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A new species of *Caenis* Stephens, 1835 and description of male subimaginal characters of *Caenis americani* Srinivasan et al., 2021 (Ephemeroptera: Caenidae) from the Western Ghats, South India

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ABSTRACT
Caenis limai sp. n. is described from the Veerapandi River in Theni, South India based on the larva, adult, and egg stages. The total number of *Caenis* species in India thereby is being augmented to eleven. The most closely related species to *Caenis limai* sp. n. is *Caenis ulmeriana* Malzacher, 2015 and the comparisons between both species are discussed herewith. The most important male subimaginal characters of *Caenis americani* Srinivasan et al., 2021 is described for the first time.

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Introduction

Indian caenids comprise only two genera: *Caenis* Stephens, 1835 and *Clypeocaenis* Soldán, 1978. Both genera have got considerable attention in the last decade in the country, i.e., five species of *Clypeocaenis* (Muthukatturaja, Balasubramanian, and Murugan 2020; Balasubramanian and Muthukatturaja 2021; Srinivasan, Sivaruban, Barathy, Isack, and Jacobus 2022) and five species of *Caenis* (Malzacher 2015; Srinivasan, Sivaruban, Barathy, and Isack 2021a; Srinivasan, Sivaruban, Barathy, Malzacher, and Isack 2021b; Muthukatturaja and Balasubramanian 2021) have been discovered and recorded. So far, nine species of *Caenis* have been reported from India: *C. incurva* Malzacher, 2015, *C. picea* Kimmins, 1947, *C. piscina* Kimmins, 1947, *C. srinagari* Traver, 1939 from North India and *C. kimminsis* Ali, 1967, *C. maratha* Malzacher, 2015, *C. americani* Srinivasan et al., 2021, *C. nigropunctatula* Malzacher, 2015, and *C. maduraiensis* Balasubramanian and Muthukatturaja, 2021 from South India. However, the original description of *C. kimminsis* was considered as superficial one according to modern standards (Staniczek et al.

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2020; Srinivasan et al. 2021b), so it is to be considered as *species inquirenda* and the identification by Selva Kumar, Sundar, and Arunachalam (2012) seems questionable. Of the eight remaining species, three (*C. nigropunctatula*, *C. maduraiensis*, *C. picea*) have both larval and adult characters known (Malzacher 2015; Malzacher and Sangpradub 2020; Muthukatturaja and Balasubramanian 2021; Srinivasan et al. 2021a). In this contribution, we describe a new species of *Caenis* from South India based on larva, adult, and egg stages along with male subimaginal characters of *C. americani* described for the first time.

Material and methods

Collections were made in several regions of Southern Western Ghats, Tamil Nadu. The collected specimens were preserved in 80% ethanol. Larvae, imagines and subimagines were associated by rearing the last instar larva in containers with stagnant water, subsequently, subimagines were removed from the container after emergence and put in another empty vessel until the emergence of imago. The morphological characters were studied with the help of the LABOMED Luzeo 6Z stereo zoom microscope and LABOMED Lx400 microscope. Photos were acquired using the AR 6 Pro digital camera and editing of photos was done by Adobe Photoshop 7.0. The eggs were dissected out and collected from the female subimago. Specimens studied using scanning electron microscopes were first dehydrated using ethanol and dried by critical point drying and then examined with a VEGA3 TESCAN scanning electron microscope at 10k. Digital SEM photographs were made and are subsequently edited with Adobe Photoshop 7.0. Type specimens are deposited in the American College Museum (AMC), Madurai, Tamil Nadu, India.

Results

Caenis limai sp. n.

(Figures 1–42)

Type material

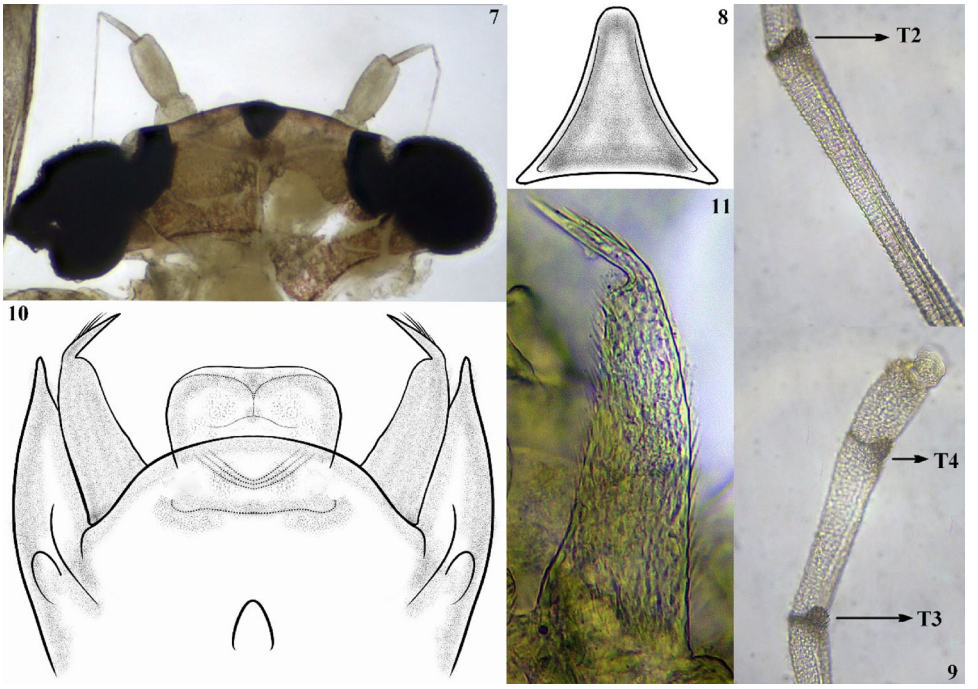
Holotype. ♂ larval exuvia, accompanied by the reared imago, 'South India, Tamil Nadu, Theni District, Veerapandi River, 9°96′63″N and 77°43′53″E, 308 m, 14.2.2022, leg. Srinivasan & Isack' (AMC/ZN/209).

Paratypes. 2 ♂ larval exuviae, accompanied by the reared subimago, 2 ♀ larval exuviae, accompanied by the reared imago, 5 larvae, with same label data as holotype (AMC/ZN/210).

Description of male imago

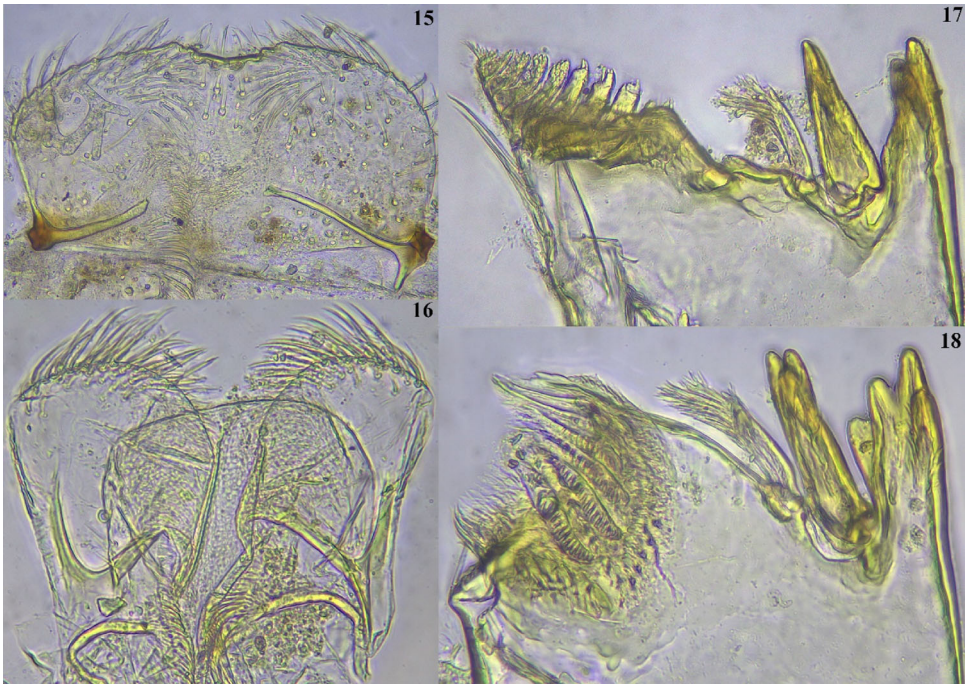
Measurements. Body length (Figure 1): 2.3 mm; forewing length: 1.8 mm; foreleg length: 2.2 mm; midleg length: 0.9 mm; hindleg length: 1.1 mm; cercus length: 6.9 mm. Ratios. Head (see Malzacher 2015, Figure 4k), c:a = 2.4, a:b = 1.1; leg, fore femur:fore tibia = 0.45; fore tibia:fore tarsus = 1.5; fore leg:hind leg = 1.9; segments of fore tarsus, 1st:2nd:3rd:4th:5th = 1:5.7:3.7:2.7:1.4.

Figures 1–6. Male imago of *Caenis limai* sp. n.: (1) lateral view of body and cerci; (2) dorsal view of body; (3) lateral view of body; (4) mesonotum; (5) abdominal terga; (6) antenna.

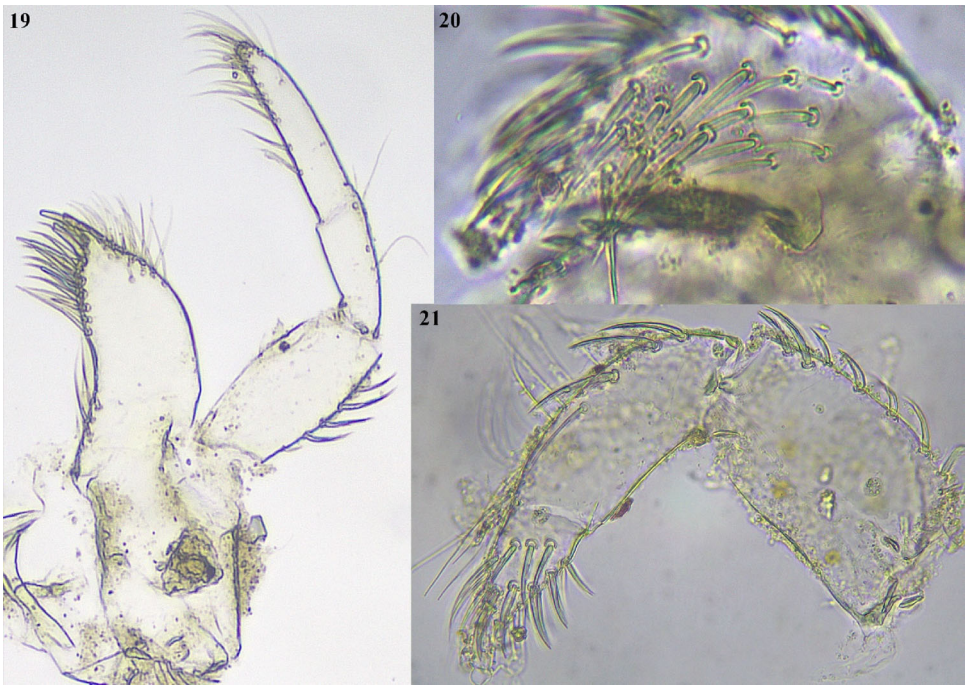


Figures 7–11. Male imago of *Caenis limai* sp. n.: (7) head, dorsal view; (8) prosternal triangle; (9) fore tarsomeres (T2 – tarsomere 2, T3 – tarsomere 3, T4 – tarsomere 4); (10) genitalia; (11) forceps.

Figures 12–14. *Caenis limai* sp. n.: (12) male larva along with exuvia of male larva (holotype) with the same magnification; (13) female larva; (14) closer view of female larva.

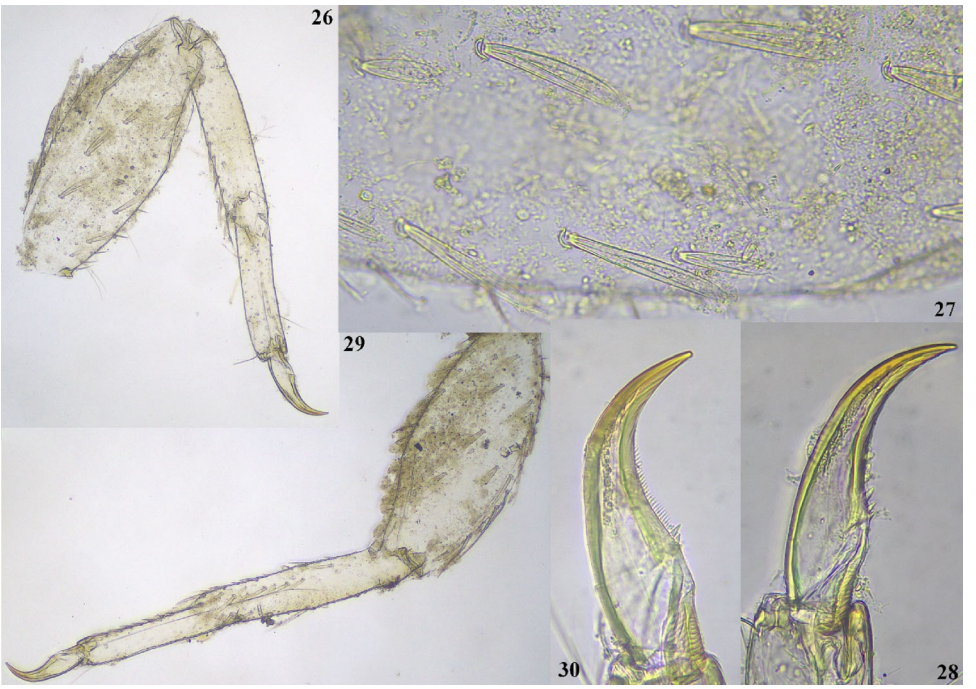


Figures 15–18. Larval exuvia (holotype) of *Caenis limai* sp. n.: (15) labrum; (16) hypopharynx; (17) right mandible; (18) left mandible.

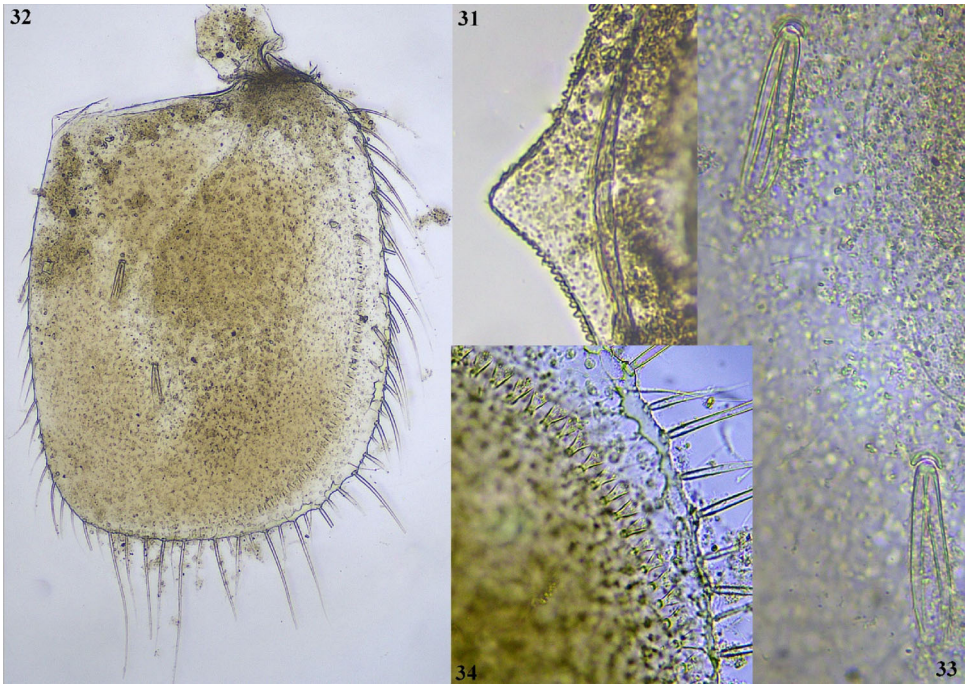


Figures 19–21. Larval exuvia (holotype) of *Caenis limai* sp. n.: (19) maxilla; (20) paraglossa setation; (21) labial palp.

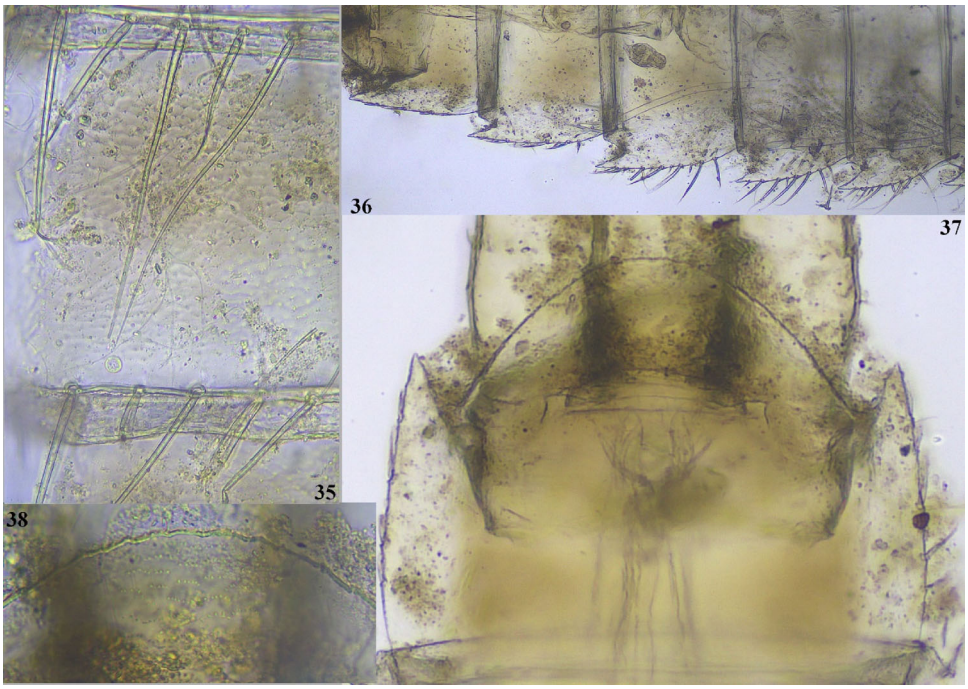
Figures 22–25. Larval exuvia (holotype) of *Caenis limai* sp. n.: (22) foreleg; (23) forefemur setation; (24) foretarsi setation; (25) foreclaw.



Figures 26–30. Larval exuvia (holotype) of *Caenis limai* sp. n.: (26) midleg; (27) midfemur setation; (28) midclaw; (29) hindleg; (30) hindclaw.



Figures 31–34. Larval exuvia (holotype) of *Caenis limai* sp. n.: (31) posteromedian process of tergum II; (32) dorsal view of gill cover; (33) detail of setation in the dorsal surface of gill cover; (34) detail of microtrichia in gill cover.



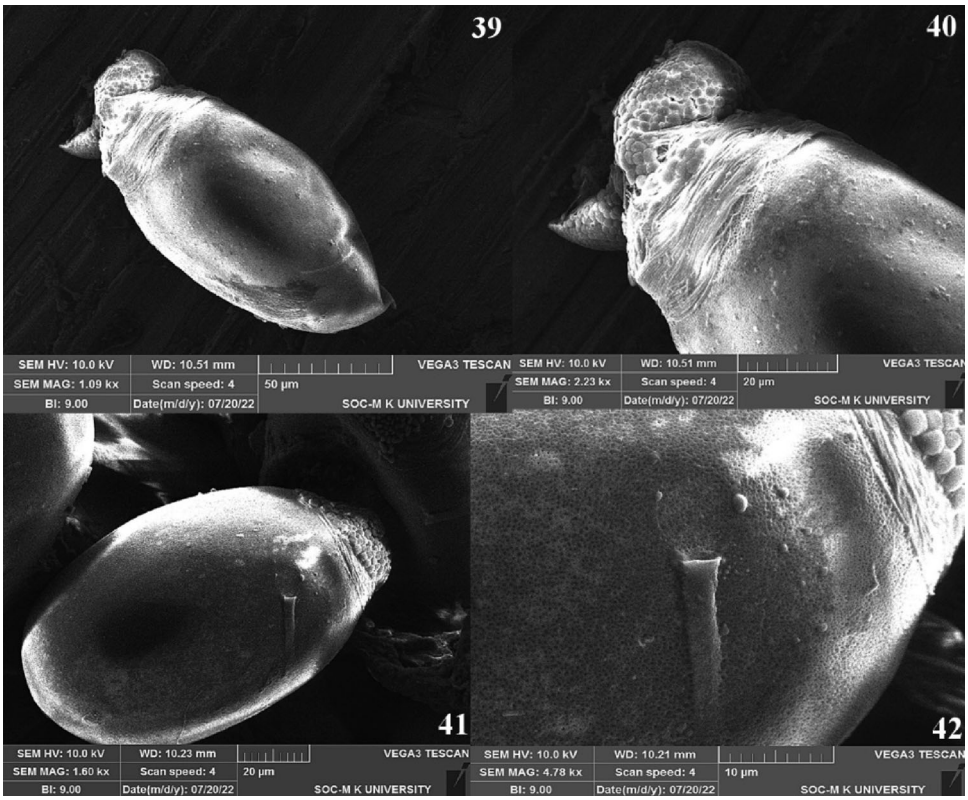
Figures 35–38. Larval exuvia (holotype) of *Caenis limai* sp. n.: (35) setation on hind margin of terga VII and VIII; (36) posterolateral processes; (37) shape of sternum IX; (38) detail of shagreen field in sternum IX.

***Colouration* (Figure 2).** Head: frons light brownish; vertex shaded with greyish brown. Thorax: posterior margin of pronotum with ocher transverse band. Mesonotum with angled black dashes in anterolateral region and few dark spots behind them; scutellum darkly pigmented with anvil-shaped marking (Figure 4). Wings hyaline, costa, and subcostal vein reddish brown. Legs light brownish, except apical part of femora and tibiae with a dark brownish patch. Abdomen: terga I–II often with a faint blackish stippling (Figure 5), other segments of tergum mostly colourless. Cerci translucent.

Head. Foremargin between lateral and frontal ocelli slightly bowed (Figure 7). Pedicel 2.5 times length of scape. Base of antennal flagellum slightly dilated (Figure 6).

Thorax. Fin-shaped process present on mesonotum (Figure 3). Prosternal triangle with concave sides, tip less broadly rounded, without any transverse strip (Figure 8). Foretarsus segments 2–4 each with a tongue-shaped apico-median projection equipped with strong small spines (Figure 9).

Abdomen. Tergum II without a finger-like process. Lateral filaments moderately developed. Genitalia and sternum IX as in Figure 10. Penis broadly rounded; posterio-ventrally with broadly semicircular, light brownish sclerite; styliger sclerite broad with short apophyses. Forceps moderate, less parallel-sided, apically with a large spine equipped with 3–4 small spines (Figure 11).



Figures 39–42. SEM view of eggs of *Caenis limai* sp. n.: (39) general view; (40) epithema; (41) general view of micropyle and epithema; (42) closer view of micropyle and sperm guide.

Description of female subimago

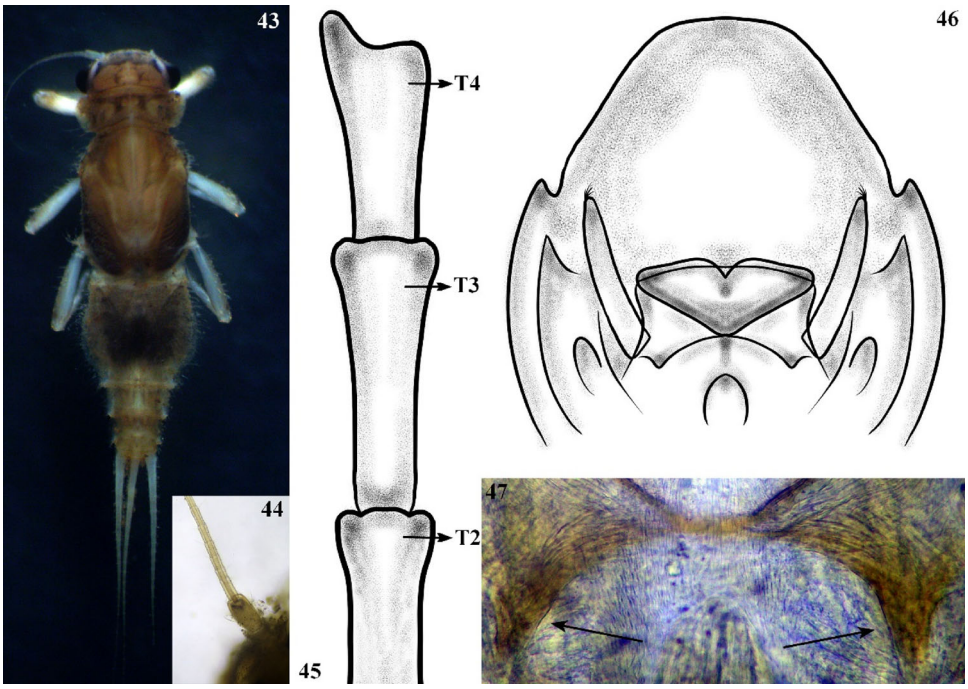
Measurements. Body length: 3.9 mm; forewing length: 2.6 mm. Colouration similar to that of males, but terga III–VI sometimes with slightly developed transverse band.

Description of mature larva

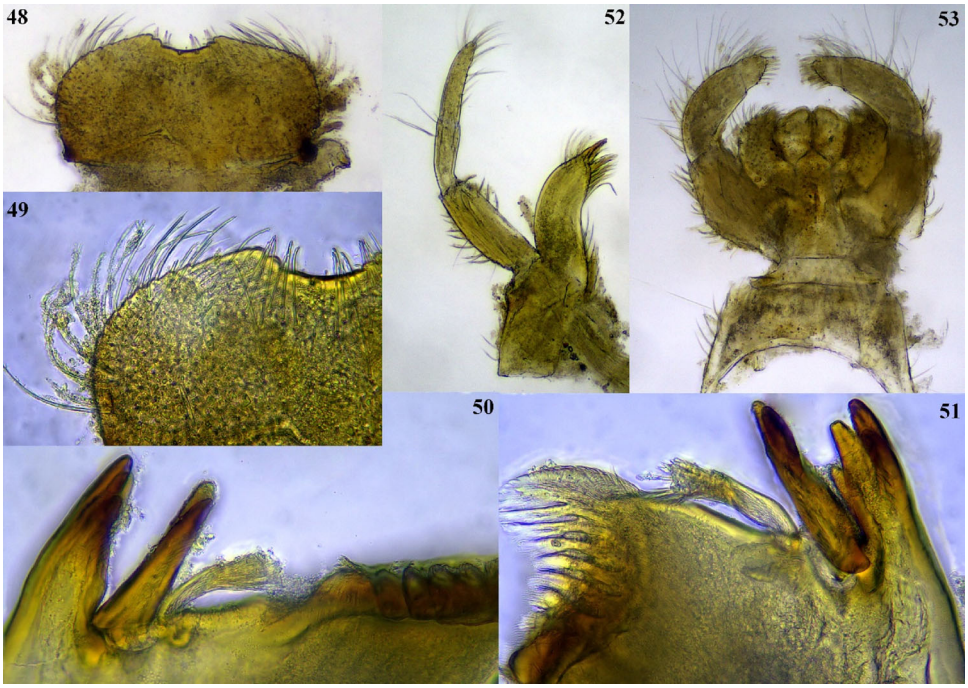
(Figure 12)

Measurements. Body length (Figure 13): 3.7–3.8 mm in female; 2.6–2.8 mm in male. Caudal filaments length: 2.9–3.1 mm in female; 1.6–1.8 mm in male. Antennae length: 1.7–1.8 mm. General body colouration is usually dark brown dorsally and pale brown ventrally.

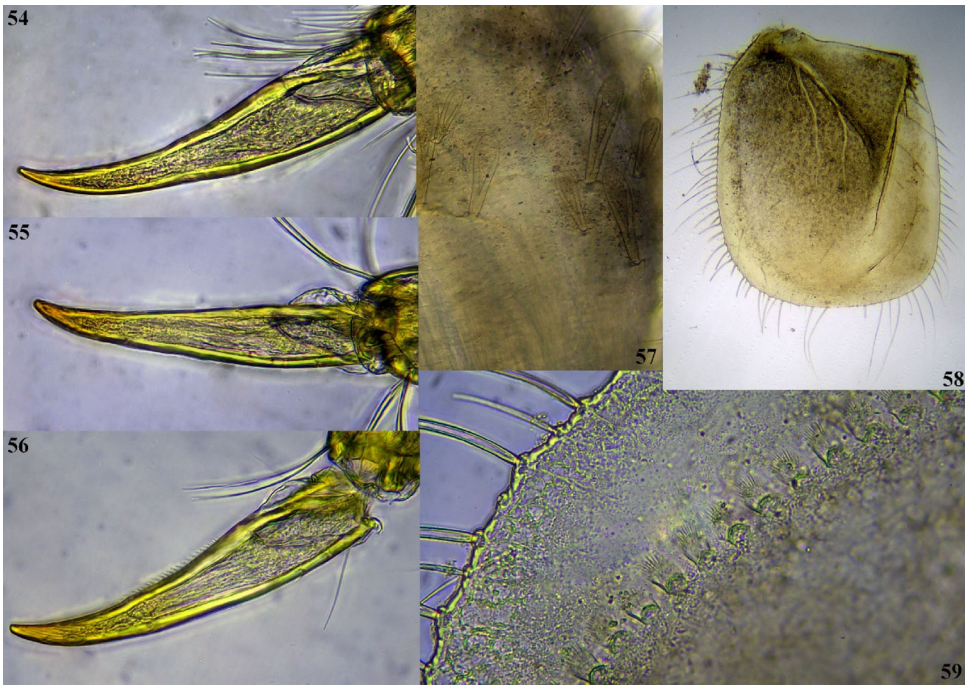
Head. Length 0.39 mm, width 0.86 mm. General colouration dark brown, with a dark brownish transverse band between lateral ocelli; vertex dark brown with branch-like markings (Figure 14). Hind margin without setae, antenna with fine, thin setae on each articulation. Pedicel 2.5 times length of scape and with 3–4 simple setae on lateral margins, genae distinctly bulged in lateral view. Mouthparts: labrum (Figure 15) twice as broad as long, medial emargination with thick setae, lateral margin with long simple setae, dorsal and ventral surface with scattered long, fine simple setae.



Figures 43–47. *Caenis americani* Srinivasan et al., 2021: (43) male larva; (44) antenna; (45) fore tarsomeres (T2–tarsomere 2, T3–tarsomere 3, T4–tarsomere 4); (46) sternum IX of male larva and visible subimaginal genitalia (ventral view); (47) apophyses.



Figures 48–53. *Caenis americani* Srinivasan et al., 2021: (48) labrum; (49) closer view of labrum; (50) right mandible; (51) left mandible; (52) maxilla; (53) labium.



Figures 54–59. *Caenis americani* Srinivasan et al., 2021: (54) foreclaw; (55) midclaw; (56) hindclaw; (57) transverse row of setae in forefemur; (58) dorsal view of gill cover; (59) detail of microtrichia in gill cover.

Hypopharynx (Figure 16) with minute hair-like setae on apical margin and superlingua with long simple setae on lateral margins. Right mandible. Outer incisor with three denticles and inner incisor with two denticles; medial margin without any process between mola and incisors (Figure 17). Left mandible. Outer incisor with four denticles; inner incisor with three denticles; medial margin without any process between mola and incisors (Figure 18). Dorsal surface and outer margin of both mandibles scattered with long spatulate setae. Maxilla (Figure 19). Three-segmented maxillary palp and with a ratio of 1:0.6:1.1; segment I with a row of five pointed bristles on outer margin; segment III with a longitudinal row of long simple setae near inner marginal surface. Labium. Glossa with few small pointed bristles laterally; paraglossa scattered with long spatulate setae (Figure 20); three-segmented labial palp with length ratio of 1:0.9:0.4 (Figure 21); segment I with a row of 7 bipinnate bristles in outer margin, segment II with long hair-like setae all over surface and along outer margin; outer marginal surface with a row of 5–7 bipinnate bristles, segment III with 6–8 spine-like setae in inner margin and two transverse rows of long, spine-like setae on apex along with scattered long hair-like setae on surface and outer margin.

Thorax. Pronotum and mesonotum light brownish and epidermal pigmentation similar to that of imago (Figure 14). Mesonotum with margins denticulate with slight bulging. Legs: coxal processes semi-circular with denticulate margins. Foreleg (Figure 22): lengths of femur:tibia:tarsus:claw 0.43:0.36:0.28:0.15 mm; femur with a transverse row of 12–13 spatulate setae on $^{3}/_{4}$ of distal region (Figure 23); proximal outer

margin with few bipinnate bristles (Figure 23); femora covered with numerous scale bases; inner margin with row of long hair-like setae on proximal half; tibia with longitudinal row of 8–10 spatulate setae on dorsal surface; outer margin with row of long hair-like setae; tarsi with longitudinal row of 2 bipinnate bristles and a long monopectinate seta on distal end (Figure 24); outer and inner margins with a row of long hair-like setae; claw thin and slender. with 2 + 2 long and minute basal denticles (Figure 25). Midleg (Figure 26): lengths of femur:tibia:tarsus:claw 0.45:0.35:0.25:0.13 mm. Femur with scattered spatulate bristles all over surface (Figure 27); outer margin with a few long spatulate setae; tibia similar to that of foreleg; tarsi with a longitudinal row of 7 bipinnate bristles and a long monopectinate seta on distal end; midclaw (Figure 28) broad with 6 basal denticles. Hindleg (Figure 29): lengths of femur:tibia:tarsus:claw 0.48:0.40:0.26:0.15 mm. Femur, tibia, and tarsi similar to that of midleg; claw strongly bent with 3 basal denticles increasing in size distally, and a row of microdenticles, decreasing in size towards distal end (Figure 30).

Abdomen. Visible abdominal terga with dark brownish sublateral patches (Figure 13); gill cover without any shading medially and dark brown patches on other region. Tergum I lack posteromedian process; posteromedian process of tergum II broadly blunt triangular and hind margin denticulate (Figure 31); gill cover with Y-shaped ridges poorly developed, inner one posteriorly reduced (Figure 32); dorsal surface with numerous scales and 2–3 spatulate setae on 2/3rd half of Y-ridge (Figure 33); left margin of Y-ridge with a row of long simple setae with few small spatulate setae (Figure 32). Right margin of Y-ridge with a row of small simple setae. Ventral row of microtrichia originates at some distance from base and ends in posteromedial region; microtrichia elongated, more or less parallel-sided, and pinnate (Figure 34). Tergalius III–VI with numerous filaments. Posterolateral processes on terga I&II absent; tergum III with slightly marked posterolateral processes; terga IV–IX with well-developed posterolateral processes (Figure 36). Hind margin of tergum VII with long hair-like setae and tergum VIII with long hair-like setae along with few spatulate setae (Figure 35) and terga IX and X with small denticles. Hind margin of sternum IX nearly semi-circular with numerous minute indentations medially (Figure 37), shagreen field with irregular transverse rows near posterior margin of sternum IX (Figure 38); Cerci translucent. Gill cover about twice length of tergalius I.

Eggs

Semi-elliptical about twice as long as wide (Figure 39). Chorion with fine pores without any meshes (Figures 41 and 42). One epithema, forming a coil of fine threads, ending in rounded knobs of same size surrounded by the coil (Figures 40 and 41). Micropyle of moderate length, with well visible circular sperm-guide (Figures 41 and 42).

Diagnosis

The new species has a unique combination of characters. Imago: (1) mesonotum with angled black dashes on anterolateral region, scutellum darkly pigmented with anvil-shaped marking (Figure 4); (2) terga I–II often with a faint blackish stippling (Figure

5); (3) base of antennal flagellum slightly dilated (Figure 6); (4) prosternal ridges with concave sides, tip less broadly rounded, without any transverse strip (Figure 8); (5) foretarsus segments 2–4 each with a tongue-shaped apico-median projection (Figure 9); (6) penis broadly rounded; posterio-ventrally with broadly semicircular, light brownish sclerite (Figure 10); (7) forceps moderate, less parallel-sided, apically with a large spine equipped with 3–4 small spines (Figure 11). Larva: (1) genae distinctly bulged in lateral view; (2) medial margin without any process between mola and incisors of right mandible (Figure 17); (3) mesonotum with margins denticulate with slight bulging; (4) forefemur with a transverse row of 12–13 spatulate setae on ¾ of distal region (Figure 22); (5) hindclaw strongly bent with 3 basal denticles increasing in size distally, and a row of microdenticles, decreasing in size towards distal end (Figure 30); (6) gill cover with Y-shaped ridges poorly developed (Figure 32); (7) hind margin of sternum IX nearly semi-circular with numerous minute indentations medially (Figure 37).

Etymology

This new species is named in honour of Dr Lucas R. C. Lima (Universidade Estadual do Piauí, Brazil), for his significant contribution to caenid mayflies. The species name is a noun in the genitive case.

Distribution

Western Ghats (Tamil Nadu, India).

Caenis americani Srinivasan, Sivaruban, Barathy, Malzacher, and Isack, 2021

(Figures 43–59)

Type material

Paratypes. 1 ♀ imago, 2 ♀ larvae 'South India, Tamil Nadu, Dindigul District, Mangalamkombu Stream, 10°30′54″N, 77°67′53″E, ca.1219 m, 16.2.2020, leg. Srinivasan & Isack' (AMC/ZN/181, 182).

Additional material

1 ♂ mature larva, 2 ♂ larvae and 2 ♀ larvae 'South India, Tamil Nadu, Theni District, Megamalai Hills, Manalar Bridge, 9°62.23′N, 77°35.01′E, ca.1580 m, 17.IV.2021, leg. Srinivasan and Isack' (AMC/ZN/252).

Additions to the description

Srinivasan et al. (2021b) discussed the female imaginal and larval characters of *Caenis americani* in detail. However, the drawings are a bit schematic and the male subimaginal characters are unknown. Therefore, here we provide the male subimaginal characters: (1) base of antennal flagellum not dilated (Figure 44); (2) segments 2 and 3 of foretarsus apically slightly broadened; broadenings equipped with small strong spines, segment 4 of foretarsus with small apico-median projection (Figure 45); (3) subimaginal genitalia and sternum IX as in Figure 46. Penis heart-shaped with rounded lobes

and a broadly dark brown v-shaped ventral sclerite. Styliger sclerite broad with apophyses of moderate length, slightly bent laterally outward (Figure 47); foremargin slightly convex. Forceps long, straight, apically with 4–5 short thin spines. Additional photographs of larval mouthparts, legs, and gill cover are also added (Figures 48–59).

Discussion

Caenis limai sp. n. is distinguished from other Oriental species of *Caenis* with known adult characters by the following characteristics: (1) foretarsus segments 2–4 each with a tongue-shaped apico-median projection; (2) penis broadly rounded; posterio-ventrally with broadly semicircular, light brownish sclerite, and (3) terga I–II with a faint blackish stippling. The new species closely resembles *Caenis ulmeriana* Malzacher, 2015 based on the body colouration of imago and larva, similar shape of forceps and penis, foremargin between lateral and frontal ocelli of male imago slightly bowed, and by the incomplete Y-shape ridge in the larva. However, it is distinguished from *C. ulmeriana* by the following characters: In imago: (1) foretarsus segments 2–4 each with an apico-median projection whereas, in *C. ulmeriana*, foretarsus segments 2–4 each with tongue-shaped projections (Malzacher 2015, Figure 4i); (2) penis posterio-ventrally with broadly semicircular, light brownish sclerite, whereas in *C. ulmeriana*, penis without any sclerite posterio-ventrally (Malzacher 2015, Figure 4a). In larva: (1) forefemur with a transverse row of 12–13 slightly developed spatulate setae on $^{3}/_{4}$ of distal region, whereas, in *C. ulmeriana*, forefemur with a transverse row of 6–9 strongly developed spatulate setae on $^{3}/_{4}$ of distal region (Malzacher and Sangpradub 2020, Figure 4g); (2) dorsal surface of gill cover with 2–3 slightly developed spatulate setae on 2/3rd half of Y-ridge, whereas in *C. ulmeriana*, dorsal surface of gill cover with 5–6 strongly developed spatulate bristles in apical half or two-third of Y-ridge (Malzacher and Sangpradub 2020, Figure 4f); (3) hind margin of sternum IX nearly semi-circular with numerous fine indentations medially, but in *C. ulmeriana*, hind margin of sternum IX broadly or triangularly rounded and with smooth margin (Malzacher and Sangpradub 2020, Figure 4a); (4) tarsus with a row of bipinnate bristles and apical one with a large monopectinate seta, whereas in *C. ulmeriana*, tarsus with a row of simple bristles and apical one often with pinnate bristles (Malzacher and Sangpradub 2020). *Caenis limai* sp. n. distinguished from other Indian species by a unique set of characters: In imago: (1) foretarsus segments 2–4 each with a tongue-shaped apico-median projection, (2) penis broadly rounded; posterio-ventrally with broadly semicircular, light brownish sclerite, (3) forceps moderate, less parallel-sided, apically with a large spine equipped with 3–4 small spines. In larva: (1) by the denticulation of claws, (2) mesonotum with margins denticulate with slight bulging; (3) forefemur with a transverse row of 12–13 spatulate setae on $^{3}/_{4}$ of distal region; (4) gill cover with Y-shaped ridges poorly developed; (5) hind margin of sternum IX nearly semi-circular with numerous minute indentations medially.

Caenis americani closely resembles *C. picea* based on the shape of forcipes and penis. However, it is distinguished from *C. picea* by the following set of characters: In imago: (1) segment 4 of foretarsus with small apico-median projection, whereas in *C. picea*, segment 4 of foretarsus apically not broadened and without any projection

(Malzacher 2015; Malzacher and Sangpradub 2020); (2) styliger sclerite broad with apophyses of moderate length, slightly bent laterally outward, whereas in *C. picea*, apophyses slightly bent laterally inward (Malzacher and Sangpradub 2020, Figure 10a). In larva: (1) hindclaw with very small microdenticles, whereas in *C. picea*, well developed denticles are present in the hindclaw (Malzacher and Sangpradub 2020, Figure 10a); (2) hind margin of tergum VIII with long bristles, whereas in *C. picea*, hind margin of tergum VIII with small denticles (Malzacher and Sangpradub 2020); (3) mesonotum distinctly bulged near anterolateral margins, whereas in *C. picea*, no bulging in the lateral margins of mesonotum (Malzacher and Sangpradub 2020). Because of the absence of the male larva and imago, *C. americani* was thought to be parthenogenetic (Srinivasan et al. 2021b). But now, when species's male subimago has been revealed and its characters have been described, these suggestions are not supported anymore.

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Disclosure statement

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

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References

Ali, S.R. (1967), 'The Mayfly Nymphs (Order: Ephemeroptera) of Rawalpindi District', *Pakistan Journal of Science*, 19, 73–86.

Balasubramanian, C., and Muthukatturaja, M. (2021), 'Two Additional New Species of *Clypeocaenis* Soldán, 1978 (Ephemeroptera: Caenidae) from the Western Ghats of Peninsular India', *Zootaxa*, 4915, 377–388..

Kimmins, D.E. (1947), 'New Species of Indian Ephemeroptera', *Proceedings of the Royal Entomological Society of London Series B: Taxonomy*, 16, 92–100..

Malzacher, P. (2015), 'Revision of the Oriental Species of the Genus *Caenis* Stephens (Insecta: Ephemeroptera: Caenidae)', *Stuttgarter Beiträge Zur Naturkunde A: Neue Serie*, 8, 27–47.

Malzacher, P., and Sangpradub, N. (2020), 'New Mayfly Species of *Caenis* and *Kalimaenis* from Thailand and Descriptions of Two New Genera of the Subfamily Caeninae (Ephemeroptera: Caenidae)', *Integrative Systematics: Stuttgart Contributions to Natural History*, 3, 1–33..

Muthukatturaja, M., and Balasubramanian, C. (2021), 'A New Species of *Caenis* Stephens, 1835 (Ephemeroptera: Caenidae) from Tamil Nadu, Southern India', *Zootaxa*, 4980, 366–372..

Muthukatturaja, M., Balasubramanian, C., and Murugan, A. (2020), 'Two New Species of *Clypeocaenis* (Ephemeroptera: Caenidae) from Western Ghats, Southern India', *Zootaxa*, 4722, 361–370..

Selva Kumar, C., Sundar, S., and Arunachalam, M. (2012), 'Diversity and Distribution of Mayflies (Insecta: Ephemeroptera) in Tamirabarani River of Southern Western Ghats, India', *International Journal of Applied Bioresearch*, 5, 1–7.

Soldán, T. (1978), 'New Genera and Species of Caenidae (Ephemeroptera) from Iran, India and Australia', *Acta Entomologica Bohemoslovaca*, 75, 119–129.

Srinivasan, P., Sivaruban, T., Barathy, S., and Isack, R. (2021a), 'New Record of *Caenis nigro-puctatula* Malzacher, 2015 (Ephemeroptera: Caenidae) from Southern India', *Aquatic Research*, 4, 299–303..

Srinivasan, P., Sivaruban, T., Barathy, S., Malzacher, P., and Isack, R. (2021b), 'A New Charismatic *Caenis* Stephens, 1835 (Ephemeroptera: Caenidae) from Southern India', *Zootaxa*, 4926, 105–116..

Srinivasan, P., Sivaruban, T., Barathy, S., Isack, R., and Jacobus, L.M. (2022), 'A New Species of *Clypeocaenis* Soldán 1978 (Ephemeroptera: Caenidae) from Tamil Nadu, India', *Zootaxa*, 5091, 467–476..

Staniczek, A. H., Malzacher, P., Bojková, J., Sroka, P., Soldán, T., Namin, J. I., Nejat, F., Abdoli, A., and Godunko, R. J. (2020), 'Caenidae (Insecta: Ephemeroptera) of Iran, with New Records and Re-Description of the Nymph of *Caenis kopetdagi* Kluge, 1985', *Aquatic Insects*, 41, 106–130..

Stephens, J.F. (1835), 'Family III. - Ephemeridae, Leach. Illustrations of British Entomology', *Mandibulata*, 6, 54–70.

Traver, J.R. (1939), 'Himalayan Mayflies (Ephemeroptera)', *Annals and Magazine of Natural History*, 4, 32–56.