

A New Record of the Genus *Areotetes* (Hymenoptera: Braconidae: Opiinae) from Korea

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한국산 미기록속 *Areotetes* (벌목: 고치벌과: 꽃파리고치벌아과)에 대한 보고

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ABSTRACT: The genus *Areotetes* van Achterberg & Li, 2013 (Hymenoptera: Braconidae: Opiinae), which is endoparasitoid of mining or infesting of fruit dipterous larvae, have been reported for the first time in China. Currently, four species of the genus *Areotetes* have been known from the province Hunan and Fujian, China. In this study the genus *Areotetes* with *Areotetes carinuliferus* van Achterberg & Li, 2013 is reported for the first time from Korea. Material studied in the present study were collected by sweeping in Mt Gongchi, Eochungdo, Province Jeonbuk, Korea. Herein, diagnosis of genus, description, distribution, and diagnostic illustration of *A. carinuliferus* are provided. In addition, DNA barcode data of the partial gene of mitochondrial *cytochrome c oxidase subunit I (COI)* are included.

Key words: Ichneumonoidea, Identification, Koinobiont, Natural enemy, Parasite

조 록: 과실파리, 굴파리의 유충에 기생하는 *Areotetes* van Achterberg & Li, 2013(벌목: 고치벌과: 꽃파리고치벌아과)는 중국에서 처음으로 보고된 바 있다. 현재까지 *Areotetes*속에는 4종이 보고되어 있다. 금번 연구에서 *Areotetes*속의 1종, *Areotetes carinuliferus* van Achterberg & Li, 2013를 한국에서 처음으로 보고하며, 본 종의 형태 진단, 분포, 도해도를 작성하였고, 추가적으로 미토콘드리아 COI 데이터를 제공한다.

검색어: 맵시벌상과, 동정, 내부기생, 천적, 기생

The subfamily Opiinae is one of the biggest koinobiont endoparasitoids (Wharton, 1997) groups in the family Braconidae (Hymenoptera: Ichneumonoidea), comprising more than 2,000 species in 39 genera worldwide (Yu et al., 2016). The genus *Areotetes* was first reported by Li et al. (2013) in China, with *Areotetes carinuliferus* as type species (Li et al., 2013). This small genus is morphologically similar to *Utetes* Foester, 1862, by basal carina at the inner side of the hind tibia but has a

propodeal areola. In current, there are four valid species from the world: *A. albiferus* van Achterberg & Li, 2013, *A. carinuliferus* van Achterberg & Li, 2013, *A. laevigatus* Weng & Chen, 2005 and *A. striatiferus* van Achterberg & Li, 2013 from China (Yu et al., 2016). As the results of taxonomic study and field survey for Opiinae, we newly discovered the genus *Areotetes* from Korea. Also, the genus *Areotetes* is reported for the first time from Korea, which has been poorly investigated with no biological information of both genus and species to date (Li et al., 2013). In this study, diagnosis, description, biology and illustrations are provided. We also provide barcode data of

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the partial gene of the mitochondrial DNA, *cytochrome c oxidase subunit I (COI)* on *A. carinuliferus*.

Material and Methods

The specimens examined were collected by sweeping in Mt Gongchi, Eochungdo, Gunsan in 2021.06.24., which were preserved in 80% ethyl alcohol for dried. These specimens are deposited in insect museum of Kunsan National University (KSNU).

van Achterberg (1990) for identification of the subfamily Opiinae, Li et al. (2013) for identification of the genus, and Yu et al. (2016) for references to the Opiinae were used. We used LEICA DMC2900 digital camera and LEICA M205 C microscope (Leica Geosystems AG) for observation and photography in this study. Illustrations were stacked using LAS V4.11 (Leica Geosystems AG, Wetzlar, Germany) and HeliconFocus 7 (Helicon Soft). Illustrations were edited using Adobe Photoshop CS6. Terminology used for morphological characters followed Achterberg (1993).

Each specimen was used for the DNA extraction in ASL, KSNU, with using a LaboPass Tissue Mini DNA isolation Kit (COSMO Genetech, Korea); there is the modification from 'non-destructive method' (Favret, 2005) that the first to third steps from the original protocol were modified, as called 'freezing method' (Yaakop et al., 2009). The sample which was not destroying is soaked with 200 μ l of a tissue lysis buffer with proteinase K solution 20 μ l. The sample with solution has to be incubated at 55°C for 10 minutes and then kept in a freezer at -22°C at least 3 hours to overnight. The primers LCO-1490 (5'-GGTCAACAAATCATAAAGATATTGG-3') and HCO-2198 (5'-TAAACTTCAGGGTGACCAAAAAATCA-3') were used for amplification. The polymerase chain reaction (PCR) amplification which was amplified by using AccuPowerH PCR PreMix (BIONEER, Corp., Daejeon, Korea) in 20 μ l reaction mixtures containing 0.4 μ M of each primer, 20 μ M of the dNTPs, 20 μ M of the MgCl₂, and 0.05 μ g of the genomic DNA template was performed using a GS1 thermo-cycler (Gene Technologies, Ltd., Essex, UK). We followed the procedure: initial denaturation at 95°C for 5 min, followed by 34 cycles at 94°C for 35 sec; an annealing temperature of 48°C for 25 sec; an extension at 72°C for 45 sec, and a final extension at 72°C

for 5 min. The PCR products were visualized as a single band by electrophoresis on a 1.5% agarose gel. After electrophoresis, an amplified product was purified using a QIAquick PCR purification kit (QIAGEN, Inc., Milan, Italy), and then sequenced using an automated sequencer at Macrogen Inc. (Seoul, South Korea).

Systematic Accounts

Family Braconidae von Esenbeck, 1811

Subfamily Opiinae Blanchard, 1845

Genus *Areotetes* van Achterberg & Li, 2013 테두리고치벌속(신칭)

Areotetes van Achterberg & Li, 2013: 39-40.

Generic diagnosis

A long carinula of the hind tibia basally; face without tubercles; frons without a pair of distinct depressions above antennal sockets; occipital carina present laterally, not or slightly curved ventrally and remaining removed from hypostomal carina; clypeus more or less convex and high; labrum normal, without emargination ventrally; hypoclypeal depression distinct; malar suture absent; mandible normal, triangular; pronotum short and subvertical; pronope absent or obsolescent; medio-posterior depression of mesoscutum rather small or absent; scutellar sulcus usually rather wide; propodeum areolate and smooth between carinae, with medium-sized medio-longitudinal carina; precoxal sulcus smooth or finely crenulate; postpectal carina completely absent; vein 2-SR of fore wing present; vein 1-M of fore wing straight or slightly curved and vein 1-SR short; vein cu-a of hind wing present and vein m-cu absent; length of fore wing less than 3.5 mm; second tergite without sharp lateral crease, smooth or striate; fourth and following tergites exposed (Li et al., 2013). The diagnosis follows van Achterberg & Li (2013).

Areotetes carinuliferus van Achterberg & Li, 2013 작은응기고치벌(신칭) (Fig. 1A-H)

Areotetes carinuliferus van Achterberg & Li, 2013: 44-47.

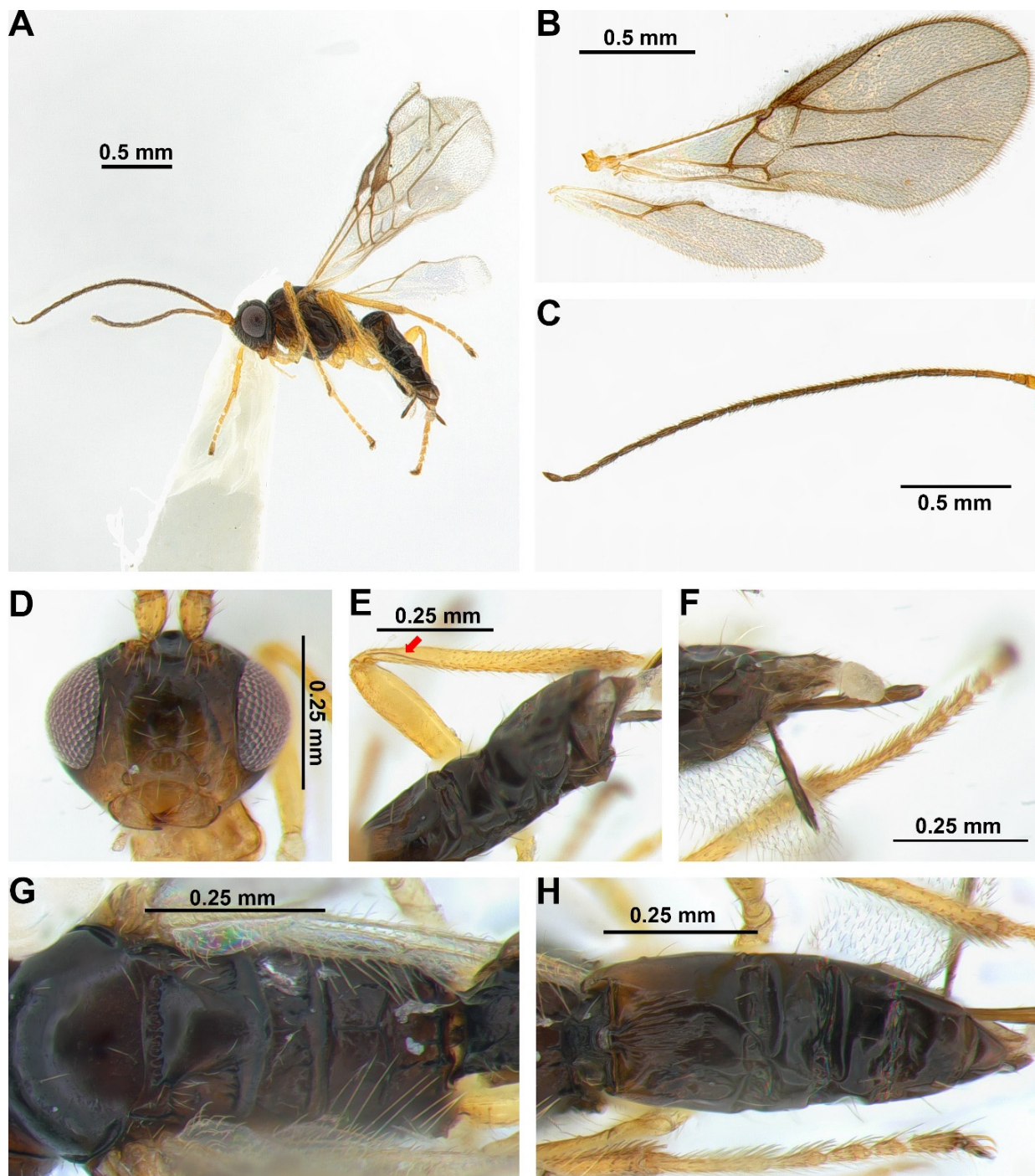


Fig. 1. Habitus of *Areotetes crenuliferus* van Achterberg & Li, 2013: A, whole body in lateral view; B, wings; C, antenna; D, head in frontal view; E, hind leg in lateral view (arrow carina of hind tibia); F, ovipositor (gray oval shape is not body part); G, mesosoma in dorsal view; H, metasoma in dorsal view.

Diagnosis

Total length of body 1.7 mm (Fig. 1A), total length of fore wing 1.9 mm (Fig. 1B). Yellowish brown scape of antenna and

annellus, third of antenna of female dark brown apically (Fig. 1C, D). Vein m-cu of fore wing arising postfurcal. Medio-posterior depression of mesoscutum absent and smooth, propodeum areolate and smooth superficially.

Colour. Generally dark brown except for clypeus, wing and leg; clypeus and mandible, brown; leg, yellowish-brown (Fig. 1E); pterostigma and veins, light-brown; metasoma dark brown but ovipositor rather light brown (Fig. F).

Description. Head (Figs. 1C, D): Antenna with 19-20 segments and 1.17, 1.35 times as long as fore wing and body, respectively, length of third segment 1.01 times as long as fourth segment, depression between antennal sockets; occipital carina present laterally, face covered with yellowish setae overall and elevated medially; clypeus convex, nearly smooth and ventral rim pointed upwards slightly, width of clypeus 2.10 times maximum height of clypeus; hypoclypeal depression present; malar suture absent; mandible slightly convex and with ventral carina, labial palp segments slender than maxillary palp. **Mesosoma** (Fig. 1G): Length of mesosoma 3.90 times as long as length of propodeum; pronope absent; superficially smooth of pronotum and mesopleuron except for a few carina; mesoscutum glabrous, medio-posterior depression of mesoscutum absent and with few setae, carina of lateral margin of mesoscutum present; scutellar sulcus narrow and crenulate, scutellum smooth and glabrous; length of propodeum 3.52 times as long as tibia of hind leg, dorsal of propodeum smooth and glabrous except for a medio-longitudinal carina connected to a propodeal areola. **Wing** (Fig. 1A, B): covered with yellowish brown setae overall; length of pterostigma of fore wing 4.92 times as long as width of pterostigma; r short and widened; 1-M, 3-SR and SR1 slightly curved; cu-a widened; CU1b short; first subdiscal cell nearly closed; apical of M+CU1 unsclerotized; m-cu of hind wing absent. **Legs** Length of femur of hind leg 1.01 times as long as length of tibia of hind leg and with few setae; basal of hind tibia with a nearly straight carinula (Fig. 1E). **Metasoma** (Fig. 1H): Length of first tergite 0.23, 1.35 and 2.18 times as long as metasoma, second tergite and third tergite, respectively; first tergite convex medially and smooth generally except for a few carina; second and third tergites largely smooth and with setae partially, but rugose densely antero-medially of second tergite; third and following tergites smooth and glabrous; length of ovipositor sheath 1.34 times as long as first tergite (Fig. 1F).

Molecular data. *COI* barcode sequence (GenBank accession no. YJ21080901)

Distribution. South Korea (new, Jeonbuk), China (Hunan).

Biology. Unknown.

Specimens examined. South Korea, 2 ♀, ♂ (KSNU): Mt Gongchi, Eochungdo, Gunsan, Jeonbuk, 36°07'28.0"N, 125°58'24.4"E, 24. VI. 2021, Hyojoong Kim leg.

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Statements for Authorship Position & Contribution

Han, Y.J.: Kunsan National University, Student in Ph.D.; Designed the research, wrote the manuscript and conducted the experiments

Sohn, J.H.: Kunsan National University, Student in Ph.D.; Collected and examined specimens

Kim, H.J.: Kunsan National University, Professor, Ph.D.; Examined specimens and designed the research

Lim, J.O.: Wonkwang University, Professor, Ph.D.; Examined specimens and designed the research

All authors read and approved the manuscript.

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