DESCRIPTION OF A NEW SPECIES OF *SIMULIUM* (*SIMULIUM*) FROM SABAH, MALAYSIA (DIPTERA: SIMULIIDAE)

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Abstract: The female and male of *Simulium* (*Simulium*) *beludense* sp. nov. are described based on reared adult specimens collected from Sabah, Malaysia. This new species was previously misidentified as *S. (S.) nigripilosum* Edwards of the *melanopus*-group because of a great similarity of their external morphology. The female genitalia examined in this study easily separate this new species from *S. (S.) nigripilosum*. It is also indicated that *S. (S.) beludense* sp. nov. is not assignable to the *melanopus*-group, but is rather closely related to *S. (S.) argentipes* Edwards from Peninsular Malaysia, *S. (S.) bidentatum* (Shiraki) from Japan and China, and *S. (S.) canlaonense* Delfinado from the Philippines, all of which belong to the different group so far undetermined.

Key words: black fly, Simuliidae, *Simulium*, Sabah, Malaysia

Smart and Clifford (1969) gave the descriptions of the male, pupa and mature larva, as well as the redescription of the female of *Simulium* (*Simulium*) *nigripilosum* originally described by Edwards (1933) from female and male specimens collected from Sabah, Malaysia. Takaoka (1983) illustrated for the first time the genitalia of the holotype female of *S. (S.) nigripilosum* loaned from British Museum (Natural History), London (abbreviated hereafter BMNH) and assigned it to the *melanopus*-group on the basis of the characteristic genitalia, particularly paraproct. The male genitalia of this species were also illustrated at the same time by Takaoka (1983) based on the reared adult specimen (also loaned from BMNH). This was one of the male adult specimens reared from the pupae collected by Smart in 1964 and determined by Smart and Clifford (1969). While revising the *melanopus*-group of the subgenus *Simulium* s.str. in Southeast Asia, I found the pupa of *S. (S.) nigripilosum* described by Smart and Clifford (1969) was atypical among the *melanopus*-group by having the eight-filamented gill and corbicular cocoon in place of the six-filamented gill and simple shoe-shaped cocoon, respectively. The subsequent examination of the reared female specimens loaned again from BMNH revealed that their genitalia were completely different from those of the holotype *S. (S.) nigripilosum* illustrated by Takaoka (1983).

In this paper, all the pupae, larvae and reared adults

thought as "*S. (S.) nigripilosum*" by Smart and Clifford (1969) are regarded as a new species, and the female and male are described below. It should be also noted that the illustration of the male genitalia given by Takaoka (1983) was not of *S. (S.) nigripilosum* but of the new species.

Simulium (*Simulium*) *beludense* sp. nov.

Figs. 1-13

DESCRIPTION. Female. Body length ca. 2.5 mm.

Head. Narrower than width of thorax. Frons brownish black, shiny, with a few dark stout hairs along each lateral margin and above antennal base; frontal ratio 1.15:1.00:1.10; frons-head ratio 1.0:4.2. Fronto-ocular area (Fig. 1) narrowly developed, with round lateral tip. Clypeus brownish black, shiny, thickly white pruinose, largely bare medially, covered moderately with dark stout hairs only near and along lateral margins. Antenna (lost in holotype) composed of 2+9 segments, brown except scape and pedicel orange in one paratype ♀ from Pegalan River, but yellow on basal 1/2 and brown on apical 1/2 in the other paratype ♀ from Tuaran River. Maxillary palp brownish black, composed of 5 segments with proportional length of 3rd, 4th and 5th segments 1.0:1.0:2.5; 3rd segment (Fig. 2) of moderate size; sensory vesicle medium in size, elliptical, with rugged surface, $0.24 \times$ length of 3rd segment, with

medium round opening medially. Maxillary lacinia with 11 or 12 inner and 12 or 13 outer teeth. Mandible with ca. 22 inner and 10 outer teeth. Cibarium (Fig. 4) with ca. 20 minute tubercles. **Thorax.** Scutum dark brown, shiny, thinly white pruinose, covered moderately with fine copper-colored pubescence, interspersed with long, upstanding dark hairs on prescutellar area. Scutellum dark brown, with long dark hairs and copper-colored pubescence. Postscutellum dark brown, shiny, white pruinose, without hairs. Pleural membrane bare. Katepisternum longer than deep, bare. **Legs.** Foreleg: coxa pale yellow, trochanter and femur brown; tibia whitish yellow with base somewhat darkened and distal 1/5 or 1/4 brown, and with median outer portion largely white sheeny in lights; basitarsus entirely brownish black, dilated (W:L = 1.0:4.1); rest tarsal segments brownish black. Midleg: coxa, trochanter and femur brown; tibia brown with posterior surface along basal 4/5 or a little more white and largely white sheeny when illuminated; tarsi brownish with basal 2/3 of basitarsus yellow. Hind leg: coxa, trochanter and femur brown; tibia (Fig. 5) brown with posterior surface along basal 2/3 white, and largely white sheeny when illuminated; tarsi (Fig. 5) brown with basal 2/3 of basitarsus whitish yellow; basitarsus parallel-sided, W:L = 1.0:5.3, calcipala short, L:W ratio 1.0:1.4; pedisulcus distinct. All tarsal claws (Fig. 7) with small subbasal tooth. All femora and tibiae covered with scale-like setae on outer surface.

Wing. Length 2.0 mm; costa with spinules and hairs; subcosta haired except distal 1/3 or 1/4 bare; basal section of vein R bare; hair tuft of stem vein dark brown; basal cell absent. **Abdomen.** Basal scale brownish black with fringe of pale hairs; all segments brownish black; tergite 2 with a pair of large, dorsolateral silvery iridescent spots broadly connected to each other in middle; tergites 3, 4 and 5 small and dull, tergites 6–8 large, shiny, with dark hairs. **Genitalia** (Figs. 8 & 9). Ventral surface of abdominal segment 7 without developed sternite. Sternite 8 well sclerotized, bare medially but with 10–13 dark long stout hairs laterally on each side; anterior gonapophysis tongue-like in shape, membranous, bent ventrally, covered with 9–11 somewhat long hairs as well as numerous microsetae except narrow portion along inner margin bare; inner borders concave, widely separated in middle from each other. Genital fork of inverted-Y form, with well sclerotized stem; arms narrow, each with strongly sclerotized distal bulge and with or without very short projection directed anterodorsally (if present, discernible when viewed from side). Paraproct enlarged, somewhat longer than wide in ventral view; nearly as long as wide, somewhat

produced ventrally and ventroanteriorly, covered with ca. 12 short stout hairs in lateral view; surface of antero-ventral corner densely covered with pale setae; inside surface largely concave anteriorly and with several minute setae. Cercus semilunar in lateral view, covered with numerous short hairs. Spermatheca nearly globular, well sclerotized with no definite reticulate pattern, with minute internal setae; tube and small area of tubal base unsclerotized.

Male. Body length 2.6 mm. **Head.** Slightly wider than thorax. Upper eye consisting of large facets in 15 horizontal rows and 15 vertical columns. Clypeus black, silvery pruinose, strongly iridescent when illuminated, sparsely covered with dark hairs. Antenna composed of 2+9 segments, dark brown except scape, pedicel and a few basal flagellar segments yellowish; 1st flagellomere 1.6 × as long as 2nd one. Maxillary palp composed of 5 segments, proportional lengths of 3rd, 4th and 5th segments 1.0:1.2:2.1; 3rd segment (Fig. 3) of normal size, with small sensory vesicle. **Thorax.** Scutum brownish black, with silvery and bluish iridescent pattern composed of an anterior pair of large spots on shoulders, a large transverse spot on prescutellar area contiguous to anterior spots by broad band along lateral margins; anterior pair of spots widely separated from each other in middle, curved posteromedially with posteromedial end somewhat pointed; scutum uniformly covered with brown pubescence, interspersed with long upright dark hairs on prescutellar area. Scutellum dark brown with long upright dark hairs. Postscutellum dark brown, white pruinose, shiny and bare. Katepisternum and pleural membrane as in ♀. **Legs.** Foreleg: coxa yellow; trochanter pale brown; femur brown to brownish black; tibia brownish black with outer surface mostly white, iridescent when illuminated; tarsi blackish; basitarsus somewhat dilated, W:L = 1.0:6.1. Midleg: coxa, trochanter and femur brownish black; tibia brownish black with posterior surface along basal 1/3 white, iridescent on basal 1/2 when illuminated; tarsi brownish black with basal 1/2 or a little more of basitarsus and basal 1/2 of 2nd tarsal segment yellow. Hind leg: brownish black except basal 1/2 of basitarsus yellow; tibia white iridescent at base when illuminated; basitarsus enlarged, W:L = 1.0:4.7, and ca. 0.7 × as wide as tibia and femur (latter two segments subequal in width); calcipala small, pedisulcus distinct. **Wing.** Length 1.9 mm; other features as in ♀ except subcosta bare. **Abdomen.** Basal scale brownish black with long dark hairs. Tergites brownish black with dark hairs; segments 2, 4–7 each with a pair of silvery and bluish iridescent spots dorsolaterally; those on segment 2 broadly connected in

Figs. 1-13. Female and male of *Simulium (Simulium) beludense* sp. nov. 1, fronto-ocular area of ♀; 2 & 3, 3rd segment of maxillary palp (a, sensory vesicle) (2, ♀; 3, ♂); 4, ♀ cibarium; 5, ♀ hind tibia and tarsi; 6, ♂ hind basitarsus and 2nd tarsal segment; 7, ♀ claw; 8 & 9, ♀ genitalia in situ (a, 8th sternite; b, anterior gonapophyses; c, genital fork; d, paraproct; e, cercus; f, spermatheca) (8, ventral view; 9, lateral view); 10, ♂ genitalia in situ (a, coxite; b, style; c, ventral plate) (ventral view); 11 & 12, ventral plate (11, lateral view; 12, end view); 13, paramere (a) and median sclerite (b) (end view).

middle. **Genitalia** (Figs. 10-13). Coxite nearly quadrate, somewhat longer than wide. Style elongate, $1.6 \times$ as long as coxite, narrowed from basal $1/3$ to apical tip, and with apical spine; style flattened dorsoventrally and having no basal protuberance. Ventral plate Y-shaped in ventral view, having median process directed ventrally with ca. 10 fine setae on each side; posteroventral surface of median process with 2 marginal rows of several small spines converging apically; basal arms diverged from each other, with apical tip curved inward. Parameres wide, each with several hooks. Median sclerite wide, thin, almost transparent except basal portion brownish.

TYPE SPECIMENS. Holotype ♀ (BMNH 1969-492), depinned, dissected, cleared in KOH and slide-mounted in Berlese; reared from pupa, collected from River Wariu, ca. 15 m in altitude, Kota Belud, Sabah, 10.III.1964, by J. Smart. Paratypes: 1 ♂, slide-mounted, same data as holotype; 1 ♂, pinned, other data same as holotype; 1 ♀, pinned, reared from pupa, collected from a stream on Tenom-Keningau Road, Pegalan Valley, ca. 180 m in alt., Sabah, 5-7.III.1964, by J. Smart; 1 ♀, pinned, reared from pupa collected from a small tributary of Tuaran River, ca. 60 m in alt., Tuaran, Sabah, 2.III.1964, by J. Smart; 1 ♂, pinned, reared from pupa collected from Tuaran River, above Tamparuli, ca. 14 m in alt., Tuaran, Sabah, 28.II.1964, by J. Smart. All type specimens examined in this study had been previously labelled as "*S. (S.) nigripilosum*" and "Brit. Mus. 1969-492" by Smart and Clifford (1969).

ECOLOGICAL NOTE. According to Smart and Clifford (1969), the pupae and larvae of this species were collected on dead leaves caught among the stones in the river which was, at place of collection, unshaded and relatively wide and shallow.

DISTRIBUTION. Sabah.

ETYMOLOGY. This new species *beludense* was named after the locality from where the holotype specimen was collected.

REMARKS. This new species has a great resemblance in external characters to *S. (S.) nigripilosum*, but distinctly differs from the latter species by the genitalia of the female. The paraproct of this new species is of normal form and lacks a ventrointernal plate (Figs. 8d & 9d) while that of *S. (S.) nigripilosum* is remarkably produced ventrally and bears a ventrointernal plate (see

Fig. 77 in Takaoka, 1983).

S. (S.) beludense appears to be very close in the adult to *S. (S.) bidentatum* (Shiraki) from Japan and China (Takaoka, 1976) by sharing many characters, eg., characteristic genitalia of both sexes, the female unpatterned shiny scutum and tarsal claws with a small basal tooth. The pupa and larva of this species, though not available in this study, also appear to resemble those of *S. (S.) bidentatum*; according to the illustrations of *S. (S.) beludense* (= "*S. (S.) nigripilosum* nec Edwards") (see Figs. 11A, 10A and 4C of Smart and Clifford, 1969), the pupal gill, cocoon, and larval postgenal cleft are almost the same as those of *S. (S.) bidentatum* (Takaoka, 1976). However *S. (S.) bidentatum* differs from *S. (S.) beludense* in the female by the predominant yellowish leg coloration and in the male by the shape of the ventral plate and the abdominal iridescent spots present only on the segments 2, 5-7. From the morphological similarities of the female genitalia, tarsal claws and scutum, this new species also seems to be closely related to *S. (S.) argentipes* Edwards from Peninsular Malaysia (Takaoka and Davies, 1995) and *S. (S.) canlaonense* Delfinado from Negros Island of the Philippines (Takaoka, 1983), both of which have been known only from female adults. However *S. (S.) beludense* differs from both species by the much darker leg coloration, and also from the former species by the copper-colored pubescence on the scutum and from the latter species by the much produced paraproct.

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