

**Nymphs of *Nigrobaetis*, *Alainites*,  
*Labiobaetis*, *Tenuibaetis* and *Baetis*  
from Japan (Ephemeroptera:  
Baetidae): Diagnoses and keys for  
genera and species**

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**Abstract**

Kobayashi (1987) distinguished 18 Japanese *Baetis* (s.l.) species in the nymphal stage. He identified 5 nominal species and gave alphabetical provisional names to other 13 species. He also provided keys to the 18 species. Recently more than 50 *Baetis* (s.l.) species were transferred to the genera *Acentrella*, *Baetiella*, *Labiobaetis*, *Alainites* and *Nigrobaetis* in the Palearctic and Oriental regions. According to up-to-date generic concepts, we transferred some Japanese *Baetis* (s.l.) species with the provisional names to other genera: sp. D, sp. I, sp. N and sp. P to *Nigrobaetis*, sp. G and sp. Q to *Labiobaetis* and sp. E and sp. H to *Tenuibaetis*. We provided keys of nymphs to the genera *Baetis* (s.str.), *Tenuibaetis*, *Labiobaetis*, *Alainites* and *Nigrobaetis* and to the Japanese species.

**Keywords:** Baetidae, generic situation, diagnoses, keys, Japan.

**Introduction**

In Japan, 20 species were described under the genus *Baetis* LEACH, 1815 by Matsumura (1931), Uéno (1931, 1969), Imanishi (1937) and Gose (1965, 1980a, b). The keys to species for male imagoes were provided by Gose (1980b) and those for nymphs by Gose (1980a, 1985). But we still have difficulties to identify the species, since some of their descriptions and diagnoses were insufficient. Kobayashi (1987) provided keys of nymphs to 18 *Baetis* species, in which alphabetical provisional names were given to 13 species except for 5 nominal species, *B. chocoatus* GOSE, 1980, *B. pseudofrequentus* MÜLLER-LIEBENAU, 1985, *B. sahoensis* GOSE 1980, *B. thermicus* UÉNO, 1931 and *B. yoshinensis* GOSE 1980. Photographs of 14 Japanese species were provided in Tanida (1991).

In the Palearctic and Oriental regions, more than 50 *Baetis* (s.l.) species have been transferred to the genera *Acentrella* BENGTTSSON, 1912 (Waltz and McCafferty, 1987), *Baetiella* UÉNO, 1931 (Waltz and McCafferty, 1987), *Labiobaetis* NOVIKOVA & KLUGE, 1987 (McCafferty and Waltz, 1995; Waltz and McCafferty, 1997), *Alainites* WALTZ & MCCAFFERTY, 1994 (Waltz *et al.*, 1994), and *Nigrobaetis* NOVIKOVA & KLUGE, 1987 (Waltz *et al.*, 1994; Waltz and McCafferty, 1997). With regard to the Japanese species, *B. sacishimensis* UÉNO, 1969 was transferred to *Nigrobaetis* (Waltz *et al.*, 1994), and *B. atagonis* IMANISHI, 1937, *B. chocoatus*, *B. florens* IMANISHI, 1937 and *B. yoshinensis* to *Alainites* (Waltz and McCafferty, 1997) and *B. pseudofrequentus* MÜLLER-LIEBENAU, 1985 to *Baetiella* (Waltz and McCafferty, 1997). Fujitani *et al.* (in submission) transferred Japanese 6 nominal species of *Baetis* (s.l.) to the genera *Labiobaetis*, *Alainites*, *Nigrobaetis* and *Tenuibaetis* KANG & YANG, 1994.

Herein, we transferred the Japanese *Baetis* (s.l.) species with provisional names to other genera on the basis of the nymphal characters to update the generic situation of Japanese species in Baetidae. We provide diagnoses of nymphs of *Nigrobaetis*, *Alainites*, *Labiobaetis* and *Tenuibaetis* and, and transfer 8 Japanese *Baetis* species having provisional names to *Nigrobaetis*, *Labiobaetis* and *Tenuibaetis*. We also provide keys to the species of *Alainites*, *Nigrobaetis*, *Labiobaetis* and *Tenuibaetis*.

**Diagnoses for genera and species**

Genus *Nigrobaetis* NOVIKOVA & KLUGE, 1987

*Baetis niger* group: Müller-Liebenau 1969, 163.

*Baetis gracilis* group (in part): Müller-Liebenau 1969, 174.

*Baetis* (*Nigrobaetis*) Novikova and Kluge, 1987, 8 (type species of the subgenus: *Ephemera niger* Linné, 1761); Novikova and Kluge, 1994, 16 (in part).

*Nigrobaetis*: Waltz *et al.*, 1994, 34; Waltz and McCafferty, 1997, 138.

*Baetis* (*Margobaetis*): Kang and Yang, in Kang *et al.*, 1994, 11 (type species of the subgenus: *Baetis mundus* Chang and Yang, 1994).

Characters for nymphs: antennal scape without a distal lobe on anterior margin (Fig. 1A); right mandible with a row of spine, prosthema manifold or bifurcate (Fig. 2A-C); maxillary palpus rounded at apex (Fig. 3A); labial palpus not pointed at apex, without large lobe on inner margin of the second segment (Fig. 4A); glossa with a subapical setal tuft (Fig. 5A); femur without villopore and robust setae possessing a medial fold on dorsal surface (Fig. 6A); scale bases trapezoidal (Fig. 7A); paraprocts with a projection on posterior end of the inner margin (Fig. 8A), a patch of notched scales present or absent.

*Nigrobaetis* sp. D (Kobayashi, 1987) n. comb.

*Baetis* sp. D, Kobayashi, 1987, 53, nymph.

This species is distinguishable by the combination of following characters: 7 pairs of gills, robust spines on inner margin of right mandible (Fig. 2A) and caudal filaments lacking dark brown bands.

*Nigrobaetis* sp. I (Kobayashi, 1987) n. comb.

*Baetis* sp. I, Kobayashi, 1987, 53, nymph.

This species is distinguishable by the combination of following characters: 7 pairs of gills, fine spines on inner margin of right mandible (Fig. 2B) and caudal filaments lacking dark brown bands.

*Nigrobaetis* sp. N (Kobayashi, 1987) n. comb.

*Baetis* sp. N, Kobayashi, 1987, 53, nymph.

The nymphs of this species lack subapical setal tuft on glossa, but possess other diagnostic characters provided for the genus *Nigrobaetis*.

This species is distinguishable by the combination of following characters: 6 pairs of gills, fine spines on inner margin of right mandible (Fig. 2B) and caudal filaments lacking dark brown bands.

*Nigrobaetis* sp. P (Kobayashi, 1987) n. comb.

*Baetis* sp. P, Kobayashi, 1987, 53, nymph.

The nymphs of this species lack subapical setal tuft on glossa, but possess other diagnostic characters provided for the genus *Nigrobaetis*. This species is distinguishable by the combination of following characters: 7 pairs of gills, robust spines on inner margin of right mandible (Fig. 2A) and dark brown bands on caudal filaments.

Other Japanese species belonging to *Nigrobaetis*: *N. chocoatus* (GOSE, 1980) and *N. sacishimensis* (UENO, 1969) (Fujitani *et al.*, in submission).

Genus *Alainites* WALTZ & MCCAFFERTY, 1994

The *gracilis* group (in part): Müller-Liebenau 1969, 174.

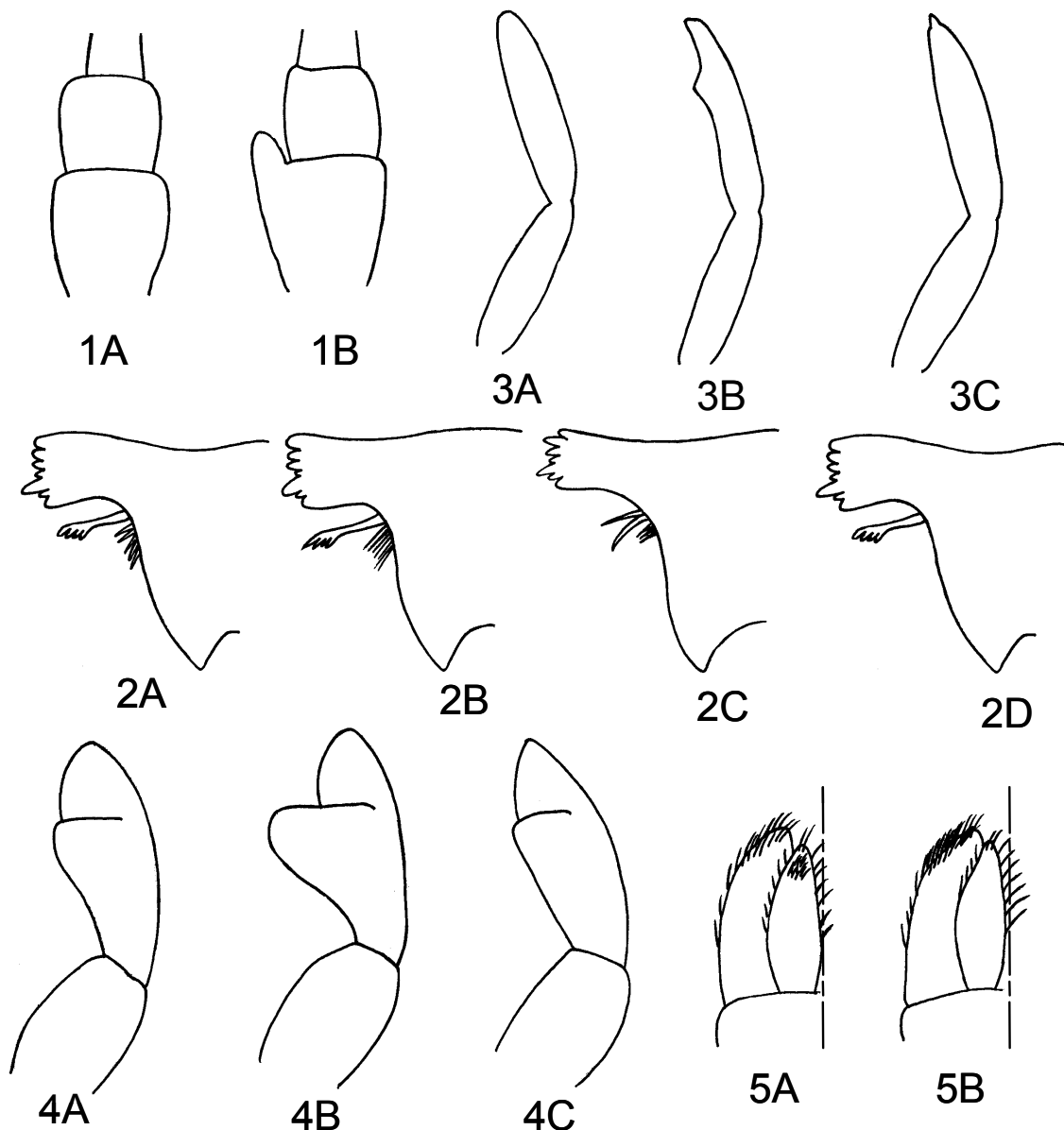
The *muticus* group: Müller-Liebenau 1974, 34.

*Alainites* Waltz and McCafferty, Waltz *et al.*, 1994, 34 (type species: *Baetis muticus* Linné, 1758). *Baetis* (*Nigrobaetis*) Novikova and Kluge, 1987, 8 (type species of the subgenus: *Ephemera niger* Linné, 1761); Novikova and Kluge, 1994, 16 (in part).

*Baetis* (*Acerbaetis*) Kang and Yang: in Kang *et al.*, 1994, 35 (type species of the subgenus: *Baetis clivosus* Chang and Yang, 1994).

Characters for nymphs: antennal scape without a distal lobe on anterior margin (Fig. 1A); right mandible with a row of spines, prosthema bifurcate (Fig. 2C); maxillary palpi rounded at apex (Fig. 3A); labial palpus not pointed at apex, without large lobe on inner margin of the second segment (Fig. 4A); glossae with a subapical setal tuft (Fig. 5A); femur without villopore and robust setae possessing a medial fold on dorsal surface (Waltz *et al.*, 1994) (Fig. 6A); scale bases trapezoidal (Fig. 7B); paraproct with a projection on posterior end of the inner margin, a patch of notched scales present or absent (Fig. 8C).

Japanese species belonging to *Alainites*: *A. atagonis* (IMANISHI, 1937), *A. florens* (IMANISHI, 1937) and *A. yoshinensis* (GOSE, 1980). There is not any *Alainites* species with alphabetical provisional names.



Figs. 1-5 - Schematized drawings of characters of baetid nymphs. 1: antennal scape, A) without a distal lobe on anterior margin, B) with a distal lobe on anterior margin; 2: right mandible, A) with a row of robust spines, B) with a row of fine spines, C) with a bifurcate prostheca and a row of spines, D) without a row of spines; 3: maxillary palpus, A) rounded at apex, B) depressed near apex; C) with a projection at apex; 4: labial palpus, A) rounded at apex, without a large lobe on inner margin of the second segment; B) rounded at apex, with a large lobe on inner margin of the second segment; C) pointed at apex, without a large lobe on inner margin of the second segment; 5: labium (left half), A) glossa with a subapical setal tuft, B) glossae without subapical setal tuft.

Genus *Labiobaetis* NOVIKOVA & KLUGE, 1987

*Baetis atrebatinus* group: Müller-Liebenau 1969, 150.

*Baetis propinquus* group: Morihara and McCafferty 1979, 130.

*Baetis molawiensis* group: Müller-Liebenau 1984, 274.

*Baetis (Labiobaetis)* Novikova and Kluge, 1987, 8 (type species of the subgenus: *Baetis atrebatinus* Eaton, 1870).

*Baetis (Mullerbaetis)* Kang and Yang: in Kang *et al.*, 1994, 32 (type species of the subgenus: *Baetis molawiensis* Müller-Liebenau, 1985).

*Labiobaetis*: McCafferty and Waltz, 1995, 19; Gattolliat, 2001, 97.

Characters for nymphs: antennal scape with a distal lobe (Fig. 1B); right mandible without a row of spine, prostheca manifold (Fig. 2D); maxillary palpus depressed near apex (Fig. 3B) or not; labial palpus not pointed at apex, with a large lobe on inner margin of the second segment (Fig. 4B) or

not; glossae without a subapical setal tuft (Fig. 5A); femur with villopore, without robust setae possessing a medial fold on the dorsal surface (Fig. 6B); scale bases trapezoidal (Fig. 7A); paraprocts without a projection on posterior end of the inner margin (Fig. 8A), a patch of notched scales present or absent in the middle.

*Labiobaetis* sp. G (Kobayashi, 1987) n. comb.

*Baetis* sp. G, Kobayashi, 1987, 53, nymph.

This species is distinguishable by the combination of following characters: a distinct depression near apex of maxillary palpus and broad submarginal setae on labrum.

*Labiobaetis* sp. Q (Kobayashi, 1987) n. comb

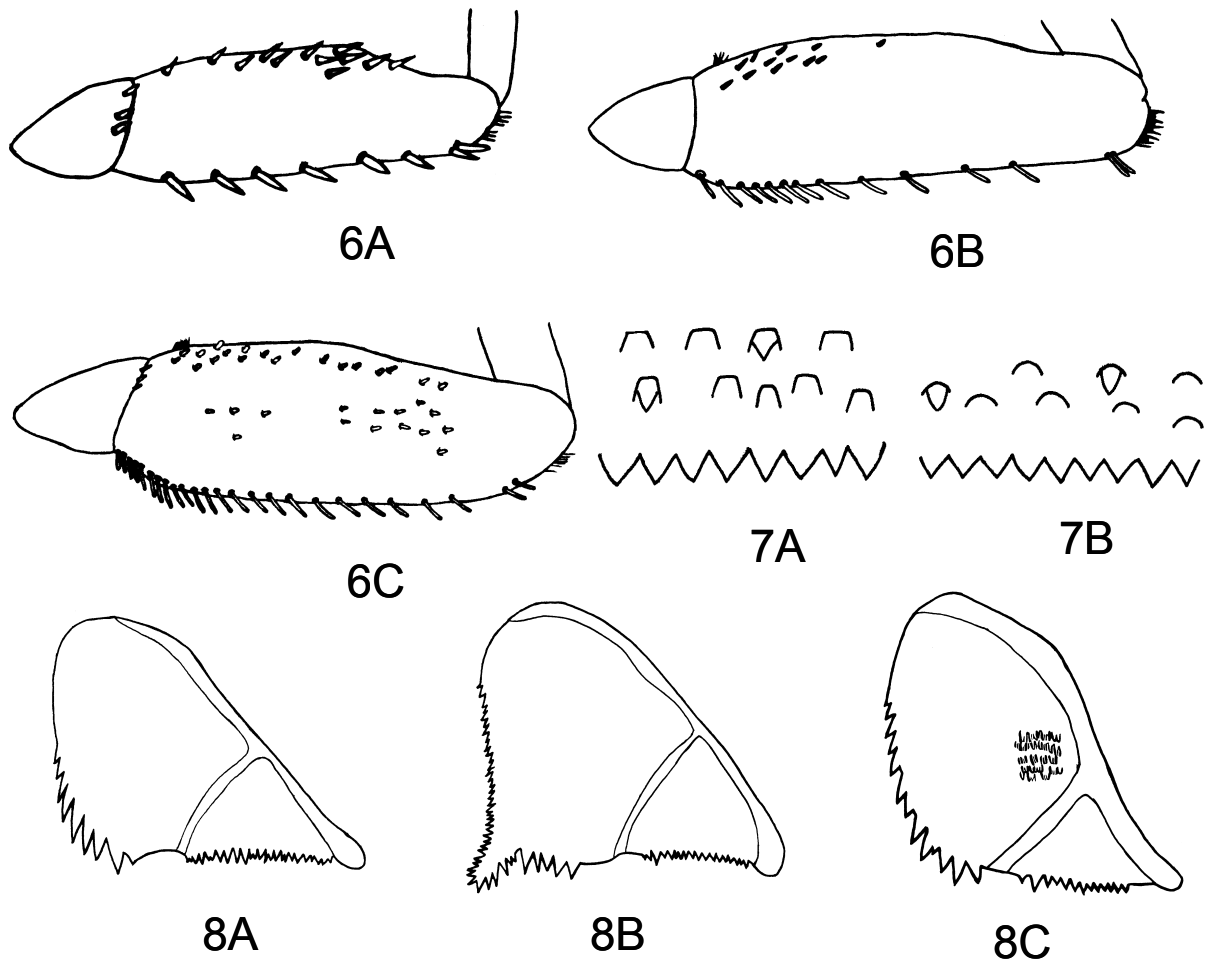
*Baetis* sp. Q, Kobayashi, 1987, 53, nymph.

This species is distinguishable by the combination of following characters: a weak depression near apex of maxillary palpus and fine submarginal setae on labrum.

Genus *Tenuibaetis* KANG & YANG, 1994

*Baetis* (*Tenuibaetis*) Kang and Yang: in Kang *et al.*, 1994, 32 (type species: *Baetis pseudofrequentus* Müller-Liebenau, 1985).

*Tenuibaetis*: Fujitani *et al.*, in submission.



Figs. 6-8 - Schematized drawings of characters of baetid nymphs. 6: femur (dorsal), A) without villopore and robust setae with a median fold, B) with villopore, without robust setae with a median fold; C) with villopore and robust setae with a median fold; 7: scales and their bases, on abdominal tergum, A) trapezoidal bases, B) rounded bases; 8: paraproct, A) without a patch of notched scales in the middle and a projection on posterior end of the inner margin; B) with a projection on posterior end of the inner margin, without a patch of notched scales in the middle; C) with a patch of notched scales in the middle, without a projection on posterior end of the inner margin.

Characters for nymph: antennal scapes lacking a distal lobe (Fig. 1A); right mandible without a row of spine, prosthema toothbrush-like (Fig. 2D); maxillary palpus rounded at apex (Fig. 3A); labial palpus pointed at apex, without large lobe on inner margin of the second segment (Kang *et al.*, 1994) (Fig. 4A); glossa without a subapical setal patch (Fig. 5B); femur with villopore and robust setae possessing a medial fold on dorsal surface (Fig. 6C); scale bases rounded (Fig. 7B); paraproct with a patch of notched scales in the middle, without a projection on posterior end of the inner margin (Fig. 8C).

The subgenus *Tenuibaetis* was erected for *Baetis* species from Taiwan (Kang *et al.*, 1994). Waltz and McCafferty (1997) transferred 5 *Baetis* (*Tenuibaetis*) species to the genus *Baetiella* UÉNO, 1931 (Type species: *Acentrella japonica* IMANISHI, 1930). But nymphs of *Tenuibaetis* are different from those of *Baetiella* in possessing hind wing pads and cerci with fine setae on the inner margins and lacking long setae on outer margins of tibiae and tarsi. Thus Fujitani *et al.* (in submission) separated *Tenuibaetis* as a distinct genus from *Baetiella*.

*Tenuibaetis* sp. E (Kobayashi, 1987) n. comb.  
*Baetis* sp. E, Kobayashi, 1987, 53, nymph.

This species is distinguishable by the combination of following characters: labial palp with 3 - 4 setae on the second segment and dark brown abdomen with middle paler segments (Kobayashi, 1987). Kobayashi (1989) showed that this species is closely related to *B. pseudofrequentus* Müller-Liebenau 1985, a type species of subgenus *Tenuibaetis*.

*Tenuibaetis* sp. H (Kobayashi, 1987) n. comb.  
*Baetis* sp. H, Kobayashi, 1987, 53, nymph.

This species is distinguishable by the combination of following characters: brownish abdomen with a pair of pale markings on the fourth and eighth segments and labial palp with 6 -

7 setae on the second segment. Kobayashi (1989) showed that this species is closely related to *T. pseudofrequentus*.

Other Japanese species belonging to *Tenuibaetis*: *T. pseudofrequentus* (Müller-Liebenau, 1985).

Genus *Baetis* LEACH, 1815

*Baetis* Leach, 1815, 137 (Type species: *Ephemera fuscata* Linné, 1761).

*Brachyphlebia*: Westwood, 1840, 25 (Type species: *Ephemera fuscata* Linné, 1761).

*Baetis fuscatus* group: Müller-Liebenau 1969, 128.

*Baetis rhodani* group (the Holarctic species).

*Baetis vernus* group (the Holarctic species): Müller-Liebenau 1969, 104.

*Baetis* (*Tatubaetis*) Kang and Yang: Kang *et al.*, 1994, 23 (Type species of the subgenus: *Baetis tatuensis* Müller-Liebenau, 1985).

Waltz and McCafferty (1997) showed that *Baetis* (*s. str.*) included all species of *fuscatus* group and the Holarctic species of the *rhodani* group and the *vernus* group proposed by Müller-Liebenau (1969). We consider *Baetis* is still polyphyletic on the basis of morphological difference between the 3 species groups, e.g., species of the *rhodani* group possess rounded bristles on abdominal terga (Müller-Liebenau, 1969). Herein we only provide a list of Japanese species which have been included in *Baetis* (*s. str.*).

Japanese species belonging to *Baetis* (*s. str.*): *B. acuminatus* GOSE, 1980, *B. bicaudatus* DODDS, 1925, *B. celcus* IMANISHI, 1937, *B. hyugensis* GOSE, 1980, *B. iriomotensis* UÉNO, 1969, *B. sahoensis* GOSE, 1980, *B. takamiensis* GOSE, 1980, *B. thermicus* UÉNO, 1931, *B. totsukawaensis* GOSE, 1980, *B. tsushimensis* GOSE, 1980, *B. uenoi* GOSE, 1980, *B. yamatoensis* GOSE, 1980, *B. sp. F*, *B. sp. J*, *B. sp. M* and *B. sp. O*.

### Keys for genera and species

Keys to the genera for Japanese species described under the genus *Baetis* (*s.l.*)

1. Femur without villopore (Fig. 6A). Right mandible with a row of spines on inner margin (Figs. 2A, B, C). .....2
  - Femur with villopore (Figs. 6B, C). Right mandible without a row of spines on inner margin (Fig. 2D).....3
2. Paraproct with a projection (Fig. 8B). .....*Alainites*
  - Paraproct without a projection (Fig. 8A). .....*Nigrobaetis*
3. Antennal scape with a distal lobe on anterior margin (Fig. 1B). Maxillary palpus with a depression near apex (Fig. 3B). Scale bases trapezoidal (Fig. 7A).....*Labiobaetis*
  - Antennal scape without a distal lobe on anterior margin (Fig. 1A). Maxillary palpus without a depression near apex (Figs. 3A, C). Scale bases rounded (Fig. 7B).....4
4. Maxillary palpus rounded, without a projection at apex (Fig. 3A). Apical segments of labial palpus triangular (Fig. 4C). Femur possessing robust setae with a medial fold on dorsal surface (Fig. 6C).....*Tenuibaetis*
  - Maxillary palpus rounded, with a projection at apex (Fig. 3C). Apical segments of labial palpus rounded, truncated, or triangular. Femur lacking robust setae with a medial fold on dorsal surface (Fig. 6B).....*Baetis* (*s.s.*)

Keys to the Japanese species of genus *Nigrobaetis*

1. Glossa with a setal patch near apex (Fig. 5A). .....2
    - Glossa without a setal patch near apex (Fig. 5B).....4
  2. Right prosthema bifurcate (Fig. 2C).....*chocoratus*
    - Right prosthema manifold (Figs. 2A, B).....3
  3. Right mandible with a row of robust spines (Fig. 2A). .....sp. D
    - Right mandible with a row of fine spines (Fig. 2B). ..... sp. I
  4. Gills with 6 pairs. ....sp. N
    - Gills with 7 pairs. .... sp. P
- Nymphs of *N. sachisimensis* are unknown.

Keys to Japanese species of genus *Labiobaetis*

1. Maxillary palpus distinctly depressed near apex (Fig. 3B). Labrum with stout submarginal setae. Abdomen pale brown. ....sp. G
  - Maxillary palpus weakly depressed near apex. Labrum with fine submarginal setae. Abdomen dark brown with pale markings. ....sp. Q

Keys to the Japanese species of genus *Tenuibaetis*

1. Abdominal terga brownish, the fourth to sixth segments paler, with a pair of pale markings on the first to third and the sixth to ninth segments. Labial palpus with 3 - 4 setae on the second segment. ....sp. E
  - Abdominal terga brownish with a pair of pale markings on the fourth and eighth segments and a single pale marking on the ninth segments. ....2
2. Labial palpus with 6 - 7 setae on the second segment. Distributed in Honshu, Shikoku and Kyushu Islands.....sp. H
  - Labial palpus with 4 - 5 setae on the second segment. Distributed in Ryukyu Islands, southwest Japan. ....*pseudofrequentus*

Keys to the Japanese species of genus *Alainites*

1. Caudal filaments with dark brown bands. ....*florens*
    - Caudal filaments without dark brown bands. ....*yoshinensis*
- Nymphs of *A. atagonis* are unknown.

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