



First record of Ephemeridae (Insecta, Ephemeroptera) from Rio Grande do Sul and its rediscover from South of Brazil

ERIKCSEN AUGUSTO RAIMUNDI* & THALES RENATO OCHOTORENA DE FREITAS

Laboratório de Citogenética e Evolução, Departamento de Genética, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves, Porto Alegre, Rio Grande do Sul, Brazil.

* Corresponding author: erikcmundi@gmail.com

Abstract. After 50 years without any formal record of Ephemeridae from the South Brazil, we present the rediscover of the family from the region, recorded *Hexagenia (Pseudeatonica) albivitta* (Walker, 1853) for the first time in Rio Grande do Sul State, including notes on its morphology and ecology.

Keywords: *Hexagenia*, burrowing mayfly, aquatic insects, distribution, Pampa biome.

Resumo: Primeiro registro de Ephemeridae (Insecta, Ephemeroptera) para o Rio Grande do Sul e sua redescoberta para o sul do Brasil. Após 50 anos sem nenhum registro formal de Ephemeridae no sul brasileiro, nós apresentamos a redescoberta da família para a região, registramos *Hexagenia (Pseudeatonica) albivitta* (Walker, 1853) pela primeira vez no Rio Grande do Sul além de incluirmos notas sobre sua morfologia e ecologia.

Palavras-chave: *Hexagenia*, efêmeras escavadoras, insetos aquáticos, distribuição, bioma Pampa.

Ephemeridae, one of the families of mayflies burrowing, has seven knowing genera around the world but only one occurring in Brazil: *Hexagenia (Pseudeatonica) albivitta* (Walker 1853), known from Espírito Santo, Pará, Paraná, Rio de Janeiro and São Paulo States (Salles *et al.* 2016), and lately from Bahia (Campos *et al.* 2016). The species is also distributed in other countries, from south of North America, going down through the south of South America. McCafferty (1970) recorded *H. (P.) albivitta* for the first time in the South of Brazil, from Paraná, based on nymphs. After 50 years, no additional information on the species (even to the genus and family) was added for this region, probably due to lack of studies focused on taxonomic surveys. Therefore, Santa Catarina and Rio Grande do Sul States remain without any record of Ephemeridae, nor from their genera or species. In this paper, we recorded for the first time the family Ephemeridae and *H. (P.) albivitta* in Rio Grande do Sul, rediscovering family and species to the southern Brazil after about 50 years, and contributed with some notes about species.

The specimens were obtained manually rested near lamps at both Estação Ecológica do Taim and the margin of Rio Guaíba. The legs and genital were dissected and retained in slide with Canadian balsam; the wings, mounted in dry slide, and the remaining body, conserved in alcohol 90%. Material is housed in the Coleção Zoológica of Pontifícia Universidade Católica of Rio Grande do Sul. All structures were photographed helped by camera Leica both in stereomicroscope and in optical microscope. Map was made with QGIS software (QGIS Development Team 2018).

Below follow the additional notes on Ephemeridae and *Hexagenia (Pseudeatonica) albivitta*.

Ephemeridae family [new record from RS]

Hexagenia Walsh, 1863 [new record from RS]

Hexagenia (Pseudeatonica) albivitta (Walker, 1853) [new record from RS] (Fig. 1)

= *Baetis albivitta* WALKER, 1853: 566; HAGEN, 1861: 304.

= *Hexagenia albivitta*; EATON, 1871: 64 (male); EATON, 1873: 392; EATON, 1883-1888: 49 (male, female); HAGEN, 1890: 11 (male, female); ULMER, 1920c: 108; NEEDHAM & MURPHY, 1924: 27 (male, female); NAVÁS, 1930e: 130; LESTAGE, 1931b: 59; NAVÁS, 1933c: 63; TRAVER, 1947b: 370; KIMMINS, 1960: 309; LUGO-ORTIZ & MCCAFFERTY, 1994: 22 (subimago male); DA-SILVA *et al.*, 2009.

= *Hexagenia (Pseudeatonica) albivitta*; SPIETH, 1941: 270 (male, female); MCCAFFERTY, 1970: 225 (nymph); HUBBARD, 1982a: 262; SALLES *et al.* 2010 (male); CAMPOS *et al.*, 2016: 308 (male);

= *Palingenia continua* WALKER, 1860: 199 (male).

= *Hexagenia continua* KIMMINS, 1960: 309.

= *Palingenia dorsigera* [nomen nudum] HAGEN, 1861: 304.

= *Hexagenia benedicta* NAVÁS, 1922a: 55 (female); LESTAGE, 1931b: 59; ALBATERCEDOR & PETERS, 1985: 222.

= *Hexagenia dominans* NAVÁS, 1936b: 732.

Material examined: BRAZIL, Rio Grande do Sul: Porto Alegre, Belém Novo, Guaíba River, (30° 12.6518' S, 51° 11.2187' W, 8 m.a.s.l.), J. Maciel, col., 22/xi/2018 (1 male imago, EAR0124a – genitalia and legs, EAR0124b – wings); Rio Grande, Estação Ecológica do Taim, head office, (32° 32.2892' S, 52° 32.3388' W, 7 m.a.s.l.), 10/i/2018, Riuler Corrêa Acosta, photography (1 male adult). At that time, we had not have the federal licenses to collect in the Estação Ecológica do Taim in which *H. (P.) albivitta* was recorded, so we only have the photography (Fig. 2).

Several species were synonymized as *H. (P.) albivitta*, and those description, at least the majority manuscripts, are little informative. However, *H. (P.) albivitta* has a conspicuous set of characteristics making the identification easier. The diagnosis of *H. (P.) albivitta* presented by Dominguez *et al.* (2006) (here adapted) considers the following characteristics that differs from the other species of *Hexagenia*: 1) fore wing with membrane tinted with yellowish gray, darker in costal and subcostal areas; 2) hind wings with cross veins shaded with brown; 3) abdominal terga with black saw-tooth line along lateral margin of segments to whitish spiracular line; 4) abdominal sterna reddish brown laterally, with median line lighter; and 5) genitalia as in Fig. 82C (in Dominguez *et al.* 2006). Although, in the *H. (P.) albivitta* analyzed, minor differences can be found,

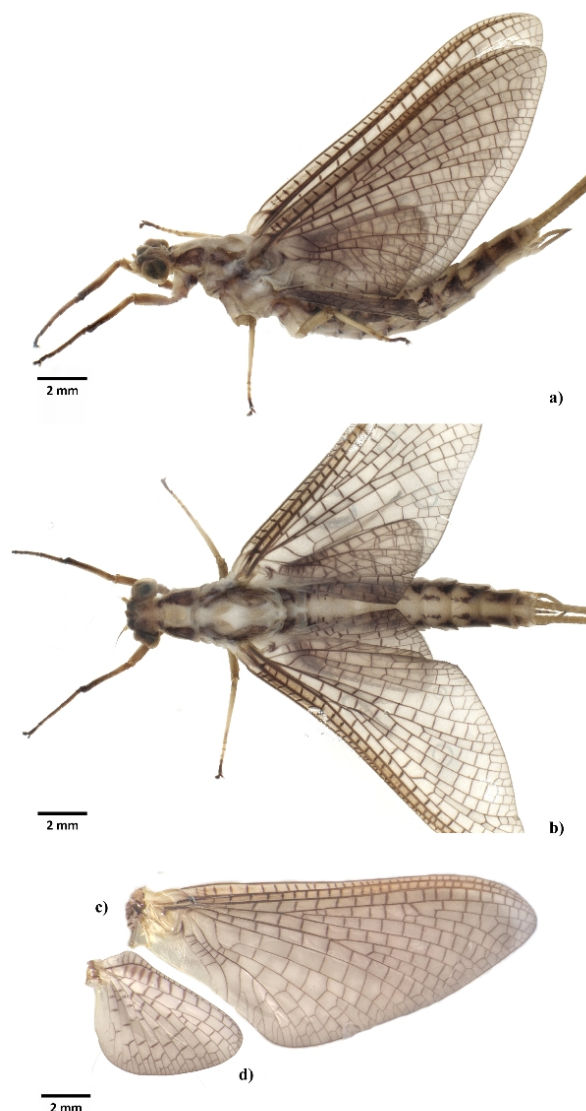


Figure 1. *Hexagenia (Pseudeatonica) albivitta*. **A.** Habit lateral view. **B.** Habit dorsal view. **C.** Fore wing. **D.** Hind wing.



Figure 2. *Hexagenia (Pseudeatonica) albivitta*. Living specimen at Estação Ecológica do Taim, Rio Grande, Rio Grande do Sul. Courtesy of photography: Riuler Corrêa Acosta.



Figure 3. Location of the occurrence of *Hexagenia (Pseudeutonica) albivitta* in South Brazil. Star symbol indicates Guaíba lake, Porto Alegre, Rio Grande do Sul state, and the lozenge, the Estação Ecológica do Taim, Rio Grande, Rio Grande do Sul.

especially in the coloration and its pattern, probably by the habitat and/or geographical region collected.

The fore wings present membrane light brown, with costal and subcostal area washed with darker; and fore leg light yellowish brown darker toward apex of tibia, tarsi dark brown, darker on tarsal claw. On the other side, the knowledge of measures have been few explored since then, and analyzing additional information on the specie, size body and length of the forewing and caudal filaments were already presented, and they fit with our analyzed specimens. Even so, we present some important measurements (in mm) of the species, which can be used in further studies. *Body*: 20. *Thorax*: forewing length: 17; hind wing length: 7.5; fore leg length: 11.6; midleg: 8.6; hind leg: 11. *Genitalia*: forceps segment I: 0.7, segment II: 1.8, segment III 0.7; Penis: 0.8. Caudal filament: 21.

The Ephemeridae family and the analyzed species were formally recorded in southern Brazil by McCafferty (1970), recorded for the first time in Paraná State (Patos river), in mud deposits and between rocks, but always associated with mud or muddy substrate. The occurrence of Ephemeridae in Rio Grande do Sul was cited twice. First, reported

by Costa Lima (1983) based on a personal communication from a person who had seen the species flying. However, we cannot know if the species is in fact *H. (P.) albivitta*, even if is Ephemeridae. Second, the genus was cited by Fiorentin *et al.* (2005), but they only retrieve the information from Costa Lima and use it to elaborate an identification key of mayfly families from RS. Therefore, there is not any record in these manuscripts about where the specimens were collected (if they were) nor even where they were supposed to be housed. Finally, according to the site "Ephemeroptera do Brasil" (Salles *et al.* 2016) and the "Catálogo Taxonômico da Fauna do Brasil" (Salles & Boldrini 2019), the family does not occur in RS as well as in SC.

In our study, we did not found nymphs, but the areas where the imagoes were found are associated with lentic environments with contrasting water quality. In the first case, the imago was found near to the margin of Lago Guaíba, a broad and lentic area, which flows into Lagoa dos Patos. The area is strongly influenced by urban, rural and industrial activities, with high values of heavy metals such as Zn, Cu, Ni, and Pb and other types of

Table I. Occurrence points of *Hexagenia (P.) albivitta* and original references. * occurrence estimated by Spieth (1941).

Country	State	Region	Latitude	Longitude	First reference
Argentina	Buenos Aires	-	-34.6076	-58.4371	Eaton 1873
Argentina	Entre Ríos	Guaaleguaychú	-33.0110	-58.5046	Navás 1930
Brazil	Amazonas	-	-4.1842	-65.2120	Eaton 1871
Brazil	Bahia	Igrapiúna	-13.8219	-39.1423	Campos <i>et al.</i> 2016
Brazil	Espírito Santo	São Mateus	-18.7158	-39.8492	Salles <i>et al.</i> 2010
Brazil	Espírito Santo	-	-19.5688	-40.1722	Eaton 1883
Brazil	Pará	-	-4.7494	-52.8973	Walker 1853
Brazil	Paraná	Prudentópolis	-25.2349	-50.9522	McCafferty 1970
Brazil	Rio de Janeiro	Araruama	-22.8733	-42.3429	Da-Silva <i>et al.</i> 2009
Brazil	Rio Grande do Sul	Porto Alegre	-30.2000	-51.1833	Present work
Brazil	Rio Grande do Sul	Rio Grande	-32.5333	-52.5333	Present work
Brazil	São Paulo	Jundiaí	-23.1888	-46.8845	Navás 1922
Colombia	-	-	2.8894	-73.7839	Needham & Murphy 1924a
Costa Rica	Puntarenas	-	9.7882	-85.0593	McCafferty 1970
Guatemala	Alta Verapaz	Polochic river	15.3370	-89.7381	Lugo-Ortiz & McCafferty 1996
Guatemala	Petén	Sayaxché	16.3132	-90.1683	McCafferty <i>et al.</i> 2004
Guyana	Bartica	-	6.4058	-58.6198	Needham & Murphy 1924a
Mexico	Chiapas	Agua Azul	16.5000	-92.5000	McCafferty 2011
Mexico	Veracruz	Mendoza	20.5457	-97.4792	Lugo-Ortiz & McCafferty 1996
Paraguay*	-	-	-23.3166	-58.1693	Spieth 1941
Peru	Puerto Bermudez	-	-12.0758	-77.0071	Needham & Murphy 1924a
Uruguay*	-	-	-32.8756	-56.0202	Spieth 1941

pollutants (de Andrade *et al.* 2017). On the other side, *H. (P.) albivitta* can also be found in protected areas such as the Estação Ecológica do Taim, a complex area with several lakes, located between the Atlantic Ocean and the Lagoa Mirim, and important conservation area of the Pampa biome (Fig. 3). Because of the wide geographic distribution of *Hexagenia (P.) albivitta*, occurring from the Central America, down to South America, in Colombia, Brazil, Guyana, Paraguay, Argentina, and Uruguay (Table I), there are some variations in its biology (Dominguez *et al.* 2006) and ecology, as we can see in our study concerning to environmental conditions where they were found. Since adults have limited dispersion, it is expected that they be close to where they emerged, around the lakes. Therefore, this kind of record evokes thoughts about how many species not so large body sized and morphologically conspicuous as *H. (P.) albivitta* are may be known in the region.

Acknowledgements

To the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for the postdoctoral scholarship for EAR (Process n° 150192/2018-5). To Laboratório de Entomologia Sistemática and Departamento de Zoologia of Universidade Federal do Rio Grande do Sul for allowing the use of all the material. To Riuler Corrêa Acosta, Ricardo Brugnera and J. Maciel for letting us to access the specimens. To the anonymous reviewers of this manuscript.

References

- Campos, R., Mariano, R. & Calor, A. R. 2016. Mayflies (Ephemeroptera) from Reserva Ecológica Michelin, Bahia, Brazil. **Aquatic Insects**, 37(4): 303-315. doi: 10.1080/01650424.2016.1267769.
- Costa Lima, Â. M. da. 1983. **Insetos do Brasil**. Escola Nacional de Agronomia. Série Didática. N° 2, Tomo I. 470 p.
- Da-Silva, E. R., Gonçalves, I. C. & Souza, M. R.

2009. Lista de Espécies da Ordem Ephemeroptera (Insecta) Ocorrentes no Estado do Rio de Janeiro, Brasil. **Arquivos do Museu Nacional**, 67(3-4): 383-394.
- de Andrade, L. C., Tiecher, T., de Oliveira, J. S., Andreazza, R., Inda, A. V. & de Oliveira Camargo, F. A. 2017. Sediment pollution in margins of the Lake Guaíba, Southern Brazil. **Environmental Monitoring and Assessment**, 190(3): 1-13. doi: 10.1007/s10661-017-6365-9.
- Dominguez, E., Molineri, C., Pescador, M., Hubbard, M. & Nieto, C. 2006. Ephemeroptera of South America. In: Adis, J., Arias, J. R., Rueda-Delgado, G. & Wantzen, K. M. (Eds.). **Aquatic Biodiversity in Latin America Biodiversidad Acuática en América Latina (ABLA)**, Vol. 2. Pensoft, Sofia-Moscow, 646 p.
- Eaton, A. E. 1871. A monograph on the Ephemeridae. **Transactions of the Entomological Society of London**, 19(1): 1-6. doi: <https://doi.org/10.1111/j.1365-2311.1871.tb01484.x>
- Eaton, A. E. 1873. Notes on the Ephemeridae, by Dr. H. A. Hagen; compiled (with remarks) by the Rev. A. E. Eaton, M. A. **Transactions of the American Entomological Society**, 1873: 381-406.
- Eaton, A. E. 1883-1888. A revisional monograph of recent Ephemeridae or mayflies. **Transactions of the Linnean Society of London**, Second Series, Zoology, 3: 1-352.
- Fiorentin, G. L., Neiss, U. G., Da-Silva, E. R. & Benetti, C. J. 2005. Caracterização morfológica de náíades de Ephemeroptera, com chave para famílias ocorrentes no Rio Grande do Sul, Brasil. **Acta Biologica Leopoldensia**, 27(3): 163-168.
- Lugo-Ortiz, C. R. & McCafferty, W. P. 1996. New Central American and Mexican records of Ephemeroptera species. **Entomological News**, 107(5): 303-310.
- McCafferty, W. P. 1970. Neotropical nymphs of the genus *Hexagenia* (Ephemeroptera: Ephemeridae). **Journal of the Georgia Entomological Society**, 5: 224-228.
- McCafferty, W. P. 2011. New Mexican and Central American Ephemeroptera Records, with First Species Checklists for Mexican States. **Transactions of the American Entomological Society**, 137(3-4): 317-327. doi: <https://doi.org/10.3157/061.137.0310>.
- McCafferty, W. P., Baumgardner, D. E. & Guenther, J. L. 2004. The Ephemeroptera of Central America. Part 1: Guatemala. **Transactions of the American Entomological Society**, 130(2-3): 201-219.
- Navás, L. 1922. Efemerópteros nuevos o poco conocidos. **Boletín de la Sociedad Entomológica de España**, 5: 54-63.
- Navás, L. 1930. Insectos de la Argentina. **Revista de la Sociedad Entomologica Argentina. Sexta Serie**, 3(1-6): 125-132.
- Needham, J. G., Murphy, H. E. 1924. Neotropical mayflies. **Entomological Series**, 4: 1-79.
- Salles, F. F., Nascimento, J. M. C., Massariol, F. C., Angeli, K. B., Silva, P. B. E., Rúdio, J. A. & Boldrini, R. 2010. Primeiro levantamento da fauna de Ephemeroptera (Insecta) do Espírito Santo, Sudeste do Brasil. **Biota Neotropica**, 10(1): 293-307. doi: 10.1590/S1676-06032010000100025.
- Salles, F. F., Boldrini, R., Nascimento, J. M. C., Angeli, K. B., Massariol, F.C. & Raimundi, E.A. 2016. **Ephemeroptera do Brasil**, accessible at <http://ephemeroptera.com.br/lista/>. (Accessed 07/07/2018).
- Salles, F. F., Boldrini, R. 2019. **Ephemeroptera**. In: Catálogo Taxonômico da Fauna do Brasil. PNUD, accessible at <http://fauna.jbrj.gov.br/fauna/faunadobrasil/12>. (Accessed 04/09/2019).
- Spieth, H. T. 1941. Taxonomica studies on the Ephemeroptera. II. The genus *Hexagenia*. **American Midland Naturalists**, 26: 233-280.
- Team, Q. D. 2018. **QGIS Geographic Information System**. Open Source Geospatial Foundation Project, accessible at <http://qgis.osgeo.org>.
- Ulmer, G. 1920. Neue Ephemeropteren. **Archiv für Naturgeschichte** 85: 1-80.
- Walker, F. 1853. Ephemerinae. List of the specimens of neuropterous insects in the collection of the British Museum. Part III - (Termitidae-Ephemeridae), 533-585.

Received: July 2019

Accepted: September 2019

Published: September 2019