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

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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
  1. *batoense* species-group
  2. *angulistylum* Takaoka and Davies, 1995
  3. *decuplum* Takaoka and Davies, 1995
  4. *dentistylum* Takaoka and Davies, 1995
  5. *gombakense* Takaoka and Davies, 1995
  7. *siamense* Takaoka and Suzuki, 1984
  8. *ceylonicum* species-group
  9. *asakoae* Takaoka and Davies, 1995
  10. *inthanonense* Takaoka and Suzuki, 1984
  11. *sheilae* Takaoka and Davies, 1995
  12. *burtoni* Takaoka and Davies, 1995

- **Subgenus Montisimulium** Rubtsov
  14. *sp. G*

- **Subgenus Neumannia** Enderlein
  15. *feuerborni* species-group
  16. *aureohirtum* Brunetti, 1911
  17. *caudisclerum* Takaoka and Davies, 1995

- **Subgenus Simulium** Latreille s. str.
  18. *choochotei* Takaoka, 2002
  19. *digrammicum* Edwards, 1928
  20. *grossifilum* Takaoka and Davies, 1995
  22. *nigrogilvum* Summers, 1911
  23. *rudnicki* Takaoka and Davies, 1995
  24. *suchariti* Takaoka and Choochote, 2004
  25. *yongi* Takaoka and Davies, 1997
  27. *multistriatum* species-group
  28. *chaliowae* Takaoka and Boonkemtong, 1999
  29. *fenestratum* Edwards, 1934
  30. *malayense* Takaoka and Davies, 1995
  31. *triglobus* Takaoka and Kuvangkadilok, 1999
  32. *nobile* De Meijere, 1907
  33. *nodosum* Puri, 1933

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(E) striatum species-group
34 ) chiangmaiense Takaoka and Suzuki, 1984
35 ) nakhoenense Takaoka and Suzuki, 1984
36 ) quinquenatum (Shiraki, 1935)
37 ) thailandicum Takaoka and Suzuki, 1984
(F) tuberosum species-group
38 ) brevipar Takaoka and Davies, 1995
39 ) rufibasis Brunetti, 1911
40 ) setsukoe Takaoka and Choochote, 2004
41 ) tani Takaoka and Davies, 1995
42 ) weji Takaoka, 2001
(G) variegatum species-group
43 ) barnesi Takaoka and Suzuki, 1984
44 ) chamlongi Takaoka and Suzuki, 1984
(H) Simulium s. str. unplaced to group
45 ) 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)
MA TUR E LA R V A E

1. Hypostomium very wide, with 13 apical teeth
   ̔ɽ Daviesellum
Hypostomium of moderate width, with 9 apical teeth
   ̔ɽ Simulium s. str.
Last abdominal segment lacks ventral papillae or with small ones
   ̔ɽ Simulium
Last abdominal segment with large ventral papillae
   ̔ɽ

2. Postgenal cleft vestigial
   ̔ɽ Montisimulium
Postgenal cleft distinctly formed
   ̔ɽ

3. Lateral margin of hypostomium serrated
   ̔ɽ ‘Nevermannia
Lateral margin of hypostomium smooth
   ̔ɽ Gomphostilbia

K E Y S T O T H E S P E C I E S  
O F T H E S U B G E N U S D A V I E S E L L U M

A D U LT F E M A L E S

1. Genital fork with a distinct projection directed anteriorly
   ̔ɽ ‘c ourt ney i
Genital fork without such a projection
   ̔ɽ ‘p ahangense

A D U LT M A L E S

1. Ventral plate much longer than wide when viewed ventrally
   ̔ɽ ‘c ourt ney i
Ventral plate much shorter than wide when viewed ventrally
   ̔ɽ ‘p ahangense

P U P A E

1. Frons densely covered with tubercles
   ̔ɽ ‘c ourt ney i
Frons mostly bare (though narrow portion near the lower margin tuberculate)
   ̔ɽ ‘p ahangense

M A T U R E LA R V A E

1. Postgenal cleft long, but its apex not reaching the posterior margin of hypostomium
   ̔ɽ ‘c ourt ney i
Postgenal cleft long, its apex reaching the posterior margin of hypostomium
   ̔ɽ ‘p ahangense

K E Y S T O T H E S P E C I E S  
O F T H E S U B G E N U S G O M P H O S T I L B I A

A D U LT F E M A L E S

1. Antenna composed of 10 segments
   ̔ɽ ‘b urtoni
Antenna composed of 11 segments
   ̔ɽ ‘c hampornense
2. Tergite 5 shiny
   ̔ɽ ‘b urtoni
Tergite 5 not shiny
   ̔ɽ ‘c hampornense
3. Mid and hind femora almost yellow except apical cap dark
   ̔ɽ ‘d entistylum
Mid and hind femora alomst dark except base pale
   ̔ɽ ‘s iamense
Hind tibia mostly dark
   ̔ɽ ‘s iamense
Hind tibia whitish yellow or dark yellow on basal 2/5 or more
   ̔ɽ ‘s iamense
Hind tibia with a dark subbasal spot
   ̔ɽ ‘s iamense
Hind tibia without such a dark subbasal spot
   ̔ɽ ‘s iamense
Sensory vesicle of medium size, 0.3 times as long as 3rd maxillary palpal segment
   ̔ɽ ‘a ngulistylum
Sensory vesicle enlarged, 0.5 or 0.6 times as long as 3rd maxillary palpal segment
   ̔ɽ ‘d ecuplum
Arms of genital fork with a short projection directed anteriorly
   ̔ɽ ‘p arahiyangum
Arms of genital fork without such a projection
   ̔ɽ

8. Hind tibia whitish yellow on basal 2/3; sensory vesicle of moderate size, 0.3 times as long as 3rd maxillary palpal segment
   ̔ɽ ‘a sakoe
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
   ̔ɽ ‘i nthanonense
Frons-head ratio 1.0 : 4.8: sensory vesicle enlarged, 0.57 times as long as 3rd maxillary palpal segment
   ̔ɽ ‘i nthanonense
Frons-head ratio 1.0 : 5.7: sensory vesicle enlarged, 0.68 times as long as 3rd maxillary palpal segment
   ̔ɽ ‘s heilae
(*The female of S. gombakense, which is unknown, is not included)

A D U LT M A L E S

1. Antenna composed of 10 segments
   ̔ɽ ‘b urtoni
Antenna composed of 11 segments
   ̔ɽ ‘c hampornense
2. Ventral plate produced ventrally
   ̔ɽ ‘b urtoni
Ventral plate nearly flat
   ̔ɽ ‘c hampornense
3. Hind basitarsus enlarged
   ̔ɽ ‘s heilae
Hind basitarsus slender, much thinner than hind tibia
   ̔ɽ ‘s heilae
4. Eye with 16 horizontal rows of large facets
   ̔ɽ ‘i nthanonense
Eye with 13 horizontal rows of large facets
   ̔ɽ ‘i nthanonense
5. Hind tibia mostly medium brown to brownish black with basal 1/3 or a little less somewhat pale
   ̔ɽ ‘a sakoe
Hind tibia whitish on a little less than basal 1/2 and brownish black on the rest
   ̔ɽ ‘a sakoe
6. Mid and hind femora yellow except apical cap dark
   ̔ɽ ‘d entistylum
Mid and hind femora almost dark except base pale
   ̔ɽ ‘d entistylum
Hind tibia almost dark except base pale
   ̔ɽ ‘d entistylum
Hind tibia whitish on basal 1/2 or more
   ̔ɽ ‘d entistylum
8. Abdominal segments 2, 5, 6 and 7 each with a dorso-
lateral pair of shiny whitish-pruinose patches

Abdominal segments 2, 6 and 7 each with a dorsolateral pair of shiny whitish-pruinose patches

9. Upper eye with 12 or 13 vertical columns and 15 horizontal rows of large facets

Upper eye with 17 vertical columns and 15 horizontal rows of large facets

10. Hind tibia whitish on basal 2/3, with a dark subbasal spot

Hind tibia whitish yellow on basal 1/2, without such a dark subbasal spot

PUPAE

Gill of much inflated structure with 2 triplet groups of finger-like projections and 8 slender filaments

Gill with 8 or 10 filaments

Gill filaments all shorter than pupal body (shorter than 1.6 mm), short-stalked

Gill filaments subequal to, or longer than, pupal body (longer than 1.9 mm), moderately-stalked

Antennal sheath smooth

Antennal sheath with tubercles

Gill filaments arranged in 2 groups, i.e. 1 dorsal (4 individual and 2 paired filaments) and 1 ventral (2 paired filaments)

Gill filaments arranged in 3 groups (3+3+2 filaments from dorsal to ventral)

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)

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)

Dorsal and middle triplet groups and ventral pair group arising basally at the same level

Dorsal and middle triplet groups sharing a short stalk, which arises, with a stalk of ventral pair group, from short common basal stalk

Dorsal and middle triplet groups consisting of 1 individual filament and 2 paired filaments with a very long stalk

Dorsal and middle triplet groups consisting of 1 individual filament and 2 paired filaments with a short or medium-long stalk

Gill with 8 filaments

Decuplum

Postgenal cleft long, but its apex not reaching the posterior margin of hypostomium; thorax and abdomen sparsely or moderately covered with minute setae

Postgenal cleft long, its apex nearly or completely reaching the posterior margin of hypostomium

Postgenal cleft otherwise

Abdomen markedly constricted between segments 4 and 5

Abdomen not constricted between segments 4 and 5

Postgenal cleft short, much shorter than postgenal bridge

Postgenal cleft longer than postgenal bridge

Abdomen almost bare except the last segment; pharate pupal gill of inflated structure

Abdomen moderately or densely covered with simple or branched dark spinous setae or spinules dorsally on segments 5-8; pharate pupal gill filamentous

Abdomen moderately covered with simple minute dark setae dorsally on segments 5-8

Abdomen moderately or densely covered with branched dark spinous setae or spinules dorsally on segments 5-8

Thoracic cuticle moderately covered with minute dark spinules with 7-11 branches dorsally; pharate pupal gill with 10 filaments

Thoracic cuticle almost bare dorsally; pharate pupal gill with 8 filaments

Minute dark spinous setae on abdominal segments 5-8 somewhat flat and stout basally, with short branches apically

MATURE LARVAE

Thoracic segment 3 and abdominal segments 1-5 each with 1 or 2 pairs of dorsal and/or dorsolateral protuberances

Thoracic segment 3 and abdominal segments 1-5 without any dorsal or dorsolateral protuberance

Postgenal cleft very long, its apex reaching the posterior margin of hypostomium; thorax and abdomen densely covered with dark spines of various sizes

Postgenal cleft long, but its apex not reaching the posterior margin of hypostomium; thorax and abdomen densely covered with dark spines of various sizes

Postgenal cleft otherwise

Abdomen marked by a constriction between segments 4 and 5

Abdomen not constricted between segments 4 and 5

Postgenal cleft short, much shorter than postgenal bridge

Postgenal cleft longer than postgenal bridge

Abdomen almost bare except the last segment; pharate pupal gill of inflated structure

Abdomen moderately or densely covered with simple or branched dark spinous setae or spinules dorsally on segments 5-8; pharate pupal gill filamentous

Abdomen moderately covered with simple minute dark setae dorsally on segments 5-8

Abdomen moderately or densely covered with branched dark spinous setae or spinules dorsally on segments 5-8

Thoracic cuticle moderately covered with minute dark spinules with 7-11 branches dorsally; pharate pupal gill with 10 filaments

Thoracic cuticle almost bare dorsally; pharate pupal gill with 8 filaments

Minute dark spinous setae on abdominal segments 5-8 somewhat flat and stout basally, with short branches apically

siamense

decuplum

parahiyangum

angulistylum

parahiyangum

chumpornense

dentistyium

siamense

decuplum

burtonti

asakoa

inthanonense

sheilae

asakoa
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 5\&12 (mostly 8\&10) branches——angulistyllum

**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 brown in ground color, with 3 dark longitudinal vittae at certain angle of light; paramere with 3 or 4 parameral hooks——feuerborni
   Scutum whitish brown 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——nigrogilivum
   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 medically 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——chiangmaiensi, 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
Mid femur entirely yellow
Mid tarsal segments 2 and 3 light brown to brownish
Mid femur almost entirely dark brown
Mid tibia white on basal 4/5 or 5/6 and light to dark brown on the rest; cibarium with a smooth medial projection
Cibarium with tubercles near the base of medial projection
All femora almost yellow; three spermathecae present
At least mid and hind femora mostly dark; one spermatheca present
Hind basitarsus much enlarged, 3.2
Fore tibia medium brown, with white shiny area on
Mid femur blackish brown with basal 1/5 or 1/4 yellow
Mid femur almost entirely dark brown
Mid tarsal segments 2 and 3 entirely yellow
Mid femur entirely yellow
Mid femur almost dark brown
Abdominal segment 7 with a pair of clustered hairs ventrally
Abdominal segment 7 without such a pair of clustered hairs ventrally
A pair of clustered hairs on abdominal segment 7 short, subequal in length to those on the surrounding area
A pair of clustered hairs on abdominal segment 7 much longer than those on the surrounding area
Mid tibia almost light brown with base somewhat yellow
Mid tibia white on basal 1/2 or more and medium brown on the rest
Mid tibia 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
Hind basitarsus white on basal 3/5 or more and brownish black on the rest; scutum covered with dark brown hairs only
Sensory vesicle enlarged, 0.7 times as long as the 3rd maxillary palpal segment
digrammicum
Sensory vesicle medium-sized, 0.3 times as long as the 3rd maxillary palpal segment
brevispar
(*The females of S. baimaii and S. thailandicum, which are unknown, are not included)

ADULT MALES
Basal portion of radial vein fully haired
Basal portion of radial vein bare
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
Abdomen with a pair of shiny white pruinose spots dorsally or dorsolaterally on segments 2, 5, 6 and 7; width of style becoming much narrower apically
Fore basitarsus with thick dorsal hair crest; hind basitarsus nearly parallel-sided; ventral plate nearly quadr rate, parallel-sided when viewed ventrally
Fore basitarsus with moderate dorsal hair crest; hind basitarsus spindle-shaped; ventral plate gradually narrowed posteriorly when viewed ventrally
digrammicum
Scutum broadly silvery pruinose with transverse, inverted-V-shaped, black band
Scutum otherwise
Ventral plate with a narrow body parallel-sided when viewed ventrally
Ventral plate with a wide body broadened medially when viewed ventrally
Mid femur and tibia almost yellow
Mid femur and tibia otherwise
Mid tibia mostly dark (including posterior surface)
Mid tibia whitish or yellowish (at least on posterior surface) on basal 1/2 or more and dark brown on the rest
Fore tibia medium brown, with white shiny area on outer surface
Fore tibia medium to dark brown, without white area on outer surface
Hind basitarsus white or whitish yellow on basal 1/2 or less and dark brown to brownish black on the rest
Hind basitarsus white or whitish yellow on more than basal 1/2 and light to dark brown on the rest
Hind basitarsus somewhat enlarged, about 5.0 times as long as wide and much narrower than hind tibia
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. Upper eye with 20 vertical columns of large facets

Upper eye with 15-17 vertical columns of large facets

12. Hind basitarsus whitish yellow on basal 1/3 and brownish black on the rest

Hind basitarsus whitish yellow on basal 1/2 or a little less and brownish black on the rest

13. Hind basitarsus, narrow (similar to that of female), parallel-sided, white with apical 1/6 light brown

Hind basitarsus enlarged, wedge-shaped, whitish yellow on basal 3/5 or a little less and dark brown on the rest

14. Abdominal segments 2, 5, 6 and 7 each with a pair of silvery iridescent spots dorsolaterally

Abdominal segments 2, 6 and 7 each with a pair of silvery iridescent spots dorsolaterally

15. Hind basitarsus whitish yellow on basal 1/2 or a little more or less and brownish black on the rest

Hind basitarsus whitish yellow on basal 3/5 and brownish black on apical 2/5

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

Hind basitarsus entirely light to dark brown, or so with basal 2/5 whitish yellow or dark yellow; body of ventral plate longer than wide

17. Body of ventral plate about 1.8 times as wide as long, and much shorter than arms

Body of ventral plate about 2.3 times as wide as long, and much longer than arms

18. Hind basitarsus entirely light to dark brown

Hind basitarsus brownish black with basal 2/5 whitish yellow or dark yellow

19. Ventral plate subquadrate when viewed ventrally, and with distinct teeth on its posterior surface

Ventral plate gradually narrowed posteriorly when viewed ventrally, and without any tooth on its posterior surface

20. Upper eye with 20 vertical columns and 20 horizontal rows of large facets

Upper eye with 15-17 vertical columns and 16 or 17 horizontal rows of large facets

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

Upper eye with 17 vertical columns and 17 horizontal rows of large facets; ventral plate with teeth irregularly situated on its posterior surface

(*The males of S. baimaii, S. barnesi and S. suchariti, which are unknown, are not included)

PUPAE

1. Gill of inflated form

Gill filamentous

2. Gill with 2 filaments arising from long inflated trunk

Gill with 3 or 6 inflated tubes with rounded apex

3. Gill with 3 inflated tubes

Gill with 6 inflated tubes with minute spines

4. Gill with 6 filaments

Gill with 8 or 10 filaments

5. Cocoon simple wall-pocket-shaped

Cocoon shoe-shaped or boot-shaped

6. Cocoon with an anterolateral window on each side

Cocoon without lateral window

7. Gill filaments subequal in length and thickness to one another

Gill filaments decreased in thickness from dorsal to ventral

8. Gill filaments short-stalked; dorsal spine-combs present on abdominal segments 7-9

Cocoon with a small anterolateral window on each side; frons moderately covered with very large tubercles; terminal hooks present

9. Cocoon with a moderate anterolateral window on each side; frons densely covered with small and medium-sized tubercles; terminal hooks absent

10. Integuments of head and thorax bare (except posterior 1/2 of thorax with minute tubercles)

Integuments of head and thorax moderately or densely covered with tubercles

11. Cocoon very thin, transparent, and its anterior margin often not well defined; inner filament of the ventralmost pair narrowed basally; dorsal spine-combs present on abdominal segment 8

Cocoon thickly woven, not transparent, and its anterior margin well defined; inner filament of the ventralmost pair not narrowed basally; dorsal spine-combs present on abdominal segments 7-9; terminal hooks present

12. Terminal hooks present

Terminal hooks absent

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………………………………………………………………………………..ruflasis
Dorsalmost filament of the dorsal pair much thicker than the counter filament…………………………………………………………..setsukoue

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……………………………………………………………………………………………………………………………………………….malayense

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……………………………………………………………………………………..nigrogilvum

18. Abdominal segment 8 with spine-combs dorsally…………………………………………………………………………………………………nigrogilvum
Abdominal segment 8 without any spine-comb dorsally…………………………………………………………………………………………..malayense

19. Gill with 8 filaments…………………………………………………………………………………………………………………………………………………nigrogilvum
Gill with 10 filaments…………………………………………………………………………………………………………………………………………………nigrogilvum

20. Cocoon wall-pocket-shaped……………………………………………………………………………………………………………………………………..nigrogilvum
Cocoon shoe-shaped………………………………………………………………………………………………………………………………………………..nigrogilvum

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…………………………………………………………………………………………..fenestratum
Cocoon without open spaces in the webs……………………………………………………………………………………………………………………fenestratum

23. Gill filaments subequal in thickness to one another………………………………………………………………………………………………fenestratum
Two ventralmost paired filaments much thinner than the others………………………………………………………………………………………fenestratum and malayense

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……………………………………………………………chaliowae

25. Gill filaments arranged in 2+3+3 filaments from dorsal to ventral; all filaments subequal in thickness to one another…………………………..quinquestriatum
Gill filaments arranged in 2+2+2+2 filaments; 4 or 5 dorsal filaments slightly to markedly thicker than the others……………………………………..chaliowae

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……………………………………………………………………………………………..malayense

2. Abdominal segments 1 ♀ 5 (or up to 8) each with 1 or more pairs of protuberances dorsally or dorsolaterally……………………………………………………………………………………………..nigrogilvum
Abdominal segments lacking protuberances………………………………………………………………………………………………………………..malayense

3. Abdominal segments 1 ♀ 5 (or up to 8) each with a pair of protuberances dorsally and dorsolaterally………………………………………………………………………………………………nigrogilvum
Abdominal segments 1 ♀ 5 (or up to 8) each with a pair of protuberances dorsally or dorsolaterally………………………………………………………………………………………………nigrogilvum

4. Postgenal cleft very long, its apex reaching the posterior border of hypostomium………………………………………………………………………..nigrogilvum
Postgenal cleft very long, but its apex not reaching the posterior border of hypostomium……………………………………………………………..nigrogilvum

5. Pharyse pupal gill with 6 filaments………………………………………………………………………………………………………………………nigrogilvum
Pharyse pupal gill with 3 filaments………………………………………………………………………………………………………………………..nigrogilvum

6. Pharyse pupal gill with 8 filaments………………………………………………………………………………………………………………………..nigrogilvum
Pharyse pupal gill with 10 filaments………………………………………………………………………………………………………………………..nigrogilvum

7. Abdominal segments 1 ♀ 6 each with a pair of protuberances dorsally……………………………………………………………………………nigrogilvum
Abdominal segments 1 ♀ 6 each with a pair of protuberances dorsally……………………………………………………………………………nigrogilvum

8. Pharyse pupal gill with 10 filaments arranged in 2+3+3 filaments…………………………………………………………………………………..nigrogilvum
Pharyse pupal gill with 10 filaments arranged in 2+3+3 filaments…………………………………………………………………………………..nigrogilvum

9. Postgenal cleft moderately widened medially, its greatest width much larger than the width at base……………………………………………..nigrogilvum
Postgenal cleft not widened or slightly so mediately, its greatest width subequal to, or slightly larger than, the width at base……………………………..nigrogilvum

10. Pharyse pupal gill with 6 filaments………………………………………………………………………………………………………………………nigrogilvum
Pharyse pupal gill with 8 filaments………………………………………………………………………………………………………………………..nigrogilvum

11. Abdomen with its greatest width on segment 8……………………………………………………………………………………………………………..nigrogilvum
Abdomen with its greatest width on segment 6 or 7………………………………………………………………………………………………………..nigrogilvum

12. Cephalic apotome mostly pale yellow…………………………………………………….nigrogilvum
Cephalic apotome mostly light to medium brown………………………..nigrogilvum

13. Posterior cirrlet with 144-160 rows of hooklets………………………………………………………………………………………………………..nigrogilvum
Posterior cirrlet with ca. 210 rows of hooklets………………………………………………………………………………………………………..nigrogilvum

14. Body longer than 7.0 mm………………………………………………………………………………………………………………………suchariti
Body shorter than 7.0 mm………………………………………………………………………………………………………………………suchariti
15. Postgenal cleft widely rounded apically

16. Postgenal cleft nearly pointed apically

17. Pharate pupal gill with 8 filaments

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

19. Postgenal cleft of medium size, nearly as long as wide; pharate pupal gill with 6 inflated tubular filaments

20. Cephalic apotome yellow, with dark area medially just in front of posterior margin

21. Body color reddish brown; dorsal pair of pharate pupal gill filaments subequal in thickness to each other

22. Each lobe of rectal organ with 14–16 finger-like secondary lobules; posterior cirplet with ca. 86 rows of hooklets with up to 17 hooklets per row

23. Body color reddish brown

(*The mature larvae of S. barnesi, S. chalhiovae and S. thailandicum, which are unknown, are not included)

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