

## Faunistic Study of the Genus *Miscophus* Jurine, 1807 (Hymenoptera: Crabronidae) from Iran

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### ABSTRACT

The genus *Miscophus* Jurine, 1807 (Hymenoptera: Crabronidae) was studied in two discrete fragments of the Northern (Alborz, Qazvin, Guilan, Mazandaran and Tehran provinces), and southern (Khuzestan and Hormozgan provinces) inlands of Iran. The specimens were collected using Malaise traps in the years 2010, 2011 and 2017. Twelve species were identified, of which five species are new records for the fauna of Iran: *Miscophus ctenopus* Kohl, 1885; *M. niger* Dahlbom, 1844; *M. aenigma* Honore, 1944; *M. irwini* Schmid-Egger, 2022 and *M. caninus* Andrade, 1953. An identification key for all Iranian species of the genus *Miscophus* and brief diagnoses for the new records are provided.

**Keywords:** New record, distribution, identification key, diagnosis, Malaise trap.

## INTRODUCTION

The subfamily Crabroninae (Hym., Crabronidae) is the most species-rich among Spheciformes wasps, encompassing 4889 described species, with 109 genera, and seven tribes (Bothynostethini, Crabronini, Oxybelini, Larrini, Miscophini, Palarini and Trypoxylini) (Branstetter et al., 2017; Sann et al., 2018; 2021). The tribe Miscophini includes 17 genera, with *Miscophus* Jurine, 1807 being the largest genus comprising about 198 described species worldwide (Kumar, Mawadda, Terine, & Amal, 2024; Pulawski, 2024; Schmid-Egger, Ghaderipour, Talebi, Mehrabadi, & Madjdzadeh, 2025). The majority of the known species are distributed in the Afrotropical region comprising 86 species (43.4%) followed by the Palaearctic region with 84 species (42.4%), the Nearctic with 15 species (7.58%), and the oriental region with three species (1.5%). Additionally, eight species are distributed in both Afrotropical and Palaearctic (4.2%), and one species in both the Palaearctic and Oriental (0.5%) (Pulawski, 2024; Amal, Girish Kumar, & Hegde, 2024; Girish Kumar & Amal, 2025).

Member of the genus *Miscophus* can be separated from other genera of the subfamily Crabroninae by the combination of the following characters: Forewing with one or two submarginal cell, one or two discoidal, marginal cell usually closed apically, hind wing with a jugal lob; apical clypeal margin usually excised laterally; episternal sulcus present, mesopleuron without hypersternaulus (Bohart & Menke, 1976).

The biology of the tribe Miscophini is not well known and the prey captured by adult wasps exhibits diverse range, predominantly consisting of adult Hemiptera, Psocoptera, larvae of Lepidoptera, and spiders (Bohart & Menke, 1976; Kurczewski, Edwards, Kimsey, & Kurczewski, 2012, Kurczewski, Abela, & Ubick, 2020). The genus *Miscophus* constructs multicellular nests either in the ground or in pre-existing holes. Each cell is provisioned with insects or spiders (Bohart & Menke, 1976; Gess & Gess, 2014) for consumption by larvae.

Prior to this study, 13 species of this genus have been reported from Iran (Atbaei, Fallahzadeh, & Ljubomirov, 2015; Jahantigh, Rakhshani, Mokhtari, & Ramroodi, 2017; Sadeghi, Fallahzadeh, Ostavon, Ljubomirov, & Hesami, 2019; Rezaei, Fallahzadeh, Dousti, & Saghaei, 2020; Schmid-Egger et al., 2025). The aim of this study is to improve our understanding of the Iranian Crabronidae and to enhance existing knowledge by providing additional information on the distribution of newly recorded and previously documented species. An identification key to the Iranian species of the genus *Miscophus* has been provided.

## MATERIALS AND METHODS

This study is based on the specimens deposited in the collection of the Department of Entomology, Tarbiat Modares University (TMUC), Tehran, Iran. Specimens were collected using Malaise traps from different regions of Iran and preserved in 75% ethanol, and stored in a freezer (at -20°C) for subsequent studies. The specimens were treated with the AXA method, (van Achterberg, 2009), which involved immersion

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in a mixture of ethanol (60%) / xylene (40%) for two days, followed by treatment with amyl acetate for an additional two days, and finally placed on filter paper for drying. The specimens were then dried on filter paper, labeled, and some were mounted on triangular point cards. Examination of the external morphology was conducted using an Olympus SZH10 stereomicroscope. Photographs were taken with a Canon DS126211 digital camera mounted on the stereomicroscope. A series of 7-15 images was stacked into a single in-focus image using Zerene stacker software. Final adjustments to image size and background were made using Adobe Photoshop CS18. To avoid repetition in the "Material Examined" section, the GPS coordinates, altitudes of sampling locations, and collector details are provided in Table 1. The terminology and morphological characters followed Bohart & Menke (1976). Identification was mainly carried out using reliable keys provided by Andrade (1960), Schmid-Egger, & Bitsch (2007), Schmid-Egger & Straka (2019), Schmid-Egger & Al-Jahadhami (2022), and Schmid-Egger et al. (2025). Voucher specimens are deposited in the collection Department of Entomology, Tarbiat Modares University (TMUC), Tehran, Iran.

The following abbreviations and acronyms are used:

A1-A13 = antennomeres numbered from the scape (A1) to the apical antennomere (A13). TMUC: Department of Entomology Tarbiat Modares University Collection, Tehran, Iran.

CSE: Private collection, Christian Schmid-Egger.

Table 1. List of the sampling location in some part of Iran.

NO	Locality	Coordinate	Altitude in m a.s.l.	Collector
01	South Zakin	27°28'53.23" N, 56°18'27.03" E	680	A. Ameri
02	North Zakin	27°53'7.32" N, 56°19'58.34" E	1020	A. Ameri
03	Geno	27°24'16.16" N, 56°08'51.80" E	1274	A. Ameri
04	Goleshvar	27°58'30.1" N, 56°59'53.55" E	14	A. Ameri
05	chelogavmishi	27°10'30.39" N, 57°01'09.79" E	16	A. Ameri
06	Ramakan	26°52'25.27" N, 56°17'33" E	34	A. Ameri
07	Faryab	27°28'58.72" N, 57°04'24.62" E	313	A. Ameri
08	Baneh	27°51'51.50" N, 56°18'34.17" E	1630	A. Ameri
09	Bangelayan,	27°28'53.23" N, 56°18'27.03" E	685	A. Ameri
10	near Environmental Checkpoint	27°28'53.23" N, 56°18'27.03" E	680	A. Ameri
11	Shahriar	35°40'03.06" N, 50°56'52.14" E	1168	A. Mohammadi
12	Sarziarat	35°55'10.38" N, 51°06'51.24" E	1980	A. Nadimi
13	Arangeh	35°55'07.20" N, 51°05'09.24" E	1891	A. Nadimi
14	Lowshan	36°40'09.12" N, 49°25'37.74" E	291	A. Nadimi
15	Shahrestank	35°58'16.26" N, 51°21'25.80" E	2225	A. Nadimi
16	Shahrestank	35°57'34.98" N, 51°22'20.34" E	2305	A. Nadimi
17	Barajin	36°21'39.72" N, 50°03'55.56" E	1541	A. Nadimi
18	Kuhin	36°22'14.22" N, 49°38.02" E	1514	A. Nadimi
19	Zereshk Road	36°25'23.88" N, 50°06'37.68" E	1926	A. Nadimi
20	km 7 of Zereshk Road	36°25'39.36" N, 50°06'36.90" E	1997	A. Nadimi
21	Zereshk Road	36°21'43.02" N, 50°03'53.22" E	1553	A. Nadimi
22	Karaj	35°46'08.88" N, 50°56'55.20" E	1277	A. Nadimi
23	Naghshe Hyr	31°46'20.56" N, 48°48'01.17" E	20	M. Zargar

Table continued

24	Bandbal	32°17'27.94" N, 48°25'46.98" E	97	M. Zargar
25	Ghor Abad	30°59'37.73" N, 49°46'50.63" E	126	M. Zargar
26	Dodangeh	30°72'83.17" N, 50°17'60.22" E	320	M. Zargar
27	Dorab	32°12'23.00" N, 49°26'37.00" E	760	M. Zargar
28	Taraz	32°20'49.70" N, 49°05'11.31" E	390	M. Zargar
29	Shamsabad,	32°29'64.65" N, 48°42'57.45" E	94	M. Zargar
30	Chezi Yeola	32°08'02.78" N, 49°38'30.56" E	650	M. Zargar
31	Goldamcheh	28°40'28.39" N, 53°33'48.10"E	1031	A. Amiri
32	Shahrmian	30°54'39.07"N, 52°28'16.82"E	2120	A. Amiri
33	Orkom	36°45'44.34" N, 50°18'11.88" E,	1201	M. khayrandish
34	Ghazi Chak	36°45'57.54" N, 50°19'35.22" E,	1803	M. Khayrandish

## RESULTS

### Family Crabronidae Latreille, 1802

### Subfamily Crabroninae Latreille, 1802

### Genus *Miscophus* Jurine, 1807

### *Miscophus aenigma* Honore, 1944

**Material examined:** 7♀♀; HORMOZGAN province: Bandar Abbas, South Zakin (loc. 01), 24.06.2012, 1♀ (TMUC); Bandar Abbas, Geno, Geno (loc. 03), 12.05.2011, 1♀ (TMUC); Minab, chelogavmishi (loc. 05), 05.04.2012, 1♀ (CSE); Minab, Goleshvar (loc. 04), 06.07.2012, 1♀ (TMUC); Qeshm Island, Ramakan, Ramakan (loc. 06), 18.06.2012, 2♀♀; 17.07.2012, 1♀ (TMUC).

**Distribution in Iran:** Hormozgan (current study).

**General distribution:** Egypt (de Andrade, 1960), United Arab Emirate (Schmid-Egger, 2011, 2014), Iran (new record).

**Diagnosis. Female:** Body black; length 3-3.5 mm (Fig. 1a); frons with micropunctures and cupreous shimmer; mandible and anterior margin of clypeus light reddish (Fig. 1b); antenna brown, short, and first flagellomere 1-1.5× as long as pedicel (Fig. 1c); gena smooth and shiny, with sparse short appressed pilosity; scutum, scutellum and metanotum shiny, with fine punctuation; mesopleuron shiny, its upper part with sparse punctuation, lower part with sparse micropunctures; angle between dorsal and posterior surface of propodeum about 90-100 degree in lateral view (Fig. 1d); dorsal surface of propodeum with a median keel, finely and densely microsculptured, and dense suberect setae directed anteriorly (Fig. 1e); tegula white; fore and hind wings hyaline, forewings venation white (Fig. 1f); forefemur black, with small apical spot, basal half of foretibia dorsally with whitish band, hind tibia dorsally with whitish band at basal two-thirds, tarsi yellowish brown; gaster black, somewhat shiny, with fine grain-like punctures.

### *Miscophus ater* Lepeletier de Saint Fargeau, 1845

**Material examined:** 19♀♀; TEHRAN province: Shahriar, Shahriar, (loc. 11), 24.08.2010, 1♀ (TMUC); ALBORZ province: Asara, Shahrestanak, (loc 16), 20.07.2010, 1♀ (TMUC); Asara, Sarziarat (loc. 12), 06.07.2010, 1♀ (TMUC); 07.09.2010, 1♀ (TMUC); Asara, Arangeh, (loc.13), 14. 07.2010, 1♀ (TMUC); 07.09.2010, 1♀ (TMUC); QAZVIN province: Lowshan, (loc.14), 05.07.2011, 1♀ (TMUC); 05.vii.2011, 1♀ (TMUC); HORMOZGAN province:

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Bandar Abbas, Geno, Geno, (loc. 13), 26.04.2011, 1♀ (CSE), 1♀ (TMUC); Bandar Abbas, South Zakin, (loc.01), 23.05.2011, 1♀ (TMUC); KHUZESTAN province: Abadan, Naghshe Hyr, (loc.23), 05.05.2017, 1♀ (TMUC); Dezful, Qaleh-Rob, Bandbal (loc.24), 22.05.2017, 1♀ (TMUC); Ramhormoz, Ghor Abad, (loc.25), 22.05.2017, 1♀ (TMUC); Behbahan, Dodangeh (loc.26), 06. 07.2017, 1♀ (TMUC); Andika, Dorab (loc.27), 05.05.2017, 1♀ (TMUC); Lali, Taraz, (loc.28), 22.05.2017, 2♀ (TMUC); FARS province, Eghlid, Shahrman, (32), 08.06.2012, 1♀ (TMUC).

**Distribution in Iran:** Alborz (Ebrahimi, 2014; current study), Tehran (Ebrahimi 2005), Qazvin, Hormozgan, Khuzestan, Fars (current study).

**General distribution:** Palaeartic region (Pulawski, 2024).

### *Miscophus albufeirae de Andrade, 1952*

**Material examined:** 3♀♀; KHUZESTAN province: Lali, Taraz, (loc. 28), 05.05.2017, 1♀ (TMUC), Andika, Dorab, (loc. 24), 21.03. 2017, 1♀ (CSE); ALBORZ province: Asara, Shahrestank, (loc. 15), 07.09.2010, 1♀ (TMUC).

**Distribution in Iran:** Fars (Rezaei, Fallahzadeh, Dousti, & Saghaei, 2020); Alborz, Khuzestan (current study).

**General distribution:** Cyprus, France, Greece, Iran, Portugal, Russia, Spain, Turkey (Pulawski, 2024).

### *Miscophus bicolor Jurine, 1807*

**Material examined:** 7♀♀, 2♂♂; TEHRAN province: Shahriar, (loc.11), 10.08.2010, 1♀, (TMUC); 24.08.2010, 1♀ (TMUC); QAZVIN province: Zereskh Road, Barajin (loc.17) , 27.06.2011, 1♀ (TMUC); Kuhin, (loc. 18), 26.07.2011, 1♂ (TMUC); Zereskh Road, (loc.19), 27.07.2011, 1♀ (TMUC), 1♀ (CSE); KHUZESTAN province: Andika, Chezi Yeola, (loc.30), 21.04.2017, 1♂ (TMUC); 05.05.2017, 1♀ (TMUC); Andika, Dorab, (loc.27), 22.05.2017, 1♀ (TMUC).

**Distribution in Iran:** Mazandaran (de Beaumont 1957), Tehran (de Andrade 1960); Fars (Rezaei & Fallahzadeh 2015; Sadeghi et al. 2019), Alborz, Qazvin, Khuzestan (Current study).

**General distribution:** Palaeartic region (Pulawski, 2024).

### *Miscophus binaludensis Schmid-Egger, 2025*

**Material examined:** 1♀; QAZVIN province: km 7 of Zereskh Road (loc. 20), 29.08.2011, 1♀ (TMUC).

**Distribution in Iran:** Razwi-Khorasan province (Schmid-Egger et al. 2025); Qazvin province (current study)

General distribution: Iran

### *Miscophus caninus Andrade, 1953*

**Material examined:** 7♀♀, 1♂; ALBORZ province: Asara, Shahrestanak, (loc. 16), 08.06.2011, 1♀ (TMUC); QAZVIN province (loc.19): Zereskh Road (loc.19), 03.08.2011, 1♀ (TMUC); km 7 of Zereskh Road (loc.20), 26.07.2011, 1♀ (TMUC); 29.08.2011, 1♀ (TMUC); Zereskh Road, (loc.21), 26.07.2011, 1♀ (TMUC); , Barajin (loc.17), 05.07.2011, 1♂, 1♀ (CSE); FARS province: Eghlid, Shahrman, (loc. 32), 19.07. 2012, 1♀ (TMUC).

**Distribution in Iran:** Alborz, Qazvin, Fars (current study).

**General distribution:** Cyprus (de Andrade, 1960); Turkey (Kaplan & Yıldırım, 2021), Iran (new record).

**Diagnosis. Female.** Body black; body length 4.2 - 4.5 mm (Fig. 2a); clypeus with distinct lateral and median sections, median section subdivided (Fig. 2b); frons shiny, with dense and granulate punctures; lower part of face above antennal socket and clypeus with short pilosity; gena shiny, with sparse short and appressed pilosity (Fig. 2c); pronotal collar with sparse, short pilosity; mesoscutum and mesoscutellum shiny, with dense and well-defined punctuation, spaces between punctures smaller than a diameter of punctation; mesopleuron shiny, with dense punctuation, interpunctural spaces smaller than a puncture diameter (Fig. 2d); dorsal surface of propodeum shiny, with sparse pilosity, a sharp median carina, and finely oblique longitudinally striation (Fig. 2e); basal half of tegula and precostal plate black; fore and hind wings hyaline (Fig. 2f); tergites with very finely punctures.

### ***Miscophus ctenopus* Kohl, 1884**

**Material examined:** 4♀♀; HORMOZGAN province: Bandar Abbas, Geno, Geno, (loc.03), 06.05.2011, 1♀ (TMUC); Qeshm island, Ramakan, Ramakan, (loc. 06), 18.06.2012, 1♀ (TMUC), 03.07.2012, 1♀ (CSE); Rudan, Faryab, (loc.07), 27.05.2011, 1♀ (TMUC).

**Distribution in Iran:** Hormozgan (current study).

**General distribution:** Arabian Peninsula (Gadallah, 2020), Egypt (Roche, 2007), Libya (de Beaumont, 1956) Oman, United Arab Emirates (Schmid-Egger, 2014), Saudi Arabia (Gadallah, Al Dhafer, Aldryhim, Fadl, & Elgharrawy, 2013), Sudan (Osborn & Krombein, 1969), Iran (**new record**).

**Diagnosis. Female.** Body black; body length 8 - 9.2 mm (Fig. 3a); eye larger than half face; frons, face and clypeus (except lamella) covered with very dense silvery pubescence; clypeus slightly arcuate; apical margin of clypeal lamella depressed medially and slightly raised (Fig. 3b); scape below yellowish, pedicel and flagellum black; gena with erect whitish pilosity; scutum, scutellum, metanotum and propodeum, covered with dense silvery pubescence (Fig. 3c); mesopleuron with dense silvery pubescence (Fig. 3d); tegula, precostal plate with black spot; fore and hind wings hyaline, venations dark brown and apex of forewing all darkened (Fig. 3); legs red except coxae black, fore basitarsus with spines long, thick and strongly spatulate apically (Fig. 3f); gaster red with very short pubescence.

### ***Miscophus gratusus* de Andrade, 1960**

**Material examined:** 4♀♀; HORMOZGAN province: Bandar Abbas, Zakin, Baneh, (loc. 08), 23.05.2011, 1♀ (CSE); KHUZESTAN province: Andika, Dorab (loc.27), 05.05.2017, 1♀ (TMUC); Lali, Taraz (loc.28), 22.05.2017, 1♀ (TMUC); Abadan, Naghshe Hyr, (loc.23), 05.05.2017, 1♀.

**Distribution in Iran:** Fars (Atbaei et al. 2015; Rezaei & Fallahzadeh, 2015), Hormozgan, Khuzestan (current study).

**General distribution:** Greece (Standfuss & Standfuss, 2006), Iran (Atbaei et al., 2015), Syria (Andrade, 1960).

### ***Miscophus irwini* Schmid-Egger, 2022**

**Material examined:** 4♀♀, 1♂; HORMOZGAN province: Bandar Abbas, Geno, Geno, (loc.03), 06.05.2011, 1♀, 1♂ (TMUC); Zakin, Baneh, (loc.08), 23.05.2011, 1♀, (TMUC); South Zakin, (loc.01), 06.06.2011, 1♀ (TMUC), Rudan, Faryab, (loc.07), 27.05.2011, 1♀, 1♂ (CSE).

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**Distribution in Iran:** Hormozgan (current study).

**General distribution:** Israel (Schmid- Egger & AL-Jadhami, 2022), Iran (**new record**).

**Diagnosis: Female.** Body black; body length 8-9.4 mm (Fig. 4a); posterior ocelli closer to each other than to anterior ocellus; frons, face and clypeus densely covered with silvery pubescence, concealing integument; clypeus slightly arcuate, apical margin of clypeal lamella and mandible red, mandible apex black (Fig. 4b); scape ventrally yellowish, flagellum black; gena with erect whitish pilosity; mesopleuron and lateral sides of propodeum, covered with dense silvery pubescence (Fig. 4c); scutum, scutellum, metanotum and dorsal surface of propodeum with dense silvery pubescence; dorsal propodeal surface with developed median keel, pilosity directed laterally (Fig. 4d); tegula and precostal plate yellow with black spot at base; fore and hind wings hyaline, venation dark brown (Fig. 4e); legs red except coxae black, femur slightly black in dorsal surface; fore tarsus with 3 spines, apical spine longer than second tarsal segment (Fig. 4e).

***Miscophus Kharazii* Schmid-Egger & Ghaderipour, 2025**

**Material examined:** 4♀♀; FARS province: Jahrum, Goldamcheh, (loc.31), 30.05.2012, 2♀ (TMUC); 02.07.2012, 2♀ (TMUC).

**Distribution in Iran:** Tehran (Schmid-Egger et al. 2025), Fars (current study).

**General distribution:** Iran.

***Miscophus mimeticus* Honore, 1944**

**Material examined:** 5♀♀; QAZVIN province: Kuhin, (loc.18), 31.05.2011, 1♀ (TMUC); 05.07.2017, 1♀ (TMUC); km 7 of Zereshk Road, (loc.20), 27.09.2011, 1♀ (TMUC); HORMOZGAN province, Bandar Abbas, Geno, Geno, (loc.03), 12.05.2011, 1♀ (TMUC); KHUZESTAN province: Abadan, Naghshe Hyr, (loc.23), 05.05.2017, 1♀ (CSE).

**Distribution in Iran:** Fars (Atbaei et al., 2015; Sadeghi et al., 2019); Qazvin, Hormozgan, Khuzestan (current study).

**General distribution:** Egypt (Roche, 2007), Iran (Sadeghi et al., 2019), Kazakhstan (Kazenas, 2001), United Arab Emirates (Schmid-Egger, 2011), Oman, Yemen (Schmid-Egger & Al-Jadhami, 2022).

***Miscophus niger* Dahlbom, 1844**

**Material examined:** 34♀♀, 6♂♂; ALBORZ province: Asara, Sarzariat, (loc.12), 14.07.2010, 1♀ (TMUC), 14.11.2010, 1♀ (TMUC); Asara, Arangeh, (loc. 13), 14.09.2010, 1♀ (TMUC); 21.09.2010, 1♀ (CSE); Karaj (loc.22), 25.05.2010, 1♀ (TMUC); Asara, Shahrestanak, (loc.15), 06.07.2010, 1♀ (CSE), Asara, Shahrestanak, (loc.16), 07.09.2010, 1♀(TMUC); Qazvin province: km 7 of Zereshk Road, (loc.20), 26.06.2011, 2♀♀ (TMUC), 1♀ (CSE); 29.08.2011, 1♀ (TMUC); 05.07.2011, 1♀; 29.08.2011, 1♀ (TMUC); Zereshk Road, (loc.19), 03.08.2010, 2♀♀; 31.05.2011, 1♀ (TMUC); Lowshan, (loc.14), 05.07.2011, 1♀ (CSE), 05.08.2011, 1♀ (TMUC); GUILAN province: Rudsar, Rahim Abad, Orkom, (loc.33) , 11.10.2010, 1♀ (TMUC); Rudsar, Rahim Abad, Ghazi Chak (loc.34), 05.09.2010, 1♀ (TMUC), KHUZESTAN province: Lali, Taraz, (loc.28), 22.05.2017, 1♀ (TMUC); 05.05.2017, 1♂ (TMUC). Andika, Chezi Yeola, (loc. 30), 06.07.2017, 1♀ (TMUC); 21.03.2017, 1♀ (TMUC);, 05.05.2017, 1♀ (TMUC); Andika, Dorab, (loc.27), 23.07.2017, 1♂ (TMUC), 23.07.2017, 2♀♀ (TMUC); Behbahan, Dodangeh,

(loc.26), 1♀ (TMUC), 06.07.2017, 1♀ (TMUC); HORMOZGAN province: Bandar Abbas, South Zakin, (loc.01), 24.05.2012 1♀ (TMUC); 13.06.2011, 1♀ (TMUC), 03.08.2012, 1♂ (TMUC); Bandar Abbas, North Zakin, (loc. 02), 25.05.2011, 1♀ (TMUC); Bandar Abbas, Geno, near Environmental Checkpoint, (loc.10), 04.04.2012, 2♂♂; 11.07.2012, 1♀ (TMUC); Bandar Abbas, Bangelayan, (loc.09), 13.11.2012, 1♀ (TMUC); Bandar Abbas, Zakin, Baneh, (loc.08), 02.05.2011, 1♂(TMUC); 23.05.2011, 1♀(TMUC).

**Distribution in Iran:** Alborz, Qazvin, Khuzestan, Hormozgan, Guilan (current study).

**General distribution:** Palaearctic region (Pulawski, 2024), Iran (**new record**).

**Diagnosis. Female.** Body black; body length 4.5 - 6 mm (Fig. 5a); frons somewhat convex; upper part of face with fine and coarse punctures, lower part (above antennal sockets) with dense silvery pubescence; upper part of clypeus with pubescence, lower part with fine and dense punctuation; clypeal lamella straight; basal part of mandibles black, middle part red. (Fig. 5b); scutum shiny, with deep and well-defined punctures, interpunctural spaces less than one puncture diameter (Fig. 5c); mesopleuron shiny, with dense and well-defined punctuation, interpunctural spaces less than one puncture diameter (Fig. 5d); dorsal surface of propodeum with diagonal-longitudinal striae in upper half and irregular transverse striation in lower half (Fig. 5e); metasomal tergites black, with fine and dense separated punctuation; wings hyaline, venation dark brown, apex of forewing slightly darkened (Fig. 5f); legs black except tarsi dark brown; gaster black.

**Male:** Body length 3.1-4.5 mm. Coloration and sculpture similar to female. Clypeal lamella forming a flat triangular projection.

### Key to the species of the genus *Miscophus* Jurine, 1807 known from Iran

The following identification key basically follows Schmid-Egger & Straka, 2019 and Schmid-Egger & Al-Jahdhami, 2022 with the inclusion of six recently described species (Schmid-Egger et al., 2025) and five new records presented in this article.

#### Females

- 1- Anterior margin of clypeus continuous, without indentation (Fig. 6a) ..... *M. mimeticus* Honore, 194
- Anterior margin of clypeus divided into three parts (Fig. 7e) ..... 2
- 2- Dorsal surface of propodeum smooth and markedly shiny, at most with some weak transverse striae near median carina; frons shiny, with sparse punctuation; angle between propodeal dorsum and declivity about 125° (obtuse) in lateral view (obtuse angle)..... 3
  - Dorsal surface of propodeum dull (microsculpture) or shiny with striation or honey-comb like sculpture, in some species with pilosity; mesonotum and frons in most species microsculptured or densely punctate (interspaces at most less than two puncture diameter); angle between propodeal dorsum and declivity about 90-100° (right angle) in lateral view. .... 4
  - 3- Body black; face smooth and shiny black (Fig. 6b) .....
    - ..... *M. liebigi* Schmid-Egger and Ghaderipour, 2025
    - Body yellow; face smooth and shiny yellow with black spot (Fig. 6c). ....
      - .....*M. flavus* Schmid-Egger and Ghaderipour, 2025

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- 4- Gena with erect white pilosity ..... 5  
 - Gena without erect white pilosity or with short appressed pilosity ..... 9
- 5- Spines of fore basitarsus long, thick, strongly spatulate apically (Fig. 2f). [Tegula and/or precostal plate with black spot. Wing venation dark, forewing apex darkly infumate] ..... *M. ctenopus* Kohl, 1884  
 - Spines of fore basitarsus thin, not spatulate ..... 6
- 6- Frons with a fine and deep longitudinal impressed line, extending to anterior ocellus, divided face medially [Propodeum shiny with a fine transverse striation in the middle; metasomal tergites covered with some short, dense silver pubescence; gaster red; apical spine of fore basitarsus reaching almost midlength of third tarsomere; ventral surface of metasomal sternite 1-3 yellow] ..... *M. pretiosus* Kohl 1884  
 - Frons flat, without deep longitudinal furrow, covered with dense silvery pubescence.... 7
- 7- Fore basitarsus with 3 spines. .... 8  
 - Fore basitarsus with 4 spines (Fig. 6d). [tegula, precostal plate and femora black] ..... *M. pseudopapyrus* Schmid-Egger & Ghaderipour, 2024
- 8- Femora mostly light red with yellow markings, or entirely yellow; tegula light yellow; lower half of clypeus yellow. [Tibiae with yellow stripe above, forefemur often with yellow parts]. ..... *M. flavopictus* Pulwaski, 1964  
 - Hind femur red, fore and midfemora partly or all black (Fig. 4f). Tegula red with black center; clypeus black except anterior margin ..... *M. irwini* Schmid-Egger, 2022
- 9- Propodeal surface and sides grain-like microsculptured or punctured, dull without shiny interspaces and with few or no ridges; scape yellow below..... 10  
 - Propodeal surface and sides striate or honey-comb like sculptured, with shiny interspace. scape usually black..... 12
- 10- Flagellomere I short, 1-1.5× as long as pedicel (Fig. 1c); body length less than 4.0 mm..... *M. aenigma* Honore 1944  
 - Flagellomere I long, 2 × as long as pedicel (Fig. 6e); body length more than 4.0 mm..... 11
- 11- Fore and midfemora with yellow spots (Fig. 8a); propodeal dorsum 1.5× as wide as long, with medial keel, laterally with indistinct diagonal striae, lateral parts punctured (Fig. 8b). ..... *M. binaloudensis* Schmid-Egger, 2025  
 - Femora black. Propodeal dorsum 1.1× as long as wide, with median keel, laterally with indistinct diagonal striation, with dense directed anteriorly erect pilosity, (Fig. 6f). [Forebasitarsus with a dense lateral row of white setae and six black spines, spines 0.3 as long as tarsal diameter, apical spine slightly longer] ..... *M. kharazii* Schmid-Egger and Ghaderipour, 2025
- 12- Gaster basally red (Fig. 7b). [mesopleuron with dense, well-defined punctuation, interpunctural spaces less than a puncture diameter] ..... *M. bicolor* Jurine, 1807  
 - Gaster entirely black ..... 13

- 13- Foretibia light red or dark red. .... 14  
 - Fore tibia black. .... 15
- 14- Femora black; foretibia dark red, at least ventrally; propodeal dorsum with irregular diagonal striation (Fig. 7h)..... *M. albufeirae* de Andrade, 1952  
 - Femora red; foretibia dark red; propodeal dorsum with a distinct longitudinal keel and faint lateral diagonal striae (Fig. 7c). [Frons with cupreous shimmer, mesopleuron nearly impunctate and shiny]. .... *M. hormozganensis* Schmid-Egger & Ghaderipour, 2025
- 15- Median lobe of clypeal apical margin subdivided (Fig. 2b).....  
 ..... *Miscophus caninus* Andrade, 1953  
 - Median lobe of clypeal apical margin clypeus straight or arcuate (Fig. 7e)..... 16
- 16- Mandible black on basal half (Fig. 5b). [Scutum with separated punctures, interspaces visible; dorsal of propodeum with diagonal-longitudinal striae throughout, sometimes irregular]. .... *M. niger* Dahlbomm, 1844  
 - Mandible entirely light red (Fig. 7e) ..... 17
- 17- Frons with cupreous shimmer; propodeal dorsum with irregular diagonal striation (Fig. 7d). [In forewing, distance between the 2nd submarginal cell to apex of the wing equal or shorter than width of the wing]. .... *M. ater* Lepeletier de Saint Fargeau, 1845  
 - Frons shiny; propodeal dorsum smooth, shiny, with medial longitudinal carina, basal third with oblique sharp carinae, distal two-third with fine, dense transverse striation (Fig. 7f) ..... *M. gratiosus* de Andrade, 1960



Figure 1. *Miscophus aenigma*. Female; a) Habitus, lateral view; b) Head, frontal view; c) Antenna, frontal view; d) Mesopleuron, lateral view; e) Propodeum, dorsal view; f) Fore and hind wings.

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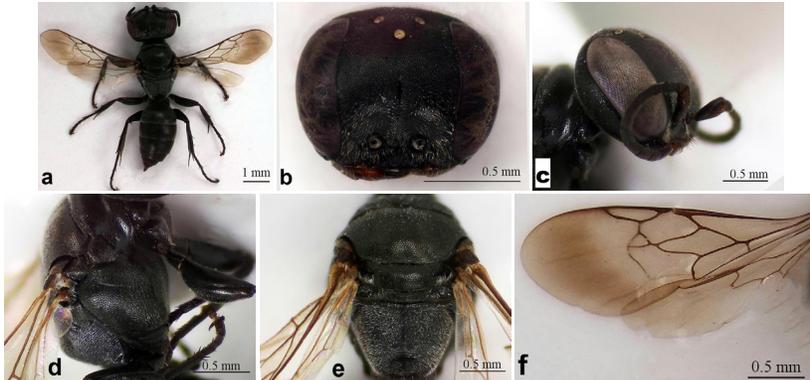


Figure 2. *Miscophus caninu*. Female; a) Habitus, dorsal view; b) Head, frontal view; c) Gena, lateral view; d) Mesopleuron, lateral view; e) Propodeum, dorsal view; f) Fore and hind wings.

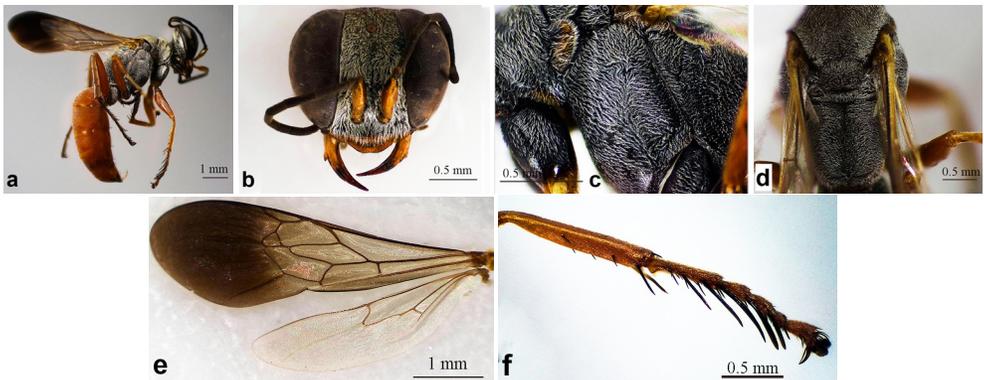


Figure 3. *Miscophus ctenopus*. Female; a) Habitus, lateral view; b) Head, frontal view; c) Mesopleuron, lateral view; d) Propodeum, dorsal view; e) Fore and hind wings; f) Fore tibia and tarsi.

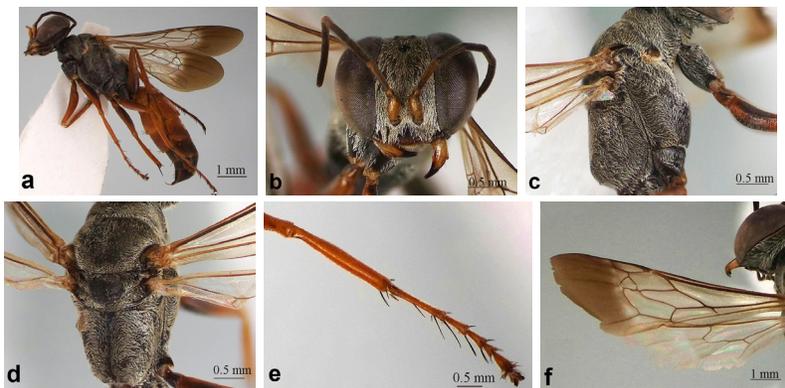


Figure 4. *Miscophus irwini*. Female; a) Habitus, lateral view, b) Head, frontal view; c) Mesopleuron, lateral view; d) Mesosoma dorsal view; e) Forebasitarsus, lateral view, f) Fore and hind wings.

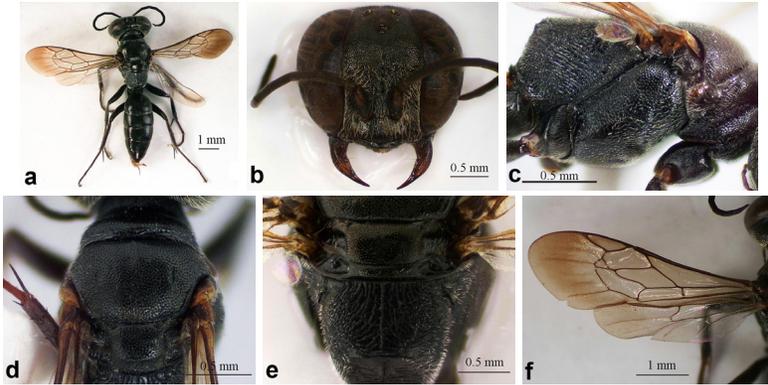


Figure 5. *Miscophus niger*. Female; a) Habitus, dorsal view; b) Head, frontal view; c) Mesopleuron, lateral view; d) Scutum, dorsal view; e) Propodeum, dorsal view; f) Fore and hind wings.

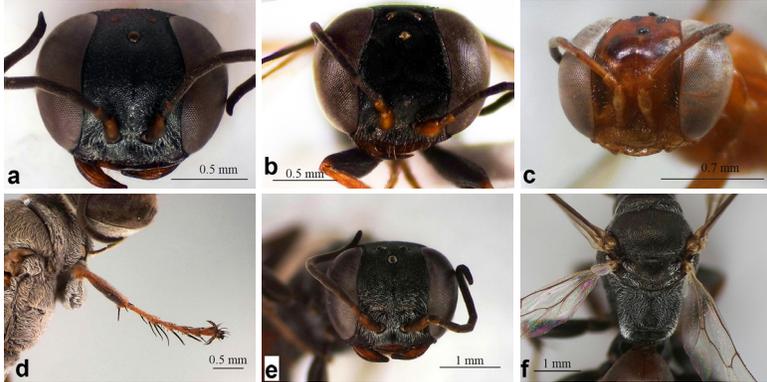


Figure 6. Female morphological characters; a) *Miscophus mimeticus*, face; b) *M. liebigi*, face; c) *M. flavus*, face; d) *M. pseudopapyrus*, fore basitarsus; e) *M. kharazii*, face; f) *M. kharazii*, propodeum dorsal.

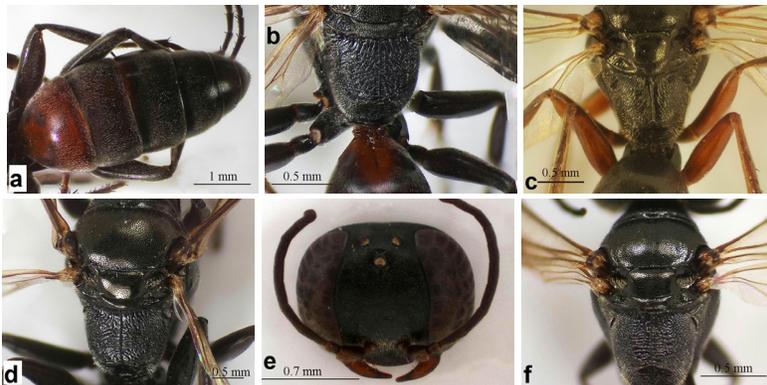


Figure 7. Female morphological characters; a) *Miscophus bicolor*, metasoma; b) *M. albuferiae*, propodeum in dorsal view; c) *M. hormozganensis*, propodeum in dorsal view; d-e) *M. ater*, propodeum in dorsal view and face; f) *M. gratiosus*, propodeum in dorsal view.

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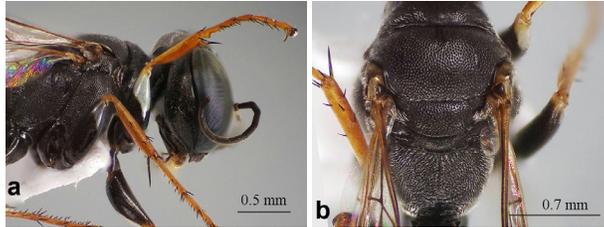


Figure 8. Female morphological characters; a) *Miscophus binaloudensis*, fore and midfemora; b) *M. binaloudensis*, dorsal propodeum.

## DISCUSSION

The present study represents the first taxonomic work of the genus *Miscophus* Jurine, 1807 (Hymenoptera, Crabronidae) in Iran. Prior to this study, several faunistic surveys on Iranian Crabronidae have been conducted in northern, central and southern regions of the country) (Jahantigh et al., 2017; Sadeghi et al., 2019; Rezaei et al., 2020; Schmid-Egger, 2022; Schmid-Egger et al., 2025) reporting a total of 13 species of the genus *Miscophus* from five provinces of Iran: Alborz (one species) (Ebrahimi, 2014), Tehran (three species) (Ebrahimi, 2005, 2014; de Andrade 1960), Fars (seven species) (Atbaei et al, 2015; Rezaei & Fallahzadeh, 2015; Sadeghi et al., 2019; Rezaei et al., 2020), Kerman (one species) (Schmid-Egger, 2022), and Mazandaran (two species) (de Beaumont, 1957). Our research significantly expands this knowledge by documenting seven species from Alborz, 11 species from Hormozgan, seven species from Qazvin, six species from Khuzestan, and one species from Guilan provinces (Fig. 8). Hormozgan province exhibited the highest species diversity (11 species), may attributed to its diverse topography and favorable climatic conditions for these wasps, which contribute to species richness and abundance.

Considering the five new records in this research and previous literature from Iran (Jahantigh et al., 2017; Sadeghi et al, 2019; Rezaei et al, 2020; Schmid-Egger et al., 2025), the total species number of Iranian *Miscophus* and Crabronidae has now increased to 18 and 385 species, respectively. In the adjacent countries of Iran, 17 species of *Miscophus* have been reported in Turkey (Yıldırım, Ljubomirov, & Lelej, 2014; Pulawski, 2024), 14 species in Russia (Belokobylskij & Lelej, 2017), 25 species in Kazakhstan and Central Asia

(Kazenas, 2001), 11 species from United Arab Emirates (Schmid-Egger, 2011, 2014), 16 species from Oman (Guichard, 1980; Schmid-Egger & Al-Jahdhami, 2022), and 6 species from Saudi Arabia (Gadallah et al., 2013; Gadallah, El-Ghiet & Edmardash, 2021). Among all the identified species, *M. niger* with 40 specimens (31.11 %), and *M. ater* with 19 specimens (15.48%) were the most abundant species in the surveyed areas. *Miscophus niger* exhibits a wide distribution in the Palaearctic region (Central, Northern, and Eastern Europe) (Pulawski, 2024). Accordingly, this species has been recorded in five provinces of Iran (Alborz, Hormozgan, Khuzestan, Qazvin, Guilan) in the current study. However, *M. pretiosus* has been previously reported from Mazandaran and Fars provinces (de Beaumont 1957; Rezaei & Fallahzadeh, 2015) but was not collected during this study.

*Miscophus pretiosus* and *M. albufeirae* are predominantly distributed in the Palaearctic region, while *M. ctenopus* is mainly reported in the Algeria, Morocco, Tunisia, Egypt, Israel, Jordan, Oman, Saudi Arabia, United Arab Emirates, and Yemen (Pulawski, 2024). The latter species was also collected in southern Iran (de Andrade, 1960). *Miscophus aenigma* has been reported from Egypt and United Arab Emirates (de Andrade, 1960; Schmid-Egger 2011, 2014; Gadallah, 2020). In this research, this species is reported for the first time from Hormozgan province in southern Iran.

Sixteen Malaise traps were deployed in across various habitats and altitudes in the northern Iranian provinces of Guilan (8 traps) and Mazandaran (8 traps). Despite the diverse vegetation, favorable climatic conditions (including frequent rainfall), the environmental factors appear suboptimal for proliferation of *Miscophus* species. Only a single female of *M. niger* was collected in Guilan province, and no specimens were found in Mazandaran. Accordingly, de Beaumont (1957) reported only two species of *Miscophus* from Mazandaran province.

Given that the sampling sites covered only a limited fraction of Iran's ecosystems, it is anticipated numerous *Miscophus* species remain undiscovered and will be identified through expanded surveys. Furthermore, the biology and ecological preferences of the recorded species remain largely unknown, highlighting the need for further research on their distribution, habitat requirements, and life history.

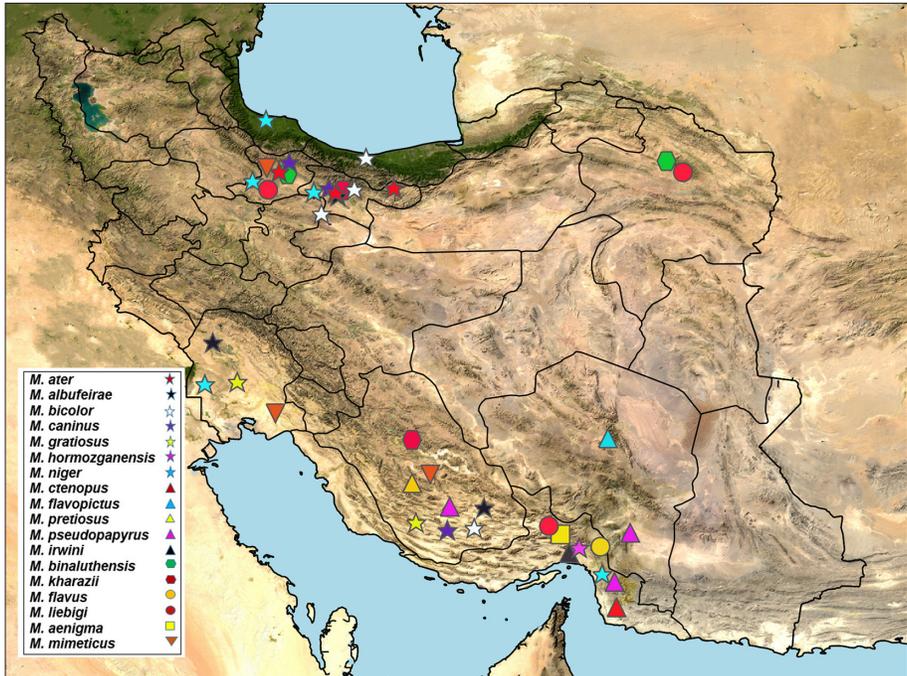


Figure 9. Distribution of *Miscophus* species (Hymenoptera: Crabronidae) in Iran.

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