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Original article

Taxonomic review of the genus *Stenotus* Jakovlev (Hemiptera: Heteroptera: Miridae) from the Korean Peninsula

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ARTICLE INFO

Article history:

Received 15 December 2015

Received in revised form

26 December 2015

Accepted 30 December 2015

Available online 8 January 2016

Keywords:

Heteroptera

Miridae

Stenotus

new record

Korean Peninsula

ABSTRACT

A genus *Stenotus* Jakovlev (Hemiptera: Heteroptera: Miridae) is reviewed taxonomically from the Korean Peninsula with a new record *Stenotus binotatus* (Fabricius 1794). Morphological information, such as descriptions of male and female genitalia, of the Korean species with photographs and illustrations, and a key to the Korean species are provided.

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Introduction

The family Miridae (Hemiptera: Heteroptera: Cimicomorpha), also called plant bugs, is the largest group of Heteroptera in the world (Schuh and Slater 1995), and contains major insect pests (Wheeler 2000a) and predatory groups which can be used as biological control agents (Wheeler 2000b). The genus *Stenotus* Jakovlev comprises, to date, 53 extant species in the world (Schuh 2002–2013). These *Stenotus* species are known as insect pests in some countries, because most of them use the plant Family Poaceae like grasses and wheat as host plants (Wheeler 2001). Among them, *Stenotus binotatus* (Fabricius, 1794) is most famous for insect pests of alfalfa, apple and wheat (Braumah et al 1982; Swallow and Cressey 1987; Wheeler 2001), and was introduced to some regions (e.g. tropical Africa) (Kerzhner and Josifov 1999). Among them, 11 species are known in the Palearctic Region and only one species is recorded from the Korean Peninsula (Kerzhner and Josifov 1999): *Stenotus rubrovittatus* (Matsumura 1913). In this paper, a new record of *S. binotatus* is reported from the Korean Peninsula, and the genus *Stenotus* is reviewed taxonomically with

the first descriptions and illustrations of male and female genitalia and *S. rubrovittatus*. A key to the Korean species is also provided.

Materials and methods

Photographs of specimens examined were taken by a Leica M165C microscope (Germany). Measurements were taken using the software program of the same microscope. All measurements are given in millimeters (mm). To observe male and female genitalia, a genital segment of each specimen was detached, and then soaked and boiled in 10% KOH solution at 70°C at 3–5 minutes until it became transparent. After it was placed in distilled water, it was dissected to examine genitalia. Terminology follows mainly Yasunaga (1991), Braimah et al (1982), and Yasunaga and Schwartz (2007). The depository of the specimens is the Laboratory of Systematic Entomology, Chungnam National University, Daejeon, Korea. An asterisk (*) means its additional distribution and host plant.

Taxonomic accounts

Genus *Stenotus* Jakovlev 홍색얼룩장님노린재속

Oncognathus Fieber, 1858: 303. Junior homonym of *Oncognathus* Lacordaire, 1854, Coleoptera; syn. Reuter, 1896: 122. Type species by monotypy: *Lygaeus binotatus* Fabricius, 1794.

Stenotus Jakovlev, 1877: 288. Type species by monotypy: *Stenotus sareptanus* Jakovlev, 1877.

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Peer review under responsibility of National Science Museum of Korea (NSMK) and Korea National Arboretum (KNA).

Umslopogas Kirkaldy, 1902: 254. Syn. Poppius, 1910: 36; Reuter, 1910: 160.
Zulaimena Kirkaldy, 1902: 256. Syn. Poppius, 1910: 36; Reuter, 1910: 160.
Korasiocapsus Kirkaldy, 1902: 260. Syn. Reuter, 1907: 10.
Makua Kirkaldy, 1902: 282. Syn. Poppius, 1912: 60.
Nymannus Distant, 1904: 195. Syn. Carvalho, 1981: 5.
Tancredus Distant, 1904: 430. Syn. Poppius, 1911: 16.
Indoelum Kirkaldy, 1906: 138. Syn. Distant, 1911: 240.

Diagnosis. Differs from other representatives of Mirini as follows: first segment of hind tarsi 1.5–2 times as long as second segment (Figure 1F); male genitalia membranous with sclerites (Figures 2C, 2D, 3C, and 3D).

Key to the species of Korean *Stenotus*

1. Antennae yellowish green, first antennal segment with erect dark setae, collar with dark setae, pronotum with a pair of dark spot, hemelytra with longitudinal dark brown stripe, femur yellowish green, vein yellowish green, apex of hypophysis of left paramere somewhat blunt, vesica of male membranous with six sclerites, genitalia of female with distinct sclerotized rings.....*S. binotatus*.
- Antennae reddish brown, first antennal segment without any setae, collar without any setae, pronotum without any spot,

hemelytra with longitudinal reddish brown stripe, femur reddish brown, vein reddish brown, apex of hypophysis of left paramere sharp, vesica of male membranous with three sclerites, genitalia of female with small and thin sclerotized rings *S. rubrovittatus*.

***Stenotus binotatus* (Fabricius, 1794)** 두점박이장님노린재(신칭)
 (Figures 1A–C, 1F–H, and 2A–F)

Lygaeus binotatus Fabricius, 1794: 172.

Cimex paykulli Turton, 1802: 609.

Stenotus sareptanus Jakovlev, 1877: 289. Syn. Reuter, 1885: 159.

Diagnosis. Differs from other species of *Stenotus* by generally yellowish green body, generally yellowish green antennae (Figures 1A and 1B), densely covered with erect dark setae on the first antennal segment (Figure 1G), some dark erect setae on collar (Figure 1H), a pair of dark spots on the pronotum, longitudinal dark brown line on hemelytra, generally yellowish green legs, yellowish green vein (Figures 1A and 1B) and left paramere with large sensory lobe (Figure 2A).

Redescription. MALE: Body elongate–oval, length 6.12–6.13.

Coloration: yellow to yellowish green and dark brown. Head: generally yellow to yellowish green; compound eyes dark brown; antennae generally brown, first antennal segment yellowish brown; tylus dark brown; rostrum generally yellowish green, third rostral segment brown, fourth rostral segment dark brown. Thorax: pronotum generally yellowish green, with a pair of spots on

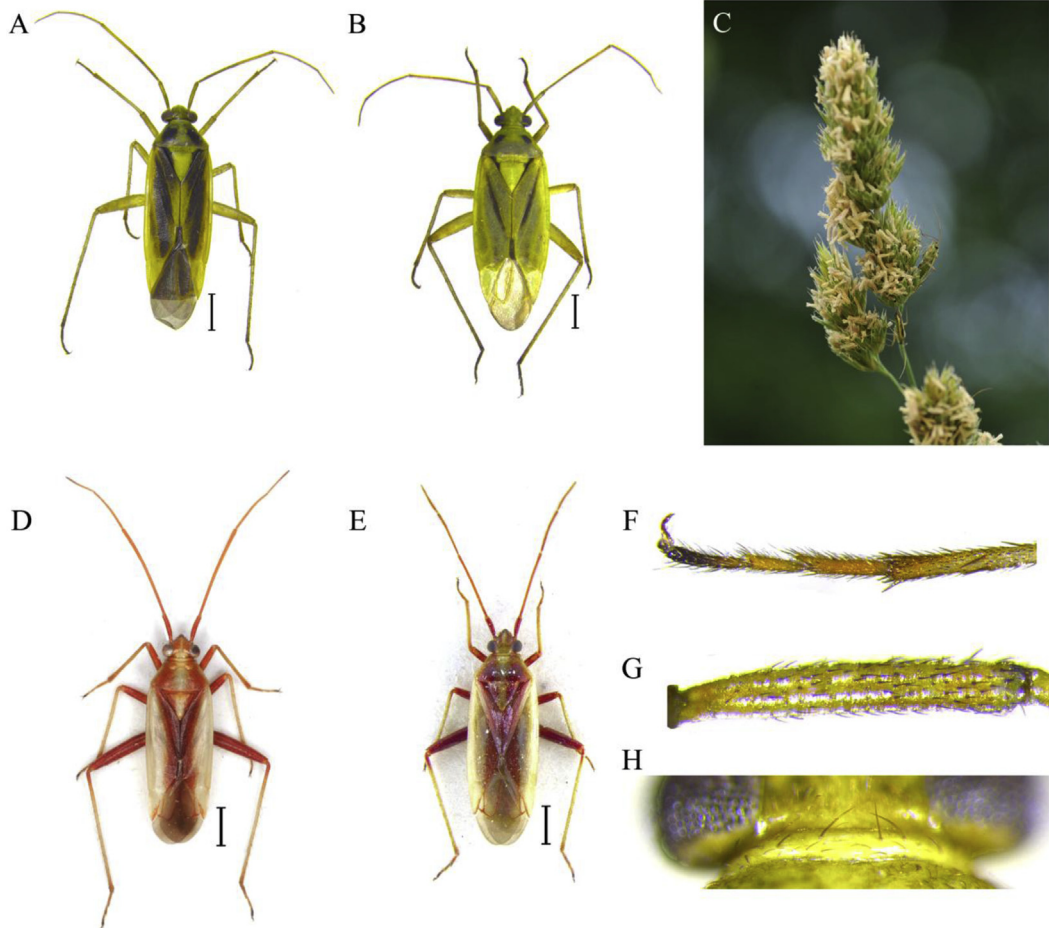


Figure 1. Diagnostic characters and host plant of Korean *Stenotus* species. A, B, F, G, H, *Stenotus binotatus*; D, E, *Stenotus rubrovittatus*; C, host plant of *S. binotatus*. A, Male; B, female; C, adults on host plant [*Dactylis glomerata* (Linnaeus, 1753) (Poaceae; Orchard grass)]; D, male; E, female; F, tarsus; G, setae of first antennal segment; H, setae on collar. <scale bar: 1 mm>

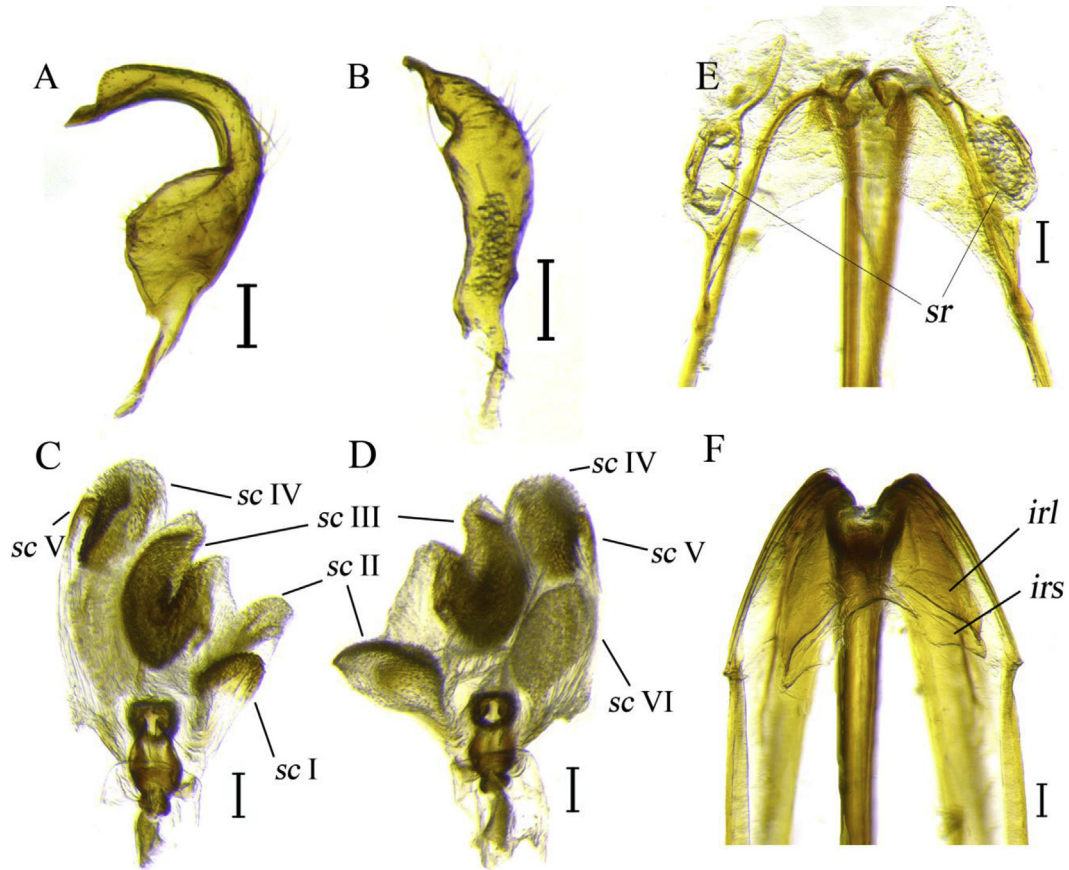


Figure 2. Male and female genitalia of *Stenotus binotatus*. A, Left paramere; B, right paramere; C, vesica in dorsal view; D, vesica in ventral view; E, sclerotized ring; F, posterior wall. sc = sclerites; sr = sclerotized rings; irl = interramal lobe; irs = interramal sclerite. <scale bar: 1 mm>

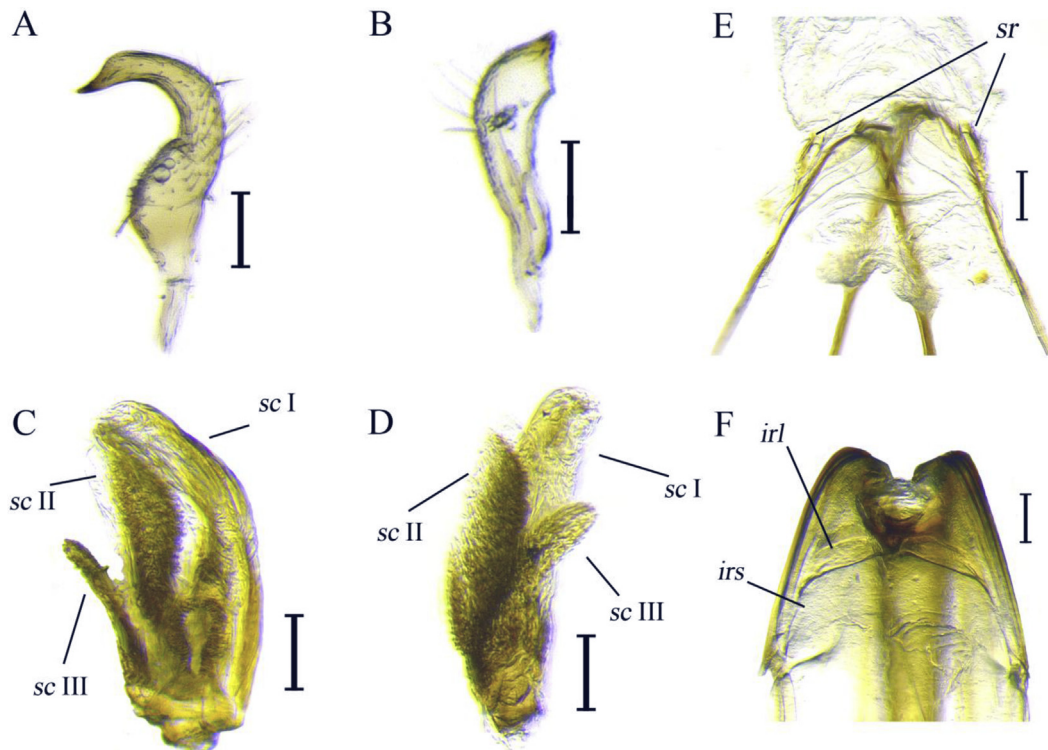


Figure 3. Male and female genitalia of *Stenotus rubrovittatus*. A, Left paramere; B, right paramere; C, vesica in dorsal view; D, vesica in lateral view; E, sclerotized ring; F, posterior wall. sc = sclerites; sr, sclerotized rings; irl, interramal lobe; irs, interramal sclerite. <scale bar: 0.1 mm>

pronotum, sometimes individual variation in spots size; collar yellowish green; callus yellowish green; scutellum generally bright yellow to yellowish green, 1/2 anterior part of each side dark brown connecting to longitudinal dark brown stripe on hemelytra; ostiole peritreme yellowish green; hemelytra generally yellow to yellowish green, with longitudinal dark brown stripe, sometimes individual variation in width of dark brown stripe; clavus generally dark brown, posterior part of clavus yellow to yellowish green; corium almost dark brown; embolium almost yellow to yellowish green; cuneus entirely yellow to yellowish green; membrane fuscous to dark brown, vein yellowish brown; legs yellow to brown; femora almost yellowish green to brown; apex of tibia dark brown; tarsus dark brown. Abdomen: yellow to yellowish green.

Surface and vestiture: glossy, covered with silvery pubescence; first antennal segment with erect setae (Figure 1G); pronotum covered with short silvery pubescences; collar with erect setae (Figure 1H); femora with densely suberect setae; tibia with erect setae.

Structure: Head: ocelli absent; vertex width shorter than first antennal segment; first segment relatively thick, proportion of first to fourth antennal segments 0.7:2.3:1.4:0.7; rostrum reaching to hind coxae; proportion of first to fourth rostral segments 0.6:0.7:0.6:0.7. Thorax: pronotum trapezoid, mesal pronotal length longer than width of anterior margin, with callus somewhat swollen; scutellum equilateral; lateral margin of hemelytra slightly curved, cuneal fracture developed; legs generally slender; first segment of hind tarsi 1.5–2 times as long as second segment (Figure 1F). Abdomen: rounded, almost reaching to apex of membrane.

GENITALIA: gonopore short and rounded with curved parameres (Figures 2A and 2B); left paramere with hypophysis, hypophysis distinctly prominent, sensory lobe large, with erect setae (Figure 2A); right paramere with hypophysis prominent upward, with erect setae (Figure 2B); vesica membranous, with six sclerites (Figures 2C and 2D).

FEMALE: Ovoid, length 6.34–6.53.

Coloration: as in male except for smaller spot on pronotum and thin longitudinal stripe on hemelytra.

Surface and vestiture: as in male.

Structure: somewhat more rounded oval in overall shape than male. **GENITALIA:** sclerotized rings with distinct projection upwardly as long as ring (Figure 2E), posterior wall of bursa copulatrix divided into two parts, interramal lobe (*irl*) and interramal sclerite (*irs*) of posterior wall (Figure 2F).

Measurements (in mm). Male ($n = 6$)/female ($n = 2$): body length, tylus–apex of membrane: 6.12–6.13/6.34–6.53; head length, excluding collar: 0.40–0.41/0.53–0.54; head width, including compound eyes: 0.97–1.03/1.07–1.12; vertex width: 0.38–0.39/0.48–0.52; first antennal segment length: 0.75–0.76/0.68–0.82; second antennal segment length: 2.24–2.38/2.20–2.54; third antennal segment length: 1.27–1.48/1.45–1.46; fourth antennal segment length: 0.68–0.94/0.71–0.72; total antennal length: 4.94–5.56/5.04–5.54; first rostral segment length: 0.60–0.61/0.72–0.74; second rostral segment length: 0.70–0.71/0.80–0.85; third rostral segment length: 0.59–0.60/0.65–0.69; fourth rostral segment length: 0.70–0.75/0.77–0.79; total rostral length: 2.59–2.67/2.94–3.07; anterior pronotal margin width (straight): 0.55–0.63/0.79–0.82; mesal pronotal length: 0.76–0.80/0.83–0.85; basal pronotal width (straight): 1.53–1.56/1.72–1.82; anterior scutellumal margin width (straight): 1.05–1.08/1.14–1.32; mesal scutellumal length: 0.93–0.94/1.03–1.23; outer embolial margin length (straight): 3.09–3.15/3.18–3.20; outer cuneal margin length (straight): 0.88–1.04/0.82–1.07; maximum width across hemelytra: 0.96–0.97/0.89–0.90; foreleg (femur: tibia: tarsus): 1.45–1.47/1.75–1.86/0.58–0.67/1.34–1.49/1.82–1.98/0.70–0.72; mid leg (femur:

tibia: tarsus): 1.41–1.46/2.07–2.15/0.80–0.84/1.54–1.65/2.10–2.31/0.74–0.76; hind leg (femur: tibia: tarsus): 1.95–2.19/3.15–3.24/0.83–0.88/2.15–2.39/3.44–3.69/0.93–0.95.

Specimen examined. [CNU] 1♂♀, Gung-dong, Yuseong-gu, Daejeon, South Korea, Light trap, 26.v.2015, J.G. Kim; [CNU] 3♂♂4♀♀, Geumgang arboretum, Donam-ri, Geumnam-myeon, Sejong, South Korea, on *Dactylis glomerata*, 3.vi.2015, J.G. Kim; [CNU] 5♂♂7♀♀, Ssangji-ri, Gosam-myeon, Anseong-si, Gyeonggi-do, South Korea, on *Dactylis glomerata*, 9.vi.2015, J.G. Kim.

Distribution. Korea*(new record), Albania, Andorra, Austria, Azerbaijan, Belgium, Bosnia Hercegovina, Bulgaria, Byelorussia, Croatia, Czech Republic, Denmark, Kazakhstan, Estonia, Turkey, Finland, France, Great Britain, Germany, Georgia, Greece, Hungary, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Moldavia, Montenegro, The Netherlands, Norway, Poland, Portugal, Romania, Russia (Central, Northern, South European Territory), Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, N. America, Hawaii, New Zealand.

Hosts. *Dactylis glomerata* (Poaceae) (Figure 1C), *Phleum pretense* (Poaceae), *Hordeum vulgare* (Poaceae), *Triticum aestivum* (Poaceae) [see Eyles (1999) and Knight (1968) for details].

Stenotus rubrovittatus (Matsumura, 1913) 홍색얼룩장님노린재 (Figures 1D, 1E, and 3A–F)

Calocoris rubrovittatus Matsumura, 1913: 181.

Stenotus rubrocinctus Linnavuori, 1961: 157. Syn. Kerzhner, 1972: 284.

Diagnosis. Distinguished from other congeners by generally red to brown head, pronotum, and scutellum except for longitudinal pale brown stripe, longitudinal reddish brown stripe on hemelytra, reddish brown femur, reddish brown ring at base of tibia (Figures 1D and 1E) and apex of hypophysis of left paramere sharp (Figure 3A).

Re-description. MALE: Body elongate-oval, length 4.37–4.72.

Coloration: generally reddish brown. Head: generally red to brown with longitudinal pale brown stripe, posterior part of head pale brown; compound eyes dark brown; antennae entirely reddish brown; tylus dark brown; rostrum generally yellowish green to pale brown, rostral generally yellowish green to pale brown, 1/2 posterior part of fourth rostral segment dark brown. Thorax: pronotum generally red to brown, with longitudinal pale brown stripe, sometimes individual variation in width of red part; collar pale brown with each red apices; callus red to brown; scutellum generally red to brown, red to brown part on scutellum connecting to longitudinal red stripe on hemelytra, with longitudinal pale brown stripe; ostiole peritreme reddish brown to brown; hemelytra generally reddish brown, with longitudinal red stripe, sometimes individual variation in width of red stripe; clavus almost red to reddish brown; corium generally pale brown with longitudinal reddish inner part; embolium entirely pale brown; cuneus entirely pale brown; membrane fuscous to dark brown, somewhat transparent, veins reddish brown; legs generally reddish brown; femora almost reddish brown; tibia almost pale brown except for reddish base of tibia; tarsus generally reddish brown, third tarsal segment dark brown. Abdomen: generally pale brown to yellowish green.

Surface and vestiture: glossy, covered with silvery pubescence.

Structure: Head: ocelli absent; vertex width shorter than first antennal segment; first segment relatively thick, proportion of first to fourth antennal segments 0.5:1.9:1.1:0.8; rostrum reaching to hind coxae; proportion of first to fourth rostral segments 0.5:0.6:0.5:0.6. Thorax: pronotum trapezoid, mesal pronotal length longer than width of anterior margin, with callus somewhat swollen; scutellum equilateral; lateral margin of hemelytra slightly curved, cuneal fracture developed; legs generally slender; first segment of hind tarsi 1.5–2 times as long as second segment. Abdomen: rounded, almost reaching to apex of membrane.

GENITALIA: gonopore short and rounded with curved parameres (Figures 3A and 3B); left paramere with hypophysis, hypophysis distinctly prominent, sensory lobe somewhat large, with erect setae (Figure 3A); right paramere with hypophysis slightly prominent upward, with erect setae (Figure 3B); vesica membranous, with three sclerites (Figures 3C and 3D).

FEMALE: Ovoid, length 5.25–5.57.

Coloration: as in male.

Surface and vestiture: as in male.

Structure: somewhat more rounded oval in overall shape than male. GENITALIA: small and thin sclerotized rings (Figure 3E), posterior wall of bursa copulatrix divided into two parts, *irl* and *irs* of posterior wall, *irl* somewhat narrow (Figure 3F).

Measurements (in mm). Male ($n = 6$)/female ($n = 6$): Body length, tylus-apex of membrane: 4.37–4.72/5.25–5.57; head length, excluding collar: 0.38–0.46/0.35–0.59; head width, including compound eyes: 0.82–0.84/0.89–0.93; vertex width: 0.36–0.37/0.45–0.48; first antennal segment length: 0.48–0.57/0.59–0.63; second antennal segment length: 1.82–1.96/1.89–1.97; third antennal segment length: 1.00–1.13/1.06–1.10; fourth antennal segment length: 0.74–0.82/0.83–0.86; total antennal length: 4.04–4.48/4.37–4.56; first rostral segment length: 0.46–0.50/0.56–0.58; second rostral segment length: 0.50–0.58/0.60–0.62; third rostral segment length: 0.45–0.47/0.50–0.54; fourth rostral segment length: 0.52–0.54/0.64–0.67; total rostral length: 1.93–2.09/2.30–2.41; anterior pronotal margin width (straight): 0.56–0.58/0.72–0.80; mesal pronotal length: 0.50–0.52/0.63–0.79; basal pronotal width (straight): 1.23–1.28/1.55–1.59; anterior scutellum margin width (straight): 0.74–0.91/0.92–1.00; mesal scutellum length: 0.67–0.71/0.80–0.83; outer embolial margin length (straight): 2.21–2.41/2.63–2.84; outer cuneal margin length (straight): 0.62–0.70/0.83–0.93; maximum width across hemelytra: 0.69–0.71/0.76–0.86; foreleg (femur: tibia: tarsus): 1.11–1.15:1.29–1.32:0.54–0.58/1.17–1.22:1.37–1.39:0.74–0.75; mid leg (femur: tibia: tarsus): 1.40–1.52:1.25–1.52:0.61–0.71/1.25–1.27:1.62–1.63:0.74–0.76; hind leg (femur: tibia: tarsus): 1.71–1.84:2.49–2.56:0.78–0.80/1.90–2.02:2.62–2.79:0.92–0.95.

Specimen examined. [CNU] 1♂1♀, Daesong-san (Mt), Pyongyang, North Korea (on label: Kanson, Thesong, North Korea), 28.viii.1989, M. Josifov; [CNU] 4♂♂5♀♀, Gung-dong, Yuseong-gu, Daejeon, South Korea, on *Hordeum* spp., 16.v.2014, J.G. Kim; [CNU] 3♂♂5♀♀, Maebang-san (Mt), Dae-dong, Yuseong-gu, Daejeon, South Korea, on *Poa* spp., 12.viii.2014, J.G. Kim; [CNU] 4♀♀, Jocheon-eup, Jeju-si, Jeju-do, South Korea, 20.viii.2014, Light trap, J.G. Kim; [CNU] 7♀♀, Gung-dong, Yuseong-gu, Daejeon, South Korea, 1.vi.2015, J.G. Kim; [CNU] 2♂♂3♀♀, Ssangji-ri, Gosam-myeon, Anseong-si, South Korea, 8.vi.2015, J.G. Kim.

Distribution. China (Central, North), Japan, Korea, Russia (Far East).

Hosts. *Bromus secalinus* (Poaceae)*, *Bromus japonicus* (Poaceae)*, *Hordeum vulgare* var. *hexastichon* (Poaceae)*, *Oryza sativa* (Poaceae) (Wheeler 2001).

Acknowledgments

This research was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR201501203), and supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning (NRF-2014R1A1A1005338).

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