

## Eight New and Four Newly Recorded Species of Chironomidae (Insecta: Diptera) from Korea

Han Il Ree\*

Department of Environmental Medical Biology, Arthropods of Medical Importance Resource Bank, Yonsei University College of Medicine, Seoul 120-752, Korea

### ABSTRACT

Adult chironomids were collected by various methods, such as light traps, sweeping on grasses, aspiration of light-attracted adults, and sweeping of swarming males with insect nets at various localities. All collected specimens were slide-mounted and identified. I report eight species new to science: *Chironomus jangchungensis* n. sp., *Demicryptochironomus paracamptolabis* n. sp., *Demicryptochironomus wontongensis* n. sp., *Microtenidipes paratamagouti* n. sp., *Polypedilum macrohemisphere* n. sp., *Eukiefferiella busanensis* n. sp., *Psectrocladius paratogaminimus* n. sp., and *Pseudosmittia seosania* n. sp. I also report four species for the first time in Korea: *Chironomus fujiprimus* Sasa, *Pentapedilum convexum* Johannsen, *Tanytarsus smolandicus* Brundin, and *Tanytarsus oyamai* Sasa. All species are fully described with illustrations. This is the first report of the genera *Eukiefferiella* and *Pseudosmittia* in Korea.

**Keywords:** chironomidae, taxonomy, new record, new species, Korea

### INTRODUCTION

There are numerous species of non-biting midges (Diptera: Chironomidae). Chironomid larvae develop in almost all kinds of water sources. Because of their enormous numbers, fast growth and short life span, they are well-known nuisance insects, and also play an important role in allergic diseases (Kay et al., 1978; Lee et al., 1995; Yong et al., 1999). Very little historical information about Korean chironomids was available. In 1968, only one species of Chironomidae, *Chironomus plumosus prasimus*, was listed (without any references) in the *Nomina Animalium Koreanorum, II. Insecta*, which was published by the Zoological Society of Korea. Ree and Kim (1981) reported 31 species of Chironomidae, including six new species from 45 different localities in Korea, representing the first taxonomic study of Korean Chironomidae. Since then, 34 new and 68 unrecorded species of Chironomidae have been reported in 19 scientific papers published during the period of 1988–2012. In this report, I extend the fauna of Korean Chironomidae to 145 species, 54 genera, and 5 subfamilies.

### MATERIALS AND METHODS

Chironomid adults were collected by sweeping with an insect net on grasses around breeding places during daytime hours. Swarming males were collected by sweeping an insect net in the evenings. Light traps were operated at night. Chironomid adults attracted to light and resting on the walls and windows of stores, restaurants, and official buildings were aspirated using a sucking tube. The collected specimens were preserved in 75% ethanol.

The antennae, head, wings, abdomen and hypopygium of each specimen preserved in 75% ethanol was dissected using two fine dissecting needles under a stereomicroscope, and mounted on either phenol balsam mounting media or Hoyer's solution. Terminology follows Sæther (1980).

Measurements of slide mounted specimens were obtained from observing the specimens with a compound microscope equipped with a micrometer. The values were transformed to mm or  $\mu\text{m}$  using the scale of the micrometer. The length of the wing was measured from the apex of the wing to the acrista, which represents the size of the body. The antennal ratio (AR) was calculated by dividing the length of the longest flagellar segment plus any segment distal to it by the

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

\*To whom correspondence should be addressed  
Tel: 82-2-2228-1840, Fax: 82-2-363-8676  
E-mail: para@yuhs.ac

combined length of the remaining segments of the flagellum, not including the pedicel. Leg ratio (LR) was calculated by dividing the length of the first tarsal segment by the length of the tibia of the fore leg. Abbreviations used for wing length, radius-medial cross veins, and forked Cu are WL, RM, and FCu, respectively.

The type specimens were deposited in the collection of Arthropods of Medical Importance Resource Bank, Department of Environmental Medical Biology, Yonsei University.

## SYSTEMATIC ACCOUNTS

Order Diptera  
Family Chironomidae Holiday  
Subfamily Chironominae Macquart  
Genus *Chironomus* Meigen

### <sup>1</sup>\**Chironomus fujiprimus* Sasa, 1985 (Fig. 1)

*Chironomus fujiprimus* Sasa, 1985: 104; Sasa and Kawai, 1987: 10.

**Material examined.** 20♂♂, 6♀♀, Korea: Gyeonggi-do, Yoju-gun, Gumsa-myeon, 29 Sep 2009, Song KH.

**Diagnosis.** Greenish yellow, large species (WL 4.0 mm). Superior volsella hooked at tip, with 7–8 setae at base. Gonostylus tapered apically, with 12–14 irregular setae on inner-lateral tip. LR 1.30.

**Description (male).** **Head:** Eye bare, strongly produced dorsomedially. Frontal tubercle rather small, tip narrowed, forming nipple shape (Fig. 1B). Clypeus yellow, with 32–35 setae. Palp pale dark brown, with 4 segments: 83, 259, 259, 403 μm (1 : 3.1 : 3.1 : 4.9). **Thorax:** Greenish yellow in ground color. Antepronotum yellow, well developed, reaching anterior margin of scutum. Scutum greenish orange yellow, with inconspicuous light brown vittae; acrosticals absent; 18–19 dorsocentrals each side. Scutellum greenish pale yellow, with 38–40 setae. Postnotum greenish orange yellow. **Wing (Fig. 1A):** WL 4.0 mm. Costa not produced, almost reaching apex of wing. R<sub>4+5</sub> distal to M<sub>3+4</sub>. R<sub>2+3</sub> ending near R<sub>1</sub>. Wing membrane bare. Only veins R, R<sub>1</sub> and distal 1/3 of R<sub>4+5</sub> with setae. An reaching well beyond FCu. Anal lobe developed. Squama with setae. **Legs:** Femur and tibia yellowish green, tarsi I and II yellow with darker tip, tarsus III yellow with darker distal half, tarsi IV and V dark. Mid and hind tibial combs contiguous, each comb with a rather short spur. Pulvillus developed. LR 1.30. **Abdomen:** Uniformly light green. **Hypopygium (Fig. 1C):** Anal point dark brown, a little expanded on distal half (clavate form).

Superior volsella (Fig. 1D) bare, rather long, horn-shaped, abruptly bent at tip, with 7–8 setae basally, inferior volsella cylindrical, with 30–36 recurved setae. Gonostylus yellowish dark brown, tapered apically, with 12–14 setae irregularly arising on inner-lateral tip. Anal tergite with 36–40 apical and median setae; anal tergite band V-type, sclerotized, and darkened.

**Female.** Same as male, except for the usual sexual differences. Antenna (Fig. 1E) pale orange yellow, with 5 segments (1st and 2nd segments fused): 93, 61, 61, 61, 168 μm. Cercus as shown in Fig. 1F. WL 4.2 mm.

**Distribution.** Japan, Korea.

**Remarks.** All antennae of the examined specimens were lost, so the AR could not be measured. The reported AR of the Japanese specimens is 3.57 (Sasa, 1985). The key characters of Korean specimens are consistent with those of Japanese specimens except for a small difference in the LR value (1.30 vs. 1.45, respectively).

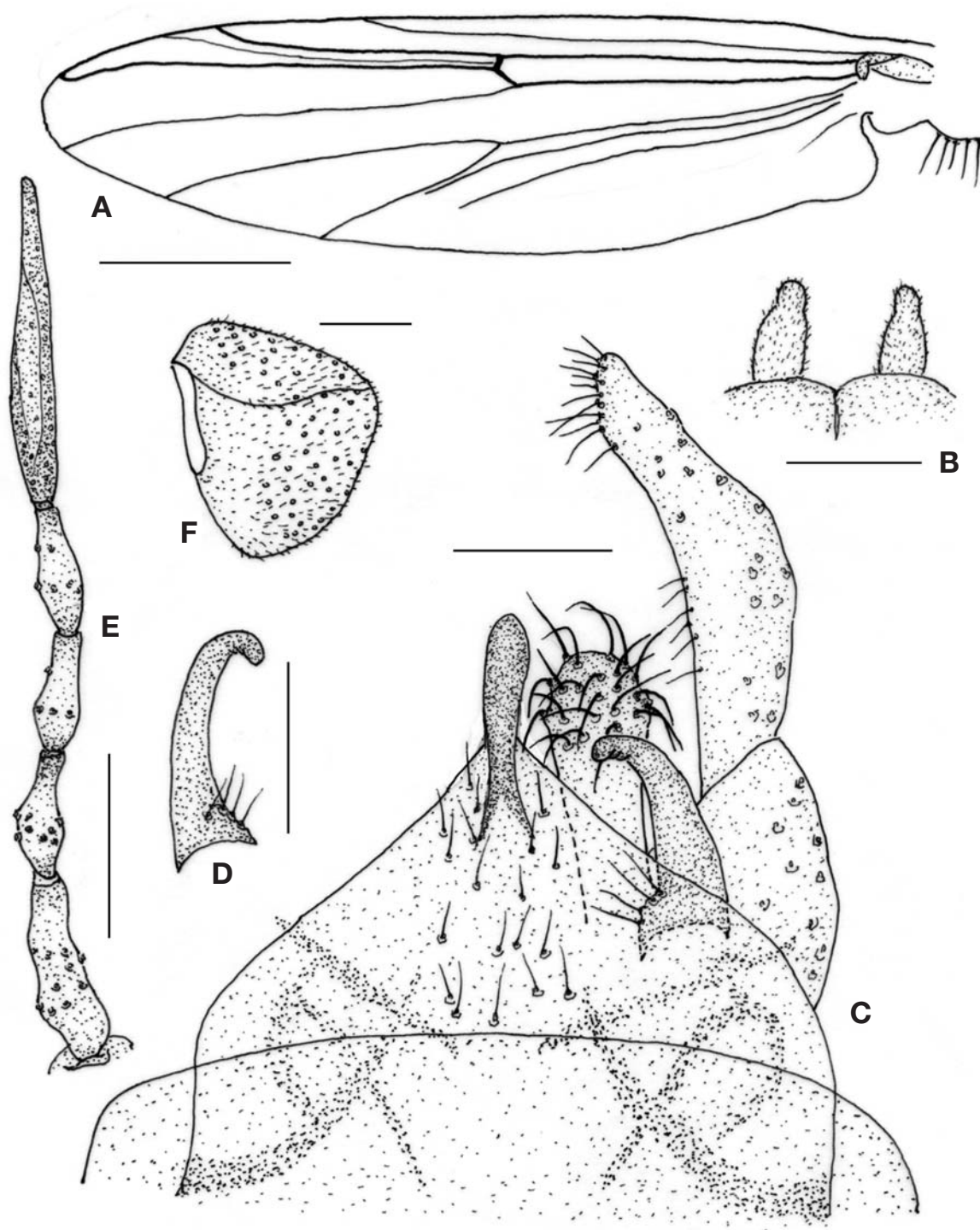
### <sup>2</sup>\**Chironomus jangchungensis* sp. nov. (Fig. 2)

**Material examined.** Holotype: ♂ (RCH-6203), Korea: Seoul, Jung-gu, Jangchung-dong, 8 Oct 1979, Ree HI. Paratypes: 10♂♂, same as holotype.

**Diagnosis.** Pale yellow, medium to large species (WL 3.15 mm). Anal tergite produced distally, with 12–14 short, pale apical setae and 11 long pale median setae. Anal point moderately long, bent upward. Apical bare blade of superior volsella with broad, round apex, abruptly bent upward, and 4–5 irregularly arranged setae at base. AR 2.91. LR 1.62.

**Description (male).** **Head:** Eye bare, produced dorsomedially. Antenna yellowish brown, with 11 segments. AR 2.91. Frontal tubercle moderately large (Fig. 2B). Palp pale yellow, with 4 segments: 61, 243, 214, 196 μm (1 : 4.0 : 3.5 : 3.2). Clypeus pale yellow, roughly round, with 27 strong, pale setae on dorso-central site. **Thorax:** Pale yellow on ground color. Antepronotum pale yellow, developed. Scutum pale yellow, vittae absent, 6 prealars. Scutellum pale, with 22 setae. Postnotum pale yellow. **Wing (Fig. 2A):** WL 3.15 mm. Membrane bare, transparent. All veins bare, except R, R<sub>1</sub> and R<sub>4+5</sub>. Costa not produced. R<sub>4+5</sub> almost reach wing apex, far beyond M<sub>3+4</sub>. RM pale, proximal to FCu. Anal lobe developed. Squama with 17–20 setae. Arculus and brachiolum pale. **Legs:** All segments uniformly pale yellow. Fore tibia with a pale, sharply pointed spur (Fig. 2E); mid and hind tibial combs contiguous, each with a short spur (Fig. 2F). Pulvillus large. LR 1.62. **Abdomen:** Uniformly pale yellow. **Hypopygium (Fig. 2C):** Anal tergite moderately produced distally, with 12–14 short, pale apical setae

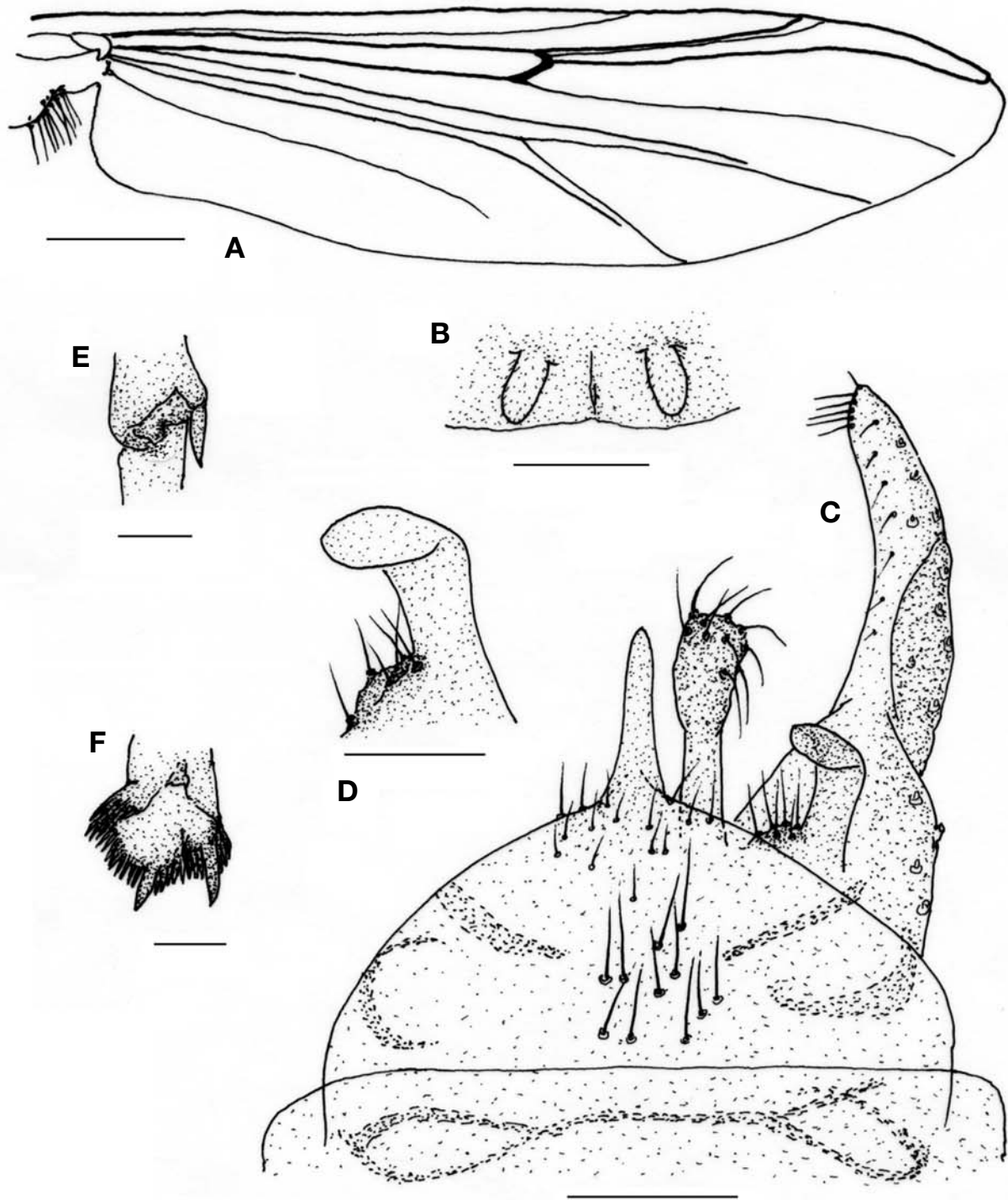
Korean name: <sup>1</sup>\*금사갈따구 (신칭), <sup>2</sup>\*장충갈따구



**Fig. 1.** *Chironomus fujiprimus* (male). A, Wing; B, Frontal tubercle; C, Hypopygium; D, Superior volsella; E, Antenna (female); F, Cercus (female). Scale bars: A=1 mm, B=0.5  $\mu$ m, C, D, F=0.1  $\mu$ m, E=0.2  $\mu$ m.

around base of anal point and 11 long, pale median setae; apodemes not distinct. Anal point moderately long, bent upwards. Superior volsella with apical bare blade, broad,

round apex, abruptly bent upward, and 4–5 irregularly arranged setae at base. Inferior volsella cylindrical, slightly expanded at apex, with 12–15 recurved setae. Gonostylus narrow,



**Fig. 2.** *Chironomus jangchungensis* sp. nov. (male). A, Wing; B, Frontal tubercle; C, Hypopygium; D, Superior volsella; E, Apical spur of fore tibia; F, Comb scales of hind tibia. Scale bars: A=0.5 mm, B, D-F=0.05  $\mu$ m, C=0.1  $\mu$ m.

slightly tapered distally, with 1 short apical and 4–5 subapical inner setae.

**Female.** Unknown.

**Etymology.** This species named after the type locality (Jangchung-dong).

**Distribution.** Korea.

**Remarks.** This new species is easily distinguishable from other species of the genus *Chironomus*, by the following two characters: 1) the anal point is bent upward (dorsal direction), which is not observed in any other species of this genus; 2) the apical bare blade of the superior volsella has a broad, round tip, which is deeply bent dorsally.

Genus *Demicryptochironomus* Lenz

<sup>1</sup>\**Demicryptochironomus paracamptolabis* sp. nov. (Fig. 3)

**Material examined.** Holotype: ♂ (RCH-7053), Korea: Jeollabuk-do, Muju-gun, Muju-eup, Dangsari-ri, 28 Aug 2009, Jeong KY, Nam SH. Paratypes: 29 ♂♂, same as holotype.

**Diagnosis.** Small to medium (WL 1.3 mm), yellowish pale species. Anal tergite triangular, strongly produced distally; 5–7 apical setae each side of anal point; median setae absent. Anal point narrow, parallel-sided, with round tip. Superior volsella pediform, covered with microtrichiae and several short apical setae. Inferior volsella absent. Gonostylus long, slightly tapered apically, with weak longitudinal keel, AR 1.63. LR 1.84.

**Description (male). Head:** Eye bare, widely produced dorsomedially. Frontal tubercle moderately developed (Fig. 3B). Antenna brownish yellow, 11 segmented. AR 1.63. Palp (Fig. 3E) brownish pale yellow, with 5 segments: 29, 36, 95, 119, 125 μm (1 : 1.2 : 3.3 : 4.1 : 4.3). Clypeus yellow, with 13 setae on dorsal half. **Thorax:** Light yellow in ground color. Anteprepronotum slightly narrow dorsally, notched medially. Scutum light yellow, with deep yellow vittae; 13 long, erect acrosticals; 7–9 dorsocentrals, arising from small pit. Scutellum pale yellow, with 7 uniserial setae. Postnotum yellow. **Wing (Fig. 3A):** WL 1.3mm. Membrane bare, greyish yellow in color. All veins bare, except R<sub>1</sub> and basal R<sub>1+2</sub>. Costa not produced. R<sub>2+3</sub> distinct, ending near R<sub>1+2</sub>. R<sub>4+5</sub> distal to M<sub>3+4</sub>. FCu distal to RM. Cu<sub>1</sub> straight. Anal lobe not developed. An reaching below FCu. Squama with 3 setae. Brachiolum and arculus pale, without seta. **Legs:** Fore femur pale yellow, slightly darker distally; fore tibia and tarsi I–V yellowish brown. Mid and hind femur, tibia and tarsi I–III pale yellow, tarsi IV–V darker. Mid and hind tibial combs contiguous, each with a spur (Fig. 3D). Pulvillus distinct. LR 1.84. **Abdomen:** Uniformly pale. **Hypopygium (Fig. 3C):** Anal tergite triangular; median setae absent; 4–5 apical setae each side of anal point; anal tergal band poorly developed. Anal point long, narrow, parallel-sided. Superior volsella pediform, covered with microtrichiae and several short setae apically, Inferior volsella absent. Gonocoxite short. Gonostylus long, slightly tapered apically, with irreg-

ularly arising short setae on distal inner-margin, and weakly developed keel.

**Etymology.** The specific name *paracamptolabis* is given for its similar morphological similarity to *camptolabis*.

**Distribution.** Korea.

**Female.** Unknown.

**Remarks.** The structure of hypopygium of this new species is similar to that of *camptolabis* described by Edwards (1929) and Sasa (1984), though the species described here has an indistinct longitudinal keel on the gonostylus, which is a unique character with in the genus *Demicryptochironomus*.

<sup>2</sup>\**Demicryptochironomus wontongensis* sp. nov. (Fig. 4)

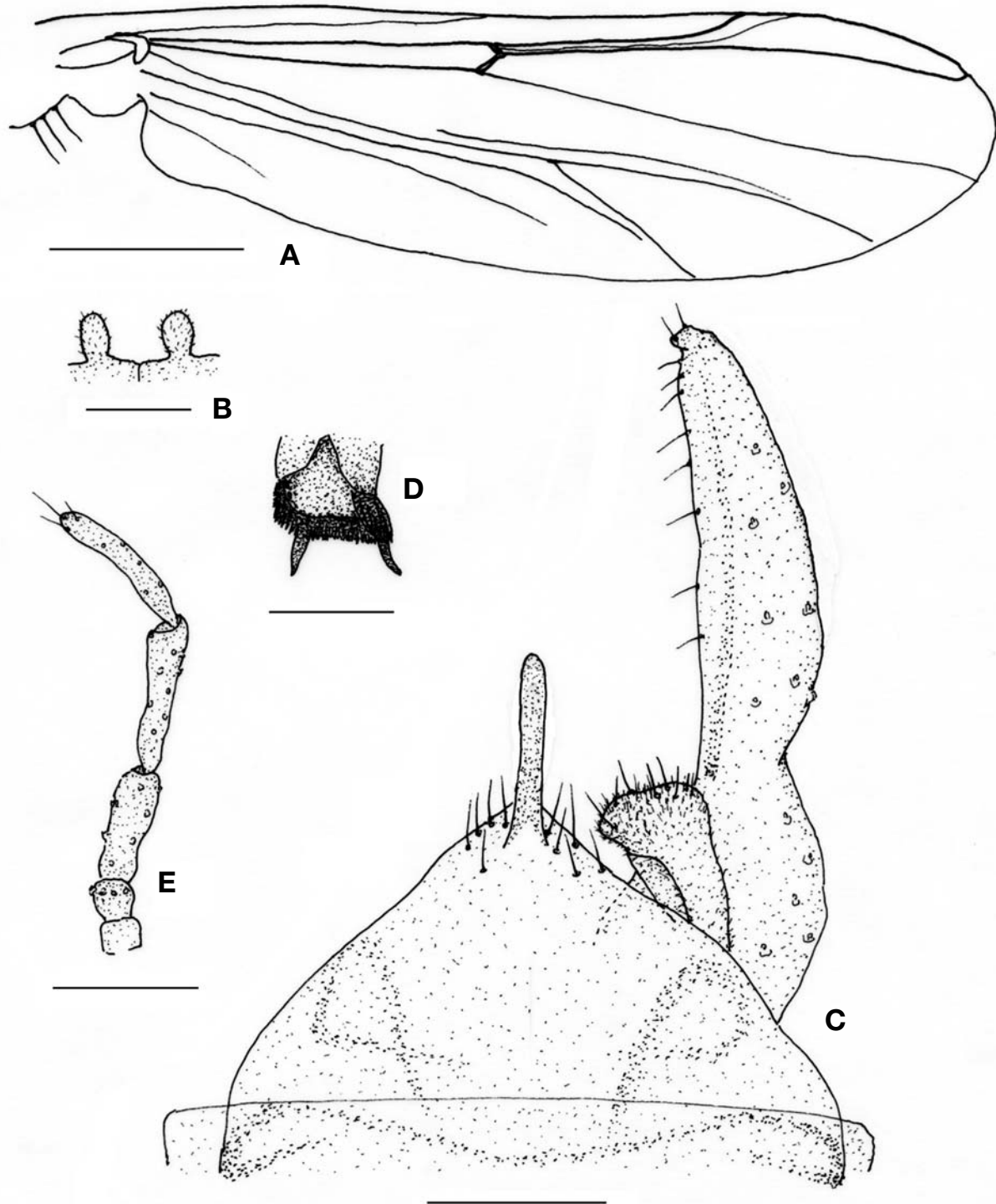
**Material examined.** Holotype: ♂ (RCH-2674), Korea: Gangwon-do, Inje-gun, Wontong-myeon, 2 Oct 1988, Ree HI. Paratypes: 4 ♀♀ (RCH-2675, 2677, 2679, 2693), same as holotype.

**Diagnosis.** Brownish yellow, medium-sized species (WL 2.3 mm). Anal point very long, narrow, parallel-sided, with 10–11 apical setae each side. Superior volsella small, 2 finger-like lobes, subequal, each lobe with an apical seta. AR 2.65. LR 1.47.

**Description (male). Head:** Brownish yellow. Eye brown, bare, dorsomedially extended. Frontal tubercle minute (Fig. 4B). Antenna pale dark brown (1st–3rd segments pale), with 11 segments. AR 2.65. Palp pale dark brown, with 4 segments: 40, 144, 158, 158 μm (1 : 3.6 : 3.9 : 3.9). Clypeus (Fig. 4C) shield-like, brown, with 12 long setae, **Thorax:** Yellowish brown in ground color. Anteprepronotum moderately developed. Scutum yellowish brown, without vittae; 14 acrosticals; 11–12 dorsocentrals and 4 prealars each side. Scutellum pale yellow, with 19 setae. Haltere pale. **Wing (Fig. 4A):** WL 2.3 mm. Membrane bare. All veins pale, without seta, only R, R<sub>1</sub> and R<sub>4+5</sub> with setae. Costa not extended from R<sub>4+5</sub>. R<sub>2+3</sub> end near R<sub>1</sub>. R<sub>4+5</sub> far distal to M<sub>3+4</sub>. FCu slightly distal to RM. Cu<sub>1</sub> straight. Anal lobe moderately developed. Squama fringed. Arculus pale, brachiolum pale with 2 long setae. **Legs:** Foreleg dark brown, except pale femur; mid- and hind-legs pale, except for darker tip (tarsi III–V). Mid and hind tibial combs contiguous, each with a short spur. Pulvillus large. LR 1.47. **Abdomen:** All segments pale yellow. **Hypopygium (Fig. 4D):** Anal tergite produced distally (triangular in form), with 10–11 apical setae each side of anal point; median setae absent; anal tergal band absent; transverse sternapodeme smoothly rounded. Anal point long (300 μm), narrow, parallel-sided. Superior volsella small, 2 subequal, finger-like lobes, each with an apical spur (Fig. 4E). Inferior volsella absent. Gonocoxite small. Gonostylus long, slightly

Korean name: <sup>1</sup>\*세 모반음갈따구 (신칭), <sup>2</sup>\*원통반음갈따구 (신칭)

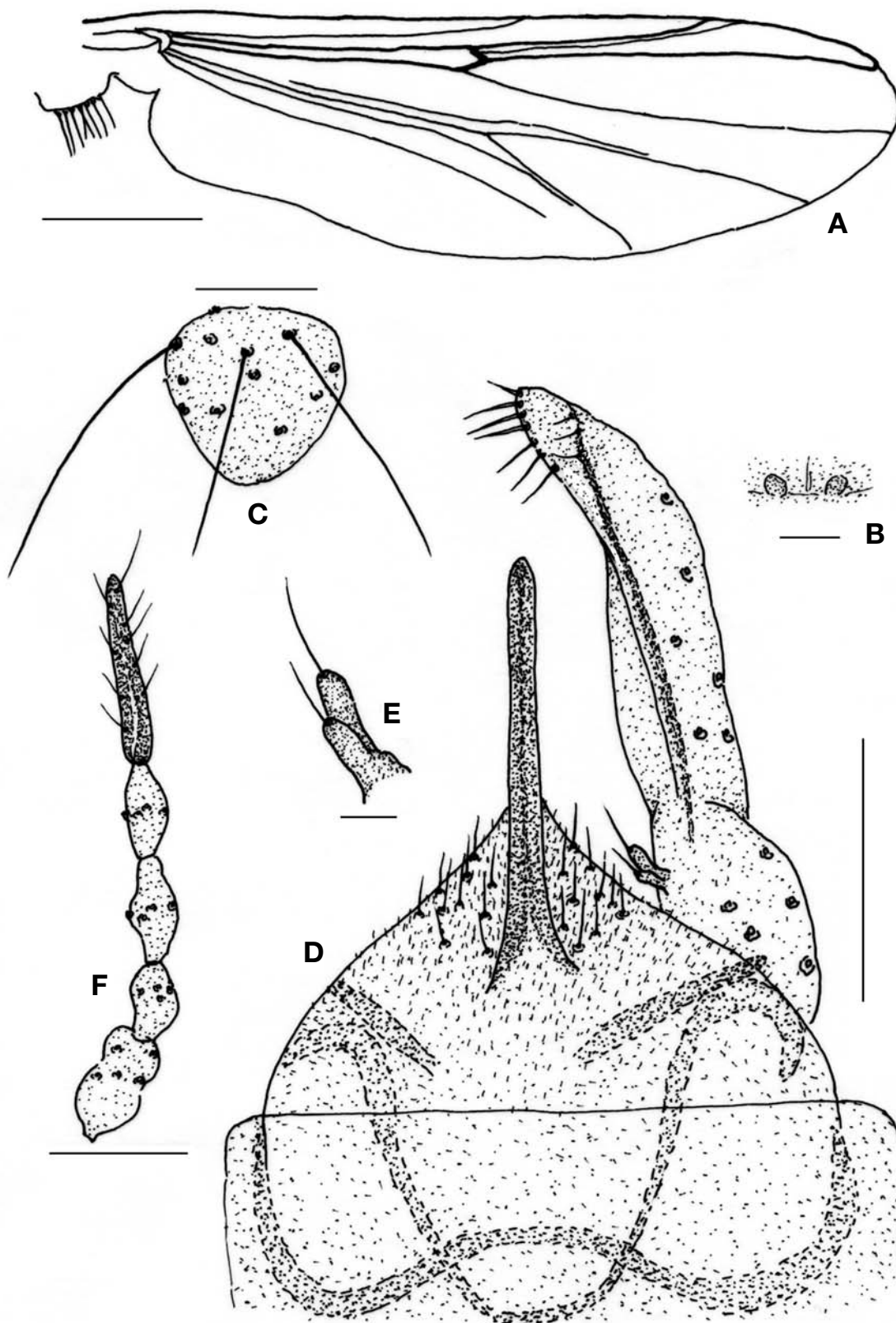




**Fig. 3.** *Demicryptochironomus paracamptolabis* sp. nov. (male). A, Wing; B, Frontal tubercle; C, Hypopygium; D, Comb scale of hind tibia; E, Palp. Scale bars: A=0.3 mm, B=0.03  $\mu$ m, C, D=0.05  $\mu$ m, E=0.1  $\mu$ m.

swollen inner-basally, tip smoothly rounded with 1 apical and 3 subapical strong, pale setae; longitudinal keel present dorsally.

**Female.** Generally same as male, except for the usual sexual differences. Antenna 5 segmented; 1st–4th segments pale, 5th segment dark brown (Fig. 4F).



**Fig. 4.** *Demicryptochironomus wontongensis* sp. nov. (male). A, Wing; B, Frontal tubercle; C, Clypeus; D, Hypopygium; E, Superior volsella; F, Antenna (Female). Scale bars: A=0.5 mm, B=0.02  $\mu$ m, C=0.05  $\mu$ m, D, F=0.1  $\mu$ m, E=0.10  $\mu$ m.

**Etymology.** The new name refers to the locality where this species was collected.

**Distribution.** Korea

**Remarks.** This new species is easily distinguishable from other species of *Demicryptochironomus* by its long anal point and two subequal, finger-like lobes of the superior volsella.

Genus *Microtendipes* Kieffer

<sup>1</sup>\**Microtendipes paratamagouti* sp. nov. (Fig. 5)

**Material examined.** Holotype: ♂ (RCH-6293), Korea: Jeju-do, Seoguipo-si, Jungmun-dong, 2 Oct 2008, Ree HI, Jeong KY. Paratypes: 1 ♂ (RCH-3671), Gyeongsangbuk-do, Gimcheon-si, Daehang-myeon, Jikji Temple, 18 Oct 1996, Ree HI; 5 ♂♂ (RCH 6270, 6272, 6279, 6288, 6296), same as holotype.

**Diagnosis.** Brownish, large species (WL 2.9 mm). Anal tergite large, hemisphere, without median seta. Anal point rather short, slightly tapered apically, with round tip. Superior volsella broadly expanded on distal half, with 4–7 dorsal setae on middle and 1 seta at inner base. Tibia of foreleg dark, with narrow, long apical spur. AR 1.92, LR 1.17.

**Description (male).** **Head:** Brownish yellow. Eye black, bare, extended dorsomedially. Frontal tubercle absent. 10–11 postoculars each side. Antenna yellowish dark brown, with 13 segments. AR 1.92. Palp dark brown, with 5 segments: 47, 65, 302, 281, 346 μm (1 : 1.4 : 6.4 : 6.0 : 7.4); first segment narrower than second one. Clypeus brown, with 19 setae. **Thorax:** Brown in ground color. Antepnotum moderately developed, narrow dorsally, without setae. Scutum brown, with dark brown vittae (not clearly defined); acrosticals absent; 4 prealars. Scutellum dark brown, with 15 setae. Postnotum dark brown. Preepisternum dark brown. Haltere pale. **Wing (Fig. 5A):** WL 2.9 mm. Membrane bare, transparent. Costa not extended from R<sub>4+5</sub>. R<sub>2+3</sub> running very close to R<sub>1</sub> (apical end of R<sub>2+3</sub> almost overlap to R<sub>1</sub>). Veins all pale, transparent, setae only on R, R<sub>1</sub>. R<sub>4+5</sub> distal to M<sub>3+4</sub>. FCu distal to RM. Cu<sub>1</sub> straight. Anal lob moderately developed. Squama with 14 setae. Arculus and brachiolum pale. **Legs:** Fore leg: femur pale with dark brown tip, fore tibia uniformly dark brown (Fig. 5D), tarsi I–II pale yellow, tarsi III–V darker. Mid and hind legs: all segments pale yellow. Fore tibia with an extremely long, narrow spur at tip; mid and hind tibial combs contiguous, with a rather small spur, curved at tip. Pulvillus developed. LR 1.17. **Abdomen:** Tergite I–V pale yellow; tergite VI–VIII deep yellow. **Hypopygium (Fig. 5B):** Anal tergite large, hemispheric-shaped,

with 11–14 rather short, apical setae each side of anal point; median setae absent; anal tergal band V-type; all apodemes dark brown, well developed. Anal point rather short, slightly tapered apically, with round tip. Broadly expanded distal half of superior volsella curved inward, with 4–7 dorsal setae at middle and 1 seta at base. Inferior volsella cylindrical, with many setae on distal half. Gonostylus rather short (shorter than gonocoxite), with 3 strong setae apically.

**Female.** Unknown.

**Etymology.** This species name refers to closely related species, *M. tamagouti*.

**Distribution.** Korea.

**Remarks.** Superior volsella of this species shows considerable variation in the shape of the distal half and the number of dorsal setae (Fig. 5C). This new species is closely related to *M. tamagouti* Sasa, 1983. The main differences are 1) minute frontal tubercles present in *tamagouti* that are absent in the new species; 2) median setae present in the former, but absent in the later; 3) superior volsella of the former species has 2–3 long inner setae at base, while there is only 1 long seta at base in the newly-described species; 4) the LR of *tamagouti* is 1.88, whereas that of the new species is 1.17.

Genus *Pentapedilum* Kieffer

<sup>2</sup>\**Pentapedilum convexum* (Johannsen, 1932) (Fig. 6)

*Pentapedilum convexum* Johannsen, 1932: 540.

*Polypedilum* (*Pentapedilum*) *convexum*: Tokunaga, 1964: 596; Oyewo and Sæther, 2008: 49; Yamamoto et al., 2012: 35.

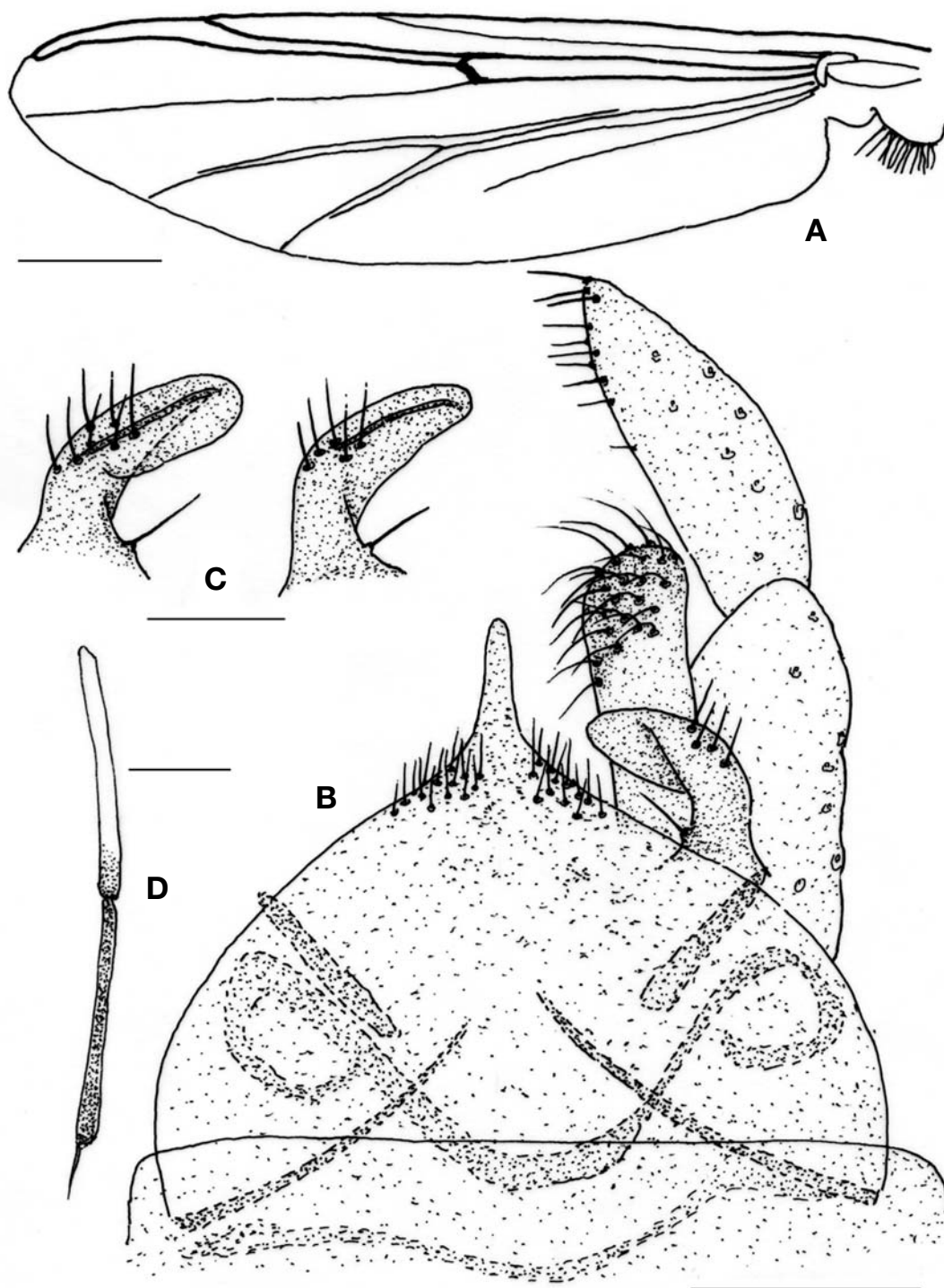
**Material examined.** 11 ♂♂, 1 ♀, Korea: Jeju-do, Seoguipo-si, Jungmun-dong, 1 Oct 2008, Ree HI, Jeong KY.

**Diagnosis.** Yellowish, small to medium sized species (WL 1.4 mm). Wing membrane covered with macrotrichiae, except at base. Clypeus round with 32 extraordinarily long setae. Round apex of haltere with 5 setae. Anal point short, broad, with round tip. Superior volsella extremely narrow, a long outer-lateral seta at middle, with 4 setae at inner base. AR 0.43. LR 2.41.

**Description (male).** **Head:** Yellowish brown. Eye bare, moderately extended to dorsomedially. Antenna yellowish brown, 12 segmented (1st and 2nd segment fused). AR 0.43. Frontal tubercle absent. 9–11 postoculars each side. Clypeus brownish yellow, round, with 32 long, stout setae (Fig. 6B). Palp pale dark brown, with 5 segments: 29, 39, 85.7, 121, 214 μm (1 : 1.4 : 3.0 : 4.3 : 7.5). **Thorax:** Antepnotum brownish yellow, narrowed dorsally. Scutum brownish yellow, with

Korean name: <sup>1</sup>\*작은꼬리왜소갈다구, <sup>2</sup>\*혀오각갈따구

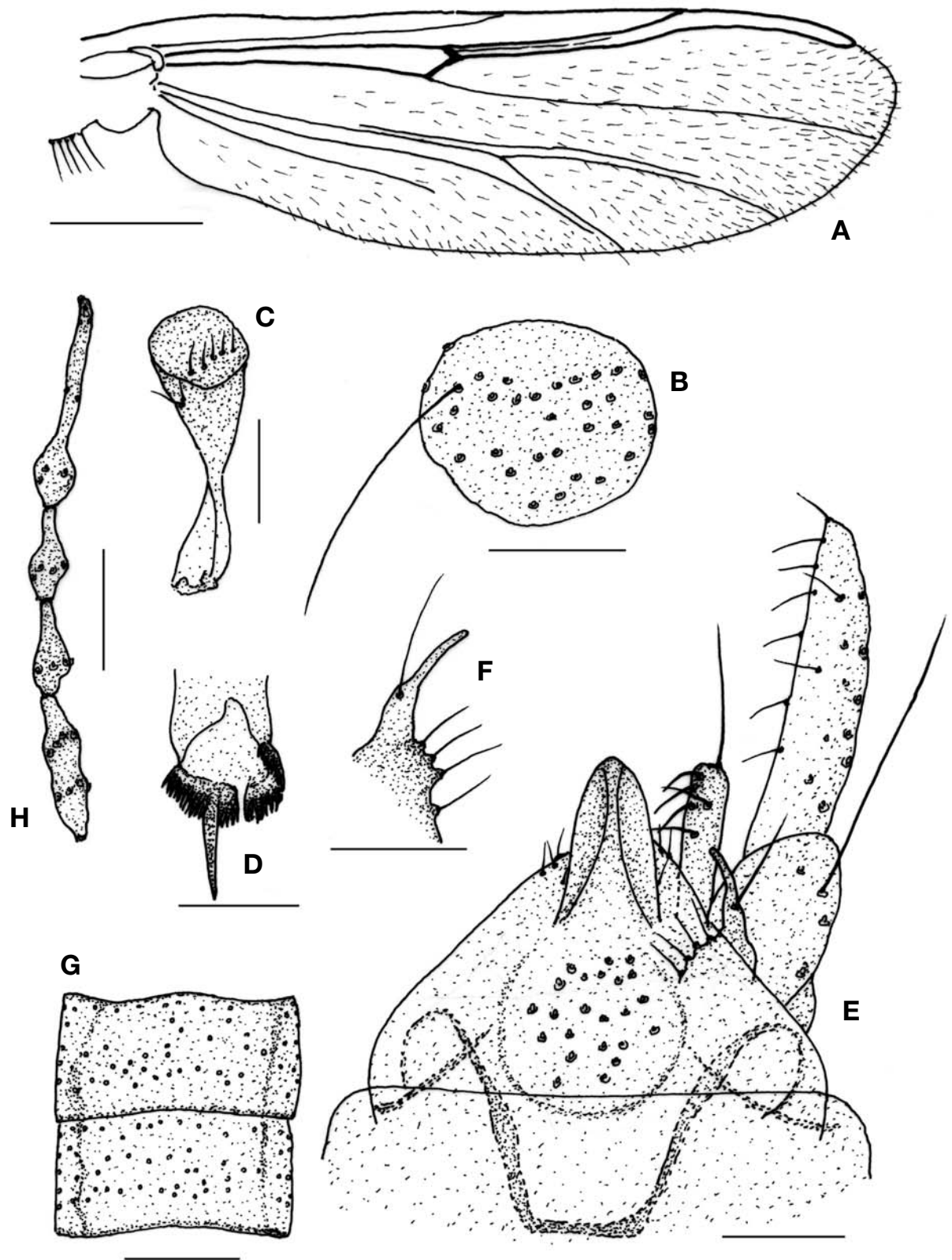




**Fig. 5.** *Microtendipes paratamagouti* sp. nov. (male). A, Wing; B, Hypopygium; C, Variation of superior volsella; D, Fore femur and tibia. Scale bars: A, D=0.5 mm, B=0.1  $\mu$ m, C=0.05  $\mu$ m.

inconspicuous brown vittae; 19 biserial acrosticals; 24–25 dorsocentrals and 7–9 prealars each side. Scutellum brownish pale yellow, with 19 setae. Postnotum brown. Haltere

pale dark brown, with 7 setae (Fig. 6C). **Wing (Fig. 6A):** WL 1.4 mm. Membrane covered with macrotrichiae. Almost all veins with setae. Costa not produced.  $R_{2+3}$  not distinct.  $R_{4+5}$



**Fig. 6.** *Pentapedilum convexum* (male). A, Wing; B, Clypeus; C, Haltere; D, Hind tibial comb scale; E, Hypopygium; F, Superior volsella; G, Abdominal tergite III-IV; H, Antenna (Female). Scale bars: A=0.3 mm, B, D-F=0.05  $\mu$ m, C, H=0.1  $\mu$ m, G=0.2  $\mu$ m.

beyond  $M_{3+4}$ . RM proximal to FCu.  $Cu_1$  straight. An scarcely reaching FCu. Anal lobe not developed. Squama with setae. **Legs:** All segments brownish yellow. Mid and hind tibial combs narrowly separated, with a long spur (Fig. 6D). LR 2.41. **Abdomen:** All segments uniformly pale yellow, with vertical dark stripe each side of tergum. Setal arrangement and longitudinal stripe as shown in Fig. 6G. **Hypopygium (Fig. 6E):** Anal tergite triangularly produced distally; 26 long median setae; several short apical setae each side of anal point. Anal point broad, with round tip and deep keel ventrally. Superior volsella with extremely narrow apical blade, a long outer lateral seta at middle and 4 setae at inner base (Fig. 6F). Inferior volsella cylindrical with a long seta and 5–7 recurved setae apically. Gonostylus straight, apically tapered, with round tip.

**Female.** Generally same as in male, except for usual sexual differences. Antenna (Fig. 6H) brown, with 4 segments (first and second segment fused).

**Distribution.** Europe, Indonesia, China, Russian Far East, Japan, Korea.

**Remarks.** *Pentapedilum convexum* has the following unique characters: 1) broad anal point with round tip and deep ventral keel, 2) very narrow blade of superior volsella, 3) 5 uniserial setae on top of haltere, and 4) round clypeus with extraordinarily long setae. Sasa (1979) reported a new species, *Pentapedilum kasmiensis*, the morphological characters of which are almost identical to *P. convexum*. Yamamoto et al. (2012) speculated that they were conspecific.

Genus *Polypedilum* Kieffer

<sup>1</sup>\**Polypedilum macrohemisphere* sp. nov. (Fig. 7)

**Material examined.** Holotype: ♂ (RCH-7011), Korea: Jeollabuk-do, Muju-gun, Muju-eup, Dangan-ri, 28 Aug 2009, Jeong KY, Nam SH. Paratypes: 2♂♂ (RCH-6364, 6635), same as holotype, except date 5 Sep 2008.

**Diagnosis.** Small to medium-sized (WL 1.8 mm), pale yellow species. Clypeus round, with 16 setae arising on dorso-central site. Anal tergite extraordinarily large, roundly produced distally, with 10–11 apical setae each side of anal point. Anal point small, narrow, parallel-sided. Superior volsella with short, narrow, abruptly curved apical blade, and broad basal half covered with microtrichiae and 1 seta. AR 1.67. LR 1.75.

**Description (male).** **Head:** Eye bare, produced dorsomedially. Frontal tubercle absent. Antenna yellowish brown, with 13 segments. AR 1.67. Clypeus yellow, with 16 setae arising on dorsocentral site (Fig. 7B). Palp pale brownish

yellow, with 4 segments: 43, 107, 104, 143  $\mu\text{m}$  (1 : 2.5 : 2.4 : 3.3). **Thorax:** yellow in ground color. Antepronotum yellow, narrowed dorsally, Scutum yellow, vittae absent; 12 acrosticals; 15–16 dorsocentrals and 5 prealars each side. Scutellum pale yellow, with 20 setae. Postnotum brownish yellow. Haltere pale. **Wing (Fig. 7A):** WL 1.8mm. Membrane bare. Costa not produced.  $R_{2+3}$  ending near tip of  $R_1$ .  $R_{4+5}$  distal to  $M_{3+4}$ . FCu distal to RM.  $Cu_1$  straight. Postcubitus distinct. An scarcely reaching FCu. Anal lobe moderately developed. Squama with setae. Arculus pale, brachiolum pale with 1 seta. **Legs:** Uniformly pale yellow; foreleg slightly darker. Mid and hind tibial combs contiguous, with 1 long spur (Fig. 7C). Pulvillus not developed. LR 1.75. **Abdomen:** All segments pale yellow. **Hypopygium (Fig. 7D):** Anal tergite extraordinarily large, roundly produced distally; 11 median setae; 10–11 apical setae each side of anal point; phalopodeme and lateral sternopodeme pale; anal tergal band poorly developed. Anal point rather short, narrow, parallel-sided. Superior volsella with short, narrow, abruptly curved apical blade and broad basal half covered with microtrichiae and 1 seta. Inferior volsella cylindrical, with 1 long seta and 10–12 strong, recurved setae apically. Gonostylus tapered distally, with pointed tip.

**Female.** Unknown.

**Etymology.** The species name refers to large, hemispheriform anal tergite.

**Distribution.** Korea.

**Remarks.** This new specie is characterized by the extraordinarily small anal point, large hemispheriform anal tergite, and small, unique shape of superior volsella.

Genus *Tanytarsus* v.d. Wulp

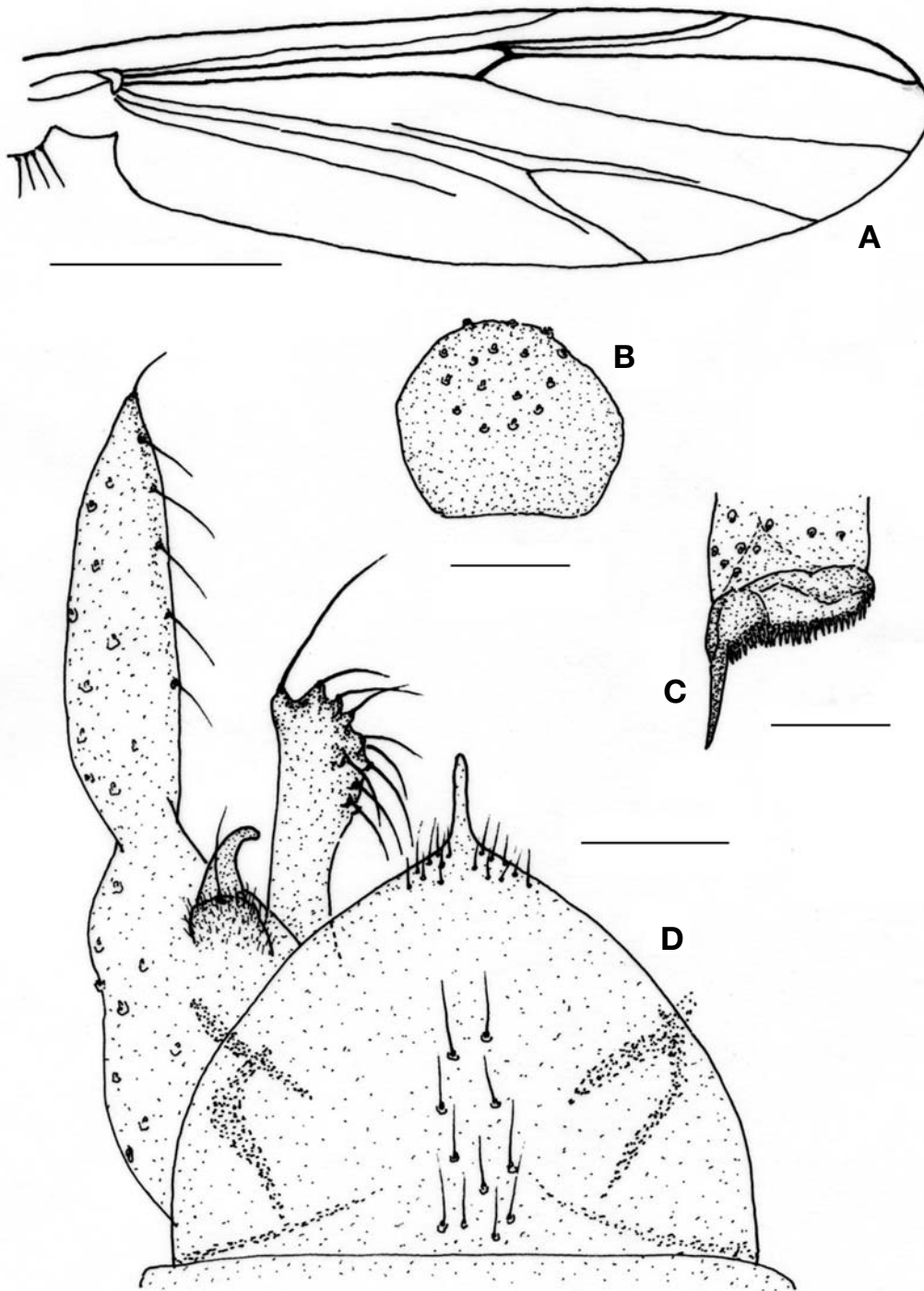
<sup>2</sup>\**Tanytarsus smolandicus* Brundin, 1947 (Fig. 8)

*Tanytarsus smolandicus* Brundin, 1947; 68; Reiss and Fittkau, 1971: 111.

**Material examined.** 4♂♂, Korea: Jeollabuk-do, Muju-gun, Muju-eup, Dangan-ri, 5 Sep 2008, Jeong KY, Nam SH; 8♂♂, same locality, 22 May 2009; 5♂♂, same locality, 28 Aug 2009.

**Diagnosis.** All body color pale yellow, small to medium species (WL 1.8 mm). Wing membrane with macrotrichiae mostly on apical half. Anal tergite rounded distally, with 3 minute median setae. Anal point slightly broadened at middle, with 2–3 weak spines and anal crest. Superior volsella small, round, with 5–6 dorsal and 8–9 ventral setae; digitus short, not produced from margin of superior volsella. Median volsella short, with 2–3 lamellar and many simple setae. AR

Korean name: <sup>1</sup>\*반원부늬깔따구 (신칭), <sup>2</sup>\*황백장부깔따구 (신칭)

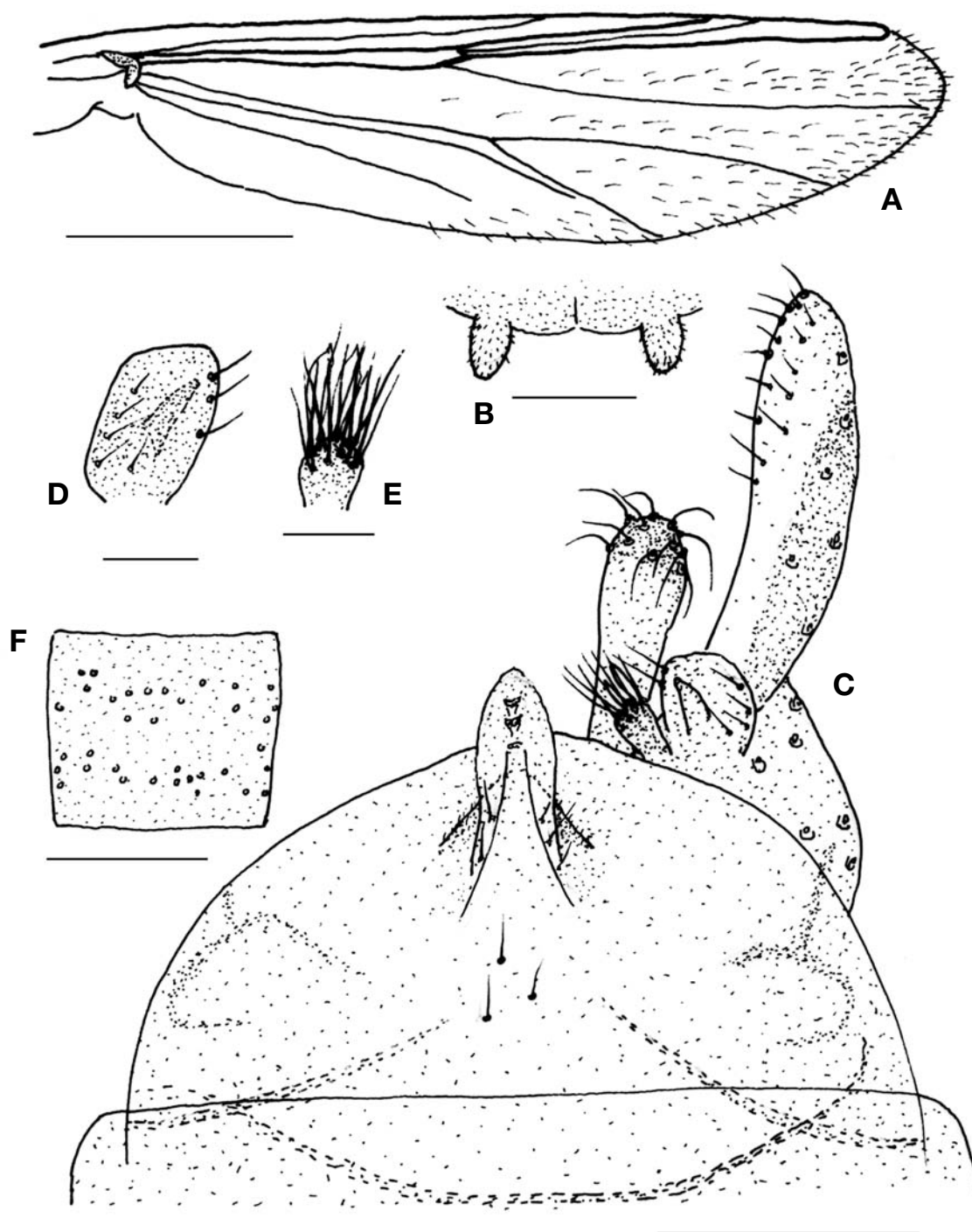


**Fig. 7.** *Polypedilum macrohemisphere* sp. nov. (male). A, Wing; B, Clypeus; C, Hind tibial combs; D, Hypopygium. Scale bars: A=0.5 mm, B-D=0.05  $\mu$ m.

1.22. LR 3.05.

**Description (male). Head:** Eye bare, shortly extended dorso-medially. 7–8 postoculars. Frontal tubercle moderately short (Fig. 8B). Antenna yellowish brown, with 13 segments. AR

1.22. Palp pale, 4 segmented: 36, 111, 118, 189  $\mu$ m (1 : 3.1 : 3.3 : 5.3). Clypeus pale yellow, with 16 setae. **Thorax:** Pale yellow in ground color. Antepronotum pale yellow, narrowed dorsally, lobes widely separated. Scutum pale yellow,



**Fig. 8.** *Tanytarsus smolandicus* (male). A, Wing; B, Frontal tubercle; C, Hypopygium; D, Superior volsella; E, Median volsella; F, Abdominal tergum IV. Scale bars: A=0.5 mm, B, C=0.1  $\mu$ m, D, E=0.05  $\mu$ m, F=0.2 mm.

vittae absent; 13 acrosticals; 6–8 dorsocentrals and 0–1 prealars each side. Scutellum pale yellow, with 4 setae. Postnotum pale yellow. Haltere pale. **Wing (Fig. 8A):** WL 1.8 mm. Membrane with macrotrichiae, mostly on distal half.

All veins with setae, except subcosta and  $R_{2+3}$ . Costa not produced.  $R_{4+5}$  slightly distal to  $M_{3+4}$ . Anal lobe not developed. Squama bare. Arculus brown, brachiolum pale yellow with 1 seta. **Legs:** Uniformly pale yellow. Mid and hind tibi-

al combs separated, each with a spur. Pulvillus absent. LR 3.05. **Abdomen:** All segments pale yellow, with irregularly arising 30–40 biserial setae (Fig. 8F). **Hypopygium (Fig. 8C):** Anal tergite roundly produced distally, with 2–3 short median setae; apodemes and anal tergal band not developed. Anal point short and wide, rounded apically, with 2–3 rather poor spines and distinct anal crest. Superior volsella (Fig. 8D) roughly spheric-shaped, with 2–3 inner-lateral setae, 4–5 dorsal short setae, and 8–9 ventral setae; digitus short, not extending beyond margin of superior volsella. Inferior volsella cylindrical, slightly expanded apically, with 10–13 rather short setae apically. Median volsella (Fig. 8E) very short, with 2–3 lamellar setae and many simple setae. Gonostylus slightly tapered apically, with irregular, short setae subapically.

**Distribution.** Europe, Korea.

**Remarks.** Morphological structures of the present species match those of *Tanytarsus smolandicus* Brundin, 1947 well, except for the value of LR. The LR of the Korean specimens was 3.05, whereas that reported for the European specimens was 2.7. This species is the first description of this species in Asia.

<sup>1</sup>\**Tanytarsus oyamai* Sasa, 1979 (Fig. 9)

*Tanytarsus oyamai* Sasa, 1979: 3; Sasa and Kawai, 1987: 38; Sasa and Okazawa, 1992: 41; Sasa, 1993: 57; Ekrem, 2002: 26.

**Material examined.** 5 ♂♂, Korea: Busan-si, Buk-gu, Daejeo-dong, 21 Jun 1979, Ree HI.

**Diagnosis.** Small to medium (WL 1.5 mm), brownish species. Wing membrane with macrotrichiae on apical end only. Anal point round at tip, with 2–3 poor spines between strong anal crests. Superior volsella tapered apically, with 2–3 inner-lateral and 6–7 dorsal setae; with very small digitus present. Median volsella short, with simple setae only. AR 1.07. LR 1.70.

**Description (male). Head:** Brown in ground color. Eye bare, extended dorsomedially. 12–13 postoculars. Frontal tubercle present (36 µm long × 10 µm wide). Antenna pale dark brown, with 13 segments. AR 1.07. Palp pale brownish yellow, with 5 segments: 36, 39, 100, 82, 112 µm (1 : 1.1 : 2.8 : 2.3 : 3.1). Clypeus brown, with 21 setae. **Thorax:** Light brown in ground color. Antepronotum dark brown, bare, narrowed dorsally. Scutum brown, with dark brown vittae; 7 acrosticals; 7–8 dorsocentrals each side; prealars absent. Scutellum brown, with 6 setae, Postnotum dark brown. Haltere pale dark brown. Preepisternum dark brown. **Wing (Fig. 9A):** WL 1.5 mm. Membrane with macrotrichiae on apical

end. R<sub>2+3</sub> ending at middle of R<sub>1</sub> and R<sub>4+5</sub>. R<sub>4+5</sub> distal to M<sub>3+4</sub>. FCu distal to RM. Cu<sub>1</sub> straight. An scarcely reaching FCu. Anal lobe not developed. Squama bare. Arculus and brachiolum pale dark brown. **Legs:** Uniformly dark brown. Mid and hind tibial combs separated, each with a spur. Pulvillus not developed. LR 1.70. **Abdomen:** Uniformly pale dark brown. **Hypopygium (Fig. 9B):** anal tergite smoothly rounded, with 3 rather short median setae; apical setae absent; anal tergal band prominent, V-type; all apodemes developed. Anal point moderately broad, round at tip, with 2–3 poorly developed spines between strong anal crests. Superior volsella (Fig. 9C) tapered apically, with 2–3 inner-lateral setae and 6–7 dorsal setae; digitus small, not extending to margin of superior volsella. Median volsella (Fig. 9D) short, with many simple setae. Inferior volsella cylindrical with many apical setae. Gonostylus smoothly tapered apically, with irregularly arised setae apically and subapically.

**Distribution.** Japan, Korea.

**Remarks.** Morphological structures of the Korean specimens match those of *Ta. oyamai* Sasa, 1979 well, except for 2–3 spines on the anal point and the simple setae of the median volsella in the Korean specimens, whereas in the Japanese specimens, there were 4–5 spines on the anal point and the median volsella had sharply pointed branches.

Subfamily Orthocladiinae Edwards

<sup>2</sup>\*Genus *Eukiefferiella* Thienemann

<sup>3</sup>\**Eukiefferiella busanensis* sp. nov. (Fig. 10)

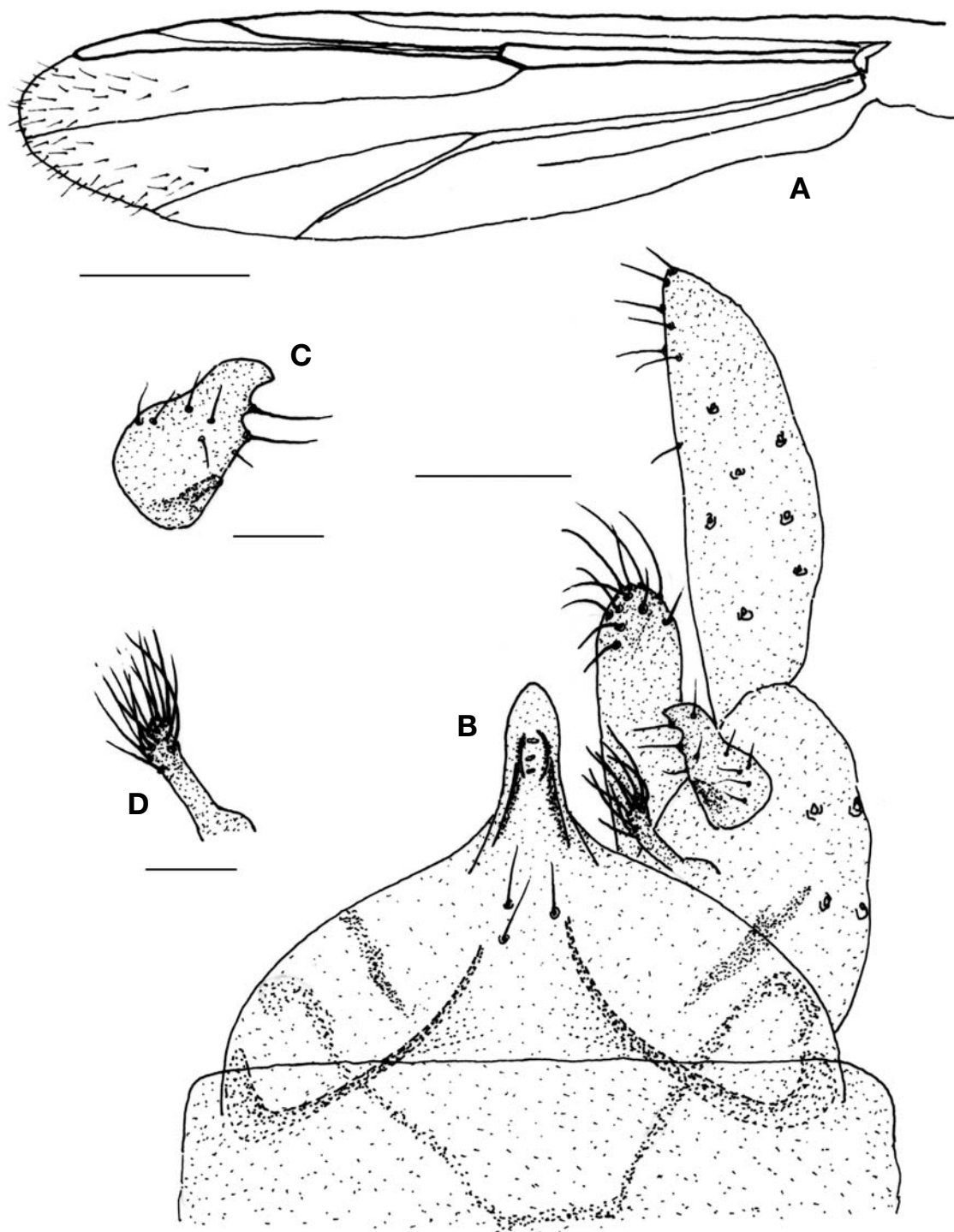
**Material examined.** Holotype: ♂ (RCH-4145), Korea: Busan-si, Buk-gu, Daejeo-dong, 15 Sep 1980, Ree HI. Paratypes: 19 ♂♂, same as holotype.

**Diagnosis.** Small to medium, yellowish pale species (WL 1.4 mm). Antenna and all veins of wing extremely pale, almost transparent. Anal tergite small, without any setae, except 2 minute median setae. Gonocoxal lobe rather small, triangular, with 5–6 setae. Gonostylus expanded distally, with a pale megaseta. AR 1.36. LR 0.56.

**Description (male). Head:** Eye bare, shortly extended dorsomedially. Frontal tubercle absent. Antenna extremely pale, almost transparent, with 13 segments. AR 1.36. Palp pale, with 5 segments: 36, 39, 84, 93, 150 µm (1 : 1.1 : 2.4 : 2.6 : 4.2). Clypeus pale yellow, more or less rectangular, with 11 pale setae. **Thorax:** Brownish yellow in ground color. Antepronotum pale yellow, well developed, without seta. Scutum brownish yellow, with inconspicuous brown vittae; acrosticals minute, difficult to observe. Scutellum yellow, with 4 pale setae. Postnotum brownish yellow. Haltere pale. **Wing**

Korean name: <sup>1</sup>\*오야마장부갈따구 (신칭), <sup>2</sup>\*관눈갈따구속 (신칭), <sup>3</sup>\*부산팔눈갈따구 (신칭)

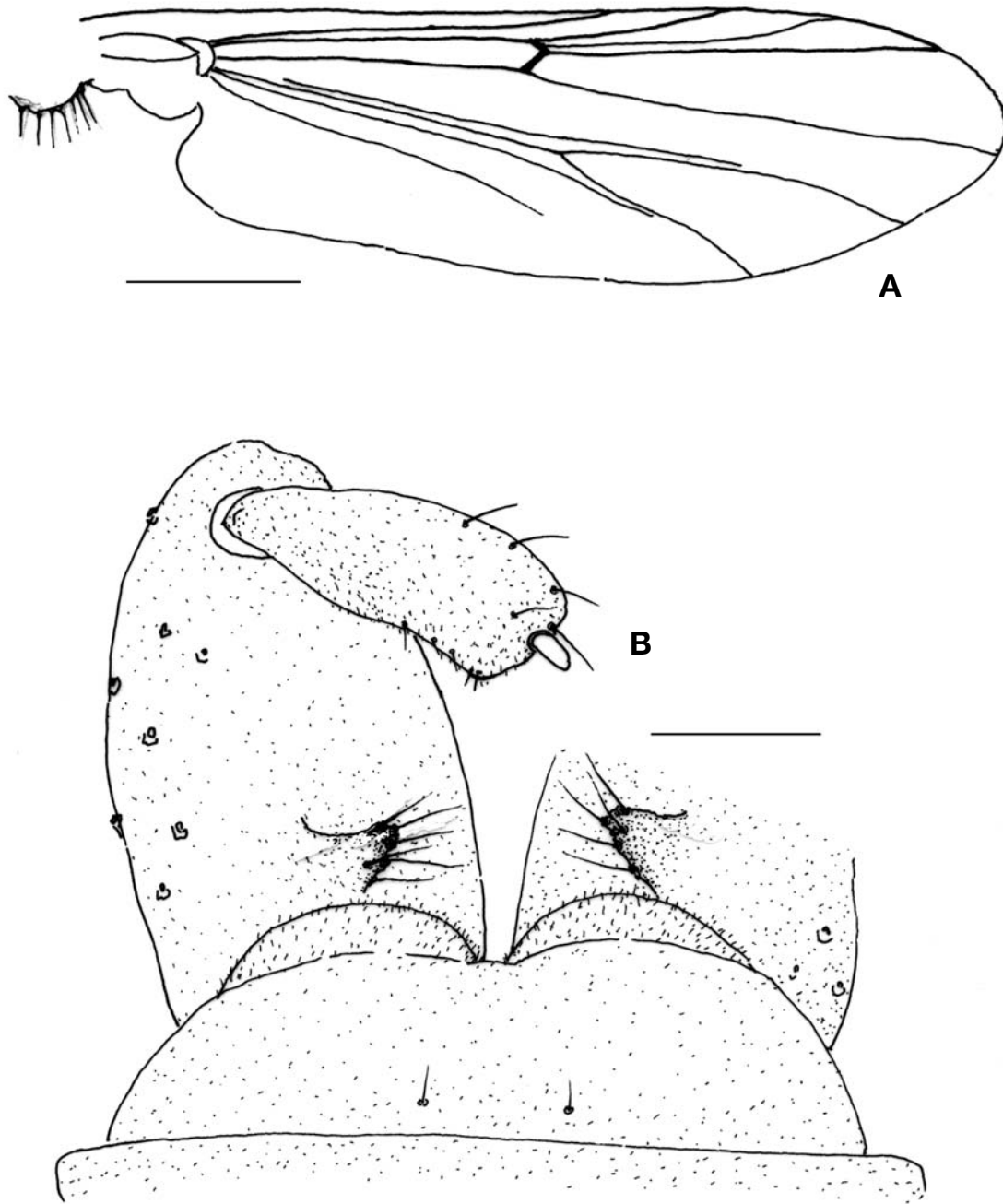




**Fig. 9.** *Tanytarsus oyamai* sp. nov. (male). A, Wing; B, Hypopygium; C, Superior volsella; D, Median volsella. Scale bars: A=0.03 mm, B=0.05  $\mu$ m, C, D=0.02  $\mu$ m.

**(Fig. 10A):** WL 1.4 mm. Membrane bare, transparent. All veins pale, almost transparent, without setae. Costa not produced.  $R_{2+3}$  ending at middle of  $R_1$  and  $R_{4+5}$ .  $R_{4+5}$  distal to

$M_{3+4}$ . FCu distal to RM.  $Cu_1$  almost straight. An reaching below FCu. Anal lobe moderately developed. Squama with setae. Brachiolum and arculus pale. **Legs:** All segments



**Fig. 10.** *Eukiefferiella busanensis* sp. nov. (male). A, Wing; B, Hypopygium. Scale bars: A=0.3 mm, B=0.5  $\mu$ m.

extremely pale. Fore and mid tibiae with a rather short, pale spur apically; hind tibia with a long spur and comb spurs. Pulvillus absent, LR 0.56. **Abdomen:** All segments pale yellow. **Hypopygium (Fig. 10B):** Anal tergite rather small, setae completely absent, except for 2 minute median setae. Anal point absent. Gonocoxite large; gonocoxal lobe rather

small, triangular, with 5–6 setae. Gonostylus pale yellow, rather large, somewhat expanded distally, with a pale megaseta.

**Female.** Unknown.

**Etymology.** The new specific name refers to the name of city where this species was collected.

**Distribution.** Korea.

**Remarks.** This new species has an extremely pale body color, including wing veins. Anal tergite is extremely simple, no setae, except for 2 tiny median setae, and no apodemes and anal tergal bands. This is the first record of the genus *Eukiefferiella* in Korea.

Genus *Psectrocladius* Kieffer

<sup>1</sup>\**Psectrocladius paratogaminimus* sp. nov. (Fig. 11)

**Material examined.** Holotype: ♂ (RCH-3489), Korea: Gyeongsangnam-do, Jinhae-si, Songhak-dong, 6 Jul 2005, Ree HI. Paratypes: 3♂♂, same as holotype.

**Diagnosis.** Medium sized (WL 2.4 mm), dark brown species. Anal tergite roundly produced distally, without median setae. Anal point narrow, tapered distally, with large triangular base. Gonocoxal lobe large, triangular, with many short setae. AR 1.70. LR 0.73.

**Description (male). Head (Fig. 11B):** Eye bare, just a little extended (Wedge-shaped) dorsomedially. 7–8 postoculars. Antenna dark brown, rather short, with 12 segments (Fig. 11C). AR 1.70. Palp dark brown, with 4 segments: 50, 118, 143, 150 μm (1 : 2.4 : 2.9 : 3.0). Clypeus yellowish brown, with 14 setae. **Thorax:** Reddish brown in ground color. Anteprepronotum normally developed, extended medially. Scutum reddish brown, vittae dark brown; acrosticals absent; 10–13 dorsocentrals each side. Scutellum dark brown, with 4 setae. Postnotum dark brown. **Wing (Fig. 11A):** WL 2.4 mm. Costa produced. Membrane bare. Veins all bare. R<sub>2+3</sub> ending at middle of R<sub>1</sub> and R<sub>4+5</sub>. R<sub>4+5</sub> distal to M<sub>3+4</sub>. Cu<sub>1</sub> almost straight. Anal lobe well developed. Squama with numerous setae. Arculus and brachiolum pale dark brown. **Legs:** All segments uniformly dark brown. Frontal tibia with a long apical spur; Mid tibia with a strong spur; hind tibia with a strong spur and many comb spurs. Pulvillus large. LR 0.73. **Abdomen:** dark brown, with numerous setae. **Hypopygium (Fig. 11D):** Anal tergite roundly extended distally, with transverse and lateral sternapodemes. Anal point rather short, narrow, bare, with sharply pointed apex, and with large triangular base with many setae. Gonocoxite large; gonocoxal lobe large, round, with many setae dorsally. Gonostylus narrowed at base, expanded distally, with a moderately weak mego seta.

**Female.** Unknown.

**Etymology.** This new specific name derived from the closely related species, *Ps. togaminimus*.

**Distribution.** Korea.

**Remarks.** This new species and *P. togaminimus* Sasa et

Okazawa, 1992 are characterized by having 1) a short, sharply pointed anal point, with a large triangular base, 2) large, round gonocoxal lobe, and 3) similar AR, LR and WL values. However, these two species have a different body color; the former species has reddish brown scutum with dark brown vittae, dark brown scutellum, and dark brown femur and tibia of mid and hind legs, whereas the later species has a pale yellow scutum with brownish yellow vittae, yellow scutellum, and yellow femur and tibia of the mid and hind legs. Furthermore, the broadened triangular base of anal point is much larger in the former species than the latter species.

<sup>2</sup>\*Genus *Pseudosmittia* Goetghebuer

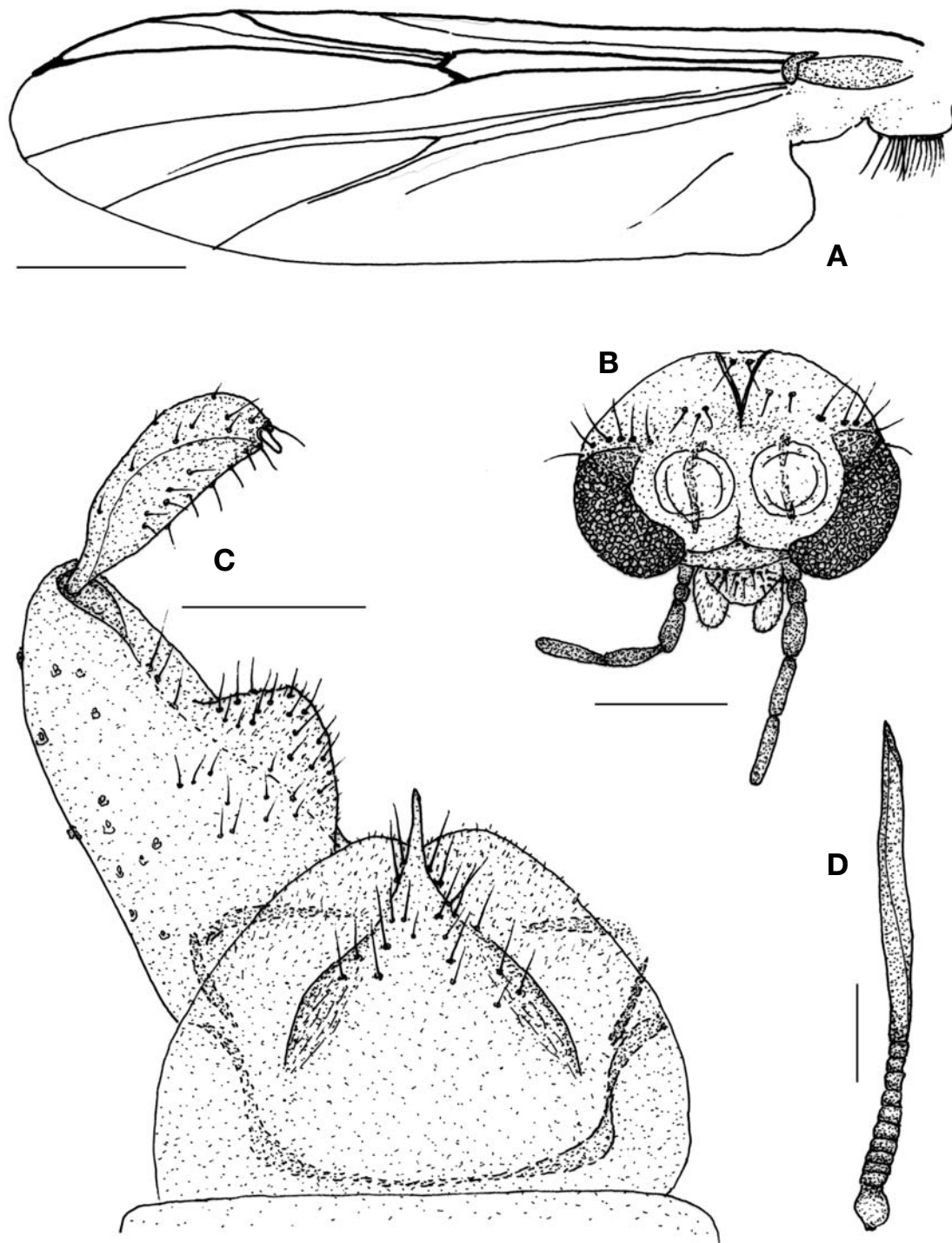
<sup>3</sup>\**Pseudosmittia seosania* sp. nov. (Fig. 12)

**Material examined.** Holotype: ♂ (RCH-2772), Korea: Chungcheongnam-do, Seosan-gun, Seosan-eup, 25 Apr 1982, Ree HI. Paratypes: 4♂♂, same as holotype; 2♂♂, Seoul, Jung-gu, Jangchung-dong, 8 Oct 1979, Ree HI.

**Diagnosis.** Small to medium (WL 1.6 mm), dark brown species. Clypeus rectangular with 6 setae. FCu far distal to RM. Anal tergite large, hemisphereic-shaped, without setae. Gonocoxite large, with 2 inner lobes: dorsal one rectangular and ventral one smoothly round, with microtrichiae. AR 1.40. LR 0.38.

**Description (male). Head (Fig. 12B):** Dark brown in ground color. Eye bare, reniform. 3–4 postoculars. Antenna dark brown, with 13 segments; apical seta absent; AR 1.40. Palp pale dark brown, with 5 segments: 18, 43, 87, 87, 96 μm (1 : 2.4 : 4.8 : 4.8 : 5.3). Clypeus oblong, with 6 setae. **Thorax:** Brown in ground color. Anteprepronotum brown, bare, notched medially. Scutum brown, without vittae; acrosticals not observed; 5–6 dorsocentrals and 2 prealars each side. Scutellum dark brown, with 6 uniserial setae. Postnotum dark brown. **Wing (Fig. 12A):** WL 1.6 mm. Membrane bare. All veins bare. Costa not produced. R<sub>2+3</sub> ending near end of R<sub>4+5</sub>. M<sub>3+4</sub> below R<sub>4+5</sub>. Cu<sub>1</sub> slightly bent at middle. FCu far distal to RM. An ending below FCu. Anal lobe moderately developed. Squama bare. Arculus and brachiolum dark brown, bare. **Legs:** All segments uniformly dark brown. Fore tibia with a long apical spur; mid tibia with 2 short apical spurs; hind tibia with a strong spur and comb spurs. Pulvillus absent. LR 0.38. **Abdomen:** All segments uniformly dark brown. **Hypopygium (Fig. 12C):** Anal tergite large, hemispheric, without any setae; anal tergal band absent; all apodemes sclerotized; virga U-shape. Anal point absent. Gonocoxite large, with 2 gonocoxal inner lobes (Fig. 12D): dorsal one

Korean name: <sup>1</sup>\*진해풀갈따구 (신칭), <sup>2</sup>\*가털눈갈따구속 (신칭), <sup>3</sup>\*서산가털눈갈따구 (신칭)



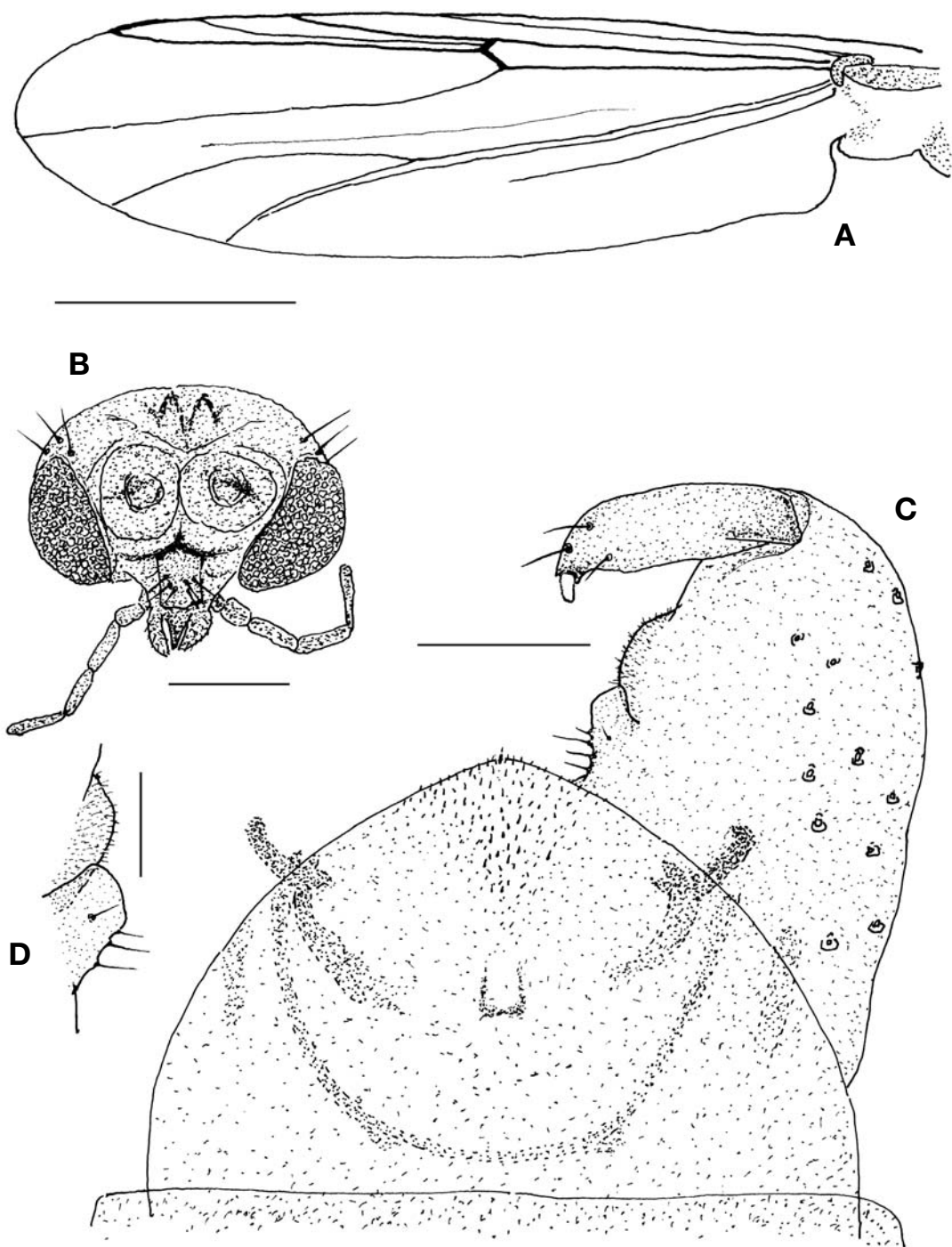
**Fig. 11.** *Psectrocladius paratogaminimus* sp. nov. (male). A, Wing; B, Head; C, Antenna; D, Hypopygium. Scale bars: A=0.5 mm, B=0.3  $\mu$ m, C=0.2  $\mu$ m, D=0.1  $\mu$ m.

rectangular, with 2–3 inner-lateral setae and a short dorsal seta, and ventral one smoothly swollen, covered with microtrichiae. Gonostylus relatively short, parallel-sided, with a

dark brown megaseta.

**Female.** Unknown.

**Etymology.** The new name refers to the place where this



**Fig. 12.** *Pseudosmittia seosania* sp. nov. (male). A, Wing; B, Head; C, Hypopygium; D, Gonocoxal inner lobe. Scale bars: A=0.5 mm, B=0.2  $\mu$ m, C=0.5  $\mu$ m, D=0.02  $\mu$ m.

species was collected.

**Distribution.** Korea.

**Remarks.** This new species can be easily distinguished from other related species in the genus *Pseudosmittia* by the fol-

lowing characters: 1) clypeus oblong, with 6 setae, 2) large hemispheric-shaped anal tergite with no setae, and 3) two gonocoxal inner lobes (rectangular dorsal lobe and smoothly round ventral lobe).

## ACKNOWLEDGMENTS

This survey of Korean Indigenous Species was supported by the National Institute of Biological Resources (NIBR), Ministry of Environment of Korea.

## REFERENCES

- Brundin L, 1947. Zur kenntnis der schwedischen Chironomiden. *Archiv für Zoologie*, 39:1-95.
- Edwards FW, 1929. British non-biting midges (Diptera, Chironomidae). *Transactions of Entomological Society of London*, 77:279-430.
- Ekrem T, 2002. A review of selected South-East Asian *Tanytarsus* v.d. Wulp (Diptera: Chironomidae). *Hydrobiologia*, 474:1-39.
- Johannsen OA, 1932. Chironomidae of the Malayan subregion of the Dutch East Indies. *Archiv für Hydrobiologie, Supplement*, 11:508-552.
- Kay AB, Gad EL, Rab MO, Stewart J, Erwa HH, 1978. Widespread IgE-mediated hypersensitivity in Northern Sudan to the chironomid *Cladotanytarsus lewisi* ('green nimitti'). *Clinical Experience of Immunology*, 34:106-110.
- Lee KY, Kang HY, Kim DS, Kim KE, Jeong BJ, Ree HI, 1995. Immunological responses to *Chironomus flaviplumus* in atopic children. *Journal of Korean Society of Allergology*, 15:250-261.
- Oyewo EA, Sæther OA, 2008. Revision of *Polypedilum* (*Pentapedilum*) kieffer and *Ainuyusurika* Sasa et Shirasaki (Diptera: Chironomidae). *Zootaxa*, 1953:1-145.
- Ree HI, Kim HS, 1981. Studies on Chironomidae (Diptera) in Korea. 1. Taxonomical study on adults of Chironomidae. *Proceedings of the College of Natural Sciences, Seoul National University*, 6: 123-226.
- Reiss F, Fittkau EJ, 1971. Taxonomie und Ökologie europäisch verbreiteter *Tanytarsus* Arten (Chironomidae, Diptera). *Archiv für Hydrobiologie, Supplement*, 40:75-200.
- Sasa M, 1979. A morphological study of adults and immature stages of 20 Japanese species of the family Chironomidae (Diptera). *Research Report from the National Institute for Environmental Studies, Japan*, 7:1-147.
- Sasa M, 1983. Studies on chironomid midges of the Tama River. Part 5. An observation on the distribution of Chironomidae along the main stream in June, with description of 15 new species. *Research Report from the National Institute for Environmental Studies, Japan*, 43:1-67.
- Sasa M, 1984. Studies on chironomid midges in lakes of the Nikko National Park. Part II. Taxonomical and morphological studies on the chironomid species collected from lakes in the Nikko National Park. *Research Report from the National Institute for Environmental Studies, Japan*, 70:19-215.
- Sasa M, 1985. Studies on the chironomids collected from lakes in the Mount Fuji (Diptera, Chironomidae). *Research Report from the National Institute for Environmental Studies, Japan*, 83:101-154.
- Sasa M, 1993. Studies on the chironomid midges collected with light traps in a rice paddy area of Toyama. *Research Report of Toyama Prefectural Environmental Pollution Research Center*, 1993:55-62.
- Sasa M, Kawai K, 1987. Studies on the chironomid midges of Lake Biwa (Diptera, Chironomidae). *Lake Biwa Study Monograph*, 3:1-119.
- Sasa M, Okazawa T, 1992. Studies on the chironomid midges (yusurika) of Togamura, Toyama. Part 2. The subfamily Orthocladiinae. *Research Report of Toyama Prefectural Environmental Pollution Research Center*, 1992:92-204.
- Sæther OA, 1980. Glossary of chironomid morphology and terminology (Diptera: Chironomidae). *Entomologica Scandinavica, Supplement*, 14:1-51.
- Tokunaga M, 1964. Diptera, Chironomidae. *Insects of Micronesia*, 12:485-628.
- Yamamoto N, Hirowatari T, Yamamoto M, 2012. The subgenus *Pentapedilum* Kieffer (Diptera: Chironomidae) in the Yaeyama Islands, the Ryukyus, Japan. *Zootaxa*, 3191:33-40.
- Yong TS, Lee JS, Lee IY, Park SJ, Park GM, Ree HI, Park JW, Hong CS, Park HS, 1999. Identification of *Chironomus kiiensis* allergens, a dominant species of non-biting midges in Korea. *Korean Journal of Parasitology*, 37:171-179.

Received September 11, 2012  
 Revised October 5, 2012  
 Accepted October 8, 2012