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Five new species of *Alisotrichia* Flint, 1964 (Trichoptera: Hydroptilidae: Leucotrichiinae) from Northeastern Brazil

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ABSTRACT

Five new species of *Alisotrichia* Flint, 1964 microcaddisflies are described and illustrated from type material collected in Northeastern Brazil, constituting the first records of the genus to this region, as it was previously known only from Southeastern and Northern Brazil. The number of Brazilian species of *Alisotrichia* is doubled herein from five to ten, however, likely there are still many other species to be described. The new species described here are all placed in the *orophila* species group: *A. froehlichi* **sp. nov.** (Sergipe State), *A. calori* **sp. nov.** (Bahia and Paraíba states), *A. penispinata* **sp. nov.** (Ceará and Pernambuco states), *A. dilatata* **sp. nov.** (Ceará and Mato Grosso do Sul states), and *A. nordestina* **sp. nov.** (Ceará and Sergipe states). These new species are separated mainly by features of male genitalia, particularly the dorsal area of segment X, the shape of the segment VIII, and the phallus morphology. Currently, the *orophila* species group is composed by 37 species, more than half of the species diversity of *Alisotrichia*.

Introduction

Hydroptilidae constitute the most species rich family of caddisflies, with approximately 2,600 species distributed in six subfamilies and 76 genera (Thomson, 2023). Leucotrichiinae are restricted to the New World, but mostly Neotropical and divided into two tribes: Leucotrichiini and Alisotrichiini (Santos et al., 2016). Within Alisotrichiini, six genera are known: *Alisotrichia* Flint, 1964 (62 spp.), *Byrsopteryx* Flint, 1981 (19 spp.), *Celaenotrichia* Mosely, 1934 (1 sp.), *Cerasmatrichia* Flint, Harris & Botosaneanu, 1994 (13 spp.), *Mejicanotrichia* Harris & Holzenthal, 1997 (7 spp.), and *Scelobotrichia* Harris & Bueno-Soria, 1993 (3 spp.), which together add up to 105 extant species (Harris and Armitage, 2023; Thomson, 2023).

Species of *Alisotrichia* occur throughout the New World, from the U.S.A. to Argentina (Holzenthal and Calor, 2017; Thomson, 2023). Free-living larvae are found on boulders of fast-flowing rivers, or in madicolous habitats on bedrock substrate of splash zones near waterfalls (Marshall, 1979; Bowles et al., 1999). Adults of *Alisotrichia* can be distinguished from those of other genera in the tribe by the absence of the tibial spur on forelegs and, in males, by the antennae having the scape modified, and the aedeagus with only a mesal constriction (Flint, 1970). *Alisotrichia* species can be organized in five species groups based mainly on male morphological features: *arizonica*, *hirudopsis*, *lobata*, *orophila*, and *arcana* groups (Harris and Holzenthal, 1993). Although species are distributed across the Americas, only three out of 62 extant species of *Alisotrichia* do not occur in the Neotropics, with the highest diversity of the genus being observed in the Antilles (30 spp.), continental Central America (9 spp.), and northern South America (8 spp.). These numbers likely represent a knowledge gap on the genus diversity, since many localities in South America were not extensively studied yet. In Brazil, despite its environmental diversity, including freshwater habitats typical for *Alisotrichia,* only five species have been previously recorded from four states: *Alisotrichia cacaulandia* Harris & Flint, 2002 (Rondônia State); *A. holzenthali* Santos, 2011 (Minas Gerais State); *A. ubatuba* Santos, 2011, (Rio de Janeiro and São Paulo states); *A. macae* Santos, 2011 (Rio de Janeiro State); and *A. nessimiani* Santos, 2011 (Rio de Janeiro State).

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The Northeast Region of Brazil is a formal administrative region, with about 20% of the Brazilian territory and encompass nine states. To date, 207 species of Trichoptera are recorded from states in this region (Santos et al., 2023), corresponding to 23% of the Brazilian fauna. This region also houses 54 species of Hydroptilidae (Santos et al., 2023) and, although no nominal species of *Alisotrichia* has been described from this region, three undescribed species were listed in a survey carried out in the Caatinga biome (Takiya et al., 2016). In the present paper, five new species of *Alisotrichia* are described and illustrated from male specimens collected at different localities in Northeastern Brazil (Fig. 1).

Material and methods

Specimens were collected at different localities in Alagoas, Bahia, Ceará, Paraíba, Pernambuco, and Sergipe states, Brazil (Fig. 1). Collecting techniques included collapsible light traps (Nessimian et al., in press) and light pan traps (Calor and Mariano, 2012), as well as Malaise traps (Gressitt and Gressitt, 1962). Specimens were preserved in 80% ethanol. To observe and to illustrate genital structures, male abdomens were removed and clarified using warmed solution of 10% KOH (Ross, 1944). After clarification, the abdomen of holotypes was placed in glycerin jelly, mounted on a temporary slide, and then observed under a compound microscope LEICA DM 4000 B LED equipped with digital camera LEICA DMC 2900. Photographs at different focal planes were taken and stacked with CombineZP Image Stacking Software (Hadley, 2010) to be illustrated into an Adobe Illustrator® CC v. 22.0.1 (Adobe Inc.) document. After observation, abdomens were returned to alcohol and stored with the specimen body. Maps were made with QGIS v. 3.10.8 (QGIS Development Team, 2020) using Brazilian biome shape layers (IBGE, 2019). Species description was made using the software DELTA (Description Language for Taxonomy) (Dallwitz et al., 1999). Terminology used in descriptions follow mainly that of Marshall (1979) and Harris and Flint (2002).

Examined specimens are deposited at the following institutions in Brazil: Coleção Entomológica Prof. José Alfredo Pinheiro Dutra, Departamento de Zoologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro (DZRJ); Coleção de Invertebrados, Instituto Nacional de Pesquisas da Amazônia, Manaus (INPA); Coleção Entomológica do Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro (MNRJ); Coleção Entomológica de Trichoptera do Museu de História Natural da Bahia, Instituto de Biologia, Universidade Federal da Bahia, Salvador (UFBA); and Coleção Zoológica do Maranhão, Universidade Estadual do Maranhão, Caxias (CZMA).

Results

Alisotrichia froehlichi sp. nov.

urn:lsid:zoobank.org:act:09D7DDEE-5BE5-44D8-B77A-84FC3ED53DF7
(Figs. 2, 3A-3E)

Description. Adult male. Forewing length 1.70–1.98 mm (mean = 1.84 mm, SD = 0.10, n = 11). General color, in ethanol, brown (Fig. 2). Antennae 18-articulated; scape enlarged, semicircular in anterior view (Fig. 3E); pedicel slightly globose, chalice-like, longer than the next two articles combined (Fig. 3E); flagellomeres short, covered by scale-like setae, apical article tapering (Fig. 3E). Ocelli 2. Maxillary palpi 5-articulated, 4th and 5th palpomeres thin, 5th palpomere about 1.5x longer than 4th. Labial palpi 3-articulated. Mesoscutellum with transverse suture. Metascutellum approximately elliptical. Tibial spurs formula 0,2,4, each pair of meso- and metatibial spurs with one spur about twice as long as the other. Fore- and hind wings with long dark brown setae (Fig. 2). Abdominal segment VII with ventromesal process, bifurcate in lateral view, with dorsal branch longer than ventral (Fig. 3C).

Male genitalia. Segment VIII with a pair of dorsolateral processes, posterad directed, each bearing a very long, spine-like seta, extending beyond segment apex (Figs. 3A, 3C); in lateral view, with rounded apex (Fig. 3C); in ventral view, posterior margin with a very deep mesal Y-shaped incision, with a pair of short, acute processes directed inwards, and a pair of shallow lateral V-shaped incisions (Fig. 3B). Segment IX fused with segment X, reduced ventrally; with a pair of slender, lateral elongate processes, slightly curved inwards in dorsal view (Fig. 3A); anterolateral margins with a pair of slender apodemes reaching segment VII internally (Figs. 3A-3C). Segment X long, membranous; with lateral margins slightly arched in dorsal view (Fig. 3A); dorsally with a pair of slender sclerites, each one thinner at midlength, tapering to a rounded apex (Fig. 3A). Subgenital plate, in ventral view, long, extending beyond half length of segment VIII; with anterior portion projecting into a pair of rods; posterior margin subquadrate, with a subapical circular open area (Fig. 3B).

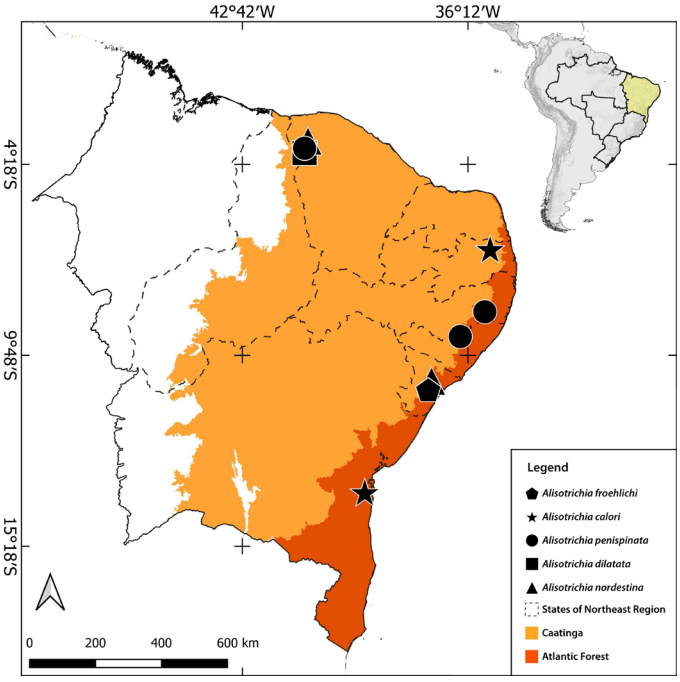

Figure 1 Localities in Northeastern Brazil (yellow in top right map) where type specimens of the new *Alisotrichia* species were collected.

Figure 2 *Alisotrichia froehlichi* **sp. nov.** Paratype male (in alcohol), dorsal habitus. Scale bar = 0.5 mm.

Inferior appendages absent. Phallus tubular, constricted mesally; superior portion with basal and median third shovel-like, slightly sclerotized; apical third membranous and apically rounded (Fig. 3D); ejaculatory duct protruding subapically, in an inverted funnel-like portion (Fig. 3D).

Taxonomic notes. This new species is placed in the *orophila* species group by having a pair of dorsolateral processes on segment VIII. *Alisotrichia froehlichi* **sp. nov.** is most similar to *A. kanukua* Harris & Flint, 2002 and *A. dilatata* **sp. nov.** because they share the segment X, in dorsal view, with arched lateral margins and apex slightly concave, and segment VIII, in lateral view, with rounded apex, and in ventral view, with a mesal Y-shaped incision and paired lateral V-shaped incisions. However, *A. froehlichi* **sp. nov.** can be distinguished by the presence of the ventromesal process on abdominal segment VII, and by the posterior margin of the segment VIII, in ventral view, with a pair of short acute processes, directed inwards, arising at the edge of the mesal incision (Fig. 3B). In addition, the posterior margin of segment VIII, in ventral view, also bears shallow lateral incisions, but in this new species they are shallower than in others (Fig. 3B). The general aspect of the phallus is also diagnostic, with basal and sclerotized portion resembling a shovel and apical region mostly membranous (Fig. 3D).

Etymology: This species is named in honor of Dr. Claudio G. Froehlich, in reference to his important contributions to the knowledge of Neotropical aquatic insects.

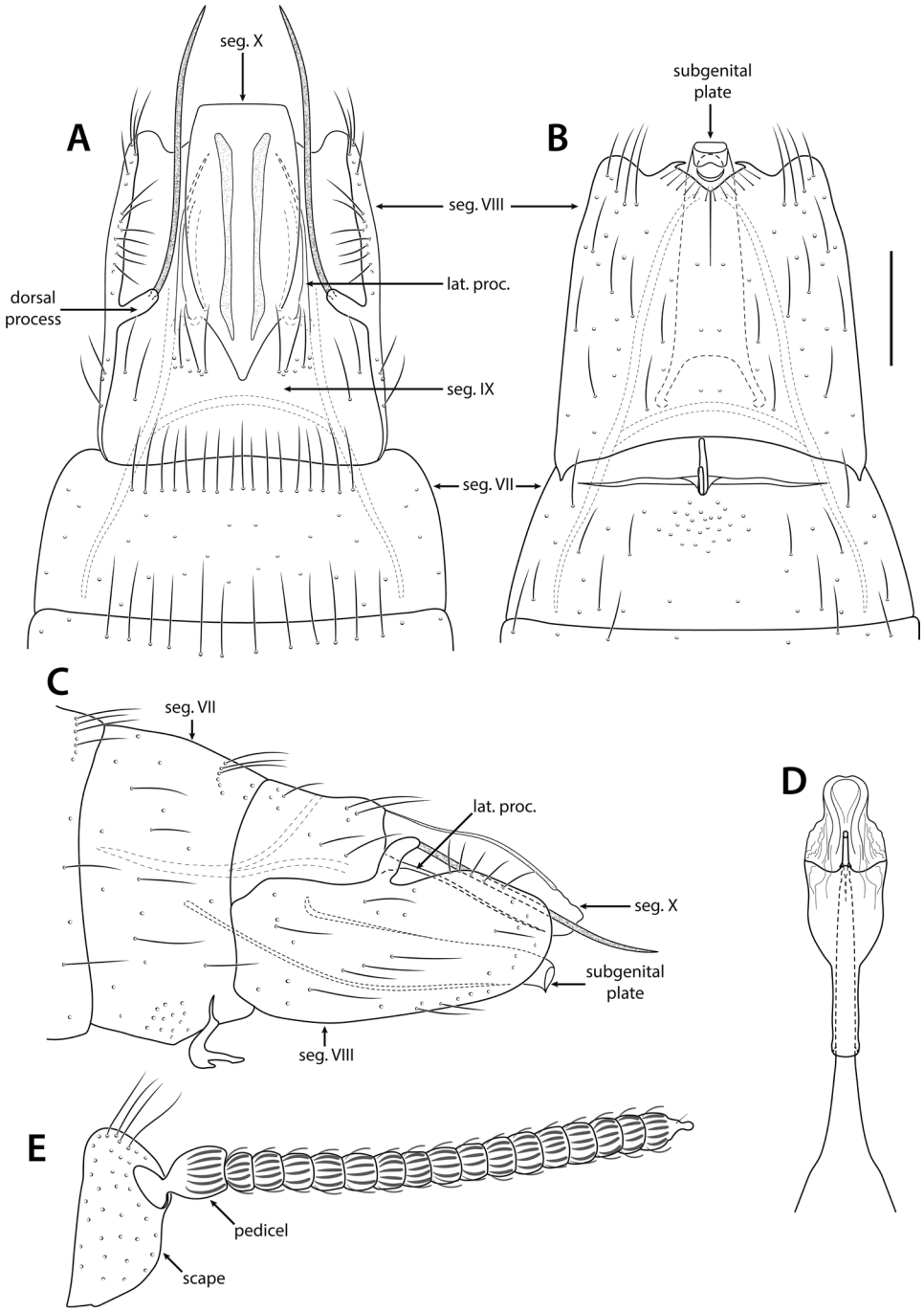

Figure 3 *Alisotrichia froehlichi* **sp. nov.** Male genitalia (holotype): A–D. (A) dorsal view; (B) ventral view; (C) lateral view; (D) phallus, dorsal view. (E) antenna, frontal view. Abbreviation: lat. proc. = lateral process of segment IX. Scale bar = 0.1 mm.

Distribution: Brazil (Sergipe). Atlantic Forest biome.

Material examined. Holotype male: BRAZIL: Sergipe, Itabaiana, Parque Nacional da Serra de Itabaiana, Riacho dos Negros, 10°44'51"S, 37°20'24"S, 202 m, 17.vi.2014, Pennsylvania trap, D.M. Takiya, A.P.M. Santos, W.R.M. Souza & A.C. Domahovski leg. (DZRJ).

Paratypes: same data as holotype, 2 males (DZRJ), 2 males (MNRJ), 2 males (INPA), 2 males (UFBA); same data as holotype, but Parque Nacional da Serra de Itabaiana, Riacho Água Fria, 10°45'17"S, 37°20'32.4"W, 196 m, 17–19.vi.2014, D.M. Takiya, A.P.M. Santos, W.R.M. Souza & A.C. Domahovski leg., 2 males (DZRJ).

Alisotrichia calori sp. nov.

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(Figs. 4, 5A-5E)

Figure 4 *Alisotrichia calori* **sp. nov.** Paratype male (in alcohol), dorsal habitus. Scale bar = 0.5 mm.

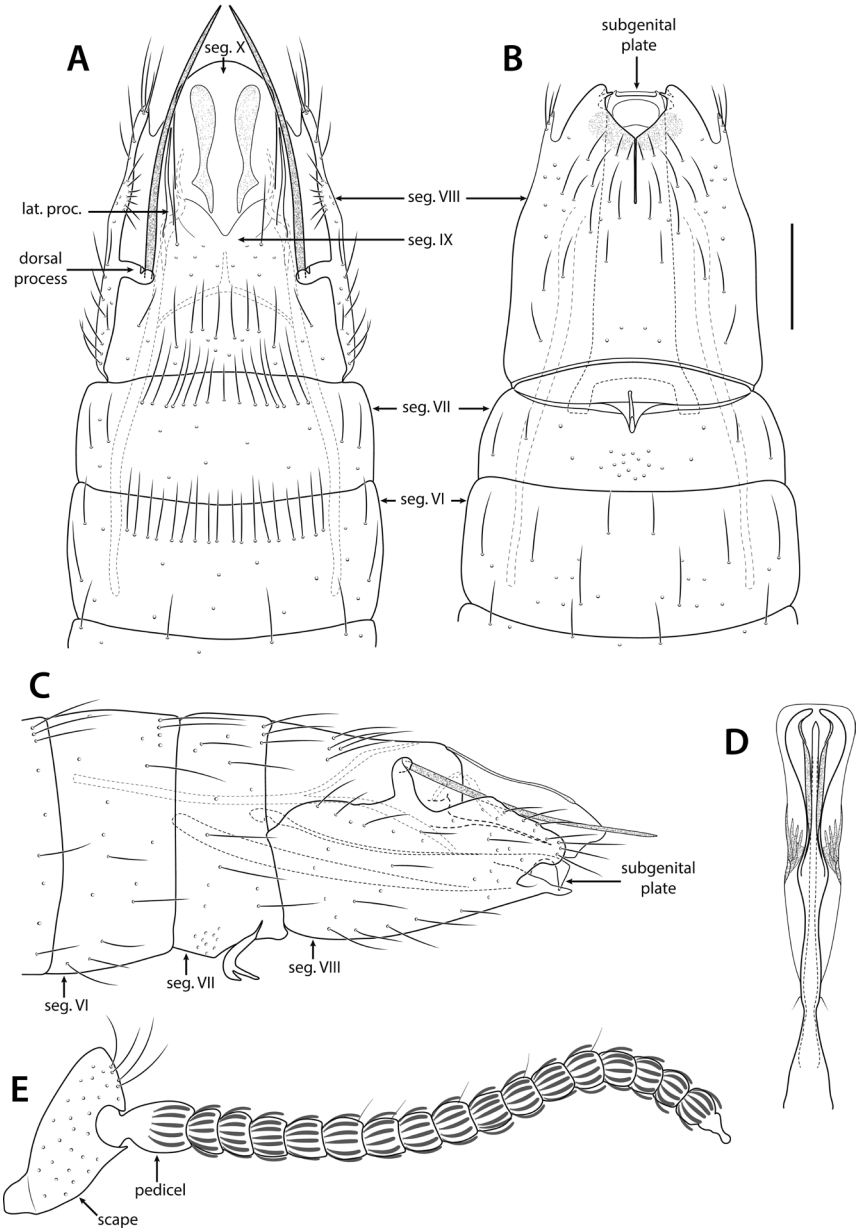

Figure 5 *Alisotrichia calori* **sp. nov.** Male genitalia (holotype): A–D. (A) dorsal view; (B) ventral view; (C) lateral view; (D) phallus, dorsal view. (E) antenna, frontal view. Abbreviation: lat. proc. = lateral process of segment IX. Scale bar = 0.1 mm.

Description. Adult male. Forewing length 1.69–1.98 mm (mean = 1.83 mm, SD = 0.09, n = 24). General color, in ethanol, brown (Fig. 4). Antennae 18-articulated; scape enlarged, semielliptical, with posterior margin produced in anterior view (Fig. 5E); pedicel slightly globose, chalice-like, about the same length as that of the length of the next two articles combined (Fig. 5E); flagellomeres short, covered by scale-like setae, apical article tapering (Fig. 5E). Ocelli 2. Maxillary palpi 5-articulated, 4th palpomere oval, 5th palpomere thin and as long as 4th. Labial palpi 3-articulated. Mesoscutellum with transverse suture. Metascutellum diamond-shaped. Tibial spurs formula 0,2,4, each pair of meso- and metatibial spurs with one spur about twice as long as the other. Fore- and hind wings with long dark brown setae, forewings with white setae forming spots (Fig. 4). Abdominal segment VII with ventromesal process, bifurcate in lateral view, with dorsal branch longer than ventral (Fig. 5C).

Male genitalia. Segment VIII with a pair of dorsolateral processes, directed anterad, with apex curved posterad, each one bearing an elongate, spine-like seta, extending beyond segment apex (Figs. 5A, 5C); in lateral view, with bifid apex, dorsal portion rounded, ventral portion acute (Fig. 5C); in ventral view, posterior margin with a deep mesal Y-shaped incision, laterally to mesal incision paired lobes with a digitate process internally, and outerad of lobes paired narrow U-shaped incisions (Fig. 5B). Segment IX fused with segment X, reduced ventrally; with a pair of slender, lateral elongate processes, slightly curved inwardly in dorsal view (Fig. 5A); anterolateral margins with a pair of slender apodemes reaching segment VI internally (Figs. 5A-5C). Segment X long, membranous, slightly elliptical in dorsal view (Fig. 5A); dorsally with a pair of sclerites shaped like a leg on tiptoe, with a constriction followed by a subbasal dilatation, tapering to an acute basis, apex rounded (Fig. 5A). Subgenital plate, in ventral view long, reaching segment VII internally; anterior portion projecting into a pair of rectangular rods; posterior margin rounded, with a wide subapical open area (Fig. 5B). Inferior appendages absent. Phallus tubular, long, mesolaterally with four digitate sclerites grouped at each side of phallus, at midlength, sclerites partially overlapping (Fig. 5D); with a pair of apical lobes, each tapering to a rounded apex, directed inwardly, with internal margins sclerotized (Fig. 5D); ejaculatory duct projecting between apical lobes (Fig. 5D).

Taxonomic notes. *Alisotrichia calori* **sp. nov.** belongs to the *orophila* group because of the presence of dorsolateral processes on segment VIII (Fig. 5A). This new species is very distinctive, but in some respects resembles the previous one, *A. froehlichi* **sp. nov.,** and *A. dilatata* **sp. nov.**, mainly because of the deep Y-shaped and the lateral pair of incisions on posterior margin of segment VIII in ventral view (Fig. 5B). *Alisotrichia calori* **sp. nov.** can be easily distinguished from these by: (1) the shape of the dorsal sclerite on segment X, which resembles a leg on tiptoe; (2) the mesal Y-shaped incision on posterior margin of segment VIII in ventral view, delimited by paired lateral rounded lobes, each with a very small digitate process internally (Fig. 5B); and (3) the shape of the phallus, with lateral digitate sclerites grouped laterally at midlength (Fig. 5D).

Etymology: This species is named in honor of Dr. Adolfo Calor, Brazilian entomologist and former student of Dr. Claudio Froehlich, in recognition of his contributions to the study of the neotropical caddisflies and for providing material used in this work.

Distribution: Brazil (Bahia, Paraíba). Caatinga and Atlantic Forest biomes.

Material examined. Holotype male: BRAZIL: Paraíba, Bananeiras, Cachoeira do Roncador, 28.ix.2011, bandeja branca, A.R. Calor, F.B. Quinteiro, V. Gomes leg. (DZRJ).

Paratypes: same data as holotype, 7 males (UFBA), 5 males (DZRJ), 5 males (MNRJ), 5 males (INPA); Bahia, Igrapiúna, Reserva Ecológica Michelin, Cachoeira Pancada Grande, 28.iii.2022, A.R. Calor & R. Pereira leg., 1 male (UFBA).

***Alisotrichia penispinata* sp. nov.**

urn:lsid:zoobank.org:act:EE31614A-1408-4340-815C-5943A9D21E88
(Figs. 6, 7A-7E)

Alisotrichia sp. 1 in Takiya et al. (2016)

Description. Adult male. Length 1.58–2.02 mm (mean = 1.77 mm, SD = 0.09, n = 67). General color, in ethanol, brown (Fig. 6). Antennae 18-articulated; scape enlarged, semi-rectangular in anterior view (Fig. 7E); pedicel slightly globose, chalice-like, about the same length as that of the next two articles combined (Fig. 7E); flagellomeres short, covered by scale-like setae, apical article tapering (Fig. 7E). Ocelli 2. Maxillary palpi 5-articulated, 4th palpomere oval, 5th palpomere about 1.5x longer than 4th. Labial palpi 3-articulated. Mesoscutellum with transverse suture. Metascutellum diamond-shaped. Tibial spurs formula 0,2,4, each pair of meso- and metatibial spurs with one spur about twice as long as the other. Fore- and hind wings with long dark brown setae, forewings with scattered white setae (Fig. 6). Abdominal segment VII with ventromesal process, bifurcate in lateral view, with dorsal branch longer than ventral (Fig. 7C).

Male genitalia. Segment VIII with a pair of dorsolateral processes, posterad directed, each bearing an elongate, spine-like seta, slightly surpassing the segment apex (Figs. 7A, 7C); in lateral view, with apical portion tapering abruptly to an acute apex (Fig. 7C); in ventral view, posterior margin with a deep mesal wide incision, with serrated, sclerotized inner margins, bearing a pair of pointed sclerotized processes at midlenght, with a small, mesal bifid projection (Fig. 7B); mesal incision with margins produced inwardly, in lateral view, forming a sclerotized Y-shaped structure (Fig. 7C). Segment IX fused with segment X, reduced ventrally; with a pair of lateral slender, elongate processes, curved downwards in lateral view, curved inwardly in dorsal view (Figs. 7A, 7C); anterolateral margins with a pair of slender apodemes reaching segment VI internally (Figs. 7A-7C); ventrally with an arch-like apodeme (Fig. 7B). Segment X long, membranous; apical portion slightly dilated; apex with with U-shaped mesal incision (Fig. 7A); dorsally with a pair of slender, sinuous sclerites, with basal region acute, median region slightly constricted, and apical region slightly dilated and rounded (Fig. 7A). Subgenital plate inverted, with basal portion directed posterad, apical portion directed anterad and partially folded under itself, not visible externally. Inferior appendages absent.

Figure 6 *Alisotrichia penispinata* **sp. nov.** Paratype male (in alcohol), dorsal habitus. Scale bar = 0.5 mm.

Phallus tubular, long, constricted at basal third; mesoapically enlarged, with margins sclerotized; apically constricted, with a pair of sclerotized, smaller anterior spine-like processes, and a pair of sclerotized, larger posterior spine-like processes; laterally with paired lobes, each with lateral margins bordered by numerous small spines, superior and inner margins of lobes with numerous larger spines, posteriorly with a pair of straight, knife-like, sclerotized processes, and a pair of inwardly curved, sclerotized processes, with apices crossing the other (Fig. 7D); ejaculatory duct protruding subapically, in an inverted funnel-like portion (Fig. 7D).

Taxonomic notes. *Alisotrichia penispinata* **sp. nov.** belongs to the *orophila* group by having a pair of dorsolateral processes on segment VIII each bearing a long and spine-like setae. This new species is very similar to *A. nessimiani* Santos, 2011 due to the general aspect of the male genitalia structures, mainly the segment IX. However, *A. penispinata* **sp. nov.** can be distinguished from *A. nessimiani* and other species in the genus by the shape of the phallus apex, particularly because of the more conspicuous processes. In the new species, the pair of lateral processes on phallus apex is lobate and bordered by many small spines (Fig. 7D), whereas in *A. nessimiani* it is more triangular with serrate margins. In addition, in *A. nessimiani* the posterior margin of the segment X is almost straight, while in *A. penispinata* **sp. nov.** it is concave. Moreover, the Y-shaped sclerotized structure ventroapically at the lateral side of segment VIII (Fig. 7C) helps to distinguish this new species.

The subgenital plate of the holotype of *A. penispinata* **sp. nov.** is completely internalized and inverted, with its apex directed anterad and folded under itself. In some specimens, this structure was even more folded, resembling the "spring-like process" (Harris and Flint, 2002) described for *A. circinata* Flint, 1992, *A. panamensis* Harris & Flint, 2002, *A. muellita* Harris & Flint, 2002, and *A. woldai* Harris & Flint, 2002, or the "spiral process" (Angrisano and Sganga, 2009) decribed for *A. cainguas* Angrisano & Sganga, 2009. Due to the position in which they are found, and their similar shape, probably these structures are the same, corresponding to the apical portion of the subgenital plate.

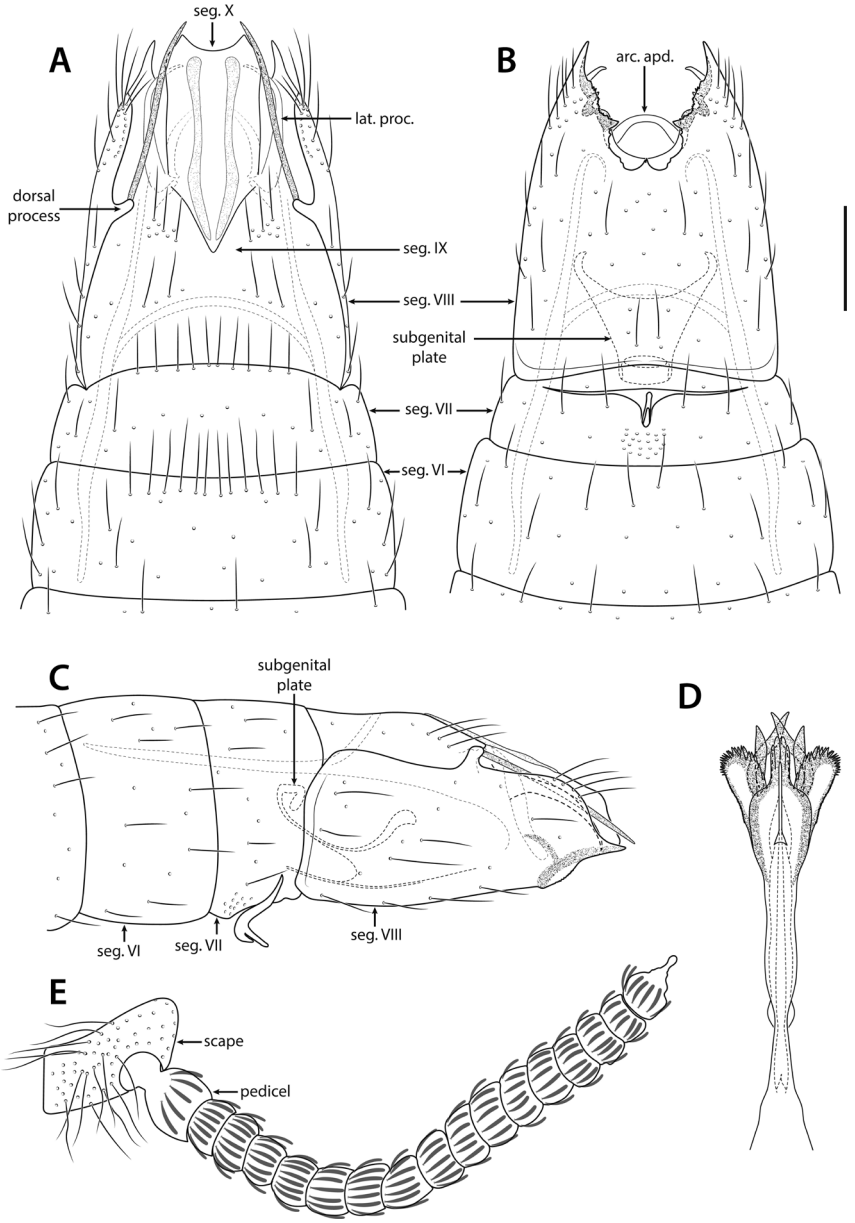

Figure 7 *Alisotrichia penispinata* **sp. nov.** Male genitalia (holotype): A–D. (A) dorsal view; (B) ventral view; (C) lateral view; (D) phallus, dorsal view. (E) antenna, frontal view. Abbreviations: arc. apd. = arch-like apodeme; lat. proc. = lateral process of segment IX. Scale bar = 0.1 mm.

Etymology: This species is named in reference to the small spines on lateral lobes of phallus apex, from Latin: "penis" (penis, phallus) and "spina" (spine).

Distribution: Brazil (Alagoas, Ceará, Pernambuco). Caatinga and Atlantic Forest biomes.

Material examined. Holotype male: BRAZIL: Ceará, Ubajara, Parque Nacional de Ubajara, Rio Cafundó pouco acima da cachoeira, 03°50'13"S, 40°54'35"W, 795 m, 13-19.ix.2012, Malaise trap, J.A. Rafael et al. leg. (CZMA).

Paratypes: same data as holotype, 12 males (CZMA), 5 males (DZRJ), 3 males (MNRJ); same data as holotype, but trilha para samambaia, Rio Gameleira, 03°50'25"S, 40°54'19"W, 874 m, 20-24.iv.2012, Malaise trap, D.M. Takiya et al. leg., 11 males (INPA); same data as holotype, but Rio das Minas na altura do teleférico, 03°49'58"S, 40°53'53"W, 420 m, 20-27.iv.2012, Malaise trap, J.A. Rafael et al. leg., 7 males (UFBA); same data as holotype, but trilha Araticum, Rio das Minas, 03°50'03"S, 40°54'18"W, 524 m, 21-24.v.2012, Rafael et al. leg., 2 males (MNRJ); Alagoas, Quebrangulo, Reserva Biológica de Pedra Talhada, Rio Caranguejo acima do alojamento, 09°15'26"S, 36°25'07.9W, 28.vi.2014, Pennsylvania trap, D.M. Takiya, A.P.M. Santos, W.R.M. Souza, A.C. Domahovski leg., 2 males (INPA), 6 males (UFBA), 9 males (MNRJ); same data as preceding, but 19-21.vi.2014, Malaise trap, 8 males (DZRJ); Pernambuco, Bonito, Pedra Redonda, Rio Verdinho, 02.viii.2009, 1 male (UFBA).

Alisotrichia dilatata sp. nov.

urn:lsid:zoobank.org:act:528B112C-6263-449B-90E1-9E50E15CCF7A
(Figs. 8, 9A-9E)

Alisotrichia sp. 2 in Takiya et al. (2016)

Description. Adult male. Length 1.41–1.72 mm (mean = 1.56 mm, SD = 0.07, n = 116). General color, in ethanol, light brown (Fig. 8). Antennae 18-articulated; scape enlarged, almost elliptical, with anteroventral margin produced in anterior view (Fig. 9E); pedicel slightly globose, chalice-like, about the same length as that of the next two articles combined (Fig. 9E); flagellomeres short, covered by scale-like setae, apical article tapering (Fig. 9E). Ocelli 2. Maxillary palpi 5-articulated, 4th and 5th palpomeres thin, 5th palpomere about 1.5x longer than 4th. Labial palpi 3-articulated. Mesoscutellum with transverse suture. Metascutellum diamond-shaped. Tibial spurs formula 0,2,4, each pair of meso- and metatibial spurs with one spur about twice as long as the other. Fore- and hind wings with long dark brown setae (Fig. 8). Abdominal segment VII without ventromesal process (Fig. 9B, 9C).

Male genitalia. Segment VIII with a pair of dorsolateral processes, posterad directed, each bearing an elongate, spine-like seta, extending beyond segment apex (Figs. 9A, 9C); in lateral view, with rounded apex (Fig. 9C); in ventral view, posterior margin with a deep mesal Y-shaped and lateral narrow V-shaped incisions (Fig. 9B). Segment IX fused with segment X, reduced ventrally; with a pair of lateral slender, elongate processes, slightly curved upwards in lateral view, slightly curved inwardly in dorsal view (Fig. 9A); anterolateral margins with a pair of slender apodemes reaching segment V internally (Figs. 9A-9C). Segment X long, membranous; with lateral margins slightly arched in dorsal view, with apex slightly concave (Fig. 9A); dorsally with a pair of slender, sinuous sclerites, tapering to acute apices (Fig. 9A). Subgenital plate, in ventral view, long, reaching segment VII internally, with anterior portion produced into a pair of rods; posterior margin subrectangular, with a small subapical open area (Fig. 9B). Inferior appendages absent. Phallus tubular, long, with a mesal constriction followed by a dilatation, subapically constricted and covered by a very thin membrane; with a pair of apical lobes, each one with bifid apex, internally flattened and with a pointed projection. (Fig. 9D); ejaculatory duct projecting between apical lobes (Fig. 9D).

Taxonomic notes. This new species also belongs to the *orophila* group due to the presence of a pair of dorsolateral processes on segment VIII. *Alisotrichia dilatata* **sp. nov.** is more similar to *A. kanukua* Harris & Flint, 2002 and *A. froehlichi* **sp. nov.** by the segment X having slightly arched lateral margins, with slender sclerites, and segment VIII with rounded apex in lateral view and posterior margin bearing a median Y-shaped and a pair of V-shaped lateral incisions in ventral view. This new species can be distinguished from this and other *Alisotrichia* species by: (1) the dorsal sclerites on segment X sinuous (Fig. 9A); (2) the deeper mesal Y-shaped and a pair of shallow lateral V-shaped incisions on posterior margin of segment VIII in ventral view (Fig. 9B); and (3) the pair of long, slender, lateral processes of segment IX (Fig. 9E). Furthermore, in *A. dilatata* **sp. nov.** the phallus aspect is peculiar, with apical portion almost elliptical in dorsal view, and the pair of bifid apical lobes are flattened apically and produced into a pointed projection (Fig. 9D).

Etymology: The species name is a reference to the apical portion of the phallus being expanded or dilated, from Latin, "dilatata" (expanded).

Distribution: Brazil (Ceará, Mato Grosso do Sul). Caatinga and Cerrado biomes.

Material examined. Holotype male: BRAZIL: Ceará, Ubajara, Parque Nacional de Ubajara, Rio das Minas na altura do teleférico, 03°49'58"S, 40°53'53"W, 420 m, 20-27.iv.2012, Malaise trap, J.A. Rafael et al. leg. (CZMA).

Paratypes: same data as holotype, 21 males (CZMA), 22 males (DZRJ), 22 males (MNRJ), 22 males (INPA), 22 males (UFBA); same data as holotype, but trilha Araticum, Rio das Minas, 03°50'03"S, 40°54'18"W, 524 m, 21-24.v.2012, Rafael et al. leg., 5 males (CZMA).

Additional material: BRAZIL: Mato Grosso do Sul, Costa Rica, Rio Sucuriú, 18°59'03"S, 53°10'0"W, 02.xi.2004, Light, O. Froehlich leg., 1 male (UFBA)

Alisotrichia nordestina sp. nov.

urn:lsid:zoobank.org:act:B7058880-31E1-4334-A81E-DCBDC87EC505
(Figs. 10, 11A-11E)

Alisotrichia sp. 3 in Takiya et al. (2016)

Description. Adult male. Length 1.40–1.75 mm (mean = 1.52 mm, SD = 0.07, n = 29). General color, in ethanol, light brown (Fig. 10). Antennae 18-articuled; scape enlarged, subtriangular in anterior view (Fig. 11E); pedicel slightly globose, about the same length as that of the next two articles combined (Fig. 11E); flagellomeres short, covered by scale-like setae, apical article tapering (Fig. 11E). Ocelli 2. Maxillary palpi 5-articulated, 4th and 5th palpomeres thin, 5th palpomere about 1.5x longer than 4th. Labial palpi 3-articulated.

Figure 8 *Alisotrichia dilatata* **sp. nov.** Paratype male (in alcohol), dorsal habitus. Scale bar = 0.5 mm.

Mesoscutellum with transverse suture. Metascutellum subtriangular. Tibial spurs formula 0,2,4, each pair of meso- and metatibial spurs with one spur about twice as long as the other. Fore- and hind wings with long dark brown setae, forewings with white setae forming spots (Fig. 10). Abdominal segment VII with ventromesal process, bifurcate in lateral view, with dorsal branch slightly longer than ventral (Fig. 11C).

Male genitalia. Segment VIII with a pair of dorsolateral processes, directed posterad, each bearing an elongate, spine-like seta, extending beyond segment apex (Figs. 11A, 11C); with a subapical constriction, posterior margin with a pair of lateral acute sclerotized processes, directed posterad, in lateral view (Fig. 11C); in ventral view, mesally with a pair of short and rounded lobes, separated by a shallow incision, lateral acute sclerotized processes slightly curved inwardly (Fig. 11B). Segment IX fused with segment X, reduced ventrally; with a pair of lateral elongate processes, curved downwards in lateral view; slightly curved inwards in dorsal view (Figs. 11A, 11C); anterolateral margin with a pair of slender apodemes reaching segment VII internally (Fig. 11A-11C). Segment X long, membranous, almost rectangular in dorsal view (Fig. 11A); dorsally with a pair of slender sclerites, with rounded and divergent apices (Fig. 11A). Subgenital plate, in ventral view, short, not extending beyond half length of segment VIII; anterior portion projecting into a pair of rods; posterior portion trapezoidal (Fig. 11B). Inferior appendages absent. Phallus tubular and short, constricted mesally; with a pair of apical capitate lobes, each one with internal margin concave, pointed projection at midlenght, and a rod-like projection at base (Fig. 11D); apical portion covered by a thin, quadrangular membrane (Fig. 11D); ejaculatory duct projecting between apical lobes (Fig. 11D).

Taxonomic notes. This new species has a pair of dorsolateral processes on segment VIII, thus, is placed in the *orophila* group. *Alisotrichia nordestina* **sp. nov.** is very distinctive and somewhat resembles *A. macae* Santos, 2011, *A. mathisi* Harris & Flint, 2002, and *A. paxilla* Harris & Flint, 2002, particularly because of the pointed, sclerotized posterolateral processes on segment VIII (Fig. 11A-11C). However, the new species is readily distinguished from these other species by the shallow mesal incision on posterior margin of segment VIII in ventral view, forming a pair of short and rounded lobes (Fig. 11B); and by the shape of the phallus apex, with a pair of capitate lobes, each one with the internal margin concave, a pointed projection, and an additional rod-like projection at base (Fig. 11D).

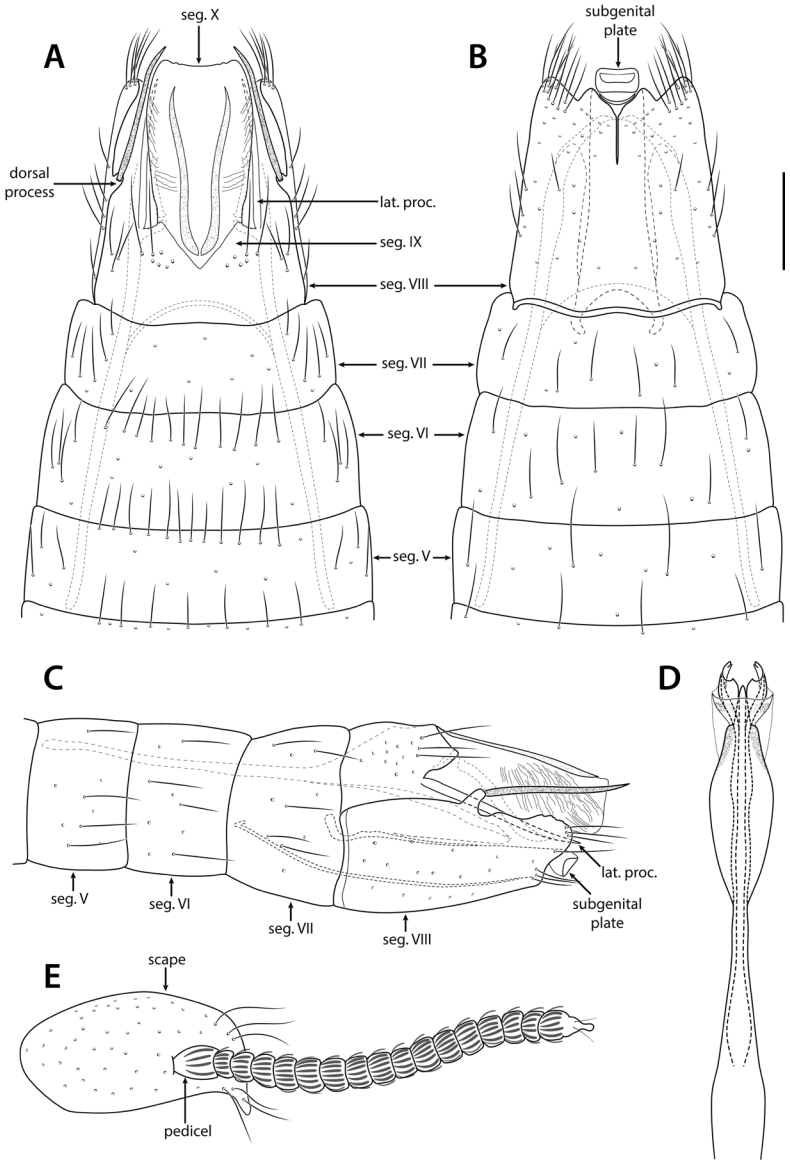

Figure 9 *Alisotrichia dilatata* **sp. nov.** Male genitalia (holotype): A–D. (A) dorsal view; (B) ventral view; (C) lateral view; (D) phallus, dorsal view. (E) antenna, frontal view. Abbreviation: lat. proc. = lateral process of segment IX. Scale bar = 0.1 mm.

Figure 10 *Alisotrichia nordestina* **sp. nov.** Paratype male (in alcohol), dorsal habitus. Scale bar = 0.5 mm.

Etymology: "Nordestina", a Portuguese adjective, is the gentilic for those born in Northeast Region of Brazil and refers to the localities where specimens of this species have been collected.

Distribution: Brazil (Ceará, Sergipe). Caatinga and Atlantic Forest biomes.

Material examined. Holotype male: BRAZIL: Sergipe, Itabaiana, Parque Nacional da Serra de Itabaiana, Riacho Água Fria, 10°45'17"S, 37°20'32.4"W, 196 m, 17-19.vi.2014, Malaise trap, D.M. Takiya, A.P.M. Santos, W.R.M. Souza, A.C. Domahovski (DZRJ).

Paratypes: same data as holotype, 7 males (DZRJ), 6 males (UFBA), 6 males (INPA), 6 males (MNRJ); same data, but Riacho dos Negros, 10°44'50.8"S, 37°20'24"S, 202 m, 17.vi.2014, Pennsylvania trap, D.M. Takiya, A.P.M. Santos, W.R.M. Souza, & A.C. Domahovski leg., 2 males (DZRJ); Ceará, Ubajara, Parque Nacional de Ubajara, Rio das Minas na altura do teleférico, 03°49'58"S, 40°53'53"W, 420 m, 20-27.iv.2015, Malaise trap, J.A. Rafael et al. leg., 1 male (DZRJ).

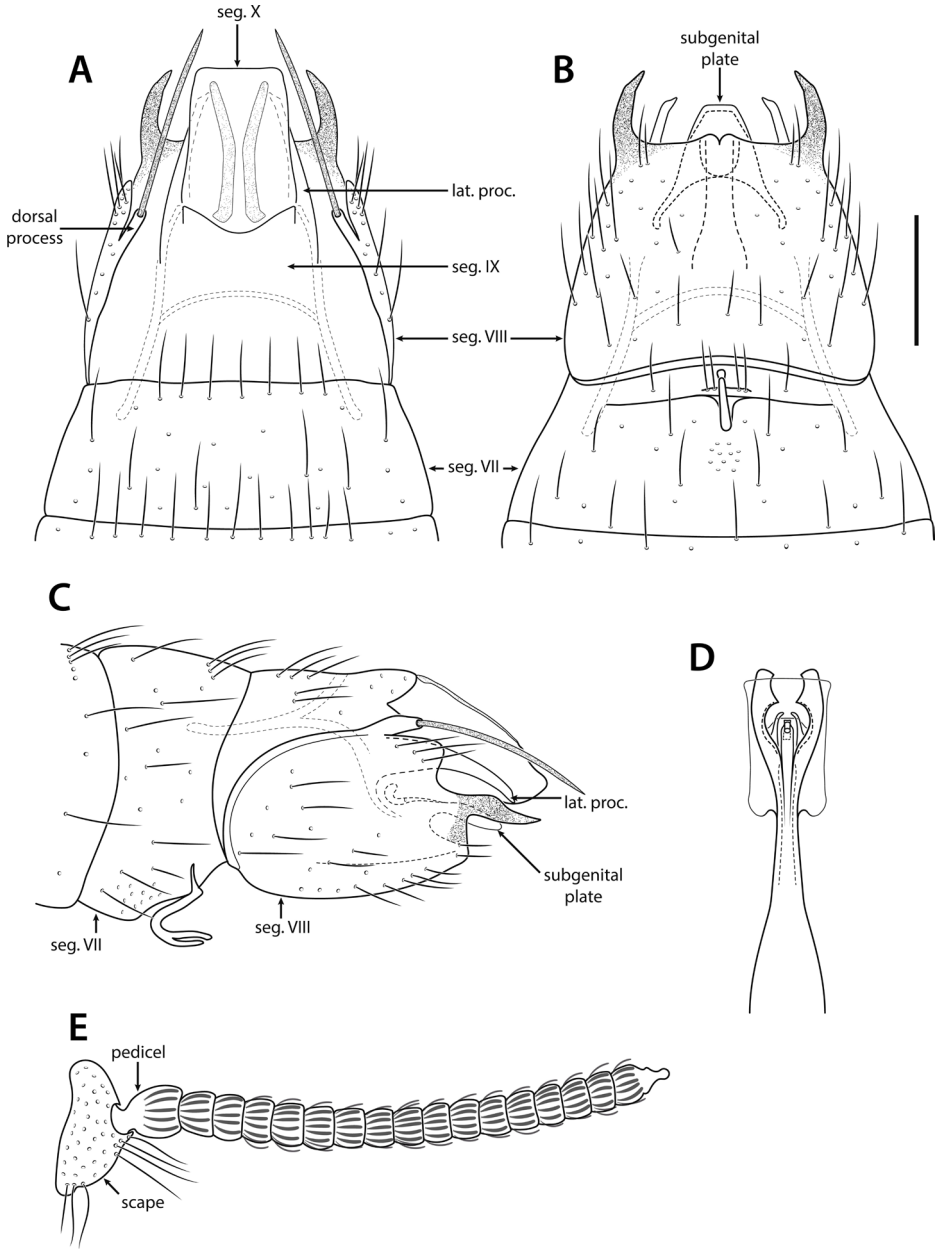

Figure 11 *Alisotrichia nordestina* **sp. nov.** Male genitalia (holotype): A–D. (A) dorsal view; (B) ventral view; (C) lateral view; (D) phallus, dorsal view. (E) antenna, frontal view. Abbreviation: lat. proc. = lateral process of segment IX. Scale bar = 0.1 mm.

Discussion

The first record of a Hydroptilidae species from Northeastern Brazil occurred only ten years ago (Souza et al., 2013), as a reflection of Wallacean and Linnean shortfalls (Hortal et al., 2015). Currently, with the species described in this work, the number of species in this region reached 58 but, of the nine states of the Northeastern Region, four have less than 10 species recorded: Maranhão, Paraíba, Sergipe, and Rio Grande do Norte, with the latter having no recorded species (Santos et al., 2023). This indicates that probably there are still many other species to be described and recorded from Northeastern states.

The Caatinga biome, along with the Chaco and Cerrado biomes, is part of the South American dry diagonal, an arid corridor that separates the Amazon and the Atlantic rainforests (Ab'Saber, 1977). Most of the Northeast Region of Brazil is occupied by the Caatinga, which is characterized by the absence of rain for long periods and high average annual temperature (Prado, 2003). Despite this, *Alisotrichia* species described seems to be typical of humid forests, and even those from Ceará and Paraíba states, within the Caatinga area, are in fact from humid forest. Localities in these two states with *Alisotrichia* species described here (in Bananeiras and Ubajara municipalities) are known as "brejos de altitude". "Brejos de altitude" are humid forest enclaves within the Caatinga area and likely represent past connections between the Amazon and Atlantic forests (Ledo and Colli, 2017).

Presently, the *orophila* species group is composed by 37 species, more than half of the species diversity of *Alisotrichia*. Harris and Holzenthal (1993) recovered this species group as monophyletic and, apparently, there was a large diversification of this lineage in South America. Of the 25 species of *Alisotrichia* known from South America, 14 are in the *orophila* species group, including the new species described here. However, biogeographical studies are needed to indicate historical processes that led to this distribution.

Conclusions

The genus *Alisotrichia* now has 67 species, ten of which are recorded for Brazil. The new data presented herein indicate that the microcaddisfly fauna is still very underexplored. Groups that were not extensively studied, such as *Alisotrichia*, and localities poorly sampled, such as in Northeastern Brazil, probably will reveal a high number of new species.

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Conflicts of interest

The authors declare no conflicts of interest.

Author contribution statement

AAA, DMT, and APMS contributed to the study conceptualization, design, species description. AAA produced the photographs, illustrations, maps, and wrote the first draft of the manuscript. All authors commented on previous versions of the manuscript, read and approved the final manuscript.

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