



Diplazontinae (Hymenoptera: Ichneumonidae) of the West Azarbaijan province with a new record for the Iranian fauna

Soroush Karimi

Department of Plant Protection, Mahabad Branch, Islamic Azad University, Mahabad, Iran.

✉ soroush.karimi1368@gmail.com

<https://orcid.org/0000-0001-7416-9376>

Akbar Ghassemi-Kahrizeh

Department of Plant Protection, Mahabad Branch, Islamic Azad University, Mahabad, Iran.

✉ a.ghasemi@iau-mahabad.ac.ir

<https://orcid.org/0000-0003-0744-2998>

Abbas Hosseinzadeh

Department of Plant Protection, Mahabad Branch, Islamic Azad University, Mahabad, Iran.

✉ abas1354@yahoo.com

<https://orcid.org/0000-0003-1951-0214>

Hossein Lotfalizadeh

Department of Plant Protection, East-Azarbaijan Agricultural and Natural Resources Research Center, Agricultural Research, AREEO, Tabriz, Iran.

✉ h.lotfalizadeh@areeo.ac.ir

<http://orcid.org/0000-0002-7927-819X>

Abbas Mohammadi-Khoramabadi

Department of Plant Production, College of Agriculture and Natural Resources of Darab, Shiraz University, Darab, 74811-96711, Fars, Iran.

✉ mohamadk@shirazu.ac.ir

<https://orcid.org/0000-0001-6711-9952>

ABSTRACT. Species of the subfamily Diplazontinae (Hym.: Ichneumonidae) were studied in West Azarbaijan province (Northwest of Iran). The specimens were collected using Malaise traps, during 2019–2020. Five species belonging to three genera were collected and identified. One species, *Homotropus riedeli* Johansson, 2020 was a new record for Iran as well as Asia. The distribution range of this species extends from Sweden to the north-west of Iran. A checklist is being compiled for 27 known Iranian species of this subfamily. In addition, a distribution map based on the recorded areas for each species within the Iranian provinces has been provided. We proposed a new direction for future biodiversity inventories of this subfamily in Iran.

Keywords: Checklist, *Homotropus*, fauna, parasitoid, Syrphidae

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INTRODUCTION

The subfamily Diplazontinae Viereck, 1918 (Hymenoptera: Ichneumonidae) comprises 22 genera and 355 described species in the world (Yu et al., 2016; Broad et al., 2018). The Holarctic region with its boreal and high alpine areas seems especially rich in species (Manukyan, 1995; Klopstein, 2007, 2014). Diplazontinae species are solitary, koinobiont endoparasitoids of the family Syrphidae Latreille, 1802 (Insecta, Diptera) and all but one genus (*Bioblapsis* Förster, 1869) which attack a fungus-feeding syrphid, appear to be specialized on the host aphids (Johansson, 2020). These wasps are the main biotic factors that reduce the population and abundance of syrphid flies (Mohammadi-Khoramabadi et al., 2016b). *Diplazon laetatorius* (Fabricius, 1781) is the most common and widespread species parasitizing about 40

Corresponding author: Ghassemi-Kahrizeh, A., ✉ a.ghasemi@iau-mahabad.ac.ir

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species of Syrphidae around the world (Broad et al., 2018). The morphological characteristics of this subfamily are fore wings with vein 2M-Cu with one or two bullae; clypeus small and separated from face by a groove or transverse impression, the whole surface not strongly bulging, the apical margin usually concave and notched; antenna with more than 13 flagellomeres, male antenna often with tyloids; sternaulus of mesopleuron short or absent; metasomal segment 1 short, the glymma small and shallow, and the spiracle in front of middle; metasoma dorsoventrally depressed or in some females with apex laterally compressed; ovipositor short, not or barely extending beyond metasomal apex (Klopfstein, 2007, 2014; Broad et al., 2018).

The Azarbaijan plateau in the northwest comprises one of the largest mountain ranges in Iran. This mountainous area has been identified as part of the Armeno-Kurdic distribution pattern (Azarbaijan and Kurdistan provinces of Iran) (Noroozi et al., 2018). Although the plant diversity is relatively well-studied (Noroozi et al., 2019), the fauna especially the tinny Darwin parasitoid wasps need further research. In the case of the subfamily Diplazontinae, 26 species have been reported so far from all over Iran (Table 1). A study in the northwest of Iran revealed that 10 species of this subfamily occur in Ardabil province (Ghafouri Moghaddam et al., 2016). Only *Woldstedtius biguttatus* (Gravenhorst, 1829), has been reported from East Azarbaijan province (Masnadi-Yazdinejad & Jussila, 2008); and three species, *Diplazon laetatorius*, *D. tetragonus* (Thunberg, 1824) and *Homotropus nigritarsus* (Gravenhorst, 1829) from West Azarbaijan province (Malkeshi and Kheibani, 1997; Manukyan, 2007; Mohammadi-Khoramabadi et al., 2020) and without any record from Kurdistan province.

The subfamily Diplazontinae is still poorly studied in Iran and requires further sampling and faunistic studies, especially in the vast and diverse areas such as the West Azarbaijan province. The aim of this work was to provide new country records of Diplazontinae species from Iran.

MATERIAL AND METHODS

This study was conducted in West Azarbaijan province in northwestern Iran in the spring and summer of 2019–2020. A total of 10 specimens were collected using Malaise traps. The specimens were preserved in 75% ethanol and subsequently prepared according to the AXA method (Achterberg, 2009). A LEICA® stereomicroscope equipped with an Olympus® SC 50 CCD camera and cellSensImaging software was used for taking photographs. The specimens were then identified according to the keys and descriptions provided by Klopfstein (2014) and Johansson (2020). The morphological terminology and microsculpture follow Broad et al. (2018). The voucher specimens were deposited at HMIM (Hayk Mirzayans Insect Museum, Tehran, Iran).

RESULTS

A total of 10 specimens were collected, representing five species, as follows. Of these, one species is a new record for Iran. The list of species is arranged alphabetically.

Taxonomic hierarchy

Class Insecta Linnaeus, 1758

Order Hymenoptera Linnaeus, 1758

Family Ichenumonidae Latreille, 1802

Subfamily Diplazontinae Viereck, 1918

Genus *Diplazon* Nees, 1819

***Diplazon laetatorius* (Fabricius, 1781)**

Material examined. 2♀♀, Iran, West Azarbaijan province, Bukan, 36°31'49"N, 46°11'50"E, 1337 m, 2-IX-2019, leg.: S. Karimi.

Distribution. Worldwide (Klopfstein, 2014).

***Diplazon tetragonus* (Thunberg, 1824)**

Material examined. 1♀, Iran, West Azarbaijan province, Mahabad, 36°47'29"N, 45°49'07"E, 1589 m, 2-IX-2019, leg.: S. Karimi. 1♂, Bukan, 36°34'30"N, 46°04'12"E, 1407 m, 18-VIII-2020, leg.: S. Karimi.

Distribution. Holarctic and Oriental (Varga, 2020).

Genus *Homotropus* Foerster, 1869***Homotropus nigritarsus* (Gravenhorst, 1829)**

Material examined. 1♀, Iran, West Azarbaijan province, Mahabad, 36°47'29"N, 45°49'07"E, 1589 m, 2-IX-2019, leg.: S. Karimi.

Distribution. Holarctic and Neotropical (Klopfstein, 2014).

***Homotropus riedeli* Johansson, 2020 (Fig. 1A-I)**

Material examined. 1♀, Iran, West Azarbaijan province, Piranshahr, 36°34'32"N, 45°12'43"E, 1399 m, 15-VII-2020, leg.: S. Karimi.

Diagnosis. — **Female.** This species was originally described by Johansson (2020) from Sweden. Our specimen is very similar to the holotype. Face entirely coriaceous and matt (Fig. 1B). Antenna with 20 flagellomeres (Fig. 1D). Mesopleuron centrally anteriorly with shallow punctures (Fig. 1H). The interstices about equal to the diameter of punctures. In lower part, punctures become indistinct against coriaceous background. In upper part, punctures partly fade to irregular, almost rugose sculpture. The area around mesopleural furrow polished without punctures. Metapleuron coriaceous, shining. Mesoscutum shining with weak microsculpture between punctures, centrally becoming more strongly coriaceous. Scutellum weakly coriaceous with distinct punctures, interstices between punctures slightly larger than diameter of punctures (Fig. 1E). Propodeum strongly irregularly rugose, with area petiolaris and indicated area superomedia delimited by strong, irregular carinae (Fig. 1E-F). Indicated area superomedia with surface covered with irregular transverse carinae. Coxae coriaceous, matt. Fore wing with areolet closed and vein 3rs-m pigmented (Fig. 1G). Metasoma laterally compressed from 4th tergite. T I strongly longitudinally striate. Second tergite strongly coriaceous with weak striation basally. T III polished with weak microsculpture, in basal half coriaceous and matt. T IV-VII polished with weak microsculpture (Fig. 1I). Spiracle of T II above lateral fold and on T III on lateral fold.

Coloration. Body and head black. Antennae reddish brown. Scapus brown, fading to brownish yellow ventrally. Clypeus, mandibles except mandibular teeth, palpi and large central face patch yellow. Face below antennal sockets dark reddish brown. Lower part of mesopleuron, metapleuron and a large spot on propodeum laterally orange. Scutellum orange. Large shoulder mark, subtegular ridge, tegulae, hind margin of mesopleuron and large spot at the hind corner of pronotum yellow. Legs orange. Fore and mid coxae yellow, orange basally. Trochanters and trochantelli on fore and mid leg yellow. Hind trochanter and trochantelli with large yellow spot. Hind legs apart from trochanter and trochantelli, entirely orange. Metasoma orange. T I centrally black with lateral and apical margins widely orange. Terga VII, and VIII black (Johansson, 2020).

Distribution. Sweden (Johansson, 2020). It is a new record for Iran and Asia.

Comment. The holotype of *H. riedeli* was collected by Malaise traps from 7th July to 14th September in Sweden which corresponds to the date collected in Iran.

Genus *Syrphophilus* Dasch, 1964***Syrphophilus bizonarius* (Gravenhorst 1829)**

Material examined. 1♀, Iran, West Azarbaijan province, Mahabad, 36°47'29"N, 45°49'07"E, 1589 m, 2-IX-2019, leg.: S. Karimi.; 1♀, Piranshahr, 36°34'32"N, 45°12'43"E, 1399 m, 16-VII-2020, leg.: S. Karimi.; 1♀, Naghadeh, 37°00'03"N, 45°32'06"E, 1301 m, 27-IX-2019, leg.: S. Karimi.; 1♀, Mahabad, 36°47'29"N, 45°49'07"E, 1589 m, 2-XI-2019, leg.: S. Karimi.

Distribution. Holarctic and Oriental (Klopfstein, 2014).



Figure 1. *Homotropus riedeli* Johansson, 2020, female. **A.** Habitus, lateral view; **B.** Head, frontal view; **C.** Head, dorsal view; **D.** Antenna, lateral view; **E.** Mesosoma and propodeum, dorsal view; **F.** Propodeum, dorsal view; **G.** Fore wing venation; **H.** Head and mesosoma, lateral view; **I.** Metasoma, dorsal view.

DISCUSSION

Table 1 and Figure 2 (the distribution map) show the list of Diplazontinae species and the surveyed provinces of Iran. Mazandaran ranks first among the studied Iranian provinces with 15 recorded Diplazontine species (Mohammadi-Khoramabadi et al., 2013; Mohammadi-Khoramabadi and Klopstein, 2015; Bakhtiarynasab et al., 2014), followed by Tehran (12 species) (Masnadi & Jussila, 2008; Mohammadi-Khoramabadi et al., 2013; Hasanshahi et al., 2014), Guilan (12 species) (Mohammadi-Khoramabadi et al., 2013), Ardabil (10 species) (Ghafouri Moghaddam et al., 2016; Mohammadi-Khoramabadi et al., 2013), Yazd (7 species) (Zarepour et al., 2008, 2009; Bakhtiarynasab et al., 2014; Klopstein, 2014; Habibi et al., 2016) and Kerman (7 species) (Kolarov & Ghahari, 2005; Barahoei et al., 2012; Bakhtiarynasab et al., 2014, 2015; Mohebban et al., 2016) (Table 1). While, seven provinces including Chaharmahal & Bakhtiyari, North Khorasan, East Azarbaijan, Golestan, Khuzestan, Markazi and Kohgiluyeh & Boyerahmad are represented by only a single species of Diplazontinae, and no species have been so far reported from the Kurdistan, Zanjan, Hamadan, Kermanshah, Lorestan, Ilam, Qom, Semnan, South Khorasan, Bushehr, and Hormozgan provinces. We suggest that future biodiversity inventories should focus on unexplored Iranian provinces.



Figure 2. The distribution map of the species of the subfamily Diplazontinae in Iran. The numbers mentioned in each province indicate the number of species identified there. Provinces without identified species are left with a white background.

Table 1. Known genera and species of the subfamily Diplazontinae in Iran.

Genera	Species	Distribution in Iran	References
<i>Enizemum</i> Forster, 1869	<i>E. ornatum</i> (Gravenhorst, 1829)	Kerman, Qazvin, Khorasan-e Razavi, Sistan & Baluchestan, Yazd	Barahoei et al. (2012, 2013); Mohammadi-Khoramabadi et al. (2013, 2014, 2016a, 2016b); Bakhtiarynasab et al. (2014, 2015); Habibi et al. (2016); Mohebban et al. (2016)
	<i>E. schwarzi</i> Diller, 1987	Kerman	Mohebban et al. (2016)
<i>Diplazon</i> Nees, 1819	<i>D. annulatus</i> (Gravenhorst, 1829)	Guilan, Mazandaran	Mohammadi-Khoramabadi et al. (2013)
	<i>D. laetatorius</i> (Fabricius, 1781)	Alborz, Ardabil, Chaharmahal & Bakhtiari, Fars, Guilan, Isfahan, Kerman, Mazandaran, North Khorasan, Qazvin, Khorasan-e Razavi, Sistan & Baluchestan, Tehran, West Azarbaijan, Yazd	Zarepour et al. (2008, 2009); Malkeshi and Kheiabani (1997); Rakhshani et al. (2010); Nourbakhsh et al. (2008); Barahoei et al. (2012, 2013, 2015); Bani-Hashemi et al. (2013); Mohammadi-Khoramabadi et al. (2013, 2016a, 2016b); Bakhtiarynasab et al. (2014, 2015); Sarrafi et al. (2015); Mohebban et al. (2016); Habibi et al. (2016, 2017); Current study
	<i>D. orientalis</i> (Cameron, 1905)	Fars	Kolarov and Ghahari (2005)
	<i>D. pectoratorius</i> (Gravenhorst, 1829)	Ardabil, Guilan, Mazandaran	Mohammadi-Khoramabadi et al. (2013); Ghafouri Moghaddam et al. (2016)
	<i>D. schachtii</i> Diller 1986	Yazd	Klopfstein (2014)
	<i>D. tetragonus</i> (Thunberg, 1824)	West Azarbaijan, not defined	Manukyan (2007); Current study
	<i>D. tibiatorius</i> (Thunberg, 1822)	Mazandaran, Qazvin, Tehran	Mohammadi-Khoramabadi et al. (2013)
<i>Homotropus</i> Forster, 1869	<i>H. crassicornis</i> (Thomson, 1890)	Ardabil	Ghafouri Moghaddam et al. (2016)
	<i>H. elegans</i> (Gravenhorst, 1829)	Ardabil, Kerman, Yazd	Bakhtiarynasab et al. (2014, 2015); Habibi et al. (2016, 2017); Ghafouri Moghaddam et al. (2016); Mohebban et al. (2016)
	<i>H. longiventris</i> (Thomson, 1890)	Ardabil, Mazandaran	Mohammadi-Khoramabadi and Klopfstein (2015); Ghafouri Moghaddam et al. (2016)
	<i>H. nigritarsus</i> (Gravenhorst, 1829)	Alborz, Ardabil, Fars, Guilan, Isfahan, Khuzestan, Markazi, Mazandaran, Qazvin, Tehran, West Azerbaijan, Yazd	Mohammadi-Khoramabadi et al. (2013, 2016b, 2020); Barahoei et al. (2015); Sarafi et al. (2015); Ghafouri Moghaddam et al. (2016); Habibi et al. (2016); Current study
	<i>H. pictus</i> (Gravenhorst, 1829)	Alborz, Ardabil, Guilan, Kerman, Mazandaran, Tehran, Yazd	Mohammadi-Khoramabadi et al. (2013); Ghafouri Moghaddam et al. (2016); Habibi et al. (2016); Mohebban et al. (2016)
	<i>H. riedeli</i> (Johansson, 2020)	West Azarbaijan	Current study
	<i>H. signatus</i> (Gravenhorst, 1829)	Ardabil, Fars, Isfahan, Kerman, Mazandaran, Khorasan-e Razavi, West Azarbaijan, Yazd	Bakhtiarynasab et al. (2014, 2015); Barahoei et al. (2014, 2015); Sarafi et al. (2014, 2015); Mohammadi-Khoramabadi et al. (2016a); Ghafouri Moghaddam et al. (2016); Habibi et al. (2016); Mohebban et al. (2016); Current study
<i>Promethes</i> Forster, 1869	<i>P. sulcator</i> (Gravenhorst, 1829)	Alborz, Ardabil, Guilan, Isfahan, Kerman, Khorasan-e Razavi, Sistan & Baluchestan, Tehran	Mohammadi-Khoramabadi et al. (2013); Barahoei et al. (2013, 2014, 2015); Ghafouri Moghaddam et al. (2016); Mohebban et al. (2016)
<i>Phthorima</i> Forster, 1869	<i>Ph. compressa</i> (Desvignes, 1856)	Golestan	Samin et al. (2020)*
<i>Sussaba</i> Cameron, 1909	<i>S. erigator</i> (Fabricius, 1804)	Tehran	Masnadi-Yazdinejad & Jussila (2008)
	<i>S. flavipes</i> (Lucas, 1849)	Guilan, Mazandaran, Tehran	Masnadi-Yazdinejad & Jussila (2008); Mohammadi-Khoramabadi et al. (2013)
	<i>S. pulchella</i> (Holmgren, 1858)	Guilan, Mazandaran, Tehran	Masnadi-Yazdinejad & Jussila (2008); Mohammadi-Khoramabadi et al. (2013)
<i>Syrphoctonus</i> Forster, 1869	<i>S. tarsatorius</i> (Panzer, 1809)	Alborz, Guilan, Mazandaran, Tehran	Mohammadi-Khoramabadi et al. (2013)
<i>Syrphophilus</i> Dasch, 1964	<i>S. bizonarius</i> (Gravenhorst, 1829)	Alborz, Guilan, Mazandaran, Tehran, Qazvin, Ardabil, Isfahan, West Azarbaijan	Ghahari and Schwarz (2012); Mohammadi-Khoramabadi et al. (2013); Hasanshahi et al. (2014); Barahoei et al. (2015); Ghafouri Moghaddam et al. (2016); Current study
<i>Tymmophorus</i> Schmiedeknecht, 1913	<i>T. obscuripes</i> (Holmgren, 1858)	Tehran, Mazandaran	Mohammadi-Khoramabadi et al. (2013)
<i>Woldstedtius</i> Carlson, 1979	<i>W. biguttatus</i> (Gravenhorst, 1829)	East Azarbaijan, Guilan, Kuhgiluyeh & Boyerahmad, Mazandaran, Qazvin	Masnadi-Yazdinejad & Jussila (2008); Mohammadi-Khoramabadi et al. (2013)
	<i>W. citropeptoralis</i> (Schmiedeknecht, 1926)	Mazandaran	Mohammadi-Khoramabadi et al. (2013)
<i>Xestopelta</i> Dasch, 1964	<i>X. gracilima</i> (Schmiedeknecht, 1926)	Guilan, Tehran	Mohammadi-Khoramabadi et al. (2013)

* Unconfirmed record

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: S. Karimi: Sampling and mounting of the specimens, and preparation of the photographs; A. Ghassemi-Kahrizeh: Preparation of the photographs, writing and revising the manuscript and correspondence; A. Hosseinzadeh: Writing and revising the manuscript; H. Lotfalizadeh: Identification of the specimens, and help for the preparation of the photographs; A. Mohammadi-Khoramabadi: Identification of the specimens, and help for the preparation of the photographs. All authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in deposited at HMIM (Hayk Mirzayans Insect Museum, Tehran, Iran), and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study only included plants and arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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زنبورهای زیرخانواده (Hymenoptera: Ichneumonidae) Diplazontinae استان آذربایجان غربی با یک گزارش جدید برای فون ایران

سروش کریمی^۱، اکبر قاسمی کهریزه^{۱*}، عباس حسینزاده^۱، حسین لطفعلی زاده^۲، عباس محمدی خرمآبادی^۳

۱ گروه گیاه پزشکی، واحد مهاباد، دانشگاه آزاد اسلامی، مهاباد، ایران.

۲ بخش تحقیقات گیاهپزشکی، مرکز تحقیقات و آموزش کشاورزی استان آذربایجان شرقی، سازمان تحقیقات، آموزش و ترویج کشاورزی، تبریز، ایران.

۳ گروه تولیدات گیاهی، دانشکده کشاورزی و منابع طبیعی داراب، دانشگاه شیراز، فارس، ایران

* پست الکترونیک نویسنده مسئول مکاتبه: a.ghasemi@iau-mahabad.ac.ir

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چکیده: گونه‌های زیرخانواده Diplazontinae Veireck 1918 (Hym.: Ichneumonidae) در استان آذربایجان غربی واقع در شمال-غرب ایران مطالعه شد. نمونه‌ها با استفاده از تله مالیز در سال‌های ۱۳۹۸ و ۱۳۹۹ جمع‌آوری شد. پنج گونه متعلق به سه جنس شناسایی گردید. از این میان، گزارش گونه *Homotropus riedeli* (Johansson, 2020) برای فون ایران و آسیا جدید بود. مناطق پراکنش این گونه از سوئد تا شمال‌غرب ایران گسترش یافته است. چک‌لیستی از ۲۷ گونه شناسایی شده زیرخانواده Diplazontinae در ایران ارائه شد. همچنین نقشه پراکنش گونه‌ها بر اساس مناطق ثبت شده برای هر گونه در استان‌های مختلف ایران تهیه شد. بعلاوه، مسیر جدیدی برای بررسی تنوع زیستی این زیرخانواده در ایران پیشنهاد گردید.

واژگان کلیدی: چک‌لیست، *Homotropus*، فون، پارازیتوئید، سیرفیده