Rev. Acad. Colomb. Cienc. Ex. Fis. Nat. 44(171):482-492, abril-junio de 2020
doi: https://doi.org/10.18257/raccefyn.1025

Original article

First record of the larvae *Byrsopteryx* Flint, 1981 (Trichoptera: Hydroptilidae) in Colombia

Primer registro de larvas de *Byrsopteryx* Flint, 1981 (Trichoptera: Hydroptilidae) en Colombia

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Abstract

Hydroptilidae is one of the most diverse families of the order Trichoptera in the world. Neotropical fauna has 36 genera. In Colombia, 14 have been reported in the larval stage and 11 in the adult stage. In the present study, a *Byrsopteryx* larva is registered for the first time in Colombia. The larva was found in the Orotoy River (919 MASL), a stream from the foothills of the eastern flank of the country's Eastern Cordillera (Orinoquia) characterized as waterfall current with riffle on rocks and pebbles, preserved riparian vegetation with open canopy, and clay-loam soil. The water temperature was 19.7 ºC, pH 5.8, conductivity 15.6 uS/cm, and dissolved oxygen 9.1-9.7 mg/lO_2. Given the high diversity of aquatic ecosystems and the limited knowledge of Hydroptilidae genera in Colombia, we hope to open the way for new research and discovery of more species in the country.

Keywords: Microcaddisflies; Oriental Andean cordillera; Orotoy river; Orinoco basin; Neotropic.

Resumen

Hydroptilidae es una de las familias más diversas del orden Trichoptera en el mundo. En el Neotrópico se han reportado 36 géneros y en Colombia se han registrado 14 en estado larval y 11 en estado adulto. Se registra por primera vez para Colombia la larva de *Byrsopteryx*. La larva se encontró en el río Orotoy (919 m s.n.m.), corriente del piedemonte del flanco oriental de la Cordillera Oriental del país (Orinoquia). El tramo se caracterizó por ser de tipo cascada, corriente rápida sobre rocas y guijarros, vegetación riparia conservada con dosel abierto y suelo franco-arcilloso. La temperatura del agua era de 19,7 ºC, el pH de 5,8, la conductividad de 15,6 uS/cm y el oxígeno disuelto de 9,1-9,7 mg/l O_2. Dada la gran diversidad de ecosistemas acuáticos y el escaso conocimiento de géneros de esta familia en Colombia, se espera que en un futuro cercano se aúnen esfuerzos que fomenten la investigación y el descubrimiento de nuevas especies para el país.

Palabras clave: Microtricópteros; Cordillera Oriental de los Andes; Río Orotoy; Cuenca del Orinoco; Neotrópico.

Introduction

Hydroptilidae, with about 2000 described species (**Holzenthal, *et al.*,** 2007), is the family of caddisflies with the largest diversity among the order (**Holzenthal, *et al.*,** 2007; **Holzenthal & Calor,** 2017). It contains 36 genera including *Dicaminus* Müller, 1879, divided into six subfamilies: Hydroptilinae, Leucotrichiinae, Neotrichiinae, Ochrotrichiinae, Orthotrichiinae, and Stactobiinae (**Holzenthal & Calor,** 2017). In Colombia, the current register of larvae includes those from *Hydroptila* Dalman, 1819, *Oxyethira* Eaton, 1873 (Hydroptilinae), *Alisotrichia* Flint, 1964, *Betrichia* Mosely, 1939, *Celaenotrichia* Mosely,

Citation: Vásquez-Ramos JM, Osorio-Ramírez DP, Caro-Caro CI. First record of the larvae *Byrsopteryx* Flint, 1981 (Trichoptera: Hydroptilidae) in Colombia. Rev. Acad. Colomb. Cienc. Ex. Fis. Nat. 44(171):482-492, abril-junio de 2020. doi: https://doi.org/10.18257/raccefyn.1025

Editor: Gladys Reinoso

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Received: October 1, 2019
Accepted: April 28, 2020
Published: June 30, 2020

1934, *Cerasmatrichia* Flint, Harris y Botosaneanu, 1994, *Leucotrichia* Mosely, 1934, *Zumatrichia* Mosely, 1937 (Leucotrichiinae), *Mayatrichia* Mosely, 1937, *Neotrichia* Morton, 1905 (Neotrichiinae), *Metrichia* Ross, 1938, *Ochrotrichia* Mosely, 1934, *Rhyacopsyche* Müller, 1879 (Ochrotrichiinae), and *Ithytrichia* Eaton, 1873 (Orthotrichiinae) (**Table 1**).

The genus *Byrsopteryx* Flint, 1981 belongs to the subfamily Leucotrichiinae, tribe Alisotrichiini (**Santos, *et al.,*** 2016; **Holzenthal & Calor,** 2017) and it currently has 16 described species reported in Mexico, Dominica, Guadeloupe, Costa Rica, Panamá, Ecuador, Brazil and Venezuela (**Holzenthal & Calor,** 2017; **Armitage, *et al*.,** 2016; **Armitage, *et al.,*** 2020). We report here the first occurrence of the larvae *Byrsopteryx* in Colombia, in the sub-basin of the Orotoy River located in the Orinoco River's macro-basin, which is also the first record of this genus for Colombia.

Table 1. Hydroptilidae genera and review of reports of larvae and adults in Colombia

Sub- family	Genus	Reference larvae Colombia	Reference adults Colombia	Distribution (Holzenthal & Calor, 2017)
Hydroptilinae	*Hydroptila* Dalman, 1819	Roldán-Pérez, 1988 Posada-García & Roldán-Pérez, 2003 Arango, *et al*., 2008 Vásquez-Ramos, *et al*., 2010 Vásquez-Ramos & Reinoso, 2012 Forero-Céspedes, *et al*., 2013 Longo, *et al*., 2013 Vásquez-Ramos, *et al*., 2013 Vásquez-Ramos, *et al*., 2014 Latorre-Beltrán, *et a*l., 2014 López-Delgado, *et al.,* 2015 Zamora, 2015 Córdoba-Ariza, *et al*., 2020	Flint, 1991 Muñoz-Quesada, 2000 Holzenthal & Calor, 2017 Mey & Ospina-Torres, 2018	Cosmopolitan
	Oxyethira Eaton, 1873	Posada-García & Roldán-Pérez, 2003 Medellín, *et al*., 2004 Arango, *et al.,* 2008 Posada, *et al*., 2008 Vásquez-Ramos & Reinoso, 2012 Longo *et al*., 2013 López-Delgado, *et al*., 2015 Ramírez, *et al.,* 2018 Mosquera-Murillo, 2019 Córdoba-Ariza, *et al*., 2020	Flint, 1991 Muñoz-Quesada, 2000 Holzenthal & Calor, 2017	Cosmopolitan
	Tricholeiochiton Kloets and Hinks, 1944	No reports	No reports Holzenthal & Calor, 2017	Europe; Asia (southeast); Australia; Brazil
Leucotrichiinae	*Acostatrichia* Mosely, 1939	No reports	No reports Holzenthal & Calor, 2017	South America and Panama
	Alisotrichia Flint, 1964	Arango, *et al*., 2008	Flint, 1991 Muñoz-Quesada, 2000 Holzenthal & Calor, 2017	United States (southwestern); México (south); Venezuela; Antilles; Dominican Republic (ambar)
	Anchitrichia Flint, 1970	No reports	Flint, 1991 Muñoz-Quesada, 2000 Oláh & Flint, 2012 Holzenthal & Calor, 2017	Central America; Andes
	Ascotrichia Flint, 1983	Unknown larvae Holzenthal & Calor, 2017 Pes, *et al*., 2018	No reports. Holzenthal & Calor, 2017	South America (eastern)
	Betrichia Mosely, 1939	Vásquez-Ramos, *et al.,* 2013 Vásquez-Ramos *et al.,* 2014 The larva of *Betrichia* was described mistakenly as *Ceratotrichia* (Pes, *et al*., 2018)	No reports. Holzenthal & Calor, 2017	South America (eastern)

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Sub- family	Genus	Reference larvae Colombia	Reference adults Colombia	Distribution (Holzenthal & Calor, 2017)
Leucotrichiinae	*Byrsopteryx* Flint, 1981	No reports	No reports. Holzenthal & Calor, 2017	Central America (southern); South America; Lesser Antilles
	Celaenotrichia Mosely, 1934	Mosquera-Murillo, 2019	No reports Holzenthal & Calor, 2017	Chile; Argentina
	Ceratotrichia Flint, 1992	Unknown lavae Pes, *et al*., 2018	No reports Holzenthal & Calor, 2017	Panama; Venezuela; Ecuador; Peru; Bolivia
	Cerasmatrichia Flint, Harris and Botosaneanu, 1994	Arango, *et al.,* 2008 Serna, *et al*., 2015	Muñoz-Quesada, 2000 Holzenthal & Calor, 2017	From Costa Rica (south) to Peru; Trinidad (eastern); Lesser Antilles
	Costatrichia Mosely, 1937	Unknown lavae. Pes, *et al.,* 2018	No reports Holzenthal & Calor, 2017	Mexico; Central America; South America
	Leucotrichia Mosely, 1934	Posada-García & Roldán-Pérez, 2003 Medellín, *et al.,* 2004 Arango, *et al*., 2008 Rivera-Usme, *et al*., 2008 Vásquez-Ramos, *et al*., 2010 Forero-Céspedes. *et al*., 2013 Vásquez-Ramos, *et al*., 2013 Vásquez-Ramos, *et al*., 2014 Latorre-Beltrán, *et al*., 2014 López-Delgado, *et al.,* 2015	Flint, 1991 Muñoz-Quesada, 2000 Holzenthal & Calor, 2017	United States; Central America; South America; Greater Antilles; Lesser Antilles (southern)
	Mejicanotrichia Harris and Holzenthal, 1997	No reports	No reports Holzenthal & Calor, 2017	México; Guatemala
	Peltopsyche Müller, 1879	No reports	No reports. Holzenthal & Calor, 2017	Brazil; French Guiana; Guiana; Paraguay; Uruguay; Argentina
	Scelobotrichia Harris and Bueno-Soria, 1993	No reports	No reports Holzenthal & Calor, 2017	Mexico
	Tupiniquintrichia Santos, Nessimian and Takiya, 2016	Little-known larvae Pes, *et al*., 2018	No reports Holzenthal & Calor, 2017	Brazil
	Zumatrichia Mosely, 1937	Posada-García & Roldán-Pérez, 2003 Vásquez-Ramos, *et al*., 2010 Forero-Céspedes, *et al*., 2013 Vásquez-Ramos, *et al.,* 2013 Vásquez-Ramos, *et al*., 2014 López-Delgado, *et al*., 2015	No reports Holzenthal & Calor, 2017	Neotropic; United States; Mexico; Central America; South America (northern); Lesser Antilles
Neotrichiinae	*Kumanskiella* Harris and Flint, 1992	No reports	No reports Holzenthal & Calor, 2017	Endemic Greater Antilles
	Mayatrichia Mosely, 1937	Vásquez-Ramos, *et al.,* 2013 Longo & Blanco, 2014 Vásquez-Ramos, *et al.,* 2014 Latorre-Beltrán, *et al*., 2014 Córdoba-Ariza, *et al.*, 2020	No reports Holzenthal & Calor, 2017	North America; Central America; Neotropic (Ecuador)
	Neotrichia Morton, 1905	Medellín, *et al.*, 2004 Vásquez-Ramos, *et al.,* 2010 Vásquez-Ramos & Reinoso, 2012 Forero-Céspedes *et al*., 2013 Vásquez-Ramos *et al*., 2013 Vásquez-Ramos, *et al.,* 2014 López-Delgado, *et al.,* 2015	Flint, 1991 Muñoz-Quesada, 2000 Holzenthal & Calor, 2017	North America; Central America; South America; West Indies
	Taraxitrichia Flint and Harris, 1991	No reports	No reports. Holzenthal & Calor, 2017	Venezuela; Brazil (not confirmed)

Sub- family	Genus	Reference larvae Colombia	Reference adults Colombia	Distribution (Holzenthal & Calor, 2017)
Ochrotrichiinae	*Angrisanoia* Özdikmen, 2008	Unknown larvae. Holzenthal & Calor, 2017 Pes, *et al.,* 2018	No reports. Holzenthal & Calor, 2017	Venezuela; French Guiana; Uruguay; Argentina
	Metrichia Ross, 1938	Posada-García & Roldán-Pérez, 2003 Medellín, *et al.,* 2004 Arango, *et al*., 2008 Posada-García, *et al*., 2008 Vásquez-Ramos, *et al.,* 2010 Forero-Céspedes, *et al*., 2013 Latorre-Beltrán, *et al*., 2014 López-Delgado, *et al*., 2015 Murillo-Montoya, *et al*., 2018	Flint, 1991 Muñoz-Quesada, 2000 Holzenthal & Calor, 2017 Mey & Ospina-Torres, 2018	United States (southwestern); Central America; South America; Greater Antilles; Lesser Antilles
	Nothotrichia Flint, 1967	No reports	No reports Holzenthal & Calor, 2017	United States; Chile; Costa Rica; Panamá; Brazil
	Ochrotrichia Mosely, 1934	Roldán-Pérez, 1988 Posada-García & Roldán-Pérez, 2003 Medellín, *et al.,* 2004 Arango, et al., 2008 Vásquez-Ramos, *et al*., 2010 Vásquez-Ramos & Reinoso, 2012 Vásquez-Ramos *et al*., 2013 Vásquez-Ramos *et al.,* 2014 Latorre-Beltrán *et al.,* 2014 López-Delgado, *et al*., 2015 Mosquera-Murillo & Córdoba-Aragón, 2015 Ramírez, *et al.,* 2018 Mosquera-Murillo, 2019	Muñoz-Quesada, 2000 Holzenthal & Calor, 2017	North America; Central America; South America; West Indies
	Ragatrichia Oláh and Johanson, 2011	No reports	No reports. Holzenthal & Calor, 2017	French Guiana; Guiana; Suriname; Argentina
	Rhyacopsyche Müller, 1879	Mey & Joost, 1990 Posada-García & Roldán-Pérez, 2003 Arango *et al.,* 2008 Mosquera-Murillo, 2019	Mey & Joost, 1990 Flint, 1991 Muñoz-Quesada, 2000 Wasmund & Holzenthal, 2007 Holzenthal & Calor, 2017 Mey & Ospina-Torres, 2018	Central America; South America
Orthotrichiinae	*Ithytrichia* Eaton, 1873	López-Delgado *et al*., 2015	No reports. Holzenthal & Calor, 2017	Europe; North America; South America
	Orthotrichia Eaton, 1873	No reports	No reports Holzenthal & Calor, 2017	Cosmopolitan
Stactobiinae	*Bredinia* Flint, 1968	No reports	No reports. Holzenthal & Calor, 2017	Neotropic
	Flintiella Angrisano, 1995	No reports	Holzenthal & Calor, 2017	Neotropic
	Orinocotrichia Harris, Flint and Holzenthal, 2002	Unknown lavae. Holzenthal & Calor, 2017 Pes *et al.,* 2018	No reports. Holzenthal & Calor, 2017	Venezuela; Brazil; French Guiana
	Tizatetrichia Harris, Flint and Holzenthal, 2002	Unknown lavae. Holzenthal & Calor, 2017 Pes *et al*., 2018	No reports. Holzenthal & Calor, 2017	Costa Rica
Insertae sedis	*Dicaminus* Müller, 1879	Unknown larvae. Holzenthal & Calor, 2017 Pes, *et al*., 2018	No reports. Holzenthal & Calor, 2017	Brazil

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Materials and methods

Study site

The Orotoy River runs through the municipalities of Acacías, Castilla La Nueva, Guamal, and San Carlos de Guaroa, department of Meta (Colombia), on the eastern flank of the Oriental Andean Cordillera. The river is born at an altitude of 1.620 MASL, it is 54.5 km long, and drains into the Orinoco River basin (**Caro, *et al*.,** 2011). The precipitation is unimodal with two distinctly marked periods: the dry season goes from December to March and the rainy season from April to November (**Ramírez-Gil & Ajiaco-Martínez,** 2001, 2011; **Ramírez-Gil, *et al*.,** 2011).

Data collection

The caddisfly larvae was collected with a Surber net (350 um mesh size) at the site El Recreo (3°57'18,8'' N, 73°50'44.4''W) located 919 MASL in April 2011 (precipitation period of transition to high water). The channel was characterized by riffles, a width between 5.0 and 6.30 m, an average depth of 0.37 m, and a discharge of 0.315 m^3/s. The bottom channel is composed of metamorphic rock and clay-loam soil while the bank shows the secondary forest characteristic of Meta's tropical foothill wet zone biome (**Romero, *et al*.,** 2004); changes in longitudinal and transversal continuity due to expanding areas for livestock were observed. In that portion, the channel is cascade type (**Montgomery & Buffington,** 1997) with a fast-flowing stream running over rock and pebbles exposed to light (**Figure 1**). Larvae was living on rock surfaces occasionally above the waterline. The water temperature was 19.7°C, slightly acidic (pH 5.8), with a high dissolved oxygen content (9.1 – 9.7 mg/l O_2), and low conductivity (15.6 uS/cm).

Identification

The taxonomical identification of the larva genus was done by consulting the literature (**Angrisano & Sganga,** 2009; **Santos & Nessimian,** 2010; **Springer,** 2010) and the experts Paola Alejandra Rueda Martín (CONICET, Argentina) and Monika Springer (*Universidad de Costa Rica*). The collected specimens were deposited in the macroinvertebrates

Figure 1. Channel stream in the Orotoy river where the organisms were collected

biological collection (CZUT-Ma-15061) at *Universidad del Tolima*. The collection license for zoological material was provided by *Corporación para el Desarrollo Sostenible del Área de Manejo Especial La Macarena* (CORMACARENA) (file PM.GA. 3.37.19.010.002 – Resolution PS.GJ.1.2.6.11).

Results and discussion

This is the first record of *Byrsopteryx* larvae in Colombia. The specimen we analized had the characters proposed by **Flint** (1981), **Harris & Holzenthal** (1994), **Angrisano & Sganga** (2009), **Santos & Nessimian** (2010), and **Springer** (2010): brown head; no pigment around the eyes (**Figure 2**); 9 mm-long setae (**Figure 2**); pronotum with middorsal ecdysial line and a pair of anterolateral depressed areas; meso- and metanota without them; pro- and mesonota with transverse mesal line (**Figures 3, 4**); all pairs of legs with similar short and stout structure (**Figure 4**); slightly enlarged but not compressed or depressed abdomen (**Figure 3**); nine abdominal segments with sclerotized tergites and variable size (**Figure 3**); each of the segments III to VII with wide and short tergite; segments VIII and IX heavily sclerotized forming together a large circular operculum that closes from the posterior margin to the anal proleg (**Figure 3**); short anal proleg (**Figure 2, 4**); free-moving larval case made of silk with bits of sand and mineral material, laterally depressed and slightly undulatory, and round anterior and posterior openings directed slightly ventrally (**Figures 2, 3**).

This *Byrsopteryx* larva record for Colombia completes the distribution of this genus in the north part of the South America region. It had been reported before in México, Dominica, Guadeloupe, Costa Rica, Panamá, Ecuador, Brazil, and Venezuela (**Holzenthal & Calor,** 2017; **Armitage, *et al.*,** 2016; **Armitage, *et al.*,** 2020) (**Figure 5 – Table 2**). The localities where they were collected are more or less conserved, the streams were exposed to light and had rock areas, riffles, and splatter zones (**Flint,** 1981; **Harris & Holzenthal,** 1994; **Botosaneanu,** 2000; **Santos & Nessimian,** 2010). Which are similar to the site in the Orotoy river; however, it is the first time that they are reported in this physical and chemical parameters. The research on adult specimens of the order Trichoptera in the country has been scarce (**Mey & Joost,** 1990; **Flint,** 1991; Rincón, 1999; **Muñoz-Quesada,** 2000, 2004) (**Table 1**) and the efforts have focused on determining the ecological

Figures 2-4. Larvae of *Byrsopteryx*. **2:** Individual inside of refuge. **3:** Dorsal view of larvae; pro-, meso- and metanotum characteristics; abdominal segments VIII and IX heavily sclerotized. **4:** Lateral view larvae; abdominal segments with sclerotized tergites dorsally. Photos by J.I. Rojas-Peña. All photos at the same scale

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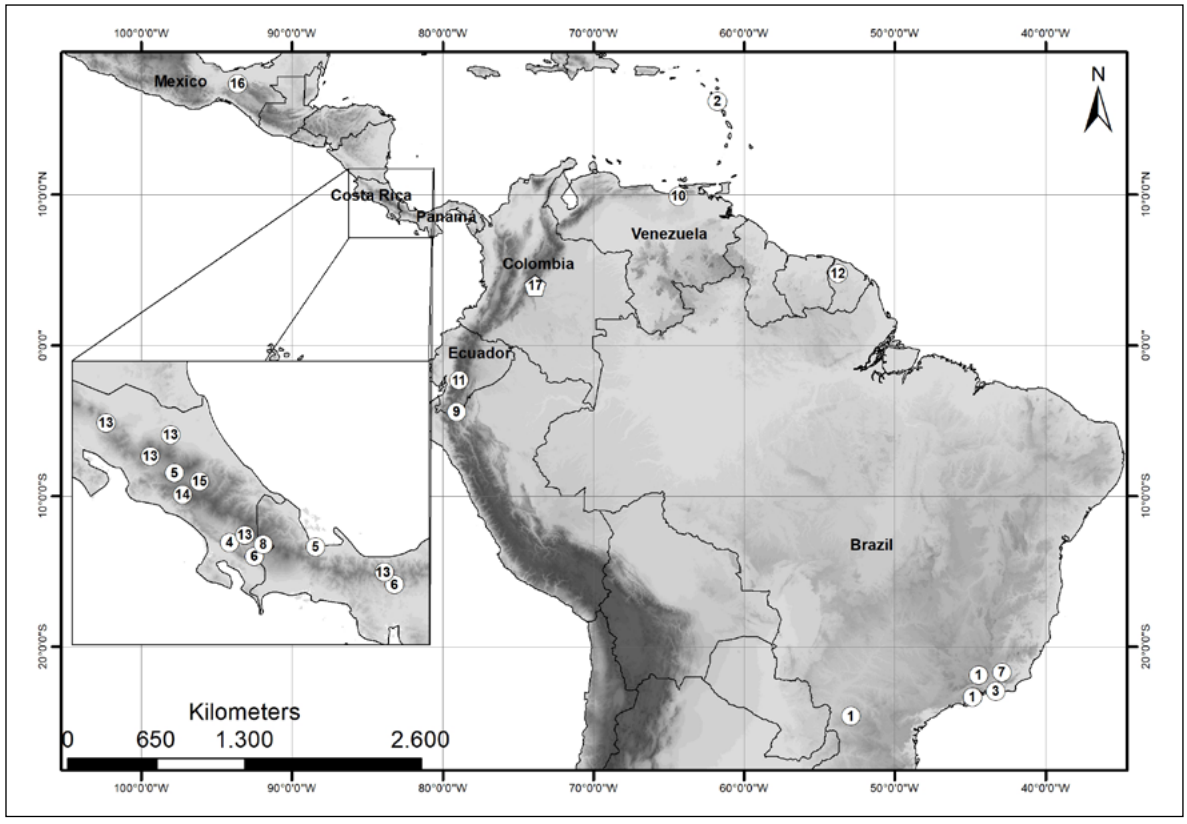

Figure 5. Geographic distribution of *Byrsopteryx*. See Table 2 for numbers (**17.** New record, this study)

and taxonomic aspects of caddisflies larvae in Andean mountains (**Ballesteros, *et al*.,** 1997; **Posada-García & Roldán-Pérez,** 2003; **Latorre-Beltrán, *et al*.,** 2014; **López, *et al*.,** 2015; **Mosquera-Murillo & Córdoba-Aragón,** 2015; **Serna, *et al*.,** 2015). However, caddisflies from one of the largest regions in Colombia (Orinoquia) have not been studied (**Moreno-Rodríguez, *et al*.,** 2017). Recently, **Longo, *et al*.** (2013) study in running waters in that region reported for the first time genus *Blepharopus* Kolenati, 1859 (Hydropsychidae) larvae.

The research on the diversity of the Trichoptera order in Colombia has to increase. This record is evidence of the possibilities of studying the Trichoptera order at ecological and taxonomical levels and of the need to conduct faunal studies determining larvae-adult association to know which species are present in the region.

Acknowledgements

We thank Paola Alejandra Rueda Martín at the *Instituto de Biodiversidad Neotropical, Facultad de Ciencias Naturales* and *IML* at CONICET, and Monika Springer (*Escuela de Biología de la Universidad de Costa Rica*), curator of the *Museo de Zoología,* and research associate in the *Centro de Investigación en Ciencias del Mar y Limnología* (CIMAR) for their help to confirm the identification of the specimen. We also thank Ana María Oliveros Monroy for her valuable assistance in the field; Oscar Javier Díaz Celis for the elaboration of map illustrations, and the *Instituto de Ciencias Ambientales de la Orinoquia Colombiana* (ICAOC) at *Universidad de los Llanos* for supporting our research and providing the biological material collected in the context of the DHS 169-09 agreement signed between *Universidad de los Llanos* and ECOPETROL. Finally, we thank the reviewers for their contribution to improve this manuscript.

Table 2. *Byrsopteryx* species of the Neotropical region (according to **Holzenthal & Calor**, 2017 and others).

ID	Species	Descriptor	Country	Locality	Altitude MASL	References
1	*B. abrelata*	Harris & Holzenthal, 1994	Brasil	Rio de Janeiro	950	Harris & Holzenthal, 1994
				Rio de Janeiro	1298	Santos & Nessimian, 2010
				Parana	–	Blahnik, *et al*. 2004
				Sao Paulo	15	Santos & Nessimian, 2010
2	*B. bipartiterga*	Botosaneanu, 2000	Guadeloupe		580	Botosaneanu, 2000
3	*B. carioca*	Santos & Nessimian, 2010	Brasil	Rio de Janeiro	475	Santos & Nessimian, 2010
4	*B. chaconi*	Harris & Holzenthal, 1994	Costa Rica	Puntarenas	100	Harris & Holzenthal, 1994
5	*B. cuchilla*	Harris & Holzenthal, 1994	Costa Rica	Cartago	–	Harris & Holzenthal, 1994
			Panamá	Bocas del Toro	–	Armitage, *et al*., 2016
6	*B. esparta*	Harris & Holzenthal, 1994	Costa Rica	Puntarenas	1150	Harris & Holzenthal, 1994
			Panamá	Veraguas	536	Armitage, *et al*., 2020
7	*B. espinhosa*	Harris & Holzenthal, 1994	Brasil	Rio de Janiero	1180	Harris & Holzenthal, 1994
				Rio de Janiero	933	Santos & Nessimian, 2010
8	*B. gomezi*	Harris & Holzenthal, 1994	Costa Rica	Puntarenas	1400	Harris & Holzenthal, 1994
9	*B. loja*	Harris & Holzenthal, 1994	Ecuador	Zamora-Chinchipe	2000	Harris & Holzenthal, 1994
10	*B. mirifica*	Flint, 1981	Venezuela	Aragua	–	Flint, 1981
11	*B. rayada*	Harris & Holzenthal, 1994	Ecuador	Cañar	2910	Harris & Holzenthal, 1994
12	*B. septempunctata*	Flint, 1968	Dominica		–	Flint, 1968
13	*B. solisi*	Harris & Holzenthal, 1994	Costa Rica	Puntarenas	720	Harris & Holzenthal, 1994
				Puntarenas	840	Harris & Holzenthal, 1994
				Alajuela	710	Harris & Holzenthal, 1994
				Guanacaste	–	Harris & Holzenthal, 1994
				Heredia	140	Harris & Holzenthal, 1994
			Panamá	Veraguas	515	Armitage, *et al*., 2020
				Veraguas	395	Armitage, *et al*., 2020
14	*B. tapanti*	Harris & Holzenthal, 1994	Costa Rica	Cartago	1400	Harris & Holzenthal, 1994
15	*B. tica*	Harris & Holzenthal, 1994	Costa Rica	Cartago	1540	Harris & Holzenthal, 1994
16	*B. tabasquensis*	Bueno-Soria, Santiago-Fragoso, & Barba-Álvarez, 2001	Mexico	Tabasco	–	Bueno-Soria, *et al.*, 2001
17	*Byrsopteryx*	Flint, 1981	Colombia	Meta	919	This publication

Authors' contributions

JMVR contributed with the taxonomic determination, data analysis, and the drafting of the manuscript. DPOR contributed to the project formulation, data analysis, and the drafting of the manuscript. CICC contributed to the formulation of the project and the drafting of the manuscript.

Conflict of interest

None to declare

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