

## A LIST OF AND KEYS TO BLACK FLIES (DIPTERA: SIMULIIDAE) IN THAILAND

HIROYUKI TAKAOKA<sup>1</sup> and WEJ CHOOCHOTE<sup>2</sup>

Accepted 13, May, 2004

**Abstract:** Forty-five known species of *Simulium* Latreille s. l. in Thailand are listed, and keys to subgenera and species within each subgenus are provided for adults, pupae and mature larvae.

**Key words:** *Simulium*, black fly, Thailand, key, identification

Takaoka and Suzuki [1] provided the first keys to identify all the 19 species of *Simulium* Latreille s. l. so far recorded from Thailand. During the last two decades, the number of species newly described or recorded from this country has increased dramatically to 45 [2]-[9]. New keys to identify all the known species are essential for further taxonomic and ecological studies on Simuliidae in Thailand.

We present a list of the species of *Simulium* s. l. and keys to subgenera and species for adult females, males, pupae and mature larvae. The definitions of the subgenera and species-groups refer to those of Takaoka [10], and terms of morphological features used in the keys follow Takaoka [10].

### LIST OF THE SPECIES OF SIMULIIDAE IN THAILAND

#### Genus *Simulium* Latreille s. l.

##### Subgenus *Daviesellum* Takaoka and Adler

- 1 ) *courtneyi* Takaoka and Adler, 1997
- 2 ) *pahangense* Takaoka and Davies, 1995

##### Subgenus *Gomphostilbia* Enderlein

- (A) *batoense* species-group
- 3 ) *angulistylum* Takaoka and Davies, 1995
  - 4 ) *decuplum* Takaoka and Davies, 1995
  - 5 ) *dentistylum* Takaoka and Davies, 1995
  - 6 ) *gombakense* Takaoka and Davies, 1995
  - 7 ) *parahiyangum* Takaoka and Sigit, 1992
  - 8 ) *siamense* Takaoka and Suzuki, 1984
- (B) *ceylonicum* species-group
- 9 ) *asakoeae* Takaoka and Davies, 1995
  - 10 ) *inthanonense* Takaoka and Suzuki, 1984
  - 11 ) *sheilae* Takaoka and Davies, 1995
- (C) *varicorne* species-group

- 12 ) *burtoni* Takaoka and Davies, 1995
- 13 ) *chumpornense* Takaoka and Kuvangkadilok, 2000

##### Subgenus *Montisimulium* Rubtsov

- 14 ) sp. G

##### Subgenus *Nevermannia* Enderlein

- (A) *feuerborni* species-group
- 15 ) *feuerborni* Edwards, 1934
- (B) *ruficorne* species-group
- 16 ) *aureohirtum* Brunetti, 1911
- (C) *vernum* species-group
- 17 ) *caudisclerum* Takaoka and Davies, 1995

##### Subgenus *Simulium* Latreille s. str.

- (A) *griseifrons* species-group
- 18 ) *choochotei* Takaoka, 2002
  - 19 ) *digrammicum* Edwards, 1928
  - 20 ) *grossifilum* Takaoka and Davies, 1995
  - 21 ) *maenoi* Takaoka and Choochote, 2002
  - 22 ) *nigrogilvum* Summers, 1911
  - 23 ) *rudnicki* Takaoka and Davies, 1995
  - 24 ) *suchariti* Takaoka and Choochote, 2004
  - 25 ) *yongi* Takaoka and Davies, 1997
- (B) *malyschevi* species-group
- 26 ) *siripoomense* Takaoka and Saito, 1996
- (C) *multistriatum* species-group
- 27 ) *chainarongi* Kuvangkadilok and Takaoka, 1999
  - 28 ) *chaliowae* Takaoka and Boonkemtong, 1999
  - 29 ) *fenestratum* Edwards, 1934
  - 30 ) *malayense* Takaoka and Davies, 1995
  - 31 ) *triglobus* Takaoka and Kuvangkadilok, 1999
- (D) *nobile* species-group
- 32 ) *nobile* De Meijere, 1907
  - 33 ) *nodosum* Puri, 1933

1 . Department of Infectious Disease Control, Faculty of Medicine, Oita University, Hasama, Oita, 879-5593, Japan

2 . Department of Parasitology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand

(E) *striatum* species-group34 ) *chiangmaiense* Takaoka and Suzuki, 198435 ) *nakhonense* Takaoka and Suzuki, 198436 ) *quinquestriatum* (Shiraki, 1935)37 ) *thailandicum* Takaoka and Suzuki, 1984(F) *tuberosum* species-group38 ) *brevipar* Takaoka and Davies, 199539 ) *rufibasis* Brunetti, 191140 ) *setsukoe* Takaoka and Choochote, 200441 ) *tani* Takaoka and Davies, 199542 ) *weji* Takaoka, 2001(G) *variegatum* species-group43 ) *barnesi* Takaoka and Suzuki, 198444 ) *chamlongi* Takaoka and Suzuki, 1984(H) *Simulium* s. str. unplaced to group45 ) *baimaii* Kuvangkadilok and Takaoka, 1999

## Notes:

\* 1 . *Simulium* (*Montisimulium*) sp. G is known only from larval specimens collected at Ang Ka, Doi Inthanon National Park [11].

\* 2 . *Simulium* (*Gomphostilbia*) *burtoni* is newly recorded based on three adult females collected on a human attractant at Tambol Ban Laung, Doi Inthanon National Park, in January and February 2004, by W. Choochote, and a female specimen emerged from the pupa collected at Hauy Mor, Chiang Mai Province, in June 2001, by W. Choochote and H. Takaoka. Identification of *S. burtoni* is tentative because adult female specimens of *S. burtoni* collected from northern Thailand seem to differ from the original description [12] in that they have a shiny fifth tergite and dark subbasal spot on the hind tibiae. However, our reexamination of the type female specimen shows that the fifth tergite of *S. burtoni* is shiny (it was wrongly noted to be dull in the original description). It is also shown that there appears to be no dark subbasal spot on the hind tibiae of the type specimen, as described in the original description. However, it is difficult to conclude that its hind tibiae lack the dark subbasal spot since the type specimen was dried and pinned soon after it had emerged from the pupa, and then preserved in 70% ethanol. It is possible that the dark subbasal spot was as yet undeveloped in the freshly emerged adult or that it faded in alcohol. Additional adult specimens of *S. burtoni* from the type locality of Malaysia are needed to solve this problem.

\* 3 . *Simulium* (*Simulium*) sp. D, reported from six females collected while biting on human attractant in Doi Inthanon National Park by Takaoka and Suzuki [1], was described as a new species, *S. (S.) setsukoe*, by Takaoka and Choochote [9].

\* 4 . *Simulium* (*Simulium*) sp. E, which shows a much paler coloration of the female legs than *S. (S.) rufibasis* [1], is tentatively included in *S. (S.) rufibasis*, since apart from

the female leg coloration, there is no morphological difference in the female, male and pupal stages between *S. (S.)* sp. E and *S. (S.) rufibasis*.

\* 5 . *Simulium baimaii*, left unassigned to any subgenus by Takaoka and Kuvangkadilok [4], is treated under the subgenus *Simulium* s. str. for convenience' sake.

KEYS TO THE SUBGENERA  
OF *SIMULIUM* S. L. IN THAILAND

## ADULT FEMALES\*

- 1 . Katepisternum haired.....*Gomphostilbia*  
Katepisternum bare.....2
  - 2 . Claw with a large basal tooth.....*Nevermannia*  
Claw simple or with a small subbasal tooth.....3
  - 3 . Paraproct with a cluster of dark spines.....*Daviesellum*  
Paraproct without any dark spine.....*Simulium* s. str.
- (\*The female of *Montisimulium* is not included because that of *S. (M.)* sp. G is unknown)

## ADULT MALES\*

- 1 . Katepisternum haired.....*Gomphostilbia*  
Katepisternum bare.....2
  - 2 . Coxite longer than style.....*Nevermannia*  
Coxite shorter than style.....3
  - 3 . Coxite much longer than wide.....*Daviesellum*  
Coxite as long as, or slightly shorter than, wide.....  
.....*Simulium* s. str.
- (\*The male of *Montisimulium* is not included because that of *S. (M.)* sp. G is unknown)

## PUPAE\*

- 1 . Grapnel-like hooklets present on the last abdominal segment.....*Gomphostilbia*  
Grapnel-like hooklets absent on the last abdominal segment.....2
- 2 . Cocoon with an anterodorsal projection.....  
.....*Nevermannia*  
Cocoon without any anterodorsal projection.....3
- 3 . Dorsal surface of abdominal segment 2 with stout hooks similar in size to those on abdominal segments 3 and 4.....*Daviesellum*  
Dorsal surface of abdominal segment 2 with spines (in place of such distinct hooks) much smaller than hooks on abdominal segments 3 and 4.....  
.....*Simulium* s. str.

(\*The pupa of *Montisimulium* is not included because that of *S. (M.)* sp. G is unknown)

## MATURE LARVAE

- 1 . Hypostomium very wide, with 13 apical teeth.....  
.....*Daviesellum*  
Hypostomium of moderate width, with 9 apical teeth.....2
- 2 . Last abdominal segment lacks ventral papillae or with small ones.....*Simulium* s. str.  
Last abdominal segment with large ventral papillae.....3
- 3 . Postgenal cleft vestigial.....*Montisimulium*  
Postgenal cleft distinctly formed.....4
- 4 . Lateral margin of hypostomium serrated.....  
.....*Nevermannia*  
Lateral margin of hypostomium smooth.....  
.....*Gomphostilbia*

KEYS TO THE SPECIES  
OF THE SUBGENUS *DAVIESELLUM*

## ADULT FEMALES

- 1 . Genital fork with a distinct projection directed anteriorly.....*courtneyi*  
Genital fork without such a projection.....*pahangense*

## ADULT MALES

- 1 . Ventral plate much longer than wide when viewed ventrally.....*courtneyi*  
Ventral plate much shorter than wide when viewed ventrally.....*pahangense*

## PUPAE

- 1 . Frons densely covered with tubercles.....*courtneyi*  
Frons mostly bare (though narrow portion near the lower margin tuberculate).....*pahangense*

## MATURE LARVAE

- 1 . Postgenal cleft long, but its apex not reaching the posterior margin of hypostomium.....*courtneyi*  
Postgenal cleft long, its apex reaching the posterior margin of hypostomium.....*pahangense*

KEYS TO THE SPECIES  
OF THE SUBGENUS *GOMPHOSTILBIA*

## ADULT FEMALES\*

- 1 . Antenna composed of 10 segments.....2  
Antenna composed of 11 segments.....3
- 2 . Tergite 5 shiny.....*burtoni*  
Tergite 5 not shiny.....*chumpornense*
- 3 . Mid and hind femora almost yellow except apical cap

- dark.....*dentistylum*
- Mid and hind femora almost dark except base pale.....4
- 4 . Hind tibia mostly dark.....*siamense*  
Hind tibia whitish yellow or dark yellow on basal 2/5 or more.....5
- 5 . Hind tibia with a dark subbasal spot.....6  
Hind tibia without such a dark subbasal spot.....8
- 6 . Sensory vesicle of medium size, 0.3 times as long as 3rd maxillary palpal segment.....*angulistylum*  
Sensory vesicle enlarged, 0.5 or 0.6 times as long as 3rd maxillary palpal segment.....7
- 7 . Arms of genital fork with a short projection directed anteriorly.....*decuplum*  
Arms of genital fork without such a projection.....  
.....*parahiyangum*
- 8 . Hind tibia whitish yellow on basal 2/3; sensory vesicle of moderate size, 0.3 times as long as 3rd maxillary palpal segment.....*asakoe*  
Hind tibia whitish yellow on basal 2/5 or 1/2; sensory vesicle enlarged, 0.57 or 0.68 times as long as 3rd maxillary palpal segment.....9
- 9 . Frons-head ratio 1.0 : 4.8; sensory vesicle enlarged, 0.57 times as long as 3rd maxillary palpal segment.....  
.....*inthanonense*  
Frons-head ratio 1.0 : 5.7; sensory vesicle enlarged, 0.68 times as long as 3rd maxillary palpal segment.....  
.....*sheilae*

(\*The female of *S. gombakense*, which is unknown, is not included)

## ADULT MALES

- 1 . Antenna composed of 10 segments.....2  
Antenna composed of 11 segments.....3
- 2 . Ventral plate produced ventrally.....*burtoni*  
Ventral plate nearly flat.....*chumpornense*
- 3 . Hind basitarsus enlarged.....4  
Hind basitarsus slender, much thinner than hind tibia.....6
- 4 . Eye with 16 horizontal rows of large facets.....  
.....*inthanonense*  
Eye with 13 horizontal rows of large facets.....5
- 5 . Hind tibia mostly medium brown to brownish black with basal 1/3 or a little less somewhat pale.....*sheilae*  
Hind tibia whitish on a little less than basal 1/2 and brownish black on the rest.....*asakoe*
- 6 . Mid and hind femora yellow except apical cap dark.....  
.....*dentistylum*  
Mid and hind femora almost dark except base pale.....7
- 7 . Hind tibia almost dark except base pale.....8  
Hind tibia whitish on basal 1/2 or more.....10
- 8 . Abdominal segments 2, 5, 6 and 7 each with a dorso-

- lateral pair of shiny whitish-pruinose patches.....  
.....*siamense*
- Abdominal segments 2, 6 and 7 each with a dorso-lateral pair of shiny whitish-pruinose patches.....9
- 9 . Upper eye with 12 or 13 vertical columns and 15 horizontal rows of large facets.....*decuplum*
- Upper eye with 17 vertical columns and 15 horizontal rows of large facets.....*parahiyangum*
- 10 . Hind tibia whitish on basal 2/3, with a dark subbasal spot.....*angulistylum*
- Hind tibia whitish yellow on basal 1/2, without such a dark subbasal spot.....*gombakense*

## PUPAE

- 1 . Gill of much inflated structure with 2 triplet groups of finger-like projections and 8 slender filaments.....  
.....*gombakense*
- Gill with 8 or 10 filaments.....2
- 2 . Gill with 10 filaments.....*decuplum*
- Gill with 8 filaments.....3
- 3 . Gill filaments all shorter than pupal body (shorter than 1.6 mm), short-stalked.....4
- Gill filaments subequal to, or longer than, pupal body (longer than 1.9 mm), moderately-stalked.....7
- 4 . Antennal sheath smooth.....5
- Antennal sheath with tubercles.....6
- 5 . Gill filaments arranged in 2 groups, i.e. 1 dorsal (4 individual and 2 paired filaments) and 1 ventral (2 paired filaments).....*chumpornense*
- Gill filaments arranged in 3 groups (3+3+2 filaments from dorsal to ventral).....*angulistylum*
- 6 . Antennal sheath with marked ridges each corresponding to flagellar segments 1-9, each ridge covered with several tubercles; gill filaments arranged in 3 groups (3+3+2 filaments from dorsal to ventral).....  
.....*parahiyangum*
- Antennal sheath with less marked ridges corresponding to flagellar segments 1-9, each ridge covered with a few tubercles; gill filaments arranged in 4 groups (2+1+3+2 filaments from dorsal to ventral).....  
.....*dentistylum*
- 7 . Dorsal and middle triplet groups and ventral pair group arising basally at the same level.....*siamense*
- Dorsal and middle triplet groups sharing a short stalk, which arises, with a stalk of ventral pair group, from short common basal stalk.....8
- 8 . Dorsal and middle triplet groups consisting of 1 individual filament and 2 paired filaments with a very long stalk.....*burtoni*
- Dorsal and middle triplet groups consisting of 1 individual filament and 2 paired filaments with a short or medium-long stalk.....9
- 9 . Cocoon with a distinct anterodorsal projection.....  
.....*inthanonense*
- Cocoon with an anterodorsal bulge.....10
- 10 . Terminal hooks weakly undulate on outer margin.....  
.....*sheilae*
- Terminal hooks weakly serrate on outer margin.....  
.....*asakoe*

## MATURE LARVAE

- 1 . Thoracic segment 3 and abdominal segments 1-5 each with 1 or 2 pairs of dorsal and/or dorsolateral protuberances.....2
- Thoracic segment 3 and abdominal segments 1-5 without any dorsal or dorsolateral protuberance.....3
- 2 . Postgenal cleft very long, its apex reaching the posterior margin of hypostomium; thorax and abdomen densely covered with dark spines of various sizes.....  
.....*parahiyangum*
- Postgenal cleft long, but its apex not reaching the posterior margin of hypostomium; thorax and abdomen sparsely or moderately covered with minute setae.....  
.....*chumpornense*
- 3 . Postgenal cleft very long, its apex nearly or completely reaching the posterior margin of hypostomium.....4
- Postgenal cleft otherwise.....5
- 4 . Abdomen markedly constricted between segments 4 and 5.....*dentistylum*
- Abdomen not constricted between segments 4 and 5.....  
.....*sheilae*
- 5 . Postgenal cleft short, much shorter than postgenal bridge.....*inthanonense*
- Postgenal cleft longer than postgenal bridge.....6
- 6 . Abdomen almost bare except the last segment; pharate pupal gill of inflated structure.....*gombakense*
- Abdomen moderately or densely covered with simple or branched dark spinous setae or spinules dorsally on segments 5-8; pharate pupal gill filamentous.....7
- 7 . Abdomen moderately covered with simple minute dark setae dorsally on segments 5-8.....*asakoe*
- Abdomen moderately or densely covered with branched dark spinous setae or spinules dorsally on segments 5-8.....8
- 8 . Thoracic cuticle moderately covered with minute dark spinules with 7-11 branches dorsally; pharate pupal gill with 10 filaments.....*decuplum*
- Thoracic cuticle almost bare dorsally; pharate pupal gill with 8 filaments.....9
- 9 . Minute dark spinous setae on abdominal segments 5-8 somewhat flat and stout basally, with short branches apically.....*siamense*

- Minute dark spinous setae on abdominal segments 5-8 slender and hair-like basally, with long branches.....10
- 10 . Minute dark spinous setae on abdominal segments 5-8 with 0-5 branches.....*burtoni*
- Minute dark spinous setae on abdominal segments 5-8 with 5-12 (mostly 8-10) branches.....*angulistylum*

KEYS TO THE SPECIES  
OF THE SUBGENUS *NEVERMANNIA*

ADULT FEMALES

- 1 . Antenna yellow with at least 1st flagellar segment darkened; hind tibia yellow on basal 1/2, dark on apical 1/2, and with subbasal dark ring.....*aureohirtum*
- Antenna almost all darkened or mostly so except a few basal segments pale; hind tibia nearly all brown.....2
- 2 . Scutum reddish brown in ground color, with 3 dark longitudinal vittae.....*feuerborni*
- Scutum brownish black in ground color, without any longitudinal vitta.....*caudisclerum*

ADULT MALES

- 1 . Antenna yellow or yellowish brown with 1st flagellar segment darkened; hind basitarsus slender, parallel-sided, much narrower than hind tibia.....*aureohirtum*
- Antenna almost all darkened; hind basitarsus inflated, its greatest width nearly as wide as that of hind tibia.....2
- 2 . Scutum whitish pruinose with 3 dark longitudinal vittae at certain angle of light; paramere with 3 or 4 parameral hooks.....*feuerborni*
- Scutum whitish pruinose without any longitudinal vitta; paramere with a single parameral hook.....*caudisclerum*

PUPAE

- 1 . Gill with 4 filaments.....*caudisclerum*
- Gill with 6 filaments.....2
- 2 . All filaments extending forwards close together, and 2 ventral filaments with rather long stalk.....*feuerborni*
- All filaments diverging widely from the base, and 2 ventral paired filaments with short stalk.....*aureohirtum*

MATURE LARVAE

- 1 . Abdomen with distinct reddish-brown markings dorsally.....*feuerborni*
- Abdomen without any distinct colored marking dorsally.....2
- 2 . Abdomen with accessory sclerite ventrolaterally on each side of the last segment; mandibular serrations

- composed of 1 well-developed and 1 small teeth and with supernumerary serrations.....*caudisclerum*
- Abdomen without any accessory sclerite; mandibular serrations composed of 2 well-developed teeth and without supernumerary serrations.....*aureohirtum*

KEYS TO THE SPECIES  
OF THE SUBGENUS *SIMULIUM* S. STR.

ADULT FEMALES\*

- 1 . Claw with a small subbasal tooth.....2
- Claw without any tooth.....6
- 2 . Basal section of radial vein fully haired; fore basitarsus with thick dorsal hair crest.....*nigrogilvum*
- Basal section of radial vein bare; fore basitarsus with moderate dorsal hair crest.....3
- 3 . Mid and hind femora mostly yellowish.....*chamlongi*
- Mid and hind femora mostly brownish.....4
- 4 . Scutum densely covered with yellow hairs.....*barnesi*
- Scutum moderately covered with brassy hairs.....5
- 5 . Antenna brownish black with scape, pedicel and base of 1st flagellar segment yellow; abdominal segment 7 with branched hairs medially on ventral surface.....*siripoomense*
- Antenna yellow or tawny with 2 apical segments blackish; abdominal segment 7 with simple hairs on ventral surface.....*nobile*
- 6 . Scutum with distinct longitudinal vittae.....7
- Scutum without any vitta.....17
- 7 . Fore tibia medium to dark brown, without white area on outer surface; hind tibia dark brown to brownish black with base yellow; inner margin of ovipositor valve with ventrally produced round flap.....*chiangmaiense*, *nakhonense* and *quinquestriatum*
- Fore tibia with white shiny area on outer surface; hind tibia whitish or yellowish on basal 2/3 or more and dark brown to brownish black on the rest; inner margin of ovipositor valve without such a flap.....8
- 8 . Basal section of radial vein fully haired.....9
- Basal section of radial vein bare.....11
- 9 . Hind basitarsus whitish on basal 3/5 and dark brown on the rest; ovipositor valve rounded, covered with short setae, and with elongate internal projection.....*grossifilum*
- Hind basitarsus whitish on basal 1/2 and dark brown on the rest; ovipositor valve triangular, covered with long stout hairs, and without such an internal projection.....10
- 10 . Cibarium with a round short medial projection along posterior margin.....*choochotei*

- Cibarium with a narrow long medial projection along posterior margin.....*digrammicum*
- 11 . Mid tibia white on basal 2/3 or 3/4 and dark brown or brownish black on the rest; cibarium with a tuberculate medial projection.....12  
Mid tibia white on basal 4/5 or 5/6 and light to dark brown on the rest; cibarium with a smooth medial projection.....13
- 12 . Cibarium with tubercles near the base of medial projection.....*suchariti*  
Cibarium bare near the base of medial projection.....*maenoi*
- 13 . All femora almost yellow; three spermathecae present.....*triglobus*  
At least mid and hind femora mostly dark; one spermatheca present.....14
- 14 . Hind basitarsus whitish yellow on a little more than basal 1/2 and dark brown on the rest.....*fenestratum*  
Hind basitarsus whitish yellow on basal 3/5 and dark brown on the rest.....15
- 15 . Sternite 8 with 10-16 long hairs on each side.....*malayense*  
Sternite 8 with 23-34 long hairs on each side.....16
- 16 . Mid femur blackish brown with basal 1/5 or 1/4 yellow.....*chaliowae*  
Mid femur almost entirely dark brown.....*chainarongi*
- 17 . Mid tarsal segments 2 and 3 entirely yellow.....*nodosum*  
Mid tarsal segments 2 and 3 light brown to brownish black.....18
- 18 . Mid femur entirely yellow.....*rudnicki*  
Mid femur almost dark brown.....19
- 19 . Abdominal segment 7 with a pair of clustered hairs ventrally.....20  
Abdominal segment 7 without such a pair of clustered hairs ventrally.....22
- 20 . A pair of clustered hairs on abdominal segment 7 short, subequal in length to those on the surrounding area.....*setsukoa*  
A pair of clustered hairs on abdominal segment 7 much longer than those on the surrounding area.....21
- 21 . Mid tibia almost light brown with base somewhat yellow.....*weji*  
Mid tibia white on basal 1/2 or more and medium brown on the rest.....*rufibasis*
- 22 . Hind basitarsus white on a little more than basal 1/2 and brownish black on the rest; scutum covered with yellowish hairs as well as dark ones.....*yongi*  
Hind basitarsus white on basal 3/5 or more and brownish black on the rest; scutum covered with dark brown hairs only.....23
- 23 . Sensory vesicle enlarged, 0.7 times as long as the 3rd

- maxillary palpal segment.....*tani*  
Sensory vesicle medium-sized, 0.3 times as long as the 3rd maxillary palpal segment.....*brevipar*  
(\*The females of *S. baimaii* and *S. thailandicum*, which are unknown, are not included)

## ADULT MALES\*

- 1 . Basal portion of radial vein fully haired.....2  
Basal portion of radial vein bare.....4
- 2 . Abdomen with a pair of shiny whitish-grey pruinose spots dorsally or dorsolaterally on segments 2, 5, 6 and 7; width of style nearly the same from base to apical tip when viewed ventrolaterally.....*choochotei*  
Abdomen with a pair of shiny white pruinose spots dorsally or dorsolaterally on segments 2, 6 and 7; width of style becoming much narrower apically.....3
- 3 . Fore basitarsus with thick dorsal hair crest; hind basitarsus nearly parallel-sided; ventral plate nearly quadrate, parallel-sided when viewed ventrally.....*nigrogilvum*  
Fore basitarsus with moderate dorsal hair crest; hind basitarsus spindle-shaped; ventral plate gradually narrowed posteriorly when viewed ventrally.....*digrammicum*
- 4 . Scutum broadly silvery pruinose with transverse, inverted-V-shaped, black band.....5  
Scutum otherwise.....6
- 5 . Ventral plate with a narrow body parallel-sided when viewed ventrally.....*nobile*  
Ventral plate with a wide body broadened medially when viewed ventrally.....*nodosum*
- 6 . Mid femur and tibia almost yellow.....*rudnicki*  
Mid femur and tibia otherwise.....7
- 7 . Mid tibia mostly dark (including posterior surface).....8  
Mid tibia whitish or yellowish (at least on posterior surface) on basal 1/2 or more and dark brown on the rest.....16
- 8 . Fore tibia medium brown, with white shiny area on outer surface.....9  
Fore tibia medium to dark brown, without white area on outer surface.....15
- 9 . Hind basitarsus white or whitish yellow on basal 1/2 or less and dark brown to brownish black on the rest.....10  
Hind basitarsus white or whitish yellow on more than basal 1/2 and light to dark brown on the rest.....13
- 10 . Hind basitarsus somewhat enlarged, about 5.0 times as long as wide and much narrower than hind tibia.....*chamlongi*  
Hind basitarsus much enlarged, 3.2-3.5 times as long as wide, and subequal to, or a little wider than, the greatest width of hind tibia.....11

- 11 . Upper eye with 20 vertical columns of large facets.....  
 .....*setsukoa*  
 Upper eye with 15-17 vertical columns of large facets  
 .....12
- 12 . Hind basitarsus whitish yellow on basal 1/3 and  
 brownish black on the rest.....*rufibasis*  
 Hind basitarsus whitish yellow on basal 1/2 or a little  
 less and brownish black on the rest.....*tani*
- 13 . Hind basitarsus, narrow (similar to that of female),  
 parallel-sided, white with apical 1/6 light brown.....  
 .....*siripoomense*  
 Hind basitarsus enlarged, wedge-shaped, whitish yellow  
 on basal 3/5 or a little less and dark brown on the  
 rest.....14
- 14 . Abdominal segments 2, 5, 6 and 7 each with a pair of  
 silvery iridescent spots dorsolaterally.....*weji*  
 Abdominal segments 2, 6 and 7 each with a pair of sil-  
 very iridescent spots dorsolaterally.....*brevipar*
- 15 . Hind basitarsus whitish yellow on basal 1/2 or a little  
 more or less and brownish black on the rest.....  
 .....*quinquestriatum*  
 Hind basitarsus whitish yellow on basal 3/5 and  
 brownish black on apical 2/5.....  
 .....*chiangmaiense, nakhonense and thailandicum*
- 16 . Hind basitarsus whitish on basal 1/2 or a little less and  
 brownish black on the rest; body of ventral plate  
 wider than long.....17  
 Hind basitarsus entirely light to dark brown, or so with  
 basal 2/5 whitish yellow or dark yellow; body of ven-  
 tral plate longer than wide.....18
- 17 . Body of ventral plate about 1.8 times as wide as long,  
 and much shorter than arms.....*yongi*  
 Body of ventral plate about 2.3 times as wide as long,  
 and much longer than arms.....*grossifilum*
- 18 . Hind basitarsus entirely light to dark brown.....19  
 Hind basitarsus brownish black with basal 2/5 whitish  
 yellow or dark yellow.....20
- 19 . Ventral plate subquadrate when viewed ventrally, and  
 with distinct teeth on its posterior surface.....*chaliowae*  
 Ventral plate gradually narrowed posteriorly when  
 viewed ventrally, and without any tooth on its poste-  
 rior surface.....*maenoi*
- 20 . Upper eye with 20 vertical columns and 20 horizontal  
 rows of large facets.....*chainarongi*  
 Upper eye with 15-17 vertical columns and 16 or 17  
 horizontal rows of large facets.....21
- 21 . Upper eye with 15 vertical columns and 16 horizontal  
 rows of large facets; ventral plate with 2 vertical rows  
 of teeth nearly parallel-sided on its posterior surface  
 .....*malayense*  
 Upper eye with 17 vertical columns and 17 horizontal  
 rows of large facets; ventral plate with teeth irregu-  
 larly situated on its posterior surface.....*fenestratum*  
 (\*The males of *S. baimaii*, *S. barnesi* and *S. suchariti*,  
 which are unknown, are not included)

## PUPAE

- 1 . Gill of inflated form.....2  
 Gill filamentous.....4
- 2 . Gill with 2 filaments arising from long inflated trunk  
 .....*baimaii*  
 Gill with 3 or 6 inflated tubes with rounded apex.....3
- 3 . Gill with 3 inflated tubes.....*nodosum*  
 Gill with 6 inflated tubes with minute spines.....  
 .....*grossifilum*
- 4 . Gill with 6 filaments.....5  
 Gill with 8 or 10 filaments.....19
- 5 . Cocoon simple wall-pocket-shaped.....6  
 Cocoon shoe-shaped or boot-shaped.....16
- 6 . Cocoon with an anterolateral window on each side.....7  
 Cocoon without lateral window.....10
- 7 . Gill filaments subequal in length and thickness to one  
 another.....8  
 Gill filaments decreased in thickness from dorsal to  
 ventral.....9
- 8 . Gill filaments short-stalked; dorsal spine-combs pre-  
 sent on abdominal segments 7-9.....*siripoomense*  
 Gill filaments almost sessile; dorsal spine-combs pre-  
 sent only on abdominal segment 8.....*rudnicki*
- 9 . Cocoon with a small anterolateral window on each  
 side; frons moderately covered with very large tuber-  
 cles; terminal hooks present.....*maenoi*  
 Cocoon with a moderate anterolateral window on each  
 side; frons densely covered with small and medium-  
 sized tubercles; terminal hooks absent.....*suchariti*
- 10 . Integuments of head and thorax bare (except posterior  
 1/2 of thorax with minute tubercles).....11  
 Integuments of head and thorax moderately or densely  
 covered with tubercles.....12
- 11 . Cocoon very thin, transparent, and its anterior margin  
 often not well defined; inner filament of the ventral-  
 most pair narrowed basally; dorsal spine-combs pre-  
 sent on abdominal segment 8; terminal hooks absent.....  
 .....*yongi*  
 Cocoon thickly woven, not transparent, and its anterior  
 margin well defined; inner filament of the ventral-  
 most pair not narrowed basally; dorsal spine-combs  
 present on abdominal segments 7-9; terminal hooks  
 present.....*chamlongi*
- 12 . Terminal hooks present.....*tani*  
 Terminal hooks absent.....13
- 13 . Gill filaments with short-stalked; dorsalmost filament

- basally directed upward or forward, then curved forward or downward; abdominal segment 7 with spine-combs dorsally.....14
- Gill filaments almost sessile; dorsalmost filament basally directed forward or downward; abdominal segment 7 without spine-combs dorsally.....15
- 14 . Two filaments of the dorsal pair subequal in thickness to each other.....*rufibasis*  
Dorsalmost filament of the dorsal pair much thicker than the counter filament.....*setsukoa*
- 15 . Thoracic integument with pit-like organ at base of gill.....*brevipar*  
Thoracic integument without such organ at base of gill.....*weji*
- 16 . Cocoon loosely woven, with many small open spaces in webs.....*choochotei*  
Cocoon tightly woven.....17
- 17 . Cocoon with an anterolateral flap and a small anterolateral window on each side; terminal hooks present.....*digrammicum*  
Cocoon without such flap and window; terminal hooks absent.....18
- 18 . Abdominal segment 8 with spine-combs dorsally.....*nobile*  
Abdominal segment 8 without any spine-comb dorsally.....*nigrogilvum*
- 19 . Gill with 8 filaments.....20  
Gill with 10 filaments.....25
- 20 . Cocoon wall-pocket-shaped.....21  
Cocoon shoe-shaped.....22
- 21 . Cocoon with an anterolateral window on each side.....*fenestratum*  
Cocoon without any window.....*malayense*
- 22 . Cocoon roughly woven anteriorly, leaving some large open spaces in webs of the anterior collar and many small open spaces near anterior margin.....23  
Cocoon without open spaces in the webs.....24
- 23 . Gill filaments subequal in thickness to one another.....*triglobus*  
Two ventralmost paired filaments much thinner than the others.....*chiangmaiense*
- 24 . Basal portion of the dorsalmost filament about 1.4 times as thick as the ventralmost one.....*chaliowae*  
Basal portion of the dorsalmost filament about twice as thick as the ventralmost one.....*chainarongi*
- 25 . Gill filaments arranged in 2+3+3+2 filaments from dorsal to ventral; all filaments subequal in thickness to one another.....*quinquestriatum*  
Gill filaments arranged in 2+2+2+2+2 filaments; 4 or 5 dorsal filaments slightly to markedly thicker than the others.....26
- 26 . Head integument with round tubercles.....*nakhonense*  
Head integument with angular tubercles.....*thailandicum*
- MATURE LARVAE\*
- 1 . Last abdominal segment with a distinct accessory sclerite ventrally.....*nigrogilvum*  
Last abdominal segment without any accessory sclerite.....2
- 2 . Abdominal segments 1-5 (or up to 8) each with 1 or more pairs of protuberances dorsally or dorsolaterally.....3  
Abdominal segments lacking protuberances.....9
- 3 . Abdominal segments 1-8 each with 1-6 pairs of protuberances dorsally and dorsolaterally.....*siripoomense*  
Abdominal segments 1-5 (or up to 8) each with a pair of protuberances dorsally or dorsolaterally.....4
- 4 . Postgenal cleft very long, its apex reaching the posterior border of hypostomium.....5  
Postgenal cleft very long, but its apex not reaching the posterior border of hypostomium.....6
- 5 . Pharate pupal gill with 6 filaments.....*nobile*  
Pharate pupal gill with 3 filaments.....*nodosum*
- 6 . Pharate pupal gill with 8 filaments.....7  
Pharate pupal gill with 10 filaments.....8
- 7 . Abdominal segments 1-6 each with a pair of protuberances dorsally.....*chainarongi*  
Abdominal segments 1-8 each with a pair of protuberances dorsally.....*chiangmaiense*
- 8 . Pharate pupal gill with 10 filaments arranged in 2+3+3+2 filaments.....*quinquestriatum*  
Pharate pupal gill with 10 filaments arranged in 2+2+2+2+2 filaments.....*nakhonense*
- 9 . Postgenal cleft moderately widened medially, its greatest width much larger than the width at base.....10  
Postgenal cleft not widened or slightly so medially, its greatest width subequal to, or slightly larger than, the width at base.....11
- 10 . Pharate pupal gill with 6 filaments.....*chamlongi*  
Pharate pupal gill with 8 filaments.....*fensestratum* and *malayense*
- 11 . Abdomen with its greatest width on segment 8.....12  
Abdomen with its greatest width on segment 6 or 7.....14
- 12 . Cephalic apotome mostly pale yellow.....*yongi*  
Cephalic apotome mostly light to medium brown.....13
- 13 . Posterior circlet with 144-160 rows of hooklets.....*rudnicki*  
Posterior circlet with ca. 210 rows of hooklets.....*choochotei*
- 14 . Body longer than 7.0 mm.....*suchariti*  
Body shorter than 7.0 mm.....15



- 15 . Postgenal cleft widely rounded apically.....16  
 Postgenal cleft nearly pointed apically.....19
- 16 . Pharate pupal gill with 2 filaments.....*baimaii*  
 Pharate pupal gill with 6 or 8 filaments.....17
- 17 . Pharate pupal gill with 8 filaments.....*triglobus*  
 Pharate pupal gill with 6 filaments.....18
- 18 . Body length 5.9-6.4 mm; elongate spot on each side of  
 postgenal cleft positive; each lobe of rectal organ  
 with 8-12 finger-like secondary lobules.....*maenoi*  
 Body length 5.0-5.5 mm; elongate spot on each side of  
 postgenal cleft negative; each lobe of rectal organ  
 with 14-18 finger-like secondary lobules.....  
 .....*digrammicum*
- 19 . Postgenal cleft of medium size, nearly as long as wide;  
 pharate pupal gill with 6 inflated tubular filaments.....  
 .....*grossifilum*  
 Postgenal cleft long, much longer than wide; pharate  
 pupal gill with 6 thread-like filaments.....20
- 20 . Cephalic apotome yellow, with dark area medially just  
 in front of posterior margin.....21  
 Cephalic apotome pale yellow to pale brown, without  
 dark area medially just in front of posterior margin.....  
 .....22
- 21 . Body color reddish brown; dorsal pair of pharate pupal  
 gill filaments subequal in thickness to each other.....  
 .....*rufibasis*  
 Body color dark grey to greyish black; one of dorsal  
 pair of pharate pupal gill filaments much thicker than  
 the counter filament.....*setsukoeae*
- 22 . Each lobe of rectal organ with 14-16 finger-like second-  
 ary lobules; posterior circlet with ca. 86 rows of  
 hooklets with up to 17 hooklets per row.....*weji*  
 Each lobe of rectal organ with 7-12 finger-like second-  
 ary lobules; posterior circlet with 70-74 rows of  
 hooklets with up to 12 or 14 hooklets per row.....23
- 23 . Body color reddish brown.....*tani*  
 Body color dark grey.....*brevipar*  
 (\*The mature larvae of *S. barnesi*, *S. chaliowae* and *S. thai-*  
*landicum*, which are unknown, are not included)

#### ACKNOWLEDGEMENT

This work was financially supported by a Grant-in-Aid of Japan US Medical Research Cooperation Program (the fiscal year 2003).

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