

Three New Species of the Genus *Ameletus* from Taiwan (Ephemeroptera: Siphonuridae)

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ABSTRACT

Three new species of genus *Ameletus* Eaton, i.e., *A. formosus* n. sp., *A. montivagus* n. sp. and *A. atratus* n. sp., from Taiwan have been described based on nymphal stage. In addition, the egg of *A. formosus* was observed using scanning electron microscopy. Key to these species is given.

Key Words: Siphonuridae, *Ameletus*, nymph, egg, Taiwan.

台灣的 *Ameletus* 屬三新種(蜉蝣目：短絲蜉蝣科)

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摘 要

本文首次報告分布於台灣的短絲蜉蝣科之 *Ameletus* 屬，共計 3 新種，分別為：*A. formosus* n. sp., *A. montivagus* n. sp. 及 *A. atratus* n. sp.。種類的判別均根據稚蟲特徵。其中，*A. formosus* 自老熟雌稚蟲腹內取得卵，並經用掃描式電子顯微鏡觀察與描述。文中附種的檢索表。

關鍵詞：短絲蜉蝣科、*Ameletus*、稚蟲、卵、台灣。

Introduction

Over forty species are known in the genus of *Ameletus*, and most of them occur in Nearctic area (Sinichenkova and Tshernova, 1976). Until now, no *Ameletus* have been reported from Taiwan and its neighboring areas. In northeast Asia alone over 12 species are known from the collected works of Imanishi (1930, 1932, 1933, 1940), Gose (1968), Sinichenkova and Tshernova (1976), Baikova (1977), Bae (1985) and Sinichenkova and Varykhanova (1989). In southern Asia, only two species have been found in Himalayan area (Traver, 1939). Taiwan seems to be the most southern part of the distribution.

Nymphs of *Ameletus* species which inhabit the high mountain are adapted to cool water (8–15°C). Nymphs swim in moderately fast currents and stay on rocky-sandy soil, upon or under rocks. Normally, they are immobile, but when flushed they can swim actively and rapidly.

Imanishi (1933), Sinichenkova and Tshernova (1976) and Baikova (1977) differ the nymphs of this genus by the color pattern of labrum and abdomen. Baikova (1977) showed labrum with many variations in color pattern of abdomen within species also. While the thorax including legs of the nymphal specimen is of little use in classification, the flagellum of antenna, genital plate (sternum IX) and gills are very useful.

All types and examined specimens in this work were mature nymphs. Egg materials of *A. formosus* n. sp. were obtained from mature female nymphs (with black wing pads) and observed here via a scanning electron microscope (SEM).

Abbreviations used in the collection localities, collectors and deposition of types are: Taiwan (TW), Ilan Hsien

(ILH), Hualien Hsien (HLH), Kaoshiung Hsien (KSH), Chiai Hsien (CIH), Nantou Hsien (NTH), Taichung Hsien (TCH), Hsinchu Hsien (HCH), Shih-Chang Kang (SCK), Hsien-Cheng Chang (HCC), Wen-Bin Yeh (WBY), Department of Entomology, National Chung Hsing University, Taichung, Taiwan (NCHU) and National Museum of Natural Science, Taichung, Taiwan (NMNS).

Genus *Ameletus* Eaton, 1885

Ameletus Eaton, 1885: 210; Type species: *Ameletus submontanus* Eaton; Type locality: Colorado.

The generic description is after Edmunds et al. 1976 as follows.

Body length: 6–14 mm. Crown of galea-lacinia of maxillae with many long pectinate spines. Posterolateral projections on apical abdominal segments poorly to moderately developed. Gills singles, oval, and small, with lateral and mesal or submesal sclerotized bands. Caudal filaments usually with a wide dark transverse band at middle and a narrow dark band at apex or with many small dark bands.

Key to the Species of Genus *Ameletus* of Taiwan (for nymph only)

1. Flagellum of antenna 15-segmented; gills I and II long oval (Figs. 2-F, 2-G) *A. montivagus* n.sp.
- Flagellum of antenna 20-segmented; gills I and II oval (Figs. 1-F, 1-G, 3-F, 3-G) 2
2. Posteromedian margin of abdominal sternum IX with a sharp emargination (Fig. 1-E); length of labrum about 3/4 of width *A. formosus* n.sp.
- Posteromedian margin of abdominal sternum IX with a shallow emargination (Fig. 3-E); length of labrum slightly longer than width
..... *A. atratus* n.sp.

Ameletus formosus Kang & Yang n.sp.
(Figs. 1, 4)

Mature nymphs: (Fig. 1) Body length: female 10.0-12.5 mm, male 9.10-

12.02 mm. Cerci length of female 5.10-6.20 mm.

Head: antenna pale, apical segments brownish, flagellum with 20 segments; male eyes 0.52-0.54 x as long as head. Labrum: (Fig. 1-A) length about 3/4 of

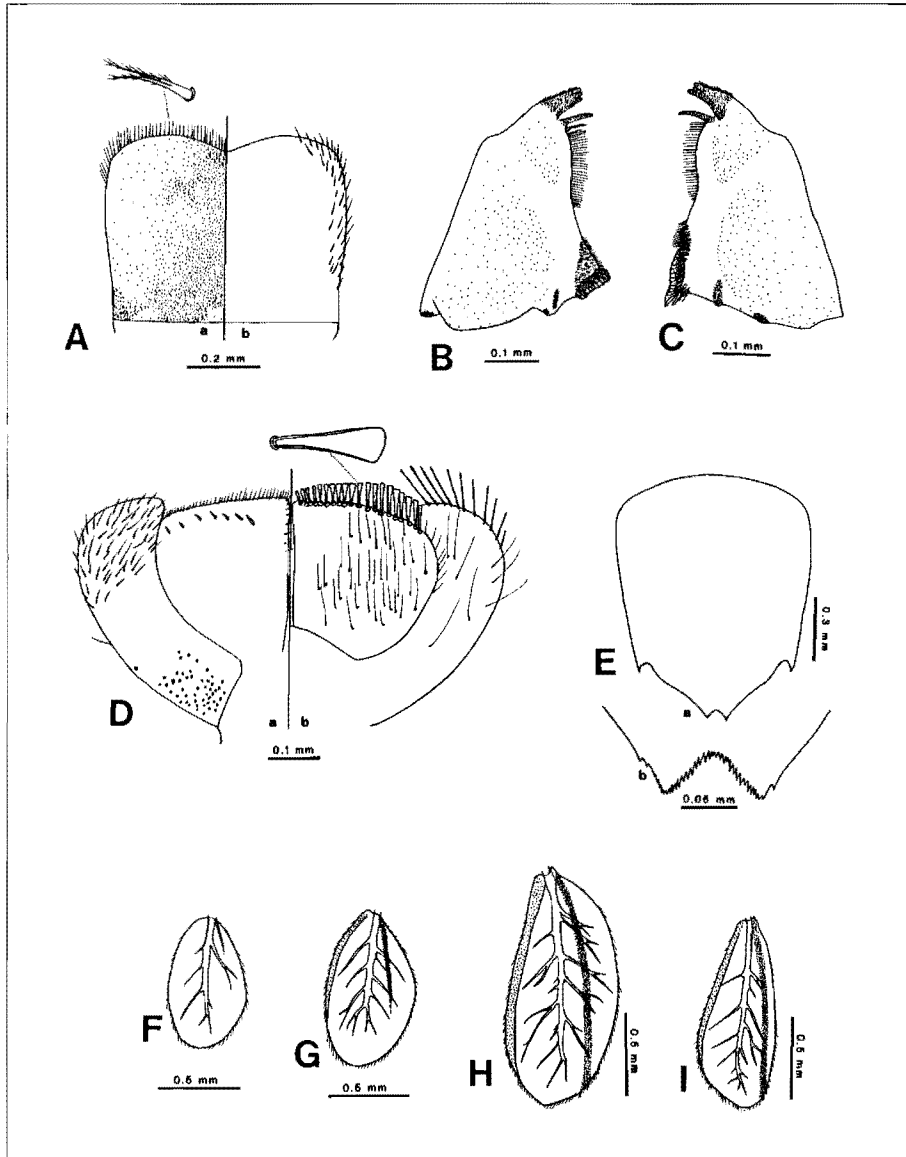


Fig. 1. Nymph of *Ameletus formosus* n.sp. A, labrum (a, dorsal, b, ventral); B, left mandible; C, right mandible; D, labium (a, dorsal, b, ventral); E, a, sternum IX, female, b, magnification of posterior margin; F, gill I; G, gill II; H, gill IV; I, gill VII.

width, lateral margins slightly convex, widest anteriorly; middle and base brownish, lateral areas paler, near posterior margin with a pair of paler markings laterally and a triangular, light brown marking medially; anterior margin with a shallow emargination; dorsum with a row of thick biforked pinnate setae along anterior margin and with several long and short pinnate acute setae anteromedially. Hypopharynx: apex of lingua with 3 lobes, median one markedly lower than on laterals. Mandibles: (Figs. 1-B, 1-C) outer incisor of left mandible 4-forked, right 3-forked; lateral margins of mandible with a blunt ridge near apical 1/3; dorsum brownish on lateral 2/3 and with a triangular brown area apically. Labium: (Fig. 1-D) paraglossa with pores on lateral half of basal 1/3; glossa semicircular, venter with long fine setae and a row of cuneate setae along anterior margin; dorsum of glossa with a row of fine setae along anterior margin, apical half of mesal margin with a row of acute setae and a row of small acute setae near anterior margin.

Abdomen: terga brown, terga VI-IX slightly bright posteromedially; terga II-IX with a vague pale longitudinal marking medially, with a pair of darkish stripes anteromedially, the stripes convergent anteriorly and distinct on anterior abdominal segments; lateral areas of terga II-IX with a pale marking near lateral margin. Posterior margin of sternum IX of female triangularly with a sharp, dentate emargination medially (Fig. 1-E), male with a pair of large blunt processes. Gills: gills I and II small, oval, 0.57-0.60 x as wide as long (Figs. 1-F, 1-G); gills III-VI alike, oval, tracheas distinct, gill IV 0.47-0.49 x as wide as long (Fig. 1-H). Caudal filaments: uniform paler or light yellow.

Egg: (Fig. 4) surface with reticular, raised ridges all over the egg, net-like. Chorionic sculpture reinforced by little conic counterscape, increase number and size on one pole of egg.

Holotype: mature female nymph, Tzuenchiao, Hsiulin, HLH, TW, (2,010 m), 4-IV-1991, SCK. In NCHU.

Paratypes: 1♂, 8♀♀, same data as for holotype; 6♂♂, 3♀♀, Piluchi, Lenai, NTH, TW, (2,300 m), 1-XII-1990, WBY. 4♂♂, 8♀♀ in NCHU, 3♂♂, 3♀♀ in NMNS.

Other mature nymphal specimens examined: 5♂♂, 3♀♀, Nanhutashan, Tatung, ILH, TW, (2,300 m), 8-V-1990, WBY; 1♀, Chungyang-chienshan, Hoping, TCH, TW, 12-V-1990, WBY; 1♂, 1♀, Hsini, NTH, TW, 21-VI-1990, SCK; 2♂♂, 2♀♀, Alishan, CIH, TW, (2,216 m), 24-VII-1990, HCC; 7♂♂, 3♀♀, Kuan-yuan, Hsiulin, HLH, TW, (2,580 m), 2-XII-1990, WBY; 1♂, Yuinhai, Lenai, NTH, TW, (2,360 m), 25-I-1991, SCK & HCC; 1♂, 2♀♀, Wuchia-Chilai, Hsiulin, HLH, TW, (1,450 m), 29-I-1991, SCK & HCC; 3♂♂, 2♀♀, Alishan, CIH, TW, (2,195 m), 8-II-1991, HCC; 1♂, 2♀♀, Tienchih, Taoyuan, KSH, (2,310 m), 2-IV-1991, SCK; 1♂, 9♀♀, Tzuenchiao, Hsiulin, HLH, TW, (2,010 m), 4-IV-1991, SCK; 2♂♂, 1♀, Chiayan, Hoping, TCH, TW, (1,520 m), 28-V-1991, SCK & HCC; 4♂♂, Tulien, Tatung, ILH, TW, (1,475 m), 29-V-1991, SCK & HCC; 6♂♂, 7♀♀, Nanhutashan, Tatung, ILH, TW, (2,450 m), 6-VII-1991, HCC; 3♀♀, Tatung, ILH, TW, (2,500 m), 7-VII-1991, HCC; 5♂♂, 5♀♀, Nanhutashan, Tatung, ILH, TW, (2,285 m), 7-VII-1991, HCC; 6♀♀, Alishan, CIH, TW, (1,845 m), 19-XI-1991, SCK.

Distribution: Taiwan

Etymology: species is named for the incunabular name of Taiwan, masculine.

Note: This new species resembles *Ameletus camtschaticus* Ulmer 1927 (nymph described by Sinichenkova and Tshernova, 1976) but can be differentiated in nymphs by the following characters: (1) mandible with a blunt ridge at lateral margin, near apical 1/3 but smooth in *camtschaticus*; (2) gills II-VII each with a narrow ridge on ventral margins only, not along every margins;

(3) sternum IX without rather sharp shallow notches in latter area and (4) caudal filaments with uniform color. The egg of this species resembles known European species, *A. inopinatus* Eaton, 1887 (egg described by Studemann *et al.*,

1988), but the ridges of net-like structure are fine and conic counterscape increase in number and size toward one pole, not both poles.

***Ameletus montivagus* Kang & Yang n.**

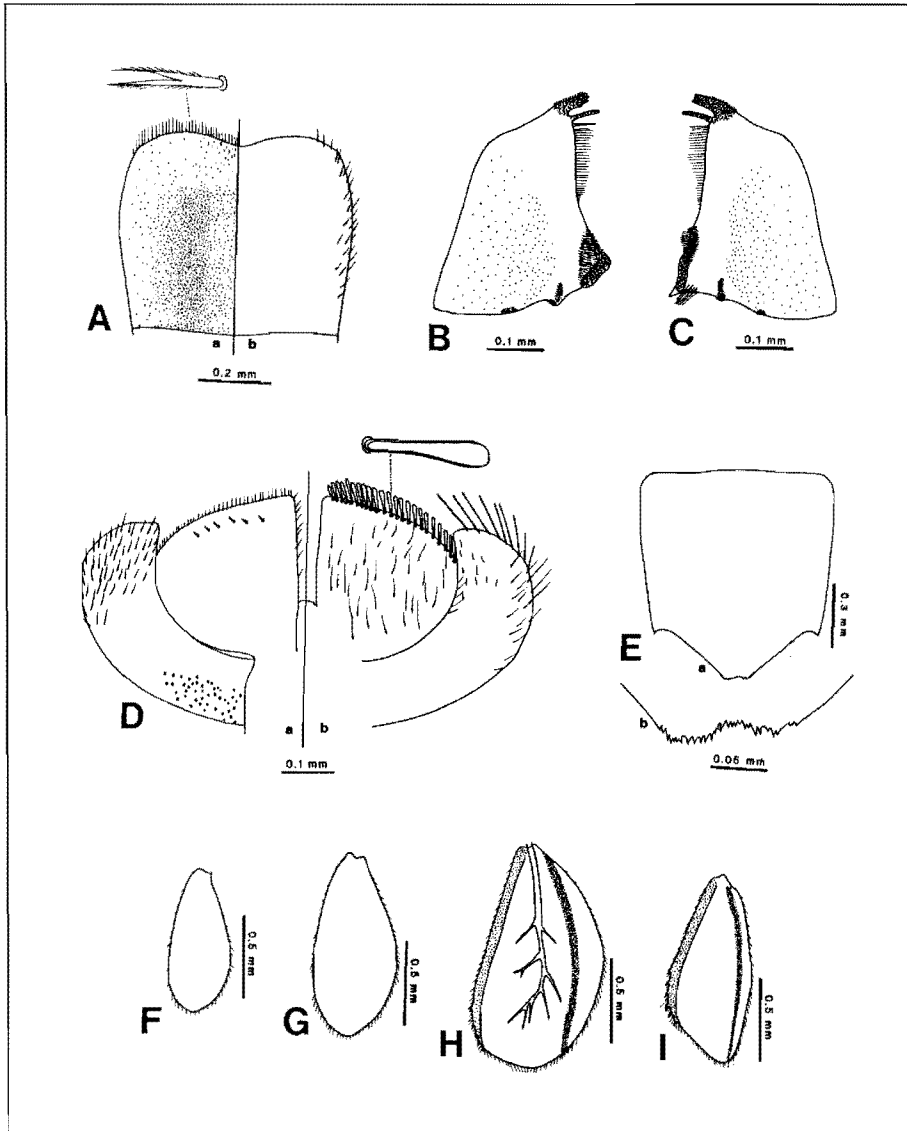


Fig. 2. Nymph of *Ameletus montivagus* n.sp. A, labrum (a, dorsal, b, ventral); B, left mandible; C, right mandible; D, labium (a, dorsal, b, ventral); E, a, sternum IX, female, b, magnification of posterior margin; F, gill I; G, gill II; H, gill IV; I, gill VII.

sp. (Fig. 2)

Mature nymphs: (Fig. 2) Body length: female 9.80–11.45 mm, male 9.05–11.04 mm. Cerci length of female 4.60–5.24 mm.

Head: antenna pale, flagellum 15-segmented. Labrum: (Fig. 2-A) length slightly less than width, lateral margins slightly convex, widest at middle; dorsum with 2 vague, broad brownish stripes medially, anterior area and lateral areas paler; anterior margin with a shallow emargination; dorsum with a row of thick biforked pinnate setae along anterior margin and with several long and short pinnate acute setae anteromedially. Hypopharynx: apex of lingua with 3 lobes, subequal in level. Mandibles: (Figs. 2-B, 2-C) outer incisor of left mandible 4-forked, right 3-forked; lateral margins of mandible with a blunt ridge near apical 2/5; dorsum brownish on lateral 2/3 and with a triangular brown area apically. Labium: (Fig. 2-D) paraglossa with pores on lateral half of basal 1/3; glossa semicircular, venter with long fine setae sparsely and with a row of flat clavate setae along anterior margin; dorsum of glossa with a row of fine setae along anterior margin, apical half of mesal margin with a row of acute setae and a row of small acute setae near anterior margin.

Abdomen: terga brown, terga VI–IX slightly bright posteromedially; terga II–VI with a pair of vague, darkish stripes anteromedially, the stripes convergent anteriorly and distinct on anterior abdominal segments; terga VII–IX with a pale stripe on middle line and a broad, vague, V-shaped pale marking near posterior margin. Posterior margin of sternum IX of female triangularly, apex nearly truncate, dentate irregularly (Fig. 2-E), male with a pair of large blunt processes and a pair of small acute processes posteromedially. Gills: gills I and II small, long oval, 0.44–0.47 x as wide as long

(Figs. 2-F, 2-G); gills III–VI alike, oblique oval, gill IV 0.55–0.58 x as wide as long (Fig. 2-H). Caudal filaments: uniform paler or light yellow.

Holotype: mature female nymph, Hohuanchi, Lenai, NTH, TW, (2,900 m), 3–XII–1990, WBY. In NCHU.

Paratypes: 2♀♀, same data as for holotype; 8♂♂, 1♀, Kuanyuan, Hsiulin, HLH, TW, (2,580 m), 2–XII–1990, WBY. 5♂♂, 2♀♀ in NCHU, 3♂♂, 1♀ in NMNS.

Distribution: Taiwan

Etymology: *montivagus*, L., masculine, meaning wandering over the mountains.

Note: This new species resembles *Ameletus formosus* n.sp. but can be separated by the shape of labrum, gills, posterior margin of sternum IX and the number of segments of flagellum.

Ameletus atratus Kang & Yang n.sp. (Fig. 3)

Mature nymphs: (Fig. 3) Body length: female 10.20–12.85mm, male 9.25–11.90 mm. Cerci length of female 4.84–5.47 mm.

Head: antenna pale, darkish on apical 4–5 segments, flagellum 20-segmented; eyes of male 0.66–0.68 x as long as head; Labrum: (Fig. 3-A) length slightly longer than width, lateral margins nearly parallel; dorsum darkish on middle line and base; anterior margin with a shallow emargination; dorsum with a row of thick biforked pinnate setae along anterior margin and with several long and short pinnate acute setae anteromedially. Hypopharynx: apex of lingua with 3 lobes, subequal in level or middle lobe slightly lower than on laterals. Mandibles: (Figs. 3-B, 3-C) outer incisor of left mandible 4-forked, right 3-forked; lateral margins of mandibles nearly curve smoothly; dorsum brownish on lateral 2/3. Labium: (Fig. 3-D) paraglossa with a few pores near base; glossa semicircular, venter with

long fine setae sparsely and with a row of long flat clavate setae along anterior margin; dorsum of glossa with a row of fine setae along anterior margin, apical half of mesal margin with a row of acute setae, a row of small acute setae near anterior margin and with several fine

acute setae on mesal anterolateral corner.

Abdomen: terga brown, terga I-IV bright; II-IX with a pair of pale markings laterally; terga II-VI, with a pair of oblique brownish stripes and darkish anteriorly; terga V-IX with a pale stripe on middle line. Posterior margin of ste-

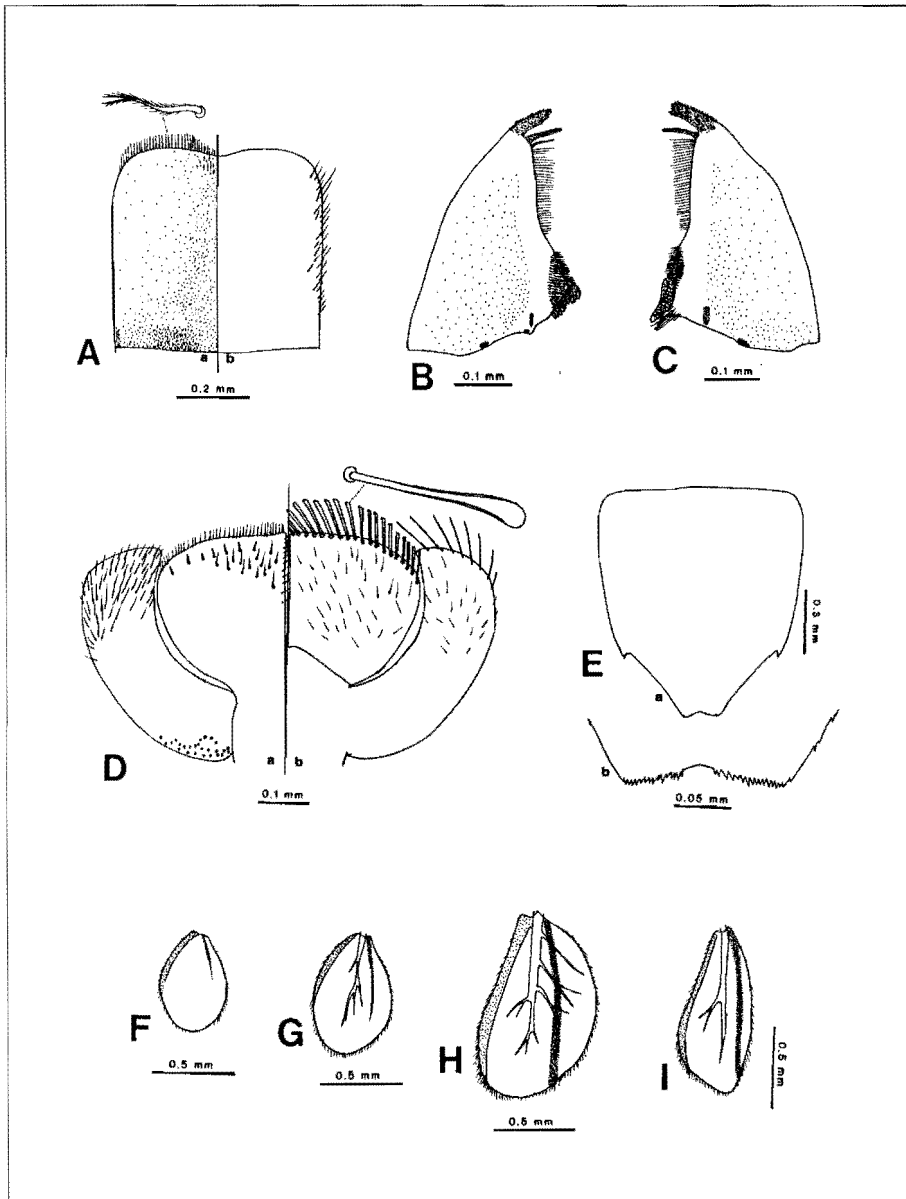


Fig. 3. Nymph of *Ameletus atratus* n.sp. A, labrum (a, dorsal, b, ventral); B, left mandible; C, right mandible; D, labium (a, dorsal, b, ventral); E, a, sternum IX, female, b, magnification of posterior margin; F, gill I; G, gill II; H, gill IV; I, gill VII.

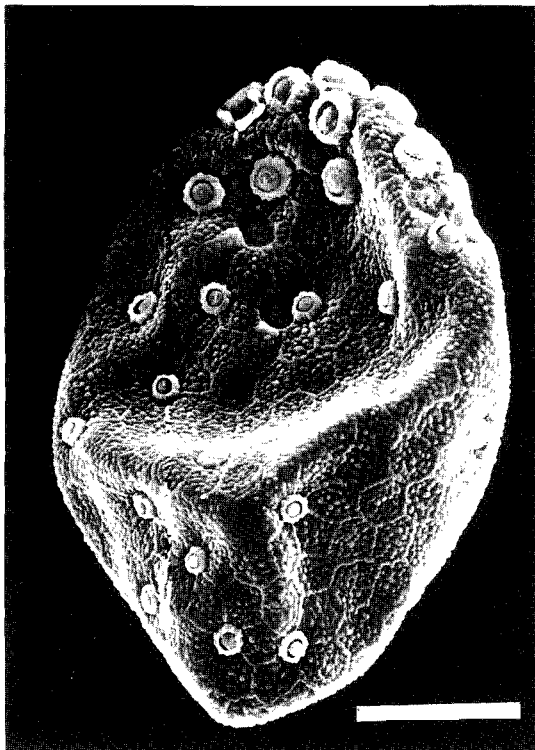


Fig. 4. SEM view of the whole egg of *Ameletus formosus* n.sp. [scale= 50 mm]

num IX of female triangularly, apex with a shallow emargination, laterals of emargination dentate (Fig. 3-E), male with a pair of large of blunt processes and a pair of small acute processes posteromedially. Gills: gill I and II small, oval, 0.65-0.66 x as wide as long (Figs. 3-F, 3-G); gills III-VI alike, oblique oval, gill IV 0.63-0.65 x as wide as long (Fig. 3-H). Caudal filaments: uniform paler or light yellow, distal segments dark brown distinctly.

Holotype: mature female nymph, Chihtuan, Tatung, ILH, TW, (1,130 m), 18-XI-1990, SCK & HCC. In NCHU.

Paratypes: 10♂♂, 2♀♀ (1 immature), same data as for holotype. 7♂♂, 2♀♀ in NCHU, 3♂♂ in NMNS.

Distribution: Taiwan

Etymology: atratus, L., masculine, meaning clothed in black.

Note: This new species resembles

Ameletus fomusus n.sp. and *A. montivagus* n.sp. but can be differentiated in the nymphs by the following characters: (1) length of labrum slightly longer than width, and lateral margins nearly parallel; (2) caudal filaments dark brown on apical segments distinctly; (3) flat clavate setae of glossa on anteroventral margin longer than on the latter; (4) glossa with over one row of fine acute setae on mesal anterolateral corner.

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References

- Bae, Y. J.** 1985. The taxonomic study of Korean Ephemeroptera. Thesis for the degree of Master, Dept. Biol. Graduate School, Korea Univ. 195 pp. (In Korean)
- Baikova, O. Ya.** 1977. Mayflies of the genus *Ameletus* Eaton (Ephemeroptera) in the Amur Basin. Entomol. Rev. 55: 56-60.
- Edmunds, G. F., Jr., S. L. Jensen, and L. Berner.** 1976. The mayflies of North and Central America. Minneapolis (Univ. Minnesota Press) x+330 pp.
- Gose, K.** 1968. Two new mayflies from Japan. Kontyu 36(2): 147-150.
- Gui, H.** 1985. A catalog of the Ephemeroptera of China. J. Nanjing Normal Univ. 85: 79-97. (In Chinese)
- Imanishi, K.** 1930. Mayflies from Japanese torrents I. new mayflies of the genera *Acentrella* and *Ameletus*. Trans. Nat. Hist. Formosa 20: 263-267.
- Imanishi, K.** 1932. Mayflies from Japanese torrents. II. Further notes on the

- genus *Ameletus*. Annot. Zool. Japon. 13: 525-533.
- Imanishi, K.** 1933. Mayflies from Japanese torrents. III, notes on the genus *Ameletus* with a list of the Japanese Siphonuridae. Ins. Mats. 8(2): 64-69.
- Imanishi, K.** 1940. Ephemeroptera of Manchoukuo, Inner Mongolia, Chosen. Rep. Limnobiol. Surv. Kwant. & Manch. pp. 169-263. (In Japanese)
- Sinichenkova, N. D., and O. A. Tshernova.** 1976. New data on the Asiatic species of the genus *Ameletus* Eaton (Ephemeroptera, Siphonuridae). Entomol. Rev. 55: 7-13.
- Sinichenkova, N. D., and K. V. Varykhanova.** 1989. A new species of the mayfly genus *Ameletus* Eaton (Ephemeroptera, Siphonuridae) from Mongolia. Entomol. Rev. 69: 152-157.
- Studemann, D., P. Landolt, and I. Tomka.** 1988. Morphology and taxonomy of imagines and eggs of Central and Northern European Siphonuridae (Ephemeroptera). Mitt. Schweiz. Entomol. Ges. 61: 303-328.
- Traver, J. R.** 1939. Himalayan mayflies (Ephemeroptera). Ann. Mag. Nat. Hist. Ser. 11, 4: 32-56.

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