

## Taxonomy

# The genus *Rivudiva* Lugo-Ortiz and McCafferty (Ephemeroptera: Baetidae): First generic description of adults, new combinations, and notes on the nymphs

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**Abstract** – In the present paper, based on the rearing of nymphs in the field, we present for the first time the description of the adult stage of *Rivudiva* Lugo-Ortiz and McCafferty and of its type species, *R. minnatena* Lugo-Ortiz and McCafferty. Adults of *Rivudiva* can be distinguished from the other genera of Baetidae by the following combination of characters: (1) hindwings present or absent, when present with two longitudinal veins and with costal projection pointed, placed in the basal fourth of anterior margin; (2) forceps three-segmented, segment III long, about 2× as long as wide; (3) distal margin of subgenital plate with small pointed projection. Besides that, *R. coveloae* (Traver, 1971 [Proc. Entomol. Soc. Washington, 73, 58–63]), new combination, and *R. venezuelensis* (Traver, 1943 [Bol. Entomol. Venezolana, 2, 79–98]), new combination, are proposed based on the characteristics listed above, specially the distal margin of subgenital plate with a small pointed projection. Comments on the biology of the nymphs are also provided.

**Key words:** Ephemeroptera / taxonomy / Neotropics / description / new combination

## Introduction

The genus *Rivudiva* Lugo-Ortiz and McCafferty was established to include two species of Baetidae (Ephemeroptera), one from Southern Brazil and another from Southern Brazil and Paraguay, respectively *R. minantenna* Lugo-Ortiz and McCafferty, and *R. trichobasis* Lugo-Ortiz and McCafferty (Lugo-Ortiz and McCafferty, 1998). Later, Orth *et al.* (2000) reported the genus from French Guyana based on a single nymph, considerably extending its known distributional range, and Salles *et al.* (2004) reported *R. minantenna* from Rio de Janeiro State, South-eastern Region of Brazil.

Domínguez *et al.* (2006), after examination of the type-material, added some important characteristics to the original description of both species. However, the adults of the genus remain unknown, as well as any information regarding biological aspects of the nymph.

Recently, while collecting material for a mayfly survey in the Southeastern Region of Brazil, we were able to find a good series of nymphs of *R. minantenna*, which allowed us to rear a few of them in the field. Based on these adults, we were also able to assign two species of Baetidae, one

originally described as *Baetis* Leach and the other as *Pseudocloeon* Klapálek to the genus *Rivudiva*. Therefore, our aim here is to provide the descriptions of the adults of *Rivudiva* and of *R. minantenna*, to propose two new combinations, and also to make some comments regarding the biology of the nymphs.

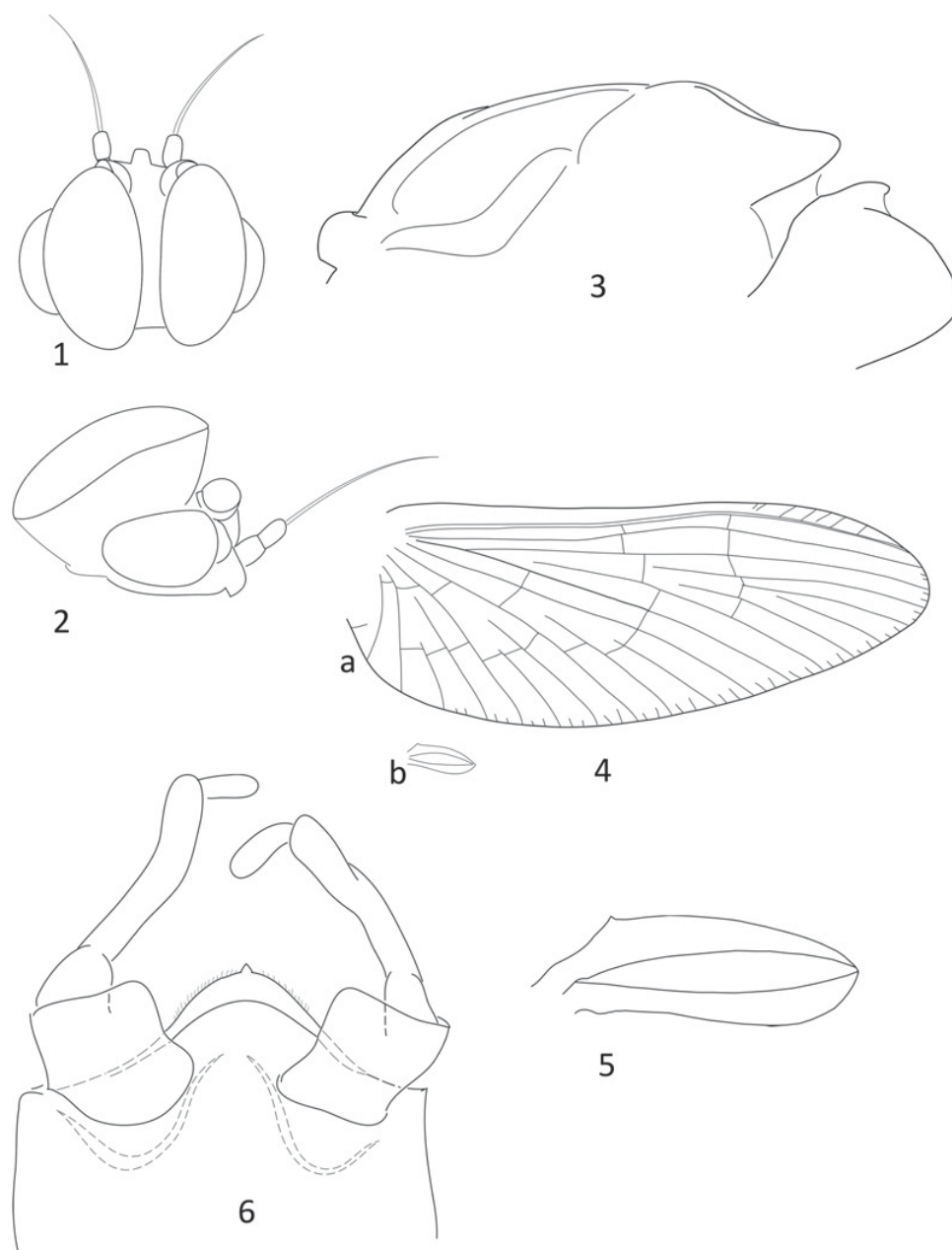
## *Rivudiva* Lugo-Ortiz and McCafferty (1998) (Figs. 1–6)

*Rivudiva* Lugo-Ortiz and McCafferty (1998, p. 61); Orth *et al.* (2000, p. 36); Domínguez *et al.* (2006, p. 174).

## Diagnoses

Adults of *Rivudiva* can be distinguished from the other genera of Baetidae by the following combination of characters: (1) hindwings present or absent, when present with two longitudinal veins and with costal projection pointed, placed in the basal fourth of anterior margin (Figs. 4b and 5); (2) forceps three-segmented, segment III long, about 2× as long as wide (Fig. 6); (3) distal margin of subgenital plate with small pointed projection (Fig. 6).

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**Figs. 1–6.** *Rivudiva minantenna*, adults. 1: Head of male (dorsal view). 2: Head of male (lateral view). 3: Meso- and metanotum (lateral view). 4: Wings of female (a: forewing; b: hindwing). 5: Hindwing of female (enlarged). 6: Genitalia of male (ventral view).

### Male imago

#### Head

Turbinate eyes oblong, length  $2\times$  width; stalk height  $0.9\times$  width of dorsal portion; inner margins parallel and close to each other (Figs. 1 and 2).

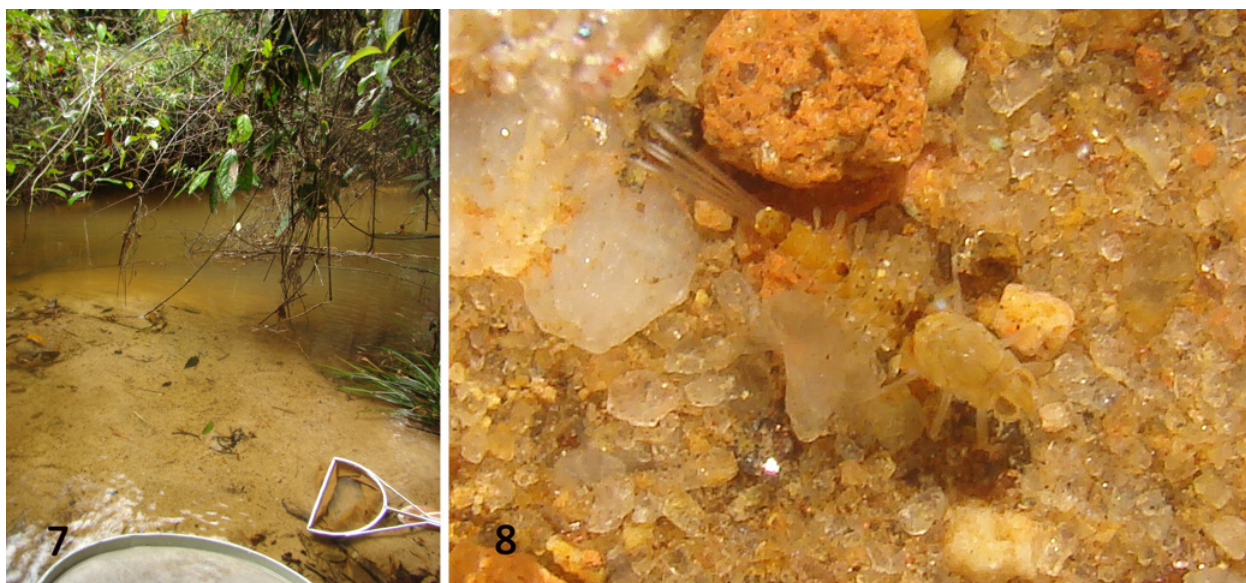
#### Thorax

Anteronotal protuberance rounded (Fig. 3). Fore wings (Fig. 4a) with paired marginal intercalary veins; intercalary vein short, length of each intercalary vein about  $0.3\times$  distance between adjacent longitudinal veins; length

of forewing about  $2.7\times$  width. Hind wings (Figs. 4b and 5) present or absent, when present with two complete longitudinal veins; costal projection pointed, basally narrow and placed in the basal fourth of anterior margin, cross veins absent. Metascutellar protuberance dorso-posteriorly directed (Fig. 3).

#### Genitalia (Fig. 6)

Forceps three-segmented. Forceps segment I without projections;  $0.3\times$  length of segment II; distance between segments about  $1.3\times$  width of segment I. Forceps segment II with a slightly constriction at base.



**Figs. 7–8.** *Rivudiva minantenna*. 7: General aspect of habitat of nymph (Reserva Biológica Augusto Ruschi). 8: Nymph on sand.

Forceps segment III long, about  $2\times$  as long as wide; about  $0.3\times$  length of segment II. Posterior margin of subgenital plate rounded, medially with a small pointed projection.

***Rivudiva minantenna* Lugo-Ortiz and McCafferty (1998) (Figs. 1–8)**

*Rivudiva minantenna* Lugo-Ortiz and McCafferty (1998, p. 63); Salles *et al.* (2004, p. 727); Domínguez *et al.* (2006, p. 176).

### Male imago

Length: body, 4.6 mm. Fore wings with apex wrinkled, not possible to measure; hind wings, 1.4–1.5 mm. General coloration yellowish brown.

### Head

Coloration yellowish white, medially with yellowish brown mark. Antennae whitish, apex of scape and base of pedicel brown. Turbinate eyes with dorsal portion orangish, basal half of stalk yellowish brown, apical half yellowish.

### Thorax

Pronotum brown; mesonotum brown, except for areas along sutures, anteronotal transverse impression, scutocutelar impression, yellowish brown; metanotum brown, anterior half washed with red. Legs whitish, except for brown coxae. Leg I: tibia  $2.0\times$  length of femur, tarsi  $1.5\times$  length of femur and with five segments decreasing in length apically. Legs II and III: tibia subequal in length to the femur, tarsi half the length of femur. Wings membrane

hyaline, stigmatic area wrinkled; veins whitish. Hindwing membrane hyaline; veins whitish.

### Abdomen

Terga light yellowish brown; segments II, III, V and VI with lateral oblique reddish mark; segments II, III and VI with medial reddish mark. Sterna light yellowish brown. Area between base of forceps washed with red; first segment of forceps light brown, segments II and III whitish. Cercus broken and lost.

### Female imago

Length: body, 6.5 mm. Fore wings, 5.30; hind wings, 0.80 mm. Similar to male imago, except for: general coloration yellowish brown washed with red. Antennae yellowish brown, apex and lateral margin of scape and apex of pedicel washed with red. Mesonotum without paler areas. Legs yellowish. Forewing veins yellowish brown. Stigmatic area with seven crossveins, touching or not subcostal vein. Hindwing membrane hyaline; veins yellowish brown. Tergum II with medial reddish mark larger and darker, tergum IX with lateral reddish mark.

### Nymph

The morphology of the nymph was adequately characterized by Lugo-Ortiz and McCafferty (1998), and later by Domínguez *et al.* (2006). However, according to Lugo-Ortiz and McCafferty (1998), probably because they did not have access to fresh material, no distinct body color pattern was described. In the nymphs we examined, the body color pattern, especially the abdominal color pattern, is very distinctive and deserves a brief description.

### Head and thorax (Fig. 7)

Yellowish brown with no distinct color pattern. A few nymphs present the basal third of mesonotum dark brown.

### Abdomen (Fig. 7)

Yellowish brown. Terga II and IX almost completely brown, more marked medially on tergum II and laterally on tergum IX; tergum III to V with medial oblique, narrow, brown mark succeeded by a brown spot; tergum III and VI often with antero-medial brown mark; tergum V to VII with median whitish spot; most terga with antero-lateral whitish marks. Cercus and terminal filament yellowish, setae at apical 1/5 whitish.

### Material examined

One male imago (reared), 1 female imago (reared), 20 nymphs: Brazil, Espírito Santo, Santa Teresa, Sítio Capitel de Santo Antônio, S19°52'33", W40°31'50", 720 m, 19/02/2009, F.F. Salles, J.M.C. Nascimento, F.C. Massariol, R. Boldrini, K.B. Angeli cols.; 10 nymphs: Brazil, Espírito Santo, Santa Teresa, Reserva Biológica Augusto Ruschi, S19°55'22", W40°33'13", 805 m, 20/02/2009, F.F. Salles, J.M.C. Nascimento, J.A. Rúdio cols. All material housed at the Entomological Collection of the Universidade Federal do Espírito Santo.

### Biology

Nymphs of *R. minantenna* were found exclusively in areas of slow current on the sand bottom of streams in the city of Santa Teresa (Fig. 7). As can be seen in Figure 8, the body color pattern of the nymphs, especially the abdomen with brown-yellowish segments, interrupted by brown or white marks, allows a perfect camouflage with the substrate. This camouflage is so efficient, that even when we moved some nymphs to a tray with sand (to make some observations and take pictures), it was difficult to find them unless they were swimming.

The body color pattern we present here is also important for distinguishing the nymphs of the two species of *Rivudiva*. We were able to study some fresh material of *R. trichobasis*, and the body color pattern matches those originally described by Lugo-Ortiz and McCafferty (1998): abdominal coloration yellowish-brown, with anteriorly broad and abruptly narrow medium brown marks on terga III and VI.

### *Rivudiva coveloae* (Traver, 1971), new combination

*Baetis coveloae* Traver (1971, p. 61).

*Camelobaetidium coveloae*; Lugo-Ortiz and McCafferty (1999, p. 258); Domínguez *et al.* (2006, p. 129).

### Remarks

Traver (1971) placed this species in the genus *Baetis* with reluctance, once it showed hindwings similar to those of the genus *Camelobaetidium* Demoulin (*Dactylobaetis* Traver and Edmunds by that time), but a distinctive spine between the male genital forceps. Later, Lugo-Ortiz and McCafferty (1999), based mainly on the shape of the hindwing, transferred this species to *Camelobaetidium* and considered that the spine was a species variability within this genus. Domínguez *et al.* (2006), however, pointed out that the shape of the hindwing is not restricted to *Camelobaetidium* and that the placement of *C. coveloae* in this genus should remain dubious.

We consider that the shape of the hindwing and of the third segment of the forceps, and mostly, the small pointed projection on the subgenital plate of *C. coveloae*, are enough to transfer this species to the genus *Rivudiva*. In fact, we do not discard the possibility the *R. minantenna* is a junior synonym of *R. coveloae*. However, as even after examination of the type material, it may not be possible to decide if the two species are synonymies, we prefer to keep them as distinct species for the moment.

### *Rivudiva venezuelensis* (Traver, 1943), new combination

*Pseudocloeon venezuelensis* Traver (1943, p. 92).

*Cloeodes venezuelensis*; Lugo-Ortiz and McCafferty (1999, p. 261); Domínguez *et al.* (2006, p. 153).

### Remarks

Based on the absence of hindwings, Traver (1943) described this species in the genus *Pseudocloeon*. Later, Lugo-Ortiz and McCafferty (1999), based mainly on the eye morphology of the males, transferred it to *Cloeodes* Traver, but pointed out the presence of a spine between the male forceps.

Again, we consider the small pointed projection on the subgenital plate the main character to justify the transfer of this species to *Rivudiva*. The absence of hindwing is in agreement with the diagnoses of the genus, once hindwing pads are absent in *R. trichobasis*, and the presence of *Rivudiva* in Venezuela is not surprising, once the genus was already reported from French Guyana (Orth *et al.*, 2000). As was the case of *R. minantenna* and *R. coveloae*, we do not discard the possibility the *R. trichobasis* is a junior synonym of *R. venezuelensis*. We kept them as distinct species for the same reasons presented to the former species.

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