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The Genus *Philanthus* (Hymenoptera: Sphecidae: Philanthinae) in Korea

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ABSTRACT

The genus *Philanthus* Fabricius, 1790 in Korea are reviewed, and two species, *Philanthus triangulum* and *P. coronata*, are treated. The former is new to Korea. This species is easily separated from congeners by dense punctures in propodral enclosure and tri-forked marking in lower face. DNA barcoding test is supportive in our identification as well as conspecitficity of Korean materials showing variation in size and coloration. The observed data on flower associations of this species specified with domestic localites and date are separately provided. The current status of *Philanthus coronatus* that has been the only representative of the genus but forgotten for a lengthy time in Korea is discussed.

Keywords: *Philantuhus triangulum*, *P. coronata*, new record, Korea

INTRODUCTION

According to Kim (2014), the genus *Philanthus* Fabricius, 1790 in Korea was represented by one species, *Philanthus coronatus* (Thunberg, 1784). The occurrence of this species in Korea was first recognized by Tsuneki (1943) through an ecological study describing detailed nesting habits. Since then, there has been, however, no additional record on occurrence of this species in Korea.

Meanwhile, authors have recently collected several specimens of the genus undetected in Korea before 2014. They clearly fall within *Philanthus triangulum* species group *sensu* Beaumont (1951) and Gayubo (1991). Based on the morphological examination and DNA barcording test, they all are identified as *Philantus triangulum* (Fabricius, 1775). This species has been known to be Afrotropic southward to South Africa and trans-Palearctic from Europe (GBIF Secretariat, 2017) through Russia (Pulawski, 1978) eastward to China (Wu and Zhou, 1996) in distribution.

In this study, the species *Philanthus triangulum* is recorded in Korea for the first time, thus distribution of this species is augmented eastward to the Korean Peninsula herein. The flowers visited by this species are also provided, with observed locaities and dates. The assumed current status of *Philanthus coronata* in Korea is discussed.

MATERIALS AND METHODS

As another identification tool in addition to morphological examination, DNA-barcoding analysis was conducted with PCR amplified partial mitochondrial cytochrome c oxidase subunit I (mtDNA COI) gene sequences proposed by Hebert et al. (2003) including the primer combination named LCO 1490 and HCO2198 in Folmer et al. (1994). MEGA X program (Kumar et al., 2018) with Kimura 2-parameter (K2P) model (Kimura, 1980) was used to obtain genetic distances among specimens. Considering the variability of our specimens in size and coloration, three specimens were selected for DNA analysis: a female (Fig. 1A and number 1 in Table 1 herein; Sindu-ri, Wonbuk-myeon, Taean-gun, Chungcheongnam-do, 36°51′19.3″N, 126°12′08.8″E, 3 Aug 2017, Kim JK), a xanthophyll male (Fig. 1B and number 2 in Table 1 herein; Sowhang-ri, Ungcheon-eup, Boryeong-si, Chungcheongnam-do, 37°12′16.41″N, 126°39′07.76″E, 30 Jun 2017, Kwon OC), and a melanic male (Fig. 1C and number 3 in Table 1 herein;

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Haean-myeon, Yanggu-gun, Gangwon-do, 25 Jun 2016, Lee HS) much smaller than any other females and males.

All measurements of body parts were taken as the maximal length of the part being considered. Body length was measured from the anterior end of the head to the posterior end of the metasoma in dorsal view.

Some voucher specimens used herein will be deposited at the Insect Collection of National Institute of Biological Resources (NIBR) in Incheon, Korea.

SYSTEMATIC ACCOUNTS

Order Hymenoptera
Family Crabronidae Latreille, 1802
Subfamily Philanthinae Latreille, 1802
Tribe Philanthini Latreille, 1802
Genus *Philanthus* Fabricius, 1790

[1]**Philanthus triangulum* (Fabricius, 1775)

Vespa triangulum Fabricius, 1775: 373, sex not indicated. Holotype: ♀, Denmark: Hafniae, now Copenhagen (Zoological Museum, University of Copenhagen, Copenhagen, Denmark), see van der Vecht, 1961: 61. Synonymized with *Philanthus ruspatrix* by Day, 1979: 71, 80. Conserved by ICZN (International Commission on Zoological Nomenclature), 1990, Opinion 1578.

Philanthus triangulum: Fabricius, 1790: 224 (new combination, redescription).

Material examined. Korea: ♀, Gyeonggi-do: Yangpyeong-gun, Yangsu-ri, 7 Aug 2014, Lee HS; 2♂♂, Gangwon-do: Cheolweon-gun, Dosong-eup, Dongsong-ri, 15 Sep 2015, Kim JK; ♀, ♂, Yanggu-gun, Haean-myeon, 25 Jun 2016, Lee HS; 13♀♀, Gyeonggi-do: Hwaseong-si, Songsan-myeon, Jinhwa-ri, 37°12′16.41″N, 126°39′07.76″E, 15 Oct 2016, Kwon OC; ♂, Chungcheongnam-do: Boryeong-si, Ungcheon-eup, Sowhang-ri, 37°12′16.41″N, 126°39′07.76″E, 30 Jun 2017, Kwon OC; 2♀♀, Taean-gun, Wonbuk-myeon, Sindu-ri, 36°51′19.3″N, 126°12′08.8″E, 3 Aug 2017, Kim JK; 1♀, Gyeonggi-do: Gwacheon-si, Gwacheon-dong, 37°26′52.7″N 126°59′23.8″E, 18 Jul 2017, Hwang IC; ♂, Chungcheongnam-do: Seocheon-gun, Biin-myeon, Dasi-ri, 36°06′38″N, 126°36′19″E, 8 Sep 2017, Kim JK; ♂, Gyeonggi-do: Anyang-si, Manan-gu, Anyan-dong, Gwanak arboretum, 5 Oct 2019, Lee HS; ♀, ♂, Seoul: Gangdong-gu, Godeok-dong, 6 Oct 2019, Lee HS.

Diagnosis. Body length 13–16 mm in females, 10–12 mm in males (Fig. 1A–C). Head distinctly broader than long in frontal view, and broader than mesosoma in dorsal view. Apico-median margin of clypeus with a pair of teeth in female. In male, two pairs of hair bundles in apico-lateral margins and apico-mid margins, the former large, tightly bundled like plates, curl to mid-point, and the latter small, taper off like a pair of teeth. In both sexes, almost entire mesosoma, except for larger sub-median part of mesonotum and anterior half of scutellum in female and anterior half of scutellum in male, densely punctate; especially, propodeal enclosure densely punctate, punctures almost touching one another (Fig. 1F).

In a majority of materials of both sexes, lower half of face (Fig. 1D, E), pronotal dorsum, pronotal lobe, scutellum (often lost) and metanotum creamy yellow; interantennal marking tri-forked. Legs (except for coxa, trochanter and basal half of mid and hind femur or a little more), apical bands dilated laterally on metasomal terga 1–4, entire metasomal terga 5–6 (also 7 in male), apical dumbbell-like markings on metasomal sterna 2–4, entire metasomal sterna 5–6 (also 7 in male) yellow. Occiput largely reddish, sometimes with paired yellow inner markings.

In a melanic male (Fig. 1C), apical band of metasoma much reduced.

Observed flowers visited. Korea: Seoul: Yongsan-gu, Ichon-dong, Natural Education site, 4 Jul 2015, Cho SJ, on *Thymus quinquecostatus* var. *japonicus*; ditto, 17 Jul 2015, Cho SJ, on *Sorbaria sorbifolia* var. *stellipila* and *Thymus quinquecostatus* var. *japonicas*; ditto, 3 Jul 2016, Cho SJ, on *Erigeron annuus* and *Solidago altissima*; ditto, 13 Jul 2016, Cho SJ, on *Mentha* sp.; ditto, 18 Oct 2016, Cho SJ, on *Mentha* sp. and *Aster pilosus*; ditto, 30 May 2017, Cho SJ, on *Thymus quinquecostatus* var. *japonicus*; ditto, 19 Jun 2017, Cho SJ, on *Solidago altissima*, *Oreganum vulgare* and *Mentha* sp.; ditto, 1 Aug 2017, Cho SJ, on *Veronica linariaefolia* and *Callicarpa dichotoma*; ditto, 17 Jun 2018, Cho SJ, on *Solidago altissima* and *Monarda didyma* var. *alba*; ditto, 17 Aug 2018, Cho SJ, on *Patrinia scabiosaefolia*; Gyeonggi-do: Hwaseong-si, Songsan-myeon, Jinhwa-ri, 37°12′16.41″N, 126°39′07.76″E, 15 Oct 2016, Kwon OC, on *Symphyotrichum pilosum* and *Aster koraiensis*; Chungcheongnam-do: Taean-gun, Wonbuk-myeon, Sindu-ri, 36°51′19.3″N, 126°12′08.8″E, 3 Aug 2017, Kim JK, on *Zanthoxylum schinifolium*; Seoul: Donjak-gu, Sindaebang-dong, Boramae park, Sep 2017, Cho SJ, on *Aster koraiensis*; ditto, 31 Aug 2018, Cho SJ, on *Zanthoxylum schinifolium*; Gyeonggi-do: Seongnam-si, Bundang-gu, Sampyeong-dong, Pangyo park, 9 Sep 2017, Cho SJ, on *Celosia cristata* and *Allium tuberosum*; Euijeongbu-si, Euijeongbu 1-dong, 3 Oct 2016, Paul B, on *Aster pilosus*; Chungcheongbuk-do: Jincheon-gun, Jincheon-eup, 14 Oct

Korean name: [1]*꼴벌잡이노래기벌

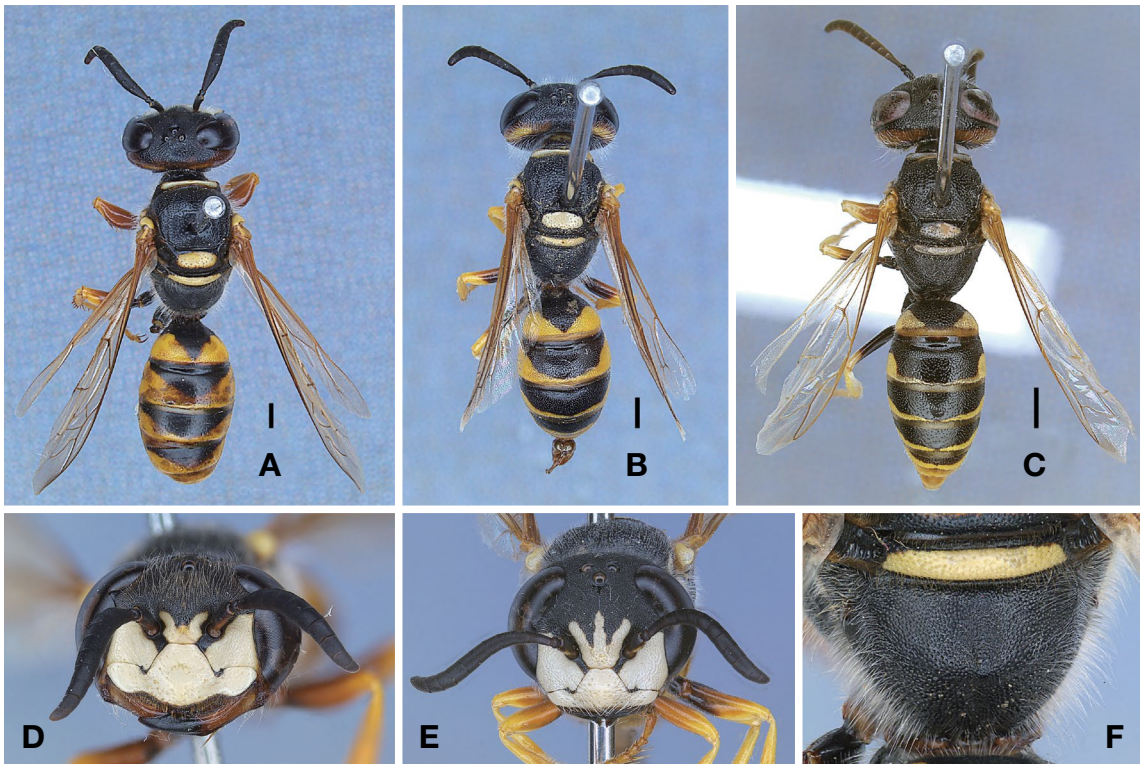

Fig. 1. *Philanthus triangulum*. A, General habitus, female; B, General habitus, male, xanthophyll form; C, General habitus, male, melanic form; D, Head, female; E, Head, male; F, Propodeal dorsum, female. Scale bars: A–C = 1 mm.

Table 1. Pairwise genetic distances of DNA barcoding regions among population of *Philanthus triangulum* from Korea and other selected foreign countries

	1	2	3	4	5	6	7	8	[a]Localities/countries of materials	GenBank accession No.
1									Taean, Korea	MN650651
2	0.0000								Boryeong, Korea	MN650652
3	0.0000	0.0000							Yanggu, Korea	MN650653
4	0.0124	0.0124	0.0124						United Arab Emirate	MH609450
5	0.0015	0.0015	0.0015	0.0140					Moroco	MH610915
6	0.0000	0.0000	0.0000	0.0124	0.0015				Germany	MH610114
7	0.0015	0.0015	0.0015	0.0140	0.0000	0.0015			Bulgaria	MH609109
8	0.0015	0.0015	0.0015	0.0140	0.0000	0.0015	0.0000		Italy	MH609837
9	0.0015	0.0015	0.0015	0.0140	0.0000	0.0015	0.0000	0.0000	Turkey	MH609588

[a]Korean localites in M & M herein, detailed localities of foreign countries in features of each GenBank.

2016, Yeom CM, on *Aster pilosus*; Chungcheongnam-do: Seosan-si, Jukseong-dong, 27 Jun 2016, Kim HT, on *Erigeron annuus*.

Notes. With the addition of some characteristics to Beaumont (1951), Gayubo (1991) defined the *Philanthus triangulum* species group as follows: "Propusely punctate propodeal enclosure and mesopleuron all over. First gastral segment broad. Male with brushes occupying whole of the anterior edge of clypeus or separated by about the width of a brush; this edge is tridentate at the centre. Female shows one or two strong central teeth bordered by another two, not so pronounced, on anterior edge of clypeus." All of the Korean materials herein are well-matched with the above characteristics.

Amplified partial COI gene sequences of the three Korean

Fig. 2. *Philanthus triangulum* foraging on *Aster pilosus* Willd.

materials (658 bp) that are different in sex, coloation and size are completely identical (GenBank accession numbers: MN650651, MN650652, MN650653). Also, they are different at most 1.4% from the selected Afrotropical (from Moroco), European (from Germany, Bulgaria, and Italy), Middle East (from United Arb Emirate) and West Asian (from Turkey) materials. Pairwise genetic distances calculated among the Korean and foreign materials are tabulated in the Table 1.

Most speciemens were captured on flowers because this wasp likes to forage on flowers for eating honey (Fig. 2). And it prefers flowering place to others for hunting honeybee.

Distribution. Afrotropic and western Palearctic (GBIF Secritariat, 2017) eastward to Russia (Pulawski, 1978), China (Wu and Zhou, 1996), and Korea (new record).

[1*]***Philanthus coronatus* (Thunberg, 1784)**

Sphex coronata Thunberg, 1784: 25 (as *coronata*, incorrect original termination), ♂ (holotype or syntypes), France: Parisiis, now Paris (depository uncertain).

Philanthus coronatus (Thunberg): Thunberg, 1815: 128 (new combination, diagnostic); Tsuneki, 1943: 33–36 (nesting habitat observed in Seoul, Korea); Tsuneki, 1982: 18 (in the list of the species of the Sphecidae known from the Korean Peninsula); Paik, 1985: 203 (in the list of Sphecidae of Korea); Lee et al., 2010: 211 (in checklist of Korean Insects); Kim, 2014: 450 (in list of catalogue of Korean Spheciformes).

Distribution. Transpalearctic: Europe (GBIF Secretariat, 2017) through Russia (Nemkov, 2014) to NE China (Wu and Zhou, 1996) and Korea (Tsuneki, 1943).

Notes. The occurrence of this species in Korea was first documented by Tsuneki (1943). He described detailed nesting habits of this species (without taxonomic concern, but judging from the line drawing provided by him, his identification may be correct) observed in sandy soil in the vicinity of "Gyeongseong Airport in Gyeongseong" (later called 'Yeouido Airport' in Seoul). Like other typical city areas in Seoul, the area is too highly urbanized to provide proper nesting site for this species.

Since Tsuneki (1943), no additional finding of this species in Korea has been reported. All succeeding records on this species in Korea (e.g., Tsuneki, 1982; Paik, 1985; Paek et al., 2010; Kim, 2014) were the merely iterate citations of the first record. First author has been making an effort to find this species in Korea for a lengthy time but failed in vain. Presumably this species is currently in the status of great rarity or extinction in South Korea.

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CONFLICTS OF INTEREST

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

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Korean name: [1*]금관노래기벌

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