



A new species of *Thraulodes* Ulmer (Ephemeroptera: Leptophlebiidae) from Southeastern Brazil

INÊS C. GONÇALVES¹, ELIDIOMAR R. DA-SILVA² & JORGE L. NESSIMIAN³

¹Programa de Pós-Graduação em Zoologia, Museu Nacional do Rio de Janeiro, Laboratório de Entomologia, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Caixa Postal 68044, 21941–971, Rio de Janeiro, RJ, Brasil. E-mail: inescg@ig.com.br

²Laboratório de Insetos Aquáticos, Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Estado do Rio de Janeiro, 22290-240, Rio de Janeiro, RJ, Brasil. E-mail: elidiomar@pq.cnpq.br

³Laboratório de Entomologia, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Caixa Postal 68044, 21941–971, Rio de Janeiro, RJ, Brasil. E-mail: nessimia@acd.ufrj.br

Abstract

A new species of the mayfly genus *Thraulodes* Ulmer is described based on specimens from the states of Rio de Janeiro and São Paulo, Brazil. Nymph and imagos from both sexes are described. The new species can be easily recognized by abdominal and legs color pattern whether from nymphs or imagos.

Key words: mayflies, taxonomy, Neotropics, South America

Resumo

Uma nova espécie do gênero *Thraulodes* Ulmer é descrita com base em exemplares procedentes dos estados do Rio de Janeiro e São Paulo, Brasil. A ninfa e os adultos de ambos os sexos são descritos. Essa espécie pode ser facilmente reconhecida pelo padrão de coloração do abdome e das pernas, tanto para ninfas quanto adultos.

Palavras-chave: efemerópteros, taxonomia, Região Neotropical, América do Sul

Introduction

Thraulodes Ulmer is probably one of the most abundant and geographically widespread genus of Leptophlebiidae (Ephemeroptera) in South America. The genus is pan-american and distributed between 30–45°N and 25–28°S (Traver & Edmunds 1967; Domínguez *et al.* 2006). Nymphs are found at a wide range of altitudes, with cases in which the same species is registered from 400 to 1700m. They are generally found in well-aerated waters although being able to tolerate some temperature and oxygen level fluctuations and are most abundant in stream areas of seven to fifteen centimeters deep. The nymphs are poor swimmers and creep over the substrate, being usually associated with stony bottoms. Some nymphs can also be found on submerged vegetation (Edmunds *et al.* 1976; Domínguez *et al.* 2006).

Despite its abundance in South America, with about 27 species, only seven are reported from Brazil. All of them registered from Southeastern and Southern Brazil and most known only from its adult stage, a common scenario for the genus (Domínguez *et al.* 2006; Salles 2006). In fact, in Brazil, just *T. itatiajanus* Traver & Edmunds and *T. schlingerii* Traver & Edmunds are known from both, adult and nymphal stages (Da-Silva 2003; Lopes *et al.* 2003). The present work describes a new species from Southeast Brazil from all life stages, including both adult sexes.

Material and methods

Specimens were preserved in 80% ethanol. Associations between imagos and nymphs were done by reared nymphs from the rivers Boa Vista and Macaé, Nova Friburgo. Nymphs were collected on rocky stream bottoms and winged stages were caught on light traps. Type and non-type material are deposited at Coleção Entomológica Prof. José Alfredo Pinheiro Dutra, Departamento de Zoologia, Universidade Federal do Rio de Janeiro (DZRJ) and Museu de Zoologia da Universidade de São Paulo (MZUSP). The terminology proposed by Traver & Edmunds (1967) and modified by Domínguez *et al.* (2006) was used to address the male genitalia. Drawings were made with the aid of camera lucida.

Thraulodes jones sp. nov. Gonçalves, Da-Silva & Nessimian

Male Imago (Holotype): Length: body 12.0 mm; forewing 12.4 mm; hind wing 2.0 mm. General coloration light brown, with dark brown markings. First abdominal segments whitish. Wings hyaline.

Head: Area between eyes and ocelli dark brown. Anterior margin of head yellowish, translucent. Ocelli white surrounded by black ring. Upper portion of turbinate eyes orange brown. Base of antenna surrounded by dark brown; scape with dark brown ring and pedicel dark brown; flagellum yellowish.

Thorax: Pronotum yellowish bearing two median dark marks extending to posterior margin. General color of mesonotum and metanotum light brown. Posterior area of mesonotum yellowish, apex dark brown. Prosternum and mesosternum dark brown. Mesosternum with two median longitudinal light brown lines. Metasternum whitish with two dark brown markings. Thoracic pleura whitish with dark brown marks.

Legs: Femora of foreleg whitish with a blackish subtriangular basal mark; blackish median band, well marked centrally and inconspicuous toward margins; inner margin of femora with apical half blackish; apical margin of femora blackish; area between median band and apex orange brown. Tibia light orange brown, distal fourth blackish. Tarsus brown with base and apex whitish; last tarsal segment and tarsal claws blackish (Fig. 1). Median and hind legs similar to foreleg in color, except for lack of basal blackish mark on femora; tarsi yellowish, with last tarsomere blackish.

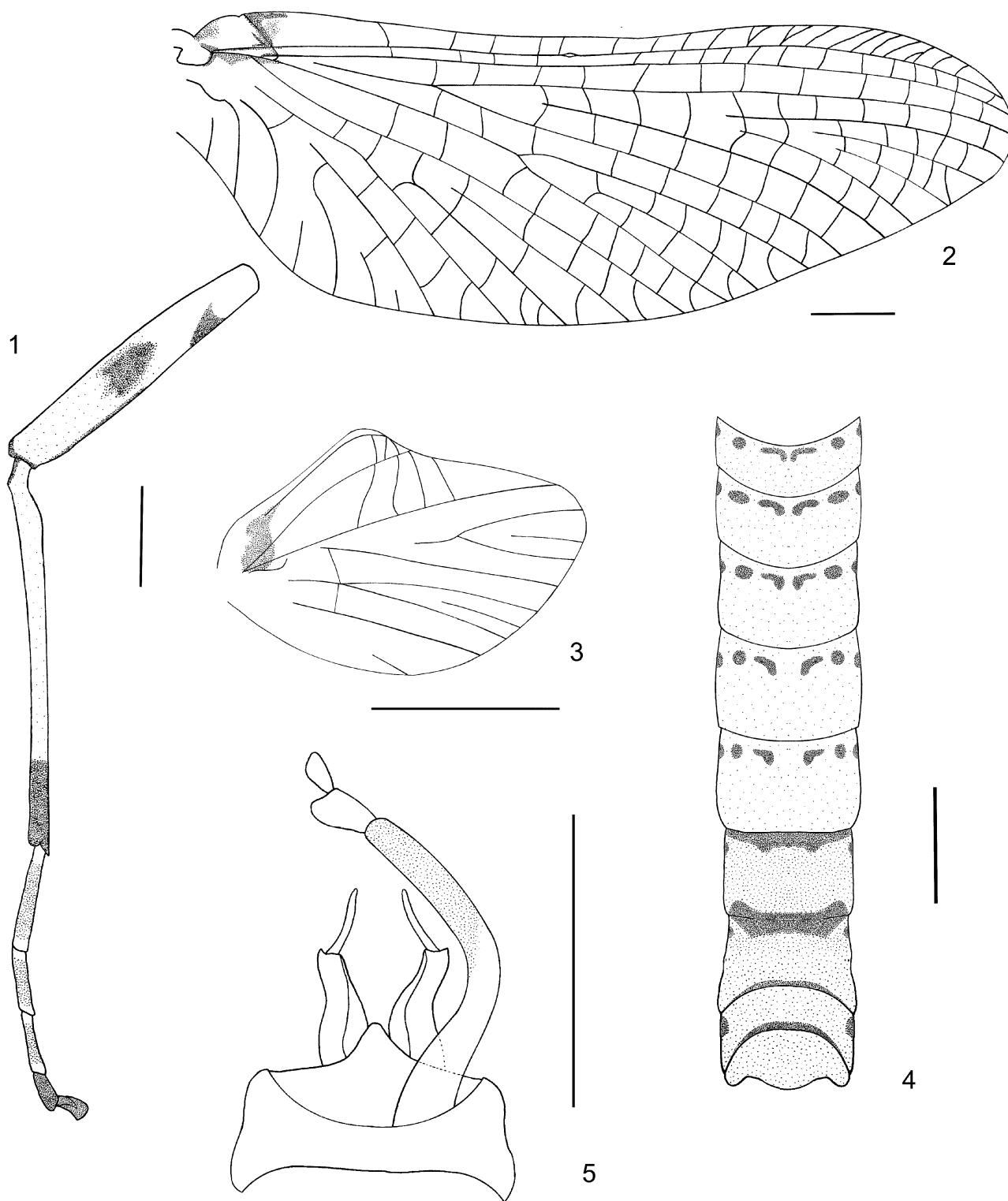
Wings: Membrane of wings hyaline with dark brown stain at base (Figs. 2–3). Forewing veins brownish, hind wing veins whitish. Area between C, Sc and R1 of forewing whitish toward apex. Five basal and 17–18 cross-veins distal to bullae.

Abdomen: Tergum I whitish with wide anteromedian blackish mark. Terga II–VI whitish translucent bearing 3 pairs of sub apical marks: median, sublateral and lateral. Terga VII–X orange brown. Terga VII–IX possessing one lateral sub apical blackish mark; anterior and posterior margins dark brown, except for anterior margin of tergum IX. All terga possessing a blackish dash on lateral margins (Fig. 4). Sterna whitish translucent. Sterna I–VII with pair of median, sub apical and apical-lateral blackish spots. Sterna VIII–IX without marks.

Genitalia: Styliiger plate whitish bearing very subtle grooves, posterior median projection present with rounded apex. Forceps whitish, first segment with distal half washed with gray, second segment with rounded internal distal projection. Penes long and slender, without lateral pouch. Inner margin sclerotized; apicolateral area with acute projection directed externally and posteriorly; subapical spines long and projected internally and posteriorly (Fig. 5). Caudal filaments whitish, with wide and narrow dark brown bands irregularly distributed.

Variations: Body measurements were smaller in some specimens, about 10.0 mm body length; 11.0 mm forewing; and 2.0 mm hind wing; Paratypes showed scape whitish and flagella shaded with dark brown. In one male paratype, the triangular mark at base of fore femora was absent and only 4 cross-veins basal to bullae were found. The dashes on lateral margins of abdominal terga were less conspicuous at first abdominal segments on one paratype.

Female Imago: Length: body 10.0–11.0 mm; forewing 11.5–12.7 mm; hind wing 1.4–2.0 mm. General coloration light brown, abdomen shaded with dark brown. Wings hyaline.



FIGURES 1–5. *Thraulodes jones* sp. nov. Male imago. 1. Fore leg. 2. Forewing. 3. Hind wing. 4—Abdominal terga II—X. 5. Genitalia (scale: 1.0 mm).

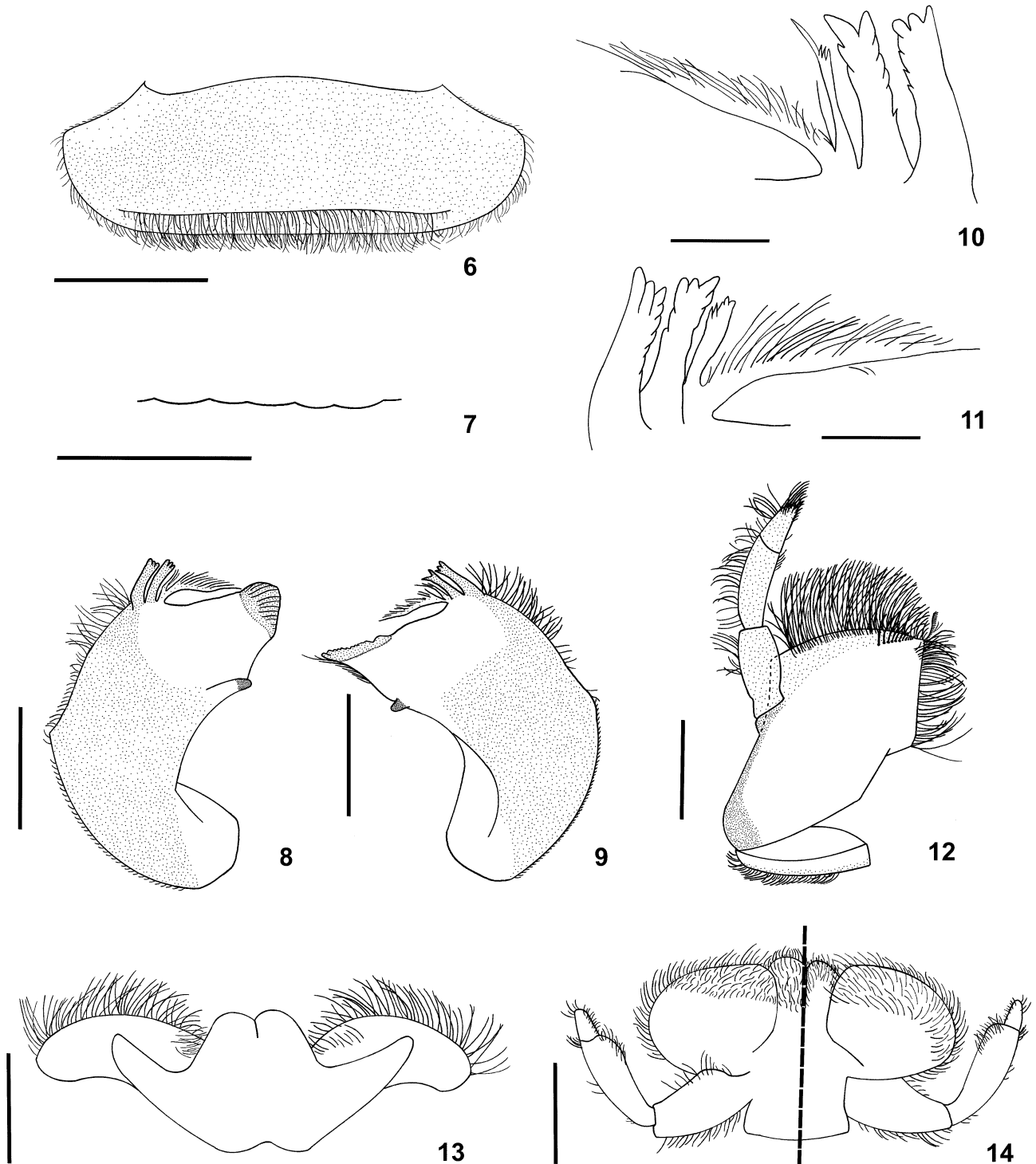
Head: Area between eyes and ocelli shaded with dark brown. Eyes black. Ocelli white surrounded by black. Anterior margin of head yellowish. Scape yellowish, pedicel dark brown and flagellum shaded with dark brown.

Thorax: Pronotum yellowish; anterior and posterior margins of pronotum dark brown; median mark shaded with dark brown from which 2 pairs of marks arise, one on each side of pronotum. General color of

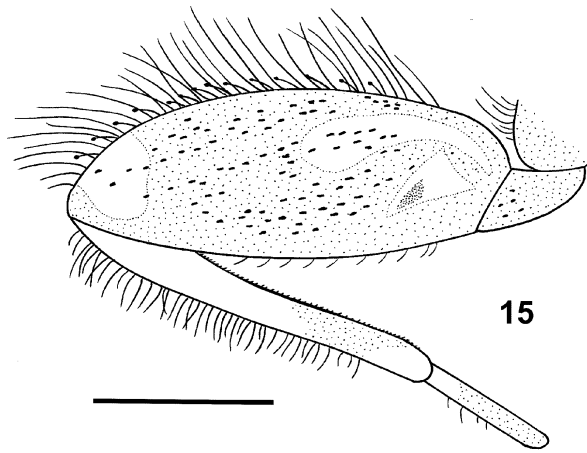
mesonotum and metanotum as in male. Prosternum and metasternum whitish. Mesosternum dark brown with two median longitudinal light brown lines.

Legs: Legs similar to male.

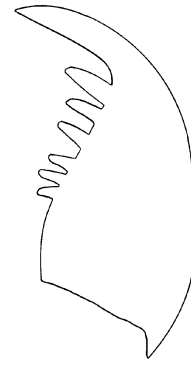
Wings: Wings similar to male, except for having 3–4 cross-veins basal to bullae and C, Sc and R1 area of forewing not whitish toward apex.



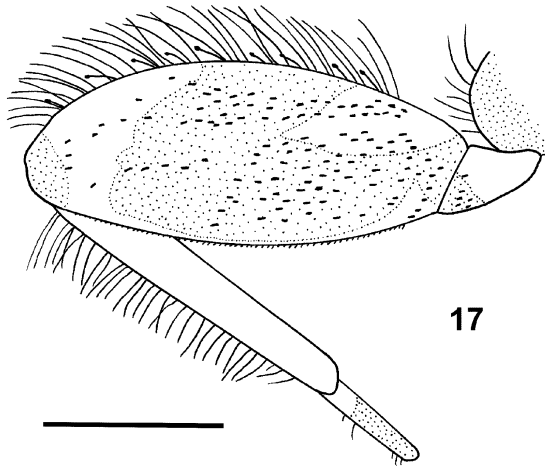
FIGURES 6–14. *Thraulodes jones* sp. nov. Nymph. 6. Labrum d.v. 7. Detail of denticles on labrum d.v. 8. Left mandible d.v. 9. Right mandible d.v. 10. Detail of right mandible d.v. 11. Detail of left mandible d.v. 12. Maxilla d.v. 13. Hypopharynx d.v. 14. Labium (left: v.v. ; right: d.v.). d.v. - dorsal view, v.v.—ventral view (scale: 0.5mm, except for Figs. 10–11, 0.1mm).



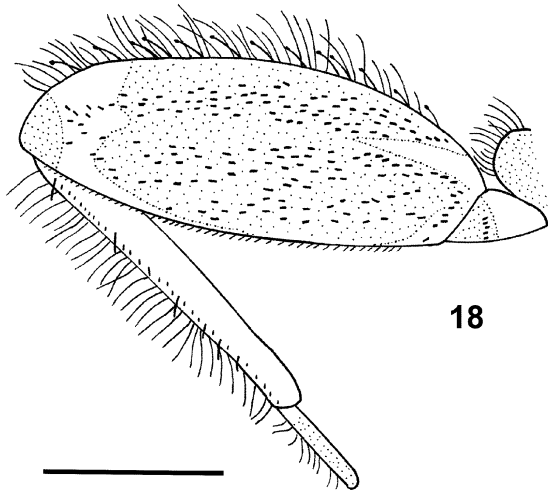
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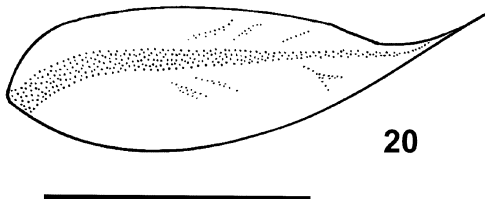
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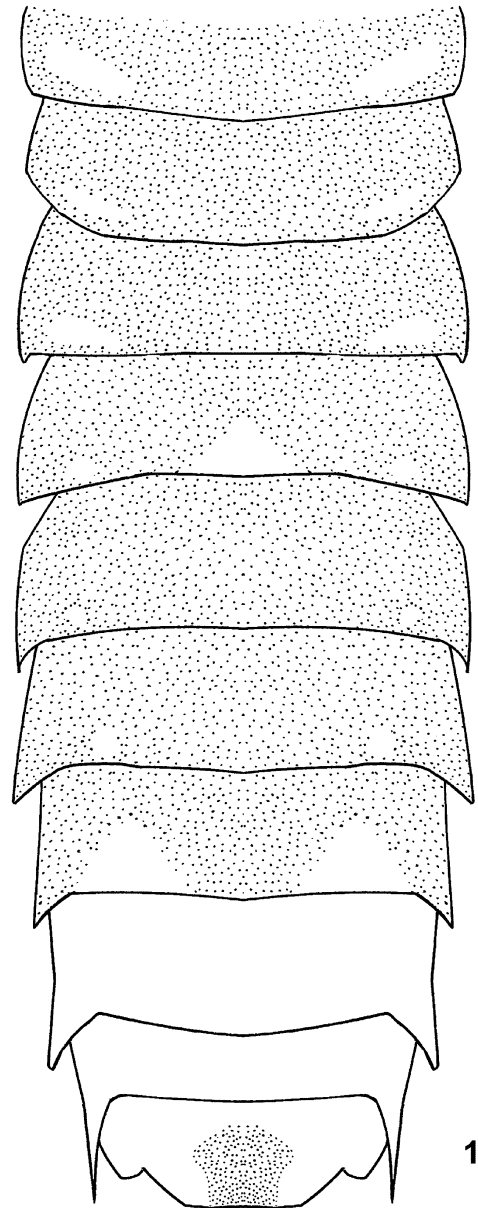
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FIGURES 15–20. *Thraulodes jones* sp. nov. Nymph. 15. Fore leg. 16. Tarsal claw. 17. Mid leg. 18. Hind leg. 19. Abdominal terga. 20. Gill. (scale: Figs. 15, 17, 18, 20, 1.0 mm; Fig. 16, 0.1 mm; Fig. 19, 2.5 mm)(Drawings of legs and abdomen from a non mature nymph).

Abdomen: Terga I–III shaded with dark brown; tergum IV also shaded except for yellowish median triangular mark extending from middle to posterior margin; terga V–VI yellowish shaded with dark brown on anterior area; tergum VII yellowish with anterior and posterior margins shaded with dark brown; tergum VIII yellowish, shaded with dark brown on anterior margin; terga IX–X yellowish; terga III–VI with a pair of sub apical dark brown marks; all terga possessing a dark brown dash on lateral margins. Sterna I–VI with a pair of apico-lateral dark brown marks, remaining sterna yellowish. Apex of female sternum cleft, V-shaped. Caudal filaments whitish, with wide and narrow dark brown bands irregularly distributed.

Variations: Some females showed terga VII–IX more heavily shaded with dark brown. Females collected at Macaé de Cima, Nova Friburgo, were found to be slightly bigger: body 11.5–12.0 mm; forewing: 15.0–16.2 mm; hind wing: 2.0–2.1 mm. They also showed a color pattern more intense than described above, prosternum with dark brown median mark and abdominal sterna with color pattern as in males.

Mature Nymph (male): Length: body: 10.0–11.0 mm; caudal filaments: more than 13.0 mm (broken). General color dark brown with light brown areas.

Head: Ocelli black; area surrounding ocelli light brown. Eyes black; turbinated portion dark brown reddish. Antennae about 2.6–2.7 times the size of the head, scape and pedicel dark brown, flagellum light brown. Labrum brown with basal lateral area light brown, wider than clypeus; its width about 3 times its length; presence of apical and sub-apical rows of whitish long setae (Fig. 6); anterior margin straight; with five very subtle emarginations (Fig. 7); lateral margins rounded. Mandibles with row of whitish setae on outer margin extending to level of outer incisor; setae long on distal half and short on basal half; outer margin projected; inner margin of outer incisor and both margins of inner incisor serrate; molars with serrate ridges; prosthecae well developed. Incisors, outer margin and basal third of mandibles brown; apical third whitish; molars and prosthecae light brown (Figs. 8–9). Right mandible outer incisor with three apical denticles; inner incisor with two denticles (Fig. 10); setae near molars light brown. Left mandible possessing 3 denticles on inner and outer incisors (Fig. 11). Maxilla whitish, flattened and rectangular; apical margin brown with row of apical long brown setae, simple and pectinated, and sub-apical interrupted row of shorter but thicker setae; inner margin bordered by long light brown setae, culminating on single pectinated setae; outer margin brown, dark brown basal to palpi insertion; posterior margin light brown, with light brown setae; palpi brown with outer margin bordered by long whitish setae, denser on segment III; inner margin of segment III and apical third of segment II with row of long setae (Fig. 12). Hypopharynx whitish with light brown setae; superlingua bearing long setae on apical margin and at base (Fig. 13); apex of lingua ventrally covered by short setae; outer margin more densely setose so that the region appears to be somewhat darkened. Labium yellowish white; densely covered by long light brown setae on glossa and apical third of paraglossa; first segment of palpi with scattered whitish setae on inner and outer margins; second segment with denser setae at apical third, outer margin with long setae and inner margin bearing short, spine-like setae (Fig. 14).

Thorax: Pronotum brown with several scattered light brown spots; lateral margins light brown with sublateral dark brown stripe, posterior margin with light brown border not reaching lateral margins. General coloration of mesonotum dark brown, scattered with several brown spots; two brown longitudinal lines one on each side of median suture. Wing pads light brown, veins dark brown. Thoracic sterna yellowish.

Legs: Femora of all legs brown with light brown marks, tibia, tarsi and claw light brown. Foreleg (Fig. 15): coxa with wide dark brown margin, outer margin bordered by long simple setae; femora dark brown with one basal, one sub-median and one sub-apical light brown marks; basal mark lighter, with inner grayish spot; outer margin with row of simple long setae and fewer shorter clavate setae, inner margin with few long simple setae, not as long as those of outer margin; margins and dorsal area of femora presenting short bristles; outer margin and dorsal region of tibia with row of simple setae, not as long as those on femora; inner margin with row of spines; apical half of tibia and tarsus somewhat shaded with brown; tarsus bearing simple setae. Tarsal claws with seven denticles, apical denticle over twice longer than subapical denticle (Fig. 16). Mid leg (Fig. 17): similar to foreleg except femora with one basal and one sub apical light brown mark and inner margin with row of strong short spines; outer margin of tibia with fringe of long simple setae; inner margin without setae. Hind leg (Fig. 18): similar to foreleg except basal mark of femora less conspicuous than in other legs, reduced to a line; inner margin with row of strong short spines, slightly longer than those of mid leg; outer

margin of tibia fringed with long simple setae, short bristles and few clavate setae, inner margin with row of short bristles and row of long simple setae, although not as long as those of femora; outer margin of tarsus with row of simple long setae, some clavate setae and short bristles;

Abdomen: Terga I–VII mainly dark brown, postero-lateral areas light brown; terga VIII–X light brown, somewhat yellowish. Tergum X with median mark and lateral margins dark brown (Fig. 19). Caudal filaments brownish. Posterior margin of terga and caudal filaments with row of spines, longer on caudal filaments. Gills purplish gray, with symmetrical lamellae; main trachea strongly pigmented but branches are visible although weakly marked; gills broad, tapering toward apex (Fig. 20).

Variations: Body length was higher on female mature nymphs, reaching 12.0 mm. Some specimens showed different abdominal color pattern, with dark brown anterior margin on tergum VIII and on tergum IX, this coloration was interrupted on median region. Aside that, subtle variations on color intensity were found, with specimens overall darker or lighter on their color patterns.

Type material: Holotype: Brazil, Rio de Janeiro: Nova Friburgo, Lumiar, Rio Boa Vista, Cachoeira Indiana Jones, 900 m, 22°19'02.1"S/42°17'28.5"W, 15.xi.2008, Gonçalves, I.C. *leg.* 1 male imago (DZRJ800); Allotype: Nova Friburgo, Lumiar, tributário de primeira ordem do Córrego Santa Margarida, 844 m, 22°20'35.5"S/42°18'00.0"W, 16.xi.2008, Gonçalves, I.C. *leg.* (Light trap) 1 female imago (allotype; DZRJ807). Paratypes: same data, 2 nymphs (MZUSP); same data, 1 nymph (DZRJ802); same locality and date, Alecrim, V.P. *leg.* 6 nymphs (DZRJ803); same data, 1 nymph (DZRJ804); Nova Friburgo, Lumiar, Rio Boa Vista, 583 m, 22°23' 57.9"S/42°19'14.6"W, 15.xi.2008, Alecrim, V.P. *leg.* 1 nymph (DZRJ805); Nova Friburgo, Lumiar, first order tributary of Córrego Santa Margarida, 844 m, 22°20'35.5"S/42°18'00.0"W, 16.xi.2008, Gonçalves, I.C. *leg.* (Light trap), 1 male and 3 female imagos (MZUSP); same data, 1 male imago (DZRJ806);

Additional material: **Brazil, Rio de Janeiro:** Nova Friburgo, Macaé de Cima, Rio Macaé, 935 m, 22°24'46"S/42°31'16.2"W, 12.ix.2009, Alecrim, V.P. *leg.*, 4 female imagos (DZRJ812); same data, Gonçalves, I.C. *leg.*, 1 nymph (MZUSP); same locality, 13.ix.2009, Gonçalves, I.C. *leg.*, 1 female imago (DZRJ809); same data, 1 female subimago (DZRJ810); same data, 5 nymphs (DZRJ811); same locality, 14.ix.2009, Alecrim, V.P. *leg.*, 3 female imagos (MZUSP); same locality, 18.ix.2008, Alecrim, V.P. *leg.*, 4 nymphs (DZRJ808); Nova Friburgo, Macaé de Cima, Rio Macaé, 977 m, 22°25'30.6"S/42°32'00.7"W, 13.ix.2009, Gonçalves, I.C. *leg.*, 3 nymphs (MZUSP); Teresópolis, Parque Nacional da Serra dos Órgãos, Rio Paquequer, 933 m, 22°27'8.13"S/42°59'31.77"W, 10.v.2008, Henriques-Oliveira, A.L., Santos, A.P.M. & Ferreira-Jr., N. *leg.* (light trap), 1 male subimago (DZRJ816); Macaé, Sana, Córrego do Colégio, 294 m, 22°20'23.4"S/42°12'13.5"W, 19.ii.2009, Gonçalves, I.C. *leg.* (light trap), one female subimago (DZRJ818); same data, 1 male and 2 female imagos (DZRJ819); **São Paulo:** Ubatuba, Parque Estadual da Serra do Mar – Núcleo Picinguaba, Rio da Fazenda, 41 m, 23°20'16.7"S/44°50'10.9"W, 02.x.2005, Santos, A.P.M. & Dumas, L.L. *leg.* (Light trap), 1 male and 2 female subimagos (DZRJ821); same locality and date, Santos, A.P.M. *leg.* (Light trap), 1 male subimago (DZRJ822).

Etymology: The name *jones* is a reference to the type locality, the Boa Vista river at Indiana Jones waterfall.

Life cycle associations: Nymphs and adults were associated from one male nymph (Holotype) and two female nymphs reared to adult stage.

Biology: Nymphs were found on rocky stream bottoms in areas of moderate current.

Discussion

Male imagos of *Thraulodes jones* sp. nov. can be distinguished from other species of *Thraulodes* by the following combination of characteristics: (1) forewings with five basal and 17–18 cross-veins distal to bullae (Fig. 2), (2) abdominal color pattern as in Fig. 4, (3) Foreleg color pattern as in Fig. 1, and (4) genitalia: penes long and slender, without lateral pouch, possessing apicolateral area acute and projected and subapical spine long and directed internally and posteriorly (Fig. 5).

Only *T. cochunaensis* Domínguez and *T. flinti* Domínguez were known to possess one band and one macula on the fore femora. While the former present an apical band and a median macula, *Thraulodes jones* sp nov. is the only species of the genus so far to have a median band and basal macula on fore leg. *Thraulodes jones* sp nov. genitalia resembles those of *T. itatiajanus* and *T. papilionis* Traver & Edmunds in having an long and slender penes, with long subapical spines projected internally and posteriorly. As in *T. papilionis*, the penes of *T. jones* sp nov. possess an acute projection on apicolateral area.

Nymphs of *T. jones* sp. nov. can be diagnosed mainly by the color pattern of the (1) abdomen (Fig. 19) and (2) legs (Figs. 15–17). These nymphs resemble those of *T. itatiajanus* by having similar abdominal color pattern, anterior margin of labrum straight and outer margin of mandibles projected. Despite the similarities *T. jones* sp. nov. nymphs are readily distinguished by the leg and abdominal color pattern as cited above in diagnosis. *Thraulodes itatiajanus* also possess broad gills, but unlike that species *T. jones* sp. nov. shows visible tracheal branches, although not as marked as main trachea.

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