

## Notes on black flies (Diptera: Simuliidae) from North-East India: New records of five species from Arunachal Pradesh and taxonomic reviews of two species from Assam

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**Abstract.** In recent surveys of black flies in Arunachal Pradesh, North-East India, five species are newly recorded from Arunachal Pradesh: *Simulium* (*Montisimulium*) *nemorivagum* Datta, 1973, *Simulium* (*Gomphostilbia*) *darjeelingense* Datta, 1973, *Simulium* (*Gomphostilbia*) *decuplum* Takaoka & Davies, 1995, *Simulium* (*Simulium*) *barnesi* Takaoka & Suzuki, 1984 and *Simulium* (*Simulium*) *pradyai* Takaoka & Somboon, 2008, of which the latter three species also represent new records from India. Taxonomic reviews of two species of black flies reported from Assam show that *Simulium* (*Gomphostilbia*) *unum* Datta, 1975 is a junior synonym of *Simulium* (*Gomphostilbia*) *darjeelingense*, and the larva of *Simulium* (*Gomphostilbia*) sp. nr. *varicornis* Edwards is identifiable as *Simulium* (*Gomphostilbia*) *parahiyangum* Takaoka & Sigit, 1992.

### INTRODUCTION

Black flies are one of the biting dipteran insect groups of medical importance and have a worldwide distribution, occurring anywhere there are running streams or rivers suitable for breeding of their immature stages (Crosskey, 1990). In India, 71 species (56 named and 15 unnamed) of black flies, all in the genus *Simulium* Latreille, have been recorded (Adler & Crosskey, 2011; Takaoka *et al.*, 2011), of which four species are recorded from Arunachal Pradesh, the north-easternmost state among the seven states in North-East India, and 16 species (eight named and eight unnamed) from Assam, a state located south-west of Arunachal Pradesh, and three from both states (Adler & Crosskey, 2011).

In recent surveys of adult and immature black flies in Arunachal Pradesh, we collected five more species from this state, of which three represent new records from India. In addition we had an opportunity to taxonomically review one named and one unnamed species of the subgenus *Simulium* (*Gomphostilbia*) Enderlein, described from Assam by Datta (1975).

In this paper, notes are given for five species newly recorded from Arunachal Pradesh and the results of taxonomic reviews of two species are presented.

All the adult black flies examined were those that emerged from pupae except one female of *S.* (*Simulium*) *barnesi* Takaoka & Suzuki, 1984, which was netted together with many females of *S.* (*S.*) *indicum* Becher, 1884 while flying around one of us (SB). All the

pupae, pupalexuviae and larvae were collected from a main channel and a tributary of the River Sessa Nullah, in Sessa, West Kameng District, Arunachal Pradesh, in February and March, 2010, and preserved in 80% ethanol by SB. Terms used for morphological features follow those of Takaoka (2003).

#### NEWLY RECORDED SPECIES FROM ARUNACHAL PRADESH, INDIA

##### ***Simulium (Montisimulium) nemorivagum* Datta, 1973**

*Simulium (Eusimulium) nemorivagum* Datta, 1973: 373–375 (male, pupa and larva); Datta, 1974b:457–459 (female).

*Simulium (Montisimulium) nemorivagum* Datta: Crosskey *et al.*, 1996: 416; Takaoka & Somboon, 2008: 222–223; Shrestha & Takaoka, 2009: 255.

**SPECIMENS EXAMINED.** Three larvae collected from a small shaded tributary stream of the River Sessa Nullah (altitude 3,250 m; 27°06'00" N, 92°24'00" E), rapidly flowing in a natural forest, Sessa West Kameng District, Arunachal Pradesh, India, 7. III. 2010.

**DISTRIBUTION.** Bhutan, China (Tibet), India [West Bengal and Arunachal Pradesh (**New record**)], Nepal and Pakistan.

**REMARKS.** This species was originally described from Darjeeling, India (1973) and later recorded from Tibet, China (Crosskey *et al.*, 1996), Bhutan (Takaoka & Somboon, 2008), Nepal (Shrestha & Takaoka, 2009) and Pakistan (Adler & Crosskey, 2011). The pupa of this species is characterized by the 12 gill filaments arranged as 2+[(2+1)+(2+1)]+(2+2) filaments from dorsal to ventral (Datta, 1973; Takaoka & Somboon, 2008). The pharate pupal gill of the larvae examined in this study agrees with that of *S. (M.) nemorivagum*.

##### ***Simulium (Gomphostilbia) darjeelingense* Datta, 1973**

*Simulium (Gomphostilbia) darjeelingense* Datta, 1973: 380–382 (female, male and pupa); Shrestha & Takaoka, 2009: 254.

**SPECIMENS EXAMINED.** One female with associated pupal exuviae, 1 pharate male with associated pupal exuviae, 5 pupae and 1 pupal exuviae, same data as for *S. (M.) nemorivagum* except the date, 20. II. 2010.

**DISTRIBUTION.** India [West Bengal and Arunachal Pradesh (**New record**)] and Nepal.

**REMARKS.** *Simulium (G.) darjeelingense* was described from Darjeeling, India (Datta, 1973) and later recorded from Nepal (Shrestha & Takaoka, 2009). This species is placed in the *ceylonicum* species-group by having the enlarged male hind basitarsus. The pupa of this species is unique within this species-group in that eight gill filaments are all short and arise from a short common basal stalk, the characteristic separating it from all the other members of the *ceylonicum* species-group except *Simulium (Gomphostilbia) chayamaritae* Takaoka & Srisuka, 2010 from Thailand (Takaoka & Srisuka, 2010) which also has the gill with such short filaments. However, the pupa of *S. (G.) chayamaritae* differs from that of *S. (G.) darjeelingense* by having cone-shaped tubercles with pointed apices on the frons and thorax (Takaoka & Srisuka, 2010).

The pharate male collected in Arunachal Pradesh almost agrees with the male of *S. (G.) darjeelingense* in many characteristics including the enlarged hind basitarsus and the enlarged upper-eye facets in 13 vertical columns and in 15 horizontal rows (in 14 vertical columns and 14 horizontal rows in *S. (G.) darjeelingense*). The characteristics of the pupal exuviae of this pharate male agree well with those of *S. (G.) darjeelingense* except the terminal hooks, which are present in the pupal exuviae from Arunachal Pradesh but absent in *S. (G.) darjeelingense* according to the latter's original description by Datta (1973). The possibility that terminal hooks in *S. (G.) darjeelingense* might have been overlooked is not ruled out, because all other *Gomphostilbia* species (of which the pupa is known) so far described bear distinct terminal hooks. The pupa collected from Nepal and identified as *S. (G.) darjeelingense* bears terminal hooks (Shrestha & Takaoka, 2009).

***Simulium (Gomphostilbia) decuplum* Takaoka & Davies, 1995**

*Simulium (Gomphostilbia) decuplum* Takaoka & Davies, 1995: 46–50 (female, pupa and larva); Takaoka & Saito, 1996: 165.

SPECIMENS EXAMINED. Five pupae and 2 pupal exuviae, same data and date as for *S. (M.) nemorivagum*.

DISTRIBUTION. Peninsular Malaysia, Thailand, and India (Arunachal Pradesh) (**New record**).

REMARKS. This species was originally described from peninsular Malaysia (Takaoka & Davies, 1995) and subsequently recorded from Thailand (Takaoka & Saito, 1996). This species is characterized by having the pupal gill with 10 short slender filaments arranged as [(2+2)+(2+2)]+2 or [1+1+1+1+(1+1+2)]+2 (in place of eight gill filaments per side, as in most other species of the subgenus *Gomphostilbia*). The pupae and pupal exuviae collected in Arunachal Pradesh agree with the description of the pupa of *S. (G.) decuplum* in many morphological characteristics including the number and arrangement of the gill filaments.

***Simulium (Simulium) barnesi* Takaoka & Suzuki, 1984**

*Simulium (Simulium) barnesi* Takaoka & Suzuki, 1984: 31–33 (female).

SPECIMEN EXAMINED. One female caught with a net near a narrow stream (altitude 190 m; 27°00'77" N, 92°67'24" E) in Tippi, Arunachal Pradesh, India, 8. I. 2011.

DISTRIBUTION. Thailand and India (Arunachal Pradesh) (**New record**).

REMARKS. This species was described from a female collected from Thailand and deposited in the Natural History Museum in London, UK (Takaoka & Suzuki, 1984). The male, pupa and larva of this species remain unknown. This species was placed in the *variegatum* species-group and the female is characterized by the paraproct with a strongly sclerotized anteromedian plate and a flat ventral surface lacking a shallow groove, coupled with dark legs (Takaoka & Suzuki, 1984). By its characteristic paraproct, *S. (S.) barnesi* is easily distinguished from the three species of the *variegatum* species-group so far recorded from India: *S. (S.) gurneyae*

Senior-White, 1922, *S. (S.) himalayense* Puri, 1932 and *S. (S.) nilgiricum* Puri, 1932 (see Puri, 1932a).

***Simulium (Simulium) pradyai* Takaoka, 2008**

*Simulium (Simulium) pradyai* Takaoka, 2008: 256–261 (female and pupa); Shrestha & Takaoka, 2009: 256.

SPECIMENS EXAMINED. One female with associated pupal exuviae and 3 males with associated pupal exuviae and 1 pupal exuviae, collected from a wide but shallow main channel of the River Sessa Nullah (altitude 3,250 m; 27°06'00" N, 92°24'00" E), moderately flowing in an open area along the edge of a natural forest in Sessa, West Kameng District, Arunachal Pradesh, 20. II. 2010.

DISTRIBUTION. Bhutan, Nepal and India (Arunachal Pradesh) (**New record**).

REMARKS. *Simulium (S.) pradyai* was originally described from Bhutan and assigned to the *tuberosum* species-group (Takaoka & Somboon, 2008). This species seems to be more similar in the female to *Simulium (Simulium) rufibasis* Brunetti, 1911 and *Simulium (Simulium) ramosum* Puri, 1932 than to *Simulium (Simulium) nigrifacies* Datta, 1974 and *Simulium (Simulium) nitidithorax* Puri, 1932, all of the *tuberosum* species-group described from India (Datta, 1974a; Puri, 1932b), in having a pair of hair tufts on the seventh sternite, but is easily distinguished in the pupa from these four related species by the almost bare frons and anterodorsal surface of the thorax and the six gill filaments arranged in three pairs with medium-long stalks (Takaoka & Somboon, 2008).

TAXONOMIC REVIEWS OF TWO KNOWN SPECIES OF BLACK FLIES FROM ASSAM

***Simulium (Gomphostilbia) unum* Datta, 1975**

*Simulium (Gomphostilbia) unum* Datta, 1975: 38 (pupae)

REMARKS. *Simulium (G.) unum* was described from five pupae collected from Sonai Rupai, Assam (Datta, 1975). Although it is currently placed in the *batoense* species-

group (Adler & Crosskey, 2011), the assignment of this species to a certain species-group within the subgenus *Gomphostilbia* has to be ascertained when adults are available, since its female and male (as well as the larva) remained unknown. The pupa of this species is characterized by the gills with eight short filaments arising from a short common basal stalk, and arranged as 2+4+2 filaments from dorsal to ventral. These characteristics of the pupal gill are very similar to those of *S. (G.) darjeelingense* described and illustrated by Datta (1975). The other pupal characteristics of *S. (G.) unum* are almost the same as those of *S. (G.) darjeelingense* except the terminal hooks, which are present in *S. (G.) unum* but absent in *S. (G.) darjeelingense*. Apart from the *ceylonicum* species-group, *Simulium (Gomphostilbia) parahiyangum* Takaoka & Sigit, 1992 from Java, Sumatra, Malaysia and Thailand, *Simulium (Gomphostilbia) dentistylum* Takaoka & Davies, 1995 from peninsular Malaysia and Thailand, and *Simulium (Gomphostilbia) montiblense* Takaoka, 1983 from Palawan Island, Philippines, all of the *batoense* species-group, bear short gill filaments, but differ from *S. (G.) unum* by the other characteristics including the arrangement of the gill filaments (Kuvangkadilok & Takaoka, 2000; Takaoka, 1983; Takaoka & Davies, 1995; Takaoka & Sigit, 1992).

At present, it is difficult to find a difference between *S. (G.) unum* and *S. (G.) darjeelingense*. *Simulium (G.) unum* should be treated as a junior synonym of *S. (G.) darjeelingense* until adult female and male specimens are obtained from its type locality (Sonai Rupai, Assam) for confirmation of its identity.

***Simulium (Gomphostilbia) sp. nr. varicorne* Edwards**

*Simulium (Gomphostilbia) sp. nr. varicorne* Edwards: Datta, 1975: 35 (larva).

REMARKS. *Simulium (G.) sp. nr. varicorne*, one of the two unnamed species reported from Assam by Datta (1975), was described from two larvae collected from Sonai Rupai. The female, male and pupa remain unknown. According to the original

description (Datta, 1975), the larva of this unnamed species is most remarkably characterized by the prominent dorsal protuberances on abdominal segments 1–5 and several dark stout spines on abdominal segments 6–8, as well as numerous flat spinules on the thorax and abdomen, and the deep postgenal cleft reaching the posterior margin of the hypostoma, all these characteristics combined not being found in other named species of the subgenus *Gomphostilbia* except in the larva that was once thought by Edwards (1934) to be that of *Simulium (Gomphostilbia) varicorne* Edwards, 1925, described from a male collected from Sumatra, Indonesia. We note here that the larva in question is no longer that of *S. (G.) varicorne* but that of *S. (G.) parahiyangum* Takaoka & Sigit, 1992 because Edwards' incorrect association of the larva and pupa with the male of *S. (G.) varicorne* was demonstrated by Takaoka & Sigit (1992).

The morphological characteristics of the larva of *S. (G.) sp. nr. varicorne* described and illustrated by Datta (1975) are in good accordance with those of *S. (G.) parahiyangum*, as already mentioned by Takaoka & Davies (1996), but are different from those of the larva of *S. (G.) varicorne* recently collected from Peninsular Malaysia, which lacks dark stout spines on the dorsal surface of the abdomen (Unpublished data by HT). In addition, the pharate pupal gill with eight short slender filaments arising from a short common basal stalk in the larva of *S. (G.) sp. nr. varicorne* differs from the pupal gill of *S. (G.) varicorne* collected from peninsular Malaysia (Takaoka & Davies, 1995) but conforms to that of *S. (G.) parahiyangum* (Takaoka & Sigit, 1992).

The larva of *S. (G.) sp. nr. varicorne* in Assam should be identified as *S. (G.) parahiyangum* until adult and pupal specimens are obtained from Sonai Rupai, Assam, for its final identification.

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