Original Article

Three new black fly species of the genus *Simulium* (Diptera: Simuliidae) from Nepal

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Abstract: Three new species of black flies of the genus *Simulium* Latreille are described from Nepal: *Simulium purandharaense* sp. nov. in the *S. batoense* species-group in the subgenus *Gomphostilbia* Enderlein, *S. nivritiae* sp. nov. in the *S. feuerborni* species-group in the subgenus *Nevermannia* Enderlein, and *S. phidimense* sp. nov. in the *S. malyschevi* species-group in the subgenus *Simulium* Latreille s. str. The female, male and pupa of *S. praelargum* Datta in the *S. feuerborni* species-group are redescribed.

Key words: Biodiversity, fauna, Oriental Region, taxonomy

INTRODUCTION

The Simuliidae in Nepal has been relatively poorly studied. Only 12 species were recorded from Nepal before we reported 20 more species including 10 new species from Nepal (Shrestha and Takaoka, 2009; Takaoka and Shrestha, 2010). All species belong to the genus *Simulium* Latreille and are classified into six subgenera. As in the other countries, such as Thailand, Malaysia, and Indonesia in the Oriental Region, the fauna of black flies in Nepal is characterized by the high diversity in lineages or putative phylogenetic segregates, defined by Takaoka (2017a). A total of 18 different lineages are known in Nepal: three subgenera (*Asiosimulium* Takaoka & Choochote, *Eusimulium* Roubaud, *Montisimulium* Rubtsov), and 15 species-groups of the three other subgenera (six species-groups in *Gomphostilbia* Enderlein, three species-groups in *Nevermannia* Enderlein and six species-groups in *Simulium* Latreille s.str.) (Adler, 2020).

Recently, we reported 10 new species and three newly recorded species from Nepal in three previous papers (Takaoka et al., 2020a, b, c). In this fourth paper, we describe three more new species, of which one is placed in the *S. batoense* species-group in *Gomphostilbia*, one in the *S. feuerborni* species-group in *Nevermannia* and one in the *S. malyschevi* species-group in *Simulium*, increasing one more lineage to the fauna.

All materials examined in this study include adults

reared from pupae and their pupal exuviae and cocoons, which were preserved in 80 ethanol after being collected from various localities in Nepal in 2009–2011 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 purandharaense Takaoka & Shrestha sp. nov.

Female ($n=1$). Body length 2.0 mm. **Head.** Slightly narrower than width of thorax. Frons dark brown, densely covered with yellowish-white scale-like recumbent short hairs interspersed with few dark longer hairs near vertex; frontal ratio 1.75:1.00:2.54; frons:head ratio 1.00:4.76. Fronto-ocular area well developed, narrow, directed dorsolaterally. Clypeus dark brown, densely covered with yellowish-white scale-like hairs interspersed with several dark longer hairs on each side. Labrum 0.65 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 composed of five palpomeres, light to medium brown, proportional lengths of third, fourth, and fifth palpomeres 1.0:1.1:2.5; sensory vesicle (Fig. 1A)

Fig. 1. Female of *S. purandharaense* sp. nov. A, third palpomere with sensory vesicle (right side; front view). B, cibarium (front view). C, hind tibia (left side; outer view). D, basitarsus and second tarsomere of hind leg (left side; outer view). E, claw (lateral view). F, sternite 8 and ovipositor valve (right half; ventral view). G, genital fork (ventral 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; 0.01 mm for E.

ellipsoidal, medium-long (0.43–0.46 times length of third palpomere), with medium-sized opening. Lacinia with 8 inner and 13 outer teeth. Mandible with 21 inner and 8 or 9 outer teeth. Cibarium (Fig. 1B) medially forming sclerotized plate folded forward from posterior margin, with weakly sclerotized

mediolongitudinal ridge with dark bifid apex. **Thorax.** Scutum dark brown except anterolateral calli ochreous, thinly pruinose and shiny when illuminated at certain angles, densely covered with yellow scale-like recumbent short hairs intermixed with similar dark short hairs near anterior margin; scutum with

faint dark longitudinal vittae (one medial and two submedial). Scutellum medium brown, with dark brown long upright hairs along posterior margin (short hairs lost). Postnotum dark brown, slightly shiny when illuminated at certain angles, and bare. Pleural membrane ochreous and 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 with anterior surface dark yellow; trochanter dark yellow to light brown except base whitish yellow; femur light brown with apical cap medium brown (though extreme tip light brown); tibia medium brown except extreme basal tip whitish yellow and median portion on outer surface light brown; tarsus dark brown, with moderate dorsal hair crest; basitarsus moderately dilated, 5.58 times as long as its greatest width. Midleg: coxa medium brown except posterolateral surface dark brown; trochanter light brown except base whitish yellow; femur light brown with apical cap medium brown (though extreme tip light brown); tibia medium to dark brown except extreme basal tip whitish yellow; tarsus dark brown except basal half of basitarsus whitish yellow to dark yellow. Hind leg: coxa medium brown; trochanter whitish yellow; femur medium brown with base whitish yellow and apical cap dark brown (though extreme tip light brown); tibia (Fig. 1C) medium brown except basal one-fourth yellowish white and apical one-third dark brown; tarsus medium to dark brown except basal two-thirds (though base light brown) and basal half of second tarsomere yellowish white; basitarsus (Fig. 1D) narrow, nearly parallel-sided, 6.9 times as long as wide, and 0.59 and 0.50 times as wide as greatest widths of tibia and femur, respectively; calcipala (Fig. 1D) slightly longer than width at base, and 0.45 times as wide as greatest width of basitarsus; pedisulcus (Fig. 1D) well developed; claw (Fig. 1E) with a large basal tooth 0.53 times length of claw. **Wing.** Length 1.5 mm. Costa with dark spinules and hairs except basal patch of hairs yellow. Subcosta with one dark hair medially on right wing and entirely bare on left wing. Hair tuft on base of radius dark brown. Basal portion of radius fully haired; R_1 with dark spinules and hairs; R_2 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 dark brown except anterior half of segment 2 white, moderately covered with dark short to long hairs; tergites of segments 2 and 6–9 shiny when illuminated at certain angles. Sternal plate on segment 7 undeveloped. **Terminalia.** Sternite 8 (Fig. 1F) bare medially, with 11 or 12 medium-long to long hairs together with four slender short hairs on each side. Ovipositor valve (Fig. 1F) triangular (though posteromedial tip rounded), thin, membranous, moderately covered with microsetae interspersed with

two 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 medially. Paraproct in ventral view (Fig. 1H) subquadrate, somewhat depressed along medial margin, with four sensilla on anteromedial surface; paraproct in lateral view (Fig. 1I) somewhat produced ventrally beyond ventral tip of cercus, 0.63 times as long as wide, with 20 or 21 medium-long to long hairs on ventral and lateral surfaces. Cercus in lateral view (Fig. 1I) short, rounded posteriorly, 0.49 times as long as wide. Spermatheca (Fig. 1J) ellipsoidal, 1.42 times as long as its greatest width, well sclerotized and darkened except duct and small area near juncture with duct unpigmented, and with many fissures on outer surface; internal setae absent; both accessory ducts slender, subequal in diameter to major one.

Pupa ($n=1$). Body length 2.3 mm. **Head.** Integument yellow, moderately covered with round tubercles except antennal sheaths bare. Frons with three unbranched long trichomes with straight or coiled apices (Fig. 2A) on right side, and two similar trichomes on left side; face with one unbranched long trichome with a coiled apex (Fig. 2B) on each side, and one additional bifid long trichome (Fig. 2C) near posterior margin of lateral surface on left side. **Thorax.** Integument yellow, moderately covered with tubercles, and with three long dorsomedial trichomes with coiled apices (Fig. 2D), two anterolateral trichomes (anterior trichome medium-long, with a straight apex, posterior one long, with a coiled apex) (Fig. 2E), one short mediolateral trichome with a straight apex (Fig. 2F), and three short ventrolateral trichomes with straight apices (Fig. 2G); all trichomes unbranched. Gill (Fig. 2H) composed of eight slender thread-like filaments, arranged as $[(1+2)+(1+2)]+2$ or $[3+(1+2)]+2$ from dorsal to ventral, with short common basal stalk; dorsal triplet composed of one inner and two outer filaments with no or extremely short secondary stalk; middle triplet composed of one inner and two outer paired filaments with short secondary stalk; stalk of ventral pair of filaments relatively long, 2.1 and 1.2 times as long as common basal stalk and interspiracular trunk, respectively; two filaments of ventral pair subequal in length (3.0 mm) and thickness to each other; three filaments of middle triplet subequal in length (2.3–2.6 mm) and thickness to one another; three filaments of dorsal triplet subequal in length (1.9–2.3 mm) and thickness to one another; two filaments of ventral pair 1.4–1.7 times as thick as six other filaments; all filaments whitish yellow to yellow, gradually tapered toward apex; cuticle of two filaments of ventral pair with moderately defined annular ridges and furrows though becoming less marked apically, and those of dorsal and middle triplets almost smooth except some basal portions with

Fig. 2. Pupa of *S. purandharaense* sp. nov. A, frontal trichome. B, facial trichome. C, additional bifid trichome near posterior margin of lateral surface on left side. D–G, thoracic trichomes (D, dorsomedial; E, anterolateral; F, mediolateral; G, ventrolateral). H, gill filaments (left side; lateral view). I, hair-like seta on dorsum of abdominal segment 1. J, hair-like seta and minute seta on dorsum of abdominal segment 2. K, terminal hooks (caudal view). Scale bars. 0.1 mm for H; 0.02 mm for A–G, I and J; 0.01 mm for K.

weakly defined annular ridges; all filaments densely covered with minute tubercles. **Abdomen.** Dorsally, segments 1 and 2 light yellowish; all segments without tubercles; segment 1 with one unbranched slender short hair-like seta (Fig. 2I) on each side; segment 2 with one unbranched slender short hair-like seta and five minute setae (Fig. 2J) submedially on each side; segments 3 and 4 each with four hooked spines and one somewhat spinous minute seta on each side; segment 5 lacking spine-combs and comb-like groups of microspines on each side; segments 6–9 each with spine-combs in transverse row and comb-like groups of microspines on each side; segments 5–8 each with few minute setae near posterior margin on each side; segment 9 with a pair triangular terminal hooks (Fig. 2K) when viewed caudally. Ventrally, segment 4 with one unbranched hook (subequal in size to those on segments 5–7) and few slender short setae on each side; segment 5 with two bifid hooks submedially and few short slender setae on each side; segments 6 and 7 each with one bifid inner hook, one unbranched outer hook 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.** Slipper-shaped, moderately woven, moderately extended ventrolaterally; individual threads visible.

Male and Mature larva. Unknown.

Type material. HOLOTYPE. Female (with associated pupal exuviae, in 80% ethanol), collected from a stream (25°C, elevation 514m, 28°11.149' N, 82°03.700' E), Purandhara, Dang, Nepal, 10-V-2011, by S. Shrestha.

Distribution. Nepal.

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

Remarks. *Simulium purandharaense* sp. nov. is assigned to the *S. batoense* species-group in the subgenus *Gomphostilbia*, redefined by Takaoka (2012), in having the hind tibia mostly darkened (Fig. 1C), and cibarium with a narrow mediolongitudinal ridge (Fig. 1B).

This new species is similar to *S. chuzargangense* Takaoka & Somboon described from a female reared from a pupa collected from Bhutan (Takaoka and Somboon, 2008) in many characters including the female wing with the subcosta bare or with one hair, but is distinguished from the latter in the female by the relative length of the sensory vesicle against the third palpomere (0.43–0.46 in this new species *versus* 0.38 in *S. chuzargangense*), relative width of the head against the greatest width of the frons (4.8 in this new species *versus* 5.2 in *S. chuzargangense*), and relative length of the spermatheca against its greatest width (1.42 in this new species *versus* 1.56 in *S. chuzargangense*).

The female of this new species is also similar to that

of *S. kolakaense* Takaoka from Sulawesi, Indonesia (Takaoka, 2003) in sharing the almost bare subcosta, a sensory vesicle of medium length, and the size of the spermatheca. However, it is distinguished from the latter species in the female by the relative width of the head against the greatest width of the frons (4.8 in this new species *versus* 5.5 in *S. kolakaense*), and in the pupa by the gill filaments, of which two filaments of the ventral pair are 1.2–1.6 times as long as six other filaments (twice or more times longer in *S. kolakaense*).

This new species is similar to *S. binuanense* Takaoka & Tenedero from Palawan, the Philippines (Takaoka and Tenedero, 2008) in having the bare subcosta but is distinguished from the latter in the female by the frons densely covered with setae (with several hairs only along each lateral margin and widely bare medially in *S. binuanense*), relative length of the sensory vesicle against the third palpomere (0.43–0.46 in this new species *versus* 0.56 in *S. binuanense*), and in the pupa by the relative length of the stalk of the ventral pair of filaments against the interspiracular trunk (1.1 in this new species *versus* 2.5 in *S. binuanense*).

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

Female ($n=2$). Body length 2.5–3.2 mm. **Head.** Slightly narrower than thorax. Frons dark brown, densely covered with whitish-yellow recumbent hairs interspersed with few dark brown longer and stouter hairs along each lateral margin. Frontal ratio 1.54:1.00:2.07. Frons:head ratio 1.00:4.93–4.95. Fronto-ocular area well developed, triangular, directed laterally and slightly upward. Clypeus dark brown, densely covered with whitish-yellow recumbent hairs intermixed with several dark longer and stouter hairs on each side. Labrum 0.94–0.99 times as long as clypeus. Antenna composed of scape, pedicel and nine flagellomeres, dark brown except scape, pedicel, and base of first flagellomere yellow. Maxillary palpus consisting of five palpomeres; proportional length of third, fourth, and fifth palpomeres 1.00:0.78:1.56; palpomeres 1 and 2 yellow, palpomere 3 dark brown, palpomeres 4 and 5 medium brown; palpomere 3 (Fig. 3A) much enlarged; sensory vesicle (Fig. 3A) elongate, 0.47–0.58 times as long as third palpomere, with medium to large opening. Lacinia with seven or eight inner and 12 or 13 outer teeth. Mandible with 21 inner teeth and lacking outer teeth. Cibarium with 11 tiny conical processes near ventral margin, though lacking any processes near dorsal margin. **Thorax.** Scutum ochreous with three dark narrow longitudinal vittae (one medial, two submedial) (though scutum dark brown and without longitudinal vittae in one female), shiny and white pruinose except three non-pruinose narrow longitudinal vittae (one medial, two submedial) when illuminated anterodorsally and viewed dorsally, and densely covered with whitish yellow recumbent hairs intermixed with several dark

Fig. 3. Female of *S. nivritiae* sp. nov. A, third palpomere with sensory vesicle (right side; front view). B, hind tibia (left side; outer view). C, basitarsus and second tarsomere of hind leg (left side; outer view). D, claw (lateral view). E, sternite 8 and ovipositor valves (right half; ventral view). F, genital fork (ventral view). G and H, paraprocts and cerci (right side; G, ventral view; H, lateral view). I, spermatheca. Scale bars. 0.1 mm for B and C; 0.02 mm for A, and E–I; 0.01 mm for D.

brown upright hairs on prescutellar area. Scutellum ochereous, with several dark brown upright hairs and whitish yellow shorter hairs. Postnotum medium to dark brown, whitish gray pruinose when illuminated

posterodorsally and viewed dorsally, and bare. Pleural membrane bare. Katepisternum longer than deep, medium to dark brown, shiny when illuminated laterally and bare. **Legs.** Foreleg: coxa and trochanter

yellow; femur yellow with apical cap medium brown; tibia dark yellow except basal one-fourth medium brown and apical cap dark brown; tarsus dark brown; basitarsus slender, slightly dilated, 7.79–7.91 times as long as its greatest width. Midleg: coxa light brown except posterolateral surface dark brown; trochanter yellow; femur yellow with apical cap medium brown; tibia yellow to dark yellow except basal extreme yellow, subbasal portion medium brown, apical cap dark brown, and posterior surface from subbasal portion to apex medium to dark brown; tarsus dark brown. Hind leg: coxa ochreous; trochanter yellow; femur yellow with apical cap dark brown; tibia (Fig. 3B) dark grayish yellow except extreme base yellow, subbasal portion medium brown, apical cap dark brown and posterior surface from subbasal portion to apex medium to dark brown; basitarsus (Fig. 3C) grayish yellow except base and apical one-fifth medium brown; rest of tarsus medium brown except basal half of second tarsomere grayish; basitarsus (Fig. 3C) nearly parallel-sided along basal three-fifths, then slightly narrowed toward apex, 6.00–7.33 times as long as its greatest width, and 0.71–0.83 and 0.60–0.67 times as wide as hind tibia and femur, respectively; calcipala (Fig. 3C) well developed, nearly as long as wide, and 0.45 times as wide as basitarsus; pedisulcus well developed. Claw (Fig. 3D) with a large basal tooth 0.42–0.46 times as long as claw. **Wing.** Length 2.5–2.6 mm. Costa with dark brown spinules (except basal portion bare) and medium brown hairs. Subcosta with dark hairs except apical one-fourth bare. Basal portion of radius fully haired; R_1 with dark spinules and hairs; R_2 with dark hairs. Hair tuft on base of radial vein dark brown. Basal cell absent. **Halter.** White with light brown base. **Abdomen.** Basal scale medium brown, with fringe of whitish-yellow long hairs. Dorsal surface of abdomen dark brown (though tergal plate medium brown) except segment 2 medium brown, moderately covered with dark brown hairs as well as whitish-yellow hairs; tergites 2 and 6–8 shiny when illuminated at certain angles; ventral surface of segment 7 with large sternal plate medially. **Terminalia.** Sternite 8 (Fig. 3E) wide, bare medially but furnished with 17–20 long hairs and two to five short hairs on each side. Ovipositor valves (Fig. 3E) triangular, thin, membranous except inner margins narrowly sclerotized, each densely covered with microsetae interspersed with five to seven short hairs (though small portion of posteromedial corner bare); inner margins sinuous, concave medially and narrowly separated from each other. Genital fork (Fig. 3F) of inverted Y-form, with well sclerotized stem, relatively wide arms, of which inner margins basally separated from each other by small medial incision in one female; each arm with lateral plate bearing round projection directed posteromedially and narrow projection directed anterodorsally. Paraproct in ventral view (Fig. 3G) roughly subquadrate, slightly

longer than its greatest width; anteromedial surface nearly transparent, with six to eight sensilla; paraproct in lateral view (Fig. 3H) 0.85 times as long as wide, somewhat protruding ventrally beyond ventral margin of cercus, and with 19–25 medium to long hairs on ventral and lateral surfaces. Cercus in lateral view (Fig. 3H) rounded posteriorly, 0.5 times as long as basal width. Spermatheca (Fig. 3I) nearly ovoid, 1.36 times as long as its greatest width, strongly sclerotized except small area around juncture with duct and duct itself unsclerotized, with distinct reticulate surface pattern and without internal setae; both accessory ducts subequal in diameter to each other and somewhat thicker than main duct.

Male ($n=1$). Body length 3.0 mm. **Head.** Slightly wider than thorax. Upper eye vermilion, consisting of large facets in 18 vertical columns and 20 horizontal rows. Clypeus brownish black, not shiny, whitish pruinose, moderately covered with yellow hairs intermixed with dark brown longer hairs except medial portion widely bare. Antenna composed of scape, pedicel and nine flagellomeres, dark brown except scape, base of pedicel and base of first flagellomere yellow; first flagellomere elongate, 2.0 times as long as second one. Maxillary palpus light brown except third palpomere dark brown, composed of 5 palpomeres, proportional lengths of third, fourth, and fifth palpomeres 1.0:0.9:2.1; third palpomere (Fig. 4A) of moderate size; sensory vesicle (Fig. 4A) small, ellipsoidal, 0.2 times as long as third palpomere, with small opening. **Thorax.** Similar to that of female. **Legs.** Color nearly as in female except base of all tibiae light brown, and hind basitarsus grayish yellow with base medium brown; fore basitarsus slender, cylindrical, 10.1 times as long as its greatest width. Hind basitarsus (Fig. 4B) enlarged, nearly parallel-sided, 4.24 times as long as its greatest width, and 1.00 and 0.96 times as wide as greatest widths of hind tibia and femur, respectively; calcipala well developed, nearly as long as basal width, 0.4 times as wide as greatest width of basitarsus; pedisulcus moderately developed. **Wing.** As in female except subcosta with four hairs on basal half; length 2.5 mm. **Abdomen.** Basal scale dark brown, with fringe of pale long hairs. Dorsal surface of abdominal segments medium to dark brown except base of segment 2 ochreous, and moderately covered with light brown to black short to long hairs and yellow short hairs; segments 5, 6 and 7 each with a pair of slightly shiny dorsolateral patches when illuminated at certain angles. **Genitalia.** Coxite in ventral view (Fig. 4C) rectangular, 1.72 times as long as its greatest width. Style in ventral view (Fig. 4C) short, 0.68 times as long as coxite, bent inwardly, nearly parallel-sided and with short stout spine apically; style in ventrolateral view (Fig. 4D) broad, nearly parallel-sided from base to little beyond middle, then abruptly tapered apically; style in end view (Fig.

4E) with posterior surface triangular and almost bare (though few short sensilla present). Ventral plate in ventral view (Fig. 4C) lamellate, subquadrate, well sclerotized except anteromedian portion unsclerotized (thus anterior margin not well defined), with posterior margin widely concave medially (though posterior margin concave medially and submedially when ventral plate somewhat tilted), and moderately covered with fine short setae on ventral surface except anterolateral and posterolateral portions bare; arm (Fig. 4C) short, slender, convergent anteriorly;

ventral plate in lateral view (Fig. 4F) with ventral margin nearly straight and arm short, and much bent dorsally; ventral plate in caudal view (Fig. 4G) with ventral margin much produced ventromedially and dorsal margin markedly concave, with fine short setae centrally on posterior surface. Median sclerite (Fig. 4F, H) simple, club-shaped, narrow and strongly sclerotized except weakly sclerotized apical portion. Paramere in caudal view (Fig. 4I) with six hooks decreasing in length toward apex. Aedeagal membrane (Fig. 4J) moderately covered with microsetae; dorsal

Fig. 4. Male of *S. nivrithiae* 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, coxites, styles and ventral plate (ventral view). D and E, styles (left side; D, ventrolateral view; E, caudal view). F, ventral plate with median sclerite (lateral view). G, ventral plate (caudal view). H, median sclerite (ventroposterior view). I, paramere (right side; caudal view). J, aedeagal membrane (caudal view). K, dorsal plate (ventral view). L and M, tenth segment and cerci (left side; L, lateral view; M, caudal view). Scale bars. 0.1 mm for B; 0.02 mm for A and C–M.

plate (Fig. 4K) thin, light brown and in form of broad horizontal plate with broadest in middle. Lateral surface of tenth segment (Fig. 4L, M) with no or one distinct hair near posterolateral corner. Cercus (Fig. 4L, M) small, rounded and encircled by eight to ten simple hairs.

Pupa ($n=3$). Body length 3.2–3.4 mm. **Head.** Integument ochreous, moderately covered with tubercles; antennal sheaths bare; frons with two unbranched trichomes (one short, one medium-long) with straight apices (Fig. 5A) on each side; face with one long somewhat stout unbranched trichome with coiled apex (Fig. 5B) on each side. **Thorax.** Integument ochreous, moderately (though sparsely on certain portions) covered with round tubercles, with three long somewhat stout trichomes with coiled apices (Fig. 5C) mediodorsally, two trichomes (anterior trichome medium-long with straight apex, posterior one long, somewhat stout, with coiled apex) (Fig. 5D) anterolaterally, one long trichome with straight apex (Fig. 5E) mediolaterally, and three short slender trichomes with straight apices (Fig. 5F) ventrolaterally on each side; all unbranched. Gill (Fig. 5G) with six long thread-like slender filaments, arranged as 4+2 from dorsal to ventral; common basal stalk of moderate length, 0.7 times as long as interspiracular trunk; basal fenestra of medium size; four filaments in dorsal group arranged as 1+2+1 (Fig. 5H) or 2+2 (Fig. 5I) from inside to outside; two filaments of ventral pair with stalk medium-long to long, 1.2–1.5 times as long as common basal stalk and 0.8–1.1 times as long as interspiracular trunk; all filaments tapered toward tip, and slightly different in length and thickness to one another: inner filament of dorsal group longest (3.5 mm), followed by three other filaments of dorsal group (3.2–3.4 mm) and two filaments of ventral pair shortest (3.0 mm); inner filament of dorsal group thickest when compared basally, two filaments of ventral pair thinnest (0.6–0.7 times as thick as inner filament of dorsal group), and three other filaments of dorsal group intermediate; cuticular surface with distinct annular ridges and furrows though becoming less distinct near apex, and densely covered with minute tubercles. **Abdomen.** Dorsally, segments 1 and 2 medium brown, segments 3–9 light brown, and all weakly tuberculate; segment 1 with one medium-long slender simple seta (Fig. 5J) on each side; segment 2 with one medium-long seta and five short spinous setae (Fig. 5K) on each side; segments 3 and 4 each with four hooks and one short spinous seta on each side; segments 6–8 each with spine-combs directed backward in transverse row and segments 5–9 each with comb-like groups of micro-spines on each side; segments 5 with four short setae and segments 6–8 each with two short setae on each side; segment 9 with a pair of distinct horn-shaped terminal hooks (Fig. 5L). Ventrally, segments 3–8 each

with comb-like groups of micro-spines; segment 4 with four short slender setae on each side; segment 5 with two bifid hooks submedially and few short slender setae on each side; segments 6 and 7 each with one bifid inner hook, one unbranched outer hook and few slender short setae on each side. **Cocoon** (Fig. 5M). Slipper-shaped, compactly woven without open spaces in web, with anterior margin somewhat thickly woven, and extended ventrolaterally; individual threads visible or not; 4.0 mm long by 2.2 mm wide.

Mature larva. Unknown.

Type Material. HOLOTYPE. Male (with associated pupal exuviae and cocoon) (preserved in 80% ethanol) reared from a pupa, collected from a stream (elevation 2137 m, 28°07.123'N 085°23.566'E) near Grang, Nepal, 7-VIII-2009, by S. Shrestha. PARATYPE. One female (with associated pupal exuviae and cocoon), reared from a pupa, same data and date as those of holotype; one female (with associated pupal exuviae and cocoon) (preserved in 80% ethanol) reared from a pupa, collected from a stream (elevation 1541 m, 29°17.135'N 081°00.685'E) at Silgadi, Doti, Nepal, 27-X-2011, by S. Shrestha.

Etymology. The species name *nivritiae* is a present to Ms. Nivriti from her parent, Suchitra Shrestha and Naresh Dangi.

Remarks. *Simulium nivritiae* sp. nov. is placed in the *S. feuerborni* species-group, redefined by Takaoka (2003), by the combination of the following characteristics: male genitalia with a simple lamellate ventral plate (Fig. 4C), a short inwardly twisted style (Fig. 4D), a simple narrow median sclerite (Fig. 4H) and several parameral hooks (Fig. 4I); a pupal gill with six long thread-like filaments per side (Fig. 5G).

This new species is most similar to *S. langbiangense* Takaoka, Sofian-Azirun & Yacob, described from Vietnam (Takaoka et al., 2014a) in having a combination of two characters: relatively high number of male upper-eye facets in 18 vertical columns and 20 horizontal rows in this new species and in 17 or 18 vertical columns and 18 or 19 horizontal rows in *S. langbiangense* and the cocoon slipper-shaped, without an anterodorsal projection. However, this new species is distinguished from *S. langbiangense* by lacking minute papillae along the inner margin of the opening of the female sensory vesicle (with numerous distinct minute papillae in *S. langbiangense*), relative length of the female frons against its narrowest width, which is 2.1 in this new species and 2.6 in *S. langbiangense*, number of tiny conical processes on the lower portion of the cibarium, which is 11 in this new species and 32 in *S. langbiangense*, and relative length of the spermatheca against its greatest width, which is 1.36 in this new species and 1.1 in *S. langbiangense*.

Although information on the number of male upper-eye facets is not available, the following two of the 18 other species of the *S. feuerborni* species group,

Fig. 5. Pupa of *S. nivritiae* sp. nov. A, frontal trichomes. B, facial trichome. C–G, thoracic trichomes (C, dorsomedial; D, anterolateral; E, mediolateral; F, ventrolateral). G, gill filaments (left side; lateral view). H and I, basal portions of gills (right side; dorsal view). J, hair-like seta on dorsum of abdominal segment 1. K, hair-like seta and minute seta on dorsum 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–I; 0.02 mm for A–F, J and K; 0.01 mm for L.

which have a simple slipper-shaped cocoon, differ from this new species: *S. shandongense* Sun & Li from China (Chen and An, 2003) differs by the relative length of the female fore basitarsus (6.0 *versus* 7.8–7.9 in this new species), and *S. subratai* Takaoka, Tapa & Henry from India (Takaoka et al., 2011) differs by having the yellow scutum (dark brown scutum in this new species).

Five other species in the *S. feuerborni* species-group were described from adult males only, or adult female and males, or adult females only, their pupal and larval stages remaining unknown. Among these, *S. fuscinervis* Edwards recorded from Sabah, East Malaysia (Edwards, 1933), differs from this new species by having the paramere with 10 or 11 hooks (six in this new species); *S. bryopodium* Delfinado, described from Palawan Island, Philippines (Delfinado, 1971), also differs by the hind femora being dark brown (yellow with the apical cap dark brown in this new species); *S. senile* Brunetti, described from West Himalaya (Brunetti 1911), differs by having the style without an apical spine; *S. rufithorax* Brunetti described from a male and four females collected from India (Brunetti, 1911), has a reddish-brown thorax (dark brown thorax in this new species); and *S. sp.* A described from females from Myanmar (Takaoka, 1989) differs by the relative length of the female frons against its narrowest width (2.7–3.4 *versus* 2.1 in this new species).

This new species is separated from *S. praelargum* Datta, originally described from India (Datta, 1973) and recorded from Nepal, by the female cibarium with 11 tiny conical processes near the ventral margin (73 tiny conical processes in *S. praelargum*), relative length of female frons against its narrowest width, which is 2.1 (2.6 in *S. praelargum*), male paramere with six hooks (five hooks in *S. praelargum*), and cocoon slipper-shaped, without an anterodorsal bulge or projection (with a distinct anterodorsal projection in *S. praelargum*).

***Simulium praelargum* Datta, 1973**

Simulim (*Eusimulium*) *praelargum* Datta, 1973: 365–368 (Female, male, pupa and larva).

This species was originally described from India (Datta, 1973) and recorded from Nepal. The female, male and pupa of this species are redescribed here based on specimens from Nepal, particularly to provide most of numerical characters, which were not given in the original description.

Female ($n=1$). Body length 3.3 mm. Nearly as in female of *S. nivritiae* sp. nov. except following characters. **Head.** Frontal ratio 1.41:1.00:2.60. Frons-head ratio 1.00:4.35. Clypeus dark brown, densely covered with whitish-yellow recumbent hairs intermixed with several dark longer and stouter hairs on each side except portion near dorsal margin widely

bare. Labrum 0.94 times as long as clypeus. Maxillary palpus: proportional length of third, fourth, and fifth palpomeres 1.00:0.86:1.55; sensory vesicle elongate, 0.48–0.54 times as long as third palpomere, with opening of moderate size. Lacinia with six or seven inner and 13 or 14 outer teeth. Mandible with 18 inner teeth and lacking outer teeth. Cibarium smooth, with 73 tiny conical processes near ventral margin, though lacking any processes near dorsal margin. **Thorax.** Scutum ochreous, though brownish on shoulders, along lateral margins and prescutellar area, shiny and white pruinose except three non-pruinose narrow longitudinal vittae (one medial, two submedial) when illuminated anterodorsally and viewed dorsally. **Legs.** Foreleg: tibia dark brown except basal extreme whitish yellow and medial large portion on outer surface light brown; basitarsus slender, slightly dilated, 7.04 times as long as its greatest width. Midleg: tibia dark brown except basal extreme whitish yellow and median large portion on outer surface light brown. Hind leg: tibia dark brown except basal extreme whitish yellow and median large portion on outer surface light brown; basitarsus medium brown, though base and portion near apex dark brown; rest of tarsus dark brown; basitarsus 6.89 times as long as its greatest width, and 0.72 and 0.56 times as wide as hind tibia and femur, respectively; calcipala nearly as long as wide, and 0.5 times as wide as basitarsus. Claw with large basal tooth 0.43 times as long as claw. **Wing.** Length 2.9 mm. **Terminalia.** Sternite 8 with 10–20 long hairs and one or two short hairs on each side. Ovipositor valves each densely covered with microsetae interspersed with four to nine short hairs. Genital fork lacking small medial incision; each arm with distinct triangular projection with blunt or pointed apex directed anterodorsally. Paraproct in lateral view 0.84 times as long as wide, and with 25 or 26 short to medium-long hairs on ventral and lateral surfaces. Cercus in lateral view rounded posteriorly, 0.54 times as long as basal width. Spermatheca nearly ovoid, 1.07 times as long as its greatest width.

Male ($n=3$). Body length 3.0 mm. Nearly as in male of *S. nivritiae* sp. nov. except following characters. **Head.** Upper eye vermilion, consisting of large facets in 16–18 vertical columns and 18 or 19 horizontal rows. Antenna: first flagellomere elongate, 2.33 times as long as second one. Maxillary palpus: proportional lengths of third, fourth, and fifth palpomeres 1.00:0.98:1.96; sensory vesicle globular or ellipsoidal, 0.15 times as long as third palpomere, with small opening. **Thorax.** Similar to that of female except three longitudinal vittae (median and two submedian) distinct. **Legs.** Color nearly as in female except base of all tibiae light brown; fore basitarsus 9.68 times as long as its greatest width. Hind basitarsus 4.44 times as long as its greatest width. **Wing.** Length 2.7 mm. **Genitalia.** Paramere with five hooks decreasing in length toward

apex. Cercus with ten or eleven simple hairs.

Pupa ($n=4$). Body length 3.4–3.7 mm. Nearly as in pupa of *S. nivritiae* sp. nov. **Head.** Integument sparsely covered with tubercles except antennal sheaths bare; frons with two short unbranched trichomes on each side; face with one long unbranched trichome, which is 3.7 times length of frontal ones. **Thorax.** Integument sparsely covered with round tubercles, with three extremely long stout trichomes, which are 1.4–1.6 times length of facial one, mediodorsally, two trichomes (anterior trichome medium-long, posterior one extremely long, 2.8 times length of anterior one) anterolaterally, one medium-long trichome mediolaterally; all unbranched. Gill with six long thread-like slender filaments, arranged as 4+2 from dorsal to ventral; common basal stalk of moderate length, 0.68–0.75 times as long as interspiracular trunk; four filaments in dorsal group arranged as 1+2+1 from inside to outside; two filaments of ventral pair with stalk medium-long to long, 2.10–2.34 times as long as common basal stalk and 1.43–1.75 times as long as interspiracular trunk; four filaments of dorsal group subequal in length (4.0–4.6 mm) and thickness to one another and somewhat longer and thicker than two filaments of ventral pair, which are subequal in length (3.0–3.4 mm) and thickness (0.63 times as thick as those of dorsal group) to each other. **Abdomen.** Dorsally, segments 5–8 each with spine-combs directed backward in transverse row (though one of four pupae examined lacking spine-combs on segment 5). **Cocoon.** Slipper-shaped, with anterodorsal projection (*ca.* 1.0 mm long); 4.0 mm long by 2.5 mm wide.

Specimens examined. One female and three males (with their pupal exuviae and cocoons) (preserved in 80% ethanol) reared from pupae collected at the same stream where *S. nivritiae* sp. nov. was collected.

Distribution. India and Nepal.

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

Female ($n=3$). Body length 2.2–2.3 mm. **Head.** Narrower than thorax. Frons brownish black, shiny, with several dark long stout hairs along each lateral margin and few similar hairs just above lower margin; frontal ratio 1.2:1.0:1.0; frons:head ratio 1.0:3.6. Fronto-ocular area well developed, short, directed laterally and slightly upward. Clypeus brownish black, white pruinose, moderately covered with dark long stout hairs along lateral and ventral margins and middle portion of upper two-thirds widely bare. Labrum 0.74–0.86 times as long as clypeus. Antenna composed of scape, pedicel and nine flagellomeres, medium to dark brown except scape, pedicel, and base of flagellomere 1 yellow. Maxillary palpus with five palpomeres, light brown; proportional lengths of third, fourth, and fifth palpomeres 1.00:1.09–1.16:2.06–2.18; third palpomere (Fig. 6A) of normal

size; sensory vesicle (Fig. 6A) small, ellipsoidal (0.23–0.30 times length of third palpomere) having moderate opening. Lacinia with 9–11 inner and 14–16 outer teeth. Mandible with 24 inner and 11–13 outer teeth. Cibarium (Fig. 6B) with blunt median projection and with two tiny pointed processes near posterior margin on each side. **Thorax.** Scutum brownish black, unpatterned, shiny, thinly white pruinose when illuminated at certain angles, moderately covered with dark recumbent minute hairs intermixed with several dark brown long upright hairs on prescutellar area. Scutellum brownish black, white pruinose when illuminated at certain angles, covered with dark brown upright long hairs. Postnotum brownish black, white pruinose when illuminated at certain angles, and bare. Pleural membrane bare. Katepisternum dark brown to brownish black, longer than deep, and bare. **Legs.** Foreleg: coxa whitish yellow; trochanter yellow; femur deep yellow to light brown except apical cap medium brown; tibia white except inner surface of base light brown, and apical cap dark brown, and with large white sheen on outer surface when illuminated at certain angles; tarsus brownish black, with moderate dorsal hair crest; basitarsus greatly dilated, 4.1 times as long as its greatest width. Midleg: coxa dark brown; trochanter medium brown except base yellowish white; femur medium brown with apical cap dark brown; tibia medium to dark brown with extreme base and basal one-third of posterior surface yellowish white (its border obliquely defined in lateral view), and with white sheen on posterior surface when illuminated at certain angles; tarsus yellowish white except apical tip of basitarsus, apical one-third of second tarsomere, apical two-thirds of third tarsomere and fourth tarsomere light brown, and fifth tarsomere medium brown. Hind leg: coxa dark brown; trochanter yellowish white; femur medium brown except base dark yellow to light brown and apical cap dark brown; tibia (Fig. 6C) medium to dark brown except base and little less than basal half of posterior surface yellowish white (its border obliquely defined in lateral view); tarsus (Fig. 6D) yellowish white except little less than apical one-fourth of basitarsus light to medium brown, and apical one-third of second tarsomere and most of third tarsomere light brown, and entire fourth and fifth tarsomeres medium brown; basitarsus (Fig. 6D) parallel-sided, 6.73 times as long as wide, and 0.69 and 0.58 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 6D) developed, small, little shorter than its basal width, and 0.36 times as wide as greatest width of basitarsus; pedisulcus (Fig. 6D) well developed; claw (Fig. 6E) with a small subbasal tooth. **Wing.** Length 2.0 mm. Costa with dark spinules and dull hairs; subcosta bare; basal section of radius bare; R_1 with dark spinules and hairs; R_2 with hairs; hair tuft on base of radius dark brown; basal cell absent. **Halter.** White except base

Fig. 6. Female of *S. phidimense* sp. nov. A, third palpomere with sensory vesicle (right side; front view). B, cibarium (front view). C, hind tibia (left side; outer view). D, basitarsus and second tarsomere of hind leg (left side; outer view). E, claw (lateral view). F, ventral surface of abdominal segment 7. G, sternite 8 and ovipositor valves (ventral view). H, genital fork (ventral view). I and J, paraprocts and cerci (right side; I, ventral view; J, lateral view). K, spermatheca. Scale bars. 0.1 mm for C and D; 0.02 mm for A, B and F–K; 0.01 mm for E.

light brown. **Abdomen.** Basal scale medium brown, with fringe of dull hairs. Dorsal surface of abdomen medium to dark brown, with short dark hairs; tergite 2 brightly iridescent when illuminated at certain angles, and tergites 6–9 shiny. Ventral surface of segment 6

medially with unbranched stout hairs only, and that of segment 7 (Fig. 6F) medially with 30–32 stout dark hairs, of which 22–26 hairs each with two to six branches. **Terminalia.** Sternite 8 (Fig. 6G) widely bare medially, with five to eight dark medium-long to long

stout hairs and two or three yellow short hairs on each lateral surface. Ovipositor valve (Fig. 6G) flap-like, bluntly truncate posteriorly, forming oblique roof-like ridge parallel to posterior margin running obliquely, thin, membranous, covered with six to ten dark medium-long or long hairs, three or four yellow short hairs and numerous microsetae (except narrow area along posterior margin bare); inner margins not sclerotized, moderately concave medially and widely separated from each other. Genital fork (Fig. 6H) of inverted-Y form, with narrow well sclerotized stem; arms of moderate width, each with distinct projection with pointed apex directed anterodorsally. Paraproct in ventral view (Fig. 6I) triangular, pointed medially, with unpigmented shallow depression on ventral surface along anteromedial margin; anteromedial surface moderately sclerotized and with five or six sensilla; paraproct in lateral view (Fig. 6J) 0.85 times as long as wide, with unpigmented shallow depression narrowing ventrally along anteroventral margin, slightly protruding beyond ventral margin of cercus, and with seven to nine hairs on ventral and lateral surfaces. Cercus in lateral view (Fig. 6J) short, rounded posteriorly, 0.52 times as long as wide, and with numerous short to medium-long hairs. Spermatheca (Fig. 6K) large, ellipsoidal, 1.43 times as long as wide, well pigmented except portion of juncture with duct unpigmented, with weakly defined surface patterns near base, and with internal setae; accessory ducts subequal in thickness to each other and to major duct.

Male ($n=2$). Body length 2.2 mm. **Head.** Somewhat wider than thorax. Upper eye consisting of large facets in 17 or 18 vertical columns and in 16 or 17 horizontal rows. Clypeus brownish black, thickly white pruinose and brightly shiny when illuminated at certain angles, sparsely covered with dark brown hairs along and near lateral margins (most of central portion bare). Antenna composed of scape, pedicel and nine flagellomeres, dark brown except scape and pedicel dark yellow, base of first flagellomere yellow; first flagellomere elongate, 1.84 times length of second one. Maxillary palpus composed of five palpomeres, light to medium brown except first and second palpomeres grayish yellow; proportional lengths of third, fourth, and fifth palpomeres 1.0:1.2:2.4; third palpomere (Fig. 7A) somewhat widened apically; sensory vesicle (Fig. 7A) globular, 0.1 times length of third palpomere, and with small opening. **Thorax.** Scutum brownish black, with whitish pruinose pattern (brightly iridescent when illuminated at certain angles), i.e., anterior pair of large triangular spots with pointed posteromedial apex on shoulders, narrow band along each lateral margin and large transverse spot entirely covering prescutellar area, lateral band on each side connected to anterolateral spot but disconnected near base of wing to posterior spot; 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, whitish pruinose (brilliantly iridescent when illuminated at certain angles) and bare. Pleural membrane bare. Katepisternum dark brown to brownish black, bare. **Legs.** Foreleg. Coxa whitish yellow; trochanter yellow; femur yellow with apical cap medium brown; tibia dark brown except median outer surface white; tarsus dark brown; basitarsus greatly dilated, 5.25 times as long as its greatest width. Midleg. Coxa dark brown; trochanter medium brown with base light brown; femur medium brown; tibia medium brown except base whitish yellow; tarsus yellowish white except fifth tarsomere light brown. Hind leg. Coxa dark brown; trochanter yellowish white; femur dark brown except base yellowish white and apical cap brownish black; tibia brownish black except base whitish yellow; tarsus yellowish white except base and little less than apical one-third of basitarsus light to medium brown, apical one-third of second tarsomere, apical half of third tarsomere and whole of fourth and fifth tarsomeres light brown; basitarsus (Fig. 7B) nearly parallel-sided, 6.12 times as long as wide, and 0.61 and 0.58 times as wide as greatest widths of hind tibia and femur, respectively; calcipala (Fig. 7B) developed, small, little shorter than its basal width, and 0.32 times as wide as greatest width of basitarsus; pedisulcus (Fig. 7B) well developed. **Wing.** Length 1.8 mm. Other characters as in female including bare subcosta. **Halter.** White except base light brown. **Abdomen.** Basal scale dark brown, with fringe of dark brown long hairs. Dorsal surface of abdomen dark brown to black, moderately covered with dark brown short to medium-long hairs; segments 2, 5, 6 and 7 each with a pair of whitish pruinose spots (brightly iridescent when illuminated at certain angles) dorsolaterally, those on segment 2 broadly connected in middle to each other. **Genitalia.** Coxites, styles and ventral plate in ventral view as in Fig. 7C. Style in ventral view (Fig. 7C) elongate, with inner margin sinuous, with one slender subapical spine; style in ventrolateral view (Fig. 7D) 1.9 times length of coxite, 3.1 times as long as greatest width near basal one-third; style in medial view (Fig. 7E) flattened dorsoventrally except basal half gently produced dorsally, which is densely covered with fine short hairs. Ventral plate in ventral view (Fig. 7C) Y-shaped, with body narrowed posteriorly; arms medium-long and stout, widely separated from each other; ventral plate in lateral view (Fig. 7F) with body somewhat widened posteriorly, and with serrated posterior margin; ventral plate in caudal view (Fig. 7G) with body parallel-sided and rounded ventrally, bare, with four teeth in each of two vertical rows on posterior surface. Median sclerite (Fig. 7F, G) weakly sclerotized, plate-like, wide, with a blunt apical tip having incision medially. Paramere with wide base

Fig. 7. Male of *S. phidimense* 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, coxites, styles and ventral plate (ventral view); D and E, styles (right side; D, ventrolateral view; E, medial view). F, ventral plate with median sclerite (lateral view). G, ventral plate (caudal view). H, median sclerite (dorsoposterior view). Scale bars. 0.1 mm for B; 0.02 mm for A and C–H.

having several hooks apically. Aedeagal membrane moderately covered with extremely fine microsetae so that they appear absent; dorsal plate of horizontal bar form, unpigmented except some portions somewhat darkened). Abdominal segment 10 without distinct hairs on each side of posterior surface. Cercus small, rounded, with five or six hairs.

Pupa ($n=5$). Body length 2.5 mm. **Head.** Integument including antennal sheaths light ochreous, bare except face sparsely covered with small round and conical tubercles; antennal sheath without any ridges or projections; frons with two unbranched slender medium-long trichomes (Fig. 8A) on each side; face with one medium trichome (one unbranched, one bifid apically) (Fig. 8B) on each side. **Thorax.** Integument light ochreous, bare on dorsal and dorsolateral surface of little more than anterior half, and sparsely to moderately covered with small conical tubercles on dorsal, dorsolateral and lateral surfaces of little less than posterior half; thorax on each side with two long unbranched trichomes mediodorsally (Fig. 8C), two unbranched trichomes (one medium-

long, one long) anterolaterally (Fig. 8D), one medium-long unbranched trichome mediolaterally (Fig. 8E), and three unbranched trichomes (two medium-long, one long) ventrolaterally (Fig. 8F). Gill (Fig. 8G) composed of six thread-like short filaments arranged in three pairs (dorsal, middle and ventral) arising from short common basal stalk; each pair short-stalked; all filaments nearly subequal in length (*ca.* 1.3 mm) to one another; six filaments of nearly same thickness when measured basally, though lower filament of middle pair slightly thicker than others, and upper filament of ventral pair slightly thinner than others; all filaments light ochreous, with annular ridges and furrows, densely covered with minute tubercles. **Abdomen.** Dorsally, segment 1, basal half of segment 2 and narrow portion along anterior margin of segment 3 light ochreous, other segments transparent except basal areas of spine-combs on segments 7–9 yellow; segment 1 with one short branched seta (Fig. 8H) on each side; segment 2 with one short unbranched or branched seta and five minute setae (Fig. 8I) on each side; segments 3 and 4 each with four distinct

Fig. 8. Pupa of *S. phidimense* sp. nov. A, frontal trichomes. B, facial trichome. C–F, thoracic trichomes (C, dorsomedial; D, anterolateral; E, mediolateral; F, ventrolateral). G, gill filaments (right side; lateral view). H, hair-like seta on dorsum of abdominal segment 1. I, hair-like seta and minute seta on dorsum of abdominal segment 2. J, cocoon (lateral view). Scale bars. 0.5 mm for J; 0.1 mm for G; 0.02 mm for A–F, H and I.

unbranched hooks and one unbranched minute seta on each side; segments 5 and 6 each with comb-like groups of microspines on each side but lacking spine-combs; segments 7–9 each with distinct spine-combs in transverse row (though those on segment 7 fewer in number than those on segment 8, and those on segment 9 somewhat smaller than those on segment 8) and comb-like groups of microspines, on each side; segment 9 without terminal hooks. Ventrally, segments 3–9 transparent, each (except segment 9) with comb-like groups of microspines; segment 4 with few slender minute setae on each side; segment 5 with two bifid stout hooks submedially and few unbranched minute setae on each side; segments 6 and 7 each with one bifid inner hook, one outer stout hook, and few unbranched minute setae on each side. **Cocoon** (Fig. 8J). Simple, slipper-shaped, dull yellowish white, moderately woven, with one large anterolateral window on each side; posterior two-thirds with floor; individual threads invisible; 3.0–3.2 mm long by 1.2 mm wide.

Mature larva. Unknown.

Type material. HOLOTYPE. Female (with its associated pupal exuviae and cocoon) in 80% ethanol, reared from a pupa collected from a river (elevation 579 m, 27°16.557'N, 087°76.244'E), Hewa canal, Phidim, Nepal, 26-III-2010, S. Shrestha. PARATYPES. Two females and two males (with their associated pupal exuviae and cocoons), same data as in the holotype.

Distribution. Nepal.

Etymology. The specific name *phidimense* refers to the name of the locality, Phidim, where this new species was collected.

Remarks. *Simulium phidimense* sp. nov. is assigned to the *S. malyschevi* species-group of the subgenus *Simulium*, redefined by Takaoka (2017b), in having the female claw with a small subbasal tooth (Fig. 6E), ovipositor valve with the oblique posterior margin (Fig. 6G), pupal gill with six thread-like filaments and cocoon slipper-shaped, with a large anterolateral window on each side (Fig. 8J). This species represents the first record of the *S. malyschevi* species-group in Nepal.

This new species is similar in the pupa to *S. hirtipannus* Puri from India, *S. siripoomense* Takaoka & Saito from Thailand, and *S. obliquum* Takaoka & Low from Vietnam (Puri, 1932; Takaoka and Saito, 1996; Takaoka and Mulla, 2000; Takaoka et al., 2017). However, this new species is distinguished from these three species in the female by the ventral surface of abdominal segment 7 with 22–26 branched hairs medially (64 branched hairs in *S. hirtipannus*, 44 branched hairs in *S. siripoomense*, and 46–51 branched hairs in *S. obliquum*); from *S. hirtipannus* and *S. siripoomense* by the ventral surface of abdominal segment 6 without branched hairs medially (with

branched hairs in the latter two species); from *S. hirtipannus* by the frons:head ratio (1.0:3.6 in this new species versus 1.0:2.0 in *S. hirtipannus*), hind trochanter yellowish white (black in *S. hirtipannus*) and paraproct covered with seven to nine stout hairs (18 stout hairs in *S. hirtipannus*); and from *S. siripoomense* by the length ratio of the sensory vesicle against the third palpomere (Fig. 6A) (0.23–0.30 in this new species but 0.4 in *S. siripoomense*).

This new species is distinguished from three other species of the *S. malyschevi* species-group known in the Oriental Region: from *S. baimaii* Kuvangkadilok & Takaoka and *S. lomkaoense* Takaoka & Srisuka, both from Thailand (Takaoka and Kuvangkadilok, 1999; Takaoka and Choochote, 2006; Takaoka et al., 2014b) by having branched hairs on the ventral surface of abdominal segment 7 (lacking branched hairs in the two known species) and pupal gill with six thread-like filaments (with two inflated filaments in the two known species); and from *S. damingense* Chen, Zhang & Zhang from Guangxi Province, south China (Chen and An, 2003) by the number of stout hairs on each side of sternite 8 (five to eight in this new species versus ca. 20 in *S. damingense*), cibarium with a median projection (no projection in *S. damingense*), and claw with a small subbasal tooth (no tooth in *S. damingense*), although there is a possibility that the latter two female characters in *S. damingense* may have been overlooked.

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