New species of robber fly of the genus Andrenosoma Rondani, 1856 (Diptera: Asilidae) from Iran

Jonas Mortelmansa,*, Diederik Volckerta, Farzaneh Kazeranib and Ali Asghar Talebid

aGhent, Belgium; bZottegem, Belgium; cResearch Institute of Forests and Rangelands, Agricultural Research Education and Extension Organization (AREEO), Tehran, Iran; dDepartment of Entomology, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran

(Received 12 October 2021; accepted 12 June 2022; first published online 6 July 2022)

Andrenosoma lottae Mortelmans sp. nov. is described based on males and females from Fars province, Iran. Pictures of the habitus are provided, together with details of the male terminalia to facilitate species identification. The status of Andrenosoma violacea is discussed and hereby put forward as a species inquirenda.

http://www.zoobank.org/urn:lsid:zoobank.org:pub:2E6AB0F2-7227-4BDA-BA1C-3BA032B7A84D

Keywords: Palaearctic; taxonomy; Andrenosomatini; Laphriinae

Introduction

Robber flies (Diptera: Asilidae) is a large family of thermophilic and predacious flies with a special preference for arid and semi-arid areas (Hull, 1962). Iran is a species-rich country with approximately 308 species in 88 genera (Ghahari et al., 2014; Mohammadi et al., 2021). The genus Andrenosoma comprises 64 species and is distributed in the Neotropical (37 species), Palaearctic (15 species), Australasian (4 species), Afrotropical (3 species) and Indo-Malayan regions (2 species) (Tomasovic & Saghaei, 2009; García et al., 2017; Tomasovic & Bartolozzi, 2018). In Iran, the genus is represented by four species (Figure 1): A. atra (Linnaeus, 1758), A. albibarbe (Meigen, 1820), A. serratum Hermann, 1906 and A. farsicola Tomasovic & Saghaei, 2009 (Hayat et al., 2008; Tomasovic & Saghaei, 2009; Ghahari et al., 2014). Andrenosoma farsicola is endemic to Iran.

Species of Andrenosoma Rondani, 1856 are medium-to large sized robber flies (8–20 mm). Adults are often found lurking on trees looking for prey and commonly can be found in coniferous forest clearings, where they feed on xylophagous insects’ larvae for example on fallen trees (García et al., 2017). Identification of Andrenosoma remains challenging as diagnostic characters are situated in male terminalia and often poorly described, whereas external morphological characters are variable and reference material is needed for identification.

Material and Methods

Morphological analyses and diagnoses of the specimens were performed with a Euromex NZ1903b stereomicroscope with 60x magnification. Diagnoses of the male genitalia, general measurements, and photographs of the specimens were made by use of a Leica M205 stereomicroscope with a maximum of 160x magnification, at the LifeWatch Marine Observatory (Flanders
Marine Institute, Ostend, Belgium). With prior approval from the RBINS collections manager, Wouter Dekonick, we dissected one male specimen to enable examination of the terminalia. To prepare the male terminalia for examination, the authors employed a technique commonly used to study dipteran terminalia: (1) completely removing the abdomen, (2) soaking it for 10 minutes in warm KOH, (3) soaking it for 20 minutes in tap water, (4) soaking it for 10 minutes in EtOH-HCl (acidified ethanol), and finally (5) soaking it for 20 minutes in tap water. After examination, the macerated abdomen is placed in a plastic microvial containing a few drops of glycerin, and the microvial is pinned beneath the rest of the specimen. The abdomen was examined by placement in a spot plate with the depression filled with tap water. For photography, the abdomen was immobilized by placing it in a spot plate with the depression filled with glycerin.

Terminology used in this paper follows that of Cumming & Wood (2009). The map (Figure 1) is created with the open-source software R (RStudioTeam, 2019) The free raster map data used as background for the maps are accessible via Natural Earth (www.naturalearthdata.com). Species records are based on published data (Richter, 1985; Hayat et. al., 2008; Tomasovic & Saghaei, 2009; Ghahari et. al., 2014).

Abbreviation: RBINS = Royal Belgian Institute of Natural Sciences, Brussels (Belgium).

Results

*Andrenosoma* Rondani, 1856

*Andrenosoma* is a typical member of the tribe Andrenosomatini, subfamily Laphriinae. The genus is recognised by the following combination of characters: antennae without an obvious arista, but a small sensory element placed in a small cavity at, or near the apex of the postpedicel (Geller-Grimm, 2003). Antennal postpedicel virtually as long as scape and pedicel combined in *Andrenosoma*. Vertex well-excavated with a broad frons and sharply marked ocellar tubercle (Hull, 1962). Facial swelling rather weakly developed (Hull, 1962). Proboscis shorter then height of head, dorsoventrally flattened and bent only slightly upwards apically (Hull, 1962). Proboscis tapering apically (compare to e.g., *Pilica* Curran, 1931) (Hull, 1962). The two-segmented palpi flattened (not round as in Laphriini). Metanotal callosity without setae (Hull, 1962). Costa complete (Fisher, 1986). Male genitalia rotated 45-90°, cerci and epandrium separated. A complete genus description can be found in Hull (1962) and Fisher (1986). The characters described here are only shared with the genus *Pogonosoma* Rondani, 1856, which occurs in the Holarctic region and can be separated from *Andrenosoma* by the presence of an extra cross-vein, between R2+3 and R4, thus creating 3 submarginal cells (only two in *Andrenosoma*).

*Andrenosoma lottae* Mortelmans sp. nov. (Figures 2–3)

**Holotype:** ♂️ Iran, Fars, Rd Chiraz-Kazeroun, Fort Sine-Sefid, 1.vi.1937 [RBINS, IG 24.236], leg. F. H. Brandt. General condition of the type is good, although abdomen is dissected from tergite 4 onwards (although studied prior to dissection), and right legs 1 and 2 missing. – **Paratypes:** 1♀️ Iran, Fars, d Chiraz-Kazeroun, Fort Sine-Sefid, 29.iv.1937 [RBINS, IG 24.236], leg. F. H. Brandt; 1♀️ Iran, Fars, Rd Chiraz-Kazeroun, Fort Sine-Sefid, 23.iv.1937 [RBINS, IG 24.236], leg. F.H. Brandt; 1♂️ Iran, Kerman Prov., 2km north of Dashtak (30.320°N, 52.386°E), 19.iv.2016, leg. J. Mortelmans & D. Volckaert.

**Male.** Head (Figures 2): Completely black in ground colour, with heavy silver pubescence; narrow longitudinal shiny strip from occiput to antennae, with slight pubescence between ocelli and antennae; face below antennae convex, slightly protruding beyond the eyes in lateral view; mystax with white setae and smaller white setulae; ocellar tubercle with slight greyish pubescence, bearing two white setae pointing anteriorly;
hairs on face and frons white; occiput with many with long white to yellow setulae, including some heavier yellow setae dorsally; antennal sockets located at one fourth from top of head, scape and pedicel black with very light greyish pubescence; antennal postpedicel black with slight reddish tinge; antennae bare, except antennal pedicel with several white setae; postpedicel distinctly longer than scape and pedicel combined. Small sensory element placed in a small cavity at the apex of the postpedicel; proboscis black with white setulae, wide on its basal part and constricted at the apex, flattened dorsoventrally; proboscis without stout setae on middorsal margin; palpi two-segmented, both segments black, with white setulae on outer side, flattened laterally and leaf-like. – Thorax (Figure 2): Scutum completely black with slight whitish pubescence, except for dark reddish anterior humeri; postsutural area of scutum between suture and posterior end of scutum, on each side of the dorsocentral bristles, shiny and without pubescence; presutural area of scutum, just in front of the suture to the posterior end of postpronotal lobe, on each side of the dorsocentral bristles, shiny and without pubescence. These four areas are bordered by areas with heavier pubescence. Median line of scutum very narrow, heavily dusted, bordered by two lines of shinier areas; area just anterior of scutellum heavily pubescent; scutum with many thin, semi-erect, white setae. Other setae include the 2 [left side] or 3 [right side] supra-alaris, and 3 post-alaris. Two dorsocentral setae near posterior end of scutum, near the scutellum [the setae are worn off, although two implantations of setae are visible]; scutellum black with slight whitish pubescence, especially anteriorly; scutellum with several white discal setulae and two weak white marginal setae; posterior margin of scutellum shiny; pleura black with reddish tinge, especially on anepimeron; pleura mainly shiny except for
Figure 2. *Andrenosoma lottae*. A. Male holotype, lateral view, details on head; 2B. Male holotype, dorsal view; 2C. Male holotype, lateral view; 2D. Female paratype, detail on wing.

proepisternum, upper half of anepisternum, posterior margin of anepisternum, anterior margin of anepimeron, creating a reversed U-shape; meron and anatergite also with white pubescence; all pleura with white setulae, especially on top of the pubescent zones, except for the anatergite that hold a row of strong yellow setulae; halter yellow; postmetacoxal area not fused. – *Legs* (Figure 2): Legs black with reddish tinge, especially on tarsi, tibiae and coxa; posterior surface of tibiae 1 and 2 deeply red-black, barely distinct to the black of anterior surface; coxa 1 and 2 heavily white pubescent with strong white setulae anteriorly; coxa 3 slightly pubescent with weak white setulae; trochanters 1-3 shiny with weak white setulae; femora enlarged, heavy and club shaped compared to slender tibiae; femora with several weak white setulae, except for the tip of femur 3 bearing several setae posteriorly; tibiae with several weak white setulae, in addition to several white setae distributed over length of tibiae; tip of tibiae 1 and 3 with two small, but strong setae ventrally; tarsi with several weak white setulae, but also several strong white setae, especially near the top of each tarsal segment; Pulvilli white; claws long, yellow basally, black on top half. – *Wing* (Figure 2): Wings slightly brown infuscate; veins yellow; anal cell closed at wing margin, two posterior cells petiolate and cell r1 petiolate; two submarginal cells; alula hyaline, very small and rounded; microtrichia present all over, except for basal radial cell, basal medial cell, posterior cubital cell, anal cell and alula. – *Abdomen*: Tergites and sternites shining, without pubescence; tergites bright red with only lateral margins having a narrow, continuous, black strip; this black band half as wide as diameter of tibiae; tergites with scarce
Figure 3. *Andrenosoma lottae*. A+B. Male holotype, spiny apex of gonocoxite and gonostyli in lateral view. Secondary distal lobe not visible from this angle as it is broken off. The schematic figure on the right shows the secondary distal lobe (mirrored from the other side). Scale bar = 0.5 mm; C+D. Male holotype, epandrium in dorsal; E+F. Male holotype, epandrium in ventral view (the cerci are removed). In ventral view the gonostyli the secondary distal lobe and the spiny apex of gonocoxite are clear. The left secondary distal lobe is broken and not photographed (although it is drawn). Scale bar = 1 mm.

coverage of short white setulae; near tip of abdomen more black setulae; sternites red and scarce coverage of short white setulae. – Male terminalia (Figures 3): Hypopygium permanently rotated through 45°, epandrium not divided; gonocoxites elongated and broadly oval with ventro-distal end especially pointy; epandrium and cerci not fused; secondary distal lobe of the gonocoxite fixed, with a semicircular incision near the apex, leaving two equally big spines; gonostyli articulate, semi-circular and narrowly incised
on the apex leaving a wide dorsal projection and a narrow, haired, ventral projection; aedagus with three long fined curved endophalli; hypandrium absent.

**Female:** Like the male, unless for the following differences: Pubescence stronger compared to male; 4-6 strong white scutellar setae [2 weak setae in the male]; anatergite with a row of strong white setulae [not yellow as in male]; black lateral margin on tergites much smaller and slightly interrupted near posterior margin of each tergite. Female terminalia not examined.

**Etymology:** A patronym honoring the first author’s godchild, Lotte.

**Distribution:** Only known from a small regional scale between Shiraz and Kazeroun, Iran (Kerman and Shiraz provinces).

**Biology:** This region is situated in the southwest of Iran, belonging to the Irano-Turanian floristic region. Phytogeographically, large parts of Iran are characterized by inclusion of Irano-Turanian floristic elements (Akhani et al., 2010). Most of the deserts, salt marshes and sand dunes of the central part of Iran are located in the Turani Iranian plain region. The average rainfall in this area is 250 mm and the average maximum temperature of the hottest month of the year varies between 30° and 40°C (Sagheb Talib, 2014). The vegetation of where the new species have been found is mostly covered by Oak forest (*Quercus* sp.), *Pistacia atlantica* and *Brabejum stellatifolium* trees as well as some flowers like anemone and chamomile.

**Ecology:** One specimen of the type series was caught in dense bushes in an otherwise bare landscape. Laphriinae are a dominant forest-inhabiting group of robber flies, distributed in wooded areas throughout the world (Fisher, 2009) of which females deposit eggs in openings of dead tree trunks and stumps, as the larvae will live in rotten wood feeding on wood-inhabiting species (Lavigne & Bullington, 1984). Therefore, the occurrence of *Andrenosoma* in a rather bare landscape is unusual. However, also Lehr (1958) found adults in such environments perching within shrubs and bushes.

**Discussion**

**Morphology of male terminalia.** Species of *Andrenosoma* are identified by abdominal colour patterns (ranging from entirely black to entirely red, with all intermediates), the construction of the first posterior cell (open, closed or stalked), colour of mystax, and especially by the morphology of the male terminalia. Practically every publication on *Andrenosoma* describes the gonostyli (= dististyli, surstyli or gonopods by some authors) in lateral view for species identification (Engel, 1930; Séguy, 1952; Richter, 1985; Fisher, 1986; Kovar & Hradsky, 1996; Geller-Grimm & Taylor, 1999; Maldès, 2004; Tomasovic & Ghagaei, 2009; Tomasovic & Bartolozzi, 2018; Garcia et al., 2018).

While studying material of *A. lottae* sp. nov., problems arose to annotate two structures of the male terminalia as the gonocoxite bears an inner, moveable, lateral process (which is relatively concealed in lateral view of the gonocoxite) as well as an outer, non-moveable, subapical process (which is well visible in lateral view of the gonocoxite). Initially, it was difficult to annotate these structures – which of these structures is the gonostyli? For *A. lottae* sp. nov. and *A. farsicola* we considered the inner process as the gonostyli as this structure is moveable, whereas the fixed process is considered a secondary distal lobe of the gonocoxite. For *A. lottae* sp. nov. and *A. farsicola* the secondary distal lobe is easily seen from a lateral view and entomologist might erroneously annotate this structure as gonostyli. Remarkably, for other species of *Andrenosoma* we could examine (i.e., *A. atra, A. albibarbe, A. aff. albibarbe* and *A. cyrtoxys*) it was clear
both inner and outer structures of the gonocoxite are articulate and moveable, which is different compared to *A. farsicola* and *A. lottae* sp. nov. in which the outer structure is fixed.

In all literature that depicts male terminalia of *Andrenosoma*, only the outer structure on the gonocoxite is drawn (and annotated as gonostylus), whereas the inner process is rarely depicted. Only Kovar and Hradsky (1996) and Richter (1985) illustrate a small segment of the ‘inner process’ that protruded from behind the ‘outer process’; and Fisher (1986) who successfully illustrates the entire shape of the inner process of *A. atra*. As both inner and outer structures are moveable, it remains unanswered whether we can annotate the ‘outer process’ as gonostylus in these taxa. Careful interpretation of the figures and annotations in literature remains essential for identification of *Andrenosoma* and a revision of Palaearctic *Andrenosoma* is necessary in order to detect whether authors draw the inner or outer structure on the gonocoxite. We assume the inner process is of value for species identification.

**Relationship to other species of Andrenosoma.** *Andrenosoma lottae* sp. nov. is clearly related to *A. farsicola*, based on male terminalia: both species have a unique epandrium that has a pointy ventro-distal end and a fixed secondary distal lobe of the gonocoxite. Furthermore, both species occur in the same steppe-like habitat, which is distinctly different to other (Palaearctic) *Andrenosoma*. It can be argued these differences are of generic value, but again, only a revision of Palaearctic *Andrenosoma* might answer such question. *Andrenosoma lottae* sp. nov. differs to *A. farsicola* by the shape of gonocoxite, the shape of the secondary distal lobe, the shape of the gonostylus, by the smaller size (10 mm in *A. lottae* sp. nov. to 19 mm in *A. farsicola*) and by the entire red abdomen (black in *A. farsicola*).

*Andrenosoma valentinae* Richter, 1985 is especially related to *A. lottae* sp. nov. based on the abdominal colour patterns: both species have red tergites and red sternites, which is unique for Palaearctic *Andrenosoma*. It is remarkable that Richter (1985) described its genitalia to be rotated 180°, which is typical for *Mactea* Richter & Mamaev, 1976. *Mactea* is closely related to *Andrenosoma* and occurs in the far east of the Palaearctic realm and extends southwards into the Indo-Malayan region (i.e., Japan, China, Russia Far East, Taiwan, and Indonesia) (Hradsky & Geller-Grimm, 2003). The differences between both genera are listed in Hradsky and Geller-Grimm (2003), Lehr (1989, 1999) and Richter and Mamaev (1976) and can be summarised as such: the apical end of proboscis is bent apically in the top third [only slightly turned upwards or even straight in *Andrenosoma*], the male genitalia are rotated 180°C (45-90° in *Andrenosoma*), cerci and epandrium fused (separated in *Andrenosoma*). *Andrenosoma valentinae* is found close to Iran, just north of Tabriz. A translation of the Russian description of *A. valentinae* Richter, 1985 is given in the Supplementary Annex 1.

Finally, the closed and stalked first posterior cell is an interesting character, only shared with *A. atra* and *A. farsicola*. The first species is a widespread species in Europe, the second is an Iranian endemic, only known from Jahrom, Kerman province. Both species are characterised by the completely dark abdomen, distinctly different to *A. lottae* sp. nov.

**Taxonomic status of Andrenosoma violacea.** During the comparison to species of Andrenosomatini, we were unable to study nor interpret the species concept of *Andrenosoma violacea* (Fabricius, 1777), a species not recorded since its description. This enigmatic species is described from Hattorf, central Germany, as *Asilus violacea* Fabricius, 1777. A small part of the description was later copied into Fabricius (1781), and later again copied into Fabricius (1794). This triplicate description, dealing with the same species, resulted in a widespread mistake: practically all sources refer to *Andreno-
soma violacea (Fabricius, 1781) [e.g., Engel (1930)] or Andrenosoma violacea (Fabricius, 1794) [e.g., Von der Dunk, 2007]; and not to Andrenosoma violacea (Fabricius, 1777). The description by Fabricius (1777) reads as: “Hirsutus ater, abdomine violacea. Corpus totum pilis erectis rigidis hirtum, atrum. Abdomen ovatum, violaceum, nitidum. Alae fuscae”, translated as “Black setae, purple abdomen. Entire body covered with erect, stout black setae. Abdomen oval (?), purple, shiny. Wings darkened”. The description by Fabricius (1781) reads as: “Hirßutus ater, abdomine violacea”, translated as “Black setae, purple abdomen”. The description by Fabricius (1794) is identical with Fabricius (1777) and does not include new information. We do not doubt all three descriptions refer to the same species: the three descriptions are identical and material comes from Hattorf. Fabricius (1805) moved the species from Asilus to Laphria. Meigen (1820), apparently studying the type, gives further documentation on A. violacea: “Nach Hrn. Wiedemanns Bemerkung gleicht diese Art völlig der vorigen [L. atra] und unterscheidet sich bloß von derselben dadurch, dass an Fühlerwurzeln und Scheitel einige graugelbe Haare stehen, und der Bart schwarz ist. Auch die Flügel sollen minder dunkel sein”, which translates to “According to Wiedemann's remarks, this type is completely similar to the previous one [=Laphria atra] and differs from this one only in the fact that there are gray-yellow hairs on the base of the antennal implant and vertex, the mystax is black. Also the wings should be less dark’. This paragraph implies both Wiedemann [in a personal letter to Meigen? See Pont (1996)] and Meigen found a very close relationship between Andrenosoma atra and A. violacea, but neither suggest synonymy. Séguy (1952) lists Laphria violacea Meigen [no date given] as a synonym of A. atra. This is remarkable, as Meigen never published a species named L. violacea. We assume Séguy (1952) meant to say Laphria violacea Fabricius, a species that was synonymized by Meigen. In that case, Séguy (1952) misinterpreted Meigen, as Meigen did not synonymized these species. Finally, we could not recover the source for the generic switch to Andrenosoma. All of this suggest a troublesome history that can only be solved through examination of type material. Examining type material is troublesome, as Zimsen (1964) published on Asilus violacea Fabricius, 1777 that only a name label exists in the Fabricius’ collection, and no specimen is found (which is confirmed by the current curators, T. Pape and M. Kuhlmann, pers. comm. 2021). Without type, it is not possible to interpret Fabricius’ short descriptions.

More recently, Von der Dunk (2007) implies a synonymy of Andrenosoma violacea (Fabricius, 1794) [the reference should be Andrenosoma violacea (Fabricius, 1777)] with A. atra; and says the name A. violacea has no validity. Von der Dunk (2007) does not gives references for these statements, but we assume this is based on Meigen (1820) which is, yet again, misinterpreted. Moreover, it remains troublesome von der Dunk (1996) presents a key to Asilidae and presents two previously unknown characters for A. violacea: the 1st posterior cell closed and size maximum 12 mm (at this time, the type material was already lost). Yet again, Von der Dunk (1996) is not giving references nor is he listing his studied material. We were unsuccessful to contact Von der Dunk to inquire about these facts. As nothing else is known on this enigmatic species, we consider this name a species inquirenda, which article 75.5 of the ICZN restricts to a nominal species-group taxon that cannot be determined from its existing name-bearing type; and not a synonym of A. atra, as not a single character can be interpreted correctly.

Supplementary Material
Supplementary Material is given as a Supplementary Annex, which is available via the “Supplementary” tab on the article’s online page.
Acknowledgements

I thank the LifeWatch Observatory (as part of the Flemish contribution to the LifeWatch ESFRI by Flanders Marine Institute, Belgium) for use of their binocular microscope. I thank Pol Limbourg and Wouter Dekoninck (RBINS) for their help during our visits to the collection of the RBINS. I thank William L. Murphy (Smithsonian Institution, Indiana, USA) for checking the final manuscript. The recent collection of asilid flies by the two senior authors was supported by the Tarbiat Modares University. Reinoud van den Broek and Piluca Álvarez Fidalgo are acknowledged for lending the first author an interesting specimen of *Andrenosoma* aff. *albibarbe*, Torsten Dikow and Eric Fisher for their valuable comments on male terminalia, and Thomas Pape and Michael Kuhlmann for their interesting views and comments on the taxonomic status of *A. violacea*.

Disclosure Statement

No potential conflict of interest was reported by the authors.

References

Akhani, H., Djamali, M., Ghorbanalizadeh, A., Ramezani, E. (2010). Plant biodiversity of Hyrcanian relict forests, N Iran: an overview of the flora, vegetation, palaeoecology and conservation. *Pakistan Journal of Botany*, 42, 231–258.

Cumming, J. M., & Wood, D. M. (2009). Adult morphology and terminology [Chapter] 2. Pp. 9–50. In: B. V. Brown, A. Borkent, J. M. Cumming, D. M. Wood, N. E. Woodley, & M. A. Zumbado (Eds.), *Manual of Central American Diptera*. Vol. 1. Ottawa, Ontario: National Research Council Research Press.

Engel, E. O. (1930). Asilidae. In: Linder (Ed.), *Die Fliegen der Palaearktischen Region*. 24. Stuttgart: Schweizerbart.

Fabricius, J. C. (1777). *Genera insectorum eorumque characteres natravse secundum nvmervm, figvram, sitvm et proportionem omnivm partivm oris adiecta mantissa speciervm nvper detectarvum*. 1-310. Chilonii: Bartsch.

Fabricius, J. C. (1781). *Species insectorum exhibentes eorum differentias specificas, synonyma avctorvm, loca natalia, metamorphosin adiectis observationibvs, descriptionibvs*. Tom. I + II. 1–517. Hambvrgi, Kilonii. (Bohn).

Fabricius, J. C. (1794). *Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species adjectis synonymis, locis, observationibus, descriptionibus*. Tom. IV. pp. [1–7], 1–472, [1–6]. Hafniae: Prof. (Bohn).

Fabricius, J. C. (1805). *Systema antiatorum secundum ordines, genera, species adjectis synonymis, locis, observationibus, descriptionibus*. Pp. 15–372. Brunsvigae: Reichard.

Fisher, E. M. (1986). A reclassification of the Robber Fly Tribe Andrenosomini, with a Revision of the Genus Dasylis Loew (Diptera: Asilidae). University of California Riverside: Ph.D. Thesis.

Fisher, E.M. (2009). Asilidae (robber flies, assassin flies, moscas cazadoras, moscas ladronas). Pp. 585–632. In: B. V. Brown, A. Borkent, J. M. Cumming, D. M. Wood, N. E. Woodley, & M. A. Zumbado (Eds.), *Manual of Central American Diptera*: Vol. 1. Ottawa (Ontario): NRC Research Press.

Garcia, M., Perez, G., & Portillo, M. (2017). Taxonomic review of the species of *Andrenosoma* (Diptera: Asilidae) in Spain and description of a new species. *Zootaxa*, 4299, 423-431.

Geller-Grimm, F. (2003). A world catalogue of the genera of the family Asilidae (Diptera). *Studia dipterologica*, 10, 473–526.

Geller-Grimm, F., & Taylor, M. (1999). *Key for the identification of the Palaearctic Andrenosoma-species (Diptera: Asilidae). Rubber flies (Asilidae).* www.geller-grimm.de/andrenoe.htm.

Ghahari, H., Hayat, R., Lavigne, R., & Ostovan, H. (2014). An annotated checklist of Iranian Asilidae (Insecta: Diptera: Brachycera: Asiloidea). *Linzer biologische Beiträge*, 46, 1379–1446.
Hayat R., Ghahari H., Lavigne R., & Ostovan H. (2008). Iranian Asilidae (Insecta: Diptera). *Turkish Journal Zoology, 32*, 175–195.

Hradsky, M. & Geller-Grimm, F. (2003). Notes on the genus *Mactea* Richter & Mamaev, 1976 (Diptera: Asilidae) including the description of new species. *Studia Dipterologica, 9*, 87–91.

Hull, F. M. (1962). Robber Flies of the world: The genera of the family Asilidae. *Bulletin of the United States National Museum, 224*, 1–907.

Kovář, I., & Hradský, M. (1996). A new species of the genus *Andrenosoma* Rondani from the Canary Islands (Insecta: Diptera: Asilidae). *Reichenbachia, 31*, 225–228.

Lavigne, R. J., & Bullington, S. W. (1984). Ethology of *Laphria fernaldi* (Back.) (Diptera: Asilidae) in South West Wyoming. *Proceedings of the Entomological Society of Washington, 86*, 326–336.

Lehr, P. A. (1958). On the biology and behaviour of robber flies (Asilidae-Diptera). *Trudy Instituta Zoologii, Akademiya Nauk Kazakhstan SSR, 8*, 173–196.

Lehr, P. A. (1989): Robber flies of the subfamily Laphriinae (Diptera, Asilidae) of USSR. *Entomologiceskoe Obzorenije, 68*, 406–421 [In Russian; English translation: *Entomological Review, 68*, 1992: 121–136].

Lehr, P. A. (1999): 52. Fam. Asilidae. In: Lehr, P. A. (ed.): *Key to the insects of Russian Far East. Vol. VI. Diptera and Siphonaptera*. [In Russian], Pt. 1; 591–640.

Maldès, J. M. (2004). *Andrenosoma albivarbe* (Meigen, 1820), mise au point et répartition (Diptera, Asilidae). *Bulletin de la Société entomologique de France, 109*, 489–490.

Meigen J. W. (1820). Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Aachen: Friedrich Wilhelm Forstmann.

Mohammadi, R., Talebi, A.A., Fathipour, Y., Kazerani F., & Van Den Broek, R. (2021). Robber flies (Diptera: Asiloidea: Asilidae) of northern Iran, with four new records for Iranian fauna. *Journal of Crop Protection, 10*, 349–362.

Pont, A. C. (1996). The dipterist C. R. W. Wiedemann (1770-1840). His life, work and collections. *Steenstrupia, 21*, 125–154.

Richter, V. A., & Mamaev, B. M. (1976): New genus of the robber flies (Diptera, Asilidae) from the Far East. *Trudy zoologicheskogo Instituta Akademiya Nauk (St. Petersburg), 47*, 113–116. [In Russian].

Richter, V. A. (1985). A new species of the genus *Andrenosoma* Rd. (Diptera, Asilidae) from Transcaucasia [In Russian]. *Reports of NAS RA, 80*, 226–228.

Richter, V. A., & Mamaev, B. M. (1976). New genus of the robber flies (Diptera, Asilidae) from the Far East. *Trudy zoologicheskogo Instituta Akademi Nauk SSSR (St. Petersburg), 47*, 113–116. [In Russian].

Rondani, C. (1856). *Dipterologiae italicae prodromus. Vol. I. Genera italicae ordinis dipterorum ordinatim disposita et distincta et in familias et stirpes aggregata. Parma: Stocchi.*

RStudio Team (2019). *RStudio: Integrated Development for R*. RStudio, PBC. Boston, MA. [http://www.rstudio.com].

Sagheb-Talebi, K. (2014): Appropriate characteristics of beech stands for application of close to nature silvi-culture (selection system) of Hycranian Region (Guilan, Mazandaran and Golestan Provinces). Tehran: Research Institute of Forests and Rangelands.

Séguy, E. (1952). *Andrenosoma nouveaux de France* (Dipt., Asilidae). *Revue Française d’Entomologie, 19*, 192–196.

Tomasovic, G., & Bartolozzi, L. (2018). Contribution to the knowledge of the robber flies from Vietnam, with description of nine new species (Diptera: Asilidae). *Onychium, 14*, 173–202.

Tomasovic, G., & Saghaei, N. (2009). Contribution to the knowledge of the *Asilidae* (Diptera: Brachycera) from Fars province (Iran). *Faunistische Entomology, 62*, 45–56.

Von der Dunk, K. (1996). Bestimmungsschlüssel für Raubfliegen (Dipt., Asilidae). *Galathea. Berichte des Kreises Nürnberger Entomologen, 12* 131–146.

Von der Dunk, K. (2007). Beitrag zum Vorkommen seltener Raubfliegen (Dipt., Asiiidae). *Berichte des Kreis Nürnberger Entomologen, 23*, 153–162.

Zimsen, E. (1964). *The type material of J. C. Fabricius*. Copenhagen: Munksgaard.