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Description of *Philodromus paiki* sp. nov. and *Philodromus spinitarsis* Simon, 1895 (Araneae: Philodromidae) from Korea

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Contribution to Environmental Biology

- Spiders are a predatory group that plays a wide variety of ecological roles within ecosystems.
- The present study corrects past misidentifications of these spiders and provides important information for understanding Korean spider fauna.

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Abstract: The present study describes *Philodromus paiki* sp. nov., which was previously misidentified as *P. fuscomarginatus* (De Geer, 1778), *P. poecilus* (Thorell, 1872), and *P. spinitarsis* Simon, 1895 in Korea, as a new species with diagnosis, detailed descriptions, and taxonomic photographs. Additionally, *P. spinitarsis* is also described to correct previous misidentifications of Korean records of the species.

Keywords: diagnosis, description, morphology, new species, taxonomy, Korea

1. INTRODUCTION

Philodromus Walckenaer, 1826 is the most diverse genus in the family Philodromidae Banks, 1892, which commonly occurs in undergrowth and low herbage such as grass, bushes and tree trunks (Schick 1965; Levy 1977; Dondale and Redner 1978; Namkung 2001; Muster 2009; Kim *et al.* 2016). *Philodromus* currently comprises 216 species worldwide including nine species known from Korea (World Spider Catalog 2023). Among them, *P. poecilus* (Thorell 1872) and *P. spinitarsis* Simon, 1895 have been taxonomically very confusingly recorded in Korea. Muster (2009) raised a question of the presence of *P. poecilus* from Korea and considered most Korean records of *P. poecilus* as results of misidentifications. The present study describes *P. paiki* sp. nov., which was previously misidentified as *P. fuscomarginatus* (De Geer 1778), *P. poecilus*, and *P. spinitarsis* in Korea, as a new species with diagnosis, detailed descriptions, and taxonomic photographs. Moreover, *P. spinitarsis* is also described with detailed descriptions and taxonomic photographs for correcting previous misidentifications of Korean records of the species.

2. MATERIALS AND METHODS

All specimens were preserved in 98% Ethyl alcohol and external morphology was examined under a Leica S8APO (Singapore) stereomicroscope. Images were captured with a Dhyana 400DC zoom digital camera (China) mounted on a Leica S8APO and assembled

using Helicon Focus 8.2.0 image stacking software (Khmelik *et al.* 2006). Measurements of body parts were made with an ocular micrometer and are recorded in millimeters. Internal genitalia of females were removed and treated in 10% KOH for 2 hours before illustration. Leg measurements are shown as: Total length (femur, patella, tibia, metatarsus, tarsus). Morphological terminology mainly follows Muster (2009). The examined specimens are deposited in the Nakdonggang National Institute of Biological Resources (NNIBR), Sangju and Konkuk University (KKU), Seoul, Korea. The following abbreviations are used in the descriptions: ALE = anterior lateral eye, AME = anterior median eye, PLE = posterior lateral eye, PME = posterior median eye, ALE–AME = distance between ALE–AME, ALE–PLE = distance between ALE–PME, AME–AME = distance between AMEs, AME–PME = distance between AME–PME, PLE–PME = distance between PLE–PME, PME–PME = distance between PMEs, AER = anterior eye row, PER = posterior eye row in the eye region.

3. TAXONOMY

Family Philodromidae Thorell, 1869

Genus *Philodromus* Walckenaer, 1826

Type species. *Araneus aureolus* Clerck, 1757.

***Philodromus paiki* sp. nov.**

백새우게거미 (신칭) (Fig. 1)

Philodromus fusco-marginatus Nakatsudi, 1942: 14 (♂, misidentified).

Philodromus fuscomarginatus Paik, 1979: 430 (♀♂, misidentified).

Philodromus spinitarsis Kim & Jung, 2001: 201 (♀♂, misidentified); Namkung, 2001: 510 (♀♂, misidentified); Namkung, 2003: 513 (♀♂, misidentified).

Philodromus poecilus Kim & Lee, 2017: 74 (♀♂, misidentified).

Type materials. Holotype: KOREA: 1♂ (NNIBR, #NNIBRIV110918), Gyeonggi-do, Pocheon-si, Yeongbuk-myeon, Mt. Mangbongsan, 38°04′06″N, 127°19′14″E, alt. 223 m, 3 July 2022, leg. Lee S.Y. & S.T. Kim. Paratypes: 2♂♂ (KKU, #Ara_Phil_*Philodromus paiki*_19830520_01-02), Incheon-si, Ganghwa-gun, Hwadomyeon, Mt. Manisan, 37°36′41″N, 126°27′10″E, alt. 38 m, Korea, 20 May 1983, leg. S.T. Kim; 2♀♀ (NNIBR, #NNIBRIV110919; KKU, #Ara_Phil_*Philodromus paiki*_1983_01-03), Jeollanam-do, Wando-gun, Gunoe-myeon, Is. Baekil-do, 34°17′47″N, 126°35′09″E, alt. 37 m, 13, July, 2004, leg. S.T. Kim; 1♀, Mt. Suraksan, Sanggye-dong, Nowon-gu, Seoul, 37°40′59″N, 127°03′47″E, alt. 63 m, 11 June 2017, leg. Lee S.Y. & S.T. Kim.

Etymology. The specific epithet is a patronym in honor of Prof. Paik, Kap Yong, a Korean araneologist. He collected and described *P. fuscomarginatus* from Korea in 1979, which is the first record of this species.

Diagnosis. *Philodromus paiki* sp. nov. is similar to *P. fuscomarginatus* (De Geer 1778) in the shape of the genital organ and body appearance but can be distinguished from the latter by the combination of the following morphological characters: Male - ventral tibial apophysis thick, retrolateral tibial apophysis thick and thumb-shaped with straight tip (Fig. 1I–K), *versus* ventral tibial apophysis slender, retrolateral tibial apophysis long and slender with curved tip in *P. fuscomarginatus* (Muster 2009: 154, f. 5, 11a–c); Female - epigynal groove much longer than wide, spermatheca elliptical with clearly visible bursa copulatrix, fertilization duct oriented upward (Fig. 1E–G) *versus* epigynal groove slightly longer than wide, spermatheca kidney-shaped without clearly visible bursa copulatrix, fertilization duct oriented laterad in *P. fuscomarginatus* (Muster 2009: 154, f. 22a, b).

Description. Male (holotype). Habitus as in Fig. 1A. Total length 6.20. Carapace 3.04 long/3.21 wide. Eyes: AER 0.85, PER 1.29, ALE 0.15, AME 0.14, PLE 0.17, PME 0.11, ALE–AME 0.07, ALE–PLE 0.32, AME–AME 0.21, AME–PME 0.25, PLE–PME 0.27, PME–PME 0.40. Chelicera 0.92 long/0.53 wide. Endite 0.79 long/0.48 wide. Labium 0.59 long/0.49 wide. Sternum 1.62 long/1.67 wide. Legs: I 11.41 (3.18, 1.48, 2.64, 2.60, 1.51), II 13.95 (3.95, 1.68, 3.34, 3.19, 1.79), III 12.04 (3.58, 1.41, 2.80, 2.76, 1.49), IV 10.69 (3.18, 1.18, 2.42, 2.53, 1.38). Palp 3.23 (1.13, 0.52, 0.39, - , 1.19). Abdomen 3.16 long/2.57 wide.

Carapace pear-shaped, dark brown, cephalic region light with yellowish brown midline, one pair of black and short paramedian stripes present between PMEs, thoracic region radially light with blackish brown margin, cervical and radial furrows distinct, longitudinal fovea aciculate and slightly depressed (Fig. 1A). Eye

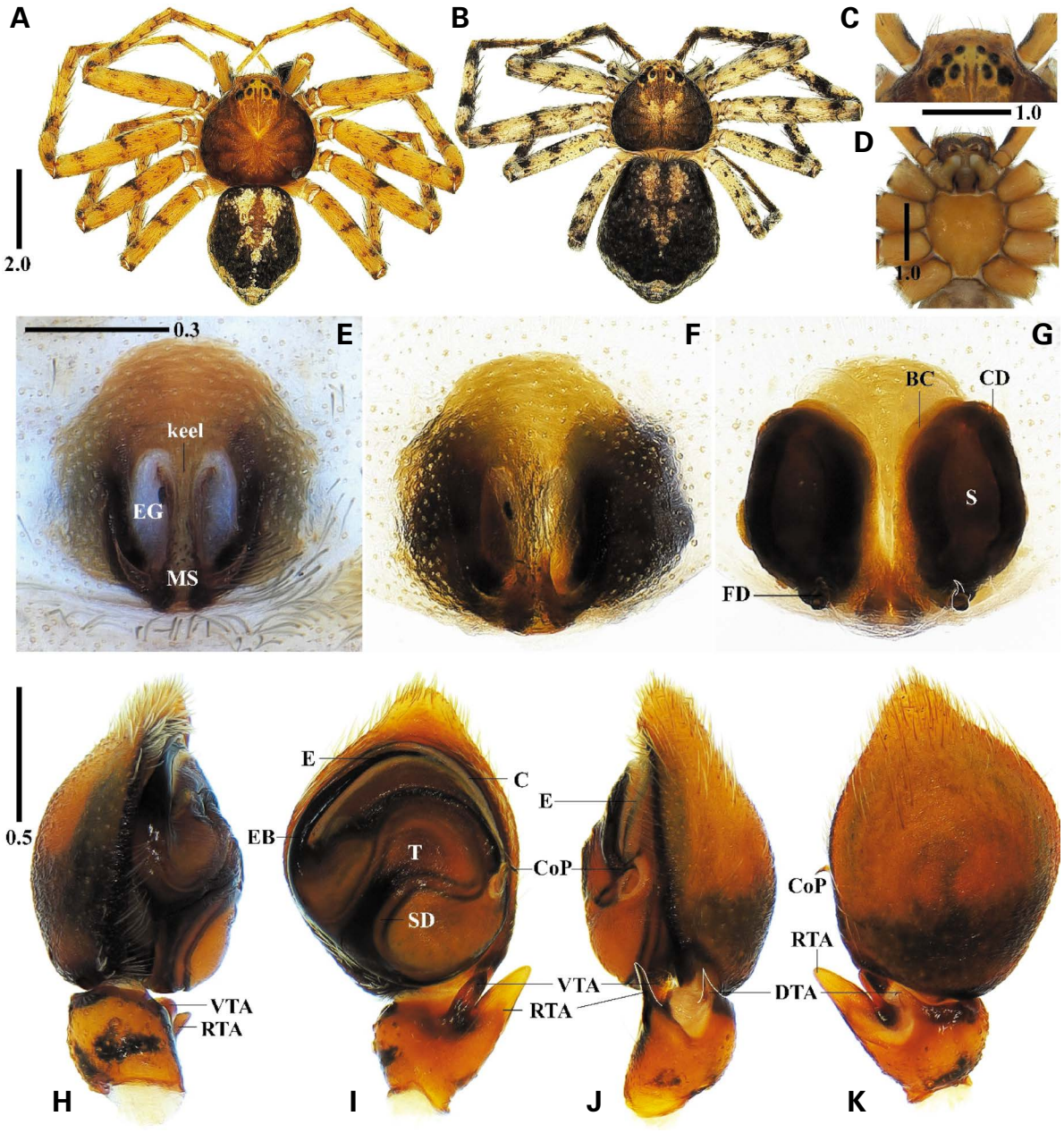

Fig. 1. *Philodromus paiki* sp. nov. : A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male eye area from above; D. Male sternum; E. Female epigynum, ventral view; F. Female internal genitalia, ventral view; G. *Ditto*, dorsal view; H. Male palp, prolateral view; I. *Ditto*, ventral view; J. *Ditto*, retrolateral view; K. Palp, dorsal view (BC = bursa copulatrix, C = conductor, CD = copulatory duct, CoP = conductor process, DTA = distal tibial apophysis, E = embolus, EG = epigynal groove, EB = embolic base, FD = fertilization duct, MS = median septum, RTA = retrolateral tibial apophysis, S = spermatheca, SD = sperm duct, T = tegulum, VTA = ventral tibial apophysis). Scale bars in mm.

area yellowish brown, eight eyes on black eye tubercles in two rows, both eye rows recurved, posterior median eyes smaller than others (Fig. 1C). Endite pale blackish brown, longer than wide. Labium blackish brown, longer than wide. Sternum heart-shaped, pale blackish brown, convex, almost hairless, anterior end slightly depressed, longer than wide, posterior tip blunt, medially depressed, and slightly protruded between cox-

ae IV (Fig. 1D). Legs yellowish brown with blackish brown irregular flecks, thick and strongly developed, clothed densely with short black hairs, leg spination: I (femur 3-3-3d/0v, tibia 2-3-3d/2-2-2-2-0-2v, metatarsus 2-2-2d/2-2-2v), II (femur 1-1-3d/0v, tibia 2-3-2d/2-2-2-2-0-2v, metatarsus 3-2-2d/2-2-2v), III (femur 1-1-1d/0v, tibia 2-3-2d/2-2-2-0-2v, metatarsus 2-2-2d/ 2-2-3v), IV (femur 1-1-1d/0v, tibia 1-3-1d/2-2-0-2-2-0-0-2v, metatarsus 2-2-2d/2-2-3v), leg formula II-III-I-IV (Fig. 1A). Abdomen pentagonal with blunt posterior end, black with yellowish white margin, dorsum with a brown longitudinal cardiac pattern occupying anterior half, one pair of yellowish white triangular patterns anteriorly and irregular patterns posteriorly present along cardiac pattern, yellowish white marking present at posterior end of cardiac pattern (Fig. 1A). Palp (Fig. 1H–K): bulb round; embolus filiform with smooth base; conductor narrow and membranous, conductor process small and pointed; ventral tibial apophysis large, finger-shaped with a pointed tip, strongly sclerotized; retrolateral tibial apophysis large, thumb-shaped with a blunt tip, moderately sclerotized, lager than ventral tibial apophysis; dorsal tibial apophysis small and spine-shaped.

Female (paratype). General appearance similar to the male, habitus as in Fig. 1B. Total length 6.06. Carapace: 2.31 long/2.61 wide. Eyes: AER 0.80, PER 1.20, ALE 0.14, AME 0.12, PLE 0.17, PME 0.12, ALE–AME 0.06, ALE–PLE 0.32, AME–AME 0.23, AME–PME 0.25, PLE–PME 0.25, PME–PME 0.38. Chelicera: 0.80 long/0.48 wide. Endite: 0.61 long/0.47 wide. Labium: 0.45 long/0.46 wide. Sternum: 1.29 long/1.39 wide. Legs: I 8.63 (2.61, 1.20, 2.01, 1.78, 1.03), II 10.47 (3.26, 1.39, 2.50, 2.20, 1.12), III 8.14 (2.59, 0.95, 1.91, 1.69, 1.00), IV 7.96 (2.54, 0.93, 1.83, 1.70, 0.96). Palp: 2.57 (0.72, 0.41, 0.50, - , 0.94). Abdomen 3.75 long/3.12 wide. Epigynum 0.60 wide.

Chelicera dark yellowish brown and strongly developed with one promarginal tooth. Endite pale yellowish brown to blackish brown with black anterior margin, longer than wide. Labium blackish brown, longer than wide. Sternum almost rectangular, pale brown with dark margin, convex, almost hairless, anterior end slightly depressed, brown large marking on the center, longer than wide, posterior tip broad, blunt and slightly protruded between coxae IV. Legs light yellowish brown with black irregular flecks, thick and strongly developed, clothed densely with short black and white hairs, leg spination: I (femur 3-3-3d/0v, tibia 2-3-2d/2-2-2-2-0v, metatarsus 2-3-2d/2-2-2v), II (femur 1-1-3d/0v, tibia 1-2-2d/2-2-2-2-2v, metatarsus 2-2-2d/2-2-2v), III (femur 1-1-1d/0v, tibia 1-2-0d/2-2-2-2-0v, metatarsus 2-2-1d/2-2-2v), IV (femur 1-1-1d/0v, tibia 1-2-1d/2-2-2-0v, metatarsus 2-2-2d/2-2-3v), leg formula II-I-III-IV (Fig. 1B). Epigynum (Fig. 1E): epigynal plate round and moderately sclerotized; median septum pillar-shaped with icicle-shaped keel; epigynal atrium divided into two elliptical epigynal grooves, epiginal groove elongated, much longer than wide. Internal genitalia (Fig. 1F, G): spermatheca large and elliptical; copulatory duct thick and distinct; bursa copulatrix distinct; fertilization duct small and oriented upward.

Habitat. Bush layer in mountainous valleys and lakeside.

Distribution. Korea (Incheon , Pocheon-si, Seoul, Wando-gun).

***Philodromus spinitarsis* Simon, 1895**
나무결새우게거미 (Fig. 2)

Artanes fuliginosus Karsch, 1879: 80.

Philodromus spinitarsis Simon, 1895: 1058; Bösenberg & Strand, 1906: 267; Saitō, 1959: 133; Yaginuma, 1960: 101; Zhu & Wang, 1963: 478; Yaginuma, 1971: 101; Song, Yu & Shang, 1981: 86; Qiu, 1983: 98; Hu, 1984: 332; Guo, 1985: 163; Zhu & Shi, 1985: 182; Yaginuma, 1986: 217; Song, 1987: 265; Wu & Song, 1987: 32; Zhang, 1987: 217; Hu & Wu, 1989: 321; Chikuni, 1989: 134; Feng, 1990: 192; Chen & Gao, 1990: 165; Chen & Zhang, 1991: 285; Logunov, 1992: 57; Zhao, 1993: 343; Barrion & Litsinger, 1994: 290; Zhao, 1995: 1059; Song & Zhu, 1997: 195; Song, Zhu & Chen, 1999: 476; Hu, 2001: 328; Song, Zhu & Chen, 2001: 376; Ono & Ban, 2009: 481; Zhu & Zhang, 2011: 426; Yin *et al.*, 2012: 1249; Kim & Lee, 2017: 78; Zhang, Peng & Zhang, 2022: 264.

Philodromus karschi Mello-Leitão, 1929: 268.

Philodromus davidi Schenkel, 1963: 245; Namkung, 1964: 43.

Philodromus poecilus Paik, 1979: 435 (♂, misidentified); Kim & Jung, 2001: 198 (♀♂, misidentified); Namkung, 2001: 509 (♀♂, misidentified); Namkung, 2003: 512 (♀♂, misidentified).

Specimens examined. KOREA: 1♂, Daegu-si, Donggu, Jungdae-dong, Pagyesa Temple, 15 July 2000,

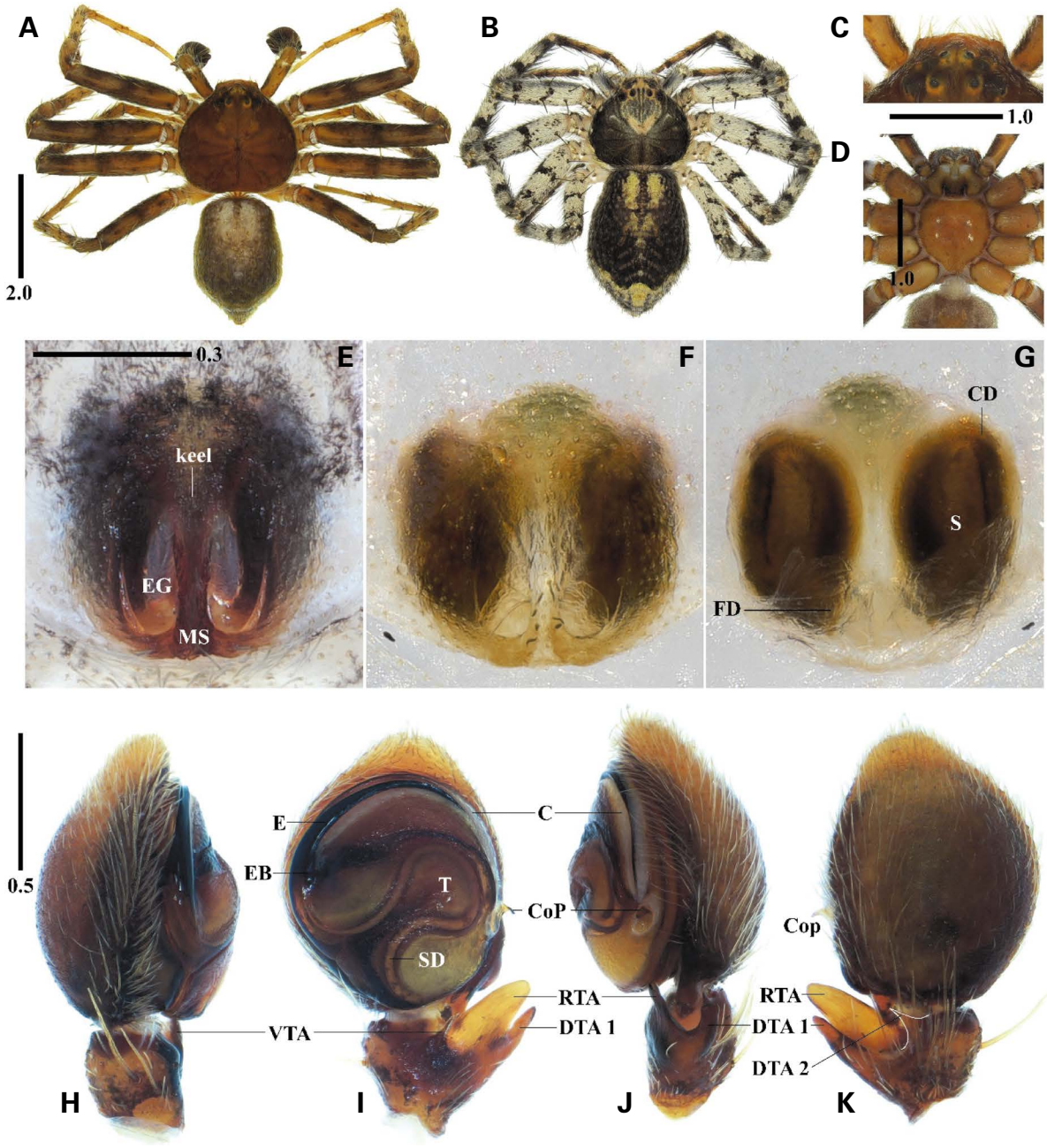

Fig. 2. *Philodromus spinitarsis* Simon, 1895: A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male eye area from above; D. Male sternum; E. Female epigynum, ventral view; F. Female internal genitalia, ventral view; G. *Ditto*, dorsal view; H. Male palp, prolateral view; I. *Ditto*, ventral view; J. *Ditto*, retrolateral view; K. Palp, dorsal view (C = conductor, CD = copulatory duct, CoP = conductor process, DTA = dorsal tibial apophysis, E = embolus, EG = epigynal groove, EB = embolic base, FD = fertilization duct, MS = median septum, RTA = retrolateral tibial apophysis, S = spermatheca, SD = sperm duct, T = tegulum, VTA = ventral tibial apophysis). Scale bars in mm.

leg. S.T. Kim; 1♀, Jeollabuk-do, Jeongeup-si, Naejang-dong, Mt. Naejangsan, 7 August 2012, leg. Lee S.Y. & S.T. Kim; 5♀♀, 5♂♂, Incheon-si, Namdong-gu, Munemi-ro, Incheon Grand Park, 31 December 2021, leg. C.M. Jang.

Description. Male. Total length 5.86. Carapace 2.70 long/2.88 wide. AER 0.77, PER 1.15. Chelicera 0.83 long/0.41 wide. Endite 0.61 long/0.40 wide. Labium

0.45 long/0.38 wide. Sternum 1.43 long/1.41 wide. Legs: I 9.44 (2.67, 1.16, 2.19, 2.12, 1.30), II 11.52 (3.21, 1.31, 2.77, 2.60, 1.63), III 10.25 (2.97, 1.12, 2.47, 2.34, 1.35), IV 9.03 (2.66, 0.95, 2.10, 2.08, 1.24). Palp 2.89 (0.96, 0.51, 0.34, - , 1.08). Abdomen 3.16 long/2.13 wide.

Carapace round, chestnut, cephalic region with dark midline, cervical and radial furrows dark and distinct, longitudinal fovea aciculate and slightly depressed (Fig. 2A). Eight eyes on shallow eye tubercles in two rows, both eye rows recurved, median eyes smaller than lateral eyes (Fig. 2C). Chelicera dark brown with one promarginal tooth. Endite turbid brown, longer than wide. Labium dark brown, longer than wide. Sternum heart-shaped, brown, convex, longer than wide, margin clothed sparsely with black recumbent hairs, anterior end slightly depressed, posterior tip broad, medially depressed, and moderately protruded between coxae IV (Fig. 2D). Legs turbid chestnut with irregular flecks, thick and strongly developed, metatarsi and tarsi turbid yellowish brown, clothed densely with short recumbent hairs, leg spination: I (femur 0-2-1-2-1-0-3d/0v, tibia 3-0-2-1-3d/1-2-1-2-2-2v, metatarsus 3-2-2d/2-2-2v), II (femur 3-2-2d/2-2-2v, tibia 3-3-3d/2-2-2-2-2v, metatarsus 2-2-1d/2-2-2v), III (femur 0-1-2-1-2-3d/0v, tibia 3-0-0-2-1-3-0d/2-2-2-2v, metatarsus 3-2-2d/2-2-3v), IV (femur 0-1-0-1-2-3d/0v, tibia 3-2-3d/2-2-2v, metatarsus 3-2-2d/2-2-3v), leg formula II-III-I-IV (Fig. 2A). Abdomen pentagonal, blackish brown with a short longitudinal cardiac pattern and 2−3 pairs of muscle impressions, pale grayish brown anteromesally (Fig. 2A). Palp (Fig. 2H−K): bulb round; embolus filiform with smooth base; conductor narrow; conductor process present, small and tongue-shaped; ventral tibial apophysis small, spine-shaped, sclerotized; retrolateral tibial apophysis large, thumb-shaped with blunt tip, connected to dorsal tibial apophysis; two dorsal tibial apophysis present, dorsal tibial apophysis 1 large and finger-shaped with truncated tip, dorsal tibial apophysis 2 small and aciculate.

Female. Total length 5.46. Carapace: 2.36 long, 2.71 wide. AER 0.77, PER 1.11. Chelicera: 0.76 long, 0.43 wide. Endite: 0.61 long, 0.37 wide. Labium: 0.48 long, 0.43 wide. Sternum: 1.23 long, 1.38 wide. Legs: I 8.51 (2.60, 1.08, 1.97, 1.74, 1.12), II 10.48 (3.25, 1.33, 2.55, 2.15, 1.20), III 9.34 (2.96, 1.13, 2.22, 1.97, 1.06), IV 8.08 (2.49, 0.94, 1.90, 1.74, 1.01). Palp: 2.71 (0.79, 0.51, 0.50, - , 0.91). Abdomen 3.10 long/2.77 wide. Epigynum 0.53 wide.

General appearance similar to the male, habitus as in Fig. 2B. Carapace round, black, cephalic region with a pair of paramedian stripes, thoracic region with pale yellowish-brown heart-shaped pattern posteriorly, wider than long (Fig. 2B). Eye area light, eight eyes on shallow eye tubercles in two rows, both eye rows recurved, median eyes smaller than lateral eyes. Sternum pale grayish brown with one pair of black markings centrally, wider than long, covered densely with long grayish brown hairs. Legs turbid gray with irregular flecks, thick and strongly developed, metatarsi and tarsi turbid yellowish brown, clothed densely with short recumbent hairs, leg spination: I (femur 2-1-1d/0v, tibia 0-2-1d/1-1-1-1-2-1v, metatarsus 2-2-2d/2-2-2v), II (femur 1-1-1d/1-1-1-1-1-2-1v, tibia 2-2-1d/2-2-2v, metatarsus 2-2-2d/2-2-3v), III (femur 1-1-1d/0v, tibia 0-2-1d/1-1-1-1-1-2v, metatarsus 2-2-2d/2-2-2v), IV (femur 2-2-3d/1-1-1-0-0-2-0-0-2v, tibia 2-2-2d/2-2-3v, metatarsus 2-2-2d/2-2-3v), leg formula II-III-I-IV (Fig. 2B). Abdomen elongated oval, black with longitudinal cardiac pattern occupying anterior half and three pairs of muscle impressions, two pairs of turbid yellowish-brown patterns present anteriorly and three spots posteriorly, posterior end turbid yellowish brown (Fig. 2B). Epigynum (Fig. 2E): epigynal plate oval and longer than wide; median septum pillar-shaped with icicle-shaped keel; epigynal atrium divided into two epigynal grooves; epigynal groove elongated, much longer than wide. Internal genitalia (Fig. 2F, G): spermatheca large and elliptical; copulatory duct thick and distinct, bursa copulatrix indistinct; fertilization duct small and oriented upward.

Habitat. Bush layer and artificial construction in mountainous and hilly valleys.

Distribution. Korea, China, Japan, Russia (South Siberia, Far East).

CRediT authorship contribution statement

CM Jang: Conceptualization, Methodology, Investigation, Collection, Original draft preparation. **SY Lee:** Methodology, Investigation, Collection, Review and editing. **JS Yoo:** Methodology, Review and editing. **ST Kim:** Conceptualization, Methodology, Investigation, Collection, Identification, Original draft preparation, Review and editing, Project administration, Funding acquisition.

Declaration of Competing Interest

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

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