

Taxonomy of *Cloeon* and *Procloeon* (Ephemeroptera: Baetidae) in Korea

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ABSTRACT

Comprehensive examinations of larval and adult materials of mayflies from Korea resulted in the recognition of *Cloeon dipterum*, *Procloeon maritimum* (new record), *P. pennulatum* (new record), and *P. halla* n. sp. in Baetidae (Cloeoninae). Larvae and known adults are described with illustrations.

Key words: *Cloeon*, *Procloeon*, Baetidae, Ephemeroptera, taxonomy, Korea

INTRODUCTION

In a series of taxonomic studies of Korean Baetidae, Park *et al.* (1996) previously presented historical review and the taxonomy of *Acentrella* and *Baetiella*. In this paper, we include the genera *Cloeon* and *Procloeon* which belong to the subfamily Cloeoninae in Baetidae (Kluge and Novikova, 1992). Bae (1997) presented a historical review of Ephemeroptera systematics in Northeast Asia, including Korea, Japan, Far East Russia, and northeastern China. Bae *et al.* (1997) compared some taxonomically related mayfly species, found in Korea and Far East Russia, including Baetidae.

Materials and methods used in this paper are the same as those of Park *et al.* (1996). Materials from North Korea as well as reference materials from Far East Russia and Japan were also examined. Some baetid species which were undetermined 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, including types, are deposited at Seoul Women's University.

SYSTEMATICS

Cloeon Leach

Cloeon Leach is one of the earliest genera of Ephemeroptera established by Leach in 1815, together with *Baetis* Leach. Generic concept of *Cloeon* has been restricted since Eaton (1885), and various workers (Sowa 1975; Edmunds *et al.*, 1976; Gillies, 1980; McCafferty and Waltz, 1990; Kluge and Novikova, 1992) have revised or reclassified the genus.

The adult of *Cloeon* was previously distinguished from other genera of Baetidae (e.g., *Centroptilum*) by the absence of hindwings, but that concept is not currently in use because reductions and/or losses of the hindwings occur in many lineages of Baetidae (Edmunds *et al.*, 1976; McCafferty and Waltz, 1990). In a revision of the Cloeoninae of the palaearctic region, Kluge and Novikova (1992) much restricted the concept of *Cloeon* by the characters of the hindtarsal index and the forewing crossvein arrangement in adults.

Among the baetid genera known in Korea, the larva of *Cloeon* can be distinguished by the characters of the absence of hindwingpads, weakly developed lateral spines in abdominal segment 8-10 (Fig. 2), and the round posterior margin of the abdominal tergum 10 which possesses subequal marginal spines (Fig. 19). The adult of *Cloeon* can be distinguished by the single intercalary vein of forewings (Fig. 4) and the absence of hindwings. Larvae of *Cloeon* are found among aquatic macrophytes in pools or in the margin of riffles in streams or rivers, and also frequently found in ponds or lakes.

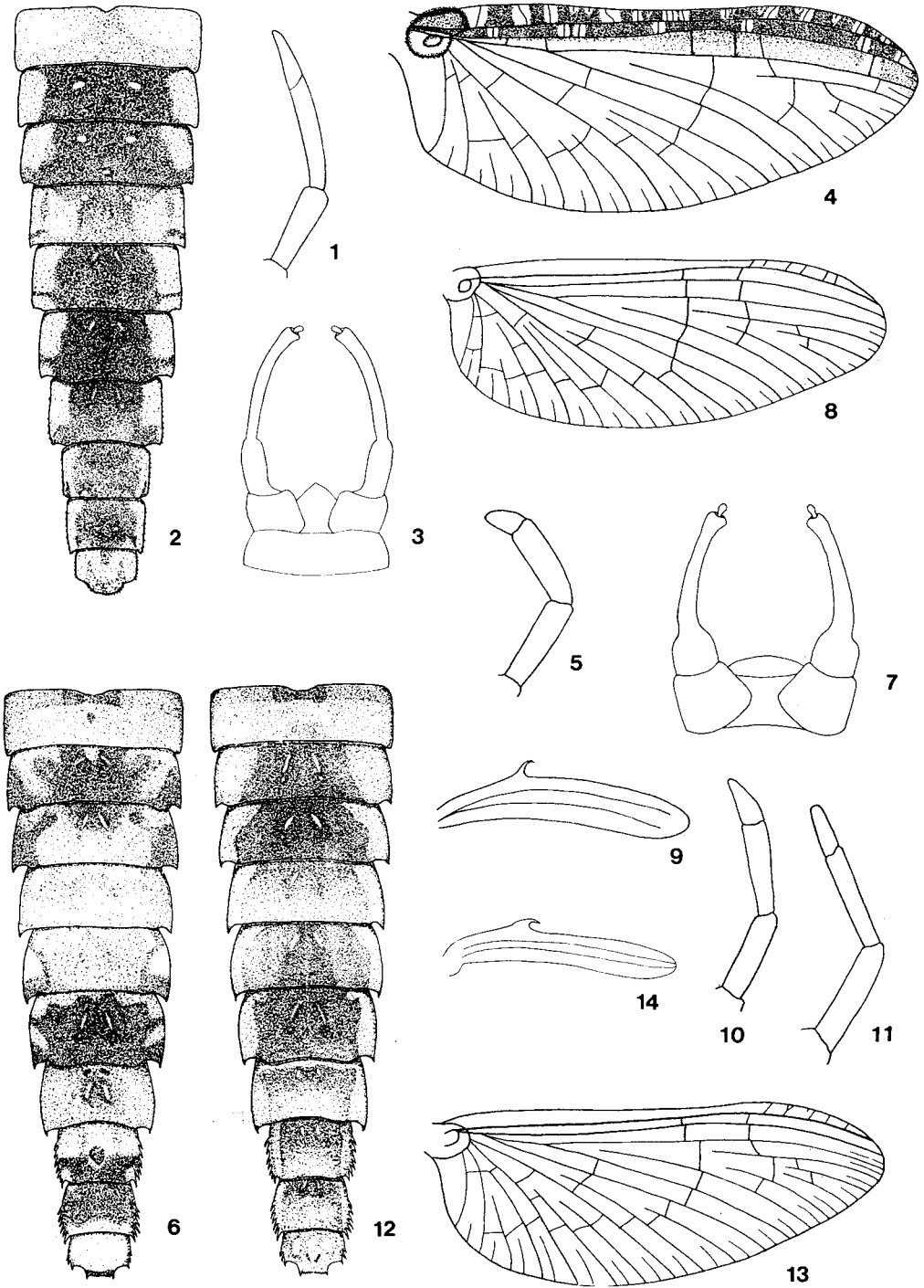
***Cloeon dipterum* (Linnaeus) (Figs. 1-4, 17-19)**

Ephemerella diptera Linnaeus, 1761 (for full citation and synonymy see Eaton, 1885 and Sowa, 1975).

Cloeon dipterum (Linnaeus): Leach, 1815: 137; Eaton, 1885: 182; Uéno, 1928: 49; Imanishi, 1940: 215; Sowa, 1975: 215 [*sensu stricto*]; Yoon and Bae, 1988: 112; Bae *et al.*, 1994: 34.

Mature larva. Dimensions (mm): Body length 8.7-10.3; antennae 5.0-6.0; forefemora, foretibiae and foretarsi 1.5, 0.8 and 1.0; midfemora, midtibiae and midtarsi 1.8, 1.0 and 0.8; hindfemora, hindtibiae and hindtarsi 1.8, 1.0 and 1.0; cerci 6.0-6.4; terminal filament 6.0-6.4.

Description: General body color light brown. **Head.** Vertex with paired longitudinal markings. Antennae relatively long, extending to abdominal segment 3, with whirl of minute hairlike setae at each segment. Labrum slightly concave. Maxillary palp (Figs. 1, 17) 3-segmented with hairlike setae. Labial palp (Fig. 17) 3-segmented; segments 2 and 3 distinctly articulated; segments 3 truncate, with strongly developed simple-stout setae apically. **Thorax.** Notae with small light irregular markings. Legs white; claws (Fig. 18) with two rows of well developed denticles. **Abdomen.** Abdominal terga 1-9 (Fig. 2) with pair of tiny light markings; posterolateral projections weakly developed; lateral margins with simple-stout setae; posterior margin of tergum 1-9 with acute spines as in Fig. 27; posterior margin of tergum 10 (Fig. 19) round, with row of spines (spines subequal). Gills 1-6 paired; dorsal lamella smaller; gills 3 largest; gills 7 single, elongated. Caudal filaments ca. 0.6 × length of



Figs. 1-14. 1-4, *Cloeon dipterum*: 1, maxillary palp; 2, larval dorsal abdomen; 3, male adult genitalia; 4, female adult forewing; 5-9, *Procloeon maritimum*: 5, maxillary palp; 6, larval dorsal abdomen; 7, male adult genitalia, 8, female adult forewing; 9, female adult hindwing; 10, *P. pennulatum*: maxillary palp; 11-13, *P. halla*: 11, maxillary palp; 12, larval dorsal abdomen; 13, female adult forewing; 14, female adult hindwing

body, with whirl of simple-stout setae; simple-stout setae on every 4th segment prominent.

Male adult. Dimensions (mm): Body length 5.5-8.5; antennae 1.0; longitudinal diameter of compound eye 0.92; cross diameter of compound eye 0.62; distance between compound eyes 0.12; height of dorsal compound eye 0.37; forefemora, foretibiae and foretarsal segments 1, 2, 3, 4 and 5 1.70, 2.55, 0.07, 0.95, 0.87, 0.47 and 0.32; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4 and 5 1.55, 1.30, 0.07, 0.37, 0.87, 0.25 and 0.17; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 1.55, 1.17, 0.07, 0.70, 0.22, 0.10 and 0.25 forewing length 5.0-8.9; forewing width 2.0-3.2; forceps segments 1, 2 and 3 0.15, 0.65 and 0.05; cerci 12.0-14.0.

Description: General body color light brown with purplish brown markings. **Head.** Dorsal compound eyes light yellow; height of dorsal eye ca. $0.5 \times$ width of dorsal eye; distance between compound eyes ca. $0.2 \times$ cross diameter of a compound eye; ventral eyes oval, light grey, with paired dark grey longitudinal stripes. Ocelli dome-shaped, light yellow, with circumferential black stripe. Antennae 3-segmented; segments 1 and 2 with circumferential stripes apically. **Thorax.** Color purplish brown; membranous region white. Forewings transparent, without markings; areas between Sc and R translucent. Forefemora purplish brown, with dark spot basally and apically; tibiae and tarsi white, without markings; claws basally dark brown. **Abdomen.** Abdominal terga light yellow with broad lateral purplish brown stripes; tergum 1-6 with U-shaped markings; tergum 7-9 with W-shaped markings; sternum 1-10 with distinct sublateral stripes. Forceps (Fig. 3) white, slender; segment 2 $1.5 \times$ length of segment 1, with minute hairlike setal field apicomediaally; segment 3 $3.5 \times$ length of segment 1; penes (Fig. 3) apically angled. Cerci $2.0 \times$ length of body; every joint with dark purplish marking; marking on every other joint high lightened.

Female adult. Dimensions (mm): Body length 6.5-10.4; antennae 0.95-1.30; forefemora, foretibiae, foretarsal segments 1, 2, 3, 4 and 5 1.60, 1.70, 0.07, 0.70, 0.30, 0.12 and 0.30; midfemora, midtibiae, midtarsal segments 1, 2, 3, 4 and 5 1.90, 1.60, 0.07, 0.58, 0.27, 0.12 and 0.25; hindfemora, hindtibiae, hindtarsal segments 1, 2, 3, 4 and 5 1.70, 1.60, 0.07, 0.56, 0.25, 0.15 and 0.25; forewing length 6.2-9.5; forewing width 2.5-3.0; cerci 9.0-12.0.

Description: General body color similar to male. **Head.** Vertex with paired longitudinal stripes. Compound eyes light grey with paired longitudinal stripes. **Thorax.** Dorsal prothorax with dark purplish brown, paired vertical stripes. Forewing (Fig. 4) anterior areas between C and R greenish brown stained except around crossveins; areas between C and Sc with ca. 15 crossveins. **Abdomen.** Abdominal terga 1-9 color and markings similar to male. Cerci similar to male.

Materials examined. 1L: KG, Chongpyong, Chojong Cr. at Kyongchun Hwy Br., VIII24, 1994, Y.J. Bae (YJB); 1F: KG, Kanghwa, Chondung-sa, VII19, 1993, PM 9, at light, YJB; 12M, 44F, 1Ms and 4Fs: KG, Koyang, Ilsan, Chuyop-dong, VII17-27, IX8, 1995, VI20-23, VII3-26, VIII4-22, 1996, at apartment window light, S.Y. Park (SYP) and W.H. Lee; 7L: KG, Namyangju, Wangsuk Cr. at Imsong Br., VI5, 22, 1996, SYP; 6M, 3F, 1Fs and 24L: KG, Namyangju, Umhyon-ri, VI1, 1996, SYP and S.J. Lee; 1M: KW, Wonju, Kuirae-ri, Paekun Mt., VII4, 1996, YJB; 1M and 1F: KN, Namhae, Mangun Mt., VII3, 1983; 3F, 1Ms and 4Fs: CLN, Kurye, Chiri Mt., Piagol, VI24, 25, 1996, YJB and SYP; 7L: CJ, Pukcheju, Hallimjong, IX18, 1983.

***Procloeon* Bengtsson**

Procloeon has been historically confused with *Cloeon* and *Centroptilum* Eaton (see Gillies, 1980, 1990; Keffermüller and Sowa, 1984; McCafferty and Waltz, 1990). McCafferty and Waltz (1990) restricted *Procloeon* as a group which lacks a distinctive median spine between the forceps of the male genitalia. Kluge and Novikova (1992) even more restricted the concept of *Procloeon* for only *pennulatum* group of the genus *Centroptilum*.

Among the baetid genera known in Korea, the larva of *Procloeon* (Figs. 15, 16) can be distinguished by strongly developed lateral spines in the abdominal tergum 8-10 (Fig. 5, 12) and straight posterior margin of the abdominal tergum 10 (Figs. 22, 28) which possesses a pair of prominent lateral spines. The adult of *Procloeon* can easily be distinguished by the presence of unique curved costal projection in hindwings (Figs. 9, 14). Larvae of *Procloeon* are found among macrophytes in pools or in the margin of riffles in streams or rivers.

***Procloeon maritimum* (Kluge) (Figs. 5-9, 20-22)**

Centroptilum maritimus Kluge, 1983: 65.

Cloeoptilum maritimum (Kluge): Tshernova *et al.*, 1986: 130.

Cloeon (*Procloeon*) *maritimum* (Kluge): Kluge and Novikova, 1992: 74.

Procloeon sp. A: Bae and Soldán, 1997: 146.

Procloeon sp. 1: Bae and Andrikovics, 1997: 155.

Mature larva. Dimensions (mm): Body length 5.5-6.0; antennae 1.50; forefemora, foretibiae and foretarsi 1.00, 0.50 and 0.60; midfemora, midtibiae and midtarsi 0.90, 0.42 and 0.45; hindfemora, hindtibiae and hindtarsi 1.05, 0.35 and 0.47; claws 0.25; cerci 1.70.

Description: General body color light yellow with dark brown markings. **Head.** Vertex with brown diagonal marking. Maxillary palp (Figs. 5, 20) 3-segmented; terminal segments apically round, <0.33

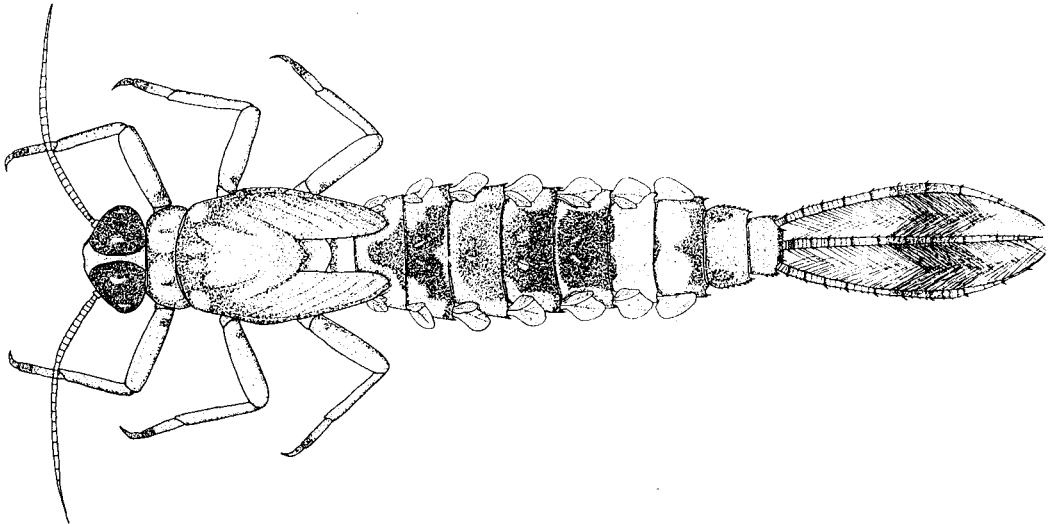


Fig. 15. *Procloeon pennulatum*, larval habitus

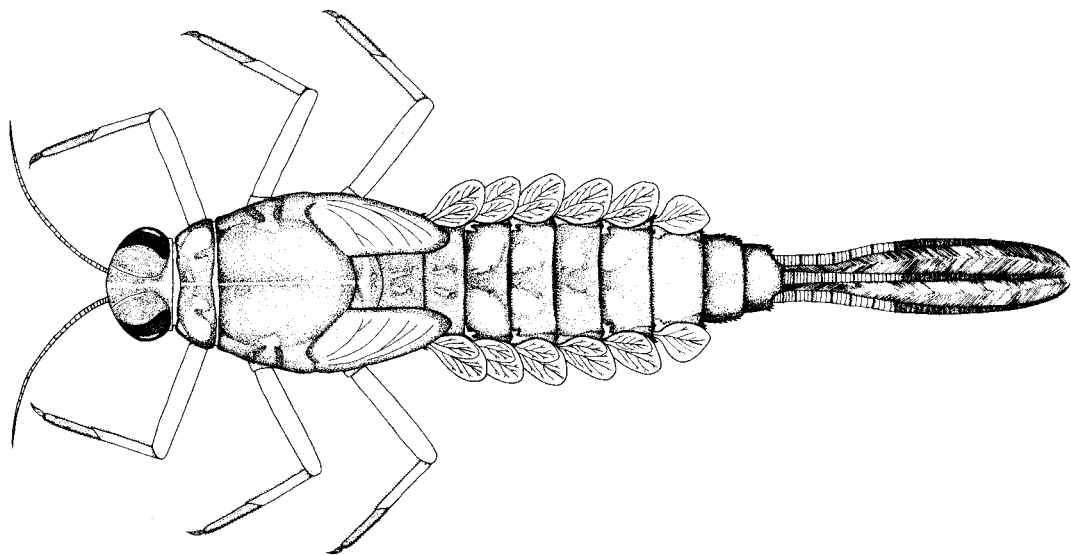


Fig. 16. *Procloeon halla*, larval habitus

\times length of segment 2; labial palp (Fig. 20) 2-segmented; terminal segment apically broad and with simple-stout setae. **Thorax.** Notae with dark brown and brown irregular markings; sternae with 2 pairs of dark brown markings. Femora with brown marking at 3/4 from base; tarsi brown; claws (Fig. 21) brown, relatively long, with rudimentary denticles basally. **Abdomen.** Abdominal tergum 1-9 (Fig. 6) with irregular brown markings; tergum 2, 3, 6, 8, and 9 dark; lateral margins of tergum 8-10 (Fig. 6) with well-developed spines; posterolateral projections acute; posterior margin of tergum 1-9 with acute spines as in Fig. 27; posterior margin of tergum 10 straight, with row of ca. 12 acute spines (lateral spines enlarged) (Fig. 22). Gills 1-6 palm shaped, light, with unclear tracheae; gills 7 smallest. Caudal filaments $<1/3 \times$ length of body, with whirl of simple-stout setae; simple-stout setae on every 4th segment prominent.

Male adult. Dimensions (mm): Body length 4.6; antennae 1.0; longitudinal diameter of compound eye 0.82; cross diameter of compound eye 0.60; distance between compound eyes 0.07-0.10; height of dorsal compound eye 0.35; forefemora, foretibiae and foretarsal segments 1, 2, 3, 4 and 5 0.95, 0.97, 0.05, 0.87, 0.42, 0.25 and 0.15; midfemora, midtibiae and midtarsal segments 1, 2, 3, 4 and 5 1.00, 0.85, 0.07, 0.30, 0.17, 0.05 and 0.15; hindfemora, hindtibiae and hindtarsal segments 1, 2, 3, 4 and 5 0.75, 0.57, 0.08, 0.27, 0.12, 0.05 and 0.15; forewing length 4.2-5.0; forewing width 1.6-2.0; hindwing length 1.0; forceps segments 1, 2 and 3 0.05, 0.29 and 0.05.

Description: General body color light yellow. **Head.** Compound eyes turbinate; dorsal eyes yellow, as high as wide; ventral eyes black; ocelli dome-shaped, light yellow, with circumferential brown stripe. **Thorax.** Legs white. Forewings (as in Fig. 8) transparent with white veins; hindwings (as in Fig. 9) narrow and long, ca. $2.0 \times$ longer than wide, with two longitudinal vein and curved costal process at 1/4 basally. **Abdomen.** Abdominal terga 2-7 with marginal transverse line posteriorly. Forceps (Fig. 7) white, 3-segmented; penes round. Cerci white, ca. $2.0 \times$ length of body.

Female adult. Dimensions (mm): Body length 6.0; antennae 1.70; forefemora, foretibiae and foretarsal segments 1, 2, 3, 4 and 5 1.00, 0.90, 0.05, 0.25, 0.20, 0.10 and 0.15; midfemora, midtibiae and midtarsal segments 1, 2, 3, 4 and 5 0.90, 0.67, 0.05, 0.25, 0.12, 0.05 and 0.15;

hindfemora, hindtibiae and hindtarsal segments 1, 2, 3, 4 and 5 0.85, 0.70, 0.07, 0.30, 0.10, 0.05 and 0.17; forewing (Fig. 8) length 5.50; forewing width 2.20; hindwing (Fig. 9) length 1.0.

Description: General body color and shape similar to male.

Materials examined. 1M, 1F and 1L: KG, Chongpyong, Chochong Cr. at Kyongchun Hwy Br., VIII24, 1994, YJB; 1L: KG, Chongpyong, Chochong Cr. at Sangnoksu rec. area, VIII21, 1994, YJB; 4L: KW, Wonju, Chiak Mt. at Sangwongol, 350m, VII2, 1996, YJB; 1Ms, 2Fs and 21L: KW, Yongwol, Paedok Mt., Pophung-ri, VIII11, 1993, YJB; 1L and 1F: KG, Kapyong, Myongji Mt., IX2, 1981, VI10, 1995; 1M, 1F and 2Fs: KG, Kapyong VII18, 1994, K. Jung; 1M: KG, Taesong-ri, VIII24, 1994; 3L: CCB, Chechon, Pongyang, Chupo Cr. at Okchon, VII3, 1996, YJB; 2F: KN, Namhae Kumsan, VI2, 1994, K. Jung.

***Procloeon pennulatum* (Eaton) (Figs. 10, 15, 23, 24)**

Centroptilum pennulatum Eaton, 1870: 2.

Procloeon pennulatum (Eaton): McCafferty and Waltz, 1990: 780. (see McCafferty, 1993 for synonymy).

Cloeon (Procloeon) pennulatum (Eaton): Kluge and Novikova, 1992: 74.

Procloeon sp. B: Bae and Soldán, 1997: 146.

Mature larva. Dimensions (mm): Body length 7.0-8.0; antennae 2.30; forefemora, foretibiae and foretarsi 1.25, 0.70 and 0.70; midfemora, midtibiae and midtarsi 1.30, 0.65 and 0.65; hindfemora, hindtibiae and hindtarsi 1.30, 0.70 and 0.65; claws 0.27; cerci 2.60.

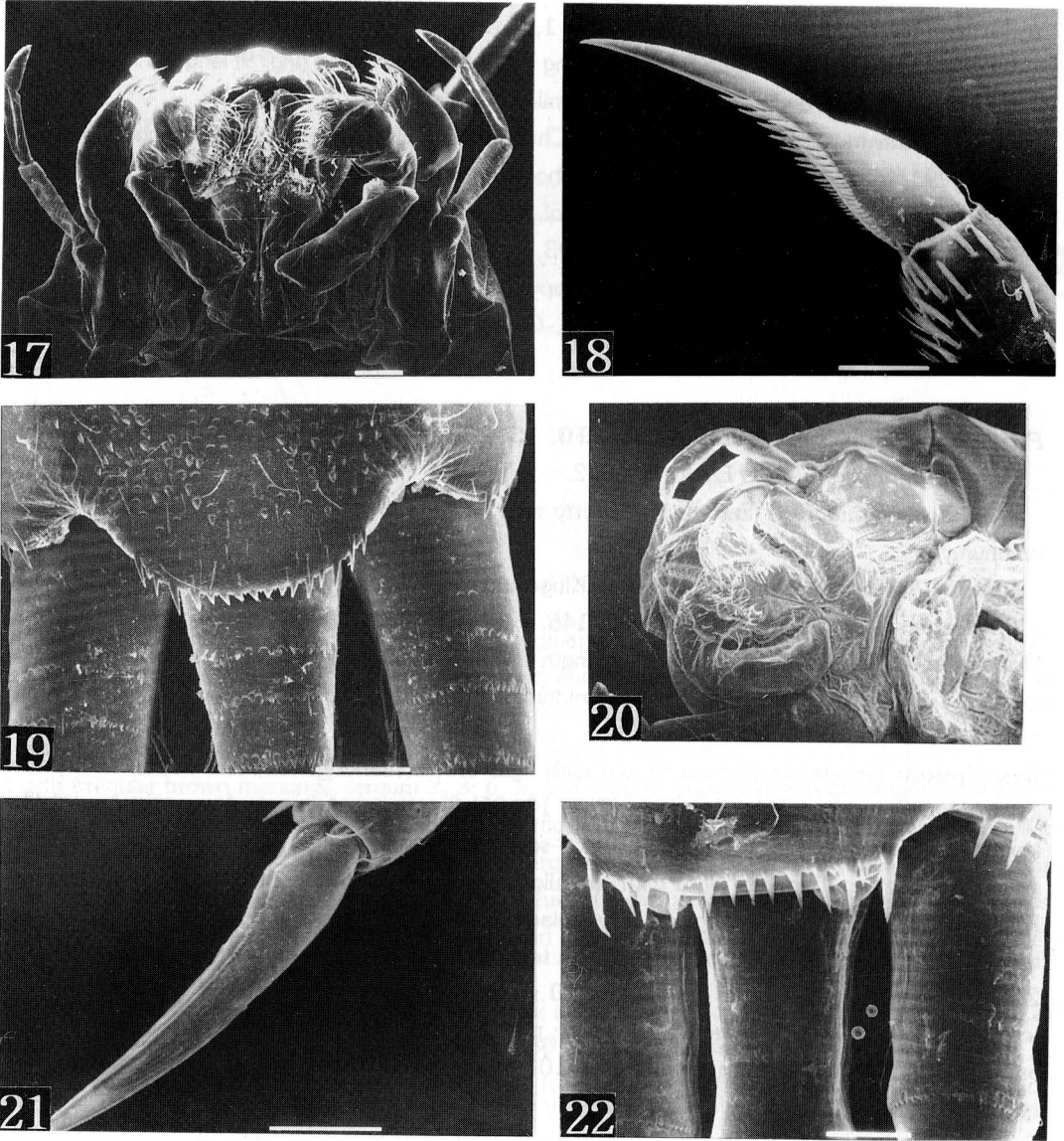
Description: General body color brown with light brown markings. **Head.** Vertex with paired longitudinal brown lines. Maxillary palp (Figs. 10, 23) 3-segmented; terminal segment ca. $<1/3 \times$ length of segment 1. Labial palp (Fig. 23) 2-segmented, apically triangular, with well developed simple-stout setae. **Thorax.** Nota with irregular light brown markings; sterna without markings. Femora with light brown markings apically; tibiae light; tarsi brown; claws (Fig. 24) brown, with two rows of rudimentary denticles basally, and with terminal hair. **Abdomen.** Tergum 2-5 (Fig. 15) with 2 pairs of light spots; tergum 1, 4, and 7-10 somewhat lighter; posterolateral projections acute; tergum 8-10 with well-developed lateral spines; posterior margin of tergum 1-9 with marginal spines as in Fig. 27; posterior margin of tergum 10 straight, with row of acute spines (lateral spines enlarged) as in Fig. 22. Gills light with slightly developed tracheae; gills 1-6 paired; gills 7 single. Caudal filaments ca. $<1/3 \times$ length of body, with broad brown band at mid-length.

Male adult. Unknown.

Female adult. Unknown.

Materials examined. 12L: KW, Chiak Mt., Sangwongol 350m, VII2, 1996, YJB; 2L: KW, Chiak Mt., Chupo Cr., Okchon, VII3, 1996, YJB; 2L: KW, Yongwol, Pophung-ri, Paedok Mt., VIII 11, 1993, YJB; 16L: KG, Chongpyong, Chochong Cr. at Kyongchun Hwy, VIII24, 1994, YJB; 1L: CCN, Kyeryong Mt., VII11, 1995.

Remarks. Larval materials from Russia deposited at Zoological Institute in St. Petersburg were examined for this study. The larvae lacked terminal hair in claws whereas it was shown in the Korean specimens (see Fig. 24). It is not clear whether it originally lacked or was removed by accident.

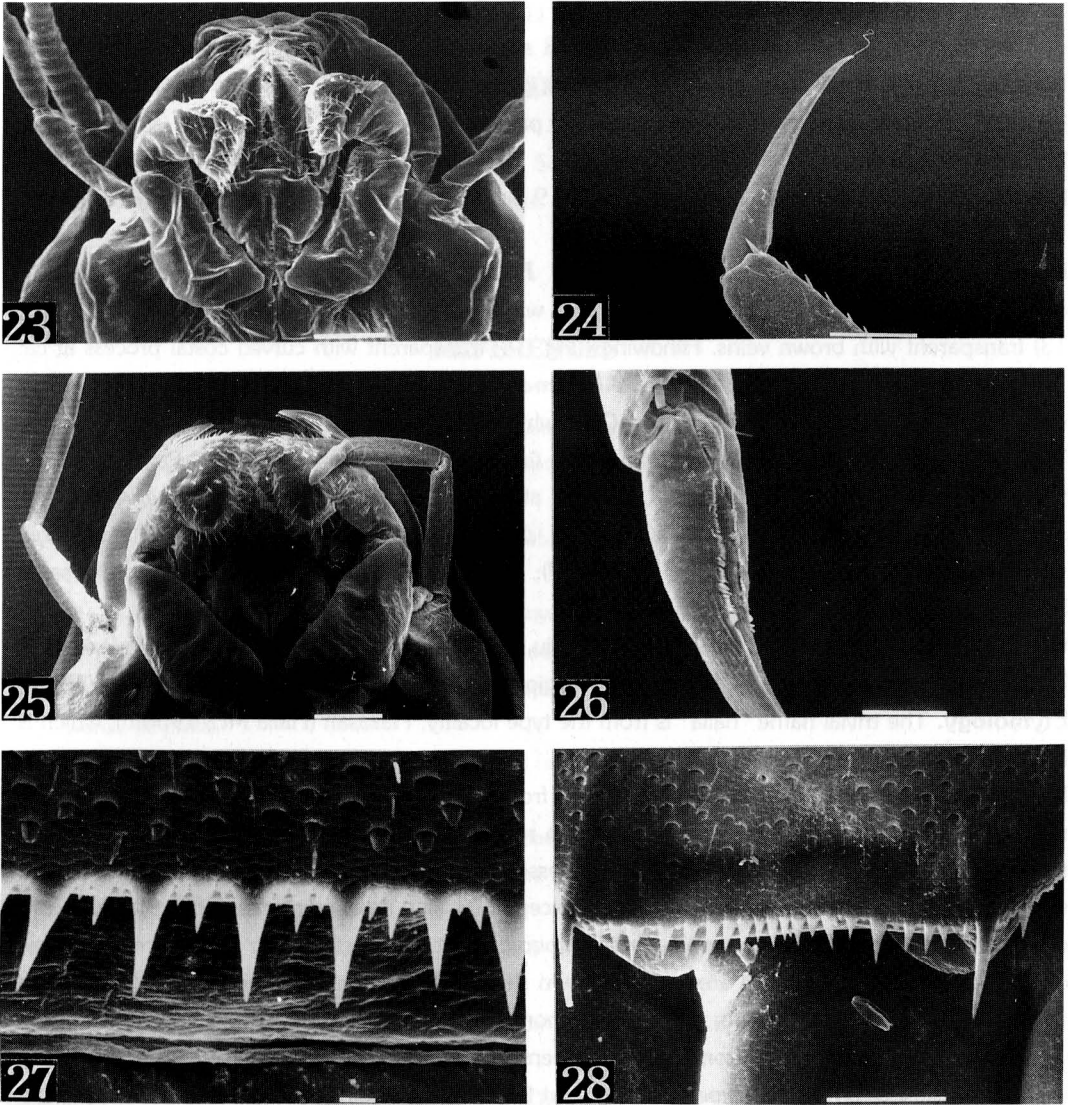


Figs. 17-22. SEMs of larval parts. 17-19, *Cloeon dipterum*: 17, ventral mouthparts (bar = 100 μm); 18, claw (bar = 100 μm); 19, 10th abdominal tergum and basal caudal filaments (bar = 100 μm); 20-22, *Procloeon maritimum*: 20, ventral mouthparts; 21, claw (bar = 50 μm); 22, 10th abdominal tergum and basal caudal filaments (bar = 10 μm)

***Procloeon halla* n. sp. (Figs. 11-14, 16, 25-28)**

Mature larva. Dimensions (mm): Body length 8.0-13.0; antennae 2.50; forefemora, foretibiae and foretarsi 1.70, 1.05 and 1.05; midfemora, midtibiae and midtarsi 1.75, 0.93 and 0.90; hindfemora, hindtibiae and hindtarsi 2.00, 0.90 and 0.97; cerci 4.0.

Description: General body color dark brown with brown markings. **Head.** Vertex without markings. Maxillary palp (Figs. 11, 25) 3-segmented; terminal segment $<0.5 \times$ length of segment 1.



Figs. 23-28. SEMs of larval parts. 23-24, *Procloeon pennulatum*: 23, ventral mouthparts (bar = 100 μm); 24, claw (bar = 100 μm); 25-28, *P. halla*: 25, ventral mouthparts (bar = 100 μm); 26, claw (bar = 50 μm); 27, posterior margin of 5th abdominal tergum (bar = 10 μm); 28, posterior margin of 10th abdominal tergum (bar = 50 μm)

Labial palp (Fig. 25) 2-segmented; terminal segment round and very broad apically, with well developed simple-stout setae. **Thorax.** Pronotum (Fig. 16) with pair of J-shaped light markings as in Fig. 16; mesonotum and metanotum with irregular brown markings; sterna white, without markings. Femora light, apically slightly dark; tibiae light brown; tarsi brown; claws (Fig. 25) brown, relatively short, ca. 0.3x length of tarsi, with 2 rows of minute denticles basally. **Abdomen.** Abdominal tergum (Figs. 12, 16) 2-3, 5-6, and 9 darker; tergum 1-9 with paired submedian tiny light spots; tergum 8-10 with well-developed lateral spines (Fig. 12); posterolateral projections acute; posterior margin of tergum 1-9 with acute spines (Fig. 27); posterior margin of tergum 10 straight, with row of

ca. 22 acute spines (lateral spines enlarged) (Fig. 28); sternum 6-9 with light brown markings posterolaterally; paraproct V-shaped, with ca. 8 spines. Gills (Fig. 16) light, with well-developed tracheae; gills 1-6 double (dorsal lamellae smaller); gills 7 single. Caudal filaments $<0.33 \times$ length of body; ca. $1/3$ basal part light and remaining distal part dark brown.

Male adult. Unknown

Female adult. Dimensions (mm): Body length 9.2; forewing length 9.0; forewing width 3.6; cerci 11.0.

Description: General body color light brown. **Head.** Compound eyes black; ocelli light with circumferential black stripe. **Thorax.** Metanotum with longitudinal marking medially. Forewings (Fig. 13) transparent with brown veins. Hindwings (Fig. 14) transparent with curved costal process at ca. $1/3$ basally. Legs light, without markings. **Abdomen.** Color reddish brown; tergum 1-6 with paired markings laterally as in larval gill markings. Cerci white.

Type materials. Holotype: Mature male larva (in alcohol, BAE-335): Cheju-do, Pukcheju, Uedo town (at mountain foot of Hallasan), Uedo Cr. at ca. 1km from sea coast (at preserve area for drinking water), V27, 1996, 6:30 AM, Y.J. Bae, deposited at SWU. **Paratypes:** 15L (in alcohol), same locality as holotype, V25, 1996, YJB (SWU); 1F (reared, in alcohol) and 57L (in alcohol), same locality as holotype, V27, 1996, YJB (SWU).

Other materials examined. 18L: CJ, Namjeju, Andokgyegok, V8, 1983; 13L: CJ, Pukcheju, Kwangnyong, X24, 1982; 9L: CJ, Soguipo, Kangjong Cr. at 1st Kangjong Br., V26, 1996, YJB.

Etymology. The trivial name "halla" is from the type locality, Hallasan (Halla Mt., 1950m), which is located at the center of Cheju island.

Remarks. Larva of *P. halla* can be distinguished from other *Procloeon* spp. by the characters of the relatively short claws (Fig. 26) which possess two rows of minute denticles and posterior margin of the abdominal tergum 10 (Fig. 28) which possesses row of >22 acute spines. As Cheju island is volcanic origin, most of its streams are dried except the rainy season, normally from late June to early July; only some of the streams have short perannial stream section near the sea coast. Larvae of *P. halla* were found in pool areas of the down stream section which is consist of volcanic rocks and sand and covered with algae. Larvae were more frequently collected in the margin of the pools with coarse sand and gravel bottom and with green-colored algae and some detritus. All sized larvae were evenly collected from the type locality at that time. In the type locality, larvae of a stenopsychid caddisfly (*Stenopsyche griseipennis*) were most abundant and larvae of *Rhyacophila nigrocephala* (Rhyacophilidae), *Apatania* sp. (Limnephilidae), *Choroterpes (Euthraulius) altioculus* (Leptophlebiidae), *Copera annulata* (Platycnemididae), and Tipulidae sp. and adults of *Potamonectes histalis* (Dytiscidae) and Hydrophilidae sp. were also collected.

Last instar larvae from the type locality were collected in the morning of May 27 and brought in a plastic basket to Seoul by airplane. A female subimago was emerged in the afternoon of the same day (imago obtained on May 28 afternoon), but failed to get male adults. Subimago and adult of the species rested at the position of wings spread. On February 28, 1997, YJB visited the type locality again, but could not find any larvae of *P. halla* at the stream section.

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한국산 *Cloeon* 및 *Procloeon*속(하루살이목: 꼬마하루살이과)의 분류

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적 요

한국산 꼬마하루살이과의 유충 및 성충표본에 대한 종합적인 검토를 한 결과 *Cloeon dipterum*, *Procloeon maritimum*(미기록종), *P. pennulatum*(미기록종) 및 *P. halla*(신종)를 확인하였다. 이들의 유충 및 알려진 성충에 대하여 삽화 및 주사전자현미경사진과 함께 기재하였다.