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A new species of the subgenus *Gomphostilbia* Enderlein, 1921 (Diptera: Simuliidae, *Simulium*) from the Eastern Ghats, India

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ABSTRACT. A new black fly species, *Simulium* (*Gomphostilbia*) *sirumalaiense* Vijayan & Anbalagan **sp. nov.**, is described based on the morphological characters of adults (female and male), as well as the pupae and larvae. Pupae and larvae of a new species were collected from leaf litter and debris in streams, specifically on various plants and submerged boulders, cobbles, and pebbles. This new species is placed in the *Simulium batoense* species-group of the subgenus *Gomphostilbia* Enderlein, 1921 by the following characters: antenna with nine flagellomeres, pleural membrane bare, female subcosta bare, pupal gill of eight slender thread-like filaments, hypostomal bristles per side lying parallel to the lateral margin in the larvae. It is morphologically similar to *Simuim* (*G.*) *cauveryense*.

Keywords: black flies, *batoense* species-group, aquatic habitats, lotic streams

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INTRODUCTION

Black flies are medically and ecologically important species in stream ecosystems (Jitklang et al., 2020; Pavitra et al., 2020). A total of 86 species of black flies are recorded in the Western Ghats, India, whereas documentation of black flies is scarce in the Eastern Ghats (Anbalagan et al., 2020b; Vijayan & Anbalagan, 2023; Vijayan et al., 2025).

Taxonomic studies of black flies are crucial for understanding their biodiversity, ecological roles, and potential as disease vectors. Simuliidae comprises over 2415 described species worldwide, with the genus *Simulium* being the most diverse, encompassing more than 1900 species (Anbalagan & Vijayan, 2022; Srisuka et al., 2024; Adler, 2025). A total of 90 species belong to six subgenera: *Eusimulium* Roubaud, 1906 (one species unnamed), *Gomphostilbia* Enderlein, 1921 (19 named and 3 unnamed species), *Montisimulium* Rubtsov, 1974 (five named and one unnamed species), *Nevermannia* Enderlein, 1921 (9 named and two unnamed species), *Simulium* Latreille, 1802 (41 named and eight unnamed species) and *Wilhelmia* Enderlein, 1921 (one species). According to Anbalagan & Vijayan (2022), Vijayan & Anbalagan (2023), Adler (2025), and Vijayan et al. (2025), 19 named species of the subgenus *Gomphostilbia* in India were recorded under six species-groups and one unnamed group: *Simulium* (*G.*) *batoense* Edwards, 1934 (13 named species), *Simulium* (*G.*) *ceylonicum* Enderlein, 1921 (one species), *Simulium* (*G.*) *darjeelingense* Datta, 1973 (one species), *Simulium* (*G.*) *epistum* Delfinado, 1971 (two species), and *Simulium* (*G.*) *gombakense* Takaoka & Davies, 1995 (two species).

Peninsular India has two main mountain ranges: the Western and Eastern Ghats, the major source of many streams and rivers. Due to threatening factors of climate change and anthropogenic impact, the

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floral and faunal diversity requires documentation of the diversity of species in both the Western and Eastern Ghats (Clarke et al., 2019; Gomes et al., 2019; Khelifa et al., 2021). The forest in the Eastern Ghats is the most affected, compared to the Western Ghats and Himalayas, as they are experiencing heavy pressure on all sides. Many studies have documented the flora and fauna of the Himalayas and Western Ghats (Jeyakumar et al., 2002). However, there is limited attention given to these aspects in the Eastern Ghats.

Much research has examined aquatic insects of the Eastern Ghats (Anbalagan et al., 2014; Balachandran et al., 2017; Dinakaran & Anbalagan, 2007; Ramar et al., 2018; Vijayan & Anbalagan, 2018). The taxonomy of black flies, nevertheless, is addressed merely in two reports (Anbalagan et al., 2020b; Vijayan et al., 2025). Additionally, there is an urgent need for ecological protection and sustainable usage, as well as for the documentation and conservation of this biodiversity. In this study, we describe a new black fly species in the *batoense* species-group of the subgenus *Gomphostilbia*, based on adults reared from pupae, associated pupal exuviae and mature larvae collected from the Athumedu, Kolinjipatti stream, Kombaikkadu stream and Thadaganachiamman eastern hills in the southern portion of the Eastern Ghats, India. The present investigation increases the number of black fly species known in India.

MATERIAL AND METHODS

Streams of Athumedu, Kolinjipatti, Kombaikkadu and Thadaganachiamman were surveyed in the southern region of the Eastern Ghats (Fig. 1). The study areas of Eastern Ghats are located between 10°13'41.32"–10°24'02.31"N and 78°01'41.32"–78°00'25.13"E in a north-east to south-west direction. Athumedu stream width 0.8–1.0 m, depth 8 cm, water temperature 19.2°C, partially shaded, elevation 1119 m. Kolinjipatti stream: width 2.3–2.4 m, depth 10 cm, water temperature 29.1°C, exposed to the sun, elevation 252 m. Kombaikkadu stream: width 4.0–4.1 m, depth 13 cm, water temperature 25.2°C, exposed to the sun, elevation 290 m. Thadaganachiamman stream: width 2.1–2.2 m, depth 12 cm, water temperature 25.6°C, more than partially shaded, elevation 308 m. The *batoense* species-group was found at low to mid-level altitudes. This finding was supported by Anbalagan et al. (2020a), Takaoka et al. (2018), and Vijayan et al. (2019). The Eastern Ghats are a discontinuous range of mountains. The diversified ecological niches and environmental situations provide habitat for a rich fauna. Sirumalai lies in Dindigul district, the annual mean maximum and minimum temperatures are 28°C and 10°C, respectively. During the monsoon, rainfalls generally are 156–195 cm per year, but are not evenly distributed throughout the year. The survey was carried out from July 2018 to January 2019. Larvae and pupae were collected manually with a fine brush and forceps from stream substrates (leaf litter, boulders, pebbles, and submerged human waste materials like polythene, snack covers, and cloths). Sterilized water was used for rearing to prevent introducing fungal spores into the system. Collected larvae and those not used for rearing pupae were preserved separately in the field in 70% ethanol. The pupae were separated and placed on wet filter paper in a small plastic container for rearing. They were kept in an incubator adjusted to be similar to their habitat (21–27°C) for one or two days until adult emergence. We maintained regular inspection and adequate ventilation in the rearing area to prevent stagnant air and replaced rearing substrates to prevent the accumulation of organic matter that can promote fungal growth. We employed disinfectants, including 70% ethanol, to sterilize all containers, instruments, and surfaces beforehand. This practice is effective in reducing microbial load and preventing fungal outbreaks (Anbalagan et al., 2011; Hunter et al., 1994; Jonusaite & Buda, 2002; Vasiliev & Aibulatov, 2023; Vijayan et al., 2017). Emerging specimens were stored in 70% ethanol at −20°C, and all type specimens were deposited at the Department of Animal Health and Management, Science Campus, Alagappa University, Karaikudi, Tamil Nadu, India (DAHMA).

Morphological characteristics of larvae, pupae, and adults were examined under a compound and stereo microscope. Dissected parts (heads, thoraxes, abdomens, legs, and wings) were cleared with 85% lactic acid and transferred to glycerin for mounting. Permanent slides were made using a small drop of Canada balsam and were kept for two weeks without disturbing them to become dry. Clear nail polish was applied to the edges of the dried slides to be sealed. The mounting slides were examined under a

Leica® DM300 LED compound microscope. Morphology characters were measured using a micrometre. Morphology characters were manually illustrated using a camera lucida attached to a Leica® MZ16 stereo microscope. Description, illustrations, and terms for morphological features were according to Adler et al. (2004), Anbalagan et al. (2020a), Takaoka (2003), and Vijayan et al. (2019). Dichotomous keys (Takaoka, 2012; Takaoka et al., 2019; Pramual et al., 2022) were used for the identification of specimens.

RESULTS

Taxonomic hierarchy

Order Diptera Linnaeus, 1758

Family Simuliidae Newman, 1834

Subfamily Simuliinae Newman, 1834

Tribe Simuliini Newman, 1834

***Simulium* (*Gomphostilbia*) Enderlein, 1921**

***Simulium* (*Gomphostilbia*) *sirumalaiense* Vijayan & Anbalagan sp. nov.** (Figs 2–4)

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Material examined. **Holotype** ♀ (Slide - DAHMA), India, Thadaganachiamman, Madurai district, 10º13'41.32''N, 78º01'41.32''E, 308 m, 12-VII-2018, S. Vijayan & S. Anbalagan, legs; **Paratypes** (DAHMA)**:** 1♀, 1♂, Athumedu, Dindigul district, 10º24'02.31''N, 78º00'25.13''E, 1119 m, 1-I-2019; 3♀♀, 1♂, Kolinjipatti, Dindigul district, 10º13'27.82''N, 78º06'83.42''E, 252 m, 31-X-2018; 1♀, 2♂♂, Kombaikkadu, Dindigul district, 10º15'87.28''N, 78º06'14.72''E, 290 m, 31-X-2018; S. Vijayan & S. Anbalagan, legs; For all type of specimens the associated pupal exuviae and cocoon are also included.

Additional materials (DAHMA)**.** 15 mature larvae, 8 pupae (with cocoon), Thadaganachiamman, Madurai district, 10º13'41.32''N, 78º01'41.32''E, 308 m, 12-VII-2018, S. Vijayan & S. Anbalagan, legs; 8 mature larvae, 5 pupae (with cocoon), Athumedu, Dindigul district, 10º24'02.31''N, 78º00'25.13''E, 1119 m, 1-I-2019; 5 mature larvae, 2 pupae (with cocoon), Kolinjipatti, Dindigul district, 10º13'27.82''N, 78º06'83.42''E, 252 m, 31-X-2018; 8 mature larvae, 5 pupae (with cocoon), Kombaikkadu, Dindigul district, 10º15'87.28''N, 78º06'14.72''E, 290 m, 31-X-2018; S. Vijayan & S. Anbalagan, legs.

Etymology. The species name *sirumalaiense* refers to the name of the Thadaganachiamman stream, Sirumalai, where this new species was collected.

Diagnosis. *Simulium* (*G.*) *sirumalaiense* **sp. nov.**, is morphologically similar to *S.* (*G.*) *cauveryense* described from Tamil Nadu, South India (Anbalagan et al., 2015) in sharing the following characteristics: maxillary palp proportion lengths of 3rd, 4th and 5th segments 1.0: 1.2: 2.1 and maxillary lacinia with 9 inner and 11 outer teeth in the female, coxite in ventral view 1.26 times as long as its greatest width in the male, common basal stalk 0.43 times as length of interspiracular trunk in the pupa and anal sclerite 0.92 times as long as posterior arms and posterior circlet with 62 rows of up to 12–14 hooklets per row in the larva. The new species is distinguished from *S.* (*G.*) *cauveryense* by the following characters (those of *S.* (*G.*) *cauveryense* in the parentheses): in the female by the fore basitarsus 6.0 times as long as its greatest width (6.4 times as long as its greatest width), claw with large basal tooth 0.5 times as long as claw (0.63 times as long as claw), sternite 8 covered with 6 long hairs on each side (11–13 long hairs on each side) and spermatheca 1.46 times as long its greatest width (1.65 times as long its greatest width), in the male by the sensory vesicle 0.38 times as long as 3rd segment (0.23 times as long as 3rd segment) and fore basitarsus 7.4 times as long as its greatest width (6.6 times as long as its greatest width) and ventral plate in ventral view 0.41 times as long as wide (0.58 times as long as wide), in the pupa by the gill composed 8 slender thread-like filaments, arranged as [(1 + 2) + (1 + 2)] + 2 (gill composed 10 slender thread-like filaments, arranged as [(2 + 3) + (1 + 2)] + 2 or {[2 + (2 + 1)] + (1 + 2)} + 2) and stalk of ventral pair medium-long 2–2.2 times length of common basal stalk (stalk of ventral pair short 1.6–1.7 times length of common basal stalk, and in the larva by the labral fan with 33 main rays (labral fan with 25 main rays) and postgenal cleft 2.1 as long as postgenal bridge (postgenal cleft 2.71 as long as postgenal bridge).

Figure 1. The image depicts the location of the investigation and collection of this new species.

Description. — **Female** (Holotype + 5 paratypes) (Fig. 2). Body length 2.5–2.6 mm.

Head. Nearly as wide as thorax. Frons grey, shiny, moderately covered with yellowish-white scale-like recumbent short hairs; frontal ratio 1.0:0.9:1.2; head ratio 1.00:0.61.0. Fronto-ocular area well developed, narrow, directed dorsolaterally. Clypeus brownish black, densely covered with yellowish-white recumbent hairs interspersed with a few to several dark longer hairs on each side. Labrum 0.6 times as long as clypeus. Antenna composed of scape, pedicel and nine flagellomeres, grey to white except scape, pedicle and base of first flagellomere dark yellow, proportional length of first and second flagellomeres 1.0:0.7. Maxillary palp composed of five palpomeres, dark brown, proportional length of third, fourth, and fifth palpomeres 1.0:1.2:2.1; third palpomere of moderate size (Fig. 2A); sensory vesicle ellipsoidal, long, 0.32 times length of third palpomere and with medium–sized opening. Maxillary lacinia with 9 inner and 11 outer teeth. Mandible with 19 inner and 8 outer teeth. Cibarium (Fig. 2B) with a medially forming sclerotized plate folded anteriorly from posterior margin, with strongly sclerotized medial longitudinal ridge well-sclerotized cup-like apex, and two spines on each side.

Thorax. Scutum dark brown except anterolateral calli dark ochreous, with three brownish-black longitudinal vittae (one narrow median and two lateral), median vitta united anteriorly to anterior calli, lateral vittae united posteriorly to prescutellar area; scutum shiny when illuminated at certain angles, moderately covered with yellow scale-like recumbent short hairs interspersed with dark brown long upright hairs on prescutellar area. Scutellum shiny, with dark brown short hairs. Postnotum brownish-yellow and bare. Pleural membrane bare. Katepisternum brownish black to black, longer than deep, shiny when illuminated at certain angles, moderately covered with fine short hairs. *Legs*. Foreleg: coxa yellow; trochanter yellow except apical portion somewhat darkened; femora light brown; tibiae light brown; tarsus brownish black, with moderate dorsal hair crest; basitarsus slightly dilated, 6.0 times as long as its greatest width. Midleg: coxa yellowish brown except posterior surface dark brown; trochanter yellow to light brown; femora and tibiae brown; tarsus brownish black except basal 1/2 of basitarsus dark yellow. Hind leg: coxa yellowish brown; trochanter yellow; femora medium brown with base yellow and apical cap dark brown; tibiae light to dark brown with basal 1/4 white, covered with brownish fine hairs on outer and posterior surfaces; tarsus brownish-black except basal 2/3 of basitarsus (though base light brown); hind basitarsus (Fig. 2C) narrow, nearly parallel-sided, 7.0 times as long as wide, and 0.57 and 0.51 times as wide as greatest width of tibiae and femora, respectively; calcipala (Fig. 2C) slightly shorter than width at base, and 0.48 times as wide as greatest width of basitarsus. Pedisulcus (Fig. 2C) well defined. Claw (Fig. 2D) with large basal tooth 0.5 times as long as claw. *Wing*. Length 1.74 mm. Costa with dark brown spinules and light brown hairs. Hair tuft on base of radial vein dark brown. Basal portion of radius fully haired. Basal cells absent. Halter. Clear white except margin and basal stem darkened.

Abdomen. Basal scale dark yellow, with fringe of yellowish-white hairs. Dorsal surface of abdomen medium to dark brown except segment two light brown though middle portion of tergal plate ochreous, moderately covered with dark short to long hairs; tergites of segments 2 and 6–8 shiny when illuminated at certain angles. Ventral surface of segments 2–3 creamy, those of other segments light to dark brown; sternal plate on segment 7 undeveloped. *Genitalia*. Sternite 8th (Fig. 2E) well sclerotized and bare medially, covered with six long hairs on each side. Ovipositor valves tongue-like, thin, membranous and moderately covered with microsetae; inner margins convex, somewhat sclerotized, and slightly separated from each other. Genital fork (Fig. 2F) of usual inverted-Y forms; stem slender and well sclerotized; arms of moderate width, lateral plate of each arm with thin lobe directed posteromedially and small stout projection directed anterodorsally. Paraproct in ventral view concave anterolaterally, with 3 sensilla on anteromedial surface; paraproct in lateral view (Fig. 2G) much produced ventrally, 0.48 times as long as wide, with 10–12 medium to long hairs on ventral and lateral surfaces. Cercus in lateral view (Fig. 2H) short, rounded posteriorly, 0.52 times as long as wide. Spermatheca (Fig. 2I) ellipsoidal, 1.46 times as long as its greatest width, well sclerotized except duct and small area near juncture with duct unsclerotized, and with hexagonal pattern on surface; internal setae absent; both accessory ducts slender, subequal in diameter to major one.

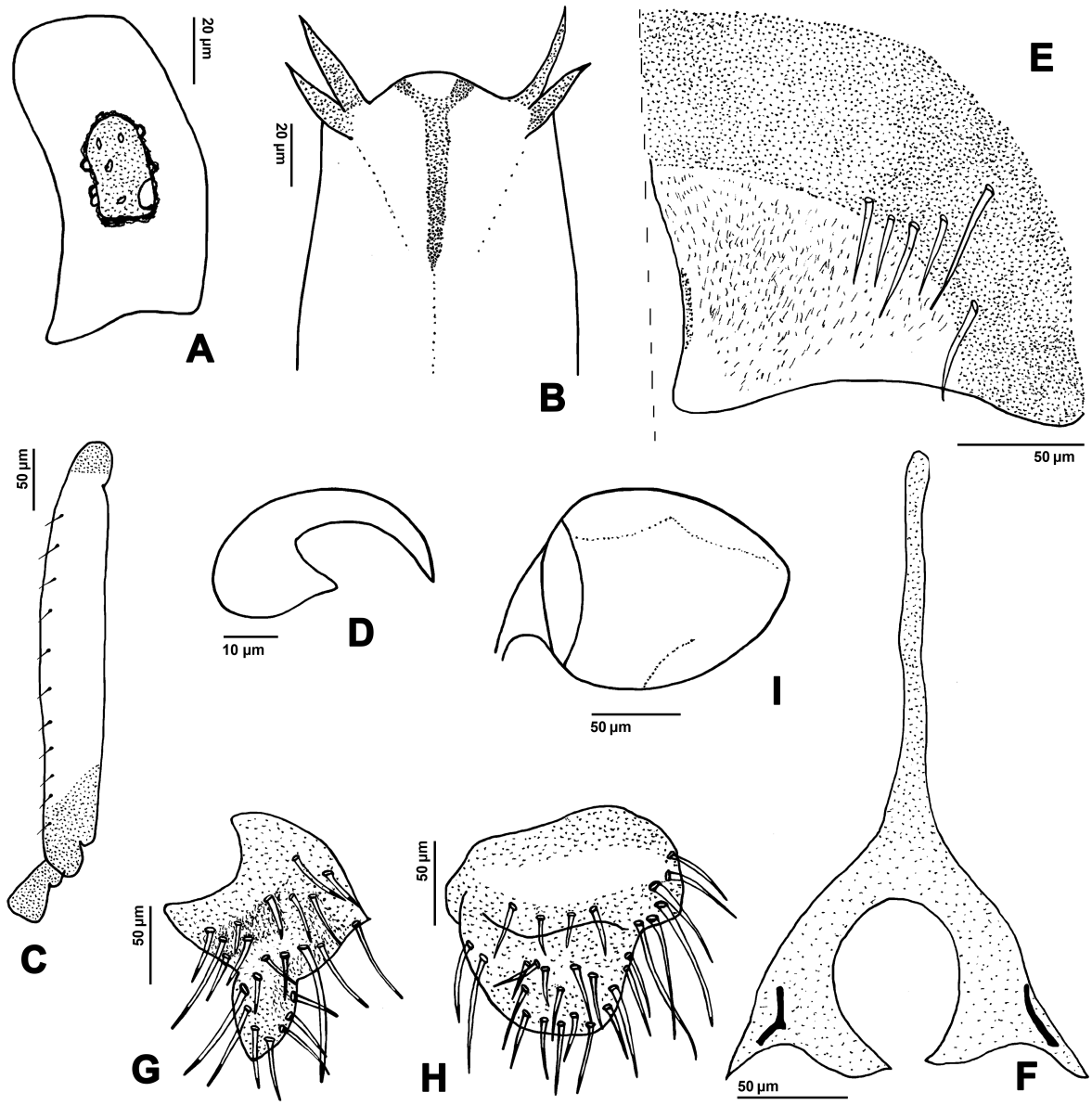

Figure 2. *Simulium* (*Gomphostilbia*) *sirumalaiense* **sp. nov.,** female. **A.** Third segment of right maxillary palp showing sensory vesicle (frontal view); **B.** Cibarium (frontal view); **C.** Basitarsus and 2nd tarsomere of left hind leg showing calcipala and pedisulcus (frontal view); **D.** Tarsal claw; E. Eighth sternite, ovipositor valve (ventral view); **F.** Genital fork (ventral view); **G–H.** Right paraprocts and cercus (G. Ventral view; H. Lateral view); **I.** Spermatheca (lateral view).

Male (5 paratypes) (Fig. 3). Body length 2.4 mm.

Head. somewhat wider than thorax. Upper eye yellowish brown, consisting of 16 vertical columns and 12 horizontal rows of large facets. Face brownish black, grayish white pruinose. Clypeus brownish black, whitish pruinose, densely covered with golden-yellow scale-like medium-long hairs (directed upward and lateral), interspersed with several dark brown simple longer hairs. Antenna 1st flagellomere elongate, 1.25 times as long as 2nd one. Maxillary palp light to medium brown, proportional lengths of 3rd, 4th, and 5th segments 1.0:1.38:3.37; 3rd segment (Fig. 3A) widened apically; sensory vesicle (Fig. 3A) ellipsoidal, small (0.38 times as long as 3rd segment), and with small opening.

Thorax. Scutum slightly darker than female and short hairs on scutum golden yellow. *Legs*. Foreleg: coxa yellow; trochanter yellow with some portions light brown; femora light brown except apical cap brown;

tibiae brown with median 2/3 light brown and covered with dark brown hairs; tarsus brown to dark brown; basitarsus moderately dilated 7.4 times as long as its greatest width. Midleg: coxa yellowish brown; trochanter yellow to brown; femora yellow except apical 1/4 brown; tibiae medium brown to dark brown; tarsus dark brown to brownish black except anterior surface of little less than basal 1/2 of basitarsus dark yellow to light brown. Hindleg: coxa dark yellow to brown; trochanter yellow; femora light brown except apical 1/2 dark brown; tibiae brown except basal and apical portion dark brown; tarsus medium to dark brown except basal 1/2 (or little less) of basitarsus whitish-yellow and little less than basal 1/3 of 2nd tarsomere white; basitarsus (Fig. 3B) slender, spindle-shaped, 6.2 times as long as wide, and 0.44 and 0.38 times as wide as greatest width of tibiae and femora, respectively; calcipala (Fig. 3B) nearly as long as wide, and 0.43 times as wide as greatest width of basitarsus. Pedisulcus (Fig. 3B) well defined. *Wing*. Length 1.7 mm. Costa with dark brown spinules as well as dark brown hairs except basal portion with patch of yellowish hairs. Subcosta bare. Hair tuft on stem vein dark brown. Basal portion of radius fully haired; R1 with dark spinules and hairs and R2 with hairs only. Basal cells absent. Halter. Yellowish brown except outer surface ochreous, basal stem darkened and apex white.

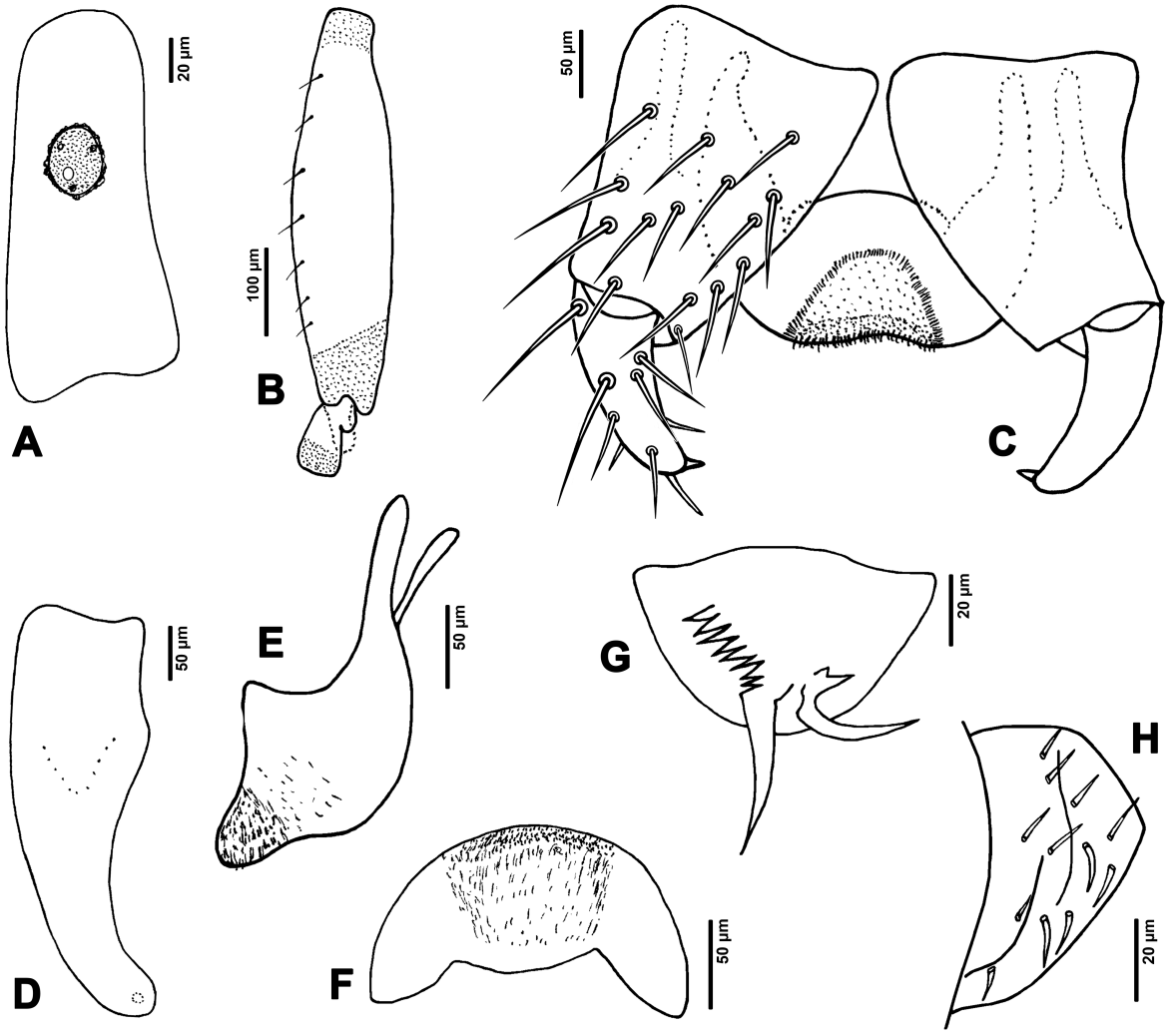

Figure 3. *Simulium* (*Gomphostilbia*) *sirumalaiense* **sp. nov.**, male. **A.** Third segment of left maxillary palp showing small sensory vesicle (frontal view); **B.** Basitarsus and 2nd tarsomere of left hind leg showing calcipala and pedisulcus (frontal view); **C.** Coxites, styles, ventral plate and median sclerite (ventral view); **D.** Left style (frontal view); **E.** Ventral plate and median sclerite; **F.** Ventral plate (ventral view); **G.** Left paramere and aedeagal membrane (hind view); **H.** Tenth abdominal segment and cercus (right side and lateral view).

Abdomen. Basal scale dark brown, with fringe of light to medium brown hairs. Dorsal surface of abdomen dark brown except segment two light brown (though posterior 1/4 of dorsal surface brown), covered with dark brown short to long hairs; segments 2, 2–7 with shiny dorsolateral or lateral patches; ventral surface of segment two yellow, those of segments 3 and 4 yellow except sternites medium brown, and those of other segments medium to dark brown. *Terminalia*. Coxite in ventral view (Fig. 3C) nearly rectangle, 1.26 times as long as its greatest width. Gonostyle in ventral view slightly bent inward, slightly tapered from base to apex, sharped apically and with apical spine; style in medial view (Fig. 3D) longer than coxite (0.74 times as long as coxite), gently bent inward, nearly parallel-sided, with apical spine; style in ventro-lateral view very slightly tapered toward apical 3/4, with rounded apex. Ventral plate in ventral view (Fig. 3C) with body transverse, 0.41 times as long as wide, tapered posteriorly, with anterior margin produced antero-medially, and posterior margin concave medially, densely covered with microsetae on ventral surface; basal arms of long, directed forward, then convergent apically; ventral plate in lateral view (Fig. 3E) moderately produced ventrally; ventral plate in ventral view (Fig. 3F) triangular dorsally, without microsetae on posterior surface. Median sclerite thin, plate-like, wide. Paramere (Fig. 3G) of moderate size, with 2 distinct long and stout hooks and several smaller ones. Aedeagal membrane moderately setose, slightly sclerotized at base but dorsal plate not well defined. Ventral surface of abdominal segment 10 with 6–8 distinct hairs near posterior margin. Cercus in lateral view (Fig. 3H) small, rounded, with 10–13 hairs.

Pupae (n = 4) (Fig. 4A–C)**.** Body length 2.5–2.8 mm. *Head*. Integument dark yellow, moderately covered with small round tubercles; antennal sheath with protuberance; face with pair of simple very long trichomes with coiled apices, and frons with 2 pairs of simple very long trichomes with coiled apices; 3 frontal trichomes on each side arising close together, subequal in length to one another and slightly longer than facial one. *Thorax*. Integument yellow, covered with round tubercles, with 4 simple very long dorsomedial trichomes with coiled apices, one simple very long anterolateral trichome with coiled apices, 1 simple very long mediolateral trichome with uncoiled apex, and 1 simple ventrolateral trichome with uncoiled apices (1 long and 2 short) on each side. *Gill* (Fig. 4A) composed of 8 slender thread-like filaments, arranged as 2 + [(2 + 1) + (1 + 2)] filaments from dorsal to ventral, with short common basal stalk having somewhat swollen transparent organ ventrally at base (Fig. 4B); common basal stalk 0.43 times length of interspiracular trunk; both primary and secondary stalks of dorsal triplet short, primary stalk of middle triplet short, but secondary stalk medium-long; length of primary and secondary stalks of middle triplet combined slightly longer than stalk of ventral pair; stalk of ventral pair medium-long, 2–2.2 times length of common basal stalk and 0.60–0.67 times length of interspiracular trunk; stalk of ventral pair 1.22–1.26 times as thick as primary stalk of middle triplet, and 1.1–1.2 times as thick as primary stalk of dorsal triplet; primary stalk of dorsal triplet lying against stalk of ventral pair at angle of 40–50 degrees or little more when viewed laterally; all filaments yellowish brown, gradually tapered toward apex; entire length of filaments (measured from base of gill to tips of filaments) based on one pupa as follows: 0.8–2.7 mm for dorsal triplet, 2.5–2.9 mm for middle triplet and 2.4–2.7 mm for ventral paired filaments. *Abdomen*. Segment 9 with a pair of triangular flat terminal hooks, of which the outer margin slightly longer than inner margin and not crenulated (Fig. 4C). *Cocoon* (n = 13). 2.3–2.6 mm long by 2.4–1.6 mm wide; wall pocket-shaped, thinly and moderately woven, widely extended ventrolaterally; anterior margin somewhat thickly woven, with dorsal portion not or slightly produced anteriorly when viewed dorsally; posterior 1/2 with floor roughly or moderately woven.

Mature larvae (n = 11) (Fig. 4D–E)**.** Body length 5.2–5.7 mm. Body creamy to colour markings as follows: thoracic segment 1 encircled with ochreous broad transverse band (though disconnected ventrally), proleg grayish, thoracic segments 2 and 3 yellowish-grey dorsally and each with distinct ochreous wide areas ventrally, abdominal segments 1–4 each encircled with yellowish brown broad band, abdominal segments 5–8 almost entirely covered by yellowish brown transverse broad band on dorsal and dorsolateral surfaces; abdominal segments 5 and 6 each with W-shaped broad transverse grayish-brown band on dorsolateral surfaces of posterior 1/2 of each segment; abdominal segment 7 and 8 with transverse yellowish brown band on ventral surface; Cephalic apotome yellowish brown, and sparsely covered with simple minute setae; head spots indistinct.

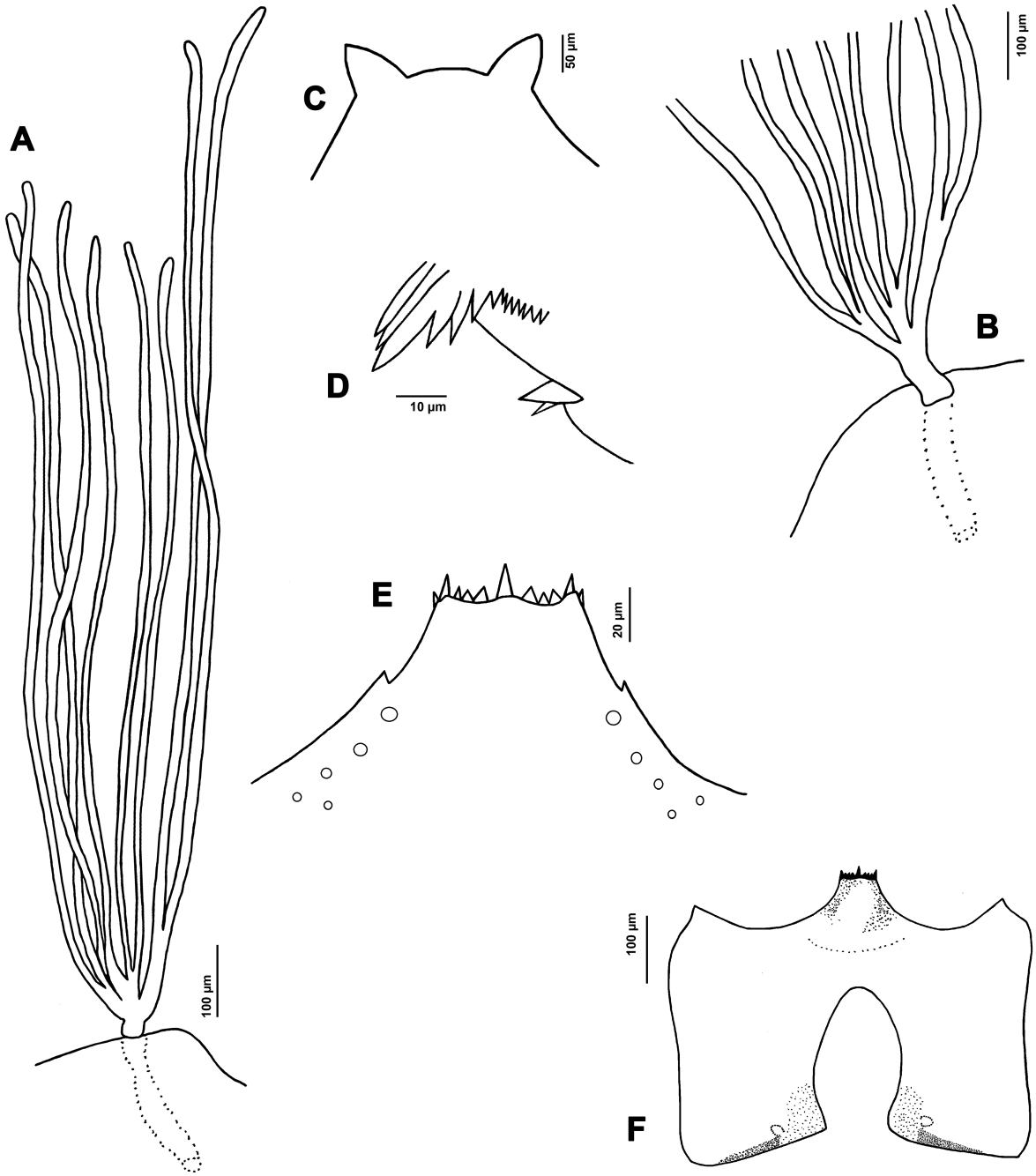

Figure 4. Pupa and larva of *Simulium* (*Gomphostilbia*) *sirumalaiense* **sp. nov.** A–C, pupa; D–F, larva. **A.** left gill filaments (lateral view); **B.** basal portion gill (outer view); **C.** terminal hooks (hind view); **D.** right mandible (lateral view); **E.** hypostoma (ventral view); **F.** head capsule showing postgenal cleft and hypostoma (ventral view).

Lateral surface of head capsule yellowish brown except eye-spot region yellow, and very sparsely covered with simple minute setae, spots indistinct. Ventral surface of head capsule yellowish brown except somewhat darkened area near posterior margin on each side of postgenal cleft, and very sparsely covered with simple minute setae. Antenna composed of 3 segments and apical sensillum, 1.32 times longer than stem of labral fan; proportional lengths of 1st, 2nd, and 3rd segments 1.00:1.43:1.15. Labral fan with 26–28 main rays. Mandible (Fig. 4D) with 3 comb-teeth decreasing in length from 1st to 3rd; mandibular serrations composed of two teeth (one medium-sized and one small); major tooth at acute angle against mandible on apical side; supernumerary serrations absent. Hypostoma (Fig. 4E) with row

of nine apical teeth; median and each corner tooth prominent (though median tooth slightly longer than corner teeth) and much longer than 3 intermediate teeth on each side; lateral margin smooth; 5 hypostomal bristles per side lying parallel to lateral margin. Postgenal cleft (Fig. 4F) lanceolate, 2.1 times as long as postgenal bridge. Cervical sclerite composed of 2 very pale small pieces, not fused to occiput, moderately separated medially from each other. Anal sclerite of usual X-form, with anterior arms small, shorter (0.92 times as long as posterior arms) than posterior ones, broadly sclerotized at base; accessory sclerite absent. Posterior circlet with 62–65 rows of hooklets with up to 12–14 hooklets per row.

Biological notes. The pupae and larvae of this new species were collected from leaf litter, woody debris, submerged boulders, cobbles, and pebbles in current streams and rivers. Associated species were *S.* (*G.*) *kumbakkaraiense* Anbalagan, Vijayan, Dinakaran, & Krishnan, 2019, *S.* (*G.*) *alagarense* **sp. nov.** and *S.* (*S.*) *striatum* Brunetti, 1912.

Habitat. Specimens were collected on leaves of black plum (*Sygigum cumini*), bamboo (*Bambusa vulgaris*), coca-bush (*Erythroxylum* spp.), pongam (*Pongamia pinnata*), and submerged boulders (Fig. 1A), cobbles and pebbles (Fig. 1B–D).

Distribution. Aathumedu (Fig. 1A), Kolinjipatti stream (Fig. 1B), Kombaikkadu stream (Fig. 1C), and Thadaganachiamman stream (Fig. 1D).

Taxonomic remarks. The following morphological characteristics of *Simulium* (*G.*) *sirumalaiense* **sp. nov.**, place it in the subgenus *Gomphostilbia* in *Simulium*: haired katepisternum in the adults, abdominal segment 9 with a pair of triangular flat terminal hooks in the pupa and smooth lateral margins of hypotoma in the larva. In addition, this new species is assigned to the *batoense* species-group of the subgenus *Gomphostilbia* by having a bare pleural membrane, dark brown hair tuft on the base of the radius, dark tibiae of the female and male, and slender male hind basitarsus, eight-gill filaments and grapnel-like hooklets in the pupa, as proposed by Takaoka (2012).

DISCUSSION

Gomphostilbia is globally among the most species-rich subgenera of *Simulium*, with 230 species in South East Asia (Takaoka, 2012). These flies are typically found near fast-flowing, oxygen-rich water bodies, which serve as breeding sites for their larvae. A similar finding was previously reported by Vijayan & Anbalagan (2018). Leaf litter is among the organic materials found in flowing rivers and streams. The majority of organic materials, leaf litter, woody debris, and submerged boulders, cobbles, and pebbles contribute to the growth of larval black flies. The leaf litter is most important for *Gomphostilbia* species such as *S.* (*G.*) *peteri* Anbalagan, Prasanna, Dinakaran, & Krishnan, 2014. This finding was very similar to the assortment of specimens. *Simulium* (*G.*) *sirumalaiense* **sp. nov.**, is the only member of the *batoense* species-group with nine flagellomeres in the antenna; pleural membrane bare; subcosta bare; tibiae light to dark brown but white in basal quarter; hind basitarsus narrow and nearly parallel-sided, 7.0 times as long as wide, and 0.57 and 0.51 times as wide as the greatest width of tibiae and femora, respectively; and sternite 8th well sclerotized and bare medially. *Simulium* (*G.*) *cauveryense* Anbalagan, Balachandran, Prasanna, Kannan, Dinakaran & Krishnan, 2015 was collected in the Western Ghats from polythene, wood, and submerged boulders. *Simulium* (*G.*) *sirumalaiense* **sp. nov.** was also collected from leaf litter, woody debris, submerged boulders, and pebbles. These observations indicate that the *batoense* species-group in the Ghats is associated with submerged leaf litter, woody debris, boulders, and pebbles.

The present study contributes to a better understanding of black fly taxonomy in the Southern Eastern Ghats, highlighting the richness of the group in this underexplored region. Limited species were recorded, including members of the subgenera *Gomphostilbia* and *Nevermannia*. Despite these findings, the current knowledge remains fragmentary. Furthermore, integrative taxonomic studies, combining both morphological and molecular approaches, are essential to clarify species boundaries and resolve cryptic diversity. Additionally, comprehensive ecological and medical investigations are needed to understand the vectorial roles of these species and their potential impact on public health. In conclusion, the black fly fauna of the Southern Eastern Ghats remains insufficiently studied, and this research lays the groundwork for future taxonomic, ecological, and epidemiological assessments in the region.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: S. Vijayan: Manuscript preparation, collecting the specimens in the fields, taxonomic identification, scientific drawing, revising the manuscript and correspondence; S. Anbalagan: Manuscript preparation, taxonomical expertise, and scientific drawing. Both authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited Department of Animal Health and Management, Science Campus, Algappa University, Karaikudi, Tamil Nadu, India (DAHMA) and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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یک گونه جدید از زیرجنس *Gomphostilbia* Enderlein, 1921 (Diptera: Simuliidae, *Simulium*) از گهات شرقی، هند

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چکیـده: یک گونه جدید سیاه‌مگس به نام *Simulium sirumalaiense* Vijayan & Anbalagan **sp. nov.**، بر اساس ویژگی‌های ریخت‌شناسی حشرات کامل (ماده و نر)، و همچنین همچنین شفیره و لاروها توصیف شد. شفیره و و لاروهای این گونهٔ جدید از محل بقایای برگ و زباله‌ها در جویبارها، به‌ویژه روی گیاهان مختلف و سنگ‌های غوطه‌ور، سنگ‌ریزه‌ها و شن‌ها جمع‌آوری شدند. این گونه جدید بر اساس ویژگی‌های زیر در گروه گونه *Simulium batoense* زیرجنس *Gomphostilbia* Enderlein قرار می‌گیرد: شاخک دارای ۹ بند، غشای پهلوی بدون مو، رگ زیرکناری در جنس ماده فاقد مو، گیل‌های تنفسی شفیره دارای ۸ فیلامنت رشته‌ای باریک، و موهای زیردهانی در لاورها در هر طرف موازی با حاشیه جانبی. این گونه از نظر ریخت‌شناسی مشابه *Simulium* (*G.*) *cauveryense* است.

واژگـان کلیدی: سیاه‌مگس، گروه گونه *batoense*، زیستگاه‌های آبی، جویبارهای جاری