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Two-winged Leptophlebiidae (Ephemeroptera) from Brazil: new species, records and stage description

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Two-winged Leptophlebiidae (Ephemeroptera) from Brazil: new species, records and stage description

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In the present paper, based on material from Brazil, we present a contribution to the taxonomy of the Neotropical two-winged Leptophlebiidae. The male imago of *Perissophlebiodes* Savage is described, in addition to a new species of *Askola* Peters from Amazonas. *Askola emmerichi* Domínguez, Molineri and Mariano, so far recorded from Venezuela, is reported from Brazil and compared to the new species herein described. *Askola yanoman*, sp. nov. can be separated from other species of the genus by the following combination of characters: (1) general colouration yellowish brown with areas washed with greyish brown; (2) dorsal portion of eyes brown, eyes meet on meson of head; (3) penis yellowish brown with darker margin, extending beyond the posterior margin of the styliger plate.

Keywords: taxonomy; diversity; Atalophlebiinae; mayflies; Neotropical Region

Introduction

Two-winged Leptophlebiidae (Ephemeroptera) are represented by two distinct lineages in the Neotropics (Domínguez 2009), one represented by two relatively speciose genera, *Askola* Peters, 1969 and *Hagenulopsis* Ulmer, 1920 and the other represented by two poorly known genera, *Perissophlebiodes* (Savage, 1983) and *Bessierus* Thomas & Orth, 2000.

Hagenulopsis is the only genus known to occur outside South America, with 10 species distributed from Argentina to Central America, including Caribbean islands (Lugo-Ortiz and McCafferty 1996; Boutonnet, Thomas and Lala 2004; Domínguez, Molineri and Mariano 2009). *Askola* presents a more restricted and disjunct distribution, with three species reported from south-eastern South America and one from the northern area of the continent (Domínguez et al. 2009). *Perissophlebiodes* and *Bessierus*, in contrast, are monotypic and, unlike *Askola* and *Hagenulopsis*, exclusively known at nymphal stage (Savage 1982, 1983; Thomas, Orth, Horeau and Dominique 2001).

In the present paper, based on material from Brazil, we present a contribution to the taxonomy of this non-monophyletic lineage. The male imago of *Perissophlebiodes* is described, in addition to a new species of *Askola* from Amazonas. *Askola*

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emmerichi Domínguez, Molineri and Mariano, 2009, so far recorded from Venezuela, is reported from Brazil and compared to the new species herein described.

Materials and methods

Photographs were taken either using an OPTON[®] Q719K-AC microscope with a TA-0124S digital camera or a Leica (M165C) stereomicroscope with a DFC420 digital camera. A series of partially focused digital images of each subject was stacked using the program Leica Application Suite V3.4.1 (Version 2009) or CombineZ to produce final images with enhanced quality. Line drawings were made with the aid of a camera lucida, photographs, or both. In either case, final illustrations were prepared according to Coleman (2003, 2006).

The material examined is housed in the Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil, in the Entomological Collection of the Universidade Federal do Espírito Santo (UFES), Vitória, Brazil, or in the Invertebrate Collection of the Centro Universitário Norte do Espírito Santo (CEUNES), São Mateus, Brazil.

Taxonomy

Genus *Perissophlebiodes* (Savage, 1982) (Figures 1–7 and 18)

Savage, 1982: 209 (type species: *Perissophlebia flinti* Savage, original designation).

Savage, 1983: 204 (type species: *Perissophlebia flinti* Savage, objective synonymy)

Domínguez, Molineri, Pescador, Hubbard and Nieto 2006: 477.

Male imago

Length of body 4.6 mm, forewing length 4.8 mm.

Eyes meet on meson of head (Figure 2), lower portion of eyes approximately 3/4 length of upper portion.

Wings (Figure 5). Maximum width of forewing is 1/3 of maximum length of forewing; vein Rs of forewing forked 1/6 of distance from base to margin; vein MA forked a little less than 1/2 of distance from base to margin, fork asymmetrical, distal portion of vein MA not sagged posteriorly; vein MP forked 2/5 of distance from base to margin, fork symmetrical, distal portion of vein not sagged posteriorly; vein ICu2 attached at base to vein ICu1 by a cross vein. Hind wings absent.

Legs. Apex of forelegs broken off and missing; meso and metathoracic legs with dissimilar paired claws, one apically hooked, the other one blunt.

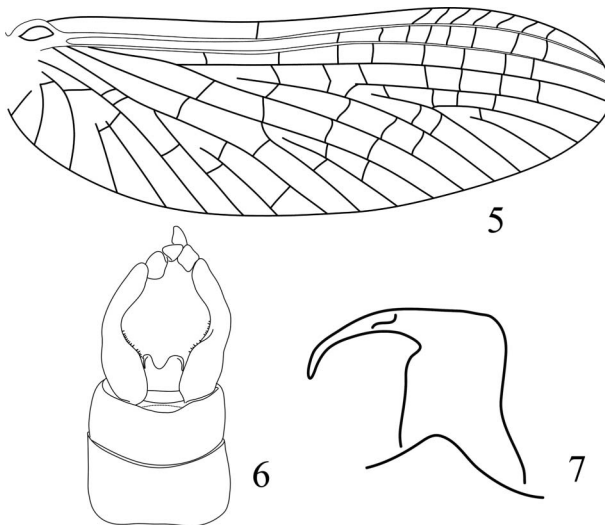
Male genitalia (Figures 6 and 7): segment 2 of forceps subequal in length to segment 3, segment 2 of forceps 1/6 length of segment 1; base of forceps broad, inner angle of forceps segment 1 located about 1/3 distance from base (its inner margin forming an angular bend near base of forceps); forceps sockets not separated (Figure 6) length of styliger plate along median line 1/2 maximum width; penes divided in apical 1/3, apex of each penis lobe with a ventrally orientated hooked projection (Figure 7).

Comments

The male imago of *Perissophlebiodes* can be separated from all other genera of Leptophlebiidae by the following combination of characteristics: (1) fork of vein MA



Figures 1–4. *Perissophlebiodes flinti*, male imago. (1) Head and thorax, lateral view; (2) head and thorax, dorsal view; (3) abdomen, dorsal view; (4) abdomen, lateral view.



Figures 5–7. *Perissophlebiodes flinti*, male imago. (5) Forewing; (6) genitalia, ventral view; (7) apex of penes.

of forewing asymmetrical (Figure 5); (2) vein ICu1 of forewings attached at base to vein CuA by a crossvein; (3) hind wings absent; (4) claws of a pair dissimilar, one apically hooked, the other blunt; (5) forceps sockets not separated (Figure 6); (6) penes divided in apical 1/3, apex of each penis lobe with a ventrally orientated hooked projection (Figure 7); (7) inner angle of forceps segment 1 located about 1/3 distance from base; and (8) male styliger plate half as long as wide (Figure 6).

Among the diagnostic characteristics of *Perissophlebiodes*, the non-separated forceps sockets are very unusual. This has been considered an exclusive characteristic of *Thraulodes* Ulmer, until recently Mariano (2010) also stated this character for two species of *Simothraulopsis* Demoulin from Brazil. According to Domínguez (2009), *Thraulodes* is not closely related to *Perissophlebiodes*. *Simothraulopsis*, on the other hand, together with *Homothraululus* Demoulin, is the sister group of *Perissophlebiodes* + *Bessierus*. The adults of *Bessierus* remain unknown, hence it is impossible to know the state of this character. Of the eight species of *Homothraululus* and *Simothraulopsis* (three and five, respectively), only in those two described by Mariano (2010) the forceps sockets are not separated. Given that scenario, it seems that this character would have appeared more than once during the evolution of Neotropical Atalophlebiinae.

In order to incorporate the male imago of *Perissophlebiodes*, the following emendation is proposed to the key of Domínguez et al. (2006).

2. Male styliger plate subequal in length and width; each penis lobe lacking ventral spine *Askola*
 – Male styliger plate half as long as wide; each penis lobe with ventral spine or with a ventrally orientated hooked projection 3
 3. Vein ICu1 of forewings attached at base to vein CuP; each penes lobe with ventral spine; forceps sockets separated *Hagenulopsis*
 – Vein ICu1 of forewings attached at base to vein CuA; each penes lobe with a ventrally orientated hooked projection; forceps sockets not separated *Perissophlebiodes*

***Perissophlebiodes flinti* (Savage, 1982) (Figures 1–7 and 18)**

Perissophlebia flinti Savage, 1982: 212.

Perissophlebiodes flinti, Savage, 1983: 204; Domínguez et al., 2006: 477; Da-Silva, Salles and Polegatto 2008: 379; Polegatto and Froehlich, 2009: 257; Salles et al., 2010: 306.

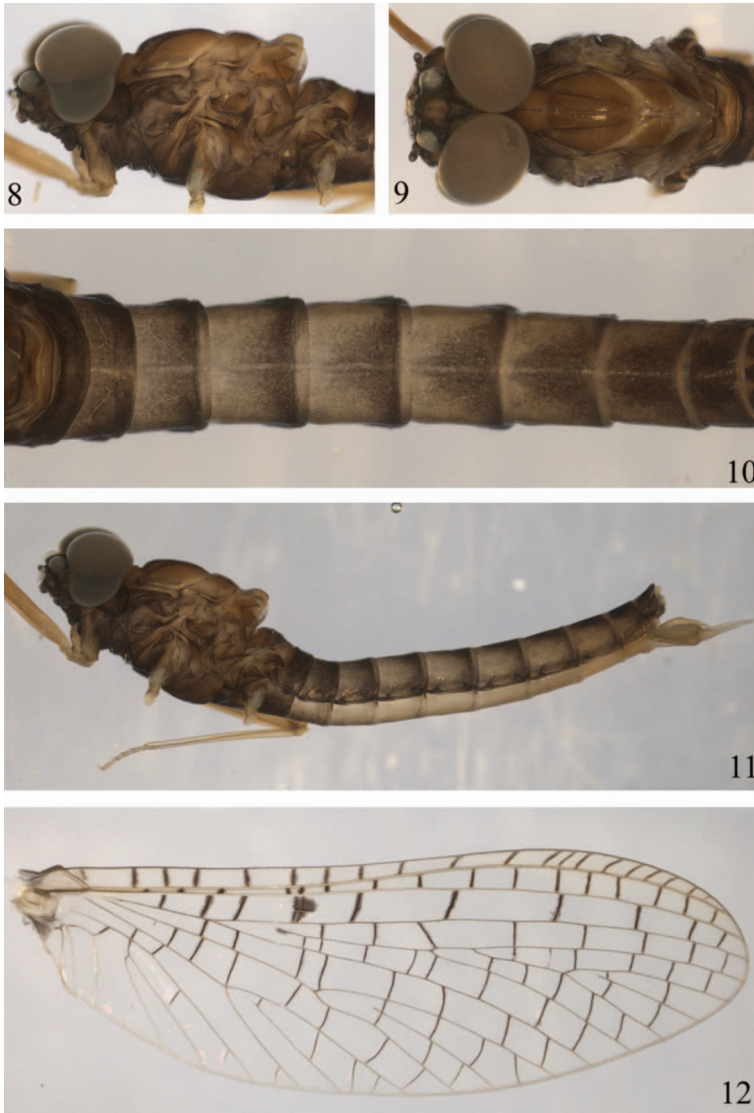
Material examined

One male imago (reared), Brazil, Espírito Santo, Santa Teresa, Sítio Capitel de Santo Antônio, S19°52'31.7", W40°31'47.3" 720m, 19/1/2008, F.F. Salles, R. Boldrini, cols. 18 nymphs, same data, except for S19°52'16.0", W40°31'43.1" 718m, 20/1/2008; S19°52'31.0", W40°31'49.1" 768m, (CEUNES).

Male imago

Length of body 4.6 mm, length of forewing 4.8 mm.

General colouration (Figures 1–4). Thorax reddish brown, abdomen translucent brown, wings hyaline.



Figures 8–12. *Askola yanoman* sp. nov., male imago. (8) Head and thorax, lateral view; (9) head and thorax, dorsal view; (10) abdomen, dorsal view; (11) abdomen, lateral view; (12) forewing.

Head (Figures 1 and 2). Dorsal portion of eyes orange, lower portion black; eyes meet on meson of head; ocelli white, a grey ring at base; head brown washed with yellow. Antennae translucent brown, apex of flagellum paler.

Thorax. Pronotum brown, with dark brown marks on lateral margins and sublateral region. Mesonotum reddish brown, except for membranous areas yellowish, antelateroparapsidal suture darker, scuto-escutellar impression orangish brown, scutellum brown. Metanotum yellowish brown. Pleurae with some whitish areas, sterna brown.

Legs. Coxae, trochanters, femora and apex of tibiae yellowish, remainder translucent yellow; femora with brown band in apical third.

Wings. Membrane hyaline except estigmatic area opaque; longitudinal veins yellowish, cross veins whitish.

Abdomen (Figures 3 and 4). Translucent brown with medial line yellowish white, except for segment X yellowish tan. Tergum I uniformly brown; terga II–VIII with anteromedial unpigmented triangular mark; tergum IX with posteromedial whitish mark. Abdominal sternum whitish brown.

Genitalia. Styliiger plate yellowish brown, forceps and penes yellowish tan, paler toward apex. [Caudal filaments broken off and lost.]

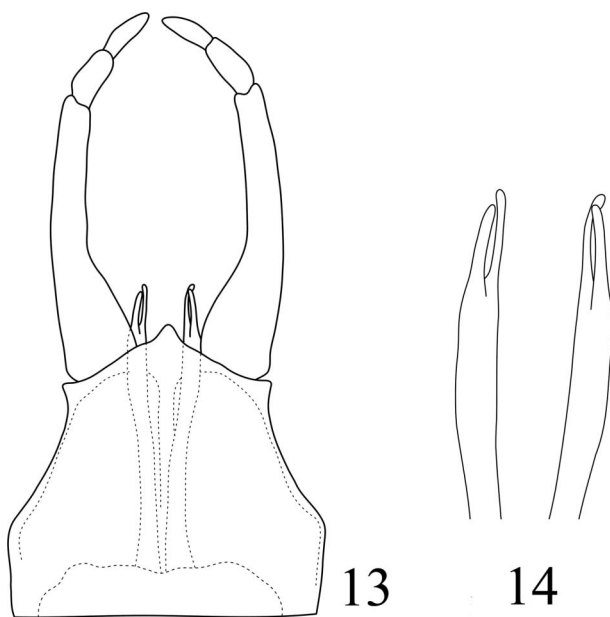
Distribution

BRAZIL (Figure 18): Bahia, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo.

Askola yanoman sp. nov. (Figures 8–14 and 18)

Material examined

HOLOTYPE: Male imago, BRAZIL, Amazonas, Barcelos, Serra do Aracá, N00°54'35.6", W63°25'45.3" 1099m, 01/VIII/2009, FF Salles col. (UFES). PARATYPES: 9 male imagos, same data as holotype (3 at CEUNES, 3 at INPA, 3 at IFML).



Figures 13–14. *Askola yanoman* sp. nov., male imago. (13) Genitalia, ventral view; (14) apex of penes.

Male imago

Length of body 5.0–7.0 mm, length of forewings 5.8–6.8 mm.

General colouration (Figures 8–12). Thorax yellowish brown, abdomen translucent yellowish white washed with greyish brown, wings hyaline.

Head (Figures 8 and 9). Dorsal portion of eyes brown, lower portion grey; eyes widely meeting dorsally on meson of head; ocelli white, surrounded with grey; head dark brown with lighter mark between ocelli. Antennae: scape brown, pedicel yellowish white with a brown band in apical portion, flagellum whitish.

Thorax. Pronotum brown, with dark marks on hind and lateral margins. Mesonotum yellowish brown except medioparapsidal suture brown, lateroparapsidal suture and scuto-scutelar impression yellowish white. Metanotum dark yellow washed with brown. Pleurae with some areas heavily washed with dark brown, sterna brown. Legs dark yellow, lighter toward apex. Leg I, coxa and trochanter washed with brown, apex of femora, tibiae and tarsal segments with brown band; distal portion of femora of legs II and III with yellowish brown bands. Wings (Figure 12). Membrane hyaline except estigmatic area yellowish and greyish brown area around some cross veins as in Figure 12; longitudinal veins yellowish, cross veins light grey.

Abdomen (Figures 10 and 11). Translucent yellowish white, washed with greyish brown. Terga I and IX uniformly greyish brown; terga III–VII washed with greyish brown on posterior and lateral margin and median area; terga II and VIII almost completely washed with dark brown; terga X dark brown, with anteromedian yellowish triangular mark. Terga II–IX with a transparent medial line. Abdominal sternum I uniformly greyish brown, II and III washed with greyish brown; remainder yellowish.

Genitalia. Styliiger plate yellowish, darker on margins, forceps light yellow, penes yellowish brown with darker margin. Caudal filaments yellowish white every other intersegmental union with a narrow brown band.

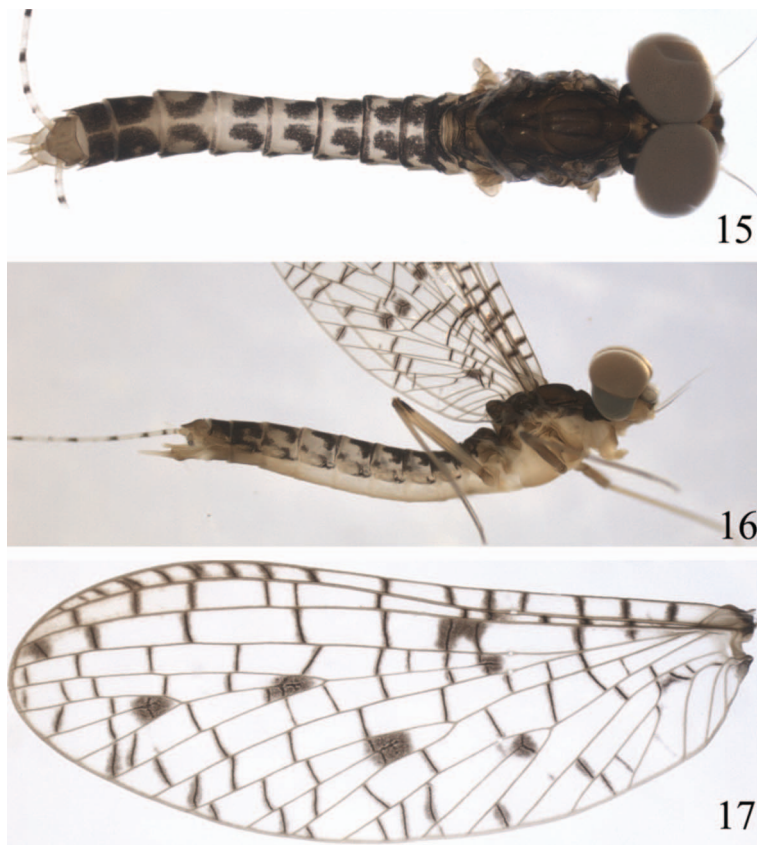
Etymology

The species epithet is a noun in apposition, from *Yanoman*, an indigenous tribe that inhabits the area where the new species was found.

Comments

The male imago of *Askola yanoman* sp. nov. can be separated from the other species of the genus by the following combination of characteristics: (1) general colouration yellowish brown with areas washed with greyish brown (Figures 8–12); (2) dorsal portion of eyes brown, eyes meet on meson of head (Figure 9); (3) penis yellowish brown with darker margin, extending beyond the posterior margin of the styliiger plate (Figures 13 and 14).

The male imago of *A. yanoman* sp. nov. is somewhat similar to those of *A. emmerichi*, sharing features such as pigmented forewings (Figures 12 and 17) and penes extending well beyond the posterior margin of styliiger plate (Figures 13). However, they can be easily separated by differences in colour pattern, such as: (1) the wings are more pigmented in *A. emmerichi* (Figure 17) than in *A. yanoman* sp.



Figures 15–17. *Askola emmerichi*, male imago. (15) General aspect, dorsal view; (16) general aspect, lateral view; (17) forewing.

nov. (Figure 12); (2) abdominal terga are darker in *A. emmerichi* but with unpigmented areas on segments II to VII (Figures 15 and 16), whereas they are lighter but without unpigmented areas in *A. yanoman* sp. nov. (Figures 10 and 11); (3) the thoracic pleurae and sterna of *A. emmerichi* are yellowish (Figure 16), whereas in *A. yanoman* sp. nov. they are brown (Figure 8).

Askola yanoman sp. nov. would key out in couplet 4 of the key proposed by Domínguez et al. (2009). In order to include the new species, the following emendation needs to be incorporated to that key:

- 4. Forceps yellowish-brown or light yellow; penes extending well beyond the posterior margin of styliger plate..... 5
- Forceps whitish, except basal articulation orangeish; penes not extending beyond posterior margin of styliger plate.....*A. paprockii*
- 5. Forceps yellowish-brown, except inner margins whitish; general colouration as in Figures 15 and 16; forewing as in Figure 17..... *A. emmerichi*
- Forceps light yellow; general colouration as in Figures 8–11; forewing as in Figure 12 *A. yanoman* sp. nov.

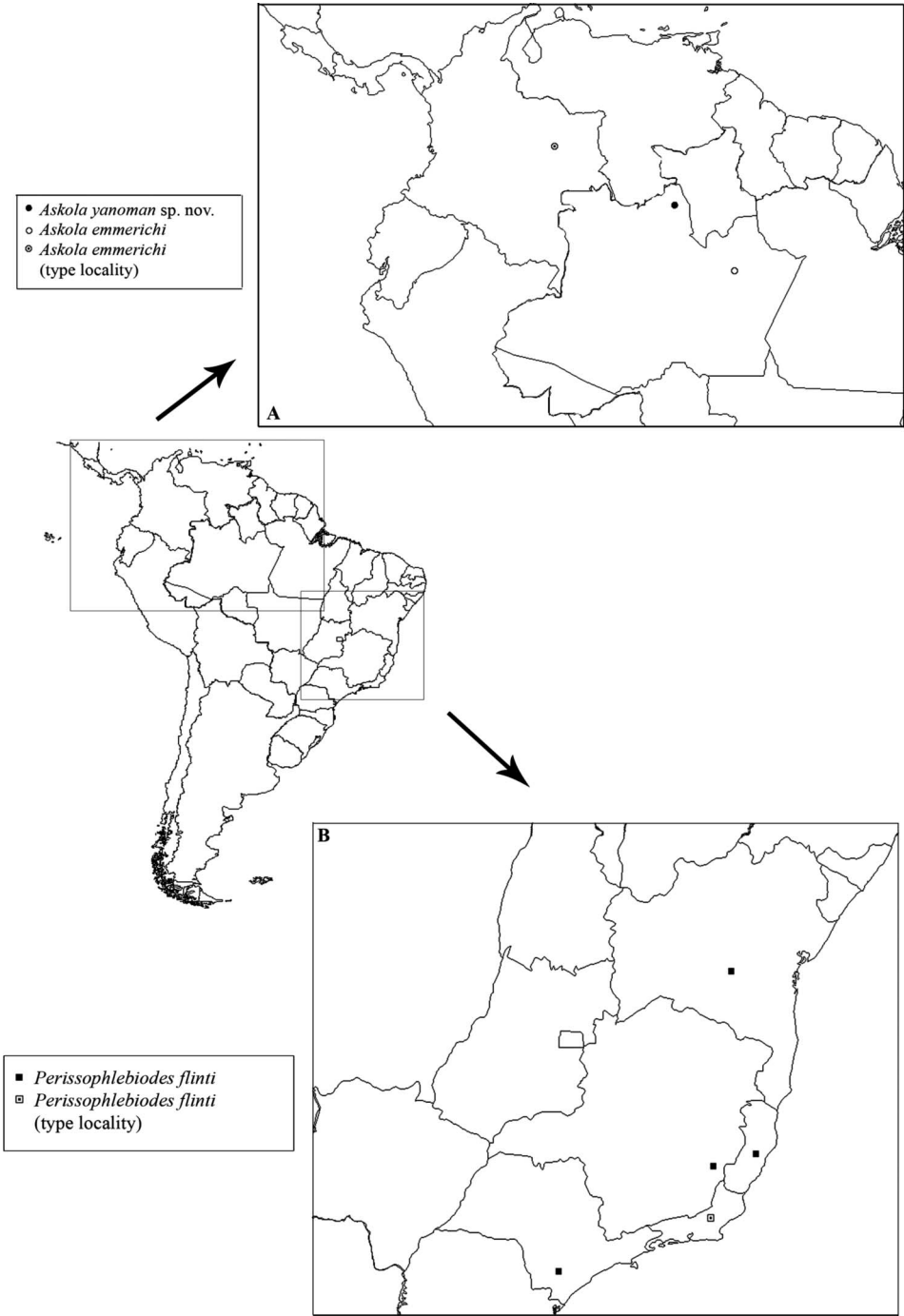


Figure 18. Map of South America showing in detail the distribution of (A) *Askola yanoman* sp. nov. and *Askola emmerichi* and (B) *Perissophlebiodes flinti*.

Biological aspects

The adults of *A. yanoman* sp. nov. were captured flying in the morning, around 8:00 am, around two metres above a flooded area. This area is located 50 metres from the main river (Igarapé do Anta) of the Serra do Aracá. Two immature nymphs of *Askola* were collected, one at the flooded area and the other at the Igarapé do Anta. The Serra do Aracá, where the material was collected, is an elevated area (reaching 1500 m a.s.l.) in the State of Amazonas near the borders of Roraima State and Venezuela (Figure 18). Only six species of mayflies were collected during the expedition to the top of this mountain; at least four of them are new to science and will be described elsewhere. Notably, none of them, including *A. yanoman* sp. nov., were found at the base of the Serra do Aracá or neighbouring areas, suggesting a high level of endemism in this area.

Distribution

BRAZIL: Amazonas (Figure 18).

***Askola emmerichi* Domínguez, Molineri & Mariano, 2009** (Figures 15–18)

Domínguez et al. 2009: 31.

Material examined

12 male imagos, Brazil, Amazonas, Manaus, Presidente Figueiredo, Igarapé do Km 18,5, BR 174, S02°49'01.5", W60°02'07.5" 30m, Lençol, 19/01/2008 (28/x/2009), R. Boldrini, col. (6 at INPA, 6 at CEUNES).

Distribution

VENEZUELA and BRAZIL (new record): Amazonas (Figure 18).

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References

- Boutonnet, J., Thomas, A., and Lala, G. (2004), 'Macroinvertebrates of brooks and rivers of Martinique II. The family Leptophlebiidae: systematics, biogeography and ecological distribution [Ephemeroptera]', *Ephemera* (2002), 4(2), 81–112.
- Coleman, C.O. (2003), "'Digital inking": How to make perfect line drawings on computers', *Organism, Diversity and Evolution*, 3, Electronic Supplement, 14, 1–14. <http://www.senckenberg.de/odes/03-14.pdf>
- Coleman, C.O. (2006), 'Substituting time-consuming pencil drawings in arthropod taxonomy using stacks of digital photographs', *Zootaxa*, 1360, 61–68.
- Da-Silva, E.R., Salles, F.F., and Polegatto, C.M. (2008), '*Perissopheoides flinti* (Savage, 1982)', in *Livro Vermelho da fauna brasileira ameaçada de extinção* (Vol. 1), eds. A.B.M. Machado, G.M. Drummond and A.P. Paglia, Brazil: Fundação Biodiversitas, p. 511.

- Domínguez, E. (2009), 'Overview and phylogenetic relationships of the two-winged genera of South American Leptophlebiidae (Ephemeroptera)', *Aquatic Insects*, 31, Supplement, 1, 63–71.
- Domínguez, E., Molineri, C., and Mariano, R. (2009), 'Revision of the South American species of *Hagenulopsis* Ulmer and *Askola* Peters (Ephemeroptera: Leptophlebiidae) with description of six new species', *Zootaxa*, 2142, 29–44.
- Domínguez, E., Molineri, C.M., Pescador, M., Hubbard, M.D., and Nieto, C. (2006). 'Ephemeroptera of South America', in *Aquatic Biodiversity of Latin America* (Vol. 2), eds. J. Adis, J.R. Arias, G. Ru-Delgado and K.M. Wantzen, Moscow and Sofia, p. 646.
- Lugo-Ortiz, C.R., and McCafferty, W.P. (1996), 'New species of Leptophlebiidae (Ephemeroptera) from Mexico and Central America', *Annales de Limnologie*, 32(1), 3–18.
- Mariano, R. (2010), 'Two new species of *Simothraulopsis* Traver, 1947 (Ephemeroptera: Leptophlebiidae: Atalophlebiinae) from northeastern Brazil', *Aquatic Insects*, 32(2), 129–134.
- Polegatto, C.M., and Froehlich, C.G. (2009), '*Perissophlebiodes flinti* Savage 1982 (Ephemeroptera; Leptophlebiidae: Atalophlebiinae); novo registro, distribuição e comentários sobre sua identificação', *Biota Neotropica*, 9(1), 257–258.
- Salles, F.F., Nascimento, J.M.C., Massariol, F.C., Angeli, K.B., Barcelos, P., Rúdio, J.A., and Boldrini, R. (2010), 'Primeiro levantamento da fauna de Ephemeroptera (Insecta) do Espírito Santo, Sudeste do Brasil', *Biota Neotropica*, 10(1), 293–307.
- Savage, H.M. (1982), 'A curious new genus and species of Atalophlebiinae (Ephemeroptera: Leptophlebiidae) from the southern coastal mountains of Brazil', *Studies on Neotropical Fauna and Environment*, 17, 209–217.
- Savage, H.M. (1983), '*Perissophlebiodes*, a replacement name for *Perissophlebia* Savage nec Tillyard (Ephemeroptera: Leptophlebiidae)', *Entomological News*, 94, 204.
- Thomas, A., Orth, K., Horeau, V., and Dominique, Y. (2001), 'Les Éphémères de la Guyane Française. 3. *Bessierus doloris* n. gen., n. sp. [Ephemeroptera, Leptophlebiidae]', *Ephemera* (2000), 2(1), 49–57.