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 Youness Mabrouki,  Andrei Bogdan Terec,  Fouzi A. Taybi,  Anna Dénes,  Lujza Keresztes

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Taxonomic notes and key to the West Palearctic *Antocha* (*Antocha*) Osten Sacken, 1860 (Diptera, Limoniidae) with description of a new species from Morocco

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Abstract

Background

The Mediterranean region of the Western Palearctic is one of the most species-rich biomes in the world, hosting a high level of endemism and relict species with important conservation value. The North Africa Atlas Mountains (spanning Morocco, Algeria, and Tunisia) belong to a poorly investigated region of the Mediterranean area, with overlooked aquatic biodiversity, hence a number of species still remain to be discovered.

New information

The subgenus *Antocha* Osten Sacken, 1860 is recorded for the first time from Africa, with description of *Antocha* (*Antocha*) *aule* Keresztes & Mabrouki **sp. n.** from hilly regions of the Middle Atlas region, Morocco. Taxonomic revision of the sugenus *Antocha* from the Western Palearctic area is proposed based on male genital structures, especially in the shape of the outer gonostylus and aedeagus of individuals belonging to populations from geographically distant regions. The unique design of the male terminalia differentiate well the newly discovered species from its closely-related and range-restricted *A. phoenicia* Thomas & Dia, 1982. This is in contrast with the high intraspecific and geographically poorly defined variability of the widespread *Antocha* (*A.*) *vitripennis* (Meigen, 1830).

Illustrations of male genital parts, distribution data, and key to the species from the Western Palearctic area are also provided.

The newly discovered species belongs to the *Antocha vitripennis* Species Group and represents native elements of limited distribution in the Western Palearctic area, likely isolated in a few freshwater ecosystems in a region with severely declining water reserves in the Middle Atlas region, Morocco. Therefore, the discovery of the new species is of special conservation value regarding the freshwater resources from here.

Keywords

new species, *Antocha vitripennis* Species Group, freshwater ecosystems, Mediterranean area, the Middle Atlas region, conservation

Introduction

The Mediterranean area is one of the world's outstanding biodiversity hotspots with high conservation value within the West Palearctic (Delibes-Mateos et al. 2008). The geographic area surrounding the Mediterranean Sea hosts a unique biodiversity resulting from long-term evolutionary events in both terrestrial and aquatic ecosystems, with high numbers of relicts and/or endemic taxa, facing nowadays severe habitat loss and decline of some species (Barredo et al. 2016). The southern region of the Mediterranean area, including Morocco, has a special interest in nature conservation, because its geographical position, localized along the coastlines of northern Africa between the Atlantic Ocean and the Mediterranean Sea, supports high diversity ecosystems shaped by both the Mediterranean and the Saharan climate types (Abdul Malak et al. 2010). Despite its geographic position, and extraordinary diversity of ecosystems, Morocco has been poorly investigated in general, especially regarding its aquatic Diptera fauna, including short-palped craneflies, Limoniidae (Adghir et al. 2018, De Jong et al. 2021, Driauach et al. 2013, Driauach and Belqat 2015, Driauach and Belqat 2016, Ebejer et al. 2019, Eiroa et al. 2020, Kettani et al. 2022, Pârvu et al. 2006, Pierre 1924, Savchenko et al. 1992, Séguy 1941a, Séguy 1941b, Starý 1971, Starý 1974, Starý 2006, Starý 2009, Starý 2011, Starý and Oosterbroek 2008, Taybi et al. 2021, Vaillant 1956).

Antocha Osten Sacken, 1860 is a relatively large genus of the subfamily Limoniinae (Diptera, Limoniidae), including 162 species according to Oosterbroek (2023), grouped in three subgenera, *Antocha* (s. str.) Osten Sacken, 1860, *Orimargula* Mik, 1883, and *Proantocha* Alexander, 1919. Species of this genus are distributed in almost all zoogeographical regions of the world, with high species diversity detected in the Oriental Palearctic (83 species) and the East Palearctic (53 species) areas. A lower number of species was recorded from the Afrotropics (21 species), Nearctic (7 species), Australasian/Oceanian (3 species), and Neotropics (1 species). In the West Palaeartic Region members of only two subgenera occur. *Antocha* (*Antocha*) is represented by four species,

frequently collected in lower mountainous to hilly areas, while *Antocha (Orimargula)* has a single species, distributed mostly in the mountains belonging to this biogeographic area.

The subgenus *Antocha* contains small to medium-sized dipterans with body length between 2.8 to 5.0 mm, up to 8.0 mm, and exceptionally up to 11 mm in the case of *Antocha (A.) unicolis* Alexander, 1968. A general revision of the species belonging to the subgenus was recently published by Podenas and Byun (2013), Podenas and Byun (2014), Podenas and Young (2015), Markevičiūtė et al. (2019), and Markevičiūtė et al. (2021) who focused more on the Oriental fauna. General color of the species is brownish from yellow-brownish to dark brown or nearly black. The most important morphological characters of the species of *Antocha (A.)* are the following: antennae simple with rings of verticils at bases of flagellomeres, or antennal flagellomeres short-oval and covered with long dense pubescence (Podenas and Byun 2013); wings are wide with large, well developed, prominent anal angle; male terminalia slightly wider than abdomen, gonocoxite elongate, oval or cylindrical and often with well-developed ventro-mesal lobe; two pairs of terminal gonostyli, with outer gonostylus usually darkened and strongly sclerotized and the inner gonostylus usually fleshy and curved downward; ovipositor with a straight or slightly arched cercus, with the lower margin smooth or serrated (Podenas and Byun 2014, Podenas and Young 2015, Markevičiūtė et al. 2019). The four West Palaearctic species included in this subgenus are: *A. (A.) hirtipes* Savchenko, 1971 (recorded from Georgia, only); *A. (A.) libanotica* Lackschewitz, 1940 (recorded from Georgia, Armenia, Azerbaijan, Cyprus, Lebanon, Iran, Turkmenistan, Tajikistan, Afghanistan), *A. (A.) phoenicia* (only recorded from Lebanon), and *A. (A.) vitripennis* Meigen, 1830, widespread in the whole West Palearctic area and also recorded from the East Palearctic Region (Oosterbroek 2023).

Larvae are aquatic, apneustic, developing in the riffles, gravel or detritus of fast running streams and rivers (Fuller and Hynes 1987, Ujvárosi 2005, Vogtenhuber 2007). Adults are present in large numbers close to the larvae sites near the water margins, and they are usually attracted to light or fall into Malaise-traps in suitable locations (Keresztes, pers. data). Hancock and Hewitt (2020) reported also on a curious case of a large number of adult specimens trapped by the glandulous leaf of the butterwort plant *Pinguicularia* ssp. near the river margins in Spain.

In this paper, we discuss morphological variability of the male genital structures of *Antocha (Antocha) vitripennis* (Meigen 1830), widely distributed in the West Palearctic area and describe a new species of the subgenus *Antocha* from the Middle Atlas Mountains, Morocco.

Materials and methods

Material included in this study represent 201 male individuals of the subgenus *Antocha*, including the new species (Table 1). We use entomological net and UV trap to collect adult specimens between 2001 and 2022, but a large amount of material was collected also by entomologists from different parts of the West Palearctic Region (Fig. 1, Table 1). All the material listed here are stored in 96% ethanol and deposited in the Diptera Collection of

the Faculty of Biology and Geology, Cluj Napoca, Romania. Holotype and paratypes of the new species are deposited in the Museum of Zoology of the Babeş-Bolyai University (MZBBU), Cluj Napoca, Romania. Male genitalia were left overnight in 10% potassium hydroxide (KOH) and for one hour in undiluted glacial acetic acid, to neutralize and wash out the soap that was created from the soft tissues. The male genitalia were then transferred to a larger amount of glycerol to wash out the acid. Afterwards, they were transferred to a drop of glycerol on a slide with rounded excavation. Male abdomens were dissected and examined under microscope (Olympus CZ23). Photos were taken using a Canon EOS 650D digital camera, attached to the microscope, with an LM Digital SLR Adapter (MicroTechLab, Austria). Layer photos were combined using Zerene Stacker software. Nomenclature of the genital parts follows Podenas and Young (2015) and Markevičiūtė et al. (2019).

Results

Morphological variability of male terminalia of *Antocha* (s. str.) *vitripennis* (Meigen, 1830) in the West Palearctic Region

A number of 198 male individuals of *Antocha* (s. str.) *vitripennis* (Meigen, 1830) were investigated from the whole West Palearctic Region, representing 20 different populations from Albania, Austria, Bulgaria, Germany, Spain, Georgia, Greece, Croatia, Montenegro, and Romania. A comparative analysis of the outer gonostylus, parameres and aedeagus lobes of individual specimens shows high variability in the species within its whole distribution area, which allowed us to group individuals in at least four different types (Fig. 2).

Taxon treatments

Antocha (s. str.) *vitripennis* (Meigen, 1830)

Materials

- a. taxonRemarks: *Antocha* (A.) *vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: *Antocha*; continent: Europe; country: Austria; locality: Burgenland; verbatimSRS: WGS84; decimalLatitude: 47.373709; decimalLongitude: 16.010401; eventDate: 2012-06-19; eventRemarks: leg. Graf, W.; sex: 25 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 79366A14-4113-5B33-A33D-F8A53400A6F5
- b. taxonRemarks: *Antocha* (A.) *vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: *Antocha*; continent: Europe; country: Austria; locality: Vienna hills; verbatimSRS: WGS84; decimalLatitude: 48.136847; decimalLongitude: 16.098223; eventDate: 2012-06-15; eventRemarks: leg. Graf, W.; sex: 5 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 9DDFE354-5E4F-573E-942B-3843C0C0DB9B
- c. taxonRemarks: *Antocha* (A.) *vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: *Antocha*; continent: Europe; country: Bulgaria; locality: Stara Planina; verbatimSRS: WGS84; decimalLatitude: 42.784125; decimalLongitude: 25.912326;

- eventDate: 2013-06-01; eventRemarks: leg. Kolcsár, L.-P. & Török E.; sex: 4 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 6A29D2D0-E4AF-5CE3-A81C-036A4BD20558
- d. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Croatia; locality: NP Plitvicka Jezera; verbatimSRS: WGS84; decimalLatitude: 44.925833; decimalLongitude: 15.619167; eventDate: 2008-06-30; eventRemarks: leg. Ivkovic, M.; sex: 7 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 2A66D0CC-CCD5-5A6E-9A20-A6D9334F252B
- e. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Croatia; locality: Omiši Forests; verbatimSRS: WGS84; decimalLatitude: 43.437297; decimalLongitude: 16.757657; eventDate: 2005-07-19; eventRemarks: leg. Ivkovic, M.; sex: 6 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 251B5C15-3723-56FD-B042-0C01B7967645
- f. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Germany; locality: Danube lowland; verbatimSRS: WGS84; decimalLatitude: 49.026846; decimalLongitude: 12.075860; eventDate: 2013-07-13; eventRemarks: leg. Graf, W.; sex: 2 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: BECE70D5-B754-5935-9001-B81960BA27E7
- g. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Romania; locality: Rodnei Mts.; verbatimSRS: WGS84; decimalLatitude: 47.423995; decimalLongitude: 24.548807; eventDate: 2003-07-26; eventRemarks: leg. Keresztes, L.; sex: 22 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: D66D3EC9-E42A-5987-97F1-822CA33263A1
- h. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Romania; locality: Harghita Mts.; verbatimSRS: WGS84; decimalLatitude: 46.412488; decimalLongitude: 25.745437; eventDate: 2001-07-15; eventRemarks: leg. Keresztes, L.; sex: 33 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: DEDA028B-7B5B-55EF-8CA3-E2921DA7F57E
- i. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Romania; locality: Ciucaș Mts.; verbatimSRS: WGS84; decimalLatitude: 45.534297; decimalLongitude: 25.836821; eventDate: 2004-07-21; eventRemarks: leg. Keresztes, L.; sex: 37 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 2B539852-8D49-5E50-92FF-60D19C01A2FA
- j. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Romania; locality: Trascaului Mts.; verbatimSRS: WGS84; decimalLatitude: 46.565262; decimalLongitude: 23.675828; eventDate: 2001-06-06; eventRemarks: leg. Keresztes, L.; sex: 7 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: AC7E5A4E-0B19-5CB6-8FE1-CC1ADB71D099
- k. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Romania; locality: Clujului Hills; verbatimSRS: WGS84; decimalLatitude: 46.755529; decimalLongitude: 23.509461; eventDate: 2004-08-24; eventRemarks: leg. Keresztes, L.; sex: 8 males; lifeStage: adult;

- identifiedBy: Keresztes Lujza; occurrenceID: 95346811-C0F2-5416-B99C-D741EE62D525
- l. taxonRemarks: *Antocha (A.) vitripennis*, type 1; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Spain; locality: Serrania de Cuenca; verbatimSRS: WGS84; decimalLatitude: 39.503257; decimalLongitude: -1.900691; eventDate: 2009-08-04; eventRemarks: leg. Martinez, J.; sex: 1 male; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: B87A4D3A-E5F6-5EBB-8754-ECF5CC2BAE6E
- m. taxonRemarks: *Antocha (A.) vitripennis*, type 2; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Albania; locality: Korce; verbatimSRS: WGS84; decimalLatitude: 41.016258; decimalLongitude: 20.513618; eventDate: 2019-05-03; eventRemarks: leg. Keresztes, L.; sex: 1 male; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: ODBE5507-F359-5382-A5FE-55C18D749170
- n. taxonRemarks: *Antocha (A.) vitripennis*, type 2; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Germany; locality: Eifel hills; verbatimSRS: WGS84; decimalLatitude: 49.755204; decimalLongitude: 6.735459; eventDate: 2007-08-05; eventRemarks: leg. Neu, P.; sex: 12 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 460335F1-D823-5A08-B806-95B25AA9EBB1
- o. taxonRemarks: *Antocha (A.) vitripennis*, type 2; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Romania; locality: Cerna Mts; verbatimSRS: WGS84; decimalLatitude: 45.256819; decimalLongitude: 22.814289; eventDate: 2004-08-10; eventRemarks: leg. Bálint, M.; sex: 6 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 7BB55E4A-2ABA-5593-9558-7DA78E32C417
- p. taxonRemarks: *Antocha (A.) vitripennis*, type 3; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Bulgaria; locality: Pirin Mts; verbatimSRS: WGS84; decimalLatitude: 41.768952; decimalLongitude: 23.426897; eventDate: 2003-08-19; eventRemarks: leg. Pauls, S.; sex: 2 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: EBFCE991-C43B-5700-AED9-87D6EC9239F8
- q. taxonRemarks: *Antocha (A.) vitripennis*, type 3; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Greece; locality: Olympus Mts.; verbatimSRS: WGS84; decimalLatitude: 40.079097; decimalLongitude: 22.373471; eventDate: 2012-07-14; eventRemarks: leg. Rákossy, L.; sex: 1 male; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 923E950B-71DF-5477-8CEF-6679A1C8E175
- r. taxonRemarks: *Antocha (A.) vitripennis*, type 4; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Albania; locality: Domosdova Plain; verbatimSRS: WGS84; decimalLatitude: 41.075075; decimalLongitude: 20.498387; eventDate: 2019-05-01; eventRemarks: leg. Keresztes, L.; sex: 13 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: E1F6DA3B-BC17-5006-8729-BBFE1E25620C
- s. taxonRemarks: *Antocha (A.) vitripennis*, type 4; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Georgia; locality: North Caucasus; verbatimSRS: WGS84; decimalLatitude: 43.122052; decimalLongitude: 42.750700; eventDate: 2012-07-18; eventRemarks: leg. Graf, W.; sex: 1 male; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 15613FC2-197C-5AEA-AD73-E26DB524C721

- t. taxonRemarks: *Antocha (A.) vitripennis*, type 4; class: Insecta; order: Diptera; family: Limoniidae; genus: Antocha; continent: Europe; country: Montenegro; locality: Prokletje Mts.; verbatimSRS: WGS84; decimalLatitude: 42.550042; decimalLongitude: 19.825639; eventDate: 2022-05-02; eventRemarks: leg. Dénes, A.; sex: 5 males; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: 7E92A44E-7B20-570D-97A9-C782E16951D0

Taxon discussion

Type 1 corresponds to the “normal” shape of the inner gonostylus, according to Geiger (1985) and it is the most widespread among male individuals in the western part of Europe. Apical part of outer gonostylus tapered, ending in a single point, lacking protrusion or humps or teeth on its upper surface (Fig. 2a, b). Among this type it is also important to point to the most frequently detected narrow and straight parameres, slightly curved in the distal end (Fig. 2c), but also a number of individuals, even in the same population, where the parameres are divergent and highly sinuous in shape (Fig. 2d), for example in several individuals collected from Lafnitz, Austria.

The lobes of aedeagus are rounded, protruded, or almost straight at their distal end (Fig. 2a, c, d). Our data show that this type of inner gonostylus is widespread also in the central and eastern parts of Europe, and it was detected in the hilly regions from Germany, Spain, Austria, Croatia, Romania, and also in the Balkan Range Mountains (Stara Planina), Bulgaria. Out of the 201 male individuals, 137 specimens belong to this type, also representing the majority of male individuals investigated by us (roughly 66%).

Type 2 distinct from type 1 in the outer gonostylus tip, which is bifurcated, the upper arm is shorter, always wider, more or less rounded or triangular, while the lower point is narrower, longer and almost thorn like (Fig. 2d, e, h). Male individuals examined by us from Germany (surrounding areas of the city of Kassel), Romania (Banat Region), and Albania (Korce region) belong to this type, representing 9% from the total individuals collected by us. Parameres almost parallel, slightly sinuous at the distal end. The distal end of aedeagus similar to type 1.

Type 3 represents individuals with outer gonostylus, ending in two points, similar to type 2, but the upper extension of the distal end is well developed, rounded and hump-like, while the lower part is more pointed and thorn-like (Fig. 2f). This type was completely absent from the material collected in the western part of Europe and we could only identify, in this case, a few specimens collected at high altitudes, in Bulgaria (Pirin Mountains, 1780 m) and Greece (Olympus Mountains, 2100 m) (less, than 3% from the total individuals examined by us). Type 3 were collected from higher elevation, above 1500 m (Table 1). Parameres and aedeagus similar to type 1 and type 2.

Type 4 corresponds with outer gonostylus sharply curved inwards and rounded at the distal end. A more or less well-developed tooth-like extension can often be distinguished in its lower corner (Fig. 2g). However, this type is difficult to separate from the previous type 3, because we encountered a series of transitional forms among

individuals collected in the Balkan Range, which also resembles type 2 in some cases (Fig. 2h). Type 4 was identified among individuals collected in Albania, Montenegro, and Georgia, and it is the dominating type in the Balkan area, representing 22% from the total individuals examined by us. Parameres are slenderer and sinuous. Aedeagus with well-developed distal lobes.

***Antocha (Antocha) aule* Keresztes & Mabrouki 2023, sp. n.**

- ZooBank [urn:lsid:zoobank.org:pub:8F608A95-F4AA-443C-8634-4FA00F05FAAF](https://zoobank.org/pub:8F608A95-F4AA-443C-8634-4FA00F05FAAF)

Nomenclature

This work and the nomenclatural acts it contains have been registered in ZooBank. The ZooBank Life Science Identifier (LSID) for this publication is:

<http://zoobank.org/urn:lsid:zoobank.org:pub:8F608A95-F4AA-443C-8634-4FA00F05FAAF>

Materials

Holotype:

- a. scientificNameID: urn:lsid:zoobank.org:pub:8F608A95-F4AA-443C-8634-4FA00F05FAAF; class: Insecta; order: Diptera; family: Limoniidae; genus: *Antocha*; subgenus: *Antocha*; continent: Africa; waterBody: Cascade near Bakrit; country: Morocco; locality: Middle Atlas Range, Bakrit; verbatimElevation: 1640; verbatimSRS: WGS84; decimalLatitude: 33.049438; decimalLongitude: -5.272774; eventDate: 2021-05-16; eventRemarks: leg. Mabrouki, Y. & Taybi F.A.; sex: 1 male; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: CB927E68-C824-5E85-8FAE-964FC5DE2F27

Paratype:

- a. scientificNameID: urn:lsid:zoobank.org:pub:8F608A95-F4AA-443C-8634-4FA00F05FAAF; class: Insecta; order: Diptera; family: Limoniidae; genus: *Antocha*; subgenus: *Antocha*; continent: Africa; waterBody: Cascade near Bakrit; country: Morocco; locality: Middle Atlas Range, Bakrit; verbatimElevation: 1640; verbatimSRS: WGS84; decimalLatitude: 33.049438; decimalLongitude: -5.272774; eventDate: 2021-05-16; eventRemarks: leg. Mabrouki, Y. & Taybi F.A.; sex: 2 males, 4 females; lifeStage: adult; identifiedBy: Keresztes Lujza; occurrenceID: D03EBE02-2C09-573C-8C87-2E409459F84C

Description

Male. Color dark brown. Body length 5.5 mm, wing length 6.5 mm. General appearance in Fig. 3a.

Head. Dark brown, with light brown proboscis. Palp grayish-brown. Antennae brownish, with 16 segments (Fig. 3b). Scapus long and cylindrical. Pedicel is large and short. Antennal flagellomeres short-oval and covered with long dense pubescence, except the last four segments which gradually become smaller and cylindrical, last segment

ending pointed. Short bristles present on every antennal segment, rings of verticils at bases of flagellomeres, mostly on its dorsal surface. Larger bristles are present also at the ventral surface of the segments 13, 15, and 16.

Thorax. Praescutum with a broad brown median band to the thoracic suture and two wide lateral bands (Fig. 3c) with similar color extending to scutellum, and sometimes fused with the medial band. Conspicuous dark brown triangle on metathorax. The rest of the thorax lighter brownish. Anterolateral region of the praescutum yellowish. Scutellum greyish brown. Scutum dark laterally and lighter in the center. Legs long and slender, pubescent (Fig. 3d). Coxa lighter to yellowish, rest of the legs brownish. Wing nearly translucent to whitish, generally white and large, with nearly right-angled cell a₂ (Fig. 3e). Veins brownish-yellowish, with stronger bristles on C and R₁ (Fig. 3e, f, g). Stigma indistinct, nearly invisible (Fig. 3f, g). Haltere with a yellowish stem and a whitish-grayish knob.

Abdomen. Dark brown, first segment lighter, with whitish-clouded tint dorsally, the last segments darker.

Male Terminalia. Very close to *Antocha* (*A.*) *phoenicia*. Distal margin of the 9th abdominal tergite straight with two slight protrusions on the both sites of the central part. Gonocoxite cylindrical, with long hairs. Inner gonostylus fleshy, pubescent, distal end abruptly curved downward. Outer gonostylus strongly sclerotized, short and curved. Distal end shorter and thicker and less pointed with a hardly visible hump on the dorsal surface. Interbase with exteriorly-diverged lobes. Parameres straight and parallel, lacking sinuosity, slightly bent near the apex. Aedeagus has two distal lobes. Lateral edges of the lobes straight, tips pointed directed straight back (Fig. 3h, i, j, k).

Female. Color similar to males. Body length 5.8 mm, wing length 6.7 mm. General habitus similar to males, except the dark brown triangle on metathorax reduced.

Ovipositor. Cerci and hypogynal valve long and slender (Fig. 3l).

Diagnosis

Males of the new species are highly similar to *Antocha* (*A.*) *phoenicia*, especially in the general habitus of males and females and features in male and female genitalia. Type material of *A. phoenicia* was not available to us, but detailed description of the male genital parts by Thomas and Dia (1982) allowed us a good comparison with the male individuals collected in Morocco.

The new species belongs to the *Antocha* (*A.*) *vitripennis* Species Group, based on a simple, slender, slightly sinuous or parallel parameres, without secondary protuberances or hooks. However, the males of the new species differ from all known species of the subgenus *Antocha*, primarily on the conspicuously different aedeagal lobes, which are narrow and straight, oriented parallel to the aedeagus axis (Fig. 3j). All of the other West Palearctic species of *Antocha* (*s. str.*) have a rather variable shape of the aedeagal lobes, more-or less rounded, but always wider at the base (Fig.

2c, d). The *Antocha (A.) aule* sp. n. males differ from those of their most similar congeners, mainly exhibiting the combination of the following characters: (1) outer gonostylus short and curved, with sharply rounded tip lacking thorn-like appendages; (2) interbase with long and laterally prolonged membranous part; (5) parameres short and parallel, slightly curved at their distal end; (6) aedeagus with well-developed narrow lobes oriented straightly posteriorly respective to the body axis. Females are highly similar to *Antocha (A.) phoenicia*.

Etymology

The word *aule* comes from the highly popular story written by J. R. R. Tolkien, *The Lord of the Rings*, in which Aule creates the “dwarves” (here, the small flies), but put them into a deep sleep, because of other priorities. Here, we use the word *aule* in the sense that for centuries the new species was overlooked, and the scientific community has ignored detailed research of these aquatic insects (in “deep sleep”) until their recent discovery.

Ecology

The species was discovered in a single site in Morocco, therefore we consider a range-restricted micro-endemic species of the Middle Atlas Range. Specimens were captured in Bakrit, a location in the Middle Atlas Range, a mountain range stretching over some 350 km, from southwest to northeast of the Mediterranean part of Morocco, located between the Rif Mountains and the High Atlas Mountains, and covering a total area of 2.3 million hectares, i.e. 18% of Morocco’s high altitude mountain domain (Fig. 4a). This chain belongs to the Atlas Mountains and more precisely, to one of the three elements of the Moroccan Atlas, the other two being the High Atlas and the Anti-Atlas (or Lesser Atlas). The heavy rainfall gives the Middle Atlas Mountains the form of a “water tower” (also via snowmelt hydrology) from both hydrogeological and hydrographic perspectives, and the main water supply for median and low reaches.

Bakrit region is well-known for its rich superficial water resources, i.e. streams, waterfalls, and springs, and the new species was captured from the banks of a fast-flowing stream, with the type locality belonging to the Oum Errabiâ River basin (Fig. 4b, c).

Accompanying species: Different aquatic invertebrate species can be found in the habitat of *Antocha aule* sp. nov. including the recently described caddisfly *Tinodes atlasensis* Ibrahim, Mabrouki & Taybi, 2021, and freshwater gastropod *Pseudamnicola bouhaddioui* Taybi, Glöer & Mabrouki, 2022, in addition to other invertebrate species such as *Hydropsyche* sp. (Trichoptera); *Ecdyonurus rothschildi* (Navàs, 1929), *Rhithrogena* sp., *Baetis* spp., *Caenis* sp. (Ephemeroptera); *Calopteryx haemorrhoidalis* (Vander Linden, 1825), *Anax* sp., *Onychogomphus* sp., *Sympetrum* sp., *Orhetrum* sp. (Odonata); *Hydrometra stagnorum* (Linnaeus, 1758) (Heteroptera); *Atyaephyra desmarestii* (Millet, 1831) (Decapoda); *Physella acuta* (Draparnaud, 1805), *Ancylus*

fluviatilis O.F. Müller, 1774; *Theodoxus* sp., *Melanopsis* sp. (Mollusca); *Simulium* sp., *Prosimulium* sp. (Diptera) (Ibrahimi et al. 2021, Taybi et al. 2022).

Identification keys

Key to West Palearctic males of <i>Antocha</i> (<i>Antocha</i>)		
1	Wing without triangle on aua	<i>Antocha</i> (<i>Orimargula</i>)
–	Wing with triangle on aua	<i>Antocha</i> (<i>Antocha</i>) 2
2	Parameres wide, with 2 teeth-like points at distal end	<i>A. (A.) libanotica</i>
–	Parameres slender and simple ending with one point at distal end	3
3	Outer gonostylus gradually narrowed at distal end, ending in one or two distinct points, slightly curved downward, parameres slender and sinuous, sometimes parallel with the aedeagal axis	<i>A. (A.) vitripennis</i>
–	Outer gonostylus sharply curved down at distal end, rounded, parameres straight and parallel with the aedeagal axis	4
4	Aedeagal terminal lobes weakly developed	<i>A. (A.) hirtipes</i>
–	Aedeagal lobes well developed	5
5	Aedeagal lobes wide at base, divergent distally	<i>A. (A.) phoenicia</i>
–	Aedeagal lobes narrow at base, parallel distally with aedeagal axis	<i>A. (A.) aule</i> sp. n.

Discussion

Antocha (*A.*) *vitripennis* (Meigen, 1980) has a long-debated taxonomy. The species was first described from the northern part of Germany (most probably around Stoltenberg) by Meigen (1830) as *Limnobia vitripennis* (syntypes deposited in the Muséum national d'Histoire naturelle, Paris (France), Diptera Collection (ED), specimen identification code MNHN-ED-ED2450), based on translucent or opalescent wings (*vitri* - window, *pennis* - wing, lat.), later transferred to the subgenus *Antocha* of the genus *Antocha* by Osten Sacken (1860).

The species is widely distributed in the whole West Palearctic area (Oosterbroek 2023), but also detected from Bashkortostan Republik in Russia (Eastern Palearctic) (Kolcsár et al. 2021).

A. fulvescens Lackschewitz, 1940 very close to *A. vitripennis* were described by Lackschewitz (1940) from Albania in 1940, and later identified also from France (Geiger 1985), based on a generally lighter color of the specimens, shape of the outer gonostylus ending in two points, and the divergent position of the parameres relative to the body axis. Based on comparative analyses of a large material of *Antocha* from Europe, Geiger revised the taxonomic status of *A. (A.) fulvescens* and synonymized with *A. (A.) vitripennis* because of the high variability of the male genital structures of individuals in sympatric populations, not only in the Balkan Range, but also from different European countries, like Switzerland, France, and Germany (Geiger 1985). However, Mendl still argued on the possibility of the presence of more subspecies of *Antocha (A.) vitripennis* in Europe, especially in the Balkan Range (Mendl 1979).

Our result supports the work of Geiger (1985) on the presence of the single, but highly variable *Antocha (A.) vitripennis* in Europe, based on a large fresh material collected from different biogeography regions of Europe. Examination of 201 male genital structures reveals highly different morphological types of the outer gonostylus (here noted as type 1 to type 4), which is not followed by any other detectable differences in the other parts of the male terminalia. The geographic distribution of the identified differences does not draw out any clear clinal pattern (Fig. 1). The widely distributed type 1 is very frequent in Western Europe and Central Europe, and represented the majority of individuals investigated by us (66%), but were present sporadically also in the Balkan Range, mostly along some intermittent waters in the hilly area around the Plitvice Lakes (Croatia) and the Eastern Stara Planina Mountains (Bulgaria). Type 2, represent a morphological variability of male genital structures similar to *A. fulvipennis* (sensu Lackschewitz 1940) and were identified by us not only in the Balkan area (Albania), but also in Germany and Romania. Type 3 however is a particular case of highly different morphology of the outer gonostylus, distinct from type 1 or type 2, collected only from the mountainous areas of Bulgaria and Greece, up to 1500 m altitude, which is also unusual for *A. vitripennis*, a species frequently collected at lower hilly or mountainous regions, but missing from high altitudes. Unfortunately, the small number of individuals (2 males) collected during our investigation did not allowed us to support the presence of a separate *Antocha* taxa in the Balkans, but points to the necessity for a more comprehensive revision of the subgenus in its whole range. Type 4 is even more difficult to appreciate, but it is typical for a large number of individuals collected in the Southern Balkans, but also in the case of one male from Georgia, and supports a wide range of transitional forms between type 2 and type 3, also highly similar with *A. hirtipes* Savchenko, 1971, described from Georgia by Savchenko in 1971. The detection variability of type 4, and its similarity with *A. hirtipes* makes the status of the later taxa in Georgia questionable. The single male individual of *A. vitripennis* collected by us in Georgia is not clearly different from the individuals of *A. vitripennis* from the Balkan Area. However, in the original description of *A. hirtipes* (Savchenko 1971), the aedeagus lobes are not figured, which is clearly well developed in the male individuals collected by us. Based on these taxonomic challenges and also the recent discovery of *A. vitripennis* in the Eastern Palearctic area (Kolcsár et al. 2021), a taxonomic revision of all members of the subgenus is highly recommended.

The new species, *Antocha aule* sp. n. is clearly separated morphologically from all other members of the subspecies *Antocha*, based on a combination of unique design of the outer gonostylus, parameres, and aedeagus, and represents a highly-isolated species close to *A. phoenicia*, the single species discovered from Africa to date belonging to the subgenus *Antocha*.

The type locality of the new species, Bakrit, belongs to the Middle Atlas Range, which is located in the southwest to northeast of the Mediterranean part of Morocco. The scientific and socio-economic interests of the included aquatic ecosystems are no longer demonstrated as an area with rich and varied natural resources, which generally support the presence of an interesting aquatic biodiversity with high rates of endemism (Taybi et al. 2020, Ibrahim et al. 2021, Mabrouki et al. 2021). The newly discovered species from here complete the diversity of aquatic fauna from this location and support conservation efforts for these unique aquatic ecosystems.

In conclusion, the subgenus *Antocha* (s. str.) is represented by five species in the West Palearctic area. Except for the high mountainous *Antocha* (*A.*) *libanotica* Lackschewitz, 1940, which has a highly different shape of parameres, ending in two points, the rest of the West Palearctic species, *A.* (*A.*) *hirtipes*, *A.* (*A.*) *phoenicia*, and *A.* (*A.*) *vitripennis*, including the recently discovered *A.* (*A.*) *aule* sp. n., are mostly hilly species, highly similar in general habitus and shape of the male and female Terminalia. The taxonomic status of type 3 of *A. vitripennis* remains challenged, and this particular morphology of the outer gonostylus was detected in some few individuals only, collected at higher elevation in the Pirin Mountains, Bulgaria and Olympus Mountains, Greece. Further, morphological investigation supported by molecular data is highly recommended to test the taxonomic status of this particular morphology, as well as for the other members of the subgenus *Antocha*.

Despite the extremely high morphological variability of the male outer gonostylus in the case of *A. vitripennis*, a series of small but constant details on other male genital structures, including the parameres and aedeagus, allow us to separate the five species of the subgenus *Antocha*, supported also by information from the literature (Savchenko 1971 Thomas and Dia 1982).

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References

- Abdul Malak D, Cuttelod A, Garcia N (2010) The status and distribution of freshwater biodiversity in Northern Africa. IUCN. xiii+141pp
- Adghir A, De Jong H, Kettani K (2018) The Tipulidae (Diptera) of northern Morocco with a focus on the Rif region, including the description of a new species of *Tipula* (*Lunatipula*) and an updated checklist for Morocco. *Annales de la Société Entomologique de France* (N.S) 54 (6): 522-538. <https://doi.org/10.1080/00379271.2018.1530949>
- Barredo JI, Caudello G, Dosio A (2016) Mediterranean habitat loss under future climate conditions: Assessing impacts on the Natura 2000 protected area network. *Applied Geography* 75: 83-92. <https://doi.org/10.1016/j.apgeog.2016.08.003>
- De Jong H, Adghir A, Bosch E, Kettani K (2021) Taxonomy of *Nephrotoma guestfalica* (Westhoff, 1879) (Diptera, Tipulidae), with the description of a new subspecies from Morocco. *Tijdschrift voor Entomologie* 163: 31-45. <https://doi.org/10.1163/22119434-20192086>
- Delibes-Mateos M, Delibes M, Ferreras P, Villafuerte R (2008) Key Role of European Rabbits in the Conservation of the Western Mediterranean Basin Hotspot. *Conservation biology: the journal of the Society for Conservation Biology* 22 (5). <https://doi.org/10.1111/j.1523-1739.2008.00993.x>.
- Driauach O, Belqat B, De Jong H (2013) A first checklist of the short-palped crane flies (Diptera: Limoniidae, Pediciidae) of Morocco. *Boletín de la Sociedad Entomológica Aragonesa* (S.E.A.) 53: 187-190.
- Driauach O, Belqat B (2015) A new species of the genus *Baeoura* from Morocco, with a key to the West Palaearctic species (Diptera: Tipuloidea: Limoniidae. *ZooKeys* 532: 99-105. <https://doi.org/10.3897/zookeys.532.5994>
- Driauach O, Belqat B (2016) Additions to the Limoniidae and Pediciidae fauna of Morocco, with an updated checklist (Diptera, Tipuloidea). *ZooKeys* 563: 129-146. <https://doi.org/10.3897/zookeys.563.7384>
- Ebejer MJ, Kettani K, Gatt P (2019) First records of families and species of Diptera (Insecta) from Morocco. *Boletín de la Sociedad Entomológica Aragonesa* (S.E.A.) 64: 143-153.
- Eiroa E, Keresztes L, Martín L, González M, Martínez J (2020) Contribución al conocimiento de los Tipuloidea (Diptera) de Teruel (Aragón, este de la Península Ibérica). *Boletín de la Sociedad Entomológica Aragonesa* 67: 246-250.
- Fuller RL, Hynes HB (1987) The life cycle, food habits and production of *Antocha saxicola* Osten Sacken (Diptera: Tipulidae). *Aquatic Insects* 9: 129-135. <https://doi.org/10.1080/01650428709361285>
- Geiger W (1985) Limoniidae (Diptera), sous-famille Limoniinae de Suisse: synonymies nouvelles. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft= Bulletin de la Société Entomologique Suisse* 58: 69-76.
- Hancock EG, Hewitt SM (2020) Craneflies (Diptera, Tipuloidea) trapped by the leaves of longleaved Spanish butterwort, *Pinguicula vallisneriifolia* Webb (Lentibulariaceae). *Dipterists Digest* (2nd series) 27: 45-49.

- Ibrahim H, Mabrouki Y, Taybi AF (2021) *Tinodes atlasensis* Ibrahim, Mabrouki & Taybi sp. nov. (Trichoptera: Psychomyiidae), a new species from Atlas Mountains, Morocco. *Natura Croatica* 30 (2): 367-375. <https://doi.org/10.20302/NC.2021.30.23>
- Kettani K, Ebejer MJ, Ackland DM, Bächli G, Barraclough D, Barták M, Carles-Tolrá M, Černý M, Cerretti P, Chandler P, Dakki M, Daugeron C, De Jong H, Dils J, Disney H, Droz B, Evenhuis N, Gatt P, Gracioli G, Grichanov IY, Haenni J-P, Hauser M, Himmi O, Macgowan I, Mathieu B, Mouna M, Munari L, Nartshuk EP, Negrobov OP, Oosterbroek P, Pape T, Pont AC, Popov GV, Rognes K, Skuhrová M, Skuhrový V, Speight M, Tomasovic G, Trari B, Tschorsnig H-P, Vala J-C, Tschirnhaus M, Wagner R, Whitmore D, Woźnica AJ, Zatwarnicki T, Zwick P (2022) Catalogue of the Diptera (Insecta) of Morocco—an annotated checklist, with distributions and a bibliography. *ZooKeys* 1094: 1-466. <https://doi.org/10.3897/zookeys.1094.62644>
- Kolcsár L-P, Oosterbroek P, Gavryushin DI, Olsen KM, Paramonov NM, Pilipenko VE, Starý J, Polevoi A, Lantsov VI, Eiroa E, Andersson M, Salmela J, Quindroit C, d'Oliveira MC, Hancock EG, Mederos J, Boardman P, Viitanen E, Watanabe K (2021) Contribution to the knowledge of Limoniidae (Diptera: Tipuloidea): first records of 244 species from various European countries. *Biodiversity Data Journal* <https://doi.org/10.3897/BDJ.9.e67085>
- Lackschewitz P (1940) Die paläarktischen Rhamphidiinen und Eriopterinen (Diptera) des Wiener Naturhistorischen Museums. *Annalen des Naturhistorischen Museums in Wien* 50 (1939): 1-67.
- Mabrouki Y, Taybi AF, Glöer P (2021) Further records of freshwater Gastropods (Mollusca: Hydrobiidae, Lymnaeidae, Planorbidae) from Morocco. *Bonn Zoological Bulletin* 70 (2): 273-279. <https://doi.org/10.20363/BZB-2021.70.2.273>
- Markevičiūtė R, Sigita P, Saldaitis A (2019) A new species of *Antocha* Osten Sacken, 1860 (Diptera: Limoniidae) from Sichuan, China. *Zootaxa* 4661 (1): 118-132. <https://doi.org/10.11646/zootaxa.4661.1.5>
- Markevičiūtė R, Sigita P, Saldaitis A (2021) New *Antocha* Osten Sacken (Diptera: Limoniidae) from Sichuan, China. *Zootaxa* 4969 (2): 280-292. <https://doi.org/10.11646/zootaxa.4969.2.3>
- Meigen JW (1830) Systematische Beschreibung Der Bekannten Europäischen Zweiflügeligen Insekten. *Smithsonian Libraries* <https://doi.org/10.5962/bhl.title.13731>
- Mendl H (1979) Revision der Limoniiden-Sammlung von Hans Bangerter im Naturhistorischen Museum zu Berlin/Schweiz, Beitr. 29 (2). Ent, Berlin, 343 - 372 pp.
- Oosterbroek P (2023) Catalogue of the Craneflies of the World. Version: 4 March, 2023. URL: <http://nlbif.eti.uva.nl/ccw/index.php>
- Osten Sacken CR (1860) New genera and species of North American Tipulidae with short palpi, with an attempt at a new classification of the tribe. *Proceedings of the Academy of Natural Sciences of Philadelphia* 1859: 219.
- Pârvu C, Popescu-Mirceni R, Zaharia R (2006) Faunistic data on some dipteran families (Insecta: Diptera) from Morocco (Results of "Hamada" Expedition 2005). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa» XLIX*: 271-281.
- Pierre C (1924) Nematocera *Polyneura recueillis* au Maroc par M.Charles Alluaud (3e liste, 1922-1923) (Insectes Diptères). *Bulletin de la Société des Sciences Naturelles du Maroc* 4: 198-201.

- Podenas S, Byun HW (2013) Antochini crane flies (Diptera: Limoniidae: Limoniinae) of Korea. *Journal of Species Research* 2 (2): 167-184. <https://doi.org/10.12651/JSR.2013.2.2.167>
- Podenas S, Byun HW (2014) New species of *Antocha* Osten Sacken, 1860 crane flies (Diptera: Limoniidae) for South Korea. *Zootaxa* 3900 (1): 117. <https://doi.org/10.11646/zootaxa.3900.1.7>
- Podenas S, Young CW (2015) *Antocha* crane flies from Taiwan (Diptera: Limoniidae: Limoniinae). *Zootaxa* 4048 (4): 523-537. <https://doi.org/10.11646/zootaxa.4048.4.4>
- Savchenko EN (1971) New Palaearctic species of Limoniid-flies (Diptera, Limoniidae). *Dopovidi Akademii Nauk Ukrain's'koï RSR (B) 2. The genus Antocha O.-S.: 855-857. [In Ukrainian].*
- Savchenko EN, Oosterbroek P, Stary J (1992) Family Limoniidae. *Catalogue of Palaearctic Diptera* 1: 183-369.
- Séguy E (1941a) Récoltes de R. Paulian et A. Villiers dans le haut Atlas marocain, 1938, (XVIIe note) Diptères. *Revue Française d'Entomologie* 8: 25-33.
- Séguy E (1941b) Diptères recueillis par M. Berland dans le sudmarocain. *Annales de la Société Entomologique de France* 110: 1-23.
- Stary J (1971) A new Palaearctic representative of the subgenus *Protogonomyia* Alexander (Diptera, Tipulidae). *Acta Entomologica Bohemoslovaca* 68: 319-321.
- Stary J (1974) The identity of *Gonomyia (Idiocera) sexguttata* (Diptera, Tipulidae). *Acta Entomologica Bohemoslovaca* 71: 136-140.
- Stary J (2006) *Hoplobasis (Parilisia)* species related to *H. (P.) punctigera* (Lackschewitz, 1940) and *H. (P.) spinosa* (Nielsen, 1953) with the description of a new species (Diptera, Limoniidae). *Studia Dipterologica* 13: 115-125.
- Stary J, Oosterbroek P (2008) New records of West Palaearctic Limoniidae, Pediciidae and Cylindrotomidae (Diptera) from the collections of the Zoological Museum Amsterdam. *Zootaxa* 1922: 1-20. <https://doi.org/10.5281/zenodo.184739>
- Stary J (2009) West Palaearctic species of the genus *Eloephila* (Diptera: Limoniidae). *European Journal of Entomology* 106: 425-440. <https://doi.org/10.14411/eje.2009.054>
- Stary J (2011) Descriptions and records of the Palaearctic *Molophilus* Curtis (Diptera, Limoniidae). *Zootaxa* 2999: 45-62. <https://doi.org/10.11646/zootaxa.2999.1.5>
- Taybi AF, Mabrouki Y, Berrahou A, Dakki A, Millán A (2020) Longitudinal distribution of macroinvertebrate in a very wet North African basin: Oued Melloulou (Morocco). *International Journal of Limnology* 56 <https://doi.org/10.1051/limn/2020016>
- Taybi AF, Mabrouki Y, Keresztes L (2021) First record of *Phyllolabis savtshenkoi* (Diptera, Limoniidae) in Morocco. *Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa"* 64 (1): 115-118. <https://doi.org/10.3897/travaux.64.e63917>
- Taybi AF, Glöer P, Mabrouki Y (2022) Four new species of the genus *Pseudamnicola* Paulucci, 1878 from Morocco (Gastropoda, Hydrobiidae). *Invertebrates Zoology* 19 (2): 191-198. <https://doi.org/10.15298/invertzool.19.2.07>
- Thomas AG, Dia A (1982) Les antocha (imagos) du sud du Liban (Diptera, Limoniidae). *Annales de Limnologie* 18 (3): 319-326. <https://doi.org/10.1051/limn/1982007>
- Ujvárosi L (2005) Limoniidae and Pediciidae (Insecta. Diptera) assemblages along mountainous streams: additions to assess the biodiversity in wet habitats in Carpathians, Romania. *Acta Biologica Debrecina, Oecologica Hungarica* 13: 233-248.

- Vaillant F (1956) Research sur la fauna madicole (Hygroptérique s.l.) de France, de Corse et d'Afrique de Nord. Memoires du Museum National d'Histoire Naturelle, Serie A, Zoologie 11: 1-257.
- Vogtenhuber P (2007) Schnakenverwandte - tipuliformes - Diptera, Tipulimorpha. Erfassung der Biodiversität im Waldgebiet "Schnellert" (Gemeinde Berdorf). Ferrantia 50: 349-357.

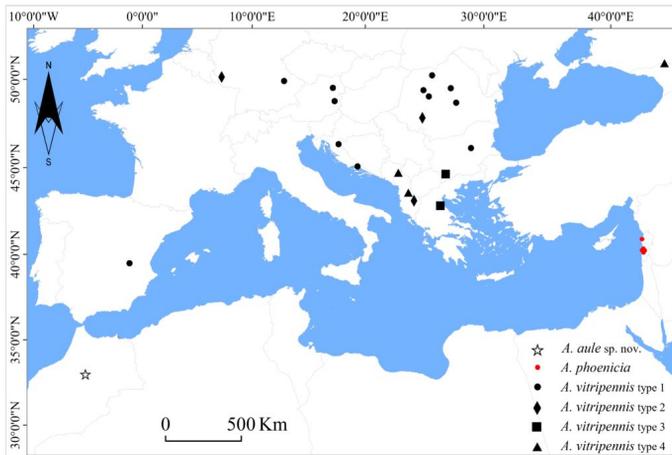


Figure 1.

Distribution data of *Antocha* (*Antocha*) included in the present investigation (more details can be found in Table 1).

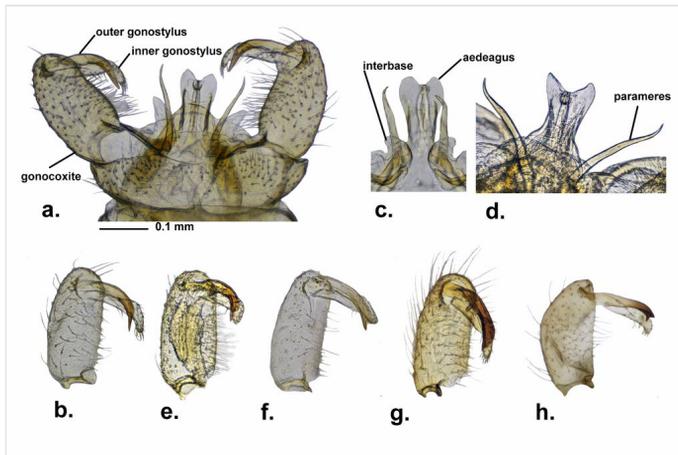


Figure 2.

Variability of the distal end of the outer gonostylus of the male genital structures of *Antocha* (*A.*) *vitripennis* from the Western Palearctic area: a. male terminalia, dorsal (Regensburg, Germany); b. gonopodium with outer gonostylus, type 1 (Germany); c. type 1, aedeagus with parallel parameres (Germany); d. type 1, aedeagus with divergent parameres (Austria); e. gonopodium with outer gonostylus, type 2 (Germany, Kassel); f. gonopodium with outer gonostylus, type 3 (Greece, Olympus); g. gonopodium with outer gonostylus, type 4 (Montenegro, Prokletje Mountains); h. gonopodium with outer gonostylus, special case of type 2 (Albania, Korce).

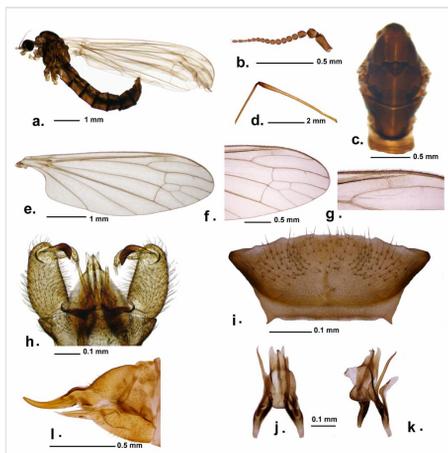


Figure 3.

Antocha (Antocha) aule sp. n. a. male habitus, lateral. b. antennae, c. thorax, dorsal, d. femur and part of tibiae, third left leg, e. right wing, f. tip of the right wing, g. stigma on the right wing, h. male hypopygium, dorsal, i. 9th tergite, dorsal, j. aedeagus with parameres, dorsal, k. aedeagus with parameres, lateral, l. female terminalia with cercus and hypovalvae.



Figure 4.

Different landscape elements of the Bakrit region, Middle Atlas, Morocco, showing the habitat of the *Antocha (Antocha) aule* n. sp. **a** general view of the area, **b** detail on the Oum Errabiâ River, **c** waterfall on the Oum Errabiâ River.

Table 1.

Sampling sites of the material of *Antocha* included in this study, with number on individual males, localities, coordinates, altitude and name of the collectors. Species (morpho-types) abbreviation: **AV-TYPE 1** – *Antocha* (*A.*) *vitripennis*, type 1; **AV-TYPE 2** – *Antocha* (*A.*) *vitripennis*, type 2; **AV-TYPE 3** – *Antocha* (*A.*) *vitripennis*, type 3; **AV-TYPE 4** – *Antocha* (*A.*) *vitripennis*, type 4; **AU-SP. N.** – *Antocha aule* sp. n.; **AP- LT** *Antocha* (*A.*) *phoenicia* –literature data

Species/ Type	Male	Country	Region	N	E	Data	Collectors
Av - type 1	25	Austria	Burgenland	47.373709°	16.010401°	19.06.2012	Graf, W.
Av - type 1	5	Austria	Vienna hills	48.136847°	16.098223°	15.06.2012	Graf, W.
Av - type 1	4	Bulgaria	Stara Planina	42.784125°	25.912326°	01.06.2013	Kolcsár, L-P, Török E.
Av - type 1	7	Croatia	NP Plitvicka Jezera	44.925833°	15.619167°	30.06.2008	Ivkovic, M.
Av - type 1	6	Croatia	Omiš Forests	43.437297°	16.757657°	19.07.2005	Ivkovic, M.
Av - type 1	2	Germany	Danube lowland	49.026846°	12.075860°	13.07.2013	Graf, W.
Av - type 1	22	Romania	Rodnei Mts.	47.423995°	24.548807°	26.07.2003	Keresztes, L.
Av - type 1	33	Romania	Harghita Mts.	46.412488°	25.745437°	15.07.2001	Keresztes, L.
Av - type 1	37	Romania	Ciucaș Mts.	45.534297°	25.836821°	21.07.2004	Keresztes, L.
Av - type 1	7	Romania	Trascaului Mts.	46.565262°	23.675828°	06.06.2001	Keresztes, L.
Av - type 1	8	Romania	Clujului Hills	46.755529°	23.509461°	24.08.2004	Keresztes, L.
Av - type 1	1	Spain	Serrania de Cuenca	39.503257°	(-)1.900691°	04.08.2009	Martinez, J.
Av - type 2	1	Albania	Korce	41.016258°	20.513618°	03.05.2019	Keresztes, L.
Av - type 2	12	Germany	Eifel hills	49.755204°	6.735459°	05.08.2007	Neu, P.
Av - type 2	6	Romania	Cerna Mts.	45.256819°	22.814289°	10.08.2004	Bálint, M.
Av - type 3	2	Bulgaria	Pirin Mts.	41.768952°	23.426897°	19.08.2003	Pauls, S.
Av - type 3	1	Greece	Olympus Mts.	40.079097°	22.373471°	14.07.2012	Rákosy, L.
Av - type 4	13	Albania	Domosdova Plain	41.075075°	20.498387°	01.05.2019	Keresztes, L.
Av - type 4	1	Georgia	North Caucasus	43.122052°	42.750700°	18.07.2012	Graf, W.
Av - type 4	5	Montenegro	Prokletje Mts.	42.550042°	19.825639°	02.05.2022	Dénes, A.
AU - SP. N.	3	Morocco	Middle Atlas Mts.	33.049438°	(-)5.272774°	16.05.2021	Mabrouki, Y.
AP- LT		Lebanon	Bassin du Nahr el Aouali	34.326082°	35.756127°	06.05.1981	Dia, A.
AP- LT		Lebanon	Bassin du Nahr el Aouali	34.326082°	35.756127°	11.09.1980	Dia, A.
AP- LT		Lebanon	Bassin du Nahr el Aouali	33.574301°	35.497644°	14.05.1981	Dia, A.
AP- LT		Lebanon	Bassin du Nahr el Aouali	33.652399°	35.626759°	08.05.1981	Dia, A.
AP- LT		Lebanon	Bassin du Nahr ed Damour	33.725225°	35.564452°	20.04.1981	Dia, A.

AP- LT		Lebanon	Bassin du Nahr ed Damour	33.729448°	35.456613°	24.04.1981	Dia, A.
AP- LT		Lebanon	Bassin du Nahr ed Damour	33.784041°	35.592527°	20.04.1981	Dia, A.