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Sección Básica / Basic

Artículos de investigación / Research paper

New records of Ephemeroptera from the Colombian Orinoco river basin of the Meta department

Nuevos registros de Ephemeroptera para la cuenca colombiana del Orinoco en el departamento de Meta

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Abstract: There is extensive research of the Ephemeroptera communities taxonomy and ecology in the Andean region of Colombia. However, other regions such as the Orinoquia have been insufficiently studied. From this region, in the Meta department, four species have been registered: *Varipes lasiobrachius* Lugo-Ortiz & McCafferty, *Coryphorus aquilus* Peters, *Miroculis* (Atroari) *colombiensis* Savage & Peters and *Tricorythopsis rondoniensis* (Dias, Cruz & Ferreira). The main objective of this study is to report for the first time for this region the species: *Mayobaetis ellenae* (Mayo), *Hydrosmylodon primanus* (Eaton), *Haplohyphes baritu* Domínguez, *Camelobaetidus edmundsi* Dominique, Mathuriau & Thomas and *Nanomis galera* Lugo-Ortiz & McCafferty.

Key words: Distribution, Andean-Orinoco, foothill, taxonomy.

Resumen: En la región andina Colombiana, se han realizado diversas investigaciones en taxonomía y ecología de las comunidades de Ephemeroptera. Sin embargo, otras regiones, como la Orinoquia, se encuentran poco estudiadas. En esta región, se han reportado cuatro especies: *Varipes lasiobrachius* Lugo-Ortiz & McCafferty, *Coryphorus aquilus* Peters, *Miroculis* (Atroari) *colombiensis* Savage & Peters y *Tricorythopsis rondoniensis* (Dias, Cruz & Ferreira). El objetivo principal de este estudio fue reportar por primera vez para la región las especies: *Mayobaetis ellenae (*Mayo), *Hydrosmylodon primanus* (Eaton), *Haplohyphes baritu* Domínguez, *Camelobaetidius edmundsi* Dominique, Mathuriau & Thomasy *Nanomis galera* Lugo-Ortiz & McCafferty.

Palabras clave: Distribución, Andean-Orinoco, pie de monte, taxonomy.

Introduction

The Ephemeroptera order is represented by approximately 3,500 species grouped in 460 genera and 42 families of which the Baetidae, Leptophlebiidae and Leptohyphidae families represent the greatest diversity in the Neotropic with approximately 473 described species (Barber-James *et al.* 2013; Dominguez and Dos Santos 2013; Barber-James 2014; Salles *et al*. 2016).

In South America there are 570 reported species (Domínguez and Dos Santos, 2013), of which, approximately, 86 are known in Colombia (Dias *et al.* 2009; Domínguez *et al.* 2012; Forero-Céspedes *et al.* 2014; García *et al.* 2013; Gutiérrez and Reinoso-Flórez, 2010; Gutiérrez, *et al.* 2013; Gutiérrez and Llano 2015; Hoyos *et al.* 2014; Molineri, 2014; Molineri *et al.* 2011; Motta-Díaz *et al.* 2012; Rozo and Salinas 2016; Salinas *et al.* 2011; Salinas *et al.* 2013; Salinas *et al.* 2012; Vinasco-Mondragón and Zúñiga, 2016; Zúñiga *et al.* 2014; Zúñiga *et al.* 2015; Zúñiga and Torres-Zambrano 2015). In the country, the Baetidae, Leptophlebiidae and Leptohyphidae families represent more than 70 % of the Ephemeroptera order diversity. Most of these reports of these families are found in the Amazonas department and the Andean region (Zuñiga *et al*. 2004; Dias *et al.* 2009; Salinas *et al.* 2012).

Despite the taxonomic and ecological importance of their Ephemeroptera communities (Bauernfeind and Moog 2000; Prat *et al.* 2009), regions like the Colombian Orinoquia have been among the least studied (Dias *et al.* 2009; Zúñiga and Torres-Zambrano 2015; Dias *et al*. 2016). At present, only four species had been reported for this region: *Varipes lasiobrachius* Lugo-Ortiz & McCafferty, 1998, *Coryphorus aquilus* Peters, 1981, *Miroculis (Atroari) colombiensis* Savage & Peters, 1983 and *Tricorythopsis rondoniensis* (Dias, Cruz & Ferreira, 2009).

In order to extend the knowledge of Ephemeroptera fauna diversity and distribution in Colombia, the objective of this article is to report for the first time for the Colombian Orinoquia the species: *Mayobaetis ellenae* (Mayo, 1973), *Hydrosmylon primanus* (Eaton, 1892), *Haplohyphes baritu* Domínguez, 1984, *Camelobaetidius edmundsi* Dominique, Mathuriau & Thomas, 2001 and *Nanomis galera* Lugo-Ortiz & McCafferty, 1999.

Material and methods

The collection of Ephemeroptera was done in the Orotoy river (Meta), which has an altitude range between 1,620 and 240 masl and a riverbed length of 53 km. The upper and middle zones of the river have the qualities of a mountain

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river and the rest of the basin is described as an eastern cordillera piedmont river and low plain river (Caro *et al.* 2011). Hence, more areas of the stream prevail with rapids than backwaters. Most of the riverbed is composed of pebbles and a soft sandy clay substrate, with an average depth of 0.54 meters. The basin is covered in secondary vegetation and has characteristics of the plain foothill forest with a significant alteration of the longitudinal and transversal continuity because of the expansion of areas for the establishment of productive activities related to the tourism, livestock and the production of hydrocarbon, palm oil and, rice.

The collection was completed during a hydrological cycle between 2010 and 2011 with 17 sampling stations located along the river (Fig 1). Nymphs were collected with a 350 micron aquatic entomological net and fixed in 96 % ethanol. On the other hand, the variables physical and chemical were measured *in situ*: temperature, pH, conductivity and oxygen dissolved in the sampled sites. The species diagnosis was based on Domínguez *et al.* (2006) and Hoyos *et al.* (2014). The examined specimens were deposited in the University of Caldas Entomological Collection of the Biology Program, in Manizales, Colombia (CEBUC – Colección Entomológica del Programa de Biología de la Universidad de Caldas).

Results

Camelobaetidius edmundsi Dominique, Mathuriau & Thomas, 2001 (Fig. 2A)

Camelobaetidius edmundsi Dominique *et al.* 2001: 19; Domínguez *et al.* 2006: 129; Cruz *et al.* 2012: 2; Salinas *et al.* 2012: 202.

Diagnosis. 1) Labrum, dorsally with a pair of subapical setae near midline and 2-3 setae near lateral margin; 2) segment II of labial palpi with a strong rounded distomedial blunt projection; 3) coxal gills absent; 4) tarsal claws with 34-39 denticles; 5)abdominal gills whitish; 8) terminal filament subequal in length to cerci (Dominguez *et al.* 2006).

Material examined. 218 nymphs. **COLOMBIA.** Meta: Acacías, E1 - El Recreo, 3°57’18.8”N, 73°50’44.4”W, 919m, 07/02/2011, 30/05/2011; E2 - Vereda Monserrate, 3°56’14.5”N, 73°48’51,8”W, 692m, 30/05/2011; E10 - Vereda El Triunfo, 3°52’6.2”N, 73°37’40.9”W, 395m, 02/06/2011, 08/02/2011, 13/04/2011; E11 - Vereda La Primavera, 3°51’52,4”N, 73°36’16.0”W, 360m, 08/02/2011, 03/06/2011; E12 - Vereda La Primavera, 3°51’51.9”N, 73°36’1.5”W, 366m, 09/12/2010, 14/04/2011, 03/06/2011; E13 - Vereda La Primavera, 3°52’32.7”N, 73°33’42.5”W, 341m, 09/02/2011, 14/04/2011, 04/06/2011; E14 - Vereda Patio Bonito, 3°52’22,8”N, 73°33’25.8”W, 343m, 09/02/2011, 14/04/2011, 04/06/2011; E15 - Vereda Dinamarca, 3°50’35,9”N, 73°29’57.9”W, 278m, 10/02/2011, 15/04/2011, 06/06/2011; E17 - Vereda Dinamarca, 3°51’16.3”N, 73°27’39.4”W, 277m, 15/04/2011; Castilla La Nueva, E6 - Vereda Betania, 3°53’54.5”N, 73°41’23.1”W, 472m, 12/04/2011, 01/06/2011; E7 - Vereda Betania, 3°53’43.4”N, 73°41’11.5”W, 468m, 08/02/2011, 13/04/2011, 01/06/2011; E8 - Vereda Cacayal, 3°52’9.0”N, 73°38’18.6”W, 419m, 08/12/2010, 08/02/2011, 13/04/2011, 02/06/2011; Guamal, E3 - Vereda Monserrate, 3°56’8.3”N, 73°48’42.2”W, 651m, 06/02/2011, 30/05/2011; E4 - Vereda Brisas de Orotoy, 3°55’41.4”N, 73°46’47.6”W, 571m, 07/02/2011, 12/04/2011, 31/05/2011; E5 -Vereda Brisas de Orotoy, 3°55’51.1”N, 73°46’35.3”W, 569 07/12/2010; 31/05/2011; San Carlos de Guaroa, E18 - Vereda Patagonia, 3°51’49.7”N, 73°23’26”W, 249m, 11/12/2010, 15/04/2011, 06/06/2011.

Comments. The analyzed nymphs were collected in Meta and were found widely distributed in the Andean region (Dias *et al.* 2009; Cruz *et al.* 2012; Salinas *et al.* 2012). The physicochemical variables of the Orotoy river habitat conditions were recorded with temperatures between 19.7 and 29.7 °C, pH ranges of 5.99 and 6.99, 6.03 to 8.62 mg/l O_2 of dissolved oxygen, dissolved solids between 5 and 23 mg/l and low conductivity levels (between 9.23 and 17.7 µS/cm).

Previous distribution. Venezuela: Aragua. Colombia: Antioquia, Caldas, Cauca, Quindío, Putumayo, Risaralda and Valle del Cauca (Dominguez *et al.* 2006; Dias *et al.* 2009).

Mayobaetis ellenae (Mayo, 1973) (Fig 2B)

Baetis sp. 1 Roback, 1966: 137; *Baetis ellenae* Mayo, 1973: 285; Berner 1980: 190; *Moribaetis (Mayobaetis) ellenae*

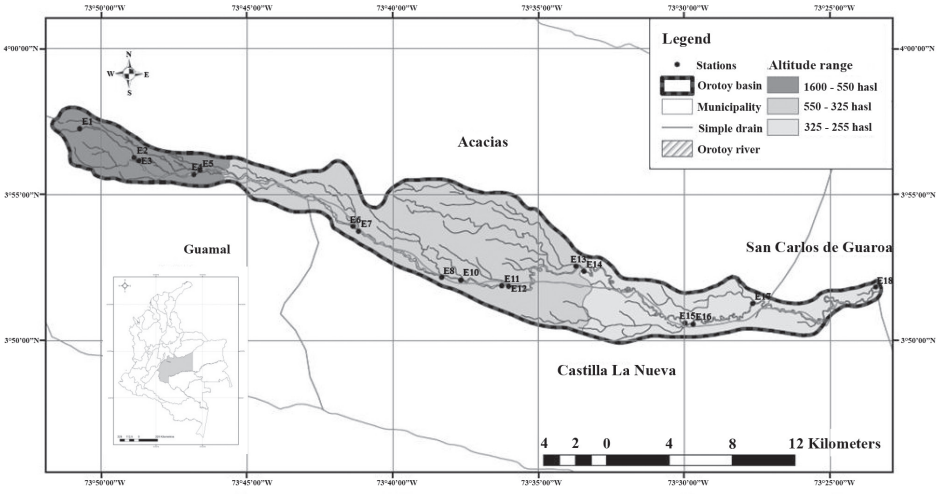

Figure 1. Map Orotoy river basin of the Meta department (Colombia), location of sampling stations.

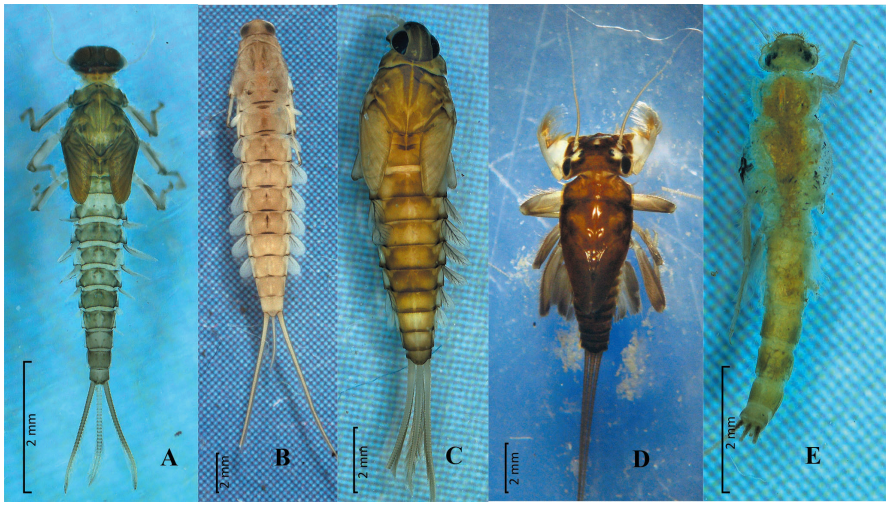

Figure 2. Nymphs, dorsal view. **A.** *Camelobaetidius edmundsi.* **B.** *Mayobaetis ellenae.* **C.** *Nanomis galera.* **D.** *Hydrosmilodon primanus.* **E.** *Haplohyphes baritu.*

Waltz & McCafferty, 1985: 240; *Mayobaetis ellenae*: Lugo-Ortiz & McCafferty, 1996: 369; Domínguez *et al.* 2006: 163; Cruz *et al.* 2012: 1; Salinas *et al.* 2012: 203.

Diagnosis. 1) Antennae short, 1.5 times of head capsule, scape 3 times length of pedicel, scape and pedicel dorsoventrally flattened, with scale-like tubercle and with a row of fine setae. 2) Labrum with a row of long bifid plumose setae, increasing in length toward lateral margin; lateral margin with a row of long fine simple setae; dorsal arc continuous with medial set of setae subequal in length; ventrally with lateral margin sclerotized, submarginal row of robust, apically bifid and plumose setae and with a row of short spine-like setae on distal half. 3) Labium. Apex dorsally of glossae with three robust blade-like pectinate setae and two blunt setae, dorsal surface with four slender pectinate setae. 4) Terminal filament 0.3 times length of cerci, cerci with short spines on external margin (Dominguez *et al.* 2006).

Material examined. 5 nymphs. **COLOMBIA.** Meta: Acacías, E1 - Vereda El Recreo, 3°57'18.8"N, 73°50'44.4"W, 919 m, 06/02/2011; E2 - Vereda San Juanito, 3°56'14.5"N, 73°48'51,85"W, 692m, 11/04/2011; Guamal, E3 - Vereda Monserrate, 3°56'8.3"N, 73°48'42.2"W, 651m, 06/02/2011.

Comments. *M. ellenae* can be found near waterfalls and on rocks (it extends from769 to 2810 m of altitude). It was described originally by Mayo (1973) as *Baetis ellenae*. Lugo-Ortiz and McCafferty (1996) designated it as generic *Mayobaetis* sp. and Nieto (Domínguez *et al.* 2006) complemented the diagnosis of the species. This genus has a wide distribution in Colombia (Dias *et al.* 2009; Salinas *et al.* 2012). The Orotoy river habitat conditions where the species was reported are characterized by the presence of rapids, a 3-9 meters wide wet riverbed, an average depth of 0.37 meters and a discharge of 0.2 to 0.7 m^3/s when the sampling was performed (low waters and transition to high waters). The riverbed is formed by metamorphic rock that covers between 30 and 40 % of the surface. The variables recorded fluctuate between 21.6 and 22.5 °C, 23 to 12.5 mg/l dissolved solids, 6.6 to 6.2 pH, high levels of dissolved oxygen (8.8 mg/l O2) and low conductivity levels (21 to 15 µS/cm).

Previous distribution. Costa Rica: San José. Ecuador: Cotopaxi. Honduras: Baja Verapaz and El Progreso. Perú: Puente Perez. Venezuela: Aragua. Colombia: Antioquia, Boyacá, Caldas, Cauca, Cundinamarca, Magdalena, Nariño, Putumayo, Quindío, Risaralda and Valle del Cauca (Mayo 1973; Dias *et al*. 2009).

Nanomis galera Lugo-Ortiz & McCafferty, 1999
(Fig. 2C)

Nanomis galera Lugo-Ortiz & McCafferty, 1999: 100.

Diagnosis. 1) Labrum dorsally with 1 pair of subapical setae near the midline and 5-6 subapical setae laterally; 2) labium with segment II of palp with slight distomedial projection; 3) posterior margin of abdominal terga I-V smooth and terga VI-X with spines; 4) gills on segments I-VII, asymmetrical, tracheae pigmented (Domínguez *et al.* 2006).

Material examined. 2 nymphs. **COLOMBIA.** Meta: Acacías, E1 - Vereda El Recreo, 3°57'18.8"N, 73°50'44.4"W, 919m, 06/02/2011.

Comments. The nymphs were collected in a rapid zone where the riverbed is formed by metamorphic rock with an average depth of 0.32 meters. The water temperature for the sampling period was of 20.4 °C, pH of 6.47, dissolved oxygen of 9.05 mg/l O2, 23 mg/l of dissolved solids and 21.67 µS/cm of conductivity. This species has been reported in an altitudinal range of 1315 to 2485 masl (Gutiérrez & Dias 2015), the Orotoy river is located at 919 masl.

Previous distribution. Argentina: Cordoba and Tucuman. Bolivia. Colombia: Cundinamarca and Tolima. Ecuador: Carchi and Napo. Perú: Cuzco (Dominguez *et al.* 2006).

Hydrosmilodon primanus Flowers & Domínguez, 1992
(Fig. 2D)

Thraulus primanus Eaton, 1892: 7; Kimmins 1934: 342; Traver 1947: 149; *Traverella primana* Traver, 1960: 5; Allen 1973: 1292; Flowers 1992: 37; *Traverella primanus* Edmunds,

1950: 551; *"Traverella" primana* Flowers & Domínguez, 1991: 49; *Hydrosmilodon primanus* Flowers & Domínguez, 1992; *Hydrosmilodon primanus* Salinas *et al.* 2013: 1.

Diagnosis. 1) Labrum as wide as head, bearing long setae. 2) Long setae on maxillary palpi ordered in rows. 3) Inner distal margin of galela-lacinia expanded. 4) Maxillae with a very large bladelike tusk. 5) Apical denticle on tarsal claws larger than those preceding it. 6) anterior and often posterior margins of basal segments of labial palpi with well-defined black markings. 7) Gills on segments 1-7 plate-like, each ending in single finger-like process, and 8) posterolateral spines present on abdominal segments 8 and 9 (Flowers and Domínguez 1992).

Material examined. 3 nymphs. **COLOMBIA.** Meta: Acacías, E13 - Vereda Patio Bonito, 3°52'32.7"N, 73°33'42.5"W, 341m, 10/12/2010; E17 - Vereda Dinamarca, 3°51'16.3"N, 73°27'39.4"W, 277m, 10/12/2010.

Comments. The nymphs can be found in rocky substrate. *H. primanus* was recorded for the first time in Colombia in the Department of Tolima (Salinas *et al.* 2013) at 479 masl an altitude similar to the one registered in some streams in Costa Rica (470 m). However, in the Orotoy river *H. primanus* was registered at lower altitudes. The nymphs were collected only in the low water period in an area where the Orotoy river physical conditions are characterized for a wet riverbed of 24 to 33 meters, with an average depth of 0.6 meters and a discharge of 2.05 m^3/s in the time of sampling.

Previous distribution. Costa Rica: Alajuela and Guanacuaste. Honduras: Atlantida, Comayagua, Intibuca and El Paraiso. Panamá: Bocas del Toro and Miramar. Colombia: Tolima (Flowers and Domínguez 1992; Salinas *et al.* 2013).

Haplohyphes baritu Domínguez, 1984
(Fig. 2E)

Haplohyphes baritu Domínguez *et al.* 1994: 97; Lugo-Ortiz & Mccafferty 1995: 169; Molineri 1999: 29; Molineri, 2003: 4; Hoyos *et al.* 2014: 132.
Haplohyphes furtiva Domínguez, 1984: 108; Domínguez *et al.* 1994: 98; Molineri 1999: 29; Molineri 2003: 4.
Haplohyphes furtivus [sic]; Lugo-Ortiz & McCafferty, 1995: 169.

Diagnosis. 1) Fore wing buds shaded with gray on basal half of costal margin; 2) head shaded with gray (Domínguez *et al.* 2006).

Material examined. 12 nymphs. **COLOMBIA.** Meta: Acacías, E1 - Vereda El Recreo, 3°57'18.8"N, 73°50'44.4"W, 919m, 06/02/2011; E2 -Vereda San Juanito, 3°56'14.5"N, 73°48'51.8"W, 692m, 06/02/2011; Castilla La Nueva, E8 - Vereda Cacayal, 3°52'9.0"N, 73°38'18.6"W, 419m, 02/06/2011.

Comments. Hoyos *et al.* (2014) recorded *H. baritu* for the first time in Colombia in the three mountains that constitute the Colombian Andes. In the Orotoy basin it is only distributed in the low zone with altitude between 325 and 249 m (Caro *et al.* 2011).

Previous distribution. Northwestern Argentina: Salta. Southwestern Bolivia: La Paz. Colombia: Antioquia, Caquetá, Cauca, Huila, Nariño, Putumayo, Risaralda, Valle del Cauca (Hoyos *et al.* 2014).

Conclusion

The Orinoquia is one of the regions of greatest water wealth of Colombia; however, in spite of this, few studies of aquatic communities and, especially, insects exist. With the reports in the present article, the number of known species in this region increased from four to nine. Hence, it contributed to knowledge of the order Ephemeroptera for the Meta department and the Orinoquia region, and expanded the known distribution of the species in Colombia.

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