Systematic Entomology

Systematic Entomology (2012), **37**, 578–602

Systematics and taxonomy of the *ruficornis* group of genus *Merodon* Meigen (Diptera: Syrphidae)

ANTE VUJIĆ[1], SNEŽANA RADENKOVIĆ[1], GUNILLA STÅHLS[2], JELENA AČANSKI[1], ANA STEFANOVIĆ[1], SANJA VESELIĆ[1], ANDRIJANA ANDRIĆ[1] and RÜSTEM HAYAT[3]

[1]Department of Biology and Ecology, University of Novi Sad, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia, [2]Finnish Museum of Natural History, Zoological Unit, PO Box 17, University of Helsinki, FI-00014, Finland and [3]Department of Plant Protection, Suleyman Demirel University, 32260 Isparta, Turkey

Abstract. We revise the *ruficornis* group of species of *Merodon* Meigen (Diptera, Syrphidae) providing an illustrated key, a discussion of taxonomic characters and a morphological diagnosis. A total of 18 species from the *ruficornis* group are treated including distributional data. Descriptions are provided for seven new species: *M. gallicus* Vujić & Radenković **sp.n.**, *M. hoplitis* Hurkmans **sp.n.**, *M. lamellatus* Vujić & Radenković **sp.n.**, *M. nigripodus* Vujić & Hayat **sp.n.**, *M. ovaloides* Vujić & Radenković **sp.n.**, *M. ponticus* Vujić & Radenković **sp.n.**, and *M. turcicus* Vujić & Hayat **sp.n.** The taxon *M. auripes* Sack, is redefined and a neotype designated. Lectotypes are designated for *M. graecus* Loew; *M. planiceps* Loew and *M. crymensis* Paramonov. The monophyly and systematic position of this species group was assessed based on parsimony and maximum likelihood analyses of mitochondrial COI and nuclear 28S rDNA sequences. A very high level of endemism was observed in the *ruficornis* species group. Among 18 taxa, 12 are limited-range endemics, present in few mountain areas or in a small part of the total range of the group. These endemics clearly show the importance of geographic isolation in the process of speciation.

Introduction

Syrphidae comprises one of the most biologically diverse and species-rich dipteran families, with almost 6000 described species (Thompson, 2005). The genus *Merodon* Meigen is distributed over the Palaearctic and Ethiopian regions and comprises more than 160 species (Ståhls *et al.*, 2009). It is widespread in the Mediterranean region and the second largest genus of European hoverflies with more than 50 European species, excluding Turkey (Speight, 2010). Fifty-five species are known from Turkey and on the steppes of Eastern Europe and beyond (Vujić *et al*., 2011). Until now, the only comprehensive study of the Palaearctic species of this genus was that of Hurkmans (1993) revising 61 species. Marcos-García *et al*. (2007) revised the *Merodon* species of the Iberian Peninsula and recorded 34 species (8 of them described as new). Integrated taxonomic studies of *Merodon* in the eastern Mediterranean region of Europe were presented by Vujić *et al*. (2007, 2011), Ståhls *et al.* (2009) dealing with the fauna and molecular taxonomy and identification, respectively, of the *Merodon* species from the island of Lesvos (Greece).

The taxonomic status and identification of many Palaearctic *Merodon* species still requires clarification. The *M. ruficornis* group contains closely related species with the following combination of characteristics for distinguishing them from all other *Merodon* groups: mid coxa hairy posteriorly; anterior anepisternum with area bare of hairs ventral to postpronotum; only tergite 2 with clear reddish lateral spots; male with projections or spikes on metalegs (on trochanter, tibia and ventral margin of femur); posterior lobe of surstylus curved and dorsally aligned (Vujić *et al*., 2007). This group of species has a predominantly northern and eastern Mediterranean distribution, with no representatives on the Iberian Peninsula (Marcos-García *et al*., 2007). It is most diverse on the Balkan Peninsula, in Turkey, and the Caucasus region. During the last

Correspondence: Ante Vujić, Department of Biology and Ecology, University of Novi Sad, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia. E-mail: ante.vujic@dbe.uns.ac.rs

decade, this group of species has been the subject of many publications, including taxonomic, molecular, morphometric and evolutionary studies. Radenković *et al*. (2002) established new synonyms and clarified the taxonomy of five species the *ruficornis* group after the examination of type material of five species of the *ruficornis* group. Recently, one endemic from Lesvos, *M. papillus* Vujić, Radenković & Pérez-Bañon of the *ruficornis* group was described, including partial sequences of the mitochondrial COI gene for the purpose of DNA identification (Vujić *et al*., 2007). Vujić *et al.* (2011) presented new data for the genus *Merodon* in Turkey including a description of a new species from the *ruficornis* group, *M. ilgazense* Vujić, Marcos-García, Sarıbıyık & Ricarte. Based on a revision of the genus *Merodon* from the northern Black Sea region, Popov (2010) described another new species from this group, *M. alexandri* Popov.

Using COI barcodes allowed all 22 species of the genus *Merodon* occurring on Lesvos to be clearly distinguished, except for the two included species from *ruficornis* group – *M. loewi* van der Goot and *M. papillus* – that shared the same COI haplotype despite their clear morphological differences (Ståhls *et al*., 2009). In addition, previous studies in the Balkan Peninsula showed that *M. loewi* shared the same COI haplotype with another *ruficornis* group species, *M. armipes* Rondani, although these taxa are well defined morphologically (Milankov *et al*., 2008). The suggested reasons for identical haplotypes between taxa are retained polymorphism or mitochondrial introgression between the taxa (Ståhls *et al*., 2009).

Adults of *Merodon* feed on pollen and nectar and visit the flowers of a wide range of plant species (Marcos-García *et al*., 2007), especially those with easily accessible pollen. The biology of the larvae of *Merodon* species is poorly known but the development of all the known species occurs underground in bulbs or tubercles of monocotyledonous species in Liliaceae and Amaryllidaceae (Séguy, 1961; Hurkmans, 1993; Hurkmans & De Goffau, 1995). Speight (2010) stated that the species *M. armipes* (*ruficornis* group) apparently was associated with the tassel hyacinth, *Muscari* (Hyacinthaceae), in southern Germany (D. Doczkal, personal communication) and that *Ornithogalum* (Hyacinthaceae) is almost certainly an alternative host. Hurkmans (1988) observed a female of *M. loewi* exhibiting egg-laying behavior on *Ornithogalum* plants. Substantial contributions to the knowledge of the behaviour and ecology of 16 *Merodon* species were presented by Hurkmans & Hayat (1997), including data on two species in the *ruficornis* group. Based on long-term fieldwork over the last 20 years, the authors of this paper can conclude that all species of the *ruficornis* group appear exclusively in localities where *Ornithogalum* plants are present. The adult flies visit the flowers and have been observed ovipositing in the vicinity of their bulbs. Examination of the gut contents of the taxa of the *ruficornis* group confirmed the dominant preference for pollen of *Ornithogalum* spp., as compared with the other studied syrphids (Suturović, 2008).

Here we present a taxonomic account of this diverse species group of *Merodon* based on examined materials from all major European institutions and private collections holding specimens of the genus. In addition, DNA sequence data from mitochondrial COI and nuclear 28S rDNA genes were obtained for 7 species of the *ruficornis* group and 29 other *Merodon* taxa. Those data were analysed to assess the monophyly and placement of the studied species group.

Material and methods

Morphological studies

This study is based on the examination of all available material of the *Merodon ruficornis* group cited in the references, and also of unpublished material deposited in the museum, university and private collections listed below. Type specimens of all species (except *M. portschinskyi* Stackelberg) have been studied. The following acronyms of museums and entomological collections containing material studied are used in the text: BMNH – Natural History Museum, London, UK; BSA – Benediktinerstift Admont, Austria; EMIT – Entomological Museum of Isparta, Turkey; HPM – Croatian Natural History Museum, Zagreb; LSF – Museo Zoologico La Specola, Firenze, Italy; MACMUSNH – Macedonian Museum of Natural History, Skopje; MNHN – Musee National d'Histoire Naturelle, Paris, France; NHMBEO – Prirodnjacki muzej Beograd, Serbia; FSUNS – Faculty of Sciences, Department of Biology and Ecology, University of Novi Sad, Serbia; NHMW – Naturhistorisches Museum Wien, Austria; RMNH – Nationaal Natuurhistorisch Museum, Leiden, Netherlands; SAR – Zemaljski Muzej Sarajevo, Bosnia-Herzegovina; TAU – Tel Aviv University, Israel; TULCEA – Zoological Museum of Tulcea, Romania; UASK – Ukrainian Academy of Sciences, Schmalhausen Institute of Zoology, Kiev, Ukraine; MZH – Zoological Museum of The Finnish Museum of Natural History, Helsinki, Finland; WML – World Museum Liverpool, UK; ZHMB – Zoologisches Museum of the Humboldt University, Berlin, Germany; ZMA – Zoological Museum, Amsterdam, The Netherlands; ZMC – Zoological Museum, Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark; A.S.coll. – Axel Ssymank collection, Germany; D.D. coll. – Dieter Doczkal collection, Germany; G.P. coll. – Grigory Popov collection, Ukraine; J.S.coll. – John Smit collection, The Netherlands; M.J.S. coll. – M.J. Smart collection, UK; S.S. coll. – Süleyman Sarıbıyık collection, Turkey.

The characters used in the key, descriptions, and drawings employ the terminology established by Thompson (1999) and those relating to male genitalia are those employed by Hurkmans (1993) and Doczkal (1996). Colour characters are described from dry mounted specimens. To study the male genitalia, specimens were relaxed in closed pot with high level of humidity and the genitalia were extracted using an insect pin with a hooked tip. The genitalia were stored in microvials containing glycerol after clearing in warm 10% potassium hydroxide (KOH) for few minutes and washing in distilled

water. Drawings were made with a FSA 25 PE drawing tube attached to a binocular microscope.

For each new species we provide a short description and figures of adult morphological data. Diagnoses comprise accounts of unique characters relative to the species considered here and also combinations of characters which enable taxa to be distinguished and recognized. Keys are also provided to enable identification of adults. The type material was examined by Ante Vujić.

In 'Material examined', additional records usually are stated only the country but a detailed list of examined material is included as Table S1.

Molecular studies

Laboratory procedures. Specimens used for molecular analyses are listed in Table S2. Specimens with a labcode including the acronym MZH are deposited as DNA voucher specimens in the Zoological Museum of the Finnish Museum of Natural History, Helsinki, Finland and labelled accordingly, while the remaining specimens are deposited in collections of the University of Novi Sad, Serbia (FSUNS).

DNA was extracted from one to two legs using the Nucleospin Tissue DNA extraction kit (Machery-Nagel, Düren, Germany) following the manufacturer's protocols and then resuspended in 50 μL of ultra-pure water.

PCR reactions were carried out in 25 μL reaction aliquots containing 2–4 μL DNA extract, 1 μL of each primer (at 10 pmol/μL), 0.25 μL of DNA polymerase (5U/μL), 2 μL 2.5 mM $MgCl_2$, 2.5 μL 10× Buffer II (MBI Fermentas, St. Leon-Rot, Germany) and 4 μL 200 mM dNTP (GeneAmp, Applied Biosystems, Foster City, CA, USA) and ultra-pure water. Thermocycler conditions were initial denaturing at 95°C for 2 min, 29 cycles of 30 s denaturing at 94°C, 30 s annealing at 49°C, 2 min extension at 72°C, followed by a final extension of 8 min at 72°C. The universally conserved primers used for amplifying and sequencing the COI fragment (*c*. 770 bp J+P) were the forward primer C1-J-2183 (5′-CAA CAT TTA TTT TGA TTT TTT GG-3′) (alias JERRY) and reverse primer TL2-N-3014 (5′-TCC AAT GCA CTA ATC TGC CAT ATT A-3′) (alias PAT) (Simon *et al*., 1994). The D2–3 region of the nuclear 28S rRNA gene was amplified with the forward primer F2 (5′-AGA GAG AGT TCA AGA GTA CGT G-3′) and reverse primer 3DR (5′-TAG TTC ACC ATC TTT CGG GTC-3′).

Amplified DNA was electrophoresed on 1.5% agarose gels and PCR products were purified using the GFX PCR Purification Kit (GE Healthcare Biosciences, Little Chalfont, UK) and then sequenced (with the PCR primers) in both directions using the Big Dye Terminator Cycle Sequencing Kit v3.1 (Applied Biosystems, Foster City, CA, USA) at a quarter of the recommended volumes on an ABI PRISM 377 or ABI 3730 (Applied Biosystems) DNA analyzer. The sequences were edited for base-calling errors and assembled using Sequence Navigator™ v1.01 (Applied Biosystems). All new sequences were submitted to GenBank (see Table S2 for accession numbers).

Sequence alignment. The protein-coding COI gene was aligned manually and it was not necessary to include gaps in this alignment. The alignment of the 28S rDNA fragment was carried out using the E-INS-I strategy as implemented in MAFFT (Katoh *et al*., 2005, 2009).

Phylogenetic analyses. A total of 41 terminal taxa were included in the parsimony and maximum likelihood analyses. The analyses included 7 *ruficornis*-group taxa, 29 other *Merodon* taxa and 2 outgroup taxa, *Eumerus flavitarsis* Zetterstedt and *Platynochaetus setosus* (Fabricius). The trees were rooted on *E. flavitarsis.* Parsimony analysis was performed using NONA (Goloboff, 1999) and spawn with the aid of Winclada (Nixon, 2002), using heuristic search algorithm with 1000 random addition replicates (mult*1000), holding 100 trees per round (hold/100), max trees set to 100 000 and applying TBR branch swapping. All base positions were treated as equally weighted characters, and gaps were treated as fifth state. Nodal support was assessed with bootstrap resampling (1000 replicates) using Winclada (Nixon, 2002) and Bremer support values using Nona.

Maximum likelihood analysis was run as implemented in MEGA5 (Tamura *et al.*, 2011) using the GTR+ invariant gamma evolutionary model using the close-neighbor-interchange heuristic and bootstrapping with 1000 replicates.

Results

Morphology. The *Merodon ruficornis* group of species was shown to be a morphologically distinct group of species with several synapomorphic characters, especially in the structure of metalegs (e.g. Milankov *et al*., 2002).

Diagnosis. Male. Trochanter, femur and tibia of metaleg usually with processes (as on Fig. 1D). Male genitalia with characteristic hook-like posterior surstyle lobe (as on Fig. 5A: ps).

Female. Tergite 4 with transversal depression (Fig. 3B, C: td), except in *M. papillus* (Fig. 3A). Tergites dark, except tergite 2 with pair of lateral red-orange spots. Tergites 2–4 with pair of transversal, white dusted stripes (except in *M. alexandri*, it has undusted tergites, but tergites 3–4 with pair of white haired stripes medially). Tergite 5 with two small lateral depressions (Fig. 3A–C: ld). Vertex at the level of ocellar triangle shiny black (Fig. 2A).

General description. Male. Head (Fig. 1A–C): Antenna (Fig. 1C) brown-orange, first flagellomere 1.3× as long as wide, 1.6× longer than pedicel, concave dorsally, apex acute; arista: second, third and basal part of fourth flagellomeres pale, fourth flagellomere brown and thickened basally and dark brown apically, 1.5× longer than first flagellomere; covered with short, dense microscopic hairs. Face and frons black, covered with long whitish-yellow hairs and silver microtrichia. Oral margin shiny black, well protruded (Fig. 1B). Vertical

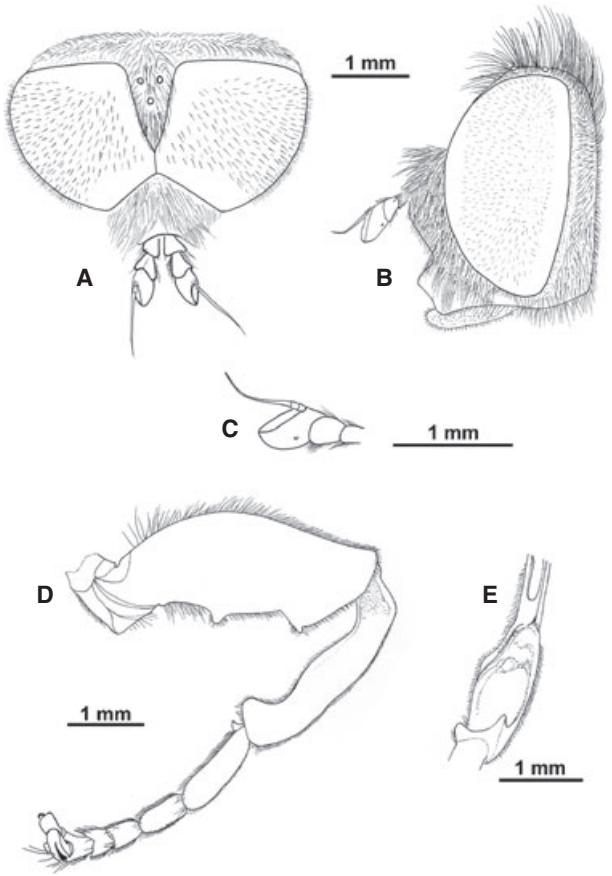

Fig. 1. Male of *Merodon papillus*. (A) head, dorsal view; (B) head, lateral view; (C) antenna, lateral view; (D) left metaleg, lateral view; (E) left metatibia, ventral view.

triangle (Fig. 1A) isosceles, 2.5× longer than eye contiguity, shiny black except in front of anterior ocellus with white microtrichia, covered with long whitish-yellow hairs except black ones in ocellar triangle. Ocellar triangle (Fig. 1A) equilateral or sligtly isosceles. Eye contiguity about eight to ten ommatidia long. Eye hairs long as scape, pale. Post-ocular orbit with whitish-yellow hairs, along the eye margin with dense white microtrichia and posteriorly with metallic bluish-greenish lustre.

Thorax: Scutum and scutellum black with bronze lustre, covered with dense, erect yellow hairs, as long as first flagellomere. Pleurae covered with grey-green microtrichia and the following parts with long yellow hairs: anterior part of proepimeron, posterior part of anterior anepisternum, the most of posterior anepisternum except anterior end, anteroventral and posterodorsal part of katepisternum, anepimeron, metasternum; katatergit with dense, erect, short, light-brown hairs. Wing hyaline, with dense, brown microtrichia. Calypter pale yellow. Halter with light brown pedicel and yellow capitulum (outer part darkened). Femora dark brown-black, except usually paler apex; tibiae can be from completely dark to pale basally and apically; colour of tarsi varies. Metatrochanter with process (Fig. 10: pt). Metafemur (Fig. 10) thickened and curved, often with ventral protuberance (Fig. 10: pf) in the basal one third of its length. Metatibia with apical spur(s) (Fig. 10: at).

Abdomen: Black with bronze reflections, slightly tapering, as long as mesonotum. Tergites 2–4 black with more or less distinct white transverse bands of microtrichia interrupted in the middle (in some specimens it may lack); tergite 2 with orange anterolateral spots; hairs on tergites mainly erect and yellow, but tergites 2–4 medially usually with some black hairs. Sternites blackish-brown, covered with long pale yellow hairs.

Male genitalia: Posterior surstyle lobe rounded, pointed anteriorly (as on Fig. 5A: ps); margin of surstylus convex (as on Fig. 5A); anterior surstyle lobe with small interior accessory lobe (as on Fig. 5B: ia); cercus oval or rectangular (as on Figs 22A, 28A). Hypandrium with folded thecal ridge (as on Fig. 5C: ft). Lateral sclerite of aedeagus long, narrow, hammer-like in lateral view (as on Fig. 5C: ls).

Female. Similar to the male except normal sexual dimorphism (Fig. 2) and for the following characteristics: Tergite 4 with transversal depression (Fig. 3B, C: td). Black hairs on tergites more present than in males: posterior margin of tergite 2,

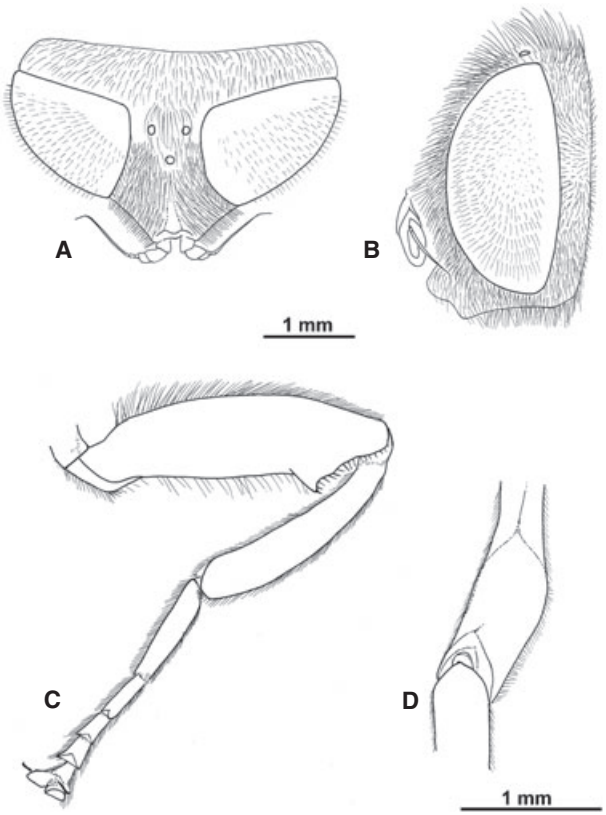

Fig. 2. Female of *Merodon papillus.* (A) head, dorsal view; (B) head, lateral view; (C) left metaleg, lateral view; (D) left metatibia, ventral view.

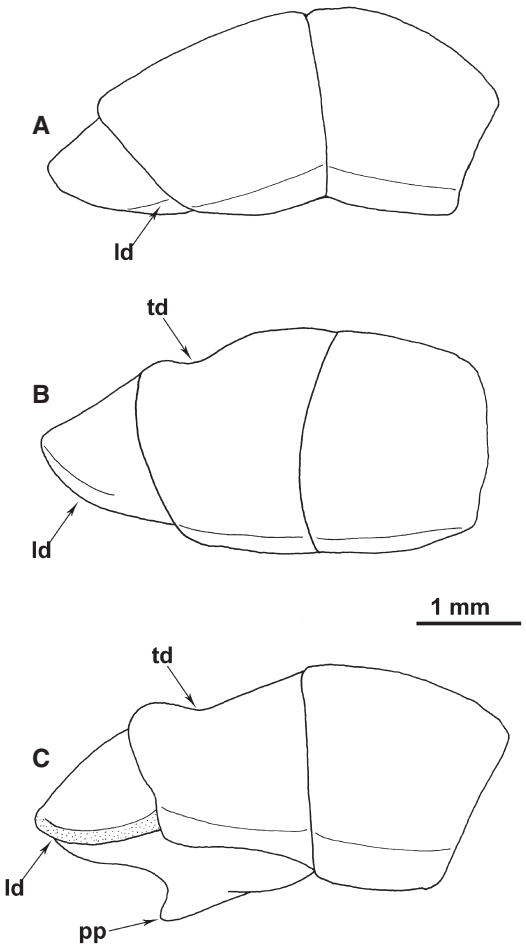

Fig. 3. Abdomen (segments 3–5) of female. (A) *Merodon papillus*; (B) *M. trebevicensis*; (C) *M. armipes* (ld, lateral depression on tergite 5; pp, posterior process on sternite 4; td, transversal depression on tergite 4).

tergites 3–4 predominately black haired, except lateral sides and white microtrichose stripes with pale hairs.

Length: Small species 7–11 mm; medium-sized 10–12 mm; large species 11–14 mm.

Variability. Main interspecific variability is in the shape of the metalegs, which is the most important diagnostic feature. Male genitalia, usually the most well-used taxonomic character in the whole genus, are less valuable in this group, with a few exceptions: *M. papillus*; *M. hoplitis* Hurkmans **sp.n.**; *M. alexandri*; *M. nigripodus* Vujić & Hayat **sp.n.** and *M. ovaloides* Vujić & Radenković **sp.n.** have some clear apomorphic characters. In other species differences in the structure of male genitalia are very small.

Morphological intraspecific variability is present in colour of tarsi, colour of hairs on tergites and degree of development of microtrichose stripes on tergites. Populations of almost all species in the eastern part of Turkey have reduced microtrichose stripes on tergites. This reduced character state is present in some other species groups, as in taxa of the *M. aureus* group in Turkey. Also eastern populations of some species (such as *M. loewi*) have darker legs and stronger black coloration of body. In some species the shape of some metaleg structures and male genitalia can be variable (as discussed under each particular species). In Turkish populations of *M. loewi* and *M. turcicus* Vujić & Hayat, **sp.n.**, particularly large variability is observed. Many specimens show some intermediate character states that indicate possible introgressions.

Merodon abruzzensis Van der Goot, 1964

(Figs 4B, D, E, 5D, E, 6)

Diagnosis. Basal three tarsomeres light brown, the rest dark brown-black. In males (Fig. 4B), metatrochanter with medium-sized process; protuberance on metafemur small, but always present; metatibia with apical spur projected backwards. Tergites 2–4 medially black haired; microtrichose stripes present at least on tergite 2. Female with rounded apex of metatibia (Fig. 4D, E).

M. abruzzensis is extremely similar to *M. ruficornis* from which it differs in the rounded shape of spur on metatibia in males (Fig. 4B); in *M. ruficornis* this spur is with thorn-like ventral projection (Fig. 4A) and male genitalia: inner thorns on posterior and anterior surstyle lobe long and distinct (Fig. 5D,

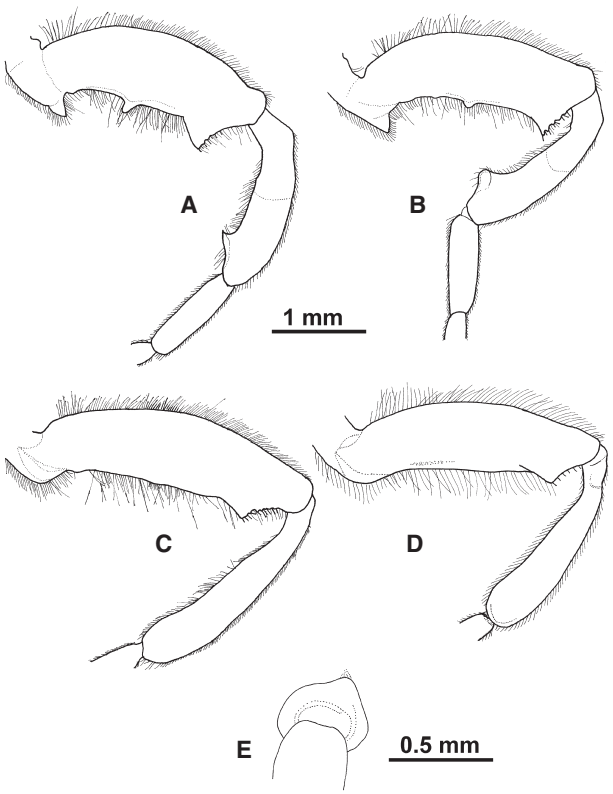

Fig. 4. Left metaleg (A, B, male; C–E, female). (A, C) *Merodon ruficornis*, (B, D, E) *M. abruzzensis*; (A–D) lateral view; (E) apex of metatibia.

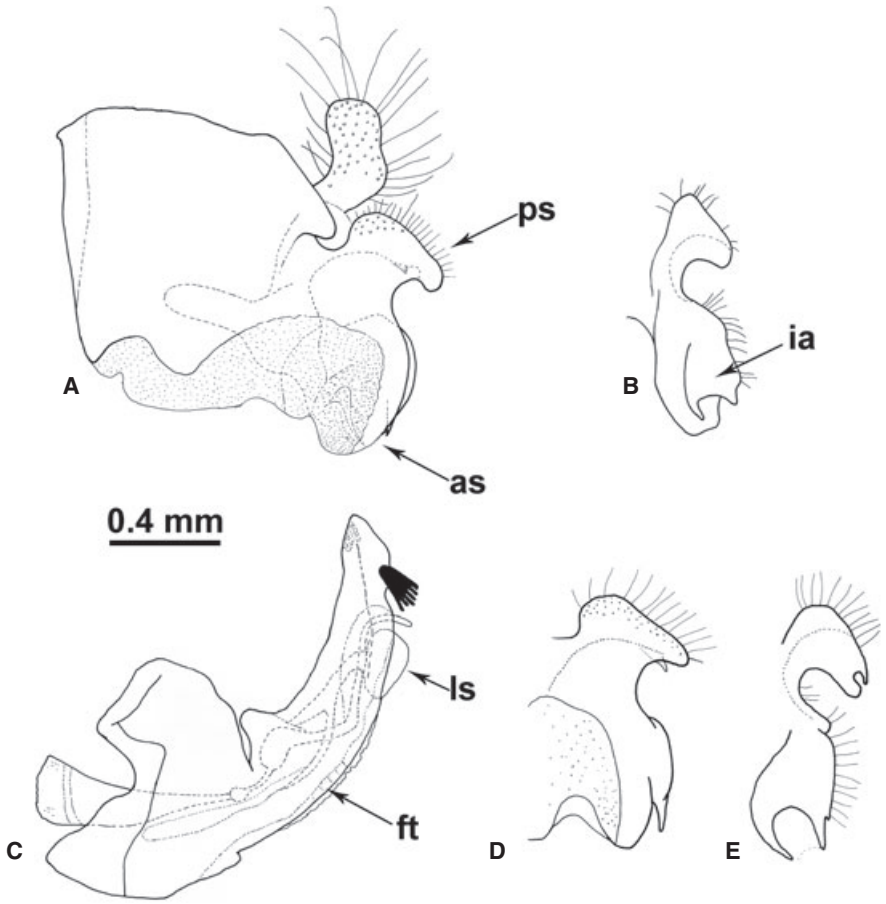

Fig. 5. Male genitalia. (A–C) *Merodon ruficornis*, (D, E) *M. abruzzensis*; (A) epandrium, lateral view (as, anterior surstyle lobe, ps, posterior surstyle lobe); (B, E) left surstyle, anterior view (ia, interior accessory lobe of anterior surstyle lobe); (D) left surstyle, lateral view; (C) hypandrium, lateral view (ft, folded thecal ridge; ls, lateral sclerite of aedeagus).

E), in *M. ruficornis* very small (Fig. 5A, B). Females seem to be inseparable, except by the distribution: *M. abruzzensis* locally endemic with its range on the Abruzzi Mountains in Italy, at the border of *M. ruficornis* distribution (Fig. 6).

Material examined. Type material: Paratypes, Italy: 3♂♂, Abruzzo (Province of L'Aquila, Gran Sasso), 1.viii.1960 (ZMA); 3♂♂, Abruzzo (Province of L'Aquila, Gran Sasso) 21.vii.–1.viii.1960 (ZMA); ♀, Abruzzo (Province of L'Aquila, Gran Sasso) 21.vii.–1.viii.1960 (ZMA); ♂, Abruzzo (Province of L'Aquila, Ovindoli, Mt.Sirente) 23.vii.1960 (ZMA); ♂, Abruzzo (Province Gran Sasso, Campo Imperatore, Rif. Albergo) 2.viii.1960 (ZMA).

Range. (Fig. 6). Endemic species from Abruzzi Mountains in Italy.

***Merodon alexandri* Popov, 2009**
(Figs 7A, 8; 9)

Diagnosis. Tergites in both sexes shiny, without white microtrichose stripes. Basal three tarsomeres pale (at least on metaleg). Male metaleg (Fig. 7A): process on metatrochanter small; metafemur smooth ventrally, without protuberance; metatibia with one apical simple, shark fin-like spur. Tergites 3–4 (2) medially with black hairs. Similar to *M. ponticus* **sp.n.** from which differs: in males by absence of protuberance on ventral surface of metafemur and shorter process on metatrochanter (Fig. 7A, E) and short rectangular posterior surstyle lobe in male genitalia (Fig. 8A, B); in females by absence of microtrichose stripes on tergites.

Material examined. Type material: Holotype, ♂, Ukraine: Kharkiv, Gaidary (40 km S from Kharkiv), 11.v.1999 leg. G.V.Popov (Popov, 2009). Paratypes, Ukraine: 3♂♂, Kharkiv, Gaidary (40 km S from Kharkiv), 8.v.1999 (FSUNS, 02628, 02629, 02630); RUSSIA: 2♂♂, South Russia, Waluiki (Valuyki), leg. R.M. Velitchkovsky (NHMW).

Additional records. Popov (2009): Ukraine: 147♂♂, 38♀♀; Russia: 3♂♂, ♀ (all paratypes).

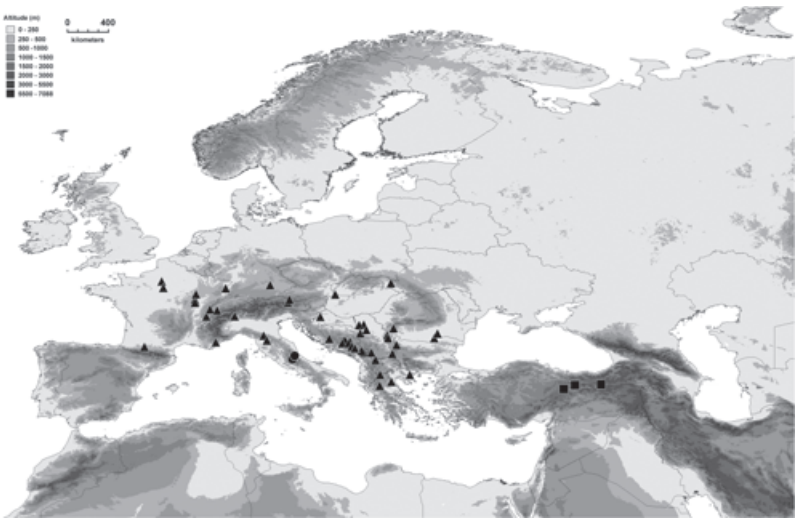

Fig. 6. Distribution. • *Merodon abruzzensis*; ▲ *M. ruficornis*; ■ *M. lamellatus* **sp.n.**

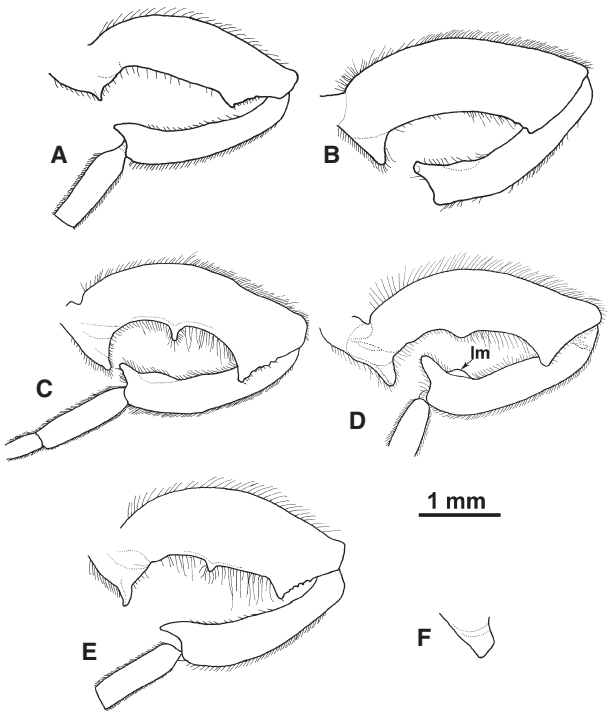

Fig. 7. Left metaleg of male. (A) *Merodon alexandri*; (B) *M. nigripodus* **sp.n.**; (C, D) *M. auripes* (lm, lamella of metatibia); (E, F) *M. ponticus* **sp.n.**; (F) metatrochanter.

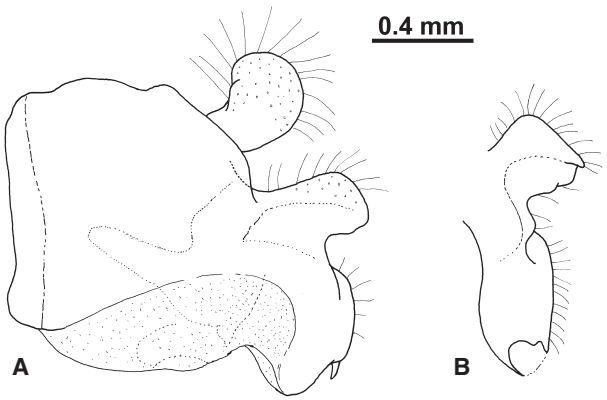

Fig. 8. Male genitalia of *Merodon alexandri.* (A) epandrium, lateral view; (B) left surstyle, anterior view.

Range. (Fig. 9). Endemic species from Ukraine and Russian steppes.

Merodon armipes **Rondani, 1843**

(Figs 3C, 10, 11)

Diagnosis. Basal three tarsomeres in both sexes pale (at least on metaleg). Male metaleg (Fig. 10): process on metatrochanter very large, as long as width of metatibia; metafemur with small ventral protuberance; metatibia with two apical spurs (large outer, anteroventral with shape of duck beak, and narrow, sharp inner, posteroventral ones). Tergites pale haired. Sternite 4 in females with a thorn-like posterior process (Fig. 3C: pp) – a unique apomorphic character in the *ruficornis* group.

Material examined. Type material: Lectotype (designated by W. Hurkmans, published here), ♂, '393.24' (no.61) under label 'armipes' in coll. C. Rondani (LSF). Paralectotypes, Switzerland: ♂, Zurich (Brione), leg. Rondani* (ZHMB); Germany: ♂, Baden-Württemberg (Rhein), leg.Hoffmansegg S (ZHMB).

Additional records. Albania: 8♂♂, 5♀♀ (RMNH, NHMW); Austria: 3♂♂ (NHMW, ZHMB); Bosnia and Herzegovina: 4♂♂, 10 ♀♀ (ZAG, SAR, FSUNS); Croatia: 8♂♂, 3♀♀ (BMNH, NHMW, ZAG, ZMUC); France: ♂, 9♀♀ (TAU, FSUNS); FYR Macedonia: 7♂♂, ♀ (FSUNS, RMNH); Germany: 3♂♂ (NHMW, FSUNS); Greece: 7♂♂, ♀ (ZMUC,

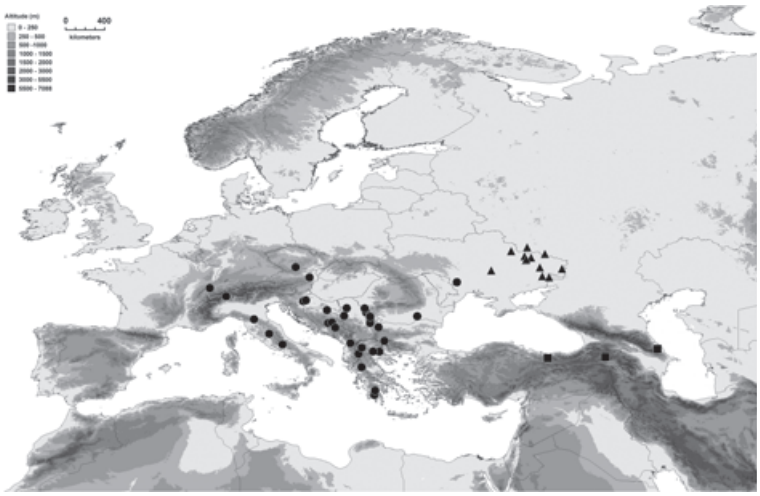

Fig. 9. Distribution. ▲ *Merodon alexandri*; • *M. auripes*; ■ *M. ponticus* **sp.n.**

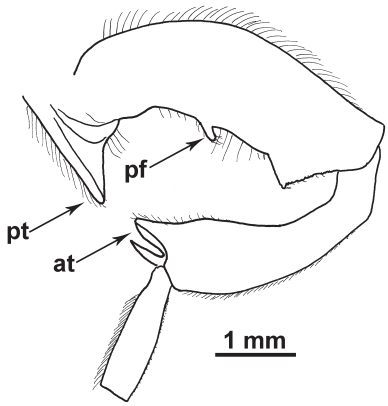

Fig. 10. Left metaleg of *Merodon armipes*, lateral view (at, apical spurs of metatibia; pf, protuberance of metafemur; pt, process of metatrochanter).

ZMA, FSUNS); Hungary: 3♂♂, ♀ (ZMUC, RMNH, FSUNS); Italy: 36♂♂, 22♀♀ (ZMA, ZHMB, ZMUC, MZH, RMNH, FSUNS, BMNH, NHMW); Montenegro: 114♂♂, 36♀♀ (FSUNS, BMNH, NHMW); Romania: 2♂♂, 4♀♀ (ZHMB); Serbia: 31♂♂, 5♀♀ (BEO, FSUNS); Slovenia: 24♂♂, 8♀♀ (BEO, RMNH, M.J.S. coll., NHMW); Turkey: 6♂♂, 1♀ (ZMA, FSUNS, BMNH, A.S.coll.).

Range. (Fig. 11). One of the most widely distributed species from *ruficornis* group, from France and Germany in the west to Caucasus in the east. The most abundant populations are present on the Balkan and Apennine peninsulas, from the cost to the high mountains. This is the only species of *ruficornis* group in Europe that appears up to 1800 m altitude.

***Merodon auripes* Sack, 1913: 621**
(Figs 7C, D, 9, 12A, B)

Diagnosis. Basal three tarsomeres of all legs pale. Males (Fig. 7C, D) with medium-sized process on metatrochanter; metafemur with small, but always present ventral protuberance; metatibia with one apical spur. Tergites 2–4 medially black haired; microtrichose stripes present at least on tergite 2. Female with angular apex of metatibiae (as on Fig. 24E, F). *M. auripes* is similar to *M. ponticus* **sp.n.** from which it differs in the undulating ventral margin of spur (called lamella) on metatibia in males (Fig. 7D: l m); in *M. ponticus* **sp.n.** this margin is straight (Fig. 7E) and male genitalia: posterior surstyle lobe hook-like and inner thorn on anterior surstyle lobe distinct (Fig. 12A, B), in *M. ponticus* **sp.n.** posterior surstyle lobe short and rounded and anterior surstyle lobe with indistinct thorn (Fig. 12C, D). Females seem to be inseparable, except by the distribution: *M. auripes* is distributed in Southern Europe and *M. ponticus* **sp.n.** in Turkey and Azerbaijan. *Merodon auripes* can be separated from *M. loewi* (Fig. 21A–C) in males by presence of ventral protuberance on metafemur and smaller process on metatrochanter (Fig. 7C, D). In females long hairs on ventral surface of metafemur at least two thirds of its width (in *M. loewi* short, less than one half of its width) (Fig. 21D). Generally, basal three tarsomeres of *M. auripes* are paler than in *M. loewi* (often brownish or even black in eastern populations in *M. loewi*). This is the main difference between *M. auripes* and specimens of *M. planiceps* with small protuberance on metafemur (tarsomeres always dark-brown to black in *M. planiceps*).

This species was long overlooked in all regional lists and cited in European fauna only as literature data, based on just one type specimen. Generally the specimens belonging to *M. auripes* were identified in institutional collections as *M. ruficornis*. This was the case also in Milankov *et al.* (2002) where specimens labelled as *M. ruficornis* actually belong to *M. auripes*, as explained in Milankov *et al.* (2008). Radenković *et al.* (2002) resolved the identity of *M. ruficornis* after examination of Meigen's and Strobl's types (*recurvus* Strobl, *ruficornis* Meigen, *trebevicensis* Strobl). Unfortunately, the type of *M. auripes* Sack could not be traced and is deemed to be lost: the species was based on one male from Szászkabánya/Sasca Montană/ – former territory of Hungary, today Romania (Sack, 1913). The identity accepted in this

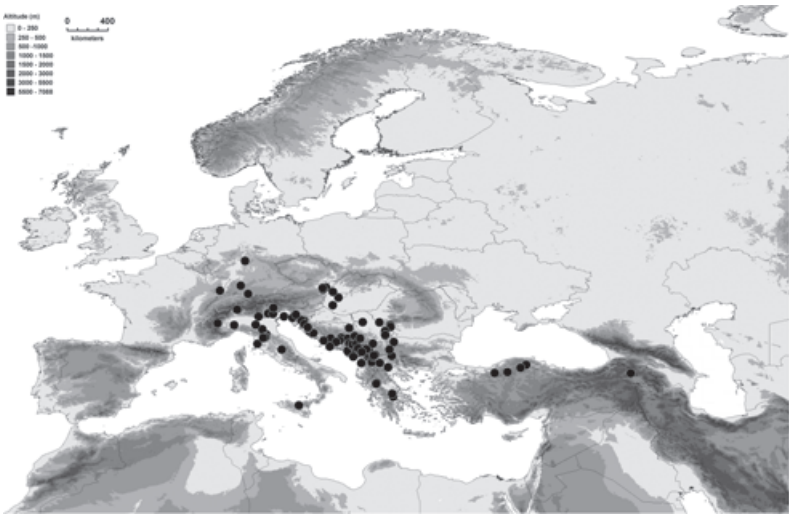

Fig. 11. Distribution of *Merodon armipes.*

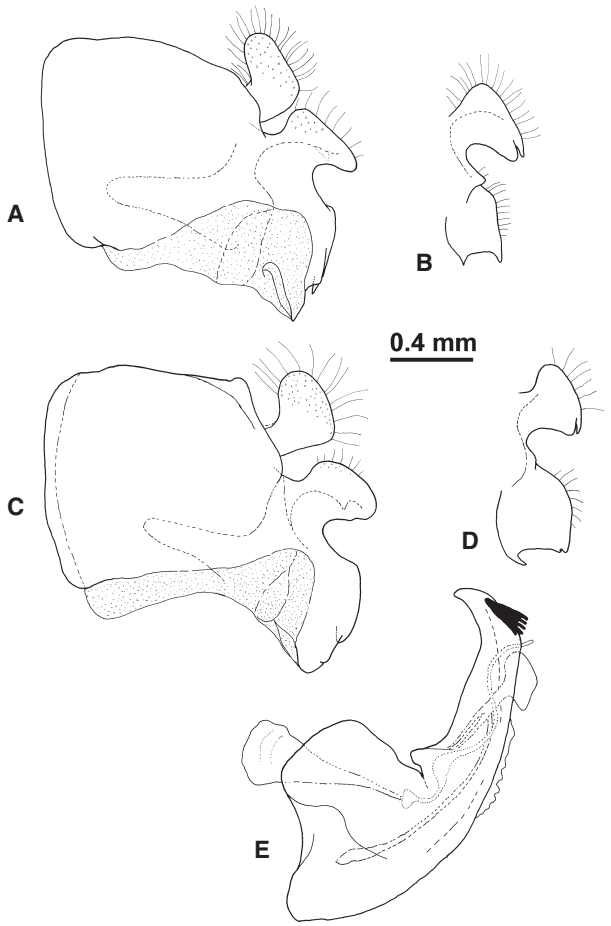

Fig. 12. Male genitalia. (A, B) *Merodon auripes*, (C–E) *M. ponticus* **sp.n.**; (A, C) epandrium, lateral view; (B, D) left surstyle, anterior view; (E) hypandrium, lateral view.

publication is established based on Sack's (1932: 306) description: the characters on metaleg of the holotype, presented on figure 104, are very clear and obviously agree with the concept of *M. ruficornis* sensu Milankov *et al*., 2002. Here we designate a neotype for the taxon to solve this problem with doubtful and confusing identities.

Material examined. Type material: Neotype (designated here), ♂, Serbia, Vršačke planine, Prevala, 25.iv.1986 (00250) (only few km from the type locality, Sasca mountains; both hills belong to the low Carpathian mountains) (FSUNS).

Additional records. Albania: ♂ (NHMW); Austria: ♂, 3♀♀ (NHMW); Bosnia AND Herzegovina: 4♂♂, 3♀♀ (FSUNS, SAR); Bulgaria: ♀ (J.S.coll.); Croatia: ♂,♀ (ZMA); FYR Macedonia: 3♂♂, 3♀♀ (FSUNS); Greece: 5♂♂, 2♀♀ (ZMUC, ZMA); Italy: ♂, 3♀♀ (ZMA, UASK); Serbia: 52♂♂, 17♀♀ (ZMA, BEO, FSUNS, RMNH); Switzerland: ♂, ♀ (RMNH); Ukraine: 2♂♂ (G.P. coll.); Romania: ♀ (ZMA).

Range. (Fig. 9). Species with mostly continental distribution, registered on the Balkan and Apennine peninsulas and Central Europe. Populations of this species appear mostly on low mountains, up to an altitude of 800 m.

Merodon gallicus Vujić & Radenković sp.n.

(Figs 13C, 14A–C, 15A, 16)

Description. Male. Robust species with pale haired golden tergites. Metafemur (Fig. 13C) with large ventral hook-like protuberance in the basal one third of its length. Metatrochanter (Fig. 13C) with short process, few times shorter than protuberance on metafemur. Metatibia (Fig. 13C) with two long, sharp, narrow apical spurs about the same length. Male genitalia (Fig. 14A–C): posterior surstyle lobe hook-like with distinct inner pointed process (Fig. 14A, B); anterior surstyle lobe with long inner thorn (Fig. 14B); cercus rounded (Fig. 14A).

Female. Metafemur with small ventral protuberance (Fig. 15A). Microtrichose stripes on tergites 2–4 well defined,

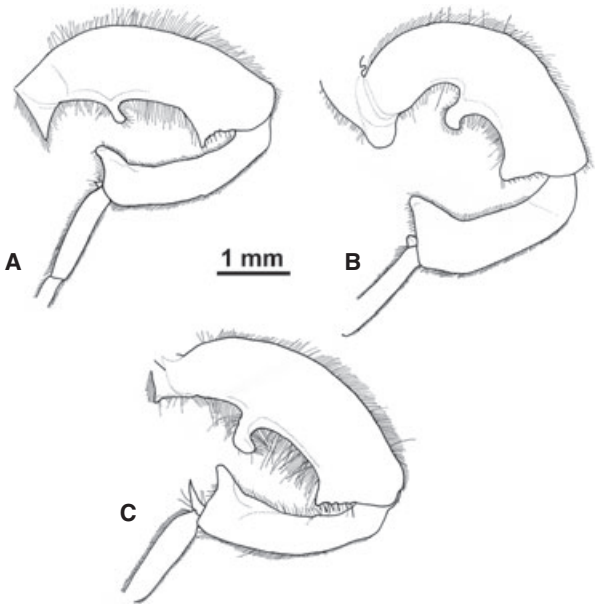

Fig. 13. Left metaleg of male. (A) *Merodon trebevicensis*; (B) *M. hoplitis* **sp.n.**; (C) *M. gallicus* **sp.n.**

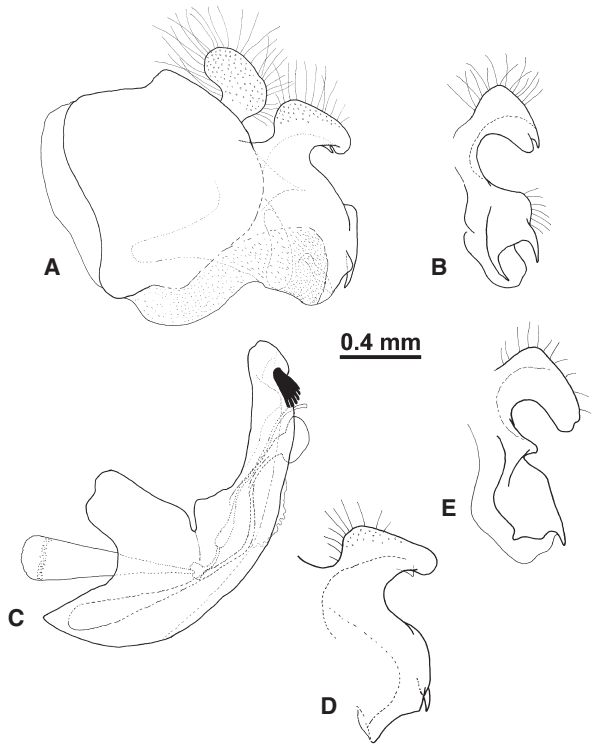

Fig. 14. Male genitalia. (A–C) *Merodon gallicus* **sp.n.**, (D, E) *M. trebevicensis*; (A) epandrium, lateral view; (B, E) left surstyle, anterior view; (D), left surstyle, lateral view; (C) hypandrium, lateral view.

white-greyish; tergites pale haired laterally, medially with many black hairs from posterior half of tergite 2 until posterior

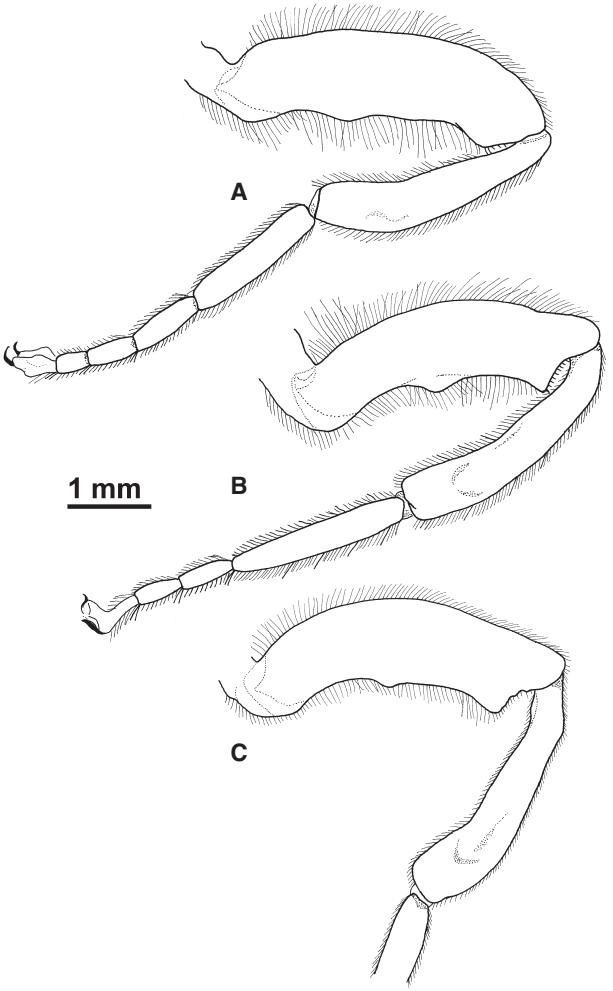

Fig. 15. Left metaleg of female, lateral view. (A) *Merodon gallicus* **sp.n.**; (B) *M. trebevicensis*; (C) *M. hoplitis* **sp.n.**

margin of tergite 5. Vertex at the level of ocellar triangle black haired; frons with short black hairs on central stripe.

Diagnosis. Similar to *M. trebevicensis* and *M. hoplitis* **sp.n.** from which it differs in male by structure of metalegs (Fig. 13A–C): metatibia with two long apical processes almost of the same length in lateral view (Fig. 13C); and male genitalia: anterior surstyle lobe with long and distinct inner thorn (Fig. 14B). Female extremely similar to *M. trebevicensis*, can be distiguished only by the distribution.

Material examined. Type material: Holotype, ♂, France: Bourgogne, Curley, 28.vi.24, ex coll. Hesse (MNHN). Paratypes, France: 5♂♂, Bourgogne, Curley, 21.vi.24, ex coll. Hesse (MNHN); 1♀, Combe, Lauroux, 20.v.1932, ex coll. Hesse (MNHN); ♂,♀, Daniville, vii.1916, leg. G. Portevin, Collection Lucien Chopard 1919, (MNHN); ♂, Lorraine, 3 km SSW Colombey-les-Belles, 10.vi.1968, leg. P.H. van

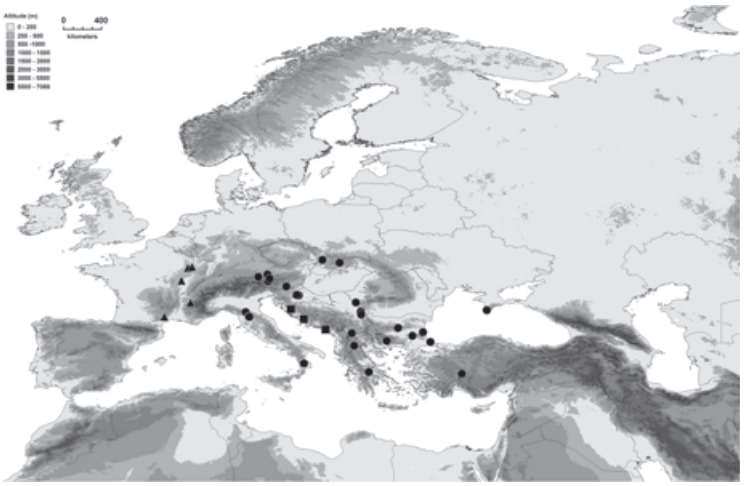

Fig. 16. Distribution. ▲ *Merodon gallicus* **sp.n.**; ■ *M. hoplitis* **sp.n.**; ● *M. trebevicensis.*

Doesburg, (RMNH); ♂, Rhone-Alpes, Jarrie, 6.ix, ex coll. Hesse (MNHN).

Range. (Fig. 16). Endemic for France; sister species with *M. trebevicensis*; their distributions are separated by the Alps.

Etymology. The name *gallicus* is based on the word Gallia that in Roman time referred mainly to present-day France.

***Merodon hoplitis* Hurkmans sp.n.**
(Figs 13B, 15C, 16, 17)

Remark. Hurkmans recognized this new species and named it *hoplitis* in the unpublished manuscript that he handed to the authors Vujić and Radenković to complete. The original description of Hurkmans is modified here to be comparable with descriptions of other species from this group.

Description. Male. Robust species with extremely broad metalegs and pale haired tergites. Metafemur (Fig. 13B) very thick and swollen, with large ventral protuberance in the basal one third of its length. Metatrochanter (Fig. 13B) with medium-sized, unhaired shiny process. Metatibia (Fig. 13B) with three apical spurs: two small posteroventral (inner) (one relatively sharp, another rounded) and one large, broad anteroventral (outer). Basal three tarsomeres of all legs light brown or all tarsi dark brown dorsally, with some strong black bristles. Male genitalia (Fig. 17): posterior surstyle lobe rectangular with indistinct inner process (Fig. 17A); anterior surstyle lobe with very small inner thorn (Fig. 17B); cercus with characteristic concave ventral margin (Fig. 17A).

Female. Metafemur covered with short hairs, especially in apical third; ventral protuberance small (Fig. 15C). Microtrichose stripes on tergites 2–4 well defined, white-greyish; tergites pale haired except some black hairs medially from posterior half of tergite 2 until anterior half of tergite 4. Tergite 5 with two deep longitudinal depressions laterally. Vertex at the level of ocellar triangle and frons along median stripe black haired.

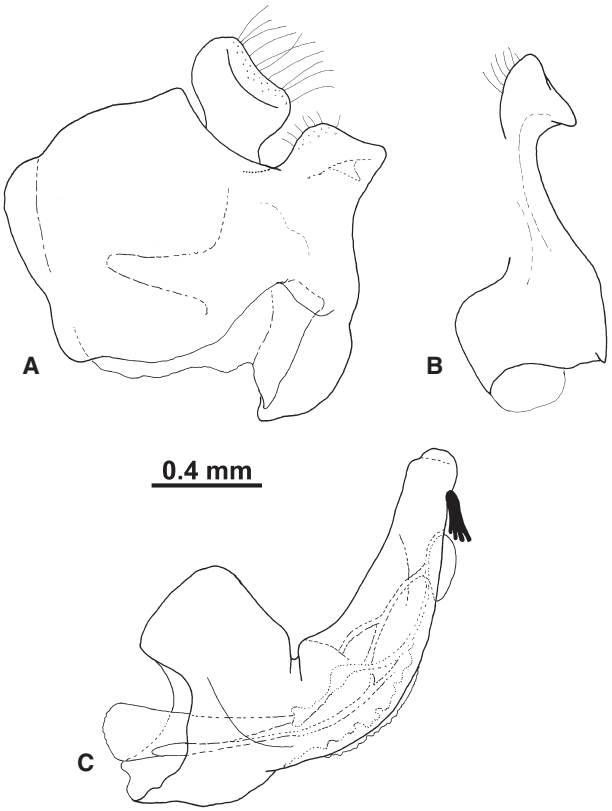

Fig. 17. Male genitalia of *Merodon hoplitis* **sp.n.** (A) epandrium, lateral view; (B) left surstyle, anterior view; (C) hypandrium, lateral view.

Diagnosis. Similar to *M. trebevicensis* and *M. gallicus* **sp.n.** from which it differs in male by structure of metalegs (Fig. 13): very broad metafemur and two short inner spurs on metatibia in *M. hoplitis* **sp.n.**; and male genitalia: characteristic shape

of cercus and posterior surstyle lobe in *M. hoplitis* **sp.n.** (Fig. 17A). Female can be distinguished by the short hairs on metafemur (Fig. 15C).

Material examined. Type material: Holotype, ♂, Croatia: Velebit, Brusani, 9.vi.1969, 600 m, H. J. P.Lambeck, (ZMA). Paratypes, Croatia: 95♂♂, 32 ♀♀, Velebit, Brusani, 9.vi.1969 to 13.vi.1969, 600 m, H.J.P.Lambeck, (ZMA); ♀, Dalmatia, Salona, 26.iv.30, Zerny, (FSUNS). Montenegro: ♂, ♀, Orjen, 4.v.2003, 4♂♂, 6♀♀, 1.vi.2008, Vratno, 25♂♂, 20♀♀, 1.vi.2011 (FSUNS).

Range. (Fig. 16). Endemic to the Dinaric Mountains (along Adriatic cost on the Balkan Peninsula).

Etymology. The word *hoplitis*, is Greek noun ὁπλίτης, meaning a heavily-armed infantry soldier of Ancient Greece, refers to the projections and spurs on metalegs of the taxon.

***Merodon ilgazense* Vujić, Marcos-García, Sarıbıyık & Ricarte, 2011**
(Figs 18A, 19)

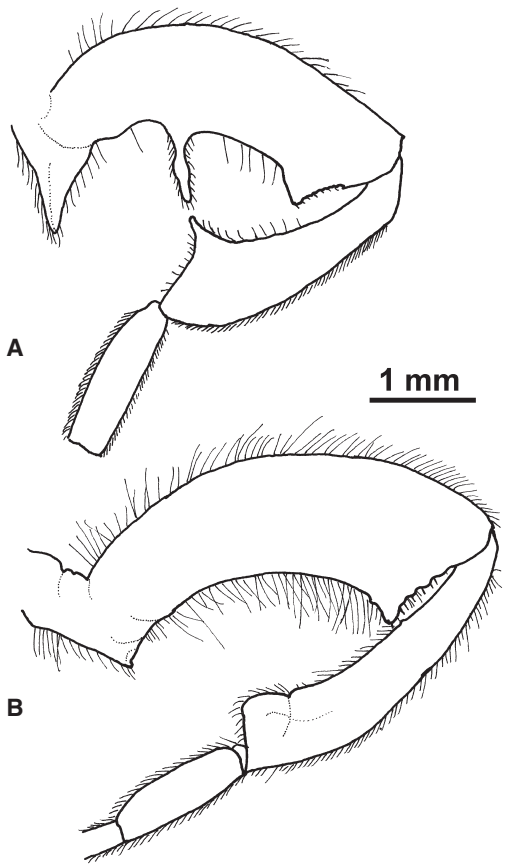

Fig. 18. Left metaleg of male, lateral view. (A) *Merodon ilgazense*; (B) *M. lamellatus* **sp.n.**

Diagnosis. A recently described species known only from one male (Vujić *et al*., 2011). Metaleg very peculiar, with extremely long process on metatrochanter and protuberance on metafemur (Fig. 18A). Metatibia with two apical spurs (Fig. 18A), inner, posteroventral sharp and outer, anteroventral triangular, pointed vertically. Basal three tarsomeres of all legs reddish, without strong black bristles. Tergites 3–4 covered with black hairs medially; microtrichose stripes narrow, almost indistinct on tergite 4.

Material examined. Type material: Holotype, ♂, Turkey: Kastamonu, Ilgaz (Mountain pass, Tosya), 8.vi.1996, 1650 m, S.S. coll.

Range. (Fig. 19). Species described based on a single male from Turkey, most probably local endemic of the Ilgaz Mountain.

***Merodon lamellatus* Vujić & Radenković sp.n.**
(Figs 6, 18B, 20, 21F)

Description. Male. Medium-sized species with pale haired tergites laterally and black haired medially. Metatrochanter with small process (Fig. 18B). Metafemur swollen, without ventral protuberance, covered with hairs shorter than its width (Fig. 18B). Metatibia with one apical triangular lamellar spur (Fig. 18B). Basal three tarsomeres of all legs pale brownish to yellow, at least on metaleg. Male genitalia: posterior surstyle lobe rounded, with indistinct inner process (Fig. 20A, B); anterior surstyle lobe with small inner thorn (Fig. 20B); cercus rounded (Fig. 20A).

Female. Metafemur covered with short hairs, especially in apical third; metatrochanter rounded (Fig. 21F). Microtrichose stripes on tergites 2–4 well defined, white-greyish; tergites pale haired except some black hairs medially from posterior half of tergite 2 until anterior half of tergite 4. Tergite 5 with strong lateral, longitudinal depressions. Vertex at the level of ocellar triangle and frons along central stripe black haired.

Diagnosis. Metatrochanter of male with small process, metafemur without ventral protuberance, and metatibia with plate-like apical spur (Fig. 18B); male genitalia: posterior surstyle lobe oval (Fig. 20A). Female can be distinguished by rounded metatrochanter (Fig. 21F) and pale three basal tarsomeres.

Material examined. Type material: Holotype, ♂, Turkey: Sivas, Kızıldağ, 10.vi.1999, 2100 m, (ZMA). Paratypes: Turkey: ♂, Sivas, Kızıldağ, 10.vi.1999, 2100 m, (ZMA); ♀, Sivas, Paşa Fabrikası, 20.v.2001, (ZMA); ♂, Erzurum, Aşkale, 25.vi.2000, M.Kesdek, (EMIT).

Range. (Fig. 6). Endemic species from the Turkish part of Caucasian region. Related to *M. ruficornis*, a taxon only distributed in Europe.

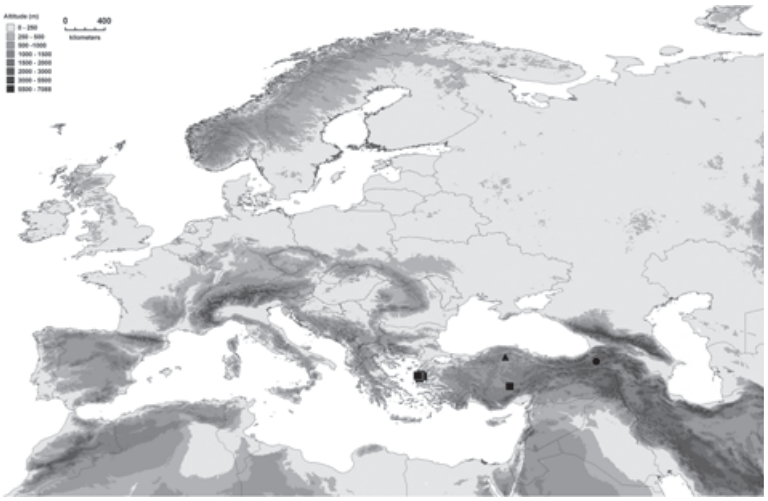

Fig. 19. Distribution. ▲ *Merodon ilgazense*; ● *M. nigripodus* **sp.n.**; ■ *M. papillus.*

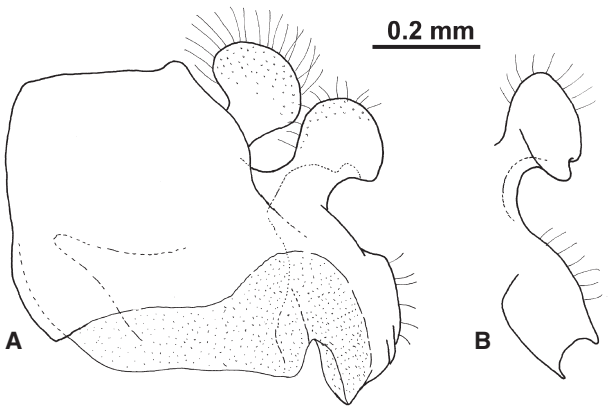

Fig. 20. Male genitalia of *Merodon lamellatus* **sp.n.** (A) epandrium, lateral view; (B) left surstyle, anterior view.

Etymology. The word *lamellatus* is derived from Latin, diminutive of *lamina* meaning thin plate, refers to the apical triangular lamellar spur of metatibia.

***Merodon loewi* Van der Goot, 1964**

nom. nov. for *Merodon graecus* Loew, 1862 (Van der Goot, 1964)

(Figs 21A–E, 22A–C, 23, 31B)

Diagnosis. Hairs on metafemur short, the longest hairs shorter than one third of its width; three basal tarsomeres of metaleg usually reddish, on pro- and mesolegs brown-reddish ventrally and dark brown to black dorsally (in some specimens, especially in eastern part of range all tarsi can be dark). Male metalegs: process on metatrochanter strong, with obtuse apex (Fig. 21A–C); metatibia with only one apical spur and lamella with transverse furrow; metafemur without ventral tubercle (Fig. 21A, B); tergites 2–4 in western populations with microtrichose stripes, reduced in eastern populations (usually in specimens with dark tarsi, mirotrichose stripes

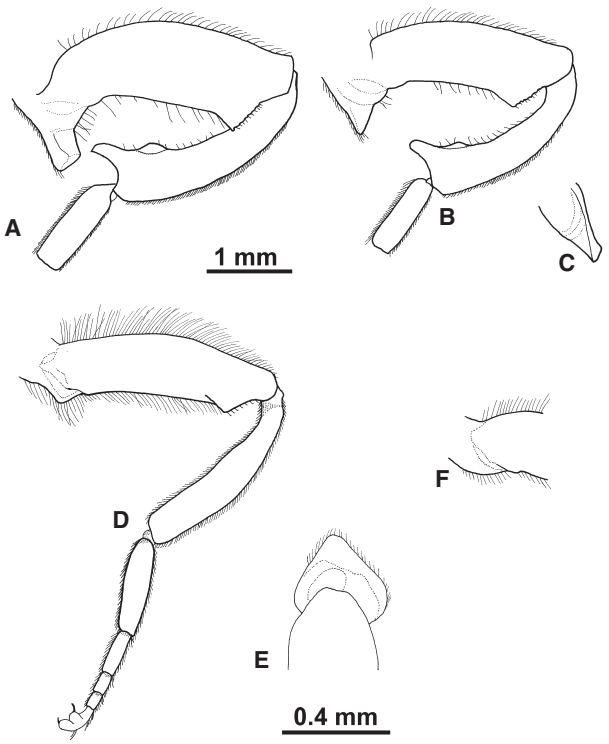

Fig. 21. Left metaleg. (A–E), *Merodon loewi*; (A, B) male, lateral view; (C) male metatrochanter, dorsal view; (D) female, lateral view; (E) apex of metatibia, female; (F) female of *M. lamellatus* **sp.n.**, metatrochanter and base of metafemur.

lacking). Male genitalia on Fig. 22A–C. Metatibia of female with apical, anteroventral, triangular small ridge (Fig. 21D); in *M. ruficornis* and *M. abruzzensis* apex of metatibia rounded, without ridge (Fig. 4D). *M. loewi* can be confused with *M. auripes*, from which male differs in smooth ventral margin of metafemur (in *M. auripes* ventral protuberance always present) and female by darkened dorsal surface of tarsi on pro- and sometimes on mesolegs (in *M. auripes* three

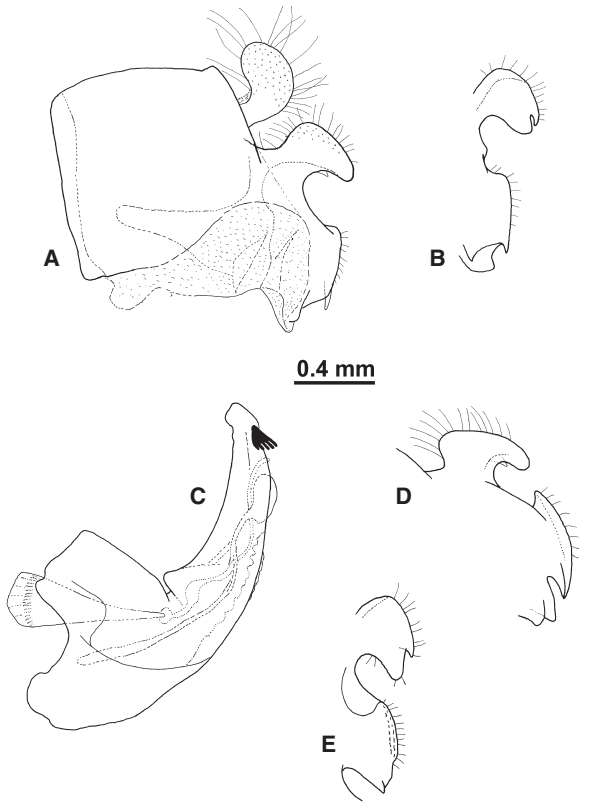

Fig. 22. Male genitalia. (A–C) *Merodon loewi*, (D, E) *M. nigripodus* **sp.n.**; (A) epandrium, lateral view; (B, E) left surstyle, anterior view; (D) left surstyle, lateral view; (C) hypandrium, lateral view.

basal tarsomeres of all legs reddish-yellow). *M. loewi* is very similar to *M. planiceps* and *M. ovaloides* **sp.n.**, except small differences in the structure of metalegs. It can be separated by the length of hairs on metafemur: short in *M. loewi* (Fig. 21A, B) and longer in other two species (as in Fig. 27A).

Material examined. Type material: This species was described under name *M. graecus* by Loew (1862) based on unspeciefied number of specimens from Greece and Bulgaria (Varna). This name was preoccupied by Walker, 1852 (junior synonym of *M. avidus* Rossi 1790). Van der Goot (1964) proposed a new name for Loew's species. Lectotype (hereby designated): Bulgaria: ♂, Varna (ZHMB). Paralectotypes: Bulgaria: ♀, Varna (ZHMB); Greece: ♂, Parnassos, 21.iv.1966 (ZHMB).

Additional records. Bulgaria: 2♂♂, ♀ (ZMA, ZMUC); FYR Macedonia: 8♂♂, ♀ (FSUNS, RMNH, MACMUSNH); Greece: 82♂♂, 29♀♀ (ZMA, ZMUC, FSUNS, RMNH, BMNH, TAU, A.S. coll., D.D. coll.); Israel: ♂ (TAU); Italy: 3♂♂, 2♀♀ (ZMA, NHMW, RMNH); Russia: ♂, ♀ (RMNH, NHMW); Serbia: 8♂♂, 3♀♀ (ZMA, FSUNS); Turkey: 69♂♂, 22♀♀ (ZMA, ZHMB, FSUSN, EMIT, NHMW, BMNH, SAR, A.S. coll.).

Range. (Fig. 23). Species with relatively wide range from Apennine Peninsula to Caucasus and Russian steppes. Most of the populations are concentrated in the area from eastern Balkan, through Turkey, to Caucasus Mountains.

***Merodon nigripodus* Vujić & Hayat sp.n.**
(Figs 7B, 19, 22D, E)

Description. Male. Small black species with pale haired tergites laterally and black haired medially. Legs black. Metatrochanter with medium-sized, triangular process, as long as apical spur on metatibia (Fig. 7B). Metafemur almost straight, without ventral protuberance, covered with short hairs (Fig. 7B). Metatibia narrow, with one medium-sized anteroventral apical spur (Fig. 7B). Male genitalia: posterior surstyle lobe hook-like, with small inner process (Fig. 22D, E); anterior surstyle lobe with distinct dorsal extension (Fig. 22D). Female. Unknown.

Diagnosis. Process on metatrochanter small and pointed (Fig. 7B); lamella posterior to the apical spur of metatibia small, triangular, occupies less than one fourth of length of tibia (Fig. 7B); metafemur without long and dense hairs (Fig. 7B); anterior surstyle lobe with very strong dorsal extension (Fig. 22D).

Material examined. Type material: Holotype, ♂, Turkey: Erzurum, Şenkaya, 9.vii.1992, R.Hayat (EMIT).

Range. (Fig. 19). Description is based on only one male from Erzurum province that belongs to Caucassian region. It is most probably local endemic.

Etymology. The word *nigripodus* is derived from Greek noun poús (genitive podós) meaning foot and adjective niger/gra/grum meaning black colour referring to the black legs of the taxon.

***Merodon ovaloides* Vujić & Radenković sp.n.**
(Figs 24A–D, 25, 26)

Description. Male. Medium-sized species with pale haired tergites. Metatrochanter with medium-sized, pointed process as long as the apical prolongation on metatibia (Fig. 24A, B). Metafemur swollen, covered with long and dense ventral hairs and with indistinct ventral protuberance (Fig. 24A, B). Metatibia with one apical, anteroventral, triangular spur, strongly curved innerly (Fig. 24A–C). Legs dark, except light brown at apical end of femora, basal end of tibiae and, in some specimens, ventral surface of basal three tarsomeres. Male genitalia: posterior surstyle lobe rounded (Fig. 25A); anterior surstyle lobe with medium-sized inner thorn (Fig. 25B); cercus rounded with flat dorsal margin (Fig. 25A).

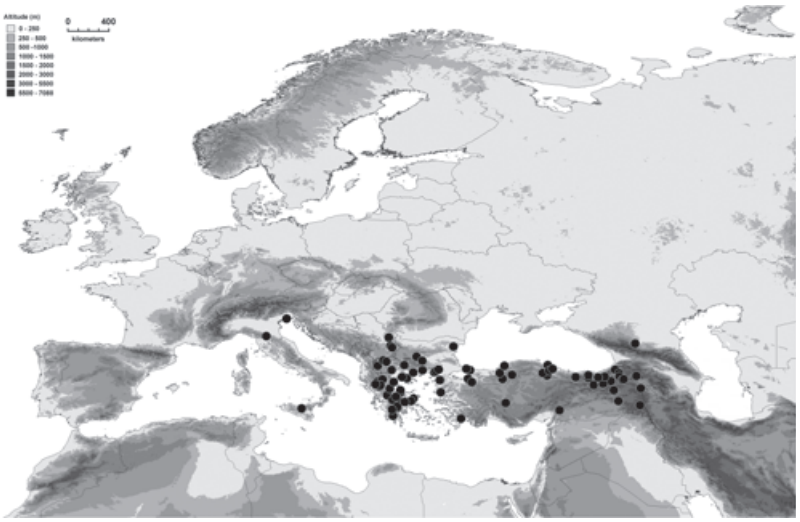

Fig. 23. Distribution of *Merodon loewi.*

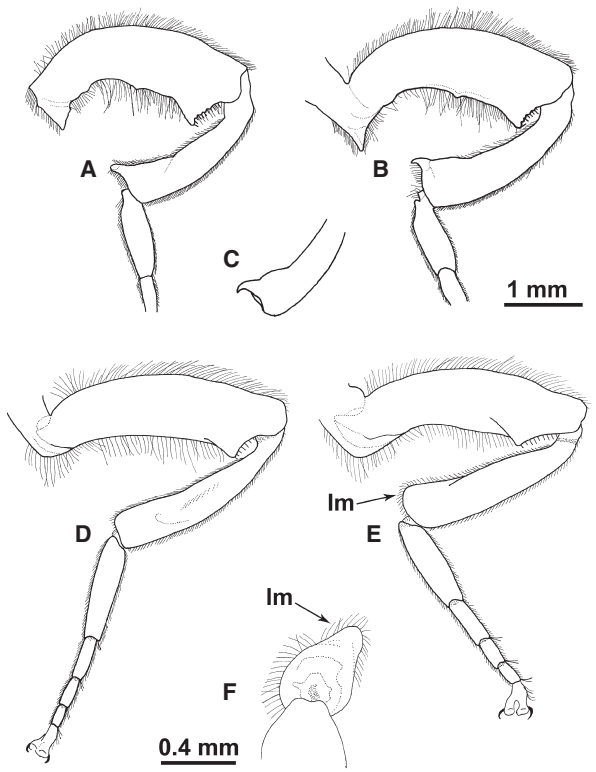

Fig. 24. Left metaleg. (A–D) *Merodon ovaloides* **sp.n.**; (A, B) male, lateral view; (C) male metatibia, anterior view; (D) female, lateral view; (E, F) *M. turcicus* **sp.n.**, female; (E) lateral view; (F) apex of metatibia (lm, lamella of metatibia).

Female. Metafemur covered with long hairs; ventral protuberance absent (Fig. 24D). Microtrichose stripes on tergites 3–4 well defined, white-greyish; tergites pale haired except black hairs medially from posterior half of tergite 2 until end of tergite 5. Vertex at the level of ocellar triangle and frons along central stripe black haired.

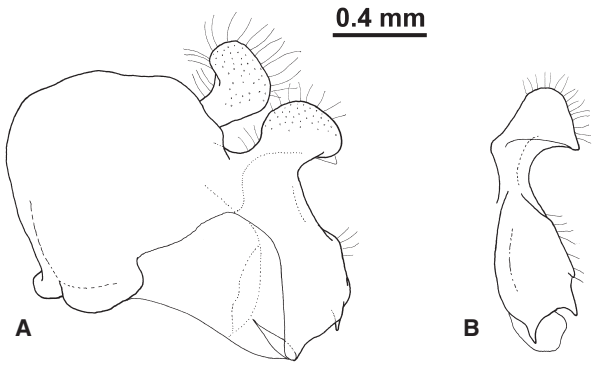

Fig. 25. Male genitalia of *Merodon ovaloides* **sp.n.** (A) epandrium, lateral view; (B) left surstyle, anterior view.

Diagnosis. Metatrochanter of male with medium-sized process, metafemur with indistinct ventral protuberance, metatibia with one apical, anteroventral, spur strongly curved innerly (Fig. 24A–C). Similar to *M. planiceps, M. portschinskyi* and *M. turcicus* **sp.n.** from which differs by oval posterior surstyle lobe in male genitalia (Fig. 25A), hook-like in other three species (as on Fig. 28A). Female can be distinguished from *M. turcicus* (Fig. 24E, F) by smaller lamella on the apex of metatibia (Fig. 24D and as on Fig. 21E) and predominately pale haired tergite and sternite 5 (many black hairs in *M. planiceps* and *M. turcicus*).

Material examined. Type material: Holotype, ♂, Turkey: Kastamonu, Agli, Karacakese, 18.vi.1995, 1300 m, (FSUNS). Paratypes: Turkey: ♂, Kastamonu, Bostan village, 12.vii.1997, 1400 m, (FSUNS); ♀, Kastamonu, Ilgaz, Tüfekçi vicinity, 10.vi.2001, 1700 m, (FSUNS); ♀, Kastamonu, Ilgaz Mountain National Park, 12.vii.1997, 1875 m, S. Saribiyik, (FSUNS); ♀, Kastamonu, Burnuk village, 6.vii.1996, 1190 m, S. Saribiyik, (FSUNS); No country data, ♂, Imre Frivaldszky,

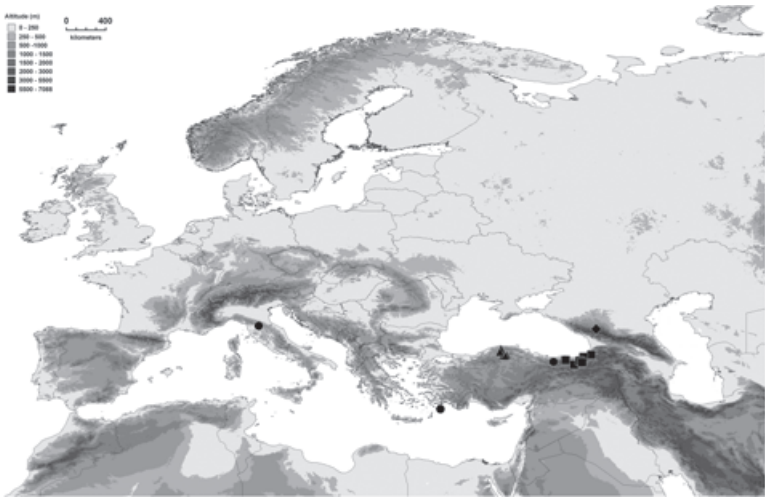

Fig. 26. Distribution. ▲ *Merodon ovaloides* **sp.n.**; ♦ *M. portschinskyi*; ● *M. planiceps*; ■ *M. turcicus* **sp.n.**

Merodon hungaricus, (Paramonov, unpublished name), Typus, Ungar/Friv. (UASK).

Range. (Fig. 26). Endemic species from Kastamonu province in Turkey.

Etymology. The word *ovaloides* is derived from Latin noun ovum, meaning egg, refers to the oval shape of posterior surstyle lobe of male genitalia.

***Merodon papillus* Vujić, Radenković & Pérez-Bañon, 2007**
(Figs 1, 2, 3A, 19)

Diagnosis. The male differs from all other species of the *ruficornis* group by the two wart-like prominences present in the middle of the posterior margin of sternite 4 (page 322, figs 8, 9, in Vujić *et al*., 2007); thick metafemur with a protuberance in the basal one third of its ventral surface; metatibia with a sinuous depression ventrally before two apical spurs, a small posteroventral and pointed anteroventral one (Fig. 1D, E). The female differs from all other species of the *ruficornis* group by the absence of transversal depression on tergite 4 (Fig. 3A); otherwise similar to *M. planiceps* with dark legs and lateral microtrichose stripes on frons, that are as broad as the shining central stripe (as on Fig. 31A); it can be distuinguished from *M. planiceps* by: black haired central shining stripe on frons; thicker hind femur, relatively short metatibia, about three fourth of length of metafemur (about fourth fifth of length of metafemur in *M. planiceps*) (Figs 2C, 27C).

Material examined. Type material: Holotype, ♂, Greece: Lesvos, Vatuosa, 14.iv.2001, 200 m, S. Rojo & C. Pérez-Bañón, (FSUNS). Paratypes, Greece: ♀, Lesvos, 20 km SE from Mystegna, 9.iv.2004, 20 m, (FSUNS); ♂, Lesvos, Filia, 20.iv.2001, (FSUNS); ♀, Lesvos, Polichnitos, 30.iv.2008, (FSUNS); ♂, Lesvos, Sikamia, 24.iv to 12.v.2001, (FSUNS); ♂, 2♀♀, Lesvos, Sikamia – meadow, 3.v.2008, (FSUNS); ♂, Lesvos, Thermi, 9.iv.2001, (FSUNS); ♂, Lesvos, Vatera, 12.iv.2005, 200 m, M. Hull, (WML).

Additional records. Turkey: ♂, Aksaray, Village Sivrihisar, 2.vi.1997 (FSUNS).

Range. (Fig. 19). Endemic species described from Lesvos (Greece) and registered at one more locality in Turkey.

***Merodon planiceps* Loew, 1862**
(Figs 26–28)

Diagnosis. In both sexes, all tarsi dark, at least dorsally; metafemur swollen, covered with long ventral hairs, the longest ones usually more than two thirds of its width (Fig. 27A). Male metalegs (Fig. 27A, B): process on metatrochanter medium in size; metafemur with small ventral protuberance; metatibia with strong apical, anteroventral spur; tergites pale haired (exceptionally some black hairs can be present in central part of tergites 3 and 4). Male genitalia (Fig. 28): posterior surstyle lobe hook-like with distinct inner process (Fig. 28A); anterior surstyle lobe with large inner thorn (Fig. 28B); cercus rectangular (Fig. 28A). Similar to *M. ovaloides* from which differs by posterior surstyle lobe in male genitalia (oval in *M. ovaloides*) (Figs 25A, 28A). Female can be distiguished by predominately black haired tergite and sternite 5 (pale haired in *M. ovaloides*) and from *M. turcicus* by smaller lamella on the apex of metatibia (Fig. 27C).

Material examined. Type material: Lectotype (hereby designated), Greece: ♂, Rodos, iv, H. Loew (ZHMB).

Additional records. Italy: ♂ (ZMA); Turkey: 9♂♂, 3♀♀ (ZMA, TAU).

Range. (Fig. 26). Species with disjunct range, recorded in Italy, Greece and Turkey, on three distant localities.

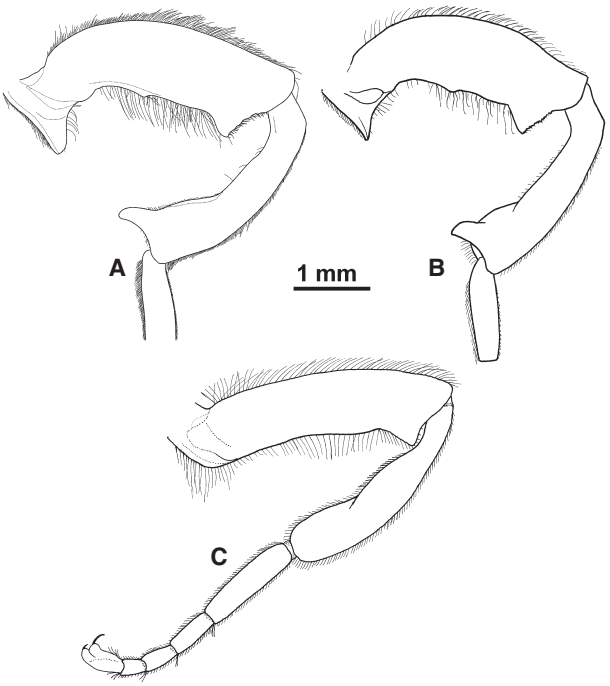

Fig. 27. Left metaleg of *Merodon planiceps*, lateral view. (A, B) male; (C) female.

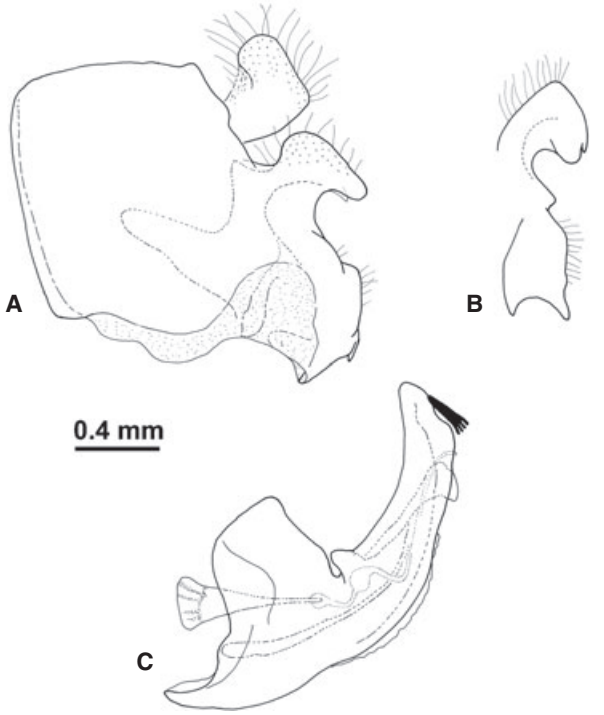

Fig. 28. Male genitalia of *Merodon planiceps.* (A) epandrium, lateral view; (B) left surstyle, anterior view; (C) hypandrium, lateral view.

Merodon ponticus **Vujić & Radenković sp.n.**
(Figs 7E, F, 9, 12C–E)

Description. Male. Medium-sized species with pale haired tergites laterally and black haired medially. Basal three tarsomeres of all legs pale yellow. Metatrochanter in male with medium-sized broad process (Fig. 7E, F). Metafemur with long hairs (one half to two thirds of its width) and small ventral protuberance ventrally (Fig. 7E). Metatibia with one apical, anteroventral triangular plate-like spur (Fig. 7E). Male genitalia (Fig. 12C–E): posterior surstyle lobe rounded, stocky, with small inner process (Fig. 12C, D); anterior surstyle lobe with indistinct inner thorn (Fig. 12D); cercus rounded (Fig. 12C).

Female. Metafemur with ventral protuberance small or indistinct. Microtrichose stripes on tergites 2–4 well defined, white-greyish. Vertex at the level of ocellar triangle black haired.

Diagnosis. Metatrochanter of male with medium-sized, rectangular process (Fig. 7E, F), metafemur with ventral protuberance, and metatibia with plate-like apical anteroventral spur (Fig. 7E); basal three tarsomeres of all legs yellow. Similar to *M. auripes* from which it differs by shape of metatibial spur (Fig. 7D, E), short and broad posterior surstyle lobe (Fig. 12A, C) and indistinct inner thorn on anterior surstyle lobe (Fig. 12B, D). Female are very similar and can be distiguished by distribution patterns: *M. ponticus* **sp.n.** is present in Turkey and Azerbaijan and *M. auripes* in Europe.

Material examined. Type material: Holotype, ♂, Turkey: Giresun, Giresun Mountains, Tamdere, 14 to 17.vii.1986, 1700 m, coll. W. Hurkmans acq.1992, (ZMA). Paratypes, Azerbaijan: ♂, 2♀♀, Caucasus, Kussary, vi.1984, Mik, (NHMW, FSUNS); Turkey: ♀, Kars, Sarıkamış, Kars Deresi, 30.vi.–5.vii.1986, 1200 m, (ZMA).

Range. (Fig. 9). Endemic species from Caucasus Mountains, with range between Black and Caspian seas. It is sister species with *M. auripes*, which has European distribution.

Etymology. The word *ponticus* is derived from Greek noun Πόντος, meaning sea, historical Greek designation for a region on the southern coast of the Black Sea, located in modern-day northeastern Turkey, referring to the range of this species.

Merodon portschinskyi **Stackelberg, 1924**
(Figs 26, 29D, E, 30A, B)

Diagnosis. All tarsi dark, at least dorsally; metafemur covered with short ventral hairs (the longest one shorter than one half of its width). Male metalegs (Fig. 29D, E): process on metatrochanter medium in size; metafemur without ventral protuberance; metatibia with strong apical anteroventral spur that continues into undulate lamella and with small but distinct inner posteroventral spur (Fig. 29E); male genitalia: posterior surstyle lobe hook-like with distinct inner

process (Fig. 30A, B); anterior surstyle lobe with small inner thorn (Fig. 30B); cercus rectangular (Fig. 30A). Similar to *M. turcicus* **sp.n.** from which it differs by black hairs on trochanters and lateral side of metafemur (usually pale in *M. turcicus*), and presence of microtrichose bands on lateral side of tergites 3–4. Female not studied.

Material examined. Russia: ♂, NW Kaukasus, река Чукчур (Tshuktshur Wasser), 9.vii.79, 1600–1650 m, (ZMA).

Range. (Fig. 26). Endemic species described from North Caucasian Mountains, closely related to *M. turcicus* **sp.n.**, with range on South Caucasus.

***Merodon ruficornis* Meigen, 1822**

syn. *Merodon mucronatus* Rondani, 1857
syn. *Merodon recurvus* Strobl, 1909
syn. *Merodon strobli* Bradescu, 1986
(Figs 4A, C, 5A–C, 6)

Diagnosis. In both sexes, basal three (two) tarsomeres brownish to reddish. Male metalegs (Fig. 4A): metatrochanter with small process; size of protuberance on metafemur variable, from small to medium, but always present; metatibia with apical spur projected backwards. Tergites 2–4 medially black haired; microtrichose stripes present at least on tergite 2. Female with rounded apex of metatibiae (Fig. 4C). *M. ruficornis* is very similar to *M. abruzzensis* from which differs in the thorn-like shape of spur on metatibia in males (Fig. 4A), in *M. abruzzensis* this spur is rounded (Fig. 4B) and small inner thorns on anterior and posterior surstyle lobe (Fig. 5A, B), in *M. abruzzensis* these thorns are distinct (Fig. 5D, E). Females are morphologically inseparable, except by the range: *M. ruficornis* is distributed in south European mountains, and *M. abruzzensis* is a local endemic of the Abruzzi Mountains in Italy, where *M. ruficornis* is not recorded.

Material examined. Type material: Lectotype (hereby designated), ♂, Meigen coll., 1916 40, (MNHN); Paralectotype, ♀, Meigen coll., 1916 40, (MNHN). Additional types: Holotype of *Merodon mucronatus*: Italy: ♂, Liguria, Pedemonte, 1857, leg. Rondani (LSF); Holotype of *Merodon mucronatus* var. *recurvus*: Bosnia and Herzegovina: ♂, Ivan Planina, leg. Apfelb., det. Strobl 1898; (BSA); Holotype of *Merodon strobli*: Romania: ♂, Carpates Méridionales, Monts Mehedinti (Băile Herculane, vallé du ruisseau Ferigari), 20.v.1984, 350 m, (TULCEA).

Additional records. Austria: 5♂♂, (ZMA, NHMW); Bosnia and Herzegovina: 15♂♂, 7♀♀ (FSUNS, SAR, ZAG); Croatia: 54♂♂, 8♀♀ (ZMA, ZAG); France: 10♂♂, 2♀♀ (MNHN, BMNH); Germany: ♂ (ZMA); Greece: 6♂♂, 2♀♀ (FSUNS, BMNH); Hungary: ♂, 3♀♀ (RMNH); Italy: ♂, ♀ (ZMA); Montenegro: 7♂♂, 4♀♀ (SAR, FSUNS); Romania: 2♂♂, ♀ (ZMUC, BMNH); Serbia: 34 ♂♂, 9♀♀ (ZMA, BEO, FSUNS); Slovakia: ♂, ♀ (ZMA); Switzerland: 7♂♂, 6♀♀ (ZMA, BMNH); Ukraine: ♂ (NHMW).

Range. (Fig. 6). Species predominantly distributed in central parts of Europe, including France to the west, and Apennine and Balkan peninsulas to the south.

***Merodon trebevicensis* Strobl, 1900**

syn. *Merodon crymensis* Paramonov, 1925
(Figs 13A, 15B, 16)

Diagnosis. Males with large protuberance on metafemur, as long as process on metatrochanter (Fig. 13A). Metatibia with two apical spurs, big anteroventral and smaller inner posteroventral one (Fig. 13A). Basal three tarsomeres brown to dark, with few black bristles along outher margin. Tergites pale haired, with clear mirotrichose stripes. In female metafemur long haired, with distinct ventral protuberance (Fig. 15B). Tergites 2–5 and sternite 5 medially with a number of black hairs. Extremely similar to *M. gallicus* **sp.n.** (Fig. 13C) from which male differs in longer process on metatrochanter and shorter inner posteroventral spur on metatibia (Fig. 13A), which is very long, narrow and sharp in *M. gallicus* **sp.n.** (Fig. 13C). Females are inseparable morphologically, except by the distribution: range of *M. gallicus* is limited to the French western Alps.

Material examined. Type material: Holotype, ♂, Bosnia and Herzegovina: Trebevic, leg. Apfelb., det. Strobl 1900; *Merodon mucronatus* var. *trebevicensis*, (BSA). Additional type: Lectotype of *Merodon crymensis*: Ukraine: ♀, Krym, Dorf Baidary, 10.vi.1923, (UASK).

Additional records. Austria: 2♂♂, 3♀♀ (ZMA, NHMW, BMNH); Bulgaria: 3♂♂, 3♀♀ (ZMA, ZMUC, SAR); Croatia: 2♂♂, ♀ (ZAH, ZMA, NHMW); FYR Macedonia: ♀ (RMNH); Greece: 2♂♂ (ZMA, AXEL SSYMANK coll.); Italy: 5♂♂, 3♀♀ (ZMA); Serbia: 12♂♂, ♀ (FSUNS, ZMA); Slovakia: 3♂♂ (ZMA, MZH); Turkey: 2♂♂ (ZMA).

Range. (Fig. 16). Species with large range, from the Alps in the west, to Crimea and central Turkey in the east.

***Merodon turcicus* Vujić & Hayat sp.n.**
(Figs 24E, F, 29A–C, 30C–E, 31A)

Description. Male. Medium-sized species with tergites pale haired laterally and black haired medially. The species exhibits variability in the shape of metalegs, especially in metatrochanter and metatibia (Fig. 29A–C). Metatrochanter with medium-sized process (Fig. 29A–C). Metafemur without ventral protuberance and usually covered with long and dense ventral hairs (Fig. 29A). Metatibia with one distinct apical anteroventral triangular spur not extended more than the apex of metatibia (Fig. 29A–C) and one small inner posterior spur

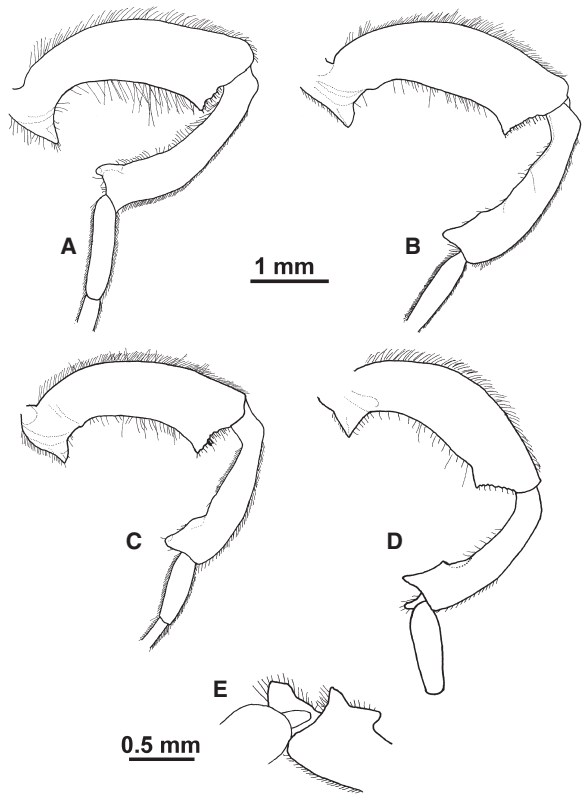

Fig. 29. Left metaleg of male. (A–C) *Merodon turcicus* **sp.n.**, lateral view; (D, E) *Merodon portschinskyi*; (D) lateral view; (E) apex of metatibia.

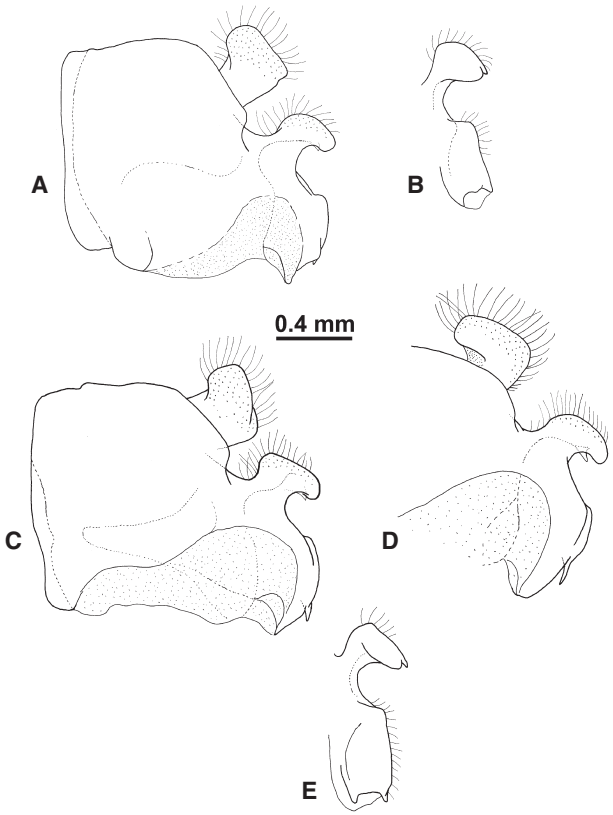

Fig. 30. Male genitalia. (A, B) *Merodon portschinskyi*, (C–E) *M. turcicus* **sp.n.**; (A, C, D) epandrium, lateral view; (B–E), left surstyle, anterior view.

similar to *M. portschinskyi*, but smaller. Legs dark. Male genitalia: posterior surstyle lobe hook-like with clear inner thorn (Fig. 30C–E); anterior surstyle lobe with small inner thorn (Fig. 30E); cercus rectangular (Fig. 30C, D).

Female. Metafemur covered with long hairs (Fig. 24E). Metatibia with well-developed lamella in apical third (Fig. 24E, F: lm). Microtrichose stripes on tergites 3–4 well defined, white-greyish; tergites pale haired laterally and with many black hairs medially from posterior half of tergite 2 until end of tergite 5. Vertex at the level of ocellar triangle and frons along central stripe black haired; microtrichose lateral stripes wide occupy more than half of frons width (Fig. 31A).

Diagnosis. Metatrochanter of male with medium-sized process, metafemur without ventral protuberance, and metatibia with triangular apical spur, ended before its apex (Fig. 29A–C). Similar to *M. portschinskyi*, from which differs by: pale hairs on trochanter and metafemur (black in *M. portschinskyi*), absence of microtrichose bands on lateral side of tergites. *M. turcicus* **sp.n.** can be confused also with *M. planiceps* and *M. ovaloides* **sp.n.**, but differs by absence of ventral protuberance on metafemur (Fig. 29A–C). Female can be distinguished from *M. planiceps* by larger lamella on the apex of metatibia (Fig. 24E, F: l m; 27C) and from

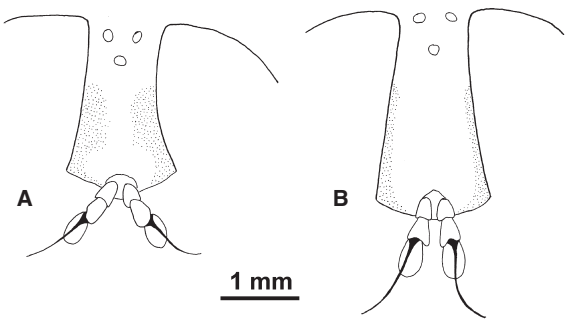

Fig. 31. Female frons, dorsal view. (A) *Merodon turcicus* **sp.n.**; (B) *M. loewi.*

M. ovaloides by predominately black haired tergites and sternite 5 (pale haired in *M. ovaloides*).

Material examined. Type material: Holotype, ♂, Turkey: Trabzon, Zigana Dağı, Hamsiköy, 08–12.vii.1986, 1600 m, (ZMA). Paratypes, Turkey: ♀, Artvin, Above Artvin, 6.vi.1962, 1800 m, Guichard, Harvey (BMNH); ♀, Erzurum, 16 km NW from Ispir, 18.vii.1992, 1500 m, (ZMA); 2♂♂, Erzurum, Ovit Mountain Pass (Ovitdağı Geçidi), 17.vii.1992, 1900 m, (ZMA); ♀, Erzurum, Pazaryolu, Kirlar Dağı, 25.vii.2000,

M.Kesdek, (EMIT); ♂, (Kop mountain pass) Kop Dağı Geçidi, Bayburt, 16.vii.1992, 2300 m, (ZMA); ♀, (Kop mountain pass) Kop Dağı Geçidi, Bayburt, 28.vi.1990, 2300 m, Ş.Güclü, (EMIT); ♂, (Kop mountain pass) Kop Dağı Geçidi, Bayburt, 28.vi.1990, 2300 m, R.Hayat, (EMIT); 2♀♀, Rize, Ayder Yaylası, 5.viii.1995, E.Ergin, (EMIT); ♂, Rize, Ovit Mountain Pass (Ovitdağı Geçidi) - N Side, 9.viii.1989, 1200 m, (ZMA); ♂, Rize, Pass Ikizdere, Ispir - N side, 30.vii.1983, 1200 m, (ZMA); 2♂♂, Trabzon, Zigana Dağı, Hamsiköy, 08–12.vii.1986, 1600 m, (ZMA).

Range. (Fig. 26). Endemic species from south Caucasus.

Etymology. The word *turcicus* is derived from Latin adjective meaning Turkish, refers to the range of this species.

Key to species

Males

1. Two wart-like prominences present in the middle of the posterior margin of sternite 4. Metatrochanter with small obtuse process; metafemur with distinct ventral protuberance; apex of metatibia with lamellar outer anteroventral spur and curved inner posteroventral spur (Fig. 1D, E). . . . . *Merodon papillus* Vujić, Radenković & Pérez-Bañon
– Sternite 4 without these prominences. 2
2. Metafemur with long protuberance ventrally, as long as or longer than the process on metatrochanter (as on Fig. 13). . . 3
– Metafemur without or with shorter protuberance ventrally (as on Fig. 10). 6
3. Metafemur strongly thickened and swollen (Fig. 13B). Cercus with characteristic shape; posterior surstyle lobe rectangular (Fig. 17A). . . . . *Merodon hoplitis* Hurkmans **sp.n.**
– Metafemur less thickened. 4
4. Metafemur with extremely long ventral protuberance (more than one half of its width); metatibia with two apical spurs, one outer anteroventral pointed vertically and another inner posteroventral directed horizontally (Fig. 18A). . . . . *Merodon ilgazense* Vujić, Marcos-García, Sarıbıyık & Ricarte
– Protuberance on metafemur shorter (less than one half of its width). 5
5. Protuberance on metafemur distinctly longer than process on metatrochanter; inner posteroventral apical spur on metatibia long and pointed (Fig. 13C). Thorns on anterior surstyle lobe and inner side of posterior surstyle lobe strong (Fig. 14A, B). . . . . *Merodon gallicus* Vujić & Radenković **sp.n.**
– Protuberance on metafemur shorter or the same length as process on metatrochanter; inner posteroventral apical spur on metatibia shorter (Fig. 13A). Thorns on anterior surstyle lobe and inner side of posterior surstyle lobe shorter and less distinct (Fig. 14D, E). . . . . *Merodon trebevicensis* Strobl
6. Metafemur with distinct protuberance ventrally (as on Fig. 4A, B). 7
– Metafemur without protuberance ventrally. 13
7. Metatrochanter with very long process (0.7 width of metafemur); metatibia with two distinct apical spurs (wide anteroventral one that looks like duck beak, and narrow, pointed posteroventral one) (Fig. 10). . . . . *Merodon armipes* Rondani
– Legs with different features. 8
8. Anterior spur at the apex of metatibia directed backwards (as on Fig. 4A). 9
– Anterior spur at the apex of metatibia pointed forwards or upwards (as on Fig. 7E). 10
9. Spur at the apex of metatibia triangular, thorn-like (Fig. 4A). Thorns on anterior surstyle lobe and inner side of posterior surstyle lobe short, almost indistinct (Fig. 5A, B). . . . . *Merodon ruficornis* Meigen
– Spur at the apex of metatibia rounded (Fig. 4B) Thorns on anterior surstyle lobe and inner side of posterior surstyle lobe distinct (Fig. 5D, E). . . . . *Merodon abruzzensis* Van der Goot
10. Lamella behind the apical spur of metatibia with undulated fold (as on Fig. 7D: l m). 11
– Lamella behind the apical spur of metatibia with straight ventral margin (Fig. 7E). Posterior surstyle lobe rounded (Fig. 12C); thorn on anterior surstyle lobe indistinct (Fig. 12D). . . . . *Merodon ponticus* Vujić & Radenković **sp.n.**
11. Tibiae at both ends and basal three tarsomeres pale. . . . . *Merodon auripes* Sack
– Legs predominantly dark. Basal metafemur strongly curved (as on Fig. 24A). 12
12. Process on metatrochanter shorter and more pointed (Fig. 24A, B). Posterior surstyle lobe rounded (Fig. 25A). . . . . *Merodon ovaloides* Vujić & Radenković **sp.n.**
– Process on metatrochanter longer and broader (Fig. 27A). Posterior surstyle lobe hook-like (Fig. 28A). . . . . *Merodon planiceps* Loew
13. Legs dark. 14
– At least basal two (three) tarsomeres pale. 19
14. Spur at the apex of metatibia small, triangular, lamella indistinct; process on metatrochanter small and pointed; ventral margin of metafemur without long and dense hairs (Fig. 7B); margin of anterior surstyle lobe with very strong dorsal extension (Fig. 22D). . . . . *Merodon nigripodus* Vujić & Hayat **sp.n.**
– Spur at the apex of metatibia larger, lamella present (as on Fig. 21A). 15
15. Posterior surstyle lobe rounded and with indistinct inner thorn (Fig. 25A). Process on metatrochanter small and pointed; anteroventral spur at the apex of metatibia with innerly curved apical extension (Fig. 24A–C); metafemur can be with trace of ventral protuberance. . . . . *Merodon ovaloides* Vujić & Radenković **sp.n.**
– Posterior surstyle lobe with more or less flat dorsal margin. 16
16. Anteroventral apical spur of metatibia extended more than anterodorsal end of metatibia (as on Fig. 21A); posterior side of apex of metatibia without small spur. 17
– Anteroventral apical spur of metatibia not extended more than anterodorsal end of metatibia (Fig. 29A–D), posterior

side of apex of metatibia usually with small spur (as on Fig. 29D, E). 18
17. Process on metatrochanter wide and strong; hairs on ventral side of metafemur two times shorter than its width (Fig. 21A, B); cercus oval (Fig. 22A). . . . . *Merodon loewi* Van der Goot
– Process on metatrochanter narrower; hairs on ventral side of metafemur long and dense, at least two thirds of its width (Fig. 27A, B); cercus rectangular (Fig. 28A). . . . . *Merodon planiceps* Loew
18. Long hairs on trochanters predominantly black; metafemur anteriorly covered with mostly black hairs; tergites 3 and 4 with microtrichose bands clearly visible from lateral view; apical spur at posterior side of metatibia bigger (Fig. 29D, E). . . . . *Merodon portschinskyi* Stackelberg
– Long hairs on trochanters predominantely pale; metafemur anteriorly covered with mostly pale hairs; tergites 3 and 4 without microtrichose bands (some specimens have traces of microtrichia on tergites, but there are invisible from lateral view); apical spur at posterior side of metatibia small, in some specimens almost indistinct. . . . . *Merodon turcicus* Vujić & Hayat **sp.n.**
19. Spur at the apex of metatibia plate-like, not extended more than anterodorsal end of metatibia; metatrochanter with very small process (Fig. 18B); posterior surstyle lobe rounded (Fig. 20A). . . . *Merodon lamellatus* Vujić & Radenković **sp.n.**
– Spur at the apex of metatibia extended more than anterodorsal end of metatibia (as on Fig. 7D). 20
20. Lamella behind apical spur of metatibiae with straight ventral margin (Fig. 7A); posterior surstyle lobe rectangular (Fig. 8A). . . . . *Merodon alexandri* Popov
– Lamella behind apical spur of metatibiae with rounded ventral margin (Fig. 21A, B); posterior surstyle lobe hook-like (Fig. 22A). . . . . *Merodon loewi* Van der Goot

Females

1. Tergite 4 with transversal depression (Fig. 3B, C: td). . . . 2
– Tergite 4 without transversal depression (Fig. 3A), tarsi dark, at least dorsally. . . . . *Merodon papillus* Vujić, Radenković & Pérez-Bañon
2. Tergites undusted. . . . . *Merodon alexandri* Popov
– Tergites 2–4 with dusted stripes. 3
3. Sternite 4 with strong thorn-like protuberance (Fig. 3C: pp). . . . . *Merodon armipes* Rondani
– Sternite 4 without protuberance. 4
4. Metafemur with protuberance ventrally. 5
– Metafemur without protuberance. 12
5. Hairs on metafemur short, adpressed, especially in apical third (Fig. 15C). Mediotergite entirely dusted. Distribution: Adriatic mountains. . . . . *Merodon hoplitis* Hurkmans **sp.n.**
– Hairs on metafemur longer (as on Fig. 15B). Mediotergite postero-medially shiny. Some other range. 6
6. Basal three tarsomeres of all legs pale. 7
– Tarsi darkened at least dorsally. 11
7. Apex of metatibia rounded (as on Fig. 4D). 8
– Apex of metatibia angled (as on Fig. 24D). 9
8. Distribution: Italy, Abruzzi Mountains. . . . . *Merodon abruzzensis* Van der Goot
– Distribution: rest of Europe. . . . *Merodon ruficornis* Meigen
9. Metatarsus of metaleg without or with only few black bristles. 10
– Metatarsus of metaleg with black bristles. Distribution: western of Alps to Caucasus area. . . . . *Merodon trebevicensis* Strobl
10. Distribution: Turkey and Azerbaijan. . . . . *Merodon ponticus* Vujić & Radenković, **sp.n.**
– Distribution: France. . . . . *Merodon gallicus* Vujić & Radenković **sp.n.**
11. Distribution: western of Alps to Caucasus area. Metatarsus of metaleg with black bristles. . . *Merodon trebevicensis* Strobl
– Distribution: France. Metatarsus of metaleg without or with only few black bristles. . . . . *Merodon gallicus* Vujić & Radenković **sp.n.**
12. Three basal tarsomeres pale, at least of metaleg. 13
– Tarsi darkened at least dorsally. 19
13. Apex of metatibia rounded (as on Fig. 4D). 14
– Apex of metatibiae angled (as on Fig. 24D). 16
14. Distribution: Europe. 15
– Distribution: Turkey. . . . . *Merodon lamellatus* Vujić & Radenković **sp.n.**
15. Distribution: Italy, Abruzzi Mountains. . . . . *Merodon abruzzensis* Van der Goot
– Distribution: rest of Europe. . . . *Merodon ruficornis* Meigen
16. Hairs on ventral surface of metafemur long (the longest ones at least two thirds width of metafemur). 17
– The longest hairs on ventral surface of metafemur shorter, usually one half width of metafemur (Fig. 21D). 18
17. Distribution: Turkey and Azerbaijan. . . . . *Merodon ponticus* Vujić & Radenković **sp.n.**
– Distribution: Europe. . . . . *Merodon auripes* Sack
18. Metatrochanter angled (Fig. 21D). . . . . *Merodon loewi* Van der Goot
– Metatrochanter rounded (Fig. 21F). . . . . *Merodon lamellatus* Vujić & Radenković **sp.n.**
19. Apex of metatibia rounded (as on Fig. 4D). 20
– Apex of metatibia angled (as on Fig. 24D). 21
20. Distribution: Italy, Abruzzi Mountains. . . . . *Merodon abruzzensis* Van der Goot
– Distribution: rest of Europe. . . . . *Merodon ruficornis* Meigen
21. The longest hairs on ventral surface of metafemur shorter, usually usually one halfwidth of metafemur (Fig. 21D); frons with narrow lateral stripes of microtichia along eye margins (Fig. 31B). . . . . *Merodon loewi* Van der Goot
– Hairs on ventral surface of metafemur long (the longest ones at least two thirds width of metafemur); microtrichose stripes on frons broader (as on Fig. 31A). 22
22. Apex of metatibia with distinct lamella (Fig. 24E, F: lm). . . . . *Merodon turcicus* Vujić & Hayat **sp.n.**
– Apex of metatibia with smaller lamella (Fig. 27C). 23

23. Tergite and sternite 5 predominately pale haired (exceptionally few black ones can be present). . . . . *Merodon ovaloides* Vujić & Radenković **sp.n.**
– Tergite and sternite 5 with number of black hairs on central part. . . . . *Merodon planiceps* Loew 1862

Molecular analysis

Sequences. The pruned COI data matrix used for analyses contained a total of 727 nucleotide characters and the full fragment was obtained for all included taxa. Uncorrected pairwise interspecific divergences for the COI gene fragment among *Merodon* spp. ranged between 1.38 and 12.24%. The pruned fragment of the D2–3 domain of the 28S ribosomal gene varied in length between 579 and 606 nucleotides, and the aligned 28S dataset comprised 653 nucleotide characters that were included in phylogenetic analysis. The 28S sequence fragment was not obtained for five taxa (*M. antonioi* Marcos-García, Vujić & Mengual, *M. desuturinus* Vujić, Šimić & Radenković, *M. erivanicus* Paramonov, *M. hoplitis* **sp.n.** and *Platynochaetus setosus* (Fabricius).

Phylogenetic analyses. The combined analysis of the two gene regions resulted in four equally parsimonious trees of length 1155 steps (CI = 0.42, RI = 0.59), strict consensus shown in Fig. 32 with Bremer support values below branches and bootstrap support above. The monophyly of the *ruficornis* group was well supported, and high support was also found for a few smaller species groups.

The likelihood score for the best ML tree was −7167.69. The topology of the most likely tree (not shown) is identical to the parsimony tree, except for *Merodon clunipes* (Fallen) in the ML tree grouped as sister to the *avidus* group (defined in Milankov *et al.*, 2001).

Phylogenetic relationships. Based on morphological and allozyme data, Vujić *et al.* (2005) proposed the existence of four subgenera in the genus *Merodon*, but did not formalize these. Based on a parsimony analysis of mitochondrial COI sequences of Iberian species of *Merodon* Mengual *et al.* (2006) identified four reasonably well supported clades within the genus, the *desuturinus, albifrons, nigritarsis* and *aureus* groups. Our parsimony results based on the COI and 28S genes (Fig. 32) included a broad representation of *Merodon* species from Europe and Turkey and produced a similar topology with three lineages corresponding to those of Mengual *et al.* (2006), namely the *nigritarsis*, *aureus* and *albifrons* + *desuturinus* groups. The third lineage including the two sister groups, *desuturinus* and *albifrons* corresponds to subgenus 3 sensu Vujić *et al.* (2005). The *ruficornis* group of species comprises morphologically extremely similar and was resolved as a monophyletic group of taxa forming a subgroup within the *albifrons* group (sensu Mengual *et al.*, 2006 and Vujić *et al.*, 2005; comprising *albifrons* s.s., and *constans*, *equestris* and *geniculatus* species groups). The *ruficornis* subgroup

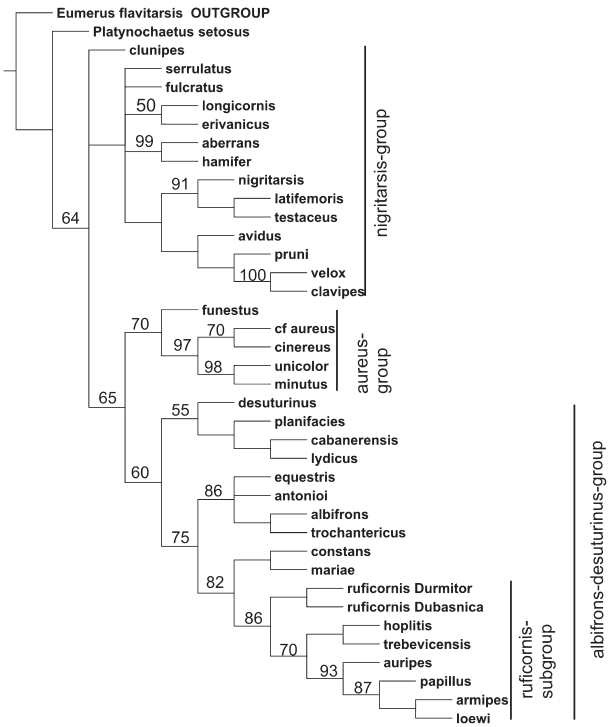

Fig. 32. Strict consensus cladogram of four equally parsimonious trees, length = 155 steps, CI = 0.42, RI = 0.59. Bootstrap values shown above nodes (>50), and Bremer support values below.

shows comparatively low uncorrected divergences of COI sequences between some species-pairs (e.g. *M. auripes* vs *M. loewi* 1.69–1.95%) thus indicating a possible more recent diversification of these taxa.

The placement of the *ruficornis* subgroup as a monophyletic clade within the *albifrons* s.l. lineage is confirmed.The sister group relationship of the *albifrons* group s.l. with the *desuturinus* group was recovered with moderate support. The support of the phylogenetic position of the *ruficornis* subgroup as the most derived group of the genus is of high importance for the understanding of the relationships and the evolution of various morphological characters within the genus. Morphological characters clearly support the monophyly of the *ruficornis* group with extremely similar features among the taxa except for the shape of metalegs, that is the main diagnostic character in almost all taxa. This type of metaleg morphological development is clearly apomorphic within the genus *Merodon*.

Discussion

Integrative taxonomy

The *Merodon ruficornis* group has been the focus of multiple integrated studies during recent years employing all commonly applied sources of taxonomical characters that

have been used for understanding and elucidating questions on species delimitation, traditional morphological characters, allozymes, mtDNA COI sequence data and landmark-based wing geometric morphometrics.

Milankov *et al.* (2002) investigated five species of the *ruficornis* group occurring on the Balkan Peninsula – *M. armipes* Rondani, *M. auripes* Sack, *M. loewi* Van der Goot, *M. ruficornis* Meigen and *M. trebevicensis* Strobl – and concluded that morphological characters and allozyme markers allowed identification and separation of the included taxa in most cases. Later, Milankov *et al*. (2008) added mtDNA COI sequences for these *ruficornis* group taxa and again explored how well the species were discriminated by COI and previous character systems, but concluded that each character system failed to discriminate between at least one species-pair. However, integrating the information from these three character systems allowed for recognition of each taxon by at least two of the data sources, and Milankov *et al*. (2008) noted that morphological traits and COI sequences clearly separated *M. armipes* from *M. auripes*, while allozyme data did not allow diagnosis, with other examples of converse cases. Additionally, a recent study by Francuski *et al*. (2009) using landmark-based geometric morphometrics for the wings of the same *ruficornis* group species on the Balkan Peninsula, showed that wing size and shape exhibited interspecific differentiation between nearly all compared species pairs and sexes, but was not completely diagnostic for all comparisons. The above-mentioned results greatly support a more general conclusion that species delimitation is most informative when based on an integrative approach considering several character sources, but that none of the character sources succeed in being 100% conclusive despite specimen sampling included only one particular region while several of the taxa exhibit much wider distributional ranges. Comprehensive studies requiring sufficient individuals for the analyses are possible for the abundant taxa of this group (e.g. the above mentioned), but availability of specimens of most species of this group generally is limited as species are not abundant and are known from restricted (and often remote) geographical regions. Hence, the present traditional taxonomic treatment does facilitate uncomplicated later testing by application of wing geometric morphometrics analyses and DNA sequencing of unsequenced *ruficornis* group taxa in future studies, as these methods are feasible for slightly older pinned museum specimens.

Diversity and distribution

The species diversity of the *Merodon ruficornis* group is very high, with 18 described taxa, in comparison with other recognized species groups of the genus *Merodon* (the *albifrons, desuturinus, avidus, aureus* groups – Mengual *et al.*, 2006; *aureus* group – Vujić *et al*., 2007; *natans, aureus, nigritarsis* groups – Radenković *et al.*, 2011) comprising species numbers usually between 2 and 10.

The group has predominately northern and eastern Mediterranean distribution, but without representatives on the islands (except the few species on Lesvos and Rhodes, islands that are situated very close to the Anatolian Peninsula).

The level of endemism is very high, 12 species (66.5%) have very local distribution connected with only few mountains or mountain ranges. Revision of the Iberian species of genus *Merodon* has shown also that each Iberian mountain chain comprises some endemic species and more than 60% of the Iberian species are present in the mountains of the Sistema Central of Spain where the percentage of endemism (46.2%) is the highest (Marcos-García *et al*., 2007). In addition to the Iberian Peninsula, also for the Anatolian Peninsula (Turkey) a high number of species (55) and level of endemism is characteristic (Vujić *et al.*, 2011).

For the taxa of the *ruficornis* group, two regions are identified with a high level of endemism. These are the Anatolian Peninsula and the Caucasus, with 30 and 38.5% of endemics, respectively.

Cryptic species diversity in *Merodon* had been confirmed already (Milankov *et al*., 2008, 2009; Ståhls *et al*., 2009; Francuski *et al.*, 2011; Radenković *et al*., 2011), with identification of several morphologically inseparable taxa detectable only by molecular data. Furthermore, among the *ruficornis* group there are some morphologically close species, e.g. *M. gallicus* **sp.n.**, distributed in France to the Alps is closest to *M. trebevicensis*, a species distributed in Turkey and Crimea in the east with the Alps as the western border, and *M. ponticus*, a Caucasus endemic closest to *M. auripes*, which is distributed in Central Europe and on the Balkan and Apennine peninsulas. In these cases it can be argued that geographic isolation has structured the distribution pattern.

It is interesting that some of the clusters of morphologically close species within the *ruficornis* group have the same distribution pattern: *M. ruficornis*, widely distributed in Europe has two morphologically very close species with very restricted ranges – *M. abrruzzensis*, endemic of Abruzzi Mountains, Italy, near to the southern limit of *M. ruficornis* range on the Apennine Peninsula, and *M. lamellatus* **sp.n.**, present in the Caucasus Mountains. Another example is a cluster including four *ruficornis* group taxa – *M. ovaloides* **sp.n.**, *M. planiceps*, *M. portschinskyi* and *M. turcicus* **sp.n.** – of which *M. planiceps* appears on the Apennine and Anatolian peninsulas while the other three species have very limited distributions (Kastamonu province in Turkey, NW Caucasus and South Caucasus, respectively).

We hypothesize that the process of speciation has taken place in geographically isolated populations and resulted in the formation of closely related sister species in different parts of the range of a common ancestor.

Supporting Information

Additional Supporting Information may be found in the online version of this article under the DOI reference: 10.1111/j.1365-3113.2012.00631.x

Table S1. Detailed list of examined material.

Table S2. List of specimens included in molecular analysis.

Please note: Neither the Editors nor Wiley-Blackwell are responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

Acknowledgements

We thank C. Kehlmaier, A. van Eck, E. Gilasian and D. Sommaggio for providing specimens for molecular work. The project was partly supported by the Ministry of Education and Science of the Republic of Serbia No. 173002 and the Provincial Secretariat for Science and Technological Development of the Republic of Serbia (Genetic resources of agorecosystems in Vojvodina and sustainable agriculture).

References

Doczkal, D. (1996) Description of two new species of the genus *Eumerus* Meigen (Diptera, Syrphidae) from Corsica. *Volucella*, **2**, 3–19.

Francuski, Lj., Ludoški, J., Vujić, A. & Milankov, V. (2009) Wing geometric morphometric inferences on species delimitation and intraspecific divergent units in the *Merodon ruficornis* group (Diptera, Syrphidae) from the Balkan Peninsula. *Zoological Science*, **26**, 301–308.

Francuski, Lj., Ludoški, J., Vujić, A. & Milankov, V. (2011) Phenotypic evidence for hidden biodiversity in the *Merodon aureus* group (Diptera, Syrphidae) on the Balkan Peninsula: conservation implication. *Journal of Insect Conservation*, **15**, 379–388.

Goloboff, P. (1999) *NONA Computer Program Vs 2.0.* Published by the author, Tucuman.

Hurkmans, W. (1988) Ethology and ecology of *Merodon* in Turkey (Diptera: Syrphidae). *Entomologische Berichten (Amsterdam)*, **48**, 107–114.

Hurkmans, W. (1993) A monograph of *Merodon* (Diptera: Syrphidae) Part 1. *Tijdschrift voor Entomologie*, **136**, 147–234.

Hurkmans, W. & De Goffau, L. (1995) Het geslacht *Merodon* in Nederland: phytosanitaire, ethologische, ecologische en systematische aspecten (Diptera: Syrphidae). *Entomologische Berichten*, **55**, 21–29.

Hurkmans, W. & Hayat, R. (1997) Ethology and ecology of *Merodon* (Diptera, Syrphidae) in Turkey II: descriptions of new species and notes on other syrphid flies. *Dipterists Digest*, **3**, 62–79.

Katoh, K., Kuma, K., Toh, H. & Miyata, T. (2005) MAFFT. Version 5: improvement in accuracy of multiple sequence alignment. *Nucleic Acids Research*, **33**, 511–518. DOI: 10.1093/nar/gki198.

Katoh, K., Asimenos, G. & Toh, H. (2009) Multiple alignment of DNA sequences with MAFFT. *Bioinformatics for DNA Sequence Analysis*, *Methods in Molecular Biology, 537* (ed. by D. Posada), pp. 39–64. Humana Press (Springer), New York, NY.

Laurenne, N.M., Broad, G.R. & Quicke, D.L.J. (2006) Direct optimization and multiple alignment of 28S D2–D3 rDNA sequences: problems with indels on the way to a molecular phylogeny of the cryptine ichneumon wasps (Insecta: Hymenoptera). *Cladistics*, **22**, 442–473.

Marcos-García, M.Á., Vujić, A. & Mengual, X. (2007) Revision of Iberian species of the genus *Merodon* (Diptera: Syrphidae). *European Journal of Entomology*, **104**, 531–572.

Mengual, X., Ståhls, G., Vujić, A. & Marcos-García, M.A. (2006) Integrative taxonomy of Iberian *Merodon* species (Diptera, Syrphidae). *Zootaxa*, **1377**, 1–26.

Milankov, V., Vujić, A. & Ludoški, J. (2001) Genetic divergence among cryptic taxa of *Merodon avidus* (Rossi, 1790) (Diptera: Syrphidae). *International Journal of Dipterological Research*, **2**, 15–24.

Milankov, V., Vujić, A. & Šimić, S. (2002) Identifying the species of the *ruficornis* group of the genus *Merodon* Meigen (Diptera: Syrphidae) using morphological and genetic markers. *Studia Dipterologica*, **9**, 319–326.

Milankov, V., Ståhls, G. & Vujić, A. (2008) Molecular diversity of populations of the *Merodon ruficornis* group (Diptera, Syrphidae) on the Balkan Peninsula. *Journal of Zoological Systematics and Evolutionary Research*, **46**, 143–152.

Milankov, V., Ludoški, J., Ståhls, G., Stamenković, J. & Vujić, A. (2009) High molecular and phenotypic diversity in the *Merodon avidus* complex (Diptera, Syrphidae): cryptic speciation in a diverse insect taxon. *The Zoological Journal of the Linnean Society*, **155**, 819–833.

Nixon, K.C. (2002) *Winclada Version 1.00.08.* Published by author, Ithaca, NY [WWW document]. URL http://www.cladistics.com

Popov, G.V. (2009) *Merodon alexandri* spec. nov. – a new species of hover-flies (Diptera: Syrphidae) from Nothern Black Sea Region. *Studia Dipterologica*, **16**, 133–151.

Radenković, S., Vujić, A. & Šimić, S. (2002) On the identity and synonymy of two species from *Merodon ruficornis* group (Diptera: Syrphidae). *Acta Entomologica Serbica*, **7**, 51–57.

Radenković, S., Vujić, A., Ståhls, G., Pérez-Bañon, C., Rojo, S., Petanidou, T. & Šimić, S. (2011) Three new cryptic species of the genus *Merodon* Meigen (Diptera: Syrphidae) from the island of Lesvos (Greece). *Zootaxa*, **2735**, 35–56.

Sack, P. (1913) Zwei neue palaarktischen *Merodon*-Arten. *Annales Historico-Naturales Musei Nationalis Hungarici*, **11**, 620–622.

Sack, P. (1932) Syrphidae. *Die Fliegen der Paläarktischen Region*, Band IV/6 (ed. by E. Linder), pp. 1–451. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

Séguy, E. (1961) *Diptères Syrphides de l'Europe occidentale*, Vol. 23. Mémoires du Muséum National d'Histoire Naturelle Serie A Zoologie, Paris.

Speight, M.C.D. (2010) Species accounts of European Syrphidae (Diptera) 2010. *Syrphthe Net, the Database of European Syrphidae*, Vol. 59, pp. 1–285. Syrph the Net Publications, Dublin.

Ståhls, G., Vujić, A., Pérez-Bañón, C., Radenković, S., Rojo, S. & Petanidou, T. (2009) COI barcodes for identification of Merodon hoverflies (Diptera, Syrphidae) of Lesvos Island, Greece. *Molecular Ecology Resources*, **9**, 1431–1438.

Suturović, E. (2008) *Povezanost taksona* Merodon loewi *van der Goot, 1964 (Diptera: Syrphidae) sa vrstama roda* Ornithogalum *L. 1753 (Amaryllidales, Hyacinthaceae)* [*Relationship between species* Merodon loewi *van der Goot, 1964 (Diptera: Syrphidae) and species from genus* Ornithogalum *L. 1753 (Amaryllidales, Hyacinthaceae)*]. Završni rad, Prirodno-matematički fakultet, Univerzitet u Novom Sadu, Srbija [Master Thesis, Faculty of Sciences, University of Novi Sad, Serbia].

Tamura, K., Peterson, D., Peterson, N., Stecher, G., Nei, M. & Kumar, S. (2011) MEGA5: molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. *Molecular Biology and Evolution*, **28**, 2731–2739.

Thompson, F.C. (1999) A key to the genera of the flower flies (Diptera: Syrphidae) of the Neotropical Region including descriptions of new genera and species and a glossary of taxonomic terms. *Contributions on Entomology, International*, **3**, 321–378.

Thompson, F.C. (2005) *Biosystematic Database of World Diptera. Version 7.5* [WWW document]. URL http://www.sel.barc.usda.gov/Diptera//biosys.htm [accessed on 30 November 2011].

Van der Goot, V.S. (1964) Fluke's catalogue of Neotropical Syrphidae (Insecta, Diptera), a critical study with an appendix on new names in Syrphidae. *Beaufortia*, **127**, 212–221.

Vujić, A., Ståhls, G., Radenković, S. & Šimić, S. (2005) Subgeneric division of the genus *Merodon* Meigen, 1803 (Diptera: Syrphidae) – morphological and molecular evidence. *3rd International Symposium on Syrphidae*. Leiden, 2–5 September, pp. 36–37 (Abstract).

Vujić, A., Pérez-Bañón, C., Radenković, S., Ståhls, G., Rojo, S., Petanidou, T. & Šimić, S. (2007) Two new species of the genus *Merodon* Meigen 1803 (Diptera: Syrphidae) from the island of Lesvos (Greece), in the eastern Mediterranean. *Annales de la Société Entomologique de France*, **43**, 319–326.

Vujić, A., Marcos-García, M.Á., Sarıbıyık, S. & Ricarte, A. (2011) New data on the *Merodon* Meigen 1803 fauna (Diptera: Syrphidae) of Turkey including description of a new species and changes in the nomenclatural status of several taxa. *Annales de la Société Entomologique de France (N.S.)*, **47**, 78–88.

Accepted 20 March 2012