

Description of the female of *Simulium chayamaritae* (Diptera: Simuliidae) from Thailand

Takaoka, H.^{1*}, Srisuka, W.² and Saeung, A.³

¹Tropical Infectious Diseases Research and Education Centre (TIDREC), University of Malaya, 50603, Kuala Lumpur, Malaysia

²Entomology Section, Queen Sirikit Botanic Garden, P.O. Box 7, Maerim, Chiang Mai 50180, Thailand

³Department of Parasitology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand

*Corresponding author e-mail: takaoka@oita-u.ac.jp

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Abstract. *Simulium chayamaritae* Takaoka & Srisuka from Thailand belongs to the *Simulium darjeelingense* species-group of *Simulium* (*Simulium*) (Diptera: Simuliidae). The female of this species is described for the first time based on a female reared from a pupa collected from Chiang Mai, Thailand. It is characterized by the sensory vesicle elongate and the inner margins of the arms of the genital fork divergent, then convergent apically. It is similar to the female of *S. eshimai* Takaoka & Adler of the same species-group from Vietnam. Taxonomic notes are given to separate it from two other species of the *S. darjeelingense* species-group from India and Malaysia, and 28 of 31 other species of the subgenus *Gomphostilbia* recorded from Thailand.

Simulium chayamaritae Takaoka & Srisuka was described based on male, pupal and larval specimens from Doi Pha Hom Pok National Park, Chiang Mai, Thailand (Takaoka & Srisuka, 2010). It was first placed in the *Simulium ceylonicum* species-group of *Simulium* (*Gomphostilbia*) (Diptera: Simuliidae), and later transferred to the *S. darjeelingense* species-group, defined by Takaoka (2012). This small species-group is characterized in the male by the fore coxa darkened, hind basitarsus enlarged, tuft hairs on the base of the radial vein darkened, and ventral plate flat, and in the pupa by the gill with eight short slender filaments and terminal hooks triangular and not crenulated on the outer margin.

Recently, we collected a pupa of *S. chayamaritae* in Doi Inthanon National Park, Chiang Mai, northern Thailand, and obtained a female reared from the pupa. The female of this species is described for the first time.

It is compared morphologically with females of three of five other members of

the same species-group: *S. darjeelingense* Datta from India (Datta, 1973), *S. guniki* Takaoka from Sabah, Malaysia (Takaoka, 2001), and *S. eshimai* Takaoka & Adler from Vietnam (Takaoka *et al.*, 2017a). The females of two other members, *S. guizhouense* Chen, Zhang & Yang, from China (Chen *et al.*, 2003) and *S. xizangense* An, Zhang & Den from Tibet (An *et al.*, 1990), are unknown.

Further, considering the importance of species identification of adult females in investigating their biting habits and roles in transmission of pathogens, taxonomic notes are given to separate it from 28 of 31 other species of the subgenus *Gomphostilbia* recorded from Thailand.

Methods of collection of pupae, rearing of living pupae until adult emergence, morphological observation, terms of features, description, and illustration, followed Takaoka (2003). The identification of a pupa was based on the original description of *S. chayamaritae* by Takaoka

and Srisuka (2010). The diagnostic pupal characters of *S. chayamaritae* are the frons and anterior part of the thorax covered with cone-like tubercles having sharply pointed apices and presence of an additional pair of facial trichomes.

***Simulium (Gomphostilbia) chayamaritae* Takaoka & Srisuka, 2010**

Simulium (Gomphostilbia) chayamaritae Takaoka & Srisuka, 2010: 265–270 (Male, pupa and mature larva).

Female. Body length 2.0 mm. **Head.** Slightly narrower than thorax. Frons brownish black, slightly shiny, densely covered with yellow scale-like recumbent short hairs and few dark hairs along each lateral margin; frontal ratio 1.6:1.0:1.8; frons:head ratio 1.0:4.2. Fronto-ocular area well developed, narrow, directed dorsolaterally. Clypeus brownish black, densely covered with yellowish white recumbent hairs interspersed with few dark longer hairs on each side. Labrum 0.6 times as long as clypeus. Antenna composed of scape, pedicel and nine flagellomeres, dark brown except scape and basal half of pedicel yellow. Maxillary palp composed of five segments, light brown except third segment dark brown, proportional lengths of third, fourth, and fifth segments 1.0:1.0:2.0; third segment (Fig. 1A) somewhat enlarged; sensory vesicle (Fig. 1A) elongate, 0.54–0.59 times length of third segment and with medium-sized opening. Maxillary lacinia with 13 or 14 inner and 20 outer teeth. Mandible with 32 inner teeth and six or seven outer teeth at some distance from apex. Cibarium (Fig. 1B) with dorsal margin having short plate produced forward and downward, and with weakly-sclerotized mediolongitudinal stripe bearing well-sclerotized V-shaped ridge apically. **Thorax.** Scutum brownish black, slightly shiny when illuminated at certain angles, densely covered with yellow scale-like recumbent hairs mixed with whitish similar hairs on peripheral portions. Scutellum dark brown, covered with yellow short hairs and light-brown long upright hairs. Postnotum brownish black, slightly shiny when illuminated at certain angles, and bare.

Pleural membrane bare. Katepisternum longer than deep, dark brown, white pruinose and shiny when illuminated at certain angles, moderately covered with pale and dark short hairs. **Legs.** Foreleg: coxa yellow, though outer surface dark yellow; trochanter dark yellow; femur light brown with apical cap medium brown (though extreme tip yellow); tibia light brown except basal one-third medium brown (though extreme tip yellow) and apical one-third medium brown; tarsus brownish black, with moderate dorsal hair crest; basitarsus slender, slightly dilated, 7.5 times as long as its greatest width. Midleg: coxa medium brown except posterolateral surface dark brown; trochanter light brown except base yellow; femur light brown except basal one-fourth yellow and apical cap medium brown (though extreme tip yellow); tibia yellow basally, gradually darkened toward apex, with dark subbasal spot and apical cap dark brown (though extreme tip yellow); tarsus dark brown except basal one-third of basitarsus somewhat dark yellow to light brown. Hind leg: coxa medium brown; trochanter yellow; femur light brown except base yellow and apical cap dark brown (though extreme tip yellow); tibia (Fig. 1C) light brown except base yellow, subbasal triangular spot medium brown and apical cap dark brown; tarsus (Fig. 1D) medium brown except basal two-thirds of basitarsus (though base light brown) and basal half of second tarsomere grayish yellow; basitarsus (Fig. 1D) nearly parallel-sided, though slightly narrowed toward apex, 6.8 times as long as wide, and 0.65 and 0.52 times as wide as greatest widths of tibia and femur, respectively; calcipala (Fig. 1D) well developed, nearly as long as wide, and 0.6 times as wide as greatest width of basitarsus; pedisulcus (Fig. 1D) well developed; claw (Fig. 1E) with large basal tooth 0.55 times length of claw. **Wing.** Length 2.0 mm. Costa with dark-brown spinules and yellow to light-brown hairs. Subcosta haired except near apex bare. Hair tuft on base of radius medium brown. Basal portion of radius fully haired. Basal cell absent. **Halter.** White except basal stem darkened. **Abdomen.** Basal scale grayish

yellow, with fringe of yellowish hairs. Dorsal surface of abdomen medium brown and moderately covered with yellow short hairs and dark short to long hairs; tergites of segments 2 and 6–9 shiny when illuminated at certain angles. Ventral surface of segment 2 creamy, those of other segments ochreous except sternite 8 dark brown; sternal plate on segment 7 undeveloped. **Terminalia.** Sternite 8 (Fig. 1F) bare medially, with 13–16 medium-long to long hairs together with few slender short hairs on each side. Ovipositor valves (Fig. 1F) triangular (though posteromedial corners rounded), thin, membranous, moderately covered with microsetae interspersed with two short hairs; inner margins nearly straight or sinuous, moderately sclerotized, and somewhat separated from each other. Genital fork (Fig. 1G) of usual inverted-Y form, with slender stem; arms of moderate width, with lateral plate angulated anterodorsally; inner margins of arms divergent, then slightly convergent apically. Paraproct in ventral view (Fig. 1H) with anteromedial margin slightly raised ventrally, with partially pigmented anteromedial surface having four or five sensilla; paraproct in lateral view (Fig. 1I) moderately produced ventrally, 0.7 times as long as wide, with 13 medium-long to long hairs on ventral and lateral surfaces. Cercus in lateral view (Fig. 1I) short, rounded posteriorly, 0.5 times as long as wide. Spermatheca (Fig. 1J) ellipsoidal, 1.6 times as long as greatest width, well sclerotized except duct and small area near juncture with duct unsclerotized, and with many fissures on surface; internal setae absent; both accessory ducts slender, subequal in diameter to major one.

Specimen examined. One female (with its associated pupal exuviae and cocoon) in 80% ethanol, reared from a pupa collected from a stream (width 1.5 m, depth 13 cm, bottom sandy, temperature 14.5°C, pH 5.4, partially shaded, elevation 2,210 m, 18°33'29.4"N, 98°28'51.7"E) fast flowing in a natural forest, Kiew Mae Pan, Chomthong District, Doi Inthanon National Park, Chiang Mai Province, Thailand, 29-IX-2014, by W. Srisuka.

Remarks. The female of *S. chayamaritae* is similar to that of *S. eshimai* described from Vietnam (Takaoka *et al.*, 2017a) in many characters including the sensory vesicle elongate, the frons of similar shape and size, and hind tibia mostly darkened. However, there are a few features differing between the two species: relative length of the labrum against the clypeus (0.6 in *S. chayamaritae* versus 0.8 in *S. eshimai*), relative length of the hind basitarsus against its greatest width (6.8 in *S. chayamaritae* versus 7.7 in *S. eshimai*), and inner margins of the arms of the genital fork (slightly convergent apically in *S. chayamaritae* versus divergent apically in *S. eshimai*).

Simulium guniki from Sabah, Malaysia (Takaoka, 2001) differs in the female from this species by the frons narrow (head:frons ratio 1.0:6.1), sensory vesicle medium-long, 0.33 times the length of the third maxillary palpal segment, and claw with a shorter tooth 0.4 times as long as the claw.

The female of *S. darjeelingense* from India (Datta, 1973) differs from this species by the sensory vesicle medium-long, 0.4 times as long as the third maxillary palpal segment, fore coxa brown, genital fork with slender arms, of which inner margins divergent apically, and spermatheca 1.4 times as long as its greatest width.

Notably, the female of *S. chayamaritae* has close similarities to those of most species of the *S. decuplum* subgroup and *S. parahiyangum* subgroup of the *S. batoense* species-group, defined by Takaoka (2012), in many characters such as the sensory vesicle elongate, scutum with yellow fine hairs, hind tibia mostly darkened, and terminalia including the genital fork of the same shape. In Thailand, five of 10 species of the *S. decuplum* subgroup are known to occur: *S. chiangraiense*, *S. huaikaeoense*, *S. khaokhoense*, *S. maeklangense* and *S. pamiangense*, and one of 12 species of the *S. parahiyangum* subgroup: *S. ngaoense* (Takaoka *et al.*, 2018a, b). However, *S. chayamaritae* is barely distinguished in the female from all these six species by the fore basitarsus more slender, 7.5 times as long as its greatest

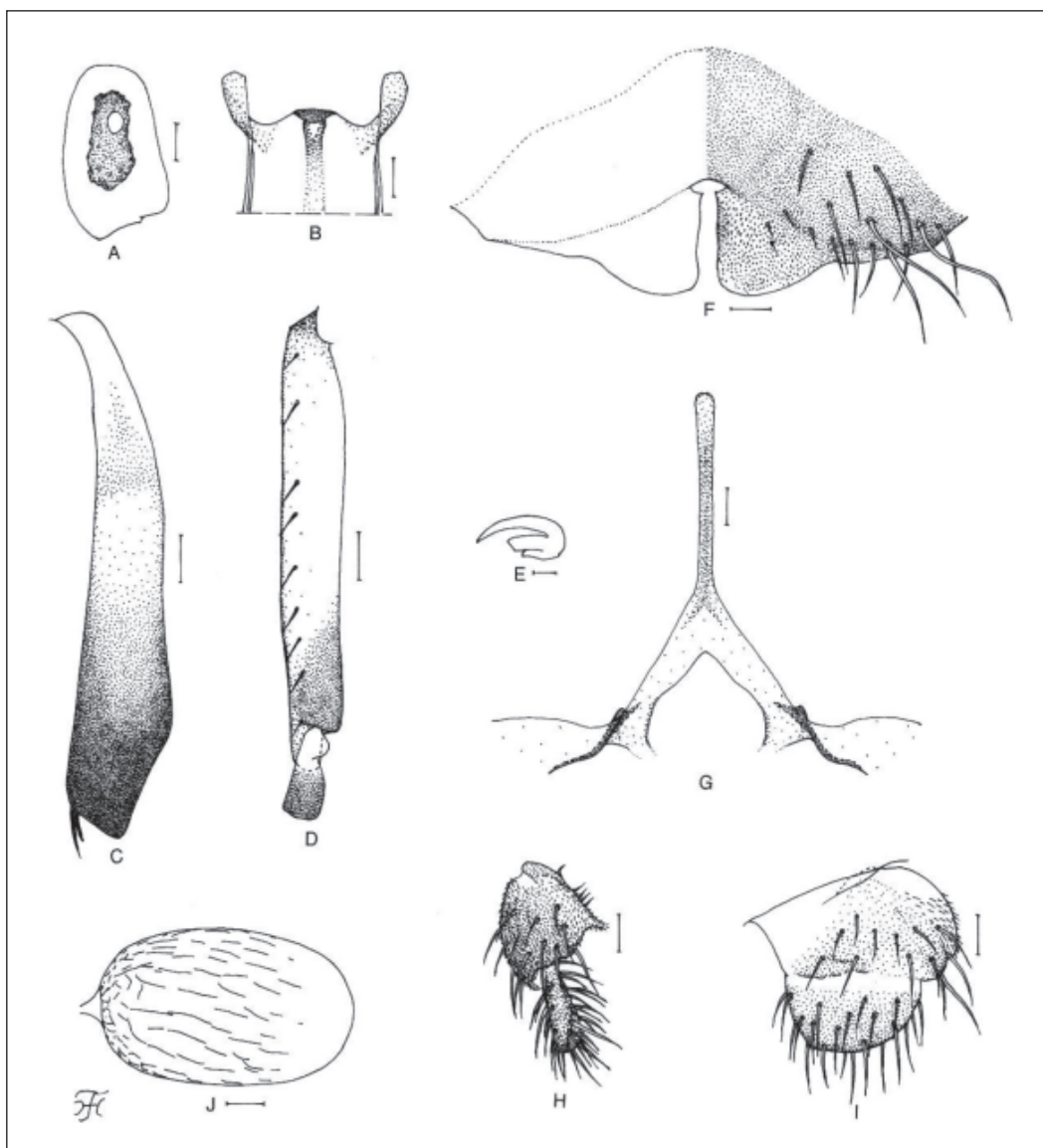


Figure 1. Female of *Simulium chayamaritae*. (A) Third segment of maxillary palp with sensory vesicle (right side; front view). (B) Cibarium (front view). (C) Hind tibia (left side; outer view). (D) Hind basitarsus and second tarsomere (left side; outer view). (E) Claw. (F) Sternite 8 and ovipositor valves (ventral view). (G) Genital fork (ventral view). (H) and (I) Paraprocts and cerci (H, ventral view; I, lateral view). (J) Spermatheca. Scale bars. 0.05 mm for C and D; 0.02 mm for A, B and E–J; 0.01 mm for E.

width (5.3–6.8 in six Thai species) and also from *S. ngaoense* by abdominal segment 2 medium brown (yellow in *S. ngaoense*).

In Thailand, 25 other species of the subgenus *Gomphostilbia* are recorded: three species of the *S. asaokoae* species-group, three species of the *S. batoense* species-group, four species of the *S. ceylonicum*

species-group, four species of the *S. epistum* species-group, five species of the *S. gombakense* species-group, five species of the *S. varicornis* species-group, and one unplaced to group (Takaoka *et al.*, 2017b; Adler & Crosskey, 2018). The females of three species, *S. dentistylum* Takaoka & Davies, *S. doisaketense* Jitklang *et al.* and

S. otsukai Takaoka & Choochote, are unknown (Jitklang *et al.*, 2008; Takaoka *et al.*, 2009; Takaoka & Davies, 1995).

The female of *S. chayamaritae* is distinguished from those of the remaining 22 species by a combination of the following characters: the antenna with nine flagellomeres, sensory vesicle elongate, hair tuft of the base of the radius darkened, and hind tibia mostly darkened.

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