# New species of Thraulodes Ulmer, 1920 and checklist of Leptophlebiidae (Insecta: Ephemeroptera) from Rondônia State, Northern Brazil

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ORIGINAL ARTICLE

# New species of *Thraulodes* Ulmer, 1920 and checklist of Leptophlebiidae (Insecta: Ephemeroptera) from Rondônia State, Northern Brazil

**Stênio R. S. Nascimento[1] · Claudia R. T. De Lima[1] · Mylena N. Cardoso[3] · Izaias M. Fernandes[3] · Rosaly Ale-Rocha[1] · Neusa Hamada[2] · Paulo V. Cruz[2,4]**

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**Abstract**
Rondônia is one of the Amazonian states with a small number of reports of the family Leptophlebiidae, with only five species. The lack of data is particularly relevant because the group is ignored in the decision-making process (land-use, areas of conservation and climatic mitigation). The aim of this study is to provide data on the biodiversity of Leptophlebiidae from Rondônia by compiling old and new records and to describe a new species *Thraulodes inopinatus* sp. n. The results added 11 new records for the state, increasing the number of species from five to 16. Rondônia has now become the third state with the most records of Leptophlebiidae species in the northern region (Brazil). The newly discovered *Thraulodes inopinatus* sp. n. has hyaline membrane fore and hindwings, differentiating it from *T. marianoi* and *T. basimaculatus*. The median projection of the styliger plate has a rounded shape with a dorsal curvature, the penis lobe is wide medially and taper towards the apex, and the telopenis groove opens ventro-laterally, differentiating the new species from *T. niger*, *T. nigrabdominalis*, *T. nigripes* and *T. nigrotibialis*.

**Keywords** Hagenulinae · Mayfly · Aquatic insects · Taxonomy · Neotropical region

## Introduction

*Thraulodes* Ulmer, 1920 is the most species-rich genus of the Leptophlebiidae with about 70 valid species, and most of its species are known only from the adult stage (Boldrini et al. 2018; Kluge 2020; Jacobus et al. 2021). It is widely distributed in the New World from Argentina to the south-west of the USA, being most common in the Neotropical region (Domínguez et al. 2006; Jacobus 2024). In South America, 59 species are known, of which 31 species have been described for Brazil (Molineri et al. 2024; Salles et al. 2024a, b).

✉ Stênio R. S. Nascimento
stenio04@hotmail.com

Claudia R. T. De Lima
claudia.tavares.lab@gmail.com

Mylena N. Cardoso
mylenancardoso@gmail.com

Izaias M. Fernandes
izaias.fernandes@unir.br

Rosaly Ale-Rocha
alerocha@inpa.gov.br

Neusa Hamada
neusaha@gmail.com

Paulo V. Cruz
pvilelacruz@gmail.com

[1] Programa de Pós-Graduação em Entomologia (PPGEnt), Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil

[2] Instituto Nacional de Pesquisas da Amazônia (INPA), Coordenação de Pós-Graduação (COPOG), Divisão do Curso em Entomologia (DiEnt), Coordenação de Biodiversidade (CoBio), Laboratório de Citotaxonomia e Insetos Aquáticos, Manaus, Amazonas, Brazil

[3] Laboratório de Biodiversidade e Conservação (LABICON), Universidade Federal de Rondônia (UNIR), Rolim de Moura, Rondônia, Brazil

[4] Departamento de Biologia, Laboratório de Biologia e Diversidade de Insetos (LabDIn), Programa de Pós-Graduação em Conservação e Uso de Recursos Naturais (PPGReN), Universidade Federal de Rondônia (UNIR), Coleção Entomológica, Porto Velho, Rondônia, Brazil

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Most *Thraulodes* species in Brazil have been recorded from the southeastern and southern regions (Lima et al. 2013; Salles et al. 2024b). The genus is still little known for the northern region, with only seven recorded species: *Thraulodes alboniger* Kluge, 2020 from Amazonas state (Nascimento et al. 2021), *T. marreroi* Chacón, Segnini & Domínguez, 1999 (Gama-Neto et al. 2018) and *T. rodrigoi* Boldrini, Dantas & Lima, 2018 from Roraima state, *T. schlingeri* Traver & Edmunds, 1967 from Acre state (Mariano et al. 2011), *T. solstitium* Orlando, Salles, Boldrini & Kütter, 2021 from Tocantins state, *T. yara* Nascimento, Castelaci & Hamada, 2021 from Amapá state and *T. ykamiaba* Nascimento, Castelaci & Hamada, 2021 from Rondônia state.

The small number of records in the region is not exclusive to the genus, as its whole family (Leptophlebiidae) is little known in all Amazonia, with special concern with southwestern Amazonia states. One of these states, Rondônia, with only five species reported, is the state with higher deforestation rates, accelerated biodiversity loss, and impacts related to climate change (Lawton and May 1995; Freitag and Van Jaarsveld 1998; Wilson 1999; Myers et al. 2000; Chapin et al. 2000; Wearn et al. 2012). Species distribution data are particularly relevant in areas under strong anthropic influence (Samways et al. 2020) because they are used in land use and conservation decisions.

Against this background, the aim of this study is to provide data on the biodiversity of Leptophlebiidae (Ephemeroptera) from Rondônia by compiling old and new records and to describe a new species of *Thraulodes* based on male imago.

## Material and methods

The specimens were collected in a Cerrado and Amazon Forest ecotone in various locations in Rondônia state, in northern Brazil (Table 1). Imagoes were captured using a light trap from dusk to dawn (Frost 1957). Their spatial distribution is shown in Figs. 1a, b. The specimens were preserved in 80% ethanol. Legs and genitalia of male imagoes were dissected and examined in alcohol gel and permanently mounted in Euparal® and wings were dry mounted. The terminology used to describe the thorax morphology follows Kluge (1994) and terms referring to the genitalia follow Traver and Edmunds (1967).

Pictures were taken using a Leica M165 C Stereomicroscope coupled to a Leica MC170 HD camera. Leica Application Suite V4.11 software was used to create multidimensional images with improved quality through a variety of focal positions. Photographs were assembled into plates using Adobe Photoshop®. Drawings were made with the aid of Adobe Illustrator CC® software according to Coleman (2003, 2006). The maps were created using the QGis ver. 3.22.5 free software.

The types and other specimens examined are deposited at the Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil (INPA).

## Taxonomy

***Thraulodes inopinatus*** **Nascimento, Ale-Rocha, Hamada & Cruz sp. n.**

http://zoobank.org/urn:lsid:zoobank.org:act:8A3FEFFD-9DC7-4287-83B8-B920EAA8DAF3

(Figs. 2, 3 and 4)

**Diagnosis.** (1) Costal membrane basal to bulla with one cross veins and 10 cross veins distal to bulla; (2) terga I–V with a darker grayish-brown basal and lateral spot, terga VI and VII with a darker grayish-brown lateral spot; (3) styliger plate triangular with posterior median projection apically rounded and curved dorsally; (4) penes medial region wide, narrowing towards the apex, apicolateral area not forming an"ear", poorly developed lateral pouch, telopenes strongly sclerotized, medium sized and lanceolate, ventrally projected.

**Description.** *Male imago*. Body length: 6.1–5.3 mm ($n = 4$); forewing length: 5.7–5.5 mm; hind wing length: 1.1–1.0 mm. General coloration: Brown, with some areas dark brown, legs dark brown; membrane of wings hyaline.

*Head.* Dark brown. Upper portion of eyes orange brown; lower portion grayish-brown. Ocelli whitish, surrounded by grayish-brown ring. Antennae with scape and pedicel dark brown; flagellum light brown (Fig. 2a, b, c).

*Thorax.* Pronotum brown with blackish marks on the sides. Mesonotum dark brown, except for mesonotal, mediooparapsidal and lateroparapidal sutures dark, scuto-scutellar suture blackish; scutellum with dark mark laterally. Pleurae and sterna dark brown, with blackish marks irregularly distributed (Fig. 2a, b, c).

*Wings.* Forewing membrane hyaline, with dark spot at the base, longitudinal and cross veins yellowish-brown, costal membrane basal to bulla with one cross veins and 10 cross veins distal to bulla (Fig. 3a). Hindwing with blunt costal projection and 4 cross veins; wing membrane hyaline; with dark spot at the base; veins yellowish-brown (Fig. 3a).

*Legs.* Foreleg dark brown, tarsus brown, middle and hind legs with apical region of the tibia and tarsus brown (Fig. 3c, d, e).

*Abdomen.* Terga brown, except tergum II–V light brown, terga I–V with a darker grayish-brown anterior and lateral spot, terga VI and VII with a darker grayish-brown lateral spot (Fig. 2a, b).

**Table 1** Sites with Leptophlebiidae (Ephemeroptera) species records at Rondônia State, Brazil, followed by location, date of sample, and geographic coordinates

| Site | Location | Date | Coordinates |
|---|---|---|---|
| S1 | Ribeirão River, Ribeirão | 09.viii.1985 | S10°15′0.00″; W65°16′0.00” |
| S2 | Candeiras River, Travessia Paú | 14.viii.1985 | S10°30′0.00″; W63°15′0.00” |
| S3 | Pedra da Memória River, Ribeirão | 21.viii.2012 | S10°28′20.4″, W65°20′5.0” |
| S4 | Mamoré River, Guajará-Mirin | 22.viii.2012 | S10°3′12.2″; W65°23′47.7” |
| S5 | Candeias River, Candeias do Jamari | 26.viii.2012 | S08°47′30.2″, W63°42′20.3” |
| S6 | Urupá River, Nova Londrina | 02.ix.2012 | S11°02′05″, W62°08′34” |
| S7 | Hermes river, Colorado d'Oeste | 11.ix.2012; 26.viii.2012; 19.viii.2022 | S13°12′08.1″, W60°23′26.1” |
| S8 | 192 waterfall, road 192 south, crossing pasture, Rolim de Moura | 15–21.viii.2022 | S11°50′39.34″, W61°42′50.3” |
| S9 | Stream crossing road, road (linha) 60, under bridge, Vilhena | 16.viii.2022 | S12°52′46.3″, W60°11′32.3” |
| S10 | Linha 60 after bridge, old balneary, Vermelho River, Vilhena | 17.viii.2022 | S12°52′53″, W60°11′38.8” |
| S11 | Road RO 435, between Colorado d'Oeste and Vilhena | 18.viii.2022 | S12°53′53.9″, W60°28′01.5” |
| S12 | Cabixi River, Colorado d'Oeste, border with Mato Grosso state | 19.viii.2022 | S13°15′32.9″, W60°20′03.7” |
| S13 | Urupá River, Urupá, balneary in pasture | 23.viii.2022 | S11°02′07.8″, W62°08′41.5” |
| S14 | Guaporé River, Costa Marques | 26.viii.2022 | S12°27′18.1″, W64°12′13.0” |

*Genitalia*. Styliger plate light brown, triangular with posterior median projection apically rounded and curved dorsally, covering 1/3 of penes (Figs. 2d, e, 4a). Segment I of forceps brown with apical half yellowish, segment II and III yellowish (Fig. 2e, f). Penes brownish, medial region wide, narrowing towards the apex, apicolateral area not forming an"ear", poorly developed lateral pouch, telopenes strongly sclerotized, medium sized and lanceolate, ventrally projected, with groove opened ventro-laterally (Figs. 2d, e, f, g, 4a, b, c).

**Type material. Holotype:** 1 ♂ imago in alcohol, Brazil, Rondônia state, Vilhena municipality, Stream crossing road, road (linha) 60, under bridge, S12°52′46.3″, W60°11′32.3″, 16.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA-EPH 000046). **Paratypes:** 2 ♂ imagos in alcohol (light trap), same data as holotype (INPA-EPH 000047); 1 ♂ imago in alcohol, Brazil, Rondônia state, Vilhena municipality, Linha 60 after bridge, old balneary, Vermelho River, S12°52′53″, W60°11′38.8″, 17.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA-EPH 000048).

**Female imago.** Unknown.

**Nymph.** Unknown.

**Etymology.** The species epithet ‘*inopinatus*’ is Latin for ‘unexpected’, reflecting its surprising discovery.

## Checklist

***Hagenulopsis minuta* Spieth, 1943** (Fig. 5a, b)

**Material examined**. 1 ♂ imago (light trap), Brazil, Rondônia State, Vilhena municipality, Vermelho River, Linha 60 after bridge, old balneary, S12°52′53″, W60°11′38.8″, 17.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Amazonas (Peters and Domínguez 2001), Bahia (Lima et al. 2016), Espírito Santo (Campos et al. 2022), Mato Grosso (Campos et al. 2022), Minas Gerais (Campos et al. 2022), Pará (Peters and Domínguez 2001), Piauí (Campos et al. 2022) and Roraima (Gama-Neto and Hamada 2014). **New record.** Rondônia State.

***Hydromastodon sallesi* Polegatto & Batista, 2007**

**Material examined**. 5 ♂ imago (light trap), Brazil, Rondônia State, Urupá municipality, Urupá River, balneary in pasture, S11°02′07.8″, W62°08′41.5″. 23.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 2 ♂ imago (light trap), Brazil, Rondônia State, Costa Marques municipality, Guaporé River, S12°27′18.1″, W64°12′13.0″, 26.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Maranhão (Nascimento et al. 2020a), Mato Grosso (Polegatto and Batista 2007), Mato Grosso do Sul (Silva and Salles 2017), Piauí (Faria et al. 2023), Rondônia (Salles et al. 2016), Roraima (Polegatto and Batista 2007) and Tocantins (Orlando et al. 2021).

***Hydrosmilodon gilliesae* Thomas & Péru, 2004** (Fig. 5c, d)

**Material examined**. 1 ♂ imago (light trap), Brazil, Rondônia State, Costa Marques municipality, Guaporé River, S12°27′18.1″, W64°12′13.0″, 26.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Bahia (Lima et al. 2012a), Espírito Santo (Salles et al. 2010), Maranhão (Nascimento et al. 2020b), Mato Grosso (Shimano et al. 2011), Pará (Oliveira et al. 2023), Pernambuco (Lima et al. 2012b),

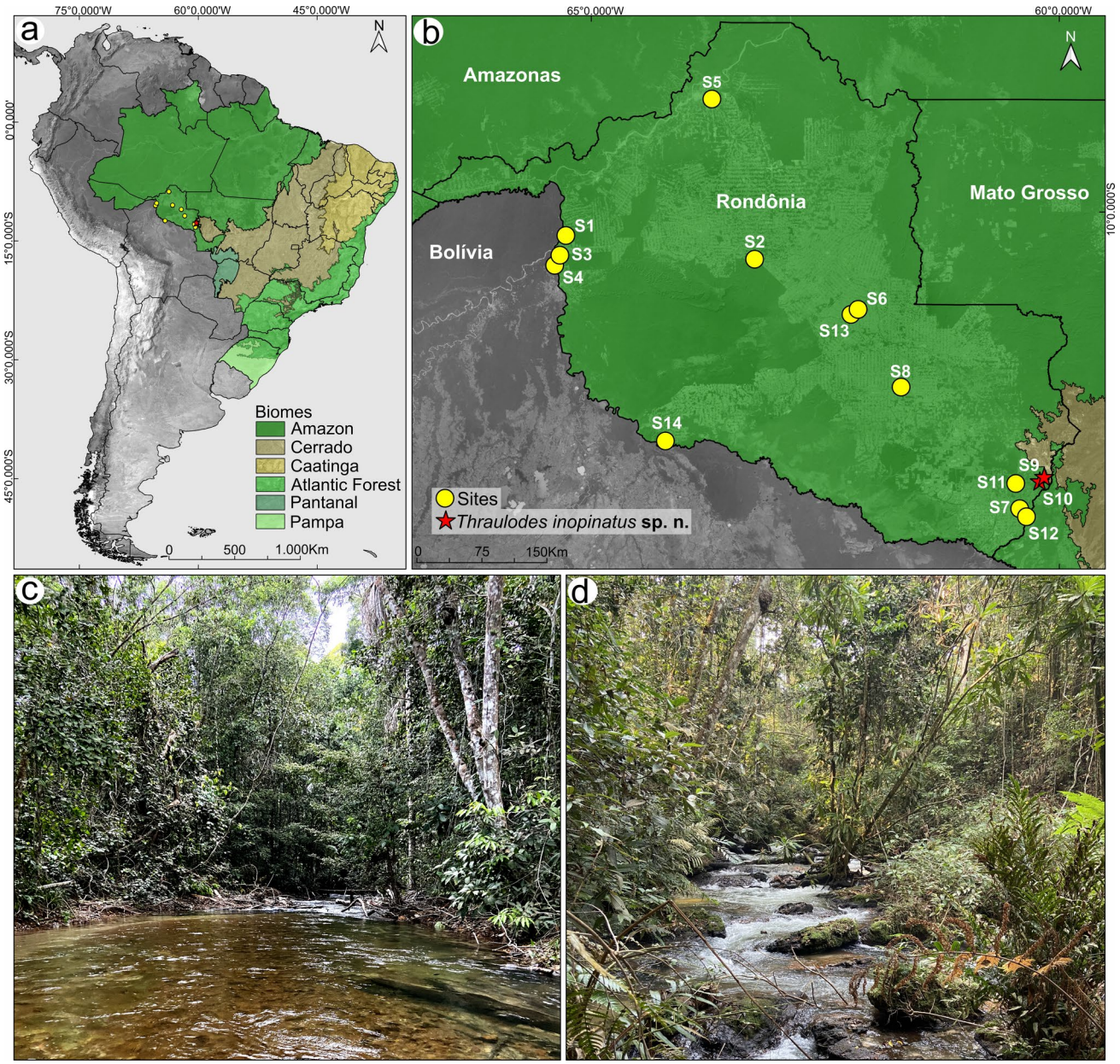


**Fig. 1** **a** Map of South America highlighting Brazilian biomes; **b** map of Rondônia State -Brazil, indicating the collection sites; **c** type locality, stream crossing road, linha 60, Vilhena municipality; **d** type locality, linha 60 after bridge, old balneary, the Vermelho River, Vilhena municipality

Roraima (Salles et al. 2016), São Paulo (Salles et al. 2016) and Tocantins (Orlando et al. 2021). **New record**: Rondônia State.

### *Leentvaaria palpalis* **Demoulin, 1966** (Fig. 5e, f)

**Material examined**. 13 ♂ imagos (light trap), Brazil, Rondônia State, Urupá municipality, Urupá River, balneary in pasture, S11°02′07.8″, W62°08′41.5″, 23.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 11 ♂ imagos (light trap), Brazil, Rondônia State, Costa Marques municipality, Guaporé River, S12º27′18.1″, W64º12′13.0″, 26.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Espírito Santo (Lima et al. 2012a), Maranhão (Nascimento et al. 2020a), Mato Grosso (Salles et al. 2016), Pernambuco (Lima et al. 2012b), Piauí (Faria et al. 2023) and Roraima (Salles et al. 2016). **New record**: Rondônia State.

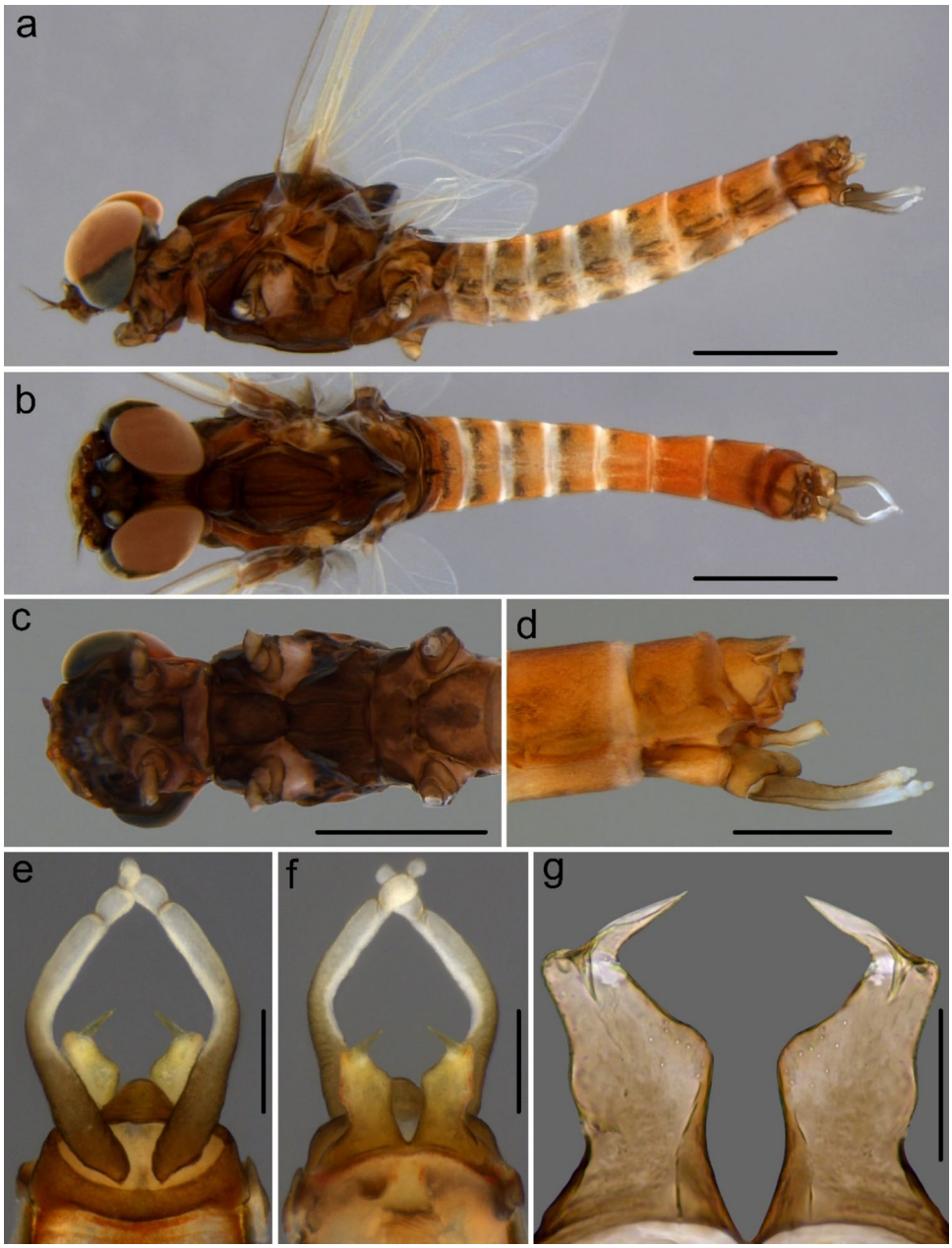


**Fig. 2** *Thraulodes inopinatus* sp. n. male imago: **a** habitus, lateral view; **b** habitus, dorsal view; **c** detail of head and thorax, ventral view; **d** abdominal segments VIII–X, lateral view; **e** detail of genitalia, ventral view; **f** detail of genitalia, dorsal view; **g** detail of penes, ventral view. Scale bars: 1 mm (a, b, c), 0.5 mm (d, e, f), 0.1 mm (g)

***Paramaka convexa* (Spieth, 1943)** (Fig. 5g, h)

**Material examined**. 6 ♂ imagos (light trap), Brazil, Rondônia State, Rolim de Moura municipality, 192 waterfall, road 192 south, crossing pasture, S11°50′39.34″, W61°42′50.3″, 15–21.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 4 ♂ imagos (light trap), Brazil, Rondônia State, Colorado d'Oeste municipality, Cabixi River, border with Mato Grosso state, S13°15′32.9″, W60°20′03.7″, 19.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 3 ♂ imagos (light trap), Brazil, Rondônia State, Urupá municipality, Urupá River, balneary in pasture, S11°02′07.8″, W62°08′41.5″, 23.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 1 ♂ imago (light trap), Brazil, Rondônia State, Costa Marques municipality, Guaporé River, S12º27′18.1″, W64º12′13.0″, 26.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Bahia (Mariano 2011), Maranhão (Nascimento et al. 2020a), Mato Grosso (Shimano et al. 2011), Minas Gerais (Salles et al. 2025), Pará (Savage and Domínguez 1992), Piauí (Faria et al. 2023), Roraima (Raimundi et al. 2017) and Tocantins (Salles et al. 2025). **New record**: Rondônia State.

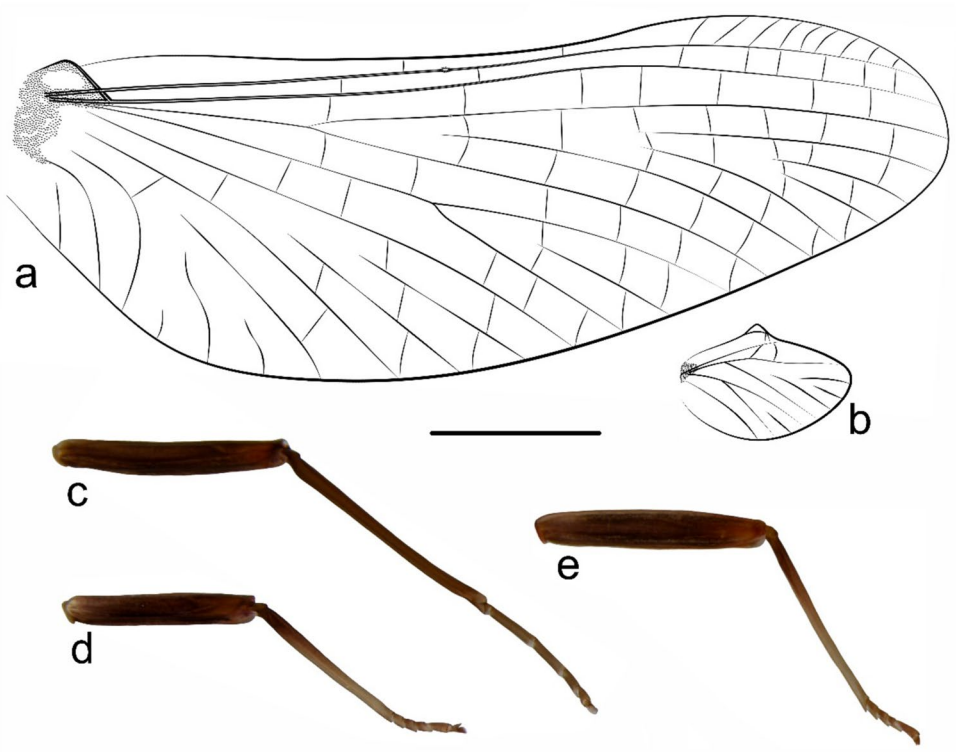


**Fig. 3** *Thraulodes inopinatus* sp. n. male imago: **a** forewing; **b** hindwing; **c** foreleg; **d** middle leg; **e** hind leg. Scale bar: 1 mm

***Paramaka pearljam* Mariano, 2011** (Fig. 5i, j)

**Material examined**. 9 ♂ imagos (light trap), Brazil, Rondônia State, Vilhena municipality, Vermelho River, Linha 60 after bridge, old balneary, S12°52′53″, W60°11′38.8″, 17.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 4 ♂ imagos (light trap), Brazil, Rondônia State, Colorado d'Oeste municipality, Cabixi River, border with Mato Grosso state, S13°15′32.9″, W60°20′03.7″, 19.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Mato Grosso (Mariano 2011) and Piauí (Faria et al. 2023). **New record**: Rondônia State.

***Simothraulopsis demerara* (Traver, 1947)**

**Material examined**. 1 ♂ imago (light trap), Brazil, Rondônia State, Urupá municipality, Urupá River, balneary in pasture, S11°02′07.8″, W62°08′41.5″, 23.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Amapá (Nascimento et al. 2017), Amazonas (Domínguez et al. 1997), Bahia (Lima et al. 2016), Ceará (Nascimento et al. 2017), Espírito Santo (Salles et al. 2010), Goiás (Raimundi 2019), Maranhão (Nascimento et al. 2020b), Mato Grosso (Nascimento et al. 2017) Pará (Domínguez et al. 1997), Paraná (Faria and Salles 2019), Pernambuco (Lima et al. 2012b), Piauí (Takiya et al. 2016), Rondônia (Nascimento et al. 2017), Roraima (Nascimento et al. 2017) and Tocantins (Boldrini and Krolow 2017).

***Simothraulopsis janae* Mariano, 2010**

**Material examined**. 1 ♂ imago (light trap), Brazil, Rondônia State, Urupá municipality, Urupá River, balneary in pasture, S11°02′07.8″, W62°08′41.5″, 23.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 1 ♂ imago (light trap), Brazil, Rondônia State, Costa Marques municipality, Guaporé River, S12º27′18.1″, W64º12′13.0″, 26.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Bahia (Mariano 2010), Maranhão (Nascimento et al. 2020a), Mato Grosso (Nascimento et al. 2017), Minas Gerais (Nascimento et al. 2017), Pará (Nascimento et al. 2017), Pernambuco (Lima et al. 2012b), Rondônia (Nascimento et al. 2017), Roraima (Gama-Neto and Hamada 2014) and Piauí (Faria et al. 2023).

***Thraulodes alboniger* Kluge, 2020** (Fig. 6a, b)

**Material examined**. 1 ♂ subimago (light trap), Brazil, Rondônia State, Road RO 435, between municipalities Colorado d'Oeste and Vilhena, S12°53′53.9″, W60°28′01.5″, 18.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

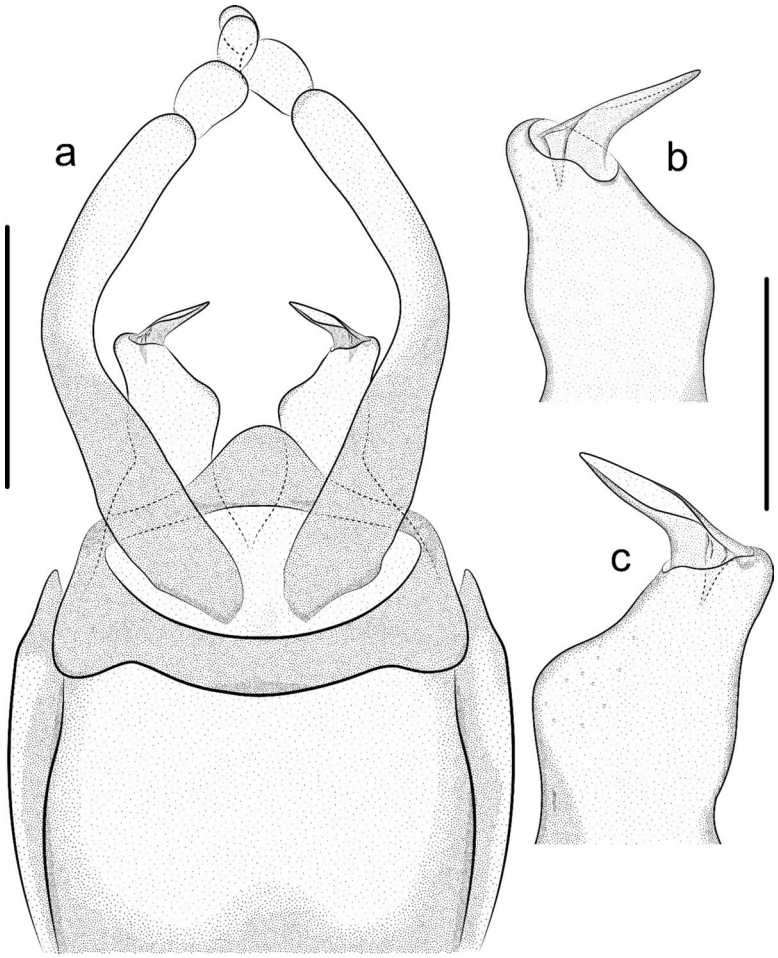


**Fig. 4** *Thraulodes inopinatus* sp. n. male imago: **a** detail of genitalia, ventral view; **b** detail of penes, dorsal view; **c** detail of penes, ventral view. Scale bars: 0.5 mm (a), 0.1 mm (b, c)

**Distribution**. Brazil: State of Amazonas (Nascimento et al. 2021). **New record**: Rondônia State.

***Thraulodes marreroi* Chacón, Segnini & Domínguez, 1999** (Fig. 6c, d)

**Material examined**. 5 ♂ imagos (light trap), Brazil, Rondônia State, Urupá municipality, Urupá River, balneary in pasture, S11°02′07.8″, W62°08′41.5″, 23.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: States of Maranhão (Nascimento et al. 2020b) and Roraima (Gama-Neto et al. 2018). **New record**: Rondônia State.

***Thraulodes yaciara* Nascimento, Castelaci & Hamada, 2021** (Fig. 6e, f)

**Material examined**. 5 ♂ imagos (light trap), Brazil, Rondônia State, Colorado d'Oeste municipality, Cabixi River, border with Mato Grosso state, S13°15′32.9″, W60°20′03.7″, 19.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: State of Mato Grosso (Nascimento et al. 2021). **New record**: Rondônia State.

***Thraulodes ykamiaba* Nascimento, Castelaci & Hamada, 2021**

**Material examined**. 3 ♂ imagos (light trap), Brazil, Rondônia State, Colorado d'Oeste municipality, Hermes river, S13°12′08.1″, W60°23′26.1″, 19.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: State of Rondônia (Nascimento et al. 2021).

***Traverella excelsior* Nascimento & Lima, 2020** (Fig. 6g, h)

**Material examined**. 1 ♂ imago (light trap), Brazil, Rondônia State, Rolim de Moura municipality, 192 waterfall, road 192 south, crossing pasture, S11°50′39.34″,

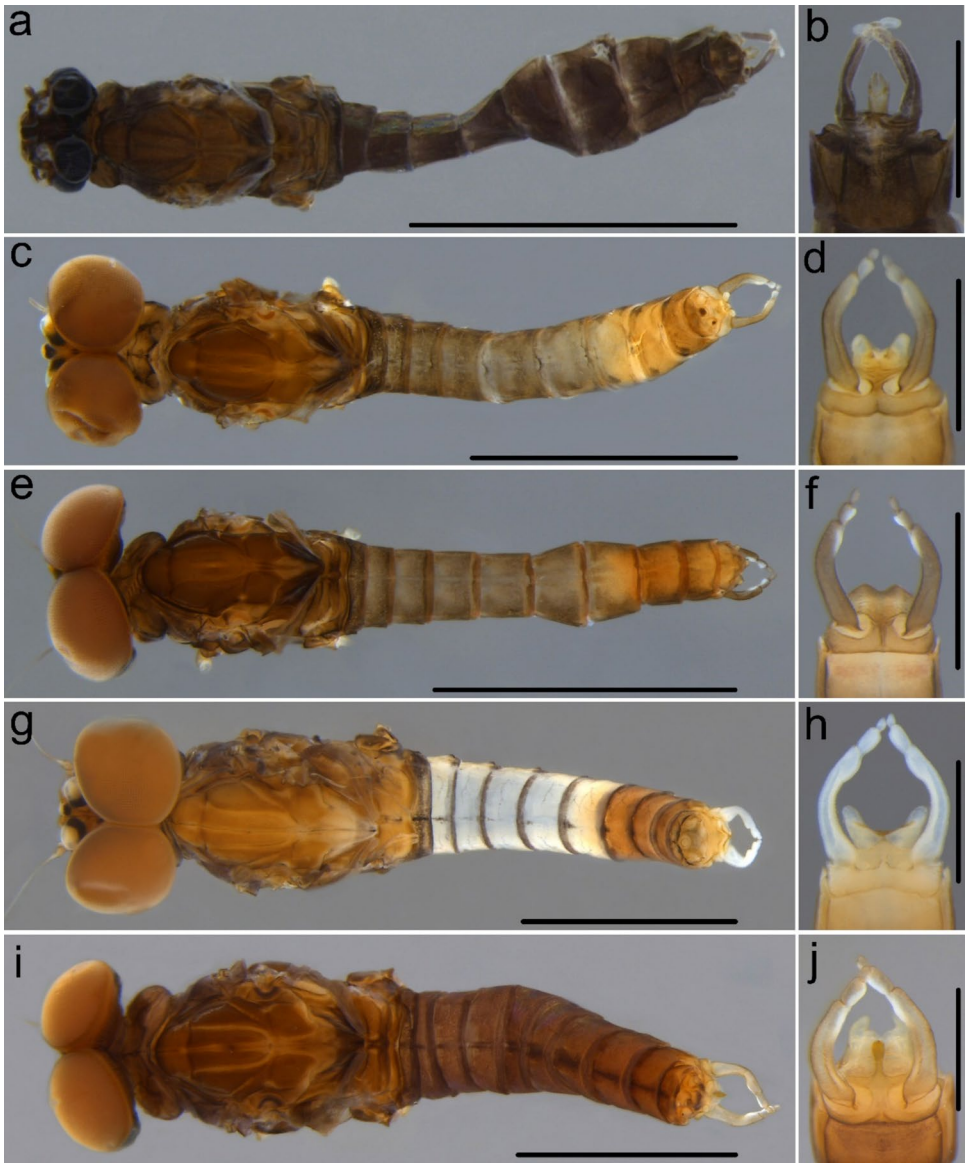


**Fig. 5** Male imagos, body dorsal view and genitalia ventral view: **a, b** *Hagenulopsis minuta*; **c, d** *Hydrosmilodon gilliesae*; **e, f** *Leentvaaria palpalis*; **g, h** *Paramaka convexa*; **i, j** *Paramaka pearljam*. Scale bars: 1 mm (a, c, e, g, i), 0.5 mm (b, d, f, h, j)

W61°42′50.3″, 15–21.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 3 ♂ imagos (light trap), Brazil, Rondônia State, Colorado d'Oeste municipality, Cabixi River, border with Mato Grosso state, S13°15′32.9″, W60°20′03.7″, 19.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: State of Maranhão (Nascimento et al. 2020a). **New record**: Rondônia State.

### *Ulmeritoides amajari* Boldrini & Lima, 2017 (Fig. 6i, j)

**Material examined**. 1 ♂ subimago (light trap), Brazil, Rondônia State, Urupá municipality, Urupá River, balneary in pasture, S11°02′07.8″, W62°08′41.5″, 23.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA). 4 ♂ imagos (light trap), Brazil, Rondônia State, Costa Marques municipality, Guaporé River, S12º27′18.1″, W64º12′13.0″, 26.viii.2022, Nascimento, S.R.S., Cruz, P.V., Lima, C.R.T. cols. (INPA).

**Distribution**. Brazil: State of Roraima (Boldrini and Lima 2017). **New record**: Rondônia State.

### *Ulmeritoides misionensis* Domínguez, 1995

*Ulmeritoides misionensis* was reported for Brazil by Da-Silva and Lopes in 2001 based on nymphs collected in the state of Rondônia. This species was not collected in this study.

**Distribution**. Brazil: State of Rondônia (Da-Silva and Lopes 2001).

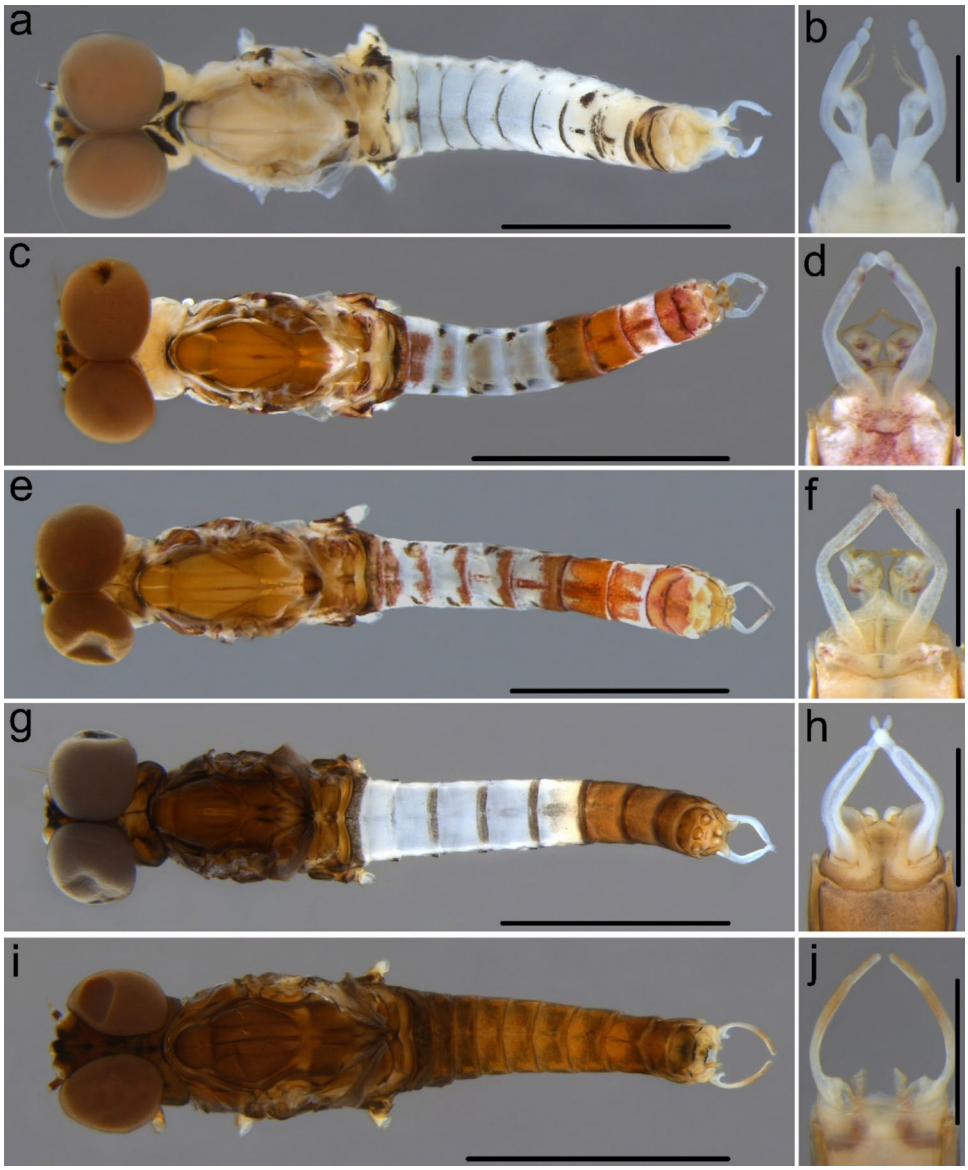


**Fig. 6** Male imagos, body dorsal view and genitalia ventral view: **a, b** *Thraulodes alboniger*; **c, d** *Thraulodes marreroi*; **e, f** *Thraulodes yaciara*; **g, h** *Traverella excelsior*; **i, j** *Ulmeritoides amajari*. Scale bars: 1 mm (a, c, e, g, i), 0.5 mm (b, d, f, h, j)

## Discussion

*Thraulodes* is a diverse genus in Brazil, however, species exhibiting morphological characteristics with a dark body color pattern and dark tibiae on all legs have so far only been identified in Brazil as *T. marianoi* Silva, Salles & Pinto, 2020. The newly described *Thraulodes inopinatus* sp. n. presents fore and hindwings membrane hyaline, while *T. marianoi* has a brown proximal half of the forewing, with the hindwing entirely brown. The same wing characteristics that distinguish the new species from *T. marianoi* also differentiate it from *T. basimaculatus* Giordano & Domínguez, 2005, from Bolivia. Another distinction is that *T. marianoi* exhibits a penis with a distinct lateral area resembling an"ear", whereas in *Thraulodes inopinatus* sp. n. the lateral area does not.

Kluge (2020) described four species from Peru with the same dark color pattern as the new species: *T. niger*, *T. nigrabdominalis*, *T. nigripes* and *T. nigrotibialis*. Among these, *Thraulodes inopinatus* sp. n. is morphologically similar to *T. nigrabdominalis*. In *T. nigrabdominalis*, the median projection of the styliger plate is triangular, the lobes of the penis are long and narrow with a cylindrical shape, and the telopenis groove opens dorsolaterally. In contrast, in *Thraulodes inopinatus* sp. n. the median projection of the styliger plate has a rounded shape with a dorsal curvature, the penis lobe is wide medially and taper towards the apex, and the telopenis groove opens ventro-laterally.

The results of this study added 11 new records for the state, increasing the number of species from five to 16 (Table 2). Rondônia has now become the third state with the most records of Leptophlebiidae species in the Northern Region. Lima et al. (2024) used niche modeling

**Table 2** List of Leptophlebiidae species in Rondônia State, Brazil, followed by their sites. * = previous records

| Species | Sites |
|---|---|
| *Hagenulopsis minuta* Spieth, 1943 | S10 |
| *Hydromastodon sallesi* Polegatto & Batista, 2007* | S6; S13; S14 |
| *Hydosmilodon gilliesae* Thomas & Péru, 2004 | S14 |
| *Leentvaaria palpalis* Demoulin,1966 | S13; S14 |
| *Paramaka convexa* (Spieth, 1943) | S8; S12; S13; S14 |
| *Paramaka pearljam* Mariano, 2011 | S10; S12 |
| *Simothraulopsis demerara* (Traver, 1947)* | S5; S6; S7; S13 |
| *Simothraulopsis janae* Mariano, 2010* | S3; S4; S6; S13; S14 |
| *Thraulodes alboniger* Kluge, 2020 | S11 |
| *Thraulodes marreroi* Chacón, Segnini & Domínguez, 1999 | S13 |
| *Thraulodes yaciara* Nascimento, Castelaci & Hamada, 2021 | S12 |
| *Thraulodes ykamiaba* Nascimento, Castelaci & Hamada, 2021* | S7 |
| *Thraulodes inopinatus* **sp. n** | S9; S10 |
| *Traverella excelsior* Nascimento & Lima, 2020 | S8; S12 |
| *Ulmeritoides amajari* Boldrini & Lima, 2017 | S13; S14 |
| *Ulmeritoides misionensis* Domínguez, 1995* | S1; S2 |

to investigate the distribution of Leptophlebiidae species in the Brazilian Amazon, predicting the occurrence of nine species in Rondônia, five of which were corroborated by the present study: *H. gilliesae*, *L. palpalis*, *P. convexa*, *S. demerara*, and *S. janae*.

Our records, combined with recent studies in the state of Rondônia (Cruz et al. 2023; Nascimento et al. 2023; De Lima et al. 2025), demonstrate a high diversity of genera and species, even in highly anthropized areas. Considering the new data, there is a need to reassess recent biodiversity models, collection efforts, threats, and priority areas for the order Ephemeroptera in the Amazon (Cardoso et al. 2023; Lima et al. 2024).

## Key to the male imagos of *Thraulodes* with dark coloration on the tibiae of all legs

1. Forewing membrane brown on proximal half [Fig. 6 in Silva et al. (2020). Figure 1 in Giordano and Domínguez (2005) ..... 2
1'. Forewing with membrane hyaline [Fig. 427 in Kluge (2020)] ..... 3
2(1). Penes short and wide with distinct "ear-like" lateral area and poorly developed lateral pouch [Fig. 11 in Silva et al. (2020)] ..... *T. marianoi*
2'. Penes narrow with a short and robust spine, without lateral fold, apicolateral area not forming a"ear"and recurved fold weak [Fig. 5 in Giordano and Domínguez (2005)] ..... *T. basimaculatus*
3(1'). Styliger plate without median extension [Fig. 529 in Kluge (2020)] ..... *T. nigrotibialis*
3'. Styliger plate with median extension (Figs. 2e, 4a) ..... 4
4(3'). Styliger plate with posterior median projection short (Figs. 2e, 4a) ..... 5
4'. Styliger plate with posterior median projection long [(Fig. 432 in Kluge (2020)] ..... 6
5(4). Penes lobes long, narrow and slightly divergent, without lateral pouch, not widened apically, without "ear". Telopenes with spear-like shape, stout, with groove opened dorsally-laterally [(Figs. 471, 472 in Kluge (2020)] ..... *T. nigrabdominalis*
5'. Penes medial region wide, narrowing towards the apex, apicolateral area not forming an"ear"(Figs. 2g, 4a). Telopenes medium sized and lanceolate, ventrally projected, with groove opened ventrally-laterally (Figs. 2g, 4b, c) ..... *Thraulodes inopinatus* sp. n.
6(4'). Penes lobes long, without lateral pouch, not widened apically, without "ear". Telopenes spear-like, with groove opened dorsally-laterally [(Figs. 433, 439 in Kluge (2020)] ..... *T. niger*
6'. Penes lobes with well-developed "ears". Telopenes spear-like, long and straight [(Figs. 496, 501 in Kluge (2020)] ..... *T. nigripes*

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Desenvolvimento das Ações Científicas e Tecnológicas e à Pesquisa do Estado de Rondônia (FAPERO). Edital PDJr 21/2022/CNPq/FAPERO, Processes: 0012.068218/2022 -46 and 0012.067617/2022 -90—Resistência e resiliência de insetos aquáticos em riachos ameaçados pelas atividades antrópicas na Amazônia and Process: 0012.068211/2022 -24—Ecologia e Conservação de Ephemeroptera (Insecta): uma abordagem do Brasil e do estado de Rondônia; Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), process: 408346/2023 -0; Chamada CNPq/MCTI/Nº10/2023: Diversidade de Ephemeroptera (Insecta) do Brasil: expandindo as fronteiras da geração e divulgação do conhecimento; Insetos Aquáticos na América do Sul: taxonomia integrativa, biologia e ecologia, CNPq process n. 308970/2019 -5. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil Finance Code 001.

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## Declarations

**Conflicts of interest** The authors declare no conflict or competing of interest.

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