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New data on the digger wasps fauna of families Pemphredonidae, Psenidae and Philanthidae (Hymenoptera: Apoidea) in Iran

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ABSTRACT. The digger wasps fauna (Hymenoptera: Apoidea) of Fars province in southern Iran was partly investigated. Members of three families: Pemphredonidae (5 species of 3 genera), Psenidae (3 species of 2 genera) and Philanthidae (2 species of 2 genera) were collected and documented. The following eight species: *Diodontus brevilabris* de Beaumont, 1967, *D. crassicornis* Gribodo, 1894, *D. insidiosus* Spooner, 1938, *Passaloecus corniger* Shuckard, 1837, *Pemphredon inornata* Say, 1824, *Mimesa punctipleuris* (Gussakovskij, 1937), *Psenulus laeovigatus* (Schenck, 1857) and *Cerceris spinifera haladai* K. Schmidt, 2000, are new to the Iranian wasp fauna. In addition, two species: *Psenulus schencki* (Tournier, 1889) and *Philanthus variegatus* Spinola, 1839, are new records for Fars province. For each species, we include available distributional data as well as comments on its taxonomy and geographical distribution.

Key words: Hymenoptera, fauna, new records, Iran

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Introduction

Apoide wasps (Apoidea excluding Apidae) are the largest group of the aculeate wasps (Hymenoptera: Aculeata), comprising over 10,000 described species worldwide (Aguilar et al., 2013; Pulawski, 2020), which were usually assigned to four families Ampulicidae, Crabronidae, Heterogynaidae and Sphecidae *sensu stricto* or placed all in one family Sphecidae *sensu lato* (for history of classification and details see Pulawski, 2020). Brothers (1999) and Melo (1999) re-classified Apoidea and found that Sphecidae *sensu lato* are paraphyletic with relation to apoide bees. Therefore, Apoidea were splitted into five monophyletic families: Apidae, Ampulicidae, Crabronidae, Heterogynaidae and Sphecidae. Based on recent molecular and phylogenetic studies, Debevec et al. (2012) demonstrated that two families Ampulicidae and Heterogynaidae are sequential sister taxa to Sphecidae and Crabronidae. Later, Branstetter et al. (2017) suggested that Heterogynaidae and paraphyletic Sphecidae *sensu stricto* placed in a polyphyletic Crabronidae. Most recently,

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Sann et al. (2018) established the polyphyletic nature of the digger wasp family "Crabronidae", and they suggested splitting it into eight families: Ammoplanidae, Astatidae, Bembecidae, Crabronidae, Mellinidae, Pemphredonidae, Philanthidae, and Psenidae.

During the last two decades, numerous papers have been published on the fauna of Iranian digger wasps, the representatives are: Ebrahimi, 2000a, 2000b, 2005, 2008, 2014; Dollfuss, 2006, 2008; Schmid-Egger, 2004, 2019; Fallahzadeh et al., 2006, 2009, 2018; Pulawski, 2007; Ghazi-Soltani et al., 2009, 2010a, 2010b, 2010c; Atbaei et al., 2015; Rezaei & Fallahzadeh, 2015; Schmid-Egger et al., 2016; Sadeghi et al., 2016, 2018a, 2018b, 2019; Jahantigh et al., 2017; Khosroabadi et al., 2019). The main purpose of the present study was to increase our knowledge about the fauna of Iranian Pemphredonidae, Psenidae and Philanthidae in the Fars province.

Material and methods

Specimens for the current study were collected using Malaise traps at seven locations with four elevation levels in the Fars province, Iran: about 2000 (Dasht-e Arzhan and Dalin), about 1500 (Shiraz, Kavar and Zafar Abad), about 700 (Larestan: Karmostaj), and about 500 (Larestan: Hormood Abbasi) meters above the sea level, respectively. Sampling localities are briefly described in Table 1. Voucher specimens are deposited at the Insect Collection of Jahrom Branch, Islamic Azad University, Iran (JIAU) and the Institute of Biodiversity and Ecosystem Research, Sofia, Bulgaria (IBER). Family-level classification is based on the most recent classification of Apoidea suggested by Sann et al. (2018). Nomenclature and general distributional for each species were adapted from Antropov et al. (2017) and Pulawski (2020). Data under Material examined for the recorded species are presented in the following order: number of specimens examined, locality, and date of collection. The GPS coordinates, altitudes of sampling localities, and collector names are given in Table 1. The genera and species are listed alphabetically under each family.

Table 1. List of the sampling localities in Fars province, Iran.

| No. | Locality | Coordinate | Altitude in m a. s. l. | Collector |
|-----|-----------------------------|--------------------------------|------------------------|------------|
| 01 | Dasht-e Arzhan | 29°39'39.0" N 51°59'03.4" E | 2152 | Sh. Rezaei |
| 02 | Dalin | 30°02'15.0" N 52°07'54.7" E | 2019 | Sh. Rezaei |
| 03 | Shiraz (Bustan-e Jannat) | 29°36'52.0" N 52°28'09.0" E | 1584 | Sh. Rezaei |
| 04 | Kavar | 29°11'52.0" N 52°42'06.0" E | 1547 | Sh. Rezaei |
| 05 | Zafar Abad | 29°24'06.0" N 52°35'01.0" E | 1514 | Sh. Rezaei |
| 06 | Larestan (Karmostaj) | 27°31'55.0" N 54°26'01.0" E | 781 | Sh. Rezaei |
| 07 | Larestan (Hormood Abbasi) | 27°32'06.0" N 54°59'02.0" E | 506 | Sh. Rezaei |

Results

Digger wasps collected in the current study represent three families, 7 genera and 10 species as follows:

Family: Pemphredonidae

Genus: *Diodontus* Curtis, 1834

Diodontus brevilabris de Beaumont, 1967

Material examined: Iran, Fars province: Dalin (loc. 02, [Table 1](#)), 19-25.vi.2019, 1♀.

Distribution: Caucasus, Europe, Iran (new record), Kyrgyzstan, Russia, Turkey, Turkmenistan.

Remarks: Because of morphological similarity (see [Budrys, 1996](#)) and the lack of regional keys, this group is considered to be difficult for identification. Recently, [Olszewski et al. \(2016\)](#) keyed Central and Eastern European species while [Budrys et al. \(2019\)](#) keyed the species of *D. minutus* (Fabricius, 1793) species-group of the Mediterranean region. The later key can be used partially to identify fauna from southern Iran. *Diodontus brevilabris* was originally described from Turkey ([de Beaumont, 1967](#)).

Diodontus crassicornis Gribodo, 1894

Material examined: Iran, Fars province: Dasht-e Arzhan (loc. 01, [Table 1](#)), 7-20.vi.2019, 1♂; Kavar (loc. 04, [Table 1](#)), 16-26.vii.2019, 1♂.

Distribution: Algeria, Egypt, Iran (new record), Spain, Tunisia.

Remarks: Iran represents the northeastern limit of this species distribution.

Diodontus insidiosus Spooner, 1938

Material examined: Iran, Fars province: Larestan (loc. 06, [Table 1](#)), 21-30.iv.2018, 1♂.

Distribution: Europe, Iran (new record), Kazakhstan, Russia.

Genus: *Passaloecus* Shuckard, 1837

Passaloecus corniger Shuckard, 1837

Material examined: Iran, Fars province: Shiraz (loc. 03, [Table 1](#)), 24-30.iv.2018, 1♀; 1-9.vi.2019, 1♀; 1-10.ix.2019, 1♀; 22-30.ix.2019, 1♀.

Distribution: Europe, Iran (new record), Japan, Kazakhstan, North Africa, Russia, Turkey.

Genus: *Pemphredon* Latreille, 1796

Pemphredon inornata Say, 1824

Material examined: Iran, Fars province: Shiraz (loc. 03, [Table 1](#)), 1-7.v.2018, 1♀; 17-23.vii.2018, 3♀♀; 21-27.viii.2018, 1♀; Dasht-e Arzhan (loc. 01, [Table 1](#)), 22-31.v.2019, 3♀♀.

Distribution: Central Asia, Europe, China, Iran (new record), Japan, Korean Peninsula, Mongolia, North Africa, North America, Russia, Turkey.

Family: Psenidae

Genus *Mimesa* Shuckard, 1837

Mimesa punctipleuris (Gussakovskij, 1937)

Material examined: Iran, Fars province: Larestan (loc. 07, [Table 1](#)), 29.v.2015-29.6.2015, 1♂.

Distribution: China, Iran (new record), Kazakhstan, Kyrgyzstan, Mongolia, Russia.

Remarks: No review study on Iranian *Mimesa* species is available, therefore the study of this fauna is very difficult. Identification is based on [de Beaumont \(1937\)](#) and [Budrys \(1985\)](#).

Genus: *Psenulus* Kohl, 1896

Psenulus laevigatus (Schenck, 1857)

Material examined: Iran, Fars province: Shiraz (loc. 03, [Table 1](#)), 10-20.iv.2018, 1♀; 1-9.vi.2019, 1♀; Zafar Abad (loc. 05, [Table 1](#)), 18-25.vi.2019, 2♀♀.

Distribution: Europe, Iran (new record), Japan, Korean Peninsula, Russia, Turkey.

Psenulus schencki (Tournier, 1889)

Material examined: Iran, Fars province: Shiraz (loc. 03, [Table 1](#)), 24-30.iv.2018, 1♂; 17-23.vii.2018, 1♂; 21-27.viii.2018, 1♂.

Distribution: Iran: Khorasan-e Razavi ([Samin et al., 2018](#)), Fars (new record), Europe, Georgia, North Africa, Turkey.

Family: Philanthidae

Genus: *Cerceris* Latreille, 1802

Cerceris spinifera haladai K. Schmidt, 2000

Material examined: Iran, Fars province: Zafar Abad (loc. 05, [Table 1](#)), 11-21.v.2019, 1♀; 12-20.vii.2019, 1♀.

Distribution: Iran (new record), Turkey.

Genus: *Philanthus* Fabricius, 1790

Philanthus variegatus Spinola, 1839

Material examined: Iran, Fars province: Larestan (loc. 06, [Table 1](#)), 21-30.iv.2019, 1♂.

Distribution: Iran: Qazvin ([de Beaumont, 1957](#)), Ardabil ([de Beaumont, 1957](#); [Ebrahimi, 2014](#)), East Azerbaijan ([Sakenin et al., 2011](#)), Kerman, Mazandaran ([Ebrahimi, 2014](#)), Fars (new record), Afghanistan, Armenia, Azerbaijan, Central Asia, China, Iraq, Israel, Kazakhstan, Kuwait, North Africa, Oman, Pakistan, Russia, Saudi Arabia, Syria, Turkey, United Arab Emirates.

Discussion

The digger wasps (former family Crabronidae) in Fars and Hormozgan provinces in southern Iran have received increasing attention in recent years ([Fallahzadeh et al., 2006, 2009, 2018](#); [Atbaei et al., 2015](#); [Rezaei & Fallahzadeh, 2015](#); [Schmid-Egger et al., 2016](#); [Sadeghi et al., 2016, 2018a, 2018b, 2019](#); [Khosroabadi et al., 2019](#)). Before 2015, the number of known species from the Fars province was 28 (see [Atbaei et al., 2015](#)). Since then, the number of known species of these wasps from the Fars province increased significantly to 158 species. In the current study, eight species: *Diodontus brevilabris*, *D. crassicornis*, *D. insidiosus*, *Passaloecus corniger*, *Pemphredon inornata*, *Mimesa punctipleuris*, *Psenulus laevigatus* and *Cerceris spinifera haladai*, were added to the Iranian wasp fauna. In addition, two species: *Psenulus schencki* and *Philanthus variegatus*, were new records for the Fars province.

The genus *Diodontus* includes 79 species on all major continents while the Palaearctic fauna has more than half of the known species ([Pulawski, 2020](#)). Only five species of the genus *Diodontus* had been recorded from Iran prior to the present study: *D. hyalipennis*

Kohl, 1892, *D. minutus* (Fabricius, 1793), *D. spinicollis* Gussakovskij, 1933, *D. temporalis* Kohl, 1901 and *D. tristis* (Vander Linden, 1829) (Gussakovskij, 1933; de Beaumont, 1957; Ebrahimi, 2005, 2014; Atbaei et al., 2015; Rezaei & Fallahzadeh, 2015). With addition of the three species reported in the present study, the number of *Diodontus* known from Iran increases to eight.

Passaloecus, a small genus distributed worldwide, contains about 40 described species. The genus appears to be especially well represented in the Palaearctic region from where more than half of the known species have been recorded (Pulawski, 2020). So far, the *Passaloecus* species recorded from Iran are *Passaloecus gracilis* (Curtis, 1834), *P. pictus* Ribaut, 1952 and *P. turionum* Dahlbom, 1844 (de Beaumont, 1957; Ebrahimi, 2005, 2014; Atbaei et al., 2015; Rezaei & Fallahzadeh, 2015), and now we added *P. corniger* to the fauna of Iran.

Dollfuss (1995) revised and keyed out the world species of *Pemphredon*. It is a Holarctic genus with more than 45 described species of which about 28 occur in the Palaearctic region (Pulawski, 2020). Up to now, only *P. austriaca* Kohl, 1888, *P. lethifer* (Shuckard, 1837), *P. rugifer* (Dahlbom, 1844) and *P. morio* Vander Linden, 1829 have been reported from Iran (Gussakovskij, 1933; Dollfuss, 1995; Ebrahimi, 2005, 2014; Atbaei et al., 2015; Rezaei & Fallahzadeh 2015; Samin et al., 2018), and now we added *P. inornata* to the fauna of Iran.

Mimesa is an Old World genus with 76 described species, of which more than 40 are found in the Palaearctic region (Pulawski, 2020). *Mimesa punctipleuris* was originally described from Mongolia (Gussakovskij, 1937). Ma et al. (2008) reviewed the Chinese species, while Schmid-Egger (2014) revised and keyed out the species from North Africa and the Arabian Peninsula. Currently, six species: *M. caucasica* Maidl, 1914, *M. crassipes* A. Costa, 1871, *M. grandii* Maidl, 1933, *M. jacobsoni* (Gussakovskij, 1937), *M. punctipleuris* and *M. scheuchli*, are known from Iran (for previous records see Jahantigh et al., 2017).

Psenulus, a cosmopolitan genus, currently consists of 161 species, most of which are found in the Oriental and Palaearctic regions (Pulawski, 2020). *Psenulus schencki* was hitherto recorded from northeastern Iran. Therefore, its presence in southern Iran extends the known distribution of this species in the Iranian plateau.

Cerceris is a worldwide, large genus containing about 867 species, of which about 270 have been reported from the Palaearctic region (Pulawski, 2020). Recently, Sadeghi et al. (2019) reviewed all of *Cerceris* of Iran and listed 53 species and subspecies. *Cerceris spinifera haladai* was originally described from Turkey and has not been recorded thereafter.

Philanthus is a cosmopolitan genus that currently includes 134 nominal species (Pulawski, 2020). The present record of *Philanthus variegatus* from southern Iran reveals the wide distribution of this species on the Iranian plateau.

At present, considering the results of this work, the number of known species from the Fars province is about 168. Indeed, the 168 included species are only a fraction of what must occur in the Fars province. On the other hand, comprehensive research has not been conducted elsewhere in the country and many provinces are poorly known and not well investigated. The species reported from Fars are several times as much as from any other part of Iran, and a simple comparison shows that other areas need further investigation (see Jahantigh et al., 2017). Therefore, further researches on the diversity, biology and behavior of digger wasps in other areas are strongly recommended.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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یافته‌های جدید از زنبورهای حفار خانواده‌های *Philanthidae* و *Psenidae*, *Pemphredonidae* (Hymenoptera: Apoidea) از ایران

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چکیده: فون زنبورهای حفار (Hymenoptera: Apoidea) در استان فارس مطالعه شد و نمونه‌هایی از سه خانواده *Pemphredonidae* (پنج گونه از سه جنس)، *Psenidae* (سه گونه از دو جنس) و *Philanthidae* (دو گونه از دو جنس) جمع‌آوری شد که در اینجا ارائه می‌شود. هشت گونه *D. Diodontus brevilabris* de Beaumont, 1967، *Passaloecus D. insidiosus* Spooner, 1938، *crassicornis* Gribodo, 1894، *Mimesa Pemphredon inornata* Say, 1824، *corniger* Shuckard, 1837 و *Psenulus laevigatus* (Schenck, 1857) *punctipleuris* (Gussakovskij, 1937) و *Cerceris spinifera haladai* K. Schmidt برای فون زنبورهای ایران جدید هستند. علاوه بر این دو گونه *Psenulus schencki* (Tournier, 1889) و *Philanthus variegatus* Spinola, 1839 برای اولین بار از استان فارس گزارش می‌شوند. اطلاعات در دسترس در ارتباط با تاکسونومی و پراکنش گونه‌های جمع‌آوری شده ارائه شد.

واژگان کلیدی: بال غشاییان، فون، گزارش‌های جدید، ایران