Four new species of the *Simulium* (*Simulium*) *tuberosum* species-group (Diptera: Simuliidae) from Nepal

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**Abstract:** Four new species of black flies of *Simulium* (*Simulium*) are described from adults and their associated pupal exuviae and cocoons in Nepal. All these new species, *S. tatopaniense*, *S. dailekhenense*, *S. langbangense*, and *S. nakanoi*, are in the *S. tuberosum* species-group of the subgenus *Simulium* Latreille. *Simulium dailekhenense* sp. nov. and *S. langbangense* are the same species previously reported as *S. ramosum* Puri and *S. rufibasis* Brunetti from Nepal, respectively. A list of 57 black fly species recorded from Nepal is provided.

Key words: biodiversity, fauna, Oriental Region, taxonomy

**INTRODUCTION**

The Simuliidae in Nepal have been relatively poorly studied. Only 12 species were recorded from Nepal before we collected pupae and larvae of black flies from various localities in this country from 2008 to 2011 (Shrestha and Takaoka, 2009). In the first two papers (Shrestha and Takaoka, 2009; Takaoka and Shrestha, 2010), we reported 20 more species including 10 new species from Nepal. In 2020, we described 16 new species and reported three newly recorded species from Nepal in five papers (Takaoka et al., 2020a, b, c, d, e).

In the present paper, we describe four more new species of black flies. These are in the *Simulium* (*Simulium*) *tuberosum* species-group, defined by Rubtsov (1959–1964), and redefined by Takaoka and Davies (1996).

All 57 species of black flies recorded from Nepal are classified in six subgenera in the genus *Simulium* Latreille: one species in *Asiosimulium* Takaoka & Choochote, one in *Eusimulium* Roubaud, 15 in *Gomphostilbia* Enderlein, three in *Montisimulium* Rubtsov, nine in *Nevermannia* Enderlein including two new species described by Adler et al. (2020b), and 28 in *Simulium* Latreille (Adler, 2020). A list of these 57 species of black flies from Nepal is provided in the appendix.

All materials examined in this study include adults reared from pupae and their pupal exuviae and cocoons, collected from various localities in Nepal in 2009 and 2011, and fixed in 80% ethanol by S. Shrestha.

Methods of morphological observation, terms of features, descriptions, and illustrations followed those of Takaoka (2003) and partially those of Adler et al. (2004).

The holotypes and paratypes of the new species are deposited in the Entomology Section of the Queen Sirikit Botanic Garden, Chiang Mai, Thailand.

*Simulium tatopaniense* Takaoka & Shrestha sp. nov.

**Female** (*n* = 1). Body length 3.0 mm. **Head.** Slightly narrower than thorax. Frons dark brown, shiny, with several dark stout hairs along each lateral margin and few hairs near lower margin; frontal ratio 1.39:1.00:1.39; frons:head ratio 1.00:3.65. Fronto-ocular area well developed, short, directed laterally, and rounded apically. Clypeus dark brown, shiny, moderately covered with several dark brown medium-long hairs along each lateral margin and mediolongitudinal portion bare. Labrum 0.66 times length of clypeus. Antenna composed of scape, pedicel and nine flagellomeres, dark brown, except scape, pedicel and base of first flagellomere yellow. Maxillary palpus with five palpomeres, medium brown except third palpomere dark brown; proportional lengths of third, fourth, and fifth palpomeres 1.00:1.00:1.00; third palpomere (Fig. 1A) of moderate size, with medium-sized ellipsoidal sensory vesicle (0.41 times length of third palpomere) having medium-sized opening. Lacinia with 15 or 16 inner and 19 outer...
teeth. Mandible with 28 inner and 12 outer teeth. Cibarium (Fig. 1B) with 70 tiny processes. **Thorax.** Scutum dark brown, shiny, white-pruinose when illuminated at certain angles, moderately covered with brassy short fine hairs interspersed with several dark brown long upright hairs on prescutellar area. Scutellum yellowish white (pigmentation probably incomplete), covered with dark brown upright long hairs. Postnotum dark brown, shiny and white-pruinose when illuminated at certain angles, and bare. Pleural membrane bare. Katepisternum longer than deep, dark brown, shiny and white-pruinose when illuminated at certain angles, and bare. **Legs.** Foreleg: coxa yellowish white; trochanter dark yellow except basal half yellowish white; femur yellowish white except apical cap medium brown (probably light brown except base yellowish and apical cap medium brown, when color is complete); tibia medium brown except median outer surface white; tarsus dark brown, with moderate dorsal hair crest; basitarsus (Fig. 1C)

Fig. 1. Female of *S. tatopaniense* sp. nov. A, third palpomere with sensory vesicle (right side; front view). B, cibarium (front view). C, basitarsus of foreleg (left side; outer view). D, basitarsus and second tarsomere of hind leg (left side; outer view). E, sternite 8 and ovipositor valves (ventral view). F and G, genital forks (F, ventral view; G, lateral view). H and I, paraprocts and cerci (right side; H, ventral view; I, lateral view). J, spermatheca. Scale bars. 0.1 mm for C and D; 0.02 mm for A, B, and E–J.
greatly dilated, 3.72 times as long as its greatest width. Midleg: coxa dark brown except posterolateral surface brownish black; trochanter medium brown except base yellowish white; femur yellowish white except apical cap medium brown (probably medium brown except apical cap dark brown, when color is complete); tibia medium brown except base yellowish white, though yellowish white portion wider on posterior surface, and apical cap dark brown; tarsus yellowish white except apical tip of basitarsus, apical one-third of second tarsome and apical two-thirds of third tarsomere light brown. Hind leg: coxa medium brown; trochanter dark yellow; femur yellowish white except apical cap medium brown (probably light to medium brown except extreme base yellowish and apical cap dark brown, when color is complete); tibia medium brown except base yellowish white, though yellowish white portion much wider (about basal one-third) on posterior surface, and apical cap dark brown; tarsus light to medium brown except basal two-thirds of basitarsus (though base light brown) and basal half of second tarsomere yellowish white; basitarsus (Fig. 1D) nearly parallel-sided, 5.56 times as long as wide, and 0.68 and 0.54 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 1D) moderately developed, nearly as long as wide, and 0.44 times as wide as greatest width of basitarsus; pedisculus (Fig. 1D) well developed; claw simple, without tooth. **Wing.** Length 2.0 mm. Costa with dark spinules and hairs; subcosta haired except near apex bare; basal section of radius bare; R, with dark brown spinules and hairs; R₂, with dark brown hairs; hair tuft on base of radius dark brown; basal cell absent. **Halter.** White except base darkened. **Abdomen.** Basal scale medium brown, with fringe of yellow hairs (though bases darkened). Dorsal surface of abdomen medium brown to brownish black, with dark short hairs; tergite 2 and 6–9 shiny and iridescent when illuminated at certain angles. Ventral surface medium brown to brownish black; segment 7 with large median sternal plate. **Terminalia.** Sternite 8 (Fig. 1E) well sclerotized and bare medially, covered with 11–13 long and medium-long stout hairs and three or four short fine hairs on each side. Ovipositor valves (Fig. 1E) nearly triangular, rounded posteromedially, membranous except inner margins weakly sclerotized, each densely covered with microsetae except narrow portion near posteromedial corner bare, together with 13–15 short fine hairs; inner margin somewhat concave medially. Genital fork (Fig. 1F, G) of inverted-Y form; stem slender and well sclerotized; arms of moderate width, each with strongly-sclerotized projection directed forwardly from lateral ridge. Paraproct in ventral view (Fig. 1H) narrow, pointed posteromedially, somewhat concave anterolaterally, and with strongly sclerotized anteromedial surface; paraproct in lateral view (Fig. 1I) somewhat produced ventrally, 0.66 times as long as wide, covered with 19 or 20 short to medium-long hairs and numerous microsetae on lateral and ventral surfaces. Cercus in lateral view (Fig. 1I) short, rounded posteriorly, 0.42 times as long as its greatest width, and covered with medium-long and short hairs. Spermatheca (Fig. 1J) ovoidal, 1.18 times as long as wide, moderately sclerotized except duct and narrow area of juncture with duct unsclerotized, without discernible reticulate surface patterns; minute internal setae present; accessory ducts subequal in thickness to each other and slightly thicker than main duct.

**Male** (*n=1*). Body length 3.0 mm. **Head.** Slightly wider than thorax. Upper eye medium brown, with large facets in 20 vertical columns and 20 horizontal rows. Clypeus dark brown, thickly white-pruinose, silvery or bluish, shiny when illuminated at certain angles, covered with dark brown hairs along lateral margins and near ventral margin and medial portion bare. Antenna composed of scape, pedicel and nine flagellomeres, medium brown to brownish black except base of first flagellomere yellowish; first flagellomere elongate, twice as long as second one. Maxillary palpus grayish to dark brown, composed of five palpomeres, with proportional lengths of third, fourth, and fifth palpomeres 1.00 : 1.21 : 2.65; third palpomere (Fig. 2A) of moderate size; sensory vesicle (Fig. 2A) small, ellipsoidal, 0.24 times as long as third palpomere, and with small opening. **Thorax.** Scutum dark brown to brownish black, with white-pruinose pattern, *i.e.*, anterior pair of crescent spots (though not sharply pointed posteriorly) on shoulders extended posteriorly along lateral margins but disconnected near base of wings to large transverse posterior spot entirely covering prescutellar area; these pruinose areas silvery or bluish iridescent when illuminated at certain angles; scutum uniformly and moderately covered with brassy recumbent short hairs interspersed with dark brown long upright hairs on prescutellar area. Scutellum dark brown, with several dark brown long upright hairs. Postnotum brownish black, white-pruinose when illuminated at certain angles and bare. Pleural membrane bare. Katepisternum longer than deep, black, white-pruinose when illuminated at certain angles, and bare. **Legs.** Foreleg: coxa yellow; trochanter light brown; femur light to medium brown; tibia medium brown except median large portion white on outer surface; tarsus dark brown to brownish black, with moderate dorsal hair crest; basitarsus greatly dilated, 4.23 times as long as its greatest width. Midleg: coxa dark brown except posterolateral surface brownish black; trochanter, femur and tibia medium brown; tarsus light brown except basal four-fifths of basitarsus and basal half of second tarsomere yellowish white. Hind leg: coxa medium brown; trochanter light brown; femur medium brown except apical cap dark brown and extreme base light brown; tibia medium to dark brown except apical cap brownish black and
basal tip yellowish white; tarsus (Fig. 2B) medium brown except little less than basal half of basitarsus (though extreme base light brown) and basal half of second tarsomere whitish yellow; basitarsus (Fig. 2B) much enlarged, gradually widened from base to apical two-fifths, then nearly parallel-sided, 3.66 times as long as its greatest width, 0.93 and 0.98 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 2B) small, slightly shorter than wide, 0.27 times as wide as greatest width of basitarsus; pedisulcus (Fig. 2B) well developed. Halter. White except basal portion darkened. Wing. Length 1.9 mm. Other characters as in female except subcosta bare. Abdomen. Basal scale brownish black, with fringe of dark long hairs. Dorsal surface of abdomen dark brown to brownish black, with dark short hairs; segments 2, 6 and 7 each with a pair of silvery or bluish iridescent spots dorsolaterally, those on segment 2 broadly connected in middle to each other. Genitalia. Coxite in ventral view (Fig. 2C) nearly quadrate, 1.22 times as long as wide. Style in ventral view (Fig. 2C) elongate, 1.64 times as long as coxite, with basal protuberance having several conical spines, and with subterminal spine; style in ventrolateral view (Fig. 2D) widest at basal one-third, slightly widened from base to basal one-third, somewhat tapered toward middle, then slightly tapered to apex, and with round apex; style in medial view (Fig. 2E)
much produced dorsally near base forming round protuberance having several small conical spines on its apex. Ventral plate in ventral view (Fig. 2F) well sclerotized, with body subquadrate (though slightly narrowed basally), 0.53 times as long as wide, posterior margin somewhat concave, and with round projection directed ventrally, which is covered with many minute setae; arms divergent from each other; ventral plate in lateral view (Fig. 2G) with posterior margin weakly serrated along basal two-thirds; ventral plate in caudal view (Fig. 2H) rounded ventrally, with lateral margin serrated along basal two-thirds, with numerous setae on posterior surface except most of basal and lateral portions bare. Median sclerite in lateral view (Fig. 2G) arising just anterior to ventral plate, directed dorsally; median sclerite in caudal view (Fig. 2I) plate-like, gradually widened from base to apex, with round apex. Paramere in caudal view (Fig. 2J) broad basally, with at least three distinct hooks. Aedeagal membrane (Fig. 2J) densely covered with microsetae, and with moderately scleritized dorsal plate in form of horizontal bar (Fig. 2K). Abdominal segment 10 with five or six distinct hairs on ventral and lateral surfaces on each side. Cercus small, rounded, with eight or nine distinct hairs.

**Pupa (n=2).** Body length 2.5–2.8 mm. **Head.** Integument dark yellow except ventral surface yellowish white, moderately covered with relatively larger tubercles having minute secondary projections on frons (Fig. 3A), and relatively smaller tubercles on antennal sheaths and face; frons with two unbranched short slender trichomes subequal in length to each other (Fig. 3B) on each side, though one trichome much shorter than other on left side of frons of female pupa (Fig. 3C); face with one unbranched short trichome (Fig. 3D) on each side. **Thorax.** Integument dark brown except wing sheaths yellowish white, moderately covered with relatively larger tubercles (similar to those on frons) on anterior half of dorsal surface, and relatively smaller tubercles on posterior half of dorsal surface and on each lateral surface, and with pit-like organ near base of each gill (Fig. 3I); thorax with two dorsomedial trichomes of different length (Fig. 3E), though one trichome lost in female pupa, two anterolateral trichomes of different or same length (Fig. 3F), one mediolateral trichome (Fig. 3G), and three ventrolateral trichomes (Fig. 3H), on each side; all trichomes short and unbranched. Gill (Fig. 3J) with six slender thread-like filaments in three pairs (one dorsal, one middle and one ventral) arising directly from thorax and lacking common basal stalk; all pairs short-stalked; lower filament of ventral pair basally directed downward, then forward, other filaments directed forward, then curved upward or inward to various extent; outer filament of dorsal pair longest (1.9 mm long) and thickest, followed by inner filament of dorsal pair (1.7 mm long), two filaments of middle pair and dorsal filament of ventral pair (1.4–1.5 mm long), and ventral filament of ventral pair shortest (1.2 mm long); relative basal thickness of six filaments from dorsal to ventral 2.1:1.3:1.0:1.0:1.0:1.0 in female pupa, 2.6:1.6:1.4:1.4:1.2:1.0 in male pupa; upper outer filament of dorsal pair gradually tapered from base toward apex, other filaments nearly subequal in thickness from base to one-half or more, then slightly tapered toward apex; all filaments whitish yellow, with distinct annular ridges and furrows forming definite reticulate surface patterns, though ridges and furrows less marked or absent in portions of four filaments of middle and ventral pairs, and densely covered with minute tubercles. **Abdomen.** Dorsally, all segments unpigmented except segment 1 entirely light brown; segment 1 with one unbranched short seta (Fig. 3K) on each side; segment 2 with one unbranched short seta and five minute setae (Fig. 3L), on each side; segments 3 and 4 each with four distinct hooks and one unbranched minute seta on each side; segments 5 and 6 lacking spine-combs; segments 7 and 8 each with distinct spine-combs in transverse row in female pupa but segments 8 and 9 each with distinct spine-combs in transverse row in male pupa; segments 6–9 each with comb-like groups of microspines on each side; segment 9 without terminal hooks. Ventrally, segments 3–8 unpigmented, each with comb-like groups of microspines; segment 4 with one unbranched hook and two slender minute setae on each side; segment 5 with two bifid hooks submedially and few unbranched short setae on each side; segments 6 and 7 each with one bifid inner hook and one unbranched outer hook somewhat separated from each other, and few unbranched short setae on each side. **Cocoon.** Slipper-shaped, thickly woven (in particular anterior margin), medium brown, not extended ventrolaterally, and with thick anterodorsal margin; individual threads invisible; 2.8 mm long by 1.2 mm wide.

**Mature larva.** Unknown.

**Type material.** HOLOTYPEx. Male (with its associated pupal exuviae and cocoon) (in 80% ethanol), reared from a pupa collected from a small stream (elevation 1,576 m, 27°95’66.2” N, 85°95’51.4” E), at Tatopani, Sindhupalchowk district, Nepal, 16-VII-2009, by S. Shrestha. PARATYPE. One female, same data as for holotype.

**Distribution.** Nepal.

**Etymology.** The species name *tatopaniense* refers to the locality, Tatopani, where this new species was collected.

**Remarks.** *Simulium tatopaniense* sp. nov. is assigned to the *S. tuberosum* species-group of the subgenus *Simulium*, based on the male genitalia (Fig. 2E, F). This new species is placed in the *S. brevipar* subgroup of this species-group, defined by Takaoka (2017), by having a pit-like organ on the thoracic integument.
Fig. 3. Pupa of *S. tatopaniense* sp. nov. A, relatively large tubercles having tiny secondary projections on frons. B and C, frontal trichomes. D, facial trichome. E–H, thoracic trichomes (E, dorsomedial; F, anterolateral; G, mediolateral; H, ventrolateral). I, anterior part of thorax showing pit-like organ at base of gill filaments (left side; dorsal view). J, gill filaments (left side; lateral view). K, hair-like seta on dorsum of abdominal segment 1. L, hair-like seta and minute seta on dorsum of abdominal segment 2. Scale bars. 0.1 mm for J; 0.04 mm for I; 0.01 mm for A–H, K and L.
near the base of the gill (Fig. 31).

Among eight species of the S. brevipar subgroup, S. huense Takaoka & Ya'cob from Vietnam (Takaoka et al., 2015, 2017) and S. sigiti Takaoka & Hadi from Java, Indonesia (Takaoka and Hadi, 1991) are similar to this new species by having the similar number of the male upper-eye (large) facets in 20 or 21 vertical columns and 20 or 21 horizontal rows. However, this new species is distinguished from S. huense by the relative length of the male fore basitarsus against its greatest width (4.23 in this new species versus 5.4 in S. huense) and shape of the male hind basitarsus (wedge shaped (Fig. 2B) in this new species versus spindle-shaped in S. huense); and from S. sigiti by the relative length of the male hind basitarsus against its greatest width (3.66 in this new species versus 4.5 in S. sigiti) and the pupal gill filaments, of which one of the dorsal paired filaments is much thicker than others (Fig. 31) (all filaments subequal in thickness in S. sigiti).

The female of this new species is characterized by the fore basitarsus greatly inflated (relative length of the fore basitarsus against its greatest width being 3.72) (Fig. 1C), by which it is separated from five of six other species of the S. brevipar subgroup, in which the fore basitarsi are less inflated than that of this new species. Simulium tiomanense Takaoka, Sofian-Azirun & Belabut, of which the female is unknown, differs from this new species by the smaller number of male upper-eye (large) facets in 16 vertical columns and 16 or 17 horizontal rows (Takaoka et al., 2012).

**Simulium dailekhense** Takaoka & Shrestha sp. nov.

**Simulium** (Simulium) ramosum (not sensu Puri), Shrestha and Takaoka, 2009: 256 (Female and pupa).

**Female** (n=3). Body length 2.2–2.5 mm. **Head.** Slightly narrower than thorax. Frons brownish black, shiny, with several dark stout hairs along lateral margins and few hairs near lower margin; frontal ratio 1.20–1.33:1.00:1.02–1.06; frons:head ratio 1.00:3.72–3.75. Fronto-ocular area well developed, short, directed laterally, and rounded apically. Clypeus brownish black, grayish-pruinose, shiny, sparsely covered with dark brown medium-long hairs along lateral margins and near lower margins and upper two-thirds bare medially. Labrum 0.64–0.68 times length of clypeus. Antenna composed of scape, pedicel and nine flagellomeres, entirely medium to dark brown (though scape, pedicel and base of first flagellomere light brown in one female). Maxillary palpus with five palpomeres, medium brown except third palpomere dark brown; proportional lengths of third, fourth, and fifth palpomeres 1.0:1.0–1.1:2.0–2.2; third palpomere (Fig. 4A) of moderate size, with medium-sized ellipsoidal sensory vesicle (0.43–0.48 times length of third palpomere) having medium-sized opening. Lacinia with 14 or 15 inner and 16–18 outer teeth. Mandible with 34 inner and 12–14 outer teeth. Cibarium with 86–90 tiny processes near posterodorsal margin. **Thorax.** Scutum dark brown, shiny, white-pruinose when illuminated at certain angles, moderately covered with yellow short fine hairs interspersed with several dark brown long upright hairs on prescutellar area. Scutellum dark brown, covered with dark brown upright long and brassy short hairs. Postnotum dark brown, shiny and white-pruinose when illuminated at certain angles, and bare. Pleural membrane bare. Katepisternum longer than deep, dark brown, shiny and white-pruinose when illuminated at certain angles, and bare. **Legs.** Foreleg: coxa whitish yellow; trochanter light brown except base whitish yellow; femur light to medium brown; tibia whitish except apical cap dark brown, with white sheen on median outer surface when illuminated at certain angles; tarsus dark, with moderate dorsal hair crest; basitarsus moderately dilated, 4.93–5.07 times as long as its greatest width. Midleg: coxa dark brown with posterolateral surface brownish black; trochanter light brown; femur light brown except apical cap medium brown; tibia light brown except basal two-fifths yellowish white and apical cap medium brown (though little more than basal half of posterior surface white), and with whitish sheen on basal three-fourths of posterior surface when illuminated at certain angles; tarsus medium brown except basal half of basitarsus yellowish white. Hind leg: coxa dark brown; trochanter dark yellow; femur light brown except extreme base whitish yellow and apical cap dark brown; tibia (Fig. 4B) yellowish white on basal half or little less and medium to dark brown on rest (though basal two-thirds on posterior surface white), and with whitish sheen on basal two-thirds of posterior surface when illuminated at certain angles, and tarsus medium brown except little less than basal two-thirds of basitarsus (though base light brown) and basal half of second tarsomere yellowish white; basitarsus (Fig. 4C) nearly parallel-sided, 5.87–6.47 times as long as wide, and 0.75 and 0.60–0.63 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 4C) moderately developed, slightly shorter than wide, and 0.4 times as wide as greatest width of basitarsus; pedisculus (Fig. 4C) well developed; claw simple, without tooth. **Wing.** Length 2.0–2.2 mm. Costa with dark spinules and hairs; subcosta haired except apical one-fourth bare; basal section of radius bare; R₁ with dark spinules and hairs; R₂ with dark hairs; hair tuft on base of radius dark brown; basal cell absent. **Halter.** White except base darkened. **Abdomen.** Basal scale dark brown, with fringe of whitish fine hairs. Dorsal surface of abdomen dark brown to brownish black, with light to dark brown short hairs; tergite 2 and 6–9 shiny when illuminated at certain angles. Ventral surface of segment 7 with a pair of submedian sternal plates each bearing 15–19 stout long hairs, of which 10–12 hairs arising in cluster and somewhat longer
Sternite 8 (Fig. 4E) bare medially, covered with four to eight long and medium-long stout hairs and three to five short fine hairs on each side. Ovipositor valves (Fig. 4E) nearly tongue-like, rounded postero-medially, membranous except inner margins weakly sclerotized, each densely covered with microsetae together with four to six short fine hairs; inner margin concave medially. Genital fork (Fig. 4F) of inverted-Y form; stem slender and well sclerotized, with widened apex 2.7 times as wide as middle of stem; arms of moderate width, each with moderately sclerotized projection directed forwardly from lateral ridge. Paraproct in ventral view (Fig. 4G) pointed posteromedially, moderately concave anterolaterally, and with strongly sclerotized anteromedial surface bearing several sensilla; paraproct in lateral view (Fig. 4H) somewhat produced ventrally and posteriorly, 0.6 times as long as wide, covered with 22 or 23 short to medium-long hairs and numerous microsetae on lateral and ventral surfaces. Cercus in lateral view (Fig. 4H) short, rounded posteriorly, 0.42 times as long as its greatest width, and covered with medium-long and short hairs. Spermatheca (Fig. 4I) nearly globular, 1.1 times as long as wide, moderately sclerotized and pigmented except duct and narrow area of juncture with duct unpigmented, without discernible reticulate surface patterns; minute internal setae present; accessory ducts unpigmented, subequal in thickness to each other and slightly thicker than main duct.

Male (n=3). Body length 2.8 mm. Head. Slightly wider than thorax. Upper eye medium brown, with large facets in 18–20 vertical columns and 19–21 horizontal rows on each side. Clypeus dark brown, thickly white-pruinose, shiny when illuminated at certain angles, sparsely covered with dark brown
hairs along lateral margins and near lower margin and medial portion of upper half or two-thirds bare. Antenna composed of scape, pedicel and nine flagellomeres, all dark brown; first flagellomere elongate, 1.85 times as long as second one. Maxillary palpus light to medium brown, composed of five palpomeres with proportional lengths of third, fourth, and fifth palpomeres 1.00:1.17:2.37; third palpomere (Fig. 5A) of moderate size; sensory vesicle (Fig. 5A) small, ellipsoidal (0.23–0.29 times as long as third palpomere), and with medium-sized opening.

Thorax. Scutum brownish black, with white-pruinose pattern, i.e., anterior pair of crescent spots on shoulders extended posteriorly along lateral margins and narrowly connected near base of wings to large transverse posterior spot entirely covering prescutellar area; these pruinose areas silvery when illuminated at certain angles; scutum uniformly and moderately covered with yellow (appearing to be brassy in one male) recumbent short hairs, interspersed with dark brown longer upright hairs on prescutellar area. Scutellum brownish black, with several dark brown longer upright hairs and short dark hairs. Postnotum brownish black, white-pruinose when illuminated at certain angles and bare. Pleural membrane bare. Katepisternum longer than deep, dark brown, white-pruinose when illuminated at certain angles, and bare. Legs. Foreleg: coxa light brown; trochanter medium brown; femur medium brown with apical cap dark brown; tibia medium brown except median large portion white on outer surface, and with sheen on outer surface when illuminated at certain angles; tarsus brownish black, with moderate dorsal hair crest; basitarsus greatly dilated, 5.36–6.17 times as long as its greatest width. Midleg: coxa brownish black; trochanter medium brown; femur medium

Fig. 5. Male of *S. dailekhense* sp. nov. A, third palpomere with sensory vesicle (right side; front view). B, basitarsus and second tarsomere of hind leg (left side; outer view). C, coxite and style (right side; ventral view). D and E, styles (D, right side and ventrolateral view; E, left side and medial view). F and H, ventral plates (F, ventral view; H, caudal view). G, ventral plate and median sclerite (lateral view). I, median sclerite (caudal view). Scale bars. 0.1 mm for B; 0.02 mm for A, and C–I.
brown; tibia medium brown except basal one-fourth of posterior surface yellowish white; tarsus light brown. Hind leg: coxa brownish black; trochanter dark yellow to light brown; femur light to medium brown except base dark yellow and apical cap dark brown; tibia medium to dark brown except base yellowish white; tarsus (Fig. 5B) medium brown except basal four-ninths of basitarsus yellowish white (though extreme base somewhat darkened) and basal half of second tarsomere white; basitarsus (Fig. 5B) much enlarged, 3.35–3.75 times as long as its greatest width, and 0.94–1.04 and 1.09–1.13 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 5B) small, nearly as long as wide, 0.24 times as wide as greatest width of basitarsus; pedisulcus (Fig. 5B) well developed. **Halter.** White except basal portion darkened. **Wing.** Length 2.0 mm. Other characters as in female except subcosta bare. **Abdomen.** Basal scale brownish black, with fringe of light brown long hairs. Dorsal surface of abdomen dark brown to brownish black, with fringe of light brown long hairs. Abdomen, in female except subcosta bare. **Basal scale** (5B) well developed. **Halter.** White except basal portion darkened. **Wing.** Length 2.0 mm. Other characters as in female except subcosta bare. **Abdomen.** Basal scale brownish black, with fringe of light brown long hairs. Dorsal surface of abdomen dark brown to brownish black, with dark short hairs; segments 2, 5, 6 and 7 each with a pair of silvery spots dorsolaterally, those black, with dark short hairs; segments 2, 5, 6 and 7 yellow to light brown; segments 3 and 4 each with four distinct hooks and one unbranched short seta and five minute setae in each other; segment 5 with two bi/ id hooks; segments 6 and 7 each with one bi/ id inner hook somewhat separated on dorsal and dorsolateral surface of anterior three-fifths, and moderately covered with small tubercles on dorsal surface of posterior two-fifths; thorax with two long mediadorsal trichomes each with three to five branches (Fig. 6D), two anterolateral trichomes (anterior trichome bi/ id, medium-long, posterior one bi/ id or trifid, long) (Fig. 6E), one unbranched medium-long mediolateral trichome (Fig. 6F), and three medium-long ventrolateral trichomes (one unbranched, short, two unbranched or bifid, medium-long) (Fig. 6G) on each side. Gill (Fig. 6H) with six thread-like filaments in three pairs arising from short common basal stalk; each pair short-stalked; stalks of dorsal and ventral pairs lying at angle of 45–60 degrees when viewed laterally; filaments decreasing in length and thickness from dorsal to ventral; upper filament of dorsal pair longest (2.0–2.2 mm), and lower filament of ventral pair shortest (1.3–1.6 mm); relative basal thickness of each filament from dorsal to ventral 1.75 : 1.50 : 1.38 : 1.25 : 1.13 : 1.00. all filaments whitish yellow, with distinct annular ridges and furrows forming definite reticulate surface patterns, and densely covered with minute tubercles. **Abdomen.** Dorsally, all segments unpigmented except segment 1 entirely light yellow; segment 1 with one unbranched medium-long seta (Fig. 6I) on each side; segment 2 with one unbranched short seta and five minute setae (Fig. 6J), of which four somewhat stout on each side; segments 3 and 4 each with four distinct hooks and one unbranched minute seta on each side; segments 5 and 6 lacking spine-combs; segments 7–9 each with distinct spine-combs in transverse row; segments 6–9 each with comb-like groups of microspines on each side; segment 9 without terminal hooks in three pupae, with terminal hooks though so small and vestigial in four pupae, and with several small scattered tubercles in one pupa. Ventrally, segments 3–8 unpigmented, each with comb-like groups of microspines; segment 4 with one unbranched hook and few slender minute setae on each side; segment 5 with two bifid hooks submedially and few unbranched short setae on each side; segments 6 and 7 each with one bifid inner hook and one unbranched outer hook somewhat separated from each other, and few unbranched short setae on each side. **Cocoon.** Slipper-shaped, thickly woven, ochreous, and somewhat extended ventrolaterally; individual threads not visible; 3.0–3.2 mm long by 1.4–1.7 mm wide.
Fig. 6. Pupa of *S. dailekhense* sp. nov. A, relatively large tubercles on frons. B, frontal trichome. C, facial trichome. D–G, thoracic trichomes (D, dorsomedial; E, anterolateral; F, mediolateral; G, ventrolateral). H, gill filaments (right side; lateral view). I, hair-like seta on dorsum of abdominal segment 1. J, hair-like seta and minute setae on dorsum of abdominal segment 2. Scale bars. 0.1 mm for H; 0.02 mm for A–G, I, and J; 0.01 mm for A.
**Mature larva.** Unknown.

**Type material.** HOLOTYPE. Male (with its associated pupal exuviae and cocoon) (in 80% ethanol) reared from a stream (17°C; elevation 2,097 m; 28°41'58.1” N, 081°41’58.1” E), Sero 9, Dailekh. Nepal, 20-VIII-2011, by S. Shrestha. PARATYPES. One female and one male (with their associated pupal exuviae and cocoons) (in 80% ethanol), same data as for the holotype; one female and one male (with their associated pupal exuviae and cocoons) in 80% ethanol, reared from pupae, collected from a stream (elevation 2,167 m; 28°07’71.8” N, 085°23’54.1” E), Bokejhunda, Rasuwa District, Nepal, 7-VIII-2009, by S. Shrestha; one female (with its associated pupal exuviae and cocoon), reared from a pupa, collected from a stream (elevation 1,600 m, 27°47’N, 85°23’E) in Shivapuri National Park, in the northern slope of Kathmandu Valley, Nepal, 29-1-2009, by S. Shrestha.

**Distribution.** Nepal.

**Etymology.** The species name dailekhense refers to the locality, Dailekh, where this new species was collected.

**Remarks.** Simulium dailekhense sp. nov. is placed in the S. rufibasis subgroup of the S. tuberosum species-group, roughly defined by Takaoka (2017), by having a pair of clustered stout hairs on the sternal plates of abdominal segment 7 (Fig. 4D).

Simulium dailekhense sp. nov. is the same species as that previously recorded based on two females and their pupal exuviae from Nepal as S. ramosum Puri originally described from India (Puri, 1932; Shrestha and Takaoka, 2009). Reexamination confirmed that the female and pupa of this new species are morphologically indistinguishable from those of S. ramosum. However, the male available in this study is clearly distinguished from that of S. ramosum by the fore coxa and trochanter light or medium brown (yellowish in S. ramosum) and hind basitarsus yellowish white on the basal four-ninths (Fig. 5B) (yellowish on the basal half in S. ramosum). For this reason, S. ramosum should be removed from Nepal in the Inventory of World Blackflies.

This new species is distinguished in the pupa from all the 12 other species of the S. rufibasis subgroup by the frons and thorax with relatively large tubercles (Fig. 6A) and branched trichomes on the frons and thorax (Fig. 6B–E).

**Simulium nakanoi** Takaoka & Shrestha sp. nov.

**Female** (n=2). Body length 2.2 mm. Nearly as in female of S. dailekhense sp. nov. except following characteristics. **Head.** Frontal ratio 1.36:1.00:1.13; frons:head ratio 1.00:3.86. Labrum 0.72 times length of clypeus. Antenna entirely medium to dark brown except scape, pedicel and base of first flagellomere light brown. Maxillary palpus: proportional lengths of third, fourth, and fifth palpomeres 1.00:1.00:2.14; sensory vesicle medium-long (0.38 times length of third palpomere) having medium-sized opening. Lacinia with 11 or 12 inner and 15 outer teeth. Mandible with 33 inner and 12 outer teeth. Cibarium with 76 tiny processes near posterocephal margin. **Thorax.** Scutum moderately covered with yellow short fine hairs intermixed with dark short fine hairs near anterior margin, and interspersed with several dark long upright hairs on prescutellar area. **Legs.** Foreleg: basitarsus moderately dilated, 6.00–6.20 times as long as its greatest width. Midleg: coxa dark brown with posterolateral surface brownish black; trochanter light brown; femur light brown except apical cap medium brown; tibia light brown except basal two-fifths yellowish white and apical cap medium brown (though little more than basal half of posterior surface white), and with whitish sheen on basal three-fourths of posterior surface when illuminated at certain angles; tarsus medium brown except basal half of basitarsus yellowish white. Hind leg: trochanter yellow; tibia (Fig. 7A) yellowish white on basal half and medium to dark brown on rest (though little more than basal half on posterior surface white); tarsus medium brown except basal three-fifths to half of basitarsus (though base light brown) and basal half of second tarsomere yellowish white; basitarsus (Fig. 7B) nearly parallel-sided, 6.14–6.29 times as long as wide, and 0.78 and 0.70–0.78 times as wide as greatest widths of hind tibia and femur, respectively. **Wing.** Length 2.0 mm. **Abdomen.** Ventral surface of segment 7 with a pair of submedian sternal plates each bearing 15–17 stout long hairs, of which 10–12 hairs are arising in cluster and 2.5 times as long as other hairs on sternal plate (Fig. 7C). **Terminalia.** Sternite 8 bare medi ally, covered with six long and medium-long stout hairs and two to three short fine hairs on each side. Ovipositor valves each densely covered with microsetae together with six or seven short fine hairs. Paraproct in lateral view covered with 24 or 25 short to medium-long hairs and numerous microsetae on lateral and ventral surfaces. Cercus in lateral view short, rounded posteriorly, 0.42 times as long as its greatest width, and covered with medium-long and short hairs. Spermatheca ovoid, 1.2 times as long as wide. **Male** (n=4). Nearly as in male of S. dailekhense sp. nov. except following characteristics. Body length 2.0–2.4 mm. **Head.** Upper eye with large facets in 13 or 14 vertical columns and 16 or 17 horizontal rows on each side. Antenna: first flagellomere elongate, 1.79 times as long as second one. Maxillary palpus: proportional lengths of third, fourth, and fifth palpomeres 1.0:1.0:2.2; sensory vesicle ellipsoidal, 0.22–0.31 times as long as third palpomere. **Thorax.** Scutum moderately covered with yellow recumbent short hairs interspersed with dark brown longer upright hairs on prescutellar area. **Legs.** Foreleg: coxa whitish yellow; trochanter light brown except base whitish yellow;
Fig. 7. Female and male of S. nakanoi sp. nov. A–C, female; D–M, male. A, tibia of hind leg (left side; outer view). B, basitarsus and second tarsomere of hind leg (left side; outer view). C, middle part of abdominal segment 7 with a pair of stout hairs in cluster (ventral view). D, tibia of foreleg (left side; lateral view). E, tibia of hind leg (left side; outer view). F, basitarsus and second tarsomere of hind leg (left side; outer view). G, coxite and style (right side; ventral view). H and I, styles (H, right side and ventrolateral view; I, left side and medial view). J and L, ventral plates (J, ventral view; L, caudal view). K, ventral plate and median sclerite (lateral view). M, median sclerite (caudal view). Scale bars. 0.1 mm for A, B, and D–F; 0.02 mm for C, and G–M.
femur medium brown with base light brown and apical cap dark brown; tibia white except apical one-third medium to dark brown (though inner surface of subbasal portion light brown in one male—Fig. 7D); basitarsus 6.60–6.80 times as long as its greatest width. Midleg: trochanter medium brown except base whitish yellow; femur medium brown except apical cap dark brown; tibia medium brown except basal two-fifths yellowish white (though basal half on posterior surface yellowish white); tarsus medium brown except basal one-fourth to half of basitarsus whitish yellow.

Hind leg: coxa dark brown; trochanter yellow; femur medium brown except base yellow and apical cap dark brown; tibia (Fig. 7E) medium to dark brown except basal half or little less yellowish white; tarsus (Fig. 7F) medium brown except basal two-fifths of basitarsus yellowish white (though extreme base somewhat darkened) and basal half of second tarsomere white; basitarsus (Fig. 7F) much enlarged, 3.24–3.32 times as long as its greatest width, and 1.13–1.17 and 1.42–1.47 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 7F) small, nearly as long as wide, 0.20 times as wide as greatest width of basitarsus.

**Wing.** Length 1.9–2.0 mm. Subcosta with three or four hairs in one male. **Abdomen.** Segments 2, 6 and 7 each with a pair of shiny dorsolateral silvery spots. **Genitalia.** Coxite in ventral view (Fig. 7G) nearly quadrate. Style in ventral view (Fig. 7G) nearly parallel-sided from base to middle, then gradually tapered toward round apex, with an apical spine; style in ventrolateral view (Fig. 7H) 1.9 times as long as coxite, 3.4 times as long as its greatest width at basal one-third, then slightly tapered gradually to apex. Style in medial view (Fig. 7I) somewhat produced dorsally near basal one-third forming low protuberance having several small cone-like spines on its dorsal surface. Ventral plate in ventral view (Fig. 7J) well sclerotized, with body subquadrate, much shorter than wide, posterior margin somewhat concave submedially, and with round projection directed ventrally, which is covered with many minute setae; arms strongly divergent from each other; ventral plate in lateral view (Fig. 7K) with posterior margin serrated along little more than basal half; ventral plate in caudal view (Fig. 7L) with lateral margins serrated along little more than basal half. Median sclerite in caudal view (Fig. 7M) plate-like, gradually widened from base to apex. Abdominal segment 10 with six or seven distinct hairs on ventral and lateral surfaces on each side. Cercus with eight distinct hairs.

**Pupa** (*n* = 6). Body length 2.3–2.6 mm. **Head.** Integument yellow, bare except small area of face between trichomes sparsely to moderately covered with small round tubercles; frons with two unbranched long trichomes of same length (Fig. 8A) on each side; face with one unbranched long trichome (Fig. 8B) on each side, which much shorter than frontal trichomes.

**Thorax.** Integument yellow, bare except narrow portion of dorsal surface along medio longitudinal line of anterior one-fourth to one-third, dorsal surface of posterior half or little less, and ventrolateral surface posterior to basal portion of gill on each side sparsely to moderately covered with small round tubercles; thorax with two extremely long mediodorsal trichomes (Fig. 8C), two anterolateral trichomes (anterior trichome long and posterior one extremely long) (Fig. 8D), one medium-long mediolateral trichome (Fig. 8E), and three medium-long ventrolateral trichomes of same length (Fig. 8F) on each side; all unbranched. Gill (Fig. 8G) with six slender thread-like filaments in three pairs (one dorsal, one middle and one ventral) arising from short common basal stalk; basal fenestra small; all pairs short-stalked; stalks of dorsal and ventral pairs lying at angle of 70–90 degrees when viewed laterally; filaments decreasing in length and thickness from dorsal to ventral, with upper filament of dorsal pair longest (*ca.* 1.6 mm), followed by lower filament of dorsal pair (*ca.* 1.4 mm), and two filaments of middle pair and upper filament of ventral pair almost same in length (*ca.* 1.2 mm), and lower filament of ventral pair shortest (*ca.* 1.0 mm); relative basal thickness of each filament from dorsal to ventral when measured basally 1.6 : 1.4 : 1.2 : 1.2 : 1.2 : 1.0; all filaments light brown, gradually tapered toward apices, with distinct annular ridges and furrows forming definite reticulate surface patterns, and densely covered with minute tubercles.

**Abdomen.** Nearly as in that of *S. dailekhense* sp. nov. except dorsum of segment 1 with one unbranched medium-long seta (Fig. 8H) on each side; dorsum of segment 2 with one unbranched short seta and five minute setae, of which four somewhat stout (Fig. 8l) on each side. **Cocoon.** Slipper-shaped, thickly woven, ochreous, and somewhat extended ventrolaterally; individual threads visible; 3.2 mm long by 1.8 mm wide.

**Mature larva.** Unknown.

**Type material.** HOLOTYPE. Male (with its associated pupal exuviae and cocoon) (in 80% ethanol), reared from a pupa collected from a stream (elevation 1,600 m, 27°47'N, 85°23'E) in Shivapuri National Park, in the northern slope of Kathmandu Valley, Nepal, 29-1-2009, by S. Shrestha. PARATYPES. Two females and three males (with their associated pupal exuviae and cocoons) (in 80% ethanol), reared from pupae, same data as for the holotype except date 18-11-2009.

**Distribution.** Nepal.

**Etymology.** The species name *nakanoi* is in honor of Dr. Atsuhiro Nakano, who was helpful in collecting black flies and biting midges while H.T. was working at Kagoshima University.

**Remarks.** *Simulium nakanoi* sp. nov. is placed in the *S. rufibasis* subgroup of the *S. tuberosum* species-group, roughly defined by Takaoka (2017), by having
a pair of clustered stout hairs on the sternal plates of female abdominal segment 7 (Fig. 7C).

*Simulium nakanoi* sp. nov. is similar to *S. pradyai* Takaoka described from females reared from pupae from Bhutan (Takaoka and Somboon, 2008) and *S. rosliramlii* Takaoka and Chen from Vietnam (Takaoka
et al., 2017) in sharing the almost bare frons and thorax of the pupa. However, this new species is distinguished from S. pradyai by the relative length of the female fore basitarsus against its width, which is 6.00–6.20 in this new species but 5.36 in S. pradyai. The male of this new species is distinguished from that of S. pradyai by the number of upper-eye facets, which is in 13 or 14 vertical columns and 16 or 17 horizontal rows in this new species but in 17 vertical columns and 18 horizontal rows in S. pradyai (Takaoka, unpublished data).

This new species is distinguished from S. rosliramlii in the male by the fore coxa whitish yellow (medium brown in S. rosliramlii) and hind tibia dark brown except the basal half or little less yellowish white (Fig. 7E) (dark brown except the basal tip dark yellow to light brown in S. rosliramlii).

**Simulium langtangense Takaoka & Shrestha sp. nov.**

*Simulium* (*Simulium*) rufibasis (not *sensu* Brunetti), Shrestha and Takaoka, 2009: 256–257 (Female and pupa).

**Female** (*n*=1). Body length 2.1 mm. **Head.** Slightly narrower than thorax. Frons brownish black, shiny, with several dark stout hairs along lateral margins and few hairs near lower margin; frontal ratio 1.37:1.00:1.31; frons:head ratio 1.00:3.68. Fronto-ocular area well developed, short, directed laterally, and rounded apically. Clypeus brownish black, grayish-pruinose, shiny, moderately covered with dark brown medium long hairs except upper portion bare medi ally. Labrum 0.72 times length of clypeus. Antenna composed of scape, pedicel and nine flagellomeres, medium to dark brown except scape, pedicel and base of first flagellomere yellow. Maxillary palpus with five palpomeres, light brown except third palpomere medium brown; proportional lengths of third, fourth, and fifth palpomeres 1.00:1.03:2.05; third palpomere of moderate size, with medium-sized ellipsoidal sensory vesicle (0.41–0.44 times length of third palpomere) having medium-sized opening. Lacinia with 14 inner and 14 or 15 outer teeth. Mandible with 31 inner and 13 outer teeth. Cibarium with 98 tiny processes near posterodorsal margin.

**Thorax.** As in female of *S. dailekhense* sp. nov. **Legs.** Foreleg: coxa whitish yellow; trochanter light brown except base whitish yellow; femur light to medium brown; tibia white to whitish yellow except apical cap dark brown, with white sheen on median outer surface when illuminated at certain angles; tarsus dark brown, with moderate dorsal hair crest; basitarsus moderately dilated, 4.71 times as long as its greatest width. Midleg: coxa dark brown with posterolateral surface brownish black; trochanter light brown; femur medium brown except apical cap dark brown; tibia light to medium brown except basal two-fifths or little more yellowish white, and with whitish sheen on basal half of posterior surface when illuminated at certain angles; tarsus medium brown except basal half or little more of basitarsus whitish yellow. Hind leg: coxa dark brown; trochanter yellow; femur medium brown except base whitish yellow and apical cap dark brown; tibia (Fig. 9A) yellowish white on little less than basal half, and medium to dark brown on rest, and with whitish sheen on basal half of posterior surface when illuminated at certain angles; tarsus medium brown except basal two-thirds of basitarsus (though base light brown) and basal half of second tarsomere whitish yellow; basitarsus (Fig. 9B) nearly parallel-sided, 6.11 times as long as wide, and 0.74 and 0.67 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 9B) moderately developed, slightly shorter than wide, and 0.39 times as wide as greatest width of basitarsus; pedisculus (Fig. 9B) well developed; claw simple, without tooth. **Wing.** Length 2.0 mm. Other characters as in female of *S. dailekhense* sp. nov. **Halter and Abdomen.** As in female of *S. dailekhense* sp. nov. Ventral surface of segment 7 with a pair of submedian sternal plates each bearing 16 or 17 stout long hairs, of which 10–12 hairs are arising in cluster and 2.5 times as long as other hairs on sternal plate (similar to Fig. 7C). **Terminalia.** Nearly as in female of *S. dailekhense* sp. nov. except following characteristics. Sternite 8 bare medially, covered with six or seven long and medium-long stout hairs and four short fine hairs on each side. Ovipositor valve densely covered with microsetae together with seven to nine short fine hairs. Genital fork (Fig. 9C) of inverted-Y form; stem slender and well sclerotized, with widened apex 4.4 times as wide as middle of stem. Paraproct in lateral view somewhat produced ventrally and posteriorly, 0.53 times as long as wide, covered with 22–24 short to medium-long hairs and numerous microsetae on lateral and ventral surfaces. Cercus in lateral view short, rounded posteriorly, 0.5 times as long as its greatest width, and covered with medium-long and short hairs. Spermatheca nearly globular, 1.09 times as long as wide.

**Male** (*n*=2). Body length 2.1 mm. **Head.** Slightly wider than thorax. Upper eye medium brown, with large facets in 17 or 18 vertical columns and 18 or 19 horizontal rows. Clypeus dark brown, thickly white-pruinose, shiny when illuminated at certain angles, sparsely covered with dark brown hairs along lateral margins and near lower margin and medial portion of upper half or two-thirds bare. Antenna composed of scape, pedicel and nine flagellomeres, all dark brown; first flagellomere elongate, 1.85 times as long as second one. Maxillary palpus light to medium brown, composed of five palpomeres, with proportional lengths of third, fourth, and fifth palpomeres 1.0:1.06–1.17:2.37–2.41; third palpomere of moderate size; sensory vesicle small, ellipsoidal (0.23–0.29 times as long as third palpomere), and with small opening.
Thorax. As in male of *S. dailekhense* sp. nov. **Legs.** Foreleg: coxa dark yellow to light brown; trochanter medium brown; femur medium brown with apical cap dark brown; tibia medium brown except median large portion white on outer surface, and with sheen on outer surface when illuminated at certain angles; tarsus dark brown, with moderate dorsal hair crest; basitarsus moderately dilated, 5.52–5.75 times as long as its greatest width. Midleg: coxa dark brown except postelateral surface brownish black; trochanter medium brown; femur medium brown except apical cap dark brown; tibia medium brown except apical extreme yellowish white; tarsus light brown. Hind leg: coxa dark brown; trochanter dark yellow; femur medium brown except base dark yellow and apical cap dark brown; tibia dark brown except basal extreme yellowish; tarsus (Fig. 9D) medium brown except basal two-fifths of basitarsus yellowish white (though extreme base somewhat darkened) and basal half of second tarsomere dark yellow; basitarsus (Fig. 9D) much enlarged, 3.16–3.50 times as long as its greatest width, and 1.14–1.19 and 1.20–1.25 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 9D) small, nearly as long as wide, 0.21–0.22 times as wide as greatest width of basitarsus; pedisulcus (Fig. 9D) well developed. **Halter.** White except basal portion darkened. **Wing.** Length 2.0 mm. Other characteristics as in female except subcosta bare.
Halter and Abdomen. As in male of S. dailekhense sp. nov. except abdominal segments 2, 6 and 7 each with a pair of silvery spots dorsolaterally. Genitalia. Coxite in ventral view (Fig. 9E) nearly quadrate. Style in ventral view (Fig. 5E) nearly parallel-sided from base to little less than basal half, then gradually tapered toward round apex, with an apical spine; style in ventrolateral view (Fig. 9F, G) 1.85 times as long as coxite, 2.5 times as long as its greatest width at basal one-third, slightly widened from base to basal one-third, then slightly or moderately tapered to apex. Style in medial view (Fig. 9H) somewhat produced dorsally near basal one-third forming low protuberance having several small cone-like spines on its dorsal surface. Ventral plate in ventral view (Fig. 9I) with body subquadrate, 0.65 times as long as wide, posterior margin somewhat concave, and with round projection directed ventrally, which is covered with many minute setae; arms somewhat divergent from each other; ventral plate in lateral view (Fig. 9I) with posterior margin serrated along basal half; ventral plate in caudal view (Fig. 9K) triangular, with rounded ventral apex, with lateral margin serrated along basal half, with numerous setae on posterior surface except each side of basal portion bare. Median sclerite in lateral view (Fig. 9J) arising just anterior to ventral plate, directed dorsally; median sclerite in ventrocaudal view (Fig. 9L) plate-like, gradually widened from base to middle, then slightly narrowed toward apex, with round apex. Paramere with several distinct hooks (similar to Fig. 2I). Aedeagal membrane moderately covered with minute setae (similar to Fig. 2I), and with moderately sclerotized dorsal plate in form of horizontal bar (similar to Fig. 2K). Abdominal segment 10 with four or six distinct hairs on ventral and lateral surfaces on each side. Cercus small, rounded, with six to eight distinct hairs.

Pupa (n=7). Body length 2.3–2.5 mm. Head. Integument yellow, and moderately covered with round tubercles (Fig. 10A); frons with two unbranched long trichomes (Fig. 10B) on each side; face with one unbranched long trichome (Fig. 10C) on each side. Thorax. Integument yellow, moderately covered with round tubercles, though dorsal surface of posterior half covered with smaller conical tubercles; thorax with two extremely long mediiodorsal trichomes (Fig. 10D), two long anterolateral trichomes (anterior trichome much shorter than posterior one) (Fig. 10E), one medium-long mediolateral trichome (Fig. 10F), and three ventrolateral trichomes (one short, two medium-long) (Fig. 10G) on each side; all unbranched. Gill (Fig. 10H) with six thread-like filaments in three pairs arising from short common basal stalk; each pair short-stalked; stalks of dorsal and ventral pairs lying at angle of 90 degrees when viewed laterally; filaments decreasing in length and thickness from dorsal to ventral; upper filament of dorsal pair longest (1.6–1.8 mm), and lower filament of ventral pair shortest (1.1–1.3 mm); relative basal thickness of each filament from dorsal to ventral 1.40–1.43:1.29–1.33:1.09–1.13:1.09–1.13:1.00:1.00. All filaments whitish yellow, with distinct annular ridges and furrows forming definite reticulate surface patterns, and densely covered with minute tubercles. Abdomen. Nearly as in pupa of S. dailekhense sp. nov. except dorsum of segment 1 with one unbranched medium-long seta (Fig. 10I) on each side; dorsum of segment 2 with one unbranched medium-long seta and five minute setae (Fig. 10J); dorsum of segment 9 lacking terminal hooks. Cocoon. Slipper-shaped, thickly woven, pale yellow to ochreous; individual threads visible or not; 2.5–2.8 mm long by 1.0–1.3 mm wide.

Mature larva. Unknown.

Type material. HOLOTYPE. Male (with its associated pupal exuviae and cocoon) (in 80% ethanol) reared from a pupa collected from a stream (elevation 1,552 m, 28°15'51.9" N, 085°35'28.3" E), on the way to Langtang, Nepal, 6-VIII-2009, by S. Shrestha. PARATYPES. One female and one male (with their associated pupal exuviae and cocoon) (in 80% ethanol), same data as for the holotype.

Distribution. Nepal.

Etymology. The species name langtangense refers to the locality, Langtang, where this new species was collected.

Remarks. Simulium langtangense sp. nov. is also placed in the S. rufibasis subgroup of the S. tuberosum species-group, by having a pair of clustered stout hairs on the sternal plates of female abdominal segment 7.

Simulium langtangense sp. nov. is the same species as that previously recorded based on a female and its pupal exuviae from Nepal as S. rufibasis Brunetti originally described from India (Brunetti, 1911; Shrestha and Takaoka, 2009). Reexamination shows that the female and pupa of this new species are morphologically indistinguishable from those of S. rufibasis except the female hind basitarsus, which is yellowish white on the basal three-fifths in this new species but yellowish white on the basal one-third to half in S. rufibasis, according to the redescriptions by Puri (1932).

The male of this new species is clearly distinguished from that of S. rufibasis by having a pair of silvery dorsolateral spots each on abdominal segments 2, 6 and 7 (on abdominal segments 2, 5, 6 and 7 in S. rufibasis). Accordingly, it means that S. rufibasis has not yet confirmed from Nepal. Simulium rufibasis should be removed from Nepal in the Inventory of World Blackflies.

This new species is similar to S. manooni Takaoka & Choochote and S. tenebrosum Takaoka, Srisuka & Saeung complex from Thailand by having a darkened male forecoxa, a similar number of male upper-eye (large) facets, and pupal frons and thorax moderately
covered with tubercles (Takaoka and Choochote, 2005; Takaoka et al., 2019), although there is a difference in the relative length of the male fore basitarsus against its greatest width (5.52–5.75 in this new species versus 6.6 in *S. manooni* and 7.2–8.2 in *S. tenebrosum* complex).

This new species is also similar to *S. rosliramlii* and *S. giayense* Takaoka & Lau, both from Vietnam, in sharing the darkened male fore coxae (Takaoka et al.,...
2017) but is distinguished from both species by the number of male upper-eye (large) facets (17 or 18 vertical columns and 18 or 19 horizontal rows in this new species versus 20–22 vertical columns and 21 or 22 horizontal rows in S. rosliramlii and 20 vertical columns and 20 horizontal rows in S. giayense) and the relative length of the male fore basitarsus against its greatest width (5.52–5.75 in this new species versus 6.4–7.2 in S. rosliramlii and 8.0 in S. giayense).

The males of S. setsukoae Takaoka & Choochote from Thailand and S. fuscicoxae Takaoka & Yáñez from Vietnam, both in the S. ru/fibasis subgroup, are not known (Takaoka and Choochote, 2004; Takaoka et al., 2017). However, females of these two species differ from this new species by having darkened fore coxae.

The darkened fore coxae of the male of this new species, combined with the pupal frons and thorax from this new species by having darkened fore coxae. However, females of these two species differ from this new species by having darkened fore coxae.

This new species is distinguished in the pupa from S. dailekhense sp. nov. by the presence of tubercles on the frons and thorax unbranched (Fig. 10D–G) and from S. nakanoi sp. nov. by the thoracic trichomes.

### Appendix: A list of species of black flies in Nepal

Genus Simulium Latreille

Subgenus Asiosimulium Takaoka & Choochote

- S. sachini Takaoka & Henry, 2010 (=S. gombakense (not sensu Takaoka & Davies), Shrestha and Takaoka, 2009)
- S. varicorne species-group
  - S. varicorne Edwards, 1929*

Subgenus Montsimulium Rubtsov

- S. dattai Takaoka & Somboon, 2008
- S. jumlaense Takaoka & Adler, 2020
- S. nemorivagum Datta, 1973

Subgenus Neversmannia Enderlein

- S. feuerborni species-group
  - S. praepalustrum Datta, 1973*
  - S. nivritiae Takaoka & Shrestha, 2020

S. rufi/picorne species-group

- S. aureohirtum Brunetti, 1911* (=S. sp. A Lewis, 1964)

S. vernalis species-group

- S. gandakiense Adler, Takaoka & Ruiz-Arrondo, 2020
- S. gracile Datta, 1973
- S. lekhanianense Takaoka & Shrestha, 2010
- S. letense Takaoka & Shrestha, 2010
- S. magnacentrum Adler, Takaoka & Ruiz-Arrondo, 2020
- S. purii Datta, 1973

Subgenus Simulium Latreille

- S. griseifrons species-group
  - S. titarense Takaoka & Shrestha, 2010
- S. indicum species-group
  - S. indicum Becher, 1885

- S. malyschevi species-group
  - S. phidimense Takaoka & Shrestha, 2020

S. multistriatum species-group

- S. barraudi Puri, 1932 (=S. sp. B Lewis, 1964)
- S. gokarnaense Takaoka & Shrestha, 2020
- S. hillycum Maskey 1989
- S. maskeyae Takaoka & Shrestha, 2020
- S. ratekholaense Takaoka & Shrestha, 2020
- S. tamorensis Takaoka & Shrestha, 2010

S. striatum species-group

- S. bagmaticum Maskey, 1987
- S. beniense Takaoka & Shrestha, 2020
- S. chainpureNSE Takaoka & Shrestha, 2020
- S. dadagaunense Takaoka & Shrestha, 2020
- S. grisescens Brunetti, 1911
- S. pallidum Brunetti, 1911
- S. variabilis Lewis, 1964
- S. varicorne species-group
  - S. varicorne Edwards, 1929*

Subgenus Nevermannia Enderlein

- S. feuerborni species-group
  - S. praepalustrum Datta, 1973*
  - S. nivritiae Takaoka & Shrestha, 2020

S. rufi/picorne species-group

- S. aureohirtum Brunetti, 1911* (=S. sp. A Lewis, 1964)

S. vernalis species-group

- S. gandakiense Adler, Takaoka & Ruiz-Arrondo, 2020
- S. gracile Datta, 1973
- S. lekhanianense Takaoka & Shrestha, 2010
- S. letense Takaoka & Shrestha, 2010
- S. magnacentrum Adler, Takaoka & Ruiz-Arrondo, 2020
- S. purii Datta, 1973

Subgenus Simulium Latreille

- S. griseifrons species-group
  - S. titarense Takaoka & Shrestha, 2010
- S. indicum species-group
  - S. indicum Becher, 1885

- S. malyschevi species-group
  - S. phidimense Takaoka & Shrestha, 2020

S. multistriatum species-group

- S. barraudi Puri, 1932 (=S. sp. B Lewis, 1964)
- S. gokarnaense Takaoka & Shrestha, 2020
- S. hillycum Maskey 1989
- S. maskeyae Takaoka & Shrestha, 2020
- S. ratekholaense Takaoka & Shrestha, 2020
- S. tamorensis Takaoka & Shrestha, 2010

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- S. bagmaticum Maskey, 1987
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- S. chainpureNSE Takaoka & Shrestha, 2020
- S. dadagaunense Takaoka & Shrestha, 2020
- S. grisescens Brunetti, 1911
- S. pallidum Brunetti, 1911
- S. variabilis Lewis, 1964
- S. varicorne species-group
  - S. varicorne Edwards, 1929*

Subgenus Nevermannia Enderlein

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  - S. praepalustrum Datta, 1973*
  - S. nivritiae Takaoka & Shrestha, 2020

S. rufi/picorne species-group

- S. aureohirtum Brunetti, 1911* (=S. sp. A Lewis, 1964)

S. vernalis species-group

- S. gandakiense Adler, Takaoka & Ruiz-Arrondo, 2020
- S. gracile Datta, 1973
- S. lekhanianense Takaoka & Shrestha, 2010
- S. letense Takaoka & Shrestha, 2010
- S. magnacentrum Adler, Takaoka & Ruiz-Arrondo, 2020
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Subgenus Simulium Latreille

- S. griseifrons species-group
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- S. gokarnaense Takaoka & Shrestha, 2020
- S. hillycum Maskey 1989
- S. maskeyae Takaoka & Shrestha, 2020
- S. ratekholaense Takaoka & Shrestha, 2020
- S. tamorensis Takaoka & Shrestha, 2010

S. striatum species-group

- S. bagmaticum Maskey, 1987
- S. beniense Takaoka & Shrestha, 2020
- S. chainpureNSE Takaoka & Shrestha, 2020
- S. dadagaunense Takaoka & Shrestha, 2020
- S. grisescens Brunetti, 1911
- S. pallidum Puri, 1932
- S. sanyanense Takaoka & Shrestha, 2020
- S. sp. nr. striatum Takaoka, Shrestha & Dangi, 2020

S. tuberosum species-group

- S. pradyai Takaoka & Somboon, 2008
- S. langtangense Takaoka & Shrestha, sp. nov. (=S. rufi/basis (not sensu Brunetti), Shrestha & Takaoka, 2009)
- S. dailekhense Takaoka & Shrestha, sp. nov. (=S. ramosum (not sensu Puri), Shrestha and Takaoka, 2009)
- S. nakanoi Takaoka & Shrestha, sp. nov.
- S. tatopaniense Takaoka & Shrestha, sp. nov.
**S. variegatum** species-group

* S. himalayense Puri, 1932* (=S. vega Maskey, 1998)**

* S. ottanum* (Shiraki), 1935*

* S. tulshii* Takaoka & Shrestha, 2010

* S. vega sp. A Maskey, 1986*

* S. vega sp. B Maskey, 1986*

**Simulium s. str.** species unplaced to group

**S. singtamense** Datta & Pal, 1975*

* The records of these ten species from Nepal in World Blackflies (Adler, 2020) were based on the thesis of Maskey (1986), which lacks information about the life stages of specimens and morphological characteristics on which Dr. Maskey based her identifications of the species. For this reason, all these records might be unreliable and need to be confirmed, except those of *S. aueroihirtum* Brunetti and *S. praelargum* Datta which were confirmed by Shrestha and Takaoka (2009) and Takaoka et al. (2020d), respectively.

The identification of *S. varicorne* Edwards by Maskey (1986) probably is wrong if it was based only on the pupa and/or larva, which has long been considered *S. varicorne* since they were wrongly associated with the male of *S. varicorne* by Edwards (1934). The pupa and larva might have been those of *S. paraehyangum* Takaoka & Sigit, or two other related species (Takaoka et al., 2018). Even if the identification of *S. varicorne* is based on a male(s), its identification should be confirmed because there are three other related species, which are similar in the male to one another, in the *S. varicorne* species-group (Takaoka, 2012).

**Simulium vega** Maskey was suggested as a synonym of *S. himalayense* Puri in the 2008 version of World Blackflies (Adler, 2020).

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