한국동물분류학회지 제14권 제1호
The Korean Journal of Systematic Zoology
Vol. 14, No. 1: 1-12 (March 1998)

Alainites, Baetis, Labiobaetis and *Nigrobaetis* (Ephemeroptera: Baetidae) in Korea

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ABSTRACT

Comprehensive examinations of larval and adult materials of mayflies from Korea resulted in *Alainites muticus, Baetis fuscatus, B. pseudothermicus* (new record), *B. silvaticus* (new record), *B. ursinus* (new record), *Labiobaetis atrebatinus*, and *Nigrobaetis acinaciger* (new record) in Baetidae. Larvae and known adults are described, figured, and photographed with SEM.

Key words: *Alainites, Baetis, Labiobaetis, Nigrobaetis,* Baetidae, Ephemeroptera, taxonomy, Korea

INTRODUCTION

In a series of taxonomic studies of Korean Baetidae, Park *et al.* (1996) and Bae and Park (1997) previously dealt with the genera *Acentrella, Baetiella, Cloeon*, and *Procloeon*. In this third series of the study, we include the remaining known genera of Baetidae (Baetinae), *Alainites, Baetis, Labiobaetis*, and *Nigrobaetis*.

For detailed historical review, synonymy, and other taxonomic changes in Baetidae of Korea, refer to Bae *et al.* (1994), Park *et al.* (1996), Bae (1997), Bae *et al.* (1997), and Bae and Park (1997). Materials and methods used in this paper are the same as in previous studies. For each species, however, only diagnostic characters for larva and known adult are provided with line-drawings and SEM photographs. Some baetid species which have not been determined in the mayfly fauna of North Korea (Bae and Soldán, 1997; Bae and Andrikovics, 1997) are verified in this paper. All the materials used in this study are deposited at Seoul Women's University.

This work was supported by the Korea Science and Engineering Foundation (project # 961-0508-063-2).

TAXONOMY

Genus *Alainites* Waltz, McCafferty, and Thomas, 1994

Waltz *et al.* (1994) elected the genus *Alainites* based on the *Baetis gracilis* group (Müller-Liebenau, 1969) in part or *Baetis muticus* group (Müller-Liebenau, 1974; Novikova and Kluge, 1994). The larva of *Alainites* is characterized by laterally compressed body, tergal setation, paraproct development, etc. (Waltz *et al.*, 1994; Waltz and McCafferty, 1996).

***Alainites muticus* (Linnaeus, 1758) (Figs. 4, 18)**

Ephemera mutica Linnaeus, 1758 (Müller-Liebenau, 1969 for full citation and synonymy).

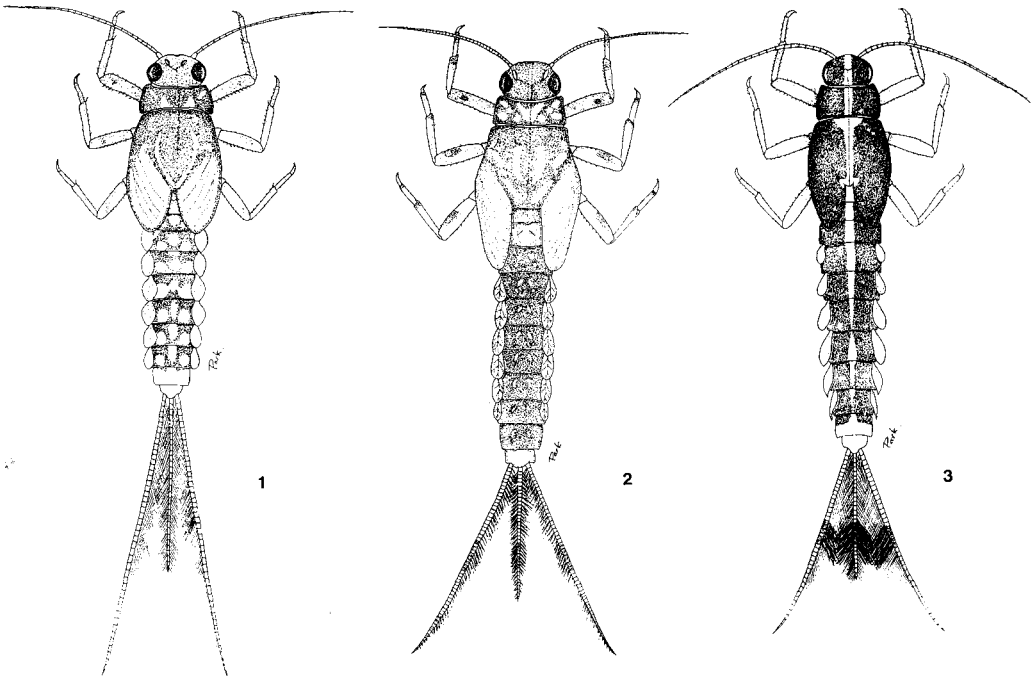
Baetis Kua: Yoon and Bae, 1988, p.111.

Baetis (*Nigrobaetis*) *muticus* (Linnaeus): Novikova and Kluge, 1994, p.635; Bae *et al.*, 1997 (in press).

Alainites muticus (Linnaeus): Waltz *et al.*, 1994, p.34.

Material examined. 6L: KG, Yangju, Pogwangsa, IV4, 1981; 3L: KG, Namyangju, Chonmasan, V6, 1995.

Mature larva. Dimensions (mm)**:** Body length 7.0-8.0; antennae 3.5; forefemora, foretibiae and foretarsi 0.82, 0.80 and 0.82; midfemora, midtibiae and midtarsi 0.85, 0.75 and 0.52; hindfemora, hindtibiae and hindtarsi 1.07, 0.75 and 0.43; cerci 4.0; terminal filament 2.0.



Figs. 1-3. Larval habitus: 1, *Baetis ursinus*; 2, *Labiobaetis atrebatinus*; 3, *Nigrobaetis acinaciger*.

Description: General body laterally compressed, elongate; color brown, without distinct markings (Fig. 4). Mouthparts (Fig. 18); maxillary palp segment 3 articulated (segment 3 0.3 × length of segment 2). Gill lamellae on abdominal tergum 1-7 with distinct tracheae. Paraproct with prolongation. Caudal filaments brown; length of cerci 2.0 × length of terminal filament.

Male adult. Unknown.

Female adult. Unknown.

Genus *Baetis* Leach

The concept of *Baetis* was historically complicated, but its present concept has restricted to only *Baetis fuscatus* group and some closely related genera (Müller-Liebenau, 1969; McCafferty and Waltz, 1990; Novikova and Kluge, 1994; Waltz and McCafferty 1996). The larva of *Baetis* can be characterized by the possession of single ovoid gills on the abdominal segment 1-7, the 2nd segment of the labial palp expanded (Fig. 19), and the three caudal filaments well-developed. The adult of *Baetis* possesses double marginal intercalaries in forewings and distinct costal process in hindwings. Larvae of *Baetis* occur in common in wide range of lotic and lentic habitats. They are found from small headwater streams to large rivers or estuaries, often in polluted streams.

***Baetis fuscatus* (Linnaeus, 1761) (Figs. 5, 6, 19)**

Ephemera fuscata Linnaeus, 1761 (Müller-Liebenau, 1969 for full citation and synonymy).

Baetis nla: Imanishi, 1940, p.221; Yoon and Bae, 1988, p.111.

Baetis fuscatus (Linnaeus): Müller-Liebenau, 1969, p.128; Bae and Soldán, 1997, p.145; Bae and Andrikovics, 1997, p.155; Bae *et al.*, 1997 (in press).

Material examined. 5M & 14F (reared) & 165L: KG, Namyangju, Wangsuk cr. at Imsong br. and Pupyong br., V22, VI5, VI22, 1996.

Mature larva. Dimensions (mm)**:** Body length 6.0; antennae 1.6; forefemora, foretibiae and foretarsi 0.75, 0.50 and 0.45; midfemora, midtibiae and midtarsi 0.62, 0.45 and 0.37; hindfemora, hindtibiae and hindtarsi 0.65, 0.47 and 0.37; cerci 2.3; terminal filament 1.6.

Description: General body color brown. Mouthparts (Fig. 19) maxillary palp segments 3 not clearly articulated; terminal segments of labial palp with many hairlike setae. Abdominal tergum 2-8 (Fig. 5) with paired opaque dark dots; tergum 2-4 and 6-7 with paired light markings in posterior half (markings on tergum 2 often connected); tergum 9 and 10 light, without marking. Caudal filaments light with brown belt at mid-length; terminal filament ca. 0.7 × length of cerci.

Male adult. Dimensions (mm)**:** Body length 5.2; antennae 0.95; longitudinal diameter of compound eye 0.60; cross diameter of compound eye 0.55; distance between compound eyes 0.20; height of dorsal compound eye 0.45; forefemora, foretibiae, foretarsal segments 1, 2, 3, 4 and 5 1.00, 1.20, 0.05, 0.52, 0.42, 0.22 and 0.15; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4 and 5 0.72, 0.77, 0.05, 0.15, 0.07, 0.05 and 0.15; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 0.77, 0.62, 0.05, 0.17, 0.05, 0.03 and 0.15; forewing length 5.0; forewing width 2.0; forceps segments 1, 2 and 3 0.12, 0.35 and 0.05.

Description: General body color brown. Dorsal compound eyes orange; height of dorsal eye ca. 0.7 × width of dorsal eye; distance between compound eyes ca. 0.3 × cross diameter of a compound eye; ventral eyes black. Ocelli yellow. Antennae light brown. Thoracic nota brown. Forewings veins

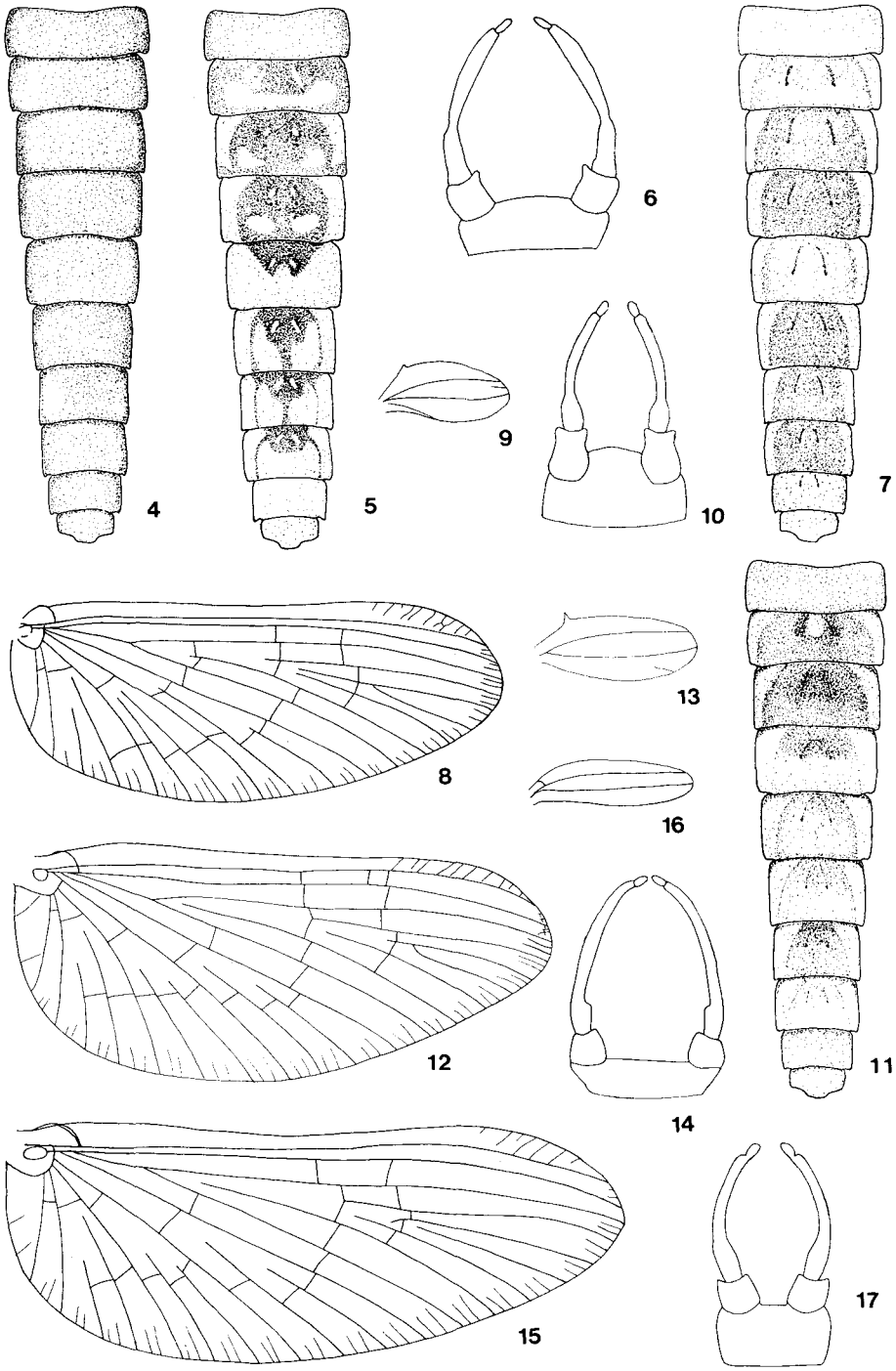


Fig. 4-17. 4, *Alainites muticus*, larval dorsal abdomen; 5-6, *Baetis fuscatus*: 5, larval dorsal abdomen; 6, male adult genitalia; 7-10, *B. pseudothermicus*: 7, larval dorsal abdomen; 8, male adult forewing; 9, male adult hindwing; 10, male adult genitalia; 11-14, *B. silvaticus*: 11, larval dorsal abdomen; 12, male adult forewing; 13, male adult hindwing; 14, male adult genitalia; 15-17, *Labiobaetis atrebatinus*: 15, male adult forewing; 16, male adult hindwing; 17, male adult genitalia.

white. Legs white. Abdominal tergum 1-6 and 10 white; tergum 7-9 brown; tergum 2-8 laterally with small brown dots. Forceps (Fig. 6) white; length of segment 2 ca. 3.0 × length of segment 1. Cerci white.

Female adult. Dimensions (mm)**:** Body length 5.2; antennae 0.72; forefemora, foretibiae, foretarsal segments 1, 2, 3, 4 and 5 0.77, 0.82, 0.05, 0.12, 0.06 0.02 and 0.22; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4 and 5 0.85, 0.80, 0.05, 0.15, 0.07, 0.02 and 0.22; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 0.90, 0.92, 0.05, 0.12, 0.06, 0.03 and 0.22; forewing length 5.20; forewing width 2.0; cerci 9.0. General body color and shape similar to male.

Remarks. This species has been known as *Baetis* nla (Imanishi, 1940) in Korea which was characterized by the light markings on the abdominal terga (lacking distinct dark dots). Previous reports on "*Baetis* nla" in faunistic and ecological papers in Korea are most probably this species. This is one of the most common mayflies in Korea and often found in moderately polluted streams near urban areas.

***Baetis pseudothermicus* Kluge, 1983 (Figs. 7-10, 20)**

Baetis pseudothermicus Kluge, 1983, p.53.

Baetis thermicus Uéno: Yoon and Bae, 1988, p.110.

Baetis sp. A: Bae and Soldán, 1997, p.145.

Baetis sp. 1: Bae and Andrikovics, 1997, p.155.

Material examined. 6L: KG, Kapyong, Moktong, IV30, 1994; 2L: KG, Kapyong, Yumyongsan, V14, 1983; 1L: KG, Kanghwado, Chondungsa, VII20, 1993; 1L: KW, Inje, Pangtae cr., V18, 1996; 30L: KW, Yangyang, Soraksan, Osaek, Sorakpokpo, VI20, 1995; 27L: KW, Hongchon, Kachilbong, VI23, 1984; 1L: KW, Hongchon, Kyebangsan, Undugol, VI5, 1983; 1L: KW, Chongson, Sukam-ri, V5, 1985; 3L: KW, Samchok, Tutasan, Murunggyegok, V26, 1985; 3L: KW, Wonju, Chiaksan, Kuryongsa, V17, 1985; 9L: CCB, Chechon, Woraksan, Songgye, V30, 1987; 1M & 1F: CCB, Chechon, Toktong, VII14, 1996; 56L: CCB, Tanyang, Taedae-ri, Ouigok, VI2, 1996; 9L: CCB, Poun, Songnisan, Sesimjong, VIII10, 1983; 5L: KB, Yongju, Sobaeksan, Huibangsa, V19, 1984; 31L: CLB, Chonju, Wibongsan, Wibongsa, VIII6, 1994; 7L: CLB, Kimje, Moaksan, Kumsansa, V23, 1992; 2L: CLN, Haenam, Turyunsan, Chongsinam, IV23, 1993.

Mature larva. Dimensions (mm)**:** Body length 5.5-7.0; antennae 2.5; forefemora, foretibiae and foretarsi 1.15, 0.85 and 0.62; midfemora, midtibiae and midtarsi 1.22, 0.85 and 0.60; hindfemora, hindtibiae and hindtarsi 1.17, 0.80 and 0.57; cerci 4.5-5.3; terminal filament 2.7.

Description: General body color brown. Abdominal tergum 3-4 and 6-8 darker; tergum 2-9 with dark submedian streaks and dots (Fig. 7); posterior margin of abdominal tergum with round notches (Fig. 20); surface of tergum with relatively short and apically round setae (Fig. 20). Gills 1-7 with distinct tracheae. Caudal filaments brown; terminal filament ca. 0.5 × length of cerci.

Male adult. Dimensions (mm)**:** Body length 5.0; antennae 1.00; longitudinal diameter of compound eye 0.60; cross diameter of compound eye 0.47; distance between compound eyes 0.05; height of dorsal compound eye 0.35; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4 and 5 0.75, 0.77, 0.05, 0.12, 0.07, 0.05 and 0.15; (fore and hindlegs missing); forewing length 4.5; forewing width 1.7; forceps segments 1, 2 and 3 0.12 0.32 and 0.05.

Description: General body color light brown. Dorsal compound eyes yellow; height of dorsal eye ca. 0.5 × width of dorsal eye; distance between compound eyes ca. 0.11 × cross diameter of a compound eye; ventral eyes black. Ocelli yellow. Thoracic nota brown. Forewings (Fig. 8) transparent with light brown veins. Hindwings (Fig. 9) with small costal process at 1/4 distance from base, and with 3 longitudinal veins. Legs light. Abdominal terga light yellow; posterior margin of tergum 1-8 dark. Forceps (Fig. 10) white. Cerci white.

Female adult. Dimensions (mm)**:** Body length 5.0; antennae 0.70; forefemora, foretibiae, foretarsal segments 1, 2, 3, 4 and 5 0.70, 0.67, 0.05, 0.1, 0.07 0.05 and 0.15; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4 and 5 0.67, 0.67, 0.05, 0.12, 0.06, 0.05 and 0.13; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 0.70, 0.65, 0.05, 0.10, 0.05, 0.04 and 0.15; forewing length 4.7; forewing width 1.8. Body color and shape similar to male.

Remarks. Based on the examination of larval and adult materials (including holotype and paratypes) of *B. pseudothermicus* from Far East Russia, we determined materials of South Korea as well as those of North Korea (Bae and Soldán, 1997; Bae and Andrikovics, 1997) as *B. pseudothermicus*. Imanishi (1940) reported larvae of *Baetis thermicus* Uéno from North Korea. We, however, could not confirm it because any reference materials of *B. thermicus* have not been available at this time. Previous reports on *B. thermicus* in various faunistic and ecological papers in Korea are most probably to be this species. This is one of the most common mayflies in Korea.

***Baetis silvaticus* Kluge, 1983 (Figs. 11-14, 21)**

Baetis silvaticus Kluge, 1983, p.55.

Baetis sp. B: Bae and Soldán, 1997, p.145.

Baetis sp. 2: Bae and Andrikovics, 1997, p.155.

Material examined. 4L: SL, Socho-gu, Chonggyesan, VIII8, 1994; 5L: KG, Pochon, Sanjonghosu, VII27, 1995; 40L: KW, Taebaek, Taebaeksan, Tanggol, VIII13, 1983; 1M (reared) & 6L: KW, Wonju, Chiaksan, Sangwongol, VII2, 996; 3L: CCB, Chechon, Woraksan, VI24, 1994; 3L: CCB, Chechon, Pongyang, Nomok, VIII22, 1995; 4M, 1Fs (reared) & 1L: CCB, Tanyang, Taedae-ri, Sobaeksan, Ouigok, VI15, 1996; 2L: CCB, Tanyang, Sobaeksan, Nam cr., VI, 1994; 1L: CCN, Kongju, Kyeryongsan, V28, 1995; 2L: CCN, Yesan, Sudoksa, VIII2, 1983; 6L: CLB, Kimje, Moaksan, Kumsansa, IX30, 1984; 1L: CLB, Chonju, Wibongsan, Wibongsa, VIII6, 1994; 8L: CLN, Sungju, Songgwangsa, V30, 1983.

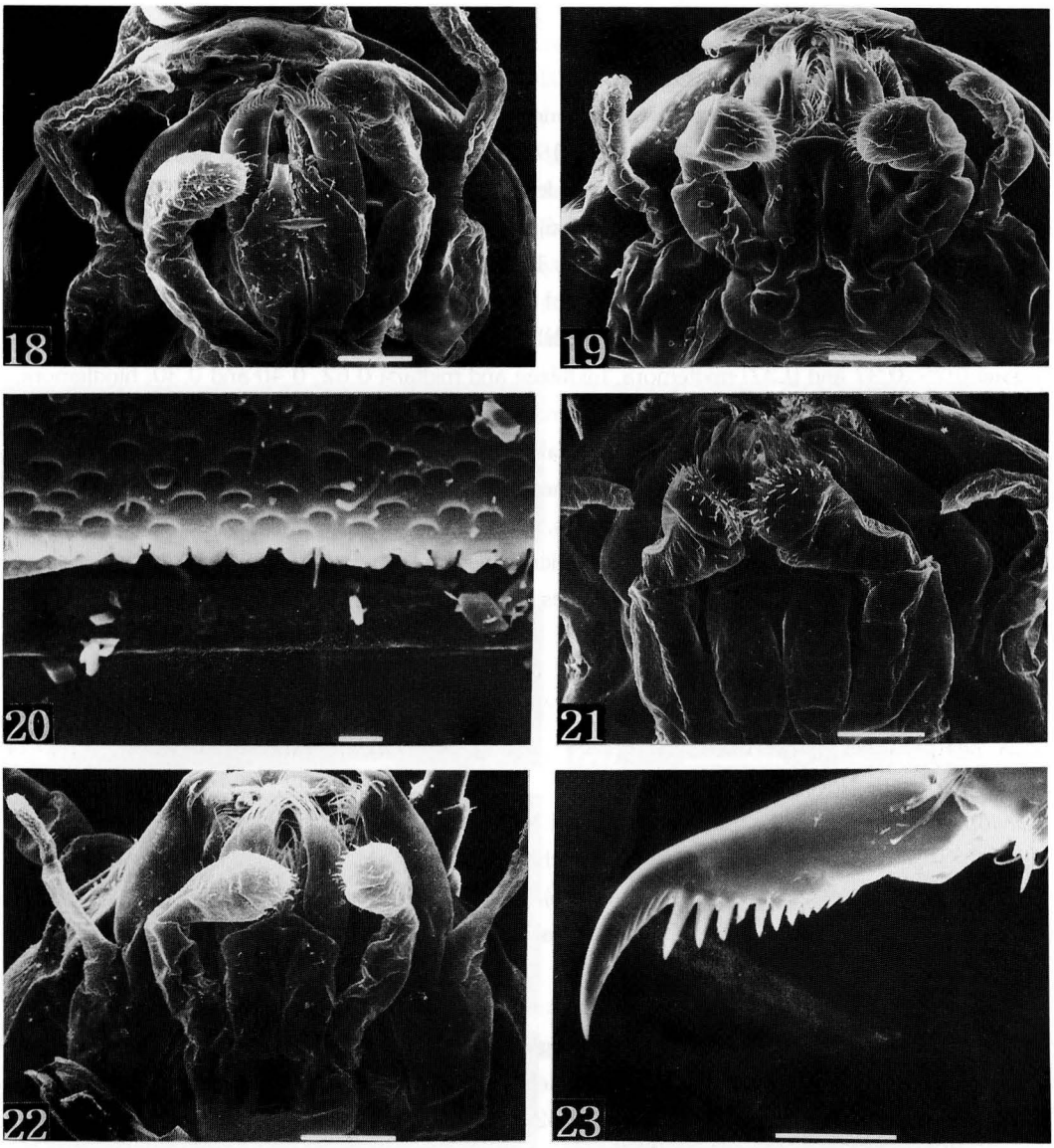
Mature larva. Dimensions (mm)**:** Body length 7.0; antennae 2.6; forefemora, foretibiae and foretarsi 1.02, 0.82 and 0.52; midfemora, midtibiae and midtarsi 1.05, 0.85 and 0.45; hindfemora, hindtibiae and hindtarsi 1.17, 0.62 and 0.42; cerci 5.5; terminal filament 2.6.

Description: General body color brown. Mouthparts as in Fig. 21. Abdominal tergum 3-4 and 6-8 darker; tergum 2-9 with dark submedian streaks and dots (Fig. 11); posterior margin of abdominal tergum with pointed notches as in Fig. 26. Gills 1-7 with distinct tracheae. Caudal filaments brown; terminal filament ca. 0.5 × length of cerci.

Male adult. Dimensions (mm)**:** Body length 5.8; antennae 1.10; longitudinal diameter of compound eye 0.52; cross diameter of compound eye 0.45; distance between compound eyes 0.12; height of dorsal compound eye 0.50; forefemora, foretibiae, foretarsal segments 1, 2, 3, 4 and 5 1.10, 2.15, 0.07, 0.90, 0.85, 0.04 and 0.17; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4

and 5 0.87, 0.10, 0.05, 0.20, 0.15 0.07 and 0.15; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 0.75, 1.00, 0.05, 0.20, 0.17, 0.05 and 0.12; forewing length 5.8; forewing width 2.4; forceps segments 1, 2 and 3 0.17, 0.40 and 0.05; cerci 16.0.

Description: General body color light brown. Dorsal eyes orange; height of dorsal eye as long as width of dorsal eye; distance between compound eyes ca. 0.2 × cross diameter of a compound eye; ventral eyes black. Ocelli light yellow. Antennae light. Thorax nota light brown. Forewings (Fig. 12)



Figs. 18-23. SEMs of larval parts: 18, *Alainites muticus*, ventral mouthparts (bar = 100 μm); 19, *Baetis fuscatus*, ventral mouthparts (bar = 100 μm); 20, *B. pseudothermicus*, posterior margin of 5th abdominal tergum (bar = 10 μm); 21, *B. silvaticus*, ventral mouthparts (bar = 100 μm); 22-23, *Baetis ursinus*: 22, ventral mouthparts (bar = 100 μm); 23, claw (bar = 50 μm).

transparent; basal portion of longitudinal veins brown. Hindwings (Fig. 13) with brown costal process at 1/4 distance from base. Legs white. Abdominal terga light yellow; posterior margin of tergum 1-8 dark. Forceps (Fig. 14) white; segments 2 with distinct process mesially at ca. 1/4 from base.

Female adult. Unknown

Remarks. The larva of *B. silvaticus* is similar to that of *B. pseudothermicus*, but can be distinguished by the armature of the dorsal surface and posterior margin of the abdominal terga.

***Baetis ursinus* Kazlauskas, 1963 (Figs. 1, 22-24)**

Baetis ursinus Kazlauskas, 1963, p.585; Kluge, 1983, p.58.

Baetis sp. C: Bae and Soldán, 1997, p.145.

Material examined. 6L: KG, Kapyong, Kapyong cr. at Omok br., VII25, 1994, IV16, 1995; 17L: KG, Kapyong, Kapyong cr. at Moktong, X6, 1985, VII24, 1994, V1, 1995; 1L: KG, Kapyong, Yumyongsan, IV10, 1995; 1L: KW, Inje, Soraksan, Paektamsa, VI4, 1983; 1L: KW, Yangyang, Soraksan, Osaek, VI20, 1995; 21L: KW, Wonju, Chiaksan, Sangwongol, VII2, 1996; 3L: KW, Wonju, Chiaksan, Chupo cr. at Okjon, V4, VII3, 1996; 4L: CCB, Tanyang, Osangchon, Ogok cr. at Tolbaram, VI4, 1993.

Mature larva. Dimensions (mm)**:** Body length 3.0-4.0; antennae 1.5; forefemora, foretibiae and foretarsi 0.75, 0.37 and 0.37; midfemora, midtibiae and midtarsi 0.62, 0.40 and 0.30; hindfemora, hindtibiae and hindtarsi 0.70, 0.45 and 0.32; cerci 3.0; terminal filament 1.8.

Description: General body color brown. General body shape as in Fig. 1. Mouthparts as in Fig. 22. Dorsal thorax (Fig. 1) brown; posterior half of mesonotum including forewingpads white. Claws (Fig. 23) with single row of well developed denticles. Abdominal tergum 2-3 and 5-8 with longitudinal median light stripe and paired light round markings (Fig. 1); tergum 4, 9 and 10 light; posterior margin of abdominal tergum with pointed notches (Fig. 24). Gills 1 very small. Caudal filaments light; terminal filament ca. 0.6 × length of cerci.

Male adult. Unknown.

Female adult. Unknown.

Genus *Labiobaetis* Novikova and Kluge, 1987

Labiobaetis was established by Novikova and Kluge (1987) based on *Baetis atrebatinus* group (Müller-Liebenau, 1969). The genus was well characterized by McCafferty and Waltz (1995) and more discussed by Waltz and McCafferty (1996). The larva of *Labiobaetis* is distinguished by the excavate tip of the maxillary palp, enlarged labial palp, and the notched antennal segment 1. The hindwings of adult lack costal process.

***Labiobaetis atrebatinus* (Eaton, 1870) (Figs. 2, 15-17, 25, 26)**

Baetis atrebatinus Eaton, 1870, p.4; Müller-Liebenau, 1969, p.150.

Baetis atrebatinus orientalis Kluge, 1983, p.62.

Baetis (*Labiobaetis*) *atrebatinus orientalis* Kluge: Tshernova *et al.*, 1986, p.131.

Baetis (*Labiobaetis*) *atrebatinus* Eaton: Novikova and Kluge, 1987, p.13.

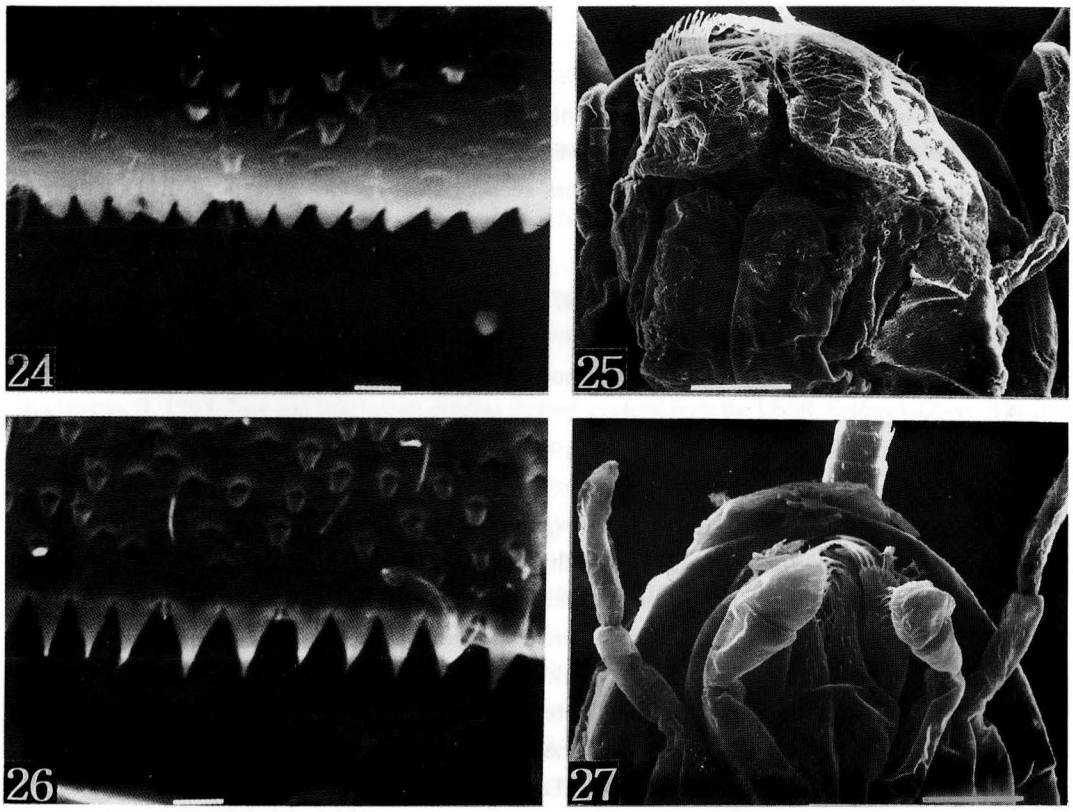
Labiobaetis atrebatinus (Eaton): McCafferty and Waltz, 1995, p.21; Bae and Soldán, 1997, p.146.

Material examined. 38M, 38F (reared) and 1L: KG, Namyangju, Wangsuk cr., X5, 13, 1995; 7L: KG, Kapyong, Kapyong cr., VII15, 1993; 21L: KG, Kapyong, Chojong cr., VII4, VIII21, 24, 1994; 11L: KW, Yongwol, Pobhung-ri, VIII11, 1993; 1M (reared): CCB, Chechon, Chupo cr. at Okjon, VII3, 1996; 1L & 1F (reared): KG, Kapyong, Sudong cr. at Sudong br., VII5, 9, 1993.

Mature larva. Dimensions (mm)**:** Body length 7.0-7.5; antennae 2.5; forefemora, foretibiae and foretarsi 0.75, 0.57 and 0.45; midfemora, midtibiae and midtarsi 0.85, 0.62 and 0.37; hindfemora, hindtibiae and hindtarsi 0.87, 0.57 and 0.37; cerci 3.3; terminal filament 2.2.

Description: General body (Fig. 2) color reddish brown. Vertex with 3-4 pairs of small light markings. Antennae segments 1 and 2 brown; segments 3 light. Mouthparts as in Fig. 25; terminal segment of maxillary palp excavate; labial palp enlarged and with many hairlike setae. Abdominal terga 2-9 (Fig. 2) with light submedian streaks and dots behind them; posterior margin of abdominal tergum with pointed notches (Fig. 26). Gills 1 small; gills 2-7 somewhat elongate, with well-developed tracheae. Cerci ca. 0.5 × length of body; terminal filament ca. 0.7 × length of cerci.

Male adult. Dimensions (mm)**:** Body length 5.2-5.6; antennae 1.10; longitudinal diameter of compound eye 0.80; cross diameter of compound eye 0.50; distance between compound eyes 0.00; height of dorsal compound eye 0.37; forefemora, foretibiae, foretarsal segments 1, 2, 3, 4 and 5 1.05, 1.90, 0.12, 0.60, 0.52, 0.37 and 0.12; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4



Figs. 24-27. SEMs of larval parts: 24, *Baetis ursinus*, posterior margin of 5th abdominal tergum (bar = 10 μm); 25-26, *Labiobaetis atrebatinus*: 25, ventral mouthparts (bar = 100 μm); 26, posterior margin of 5th abdominal tergum (bar = 10 μm); 27, *Nigrobaetis acinaciger*, ventral mouthparts (bar = 100 μm).

and 5 0.87, 0.92, 0.06, 0.10, 0.10, 0.15 and 0.15; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 0.95, 0.85, 0.05, 0.10, 0.08, 0.05 and 0.15; forewing length 5.5; forewing width 2.3; forceps segments 1, 2 and 3 0.15, 0.62 and 0.05; cerci 12.0.

Description: General body color reddish brown. Dorsal eyes reddish brown; ventral eyes dark grey. Ocelli yellow. Antennae segments 1 and 3 light; segments 2 dark brown. Forewings (Fig. 15) transparent; veins white; area between C and R slightly translucent. Hindwings (Fig. 16) with 2 longitudinal veins, without costal process. Abdominal tergum 1 brown; tergum 2-6 light yellow; tergum 7-10 reddish brown; posterior margin of tergum 2-9 reddish brown. Forceps (Fig. 17) white, segments 2 ca. 4.0 × length of segments 1; segments 3 not clearly articulated. Cerci white, ca. 2.2 × length of body.

Female adult. Dimensions (mm)**:** Body length 4.6-6.0; antennae 0.75; forefemora, foretibiae, foretarsal segments 1, 2, 3, 4 and 5 0.62, 0.95, 0.03, 0.10, 0.10 0.05 and 0.17; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4 and 5 0.75, 0.95, 0.03, 0.07, 0.06, 0.04 and 0.15; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 0.80, 0.82, 0.05, 0.10, 0.07, 0.03 and 0.13; forewing length 5.4; forewing width 2.0; cerci 7.1. General body color and shape similar to male.

Remarks. The larvae are found in the margin of streams where current is moderately fast and aquatic macrophytes are abundant.

Genus *Nigrobaetis* Novikova and Kluge, 1994

Nigrobaetis was originally treated as *Baetis niger* group by Müller-Liebenau (1969) and later was well characterized by Waltz *et al.* (1994), Novikova and Kluge (1994), and Waltz and McCafferty (1996). The larvae are cylindrical in body cross section, dark in color, and lack prolongation in paraproct.

***Nigrobaetis acinaciger* Kluge, 1983 (Figs. 3, 27)**

Baetis acinaciger Kluge, 1983, p. 59.

Baetis (*Nigrobaetis*) *acinaciger* Kluge: Tshernova *et al.*, 1986, p.134; Novikova and Kluge, 1994, p.635.

Nigrobaetis acinaciger (Kluge): Waltz *et al.*, 1994, p.35.

Material examined. 5L: KW, Inje, Pangtae cr., V16-18, 1996; 3L: KG, Kapyong, Kapyong cr. at Moktong, V1, 1994; 1L: KG, Kapyong, Kapyong cr. at Omok br., VII25, 1994.

Mature larva. Dimensions (mm)**:** Body length 3.8-4.2; antennae 2.8; forefemora, foretibiae and foretarsi 0.75, 0.50 and 0.37; midfemora, midtibiae and midtarsi 0.80, 0.55 and 0.52; hindfemora, hindtibiae and hindtarsi 0.87, 0.45 and 0.30; cerci 2.8; terminal filament 2.3.

Description: General body (Fig. 3) color dark brown with median white stripe. Antennae light brown. Mouthparts as in Fig. 27. Thoracic nota (Fig. 3) color dark brown with longitudinal white median stripe; anterior and posterior area of mesonotum with light median marking; sterna white, with symmetrical 3-paired dark brown maculae. Legs light brown. Abdominal tergum 1-8 dark brown with white median stripe; posterior half of tergum 9 and tergum 10 white. Gills on abdominal segment 2-7; gills 2 small; gills 3-5 oval; gills 6-7 narrow and apically pointed. Caudal filaments brown with broad black belt at mid-length.

Male adult. Unknown.

Female adult. Unknown.

ACKNOWLEDGEMENTS

We thank Drs. N. Ju. Kluge (St. Petersburg), T. Soldán (České Budějovice), and W. P. McCafferty (W. Lafayette, Indiana) for their useful comments.

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RECEIVED: 26 November 1997
ACCEPTED: 29 December 1997

한국산 *Alainites, Baetis, Labiobaetis* 및 *Nigrobaetis*속 (하루살이목: 꼬마하루살이과)의 분류

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적 요

한국산 꼬마하루살이과의 유충 및 성충 표본에 대한 종합적인 검토를 한 결과 *Alainites muticus, Baetis fuscatus, Labiobaetis atrebatinus*와 한국 미기록종인 *B. pseudothermicus, B. silvaticus, B. ursinus* 및 *Nigrobaetis acinaciger*를 확인하였다. 이들의 유충과 알려진 성충을 그림 및 주사전자현미경 사진과 함께 기재하였다.