A survey of braconid wasps (Hymenoptera: Braconidae: Euphorinae, Homolobinae, Macrocentrinae, Rogadinae) in Kerman province, southeastern Iran

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ABSTRACT. The fauna of the braconid subfamilies Euphorinae, Homolobinae, Macrocentrinae and Rogadinae were studied in Kerman province. Specimens were collected using Malaise traps and sweeping net during 2013–2014. A total of 14 species and eight genera were collected and identified. Among the collected material, *Aleiodes* (*Chelonorhogas*) *ruficornis* (Herrich-Schaffer, 1838) is a new record for the fauna of Iran. All species are new for the fauna of Kerman province.

Key words: Braconidae, fauna, new record, Iran

Introduction

Braconid wasps (Hymenoptera: Braconidae) represent an important group of parasitic Hymenoptera in biodiversity studies. They are worldwide in distribution with about 19,801 described species (Yu et al. 2012), play a major ecological role in the regulation of many other insect groups. They are used in the biological control of agricultural and forest pests (Coronado et al. 2004). The vast majority of the braconids are parasitoids of other insects. The most common hosts of braconid parasitoids are the larvae of Lepidoptera, Coleopteran, and Diptera (Wharton et al. 1997). Euphorinae is one of the most interesting and diversified subfamily of Braconidae including about 55 genera from 16 tribes and about 1,213 species distributed all around the world, of which 456 species are known from the Palearctic region (Yu et al. 2012). This subfamily is one of only two groups of Ichneumonoidea that include species developing entirely on the adult stages of other insects or attacking subadults of hemimetabolous orders (Quicke 2015) and usually characterized by the petiolate or very elongate first metasomal tergite and the reduction of vein CU1b of fore wing (Shaw and Huddleston 1991; van Achterberg 1993a).
The subfamily Homolobinae comprises 62 species in three genera and two tribes. All homolobines are koinobiont endoparasitoids of Lepidopteran larvae, mainly belonging to the Noctuidae and Geometridae, but with records from other families including Erebidae (Lymantriinae) and Lasiocampidae (Quicke 2015). Most species have short ovipositors and attack exposed hosts (Shaw and Huddleston 1991). The subfamily Macrocentrinae includes 236 species and eight genera. Macrocentrines are all koinobiont endoparasitoids of lepidopteran larvae, and most species are gregarious (Beyarslan et al. 2013).

The subfamily Rogadinae is a cosmopolitan subfamily of koinobiont endoparasitoids of Lepidoptera (Shaw 1997). All Rogadinae induce the hardening of the host larva before pupation, producing a “mummy” which conceals the parasitoid pupa (Shaw et al. 1997). More than 1159 Rogadinae species have been described in 58 recognized genera, which most of them are restricted to northern Europe, Asia, and North America (Yu et al. 2012). Recently, several studies have been done on Euphorinae (Hedwig 1957; Aubert 1966; Herard et al. 1979; Arbab and McNeill 2001; Abbasiapur 2001; Nikdel et al. 2004; van Achterberg 1979; Lashkari-Bod et al. 2011; Farahani and Talebi 2012; Farahani et al. 2013a,b; Ameri et al. 2014; Sedighi and Madjdzadeh 2015), Homolobinae (Achterberg 1979; Farahani et al. 2012b), Macrocentrinae (Aubert 1966; van Achterberg 1993b; Farahani et al. 2012a; Hasanshahi et al. 2016) and Rogadinae (Telenga 1941; Hedwig 1957; Shenefelt 1975; Lashkari-Bod et al. 2011; Farahani et al. 2015). The number of Euphorinae, Homolobinae, Macrocentrinae and Rogadinae known from Iran has reached to 53, 3, 7 and 27 species, respectively (Farahani et al. 2016). The objective of this study (being part of our ongoing research on the braconid fauna of Iran) is to improve our knowledge of the family Braconidae in Iran.

Material and methods
The braconid specimens were collected using a standard Sweep net and Malaise traps mostly in alfalfa fields (*Medicago sativa* L.) and *Triticum aestivum* L. at different altitudes located in Kerman province during 2013–2014. Majority of specimens were collected using sweep net and in few cases, the specimens were collected by Malaise traps. Four Malaise traps were used for collecting of samples. The specimens were collected from the traps and sorted weekly. The collected specimens were subsequently dried and mounted on cards using AXA method (van Achterberg 2009). The external morphology of specimens was studied using NIKON™ SMZ800 stereomicroscope. The collected species were identified using the keys and diagnostic literatures: van Achterberg (1979, 1993b), Papp (1991), Stigenberg and Ronquist (2011), Farahani et al. (2013b), van Achterberg and Shaw (2016).

Morphological terminology follows van Achterberg (1993a). Nomenclature and distributional data are mainly used from Yu et al. (2012). The specimens were deposited in the Insect Collection of the Zoological Museum of Shahid Bahonar University of Kerman, Kerman, Iran (ZMSBUK). Abbreviations used in the text: S. n: Sweeping net; M. t: Malaise trap.

Results
A total of 14 species and eight genera belonging to four subfamilies, Euphorinae, Homolobinae, Macrocentrinae and Rogadinae were collected and identified. Among the collected material the species *Aleiodes (Chelonorhogas) ruficornis* is a new record for the fauna of Iran. All species are new for the fauna of Kerman province. The recorded species are listed below:
Subfamily Euphorinae Foerster, 1862

*Dinocampus coccinellae* (Schrank, 1802)

**Material examined:** 1♀, S.n, Bidkhan (29º34’ N 56º30’ E, 2943 m a.s.l.), 01.VIII.2014; 1♀, S.n, Negar (29º53’ N 56º46’ E, 2096 m a.s.l.), 21.VIII.2014; leg.: F. Abdolalizadeh; 1♂, S.n, Dashtkar (29º55’ N 56º37’ E, 2073 m a.s.l.), 21.VIII.2014; leg.: F. Abdolalizadeh; 1♀, S.n, Bidkhan (29º35’ N 56º30’ E, 2884 m a.s.l.), 26.IX.2014; leg.: F. Abdolalizadeh.

*Leiophron deficiens* (Ruthe, 1856)

**Material examined:** 1♂, S.n, Bidkhan (29º41’ N 56º31’ E, 2760 m a.s.l.), 14.VII.2014; leg.: F. Abdolalizadeh.

*Leiophron* (*Peristenus*) *relica* (Ruthe, 1856)

**Material examined:** 7♀, 1♂, S.n, Negar (29º53’ N 56º46’ E, 2101 m a.s.l.), 04.IX.2014; 1♀, 1♂, S.n, Bidkhan (29º34’ N 56º30’ E, 2943 m a.s.l.), 14.VII.2014; leg.: F. Abdolalizadeh.

*Meteoricrubens* (Nees, 1811)

**Material examined:** 1♀, 1♂, S.n, Bidkhan (29º35’ N 56º30’ E, 2852 m a.s.l.), 18.VI.2014; 1♀, 1♂, S.n, Bidkhan (29º34’ N 56º30’ E, 2943 m a.s.l.), 14.VII.2014; leg.: F. Abdolalizadeh.

*Perilitus* (*Perilitus*) *aethiops* Nees, 1834

**Material examined:** 1♂, S.n, Dashtkar (29º50’ N 56º39’ E, 2117 m a.s.l.), 22.VIII.2013; leg.: M. Ranjbar; 2♂, 2♀, S.n, Negar (29º51’ N 56º47’ E, 2097 m a.s.l.), 26.IX.2014; 6♂, 3♀, S.n, Dashtkar (29º53’ N 56º42’ E, 2081 m a.s.l.), 04.IX.2014; 2♂, 3♀, S.n, Dashtkar (29º55’ N 56º38’ E, 2073 m a.s.l.), 30.V.2014; leg.: F. Abdolalizadeh; 1♀, S.n, Bidkhan (29º42’ N 56º33’ E, 2315 m a.s.l.), 12.IX.2014; leg.: F. Abdolalizadeh.

*Wesmaelia petioluta* (Wollaston, 1858)

**Material examined:** 1♂, S.n, Dashtkar (29º55’ N 56º38’ E, 2073 m a.s.l.), 21.VIII.2014, leg.: F. Abdolalizadeh.

Subfamily Homolobinae van Achterberg, 1979

*Homolobus* (*Apatia*) *truncator* (Say, 1829)

**Material examined:** 2♀, S.n, Bidkhan (29º35’ N 56º30’ E, 2751 m a.s.l.), 24.VII.2014; leg.: F. Abdolalizadeh.

Subfamily Macrocentrinae Foerster, 1862

*Macrocentrus* *collaris* (Spinola, 1808)

**Material examined:** 3♀, 2♂, S.n, Bidkhan (29º35’ N 56º30’ E, 2751 m a.s.l.), 14.VII.2014; 1♀, S.n, Bidkhan (29º41’ N 56º31’ E, 2435 m a.s.l.), 12.IX.2014; 1♀, 3♂, S.n, Bidkhan (29º42’ N 56º33’ E, 2917 m a.s.l.), 25.IX.2014; 2♀, 4♂, S.n, Bidkhan (29º34’ N 56º30’ E, 2941 m a.s.l.), 24.X.2014; 2♀, 2♂, S.n, Bidkhan (29º34’ N 56º30’ E, 2935 m a.s.l.), 28.VIII.2014; 3♀, S.n, Bidkhan (29º35’ N 56º30’ E, 2751 m a.s.l.), 14.VII.2014; 1♀, S.n, Bidkhan (29º34’ N 56º30’ E, 2884 m a.s.l.), 15.VIII.2014; 1♀, 1♂, S.n, Dashtkar (29º34’ N 56º39’ E, 2077 m a.s.l.), 04.IX.2014; 1♀, S.n, Negar (29º52’ N 56º47’ E, 2095 m a.s.l.), 26.IX.2014, leg.: F. Abdolalizadeh.

*Macrocentrus* *flavus* Vollenhoven, 1878

**Material examined:** 1♀, S.n, Kuhbanan (31º27’ N 56º15’ E, 2183 m a.s.l.), 02.VII.2014; leg.: S. Kazemi; 1♀, S.n, Bidkhan (29º42’ N 56º33’ E, 2941 m a.s.l.), 24.X.2014, leg.: F. Abdolalizadeh.

Subfamily Rogadinae Foerster, 1862

*Aleiodes* (*Aleiodes*) *bicolor* (Spinola, 1808)

**Material examined:** 2♀, S.n, Sirch (30º12’ N 57º32’ E, 1760 m a.s.l.), 12.IX.2014; leg.: M. Iranmanesh; 1♀, 1♂, S.n, Negar (29º52’ N 56º47’ E, 2093 m a.s.l.), 04.IX.2014; 2♂, S.n, Bidkhan (29º34’ N 56º30’ E, 2941 m a.s.l.), 24.X.2014; 1♀, 1♂, S.n, Bidkhan (29º34’ N 56º30’ E, 2943 m a.s.l.), 01.VIII.2014; 2♀, 1♂, S.n, Bidkhan (29º39’ N 56º31’ E, 2483 m a.s.l.), 01.VIII.2014; 2♀, 2♂, S.n, Bidkhan (29º35’ N 56º30’ E, 2910 m a.s.l.), 28.VIII.2014; 2♀, 2♂, S.n, Bidkhan (29º35’ N 56º37’ E, 2867 m a.s.l.), 26.IX.2014; leg.: F. Abdolalizadeh.
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Aleiodes (Aleiodes) circumscriptus (Nees von Esenbeck, 1834)

Material examined: 2♀, S.n, Bidkhan (29°35' N 56°30' E, 2861 m a.s.l.), 12.IX.2014; 1♀, S.n, Bidkhan (29°39' N 56°31' E, 2483 m a.s.l.), 28.IX.2014; 1♀, S.n, Bidkhan (29°35' N 56°30' E, 2867 m a.s.l.), 01.VIII.2014; 1♂, S.n, Bidkhan (29°34' N 56°30' E, 2939 m a.s.l.), 25.IX.2014; 1♀, S.n, Bidkhan (29°33' N 56°30' E, 2751 m a.s.l.), 14.VII.2014; 1♀, S.n, Bidkhan (29°35' N 56°30' E, 2504 m a.s.l.), 14.VI.2014; 1♀, S.n, Bidkhan (29°34' N 56°30' E, 2943 m a.s.l.), 01.VIII.2014; 1♀, S.n, Bidkhan (29°35' N 56°30' E, 2861 m a.s.l.), 01.VIII.2014; 1♀, S.n, Bidkhan (29°35' N 56°30' E, 2867 m a.s.l.), 15.VIII.2014; 1♀, S.n, Bidkhan (29°35' N 56°30' E, 2751 m a.s.l.), 14.VI.2014; 1♀, S.n, Bidkhan (29°35' N 56°30' E, 2867 m a.s.l.), 14.VII.2014; S.n, Negar (29°53' N 56°46' E, 2096 m a.s.l.), 21.VIII.2014, leg.: F. Abdolalizadeh.

Aleiodes (Aleiodes) nocturnes (Telenga, 1941)

Material examined: 1♀, S.n, Negar (29°53' N 56°46' E, 2095 m a.s.l.), 30.V.2014; 1♀, S.n, Bidkhan (29°35' N 56°30' E, 2504 m a.s.l.), 14.VI.2014; leg.: F. Abdolalizadeh.

Aleiodes (Chelonorhogas) apicalis (Brullé, 1832)

Material examined: 1♀, M.t, Bidkhan (29°36' N 56°30' E, 3058 m a.s.l.), 18.VI.2014; leg.: F. Abdolalizadeh.

*Aleiodes (Chelonorhogas) ruficornis (Herrich-Schaffer, 1838) (Fig. 1A-F)

Material examined: 1♂, M.t, Chatrood (30°36' N 56°55' E, 1874 m a.s.l.), 06.V.2013; 1♂, M.t, Sirch (30°11' N 57°03' E, 2545 m a.s.l.), 19.VI.2013, leg.: Sh. Mohebban; 1♂, 2♀, S.n, Bidkhan (29°35' N 56°30' E, 2861 m a.s.l.), 28.VIII.2014; S.n, Negar (29°53' N 56°46' E, 2094 m a.s.l.), 26.IX.2014, leg.: F. Abdolalizadeh.

Diagnostic characters (female): Body length 6.5–8.2 mm; antenna with 38–42 segments, distinctly shorter than body length; compound eyes medium-sized (Fig. 1A); hypoclypeal depression as wide as its distance from compound eye (Fig. 1B); length of temple 1.1 times compound eye in dorsal view (Fig. 1C); mesopleuron rugose (Fig. 1D); vein 3-SR of fore wing 2.3 times as long as r, length of vein 2-CU1 1.9 times vein 1-CU1 (Fig. 1E); first, second and basal third metasomal tergites with longitudinal striae, second metasomal tergite transverse, 1.5 times wider than its length, with distinct smooth triangular area medio-basally (Fig. 1F).

Coloration: Body black; antenna brownish, usually apical half dark, head and mesosoma black; legs reddish; first and second metasomal tergites reddish, third metasomal tergite reddish in lateral view, following tergites completely black.

Distribution in Iran: Kerman province. New record for Iran.

Discussion

In this study, fourteen species of four subfamilies, were identified and recorded from Kerman province, southeast Iran. One species was recorded for the first time for the fauna of Iran. The present number of the species registered in Kerman does not at all approach the true number of the braconid species existing in this province. Distributions of the species according to zoogeographical regions is variable. Among the identified species some of them such as Dinocampus coccinellae, Perilitus (Perilitus) aethiops, Wesmaelia petiolata and Macrocentrus collaris distributed in most zoogeographical regions. However, the species such as Leiophron deficiens, Aleiodes (Aleiodes) bicolor and Aleiodes (Aleiodes) circumscriptus have a wide distribution in Palearctic region and they are endemic in this region (Beyarslan 2015). Aleiodes (Chelonorhogas) ruficornis is reported for the first time from Iran in the present study.
Figure 1. *Aleioidea ruficornis* (Herrich-Schaffer, 1838): A. Head, lateral view; B. Head, frontal view; C. Head, dorsal view; D. Mesosoma, lateral view; E. Fore wing; F. Metasoma, dorsal view.

It is distributed in the Palearctic and Oriental regions (Germany, Italy, Switzerland and the UK) (Yu et al. 2012). This species has not been reported from adjacent countries of Iran so far. *Aleioidea ruficornis* is the koinobiont endoparasitoid of larval stages of the family Nuctuidae (Lepidoptera). Most of the species introduced in this study are parasitoids of lepidoptera and Hemiptera that are important pests of agricultural plants. No data is available on the presence of the collected species in Kerman province. However several studies has been carried out on some species of this study in adjacent provinces (Farahani et al. 2013a; Ameri et al. 2014; Al-e-Mansour, and Mostafavi 1993; van Achterberg 1993b; Lashkari-Bod et al. 2011).

In general the wasps of the mentioned braconids are considered as the most important group of insects which have significant role in biological control of agricultural pests. Some species such as *Perilitus aethiops* and *Aleioidea (Aleioidea) circumscriptus* are important in the biological control of pest insects (Yu et al. 2012). In fact the aim of biological control is to decreases the population of pests as they impose the least damages to the ecosystem (Quicke 2015). With regard to specific
climatic and geographical conditions of Kerman province which has enriched fauna of insects, it can be expected that the number of species of the studied subfamilies and the other species belonging to braconids is high in this region. So, due to the climatic similarities of this province with the other neighboring parts, reporting the different species of this family can be predicted or expected.

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مطالعه زنبورهای خانواده Braconidae (Euphorinae, Homolobinae, Macrocentrinae, Rogadinae) در استان کرمان، جنوب شرق ایران

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نوع گونه‌ی Aleiodes (Chelonorhogas) ruficornis (Herrich-Schaffer, 1838) از خانواده Braconidae در استان کرمان اولین بار از ایران گزارش شده است که در کرج، کرمان، و برخی از نقاط دیگر استان کرمان گزارش گردیده است.