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Tetrastichinae (Hymenoptera: Eulophidae) Associated with Plant Galls in Kerman Province, with Ten New Records from Iran

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ABSTRACT

Fourteen species of chalcid wasps associated with plant galls, *Rosa beggeriana* Schrenk, *Ephedra major* (Host), *Salix alba* L., and *Artemisia sieberi* Besser were found in Kerman Province, south-eastern Iran during 2010 - 2011. The identified wasps belong to four genera consisting of *Aprostocetus* Westwood, *Baryscapus* Föerster, *Sigmophora* Rondani, and *Stepanovia* Kostjukov, Tetrastichinae (Hym.: Eulophidae). Ten species are newly recorded for the Iranian fauna including *Aprostocetus arenarius* (Erdös), *A. cecidomyiarum* (Bouché), *A. diplosidis* Crawford, *A. epicharmus* (Walker), *A. fabicola* (Rondani), *A. fonscolombei* Graham, *A. lycidas* (Walker), *A. minimus* (Ratzeburg), *A. rhipheus* (Walker) and *A. zoilus* (Walker). *A. arenarius*, *A. diplosidis*, *A. epicharmus*, and *A. fabicola* are associated with *Diplolepis fructuum* (Rübsaamen) (Hym.: Cynipidae) on *Rosa beggeriana* Schrenk. *A. lycidas* is associated with both *D. fructuum* on *R. beggeriana* and *Artemisia sieberi* Besser. *A. cecidomyiarum*, *A. fonscolombei*, *A. rhipheus*, and *A. zoilus* are associated with *Ephedra major* Host. *A. minimus* is associated with leaf galls of *Salix alba* L. Short taxonomic comments, biological data and geographical distribution of the species are briefly mentioned.

Key words: Tetrastichinae, *Diplolepis fructuum*, *Rosa beggeriana, Salix alba, Ephedra major, Artemisia sieberi,* host, new records, Iran.

INTRODUCTION

The galls support species-rich and closed communities of inquilines (including cynipids, gall midges, moths and beetles) and parasitic Hymenoptera (predominantly Chalcidoidea) that have become an important model system and a very convenience source of information on herbivore-plant relationships and on the interaction between herbivores and their natural enemies (Redfern, 2011). Different species of parasitic wasps belonging to different families such as Eulophidae, Eupelmidae, Eurytomidae, Pteromalidae, Torymidae (Chalcidoidea), Ichneumonidae (Ichneumonoidea), Cynipidae (Cynipoidea) have been reared from plant galls (Kostjukov, 1978, Lotfalizadeh *et al.,* 2012; Mahdavi, Madjdzadeh, 2013). The fauna of Iranian Tetrastichinae is poorly studied. The first record from Iran was *Tetrastichus epilachnae* (Girard, 1896) (Herting, 1973; Kiryukhin, 1948) and then different authors added some records on this subfamily

(e.g. Hesami *et al*., 2004; 2006; 2010a; Cikman, Doğanlar, 2006; Lotfalizadeh *et al*., 2006; Nazemi-Rafie *et al*., 2007; Yefremova *et al*., 2007; Dousti *et al*., 2008; Golizadeh *et al*., 2008; Talebi *et al*., 2008; Amiri *et al*., 2009; Ebrahimi *et al*., 2009; Hasanpour *et al*., 2009; Hesami, 2009; Thu *et al*., 2009; Talebi *et al*., 2011; Ghahari, Yefremova, 2013). Up to date, 45 species of Tetrastichinae belonging to the 13 genera are known from Iran (Hesami *et al*., 2010b; Yegorenkova *et al*., 2012). The objective of the present study was to report on our investigation of Tetrastichinae associated with plant galls in Kerman province, southeastern Iran together with taxonomic remarks and reporting new host associations about Tetrastichinae of Iran.

MATERIAL AND METHODS

The present research was conducted within the range of two areas, Bidkhan and Sang-e-sayad, in Kerman province located in southeast of Iran between April 2010 to June 2011. The Bidkhan village is located about 90 km southwest of Kerman city and 40 Km southwest of Bardsir County (056°40' E - 29°30' N and 056°27' E - 29°41' N) at maximum 3500 m (Bidkhan Mountain) above sea level. The Sang-e-sayad is located southwest of Kerman city and southeast of Bardsir County (056°44' E - 29°36' N) at about 3112 m above sea level. Fresh and dry galls of four host plants, begger rose (*Rosa beggeriana* Schrenk), white willow (*Salix alba L.*), ephedra (*Ephedra major* Host*)*, and sagebrush (*Artemisia sieberi* Besser) were collected. The galls were transferred to the laboratory and kept at room temperature in mesh-covered transparent plastic rearing containers under room condition until the emergence of parasitoids. The containers were checked every day and emerged parasitoids removed. The emerged parasitoid wasps were preserved in 75% ethanol. All the material was card-mounted following Noyes (1982). Prior to mounting the specimens were treated with hexamethyldisilazane in order to avoid collapsing. The external morphology of the specimens was studied using a Nikon SMZ800 stereomicroscope. The specimens were identified using Graham (1987, 1991) and Kostjukov (1978). The material was deposited in collection of SMM (Shahid Bahonar University of Kerman, Kerman, Iran). The identified species are ordered based on genus name alphabetically and new records are marked by asterisk. For each species general data regarding their geographic distribution, biology as well as brief taxonomic comments are given.

RESULTS

For the present study, a total of 46 specimens of Tetrastichinae reared from plant galls in southestern Iran were examined. In addition to Tetrastichinae, specimens belonging to other families were also reared including Eulophidae, Eupelmidae, Eurytomidae, Pteromalidae, Torymidae (Chalcidoidea), Ichneumonidae (Ichneumonoidea), Cynipidae (Cynipoidea). Four genera including 14 species of Tetrastichinae (Hym.: Eulophidae) were reared and identified. They include four previsously reported species, *Stepanovia eurytomae* (Nees), *A. lachares* (Walker), *Baryscapus hylesini* Graham, and *Sigmophora brevicornis* (Panzer), and ten newly recorded species for

the Iranian fauna, *Aprostocetus arenarius* (Erdös), *A. cecidomyiarum* (Bouché), *A. diplosidis* Crawford, *A. epicharmus* (Walker), *A. fabicola* (Rondani), *A. fonscolombei* Graham, *A. lycidas* (Walker), *A. minimus* (Ratzeburg), *A. rhipheus* (Walker) and *A. zoilus* (Walker), which are marked with an asterisk in the text.

List of species

***Aprostocetus* Westwood, 1833**

***Aprostocetus arenarius* (Erdös, 1954)** *

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°35' N 056°30' E, 2835m, August 2010, emerged from galls of *Diplolepis fructuum* (Rübsaamen) (Hym.: Cynipidae) on *Rosa beggeriana* Schrenk (A. Moeinadini), 1♀.

Distribution: Czech Republic, France, Corsica, Germany, Hungary, Italy, Slovakia, Yugoslavia, United Kingdom, Sweden.

Remarks: *Diplolepis fructuum* (Hym.: Cynipidae) was considered as a new host for *A. arenarius* for the first time in the present study as they are the larval endoparasitoids. According to Graham (1987) this species appears to be associated with grasses in dry habitats.

***Aprostocetus cecidomyiarum* (Bouché, 1834)** *

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°36' N 056°30' E, 2746m, April 2010, emerged from galls on *Ephedra major* Host (A. Moeinadini), 3♂♂.

Distribution: *Aprostocetus cecidomyiarum* is distributed across the Palaearctic region.

Remarks: It is a common primary parasitoid of many species of Cecidomyiidae (Diptera) and Cynipidae (Hymenoptera) and in association with many species of plants from several families such as Asteraceae (*Artemisia* spp.), Oleaceae (*Fraxinus* sp.), Salicaceae (*Salix* sp.) (Noyes, 2014).

Aprostocetus diplosidis* Crawford, 1907

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°35' N 056°30' E, 2943m, December 2010, emerged from galls of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana* (A. Moeinadini), 1♀ 1♂.

Distribution: *Aprostocetus diplosidis* is almost cosmopolitan in warm temperate and tropical regions.

Remarks: This species is recorded as an important parasitoid of midges *Contarinia sorghicola* (Coquillett, 1898) and *Stenodiplosis sorghicola* Coquillett, 1899 (Diptera: Cecidomyiidae) (Thompson, 1955, Barrow, 1974, Bonzi, 1979, Lampo, 1994, Campos *et al*., 1998). *Diplolepis fructuum* (Hym.: Cynipidae) was considered as a new host for *A. diplosidis* for the first time in the present study.

Aprostocetus epicharmus* (Walker, 1839)

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°34' N 056°30' E, 3077m, May 2011, emerged from galls of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana* (A. Moeinadini), 3♀♀ 2♂♂.

Distribution: *Aprostocetus epicharmus* is widely distributed in the Palaearctic region, from Europe to China.

Remarks: It is reported mainly as parasitoid of Cecidomyiidae (Diptera) and Cynipidae (Hymenoptera) (Noyes, 2014). It is in association with many species of plants from several families such as Asteraceae, Fabaceae, Papaveraceae, etc. (Noyes 2014). Graham (1987) reared it from a gall on *Linaria genistifolia* (L.) MILL. (Scrophulariaceae). In the present study, *D. fructuum* (Hym.: Cynipidae) was considered as a new host for *A. epicharmus* for the first time.

Aprostocetus fabicola (Rondani, 1877) *

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°35' N 056°30' E, 2835m, August 2010, emerged from galls of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana* (A. Moeinadini), 1♀.

Distribution: England, France, Hungary, Italy, Russia, Sweden, United Kingdom.

Remarks: *Aprostocetus fabicola* belongs to the *caudatus* species group (Graham, 1987). In the present study, *D. fructuum* (Hym.: Cynipidae) was considered as a new host for *A. fabicola* for the first time.

Aprostocetus fonscolombei Graham, 1987*

Material examined: Iran: Kerman province, Bardsir, Sang-e-Sayad, 29°39' N 056°44' E, 2666m, April 2011, emerged from galls of Cecidomyiidae on *E. major* (A. Moeinadini), 6♀♀.

Distribution: *Aprostocetus fonscolombei* was recorded only in Czech Republic, France, Russia, Spain, Yugoslavia.

Remarks: The species belongs to the *epicharmus* species group. The present study established trophic association of this species with the family *Cecidomyiidae emerged* from galls on *E. major* for the first time.

Aprostocetus lachares (Walker, 1839)

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°35' N 056°30' E, 2835m, August 2010, emerged from galls of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana* (A. Moeinadini), 5♀♀.

Distribution: England, France, Greece, Iran, Sweden, United Kingdom. From Iran Aprostocetus lachares is already reported from Mazandaran (Domenichini, 1966, Graham, 1987) and Fars Provinces (Hesami *et al*., 2006).

Remarks: Hosts of *Aprostocetus lachares* were unknown till the present study. The first trophic association of this species with *D. fructuum* was established in the present study. *A. lachares* is similar to *A. fabicola* in colour body and mesoscutum sculpture, from which it can be separated mainly by longer gaster and scutellum with submedian lines hardly nearer to sublateral lines than to each other (Graham, 1987).

Aprostocetus lycidas (Walker, 1839) *

Material examined: Iran: Kerman province, Bardsir, Sang-e-Sayad, 29°36' N 056°44' E, 2833m, April 2011, emerged from galls of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana*, 2♀♀, Iran: Kerman

province, Bardsir, Sang-e-Sayad, N29°39.403' E056°44.868', 2666m, April 2011, emerged from galls on *Artemisia sieberi* Besser (A. Moeinadini), 1♂.

Distribution: It is widely distributed across the Palaearctic region.

Remarks: *Aprostocetus lycidas* is known to parasitize nine species belonging to eight genera of Cecidomyiidae (Diptera) such as *Hartigiola annulipes* (Hartig), *Mikiola fagi* (Hartig) etc. It is in association with plants such as Fagaceae and Salicaceae (Noyes, 2014). *Diplolepis fructuum* (Hym.: Cynipidae) was established as a new host for *A. lycidas* for the first time in the present study.

Aprostocetus minimus (Ratzeburg, 1848) *

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°36' N 056°30' E, 2782m, August 2010, emerged from leaf galls of *Rabdophaga* sp. (Dip: Cecidomyiidae) on *Salix alba* L. (A. Moeinadini), 1♂.

Distribution: *Aprostocetus minimus* is distributed across the Palaearctic region.

Remarks: Species of the genus *Rhabdophaga* (Diptera: Cecidomyiidae) are considered as primary parasitoids in association with *Salix* sp. (Salicaceae) (Domenichini, 1966, Graham, 1987).

Aprostocetus rhipheus (Walker, 1839) *

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°36' N 056°30' E, 2746m, April 2010, emerged from galls on *E. major* (A. Moeinadini), 1♂.

Distribution: *Aprostocetus rhipheus* is distributed across the Palaearctic region.

Remarks: Its biology was already unknown. The present study revealed trophic association of *A. rhipheus* emerged from galls on *E. major* for the first time.

Aprostocetus zoilus (Walker, 1839) *

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°35' N 056°30' E, 2895m, April 2011, emerged from galls on *E. major*, 2♀♀ 1♂, Iran: Kerman province, Bardsir, Sang-e-Sayad, 29°39' N 056°44' E, 2666m, April 2011, emerged from galls on *E. major* (A. Moeinadini), 2♀♀.

Distribution: Palaearctic.

Remarks: *Phyllonorycter issikii* (Kumata, 1963) (Lepidoptera: Gracillariidae) (Yegorenkova *et al*., 2007) is considered as its host, and it is in association with plants such as *Alopecurus pratensis* (L.) (Poaceae) (Domenichini, 1966).

Baryscapus Föerster

Baryscapus hylesini Graham, 1991

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°36' N 056°30' E, 2746m, March 2010, emerged from galls on *E. major* (A. Moeinadini), 1♂.

Distribution: *Baryscapus hylesini* is distributed across the Palaearctic region. Yefremova *et al*. (2007) recorded this species for the first time from Isfahan province in Iran.

Remarks: *Baryscapus hylesini* has been recorded as parasitoid of *Agrilus suvorovi populneus* Schaef. (Coleoptera: Buprestidae) and *Hylesinus fraxini* Panzer, 1779 (Coleoptera: Curculionidae) (Graham, 1991, Yefremova *et al*., 2007).

Sigmophora Rondani, 1867

Sigmophora brevicornis (Panzer, 1804)

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°35' N 056°30' E, 2835m, August 2010, emerged from galls of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana* (A. Moeinadini), 2♀♀.

Distribution: Cosmopolitan. This species was recorded from Tehran province, Iran (Hesami *et al*., 2006).

Remarks: This species is in association with many species of plants from several families such as Fabaceae, Oleaceae, Rosaceae, etc. (Noyes, 2014). In Iran the species was cited by Hesami *et al*. (2006) as parasitoid of *Diplolepis rosae* (L.) (Hymenoptera: Cynipidae). *Diplolepis fructuum* (Hym.: Cynipidae) was established as a new host for *S. brevicornis* for the first time in the present study.

Stepanovia Kostjukov

Stepanovia eurytomae (Nees, 1834)

Material examined: Iran: Kerman province, Bardsir, Bidkhan, 29°36' N 056°30' E, 2746m, March 2010, emerged from galls on *Ephedra major*, 1♀, Iran: Kerman province, Bardsir, Bidkhan, 29°34' N 056°30' E, 3077m, May 2011, emerged from galls of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana* (A. Moeinadini), 5♀♀ 4♂♂.

Distribution: This species is distributed in the Palaearctic region and already reported from northeast and southeast Iran (Lotfalizadeh *et al*., 2006, 2012).

Remarks: *Stepanovia eurytomae* is a gregarious parasitoid in galls of several species of *Diplolepis* in the Palaearctic region including *Diplolepis mayri* (Schlechtendal), *D. eglanteriae* (Hartig), *D. spinosissimae* (Giraud) and *D. fructuum* (Graham, 1987). It was already stated as a parasite of *D. fructuum* (Lotfalizadeh *et al*., 2006, 2012). Data for emerging from galls on *Ephedra major* probably showed a new association for *S. eurytomae*.

DISCUSSION

Fourteen species of Tetrastichinae were found in this study from Kerman province, southeast Iran; of these, 10 species viz: *Aprostocetus arenarius* (Erdös), *A. cecidomyiarum* (Bouché), *A. diplosidis* Crawford, *A. epicharmus* (Walker), *A. fabicola* (Rondani), *A. fonscolombei* Graham, *A. lycidas* (Walker), *A. minimus* (Ratzeburg), *A. rhipheus* (Walker) and *A. zoilus* (Walker) were recorded for the first time from Iran, which increased the number of known Tetrastichinae in Iran from 45 to 55 species. Among the known species of Tetrastichinae in Iran, *Citrostichus phillocnistoides* (Narayanan, 1960) was already recorded from Kerman province (Yefremova *et*

al., 2007, Ebrahimi *et al.,* 2009). To date only two species, *Stepanovia aurantiaca* (Ratzeburg, 1852) and *Stepanovia eurytomae* (Nees, 1834) reported on *D. fructuum* in Iran (Kostjukov, 1978, Lotfalizadeh *et al*., 2012). In the present study new host associations of *D. fructuum* (Hym.: Cynipidae) on *R. beggeriana* with six species of *Aprostocetus* namely *Aprostocetus arenarius, A. diplosidis, A. epicharmus, A. fabicola, A. lachares, A. lycidas* and also *Sigmophora brevicornis* as well as trophic association of *A. rhipheus* emerged from galls on *E. major* was reported for the first time. However 45 species of parasitoids belonging to 18 genera are known to be associated with *Diplolepis* species on *Rosa* spp. in the Palaearctic region (Askew 1960, Schröder 1967, Nordlander 1973, Zerova and Djakontshuk 1976, Nieves-Aldrey 1981, Pujade-Villar 1992, Noyes 2014), there are limited data on parasitoids of *Diplolepis fructuum* Rübsaamen (Diplolepidini) in the Western Palaearctic. Several studies show that 24 species of parasitic hymenoptera belonging to seven families, Eulophidae, Eupelmidae, Eurytomidae, Pteromalidae, Torymidae (Chalcidoidea), Ichneumonidae (Ichneumonoidea), Cynipidae (Cynipoidea) are known to be associated with *D. fructuum* in Iran (Rakhshani *et al*., 2003, Talebi *et al*., 2004, Mohammadi *et al*., 2011, Lotfalizadeh *et al*., 2006, 2007, 2009, 2012). These studies demonstrate that there are a large number of parasitic species reared from *D. fructuum* in Kerman province, southeast Iran. Studies of the insect fauna and its distribution are of considerable importance for local and national insect biodiversity plans. It is estimated that there are many more species of parasitic hymenoptera that are associated with *D. fructuum* in southeast Iran and even other regions that needs more samplings to be discovered.

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