



## RESEARCH ARTICLE

# Description of the males of *Simulium (Gomphostilbia) miblosi* Takaoka and *S. (G.) apoense* Takaoka (Diptera: Simuliidae) from Mindanao, the Philippines

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### ABSTRACT

The males of *Simulium (Gomphostilbia) miblosi* Takaoka in the *S. epistum* species-group, and *S. (G.) apoense* Takaoka in the *S. ceylonicum* species-group, both from Mindanao, the Philippines, are described for the first time. The male of *S. (G.) miblosi* is characterized by the hind tibia yellowish white on the basal three-fifths, elongate calcipala 1.5 times as long as its basal width, and ventral plate triangular ventrally (0.74 times as high as its greatest width) when viewed caudally. Tubercles on the frons and trichomes on the head and thorax of the pupa of this species are illustrated for the first time. The male of *S. (G.) apoense* is characterized by the small sensory vesicle 0.16–0.19 times as long as the third palpal segment, and enlarged hind basitarsus 1.0 and 1.2–1.3 times as wide as the hind tibia and femur, respectively. Taxonomic notes of these two species relevant to related species in each species-group are given.

**Keywords:** black fly; taxonomy; biting insects.

### INTRODUCTION

The fauna of black flies in the Philippines is represented by 88 species in four subgenera of the genus *Simulium* Latreille: four species in *Nevermannia* Enderlein, 33 species in *Gomphostilbia* Enderlein, 37 species in *Simulium* s. str. and 14 species in *Wallacellum* Takaoka (Adler, 2021). The biting habits and medical and veterinary importance of these species in the Philippines are unknown.

The species in the subgenus *Gomphostilbia* are divided into six species-groups: one species in the *S. ambigens* species-group, three species in the *S. baisasae* species-group, 13 species in the *S. banauense* species-group, five species in the *S. batoense* species-group, three species in the *S. ceylonicum* species-group, and eight species in the *S. epistum* species-group (Takaoka, 2012).

We describe the males of *S. (G.) miblosi* Takaoka in the *S. epistum* species-group and *S. (G.) apoense* Takaoka in the *S. ceylonicum* species-group for the first time. Tubercles on the frons, trichomes on the head and thorax, and terminal hooks of the pupa of *S. (G.) miblosi*, and pupal terminal hooks of *S. (G.) apoense* are also illustrated for the first time.

### MATERIAL AND METHODS

Specimens used for morphological observation and description are as follows.

*Simulium (G.) miblosi*: Three males reared from pupae collected from a stream (width 3–5 m, partially shaded, 19°C, elevation 1,300 m) near the village of Intabas in Mt. Katanglad, Bukidnon, Mindanao, Philippines, 12-XI-2007, by H. Takaoka & V.F. Tenedero.

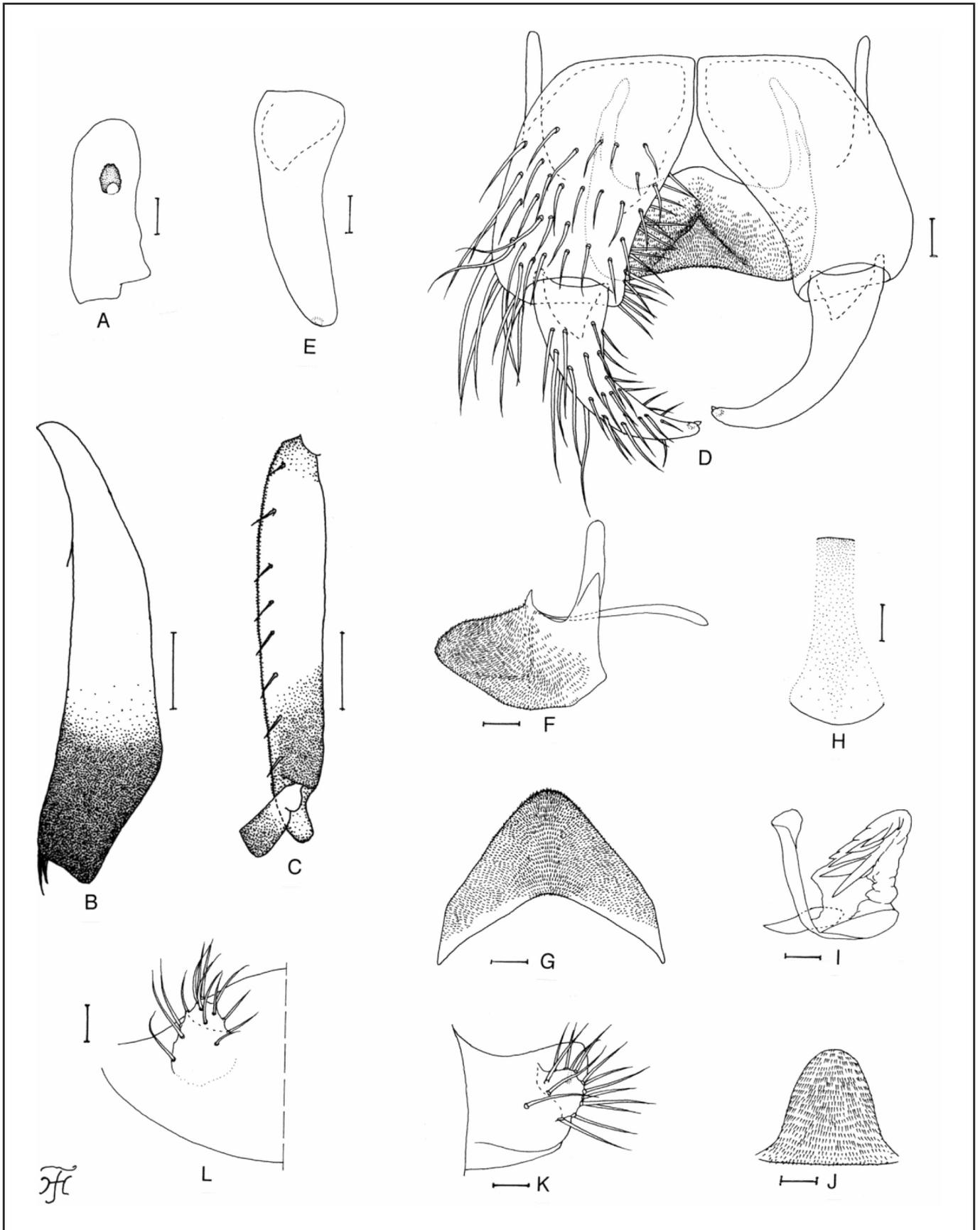
*Simulium (G.) apoense*: Four males reared from pupae collected from a ditch (width 0.2–0.4 m, exposed to the sun, 20.5°C, elevation 1,180 m), Marilog, Davao del Sur, Mindanao, Philippines, 25-II-2008, by H. Takaoka & V.F. Tenedero.

The methods of collection, description and illustration, and terms for morphological features, follow those of Takaoka (2003) and partially those of Adler *et al.* (2004). The specimens used are deposited in the Entomology Section of the Queen Sirikit Botanic Garden, Chiang Mai, Thailand.

### RESULTS AND DISCUSSION

#### *Simulium (Gomphostilbia) miblosi* Takaoka, 1983

**Male** (n=3). Body length 2.2–2.5 mm. **Head.** Slightly wider than thorax. Upper eye medium brown, consisting of large facets in 13 vertical columns and 14 horizontal rows on each side. Clypeus brownish black, whitish pruinose, densely covered with yellow scale-like medium-long hairs (mostly directed upward) interspersed with several dark brown longer hairs near lower margin on each side. Antenna composed of scape, pedicel and nine flagellomeres, whitish yellow except apical three to five flagellomeres light brown; first flagellomere elongate, 1.8 times length of second. Maxillary palpus light to medium brown except first and second segments yellow, with five segments, proportional lengths of third, fourth, and fifth segments 1.0:1.1:2.4; third segment (Figure 1A) slender; sensory vesicle (Figure 1A) small, ellipsoidal (0.16–0.18 times length of third segment), and with small opening. **Thorax.** Scutum dark brown, shiny on shoulders, along both lateral margins and on prescutellar area when illuminated at certain angles, and densely



**Figure 1.** Male of *Simulium* (*G.*) *miblosi*. A, third palpal segment with sensory vesicle (front view). B, hind tibia (left side; outer view). C, hind basitarsus and second tarsomere (left side; outer view). D, coxites, styles and ventral plate (ventral view). E, style (right side; ventrolateral view). F, ventral plate and median sclerite (lateral view). G, ventral plate (caudal view). H, median sclerite (caudal view). I, paramere (left side; dorsal view). J, aedeagal membrane (caudal view). K and L, Abdominal segment 10 and cerci (right side; K, lateral view; L, caudal view). Scale bars: 0.1 mm for B and C; 0.02 mm for A, and D–L.

covered with yellow scale-like recumbent short hairs. Scutellum dark brown, covered with yellow short hairs and dark brown long upright hairs along posterior margin. Postnotum dark brown, slightly shiny when illuminated at certain angles, and bare. Pleural membrane bare. Katepisternum medium to dark brown, longer than deep, shiny when illuminated at certain angles, moderately covered with yellow and brown fine short hairs. **Legs.** Foreleg: coxa yellow; trochanter light brown; femur light brown except apical cap medium brown (though apical tip paler); tibia whitish except apical three-tenths dark brown; tarsus brownish black; basitarsus slightly dilated, 6.58–6.88 times as long as its greatest width. Midleg: coxa medium brown except posterolateral surface brownish black; trochanter light brown; femur medium brown (though apical tip paler); tibia medium to dark brown except basal one-third or little more whitish yellow; tarsus dark brown. Hind leg: coxa light brown; trochanter yellow; femur medium brown with extreme base yellow and apical cap dark brown (though apical tip paler); tibia (Figure 1B) yellowish white on basal three-fifths and light brown to brownish black on rest; tarsus dark brown except basal two-thirds of basitarsus and basal half of second tarsomere yellow; basitarsus (Figure 1C) nearly parallel-sided, 5.21 times as long as wide, and 0.64–0.67 and 0.50–0.54 times as wide as greatest width of tibia and femur, respectively; calcipala (Figure 1C) 1.5 times as long as its basal width, and 0.43 times as wide as greatest width of basitarsus; pedisulcus (Figure 1C) well developed. **Wing.** Length 2.0–2.1 mm. Costa with dark spinules and hairs except basal patch of yellow hairs. Subcosta bare. Base of radius with tuft of dark hairs mixed with few yellow hairs. Basal portion of radius fully haired.  $R_1$  with dark spinules and hairs;  $R_2$  with hairs only. Basal cell absent. **Halter.** Dull white except basal stem darkened. **Abdomen.** Basal scale medium brown, with fringe of yellow hairs. Dorsal surface of abdomen medium brown to brownish black, covered with dark brown short to long hairs except parts of segment 2 with yellowish hairs; segments 2 and 5–7 each with pair of shiny dorsolateral or lateral patches. **Genitalia.** Coxite in ventral view (Figure 1D) nearly rectangular, 1.7 times as long as its greatest width. Style in ventral view (Figure 1D) bent inward, with single apical spine; style in ventrolateral view (Figure 1E) tapered to round apex, and 0.9 times length of coxite and 2.7 times as long as its greatest width at base. Ventral plate in ventral view (Figure 1D) with body transverse, 0.44 times as long as wide, with lateral margins slightly rounded, with anterior margin produced anteromedially, posterior margin somewhat concave, and densely covered with microsetae on ventral surface; basal arms of moderate length, slightly convergent apically; ventral plate in lateral view (Figure 1F) much produced ventrally; ventral plate in caudal view (Figure 1G) triangular ventrally, 0.74 times as high as its greatest width, and densely covered with microsetae on posterior surface. Median sclerite arising near anterior tip of ventral plate (Figure 1F) and broad, plate-like in caudal view (Figure 1H). Parameres (Figure 1I) of moderate size, each with two long stout hooks and several medium-long to short hooks. Aedeagal membrane (Figure 1J) densely setose; dorsal plate absent. Ventral surface of abdominal segment 10 (Figure 1K, L) somewhat sclerotized widely and without distinct hairs near posterolateral corners. Cercus (Figure 1K, L) small, rounded, with 15 or 16 hairs.

**Remarks.** The female and pupa of *S. (G.) miblosi* are similar to those of *S. (G.) lehi* Takaoka from Sarawak, Malaysia in many characteristics including the mandible without teeth on the outer margin, unarmed cibarium, relatively elongate calcipala, and hind tibia whitish yellow on the basal three-fourths in the female, and last abdominal segment with two microsetae (Figure 2L) rather than grapnel-shaped hooklets, and cocoon shoe-shaped, with a low anteroventral collar in the pupa (Takaoka, 2001b).

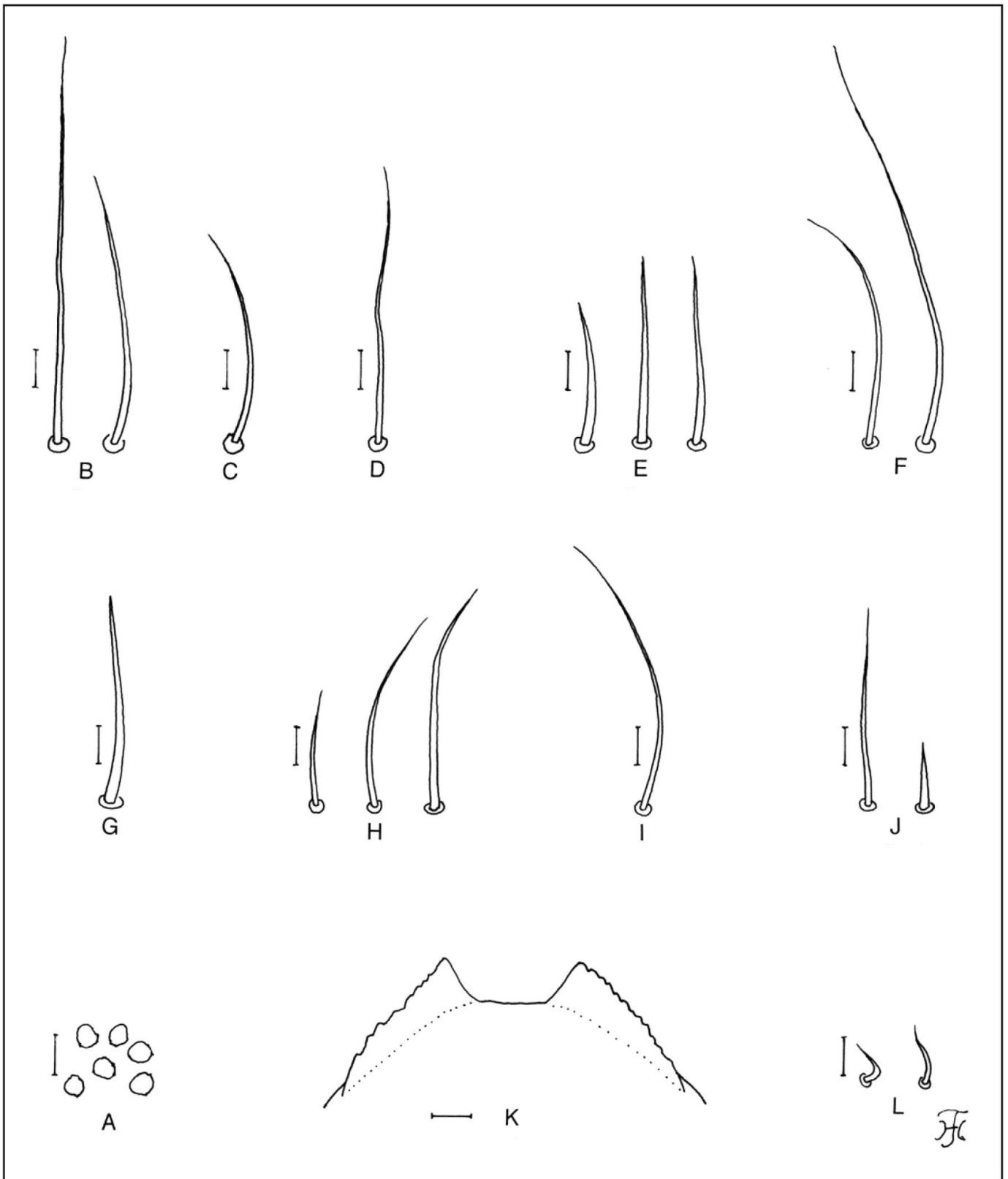
The male of *S. (G.) miblosi* is also similar to that of *S. (G.) lehi* in the color of the legs, size of the calcipala (Figure 1C), and shape of the genitalia (Figure 1G–J). However, it is distinguished by the number of upper-eye (large) facets in 13 vertical columns and 14

horizontal rows (10 vertical columns and 11 horizontal rows in *S. (G.) lehi*).

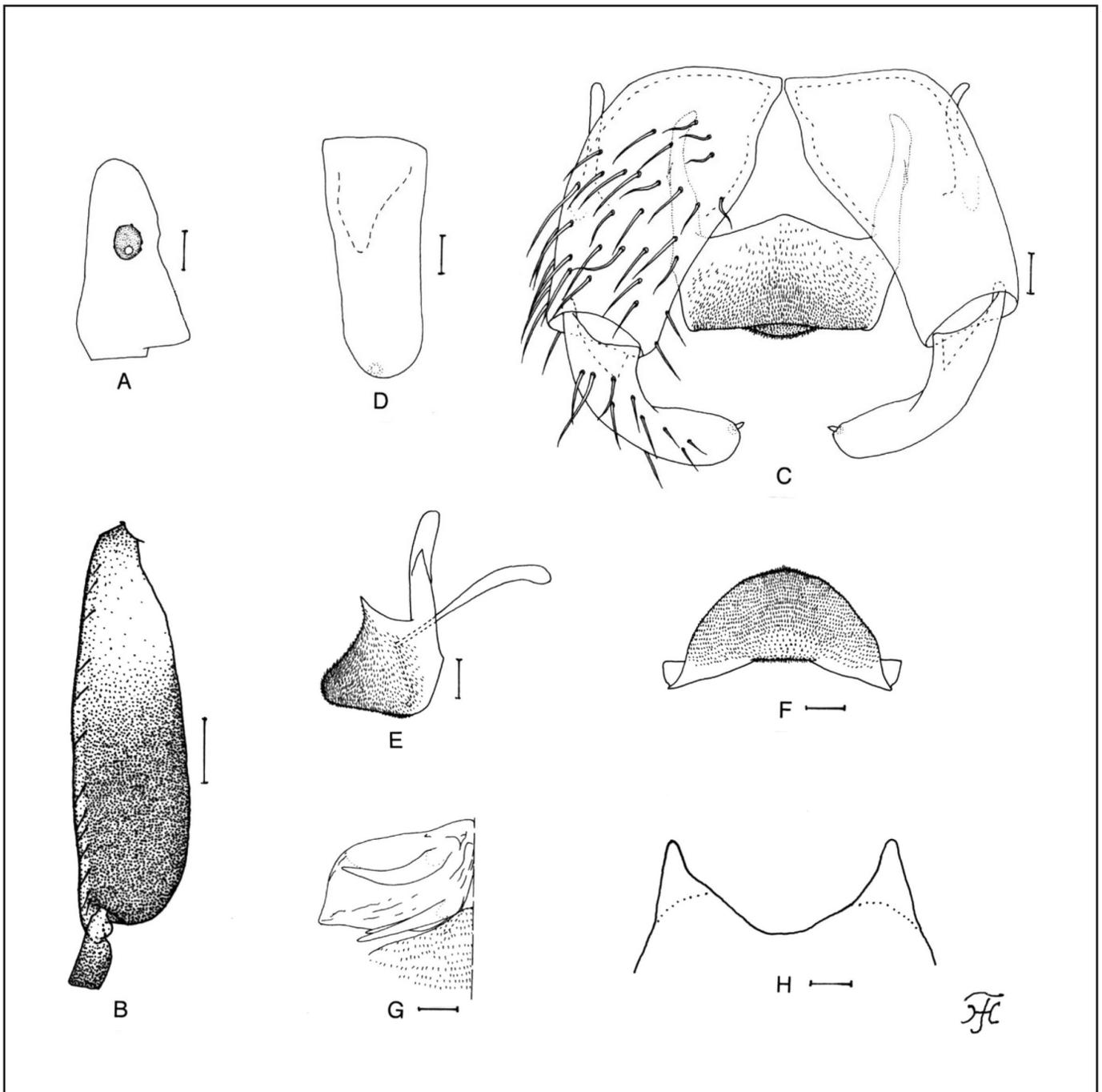
In the present study, tubercles (Figure 2A) on the frons, trichomes (Figure 2B–H) on the head and thorax, and terminal hooks (Figure 2K) of the pupa of this species are illustrated for the first time. Tubercles on the frons and anterodorsal surface of the thorax are of irregular shapes and have tiny secondary projections (Figure 2A). The pupa of this species is exceptional among species in the subgenus *Gomphostilbia* by having two pairs of frontal trichomes (Figure 2B) (rather than three pairs), and two unbranched setae (Figure 2L) (rather than grapnel-shaped hooklets) on each side of abdominal segment 9 (Takaoka, 1983). In the present study, these characteristics are confirmed, although an additional trichome (Figure 2C) at some distance from two trichomes on the left side of the frons in one pupa was observed. In addition, all three pairs of dorsomedial trichomes on the pupal thorax of this species are short or medium-long (Figure 2E) (rather than long).

#### *Simulium (Gomphostilbia) apoense* Takaoka, 1983

**Male** (n=4). Body length 3.0–3.2 mm. **Head.** Nearly as wide as thorax. Upper eye consisting of large facets in 11 vertical columns and 13 horizontal rows. Face dark brown, white-pruinose. Clypeus brownish black, white-pruinose, densely covered with golden yellow medium-long hairs (mostly directed upward) interspersed with several dark longer hairs. Antenna composed of scape, pedicel and nine flagellomeres, light to medium brown except scape, pedicel and base of first flagellomere yellow; first flagellomere elongate, 1.50–1.57 times length of second one. Maxillary palpus light to medium brown, with five segments, proportional lengths of third, fourth, and fifth segments 1.00:1.24–1.28:3.03–3.09; third segment (Figure 3A) widened apically; sensory vesicle (Figure 3A) globular or ellipsoidal, small, 0.16–0.19 times length of third segment, and with small opening. **Thorax.** Scutum brownish black, with three faint black vittae (one middle and two submedian), thinly white-pruinose entirely when illuminated anteriorly and viewed dorsolaterally, and densely covered with whitish yellow short hairs. Scutellum dark brown, with dark upright hairs and yellow short hairs. Postnotum brownish black, bare. Pleural membrane ochreous and bare. Katepisternum dark brown, longer than deep, shiny when illuminated at certain angles, and moderately covered with yellow and dark brown short hairs. **Legs.** Foreleg: coxa whitish yellow; trochanter light brown except base whitish yellow; femur light brown with apex medium brown (though extreme tip yellow to light brown); tibia white except apical cap brownish black; tarsus brownish black, with moderate dorsal hair crest; basitarsus moderately dilated, 6.3–6.8 times as long as its greatest width. Midleg: coxa medium brown except posterolateral surface dark brown; trochanter light brown; femur light brown with apex medium to dark brown (though extreme tip somewhat paler); tibia yellowish white on basal one-third, and medium to dark brown on rest; tarsus medium to dark brown except basal half of basitarsus dark yellow to light brown, though its border not well defined. Hind leg: coxa light to medium brown; trochanter whitish yellow; femur medium brown with extreme base whitish yellow and apical cap dark brown; tibia medium brown to brownish black except basal three-sevenths yellowish white; tarsus medium to dark brown except basal one-third of basitarsus dark yellow to light brown (though base medium brown) and basal one-third of second tarsomere light brown; basitarsus in lateral view (Figure 3B) widened from base to apical one-fourth, then gently narrowed toward apex, 3.4 times as long as wide, and 1.0 and 1.2–1.3 times as wide as greatest width of tibia and femur, respectively; calcipala (Figure 3B) slightly shorter than basal width, and 0.2 times as wide as greatest width of basitarsus. Pedisulcus (Figure 3B) well defined. **Wing.** Length 2.0–2.2 mm. Costa with dark spinules and hairs except some hairs of basal hair tuft whitish. Subcosta bare. Hair tuft on base of radial vein dark brown. Basal portion of radius fully haired;  $R_1$  with dark spinules and hairs;  $R_2$  with hairs only. Basal cell



**Figure 2.** Pupa of *Simulium* (*G.*) *miblosi*. A, tubercles on frons. B, frontal trichomes. C, additional frontal trichome. D, facial trichome. E–H, thoracic trichomes (E, dorsomedial; F, anterolateral; G, mediolateral; H, ventrolateral). I, hair-like seta on dorsum of abdominal segment 1. J, hair-like seta and minute seta on dorsum of abdominal segment 2. K, terminal hooks (caudal view). L, two microsetae on lateral surface of abdominal segment 9. Scale bars: 0.01 mm for A–L.



**Figure 3.** Male of *Simulium* (*G.*) *apoense*. A, third palpal segment with sensory vesicle (front view). B, hind basitarsus and second tarsomere (left side; outer view). C, coxites, styles and ventral plate (ventral view). D, style (right side; ventrolateral view). E, ventral plate and median sclerite (lateral view). F, ventral plate (caudal view). G, paramere and aedeagal membrane (right half; caudal view). H, pupal terminal hooks (caudal view). Scale bars: 0.1 mm for B; 0.02 mm for A, and C–G; 0.01 mm for H.

absent. **Halter.** White except basal stem darkened. **Abdomen.** Basal scale dark brown, with fringe of light brown hairs. Dorsal surface of abdomen medium brown to brownish-black except base of segment 2 somewhat paler, moderately covered with dark short to long hairs; segments 2 and 5–8 each with pair of shiny dorsolateral or lateral patches. **Genitalia.** Coxite in ventral view (Figure 3C) nearly rectangular, 1.94 times as long as its greatest width. Style in ventral view (Figure 3C) gently bent inward, nearly parallel-sided and with apical spine; style in ventrolateral view (Figure 3D) 0.76 times length of coxite, slightly narrowed from base to apex, with round apex. Ventral plate in ventral view (Figure 3C) with body transverse, 0.51 times as long as wide, narrowed posteriorly, with anterior margin

produced anteromedially, and posterior margin nearly straight (although slightly produced posteromedially), densely covered with microsetae on ventral surface (except anterolateral areas bare); basal arms of moderate length, slightly divergent, then somewhat convergent apically; ventral plate in lateral view (Figure 3E) moderately produced ventrally; ventral plate in caudal view (Figure 3F) rounded ventrally, densely covered with microsetae on posterior surface. Median sclerite thin, plate-like. Parameres (Figure 3G) of moderate size, each with three distinct hooks. Aedeagal membrane (Figure 3G) moderately setose; dorsal plate absent. Abdominal segment 10 without distinct hairs near posterolateral surface. Cercus small, rounded, and encircled with 20–22 hairs.

**Remarks.** *Simulium* (*G.*) *apoense* was described from a single female, its associated pupal exuviae and a mature larva collected from Mindanao (Takaoka, 1983). It was placed in the *S. ceylonicum* species-group based on the dark hair tuft on the base of the female and male radial vein and the ventral plate narrowed posteriorly when viewed ventrally (Takaoka, 2012). At that time, the males of *S. (G.) apoense*, which were reared from pupae collected in Mindanao, were available for observation, although their characteristics were not described. The assignment of this species to the *S. ceylonicum* species is confirmed in the present study.

The male of *S. (G.) apoense* is almost indistinguishable from that of *S. (G.) sheilae* Takaoka & Davies, originally described from Peninsular Malaysia (Takaoka & Davies, 1995), and subsequently recorded from Thailand (Kuvangkadilok & Takaoka, 2000), Sumatra (Takaoka et al., 2000), Sabah (Takaoka, 2001a) and Sarawak (Takaoka, 2001b), although there are slight differences in the relative length of the sensory vesicle against the third palpal segment (0.16–0.19 in this species versus 0.23 in *S. (G.) sheilae*) and in the relative width of the hind basitarsus against the hind tibia and femur (1.0 and 1.2–1.3 in this species versus 0.9 and 1.1 in *S. (G.) sheilae*).

The pupal terminal hooks of this species are simple and cone-like (Figure 3H), slightly different from those of *S. (G.) sheilae*, which are somewhat wider basally and have the outer margins somewhat undulate (Takaoka & Davies, 1995; Takaoka et al., 2018).

The male of *S. (G.) apoense* is also similar to that of *S. (G.) mindoroense* Takaoka & Tenedero from Mindoro, the Philippines, although there are some differences in the relative length of the sensory vesicle against the third palpal segment (0.16–0.19 in this species versus 0.24 in *S. (G.) mindoroense*) and in the relative width of the hind basitarsus against the hind tibia and femur (1.0 and 1.2–1.3 in this species versus 0.9 and 1.0 in *S. (G.) mindoroense*). On the contrary, *S. (G.) apoense* is easily distinguished from *S. (G.) mindoroense* in the female by the relative length of the tooth to the claw (0.52 in this species versus 0.44 in *S. (G.) mindoroense*), and in the pupa by the terminal hooks (simple and cone-like (Fig. 3H) in this species versus wide and plate-like in *S. (G.) mindoroense*) (Takaoka & Tenedero, 2007).

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#### Declaration of Competing Interest

We declare that this is our original work. It has not been published elsewhere and we have no conflicts of interest concerning the work reported in this paper. All authors have contributed to this study throughout the study design, field work, data collection, data analyses and data interpretation. The authors have read and approved the manuscript.

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