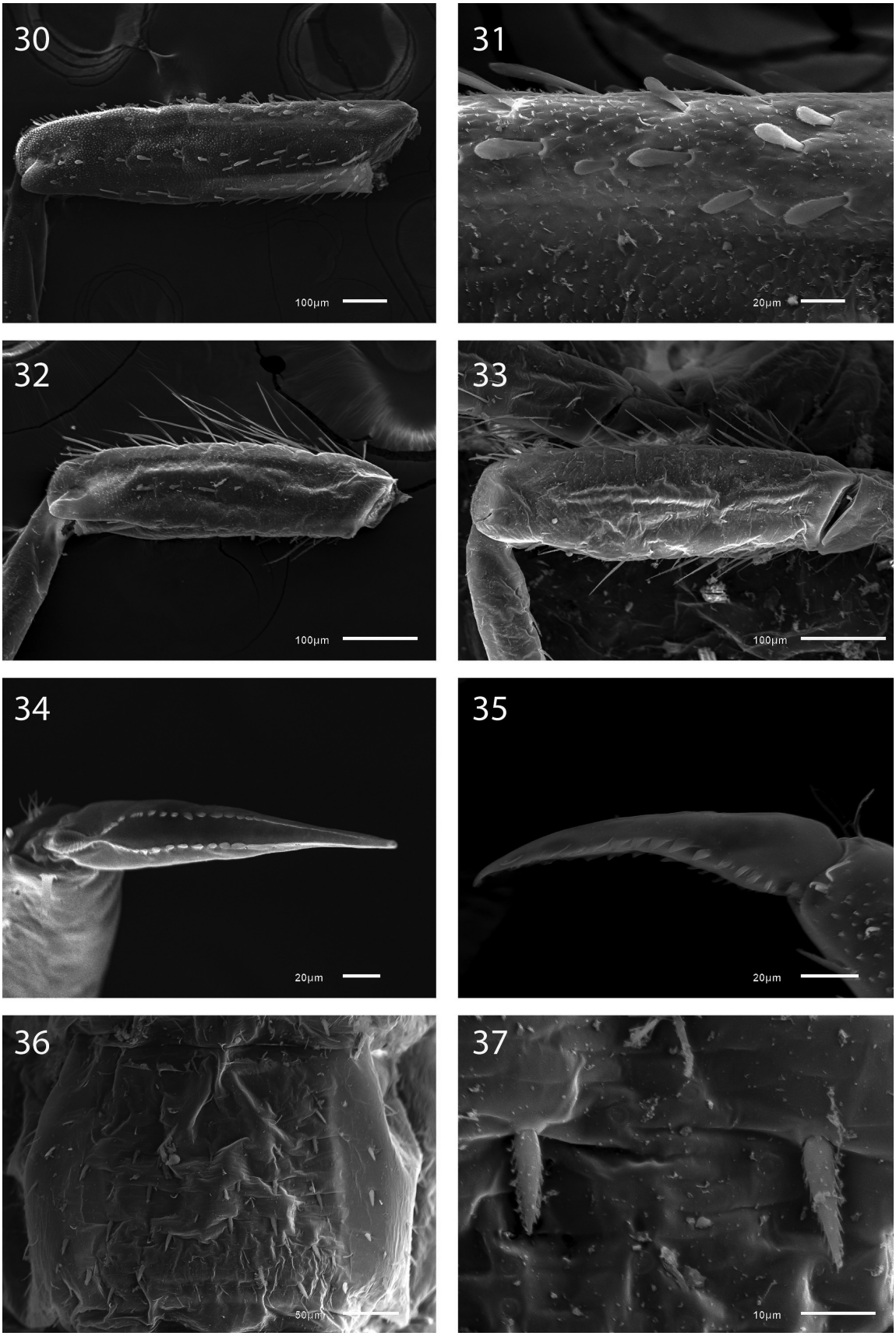
FIGURES 11–16. *Rivudiva oonirikoperi*, sp. nov., nymph. (11) Labrum; (12) Left mandible; (13) Right mandible; (14) Hypopharynx; (15) Maxilla; (16) Labium (left = dorsal surface, right = ventral surface).



FIGURES 17–21. *Rivudiva oonirikoperi*, sp. nov., nymph. (17) Fore leg (anterior surface); (18) detail of foreclaw; (19) mid leg (anterior surface); (20) Paraproct; (21) Dorsal view of body.



FIGURES 22–29. *Rivudiva* spp. SEM photographs. (22) Labrum of *R. inma*, sp. nov.; (23) Labrum of *R. trichobasis*; (24) Maxilla of *R. inma*, sp. nov.; (25) Detail of crown of maxilla of *R. inma*, sp. nov., dorsal view; (26) Detail of crown of maxilla of *R. trichobasis*, lateral view; (27) Detail of crown of maxilla of *R. minantenna*, lateral view; (28) Scape and pedicel of *R. trichobasis*; (29) Outer and inner incisors of *R. trichobasis*. (ds, dentiseta; dc, dorsal canine; ii, inner incisor; oc, outer canine; oi, outer incisor; pe, pedicel; vc, ventral canine).



FIGURES 30–37. *Rivudiva* spp. SEM photographs. (30) Fore femur of *R. inma*, sp. nov.; (31) Fore femur of *R. inma*, sp. nov., detail of outer margin; (32) Femur of *R. minantenna*; (33) Femur of *R. trichobasis*; (34) Tarsal claw of *R. inma*, sp. nov., inner view; (35) Tarsal claw of *R. minantenna*, lateral view; (36) Abdominal sternum of *R. trichobasis*; (37) Abdominal sternum of *R. trichobasis*, detail of setae.

Rivudiva minantenna **Lugo-Ortiz & McCafferty, 1998**

Rivudiva minantenna Lugo-Ortiz and McCafferty (1998: 63); Salles *et al.* (2004: 727); Domínguez *et al.* (2006: 176); Salles & Nascimento (2009: 233).

Material examined. Paratype (slide #301 IBN): BRAZIL, Rio Grande do Sul state, Rio Santa Maria, S 31º 10' W 54º 23', 280 m.a.s.l., xi.1964, F Plaumann col. 3 nymphs, BRAZIL, Espírito Santo state, Linhares, Rio São José, S 19° 07' 33.1'', W 40° 14' 26.1'', 20 m.a.s.l., 26.viii.2011, FF Salles leg. (1 UFVB, 1 IBN, 1 used for SEM images).

FIGURES 38–40. Habitus of living nymphs of *Rivudiva* spp. (38) Male of *Rivudiva inma*, sp. nov.; (39) Female of *Rivudiva inma*, sp. nov.; (40) Female of *R. trichobasis*.

Diagnosis

Nymph. 1) antenna without spine-like setae on scape and pedicel; 2) distal margin of labrum with deep, wide, medial emargination (as in Fig. 1); 3) dorsal surface of labrum with irregular row of setae; 4) tuft on apex of lingua formed by long simple setae (as in Fig. 4); 5) maxillary palp segment I long, reaching apex of galea-lacinia; 5) glossa with base ventrally expanded, apex narrow, obliquely truncate and with dorsal thick setae distomedially (as in Fig. 6); 6) hind wing pads present; 7) trochanter without robust, long and apically pointed setae; 8) outer dorsal row, medial dorsal row and inner dorsal row of femora with robust, long and apically pointed setae, those of outer row almost as long as maximum width of femur (Fig. 32); 9) abdominal sterna without robust apically pointed setae; 10) paraproct with 10-12 marginal spines (according to original description).

Imago. Unknown.

Distribution. Brazil (Rio Grande do Sul, Santa Catarina, and Espírito Santo) (Fig. 41).

Comments. This species was also reported from Rio de Janeiro by Salles *et al.* (2004). However, based on the new evidences presented here, it became clear that these specimens belong to an additional new species. As we only have a single mature nymph in good condition, we refrain from describing this species in the present paper.

Rivudiva trichobasis **Lugo-Ortiz & McCafferty, 1998**

Rivudiva trichobasis Lugo-Ortiz and McCafferty (1998: 64); Domínguez *et al.* (2006: 176); Falcão *et al.* (2011: 539); Cruz *et al.* (2011: 60); Boldrini *et al.* (2012: 93); Boldrini & Cruz (2014: 5).

Material examined. 1 nymph, Paratype (slide #270 IBN): BRAZIL, Rio Grande do Sul state, Arroio dos Vargas, S 30º 50' W 53º 10', 120 m.a.s.l., xi.1964, F Plaumann col. 7 nymphs, BRAZIL, Espírito Santo state, Linhares, Rio São José, S 19°07'33.1 W 40°14'26.1", 24 m.a.s.l., 26.viii.2011, FF Salles leg. (4 UFVB, 3 IBN, 1 used for SEM images). 1 nymph, BRAZIL, Espírito Santo state, Afonso Cláudio, Cachoeira do Funil, S 20°08'35.1", W 41°09'02.0'', 440 m.a.s.l., 02.iii.2014, FC Massariol col. (UFVB). 19°07'33.1"S/ 40°14'261"W. 1 nymph, BRAZIL, Espírito Santo state, Cariacica Reserva Biológica Duas Bocas, S 20°15'28.5", W 40°29'38.3", 210 m.a.s.l., 02.x.2013, FC Massariol col. (UFVB).

Diagnosis

Nymph. 1) antenna with robust, apically pointed setae on scape and pedicel (Fig. 28); 2) distal margin of labrum with deep, wide, medial emargination (Fig. 23); 3) dorsal surface of labrum with irregular rows of setae (Fig. 23); 4) outer margin of mandibular incisors with spine-like processes (Fig. 29); 5) tuft on apex of lingua formed by short simple setae (as in Fig. 14); 6) maxillary palp segment I of intermediate length, reaching ⅔ of apex of galea-lacinia; 7) glossa with base not expanded, apex rounded and with dorsal thick setae mostly restricted to distal margin (as in Fig. 16); 8) hind wing pads absent; 9) trochanter with robust, long apically pointed setae; 10) outer dorsal row, medial dorsal row and inner dorsal row robust of femora with long and apically pointed setae, those of outer row almost as long as maximum width of femur (Fig. 33); 11) abdominal sterna with robust, apically pointed setae (Figs 36–37); 12) paraproct with robust, apically pointed setae and 8-10 marginal spines.

Imago (according to Cruz *et al.* 2011). 1) dorsal portion of turbinate eyes with inner margins not parallel, divergent anteriorly (figs 1, 2 in Cruz *et al.* 2011); 2) length of forewing about 3.7× width (fig. 3 in Cruz *et al.* 2011); 3) hind wings absent; 4) segment III of abdomen with one large medially red mark near anterior margin (figs 4, 5 in Cruz *et al.* 2011); 5) forceps segment III oval, 2× as long as wide (fig. 6 in Cruz *et al.* 2011); 6) posterior margin of subgenital plate with apex concave (fig. 6 in Cruz *et al.* 2011).

Distribution. Paraguay and Brazil (Rio Grande do Sul, Espírito Santo, Amazonas and Roraima) (Fig. 41).

Discussion

The species of *Rivudiva* known at the nymphal stage are represented by two morphological groups. *Rivudiva minantenna* and *R. inma*, sp. nov. possess glossa with base expanded and apex obliquely truncate (Fig. 6), hind wing pads

present, and abdominal sterna with simple setae. *Rivudiva trichobasis* and *R. oonirikoperi, sp.* nov., on the other hand, share the outer margin of incisors with spine-like processes (Figs 12–13), glossa not expanded at base and apically rounded (Fig. 16), hindwing pads absent, and the presence of robust apically pointed setae on abdominal sterna (Figs 36–37).

FIGURE 41. Map of South America showing the distribution of the distinct species of *Rivudiva*.

Rivudiva inma, sp. nov. can be distinguished from *R. minantenna* mainly by leg setation. On the new species the femoral setae are predominantly clavate and short (Figs 7, 30–31), while pointed and long in *R. minantenna* (Fig. 32). Setae are also present on the trochanter of the new species and absent in the other. The body color pattern of the new species is very conspicuous (Figs 38–39), while examined material of *R. minantenna* present a uniform coloration. However, coloration in *Rivudiva* must be used with caution, especially when comparing old material with specimens recently fixed in alcohol or alive. Most of the colors and marks observed tend to disappear after fixation, and the body, in general, assumes a whitish or whitish-yellow uniform coloration (compare Fig. 40 with fig. 133 in Falcão *et al.* 2011, both representing the same species).

Rivudiva oonirikoperi, sp. nov. and *R. trichobasis* can be distinguished from each other by the presence of robust, apically pointed setae on scape and pedicel of the later species (Fig. 28), by the shape of the distal margin of labrum (without emargination in *R. oonirikoperi,* sp. nov., Fig. 11), and by the number of spines on paraproct (3 in the new species, 8–10 in *R. trichobasis*). *Rivudiva oonirikoperi,* sp. nov. is the only species of the genus in which long and robust apically pointed setae are also present on fore tarsus (Fig. 17).

Concerning diagnostic features of the genus, a remarkable characteristic was found on the maxillae of all examined species. As typical for other Baetidae, the crown of galea-lacinia is composed of three canines and two rows of setae: the inner-dorsal row, with 3 dentisetae and several thinner setae, and the inner-ventral row. The ventral canine, the one closer to the inner ventral row, is laterally expanded and assumes a somewhat rectangular shape (instead of triangular) (Figs 26–27). In *R. trichobasis* this canine is very expanded ventrally and covers completely the base of the most distal setae of the inner-ventral row (Fig. 26). These setae are also unusual, as they are clavate instead of apically pointed. The ventral canine in *R. minantenna* (Fig. 27) and in *R. inma*, sp. nov., besides expanded, is also curved ventrally; in *R. oonirikoperi*, sp. nov. the ventral canine is also expanded, but slender and not curved ventrally. We have not found this characteristic concerning the expansion and consequent shape of the ventral canine in any other genus of Baetidae and, therefore, consider it as a putative synapomorphy of *Rivudiva* (see Cruz *et al.* 2018 for a complete list of synapomorphies).

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