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Brian J. Armitage

Steven C. Harris

Roger J. Blahnik

Robin E. Thomson

Tomas A. Rios Gonzalez

See next page for additional authors

Authors

Brian J. Armitage, Steven C. Harris, Roger J. Blahnik, Robin E. Thomson, Tomas A. Rios Gonzalez, and Yusseff Aguirre

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Brian J. Armitage
Instituto Conmemorativo Gorgas de Estudio de la Salud
Ave. Justo Arosemena y Calle 35
Apartado Postal Nº 0816-02593
Panamá, Republic of Panamá

Steven C. Harris
Department of Biology and Geosciences
Clarion University
Clarion, PA 16214 USA

Roger J. Blahnik
Department of Entomology
University of Minnesota
St. Paul, MN 55108 USA

Robin E. Thomson
Department of Entomology
University of Minnesota
St. Paul, MN 55108 USA

Tomás A. Ríos González
Museo de Peces de Agua Dulce e Invertebrados
Universidad Autónoma de Chiriquí
David, Republic of Panamá

Yusseff Aguirre
Museo de Peces de Agua Dulce e Invertebrados
Universidad Autónoma de Chiriquí
David, Republic of Panamá

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Brian J. Armitage
Instituto Conmemorativo Gorgas de Estudio de la Salud
Ave. Justo Arosemena y Calle 35
Apartado Postal Nº 0816-02593
Panamá, Republic of Panamá
tobikera89@gmail.com

Steven C. Harris
Department of Biology and Geosciences
Clarion University
Clarion, PA 16214 USA
sharris@clarion.edu

Roger J. Blahnik
Department of Entomology
University of Minnesota
St. Paul, MN 55108 USA
blahn003@umn.edu

Robin E. Thomson
Department of Entomology
University of Minnesota
St. Paul, MN 55108 USA
thom1514@umn.edu

Tomás A. Ríos González
Museo de Peces de Agua Dulce e Invertebrados
Universidad Autónoma de Chiriquí
David, Republic of Panamá
tomas.rios@unachi.ac.pa

Yusseff Aguirre
Museo de Peces de Agua Dulce e Invertebrados
Universidad Autónoma de Chiriquí
David, Republic of Panamá
yusseff1422@gmail.com

Abstract. The Republic of Panama currently includes 414 recorded species of Trichoptera. Herein we add two new genera (Hydroptilidae: *Angrisanoia* Ozdikmen, 2008 and *Mayatrichia* Mosely, 1937) and 17 new country records (Philopotamidae: *Chimarra (C.) tapanti* Blahnik, *Wormaldia bolivari* Muñoz-Quesada and Holzenthal, and *Wormaldia zunigae* Muñoz-Quesada and Holzenthal; Hydropsychidae: *Centromacronema pygmaeum* Botosaneanu; Hydroptilidae: *Brysopteryx esparta* Harris and Holzenthal, *Byrsopteryx solisi* Harris and Holzenthal, *Costatrichia falsa* Santos, Takiya, and Nessimian, *Mayatrichia illobia* Harris and Holzenthal, *Metrichia amplitudinis* Bueno-Soria and Holzenthal, *Ochrotrichia boquillas* Moulton and Harris, *O. conformalis* Bueno-Soria and Holzenthal, *O. quinealensis* Bueno-Soria and Holzenthal, and *O. unica* Bueno-Soria and Santiago; Leptoceridae: *Triaenodes morai* Holzenthal and Andersen; Odontoceridae: *Marilia kingsolveri* Bueno-Soria and Rojas-Ascencio; and, Helicopsychidae: *Helicopsyche alajuela* Johanson and Holzenthal and *Helicopsyche breviterga* Flint) to Panama's caddisfly fauna. The newly recorded taxa increase Panama's total known caddisfly fauna to 431 species, distributed among 15 families and 55 genera. These results are part of an ongoing effort to characterize the caddisfly fauna of Panama, and to evaluate the aquatic insect diversity of the country's major watersheds (cuencas).

Key words. Philopotamidae, Hydropsychidae, Helicopsychidae, Hydroptilidae, Leptoceridae, Odontoceridae, Central America, Neotropics, species inventory.

Resumen. La República de Panamá actualmente incluye 414 especies registradas de Trichoptera. Aquí agregamos dos nuevos géneros (Hydroptilidae: *Angrisanoia* Ozdikmen, 2008 y Mayatrichia Mosely, 1937) y 17 nuevos registros para el país (Philopotamidae: *Chimarra* (*C.*) *tapanti* Blahnik, *Wormaldia bolivari* Muñoz-Quesada y Holzenthal, y *Wormaldia zunigae* Muñoz-Quesada y Holzenthal; Hydropsychidae: *Centromacronema pygmaeum* Botosaneanu; Hydroptilidae: *Brysopteryx esparta* Harris y Holzenthal, *Byrsopteryx solisi* Harris y Holzenthal, *Costatrichia falsa* Santos, Takiya, y Nessimian, *Mayatrichia illobia* Harris y Holzenthal, *Metrichia amplitudinis* Bueno-Soria y Holzenthal, *Ochrotrichia boquillas* Moulton y Harris, *Ochrotrichia conformalis* Bueno-Soria y Holzenthal, *Ochrotrichia quinealensis* Bueno-Soria y Holzenthal, y *Ochrotrichia unica* Bueno-Soria y Santiago; Leptoceridae: *Triaenodes morai* Holzenthal y Andersen; Odontoceridae: *Marilia kingsolveri* Bueno-Soria y Rojas-Ascencio; y, Helicopsychidae: *Helicopsyche alajuela* Johanson y Holzenthal y *Helicopsyche breviterga* Flint) a la fauna de Trichoptera de Panamá. Los taxones recien reportados aumentan el total de la fauna de Trichoptera de Panamá a 431 especies, distribuidas en 15 familias y 55 géneros. Estos resultados son parte de un esfuerzo continuo para caracterizar la fauna de Trichoptera y para evaluar la diversidad de insectos acuáticos de las principales cuencas hidrográficas (cuencas) de Panamá.

Palabras clave. Philopotamidae, Hydropsychidae, Helicopsychidae, Hydroptilidae, Leptoceridae, Odontoceridae, América Central, Neotrópico, inventario de especies.

Introduction

Some of the species recorded in this publication were discovered as a result of general surveys of Panama's caddisfly fauna. This effort is now formalized in a registered project at the Museo de Peces de Agua Dulce e Invertebrados (MUPADI) of the Universidad Autónoma de Chiriquí (UNACHI) in David, Panama. The publication series (The Trichoptera of Panama) within which this paper is included now serves as the official series for this project. Other species described or recorded in this publication were discovered during work on a new project, initiated in 2017, involving biological surveys of Panama's national parks. Designated "Proyecto Sistema de Producción Sostenible Conservación de la Biodiversidad (PSPSCB)", this project is managed by Panama's Ministerio de Ambiente and, in collaboration with the Instituto Conmemorativo Gorgas de Estudios de la Salud (Gorgas Institute), executed by the Colección Zoológica Dr. Eustorgio Méndez (COZEM). These biodiversity surveys are included under the framework of the "Sistema Nacional de Información y Monitoreo de la Diversidad Biológica", or National Biological Diversity Information and Monitoring System, to better understand the country's biodiversity. Primary funding was provided by the World Bank. The various components of this latter project include one on aquatic invertebrates.

Until the last 27 years, the insect order Trichoptera (caddisflies) was poorly known in Panama, both in terms of diversity and distribution. In general, repeated collections were made in a relatively few locations. Aguila (1992) published the first list of caddisflies (Insecta: Trichoptera) from Panama, listing 168 species in 39 genera and 13 families. Through 2014, six genera and 78 species were added to Panama's caddisfly fauna by a cadre of researchers, bringing the total to 246 species distributed among 13 families and 45 genera. Beginning in 2015 and continuing into the current year, Armitage et al. (2015), Harris and Armitage (2015), Muñoz-Quesada and Holzenthal (2015), Bueno-Soria and Barba-Álvarez (2015), Armitage et al. (2016), Armitage and Harris (2018a), and Thomson and Armitage (2018), Armitage et al (2018), Harris and Armitage (2019), Razuri-Gonzalez and Armitage (2019) and Blahnik and Armitage (2019) have added two families, eight genera, and 168 new species and new country records of caddisflies.

Based on specimens collected recently, in this paper we add country records for two genera and 17 species of caddisflies to Panama's fauna. Thus, the new total of known caddisflies from the Republic of Panama is 431 species distributed among 15 families and 55 genera.

Materials and Methods

Single-night collections were made, in general, using UV-light traps (Calor and Mariano 2012). Multiple-night collections were made employing Malaise traps, as indicated below. Specimens were prepared and examined following standard methods outlined in Blahnik and Holzenthal (2004). Male genitalia were soaked in 5% KOH overnight, and washed in acidified water and alcohol prior to examination under various dissecting scopes.

Specimens listed in this publication will be deposited in COZEM or the authors' collections. The order of families below follows the classification presented by Holzenthal et al. (2015).

The new species of *Angrisanoia* Ozdikmen will be described in a forthcoming publication. Citation information for species authorities mentioned in this paper can be found in the Trichoptera Literature Database (http://www.trichopteralit.umn.edu/).

Results

Philopotamidae

***Chimarra (C.) tapanti* Blahnik, 1998**

PANAMA, Chiriquí Province, Cuenca 102, Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N and 82.690512°W, 1692 m, Malaise trap, B. Armitage, 26-28 December 2017, 1 male.

Distribution. Costa Rica, Panama.

***Wormaldia bolivari* Muñoz-Quesada and Holzenthal, 2015**

PANAMA, Chiriquí Province, Cuenca 108, Quebrada Grande, Boquete, Valle Escondido, 8.78365˚N and 82.44429˚W, 1147 m, T. Arefina-Armitage, 15 September 2018, 1 male.

Distribution. Panama, Venezuela.

***Wormaldia zunigae* Muñoz-Quesada and Holzenthal, 2015**

PANAMA, Chiriquí Province, Cuenca 108, tributary of Quebrada Grande, Boquete, Valle Escondido, 8.78173°N and 82.44395°W, 1194 m, UV light trap, B. Armitage and T. Arefina-Armitage, 11 March 2018, 1 male; ibid., Quebrada Grande, 8.78365˚N and 82.44429˚W, 1147 m, T. Arefina-Armitage, 15 September 2018, 1 male.

Distribution. Colombia, Panama.

Hydropsychidae

***Centromacronema pygmaeum* Botosaneanu, 1993**

PANAMA, Bocas del Toro Province, Cuenca 093, Quebrada Martinez, Willie Mazu, 8.79361°N and 82.19392°W, 538 m, Malaise trap, T. Ríos and Y. Aguirre, 5–19 July 2019, 3 males.

Distribution. Panama, Trinidad, Venezuela.

Hydroptilidae

***Angrisanoia* sp.**

PANAMA, Veraguas Province, Cuenca 132, Santa Fe National Park, Río Mulaba, Isleta, PSPSCB-PNSF-C132-2017-015, 8.54513°E and 81.11970°W, 412 m, UV light trap, T. Ríos, E. Alvarez, and C.

Nieto, 22 April 2017, 1 male; ibid., Cuenca 097, Santa Fe National Park, Río Llanito, PSPSCB-PNSF-C097-2017-012, 8.56553°E and 81.18817°W, 340 m, UV light trap, A. Cornejo, T. Ríos, E. Alvarez, and C. Nieto, 20 April 2017, 1 male.

Distribution (for the genus). Argentina, French Guiana, Panama, Uruguay, Venezuela.

Note. This apparent new species will be described in a future publication with others from Panama's national parks.

***Brysopteryx esparta* Harris and Holzenthal, 1994**

PANAMA, Veraguas Province, Cuenca 097, Santa Fe National Park, afluente Río Calovebora, PSPSCB-PNSF-C097-2017-005, 8.54318°E and 81.16398°W, 536 m, Malaise trap, T. Ríos, E. Alvarez, and C. Nieto, 19–23 April 2017, 1 male.

Distribution. Costa Rica, Panama.

***Byrsopteryx solisi* Harris and Holzenthal, 1994**

PANAMA, Veraguas Province, Cuenca 097, Santa Fe National Park, Río Calovebora, PSPSCB-PNSF-C097-2017-006, 8.55038°E and 81.16486°W, 515 m, Malaise trap, A. Cornejo, T. Ríos, E. Alvarez, and C. Nieto, 19-23 April 2017, 1 male; ibid., Río Piedra de Moler, PSPSCB-PNSF-C097-2017-011, 8.55343°E and 81.17675°W, 395 m, UV light trap, A. Cornejo, T. Ríos, E. Alvarez, and C. Nieto, 20 April 2017, 1 male.

Distribution. Costa Rica, Panama.

***Costatrichia falsa* Santos, Takiya, and Nessimian, 2013**

PANAMA, Veraguas Province, Cuenca 132, Santa Fe National Park, Río Mulaba, afluente 1er Brazo, PSPSCB-PNSF-C132-2017-008, 8.54318°E and 81.16398°W, 770 m, Malaise trap, T. Ríos, E. Alvarez, and C. Nieto, 19-23 April 2017, 2 males.

Distribution. Costa Rica, Panama.

***Mayatrichia illobia* Harris and Holzenthal, 1990**

PANAMA, Veraguas Province, Cuenca 097, Santa Fe National Park, Río Llanito, PSPSCB-PNSF-C097-2017-012, 8.56553°E and 81.18817°W, 340 m, UV light trap, A. Cornejo, T. Ríos, E. Alvarez, and C. Nieto, 20 April 2017, 8 males.

Distribution. Costa Rica, Ecuador, Panama.

***Metrichia amplitudinis* Bueno-Soria and Holzenthal, 2003**

PANAMA, Chiriqui Province, Cuenca 102, Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N and 82.690512°W, 1692 m, Malaise trap, B. Armitage, 26-28 December 2017, 2 males; ibid., J. Dietrich, 28 January–2 February 2018, 1 male; ibid., 16-20 February 2018, 9 males; ibid., 16-20 March 2018, 1 male.

Distribution. Costa Rica, Panama.

***Ochrotrichia boquillas* Moulton and Harris, 1997**

PANAMA, Veraguas Province, Cuenca 132, Santa Fe National Park, Río Mulaba, 2do Brazo, PSPSCB-PNSF-C132-2017-007, 8.52577°E and 81.13045°W, 623 m, UV light trap, A. Cornejo, T. Ríos, E. Alvarez, and C. Nieto, 20 April 2017, 1 male.

Distribution. Mexico, Panama, U.S.A.

***Ochrotrichia conformalis* Bueno-Soria and Holzenthal, 2008**

PANAMA, Veraguas Province, Cuenca 097, Santa Fe National Park, afluente Río Calovebora, PSPSCB-PNSF-C097-2017-005, 8.54318°E and 81.16398°W, 536 m, Malaise trap, T. Ríos, E. Alvarez, and C. Nieto, 19-23 April 2017, 1 male.

Distribution. Costa Rica, Panama.

***Ochrotrichia quinealensis* Bueno-Soria and Holzenthal, 1998**

PANAMA, Veraguas Province, Cuenca 097, Santa Fe National Park, afluente Río Calovebora, PSPSCB-PNSF-C097-2017-005, 8.54318°E and 81.16398°W, 536 m, UV light trap, T. Ríos, E. Alvarez, and C. Nieto, 21 April 2017, 2 males; ibid., Cuenca 132, Santa Fe National Park, Río Mulaba, 2do Brazo, PSPSCB-PNSF-C132-2017-007, 8.52577°E and 81.13045°W, 623 m, Malaise trap, A. Cornejo, T. Ríos, E. Alvarez, and C. Nieto, 19-23 April 2017. 4 males; ibid., Río Mulaba, afluente 1er Brazo, PSPSCB-PNSF-C132-2017-008, 8.51706°E and 81.12140°W, 770 m, Malaise trap, T. Ríos, E. Alvarez, and C. Nieto, 19–23 April 2017, 4 males; ibid., Río Mulaba, 1er Brazo, PSPSCB-PNSF-C132-2017-009, 8.52560°E and 81.12956°W, 623 m, UV light trap, T. Ríos, E. Alvarez, and C. Nieto, 19 April 2017, 6 males; ibid., Río Mulaba, 3er Brazo, PSPSCB-PNSF-C132-2017-010, 8.52906°E and 81.13943°W, 662 m, UV light trap, T. Ríos, E. Alvarez, and C. Nieto, 19 April 2017, 6 males; ibid., Río Mulaba, afluente, antes de caseta MiAmbiente, PSPSCB-PNSF-C132-2017-014, 8.53143°E and 81.14975°W, 746 m, UV light trap, T. Ríos, E. Alvarez, and C. Nieto, 21 April 2017, 20 males; ibid., Río Mulaba, Isleta, PSPSCB-PNSF-C132-2017-015, 8.54513°E and 81.11970°W, 412 m, UV light trap, T. Ríos, E. Alvarez, and C. Nieto, 22 April 2017, 6 males.

Distribution. Costa Rica, Panama.

***Ochrotrichia unica* Bueno-Soria and Santiago, 1992**

PANAMA, Veraguas Province, Cuenca 132, Santa Fe National Park, Río Mulaba, Isleta, PSPSCB-PNSF-C132-2017-015, 8.54513°E and 81.11970°W, 412 m, UV light trap, T. Ríos, E. Alvarez, and C. Nieto, 22 April 2017, 1 male.

Distribution. Colombia, Panama.

Leptoceridae

***Triaenodes morai* Holzenthal and Andersen, 2004**

PANAMA, Coclé Province, Cuenca 103, Omar Torrijos National Park, Quebrada Corazones, PSPSCB-PNGDOTH-C103-2017-001, 8.67760°N and 80.60007°W, 728 m, UV light trap, A. Cornejo, E. Pérez, T. Ríos, E. Alvarez, and C. Nieto, 24 March 2017, 1 male.

Distribution. Costa Rica, Nicaragua, Panama.

Odontoceridae

***Marilia kingsolveri* Bueno-Soria and Rojas-Ascencio, 2004**

PANAMA, Chiriquí Province, Cuenca 108, Río Majagua, Banquito de Palmira, 8.68083˚N and 82.53250˚W, 840 m, Malaise trap, T. Ríos and Y. Aguirre, 28 February-14 March 2019, 1 male.

Distribution. Costa Rica, Panama.

Helicopsychidae

***Helicopsyche alajuela* Johanson and Holzenthal, 2010**

PANAMA, Chiriquí Province, Cuenca 108, Río Majagua, Banquito de Palmira, 8.68083°N and 82.53250°W, 840 m, Malaise trap, T. Ríos and Y. Aguirre, 28 February–14 March 2019, 1 male.

Distribution. Costa Rica, Panama.

***Helicopsyche breviterga* Flint, 1991**

PANAMA, Chiriquí Province, Cuenca 108, Río Majagua, Banquito de Palmira, 8.68083°N and 82.53250°W, 840 m, Malaise trap, T. Ríos and Y. Aguirre, 28 February–14 March 2019, 2 males; ibid., 14 March–4 April, 2019, 1 male.

Distribution. Colombia, Ecuador, Panama, Venezuela.

Discussion

The presence of *Angrisanoia* in Panama represents its northernmost extent. A small genus of microcaddisflies with five described species, it was formerly known only from South America (Venezuela and French Guiana, south to Argentina). Three species are known from French Guiana (2 species) and Venezuela (1 species), and could potentially be found in Panama. This type of dispersal could be assisted by the often strong eastern trade winds, which blow across northern South America and the southern Caribbean Sea to Panama during the dry season (December through April). However, this theory is only weakly supported by known caddisfly taxa (e.g., species shared with Colombia = 46, Venezuela = 45, Guyana = 9, Suriname = 11, French Guiana = 3, and Trinidad and Tobago = 22). It would require intensive and prolonged sampling of Panama's northeastern Caribbean coast to further substantiate such a distributional mechanism. Additional collections from the coastal areas of Guyana, Suriname, and French Guiana would also be useful.

Mayatrichia is another small genus of microcaddisflies with four described species. *Mayatrichia illobia* is known from Costa Rica and Ecuador, so its presence in Panama is not unexpected. Two of the other three species of this genus are known from Costa Rica, and the third from Mexico, so the occurrence of additional species of *Mayatrichia* in Panama would be possible.

The discovery of *Ochrotrichia boquillas* represents a significant southern range extension. First described from Big Bend National Park (Moulton and Harris 1997), it was subsequently collected from the Edwards Plateau in Texas (Bowles et al. 2007) and the Sierra Tarahumara region of Chihuahua in Mexico (Bueno-Soria et al. 2007). In the latter paper, parsimony analysis of endemicity suggested that the Trichoptera of the Sierra Tarahumara are biotically related to the Neotropical Region, even though that location is technically in the Nearctic Region and associated with the mountains of the southwestern United States. Finding this species in Panama supports that analysis, and suggests that this species could be found, at least historically, throughout Mexico and other parts of Central America.

Whereas Panama shares almost 61% of its caddisfly fauna with Costa Rica, less than 10% of its microcaddisfly species (Trichoptera: Hydroptilidae) are the same (Armitage and Harris 2018b). As this is the largest family in Panama's fauna and the source of most new increases in species numbers, we propose that there is potential for many more new country records in this family. By the end of 2020, we anticipate, based on new, undescribed species in hand and current trends, that an increase to Panama's recorded caddisfly fauna will exceed 500 species.

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encompassed in this publication, and who granted the special collection permit No. SC / A-27-19 for the Bosque Protector Palo Seco under which *Centromacronema pygmaeum* was collected. Collections of specimens from the Río Majagua and Quebrada Martinez drainages were made as part of a registered project (code: 1.87-205-000-2019-151-i01) in the VIP–UNACHI (Universidad Autónoma de Chiriquí) for which the first, fifth, and sixth authors are co-investigators. We are grateful for the overall coordination of the entomofaunal portion of the national parks project by Aydeé Cornejo of the Gorgas Institute. We thank Carlos Nieto, Eric Álvarez, and Edgar Pérez for their significant efforts to collect all of the aquatic insect material from the national parks. We express our appreciation to Jeffrey Dietrich of Mount Totumas Cloud Forest and Biological Reserve for collecting specimens and also for facilitating our research. We appreciate the efforts of Tatiana I. Arefina-Armitage for collecting and for editing the manuscript. Finally, we thank Monika Springer of the University of Costa Rica and an anonymous taxonomic researcher for reviewing and improving this manuscript.

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