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and Hayat (1994) additionally reviews the worldwide use of this family in the pest biocontrol programs though now is outdated.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*

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.

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 (Fallahzadeh & Japoshvili, 2017) and Khuzestan (present study) provinces.

Host records: Iran: Nephus bipunctatus (Kugelann) (Coleoptera: Coccinellidae) on Lactuca serriola L. (Asteraceae) associated with Peliococcus kimmericus (Kiritshenko) (Hemiptera: Pseudococcidae) (Fallahzadeh et al., 2006). Worldwide: one species of Chrysomelidae and 62 species of Coccinellidae (Coleoptera) and 2 species of Coccidae and 3 species of Pseudococcidae (Hemiptera) (Noyes, 2017).
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(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).

_Tomsonisca* sp.**

**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 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).

**Host records:** Iran: *Homalotylus quaylei* Timberlake (OILB, 1971) and *Anagyrus* sp. (Hymenoptera: Encyrtidae) (Hesami & Fallahzadeh, 2004), hyperparasitoid (as Prochiloneurus indicus Shafee, Alam & Agarwal, 1975) of *Nipaecoccus viridis* (Newstead) (Hemiptera: Pseudococcidae) on *Citrus* sp. (Rutaceae) and *Morus alba* L. (Moraceae) (Asadeh & Mossadeh, 1991), hyperparasitoid of *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae) on *M. alba* L. (Moraceae) (Fallahzadeh et al., 2007). Worldwide: over 20 species of Asterolecaniidae, Coccidae and Eriococcidae (Noyes, 2017).

(Subfamily Tetracneminae Howard, 1892)

Genus *Aenasius* Walker, 1846

**Distribution:** Nearly cosmopolitan (Noyes, 2000) and Iran in Bushahr, Fars, Hormozgan, Kerman, Kohgiluyeh-va-Boyerahmad and Khuzestan provinces (Mossadegh et al. 2013, 2015 [as Aenasius bambawalei Hayat, 2009]; Fallahzadeh et al. 2014).

_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 aligarhensis* 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*


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).
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).


Figure 1. Apoleptomastix bicoloricornis. A. Female, lateral view; B. Male, lateral view; C. Antenna of female; D. Antennae of male.
**Figure 2.** *Rhopus nigroclavatus*. **A.** Dorsal aspect of female; **B.** Antennae of male.

**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, Meshrāgeh, 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 dactylopii (Howard, 1898)</td>
<td>Anagyrus diversicornis (Howard, 1894)</td>
</tr>
<tr>
<td>Anagyrus cf. kamali</td>
<td>Anagyrus mirzai Agarwal &amp; Alam, 1959</td>
</tr>
<tr>
<td>Apoleptomastix bicoloricornis (Girault, 1915)</td>
<td>present study</td>
</tr>
<tr>
<td>Apoleptomastix sp.</td>
<td>Apoleptomastix sp.</td>
</tr>
<tr>
<td>Cheiloneurus sp.</td>
<td>Cheiloneurus sp.</td>
</tr>
<tr>
<td>Ericynus robustior Mercet, 1921</td>
<td>present study</td>
</tr>
<tr>
<td>Homalotylus flaviminius (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 nigroclavatus (Ashmead, 1902)</td>
<td>present study</td>
</tr>
<tr>
<td>Prochiloneurus aegyptiacus (Mercet, 1929)</td>
<td>present study</td>
</tr>
<tr>
<td>Prochiloneurus bolivari Mercet, 1919</td>
<td>present study</td>
</tr>
<tr>
<td>Prochiloneurus pulchellus Silvestri, 1915</td>
<td>Alizadeh et al. (2013)</td>
</tr>
<tr>
<td>Syrphophagus aphidivorus (Mayr, 1876)</td>
<td>Japoshvili and Noyes (2005)</td>
</tr>
<tr>
<td>Syrphophagus arundinicolora Hoffer, 1965</td>
<td>Rezaei et al. (2006)</td>
</tr>
<tr>
<td>Thomsonisca sp.</td>
<td>present study</td>
</tr>
<tr>
<td>Thomsonisca albimanus Thomson, 1876</td>
<td>present study</td>
</tr>
</tbody>
</table>
References


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

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چکیده: در این بررسی ۱۵ گونه زنبور از خانواده Encyrtidae گردآوری گردید که ۱۲ گونه از آنها شناسایی شد. پنج گونه برای استان خوزستان جدید هستند که از آنها جنس‌های Apoleptomastix، Rhopus و Thomsonisca برای نخستین بار از ایران گزارش می‌شودند. هفت گونه برای استان جدید هستند که از آنها یک گونه نام‌گذاری و شناسایی نشد. گونه‌های Apoleptomastix bicoloricornis (Girault, 1915) و Apoleptomastix bicolored (Mayr, 1902) (Ashmead, 1876) برای نخستین بار از Rhopus nigroclavatus (Ashmead, 1902) برای نخستین بار از ایران گزارش می‌شود.

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