




Bimaculate species of the genus *Foenatopus* Smith (Hym., Stephanidae) in Iran, with a new record

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ABSTRACT. Two species of the genus *Foenatopus* Smith, 1846 (Hym.: Stephanidae), were collected from West-Azərbayjan province, the northwest Iran; *Foenatopus prousti* Aguiar & Turrisi, 2010 and *F. turcomanorum* (Semenov, 1891). These species belong to the bimaculate group of this genus. *Foenatopus turcomanorum* is a new record for Iran. Their morphological characters and distribution are provided. The Iranian species of the bimaculate group of *Foenatopus* are summarized and tabulated.

Key words: Parasitoid wasp, northwestern Iran, distribution, new record, checklist.

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INTRODUCTION

The genus *Foenatopus* Smith, 1846 is the largest genus of the family Stephanidae (Hymenoptera: Stephanoidea) with more than 160 nominated species in the world (Aguiar, 2004; Chen et al., 2016; Ghafouri Moghaddam et al., 2018). Members of this genus are distributed in the Afrotropical, Neotropical, Palaearctic and Oriental regions (Gupta & Gawas, 2020). *Foenatopus* species are biologically associated with xylophagous beetles of the families Buprestidae and Cerambycidae (Coleoptera) (Aguiar, 2006; Jamshidi et al., 2020).

There have been yet reported seven species from the family Stephanidae including six species of *Foenatopus* in Iran up to date (Masnadi-Yazdinejad & Lotfalizadeh, 2009; Aguiar et al., 2010; Ghafouri Moghaddam et al., 2018; Jamshidi et al., 2020). Aguiar et al. (2010) described three species from the Middle East with two new species *F. prousti* Aguiar & Turrisi, 2010 and *F. crispus* Aguiar, 2010 from Iran. They keyed out these species and their closely allied species. Subsequently, Ghafouri Moghaddam et

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al. (2018) reported two species of *Foenatopus* by describing *F. nimaarkanii* Ghafouri Moghaddam & Rakhshani, 2018. Most recently, Jamshidi et al. (2020) reported *Foenatopus hesperophagus* Aguiar as a parasitoid of *Anthaxia* sp. (Col., Buprestidae), on *Pistacia vera* L., 1753 (Anacardiaceae) in the western Iran. A group of this genus has double whitish spots (“bimaculate”) on the metasomal tergites (Aguiar et al., 2010; Ghafouri Moghaddam et al., 2018). The present study treated 1) a new record of species belonging to the genus *Foenatopus* in Iran; 2) briefing bimaculate species of *Foenatopus* in Iran.

MATERIAL AND METHODS

Specimens for this study were collected by a Malaise trap which was installed within 1 km of Kavlan village, Mahabad County, West-Azərbayjan province, during 2019 (Fig. 1). The collecting container was filled with 70% alcohol as a killing and preserving agent. The collected specimens were then dried and card-mounted following Noyes (1982). Identification was done using Aguiar (2004), Aguiar et al. (2010) and Ghafouri Moghaddam et al. (2018). Morphological terms, including the wing venation, follow Aguiar (2001) and Aguiar et al. (2010). Classifications at the subfamily and generic level follow Aguiar (2004).

Measurements and illustration of external morphology of dry-mounted specimens were made using an Olympus™ SZH stereomicroscope, with lighting achieved through a 27W fluorescent lamp,, and equipped with a Canon™ A720 digital camera mounted with an adapter. Assemblage and edition optimization of obtained photos were done using Adobe Photoshop CS4® software. Voucher specimens are deposited in the Hayk Mirzayans Insect Museum, Iranian Research Institute of Plant Protection, Tehran, Iran (HMIM).

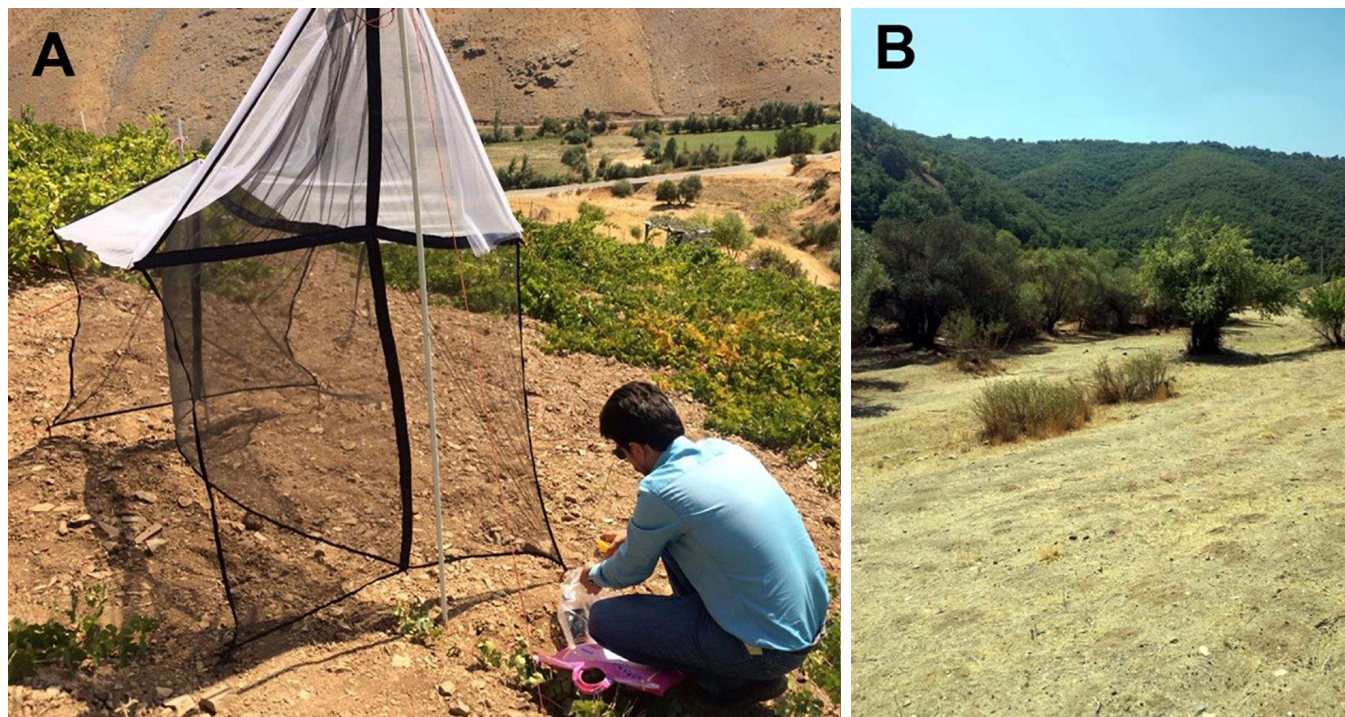


Figure 1. Collecting site of Stephanidae in the northwest of Iran: **A.** the installed Malaise trap near Kavlan village (Mahabad-Sardasht road); **B.** Kuran forest adjacent to collecting site.

RESULTS

Two bimaculate specimens of the genus *Foenatopus* were collected and identified as the following: *Foenatopus prousti* Aguiar & Turrisi, 2010 and *Foenatopus turcomanorum* (Semenov, 1891).

Order Hymenoptera Linnaeus, 1758

Superfamily Stephanoidea Leach, 1815

Family Stephanidae Leach, 1815

Genus *Foenatopus* Smith, 1846

***Foenatopus prousti* Aguiar & Turrisi, 2010 (Figs 2–3)**

Material examined. 1 ♀ (HMIM), Iran, West-Azərbayjan province, Mahabad-Sardasht road, Kavlan village (36°23'42"N, 45°40'8"E, 1586 m), 8.ix.2019, Malaise trap, S. Karimi leg.

Remarks. This species runs to couplet 6 in Aguiar et al. (2010)'s key of the bimaculate species of this genus. Our examined specimen resembles those described by Aguiar et al. (2010) from the south and western Iran. It is characterized by its color pattern of the propodeum (Fig. 3D), petiole and the first tergite (Figs 3H–I), the strongly compressed head (Fig. 3B), and mesosoma. It has a body length 11.4mm (including ovipositor); ovipositor length 4.5 mm, fore wing length 4.7 mm; body brown to light brown, with dark brown mesosoma (Figs 3C–D); with distinct whitish marks in the following parts: clypeus; fore and mid tibia basally and apically; basitarsus of mid leg basally; on hind leg, coxa distally, femur distally and both ventral teeth, compressed part of tibia apically, basitarsus entirely; propodeum dorso-apically; petiole basally and apically; T4 with two large separated pale yellow spots. Detailed sculpture was described by Aguiar et al. (2010).

Distribution. Fars, Lorestan (Aguiar et al., 2010), and West-Azərbayjan provinces (present study).

Ecology. The host of this species is unknown. Based on the collecting date in this study (8.IX.2019) together with available data in Fars (27.IV.2006 and 15.IX.2007) and Lorestan provinces (2.V.2007) (Aguiar et al., 2010), it seems likely be indicated that this species has two distinct flight periods in Iran. It is important to consider that these localities have different altitudes and biogeographical conditions but the common point of these collection localities is Zagros Mountains ranges that our collection site is located in the northern border, Fars and Lorestan provinces in the southern border.



Figure 2. *Foenatopus prousti* Aguiar & Turrisi, 2010, female. General habitus, in lateral view.

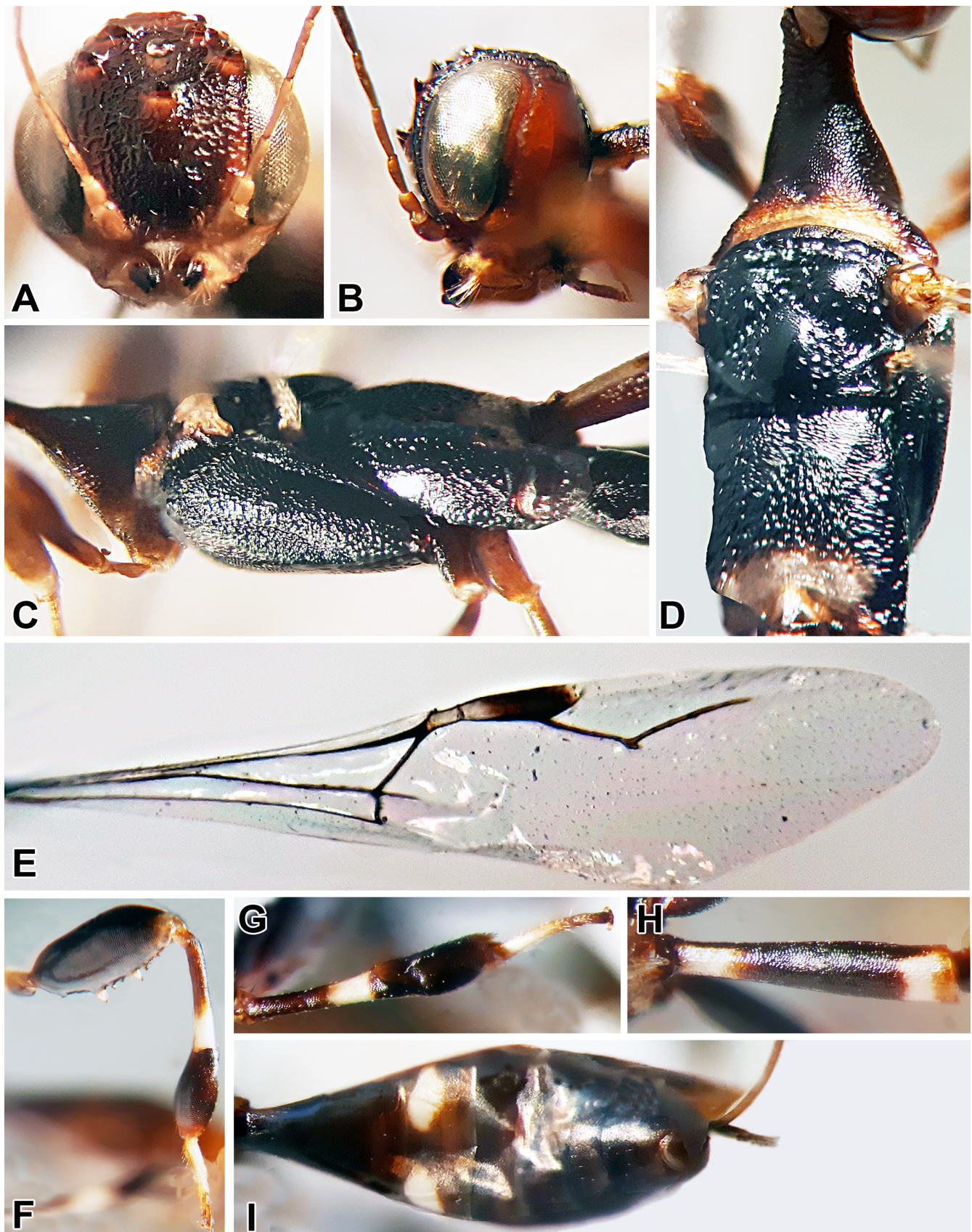


Figure 3. *Foenatopus prousti* Aguiar & Turrisi, 2010, female. **A.** Head, in frontal view; **B.** Head, in lateral view; **C.** Mesosoma, in dorsal view; **D.** Mesosoma, in lateral view; **E.** Fore wing; **F.** Hind leg, in lateral view, **G.** Hind tibia, in lateral view; **H.** Petiole, in dorsal view; **I.** Metasoma, in dorsal view.

***Foenatopus turcomanorum* (Semenov, 1891) (Figs 4–5)**

Material examined. 1 ♀ (HMIM), Iran, West-Azərbayjan province, Mahabad-Sardasht road, Kavlan village (36°23'42"N, 45°40'8"E, 1586 m), 8.ix.2019, Malaise trap, S. Karimi leg.

Remarks. This species can be separated from *F. prousti* by a distinctly smaller white spot of metasoma (Fig. 5J) (*viz.* larger in *F. prousti* (Fig. 3E)); uniformly colored hind tibia (Fig. 5G) (*viz.* with a distinct median white band in *F. prousti* (Fig. 3B, 3C)); uniformly colored petiole (Fig. 5E) (*viz.* with distinct basal and distal white bands in *F. prousti* (Fig. 3D)).

Aguiar et al. (2010) compared it with *F. bisignatus* Aguiar & Jennings, 2010; *F. hesperophagus* Aguiar, 2010; and *F. crispus* Aguiar, 2010. It can be distinguished from other species by the following relevant characters: globular head (Fig. 5B); pronotum transversely strigate with microreticulate between them (Fig. 5C); smooth and polished interfoveolar area; vein 1Cu nearly as long as cross vein 1cu-a, vein 1-1A apically straight and vein 2-1A spectral on fore wing (Fig. 5F); unicolorous propodeum (Fig. 5D); two small white spots on T4 widely separated (Fig. 5J).

Distribution. Central Asian countries including Turkmenistan, Tajikistan and Afghanistan (Semenov, 1891; Tobias, 1988) and Turkey (Yildirim & Kolarov, 2006). New record for Iran (West-Azərbayjan province).

Ecology. The current collecting date (8.IX.2019) of this species and correspondence in Turkmenistan (11.VI.[18]88) (Aguiar et al., 2010), may indicate at least a long period of adult flight. More sampling needs to reveal the precise flight period of this species but this group of parasitic wasps are rarely collected.



Figure 4. *Foenatopus turcomanorum* (Semenov, 1891), female. General habitus, in lateral view.

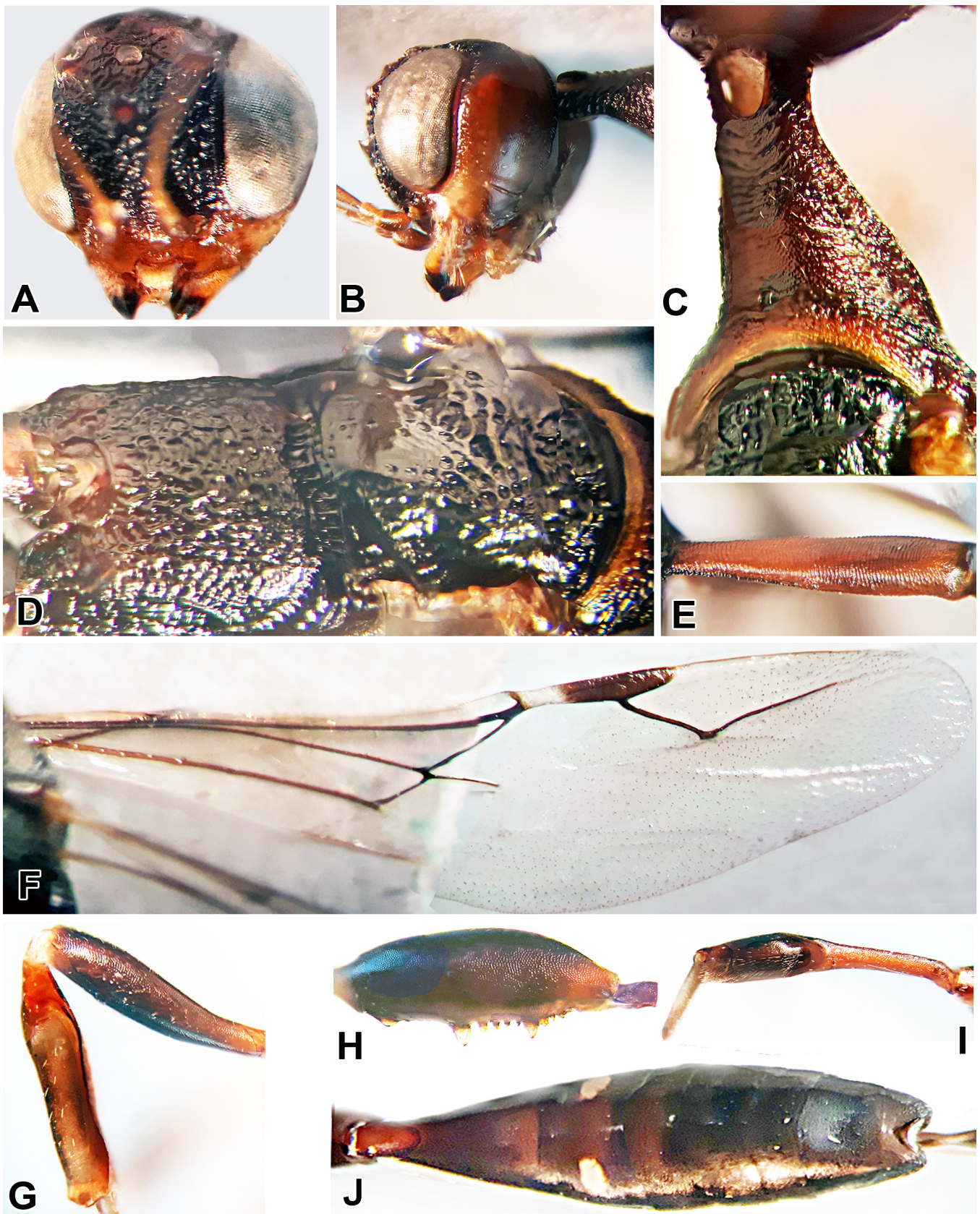


Figure 5. *Foenatopus turcomanorum* (Semenov, 1891), female. **A.** Head, in frontal view; **B.** Head, in lateral view; **C.** Pronotum, in dorsal view; **D.** Mesonotum and propodeum, in dorsal view; **E.** Petiole, in dorsal view; **F.** Fore wing; **G.** Fore leg, in lateral view; **H.** Hind femur, in lateral view; **I.** Hind tibia, in lateral view; **J.** Metasoma, in dorsal view.

DISCUSSION

All records of the family Stephanidae were made from central, southern, eastern and western Iran (see Fig. 2 in Ghafouri Moghaddam et al., 2018) and this is the first effort to find it in the northwest of Iran. Our finding adds a new record of *F. turcomanorum* to the stephanid fauna of Iran and reveals the extended distribution of *F. prousti* to the northwest of Iran. Both species were collected in the northwest the Zagros Mountain ranges of Iran in the Irano-Anatolian biodiversity hotspot (Noroozi, 2020). Ecologically, most of the known species of this genus were reported from highlands and around dead trees, but recently described species from Iran, *F. nimaarkanii* Ghafouri Moghaddam & Rakhshani, 2018 was collected from an alfalfa field in lowland at 461 and 659 m. Future studies will reveal more detailed ecological aspects of this genus. The number of species belongs the genus *Foenatopus* in Iran reached six (Table 1).

Table 1. Bimaculate species of the genus *Foenatopus* Smith, 1846 in Iran and their distribution.

Species	Distribution in Iran (provinces)	References
<i>F. bisignatus</i> Aguiar & Jennings, 2010	Sistan-o Baluchestan	Ghafouri Moghaddam et al. (2018)
<i>F. crispus</i> Aguiar, 2010	Fars	Aguiar et al. (2010)
<i>F. hesperophagus</i> Aguiar, 2010	Kermanshah	Jamshidi et al. (2020)
<i>F. nimaarkanii</i> Ghafouri Moghaddam & Rakhshani, 2018	Kerman, Sistan-o Baluchestan	Ghafouri Moghaddam et al. (2018)
<i>F. prousti</i> Aguiar & Turrisi, 2010	Fars West-Azarbaijan	Aguiar et al. (2010) Present study
<i>F. turcomanorum</i> (Semenov, 1891)	West-Azarbaijan	Present study (new record)

AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: S. Karimi: sampling and mounting of the specimens, and preparation of the photographs; H. Lotfalizadeh: identification of the specimens, and preparation of the photographs; writing the manuscript and correspondence; A. Mohammadi-Khoramabadi: Confirming the identity of specimens and revising the manuscript; All authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

Not applicable.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

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CONFLICT OF INTERESTS

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

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گونه‌های دو لکه‌ای متعلق به جنس *Foenatopus* Smith (Hym., Stephanidae) در ایران، به همراه یک گزارش جدید

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چکیده: دو گونه از بال‌غشاییان تاج‌دار از جنس *Foenatopus* Smith, 1846 (Hym., Stephanidae) شامل *Foenatopus prousti* Aguiar & Turrisi, 2010 و *F. turcomanorum* (Semenov, 1891) از استان آذربایجان غربی در شمال غرب ایران جمع‌آوری شدند. این دو گونه به گونه‌های دو لکه‌ای این جنس متعلق هستند. از این میان گونه *Foenatopus turcomanorum* برای نخستین بار از ایران گزارش می‌شود. مشخصات مورفولوژیک و پراکنش جغرافیایی آنها مورد بررسی قرار گرفت. همه گونه‌های متعلق به گروه دو لکه‌ای جنس *Foenatopus* در ایران بصورت خلاصه در جدولی مرور شد.

واژگان کلیدی: زنبور پارازیتوئید، شمال غرب، ایران، پراکنش، گزارش جدید، چک‌لیست.