



Taxonomic revision of the *Merodon tarsatus* species group (Diptera, Syrphidae)

Ante Vujić¹, Snežana Radenković¹, Anatolij Barkalov², Nataša Kočiš Tubić¹, Laura Likov¹, Tamara Tot¹, Grigory Popov³, Alex Prokhorov³, Ebrahim Gilasian⁴, Shehzad Anjum⁵, Mihajla Djan¹, Banafsha Kakar⁶, Andrijana Andrić⁷

1 University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, 21000 Novi Sad, Serbia;

2 Institute of Systematics and Ecology of Animals, Siberian Branch of the Academy of Sciences, 630091 Novosibirsk, Russia;

3 Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, 01030 Kyiv, Ukraine; Grigory Popov

4 Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, Agricultural Research, Education and Extension Organization, Tehran, 19395-1454 Iran;

5 National Insect Museum, National Agriculture Research Centre, 44000 Islamabad, Pakistan;

6 Department of Zoology, Sardar Bahadur Khan Women's University, 87300 Quetta, Pakistan;

7 University of Novi Sad, BioSense Institute, 21000 Novi Sad, Serbia;

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Corresponding author: Andrijana Andrić (andrijana.andric@biosens.uns.ac.rs)

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Abstract

The phytophagous hoverfly genus *Merodon* Meigen, 1803 (Diptera, Syrphidae) presently comprises 205 described species distributed in the Palaearctic and Afrotropical regions, and it is differentiated into multiple species groups. In this work, we revise the *Merodon tarsatus* species group, providing an illustrated key to species, a detailed discussion on relevant taxonomic characters, and a morphological diagnosis. We summarize morphological characteristics of the 12 species in the *M. tarsatus* group, together with available distributional data. Moreover, we provide descriptions for five new species, namely *Merodon angustitarsis* Vujić & Gilasian **sp. nov.**, *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** and *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** Additionally, we describe one more species, *Merodon nigroalatus* Vujić, Likov & Radenković **sp. nov.**, that belongs to the same lineage and is related to the *Merodon tarsatus* group based on molecular markers and structure of male genitalia, but lacks modifications of the metatarsus and sternum 4 that are the main diagnostic features of the group. Furthermore, we redefine and redescribe seven taxa of the *M. tarsatus* group. Following detailed analyses of type material, we revise the status of all available taxa related to *M. tarsatus* and we propose the following new synonyms: *M. ankylogaster* Hurkmans, 1993 **syn. nov.** (junior synonym of *M. hypochrysos* Hurkmans, 1993); *M. persicus* Hurkmans, 1993 **syn. nov.** (junior synonym of *M. oidipous* Hurkmans, 1993); and *M. xanthipous* Hurkmans, 1993 **syn. nov.** (junior synonym of *M. marginicornis* Hurkmans, 1993). We apply Maximum Parsimony and Maximum Likelihood analyses of the 5' end of the mitochondrial *COI* gene sequences to genetically characterize species in the *M. tarsatus* group and the related species, *M. nigroalatus* Vujić, Likov & Radenković **sp. nov.**

Keywords

COI gene, distributional data, hoverflies, morphology, new species, new synonyms

1. Introduction

The phytophagous hoverfly genus *Merodon* Meigen, 1803 (Diptera: Syrphidae: Eristalinae: Merodontini) is distributed across the Palaearctic and Afrotropical regions and presently comprises 205 described species (Vujić et al. 2021a, 2022a, 2022b), while *Merodon equestris* (Fabricius, 1794), or “large narcissus bulb fly”, is the only species of the genus established outside these regions and has become established in the Nearctic Region and New Zealand (Speight 2020). This species is widely known for its larvae damaging *Narcissus* L. and other bulbous plants of horticultural importance (Hodson 1932; Conijn 1990; Jarvis and Collier 2002). Adult *Merodon* hoverflies visit the flowers of a wide range of plant species (Marcos-García et al. 2007), thus acting as important pollinating agents.

In summarizing previously published data (Šašić et al. 2016; Radenković et al. 2018), Vujić et al. (2019) recognized five monophyletic lineages within *Merodon*, namely the following: *albifrons*, *aureus*, *avidus-nigritarsis*, *desuturinus*, and *natans*. The *avidus-nigritarsis* lineage contains 10 species groups (*M. aberrans*, *M. aurifer*, *M. avidus*, *M. clavipes*, *M. fulcratus*, *M. italicus*, *M. nigritarsis*, *M. pruni*, *M. serrulatus*, and *M. tarsatus*), as well as eight individual taxa (*M. auronitens* Hurkmans, 1993, *M. caudatus* Sack, 1913, *M. clunipes* Sack, 1913, *M. crassifemoris* Paramonov, 1925, *M. eumerusi* Vujić, Radenković & Likov, 2019, *M. hirtus* Sack, 1932, *M. murinus* Sack, 1913 and *M. ottomanus* Hurkmans, 1993), amounting to a total of 67 described species (Vujić et al. 2021a).

The highest species diversity of *Merodon* has been recorded in the Mediterranean region (Vujić et al. 2012). In particular, the Iberian Peninsula and Asia Minor (Anatolian Peninsula) are considered centers of *Merodon* diversity and endemism, as evidenced by the many studies on the *Merodon* fauna in the Mediterranean (Marcos-García et al. 2007; Vujić et al. 2007, 2011, 2013, 2015, 2020a, 2020b, 2020c, 2021b, 2021c; Ståhls et al. 2009, 2016; Radenković et al. 2011, 2020; Kaloveloni et al. 2015; Ačanski et al. 2016, 2017; Likov et al. 2020). Some recent publications have also emphasized high *Merodon* diversity in the Middle East and Central Asia. For instance, Vujić et al. (2013) described three new species from the *M. nigritarsis* species group in the Middle East and, more recently, two new remarkable species were described from biodiversity hotspots in the Middle East and Central Asia (Vujić et al. 2019). *Merodon eumerusi* clearly belongs to the *avidus-nigritarsis* lineage of *Merodon*, displaying the unusual apomorphic characters unique to the genus, was described from the Pamir and Tian Shan mountain ranges distributed across Kyrgyzstan, Uzbekistan and Tajikistan (Vujić et al. 2019). *Merodon mixtum* Vujić, Radenković &

Likov, 2019, possesses morphological characters typical of different species groups within the *albifrons* lineage, and it was discovered in the Irano-Anatolian mountains (Vujić et al. 2019). Likov et al. (2020) discussed the diversity of the *M. nigritarsis* species group and concluded that this group comprises mainly mountainous taxa, mostly distributed on the Balkan, Anatolian, Apennine and Iberian Peninsulas, as well as in the Middle East. A recent study of the *M. serrulatus* group revised 13 recognized species, including seven newly described species (Vujić et al. 2020a). Four of these seven newly described species are distributed in Central Asia: *M. disjunctus* Vujić, Likov & Radenković, 2020 (Kyrgyzstan, Tajikistan and Kazakhstan); *M. nigrocapillatus* Vujić, Likov & Radenković, 2020 (Tajikistan); *M. nigropunctum* Vujić, Likov & Radenković, 2020 (Uzbekistan); and *M. trianguloculus* Vujić, Likov & Radenković, 2020 (Turkmenistan) (Vujić et al. 2020a). The *M. aurifer* species group has also been revised recently, with a description of one new species, i.e., *M. nudicorpus* Vujić & Radenković, 2021 (Vujić et al. 2021b).

The *Merodon tarsatus* species group is the only group of the genus with limited distribution in the Middle East and Central Asia that lacks European representatives. It was first established by Hurkmans (1993) based on the following apomorphies: basitarsus of hind leg strongly swollen, specialized pubescence present on inner face; fourth abdominal sternum at least keeled, mostly strongly modified. He cited nine species in this group: *Merodon ankylogaster* Hurkmans, 1993; *M. auronitens*; *M. caudatus*; *M. oidipous* Hurkmans, 1993; *M. persicus* Hurkmans, 1993; *M. tangerensis* Hurkmans, 1993; *M. tarsatus* Sack, 1913; *M. turkestanicus* Paramonov, 1927; and *M. xanthipous* Hurkmans, 1993 (Hurkmans 1993). However, Vujić et al. (2021a) has since assigned 13 species to the *M. tarsatus* group, seven of which had been described previously (*M. hypochrysos* Hurkmans, 1993; *M. marginicornis* Hurkmans, 1993; *M. oidipous*; *M. rufitarsis* Sack, 1913; *M. smirnovi* Paramonov, 1927; *M. tarsatus*; and *M. turkestanicus*), and six species that remain to be formally described.

Here, we present a taxonomic review of the *Merodon tarsatus* species group based on a detailed examination of material gathered from our long-term research on the genus *Merodon*. Our aims are to: 1) review material of this group stored in several major entomological institutions and private collections; 2) define and describe the taxa within the *M. tarsatus* species group, including new species; 3) provide diagnostic characters of all species and complete a key for the *M. tarsatus* group; and 4) conduct DNA sequence analysis of the 5' region of the mitochon-

drial *COI* gene for nine species of the *M. tarsatus* group. We additionally processed a species close to the *M. tarsatus* group that belongs to the same lineage.

2. Material and Methods

2.1. Taxonomic research

2.1.1. Examined material and institutional acronyms

In the present study specimens belonging to the *Merodon tarsatus* species group, as well as additional species close to it, *Merodon nigroalatus* Vujić, Likov & Radenković **sp. nov.** belonging to *avidus-nigratarsis* lineage, were examined. In total 1368 specimens (1365 belonging to the *M. tarsatus* group and three specimens of *M. nigroalatus* Vujić, Likov & Radenković **sp. nov.**) from Afghanistan, Iran, Israel, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkey, Turkmenistan, and Uzbekistan were studied. The material examined in this study are deposited in the following entomological collections: Daniele Sommaggio collection, Bologna, Italy (**D.S. coll.**); Dieter Doczkal collection, Munich, Germany (**D.D. coll.**); Entomological Museum of Isparta, Isparta, Turkey (**EMIT**); Finnish Museum of Natural History, University of Helsinki, Helsinki, Finland (**MZH**); Faculty of Sciences, Department of Biology and Ecology, University of Novi Sad, Serbia (**FSUNS**); Hayk Mirzayans Insect Museum, Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, Tehran, Iran (**HMIM**); I. I. Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine, Kyiv, Ukraine (**SIZK**); Jirka Hadrava collection, Prague, Czech Republic (**J.H. coll.**); Maleki Milani Hasan collection, Tabriz, Iran (**MMH**); Martin Hauser collection, Sacramento, California, United States of America (**M.H. coll.**); Miroslav Barták collection, Prague, Czech Republic (**M.B. coll.**); National History Museum, Prague, Czech Republic (**NMPC**); National Insect Museum Islamabad, Pakistan (**NARC**); Naturalis Biodiversity Center, Leiden, The Netherlands (**NBCN**); National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA (**NMNH**); Naturhistorisches Museum Wien, Vienna, Austria (**NHMW**); Sakari Kerppola collection, Helsinki, Finland (**S.K. coll.**); Sander Bot collection, Haren, The Netherlands (**S.B. coll.**); Siberian Zoological Museum, Novosibirsk, Russia (**SZMN**); Tel Aviv University, Tel Aviv, Israel (**TAUI**).

All type specimens of species in the *Merodon tarsatus* group were examined. Within the “Type material examined” sections below, we provide complete data for each studied specimen. For holotypes, information on general condition is described. The original label data has been given verbatim for the type specimens. The contents of each label are presented in quotation marks (“”), with a slash (/) denoting separate lines within a label. For non-

type specimens, data on specimens is presented in the sections entitled “Additional material examined”.

2.1.2. Morphological study and terminology

Differential diagnoses are given for all studied species. We describe five new species in full and redescribe a further seven species based on terminology following Thompson (1999), except for the term “fossette” (Doczkal and Pape 2009) and those proposed in Marcos-García et al. (2007) for structures of the male terminalia. Measurements (in mm) were taken using a stereomicroscope with an eyepiece graticule. Male genitalia were dissected with a hook-tipped entomological pin. Dry hoverfly specimens were relaxed in a humidity chamber before removing the genitalia. The genitalia were cleaned in boiled 10% KOH solution for 3–5 min, then immersed in glacial acetic acid to neutralize the KOH, before being washed in ethanol to remove the acid. Finally, all such samples were stored in plastic microvials containing glycerin and pinned with the source specimen.

2.1.3. Photographs and drawings

Photographs were composed with software CombineZ (Hadley 2006) based on photos taken by a Nikon Coolpix D7100 digital camera attached to a Nikon SMZ 745T stereomicroscope (Nikon Corporation, Tokyo, Japan). Drawings of male genitalia were made with a FSA 25 PE drawing tube mounted on a Leica MZ16 stereomicroscope (Leica Microsystems, Wetzlar, Germany).

2.1.4. Distribution data and maps

Information about distribution is given for all studied species. DIVA-GIS software version 7.5.0 (Hijmans et al. 2012) was used to create the distribution maps. Country distribution of the species of *Merodon tarsatus* group is shown in Table 1.

2.2. Genetic analysis

Laboratory process. The genomic DNA of each specimen was extracted from two or three legs using a slightly modified SDS extraction protocol (Chen et al. 2010). Genomic DNA vouchers are deposited at the Faculty of Sciences, Department of Biology and Ecology, University of Novi Sad (FSUNS). For this purpose, the 5' end of the mitochondrial protein-coding cytochrome c oxidase subunit I (*COI*) gene was amplified. Primer pair LCO1490 and HCO2198 (Folmer et al. 1994) was used for the amplification of the gene region. The PCR reactions were carried out according to Kočiš Tubić et al. (2018). The amplification products were enzymatically purified by Exonuclease I and FastAP Thermosensitive Alkaline Phosphatase enzymes (ThermoScientific, Lithuania) and sequenced using forward primer on an ABI3730x1 Genetic Analyzer (Applied Biosystems, Foster City, CA, USA) at the Finn-

ish Institute for Molecular Medicine (FIMM), Helsinki, Finland (<http://www.fimm.fi>) and by the Macrogen EZ-Seq service (Macrogen Europe, Amsterdam, The Netherlands).

Data analysis. The obtained *COI* gene sequences were edited for base-calling errors using BioEdit 7.2.5. (Hall 1999). Alignment of the sequences was achieved using the Clustal W algorithm (Thompson et al. 1994) implemented in BioEdit 7.2.5. (Hall 1999). All sequences in the analyzed dataset were trimmed to equal lengths. Maximum-Parsimony (MP) analysis was performed in NONA (Goloboff 1999), spawned with the aid of ASADO, version 1.85 (Nixon 2008), using the heuristic search algorithm (settings: mult*1,000, hold/100, max trees 100,000, TBR branch swapping). Maximum-Likelihood (ML) tree was constructed by MEGA 7.0 (Kumar et al. 2016) and applying the Tamura-Nei model (Tamura and Nei 1993) as the best choice model determined by MEGA 7.0 for the analyzed dataset with a discrete Gamma distribution used to model evolutionary rate differences among sites (5 categories (+G, parameter = 0.1619)). Nodal support values were estimated using nonparametric bootstrapping with 1,000 replicates for both, MP and ML trees. The trees were rooted with *Platynochaetus macquarti* Loew, 1862,

while *Eumerus amoenus* Loew, 1848, as well as representatives of three out of the five main *Merodon* lineages (following Vujić et al. 2021a) were also included in the analyses as outgroups (*M. neonanus* Vujić & Taylor, 2015 of the *aureus* lineage; *M. loewi* van der Goot, 1964 of the *albifrons* lineage; and *M. avidus* (Rossi, 1790) of the *avidus-nigritarsis* lineage, to which the *M. tarsatus* group belongs). The details and GenBank accession numbers of all analyzed species and outgroups are presented in the Supplementary file 1: Table S1.

3. Results

3.1. Taxonomic revision

3.1.1. Diagnostic characters and diversity of *Merodon tarsatus* species group

The *Merodon avidus-nigritarsis* lineage contains medium to large species (11–20 mm) usually with white pollinose vittae on scutum and white pollinose fasciae on terga; an-

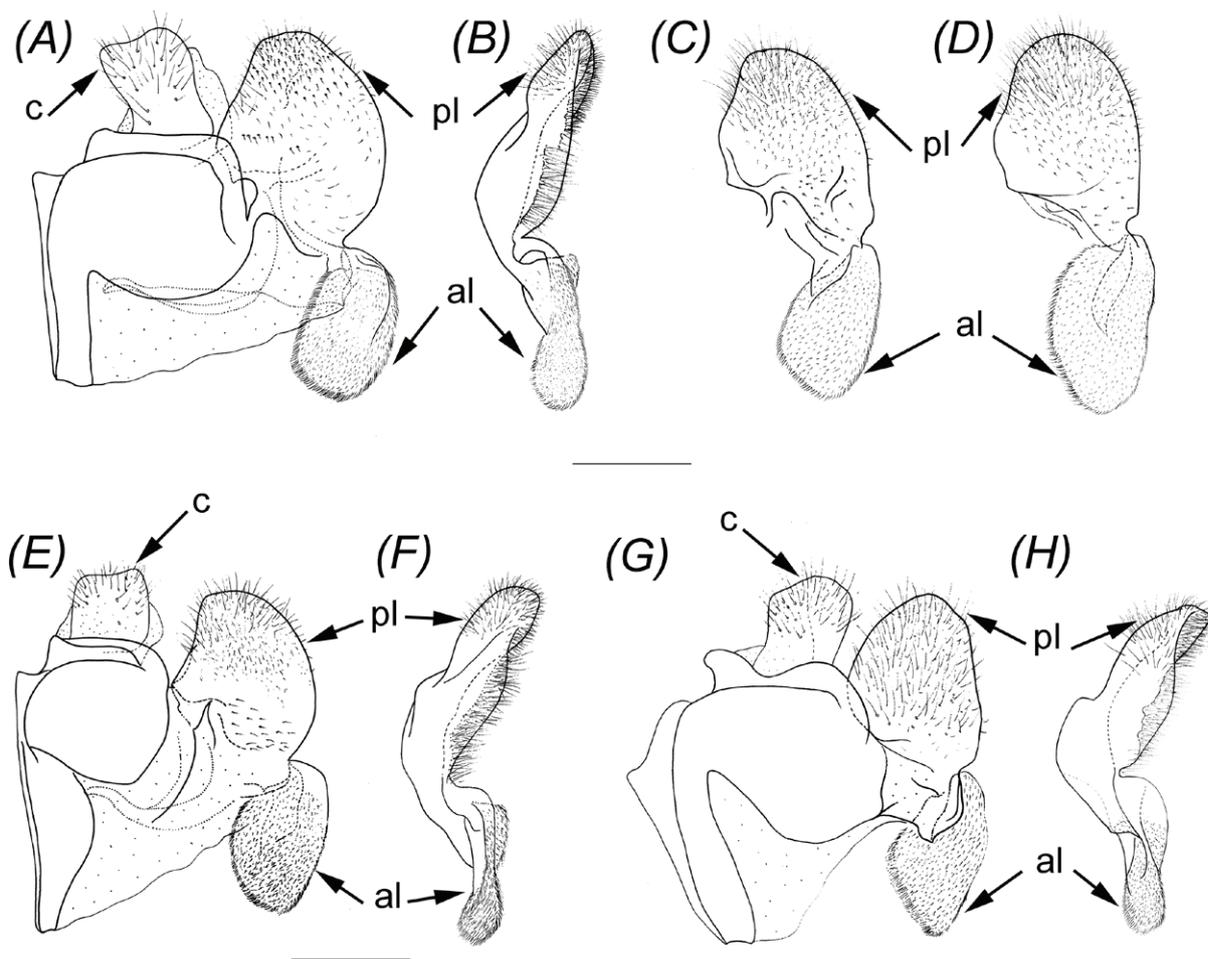


Figure 1. Male genitalia, epandrium. **A–D** *M. tarsatus*, **E, F** *M. turkestanicus*, **G, H** *M. namaghijamii* Vujić, Likov & Radenković sp. nov. (A, C–E, G) lateral view, (B, F, H) ventral view. Abbreviations: al – anterior surstyle lobe, c – cercus, pl – posterior surstyle lobe. Scale bar: 0.5 mm.

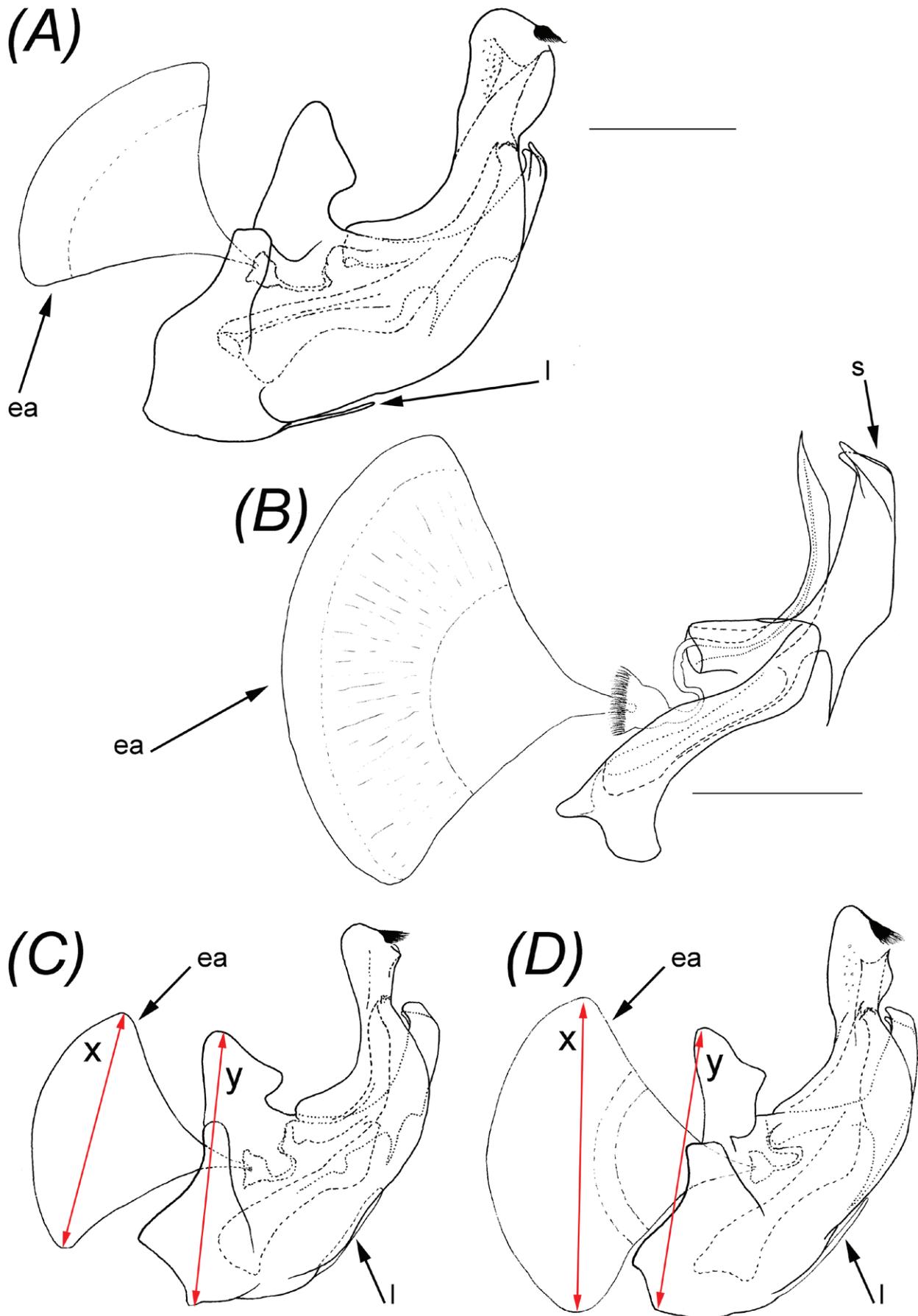


Figure 2. Male genitalia, hypandrium, lateral view. **A, B** *M. tarsatus*, **C** *M. turkestanicus*, **D** *M. namaghijamii* Vujić, Likov & Radenković *sp. nov.* (A, C, D) hypandrium, (B) aedeagus. Abbreviations: ea – ejaculatory apodeme, l – lingula, s – lateral sclerite of aedeagus, x – maximal width of ejaculatory apodeme, y – basal width of hypandrium. Scale bar: 0.5 mm.

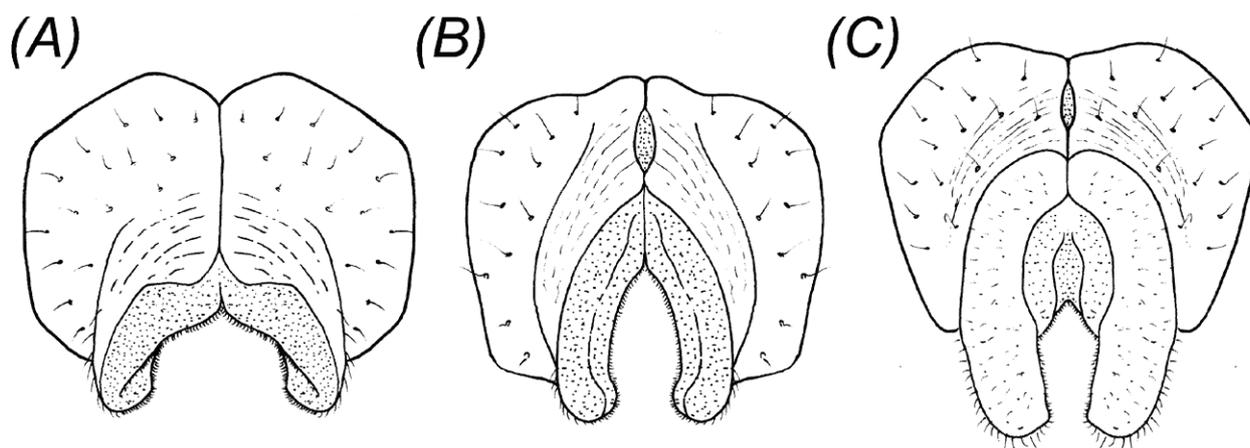


Figure 3. Sternum 4 of male, ventral view. **A** *M. hypochrysos*, **B** *M. tarsatus*, **C** *M. oidipous*. Scale bar: 0.5 mm.

terior anepisternum bare ventrally to the postpronotum; abdomen elongate, usually narrow and tapering, longer than scutum and scutellum together; posterior part of mesocoxa usually without long pile (with exception of *M. eumerusi*); basoflagellomere usually at most twice as long as wide; legs without additional calcar, spina(e) (with exception of *M. eumerusi*) or tubercle; male genitalia (as in Figs 1, 2): anterior surstyle lobe usually rhomboid-shaped, covered with dense short pile (as in Fig. 1A: al); posterior surstyle lobe usually longer than anterior one (as in Fig. 1A: pl); cercus rectangular, without prominences (as in Fig. 1A: c); hypandrium usually narrow, elongate and sickle-shaped (as in Fig. 2); posterior end of lateral sclerite of aedeagus tapering (as in Fig. 2B: s); theca of hypandrium usually with a pair of lateral projections, not present in *M. tarsatus* group; lingula developed (as in Fig. 2A: l).

The *Merodon tarsatus* species group belongs to the *avidus-nigratarsis* lineage on the basis of the absence of long pile posteriorly on the mesocoxa. This group contains small to large species (6–13 mm) characterized in males with sternum 4 medially clearly divided with membranous structure and with lateral tubercles or laminate extensions on posterior margin (Fig. 3); sternum 4 in lateral view usually fin-shaped (Figs 4, 5); in both sexes basotarsomere of metatarsus usually expanded (Figs 6–9) and/or with well-defined, brush-like area of dense pile ventrally (as on Fig. 6B). Antennae from black and dark brown to reddish-yellow; basoflagellomere between 1.6–2.5 times as long as wide (except in *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** as long as wide), in most species strikingly concave dorsally, except in *M. hypochrysos*, *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** and *M. rufatarsis* (as in Figs 10–13). Species with dark scutum and abdomen. Scutum covered with erect, usually yellow to gray-whitish pile. Legs (Figs 14–17) mostly black, ventral margin of metatrochanter usually angular. Metafemur medium broad. Metatibia with sharp apicomedial lamina covered with tuft of long pile (as in Fig. 18). Tarsi usually black dorsally and dark brown ventrally, but in some species can be reddish-yellow to brown, especially in females. Abdomen elongated, broad-

er than in other species groups from *avidus-nigratarsis* lineage (Figs 19–21), slightly longer than scutum and scutellum together. Terga 2–4 with white pollinose fasciae (at least in females) (as in Figs 19–21); terga black, tergum 2 without reddish-orange lateral maculae. Male genitalia (Figs 1–2, 22–25): anterior surstyle lobe usually oval, rectangular or triangular, elongated (Figs 1, 22–24: al), covered with dense short pile; posterior surstyle lobe oval to triangular or trapezoid (Figs 1, 22–24: pl); cercus rectangular, without prominences (Figs 1, 22–24: c). Hypandrium elongated and sickle shaped (Figs 2, 25); lateral sclerite of aedeagus finger-like with basal thorn-like process (as in Fig. 2B: s); lingula present, in most of the species elongated and narrow (Figs 2: l, 25: l).

The *Merodon tarsatus* group consists of seven described and five undescribed species. This group of species is geographically restricted to the Middle East and Central Asia (Figs 26–28).

***Merodon angustatarsis* Vujić & Gilasian sp. nov.**

<https://zoobank.org/CACF11A4-B019-430F-BF76-93F6CC896631>

Figs 4A, 7A–C, 10A, 12A, 14A, 16A, 19A, 21A, 22A–C, 27, 29A, 30A

M. aff. tarsatus 1 (Vujić et al. 2021a).

Type locality. IRAN: Māzandarān Province, Baladeh District, Nesen; 36°14'24"N, 51°27'27"E; 2920 m a.s.l.

Type material. *Holotype*: ♂; HMIM [specimen dry pinned, in very good condition with genitalia in separate microvial]. Original labels: "Mazandaran-Baladeh / Nesan / N 36 14 24.2 E 051 27 27.0 / 2920m. / Gilasian / 9.VI.2006" [left part of the label vertical], "02532". — *Paratypes*: IRAN • 1 ♀; Yazd Province, Taft County, Sānij; 31°33'36"N, 54°01'46"E; 3020 m a.s.l.; 15 May 2007; Gilasian E. leg.; HMIM 04461 • 2 ♂♂; N. Iran, Alborz (mountain range), Tochal; 35°53'50"N, 51°25'05"E; 2000–2500 m a.s.l.; 29–30 Jun. 1973; Loc. no. 261 Exp. Nat. Mus. Praha; HMIM 02530, 02536 • 1 ♀; same data as for preced-

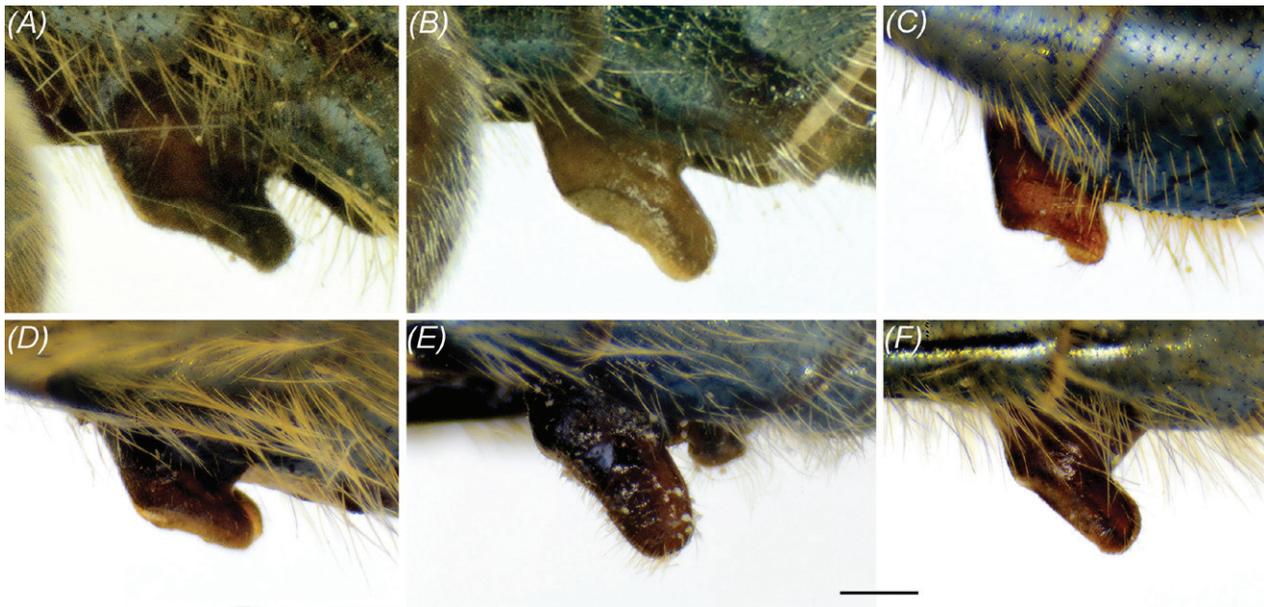


Figure 4. Sternum 4 of male, lateral view. **A** *M. angustitarsis* Vujić & Gilasian **sp. nov.**, **B** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **C** *M. hypochrysos*, **D** *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, **E** *M. oidipous*, **F** *M. tarsatus*. Scale bar: 0.5 mm.

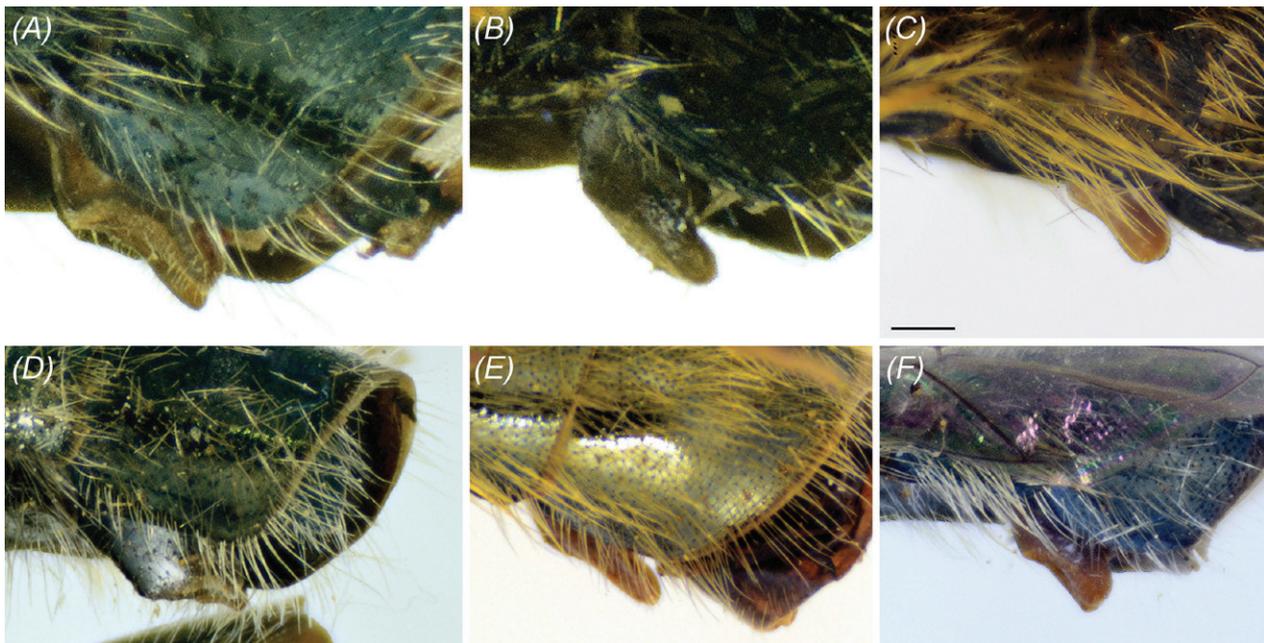


Figure 5. Sternum 4 of male, lateral view. **A** *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, **B** *M. marginicornis*, **C** *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, **D** *M. rufitarsis*, **E** *M. smirnovi*, **F** *M. turkestanicus*. Scale bar: 0.5 mm.

ing; HMIM 02537 • 1 ♂; N. Iran, Alborz (mountain range), Tochal; 35°53'50"N, 51°25'05"E; 2000–2500 m a.s.l.; 29–30 Jun. 1973; Loc. no. 261 Exp. Nat. Mus. Praha; NMPC 05924; • 1 ♂; N. Iran, Kuh-e Tochal-top; 3500–4000 m a.s.l.; 16–26 Jul. 1977; Loc. no. 403 Exped. Nat. Mus. Praha; HMIM 02526 • 5 ♀♀; same data as for preceding; HMIM 02527 to 02529, 02589, 02531 • 1 ♀; Tehran Province, Dizin, Velāyatrud; 36°09'03"N, 51°22'12"E; 2250 m a.s.l.; 30 May 1991; Ebrahimi E., Badii M. leg.; HMIM 02593 • 1 ♀; Khorāsān-e Razavi Province, Ghoochan, Emamgholi, Chovinli; 37°27'59"N, 58°34'45"E; 2300 m a.s.l.; 1 Jun. 2006; Gilasian E. leg.; HMIM 02542. — TURKMENISTAN • 1 ♀; Ahal Region, Gökdepe District, SW of Geok Tepe; 38°04'52"N, 57°52'48"E; 8 May 1988; Barkalov A. leg.; SZMN 05803

• 1 ♀; Ahal Region, Gökdepe District, SW of Geok Tepe; 38°04'52"N, 57°52'48"E; 11 May 1988; Barkalov A. leg.; SZMN 05849.

Additional material examined. IRAN • 1 ♀; Fārs Province, Road Chiraz (Shiraz)-Kazeroun, Fort Sine-Sefid; 29°30'N, 52°E; 29 Apr. 1937; Brandt F.H. leg.; Paratype of *Merodon ankylogaster*; NBCN 02591.

Diagnosis. Medium sized (8–10 mm), medium long pilose, dark species, with olive-brown reflection (Figs 19A, 21A); antennae reddish-brown, basoflagellomere elongated, 1.8–1.9 times as long as wide with convex dorsal margin (Figs 10A, 12A); femora mostly black, tibiae and

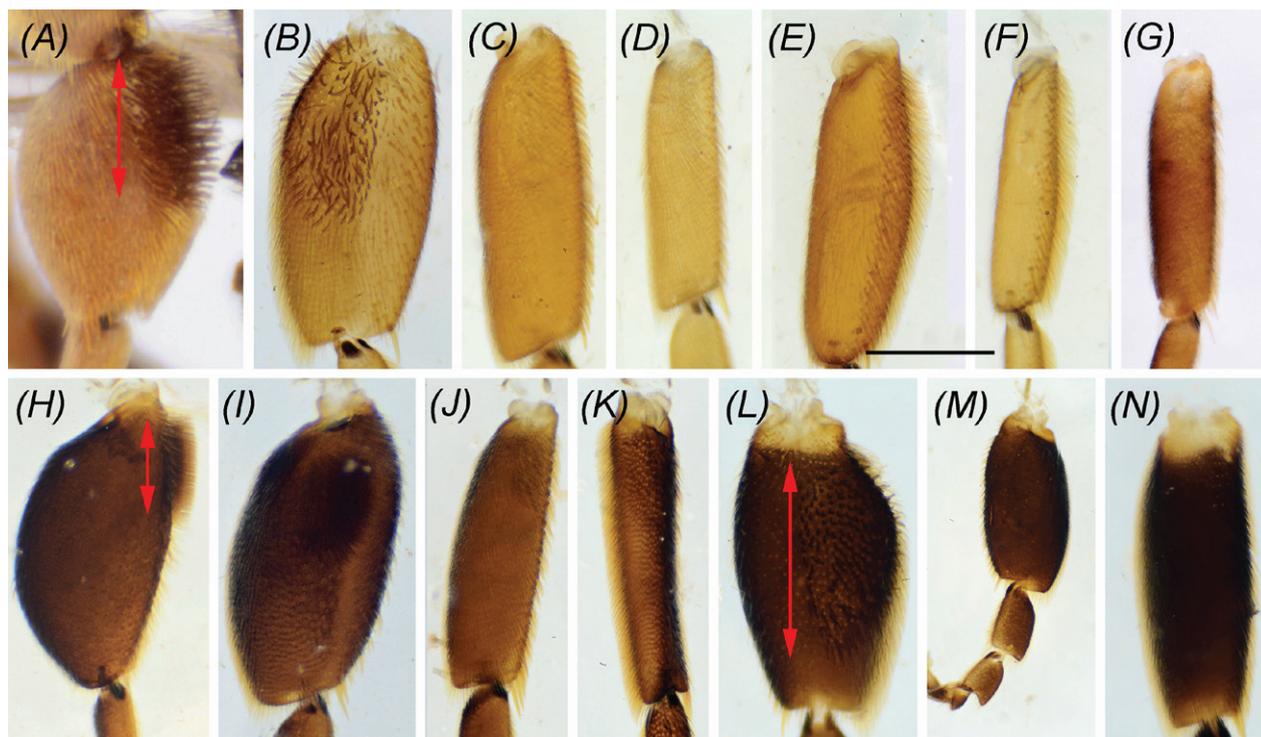


Figure 6. Metabasotarsomere. **A–F** *M. smirnovi*, **G** *M. turkestanicus*, **H–K** *M. oidipous*, **L–N** *M. tarsatus*. (**A, B, H, I, L, M**) male, (**C–G, J, K, N**) female; (**A, E, F, H, K, N**) lateral view, (**B–D, I, J, L**) ventral view, (**G, M**) dorsal view. Arrows mark length of brush-like area of dense pile. Scale bars: 0.5 mm (**A–L, N**), 1 mm (**M**).

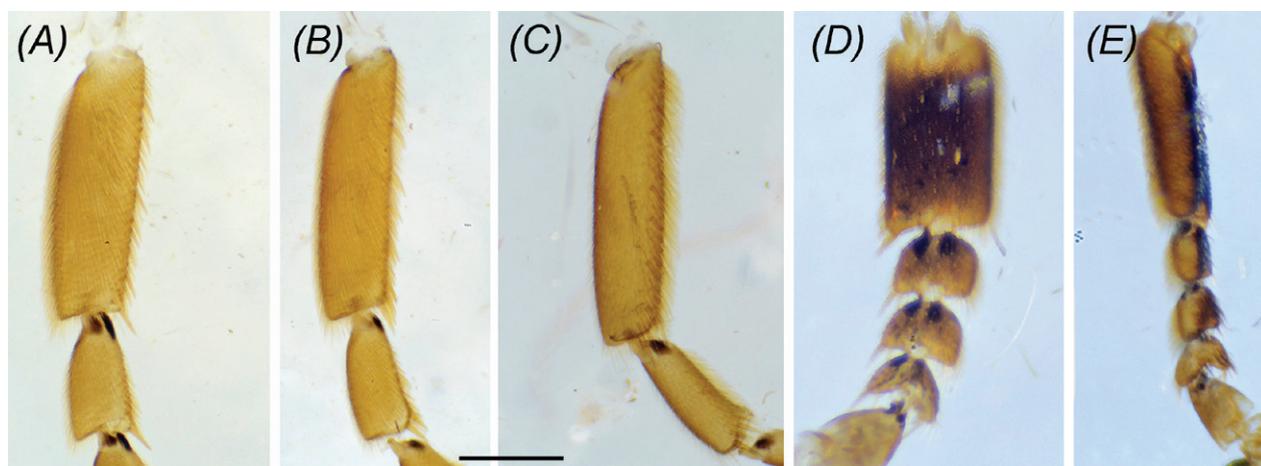


Figure 7. Metatarsi. **A–C** *M. angustitarsis* Vujić & Gilasian **sp. nov.**, **D, E** *M. hypochrysos*. (**A, D, E**) male, (**B, C**) female; (**A**) ventro-lateral view, (**D**) ventral view, (**B, C, E**) lateral view. Scale bars: 0.5 mm (**A–C**), 1 mm (**D, E**).

tarsi partly yellow (Figs 14A, 16A); body pile whitish, yellow to gray. Male: metafemur broad, about 3.7–3.8 times longer than wide, covered with long pilosity (Fig. 14A); basotarsomere of metatarsus less expanded, about 1.3 times broader than the second tarsomere (Fig. 7A), with ventrolateral row of long, strong setae (Fig. 7A), and ventrally without well-defined brush-like area of dense pile extended in basal half (Fig. 7A); ventral margin of metatrochanter angular (Fig. 14A); sternum 4 with long laminate extensions on posterior margin (Fig. 4A); male genitalia: anterior surstyle lobe rectangular with convex ventral margin (Fig. 22A: al), and posterior surstyle lobe broad, trapezoidal, with angular protrusion on the mar-

gin (Fig. 22A: pl); ejaculatory apodeme as long as broad (Fig. 22C: ea); lingula elongated and narrow (Fig. 22C: l). Female: tarsi brown (Fig. 16A), second tarsomere of metaleg longer, about half of basotarsomere (Fig. 7B, C); frons with broad lateral pollinose vittae along eye margins (Fig. 29A); terga 3–4 usually with narrow fasciae, extends less than 1/6 of the length of terga (Fig. 21A).

Male clearly differs from *Merodon rufitarsis* by a longer basotarsomere of metaleg in *M. angustitarsis* Vujić & Gilasian **sp. nov.** (Fig. 14A), while shorter in *M. rufitarsis* (Fig. 15C); by presence of ventrolateral row of setae on basotarsomere of metaleg in *M. angustitarsis* Vujić & Gilasian **sp. nov.** (Fig. 7A), while absent in *M. rufitarsis*;

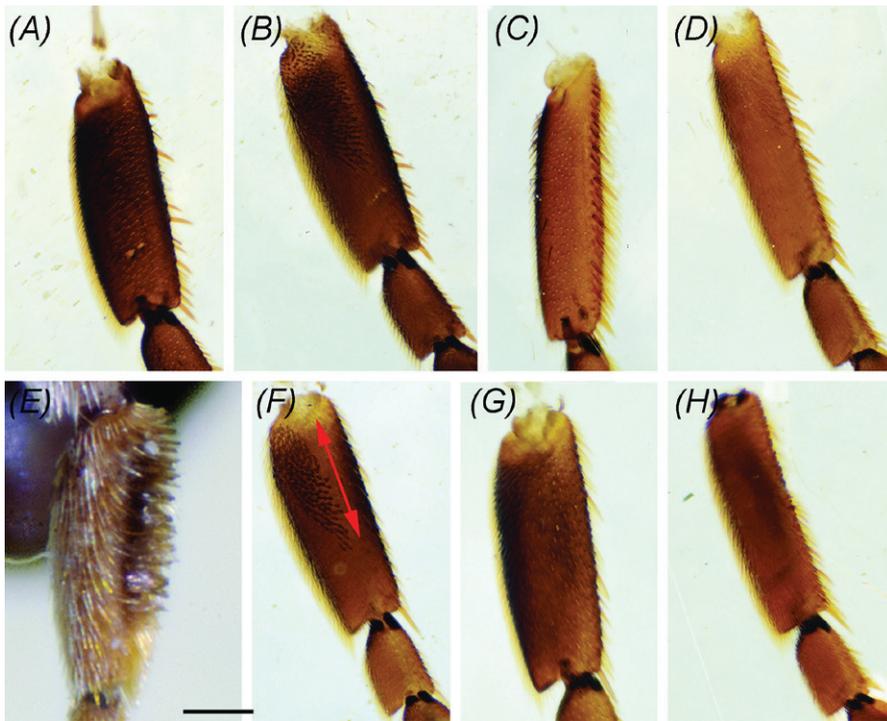


Figure 8. Metabasotarsomere. A–D *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, E *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, F–H *M. marginicornis*. (A, B, E–G) male, (C, D, H) female; (A, G) dorso-lateral view, (B, D, F) ventral view, (C, E, H) lateral view. Arrow marks length of brush-like area of dense pile. Scale bar: 0.5 mm.

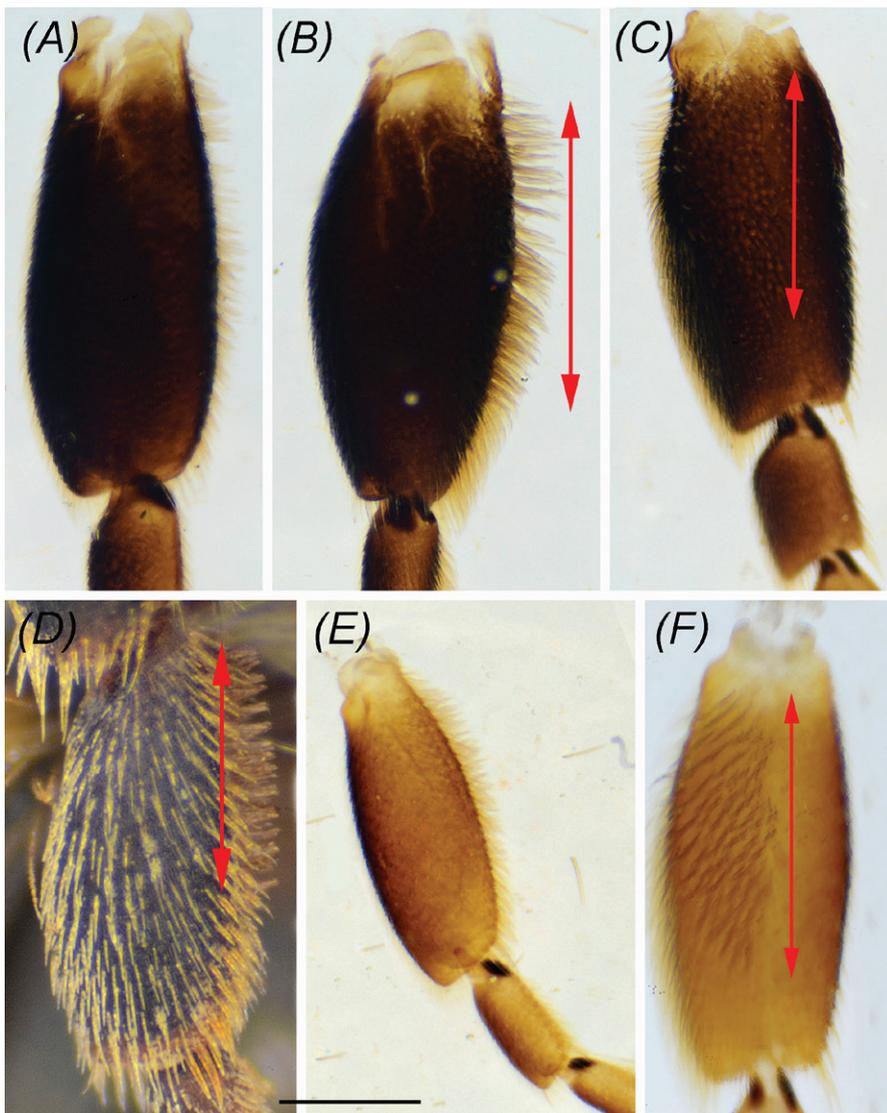


Figure 9. Metabasotarsomere of male. A–C *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, D *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, E–F *M. turkestanicus*. (A) dorsal view, (B, D, E) lateral view, (C, F) ventral view. Arrows mark length of brush-like area of dense pile. Scale bars: 0.5 mm (A–D, F), 0.75 mm (E).

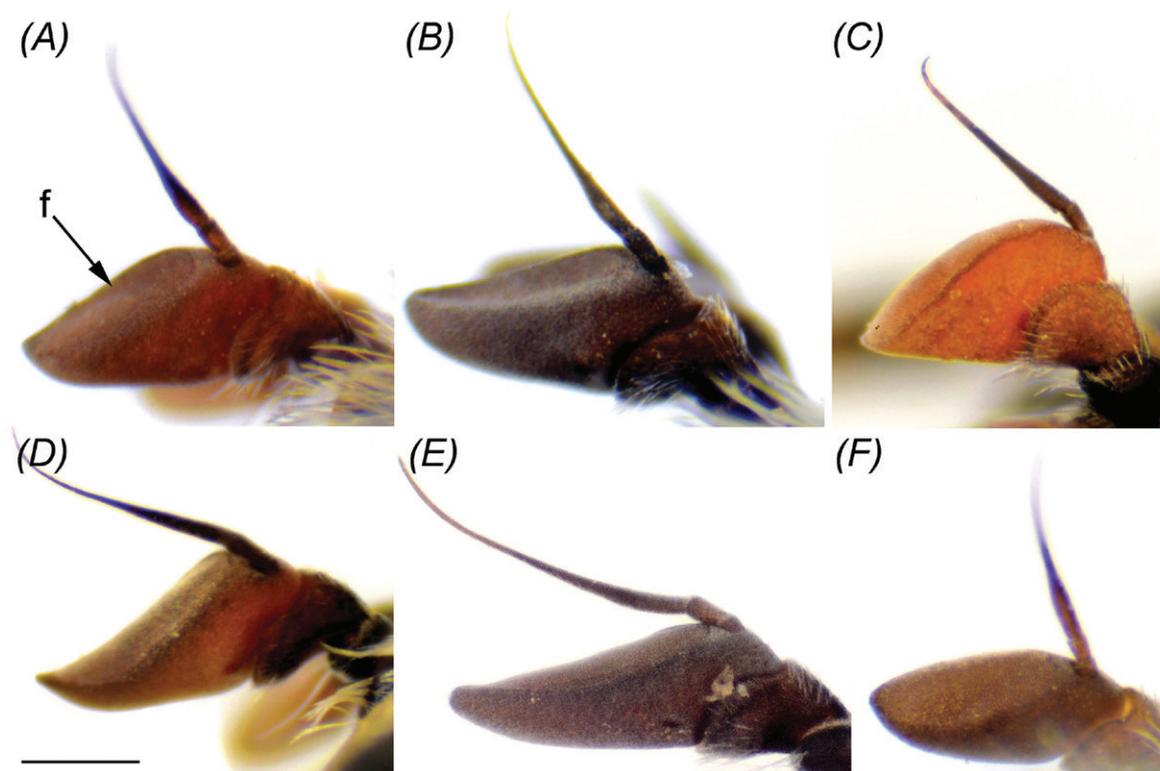


Figure 10. Basoflagellomere of male, lateral view. **A** *M. angustitarsis* Vujić & Gilasian **sp. nov.**, **B** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **C** *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, **D** *M. marginicornis*, **E** *M. smirnovi*, **F** *M. turkestanicus*. Scale bar: 0.5 mm.

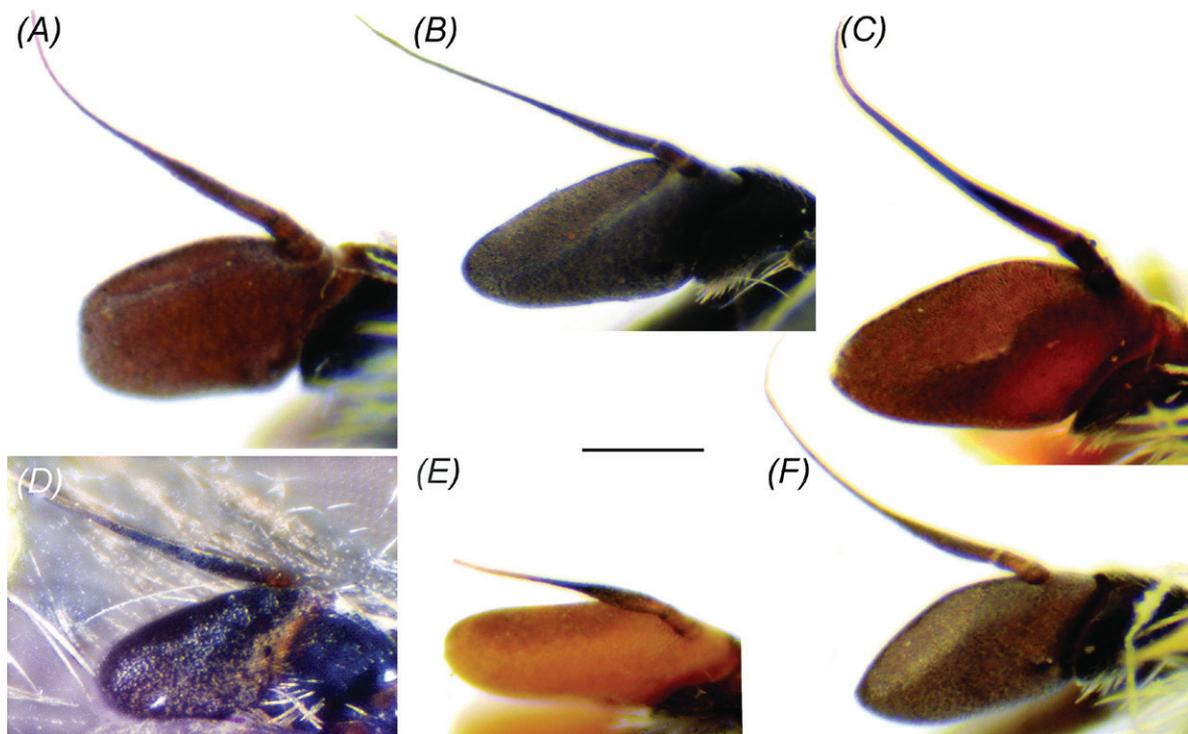


Figure 11. Basoflagellomere of male, lateral view. **A** *M. hypochrysos*, **B** *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, **C** *M. oidipous*, **D** *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, **E** *M. rufitarsis*, **F** *M. tarsatus*. Scale bar: 0.5 mm.

and by the shape of the surstyle lobes of male genitalia (Fig. 22A, B, D, E).

Description. MALE. Head: Antenna reddish-brown; basoflagellomere (Fig. 10A) elongated, about 1.8–1.9 times as long as wide, and about 2 times as long as pedicel,

convex dorsally, strongly tapering to apex; fossette dorsolateral and large (Fig. 10A: f); arista black, thickened at basal third; face and frons black with gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin black, with sparse microtrichia; lunule shiny black to brown, bare; eye contiguity about 8–12 facets long; vertex isosceles, shiny black, anterior part pollinose; vertex with long, gray-yellowish pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with white-gray pile, ventrally covered with dense, gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 30A); vertical triangle: eye contiguity: frons = 2–2.5 : 1 : 1.2–2.

— **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect yellow to white pile; scutum with four pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow to gray pile; wings mostly covered with microtrichia; wing veins brown; calypteres pale yellow; halter brown; femora mostly black, tibiae and tarsi partly yellow; pile on legs pale yellow; ventral margin of metatrochanter angular; metafemur moderately broad, about 3.7–3.8 times longer than wide, with long pile on ventral surface, about 2/3 of width of metafemur, longer than pile on dorsal surface (Fig. 14A); apicomedial lamina on metatibia small, covered with a few long gray pile; basotarsomere of metatarsus about 1.3 times broader than second tarsomere (Fig. 7A), with ventrolateral row of long, strong setae (Fig. 7A), and ventrally with weakly defined brush-like area of dense pile (Fig. 7A).

— **Abdomen** (Fig. 19A): About 1.3 times longer than mesonotum; terga dark brown to black; terga 2–4 each with pair of narrow white pollinose fasciae; pile on terga gray-whitish except black pilosity on medial part of terga 2 and 3; sterna dark brown, covered with long whitish pile.

— **Male genitalia:** Anterior surstyle lobe rectangular with convex ventral margin, about 1.5 times longer than wide, covered with dense, short pile (Fig. 22A, B: al); posterior surstyle lobe broad, trapezoidal, with angular protrusion on lateral margin (Fig. 22A, B: pl); cercus rectangular (Fig. 22A: c); hypandrium sickle-shaped, without lateral projections (Fig. 22C); lingula very elongated and narrow (Fig. 22C: l).

— **FEMALE.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere about 2.2 times longer than wide (Fig. 12A); frons with pollinose vittae along eye margins (Fig. 29A); frons covered with mostly gray-yellow pile, intermixed with black pile; ocellar triangle covered with gray to whitish pile, mixed with black ones (Fig. 29A); medial part of terga 2–4 usually with short adpressed black pile; pollinose fasciae on terga 2–4 extends less than 1/6 of length of terga (Fig. 21A); basotarsomere of metatarsus brown, with a few distinct spine-like setae within ventrolateral row of setae, and in ventral view more or less with parallel margins; length of second tarsomere of metaleg subequal to or less than half length of basotarsomere (Fig. 16A).

Etymology. The name “*angustitarsis*”, as arbitrary combination, derives from the Latin adjective “angustus” meaning narrow, and the noun “tarsus” referring to the fifth part (terminal segments) of the leg. This describes the distinctive narrow shape of the basotarsomere of the metaleg.

Distribution and ecological data. *Merodon angustitarsis* Vujić & Gilasian **sp. nov.** occurs in Iran and in southern Turkmenistan (Fig. 27). It was found within a cold-desert steppe scrubland ecosystem with *Artemisia sieberi* – *Zygophyllum* sp. as dominant vegetation type, cold and arid semi steppe scrubland and grasslands ecosystem (*Astragalus* spp.), and cold and humid prairies ecosystem (*Trifolium* spp.) (Azizi Jalilian et al. 2020). These localities belong to four ecoregions: Elburz range forest steppe, Kopet Dag woodlands and forest steppe, Zagros mountains forest steppe, and Central Persian desert basins (Olson et al. 2001). Nesen, the locality where the holotype of *M. angustitarsis* Vujić & Gilasian **sp. nov.** was collected, is a mountainous area located in Alborz mountain range with very cold winters and moderate warm summers (–30 to 20°C), and 400–500 mm annual precipitation; *Plantago major* L. and *Allium ursinum* L. are the dominant plant species. Most paratypes of *M. angustitarsis* Vujić & Gilasian **sp. nov.** were collected in Tochal, a mountainous area located in the Alborz mountain range, with 16.7°C average annual temperature and 300–400 mm annual precipitation; *Astragalus* spp. are the dominant plant species of this area. Other paratypes were collected in mountainous areas of: Dizin, located in the central part of the Alborz mountain range with very cold winters and moderate summers (–20 to 20°C), with *Juniperus* spp., *Rhus coriaria* L., *Crataegus pontica* K. Koch., and *Thymus vulgaris* L. as the dominant plant species; Chovinli, with very cold winters and moderate summers, with 310 mm annual precipitation and 12.5°C average annual temperature, with *Juniperus excelsa* M. Bieb., *Ficus carica* L., *Prunus cerasifera* Ehrh., *Celtis australis* L., and *Atriplex* spp. as the dominant plant species; Sānij, a semi-arid mountainous area close to the Zāgros mountain range with cold winters and hot summers (12 to 34°C), with 300–350 mm annual precipitation, with *Zygophyllum atriplicoides* subsp. *eurypterum* (Boiss. & Buhse) Popov, *Artemisia sieberi* Besser, and *Lactuca orientalis* (Boiss.) Boiss. as the dominant plant species. On the basis of our data the flight period is from late April to July, mostly independent of altitude.

***Merodon dumosus* Vujić, Likov & Radenković sp. nov.**

<https://zoobank.org/AB67FF7B-E07B-43F2-850C-8EE304414A85>

Figs 4B, 8A–D, 10B, 12B, 14B, 15K, 16B, 20A, 21B, 23A–C, 28, 29B, 31A

M. aff. tarsatus 2 (Vujić et al. 2021a).

Type locality. ISRAEL: Mount Hermon [Hebrew: Har Hermon]; 2000 m a.s.l.

Type material. *Holotype*: ♂; TAU 04907 [specimen dry pinned, in very good condition with genitalia in separate microvial]. Original labels: "ISRAEL: Har / Hermon, 2000m / 12.vi.1996 / A. Friedberg", "04907". — *Paratypes*: IRAN • 1 ♀; Kermān Province, Bāft County, Deh Sard; 28°45'22"N, 56°31'22"E; 2280 m a.s.l.; 22 Apr. 2006; Gilasian E. leg.; HMIM 02571 • 1 ♂; Kermān Province, Bāft County, Ghale Asgar; 29°30'13"N, 56°38'19"E; 2740 m a.s.l.; 4 May 2007; Gilasian E., Nematian M. leg.; HMIM 02570 • 1 ♀; same data as for preceding; HMIM 02534 • 1 ♂; Kermān Province, Rayen District, Kuh-e Hazaran; 29°30'42"N, 57°16'18"E; 3800 m a.s.l.; 25 May 1978; Warncke K. leg.; NBCN 04151 • 1 ♀; Fārs Province, Sepidān; 30°16'20"N, 51°59'04"E; 2510 m a.s.l.; 9 May 2007; Gilasian E., Nematian M. leg.; HMIM 02533 • 1 ♀; Isfahān Province [Esfahān Province], Fereydunshahr, Kamaran; 2600 m a.s.l.; 1 Jul. 2004; Gilasian E., Serri S., Ziegler J., Frisch J. leg.; HMIM 02535. — ISRAEL • 1 ♀; Mount Hermon [Hebrew: Har Hermon]; 2000 m a.s.l.; 8 Jun. 1975; Kaplan M. leg.; NBCN 02573 • 2 ♂♂; Mount Hermon [Hebrew: Har Hermon]; 2000 m a.s.l.; 12 Jun. 1996; Merz B., Friedberg A. leg.; NBCN 02572, 04096 • 1 ♀; same data as for preceding; NBCN 04095 • 1 ♂; same data as for preceding; Friedberg A. leg.; TAU 04957 • 1 ♀; Mount Hermon [Hebrew: Har Hermon]; 2100 m a.s.l.; 17 Jun. 1999; Friedberg A. leg.; TAU 04908.

Diagnosis. Medium to large (10–13 mm), long pilose, dark species, with olive-brown reflection (Figs 20A, 21B); antennae reddish to dark brown, basoflagellomere elongated, 1.9–2 times as long as wide with straight to convex dorsal margin (Figs 10B, 12B); basotarsomere of all legs with ventrolateral row of long, strong setae (Fig. 8A–D); femora mostly black, tibiae and tarsi from black to partly brown-reddish (Figs 14B, 16B); body pile whitish, yellow to gray. Male: metafemur moderately curved, broad, about 3 times longer than wide, covered with long pilosity (Fig. 14B); basotarsomere of metatarsus less expanded, about 2 times broader than the second tarsomere (Fig. 14B), with ventrolateral row of long, strong setae (Fig. 8A, B), ventrally with well-defined brush-like area of dense pile extended in basal half (Fig. 8B); ventral margin of metatrochanter angular; sternum 4 with long laminate extensions on posterior margin (Fig. 4B); male genitalia: posterior surstyle lobe broad and oval, anterior surstyle lobe oval, enlarged, and longer than posterior surstyle lobe (Fig. 23A, B: al, pl); ejaculatory apodeme large, about as long as broad (Fig. 23C: ea); lingua narrow and medium size (Fig. 23C: l). Female: tarsi at least on metaleg brown dorsally; basotarsomere of metatarsus from ventral view with parallel margins and without well-defined brush-like area of dense pile (Fig. 8C, D), while spine-like setae within ventrolateral row of setae very strong and distinct; frons with narrow lateral vittae along eye margins, medially with shiny vitta (Fig. 29B); terga 3–4 usually with broad fasciae, extends about 1/4 of the length of the terga (Fig. 21B).

Male clearly differs from similar species, *Merodon latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** and *M. marginicornis* by ventrolateral row of strong setae on basotarsomere of all legs (Fig. 8A, B), absent in *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** and

weaker in *M. marginicornis* (Fig. 8F, G); by shorter basotarsomere of metaleg in *M. dumosus* Vujić, Likov & Radenković **sp. nov.** (about 2.5 times longer than second tarsomere) (Fig. 15K) in regard to *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** (about 3.5 times longer) (Fig. 15J); by the shape of basoflagellomere (Fig. 10B–D); and by the shape of the male genitalia: anterior surstyle lobe broad and oval (Fig. 23A, B: al), while smaller and narrower in *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** (Fig. 23D, E: al) and *M. marginicornis* (Fig. 23G, H: al).

Description. **MALE. Head:** Antenna reddish to dark brown; basoflagellomere (Fig. 10B) elongated, about 1.9–2 times as long as wide, about 2 times as long as pedicel, convex dorsally in basal corner, strongly tapered to apex; fossette dorsolateral and large (Fig. 10B); arista black and thickened at basal third; face and frons black with sparse gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin black, with sparse microtrichia; lunule shiny black to brown, bare; eye contiguity about 8 facets long; vertex isosceles, shiny black, anterior part pollinose; vertex with long, gray-yellowish pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with white-gray pile, ventrally covered with dense, gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 31A); vertical triangle: eye contiguity: frons = 3 : 1 : 2.5. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect pale yellow to white pile; scutum without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorso-medial anepimeron, and posterodorsal and anteroventral parts of katapisternum with long, dense pale yellow to gray pile; wings mostly covered with microtrichia; wing veins brown; calypter pale yellow; halter brown; femora mostly black, tibiae and tarsi black to partly brown-reddish; pile on legs pale yellow-white; ventral margin of metatrochanter angular; metafemur moderately curved, broad, about 3 times longer than wide, with long pile on ventral surface, about 2/3 of width of metafemur, longer than pile on dorsal surface (Fig. 14B); apicomedial lamina on metatibia distinct, covered with tuft of long orange pile; basotarsomere of all legs with ventrolateral row of long, strong setae (Fig. 8A, B); basotarsomere of metatarsus expanded, about 2 times broader than second tarsomere (Fig. 8A, B), ventrally with well-defined brush-like area of dense pile extended in basal half (Fig. 8B). — **Abdomen:** About 1.3 times longer than mesonotum; terga dark brown to black; terga 2–4 each with pair of distinct, white pollinose fasciae; pile on terga gray-whitish, medial part of terga 3–4 (and 2) usually with short black pile (Fig. 20A); sterna dark brown, covered with long whitish pile. — **Male genitalia:** Anterior surstyle lobe oval and enlarged, about 1.5 times longer than wide, covered with dense, short pile (Fig. 23A, B: al); posterior surstyle lobe oval and broad (Fig. 23A, B: pl); cercus rectangular (Fig. 23A: c); hypandrium sickle-shaped,

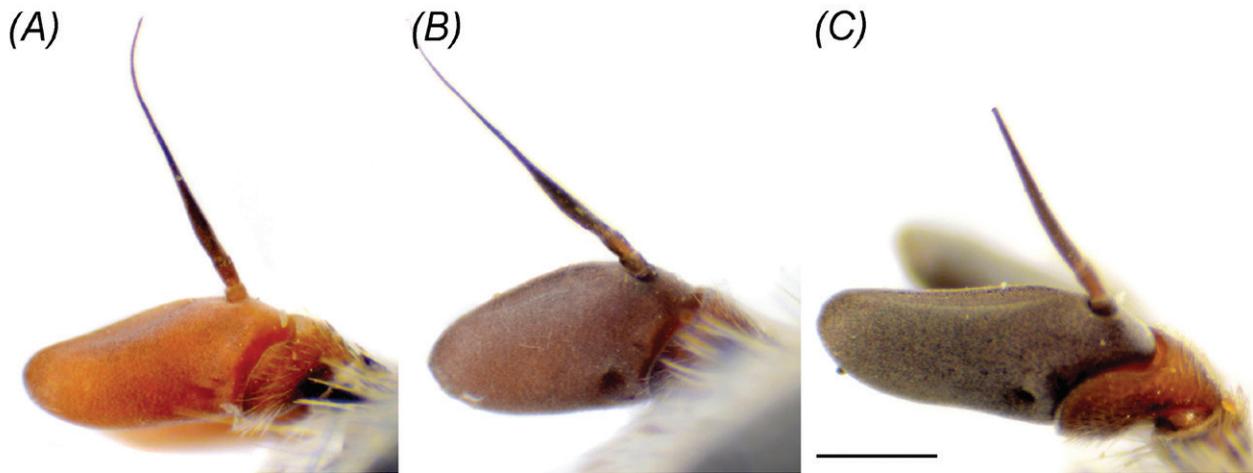


Figure 12. Basoflagellomere of female, lateral view. **A** *M. angustitarsis* Vujić & Gilasian **sp. nov.**, **B** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **C** *M. smirnovi*. Scale bar: 0.5 mm.

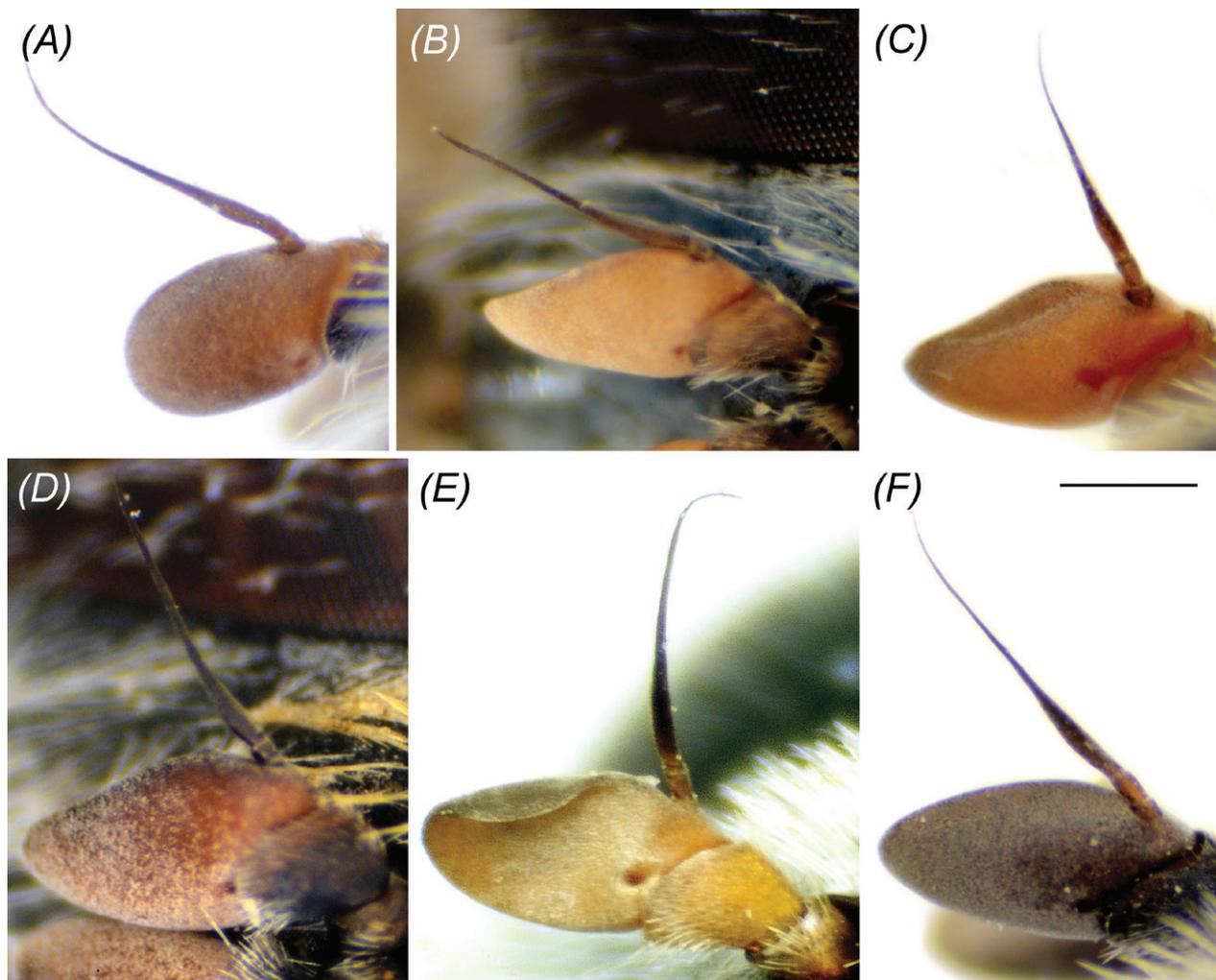


Figure 13. Basoflagellomere of female, lateral view. **A** *M. hypochrysos*, **B** *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, **C** *M. marginicornis*, **D** *M. oidipous*, **E** *M. rufitarsis*, **F** *M. tarsatus*. Scale bar: 0.5 mm.

without lateral projections (Fig. 23C); lingula narrow and medium sized (Fig. 23C: l). — **Female.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere about 1.7 times longer than wide (Fig. 12B); frons with pollinose vittae along

eye margins; frons covered with mostly gray-yellow pile; ocellar triangle covered with gray to whitish pile, in some specimens mixed with black ones (Fig. 29B); terga covered with gray-whitish to yellow pilosity; medial part of terga 2–4 usually with short, adpressed black pile; pol-

linose fasciae on terga 2–4 distinct (Fig. 21B); basotarsomere of metatarsus brown dorsally, at least on metaleg, less expanded, in ventral view with parallel margins and without well-defined brush-like area of dense pile (Fig. 8C, D); spine-like setae within ventrolateral row of setae very strong and distinct.

Etymology. The name “*dumosus*” is a Latin adjective in masculine, derived from the noun “*dumus*” meaning “overgrown with thorns”. This term refers to a row of strong setae on the basotarsomere.

Distribution and ecological data. *Merodon dumosus* Vujić, Likov & Radenković **sp. nov.** occurs in Iran and Israel (Fig. 28). Its Iranian localities are within arid and semi-arid forests ecosystem with *Quercus brantii* Lindl. as the dominant vegetation type, cold-desert steppe scrubland ecosystem (*Artemisia sieberi* – *Zygophyllum* sp.), and cold and arid semi steppe scrubland and grasslands ecosystem (*Astragalus* spp.) (Azizi Jalilian et al. 2020). These ecosystems belong to ecoregions of the Zagros mountains forest steppe and Central Persian desert basins (Olson et al. 2001). Iranian localities in the Zāgros mountain range include: Fereydounshahr, a mountainous area with very cold winters and moderate summers, with 11.5°C average annual temperature and 550 mm annual precipitation, with Lamiaceae, Fabaceae, Apiaceae, Rosaceae, Poaceae, Asteraceae and Brassicaceae as dominant plant families; Deh Sard, a mountainous area with very cold winters and moderate summers, with 250 mm annual precipitation and 20°C average annual temperature, with *Amygdalus* spp., *Pistacia atlantica* Desf., *Ebenus stellata* Boiss., *Stipa barbata* Desf., *Poa sinaica* Steud. as dominant plant species; Sepidān, a semi-arid and cold mountainous area with very cold winters and moderate summers, with 14.8°C average annual temperature and 695 mm annual precipitation, with *Acer monspessulanum* L., *Amygdalus elaeagnifolia* Spach., *Berberis integerrima* Bunge, *Crataegus azarolus* var. *aronia* L., *Fraxinus rotundifolia* Miller, *Cotoneaster persica* Pojark, *Pyrus* spp. as dominant plant species. Rayen is a dry and cold mountainous area with cold winters and hot summers (–1 to 40°C), with less than 300 mm annual precipitation, with *Astragalus* spp., *Nepeta* spp., *Acantholimon* spp., *Artemisia aucheri* Boiss., *Ferula aucheri* (Boiss.) Piwczynski, Spalik, M. Panahi & Puchalka as dominant plant species. The western part of the range of *M. dumosus* Vujić, Likov & Radenković **sp. nov.** belongs to the Eastern Mediterranean conifer-sclerophyllous-broadleaf forests ecoregion; in Israel this species was registered only in a locality on Mount Hermon with montane forest dominated by *Quercus infectoria* subsp. *veneris* (A. Kern.) Meikle, *Q. libani* G. Olivier, *Juniperus drupacea* Labill., and *Acer monspessulanum* subsp. *microphyllum* (Boiss.) Bornm., accompanied by Mediterranean maquis and semi-steppe bathas (Danin 1988). On the basis of our data the flight period is from April to early July.

Remarks. Hurkmans & Friedberg identified this species in an unpublished manuscript.

Merodon hypochrysos Hurkmans, 1993

Figs 3A, 4C, 7D, E, 11A, 13A, 14C, 17A, 20B, 22G–I, 26, 31B

Merodon hypochrysos Hurkmans, 1993: 165. Type locality: Turkey, Adiyaman province (holotype).

Merodon ankylogaster Hurkmans, 1993: 169. Type locality: Iran, Fārs province. Syn. nov.

Type locality. Turkey, Adiyaman province; Iran, Fārs province.

Type material examined. *Merodon ankylogaster* Hurkmans: Original description was based on male holotype and female paratype from the same locality (Hurkmans 1993). — **Holotype.** IRAN • ♂; Fārs Province, Road Chiraz (Shiraz)-Kazeroun, Fort Sine-Sefid; 29°35'N, 52°E; 29 Apr. 1937; Brandt F.H. leg.; NBCN [specimen dry pinned, head glued on the locality label, right mesoleg, left metaleg and right tarsi are missing, genitalia in separate microvial]. Original labels: “Iran, Fars 1937 / Rd Chiraz (Shiraz)-Kazeroun / Fort Sine-Sefid / coll F.H. Brandt 29.IV.” [written with pencil], “Holotype of / *Merodon ankylo-* / *gaster* Hurkmans” [red label handwritten], “Museum Leiden / Collectie / Van Doesburg / rec.1973”, “*Lampetia* ♂ *batumica* Param. / det. v. Doesburg”, “02559”. — **Paratype.** IRAN • 1 ♀; Fārs Province, Road Chiraz (Shiraz)-Kazeroun, Fort Sine-Sefid; 29°35'N, 52°E; 29 Apr. 1937; Brandt F.H. leg.; NBCN.

Merodon hypochrysos Hurkmans: Original description was based on holotype and 20 paratypes from Hakkari province in Turkey (Hurkmans 1993). This species was described based on only males and classified as member of “*alexaji* group” (= *serrulatus* group) by Hurkmans (1993). — **Holotype.** TURKEY • ♂; Adiyaman, 10 km North of Celikhan, Alti Haral Gölü; 38°05'N, 38°22'E; 1450 m a.s.l.; 1 Jul. 1986; Lucas J.A.W. leg.; NBCN [specimen dry pinned]. Original label: “Turkey, Adiyaman, 10 kms. North of Celikhan, Alti Haral Gölü (38°05'N, 38°22'E), 1450 m, 1.vii.1986, leg. Lucas”. — **Paratypes.** TURKEY • 20 ♂♂; Hakkari, Sat Dağları, Veregös; 37°25'N, 43°55'E; 1600–1650 m a.s.l.; 15–18 Jun. 1984; Lucas J.A.W. leg.; NBCN.

Notes on synonymy. Hurkmans designated *Merodon ankylogaster* as a member of the “*tarsatus* group”. The male holotype of *M. ankylogaster*, designated by Hurkmans (1993), belongs to *M. hypochrysos*. Based on prior citation of *M. hypochrysos* in the same publication, *M. ankylogaster* becomes a junior synonym. The character of elongated basoflagellomere with pointed apex clearly shows that the female paratype of *M. ankylogaster* does not belong to *M. hypochrysos*, but to *M. angustitarsis* Vujić & Gilasian **sp. nov.** here described (in *M. hypochrysos* basoflagellomere short with rounded apex).

Additional material examined. IRAN • 1 ♂; Kermān Province, Bāft County, Ghale Asgar; 29°30'13"N, 56°38'19"E; 2740 m a.s.l.; 3 May 2007; Gilasian E., Nematian M. leg.; HMIM • 5 ♂♂, 2 ♀♀; Fārs Province, 15 km S of Dasht-e Arjan; 29°33'09"N, 51°56'22"E; 2261 m a.s.l.; 2–6 May 2016; Obofil M. leg.; J.H. coll. • 4 ♂♂, 2 ♀♀; Fārs Province, Dasht-e Arjan; 29°37'48"N, 51°54'43"E; 2040 m a.s.l.; 5 May 2016; Kafka M. leg.; M.B. coll. • 2 ♂♂, 2 ♀♀; Kohgiluyeh & Boyer-Ahmad Province, Yāsuj, Sarab-e Taveh; 30°29'24"N, 51°39'29"E; 2390 m a.s.l.; 4 May 2016; Kafka M. leg.; M.B. coll. • 1 ♀; Isfahān

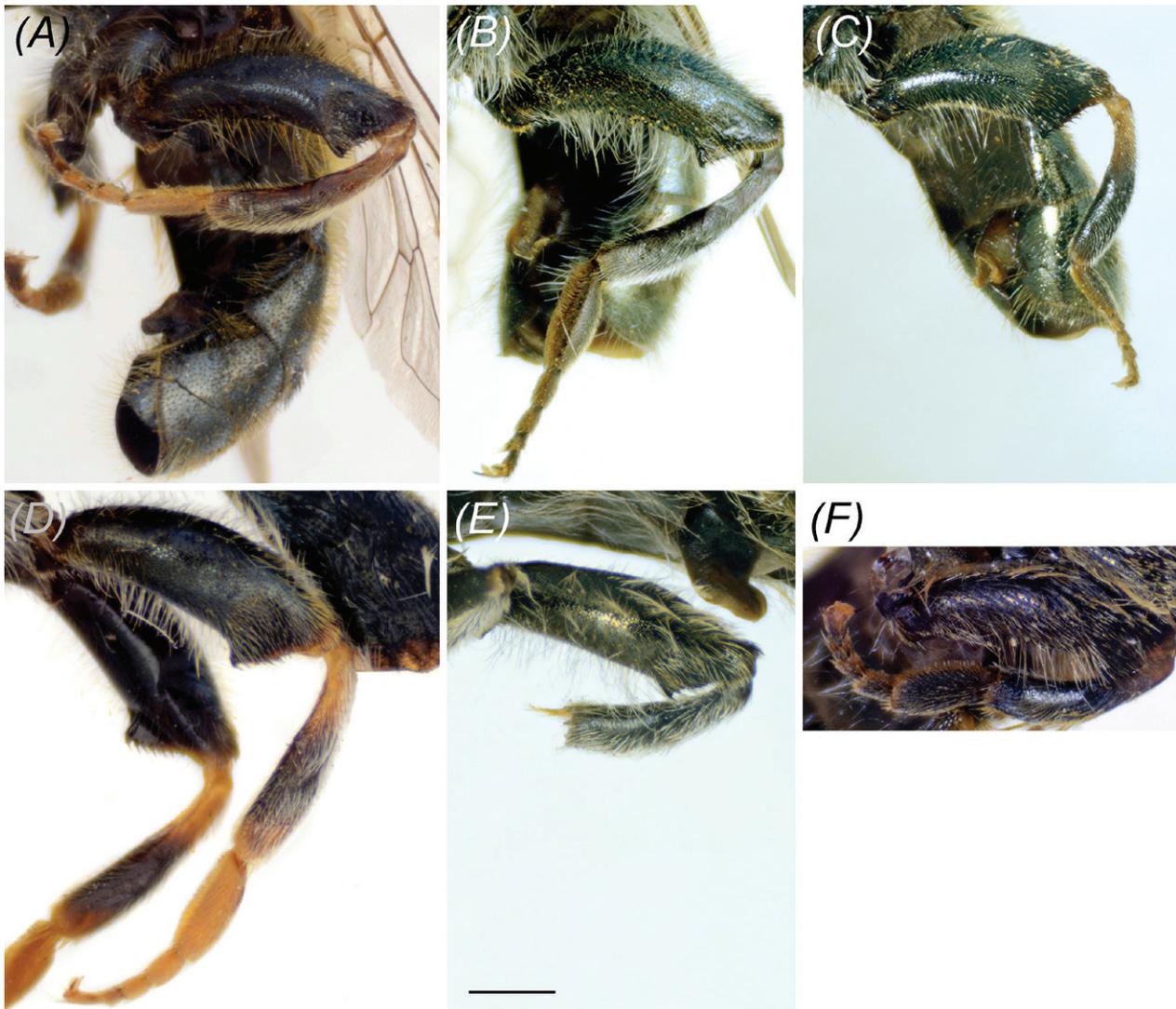


Figure 14. Metaleg of male, lateral view. **A** *M. angustitarsis* Vujić & Gilasian **sp. nov.**, **B** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **C** *M. hypochrysos*, **D** *M. marginicornis*, **E** *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, **F** *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** Scale bar: 1 mm.

Province (Esfahān Province), Semirom County, Kommeh; 31°01'01"N, 51°35'28"E; 2760 m a.s.l.; 12 May 2007; Gilasian E. leg.; HMIM • 5 ♂♂; Lorestān Province, Dorud County, Lanjabad; 33°25'08"N, 48°59'10"E; 950 m a.s.l.; 10 May 2016; Kafka M. leg.; M.B. coll. • 1 ♂; Lorestān Province, Dorud County, Lanjabad; 33°25'59"N, 49°01'44"E; 670 m a.s.l. (+/-300 m); 11 May 2016; Kafka M. leg.; M.B. coll. • 2 ♀♀; Lorestān Province, Dorud County, Lanjabad; 33°25'59"N, 49°01'44"E; 1670 m a.s.l.; 10–11 May 2016; Kafka M. leg.; M.B. coll. • 2 ♂♂; Tehran Province, Damāvand Village, Damāvand Mt area, 75 km NE Teheran (Tehran); 35°58'32"N, 52°06'20"E; 27 Jul. 1976; Lavalley A.G. leg.; USNM ENT 00036574, USNM ENT 00036575, 05120 (NMNH) • 1 ♂; East Azerbāijan Province, Arasbārān, Keleybar forest; 38°50'29"N, 47°00'02"E; Khaghaninia S. leg.; MMH 10277. — ISRAEL • 1 ♂; Mount Hermon; 2000 m a.s.l.; 8 Jun. 1975; Friedberg A. leg.; TAU1 • 1 ♀; same data as for preceding; 12 Jun. 1996 • 1 ♀; same data as for preceding; 30 May 1979; Kaplan M. leg. • 1 ♂; same data as for preceding; 20 May 1986; Eldar G. leg. • 1 ♂; same data as for preceding; 12 Jun. 1996; Merz B., Friedberg A. leg.; NBCN 02561. — TURKEY • 1 ♀; Hakkari, Sat Dağlari, Vargös; 37°25'N, 43°55'E; 2000 m a.s.l.; 17 Jun. 1984; Warncke K. leg.; NBCN 04211 • 1 ♂; Adiyaman Province, Mount Nemrut (Nemrut Dağı); 1600 m a.s.l.; 1 Jun. 1983; Schacht W. leg.;

D.D. coll. • 1 ♂; Adiyaman Province, Mount Nemrut (Nemrut Dağı); 9 Jun. 1996; Snizek M. leg.; D.D. coll.

Diagnosis. Small sized (6–8 mm), short to medium long pilose, dark species, with olive-brown reflection (Fig. 20B); antennae dark brown, basoflagellomere short, about 1.6 times as long as wide, with concave dorsal margin and rounded apex (Figs 11A, 13A); femora mostly black, tibiae and tarsi partly reddish-yellow (Figs 14C, 17A); body pile whitish, yellow to gray. Male: metafemur broad, about 3 times longer than wide, covered with shorter pile, except a few long pile ventrally (Fig. 14C); basotarsomere of metatarsus with parallel margins from dorsal view, about 1.3 times broader than the second tarsomere, ventrally without well-defined brush-like area of dense pile (Fig. 7D, E); ventral margin of metatrochanter rounded; sternum 4 with medium sized laminate extensions on posterior margin (Fig. 4C); male genitalia: anterior surstyle lobe oval, elongated, and posterior surstyle lobe broad, triangular to trapezoid (Fig. 22G, H: al, pl); ejaculatory apodeme broader than long (Fig. 22I: ea); lin-

gula very elongated and narrow (Fig. 22I: l). Female: basoflagellomere short and rounded (Fig. 13A); tarsi black to brown; basotarsomere of metaleg with very short pilosity, without well-defined brush-like area of dense pile ventrally.

Differs from other species from the *Merodon tarsatus* group by shorter pilosity on metafemur (especially dorsally), with pile shorter than base of metatibia in lateral view (Figs 14C, 17A); by shorter basoflagellomere with rounded apex (Figs 11A, 13A); by male basotarsomere of metatarsus narrow in lateral view (Fig. 7E) and with parallel margins from ventral view (Fig. 7D); and by characteristic shape of the surstyle lobes in male genitalia (Fig. 22G, H).

Re-description. MALE. Head: Antenna dark brown; basoflagellomere (Fig. 11A) short, about 1.6 times as long as wide, about 2 times as long as pedicel, concave dorsally, rounded at apex; fossette dorsolateral and small (Fig. 11A); arista brown and thickened at basal third; face and frons black with gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin small, with sparse microtrichia; lunule shiny black to brown, bare; eye contiguity short, about 4–6 facets long; vertex isosceles, shiny black (except in front of ocellar triangle); vertex with gray-yellowish pile, mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with white-gray pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 31B); vertical triangle: eye contiguity: frons = 4 : 1 : 2.5. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect yellow to white pile; scutum without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katapisternum with long, dense pale yellow to gray pile; wings mostly covered with microtrichia; wing veins brown; calypter pale yellow; halter yellow; femora mostly black, tibiae and tarsi partly reddish-yellow; pile on legs pale yellow-whitish; ventral margin of metatrochanter rounded; metafemur moderately broad, about 3 times longer than wide, with shorter pilosity, except a few longer pile on ventral surface, about half of width of metafemur (Fig. 14C); apicomedial lamina on metatibia very small, covered with a few white pile; basotarsomere of metatarsus not expanded, about 1.3 times broader than second tarsomere (Fig. 7E), 2 times longer than broad, with parallel margins in dorsal view, ventrally without well-defined brush-like area of dense pile, without spine-like setae along ventrolateral margin (Fig. 7D, E). — **Abdomen** (Fig. 20B): Short pilose, about 1.1 times longer than mesonotum; terga dark brown to black; terga 2–4 without or with poorly visible pair of narrow, white pollinose fasciae; pile on terga gray-whitish, medial part of terga 3–4 usually with black pile; sterna dark brown, covered with long whitish pile; sternum 4 with medium sized laminate extensions on posterior margin (Fig. 4C). — **Male genitalia:** Anterior surstyle

lobe oval and elongated, about 2 times longer than wide, covered with dense, short pile (Fig. 22G, H: al); posterior surstyle lobe broad, triangular to trapezoidal (Fig. 22G, H: pl); cercus rectangular (Fig. 22G: c); hypandrium sickle-shaped, without lateral projections; lingula very elongated and narrow (Fig. 22I: l). — **FEMALE.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere short, about 1.5 times longer than wide (Fig. 13A); frons with pollinose vittae along eye margins; frons covered with intermixed gray-yellow and black pile; ocellar triangle covered with gray to whitish pile, in some specimens mixed with black pile; terga covered with gray-whitish to yellow pilosity; medial part of terga 2–4 usually with short adpressed black pile; pollinose fasciae on terga 2–4 more distinct; basotarsomere of metatarsus longer, 2.5 times longer than broad (Fig. 17A).

Distribution and ecological data. *Merodon hypochrysos* occurs in the region of the Middle East, including Iran, Israel and southeastern Turkey (Fig. 26). It was recorded in Iran within arid and semi-arid forests ecosystem with *Quercus brantii* as dominant vegetation type, cold-desert steppe scrubland ecosystem (*Artemisia sieberi* – *Zygophyllum* sp.), cold and arid semi steppe scrubland and grasslands ecosystem (*Astragalus* spp.), and cold and humid prairies ecosystem (*Trifolium* spp.) (Azizi Jalilian et al. 2020). These localities belong to ecoregions of the Zagros mountains forest steppe and Elburz range forest steppe (Olson et al. 2001). Iranian collection sites of *M. hypochrysos* in the Zāgros mountain range include: Yāsuj, with very cold winters and moderate summers, 15.2°C average annual temperature and 864 mm annual precipitation, with *Quercus persica* Jaub. & Spach as the dominant plant species; Dasht-e Arjan, located in the ‘Arjan Biosphere Reserve’, with an altitude of 853–3041 m a.s.l., with wild almond trees (*Prunus scoparia* (Spach) C. K. Schneid) (‘Arjan’ in Persian) as dominant plant species; Dorud, with cold winters and moderate summers, 670 mm annual precipitation, with Asteraceae, Papilionaceae, Poaceae, Rosaceae and Lamiaceae as dominant plant families; Semirom, with very cold winters and moderate summers, 335 mm annual precipitation and 12.5°C average annual temperature, with *Astragalus verus* Olivier, *Poa bulbosa* L. and *Bromus tomentellus* Boiss. as dominant plant species. Damāvand is located close to the highest mountain in Iran with the same name Damāvand with 5671 m a.s.l., in the Alborz mountain range, with cold winters and moderate summers, with 540 mm annual precipitation and with about 10°C average annual temperature; 370 plant species belonging to 206 genera and 56 families have been recorded from this area; Asteraceae, Poaceae, Rosaceae, Lamiaceae, Brassicaceae and Caryophyllaceae are dominant plant families in this area. The Keleybar forest, with 400–600 mm annual precipitation and about 10°C average annual temperature is located in the north-east of Iran; *Quercus petraea* (Matt.) Liebl., *Carpinus betulus* L. and *Cornus mas* L. are the dominant plant species in this area. The western part of the range of *M. hypochrysos* (Turkey and Israel)

belongs to the Eastern Mediterranean conifer-sclerophyllous-broadleaf forests. The vegetation of this ecoregion includes maquis, coniferous forests of *Pinus halepensis* Mill. and *P. brutia* Ten., dry *Quercus* spp. woodlands and steppe formations (WWF 2022). The montane forest of Mt. Hermon (locality in Israel) is dominated by *Quercus infectoria* subsp. *veneris*, *Q. libani*, *Juniperus drupacea*, and *Acer monspessulanum* subsp. *microphyllum*, accompanied by Mediterranean maquis and semi-steppe bathas (Danin 1988). On the basis of our data the flight period is from early May to late July.

Merodon latiantennatus Vujić, Popov & Prokhorov sp. nov.

<https://zoobank.org/140E1D31-56CD-4D56-A5B8-DAD264F34B29>

Figs 5A, 8E, 10C, 13B, 15A, J, 16C, 20C, 21C, 23D–F, 26

M. aff. tarsatus 3 (Vujić et al. 2021a).

Type locality. AFGHANISTAN: Kabul Province, Paghman District, Paghman; 2500–2600 m a.s.l.

Type material. *Holotype*: ♂; SIZK 25352 [specimen dry pinned in good condition, the right wing is glued on locality label, right meso- and metaleg are missing, taken for molecular analysis, genitalia in separate microvial]. Original labels: “AFGHANISTAN / KABUL PROV., PAGHMAN / H=2500–2600m / 9.06.2016 O. PAK”, “TS797”, “25352”. — *Paratypes*: AFGHANISTAN • 1 ♀; Kabul Province, Paghman District, Paghman; 2600 m a.s.l.; 2 Jun. 2010; SIZK 25353 • 2 ♀♀; same data as for preceding; 2700 m a.s.l.; SIZK • 1 ♀; same data as for preceding; Pak O. leg. • 1 ♀; same data as for preceding; 1 Jul. 2013 • 1 ♀; same data as for preceding; 4 Jul. 2013 • 1 ♀; same data as for preceding; 2 Jul. 2013; Skrylnik Yu. leg. • 3 ♀♀; same data as for preceding; 2500–2600 m a.s.l.; 9 Jun. 2016; Pak O. leg.

Diagnosis. Small (7–8 mm), dark species, with bluish reflection (Fig. 20C); antennae orange (Figs 10C, 13B), basoflagellomere short, broad, triangular, about as long as wide, with large dorsal fossette in male, which extends laterally and medially (Fig. 10C); femora mostly black, tibiae and tarsi partly reddish-yellow (Figs 15A, 16C); body pile whitish to gray. Male: eyes dichoptic, separated by distance of three facets (Fig. 31C); metafemur about 3.2 times longer than wide, covered with medium long pilosity (Fig. 15A); basotarsomere of metatarsus elongated, more than 4 times longer than the second tarsomere, less expanded, about 1.5 times broader than the second tarsomere (Fig. 15A), ventrally with well-defined brush-like area of dense pile extended in 3/4 of its length (Figs 8E, 15A); ventral margin of metatrochanter angular; sternum 4 with long laminate extensions on posterior margin (Fig. 5A); male genitalia: anterior surstyle lobe rounded, and posterior surstyle lobe short and broad (Fig. 23D, E: al, pl); ejaculatory apodeme much broader than long (Fig. 23F: ea); lingula very elongated and rugose on ventral margin (Fig. 23F: l). Female: basoflagellomere and tarsi

orange-brown; basotarsomere of metaleg long and narrow, more than 3 times longer than the second tarsomere with well-defined brush-like area of dense pile ventrally (Fig. 16C).

Similar to *Merodon marginicornis* from which male differs in shorter and less spiky basoflagellomere (Fig. 10C), while strongly tapered to the apex and longer in *M. marginicornis* (Fig. 10D); and by basotarsomere of metaleg with brush-like area of dense pile extending 3/4 of its length (Fig. 8E), while in *M. marginicornis* in basal half (Fig. 8F). Clearly differs from male of *M. dumosus* Vujić, Likov & Radenković sp. nov. by more elongated basotarsomere of the metaleg, more than 3.5 times longer than the second tarsomere in *M. latiantennatus* Vujić, Popov & Prokhorov sp. nov. (Fig. 15J), while about 2.5 times in *M. dumosus* Vujić, Likov & Radenković sp. nov. (Fig. 15K); by the absence of a ventrolateral row of strong setae on basotarsomere of all legs, while is present in *M. dumosus* Vujić, Likov & Radenković sp. nov. (Fig. 8A, B); by shape of basoflagellomere (Fig. 10B, C); and by the shape of the male genitalia: anterior surstyle lobe smaller and narrower (Fig. 23D, E: al), while in *M. dumosus* Vujić, Likov & Radenković sp. nov. broad and oval (Fig. 23A, B: al). Female can be differentiated from *M. marginicornis* by narrow, elongated basotarsomere of metaleg (Fig. 16C), while broader and shorter in *M. marginicornis* (Fig. 16D).

Description. MALE. Head: Antenna orange; basoflagellomere (Fig. 10C) short, broad, triangular, about as long as wide, about 1.3 times as long as pedicel, with large dorsal fossette which extends laterally and medially (Fig. 10C); arista black and thickened at basal third; face and frons black with gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin black, with sparse microtrichia; lunule shiny black to brown, bare; eyes dichoptic, separated by distance of three facets (Fig. 31C); vertex isosceles, shiny black; vertex with gray-yellowish pile; ocellar triangle equilateral; occiput with white-gray pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 31C); vertical triangle: frons = 1.5 : 1. — **Thorax:** Scutum and scutellum black, covered with erect gray to white pile; scutum without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow to gray pile; wings mostly covered with microtrichia; wing veins dark brown; calypter yellow; halter brown-yellow; femora black, tibiae and tarsi partly reddish-yellow; pile on legs pale yellow; ventral margin of metatrochanter angular; metafemur about 3.2 times longer than wide, with medium long pile on ventral surface, about half of width of metafemur, longer than pile on dorsal surface (Fig. 15A); apicomedial lamina on metatibia small, covered with long yellowish pile; ventrolateral row of setae on basotarsomere of all legs present, but less distinct; basotarsomere of metatarsus not



Figure 15. A–I Metaleg of male, lateral view J, K metatarsus, dorsal view. A, J *M. latiantennatus* Vujić, Popov & Prokhorov sp. nov., B *M. oidipous*, C *M. rufitarsis*, D *M. smirnovi*, E–G *M. tarsatus*, H, I *M. turkestanicus*, K *M. dumosus* Vujić, Likov & Radenković sp. nov. Abbreviation: mt – metatrochanter. Scale bars: 1 mm (A–I), 0.5 mm (J, K).

expanded, about 1.5 times broader than second tarsomere (Fig. 15A), about 3.5 times longer than second tarsomere (Fig. 15J), ventrally with well-defined brush-like area of dense pile extending 3/4 of its length (Fig. 15A). — **Abdomen** (Fig. 20C): About 1.2 times longer than mesonotum; terga black with bluish lustre; terga 2–4 each with pairs of indistinct, white pollinose fascia; pile on

terga gray-whitish; sterna dark brown, covered with long whitish pile; sternum 4 with long laminate extensions on posterior margin (Fig. 5A). — **Male genitalia**: Anterior surstyle lobe rounded, about as long as wide, covered with dense, short pile (Fig. 23D, E: al); posterior surstyle lobe short and broad (Fig. 23D, E: pl); cercus rectangular (Fig. 23D: c); hypandrium sickle-shaped, without lateral

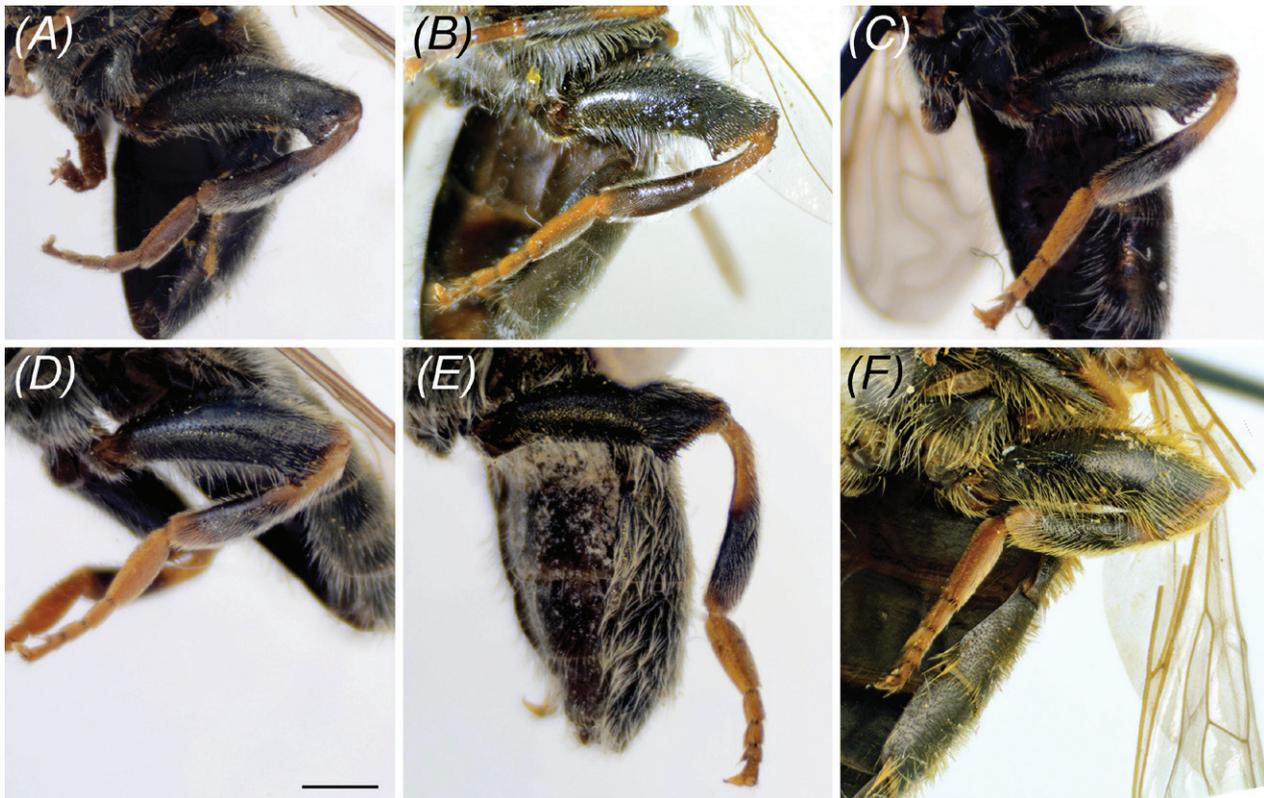


Figure 16. Metaleg of female, lateral view. **A** *M. angustitarsis* Vujić & Gilasian **sp. nov.**, **B** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **C** *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, **D** *M. marginicornis*, **E** *M. oidipous*, **F** *M. rufitarsis*. Scale bar: 1 mm.



Figure 17. Metaleg of female, lateral view. **A** *M. hypochrysos*, **B** *M. tarsatus*, **C** *M. smirnovi*. Scale bar: 1 mm.

projections; ejaculatory apodeme extremely broad (Fig. 23F: ea); lingula very long and rugose on ventral margin (Fig. 23F: l). — **FEMALE**. Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere orange-brown, tapering to apex, about 2 times longer than wide, with small fossette (Fig. 13B); frons with pollinose vittae along eye margins; frons cov-

ered with mostly gray-yellow pile; ocellar triangle covered with gray to whitish pile mixed with black pile; terga covered with gray-whitish to yellow pilosity; medial part of terga 2–4 usually with short adpressed black pile; pollinose fasciae on terga 2–4 more distinct; basotarsomere of metatarsus elongated, about 3.5 times longer than wide

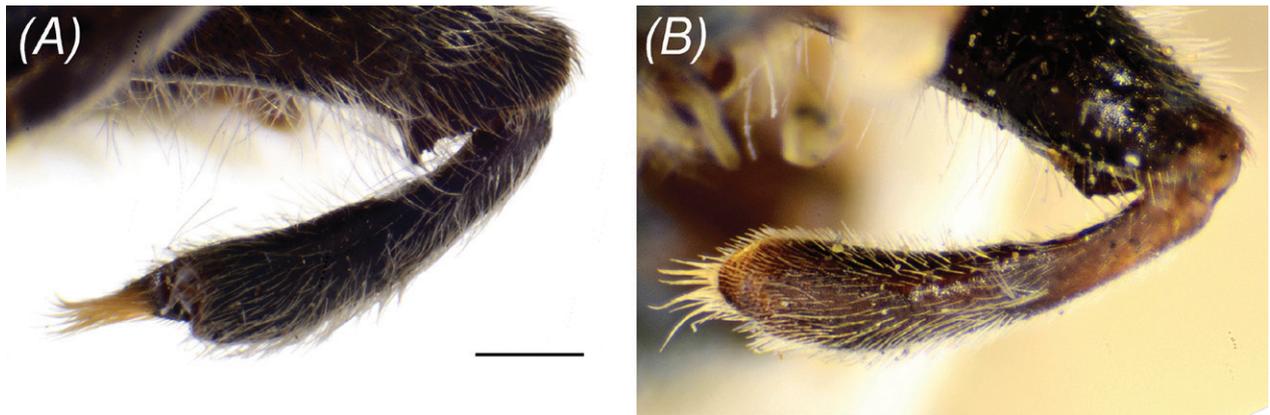


Figure 18. Metatibia of male. **A** *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, **B** *M. turkestanicus*. (A) lateral view, (B) medial view. Scale bar: 0.5 mm.

(Fig. 16C), ventrally with well-defined brush-like area of dense pile, but less defined than in males.

Etymology. The name “*latiantennatus*”, as arbitrary combination, is derived from the Latin adjectives “*latus*” meaning “wide, broad” and “*antennatus*” meaning “having antenna”, referring to the shape of the male basoflagellomere.

Distribution and ecological data. *Merodon latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** has so far only been recorded in eastern Afghanistan (Fig. 26), at the foot of the southern Hindu Kush mountain range (at 2500–2700 m a.s.l.). It was collected at only one locality which belongs to the Central Afghan Mountains xeric woodlands (Olson et al. 2001), an open woodland ecoregion, characterized by *Prunus* L. trees at 2000–2800 m a.s.l. marking the transition zone between *Pistacia atlantica* communities at lower altitudes and higher sub-alpine vegetation. The main vegetation types in the area are Thorny Cushions, subalpine and alpine semi deserts, dry steppes, and meadows (a mixture of several plant formations), and *Amygdalus*-Woodlands (Breckle 2007). The *Amygdalus* scrublands (often intermixed with the *Pistacia* woodlands) are rich in geophytes such as *Eremurus* M. Bieb., *Tulipa* L., *Iris* Tourn. ex L., *Allium* spp., *Gagea* Salisb., *Corydalis* D.C., and *Rheum* L. The type locality of *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** is presented on Fig. 32D. On the basis of our data the flight period is from June and July.

Merodon marginicornis Hurkmans, 1993

Figs 5B, 8F–H, 10D, 13C, 14D, 16D, 20D, 21C, 23G–I, 28, 31D

Merodon marginicornis Hurkmans, 1993: 166. Type locality: Iran, Fārs province, Shirāz (holotype).

Merodon xanthipous Hurkmans, 1993: 175. Type locality: Iran, Fārs province, Shirāz. Syn. nov.

Type locality. Iran, Fārs province, Shirāz.

Type material examined. *Merodon xanthipous* Hurkmans: Original description was based on male holotype and female paratype from the localities close to the locality of holotype of *Merodon marginicornis* (Hurkmans 1993). — **Holotype:** IRAN • ♂; Chiraz (Shiraz); 29°30'00"N, 52°00'00"E; 11 Apr. 1937; Brandt F.H. leg.; NBCN [specimen dry pinned, left metaleg, metatibia metatarsi, right metatibia and metatarsi are missing, genitalia in separate microvial]. Original labels: “IRAN Chiraz / 11.IV.1937 [11.IV. written with pencil] / coll. BRANDT”, “*Lampetia / crassicornis* ♂ Sack / det. V. Doesburg”, “Museum Leiden / Collectie / Van Doesburg / rec. 1973”, “Holotype *Merodon*” [red label handwritten], “02540”. — **Paratype:** IRAN • 1 ♀; Road Chiraz (Shiraz)-Kazeroun, Fort Sine-Sefid; 19 Apr. 1937; Brandt F.H. leg.; Sack, V. Doesburg det. as *Lampetia crassicornis*; NBCN.

Merodon marginicornis Hurkmans: Original description was based on one male specimen designated as holotype (Hurkmans 1993). This species was classified as a member of “*alexaji* group” by Hurkmans (1993). — **Holotype:** IRAN • ♂; Chiraz (Shiraz); 26°40'N, 52°30'E; 11 Apr. 1937; Brandt F.H. leg.; NBCN. Original label: “Iran, Chiraz (Shiraz) (26°40'N, 52°30'E), 11.iv.1937, Coll. F. H. Brandt”.

Notes on synonymy. Hurkmans designated *M. xanthipous* as a member of “*tarsatus* group”. Both taxa belong to the same species and based on prior citation of *M. marginicornis* in the same publication, *M. xanthipous* becomes a junior synonym.

Additional material examined. IRAN • 1 ♂; Fārs Province, Dasht-e Arjan; 29°33'07"N, 51°56'31"E; 2260 m a.s.l. (+/–300 m); 4 May 2016; Kafka M. leg.; M.B. coll. • 4 ♂♂, 1 ♀; same data as for preceding; 5 May 2016 • 3 ♂♂; Fārs Province, 15 km S of Dasht-e Arjan; 29°33'09"N, 51°56'22"E; 2261 m a.s.l.; 2–6 May 2016; Obořil M. leg.; J.H. coll. 18257, 18258, 18259 • 2 ♀♀; same data as for preceding; J.H. coll. 18269, 18275 • 1 ♂; Fārs Province, Sepidān; 30°17'13"N, 51°58'15"E; 2540 m a.s.l.; 8 May 2007; Gilasian E., Nematian M. leg.; HMIM 04460 • 1 ♀; Kermān Province, Māhān District, Bolbolouyeh Village; 30°09'37"N, 57°22'10"E; 2430 m a.s.l.; 29 Apr. 2007; Gilasian E., Nematian M. leg.; HMIM 04459 • 1 ♂, 1 ♀; Kohgiluyeh & Boyer-Ahmad Province, Yāsuj, Sarab-e Tavah; 30°29'24"N, 51°39'29"E; 2390 m a.s.l.; 4 May 2016; Kafka M. leg.; M.B. coll. • 1 ♀; Isfahān Province (Esfahān Province), Semirom County, Kommeh; 31°01'01"N, 51°35'28"E; 2760 m a.s.l.; 12 May

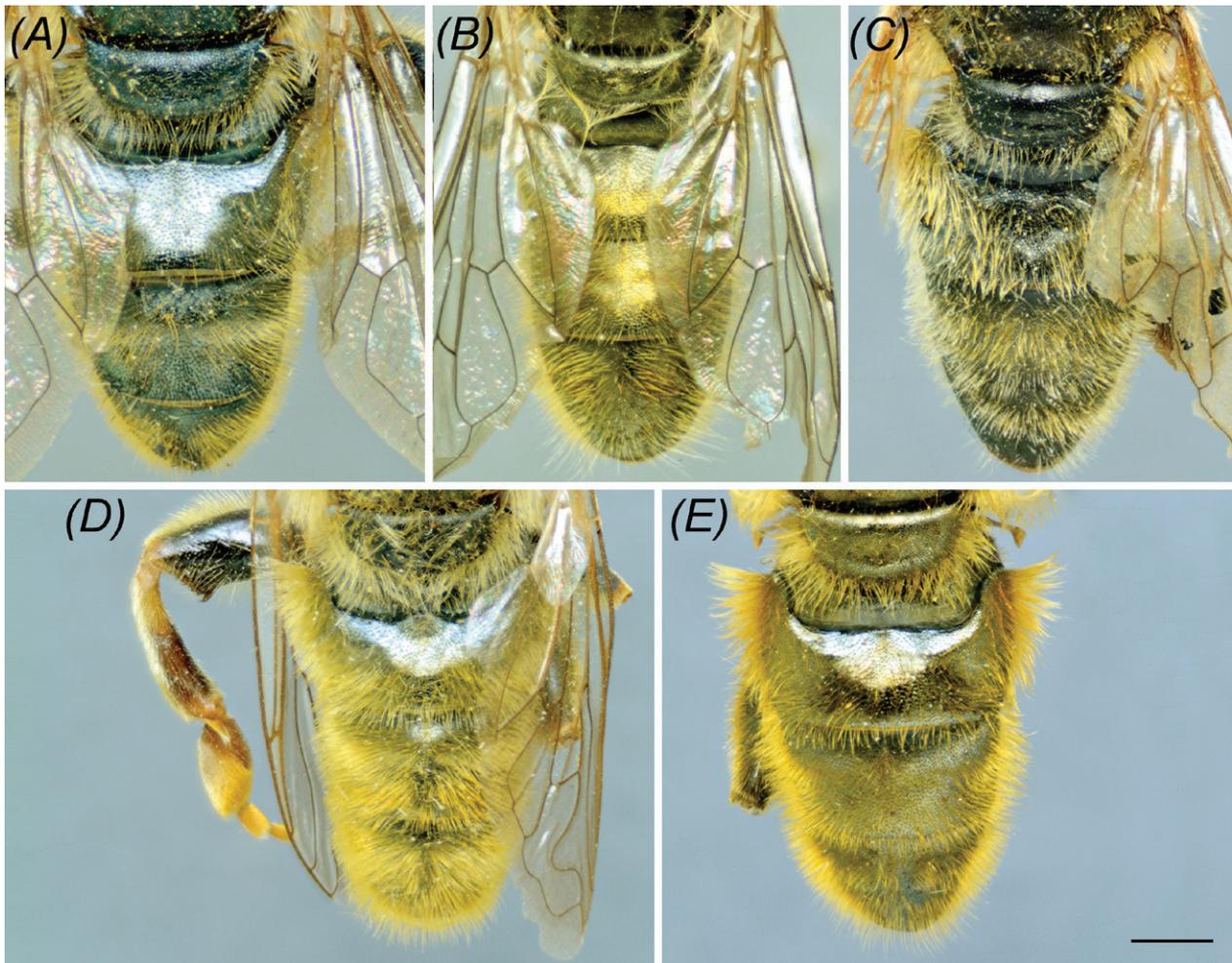


Figure 19. Abdomen of male, dorsal view. **A** *M. angustitarsis* Vujić & Gilasian *sp. nov.*, **B** *M. namaghijamii* Vujić, Likov & Radenković *sp. nov.*, **C** *M. rufitarsis*, **D** *M. smirnovi*, **E** *M. tarsatus*. Scale bar: 1 mm.

2007; Gilasian E. leg.; HMIM 02543 • 1 ♀; Chāhārmahāl & Bakhtiāri Province, 30 km SE of Lordegān; 31°21'00"N, 51°09'00"E; 1900 m a.s.l.; 31 May 2014; Halada J. leg.; M.B. coll. • 1 ♂; Alborz Province, Karaj County, 10 km N of Gachsar; 36°09'00"N, 51°18'00"E; 2300–2700 m a.s.l.; 7 Jun. 2014; Halada J. leg.; M.B. coll. 10433. — PAKISTAN • 1 ♀; Balochistan Province, Ziarat District, 35 km W of Ziarat; 30°23'14"N, 67°20'22"E; 11 May 1984; McGinley R.J. leg.; 05117, USNM ENT00036567 (NMNH) • 2 ♂♂; Balochistan Province, Qilla Saifullah District, Kan Mehtarzai; 30°44'35"N, 67°31'02"E; 5 May 2017; Banafsha K. leg.; NARC 17745, 17746 • 1 ♀; same data as for preceding; NARC 18121 • 1 ♀; same data as for preceding; NARC. — TURKMENISTAN • 50 ♂♂, 5 ♀♀; Kopet-dag Mountain, 15 km W of Firyuza settlement, Dushak mountain; 37°54'05"N, 57°54'44"E; 4–9 May 1987, 16–20 May 1988; Barkalov A., Dubatolov V.V. leg.; SZMN • 1 ♂; same data as for preceding; 2100 m a.s.l.; 7 May 1987; Barkalov A. leg.; SZMN 05843 • 14 ♂♂, 34 ♀♀; Kopet-dag Mountains, Firyuza settlement; 37°54'58"N, 58°05'22"E; 3 May 1991; Dubatolov V.V., Zinchenko V. leg.; SZMN • 1 ♂; Ahal Region, Gökdepe District, SW of Geok Tepe; 38°04'52"N, 57°52'48"E; 9 May 1988; Barkalov A. leg.; SZMN • 18 ♂♂, 27 ♀♀; same data as for preceding; 11 May 1988 • 14 ♂♂, 4 ♀♀; 50 km WNW Firyuza settlement, Mirzadag Mountain; 38°05'07"N, 57°34'27"E; 16 May 1987; Dubatolov V.V. leg.; SZMN • 1 ♂; Kopet-dag Mountains, 20 km E Nokhur settlement, Karayalchi gorge; 38°28'25"N, 57°09'09"E; 28 Apr. 1991; Dubatolov V. leg.; SZMN.

Diagnosis. Small to medium sized (7–11 mm), medium long pilose, dark species, with olive-brown reflection (Figs 20D, 21C); antennae reddish-brown, basoflagellomere elongated, 1.8–2.1 times as long as wide, with concave dorsal margin (Figs 10D, 13C); femora mostly black, tibiae and tarsi partly reddish-yellow (Figs 14D, 16D); body pile whitish-yellow to gray. Male: metafemur broad, about 3.3 times longer than wide, covered with long pilosity (Fig. 14D); basotarsomere of metatarsus expanded, about 2 times broader than the second tarsomere (Fig. 14D), with ventrolateral row of strong setae (Fig. 8F, G), ventrally with well-defined brush-like area of dense pile extended in basal half (Fig. 8F); ventral margin of metatrochanter angular; sternum 4 with medium long laminate extensions on posterior margin (Fig. 5B); male genitalia: anterior surstyle lobe triangular and elongated (Fig. 23G: al), while posterior surstyle lobe triangular (Fig. 23G, H: pl); ejaculatory apodeme longer than broad (Fig. 23I: ea); lingula short and narrow (Fig. 23I: l). Female: basoflagellomere with angular apex and large fosse (Fig. 13C); tarsi yellow-reddish (Fig. 16D), in some specimens dorsally brown to dark, especially on metaleg; basotarsomere of metaleg more or less with parallel margins from ventral view, and with a few distinct, strong spine-like setae within the ventrolateral row of setae (Fig.

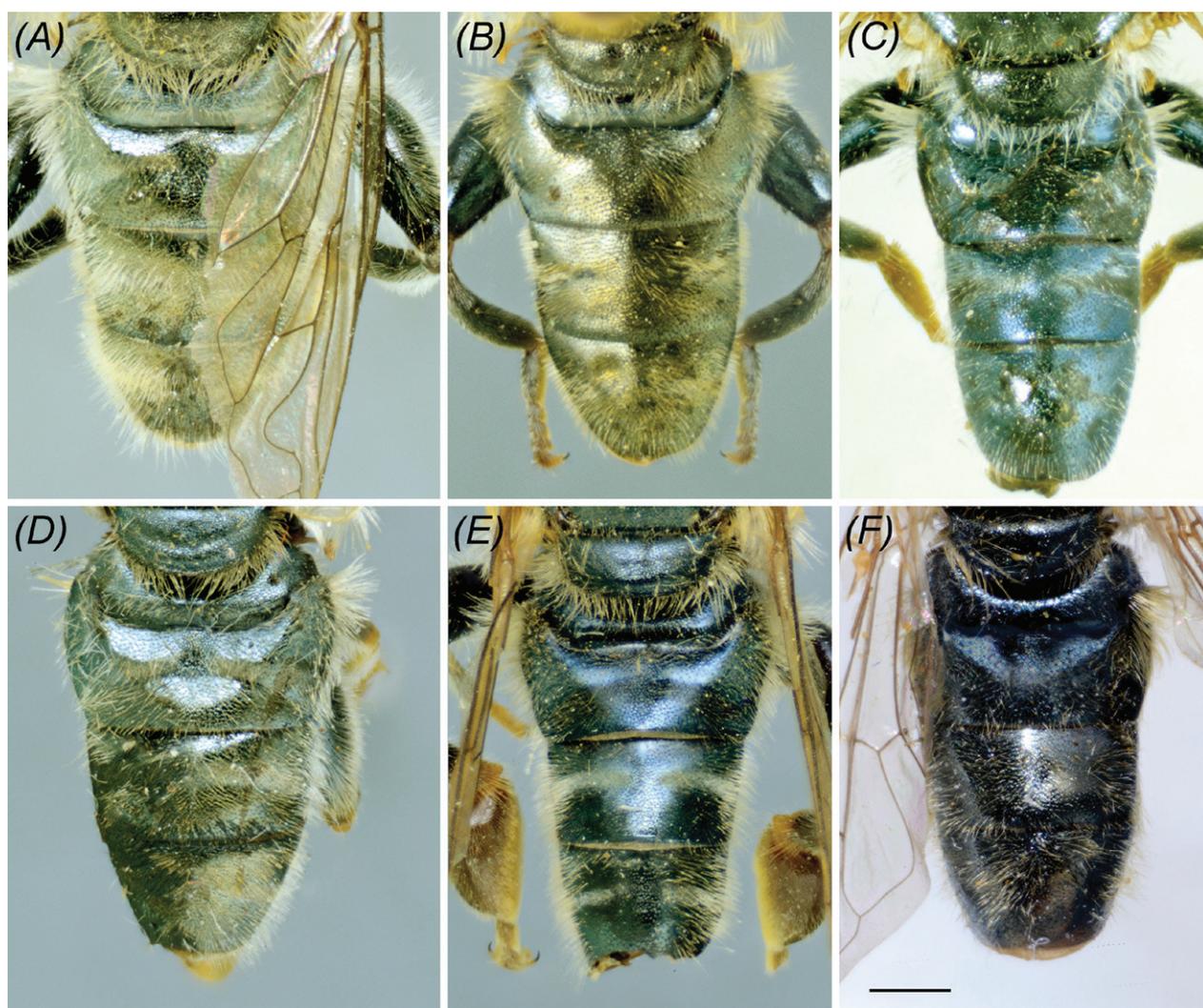


Figure 20. Abdomen of male, dorsal view. **A** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **B** *M. hypochrysos*, **C** *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, **D** *M. marginicornis*, **E** *M. oidipous*, **F** *M. turkestanicus*. Scale bar: 1 mm.

8H); metafemur with dense long pilosity ventrally (Fig. 16D).

Male similar to *Merodon latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** from which differs in more elongated basoflagellomere with pointed apex (Fig. 10D), which is shorter and more triangular in *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** (Fig. 10C); by basotarsomere of metaleg with ventral brush-like area of dense pile limited to basal half in *M. marginicornis* (Fig. 8F), while in *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** pile extending 3/4 of its length (Fig. 8E). Clearly differs from *M. dumosus* Vujić, Likov & Radenković **sp. nov.** by less distinct ventrolateral row of setae on the basotarsomere of all legs, while the setae are long and strong in *M. dumosus* Vujić, Likov & Radenković **sp. nov.** (Fig. 8A); by the shape of the basoflagellomere (Fig. 10 B, D); and by shape of male genitalia: anterior surstyle lobe triangular and elongated and posterior surstyle lobe short and triangular (Fig. 23G: al, pl), while in *M. dumosus* Vujić, Likov & Radenković **sp. nov.** anterior surstyle lobe enlarged and oval and posterior surstyle lobe large and oval (Fig. 23A: l, pl). Females can be differentiated from *M. hypochrysos* in sympatric populations by longer

basoflagellomere in *M. marginicornis* (Fig. 13C), while shorter, with oval apex in *M. hypochrysos* (Fig. 13A), and broad white pollinose fascia on terga 2–4 in *M. marginicornis* (Fig. 21C).

Re-description. MALE. Head: Antenna reddish-brown; basoflagellomere (Fig. 10D) reddish, elongated, about 1.9–2.1 times as long as wide, about 3 times as long as pedicel, concave dorsally, strongly tapering to apex, pointed apically; fossette dorsolateral and large (Fig. 10D); arista black and thickened at basal third; face and frons black with gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin black, with sparse microtrichia; lunule shiny black to brown, bare; eye contiguity about 8–10 facets long; vertex isosceles, shiny black, anterior part pollinose; vertex with long, yellowish-gray pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with white-gray pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 31D); vertical triangle: eye contiguity: frons = 2.5 : 1 : 2. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered

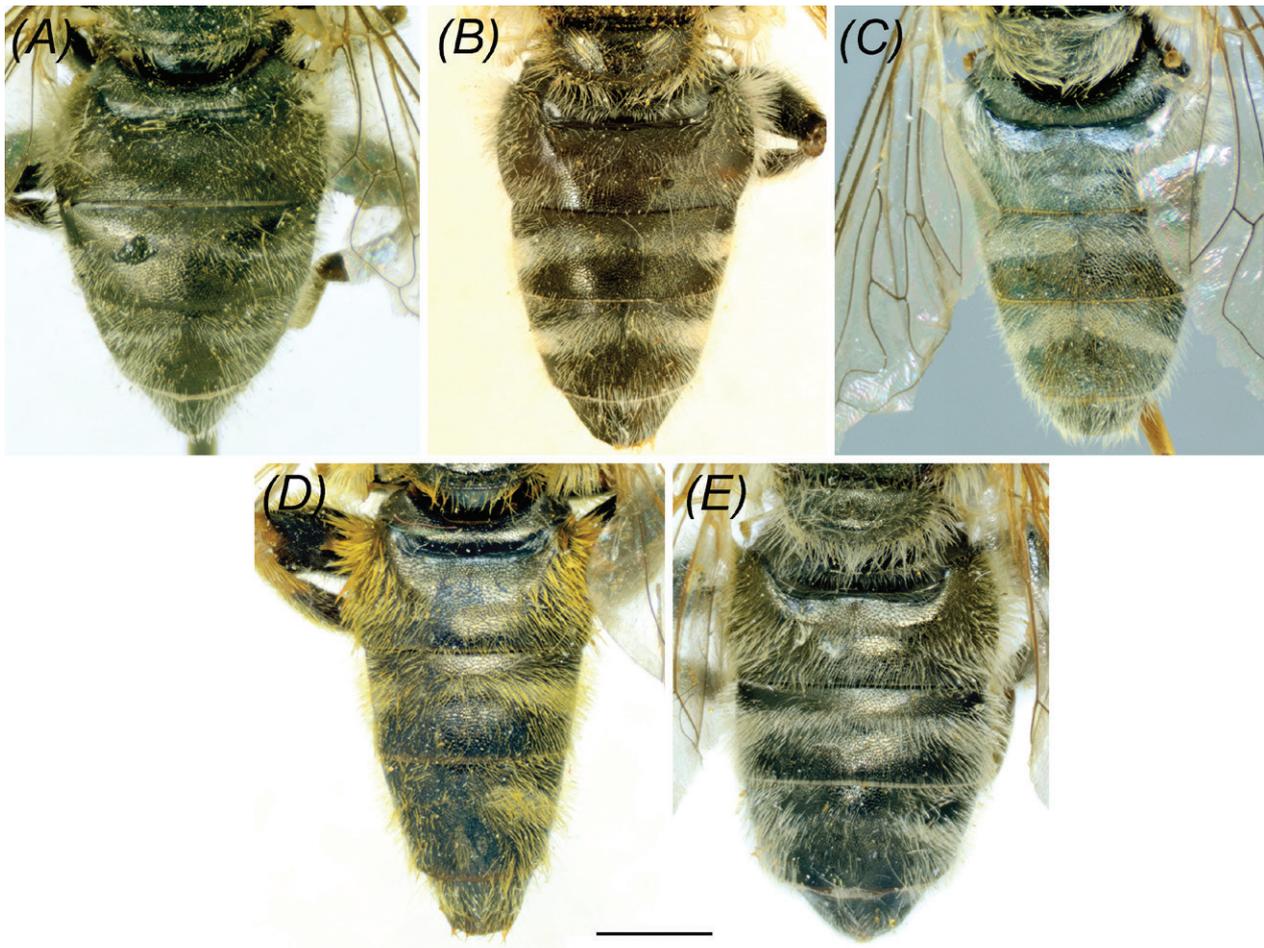


Figure 21. Abdomen of female, dorsal view. **A** *M. angustitarsis* Vujić & Gilasian *sp. nov.*, **B** *M. dumosus* Vujić, Likov & Radenković *sp. nov.*, **C** *M. marginicornis*, **D** *M. rufitarsis*, **E** *M. tarsatus*. Scale bar: 1 mm.

with dense, erect yellow to white pile; scutum without less distinct pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow to gray pile; wings mostly covered with microtrichia; wing veins brown; calypter pale yellow; halter yellow; femora mostly black, tibiae and tarsi partly reddish-yellow; pile on legs pale yellow; ventral margin of metatrochanter angular; metafemur moderately broad, about 3.3 times longer than wide, with long pile on ventral surface, about half width of metafemur, longer than pile on dorsal surface (Fig. 14D); apicomedial lamina on metatibia covered with long yellow pile; basotarsomere of metatarsus expanded, about 2 times broader than second tarsomere (Fig. 14D), ventrally with well-defined brush-like area of dense pile extended in basal half (Fig. 8F), with ventrolateral row of long, strong setae (Fig. 8G). — **Abdomen** (Fig. 20D): About 1.4 times longer than mesonotum; terga dark brown to black; terga 2–4 each with pair of distinct, white pollinose fasciae; pile on terga gray-whitish; sterna dark brown, covered with long whitish pile; sternum 4 with medium long laminate extensions on posterior margin (Fig. 5B). — **Male genitalia**: Anterior surstyle lobe triangular and elongated,

about 1.5 times longer than wide, covered with dense short pile (Fig. 23G: al); posterior surstyle lobe triangular (Fig. 23G: pl); cercus rectangular (Fig. 23G: c); hypandrium sickle-shaped, without lateral projections; lingula short and narrow (Fig. 23I: l). — **FEMALE**. Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere about 1.8 times longer than wide (Fig. 13C); frons with pollinose vittae along eye margins; frons covered with mostly gray-yellow pile; ocellar triangle covered with gray to whitish pile, in some specimens mixed with black pile; terga covered with gray-whitish to yellow pilosity; medial part of terga 2–4 usually with short adpressed black pile; pollinose fasciae on terga 2–4 distinct (Fig. 21C); basotarsomere of metatarsus yellow-reddish (Fig. 16D), less expanded, ventrally without well-defined brush-like area of dense pile (Fig. 8H); basotarsomere of metaleg more or less with parallel margins from ventral view, with a few distinct strong spine-like setae within ventrolateral row of setae (Fig. 8H).

Distribution and ecological data. *Merodon marginicornis* was recorded in Iran, southern Turkmenistan, and western Pakistan (Fig. 28). Its Iranian localities are within arid and semi-arid forests ecosystem with *Quercus brantii* as the dominant vegetation type, cold-desert

steppe scrubland ecosystem (*Artemisia sieberi* – *Zygo-phyllum* sp.), cold and arid semi steppe scrubland and grasslands ecosystem (*Astragalus* spp.), and cold and humid prairies ecosystem (*Trifolium* spp.) (Azizi Jalilian et al. 2020). The ecosystems belong to ecoregions: Zagros mountains forest steppe, Elburz range forest steppe, Kopet Dag woodlands and forest steppe, and Central Persian desert basins (Olson et al. 2001). The Iranian collection sites of *M. marginicornis* in the Zāgros mountain range include: Sepidān, a semi-arid and cold mountainous area, with very cold winters and moderate summers, 14.8°C average annual temperature and 695 mm annual precipitation, with *Acer monspessulanum*, *Amygdalus elaeagnifolia*, *Berberis integerrima*, *Crataegus azarolus* var. *aronia*, *Fraxinus rotundifolia*, *Cotoneaster persica*, *Pyrus* spp. as dominant plant species; Yāsuj, with very cold winters and moderate summers, 15.2°C average annual temperature and 864 mm annual precipitation, with *Quercus persica* as the dominant plant species; Dasht-e Arjan, located in the ‘Arjan Biosphere Reserve’, with an altitude of 853–3041 m a.s.l., with wild almond trees (*Prunus scoparia*) (‘Arjan’ in Persian) as dominant plant species; Semirōm, with very cold winters and moderate summers, 335 mm annual precipitation and 12.5°C average annual temperature, with *Astragalus verus*, *Poa bulbosa* and *Bromus tomentellus* as dominant plant species; Lordegān, with hot summers and cold winters, about 650 mm annual precipitation and 16°C average annual temperature, with *Astragalus* spp. and *Quercus brantii* as dominant plant species. The eastern part of the range of *M. marginicornis* (localities in Pakistan) belongs to Baluchistan xeric woodlands. The montane vegetation of this ecoregion includes *Juniperus* forests (including *J. seravschanica* Kom. and *J. excelsa*), open woodlands with *Pistacia atlantica*, *P. khinjuk* Stocks, *Prunus eburnea* (Spach) Aitch., *Berberis* L., *Lonicera* L., *Artemisia* spp; *Olea europaea* subsp. *cuspidata* (Wall. & G. Don) Cif. accompanied by *Dodonaea viscosa* Jacq. as the transition between the subtropical woodlands and the alpine vegetation of sclerophyllous forest (WWF 2022). The climate of the collection site in Pakistan is slightly to very hot in summer and really cold in winter; temperature rises as much as 35–40°C in summer and drops to -15°C in winter; dry warm days and cool nights are common in the summertime season; most of the rain falls in winter and ranges between 50–300 mm annually. Mostly apple orchards are grown in this locality, with wheat (*Triticum aestivum* L.) and Berseem (*Trifolium alexandrinum* L.) intercropped. On the basis of our data the flight period of *M. marginicornis* is from April to early June.

Remarks. Hurkmans treated many species groups at the same time in the monograph (Hurkmans 1993), and probably it was more difficult to have a good insight because there were many species compiled to be analyzed simultaneously, instead of more precise studies dedicated to each group separately. He assigned *M. marginicornis* erroneously in the *alexaji* group although stated that basitarsi 3 is swollen (but slightly, that was probably the reason why he did not put it in the *tarsatus* group), and

also stated that sternum 4 is deeply emarginate posteriorly, somewhat valuated (and for *M. xanthipous* that there are smaller appendages on sternum 4 in comparison to other species of the group). But a detailed study of the type material of both taxa conducted in the present study has unambiguously shown that they belong to the same species of the *tarsatus* group.

***Merodon namaghijamii* Vujić, Likov & Radenković sp. nov.**

<https://zoobank.org/4F415578-E4C1-43F7-9AA7-E9F7E478C704>

Figs 1G, H, 2D, 4D, 9A–C, 11B, 14E, 18A, 19B, 28, 31G

M. aff. tarsatus 4 (Vujić et al. 2021a).

Type locality. IRAN: Razavi Khorasan Province, Torbat-e Jām County, Bezd village, 20 km SW of Torbat-e Jām; 35°21′00″N, 60°44′00″E; 1274 m a.s.l.

Type material. *Holotype*: ♂; FSUNS [specimen dry pinned, right mesoleg and metaleg except tarsi are missing taken for molecular analysis, left metatarsi are glued on triangular shaped paper pinned with the source specimen, genitalia and right metatarsi are in separate microvials]. Original labels: “Iran, Bezd village, / 20km south west Torbat-e jam / 35°21′N 60°44′, 1274m / 08.05.2015. / Leg. Amirreza Bidel”, “Hussein Sadeghi coll. Iran”, “117”, “13262”, “TS879”, “*Merodon tarsatus* / det. A. Vujic 2016”.

Diagnosis. Medium sized (10 mm), long pilose, dark species, with olive-brown reflection (Fig. 19B); antennae dark brown, basoflagellomere elongated, 2.4 times as long as wide (Fig. 11B); legs entirely black (Fig. 18A); body pile pale yellow to gray. Male: eyes dichoptic, separated by distance of 2–3 facets (Fig. 31G); metafemur broad, about 3.3 times longer than wide, covered with long pilosity (Fig. 14E); basotarsomere of metatarsus expanded, about 2.5 times broader than the second tarsomere, ventrally with well-defined brush-like area of dense pile extending 3/4 of its length (Fig. 9B, C); ventral margin of metatrochanter angular; sternum 4 with very long laminate extensions on posterior margin (Fig. 4D); male genitalia: anterior surstyle lobe rectangular and posterior surstyle lobe oval (Fig. 1G: al, pl); ejaculatory apodeme large, broader than long (Fig. 2D: ea); lingula elongated and narrow (Fig. 2D: l).

Similar to *Merodon turkestanicus* from which differs in shape and size of basotarsomere of metaleg, broader in *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** (Fig. 9A–C) and narrower in *M. turkestanicus* (Fig. 9E, F); and by the shape of male genitalia: ventral margin of posterior surstyle lobe angular (Fig. 1G) and ejaculatory apodeme wider than basal width of hypandrium in lateral view (Fig. 2D), while in *M. turkestanicus* ventral margin of posterior surstyle lobe oval (Fig. 1E) and ejaculatory apodeme narrower than basal width of hypandrium in lateral view (Fig. 2C). Differs from *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, *M. smirnovi* and *M. tarsi-*

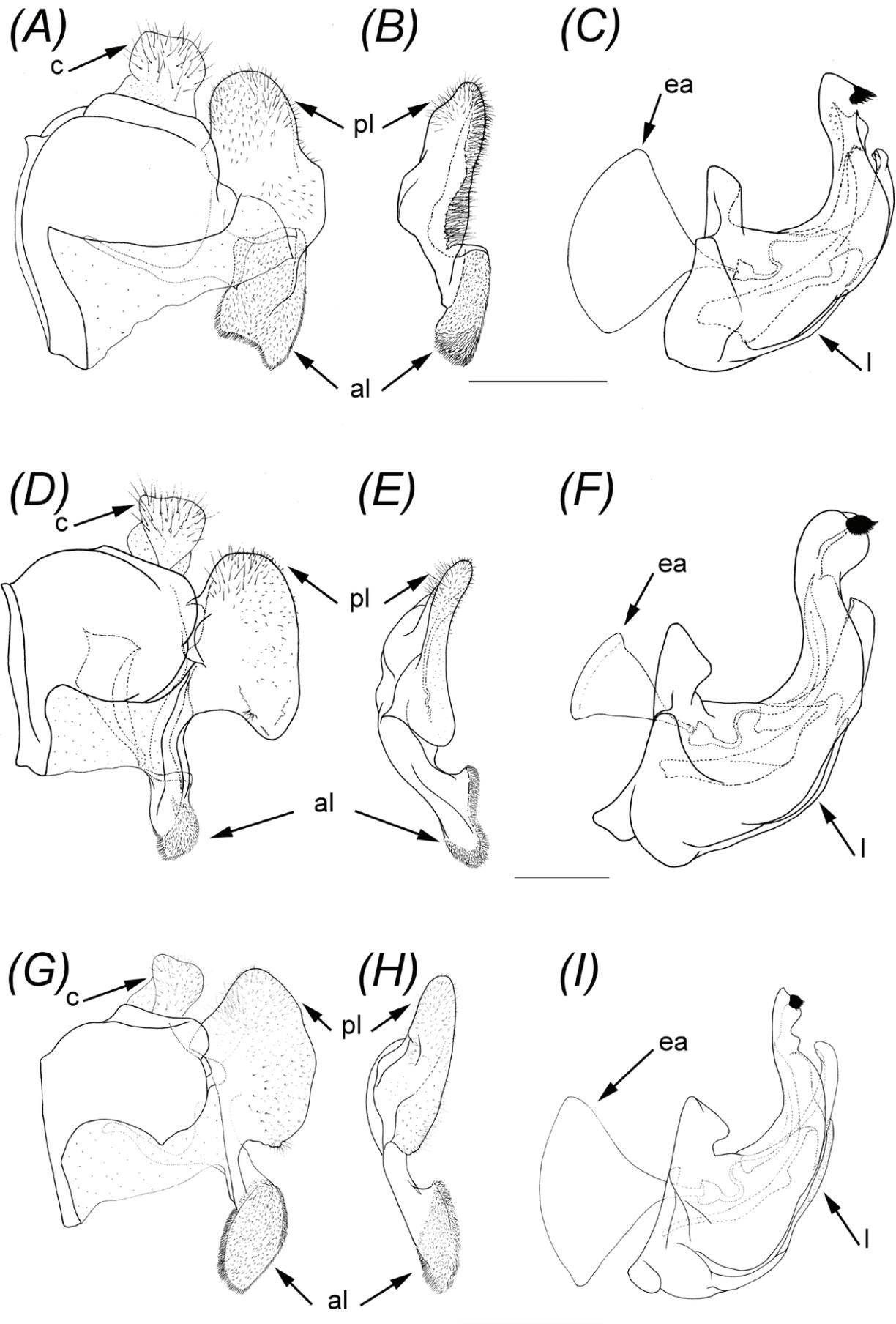


Figure 22. Male genitalia. **A–C** *M. angustitarsis* Vujčić & Gilasian sp. nov., **D–F** *M. rufitarsis*, **G–I** *M. hypochrysos*. (**A, B, D, E, G, H**) epandrium, (**C, F, I**) hypandrium. (**A, C, D, F, G, I**) lateral view, (**B, E, H**) ventral view. Abbreviations: al – anterior surstyle lobe, c – cercus, ea – ejaculatory apodeme, l – lingula, pl – posterior surstyle lobe. Scale bar: 0.5 mm.

tus by dichoptic eyes (Fig. 31G), holoptic in these three species with eye contiguity more than 6 facets long (Fig. 30C, E, F).

Description. MALE. Head: Antenna dark brown to black; basoflagellomere (Fig. 11B) elongated about 2.4 times as long as wide, more than 2 times as long as pedicel, more or less straight dorsally, tapering to apex; fessette dorsolateral and large (Fig. 11B); arista dark and thickened at basal third; face and frons black with gray microtrichia; face covered with dense whitish-yellow pile, frons with gray-yellowish pile; oral margin black; lunule shiny black to brown, bare; eye dichoptic, separated for length of 2–3 facets (Fig. 31G); vertex isosceles (Fig. 31G), shiny black; vertex with long, pale gray-yellowish pile, mixed with a few black pile on ocellar triangle; ocellar triangle equilateral (Fig. 31G); occiput with gray-yellow pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 31G); vertical triangle: frons = 1.2 : 1. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect yellowish pile; scutum without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katapisternum with long, dense pale yellow pile; wings mostly covered with microtrichia; wing veins brown; calypter pale yellow; halter yellow; legs black; pile on legs pale yellow to whitish; ventral margin of metatrochanter angular; metafemur moderately broad, about 3.3 times longer than wide, with pile on ventral surface as long as width of metafemur, longer than pile on dorsal surface (Fig. 14E); apicomedial lamina on metatibia distinct, covered with very long yellow pile (Fig. 18A); basotarsomere of metatarsus expanded, about 2.5 times broader than second tarsomere (Fig. 9B), ventrally with well-defined brush-like area of dense pile extending 3/4 of its length (Fig. 9B, C). — **Abdomen:** About 1.2 times longer than mesonotum; terga dark brown to black; terga 2–4 without white pollinose fasciae; pile on terga all yellow to gray-whitish (Fig. 19B); sterna dark brown, covered with long whitish-yellow pile. — **Male genitalia:** Anterior surstyle lobe rectangular, about 1.5 times longer than wide, covered with dense short pile (Fig. 1G: al); posterior surstyle lobe oval (Fig. 1G: pl); cercus rectangular (Fig. 1G: c); hypandrium sickle-shaped, without lateral projections (Fig. 2D); lingula elongated and narrow (Fig. 2D: l). — **FEMALE.** Unknown.

Etymology. The new species “*namaghijamii*” was named after the famous Persian writer, poet: Ahmad Ibn Abolhasan Jāmi-e Nāmaghi-e Torshizi. He was born in Namagh, Iran (1048) and died in Torbat-e Jām, Iran (1141). The holotype was collected from the county named Torbat-e Jām, located near the border of Iran and Afghanistan. This name was proposed by Hussein Sadeghi Namaghi from Iran. A noun in the genitive case.

Distribution and ecological data. *Merodon namaghijamii* Vujić, Likov & Radenković **sp. nov.** has only been recorded in northeastern Iran so far (Fig. 28). Its only known locality is within the cold-desert steppe scrubland ecosystem, with *Artemisia sieberi* – *Zygophyllum* sp. as dominant vegetation type (Azizi Jalilian et al. 2020). It belongs to the Central Persian desert basins ecoregion (Olson et al. 2001). The single specimen of *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** was collected using a malaise trap, placed at the edge of an alfalfa field (*Medicago sativa* L.) in Bezd village in the vicinity of Torbat-e Jām. Torbat-e Jām is located in northeastern Iran close to Afghanistan, with very hot summers and cold winters, with 26°C average annual temperature and 260 mm annual precipitation. *Artemisia sieberi*, *Pegannum harmala* L. and *Ziziphora tenuior* L. are the dominant plant species in this area. On the basis of our data the flight period is May.

Merodon oidipous Hurkmans, 1993

Figs 3C, 4E, 6H–K, 11C, 13D, 15B, 16E, 20E, 24F, G, 25C, 27, 30B

Merodon oidipous Hurkmans, 1993: 171. Type locality: Turkey, Hakkari province (holotype).

Merodon persicus Hurkmans, 1993: 171. Type locality: Iran, Fārs province. Syn. nov.

Type locality. Turkey, Hakkari province; Iran, Fārs province.

Type material examined. *Merodon persicus* Hurkmans: Original description was based on one male specimen designated as holotype (Hurkmans 1993). — **Holotype:** IRAN • ♂; Fārs Province, Road Chiraz (Shiraz)-Kazeroun, Fort Sine-Sefid; 25 May 1937; Brandt F.H. leg.; NBCN [specimen dry pinned, left antenna, right proleg, left third, fourth and fifth tarsomeres, left metaleg, right fourth and fifth tarsomeres and genitalia are missing, left wing partly damaged. Metafemur glued on locality label together with some tarsomeres]. Original labels: “Iran Fars 1937 / Rd Chiraz-Kazeroun / Fort Sine-Sefid / coll F.H. Brandt 25.V.” [day and month with graphite pencil written], “*Merodon persicus* / HURKMANS / HOLOTYPE” [red label, hand-written], “*Lampetia* ♂ / *smirnovi* Param. / det. v. Doesburg” [*Lampetia smirnovi* handwritten], “Museum Leiden / Collectie / Van Doesburg / rec. 1973”, “LML-05-26”, “02590”. — ***Merodon oidipous* Hurkmans:** Original description was based on holotype and two paratypes from Hakkari province in Turkey (Hurkmans 1993). This species was described based on only males and classified as a member of “*tarsatus* group” by Hurkmans (1993). — **Holotype:** TURKEY • ♂; Hakkari, Suvarihalil pas W. side; 2100 m a.s.l.; 14 Jun. 1984; Lucas J.A.W. leg.; NBCN [specimen dry pinned in good condition, third, fourth and fifth tarsomeres of metaleg are missing, genitalia in separate microvial]. Original labels: “TURKIJE : Hakkāri / Suvarihalil pas / W. side 2100m / 14-6-1984 / Leg. J.A.W. Lucas”, “Holotype of *Merodon / oidipous* Hurkmans [handwritten, red label]”, “*Merodon persicus* / Hurkmans 1993 / det. Vujić 2008”, “AM-05-45”, “02592”. — **Paratypes:** TURKEY • 2 ♂♂; Hakkari, Suvarihalil pas W. side; 2100 m a.s.l.; 14. Jun. 1984; Lucas J.A.W. leg.; NBCN.

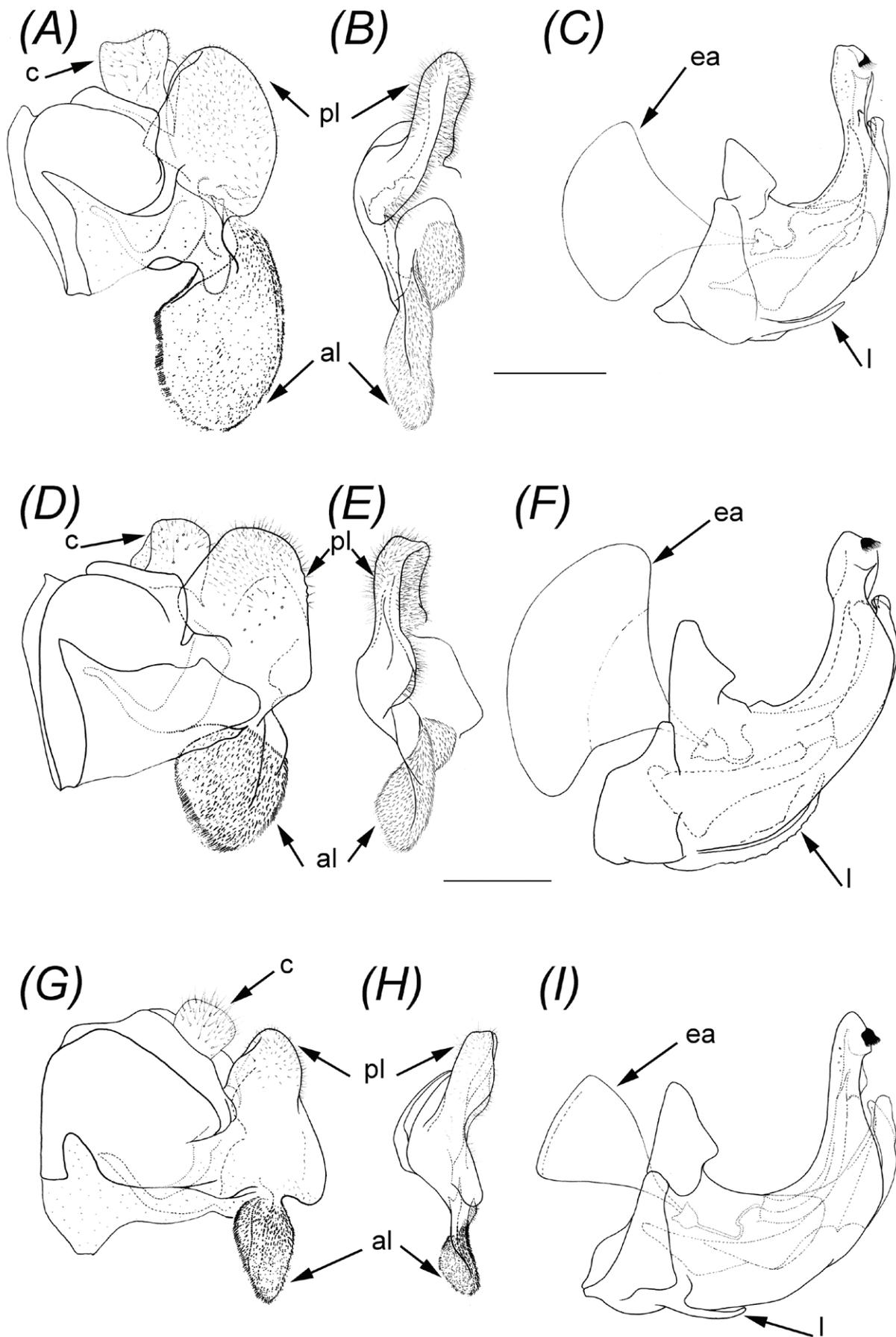


Figure 23. Male genitalia. **A–C** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **D–F** *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, **G–I** *M. marginicornis*. (A, B, D, E, G, H) epandrium, (C, F, I) hypandrium; (A, C, D, F, G, I) lateral view, (B, E, H) ventral view. Abbreviations: al – anterior surstyle lobe, c – cercus, ea – ejaculatory apodeme, l – lingula, pl – posterior surstyle lobe. Scale bar: 0.5 mm.

Notes on synonymy. Hurkmans designated *Merodon persicus* as a member of “*tarsatus* group”. Specimens described as *M. oidipous* and *M. persicus* belong to one species and based on prior citation of *M. oidipous* in the same publication, *M. persicus* becomes a junior synonym.

Additional material examined. IRAN • 2 ♂♂, 2 ♀♀; Fārs Province, Dasht-e Arjan; 29°33′07″N, 51°56′31″E; 2260 m a.s.l.; 5 May 2016; Kafka M. leg.; M.B. coll. • 1 ♂; Fārs Province, 15 km S of Dasht-e Arjan; 29°33′09″N, 51°56′22″E; 2261 m a.s.l.; 2–6 May 2016; Obořil M. leg.; J.H. coll. • 3 ♀♀; same data as for preceding; J.H. coll. 18265, 18273, 18275 • 1 ♂; Fārs Province, 10 km E Kazeroun; 29°34′00″N, 51°52′00″E; 1300 m a.s.l.; 23 May 2014; Halada J. leg.; M.B. coll. • 1 ♀; Fārs Province, 1 km W of Sangar; 29°59′50″N, 52°08′07″E; 2093 m a.s.l.; 4–5 May 2016; Obořil M. leg.; J.H. coll. 18268 • 4 ♂♂, 3 ♀♀; Kohgiluyeh & Boyer-Ahmad Province, Yāsuj, Sarab-e Taveh; 30°29′24″N, 51°39′29″E; 2390 m a.s.l.; 4 May 2016; Kafka M. leg.; M.B. coll. • 1 ♂; Kohgiluyeh & Boyer-Ahmad Province, 20 km S of Yāsuj (Jásúdz); 30°29′26″N, 51°39′27″E; 2144 m a.s.l.; 30 May 2015; Baňar P. leg.; J.H. coll. 18266 • 1 ♀; same data as for preceding; J.H. coll. 18272 • 1 ♂; Isfahān Province (Esfahān Province), Semirom County, Kommeh; 31°01′01″N, 51°35′28″E; 2760 m a.s.l.; 12 May 2007; Gilasian E. leg.; HMIM 04462.

Diagnosis. Medium sized (8–11 mm), long pilose, dark species with olive-brown to bluish reflection (Fig. 20E); antennae reddish-brown to dark brown, basoflagellomere elongated, about 2 times as long as wide (Figs 11C, 13D); tibiae and tarsi partly reddish-yellow (Figs 15B, 16E); body pile pale yellow to gray; sterna with long white pilosity. Male: metafemur curved, broad, about 3.2 times longer than wide, covered with long pilosity (Fig. 15B); basotarsomere of metatarsus extremely expanded, more than 3 times broader than the second tarsomere (Figs 6H, I, 15B), ventrally with well-defined brush-like area of dense pile on basal 1/3 (Fig. 6H, I), with ventrolateral row of strong setae; sternum 4 with very long laminate extensions on posterior margin (Fig. 4E); male genitalia: anterior surstyle lobe enlarged and trapezoidal, posterior surstyle lobe oval (Fig. 24F, G: al, pl); ejaculatory apodeme large, about as broad as long (Fig. 25C: ea); lingula elongated and narrow (Fig. 25C: l). Female: tarsi brown, at least dorsally; in ventral view broad, medially extended, but from lateral view with sunken and twisted ventral surface (Fig. 6J, K).

Similar to *Merodon smirnovi* and *M. tarsatus* from which differs in smaller ventral brush-like area of dense pile on basotarsomere of metaleg, limited to basal 1/3 (Fig. 6H, I), while is about 2/3 in *M. smirnovi* (Fig. 6A, B) and 3/4 in *M. tarsatus* (Fig. 6L); and by shape of the male genitalia: anterior surstyle lobe as long as posterior surstyle lobe in *M. oidipous* (Fig. 24F: al), while is shorter in *M. smirnovi* (Fig. 24A, C: al) and *M. tarsatus* (Fig. 1A: al).

Re-description. MALE. Head: Antenna reddish-brown to dark brown; basoflagellomere (Fig. 11C) elongated about 2 times as long as wide, about 2.2 times as long as pedicel, more or less straight dorsally, tapering to apex; fossette dorsolateral and large (Fig. 11C); arista dark and

thickened at basal third; face and frons black to dark blue with gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin with sparse microtrichia; lunule shiny black to brown, bare; eye contiguity about 6–8 facets long; vertex isosceles, shiny black; vertex with long, pale yellow-whitish pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with gray-yellow pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 30B); vertical triangle: eye contiguity: frons = 3 : 1 : 2.5. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect, yellow pile; scutum usually without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow pile; wings mostly covered with microtrichia; wing veins brown; calypter pale yellow; halter yellow; femora mostly black, tibiae and tarsi partly reddish-yellow; pile on legs pale yellow; metafemur broad, curved about 3.2 times longer than wide, with long pile on ventral surface, about as long as width of metafemur, longer than pile on dorsal surface (Fig. 15B); apicomedial lamina on metatibia distinct, covered with very long pale yellow pile; basotarsomere of metatarsus expanded, more than 3 times broader than second tarsomere (Figs 6H, I, 15B), ventrally with well-defined brush-like area of dense pile limited to basal 1/3 (Fig. 6H, I), with ventrolateral row of strong setae (Fig. 6I). — **Abdomen:** About 1.3 times longer than mesonotum; terga dark brown to black; terga 2–4 each with pairs of narrow, white pollinose fasciae; pile on terga all yellow to gray-whitish, except medial part of terga 2–4 usually with short black pile (Fig. 20E); sterna dark brown, covered with long whitish-yellow pile. — **Male genitalia:** Anterior surstyle lobe enlarged and trapezoidal, covered with dense, short pile (Fig. 24F: al); posterior surstyle lobe oval (Fig. 24F: pl); cercus rectangular (Fig. 24F: c); hypandrium sickle-shaped, without lateral projections; lingula elongated and narrow (Fig. 25C: l). — **FEMALE (first description).** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere slightly tapering to apex, about 1.5 times longer than wide (Fig. 13D); frons with pollinose vittae along eye margins variable in shape and size; frons covered with mostly gray-yellow pile; ocellar triangle covered with black pile; terga covered with gray-whitish to yellow pilosity; medial part of terga 2–4 usually with short adpressed black pile; pollinose fasciae on terga 2–4 distinct; basotarsomere of metatarsus brown (at least dorsally), from ventral view broad, medially extended, without well-defined brush-like area of dense pile (Fig. 6J), but from lateral view with sunken and twisted ventral surface (Fig. 6K); basotarsomere of metaleg with a few distinct strong spine-like setae within ventrolateral row of setae (Fig. 6J, K).

Distribution and ecological data. *Merodon oidipous* occurs in southern Iran and southeastern Turkey (Fig. 27). It

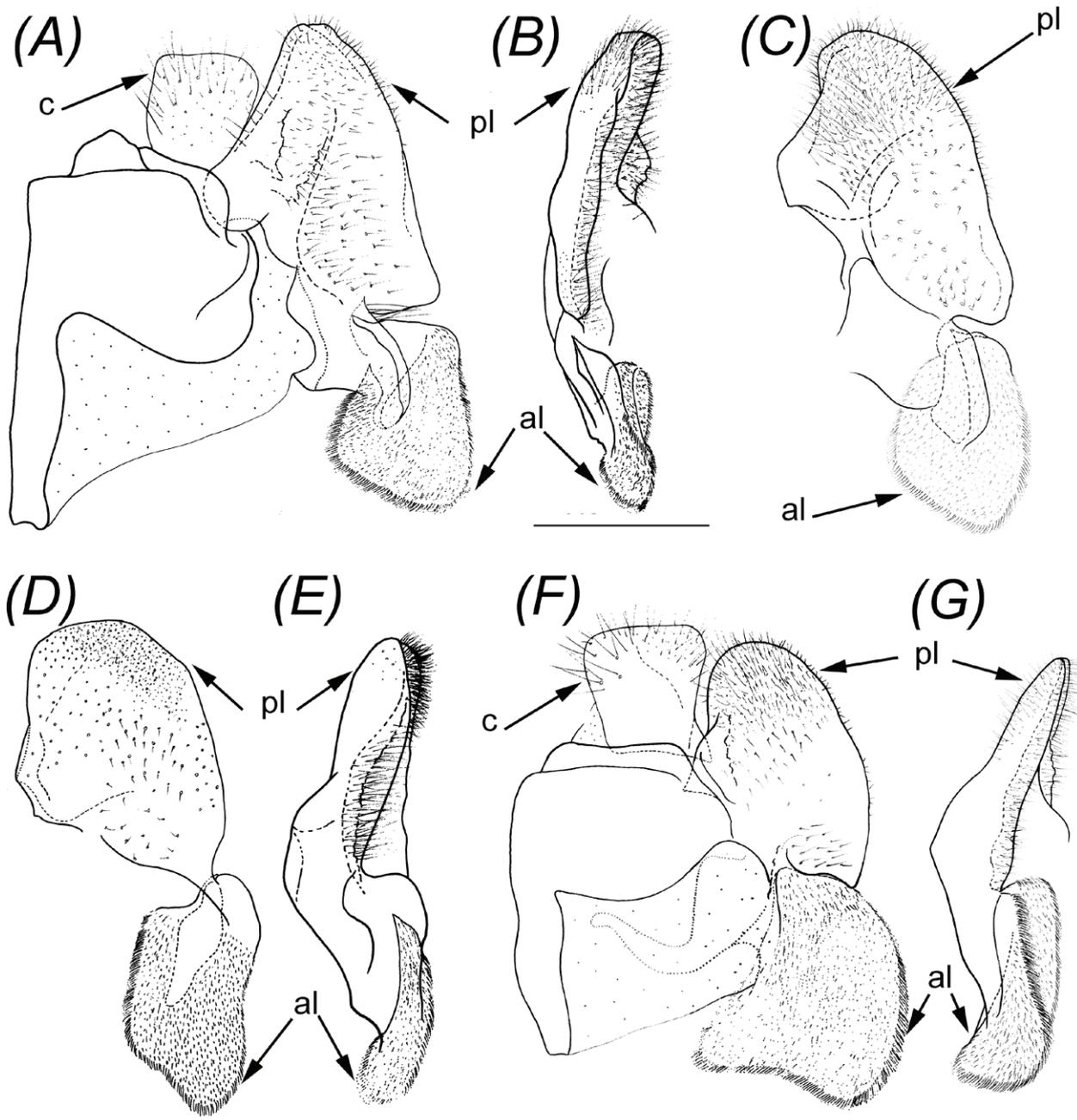


Figure 24. Male genitalia, epandrium. A–C *M. smirnovi*, D, E *M. pakistanicus* Vujić, Likov & Radenković sp. nov., F, G *M. oidipous*. (A, C, D, F) lateral view, (B, E, G) ventral view. Abbreviations: al – anterior surstyle lobe, c – cercus, pl – posterior surstyle lobe. Scale bar: 0.5 mm.

was recorded within arid and semi-arid forests ecosystem with *Quercus brantii* as the dominant vegetation type, and cold and arid semi steppe scrubland and grasslands ecosystem (*Astragalus* spp.) (Azizi Jalilian et al. 2020), at localities which belong to the Zagros mountains forest steppe ecoregion (Olson et al. 2001). Iranian collection sites of *M. oidipous* located in the Zāgros mountain range include: Yāsuj, with very cold winters and moderate summers, 15.2°C average annual temperature and 864 mm annual precipitation, with *Quercus persica* as the dominant plant species; Dasht-e Arjan, located in the ‘Arjan Biosphere Reserve’, with an altitude range of 853–3041 m a.s.l., with wild almond trees (*Prunus scoparia*) (‘Arjan’ in Persian) as the dominant plant species; Semirom,

with very cold winters and moderate summers, 335 mm annual precipitation and 12.5°C average annual temperature, with *Astragalus verus*, *Poa bulbosa* and *Bromus tomentellus* as the dominant plant species. On the basis of our data the flight period is May.

***Merodon pakistanicus* Vujić, Likov & Radenković sp. nov.**

<https://zoobank.org/4E19744C-49D5-49C7-B147-204AFA409476>

Figs 5C, 9D, 11D, 14F, 24D, E, 25B, 26, 30C

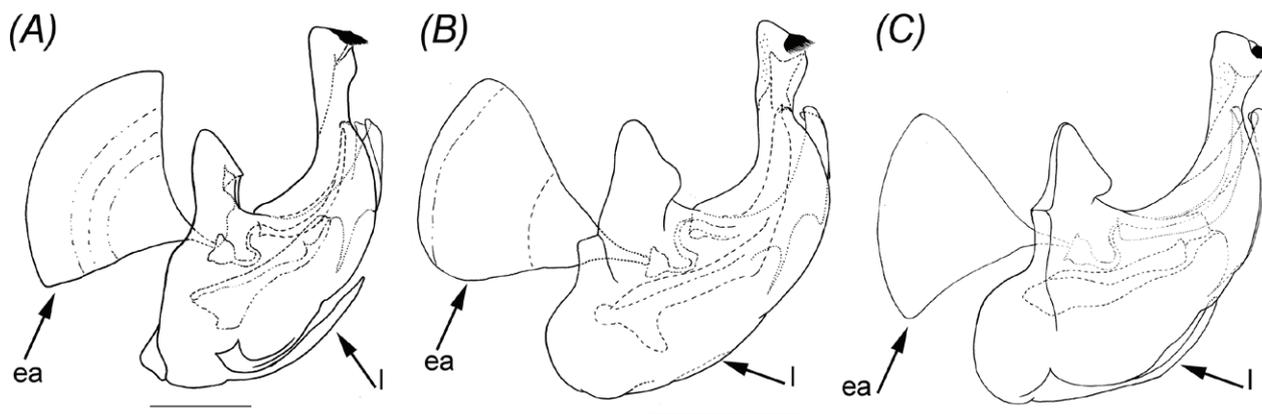


Figure 25. Male genitalia, hypandrium, lateral view. **A** *M. smirnovi*, **B** *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, **C** *M. oidipous*. Abbreviations: ea – ejaculatory apodeme, l – lingula. Scale bar: 0.5 mm.

M. aff. tarsatus 5 (Vujić et al. 2021a).

Type locality. PAKISTAN: Balochistan Province, Qilla Saifullah District, Kan Mehtarzai.

Type material. *Holotype*: ♂; NARC 18120 [specimen dry pinned, the right wing, the head, antero-dorsal part of mesonotum and mesoleg without tarsomeres are glued on locality label, metaleg taken for molecular analysis, genitalia in separate microvial]. Original labels: “Kan Mwhterzai / (Qilla Saifulah) / 27-v-2017 / Banafsha”, “10 [serial number] ♂”, “18120”, “TS512”.

Diagnosis. Medium sized (10 mm), long pilose, dark species, with olive-brown reflection; antennae black, basoflagellomere 1.8 times as long as wide (Fig. 11D); legs mostly black (Fig. 14F); body pile pale yellow to gray. Male: metafemur about 3.4 times longer than wide, covered with long pilosity (Fig. 14F); basotarsomere of metatarsus expanded, about 2 times broader than the second tarsomere (Figs 9D, 14F), ventrally with well-defined brush-like area of dense pile extended for more than 1/2 of its length (Fig. 9D); ventral margin of metatrochanter angular; sternum 4 with long laminate extensions on posterior margin (Fig. 5C); male genitalia: anterior surstyle lobe rectangular, posterior surstyle lobe trapezoidal (Fig. 24D: al, pl); ejaculatory apodeme longer than broad (Fig. 25B: ea); lingula small and narrow (Fig. 25B: l).

Differs from *Merodon namaghijamii* Vujić, Likov & Radenković **sp. nov.** and *M. turkestanicus* by holoptic eyes, eye contiguity about 10 facets long (Fig. 30C), while in *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** and *M. turkestanicus* eyes dichoptic (Fig. 31E, G) or shortly connected by distance of 1–5 facets long (Fig. 31F). Similar to *M. tarsatus*, but differs with less incrassate basotarsomere of metaleg (Fig. 9D versus 6L), male genitalia: ejaculatory apodeme longer than broad in *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** (Fig. 25B: ea), while broader than long in *M. tarsatus* (Fig. 2A, B: ea), and by molecular data (Figs 33, 34).

Description. MALE. Head: Antenna black; basoflagellomere (Fig. 11D) about 1.8 times as long as wide, about 2 times as long as pedicel, more or less straight

dorsally, tapering to apex; fossette dorsolateral and large (Fig. 11D); arista dark and thickened at basal third; face and frons black with gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin black, with sparse microtrichia; lunule shiny black to brown, bare; eye contiguity about 10 facets long; vertex isosceles, shiny black; vertex with long, pale yellow-whitish pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with gray-yellow pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 30C); vertical triangle: eye contiguity: frons = 2.5 : 1 : 2. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect yellow pile; scutum without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow pile; wings mostly covered with microtrichia; wing veins brown; calypter yellow; halter brown-yellow; legs mostly black, except partly brown-yellow tarsi, tibiae and apex of femora; pile on legs pale yellow; ventral margin of metatrochanter angular; metafemur moderately broad, about 3.4 times longer than wide, with long pile on ventral surface, about as long as width of metafemur, longer than pile on dorsal surface (Fig. 14F); apicomedial lamina on metatibia distinct, covered with very long yellow pile; basotarsomere of metatarsus expanded, about 2 times broader than second tarsomere (Figs 9D, 14F), ventrally with well-defined brush-like area of dense pile extended for more than 1/2 of its length (Fig. 9D). — **Abdomen:** About 1.4 times longer than mesonotum; terga dark brown to black; terga 2–4 without pollinose fasciae; pile on terga all yellow to gray-whitish; sterna dark brown, covered with long whitish-yellow pile. — **Male genitalia:** Anterior surstyle lobe oval to rectangular, covered with dense short pile (Fig. 24D, E: al); posterior surstyle lobe trapezoidal (Fig. 24D, E: pl); hypandrium sickle-shaped, without lateral projections; ejaculatory apodeme longer than broad (Fig. 25B: ea); lingula small and narrow (Fig. 25B: l). — **FEMALE.** Unknown.

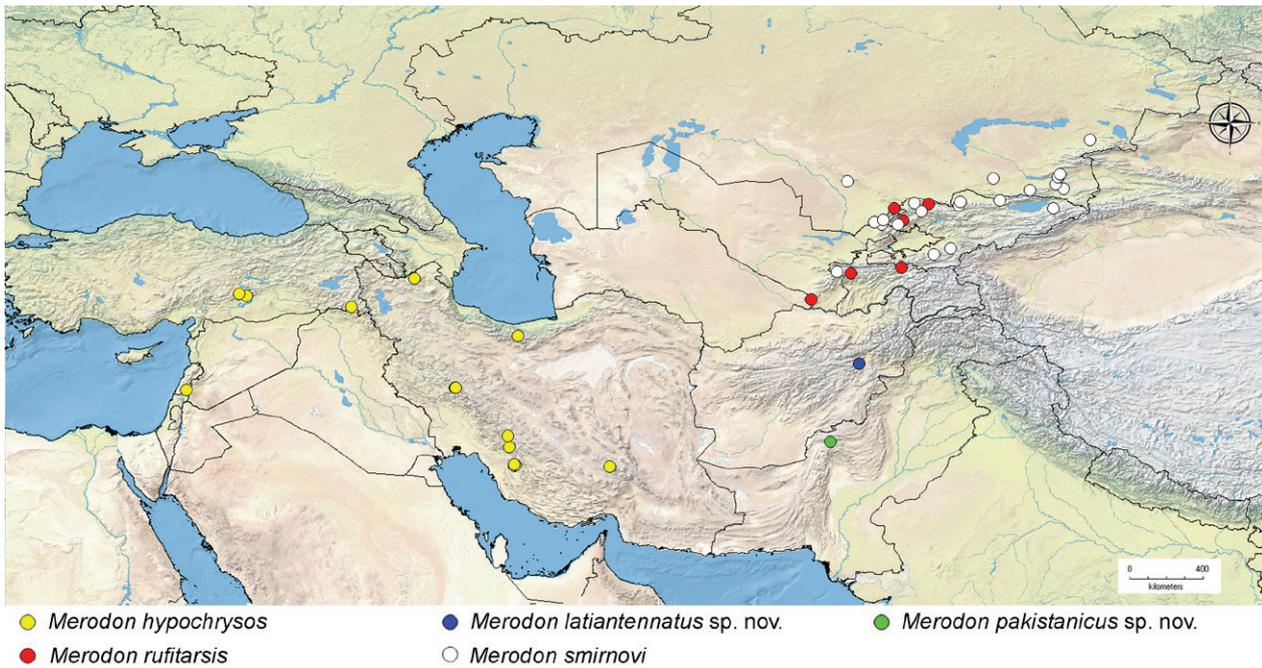


Figure 26. Distribution map of *M. hypochrysos*, *M. latiantennatus* Vujić, Popov & Prokhorov sp. nov., *M. pakistanicus* Vujić, Likov & Radenković sp. nov., *M. rufitarsis* and *M. smirnovi*.

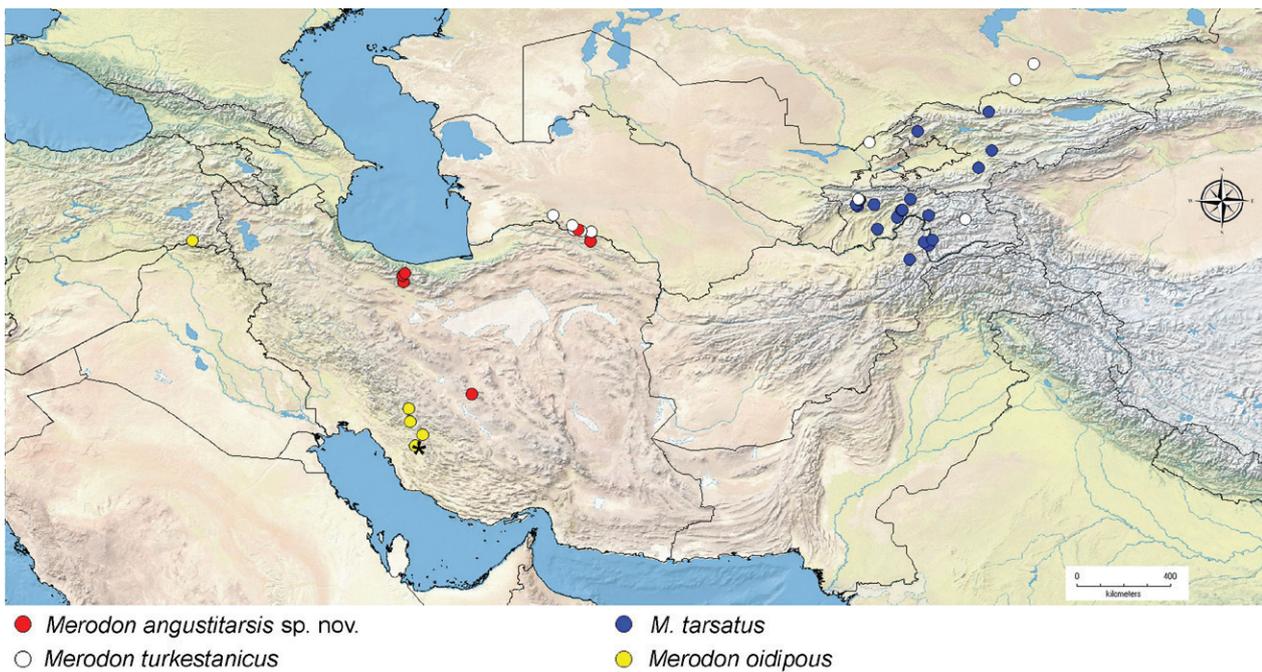


Figure 27. Distribution map of *M. angustitarsis* Vujić & Gilasian sp. nov., *M. tarsatus*, *M. turkestanicus* and *M. oidipous*. * marks overlapping locality of *M. angustitarsis* Vujić & Gilasian sp. nov. and *M. oidipous*.

Etymology. The new species “*pakistanicus*” was named after the country of origin of the holotype (Pakistan).

Distribution and ecological data. *Merodon pakistanicus* Vujić, Likov & Radenković sp. nov. has only been recorded in western Pakistan so far (Fig. 26). Its single known locality belongs to central-western part of Baluchistan xeric woodlands ecoregion (Olson et al. 2001), within the area of temperate coniferous and subtropical dry evergreen forests. The montane vegetation includes

Juniperus forests, open woodlands with *Pistacia* L., *Prunus*, *Berberis*, *Lonicera*, *Artemisia* spp., and *Olea europaea* subsp. *cuspidata* accompanied by *Dodonaea viscosa* as the transition between the subtropical woodlands and the alpine vegetation of sclerophyllous forest (WWF 2022). Climate of the collection site is slightly to very hot in summer and really cold in winter. Temperature rises as much as 35–40°C in summer and drops to -15°C in winter. Dry warm days and cool nights are common in the summertime season. Most of the rain falls in winter

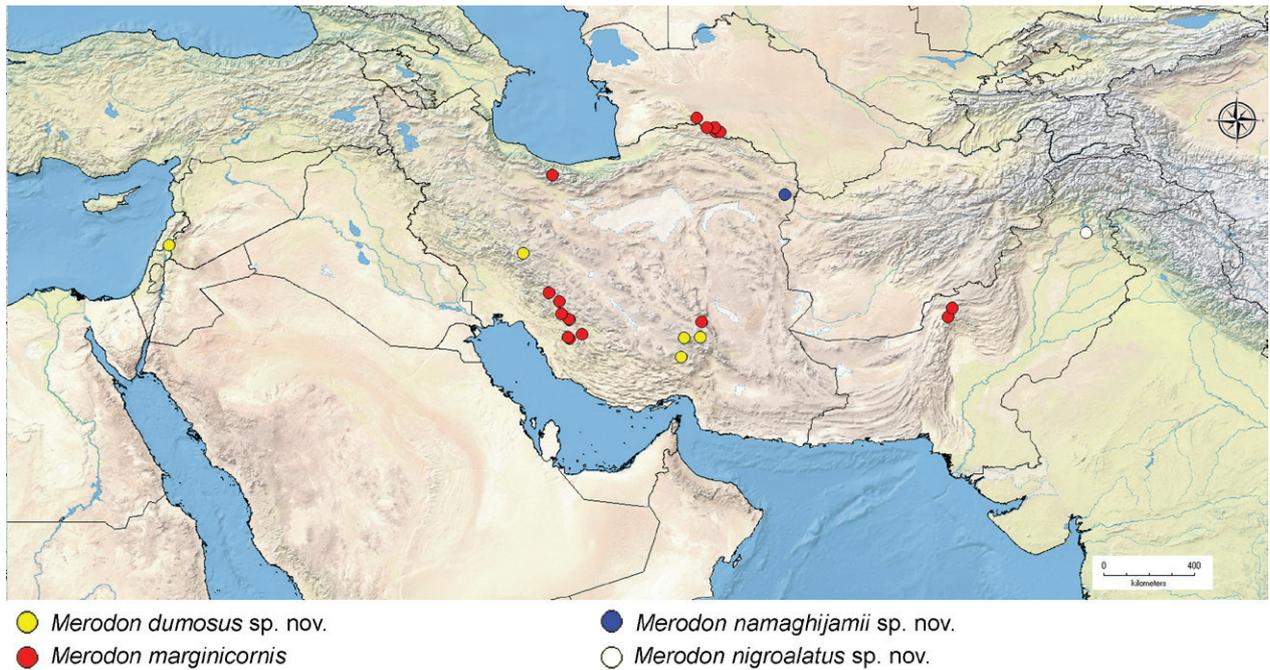


Figure 28. Distribution map of *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, *M. marginicornis* and *M. nigroalatus* Vujić, Likov & Radenković **sp. nov.**

and ranges between 50–300 mm annually. Mostly apple orchards are grown with wheat (*Triticum aestivum*) and Berseem (*Trifolium alexandrinum*) intercropped. On the basis of our data the flight period is May.

Merodon rufitarsis Sack, 1913

Figs 5D, 11E, 13E, 15C, 16F, 19C, 21D, 22D–F, 26, 30D

Merodon fulcratus Sack 1913, subsp. *rufitarsis* Sack 1913: 438.

Type locality. Tajikistan, the Alajsski Mountains.

Type material examined. *Holotype*: TAJIKISTAN • ♂; original label: ‘Alai mont’ Hurkmans (1993): the Alajasski Mountains, Tadzshikistan, approx. 39°30’N, 71 to 73°E (ZHMB).

Additional material examined. KAZAKHSTAN • 1 ♀; Ak-su-Zhabagly; 42°17’33”N, 70°40’15”E; 1400–1500 m a.s.l.; 4 Jun. 1996; Dolin W. leg.; M.H. coll. 02575. — KYRGYZSTAN • 1 ♀; 40 km S of Jany Bazar; 41°42’00”N, 71°06’00”E; 8–11 Jun. 1995; Halada J. leg.; AM-05-216; NBCN 02576 • 1 ♂; Tash-Arik, 11 km E of Talas; 42°31’00”N, 72°22’00”E; 4 Jul. 1992; Halada J. leg.; NBCN 04217. — TAJIKISTAN • 1 ♂; Sughd Province, Iskanderkul, Sarytag Village; 39°05’00”N, 68°32’00”E; 2374 m a.s.l.; 13 Jun. 2018; Barkalov A. leg.; SZMN • 1 ♂; same data as for preceding; 17 Jun. 2018. — TURKMENISTAN • 1 ♀; Kuhitang Mountain, Airibaba, plateau Dzheilyau; 37°47’19”N, 66°33’22”E; 1800–1900 m a.s.l.; 10 May 1991; Zinchenko V. leg.; SZMN 05802 • 1 ♂; near Chalatch Amudarva; 20 May 1996; Dolin W. leg.; M.H. coll. 02574.

Diagnosis. Medium sized (8–11 mm), medium long pilose, dark species, with olive-brown reflection (Figs 19C, 21D); antennae reddish-yellow to brown (Figs 11E, 13E),

basoflagellomere elongated, about 2 times as long as wide with more or less straight dorsal margin; femora mostly black, tibiae and tarsi entirely reddish-yellow, except brown medial ring on tibiae (Figs 15C, 16F); body pile whitish, yellow to gray. Male: metafemur broad, about 3.2 times longer than wide, covered with long and dense pilosity (Fig. 15C); basotarsomere of metatarsus less expanded, ventrally without well-defined brush-like area of dense pile; ventral margin of metatrochanter angular; sternum 4 with medium-size laminate extensions on posterior margin (Fig. 5D); male genitalia: surstyle lobe with deep invagination between lobes (Fig. 22D); anterior surstyle lobe narrow from lateral view, elongated (Fig. 22D: al); posterior surstyle lobe oval, beak-like (Fig. 22D: pl); ejaculatory apodeme longer than broad (Fig. 22F: ea); lingula very long and narrow (Fig. 22F: l). Female: metafemur broad, covered with long and dense pilosity (Fig. 16F).

Similar to *Merodon angustitarsis* Vujić & Gilasian **sp. nov.** from which differs by absence of ventrolateral row of setae on basotarsomere of metaleg, present in *M. angustitarsis* Vujić & Gilasian **sp. nov.** (Fig. 7A–C), and by very different shape of surstyle lobe of male genitalia (Fig. 22A, D). Similar in shape of male genitalia to *M. hypochrysos*, but differs with beak-like ventral margin of posterior surstyle lobe (Fig. 22D: pl), oval in *M. hypochrysos* (Fig. 22G: pl).

Re-description. MALE. Head: Antenna reddish-yellow to brown; basoflagellomere (Fig. 11E) yellowish, elongated, about 2 times as long as wide, about 2 times as long as pedicel, more or less straight dorsally, gradually tapering to apex; fossette dorsolateral and large (Fig. 11E); arista black and thickened at basal third; face and frons black with sparse gray microtrichia; face covered with dense

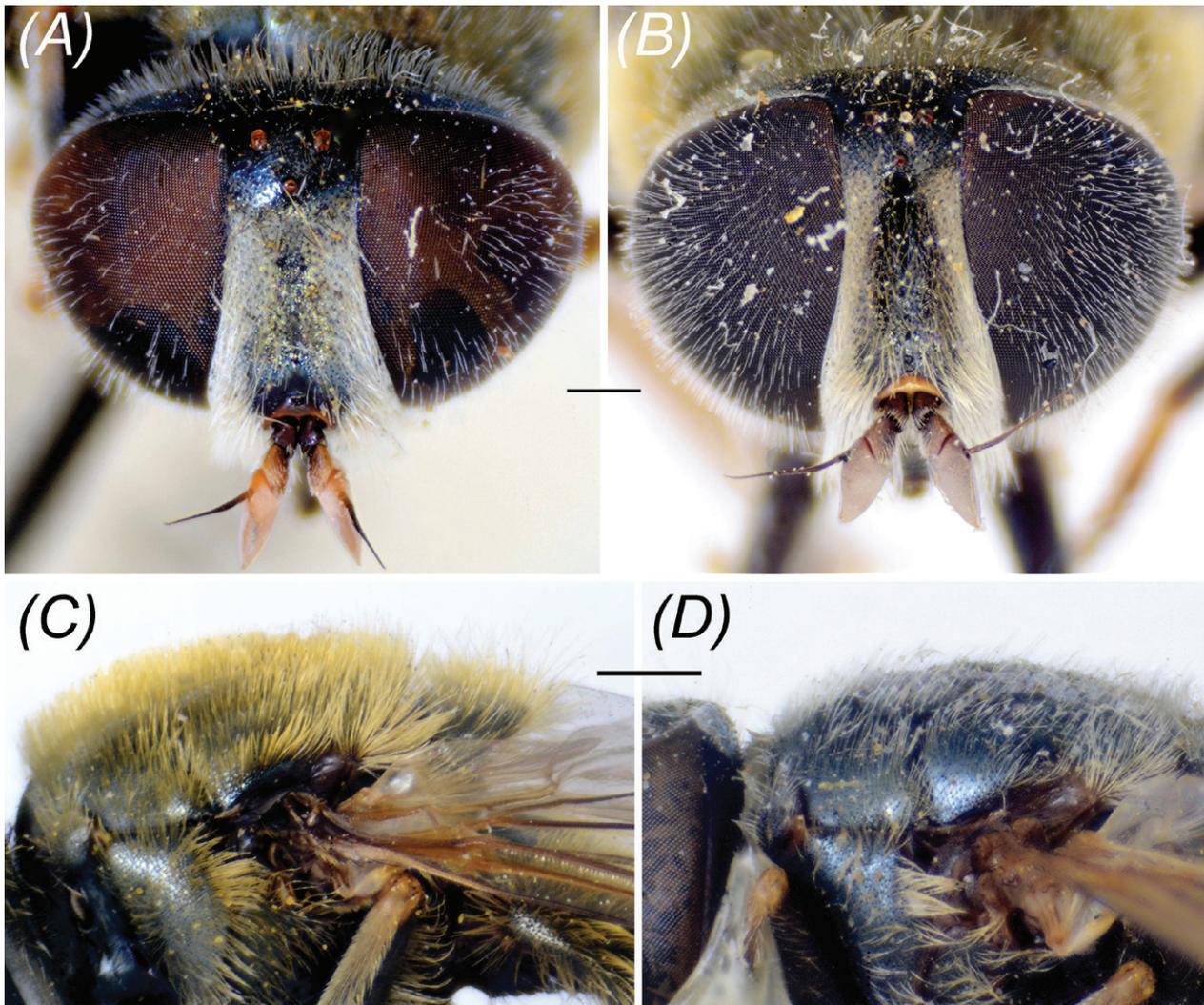


Figure 29. A, B Head of female, frontal view. A *M. angustitarsis* Vujić & Gilasian *sp. nov.*, B *M. dumosus* Vujić, Likov & Radenković *sp. nov.*, C, D Thorax of female, lateral view: C *M. tarsatus*, D *M. turkestanicus*. Scale bars: 0.5 mm (A, B), 1 mm (C, D).

whitish pile, frons with gray-yellowish pile; oral margin black; lunule shiny black to brown, bare; eye contiguity short, about 4–6 facets long; vertex isosceles, shiny black; vertex with long, whitish-gray pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with white-gray pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 30D); vertical triangle: eye contiguity: frons = 3–4 : 1 : 3–4. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect reddish-yellow to gray and white pile; scutum without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow to gray pile; wings mostly covered with microtrichia; wing veins brown-yellow; calypter pale yellow; halter yellow; femora mostly black, tibiae and tarsi entirely reddish-yellow, except brown medial ring on tibiae; pile on legs pale yellow; ventral margin of metatrochanter angular; metafemur broad, about as 3.5 times longer than wide, with long pile on ventral sur-

face, about half width of metafemur, longer than pile on dorsal surface (Fig. 15C); apicomedial lamina on metatibia medium long, covered with yellowish pile; basotarsomere of metatarsus about 1.2 times broader than second tarsomere, ventrally without well-defined brush-like area of dense pile. — **Abdomen:** About 1.3 times longer than mesonotum; terga dark brown to black; terga 2–4 without or with pair of indistinct, narrow, white pollinose fasciae; pile on terga yellow to gray-whitish (Fig. 19C); sterna dark brown, covered with long whitish pile. — **Male genitalia:** Anterior surstyle lobe narrow from lateral view, elongated (Fig. 22D: al); posterior surstyle lobe oval, beak-like (Fig. 22D: pl); ejaculatory apodeme longer than broad (Fig. 22F: ea); cercus rectangular (Fig. 22D: c); hypandrium sickle-shaped, without lateral projections; lingula very long and narrow (Fig. 22F: l). — **FEMALE.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere about 1.5 times longer than wide, with slightly rounded apex (Fig. 13E); frons with pollinose vittae along eye margins; frons covered with mostly yellow pile; ocellar triangle covered with black and yellowish-gray pile; terga covered with gray-whitish to yellow pilosity; pollinose fasciae on terga

2–4 distinct (Fig. 21D); all tarsi bright yellow; basotarsomere of metaleg narrow, without spine-like setae along ventrolateral margin (Fig. 16F).

Distribution and ecological data. *Merodon rufitarsis* occurs in northwestern Kyrgyzstan, Tajikistan, eastern Turkmenistan and southern Kazakhstan (Fig. 26). Localities where *M. rufitarsis* was found belong to three ecoregions: Tian Shan foothill arid steppe, Gissaro-Alai open woodlands and Alai-Western Tian Shan steppe (Olson et al. 2001). A variety of landscapes of Gissaro-Alai open woodlands range from foothill semideserts to alpine meadows, combined with characteristic mountain forests (WWF 2022). Many geophytes (e.g., *Allium* L., *Iris*, *Tulipa*, *Gagea*, *Eremurus*, *Rheum*) are present. The steppe grasses grow alongside wild fruit and nut forests, and at the higher altitudes a mosaic of open coniferous evergreen *Juniperus* forests forms the montane belt. The valleys of mountain rivers house riparian forests. Tall-forb vegetation of the localities of *M. rufitarsis* in the Pamir-Alai and western Tian Shan Mountains in Tajikistan and Kyrgyzstan includes: mesic mown and grazed subalpine meadows and pastures on fertile soils, forb rich mesophilous tall-forb communities of the western Pamir-Alai Mountains, scree-like tall-forb communities of the eastern Irano-Turanian region, dry tall-forb communities of the subhumid zone of the eastern Irano-Turanian region (Nowak et al. 2020a). The habitat of adults of *M. rufitarsis* in Tajikistan is presented in Fig. 32C. On the basis of our data the flight period is May to early July.

Remarks. This species was described as subspecies of *Merodon fulcratus*, but Hurkmans (1993) revised the status of the holotype, established it as distinct and valid species, and classified it as a member of “*alexexi* group”.

Merodon smirnovi Paramonov, 1927, stat. rev.

Figs 5E, 6A–F, 10E, 12C, 15D, 17C, 19D, 24A–C, 25A, 26, 30F, 35A, B

Merodon smirnovi Paramonov, 1927: 76 (= 320).

Type locality. Turkestan, Tashkent.

Type material examined. *Lectotype* (designated here in order to fix identity of the species): UZBEKISTAN • 1 ♂; Turkestan, d. Tashkent, Ak-Tash; 21 Jun. 1925; Smirnov E.S. leg.; SIZK [specimen dry pinned in good condition, left fourth and fifth tarsomeres of metaleg missing, genitalia in separate microvial]. Original labels: “Ak-Tash / d. Tashkent / Turkestan / 21.VI.25. Smirnov I.” [yellowish, pale violet ink, black-bordered label], “*Merodon / smirnovi* n. sp. / ♂. Cotypus / Paramonov. det” [pink double black-bordered, pale violet ink label], “Lectotypus / *Merodon smirnovi* Param., 1927 G.V. Popov des. 2007” [red label], “02568”. — *Paralectotype* (designated here): UZBEKISTAN • 1 ♀; Turkestan, d. Tashkent, Ak-Tash; 21 Jun. 1925; Smirnov E.S. leg.; SIZK [specimen dry pinned in very good condition]. Original label:

“Ak-Tash / d. Tashkent / Turkestan / 21.VI.25. Smirnov I.” [yellowish, pale violet ink, black-bordered label], “*Merodon / smirnovi* n. sp. / ♀ Cotypus / Paramonov. det” [pink double black-bordered, pale violet ink label], “*Paralectotypus / Merodon smirnovi* Param., 1927 G.V. Popov des. 2007” [red label], “02569”.

Additional material examined. KAZAKHSTAN • 1 ♀; Fabritchny, 40 km E of Alma Ata; 43°13'21"N, 77°20'54"E; 23 Jun. 1992; Haladada M. leg.; NBCN 02553 • 1 ♂; Karatau Mountains, 15 km N of Atabaj; 43°38'39"N, 68°19'45"E; 550–700 m a.s.l.; 9 May 1994; Merz B. leg.; NBCN 02550 • 2 ♂♂; Almaty Region, Raiymbek District, Charyn River (also known Sharyn River); 43°17'47"N, 78°59'24"E; 20 May 2003; Selin A. leg.; S.K. coll. 02549, 02556 • 1 ♀; same data as for preceding; S.K. coll. 02557 • 1 ♀; Almaty Region, Enbekshikazakh District, Kokpek; 43°29'56"N, 78°37'10"E; 21 May 2003; Selin A. leg.; S.K. coll. 02555 • 1 ♂; Almaty Region, Tamgaly; 43°48'07"N, 75°32'02"E; 886 m a.s.l.; 8 May 2015; Bot S. leg.; S.B. coll. 25467 • 2 ♀♀; same data as for preceding; S.B. coll. 25468, 25469 • 1 ♂; Almaty Region, Altyn-Emel National Park, Kalkan field station; 43°51'00"N, 78°45'00"E; 29 Apr. 2012; Barkalov A. leg.; on flowers on *Ferula* sp.; SZMN 05811 • 1 ♀; same data as for preceding; SZMN 05814 • 1 ♂; Almaty Region, Altyn-Emel National Park, near Ayak-Kalkan mount; 43°52'00"N, 78°43'00"E; 23–30 Apr. 2012; Barkalov A., Danilov Yu. leg.; SZMN • 33 ♂♂, 26 ♀♀; Almaty Region, Altyn-Emel National Park; 23 Apr.–4 May 2012; Barkalov A., Danilov Yu. N., Zinchenko V. leg.; on *Ferula* sp.; SZMN • 1 ♀; Almaty Province, Sarkand District, Koylyk; 45°41'30"N, 80°18'13"E; 25 May 2004; Selin A. leg.; S.K. coll. 02552. — KYRGYZSTAN • 1 ♀; Talasskij mountain ridge; 12 Jul. 1964; Shabalina leg.; SZMN • 1 ♂, 1 ♀; Alay (Alai Range), valley of Gulcha river; 22 Jun. 1963; Peck L. leg.; SZMN • 1 ♂, 1 ♀; Alay (Alai Range), Kirgizata river; 5 Jun. 1965; Peck L. leg.; SZMN • 2 ♂; Chatkal Range, Chap-Chyma pass; 41°31'00"N, 70°50'00"E; 2400 m a.s.l.; 2 Jul. 1966; Milko D. leg.; SZMN • 4 ♂♂, 2 ♀♀; Environs of Ala-Köl lake; 42°17'46"N, 78°30'17"E; 19 Jun. 1966, 12 Jul. 1968; Ibraimova, Peck L. leg.; SZMN • 1 ♀; 12 km S Sosnovka, Kara-Balta; 42°39'00"N, 73°54'00"E; 1630 m a.s.l.; 28 Jun. 1997; Dolin W. leg.; NHMW 02554 • 1 ♂; Chüy Region, valley of Kara-Balta river; 1800 m a.s.l.; 28 May 1995; Milko D. leg.; SZMN • 1 ♂; Chüy Region, near Bishkek, Holodnaja Woda; 42°42'00"N, 75°51'00"E; 1260 m a.s.l.; 12 Jun. 1998; Hartmann P. leg.; D.D. coll. 02551 • 1 ♂; vic. of Talas, Talas River; 42°31'00"N, 72°14'00"E; 1280 m a.s.l.; 16 Jun. 2000; Pak O. leg.; flood-plane forest; SIZK. — TAJIKISTAN • 1 ♂; Zeravshan Mountain, Marguzorskie Lakes, Padrut settlement; 39°10'09"N, 67°50'14"E; 2100 m a.s.l.; 29 Jun. 1987; Zaitsev V. leg.; SZMN. — UZBEKISTAN • 1 ♀; Tashkent Region, Bostanlik District, Chimgan; 41°30'58"N, 70°01'44"E; 1820 m a.s.l.; 12 May 2008; Selin A. leg.; MZH G0932 • 1 ♀; Tashkent Region, Bostanlik District, Chimgan, 85 km NE of Tashkent; 41°43'18"N, 70°07'39"E; 1700–2000 m a.s.l.; 9 Jun. 1982; Chvála M. leg.; NMPC 18247.

Diagnosis. Medium sized to large (9–13 mm), long pilose, dark species with olive-brown reflection (Fig. 19D); antennae dark brown to reddish-brown, basoflagellomere elongated, about 2.5 times as long as wide (Figs 10E, 12C); tibiae and tarsi partly reddish-yellow (Figs 15D, 17C); body pile pale yellow to gray; sterna with short white pilosity, except sternum 2 with medial patch of long whitish pile (Fig. 35A, B). Male: metafemur about 3.5 times longer than wide, covered with long whitish pilosity (Fig. 15D); basotarsomere of metatarsus expanded,

about 3 times broader than the second tarsomere (Fig. 6A, B), ventrally with well-defined brush-like area of dense pile extended for about 2/3 of its length (Fig. 6A, B); ventral margin of metatrochanter strongly angular; sternum 4 with very elongated laminate extensions on posterior margin (Fig. 5E); male genitalia: anterior surstyle lobe rectangular, while posterior surstyle lobe oval to triangular (since intraspecific variability), with angular ventral margin (Fig. 24A, C: al, pl); ejaculatory apodeme large, broader than long (Fig. 25A: ea); lingula very elongated and narrow (Fig. 25A: l). Female: tarsi yellow to reddish (Fig. 17C).

Similar to *Merodon tarsatus* from which differs in sternum 2 with medial patch of long white pile (Fig. 35A, B), while pile are uniformly distributed on sternum 2 in *M. tarsatus* (Fig. 35C); by partly reddish-yellow tibiae and tarsi (usually black in *M. tarsatus*); by longer basoflagellomere, more than 2.5 times as long as wide in *M. smirnovi* (Fig. 10E), while less than 2.4 times as long as wide in *M. tarsatus* (Fig. 11F); in male basotarsomere of metaleg with ventral area of strong setae extends on about 2/3 (Fig. 6A, B), while in *M. tarsatus* on 3/4 (Fig. 6L); and by male genitalia: angular ventral margin of posterior surstyle lobe in *M. smirnovi* (Fig. 24A, C: pl), while ventral margin of posterior surstyle lobe oval in *M. tarsatus* (Fig. 1A, C, D: pl). Differs from male of *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** by holoptic eyes, eye contiguity more than 6 facets long in *M. smirnovi* (Fig. 30F), while in *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** eyes dichoptic (Fig. 31G); by partly reddish-yellow tarsi, black in *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**; and by different shape of posterior surstyle lobe (Fig. 24A, C: pl, 1G: pl). Similar to *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, but male differ by strongly incrassate basotarsomere of metaleg (Fig. 6A, B), while is less incrassate in *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** (Fig. 9D); and by different shape of male genitalia (Figs 24A–C, 25A). Differs from *M. turkestanicus* by the shape of posterior surstyle lobe (Figs 1E: pl, 24A, C: pl); by eye contiguity more than 10 facets long (Fig. 30F) in male, while in *M. turkestanicus* eyes dichoptic or shortly connected by distance of 1–5 facets long (Fig. 31E, F).

Re-description. MALE. Head: Antenna dark brown to reddish-brown; basoflagellomere (Fig. 10E) elongated about 2.5 times as long as wide, more than 2 times as long as pedicel, more or less straight dorsally, tapering to apex; fossette dorsolateral and large (Fig. 10E); arista dark and thickened at basal third; face and frons black to dark blue with gray microtrichia; face covered with dense whitish pile, frons with gray-yellowish pile; oral margin with sparse microtrichia; lunule shiny brown, bare; eye contiguity about 6–14 facets long (Fig. 30F); vertex isosceles, shiny black; vertex with long, pale yellow-whitish pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with gray-yellow pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 30F); vertical triangle: eye contiguity: frons = 2.5 : 1 : 1.5–2. —

Thorax: Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect, yellow pile; scutum without or with indistinct pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow pile; wings entirely covered with microtrichia; wing veins brown; calypter pale yellow; halter yellow; femora mostly black, tibiae and tarsi partly reddish-yellow; pile on legs pale yellow; ventral margin of metatrochanter strongly angular; metafemur broad, about 3.5 times longer than wide, with long pile on ventral surface, about as wide as metafemur, longer than pile on dorsal surface (Fig. 15D); apicomedial lamina on metatibia distinct, covered with very long yellow pile; basotarsomere of metatarsus expanded, more than 3 times broader than second tarsomere (Figs 6A, B, 15D), ventrally with well-defined brush-like area of dense pile extended for about 2/3 of its length (Fig. 6A, B). — **Abdomen:** About 1.3 times longer than mesonotum; terga dark brown to black; terga 2–4 each with pair of narrow, white pollinose fasciae; pile on terga all yellow to gray-whitish (Fig. 19D); sterna dark brown, covered with short whitish-yellow pile, except sternum 2 with medial patch of long white pile (Fig. 35A). — **Male genitalia:** Anterior surstyle lobe rectangular, about 1.5 times longer than wide, covered with dense short pile (Fig. 24A, C: al); posterior surstyle lobe oval to triangular, with angular ventral margin (Fig. 24A, C: pl); cercus rectangular (Fig. 24A: c); hypandrium sickle-shaped, without lateral projections; ejaculatory apodeme large, broader than long (Fig. 25A: ea); lingula very elongated and narrow (Fig. 25A: l). — **FEMALE.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere with slightly rounded apex, about 2.7 times longer than wide (Fig. 12C); frons with pollinose vittae along eye margins; frons covered with mostly gray-yellow pile; ocellar triangle covered with black pile; terga covered with gray-whitish to yellow pilosity; medial part of terga 2–4 usually with short adpressed black pile in some specimens; pollinose fasciae on terga 2–4 distinct; basotarsomere of metatarsus less expanded, ventrally without well-defined brush-like area of dense pile and without distinct spine-like setae within ventrolateral row of setae (Fig. 6C–F); sternum 2 with sparse medial patch of long pile (Fig. 35B).

Distribution and ecological data. *Merodon smirnovi* occurs in Kyrgyzstan, southeastern Kazakhstan, north-eastern Uzbekistan (near borders with Kyrgyzstan and Kazakhstan) and western Tajikistan (Fig. 26). Its localities are within four ecoregions: Tian Shan foothill arid steppe, Tian Shan montane steppe and meadows, Central Asian northern desert, and Gissaro-Alai open woodlands (Olson et al. 2001). The latter ecoregion includes localities in Uzbekistan within the tau (mid-mountain) zone distinguished by the dominance of *Juniperus* forests and presence of deciduous forests, and within the upper adyr (lowlands and foothills) zone characterized by the

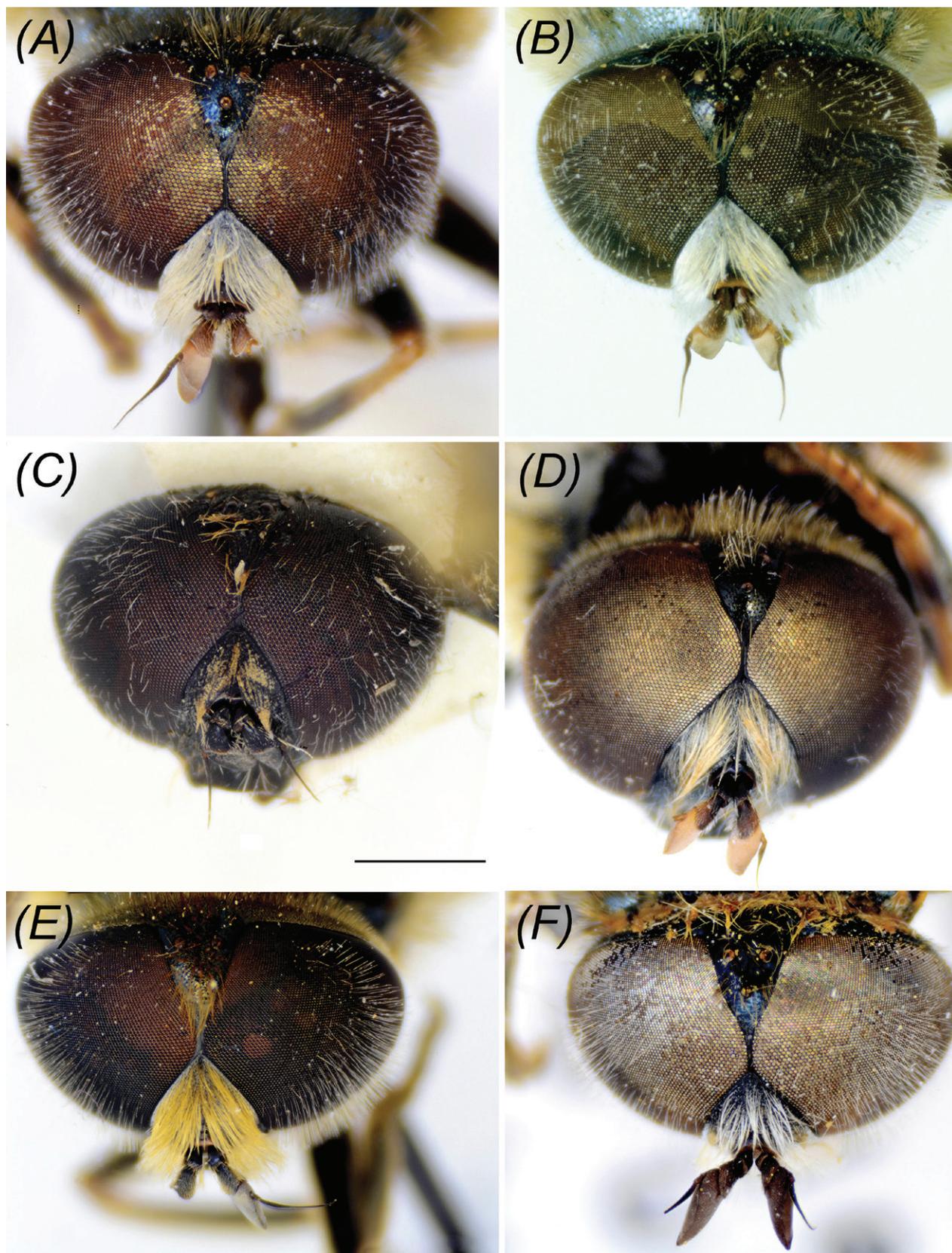


Figure 30. Head of male, dorsal view. **A** *M. angustitarsis* Vujić & Gilasian **sp. nov.**, **B** *M. oidipous*, **C** *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, **D** *M. rufitarsis*, **E** *M. tarsatus*, **F** *M. smirnovi*. Scale bar: 1 mm.

ephemeroid vegetation, dry forb steppes, and shrub communities (Sennikov et al. 2016). A variety of landscapes of Gissaro-Alai open woodlands in Tajikistan and Kyrgyzstan range from foothill semideserts and sage deserts

(*Artemisia* spp.) to alpine meadows; the steppe grasses grow alongside wild fruit and nut forests, and at the higher altitudes a mosaic of *Juniperus* forests forms the montane belt. Many geophytes (e.g., *Allium*, *Iris*, *Tuli-*

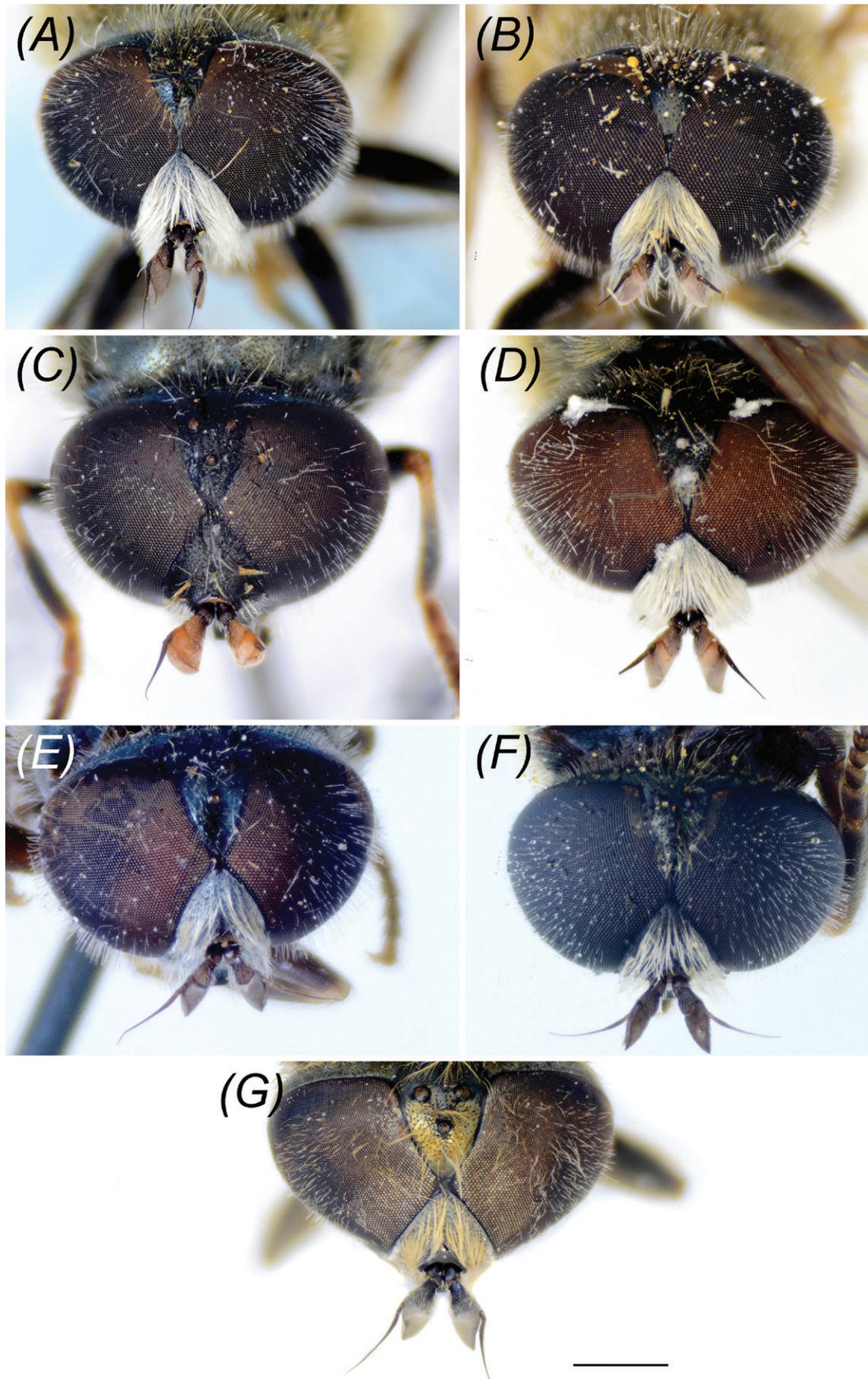


Figure 31. Head of male, dorsal view. **A** *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, **B** *M. hypochrysos*, **C** *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, **D** *M. marginicornis*, **E**, **F** *M. turkestanicus*, **G** *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** Scale bar: 1 mm.

pa, *Eremurus*) are present. The valleys of mountain rivers house riparian forests. Tian Shan foothill arid steppe and montane steppe and meadows vegetation in Kyrgyzstan and Kazakhstan includes *Artemisia* spp. steppe, dry sparse *Stipa* spp. and *Festuca* spp. grassland, *Kobresia* spp. meadows in the alpine zone, intermixed with *Picea* spp. forest stands in the subalpine zone (WWF 2022). Semidesert ecosystems of southern Kazakhstan (and true deserts further south) are characterized by *Artemisia* spp.; *Calligonum* L. and *Astragalus* L. are widespread. In the West Tien-Shan, there are characteristic mountain riparian forests, xerophile woodlands, spruce forests, *Juniper* forests and wild fruit and nut forests. Tall-forb vegetation of the localities of *M. smirnovi* in the Pamir-Alai and western Tian Shan Mountains in Tajikistan and Kyrgyzstan includes: mesic mown and grazed subalpine meadows and pastures on fertile soils, forb rich mesophilous tall-forb communities of the western Pamir-Alai Mountains, scree-like tall-forb communities of the eastern Irano-Turanian region, and dry tall-forb communities of the subhumid zone of the eastern Irano-Turanian region (Nowak et al. 2020a). *Ferula* sp. (Apiaceae) was noted as a flower visited by the adults of *M. smirnovi* in Kazakhstan (Fig. 36). On the basis of our data the flight period is from April to July.

Remarks. Original description was based on two syntypes from Uzbekistan (Paramonov 1927). Type material studied. *Merodon smirnovi* was revised by Hurkmans (1993) without examination of types and he proposed synonymy with *M. tarsatus*. We established an independent position of this taxon and revised its status from Hurkmans (1993) and confirmed the validity of the species.

Merodon tarsatus Sack, 1913

Figs 1A–D, 2A, B, 3B, 4F, 6L–N, 11F, 13F, 15E, F, 17B, 19E, 21E, 27, 29C, 30E, 35C

Merodon tarsatus Sack, 1913: 437.

Type locality. Tajikistan, Pamir.

Type material examined. *Lectotype:* syntype cited as “holotype” in Hurkmans (1993) is designated here as lectotype: TAJIKISTAN • 1 ♂; original label: “Pamir 49409 / *Mer. tarsatus* Sack det. Sack” (ZHMB).

Additional material examined. AFGHANISTAN • 1 ♀; Badakhschan, Schiva high steppe; 7 Jul. 1953; Klapperich J. leg.; Bañkowska R. det. as *Merodon smirnovi* Paramonov; NMPC 18240 • 3 ♂♂; Badakhschan, Sarekanda; 2800 m a.s.l.; 21 Jul. 1953; Klapperich J. leg.; Bañkowska R. det. as *Merodon smirnovi* Paramonov; NMPC 18234, 18236, 18231 • 4 ♀♀; same data as for preceding; NMPC 18233, 18235, 18237, 18238. — KYRGYZSTAN • 1 ♂; Alay (Alai Range), valley of Gulcha river; 14 Jun. 1963; Peck L. leg.; SZMN • 1 ♂; Alay (Alai Range), Gulcha; 2 Jun. 1965; Peck L.V. leg.; SZMN 05812 • 1 ♀; same data as for preceding; SZMN 05813 • 1 ♂; Chüy Region, valley of Kara-Balta river; 1800 m a.s.l.; 30 May 1995; Milko D. leg.; SZMN • 1 ♀; 40 km S of Jany Bazar; 41°42′00″N, 71°06′00″E; 8–11 Jun. 1995; Halada J. leg.;

NBCN 02578 • 1 ♂; near Fergansky mountain range, Wabhang 2; 2800 m a.s.l.; 14 Jun. 1997; Dolin W. leg.; M.H. coll. 02577. — TAJIKISTAN • 5 ♂♂, 1 ♀; Gorno Badakhshan, Environs of Barchadev settlement (3–7 km in gorge Bijondara from Barchadev village); 37°17′00″N, 71°31′00″E; 2640–2748 m a.s.l.; 27 Jun.–30 Jul. 2021; Zinchenko V. leg.; SZMN • 13 ♂♂; same data as for preceding; 27 Jun.–7 Jul. 2021; Barkalov A. leg. • 1 ♂; Gorno Badakhshan, Bogevdara gorge; 2700 m a.s.l.; 29 Jun. 2021; Barkalov A. leg.; SZMN • 1 ♂; Tavildara District, near Tavildara, Dehi-Kolon village; 38°23′24″N, 70°18′36″E; 24–27 May 2016; Danilov Yu., Barkalov A., Zinchenko V. leg.; SZMN • 111 ♂♂, 45 ♀♀; same data as for preceding; 29 May 2016 • 1 ♂; Tavildara District, near Tavildara, Dehi-Kolon village; 38°39′00″N, 70°31′00″E; 7–8 May 2016; Danilov Yu., Barkalov A., Zinchenko V. leg.; SZMN 15139 • 1 ♀; same data as for preceding; SZMN 15137 • 1 ♂; Tavildara District, Dehi-Kolon village; 38°39′00″N, 70°31′12″E; 1800–2000 m a.s.l.; 20 May 2016; Barkalov A. leg.; SZMN 15138 • 1 ♂; same data as for preceding; 24 May 2016; SZMN 15135 • 1 ♀; same data as for preceding; SZMN 15136 • 2 ♂♂; Environs of Tavildara settlement (4–6 km S Tavildara settlement); 38°39′00″N, 70°31′00″E; 1965 m a.s.l.; 17–22 Jun. 2021; Barkalov A. leg.; SZMN • 1 ♀; Tavildara District, N spurs of Hazratisho Ridge, Belanga River valley; 38°39′36″N, 70°30′36″E; 1880–1975 m a.s.l.; 19 May 2016; Zinchenko V. leg.; SZMN 18350 • 34 ♂♂, 18 ♀♀; Tavildara District, Sary Jangal Village; 38°39′36″N, 70°29′24″E; 1826–1945 m; 25 May 2016; Barkalov A., Danilov Yu., Zinchenko V. leg.; SZMN • 2 ♂♂, 1 ♀; Alay (Alai Range), 30 km NE of Lyakhsh; 38°29′05″N, 71°31′34″E; 2700 m a.s.l.; 17 Jun. 1975; Zaitsev V. leg.; SZMN • 5 ♂♂, 1 ♀; Kondara gorge; 38°48′00″N, 68°48′00″E; 2190 m a.s.l.; 25–27 May 2021; Barkalov A., Zinchenko V. leg.; SZMN • 1 ♂; same data as for preceding; 27 May 2021; Zinchenko V. leg. • 2 ♀♀; Kondara gorge, Varzob river; 29 May 1934; Gussakowski W. leg.; SZMN • 2 ♂♂, 2 ♀♀; Kondara gorge, Varzob river; 5–8 Jun. 1943; Stackelberg A.A. leg.; SZMN • 1 ♀; 35 km N Dushanbe, Kondara; 38°54′01″N, 68°44′22″E; 29–30 Jun. 1979; Pulawski W.J. leg.; USNM ENT 00036586, 05139 (NMNH) • 1 ♀; same data as for preceding; 1 Jul. 1979; USNM ENT 00036587, 05138 • 1 ♂; same data as for preceding; 2 Jul. 1979; USNM ENT 00036588, 05136 • 1 ♀; same data as for preceding; USNM ENT 00036589, 05137 • 1 ♂; same data as for preceding; 4 Jul. 1979; USNM ENT 00036590, 05135 • 1 ♂; same data as for preceding; 5 Jul. 1979; USNM ENT 00036591, 05134 • 1 ♂; Varzob gorge, 3–7 km NE of village Kalon; 39°03′36″N, 68°52′12″E; 2356 m a.s.l.; 28 Jun. 2018; Barkalov A. leg.; SZMN • 11 ♂♂, 1 ♀; same data as for preceding; 3–4 Jul. 2018 • 1 ♀; same data as for preceding; 2440 m a.s.l.; 1–4 Jul. 2017 • 1 ♂; same data as for preceding; 5 Jul. 2017 • 1 ♂; same data as for preceding; 2358 m a.s.l.; 3 Jul. 2018 • 114 ♂♂, 23 ♀♀; same data as for preceding; 2358–2440 m a.s.l.; 7 Jun.–12 Jul. 2017, 2018; Barkalov A., Zinchenko V. leg. • 17 ♂♂, 6 ♀♀; same data as for preceding; 7–9 Jun. 2021; Zinchenko V. leg. • 1 ♂; 15 km Tojikobod; 39°06′23″N, 70°49′43″E; 1700 m a.s.l.; 12 Jun. 1975; Zaitsev V. leg.; SZMN • 1 ♂; Hissar (Gissar) Mountains; 6 Jun. 1943; Stackelberg A.A. leg.; Museum Leiden Collectie Van Doesburg rec. 1975; Stackelberg det. as *Lampetia turkestanica* Paramonov; NBCN 02545 • 1 ♀; Hissar (Gissar) Mountains; 2 May 1944; Stackelberg A.A. leg.; Museum Leiden Collectie Van Doesburg rec. 1973; Van Doesburg det. as *Lampetia turkestanica* Paramonov; NBCN 02548 • 3 ♂♂, 1 ♀; Hissar (Gissar) Mountains, Kvak; 6 Jul. 1964; Zaitsev V. leg.; SZMN • 1 ♂, 1 ♀; Khodzha Obi Garm gorge; 30 May 2021; Zinchenko V. leg.; SZMN • 1 ♂; Hodzhamumin mountain, 7 km SSE Vose (Khulbuk); 37°44′22″N, 69°40′41″E; 700–800 m a.s.l.; 2 Jun. 2003; Perepechayenko V. leg.; steppe slopes, *Ferula* sp.; SIZK • 2 ♀♀; same data as for preceding; 1200 m a.s.l.; 28 May 2004;

Papaver sp. • 2 ♂♂, 2 ♀♀; Ganishob kishlak 10 km SW Tajikabad; 39°02'50"N, 70°47'54"E; 2100 m a.s.l.; 18 Jun. 2003; Pak O. leg.; steppe slope, *Prangos pabularia*; SIZK • 1 ♀; 3 km S Mazarkoza Pass, 25 km NE Tursunzade; 38°45'12"N, 68°27'59"E; 2000 m a.s.l.; 20 Jun. 2004; Perepechayenko V. leg.; *Juniperus* belt; SIZK • 1 ♂; Romit env.; 38°42'32"N, 69°17'46"E; 1175 m a.s.l.; 14–16 Jun. 2010; Tomkovich K. leg.; SIZK.

Diagnosis. Medium sized to large (9–13 mm), long pilose, dark species, with olive-brown reflection (Figs 19E, 21E); antennae dark brown; basoflagellomere elongated, 2.2–2.4 times as long as wide (Figs 11F, 13F); legs mostly black; tarsi dark (Figs 15E, F, 17B); body pile pale yellow to gray. Male: metafemur broad, more or less curved, about 2.5–3.5 times longer than wide, covered with long pilosity (Fig. 15E, F); basotarsomere of metatarsus expanded, about 3 times broader than the second tarsomere (Figs 6L, M, 15E, F), ventrally with well-defined brush-like area of dense pile extended for 3/4 of its length (Fig. 6L); ventral margin of metatrochanter angular; sternum 4 with very long laminate extension on posterior margin (Fig. 4F); male genitalia: anterior and posterior surstyle lobes oval (intraspecific variability in shape of posterior surstyle lobe, from oval to triangular) (Fig. 1A–D: al, pl); ejaculatory apodeme large, broader than long (Fig. 2A, B: ea); lingula very narrow and short (Fig. 2A: l).

Similar to *Merodon smirnovi* from which differs in sternum 2 with pile uniformly distributed (Fig. 35C), while sternum 2 with medial patch of long white pile in *M. smirnovi* (Fig. 35A, B); usually black tarsi and tibiae in *M. tarsatus* (Figs 15E, F, 17B), while is partly reddish-yellow in *M. smirnovi* (Figs 15D, 17C); basotarsomere of metaleg in male with ventral brush-like area of dense pile extends for 3/4 of its length (Fig. 6L), while in *M. smirnovi* is limited to about 2/3 (Fig. 6A, B); male genitalia with oval ventral margin of posterior surstyle lobe in *M. tarsatus* (Fig. 1A, C, D: pl), while angular in *M. smirnovi* (Fig. 24A, C: p). Differs from male of *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** by holoptic eyes, eye contiguity more than 10 facets long in *M. tarsatus* (Fig. 20E), while in *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** eyes dichoptic (Fig. 31G). Additionally, similar to *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, but differs in more incrassate basotarsomere of metaleg in *M. tarsatus* (Fig. 6M), narrower in *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** (Fig. 9D). Differs from male of *M. turkestanicus* by eye contiguity more than 10 facets long (Fig. 30E), while in *M. turkestanicus* eyes dichoptic or shortly connected by distance of 1–5 facets long (Fig. 31E, F), and by broader basotarsomere of metaleg in *M. tarsatus* (Fig. 6L), narrower in *M. turkestanicus* (Fig. 9E, F).

Re-description. MALE. Head: Antenna black to dark brown (Fig. 11F); basoflagellomere elongated about 2.2–2.4 times as long as wide, more than 2 times as long as pedicel, more or less straight dorsally, tapering to apex; fossette dorsolateral and large (Fig. 11F); arista dark and thickened at basal third; face and frons black with gray microtrichia; face and frons covered with dense gray-yel-

lowish pile; oral margin black, with sparse microtrichia; lunule shiny black to brown, bare; eye contiguity 6 facets or more long; vertex isosceles, shiny black; vertex with long yellow-whitish pile, in some cases mixed with black pile on ocellar triangle; ocellar triangle equilateral; occiput with gray-yellow pile, ventrally covered with dense gray microtrichia; eyes covered with dense, long whitish-gray pile (Fig. 30E); vertical triangle: eye contiguity: frons = 2.5–3 : 1 : 2. — **Thorax:** Scutum and scutellum black with olive-green to purple lustre, covered with dense, erect yellow pile; scutum usually without or with indistinct pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow pile; wings mostly covered with microtrichia; wing veins brown; calypter pale yellow; halter yellow; legs mostly black, except apex of femur, tibia basally, and brown tarsi ventrally in some specimens; pile on legs pale yellow; ventral margin of metatrochanter angular (Fig. 15G: marked with arrow); metafemur moderately broad, about 2.5–3.0 times longer than wide, with long pile on ventral surface, about as wide as metafemur, longer than pile on dorsal surface, variable in shape, from strongly curved (Fig. 15E) to almost straight (Fig. 15F); apicomedial lamina of metatibia distinct, covered with very long yellow pile; basotarsomere of metatarsus expanded, more than 3 times broader than second tarsomere (Fig. 6L, M), ventrally with well-defined brush-like area of dense pile extended for 3/4 of its length (Figs 6L, 15E, F). — **Abdomen:** About 1.2 times longer than mesonotum; terga dark brown to black; terga 2–4 each with pair of narrow to indistinct, white pollinose fasciae; pile on terga all yellow to gray-whitish (Fig. 19E); sterna dark brown, covered with long whitish-yellow pile. — **Male genitalia:** Anterior surstyle lobe oval, about 1.5–2 times longer than wide, covered with dense short pile (Fig. 1A–D: al); posterior surstyle lobe oval to triangular (Fig. 1A–D: pl); cercus rectangular (Fig. 1A: c); hypandrium sickle-shaped, without lateral projections; ejaculatory apodeme large, broader than long (Fig. 2A, B: ea); lingula very narrow and short (Fig. 2A: l). — **FEMALE.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere about 1.75 times longer than wide, slightly tapering to apex (Fig. 13F); frons with pollinose vittae along eye margins variable in shape and size; frons covered with mostly gray-yellow pile; ocellar triangle covered with black pile; terga covered with gray-whitish to yellow pilosity; medial part of terga 3 and 4 usually with short adpressed black pile; pollinose fasciae on terga 2–4 distinct (Fig. 21E); basotarsomere of metatarsus dark, less expanded, without well-defined brush-like area of dense pile (Fig. 6N) and without distinct spine-like setae within ventrolateral row of setae (Fig. 6N).

Distribution and ecological data. *Merodon tarsatus* occurs in Tajikistan, Kyrgyzstan and northeastern Afghanistan (Fig. 27). It was found at localities which belong to four ecoregions: Tian Shan foothill arid steppe, Gissa-

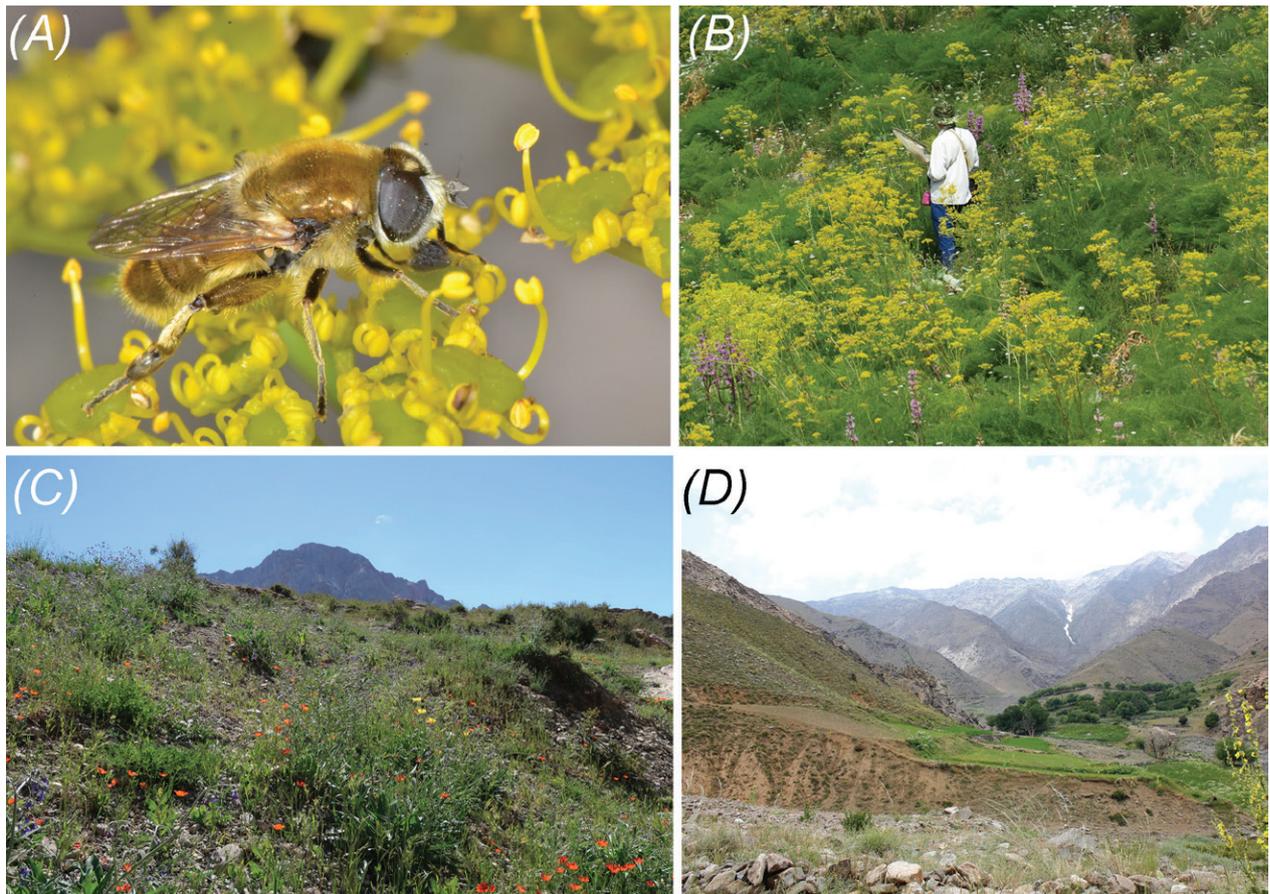


Figure 32. **A** Male of *Merodon tarsatus* on *Prangos pabularia*; **B** habitat of adults of *M. tarsatus* in Tajikistan; **C** habitat of adults of *M. rufitarsis* in Tajikistan; **D** type locality of *M. latiantennantus* Vujić, Popov & Prokhorov **sp. nov.** Photos by: A. Barkalov (A–C), Yu. E. Skrylnik (D).

ro-Alai open woodlands, Pamir alpine desert and tundra, and Hindu Kush alpine meadow (Olson et al. 2001). The localities in the latter ecoregion (Afghanistan) are characterized with two main vegetation types, Thorny Cushions, subalpine and alpine semi deserts and meadows (a mixture of several plant formations), and Dwarf *Amygdalus*-Semidesert (Breckle 2007). *Artemisia* spp. and *Ferula* spp. dominate, and many sub-shrubs and ephemeral plants are common, including geophytes like *Iris*, *Tulipa*, *Allium* spp., *Gagea*, *Anemone* L., *Colchicum* L. and *Muscari* Mill. A variety of landscapes of Gissaro-Alai open woodlands range from foothill semideserts to alpine meadows, combined with characteristic mountain forests (WWF 2022). The steppe grasses grow alongside wild fruit and nut forests, and at the higher altitudes of the mountain ranges a mosaic of open coniferous evergreen *Juniperus* forests forms the montane belt. Many geophytes (e.g., *Allium*, *Tulipa*, *Eremurus*, *Rheum*) are present. The valleys of mountain rivers house riparian forests. Tian Shan semi-desert and steppe vegetation feature *Artemisia* spp., *Stipa* spp., and *Festuca* spp. The Pamir alpine zone consists of *Kobresia* spp. and *Carex* spp. meadows. Tall-forb vegetation of the localities of *M. tarsatus* in the Pamir-Alai and western Tian Shan Mountains in Tajikistan and Kyrgyzstan includes: mesic mown and grazed subalpine meadows and pastures on fertile soils, forb rich mesophilous tall-forb communities of the western Pamir-Alai Mountains, scree-like tall-forb communities of the

eastern Irano-Turanian region, and dry tall-forb communities of the subhumid zone of the eastern Irano-Turanian region (Nowak et al. 2020a). *Prangos pabularia* Lindl. (Apiaceae) was noted as a flower visited by the adults of *M. tarsatus* in Tajikistan (Fig. 32A, B) in different places, as well as *Ferula* sp. and *Papaver* sp. On the basis of our data the flight period is from May to July.

Remarks. Original description was based on two syntypes from Tajikistan (Sack 1913). One syntype studied. This species was revised by Hurkmans (1993) as a member of the “*tarsatus* group”.

***Merodon turkestanicus* Paramonov, 1927**

Figs 1E, F, 2C, 5F, 6G, 9E, F, 10F, 15H, I, 18B, 20F, 27, 29D, 31E, F, 35D

Merodon turkestanicus Paramonov, 1927: 77 (= 321).

Type locality. Uzbekistan, Tashkent.

Type material examined. **Holotype:** UZBEKISTAN • ♂. Original labels: “N 339”, “d. Tashkent / Turkestan / 12.V.15.” [yellowish black-bordered, pale violet ink], “*Merodon / turkestanicus* / n. sp. ♂ Typus / Paramonov. det” [pink double black-bordered, violet ink], “Holotypus / *Merodon turkestanicus* Par., 1927 G.V.Popov des. 2007” [red].

Additional material examined. KAZAKHSTAN • 1 ♂; Krasnogorski, Dzhushy-Dala, near Anrakhay; 43°41'53"N, 74°49'33"E; 28 Apr. 1956; Marikovskiy P. leg.; SZMN 05804 • 1 ♀; same data as for preceding; SZMN 05805 • 1 ♂; 140 km NW of Almaty, Kanshengel; 44°19'13"N, 75°33'04"E; 600 m a.s.l.; 13 Apr. 2002; Danilevsky M. leg.; Sommagio D. det. as *Merodon smirnovi*; D.S. coll. 24945. — TAJIKISTAN • 1 ♂; 6 km N of village Kalon; 39°05'51"N, 68°49'56"E; 7 Jun. 2021; Zinchenko V. leg.; SZMN • 1 ♂; Barchadev gorge; 7 Jul. 2021; Barkalov A. leg.; SZMN. — TURKMENISTAN • 1 ♂; Scharlouk, Hura Houdon; 37°51'23"N, 58°11'41"E; 26 Apr. 1996; Dolin W. leg.; M.H. coll. 02546 • 1 ♂; 15 km W of Firyuza, Dushak Mountain; 37°54'05"N, 57°54'44"E; 2100 m a.s.l.; 8 May 1987; Barkalov A. leg.; SZMN • 2 ♂♂; same data as for preceding; SZMN 05841, 05842 • 59 ♂♂, 25 ♀♀; Dushak Mountain; 4–11 May 1987, 16–20 May 1988; Barkalov A., Dubatolov V.V. leg.; SZMN • 1 ♂; Firyuza-Vanovski; 37°54'34"N, 58°05'20"E; 23–26 Apr. 1989; Becvar S. leg.; D.D. coll. • 70 ♂♂, 22 ♀♀; Environs of Ashkhabad, Firyuza settlement; 37°54'58"N, 58°05'22"E; 652 m a.s.l.; SZMN • 134 ♂♂, 80 ♀♀; Ahal Province, Ak bugday District, SEE of Annau settlement; 37°50'08"N, 58°36'09"E; 22–30 Apr. 1988; Barkalov A., Chekanov Yu. leg.; SZMN • 31 ♂♂, 17 ♀♀; Ahal Region, Gökdepe District, SW of Geok Tepe; 38°04'52"N, 57°52'48"E; 8–11 May 1988; Barkalov A., Chekanov Yu. leg.; SZMN • 14 ♂♂, 9 ♀♀; Kopet-dag Mountains, 20 km E Nokhur settlement, Karayalchi gorge; 38°28'25"N, 57°09'09"E; 28 Apr. 1991; Dubatolov V.V., Zinchenko V. leg.; SZMN.

Diagnosis. Medium sized (9–11 mm), long pilose, dark species, with olive-brown reflection (Fig. 20F); antennae dark brown, basoflagellomere elongated, about 2.3 times as long as wide (Fig. 10F); legs mostly black (Fig. 15H, I); body pile pale yellow to gray. Male: metafemur about 4 times longer than wide, covered with long and pale pilosity (Fig. 15H, I); basotarsomere of metatarsus expanded, about 2 times broader than the second tarsomere (Fig. 9E), ventrally with well-defined brush-like area of dense pile extended for 3/4 of its length (Fig. 9F); ventral margin of metatrochanter angular; sternum 4 with large laminate extensions on posterior margin (Fig. 5F); male genitalia: anterior surstyle lobe oval (Fig. 1E: al) and posterior surstyle lobe oval to triangular (Fig. 1E: pl); ejaculatory apodeme as long as broad (Fig. 2C: ea); lingula variable, from distinct to small (Fig. 2C: l).

Differs from males of *Merodon smirnovi*, *M. tarsatus* and *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** by dichoptic eyes or shortly connected by distance of 1–5 facets long in *M. turkestanicus* (Fig. 31E, F), while these species have holoptic eyes, where the eye contiguity is more than 6 facets long. Similar to *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** from which differs in narrower basotarsomere of metaleg (Fig. 9E, F) compared with *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** (Fig. 9A–C); male genitalia: ejaculatory apodeme narrower than basal width of hypandrium in lateral view in *M. turkestanicus* (Fig. 2C: ea), while in *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** wider than basal width of hypandrium in lateral view (Fig. 2D: ea).

Re-description. MALE. Head: Antenna dark brown; basoflagellomere (Fig. 10F) elongated about 2.3 times as long as wide, about 2.5 times as long as pedicel, more

or less straight dorsally, tapering to apex; fossette dorso-lateral and large (Fig. 10F); arista dark and thickened at basal third; face and frons black with gray microtrichia, face covered with dense whitish pile, frons with gray-yellowish pile; oral margin black, with sparse microtrichia; lunule shiny black to brown, bare; eye dichoptic or with short eye contiguity about 1–5 facets long; vertex isosceles, shiny black; vertex with long, pale yellow-whitish pile, in some cases mixed with a few black pile on ocellar triangle; ocellar triangle equilateral; occiput with gray-yellow pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 31E, F); vertical triangle: frons = 1 : 2. — **Thorax:** Scutum and scutellum black with olive-green to brown lustre, covered with dense, erect whitish-yellow pile; scutum usually without pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anteroventral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anteroventral parts of katepisternum with long, dense pale yellow pile; wings mostly covered with microtrichia; wing veins brown; calypter pale yellow; halter yellow; legs mostly black, except brown base of metatibia and tarsi ventrally in some specimens; pile on legs pale yellow to whitish; ventral margin of metatrochanter angular; metafemur moderately broad, about as 4 times longer than wide, with long pile on ventral surface, about as wide as metafemur, longer than pile on dorsal surface (Fig. 15H, I); apicomedia lamina on metatibia distinct, covered with very long yellow pile (Fig. 18B); basotarsomere of metatarsus expanded, about 2 times broader than second tarsomere (Fig. 9E), ventrally with well-defined brush-like area of dense pile extended for 3/4 of its length (Fig. 9F). — **Abdomen:** About 1.2 times longer than mesonotum; terga dark brown to black; terga 2–4 without or with pair of narrow, white pollinose fasciae; pile on terga all yellow to gray-whitish (Fig. 20F); sterna dark brown, covered with long whitish-yellow pile (Fig. 35D). — **Male genitalia:** Anterior surstyle lobe oval, about 1.5 times longer than wide, covered with dense short pile (Fig. 1E, F: al); posterior surstyle lobe oval to triangular (Fig. 1E: pl); cercus rectangular (Fig. 1E: c); hypandrium sickle-shaped, without lateral projections; lingula elongated (Fig. 2C: l). — **FEMALE.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere with rounded apex, about 1.5 times longer than wide; frons covered with mostly gray-yellow pile; ocellar triangle covered with black pile; terga covered with gray-whitish to yellow pilosity; medial part of terga 2–4 usually with short adpressed black pile; pollinose fasciae on terga 2–4 more distinct; basotarsomere of metatarsus less expanded, without well-defined brush-like area of dense pile ventrally.

Distribution and ecological data. *Merodon turkestanicus* occurs in Tajikistan, Southeastern Kazakhstan, northeastern Uzbekistan and southern Turkmenistan (Kopet-Dag mountain range) (Fig. 27). It was recorded on diverse types of localities which belong to five ecoregions:

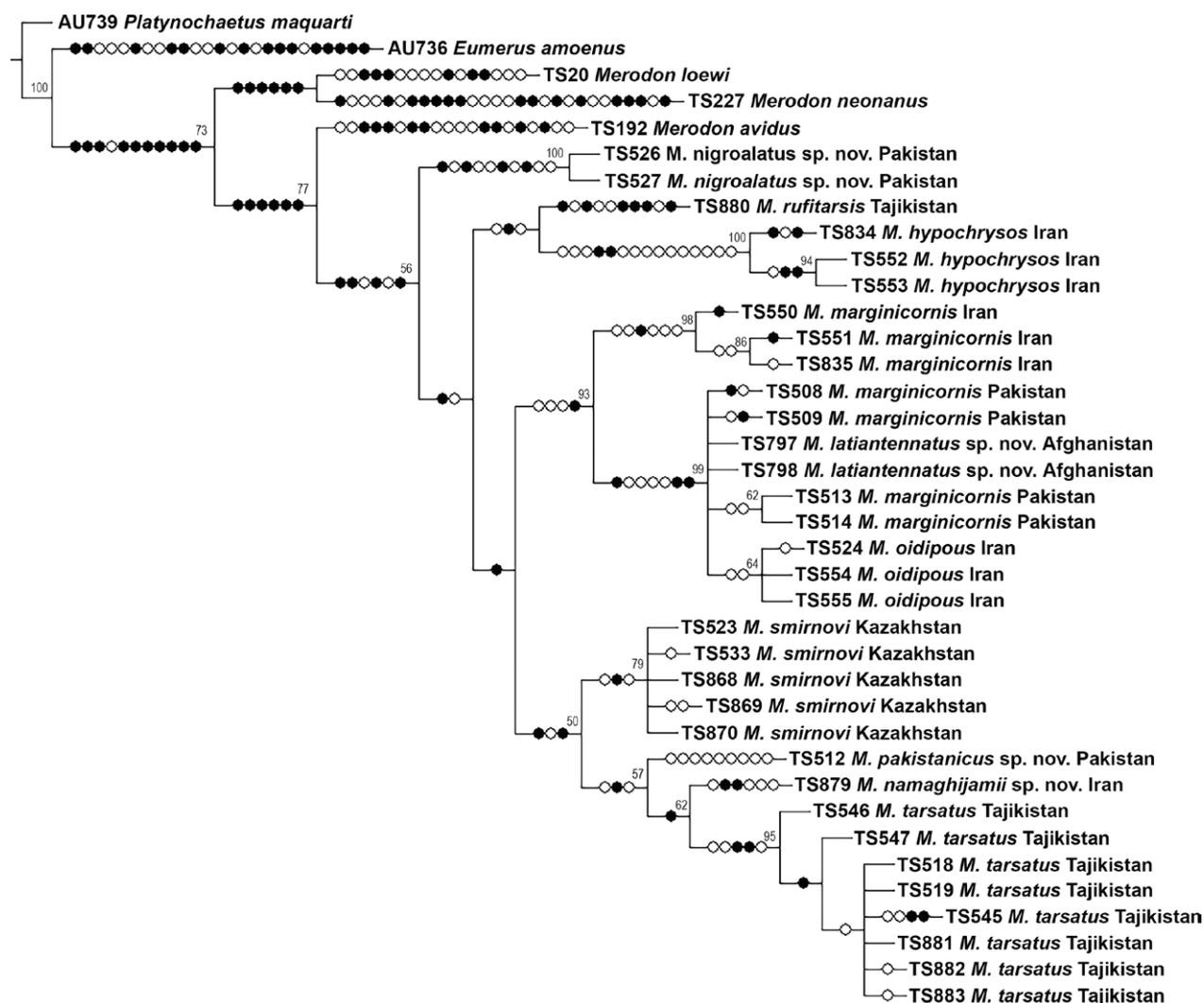


Figure 33. Maximum-Parsimony 5'COI tree of the *Merodon tarsatus* species group (filled circles stand for unique changes; open circles stand for non-unique changes; bootstrap values ≥ 50 are presented near nodes). Strict consensus tree of 16 equally parsimonious trees, L = 351, Ci = 63, Ri = 75.

Gissaro-Alai open woodlands, Alai-Western Tian Shan steppe, Central Asian northern desert, Pamir alpine desert and tundra, and Kopet Dag woodlands and forest steppe (Olson et al. 2001). Tall-forb vegetation of the localities of *M. turkestanicus* in the Pamir-Alai and western Tian Shan Mountains in Tajikistan includes: forb rich mesophilous tall-forb communities of the western Pamir-Alai Mountains, scree-like tall-forb communities of the eastern Irano-Turanian region, and dry tall-forb communities of the subhumid zone of the eastern Irano-Turanian region (Nowak et al. 2020a). Many geophytes (e.g., *Allium*, *Iris*, *Eremurus*) are present. *Artemisia* spp. communities characterize desert vegetation of Southern Kazakhstan, and Pamir alpine zone consists of *Kobresia* spp. and *Carex* spp. sedge-meadows. A variety of landscapes of Gissaro-Alai open woodlands range from foothill semideserts to alpine meadows; the steppe grasses grow alongside wild fruit and nut forests, and at the higher altitudes a mosaic of open *Juniperus* forests forms the montane belt; the valleys of mountain rivers house riparian forests (WWF 2022). The Kopet-Dag mountains are characterized by several community types: xeric shrublike

woodlands (800–2500 m a.s.l.) dominated by *Acer tuomanicum* Pojark. and *Paliurus spina-christi* Mill.; *Juniperus* woodlands (1300–2000 m a.s.l.); steppe vegetation (1000–2200 m a.s.l.) on mountain plateaus with *Stipa* spp. and *Festuca valesiaca* Schleich. ex Gaudin; mesophytic riparian and deciduous forest communities (1000–1500 m a.s.l.) formed by *Juglans regia* L., *Fraxinus angustifolia* subsp. *syriaca* (Boiss.) Yalt., *Ulmus minor* subsp. *minor* and *Cornus meyeri* (Pojark.) Pilip. with mesophilic herbaceous layer; *Artemisia* spp. communities (300–800 m a.s.l.); subtropical grasslands (800–1000 m a.s.l.) with *Thinopyrum intermedium* subsp. *intermedium*, and meadows (700–1600 m a.s.l.) with *Elymus repens* (L.) Gould in the depressions of mountain plateaus or in the river valleys. On the basis of our data the flight period is from April to early July.

Remarks. Original description was based on a holotype from Uzbekistan (Paramonov 1927). Type material studied. This species was revised by Hurkmans (1993) as a member of the “*tarsatus* group” without examination of holotype.

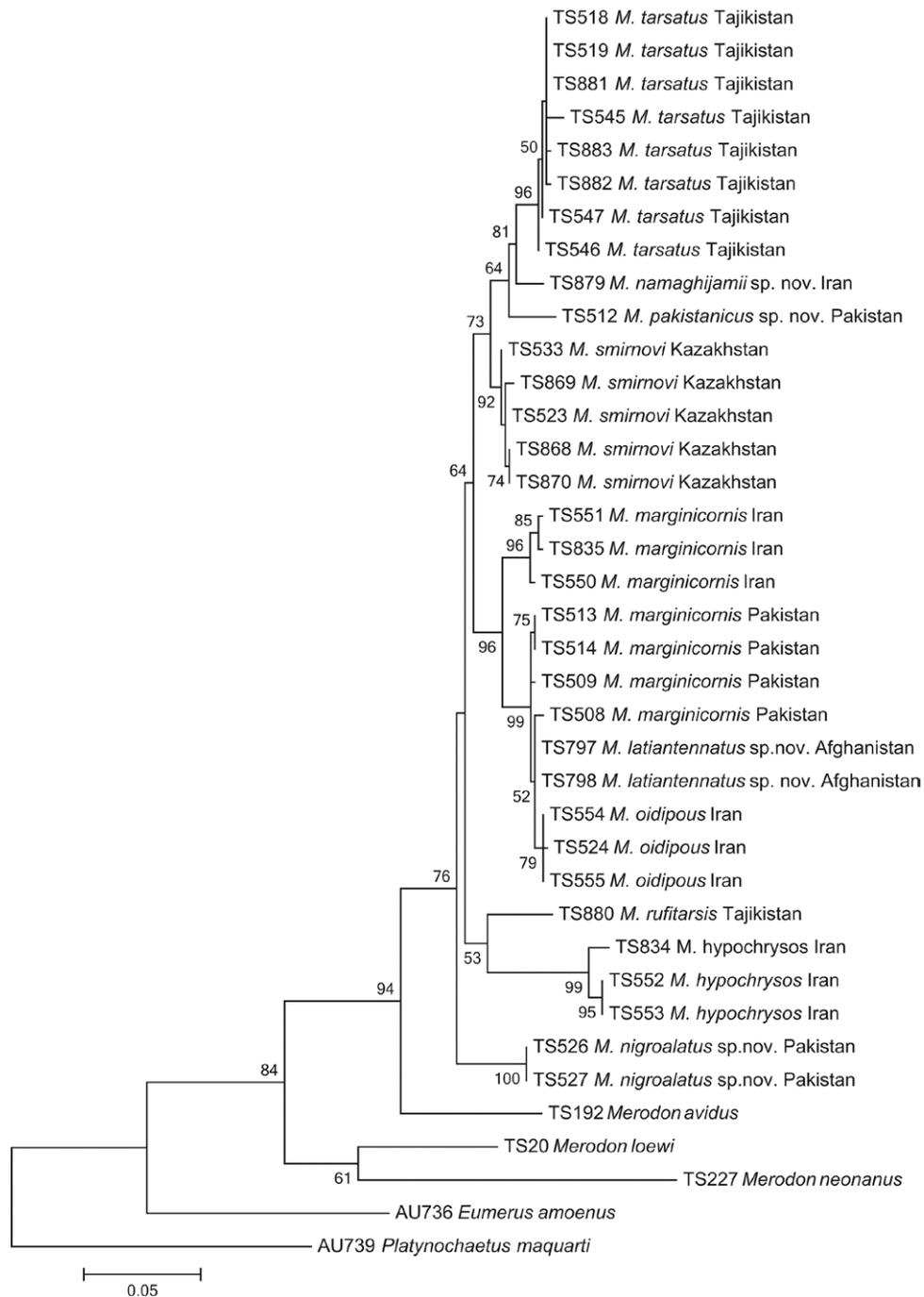


Figure 34. Maximum-Likelihood 5'COI tree of the *Merodon tarsatus* species group based on the Tamura-Nei model. Tree with highest log likelihood (−2540.4813) is shown. A discrete Gamma distribution was used to model evolutionary rate differences among sites (5 categories (+G, parameter = 0.1619)). Bootstrap values ≥ 50 are presented near nodes.

3.2. Identification key to species of the *Merodon tarsatus* group

3.2.1. Key to males of the *Merodon tarsatus* group

1. Basotarsomere of metaleg ventrally with well-defined, brush-like area of dense pile (as in Figs 6B, L, 8B, F)2
- Basotarsomere of metaleg ventrally without well-defined, brush-like area of dense pile (as in Fig. 7A, D).....11
2. Basoflagellomere stubby (ca. 1.7 times as long as wide), triangular, orange (Fig. 10C); eyes dichoptic, separated by distance of 3 facets (Fig. 31C); basotarsomere of metaleg elongated, more than 4 times longer than second tarsomere (Fig. 15J); male genitalia as in Fig. 23D–F; distribution: Afghanistan*Merodon latiantennatus* Vujić, Popov & Prokhorov sp. nov.
- Basoflagellomere more elongated (at least 2 times as long as wide), differently shaped (as in Fig. 10B, D–F); basotarsomere of different length.....3

3. Sternum 2 with medial patch of long whitish pile (Fig. 35A); basotarsomere of metaleg with ventral brush-like area of setae limited to basal 2/3 (Fig. 6A); male genitalia with angular ventral margin of posterior surstyle lobe, with deep insertion between lobes (Fig. 24A, C: pl); distribution: Tajikistan, Uzbekistan, Kazakhstan, Kyrgyzstan
Merodon smirnovi Paramonov, 1927
- Sternum 2 with uniformly distributed long whitish pile (as in Fig. 35C); basotarsomere different; male genitalia different4
4. Brush-like area of setae on basotarsomere of metaleg limited to basal 1/3 ventrally (Fig. 6H, I); basotarsomere of metaleg strongly expanded, approximately 2 or more times broader than apical width of metatibia in lateral view (Fig. 15B); male genitalia with trapezoidal anterior surstyle lobe, as long as posterior surstyle lobe (Fig. 24F: al, pl); distribution: Turkey, Iran
Merodon oidipous Hurkmans, 1993
- Brush-like area of setae on basotarsomere of metaleg extended at least 1/2 ventrally (as in Figs 6L, 8F, 9B–D, F); basotarsomere of metaleg less expanded, approximately 1.5 or less times broader than apical width of metatibia in lateral view (as in Figs 14B, 15E, F); male genitalia different5
5. Male genitalia with enlarged, oval anterior surstyle lobe, longer than posterior surstyle lobe (Fig. 23A: al, pl); basotarsomere of metaleg elongated with strong spine-like row of setae along ventrolateral margin (Fig. 8A–D); distribution: Israel, Iran
Merodon dumosus Vujić, Likov & Radenković sp. nov.
- Male genitalia with anterior surstyle lobe as long as or shorter than posterior surstyle lobe (as in Fig. 1A, E: al); basotarsomere of metaleg without or with only a few strong spine-like setae along ventrolateral margin (Figs 8F, 9C)6
6. Basotarsomere of metaleg elongated, less expanded, less than 2 times as broad as second tarsomere in lateral view (Fig. 14D), with a few strong spine-like setae along ventrolateral margin (Fig. 8F–H); male genitalia with narrow, triangular anterior surstyle lobe (Fig. 23G: al); distribution: Iran, Turkmenistan, Pakistan
Merodon marginicornis Hurkmans, 1993
- Basotarsomere of metaleg expanded, more than 2 times as broad as second tarsomere in lateral view, without spine-like setae along ventrolateral margin (as in Figs 14F, 15E, F, H, I); male genitalia with oval to/or rectangular anterior surstyle lobe (as in Figs 1A, E, 24 D: al)7
7. Eyes holoptic, eye contiguity more than 6 facets long (Figs 30C, E, 31F)8
- Eyes dichoptic (Fig. 31E, G)10
8. Basotarsomere of metaleg strongly expanded, about 3 times broader than second tarsomere (Fig. 15E, F); male genitalia: ejaculatory apodeme broader than long (Fig. 2A, B: ea); distribution: Afghanistan, Tajikistan, Kyrgyzstan
Merodon tarsatus Sack, 1913
- Basotarsomere of metaleg less expanded, about 2 times broader than second tarsomere (as in Figs 14F, 15H, I); male genitalia different9
9. Metafemur swollen, 3 times broader than metatibia in ventral view; male genitalia: ejaculatory apodeme longer than broad (Fig. 25B: ea); distribution: Pakistan
Merodon pakistanicus Vujić, Likov & Radenković sp. nov.
- Metafemur not swollen, 2 times broader than metatibia in ventral view; male genitalia: ejaculatory apodeme almost as long as wide (Fig. 2C: ea); distribution: Turkmenistan, Tajikistan, Kazakhstan, Uzbekistan
Merodon turkestanicus Paramonov, 1927 (in part)
10. Basotarsomere of metaleg less expanded, about 2 times broader than second tarsomere (Fig. 15H, I); male genitalia: ejaculatory apodeme narrower than basal width of hypandrium in lateral view (Fig. 2C: ea: $y > x$); distribution: Turkmenistan, Tajikistan, Kazakhstan, Uzbekistan
Merodon turkestanicus Paramonov, 1927 (in part)
- Basotarsomere of metaleg more expanded, about 2.5 times broader than second tarsomere (Fig. 9A–C); male genitalia: ejaculatory apodeme wider than basal width of hypandrium in lateral view (Fig. 2D: ea: $x > y$); distribution: Iran
Merodon namaghijamii Vujić, Likov & Radenković sp. nov.
11. Metafemur and metatibia broader, covered with dense pilosity (Fig. 15C); all tarsi bright yellow (Fig. 15C); baso-flagellomere yellowish (Fig. 11E); male genitalia with characteristic anterior surstyle lobe and beak-like ventral margin of posterior surstyle lobe (Fig. 22D: al, pl); distribution: Turkmenistan, Tajikistan, Kyrgyzstan, Kazakhstan
Merodon rufitarsis Sack, 1913
- Metafemur and metatibia narrower, covered with less dense pilosity (Fig. 14A, C); tarsi partly brown to black, at least basotarsomere of metaleg dorsally brown (Fig. 14A, C); male genitalia different12
12. Basotarsomere of metaleg elongated, 3.5 times longer than wide (Fig. 7A), with spine-like setae along ventrolateral margin (Fig. 7A); male genitalia with rectangular anterior surstyle lobe (Fig. 22A: al); distribution: Iran, Turkmenistan ...
Merodon angustitarsis Vujić & Gilasian sp. nov.
- Basotarsomere of metaleg short and flat, 1.5 times longer than wide dorsally with parallel margins (Fig. 7D, E), without spine-like setae along ventrolateral margin (Fig. 7D); male genitalia with oval and elongated anterior surstyle lobe (Fig. 22G: al); distribution: Israel, Turkey, Iran
Merodon hypochrysis Hurkmans, 1993

3.2.2. Key to females of the *Merodon tarsatus* group

(Females of *Merodon pakistanicus* Vujić, Likov & Radenković **sp. nov.** and *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** are unknown.)

1. Metafemur with short pilosity, shorter than base of metatibia in lateral view, except a few long pile dorsally (Fig. 17A); basoflagellomere short, 1.5 times longer than wide, with oval apical margin (Fig. 13A); distribution: Israel, Turkey, Iran *Merodon hypochrysos* Hurkmans, 1993
- Metafemur with longer pilosity, particularly dorsally, longer than base of metatibia in dorsal view (as in Figs 16, 17B, C); basoflagellomere longer, more than 1.5 times longer than wide, tapering to apex (as in Fig. 13B–F).....2
2. Metafemur and metatibia broad, with long and dense yellow pilosity (Fig. 16F); metatibia broadest apically (Fig. 16F); all tarsi bright yellow; basotarsomeres of metaleg narrow, without spine-like setae along ventrolateral margin (Fig. 16F); metaleg pilosity yellow (Fig. 16F); distribution: Turkmenistan, Tajikistan, Kyrgyzstan, Kazakhstan
..... *Merodon rufitarsis* Sack, 1913
- Species with different combination of characters3
3. Basotarsomere of metaleg narrow and elongated, 3.5 times or more longer than wide (as in Fig. 7C).....4
- Basotarsomere of metaleg broader and shorter, less than 3.3 times longer than wide (as in Fig. 6E, F)8
4. Second tarsomere of metaleg longer, about half length of basotarsomere (Fig. 7C); distribution: Iran, Turkmenistan *Merodon angustitarsis* Vujić & Gilasian **sp. nov.**
- Second tarsomere of metaleg shorter, less than half length of basotarsomere (as in Fig. 8D, H)5
5. Larger species (10–13 mm); longer spine-like setae within ventrolateral row of setae very strong and distinct (Fig. 8C, D); distribution: Israel, Iran *Merodon dumosus* Vujić, Likov & Radenković **sp. nov.**
- Smaller species (7–11 mm); longer spine-like setae within ventrolateral row of setae less distinct (as in Figs 6G, 8H).....6
6. Longer spine-like setae within ventrolateral row of setae indistinct or absent (as in Fig. 6G).....7
- Longer spine-like setae within ventrolateral row of setae distinct (Fig. 8H); distribution: Iran, Turkmenistan, Pakistan *Merodon marginicornis* Hurkmans, 1993 (in part)
7. Basoflagellomere brown to black; distribution: Turkmenistan, Tajikistan, Kazakhstan, Uzbekistan.....
..... *Merodon turkestanicus* Paramonov, 1927
- Basoflagellomere orange-brown (Figs 13B, 16C); distribution: Afghanistan
..... *Merodon latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**
8. Sternum 2 medially with pile at least two times longer than laterally (Fig. 35B); basoflagellomere narrow, elongated, with rounded apex (Fig. 12C); distribution: Tajikistan, Uzbekistan, Kazakhstan, Kyrgyzstan
..... *Merodon smirnovi* Paramonov, 1927
- Sternum 2 with pilosity uniform in length (as in Fig. 35C); basoflagellomere broader, less elongated, slightly tapering to apex (as in Fig. 13D, F)9
9. Some longer spine-like setae within ventrolateral row of setae very distinct (Fig. 8H); distribution: Iran, Turkmenistan, Pakistan..... *Merodon marginicornis* Hurkmans, 1993 (in part)
- All spine-like setae within ventrolateral row of setae equal in length (as in Fig. 6J, N)10
10. Sternum 2 clearly shorter than sternum 3; basotarsomere of metaleg from ventral view usually medially narrowed and twisted (Fig. 6K); basoflagellomere reddish-brown (Fig. 13D); distribution: Turkey, Iran.....
..... *Merodon oidipous* Hurkmans, 1993
- Sternum 2 as long as or slightly shorter than sternum 3; basotarsomere of metaleg from ventral view usually medially not narrowed and twisted; basoflagellomere brown to dark brown (Fig. 13F); distribution: Afghanistan, Tajikistan, Kyrgyzstan..... *Merodon tarsatus* Sack, 1913

(Females of *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, and *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** probably also keyed here.)

3.3. Variability

Some species of the *Merodon tarsatus* group, such as *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, *M. marginicornis*, *M. oidipous*, *M. smirnovi* and *M. tarsatus*, show variability in range of their body size, with 4–5 mm differences between minimum and maximum sized specimens. Most of the species have variable color of basoflagellomere, from dark brown to reddish-brown, and in some species, such as *M. oidipous* and *M. marginicornis*,

the basotarsomere of the metaleg varies in color, from black to reddish. The basotarsomere of the metaleg in *M. smirnovi* in both sexes (Fig. 6A–F) and *M. tarsatus* in males (Fig. 6L, M) differs in shape, from broader (Fig. 6A, L – male; 6C, E – female) to narrower (Fig. 6B, M – male; 6D, F – female). Because of these variabilities, for some specimens clear separation of females is uncertain, but simultaneous appearance with males and general distribution can help in identification.

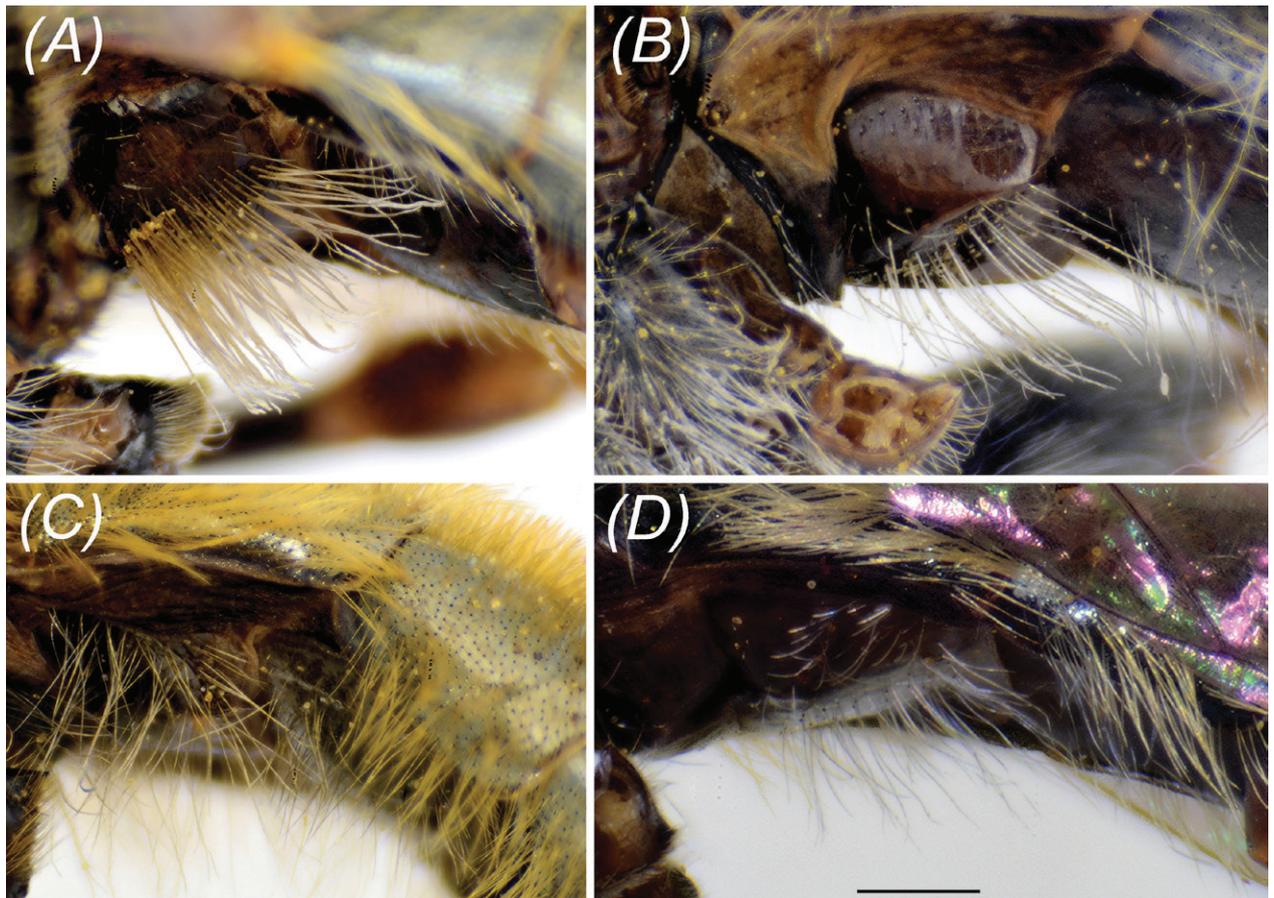


Figure 35. Sternum 2, lateral view. **A, B** *M. smirnovi*, **C** *M. tarsatus*, **D** *M. turkestanicus*. (A, C, D) male, (B) female. Scale bar: 0.5 mm.

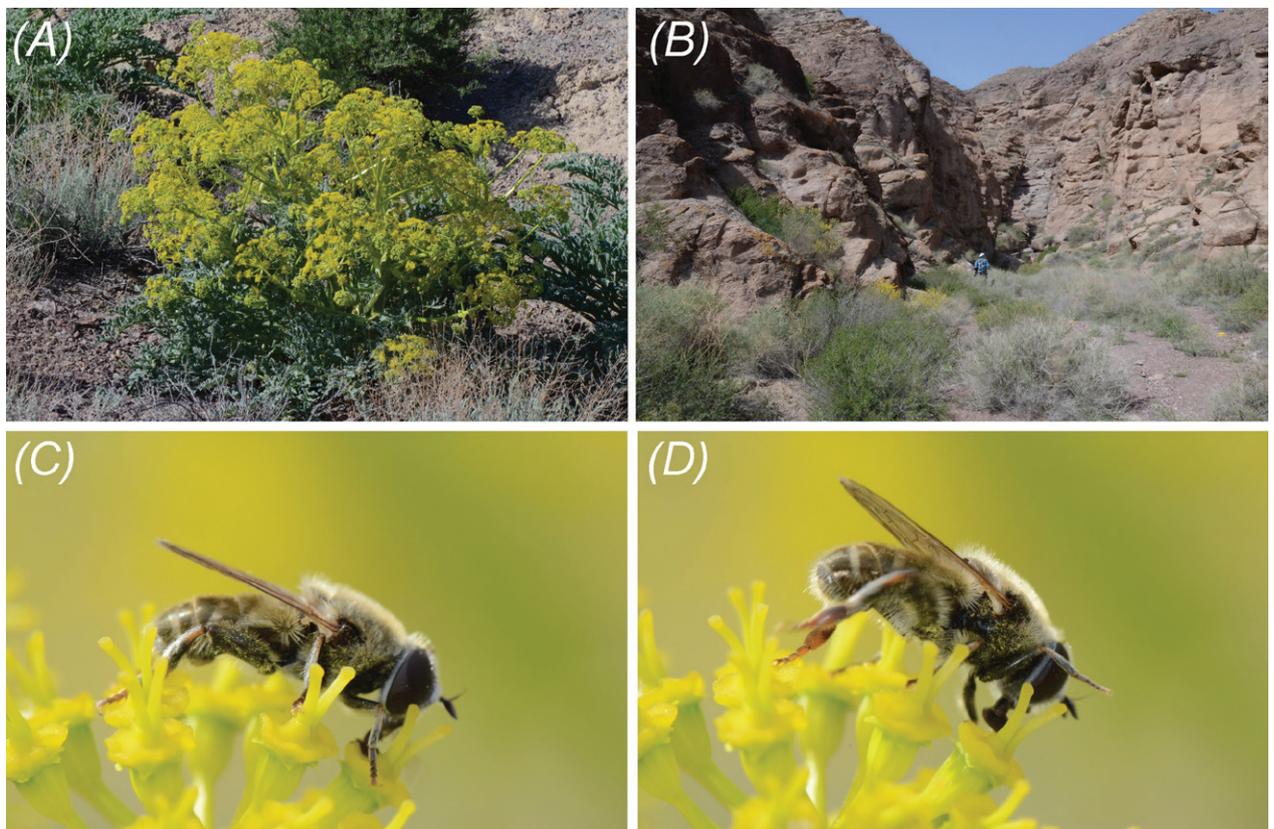


Figure 36. **A** *Ferula* sp. visited by adults of *Merodon smirnovi*; **B** habitat of adults of *M. smirnovi* in Kazakhstan; **C, D** *M. smirnovi* on *Ferula* sp. Photos by: A. Barkalov.

Table 1. Country distribution of species of the *Merodon tarsatus* group (bold font = type locality).

species	Afghani- stan	Iran	Israel	Kazakh- stan	Kyrgyz- stan	Pakistan	Tajiki- stan	Turkey	Turk- menistan	Uzbeki- stan
<i>hypochrysos</i>		X	X					X		
<i>angustitarsis</i> sp. nov.		X							X	
<i>dumosus</i> sp. nov.		X	X							
<i>namaghijamii</i> sp. nov.		X								
<i>latiantennatus</i> sp. nov.	X									
<i>marginicornis</i>		X				X			X	
<i>pakistanicus</i> sp. nov.						X				
<i>oidipous</i>		X						X		
<i>rufitarsis</i>				X	X		X		X	
<i>smirnovi</i>				X	X		X			X
<i>tarsatus</i>	X				X		X			
<i>turkestanicus</i>				X			X		X	X

Most specimens of *Merodon turkestanicus* possess dichoptic eyes (Fig. 31E), but in some specimens eyes are shortly connected by a distance of 1–5 facets long (Fig. 31F). *Merodon tarsatus* shows variability in the shape of the metafemur, from strongly curved (Fig. 15E) to almost straight (Fig. 15F), but genetic information for both forms showed as similar. *Merodon marginicornis* is distinguished by genetic variability between populations, one from Pakistan and another from Iran, but without morphological differences observed we prefer not to designate a separate taxon.

3.4. Additional species of the *Merodon avidus-nigritarsis* lineage close to *M. tarsatus* group

Merodon nigroalatus Vujić, Likov & Radenković **sp. nov.**

<https://zoobank.org/7C91975E-0396-46F6-912E-BB6CB828DFF9>

Figs 28, 37, 38, 39

M. aff. tarsatus 6 (Vujić et al 2021a).

Type locality. PAKISTAN: Khyber Paktunkhawa Province, Haripur District, Tehsil, Khanur Nikrian.

Type material. *Holotype*: ♂; NARC 05922 [specimen dry pinned, in good condition, both wings are damaged, genitalia in separate microvial]. Original labels: “Nikrian, Khan Pur / 29.iii.[20]13 / A. Haq”, “6B”, “05922”. — *Paratypes*: PAKISTAN • 1 ♂; Khyber Paktunkhawa Province, Haripur District, Tehsil, Khanur Nikrian; 29 Mar. 2013; Haq A. leg.; NARC 05923 • 1 ♀; same data as for preceding; NARC 05933.

Diagnosis. Species with unique combination of morphological characters in *Merodon avidus-nigritarsis* lineage: abdomen with red markings (Figs 37A, 38A) and wing blackish in male (Fig. 37C). Medium sized (8–10 mm), medium long pilose species, with dark brown reflection;

antennae reddish-yellow, basoflagellomere with concave dorsal margin (Figs 37D, 38C); tarsus of proleg expanded and modified (Fig. 37E), proleg and mesoleg with reddish-yellow apex of femora, and tibiae and tarsi partly reddish-yellow; metafemur mostly black, metatibia dark medially and tarsus of metaleg dark dorsally, the rest is reddish-yellow (Figs 37G–I, 38D); body pile whitish, yellow to gray. Male: metafemur about 4 times longer than wide, covered with long pilosity (Fig. 37G); basotarsomere of metatarsus ventrally with setae (Fig. 37I); sternum 4 with triangular posterior margin (Fig. 37F); male genitalia: anterior surstyle lobe quadratic (Fig. 39A: al), posterior surstyle lobe bilobate (Fig. 39B: marked with red arrows), oval, with broadly rounded apex (Fig. 39A: pl); lingula medium size (Fig. 39C: l).

Description. MALE. Head: Antenna reddish-yellow; basoflagellomere (Fig. 37D) about 2 times as long as wide, about 2.5 times as long as pedicel, concave dorsally, with rounded apical margin; fossette dorsolateral (Fig. 37D); arista reddish-brown and thickened at basal third; face and frons black with gray microtrichia, face covered with dense whitish pile, frons with yellowish pile; oral margin black, with sparse microtrichia; lunule yellowish, bare; eye contiguity about 10–12 facets long; vertex isosceles, shiny black, anterior corner pollinose; vertex with long, whitish-gray pile, or mixed with a few black pile on ocellar triangle; ocellar triangle isosceles; occiput with white-gray pile, ventrally covered with dense gray microtrichia; eyes covered with dense whitish-gray pile (Fig. 37A, B); vertical triangle: eye contiguity: frons = 3 : 1 : 2.5. — **Thorax:** Scutum and scutellum black with dark brown lustre, covered with dense, erect pale yellow pile; scutum without distinct pollinose vittae; anterior half of scutum from dull to shiny; posterodorsal part of anterior anepisternum, posterior anepisternum (except anterovenral angle), anterior anepimeron, dorsomedial anepimeron, and posterodorsal and anterovenral parts of katepisternum with long, dense, pale yellow to gray pile; wings black to dark, mostly covered with microtrichia; wing veins black; calypter pale yellow; halter yellow; tarsus of proleg modified, slightly expanded (Fig. 37E); proleg and

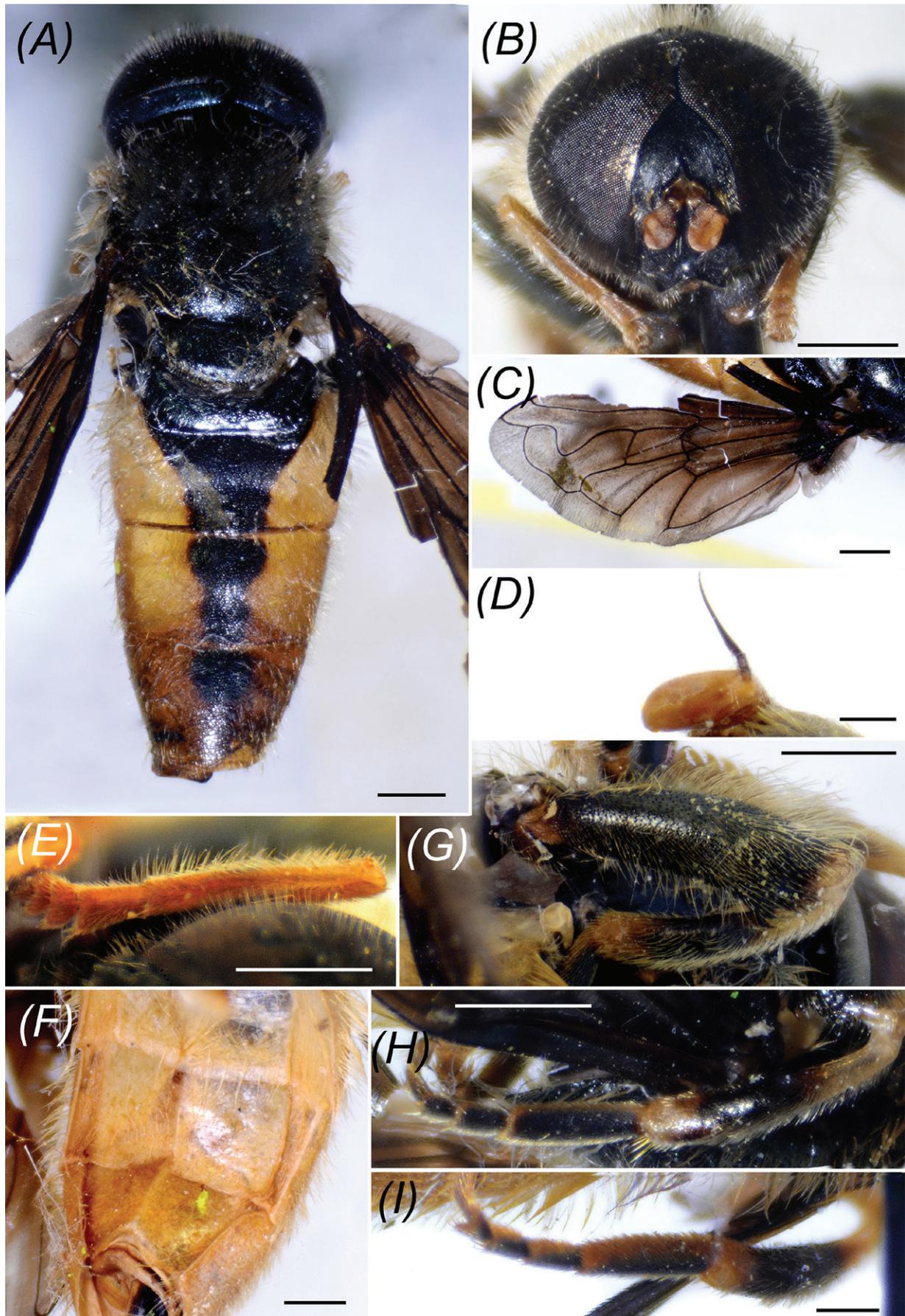


Figure 37. *Merodon nigroalatus* Vujić, Likov & Radenković **sp. nov.**, male. **A** body, dorsal view; **B** head, frontal view; **C** wing, dorsal view; **D** basoflagellomere, lateral view; **E** protibia and protarsus, dorsal view; **F** sternum, ventral view; **G** metafemur and metatibia, lateral view; **H** metatibia and metatarsus, dorso-lateral view; **I** metatarsus, lateral view. Scale bars: 1 mm (A–C, E–H), 0.25 mm (D), 0.5 mm (I).

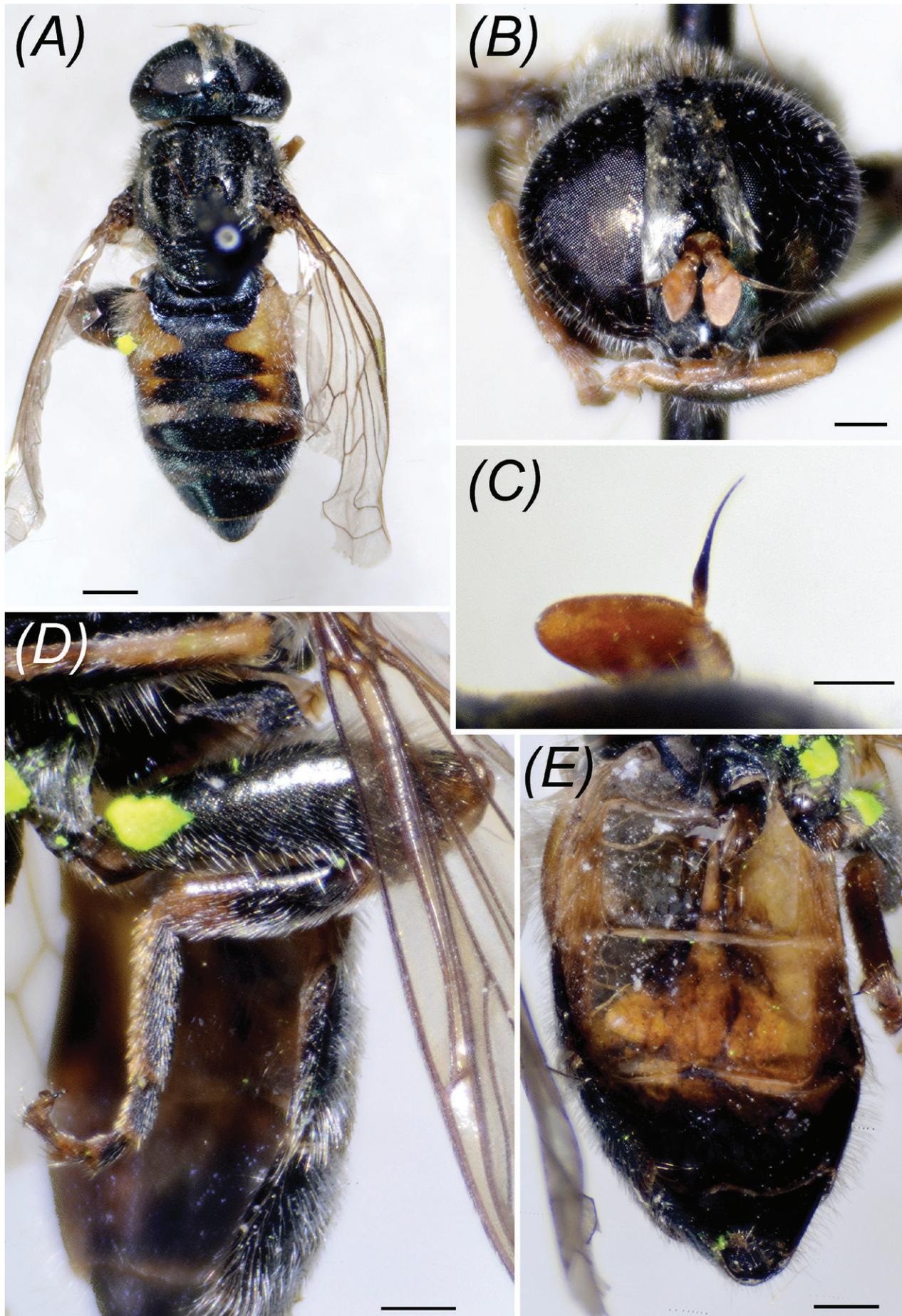


Figure 38. *Merodon nigroalatus* Vujić, Likov & Radenković *sp. nov.*, female. **A** body, dorsal view; **B** head, frontal view; **C** baso-flagellomere, lateral view; **D** metaleg, lateral view; **E** sterna, ventral view. Scale bars: 1 mm (A), 0.5 mm (B, D, E), 0.25 mm (C).

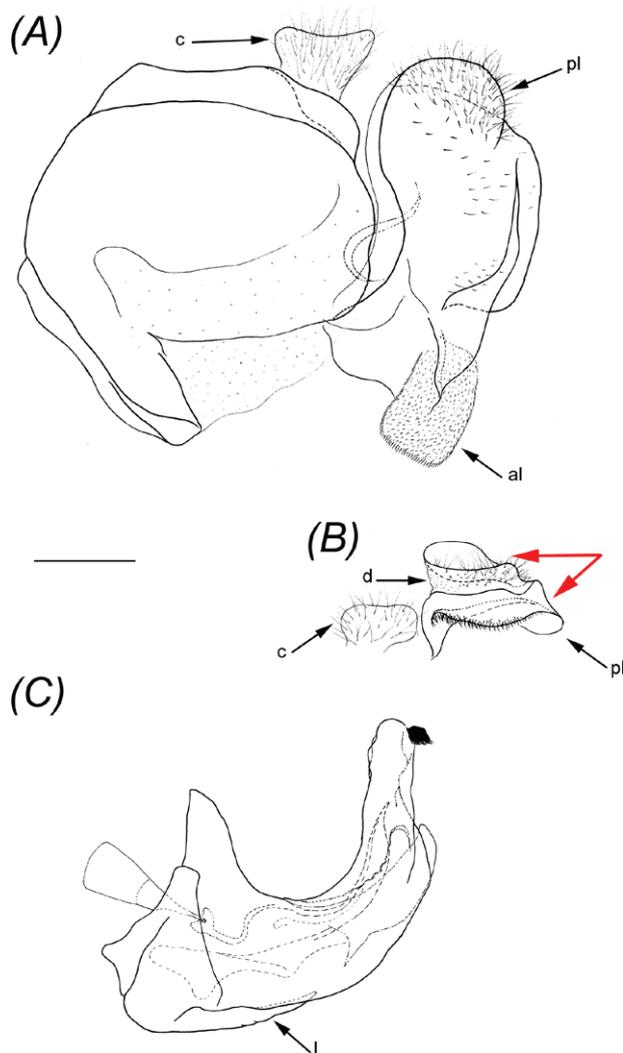


Figure 39. *Merodon nigroalatus* Vujić, Likov & Radenković **sp. nov.**, male genitalia. **A** epandrium, lateral view; **B** posterior surstyle lobe, dorsal view; **C** hypandrium, lateral view. Abbreviations: al – anterior surstyle lobe, c – cercus, d – membrane connecting two lobes of posterior surstyle lobe, l – lingula, pl – posterior surstyle lobe. Two lobes of posterior surstyle lobe marked with arrows. Scale bar: 0.5 mm.

mesoleg with reddish apex of femora, and tibiae and tarsi partly reddish-yellow; metafemur mostly black, metatibia dark medially and tarsus of metaleg dark dorsally, remaining tarsi reddish-yellow (Fig. 37E–I); pile on legs pale yellow; metafemur moderately broad, about 4 times longer than wide, with long pile on ventral surface, about 2/3 of width of metafemur, and as long as dense pile on apicodorsal surface (Fig. 37G); metatibia apicomediaally covered with a few long yellowish pile (Fig. 37H); basotarsomere of metatarsus more than 2 times longer than second tarsomere (Fig. 37I). — **Abdomen:** Broad, about 1.3 times longer than mesonotum; terga 2–4 with large, lateral reddish-yellow markings (Fig. 37A); terga 2–4 each with pair of poorly visible white, pollinose fasciae; pile on terga gray-whitish except black pilosity on medial part of terga 3–4; sterna yellowish, covered with whitish pile; sternum 4 with median V-shaped incision on posterior margin (Fig. 37F). — **Male genitalia:** Anterior surstyle

lobe quadratic, about 1.5 times longer than wide, covered with dense short pile (Fig. 39A: al); posterior surstyle lobe divided in two lobes (Fig. 39B: marked with red arrows) connected with fine membrane (Fig. 39B: d), oval, with broadly rounded apex (Fig. 39A: pl); hypandrium sickle-shaped, without lateral projections; lingula narrow and of medium length (Fig. 39C: l). — **FEMALE.** Similar to male except for normal sexual dimorphism and following characteristics: basoflagellomere about 1.7 times longer than wide (Fig. 38C); frons with pollinose vittae along eye margins (Fig. 38B); frons covered with gray-yellow pile mixed with black ones on ocellar triangle; scutum with four distinct pollinose vittae (Fig. 38A); reddish-yellow markings on abdomen smaller and limited to terga 2 and 3 (Fig. 38A); medial part of terga 2–4 with short adpressed black pile; pollinose fasciae on terga 2–4 distinct; sterna 4–5 black (Fig. 38E).

Etymology. The name “*nigroalatus*”, as arbitrary combination, is derived from Latin adjectives “niger” meaning black and “alatus” meaning winged. This describes the distinctive dark wing of the species.

Distribution and ecological data. *Merodon nigroalatus* Vujić, Likov & Radenković **sp. nov.** has only been recorded in northern Pakistan so far (Fig. 28). Its only known locality belongs to the Baluchistan xeric woodlands (Olson et al. 2001) and is situated in the north-east of this ecoregion, characterized by *Olea europaea* subsp. *cuspidata* accompanied by *Dodonaea viscosa*. These xerophytic forests support *Tamarix* spp., *Savadora oleoides*, *Ziziphus mauritiana*, *Acacia modesta*, and bulbous plants such as *Iris*, *Tulipa*, and *Allium* spp. are found on the slopes (WWF 2022). The collection site is located between subtropical and temperate zones in dry deciduous forests. The area’s arid subtropical habitat is characterized by mountainous terrain with elevations below 1000 m with high precipitation rates. Type material was collected from citrus (*Citrus sinensis*) orchard with wheat (*Triticum aestivum*) as intercropped. On the basis of our data the flight period is late March.

Remarks. Mimics bees of the genus *Sphecodes* Latreille (Hymenoptera: Halictidae). This species has a unique position inside the genus based on very distinct morphological characters. Based on molecular marker and structure of the male genitalia it is related to the *Merodon tarsatus* group, but because of absence of the main diagnostic characters of the group, such as structure of sternum 4 and basotarsomere of metaleg, it should be kept as unplaced species inside the *avidus-nigratarsis* lineage.

3.5. Genetic analyses

The genetic analyses involved 38 sequences of 5’*COI* gene including outgroups, with a total of 621 nucleotide positions in the final dataset, of which 113 were parsimony informative. Maximum-Parsimony (MP) analysis resulted in 16 equally parsimonious trees of 351 step

lengths, consistency index (Ci) = 63 and retention index (Ri) = 75 (Fig. 33). Using the TN93+G evolutionary model Maximum-Likelihood (ML) tree was constructed (Fig. 34). Comparing MP and ML trees, applied methods resulted in similar tree topologies, with slight differences in bootstrap values. The obtained trees showed separation of the *avidus-nigritarsis* lineage (ML = 94, MP = 77), clearly distinguishing *Merodon avidus* species from the other species of the lineage. Furthermore, inside the lineage the analyses resolved clear separation of *M. nigroalatus* Vujić, Likov & Radenković **sp. nov.** with a high bootstrap value (ML/MP = 100). The remaining analyzed species within the lineage clustered together forming the *M. tarsatus* species group clade. The species within this clade positioned as follows: *M. rufitarsis* and *M. hypochrysos* formed one cluster, with clear separation from each other. Also, the species *M. smirnovi* (ML = 92, MP = 79), *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** (ML = 64, MP = 57), *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** (ML = 81, MP = 62) and *M. tarsatus* (ML = 96, MP = 95) were clearly distinguished from each other, as well as from the other analyzed species. On the other hand, specimens of the *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**, *M. marginicornis* and *M. oidipous* clustered together, while two populations (one from Iran and the other one from Pakistan) of *M. marginicornis* species separated from each other. Within this clade *M. oidipous* samples formed a subclade.

4. Discussion

4.1. Taxonomy

Three species within the *Merodon tarsatus* group display very distinct diagnostic features: *M. hypochrysos* has a short basoflagellomere with a concave dorsal margin and a rounded apex, as well as a flattened male basotarsomere of the metatarsus with parallel margins as observed from the dorsal view; *M. rufitarsis* is characterized by all tarsi being bright yellow; and *M. smirnovi* possesses unique pilosity of sternum 2, with a medial patch of long white pile, and an elongated basoflagellomere that is more than 2.5 times as long as wide. Notably, despite well documented variability in body size, basoflagellomere color and tarsi color within this species group, width of the metaleg basotarsomere relative to the second tarsomere proved a reliable character for species separation in both sexes of *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, *M. marginicornis*, *M. oidipous*, *M. smirnovi* and *M. tarsatus*.

We have characterized three species based on a strongly expanded basotarsomere of the metaleg, which was ≥ 3 times broader than the second tarsomere in male *M. oidipous*, *M. smirnovi* and *M. tarsatus*. In contrast, the basotarsomere of the male metaleg in *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.**, *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** and *M. turkestanicus* is narrower, approximately twice as broad as the second tar-

somere. A third group of species possesses a narrow basotarsomere of the male metaleg, being only ~ 1.5 times (or less) as broad as the second tarsomere, namely *M. angustitarsis* Vujić & Gilasian **sp. nov.**, *M. dumosus* Vujić, Likov & Radenković **sp. nov.**, *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** and *M. marginicornis*.

In addition to our assessment of morphological characters, we conducted genetic analyses based on sequences of the 5' end of the mitochondrial *COI* gene. Many previous studies have highlighted the need for concurrent analyses of different character sets to assess diversity and relationships within *Merodon* (e.g., Milankov et al. 2008, 2013; Ståhls et al. 2009; Marcos-García et al. 2011; Radenković et al. 2011, 2018; Vujić et al. 2015; Šašić et al. 2016; Kočiš Tubić et al. 2018). Here, we have applied an integrative approach, combining morphology and genetic data, to resolve species relationships within the *M. tarsatus* species group, with this approach proving particularly informative for two species, i.e., *M. tarsatus* and *M. marginicornis*.

Our genetic analysis clustered *M. smirnovi*, *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.**, *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** and *M. tarsatus* together and these were clearly distinct genetically from the other species we analyzed. This outcome is congruent with their distinct morphological characters, i.e., broad basotarsomere of the metaleg and similar male genitalia.

Merodon tarsatus displays notable intraspecific morphological diversity. The male of this species presents variability in the shape of the metafemur, from strongly curved to almost straight. We obtained DNA sequences for specimens possessing either one of these morphological states, but all specimens resolved as a single clade on our 5' *COI* gene trees (Figs 33, 34). Thus, the molecular evidence indicates that the shape of the metafemur is not an apomorphic character. Accordingly, until additional analyses using other methods and/or molecular markers, we assert that *M. tarsatus* remains a single species.

Merodon marginicornis and two other clearly morphologically distinct species (*M. oidipous* and *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**) formed a single genetic clade, with no clear molecular separation between the specimens of *M. marginicornis* and *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.**. Similarly, it has been previously noted that *COI* gene sequences failed to distinguish morphologically well-defined species (Milankov et al. 2008; Ståhls et al. 2009). Mengual et al. (2006) noted that morphologically differentiated species even shared identical *COI* haplotypes. On the other hand, we did uncover genetic distinctiveness between two *M. marginicornis* populations, one from Iran and another from Pakistan. Given that strongly diagnostic morphological characters resolved specimens from both these populations to be the same species, further analyses are clearly warranted. The conflict and congruence between morphological and molecular data recorded here, were also emphasized in a recent revision of the *M. constans* species group (Vujić et al. 2020b).

Our genetic data and the structure of male genitalia revealed a close relationship between *M. nigroalatus* Vujić, Likov & Radenković **sp. nov.** and the *M. tarsatus* species group. Nevertheless, given its lack of the primary morphological diagnostic characters of the *M. tarsatus* group—sternum 4 without lateral tubercles or laminate extensions on the posterior margin in males, and the metabasotarsomere not being expanded in both sexes—we retain *M. nigroalatus* Vujić, Likov & Radenković **sp. nov.** as a separate taxon within the *avidus-nigratarsis* lineage.

4.2. Distribution and conservation implications

The genus *Merodon* is distributed throughout the Palearctic and Afrotropical regions. Notably, the *avidus-nigratarsis* lineage is limited to the Palearctic, but the *M. tarsatus* species group within that lineage lacks European representatives. The Mediterranean region displays the highest species diversity of *Merodon*, with the Anatolian peninsula considered a center of diversity and endemism (Vujić et al. 2011, 2015). Several recent publications have also highlighted high diversity in the Middle East and Central Asia, representing the core distribution of the *M. tarsatus* group and where a number of species have been newly described (Vujić et al. 2013, 2019, 2020a).

Indeed, four of the twelve species of this group considered herein have only been recorded within the Middle East (Figs 26–28). The westernmost part of the range of this species group includes the southern slope of Mount Hermon (Israel), within the Eastern Mediterranean conifer-sclerophyllous-broadleaf forests ecoregion (Olson et al. 2001), where *M. dumosus* Vujić, Likov & Radenković **sp. nov.** and *M. hypochrysos* are sympatric. The latter species and *M. oidipous* both occur in southeastern Turkey and all three of these species extend their distributions into the Zagros mountains forest steppe ecoregion in Iran. Three of the five newly described species of the *M. tarsatus* group have each been reported from only one locality, i.e., *M. namaghijamii* Vujić, Likov & Radenković **sp. nov.** (northeastern Iran); *M. pakistanicus* Vujić, Likov & Radenković **sp. nov.** (in Baluchistan xeric woodlands ecoregion of Western Pakistan (where *M. marginicornis* occurs)); and *M. latiantennatus* Vujić, Popov & Prokhorov **sp. nov.** (at the foothills of the southern Hindu Kush mountain range of eastern Afghanistan, within Central Afghan Mountains xeric woodlands ecoregion). *Merodon angustatarsis* Vujić & Gilasian **sp. nov.** and *M. marginicornis* occur in Iran, within mountainous ecoregions of Zagros mountains and Elburz range forest steppe, and Kopet Dag woodlands and forest steppe. The latter ecoregion extends into southern Turkmenistan where *M. turkestanicus* occurs. Three species of the *M. tarsatus* group are distributed solely in Central Asia, i.e., *M. turkestanicus*, *M. rufatarsis* and *M. smirnovi* (Figs 26, 27), with most records coming from Kyrgyzstan and Tajikistan, and a few from northeastern Uzbekistan and southeastern Kazakhstan. These records mostly pertain to Gissaro-Alai

open woodlands, Alai-Western Tian Shan steppe, Tian Shan foothill arid steppe and montane steppe and meadows ecoregions, together with reports from Central Asian northern desert and Pamir alpine desert and tundra ecoregions. *Merodon tarsatus* displays a broad Central Asian distribution, extending as far as the Hindu Kush alpine meadow ecoregion of northeastern Afghanistan.

The overall distribution of the *Merodon tarsatus* species group encompasses two biodiversity hotspots (*sensu* Mittermeier et al. 2004), i.e., the Irano-Anatolian and the Mountains of Central Asia. The Irano-Anatolian biodiversity hotspot comprises the Zagros (southwestern Iran and southeastern Turkey), Alborz (northern Iran), and Kopet-Dag (extending along the border between Turkmenistan and Iran) mountain ranges, all of which represent areas of high endemism and species richness due to topographic diversity and considerable fragmentation and isolation. Moreover, this hotspot warrants high conservation priority due to climate change and the effects of overgrazing (Noroozi et al. 2018). Nevertheless, its biodiversity remains poorly investigated (Noroozi et al. 2008). The Mountains of Central Asia biodiversity hotspot consists of some of the highest mountain ranges in the world, i.e., the Tien Shan and Pamir-Alay mountain ranges (and thus covers most of Kyrgyzstan and Tajikistan, as well as parts of southern Kazakhstan, eastern Uzbekistan, Turkmenistan and Afghanistan). This hotspot displays a high level of biological diversity due to its wide altitudinal range and variety of ecosystems. In particular, the flora of Central Asia is rich, but it has not been well studied (Li et al. 2020; Tojibaev et al. 2020). Notably, the environment of the Mountains of Central Asia hotspot is particularly sensitive to global climate change due to the low adaptive capacity of its ecosystems (Li et al. 2020; Nowak et al. 2020b).

Both of these biodiversity hotspots lie within the Irano-Turanian region, one of the largest floristic regions in the world, which exhibits a heterogeneous topography shaped by its complex tectonic history, thus fostering diverse isolated habitats that give rise to high species diversity and endemism (Djamali et al. 2012; Manafzadeh et al. 2017; Noroozi et al. 2018). Its endemic flora includes many bulb-forming species and other geophytes with underground storage organs (CEPF 2021), and it is no coincidence that regions displaying the highest *Merodon* diversity are characterized by a geophyte-rich flora. In fact, the geographical distributions of most *Merodon* taxa are most likely linked to a high diversity of this distinctive flora (Vujić et al. 2011, 2013), because *Merodon* larvae are phytophagous, inhabiting the bulbs, corms and rhizomes of the families Asparagaceae, Amaryllidaceae, Iridaceae and Liliaceae (e.g., Ricarte et al. 2017). The most significant geophyte families in the region of Central Asia and Iran are the Amaryllidaceae (particularly Allioidae), Liliaceae and Iridaceae (Noroozi et al. 2008; Tojibaev et al. 2018, 2020), and Asparagaceae in East Anatolia (Firat et al. 2015). The most species-rich geophyte genera in East Anatolia are *Allium*, *Gagea*, *Iris*, *Bellevalia* Lapeyr. and *Fritillaria* Tourn. ex L. (Firat et al. 2015), and *Allium*, *Gagea*, *Iris*, *Tulipa*, and *Eremurus* in Central Asia (including Afghanistan) (Breckle 2007; Tojibaev et al. 2018,

2020). Numerous endemic species occur in the Tien Shan and Pamir-Alay mountain ranges (Tojibaev et al. 2020), with speciation of these plant genera believed to center in Central Asia (Li et al. 2020).

Nevertheless, the Irano-Turanian region remains understudied, particularly its alpine areas and invertebrate fauna (Manafzadeh et al. 2017; CEPF 2021). It has suffered high levels of anthropogenic disturbance throughout history, with populations of many species having declined because of habitat change (Djamali et al. 2012; CEPF 2021). Nowadays, the main threats are habitat fragmentation, overgrazing, human population growth and consequent unsustainable exploitation of natural resources (notably, including trade in ornamental bulbs), which together have a devastating impact on geophyte populations (Firat et al. 2015; Tojibaev et al. 2018; Nowak et al. 2020b).

The immature stages of the *avidus-nigritarsis* lineage have only been described for two species to date: *M. avidus* (*M. avidus* species group) described from larvae and puparia in the bulbs of *Ornithogalum* L. (Asparagaceae) and surrounding soil (Andrić et al. 2014; Preradović et al. 2018); and *M. opacus* Vujić, Likov & Radenković in Vujić et al. 2020a (*M. serrulatus* species group) for which a puparium was described from a reared larva found in soil near the bulbs of various plant genera believed to be potential food sources, including *Gagea* and *Fritillaria* (Liliaceae) (Vujić et al. 2020a). As yet, there is no data on the immature stages, larval host-plants, or breeding and oviposition sites for any species in the *M. tarsatus* group. Groups of related *Merodon* species likely utilize the same plant genera as larval hosts (Vujić et al. 2020a), but further studies are needed to illuminate these plant-insect interactions.

Overall, the results of the present study reaffirm previous conclusions emphasizing the importance of underexplored regions, such as the Irano-Anatolian and Mountains of Central Asia biodiversity hotspots, in hosting high *Merodon* diversity (Vujić et al. 2019, 2020a).

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Supplementary material 1

Table S1

Authors: Vujić A, Radenković S, Barkalov A, Kočiš Tubić N, Likov L, Tot T, Popov G, Prokhorov A, Gilasian E, Anjum S, Djan M, Kakar B, Andrić A (2023)

Data type: .xlsx

Explanation note: List of molecularly analyzed samples with GenBank accession numbers (in boldface: newly generated sequences within this study).

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Link: <https://doi.org/10.3897/asp.81.e93570.suppl1>