A contribution to the knowledge of Encyrtidae (Hymenoptera: Chalcidoidea) of Khuzestan in southwestern Iran

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ABSTRACT. This contribution reports 15 species of Encyrtidae (Hymenoptera: Chalcidoidea) belonging to 12 genera from Khuzestan province of Iran of which 11 species were determined to species level. Five genera and seven species are new for the fauna of Khuzestan province. Three genera viz. Apoleptomastix, Rhopus and Thomsonisca, and three species viz. Apoleptomastix bicoloricornis (Girault, 1915), Leptomastidea bifasciata (Mayr, 1876) and Rhopus nigroclavatus (Ashmead, 1902) are new for the Iranian fauna.

Key words: fauna, Iran, Khuzestan, Encyrtidae, new records

Introduction

The insect order Hymenoptera contains several superfamilies including Chalcidoidea encompassing 23 families, one of which is the cosmopolitan Encyrtidae, which currently contains ca. 490 genera and ca. 4000 species (Noyes, 2017). Members of the family Encyrtidae can be distinguished by combination of the following characters: both sexes with mesopleuron very enlarged, undivided, bulging, often occupying more than half the thorax in lateral view; mid coxae level with middle of mesopleuron in lateral view; mesoscutum transverse and without notauli, or with very shallow and curved ones, never deep and straight; cercal plates advanced, not at apex of metasoma and frequently in anterior two-thirds; and linea calva present and distinct in most winged species. They parasitize various arthropods including a wide range of economically important, particularly agricultural, pests, therefore some encyrtids have been utilized commercially as significant introduced and/or mass-produced bio-controllers in the worldwide biological control programs of pests. Various references published on morphology, diagnosis, taxonomy and identification keys, of which Trjapitsin (1989) discusses the encyrtid’s biology as well, and Noyes and Hayat (1994) additionally reviews the worldwide use of this family in the pest biocontrol programs though now is outdated.

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Contrary to 159 encyrtid species listed from Iran by Fallahzadeh and Japoshvili (2017), the encyrtid fauna of Iran, and particularly, certain provinces including the southwestern Khuzestan from which, to date, fourteen species of Encyrtidae are known, requires much investigation as emphasized by Fallahzadeh et al. (2016). Consequently a survey which was introduced by Moravvej et al. (2016) was conducted to discover the chalcid fauna of Khuzestan province and this contribution announces the collected encyrtid species of this province.

**Material and methods**

Material was collected by sweeping and yellow pan trap as explained by Moravvej et al. (2016) and host rearing as described by Forouzan (2014) and are preserved in vials containing ethanol 75% at the Insect Collection of Chamran University. These literatures were utilized for determination of material: Timberlake (1919), Mercet (1921 & 1929), Tachikawa (1956), Kerrich (1967), Jensen and Sharkov (1989), Noyes and Hayat (1994), Anga and Noyes (1999), Noyes (2000), Zhang and Huang (2004), Hayat (2006 & 2009), Trjapitzin (1989), Trjapitzin and Triapitsyn (2008), Noyes (2010), Liu et al. (2013) and Wang et al. (2014).

**Results**

Fifteen encyrtid species belonging to 12 genera were collected and 11 of which were determined to species level; 5 and 3 genera, and 7 and 5 species are new records for the faunas of Khuzestan and Iran, respectively. New taxa for Khuzestan, Iran and undescribed species are marked with *, ** and ***, respectively.

**Family Encyrtidae Walker 1837**

**Subfamily Encyrtinae Ashmead, 1904**

**Genus Cheiloneurus Westwood, 1833**

**Distribution:** Cosmopolitan (Trjapitzin & Triapitsyn, 2008) and Iran in East and West Azerbaijan, Fars, Hormozgan, Kerman, Lorestan, Markazi, North and Razavi Khorassans (Fallahzadeh & Japoshvili, 2017) and Khuzestan (present study) provinces.

**Cheiloneurus sp.**

**Material examined:** 1♀, Aghajari, November 2015, by sweeping, leg. S.A. Moravvej: damaged body prevents species determination.

**Genus Homalotylus Mayr, 1876**

**Homalotylus flaminius** (Dalman, 1820)

**Material examined:** 1♀, 1♂, Ahwaz, autumn 2014, by host rearing, leg. A Forouzan. 1♀, Shush, September 2014, by sweeping, leg. S.A. Moravvej.

**Distribution:** Cosmopolitan (Noyes, 2010) and Iran in Alborz, Ardebil, East Azerbaijan, Fars, Hormozgan, Kermanshah, Lorestan, Markazi, Mazandaran, North and Razavi Khorassans, Khuzestan and Qazvin provinces (Fallahzadeh & Japoshvili, 2017).

**Homalotylus nigricornis** Mercet, 1921

**Material examined:** 1♀, Ahwaz, autumn 2014, by host rearing, leg. A Forouzan.

**Distribution:** Europe, Turkey, ex USSR (Noyes, 2017) and Iran in Ardabil
(Lotfalizadeh & Ebrahimi, 2001) and Khuzestan (present study) provinces.

**Host records**: Iran: Scymnus sp. (Coloptera: Coccinellidae) associated with Aphis gossypii (Glover) (Hemiptera: Aphididae) (Lotfalizadeh & Ebrahimi, 2001). Worldwide: ca. three species of Scymnus (Noyes, 2017).

Genus *Prochiloneurus* Silvestri, 1915

**Distribution**: Cosmopolitan (Wang et al., 2014) and Iran in Fars, Hormozgan, Kerman, Kermanshah, Khuzestan and Markazi provinces (Fallahzadeh & Japoshvili, 2017).

*Prochiloneurus aegyptiacus* (Mercet, 1929)

**Material examined**: 1♀, Ahwaz, autumn 2014, by host rearing, leg. A. Forouzan.

**Distribution**: Africa, Asia, Italy (Noyes, 2017) and Iran (OILB, 1971) in Fars (Hesami & Fallahzadeh, 2004; Fallahzadeh et al., 2007) and Khuzestan provinces (Asadeh & Mossadegh, 1991 [as *Prochiloneurus indicus* Shafee, Alam & Agarwal, 1975]; Alizadeh et al., 2013).


Genus *Thomsonisca* Ghesquière, 1946**

**Material examined**: 1♀, Khorramshahr, May 2015, by yellow pan trap, leg. S.A. Moravvej: damaged body prevents species determination.

**Distribution**: Iran in Khuzestan province (present study).

Genus *Trichomasthus* Thomson, 1876

**Distribution**: Cosmopolitan (Noyes, 2010) and Iran in Isfahan, Mazandaran (Fallahzadeh & Japoshvili, 2017) and Khuzestan (present study) provinces.

*Trichomasthus albimanus* Thomson, 1876*

**Material examined**: 2♀, Karoun city, the Small Ghazawiyeh, April 2017, by sweeping, leg. S.A. Moravvej. 1♀, Howeyzeh, April 2017, by sweeping, leg. S.A. Moravvej.

**Distribution**: America, Asia, Europe (Noyes, 2017) and Iran in Isfahan (Fallahzadeh & Japoshvili, 2017) and Khuzestan (present study) provinces.

**Host records**: Iran: Coccus hesperidum L. (Coccidae) (Ghahari et al., 2010). Outside: over 20 species of Asterolecaniidae, Coccidae and Eriococcidae (Noyes, 2017).

Subfamily Tetracneminae Howard, 1892

Genus *Aenasius* Walker, 1846


*Aenasius arizonensis* (Girault, 1915)

**Material examined**: 1♀, 1♂, Ahwaz, autumn 2014, by host rearing, leg. A. Forouzan.

**Distribution**: China, India, Pakistan, USA and Iran in Khuzestan, Fars, Hormozgan, Bushahr, Kerman, and Kohgiluyeh-va-Boyerahmad provinces (Mossadegh et al. 2013, 2015 [as *Aenasius bambawalei* Hayat, 2009]; Fallahzadeh et al. 2014).

Genus *Anagyrus* Howard, 1896

Distribution: Cosmopolitan (Noyes, 2000) and Iran in East Azerbaijan, Fars, Guilan, Hamadan, Kerman, Kermanshah, Markazi, Mazandaran, Khuzestan, Razavi Khorassan and Tehran provinces (Fallahzadeh & Japoshvili, 2017).

*Anagyrus aligarehensis* Agarwal & Alam, 1959 (= *Anagyrus diversicornis* Mercet, 1921 non Howard)

Material examined: 1♀, Hamidieh, the Great Gamboueh, September 2015, by sweeping, leg. S.A. Moravvej.


*Anagyrus diversicornis* (Howard, 1894)*


Distribution: Cosmopolitan except Australia (Noyes, 2000) and Iran in Guilan (Lotfalizadeh et al., 2016) and Khuzestan (present study) provinces.


Genus *Ericydnus* Haliday, 1832*

Distribution: Cosmopolitan (Noyes, 2000) and Iran in East Azerbaijan, South Khorassan (Fallahzadeh & Japoshvili, 2017) and Khuzestan (present study) provinces.

*Ericydnus robustior* Mercet, 1921*

Material examined: 1♀, 1♂, Lali, Taraz, fall 2014, by sweeping, leg. S.A. Moravvej.

Distribution: Asia, Europe (Noyes, 2017) and Iran in East Azerbaijan, South Khorassan (Fallahzadeh & Japoshvili, 2017) and Khuzestan (present study) provinces.


Genus *Apoleptomastix* Kerrich, 1982**

Distribution: Australia, Old World (Noyes & Hayat, 1994) and Iran in Khuzestan province (present study).

*Apoleptomastix bicoloricornis* (Girault, 1915)**

Material examined: 2♀, Aghajari, November, 2015, by sweeping, leg. S.A. Moravvej. 2♂, 6♀, Andimeshk, Mongereh, September 2014, by sweeping, leg. S.A. Moravvej (Fig. 1).

Distribution: Australia, Old World (Noyes & Hayat, 1994) and Iran in Khuzestan province (present study).

Host records: Iran: unknown. Worldwide: *Brevennia rehi* (Lindinger), *Coccidohystrix insolita* (Green) and *Heterococcus nigeriensis* Williams (Pseudococcidae) (Noyes, 2017).
Figure 1. Apoleptomastix bicoloricornis. A. Female, lateral view; B. Male, lateral view; C. Antenna of female; D. Antennae of male.

Apoleptomastix sp.***
Material examined: 3♀, Aghajari, November 2015, by sweeping, leg. S.A. Moravvej; these specimens are distinctly a new species which we prefer to describe by comparing with types of similar species.
Distribution: Iran in Khuzestan province (present study).
Host records: unknown.

Genus Leptomastidea Mercet, 1916*
Distribution: Old World, introduced to New World (Noyes, 2000) and Iran in Fars, Golestan, Kermanshah, West Azerbaijan (Fallahzadeh & Japoshvili, 2017) and Khuzestan provinces (present study).

Leptomastidea bifasciata (Mayr, 1876)**
Material examined: 1♀, 2♂, Ahwaz, University campus, 5.2014, by yellow pan trap, leg. S.A. Moravvej.
Distribution: Asia, Europe (Noyes, 2017) and Iran in Khuzestan province (present study).
Genus *Leptomastix* Förster, 1856*

**Distribution:** Old World, introduced to New World (Noyes, 2000) and Iran in Fars, Hormozgan, Isfahan, Kerman, Tehran (Fallahzadeh & Japoshvili, 2017) and Khuzestan (present study) provinces.

*Leptomastix* sp.*

**Material examined:** 1♂, Mahshar, Meshrageh, April 2015, by sweeping, *leg.* S.A. Moravvej. Female is required for species level determination.

Genus *Rhopus* Förster, 1856**

**Distribution:** Cosmopolitan (Noyes, 2000) and Iran in Khuzestan province (present study).

*Rhopus nigroclavatus* (Ashmead, 1902)**

**Material examined:** 3♀, 1♂, Aghajari, November 2015, by sweeping, *leg.* S.A. Moravvej (Fig. 2.).

**Distribution:** Asia, Australia, Egypt, Europe (Noyes, 2017) and Iran in Khuzestan province (present study).

**Host records:** Iran: unknown. Worldwide: 17 species of Diaspididae, Margarodidae and Pseudococcidae (Noyes, 2017).

**Discussion**

To date, at least 25 encyrtid species belonging to 13 genera are from Khuzestan (Table 1), which show a diverse morphology, taxonomy, ecology (zoogeography and biology) and economic importance. Morphologically, a broad range of features present in the collected species; see key literatures for details. Taxonomically, 13 well distinguishable genera are known, among which *Anagyrus* with 282 species and *Apoleptomastix* with 6 species are the most and the least speciose genera, respectively.

Zoogeographically, the collected taxa are known to occur mainly in the Palaearctic; however, Oriental (e.g. *Anagyrus agraensis*) and Nearctic (e.g. *Aenasius arizonensis*) species are distributed as well. Biologically, the known hosts of Encyrtidae of Khuzestan are Coleoptera (e.g. *Homalotylus*) and specially Hemiptera (e.g. Pseudococcidae parasitized by *Aenasius* and *Anagyrus*, Aphididae parasitized by *Syrphophagus*). Economically, both destructive (e.g. *Homalotylus*) and beneficial species (e.g. *Aenasius arizonensis*, *Anagyrus* spp.) appear in Khuzestan, though the later
contains most species which probably can be used commercially for pest control. At the end, we recommend further studies to find encyrtid species and their hosts in Khuzestan and also Iran to utilize them for practical biocontrol plans against pests.

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

Table 1. Updated list of Encyrtidae (Chalcidoidea) known from Khuzestan province of Iran

<table>
<thead>
<tr>
<th>Species</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aenasius arizonensis (Girault, 1915) (= bambawalei Hayat)</td>
<td>Mossadegh et al. (2013, 2015)</td>
</tr>
<tr>
<td>Anagyrus sp.</td>
<td>Alizadeh et al. (2013)</td>
</tr>
<tr>
<td>Anagyrus dactylopri (Howard, 1898)</td>
<td>present study</td>
</tr>
<tr>
<td>Anagyrus diversicornis (Howard, 1894)</td>
<td>present study</td>
</tr>
<tr>
<td>Anagyrus cf. kamali</td>
<td>Mossadegh et al. (2015)</td>
</tr>
<tr>
<td>Apoleptomastix bicoloricornis (Girault, 1915)</td>
<td>present study</td>
</tr>
<tr>
<td>Apoleptomastix sp.</td>
<td>present study</td>
</tr>
<tr>
<td>Cheiloneurus sp.</td>
<td>present study</td>
</tr>
<tr>
<td>Ericynus robustior Mercet, 1921</td>
<td>present study</td>
</tr>
<tr>
<td>Homalotylus flaminius (Dalman, 1820)</td>
<td>present study</td>
</tr>
<tr>
<td>Homalotylus nigricornis Mercet, 1921</td>
<td>present study</td>
</tr>
<tr>
<td>Leptomastidea bifasciata (Mayr, 1876)</td>
<td>present study</td>
</tr>
<tr>
<td>Lepidomastix sp.</td>
<td>present study</td>
</tr>
<tr>
<td>Rhopus nigrocalvatus (Ashmead, 1902)</td>
<td>present study</td>
</tr>
<tr>
<td>Prochiloneurus aegyptiacus (Mercet, 1929)</td>
<td>Asadeh and Mossadegh (1991), Alizadeh et al. (2013, present study)</td>
</tr>
<tr>
<td>Prochiloneurus bolivari Mercet, 1919</td>
<td>Alizadeh et al. (2013)</td>
</tr>
<tr>
<td>Prochiloneurus pulchellus Silvestri, 1915</td>
<td>Japoshvili and Noyes (2005)</td>
</tr>
<tr>
<td>Syrphophagus aphidivorus (Mayr, 1876)</td>
<td>Rezaei et al. (2006)</td>
</tr>
<tr>
<td>Syrphophagus arundinicolus Hoffer, 1965</td>
<td>Rezaei et al. (2006)</td>
</tr>
<tr>
<td>Thomsonisca sp.</td>
<td>present study</td>
</tr>
<tr>
<td>Trichomasthus albimanus Thomson, 1876</td>
<td>present study</td>
</tr>
</tbody>
</table>
References


مشارکت در شناسایی زنبورهای خانواده Encyrtidae (Hymenoptera) در استان خوزستان، جنوب غرب ایران

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چکیده: در این بررسی 15 گونه زنبور از خانواده Encyrtidae در استان خوزستان گردآوری گردید که 12 گونه از آنها شناسایی شد. پنج جنس برای استان خوزستان جدید به شناسایی می‌رسد که از آنها جنس‌های Apoleptomastix، Leptomastidea bifasciata، Thomsonisca nigroclavatus و Apoleptomastix bicoloricornis (Girault, 1915) برای نخستین بار از ایران گزارش می‌شوند. هفت گونه برای استان جدید به شناسایی می‌رسند که از آنها یک گونه نام‌گذاری و نام‌گذاری نشد. گونه‌های Apoleptomastix bicoloricornis، Leptomastidea bifasciata و Apoleptomastix nigroclavatus (Ashmead, 1902) و Thomsonisca nigroclavatus (Mayr, 1876) از ایران گزارش می‌شوند.

واژگان کلیدی: Encyrtidae، فون، گزارش جدید، ایران، خوزستان