CONTRIBUTION TO THE STUDY OF EULOPHIDAE (HYMENOPTERA: CHALCIDOIDEA) OF FARS PROVINCE OF IRAN: I- SUBFAMILIES ENTEDONINAE AND TETRASTICHINAE

Shahram Hesami*, Ebrahim Ebrahimi, Hadi Ostovan***, Mahmoud Shojai****, Karim Kamali*****, Zoya Yefremova****** and Ekaterina Yegorenkova******

* Department of Entomology, Islamic Azad University, Science and Research branch, Tehran, IRAN. E-mail: Shahram.hesami@gmail.com
** Department of Insect Taxonomy, Iranian Research Institute of Plant Protection, Tehran, IRAN.
*** Department of Entomology, Islamic Azad University, Fars Science and Research Branch, Marvdasht, IRAN.
**** Department of Entomology, Islamic Azad University, Science and Research branch, Tehran, IRAN.
***** Department of Entomology, Tarbiat Modares University, Tehran, IRAN.
****** Department of Zoology, Ul'yanovsk State Pedagogical University, Ul'yanovsk, RUSSIA.

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ABSTRACT: A checklist of the species belonging to the eulophid subfamilies Entedoninae and Tetrasichinae collected in Fars province of Iran during 2004 to 2007 is presented. 4 species of Entedoninae and 11 species of Tetrasichinae are listed among them 3 species are recorded for the first time from Iran. Available biological data and geographical distribution of each species is mentioned briefly.

KEY WORDS: Eulophidae, Entedoninae, Tetrastichinae, Fars, Iran

Eulophidae (Hymenoptera: Chalcidoidea) is one of the largest families of parasitic wasps containing over 4472 species placed in 297 genera (Noyes, 2008). Most eulophids are generally parasitoids of holometabolous insects, but overall range of hosts and biology is remarkable diverse. Although the majority of species are parasitoids, the family also contains phytophagous and predator species. Parasitoids may be ectoparasitoids (Eulophinae and Euderinae) or endoparasitoids (Entedoninae and Tetrastichinae). Several species of Eulophidae are important in biocontrol programs throughout the world (Noyes 2008).

The eulophid wasps of Iran have received attention recently. The first reported Eulophidae from Iran was *Tetrastichus epilachnae* (Girard, 1896) (Kiryukhin, 1948; Herting, 1973). Then Davachi & Chodjai (1968) reported only 2 eulophid species. Different authors added some records on this family (e. g. Doganlar, 1992; Hesami et al., 2005; Hesami et al., 2006; Hesami et al., 2007, Mahani et al., 2003; Rezaei et al., 2003; Talebi et al., 2005; Yefremova et al., 2007; Zahiri et al. 2003). In this paper we report some species from subfamilies Entedoninae and Tetrastichinae from Fars province. Also we will provide species list of two other subfamilies (Euderinae and Eulophinae) in a separate paper.

MATERIALS AND METHODS

This paper is a result of twenty two collection trips of first author to the different localities of Fars province during the years 2004-2007. The eulophid wasps were reared from hosts or captured by sweep net or malaise trap. The specimens are deposited in the Zoological Institution of Russian Academy of Science, St. Petersburg (ZISP), and Department of Plant Protection, Islamic Azad University, Shiraz branch. The taxonomic arrangement of Boucek (1988) for subfamilies is followed in this paper. The morphological terminology follows Graham (1987, 1991) and Gibson (1997). Synonyms, combinations and misspelling are according to Noyes (2008).

The abbreviations used in the text are as follows: SMV= submarginal vein, MV= marginal vein, PMV= postmarginal vein, SV= stigmal vein. Sculpture terminology follows Eady (1968) and Harris (1979).

Species account

Subfamily Entedoninae

Genus *Chrysocharis* Foerster, 1856

Chrysocharis Forster, 1856: 152. Type species: *Chrysocharis femoralis* Forster, 1861, by original designation and monotypy.

Diagnosis. Funicle usually with 3 funicle segments and distinct clava; third anellus enlarged and triangular. Antennal scape less than 7 times as long as wide.

Biology: Parasite of many Diptera (Agromyzidae: *Phytomyza* sp. and Cecidomyiidae) and Lepidoptera (*Phyllonorycter* sp., *Cameraria* sp., *Perileucoptera* sp.) (Boucek & Askew, 1968; Hansson, 1985).

Distribution. Cosmopolitan.

Identification. Keys to the species of this genus was published by Trjapitzin (1978) and Hansson (1985).

Chrysocharis laomedon (Walker, 1839)

Synonyms. *Entedon laomedon* Walker 1839, *Entedon parsodes* Walker 1839, *Entedon sartamus* Walker 1839, *Epilampsis albiceps* Delucchi 1954, *Kratochviliana laomedon* Boucek 1961

Material examined: 2♀, Iran, Fars, Dashte Arjan (29°34' N, 51°56' E, 2100 m), sweeping in oak trees, 20 April 2007.

Biology. Parasitoid of Curculionidae, Agromyzidae, many leafmining Lepidoptera (Gracillariidae, Lyonetidae, Nepticulidae and Tischeriidae) (Hansson, 1985; Noyes, 2008).

Distribution. Nearctic and Palearctic regions. This species is widely distributed in Europe without any report from the Middle East.

This is a new record for the fauna of Iran.

Genus *Closterocerus* Westwood, 1833

Closterocerus Westwood, 1883. Type species *Closterocerus trifasciatus* Westwood, 1833, by monotypy.

Diagnosis. Mesopleuron with transepimeral sulcus weakly curved or straight, arching posteriad. Fore wing usually with a single line of setae extending apically from stigma, radial cell bare, postmarginal vein equal or shorter than stigmal vein. Antenna typically strongly flattened, funicle with capitate big sensillae rounded apically (mushroom shape) (sensilla visible only in slide); sensory pores of scape in a cluster near apex of scape in males.

Biology. Host range very broad, primary parasitoid of various mining Diptera (Agromyzidae), Lepidoptera (Gracillariidae, Coleophoridae), Coleoptera and Hymenoptera; also hyperparasitoid of some Hymenoptera such as Braconidae, Eulophidae and Encyrtidae (Boucek & Askew, 1968; Hansson, 1994).
Distribution. Cosmopolitan.
Identification. Species identification can be possible with Hansson (1990).

Closterocerus formosus Westwood, 1833

Main combinations and synonyms. *Achrysocharis formosa* (Westwood, 1833), *Chrysonotomyia formosa* (Westwood, 1833), *Derostenus* (*Closterocerus*) *formosus* (Westwood, 1833), *Derostenus fullowayi* Crawford, 1913, *Derostenus silvia* (Girault, 1917), *Derostenus variipes* Crawford, 1913, *Entedon formosus* (Westwood, 1833), *Entedon ovulorum* Ratzeburg, 1848, *Entedon phaenna* Walker, 1839, *Neochrysocharis formosa* (Westwood, 1833).
Material examined. 7♀& 6♂, Iran, Fars, Shiraz (29˚45' N, 52˚28' E, 1600-1700 m), 14 June 2006, ex *Liriomyza trifolii* Burgess (Diptera: Agromyzidae) on basil; 4♀ & 1♂, Iran, Fars, Shiraz, Eram Garden (29° 38' N, 52° 31' E, 1560 m), 28 June 2006, ex *Calycomyza humeralis* (Diptera; Agromyzidae) on aster, 6 ♀ & 2♂, Iran, Fars, Shiraz, Zafar abad (29˚24' N, 52˚35' E, 1400-1500 m), 6 July 2007, ex *L. trifolii* on cucumber.
Biology. Solitary larval endoparasitoid of lepidopterous and diptereous leaf-miners.
Distribution. Cosmopolitan.

Genus *Entedon* Dalman, 1820

Diagnosis. Propodeum without true lateral plicae, with single median carina (most species); pronotum narrow dorsally, its lateral margins with protruding lateral shoulders delimited by semicircular plica beneath; propodeal spiracle on elevated area bearing lateral subconical projection beneath; mandibles with 2 teeth in all known species; first gastral tergite with oval membranous areas adjacent to the petiolar emargination.
Biology. The species of *Entedon* are recorded as solitary (most species) or gregarious (*E. cioni* Thomson, *E. cionobius* Thomson, *E. zanara* Walker) larval (rarely egg-larval, e.g. *E. ergias*) endoparasitoids of various Coleoptera, mainly Curculionidae (including Scolytinae), but also Apionidae, Chrysomelidae (Bruchinae, in particular), Anobiidae, Mordellidae, Bostrichidae, Buprestidae, Cerambycidae, Nitidulidae, However, the biological data on many species remain unknown (Gumovsky & Boyadzhiev, 2003).
Distribution. Cosmopolitan.
Identification. Askew (1991) and Gumovsky (1997a, 1997b, 1998a, 1998b, 1999a, 1999b) provided useful keys to this genus.

Entedon sp.

Material examined. 7♀ & 2♂, Iran, Fars, Shiraz,Akbar abad ring way (29˚40' N, 52˚33' E, 1730 m), 17 April 2006, ex cocoons of *Apanteles glomeratus* (Hymenoptera: Braconidae) on *Aporia crataegi* (Lepidoptera: Pieridae) on the wild almond.
This is first report of this genus from Fars province of Iran.

Genus *Pediobius* Walker, 1846

Pediobius Walker, 1846: 184. Type species: *Entedon imbreus* Walker, 1846, designation by Ashmead 1904.

Diagnosis. Propodeum medially with 2 subparallel carinae diverging posteriorly and with distinct plicae. Frontofacial sutures distinct, petiole in most species with ventrally pointed extension.
Biology. Parasitoid of Lepidoptera, Coleoptera, Diptera and Hymenoptera, some species attack spider eggs often as secondary parasitoid.
Distribution. Cosmopolitan.
Identification of species: Keys to species of *Pediobius* are published by Boucek (1965) and Trjapitzin (1978).

***Pediobius pyrgo* (Walker, 1839)**

Synonyms. *Entedon pyrgo* Walker, 1839, *Derostenus nawai* Ashmead, 1904, *Elachestus complaniusculus* Ratzeburg, 1852, *Eulophus pyralidum* Audouin, 1842, *Pediobius nawai* (Ashmead, 1904), *Pleurotropis complaniuscula* (Ratzeburg, 1852), *Pleurotropis nawai* (Ashmead, 1904), *Pleurotropis* (*Rhopalotus*) *substrigosa* Thomson, 1878, *Rhopalotus chalcidiphagus* Szelényi, 1957, *Rhopalotus substrigosus* (Thomson, 1878)
Material examined: 1♀, Iran, Fars, Shiraz, Eram Garden (29° 38' N, 52° 31' E, 1560 m), 28 September 2006, ex *Phylloncnistis citrella* Stainton (Lepidoptera: Gracillariidae).
Biology. Parasitoid of larva and pupa of different orders of insects such as Coleoptera, Dermaptera, Diptera, Hymenoptera and Lepidoptera, Also hyperparasitoid of Hymenoptera such as Braconidae, Eulophidae, Ichneumonidae and Pteromalidae through their lepidopteran hosts.
Distribution. Nearctic, Palearctic and Oriental. It's second report from Iran and first report from Fars province of Iran.

Subfamily Tetrastichinae

Genus *Aprostocetus* Westwood, 1833

Aprostocetus Westwood, 1833: 443-445. Type species: *Aprostocetus caudatus* Westwood, 1833, by designation and monotypy.
Diagnosis. Female: antennal funicle with all segments longer than host broad; mesoscutum with median line or without median line, with one and two rows of adnotaular setae, rarely with 3 rows. Scutellum normally with 2 pairs of setae; submedian lines usually distinct. Male: antennal funicle with 4 segments; funicle and clava with whorled long dark setae, scape with ventral plague.
Biology. Hosts are very variable, most of them associated with galling arthropods such as Cecidomyiidae, Cynipidae and Eriophyidae, Also on Chrysomelidae, Curculionidae (Coleoptera), Agromyzidae, Tephritidae (Diptera), Coccidae (Hemiptera), Gracillariidae, Lasiocampidae, Lymantriidae, Lyonetiidae, Pyralidae, Tischeriidae, Tortricidae, Yponomeutidae, Pieridae (Lepidoptera) and Anguinidae (Nematoda).
Distribution. Cosmopolitan.
Identification. A key for identification of European species of *Aprostocetus* was given by Graham (1987). Yefremova et al. (2007) provided a key to 9 species of Iran, but here we report a new species that is not in that key.

***Aprostocetus artemisicola* Graham, 1987**

Material examined. 2♀ & 1♂, Iran, Fars, Dashte Arjan, Arjan-Parishan protected area (29°34' N, 51°56' E, 2100 m), 21 April 2007, sweeping in the oak forest.
Biology. Parasitoid of Cecidomyiidae (Diptera) on *Artemisia* spp.
Distribution. This species is distributed in Europe without any report from the Middle East. **This is a new record for the fauna of Iran.**

Aprostocetus forsteri Walker, 1847

Synonyms. *Eulophus forsteri* Walker, 1847, *Tetrastichus forsteri* (Walker, 1847).
Material examined. 1♀, Iran, Fars, Ghalat (29˚48' N, 52˚19' E, 2090 m), 11 July 2006, Malaise trap (ZISP).
Biology. Parasitoid of *Aylax jaceae* Schenek (Hymenoptera, Cynipidae) (Graham, 1978), *Aylax salviae* Giraud (Hymenoptera, Cynipidae) (Domenichini, 1966).
Distribution: Palearctic. This is a new record for the fauna of Fars province of Iran.

Aprostocetus lachares (Walker, 1839)

Synonyms. *Cirrospilus lachares* Walker, 1839, *Tetrastichus lachares* (Walker, 1839)
Material examined. 2♀ & 1♂, Iran, Fars, Shiraz (29˚41' N, 52˚28', 1650 m), 4 August 2006, Sweeping in weeds in a garden.
Biology. Unknown.
Distribution. Palearctic. This is a new record for the fauna of Fars province of Iran.

Aprostocetus zosimus (Walker, 1839)

Main combinations an synonyms. *Aprostocetus charoba* (Walker, 1840), *Cirrospilus zosimus* Walker, 1839, *Tetrastichus zosimus* (Walker, 1839).
Material examined. 1♀, Iran, Fars, Sepidan, Bereshneh (30˚12' N, 52˚02' E, 2080 m), 17 October 2006, ex galls of *Diplolepis rosae* (L.) (Hymenoptera: Cynipidae) on *Rosa canina* also with another parasitoids *Orthopelma mediator* (Thunberg) (Hymenoptera: Ichneumonidae) and *Eupelmus urozonus* Dalman (Hymenoptera: Eupelmidae) (ZISP).
Biology. Parasitoid of Cecidomyiidae (Diptera), Coleophoridae and Lyonetiidae (Lepidoptera). Also hyperparasitoid of Platygasteridae, Pteromalidae and Eupelmidae.
Distribution. Nearctic, Palearctic, New Zealand.

Genus *Baryscapus* Forster, 1856

Baryscapus Forster, 1856: 84. Type species: *Baryscapus centricolae* Ashmead, 1887 (subsequent monotypy).
Diagnosis. Body and tegula dark, varying from black to bright metallic blue or green. Propodeal spiracle with its whole rim exposed. Cercal setae subequal in length. Malar sulcus usually distinctly curved. SMV with 2 or more dorsal setae. Midlobe of mesoscutum often with more than a single row of adnotaular setae. Male funicle and clava often without whorls of long, dark setae; when present these whorls are relatively short.
Biology. Parasitoid of Lepidoptera, Hymenoptera, Coleoptera, Diptera (Tephritidae), rarely Neuroptera and Coccoidea. Hyperparasitoid of Ichneumonidae, Braconidae, Cynipoidae and Chalcidoidea (Graham, 1991)
Distribution. Cosmopolitan.
Identification. For a key to the Palearctic species see Graham (1991).

Baryscapus erynniae (Domenchini, 1966)

Synonym. *Tetrastichus erynniae* Domenichini, 1965
Material examined. 2♀, Iran, Fars, Shiraz (29˚41' N, 52˚28' E, 1600 m), 4 August 2005, ex pupa of elm leaf beetle (*Galerucella luteola*) parasitized by a Tachinidae fly (Diptera).
Biology. Hyperparasitoid of tachinid flies through Chrysomelidae hosts.

Distribution. Nearctic and Palearctic. This is a new record for the fauna of Fars province of Iran.

Baryscapus oophagus (Otten, 1942)

Synonyms. *Eutetrastichus oophagus* (Otten, 1942), *Tetrastichus oophagus* Otten, 1942

Material examined. 2♀, Iran, Fars, Ghalat (29˚48' N, 52˚19' E, 2090 m), 7 June 2006, Malaise Trap.

Biology: Endoparasitoid of *Diprion pini* L. and *Neodiprion sertifer* Geoffroy (Hymenoptera, Diprionidae) (Domenichini 1966; Graham, 1991).

Distribution: Palearctic. This is second report from Iran and a new record for the fauna of Fars province of Iran.

Genus *Leptocybe* Fisher & LaSalle, 2004

Leptocybe Fisher & LaSalle, 2004, (in Mendel et al. 2004: 53). Type species *Leptocybe invasa* Fisher & LaSalle, 2004, by original designation and monotypy

Diagnosis. Head weak, with distinct groove and weakened area around ocellar triangle. Propodeum with a raised lobe of the callus that partially overhangs the outer rim of the spiracle; spiracular depression open to anterior margin of propodeum. Two longest cercal setae subequal in length, and straight or only slightly curved. Postmarginal vein short, less than 0.25 length of stigmal vein. Mesoscutum without median line, and with 2–3 small adnotaular setae. Malar sulcus distinctly curved. Dorsellum long, medially as long as propodeum (Mendel et al. 2004).

Biology. forming typical bump-shaped galls on the leaf midribs, petioles and stems of several *Eucalyptus* species.

Distribution. Middle East, Mediterranean, Afrotropical, Oriental, South and South-East Asia.

Leptocybe invasa Fisher & LaSalle, 2004

Material examined. 24♀, Iran, Fars, Shiraz (29° 31' N, 52° 36' E, 1450 m), June-August 2005, ex galls on leaves and petioles on *Eucalyptus camaldulensis*.

Biology. Making galls on *Eucalyptus*.

Distribution. Middle East, Mediterranean, Afrotropical, Oriental, South and South-East Asia.

Genus *Neotrichoporoides* Girault, 1913

Neotrichoporoides Girault, 1913: 50. Type species *N. uniguttata* Girault, by original designation.

Diagnosis. Genal suture below eye with triangular or elongate depression along 0.2–0.7 of its length. Antenna of female with 4 discoid anelli; other segments usually strongly elongate. Pronotum conical; mesoscutum without longitudinal median groove. Length of scutellum no more than its width, subequal to length of mesoscutum. First pair of hairs of scutellum situated in its posterior half, less frequently in middle. Each side of propodeum with 3–7 hairs. MV 5.5–9.5 times as long as SV.

Biology. Many species of the genus are trophically associated with Diptera (Diopsidae, Anthomyiidae, Lonchaeidae and Muscidae) especially on stems of Poaceae.

Distribution. Palearctic , Afrotropical, and Neotropical Regions.

Identification. For a key to the Palearctic species see Graham (1991).

Neotrichoporoides szelenyii (Erdos, 1951)

Synonyms. *Aprostocetus szelenyii* (Erdos), *Geniocerus szelenyii* Erdos, *Tetrastichus szelenyi* (Erdos)
Material examined. 1♂, Iran, Fars, Ghalat (29˚48' N, 52˚19' E, 2090 m), 11 July 2006, Malaise Trap (ZISP).
Biology. Unknown.
Distribution. Palearctic.
This is a new record for the fauna of Iran.

Genus *Oomyzus* Rondani, 1870

Oomyzus Rondani, 1870: 141. Type species *Pteromalus gallerucae* Fonscolombe, by monotypy.
Diagnosis. Head rounded; thorax compact, convex. Propodeum with deep and wide emargination, medially not longer than metanotum.
Biology. Parasitoid of egg, larva and pupa of Coleoptera, Diptera, Lepidoptera and Neuroptera (Graham, 1991, LaSalle, 1994)
Distribution. Worldwide, except South America.
Identification. For a key to the Palearctic species see Graham (1991).

Oomyzus brevistigma (Gahan, 1936)

Synonym. *Tetrastichus brevistigma* Gahan, 1936
Material examined. 1♀, Iran, Fars, Shiraz (29˚41' N, 52˚28' E, 1600 m), 27 July 2006, ex pupa of elm leaf beetle *G. luteola*.
Biology. Parasitoid of pupa of *G. luteola* (Coleoptera: Chrysomelidae).
Ditribution. Palearctic and Nearctic. This is the first report from Fars province of Iran.

Oomyzus gallerucae (Fonscolombe, 1832)

Synonyms. *Eulophus gallerucae* (Fonscolombe, 1832), *Tetracampe gallerucae* (Fonscolombe, 1832), *Tetrastichus gallerucae* (Fonscolombe, 1832)
Material examined. 5♀ & 2♂, Iran, Fars, Shiraz (29˚41' N, 52˚28' E, 1600 m), 16-19 August 2006, ex eggs of elm leaf beetle *G. luteola*.
Biology. Egg parasitoid of Chrysomelidae (Coleoptera).
Distribution. Palearctic, Nearctic and Oriental. This is the first report from Fars province of Iran.

Genus *Sigmophora* Rondani, 1867

Sigmophora Rondani, 1867:40. Type species *S. scrophulariella* Rondani, by monotypy.
Diagnosis. Vertex with transverse carina behind posterior ocelli. Genal suture with triangular depression below eye, which occupying 0.33–0.5 of its length. Antenna with 3 discoid anelli in female and 2, in male. Scutellum with 2 pairs of hairs in posterior half. SMV with 4–6 dorsal setae. First tarsal segment of middle and hind tarsi slightly shorter than second one. Body from entirely yellow to entirely dark brown or black, without metallic shine. The species is trophically associated with Diptera (Cecidomyidae. Tephritidae).
Biology. Gregarious ectoparasitoid of the larvae and pupae of Cecidomyiidae (Diptera).
Distribution. Worldwide.
Identification. For key to the species see Graham (1987) and Ikeda (1999).

***Sigmophora brevicornis* (Panzer, 1804)**

Synonyms. *Cynips brevicornis* Panzer, 1804, *Cirrospilus armaeus* Walker, 1839, *Eulophus verbasci* Dufour, 1837, *Sigmophora scrophulariella* Rondani, 1867, *Tetrastichus brevicornis* (Panzer, 1804), *Tetrastichus isaaci* Rohwer, 1921, *Tetrastichus sayatamabae* Ishii, 1950, *Tetrastichus tricolor* Ashmead, 1904, *Aprostocetus brevicornis* (Panzer, 1804).

Material examined. 2♀ & 2♂, Iran, Fars, Sepidan, Bereshneh (30˚12' N, 52˚02' E, 2080 m), 3-28 September 2006, ex ex galls of *Diplolepis rosae* (L.) (Hymenoptera: Cynipidae) on *Rosa canina* also with another parasitoids *Orthopelma mediator* (Thunberg) (Hymenoptera: Ichneumonidae), *Eurytoma rosae* Nees (Hymenoptera: Eurytomidae) and *Eupelmus urozonus* Dalman (Hymenoptera: Eupelmidae).

Biology. Parasitoid of Anobiidae and Apionidae (Coleoptera), Cecidomyiidae and Tephritidae (Diptera), Cynipidae, Eurytomidae and Tenthredinidae (Hymenoptera), Tortricidae and Yponomeutidae (Lepidoptera).

Distribution. Paleaerctic, Nearctic and Oriental.

This is the first report from Fars province of Iran.

DISCUSSION

Among the 15 species recorded in this paper, three species are new records for Iran including *Chrysocharis laomedon*, *Aprostocetus artemisicola*, *Neotrichoporoides szelenyii*. Also records of twelve previously recorded species of Eulophidae are confirmed. Most of the genera occur commonly in the other zoogeographical regions, 6 genera are cosmopolitan, and 3 genera are distributed throughout the Palearctic region and in other zoogeographical regions. The fauna of Iran does not exhibit any specific characters.

It seems that the Iranian fauna of Eulophidae is very rich and we should work further to understand the Eulophidae fauna of Iran, both, in more regions and also examine more material.

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