Two New Species of *Simulium* (*Gomphostilbia*) (Diptera: Simuliidae) From Flores, Indonesia

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Abstract

Two new species, *Simulium* (*Gomphostilbia*) *sunapii* and *S.* (*G.* *rangatense*), are described based on adults, pupae, and mature larvae from Flores, in the eastern part of the Sunda Archipelago, Indonesia. *Simulium* (*G.* *sunapii* sp. nov. is placed in the *S. asakoae* species-group, representing the easternmost geographical record for the group in this archipelago. It is characterized by a small number of male upper-eye large facets in eight or nine vertical columns and 12 horizontal rows. *Simulium* (*G.* *rangatense* sp. nov. is placed in the *S. ceylonicum* species-group and is characterized by the pupal gill with six filaments. This new species, together with two related species of the *S. ceylonicum* species-group in Flores, suggests the species radiation of this species-group might have been accompanied by a reduction of the number of pupal gill filaments from eight to four through six. Taxonomic notes are provided to distinguish these two new species from related species.

Key words: black fly, new species, Flores, Indonesia

In the Sunda Archipelago, Indonesia, the black fly fauna is represented by 43 species, all belonging to the genus *Simulium* Latreille, of which 25 species were recorded from Sumatra, 23 from Java, one from Bali, eight from Flores, and one from Timor (Edwards 1934; Takaoka and Davies 1996; Takaoka and Sigit 1997; Takaoka et al. 2000, 2006a, b, 2016; Adler and Crosskey 2016).

The biting habits and vectorial roles in the transmission of causative agents of human and animal diseases, by the females of these species remain unknown, although three Oriental species, *Simulium* (*Gomphostilbia*) *asakoae* Takaoka & Davies, *S.* (*Simulium*) *nigrogilvum* Summers, and *S.* (*S.*) *nodosum* Puri, were reported to transmit unknown filariae in Thailand (Fukuda et al. 2003, Takaoka et al. 2003, Ishii et al. 2008).

We surveyed larvae and pupae of black flies in Flores, in the eastern part of the Sunda Archipelago, in February 2016, and collected two new species, both of which are assigned to the subgenus *Gomphostilbia* Enderlein. These two new species are described based on adults, pupae, and mature larva.

The methods of collection, description, and illustration, and terms for morphological features used here, follow those of Takaoka (2003) and partially those of Adler et al. (2004).
longer hairs near vertex; frontal ratio 1.89:1.00:3.45; frons:head ratio
1.00:5.75. Fronto-ocular area well developed, narrow, directed
dorsolaterally. Clypeus brownish black, densely covered with
yellowish-white scale-like hairs interspersed with several dark longer
hairs on each side. Labrum 0.58 times length of clypeus. Antenna
composed of scape, pedicel, and nine flagellomeres, light to medium
brown except scape, pedicel, and basal one-third to one-half of first
flagellomere whitish yellow. Maxillary palp composed of five seg-
ments, light to medium brown, proportional lengths of third, fourth,
and fifth segments 1.00:1.25:2.63; third segment (Fig. 1A) slightly
widened apically; sensory vesicle (Fig. 1A) medium sized, ellipsoidal
(0.34 times length of third segment), with small opening. Maxillary
lacinia with 10–13 inner and 12 or 13 outer teeth. Mandible with 26
inner teeth and 10 outer teeth (though two teeth near tip less distinct).

Fig. 1. Female of *Simulium* (*Gomphostilbia*) *sunapii* sp. nov. (A) Third segment of maxillary palp with sensory vesicle (right side; front view). (B) Cibarium (front view). (C) Hind tibia (left side; outer view). (D) Hind basitarsus and second tarsomere (left side; outer view). (E) Claw. (F) Sternite 8 and ovipositor valve (right side only; ventral view). (G) Genital fork (ventral view). (H) & (I) Paraprocts and cerci (H, ventral view; I, lateral view). (J) Spermatheca. Scale bars. 0.1 mm for C and D; 0.02 mm for A, B, and F–J; 0.01 mm for E.
Cibarium (Fig. 1B) medially forming sclerotized plate folded forward from posterior margin, with moderately sclerotized mediolongitudinal ridge with bifid apex.

Thorax
Scutum dark brown except anterolateral calvi ochreous, and faintly with three blackish longitudinal vittae (one median, two submedian), thinly pruinose and shiny when illuminated at certain angles, densely covered with white to whitish-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 longer than deep, medium to dark brown, shiny when illuminated at certain angles, moderately covered with fine short hairs.

Legs
Foreleg: coxa whitish yellow; trochanter whitish yellow with somewhat darker areas on apical half; femur dark yellow to light brown with apical cap medium brown (though extreme tip yellowish); tibia white except apical cap dark brown, and covered with white fine hairs on basal four-fifths; tarsus brownish black, with moderate dorsal hair crest; basitarsus moderately dilated, 5.31 times as long as its greatest width. Midleg: coxa dark brown except posterolateral surface brownish black; trochanter light brown except basal half or little less whitish yellow; femur light brown with base narrowly yellowish white and apical cap medium brown (though extreme tip yellowish); tibia light brown to dark brown except anterior surface of basal one-third and posterior surface of anterior two-thirds whitish and apical cap brown black, covered with whitish fine hairs on posterior surface of basal three-fourths; tarsus brownish black though basal half or little less of basitarsus whitish yellow. Hind leg: coxa light brown; trochanter whitish yellow; femur light brown with base yellowish yellow and apical cap dark brown; tibia (Fig. 1C) white on basal half or little more (though white extensively on posterior surface of basal two-thirds and medium brown to brownish black on rest, covered with whitish fine hairs on outer and posterior surfaces of little more than basal three-fourths; tarsus brownish black except basal two-thirds or little more (though base light brown) and basal half of second tarsomere whitish yellow; basitarsus (Fig. 1D) narrow, nearly parallel-sided though slightly narrowed apically, 5.44 times as long as wide, and 0.75 and 0.64 times as wide as greatest widths of tibia and femur, respectively; calcipala (Fig. 1D) nearly as long as width at base, and 0.56 times as wide as greatest width of basitarsus; pedisulcus (Fig. 1D) well developed; claw (Fig. 1E) with large basal tooth 0.55 times length of claw.

Wing
Length 1.9 mm. Costa with dark spinules and hairs except basal patch of hairs yellow. Subcosta with dark hairs except near apex bare. Hair tuft on base of radius yellow. Basal portion of radius fully haired; R₁ with dark spinules and hairs; R₂ with hairs only. Basal cell absent.

Halter
White except basal portion darkened.

Abdomen
Basal scale light brown, with fringe of whitish-yellow hairs. Dorsal surface of abdomen medium to brownish black except anterior half of segment 2 pale, moderately covered with dark short to long hairs; tergites of segments 2 and 6–9 shiny when illuminated at certain angles. Ventral surface of segment 2 white, those of other segments medium to dark brown; sternal plate on segment 7 undeveloped.

Terminalia
Sternite 8 (Fig. 1F) bare medially, with 19 or 20 medium-long to long hairs together with five slender short hairs on each side. Ovipositor valves (Fig. 1F) triangular (though postero medial corners rounded), thin, membranous, moderately covered with microsetae interspersed with two or three short hairs; inner margins sinuous, somewhat sclerotized, and moderately separated from each other. Genital fork (Fig. 1G) of usual inverted-Y form, with slender stem; arms of moderate width, moderately folded dorsally, with unsclerotized lobe directed posteromedially. Paraproct in ventral view (Fig. 1H) pointed medi ally, with five or six sensilla on anteromedial surface; paraproct in lateral view (Fig. 1I) slightly produced ventrally beyond ventral tip of cercus, 0.74 times as long as wide, with 16–19 medium-long to long hairs on ventral and lateral surfaces. Cercus in lateral view (Fig. 1I) short, rounded posteriorly, 0.42 times as long as wide. Spermataeca (Fig. 1J) ellipsoidal, 1.54 times as long as its greatest width, well sclerotized except duct and small area near junction with duct unsclerotized, and with many fissures on outer surface; internal setae absent; both accessory ducts slightly thicker in diameter than major one.

Male
Body length 1.9–2.2 mm.

Head
Somewhat wider than thorax. Upper eye bright medium brown, consisting of eight or nine vertical columns and 12 horizontal rows of large facets. Face brownish black, white pruinose. Clypeus brownish black, whitish pruinose, moderately covered with golden-yellow medium-long hairs (though median portion bare) interspersed with several dark-brown simple longer hairs along each lateral margin. Antenna composed of scape, pedicel, and nine flagellomeres, yellowish on scape, pedicel, and base of flagellomere 1, dark yellow to light brown on rest of flagellomere 1 to flagellomere 3, and dark brown on flagellomeres 4–9; first flagellomere elongate, 1.56 times length of second one. Maxillary palp light to medium brown, with five segments, proportional lengths of third, fourth, and fifth segments 1.00:1.19:2.94; third segment (Fig. 2A) widened apically; sensory vesicle (Fig. 2A) small, globular (0.16 times length of third segment), and with small opening.

Thorax
Scutum dark brown, with longitudinal vittae (one median, two submedian) invisible or faintly visible, shiny and thinly white pruinose when illuminated at certain angles, and densely covered with whitish-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 and white pruinose when illuminated at certain angles, and bare. Pleural membrane bare. Katepisternum dark brown, longer than deep, shiny when illuminated at certain angles, moderately covered with fine short hairs.

Legs
Foreleg: color almost same as that of female; basitarsus moderately dilated, 5.91 times as long as its greatest width. Midleg: coxa
medium brown except posterior surface dark brown; trochanter light brown except base yellowish white; femur light brown (though extreme base somewhat paler) with apical cap medium brown (though apical tip yellow); tibia medium to dark brown except basal one-third or little more whitish; tarsus dark brown except basal one-third or less of basitarsus yellow (border not well defined). Hind leg: coxa light brown; trochanter whitish yellow; femur medium brown with base whitish yellow and apical cap dark brown; tibia (Fig. 2B) dark brown to brownish black except basal two-fifths whitish; tarsus (Fig. 2C) dark brown except little more than basal two-thirds of basitarsus and little less than basal half of second tarsomere yellowish white; basitarsus (Fig. 2C) enlarged, wedge-shaped, 3.00 times as long as wide, and 1.07 and 1.40 times as wide as greatest width of tibia and femur, respectively; calcipala (Fig. 2C) slightly shorter than basal width, and 0.30 times as wide as greatest width of basitarsus. Pedisulcus (Fig. 2C) well developed.

Wing
Length 1.6 mm. Other characters as in female except subcosta with two or three hairs.

Halter
White except basal stem darkened.
Abdomen
Basal scale medium brown, with fringe of light-brown hairs. Dorsal surface of abdomen dark brown to brownish black except basal half of segment 2 pale, covered with dark-brown short to long hairs; segments 2 and 5–7 each with pair of shiny dorsolateral or lateral patches, which are widely connected in middle to each other (also segments 3, 4 and 8 each with slightly shiny dorsolateral or lateral patches when illuminated at certain angles); ventral surface of segment 2 whitish, those of segments light to medium brown.

Genitalia
Coxite in ventral view (Fig. 2D) nearly rectangular, 1.77 times as long as its greatest width. Style in ventral view (Fig. 2D) bent inward, with blunt apex having single spine; style in ventrolateral view (Fig. 2E) 0.8 times length of coxite, slightly tapered toward apical one-third, then nearly parallel-sided, with rounded apex. Ventral plate in ventral view (Fig. 2D) with body transverse, 0.63 times as long as wide, with anterior margin produced anteromedially, posterior margin somewhat concave medially (though dorsomedial portion somewhat convex), and lateral margin slightly emarginated medially, and densely covered with microsetae on ventral surface; basal arms of moderate length, parallel-sided; ventral plate in lateral view (Fig. 2E) moderately produced ventrally; ventral plate in caudal view (Fig. 2F) rounded ventrally, though ventral margin nearly straight medially, densely covered with microsetae on posterior surface. Median sclerite (Fig. 2G) plate-like, wide. Parameres (Fig. 2H) of moderate size, each with four distinct long and medium-long stout hooks, and without minute setae on outer surface of basal portion. Aedeagal membrane (Fig. 2I) moderately setose; dorsal plate not defined. Ventral surface of abdominal segment 10 (Fig. 2J and K) without distinct hairs near posterolateral corners. Cercus (Fig. 2J and K) small, rounded, with 12 hairs.

Pupa
Body length 2.3–2.5 mm.

Head
Integument yellow, moderately covered with small round tubercles except antennal sheaths and ventral surface almost bare; antennal sheath without any protubercules; frons with three unbranched long trichomes with or without coiled apices (Fig. 3A), arising close together on each side; face with one unbranched long trichome with straight apex (Fig. 3B) on each side.

Thorax
Integument yellow, moderately covered with round tubercles, and with three long dorsomedial trichomes of different lengths (anterior trichome longest, posterior one shortest) with coiled apices (Fig. 3C), two long anterolateral trichomes (anterior trichome with straight apex, posterior one with coiled apex; Fig. 3D), one medium-long mediolateral trichome with straight apex (Fig. 3E), and three ventrolateral trichomes (one medium-long, two short with straight apices (Fig. 3F) on each side; all trichomes unbranched. Gill (Fig. 3G and H) composed of eight slender thread-like filaments, arranged as \[3 + (1 + 2) + 2 \text{ or } [(2 + 1) + (1 + 2)] + 2\] filaments from dorsal to ventral, with short common basal stalk having somewhat swollen transparent basal fenestra at base; common basal stalk 0.61–0.83 times length of interspiracular trunk; dorsal and middle triplets sharing stalk, and dorsal triplet composed of three individual filaments arising at same level, with short stalk, or composed of one individual and two paired filaments with extremely short stalk, middle triplet composed of one individual and two paired filaments and bearing short to medium-long primary and secondary stalks (secondary stalk variable in length, 0.12–1.63 times length of primary stalk); stalk of ventral pair of filaments variable from medium-long to long, 1.13–2.44 times length of common basal stalk, and 0.59–1.77 times length of interspiracular trunk, and 0.75 times as thick as common stalk of middle and dorsal triplets; primary stalks of middle and dorsal triplets 1.23–2.75 and 0.61–0.83 times length of common stalk of middle and dorsal triplets, respectively; primary stalk of dorsal triplet lying against that of lower pair at angle of 40–70 degrees when viewed laterally; filaments of dorsal triplet subequal in length (1.6 mm) and thickness to one another; filaments of middle triplet subequal in length (1.8–2.0 mm) and thickness to one another; two filaments of ventral pair subequal in length (2.2–2.5 mm) and thickness to each other and 1.25 times as thick as dorsal and middle triplets of filaments when compared basally; all filaments medium to dark brown, gradually tapered toward apex; cuticle of all filaments with well-defined annular ridges and furrows though becoming less marked apically, densely covered with minute tubercles.

Abdomen
Dorsally, segments 1, 2, and 9 yellow, and other segments sometimes pale yellow; segments 1 and 2 sparsely or moderately covered with minute tubercles; segments 6 and 7 each with few to several unpigmented minute spines near posterior margin on each side, segment 8 with or without few minute tubercles on each side, and segment 9 with few to several round minute tubercles on each side; segment 1 with one unbranched slender short hair-like seta (Fig. 3I) on each side; segment 2 with one unbranched slender short hair-like seta and five minute setae (Fig. 3J) submedially on each side; segments 3 and 4 each with four hooked spines and one somewhat spinous minute seta on each side; segment 5 with or without comb-like groups of minute spines on each side; segments 6–9 each with spine-combs in transverse row and comb-like groups of minute spines on each side; segments 5–8 each with few minute setae near posterior margin on each side; segment 9 with pair of wide flat terminal hooks, of which outer margin is 3.5–4.0 times length of inner margin and crenulated (Fig. 3K) when viewed caudally. Ventral margin on each side; segment 4 with one unbranched hook (somewhat smaller in size to those on segments 5–7) and few slender short setae on each side; segment 5 with pair of bifid hooks submedially and few short slender setae on each side; segments 6 and 7 each with pair of bifid inner and branched outer hooks somewhat spaced from each other and few short slender setae on each side; segments 4–8 each with comb-like groups of minute spines. Each side of segment 9 with three grapnel-shaped hooklets.

Cocoon
Wall-pocket-shaped, moderately woven, widely extended ventrolaterally; anterior margin somewhat thickly woven medially, without anterodorsal projection, though bulged in one cocoon; posterior three-fifths with floor roughly woven; individual threads visible; 2.5–3.0 mm long by 1.8–2.2 mm wide.

Mature Larva
Body length 4.2 mm. Thorax ochreous on dorsal and ventral surface, with segment 1 encircled with reddish-brown band though disconnected ventrolaterally; abdominal segments 1–4 light gray, abdominal segments 3 and 4 faintly and sparsely encircled with reddish brown markings, and abdominal segments 5–9 faintly or moderately
mottled with same colored pigments dorsally and dorsolaterally, though ventral surface of abdominal segments 5 and 6 also sparsely mottled with same colored pigments. Head capsule yellow, moderately covered with minute setae dorsally (sparsely laterally and ventrally); head spots faintly positive though mediolateral spots and posterior lateral spots indistinct; lateral surface of head capsule yellow except eye-spot region white, with faint small round spot below it and two relatively larger spots behind it; ventral surface of head capsule yellow except middle areas widely darkened, with distinct positive spot on each side of postgenal cleft. Antenna composed of three segments and apical sensillum, longer than stem of labral fan; proportional lengths of first, second, and third segments 1.00:0.73:1.03. Labral fan with 40 primary rays. Mandible (Fig. 4A) with three comb-teeth decreasing in length from first tooth to third; mandibular serration composed of two teeth (one mediumsized, one small); major tooth at angle of little less than 90 degrees.
against mandible on apical side; supernumerary serrations absent. Hypostoma (Fig. 4B) with row of nine apical teeth, of which median tooth is longer than each corner tooth; inner tooth of three intermediate teeth on each side subequal in length to corner tooth; lateral margin smooth; five or six hypostomal bristles per side lying nearly parallel to lateral margin. Postgenal cleft (Fig. 4C) arrow-headed, long, 4.71 times length of postgenal bridge. Cervical sclerites composed of pair of small yellow rod-like pieces. Thoracic proleg without hairs; thoracic and abdominal cuticle almost bare except that of abdominal segments 5–9 sparsely to moderately covered with slightly darkened unbranched minute setae mixed with unpigmented shorter minute setae on dorsal and dorsolateral surfaces; last abdominal segment densely covered with unbranched colorless minute setae on dorsolateral and lateral surfaces of each side of anal sclerite and on each lateral surface even down to base of ventral papilla; thorax and abdomen without dorsal protuberances. Rectal scales present. Rectal organ compound, each of three lobes with four finger-like secondary lobules. Anal sclerite of usual X-form, with anterior arms nearly as long as posterior ones, broadly sclerotized at base; no sensilla on broad base and posterior to posterior arms; accessory sclerite absent. Last abdominal segment with pair of large conical ventral papillae. Posterior circlet with 94 rows of hooklets with up to 13 hooklets per row.*

**Type Material**

**HOLOTYPE:** Male (with associated pupal exuviae and cocoon) reared from a pupa collected from a fast-flowing stream (width 0.2–1.0 m, depth 5–10 cm, bottom of pebbles and sands, water temperature 21.0°C), exposed to the sun, altitude 755 m, 08°35′39.103″S/120°00′46.857″E, Rangat, Kempo, Flores Island, Indonesia, 28-II-2016, by M. Sofian-Azirun, C.D. Chen, K.W. Lau, M.R.A. Halim & I. W. Suana; one male (with associated pupal exuviae and cocoon), and one mature larva, same data as the holotype; one female, one male (together with associated pupal exuviae and coconos), one female (with associated pupal exuviae and cocoon; pupal gill with seven filaments), collected from a moderately flowing stream (width 0.2–1.0 m, depth 2–10 cm, bottom rocky and sandy, water temperature 22.0°C, partially shaded, altitude 838 m, 08°36′20.443″S/120°01′19.156″E), Rangat, Kempo, Flores Island, Indonesia, same date and collectors.

**Biological Notes**

The pupae and larvae of this new species were collected from fallen leaves and grasses tailing in the water. Associated species were *S. (G.) atratum* De Meijere and *S. (G.) floresense* Takaoka, Hadi & Sigit.

**Distribution**

Flores.

**Etymology**

The species name *sunapii* is in honor of Dr. H. Sunapi, Rector, University of Mataram, Lombok, Indonesia, for his kind support of our surveys of black flies in the Lesser Sunda Archipelago.

**Remarks**

This new species is assigned to the *S. asakoae* species-group of the subgenus *Gomphostilbia*, defined by Takaoka (2012), by having the yellow hair tuft on the base of the radius, enlarged male hind tarsi (Fig. 2C), and lateral margins of the ventral plate emarginated when viewed ventrally (Fig. 2D).

The male of this new species is characterized by the smaller number of upper-eye large facets in eight or nine vertical columns and 12 horizontal rows. A similar small number of male upper-eye large facets was recorded in *S. (G.) mengi* Chen, Zhang & Wen and *S. (G.) miaolingense* Wen & Chen, both described from Guizhou Province, China (Chen and An 2003). This new species is distinguished from *S. (G.) mengi* and *S. (G.) miaolingense* by the number (12) of horizontal rows of the male upper-eye large facets (the male upper-eye large facets are in eight horizontal rows in *S. (G.) mengi* and nine horizontal rows in *S. (G.) miaoingense*).

*Simulium* (Gomphostilbia) *sunapii* sp. nov. represents the easternmost geographical distribution of the *S. asakoae* species-group in the Sunda Archipelago, where this species-group was represented by one species, *S. (G.) gyorkosae* Takaoka & Davies, which was recorded from Sumatra and Java (Takaoka and Davies 1996), although it was also recorded from Sulawesi (Takaoka 2003).

One pupa of this new species has seven gill filaments on each side. The gill filaments are arranged as (3+3)+1 filaments on the right side, and [(2+1+1)+2]+1 filaments on the left side, from dorsal to ventral. The ventral filament (2.5 mm long) is much longer and thicker than the other filaments (1.6–1.8 mm long). The female reared from the pupa is almost identical to that of *S. (G.) sunapii* sp. nov. as described above. Apart from the gill, the morphological characters of the pupa are also identical to those of *S. (G.) sunapii* sp. nov. Because the odd number of pupal gill filaments is rare in the subgenus *Gomphostilbia* and no other pupae with seven gill filaments were collected from the same stream, the specimen is thought to be an aberrant pupa with an unusual number of gill filaments.

**Simulium(Gomphostilbia) rangatense Takaoka, Sofian-Azirun & Wayan sp. nov.**

(urn:lsid:zoobank.org:act:E0181601-5969-4F40-A794-D735C4608848)

This new species is similar to *S. (G.) kamimurai* Takaoka described by Takaoka (2003) as follows.

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*Fig. 4. Larva of Simulium (Gomphostilbia) sunapii sp. nov. (A) Mandible, (B) Hypostoma, (C) Head capsule showing postgenal cleft (ventral view). Scale bars. 0.1 mm for C; 0.02 mm for A and B.*
Male
Body length 2.2 mm.

Head
Slightly wider than thorax. Upper eye bright medium brown, consisting of 12 vertical columns and 14 horizontal rows of large facets. Face brownish black, white pruinose. Clypeus brownish black, whitish pruinose, moderately covered with golden-yellow medium-long scale-like hairs (though median portion of lower half narrowly bare) interspersed with several dark-brown simple longer hairs along each lateral margin. Antenna composed of scape, pedicel, and nine flagellomeres, scape yellow, pedicel yellow on basal two-thirds and light brown on apical one-third (though ventral surface yellow), and flagellomeres light to dark brown except basal one-third of flagellomere 1 yellowish; first flagellomere elongate, 1.67 times length of second one. Maxillary palp light to medium brown, with five segments, proportional lengths of third, fourth, and fifth segments 1.00:1.17:2.92; third segment (Fig. 5A) slightly widened apically; sensory vesicle (Fig. 5A) small, globular (0.19 times length of third segment), and with small opening.

Thorax
Scutum dark brown to brownish black, with shiny, whitish-pruinose pattern consisting of spots on shoulders, narrow band along each lateral margin and large spot on prescutellar area, and densely 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 and white pruinose when illuminated at certain angles, and bare. Pleural membrane bare. Katepisternum dark brown, longer than deep, slightly shiny when illuminated at certain angles, moderately covered with fine short hairs.

Legs
Foreleg: coxa whitish yellow; trochanter grayish except ventral surface paler; femur light to medium brown; tibia medium brown with median large portion of outer surface white; tarsus dark brown, with moderate dorsal hair crest; basitarsus moderately dilated, 6.9 times as long as its greatest width. Midleg: coxa dark brown except posterolateral surface brownish black; trochanter light brown except base whitish yellow; femur light to medium brown; tibia medium brown except basal one-third whitish yellow; tarsus medium to dark brown. Hind leg: coxa dark brown; trochanter whitish yellow; femur dark brown with base whitish yellow; tibia (Fig. 5B) dark brown to brownish black except little more than basal one-third whitish yellow; tarsus medium to dark brown except basal half or little less of basitarsus and basal one-third of second tarsomere whitish yellow; basitarsus (Fig. 5C) enlarged, wedge-shaped, 3.46 times as long as wide, and 1.00 and 1.08 times as wide as greatest widths of tibia and femur, respectively; calcipala (Fig. 5C) nearly as
long as width at base, and 0.35 times as wide as greatest width of basitarsus; pedisulcus (Fig. 5C) well developed.

**Wing**
Length 1.6 mm. Costa with dark spines and hairs. Subcosta bare. Hair tuft on base of radius dark brown. Basal portion of radius fully haired; R₁ with dark spines and hairs; R₂ with hairs only. Basal cell absent.

**Halter**
White except basal portion darkened.

**Abdomen**
Basal scale dark brown, with fringe of light-brown hairs. Dorsal surface of abdomen dark brown to brownish black except tergite of segment 2 pale, covered with dark-brown short to long hairs; segments 2 and 5–7 each with pair of shiny dorsolateral or lateral patches; ventral surface of segment 2 whitish, those of other segments light to medium brown.

**Genitalia**
Coxite in ventral view (Fig. 5D) nearly rectangular, 1.78 times as long as its greatest width. Style in ventral view (Fig. 5D) bent inward, with blunt apex having single spine; style in ventrolateral view (Fig. 5E) 0.82 times length of coxite, slightly tapered toward apical one-third, then nearly parallel-sided, with rounded apex. Ventral plate in ventral view (Fig. 5D) with body transverse, 0.63 times as long as wide, with anterior margin produced anteromedially, posterior margin somewhat concave medially (though dorsomedial portion somewhat convex), and lateral margin slightly narrowed on posterior half, and densely covered with microsetae on ventral surface; basal arms of moderate length, parallel-sided or slightly divergent; ventral plate in lateral view (Fig. 5E) moderately produced ventrally; ventral plate in caudal view (Fig. 5F) trapezoidal with ventral margin nearly straight, densely covered with microsetae on ventral surface; basal arms of moderate length, parallel-sided or slightly divergent; ventral plate in lateral view (Fig. 5E) 0.82 times length of coxite, slightly tapered toward apical one-third, then nearly parallel-sided, with rounded apex.

**Pupa**
Body length 2.5 mm.

**Head**
Integument yellow, densely covered with small round tubercles except antennal sheaths and ventral surface almost bare; antennal sheath without any protuberances; frons with three unbranched trichomes (one long, two medium-long) with straight apices (Fig. 6A), all arising close together, on each side; face with unbranched medium-long trichome with straight apex (Fig. 6B), on each side.

**Thorax**
Integument yellow, densely covered with round tubercles, and with three dorsomedial trichomes (two long, one medium-long, and anterior trichome longest, posterior one shortest; Fig. 6C), two anterolateral trichomes (anterior trichome medium-long, slightly slenderer than long posterior one; Fig. 6D), one short mediolateral trichome (Fig. 6E), and three short ventrolateral trichomes (Fig. 6F), on each side; all trichomes unbranched and with straight apices. Gill (Fig. 6G) composed of six slender thread-like filaments, arranged as (2+2)+2 filaments from dorsal to ventral, with short common basal stalk having somewhat swollen transparent basal fenestra at base; common basal stalk 0.57–0.68 times length of interspiracular trunk; dorsal and middle pairs sharing short stalk; stalk of ventral pair medium-long, 1.32–1.46 and 0.67–0.83 times length of common basal stalk and interspiracular trunk, respectively, and 0.93–1.00 times as thick as common stalk of middle and dorsal pairs, 1.18–1.40 and 1.08–1.17 times as thick as stalks of middle and dorsal pairs, respectively; stalk of middle pair long, 1.87–2.13 and 3.20–3.84 times lengths of stalks of dorsal and ventral pairs, respectively; stalk of dorsal pair lying against that of lower pair at angle of 35–40 degrees when viewed laterally; all filaments medium brown, gradually tapered toward apex, subequal in length (2.3–2.5 mm when measured from base of gill to tips of filaments) to one another, though two filaments of ventral pair slightly longer than others; cuticle of all filaments with well-defined annular ridges and furrows though becoming less marked apically, densely covered with minute tubercles.

**Abdomen**
Dorsally, all segments light yellow; segments 1, 2, 8, and 9 each sparsely covered with minute tubercles, whereas segments 6 and 7 each densely covered with comb-like groups of unpigmented minute spines in transverse rows on posterior area along posterior margin (Fig. 6H and I); segment 1 with one unbranched slender short hair-like seta (Fig. 6J) on each side; segment 2 with one unbranched slender short hair-like seta and five minute setae (Fig. 6K) on each side; segments 3 and 4 each with four hooked spines and one somewhat spinous minute seta on each side; segment 5 with comb-like groups of minute spines in transverse rows near anterior margin on each side; segments 6–9 each with spine-combs in transverse row and comb-like groups of minute spines near anterior margin on each side; segment 5 with four minute setae near posterior margin on each side, and segments 6–8 each with two minute setae near posterior margin on each side; segment 9 with pair of wide flat terminal hooks, of which outer margin is 2.0–2.4 times length of inner margin and crenulated (Fig. 6L) when viewed caudally. Ventrally, segment 4 with one unbranched hook (somewhat smaller in size than those on segments 5–7) and few slender short setae on each side; segment 5 with pair of bifid hooks submedially and few short slender setae on each side; segments 6 and 7 each with pair of bifid inner and unbranched (or bifid) outer hooks somewhat spaced from each other and few short slender setae on each side; segments 4–8 each with comb-like groups of minute spines. Each side of segment 9 with three grapnel-shaped hooklets.

**Cocoon (Fig. 6M)**
Wall-pocket-shaped, loosely woven, soft, and not extended ventrolaterally; anterior margin weakly woven, without anterodorsal projection, though slightly bulged medially; posterior three-fifths with floor roughly woven; individual threads visible; 2.3 mm long by 1.3 mm wide.

**Female and Larva**
Unknown.

**Type Material**
HOLOTYPE: Male (with associated pupal exuviae and cocoon), reared from a pupa, collected from a moderate to fast-flowing
Fig. 6. Pupa of *Simulium* (Gomphostilbia) rangatense sp. nov. (A) Frontal trichomes. (B) Facial trichome. (C)–(F) Thoracic trichomes (C, mediodorsal; D; anterolateral E, mediolateral; F, ventrolateral). (G) Gill filaments (left side; outer view). (H) Dorsal surface of abdominal segment 6 showing comb-like groups of unpigmented minute spines near posterior margin, and spine-combs and comb-like groups of minute spines near anterior margin (left half). (I) Dorsal surface of abdominal segments 8 and 9 sparsely covered with minute tubercles, and spine-combs and comb-like groups of minute spines near anterior margin (left half). (J) Hair-like seta on dorsal surface of abdominal segment 1. (K) Hair-like seta and minute seta on dorsal surface of abdominal segment 2. (L) Terminal hooks (caudal view). (M) Cocoon (dorsal view). Scale bars. 1.0 mm for M; 0.1 mm for G; 0.02 mm for A–F and H–L.
stream (width 1.0–1.5 m, depth 10–20 cm, bottom of pebbles and sands, water temperature 21.0°C, exposed to the sun, altitude 785 m, 08° 36′31.889″ S/120° 01′06.248″ E), Rangat, Kempo, Flores, Indonesia, 28-II-2016, by M. Sofian-Azirun, C.D. Chen, K.W. Lau, M.R.A. Halim & I. W. Suana.

Biological Notes
The pupa of this new species was collected from a fallen leaf in the water. The only associated species was S. (G.) atratum.

Distribution
Flores.

Etymology
The species name rangatense refers to the locality name, Rangat, where this new species was collected.

Remarks
This new species is assigned to the S. ceylonicum species-group of the subgenus Gomphostilbia, redefined by Takaoka (2012), by having the dark hair tuft on the base of the radius, enlarged male hind basitarsi (Fig. 5C), and lateral margins of the ventral plate narrowed on the posterior half when viewed ventrally (Fig. 5D).

The pupa of this new species is characterized by the gill with six filaments (Fig. 6G), long stalk of the middle pair of filaments (Fig. 6G), and abdominal segments 1, 2 and 6–9 covered with minute spines or tubercles (Fig. 6H and I). Among species of the S. ceylonicum species-group, two species, S. (G.) rosemaryae Takaoka & Roberts from Sulawesi and S. (G.) kamimurai from Sulawesi and Seram, have the pupal gill with six filaments (Takaoka and Roberts 1988, Takaoka 2003). However, this new species is distinguished from these two species in the male by the hind basitarsi which is whitish yellow on the basal half or slightly less (yellow or dark yellow on the basal one-third or two-fifths in the two known species), and in the pupa by the gill with an elongated stalk of the middle pair (short in the two known species), and presence of minute tubercles on the dorsal surface of abdominal segments 1, 2, 8 and 9 (absent in the two known species).

In Flores, the S. ceylonicum species-group was previously represented by two species, S. (G.) brevilabrum Takaoka, Hadi & Sigit and S. (G.) rutengense Takaoka, Hadi & Sigit (Takaoka et al. 2006a), which have four and eight pupal gill filaments, respectively. In both species, the dorsal surface of pupal abdominal segment 9 is also sparsely covered with minute tubercles, as in this new species. The species radiation of this species-group in Flores might have been accompanied by a transformation of pupal gill filaments from eight to four through six, as shown in the same species-group from Sulawesi (Takaoka 2003).

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