1st June 2021

Brechmorhoga goncalvensis sp. nov. from south-eastern Brazil (Odonata: Libellulidae)

Diogo Silva Vilela[1,4], Gláucia Stefani-Santos[2],
Walter F. Ávila Júnior[3] & Marcos Magalhães de Souza[2]

[1] Rua Jaime Bilharinho, 575, Uberaba, Minas Gerais, Brazil
[2] Instituto Federal de Ciência e Tecnologia de Minas Gerais, Inconfidentes, Minas Gerais, Brazil
[3] Universidade Federal de Ouro Preto, Lab. Entomologia Ecológica DEBIO/ICEB, Campus Morro do Cruzeiro, Ouro Preto, Minas Gerais, Brazil
[4] Corresponding author: <deeogoo@gmail.com>

DSV https://orcid.org/0000-0001-6510-7018
GSS https://orcid.org/0000-0002-1610-2920
WFAJ https://orcid.org/0000-0003-4707-0113
MMS https://orcid.org/0000-0003-0415-1714

Received 6th November 2020; revised and accepted 18th January 2021

Abstract. *Brechmorhoga goncalvensis* sp. nov. (♂ holotype: Brazil, Minas Gerais, Gonçalves, APA Fernão Dias, 22.7363 S, 45.8191 N, 1670 m a.s.l., 14-x-2019, deposited in coll. UFMG) is described and diagnosed based on specimens collected in Minas Gerais and Rio de Janeiro states, south-eastern Brazil. The new species can easily be separated from other congeners by the posterior hamule with a truncated base bearing two basal projections, cercus with a carina of 4–5 small denticles on the apical ventral margin, and its unique body coloration of double stripes on each side of the abdominal segments.
Further key words. Dragonfly, Anisoptera, South America, *Brechmorhoga tepeaca*

Introduction

The Neotropical genus *Brechmorhoga* Kirby is composed by 15 valid species (Paulson & Schorr 2021) and six subspecies (Garrison et al. 2006). The genus is morphologically related to *Macrothemis* Hagen, *Gynothemis* Calvert, and *Scapanea* Kirby, pending a phylogenetic analysis to determine whether these are natural groups or if they are all congeneric (Garrison & von Ellenrieder 2006; Garrison et al. 2006).

In a brief study on *Brechmorhoga*, Santos (1946), treated *B. praedatrix* Calvert, 1909, and another species, identified by him as »*B. tepeacea*« Calvert, 1908, based on material from south-eastern Brazil. However, *B. tepeaca* (correct spelling) is a strictly Mexican and Central American taxon, recorded from Sonora through Veracruz states (Calvert 1901–1908; Bailowitz et al. 2015). In a survey made in Rio de Janeiro state in 2000, Rosser W. Garrison collected several specimens of Santos's »*B. tepeacea*«. He discovered later, by comparing his Brazilian specimens with Mexican specimens of *B. tepeaca*, that the species treated by Santos (1946) was not *B. tepeaca*, but instead an undescribed taxon (R.W. Garrison pers. comm.). Garrison's discovery that *B. tepeaca* does not occur in Brazil and was misidentified became well-known and the species was reported later in the literature as "*Brechmorhoga tepeaca*" (with quotation marks) or *Brechmorhoga tepeaca sensu* Santos (Kompier 2015).

Recently, R.W. Garrison brought this problem to our attention, and by examining some recently collected *Brechmorhoga* specimens we realized that we had some material of the new species. Here we provide a formal description and diagnosis of this 17th species of *Brechmorhoga*, based on material collected in southern Minas Gerais and Rio de Janeiro states, south-eastern Brazil.

Material and methods

The male holotype and four paratypes were collected at the Área de Proteção Ambiental (APA) Fernão Dias, an Environmental Protection Area within the municipality of Gonçalves, southern Minas Gerais, between October 2019 and July 2020; all were dried and stored in paper envelopes. Additional paratypes and female allotype material were collected at Parque Nacional do Itatiaia, located between Rio de Janeiro and Minas Gerais states, in February 2000.

Habitus of male holotype was scanned with an Epson V600 Perfection at colored 1 200 dpi with 200 % magnification. Figures 1b, 2b, 4c, 4e, 5c, d, 6b, and 7b were provided by Rodolfo Novelo Gutiérrez. Figures 2a, b, 3b, 4a, b, 4d, 5a, b, 6a, and 7a were provided by Rosser W. Garrison.

Morphological terminology follows Garrison & von Ellenrieder (2006) and Garrison et al. (2006). All measurements are in millimeters [mm].

Abbreviations in the text are used as follows:

AL, abdomen length (including cercus); AP, anterior projection of hamule; Ax, antenodal cross-vein; Ce, cercus; Ep; epiproct; FW, fore wing; HW, hind wing; Pt, pterostigma; PP, posterior projection of hamule; Px, postnodal cross-vein; S1–S10, abdominal segments; SD, standard deviation; TL, total length (including cercus).

Specimens examined are deposited in the following collections:

CCT-UFMG – Centro de Coleções Taxonômicas (CCT), Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil;
MNRJ – Departamento de Entomologia, Museu Nacional, Universidade do Rio de Janeiro, Rio de Janeiro, Brazil;
LEE – Laboratório de Entomologia Ecológica, Universidade Federal de Ouro Preto, Ouro Preto, Brazil;
IFSM – Instituto Federal do Sul de Minas, Campus Inconfidentes, Inconfidentes, Brazil;
RWG – Rosser W. Garrison, Sacramento, California, USA.

***Brechmorhoga goncalvensis* sp. nov. Vilela, Stefani-Santos & Ávila-Jr**

(Figs 1a, 2, 3a, 4a–b, 4d, 5a–b, 6a, 7a)

»*Brechmorhoga tepeacea*« (Calvert, 1908) – Santos (1946: 2, 6–7 – description of penis, measurements, drawings of hamule, cercus, and penis, misidentification).

Brechmorhoga tepeaca (Calvert, 1908) – Santos (1997: 36, 73 – Rio de Janeiro state, misidentification); Costa & Santos (2000: 161 – Rio de Janeiro state, misidentification); Santos et al. (2010: 84 – Rio de Janeiro state, misidentification); Vilaça (2017: 49, 74, 146, 150 – biomes of occurrence in Brazil, misidentification).

Brechmorhoga tepeaca sensu Santos – Kompier (2015: 193–194, 353 – general appearance, habitat and behavior, similar species, and discussion on misidentification by Santos).

Material studied

Holotype ♂ (UFMG-ODO-2000011). Brazil, Minas Gerais, Gonçalves municipality, APA Fernão Dias (22.7363 S, 45.8191 N, 1670 m a.s.l.), 14-x-2019, leg. M.M. Souza, CCT-UFMG.

Paratypes (7♂). 1♂ (D-015), APA Fernão Dias (22.7419 S, 45.8436 N, 1 670 m a.s.l.), 07-vii-2020, leg. G.S. Santos, MNRJ (MNRJ-ENT4-000451); 1♂ (D-032), APA Fernão Dias (22.7088 S, 45.8266 N, 1 410 m a.s.l.), 27--vii-2020, leg. G.S. Santos, LEE; 1♂ (D-033) APA Fernão Dias (22.6686 S, 45.8544 N, 1 410 m a.s.l.), 12-vii-2020, leg. M.M. Souza, LEE; 1♂ (D-044) APA Fernão Dias (22.6708 S, 45.8669 N, 1 410 m a.s.l.), 07-vii-2020, leg. G.S. Santos, IFSM; 3♂ (RWG 6694, 6715), Rio de Janeiro, Itatiaia municipality, Parque Nacional do Itatiaia, Cachoeira Véu da Noiva (22.4228 S, 44.6178 N, 1 150 m a.s.l.), 10-ii-2000, leg. R.W. Garrison, RWG.
Allotype ♀ (RWG 6703). Brazil, Rio de Janeiro, Itatiaia municipality, Parque Nacional do Itatiaia, Cachoeira Itaporani (22.4228 S, 44.6178 N, 1100 m a.s.l.), 10-ii-2000, leg. R.W. Garrison, RWG.

Etymology
Named goncalvensis (adjective) in reference to the type locality, the municipality of Gonçalves in southern Minas Gerais state.

Male (holotype)
Head (Figs 1a, 2a, paratype) – Labium pale; mouthparts brown, becoming darker apically; labrum pale green; ante- and postclypeus green, paler at clypeal suture; antefrons dark brown; postfrons and vertex dark brown/metallic blue; occipital triangle brown; rear of the head mostly brown with darker medial and upper portions and pale laterally.

Thorax (Fig. 1a) – Anterior lobe of prothorax pale, remainder brown; overall coloration of thorax brown with pale green stripes as follows: two inverted 'T' shaped ante-humeral stripes; a broad stripe medially on portion of mesepimeron; a smaller and less evident stripe on metepisternum; a broad stripe on upper metepimeron, plus a thinner one on its basal portion; outer portion of femora brown, inner portion black; hind femora armed with 14 short, stout spines directed proximally, and two apical, smaller, acute spines directed distally; tibiae and tarsi black.

Wings (Fig. 3a) – Hyaline, longer than abdomen length, venation black; pterostigma dark brown with three (FW) and two (HW) cross-veins below;

three rows of postanal loop cells; arculus proximal to Ax 3 on all wings; FW subtriangles three-celled, triangles with one cross-vein; discoidal field two cells wide; 13 Ax in FW, 11 in HW; 11 Px in FW, 12 in HW.

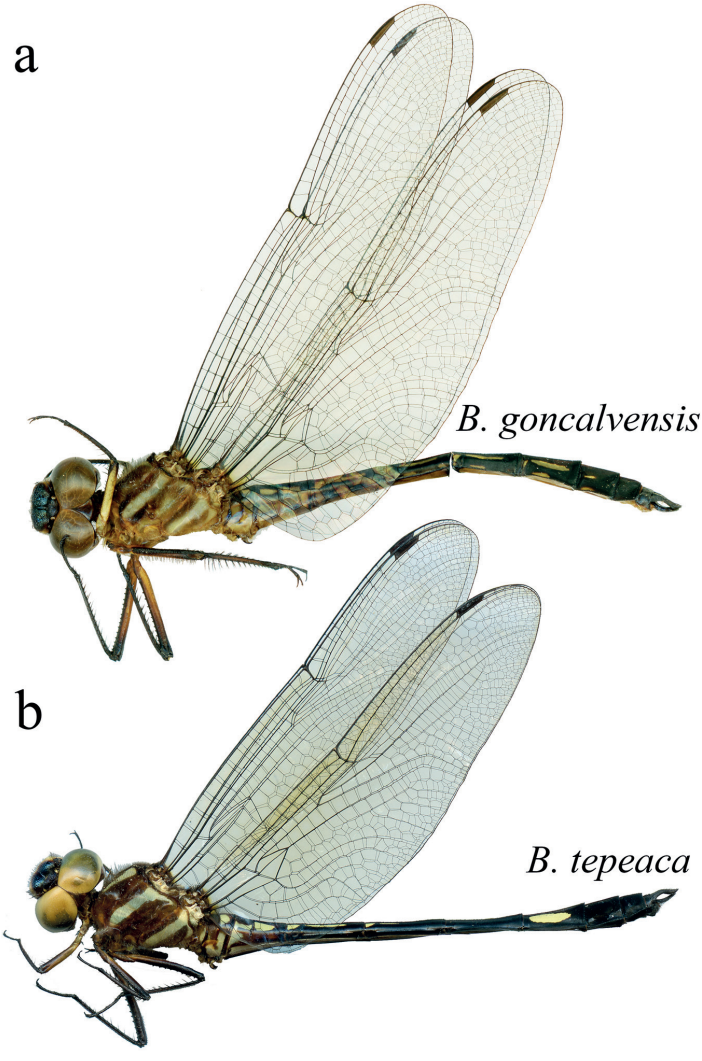

Figure 1. Lateral male habitus view of: a – *Brechmorhoga goncalvensis*, holotype; b – *B. tepeaca*, from Molango, Mexico.

Abdomen (Figs 1a, 4a, b, paratype) – Overall coloration black dorsally and brown ventrally with pale spots and stripes as follows: S2–S3 with a pair of dorsal, roughly rectangular spots; 4–7 with a pair of dorsolateral stripes, followed laterally by a smaller pair of more proximal spots and a smaller pair of small lateral stripes; S7–S8 greatly widened, reaching maximum width at distal portion of S7 and anterior S8; S8 with a pair of dorso-lateral spots, followed laterally by a pair of smaller spots; posterior hamule with anterior margin nearly straight medially, bent posteriorly near apex, and tapering to a point, truncated at the base, bearing two basal projections (AP and PP, as in Fig. 4a, paratype); vesica with terminal fold longer than wide, poorly developed lateral lobes, hood with an acute apex directed upwards.

Anal appendages (Figs 5a, b, paratype) – Black, cercus lanceolate with 4–5 small denticles on a slightly raised carina on apical ventral margin; epiproct slightly shorter than cercus, with two apical denticles.

Measurements [mm] – TL 49.3; AL 35.2; FW 39.5; HW 39.1; Ce 2.5; Ep 2.2; Pt 2.5.

Female (allotype)
Head (Figs 2b, 6a) – Paler than male holotype; postfrons and vertex dark brown; occipital triangle brown.

Thorax (Fig. 6a) – Overall coloration brown, with more extensive pale areas as follows: a thin ante-humeral stripe; mesepimeron with a broad stripe covering posterior ⅘; a smaller and less evident stripe on metepisternum; a broad medial stripe on metepimeron plus a thinner one on its basal portion. Legs colored as in males.

Wings (Fig. 6a) – Hyaline, shorter than abdomen length, venation black; pterostigma dark brown with two cross-veins below; three rows of post-anal loop cells; arculus proximal to Ax 2 on FW, and to Ax 3 on HW; FW subtriangles three celled, triangles with one cross-vein; discoidal field two cells wide; 13 Ax in FW, 9 in HW; 6 Px in FW, 8 in HW.

Abdomen (Figs 6a, 7a) – Overall coloration of S1–S3 green with narrow dark areas confined mid-dorsally, laterally at transverse carina and ventrally; S3 with a dark stripe on each side; S4–S9 narrowly black mid-dorsally, light brown laterally, with a narrow mid-lateral dark stripe followed ventrally with a narrow strip of black along ventral carina; these black markings increasing in size on more posterior segments; S10 mostly black with a pale spot laterally; vulvar lamina bilobed with medial margins convex, a V-shaped incision medially separating the two lobes.

Anal appendages (Fig. 6a) – Black, conical cercus with apex acute.

Measurements [mm] – TL 51.2; AL 36.9; Fw 35; Hw 34.4; Pt 2.3.

Variation in paratypes
Males (n = 5)
Wings – Ax in FW: 14 (80 %), 13 (20 %), Ax in HW: 11 (40 %), 10 (20 %), 9 (40 %); Px in FW: 12 (40 %), 11 (20 %), 10 (40 %); Px in HW: 13 (20 %), 12 (80 %).
Measurements [mm] – TL 48–51.7 (mean 49, SD 1); AL 35–37 (mean 36, SD 1); FW 38–39 (mean 38.3, SD 0.57); HW 37.5–39.5 (mean 38.5, SD 0.7).

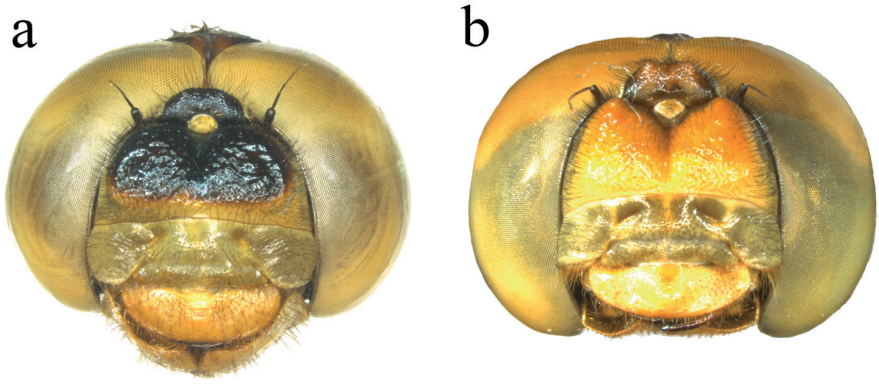

Figure 2. *Brechmorhoga goncalvensis*: frontal view of male (a) and female (b) heads, from Cachoeira Véu da Noiva, Rio de Janeiro, Brazil.

Brechmorhoga tepeaca (Calvert, 1908)
(Figs 1b, 3b, 4c, e, 5c, 6b, 7b)

Material studied (3♂, all from Mexico)
1♂, Veracruz, Coatepec, Río Huehueyapan en La Marina (19.2686 N, 96.5888 W, 1 200 m a.s.l.), 19-viii-1996, leg. R. Novelo; 1♂, Veracruz, Altotonga, Reserva Ecológica Río Pancho Poza (19.7455 N, 97.2472 W, 2 002 m a.s.l.), 14-vii-1999, leg. L. Delgado; 1♂, Hidalgo, Molango, Arroyo de la Laguna de Atezca, (20.4835 N, 98.4446 W, 1 450 m a.s.l.), 24-vii-1994, leg. R. Novelo.

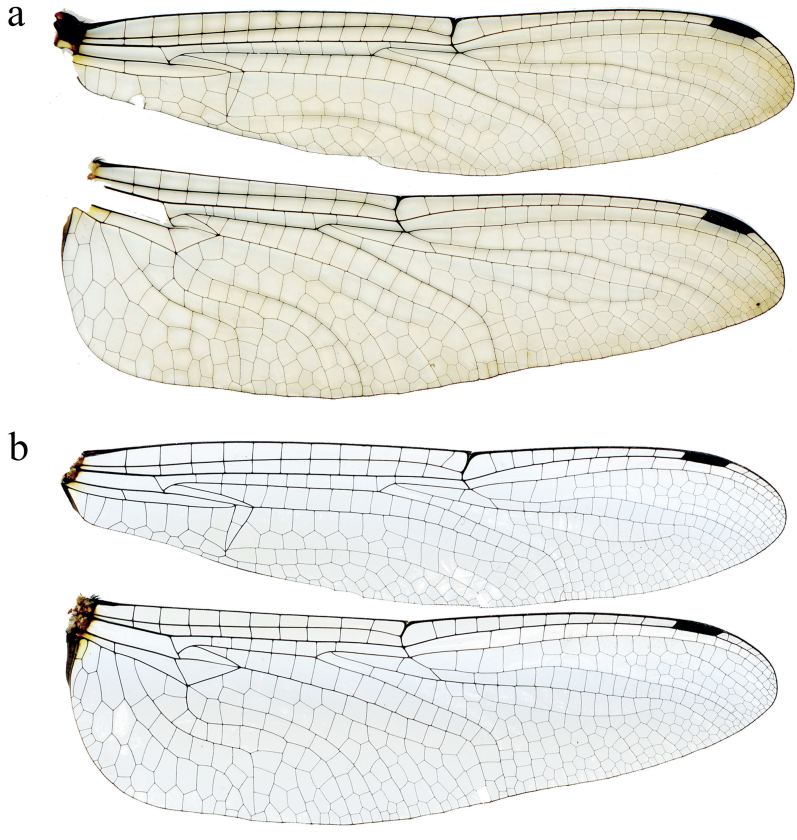

Figure 3. Male wings of *Brechmorhoga*: a – *B. goncalvensis*; b – *B. tepeaca*, from Altotonga, Mexico.

Differential diagnosis

Brechmorhoga goncalvensis can easily be separated from *B. tepeaca* by the following character combinations (contrasting characters for *B. tepeaca* in parentheses): three rows of post-anal loop cells (post loop cells in HW end in two cell rows beginning at mid distance of anal loop; Fig. 3b); posterior hamule with anterior margin nearly straight medially, bent posteriorly

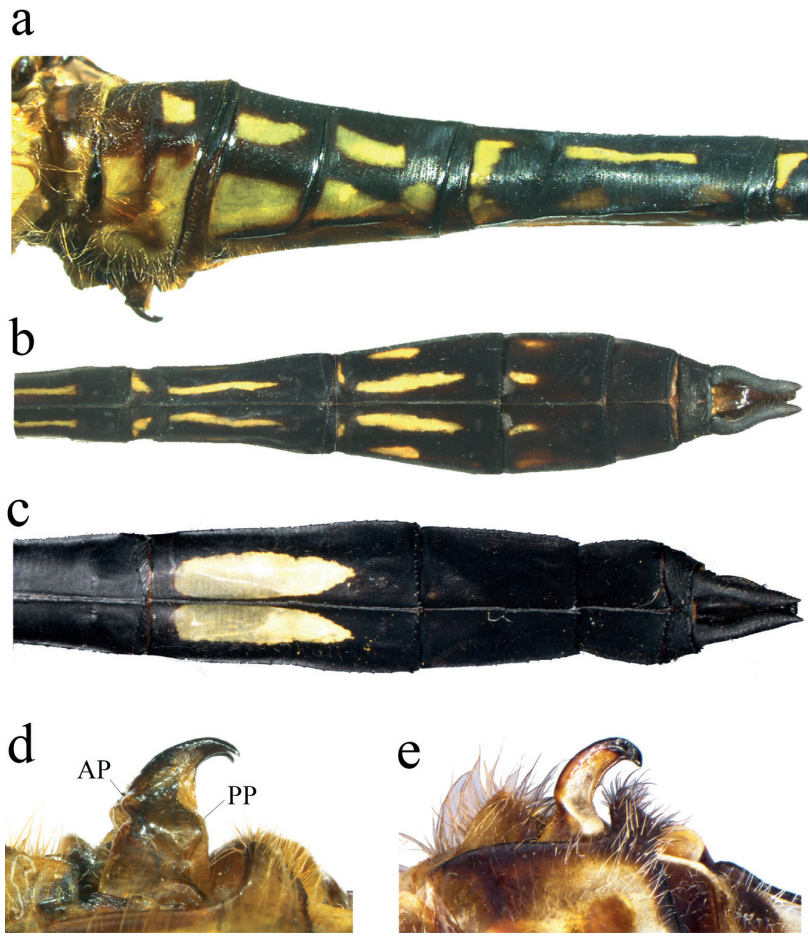

Figure 4. *Brechmorhoga goncalvensis*: a – lateral view of S1–S5, b – dorsal view of S5–S10, d – lateral view of posterior hamule; *B. tepeaca*: c – dorsal view of S6–S10, e – lateral view of posterior hamule, from Altotonga, Mexico.

near apex and tapering to a point, bearing two basal projections, AP and PP, (hamule thicker, more evenly curved anteriorly and lacking AP and PP; Fig. 4e); cercus ventrally with 4–5 small denticles on slightly raised carina along apical margin; Fig. 5a, (cercus ventrally with a row of widely spaced teeth throughout most of ventral margin; Fig. 5c); and its unique body coloration composed of double stripes on each side of each abdominal segment; Figs 1a, 4a, b (most other species including *B. tepeaca* with only one stripe per side on each segment; Fig. 4c). In *B. tepeaca*, the abdomen is predominantly black, pale markings limited to a pair of spots on dorsal S7 (Figs 1b, 4c). The female of *B. goncalvensis* also has a unique color pattern (Fig. 6a), being easily separated from other congeners such as *B. tepeaca* (Fig. 6b). The vulvar lamina of *B. goncalvensis* is short, as in other congeners, and formed by two rounded plates joined medially at base (Fig. 7a). The vulvar lamina of *B. tepeaca* also has rounded lobes, but these are approximate at basal half (Fig. 7b).

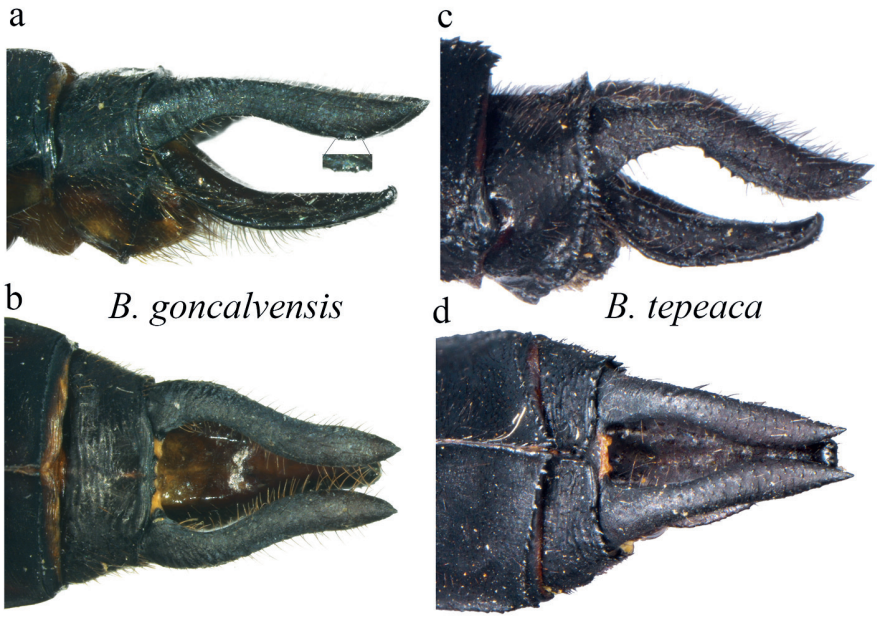

Figure 5. Lateral and dorsal male cercus views of: a,b – *Brechmorhoga goncalvensis*, and c, d – *B. tepeaca*, from Altotonga, Mexico.

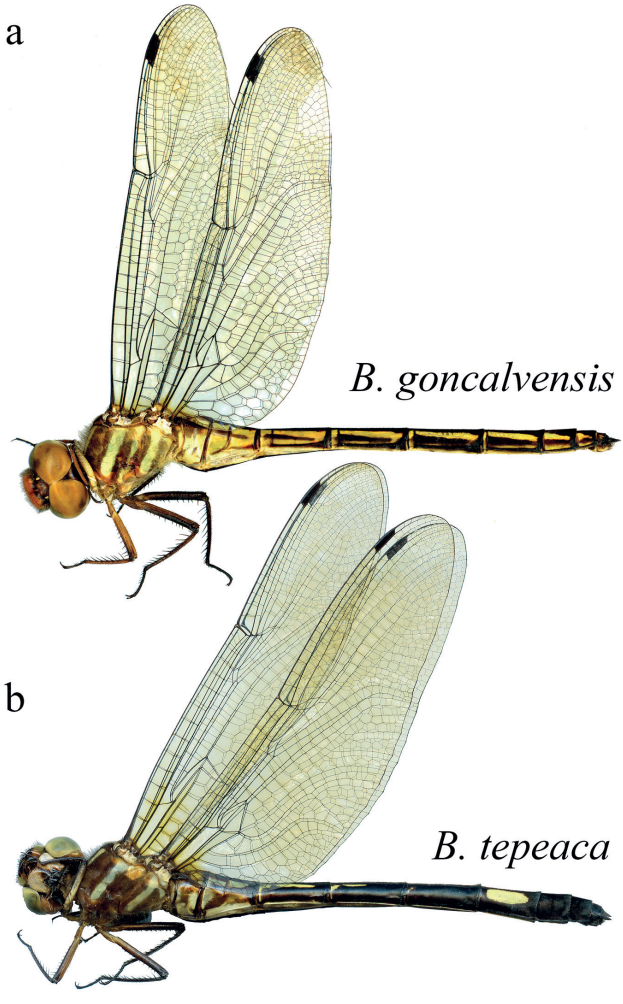

Figure 6. Lateral female habitus view of: a – *Brechmorhoga goncalvensis*, allotype; b – *B. tepeaca*, from La Marina, Mexico.

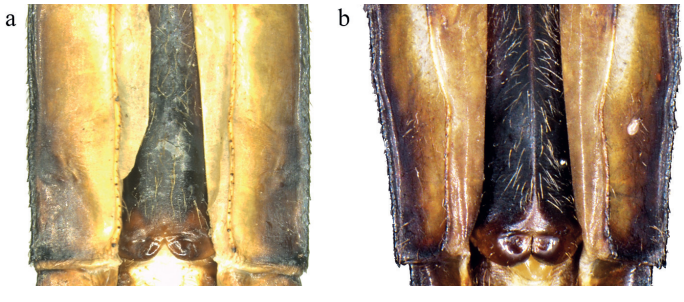

Figure 7. Genital valves of *Brechmorhoga*: a – *B. goncalvensis*, allotype; b – *B. tepeaca*, from La Marina, Mexico.

Final remarks

The newly collected individuals of *B. goncalvensis* were registered in high altitude fields, between 1 250 and 1 670 m above sea level (Fig. 8). It was spotted along lotic environments associated to the mixed forest of Minas Gerais state (Fig. 9), which is a phytophysiognomy of Atlantic Forest domain (Oliveira-Filho 2006). Previous studies reported this species to occur in Rio de Janeiro state (Santos 1946; Kompier 2015), and both localities consist in high altitude fields (>1 000 m a.s.l.), suggesting that this species prefers such high elevation habitats. Rosser W. Garrison (pers. comm.) collected this species as they cruised back and forth over a largely shaded narrow rocky stream in Rio de Janeiro state. Their habits were consistent with other species of *Brechmorhoga* that he has collected elsewhere in the Neotropical region. While other congeners usually perch in a pendent position within vegetation along marginal vegetation, we observed *B. goncalvensis* perching only on rocks nearby the water bodies as also reported by Kompier (2015). These habits are also suggestive as for some species of *Macrothemis*.

Figure 8. Distributional map of *Brechmorhoga goncalvensis*, highlighting the south-eastern region of Brazil and the type locality (red dot).

Figure 9. Type locality of *Brechmorhoga goncalvensis* in APA [Environmental Protection Area] Fernão Dias, Gonçalves municipality, Minas Gerais, Brazil. Photo: MMS (05-xii-2019)

Acknowledgments

We are indebted to Rosser W. Garrison for all his help concerning the hereby described species, including all material provided, guidance, discussions, and comments on early drafts of this paper; to Rodolfo Novelo Gutiérrez for kindly photographing his material of *B. tepeaca* and providing us several of the photographs used in this study; and to Alcimar do Lago Carvalho for

his valuable suggestions and corrections on a previous version of this manuscript. We also thank the Prefecture of Gonçalves and the Federal Institute of Minas Gerais (IFSULDEMINAS – Campus Inconfidentes) for allowing us the access to the study sites.

References

Bailowitz R.A., Danforth D. & Upson S. 2015. A field guide to the damselflies & dragonflies of Arizona and Sonora. Nova Granada Publications, Tucson

Calvert P.P. 1901–1908. Odonata. In: Biologia Centrali-Americana. Insecta. Neuroptera: 17-410. Porter & Dulau, London

Costa J.M. & Santos T.C. 2000. A Biodiversidade de Odonata do Estado do Rio de Janeiro, Brasil, registrada na literatura de 1853 a 1999 e de coleções. *XXIII Congresso Brasileiro de Zoologia,* Cuiabá, Mato Grosso Resumo IN015: 161

Garrison R.W. & von Ellenrieder N. 2006. Generic diagnoses within a closely related group of genera: *Brechmorhoga***,** *Gynothemis***,** *Macrothemis*, and *Scapanea* (Odonata: Libellulidae). *The Canadian Entomologist* 138: 269-284

Garrison R.W., von Ellenrieder N. & Louton J. 2006. Dragonfly genera of the New World. The Johns Hopkins University Press, Baltimore

Kompier T. 2015. A guide to the dragonflies and damselflies of the Serra dos Orgaos, south-eastern Brazil / Guia dos Anisoptera e Zygoptera da Serra dos Órgãos, sudeste do Brasil. REGUA Publications, Rio de Janeiro

Oliveira-Filho A.T. 2006. Definição e delimitação de domínios e subdomínios das paisagens naturais do estado de Minas Gerais. In: Scolforo J.R. & Carvalho L.M.T. (eds), Mapeamento e inventário da flora e dos reflorestamentos de Minas Gerais, Vol. 1: 21-35. UFLA, Lavras

Paulson D. & Schorr M. 2021. World Odonata List. Last revision 23 February 2021. Online on the internet, URL (02-iii-2021): http://www. pugetsound. edu/academics/academic-resources/slater-museum/biodiversity-resouces/dragonflies/world-odonata-list2/

Santos N.D. 1946. Notas sobre *Brechmorhoga praedathrix* Calvert, 1909 e *Brechmorhoga tepeacea* Calvert, 1908 (Odonata: Libellulidae). *Boletim do Museu Nacional* (Zoologia) 56: 1-7

Santos T.C. 1997. Composição preliminar e distribuição espacial da Odonatofauna na microbacia do Rio Sousa e no Rio Macacu, Cachoeiras de Macacu, RJ com notas sobre dados abióticos (Insecta: Odonata). Master's thesis, Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro

Santos T.C., Costa J.M., Carriço C., Pereira S.M., Neves R.C., Pinto C.G.A., Barbosa M.M. & Souza M.V.F. 2010. Caracterização da Odonatofauna (Insecta) de ecosistemas aquáticos de dois municípios (Silva Jardim e Cachoeiras de Macacu) com áreas abrangidas pelo Parque Estadual dos Três Picos. I Encontro Científico do Parque Estadual dos Três Picos: 81-86

Vilaça Z.A.S. 2017. Distribuição espacial da riqueza de Odonata (Fabricius, 1793) em relação às ecorregiões neotropicais: determinantes ambientais e restrições à dispersão. Masters Dissertation, Federal University of Goiás (UFG), Goiânia