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## A new species of *Thraulius* Eaton, 1881 (Ephemeroptera: Leptophlebiidae) from the Western Ghats, South India

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### ABSTRACT

*Thraulius jacobusi* sp. n. is described based on the nymphs collected from the Veerapandi River in the south of the Western Ghats. *Thraulius jacobusi* sp. n. may be distinguished from other oriental species of *Thraulius* Eaton, 1881 by the following combination of characters in the nymphs: labial palp ratio, maxillary palp ratio of segments II and III, the colouration of legs, shape and denticulation of claws, shape of tergite I, and posterolateral spines on the tergum VIII and IX. Nymphal diagnostic keys to Indian species of *Thraulius* are provided.

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*Thraulius jacobusi* sp. n.;  
Tamil Nadu; *Thraulius*  
*mudumalaiensis*;  
Western Ghats

## Introduction

The family Leptophlebiidae in South India at present comprises of 10 genera: *Isca* Gillies, 1951; *Notophlebia* Peters and Edmunds, 1970; *Thraulius* Eaton, 1881; *Petersula* Sivaramakrishnan, 1984; *Nathanella* Demoulin, 1955; *Choroterpes* Eaton, 1881; *Edmundsula* Sivaramakrishnan, 1985; *Indialis* Peters and Edmunds, 1970; *Klugephlebia* Selvakumar, Subramanian, and Sivaramakrishnan, 2016 (in Selvakumar, Sivaruban, Subramanian, and Sivaramakrishnan 2016); and *Megaglena* Peters and Edmunds, 1970 (Selvakumar et al. 2016; Vasanth, Subramanian, Selvakumar, Kubendran, and Sivaramakrishnan 2021), in which all of them are the representatives of subfamily Atalophlebiinae. The systematic position of *Thraulius* is discussed in detail by several authors in the past. O'Donnell and Jockusch (2008) placed the genus *Thraulius* in the *Choroterpes* group based on the combined analysis of H3 and 28S genes. Contrary to this, Monjardim, Paresque, and Salles (2020) placed *Thraulius* in the tribe Thraulini and separated from the tribe Choroterpini based on the combined analysis of COI and 28S genes. *Thraulius* is an old world genus that comprises 16 known species.

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In India, four species of *Thraulius* have been recorded so far (*T. gopalani* Grant and Sivaramakrishnan, 1985; *T. mudumalaiensis* Soman, 1991; *T. semicastanea* (Gillies, 1951) and *T. thiagarajani* Balasubramanian and Muthukatturaja, 2019). In this contribution, we describe a new species of *Thraulius* based on nymphs from the southern part of the Western Ghats.

## Material and methods

The nymphs of the new species were collected from the Veerapandi River of the Western Ghats, Tamil Nadu. The collected specimens were preserved in 80% ethanol. The morphological characters of the new species were studied with the help of the LABOMED Luzeo 6Z stereo zoom microscope and LABOMED Lx400 microscope. The photos were acquired using AR 6 Pro digital camera and editing of photos was done with Adobe Photoshop 7.0. Type specimens are deposited in the American College Museum (AMC), Madurai, Tamil Nadu, India.

## Results

### *Thraulius jacobusi* sp. n.

(Figures 1–25)

#### *Type locality*

India, Tamil Nadu State, Theni District, Veerapandi River, 9°96.63'N, 77°43.53'E.

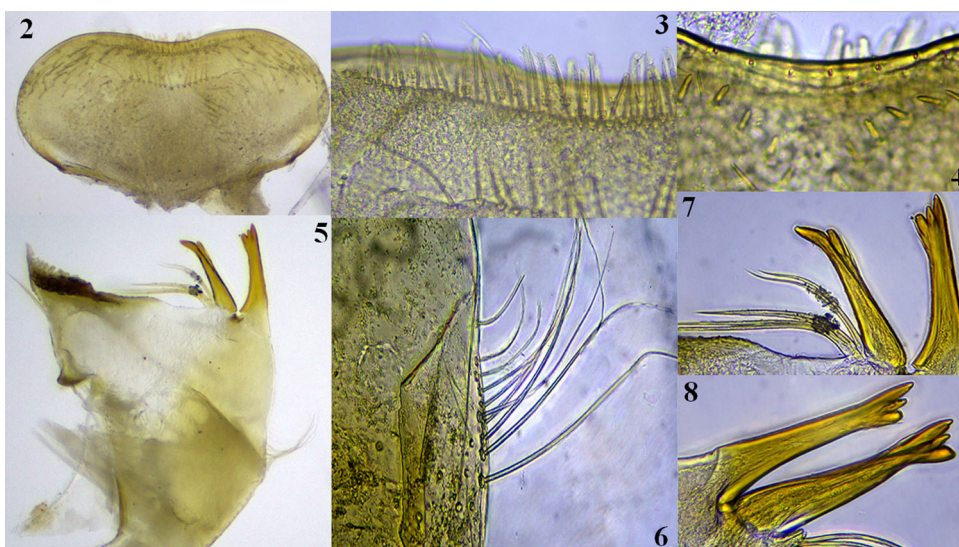
#### *Type material*

**Holotype (on slide).** ♂ mature nymph, 'South India, Tamil Nadu, Theni District, Veerapandi River, 9°96.63'N, 77°43.53'E; ca.308 m; 2.10.2020, leg. Pandiarajan Srinivasan and Rajasekaran Isack' (AMC, ZN 239).

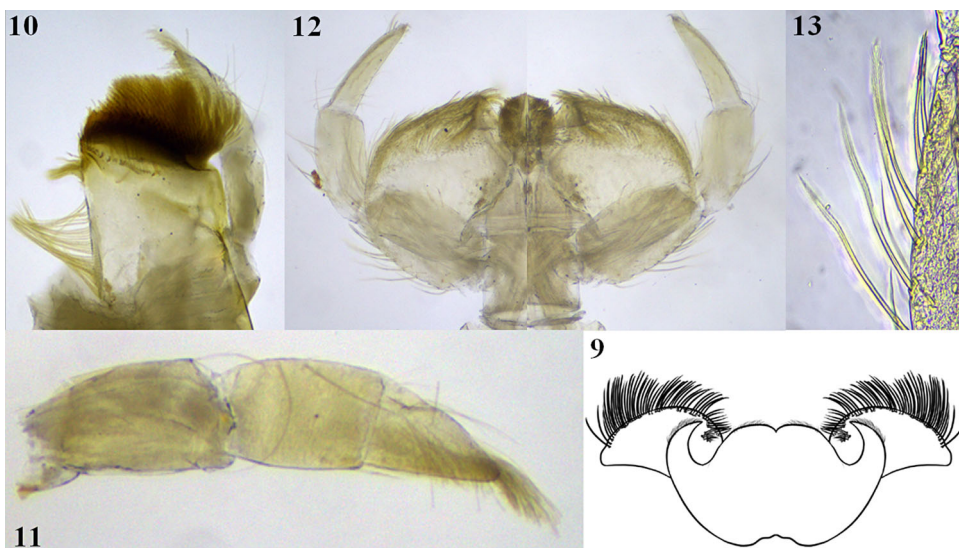
**Paratypes.** 1 ♀ mature nymph, 2 nymphs, with same label data as holotype (AMC, ZN 240).



**Figure 1.** *Thraulius jacobusi* sp. n., female nymph, dorsal view.



**Figures 2–8.** *Thraululus jacobusi* sp. n.: (2) labrum, dorsal view; (3) distal row setae in dorsal surface of labrum; (4) anterior median emargination of labrum with minute processes submarginally; (5) right mandible; (6) outer surface setae in mandible; (7) incisor and kinetodontium of right mandible; (8) incisor and kinetodontium of left mandible.

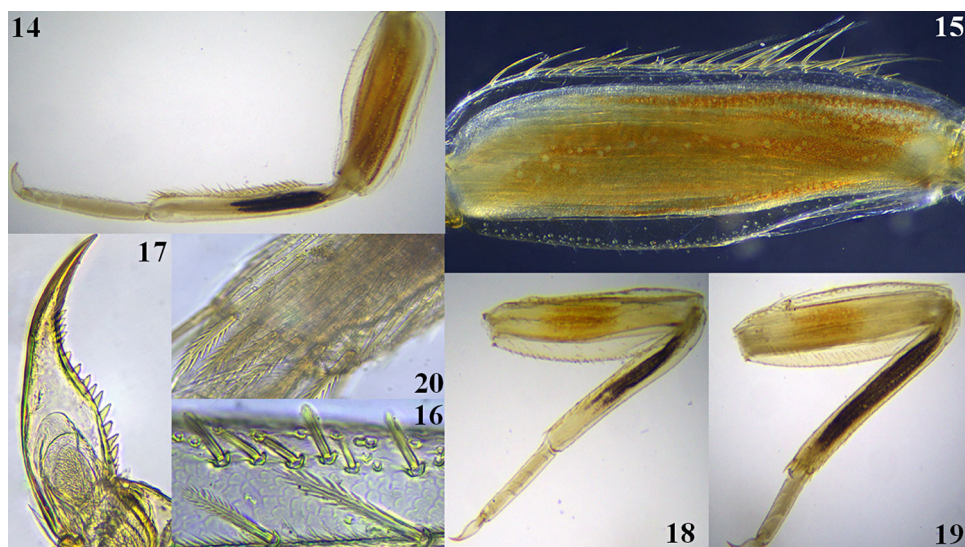


**Figures 9–13.** *Thraululus jacobusi* sp. n.: (9) hypopharynx; (10) maxilla; (11) maxillary palp; (12) labium; (13) frayed setae with feathery margins apically on outer margin of labial palp segments I and II.

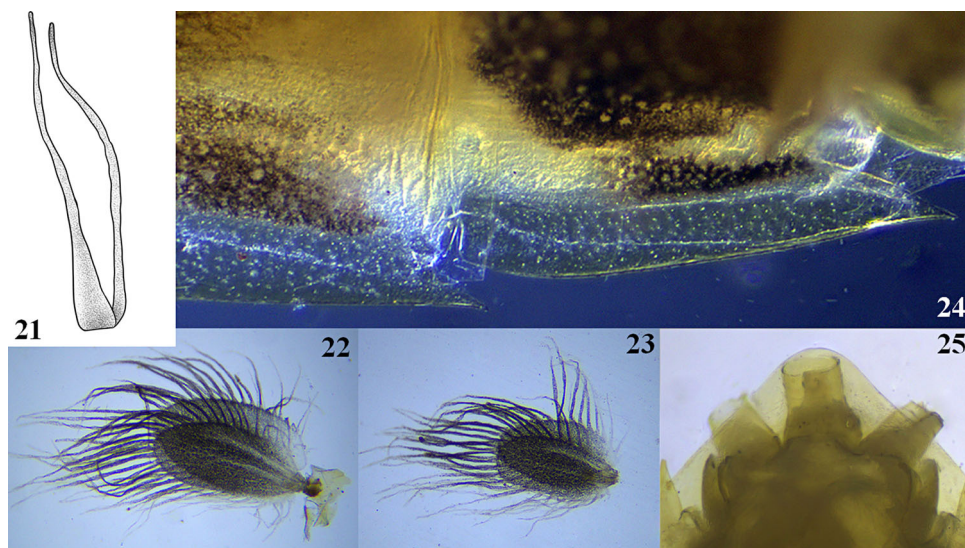
### **Description of nymph**

**Measurements.** Body length: 6.5–6.8 mm (Figure 1); cerci length subequal to body length.





**Figures 14–20.** *Thraululus jacobusi* sp. n.: (14) foreleg; (15) forefemur; (16) forefemoral surface setae; (17) foreclaw; (18) midleg; (19) hindleg; (20) hindtibial surface setae.



**Figures 21–25.** *Thraululus jacobusi* sp. n.: (21) tergalus I; (22) tergalus IV; (23) tergalus VII; (24) posterolateral spines on abdominal segments VIII and IX; (25) abdominal sternum IX (female nymph).

**Colouration.** Head and thorax generally light brownish; legs generally yellowish; fore-femora entirely washed with orange pigmentation; basal 2/3 of midfemora and hind-femora with orange pigmentation; proximal half of foretibia and midtibia with black pigmentation; hindtibia entirely washed with black pigmentation, this black colouration of tibiae as seen in Figures 14, 18, 19 belongs to the subimaginal cuticular colouration and is lacking (or much less expressed) in the previous instar nymphs; abdominal terga generally dark brownish; medially with pair of yellowish longitudinal

streaks washed with dark reddish brown pigmentation; submedial area of tergum light brownish; sublateral parts washed with blackish tints and lateral parts yellowish; abdominal sterna generally pale with pair of longitudinal reddish brownish streaks in submedial area of all segments of sternum, predominantly well developed in sterna VIII and IX; cerci light brownish.

**Head.** Labrum: two times longer than wide (Figure 2); anterio-median emargination shallow with 5–6 min processes submarginally (Figure 4); dorsally with two transverse rows of setae; distally with a row of stout setae, slightly frayed or with feathery margins apically (Figure 3); proximally with a row of long, thin, simple setae. Hypopharynx (Figure 9): linguae with well-developed lateral projections with fine, simple setae; superlinguae with a row of long simple setae on the outer margin, not reaching the apex. Mandibles: outer margin smoothly curved towards distal end, straightened towards proximally (Figure 5); middle of outer margin bears about 10–12 long, simple setae (Figure 6). Right mandible (Figure 5): outer incisor with three stout denticles and 2–3 sharp spine-like denticles on the inner margin and kinetodontium with two stout denticles and a sharp spine-like denticle on the outer margin (Figure 7); prosthema with tuft of 6 hair like setae; medial margin between prosthema and mola, projected and hump like medially; 4–5 simple setae below mola. Left mandible: outer incisor with three stout denticles with three sharp spine-like processes on the inner margin and kinetodontium with three denticles and three sharp spine-like processes on the outer margin (Figure 8); prosthema with tuft of 9–10 hair like setae. Maxilla (Figure 10): apical-ventral row of 20–22 pectinate setae and a large comb-shaped distal dentiseta; maxillary palp three-segmented; ratio of three segments 0.9:0.6:0.6; segment I 2.5 times longer than wide; inner and outer margin of segment II with 4–5 long, simple setae; segment III with a cluster of fine and straight setae, distinctly hooked apically (Figure 11); inner marginal surface with two longitudinal rows of spine-like setae. Labium (Figure 12): glossae small and semi-elliptical, equipped with stout, spines on the apical margin; paraglossae large, in which the posterior margin medially bulged. Labial palp three-segmented; ratio of three segments 1.0:0.9:0.9; segment I 1.7 times longer than wide; segments I and II outer margins with a row of long, slightly frayed setae, with feathery margins apically (Figure 13); segment III with 4 curved, spine-like setae on the dorsal surface; apically with a tuft of small, simple setae on the outer margin.

**Thorax.** Legs: foreleg (Figure 14): femur: 0.48 mm; about 2.8 times long as wide; tibia: 0.43 mm; tarsi: 0.29 mm; claw: 0.08 mm. Femur (Figure 15): outer margin with row of long bipinnate setae; inner margin with a row of broadly spatulate pinnate setae; inner marginal surface with a row of bipinnate setae (Figure 16). Tibia: outer margin mostly bare; inner margin with three rows of bipinnate setae. Tarsi: inner margin with a row of bipinnate setae; outer margin with few hair-like bristles. Claw: long, curved and apically sharply pointed with a row of 11–12 large, stout denticles towards the proximal end and 5 small, denticles near the subapical region (Figure 17). Midleg (Figure 18): femur: 0.48 mm; about 3.1 times long as wide; tibia: 0.43 mm; tarsi: 0.20 mm; claw: 0.09 mm. Femur same as of foreleg. Tibia: outer margin with row of

hair-like setae; inner marginal surface with an irregular row of bipinnate bristles. Tarsi: inner margin with a row of spine-like setae; outer margin with few hair-like bristles; midclaw and hindclaw similar to foreclaw. Hindleg (Figure 19): femur: 0.57 mm; about 3.3 times long as wide; tibia: 0.54 mm; tarsi: 0.20 mm; claw: 0.09 mm. Femur: outer margin with row of long, bipinnate setae; outer marginal surface with a row of short, stout, bipinnate setae on the proximal half; inner marginal surface with an irregular row of short, bipinnate setae; inner margin with row of short, spine-like setae. Tibia: outer and inner margin with row of stout, spine-like setae; dorsal surface equipped with numerous bipinnate setae in the distal half (Figure 20). Tarsi: inner margin with row of spine-like setae; outer margin with few hair-like bristles; hindclaw similar to that of foreleg.

**Abdomen.** Tergalii present on abdominal segments 1–7; tergalium I forked, lamellae filamentous, dorsal lamella slightly broader near base and ventral lamella slender without any visible tracheation (Figure 21); dorsal and ventral lamellae of tergalia II–VII elliptical with long fringed margins (Figures 22, 23). Posterolateral spines present only on abdominal segments VIII and IX (Figure 24). Subanal plate of female larva rounded triangular (Figure 25). Caudal filaments with a whorl of spine-like setae on every 2<sup>nd</sup> segment, setae shorter than the length of the corresponding segment.

### **Imago**

Unknown.

### **Distribution**

Western Ghats, Tamil Nadu, India.

### **Diagnosis**

Nymphal diagnostic characters of *Thraulius jacobusi* sp. n. are as follows: (i) labrum distally with a transverse row of stout setae, slightly frayed or with feathery margins apically (Figure 3); (ii) antero-median emargination of labrum, shallow with 5–6 minute processes submarginally (Figure 4); (iii) labial palp segments I and II outer margins with a row of slightly frayed setae, with feathery margins apically (Figure 13); (iv) forefemora entirely washed with orange pigmentation; basal 2/3 of midfemora and hindfemora with orange pigmentation; proximal half of foretibia and midtibia with black pigmentation; hindtibia entirely washed with black pigmentation (Figures 14, 18, 19); (v) claw long, curved and apically sharply pointed with a row of 11–12 large, stout denticles towards the proximal end and 5 small, denticles near the subapical region (Figure 17); (vi) tergalium I forked, lamellae filamentous, dorsal lamella slightly broader near base and ventral lamella slender without any visible tracheation (Figure 21) and (vii) posterolateral spines present only on abdominal segments VIII and IX (Figure 22).

## Etymology

This species is dedicated to Dr Luke M. Jacobus for his outstanding contribution to the taxonomy of Ephemeroptera. The species name is a noun in the genitive case.

## Discussion

*Thraululus jacobusi* sp. n. distinguished from the two Indian species: *T. gopalani* and *T. thiagarajani* by the filamentous ventral lamella of tergalium I with margins entire, whereas, in both *T. gopalani* and *T. thiagarajani*, well developed ovate ventral lamella on tergalium I with margins fringed (Grant and Sivaramakrishnan 1985; Balasubramanian and Muthukatturaja 2019). *Thraululus jacobusi* sp. n. is further distinguished from closely related *T. mudumalaiensis* by (i) presence of well-developed pair of longitudinal reddish brownish streaks in the submedial area of all abdominal sterna, whereas, in *T. mudumalaiensis*, abdominal sterna 2–9 without ‘macula’ (Soman 1991); (ii) labial palp segment II wider than segment III, whereas, in *T. mudumalaiensis*, labial palp segment II as wide as segment III (Soman 1991; Figure 2); (iii) maxillary palp segment III subequal to the length of segment II, whereas, in *T. mudumalaiensis*, maxillary palp segment III is much shorter than the segment II (Soman 1991; Figure 4a); (iv) maxillary palp segment II is just slightly longer than wide, whereas, in *T. mudumalaiensis*, length of segment II of maxillary palp is twice its width (Soman 1991; Figure 4a). It may also be distinguished from other oriental species of *Thraululus* with similar tergalium I such as *T. bishopi* Peters and Tsui, 1972, *T. fatuus* Kang and Yang, 1994, *T. macilentus* Kang and Yang, 1994, and *T. umbrosus* Kang and Yang, 1994 by the denticulation of claws, shape of labial palp segment II, and ratio of maxillary palp segments II and III (Peters and Tsui 1972; Kang and Yang 1994). The new species cannot be compared with *T. semicastanea* as it is known only from the adult stage; the generic status of *T. semicastanea* is highly questionable (Kluge 2022). Moreover, the geographical distance between the ranges of the two species is considerable.

## Key to the nymphs of Indian species of the genus *Thraululus* Eaton, 1881

- 1 Ventral lamella of tergalium I filamentous, margins entire . . . . . 2
- Ventral lamella of tergalium I not filamentous. . . . . 3
- 2 Maculae absent on abdominal sterna I–IX; maxillary palp segment II slightly longer than wide. . . . . *mudumalaiensis*
- Maculae present on abdominal sterna I–IX; length of maxillary palp segment II twice its width . . . . . *jacobusi* sp. n.
- 3 Tergalium VII similar in size to other tergalia . . . . . *gopalani*
- Tergalium VII shorter than other tergalia. . . . . *thiagarajani*

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## Disclosure statement

No potential conflict of interest was reported by the author(s).

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