



New records of 13 species of black flies (Diptera: Simuliidae) from Myanmar

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ARTICLE INFO

Keywords:

Aquatic insects

Fauna

Taxonomy

Intraspecific variation

ABSTRACT

A faunistic survey of black flies in Shan State, central Myanmar, was carried out in 2013. A total of 16 species were collected, of which 13 species are newly recorded from Myanmar. Among 13 newly recorded species, *S. (S.) chiangmaiense* Takaoka & Suzuki varied in the number of pupal gill filaments from eight to 10. This survey increases the number of species of black flies from Myanmar from 8 to 23. They are classified in five subgenera of the genus *Simulium*: one in *Asiosimulium*, seven in *Gomphostilbia*, one in *Montisimulium*, two in *Nevermannia* and 12 in *Simulium*.

1. Introduction

Black flies (Diptera: Simuliidae) are of medical and veterinary importance due to their habit of biting humans and domestic animals. In Asia, zoonotic onchocerciasis reported from Japan is a good example of emerging infectious diseases associated with black fly vectors (Takaoka et al., 2012). Several species of black flies are natural and experimental vectors of six *Onchocerca* species including *O. dewittei japonica* Uni, Bain & Takaoka of wild boar, a causative agent of zoonotic onchocerciasis in Japan (Fukuda et al., 2008, 2010). In addition, three human-biting black fly species, *Simulium (Gomphostilbia) asakoe* Takaoka & Davies, *S. (Simulium) nigrogilvum* Summers and *S. (S.) nodosum* Puri, are vectors of three different filarial species of animal origins in Thailand (Fukuda et al., 2003; Takaoka et al., 2003; Ishii et al., 2008). Information on the black fly fauna is prerequisite to accurately identifying vector species for studies of the transmission of parasites or pathogens.

The black fly fauna in Southeast Asia is relatively well studied except in a few countries such as Cambodia, Laos and Myanmar (Adler and Crosskey, 2017). In Myanmar, only eight species are recorded, all of which are classified in four subgenera of the genus *Simulium* Latreille: one in *Gomphostilbia* Enderlein, one in *Montisimulium* Rubtsov, two in *Nevermannia* Enderlein and four in *Simulium* Latreille (Lewis, 1974; Takaoka, 1989). Among the eight species, *S. (S.) indicum* Becher bites humans along the foothills of the Himalayan Mountains (Lewis, 1974).

We surveyed larvae and pupae of black flies in Shan State, central Myanmar, in 2013. A total of 16 species were collected, including two new species of the subgenus *Gomphostilbia*, which were recently described in a separate article (Takaoka et al., 2017b), and one known species of the subgenus *Nevermannia*. The other 13 species are newly recorded from Myanmar. *Simulium (S.) chiangmaiense* Takaoka & Suzuki, originally described from Thailand (Takaoka and Suzuki, 1984), was found to vary in the number of pupal gill filaments from eight to 10.

This survey increases the number of species of black flies recorded from Myanmar from 8 to 23. All these species are classified in five subgenera of the genus *Simulium*: one in *Asiosimulium*, seven in *Gomphostilbia*, one in *Montisimulium*, two in *Nevermannia* and 12 in *Simulium*.

2. Material and methods

All the pupae and larvae in this study were collected from 10 sites in Shan State, central Myanmar, in 2013 by W. Srisuka and K. Taai. Adults of black flies were reared from pupae except one male of the subgenus *Asiosimulium* captured by a sweep net. The collection data for 10 sites are in Table 1.

The methods of collection, description and illustration, and terms for morphological features follow those of Takaoka (2003) and partially

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Table 1
Information of 10 stream sites, where pupae and larvae of black flies were collected.

Site No.	Locality name	Latitude/Longitude	Stream width (m)	Stream depth (cm)	Stream bottom	Water temperature (C°)	Elevation (m)	Riparian Vegetation	Sampling date
1	Mong-phayak: Ta-Jaew stream	18°30'02.4"N 98°40'39.5"E	7	35	Sand	23.5	614	Brush	25 x. 2013
2	Keng-Lung: Sala-Long village	21°04'37.9"N 99°47'18.2"E	20	40	Sand/Rock	23.8	926	Open	25 x. 2013
3	Mong Lar: Hua-Muang village	21°27'08.7"N 99°40'06.6"E	0.4	10	Sand	22.3	733	Brush	25 x. 2013
4	Mong Lar: Ma River	21°36'09.9"N 99°53'16.7"E	10	40	Sand/Rock	22.8	704	Brush	25 x. 2013
5	Mong Lar: Ban-nong village	21°39'45.9"N 100°00'54.7"E	1	20	Sand	22.6	668	Brush	26 x. 2013
6	Mong Lar: Border between Myanmar-China	21°40'24.6"N 100°01'51.3"E	0.1	3	Concrete	23	633	Open	26 x. 2013
7	Mong Lar: Pa-Ka village	21°40'24.6"N 100°01'51.3"E	3	20	Sand	22.8	659	Open	26 x. 2013
8	Mong Lar: Na-Long village	21°38'58.2"N 99°56'58.3"E	7	35	Sand	22.5	704	Brush	26 x. 2013
9	Mong Lar: Pa-Pai village	21°33'07.6"N 99°49'50.1"E	0.5	10	Sand	19	767	Forest	27 x. 2013
10	Keng - Tung: San village	21°05'18.5"N 99°47'39.7"E	50	20	Sand/Rock	22.7	958	Open	27 x. 2013

those of Adler et al. (2004).

3. Results and discussion

3.1. Subgenus *Asiosimulium* Takaoka & Choochote

This is the second smallest subgenus in the Oriental Region consisting of four species (Srisuka et al., 2015). It is characterized in the female and male by having the pleural membrane and katapisternum bare and the basal portion of the radius haired, in the female by the cibarium medially with numerous pointed processes arranged in concentric circles, and in the male by the coxite longer than the style, and paramere without hooks.

In this survey, one male was collected, representing the first record of this subgenus from Myanmar.

Simulium (Asiosimulium) sp.

Specimen examined. Male, collected by a sweep net, at site 3 (Table 1).

Distribution. Myanmar (New record).

Remarks. This unnamed species is assigned to the subgenus *Asiosimulium*, defined by Takaoka and Choochote (2005), by having the pleural membrane and katapisternum bare, the basal portion of the radius haired, coxite longer than the style, and paramere without hooks.

It is characterized by abdominal segments 2–8, each having a pair of shiny dorsolateral patches, a character not found in the males of the three known species, *S. (A.) furvum* Takaoka & Srisuka, *S. (A.) oblongum* Takaoka & Choochote, and *S. (A.) wanchaii* Takaoka & Choochote, all from Thailand (Takaoka and Choochote, 2005; Takaoka et al., 2013; Srisuka et al., 2015).

The male of this species will be described and illustrated in a separate paper (Takaoka et al., 2017d).

3.2. Subgenus *Gomphostilbia* Enderlein

This is one of the two dominant subgenera in the Oriental Region (Takaoka, 2017a). It is characterized in the female and male by the pleural membrane bare (except species of certain groups) and katapisternum haired and basal portion of the radial vein haired, in the male by the coxite longer than the style, in the pupa by having grapnel-shaped hooklets on abdominal segment 9 (except a few species), in the larva by the hypostoma with lateral margins smooth, and mandible with the main tooth at an acute angle apically against the ventral margin of the mandible (Takaoka, 2012).

One species, *S. (G.) namense* Takaoka, is known from Myanmar (Takaoka, 1989). In this study, two new species, *S. (G.) myanmarensis* Takaoka, Srisuka & Saeung, and *S. (G.) monglaense* Takaoka, Srisuka & Saeung, were described in a separate article (Takaoka et al., 2017b), and four species are newly recorded. They are placed in two species-groups, the *S. asakoae* and *S. batoense* species-groups.

3.2.1. *Simulium asakoae* species-group

This species-group is characterized by the yellow hair tuft of the base of the radial veins and yellow fore coxae of the female and male, male hind basitarsus enlarged, and ventral plate emarginated laterally when viewed ventrally (Takaoka 2012). Three species, *S. (G.) myanmarensis* and *S. (G.) monglaense*, recently described from Myanmar (Takaoka et al., 2017b), and *S. (G.) namense* are placed in this species-group. The following two species are also included in this species-group.

Simulium (Gomphostilbia) asakoae Takaoka and Davies, 1995

Simulium (Gomphostilbia) asakoae Takaoka and Davies, 1995: 55–60 (Female, male, pupa and larva); Takaoka et al., 2017a: 15–23 (Female, male, pupa and larva).

Specimens examined. Eight females, five males, all reared from

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