

## Three New Species of *Krenosmittia* (Diptera: Chironomidae: Orthoclaadiinae) Found in Korea

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### ABSTRACT

The genus *Krenosmittia* is a small group of Orthoclaadiinae, containing a total of twenty species in the world. Among them, six species were found in Japan, four species in China, and five species from the Russian Far East. This genus can be distinguished from other Orthoclaadiinae genera by the eyes bare, absence of acrostichals on thorax, costa strongly extended, anal vein ending proximal to FCu, squama bare, and having a strongly developed virga. We report three new species: *K. danyangensis* n. sp., *K. triangulia* n. sp., and *K. pseudoannulata*. The genus *Krenosmittia* is the first record in Korea. Line drawings of the diagnostic characters are provided for all the species recognized in this study.

**Keywords:** *Krenosmittia*, Chironomidae, taxonomy, new species, Korea

### INTRODUCTION

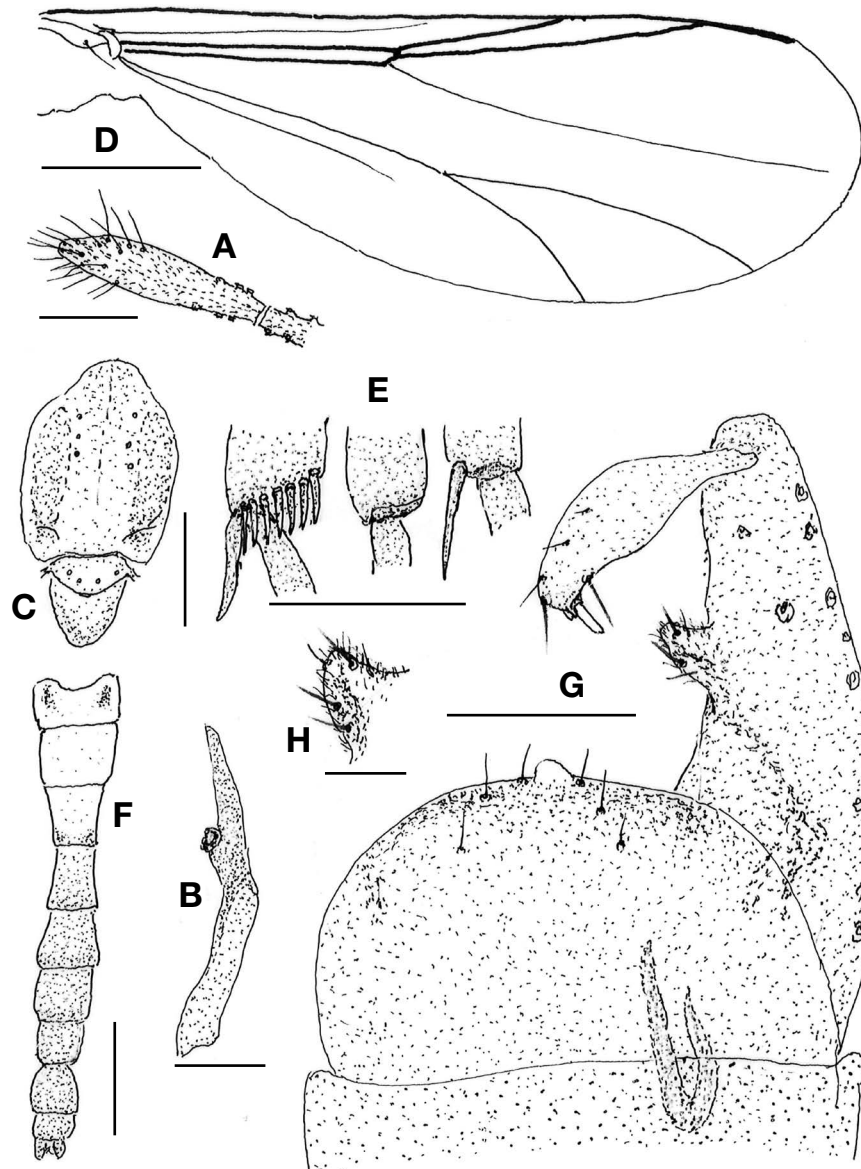
The genus *Krenosmittia* (Diptera, Chironomidae, Orthoclaadiinae) is one of the small chironomid genera. Ashe and O’Conner (2012) listed 20 species of *Krenosmittia* in the world catalog of Orthoclaadiinae. Among these 20 species, six species were found in Japan (Sasa and Okazawa, 1992; Sasa, 1996; Sasa et al., 1999; Sasa and Suzuki, 2000; Yamamoto, 2004), four species from China (Guo and Wang, 2004), and five species from the Russian Far East (Cranston and Sæther, 1986; Makarchenko and Makarchenko, 2006, 2011). Guo and Wang (2004) prepared the key to males of *Krenosmittia*, with twelve species found elsewhere in the world. The genus *Krenosmittia* is characterized by the following characters: eyes bare, acrostichals absent, scutal tubercle or tuft absent, wing membrane bare, costa strongly extended, anal vein ending proximal to FCu, squama bare, pulvillus bare, and virga strongly developed (Cranston et al., 1989; Langton and Pinder, 2007). The genus *Krenosmittia* shares bare eyes, wing membrane, squama, and extended costa with *Parakiefferiella*, *Rheosmittia*, and *Epoicocladus* but can be separated from nearly all species in these genera by the absence of a scutal tubercle or hump (Cranston et al., 1989).

### MATERIALS AND METHODS

Adult chironomids were collected by aspirating light-attracted adults on the wall and/or window glass of stores, restaurants, offices, and other buildings during nighttime at Chungcheongbuk-do, Jeollabuk-do, and Gyeonggi-do in April and July 2019. The collected specimens were preserved in 75% ethanol, for slide preparation, the adults were transferred to distilled water. On a slide, the antennae, head, wings, abdomen, and hypopygium of each specimen were dissected in Hoyer’s solution under a stereomicroscope and covered by two cover glasses. The length of the wing from the apex to the arculus represents the size of the body. The antennal ratio was calculated by dividing the length of the longest segment (plus any segment distal to it) by the combined length of the remaining segments (excluding the pedicel). The leg ratio of the foreleg was calculated by dividing the length of the first tarsal segment by the length of the tibia. Abbreviations for wing length, antennal ratio, leg ratio, radius-median cross vein, median-cubital cross vein, and forked-Cu are WL, AR, LR, RM, MCu, and FCu respectively. The terminology followed by Sæther (1980). The holotype specimens are deposited in the National Institute of Biological Resources (NIBR), and the other type and non-

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**Fig. 1.** *Krenosmittia danyangensis* n. sp. (male). A, Last segment of antenna; B, Tentorium; C, Thorax; D, Wing; E, Tip of the tibia (fore, mid and hind from right); F, Abdomen; G, Hypopygium; H, Gonocoxal inner lobe. Scale bars: A=0.05 mm, B, G=0.03 mm, C, D, F=0.2 mm, E=0.5 mm, H=0.01 mm.

type specimens are deposited in the Collection of Arthropods of Medical Importance Bank, Department of Environmental Medical Biology, College of Medicine, Yonsei University (AMIB).

## SYSTEMATIC ACCOUNTS

Order Diptera

Family Chironomidae

Subfamily Orthoclaadiinae

<sup>1</sup>\*Genus *Krenosmittia* Thieneman and Kruger

<sup>2</sup>\**Krenosmittia danyangensis* n. sp. (Fig. 1)

**Material examined.** Holotype, ♂ (RCH-14107), Korea: Chungcheongbuk-do, Danyang-gun, Danyang-eup, 4 Apr 2019, Yoon HS (NIBR).

Korean name: <sup>1</sup>\*가털눈깔따구속 (신칭), <sup>2</sup>\*단양가털눈깔따구 (신칭)

**Diagnosis.** Yellowish, small species (WL 0.94). Eye bare. Acrosticals and scutal tubercle absent. Costa strongly extended.  $R_{4+5}$  proximal to  $M_{3+4}$ . Squama bare. Mid tibia without spur. Pulvillus absent. Abdominal tergite I–III pale, tergite IV–VII yellow. Anal tergite pale yellow, hemispheric, with 6 apical setae, without median setae; virga large, strongly developed. Gonocoxal inner lobe somewhat triangular, with a round tip. Gonostylus extremely narrow in the basal, convex at middle. AR 0.26. LR 0.48.

**Description** (male,  $n = 1$ ). HEAD: Reddish yellow. Eye bare, without dorsomedial extension. Frontal tubercle absent. Antenna yellowish brown, with 13 segments, last segment with many short, terminal setae (Fig. 1A). AR 0.26. Palp pale, with 5 segments: 18, 21, 50, 64, 89  $\mu\text{m}$  (1 : 1.2 : 2.8 : 3.6 : 4.9). Clypeus brownish pale yellow, triangular, with 6 setae. Tentorium pale, narrow (Fig. 1B). THORAX (Fig. 1C): Yellow in ground color. Scutum yellow, vittae deep yellow (not clearly defined); acrosticals absent, 3–4 dorsocentrals and 3 prealars each side; scutal tubercle absent. Scutellum yellow, with 4 setae. Postnotum yellow. Haltere pale. WING (Fig. 1D): WL 0.94 mm. Membrane white, transparent, bare. All veins pale, bare. Costa strongly extended.  $R_{2+3}$  hardly observable.  $R_{4+5}$  proximal to  $M_{3+4}$ .  $Cu_1$  slightly bent. Anal lobe absent. Arculus and brachiolum pale with 1 seta. Squama bare. LEGS: All segments uniformly pale. Fore tibia with 1 long, narrow spur, mid tibia without spur, hind tibia with 1 long spur and combs (Fig. 1E). ABDOMEN (Fig. 1F): Tergite I pale with 2 dark spots; tergite II, III pale; tergite IV–VII brownish-yellow. HYPOPYGIUM (Fig. 1G): Anal tergite large, hemisphere, pale yellow, with 6 apical setae, median setae absent; apodemes poorly developed; virga large, developed with 2 long, sub-equal spines (horseshoe-shape). Anal point pale, bare, minute, round (nipple-shaped). Gonocoxite pale, long, roughly parallel-sided; gonocoxal inner lobe more or less spherical triangular, with 4–5 setae (Fig. 1H). Gonostylus pale, deeply narrowed basally, distal inner margin slightly convex, with pale megaseta, crista dorsalis absent.

**Etymology.** This new species named after the collection locality.

**Remarks.** This specimen differs from other related species by the combination of the following characters: (1) the mid tibia without spurs, (2) the apodemes poorly developed (difficult to observe), (3) the virga with two large, sub-equal spines (horseshoe-shaped), (4) the gonocoxal inner lobe somewhat spherical triangular, and (5) the pale yellow body color. The genus *Krenosmittia* is the first record in Korea.

<sup>1</sup>\**Krenosmittia pseudoannulata* n. sp. (Fig. 2)

**Material examined.** Holotype: ♂ (RCH-14105), Korea:

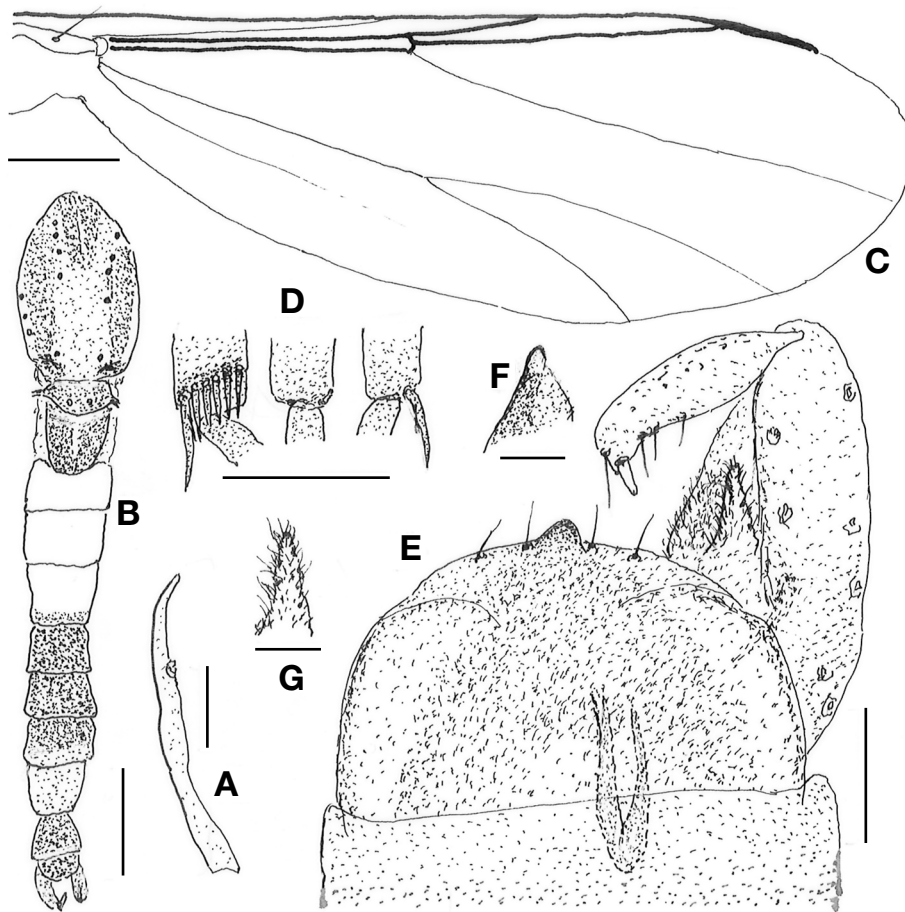
Chungcheongbuk-do, Danyang-gun, Danyang-eup, 4 Apr 2019, Yoon HS (NIBR). Paratype: ♂ (RCH-14106), ditto (AMIB).

**Diagnosis.** Brownish, small species (WL 0.78 mm). Antenna with 12 segments. Acrosticals absent. Scutal tubercle absent. Scutellum with 2 setae. Costa strongly extended. Squama bare. Tibia of mid-leg without spur. Abdominal tergite I–III pale, tergite IV–VI, VIII dark brown. Anal tergite large, hemisphere, with large virga. Anal point minute, round, dark brown. Gonocoxal inner lobe finger-like in shape. Gonostylus parallel-sided, basal inner margin slightly convex, without crista dorsalis. AR 0.29. LR 0.44.

**Description** (male,  $n = 2$ ). HEAD: Yellow. Frontal tubercle absent. Eye bare, without dorsomedial extension. Antenna pale, with 12 segments. AR 0.29 (0.28–0.29). Palp pale, with 5 segments: 14, 21, 34, 34, 73  $\mu\text{m}$  (1 : 1.5 : 2.4 : 2.4 : 5.2). Clypeus pale yellow, with 7 setae. Tentorium narrow, long (Fig. 2A). THORAX (Fig. 2B): Pale yellow in ground color. Scutum yellow, vittae light brown; scutal tubercle absent; acrosticals absent, 5 dorsocentrals and 3 prealars each side. Scutellum yellowish dark brown, with 2 setae. Postnotum yellowish dark brown. Haltere pale. WING (Fig. 2C): WL 0.78 (0.76–0.79). Membrane almost transparent, bare. Veins pale, bare (not easy to observe). Costa strongly extended.  $R_{2+3}$  difficult to observe.  $R_{4+5}$  proximal to  $M_{3+4}$ .  $Cu_1$  slightly bent. Anal lobe absent. Squama bare. Arculus pale, brachiolum pale with 1 seta. LEGS: All segments uniformly pale yellow. Coxa and trochanter relatively large. Fore tibia with 1 long, narrow spur, mid tibia without spur, hind tibia with 1 long spur and combs (Fig. 2D). Pulvillus absent. LR 0.44 (0.43–0.45). ABDOMEN (Fig. 2B): Tergite I–II pale yellow; tergite III pale yellow with the dark brown, narrow distal band; tergite IV–V, VIII dark brown; tergite VI dark brown with yellowish, narrow, distal band; tergite VII brownish-yellow. HYPOPYGIUM (Fig. 2E): Anal tergite large, hemisphere, with 4–5 apical setae, median setae absent; apodemes poorly developed; virga large, strongly developed (horseshoe-shaped). Anal point dark brown, minute, round (Fig. 2F). Gonocoxite tapered distally; gonocoxal inner lobe finger-like in shape (Fig. 2G). Gonostylus pale, parallel-sided, inner margin slightly broadened, with pale megaseta, crista dorsalis absent.

**Etymology.** The name *Krenosmittia pseudoannulata*, is derived from closed morphological similarity of *K. annulata*.

**Remarks.** This species is somewhat similar to *K. annulata* Guo and Wang, 2004 in morphology. However, in the present species, the virga is horseshoe-shaped, the tibia of the mid-leg is without spurs, and the legs are pale yellow, whereas in *K. annulata*, the virga is composed of 3–4 spines, the tibia of the mid-leg has two spurs, and the legs



**Fig. 2.** *Krenosmittia pseudoannulata* n. sp. (male). A, Tentorium; B, Thorax and abdomen; C, Wing; D, Tip of the tibia (fore, mid and hind, from right); E, Hypopygium; F, Anal point (lateral); G, Gonocoxal inner lobe. Scale bars: A, E, F=0.02 mm, B=0.2 mm, C=0.1 mm, D=0.05 mm, G=0.01 mm.

are brown (Guo and Wang, 2004).

<sup>1</sup>\**Krenosmittia triangulia* n. sp. (Fig. 3)

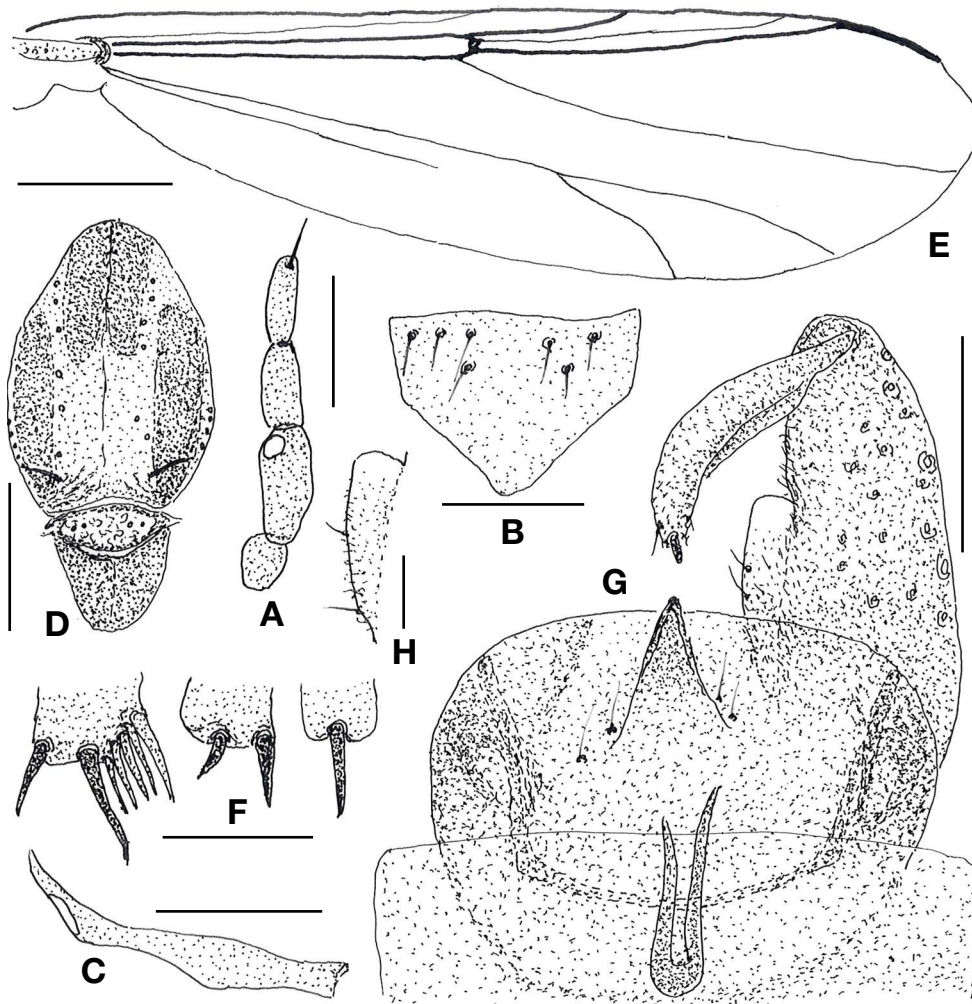
**Material examined.** Holotype, ♂ (RCH-14058), Korea: Jeollabuk-do, Buan-gun, Jinseo-myeon, 9 Apr 2019, Yoon HS (NIBR). Paratypes, 2♂♂ (RCH-14056, 14057), *ditto* (AMBI); ♂ (RCH-14375), Korea: Gyeonggi-do, Gapyeong-gun, Seolak-myeon, 5 Jul 2019, Yoon HS (AMBI).

**Diagnosis.** Small, brown species (WL 0.97 mm). Eye bare, kidney form. Antenna with 11 segments. Wing bare, white. Costa extended very long.  $R_{4+5}$  ending near  $R_{4+5}$ .  $Cu_1$  strongly sinuous. An ending far proximal to  $FCu$ . Squama bare. 2nd palp segment largest, with a pit. Anal tergite round, with very large virga. Anal point triangular, bare, distal margin sclerotized. Gonocoxal inner lobe rectangular, distal area pale,

bare. Gonostylus rather narrow, parallel-sided, slightly bent inward, without crista dorsalis. AR 0.69. LR 0.67.

**Description** (male, n = 3). **HEAD:** Brownish-yellow. Eye bare, not extended dorsomedially (kidney form). Frontal tubercle absent. Antenna brown, with 11 segments. AR 0.69 (0.67–0.71). Palp (Fig. 3A) brownish-yellow, with 4 segments: 20, 48, 32, 36  $\mu$ m (1 : 2.4 : 1.6 : 1.8); 2nd segment largest with a pit, 4th segment with 1 stout, sub-terminal seta. Clypeus (Fig. 3B) pentagon in shape, brownish yellow, with 7–8 setae. Tentorium was shown in Fig. 3C. **THORAX** (Fig. 3D): Yellowish-brown in ground color. Anteprepronotum poorly developed, narrowed dorsally. Scutum yellowish-brown, vittae brown; 6–7 minute acrosticals, 6–9 dorsocentrals, and 4 prealars each side. Scutellum brown, peripheral margin dark brown, with 4 setae. Postnotum dark brown. Haltere pale brown. **WING** (Fig. 3E): WL 0.97 (0.93–1.02) mm. Mem-

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**Fig. 3.** *Krenosmittia triangulia* n. sp. (male). A, Palp; B, Clypeus; C, Tentorium; D, Thorax; E, Wing; F, Tip of the tibia (fore, mid and hind, from right); G, Hypopygium; H, Gonocoxal inner lobe. Scale bars: A-C, F, G=0.05 mm, D, E=0.2 mm, H=0.02 mm.

brane bare, white. Veins pale yellow, all bare. Costa extended very long.  $R_{2+3}$  ending near  $R_{4+5}$ .  $R_{4+5}$  distal to  $M_{3+4}$ . FCu far distal to RM.  $Cu_1$  strongly sinuous. An ending far proximal to FCu. Anal lobe absent. Squama bare. Arculus light brown, brachiolum brownish-yellow. LEGS: Uniformly yellowish brown. Fore tibia with 1 stout, long seta, mid tibia with 2 sub-equal, stout spurs, hind tibia with 2 sub-equal, stout spurs, and 6 long comb-spurs (Fig. 3F). Pulvillus absent. LR 0.67 (0.65–0.69). ABDOMEN: All tergite uniformly light brown. HYPOPYGIUM (Fig. 3G): Anal tergite square in shape, median and apical setae absent; transverse sternapodeme long, narrow, smoothly bent, without horn each end. Virga strongly developed, large, horseshoe-shaped. Anal point triangular, wide-based, distal margin sclerotized, without setae, overlying anal tergite. Gonocoxite large; gonocoxal inner lobe scalene triangular, distally directed, spherical tip pale, bare

(Fig. 3H). Gonostylus rather narrow, parallel-sided, slightly bent inward, with megaseta, crista dorsalis absent.

**Etymology.** This species name was derived from the triangular-shaped anal point. In Latin, “*trianguli*” means triangular.

**Remarks.** The morphological characters of this species are well fitted to those of the genus *Krenosmittia*, except that 6–7 minute acrosticals present on the near apical end of the scutum, whereas the acrosticals are absent in *Krenosmittia* (Crangston et al., 1989). This new species can be differentiated from other related species, by the following characters: (1) the anal point is triangular, overlaying the anal tergite, (2) the gonocoxal inner lobe is scalene triangular with distally directed, spherical, bare tip, (3) the virga is large, strong and horseshoe-shaped, (4) the gonostylus is parallel-sided, slightly bend inward, and lack of the crista dorsalis.

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**CONFLICTS OF INTEREST**

No potential conflict of interest relevant to this article was reported.

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