



Additions to the fauna of Braconidae (Hym., Ichneumonoidea) of Iran based on the specimens housed in Hayk Mirzayans Insect Museum with six new records for Iran

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ABSTRACT. This study was based on examination of specimens of the family Braconidae (Hymenoptera: Ichneumonoidea) deposited in Hayk Mirzayans Insect Museum. Totally thirteen species from eleven genera and seven subfamilies, including Braconinae (One genus – One species), Cardiochilinae (1-1), Doryctinae (1-4), Macrocerinae (1-2), Opiinae (2-2), Rhyssalinae (1-1), Rogadinae (1-2) were identified, of which six species including *Biosteres spinaciaeformis* Fischer, 1971, *Heterospilus rubicola* Fischer, 1968, *Utetes fulvicollis* (Thomson, 1895), *Aleiodes arcticus* (Thomson, 1892), *Macrocentrus turkestanicus* (Telenga, 1950) and *Rhyssalus longicaudis* (Tobias & Belokobylskij, 1981) are new records for the Iranian braconid fauna.

Key words: Taxonomy, Parasitoid wasps, first record

Received:

02 December, 2019

Accepted:

12 July, 2020

Published:

28 July, 2020

Subject Editor:

Ehsan Rakhshani

Citation: Ameri, A., Ebrahimi, E. & Talebi, A.A. (2020) Additions to the fauna of Braconidae (Hym.: Ichneumonoidea) of Iran based on the specimens housed in Hayk Mirzayans Insect Museum with six new records for Iran. *Journal of Insect Biodiversity and Systematics*, 6 (4), 353–364.

Introduction

Braconidae after Ichneumonidae is the second largest family of Hymenoptera (Aguilar et al., 2013) include more than 21,220 species under 1,100 genera (Yu et al., 2016). The Braconidae (Hymenoptera: Ichneumonoidea) is a large cosmopolitan family with an important role in biological pest control that have been used extensively in biological control with much success. Most braconid wasps are primary parasitoids on other insects, especially upon the larval stages of Coleoptera, Diptera, and Lepidoptera, but also some hemimetabolous insects like aphids, Heteroptera or Embiidina (Sharkey, 1993; Wharton, 1998). Despite their importance, biology and taxonomy of most Braconidae is still largely unknown (Peris-Felipo, 2013; Yu et al., 2016). Members of this family are small to medium sized and vary in color of the body in a range of black, red, orange and white (Quicke, 2015). Many studies have been carried out on the fauna of braconid wasps in Iran. Indeed, the investigations on the fauna of Iranian Braconidae are growing significantly in the recent years. To date, approximately 850 species of Braconidae have

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been recorded for the fauna of Iran (Ameri et al., 2012, 2014a, 2014b, 2014c, 2015, 2019; Farahani et al., 2012, 2014a, 2014b, 2014c, 2015, 2016; Zargar et al., 2014, 2015, 2019a, 2019b; Gadallah et al., 2015; Iranmanesh et al., 2017; Rahmani et al., 2017; Dolati et al., 2018; Ghafouri Moghaddam et al., 2018; Abdoli et al., 2019a, 2019b). Considering the number of known species from Iran, additional taxonomic and faunistic studies on this family is yet required. In the present study, six new records of Braconidae for Iran, are documented. This part of our on-going study of the family Braconidae in Iran is based on material deposited in Hayk Mirzayans Insect Museum (HMIM), and the material collected by the first author.

Material and methods

The specimens were collected by standard insect nets and Malaise traps since 1985–2019. Apart from the examination of the specimens deposited in HMIM, additional specimens were also included in this study. The new series of specimens were collected using insect nets and the Malaise traps from various habitates in Khuzestan, Markazi, Zanjan, Kerman, Fars and Ardebil provinces (Figs 1, 2). The identifications were mainly carried out using reliable keys provided by Papp (1984), Tobias (1986), van Achterberg (1993), van Achterberg & Shaw (2016), Fortier & Shaw (1999), Shaw et al. (2006) and Farahani et al. (2015), and some species compared with the identified species in the Tarbiat Modares University Collection (TMUC) and HMIM. All examined materials are deposited in HMIM (The Insect Taxonomy Research Department of the Iranian Research Institute of Plant Protection, Tehran).

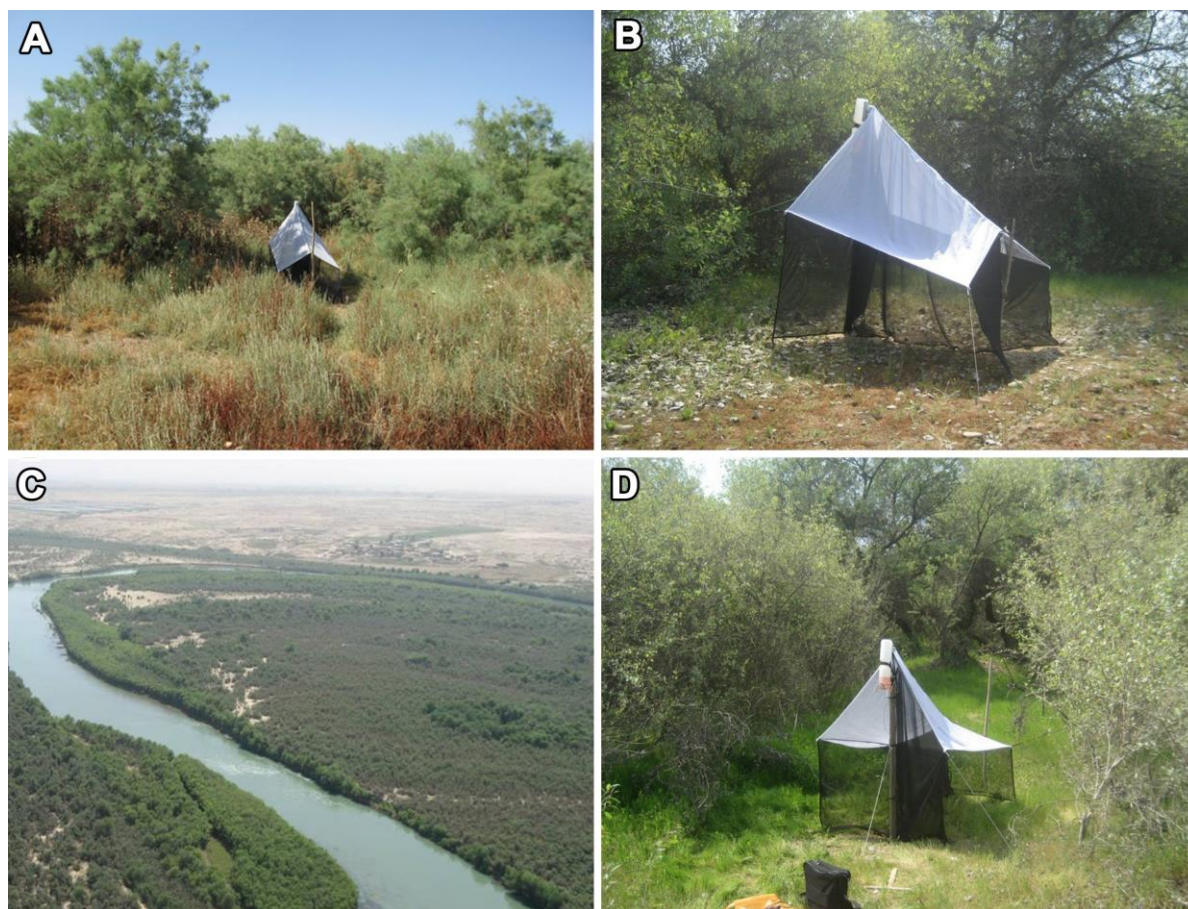


Figure 1. Sampling area in Khuzestan province of Iran, where the braconid wasps were collected.



Figure 2. Map of Iran with collection localities of the studied specimens. **1.** *Pseudovipio tataricus* (Kokujev, 1898); **2.** *Cardiochiles pseudofallax* Telenga, 1955; **3.** *Heterospilus rubicola* Fischer, 1968; **4.** *Polystenus rugosus* Forster, 1862; **5.** *Rhaconotus aciculatus* Ruthe, 1854; **6.** *Spathius polonicus* Niezabitowski, 1910; **7.** *Macrocentrus collaris* (Spinola, 1808); **8.** *Macrocentrus turkestanicus* (Telenga, 1950); **9.** *Biosteres spinaciaeformis* Fischer, 1971; **10.** *Utetes fulvicollis* (Thomson, 1895); **11.** *Rhyssalus longicaudis* (Tobias & Belokobylskij, 1981); **12.** *Aleiodes seriatus* (Herrich-Schaffer, 1838); **13.** *Aleiodes arcticus* (Thomson, 1892).

Results

Thirteen species of Braconidae within eleven genera and seven subfamilies, were collected and identified. The list of species is given below alphabetically, with distribution, synonyms and host records data. The new records for Iran are marked with an asterisk.

Subfamily Braconinae Nees, 1811

Pseudovipio tataricus (Kokujev, 1898)

Synonyms: *Pseudovipio pusillus* (Shestakov, 1932).

Material examined: Iran, Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary, (32°04'36.5" N, 48°14'15.6" E, 45m a.s.l.), 10.V.–10.VII.2015, Malaise trap, 2♀♀, Leg.: E. Gilasian.

Distribution in Iran: No specific locality cited (Telenga, 1936; Shenefelt, 1978), Khuzestan province (current study).

General distribution: Central Asia (Yu et al., 2016).

Subfamily Cardiochilinae Ashmead, 1900

Cardiochiles pseudofallax Telenga, 1955

Material examined: Iran, Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary, (32°04'40.1" N, 48°14'12.6" E, 53m a.s.l.), 10.V.–10.VII.2015, Malaise trap, 2♀♀; Leg.: E. Gilasian; East Azarbaijan province, Kalybar Vayeghan, (38°7'37" N, 45°42'26" E, 1440m a.s.l.), 5.VIII.1992, Sweeping net, 2♀♀, Leg.: M. Parchami, F. Badii.

Distribution in Iran: Khuzestan (Ameri et al., 2019) and East Azarbaijan (current study) provinces.

General distribution: Afghanistan, Azerbaijan, Iran, Turkey, Turkmenistan (Yu et al., 2016).

Subfamily Doryctinae Foerster, 1863

Heterospilus rubicola Fischer, 1968*

Synonyms: *Heterospilus tobiasi* Belokobylskij, 1983

Material examined: Iran, Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary (32°04'36.5" N, 48°12'02.6" E, 53m a.s.l.), 10.V.–10.VII.2015, Malaise trap, 2♀♀, Leg.: E. Parchami.

Distribution in Iran: Khuzestan province (current study).

General distribution: Bulgaria, Georgia, Germany, Hungary, Iran (New record), Kazakhstan, Korea, Moldova, Russia, Turkey, Uzbekistan, Serbia (Yu et al., 2016).

Polystenus rugosus Foerster, 1863

Synonyms: *Polystenus aciculatus* (Reinhard, 1865); *Polystenus hungaricus* (Szépligeti, 1900)

Material examined: Iran, Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary, (32°08'06.5" N, 48°14'15.6" E, 45m a.s.l.), 11.III.–10.V.2015, Malaise trap, 1♀, Leg.: E. Gilasian.

Distribution in Iran: Not exactly defined (Samin et al., 2016), Khuzestan province (current study).

General distribution: China, former Czechoslovakia, Germany, Hungary, Iran, Japan, Kazakhstan, Poland, Russia, Tajikistan, Turkey, Ukraine (Yu et al., 2016).

Host: Solitary ectoparasitoid of Coleoptera: Buprestidae: *Agrilus* spp., *Anthaxia manca* (Linnaeus, 1767), *Coraebus bifasciatus* (Olivier, 1790); Bostrichidae: *Sinoxylon sexdentatum* (Olivier, 1790) (Yu et al., 2016).

***Rhaconotus aciculatus* Ruthe, 1854**

Synonyms: *Rhaconotus cerdai* Docavo Alberti, 1960; *Rhaconotus major* Tobias, 1964

Material examined: Iran, Markazi province, Arak, Haftad-Gholleh, Sibak valley, (34°08'06.5" N, 50°10'0.1" E, 2090m a.s.l.), Malaise trap, 10.VI.-15.VII.2018, 5♀♀, Leg.: M. Parchami; Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary, (32°08'06.5" N, 48°14'15.6" E 45m a.s.l.), 11.III.-19.V.2015, Malaise trap, 2♀♀, Leg.: E. Gilasian.

Distribution in Iran: Hormozgan (Ameri et al., 2014c), Alborz, Guilan, Mazandaran, Tehran (Farahani et al., 2014b), Markazi and Khuzestan (current study) provinces.

General distribution: Azerbaijan, China, Czech Republic, France, Germany, Hungary, Iran, Italy, Kazakhstan, Korea, Kyrgyzstan, Moldova, Mongolia, Russia, Slovakia, Spain, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, Uzbekistan, Serbia (Yu et al., 2016).

Host: Solitary ectoparasitoid of Coleoptera: Buprestidae: *Agrilus viridis* (Linnaeus, 1758), *Anthaxia lgoeckii* Obenberger, 1917; Chrysomelidae, Bruchinae: *Caryedon serratus* (Olivier, 1790) (Yu et al., 2016).

***Spathius polonicus* Niezabitowski, 1910**

Synonyms: *Spathius melanophilae* Fischer, 1966; *Spathius radjabii* Fischer, 1970

Material examined: Iran, Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary (32°04'36.5" N, 48°14'15.6" E, 45m a.s.l.), 11.III.-10.V.2015, Malaise trap, 5♀♀, Leg.: E. Gilasian.

Distribution in Iran: Alborz (Fischer, 1970; Farahani et al. 2014b) and Khuzestan (current study) provinces.

General distribution: Palaearctic (Yu et al., 2016).

Host: Coleoptera: Buprestidae: *Agrilus constantini* Obenberger, 1927, *Agrilus lineola* Kiesenwetter, 1857, *Agrilus planipennis* Fairmaire, 1888, *Agrilus planipennis* Fairmaire, 1888, *Agrilus viridis* (Linnaeus, 1758), *Lamprodila mirifica* (Mulsant, 1855); Buprestidae: *Sphenoptera davatchii* Descarpentries, 1960, *Sphenoptera kaznakovi* Jakovlev, 1899 (Yu et al., 2016).

Subfamily Macrocentrinae Foerster, 1863***Macrocentrus collaris* (Spinola, 1808)**

Synonyms: *Macrocentrus affiniqades* Shenefelt, 1969; *Macrocentrus affinis* Hedwig, 1961; *Macrocentrus dispar* (Kollar, 1852); *Macrocentrus dubius* (Wesmael, 1835); *Macrocentrus ebeninus* (Nees, 1834); *Macrocentrus kollari* (Rondani, 1876); *Macrocentrus picipes* (Haliday, 1835).

Material examined: Iran, Kerman province, Kahnuj (28°0'40.38" N, 57°45'54.92" E, 900m a.s.l.) 10.ix.1985, Sweeping net, 1♀, Leg.: H. Barari, A. Sarafrazi, F. Badii; Ardebil province, Sarab, Sari Qayeh (37°23'27" N, 46°46'35" E, 1661m a.s.l.), 3-7.VII.2019, Sweeping net, 3♀♀, Leg.: A. Ameri; Zanjan province, Nasir Abad (36°16'27" N, 49°7'20" E, 1707m a.s.l.), 24.VI.2019, 2♀♀, Sweeping net, Leg.: A. Ameri.

Distribution in Iran: Alborz (Farahani et al., 2012), Kerman, Ardabil and Zanjan (current study) provinces.

General distribution: Afrotropical, Palearctic, Oriental, Neotropical, Oceanic (Yu et al., 2016).

Host: Lepidoptera : Noctuidae: *Acrionicta tridens* ([Denis & Schiffermüller], 1775), *Agrotis clavis* (Hufnagel, 1766), *Agrotis exclamationis* (Linnaeus, 1758), *Agrotis ipsilon* (Hufnagel, 1766), *Agrotis segetum* ([Denis & Schiffermüller], 1775), *Apamea sordens* (Hufnagel, 1766), *Chalciope mygdon* (Cramer, 1777), *Chersotis rectangula* (Denis & Schiffermüller, 1775), *Diloba caeruleocephala* (Linnaeus, 1758), *Euxoa cursoria* (Hufnagel, 1766), *Helicoverpa armigera* (Hübner, [1808]), *Heliothis virescens* (Hufnagel, 1766), *Lymantria monacha* (Linnaeus, 1758), *Mamestra brassicae* (Linnaeus, 1758), *Noctua pronuba* (Linnaeus, 1758), *Notocelia roborana* ([Denis & Schiffermüller], 1775), *Polymixis xanthomista* (Hübner, [1819]), *Polymixis xanthomista* (Hübner, [1819]), *Spodoptera littoralis* Boisduval, 1833, *Spodoptera litura* (Fabricius, 1775); Geometridae: *Lycia hirtaria* (Clerck, 1759); Nymphalidae: *Polygonia c-album* (Linnaeus, 1758), Tortricidae: *Eupoecilia ambiguella* (Hübner, 1796), *Tortrix viridana* Linnaeus, 1758; Yponomeutidae: *Yponomeuta malinella* Zeller, 1838; Coleoptera: Anobiidae: *Anobium punctatum* (Geer, 1774) (Yu et al., 2016).

Macrocentrus turkestanicus* (Telenga, 1950)

Material examined: Iran, Fars province, Kazerun, Cheshmenari (29°55'44" N, 52°55'43" E, 900m a.s.l.), 6.IV.1985, Sweeping net, 1♀, Leg.: H. Barari, A. Sarafrazi, F. Badii.

Distribution in Iran: Fars province (current study).

General distribution: India, Iran (**New record**), Tajikistan, Turkmenistan, Uzbekistan (Yu et al., 2016).

Host: Lepidoptera: Noctuidae: *Sesamia cretica* Lederer 1857, *Sesamia inferens* (Walker, 1856) (Yu et al., 2016).

Subfamily Opiinae Blanchard, 1845

Biosteres spinaciaeformis* Fischer, 1971

Material examined: Iran, Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary, (32°04'36.5" N, 48°14'15.6" E, 45m a.s.l.), 11.III.-10.IV.2015, Malaise trap, 1♂, Leg.: E. Gilasian.

Distribution in Iran: Khuzestan province (current study)

General distribution: Belgium, Canada, Denmark, Finland, Germany, Iran (**New record**), Lithuania, Netherlands, Poland, Russia, Spain, Sweden, USA, United Kingdom, Uzbekistan (Yu et al., 2016).

Utetes fulvicollis* (Thomson, 1895)

Synonyms: *Opius* (*Utetes*) *cupidus* Gahan, 1919.

Material examined: Iran, Khuzestan province, Shoush, Karkheh National Park, Persian Fallow Deer Sanctuary (32°04'36.5" N, 48°1'15.6" E, 45m a.s.l.), 11.iii.-10.V.2015, Malaise trap, 1♂, Leg.: E. Gilasian.

Distribution in Iran: Khuzestan province (current study).

General distribution: Palearctic, Iran (**New record**), Nearctic (Yu et al., 2016).

Host: Diptera: Anthomyiidae: *Pegomya betae* (Curtis, 1847), *Pegomya hyoscyami* (Panzer, 1809) (Yu et al., 2016).

Subfamily Rhyssalinae Förster, 1862

Rhyssalus longicaudis (Tobias & Belokobylskij, 1981)*

Material examined: Iran, Markazi province, Arak, Haftad-Gholleh, Protected area, Chekab valley (34°08'07.2" N, 50°15'56.1" E, 2090m a.s.l.), Malaise trap, 2.VI.2018, 1♀, Leg.: M. Parchami.

Distribution in Iran: Markazi province (current study).

General distribution: Bosnia, Finland, Hungary, Iran (**New record**), Mongolia, Russia (Yu et al., 2016).

Subfamily Rogadinae Forster, 1862

Aleiodes seriatus (Herrich-Schäffer, 1838)

Synonyms: *Rogas seriatus* Herrich-Schäffer, 1838; *Aleiodes vittiger* Wesmael, 1838; *Rogas kuslitzkyi* Tobias, 1976.

Material examined: Iran, Markazi province, Arak, Haftad-Gholleh, Sibak valley, (34°08'06.5" N, 50°10'0.1" E, 2090m a.s.l.), Malaise trap, 10.VI.-15.VII.2018, 1♀, Leg.: M. Parchami.

Distribution in Iran: Mazandaran (Farahani et al., 2015) and Markazi (current study) provinces.

General distribution: Earstern and Western Palaearctic, Oriental (Yu et al., 2016).

Host: Lepidoptera: Erebidae: *Atolmis rubricollis* (Linnaeus, 1758); Noctuidae: *Orthosia gracilis* (Denis & Schiff., 1775) (Yu et al., 2016).

Aleiodes arcticus (Thomson, 1892)*

Synonym: *Rogas arcticus* Thomson, 1892

Material examined: Iran, Markazi province, Arak, Haftad-Gholleh, Protected area, Chekab valley, (34°08'07.2" N, 50°15'56.1" E, 2090m a.s.l.), Malaise trap, 2.VI.2018, 1♀, Leg.: M. Parchami.

Distribution in Iran: Markazi province (current study).

General distribution: Finland, Germany, Iran (**New record**), Mongolia, Poland, Russia, Sweden, Switzerland, Turkey, United Kingdom (Yu et al., 2016).

Host: Lepidoptera: Geometridae: *Itame wauaria* (Linnaeus, 1758) (Yarchakovskaya, 1993), *Pygmaena fusca* (Fortier, 2009) (Yu et al., 2016).

Discussion

The result of this study led to identifying thirteen species belong to eleven genera of seven subfamilies from different parts of Iran. Moreover, this work has enriched the knowledges on the Braconidae in Iran by adding six new species records: *Biosteres spinaciaeformis* Fischer, 1971, *Heterospilus rubicola* Fischer, 1968, *Utetes fulvicollis* (Thomson, 1895) *Aleiodes arcticus* (Thomson, 1892), *Macrocentrus turkestanicus* (Telenga, 1950) and *Rhyssalus longicaudis* (Tobias &

Belokobylskij, 1981). Among the identified species some of them such as *Macrocentrus collaris* (Spinola, 1808), *Aleiodes seriatus* (Herrich-Schaffer, 1838), *Biosteres spinaciaeformis* Fischer, 1971 distributed almost in all zoogeographical regions (Yu et al., 2016). However, some species such as *Pseudovipio tataricus* (Kokujev, 1898), *Rhyssalus longicaudis* (Tobias & Belokobylskij, 1981) have a distribution in Palaearctic region and they are endemic in this region (Yu et al., 2016). Most of the collected species in this research are parasitoids of agricultural pests and can be potential biological control agents, for example *M. collaris* reported to be a gregarious parasitoid of several species of Noctuidae (Shenefelt, 1969). Due to the host range of this species, it is a potential candidate for the biological control of some important pest (i.e., *Spodoptera littoralis* Boisduval, 1833, *Spodoptera litura* (Fabricius, 1775) and *Yponomeuta malinella* Zeller, 1838) in Iran.

Aleiodes arcticus is similar to *A. itamevorus* Shaw & Marsh, 2004 and *A. (Tetrasphaeropyx) maritimus* Shaw & Marsh, 2004 in which mesopleuron lacks a defined precoxal sulcus. It can be distinguished from those species by metasomal tergite IV without strongly impressed regulation (Fortier, 2009). *Macrocentrus turkestanicus* is an interesting potential biological control agent that has strict host-specificity to the genus *Sesamia* (Lepidoptera: Noctuidae), such as *S. cretica* Lederer, 1857, *S. inferens* Walker, 1856 and *S. uniformis* (Dudgeon, 1905). *Sesamia cretica* is an important pest of maize and sugar cane in Iran (Khuzestan province) (Sedighi et al., 2016) and widely distributed in the Palaearctic region (Goftishu et al., 2016). Among the adjacent countries of Iran, *M. turkestanicus* known from Tajikistan, Turkmenistan, Uzbekistan (Yu et al., 2016). Based on the current study, highest number of species has been collected from Khuzestan province (Nine species) followed by Markazi province (four species). In this study, the specimens were collected using Malaise traps and sweeping net, therefore, the biology of the recorded species is unknown.

Acknowledgments

We would like to thank Dr. Ebrahim Gilasian and Dr. Mehrdad Parchami for their help in the collection of some specimens. We cordially thank to three anonymous reviewers for their critical review and constructive comments, which significantly helped the improvement of the paper.

Conflict of Interests

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

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مطالعه تکمیلی فون بال غشاییان خانواده Braconidae (Hym., Ichneumonoidea) موزه هایک میرزایانس و شش گزارش جدید برای ایران

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| تاریخ دریافت: ۱۱ آذر ۱۳۹۸ | تاریخ پذیرش: ۲۲ تیر ۱۳۹۹ | تاریخ انتشار: ۰۷ مرداد ۱۳۹۹ |

چکیده: این تحقیق به منظور شناسایی بال غشاییان خانواده Braconidae (Hym.: Ichneumonidae) موجود در موزه حشرات هایک میرزایانس، انجام گرفت. در مجموع ۱۳ گونه متعلق به ۱۱ جنس و ۷ زیرخانواده شناسایی گردید که شش گونه *Heterospilus rubicola* Fischer, 1971، *Biosteres spinaciaeformis* Fischer, 1968، *Aleiodes arcticus* Thomson, 1895، *Utetes fulvicollis* Thomson, 1892، *Macrocentrus turkestanicus* (Telenga, 1950) و *Rhyssalus longicaudis* (Tobias & Belokobylskij, 1981) برای اولین بار از ایران گزارش می‌شوند.

واژگان کلیدی: رده‌بندی، زنبورهای پارازیتوئید، اولین گزارش