

## Study on Diplazontinae (Hymenoptera: Ichneumonidae) in north central Iran

Abbas Mohammadi-Khoramabadi<sup>1</sup>, Ali Asghar Talebi<sup>1\*</sup> and Kees Zwakhals<sup>2</sup>

1. Department of Entomology, Faculty of Agriculture, Tarbiat Modares University, P. O. Box: 14115-336. Tehran, I. R. Iran.

2. Dr. Dreeslaan 204, 4241 CM Arkel, the Netherlands, e-mail: keeszwakhals@yahoo.com.

**Abstract:** The fauna of the subfamily Diplazontinae (Hymenoptera: Ichneumonidae) in the north central parts of Iran was studied during 2010-2011. A total of 933 specimens were collected in 30 localities at different altitudes using Malaise traps. Sixteen species belonging to 7 genera were identified of which twelve species indicated by asterisk, are new records for Iran: *Diplazon annulatus* (Gravenhorst)\*, *Diplazon laetatorius* (Fabricius), *D. pectoratorius* (Gravenhorst)\*, *D. tibiatorius* (Thunberg)\*, *Enizemum ornatum* (Gravenhorst), *Homotropus nigratarsus* (Gravenhorst)\*, *Homotropus pictus* (Gravenhorst)\*, *Promethes sulcator* (Gravenhorst), *Sussaba flavipes* (Lucas)\*, *Sussaba pulchella* (Holmgren)\*, *Syrphoctonus tarsatorius* (Panzer)\*, *Syrphophilus bizonarius* (Gravenhorst)\*, *Tymmophorus obscuripes* (Holmgren)\*, *Woldstedtius biguttatus* (Gravenhorst), *Woldstedtius citropectoralis* (Schmiedeknecht)\* and *Xestopelta gracilima* (Schmiedeknecht)\*. Detailed morphological characters and a key to the genera and species are provided. Flight periods and distribution in relation to altitude on two slopes of the Alborz mountains are discussed.

**Keywords:** Ichneumonidae, Diplazontinae, taxonomy, new record, identification key, Iran

### Introduction

Diplazontinae Viereck, 1918 is a small subfamily of Ichneumonidae (Insecta: Hymenoptera) with about 340 described species of which 171 species occur in the Palaearctic region (Yu and Horstmann, 1997; Yu *et al.*, 2005). Diplazontinae species can be easily distinguished from other ichneumonids by the bifid upper tooth of the mandible and the rectangular first metasomal tergite in most genera (Fitton and Rotheray, 1982; Wahl and Gauld, 1998; Manukyan, 2007). Based on their biology as koinobiont endoparasitoids of

aphidophagous hoverflies (Diptera: Syrphidae), they can be regarded as monophyletic (Wahl and Gauld, 1998; Sugonyaev, 2006; Quicke *et al.*, 2009).

The subfamily Diplazontinae is taxonomically classified into 23 extant monophyletic genera, each with special structure and behavior (Klopfstein *et al.*, 2010a; Klopfstein *et al.*, 2010b; Steiner *et al.*, 2010; Klopfstein, 2011; Klopfstein *et al.*, 2011). Most species have a wide distribution, as more than 70% of world Diplazontinae species belong to 14 genera distributed in the Holarctic region (Manukyan, 1995), where their aphidophagous hoverfly hosts (Diptera: Syrphidae) are very diverse and abundant (Rotheray, 1990; Greco, 1997; Bordera Sanjuán *et al.*, 2000; Jankowska, 2004; Kustov, 2006; Smith and Chaney, 2007; Cappadonna *et al.*, 2009).

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\* **Corresponding author**, e-mail: talebia@modares.ac.ir

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Study on Diplazontinae fauna in Iran has received limited attention with the report of six species from five genera (Malkeshi and Kheiabani, 1997; Kolarov and Ghahari, 2005; Manukyan, 2007; Masnadi-Yazdinejad and Jussila, 2008; Nourbakhsh *et al.*, 2008; Zarepour-Ashkezari *et al.*, 2009; Zarepour-Ashkezari *et al.*, 2010; Barahoei *et al.*, 2012; Barahoei *et al.*, 2013). The northern part of Iran is biogeographically represented by Alborz mountains extended in five provinces (Alborz, Tehran, Qazvin, Guilan and Mazandaran). More than 45 species of Syrphidae (Insecta: Diptera) (Kazerani, 2012), but only two species of Diplazontinae have been recorded from this region (Kolarov and Ghahari, 2005; Masnadi-Yazdinejad and Jussila, 2008).

This study was conducted to survey the Diplazontinae fauna in the central north of Iran with two years of Malaise trapping. Here we present phenological data for 16 species on the northern and southern slopes of the Alborz Mountains of Iran.

### Materials and Methods

The present study was carried out in 30 localities in Tehran, Guilan, Qazvin and Mazandaran provinces (35°-38° N and 49°-52° E) in the central north of Iran during 2010-2011 (Fig. 1). In 2010, the western part of Tehran province was separated and named as Alborz province, but here we refer to it as just Tehran province. The Alborz Mountains separate the tropical Caspian Sea area (Guilan and Mazandaran provinces) from Tehran and Qazvin provinces. Guilan and Mazandaran provinces extend along the Caspian Sea on the northern slopes of the Alborz Mountains. Guilan and Mazandaran provinces have humid subtropical climate with heavy annual rainfall of about 1500 mm, moderate temperature, and high relative humidity leading to diverse vegetations. The relative humidity is about 80%, which decreases with increasing altitude. The Alborz mountains provide many unique types of vegetations at various altitudes in addition to the Caspian

coast flora. The known natural biome of this region is the Caspian Hyrcanian mixed forests but coastal plains have been almost completely converted to urban sites and rice paddies (Marvie Mohajer, 2006). As the elevation increases, the flora gradually differentiate and diversify from humid forests below 700 m a.s.l. to pure oriental beech or mixed forests at middle altitudes (700-1500 m a.s.l.). Shrub lands and steppe occur in the upper mountains and the highest elevations are covered with Alpine tundra and meadows (Marvie Mohajer, 2006).

Material for the present study was collected using Malaise traps with alcohol as a killing and preservation agent. Sampling was carried out from March to November during 2010 - 2011 at four to five locations in Tehran, Guilan and Mazandaran provinces and at three locations in Qazvin province. Two Malaise traps were placed in each location. They were placed in different habitats such as forests, pastures or orchards. The geographical and main floristic characteristics of each location are presented in Table 1. Sampling procedures were similar for all locations. The specimens were extracted from Malaise traps and sorted weekly in 2010 and at bi-weekly intervals in 2011. They were then preserved in 70% ethanol, pinned or card-mounted and labeled. Photographs were taken using an Olympus SZX9 stereomicroscope equipped with a Sony CCD digital camera. Additional photo editing was done using Adobe Photoshop CS2 software. The morphological terms are linked to anatomical concepts in the Hymenoptera Anatomy Ontology (Yoder *et al.*, 2010). Identifications were made using reliable keys and the original descriptions (Beirne, 1941; Diller, 1969; Fitton and Rotheray, 1982; Manukyan, 2007; Klopffstein, 2011; Klopffstein *et al.*, 2011) Morphological terminology follows Gauld (1991). All specimens are deposited in the insect collection of the Department of Entomology, Tarbait Modares University, Tehran, Iran.



Figure 1 Provinces of Iran where specimens were collected during 2010-2011.

Table 1 Geographical and floristic characteristics of sampling localities in Tehran, Qazvin, Guilan and Mazandaran provinces during 2010 and 2011.

Province	Locality	Geographical coordinates	Altitude (m)	Habitat
Tehran	Shahryar	35° 40' 8" N, 50° 56' 56" E	1168	Rosaceous orchard
	Karaj	35° 46' 20" N, 50° 56' 47" E "	1278	Rosaceous orchard
	Arangeh	35° 55' 7" N, 51° 05' 9" E	1891	Rosaceous orchard
	Sarziarat	35° 55' 10" N, 51° 06' 33" E	1980	Rosaceous orchard
	Shahrestanak	35° 57' 34" N, 51° 22' 19" E	2305	Rosaceous orchard and pasture
Guilan	Astaneh-e-Ashrafieh	37° 22' 36" N, 49° 57' 57" E	-1	Humid forest
	Ziaz	36° 52' 34" N, 50° 13' 17" E	537	Hazelnut
	Orkom	36° 45' 44" N, 50° 18' 11" E	1201	Deciduous forests and hazelnut
	Ghazichak	36° 45' 57" N, 50° 19' 35" E	1803	Hazelnut and pasture
Qazvin	Loshan	36° 40' 9" N, 49° 25' 37" E	291	Olive orchards
	Zereshk Road	36° 21' 43" N, 50° 03' 53" E	1541	Almond and walnut orchards
	Khalilabad	36° 25' 23" N, 50° 06' 37" E	1926	Rosaceous orchard
Mazandaran	Jourband	36° 26' 17" N, 52° 07' 13" E	272	Citrus orchards
	Tangevaz	36° 21' 55" N, 52° 06' 10" E	692	Deciduous forests
	Jangal	36° 18' 51" N, 52° 07' 48" E	1353	Deciduous forests
	Gaznasara	36° 16' 56" N, 52° 10' 58" E	2032	pasture

## Results

A total of 167 specimens (41 males and 126 females), 209 (10 males and 199 females), 475 (22 males and 453 females) and 82 (4 males and 78 females) were collected from Guilan, Mazandaran, Tehran and Qazvin provinces, respectively. They represented 16 species belonging to 7 genera. The newly recorded species and genera are marked with one (\*) and two asterisks (\*\*), respectively in the following text.

### Key to the genera of *Diplazontinae* in the northern parts of Iran

- 1- Dorsal carinae on first metasomal tergite well-developed, close and parallel on posterior half (Fig. 3G); hind tibia black, with white base (Fig. 3F) ..... ***Enizemum* Forster, 1869**
  - Dorsal carinae of first metasomal tergite either absent (Fig. 3K) or if present not close and not parallel medially on posterior half (Fig. 3H); hind tibia with various colors or patterns and sometimes black with white base ..... 2
- 2- Second metasomal tergite with spiracles on laterotergites; face with two subvertical depression from the anterior tentorial pit to about the middle of face (Figs. 5B-2E); male with tyloids on flagellomeres (Figs. 5J, 5L) ..... ***Sussaba* Cameron, 1909**
  - Second metasomal tergite with spiracles on dorsal part of tergite ..... 3
- 3- Face polished and with two subvertical depressions from the anterior tentorial pit to about the middle of face (Fig. 5A); spiracles of 3<sup>rd</sup> metasomal tergite on laterotergite; propodeum polished and with a distinct area superomedia (Fig. 5F); first antennal flagellomere at least 4 time as long as wide (Fig. 5A); male with tyloids on flagellomeres ..... ***Promethes* Forster, 1869**
  - Face not polished and without two subvertical depression on face..... 4
- 4- Clypeus with a basal elevation; face with yellow inner eye margins (Figs. 2B-2F) ..... 5
  - Clypeus without a basal elevation; female with or without yellow inner eye margins on face..... 8

- 5- Propodeum without carina, polished; metasoma with tergites 3-5 concave on posterior margin (Fig. 3I); clypeus truncate apically, without a median notch ..... ***Xestopelta* Dasch, 1964**
  - Propodeum carinate; metasoma with tergites 3-5 not concave on posterior margin ..... 6
- 6- Metasomal tergites 1-3 without a distinct median transverse groove (Fig. 3K) ..... ***Tymmophorous* Schmiedeknecht, 1913**
  - Metasomal tergites 1-3 each with a median transverse groove (Figs. 2K, 2L, 2M) ..... 7
- 7- Mesoscutum with distinct notauli; hind tibia white with well defined black or red pattern (Figs. 2I, 2J)..... ***Diplazon* Nees, 1819**
  - Mesoscutum without distinct notauli; hind tibia uniformly colored ..... ***Syrphophilus* Dasch, 1964**
- 8- Clypeus notched and without a preapical transverse impression (Figs. 6A-6C); male without tyloids on antennal flagellomeres; propodeum not carinate (Fig. 6E); the distance between anterior tentorial pits less than the distance between each anterior tentorial pit and the eye (Figs. 6A-6C) ..... ***Woldstedtius* Carlson, 1979**
  - Clypeus with a preapical transverse impression (Figs. 4A-4D); male with linear tyloids on antennal flagellomeres (Fig. 4F) ..... 9
- 9- Epicnemial carina interrupted ventrally behind fore coxa (Fig. 4E) and third metasomal tergite with spiracle located on laterotergite; clypeus impressed along the apical margin only laterally making central area flat or even concave (Fig. 4D) ..... ***Syrphoctonus* Forster, 1869**
  - Epicnemial carina complete laterally and ventrally; third metasomal tergite with spiracle located on dorsal part of tergite or on laterotergite; clypeus impressed along the apical margin making it convex (Figs. 4A-4C) ..... ***Homotropus* Forster, 1869**

### Genus *Diplazon* Nees, 1819

The genus *Diplazon* characterized by the combination of the following features: 1) metasomal tergites 1-3 with a median

transverse impression (Figs. 2K, 2L, 2M); 2) hind tibia with well defined colour patterns (Figs. 2I, 2J); 3) mesoscutum with distinct notauli; 4) clypeus flat with elevated base and thin, concave apical edge (Figs. 2B-2F); 5) face coriaceous with yellow inner eye margins of the female (Figs. 2B-2F) (Fitton and Rotheray, 1982, Klopstein *et al.*, 2011).

#### Key to the species of the genus *Diplazon* in northern parts of Iran

1- Hind tibia white, narrowly fuscous at apex (Fig. 2H), basitarsus white; mesopleuron red (Fig. 2G); .....  
 ...*Diplazon pectoratorius* (Gravenhorst, 1829)

-- Hind tibia basally and basitarsus black; mesopleuron black ..... 2

2- All coxae entirely red; hind tibia tricolored and usually banded as black-white-black-orange (Fig. 2J); metasomal tergites 2-4 and sometimes 1-4 red (Fig. 2M). ....  
 .....*Diplazon laetatorius* (Fabricius, 1781)

-- Fore coxa at least partly black; hind tibia two-colored; metasoma black ..... 3

3- Hind coxa red or a mixture of red and black (Fig. 2I); fore and mid coxae black or with black base; face and metasomal tergites 2-4 distinctly punctate (Figs. 2B, 2C, 2K); first metasomal tergite usually with a yellow apical band (Fig. 2K) .....  
 .....*Diplazon tibiatorius* (Thunberg, 1822)

-- Hind coxa black; fore and mid coxae black; face finely punctate (Fig. 2D) .....  
 .....*Diplazon annulatus* (Gravenhorst, 1829)

*Diplazon annulatus* (Gravenhorst, 1829)\* (Figs. 2D, 2L)

**Material examined:** 10♀♀, 1♂. Guilan province, Ziaz, 3-10.V.2010, 1♀; Orkom, 4-11.X.2010, 1♀; Ghazichak, 1-7.VI.2010, 1♀; 7-14.VI.2010, 1♀1♂; Mazandaran province, Jourband, 1-12.IV.2011, 1♀; Tangevaz, 10-22.VI.2011, 2♀♀; Nour, 13-30.IV.2011, 2♀♀; 11.X.2011-6.XI.2011, 1♀.

**General distribution:** Holarctic and Oriental regions (Yu *et al.*, 2005), Iran (new record).

**Diagnostic characters:** *Diplazon annulatus* shares a bi-colored hind tibia as black-white-

black with *D. tibiatorius* but differs in the coloration of hind coxa which is black in *D. annulatus*. Also *D. annulatus* has not the white stripe on the posterior margin of first metasomal tergite (Fig. 2L).

**Remarks:** Sampling data showed that *D. annulatus* occurred only in the northern slopes of Alborz mountains. The flight period of *D. annulatus* showed three distinct periods in April-early May, June and October-early November (Table 2).

*Diplazon laetatorius* (Fabricius, 1781) (Figs. 2E, 3J, 3M)

**Synonyms:** *Diplazon albovarius* (Wollaston, 1858), *Diplazon attractus* (Say, 1835), *Diplazon balearicus* (Kriechbaumer, 1894), *Diplazon cinctipes* (Holmgren, 1868), *Diplazon dichrous* (Schrank, 1781), *Diplazon generosus* (Cameron, 1898), *Diplazon ikiti* (Cheesman, 1936), *Diplazon senegalensis* (Ferriere, 1925), *Diplazon sycophanta* (Cresson, 1868), *Diplazon terminalis* (Davis, 1895), *Diplazon tripicticus* (Walsh, 1873), *Diplazon varipes* (Smith, 1878), *Diplazon venustulus* (Saussure, 1892)

**Material examined:** 266 ♀♀. Guilan province, Astaneh-e-Ashrafieh, 17-24.V.2010, 1♀; 1-7.VI.2010, 7♀♀; 30.VIII.2010-6.IX.2010, 2♀♀; 20-27.IX.2010, 1♀; 4-11.X.2010, 1♀; 11-17.X.2010, 2♀♀; 15-22.XI.2010, 1♀; Ziaz, 17-24.V.2010, 3♀♀; 24-31.V.2010, 2♀♀; 7-14.VI.2010, 1♀; 14-21.VI.2010, 1♀; 21-28.VI.2010, 2♀; 26.VII.2010-2.VIII.2010, 1♀; Orkom, 13.III.2010-5.IV.2010, 1♀; 24-31.V.2010, 1♀; 1-7.VI.2010, 3♀♀; 7-14.VI.2010, 2♀♀; Ghazichak, 3-10.V.2010, 1♀; 10-17.V.2010, 1♀; 24-31.V.2010, 1♀; 13-20.IX.2010, 1♀; Tehran province, Shahryar, 26.IV.2010-3.V.2010, 3♀♀; 3-10.V.2010, 4♀♀; 10-17.V.2010, 7♀♀; 17-24.V.2010, 2♀♀; 24-31.V.2010, 2♀♀; 1-7.VI.2010, 1♀; 7-14.VI.2010, 5♀♀; 14-21.VI.2010, 1♀; 30.VIII.2010-6.IX.2010, 1♀; 6-13.IX.2010, 5♀♀; 20-27.IX.2010, 2♀♀; 27.IX.2010-4.X.2010, 2♀♀; 4-11.X.2010, 2♀♀; Karaj, 5-12.IV.2010, 1♀; 12-19.IV.2010, 1♀; 19-26.IV.2010, 3♀♀; 26.IV.2010-3.V.2010, 1♀; 3-10.V.2010, 6♀♀; 10-17.V.2010, 5♀♀; 1-

7.VI.2010, 2♀♀; 9-16.VIII.2010, 1♀; 16-23.VIII.2010, 1♀; 30.VIII.2010-6.IX.2010, 1♀; 20-27.IX.2010, 1♀; 27.IX.2010-4.X.2010, 4♀♀; 4-11.X.2010, 4♀♀; 11-17.X.2010, 2♀♀; 17-24.X.2010, 3♀♀; 24.X.2010-1.XI.2010, 2♀♀; Arangeh, 10-17.V.2010, 2♀♀; 17-24.V.2010, 1♀; 24-31.V.2010, 10♀♀; 1-7.VI.2010, 6♀♀; 7-14.VI.2010, 8♀♀; 14-21.VI.2010, 1♀; 5-12.VII.2010, 2♀♀; 12-19.VII.2010, 2♀♀; 16-23.VIII.2010, 1♀; 30.VIII.2010-6.IX.2010, 1♀; 6-13.IX.2010, 1♀; 13-20.IX.2010, 1♀; Sarzariat, 26.IV.2010-3.V.2010, 1♀; 10-17.V.2010, 5♀♀; 24-31.V.2010, 2♀♀; 7-14.VI.2010, 1♀; 14-21.VI.2010, 1♀; 5-12.VII.2010, 1♀; Shahrestanak, 10-17.V.2010, 3♀♀; 7-14.VI.2010, 1♀; 5-12.VII.2010, 1♀; Qazvin province, Loshan, 26.V.2011-9.VI.2010, 1♀; Qazvin province, Zereshk Road, 11-25.V.2010, 9♀♀; 26.V.2011-9.VI.2011, 14♀♀; 10-22.VI.2010, 5♀♀; Khalilabad, 11-25.V.2011, 3♀♀; 26.V.2011-9.VI.2011, 7♀♀; 10-22.VI.2010, 5♀; 23.VI.2011-11.VII.2011, 1♀; 11-27.VII.2011, 1♀; 28.VII.2011-16.VIII.2011, 2♀♀; 7-26.IX.2011, 4♀♀; 27.IX.2011-11.X.2011, 3♀♀; 11.X.2011-6.XI.2011, 3♀♀; Mazandaran province, Jourband, 1-12.IV.2011, 1♀; 13-30.IV.2011, 1♀; 26.V.2011-9.VI.2011, 18♀♀; 10-22.VI.2011, 9♀♀; 23.VI.2011-11.VII.2011, 1♀; 16.VIII.2011-6.IX.2011, 1♀; 7-26.IX.2011, 1♀; 11.X.2011-6.XI.2011, 4♀♀; Tangevaz, 26.V.2011-6.VI.2011, 1♀; 11-27.VII.2011, 1♀; Gaznasara, 10-22.VI.2011, 1♀; 7-26.IX.2011, 1♀; Nour, 1-10.V.2011, 1♀; 26.V.2011-9.VI.2011, 4♀♀; 10-22.VI.2011, 1♀; 7-26.IX.2011, 2♀♀; 11.X.2011-6.XI.2011, 3♀♀.

**General distribution:** Worldwide (Yu *et al.*, 2005), Iran, Mazandaran, Kerman (Kolarov and Ghahari, 2005), Sistan and Balouchestan (Barahoei *et al.*, 2013), Chaharmahal-Bakhtiari (Nourbakhsh *et al.*, 2008) and Yazd (Zarepour-Ashkezari *et al.*, 2009, 2010).

**Host record:** *Scaeva albomaculata* (Macquart, 1842) (Dip.: Syrphidae) (Nourbakhsh *et al.*, 2008, Barahoei *et al.*, 2013).

**Diagnostic characters:** *Diplazon laetatorius* can easily be recognized by a three-colored hind tibia: black (or brown)-white-black-orange (Fig. 2J).

**Remarks:** Only female specimens of *D. laetatorius* were collected from the studied area. This species was the most abundant species in Qazvin province (67%) and the second one in Guilan (21%) and Mazandaran (24%) provinces and third one in Tehran province (26%). This common species occurred in both slopes of the Alborz Mountains at all localities. The majority of adults were captured during May (27%) to June (40%), followed by September (11%), October (11%), April (5%), July (4%), August (2%), and finally November (0.4%) (Table 2).

***Diplazon pectoratorius* (Gravenhorst, 1829)\*** (Figs. 2F, 2G, 2H)

**Material examined:** 2♀♀, 1♂. Guilan province, Orkom, 5-12.IV.2010, 1♂; Mazandaran province, Gaznasara, 11-25.V.2011, 2♀♀.

**General distribution:** Holarctic, Neotropical and Oriental regions (Yu *et al.*, 2005), Iran (new record).

**Diagnostic characters:** In *Diplazon pectoratorius* the mesosoma and mesopleuron are red (Fig. 2G) and the base of the hind tibia and hind basitarsus are white (Fig. 2H).

**Remarks:** *Diplazon pectoratorius* was collected in very low numbers in the northern slopes of the Alborz mountains of Iran at an elevation of more than 1000 m a.s.l. Collecting data showed that *D. pectoratorius* has a single flight period at each collecting sites which might reflect one generation a year.

***Diplazon tibiatorius* (Thunberg, 1822)\*** (Figs. 2A, 2B, 2C, 2I, 2K)

**Synonym:** *Diplazon albosignatus* (Gravenhorst, 1829)

**Material examined:** 30♀♀, 6♂♂. Tehran province, Shahryar, 10-17.V.2010, 3♀♀; 17-24.V.2010, 1♀, 21-28.VI.2010, 1♀; 13-20.IX.2010, 1♀; 27.IX.2010-4.X.2010, 1♀; 11-17.X.2010, 1♀; 24.X.2010-1.XI.2010, 1♀; Arangeh, 16-23.VIII.2010, 1♀; 23-

30.VIII.2010, 1♀; 30.VIII.2010- 6.IX.2010, 1♀; 20-27.IX.2010, 1♀; Sarziarat, 10-17.V.2010, 1♀; Mazandaran province, Jourband, 11-25.V.2011, 1♀1♂; 26.V.2011-9.VI.2011, 4♀; 7-26.IX.2011, 1♀; 27.IX.2011-11.X.2011, 1♀; 11.X.2011-6.XI.2011, 2♀♀; Tangevaz, 10-22.VI.2011, 1♀1♂; 11.X.2011-6.XI.2011, 1♀; Gaznasara, 26.V.2011-9.VI.2011, 1♀; 11-27.VII.2011, 1♀; Nour, 11-25.V.2011, 1♀; Qazvin province, Zeresk Road, 10-22.VI.2011, 1♀; Khalilabad, 11-25.V.2011, 1♂; 28.VII.2011- 16.VIII.2011, 3♂♂.

**General distribution:** Holarctic region (Yu *et al.*, 2005), Iran (new record).

**Diagnostic characters:** *Diplazon tibiatorius* differs from *D. annulatus* by red mid and hind coxa (Fig. 2I) but sometimes this character is not clear as the hind coxa can show a mixed red and black coloration.

**Remarks:** *Diplazon tibiatorius* was the second abundant species in the genus *Diplazon* and was collected in two slopes of the Alborz Mountains. *D. tibiatorius* showed a long period of adult flight activity that was similar to *D. laetatorius* but the first adults of *D. tibiatorius* appeared later than *D. laetatorius* from the mid spring in May (Table 2). Collecting dates showed the adult flight periods of *D. tibiatorius* as: May (26%), June (26%), July (3%), August (14%), September (14%), October (17%).

### Genus *Enizemum* Forster, 1869

The species of the genus *Enizemum* have distinct closely parallel dorsal carinae on the first metasomal tergite (Fig. 3G), an areolet in the forewing and a hind tibia with white base (Fig. 3F).

***Enizemum ornatum* (Gravenhorst, 1829)** (Figs. 3E, 3F, 3G)

**Synonyms:** *Enizemum carinulatum* (Ruthe, 1859), *Enizemum deplanatum* (Gravenhorst, 1829), *Enizemum frenator* (Desvignes, 1862), *Enizemum neomexicanum* Brues, 1908, *Enizemum sumptuosum* (Schmiedeknecht, 1926)

**Material examined:** 4♀♀, 1♂. Qazvin province, Zeresk Road, 1-10.V.2010, 1♀;

Khalilabad, 1♀; 11-25.V.2011, 1♀; 26.V.2011-9.VI.2011, 1♀; 23.VI.2011-11.VII.2011, 1♂.

**General distribution:** Holarctic, Oriental (Yu *et al.*, 2005), Iran (Sistan and Baluchestan province (Barahoei *et al.*, 2013), new record for the north of Iran.

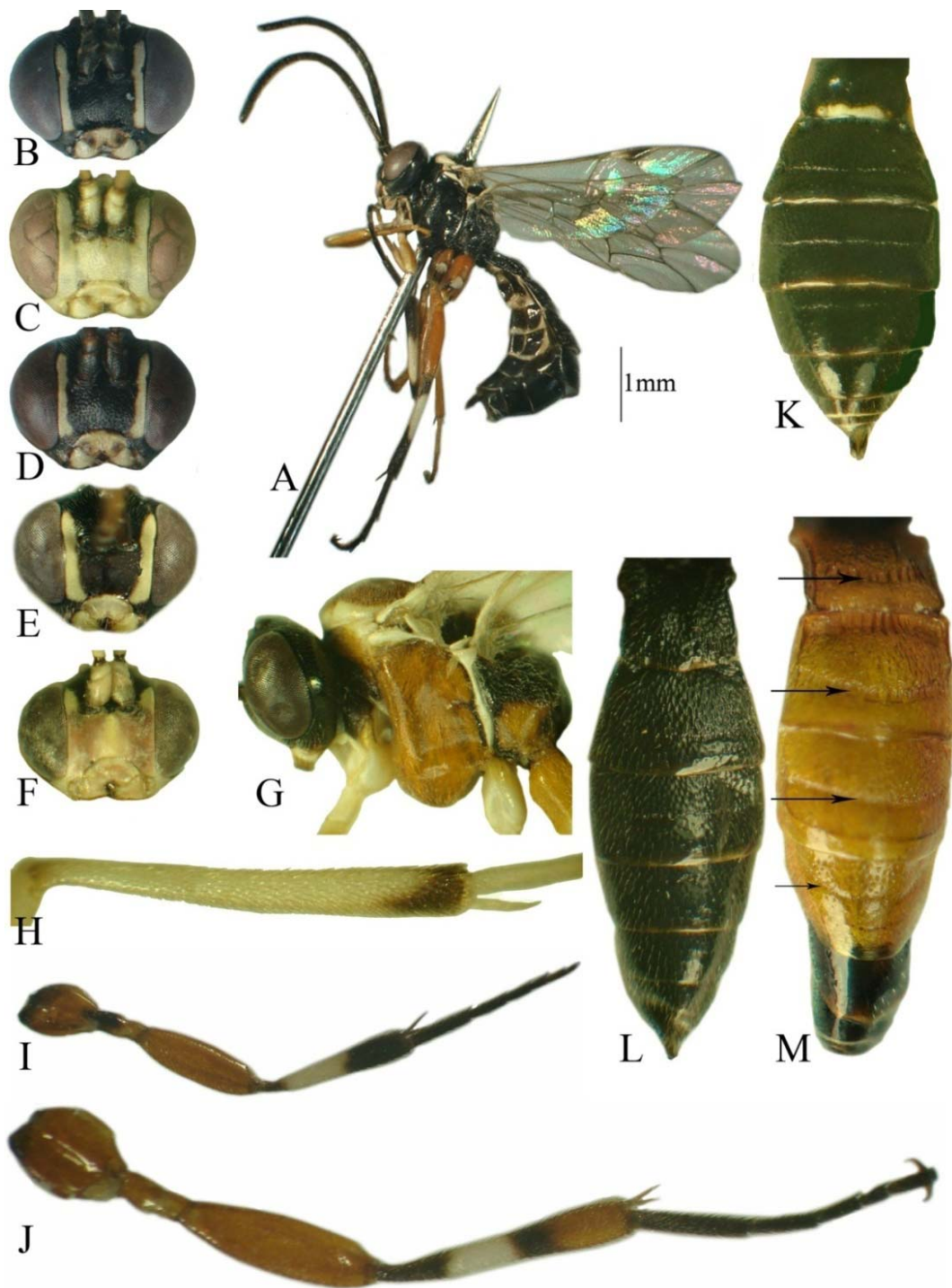
**Diagnostic characters:** *Enizemum ornatum* can be distinguished from other species of the genus by 1) a sharp dorsal carina of the first metasomal tergite which continues on the basal 1/4 of the second metasomal tergite (Fig. 3G), 2) the length of the second metasomal tergite is less than its apical width, 3) forewing with vein 2Cu equal to 2Cu-a.

**Remarks:** *Enizemum ornatum* was sampled only in Qazvin on the southern slopes of the Alborz Mountains. In comparison with another collecting sites in Iran (Barahoei *et al.*, 2013) and other neighboring countries (Yu *et al.*, 2005), *E. ornatum* may distributed in most parts of Iran except the northern slopes of the Alborz Mountains along the Caspian Sea. Adults of *E. ornatum* showed a flight period from May to early July (Table 2).

### ***Homotropus* Forster, 1869\*\***

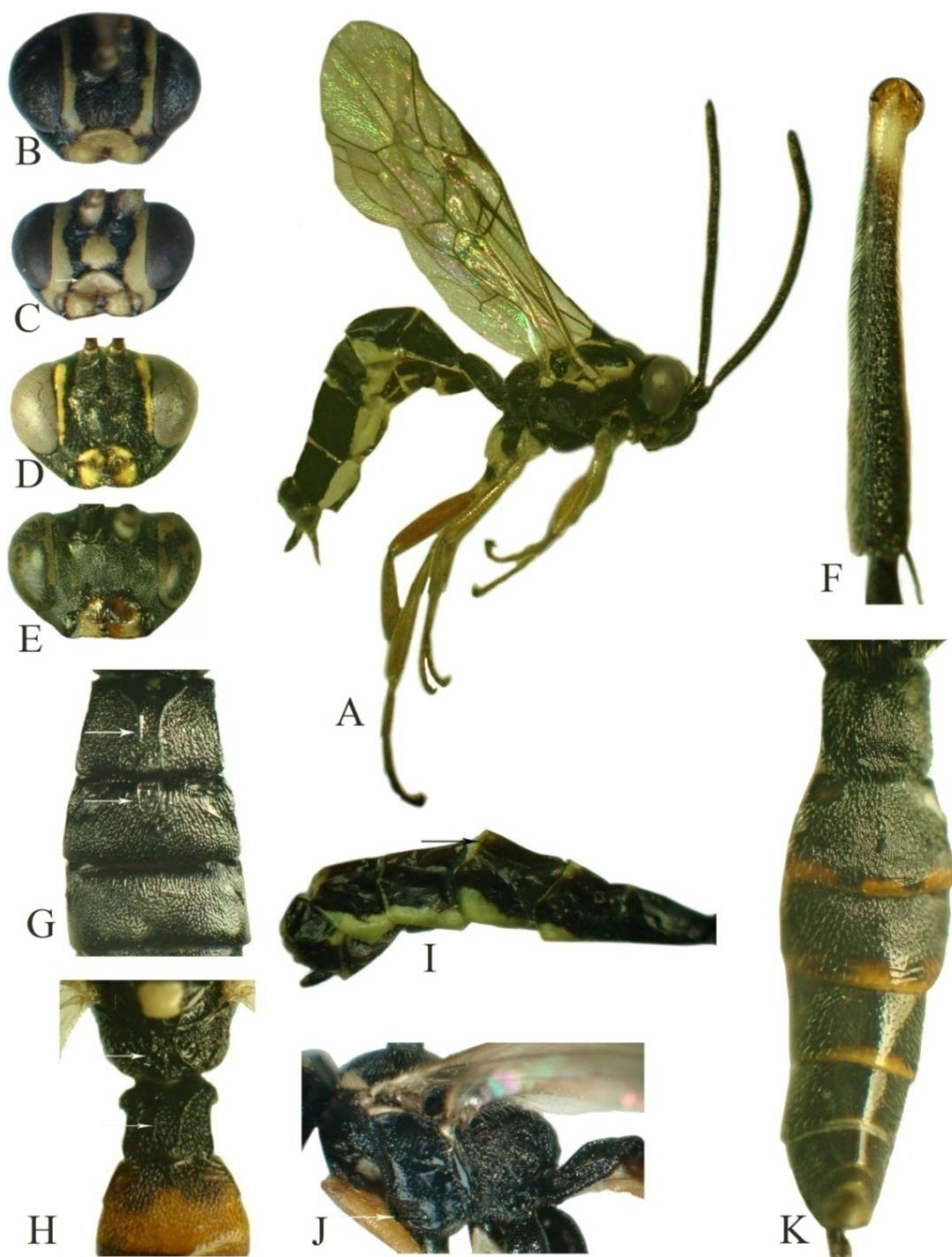
The species of the genus *Homotropus* were previously classified in the genus *Syrphoctonus*, but after recently re-evaluation of the genus, most of them were placed again in *Homotropus* (Klopfstein *et al.*, 2011). *Homotropus* species have a convex clypeus that is impressed along the apical margin (Figs. 4A, 4B, 4C) and a complete epicnemial carina on the mesopleuron. Two collected species of the genus *Homotropus* can be separated by the following key:

- 1- Hind tibia red with black end; hind tarsus black; propodeum smooth without carinae; male with linear, narrow tyloids on flagellar segments 7-14 (Fig. 4F) .....  
.....***Homotropus nigratarsus* (Gravenhorst, 1829)**
- Hind tibia white except base and apex black (Fig. 4G); hind tarsus black; scutellum black with two basal white spots; female with a small central spot on face (Fig. 4C) .....  
.....***Homotropus pictus* (Gravenhorst, 1829)**

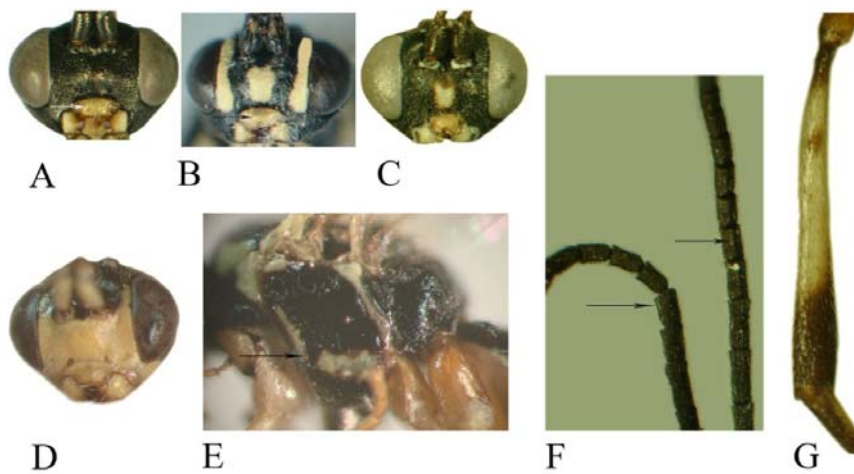


**Figure 2** *Diplazon* spp. of northern Iran. *D. tibiatorius*: A) general habitus of female, B) face of female, C) face of male, I) hind leg, K) metasoma; *D. annulatus*: D) face of female, L) metasoma; *D. laetatorius*: E) face of female, J) hind leg, M) metasoma, arrows show postmedian transverse depressions; *D. pectoratorius*: F) face of female, G) mesosoma, H) hind tibia.

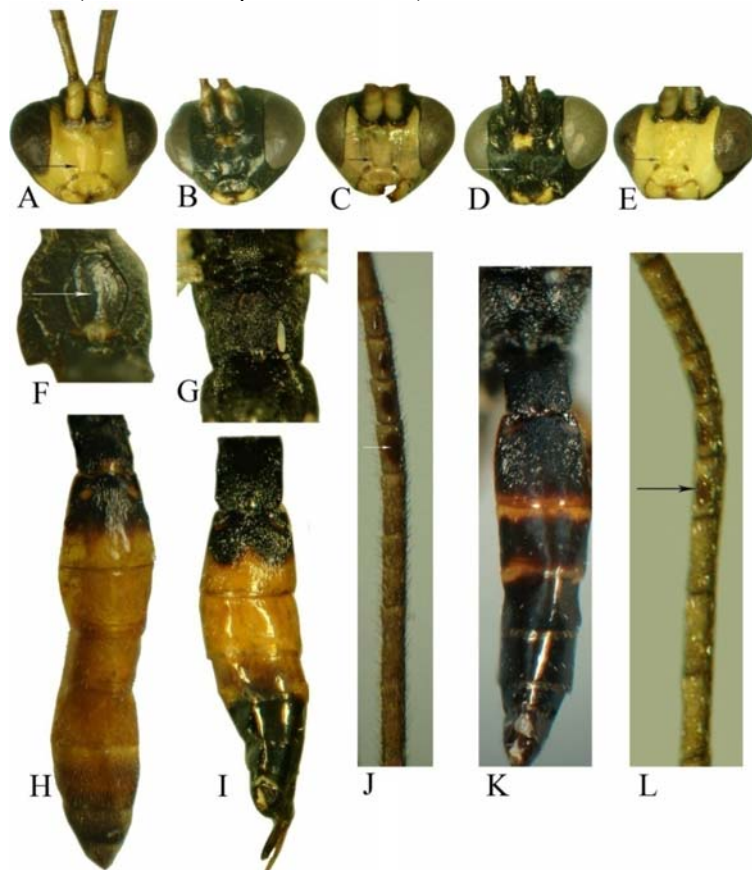




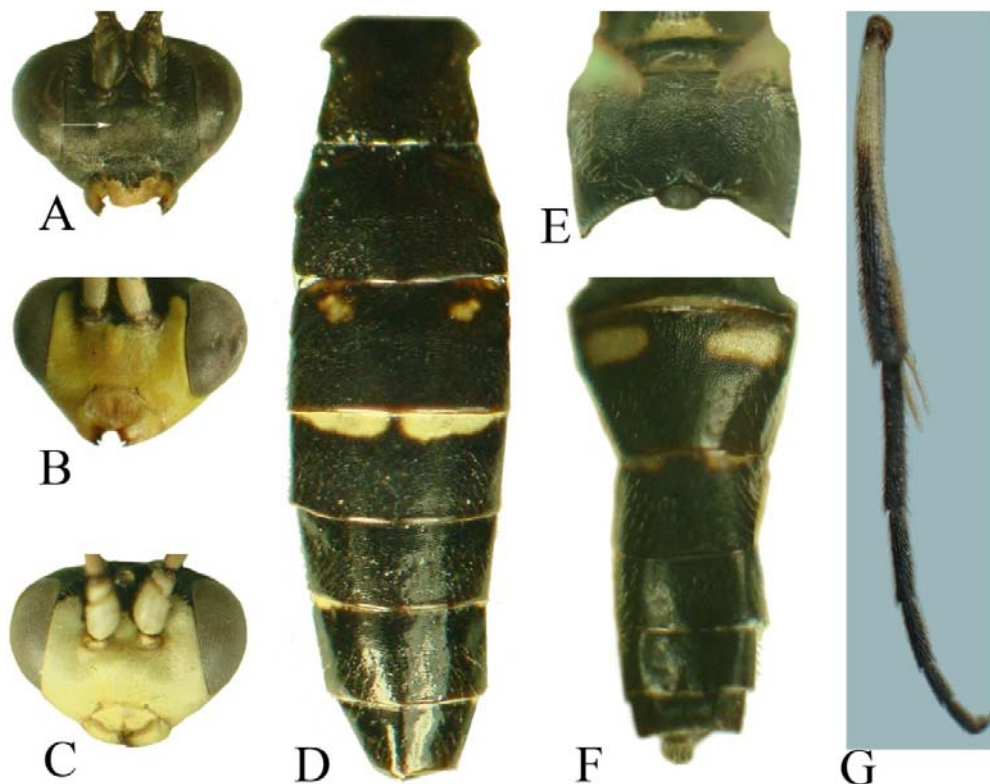
**Figure 3** *Xestopelta gracilima*: A) natural habitus of female, B) face, I) metasoma (arrow shows concave posterior margin of 4<sup>th</sup> tergite); *Syrphophilus bizonarius*: C) face of female (arrow shows elevated basal part), H) propodeum (arrow shows carinated propodeum) and two basal tergites of metasoma (arrow shows dorsal longitudinal carina), J) mesosoma (arrow shows sternaulus on ventral part of mesopleuron); *Enizemum ornatum*: E) face of female, F) hind tibia, G) three basal tergites of metasoma (arrows show parallel dorsal longitudinal carinae on first metasomal tergite which continue on the basal part of the second metasomal tergite in *E. ornatum*); *Tymmophorus obscuripes*: D) face of female, K: metasoma.



**Figure 4** *Homotropus nigritarsus*: A) face of female, B) face of male (arrow shows convex clypeus that is impressed along the apical margin in female and male), F) linear tyloids on flagellar segments (arrows indicate tyloids in anterior and lateral view); *H. pictus*: C) face of female, G) hind tibia; *Syrphoctonus tarsatorius*: D) face of male, E: mesosoma (arrow shows epicnemial carina).



**Figure 5** *Promethes sulcator*: A) face of female, F) propodeum (arrow indicates area superomedia), H) metasoma; *Sussaba flavipes*: B) face of female, C) face of male, G) propodeum, I) metasoma, J) oval tyloids on flagellar segments of male; *S. pulchella*: D) face of female, E) face of male, K) propodeum and metasoma of female, L) tyloids on flagellar segments of male. all arrows on faces indicates two vertical depression on faces.



**Figure 6** *Woldstedtius biguttatus*, A: face of female (arrow indicates protruded center), B: face of male, E: propodeum, F: metasoma from tergite 3); *W. citropectoralis*, C: face of male, D: metasoma of male, G: hind tibia and tarsus of male.

***Homotropus nigritarsus* (Gravenhorst, 1829)\***  
(Figs. 4A, 4B, 4F)

**Synonym:** *Syrphoctonus picitans* (Desvignes, 1862)

**Material examined:** 175♀♀, 20♂♂. Guilan province, Ziaz, 5-12.IV.2010, 2♂♂; 1-7.VI.2010, 1♀; Ghazichak, 12-19.IV.2010, 2♂♂; 26.IV.2010-3.V.2010, 1♂; 10-17.V.2010, 2♂♂; 17-24.V.2010, 6♂; 27.IX.2010-4.X.2010, 1♀; Tehran province, Shahryar, 19-26.IV.2010, 1♂; 26.IV.2010-3.V.2010, 3♀♀1♂; 3-10.V.2010, 1♀; 10-17.V.2010, 3♀♀1♂; 17-24.V.2010, 8♀♀; 24-31.V.2010, 1♀1♂; 1-7.VI.2010, 1♀; 7-14.VI.2010, 5♀♀; 14-21.VI.2010, 3♀♀; 21-28.VI.2010, 2♀; 20-27.IX.2010, 1♀; 4-11.X.2010, 2♀♀; 11-17.X.2010, 1♀; 17-24.X.2010, 4♀♀; Karaj, 19-26.IV.2010, 1♀; 26.IV.2010-3.V.2010, 2♀; 3-

10.V.2010, 17♀♀, 7♀♀; 10-17.V.2010, 17-24.V.2010, 7♀♀; 1-7.VI.2010, 3♀; 7-14.VI.2010, 3♀♀; 27.IX.2010-4.X.2010, 1♀; 17-24.X.2010, 1♀; Arangeh, 17-24.V.2010, 3♀♀; 24-31.V.2010, 3♀♀; 1-7.VI.2010, 2♀♀; 7-14.VI.2010, 2♀♀; 14-21.VI.2010, 1♀; 21-28.VI.2010, 5♀♀; 28.VI.2010-5.VII.2010, 1♀1♂; 5-12.VII.2010, 1♀; 12-19.VII.2010, 2♀♀; 19-26.VII.2010, 2♀♀; Sarzariat, 17-24.V.2010, 1♀; 24-31.V.2010, 4♀♀; 1-7.VI.2010, 7♀♀; 7-14.VI.2010, 4♀♀1♂; 14-21.VI.2010, 2♀♀; 21-28.VI.2010, 1♀; 5-12.VII.2010, 1♀; Shahrestanak, 10-17.V.2010, 3♀♀; 17-24.V.2010, 7♀; 24-31.V.2010, 4♀♀; 1-7.VI.2010, 5♀; 7-14.VI.2010, 1♀; 21-28.VI.2010, 2♀; 28.VI.2010-5.VII.2010, 1♀; 5-12.VII.2010, 1♀; 12-19.VII.2010, 1♀1♂; 19-26.VII.2010, 1♀; 26.VII.2010-2.VIII.2010, 1♀;

16-23.VIII.2010, 1♀; 23-30.VIII.2010, 1♀; Qazvin province, Zereshk Road, 10-22.VI.2010, 1♀; Khalilabad, 11-25.V.2011, 1♀; 26.V.2011, 3♀♀; 9.VI.2011, 10-22.VI.2011, 6♀♀; 11-27.VII.2011, 1♀; Mazandaran province, Jourband, 11.X.2011-6.XI.2011, 1♀; Tangevaz, 23.VI.2011-11.VII.2011, 1♀; 11-27.VII.2011, 1♀; 11.X.2011-6.XI.2011, 2♀♀; Gaznasara, 26.V.2011-9.VI.2011, 1♀; 10-22.VI.2011, 6♀♀; 23.VI.2011-11.VII.2011, 3♀♀.

**General distribution:** Holarctic and Neotropical regions (Yu *et al.*, 2005), Iran (new record).

**Diagnostic characters:** *Homotropus nigritarsus* can be distinguished from other species of the genus by the combination of the following characters: Clypeus bilobed (Figs. 4A, 4B), spiracles of the third metasomal tergite above the fold separating epipleuron, all coxae black, all femurs red, propodeum smooth without carinae, male with linear, narrow tyloids on flagellar segments 7-14 (Fig. 4F).

**Remarks:** *Homotropus nigritarsus* was collected on both slopes of the Alborz mountains at almost all sampling sites. However, there were more populations on southern slopes at Tehran and Qazvin provinces. Collecting dates show that the majority of adults of *H. nigritarsus* was sampled during May (41%), June (36%), April with 7%, July with 8%, October with 5%, September with 2% and finally August with 1% of all collected specimens followed (Table 2).

***Homotropus pictus* (Gravenhorst, 1829)\*** (Figs. 4C, 4G)

**Material Examined:** 1♀. Mazandaran province, Tangevaz, 11.X.2011-6.XI.2011, 1♀.

**General distribution:** Western Palaearctic (Europe) region (Yu *et al.*, 2005), Iran (new record).

**Diagnostic characters:** *Homotropus pictus* differs from *H. nigritarsus* by the coloration of hind tibia which is white with black top and base (Fig. 4G) and black scutellum marked with two basal white spots.

**Remarks:** *Homotropus pictus* was only sampled in Mazandaran province on the northern slopes of the Alborz Mountains at elevation of about 700 m a.s.l.. The specimen was captured during October.

#### **Genus *Promethes* Forster, 1869**

The genus *Promethes* shares the following characters with *Sussaba*: two vertical impressions on the face (Figs. 5A, 5E) and spiracle of the third metasomal tergite on its epipleuron, but differs in having notauli on the mesoscutum, the spiracle of the second metasomal tergite is on the dorsal part of the tergite and in the male with tyloids on some flagellomeres.

***Promethes sulcator* (Gravenhorst, 1829)** (Figs. 5A, 5F, 5H)

**Synonyms:** *Promethes aciculatus* (Provancher, 1888), *Promethes anomalus* (Taschenberg, 1865), *Promethes areolatus* (Holmgren, 1856), *Promethes auriculatus* (Provancher, 1888), *Promethes dodsi* (Morley, 1906), *Promethes longicornis* (Provancher, 1883), *Promethes splendidus* Dasch, 1964

**Material examined:** 4♀♀, 1♂. Guilan province, Ghazichak, 12-19.IV.2010, 1♂; Tehran province, Shahryar, 14-21.VI.2010, 1♀; Karaj, 26.IV.2010-3.V.2010, 1♀; 11-17.X.2010, 1♀; Shahrestanak, 17-24.V.2010, 1♀.

**General distribution:** Holarctic, Oriental regions (Yu *et al.*, 2005), Iran (Sistan and Baluchestan (Barahoei *et al.*, 2013)), new record for the north of Iran.

**Diagnostic characters:** *Promethes sulcator* can be identified by the combination of the following features: metasoma not laterally compressed (Fig. 5H), gena with a shallow or without groove, scutellum black, propodeum with distinct area superomedia in a polished background (Fig. 5F), 3<sup>rd</sup> and 4<sup>th</sup> metasomal tergites in female and 3<sup>rd</sup>-5<sup>th</sup> in male red (Fig. 5H).

**Remarks:** *Promethes sulcator* was collected in low numbers from both slopes of the Alborz Mountains at elevations of more than 1000 m a.s.l. *P. sulcator* showed one flight period in Ghazichak site (Guilan province) and in Shahryar and Shahrestanak sites (Tehran

province), but two distinct appearances on late April and mid October in the Karaj site of the Tehran province (Table 2).

### Genus *Sussaba* Cameron, 1909

In *Sussaba*, the spiracle of second metasomal tergite is on its epipleuron.

Two collected species of the genus *Sussaba* can be separated by the following key:

- 1-Mesoscutum without anterolateral spot; metasoma medially red (Fig. 5I); hind coxa sculptured laterally and posteriorly .....*Sussaba flavipes* (Lucas, 1849)  
 - Mesoscutum with anterolateral spot; metasoma with only basal margin of 2<sup>nd</sup> and 3<sup>rd</sup> tergites red (Fig. 5K); hind coxa smooth laterally and posteriorly .....  
 .....*Sussaba pulchella* (Holmgren, 1858)

*Sussaba flavipes* (Lucas, 1849)\* (Figs. 5B, 5C, 5G, 5I, 5J)

**Synonym:** *Sussaba neopulchella* Diller, 1980

**Material examined:** 34♀♀, 6♂♂. Guilan province, Ziaz, 13.III.2010-5.IV.2010, 1♀1♂; 5-12.IV.2010, 6♀♀1♂; 12-19.IV.2010, 1♀; 19-26.IV.2010, 9♀1♂; 3-10.V.2010, 1♀; 27.IX.2010-4.X.2010, 1♀; Orkom, 13.III.2010-5.IV.2010, 2♀♀; 10-17.V.2010, 1♀; 24-31.V.2010, 1♂; 1-7.VI.2010, 1♀; 28.VI.2010-5.VII.2010, 1♀; 2-9.VIII.2010, 2♀♀; Ghazichak, 10-17.V.2010, 1♀; 24-31.V.2010, 1♀; 1-7.VI.2010, 1♂; 7-14.VI.2010, 1♀; Tehran province, Shahrestanak, 9-16.VIII.2010, 1♀; Mazandaran province, Jourband, 1-12.IV.2011, 1♀; Tangevaz, 7-26.IX.2011, 1♂; 27.IX.2011-11.X.2011, 1♀; Gaznasara, 10-22.VI.2011, 1♀; 23.VI.2011-11.VII.2011, 1♀.

**General distribution:** Holarctic region (Yu et al., 2005), Iran (new record).

**Diagnostic characters:** *Sussaba flavipes* can be distinguished from *S. pulchella* by the combination of the following features: mesonotum without anterolateral spot, hind coxa coriaceous, tergites 3, 4 and apical part of tergite 2 yellow-red, tergite 3 basally finely striate and apically coriaceous, tergite 4 centrally coriaceous (Fig. 5I), male with oval tyloids on flagellomeres 6-10, tyloid of the 10<sup>th</sup>

flagellomere very small and sometimes absent (Fig. 5J).

**Remarks:** *Sussaba flavipes* was sampled on both slopes of the Alborz mountains and in higher numbers on northern ones which shows the preference of the species to more humid ecosystems. The first adults of *S. flavipes* were captured in early April at Ziaz and Orkom locality (Guilan province) and Jourband site (Mazandaran province) and their flight activity lasted to October (Table 2).

*Sussaba pulchella* (Holmgren, 1858)\* (Figs. 5D, 5E, 5K, 5L)

**Synonyms:** *Sussaba albicoxis* (Ashmead, 1906), *Sussaba elongata* (Provancher, 1874), *Sussaba erodens* (Davis, 1897), *Sussaba laticarpus* (Thomson, 1890), *Sussaba monticola* (Vollenhoven, 1880), *Sussaba ruthei* (Roman, 1931), *Sussaba uncinata* (Ashmead, 1902)

**Material examined:** 9♀♀, 4♂♂. Guilan province, Orkom, 7-14.VII.2010, 1♀1♂; Ghazichak, 12-19.IV.2010, 2♂♂; 29.IV.2010-3.V.2010, 1♀; 7-14.VI.2010, 2♀♀; Tehran province, Arangeh, 7-14.VI.2010, 1♂; Shahrestanak, 30.VIII.2010-6.IX.2010, 1♀; Mazandaran province, Jourband, 11.X.2011-6.XI.2011, 2♀♀; Tangevaz, 13-30.IV.2011, 1♀; Gaznasara, 26.V.2011-9.VI.2011, 1♀.

**General distribution:** Holarctic, Oriental regions (Yu et al., 2005), Iran (new record).

**Diagnostic characters:** *Sussaba pulchella* differs from *S. flavipes* by: mesonotum with anterolateral spot, hind coxa smooth, metasoma with tergite 3 anteriorly or completely red, tergite 3 distally smooth (Fig. 5K), male with two-colored tyloids on flagellomeres 6-10 (Fig. 5L).

**Remarks:** *Sussaba pulchella* was sampled on both slopes of the Alborz Mountains and in lower numbers compared with *S. flavipes*. Adult flight period: April (23%), May (8%), June (31%), July (15%), September (8%) and October (15%).

**Table 2** Flight periods of Diplazontinae species, according to captures of the Malaise traps, in the north of Iran.

Sampling dates 2010-2011	Diplazontinae species															
	<i>D. annulatus</i>	<i>D. laetatorius</i>	<i>D. pectoratorius</i>	<i>D. tibiatorius</i>	<i>E. ornatum</i>	<i>H. nigratarsus</i>	<i>H. pictus</i>	<i>P. sulcator</i>	<i>S. flavipes</i>	<i>S. pulchella</i>	<i>S. tarsatorius</i>	<i>S. bizonarius</i>	<i>T. obscuripes</i>	<i>W. biguttatus</i>	<i>W. citropectoralis</i>	<i>X. gracilima</i>
13 March-5 April	+	+	-	-	-	-	-	-	+	-	-	+	-	+	-	-
5-12 April	+	+	+	-	-	+	-	-	+	-	-	+	-	+	-	-
12-19 April	+	+	-	-	-	+	-	+	+	+	-	+	-	+	-	+
19-26 April	+	+	-	-	-	+	-	-	+	+	+	+	-	-	-	-
26 April-3 May	+	+	-	-	-	+	-	+	-	+	+	+	-	+	-	+
3-10 May	+	+	-	-	+	+	-	-	+	-	-	+	-	+	-	-
10-17 May	-	+	+	+	+	+	-	-	+	-	-	+	-	-	-	+
17-24 May	-	+	+	+	+	+	-	+	-	-	-	+	-	+	-	+
24-31 May	-	+	-	+	+	+	-	-	+	-	+	+	-	+	+	+
1-7 June	+	+	-	+	+	+	-	-	+	-	+	+	-	+	+	-
7-14 June	+	+	-	+	-	+	-	-	+	+	+	+	-	+	-	-
14-21 June	+	+	-	+	-	+	-	+	+	-	-	-	-	+	-	-
21-28 June	-	+	-	+	-	+	-	-	+	-	+	-	-	+	-	-
28 June-5 July	-	-	-	+	-	+	-	-	+	-	+	-	-	+	-	-
5-12 July	-	+	-	+	-	+	-	-	+	-	+	-	-	+	-	-
12-19 July	-	+	-	+	-	+	-	-	-	-	-	-	-	-	-	-
19-26 July	-	+	-	+	-	+	-	-	-	-	-	-	-	+	-	-
26 July-2 August	-	+	-	+	-	+	-	-	-	-	-	+	-	+	-	-
2-9 August	-	-	-	+	-	-	-	-	+	-	-	+	-	+	-	-
9-16 August	-	+	-	+	-	-	-	-	+	-	-	-	-	+	-	-
16-23 August	-	+	-	+	-	+	-	-	-	-	-	-	-	-	-	-
23-30 August	-	-	-	+	-	+	-	-	-	-	-	+	-	-	-	-
30 August -6 September	-	+	-	+	-	-	-	-	-	+	-	+	+	-	-	-
6-13 September	-	+	-	+	-	-	-	-	+	-	-	+	-	-	-	-
13-20 September	-	+	-	+	-	-	-	-	+	-	-	+	-	-	-	-
20-27 September	-	+	-	+	-	+	-	-	+	-	-	+	-	-	-	-
27 September-4 October	-	+	-	+	-	+	-	-	+	-	+	+	-	+	-	-
4-11 October	+	+	-	+	-	+	-	-	+	-	-	+	-	+	-	-
11-17 October	+	+	-	+	-	+	+	+	-	+	-	+	+	+	-	-
17-24 October	+	+	-	+	-	+	+	-	-	+	-	+	+	+	-	-
24 October-1 November	+	+	-	+	-	+	+	-	-	+	-	+	+	+	-	-
1-8 November	+	+	-	+	-	+	+	-	-	+	-	+	+	+	-	-
8-15 November	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-22 November	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**Genus *Syrphoctonus* Forster, 1869\*\***

The genus *Syrphoctonus* can be separated from *Homotropus* by the position of the spiracle of the third metasomal segment on its epipleuron, the incomplete epicnemial carina (Fig. 4E) and the laterally impressed clypeus along the apical margin with central area flat or even concave (Fig. 4D).

***Syrphoctonus tarsatorius* (Panzer, 1809)\*** (Figs. 4D, 4E)

**Synonyms:** *Syrphoctonus desvignesii* (Marshall, 1870), *Syrphoctonus exsultans* (Gravenhorst, 1829), *Syrphoctonus flavitrochanterus* (Uchida, 1956), *Syrphoctonus flavus* (Desvignes, 1862), *Syrphoctonus indicus* (Cameron, 1909), *Syrphoctonus insignis* (Gravenhorst, 1829), *Syrphoctonus pulchellus* (Desvignes, 1862) (synonym)

**Material examined:** 3♀♀, 1♂. Guilan province, Astaneh-e-Ashrafieh, 12-19.IV.2010, 1♀; 27.IX.2010-4.X.2010, 1♂; Tehran province, Karaj, 26.IV.2010-3.V.2010, 1♀; Mazandaran province, Gaznasara, 23.VI.2011-11.VII.2011, 1♀.

**General distribution:** Holarctic and Oriental regions (Yu et al., 2005), Iran (new record).

**Diagnostic characters:** *Syrphoctonus tarsatorius* can be identified by a combination of the following characters: clypeus bilobed (Fig. 4D), propodeum smooth, mesonotum coriaceous and not punctate, scutellum black or with yellow sides, legs red, first metasomal tergite without dorsal carina and apical part of it with a distinct granular sculpture, spiracles of metasomal segments 3-5 on laterotergites.

**Remarks:** *Syrphoctonus tarsatorius* was captured on both slopes of the Alborz Mountains. First adults of *S. tarsatorius* emerged in late April. In Tehran and Mazandaran provinces *S. tarsatorius* showed one period of flight activity, but in Guilan province it appeared in two distinct periods, namely April and early October which might reflect two generations of this species in these areas (Table 2).

**Genus *Syrphophilus* Dasch, 1964\*\***

The genus *Syrphophilus* is a moderately small genus with seven known species worldwide (Yu

et al., 2005). The species of *Syrphophilus* are similar to the species of *Diplazon* and *Tymmophorus*, but they differ in the absence of notauli on the mesoscutum. Only one species was collected in this study.

***Syrphophilus bizonarius* (Gravenhorst, 1829)\*** (Figs. 3 C, 3H, 3J)

**Synonyms:** *Syrphophilus cingulatus* (Holmgren, 1858), *Syrphophilus frontalis* (Brischke, 1878), *Syrphophilus inconstans* (Davis, 1895), *Syrphophilus iwatensis* (Uchida, 1930), *Syrphophilus saginatus* (Provancher, 1879), *Syrphophilus satoi* (Uchida, 1930)

**Material examined:** 285♀♀, 21♂♂. Guilan province, Astaneh-e-Ashrafieh, 12-19.IV.2010, 1♂; 19-26.IV.2010, 1♀; 24-31.V.2010, 1♀; 20-27.IX.2010, 1♀; 1-8.XI.2010, 2♀♀; Ziaz: 13.III.2010-5.IV.2010, 1♀; 5-12.IV.2010, 2♀♀; 19-26.IV.2010, 3♀1♂; 24-31.V.2010, 1♀; 27.IX.2010-4.X.2010, 2♀♀; 4-11.X.2010, 1♀; Orkom, 13.III.2010-5.IV.2010, 1♀; 12-19.IV.2010, 4♀♀; 10-17.V.2010, 2♀; 17-24.V.2010, 1♀1♂; 1-7.VI.2010, 1♀; 7-14.VI.2010, 1♀; 30.VIII.2010-6.IX.2010, 1♀; 6-13.IX.2010, 1♂; 13-20.IX.2010, 1♀1♂; 11-17.X.2010, 1♀; Ghazichak, 12-19.IV.2010, 1♀; 10-17.V.2010, 2♀♀; 17-24.V.2010, 1♂; 1-7.VI.2010, 1♀; Tehran province, Shahryar, 26.IV.2010-3.V.2010, 2♀♀; 3-10.V.2010, 1♀2♂♂; 10-17.V.2010, 7♀♀; 17-24.V.2010, 3♀; 30.VIII.2010-6.IX.2010, 2♀♀; 6-13.IX.2010, 3♀♀; 20-27.IX.2010, 4♀♀; 27.IX.2010-4.X.2010, 6♀♀; 4-11.X.2010, 6♀♀; 11-17.X.2010, 6♀♀; 17-24.X.2010, 4♀♀; Karaj, 13.III.2010-5.IV.2010, 1♀; 19-26.IV.2010, 1♀; 26.IV.2010-3.V.2010, 1♀; 3-10.V.2010, 29♀♀; 10-17.V.2010, 30♀♀11♂♂; 24-31.V.2010, 1♀; 1-7.VI.2010, 1♂; 20-27.IX.2010, 1♀; 27.IX.2010-4.X.2010, 4♀♀; 4-11.X.2010, 3♀♀; 11-17.X.2010, 3♀♀; 17-24.X.2010, 1♀; Arangeh, 17-24.V.2010, 9♀♀; 24-31.V.2010, 7♀♀; 1-7.VI.2010, 4♀♀; 7-14.VI.2010, 2♀♀; Sarziarat, 10-17.V.2010, 1♀; 17-24.V.2010, 2♀♀; 24-31.V.2010, 4♀♀; 1-7.VI.2010, 4♀♀; 26.VII.2010-2.VIII.2010, 1♀; Shahrestanak, 1-7.VI.2010, 1♀; 2-9.VIII.2010, 1♀; 23-30.VIII.2010, 1♀; 30.VIII.2010-

6.IX.2010, 1♀; Qazvin province, Zeresk Road, 13-30.IV.2011, 2♀♀; Khalilabad, 10-22.VI.2011, 1♀; 7-26.IX.2011, 3♀♀; Mazandaran province, Jourband, 1-12.IV.2011, 1♀; 7-26.IX.2011, 7♀♀; 27.IX.2011-11.X.2011, 5♀♀; 11.X.2011-6.XI.2011, 11♀♀; Tangevaz, 26.V.2011-9.VI.2011, 1♀; 10-22.VI.2011, 2♀♀; 16.VIII.2011-6.IX.2011, 1♂; Gaznasara, 1-10.V.2011, 1♀; 11-25.V.2011, 7♀♀; 26.V.2011-9.VI.2011, 13♀♀; 10-22.VI.2011, 17♀; 23.VI.2011-11.VII.2011, 5♀♀; 7-26.IX.2011, 1♀; Nour, 27.IX.2011-11.X.2011, 5♀♀; 11.X.2011-6.XI.2011, 12♀♀.

**General distribution:** Holarctic and Oriental regions (Yu *et al.*, 2005), Iran (new record).

**Diagnostic characters:** *Syrphophilus bizonarius* can easily be distinguished as follows: distinct sternauli on the lower part of mesopleuron (Fig. 3J), deep mesosternal suture with transverse ridges, punctuate 2<sup>nd</sup> and 3<sup>rd</sup> metasomal tergite (Fig. 3H), gena as long as the basal width of the mandibles (Manukyan, 2007).

**Remarks:** *Syrphophilus bizonarius* was the most abundant species in Guilan (23%), Mazandaran (44.5%) and Tehran (35%) provinces, but at the third place in Qazvin province (7%). Males represented about 7% of all sampled specimens. Collecting dates showed that the adults of *S. bizonarius* appeared from early April and their flight activity lasted to early November. They couldn't be found in mid June- late July and mid August. The percentage of captured specimens throughout the growing season was: April (8%), May (47%), June (14%), July (0.3%), August (0.7%), September (11%), October (18%) and November (≈1%).

### Genus *Tymmophorus* Schmiedeknecht, 1913\*\*

*Tymmophorus* is a relatively small genus with four known species in the Palaearctic (Yu *et al.*, 2005). It resembles *Diplazon* in having notauli on the mesoscutum, but can be separated by the following characters: metasomal tergites 1-3 without transverse groove, uniform hind colour.

### *Tymmophorus obscuripes* (Holmgren, 1858)\*

(Figs. 3D, 3K)

**Synonyms:** *Tymmophorus arcticus* (Holmgren, 1869), *Tymmophorus luctuosus* (Schmiedeknecht, 1926), *Tymmophorus nigrofemoratus* Dasch, 1964, *Tymmophorus rufocinctus* (Desvignes, 1862)

**Material examined:** 2♀♀. Tehran province, Shahrestanak, 30.VIII.2010-6.IX.2010, Mazandaran province, 1♀; Jourband, 11.X.2011-6.XI.2011, 1♀.

**General distribution:** Nearctic and Western Palaearctic (Europe) regions (Yu *et al.*, 2005), Iran (new record).

**Diagnostic characters:** *Tymmophorus obscuripes* has a polished face and hind tibia (Fig. 3D), vein Cu in the hind wing is inclivous, antennae and trochanters black, hind femur and hind tarsus black.

**Remarks:** *Tymmophorus obscuripes* was among the least abundant species with only two individuals during our two-year trapping, but it occurs on both slopes of the Alborz Mountains. The adults of *T. obscuripes* emerged only late in the growing season, early September in the Tehran province at the Shahrestanak locality where the climate is cold with a relatively long winter and in October in Mazandaran province, in the village Jourband with a humid and moderate climate.

### Genus *Woldstedtius* Carlson, 1979

*Woldstedtius* is the third largest genus in the subfamily Diplazontinae with 36 known species worldwide (Yu *et al.*, 2005). The following characters help to distinguish the genus: propodeum smooth without carinae (Fig. 6E), notauli absent, mesoscutum and clypeus coriaceous, clypeus truncated, flat or concave in profile with a pronounced median deep groove (Figs. 6A-6C), hind tibia black and white (Fig. 6G).

Two collected species of the genus *Woldstedtius* can be separated as follows:

1- Lower width of face (between the eyes) longer than the upper one (Fig. 6C); head and thorax mainly yellow; third metasomal tergite



with yellow spots; fourth metasomal tergite with yellow bands (Fig. 6D) .....

***Woldstedtius citropectoralis* (Schmiedeknecht, 1926)**

- Lower width of face (between the eyes) equal to the upper one (Figs. 6A, 6B); face protruded centrally (Fig. 6A); third metasomal tergite with yellow bands and roughly coriaceous (Fig. 6F) .....

***Woldstedtius biguttatus* (Gravenhorst, 1829)**

***Woldstedtius biguttatus* (Gravenhorst, 1829)** (Figs. 6 A, 6B, 6E, 6F)

**Synonyms:** *Woldstedtius confusus* (Woldstedt, 1874), *Woldstedtius rufipes* (Gravenhorst, 1829)

**Material examined:** 22♀♀, 13♂♂. Guilan province, Astaneh-e-Ashrafieh, 13.III.2010-5.IV.2010, 3♀♀1♂♂; 12-19.IV.2010, 1♀; 3-10.V.2010, 1♀; Ziaz, 13.III.2010-5.IV.2010, 1♂; 12-19.IV.2010, 1♂; 26.IV.2010-3.V.2010, 1♀; 17-24.V.2010, 1♀1♂; 24-31.V.2010, 1♂; 1-7.VI.2010, 1♀; Orkom, 3-10.V.2010, 1♂; 7-14.VI.2010, 1♂; 21-28.VI.2010, 1♀; 28.VI.2010-5.VII.2010, 1♀; 19-26.VII.2010, 1♀; Ghazichak, 5-12.IV.2010, 1♂; 12-19.IV.2010, 1♂; Qazvin province, Khalilabad, 26.V.2011-9.VI.2011, 1♀; Mazandaran province, Jourband, 27.IX.2011-11.X.2011, 1♀3♂♂; 11.X.2011-6.XI.2011, 1♂; Tangevaz, 23.VI.2011-11.VII.2011, 1♀; Gaznasara, 10-22.VI.2011, 6♀♀; 23.VI.2011-11.VII.2011, 1♀; 28.VII.2011-16.VIII.2011, 1♀.

**General distribution:** Palaearctic (Yu et al., 2005), Iran (East-Azerbaijan, Kohkiluyeh-Boyerahmad (Masnadi-Yazdinejad and Jussila, 2008), new record for the north of Iran.

**Diagnostic characters:** *Woldstedtius biguttatus* can be identified by the combination of the following characters: face with parallel inner margins of the eye, centrally strongly protruding, female with black and male with yellow face (Figs. 6A, 6B), propodeum smooth (Fig. 6E), hind tibia with uniformly distributed setae, In the male metasomal tergite 3 and 4 with anterolateral yellow spot (Fig. 6F).

**Remarks:** Collecting data showed the presence of *Woldstedtius biguttatus* distributed on both

slopes of the Alborz Mountains. Sampling dates were from April to November: April (29%), May (14%), June (31%), July (9%), August (3%) and October (14%).

***Woldstedtius citropectoralis* (Schmiedeknecht, 1926)\*** (Figs. 6C, 6D, 6G)

**Synonym:** *Woldstedtius abductor* (Bridgman, 1886)

**Material examined:** 2♂♂. Mazandaran province, Jangal, 29.V.2011-9.VI.2011, 2♂.

**General distribution:** Holarctic (Yu et al., 2005), Iran (new record).

**Diagnostic characters:** In *W. citropectoralis* the inner orbits of the eyes strongly diverge downward. The width at clypeus: width at flagellum is about 4.5: 3.7 (Fig. 6C). This character makes this species easily distinguishable from other species of the genus.

**Remarks:** On the northern slopes of the Alborz Mountains at elevation of about 1500 m, 2 males of *W. citropectoralis* were captured.

**Genus *Xestopelta* Dasch, 1964\*\***

The small genus *Xestopelta* includes five species worldwide with two in the Western Palaearctic (Yu et al., 2005). The distinct feature which marked this genus unique in the subfamily is concavity of metasomal tergites 3-5 (Fig. 3I). Fitton and Rotheray (1982) stated that this feature can just be found in males of the genus but examining of 10 females of *Xestopelta gracilima* collected in Iran showed that this character clearly present in females.

***Xestopelta gracilima* (Schmiedeknecht, 1926)\*** (Figs. 3A, 3B, 3I)

**Synonym:** *Xestopelta amabilis* (habermehl, 1935)

**Material examined:** 10♀♀. Guilan province, Ghazichak; 12-19.IV.2010, 1♀; 26.IV.2010-3.V.2010, 3♀♀; 10-17.V.2010, 1♀; 24-31.V.2010, 1♀; Tehran province, Shahrestanak, 1♀; 10-17.V.2010, 3♀♀; 17-24.V.2010.

**General distribution:** Palaearctic region (Yu et al., 2005), Iran (new record).

**Diagnostic characters:** body black; face black with yellow inner eye orbits, clypeus and

mandibles; metasoma black with ventral part of tergites 3-7 yellow (fig. 3A); Clypeus smooth, without notch, elevated basally and flattened centrally (Fig. 3B); propodeum polished; metasoma compressed laterally from segment 3 (Fig. 3I).

**Remarks:** *Xestopelta gracilima* is the well known and most wide spread species of the genus in the Palearctic. Collecting data showed that the species is present at relatively high altitudes (more than 1800 m a.s.l.) of both slopes of the Alborz Mountains. All adults were captured from mid April till late.

### Discussion

The results of this study showed that the north of Iran inhabits at least 16 species belonging to seven genera of Diplazontinae (Hym.: Ichneumonidae). Twelve Species are new to Iran's Diplazontinae fauna (Kolarov and Ghahari, 2005; Masnadi-Yazdinejad and Jussila, 2008; Nourbakhsh *et al.*, 2008; Rakhshani *et al.*, 2010; Barahoei *et al.*, 2012; Barahoei *et al.*, 2013). Southern (Tehran and Qazvin provinces) and northern slopes (Guilan and Mazandaran provinces) of the Alborz Mountains included 12 and 15 species, respectively. *Diplazon laetatorius*, *D. tibiatorius*, *Homotropus nigritarsus*, *Promethes sulcator*, *Sussaba flavipes*, *S. pulchella*, *Syrphoctonus tarsatorius*, *S. bizonarius*, *Tymmophorus obscuripes*, *Woldstedtius biguttatus* and *Xestopelta gracilima* were sampled on both slopes of the Alborz Mountains. However *D. annulatus*, *D. pectoratorius*, *H. pictus* and *W. citropectoralis* were collected only in the northern slopes of the Alborz Mountains and *Enizemum ornatum* only in the southern ones. These two slopes have different climatic characters (see Materials and methods section). In addition, collected data showed that most of the species have a wide altitudinal distribution, but *D. pectoratorius*, *H. pictus*, *W. citropectoralis* and *X. gracilima* showed that they preferred higher altitudes (above 1000 m a.s.l.). These results indicate that although many diplazontines have a multiregional distribution (Manukyan, 1995), they showed some preferences for certain altitudes and climatologically characterized regions.

Sampling sites differed both in total number of species and total sampled specimens. Ghazichak, Jourband and Gaznasara were the localities with greatest species diversity comprising nine species. Rankings of the different localities as for the decreasing order of species diversity were as follows: Shahrestanak and Tangevaz with 8, Orkom with 7, Ziaz and Khalilabad with 6, Shahryar, Sarziarat + Arangeh, Karaj, Zereshk Road with 5, Astaneh-e-Ashrafieh and Nour with 4 and finally Loshan and Jangal with just one species. The results showed that in orchards ecosystems of northern Iran 6 diplazontine species are present which is more than was expected in comparison with previous studies (Jankowska, 2004; Smith and Chaney, 2007; Nourbakhsh *et al.*, 2008; Rakhshani *et al.*, 2010). These agroecosystems also included higher density of diplazontines since 17,14 and 14% of all specimens were collected from Karaj, Shahryar and Sarziarat + Arangeh.

Sampling dates provided violable information on temporal occurrence of Diplazontinae in the north of Iran (Table 2). These data and those found by Kazerani *et al.* (2013) can be used in the future studies to investigate the potential role of Diplazontines on the ecology of Syrphids as one of the important biological control agents of aphids in agroecosystems of Iran.

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## مطالعه زنبورهای زیرخانواده (Diplazontinae (Hymenoptera: Braconiodae) در شمال مرکزی ایران

عباس محمدی خرم‌آبادی<sup>۱</sup>، علی اصغر طالبی<sup>۱\*</sup> و کیس زاخالز<sup>۲</sup>

۱- تهران، دانشگاه تربیت مدرس، دانشکده کشاورزی، گروه حشره‌شناسی، صندوق پستی ۳۳۶-۱۴۱۱۵.

۲- دکتر درיסلان ۲۰۴، آرکل، ۴۲۴۱ سی، ام، هلند.

\* پست الکترونیکی نویسنده مسئول مکاتبه: talebi@modares.ac.ir

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**چکیده:** فون زنبورهای زیرخانواده (Diplazontinae (Hymenoptera: Ichneumonidae طی سال‌های ۱۳۸۹-۱۳۹۰ در شمال مرکزی ایران مطالعه گردید. در مجموع ۹۳۳ نمونه از ۳۰ منطقه در ارتفاعات مختلف و با استفاده از تله مالیز جمع‌آوری شد. شانزده گونه در قالب ۷ جنس مورد شناسایی قرار گرفتند که از آنها، دوازده گونه که با علامت ستاره (\*) مشخص شده‌اند، برای اولین بار از ایران گزارش می‌شوند: *Diplazon annulatus* (Gravenhorst)\*, *Diplazon laetatorius* (Fabricius), *D. pectoratorius* (Gravenhorst)\*, *D. tibiatorius* (Thunberg)\*, *Enizemum ornatum* (Gravenhorst), *Homotropus nigritarsus* (Gravenhorst)\*, *Homotropus pictus* (Gravenhorst)\*, *Promethes sulcator* (Gravenhorst), *Sussaba flavipes* (Lucas)\*, *Sussaba pulchella* (Holmgren)\*, *Syrphoctonus tarsatorius* (Panzer)\*, *Syrphophilus bizonarius* (Gravenhorst)\*, *Tymmophorus obscuripes* (Holmgren)\*, *Woldstedtius biguttatus* (Gravenhorst), *Woldstedtius citropectoralis* (Schmiedeknecht)\* and *Xestopelta gracilima* (Schmiedeknecht)\*. ویژگی‌های ریخت‌شناسی و کلید شناسایی جنس‌ها و گونه‌ها ارائه گردید. دوره‌های فعالیت و پروازی حشرات کامل این گونه‌ها و نیز پراکنش آنها براساس ارتفاع از سطح دریا در دو سوی رشته کوه البرز مورد بحث قرار گرفت.

**واژگان کلیدی:** فون، گزارش جدید، Diplazontinae، ایران