

Research Article

A survey of Metopiinae (Hymenoptera: Ichneumonidae) in southern Iran, with three new records

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Abstract: The subfamily Metopiinae was taxonomically studied in Fars and Hormozgan provinces during 2011–2013. The specimens were collected by using Malaise traps and sweep net. Five species were collected and identified, of which three species are recorded for the first time from Iran: *Colpotrochia cincta* (Scopoli, 1763), *Exochus suborbitalis* Schmiedeknecht, 1924, and *Metopius (Peltocarus) turcestanicus* Clement, 1930. An identification key to the species and an updating checklist of Metopiinae of Iran, as well as zoogeographical notes are provided.

Keywords: Fars, Hormozgan, Metopiinae, Taxonomy

Introduction

The subfamily Metopiinae with 26 genera and 838 species is a medium-sized, cosmopolitan and one of the most frequently encountered groups in the family Ichneumonidae (Hym., Ichneumonoidea) (Yu *et al.*, 2012). Many metopiines are common and some of them are large and spectacular. Species of the genus *Metopius* Panzer, 1806 reach a little more than 2cm in length and frequently are black with yellow stripes (Quicke, 2015). Some of smaller taxa, such as *Exochus* Gravenhorst, 1829, are noted to produce a pungent odor when captured or handled, and this presumably serves as a defensive role (Townes and Townes, 1959). Members of this subfamily are koinobiont endoparasitoids of concealed lepidopterous larvae mainly belonging to Tortricidae and Pyralidae (Yu *et al.*, 2012). Eggs are deposited into the host larvae, often into a thin tissue, but adults emerge from the host pupae (Quicke, 2015). The ovipositor

are short and barely exerted, so when concealed hosts are attacked, the female parasitoids enter the caterpillar's retreat and their usually short robust legs and protruding smooth face are likely to be adaptations to push their way into the retreat and gain access (Quicke, 2015).

Except for some groups of pimpliformes (Mohammadi Khoramabadi *et al.*, 2013a; 2013b; Mohammadi Khoramabadi and Talebi, 2013), the taxonomy of Iranian Ichneumonidae has poorly been studied. Prior to this study, seven species of Metopiinae were reported from Iran (Barahoei *et al.*, 2012). The first species, *Exochus gravipes* was reported by Kolarov and Ghahari (2005). Among the countries bordering Iran, the fauna of Turkey has well been studied (Kolarov and Beyarslan, 1993; Kolarov and Özbeck, 1998; Çoruh *et al.*, 2002). In this research, occurrence of Metopiinae species was studied in the field work in Hormozgan and Fars provinces. An updated checklist with a key to identification of Iranian Metopiines is presented.

Materials and Methods

Sampling was performed by using Malaise traps and sweep net at different locations in

Handling Editor: Samira Farahani

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Received: 02 June 2015, Accepted: 25 July 2015

Published online: 14 August 2015

Fars and Hormozgan provinces during February 2011–August 2013. Different ecosystems were surveyed including forests, pastures, desert plants and mangrove (*Avicennia marina*), fruit orchards (tropical and non-tropical trees) and agro-ecosystems. Specimens were collected at two-week intervals using 24 Malaise traps. The captured specimens were extracted from the collecting jars, then treated with mixture of ethanol (60%) /Xylene (40%) for two days followed by Amyl acetate for two days (AXA) and finally placed on the filter paper for drying (van Achterberg, 2009). The dried specimens were then card mounted and labeled. Morphological terminology predominantly follows Townes (1969). Microsculpture terminology follows Eady (1968). Relevant literature (Townes, 1971; Kasparyan, 1981; Tolkanitz, 2007) was used for identification of the specimens. Illustrations were taken using an Olympus™ SZX9 stereomicroscope equipped with a Sony™ digital camera. A series of 7–10 captured images were merged into a single in-focus image using the image-stacking software ZereneStacker version 1.04. The specimens are deposited in the Collection of Department of Entomology, Tarbiat Modares University (TMUC), Tehran, Iran.

Results

Five species belonging to three genera of the subfamily Metopiinae were collected and identified, of which three species *Colpotrochia cincta* (Scopoli, 1763), *Exochus suborbitalis* Schmiedeknecht, 1924 and *Metopius (Peltocarus) turcestanicus* Clement, 1930 are new records for the Iranian fauna. The species are listed alphabetically with short description for the newly recorded species.

Key to genera and species of Metopiinae known from Iran

1- Face with a large flat or concave shield-shaped area bounded by a carina (Fig. 3A); mid tibia with one spur (genus *Metopius*).....2

- Face entirely convex and without shield-shaped area (Figs. 1A, 2A); mid tibia with two spurs.....5

2- Lower teeth of mandible present or absent; if present, attached to the lower outer edge of the upper teeth, not shifted to or slightly shifted to backward of the mouth; the lower edge of the clypeus is prominent above the base of labrum3

- Lower teeth of mandible strongly shifted backward into the mouth of the recess and located on the lower outer margin of the upper teeth; the lower edge of the clypeus not prominent above the base of labrum3

***Metopius (Tylopius) pinatorius* Brulle, 1846**

3- The median carina of frons running down between antennae and reaching to upper margin of the shield-shaped area, shield slightly separated from the rest of the face; second recurrent vein with two bullae; length of hind femur 4X its maximum width***Metopius (Peltocarus) croceicornis* Thomson, 1887**

- The median carina of frons not reaching to the upper margin of the shield-shaped area (Fig. 3A); second recurrent vein with one bulla (Fig. 3H); length of hind femur 3X its maximum width4

4- Occipital carina complete, often joint to hypostomal carina; antennal flagellum long and slender; mandibles with small lower tooth***Metopius (Metopius) vespoides* (Scopoli, 1763)**

- Occipital carina incomplete, only present in upper part; antennal flagellum usually short and thick; mandibles unidentate (Figs. 3A, 3B)..... ***Metopius (Ceratopius) turcestanicus* Clement, 1930**

5- Antennal sockets separated by a well-developed vertical lamella (Fig. 1A), vertical lamella with a deep median groove dorsally (Fig. 1B); areolet of fore wing present or absent (genus *Colpotrochia*) 6

- Antennal sockets not separated by a vertical lamella, or if lamella present, without median groove (Figs. 2A, 3A, 4A, 4B); areolet of fore wing absent 7

6- Fore wing without areolet (Fig. 1I); mid femur black, mid and hind tibiae yellow

medially; 5.5–9.0 mm*Colpotrochia cincta* (Scopoli, 1763)

- Fore wing with areolet; all femuræ and tibiae red; 9.0–9.5 mm.....*Colpotrochia tricolor* (Aubert, 1979)

7- Epipleuron of third metasomal tergite widened toward apex, areola of propodeum not wider than the second lateral fields; hind tibia reddish-yellow, pterostigma yellowish-brown, face of female black, often with yellow triangular protuberance between the base of the antennae *Exochus gravipes* (Gravenhorst, 1820)

- Epipleuron of third metasomal tergite semicircular (Figs. 2G, 4C, 4G), areola of propodeum almost wider than second lateral fields; hind tibia yellowish brown; pterostigma brownish, face of female whitish in upper part and black in lower part (Figs. 4A, 4E)..... 8
8- Occipital carina complete and well developed in upper part (Figs. 4B, 4D); hind femur reddish brown; lower margin of clypeus almost semicircular (Fig. 4A)

Exochus mitratus (Gravenhorst, 1829)

- Occipital carina incomplete and absent in upper part (Fig. 4F); lower margin of clypeus straight or slightly cut in the middle (Fig. 4E)

9- Head and mesosoma black, metasoma red (sometimes reddish-brown); face black, its upper part with almost narrow yellow transverse stripe; legs reddish brown

10- Body entirely black, face black, its upper part with broad yellow transverse stripe (Fig. 2A); legs reddish-yellow or seldom reddish-brown*Exochus suborbitalis* Schmiedeknecht, 1924

10- Metasoma black, except first, second and third tergites with red spots at apex; hind tibia reddish-yellow with clear light ring in the base; areola of propodeum separated from the basal area with a transverse carina; face of female and male black with yellow transverse stripe on upper parts.....*Exochus britannicus* Morely, 1911

a. Metasoma reddish-brown or red, except for the first and last tergites which are black at apex (Fig. 4G), face in female black with yellow stripe at the upper edge (Fig. 4E), face in male

black with more or less broad yellow stripes along the upper and lateral margin, vertex with large yellow triangle spots (Fig. 4F)

.....*Exochus castaniventris* Brauns, 1896
Colpotrochia cincta (Scopoli, 1763) (Fig. 5B)

Material examined: Iran, Fars province, Seddeh, Malaise trap (30°41'2.99" N, 52°08'13.46" E, 2140 m a.s.l.), 23.v.2012, 3♀, leg.: A. Amiri

Diagnostic characters (female): Body length 12–13 mm; face almost evenly convex (Fig. 1A), apical margin of clypeus straight, not separated from the face, malar space 0.33X as long as basal width of mandibles, temple 1.3X as wide as transverse diameter of the eye in lateral view (Fig. 1C), head roundly narrowed behind the eye (Fig. 1B), mandible strong and bidentate, punctuated evenly and distance of space between holes more than their diameter, vertical lamella well developed between the antennal sockets (Fig. 1B); antenna 58-segmented, its length as long as or slightly longer than body; mesonotum finely and scarcely punctuated, postscutellum carinated in 0.66 of its length (Fig. 1D), mesopleura and metapleura with scattered punctures and hairs (Figs. 1E, 1F), spiracle of metanotum very large, narrowed and linear (Fig. 1F), propodeal carina weakly developed or absent (Fig. 1E); radius originated from middle of stigma, its outer section strongly concave (Fig. 1I), areolet absent, nervulus postfurcal, second recurrent vein sinuated (Fig. 1I); femur thickened, hind femur 2.6X as long as its width; first metasomal tergite 2X as long as its apical width, with long and deep suture in the middle (Fig. 1G), length of second tergite as long as its width, other segments transverse (Fig. 1H); ovipositor very short.

Coloration: Antenna yellowish red, head and mesosoma completely black, tegula, apical half apex of scutellum and post scutellum yellow, apex of first segment, second and third metasomal segments

completely and basal half of fourth segment yellow, all coxa black, outer sides of trochanter, fore and mid femur black, all tibiae and tarsi yellow, hind trochanter and hind femur black, apex of hind tibia brown,

General distribution: Palearctic region (Yu *et al.*, 2012), Iran (**new record**).

Exochus castaniventris Brauns, 1896 (Fig. 5C)

Material examine: Iran, Fars province, Seddeh, sweep net (30°42'28.52" N, 52°9'47.44" E, 2140 m a.s.l.), 4♀, 2♂, 22.vi.2013, Dejekord (30°43'58.91" N, 51°56'55.10" E, 2171 m a.s.l.), 2♀ 8♂, 20.v.2013, Jahrom, Malaise trap (28°40'26.14" N, 53°33' 52.91" E, 1004 m a.s.l.) 8♀ 4♂, 25.iv. 2013, leg.: A. Amiri.

General distribution: Palearctic region (Yu *et al.*, 2012).

Exochus mitratus Gravenhorst, 1828 (Fig. 5D)

Material examined: Iran, Fars province, Seddeh, sweep net (30° 42' 28.52" N, 52° 9' 47.44" E, 2140 m a.s.l.), 22.vi.2013 2♀ 2♂, leg.: A. Amiri; Hormozgan province, Zakin, Malaise trap (27°28'53.23" N, 56°18'27.03" E, 680 m a.s.l.), 02.v.2013, 2♂, leg.: A. Ameri.

General distribution: Palearctic region (Yu *et al.*, 2012).

Exochus suborbitalis Schmiedeknecht, 1924 (Fig. 5E)

Material examined: Iran, Fars province, Seddeh, sweep net (30° 42' 28.52" N, 52° 9' 47.44" E, 2140 m a.s.l.) 1♀, 1♂, 22.vi.2013, leg.: A. Amiri; Hormozgan province, Haji Abad, Tezerj, Malaise trap (28° 17' 1.81" N, 55°45'14.76" E, 882 m a.s.l.) 1♂, 25.iv.2013, leg.: A. Ameri.

Morphological characters (female): Body length 6-8mm; face convex evenly smooth (Fig. 2A), clypeus not separated from face, its apical margin straight and smooth, temple 1.2X as long as transverse diameter of eye (Figs. 2B, 2C), vertex smooth with two triangular yellow spots (Fig. 2B); mesonotum finely punctate (Fig. 2D), mesopleuron smooth and shiny

(Fig. 2C), areola of propodeum almost wide, not separated from basal area by a carina (Fig. 2E), second lateral and petiolaris area are bare; fore wing without areolet, nervulus postfurcal (Fig. 2H); first metasomal tergite with two longitudinal carinae (Fig. 2F), metasomal tergites transverse, epipleuron of third metasomal tergite semicircular (Fig. 2G).

Coloration: Basal antennal segments (scape and pedicel) black to dark brown, flagellum brown, face black with yellow broad strip in its upper part, mandible brown in base and apex, apex of scutellum, hind coxa, trochanter and tibia reddish yellow, base and apex of hind tibia and apex of hind tarsal segments black, fore and mid legs yellow, other parts shiny black.

General distribution: Palearctic region (Yu *et al.*, 2012), Iran (**new record**)

Metopius (Peltocarus) turcestanicus Clement, 1930 (Fig. 5A)

Material examined: Iran, Hormozgan province, Zakin, Malaise trap (27°28'53.23" N, 56°18'27.03" E, 680 m a.s.l.), 17.iv.2012, 1♀, Roodan-Fariab (27°28'5.32" N, 57° 4' 25.42" E, 313 m a.s.l.), 16.iv.2012, 2♀, Leg.: A. Ameri

Morphological Characters (female): Body length 13-14mm, shiny; face with concave and large shield-shaped area that is entirely carinated (Fig. 3A), clypeus rugose, its apical margin straight; mandibles strong and unidentate (Figs. 3A, 3B), scarcely and deeply punctate; temple roundly narrowed behind eyes in dorsal view (Fig. 3C), 0.5X as wide as transverse diameter of eye in lateral view (Fig. 3B), malar space 0.2X as long as basal width of mandibles, vertical lamella well developed between antennal sockets, but not extending to upper ridge of face (Fig. 3A), antenna with 46 segments, all segments are transverse except first and last segments; mesonotum densely punctuated (Fig. 3D), rugose, scutellum strongly carinated to apex (Fig. 3E), pronotum with longitudinal striation in lower half (Fig. 3F) punctate in upper half, mesopleuron densely punctate in lower half part (Fig. 3F),

costula present and complete (Fig. 3E), propodeal spiracle very large, narrow and linear; radius originating from middle of stigma, radial cell covered with brown color, fore wing with large areolet (Fig. 3H), second recurrent vein originating from middle of areolet, nervulus postfurcal and reclivous

(Fig. 3H); hind femur thickened, its length 3.2X its maximum width; first metasomal tergite smooth in lateral and punctuate in the middle (Fig. 3G), all metasomal tergites transverse, second to last tergites rugose (Fig. 3G); ovipositor short.

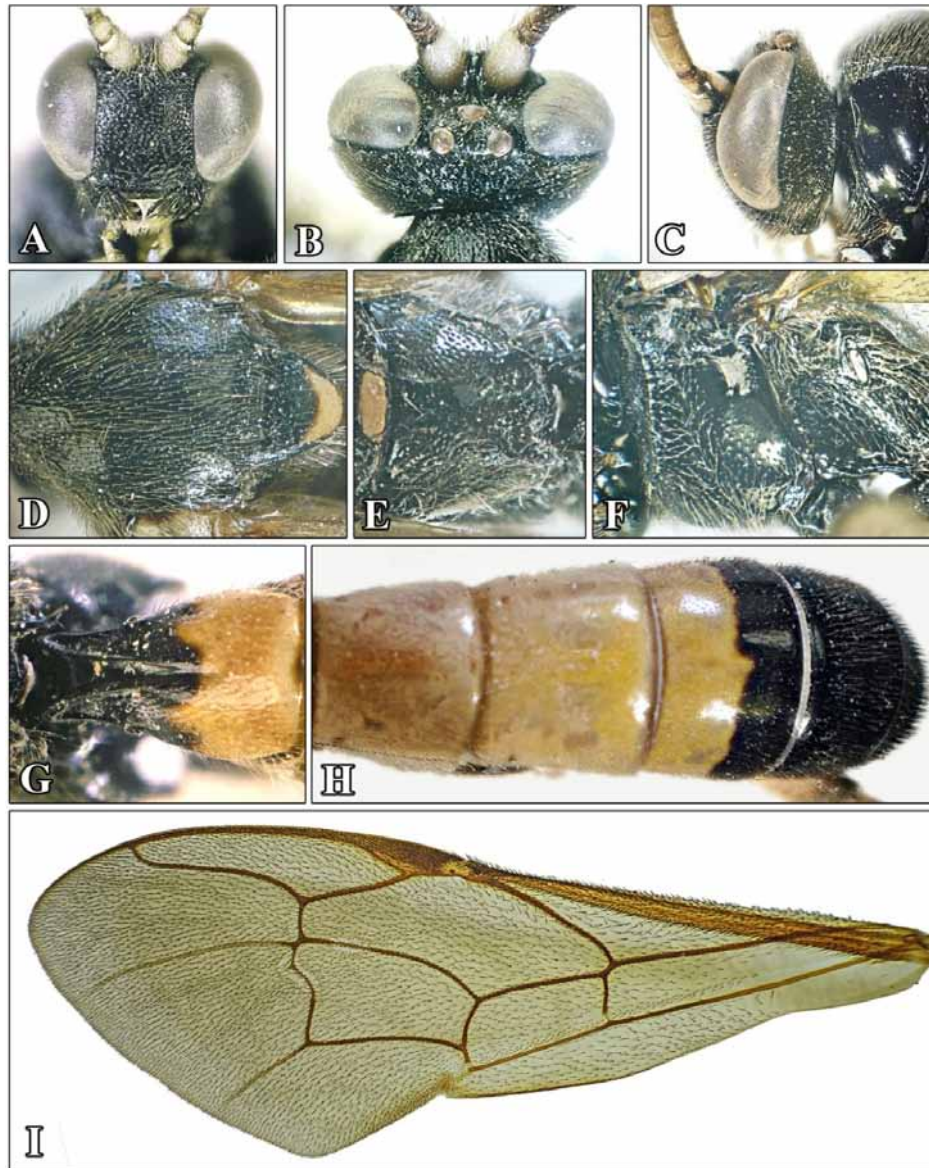


Figure 1 *Colpotrochia cincta*, A) head, frontal view; B) head, dorsal view; C) head, lateral view; D) mesonotum and scutellum; E) propodeum, dorsal view; F) mesosoma, lateral view; G) first metasomal tergite, dorsal view; H) metasomal tergite, dorsal view; I) fore wing.

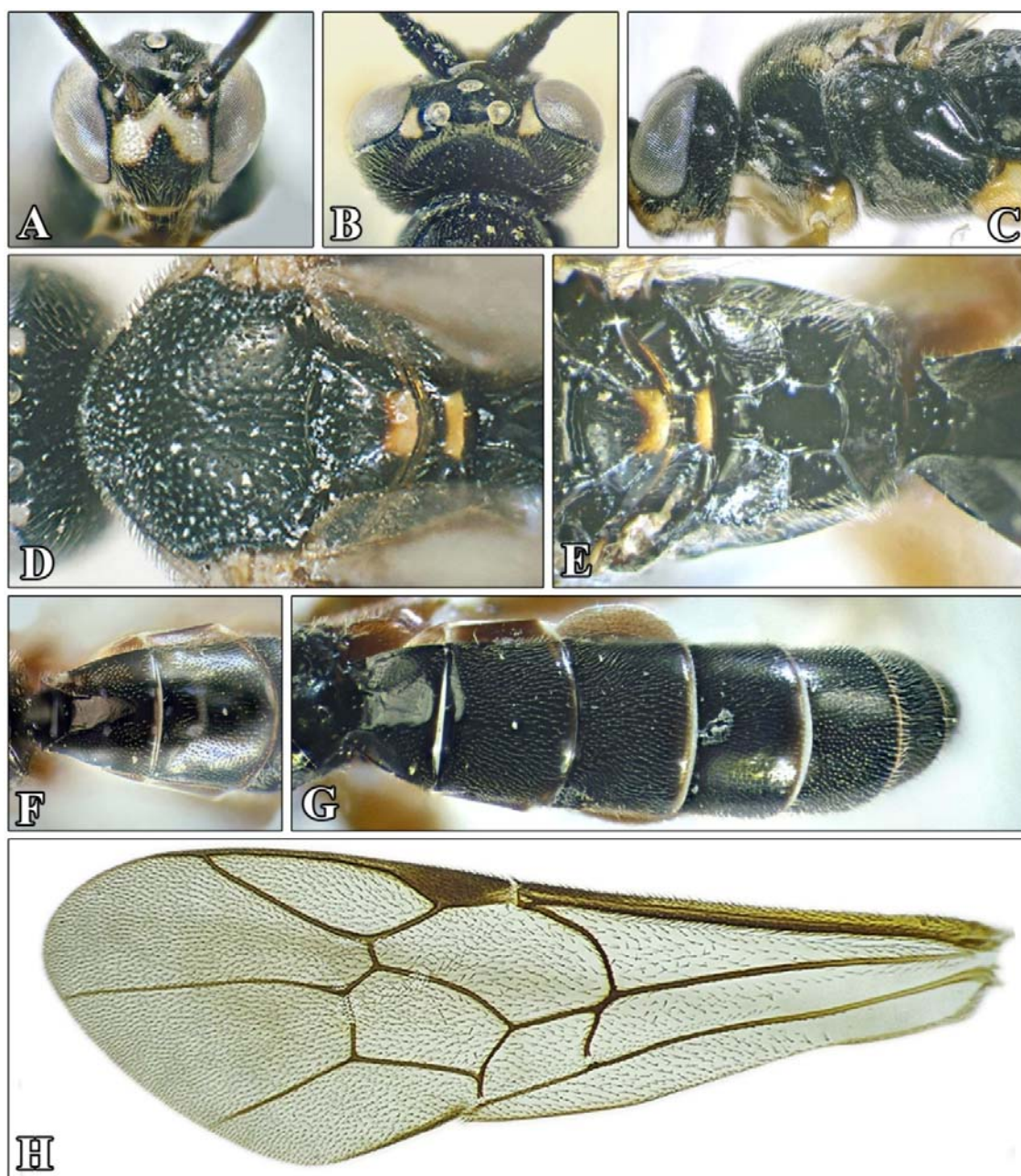


Figure 2 *Exochus suborbitalis*, A) head, frontal view; B) head, dorsal view; C) mesosoma, lateral view; D) mesonotum and scutellum, dorsal view; E) propodeum, dorsal view; F) first and second metasomal tergites, dorsal view; G) metasomal tergite, dorsal view; H) fore wing.

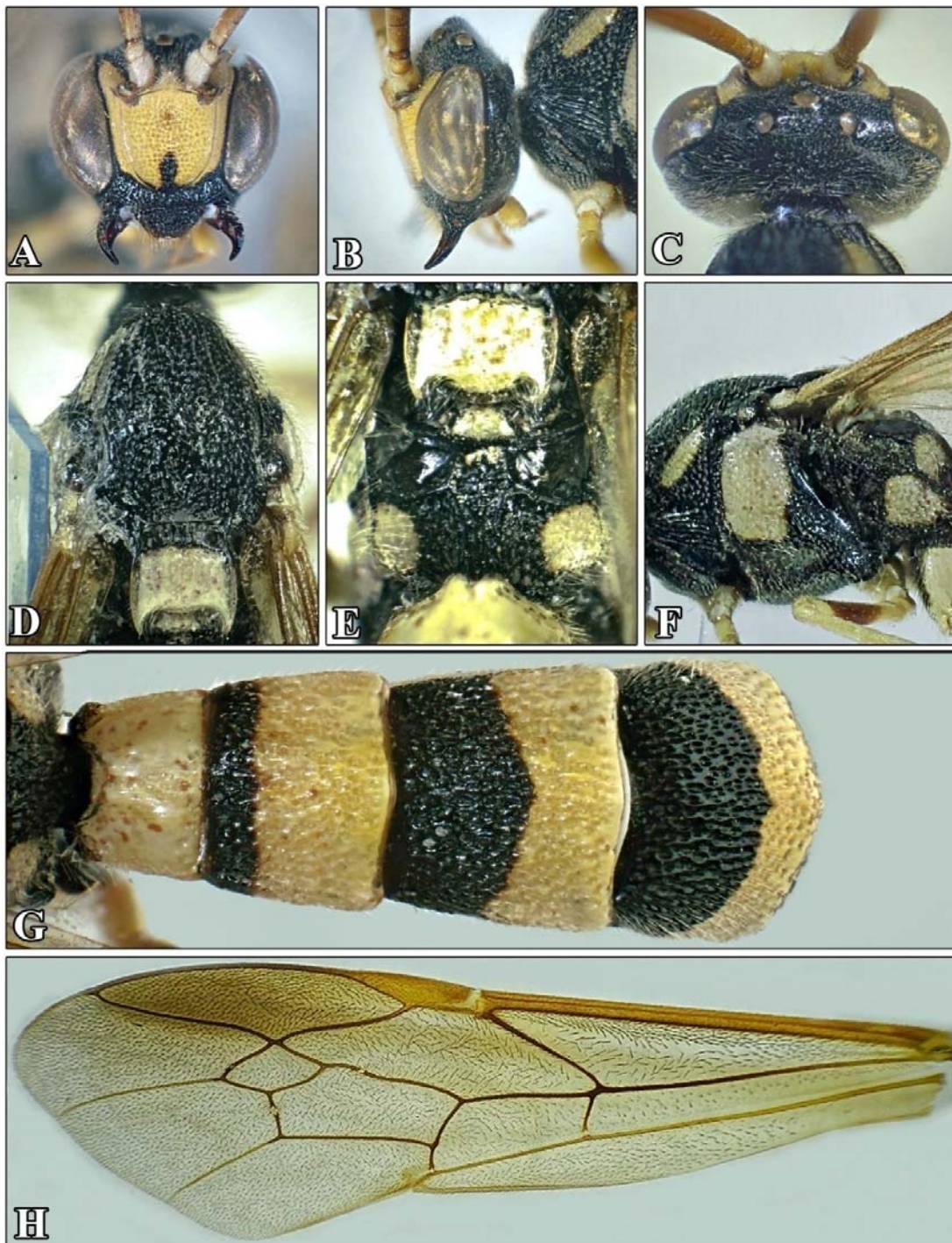


Figure 3 *Metopius turcestanicus*, A) head, frontal view; B) head, lateral view; C) head, dorsal view; D) mesonotum and scutellum, dorsal view; E) propodeum, dorsal view; F) mesosoma, lateral view; G) metasomal tergites, dorsal view; H) fore wing.

Coloration: Basal segment of antenna yellow (scape and pedicel), flagellum reddish brown, face yellow, clypeus and labrum black, mandible black, brownish in the middle, fore head black, mesosoma black, tegulae dark brown, scutellum and post scutellum yellow, first metasomal tergite completely yellow, 2nd-8th segment at basal half

black, propleuron, mesopleuron and metapleuron partly yellow, fore and mid tibia and tarsus completely yellow, front and middle femur in dorsal part, hind coxa and femur partly black, hind basitarsus yellowish, other tarsal segments brownish

General distribution: Palearctic region (Yu *et al.*, 2012), Iran (**new record**).

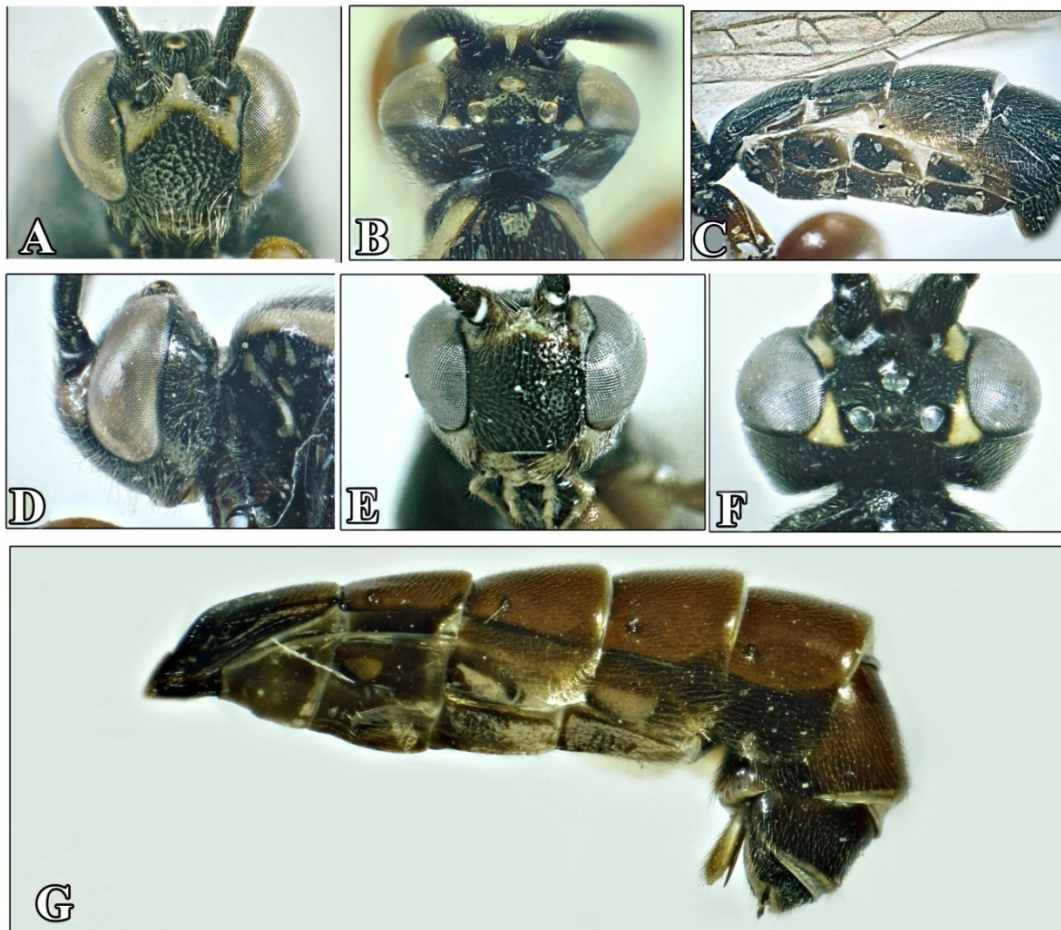


Figure 4 A-D: *Exochus mitratus*, A) head, front view; B) head, dorsal view ; C) metasomal tergite, lateral view; D) head, lateral view; E-G: *Exochus castaniventris*, E) head, frontal view; F) head, dorsal view; G) metasomal tergite, lateral view.

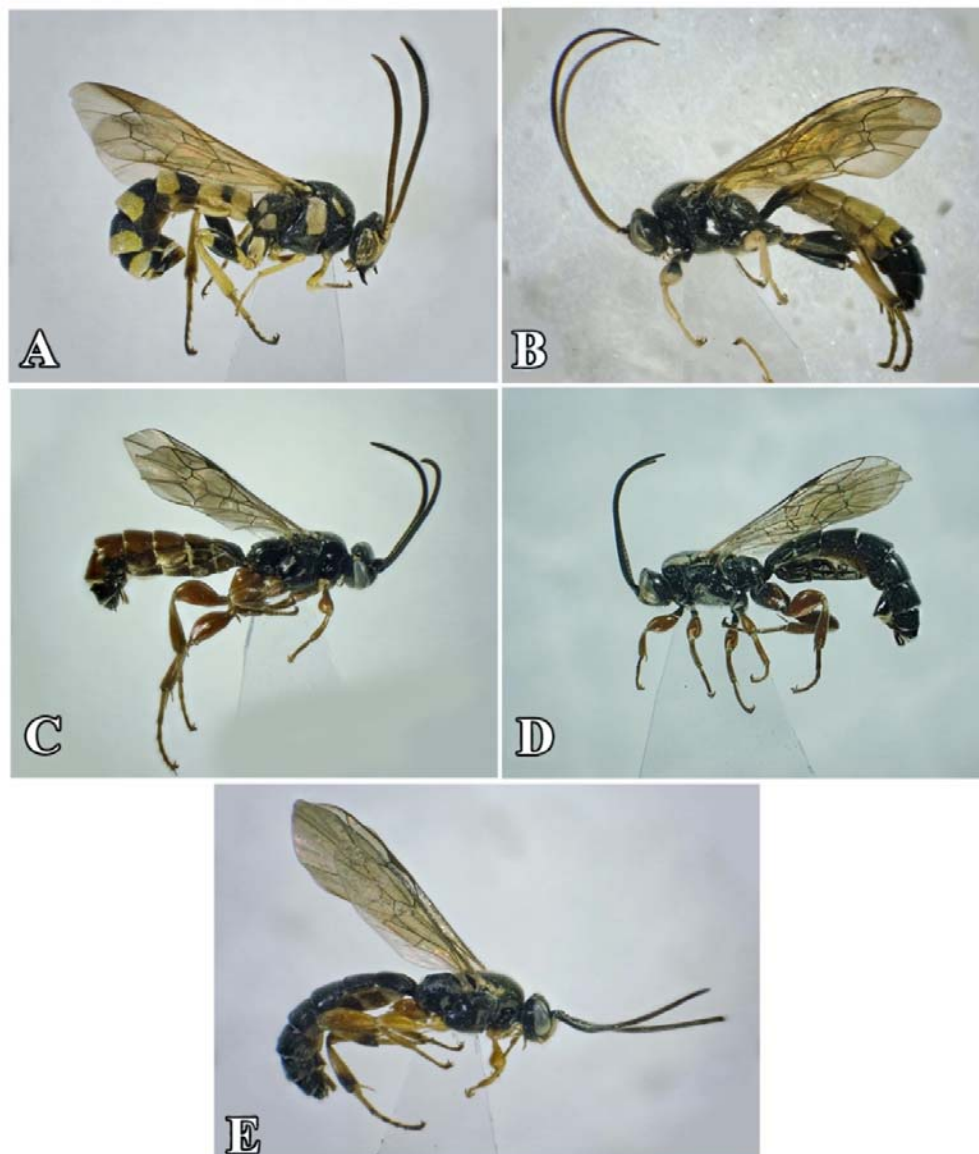


Figure 5 Lateral view of female in Metopiinae species, A) *Metopius (Peltocarus) turcestanicus*; B) *Colpotrochia cincta*; C) *Exochus castaniventris*; D) *Exochus mitratus*; E) *Exochus suborbitalis*.

Discussion

The results of this study and review of the previously recorded taxa revealed the existence of 11 species belonging to three genera in Iran (Table 1). Considering the 838 known species of Metopiinae in the world and more than 450

species in the Palaearctic region (Yu *et al.*, 2012), the occurrence of 11 species indicates our poor knowledge about distribution of this subfamily in Iran. This is the first record of the subfamily Metopiinae in Hormozgan and Fars provinces and all species studied are new records to these provinces. The number of

species recorded in Iran is much lower than neighboring countries such as Turkey (58 species), European countries such as, Germany (95 species), Hungary (65 species), Russia (196 species), Poland (107 species), and Eastern Palearctic countries such as China (156 species), Korea (32 species) and Japan (123 species) (Yu *et al.*, 2012). Our finding showed that some species of Metopiinae (e. g. *Exochus* sp.) are common in humid regions such as coast lines of rivers and lakes, where immature stages of Lepidoptera feed in rolled-up or folded leaves (Townes, 1971). The genus *Metopius* has a worldwide distribution and contains about 145 species (Yu *et al.*, 2012). However, only one species, *M. turcestanicus* was collected in Hormozgan province. The favorite habitat of *Metopius* species has been considered to be dry and open places (Townes, 1971). The unsuitable location of the Malaise traps can also be a reason for the low diversity of the collected material. The genus *Colpotrochia* is also a worldwide taxon, with species that are mostly found in tropical areas with shaded shrubbery (Townes, 1971). The genus *Exochus* is the

largest genus of this subfamily (Yu *et al.*, 2012) that is frequently reported in deciduous trees of the northern Hemisphere (Townes, 1971).

Biogeographic and bioclimatic regions are the fundamental units of comparison in many broad-scale ecological and evolutionary studies (Abbasi *et al.*, 2012). In order to conserve the beneficial insects, we need to have knowledge of their exact geographic distributions. Geographic records of parasitic wasps of the family Ichneumonidae as potential biological control agents can provide useful data for conservation of natural enemies of insect pests. Species zoogeographical characterization for each species is based on the chorotype classification of the Middle East fauna proposed by Taglianti *et al.* (1999) as follow: Holarctic chorotype (*E. gravipes* and *E. mitratus*), Palearctic chorotype (*Colpotrochia cincta*), Eastern-European chorotype (*Exochus britannicus* and *E. suborbitalis*), Central Asiatic–European–Mediterranean chorotype (*Exochus castaniventris*), Central Asiatic–Mediterranean chorotype (*Metopius (Cultrarius) turcestanicus*), Anatolian endemic (*Colpotrochia triclitor*).

Table 1 Updated checklist of Metopiinae species known in Iran.

Species	Distribution in Iran (provinces)	References
<i>Colpotrochia cincta</i> *	Fars	Current study
<i>C. triclitor</i>	Ardabil, Hamedan	Ghahari and Jussila (2010) Ghahari and Jussila (2014)
<i>Exochus britannicus</i>	Khorasan-e-Razavi	Barahoei <i>et al.</i> (2012)
<i>E. castaniventris</i>	Isfahan, Tehran, Semnan Fars	Masnadi and Jussila (2009) Ghahari (2012) Current study
<i>E. gravipes</i>	Not exactly defined	Kolarov and Ghahari (2005)
<i>E. mitratus</i>	Tehran, Fars, Hormozgan	Masnadi and Jussila (2009) Current study
<i>E. suborbitalis</i> *	Fars	Current study
<i>Metopius (Peltocarus) turcestanicus</i> *	Hormozgan	Current study
<i>M. (Peltocarus) croceicornis</i>	Tehran	Masnadi and Jussila (2009)
<i>M. (Peltocarus) vespulator M. (Peltastes) pinatorius</i>	Tehran, Qazvin West Azerbaijan	Klopfstein and Baur (2011) Ghahari and Jussila (2014)

* New records for the Iranian insect fauna.

The members of Metopiinae are parasitoids of both fully exposed and weakly concealed hosts such as leaf rollers and other important pests such as tortricids and pyralids. Identification of parasitoid species is an essential requirement of integrated pest management in different ecosystems. Therefore, the results of this study may be helpful to researchers or IPM users.

Acknowledgments

We would like to thank the Department of Entomology, Tarbiat Modares University for providing financial support for this research. We are grateful to Dr. D. Yu for sending papers and three anonymous reviewers for valuable comments and suggestions in the earlier version of this paper.

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مطالعه زنبورهای زیرخانواده (Metopiinae (Hymenoptera: Ichneumonidae) در جنوب ایران به همراه سه گزارش جدید

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دریافت: ۱۲ خرداد ۱۳۹۴؛ پذیرش: ۳ مرداد ۱۳۹۴

چکیده: در این مطالعه، تاکسونومی زیرخانواده Metopiinae طی نمونه برداری های انجام شده در سال های ۱۳۹۱ و ۱۳۹۲ در استان های فارس و هرمزگان بررسی شد. با استفاده از تور حشره گیری و تله مالیز پنج گونه جمع آوری و شناسایی شدند که از بین آنها سه گونه شامل *Colpotrochia cincta* (Scopoli, 1763)، *Exochus suborbitalis* Schmiedeknecht, 1924 و *sturcestanicus* Clement, 1930 برای فون ایران جدید می باشد. کلید شناسایی گونه ها، فهرست به روز شده و یادداشتی در مورد جغرافیای زیستی زیرخانواده Metopiinae تهیه شده است.

واژگان کلیدی: فارس، هرمزگان، Metopiinae، تاکسونومی