

New records of Dryinidae Haliday, 1833 (Hymenoptera, Chrysidoidea) from Iran

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COUVERTURE / *COVER*:

Anteon pubicorne (Dalman, 1818), female, habitus, lateral view.

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diff.pub@mnhn.fr / <https://sciencepress.mnhn.fr>

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ISSN (imprimé / *print*): 1280-9551/ ISSN (électronique / *electronic*): 1638-9387

New records of Dryinidae Haliday, 1833 (Hymenoptera, Chrysidoidea) from Iran

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Submitted on 21 April 2020 | Accepted on 2 February 2021 | Published on 15 September 2021

urn:lsid:zoobank.org:pub:5469C71F-2050-4422-8CF9-B624BEB55C78

Deraffshan H. A., Olmi M., Ghafouri Moghaddam M., Nader E. & Rakhshani E. 2021. — New records of Dryinidae Haliday, 1833 (Hymenoptera, Chrysidoidea) from Iran. *Zoosystema* 43 (23): 563-583. <https://doi.org/10.5252/zoosys-tema2021v43a23>. <http://zoosystema.com/43/23>

ABSTRACT

New records of Dryinidae Haliday, 1833 (Hymenoptera, Chrysidoidea) from Iran are listed. Two subfamilies (Anteoninae R. Perkins, 1912 and Aphelopinae R. Perkins, 1912), three genera (*Anteon* Jurine, 1807; *Aphelopus* Dalman, 1823; and *Bocchus* Ashmead, 1893) and five species *viz.* *Anteon abdunnouri* Olmi, 1987, *An. pubicorne* (Dalman, 1818), *Aphelopus melaleucus* (Dalman, 1818), *Ap. orphanidesi* Olmi, 1994 and *Bocchus hyalinus* Olmi, 1998 are newly recorded from Iran. The putative male of *Dryinus tamaricicola* Rakhshani & Olmi, 2016 is discovered in Iran and described. *Aphelopus orphanidesi* is recorded for the first time from Germany and Sweden. The diagnostic characters of the newly known species are re-evaluated. A key to the Iranian Dryinidae (excluding Gonatopodinae Kieffer, 1906) and a brief description is presented and a distribution map is provided for each species.

RÉSUMÉ

Nouvelles signalisations de Dryinidae Haliday, 1833 (Hymenoptera, Chrysidoidea) d'Iran.

De nouvelles signalisations de Dryinidae Haliday, 1833 (Hymenoptera, Chrysidoidea) d'Iran sont répertoriées. Deux sous-familles (Anteoninae R. Perkins, 1912 et Aphelopinae R. Perkins, 1912), trois genres (*Anteon* Jurine, 1807, *Aphelopus* Dalman, 1823 et *Bocchus* Ashmead, 1893) et cinq espèces, à savoir *Anteon abdunnouri* Olmi, 1987, *An. pubicorne* (Dalman, 1818), *Aphelopus melaleucus* (Dalman, 1818), *Ap. orphanidesi* Olmi, 1994 et *Bocchus hyalinus* Olmi, 1998, sont nouvellement signalés en Iran. Le mâle jusqu'ici supposé de *Dryinus tamaricicola* Rakhshani & Olmi, 2016 est découvert en Iran et décrit. *Aphelopus orphanidesi* est signalé pour la première fois en Allemagne et en Suède. Les caractères de diagnose des espèces nouvellement connues sont réévalués. Nous présentons ici une brève description et une clé des Dryinidae iraniens (à l'exclusion des Gonatopodinae Kieffer, 1906) ainsi qu'une carte de répartition pour chaque espèce.

KEY WORDS

Anteoninae,
Aphelopinae,
Bocchinae,
Dryininae,
Auchenorrhyncha,
Palaeartic,
new records.

MOTS CLÉS

Anteoninae,
Aphelopinae,
Bocchinae,
Dryininae,
Auchenorrhyncha,
Paléarctique,
signalisations nouvelles.

INTRODUCTION

The Dryinidae Haliday, 1833 (Hymenoptera, Chrysidoidea) are a small cosmopolitan family known to parasitize Hemiptera Auchenorrhyncha Dumeril, 1806 (Guglielmino & Olmi 2007; Guglielmino *et al.* 2013). About 1886 species are attributed to this family (Olmi 2020). All species of Dryinidae are ectophagous, except for the completely endophagous genus *Crovettia* Olmi, 1984 (not present in Iran) and the first endophagous larval instar of the genus *Aphelopus* Dalman, 1823 (Olmi & van Harten 2000). Dryinidae are easily distinguished from other members of Chrysidoidea by ten antennomeres and the chelate female protarsi except for the subfamilies Aphelopiinae R. Perkins, 1912 (*Aphelopus* Dalman, 1823 and *Crovettia* Olmi, 1984) and Erwiniinae Olmi & Guglielmino, 2010 (*Erwinius* Olmi & Guglielmino, 2010), whose females are achelate (Olmi & Virla 2014), and capture the hosts by their mandibles and forelegs (Olmi 1994). Males of this interesting family are little known and sexual dimorphism is so strong that opposite sexes cannot be associated without rearing or DNA analysis (Olmi 1984; Olmi *et al.* 2000). This study could reveal interesting biogeographic patterns and clarify the status of the genera and species. Anyway, the group is sufficiently distinct to warrant recognition at the generic level (Olmi *et al.* 2019).

The family Dryinidae has remained insufficiently known in Iran, due to the lack of sampling. The few known details about the Dryinidae of Iran refer to studies and descriptions of new species by Derafshan *et al.* (2016, 2017, 2020) in the eastern part of the country. Our investigations in the central, North-Eastern and South-Eastern parts of Iran, during 2015–2018, resulted in the first country records of five species representing three genera and two subfamilies records and increased the number of known Dryinidae from 12 to 17 species.

MATERIAL AND METHODS

Sampling and collection of specimens were done in various habitats (Fig. 1A–F) of the eastern and central provinces of Iran during 2015–2018, using Malaise traps (Fig. 1A, B, D, F), with 75% ethanol solution as a preservative, sweeping (Fig. 1C), and beating vegetation to knock insects onto sheets. More than seventy dryinid specimens were separated from other collected Hymenoptera and stored in plastic vials in 75% ethanol and later prepared in Alcohol-Xylene-Amyl acetate (AXA protocol: van Achterberg 2009), mounted on cards, labeled, and examined under a Nikon® SMZ645 stereomicroscope. Photographs of the external morphological characters of the specimens were taken using a Canon® EOS 700D (Canon® Inc., Japan). Image stacking was performed with ZereneStacker™ version 1.04. Plates were composed in Photoshop® CS6.

Identifications of subfamilies and genera were performed using keys published by Olmi (2006), Olmi & Virla (2014) and Olmi & Xu (2015). Females of Dryinidae were identified to the species level by using keys from Olmi & Xu (2015). Terminology of morphological characters followed that of Olmi (1984), Olmi & Xu (2015), Kawada *et al.* (2015)

and Azevedo *et al.* (2018). The term “metapectal-propodeal complex” is here used in the sense of Kawada *et al.* (2015). It corresponds to the term “propodeum” *sensu* Olmi (1984), Olmi & Virla (2014) and Olmi & Xu (2015). The terms “disc of metapectal-propodeal complex” and “first abdominal tergum” *sensu* Kawada *et al.* (2015), used here, correspond to the terms “dorsal surface of propodeum” and “posterior surface of propodeum”, *sensu* Olmi (1984), Olmi & Virla (2014) and Olmi & Xu (2015). The names of cells and veins of the fore wing are here used in the sense of Azevedo *et al.* (2018). The correspondence between old and new names is the following (the first name is the old name): median cell: radial cell (R); submedian cell: first cubital cell (1Cu); marginal cell: second radial 1 cell (2R1); first brachial cell: second cubital cell (2Cu); stigmal vein: second radial cross&radial sector (2r-rs&Rs); metacarp: poststigmal abscissa of radial 1 (PostabR1). In the text, cells and veins will be named by their respective abbreviations, including costal cell (C).

Geographic coordinates, when not available on specimen labels, were obtained using Google Earth®. Maps were prepared using SimpleMappr (Shorthouse 2010).

ABBREVIATIONS

Biogeographic regions

AFR	Afrotropical;
E-PAL	Eastern-Palaearctic;
W-PAL	Western-Palaearctic.

Depositories and institutions

AMNH	American Museum of Natural History, New York;
CNC	Canadian National Collection of Insects, Ottawa;
DPPZ	Department of Plant Protection, College of Agriculture, University of Zabol;
HNHM	Hungarian Natural History Museum, Budapest;
HTC	Hubert Tussac's collection, Cahors, France (now in the Museum of Natural History, Genève, Switzerland);
MNHN	Muséum national d'Histoire naturelle, Paris;
MOLC	Massimo Olmi's Collection, c/o DAFNE Department, University of Tuscia, Viterbo;
MRSN	Museo Regionale di Scienze Naturali di Torino;
MTC	Michael von Tschirnhaus collection, c/o Senckenberg Deutsches Entomologisches Institut (DEI), Müncheberg;
NHMUK	The Natural History Museum, London;
NHRS	Naturhistoriska Riksmuseet, Stockholm;
NUM	NTNU University Museum, Trondheim;
USNM	National Museum of Natural History, Washington, District of Columbia;
ZIL	Zoological Institute, Lund;
ZMUH	Zoological Museum of the University, Helsinki.

The collected specimens from Iran are retained in the Department of Plant Protection, College of Agriculture, University of Zabol, Muséum national d'Histoire naturelle, Paris and the Massimo Olmi's Collection, c/o DAFNE Department, University of Tuscia.

RESULTS

Two subfamilies (Anteoninae R. Perkins, 1912 and Aphelopiinae) and three genera of Dryinidae are recorded for the first time from Iran represented by five species *Anteon abdounouri* Olmi, 1987, *Anteon pubicorne* (Dalman, 1818), *Aphelopus*

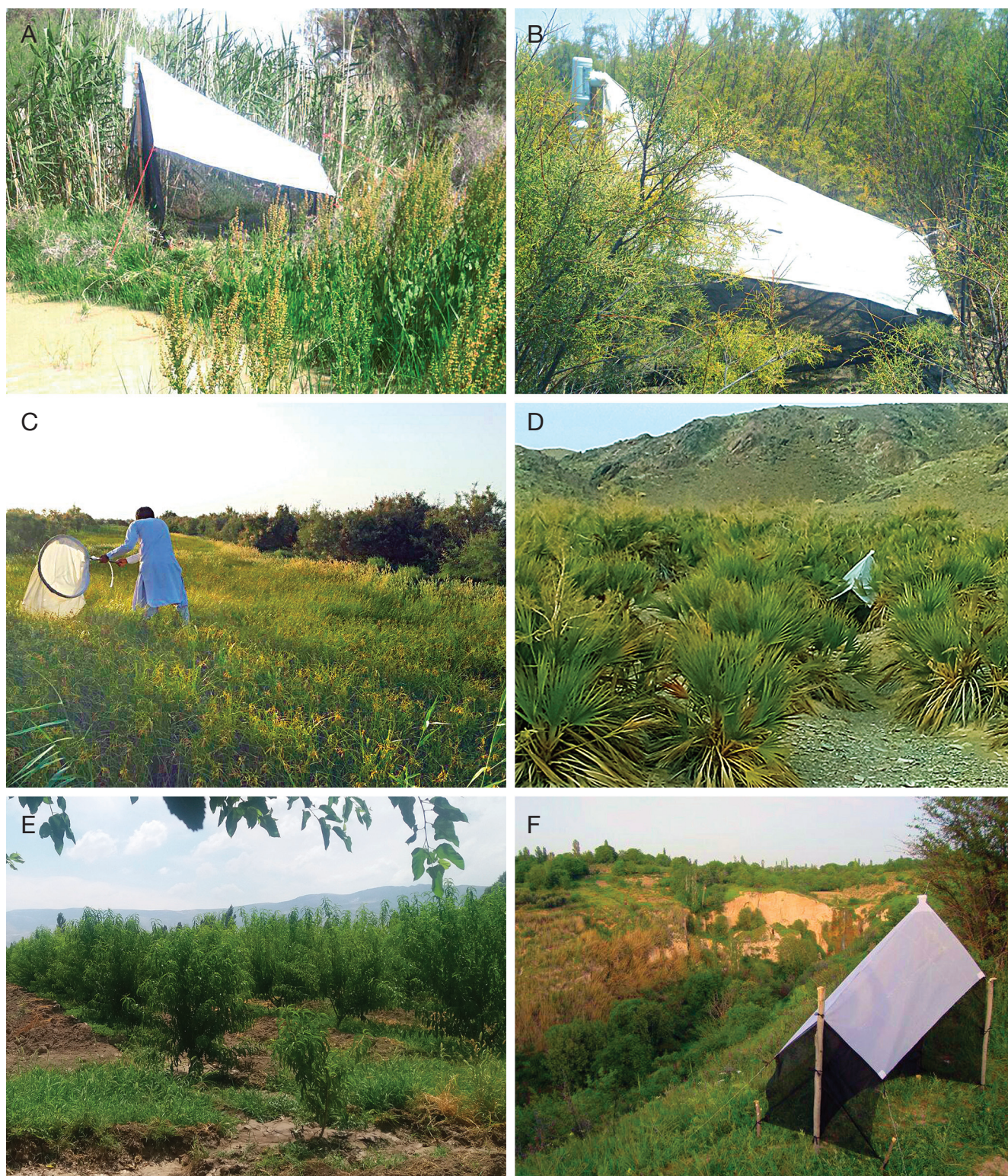


FIG. 1. — The representative habitats, where most of the dryinid specimens were collected: **A-C**, Sistan area; **A**, mixed vegetations near the river; **B**, among the salt cedars around Hamoon lake; **C**, undergrowth covered with nut grass; **D**, Baluchestan area, malaise trap among Mazari palms; **E**, and **F**, North-Eastern part of Iran, open Fruit orchards.

melaleucus (Dalman, 1818), *Aphelopus orphanidesi* Olmi, 1994, and *Bocchus hyalinus* Olmi, 1998. In addition, the putative male of *Dryinus tamaricicola* Rakhshani & Olmi, 2016 in Derafshan *et al.* 2016 was collected for the first time. Three

previously recorded species (*Mirodryinus atlanticus* Olmi, 1984; *Dryinus gharaeii* Olmi, 2005; *D. tarraconensis* Marshall, 1868) are also listed in this paper. The newly recorded taxa are marked with an asterisk (*).

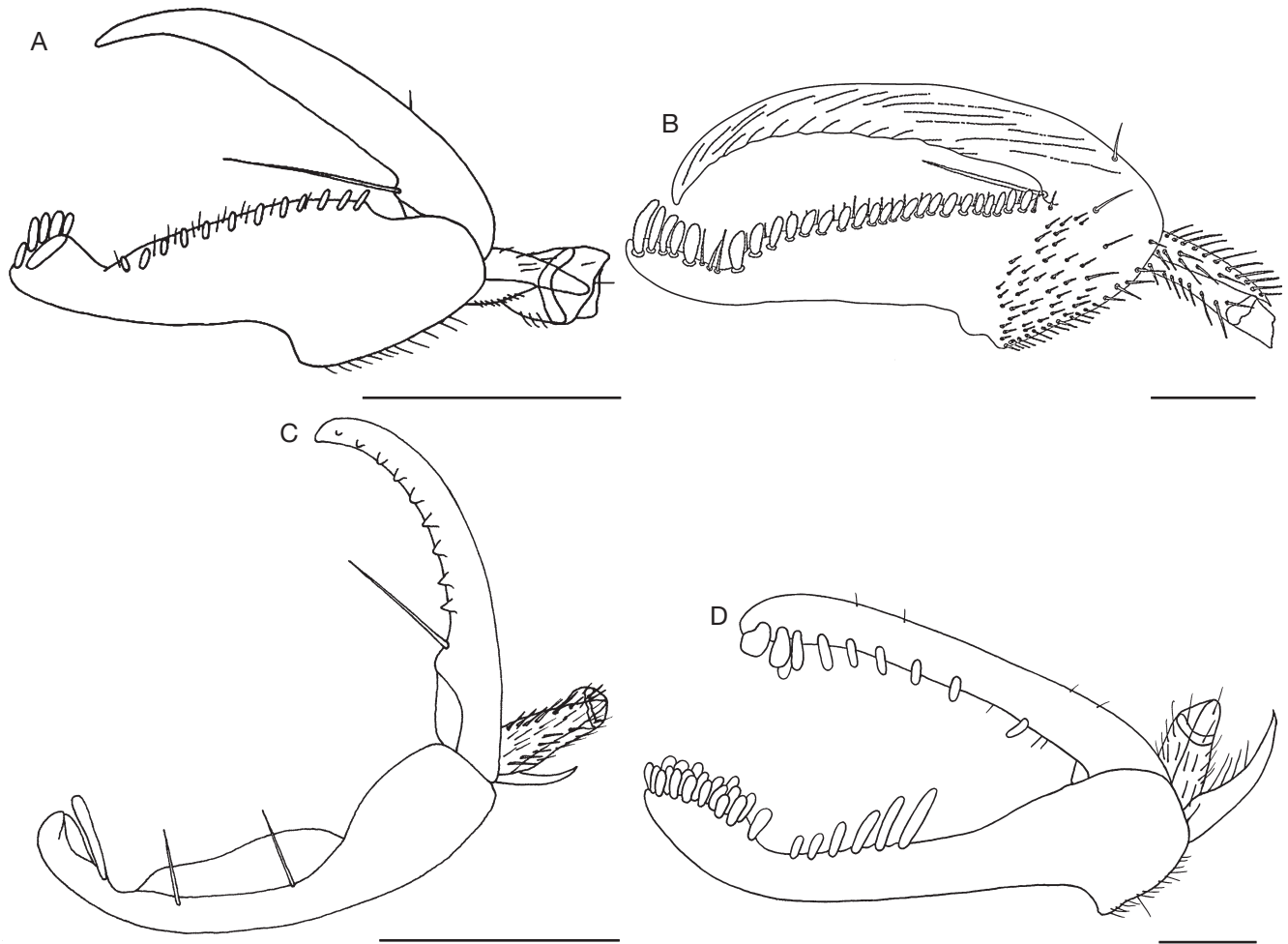


FIG. 2. — Chelae, female: **A**, *Anteon abdounouri* Olmi, 1987 (Lebanon – Redrawn from Olmi 1987); **B**, *Anteon pubicorne* (Dalman, 1818) (Italy – redrawn from Olmi, 1984); **C**, *Bocchus hyalinus* Olmi, 1998 (Oman – Redrawn from Olmi 1998); **D**, *Dryinus tamaricicola* Rakhshani & Olmi, 2016 (Iran – redrawn from Derafshan *et al.* 2016). Scale bars: 100 μ m.

TAXONOMIC ACCOUNTS

Class INSECTA Linnaeus, 1758
Order HYMENOPTERA Linnaeus, 1758
Family DRYINIDAE Haliday, 1833
Subfamily ANTEONINAE R. Perkins, 1912*

Genus *Anteon* Jurine, 1807*

Anteon Jurine, 1807: 302.

TYPE SPECIES. — *Anteon jurineanum* Latreille, 1809, by subsequent monotypy.

Anteon abdounouri Olmi, 1987*
(Figs 2A; 3A; 4; 5)

Anteon abdounouri Olmi, 1987: 33.

TYPE LOCALITY. — Lebanon, Fanar (holotype ♀, AMNH).

MATERIAL EXAMINED. — **Iran** (new record) • 1 ♂; MOLC; Sistan-o Baluchestan province, Zabol; 23.V.2016; H. A. Derafshan leg.;

swept on weeds; Nim-215 • 1 ♂; MNHN; same locality label; 23.IV.2015; swept on mix vegetations; Nim-45 • 1 ♀; MNHN; North Khorasan province, Qale Khan; 05.VI.2018; Z. Rahmani leg.; swept in orchard undergrowth.

Yemen • 1 ♂; MOLC; Lahj; VI-VII.1998; A. van Harten & A. Sallam leg.; Malaise trap • 2 ♂, 9 ♀; MOLC; Lahj; VIII.1998; A. van Harten & A. Sallam leg.

DISTRIBUTION IN IRAN (Fig. 13A). — North Khorasan and Sistan-o Baluchestan Provinces.

GENERAL DISTRIBUTION (Fig. 13A). — AFR, E-PAL and W-PAL.

DESCRIPTION

Female (Figs 2A; 4)

Head dull, completely granulate (Fig. 4B); frontal line complete (Fig. 4A). Pronotum dull, almost completely granulate, only with posterior margin unsculptured (Fig. 4C); posterior surface shorter than mesoscutum (5:9); pronotal tubercle reaching tegula (Fig. 4C); mesoscutum shiny, slightly granulate (Fig. 4C); notauli reaching approximately 0.3-0.4 × length of mesoscutum (Fig. 4C); metapectal-propodeal disc dull, reticulate rugose, with strong transverse posterior keel

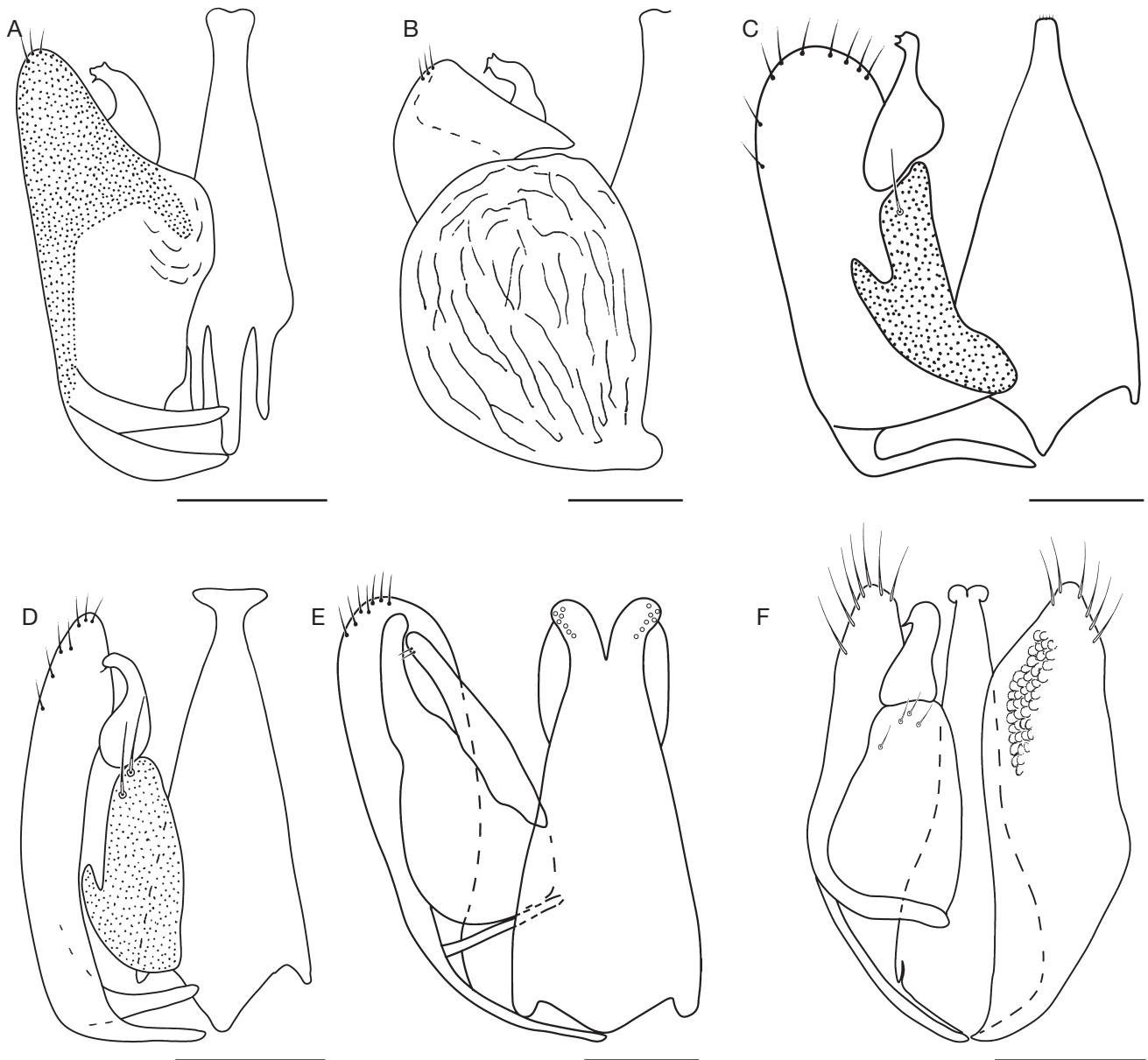


FIG. 3. — Male genitalia: **A**, *Anteon abdunnouri* Olmi, 1987 (Yemen – Redrawn from Olmi & Van Harten 2000); **B**, *Anteon pubicorne* (Dalman, 1818) (England – redrawn from Olmi, 1984); **C**, *Aphelopus melaleucus* (Dalman, 1818) (France – original drawing); **D**, *Aphelopus orphanidesi* Olmi, in Olmi & Orphanides 1994 (Holotype, Cyprus – redrawn from Olmi & Orphanides 1994); **E**, *Bocchus hyalinus* Olmi, 1998 (Oman – redrawn from Olmi et al. 2019); **F**, *Dryinus tamaricicola* Rakhshani & Olmi, in Derafshan et al. 2016 (Iran – original drawing). Scale bars: A-E, 50 μ m; F, 100 μ m.

(Fig. 4D); propodeal declivity reticulate rugose, without longitudinal keels (Fig. 4D). Protarsomere 5 with two rows of approximately 27 bristles, occasionally with two rows of approximately 12-13 lamellae in addition to some bristles (Fig. 2A); apex with about 4-6 lamellae (Fig. 2A).

Male (Fig. 5)

Head dull, completely granulate (Fig. 5A, B); frontal line absent (occasionally incomplete) (Fig. 5A); notauli reaching about $0.4 \times$ length of mesoscutum (Fig. 5C); metapectal-propodeal complex with strong transverse keel between disc of metapectal-propodeal complex and propodeal declivity (Fig. 5C); disc of metapectal-propodeal complex reticulate

rugose (Fig. 5D). Propodeal declivity without longitudinal keels, completely reticulate rugose. Paramere without distal inner pointed process, with inner medial process surrounded by membranous band (Fig. 3A).

REMARKS

In specimens from Oman, antenna darkened, legs testaceous, except brown metacoxa and clubs of femora; head slightly granulate; mesoscutum dull and strongly granulate. In specimens from Dubai and Afghanistan, frons with unsculptured area in front of anterior ocellus. Frontal line incomplete in some specimens from Afghanistan and Japan, sometimes absent in some Japanese specimens.

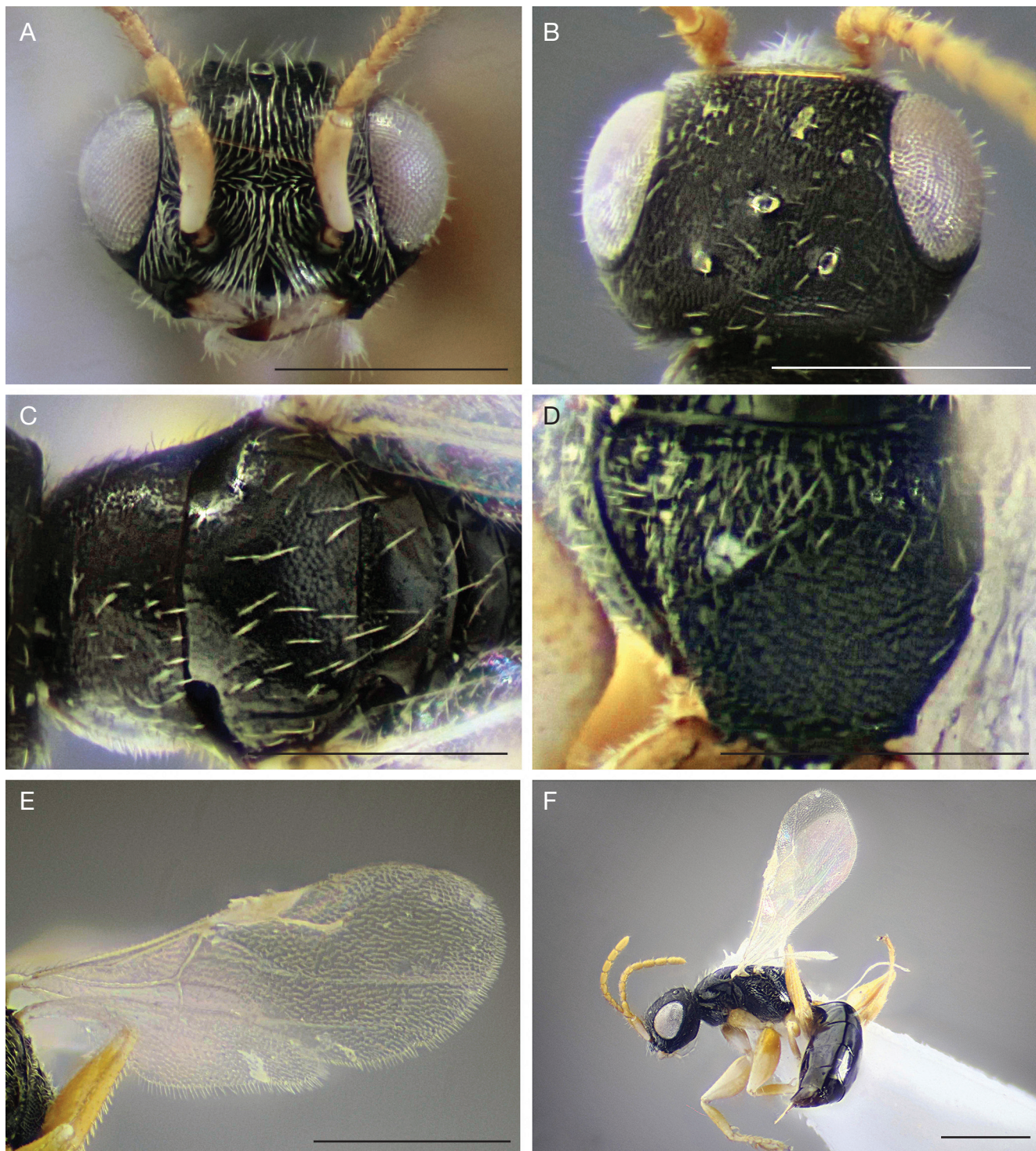


FIG. 4. — *Anteon abdounouri* Olmi, 1987, female: **A**, head, frontal view; **B**, head, dorsal view; **C**, mesosoma, dorsal view; **D**, metapectal-propodeal complex, dorsal view; **E**, fore wing; **F**, habitus, lateral view. Scale bars: A-D, 300 µm; E, F, 500 µm.

Anteon pubicorne (Dalman, 1818)*
(Figs 2B; 3B; 6-8)

Gonatopus pubicornis Dalman, 1818: 87.

TYPE LOCALITY. — Sweden, Småland (holotype ♀, NHRS).

MATERIAL EXAMINED. — **Iran** (new record) • 2 ♀; MOLC, MNHN; North Khorasan province, Abshar; 37°32'28"N, 56°56'57"E; 1100 m; 25.IX.2016; B. Motamedinia leg.; Malaise trap.

DISTRIBUTION IN IRAN (Fig. 13A). — North Khorasan province.

GENERAL DISTRIBUTION (Fig. 13A). — E-PAL and W-PAL.

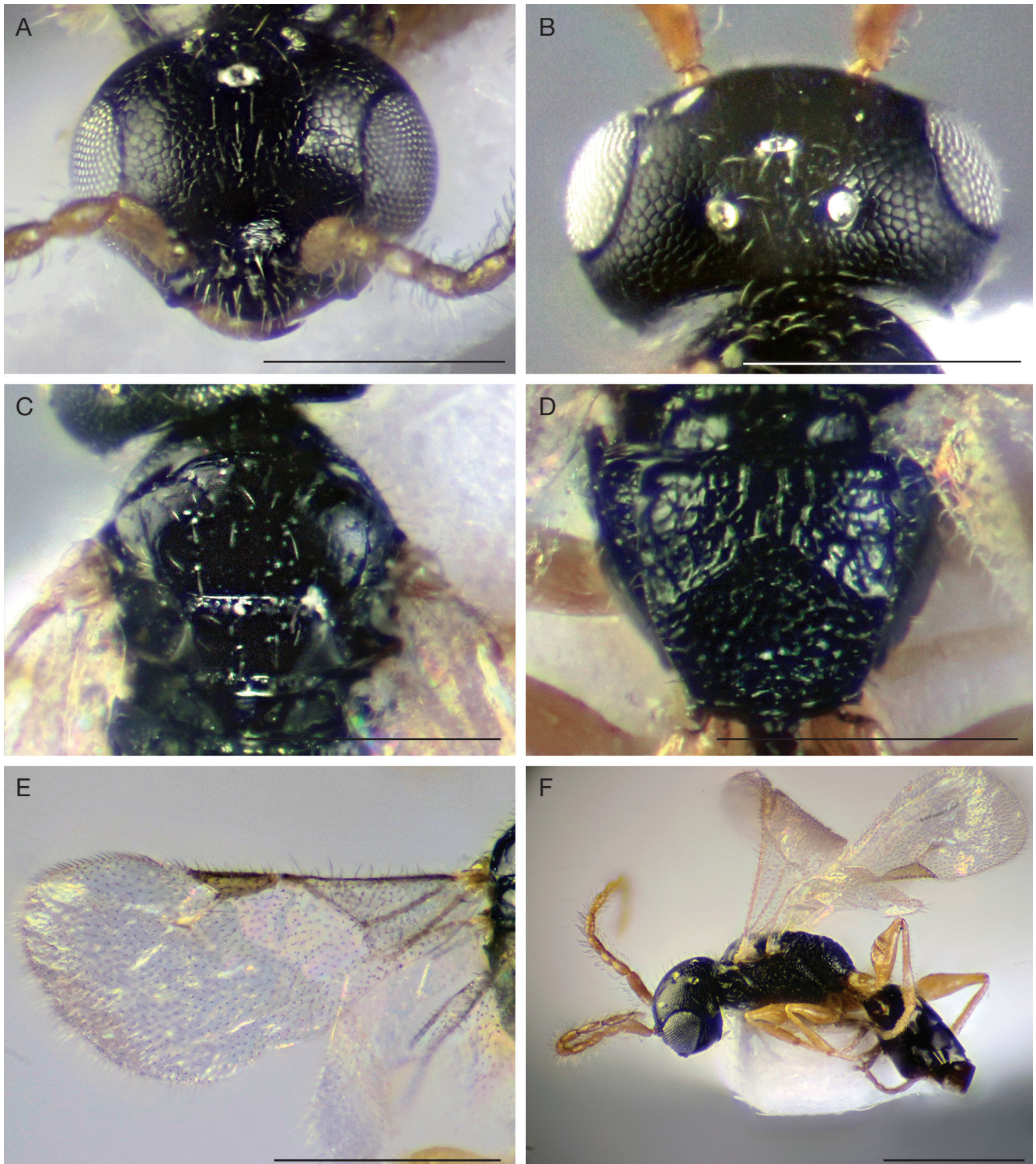


FIG. 5. — *Anteon abdunnouri* Olmi, 1987, male: **A**, head, frontal view; **B**, head, dorsal view; **C**, mesosoma, dorsal view; **D**, metapectal-propodeal complex, dorsal view; **E**, fore wing; **F**, habitus, lateral view. Scale bars: A-D, 300 μ m; E, F, 500 μ m.

DESCRIPTION

Female (Figs 2B; 6-8)

Head shiny, smooth, finely or strongly punctate, unsculptured among punctures (Fig. 6A-C); frons with two lateral keels around orbits directed towards antennal toruli (Fig. 6B); frontal line incomplete or absent in small specimens (Fig. 6B);

temple present (Fig. 6C). Pronotum shiny, strongly punctate (Fig. 6H); pronotal tubercle reaching tegula (Fig. 6H); notauli reaching approximately $0.5-0.6 \times$ length of mesoscutum (Fig. 6H); metapectal-propodeal complex reticulate rugose, with strong transverse keel between disc of metapectal-propodeal complex and propodeal declivity (Fig. 6H). Propodeal

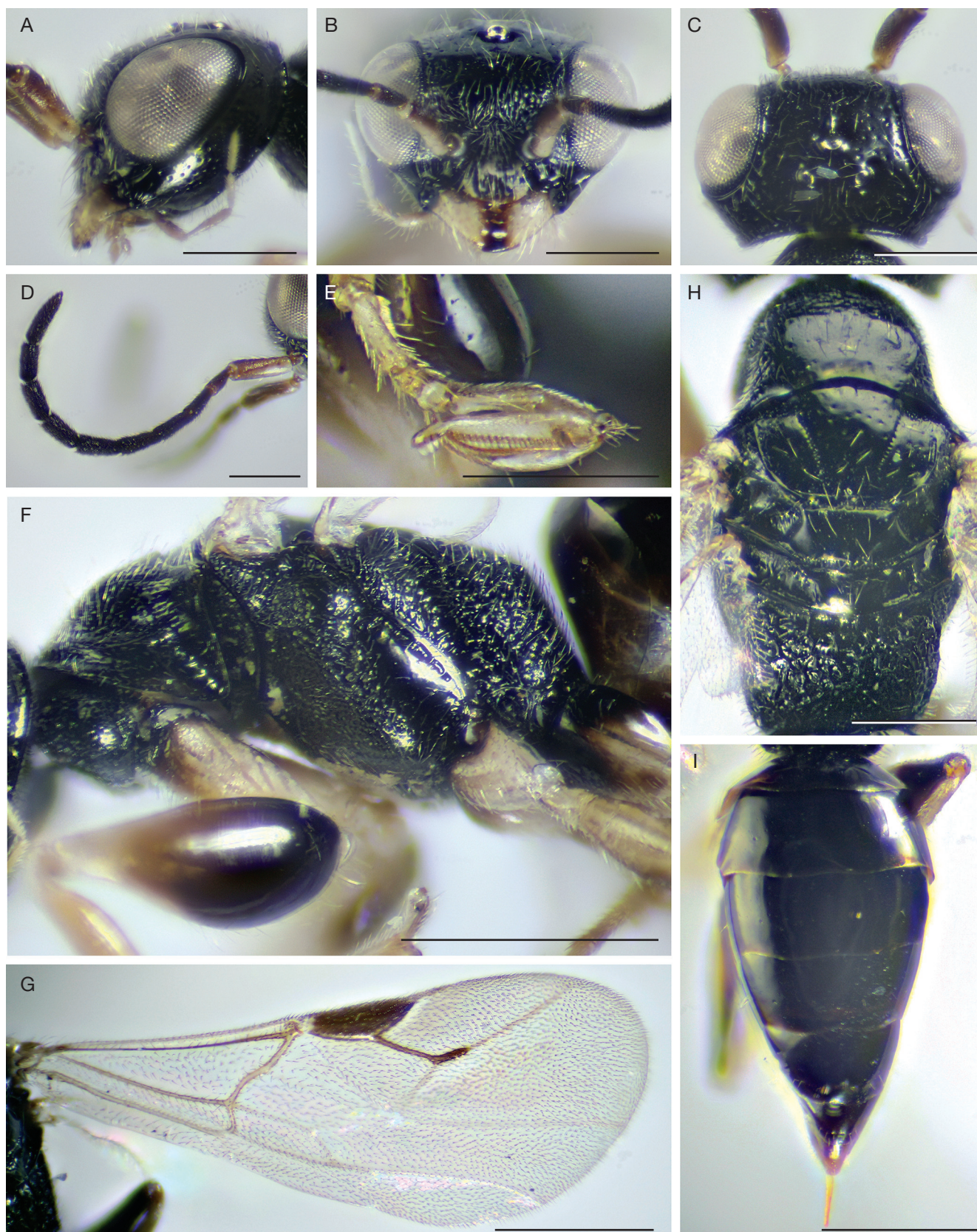


FIG. 6. — *Anteon pubicorne* (Dalman, 1818), female: **A**, head, lateral view; **B**, head, frontal view; **C**, head, dorsal view; **D**, antenna, lateral view; **E**, chela; **F**, mesosoma, lateral view; **G**, fore wing; **H**, metapectal-propodeal complex and mesosoma, dorsal view; **I**, metasoma, dorsal view. Scale bars: A-E, H, 300 μ m; F, G, I, 500 μ m.



FIG. 7. — *Anteon pubicorne* (Dalman, 1818), female, habitus, lateral view. Scale bar: 1 mm.

declivity with two longitudinal keels and median area usually as rugose as lateral areas (Fig. 6I); occasionally median area totally or partly shiny and smooth (Fig. 6I). Protarsomere 1 approximately 0.66 as long as protarsomere 4; protarsomere 2 produced into hook; protarsomere 5 with one row of 20–23 lamellae; distal apex with about 5–6 lamellae (Figs 2B; 6E).

Male

Not collected in Iran.

REMARK

In some specimens from Sweden, head uniformly brown or with cupreous tints; scape or scape + pedicel testaceous; antenna testaceous, except antennomeres 3–6 brown; mesosoma uniformly brown or with cupreous tints; legs occasionally with clubs of femora brown.

Subfamily APHELOPINAE R. Perkins, 1912*

Genus *Aphelopus* Dalman, 1823*

Aphelopus Dalman, 1823: 8.

TYPE SPECIES. — *Dryinus atratus* Dalman, 1823; designated by Westwood (1840).

Aphelopus melaleucus (Dalman, 1818)* (Figs 3C; 8)

Gonatopus melaleucus Dalman, 1818: 82.

TYPE LOCALITY. — Sweden, Västergötland (holotype ♀, NHRS).

MATERIAL EXAMINED. — Iran (new record) • 2 ♂; MOLC; Isfahan province, Nisian; 32°59'5.61"N, 52°28'13.91"E, 2191 m; 8–28.VIII.2015; E. Nader leg.; Malaise trap in orchard; code-17 • 1 ♂; MNHN; same locality label; 7–31.VII.2015; code-7; • 1 ♂; DPPZ; same locality label; 8–21.VII.2015; code-14 • 1 ♂; DPPZ; Khorasan-e Razavi province; 15.IX.2016; B. Motamedinia leg.; Malaise trap.

DISTRIBUTION IN IRAN (Fig. 13B). — Isfahan and Khorasan-e Razavi provinces.

GENERAL DISTRIBUTION (Fig. 13B). — E-PAL and W-PAL.

DESCRIPTION

Male (Figs 3C; 8)

Black; occasionally antennomeres 9–10 light. Head dull, granulate (Fig. 8A, B); frontal line incomplete, not present

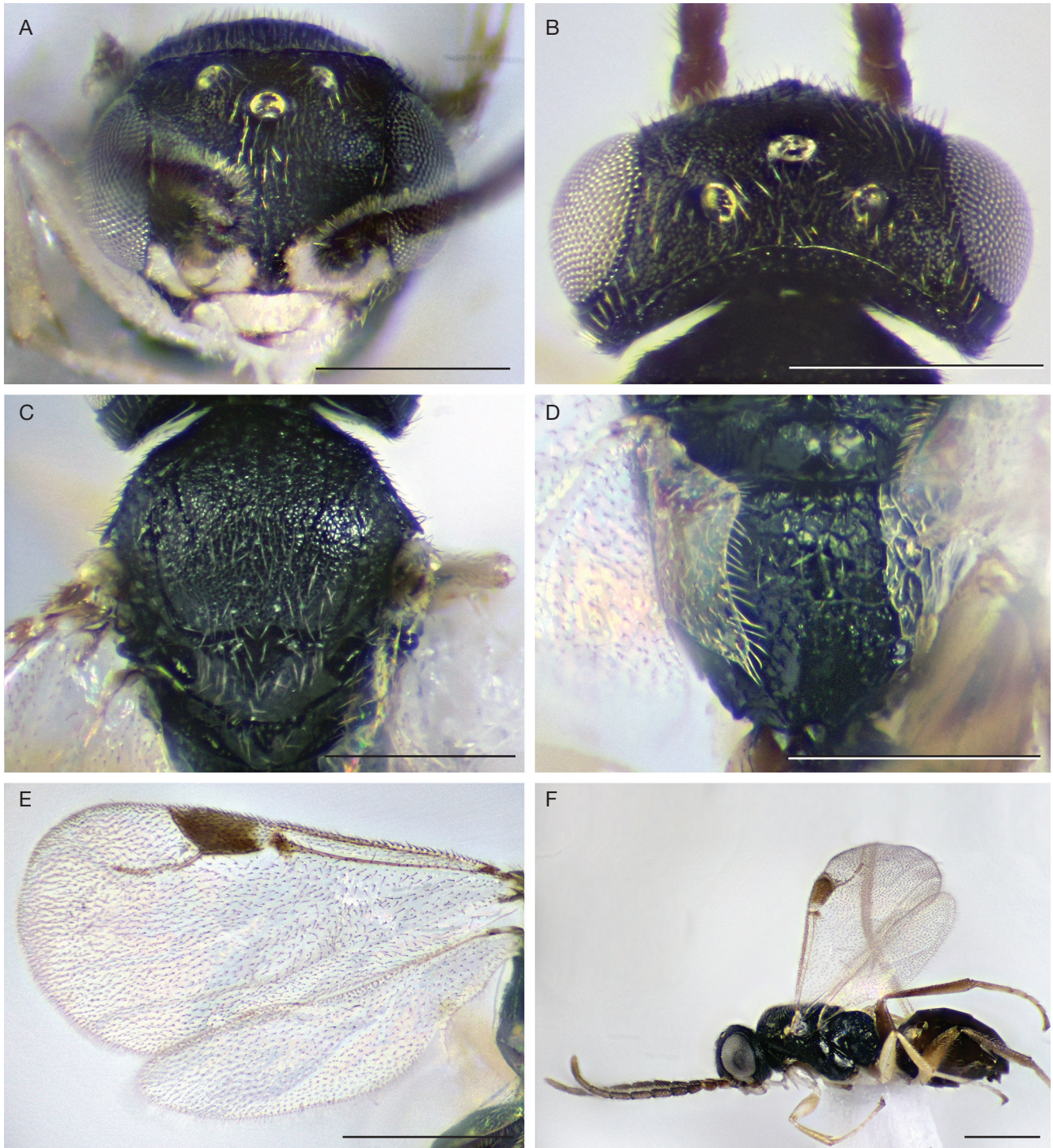


FIG. 8. — *Aphelopus melaleucus* (Dalman, 1818), male: **A**, head, frontal view; **B**, head, dorsal view; **C**, mesosoma, dorsal view; **D**, metapectal-propodeal complex, dorsal view; **E**, fore wing; **F**, habitus, lateral view. Scale bars: A-D, 300 μ m; E, F, 500 μ m.

in front of anterior ocellus, high carina shaped on anterior half of frons (Fig. 8A). Mesoscutum occasionally with median scutal line (Fig. 8C); notauli reaching approximately $0.5 \times$ length of mesoscutum (Fig. 8C); metapectal-propodeal complex dull, reticulate rugose; propodeal declivity with two complete longitudinal keels, median area shiny, almost smooth, with few irregular slight keels, less rugose

than lateral areas (Fig. 8D). Distal apex of aedeagus not tridentate, not trumpet-shaped, basivolsella with one subdistal bristle and with outer basal process little or very protruding (Fig. 3C).

Female

Not collected in Iran.

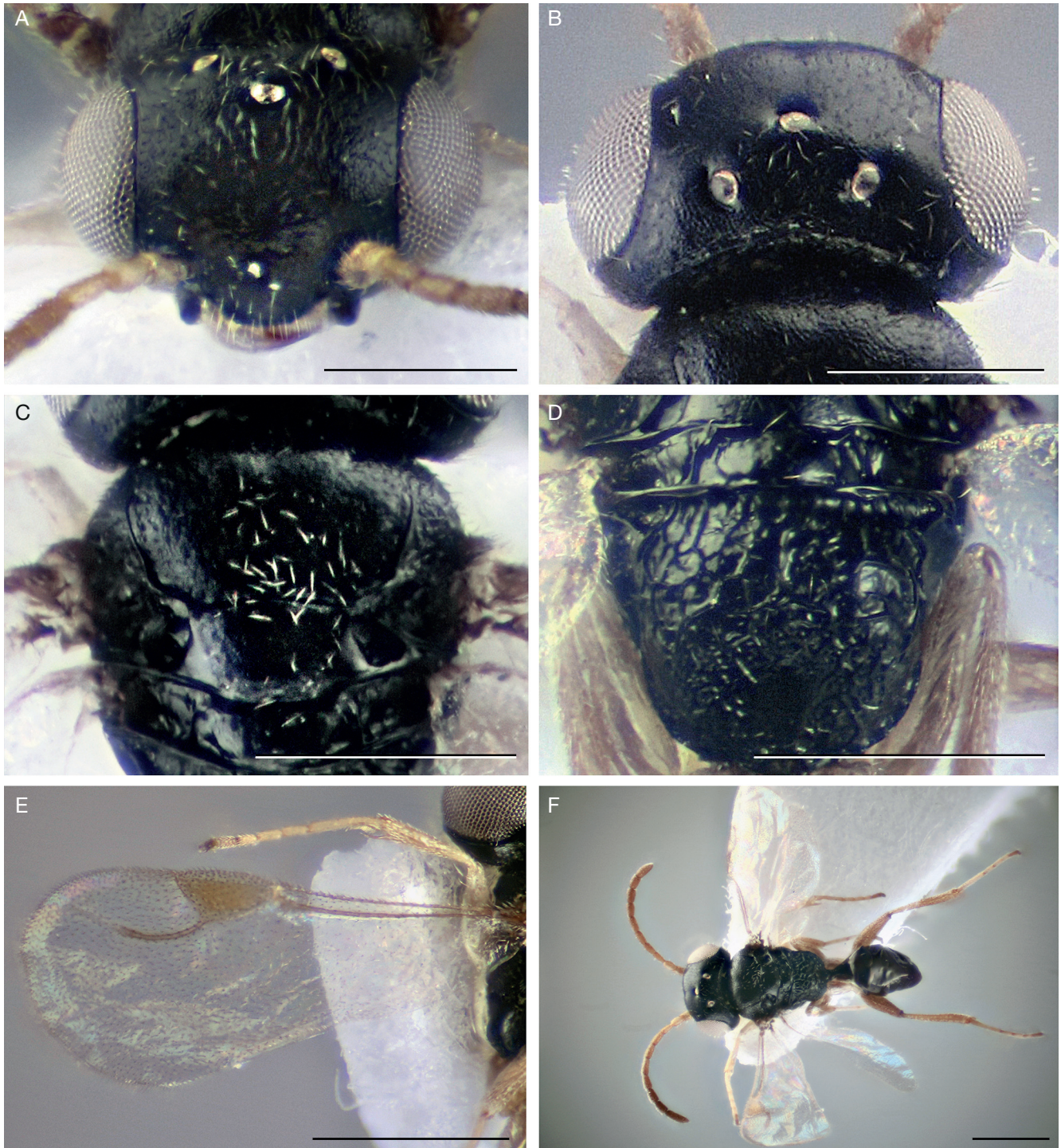


FIG. 9. — *Aphelopus orphanidesi* Olmi, 1994, female: **A**, head, frontal view; **B**, head, dorsal view; **C**, mesosoma, dorsal view; **D**, metapectal-propodeal complex, dorsal view; **E**, fore wing; **F**, habitus, dorsal view. Scale bars: A-D, 300 μ m; E, F, 500 μ m.

REMARKS

In many male specimens from England (Awbridge), head and body brown-testaceous, except mandible, clypeus and few small spots situated between antennal toruli and on gena whitish or yellowish; other specimens from above mentioned locality testaceous-reddish. In other specimens from all countries where this species is present, head occasionally completely black, without light spots.

Aphelopus orphanidesi Olmi, 1994* (Figs 3D; 9, 10)

Aphelopus orphanidesi Olmi, in Olmi & Orphanides, 1994: 408.

TYPE LOCALITY. — Cyprus, Pakhna (holotype ♂ and paratype ♀, AMNH).

MATERIAL EXAMINED. — **Holotype.** Cyprus • ♂; AMNH; Pakhna II.1993.

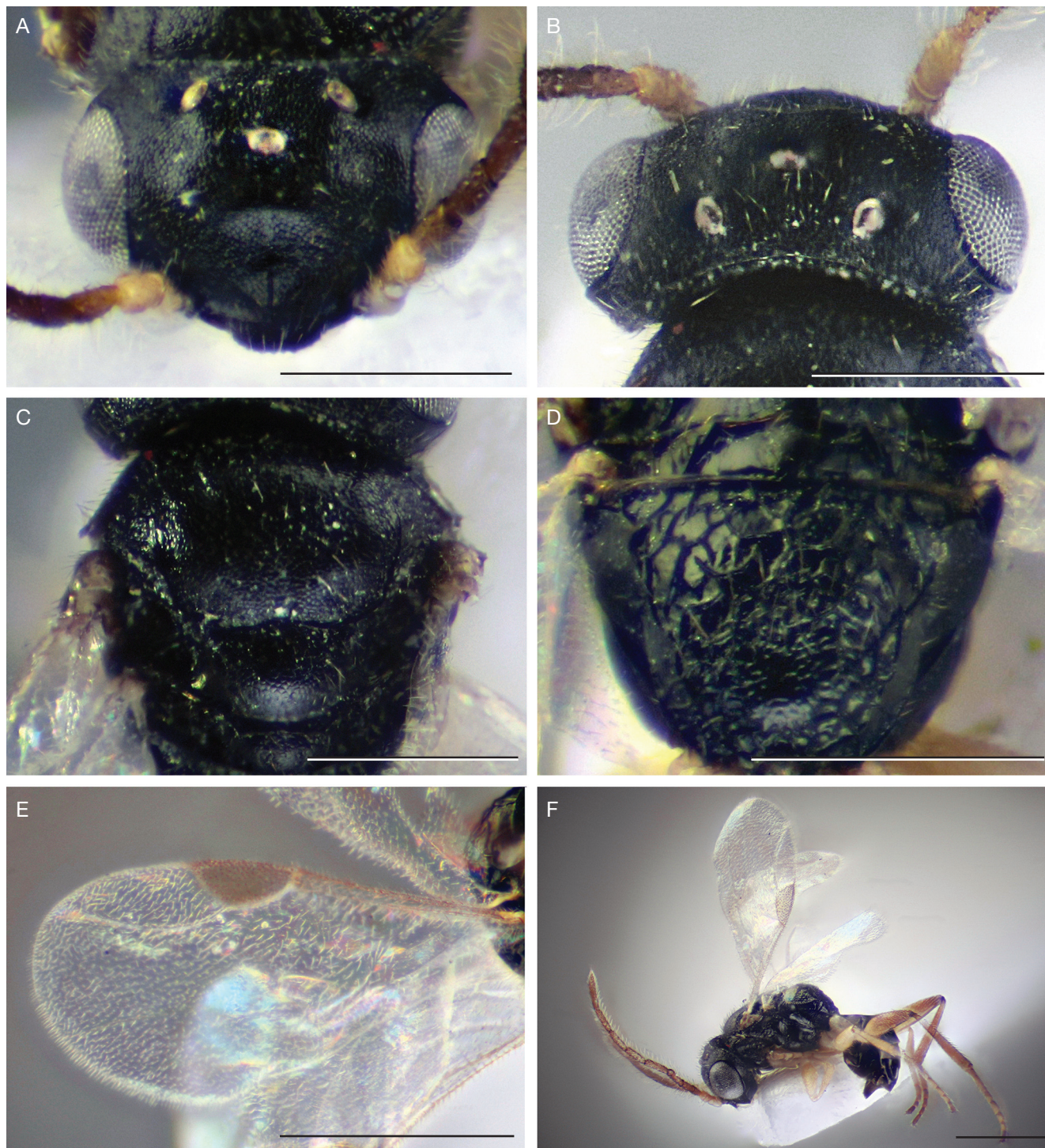


FIG. 10. — *Aphelopus orphanidesi* Olmi, 1994, male: **A**, head, frontal view; **B**, head, dorsal view; **C**, mesosoma, dorsal view; **D**, metapectal-propodeal complex, dorsal view; **E**, fore wing; **F**, habitus, lateral view. Scale bars: A–D, 300 μ m; E, F, 500 μ m.

Paratypes. Cyprus • 7 ♀; AMNH; Pakhna; II.1993; G. Orphanides leg.; reared from *Zygina rhamni* Ferrari • 6 ♂; AMNH • 1 ♂; USNM; • 2 ♂, 2 ♀; MRSN; same date and locality label • 1 ♀; NHMUK; same date and locality label.

France • 1 ♀; NHMUK; Bouches-du-Rhône, Fonscolombe; 24.VI.1986; M. de V. Graham leg. • 3 ♂; MOLC, HTC; Pyrénées-Orientales, Le Perthus; 42°27.04'N, 02°51.82'E; 1.VIII.1995; J. P. Sarthou leg.; Malaise trap.

Germany (new record) • 1 ♀; MOLC; Schleswig-Holstein, Frörup S of Flensbu Forest; Werner Barkemeyer leg.; L2727; ex Michael von Tschirnhaus collection • 1 ♀; MTC; 1.5 km NNE of Tensfeld; 54°03.37'N, 10°19.33'E; 2.V.1989; Hans Meyer leg.; K965; ex Michael von Tschirnhaus collection.

Iran (new record) • 10 ♂; 1 ♀; MOLC, DPPZ; Isfahan province, Nisian; 32°59'5.61"N, 52°28'13.91"E; 2191 m; 8–28.VIII.2015; E. Nader leg.; code-17; Malaise trap in orchards • 4 ♂; DPPZ; same

locality label; 7-31.VII.2015; code-7 • 3 ♂; MNHN; same locality label; 8-21.VII.2015; code-14 • 1 ♂; MOLC; Isfahan province, Najafabad; 32°39'N, 51°23'E; 1644 m; 7-31.VII.2015; E. Nader leg.; code-9; Malaise trap in orchards.

Italy • 1 ♀ 1 ♂; MOLC; Toscana, Livorno province, Venturina; 8-17.VIII.1998 to 17-31.VIII.1998; 17.VIII–2.IX.1999 to 2-10.IX.1999; F. Strumia leg.; Malaise trap.

Norway • Frode Ødegaard leg.; NUM.

Sweden (new record) • 1 ♂; ZIL; Sk., Dalby; 14-20.VIII.2001; R. Danielsson leg.; yellow pan trap.

DISTRIBUTION IN IRAN (Fig. 13B). — Isfahan province.

GENERAL DISTRIBUTION (Fig. 13B). — W-PAL.

DESCRIPTION

Female (Fig. 9A-F)

Black; antenna brown or brown-testaceous, except scape and pedicel yellow (Fig. 9A). Antennomeres in following proportions: 4:3:4:4:5:5:4:5:4:4:6. Head dull, granulate (Fig. 9A, B); frontal line incomplete, only a trace present in anterior third of frons (Fig. 9A). Mesoscutum dull, granulate (Fig. 9C); notauli reaching approximately $0.4 \times$ length of mesoscutum (Fig. 9C); metapectal-propodeal complex with disc reticulate rugose (Fig. 9D); propodeal declivity with wide median area shiny, almost completely unsculptured, surrounded by rugose areolae (Fig. 9D). 2r-rs&Rs vein regularly curved (Fig. 9E).

Male (Figs 3D; 10).

Head dull, granulate (Fig. 10A, B); frontal line incomplete, only present in anterior third of frons (Fig. 10A). Mesoscutum dull, granulate (Fig. 10C); notauli reaching approximately $0.4 \times$ length of mesoscutum (Fig. 10C); mesoscutellum shiny, slightly granulate (Fig. 10C); metanotum shiny, unsculptured; metapectal-propodeal complex dull, with disc reticulate rugose (Fig. 10D). Propodeal declivity almost completely shiny, unsculptured, surrounded by numerous rugose areolae. 2r-rs&Rs vein regularly curved (Fig. 10E). Distal apex of aedeagus not tridentate; basivolsella with two subdistal bristles and with an outer basal process (Fig. 3D).

REMARKS

This species is recorded from Germany and Sweden for the first time. In specimen from Sweden, Dalby, a basivolsella has two subdistal bristles, whereas the other basivolsella has only one subdistal bristle.

Subfamily BOCCHINAE Richards, 1939

Genus *Bocchus* Ashmead, 1893*

Bocchus Ashmead, 1893: 91.

TYPE SPECIES. — *Bocchus flavicollis* Ashmead, 1893, by original designation.

Bocchus hyalinus Olmi, 1998*

(Figs 2C; 3E; 11)

Bocchus hyalinus Olmi, 1998: 65.

TYPE LOCALITY. — Oman, 4 km South of Dhagmar (holotype ♀, CNC).

MATERIAL EXAMINED. — **Iran** (new record) • 1 ♀; MNHN; Kerman province, Faryab; 5.VIII.2016; M. Arab leg.; Malaise trap in Natural Ecosystem • 1 ♀; DPPZ; Sistan-o Baluchestan province, Iranshahr, Daman; 27°25'N, 060°54'E; 879 m; 18.VI.2016; H. Davari leg.; Malaise trap 2 mounted among planted Mazari palm, *Nannorrhops ritchiana* (Griff.) Aitch. • 3 ♀; DPPZ, MOLC; same locality label; 27°24'N, 060°50'E; 876 m; 16-26.VI.2016; Malaise trap 4.

Oman • 1 ♀ 5 ♂; NHMUK, MOLC; Al-Uyaina – Samail; 30.IV.2006; K. Al-Miqbali leg.; ex. *Ommatissus lybicus* De Bergevin (Tropiduchidae) on date palm.

DISTRIBUTION IN IRAN (Fig. 14A). — Kerman and Sistan-o Baluchestan provinces.

GENERAL DISTRIBUTION (Fig. 14A). — AFR and W-PAL.

DESCRIPTION

Female (Figs 2C; 11)

Body almost totally yellow-whitish, except ocelli slightly darkened; occasionally mesothoracic axilla and sutures behind mesoscutum, mesoscutellum and metanotum darkened (Fig. 11D-F). Antenna short, with antennomeres 5-9 longer than broad (antennomere 5: 6:3; antennomere 9: 4.5:3.5); head dull, completely granulate and reticulate rugose (Fig. 11A-C); frontal line complete (Fig. 11B). Pronotum crossed by strong transverse impression, reticulate rugose (Fig. 11E); pronotal tubercle reaching tegula (Fig. 11E); lateral regions of prothorax continuous with mesopleuron so that the epicnemium is not exposed (Fig. 11D); notauli posteriorly separated, occasionally hardly visible (Fig. 11E); mesoscutellum very slightly granulate, not rugose (Fig. 11E); metanotum short and rugose (Fig. 11F); metapectal-propodeal disc reticulate rugose; propodeal declivity dull and rugose (Fig. 11F). Petiole very long, much shorter than metasoma (6:27) (Fig. 11F). Protarsomere 5 with one preapical lamella, two bristles and an inner band (Fig. 2C).

Male.

Not collected in Iran.

REMARKS

In specimens from the United Arab Emirates, mesosoma ferruginous and metasoma brown; mesoscutum strongly reticulate rugose, with notauli almost completely invisible; mesoscutellum with anterior half unsculptured and posterior half reticulate rugose. In contrast, in specimen from Kenya, mesosoma ferruginous and metasoma partly brown and partly ferruginous; mesoscutum strongly reticulate rugose, with notauli completely invisible; mesoscutellum granulate.

Genus *Mirodryinus* Ponomarenko, 1972

Mirodryinus Ponomarenko, 1972: 673.

TYPE SPECIES. — *Radiimancus olmii* Móczár, 1983, by original designation.



FIG. 11. – *Bocchus hyalinus* Olmi, 1998, female: **A**, head, lateral view; **B**, head, frontal view; **C**, head, dorsal view; **D**, mesosoma, lateral view; **E**, mesosoma, dorsal view; **F**, metapectal-propodeal complex, dorsal view; **G**, chela. **H**, habitus, lateral view. Scale bars: A-C, E, F, 300 µm; D, 500 µm; G, 200 µm; H, 1 mm.

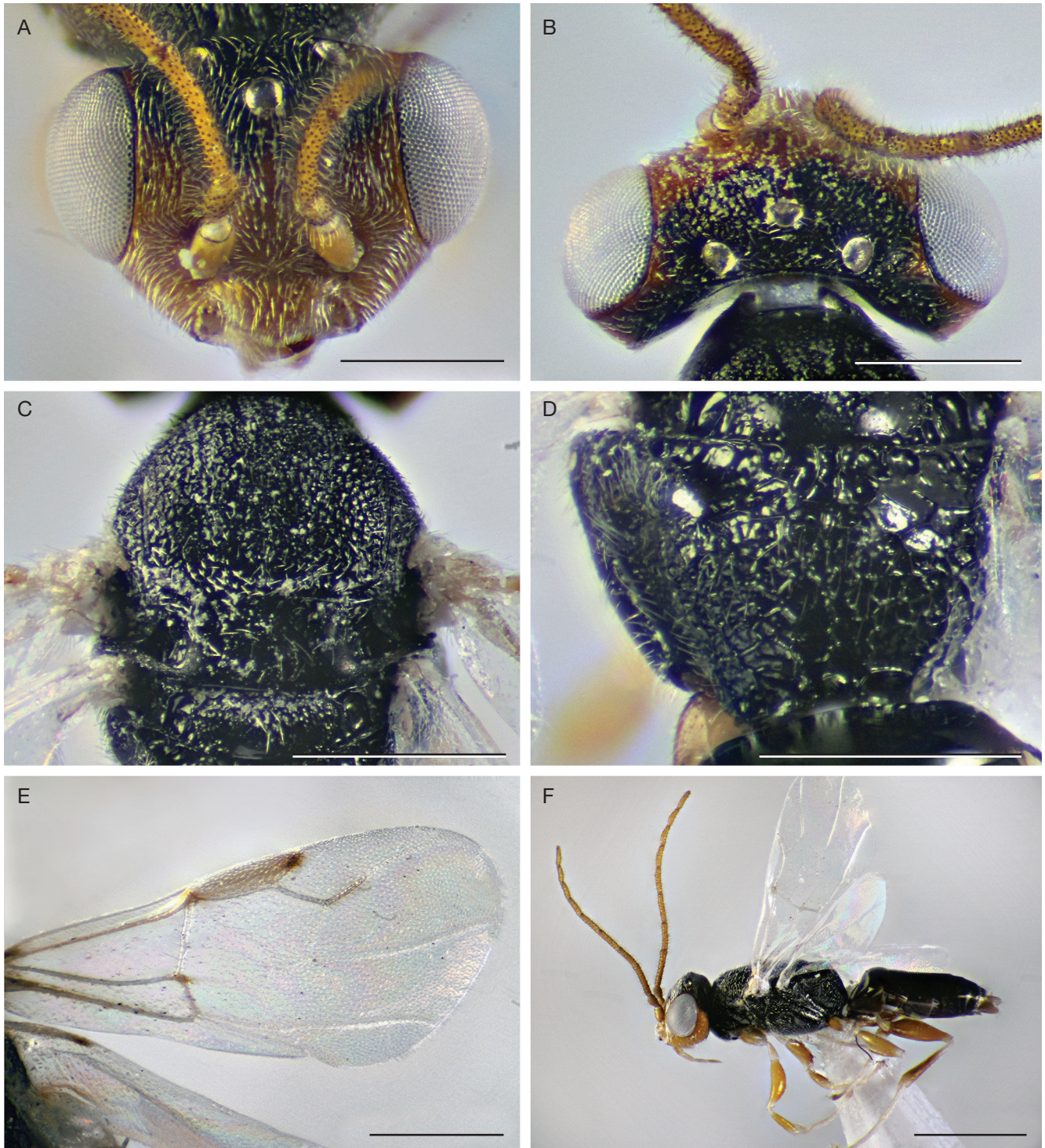


FIG. 12. — *Dryinus tamaricicola* Rakhshani & Olmi, 2016, male: **A**, head, frontal view; **B**, head, dorsal view; **C**, mesosoma, dorsal view; **D**, metapectal-propodeal complex, dorsal view; **E**, fore wing; **F**, habitus, lateral view. Scale bars: A, B, 300 μ m; C-E, 500 μ m; F, 1 mm.

Mirodryinus atlanticus Olmi, 1984

Mirodryinus atlanticus Olmi, 1984: 672.

TYPE LOCALITY. — Spain, Canary Islands, Fuerteventura Island, Gran Tarajal (holotype ♀, ZMUH).

DISTRIBUTION IN IRAN (Fig. 14A). — Sistan-o Baluchestan province.

GENERAL DISTRIBUTION (Fig. 14A). — E-PAL and W-PAL.

DESCRIPTION

Reviewed in Derafshan *et al.* (2017) for males and females, both known in Iran.

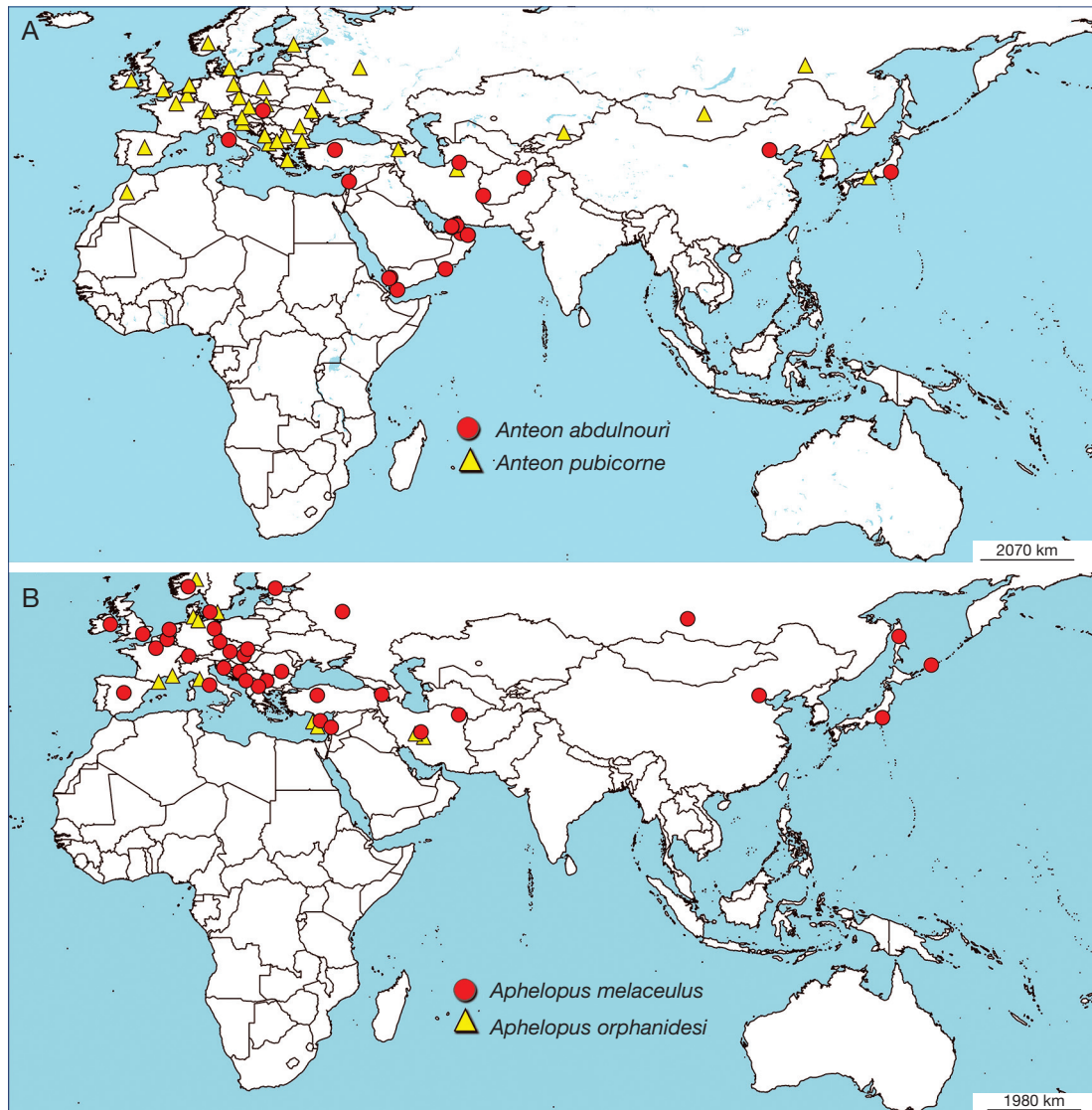


FIG. 13. – Distribution map of the Iranian Anteoninae R. Perkins, 1912 (A): *Anteon abdounouri* Olmi, 1987; *Anteon pubicorne* (Dalman, 1818) and Aphelopinae R. Perkins, 1912 (B): *Aphelopus melaceulus* (Dalman, 1818); *Aphelopus orphanidesi* Olmi, in Olmi & Orphanides 1994 (Hym., Dryinidae) in a worldwide background.

Subfamily DRYININAE Haliday, 1833

Genus *Dryinus* Latreille, 1804

Dryinus Latreille, 1804: 176.

TYPE SPECIES. — *Dryinus collaris* (Linnaeus, 1767), by subsequent monotypy (Latreille 1805).

Dryinus gharaei Olmi, 2005

Dryinus gharaei Olmi, 2005: 207.

TYPE LOCALITY. — Iran, Ilam Province, Chogasabz Region (holotype ♀, MOLC).

DISTRIBUTION IN IRAN (Fig. 14B). — Ilam province.

GENERAL DISTRIBUTION (Fig. 14B). — W-PAL.

MATERIAL EXAMINED. — Iran • Holotype ♀; MOLC; Ilam Province, Chogasabz Region, Ilam; 1.IX.2003; Babak Gharaei leg.

DESCRIPTION

Reviewed in Derafshan *et al.* (2016).

Male

Unknown.

Dryinus tamaricicola Rakhshani & Olmi, 2016 (Figs 2D; 3F; 12)

Dryinus tamaricicola Rakhshani & Olmi, in Derafshan *et al.* 2016: 412.

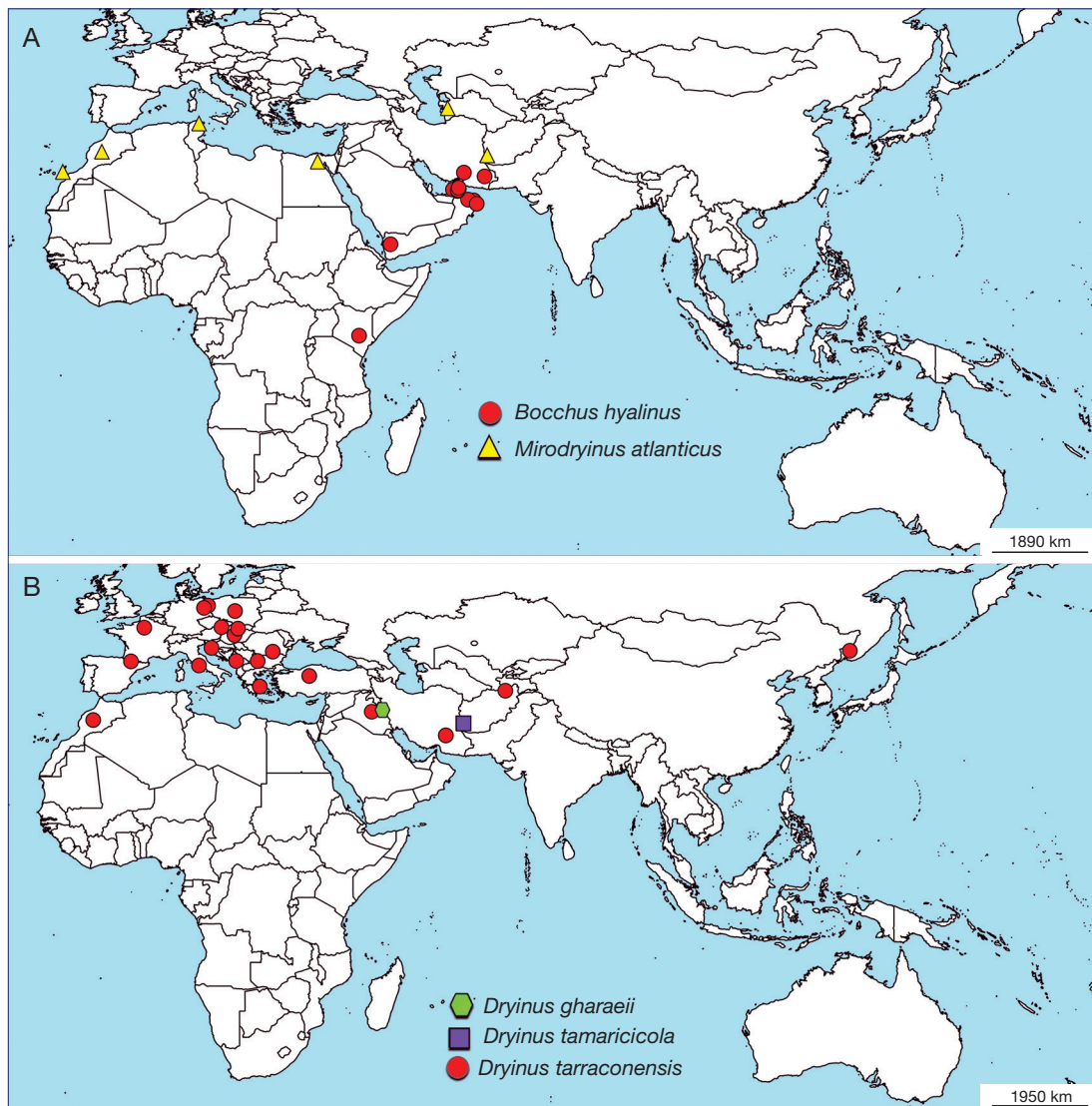


FIG. 14. — Distribution map of the Iranian Bocchinae Richards, 1939 (A): *Bocchus hyalinus* Olmi, 1998; *Mirodryinus atlanticus* Olmi, 1984; and Dryininae Halliday, 1833 (B): *Dryinus gharaeii* Olmi, 2005; *Dryinus tamaricicola* Rakhshani & Olmi, 2016; *Dryinus tarraconensis* Marshall, 1868 (Hym., Dryinidae) in a worldwide background.

TYPE LOCALITY. — Iran, Sistan-o Baluchestan, Zabol (holotype ♀, MOLC).

MATERIAL EXAMINED. — Iran • 1 ♂; MNHN; Sistan-o Baluchestan province, Zabol; 13.V.2015; H. A. Derafshan leg.; Nim-75; swept on *Tamarix stricta* • 2 ♂; DPPZ, MOLC; same locality label; 20.IX.2016; H. A. Derafshan leg.; Nim-243; swept on *Tamarix stricta*.

DISTRIBUTION IN IRAN (Fig. 14B). — Sistan-o Baluchestan province.

GENERAL DISTRIBUTION (Fig. 14B). — W-PAL.

DESCRIPTION

Male (putatively associated with the female - Figs 3F; 12)

Head testaceous, except occiput and part of vertex black; antenna testaceous; mesosoma black; metasoma brown; legs testaceous, except metacoxa partly brown and tarsi whitish. Antennomere 3 about seven times as long as broad (14:2) (Fig. 12A); antennomeres in following proportions: 5:5:14:12:12:10:9:8:7:9;

head dull, granulate and partly reticulate rugose (Fig. 12A, B); frontal line absent (Fig. 12A); temple absent (Fig. 12B); greatest breadth of posterior ocelli shorter than OL (3:4) (Fig. 12B); posterior ocelli touching occipital carina (Fig. 12B); occipital carina completely visible on dorsal side of head, where it reaches laterally eyes (Fig. 12B); palpal formula 6/3. Mesoscutum dull, granulate and reticulate rugose (Fig. 12C); notauli reaching about $0.5 \times$ length of mesoscutum (Fig. 12C); mesoscutellum shiny, unsculptured (Fig. 12C); metanotum shiny, unsculptured, except anterior half rugose (Fig. 12C); metapectal-propodeal complex reticulate rugose, without transverse or longitudinal keels (Fig. 12D). Genitalia with distivolsella situated near distal apex of aedeagus (Fig. 3F); paramere with inner side sculptured by many papillae (Fig. 3F). Tibial spurs 1/1/2.

Female

In Derafshan *et al.* (2016).

REMARKS

The male specimens were collected from the same locality as female specimens collected earlier in the same habitat (on *Tamarix* plants), and by the same methods (with a beating sheet). They were not reared. Thus, here we tentatively assign the male specimens to *D. tamaricicola*.

Dryinus tarraconensis Marshall, 1868

Dryinus tarraconensis Marshall, 1868: 204.

TYPE LOCALITY. — Spain, Huesca, near Torla (holotype ♀, HNHM).

MATERIAL EXAMINED. — Iran • 1 ♀; MOLC; Kerman Province, Bam County, Sangemes; 28°56'33.44"N, 58°07'52.36"E; 2101 m; 08.III.2015; M. Vafaei leg.; swept on weeds • 1 ♀; DPPZ; Kerman province, Bam country, Moghoye; 28°57'24.18"N, 58°06'34.90"E, 1693 m; 11.VIII.2015; M. Vafaei l.

DISTRIBUTION IN IRAN (Fig. 14B). — Kerman province.

GENERAL DISTRIBUTION (Fig. 14B). — E-PAL and W-PAL.

DESCRIPTION

Reviewed in Derafshan *et al.* (2016).

Male.

Unknown.

Subfamily GONATOPODINAE Kieffer
in Kieffer & Marshall 1906

REMARKS

This subfamily has been completely reviewed in Derafshan *et al.* (2020). Distribution in Iran is showed in figure 15.

KEY TO THE IRANIAN DRYINIDAE

FEMALES

1. Protarsus chelate (Fig. 2A-D) 2
- Protarsus not chelate [Aphelopinae R. Perkins, 1912, in Iran only *Aphelopus* Dalman, 1823] 5
2. Chela with one rudimentary claw (Fig. 2C, D) 3
- Chela without rudimentary claw (Fig. 2A, B) [Anteoninae R. Perkins, 1912, in Iran only *Anteon* Jurine, 1807] 6
3. Median leg with one tibial spur (formula 1/1/1 or 1/1/2) 4
- Median leg without tibial spurs (formula 1/0/1 or 1/0/2) [Gonatopodinae Kieffer, 1906; see Derafshan *et al.* 2020, for key to Iranian species]
4. Epicnemium concealed (Fig. 11D) [Bocchinae Richards, 1939] 7
- Epicnemium exposed [Dryininae Haliday, 1833] 8
5. Head with mandibles, clypeus and lower parts of frontal region white or testaceous *Aphelopus melaleucus* (Dalman, 1818)
- Head with mandibles white or testaceous; clypeus uniformly black; rest of head black (Fig. 9A) *Aphelopus orphanidesi* Olmi, 1994
6. Protarsomere 4 at most 0.5 as long as protarsomere 1; protarsomere 3 or 4 produced into hook (Fig. 2A) *Anteon abdunnouri* Olmi, 1987
- Protarsomere 4 at least 0.66 as long as protarsomere 1; protarsomere 2 produced into hook (Fig. 2B) *Anteon pubicorne* (Dalman, 1818)
7. Segment 5 of protarsus with inner membranous band, two bristles and with one preapical lamella (Fig. 2C) .
..... *Bocchus hyalinus* Olmi, 1998
- Segment 5 of protarsus without inner membranous band, with 1 row of about 18 lamellae and 1 row of about 7 bristles, distal apex with approximately 4-10 lamellae *Mirodryinus atlanticus* Olmi, 1984
8. Enlarged claw with one subapical tooth *Dryinus tarraconensis* Marshall, 1868
- Enlarged claw without subapical teeth or with many small subapical teeth 9
9. Posterior ocelli not touching occipital carina. Enlarged claw with many small subapical teeth *Dryinus gharaei* Olmi, 2005
- Posterior ocelli touching occipital carina. Enlarged claw without subapical teeth *Dryinus tamaricicola* Rakhshani & Olmi, 2016

MALES

1. Fore wing with three cells (Costal, radial and first cubital) enclosed by pigmented veins (Figs 5E, 11E) 2
- Fore wing with only the costal cell enclosed by pigmented veins (Figs 8E, 10E) [Aphelopinae R. Perkins, 1912: in Iran only *Aphelopus* Dalman, 1823] 5
2. Hypopygium not umbrella-shaped [Anteoninae R. Perkins, 1912: in Iran only *Anteon* Jurine, 1807] 6
- Hypopygium umbrella-shaped 3
3. Epicnemium concealed [Bocchinae Richards, 1939] 7
- Epicnemium exposed 4
4. Occipital carina complete or incomplete. Dorsal process of paramere absent [Dryininae Haliday, 1833] 8
- Occipital carina absent, occasionally present and complete. Dorsal process of paramere present [Gonatopodinae Kieffer, 1906; see Derafshan *et al.* 2020 for key to Iranian species]
5. Aedeagus with distal apex not trumpet-shaped (Fig. 3C) *Aphelopus melaleucus* (Dalman, 1818)
- Aedeagus with distal apex trumpet-shaped (Fig. 3D) *Aphelopus orphanidesi* Olmi, 1994
6. Propodeal declivity without longitudinal keels (Fig. 5D). Paramere without inner distal and pointed process (Fig. 3A) *Anteon abdunnouri* Olmi, 1987
- Propodeal declivity with two longitudinal keels. Paramere with distal inner pointed process (Fig. 3B) *Anteon pubicorne* (Dalman, 1818)
7. Metapectal-propodeal disc with strong transverse posterior keel and two complete longitudinal keels, areolae very wide (Fig. 11F). Genitalia with distivolsella articulated along inner margin of basivolsella (Fig. 3E) *Bocchus hyalinus* Olmi, 1998
- Metapectal-propodeal disc without longitudinal or transverse keel, areolae very small. Genitalia with distivolsella articulated on distal margin of basivolsella *Mirodryinus atlanticus* Olmi, 1984
8. Antennal segments broad, with segment 3 less than six times as long as broad *Dryinus tarraconensis* Marshall, 1868
- Antennal segments slender, with segment 3 seven or more than seven times as long as broad *Dryinus tamaricicola* Rakhshani & Olmi, 2016

DISCUSSION

Few studies have been conducted on the Dryinidae fauna of Iran, with most of the papers restricted to descriptions of species collected sporadically (Olmi 1984, 2005; Olmi & Xu 2015). Before the present study, three subfamilies (Bocchinae, Dryininae and Gonatopodinae), five genera (*Dryinus*, *Echthrodelpfax* R. Perkins, 1903, *Gonatopus* Ljungh, 1810, *Haplogonatopus* R. Perkins, 1905 and *Mirodryinus*) and twelve species were known from Iran (Derafshan *et al.* 2016, 2017, 2020). With the new records reported herein the totals are increased to five subfamilies (Fig. 16), eight genera and 17 species.

Some species listed in the current study, are known exclusively on the basis of only one sex. Only females are known for *An. pubicorne*, *B. hyalinus*, *D. gharaeii*, and *D. tarraconensis* and only the male in *Ap. melaleucus*. Both sexes are known for three species (*An. abdunnouri*, *M. atlanticus*, and *D. tamaricicola*). With respect to our collection of *D. tamaricicola*, because of the pronounced morphological difference between female and male in *Dryinus* species, the males we collected were putatively associated with the female. We believe the association is reasonable, particularly because of the aforementioned concordance of the sexes in collection

location, habitat and method. Nonetheless, molecular data are necessary for confirmation.

From the biogeographical point of view, all the nine species we collected are found in the following sub-regions: *An. abdunnouri* (E-PAL and W-PAL); *An. pubicorne* (E-PAL and W-PAL); *Ap. melaleucus* (E-PAL and W-PAL); *Ap. orphanidesi* (W-PAL); *B. hyalinus* (W-PAL); *M. atlanticus* (E-PAL and W-PAL); *D. gharaeii* (W-PAL); *D. tamaricicola* (W-PAL); *D. tarraconensis* (W-PAL). Two species, *D. gharaeii* and *D. tamaricicola*, are provisionally considered as endemic, but since Dryinidae have been poorly collected in Iran, their geographic distribution could be larger. *Anteon abdunnouri* and *Bocchus hyalinus* have already been recorded from the Afro-tropical region (Olmi 1998 ; Olmi & Xu 2015). We expect that more dryinids are common to both (southern part of) Iran and the Afrotropical region, as provinces located in the south-eastern and southern parts of Iran share similar climatic and floral conditions (Derafshan *et al.* 2016, 2020; Ghafouri Moghaddam *et al.* 2019; Heraty *et al.* 2019). However, further field research is necessary to verify this hypothesis.

To date, there are no host records for Dryinidae collected in Iran. Known hosts of all the species considered in this study belong to the family Cicadellidae Latreille, 1802, except *B. hyalinus* whose host belongs to the family Tropiduchidae

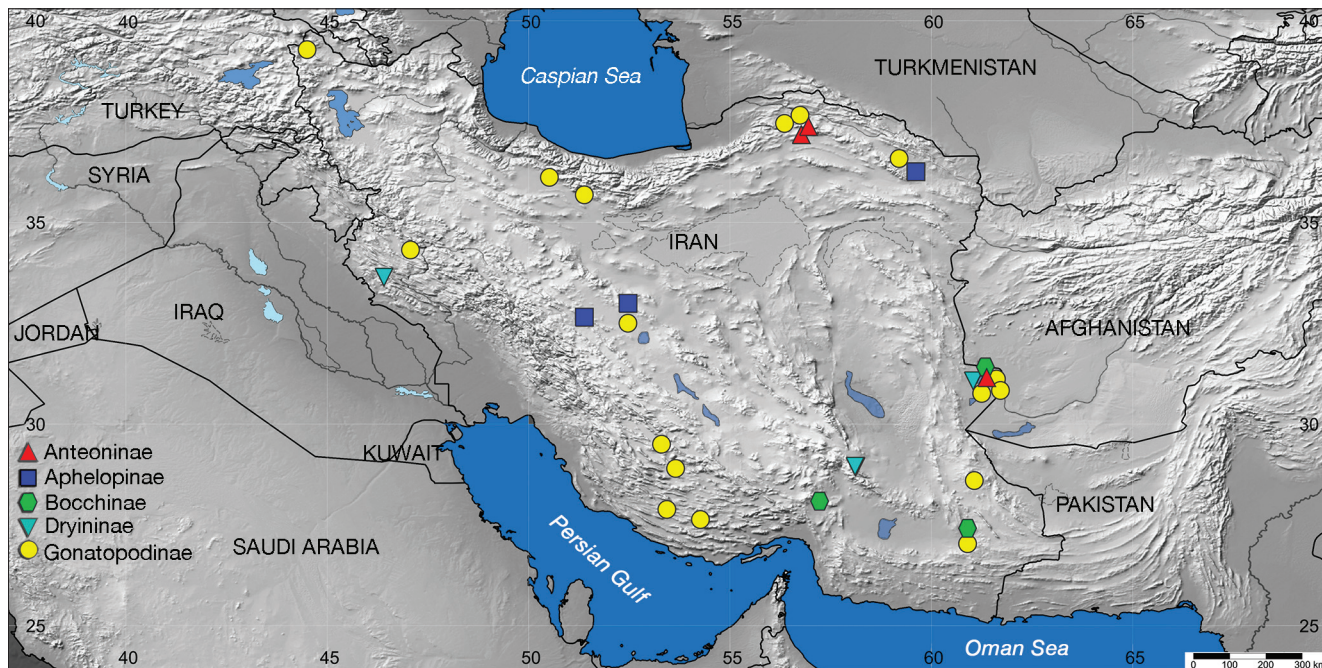


FIG. 15. — Distribution map of all subfamilies of Dryinidae Haliday, 1833 in Iran.

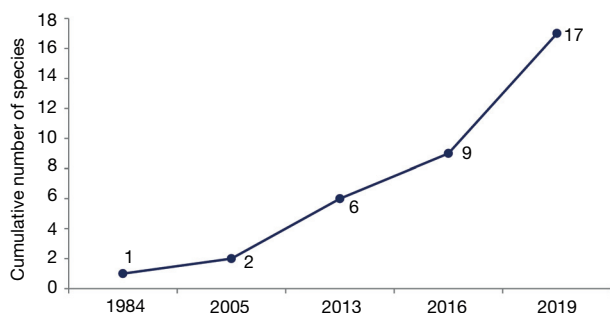


FIG. 16. — The cumulative number of discovered species of Dryinidae Haliday, 1833 from Iran (1984 to 2019).

Stål, 1866. *Dryinus* species are parasitoids of Fulgoromorpha Latreille, 1807, and their hosts in the Western Palaearctic sub-region are known only for *D. tarraconensis* (Guglielmino & Olmi 2007; Guglielmino *et al.* 2013).

An overall analysis of the discovered Dryinidae in Iran (Fig. 16) reveals that very little information was added until 2005, and also the lack of focus on this important group of biological control agents. The steep rise of the curve between 2005–2019 reveals the importance of efficient samplings, supplemented by the recent findings in Derafshan *et al.* (2016, 2017, 2020), with a significant number of the newly recorded species. According to the sporadic samplings, many areas particularly in the rainforest of the north, mountain forests in the west and semi-desertic parts in the south of the country remained unexplored. So that many other species of Dryinidae (including endemic species) are yet to be discovered by the subsequent studies.

Conflict of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

First of all, we thank our team members in the Department of Plant Protection, University of Zabol, for their assistance during the sampling, which enhanced this contribution. Funding for this study was supported by the University of Zabol (No. UOZ-GR-9618-6) to ER. Many thanks to Prof. Michael von Tschirnhaus (Bielefeld, Germany) for sending on loan specimens of *Aphelopus orphanidesi* collected in Germany. The thorough comments and suggestions by the expert reviewers, Dr Robert S. Copeland and Dr Arkady S. Lelej, greatly improved the quality of the manuscript.

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Submitted on 21 April 2020;
accepted on 2 February 2021;
published on 15 September 2021.