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New records of mayflies (Insecta: Ephemeroptera) from Bahia State, Northeastern Brazil

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Abstract

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This work presents a updated checklist of mayflies (Insecta: Ephemeroptera) from Bahia State, including new records of species based on collections performed between 2013 and 2014 in the Rio Grande Basin, West Region of Bahia, Northeastern Brazil. We add a brief biological note on ovoviviparity of *Callibaetis radiatus* Navás, 1920. A total of 350 specimens belonging to 13 species and 14 genera were collected and recorded for the first time, increasing from 41 to 54 the number of species in this state.

Additional key words: Checklist, faunistics, neotropical, survey, taxonomy.

Resumen

Lima L, Knapp W, Docio L. 2016. Nuevos registros de efímeras (Insecta: Ephemeroptera) del Estado de Bahía, noreste del Brasil. Entomotropica 31(25): 212-220

En este estudio se presenta una lista de nuevos registros de especies de insectos del orden Ephemeroptera para el estado de Bahía, basada en colecciones realizadas entre 2013 y 2014 en la cuenca del Río Grande, región oeste de Bahía, noreste de Brasil. Al mismo tiempo, presentamos una breve nota biológica acerca de la ovoviviparidad en *Callibaetis radiatus* Navás, 1920. Un total de 350 ejemplares pertenecientes a ocho familias, 14 géneros y 13 especies, fueron identificados y registrados por primera vez, aumentando de 41 a 54 el número de especies conocida en el estado.

Palabras clave Adicionales: Faunística, inventario, lista actualizada, neotropical, taxonomía.

Introduction

The mayflies (Ephemeroptera) are a major component of the benthic macroinvertebrate fauna and occupies freshwater and brackish water habitats across the world, with the exception of Antarctica (Edmunds et al. 1976). The immature stages inhabit lentic and lotic waters, while the imagos or adults are terrestrial, lack mouthparts and do not feed, relying on nutritional build up during immature stages (Brittain 1982). The mayfly nymphs play

a valuable role in aquatic fauna, especially contributing as degrading organic matter and biological indicators of water quality (Baptista 2008, Buss and Salles 2007).

The knowledge on the distribution of Ephemeroptera in Brazil has increased in recent years. According to information provided in the list of species from Brazil from the website "Ephemeroptera do Brasil" (Salles et al. 2015), there are 320 species recorded in 10 families and 72 genera.

By the year 2010, only three species were recorded to Bahia State: *Fittkaulus maculatus* Savage & Peters, 1978, *Homoeoneuria* (*Notochora*) *fittkaui* Pescador & Peters, 1980 and *Camelobaetidius hamadae* Salles & Serrão, 2005. The first checklist of mayflies of Bahia State made by Lima et al. (2010) recorded 15 additional species. Later, 23 species of the families Baetidae, Leptophlebiidae, and Leptohyphidae were added (Mariano 2010, Cruz et al. 2011, 2014; Boldrini et al. 2012, Lima et al. 2013, Molineri et al. 2015).

Bahia State presents a mosaic of biomes (Caatinga, Cerrado and Tropical rainforest) and an extensive river system, which can result in a wide diversity of aquatic insects and, consequently, species of mayfly. The Cerrado occupies an area of 9 600 000 hectares in this State. This biome has been modified by agricultural companies, because of its ability to meet a great demand for grain and pasture (Klink and Machado 2005). About 6 260 km^2 of Cerrado were lost between the years 2002 and 2009 on account of agricultural activities (Silva 2009, Rocha et al. 2011), which also impact aquatic environments due to fertilizers and pesticides. Being a group of insects so important in quality monitoring of water, and on the premise that deforestation causes loss of diversity, there is an immediate need for knowledge of its fauna. Due to the great diversity found in our collections and the urgency to better understand the mayfly fauna in this region, we chose to present this study.

Based on bibliography and collections performed between 2013 and 2014 in the Rio Grande Basin, western Bahia State, Northeastern Brazil, we present an updated checklist of mayflies (Insecta: Ephemeroptera) from Bahia. We also add a brief biological note about ovoviviparity in *C. radiatus* Návas, 1920.

Material and Methods

Collections were made between December/2013 and May/2014 in two counties and four rivers from Rio Grande Basin, West Bahia State: Rio de Ondas, Rio Grande, Rio Branco, and Rio Preto (Figure 1).

Nymphs were collected with an aquatic entomological net and, adults were captured with light traps (between 7 pm to 10 pm and 3 am to 5 am). When possible, nymphs were reared to obtain the adult stage. Collected specimens were fixed in 80 % ethanol. Permanent slides were made using Canada Balsam and Euparal® as the mounting medium, according to Edmunds et al. (1976) and Waltz and McCafferty (1987). The identifications were based on Domingues et al. (2006) and other specific papers for each species when necessary. Information on the geographical distribution of species were consulted in Dominguez et al. (2006), the frequently updated website "Ephemeroptera do Brazil" (Salles et al. 2015), and specific papers for each species.

The material examined is housed at the following institutions: Coleção Zoológica Norte Capixaba (CZNC), São Mateus, Brazil; Coleção Entomológica da Universidade Federal de Pernambuco (CEUFPE), Recife, Brazil; and Instituto de Biodiversidad Neotropical, Tucumán, Argentina (IBN).

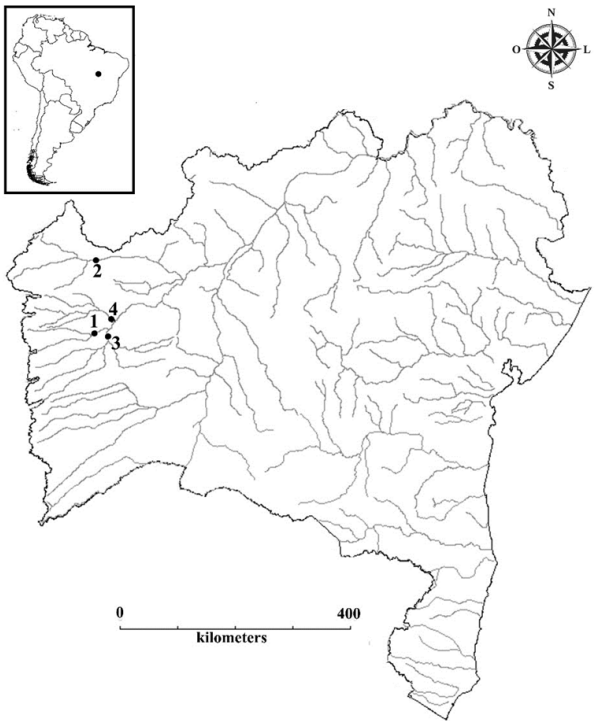

Figure 1. Map of Bahia State indicating the samples sites of Ephemeroptera: 1: Rio de Ondas, Barreiras county; 2: Rio Preto, Formosa do Rio Preto county; 3: Rio Grande, Barreiras county; 4: Rio Branco, Barreiras county.

Results and Discussion

A total of 350 specimens belonging to 13 species and 14 genera were collected and recorded for the first time in Bahia, increasing from 41 to 54 the number of species known from this state. With these results, Bahia becomes, together with Pernambuco (61) and Maranhão (22), one of the states of the Northeastern Region of Brazil with highest number of known species. Below, we provide a list of new records of mayfly species of Bahia State. For each species, we list data on geographical distribution, and comments are made when necessary.

Family Baetidae

Callibaetis radiatus Navás, 1920

(Figure 2A–D)

Previous distribution: Argentina. Paraguay. Brazil: state of Minas Gerais.

Material: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 01 adult ♀ (light trap), 15.iii.2014, W.D. Knapp, L.R.C. Lima, cols. (CZNC).

Comments: This species has all stages known, and the female imago can be distinguished from other species in the genus by the following combination of characters: 1) forewing veins C, Sc and R1 areas brown pigmented (Figure 2A); (2) marginal intercalary veins single (Figure 2A); (3) hind wing hyaline (Figure 2B); (4) costal process of hind wing truncate (Figure 2B); (5) abdominal sterna with black anterolateral marks (Figure 2C) (Cruz et al. 2014). In this study, we observed nymphs adhered to abdomen of adult female (Figure 2C, 2D), indicating an ovoviviparous reproduction in this species. However, the phenomenon of ovoviviparity in insects (the production of living young nymphs or larvae) has been recorded in some species of *Callibaetis* and *Cloeon* (Needham and Murphy 1924, Needham et al. 1935, Berner 1941). According to Edmunds (1945), ovoviparity is correlated with the longevity of female imagos, and probably all species of the genus are ovoviviparous.

Cloeodes auwe Salles & Batista, 2004

Previous distribution. Brazil: states of Amazonas, Mato Grosso, Rondônia and Roraima.

Material examined: BAHIA: Formosa do Rio Preto, Rio Preto; lat 11° 03' 1.29" S, long 45° 11' 26.83" W, 487 m; 08 nymphs, 11.v.2014, W.D. Knapp col. (CZNC).

Comments: *C. auwe* is common in the mayfly community of Amazonian streams, however a small immature nymph was recently identified as *C.* cf. *auwe* in Espírito Santo State, Southeastern Brazil (Massariol et al. 2013). Despite of the geographic distance of the type locality, its presence here represents the second occurrence of this species outside the Amazon Basin.

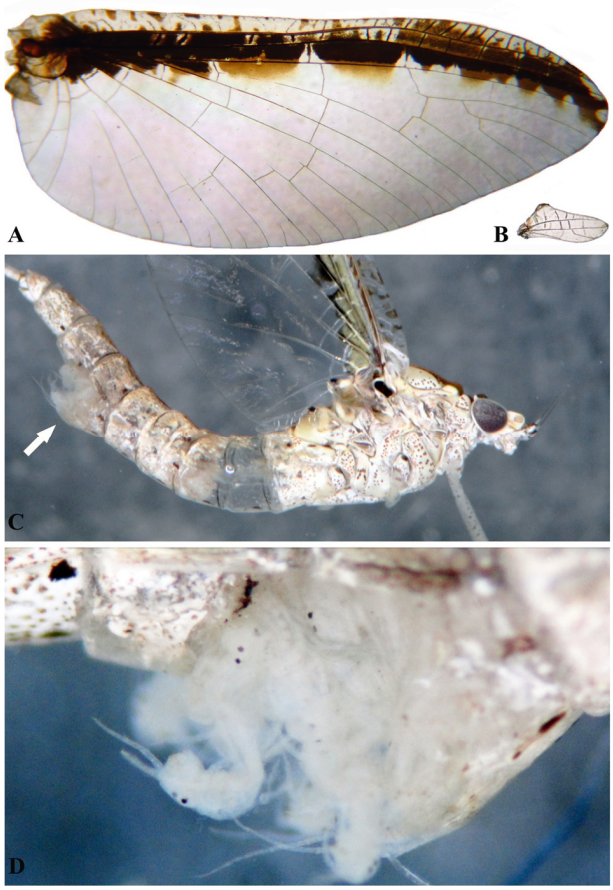

Figure 2. *Callibaetis radiatus*, female imago. A: Fore wing; B: hind wing; C: lateral view (arrow indicates young nymphs on abdomen); D: details of abdominal sterna VII and VIII with young nymphs.

Family Caenidae

Caenis fittkaui Malzacher, 1986

Previous distribution: Brazil: states of Espírito Santo, Pará, and Pernambuco.

Material examined: BAHIA: Formosa do Rio Preto, Rio Preto 11° 03' 1.29" S, long 45° 11' 26.83" W, 487 m; 02 adults ♂ (light trap), 11.v.2014, W.D. Knapp col. (CEUFPE); BAHIA: Barreiras, Rio Branco; lat 12° 0' 20.67" S, long 44° 56' 39.18" W, 439 m; 01 adult ♂ (light trap), 01.v.2014, W.D. Knapp col. (CEUFPE).

Comments: The presence of this species here represents the first record of the genus in Bahia State.

Caenis sp.

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 03 nymphs, 16.iii.2014, W.D. Knapp L.R.C. Lima, cols. (CEUFPE); same as preceding except 01 nymph, 14.iii.2014; Barreiras, Rio Branco; lat 12° 0' 20.67" S, long 44° 56' 39.18" W, 439 m; 01 adult ♂ (light trap), 01/v/2014, W.D. Knapp col. (CEUFPE).

Comment: *Caenis* sp. is a new species and its description is being prepared in another study.

Family Coryphoridae

Coryphorus sp.

Material examined: BAHIA: Formosa do Rio Preto, Rio Preto; lat 11° 03' 1.29" S, long 45° 11' 26.83" W, 487 m; 02 adults ♂ (light trap), 11.v.2014, W.D. Knapp col. (CZNC).

Comments: Coryphoridae is a monotypic family known from eggs, nymphs and adults of both sexes (Peters 1981, Molineri et al. 2002). Despite the comparison of our material in with the original description of male imago, we find distinct morphological differences on genitalia. Possibly, in this case, it can be a new species, but for its confirmation more adult specimens (male and female) and nymphs, should be obtained. The presence of this species here represents the first record of Coryphoridae from Northeastern Brazil.

Family Euthyplociidae

Campylocia anceps (Eaton, 1883)

(Figure 3A–D)

Previous distribution. Brazil: states of Amazonas, Espírito Santo, Pará, Rio de Janeiro, Rio Grande do Sul, and São Paulo.

Material examined. BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 03 nymphs, 25.i.2014, W.D. Knapp col.; same as preceding,

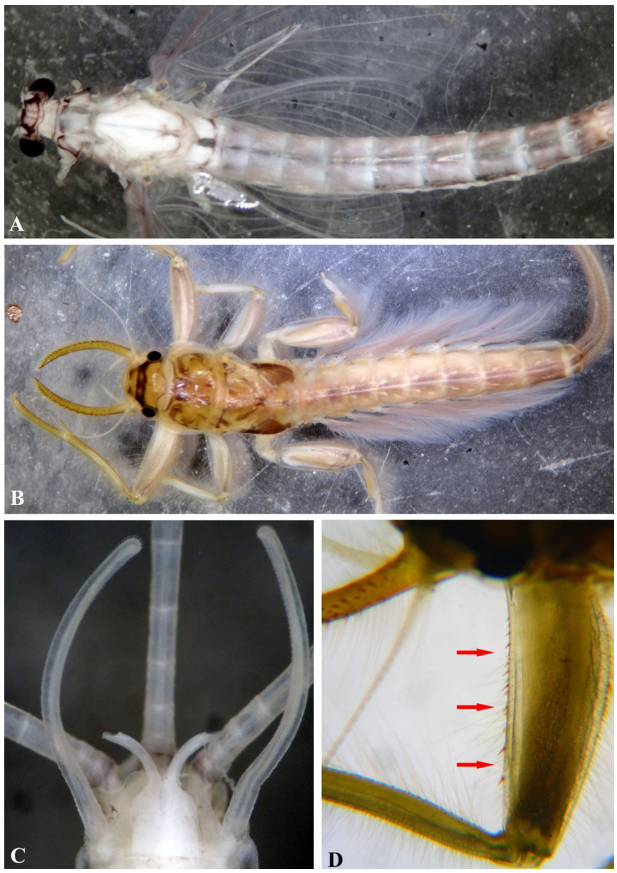

Figure 3. *Campylocia anceps*. A: dorsal view of male imago; B: dorsal view of nymph; C: male genitalia (ventral view); D: detail of fore femur of nymph (arrows indicate the spines on inner margin).

except, 01 adult ♂ (light trap), 14.i.2014. (CZNC).

Comments: *Campylocia* Needham & Murphy, 1924, is represented by three species in Brazil: *C. anceps* (Eaton, 1883), *C. bocainensis* Pereira & Da-Silva, 1990, and *C. dochmia* Berner & Thew, 1961. *C. anceps*, originally described in *Euthyplocia*, is the type-species of the genus and is known from adults of both sexes and nymphs. The adults of this species can be separated from the other species of the genus among other characteristics, by the penis lobes diverging along median line (Figure 3C) and subgenital plate with a convex to almost truncated posterior border (Dominguez et al. 2006). Although adults were not obtained by rearing, they are considered to be conspecific based on the abdominal color pattern, and by a row of short spines on inner margin of fore femur of a mature nymph collected at the same place where the adults were collected (Figure 3D). This row on fore femur is not present in *C. dochmia* and *C. bocainensis* (Gonçalves, personal communication). The presence of *C. anceps* here represents the first record of Euthyplociidae to Notheastern Region.

Family Leptohyphidae

Tricorythopsis chiriguano Molineri, 2001

Previous distribution: Bolivia. Brazil: Maranhão State.

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 01 adult ♂ (light trap), 15.iii.2014, W.D. Knapp, L.R.C. Lima cols. (CEUFPE); same as preceding except 01 adult ♀.

Comments: The presence of this species here represents the first record for Bahia State.

Family Leptophlebiidae

Askola emmerichi Dominguez, Molineri & Mariano, 2009

Previous distribution: Venezuela. Brazil: Amazonas State.

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 03 adults ♂ (light trap), 16.iii.2014, W.D. Knapp, L.R.C. Lima, cols. (CEUFPE).

Comments. The presence of *A. emmerichi* here represents the first record of the genus for the Northeastern Region.

Farrodes carioca Dominguez, Molineri & Peters, 1996

Previous distribution: Brazil: states of Espírito Santo and Rio de Janeiro.

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 02 adults ♂ (light trap), 16.iii.2014, W.D. Knapp, L.R.C. Lima cols. (CEUFPE).

Comments: The presence of this species here represents the first record of the genus from Bahia State.

***Farrodes tepui* Dominguez, Molineri & Peters, 1996**

Previous distribution. Venezuela. Brazil: Pernambuco State.

Material examined. BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 02 adults ♂ (light trap), 16.iii.2014, W.D. Knapp, L.R.C. Lima, cols. (CEUFPE); same as preceding, except 12.iii.2014; BAHIA: Barreiras, Rio Brancolat 12° 0' 20.67" S, long 44° 56' 39.18" W, 439 m; 02 adults ♂ (light trap), 01.v.2014, W.D. Knapp, col. (CEUFPE).

***Hagenulopsis minuta* Spieth, 1943**

Previous distribution: Guyana. Suriname. Venezuela. Brazil: states of Pará, Roraima and Amazonas.

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 01 nymph, 14.xii.2013, W.D. Knapp, col. (UFPE); same as preceding except 02 adults ♂, 16.iii.2014, W.D. Knapp, L.R.C. Lima cols. (CEUFPE).

Comments: Although adults were not obtained by rearing, they are considered to be conspecific based on unicolorous caudal filaments and the wing pads with no clouds around cross veins (as in the imago). The presence of this species here represents the first record of the genus for the Notheastern Region.

***Paramaka* sp.**

(Figure 4A–C)

Previous distribution: Brazil: Mato Grosso State.

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 01 adult ♂, 15.iii.2014, W.D. Knapp, L.R.C. Lima cols. (CEUFPE).

Comments: The genus *Paramaka* Savage & Domingues, 1992 (Ephemeroptera: Leptophlebiidae) is restricted to South America and is includes four species: *Paramaka convexa* (Spieth, 1943), *Paramaka antonii* Sartori, 2005, *Paramaka pearljam* Mariano, 2011 and *Paramaka incognita* Domingues, Grillet, Nieto, Molineri & Guerrero, 2014 (Boldrini and Barroso 2015). The male imago of *P. pearljam* has a conspicuous and large projection on styliger plate, with apex curved ventrally, and the penis lobes with a membranous inner projection (Mariano 2011). However, the specimen collected shows some differences in relation to the original description: the projection of styliger plate is sharp and not curved apically (Figure 4C), and the abdomen is whitish translucent on segments I–V (Figure 4B), versus completely brown in original description.

***Simothraulopsis* (*Simothraulopsis*) *demerara* (Traver, 1947)**

Previous distribution: Brazil: states of Amapá, Espírito Santo, and Pará.

Material examined: BAHIA: Barreiras, Mucambo, Rio Grande; lat 12° 16' 1.71" S, long 45° 1' 46.65" W, 464 m; 01 adult ♂ (light trap), 18.v.2014, W.D. Knapp col. (CEUFPE).

***Ulmeritoides flavopedes* (Spieth, 1943)**

Previous distribution: Suriname. Brazil: states of Mato Grosso, Pernambuco and Roraima.

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11'

Figure 4. *Paramaka* sp., male imago. A: lateral view; B: dorsal view of abdomen; C: genitalia (ventral view).

59.64" S, long 45° 13' 33.83" W, 537 m; 03 nymphs, 14.xii.2013, W.D. Knapp, col. (UFPE); BAHIA: Formosa do Rio Preto, Rio Preto; lat 11° 03' 1.29" S, long 45° 11' 26.83" W, 487 m, 01 adult ♂ (light trap), 11.v.2014, W.D. Knapp col. (CEUFPE).

Comments: The presence of this species here represents the first record of the genus from Bahia State.

Family Oligoneuriidae

***Lachlania* sp.**

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 01 adult ♀ (light trap), 15.iii.2014, W.D. Knapp, L.R.C. Lima cols. (CZNC).

Comments: Hagen (1868) established the genus *Lachlania* based on female imagos from Cuba. The absence of a terminal filament and presence of middle cross veins in the fore wings, according to Hagen (1868), separate the genus from other oligoneuriid genera. Due to lack of male adult specimens, the species identification cannot be done. Its presence represents the first record of the genus from the Northeastern Region of Brazil.

Family Polymitarcyidae

***Campsurus truncatus* Ulmer, 1920**

Previous distribution: Brazil: states of Espírito Santo, Pernambuco, and Rio de Janeiro.

Material examined: BAHIA: Barreiras, Cantinho, Rio Branco; lat 12° 0' 20.67" S, long 44° 56' 39.18" W, 439 m; 03 adults ♂ (light trap), 01.v.2014, W.D. Knapp col. (01 IBN, 02 CZNC).

Comments. The presence of this species here represents the first record of the genus from Bahia State.

***Campsurus* sp.**

Material examined: BAHIA: Barreiras, Vau da Boa Esperança, Rio de Ondas; lat 12° 11' 59.64" S, long 45° 13' 33.83" W, 537 m; 07 adults (5♂, 2♀) (light trap), 15.iii.2014, W.D. Knapp, L.R.C. Lima cols. (IBN).

Comments: *Campsurus* sp. is a new species and its description will be prepared in another study.

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