
МАТИЦА СРПСКА
1826

МАТИЦА СРПСКА
ОДЕЉЕЊЕ ЗА ПРИРОДНЕ НАУКЕ
ЗБОРНИК
МАТИЦЕ СРПСКЕ ЗА ПРИРОДНЕ НАУКЕ

MATICA SRPSKA
DEPARTMENT OF NATURAL SCIENCES
MATICA SRPSKA J. NAT. SCI.

Покренут 1951 / First published in 1951.

Until volume 10, the journal was published under the title *Научни зборник Матице српске: Серија природних наука* (Scientific Proceedings of Matica Srpska: Natural Sciences Series) (1951–1955). Volume 11 was released under the title *Зборник Матице српске: Серија природних наука* (Matica Srpska Proceedings: Natural Sciences Series) (1956), volumes 12–65 under the title *Зборник за природне науке* (Proceedings for Natural Sciences) (1957–1983), and from volume 66 the journal was published under the title *Зборник Матице српске за природне науке* (Matica Srpska Proceedings for Natural Sciences) (1984–). From volume 84 (1993) the journal was published in English under the title *Matica Srpska Proceedings for Natural Sciences* (1993–2012), and since volume 125 under the title *Matica Srpska Journal for Natural Sciences* (2013–)

146

Articales are available in full-text at the web site of Matica Srpska, Serbian Citation Index, CABI, EBSCO, Web of Science Master Journal List, AGRIS FAO (abstracts)

YU ISSN 0352-4906 UDK 5/6 (05)

MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES

146
(1/2024)

NOVI SAD
2024

CONTENTS / САДРЖАЈ

ARTICLES AND TREATISES / ЧЛАНЦИ И РАСПРАВЕ

Зборник Матице српске за природне науке / Matica Srpska J. Nat. Sci. № 146, 7—71, 2024

UDC 595.773.1(497.11)
https://doi.org/10.2298/ZMSPN2446007J
ORIGINAL ARTICLE
Received: 30. 1. 2024.
Accepted: 20. 2. 2024.

Marina A. JANKOVIĆ-MILOSAVLJEVIĆ[1*], *Tamara J. TOT*[1], *Marija S. MILIČIĆ*,[2] *Snežana D. POPOV*[1], *Snežana R. RADENKOVIĆ*[1], *Ante A. VUJIĆ*[1]

[1] University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, Novi Sad 21000, Serbia
[2] University of Novi Sad, Biosense Institute – Research Institute for Information Technologies in Biosystems, Dr Zorana Đinđića 1, Novi Sad 21000, Serbia

HOVERFLY FAUNA (DIPTERA: SYRPHIDAE) OF THE EASTERN PART OF SERBIA

ABSTRACT: One of the largest families of the order Diptera – hoverflies, are at the same time one of the most prominent insect groups, being recognized as the second most important pollinator group, bioindicator species, as well as potential biocontrol agents. Thus, raising interest in their distribution, biology and ecology is not surprising. As a contribution to the process of systematizing knowledge on these species, in this paper there are presented details on the fauna of hoverflies of the eastern part of Serbia. It was done by incorporating information on so far published findings, older, but unpublished records, as well as records collected in recent field trips across 109 localities in Eastern Serbia, all in one place. The most significant findings are *Cheilosia subpictipennis* Claussen, 1998 and *Paragus kopdagensis* Hayat & Claussen, 1997, published for the first time for Serbia, and 105 species registered for Eastern Serbia for the first time. Additionally, one potentially new hoverfly species for science is registered: *Paragus* aff. *testaceus*.

KEYWORDS: faunistics, hoverflies, insects, pollinators, species distribution

INTRODUCTION

Hoverflies comprise one of the largest families of the true flies, with more than 6,200 species known so far (Evenhuis and Pape, 2021). They hold a great promise for providing dual ecosystem services (Doyle et al., 2020; Dunn et al.,

* Corresponding author. E-mail: marinaj@dbe.uns.ac.rs

2020; Wotton et al., 2019), because of different resource requirements at larval and adult stage. Adult hoverflies play a vital role in the pollen transmission of over 70% of wildflowers (Doyle et al., 2020; Inouye et al., 2015). Their widespread distribution, availability of adequate taxonomic keys for species identification, and heterogeneity of the environmental requirements of the larvae are features that promote hoverflies into potentially good bioindicators of different ecosystem conditions and processes (Sommaggio, 1999; Sommaggio and Burgio, 2014; Popov et al., 2017). Hoverflies represent suitable organisms for studying various negative effects on biodiversity, such as agriculture intensification, because they are particularly mobile (Gao et al., 2020) and are strongly affected by the standardization in the landscape structures (Dormann et al., 2007).

There is over 60 years of tradition in hoverflies research in Serbia. Due to such dedication, fauna of most regions of Serbia is well known. Some areas, mostly mountainous, have been systematically sampled over the years and faunas of these regions have been published (Miličić et al., 2018a; Nedeljković et al., 2009; Radenković et al., 2004; Šimić and Vujić, 1996; Šimić et al., 2008; Tot et al., 2018; Vujić and Glumac, 1994; Vujić and Šimić, 1994; Vujić et al., 1998, 2002; van Steenis et al., 2015). However, some gaps have been identified (Janković et al., 2020), as there are areas which still have not been a subject of targeted faunistic research.

Geomorphological, geological and pedological diversity present in the Serbian territory, as well as the influence of different climates caused the wealth of species and ecosystem diversity (Matejić et al., 2020). Landscape heterogeneity is a habitual feature in the Balkan Peninsula, especially in the eastern Serbia, which has always attracted attention because of its vast diversity of landforms and species (Lopatin and Matvejev, 1995; Savić, 2008). This part of Serbia is a hilly-mountainous area with a moderate continental steppe climate (Jakšić, 2008; Savić, 2008). The largest geological mass of the Balkan mountain system in the region is the western part of the Stara Planina Mountain, in addition to many other mountains surrounding it (Vlah Mountain, Ozren Mountain and Rtanj Mountain). The western Stara Planina Mountains are an extension of the Carpathian mountain range and stretches in north-south direction, east of the Morava valley (Stojanović et al., 2017). Limestone gorges and canyons of the eastern Serbia are classified as one of the most significant centres of floristic diversity in Serbia (Stevanović et al., 1995). The gorges and canyons play the role of refugia and therefore have a great richness, originality and antiquity of their floras (Mišić, 1981). Western Stara planina Mountains are placed under strict protection as having "natural merit of first class". Moreover, 11 natural reserves are present in the region as well (Stojanović et al., 2017).

Due to devastating anthropogenic effects on the environment, the majority of ecological research is focusing on investigation of how species cope with different pressures such as habitat fragmentation and degradation, agriculture intensification and climate change. Important and complex results stem from these studies. Faunistic research represents the starting point for obtaining such results.

The aim of this study was to give a comprehensive checklist of hoverflies of the eastern Serbia, in order to contribute to the knowledge of hoverfly fauna of Serbia and overcome identified survey gaps.

MATERIAL AND METHODS

Sampling of hoverfly fauna was conducted on 107 localities (Table 1). Records from new field surveys which were carried out for four years (2017–2019, 2022), as well as unpublished records from previous years were included. Sites were surveyed by transect walks, length of approximately 1 km, during sunny days with little or no wind. Specimens were collected by sweeping net, appropriately prepared, pinned and labelled. In total, more than 8,000 specimens of 284 species were recorded. The entire material is deposited in the entomological collection of the Department of Biology and Ecology, University of Novi Sad, Serbia (FSUNS). Identification of adults based on external morphological features and male terminalia was conducted using a Nikon SMZ 745T stereomicroscope. Identification keys and publications were used as follows: Dušek and Láska (1976), Hippa et al. (2001), Mengual et al. (2015), Nedeljković (2011), Nedeljković et al. (2015), Radenković (1999), Radenković et al. (1995), Reemer et al. (2005), Speight and Sarthou (2017), van Steenis (2000), van Steenis and Lucas (2011), van Veen (2004), Vujić (1990, 1992, 1999a, b), Vujić and Milankov (1999), Vujić and Šimić (1995–1998), and Vujić et al. (2013). Genus and species names in this study follow Speight (2020).

Table 1. List of sampling localities

Nearest place	Locality	Latitude	Longitude
Besna kobila	Klisurica	42.57714	22.10259
Besna kobila	Kriva Feja	42.56880	22.17022
Besna kobila	Planinarski dom	42.54427	22.18993
Besna kobila	Planinarski dom 2	42.54055	22.19742
Besna kobila	Planinarski dom 3	42.53494	22.19742
Besna kobila	Planinarski dom 4	42.52423	22.20244
Dubašnica-Malinik	Adamov potok	44.01845	21.88944
Dubašnica-Malinik	Beljevina	44.08510	21.93920
Dubašnica-Malinik	Borsko jezero – Savača	44.09399	22.00878
Dubašnica-Malinik	Brestovačka banja	44.06032	22.04291
Dubašnica-Malinik	bukova šuma	43.98518	21.73012
Dubašnica-Malinik	Demižlok	44.01545	21.88708
Dubašnica-Malinik	Dubašnica	44.02493	21.83046
Dubašnica-Malinik	Dubašnica – lovište	44.07687	21.89084
Dubašnica-Malinik	Dubašnica 1	44.08070	21.88500
Dubašnica-Malinik	Dubašnica 2	44.08516	21.88539
Dubašnica-Malinik	Dubašnica 3	44.10989	21.89700

Dubašnica-Malinik	Dubašnica Lunga	44.01432	21.89387
Dubašnica-Malinik	Jablanica	43.83469	21.87621
Dubašnica-Malinik	ka Maliniku	44.00846	21.97796
Dubašnica-Malinik	klisura Lazareve reke	44.02808	21.95935
Dubašnica-Malinik	klisura Lazareve reke – vidikovac	44.02867	21.95318
Dubašnica-Malinik	Malinik	44.00106	21.90207
Dubašnica-Malinik	Malinik – bukova šuma	44.00713	21.95433
Dubašnica-Malinik	Malinik – put	43.99154	21.89966
Dubašnica-Malinik	Manastirište	44.01599	21.97761
Dubašnica-Malinik	Mikuljska reka	44.01796	21.90593
Dubašnica-Malinik	Podgorac	43.94384	21.94052
Dubašnica-Malinik	Predsednička vila	44.08028	21.88719
Dubašnica-Malinik	Prerast	44.11912	21.89863
Dubašnica-Malinik	uspon na Malinik	44.01515	21.94462
Dubašnica-Malinik	Valja Mare	44.03851	21.91934
Dubašnica-Malinik	Vojala	44.05645	21.84767
Dubašnica-Malinik	Zlot	44.01232	21.98203
Kučajske planine	Crnica – kanjon	43.95557	21.56535
Kučajske planine	Crnica – vlažne livade	43.95613	21.58886
Kučajske planine	Crnica reka	43.95647	21.56423
Kučajske planine	Papratno	43.95682	21.60598
Kučajske planine	Papratno – B. AP.	43.96049	21.61675
Kučajske planine	Papratno – bukova šuma	43.94630	21.59966
Kučajske planine	Papratno – mala kaptaža	43.97778	21.54952
Kučajske planine	Papratno – potok	43.97085	21.62112
Kučajske planine	Požare	43.94840	21.60313
Kučajske planine	Sisevac	43.95316	21.60281
Kučajske planine	Sisevac – livada	43.96550	21.60153
Kučajske planine	Sisevac – mala kaptaža	43.95561	21.60234
Kučajske planine	Sisevac – potok	43.94814	21.61042
Stara planina	Arbinje	43.32322	22.80572
Stara planina	Babin zub	43.36872	22.61543
Stara planina	Barska livada	43.26686	22.55925
Stara planina	Crni vrh	43.73743	22.36081
Stara planina	Crni vrh 1	43.73677	22.35687
Stara planina	Čukljenik	43.27535	22.07019
Stara planina	Dojkinačka reka	43.24389	22.77694
Stara planina	Dojkinačka reka – Arbinje	43.30397	22.78317
Stara planina	Dojkinačka reka 1	43.22028	22.80947
Stara planina	Dojkinačka reka 2	43.22401	22.79850
Stara planina	Dojkinačka reka 3	43.22799	22.79062
Stara planina	Dojkinci	43.28600	22.76500
Stara planina	Dojkinci – Arbinje	43.25331	22.77189
Stara planina	Dojkinci 1	43.23245	22.78149
Stara planina	Dojkinci 2	43.25002	22.77669

Stara planina	Golema reka	43.36844	22.62854
Stara planina	iznad Arbinja	43.28903	22.74014
Stara planina	iznad Toplog Dola	43.31380	22.63771
Stara planina	Kalna	43.41015	22.43009
Stara planina	Mala Lukanja	43.23587	22.69318
Stara planina	Midžor	43.39490	22.68341
Stara planina	Pilj	43.36058	22.67825
Stara planina	Planinica	43.83682	22.12349
Stara planina	put ka Babinom zubu	43.38278	22.60924
Stara planina	Rekitska reka	43.38268	22.70053
Stara planina	Rsovci	43.17152	22.77981
Stara planina	Ržana – Dojkinci	43.17482	22.82812
Stara planina	sliv reke Temske	43.26845	22.56018
Stara planina	sliv Rekitske reke	43.37136	22.64419
Stara planina	sliv Toplodolske reke	42.60666	22.35804
Stara planina	spomenik	43.26778	22.56150
Stara planina	Temska	43.25995	22.55247
Stara planina	Temska – Topli Do	43.29039	22.59588
Stara planina	Temštica	43.16925	22.79391
Stara planina	Topli Do	43.33936	22.68821
Stara planina	Topli Do-Pilj	43.35191	22.68088
Stara planina	Topli Do-Pilj 1	43.34919	22.67947
Stara planina	Topli Do-Pilj 2	43.34005	22.68481
Stara planina	Topli Do-Pilj 3	43.34236	22.69245
Stara planina	Topli Do-Pilj 4	43.33759	22.67305
Stara planina	Žarkova čuka	43.38300	22.63300
Stara planina	Zavojsko jezero	43.24430	22.65672
Stara planina	Živadinov dol	43.17145	22.93312
Suva planina	Bancarevo	43.17160	22.06360
Suva planina	Bojanine vode	43.22601	22.10678
Suva planina	Crni vrh	43.40123	22.60740
Suva planina	Čukljenik	43.27222	22.07361
Suva planina	Čukljenik – Donja Studena	43.26912	22.08885
Suva planina	Čukljenik – Gornja Studena	43.24119	22.11121
Suva planina	Gornja Studena	43.24978	22.10505
Suva planina	Gornja Studena – Bojanine vode	43.22118	22.11322
Suva planina	ispred Čukljenika	43.27601	22.07824
Suva planina	Jelašnica	43.28884	22.06892
Suva planina	Jelašnica – Donja Studena	43.28490	22.06199
Suva planina	Jelašnica – Kunovica	43.29769	22.07089
Suva planina	Jelašnička klisura	43.25335	22.07014
Suva planina	Kunovica	43.29971	22.10346
Suva planina	Sićevačka klisura	43.32710	22.11367
Svrljiške planine	Sićevački potok	43.34219	22.07455

RESULTS

Species findings:

Baccha elongata (Fabricius, 1794)

Dubašnica-Malinik: Demižlok, 31.04.1989, 2 ♂♂, 1 ♀, leg. A. Vujić, 12.06.1994, 1 ♂, leg. V. Milankov; Dubašnica-Malinik: klisura Lazareve reke, 06.07.1985, 1 ♂, 1 ♀, leg. A. Vujić, 12.07.1985, 1 ♂, 1 ♀, leg. A. Vujić, 13.05.1994, 1 ♂, leg. S. Radenković, 29.04.1997, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: Manastirište, 17.06.1997, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08.1994, 3 ♂♂, leg. A. Vujić, S. Šimić; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno, 26.07.1986, 2 ♂♂, leg. A. Vujić, 27.07.1986, 2 ♀♀, leg. A. Vujić; Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 28.05.1987, 1 ♂, leg. A. Vujić; Suva planina: Jelašnica, 02.05.1988, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Brachyopa bicolor (Fallén, 1817)

Dubašnica-Malinik: Demižlok, 14.05.1994, 7 ♂♂, leg. A. Vujić, D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 03.05.1996, 2 ♂♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1991.

Brachyopa dorsata Zetterstedt, 1837

Published material: Šimić and Vujić, 1996; Vujić, 1991.

Brachyopa insensilis (Collin, 1939)

Besna kobila: Planinarski dom, 03.05.2011, 2 ♂♂, leg. A. Vujić; Dubašnica--Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić, 20.05.1996, 1 ♂, leg. A. Vujić, 12.06.1996, 1 ♂, leg. V. Milankov; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. D. Radnović, 30.04.2008, 1 ♂, leg. P. Radišić.

Brachyopa maculipennis Thompson, 1980

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić, 19.05.1996, 2 ♂♂, leg. A. Vujić, 07.06.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 31.04.1989, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 1, 01.05.2017, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1991.

Brachyopa panzeri Goffe, 1945

Dubašnica-Malinik: klisura Lazareve reke, 31.04.1989, 1 ♂, leg. A. Vujić, 15.05.1993, 1 ♂, leg. A. Vujić.

Brachyopa pilosa Collin, 1939

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić, 12.06.1994, 1 ♀, leg. S. Radnović, 19.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić.

Brachyopa plena Collin, 1939

Published material: Vujić, 1991.

Brachyopa testacea (Fallén, 1817)

Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♀, leg. A. Vujić.

Brachyopa vittata Zetterstedt, 1843

Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić.

Brachypalpoides lentus (Meigen, 1822)

Dubašnica-Malinik: klisura Lazareve reke, 21.05.1996, 2 ♂♂, leg. A. Vujić.

Brachypalpus chrysites Egger, 1859

Dubašnica-Malinik: klisura Lazareve reke, 1 ♂, 01.04.1994, leg. A. Vujić.

Published material: Vujić and Radović, 1990.

Brachypalpus laphriformis (Fallén, 1816)

Stara planina: Dojkinci 2, 19.06.2017, 2 ♂♂, leg. A. Vujić.

Brachypalpus valgus (Panzer, 1798)

Besna kobila: Planinarski dom, 03.05.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 04.05.1996, 1 ♂, leg. S. Radenković; Dubašnica-Malinik: Dubašnica Lunga, 05.05.1996, 2 ♂♂, leg. P. Radišić, 21.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 01.04.1994, 1 ♂, leg. A. Vujić, 23.04.1996, 1 ♀, leg. A. Vujić, 19.04.1997, 2 ♀♀, leg. A. Vujić, 29.04.1997, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić and Radović, 1990.

Callicera aurata (Rossi, 1790)

Dubašnica-Malinik: ka Maliniku, 27.08.2022, 1 ♀, leg. T. Tot.

Caliprobola speciosa (Rossi, 1790)

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♂, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 2 ♂♂, 2 ♀♀, leg. A. Vujić.

Ceriana conopsoides (Linnaeus, 1758)

Dubašnica-Malinik: klisura Lazareve reke, 05.06.1989, 1 ♀, leg. A. Vujić, 30.06.1989, 1 ♀, leg. A. Vujić; Stara planina: Kalna, 31.05.1998, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 20.07.2017, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Chalcosyrphus eunotus (Loew, 1783)

Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 15.05.1994, 1 ♂, leg. D. Radnović.

Chalcosyrphus nemorum (Fabricius, 1805)

Dubašnica-Malinik: Dubašnica Lunga, 21.05.1996, 1 ♂, leg. A. Vujić, 02.06.1996, 1 ♂, leg. A. Vujić.

Published material: Milankov et al., 1995; Vujić and Milankov, 1999.

Chalcosyrphus valgus (Gmelin, 1790)

Published material: Vujić and Milankov, 1999.

Cheilosia aerea Dufour, 1848

Besna kobila: Klisurica, 02.05.2017, 1 ♀, leg. A. Vujić; Besna kobila: Planinarski dom, 02.05.2017, 2 ♂♂, leg. B. Ivošević, M. Miličić, 18.07.2017, 1 ♀, leg. A. Vujić, 19.07.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 07.05.1997, 4 ♂♂, leg. P. Radišić, 19.05.1996, 1 ♀, leg. A. Vujić, 01.07.1998, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 01.07.1998, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 19 ♂♂, leg. A. Vujić, S. Radenković, 03.05.1996, 3 ♂♂, 1 ♀, leg. A. Vujić, 21.05.1996, 2 ♂♂, leg. A. Vujić, 21.07.1997,

1 ♂, 2 ♀♀, leg. A. Vujić, 21.08.1997, 1 ♂, leg. A. Vujić, 05.05.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 18.05.1996, 1 ♂, leg. A. Vujić, 17.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.05.1996, 1 ♂, leg. S. Radenković, 21.05.1996, 1 ♂, leg. N. Dožić, 07.06. 1997, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: Podgorac, 02.06.1996, 4 ♂♂, leg. A. Vujić, S. Radenković; Stara planina: Dojkinci, 20.06.2012, 2 ♂♂, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 2 ♂♂, leg. A. Vujić; Stara planina: iznad Toplog Dola, 20.07.2017, 2 ♀♀, leg. A. Vujić; Stara planina: Topli Do, 20.07.2017, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Cheilosia zetterstedti* Becker, 1894); Vujić, 1996.

Cheilosia albipila Meigen, 1838

Dubašnica-Malinik: Demižlok, 30.04.1995, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 3 ♂♂, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Dubašnica Lunga, 05.05.1996, 4 ♂♂, leg. A. Vujić, 21.05.1996, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 23.04.1996, 4 ♂♂, leg. A. Vujić, 03.05.1996, 1 ♀, leg. A. Vujić, 19.04.1997, 1 ♂, leg. D. Radnović.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia albitarsis (Meigen, 1822)

Dubašnica-Malinik: Demižlok, 04.06.1995, 3 ♀♀, leg. A. Vujić, 20.05.1996, 2 ♂♂, leg. A. Vujić, 07.06.1996, 1 ♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♂, leg. B. Ivošević, M. Miličić, 20.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot, Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 02.06.1996, 5 ♂♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 2 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić; Dubašnica-Malinik: klisura Lazareve reke, 03.05.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Predsednička vila, 24.05.2013, 2 ♂♂, leg. A. Vujić, L. Likov, M. Miličić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 5 ♀♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, 6 ♀♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Temštica, 11.07.2011, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia antiqua (Meigen, 1822)

Dubašnica-Malinik: klisura Lazareve reke, 03.05.1996, 1 ♂, leg. A. Vujić;

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia barbata Loew, 1857

Besna kobila: Planinarski dom, 20.05.2017, 3 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 19.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 2 ♂♂, leg. A. Vujić; Stara planina: Temštica, 11.07.2011, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♂, leg. T. Tot.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia bracusi Vujić & Claussen, 1994

Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 05.05.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 02.06.2013, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 1, 01.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Stara planina: Dojkinci 2, 01.05.2017, 4 ♂♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996; Vujić and Claussen, 1994.

Cheilosia brunnipennis (Becker, 1894)

Dubašnica-Malinik: Demižlok, 30.04.1995, 1 ♀, leg. S. Radenković, 04.05.1996, 1 ♀, leg. M. Radišić; Dubašnica-Malinik: klisura Lazareve reke, 03.05.1994, 1 ♀, leg. A. Vujić, 29.04.1995, 3 ♂♂, 2 ♀♀, leg. A. Vujić, 23.04.1996, 1 ♂, 1 ♀, leg. A. Vujić, 02.05.1996, 1 ♀, leg. S. Radenković, 19.04.1997, 2 ♀♀, leg. A. Vujić, P. Radišić, 29.04.1997, 1 ♀, leg. A. Vujić, 20.06.1997, 2 ♀♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 25.04.1996, 2 ♂♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996; Vujić and Šikoparija, 2001.

Cheilosia canicularis (Panzer, 1801)

Stara planina: iznad Arbinja, 26.08.2013, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996; Vujić and Šikoparija, 2001.

Cheilosia carbonaria Egger, 1860

Stara planina: Arbinje, 20.06.2012, 3 ♂♂, leg. A. Vujić.

Cheilosia chrysocoma (Zetterstedt, 1843)

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia cumanica Szilády, 1938

Dubašnica-Malinik: Demižlok, 30.04.1995, 3 ♂♂, leg. A. Vujić, 23.08.1995, 1 ♂, leg. A. Vujić, 17.05.1996, 1 ♂, leg. A. Vujić, 07.06.1997, 1 ♂, leg. A. Vujić, 01.07.1998, 2 ♂♂, leg. A. Vujić, 23.06.2012, 1 ♀, leg. A. Vujić, 22.07.2017, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 3 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 01.07.1998, 3 ♂♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 1 ♂, 2 ♀♀, leg. A. Vujić, 21.06.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 3 ♂♂, leg. A. Vujić, 22.08.1995, 1 ♀, leg. A. Vujić, 24.08.1995, 1 ♂, leg. A. Vujić, 23.04.1996, 3 ♂♂, leg. A. Vujić, 03.05.1996, 7 ♂♂, leg. A. Vujić, 21.05.1996, 3 ♂♂, 1 ♀, leg. A. Vujić, 01.06.1996, 1 ♀, leg. A. Vujić, 19.04.1997, 28 ♂♂, 1 ♀, leg. A. Vujić, R. Mićić, P. Radišić, D. Radnović, 29.04.1997, 5 ♂♂, leg. A. Vujić, 20.05.1997, 3 ♂♂, leg. A. Vujić, 25.07.1997, 5 ♂♂, 1 ♀, leg. A. Vujić, 21.08.1997, 1 ♂, leg. A. Vujić, 19.09.1997, 1 ♂, leg. A. Vujić, 05.05.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.1996, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 29.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♂, leg. S. Radenković.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia cynocephala Loew, 1840

Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 21.08.1997, 1 ♀, leg. A. Vujić, 19.09.1997, 2 ♀♀, leg. A. Vujić.

Published material: Vujić, 1996.

Cheilosia fasciata Schiner & Egger, 1853

Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 05.05.1996, 1 ♂, 2 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia flavipes (Panzer, 1798)

Besna kobila: Planinarski dom 2, 03.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Brestovačka banja, 04.05.1996, 1 ♀, leg. M. Radišić; Dubašnica-Malinik: Demižlok, 30.04.1995, 3 ♂♂, 1 ♀, leg. A. Vujić, S. Radenković, P. Radišić, 04.05.1996, 1 ♀, leg. A. Vujić, 19.05.1996, 2 ♂♂, 2 ♀♀, leg. N. Dožić; Dubašnica-Malinik: Dubašnica 3, 28.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. S. Radenković, 03.05.1996, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia frontalis Loew, 1857

Besna kobila: Planinarski dom, 03.05.2017, 14 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić; Besna kobila: Planinarski dom 2, 1 ♂, 2 ♀♀, leg. B. Ivošević, M. Miličić; Besna kobila: Planinarski dom 3, 03.05.2017, 2 ♂♂, 2 ♀♀, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: Dojkinci 2, 01.05.2017, 4 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić.

Published material: Šimić and Vujić, 1996.

Cheilosia gagatea Loew, 1857

Published material: Vujić and Radenković, 1996.

Cheilosia gigantea (Zetterstedt, 1838)

Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♀, leg. A. Vujić, 07.06.1997, 2 ♀♀, leg. M. Radišić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 3, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 1 ♂, 21.05.1996, V. Milankov; Stara planina: Babin zub, 21.06.2012, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia grossa (Fallén, 1817)

Dubašnica-Malinik: Dubašnica Lunga, 1 ♀, leg. S. Radenković; Dubašnica-Malinik: klisura Lazareve reke, 13.04.1996, 1 ♂, leg. P. Radišić, 23.04.1996, 3 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 23.04.1996, 4 ♀♀, leg. A. Vujić, R. Mićić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia herculana Brădescu, 1982

Besna kobila: Kriva Feja, 12.09.2020, 1 ♀, leg. A. Vujić, L. Likov, M. Ranković, T. Tot.

Cheilosia himantopus (Panzer, 1798)

Dubašnica-Malinik: Demižlok, 08.06.2011, 1 ♀, leg. A. Vujić; Dubašnica, Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 28.04.2022, 1 ♂, leg. T. Tot; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić.

Published material: Vujić, 1996; Vujić and Šikoparija, 2001.

Cheilosia hypena Becker, 1894

Besna kobila: Kriva Feja, 02.05.2017, 4 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 19.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 20.06.2017, 1 ♂, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 18.05. 1996, 4 ♀♀, leg. N. Dožić, 03.05.2012, 2 ♂♂, 10 ♀♀, leg. A. Vujić; Dubašnica--Malinik: klisura Lazareve reke, 29.04.1995, 4 ♂♂, leg. A. Vujić, 04.05.2012, 2 ♂♂, leg. A. Vujić, 27.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 30.04.2011, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 29.04.2017, 1 ♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 2 ♂♂, leg. A. Vujić.

Published material: Vujić, 1996.

Cheilosia illustrata Harris, 1780

Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. S. Radenković; Stara planina: Dojkinačka reka – Arbinje, 02.07.2012, 1 ♂, leg. P. Radišić.

Published material: Vujić, 1996.

Cheilosia impressa (Loew, 1840)

Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: Demižlok, 07.06.1997, 1 ♂, leg. M. Radišić, 23.06.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 02.06.1996, 1 ♂, leg. M. Živković; Dubašnica-Malinik: klisura Lazareve reke, 11.06.1994, 1 ♂, leg. V. Milankov; Dubašnica-Malinik: Predsednička vila, 24.05.2013, 1 ♂, leg. A. Vujić, L. Likov, M. Miličić; Stara planina: Babin zub, 21.06.2012, 1 ♂, 2 ♀♀, leg. A. Vujić, J. Ačanski, L. Likov, J. Stepanov, 24.08.2013, 2 ♀♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinci, 20.06.2012, 4 ♂♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. A. Vujić; Stara planina: iznad Arbinja, 26.08.2013, 2 ♂♂, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♂, leg. T. Tot.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia insignis Loew, 1857

Dubašnica-Malinik: Demižlok, 30.04.1995, 1 ♂, 2 ♀♀, leg. A. Vujić, 04.05. 1996, 2 ♀♀, leg. A. Vujić, 20.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik: 29.04.2017, 1 ♂, 2 ♀♀, leg. B. Ivošević, M. Miličić.

Published material: Vujić and Radenković, 1996.

Cheilosia laticornis Rondani, 1857

Dubašnica-Malinik: Demižlok, 23.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Babin zub, 09.07.2011, 1 ♀, leg. A. Vujić.

Cheilosia latifrons (Zetterstedt, 1843)

Suva planina: Kunovica, 25.04.1996, 2 ♀♀, leg. A. Vujić.

Cheilosia lenis Becker, 1894

Stara planina: Arbinje, 20.06.2012, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić.

Published material: Šimić and Vujić, 1996; Vujić, 1996; Vujić et al., 1993/1994.

Cheilosia lenta (Becker, 1894)

Besna kobila: Planinarski dom 2, 03.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: spomenik, 1 ♀, 30.04.1987, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić et al., 1993/1994.

Cheilosia longula (Zetterstedt, 1838)

Besna kobila: Planinarski dom, 18.07.2017, 1 ♂, leg. A. Vujić, 19.07.2017, 1 ♀, leg. A. Vujić.

Cheilosia melanura (Becker, 1894)

Besna kobila: Planinarski dom 2, 03.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 30.04.1995, 1 ♂, leg. A. Vujić, 04.05. 1996, 2 ♂♂, leg. A. Vujić, S. Radenković.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia mutabilis (Fallén, 1817)

Dubašnica-Malinik: Demižlok, 04.06.1995, 7 ♂♂, leg. A. Vujić, S. Radenković, 07.06.1997, 3 ♂♂, 3 ♀♀, leg. M. Radišić, P. Radišić; Dubašnica--Malinik: klisura Lazareve reke, 29.04.1995, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, 1 ♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot.

Published material: Vujić, 1996.

Cheilosia nebulosa (Verrall, 1871)

Dubašnica-Malinik: klisura Lazareve reke, 19.04.1997, leg. P. Radišić; Dubašnica-Malinik: Manastirište, 23.04.1996, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 30.04.2022, 1 ♀, leg. T. Tot.

Published material: Vujić, 1996.

Cheilosia nigripes (Meigen, 1822)

Dubašnica-Malinik: Demižlok, 20.05.1996, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 02.06.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 04.05.2012, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 18.05.1996, 1 ♂, leg. A. Vujić; Stara planina: Babin zub, 21.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 6 ♂♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 02.06.2013, 2 ♂♂, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Stara planina: Topli Do, 30.04. 2022, 1 ♂, leg. T. Tot.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia orthotricha Vujić & Claussen, 1994

Published material: Šimić and Vujić, 1996; Vujić, 1996, Vujić and Claussen, 1994, Vujić and Šikoparija, 2001.

Cheilosia pagana (Meigen, 1822)

Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, 1 ♀, leg. B. Ivošević, M. Miličić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: Topli Do, 28.08.2022, 1 ♂, leg. T. Tot; Suva planina: Kunovica, 25.04.1996, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia pascuorum Becker, 1894

Besna kobila: Klisurica, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 14.05.1994, 3 ♂♂, leg. V. Milankov, S. Radenković, 20.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 15.05.1994, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 03.05.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, leg. D. Radnović.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia personata Loew, 1857

Stara planina: Dojkinci 2, 19.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia proxima (Zetterstedt, 1843)

Dubašnica-Malinik: Demižlok, 19.05.1997, 1 ♂, leg. A. Vujić, 01.07.1998, 4 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 01.07.1998, 2 ♂♂, leg. A. Vujić, 02.07.1988, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♀, leg. A. Vujić, 03.05.1995, 2 ♂♂, leg. A. Vujić, 23.04.1996, 3 ♂♂, leg. A. Vujić, 21.05.1996, 3 ♂♂, leg. A. Vujić, 14.07.1997, 1 ♂, leg. A. Vujić, 09.06.2022, 1 ♂, leg. T. Tot; Dubašnica-Malinik: Podgorac, 02.06.1996, S. Radenković; Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♂, leg. T. Tot.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia psilophthalma (Becker, 1894)

Dubašnica-Malinik: Demižlok, 30.04.1995, 1 ♂, leg. A. Vujić, 23.04.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 23.04.1996, 1 ♂, leg. A. Vujić.

Published material: Vujić, 1996.

Cheilosia pubera (Zetterstedt, 1838)

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia ranunculi Doczkal, 2000

Besna kobila: Klisurica, 02.05.2017, 1 ♂, leg. A. Vujić; Besna kobila: Kriva Feja, 02.05.2017, 1 ♂, leg. A. Vujić; Besna kobila: Planinarski dom, 02.05.2017, 2 ♂♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♂, 2 ♀♀, leg. A. Vujić, S. Radenković, 19.05.1996, 1 ♂, leg. N. Dožić, 07.06.1996, 4 ♂♂, 1 ♀, leg. A. Vujić, M. Radišić, P. Radišić; Dubašnica-Malinik: Dubašnica Lunga, 02.06.1996, 1 ♂, leg. A. Vujić, 03.06.1996, 1 ♀, leg. S. Radenković; Dubašnica-Malinik: klisura Lazareve reke, 03.05.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♀, leg. S. Radenković,

03.05.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Podgorac, 02.06.1996, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 1, 01.05.2017, 4 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: Temska, 30.04.2022, 1 ♂, leg. T. Tot; Stara planina: Topli Do, 10.06.2022, 8 ♀♀, leg. T. Tot.

Published material: Vujić, 1996 (as *Cheilosia* aff. *albitarsis*).

Cheilosia redi Vujić, 1996

Besna kobila: Planinarski dom, 02.05.2017, 2 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 19.05.1996, 2 ♂♂, leg. A. Vujić, 07.06.1996, 4 ♀♀, leg. A. Vujić, P. Radišić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 01.05.1995, 1 ♂, leg. S. Radenković, 18.05.1996, 2 ♂♂, leg. A. Vujić; Dubašnica--Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. A. Vujić, 20.04.1997, 1 ♂, leg. A. Vujić, 29.04.1997, 1 ♂, leg. A. Vujić, 04.05.2012, 3 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 21.05.1996, 1 ♀, leg. A. Tepavčević, 07.06. 1997, 1 ♀, leg. P. Radišić, 30.04.2011, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Cheilosia melanopa* (Zetterstedt, 1843)); Vujić, 1996.

Cheilosia rhynchops Egger, 1860

Stara planina: Dojkinci 2, 01.05.2017, 3 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia ruffipes (Preyssler, 1793)

Dubašnica-Malinik: Demižlok, 23.08.1995, 1 ♀, leg. A. Vujić, 25.08.1996, leg. P. Radišić, 01.07.1998, 1 ♂, leg. D. Dević, 23.06.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 14.07.1996, 1 ♂, 1 ♀, leg. P. Radišić, 19.09.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♂, leg. S. Radenković; Dubašnica-Malinik: Podgorac, 02.06.1996, 1 ♂, leg. S. Radenković; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Temštica, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 20.07.2017, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Cheilosia rufipes* (Preyssler, 1793)); Vujić, 1996.

Cheilosia scutellata (Fallén, 1817)

Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. A. Vujić, 18.07.2017, 2 ♂♂, 1 ♀, leg. A. Vujić, 19.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♂, leg. A. Vujić, 23.08.1995, 1 ♀, leg. A. Vujić, 25.08. 1996, 2 ♀♀, leg. P. Radišić, 01.07.1998, leg. P. Radišić; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♂, leg. A. Vujić, 19.09.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 01.06.1996, 1 ♀, leg. A. Vujić, 14.07.1996, 1 ♀, leg. P. Radišić, 19.09.1997, 1 ♀, leg. A. Vujić, 30.06.1998, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 19.09.1997, 3 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Podgorac, 02.06.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 09.06.2022, 1 ♀, leg. T. Tot; Stara planina: Dojkinci, 19.06.2017, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 4 ♂♂, 1 ♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot; Stara planina: iznad Toplog Dola,

20.07.2017, 1 ♀, leg. A. Vujić; Stara planina: Temštica, 11.07.2011, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 20.07.2017, 1 ♂, 1 ♀, leg. A. Vujić, 10.06.2022, 1 ♀, leg. T. Tot, 28.08.2022, 1 ♀, leg. T. Tot.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia semifasciata (Becker, 1894)

Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. A. Vujić, 04.05.2012, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia subpictipennis Claussen, 1998 *

Stara planina: Dojkinci 1, 01.05.2017, 1 ♂, leg. A. Vujić.

Cheilosia urbana (Meigen, 1822)

Besna kobila: Kriva Feja, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić, 03.05.2017, 3 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Besna kobila: Planinarski dom 2, 3 ♀♀, leg. A. Vujić, B. Ivošević, M. Miličić; Planinarski dom 3, 03.05.2017, leg. A. Vujić, B. Ivošević, M. Miličić; Dubašnica-Malinik: Brestovačka banja, 24.04.1996, 2 ♂♂, leg. A. Vujić, 20.04.1997, leg. P. Radišić, 07.06.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 30.04.1995, 7 ♂♂, 8 ♀♀, leg. A. Vujić, S. Radenković, P. Radišić, D. Radnović, 04.05.1996, 8 ♂♂, leg. A. Vujić, M. Radišić, P. Radišić, S. Radenković, 19–20.05.1996, 2 ♂♂, leg. A. Vujić, 07.06.1996, 1 ♀, leg. P. Radišić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 05.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 03.05.1994, 16 ♂♂, 2 ♀♀, leg. A. Vujić, 29.04.1995, 16 ♂♂, 4 ♀♀, leg. A. Vujić, S. Radenković, 23.04.1996, 3 ♂♂, leg. A. Vujić, D. Savić, 02.05.1996, 3 ♂♂, leg. S. Radenković, 03.05.1996, 2 ♂♂, 1 ♀, leg. M. Radišić, 21.05.1996, 2 ♂♂, leg. A. Vujić, 19.04. 1997, 2 ♂♂, 1 ♀, leg. A. Vujić, R. Mićić, D. Radnović, 20.04.1997, 2 ♂♂, 1 ♀, 29.04.1997, 2 ♂♂, leg. A. Vujić, 04.05.2012, 4 ♂♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 2 ♂♂, 3 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 23.04.1996, 9 ♂♂, leg. A. Vujić; Stara planina: Arbinje, 20.06.2012, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 1, 01.05.2017, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 3 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: Temska, 30.04.2022, 1 ♀, leg. T. Tot; Stara planina: Topli Do, 30.04.2022, 2 ♂♂, 6 ♀♀, leg. T. Tot; Suva planina: Jelašnica, 01.04.1989, 22 ♂♂, 2 ♀♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 25.04.1996, 1 ♂, 1 ♀, leg. A. Vujić, 19.05.1997, 1 ♂, leg. B. Zlatković; Suva planina: Kunovica, 25.04.1996, 1 ♂, leg. R. Mićić, 2 ♂♂, 2 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Cheilosia ruralis* (Meigen, 1822)); Vujić, 1996.

Cheilosia uviformis Becker, 1894

Dubašnica-Malinik: Demižlok, 19–20.05.1996, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 19.04.1997, 1 ♀, leg. P. Radišić, 21.04.1997, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia variabilis (Panzer, 1798)

Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♂, 1 ♀, leg. A. Vujić, 21.05. 1996, 1 ♂, leg. A. Vujić, 07.06.1997, 2 ♂♂, 3 ♀♀, leg. A. Vujić, M. Radišić, 01.07.1998, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 21.05. 1996, 1 ♀, V. Milankov; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 19.06.2020, leg. A. Vujić, I. Gorše, L. Likov, T. Tot, L. Velaja; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: iznad Toplog Dola, 20.07.2017, 2 ♂♂, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia vernalis (Fallén, 1817)

Besna kobila: Klisurica, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Besna kobila: Kriva Feja, 02.05.2017, 4 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Besna kobila: Planinarski dom, 03.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 19–20.05.1996, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: klisura Lazareve reke, 27.04.2017, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 25.08.2013, 1 ♂, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinci 1, 01.05.2017, 3 ♂♂, 3 ♀♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 13 ♂♂, 10 ♀♀, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: Topli Do, 28.08.2022, 1 ♀, leg. T. Tot; Suva planina: Kunovica, 02.04.1992, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Cheilosia vicina (Zetterstedt, 1849)

Dubašnica-Malinik: Demižlok, 19–20.05.1996, 4 ♂♂, 1 ♀, leg. A. Vujić, V. Milankov; 07.06.1997, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 18.05.1996, 1 ♂, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015; Vujić, 1996.

Cheilosia vujici Claussen & Doczkal, 1998

Suva planina: Jelašnica, 02.04.1989, 1 ♂, leg. S. Radenković.

Cheilosia vulpina (Meigen, 1822)

Besna kobila: Klisurica, 02.05.2017, 1 ♀, leg. A. Vujić; Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 07.06.1997, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot.

Published material: Šimić and Vujić, 1996; Vujić, 1996.

Chrysogaster solstitialis (Fallén, 1817)

Besna kobila: Planinarski dom, 19.07.2017, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: Vojala, 17.07.1993, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06. 2017, 2 ♀♀, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♀, leg. T. Tot.

Published material: van Seenis et al., 2015; Vujić, 1999a.

Chrysotoxum arcuatum (Linnaeus, 1758)

Stara planina: Babin zub, 09.07.2011, 1 ♂, 1 ♀, leg. A. Vujić, 21.06.2012, 1 ♀, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 1 ♀, leg. A. Vujić; Stara planina: sliv Toplo-

dolske reke, 17.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 2 ♂♂, 4 ♀♀, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Chrysotoxum bicinctum (Linnaeus, 1758)

Besna kobila: Planinarski dom, 19.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Borsko jezero – Savača, 19.08.1997, 3 ♀♀, leg. M. Došenović, D. Kopanja; Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. S. Radenković, 01.07.1998, 1 ♂, 3 ♀♀, leg. D. Dević, M. Došenović; Dubašnica-Malinik: Dubašnica 2, 20.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 1 ♀, leg. A. Vujić, 02.07.1998, 2 ♀♀, leg. A. Vujić, D. Milenković; Dubašnica-Malinik: ka Maliniku, 08.06.2022, 2 ♀♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 08–09.07.1985, 1 ♂, 1 ♀, leg. A. Vujić, 06.07.1995, 1 ♀, leg. A. Vujić, 25.07.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Vojala, 17.07.1993, 2 ♀♀, leg. A. Vujić, P. Radišić; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 2 ♀♀, leg. A. Vujić, 26.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 29–30.07.1986, 3 ♂♂, 2 ♀♀, leg. A. Vujić; Kučajske planine: Požare, 27.07.1986, 3 ♀♀, leg. A. Vujić; Kučajske planine: Sisevac, 24.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – mala kaptaža, 28.07.1986, 3 ♀♀, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 2 ♀♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Golema reka, 20.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 2 ♂♂, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♂, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 2 ♂♂, leg. A. Vujić; Stara planina: Temska, 28.08.2022, 1 ♀, leg. T. Tot.

Chrysotoxum cautum (Harris, 1776)

Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♀, leg. S. Radenković, 07.06.1997, 2 ♀♀, leg. A. Vujić, P. Radišić; Dubašnica-Malinik: klisura Lazareve reke, 21.05.1996, 1 ♂, leg. A. Vujić, 28.04.2022, 4 ♂♂, leg. T. Tot; Dubašnica-Malinik: Malinik, 18.05.1996, 1 ♀, leg. V. Milankov; Dubašnica-Malinik: Manastirište, 21.05.1996, 1 ♂, 1 ♀, N. Dožić; 17.06.1997, 1 ♀, leg. A. Vujić; 30.04.2011, 1 ♂, leg. A. Vujić; Suva planina: Čukljenik, 02.05.1988, 3 ♂♂, leg. A. Vujić; Suva planina: Kunovica, 13.04.1991, 1 ♂, leg. A. Vujić.

Published material: van Seenis et al., 2015.

Chrysotoxum elegans Loew, 1841

Besna kobila: Planinarski dom, 18.07.2017, 2 ♀♀, leg. A. Vujić, 19.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Borsko jezero – Savača, 19.08.1997, 5 ♀♀, M. Došenović, D. Kopanja; Dubašnica-Malinik: Demižlok, 07.06.1997, 6 ♂♂, 3 ♀♀, leg. A. Vujić, M. Radišić; 01.07.1998, 1 ♂, leg. D. Dević, 08.06.2011, 3♂♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 20.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Dubašnica 2, 20.06.2017, 4 ♂♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 05.06.1989, 1 ♂, leg. A. Vujić; 25.07.1997, 1 ♀, leg. A. Vujić; 21.08.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 03.06.1989, 1 ♂, 1 ♀, leg. A. Vujić,

10.06.1994, V. Milankov, S. Radnović, 03.06.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♀, leg. S. Radnović; Dubašnica-Malinik: Podgorac, 02.06.1996, 2 ♂♂, leg. S. Radenković; Dubašnica-Malinik: Predsednička vila, 1 ♀, 24.05.2013, leg. A. Vujić, L. Likov, M. Miličić; Dubašnica-Malinik: uspon na Malinik, 02.06.1995, 3 ♂♂, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 26.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 26.07.1987, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, leg. A. Vujić; Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Babin zub, 21.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.07.1988, 1 ♂, leg. A. Vujić, 02.06.2013, 3 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, 3 ♀♀, leg. A. Vujić; Stara planina: Dojkinci 2, 09.06.2017, 2 ♂♂, 2 ♀♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Planinica, 21.06.1987, 1 ♂, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 1 ♀, leg. A. Vujić.

Published material: Nedeljković et al., 2013; Šimić and Vujić, 1996; van Steenis et al., 2015.

Chrysotoxum fasciolatum (De Geer, 1776)

Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić.

Chrysotoxum festivum (Linnaeus, 1758)

Besna kobila: Kriva Feja, 19.07.2017, 2 ♀♀, leg. A. Vujić; Besna kobila: Planinarski dom, 18.07.2017, 1 ♂, 3 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić, 19–20.05.1996, 2 ♂♂, 1 ♀, leg. A. Vujić, V. Milankov, 08.06.2011, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 29.04. 1995, 1 ♂, leg. A. Vujić, 21.05.1996, 1 ♂, leg. A. Vujić, 22.08.1996, 1 ♀, leg. A. Vujić, 04.05.2012, 2 ♂♂, leg. A. Vujić, 05.05.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 03.05.1994, 1 ♂, leg. V. Milankov, 18.05.1996, 1 ♂, 1 ♀, leg. N. Dožić, 03.06.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: uspon na Malinik, 02.05.1995, 1 ♂, leg. A. Vujić; Stara planina: Crni vrh, 31.05.1988, 3 ♀♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.07.1988, 1 ♂, leg. A. Vujić; Stara planina: iznad Toplog Dola, 20.07.2017, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Kalna, 30.05.1988, 1 ♂, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 07.07.1991, 1 ♀, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 1 ♂, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 1 ♀, leg. A. Vujić.

Published material: Nedeljković et al., 2013; van Steenis et al., 2015.

Chrysotoxum octomaculatum Curtis, 1837

Dubašnica-Malinik: Demižlok, 19–20.05.1996, 1 ♂, leg. A. Vujić, 08.06. 2011, 4 ♂♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 03.06.1993, 4 ♂♂, leg. A. Vujić, P. Radišić, D. Radnović, S. Radnović; Dubašnica-Malinik: Malinik, 03.06.1989, 1 ♂, leg. A. Vujić, 10.06.1994, 1 ♀, S. Radnović; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♂, leg. M. Živković; Kučajske planine: Crnica – vlažne livade, 26.07.1986, 3 ♀♀, leg. A. Vujić, 29–30.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 1 ♀, leg. A. Vujić; Stara planina:

Crni vrh, 31.05.1988, 2 ♀♀, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 9 ♂♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 1 ♀, leg. A. Vujić, 14.07.1991, 1 ♂, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 1 ♂, 2 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Chrysotoxum tomentosum Giglio-Tos, 1890

Stara planina: Babin zub, 20.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 2 ♂♂, 2 ♀♀, leg. A. Vujić, 23.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 3 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 12.07.1991, 1 ♂, leg. A. Vujić, 21.07.1991, 2 ♀♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 3 ♂♂, 4 ♀♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 4 ♂♂, leg. A. Vujić, 14.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 2 ♀♀, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 1 ♂, leg. A. Vujić.

Published material: Nedeljković et al., 2013.

Chrysotoxum vernale Loew, 1841

Besna kobila: Planinarski dom, 02.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♀, leg. A. Vujić, 15.04.1994, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: Demižlok, 14.05.1994, 3 ♂♂, 6 ♀♀, leg. A. Vujić, V. Milankov, S. Radenković, D. Radnović, 07.06.1997, 2 ♀♀, leg. A. Vujić, P. Radišić, 08.06.2011, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica, 16.05.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♀, D. Radnović, 21.05.1996, 1 ♀, leg. V. Milankov, 02.06.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 31.04.1989, 1 ♀, leg. A. Vujić, 29.04.1995, 1 ♂, 2 ♀♀, leg. A. Vujić, S. Radenković, P. Radišić, 02.05.1996, 1 ♂, 1 ♀, leg. S. Radenković, 04.05.2012, 1 ♂, leg. A. Vujić, 05.05.2012, 1 ♂, leg. A. Vujić, 27.04.2017, 1 ♂, leg. A. Vujić, 28.04.2022, 2 ♂♂, leg. T. Tot; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 4 ♀♀, leg. D. Radnović, S. Radnović; Dubašnica-Malinik: Malinik, 13.05.1994, 1 ♂, leg. A. Vujić, 01.05.1995, 1 ♂, leg. P. Radišić, 03.05.1996, 1 ♂, leg. A. Vujić, 18.05.1996, 1 ♀, leg. V. Milankov; Dubašnica-Malinik: Manastirište, 03.05.1996, 1 ♂, leg. S. Radenković, 17.06.1997, 1 ♂, leg. A. Vujić, 30.04.2011, 3 ♂♂, 3 ♀♀, leg. A. Vujić, 24.05.2013, 1 ♀, leg. A. Vujić, L. Likov, M. Miličić; Dubašnica-Malinik: Podgorac, 02.06.1996, 1 ♀, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Planinica, 27.05.1987, 1 ♂, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 1 ♂, leg. A. Vujić; Stara planina: Temska, 30.04.2022, 1 ♂, leg. T. Tot; Stara planina: Topli Do, 28.05.1987, 1 ♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♂, leg. D. Radnović; Suva planina: Kunovica, 02.05.1988, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Chrysotoxum verralli (Collin, 1940)

Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♀, leg. A. Vujić, 02.07.1998, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 01.07.1998, 1 ♂, leg. D. Dević, 23.06.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve

reke, 28.04.2022, 1 ♂, leg. T. Tot; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♀, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 26.07.1986, 1 ♀, leg. A. Vujić.

Criorhina asilica (Fallén, 1816)

Dubašnica-Malinik: Demižlok, 07.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, S. Radnović, 07.06.1997, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 2 ♀♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot.

Published material: Šimić and Vujić, 1996; Vujić and Milankov, 1990.

Criorhina floccosa (Meigen, 1822)

Dubašnica-Malinik: Demižlok, 07.06.1997, 1 ♂, 3 ♀♀, leg. A. Vujić, P. Radišić.

Dasysyrphus albostriatus (Fallén, 1817)

Dubašnica-Malinik: Demižlok, 14.05.1994, 2 ♂♂, leg. A. Vujić, V. Milankov, 14.06.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 15.05. 1994, 1 ♂, leg. A. Vujić, 18.05.1996, 1 ♀, leg. N. Dožić, 23.08.1996, 1 ♀, leg. R. Mićić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1989, 1 ♂, leg. A. Vujić, 21.05.1996, 1 ♂, leg. A. Vujić, 22–24.08.1996, 1 ♀, leg. A. Vujić, 25.08. 1996, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 11.05.1985, 1 ♂, leg. A. Vujić, 03.05.2012, 1 ♂, leg. A. Vujić, L. Likov, S. Radenković; Dubašnica-Malinik: Malinik, 18.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 07.07.1997, 1 ♀, leg. P. Radišić; Kučajske planine: Papratno, 25.07.1986, 1 ♀, leg. A. Vujić, 27.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 26.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac, 28.07.1986, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 06.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Pilj, 07.05.1988, 1 ♂, leg. A. Vujić; Stara planina: spomenik, 07.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1991, 1 ♂, leg. P. Radišić.

Published material: Šimić and Vujić, 1996.

Dasysyrphus friuliensis (van der Goot, 1960)

Dubašnica-Malinik: Demižlok, 08.06.2011, 1 ♂, leg. A. Vujić; Stara planina: Arbinje, 26.06.1987, 3 ♂♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05. 1987, 1 ♂, leg. A. Vujić, 30.05.1988, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Topli Do-Pilj, 25.06.1987, 2 ♂♂, leg. A. Vujić.

Dasysyrphus hilaris (Zetterstedt, 1843)

Besna kobila: Planinarski dom, 03.05.2017, 1 ♂, leg. M. Miličić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 05.05.2012, 1 ♂, leg. A. Vujić, L. Likov, S. Radenković.

Dasysyrphus lenensis Bagatshanova, 1980

Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić.

Dasysyrphus pauxillus (Williston, 1887)

Dubašnica-Malinik: Dubašnica, 16.03.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić; Stara planina: Mala Lukanja, 01.05.1987, 1 ♂, leg. A. Vujić.

Dasysyrphus pinastri (De Geer, 1776) sensu Locke and Skevington (2013)

Dubašnica-Malinik: Dubašnica Lunga, 16.06.1993, 1 ♀, leg. D. Radnović; Dubašnica-Malinik: Malinik, 10.07.1985, 1 ♀, leg. A. Vujić, Stara planina: Arbinje, 26.06.1987, 1 ♂, leg. A. Vujić, 20.06.2012, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Temska, 01.05.1987, 1 ♀, leg. A. Vujić; Stara planina: Topli Do-Pilj, 25.06.1987, 1 ♂, leg. A. Vujić, Stara planina: Živadinov dol, 12.07.1991, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Dasysyrphus lunulatus* (Meigen, 1822)).

Dasysyrphus postclaviger (Stys & Moucha, 1962)

Besna kobila: Kriva Feja, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 2 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: Dojkinci 1, 01.05.2017, 1 ♀, 1 ♂, leg. A. Vujić.

Dasysyrphus tricinctus (Fallén, 1817)

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♀, leg. V. Milankov; 30.05. 1995, 1 ♂, P. Radišić; 25.08.1996, 1 ♀, leg. S. Radenković; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1996, 1 ♀, leg. V. Milankov; 23.08.1996, 5 ♂♂, 1 ♀, leg. A. Vujić, S. Dragišić, R. Mićić, S. Radenković; Dubašnica-Malinik: klisura Lazareve reke, 16.07.1993, 1 ♂, leg. A. Vujić; 22.08.1996, 1 ♂, leg. A. Vujić; 21.08.1997, 1 ♂, leg. A. Vujić; Stara planina: Arbinje, 26.06.1987, 2 ♀♀, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05.1987, 2 ♀♀, leg. A. Vujić, 06.05.1988, 1 ♀, leg. A. Vujić, 29–30.05. 1988, 2 ♀♀, leg. A. Vujić; Stara planina: Planinica, 08.05. 1988, 1 ♂, leg. A. Vujić; Stara planina: spomenik, 30.04.1987, 1 ♀, leg. A. Vujić; Stara planina: Temska, 01.05.1987, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 28.05.1987, 1 ♀, leg. A. Vujić; Suva planina: Bojanine vode, 02.05.1988, 1 ♂, 1 ♀, leg. A. Vujić; Suva planina: Čukljenik – Donja Studena, 28.05.1988, 1 ♀, leg. A. Vujić; Suva planina: Jelašnica – Donja Studena, 02.05.1988, 1 ♂, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Dasysyrphus venustus (Meigen, 1822)

Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♀, leg. A. Vujić, 14.06.1994, 1 ♀, leg. A. Vujić, 04.06.1995, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♀, leg. S. Radnović, 15.05.1994, 1 ♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 29.05.1987, 8 ♂♂, 6 ♀♀, leg. A. Vujić, 30.05.1988, 4 ♂♂, 5 ♀♀, leg. A. Vujić, 04.06.1993, 2 ♀♀, leg. P. Radišić; Stara planina: Pilj, 07.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Topli Do-Pilj, 28.05.1987, 1 ♂, 1 ♀, leg. A. Vujić, 25.06.1987, 1 ♀, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Didea fasciata Macquart, 1843

Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. P. Radišić, 23.08.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 13.08. 1994, 1 ♂, leg. S. Šimić, 27.04.2017, 1 ♂, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Doros destillatorius Mik, 1885

Dubašnica-Malinik: klisura Lazareve reke, 23.08.2013, 1 ♂, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić.

Notes: Vujić et al. in 2018 published *Doros destillatorius* as new species for Serbian hoverfly fauna: "1 ♀, Dubašnica, klisura Lazareve reke, 23.08.2013, leg. Ivošević." After restudying the specimen in this study a correction for this data is given.

Doros profuges (Harris, 1780)

Dubašnica-Malinik: klisura Lazareve reke, 03.06.1993, 1 ♂, leg. A. Vujić, 08.07.1989, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 1 ♀, leg. V. Milankov.

Epistrophe diaphana (Zetterstedt, 1843)

Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. P. Radišić; Dubašnica--Malinik: uspon na Malinik, 02.06.1995, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 03.06.1995, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♀, leg. A. Vujić, 07.06.1997, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Dojkinci 2, 19.06.2017, 2 ♂♂, leg. M. Miličić, Z. Nedeljković, T. Tot.

Epistrophe eligans (Harris, 1780)

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: Dubašnica Lunga, 15.05.1994, 1 ♂, leg. S. Radenković, 18.05. 1996, 1 ♂, leg. N. Dožić; Dubašnica-Malinik: ka Maliniku, 1 ♂, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 15.05.1993, 1 ♂, leg. A. Vujić, 03.06. 1993, 2 ♂♂, leg. A. Vujić, S. Radenković, 20.04.1997, 1 ♂, 1 ♀, leg. A. Vujić, 27.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♂, leg. A. Vujić, L. Likov, S. Radenković; Dubašnica--Malinik: Dubašnica – lovište, 05.06.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 01.05.1989, 1 ♂, leg. A. Vujić, 01.05.1995, 1 ♂, leg. S. Radenković, 18.05.1996, 1 ♂, 1 ♀, leg. N. Dožić, V. Milankov; Dubašnica: Manastirište, 07.06.1997, 1 ♀, leg. P. Radišić; Dubašnica-Malinik: klisura Lazareve reke, 28.04.2022, 3 ♂♂, leg. T. Tot; Stara planina: Topli Do, 10.06.2022, 1 ♂, leg. T. Tot.

Published material: Šimić and Vujić, 1996.

Epistrophe flava Doczkal & Schmid, 1994

Stara planina: Dojkinačka reka, 29.05.1987, 1 ♀, leg. A. Vujić.

Epistrophe grossulariae (Meigen, 1822)

Dubašnica-Malinik: Dubašnica Lunga, 22.08.1996, 1 ♀, leg. P. Radišić; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♀, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 2 ♂♂, leg. A. Vujić, 26.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno – bukova šuma, 27.07.1986, 2 ♀♀, leg. A. Vujić; Stara planina: Dojkinci – Arbinje, 26.06.1987, 2 ♂♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Epistrophe melanostoma (Zetterstedt, 1843)

Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: Demižlok, 30.04.1995, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke,

31.04.1989, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 29.04.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Stara planina: Dojkinci 1, 01.05.2017, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 2 ♂♂, leg. B. Ivošević, M. Miličić; Suva planina: Jelašnica, 05.08.1988, 1 ♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1991, 1 ♀, leg. D. Radnović, 19.05.1997, 1 ♀, leg. B. Zlatković; Suva planina: Kunovica, 13.04.1991, 1 ♂, leg. A. Vujić.

Epistrophe nitidicollis (Meigen, 1822)

Besna kobila: Planinarski dom, 03.05.2017, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: Demižlok, 14.05.1994, 2 ♂♂, leg. V. Milankov, S. Radenković, 04.06. 1995, 1 ♂, 1 ♀, leg. A. Vujić, 19–20.05.1996, 2 ♂♂, 2 ♀♀, leg. A. Vujić; 07.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica, 16.05.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1996, 3 ♂♂, 1 ♀, leg. A. Vujić, N. Dožić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. A. Vujić, 03.05.1996, 1 ♂, leg. A. Vujić, 05.05.2012, 1 ♀, leg. A. Vujić, L. Likov, S. Radenković, 27.04.2017, 1 ♀, leg. A. Vujić, 28.04.2022, 1 ♂, leg. T. Tot; Dubašnica-Malinik: Malinik, 03.06.1995, 1 ♂, leg. A. Vujić, 03.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: uspon na Malinik, 02.06.1995, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Suva planina: Bojanine vode, 28.05.1988, 1 ♀, leg. A. Vujić; Suva planina: Čukljenik, 02.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♀, leg. P. Radišić.

Epistrophella coronata (Rondani, 1857)

Published material: Doczkal and Vujić, 1998.

Episyrphus balteatus (De Geer, 1776)

Dubašnica-Malinik: Borsko jezero – Savača, 19.08.1998, 1 ♀, leg. D. Kopanja; Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 01.07.1998, 1 ♂, leg. D. Dević; Dubašnica-Malinik: Jablanica, 24.07.1986, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 08.06.2022, 3 ♂♂, leg. T. Tot, 27.08.2022, 2 ♀♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 12.07.1985, 2 ♂♂, leg. A. Vujić, 03.06.1993, 1 ♂, leg. A. Vujić, 16.07.1993, 1 ♂, leg. P. Radišić, 13.04.1996, 1 ♀, leg. P. Radišić, 19.04. 1997, 1 ♀, leg. P. Radišić, 25.07.1997, 1 ♂, leg. D. Dević, 28.04.2022, 1 ♂, leg. T. Tot, 09.06.2022, 12 ♂♂, 2 ♀♀, leg T. Tot; Dubašnica-Malinik: Malinik, 07.07.1985, 1 ♂, leg. A. Vujić, 03.06.1989, 1 ♂, 1 ♀, leg. A. Vujić, 10.06.1994, 1 ♂, leg. S. Radnović, 05.07.1995, 1 ♂, leg. S. Dragišić; Dubašnica-Malinik: Manastirište, 07.05.1997, 1 ♂, leg. V. Milankov; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 26.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 29–30.07.1986, 2 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 25.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 27.07.1986, 2 ♀♀, leg. A. Vujić; Kučajske planine: Papratno – bukova šuma, 26.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Požare, 27.07.1986, 3 ♂♂, 3 ♀♀, leg. A. Vujić; Kučajske planine: Sisevac, 21.07.1986, 2 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – livada, 25.07.1986, 1 ♀, leg. A. Vujić; Stara planina: Arbinje, 11.08.1987, 1 ♀, leg. A. Vujić; Stara planina: Babin zub, 16.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Crni vrh, 31.05.1988, 2 ♀♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 30.05.1988,

1 ♂, leg. A. Vujić, 29–30.07.1988, 1 ♀, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Kalna, 30.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 2 ♀♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 1 ♂, leg. A. Vujić; Stara planina: Temska, 01.05.1987, 1 ♀, leg. A. Vujić, 10.06.2022, 1 ♂, leg. T. Tot; Stara planina: Temska – spomenik, 12.04.1988, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 10.06.2022, 3 ♂♂, 2 ♀♀, leg. T. Tot, 28.08.2022, 6 ♀♀, leg. T. Tot; Stara planina: Topli Do-Pilj, 11.08.1987, 1 ♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 3 ♀♀, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 1 ♀, leg. A. Vujić; Svrljiške planine: Sićevački potok, 21.07.1986, 1 ♀, leg. A. Vujić, 28.07.1986, 1 ♂, leg. A. Vujić; Suva planina: Bancarevo, 16.07.1989, 1 ♂, 1 ♀, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 1 ♀, leg. A. Vujić; Suva planina: Kunovica, 02.05.1988, leg. A. Vujić; Suva planina: Sićevačka klisura, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Eristalinus aeneus (Scopoli, 1763)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♂, leg. P. Radišić; 23–24.04.1996, 3 ♂♂, leg. R. Mićić, S. Dragišić, 20.04.1997, 1 ♀, leg. A. Vujić, 21.08.1997, 1 ♀, leg. A. Vujić, 30.06.1998, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 28.04.2022, 1 ♀, leg. T. Tot; Stara planina: Arbinje, 11.08.1987, 1 ♂, leg. A. Vujić.

Eristalis alpina (Panzer, 1798)

Dubašnica-Malinik: Demižlok, 07.06.1997, 3 ♂♂, 1 ♀, leg. A. Vujić, P. Radišić.

Eristalis arbustorum (Linnaeus, 1758)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Borsko jezero – Savača, 19.08.1998, 1 ♀, leg. D. Kopanja; Dubašnica-Malinik: Demižlok, 01.07.1998, 1 ♂, 1 ♀, leg. D. Dević; Dubašnica-Malinik: Dubašnica Lunga, 15.05.1994, 1 ♀, leg. A. Vujić, 02.07.1998, 1 ♂, leg. D. Dević; Dubašnica-Malinik: klisura Lazareve reke, 08.07.1985, 1 ♀, leg. A. Vujić, S. Šimić, 05.06.1989, 1 ♂, leg. P. Radišić, 03.06.1993, 1 ♀, leg. S. Radnović, 29.04.1995, 1 ♂, leg. A. Vujić, 01.06.1996, 1 ♂, 1 ♀, leg. S. Radenković, 18.06.1997, 1 ♂, 1 ♀, leg. A. Vujić, 25.07.1997, 4 ♂♂, 2 ♀♀, leg. A. Vujić, 30.06.1998, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 10.07.1985, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♂, 1 ♀, leg. S. Radenković, 17.06.1997, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: uspon na Malinik, 27.04.2017, 2 ♂♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Valja Mare, 16.07.1993, 1 ♀, leg. A. Mladenović; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♂, leg. P. Radišić; Kučajske planine: Crnica – vlažne livade, 07.1986, 2 ♀♀, leg. A. Vujić, S. Šimić; Kučajske planine: Crnica – reka, 23.07.1986, 2 ♂♂, leg. A. Vujić, 26.07.1986, 3 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Dubašnica, 03.05.1995, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno – B. AP., 26.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Požare, 07.1986, 2 ♀♀, leg. A. Vujić, S. Šimić; Kučajske planine: Sisevac, 24.04.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – livada, 22.07.1986, 1 ♂, leg. A. Vujić, 29.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – mala kaptaža

28.07.1986, 2 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, 3 ♂♂, 1 ♀, leg. A. Vujić, 28.07.1986, 3 ♀♀, leg. A. Vujić; Stara planina: Arbinje, 10.08.1987, 1 ♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 2 ♂♂, leg. A. Vujić, D. Radnović, 23.07.1991, 2 ♂♂, leg. A. Vujić, P. Radišić; Stara planina: Pilj, 07.05.1988, 1 ♂, leg. A. Vujić; Stara planina: sliv Rekitske reke, 12.07.1991, 1 ♂, 1 ♀, leg. A. Vujić, D. Radnović; Stara planina: sliv Toplodolske reke, 17.07.1991, 2 ♀♀, leg. A. Vujić, P. Radišić; Stara planina: Temštica, 18.07.1992, 2 ♀♀, leg. A. Vujić; Stara planina: Žarkova čuka, 14.07.1991, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Suva planina: Čukljenik, 02.05.1988, 2 ♂♂, leg. A. Vujić; Suva planina: Čukljenik – Donja Studena, 28.05.1988, 1 ♀, leg. A. Vujić; Suva planina: Jelašnica, 02.04.1989, 1 ♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 4 ♂♂, leg. A. Vujić, S. Radenković; Suva planina: Kunovica, 25.04.1996, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Eristalis horticola (De Geer, 1776)

Dubašnica-Malinik: Demižlok, 14.06.1994, 1 ♂, leg. A. Vujić, 19–20.05. 1996, 1 ♂, leg. V. Milankov; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♀, leg. D. Milenković, 02.07.1998, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1990; Šimić and Vujić, 1996.

Eristalis jugorum Egger, 1858

Besna kobila: Kriva Feja 1, 12.09.2020, 1 ♀, leg. A. Vujić, L. Likov, M. Ranković, T. Tot; Besna kobila: Kriva Feja 2, 12.09.2020, 2 ♂♂, leg. A. Vujić, L. Likov, M. Ranković, T. Tot; Dubašnica-Malinik: Beljavina, 06.06.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 12.06.1994, 3 ♀♀, leg. A. Vujić, D. Radnović, V. Milankov, 07.06.1997, 1 ♀, leg. A. Vujić; Dubašnica--Malinik: Dubašnica Lunga, 21.05.1996, 1 ♂, leg. A. Vujić, 22.08.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♂, 1 ♀, leg. A. Vujić, P. Radišić; Stara planina: Arbinje, 12.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 10.06.2022, 1 ♀, leg. T. Tot.

Published material: Šimić and Vujić, 1996.

Eristalis nemorum (Linnaeus, 1758)

Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 04.05.1996, 1 ♂, leg. A. Vujić, 07.06.1997, 1 ♂, leg. A. Vujić, 01.07.1998, 1 ♀, leg. D. Dević; Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 1 ♂, leg. A. Vujić, 21.05.1996, 1 ♂, leg. A. Vujić, 23.08.1996, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 2 ♂♂, leg. A. Vujić, V. Milankov; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, leg. A. Vujić; Kučajske planine: Crnica, 07.1986, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Eristalis pertinax (Scopoli, 1763)

Besna kobila: Planinarski dom, 03.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. V. Milankov, 12.06.1994, 2 ♂♂, leg. A. Vujić, 23.08.1995, 3 ♂♂, leg. A. Vujić, A. Tepavčević, 07.06.1997, 1 ♂, 1 ♀, leg. A. Vujić, M. Radišić; Dubašnica-Malinik: Dubašnica

Lunga, 06.06.1993, 2 ♂♂, leg. A. Vujić, S. Radnović, 15.05.1994, 1 ♀, leg. D. Radnović, 02.06.1996, 1 ♀, leg. A. Vujić, 23.08.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 01.04.1994, 1 ♀, leg. A. Vujić, 11.06.1994, 1 ♀, leg. S. Radnović, 19.04.1997, 2 ♂♂, leg. P. Radišić, 29.04.1997, 1 ♀, leg. P. Radišić, 21.08.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 07.07.1985, 1 ♂, leg. P. Radišić, 03.06.1989, 1 ♀, leg. P. Radišić, 05.07.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♀, leg. P. Radišić; Stara planina: Barska livada, 30.04.1987, 4 ♂♂, leg. A. Vujić; Stara planina: Temska, 01.05.1987, 1 ♂, 1 ♀, leg. A. Vujić, S. Šimić; Suva planina: Bojanine vode, 02.05.1988, 3 ♂♂, 1 ♀, leg. A. Vujić, 28.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Gornja Studena – Bojanine vode, 02.05.1988, 1 ♂, 1 ♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 4 ♂♂, leg. P. Radišić, D. Radnović.

Published material: Šimić and Vujić, 1996.

Eristalis picea (Fallén, 1817)

Dubašnica-Malinik: Dubašnica Lunga, 02.07.1998, 2 ♀♀, leg. A. Vujić, D. Milenković.

Eristalis rupium Fabricius, 1805

Dubašnica-Malinik: Demižlok, 03.08.1995, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1990; Šimić and Vujić, 1996.

Eristalis similis (Fallén, 1817)

Besna kobila: Planinarski dom 4, 12.09.2020, 1 ♂, leg. A. Vujić, L. Likov, M. Ranković, T. Tot; Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. D. Radnović, 12.06.1994, 2 ♂♂, leg. A. Vujić, 23.08.1995, 2 ♂♂, leg. A. Vujić, 04.05.1996, 1 ♂, leg. A. Vujić, 07.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica, 31.05.1995, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 15.05.1993, 1 ♂, leg. A. Vujić, 16.07.1993, 1 ♀, leg. A. Vujić, 22.08.1995, 2 ♂♂, leg. P. Radišić; Dubašnica-Malinik: Malinik, 03.06.1989, 1 ♂, leg. D. Radnović, 10.06.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 20.04.1997, 1 ♀, leg. A. Vujić, 07.06.1997, 1 ♂, leg. P. Radišić, 19.09.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♀, leg. S. Radnović; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♂, leg. S. Šimić; Kučajske planine: Crnica – livada, 23.07.1986, 2 ♂♂, leg. A. Vujić, 26.07.1986, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 2 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Eristalis pratorum* Meigen, 1822).

Eristalis tenax (Linnaeus, 1758)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 6 ♂♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Borsko jezero – Savača, 19.08.1998, 1 ♂, leg. D. Kopanja; Dubašnica-Malinik: Brestovačka banja, 24.04.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 23.08.1995, 1 ♂, leg. M. Radišić, 19–20.05.1996, 2 ♀♀, leg. V. Milankov, 07.06.1997, 1 ♀, leg. A. Vujić, 01.07.1998, 4 ♂♂, 4 ♀♀, leg. M. Došenović; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. D.

Radnović, 22.08.1997, 1 ♂, leg. A. Vujić, 19.09.1997, 1 ♂, leg. A. Vujić, 02.07. 1998, 1 ♂, leg. M. Došenović; Dubašnica-Malinik: ka Maliniku, 27.08.2022, 2 ♀♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 07.07.1985, 1 ♀, 09.07.1985, 1 ♀ leg. A. Vujić, 28.03.1989, 1 ♀, leg. D. Radnović, 30.04.1989, 1 ♀, leg. S. Šimić, 08.07.1989, 3 ♂♂, leg. P. Radišić, 03.06.1993, 1 ♂, 1 ♀, leg. S. Radnović, 24.08.1995, 1 ♂, 1 ♀, leg. A. Tepavčević, 13.04.1996, 1 ♀, leg. M. Radišić, 23–24.04.1996, 1 ♀, leg. R. Mićić, 22.08.1996, 2 ♂♂, leg. P. Radišić, 07.06.1997, 1 ♀, leg. A. Vujić, 18.06.1997, 1 ♂, leg. A. Vujić, 21.08.1997, 1 ♀, leg. A. Vujić, 19.09.1997, 1 ♀, leg. A. Vujić, 04.05.2012, 1 ♀, leg. A. Vujić, 27.08. 2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♂, leg. S. Radnović, 13.08.1994, 1 ♂, leg. S. Šimić; Dubašnica-Malinik: Malinik, 10.7.1985, 1 ♀, leg. A. Vujić, 02.06.1995, 1 ♂, leg. A. Vujić, 03.06.1995, 2 ♂♂, leg. A. Vujić, 26.07.1997, 1 ♀, leg. D. Dević; Dubašnica-Malinik: Malinik – bukova šuma, 13.7.1985, 3 ♂♂ 1 ♀, leg. A. Vujić, 07.1985, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Malinik – put, 22.07.1985, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 07.06.1997, 1 ♂, 1 ♀, leg. P. Radišić, 17.06. 1997, 1 ♀, leg. A. Vujić, 19.07.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♂, 1 ♀, leg. S. Šimić; Kučajske planine: Crnica, 23.07.1986, 5 ♂♂, leg. A. Vujić; Kučajske planine: Crnica – kanjon, 21.07.1986, 2 ♂♂, leg. A. Vujić; Kučajske planine: Crnica reka, 23.07.1986, 4 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 26.07.1986, 3 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 25.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 27.07.1986, 6 ♂♂, leg. A. Vujić; Kučajske planine: Papratno – Apta, 26.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno – bukova šuma, 27.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac, 24.07.1986, 4 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – livada, 22.07.1986, 1 ♂, 2 ♀♀, leg. A. Vujić, 29.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, 3 ♂♂, leg. A. Vujić; Stara planina: Arbinje, 11.08.1987, 3 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Babin zub, 19.07.1991, 6 ♂♂, leg. A. Vujić, P. Radišić, 20.07.1991, 3 ♂♂, 1 ♀, leg. A. Vujić, P. Radišić; Stara planina: Dojkinačka reka, 06.05.1988, 2 ♀♀, leg. A. Vujić, 29–30.05.1988, 2 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka 2, 29.05.1987, 1 ♂, leg. A. Vujić, 30.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 4 ♂♂, 10 ♀♀, leg. A. Vujić, 23.07.1991, 4 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 3 ♂♂, 3 ♀♀, leg. A. Vujić, P. Radišić; Stara planina: Pilj, 07.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Planinica, 29.05.1988, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 12.07. 1991, 2 ♀♀, leg. A. Vujić, 21.07.1991, 3 ♂♂, 4 ♀♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 4 ♂♂, 6 ♀♀, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 1 ♀, leg. A. Vujić, 10.08.1987, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Temska, 30.04.2022, 1 ♂, leg. T. Tot; Stara planina: Temska – spomenik, 12.04.1988, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 30.04.2022, 2 ♂♂, leg. T. Tot, 10.06.2022, 1 ♂, leg. T. Tot, 28.08.2022, 4 ♂♂, 3 ♀♀, leg. T. Tot; Stara planina: Topli Do-Pilj, 26.06.1987, 1 ♀, leg. A. Vujić, 11.08.1987, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 10 ♂♂, 6 ♀♀, leg. A. Vujić; Stara planina: Zavojsko jezero, 13.07.1992, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 2 ♂♂, 2 ♀♀, leg. A. Vujić,

D. Radnović; Zlot: klisura Lazareve reke, 07.07.1985, 1 ♀, 09.07.1985, 1 ♀ leg. A. Vujić.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Eumerus alpinus Rondani, 1857

Besna kobila: Planinarski dom 3, 29.06.2019, 6 ♂♂, leg. A. Vujić.

Eumerus amoenus Loew, 1848

Dubašnica-Malinik: Demižlok, 25.08.1996, 1 ♀, leg. S. Radenković, 22.07. 2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku 21.06.2017, 3 ♂♂, 3 ♀♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 08.07.1985, 1 ♂, leg. P. Radišić, 03.06.1993, 3 ♂♂, leg. D. Radnović, 13.08.1994, 3 ♀♀, leg. A. Vujić, 24.09.1995, 4 ♀♀, leg. A. Vujić, 03.05.1996, 2 ♂♂, leg. A. Vujić, 14.07.1996, 6 ♂♂, leg. A. Vujić, S. Radenković, P. Radišić, 22.08.1996, 1 ♂, leg. A. Vujić, 25.08.1996, 1 ♀ leg. P. Radišić, 21.08.1997, 1 ♀, leg P. Radišić, 9 ♂♂, leg. A. Vujić, 19.09.1997, 18 ♂♂, 2 ♀♀, leg. A. Vujić, 23.08. 2013, 2 ♂♂, leg. A. Vujić, L. Likov, M. Miličić, 01.07.2019, 3 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Janković, M. Miličić; Dubašnica-Malinik: Manastirište 03.06.1996, 1 ♀, leg. A. Vujić, 21.05.1996, 4 ♀♀, leg. V. Milankov, A. Tepavčević; Dubašnica-Malinik: Malinik, 05.07.1995, 1 ♀, leg. A. Vujić, 26.07.1997, 1 ♀, leg. D. Dević, 21.07.2017, 24 ♂♂, 4 ♀♀, leg. A. Vujić; Stara planina: Topli Do, 10.10.2018, 2 ♂♂, 1 ♀, leg. A. Vujić, S. Popov.

Eumerus argyropus Loew, 1848

Dubašnica-Malinik: klisura Lazareve reke, 19.09.1997, 5 ♂♂, leg. A. Vujić, 21.08.1997, 1 ♂, leg. A. Vujić, 27.08.2022, 1 ♂, 2 ♀♀, leg. T. Tot.

Eumerus clavatus Becker, 1923

Dubašnica-Malinik: Demižlok, 19.07.1994, 1 ♀, leg. A. Vujić; Dubašnica--Malinik: Dubašnica Lunga, 22.08.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 16.07.1991, 3 ♂♂, leg. P. Radišić, 24.08.1995, 2 ♂♂, 1 ♀, leg. A. Vujić, 14.07.1996, 4 ♂♂, 4 ♀♀, leg. A. Vujić, S. Radenković, P. Radišić, 26.07.1997, 5 ♂♂, leg. A. Vujić, 21.08.1997, 15 ♂♂, 8 ♀♀, leg. A. Vujić, 19.09. 1997, 35 ♂♂, 19 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 19.09.1997, 1 ♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 21.06.2017, 10 ♂♂, 5 ♀♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot.

Published material: Vujić and Šimić, 1995–1998.

Eumerus hungaricus Szilády, 1940

Stara planina: Topli Do, 10.10.2018, 1 ♀, leg. A. Vujić, S. Popov.

Eumerus ornatus Meigen, 1822

Dubašnica-Malinik: Jablanica, 26.07.1986, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 02.06.1983, 1 ♂, leg. A. Vujić, 08.07.1985, 1 ♂, leg. A. Vujić, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Podgorac, 02.06.1996, 1 ♂, leg. A. Vujić; Stara planina: put ka Babinom zubu, 01.06.2013, 1 ♂, leg. A. Vujić.

Published material: Vujić and Šimić, 1995–1998.

Eumerus richteri Stackelberg 1960

Dubašnica-Malinik: klisura Lazareve reke, 16.07.1993, 2 ♂♂, leg. A. Vujić, 14.07.1996, 2 ♂♂, leg. A. Vujić, P. Radišić, 21.08.1997, 1 ♂, leg. A. Vujić, 30.06.1998,

6 ♂♂, 15 ♀♀, leg. A. Vujić, D. Milenković, 01.07.2019, 1 ♂♂, 3 ♀♀, leg. A. Vujić, M. Janković, M. Miličić.

Published material: Vujić and Šimić, 1995–1998.

Eumerus sogdianus Stackelberg, 1952

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015; Vujić and Šimić, 1995–1998.

Eumerus strigatus (Fallén, 1817)

Published material: Vujić and Šimić, 1995–1998.

Eumerus tricolor (Fabricius, 1798)

Dubašnica-Malinik: Demižlok, 14.06.1994, 4 ♂♂, leg. A. Vujić.

Published material: van Seenis et al., 2015.

Eupeodes bucculatus (Rondani, 1857)

Besna kobila: Planinarski dom, 18.07.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 1 ♂, leg. S. Dragišić; Dubašnica-Malinik: klisura Lazareve reke, 14.04.1991, 1 ♂, leg. A. Vujić, 01.04.1994, 1 ♂, leg. A. Vujić.

Eupeodes corollae (Fabricius, 1794)

Besna kobila: Planinarski dom, 18.07.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 19.07.1994, 1 ♂, 1 ♀, leg. A. Vujić, S. Radenković, 07.06.1997, 1 ♀, leg. R. Mićić; Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 1 ♀, leg. P. Radišić, 15.05.1994, 1 ♀, leg. V. Milankov, 23.08.1996, 1 ♂, leg. S. Radenković; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 2 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.08.2022, 1 ♀, leg. T. Tot, 08.06.2022, 3 ♂♂, 2 ♀♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 05.06.1989, 1 ♀, leg. A. Vujić, 08.07.1989, 1 ♂, leg. A. Vujić, 03.06.1993, 1 ♀, leg. A. Vujić, 13.05.1994, 1 ♂, 1 ♀, leg. D. Radnović, 20.07.1994, 1 ♂, 2 ♀♀, leg. A. Vujić, S. Radenković, 13.08.1994, 4 ♀♀, leg. S. Šimić, 06.07.1995, 1 ♂, leg. A. Vujić, 22.08.1996, 7 ♂♂, leg. A. Vujić, S. Dragišić, R. Mićić, P. Radišić, 18.06.1997, 1 ♀, leg. A. Vujić, 25.07.1997, 2 ♂♂, 3 ♀♀, leg. A. Vujić, 21.08.1997, 1 ♂, 1 ♀, leg. A. Vujić, 09.06.2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: Malinik, 10.06. 1994, 1 ♂, leg. S. Radnović, 05.07.1995, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♂, leg. P. Radišić; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 29–30.07.1986, 2 ♀♀, leg. A. Vujić; Kučajske planine: Papratno – bukova šuma, 26.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno – mala kaptaža, 26.07.1986, 2 ♀♀, leg. A. Vujić; Kučajske planine: Požare, 21.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac, 21.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – livada, 22.07.1986, 1 ♀, leg. A. Vujić; 22.07.1986, 2 ♀♀, leg. A. Vujić, 28.07.1986, 1 ♀, leg. A. Vujić; Stara planina: Arbinje, 11.08.1987, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Babin zub, 16.07.1991, 1 ♀, leg. A. Vujić, 09.07.2011, 1 ♂, leg. A. Vujić, Stara planina: Crni vrh, 13.04.1988, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 1 ♂, leg. Z. Nedeljković; Stara planina: Dojkinci 2, 19.06.2017, 2 ♂♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Golema reka, 20.07.1991, 1 ♂, 3 ♀♀, leg. A. Vujić, 23.06.1991, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1987, 1 ♂, leg. A. Vujić, 14.07.1991, 2 ♀♀, leg. A. Vujić;

13.07.1991, Rekitska reka, 1 ♂, 2 ♀♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 4 ♀♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 2 ♂♂, leg. A. Vujić; Stara planina: spomenik, 30.04.1987, 1 ♀, leg. A. Vujić; Stara planina: Temska, 01.05.1987, 1 ♀, leg. A. Vujić, 10.06.2022, 2 ♀♀, leg. T. Tot; Stara planina: Temštica, 11.07.2011, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 10.06.2022, 5 ♀♀, leg. T. Tot; Stara planina: Zavojsko jezero, 22.07.1992, 1 ♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 2 ♂♂, 16 ♀♀, leg. A. Vujić, 14.07.1991, 1 ♂, 7 ♀♀, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 2 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Metasyrphus corollae* (Fabricius, 1794)); van Seenis et al., 2015.

Eupeodes flaviceps (Rondani, 1857)

Dubašnica-Malinik: Demižlok, 01.07.1998, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – livada, 22.07.1986, 1 ♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♀, leg. A. Vujić; Stara planina: sliv reke Temske, 30.04.1987, 1 ♂, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 1 ♀, leg. A. Vujić.

Eupeodes latifasciatus (Macquart, 1829)

Dubašnica-Malinik: klisura Lazareve reke, 22.08.1996, 1 ♀, leg. A. Vujić, 1 ♂, 25.08.1996, leg. P. Radišić, 30.06.1998, 1 ♀, leg. M. Došenović; Kučajske planine: Crnica – vlažne livade, 29–30.07.1986, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Temska, 01.05.1987, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05. 2017, 1 ♀, leg. B. Ivošević, M. Miličić; Stara planina: Topli Do, 10.06.2022, 1 ♂, leg. T. Tot.

Eupodes luniger (Meigen, 1822)

Besna kobila: Planinarski dom, 18.07.2017, 1 ♀, leg. A. Vujić, 19.07.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić, 04.06.1994, 1 ♂, 2 ♀♀, leg. A. Vujić, 12.06.1994, 2 ♂♂, 1 ♀, leg. V. Milankov, S. Radenković, P. Radišić, 14.06.1994, 1 ♂, leg. A. Vujić, 04.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 15.05.1994, 1 ♀, leg. D. Radnović, 21.05.1996, 1 ♀, leg. V. Milankov, 19.09.1997, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Jablanica, 24.07.1986, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 14.04.1991, 1 ♂, 1 ♀, leg. A. Vujić, 03.06.1993, 1 ♂, leg. P. Radišić, 29.04.1995, 2 ♂♂, 1 ♀, leg. A. Vujić, S. Radenković, 03.05.1996, 1 ♂, leg. A. Vujić, 19.04.1997, 1 ♂, 1 ♀, leg. A. Vujić, P. Radišić, 20.04.1997, 1 ♂, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.05.1996, 1 ♀, leg. S. Radenković; Kučajske planine: Papratno, 25.07.1986, 1 ♂, leg. A. Vujić, 27.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno – B. AP., 26.07.1986, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♀, leg. A. Vujić; Kučajske planine: Požare, 21.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, 4 ♀♀, leg. A. Vujić, 22.07.1986, 1 ♀, leg. A. Vujić, 25.07.1986, 2 ♂♂, leg. A. Vujić; Stara planina: Barska livada, 30.04.1987, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.07.1988, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Golema reka, 23.07. 1991, 1 ♂, leg. A. Vujić; Stara planina: Mala Lukanja, 01.05.1987, 1 ♀, leg. A. Vujić;

Stara planina: Midžor, 14.07.1991, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Temska – spomenik, 12.04.1988, 1 ♂, leg. A. Vujić, 05.04.1992, 1 ♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 2 ♂♂, leg. A. Vujić; Stara planina: Zavojsko jezero, 13.07.1992, 1 ♀, leg. A. Vujić, 22.07.1992, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Metasyrphus luniger* (Meigen, 1822)); van Seenis et al., 2015.

Eupeodes nielseni (Dušek & Láska, 1976)

Stara planina: Dojkinačka reka, 30.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić.

Eupeodes nitens (Zetterstedt, 1843)

Dubašnica-Malinik: Dubašnica, 16.05.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 2 ♀♀, leg. S. Dragišić; Stara planina: Dojkinačka reka, 06.05.1998, 2 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Metasyrphus nitens* (Zetterstedt, 1843)).

Fagisyrphus cinctus (Fallén, 1817)

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♀, leg. A. Vujić, 19–20.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 18.05.1996, 1 ♂, leg. N. Dožić, 21.05.1996, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 12.07.1985, 2 ♂♂, leg. A. Vujić, 31.04.1989, 2 ♂♂, leg. A. Vujić, 15.05. 1993, 1 ♂, leg. A. Vujić, 29.04.1995, 1 ♂, leg. A. Vujić, 13.07.1996, 1 ♀, leg. P. Radišić, Dubašnica-Malinik: Malinik, 01.05.1995, 1 ♂, leg. S. Radenković, Kučajske planine: Papratno, 26.07.1986, 1 ♀, leg. A. Vujić, 27.07.1986, 2 ♂♂, leg. A. Vujić; Kučajske planine: Sisevac, 21.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, 1 ♂, leg. A. Vujić; Stara planina: Arbinje, 26.06.1987, 1 ♀, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 06.05.1988, 1 ♀, leg. A. Vujić, 29–30.05. 1988, 1 ♂, leg. A. Vujić; Stara planina: Pilj, 07.05.1988, 2 ♂♂, 4 ♀♀, leg. A. Vujić; Stara planina: Topli Do, 28.05.1987, 3 ♀♀, leg. A. Vujić, Suva planina: Bojanine vode, 02.05.1988, 7 ♂♂, 2 ♀♀, leg. A. Vujić, 28.05.1988, 2 ♀♀, leg. A. Vujić; Suva planina: Gornja Studena – Bojanine vode, 02.05.1988, 5 ♂♂, 2 ♀♀, leg. A. Vujić; Jelašnica – Donja Studena, 02.05.1988, 4 ♂♂, 5 ♀♀, leg. A. Vujić; Suva planina: Jelašnica, 13.04.1991, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Melangyna cincta* (Fallén, 1817)); van Seenis et al., 2015.

Ferdinandea cuprea (Scopoli, 1763)

Dubašnica-Malinik: klisura Lazareve reke, 09.07.1985, 1 ♀, leg. A. Vujić, 01.04.1994, 1 ♀, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 26.07. 1986, 1 ♀, leg. P. Radišić; Stara planina: Temska, 30.04.2022, 1 ♀, leg. T. Tot.

Ferdinandea ruficornis (Fabricius, 1775)

Dubašnica-Malinik: Manastirište, 20.04.1997, 1 ♂, leg. A. Vujić.

Hammerschmidtia ferruginea (Fallén, 1817)

Published material: Šimić and Vujić, 1996; Vujić, 1991.

Helophilus pendulus (Linnaeus, 1758)

Dubašnica-Malinik: Demižlok, 19.07.1994, 1 ♂, leg. A. Vujić, 23.08.1995, 1 ♂, leg. P. Radišić, 01.07.1998, 1 ♂, leg. A. Vujić, 22.07.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 1 ♂, leg. S. Radenković; Dubašnica-Malinik: klisura Lazareve reke, 03.06.1993, 1 ♂, leg. P. Radišić, 29.04.1997, 1 ♂, leg. P. Radišić, 18.06.1997, 1 ♀, leg. A. Vujić, 19.09.1997, 1 ♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 2 ♂♂, leg. A. Vujić.

Helophilus trivittatus (Fabricius, 1805)

Besna kobila: Planinarski dom, 12.09.2020, 1 ♀, leg. A. Vujić, L. Likov, M. Ranković, T. Tot; Besna kobila: Planinarski dom 3, 29.06.2019, 1 ♀, leg. A. Vujić; Besna kobila: Planinarski dom 4, 12.09.2020, 1 ♀, leg. A. Vujić, L. Likov, M. Ranković, T. Tot; Dubašnica-Malinik: Demižlok, 23.08.1995, 1 ♀, leg. A. Vujić, 19–20.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1996, 1 ♀, leg. P. Radišić; Dubašnica-Malinik: klisura Lazareve reke, 22.08.1995, 1 ♂, 1 ♀, leg. A. Vujić, P. Radišić, 19.09.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 14.08.1994, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac, 22.07.1986, 1 ♀, leg. A. Vujić, 25.07.1986, 1 ♀, leg. A. Vujić.

Lapposyrphus lapponicus (Zetterstedt, 1838)

Besna kobila: Klisurica, 19.07.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. V. Milankov, 14.06.1994, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♀, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♀, leg. A. Vujić, L. Likov, S. Radenković; Dubašnica-Malinik: Malinik, 10.06.1994, 1 ♀, leg. S. Radnović; Dubašnica-Malinik: Manastirište, 07.06.1997, 1 ♂, leg. P. Radišić; Stara planina: Arbinje, 11.08.1987, 1 ♂, 2 ♀♀, leg. A. Vujić, 20.06.2012, 3 ♂♂, leg. A. Vujić; Stara planina: Babin zub, 21.06.2012, 2 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Crni vrh, 31.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 06.05.1988, 1 ♀, leg. A. Vujić, 30.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 4 ♂♂, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Metasyrphus lapponicus* Zetterstedt, 1838); van Seenis et al., 2015.

Lejogaster tarsata (Meigen, 1822)

Published material: van Seenis et al., 2015; Vujić, 1999a.

Lejota ruficornis (Zetterstedt, 1843)

Stara planina: Topli Do-Pilj, 25.06.1987, 1 ♂ leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Leucozona lucorum (Linnaeus, 1758)

Dubašnica-Malinik: Demižlok, 19–20.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 22.06.1985, 1 ♂, leg. A. Vujić, 06.06.1993, 1 ♀, leg. A. Vujić, 21.05.1996, 1 ♀, leg. A. Vujić, 02.06.1996, 1 ♀, leg. M. Živković; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♀, leg. S. Radnović; Dubašnica-Malinik: Malinik, 03.06.1995, 1 ♂, leg. A. Vujić; Stara planina: Babin zub, 21.06.2012, 1 ♂, leg. A. Vujić.

Mallota fuciformis (Fabricius, 1794)

Dubašnica-Malinik: Manastirište, 20.04.1997, 1 ♂, leg. A. Vujić.

Matsumyia berberina (Fabricius, 1805)

Dubašnica-Malinik: Demižlok, 14.05.1994, 2 ♂♂, leg. D. Radnović.

Published material: Šimić and Vujić, 1996 (as *Brachymia berberina* (Fabricius, 1805)); Vujić and Milankov, 1990, 1999.

Megasyrphus erraticus (Linnaeus, 1758)

Dubašnica-Malinik: Dubašnica, 16.05.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 2 ♀♀, leg. P. Radišić, D. Radnović, Stara planina: Arbinje, 26.06.1987, 2 ♀♀, leg. A. Vujić, 20.06.2012, 1 ♀, leg. A. Vujić.

Melangyna compositarum (Verrall, 1873)

Dubašnica-Malinik: klisura Lazareve reke, 28.03.1989, 7 ♂♂, 3 ♀♀, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. M. Milićić, Z. Nedeljković, T. Tot; Stara planina: Pilj, 07.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Topli Do-Pilj, 11.08.1987, 1 ♂, leg. A. Vujić.

Melangyna guttata (Fallén, 1817)

Dubašnica-Malinik: Brestovačka banja, 08.07.1985, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♂, 1 ♀, leg. A. Vujić; 25.08.1996, 1 ♂, leg. P. Radišić; Kučajske planine: Sisevac – potok, 28.07.1986, 1 ♂, leg. A. Vujić.

Melangyna lasiophthalma (Zetterstedt, 1843)

Besna kobila: Planinarski dom 2, 03.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Malinik, 29.04.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Stara planina: Barska livada, 30.04.1987, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05.1987, 1 ♂, leg. A. Vujić, 06.05.1988, 2 ♂♂, 6 ♀♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Stara planina: Kalna, 31.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Pilj, 07.05.1988, 1 ♂, 2 ♀♀, leg. A. Vujić; Stara planina: Planinica, 11.04.1988, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Rsovci, 02.05.1987, 2 ♂♂, 5 ♀♀, leg. A. Vujić; Stara planina: Ržana – Dojkinci, 12.04.1988, 2 ♀♀, leg. A. Vujić; Stara planina: spomenik, 30.04.1987, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 28.05.1987, 2 ♀♀, leg. A. Vujić; Stara planina: Topli Do-Pilj, 28.05.1987, 2 ♂♂, 3 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Melanogaster curvistylus Vujić & Stuke, 1998

Published material: Vujić and Stuke, 1998.

Melanogaster nuda (Macquart, 1829)

Dubašnica-Malinik: Demižlok, 04.06.1995, 3 ♀♀, leg. A. Vujić; 12.06.1994, 1 ♂, 1 ♀, leg. A. Vujić, D. Radnović, 4 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. A. Vujić, 15.05.1994, 2 ♂♂, 1 ♀, leg. A. Vujić, 18.05.1996, 1 ♂, leg. N. Dožić, 03.06.1996, 3 ♂♂, 3 ♀♀, leg. S. Radenković; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 09.06.2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Chrysogaster lucida* (Scopoli, 1763)); van Steenis et al., 2015.

Melanostoma mellinum (Linnaeus, 1758)

Besna kobila: Planinarski dom, 19.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 12.06.1994, 2 ♀♀, leg. S. Radenković, P. Radišić, 19.07.1994, 1 ♂, leg. S. Radenković, 01.07.1998, 2 ♀♀, leg. D. Dević; 03.06.1996, 1 ♀, leg. S. Radenković, 23.08.1996, 1 ♂, leg. A. Vujić, 22.08.1997, 1 ♂, 1 ♀, leg. A. Vujić, 19.09.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Jablanica, 24.07.1986, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 08–09.07.1985, 1 ♂, 1 ♀, leg. A. Vujić, 13.08.1994, 1 ♂, leg. S. Šimić, 29.04.1995, 1 ♀, leg. P. Radišić, 18.06.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 11.07.1985, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 01.05.1989, 1 ♀, leg. A. Vujić, 03.06.1989, 1 ♀, leg. A. Vujić, 18.05.1996, 1 ♀, leg. N. Dožić; Dubašnica-Malinik: Malinik – put, 10.07.1985, 1 ♀, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 21.07.1986, 2 ♂♂, 1 ♀, leg. A. Vujić, 23.07.1986, 2 ♂♂, 3 ♀♀, leg. A. Vujić, 26.07.1986, 5 ♂♂, 5 ♀♀, leg. A. Vujić, 29–30.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno, 25.07.1986, 1 ♀, leg. A. Vujić, 26.07.1986, 1 ♂, leg. A. Vujić, 27.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno – bukova šuma, 26.07.1986, 1 ♂, 1 ♀, leg. A. Vujić; Kučajske planine: Požare, 21.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac, 21.07.1986, 3 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac – livada 22.07.1986, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, 1 ♂, leg. A. Vujić, 28.07.1986, 2 ♂♂, leg. A. Vujić; Stara planina: Arbinje, 26.06.1987, 1 ♂, leg. A. Vujić, 20.06.2012, 1 ♀, leg. A. Vujić; Stara planina: Babin zub, 20.07.1991, 1 ♂, leg. A. Vujić, 21.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Crni vrh, 31.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Golema reka, 20.07.1991, 2 ♀♀, leg. A. Vujić, 23.07.1991, 2 ♀♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 12.07.1991, 1 ♀, leg. A. Vujić, 21.07.1991, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 2 ♀♀, leg. A. Vujić; Stara planina: Temska, 18.07.1992, 1 ♀, leg. A. Vujić; Stara planina: Temštica, 11.07.2011, 6 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Melanostoma scalare (Fabricius, 1794)

Dubašnica-Malinik: Demižlok, 01.07.1998, 1 ♀, leg. D. Dević; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1996, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♀, leg. A. Vujić, 19.04.1997, 1 ♀, leg. P. Radišić; Dubašnica-Malinik: Malinik, 01.05.1989, 1 ♂, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 21.07.1986, 1 ♂, leg. A. Vujić, 23.07.1986, 1 ♀, leg. A. Vujić, 26.07.1986, 2 ♂♂, 6 ♀♀, leg. A. Vujić; Kučajske planine: Papratno – mala kaptaža, 26.07.1986, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♀, leg. S. Šimić; Kučajske planine: Sisevac – livada, 25.07.1986, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 1, 19.06.2017, 3 ♀♀, leg. Z. Nedeljković; Stara planina:

Dojkinci 2, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Temska, 18.07.1992, 1 ♂, leg. A. Vujić; Stara planina: Temštica, 11.07.2011, 1 ♂, leg. A. Vujić; Suva planina: Bancarevo, 16.07.1989, 1 ♂, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Meligramma euchroma (Kowarz, 1885)

Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić, 03.05.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 14.05.1994, 2 ♀♀, leg. A. Vujić, 30.04.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 15.05.1993, 1 ♀, leg. A. Vujić, 29.04.1995, 2 ♂♂, leg. A. Vujić, P. Radišić, 21.05.1996, 2 ♀♀, leg. A. Vujić, 01.06.1996, 3 ♀♀, leg. A. Vujić, S. Radenković, 19.04.1997, 18 ♂♂, 1 ♀, leg. A. Vujić, P. Radišić, D. Radnović, 20.04.1997, 2 ♂♂, leg. A. Vujić, 29.04.1997, 3 ♂♂, 1 ♀, leg. A. Vujić, P. Radišić; Dubašnica-Malinik: Malinik, 03.05.1994, 1 ♀, leg. A. Vujić, 03.05.1996, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.05.1996, 1 ♂, leg. M. Radišić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. A. Vujić, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot.

Meligramma guttata (Fallén, 1817)

Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot.

Meliscaeva auricollis (Meigen, 1822)

Dubašnica-Malinik: Demižlok, 19.07.1994, 1 ♂, leg. S. Radenković, 19–20.05.1996, 1 ♂, leg. A. Vujić, 23.06.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. S. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 08–09.07.1985, 2 ♂♂, 1 ♀, leg. A. Vujić, 12.07.1985, 1 ♂, leg. A. Vujić, 05.06.1989, 1 ♂, leg. A. Vujić, 03.06.1993, 1 ♂, leg. P. Radišić, 11.06.1994, leg. P. Radišić, 03.05.1996, 1 ♂, leg. A. Vujić, 29.04.1997, 2 ♂♂, leg. S. Dragišić, P. Radišić; Dubašnica-Malinik: Malinik, 03.06.1989, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 1 ♂, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 3 ♂♂, leg. A. Vujić; Stara planina: Arbinje, 11.08.1987, 1 ♂, leg. A. Vujić; Stara planina: Babin zub, 20.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Golema reka, 23.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Planinica, 27.05.1987, 1 ♀, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 1 ♀, leg. A. Vujić.

Published material: van Seenis et al., 2015.

Meliscaeva cinctella (Zetterstedt, 1843)

Dubašnica-Malinik: klisura Lazareve reke, 05.05.2012, 1 ♂, leg. A. Vujić, L. Likov, S. Radenković; Kučajske planine: Papratno, 27.07.1986, 1 ♂, leg. A. Vujić; Stara planina: Arbinje, 26.06.1987, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Merodon aberrans Egger, 1860

Besna kobila: Planinarski dom, 18.07.2017, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 01.07.1998, 1 ♂, leg. D. Dević; Dubašnica-Malinik: Dubašnica 1, 01.07.2019, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 08.06.2022,

1 ♂, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 12.07.1985, 1 ♀, leg. A. Vujić, 08.07.1989, 10 ♂♂, 4 ♀♀, leg. A. Vujić, 06.07.1995, 1 ♂, leg. A. Vujić, 14.07.1996, 1 ♀, leg. A. Vujić, 18.06.1997, 1 ♂, leg. A. Vujić, 30.06.1998, 6 ♂♂, 3 ♀♀, leg. A. Vujić, D. Dević, 22.06.2012, 1 ♂, 1 ♀, leg. A. Vujić, 01.07. 2019, 1 ♂, leg. A. Vujić, B. Ivošević, M. Janković, M. Miličić; Dubašnica-Malinik: Malinik, 10.07.1985, 3 ♂♂, 2 ♀♀, leg. A. Vujić, 13.07.1985, 1 ♀, leg. A. Vujić, 10.06.1994, 4 ♂♂, leg. S. Radenković, M. Radišić, 05.07.1995, 3 ♂♂, leg. A. Vujić, S. Radenković, 06.07.1995, 2 ♂♂, leg. S. Radenković, 07.07.1995, 4 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 14 ♂♂, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 26.07.1986, 1 ♀, leg. A. Vujić; Stara planina: iznad Toplog Dola, 20.07.2017, 1 ♀, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Temštica, 10.07.2011, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 20.07.2017, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Merodon aerarius Rondani, 1857

Besna kobila: Planinarski dom, 18.07.2017, 6 ♂♂, leg. A. Vujić; Stara planina: Babin zub, 24.08.2013, 19 ♂♂, 13 ♀♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinačka reka 3, 25.08.2013, 4 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♀, leg. A. Vujić; Stara planina: iznad Arbinja, 26.08.2013, 1 ♂, leg. A. Vujić; Stara planina: Topli Do-Pilj, 11.08.1987, 1 ♂, 1 ♀, leg. A. Vujić.

Merodon cinereus (Fabricius, 1794)

Besna kobila: Planinarski dom, 18.07.2017, 23 ♂♂, 8 ♀♀, leg. A. Vujić, 19.07.2017, 3 ♂♂, leg. A. Vujić; Stara planina: Arbinje, 11.08.1987, 6 ♂♂, 7 ♀♀, leg. A. Vujić; Stara planina: Babin zub, 20.07.1991, 1 ♂, leg. A. Vujić; Stara planina: iznad Arbinja, 26.08.2013, 3 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Merodon albifrons Meigen, 1822

Dubašnica-Malinik: klisura Lazareve reke, 13.08.1994, 1 ♀, leg. A. Vujić.

Merodon analis Meigen, 1822

Dubašnica-Malinik: ka Maliniku, 27.08.2022, 1 ♀, leg. T. Tot; Dubašnica--Malinik: klisura Lazareve reke, 27.08.2022, 1 ♂, 1 ♀, leg. T. Tot.

Published material: Vujić et al., 2020.

Merodon armipes Rondani, 1843

Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 4 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.05.2012, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Stara planina: put ka Babinom zubu, 01.06.2013, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić et al., 2012.

Merodon aureus Fabricius, 1805

Stara planina: Babin zub, 11 ♂♂, 3 ♀♀, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 1 ♂, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Merodon aeneus* Meigen, 1822).

Merodon auripes Sack, 1913

Published material: Vujić et al., 2012.

Merodon avidus (Rossi, 1790)

Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 08.06.2022, 2 ♀♀, leg. T. Tot, 27.08.2022, 2 ♂♂, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 05.06.1989, 1 ♀, leg. A. Vujić, 03.05.1994, 2 ♀♀, leg. A. Vujić, 11.06.1994, 2 ♂♂, leg. A. Vujić, 20.07.1994, 1 ♂, leg. A. Vujić, 13.08.1994, 10 ♂♂, leg. A. Vujić, 24.08.1995, 1 ♂, leg. A. Vujić, 01.06.1996, 4 ♂♂, leg. A. Vujić, 22.08.1996, 1 ♂, leg. A. Vujić, 25.07.1997, 2 ♂♂, 1 ♀, leg. A. Vujić, 21.08.1997, 2 ♂♂, 1 ♀, leg. A. Vujić, 19.09.1997, 8 ♂♂, leg. A. Vujić, 23.08.2013, 4 ♂♂, 4 ♀♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić, 18.06.2020, 1 ♂, leg. A. Vujić, L. Likov, T. Tot, L. Velaja, 09.06.2022, 1 ♂, leg. T. Tot; Dubašnica-Malinik: Manastirište, 08.06.1997, 1 ♂, leg. A. Vujić, 17.06.1997, 1 ♂, leg. A. Vujić, 24.05.2013, 8 ♂♂, 2 ♀♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Dubašnica-Malinik: uspon na Malinik, 02.06.1995, 4 ♂♂, leg. A. Vujić; Stara planina: Temska, 10.06.2022, 1 ♂, 1 ♀, leg. T. Tot, 28.08.2022, 1 ♂, leg. T. Tot.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Merodon balkanicus Šašić, Ačanski & Vujić, 2017

Stara planina: Babin zub, 11.07.2011, 8 ♂♂, 3 ♀♀, leg. A. Vujić; Stara planina: iznad Arbinja, 26.08.2013, 2 ♀♀, leg. A. Vujić.

Merodon bessarabicus Paramonov, 1924

Stara planina: Dojkinačka reka, 25.08.2013, 22 ♂♂, 13 ♀♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinačka reka 2, 25.08.2013, 11 ♂♂, 3 ♀♀, leg. A. Vujić.

Merodon calidus Šašić Zorić, Ačanski & Vujić, 2020

Stara planina: Babin zub, 21.06.2009, 1 ♂, leg. A. Vujić, 21.06.2012, 10 ♂♂, leg. A. Vujić; Stara planina: Temska, 10.06.2022, 1 ♂, leg. T. Tot.

Merodon chalybeatus Sack, 1913

Dubašnica-Malinik: klisura Lazareve reke, 13.08.1994, 3 ♂♂, leg. A. Vujić.

Merodon clavipes (Fabricius, 1781)

Dubašnica-Malinik: klisura Lazareve reke, 05.06.1989, 1 ♂, leg. A. Vujić, 11.06.1994, 1 ♂, leg. V. Milankov, 18.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 10.06.1994, 2 ♂♂, leg. A. Vujić, P. Radišić, 03.06.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 1 ♂, 1 ♀, leg. A. Vujić, 03.05.2012, 1 ♀, leg. A. Vujić; Stara planina: spomenik, 26.06.1987, 1 ♂, leg. A. Vujić; Stara planina: Topli Do-Pilj, 26.06.1987, 1 ♂, leg. A. Vujić; Suva planina: Čukljenik – Donja Studena, 28.05.1988, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Merodon desuturinus Vujić, Šimić & Radenković, 1995

Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. A. Vujić.

Published material: van Seenis et al., 2015.

Merodon equestris (Fabricius, 1794)

Dubašnica-Malinik: Demižlok, 08.06.2011, 2 ♂♂, leg. A. Vujić.

Published material: van Seenis et al., 2015.

Merodon loewi van der Goot, 1964

Dubašnica-Malinik: Malinik, 29.04.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 2 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Suva planina: Bancarevo, 16.04.2011, 7 ♂♂, 3 ♀♀, leg. A. Vujić.

Published material: Vujić et al., 2012.

Merodon moenium Wiedemann, 1822

Besna kobila: Planinarski dom 2, 06.06.1993, 4 ♂♂, leg. A. Vujić, P. Radišić, S. Radnović, 14.06.1994, 2 ♂♂, leg. A. Vujić, 29.06.2019, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♂, leg. A. Vujić, 07.06.1997, 1 ♂, leg. A. Vujić, 01.07.1998, 1 ♂, leg. D. Dević, 08.06.2011, 3 ♂♂, leg. A. Vujić, 23.06.2012, 1 ♂, leg. A. Vujić, 22.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 20.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Dubašnica Lunga, 01.07.1998, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 1 ♂, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 12.07.1985, 1 ♂, leg. A. Vujić, 31.04.1989, 2 ♂♂, leg. A. Vujić, 05.06.1989, 1 ♂, 1 ♀, leg. A. Vujić, 06.06.1989, 08.07.1989, 8 ♂♂, 4 ♀♀, leg. A. Vujić, 1 ♂, leg. A. Vujić, 03.06.1993, 3 ♂♂, leg. A. Vujić, D. Radnović, 16.07.1993, 4 ♂♂, leg. A. Vujić, P. Radišić, 13.08.1995, 1 ♂, leg. A. Vujić, 3 ♂♂, leg. A. Vujić, P. Radišić, 01.06.1996, 2 ♂♂, leg. A. Vujić, 14.07.1996, 5 ♂♂, leg. A. Vujić, 25.07.1997, 3 ♂♂, 3 ♀♀, leg. A. Vujić, 21.08.1997, 2 ♂♂, leg. A. Vujić, 30.06.1998, 18 ♂♂, leg. A. Vujić, 04.05.2012, 1 ♀, leg. A. Vujić, 22.06.2012, 17 ♂♂, 2 ♀♀, leg. A. Vujić, 01.07.2019, 1 ♂, leg. A. Vujić, B. Ivošević, M. Janković, M. Miličić; Dubašnica-Malinik: Malinik, 10.06.1994, 7 ♂♂, 1 ♀, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, S. Radnović, 21.07.2017, 4 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište: 17.06.1997, 1 ♂, leg. A. Vujić; 22.06.2012, 10 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06. 1993, 2 ♂♂, leg. A. Vujić; Kučajske planine: Požare, 24.07.1986, 2 ♂♂, leg. A. Vujić; Stara planina: Arbinje, 26.06.1987, 7 ♂♂, 1 ♀, leg. A. Vujić; 20.06.2012, 2 ♂♂, leg. A. Vujić; Stara planina: Babin zub, 21.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 02.06.2013, 10 ♂♂, 4 ♀♀, leg. A. Vujić; Stara planina: Dojkinačka reka – Arbinje, 02.07.2012, 1 ♂, leg. P. Radišić; Stara planina: Dojkinci, 20.06.2012, 23 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: iznad Toplog Dola, 20.07.2017, 4 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Planinica, 27.06.1987, 3 ♂♂, leg. A. Vujić; Stara planina: Rsovci, 08.06. 2009, 1 ♂, leg. J. van Steenis; Stara planina: sliv Rekitske reke, 21.07.1991, 8 ♀♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 7 ♂♂, 3 ♀♀, leg. A. Vujić; Stara planina: Temštica 18.07.1992, 1 ♂, leg. A. Vujić, 10.07.2011, 16 ♂♂, leg. A. Vujić; Stara planina: Topli Do, 20.07.2017, 1 ♂, leg. A. Vujić, 25.06.1987, 2 ♂♂, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 3 ♂♂, leg. A. Vujić, 14.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 2 ♂♂, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♂, leg. A. Vujić.

Published material: van Seenis et al., 2015.

Merodon nigritarsis Rondani, 1845

Dubašnica-Malinik: klisura Lazareve reke, 05.06.1989, 2 ♂♂, 2 ♀♀, leg. A. Vujić, 30.06.1998, 1 ♂, leg. A. Vujić, 07.06.2000, 1 ♂, leg. S. Radenković; Dubašnica-Malinik: Manastirište, 17.06.1997, 7 ♂♂, 2 ♀♀, leg. A. Vujić, V. Milankov.

Merodon obscuritarsis Strobl, 1909

Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 24.08.1995, 1 ♀, leg. A. Vujić; Stara planina: Arbinje, 11.08.1987, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Babin zub, 24.08.2013, 2 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinačka reka, 25.08.2013, 2 ♀♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinačka reka 2, 25.08.2013, 1 ♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: Dojkinačka reka 3, 25.08.2013, 7 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, L. Likov, M. Miličić; Stara planina: iznad Arbinja, 26.08.2013, 3 ♂♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Merodon tricinctus* Sack, 1913).

Merodon ruficornis Meigen, 1822

Dubašnica-Malinik: klisura Lazareve reke, 27.04.2017, 1 ♂, leg. A. Vujić; Stara planina: Temska, 30.04.2022, 1 ♂, leg. T. Tot.

Published material: Šimić and Vujić, 1996 (as *Merodon strobli* Bradescu, 1986); Vujić et al., 2012.

Merodon trebevicensis Strobl, 1900

Dubašnica-Malinik: Demižlok, 08.06.2011, 8 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 20.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Merodon crymensis* Paramonov, 1925); Vujić et al., 2012.

Microdon devius (Linnaeus, 1761)

Stara planina: Dojkinci 2, 19.06.2017, 6 ♂♂, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot.

Published material: van Seenis et al., 2015.

Microdon miki Doczkal & Schmid, 1999

Published material: van Seenis et al., 2015.

Microdon mutabilis (Linnaeus, 1758) ***/ Microdon myrmicae*** Schönrogge, Barr, Wardlaw, Napper, Gardner, Breen, Elmes & Thomas, 2002

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Myathropa florea (Linnaeus, 1758)

Besna kobila: Planinarski dom 3, 29.06.2019, 1 ♀, leg. A. Vujić; Besna kobila: Planinarski dom 4, 12.09.2020, 1 ♀, leg. A. Vujić, L. Likov, M. Ranković, T. Tot; Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: Demižlok, 01.07.1998, 2 ♂♂, 1 ♀, leg. D. Dević; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♀, leg. D. Radnović; Dubašnica-Malinik: Jablanica, 24.07.1986, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 11.07.1985, 1 ♂, leg. P. Radišić, 12.07.1985, 1 ♀,

leg. P. Radišić, 03.06.1993, 1 ♂, leg. P. Radišić, 16.07.1993, 1 ♀, leg. P. Radišić, 13.08.1994, 1 ♀, leg. S. Šimić, 25.07.1997, 2 ♂♂, 2 ♀♀, leg. D. Dević, 18.06.2020, 1 ♀, leg. A. Vujić, L. Likov, T. Tot, L. Velaja; Dubašnica-Malinik: Malinik, 07.07.1985, 1 ♀, leg. D. Radnović, 11.07.1993, 2 ♀♀, leg. D. Radnović, 10.06. 1994, 1 ♂, leg. D. Radnović, 05.07.1995, 1 ♂, leg. R. Mićić; Dubašnica-Malinik: Manastirište, 17.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, leg. P. Radišić, 22.08.1996, 1 ♂, leg. S. Dragišić; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 3 ♀♀, leg. P. Radišić, 26.07.1986, 2 ♂♂, 2 ♀♀, leg. P. Radišić; Kučajske planine: Papratno, 26.07.1986, 2 ♂♂, leg. P. Radišić, 27.07.1986, 3 ♂♂, 1 ♀, leg. P. Radišić; Kučajske planine: Požare, 07.1986, 1 ♂, 1 ♀, leg. P. Radišić; Kučajske planine: Sisevac, 21.07.1986, 2 ♂♂, 1 ♀, leg. D. Radnović; 24.07.1986, 2 ♂♂, leg. D. Radnović; Dubašnica-Malinik: ka Maliniku, 08.06.2022, 2 ♂♂, leg. T. Tot, 27.08.2022, 7 ♂♂, 2 ♀♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 27.08.2022, 2 ♀♀, leg. T. Tot; Stara planina: Arbinje, 11.08.1987, 1 ♀, leg. S. Šimić; Stara planina: Dojkinci 1, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Golema reka, 20.07.1991, 1 ♂, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 2 ♂♂, leg. A. Vujić; Stara planina: Temska, 28.08.2022, 8 ♂♂, 2 ♀♀, leg. T. Tot; Stara planina: Topli Do, 28.08.2022, 2 ♂♂, leg. T. Tot; Stara planina: Topli Do-Pilj, 25.06.1987, 1 ♀, leg. A. Vujić; Stara planina: Zavojsko jezero, 13.07.1992, 1 ♂, leg. D. Radnović, Suva planina: Bojanine vode, 28.05.1988, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Myiathropa florea* (Linnaeus, 1758)); van Seenis et al., 2015.

Myolepta dubia (Fabricius, 1805)

Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: Demižlok, 12.06.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 25.07.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 05.07.1995, 1 ♀, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 07.06.1997, 1 ♂, leg. P. Radišić; Kučajske planine: Papratno, 26.07.1986, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Topli Do-Pilj, 25.06.1987, 1 ♀, leg. A. Vujić.

Published material: Glumac, 1955.

Myolepta nigritarsis Coe, 1957

Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 22.06.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: uspon na Malinik, 02.06.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Podgorac, 02.06.1996, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Myiolepta nigritarsis* Coe, 1957).

Myolepta obscura (Becher, 1882)

Dubašnica-Malinik: Malinik, 03.06.1995, 1 ♀, leg. R. Mićić.

Myolepta potens (Harris, 1780)

Besna kobila: Planinarski dom, 19.07.2017, 1 ♀, leg. A. Vujić; Dubašnica--Malinik: Malinik, 03.06.1989, 3 ♂♂, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić.

Myolepta vara (Panzer, 1798)

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1986, 1 ♂, leg. A. Vujić, 06.06.1993, 1 ♂, leg. S. Radenković, 18.05.1996, 1 ♀, leg. N. Dožić; Dubašnica-Malinik: klisura Lazareve reke, 19.04.1997, 1 ♂, leg. R. Mićić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Zlot, 02.06.1983, 1 ♂, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Neoascia annexa (Müller, 1776)

Dubašnica-Malinik: Demižlok, 19–20.05.1996, 1 ♂, leg. A. Vujić, 07.06. 1997, 6 ♂♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 31.04.1989, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 18.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♂, leg. P. Radišić; Stara planina: Topli Do, 10.06.2022, 1 ♀, leg. T. Tot.

Published material: Šimić and Vujić, 1996; van Seenis et al., 2015.

Neoascia meticulosa (Scopoli, 1763)

Dubašnica-Malinik: Dubašnica, 16.05.1993, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1990; van Seenis et al., 2015.

Neoascia obliqua Coe, 1940

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♀, leg. A. Vujić, 22.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 16.07.1993, 1 ♀, leg. P. Radišić, 03.05.1996, 1 ♀, leg. P. Radišić; Kučajske planine: Crnica, 07.1986, 1 ♂, leg. A. Vujić, 29–30.1986, 1 ♂, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno – potok, 25.07.1986, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Crni vrh, 31.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Čukljenik, 20.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Stara planina: iznad Toplog Dola, 20.07.2017, 1 ♀, leg. A. Vujić; Suva planina: Jelašnica – Donja Studena, 02.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Kalna, 08.05.1988, 2 ♂♂, 1 ♀, leg. A. Vujić; Suva planina: Bancarevo, 16.07.1989, 2 ♂♂, 3 ♀♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 4 ♂♂, leg. P. Radišić, D. Radnović.

Published material: Šimić and Vujić, 1996.

Neoascia podagrica (Fabricius, 1775)

Dubašnica-Malinik: Brestovačka banja, 24.04.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić, 04.05.1996, 1 ♂, leg. A. Vujić, 19–20.05.1996, 2 ♂♂, leg. A. Vujić, V. Milankov, 25.08.1996, 1 ♂, leg. P. Radišić, 07.06.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 18.05. 1996, 1 ♂, leg. N. Dožić; Dubašnica-Malinik: klisura Lazareve reke, 22.08.1995, 1 ♀, leg. P. Radišić, 03.05.1996, 1 ♂, leg. A. Vujić; Stara planina: iznad Toplog Dola, 20.07.2017, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 10.06.2022, 1 ♂,

leg. T. Tot; Suva planina: Bancarevo, 16.07.1989, 7 ♂♂, 1 ♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♂, leg. S. Radenković.

Published material: Šimić and Vujić, 1996.

Neoascia tenur (Harris, 1780)

Dubašnica-Malinik: Dubašnica Lunga, 15.05.1994, 1 ♀, leg. A. Vujić, 18.05.1996, 1 ♀, leg. N. Dožić, 22.08.1997, 2 ♂♂, leg. A. Vujić, 19.09.1997, 1 ♀, leg. A. Vujić.

Neoascia unifasciata (Strobl, 1898)

Dubašnica-Malinik: Demižlok, 14.05.1994, 2 ♂♂ 1 ♀, leg. A. Vujić, 19–20.05. 1996, 1 ♂, leg. A. Vujić, 07.06.1997, 12 ♂♂, leg. A. Vujić, P. Radišić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♀, leg. S. Radenković.

Published material: Šimić and Vujić, 1996; Vujić, 1990.

Neocnemodon brevidens (Egger, 1865)

Dubašnica-Malinik: klisura Lazareve reke, 14.07.1996, 3 ♀♀, leg. S. Radenković, P. Radišić, 22.08.1996, 1 ♀, leg. P. Radišić.

Published material: Vujić, 1999b.

Neocnemodon larusi Vujić, 1999

Stara planina: Dojkinci 1, 01.05.2017, 1 ♂, leg. M. Miličić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♂, leg. A. Vujić.

Neocnemodon latitarsis (Egger, 1865)

Dubašnica-Malinik: klisura Lazareve reke, 03.05.1996, 1 ♂, leg. P. Radišić.

Published material: Vujić, 1999b.

Neocnemodon pubescens (Delucchi & Pschorn Walcher, 1955)

Published material: Šimić and Vujić, 1996; Vujić, 1999b.

Orthonevra montana Vujić, 1999

Published material: Vujić, 1999a.

Orthonevra nobilis (Fallén, 1817)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♀, leg. V. Milankov; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 1 ♂, leg. M. Miličić, 27.08.2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 25.07.1997, 2 ♀♀, leg. A. Vujić, 21.08.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♂, 1 ♀, leg. A. Vujić, P. Radišić.

Published material: van Seenis et al., 2015.

Paragus aff. ***testaceus***

Dubašnica-Malinik: klisura Lazareve reke, 25.07.1997, 2 ♂♂, leg. A. Vujić.

Paragus albifrons (Fallén, 1817)

Dubašnica-Malinik: klisura Lazareve reke, 05.06.1989, 1 ♀, leg. A. Vujić, 03.06.1993, 1 ♀, leg. A. Vujić.

Paragus bicolor (Fabricius, 1794)

Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 08.07.1985, 1 ♀, leg. S. Dragin, 05.06.1989, 1 ♀, leg. A. Vujić, 13.05.1994, 1 ♀, leg. S. Radenković, 13.08.1994, 1 ♂, leg. S. Šimić, 21.08.1997, 1 ♂, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♂, leg. A. Vujić.

Paragus constrictus Šimić, 1986

Dubašnica-Malinik: klisura Lazareve reke, 22.08.1995, 1 ♂, leg. M. Radišić, 25.07.1997, 2 ♂♂, leg. A. Vujić, 21.08.1997, 4 ♂♂, leg. A. Vujić; Stara planina: Topli Do, 1 ♂, 28.08.2022, leg. T. Tot.

Paragus finitimus Goeldlin, 1971

Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♂, leg. A. Vujić, 19.09.1997, 1 ♂, leg. A. Vujić.

Paragus haemorrhous Meigen, 1822

Dubašnica-Malinik: Brestovačka banja, 08.07.1985, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 20.06.2017, 1 ♂, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 2 ♂♂, leg. B. Ivošević, M. Miličić, 11.10.2018, 3 ♂♂, leg. B. Ivošević, M. Janković, M. Miličić, 08.06.2022, 1 ♂, 1 ♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 08.07.1989, 1 ♂, leg. A. Vujić, 20.07.1994, 1 ♀, leg. A. Vujić, 13.08.1994, 2 ♀♀, leg. S. Šimić, 22.08.1995, 4 ♂♂, 2 ♀♀, leg. A. Vujić, M. Radišić, P. Radišić, 14.07.1996, 1 ♀, leg. A. Vujić, 25.07.1997, 1 ♂, 4 ♀♀, leg. A. Vujić, 21.08. 1997, 2 ♂♂, 1 ♀, leg. A. Vujić, 19.09.1997, 1 ♂, leg. A. Vujić, 30.06.1998, 1 ♀, leg. A. Vujić, 01.07.2019, 2 ♂♂, leg. A. Vujić, B. Ivošević, M. Janković, M. Miličić, 28.04.2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: Malinik, 07.07.1985, 1 ♂, 1 ♀, leg. A. Vujić, 10.07.1985, 1 ♂, leg. A. Vujić, 10.06.1994, 1 ♂, 1 ♀, leg. V. Milankov, 18.07.1994, 2 ♂♂, 1 ♀, leg. S. Radnović, 05.07.1995, 2 ♂♂, leg. S. Radenković, 26.07.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.05.1996, 1 ♂, leg. M. Radišić; Kučajske planine: Crnica – vlažne livade, 21.07.1986, 1 ♂, leg. A. Vujić, 23.07.1986, 4 ♂♂, leg. A. Vujić, 29–30.07.1986, 2 ♀♀, leg. A. Vujić; Kučajske planine: Papratno, 25.07.1986, 2 ♀♀, leg. A. Vujić; Kučajske planine: Papratno – bukova šuma, 26.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Požare, 24.07.1986, 1 ♂, 2 ♀♀, leg. A. Vujić; Kučajske planine: Sisevac, 22.07.1986, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 2 ♂♂, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Temska, 10.06.2022, 1 ♀, leg. T. Tot, 28.08.2022, 2 ♂♂, 1 ♀, leg T. Tot; Stara planina: Temštica, 11.07.2011, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Suva planina: Bancarevo, 16.07.1989, 1 ♂, 1 ♀, leg. A. Vujić.

Paragus kopdagensis Hayat & Claussen, 1997 *

Stara planina: Golema reka, 20.07.1991, 1 ♂, 2♀♀, leg. A. Vujić.

Paragus majoranae Rondani, 1857

Published material: Vujić et al., 1999 (as *Paragus gorgus* Vujić & Radenković, 1999).

Paragus pecchiolii Rondani, 1857

Besna kobila: Klisurica, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Demižlok, 19–20.05.1996, 2 ♂♂, leg. V. Milankov, 23.06.2012, 1 ♂, leg. A. Vujić, 22.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 2 ♂♂, leg. S. Radnović; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 2 ♀♀, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 12.07.1985, 1 ♂, leg. A. Vujić, 30.04.1989, 2 ♂♂, leg. A. Vujić, 05.06.1989, 1 ♂, 1 ♀, leg. A. Vujić, 15.05.1993, 4 ♂♂, 4 ♀♀, leg. A. Vujić,

V. Milankov, 03.06.1993, 5 ♂♂, 2 ♀♀, leg. A. Vujić, S. Radnović, 06.06.1993, 1 ♂, leg. A. Vujić, 16.07.1993, 2 ♀♀, leg. P. Radišić, 13.08.1994, 2 ♂♂, 2 ♀♀, leg. S. Šimić, 29.04.1995, 2 ♂♂, leg. A. Vujić, 22.08.1995, 2 ♂♂, leg. S. Radenković, 24.08.1995, 2 ♂♂, leg. A. Vujić, 03.05.1996, 1 ♂, leg. A. Vujić, 21.05.1996, 1 ♂, leg. A. Vujić, 13.07.1996, 2 ♀♀, leg. P. Radišić, 21.08.1997, 2 ♂♂, leg. A. Vujić, 19.09.1997, 2 ♂♂, leg. A. Vujić, 09.06.2022, 3 ♂♂, 2 ♀♀, leg. T. Tot, 27.08.2022, 2 ♀♀, leg. T. Tot; Dubašnica-Malinik: Malinik, 07.07.1985, 1 ♂, leg. A. Vujić, 01.05.1989, 1 ♂, leg. A. Vujić, 18.07.1994, 2 ♀♀, leg. D. Radnović, 05.05.1995, 1 ♀, leg. S. Radenković, 18.05.1995, 1 ♀, leg. V. Milankov, 03.06.1995, 2 ♀♀, leg. R. Mićić, 05.07.1995, 1 ♀, leg. S. Radenković, 26.07.1997, 1 ♂, leg. A. Vujić, 27.07.2017, 5 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 2 ♂♂, 2 ♀♀, leg. D. Radnović, S. Radnović; Dubašnica-Malinik: uspon na Malinik, 02.06.1995, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♂, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 26.07.1986, 2 ♀♀, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 1 ♂, leg. A. Vujić; Stara planina: Temska, 28.08.2022, 1 ♂, leg. T. Tot; Stara planina: Temštica, 11.07.2011, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 10.06. 2022, 1 ♀, leg. T. Tot.

Published material: Šimić and Vujić, 1996 (as *Paragus majoranae* Rondani, 1857)

Paragus quadrifasciatus Meigen, 1822

Dubašnica-Malinik: klisura Lazareve reke, 13.08.1994, 1 ♂, leg. S. Šimić, 14.07.1996, 1 ♂, leg. P. Radišić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♂, leg. A. Vujić, S. Radenković.

Paragus testaceus Meigen, 1822

Besna kobila: Kriva Feja, 19.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 22.08.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 21.07.2017, 1 ♂, leg. A. Vujić.

Paragus tibialis (Fallén, 1817)

Dubašnica-Malinik: klisura Lazareve reke, 11.06.1994, 1 ♂, leg. A. Vujić, 13.08.1994, 1 ♂, leg. S. Šimić, 21.08.1997, 1 ♂, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 1 ♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♀, leg. P. Radišić.

Parasyrphus annulatus (Zetterstedt, 1838)

Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. P. Radišić; Dubašnica--Malinik: Malinik, 03.06.1995, 1 ♂, leg. A. Vujić; Stara planina: Midžor, 14.07. 1991, 1 ♀, leg. A. Vujić.

Parasyrphus lineolus (Zetterstedt, 1843)

Dubašnica-Malinik: Demižlok, 23.06.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica, 16.05.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 1 ♀, leg. A. Vujić, 15.05.1994, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 03.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 1 ♂, leg. A. Vujić.

Parasyrphus macularis (Zetterstedt, 1843)

Besna kobila: Kriva Feja, 02.05.2017, 2 ♂♂, leg. A. Vujić; Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. A. Vujić, 03.05.2017, 3 ♂♂, leg. B. Ivošević,

M. Miličić; Besna kobila: Planinarski dom 3, 03.05.2017, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05.1987, 1 ♀, leg. A. Vujić, 30.05.1988, 2 ♂♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Parasyrphus punctulatus (Verrall, 1873)

Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, 3 ♀♀, leg. A. Vujić, D. Radnović, 19–20.05.1996, 1 ♀, leg. V. Milankov, 20.04.1997, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 3 ♀♀, leg. P. Radišić, D. Radnović; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 28.03.1989, 1 ♀, leg. A. Vujić, 29.04.1989, 2 ♂♂, leg. A. Vujić, 31.04.1989, 6 ♂♂, 2 ♀♀, leg. A. Vujić, 15.05.1993, 2 ♂♂, leg. A. Vujić, 29.04.1995, 5 ♂♂, leg. A. Vujić, 19.04.1997, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 01.05.1989, 5 ♂♂, 4 ♀♀, leg. A. Vujić, S. Radenković, A. Tepavčević; Stara planina: Crni vrh, 08.05.1988, 3 ♂♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05.1987, 2 ♂♂, 1 ♀, leg. A. Vujić, 06.05.1988, 2 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Kalna, 08.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Mala Lukanja, 01.05.1987, 2 ♂♂, leg. A. Vujić; Stara planina: Pilj, 07.05.1988, 5 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Planinica, 27.05.1987, 1 ♂, 1 ♀, leg. A. Vujić, 08.05.1988, 1 ♀, leg. A. Vujić; Stara planina: Rsovci, 02.05.1987, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 1 ♀, leg. A. Vujić; Stara planina: Temska, 01.05.1987, 10 ♂♂, leg. A. Vujić; Stara planina: Temska – spomenik, 30.04.1987, 2 ♂♂, leg. A. Vujić; Stara planina: Topli Do, 28.05.1987, 5 ♂♂, 3 ♀♀, leg. A. Vujić; Stara planina: Topli Do-Pilj, 28.05.1987, 1 ♂, leg. A. Vujić, 25.06.1987, 2 ♂♂, 1 ♀, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 7 ♂♂, 1 ♀, leg. A. Vujić; Suva planina: Jelašnica, 01.05.1989, 1 ♂, leg. A. Vujić, 02.05.1989, 2 ♂♂, leg. A. Vujić.

Parasyrphus vittiger (Zetterstedt, 1843)

Stara planina: Arbinje, 26.06.1987, 1 ♂, 1 ♀, leg. A. Vujić, 11.08.1987, 1 ♂, leg. A. Vujić, 20.06.2012, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Philhelius citrofasciatus (De Geer, 1776)

Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: Demižlok, 04.05.1994, 4 ♂♂, 1 ♀, leg. A. Vujić, V. Milankov, D. Radnović, 30.04.1995, 1 ♂, 2 ♀♀, leg. P. Radišić, S. Radenković, 04.06.1995, 1 ♂, leg. A. Vujić, 19–20.05.1996, 2 ♂♂, 1 ♀, leg. V. Milankov, 20.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 3, 28.04.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Dubašnica Lunga, 4 ♂♂, leg. A. Vujić, S. Radenković, D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 05.05.2012, 1 ♂, leg. A. Vujić, L. Likov, S. Radenković; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♂, leg. A. Vujić, L. Likov, S. Radenković; Dubašnica-Malinik: Malinik, 13.05.1994, 1 ♀, leg. A. Vujić, 01.05.1995, 2 ♂♂, leg. S. Radenković, D. Radnović, 03.05.1996, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 29.04.1995, 1 ♂, leg. A. Vujić, 03.05.1996, 1 ♂, leg. S. Radenković; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, leg. P. Radišić; Stara planina: Dojkinačka reka, 29–30.05.1988, 1 ♂, leg. A. Vujić;

Stara planina: Topli Do-Pilj, 20.05.1987, 1 ♂, 1 ♀, leg. A. Vujić; Suva planina: Jelašnica – Donja Studena, 02.05.1988, 2 ♀♀, leg. A. Vujić.

Published material: Nedeljković et al., 2018; Šimić and Vujić, 1996 (as *Xanthogramma citrofasciatum* (De Geer, 1776)).

Philhelius dives (Rondani, 1857)

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 30.04.1989, 1 ♀, leg. A. Vujić, 05.06.1989, 2 ♀♀, leg. A. Vujić, 03.06.1993, 1 ♂, 1 ♀, leg. A. Vujić, 24.08.1995, 1 ♂, leg. M. Radišić, 19.09.1997, 1 ♀ leg. A. Vujić, 30.06.1998, 1 ♀, leg. M. Došenović, 27.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 26.07.1997, 1 ♀ leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: uspon na Malinik, 21.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Zlot, 02.06.1983, 2 ♂♂, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 1 ♂, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Temska, 10.06.2022, 1 ♀, leg. T. Tot; Suva planina: Kunovica, 02.05.1988, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996 (as *Xanthogramma pedissequum* (Harris, 1776)).

Philhelius stackelbergi Violovitsh, 1975

Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♀, leg. A. Vujić, 24.08.1995, 2 ♀♀, leg. A. Vujić, P. Radišić, 27.08.2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: Manastirište, 22.06.2012, 2 ♀♀, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♂, leg. T. Tot; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♀, leg. S. Radenković.

Published material: Nedeljković et al., 2018; Šimić and Vujić, 1996 (as *Xanthogramma pedissequum* (Harris, 1776)).

Pipiza carbonaria Meigen, 1822

Dubašnica-Malinik: Demižlok, 04.06.1995, 2 ♀♀, leg. A. Vujić, S. Radenković, 19–20.05.1996, 1 ♂, 1 ♀, leg. A. Vujić, 08.06.2011, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1966, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 03.06.1989, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Zlot, 03.06.1989, 6 ♂♂, leg. A. Vujić.

Pipiza fasciata Meigen, 1822

Dubašnica-Malinik: klisura Lazareve reke, 21.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 30.04.2011, 6 ♂♂, leg. A. Vujić, 03.05.2012, 1 ♀, leg. A. Vujić.

Pipiza lugubris Fabricius, 1775

Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, leg. A. Vujić.

Pipiza noctiluca (Linnaeus, 1758)

Dubašnica-Malinik: Demižlok, 12.04.1994, 1 ♀, leg. S. Radnović, 08.06.2011, 2 ♀♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1996, 2 ♀♀, leg. A. Vujić, 23.08.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve

reke, 21.05.1996, 1 ♀, leg. A. Vujić, 27.04.2017, 1 ♀, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 01.05.1989, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 1 ♀, leg. A. Vujić, 03.04.2011, 1 ♂, leg. A. Vujić; Stara planina: sliv reke Temske, 21.07.1991, 1 ♂, leg. A. Vujić; Suva planina: Jelašnica – Donja Studena, 02.05.1988, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić et al., 2013.

Pipiza notata Meigen, 1822

Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 30.04.2011, 1 ♂, leg. A. Vujić.

Pipiza quadrimaculata (Panzer, 1802)

Stara planina: Arbinje, 20.06.2012, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Pipizella annulata (Macquart, 1829)

Dubašnica-Malinik: Demižlok, 14.06.1994, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: klisura Lazareve reke, 03.06.1993, 7 ♀♀, leg. A. Vujić, M. Radišić, S. Radnović; Dubašnica-Malinik: Malinik, 10.06.1994, 3 ♂♂, leg. A. Vujić, P. Radišić, 06.07.1995, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: Malinik – bukova šuma, 07–10.07.1985, 3 ♂♂, 1 ♀, leg. A. Vujić.

Published material: Vujić, 1997.

Pipizella divicoi (Goeldlin, 1974)

Besna kobila: Klisurica, 02.05.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 14.05.1994, 6 ♂♂, leg. A. Vujić, D. Radnović, 12.06.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 4 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. S. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 29.04.1989, 3 ♂♂, 1 ♀, leg. A. Vujić, 04.05.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 01.05.1989, 2 ♂♂, leg. A. Vujić, 01.05.1995, 3 ♂♂, leg. A. Vujić, M. Radišić, 29.04.2017, 2 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić; Dubašnica-Malinik: Malinik – bukova šuma, 07.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, 1 ♀, leg. S. Radnović; Dubašnica-Malinik: Vojala, 17.07.1993, 4 ♂♂, leg. A. Vujić, M. Radišić; Stara planina: Crni vrh, 08.05.1988, 1 ♂, leg. A. Vujić, 31.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Rekitska reka, 13.07. 1991, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 12.07.1991, 5 ♂♂, leg. A. Vujić, 21.07.1991, 21 ♂♂, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 6 ♂♂, 10 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996; Vujić, 1997.

Pipizella maculipennis (Meigen, 1822)

Dubašnica-Malinik: Manastirište, 29.04.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 1 ♀, leg. T. Tot, 27.08.2022, 2 ♂♂, leg. T. Tot.

Published material: Vujić, 1997.

Pipizella viduata (Linnaeus, 1758)

Besna kobila: Klisurica, 02.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić; Besna kobila: Planinarski dom, 03.05.2017, 1 ♂, leg. B. Ivošević, M. Miličić,

19.07.2017, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 22.07.2017, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: ka Maliniku, 27.04.2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: Malinik, 29.04.2017, 1 ♂, 1 ♀, leg. B. Ivošević, M. Miličić; Kučajske planine: Crnica, 20.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Crnica – kanjon, 21.07.1986, 2 ♂♂, leg. A. Vujić; Kučajske planine: Crnica reka, 26.07.1986, 2 ♂♂, leg. A. Vujić; Kučajske planine: Crnica – Repuh, 23.07. 1986, 1 ♂, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 26.07.1986, 2 ♂♂, 29–30.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno – potok, 25.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – livada, 25.07.1986, 4 ♂♂, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 2 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Crni vrh 1, 31.05.1988, 1 ♂, 2 ♀♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 06.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 2 ♂♂, 1 ♀, leg. A. Vujić, B. Ivošević, M. Miličić; Stara planina: Golema reka, 20.07.1991, 3 ♂♂, leg. A. Vujić; Stara planina: iznad Toplog Dola, 20.07.2017, 2 ♂♂, leg. A. Vujić; Stara planina: Planinica, 29.05.1988, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Rsovci, 02.05.1987, 1 ♂, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 1 ♂, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 1 ♀, leg. A. Vujić; Stara planina: Temska, 30.04.2022, 1 ♂, leg. T. Tot; Stara planina: Topli Do-Pilj, 28.05.1987, 1 ♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 3 ♀♀, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Zavojsko jezero, 13.07.1992, 1 ♂, leg. A. Vujić; Suva planina: Čukljenik, 02.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Čukljenik – Donja Studena, 28.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Gornja Studena – Bojanine vode, 02.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Jelašnica – Donja Studena, 02.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05. 1994, 1 ♀, leg. S. Radenković.

Published material: Šimić and Vujić, 1996.

Pipizella virens (Fabricius, 1805)

Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 14.05.1994, 31 ♂♂, 3 ♀♀, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, D. Radnović, S. Radnović, 12.06.1994, 15 ♂♂, 3 ♀♀, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, D. Radnović, S. Radnović, 14.06.1994, 1 ♂, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, D. Radnović, S. Radnović, 19.07.1994, 4 ♂♂, 4 ♀♀, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, D. Radnović, S. Radnović, 30.04.1995, 1 ♂, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, D. Radnović, S. Radnović, 04.06. 1995, 5 ♂♂, 2 ♀♀, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, D. Radnović, S. Radnović, 23.06.2012, 1 ♂, leg. A. Vujić, V. Milankov, S. Radenković, P. Radišić, D. Radnović, S. Radnović; Dubašnica-Malinik: Dubašnica 2, 20.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 31.04.1989, 1 ♂, leg. A. Vujić, 08.07.1989, 1 ♂, leg. A. Vujić, 03.06.1993, 1 ♂, 5 ♀♀, leg. S. Radnović, 29.06.1995, 1 ♂, leg. A. Vujić, 27.04.2017, 3 ♂♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 2 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 01.05.1989, 14 ♂♂, 2 ♀♀, leg. A. Vujić, 03.06.1989, 4 ♂♂, 2 ♀♀, leg. A. Vujić,

13.05.1994, 1 ♂, 2 ♀♀, leg. A. Vujić, P. Radišić, D. Radnović, 10.06.1994, 1 ♂, leg. A. Vujić, P. Radišić, D. Radnović, 01.05.1995, 2 ♂♂, leg. A. Vujić, P. Radišić, D. Radnović, 03.06.1995, 4 ♂♂, 6 ♀♀, leg. A. Vujić, P. Radišić, D. Radnović, 05.06.1995, 1 ♂, leg. A. Vujić, P. Radišić, D. Radnović, 21.07.2017, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Malinik – bukova šuma, 07.07.1985, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, 4 ♀♀, leg. A. Vujić, S. Radnović; Dubašnica-Malinik: ka Maliniku, 27.04.2017, 4 ♂♂, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot, 21.06.2017, 1 ♀, leg. A. Vujić, M. Miličić, Z. Nedeljković, T. Tot; Kučajske planine: Crnica reka, 23.07.1986, 2 ♀♀, leg. A. Vujić; Kučajske planine: Crnica – Repuh, 23.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 2 ♀♀, leg. A. Vujić, 29–30.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno – bukova šuma, 26.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno – mala kaptaža, 26.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – livada, 25.07. 1986, 2 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 1 ♀, leg. A. Vujić.

Pipizella zloti Vujić, 1997

Dubašnica-Malinik: klisura Lazareve reke, 29.04.1995, 1 ♂, leg. A. Vujić, 27.04.2017, 2 ♂♂, leg. B. Ivošević, M. Miličić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 21.07.2017, 1 ♂, leg. A. Vujić.

Published material: Vujić, 1997.

Platycheirus albimanus (Fabricius, 1781)

Besna kobila: Klisurica, 02.05.2017, 2 ♂♂, leg. B. Ivošević, M. Miličić; Besna kobila: Kriva Feja, 02.05.2017, 1 ♂, leg. A. Vujić; Besna kobila: Kriva Feja 1, 19.09.2020, 1 ♀, leg. A. Vujić, L. Likov, M. Ranković, T. Tot; Besna kobila: Planinarski dom, 03.05.2017, 4 ♂♂, leg. A. Vujić, B. Ivošević, M. Miličić, 18.07.2017, 1 ♂, leg. A. Vujić, 19.07.2017, 1 ♂, leg. A. Vujić; Besna kobila: Planinarski dom 2, 03.05.2017, 3 ♂♂, 2 ♀♀, leg. A. Vujić, B. Ivošević, M. Miličić; Besna kobila: Planinarski dom 3, 03.05.2017, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: Demižlok, 12.06.1994, 1 ♀, leg. A. Vujić, D. Dević, N. Dožić, M. Radišić, 19–20.05.1996, 1 ♀, leg. A. Vujić, D. Dević, N. Dožić, M. Radišić, 07.06.1997, 2 ♂♂, 2 ♀♀, leg. A. Vujić, D. Dević, N. Dožić, M. Radišić, 01.07. 1998, 1 ♂, leg. A. Vujić, D. Dević, N. Dožić, M. Radišić, 23.06.2012, 1 ♀, leg. A. Vujić, D. Dević, N. Dožić, M. Radišić; Dubašnica-Malinik: Dubašnica 1, 20.06.2017, 1 ♂, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 1 ♀, leg. A. Vujić, D. Dević, S. Dragišić, P. Radišić, S. Radenković, 21.05.1996, 1 ♂, leg. A. Vujić, D. Dević, S. Dragišić, P. Radišić, S. Radenković, 22.08.1996, 2 ♀♀, leg. A. Vujić, D. Dević, S. Dragišić, P. Radišić, S. Radenković, 23.08.1996, 3 ♀♀, 1 ♂, leg. A. Vujić, D. Dević, S. Dragišić, P. Radišić, S. Radenković, 22.08.1997, 1 ♂, leg. A. Vujić, D. Dević, S. Dragišić, P. Radišić, S. Radenković, 19.09.1997, 1 ♂, 1 ♀, leg. A. Vujić, D. Dević, S. Dragišić, P. Radišić, S. Radenković, 02.07.1998, 3 ♂♂, 2 ♀♀, leg. A. Vujić, D. Dević, S. Dragišić, P. Radišić, S. Radenković; Dubašnica-Malinik: klisura Lazareve reke, 19.04.1997, 1 ♀, leg. A. Vujić, R. Mićić, M. Radišić, 20.04.1997, 1 ♂, leg. A. Vujić, R. Mićić, M. Radišić, 29.04.1997, 2 ♂♂, 1 ♀,

leg. A. Vujić, R. Mićić, M. Radišić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♀, leg. A. Vujić, L. Likov, S. Radenković; Dubašnica-Malinik: Malinik, 10.07.1995, 1 ♀, leg. A. Vujić, 04.05.1996, 1 ♀, leg. S. Radenković; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♂, leg. S. Šimić; Kučajske planine: Papratno, 27.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno – mala kaptaža, 26.07.1986, 1 ♂, leg. A. Vujić; Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić; Stara planina: Babin zub, 20.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Crni vrh, 08.05.1988, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 01.05.2017, 1 ♀, leg. A. Vujić, 19.06.2017, 1 ♀, leg. A. Vujić, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Dojkinačka reka, 29.05.1987, 16 ♂♂, 10 ♀♀, leg. A. Vujić; 06.05.1988, 4 ♀♀, leg. A. Vujić, 30.05.1988, 2 ♀♀, leg. A. Vujić, 29–30.06.1988, 1 ♀, leg. A. Vujić; Stara planina: Golema reka, 20.07.1987, 1 ♂, leg. A. Vujić, 20.07.1991, 17 ♂♂, 5 ♀♀, leg. A. Vujić; Stara planina: Pilj, 07.05.1988, 3 ♀♀, leg. A. Vujić; Stara planina: Planinica, 27.05.1987, 1 ♂, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 2 ♀♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♂, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 3 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Temska – spomenik, 30.04.1987, 1 ♂, leg. A. Vujić, 12.04.1988, 1 ♂, leg. A. Vujić, 05.04.1992, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♀, leg. T. Tot; Stara planina: Topli Do-Pilj, 28.05.1987, 1 ♀, leg. A. Vujić; 25.06.1987, 4 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 1 ♂, 4 ♀♀, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 1 ♂, leg. A. Vujić; Suva planina: Čukljenik – Donja Studena, 28.05.1988, 1 ♀, leg. A. Vujić; Suva planina: Kunovica, 09.04.1988, 1 ♂, leg. A. Vujić, 02.05.1988, 1 ♀, leg. A. Vujić; Suva planina: Jelašnica – Donja Studena, 02.05.1988, 2 ♂♂, leg. P. Radišić.

Published material: Šimić and Vujić, 1996 (as *Platycheirus cyaneus* Müller, 1764)

Platycheirus ambiguus (Fallén, 1817)

Dubašnica-Malinik: Demižlok, 01.04.1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 28.03.1989, 1 ♂, leg. A. Vujić; 29.04.1995, 1 ♂, leg. P. Radišić, 19.04.1997, 1 ♀, leg. P. Radišić.

Published material: Šimić and Vujić, 1996.

Platycheirus europaeus Goeldlin, Maibach & Speight, 1990

Kučajske planine: Crnica – vlažne livade, 23.07.1986, 1 ♂, leg. A. Vujić, 26.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac, 21.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – livada, 29.07.1986, 1 ♂, leg. A. Vujić.

Platycheirus fulviventris (Macquart, 1829)

Dubašnica-Malinik: klisura Lazareve reke, 08–09.07.1985, 1 ♀, leg. A. Vujić.

Platycheirus manicatus (Meigen, 1822)

Stara planina: Žarkova čuka, 11.07.1991, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Platycheirus melanopsis Loew, 1856

Stara planina: Midžor, 14.07.1991, 1 ♂, 6 ♀♀, leg. A. Vujić.

Platycheirus parmatus Rondani, 1857

Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 3 ♀♀, leg. P. Radišić, S. Radnović; 15.05.1994, 1 ♂, 1 ♀, leg. D. Radnović; 18.05.1996, 1 ♂, 1 ♀, leg. N. Dožić; 21.05.1996, 3 ♂♂, 6 ♀♀, leg. A. Vujić, V. Milankov.

Platycheirus peltatus (Meigen, 1822)

Dubašnica-Malinik: Dubašnica 1, 20.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Dubašnica-Malinik: Dubašnica 2, 28.04.2017, 1 ♂, B. Ivošević, M. Miličić; Kučajske planine: Sisevac – livada, 22.07.1986, 1 ♂, leg. A. Vujić.

Platycheirus scutatus (Meigen, 1822)

Dubašnica-Malinik: Demižlok, 23.07.1995, 1 ♂, leg. M. Radišić; 19–20.05. 1996, 1 ♂, leg. A. Vujić; 25.08.1996, 1 ♂, leg. S. Radenković; 07.06.1997, 2 ♂♂, leg. A. Vujić, P. Radišić; Dubašnica-Malinik: Dubašnica Lunga, 21.05.1996, 1 ♀, leg. A. Vujić; 22.08.1997, 1 ♂, leg. A. Vujić; 19.09.1997, 2 ♂♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 31.04.1989, 1 ♂, leg. A. Vujić; 08.07.1989, 1 ♀, leg. A. Vujić; 29.04.1995, 1 ♂, leg. S. Radenković; 21.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 21.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♂, leg. S. Šimić; Kučajske planine: Papratno, 27.07.1986, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05.1987, 1 ♂, leg. A. Vujić; 29–30.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci, 20.06.2012, 2 ♂♂, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♀, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Rekitska reka, 13.07.1991, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Platycheirus splendidus Rotheray, 1998

Stara planina: Dojkinačka reka, 30.05.1988, 3 ♂♂, leg. A. Vujić.

Platycheirus tarsalis (Schummel, 1836)

Dubašnica-Malinik: Dubašnica Lunga, 18.05.1996, 2 ♀♀, leg. N. Dožić; Dubašnica-Malinik: klisura Lazareve reke, 05.05.2012, 1 ♀, leg. A. Vujić, L. Likov, S. Radenković.

Platycheirus transfugus (Zetterstedt, 1838)

Stara planina: Topli Do-Pilj, 28.05.1987, 1 ♂, leg. A. Vujić.

Pocota personata (Harris, 1780)

Dubašnica-Malinik: Demižlok, 19–20.05.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke – vidikovac, 03.05.2012, 1 ♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Pseudopelecocera latifrons (Loew, 1856)

Dubašnica-Malinik: klisura Lazareve reke, 20.04.1997, 1 ♀, leg. A. Vujić.

Published material: Vujić et al., 2018 (as *Pokornyia latifrons* (Loew, 1856)).

Psilota nana Smit & Vujić, 2008

Published material: Smit and Vujić, 2008.

Pyrophaena rosarum (Fabricius, 1787)

Dubašnica-Malinik: Dubašnica Lunga, 23.08.1996, 1 ♀, leg. R. Mićić, 18.06.1997, 1 ♀, leg. A. Vujić, 19.09.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 03.06.1996, 1 ♂, leg. M. Živković; Kučajske planine: Crnica

– vlažne livade, 26.07.1986, 1 ♀, leg. A. Vujić; Stara planina: Crni vrh, 31.05. 1988, 1 ♂, leg. A. Vujić.

Rhingia campestris Meigen, 1822

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, leg. D. Radnović, 19–20.05. 1994, 1 ♂, 2 ♀♀, leg. A. Vujić, N. Dožić, 04.06.1994, 1 ♀, leg. A. Vujić, 12.06.1994, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1, 28.04.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 2 ♀♀, leg. D. Radnović, 21.05.1996, 1 ♂, 5 ♀♀, leg. A. Vujić, 02.06.1996, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 31.04.1989, 1 ♂, leg. A. Vujić, 15.05.1993, 1 ♂, leg. A. Vujić; Stara planina: Dojkinačka reka, 29.05.1987, 1 ♀, leg. A. Vujić, 29–30.05.1998, 1 ♀, leg. A. Vujić; Stara planina: Temska, 30.04. 2022, 1 ♂, leg. T. Tot; Stara planina: Topli Do, 28.05.1987, 1 ♂, leg. A. Vujić, 25.06.1987, 1 ♂, leg. A. Vujić; Suva planina: Čukljenik, 02.05.1988, 2 ♀♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 1 ♂, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Scaeva dignota (Rondani, 1857)

Dubašnica-Malinik: Beljevina, 15.05.1994, 2 ♀♀, leg. D. Radnović; Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, 1 ♀, leg. A. Vujić; 12.06.1994, 1 ♂, leg. A. Vujić, 1 ♂, leg. P. Radišić, 1 ♀, leg. S. Radnović, 14.06.1994, 1 ♂, leg. A. Vujić, 07.06.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♀, leg. A. Vujić, 15.05.1994, 1 ♀, leg. A. Vujić, 23.08.1996, 1 ♀, leg. R. Mićić; Dubašnica-Malinik: klisura Lazareve reke, 01.04.1994, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 03.06.1989, 1 ♀, leg. A. Vujić; Stara planina: Planinica, 28.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Temska, 12.04. 1988, 1 ♀, leg. A. Vujić; Stara planina: sliv reke Temske, 12.04.1988, 2 ♀♀, leg. A. Vujić; Suva planina: Kunovica, 02.05.1988, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Scaeva pyrastri (Linnaeus, 1758)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Borsko jezero – Savača, 19.08.1998, 1 ♀, leg. D. Kopanja; Dubašnica-Malinik: Demižlok, 01.07.1998, 1 ♂, leg. D. Dević; Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 01.04.1994, 2 ♀♀, leg. A. Vujić, 11.06.1994, 1 ♂, leg. P. Radišić, 13.07.1994, 1 ♀, leg. S. Šimić, 23.04.1996, 1 ♀, leg. A. Vujić, 22.08.1996, 2 ♂♂, leg. R. Mićić, 1 ♂, leg. S. Dragišić, 25.07.1997, 2 ♂♂, 2 ♀♀, leg. A. Vujić, 1 ♂, leg. D. Dević, 21.08.1997, 1 ♀, leg. A. Vujić, 19.09.1997, 1 ♀, leg. A. Vujić, 30.06.1998, 1 ♀, leg. D. Milenković, 27.08.2022, 1 ♀, leg. T. Tot; Dubašnica-Malinik: Malinik, 10.06.1994, 1 ♂, leg. P. Radišić, 10.07.1994, 1 ♀, leg. S. Radnović, 13.08.1994, 1 ♂, leg. S. Šimić, 05.07.1995, 1 ♂, leg. A. Vujić; Dubašnica--Malinik: Malinik – put, 10.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Valja Mare, 16.07.1993, 1 ♂, leg. A. Mladenović; Kučajske planine: Crnica – vlažne livade, 21.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 27.07.1986, 2 ♂♂, leg. A. Vujić; Kučajske planine: Požare, 07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac, 21.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – livada, 22.07.1986, 5 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Golema reka, 23.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Midžor, 1 ♂, 1 ♀, leg. A. Vujić;

Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♂, 2 ♀♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 1 ♂, 2 ♀♀, leg. A. Vujić; Stara planina: spomenik, 18.07.1992, 1 ♀, leg. A. Vujić; Stara planina: Temska, 10.06. 2022, leg. T. Tot; Stara planina: sliv reke Temske, 05.04.1992, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 10.06.2022, 3 ♂♂, 1 ♀, leg. T. Tot, 28.08.2022, 1 ♀, leg. T. Tot; Stara planina: Zavojsko jezero, 2 ♂♂, leg. A. Vujić; Stara planina: Žarkova čuka, 11.07.1991, 2 ♂♂, leg. A. Vujić, 14.07.1991, 4 ♂♂, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 1 ♂, 1 ♀, leg. A. Vujić; Suva planina: Kunovica, 02.05.1988, 1 ♀, leg. A. Vujić, 13.04.1991, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Scaeva selenitica (Meigen, 1822)

Besna kobila: Planinarski dom, 19.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♀, leg. S. Radenković; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♀, leg. A. Vujić, 15.05.1994, 1 ♀, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 01.04.1994, 1 ♀, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot; Stara planina: Topli Do, 28.08.2022, 1 ♀, leg. T. Tot; Stara planina: Zavojsko jezero, 13.07.1992, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Sericomyia bombiformis (Fallén, 1810)

Besna kobila: Planinarski dom, 12.09.2020, 3 ♂♂, leg. A. Vujić, L. Likov, M. Ranković, T. Tot.

Sericomyia lappona (Linnaeus, 1758)

Dubašnica-Malinik: Dubašnica Lunga, 05.05.1994, 2 ♂♂, leg. A. Vujić, D. Radnović.

Sphaerophoria interrupta (Fabricius, 1805)

Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić.

Sphaerophoria scripta (Linnaeus, 1758)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Beljevina, 15.05.1994, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. S. Radenković, 01.07.1998, 3 ♂♂, 1 ♀, leg. D. Dević; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♂, leg. S. Radnović; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. D. Radnović, 23.08.1996, 1 ♂, leg. S. Dragišić, 02.07.1998, 1 ♂, leg. D. Dević; Dubašnica-Malinik: ka Maliniku, 27.04.2022, 1 ♀, leg. T. Tot, 08.06.2022, 8 ♂♂, 3 ♀♀, leg. T. Tot, 27.08.2022, 4 ♀♀, leg. T. Tot; Dubašnica-Malinik: klisura Lazareve reke, 06.07.1985, 1 ♀, leg. A. Vujić, 12.07.1985, 1 ♀, leg. A. Vujić, 29.04.1989, 1 ♂, leg. A. Vujić, 08.07.1989, 2 ♂♂, 1 ♀, leg. A. Vujić, 01.04.1994, 1 ♂, leg. A. Vujić, 13.05.1994, 1 ♂, leg. D. Radnović, 13.08.1994, 1 ♂, leg. S. Šimić, 24.08. 1995, 1 ♂, leg. A. Tepavčević, 13.07.1996, 1 ♂, leg. D. Radnović, 23–24.04.1996, 1 ♀, leg. R. Mićić, 22.08.1996, 1 ♂, 1 ♀, leg. S. Dragišić, 19.04.1997, 1 ♂, leg. A. Vujić, 29.04.1997, 1 ♂, 1 ♀, leg. S. Dragišić, 18.06.1997, 1 ♂, leg. A. Vujić, 25.07.1997, 3 ♂♂, 1 ♀, leg. A. Vujić, 4 ♂♂, 1 ♀, leg. D. Dević, 09.06.2022, 6 ♂♂, leg. T. Tot; Dubašnica-Malinik: Malinik, 10.07.1985, 1 ♂, leg. A. Vujić, 14.07.1985, 1 ♂, leg. A. Vujić, 01.05.1989, 1 ♂, leg. A. Vujić, 10.06.1994, 1 ♂, leg. S. Radnović, 26.07.1997, 1 ♂, leg. D. Dević; Dubašnica-Malinik: Manastirište,

17.06.1997, leg. A. Vujić, 22.06.2012, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 1 ♂, leg. S. Radnović; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♂, leg. A. Vujić; Kučajske planine: Crnica – vlažne livade, 21.07. 1986, 1 ♂, leg. A. Vujić, 23.07.1986, 1 ♂, leg. A. Vujić, 26.07.1986, 2 ♀♀, leg. A. Vujić, 29–30.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno, 25.07. 1986, 1 ♀, leg. A. Vujić; Kučajske planine: Papratno – mala kaptaža, 26.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 27.07.1986, 1 ♀, leg. A. Vujić; Kučajske planine: Sisevac, 21.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 24.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – livada, 22.07.1986, 1 ♂, 1 ♀, leg. A. Vujić, 25.07.1986, 1 ♂, leg. A. Vujić; Kučajske planine: Sisevac – potok, 21.07.1986, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: Arbinje, 11.08.1987, 1 ♂, leg. A. Vujić; Stara planina: Babin zub, 19.07.1991, 2 ♀♀, leg. A. Vujić, 20.07.1991, 1 ♀, leg. A. Vujić, 21.06. 2012, 1 ♀, leg. A. Vujić; Stara planina: Dojkinačka reka, 29–30.05.1988, 1 ♂, 1 ♀, leg. A. Vujić, 30.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Golema reka, 20.07.1991, 3 ♂♂, 5 ♀♀, leg. A. Vujić, 23.07.1991, 1 ♂, leg. A. Vujić; Stara planina: Midžor, 14.07.1991, 1 ♀, leg. A. Vujić; Stara planina: Planinica, 08.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Rekitska reka, 13.07.1991, 1 ♂, 1 ♀, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 3 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: sliv Toplodolske reke, 17.07.1991, 7 ♂♂, 2 ♀♀, leg. A. Vujić; Stara planina: Temska, 30.04.2022, 2♂♂, leg. T. Tot, 10.06.2022, 8 ♂♂, 7 ♀♀, leg. T. Tot, 28.08.2022, 2 ♂♂, 1 ♀, leg. T. Tot; Stara planina: sliv reke Temske, 05.04.1992, 1 ♂, leg. A. Vujić; Stara planina: Temštica, 11.07.2011, 4 ♂♂, 7 ♀♀, leg. A. Vujić; Stara planina: Topli Do, 10.06.2022, 2 ♂♂, 3 ♀♀, leg. T. Tot, 28.08.2022, 2 ♂♂, leg. T. Tot; Stara planina: Žarkova čuka, 11.07.1991, 1 ♂, 4 ♀♀, leg. A. Vujić; Stara planina: Živadinov dol, 12.07.1991, 1 ♂, 1 ♀, leg. A. Vujić; Suva planina: Bancarevo, 16.07.1989, 1 ♀, leg. A. Vujić; Suva planina: Čukljenik, 02.05.1988, 2 ♂♂, 1 ♀, leg. A. Vujić; Suva planina: ispred Čukljenika, 19.04.1988, 1 ♂, leg. A. Vujić; Suva planina: Jelašnica – Donja Studena, 02.05. 1988, 2 ♂♂, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 2 ♂♂, leg. D. Radnović, 19.05.1997, 1 ♂, leg. A. Vujić; Suva planina: Kunovica, 02.05.1988, 1 ♀, leg. A. Vujić, 25.04.1996, 2 ♀♀, leg. S. Dragišić, R. Mićić.

Published material: Šimić and Vujić, 1996.

Sphegina clavata (Scopoli, 1763)

Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. V. Milankov; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. D. Radnović.

Sphegina clunipes (Fallén, 1816)

Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 1 ♀, leg. A. Vujić; 15.05. 1994, 2 ♂♂, leg. A. Vujić, D. Radnović, 21.05.1996, 1 ♂, leg. A. Vujić, 22.08.1997, 1 ♂, leg. A. Vujić; Stara planina: Arbinje, 11.08.1997, 1 ♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Sphegina elegans Schummel, 1843

Dubašnica-Malinik: Demižlok, 25.08.1996, 1 ♀, leg. A. Vujić.

Sphegina latifrons Egger, 1865

Dubašnica-Malinik: Demižlok, 14.05.1994, 6 ♂♂, 2 ♀♀, leg. A. Vujić, D. Radnović, 04.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica 1,

28.04.2017, 6 ♂♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 18.07.1993, 1 ♀, leg. P. Radišić, 15.05.1994, 13 ♂♂, 6 ♀♀, leg. A. Vujić, S. Radenković, D. Radnović, 21.05.1996, 18 ♂♂, 2 ♀♀, leg. A. Vujić, V. Milankov, 18.06.1997, 1 ♀, leg.V. Milankov.

Published material: Šimić and Vujić, 1996; Vujić, 1990.

Sphegina sublatifrons Vujić, 1990

Published material: Šimić and Vujić, 1996; Vujić, 1990.

Spilomyia manicata (Rondani, 1865)

Dubašnica-Malinik: Demižlok, 19.07.1994, 1 ♂, leg. A. Vujić, 23.06.2012, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 22.08.1996, 1 ♂, 1 ♀, leg. P. Radišić, 19.09.1997, 1 ♂, leg. A. Vujić.

Spilomyia saltuum (Fabricius, 1794)

Dubašnica-Malinik: klisura Lazareve reke, 24.08.1995, 1 ♀, leg. A. Vujić, 22.08.1996, 2 ♀♀, leg. A. Vujić, P. Radišić, 21.07.1997, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik, 21.07.2017, 2 ♂♂, 3 ♀♀, leg. A. Vujić.

Syritta pipiens (Linnaeus, 1758)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♂, leg. A. Vujić, 11.07.1998, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 18.06.1997, 1 ♂, leg. V. Milankov; Dubašnica-Malinik: klisura Lazareve reke, 09.07.1985, 1 ♂, leg. P. Radišić, 03.06.1993, 1 ♀, leg. D. Radnović, 05.06.1993, 1 ♀, leg. D. Radnović, 22.08.1995, 1 ♂, leg. P. Radišić, 23–24.04.1996, 2 ♂♂, 2 ♀♀, leg. R. Mićić, S. Dragišić, 01.06.1996, 1 ♀, leg. S. Radenković, 13.07.1996, 1 ♂, leg. P. Radišić, 22–24.08.1996, 2 ♀♀, leg. A. Vujić, 25.07.1997, 2 ♂♂, 1 ♀, leg. A. Vujić, D. Dević, 21.08.1997, 1 ♂, leg. A. Vujić, 30.06.1998, 1 ♂, leg. D. Dević, 09.06.2022, 4 ♀♀, leg. T. Tot; Dubašnica-Malinik: Manastirište, 23.04.1996, 1 ♂, leg. R. Mićić, 17.06.1997, 1 ♀, leg. V. Milankov; Dubašnica-Malinik: uspon na Malinik, 08.06.2022, 1 ♂, 1 ♀, leg. T. Tot, 27.08.2022, 1 ♂, leg. T. Tot; Kučajske planine: Crnica – vlažne livade, 23.07.1986, 2 ♂♂, leg. P. Radišić, 26.07.1986, 3 ♂♂, leg. P. Radišić; Kučajske planine: Sisevac, 21.07.1986, 1 ♂, leg. P: Radišić, 22.07.1986, 3 ♂♂, leg. P. Radišić, 24.07.1986, 1 ♀, leg. P. Radišić, 29.07.1986, 2 ♂♂, leg. P. Radišić; Stara planina: Arbinje, 11.08.1987, 1 ♀, leg. A. Vujić; Stara planina: spomenik, 28.05.1987, 1 ♂, leg. A. Vujić; Stara planina: Temska, 10.06.2022, 1 ♀, leg. T. Tot; Stara planina: Temštica, 18.07.1992, 1 ♀, leg. P. Radišić; Stara planina: Topli Do, 10.06.2022, 1 ♂, leg. T. Tot, 28.08.2022, 16 ♂♂, 5 ♀♀, leg. T. Tot; Stara planina: Zavojsko jezero, 13.07.1992, 1 ♂, leg. A. Vujić, 22.07.1992, 1 ♂, leg. A. Vujić; Suva planina: Bancarevo, 16.07.1989, 1 ♂, 2 ♂♂, leg. P. Radišić; Suva planina: Crni vrh, 07.07.1989, 1 ♀, leg. A. Vujić; Suva planina: Čukljenik – Donja Studena, 28.05.1988, 5 ♂♂, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Syrphus ribesii (Linnaeus, 1758)

Besna kobila: Kriva Feja, 19.07.2017, 2 ♀♀, leg. A. Vujić; Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. A. Vujić; Stara planina: iznad Toplog Dola, 20.07.2017, 1 ♂, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♀, leg. T. Tot.

Published material: Nedeljković et al., 2010; Šimić and Vujić, 1996.

Syrphus torvus Osten-Sacken, 1875

Stara planina: Babin zub, 21.06.2012, 1 ♂, leg. A. Vujić.

Published material: Nedeljković et al., 2010; Šimić and Vujić, 1996.

Syrphus vitripennis Meigen, 1822

Dubašnica-Malinik: Demižlok, 22.07.2017, 2 ♂♂, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 28.08.2022, 1 ♂, leg. T. Tot; Suva planina: Jelašnica – Donja Studena, 02.05.1988, 1 ♂, 2 ♀♀, leg. A. Vujić; Suva planina: Jelašnička klisura, 01.05.1994, 2 ♀♀, leg. S. Radenković; Suva planina: Kunovica, 13.04.1991, 1 ♂, leg. A. Vujić.

Published material: Nedeljković et al., 2010; Šimić and Vujić, 1996.

Temnostoma bombylans (Fabricius, 1805)

Besna kobila: Planinarski dom, 02.05.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. D. Radnović, 04.06.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 4 ♂♂, 1 ♀, leg. A. Vujić, D. Radnović, P. Radišić; Suva planina: Čukljenik – Donja Studena, 28.05.1985, 1 ♀, leg. P. Radišić, 28.05.1988, 1 ♀, leg. A. Vujić.

Trichopsomyia flavitarsis (Meigen, 1822)

Stara planina: Arbinje, 20.06.2012, 1 ♂, leg. A. Vujić.

Triglyphus primus Loew, 1840

Dubašnica-Malinik: Demižlok, 04.06.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 11.06.1994, 1 ♂, leg. A. Vujić.

Published material: Vujić, 1994.

Volucella bombylans (Linnaeus, 1758)

Stara planina: Dojkinci, 20.06.2012, 1 ♀, leg. A. Vujić; Stara planina: Topli Do, 10.06.2022, 1 ♀, leg. T. Tot.

Published material: Nedeljković et al., 2003; Šimić and Vujić, 1996.

Volucella inanis (Linnaeus, 1758)

Dubašnica-Malinik: klisura Lazareve reke, 11.07.1985, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Malinik – bukova šuma, 07.07.1985, 1 ♂, leg. A. Vujić, 13.07.1985, 1 ♂, leg. A. Vujić, 05.07.1995, 1 ♂, leg. S. Radenković; Stara planina: Topli Do, 28.08.2022, 1 ♀, leg. T. Tot.

Published material: Nedeljković et al., 2003; Šimić and Vujić, 1996.

Volucella inflata (Fabricius, 1794)

Stara planina: Dojkinci 2, 19.06.2017, 1 ♂, leg. M. Miličić, Z. Nedeljković, T. Tot.

Published material: Nedeljković et al., 2003.

Volucella pellucens (Linnaeus, 1758)

Dubašnica-Malinik: Adamov potok, 11.07.1985, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. P. Radišić; Dubašnica-Malinik: Brestovačka banja, 08.07.1986, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 12.06.1994, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 03.06.1993, 2 ♂♂, leg. A. Vujić, P. Radišić, 21.08.1997, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 17.06.1997, 3 ♂♂, leg. A. Vujić, V. Milankov; Dubašnica-Malinik: Valja Mare, 16.07.1993, 1 ♀, leg. A. Mladenović.

Published material: Nedeljković et al., 2003; Šimić and Vujić, 1996.

Volucella zonaria (Poda, 1761)

Dubašnica-Malinik: Beljevina, 06.06.1993, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: Brestovačka banja, 08.07.1986, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Demižlok, 23.08.1995, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 07.07.1985, 1 ♀, leg. A. Vujić, 11.07.1985, 1 ♀, leg. A. Vujić, 05.06.1989, 1 ♂, leg. A. Vujić, 11.06.1994, 2 ♂♂, leg. V. Milankov, D. Radnović, 25.07.1997, 3 ♂♂, 3 ♀♀, leg. A. Vujić, D. Dević; Dubašnica-Malinik: Valja Mare, 16.07.1993, 1 ♀, leg. A. Mladenović.

Published material: Nedeljković et al., 2003; Šimić and Vujić, 1996.

Xanthandrus comtus (Harris, 1776)

Dubašnica-Malinik: Demižlok, 07.06.1997, 1 ♀, leg. A. Vujić; Dubašnica--Malinik: Jablanica, 24.07.1986, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 12.07.1985, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Prerast, 12.08. 1994, 1 ♀, leg. S. Šimić; Stara planina: Crni vrh, 31.05.1988, 1 ♂, leg. A. Vujić; Stara planina: Dojkinci – Arbinje, 26.06.1987, 1 ♂, leg. A. Vujić; Stara planina: sliv Rekitske reke, 21.07.1991, 1 ♀, leg. A. Vujić; Suva planina: Bojanine vode, 28.05.1988, 5 ♀♀, leg. A. Vujić.

Published material: Šimić and Vujić, 1996.

Xylota abiens Meigen, 1822

Dubašnica-Malinik: Demižlok, 14.05.1994, 1 ♂, 2 ♀♀, leg. A. Vujić, S. Radenković, D. Radnović, 12.06.1994, 6 ♂♂, 2 ♀♀, leg. A. Vujić, V. Milankov, P. Radišić, D. Radnović, 19.07.1994, 2 ♂♂, leg. A. Vujić, 04.06.1995, 1 ♀, leg. A. Vujić, 19–20.05.1996, 1 ♂, leg. A. Vujić, 07.06.1997, 1 ♀, leg. A. Vujić, 01.07. 1998, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 2 ♀♀, leg. A. Vujić.

Xylota ignava (Panzer, 1798)

Dubašnica-Malinik: Demižlok, 25.08.1996, 1 ♀, leg. A. Vujić.

Xylota segnis (Linnaeus, 1758)

Dubašnica-Malinik: Demižlok, 19.07.1994, 3 ♂♂, leg. D. Radnović, 07.06. 1997, 1 ♀, leg. P. Radišić; Dubašnica-Malinik: Dubašnica – lovište, 05.06.1993, 1 ♂, leg. D. Radnović; Dubašnica-Malinik: klisura Lazareve reke, 15.05.1993, 1 ♂, leg. A. Vujić, 24.08.1995, 3 ♂♂, leg. A. Vujić, P. Radišić, S. Radenković, 21.05.1996, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 19.09.1997, 3 ♂♂, leg. A. Vujić; Dubašnica-Malinik: Mikuljska reka, 04.06.1993, 3 ♂♂, 1 ♀, leg. A. Vujić, D. Radnović; Dubašnica-Malinik: Prerast, 12.08.1994, 1 ♂, leg. S. Šimić.

Published material: Šimić and Vujić, 1996.

Xylota sylvarum (Linnaeus, 1758)

Dubašnica-Malinik: Demižlok, 14.06.1994, 2 ♀♀, leg. A. Vujić, 04.06.1995, 1 ♀, leg. S. Radenković, 01.07.1998, 1 ♂, leg. A. Vujić, 22.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Dubašnica Lunga, 06.06.1993, 1 ♂, leg. D. Radnović, 18.07.1993, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 13.08. 1994, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Manastirište, 19.09.1997, 1 ♂, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Vojala, 17.07.1993, 1 ♀, leg. A. Vujić, 22.08. 1997, 1 ♀, leg. A. Vujić.

Published material: Milankov et al., 1995; Šimić and Vujić, 1996.

Xylota tarda Meigen, 1822

Dubašnica-Malinik: Demižlok, 22.07.2017, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: klisura Lazareve reke, 24.08.1995, 1 ♂, leg. A. Vujić; Dubašnica-Malinik: Malinik, 21.07.2017, 1 ♂, leg. A. Vujić.

Xylota xanthocnema Collin, 1939

Dubašnica-Malinik: klisura Lazareve reke, 24.08.1995, 1 ♀, leg. A. Vujić; Dubašnica-Malinik: Podgorac, 02.06.1996, 1 ♀, leg. A. Vujić.

Published material: Milankov et al., 1995; Šimić and Vujić, 1996.

DISCUSSION

Over the course of this investigation, more than 8,000 specimens were recorded, documenting a variety of 284 unique species, out of which 105 were recorded for the first time for the eastern Serbia. The recorded diversity highlights the richness and variety of hoverfly fauna in the surveyed region, covering 107 localities and underscoring the ecological importance of the selected sites. Moreover, by documenting *Cheilosia subpictipennis* and *Paragus kopdagensis* for the first time in Serbia, along with a potential novel to science species *Paragus aff. testaceus*, these findings contribute to the broader understanding of hoverfly distribution and biodiversity in the region, fostering potential advancements in scientific knowledge and conservation efforts. The examination of hoverfly fauna is crucial for understanding and mitigating the factors that contribute to their vulnerability, as well as for formulating effective conservation strategies to ensure their protection (Janković et al., 2020; Milić et al., 2019; Reverté et al., 2023).

The endangerment of hoverfly species in hilly-mountainous regions, like the eastern Serbia, can be attributed to a combination of factors. These drivers encompass habitat alteration stemming from activities like habitat change/loss, overexploitation, climate change, and (soil) pollution (Alaniz et al., 2018; Miličić et al., 2018b; Pereira et al., 2022; Radenković et al., 2017). The unique needs of hoverflies, which involve specific vegetation and microclimatic conditions, render them particularly susceptible to potential alterations in their surroundings (Jauker et al., 2019; Popov et al., 2017; Schweiger et al., 2007). The IUCN Red List of hoverflies (Vujić et al., 2022) serves as a crucial tool for assessing and categorizing the conservation status of various hoverfly species worldwide, as well as for raising awareness and guiding conservation initiatives. Out of the 284 identified species, a significant majority belong to the Least Concern category, indicating a relatively stable and secure status for almost 80% of the recorded species.

However, 23 hoverfly species are currently classified as Endangered, signifying a high level of threat to their survival. Moreover, eight species are classified as Vulnerable and an additional eight as Near Threatened. Interestingly, two out of the eight species categorized as Endangered, *Cheilosia subpictipennis* and *Paragus kopdagensis*, have been documented in the Serbia for the first time. Species *Cheilosia subpictipennis* exhibits a versatile ecological preference,

being found in diverse environments such as open ground, forests, and open areas with grassy or tall herb vegetation within the *Abies/Picea* zone. Additionally, it extends its habitat range along streams into the *Fagus* zone, unimproved, non-calcareous montane grasslands up to 1,500 m, as well as reaching up to 2000 m in unimproved, non-calcareous subalpine grasslands in the southern Alps and Pyrenees (Speight, 2017). Despite its ability to thrive in diverse ecological settings, numerous habitats where the species occurs are currently at risk of endangerment due to habitat loss and fragmentation resulting from human activities such as agriculture and urbanization (Vujić et al., 2022). Additionally, climate change may alter the suitable conditions within its preferred range, affecting its ability to adapt or migrate to more suitable habitats. Species *Paragus kopdagensis* thrives in a preferred environment characterized by high humidity, grazed areas and subalpine grasslands (Speight, 2017). Notably, its presence is currently documented exclusively in the eastern part of Serbia, within Europe. Beyond the borders of Europe, this species has been identified in Turkey as documented by Hayat and Claussen in 1997. Additionally, it has been observed in the Caucasus Mountains, specifically in Georgia, as reported by Mengual et al. in 2020. Despite its adaptability and resilience in its preferred habitat, this species faces potential threats to its existence. Factors such as habitat loss due to human activities, climate change affecting the subalpine grasslands and possible alterations in grazing patterns could pose significant risks to the population (Vujić et al., 2022). Unsustainable grazing on mountain grasslands poses significant threats to both *Cheilosia subpictipennis* and *Paragus kopdagensis* species. In the eastern Serbia, the abandonment of grazing presents a noteworthy problem, rapidly diminishing grassland areas as shrubs, especially juniper, encroach (Dajić Stevanović et al., 2008). Simultaneously, overgrazing in certain areas of the region also represents a considerable threat (Vujić et al., 2022). The fact that these two species are now known to inhabit Serbia adds a layer of significance to the findings, emphasizing the critical need for refined strategies for effective grazing management as well as conservation attention in the region.

CONCLUSION

In summary, this in-depth study of hoverfly fauna in eastern Serbia makes a substantial contribution to the comprehension of hoverfly distribution and biodiversity in the region. The discovery of new occurrences and the acknowledgment of endangered species highlight the pressing need for comprehensive conservation strategies, underscoring the crucial role of ongoing monitoring of these ecologically vital insects.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the financial support of the Ministry of Science, Technological Development and Innovation of the Republic of

Serbia (Grant No. 451-03-66/2024-03/200125 and 451-03-65/2024-03/200125) and the Science Fund of the Republic of Serbia, Grant No 7737504, Serbian Pollinator Advice Strategy – for the next normal – SPAS.

REFERENCES

Alaniz AJ, Carvajal MA, Smith-Ramírez C, Barahona-Segovia RM, Vieli L (2018): Habitat loss of a rainforest specialist pollinator fly as an indicator of conservation status of the South American Temperate Rainforests. *J. Insect Conserv.* 22: 745–755.

Dajić Stevanović V, Jovanović S, Lakušić D, Niketić M (1995): Diverzitet vaskularne flore Jugoslavije sa pregledom vrsta od međunarodnog znaĉaja. In: V. Stevanović, V. Vasić (eds.), *Biodiverzitet Jugoslavije sa pregledom vrsta od međunarodnog znaĉaja*, Ecolibri, Belgrade, Serbia / Faculty of Biology, Belgrade, Serbia, 183–217.

Doczkal D, Vujić A (1998): Redescription of *Epistrophella coronata* (Rondani, 1857), stat. rest., comb. nov., with first description of the male, and notes on the generic assignment (Diptera, Syrphidae). *Volucella* 3: 51–62.

Dormann CF, Schweiger O, Augenstein I, Bailey D, Billeter R, De Blust G, DeFilippi R, Frenzel M, Hendrickx F, Herzog F, Klotz S (2007): Effects of landscape structure and land-use intensity on similarity of plant and animal communities. *Glob. Ecol. Biogeogr.* 16: 774–787.

Doyle T, Hawkes WL, Massy R, Powney GD, Menz MH, Wotton KR (2020): Pollination by hoverflies in the Anthropocene. *Proc. R. Soc. B* 287(1927): 20200508.

Dunn L, Lequerica M, Reid CR, Latty T (2020): Dual ecosystem services of syrphid flies (Diptera: Syrphidae): pollinators and biological control agents. *Pest Manag. Sci*. 76: 1973–1979.

Dušek J, Láska P (1976): European species of *Metasyrphus*: key, descriptions and notes (Diptera, Syrphidae). *Acta Entomol. Bohemoslov.* 73: 263–282.

Evenhuis NL, Pape T (2021): *Systema Dipterorum*. Version 3.1. Accessed 5 May 2021. Available from: http://diptera.org.

Gao B, Wotton KR, Hawkes WL, Menz MH, Reynolds DR, Zhai BP, Hu G, Chapman JW (2020): Adaptive strategies of high–flying migratory hoverflies in response to wind currents. *Proc. R. Soc. B* 1928: 20200406.

Glumac S (1955): Osolike muve Srbije (Syrphidae, Diptera) iz zbirke prirodnjačkog muzeja srpske zemlje u Beogradu. *Poseban otisak iz časopisa „Zaštita bilja"* 27: 1–43.

Hayat R, Claußen C (1997): A new species and new records of the genus *Paragus* Latreille, 1804 from Turkey (Diptera: Syrphidae). *Zool. Middle East* 14: 99–108.

Hippa H, Nielsen TR, van Steenis J (2001): The West Palaearctic species of the genus *Eristalis* Latreille (Diptera, Syrphidae). *Nor. J. Entomol*. 48: 289–327.

Inouye DW, Larson BM, Ssymank A, Kevan PG (2015): Flies and flowers III: ecology of foraging and pollination. *J. Pollinat. Ecol*. 16: 115–133.

Jakšić P (2008): *Prime Butterfly Areas: A Tool for Nature Conservation in Serbia*. Belgrade: Habiprot.

Janković M, Miličić M, Ačanski J, Vujić A (2020): Protected areas and prime hoverfly areas: Safe haven for hoverflies or not? *Entomol. Sci*. 23: 173–182.

Jauker F, Jauker B, Grass I, Steffan-Dewenter I, Wolters V (2019): Partitioning wild bee and hoverfly contributions to plant–pollinator network structure in fragmented habitats. *Ecology* 100: e02569.

Lopatin IK, Matvejev S (1995): *Kratka zoogeografija bioma Balkanskog poluostrva*. Ljubljana, Slovenia: Univerzitetski udžbenik.

Matejić JS, Stefanović N, Ivković M, Živanović N, Marin PD, Džamić AM (2020): Traditional uses of autochthonous medicinal and ritual plants and other remedies for health in Eastern and South-Eastern Serbia. *J. Ethnopharmacol*. 261: 113186.

Mengual X, Kazerani F, Talebi AA, Gilasian E (2015): A revision of the genus *Pelecocera* Meigen with the description of the male of *Pelecocera persiana* Kuznetsov from Iran (Diptera: Syrphidae). *Zootaxa* 3947: 99–108.

Milankov V, Vujić A, Šimić S (1995): Species of Xylotini (Diptera: Syrphidae) from the Yugoslav region. *Entomol. Gaz*. 46: 209–216.

Milić D, Radenković S, Ačanski J, Vujić A (2019): The importance of hidden diversity for insect conservation: a case study in hoverflies (the *Merodon atratus* complex, Syrphidae, Diptera). *J. Insect Conserv*. 23: 29–44.

Miličić M, Janković M, Tot T, Nedeljković Z, Popov S, Ivošević B, Radenković S, Vujić A (2018a): New findings of hoverfly fauna (Diptera: Syrphidae) of the Western part of Serbia (Zlatibor and Raška Districts). *Acta Entomol. Serbica* 23: 43–66.

Miličić M, Vujić A, Cardoso P (2018b): Effects of climate change on the distribution of hoverfly species (Diptera: Syrphidae) in Southeast Europe. *Biodivers. Conserv.* 27: 1173–1187.

Mišić V (1981): *Šumska vegetacija klisura i kanjona istočne Srbije*. Institut za biološka istraživanja Siniša Stanković, Belgrade.

Nedeljković Z (2011): *Taksonomska analiza vrsta iz podfamilije Syrphinae (Diptera: Syrphidae) u Srbiji*. Doctoral dissertation. Novi Sad: University of Novi Sad.

Nedeljković Z, Ačanski J, Djan M, Obreht Vidaković D, Ricarte A, Vujić A (2015): An integrated approach to delimiting species borders in the genus *Chrysotoxum* Meigen, 1803 (Diptera: Syrphidae), with description of two new species. *Contrib. Zool*. 84: 285–304.

Nedeljković Z, Ricarte A, Zorić LŠ, Đan M, Vidaković DO, Vujić A (2018): The genus *Xanthogramma* Schiner, 1861 (Diptera: Syrphidae) in southeastern Europe, with description of two new species. *Can. Entomol*. 150: 440–464.

Nedeljković Z, Vujić A, Radenković S, Šimić S (2003): The genus *Volucella* Geoffroy, 1764 (Diptera: Syrphidae) on the Balkan Peninsula. *Acta Entomol. Serbica* 8: 41–55.

Nedeljković Z, Vujić A, Ricarte A, Radenković S, Šimić S (2010): New data on the genus *Syrphus* Fabricius, 1775 (Diptera: Syrphidae) from the Balkan Peninsula including the first record of *Syrphus nitridifrons* Becker, 1921. *Acta Entomol. Serbica* 15: 91–105.

Nedeljković Z, Vujić A, Šimić S, Radenković S (2009): The fauna of hoverflies (Diptera: Syrphidae) of Vojvodina province, Serbia. *Arch. Biol. Sci*. 61: 147–154.

Pereira P, Ignacio M, Bogunivic I, Francos M, Barceló D, Zhao W (2022): Ecosystem services in mountain environments: benefits and threats. *Pirineos* 177: e068.

Popov S, Miličić M, Diti I, Marko O, Sommaggio D, Markov Z, Vujić A (2017): Phytophagous hoverflies (Diptera: Syrphidae) as indicators of changing landscapes. *Community Ecol*. 18: 287–294.

Radenković S (1999): *Taksonomija i distribucija roda Paragus Latreille, 1804 (Diptera: Syrphidae)*. Master's thesis. Faculty of Sciences. University of Novi Sad.

Radenković S, Schweiger O, Milić D, Harpke A, Vujić A (2017): Living on the edge: Forecasting the trends in abundance and distribution of the largest hoverfly genus (Diptera: Syrphidae) on the Balkan Peninsula under future climate change. *Biol. Conserv.* 212: 216–229.

Radenković S, Šimić S, Vujić A (1995): Genus *Scaeva* Fabricius, 1805 (Diptera, Syrphidae) on the Balkan Peninsula. *Zbornik Matice srpske za prirodne nauke / Proc. Sci. Matica Srpska* 88: 51–57.

Radenković SR, Vujić AV, Šimić SD (2004): New data on hoverfly diversity (Insecta: Diptera: Syrphidae) of the special nature reserve the Obedska Bara marsh (Ramsar site in Serbia). *Proc. Sci. Matica Srpska* 107: 21–31.

Reemer M, Hauser M, Speight MC (2005): The genus *Myolepta* Newman in the West–Palaearctic region (Diptera, Syrphidae). *Stud. Dipterol.* 11: 553–580.

Reverté S, Miličić M, Ačanski J, Andrić A, Aracil A, Aubert M, Vujić, A (2023): National records of 3000 European bee and hoverfly species: A contribution to pollinator conservation. *Insect Conserv. Divers.* 16: 758–775.

Savić IR (2008): Diversification of the Balkan fauna: its origin, historical development and present status. In: SE Makarov, RN Dimitrijević (eds.), *Advances in Arachnology and Developmental Biology: Papers Dedicated to Professor Božidar P. M. Ćurčić*, Institute of Zoology, University of Belgrade, Belgrade; Bulgarian Academy of Sciences, Sofia; Faculty of Life Sciences, University of Vienna, Vienna; Serbian Academy of Sciences and Arts, Belgrade; and UNESCO MAB Committee Serbia, Belgrade, Monographs, 12: 57–78.

Schweiger O, Musche M, Bailey D, Billeter R, Diekötter T, Hendrickx F, Herzog F, Liira J, Maelfait JP, Speelmans M, Dziock F (2007): Functional richness of local hoverfly communities (Diptera, Syrphidae) in response to land use across temperate Europe. *Oikos* 116: 461–472.

Smit J, Vujić A (2008): The Palaearctic species of the genus *Psilota* Meigen (Diptera, Syrphidae) with the description of two new species. *Stud Dipterol.* 14: 345–364.

Sommaggio D (1999): Syrphidae: can they be used as environmental bioindicators? In: MG Paoletti (ed.), *Invertebrate Biodiversity as Bioindicators of Sustainable Landscapes*, 343–356. Elsevier, Amsterdam.

Sommaggio D, Burgio G (2014): The use of Syrphidae as functional bioindicator to compare vineyards with different managements. *Bull. Insectology* 67: 147–156.

Speight MCD (2017): *Species accounts of European Syrphidae, 2017.* Syrph the Net, the database of European Syrphidae (Diptera), Syrph the Net publications, Dublin.

Speight MCD, Sarthou J-P (2017): *StN keys for the identification of the European species of various genera of Syrphidae*. Syrph the Net, the database of European Syrphidae (Diptera), Syrph the Net publications, Dublin.

Stojanovic M, Sekulic J, Trakic T (2017): A nonparametric approach in quantifying species richness of Lumbricidae in East Serbia, Balkan Peninsula. *Turkish J. Zoology* 41: 487–494.

Šimić S, Vujić A (1990): Vrste roda *Eristalis* Latreille, 1804 (Diptera Syrphidae) iz zbirke Instituta za biologiju u Novom Sadu. *Glasnik Prirodnjačkog muzeja u Beogradu*, B 45: 115–126.

Šimić S, Vujić A (1996): Hoverfly fauna (Diptera: Syrphidae) of the southern part of the mountain Stara planina, Serbia. *Acta Entomol. Serbica* 1: 21–30.

Šimić S, Vujić A, Radenković S, Radišić P (2008): Hoverflies (Insecta: Diptera: Syrphidae) of the Fruška Gora mountain. *Invertebrates (Invertebrata) of the Fruška Gora Mountain*, *1*. Department of Biology and Ecology, University of Novi Sad, Novi Sad, Serbia.

Tot T, Vujić M, Likov L, Nedeljković Z, Radenković S, Vujić A (2018): Hoverfly fauna (Diptera: Syrphidae) of the landscape of outstanding features "Vlasina". *Acta Entomol. Serbica* 23: 33–50.

Van Steenis J (2000): The West–Palaearctic species of *Spilomyia* Meigen (Diptera, Syrphidae). *Mitt. Schweiz. Entomol. Ges.* 73: 143–168.

Van Steenis J, Lucas JAW (2011): Revision of the West-Palaearctic species of *Pipizella* Rondani 1856 (Diptera, Syrphidae). *Dipterists Digest* 18: 127–180.

Van Steenis J, van Steenis W, Ssymank A, van Zuijen MP, Nedeljković Z, Vujić A, Radenković S (2015): New data on the hoverflies (Diptera: Syrphidae) of Serbia and Montenegro. *Acta Entomol. Serbica* 20: 67–98.

Van Veen M. (2004): *Hoverflies of Northwest Europe: Identification keys to the Syrphidae*. KNNV Publishing, Utrecht.

Vujić A (1990): Genera *Neoascia* Williston 1886 and *Sphegina* Meigen, 1822 (Diptera: Syrphidae) in Yugoslavia and description of species *Sphegina sublatifrons* sp. nova. *Bull. Mus. Hist. Nat. Belgrade* 45: 77–93.

Vujić A (1991): Vrste roda Brachyopa Meigen 1822 (Diptera: Syrphidae) u Jugoslaviji. *Glasnik prirodnjačkog muzeja u Beogradu* B46, 141–150.

Vujić A (1992): *Taksonomski položaj i zoogeografska analiza roda Cheilosia i srodnih rodova (Diptera: Syrphidae) na Balkanskom poluostrvu*. Doctoral dissertation. Prirodno-matematički fakultet. Univerzitet u Novom Sadu.

Vujić A (1994): Description of male of species *Triglyphus escalerai* Gil Collado, 1929 (Diptera: Syrphidae). *Graellsia* 50: 21–24.

Vujić A (1996): *Genus Cheilosia Meigen and related genera (Diptera: Syrphidae) on the Balkan Peninsula*. Novi Sad: Matica Srpska.

Vujić A (1997): The genus *Pipizella* (Diptera, Syrphidae) on the Balkan Peninsula and description of *Pipizella zloti* sp.n. *Dipterists Digest* 4: 51–60.

Vujić A (1999a): The tribe Chrysogasterini (Diptera: Syrphidae) in the Balkan Peninsula, with the description of three new species. *Stud. Dipterol.* 6: 405–423.

Vujić A (1999b): The subgenus *Neocnemodon* Goffe, 1944 (Diptera, Syrphidae) on the Balkan Peninsula and description of *Heringia* (*Neocnemodon*) *larusi* spec. nov. *Dipteron* 2: 133–142.

Vujić A, Claussen C (1994): *Cheilosia bracusi*, a new hoverfly from the mountains of central and southern Europe (Diptera: Syrphidae). *Bonn Zool. Beitr.* 45: 137–146.

Vujić A, Glumac S (1994): *Fauna osolikih muva (Diptera: Syrphidae) Fruške gore.* Novi Sad: Matica Srpska.

Vujić A, Milankov V (1990): Taxonomic status of species belonging to genus *Criorrhina* Meigen 1822 (Diptera: Syrphidae) and recorded in Yugoslavia. *Bull. Mus. Hist. Nat. Belgrade* 45: 105–114.

Vujić A, Milankov V (1999): New data for the tribes Milesiini and Xylotini (Diptera, Syrphidae) on the Balkan Peninsula. *Dipteron* 2: 113–132.

Vujić A, Radenković S (1996): Zoogeografske odlike faune osolikih muva (Diptera: Syrphidae) Dubašnice i Malinika (Srbija). *Zbornik radova Naša ekološka istina / IV naučno-stručni skup o prirodnim vrednostima i zaštiti životne sredine*, Kladovo: Organizacioni odbor, 213–216.

Vujić A, Radovic D (1990): Species of genus *Brachypalpus* Macquarti 1834 (Diptera: Syrphidae) in Yugoslavia. *Bull. Mus. Hist. Nat. Belgrade* B 45: 95–104.

Vujić A, Stuke JH (1998): A new hoverfly species of the genus *Melanogaster* from Central Europe (Diptera, Syrphidae). *Stud. Dipterol*. 5: 343–347.

Vujić A, Šikoparija B (2001): Species related to *Cheilosia canicularis* (Diptera: Syrphidae) on the Balkan Peninsula. *Acta Entomol. Serbica* 6: 107–120.

Vujić A, Šimić S (1994): *Syrphidae (Insecta: Diptera) Vršačkih planina*. Monografije Vršačkih planina. Novi Sad: Matica srpska.

Vujić A, Šimić S (1995–1998): Genus *Eumerus* Meigen 1822 (Diptera: Syrphidae) in area of former Yugoslavia. *Bull. Mus. Hist. Nat. Belgrade* 49: 173–190.

Vujić A, Gilbert F, Flinn G, Englefield E, Ferreira CC, Varga Z, Vrba J et al. (2022): *Pollinators on the edge: our European hoverflies. The European Red List of Hoverflies*. Brussels, Belgium: European Commission.

Vujić A, Radenković S, Likov L, Andrić A, Janković M, Ačanski J, Popov G, de Courcy Williams M, Zorić LŠ, Djan M (2020): Conflict and congruence between morphological and molecular data: revision of the *Merodon constans* group (Diptera: Syrphidae). *Invertebr. Syst*. 34: 406–448.

Vujić AA, Radenković SR, Nedeljković ZS, Šimić SD (2018): A new check list of hoverflies (Diptera: Syrphidae) of the Republic of Serbia. *Proc. Sci. Matica Srpska* 135: 7–51.

Vujić A, Radenković S, Ståhls G, Ačanski J, Stefanović A, Veselić S, Andrić A, Hayat R (2012): Systematics and taxonomy of the *ruficornis* group of genus *Merodon* Meigen (Diptera: Syrphidae). *Syst. Entomol*. 37: 578–602.

Vujić A, Ståhls G, Ačanski J, Bartsch H, Bygebjerg R, Stefanović A (2013): Systematics of Pipizini and taxonomy of European *Pipiza* Fallén: molecular and morphological evidence (Diptera, Syrphidae). *Zool. Scr.* 42: 288–305.

Vujić A, Šimić S, Milankov V, Radović D, Radišić D, Radnović D (1998): *Fauna Syrphidae (Insecta: Diptera) Obedske bare. Značaj i potreba zaštite.* Beograd: Zavod za zaštitu prirode Srbije.

Vujić A, Šimić S, Radenković S (1999): Mediterranean species related to *Paragus hermonensis* Kaplan, 1981, with the description of *Paragus gorgus* spec. nov. (Diptera, Syrphidae). *Volucella* 4: 29–44.

Vujić AA, Šimić SD, Radenković SR (2002): New data about hoverflies diversity (Insecta: Diptera: Syrphidae) on the Fruška Gora Mountain, Serbia. *Proc. Sci. Matica Srpska* 103: 91–106.

Vujić A, Šimić S, Radović D, Vapa L, Radišić P, Milankov V, Radenković S (1993/1994): Diversity in some groups of Diptera (Arthropoda: Insecta) on The Balkan Peninsula. *Ekologija* 28: 1–8.

Wotton KR, Gao B, Menz MH, Morris RK, Ball SG, Lim KS, Reynolds DR, Hu G, Chapman JW (2019): Mass seasonal migrations of hoverflies provide extensive pollination and crop protection services. *Curr. Biol.* 29: 2167–2173.

ОРИГИНАЛНИ ЧЛАНАК
Примљен: 30. 1. 2024.
Прихваћен: 20. 2. 2024.

ФАУНА ОСОЛИКИХ МУВА (DIPTERA: SYRPHIDAE) ИСТОЧНОГ ДЕЛА СРБИЈЕ

Марина А. ЈАНКОВИЋ МИЛОСАВЉЕВИЋ[1], Тамара Ј. ТОТ[1], Марија С. МИЛИЧИЋ,[2] Снежана Д. ПОПОВ[1], Снежана Р. РАДЕНКОВИЋ[1], Анте А. ВУЈИЋ[1]

[1] Универзитет у Новом Саду, Природно-математички факултет,
Департман за биологију и екологију,
Трг Доситеја Обрадовића 2, Нови Сад 21000, Србија
[2] Универзитет у Новом Саду,
Институт БиоСенс – Истраживачко-развојни институт за информационе технологије биосистема,
Др Зорана Ђинђића 1, Нови Сад 21000, Србија

РЕЗИМЕ: Једна од највећих фамилија из реда двокрилаца – осолике муве, уједно су и једна од најистакнутијих група инсеката, препознате као друга по значају група опрашивача, биоиндикаторске врсте, као и потенцијални агенси за биоконтролу. Стога, не изненађује повећање интересовања за њихову дистрибуцију, биологију и екологију. Као допринос процесу систематизације знања о овим врстама, у овом раду су приказани детаљи о фауни осоликих мува источног дела Србије, обједињавајући на једном месту информације о до сада објављеним налазима, старијим, али необјављеним налазима, као и налазима прикупљеним у недавним теренским истраживањима на 109 локалитета у источној Србији. Најзначајнији налази су *Cheilosia subpictipennis* Claussen, 1998 и *Paragus kopdagensis* Hayat & Claussen, 1997, први пут објављени за Србију, као и 105 врста које су по први пут забележене за источну Србију. Поред тога, регистрована је једна потенцијално нова врста осолике муве за науку *Paragus* aff. *testaceus*.

КЉУЧНЕ РЕЧИ: инсекти, опрашивачи, распрострањење врста, цветне муве, фаунистика

Зборник Матице српске за природне науке / Matica Srpska J. Nat. Sci. № 146, 73—80, 2024

UDC 633.11:632.38
https://doi.org/10.2298/ZMSPN2446073B
ORIGINAL ARTICLE
Received: 16. 11. 2023.
Accepted: 25. 12. 2023.

Ferenc F. BAGI[1*], *Renata M. ILIČIĆ*[1], *Đina S. KONSTANTIN*[1], *Nemanja S. PAVKOVIĆ*[1], *Predrag M. MILOVANOVIĆ*[2], *Tatjana Č. POPOVIĆ-MILOVANOVIĆ*[3]

[1] University of Novi Sad, Faculty of Agriculture,
Trg Dositeja Obradovića 8, Novi Sad 21102, Serbia
[2] Agrounik d.o.o.,
Krnješevačka bb, Šimanovci 22310, Serbia
[3] Institute for Plant Protection and Environment,
Teodora Drajzera 9, Belgrade 11040, Serbia

IN VITRO EFFECT OF *Bacillus* spp. ON *Alternaria alternata* INFECTING WHEAT

ABSTRACT: Species of the genus *Alternaria* are significant wheat contaminants during production, transport and storage, requiring biocontrol measures which typically rely on the bacteria from the *Bacillus* genera. As these are among the most beneficial and exploited biocontrol agents, in this study, the inhibitory activity of indigenous *Bacillus* spp. was assessed against the *Alternaria alternata* isolate originating from the wheat seed. Two of the fifteen *Bacillus* spp. included in the study showed the inhibitory effect. Specifically, 25.0−55.0% inhibition of *A. alternata* growth was achieved when the isolate coded as NB11 was applied in 10^6–10^9 cells mL^{-1} concentrations. On the other hand, when applied in 10^7–10^9 cells mL^{-1} concentrations, the isolate coded as NB16 inhibited *A. alternata* growth by 35.2−51.1%, but was ineffective at lower concentrations. Thus, these *in vitro* assays indicate that both *Bacillus* spp. (NB11 and NB16) isolated from the wheat rhizosphere can be applied in practice in the control of *A. alternata*.

KEYWORDS: wheat, pathogen, biological control

INTRODUCTION

Cereals are highly important for human consumption due to which they are the most prevalent culture. They form the base of the food pyramid in both

* Corresponding author. E-mail: ferenc.bagi@polj.edu.rs

developed countries as well as countries in transition (Brkić et al., 2021). In Serbia, wheat production volume is second only to corn, while globally wheat is the third most widely produced grain (Janić Hajnal et al., 2014). Although there are many species of wheat, which make up the genus *Triticum*, common wheat (*T. aestivum*) is the most widespread.

From seed germination to harvest, wheat can be attacked by a number of fungi, which can significantly reduce the yield and crop quality under certain weather conditions (Perelló & Larrán, 2013). Due to evident climate changes and global warming and their adverse influence on the agricultural environment, occurrences of mycotoxigenic fungi on wheat are becoming more frequent. This not only exerts a negative impact on the safety and quality of food products, but also inevitably leads to large economic losses (Janić Hajnal et al., 2014).

Phytopathogenic fungi from the genus *Alternaria* are significant contaminants of cereals that—in addition to producing mycotoxins and causing damage to the field—can cause product spoilage during processing, transport and storage. As a result, diseases caused by *Alternaria* sp. are among the most common and most researched crop diseases throughout the world (Perelló & Larrán, 2013). Among the *Alternaria* species, *A. alternata* is considered the most dominant mycotoxin-producing species associated with black spot, early blight disease and stem canker in cereal grains (Kumar et al., 2022). Although the *Alternaria* species produces more than 70 secondary metabolites, only a few phytotoxins have been chemically characterised and reported to act as mycotoxins in humans and animals (Janić Hajnal et al., 2014). Under favourable conditions, the most important mycotoxins produced by *A. alternata* are alternariol (AOH), alternariol monomethyl ether (AME) and tenuazonic acid (TA) (Somma et al., 2019). The occurrence of these metabolites in food represents a serious global problem for human and animal health due to their toxic effects.

To mitigate this issue, fungicides are usually utilised in agricultural practice, whereby different chemical fungicides are adopted as a means of wheat pathogen control (Casa et al., 2012). However, integrated pest management programs (IPMs) are being increasingly employed in the agricultural sector, with the emphasis on the use of biological products as an environmentally friendly pathogen control strategy. In this context, *Bacillus* species have been shown to be promising biological control agents (Berić et al., 2012; Gond et al., 2015; Marković et al., 2020, 2023; Jelušić et al., 2021; Iličić et al., 2022; Soliman et al., 2023). They exhibit multiple modes of action and produce a wide range of biologically active compounds with antifungal potential, making them suitable for controlling different diseases.

Guided by this evidence, the aim of this study was to utilise *in vitro* assays in order to determine the biocontrol potential of indigenous *Bacillus* species isolated from wheat rhizosphere in the control of *A. alternata*.

MATERIAL AND METHODS

Isolation of antagonistic bacteria

Isolation of the potential antagonistic bacteria was performed from the soil samples collected in the wheat rhizosphere (locality Rimski Šančevi) according to the procedure described by Berić et al. (2012). *Bacillus*-like colonies that developed after 24^h incubation at 30 °C were selected, purified and maintained in sterile LB (Luria Bertani) glycerol at -20 °C. Fifteen isolates were subsequently subjected to morphological and biochemical tests (Gram staining, spore formation, catalase production, glucose fermentation, starch hydrolysis and growth on 5% NaCl).

Antagonistic activity of the selected *Bacillus* species on the *Alternaria alternata* isolates from wheat

One isolate of *A. alternata* (SOR1IIIZA1) originating from wheat seed in Vojvodina Province was used in testing. This isolate was grown at 25 °C on PDA (Potato-Dextrose Agar) in Petri plates (ø 90 mm) for 10 days.

Antagonistic activity of the fifteen selected *Bacillus* spp. isolates (coded as NB1-9 and NB11-16) against the *A. alternata* was determined using the dual culture method. Agar discs (ø 7 mm) of the tested fungi pathogen isolate were placed in the centre of PDA plates (ø 90 mm). Drops (8 µl in volume) of bacterial suspensions of appropriate *Bacillus* spp. isolate adjusted to 10^6, 10^7, 10^8 and 10^9 cells mL^{-1} were placed on four sides near the edge of the Petri plates. Petri dishes were kept at a constant temperature (25 °C) for seven days. The assay was set in three replications and sterile distilled water served as a control treatment. All experiments were performed twice.

In order to quantify the antagonistic potential of *Bacillus* spp. isolates, the pathogen growth area was measured after 7 days of incubation at 25 °C, and the percent of inhibition was calculated using the formula given by Zarrin et al. (2009). The results were subjected to analysis of variance (ANOVA), whereby Duncan's Multiple Range Test ($p < 0.01$) was performed for assessing the differences between means related to different treatments.

RESULTS AND DISCUSSION

While all wheat pathogens have the capacity to significantly reduce yield quantity and seed quality, fungi from the *Alternaria* genus are particularly harmful as they can compromise food safety due to their toxin-producing potential (Bagi et al., 2022). Consequently, in wheat production, seed and plant treatments are regularly implemented during the vegetation phase. However, there is increased concern about the application of synthetic pesticides, prompting

research into less harmful alternatives (Moumni et al., 2023). In this context, focus is primarily given to the implementation of beneficial microorganisms, such as biological control agents from *Bacillus* genera, which have been used in experimental tests on a wide range of economically important crops (Slama et al., 2019; Wang et al., 2021; Rabbee et al., 2022).

This study contributes to this research endeavour by evaluating the antagonistic potential of 15 *Bacillus* isolates from the wheat rhizosphere, which were selected as promising biological control agents in the control of *A. alternata* originating from wheat. The antagonistic activity testing results indicated that two *Bacillus* spp. (coded as NB11 and NB16) exhibit a strong inhibitory effect against wheat pathogen *A. alternata*. Based on the results obtained using the dual culture method, isolate NB11 achieved 25.0−55.0% inhibition of *A. alternata* growth, depending on the applied concentration (Table 1). As shown in Figure 1, this *Bacillus* spp. isolate showed antagonistic potential against *A. alternata* at the lowest tested concentration (10^6 cells mL^{-1}) with a rated inhibition of 25.0%, which increased to 38.9%, 47.2% and 55.0% at 10^7, 10^8 and 10^9 cells mL^{-1}, respectively. On the other hand, the *Bacillus* isolate coded as NB16 was ineffective at 10^6 cells mL^{-1}, but when applied at the three higher concentrations it inhibited *A. alternata* growth by 35.2%, 43.7% and 51.1%, respectively (Table 2).

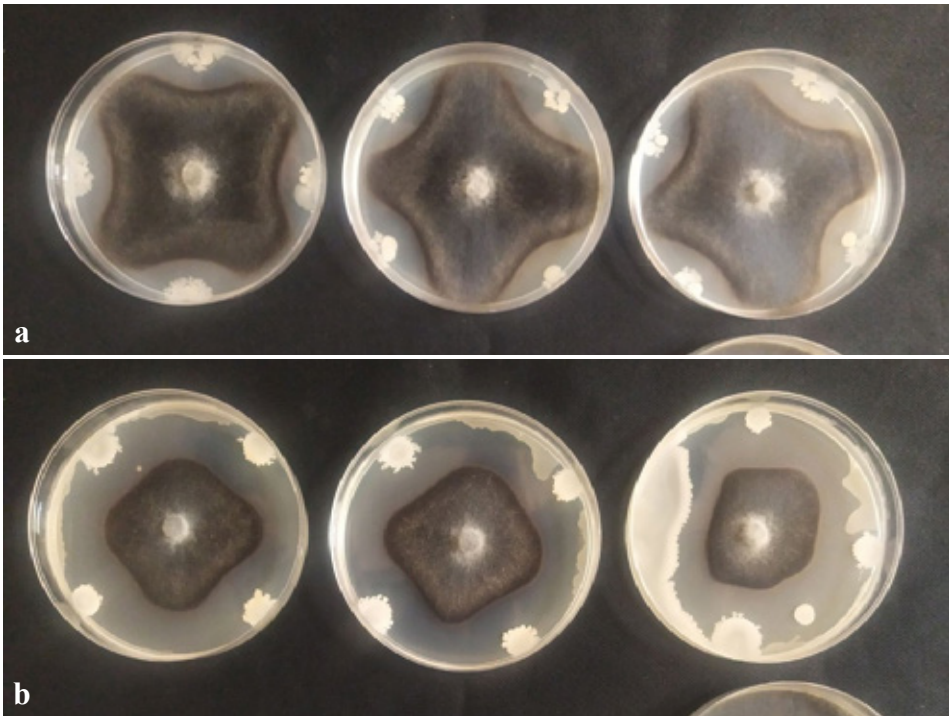


Figure 1. Antagonistic activity of the *Bacillus* isolate NB11 against *A. alternata* originating from wheat seed in dual culture, in two of the four tested concentrations: (a) 10^6 cells mL^{-1} and (b) and 10^9 cells mL^{-1}.

Table 1. The inhibitory effect of the *Bacillus* isolate NB11 on the pathogenic fungi *A. alternata*

Treatment	Concentration (cells mL^{-1})	Mycelium growth (diameter in mm)			Mean (mm)	Inhibition (%)	Sd
		Replications					
		I	II	III			
Bacillus NB11	10^6	65	67.5	70	67.5^c	**25.0**	2.04
	10^7	50	55	60	55.0^b	**38.9**	4.08
	10^8	45	50	47.5	47.5^{ab}	**47.2**	2.04
	10^9	45	39	37.5	40.5^a	**55.0**	3.24
Negative control	–	90	90	90	90.0^d	**0**	0

Sd – standard deviation; *Mean values of inhibition zone diameters are shown. Values followed by the same letter are not significantly different ($p < 0.01$) according to Duncan's multiple range test results.

Table 2. The inhibitory effects of the *Bacillus* isolate NB16 on the pathogenic fungi *A. alternata*

Treatment	Concentration (cells mL^{-1})	Mycelium growth (diameter in mm)			Mean (mm)	Inhibition (%)	Sd
		Replications					
		I	II	III			
Bacillus NB16	10^6	90	90	90	90.0^d	**0**	0
	10^7	55	60	60	58.3^c	**35.2**	2.35
	10^8	51	52	49	50.7^b	**43.7**	1.24
	10^9	45	45	42	44.0^a	**51.1**	1.41
Negative control	–	90	90	90	90.0^d	**0**	0

Sd – standard deviation; *Mean values of inhibition zone diameters are shown. Values followed by the same letter are not significantly different ($p < 0.01$) according to Duncan's multiple range test results.

The inhibitory activity of *Bacillus* species against different phytopathogens has been demonstrated in numerous *in vitro*, *in vivo* and *in planta* trials, providing evidence in support of their potential use as biocontrol agents and plant growth promoters (Slama et al., 2019; Brzezinska et al., 2020; Wang et al., 2021; Soliman et al., 2023). *Bacillus* spp. produces a variety of biologically active compounds involved in the biocontrol of plant pathogens (Prasad et al., 2023). For example, Abdelmoteleb et al. (2017) reported that *B. subtilis* produce three mucolytic enzymes which cause damage to the hypha of *A. alternata*, *Botrytis cinerea*, *Colletotrichum gloeosporioides*, *Macrophomina* sp. and *Sclerotium rolfesii*. More recently, Brzezinska et al. (2020) conducted a study on *B. subtilis* and *Bacillus* sp. and demonstrated that chitinases inhibited the growth of *A. alternata* and *Fusarium oxysporum*. In the same study, the isolates showed the ability to produce a broad range of biological substances that promote plant growth.

The present study shows that two indigenous isolates of *Bacillus* have a strong biocontrol potential and could be used to control *Alternaria* disease in wheat. Further research should thus incorporate *in vitro* and *in planta* testing to determine their efficacy and potential use as biocontrol agents and plant growth promoters.

CONCLUSION

The results obtained as a part of this work indicate that the applied treatments based on two indigenous *Bacillus* spp. are effective in *A. alternata* control and should be subjected to further trials on wheat in different stages of development.

ACKNOWLEDGEMENT

This research was supported by Matica Srpska, Department of Natural Sciences Novi Sad, Serbia and Science Fund of the Republic of Serbia, IDEAS programme, Grant No. 7736059, project "Biotechnological tools for optimization of short and medium chain carbohydrates content in cereal-based food to prevent gastrointestinal disorders – GutFriendlyCarbs".

REFERENCES

Abdelmoteleb A, Troncoso-Rojas R, Gonzalez-Soto T, González-Mendoza D (2017): Antifungical activity of autochthonous *Bacillus subtilis* isolated from *Prosopis juliflora* against phytopathogenic fungi. *Mycobiology* 45: 385–391.

Bagi F, Iličić R, Savić Z, Jeftić R, Orbović B, Suman M, Tóth B, Berényi A, Popović T (2022): Toxigenic potential of *Alternaria* species from cereals. *Matica Srpska J. Nat. Sci.* 142: 39–45.

Berić T, Kojić M, Stanković S, Topisirović Lj, Degrassi G, Myers M, Venturi V, Fira Dj (2012): Antimicrobial activity of *Bacillus* sp. natural isolates and their potential use in the biocontrol of phytopathogenic bacteria. *Food Technol. Biotechnol*. 50: 25–31.

Brkić D, Bošnir J, Jajetić A, Prskalo I, Šabarić J, Kuharić Ž, Pavlek Ž, Benić M, Racz A (2021): Žitarice i mlinski proizvodi kao dobar izvor magnezija u svakodnevnoj prehrani. *J. Appl. Health Sci.* 7: 71–86.

Brzezinska MS, Kalwasińska A, Świątczak J, Żero K, Jankiewicz U (2020): Exploring the properties of chitinolytic *Bacillus* isolates for the pathogens biological control. *Microb. Pathog.* 148: 104462.

Casa RT, Kuhnem JPR, Bogo A, Belani ANM, Bolzan JM, Oliveira FS, Blum MMC (2012): Survey, survival and control of *Alternaria alternata* in wheat seeds. *Rev. Bras. Sementes*. 34: 358–365.

Gond SK, Bergen MS, Torres MS, White JFJr (2015): Endophytic *Bacillus* spp. produce antifungal lipopeptides and induce host defence gene expression in maize. *Microbiol. Res.* 172: 79–87.

Iličić R, Popović T, Jelušić A, Bagi F, Trkulja N, Živković I, Stanković S (2022): Biocontrol ability of *Bacillus halotolerans* against stone fruit pathogens. *4th International Symposium: Modern Trends in Agricultural Production, Rural Development, Agro-economy, Cooperatives and Environmental Protection*, 29–30. June, Vrnjačka Banja, Serbia. Book of Proceedings, 170–179.

Janić Hajnal E, Orčić D, Mastilović J, Milovanović I, Kos J (2014): The choice of preparation method for the determination of *Alternaria* toxins from wheat samples by LC-MS/MS. *Food Feed Res*. 4: 131–138.

Jelušić A, Popović T, Dimkić I, Mitrović P, Peeters K, Višnjevec AM, Tavzes Č, Stanković S Berić T (2021): Changes in the winter oilseed rape microbiome affected by *Xanthomonas campestris* pv. *campestris* and biocontrol potential of the indigenous *Bacillus* and *Pseudomonas* isolates. *Biol. Control*. 160: 104695.

Kumar PS, Nattudurai G, Islam VIH, Ignacimuthu S (2022): The effects of some essential oils on *Alternaria alternata*, a post-harvest phyto-pathogenic fungus in wheat by disrupting ergosterol biosynthesis. *Phytoparasitica* 50: 513–525.

Marković S, Popović Milovanović T, Jelušić A, Iličić R, Medić O, Berić T, Stanković S (2023): Biological control of major pathogenic bacteria of potato by *Bacillus amyloliquefaciens* strains SS-12.6 and SS-38.4. *Biol. Control*. 182: 105238.

Marković S, Popović T, Jelušić A, Iličić R, Stanković S (2020): Potential of *Bacillus amyloliquefaciens* strains SS-12.6 and SS-38.4 in biological control of potato rot pathogens. *FEMS Online Conference on Microbiology,* October, Belgrade, Serbia, 28–31.

Moumni M, Brodal G, Romanazzi G (2023): Recent innovative seed treatment methods in the management of seedborne pathogens. *Food Secur.* 15: 1365–1382.

Perelló AE, Larrán S (2013): Nature and effect of *Alternaria* spp. complex from wheat grain on germination and disease transmission. *Pak. J. Bot.* 45: 1817–1824.

Prasad B, Sharma D, Kumar P, Dubey RC (2023): Biocontrol potential of *Bacillus* spp. for resilient and sustainable agricultural systems. *Physiol. Mol. Plant Pathol*. 102173.

Rabbee FM, Islam N, Baek KH (2022): Biocontrol of citrus bacterial canker caused by *Xanthomonas citri* subsp. *citri* by *Bacillus velezensis*. *Saudi. J. Biol. Sci.* 29: 2363–2371.

Slama BH, Cherif-silini H, Bouket AC, Qader M (2019): Screening for *Fusarium* antagonistic bacteria from contrasting niches designated the endophyte *Bacillus halotolerans* as plant warden against Fusarium. *Front. Microbiol*. 9: 1–24.

Soliman SA, Abdelhameed RE, Metwally RA (2023): In vivo and In vitro evaluation of the antifungal activity of the PGPR *Bacillus amyloliquefaciens* RaSh1 (MZ945930) against *Alternaria alternata* with growth promotion influences on *Capsicum annuum* L. plants. *Microb. Cell. Factories* 22: 70.

Somma S, Amatulli MT, Masiello M, Moretti A, Logrieco AF (2019): *Alternaria* species associated to wheat black point identified through a multilocus sequence approach. *Int. J. Food Microbiol.* 293: 34-43.

Wang F, Xiao J, Zhang Y, Li R, Liu L, Deng J (2021): Biocontrol ability and action mechanism of *Bacillus halotolerans* against *Botrytis cinerea* causing grey mould in postharvest strawberry fruit. *Postharvest Biol. Technol*. 174: 111456.

Zarrin F, Saleemi M, Zia M, Sultan T, Aslam M, Rehman RU, Chaudhary MF (2009): Antifungal activity of plant growth-promoting rhizobacteria isolates against *Rhizoctonia solani* in wheat. *Afr. J. Biotechnol*. 8: 219–225.

ОРИГИНАЛНИ ЧЛАНАК
Примљен: 16. 11. 2023.
Прихваћен: 25. 12. 2023.

УТИЦАЈ *Bacillus* spp. НА ПАТОГЕНА ПШЕНИЦЕ *Alternaria alternata* У *IN VITRO* УСЛОВИМА

Ференц Ф. БАГИ[1], Рената М. ИЛИЧИЋ[1], Ђина С. КОНСТАНТИН[1], Немања С. ПАВКОВИЋ[1], Предраг М. МИЛОВАНОВИЋ[2], Татјана Ч. ПОПОВИЋ МИЛОВАНОВИЋ[3]

[1] Универзитет у Новом Саду, Пољопривредни факултет, Трг Доситеја Обрадовића 8, Нови Сад 21102, Србија
[2] "Агроуник" Д.О.О., Крњешевачка ББ, Шимановци 22310, Србија
[3] Институт за заштиту биља и животну средину, Теодора Драјзера 9, Београд 11040, Србија

РЕЗИМЕ: Врсте рода *Alternaria* су значајни патогени пшенице током производње, транспорта и складиштења. Бактерије из рода *Bacillus* сматрају се једним од најкориснијих и најискоришћенијих средстава за биоконтролу. Сходно томе, у овој студији инхибиторна активност аутохтоних *Bacillus* spp. је испитана према *Alternaria alternata* изолату пореклом са семена пшенице. Два од петнаест одабраних *Bacillus* spp. су испољили инхибиторни ефекат тј. изолат NB11 постигао је инхибицију раста *A. alternata* од 25,0–55,0% у примењеним концентрацијама од 10^6 и 10^9 ћелија/ml, респективно. Изолат NB16 инхибирао је раст *A. alternata* у опсегу од 35,2–51,1% у тестираним концентрацијама од 10^7 и 10^9 ћелија/ml, респективно, али није забележена инхибиција при најнижој концентрацији од 10^6 ћелија/ml. Оба *Bacillus* spp. NB11 и NB16 изоловани из ризосфере пшенице, представљају обећавајуће агенсе биолошке контроле *A. alternata* са семена пшенице у *in vitro* тестовима.

КЉУЧНЕ РЕЧИ: пшеница, патоген, биолошка контрола

Зборник Матице српске за природне науке / Matica Srpska J. Nat. Sci. № 146, 81—89, 2024

UDC 633.15:[615.918:582.282.123.4
https://doi.org/10.2298/ZMSPN2446081J
ORIGINAL ARTICLE
Received: 4. 12. 2023.
Accepted: 16. 1. 2024.

Marko M. JAUKOVIĆ[1*], *Nikola I. ROKVIĆ*[2], *Anja D. VUKSAN*[3]

[1] Academy of Applied Technical Sciences Belgrade,
Katarine Ambrozić 3, Belgrade 11120, Serbia
[2] Veterinary Scientific Institute of Serbia,
Janisa Janulisa 14, Belgrade 11107, Serbia
[3] Field Test,
Dositejeva 11, Belgrade, Serbia

RECENT AFLATOXIN LEVELS IN MAIZE, FEED MIXTURES, MILK AND CHEESE IN SERBIA

ABSTRACT: Aflatoxins are the most widespread mycotoxins primarıly produced by fungi of the genus *Aspergillus* such as *A. flavus* and *A. parasiticus*, infecting grains during storage, spices, nuts, milk and animal feed. Even in low concentrations, they are highly toxic. Major forms of aflatoxins include B1, B2, G1, G2, and M1. Mammals that ingest AFB1 contaminated food eliminate amounts of the main hepatic metabolite known as milk toxin or aflatoxin M1 (AFM1) via milk. The incidence of contamination of aflatoxin in maize, feed mixtures, milk and cheese samples collected from Serbian producers was investigated by using the competitive enzyme linked immunosorbent assay (ELISA) technique. In this study, a total of 22 samples of maize, 25 samples of feed mixtures, 284 samples of raw, pasteurised and UHT milk and 20 samples of cheese were examined in 2021. Aflatoxin B1 (AFB1) was quantified in 3 samples (13.6%) of maize, at levels ranging from 2.45μg/kg to 48.31μg/kg and 12 samples (48%) of feed mixtures at levels ranging from 2.04 μg/kg to 21.48 μg/kg. On the other hand, AFM1 was quantified in 51 samples (17.90%) of milk at levels ranging 0.02 μg/kg to 0.26 μg/kg and 15 samples (75%) of cheese at levels ranging from 0.15 μg/kg to 0.46 μg/kg. In the Republic of Serbia, maximum limit of AFB1 in maize used for livestock is 30 μg/kg and for feed mixtures for dairy cows is 5 μg/kg. On the other hand, maximum limit of AFM1 in milk is 0.25 μg/kg. Maximum limit of AFM1 in cheese is not set. These results suggest the obvious presence of AFB1 in maize and the fact that number of feed mixture, milk and cheese samples contaminated with aflatoxins is not negligible. The occurence of aflatoxins in raw milk and comercially available milk is one of the most serious problems, as milk is a key source of nutrients for infants and young children. Therefore, continuous monitoring over milk is necessary as well as further research and risk analysis on AFM1 presence in cheese.

KEYWORDS: aflatoxin, maize, feed, milk, cheese

[*] Corresponding author. E-mail: jaukovicmarko@gmail.com

INTRODUCTION

Aflatoxins (AFs) are naturally occurring compounds that are mostly produced from the molds *Aspergillus flavus* and *Aspergillus parasiticus* and they are considered to be the most toxic of all mycotoxins (Whitaker, 2006; Tirmestein et al., 2014). Aflatoxins cause food and feed contamination and lead to severe health issues (Mahato et al., 2019). They can have a negative impact on the physiological status of humans and animals by causing DNA damage, cancer, and abnormalities in embryos under long-term exposure (Alameri et al., 2023). This compound leads to contamination of food and feed and it is greater in warm, humid and drought conditions (Coty and Jaime-Garcia, 2007; Valencia-Quintana et al., 2020). Higher prevalence of aflatoxin contamination is due to changing weather conditions worldwide (Batillani et al., 2016).

Nowadays, aflatoxins became a great concern. In the past, these toxins were problem mainly in warm and humid countries of Africa, Asia and Southern of America, but in the least decade, due to very dry and hot weather, most of European countries dealt with aflatoxin contaminations that had previously been unusual in this part of the world (Devegowda et al., 2009; Fakhri et al., 2019; Milićević et al., 2019, Serraino et al., 2019). Aflatoxin B1 (AFB1) is the most common and the most potent aflatoxin in food and feed. This compound has high carcinogenic, mutagenic and teratogenic capacity (Kos et al., 2014; Rushing et Selim, 2019). Another toxin of great concern is hydroxylated metabolite of AFB1 that can be found in milk and in other dairy products – aflatoxin M1 (AM1) (Marchese et al., 2018). If ruminants are fed with feed contaminated with AFB1, AFM1 is going to be secreted into milk in variable percentage (0.3–6.2%) of total AFB1 ingested. (Galvano et al., 2009; Frazzoli et al., 2017).

Considering that milk and cheese are a highly nutritious food, essential for the growth and human health, the occurrence of AFM1 in milk in dairy products is one of the most serious problems (Iqbal et al., 2015; Kerekes et al., 2016).

Due to all the above mentioned, the aim of this study was examination and quantification of AFB1 in maize and feed mixtures, and examination and quantification of AFM1 in milk and cheese in the Republic of Serbia in 2021.

MATERIALS AND METHODS

In this study, 22 samples of maize, 25 samples of feed mixtures, 284 samples of raw, pasteurized and UHT milk and 20 samples of cheese were analyzed. All samples were collected randomly from the market, small, medium and large producers, as a part of the food safety control. The amount of the collected samples was according to Commission Regulation (EC) No 401/2006. All samples were stored at refrigerator (4–6 ºC), protected from light.

All collected samples were prepared according to manufacturer's instructions. For a start, 5 g of each sample of maize and feed mixture were homogenized and mixed with 70% methanol purchased from Himedia (Maharashtra, India). After that, each mixture was shaken vigorously for three minutes. Every sample was filtered through Whatman No.1 filter and diluted 1:1 (1 ml of obtained filtrate with 1ml of distilled water). Diluted filtrate in the amount of 50 µl was used per well in test.

Each refrigerated milk sample in the amount of 20 µl was centrifuged for degreasing for 10 min/3,000 g prior to analysis. After centrifugation, upper cream layer was removed by aspirating through a Pasteur pipette. Skimmed milk was used directly in the test (100 µl per well).

Ground samples of cheese (1 g) were mixed with 5.5 ml of dichloromethane and vortexed for 15 seconds. Dichloromethane was purchased from Merck (Darmstadt, Germany). Samples were extracted with roto-shake gene for 15 minutes. Every sample was centrifuged 10 minutes/3,000 g. Clear supernatant was transferred into glass vial (3ml). The supernatant was evaporated to dryness (60 °C) and dissolved in 0.5 ml methanol/water (70:30; v:v) solution. The samples were degreased with hexane and vortexed 15 seconds. Hexane was purchase from Merck (Darmstadt, Germany). Every sample was centrifuged for phase separation for 10 minutes/3,000 g. The lower aqueous phase in the amount of 100 µl was diluted with 400 ml sample buffer. Volume of 100 µl was used per well in test.

Aflatoxin analysis and instrumental conditions: Enzyme Linked ImmunoSorbent Assay (ELISA) method is used in order to determinate aflatoxin B1. RIDASCREEN Aflatoxin B1 (R-Biopharm) test kit is used to determinate contaminant of interest quantitatively. Manufacturer's instructions (RIDASCREEN Aflatoxin B1 30/15 Art. No.: R1211) were followed during analysis. Multiskan FC microplate reader with absorbance range 0–6,000 A and normal reading mode were used. Special software Rida® Soft Win (Art. No. Z9999, R-Biopharm, Germany) was used for the evaluation of enzyme immunoassays.

Enzyme Linked ImmunoSorbent Assay (ELISA) method is used in order to determinate aflatoxin M1. RIDASCREEN Aflatoxin M1 (R-Biopharm) test kit is used to determinate contaminant of interest quantitatively. Manufacturer's instructions (RIDASCREEN Aflatoxin M1 Art.No.:1121) were followed during analysis. Multiskan FC microplate reader with absorbance range 0–6,000 A and normal reading mode were used. Special software Rida® Soft Win (Art. No. Z9999, R-Biopharm, Germany) was used for the evaluation of enzyme immunoassays.

RESULTS AND DISCUSSION

Validation parameters are represented in Table 1.

Table 1. Validation parameters

Matrix	Analyze	Limit of detection-LoD (µg/kg)	Limit of quantification-LoQ (µg/kg)	Recovery (%)	Repeatability (%)	Reproductivity (%)
Maize	AFB1	1.000	2.000	79–108	max 10.68	13.43
Feed mixtures	AFB1	1.000	2.000	79–108	max 10.68	13.43
Milk	AFM1	0.005	0.015	84–114	max 9.68	9.93
Cheese	AFM1	0.005	0.100	84–114	max 9.68	9.93

The results on occurrence of AFB1 in maize and feed mixtures, and the results on occurrence of AFM1 of raw milk, pasteurized milk and UHT milk are presented in Table 2, 3, 4 and 5.

Table 2. Occurrence of AFB1 in maize

Not detected (< LoD) / Total number of analyzed samples	19/22
Detected AFB1 / Total number of analyzed samples	3/22
Range of concentration (µg/kg)	2.45–48.31
Exceeded maximum contamination level for AFB1/ Total number of analyzed samples	1/22

Table 3. Occurrence of AFB1 in feed mixtures

Not detected (< LoD) / Total number of analyzed samples	13/25
Detected AFB1 / Total number of analyzed samples	12/25
Range of concentration (µg/kg)	2.04–21.48
Exceeded maximum contamination level for AFB1/ Total number of analyzed samples	3/25

Table 4. Occurrence of AFM1 in milk (monthly).

	January	February	March	April	May	June	July	August	September	October	November	December
Detected AFM1/ Total number of analyzed samples	1/22	3/28	0/23	0/26	1/22	0/15	1/36	0/17	6/22	8/29	21/28	10/16
Detected AFM1/ Total number of analyzed samples (%)	4.54	10.71	/	/	4.54	/	2.78	/	27.27	27.59	75	62.50
Range of concentration (µg/kg)	≤0.02	0.02–0.03	/	/	≤0.02	/	≤0.02	/	0.02–0.06	0.02–0.15	0.02–0.18	0.02–0.26

Table 5. Occurrence of AFM1 in cheese.

Not detected (< LoD) / Total number of analyzed samples	5/20
Detected AFM1 / Total number of analyzed samples	15/20
Range of concentration (μg/kg)	0.15–0.46

Level of most of the detected samples (54) ranged from 0.02 to 0.26 μg/kg. Number of samples (10) which exceeded EU regulated maximum limit (0.05 μg/kg) is lower (3.5%) than in study of Tomašević et al. (2015) where results show that Serbia had much higher incidence (56.3%) of milk samples beyond EU regulated maximum limit of contamination.

In March, April, June and July concentration of AFM1 in milk was below detection limit of the method. However, in September, number of contaminated samples was 27.27%, in October 27.59%, in November 75.0% and in the last month of year 62.5%, when the aflatoxin levels in milk exceeded (0.26 μg/kg) maximum contamination level in the Republic of Serbia (0.25 μg/kg) (Table 4). The increase of contamination level during the second half of the year correlates with higher levels of AFB1 detected in samples of maize and feeding mixtures produced after the harvest in 2021 (Table 2 and 3). In total number of examined samples, an obvious grow of contaminated samples in the last quarter of the year is notable, which is in correlation with study of Milićević et al. (2017). Many authors had previously shown that seasonal effect influences concentration of AFM1. They reported higher concentration of AFM1 in cold seasons as compared to hot seasons (Hussain and Anwar, 2008; Tajkarimi et al., 2008; Bilandzić et al., 2010; Xiong et al., 2013). Elevated concentrations of AFM1 determined in milk in different countries during winter are influenced by the use of greater amounts of mixed supplementary feedstuff and corn contaminated with high levels of AFB1 (Fallah et al., 2011; Asi et al., 2012).

After harvest (autumn season) AFB1 was quantified in 3 samples (13.6%) of maize, at levels ranging from 2.45 μg/kg to 48.31 μg/kg. This is less than in 2012 (72.2%), 2013 (24.7%), 2015 (36.7%) in Serbia (Kos et al., 2018). Twelve samples (48%) of feed mixtures were detected at levels ranging from 2.04 μg/kg to 21.48 μg/kg, which is less than in study of Kokić et al. (2009) (71%). In the Republic of Serbia, maximum limit of AFB1 in maize used for livestock is 30 μg/kg and for feed mixtures for dairy cows is 5 μg/kg. In 5% of samples, maximum level of contamination for AFB1 in maize was exceeded. Maximum levels for AFB1 in feed mixtures was exceeded in 12% of samples.

On the other hand, 15 samples (75%) of analized cheese in December were in levels ranging from 0.15 μg/kg to 0.46 μg/kg, which is higher than in study of Eker at al. (2019). In that study, 50% of analized cheese samples had detectable levels of AFM1. Even though maximum level of contamination for AFM1 in cheese in Serbia is not established, there are some recommendations. The maximum acceptable level of AFM1 in cheese in some European countries including Switzerland, Austria and Turkey has been established at 0.25 μg/kg (Iqbal et al., 2015). Ertas et al. (2011) detected AFM1 in 63% cheese samples, which is similar to this study. In study of Škrbić et al. (2015), 13% samples of

cheese were contaminated with AFM1 with concentration higher than 0.25 μg/kg. This examination is in accordance with our results where 10% of cheese samples had concentration higher than 0.25 μg/kg .

Because AFM1 occurs in cows when AFB1 is hydrolyzed in a cow's body, the most effective way of controlling it in food supply is to reduce contamination with AFB1 from raw materials and supplementary feedstuffs for dairy cattle. The presence of AFB1 in cattle feed was undoubtedly related to the storage temperature and moisture level, which allowed the growth of fungi such as *A. flavus* and *A. parasiticus* (Jay, 2000; Kamkar, 2005).

This results leads to the conclusion that aflatoxin M1 levels in milk depends on concentration of aflatoxin B1 in feed mixtures. This implies that Serbia is lacking the measures for the prevention of the formation of aflatoxins: avoidance of contamination of feed mixtures after harvest by use of rapid drying and good storage practice or feed control for dairy cattle with adequate storage conditions. In addition, cheese analyzed in December after harvest is highly contaminated with aflatoxin M1.

CONCLUSION

Obtained results suggest that highly contaminated feed mixtures with aflatoxin B1 lead to high contamination levels of milk and cheese with aflatoxin M1. Although only a small portion of milk samples (0.3%) had AFM1 content higher than the legal limit and 17.3% of samples were contaminated with detectable concentration of AFM1, this is an alarming sign emphasizing the need to control the production of aflatoxins dairy animal's feed on a regular basis. Aflatoxins are highly toxic and there is a concern regarding human (especially vulnerable groups, children and elderly) exposure to AFM1. Continuous control and monitoring of AFM1 is necessary due to numerous health issues. All owners and staff working on farms and in food-production plants must be informed and educated about the importance of this topic. Regular checking of critical control points of this hazard is crucial in both livestock and food supply.

REFERENCES

Alameri MM, Kong SYA, Aljaafari NM, Ali HA, Eid K, Sallagi MA, Cheng WH, Abushelaibi A, Lim SH, Loh JY, Lai KS (2023): Aflatoxin contamination: An overview on health issues, detection and management strategies. *Toxins* 15: 246. [https://doi.org/10.3390/toxins15040246]

Asi MR, Iqbal SZ, Ariño A, Hussain A (2012): Effect of seasonal variations and lactation times on aflatoxin M1 contamination in milk of different species from Punjab, Pakistan. *Food Control* 25: 34–38. [https://doi.org/10.1016/j.foodcont.2011.10.012]

Battilani P, Toscano P, Van Der Fels-Klerx HJ, Moretti A, Camardo Leggieri M, Brera C, Rortais A, Goumperis T, Robinson T (2016): Aflatoxin B1 contamination in maize in Europe

increases due to climate change. *Sci. Rep.* 1–7. Available to: https://www.nature.com/articles/srep24328

Bilandžić N, Varenina I, Solomun B (2010). Aflatoxin M1 in raw milk in Croatia. *Food Control* 21: 1279–1281. [https://doi.org/10.1016/j.foodcont.2010.03.003]

Bilandžić N, Božić Đ, Đokić M, Sedak M, Varenina I, Cvetnić Ž (2014): Assessment of aflatoxin M1 contamination in the milk of four dairy species in Croatia. *Food Control* 21: 1279–1281.

Commission Regulation (EC): No 401/2006 of 23 February 2006 laying down the methods of sampling and analysis for the official control of the levels of mycotoxins in foodstuffs. Available to: https://eur-lex.europa.eu/eli/reg/2006/401/oj

Cotly PJ, Jaime-Garcia R (2007): Influences of climate on aflatoxin producing fungi and aflatoxin contamination. *Int. J. Food Microbiol.* 119: 109–115.

Devegowda G, Murthy TNK (2009): Mycotoxins: Their effects in poultry and some practical solutions. *The Mycotoxin Blue Book*. Nottingham University Press. Edited by D. E. Diaz. 25–56.

Fakhri Y, Rahmani J, Oliveira CAF, Franco LT, Corassin CH, Saba S, Rafique J, Khaneghah AM (2019): Aflatoxin M1 in human breast milk: a global systematic review, meta-analysis, and risk assessment study (Monte Carlo simulation). *Trends Food Sci. Tech.* 88: 333–342.

Fallah AA, Rahnama M, Jafari T, Saei-Dehkordi SS (2011): Seasonal variation of aflatoxin M1 contamination in industrial and traditional Iranian dairy products. *Food Control* 22: 1653–1656.

Frazzoli C, Gherardi P, Saxena N, Belluzi G, Mantovani A (2017): The hotspot for (global) one health in primary food production: Aflatoxin M1 in dairy products. *Front. Public Health* 4: 294.

Galvano F, Ritieni A, Piva G, Pietri A (2009): Mycotoxins in the human food chain. *The Mycotoxin Blue Book*. Nottingham University Press. Edited by D. E. Diaz, 187–194.

Hussain I, Anwar J (2008): A study on contamination of aflatoxin M1 in raw milk in the Punjab province of Pakistan. *Food Control* 19: 393–395.

Eker FY, Muratoglu K, Eser AG (2019): Detection of aflatoxin M1 in milk and milk products in Turkey. *Environ. Monit. Assess.* 191: 523.

Ertas N, Gonulalan Z, Yildirim Y, Karadal F (2011): A survey of concentration of aflatoxin M1 in dairy products marketed in Turkey. *Food Control* 22: 1956–1959.

Iqbal SZ, Jinap S, Pirouz AA, Ahmad Faizal AR (2015): Aflatoxin M1 in milk and dairy products, occurrence and recent challenges: A review. *Trends Food Sci. Technol*. 46: 110–119.

Jay JM (2000). Mycotoxins. In: *Modern Food Microbiology*. Gaithersburg–Maryland: Aspen Publishers, 595–600.

Kamkar A (2005): A study on the occurrence of aflatoxin M1 in raw milk produced in Sarab city of Iran. *Food Control* 16: 593–599.

Kerekes K, Bonilauri P, Serraino A, Giacommeti F, Piva S, Zambrini V, Canever A, Farkas Z, Ambrus A (2016): An effective self-control strategy for the reduction of aflatoxin M1 content in milk and to decrease the exposure of consumers. *Food Addit. Contam.* Part A, 33: 1840–1849. [https://doi.org/10.1080/19440049.2016.1241895]

Kokić B, Čabarkapa I, Lević J, Mandić A, Matić J, Ivanov D (2009). Screening of mycotoxins in animal feed from the region of Vojvodina. *Proc. Nat. Sci. Matica Srpska* 117: 87–96.

Kos J, Lević J, Đuragić O, Kokić B, Miladinović I (2014): Occurrence and estimation of aflatoxin M1 exposure in milk in Serbia. *Food Control* 38: 41–46.

Kos J, Janić-Hajnal E, Šarić B, Jovanov P, Mandić A, Đuragić O, Kokić B (2018): Aflatoxins in maize harvested in the Republic of Serbia over the period 2012–2016. *Food Addit. Contam.: Part B Surveill.* 11: 246–255.

Mahato KD, Lee EK, Kamle M, Devi SH, Dewangan N, Kumar P, Kang GS (2019): Aflatoxins in food and feed: An overview on prevalence, detection and control strategies. *Front. Microbiol*. Section Food Microbiology. [https://doi.org/10.3389/fmicb.2019.02266]

Marchese S, Polo A, Aariano A, Velotto S, Constantini S, Severino L (2018): Aflatoxins B1 and M1. Biological properties and their involvement in cancer development. *Toxins* 10: 1–19. [https://doi.org/10.3390/toxins10060214]

Milićević DR, Spirić D, Radičević T, Velebit B, Stefanović S, Milojević L, Janković S (2017): A review of the current situation of aflatoxin M1 in cow's milk in Serbia: risk assessment and regulatory aspects. *Food Addit. Contam. Part A, Chem. Anal. Control Expo. Risk Assess.* 34: 1617–1631. [https://doi.org/10.1080/19440049.2017.1363414]

Milićević D, Petronijević R, Petrović Z, Đinović-Stojanović J, Jovanović J, Baltić T, Janković S (2019): Impact of climate change on aflatoxin M1 contamination of raw milk with special focus on climate conditions in Serbia. *J. Sci. Food Agric.* 99: 5202–5210.

Pravilnik o maksimalno dozvoljenim količinama ostataka sredstava za zaštitu bilja u hrani i hrani za životinje i o hrani i hrani za životinje za koju se utvrđuju maksimalno dozvoljene količine ostataka sredstava za zaštitu bilja (*Službeni glasnik Republike Srbije*, br. 81/2019) (Rule book on the maximum allowable amount of residues of plant protection products in food and feedstuff and on food and feedstuff for which shall be determined the maximum allowable amount of residues of plant protection products (*Official Gazette of the Republic of Serbia*, No. 81/2019).

Rushing BR, Selim MI (2019): Aflatoxin B1: An overview on metabolism, toxicity, occurrence in food, occupational exposure and detoxification methods. *Food Chem. Toxicol.* 124: 81–100. [https://doi.org/10.1016/j.fct.2018.11.047]

Serriano A, Bonilauri P, Kerekes K, Farkas Zs, Giacometti F, Canever A, Zambrini AV, Ambrus Á (2019): Occurrence of aflatoxin M1 in Raw Milk Marketed in Italy: Exposure Assessment and Risk Characterization. *Front. Microbiol.* 10: 2516. [https://doi.org/10.3389/fmicb.2019.02516]

Škrbić B, Antić I, Živančev J (2015): Presence of aflatoxin M1 in white and hard cheese samples from Serbia. *Food Control* 50: 111–117. [https://doi.org/10.1016/j.foodcont.2014.08.031]

Tajkarimi M, Aliabadi-Sh F, Salah Nejad A, Poursoltani H, Motallebi AA, Mahdavi H (2008): Aflatoxin M1 contamination in winter and summer milk in 14 states in Iran. *Food Control* 19: 1033–1036. [https://doi.org/10.1016/j.foodcont.2007.10.011]

Tirmestain MA, Mangipudy R (2014): Aflatoxin. *Encyclopedia of Toxicology* (Third Edition). Reference module in Biomedical Science, 104–106.

Tomašević I, Petrović J, Jovetić M, Raičević S, Milojević M, Miočinović J (2015): Two year survey on the occurrence and seasonal variation of aflatoxin M1 in milk and milk products in Serbia. *Food Control* 56: 64–70.

Valencia-Quintana R, Milić M, Jakšić D, Šegvić Klarić M, Tenorio-Arvide M, Perez-Flores GA, Bonassi S, Sanchez-Alarcon J (2020): Environment changes, aflatoxins and health issues, a review. *Int. J. Environ. Res. Public Health* 17: 7850. [https://doi.org/10.3390/ijerph17217850]

Whitaker TH (2006): Sampling Foods for Mycotoxins. *Food Addit. Contam*. 23: 50–61.
Xiong JL, Wang YM, Ma MR, Liu JX (2013): Seasonal variation of aflatoxin M1 in raw milk from the Yangtze River Delta region of China. *Food Control* 34: 703–706. [https://doi.org/10.1016/j.foodcont.2013.06.024]

ОРИГИНАЛНИ ЧЛАНАК
Примљен: 4. 12. 2023.
Прихваћен: 16. 1. 2024.

АКТУЕЛНИ НИВО АФЛАТОКСИНА У КУКУРУЗУ, ХРАНИ ЗА ЖИВОТИЊЕ, МЛЕКУ И СИРУ У СРБИЈИ

Марко М. ЈАУКОВИЋ[1], Никола И. РОКВИЋ[2], Ања Д. ВУКСАН[3]

[1]Академија техничких струковних студија Београд,
Катарине Амброзић 3, Београд 11120, Србија
[2] Научни институт за ветеринарство Србије,
Јаниса Јанулиса 14, Београд 11107, Србија
[3] Field Test,
Доситејева 11, Београд 11158, Србија

РЕЗИМЕ: Афлатоксини су најраспрострањенији микотоксини, продуковани од стране гљива из рода *Aspergillus* као што су врсте *A. flavus* и *A. parasiticus*. Инфицирају семена токон складиштења, зачине, коштуњаво воће, млеко и храну за животиње. Чак и у малим концентрацијама су врло токсични. Најучесталији облици афлатоксина су B1, B2, G1, G2. Сисари уносе AFB1 преко контаминиране хране. Наиме, AFB1 се брзо и лако апсорбује, након чега се акумулира у јетри. У овом органу AFB1 бива преведен у метаболит афлатоксин M1 (AFM1), који се излучује путем млека. Појава контаминације афлатоксином кукуруза, мешавине хране за животиње, млека и сира прикупљених од српских произвођача је испитивана уз помоћ ELISA методе. У овој студији, укупно 22 узорка кукуруза, 25 узорака хране за животиње, 284 узорка сировог, пастеризованог и ултра-пастеризованог млека и 20 узорака сирева испитано је у 2021 години. AFB1 је квантификован у 3 узорка (13,6%) кукуруза у опсегу од 2,45 μg/kg до 48,31 μg/kg и 12 узорака (48%) мешавине хране за животиње у опсегу од 2,04 μg/kg до 21,48 μg/kg. С друге стране, AFM1 је квантификован у 51 узорку (17,90%) млека у опсегу од 0,02 μg/kg до 0,26 μg/kg и у 15 узорака (75%) сирева у опсегу од 0,15 μg/kg до 0,46 μg/kg. У Републици Србији, максимално дозвољена концентрација AFB1 у кукурузу за стоку износи 30 μg/kg и за мешавину хране за краве износи 5 μg/kg. С друге стране, максимално дозвољена концентрација AFM1 у млеку износи 0,25 μg/kg. Максимално дозвољена концентрација AFM1 за сир у Републици Србији није прописана законом. Резултати добијени у овом раду указују на очигледно присуство AFB1 у кукурузу као и на то да појава афлатоксина у узорцима хране за животиње, млека и сира није занемарљива. Појава афлатоксина у сировом млеку и комерцијално доступном млеку је веома велики проблем, с обзиром да је млеко основни извор нутријената за одојчад и децу. Исто тако, стално праћење млека је неопходан, као и даље анализе и процена ризика појаве AFM1 у сиру.

КЉУЧНЕ РЕЧИ: афлатоксини, кукуруз, храна за животиње, млеко, сир

Зборник Матице српске за природне науке / Matica Srpska J. Nat. Sci. № 146, 91—113, 2024

UDC 634.84(497.11)
https://doi.org/10.2298/ZMSPN2446091J
ORIGINAL ARTICLE
Received: 4. 9. 2023.
Accepted: 14. 11. 2023.

Darko D. JAKŠIĆ[1], Veljko S. PEROVIĆ[2], Dragan T. NIKOLIĆ[3], Dragoslav M. IVANIŠEVIĆ[4], Bratislav M. ĆIRKOVIĆ[5], Vojkan D. STOJANOVIĆ[6], Ivan Z. BRADIĆ[7]*

[1] Institute for Science Application in Agriculture,
Bulevar Despota Stefana 68b, Belgrade 11108, Serbia
[2] University of Belgrade, National Institute of the Republic of Serbia,
Institute for Biological Research "Siniša Stanković",
Bulevar Despota Stefana 142, Belgrade 11060, Serbia
[3] University of Belgrade, Faculty of Agriculture,
Nemanjina 6, Belgrade 11080, Serbia
[4] University of Novi Sad, Faculty of Agriculture,
Trg Dositeja Obradovića 8, Novi Sad 21000, Serbia
[5] University of Priština, Faculty of Agriculture Lešak,
Lešak bb, Lešak 38219, Serbia
[6] Ministry of Agriculture, Forestry and Water Management,
Nemanjina 22–26, Belgrade 11000, Serbia
[7] Centre for Viticulture and Oenology Niš,
Kolonija EI 6, Niš 18116 (Office in Trstenik), Serbia

CLASSIFICATION OF SUSTAINABILITY POTENTIAL OF GENETIC RESOURCES OF LOCAL GRAPEVINE VARIETIES IN SERBIA

ABSTRACT: The starting point for every viticultural and wine-producing country with respect to local grapevine varieties is their identification, inventory, preservation and development of genetic resources of those varieties. There are currently 224 grapevine varieties cultivated in Serbia for the purpose of commercial production of grapes and wine. Out of that number, 31 wine varieties are local. Vineyards under those varieties can be differentiated by their importance for production of grapes and wine, and by the level of their endangerment, that is, sustainability in conditions caused by climate changes. This paper presents the creation, that is, the modeling of the Method for Vineyard Sustainability Clas-

* Corresponding author. E-mail: darkojaksic@yahoo.com.au

sification (MVSC). The purpose of MVSC classification is: to valorize vineyards with local wine grapevine varieties on grounds of their endangerment and sustainability, based on 20 examined and categorized individual vineyard sustainability parameters; to carry out comprehensive classification into one of the four established vineyard sustainability classes (Class A – very endangered vineyards, Class B – endangered vineyards, Class C – sustainable vineyards and Class D – very sustainable vineyards); spatial identification and presentation of vineyards based on determined vineyard sustainability class through application of GIS technology; and finally, application of Network Analysis (NA), prioritization of examined parameters and, therefore, vineyards. A total of 10,402 vineyards under local grapevine wine varieties were used for modeling, and it was determined that 29 vineyards with the total surface of 1.2 hectares should be classified in Class A, while 2,883 vineyards with the total surface of 158.2 hectares should be classified in Class B. With respect to the strength of 20 individual vineyard sustainability parameters, it was determined that the parameter Structure of the vine rootstock (SVR) has the greatest impact, and priority in selection of vineyards in different sustainability classes should be given to vineyards without rootstocks. In accordance with the scientific justification of obtained results, the MVSC enables comprehensive classification of the potential for sustainability of genetic resources of local grapevine varieties in Serbia, and it can be applied in other countries and wine-growing areas, as well as to other groups of grapevine varieties.

KEYWORDS: grapevine genetic resources, local grapevine varieties, MVSC classification

INTRODUCTION

The process of differentiation and valorization of local grapevine varieties, as well as getting wine-growing areas recognition for these varieties is time-consuming and hard work. Some of the reasons are reflected in a huge number of different grapevine varieties worldwide and globalization of viticulture and wine production, where a few well-known grapevine varieties prevail. It is believed that there are between 5,000 and 8,000 grapevine varieties worldwide, grown under 14,000–24,000 different synonyms (Schneider et al., 2019). The Vitis International Variety Catalogue (VIVC) encyclopedic database list 23,529 names of cultivars, breeding lines and *Vitis* species that exist in grapevine repositories and/or described in bibliography (www.vivc.de). This number includes over 12,000 *V. vinifera*, but also a considerable number of synonyms and homonyms (Maul and Topfer, 2015). The actual number of vine varieties for the *V. vinifera* species in the world is estimated to be about 6,000 (Lacombe, 2012), while the VIVC database presents 6,355 genetic profiles of cultivars. Nevertheless, only 300 to 400 of these have commercial importance in global production (Nikolić et al., 2021). According to the International Organization of Vine and Wine (OIV), 13 grapevine varieties are grown in more than 1/3, and 33 varieties in 50% of all vineyards in the world (OIV, 2017). In such global circumstances, the starting point for each wine-growing country is to identify and make an inventory of its local grapevine varieties, and preserve and develop genetic resources of these varieties.

Serbia, as a country with long-lasting tradition of viticulture and wine-making, is characterized by different *terroir* conditions, according to which comprehensive wine-growing area (Wine-growing Serbia) is divided into three

big wine-growing units, 22 regions and 77 subregions (districts) (Jakšić et al., 2015). Such abundance of agroecological conditions enables cultivation of different grapevine varieties. Currently, there are 224 grapevine varieties in Serbia that are used for commercial viticulture and wine production. Within that number of varieties, 13.84% (31 wine varieties) are local, commonly referred to as autochthonous and regional varieties (Jakšić et al., 2019.). Instead of going into a literal analysis of individual terms that explain their name and origin, or giving the official terms for domesticated varieties, all these varieties as well as old ones (grown in Serbia for a long time) are referred to in this paper as local grapevine varieties. The following is a list of those grapevine wine varieties, presented in descending order according to the size of the surface on which they are grown: *Grašac* (colour of berry skin: Blanc/B), *Frankovka* (colour of berry skin: Noir/N), *Prokupac* (N), *Tamjanika Bela* (group of genotypes/subvarieties) (B), *Smederevka* (B), *Vranac* (N), *Slankamenka Crvena* (group of genotypes/subvarieties) (color of berry skin: Rouge/R), *Muskat Krokan* (B), *Tamjanika Crna* (black genotype) (N), *Kreaca* (B), *Skadarka* (N), *Žametovka/Kavčina* (N), *Portugizer* (N), *Ružica* (R), *Bagrina* (R), *Furmint* (B), *Žilavka* (B), *Začinak* (N), *Kratošija* (N), *Kujunđuša* (B), *Buvije* (B), *Medenac Beli* (B), *Sremska Zelenika* (B), *Bakator Beli* (B), *Lipolist* (B), *Seduša* (N), *Ezerjo* (B), *Slankamenka Bela* (B), *Blatina* (B), *Bela Dinka* (B) and *Bela Skadarka* (B).

The main problems for viticulture and winemaking in Serbia are the result of massive grubbing up of vineyards that occurred in the previous period and deterioration of vineyards with local varieties, together with a lack of special programmmes to save those vineyards and select the best genetic material beforehand. Due to these circumstances, Serbia has lost considerably large areas with local varieties, which is a permanent loss of its genetic grapevine potential (Jakšić et al., 2019). However, neither are all local varieties equally important for viticulture and wine production, nor are their vineyards equally endangered/sustainable, especially in the new conditions caused by climate change. Namely, some local varieties are experiencing an expansion in production, while other local varieties are on the verge of disappearing and are present only in old or neglected vineyards on small plots or in mixed varietal vineyards. Due to this, it was necessary to classify vineyards with local varieties based on the level of their endangerment or sustainability as a starting point for scientific and vocational research, as well as for drafting strategic documents or planning specific activities with the aim of preserving, developing and valorizing local varieties.

The main objective of this paper is exactly as follows: to use a large number of parameters that primarily affect the longevity and health of vineyards and to classify vineyards with local varieties according to their endangerment, i.e. sustainability according to individual vineyard sustainability parameters. Furthermore, it is essential to establish a comprehensive classification based on the four vineyard sustainability classes and then to make spatial identification

and representation of vineyards based on established vineyard sustainability classes. Finally, there has to be prioritization and then selection of vineyards where urgent measures are needed to conserve genetic resources and select positive genotypes for further scientific research. All of the four applied methodologies represent innovative modeling, i.e., classification of vineyards with local (primarily wine) grapevine varieties called the Method for Vineyard Sustainability Classification (acronym: MVSC).

MATERIALS AND METHODS

Valorization of analyzed vineyard sustainability parameters by sustainability categories of local grapevine varieties

In order to valorize the vineyards with local grapevine varieties, within the first phase of the MVSC classification, 20 parameters were analyzed and categorized that affect the sustainability, i.e. the longevity and health of the vineyards. These included:

– General factors (which affect sustainability of vineyards and viticulture and wine production);

– *Terroir* factors (which primarily affect vineyard health and longevity, such as: climate, topography, soil, and anthropogenic *terroir* factors).

The valorization of 10 analyzed parameters (with an individual minimum score of one and maximum scores of five, ten or 20, in several categories) that affect sustainability, i.e., longevity and health of vineyards was done by using existing classifications of *terroir* factors – the Conceptual Multifactorial Spatial *Terroir* Model (CMST model) (Jakšić, 2021; Jakšić et al., 2023). Other analyzed parameters that are not part of the CMST model are valorized in a specific way adapted to this modeling. The valorization, i.e., categorization of individual vineyard sustainability parameters by sustainability categories was carried out as shown in Appendix 1.

Classification of vineyard sustainability

Given that each vineyard was individually assessed (valorized) for each of the 20 classification parameters, receiving with a minimum of one point for each parameter, the minimum score was 20. Therefore, the scores are distributed from 21 to the maximum of 140 points. The interval between each of the four MVSC classification classes (Class A, B, C and D) was 30 points, where a lower total score implies that a vineyard is endangered and higher score that a vineyard is more sustainable (Table 1).

Table 1. Classification of vineyards in the MVSC based on analyzed vineyard sustainability parameters

Minimum (mandatory) score	20			
Total score	21–50	51–80	81–110	111–140
General sustainability classes	Endangered vineyards		Sustainable vineyards	
Vineyard sustainability classes	Class A (very endangered vineyards)	Class B (endangered vineyards)	Class C (sustainable vineyards)	Class D (very sustainable vineyards)

Spatial identification and representation of vineyards within the MVSC

For spatial identification and representation of vineyards, the GIS (Geographic Information System) technology was applied through use of GIS software packages: Global Mapper 13 (https://www.bluemarblegeo.com/global-mapper/), QGIS v2.18 (https://qgis.org/en/site/index.html), ArcGIS, and Google Earth Pro.

Methodology applied to prioritize the importance of vineyard sustainability parameters and vineyards with local grapevine varieties

In the end, in order to prioritize and single out analyzed vineyard sustainability parameters, determine their mutual dependence and prioritize vineyards where field research must be conducted first, the evaluation, start of genetic resources conservation and selection of potentially valuable genetic material, i.e., genotypes of local varieties were carried out using Network Analysis (NA). The evaluation of NA was examined using the Extended Bayesian Information Criterion (EBIC) glasso. As a result, for easier interpretation, a graph was created in which green edges indicate positive relationships and red edges indicate negative relationships. The relationships between factors function as a large multiple regression. In addition, the edge weights are represented in terms of different thickness and colour density of the edge connecting the nodes, where thicker lines with denser colour indicate stronger relationships. The Expected Influence (EI) (Robinaugh et al., 2016) was used in interpretation of obtained results, to evaluate the centrality of each node in the network. The centrality is calculated as the sum of absolute weights of edges that they share with other nodes in the network. Thus, the EI of a given node is the sum of weights of edges it shares with the rest of the nodes in the network, taking into account negative associations as well, unlike other criteria (Robinaugh et al., 2016). Therefore, EI helped us determine the influence of analyzed parameters within the network for selection of vineyards within the appropriate class for scientific research and implementation of professional activities.

Vineyards with local grapevine varieties modeled in accordance within the MVSC

Out of the total of 7,033 ha or 31,667 vineyards divided by grapevine varieties, out of which 6,636 ha or 27,339 vineyards are under wine varieties, modeling (valorization and categorization, classification, mapping and prioritization) was carried out on 2,142.5 ha, or 10,402 vineyards with 31 local grapevine wine varieties.

RESULTS AND DISCUSSION

INDIVIDUAL VALORIZATION OF VINEYARDS BY SUSTAINABILITY CATEGORIES

Based on the individual valorization of 10,402 vineyards divided by local wine varieties according to the sustainability categories of local grapevine varieties, a valorization (categorization) was made for each of the 20 analyzed parameters. The valorization and later distribution were carried out based on the number of vineyards and their surface given in percentage points. This paper only presents data on the most disadvantaged category of vineyards (score 1) given for each parameter in question.

Valorization of General factors

Regarding General factors, namely the analyzed parameter Structure of grapevine varieties (SGVV), it can be seen that 13.83% of all vineyards divided by varieties have the lowest score – 1 (the most disadvantaged category for this parameter – minor varieties both in Serbia and in the region), and that they comprise 6.27% of the total area under local grapevine varieties.

The research results indicate that the distribution of the Age structure of grape producers (ASGP) was rather unfavourable. Namely, grape producers in 55.71% of all vineyards (persons that cultivate these vineyards) were over 60 years old (the most disadvantaged category in this parameter, score 1), which was the case for 27.93% of vineyard surfaces under local grapevine varieties.

As for the Structure of the development of wine production by municipality (SDWPM), this parameter was well distributed, with only 6.15% of vineyards in the lowest category (score 1) according to this parameter, in municipalities with no registered wineries, which make up only 2.99% of the total analyzed vineyard surface under local varieties in municipalities without wineries.

Out of the total number of vineyards studied and analyzed, 18.73% of the analyzed vineyards are located in areas with difficult production conditions in agriculture (parameter class with a score of 1). As for this parameter (Vineyards from the area with difficult production conditions in agriculture/VADPC), 17.01% of vineyard surface belonged to this category.

Regarding the Structure of the vine rootstock (SVR) parameter, it was determined that most of the vineyards used grapevine rootstock, with only 0.54% of vineyards not using rootstock (minimum score: 1) these represent 0.57% of total vineyard surfaces planted with local grapevine varieties.

Valorization of Climatic *terroir* factors

Valorization of Factors that primarily affect the health of vineyards

Analysis of the parameter Average number of days with daily minimum temperature below 0°C for the standard growing season (NTN0) show that this parameter was poorly distributed by category. Namely, 60.29% of the vineyards divided by varieties were classified in the most disadvantaged category (score 1) with more than 3 days of frost, which represents 73.06% of the total surface of the analyzed vineyards.

The parameter Average number of days with daily minimum temperature bellow -15 °C for the dormant period (NTN15) had a more favourable distribution. Namely, 5.43% of the vineyards classified in the lowest category (score 1), representing 10.6% of vineyards surface with over 2 frosty days.

As for the distribution of the parameter Average number of days with daily maximum temperature higher than 35 °C for the standard growing season (NTX35), it can be seen that 17.31% of the vineyards scored 1, being classified into the disadvantaged category, with more than 6.5 days with air temperature higher than 35 °C. This is 22.87% of the total surface under analyzed vineyards.

Valorization of Factors that primarily affect the longevity of vineyards

Based on the analysis, it is concluded that the Drought Index (DI) parameter was favourable for analyzed vineyards with local grapevine varieties. None of the vineyards was categorized in the lowest category, with DI over 200.

The Sunshine/Shading (S/S) parameter was also favourable. Namely, only 0.55% of the vineyards was categorized in the most disadvantaged category (score 1), with S/S of 1,000 and less. In terms of area, vineyards from the most disadvantaged category made up only 0.28% of the total vineyard surfaces under local grapevine varieties.

Valorization of Topographic *terroir* factors

Valorization of Factors that primarily affect the health of vineyards

With respect to the Topographic forms (TF) parameter, 10.76% of the vineyards were categorized in the most disadvantaged category (score 1), having the following topographic forms: hollows (valleys, coves, depressions) and ridges,

making up 6.26% of the total surface under vineyards with local grapevine varieties.

Valorization of Factors that primarily affect the longevity of vineyards

Regarding the Slope of the terrain (STe) parameter, the structure is somewhat more favourable. In fact, only 6.02% of all vineyards, i.e. 2.11% of the total surface under vineyards were categorized in the most disadvantaged category (slope over 12º) with the minimal score of 1.

As for the Elevation (E) parameter, 11.43% of the vineyards were categorized in the most disadvantaged category (low elevation of up to 150 m where negative frosts can occur), scoring 1, which makes up 17.99% of the total surfaces under vineyards.

The Terrain exposure (TE) parameter was evenly distributed, as 10.04% of the vineyards were categorized in the most disadvantaged category, with north-facing exposure (minimal score 1), representing 12.31% of the total surface under vineyards.

Valorization of Soil *terroir* factors

Valorization of Factors that primarily affect the health of vineyards

According to the Soil types (STy) parameter, 7.1% of the analyzed vineyards had the most disadvantaged category of soil types (minimal score 1), which represents 5.32% of the total surface under vineyards with local grapevine varieties.

Valorization of Anthropogenic *terroir* factors

Valorization of Factors that primarily affect the longevity of vineyards

The Age of the vineyard (AV) parameter has a relatively good structure, since only 7.08% of analyzed vineyards was over 70 years old or older (score 1), making up 2.77% of the total surface under vineyards with local grapevine varieties. However, one should note that very old vineyards should be the subject of research on clonal selection of local grapevine varieties.

The Surface of the vineyard (SV) parameter was quite unfavourable when observed in mixed varietal vineyards. Namely, 62.41% of the vineyards had the average surface below 0.1 ha, thus being categorized in the most disadvantaged category (score 1). Having analyzed this parameter by surface, it can be seen that the situation is better, with only 12.08% of the area categorized in the most disadvantaged category.

Having analyzed the Thinning of the vineyards (TV) parameter, it can be concluded that 16.36% of the total number of vineyards was categorized in the most disadvantaged category (minimal score 1), with over 12% of thinning. Area-wise, 32.18% of the total surface under vineyards with local varieties was classified into the most disadvantaged category.

Valorization of Factors that primarily affect the longevity of vineyards

With respect to the Condition of the vineyard (CV) parameter, only 1.94% of the total number of vineyards was categorized in the most disadvantaged category, implying an unsatisfactory condition of vineyards (score 1), making up 8.88% of the total surface under vineyards with local grapevine varieties.

Finally, the parameter Monovarietal/mixed varietal vineyard (M/MVV) has a rather unfavorable structure in terms of the number of vineyards, namely, 40.17% of analyzed vineyards were mixed varietal vineyards (having two or more different grapevine varieties) (score 1). Nevertheless, those vineyards are mostly on small areas and make up 9.64% of the total surface under vineyards with local grapevine varieties.

Classification of vineyards with local grapevine varieties based on vineyard sustainability classes

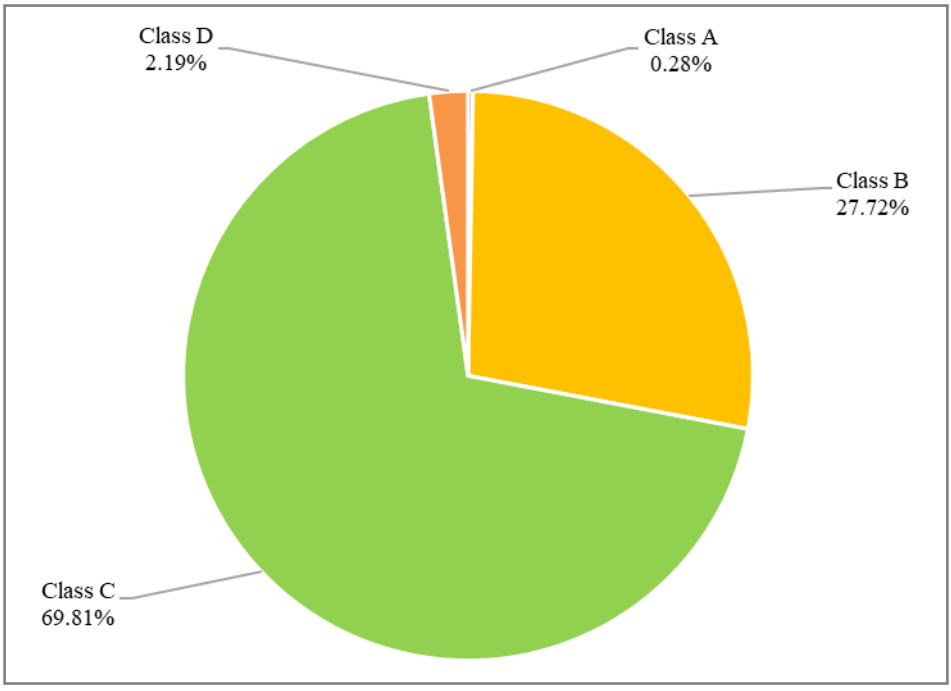
After analyzing individual scores and sublimating all values/scores for each vineyard, broken down by grapevine varieties, vineyards were classified into four vineyard sustainability classes (Table 2). Most of the vineyards from Class A (very endangered vineyards) are situated in the municipalities of Pirot, Vlasotince and Bujanovac. Most of the vineyards from Class B (endangered vineyards) are situated in the municipalities of Aleksandrovac, Pirot and Vlasotince.

When analyzing the distribution of classes based on surface, it appears that the largest areas of Class A vineyards are located in the municipalities of Pirot, Bujanovac and Vlasotince. As for Class B vineyards, the largest vineyards in terms of surface are located in the municipalities of Aleksandrovac, Trstenik and Pirot.

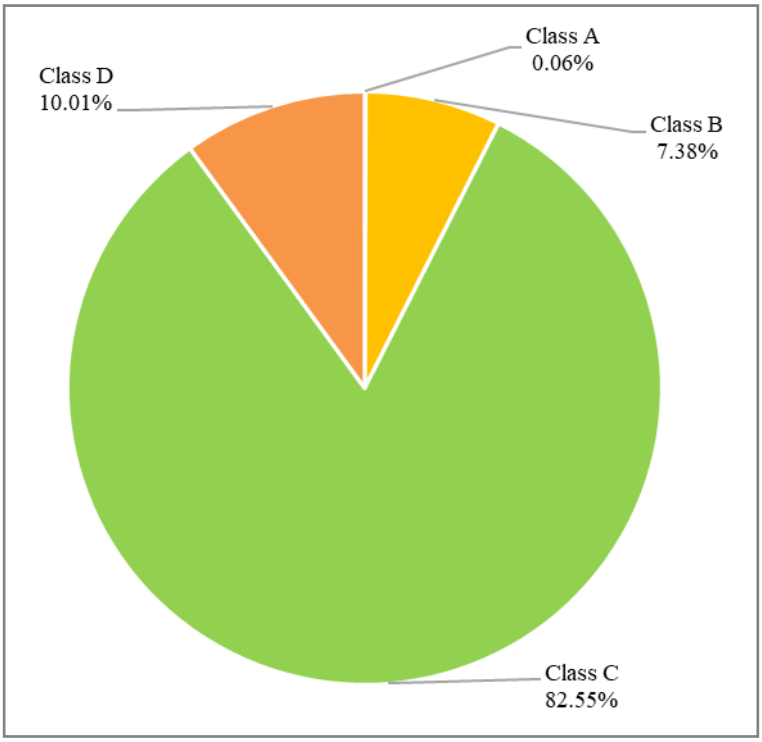
Table 2. Vineyards classified according to their sustainability of the MVSC, given by the number and the surface of vineyards with local grapevine varieties

Vineyard sustainability class	Number of vineyards	Surfaces of the vineyards (ha)
Class A (very endangered vineyards)	29	1.2
Class B (endangered vineyards)	2,883	158.2
Class C (sustainable vineyards)	7,262	1,768.6
Class D (very sustainable vineyards)	228	214.46

The structure of sustainability classes based on the number of vineyards is such that the vineyards classified in Class C (sustainable vineyards) predominate. The classes of endangered vineyards have a significant share in the total number of examined vineyards (2,912 vineyards). Class A vineyards (very endangered vineyards) have a share of 0.28% and Class B vineyards (endangered vineyards) have a share of 27.72% in the total number of all examined vineyards with local grapevine varieties (Graph 1). Analyzing the structure of sustainability classes for vineyards based on surface, we concluded that sustainable vineyards account for the largest share (Graph 2). The total surface of endangered vineyards (Class A and Class B) is 159.4 ha, which nevertheless represents a significant vineyard area that must be the subject of scientific and professional work in the near future in order to preserve and develop the genetic resources of local grapevine varieties.



Graph 1. Structure of vineyard sustainability classes (A, B, C and D) based on the number of vineyards

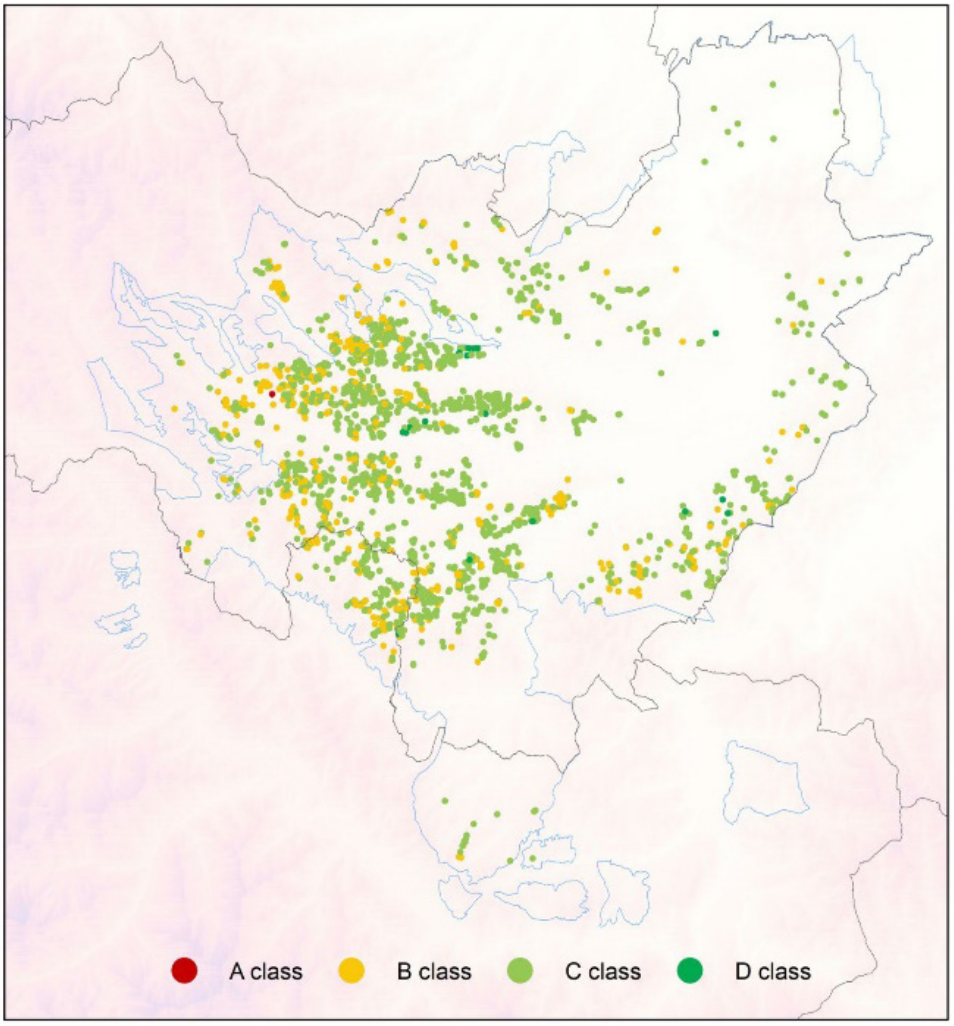


Graph 2. Structure of vineyard sustainability classes (A, B, C and D) based on vineyard surface

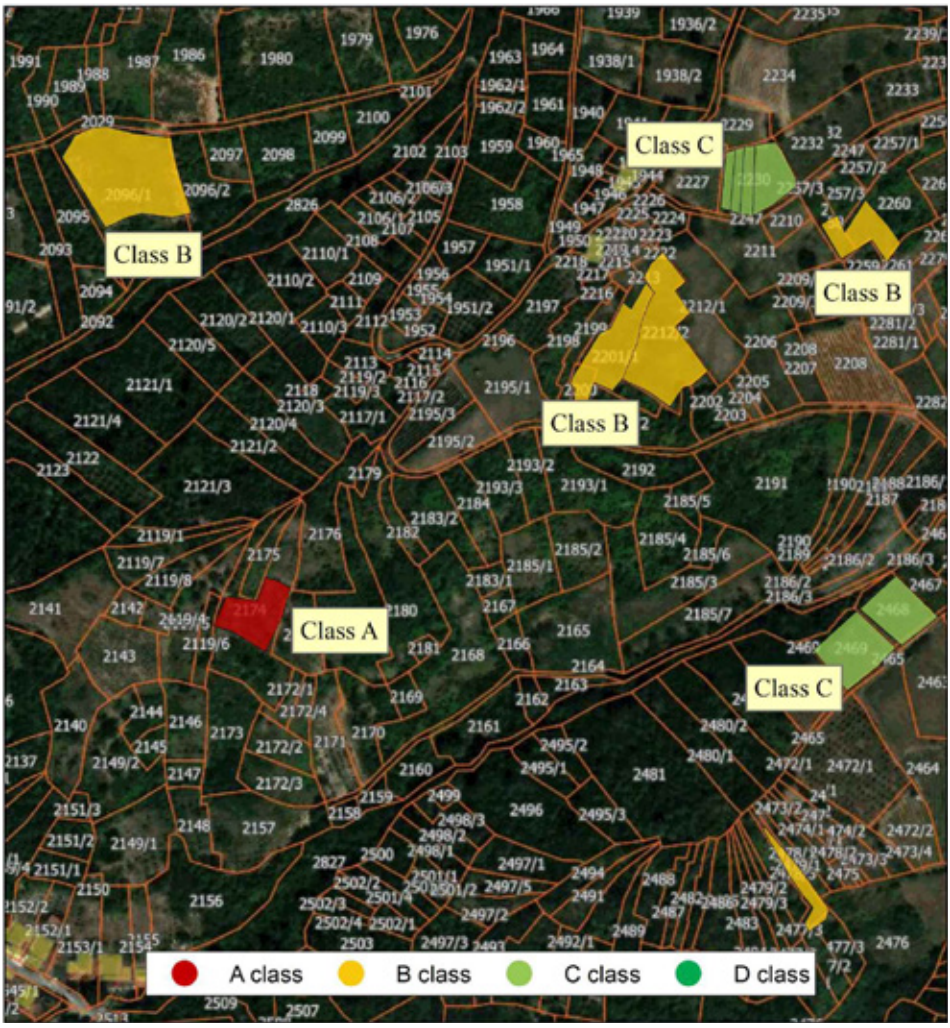
Based on the presented results of the research of vineyards with local grapevine varieties, it can be concluded that there is a significant proportion of endangered vineyards in the number of vineyards.

Spatial identification and representation of vineyards

Through the application of GIS technology and techniques, spatial identification and representation of vineyards with local grapevine varieties was carried out for all four vineyard sustainability classes of the MVSC classification. The spatial representation, i.e., mapping of vineyards of local grapevine varieties within the MVSC classification is presented on the example of the Župa wine-growing district (Map 1) and the Puhovac cadastral municipality in the Aleksandrovac municipality (Map 2).



Map 1. Mapped vineyards of local grapevine varieties classified according to the vineyard sustainability classes of the MVSC in the Župa wine-growing district



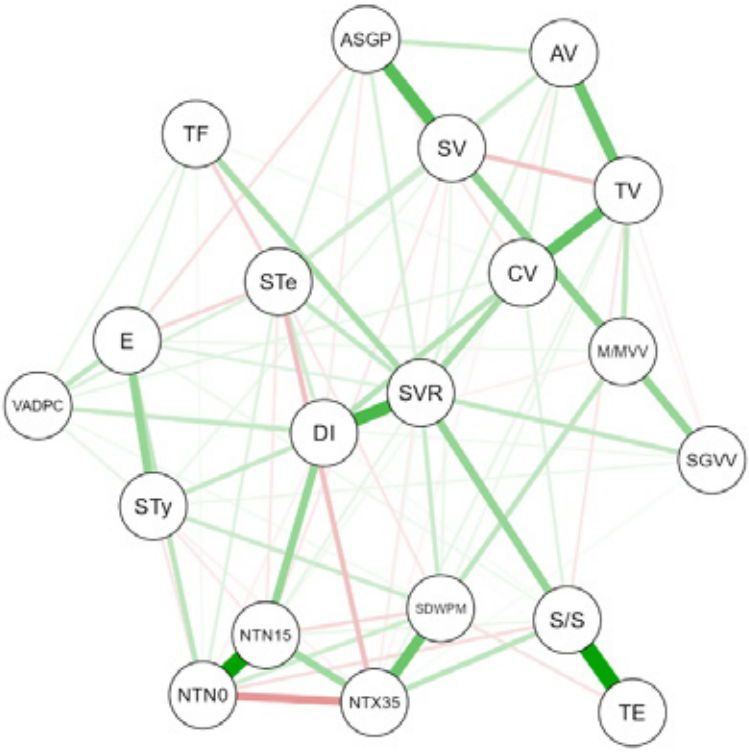
Map 2. Example of mapped vineyards of local grapevine varieties according to the vineyard sustainability classes of the MVSC in the Puhovac C. M.

The established spatial basis will facilitate future scientific and professional research, as well as implementation of measures for protection and development of genetic resources of local grapevine varieties in Serbia.

Results of prioritization of importance of parameters and vineyards

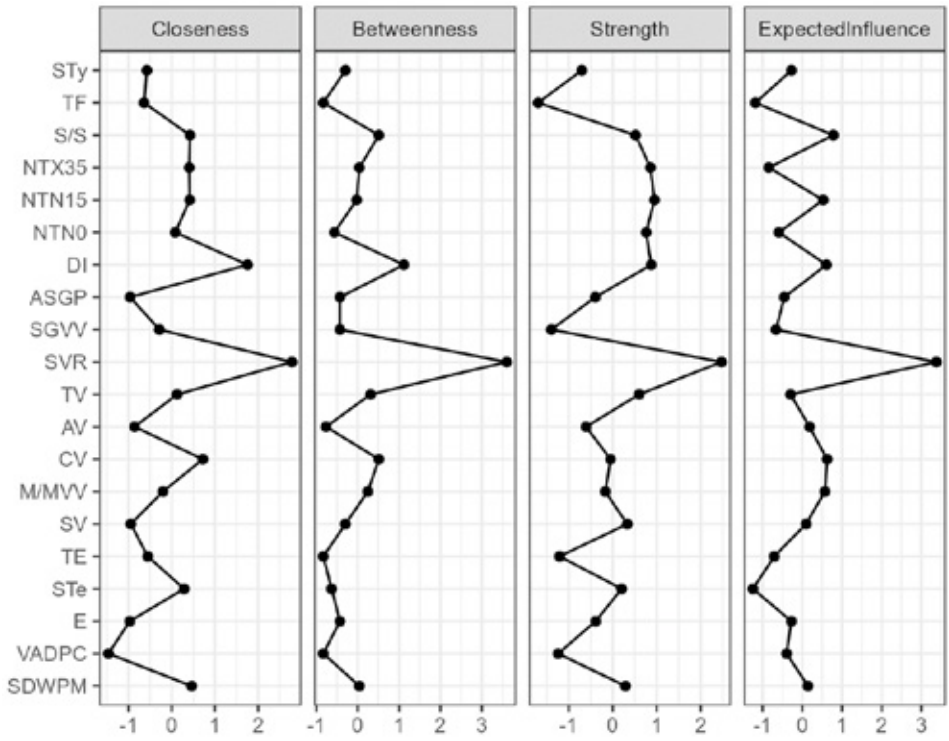
Using Network Analysis (NA), it was found that the strongest positive network nodes exist between vineyard sustainability parameters TE and S/S,

NTN0 and NTN15, DI and SVR, etc. (Graph 3). The obtained results have a scientific justification, considering that solar radiation depends on terrain exposure, that in areas where low winter temperatures prevail, late spring frosts also occur, and that vine rootstocks are directly dependent on the Drought index, etc. The most significant negative nodes in the network are represented by pairwise relations between parameters NTX35 and NTN0, TV and SV, etc., which is also scientifically justified. Namely, in areas, i.e., vineyards where high summer temperatures occur, the number of frost days during the growing season is lower, thinning is lower in vineyards with larger surfaces, etc. NA has shown that the SVR parameter for sustainability of vineyards has the highest centrality in the network.



Graph 3. Representation of mutual interactions of different strengths of positive and negative relations of vineyard sustainability parameters

NA has shown that the Structure of the vine rootstock (SVR) parameter has by far the greatest closeness, betweenness, strength, and expected influence within all vineyard sustainability parameters (Graph 4).



Graph 4. Distribution of closeness, betweenness, strength and expected influence of vineyard sustainability parameters

Analyzing the strength of vineyard sustainability parameters according to their EI, it was concluded that the parameter Structure of the vine rootstocks (SVR) has the greatest impact. This leads us to the conclusion that when choosing very endangered (Class A), endangered (Class B), or vineyards from other classes of the MVSC classification, priority should be given to vineyards classified in the most disadvantaged class of this parameter (score 1), i.e., vineyards without rootstocks (Table 3). Vineyards rated with lower scores of the parameter Sunshine/Shading (S/S), i.e., vineyards that are most shaded follow in order of priority. After that, priority should be given to vineyards that have poor scores for the parameter Condition of the vineyard (CV), and so on.

Table 3. Vineyard sustainability parameters in the order of strength of the expected influence

Variable (examined parameter)	Expected influence	Variable (examined parameter)	Expected influence
SVR	3.378	STe	-1.244
S/S	0.784	STy	-0.272
CV	0.627	E	-0.275
DI	0.610	TV	-0.295
M/MVV	0.572	VADPC	-0.394
NTN15	0.529	ASGP	-0.453
AV	0.182	NTN0	-0.592
SDWPM	0.143	SGVV	-0.663
SV	0.094	TE	-0.704
TF	-1.180	NTX35	-0.846

The above results and analysis indicate that this prioritization of vineyard sustainability parameters according to the importance of EI influence facilitates correct selection of the priority and important vineyards within the same vineyard sustainability class within the MVSC classification.

CONCLUSION

With the innovative Method for Classification of Vineyard Sustainability (MVSC), it was found that of the 10,402 modeled vineyards with local wine varieties, 29 vineyards belong to class A (very endangered vineyards), and 2,883 vineyards belong to class B (endangered vineyards). The MVSC classification used to classify the sustainability of vineyards of local grapevine wine varieties in Serbia can be successfully applied to other countries or wine-growing areas, as well as to other groups of grapevine varieties. First and foremost, the modeled MVSC classification enables efficient identification of vineyards with local grapevine varieties classified in Class A (very endangered vineyards), which are the highest priority for scientific and professional research and implementation of urgent actions for conservation of genetic resources, especially in the current conditions of climate change. Moreover, the modeled MVSC classification allows an appropriate selection of the most important vineyards with the aim of identifying potentially valuable genetic material, i.e., genotypes, as well as future clonal selection of local grapevine varieties. In this way, the basis and possibility are created for all scientific institutions, relevant ministries, public and private organizations, as well as associations of grape and wine producers to use the data of MVSC classification to initiate systematic measures for conservation and development of genetic resources of local grapevine varieties in Serbia.

Annex 1. VALORIZATION OF INDIVIDUAL VINEYARD SUSTAINABILITY PARAMETERS BY SUSTAINABILITY CATEGORIES OF LOCAL GRAPEVINE VARIETIES WITHIN THE FIRST PHASE OF MVSC

1. General factors (affecting the sustainability of vineyards and viticulture-wine production)

1.1. The Structure of grapevine varieties (SGVV) was categorized into nine categories, with values ranging from 10 (most favourable for sustainability of genetic resources of local varieties) to 1 (least favorable) (Table 4). Some data were used from the OIV publication Distribution of the world's grapevine varieties (OIV, 2017).

Table 4. Categorization of the Structure of grapevine varieties (SGVV) parameter

Prevalence in Serbia – Prevalence in the region	Acronyms for prevalence	Valorization
Leading variety (Le) – Leading variety (Le)	Le – Le	10
Leading variety (Le) – Local variety (Lo)	Le – Lo	9
Leading variety (Le) – Minor variety (Mi)	Le – Mi	8
Local variety (Lo) – Leading variety (Le)	Lo – Le	7
Local variety (Lo) – Local variety (Lo)	Lo – Lo	6
Local variety (Lo) – Minor variety (Lo)	Lo – Mi	5
Minor variety (Mi) – Leading variety (Le)	Mi – Le	3
Minor variety (Mi) – Local variety (Lo)	Mi – Lo	2
Minor variety (Mi) – Minor variety (Mi)	Mi – Mi	1

1.2. Age structure of grape producers (ASGP) was categorized in five categories, with values ranging from 10 (highest value) to 1 (lowest value) (Table 5).

Table 5. Categorization of the parameter Age structure of grape producers (ASGP)

Age structure of grape producers	Valorization
Company	10
Entrepreneur	8
Grape producer under 40 years of age	6
Grape producer (40 to 60 years of age)	3
Grape producer above 60 years of age	1

1.3. Based on the number of commercial wineries, the Structure of the development of wine production by municipality (SDWPM) was categorized into five categories, with values ranging from 5 (largest number of wineries in the municipality) to 1 (no wineries in the municipality in question) (Table 6).

Table 6. Categorization of the parameter Structure of the development of wine production by municipality (SDWPM)

Number of vineries in the municipality	Valorization
Over 20	5
11–20	4
4–10	3
Up to 3	2
No wineries	1

1.4. Vineyards from areas with difficult production conditions in agriculture (VADPC) were categorized in two categories, as follows: vineyards in developed municipalities – value 5 and vineyards in municipalities with difficult production conditions – value 1.

1.5. The Structure of the vine rootstock (SVR) was also categorized in two categories, as follows: vineyards with grapevines grafted on rootstocks – value 5 and vineyards with grapevines grown on their own rootstock – value 1.

2. Climatic *terroir* factors

Factors that primarily affect the health of vineyards

2.1. Average number of days with daily minimum temperature bellow 0 °C for the standard growing season (NTN0) was categorized into five categories defined within the CMST model (Jakšić, 2019; Jakšić et al., 2023);

2.2. Average number of days with daily minimum temperature bellow -15 °C for the dormant period (NTN15) was categorized into five categories within the CMST model (Jakšić, 2019; Jakšić et al., 2023);

2.3. Average number of days with daily maximum temperature higher than 35 °C for the standard growing season (NTX35) was also categorized into five categories within the CMST model (Jakšić, 2019; Jakšić et al., 2023).

Factors that primarily affect the longevity of vineyards

2.4. Drought Index (DI) categorized within five categories within the CMST model (Jakšić, 2019; Jakšić et al., 2023);

2.5. Sunshine/Shading (S/S) was categorized into five categories defined within the CMST model (Jakšić, 2019; Jakšić et al., 2023).

3. Topographic *terroir* factors

Factors that primarily affect the health of vineyards

3.1. Terrain exposure (TE) was categorized into five categories defined within the CMST model (Jakšić, 2019; Jakšić et al., 2023);

3.2. The Topographic forms parameter was also categorized into five categories within the CMST model (Jakšić, 2019; Jakšić et al., 2023).

Factors that primarily affect the longevity of vineyards

3.3. Slope of the terrain (º) (STe) parameter was categorized into five categories defined within the CMST model (Jakšić, 2019; Jakšić et al., 2023) with values ranging from 10 (highest value, slope 0–3º), 8 (> 3–5º), 5 (> 5–8º), 2 (> 8–12º) to 1 (lowest value, > 12º);

3.4. Elevation (m) was also categorized into five categories within the CMST model (Jakšić, 2019; Jakšić et al., 2023).

4. Soil *terroir* factors

Factors that primarily affect the longevity of the vineyards

4.1. Soil types (STy) was categorized into five categories within the CMST model (Jakšić, 2019; Jakšić et al., 2023).

5. Anthropogenic *terroir* factors

Factors that primarily affect the health of vineyards

5.1. Age of the vineyard (AV) was categorized into five categories, with values ranging from highest to lowest, where 20 stands for very young vineyards, and 1 for very old vineyards (Table 7).

Table 7. Categorization of the parameter Age of the vineyard (AV)

Age of the vineyard	Valorization
0–3	20
4–29	16
30–49	10
50–69	4
70 years and over	1

5.2. Surface of the vineyard (SV) was categorized into five categories, with values ranging from 10 (large surface) to 1 (very small surface) (Table 8).

Table 8. Categorization of the Surface of the vineyard (SV) parameter

Surface of the vineyard (ha)	Valorization
> 1	10
> 0.5–1	8
> 0.3–0.5	5
> 0.1–0.3	3
Up to 0.3	1

5.3. Thinning of the vineyard (TV) was categorized into five categories with values ranging from 10 (less thinned) to 1 (very thinned vineyards) (Table 10).

Table 10. Categorization of the Thinning of the vineyard (TV) parameter

Thinning (%)	Valorization
Up to 3	10
> 3–6	8
> 6–9	6
> 9–12	3
> 12	1

Factors that primarily affect the longevity of vineyards

5.4. Condition (status) of the vineyard (CV) was categorized into three categories, such as: good (value 5), satisfactory (value 3) and unsatisfactory (value 1).

5.5. Monovarietal/mixed varietal vineyard (M/MVV) had only two categories: monovarietal vineyards (value 5) and mixed varietal vineyards with two or more grapevine varieties (value 1).

REFERENCES

Blue Marblego Geographic, Global Mapper. Available to: https://www.bluemarblegeo.com/global-mapper/

Geographic Information System (Free and Open Source). Available to: https://qgis.org/en/site/index.html – QGIS – A.

Jakšić D (2021): *Terroir Oplenačkog vinogorja*. Doctoral dissertation, Faculty of biopharming, Bačka Topola.

Jakšić D, Bradić I, Beader I, Milić R, Ristić M (2019): *Autohtotone i regionalne sorte vinove loze Srbije*. Niš: Centar za vinogradarstvo i vinarstvo. Available to: https://cevvin.rs/publikacije/#dearflip-df_3901/3/.

Jakšić D, Ivanišević D, Đokić V, Brbaklić Tepavac M (2015): *Vinski atlas, Poljoprivreda u Republici Srbiji: Popis poljoprivrede 2012*. Republički zavod za statistiku, Beograd, Srbija. Available to: https://publikacije.stat.gov.rs/G2015/Pdf/G201514011.pdf.

Jaksic D, Perovic V, Bradic I, Ninkov J, Maras V, La Notte P, Vujadinovic Mandic M (2023): The application of advanced technologies in the research of *terroir* factors in viticulture and oenology. *XII International Symposium on Agricultural Sciences AgroReS* 2023, Trebinje, Bosnia and Herzegovina, Book of Proceedings: 64–75. [https://doi.org/10.7251/ZARS2301064J]

Julius Kühn Institut: *Vitis* International Variety Catalogue (*V*IVC). Available to: https://www.vivc.de/

Lacombe T (2012): Contribution à l'étude de l'histoire évolutive de la vigne cultivée (*Vitis vinifera* L.) par l'analyse de la diversité génétique neutre et de gènes d'intérêt. These, Montpellier SupAgro Centre International d'Etudes Supérieures en Sciences Agronomiques, Montpellier, France.

Maul E, Topfer R (2015): Vitis International Variety Catalogue (VIVC): A cultivar database referenced by genetic profiles and morphology. *38th World Congress of Vine and Wine (Part 1)*, *BIO Web of Conferences*, Vol. 5, Article No. 01009.

Nikolić D, Korać N, Todić S, Jakšić D, Ivanišević D. (2021): Grapevine genetic diversity in Serbia. *The first international conference of Vranac and other Montenegrin indigenous sorts of grapevine*. Montenegrin Academy of Science and Arts, Scientific Meetings – Vol. 159, The Section of Natural Science, Vol. 22: 159–173.

OIV (2017): Distribution of the world's grapevine varieties. Focus OIV 2017. Available to: https://www.oiv.int/public/medias/5888/en-distribution-of-the-worlds-grapevine-varieties.pdf.

Robinaugh DJ, Millner AJ, McNally RJ (2016): Identifying highly influential nodes in the complicated grief network. *J. Abnorm. Psychol.* 125: 747–757. [https://doi.org/10.1037/abn0000181]

Schneider A, Carra A, Akkak A, This P, Laucou V, Botta R (2001): Verifying synonymies between grape cultivars from France and Northwestern Italy using molecular markers. *Vitis*, 40: 197–203.

ОРИГИНАЛНИ ЧЛАНАК
Примљен: 4. 9. 2023.
Прихваћен: 18. 11. 2023.

КЛАСИФИКАЦИЈА ПОТЕНЦИЈАЛА ОДРЖИВОСТИ ГЕНЕТИЧКИХ РЕСУРСА ЛОКАЛНИХ СОРТИ ВИНОВЕ ЛОЗЕ У СРБИЈИ

Дарко Д. ЈАКШИЋ[1], Вељко С. ПЕРОВИЋ[2], Драган Т. НИКОЛИЋ[3], Драгослав М. ИВАНИШЕВИЋ[4], Братислав М. ЋИРКОВИЋ[5], Војкан Д. СТОЈАНОВИЋ[6], Иван З. БРАДИЋ[7]

[1] Институт за примену науке у пољопривреди Београд, Булевар деспота Стефана 68б, Београд 11108, Србија
[2] Универзитет у Београду, Институт од националног значаја за Републику Србију, Институт за биолошка истраживања „Синиша Станковић”, Булевар деспота Стефана 142, Београд 11060, Србија
[3] Универзитет у Београду, Пољопривредни факултет, Немањина 6, Београд 11080, Србија
[4] Универзитет у Новом Саду, Пољопривредни факултет, Трг Доситеја Обрадовића 8, Нови Сад 21000, Србија
[5] Универзитет у Приштини, Пољопривредни факултет Лешак, Лешак бб, Лешак 38219, Србија
[6] Министарство пољопривреде, шумарства и водопривреде, Немањина 22–26, Београд 11000, Србија
[7] Центар за виноградарство и винарство Ниш, Колонија ЕИ 6, Ниш (Трстеник) 18116, Србија

РЕЗИМЕ: Полазна основа сваке виноградарско-винарске земље када су локалне сорте винове лозе у питању је њихова идентификација, инвентаризација, очување и развој генетичких ресурса тих сорти. Тренутно се у Србији гаји 224 сорте винове лозе са наменом комерцијалне производње грожђа, односно вина. Од тог броја, 31 сорта су локалне винске сорте. Њихови виногради се разликују по важности за производњу грожђа и вина, али се разликују и по угрожености, односно одрживости у условима изазваним климатским променама. У овом раду је израђена, односно моделована Метода класификације одрживости винограда (*Method for Vineyard Sustainability Classification*; акроним: *MVSC*). Намена *MVSC* јесте: валоризација винограда са локалним винским сортама по основу њихове угрожености, односно одрживости на основу 20 појединачних испитиваних и категорисаних параметара одрживости; затим свеобухватна класификација на основу успостављене четири класе одрживости винограда (класа *A* – веома угрожени виногради, класа *B* – угрожени виногради, класа *C* – одрживи виногради и класа *D* – веома одрживи виногради); просторна идентификација и представљање винограда на основу утврђених класа одрживости применом *GIS* технологије; као и на крају, применом *Network* анализе (*NA*), приоритизација испитиваних параметара, а тиме и винограда. За моделовање је коришћено 10.402 винограда локалних винских сорти винове лозе, при чему је утврђено да се 29 винограда, односно 1,2 хектара, класификује у класу *A*, док се 2.883 винограда, односно 158,2 хектара класификују у класу *B*. По питању јачине појединачних 20 параметара одрживости, утврђено је да параметар *Структура подлога винове лозе* (*SVR*) има

највећи утицај, па приоритет при избору винограда у оквиру различитих класа одрживости треба да буду виногради који су на сопственом корену. У складу са научном оправданошћу добијених резултата, *MVSC* класификација омогућава свеобухватну класификацију потенцијала одрживости генетичких ресурса локалних сорти винове лозе у Србији, а може се применити и у другим земљама или виноградарским подручјима, као и за друге групе сорти винове лозе.

КЉУЧНЕ РЕЧИ: генетички ресурси винове лозе, локалне сорте винове лозе, *MVSC* класификација

Зборник Матице српске за природне науке / Matica Srpska J. Nat. Sci. № 146, 115—128, 2024

UDC 634.84(497.11)
https://doi.org/10.2298/ZMSPN2446115B
ORIGINAL ARTICLE
Received: 4. 9. 2023.
Accepted: 23. 10. 2023.

Ivan Z. BRADIĆ[1*], *Miloš P. RISTIĆ*[1], *Ivana S. MOŠIĆ*[1], *Radoslav B. MILIĆ*[1], *Milan M. BEADER*[1], *Darko D. JAKŠIĆ*[2]

[1] Centre for Viticulture and Oenology Niš,
Kolonija EI 6, Niš 18116, Serbia
[2] Institute for Science Application in Agriculture,
Bulevar Despota Stefana 86b, Belgrade 11000, Serbia

UVOLOGICAL CHARACTERISTICS OF LOCAL GRAPEVINE VARIETIES: *SMEDEREVKA* AND *ŽAMETOVKA*

ABSTRACT: Research of uvological characteristics is one of the obligatory steps for determination of general production and technological value of grapevine varieties. Such research is particularly recommended for local varieties that did not previously show satisfying characteristics necessary for production of high-quality wine. Local grapevine varieties *Smederevka* (white wine variety) and *Žametovka* (red wine variety) have mostly served for production of low-quality wine in the past. With changes in the manner of production in the sense of focus on high-quality wine and production of wine with geographical indications, vineyards planted with these varieties in Serbia have mostly been grubbed up. However, due to the characteristic and favourable *terroir* conditions, they have survived in the Trstenik wine-growing district (subregion within the Tri Morave wine-growing region). With the aim of determining uvological characteristics of these two varieties in current climate conditions that are favourable for these high-yield varieties, this paper examines the mechanical composition of grape bunches (bunch weight, number of berries, stem weight), mechanical composition of berries (weight of 100 berries, weight of skin of 100 berries, weight of mesocarp of 100 berries and weight of seeds of 100 berries), as well as grape must characteristics (sugar content and total acids in grape must) of representative genotypes of local varieties *Smederevka* and *Žametovka* in production vineyards in the Trstenik wine-growing district. Research results have shown that uvological characteristics of these varieties are slightly better in comparison with previous research carried out in other wine-growing areas, that is, in comparison with general information from literature, which indicates the necessity for further research of these varieties in different agro-ecological conditions.

KEYWORDS: *Smederevka*, Trstenik wine-growing district, uvological characteristics, *Žametovka*

[*] Corresponding author. E-mail: i.bradic@cevvin.rs

INTRODUCTION

Uvology is a part of ampelography that deals with the study of the mechanical and chemical composition of grape bunches and berries (Avramov and Žunić, 2001). Mechanical and chemical composition of grape bunches and berries, and grape must quality are elements that are important for production and technological characteristics (value for cultivation and use) of grapevine varieties that need to be determined in order to achieve the goal of preservation of local varieties and for their clonal selection. Given that grapevine is predominantly cultivated for its grapes, which is intended for processing or consumption of unprocessed grapes, research and knowledge of economic and technological characteristics is very important, and these characteristics depend on a series of abiotic and anthropogenic *terroir* factors (Jakšič, 2023).

Smederevka is a very old Serbian autochthonous grapevine variety, as confirmed by its name. In addition to Serbia, it is also cultivated in other neighbouring countries (Jakšić et al., 2019). Its bunches are large, most often conical, with medium thinning, with average weight between 200 and 300 grams (Cindrić et al., 2000). Berries are mostly large, oval, yellow-green in colour, with amber spots on the insulated side (Cindrić et al., 2000). Surfaces of commercial vineyards planted with this variety amount to 149 ha (Jakšić, 2019). The majority of surfaces of commercial vineyards with this variety are located in the Vršac, Župa and Trstenik wine-growing districts. *Smederevka* is characterized by high yields and large berries and bunches. *Smederevka* used to be one of the important local varieties in Serbia, in particular in the Trstenik wine-growing district, and it is necessary to continue research into characteristics of this variety.

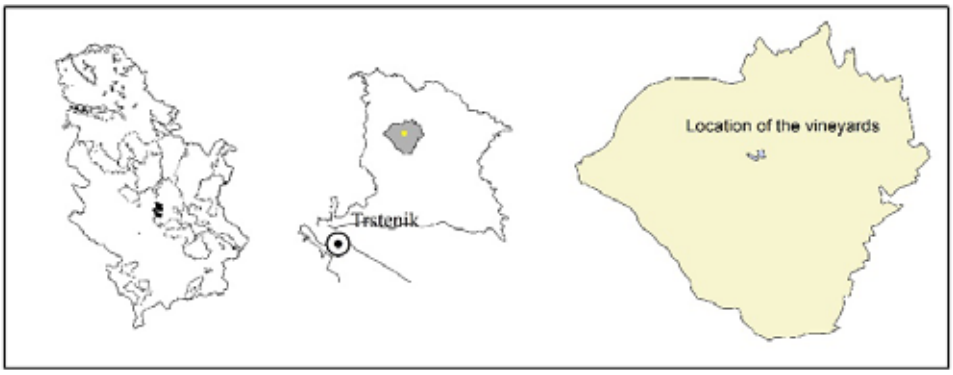
Žametovka, also known as *Kavčina*, is a red wine variety mostly cultivated in Slovenia, Croatia, Austria, Germany, and as a local variety in Serbia (Cindrić et al., 2000). *Žametovka* is the main red wine variety in production of traditional wine from grapes of several varieties with the geographical indication "Cviček" (Raspor et al., 2002; Vršić et al., 2011). The old *Žametovka* grapevine in the Slovenian city of Maribor is considered to be the oldest grapevine in the world (Vršić et al., 2011; Terčelj, 2015). The *Žametovka* variety is also characterized by high yields (Cindrić et al., 2000; Jakšić et al., 2019), with grape bunches weighing about 200 grams, branched medium-dense bunches, its berries are mid-sized and round, with thick skin, black-blue in colour and firm flesh (Cindrić et al., 2000). Surfaces of commercial vineyards with this variety in Serbia are about 10 ha (Jakšić, 2019), and the majority of these can be found in the Trstenik wine-growing district. Since this is an emerging variety, there is need for research into its characteristics with the aim of affirmation and increasing surfaces planted with this variety.

The aim of this paper is to research mechanical and chemical composition of grapes and quality of grape must from the *Smederevka* and *Žametovka* grapevine varieties.

MATERIALS AND METHODS

Research into the characteristics of grape bunches, berries, and grape must presented in this paper was carried out in 2019, 2020 and 2021 for 6 genotypes of the *Smederevka* variety and 7 genotypes of the *Žametovka* grapevine variety, through the activities: determination of mechanical composition of grape bunches and berries, and determination of chemical composition and certain qualitative characteristics of grape must.

Research was carried out in production vineyards in the Trstenik wine-growing district, which is situated in the Tri Morava wine-growing region (PDO), in the cadastral municipality of Mala Sugubina (Map 1). The vineyard with the *Smederevka* variety in which research was carried out has the surface of 0.245 ha, it was planted in 1990, average elevation of this vineyard is 334 m, and terrain exposure is south-eastern, with the terrain slope of 6.9°. The vineyard with the *Žametovka* variety has the surface of 0.232 ha, it was planted in 1979, with the average elevation of 320 m, also with south-eastern exposure, and terrain slope of 4.5°.



Map 1. Location of vineyards from which genotypes were selected

Determination of mechanical composition of grape bunches and berries

Determination of mechanical composition of grape bunches – analysis of mechanical composition of grape bunches in this paper is presented on the representative samples of grape bunches in optimal ripeness. All bunches collected from selected genotypes of the *Smederevka* and *Žametovka* varieties were analyzed. Weight (mass) of grape bunches was determined by weighing each individual bunch on an analytical scale in the oenological laboratory of the Centre for Viticulture and Oenology in Niš. After determining the weight (mass) of bunches, all berries were removed from bunches and the remaining stems were weighed on the analytical scale (g). The weight (mass) of berries on the given bunch was determined by subtracting the weight of stems from

the weight of bunches, and the number of berries per bunch was determined by counting all berries.

Mechanical composition of berries was determined through analysis on the samples of 100 berries. Further procedure for analysis of the sample of 100 berries included removing the skin and seeds from each berry. The skin was afterwards washed so as to contain no flesh and dried on an absorbent paper so as to contain no water. The seeds were also washed and dried on absorbent paper. The seeds were afterwards counted, and both the skin and seeds were weighed on a high-precision analytical scale.

Determination of chemical composition of certain qualitative characteristics of grape must

After harvesting the entirety of grape bunches from grapevine plants of the 13 selected genotypes of the *Smederevka* and *Žametovka* varieties, transport and temporary storage in cold conditions, grapes were crushed with the focus on maintaining a moderate must yield.

Analysis of chemical parametres of grape must from selected genotypes of the *Smederevka* and *Žametovka* varieties was carried out in the laboratory of the Centre for Viticulture and Oenology in Niš.

Determination of sugar content in grape must was carried out with the use of a digital refractometer in accordance with the method approved by the International Organization of Vine and Wine (hereinafter: OIV) Method OIV-MA-AS2-02 (OIV, 2016).

Determination of total acids in grape must was carried out with the use of a titrator in accordance with the OIV method: Method OIV-MAAS313-01 (OIV, 2016).

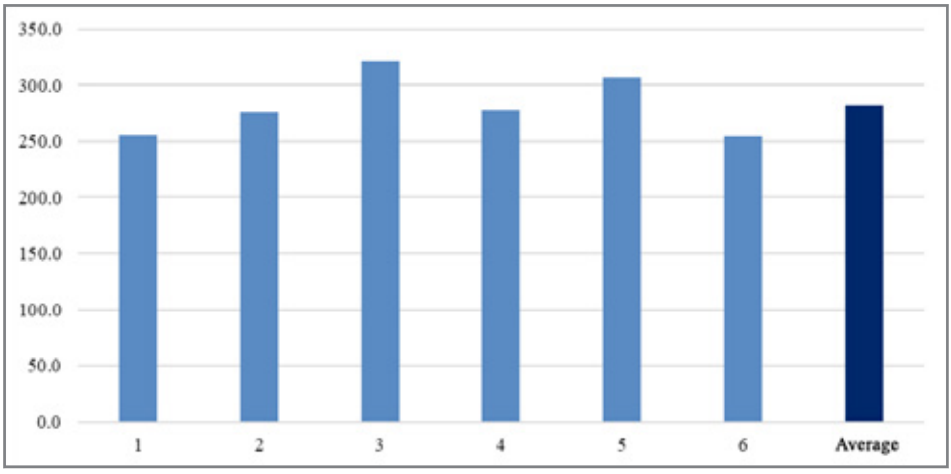
Determination of grape must pH was caried out potentiometrically in accordance with the OIV method: Method OIV-MA-AS313-15 (OIV, 2016).

RESULTS AND DISCUSSION

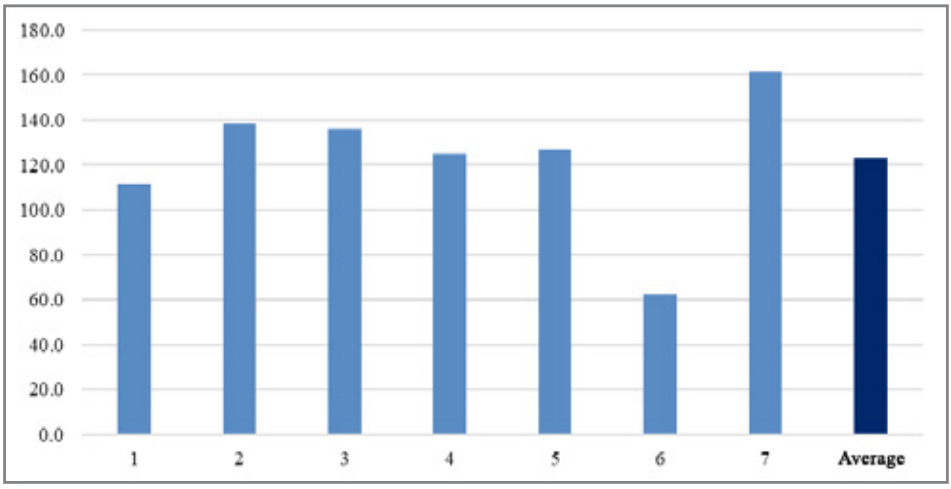
Mechanical composition of grape bunches

Research of representative genotypes of the *Smederevka* variety in the period from 2019 to 2021 in conditions prevalent in the Trstenik wine-growing district determined the average grape bunch weight of 281.8 g (Graph 1). The average grape bunch weight determined in this research is in line with information from literature (Avramov and Žunić, 2001; Žunić and Garić, 2016). However, the weight of bunches determined in these previous research papers was lower than the weight of bunches determined in the Podgorica wine-growing district (Montenegro) (Savić, 2016) and in the Čegar wine-growing district (Radojević, 2021).

Research of the weight of grape bunches on representative genotypes of the *Žametovka* variety in conditions prevalent in the Trstenik wine-growing district in the period from 2019 to 2021 determined that the average weight of bunches is 123.2 g (Graph 2). The average grape bunch weight determined in this research is lower than the weight listed in available literature (Avramov and Žunić, 2001; Žunić and Garić, 2016).



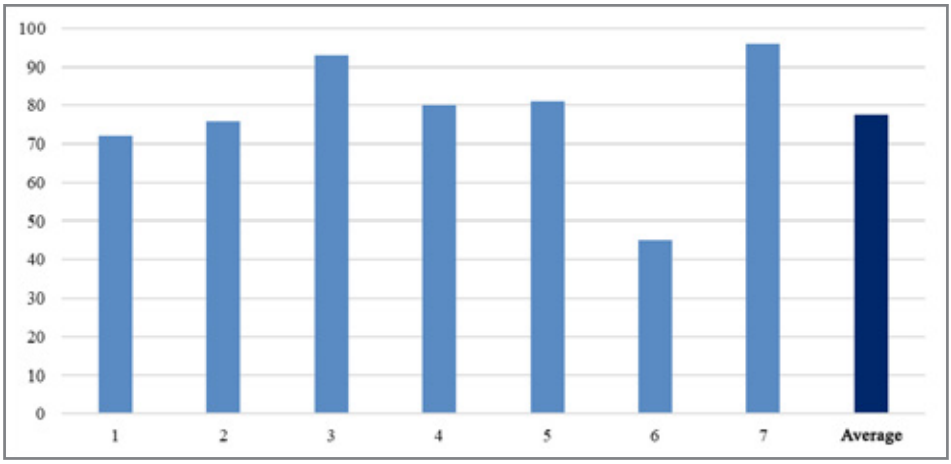
Graph 1. Average weight of grape bunches (grams) of the S*mederevka* variety in representative genotypes (1–6) and total average (2019–2021)



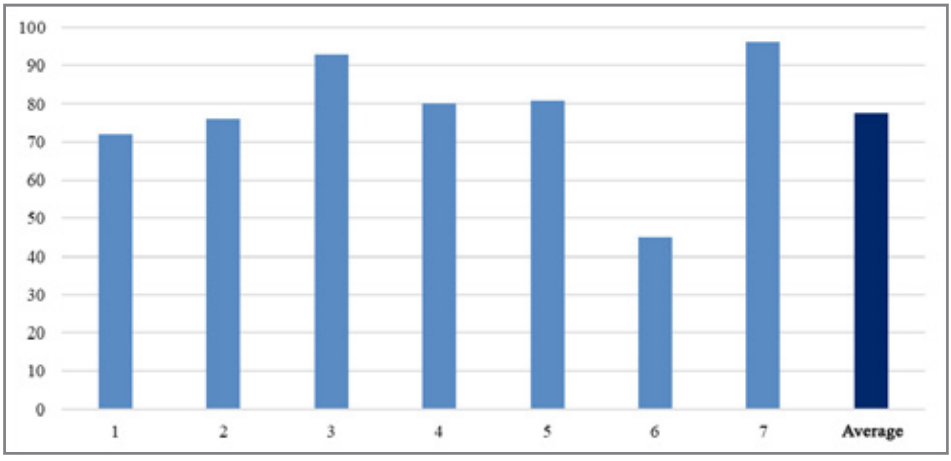
Graph 2. Average weight of grape bunches (grams) of the *Žametovka* variety in representative genotypes (1–7) and total average (2019–2021)

The determined number of berries per bunch for the *Smederevka* variety was 93 (Graph 3), which is similar (Žunić and Garić, 2016) or lower (Avramov and Žunić, 2001) in comparison with information from literature concerning this uvological characteristic of the *Smederevka* local variety. However, the number of berries per bunch was significantly lower in comparison with research into this characteristic of the S*mederevka* variety carried out in the Čegar wine-growing district (Radojević, 2021).

The average number of berries per bunch for the *Žametovka* variety was 78 (Graph 4), which is in line with information on the number of berries available in literature (Avramov and Žunić, 2001; Žunić and Garić, 2016).



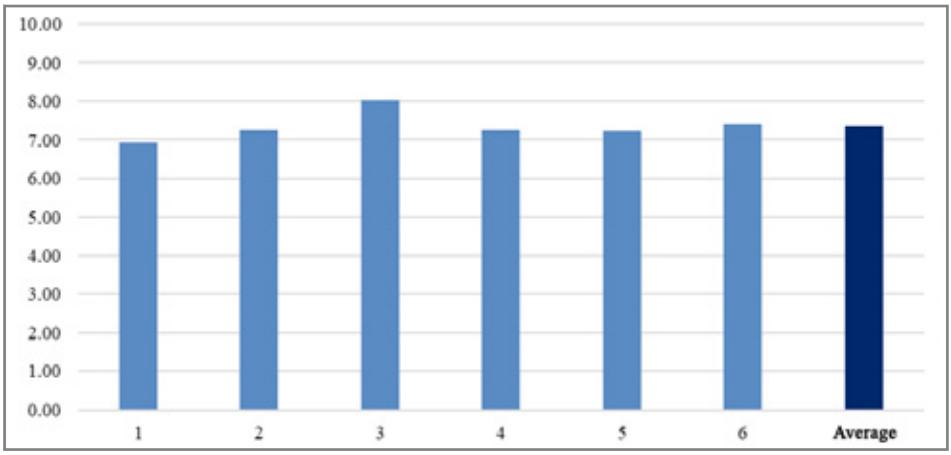
Graph 3. Average number of berries per bunch (grams) for the S*mederevka* variety in representative genotypes (1–7) and total average (2019–2021)



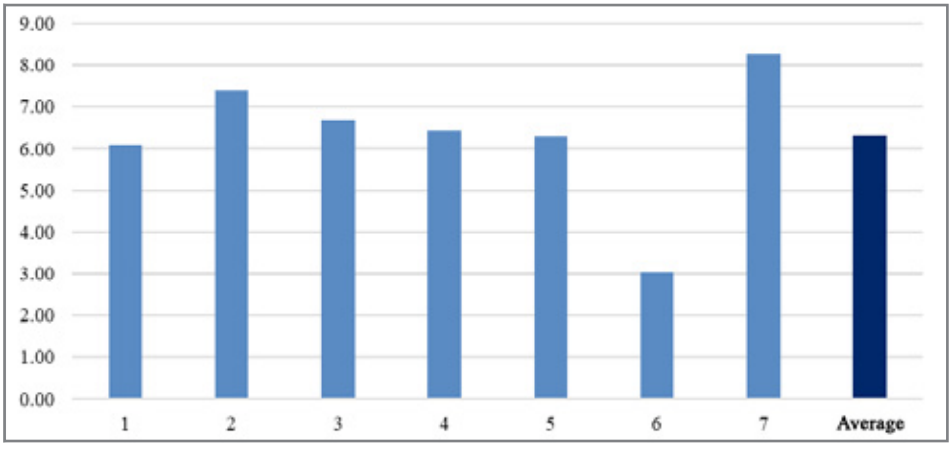
Graph 4. Average number of berries per bunch for the *Žametovka* variety in representative genotypes (1–7) and total average (2019–2021)

With respect to the average weight of grape bunch stems (g) for the *Smederevka* variety, the determined value was 7.35 g (Graph 5). Weight of bunch stems determined in this research was within values for this parametre from literature (Avramov and Žunić, 2001; Žunić and Garić, 2016). The determined weight of grape bunch stems is lower than the weight of grape bunch stems from *Smederevka* determined in the research carried out in the Čegar wine-growing district (Radojević, 2021).

The average weight of grape bunch stems for the *Žametovka* variety was 6.32 g (Graph 6). The weight of grape bunch stems determined in this research was in line with general information from available literature (Avramov and Žunić, 2001; Žunić and Garić, 2016).



Graph 5. Average weight of grape bunch stems (grams) for representative genotypes (1–6) of the S*mederevka* variety and total average (2019–2021)



Graph 6. Average weight of grape bunch stems (grams) for representative genotypes (1–7) of the *Žametovka* variety and total average (2019–2021)

Mechanical composition of grape berries

The average weight of 100 berries (g) of representative genotypes of the *Smederevka* variety was 299.1 g (Table 1). The determined average weight of 100 berries in the Trstenik wine-growing district was less than the weight of berries determined in the Čegar wine-growing district (Zirojević, 1974; Radojević, 2021).

The determined average weight of 100 berries (g) of representative genotypes of the *Žametovka* variety was 152.0 g (Table 1).

Image 1. Representative genotype 5 of the S*mederevka* grapevine variety

Image 2. Representative genotype 2 of the Ž*ametovka* grapevine variety

The determined average weight of skin of 100 berries (g) for the *Smederevka* was 27.35 g (Table 1), which is significantly less than the weight of skin for the *Smederevka* variety determined in conditions of the Čegar wine-growing district (Radojević, 2021). Unlike the *Smederevka* variety, the average weight of skin of 100 berries of the *Žametovka* variety was 15.41 g (Table 1).

The average weight of mesocarp of 100 berries of the *Smederevka* variety was 264.49 g (Table 1), which is similar (Radojević, 2021), or less (Zirojević, 1974), than the weight of the mesocarp determined in conditions in the Čegar wine-growing district. With respect to the *Žametovka* variety, average weight of the mesocarp of 100 berries (g) was 130.57 g (Table 1).

Average weight of seeds of 100 berries of the *Smederevka* variety was 7.26 g (Table 1), which is less than the value for the *Smederevka* determined in the Čegar district (Radojević, 2021). Average weight of seeds of 100 berries (g) of the *Žametovka* variety was 6.07 g (Table 1).

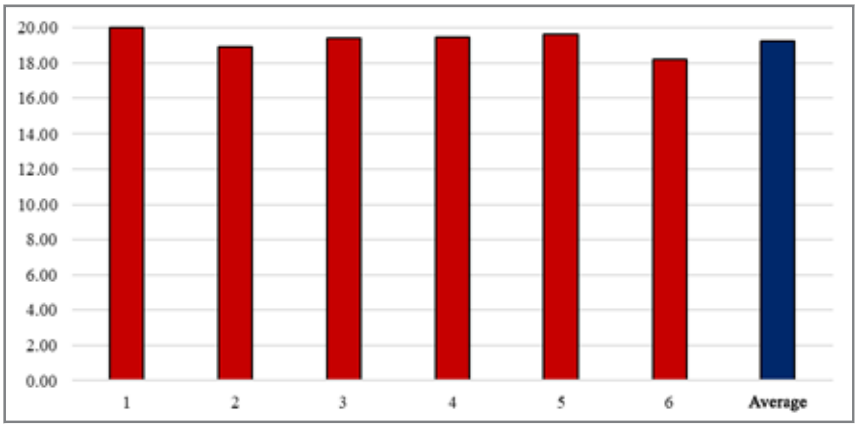
Table 1. Mechanical composition of genotypes of the *Smederevka* and *Žametovka* grapevine varieties (average 2019–2021)

Local variety	Genotype designation	100 berries (g)	Skin of 100 berries (g)	Mesocarp of 100 berries (g)	Seeds of 100 berries (g)
Smederevka	1	291.4	27.03	258.23	6.17
	2	269.5	22.4	240.25	6.82
	3	304.1	27.53	267.83	8.73
	4	308.3	30.07	270.83	7.43
	5	351.5	33.43	310.27	7.8
	6	269.8	23.63	239.53	6.6
	Average	299.1	27.35	264.49	7.26
Žametovka	1	153.1	14.73	132.08	6.32
	2	177.5	17.07	153.44	6.96
	3	145.6	14.3	125.92	5.42
	4	134.6	15.53	113.3	5.79
	5	152.9	15.33	131.85	5.7
	6	134.7	14.57	113.91	6.24
	7	165.9	16.33	143.47	6.06
	Average	152.0	15.41	130.57	6.07

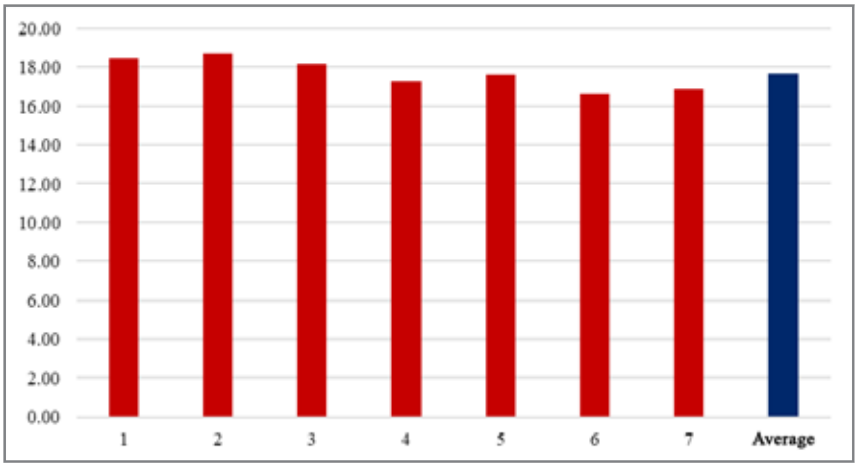
Grape must characteristics

Average sugar content for representative genotypes of the *Smederevka* variety determined in conditions in the Trstenik wine-growing district was 19.27% (Graph 7). Results for sugar content obtained in this research are in accordance with information from available literature (Avramov and Žunić, 2001; Žunić and Garić, 2016). In addition, the determined sugar content in this research was higher that the sugar content determined in conditions of the Fruška Gora (Cindrić et al., 2000), Podgorica (Savić, 2016) and Čegar wine-growing

district (Zirojević, 1974; Radojević, 2021). The determined average sugar content for representative genotypes of the *Žametovka* variety was 17.7% (Graph 8). Results of sugar content research for this paper correspond to information from available literature (Avramov and Žunić, 2001; Žunić and Garić, 2016).



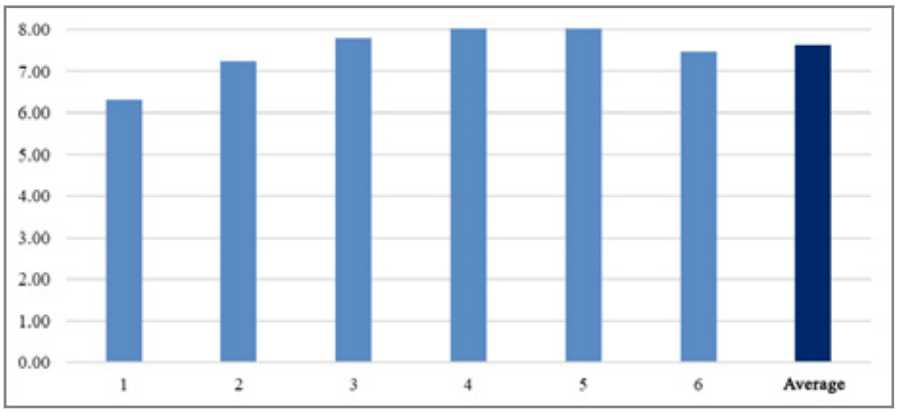
Graph 7. Average sugar content in grape must of the S*mederevka* variety, representative genotypes and total average (%) (2019–2021)



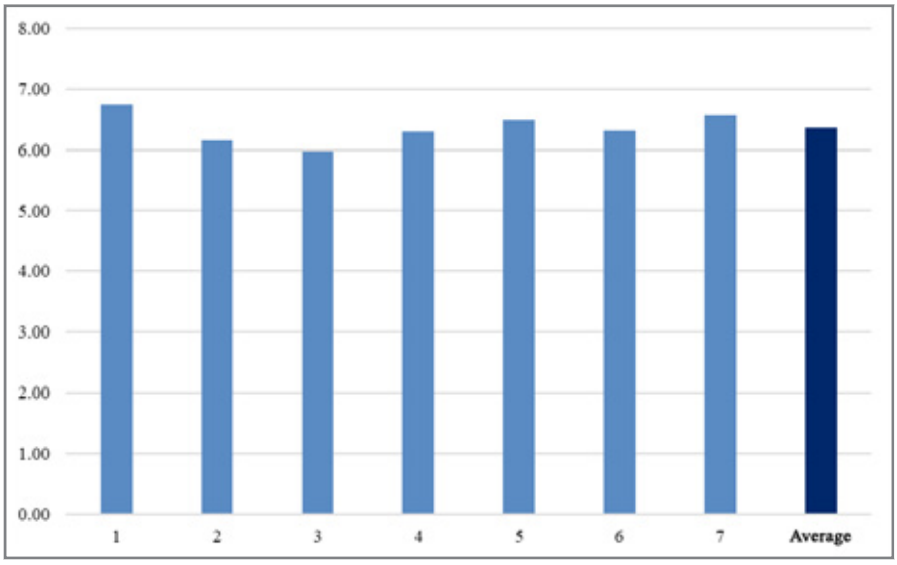
Graph 8. Average sugar content in grape must of the *Žametovka* variety, representative genotypes and total average (%) (2019–2021)

With respect to the total acids content (g/l) determined in this research for the *Smederevka* variety, it was 7.64 g/l (Graph 9). Research results for the total acids content for this paper correspond to general information from literature (Avramov and Žunić, 2001; Žunić and Garić, 2016), and are higher than the acids content determined for the *Smederevka* variety in the Podgorica

wine-growing district (Savić, 2016). The average determined acids content in our research was lower than the same parameter determined in experiments for the Grocka (Nikolić et al. 2018), Fruška Gora (Cindrić et al., 2000) and Čegar wine-growing districts (Zirojević, 1974, Radojević, 2021). Total acids content for representative genotypes of the *Žametovka* variety was 6.37 g/l (Graph 10). Research results for total acids content determined for this paper were lower than the information from available literature (Avramov and Žunić, 2001; Žunić and Garić, 2016).



Graph 9. Average total acids content in grape must from selected genotypes (1–6) of the *Smederevka* variety (%) (2019–2021)



Graph 10. Average total acids content in grape must from selected genotypes (1–7) of the *Žametovka* variety (%) (2019–2021)

CONCLUSION

Based on research of uvological characteristics of grapes from representative genotypes of local grapevine varieties *Smederevka* and *Žametovka* in conditions of the Trstenik wine-growing district, it can be concluded that there are certain differences between the examined genotypes, but that general characteristics are as usual for these varieties.

With respect to the mechanical composition of grape bunches, the average weight of bunches (g) for the *Smederevka* variety was 281.8 g, and for the *Žametovka* variety 123.2 g. The average number of berries for the *Smederevka* variety was 93, and 78 for the *Žametovka* grapevine variety. Average weight of grape bunch stems for the *Smederevka* variety was 7.35 g, and the average weight of grape bunch stems for the *Žametovka* variety was 6.32 g. The aforementioned values for the mechanical composition of grapes for the *Smederevka* and *Žametovka* varieties are in line with values from available literature, with the exception of the weight of the *Žametovka* grape bunches which was significantly lower than other available information and this is primarily explained by the age of the vineyard in which research was conducted. Furhermore, the uvological characteristics for the number of berries of the *Smederevka* variety was lower than the weight from research carried out in the Čegar wine-growing district.

Concerning the mechanical composition of berries, in particular average weight of 100 berries (g), the average value for the *Smederevka* variety was 299.1 g and for the *Žametovka* variety 152 g. The determined average weight of skin of 100 berries (g) of the *Smederevka* variety was 27.25 g and 15.41 g for the *Žametovka* variety. The average weight of mesocarp of 100 berries of the *Smederevka* variety was 264.49 g, and for the *Žametovka* variety 130.57 g. The average weight of seeds of 100 berries (g) of the *Smederevka* variety was 7.26 g and for the *Žametovka* variety 6.07 g. Characteristics of the mechanical composition of berries in research carried out in the Trstenik wine-growing district were slightly lower in comparison with the research of the *Smederevka* variety carried out in the Čegar wine-growing district.

With respect to the characteristics of grape must, that is, average sugar content (%), it amounted to 19.27% for the *Smederevka* variety and 17.7% for the *Žametovka* variety. Average total acids content (g/l) was 7.64 g/l for the *Smederevka* and 6.37 g/l for the *Žametovka* variety. Characteristics of grape must for these two varieties were mostly within the values for these parametred obtained in other research, however, sugar content for the *Smederevka* variety was higher than in all other research carried out in the Fruška Gora, Podgorica and Čegar wine-growing districts. The total acids content of the *Smederevka* variety was lower than the values for that parametre determined in other research in continental wine-growing areas. In addition, the total acids content for the *Žametovka* variety was lower than the information available in literature.

Base on the aforementioned, it can be concluded that local grapevine varieties *Smederevka* and *Žametovka* have slightly better uvological charac-

teristics in the Trstenik wine-growing district in comparison with previous research, and warrant attention and should be the subject of further research. This refers in particular to the study of the uvological characteristics of the bunches and berries of these varieties in other wine-growing areas, with special attention to future research on the sugar and acid content of grape musts under the conditions of current climatic changes.

REFERENCES

Avramov L, Žunić D (2001): *Posebno vinogradarstvo*. Zemun: Poljoprivredni fakultet u Beogradu

Cindrić P, Korać N, Kovač V (2000): *Sorte vinove loze*. Novi Sad: Univerzitet u Novom Sadu.

Jakšić D, Bradić I, Beader M, Milić R, Ristić M (2019): Autohtone i regionalne sorte vinove loze. Niš: Centar za vinogradarstvo i vinarstvo.

Jakšić D (ed.) (2019): *Vinogradarstvo i vinarstvo Srbije*. Niš: Centar za vinogradarstvo i vinarstvo.

Jakšić D (ed.) (2023): *Sorta vinove loze bagrina*. Niš: Centar za vinogradarstvo i vinarstvo.

Nikolić D, Miljković J, Rakonjac V, Radojević I, Ranković Vasić Z (2018): Inheritance and phenotypic orrelations of agronomic traits in grapevine offsprings. *Acta Sci. Pol. Hortorum Cultus*, 17: 87–99.

OIV (2021): Method OIV-MA-AS311-01A: Compendium of International Methods of Wine and Must Analysis, Vol 1, Edition 2016, OIV, Paris, France.

Raspor P, Cus F, Povhe Jemec K, Zagorc T, Cadez N, Nemanic J (2002): Yeast population dynamics in spontaneous and inoculated alcoholic fermentations of Zametovka must. *Food Technol. Biotechnol.* 40: 95–102.

Radojević I (2021): *Biološke i proizvodne osobine perspektivnih hibrida vinove loze iz različitih kombinacija ukrštanja*. Doktorska disertacija, Beograd; Poljoprivredni fakultet.

Savić S (2016): *Crnogorska ampelografija*. Podgorica: Crnogorska akademija nauka i umjetnosti

Terčelj D (2015): *The Culture of Wine in Slovenia*. Ljubljana: University of Primorska and Slovene ethnographic museum.

Vršić S, Ivančić A, Šušek A, Zagradišnik J, Valdhuber J (2011): The World's oldest living grapevine specimen and its genetic relationships. *Vitis* 50: 167–171.

Zirojević D (1974): *Poznavanje sorata vinove loze*. Tom II. Niš: Gradina.

Žunić D, Garić M (2016): *Posebno vinogradarstvo*. Kosovska Mitrovica: Poljoprivredni fakultet Univerziteta u Prištini.

ОРИГИНАЛНИ ЧЛАНАК
Примљен: 4. 9. 2023.
Прихваћен: 23. 10. 2023.

УВОЛОШКЕ КАРАКТЕРИСТИКЕ ЛОКАЛНИХ СОРТИ ВИНОВЕ ЛОЗЕ: *СМЕДЕРЕВКА* И *ЖАМЕТОВКА*

Иван З. БРАДИЋ[1], Милош П. РИСТИЋ[1], Ивана С. МОШИЋ[1], Радослав Б. МИЛИЋ[1], Милан М. БЕАДЕР[1], Дарко Д. ЈАКШИЋ[2]

[1] Центар за виноградарство и винарство Ниш, Колонија ЕИ 6, Ниш 18116, Србије
[2] Институт за примену науке у пољопривреди Београд, Булевар деспота Стефана 86б, Београд 11000, Србија

РЕЗИМЕ: Испитивање уволошких карактеристика једна је од обавеза утврђивања општих привредно-технолошких вредности сорти винове лозе. Таква истраживања је препоручљиво извршити нарочито код локалних сорти које у ранијем периоду нису показивале добре особине неопходне за производњу висококвалитетних вина. Локалне сорте *смедеревка* (бела винска сорта) и *жамето̄вка* (црна винска сорта) су у ранијем периоду углавном служиле за производњу нискоквалитетних вина. Променом начина производње у смислу потенцирања висококвалитетних вина, односно производње вина са географским пореклом, виногради са овим сортама у Србији су доста искрчени, али су се због специфичних и повољних услова *terroir*-а делимично задржале у Трстеничком виногорју (рејон Три Мораве). У циљу утврђивања уволошких карактеристика ове две сорте у садашњим условима климатских промена које погодују овим високородним сортама у овом раду испитани су механички састав грозда (маса грозда, број бобица и маса шепурине), механички састав бобице (маса 100 бобица, маса покожице 100 бобица, маса мезокарпа 100 бобица и маса семенки 100 бобица), као и карактеристике шира (садржај шећера и укупних киселина у ширу) репрезентативних генотипова локалних сорти *смедеревка* и *жамето̄вка* у производним засадима у Трстеничком виногорју. Резултати истраживања су показали да су уволошке карактеристике ових сорти углавном нешто боље у односу на ранија истраживања у другим виноградарским подручјима или у односу на опште литерарне податке, што упућује на неопходност даљих истраживања ових сорти у другим агроеколошким условима.

КЉУЧНЕ РЕЧИ: *смедеревка*, Трстеничко виногорје, уволошке особине, *жамето̄вка*

Зборник Матице српске за природне науке / Matica Srpska J. Nat. Sci. № 146, 129—142, 2024

UDC 634.84(497.11)
https://doi.org/10.2298/ZMSPN2446129P
ORIGINAL ARTICLE
Received: 2. 10. 2023.
Accepted: 23. 11. 2023.

Mladen S. PETROVIĆ[1*], *Bojan V. SAVIĆ*[2], *Darko D. JAKŠIĆ*[1]

[1] Institute for Science Application in Agriculture, Bulevar Despota Stefana 86b, Belgrade 11060, Serbia
[2] University of Belgrade, Faculty of Agriculture, Nemanjina 6, Belgrade 11080, Serbia

FORECAST OF PLANTING VINEYARDS WITH LOCAL GRAPEVINE VARIETIES IN THE REPUBLIC OF SERBIA USING THE ARIMA MODELS

ABSTRACT: Compared to the previous period, the vineyard area in the Republic of Serbia has decreased significantly. Although the planting of new vineyards is subsidized over a long period of time, not enough vineyards are planted to ensure self-sufficiency in domestic grapes, wine (wine products) and spirit drinks originating from grapes. This is especially case for vineyards with local grapevine varieties, which can be of great importance for the rural development and promotion. In this paper, utilized time series analysis, specifically Auto Regressive Integrated Moving Average (ARIMA) modeling was used to predict the dynamics of newly planted vineyard areas with all grapevine varieties and local grapevine varieties based on data from the previous 20 years (period from 2003 to 2022). The aim is to forecast the trends of newly planted vineyard areas, both for all grapevine varieties and vineyards with local grapevine varieties, for the period from 2023 to 2027. A time series refers to a structured sequence of observations. The structuring is frequently done in terms of time intervals. Forecasting time series data, or determining future trends, is one of the most crucial goals of time series analysis. Based on such analysis, it is possible to forecast the expansion of vineyard areas for the upcoming period. ARIMA models helped to determine five-year trends in data on newly planted vineyard areas. The forecast made in this paper showed that vineyard area of all grapevine varieties would be planted at an annual range of about 230 and 300 hectares over the next five years. The forecast for future annual planting for the same period (2023–2027) of vineyards with local grapevine varieties is in the range of only about 10 to 60 hectares. The obtained ARIMA forecast results, especially for the forecasts for planting vineyards with local grapevine varieties, show that it is necessary to pay special attention to this problem and to initiate numerous measures and activities in order to increase the area of vineyards with local grapevine varieties in the Republic of Serbia.

KEYWORDS: forecasting, vineyards, local grapevine varieties, ARIMA modeling

[*] Corresponding author. E-mail: mpetrovic@ipn.bg.ac.rs

INTRODUCTION

Planting vineyards has been a constant subject-matter of the agricultural policy of the Republic of Serbia; it has been limited in the European Union for several decades, and it has been also a topic when it comes to monitoring the tendencies in terms of vineyard areas by the International Organization for Vine and Wine (OIV). Given the importance of local grapevine varieties, they are given special attention in order to increase the vineyard areas with local varieties.

According to the OIV, the total vineyard area in the world in 2022 was 7.3 million hectares (OIV, 2022). Although the areas under vineyards in the world have been constantly decreasing since 2006, from 2017 onwards such areas have started to stabilize. The reason for this, however, lies in increasing the number of these areas in some countries (Russia, India, Brazil, France and others), at the expense of other countries in which the number of areas under vineyards have been decreased in recent years (Moldova, Turkey, Spain, Argentina and the USA) (OIV, 2022). Despite international varieties prevail in general, in some countries, there have been new vineyards with local varieties, as in Italy (Glera variety), Portugal (Touriga Franca, Touriga Nacional and Arinto) and other countries (OIV, 2017).

For a long time, in order to avoid the risk of oversupply of wine products and ensure the competitiveness, within the measures of the Common Market Organization (CMO) for the wine sector, the European Union has constricted the expansion of the existing vineyard areas, through the "planting rights" system. This "planting rights" has been changed after the EU passed a new common agricultural policy (Regulation [EU], No. 1308/2013). In 2016, the regulation introduced the system of authorization of planting vineyards, where each member state can increase vineyard areas, corresponding to no more than 1% of the total area actually planted with grapevines calculated on 31 July of the previous year. Such limitations and strict control of production can help avoid the risk of the wine oversupply on the market, but also the risk of devaluation of protected and renowned EU geographical indications.

In the Republic of Serbia, when it comes to the areas under vineyards and trends of planting new vineyards, the situation in the previous period has been completely opposite. Compared to 1955, when there were 135,000 ha of vineyards (Jakšić, 2019), in 2022 there were 19,973 fruitful vineyards (without data from AP Kosovo and Metohija) (Jeftić, 2023). According to the data from the Vineyard Registre, there are more than 6.5 thousand hectares of vineyards in Serbia for commercial production of grapes and wine (Jakšić, 2019). The Republic of Serbia currently does not have enough vineyard areas, and consequently, enough quantities of domestic grapes, wine (wine products) and spirit drinks originated from domestic grapes to ensure an adequate level of self-sufficiency. This is confirmed by data showing that in 2022 the total production of wine recorded in the Winery Registre was 25 million litres, 16.8 million of

which was made of domestic grapes and 8.2 million of imported, i.e. delivered raw material (Jeftić, 2023). According to the Serbian Statistical Office (RZS), the total imports of wine (excluding aromatic wine) in 2022 amounted to 22.9 million litres (Jeftić, 2023). Given such circumstances, there is a need for planting a considerable number of vineyards, and especially vineyards with local grapevine varieties that can have economic importance and they can also greatly affect the development of rural areas and promotion of Serbia or certain wine-growing areas/geographical indications. For that reason, the Serbian Ministry of Agriculture, Forestry and Water Management (MPŠV) has been encouraging the planting of new vineyards for more than two decades, giving some incentives for newly planted vineyards with local grapevine varieties (*Službeni glasnik RS*, No. 49/23). The calls from Certification of Planting Material and Clonal Selection Programme funded by the Serbian Ministry of Agriculture, Forestry and Water Management (MPŠV, 2019) until 2019 launched clonal selection of certain local grapevine varieties in Serbia. Nevertheless, except in 2008 and 2009, despite significant national and EU incentives, there have not been many newly planted vineyards in the last 20 years in Serbia (on average, 232 hectares per year). It is particularly true when it comes to newly planted vineyards with old autochthonous and regional/local grapevine varieties and there are 31 of them in Serbia (Jakšić et al., 2019). Namely, over the last 20 years, 53 hectares of vineyards with local varieties, on average, have been planted per year, and the largest area was planted in 2021.

Without going deep into the issue of lacking the certified clone planting material for local grapevine varieties, high costs of setting up and maintaining a vineyard, high price competition of wine from the neighbouring countries (Jakšić, 2019) and other problems that lead to planting less vineyards, there is a need for research and forecast planting of vineyards in the future period based on data on trends in vineyard planting in previous periods and based on using appropriate research methods. The goal of this paper was to predict vineyard planting (total vineyard areas with all grapevine varieties and with local grapevine varieties) based on the data on vineyard planting in previous years and using the ARIMA (Auto Regressive Integrated Moving) model.

MATERIALS AND METHODS

Methodology for predicting the planting of new vineyards using the ARIMA models

ARIMA models are the most widely used approaches to time series forecasting to provide complementary approaches to the problem. ARIMA models aim to describe the autocorrelations in the data (Hyndman and Athanasopoulos, 2021). The primary objectives of time series analysis include description,

explanation and prediction or forecasting of time series data. During the forecasting process, the authors work with a time series for which data are available up to a certain point in time, denoted as an "h", where "X = (X1, …, Xh)". The objective is to predict future values for "ℓ" periods in advance, represented as "Xh+ℓ", where "ℓ" is defined as the forecast horizon (Ilić et al., 2014). For annual time series, it is often appropriate to forecast three periods ahead, which corresponds to the next three years. For quarterly time series, the forecast horizon typically extends to one or two quarters. However, for daily time series, forecasts may extend over longer periods, encompassing days or even months. It is worth noting that the precision of such forecasts becomes increasingly questionable beyond the specified limitations. In such cases, these predictions are more accurately described as projections rather than forecasts (Dabetić, 2016). Projections require further consideration and additional factors and research (Joksimović et al., 2020). Seasonal ARIMA models, similar to their non-seasonal counterparts, consider the interdependence of consecutive observations within a time series, such as the relationship between observations of consecutive months (or quarters) within a year. However, unlike non-seasonal time series, seasonal time series models also account for the interdependence of observations for the same months (or quarters) in consecutive years (Mutavdžić et al., 2014).

The seasonal ARIMA model for a time series {Xt, tϵT} follows the structure (Mladenović and Nojković, 2015):

$$\phi(B)(1 - \mathrm{B})^{d} (1 - B^{S})^{D} X_{t} = \theta(B)\varepsilon_{t} ,$$

Both seasonal and non-seasonal differentiation operators are used in the definition of an ARIMA model, referred to as d- and D- times, respectively. To construct an ARIMA model effectively, it is advisable to follow the interactive approach proposed by Box and Jenkins (Mladenović and Nojković, 2015). The predictive analyzes using the ARIMA model were performed using SPSS statistical software.

Data used for the analysis

For the study, data on the dynamics of newly planted vineyards for the period 2003–2022 were used (Jakšić, 2019; Jeftić, 2023; internal interviews), including both planted areas (vineyard areas with all more than 251 grapevine varieties (Jeftić, 2023), as well as vineyard areas with just 31 local grapevine varieties). Based on the presented data, an analysis is performed to forecast the trends in newly planted vineyards with all grapevine varieties, as well as with local varieties for the next five years (2023–2027).

Table 1. Data on the areas of newly planted vineyards with all grapevine varieties and local varieties for the period 2003–2022

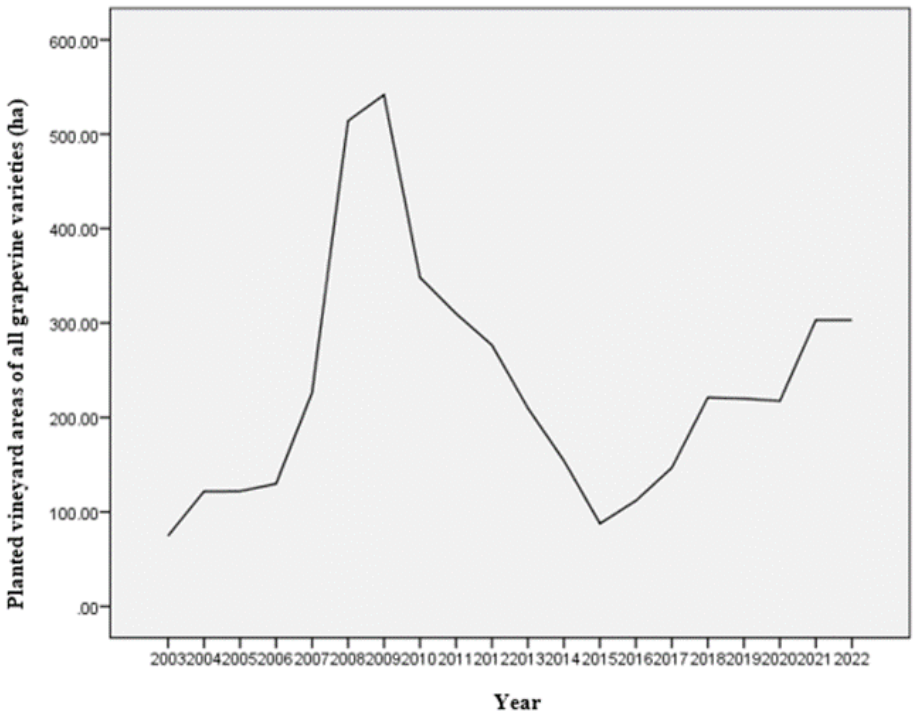
Year	Area of newly planted vineyards with all grapevine varieties (ha)	Areas of newly planted vineyards with local grapevine varieties (ha)
2003	74.709	32.405
2004	121.673	31.759
2005	121.949	28.102
2006	129.736	22.733
2007	226.078	29.288
2008	514.174	84.477
2009	541.603	79.903
2010	348.227	59.688
2011	310.088	65.110
2012	276.587	65.371
2013	209.782	64.931
2014	154.234	50.200
2015	87.645	23.885
2016	111.823	26.858
2017	146.865	44.444
2018	221.114	32.925
2019	219.933	42.010
2020	217.465	43.683
2021	303.102	122.164
2022	303.141	116.182
Average	231.996	53.306

Source: (Jakšić, 2019) and interviews of grape producers.

RESULTS AND DISCUSSION

Analysis of the forecast for planting vineyards with all grapevine varieties

Before analyzing the prediction of vineyard areas with all grapevine varieties, two tests were used to verify the data following a normal distribution: Kolmogorov-Smirnov and Shapiro-Wilk test. Based on both tests, the data were found to follow a normal distribution, allowing a further data analysis based on ARIMA modeling. Based on the data in Table 1, an analysis of the prediction of planting of vineyards with all grapevine varieties for the next five years, period 2023–2027, was performed.



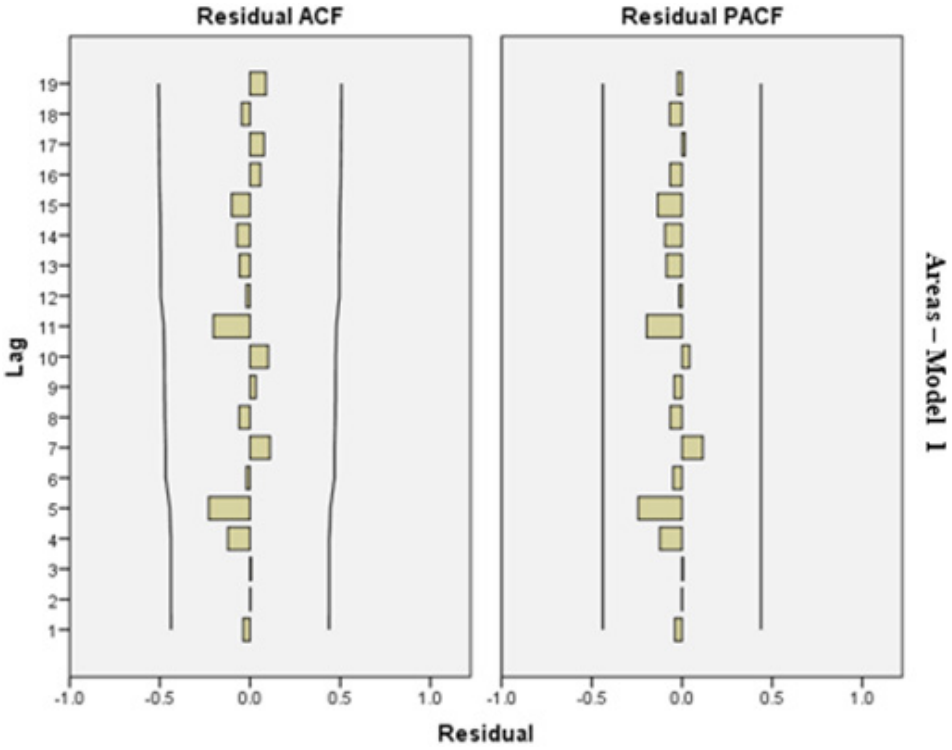
Graph 1. The trend of newly planted vineyard areas with all grapevine varieties in the period 2003–2022

From Graph 1, it can be concluded that the data do not follow one trend (a constant increase or a constant decrease in planted vineyard areas with all grapevine varieties), but there is a noticeable fluctuation in the amount of planted vineyard areas with all grapevine varieties, from which it can be concluded that it is a stationary time series. In the data modeling, based on the autocorrelation and partial correlation function of the time series, the following model (4,0,2) was chosen from several models to describe newly planted vineyards with all grapevine varieties in the Republic of Serbia.

Table 2. Estimated parameters of the ARIMA (4,0,2) model

Lag	Estimate	SE	t	Sig.
AR Lag 1	1.704	0.505	3.371	0.005
Lag 2	-1.455	0.964	-1.509	0.155
Lag 3	0.909	0.753	1.208	0.249
Lag 4	-0.494	0.281	-1.758	0.102
MA Lag 1	0.937	6.635	0.141	0.890
Lag 2	0.048	1.001	0.048	0.962

Source: Author's calculation in the SPSS program based on the data from Table 1



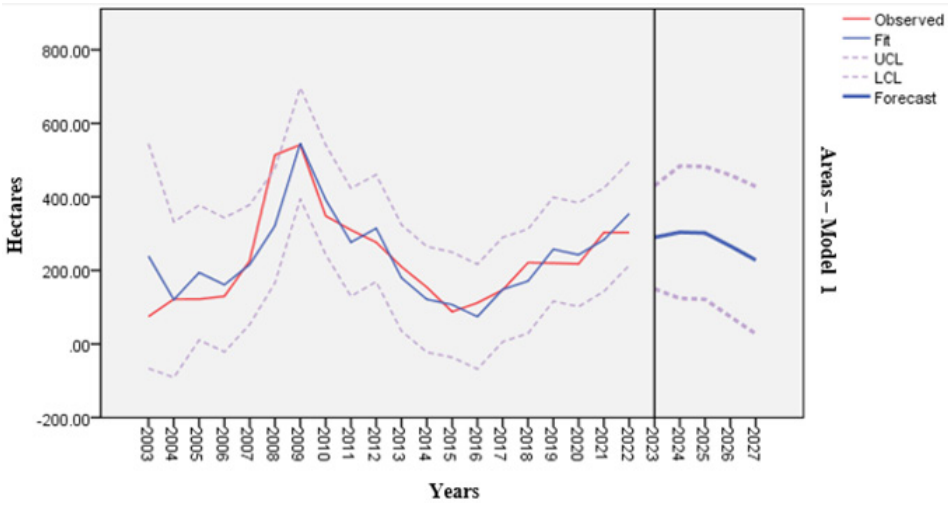
Graph 2. Correlogram results for the residuals of the estimated model 1

Based on Graph 2, it can be concluded that the residuals do not contain significant correlations on any of the lags, i.e. the residuals follow the white noise pattern.

Table 3. Estimation of newly planting vineyards with all grapevine varieties in the Republic of Serbia based on the ARIMA model (4,0,2)

Years	Estimated newly planted vineyard areas	Confidence interval of 90% of the estimated newly planted vineyard areas	
		Lower bound	Higher bound
2023	290.02	149.73	430.30
2024	303.88	123.88	483.89
2025	301.94	121.47	482.42
2026	266.51	74.05	458.96
2027	228.05	27.83	428.27

Source: Author's calculation in the SPSS program based on the data from Table 1

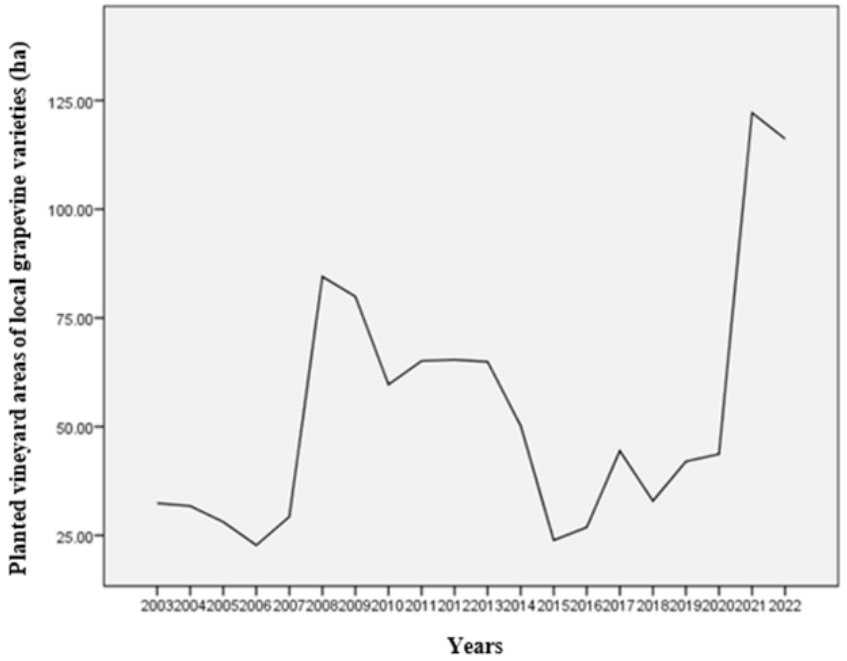


Graph 3. Newly planted vineyards with all grapevine varieties in the period 2003–2022 and the amounts estimated according to the ARIMA model for the next five years

Based on the defined ARIMA modeling, Graph 3 shows the trend of newly planted vineyard areas with all grapevine varieties in the period 2003–2022, as well as the trend of newly planted vineyard areas according to the ARIMA model. Based on the graphical representation, it can be inferred that the defined ARIMA model closely aligns with the actual figures of newly planted vineyard areas with all grape varieties, indicating that the defined model is reliable. Additionally, the defined ARIMA model forecasts the amount of newly planted vineyard areas with all grape varieties for the next five years (2023–2027). The forecast data obtained indicate that there will be no significant changes in terms of newly planted vineyard areas with all grapevine varieties, with the trend of planting remaining within the range of 230–300 hectares annually.

Analysis of the forecast for planting vineyards with local grapevine varieties

As in the above-mentioned case, before analyzing the prediction of vineyard areas with local grapevine varieties, two tests – the Kolmogorov-Smirnov and the Shapiro-Wilk tests were used to determine whether the data followed a normal distribution. Based on both tests, it was concluded that the data followed a normal distribution, enabling a further data analysis based on ARIMA modeling. Based on the data in Table 1, an analysis of the prediction of planting vineyards with local grapevine varieties for the next five years, period 2023–2027, was performed.



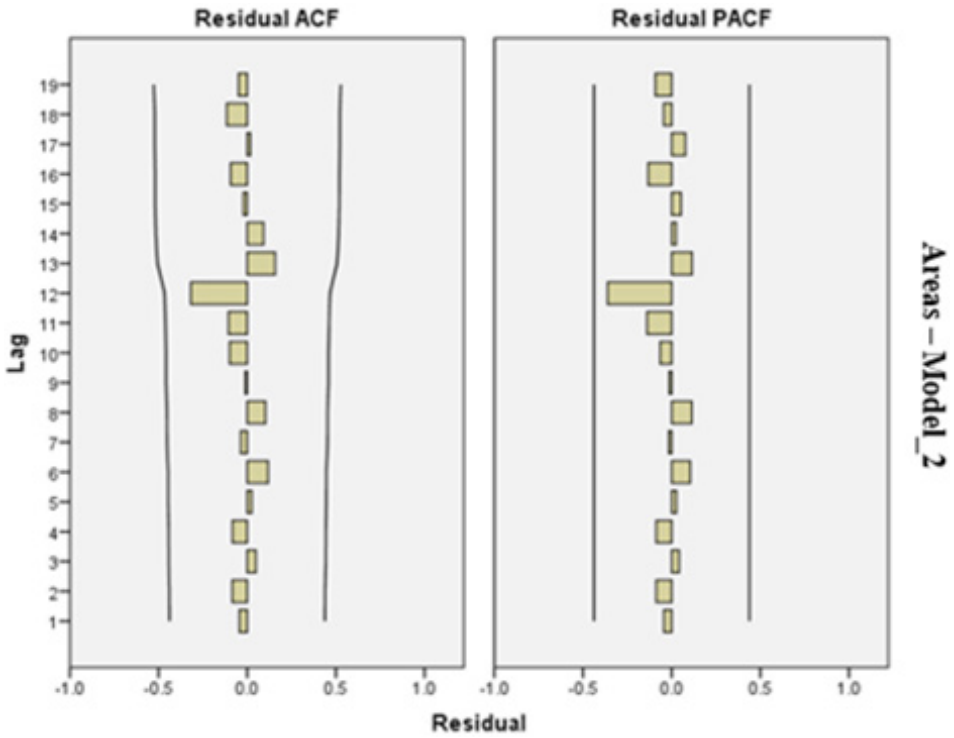
Graph 4. The trend of newly planted vineyard areas with local grapevine varieties in the period 2003–2022

From Graph 4 it can be concluded that the data do not follow one trend (a constant increase or a constant decrease in planted vineyard areas with local grapevine varieties), but there is a noticeable fluctuation in the amount of planted vineyard areas with local grapevine varieties, based on which it can be concluded that it is a stationary time series. As in the previous case, in the data modeling, based on the autocorrelation and partial correlation function of the time series, the following model (5,0,3) was chosen from several models to describe newly planted vineyards with local grapevine varieties.

Table 4. Estimated parameters of the ARIMA (5,0,3) model

Lag	Estimate	SE	t	Sig.
AR Lag 1	1.121	1.006	1.114	0.289
Lag 2	-0.590	1.977	-0.298	0.771
Lag 3	-0.368	2.095	-0.176	0.864
Lag 4	0.541	1.260	0.429	0.676
Lag 5	-0.588	0.602	-0.977	0.350
MA Lag 1	1.356	14.790	0.092	0.929
Lag 2	0.133	6.405	0.021	0.984
Lag 3	-0.573	9.493	-0.060	0.953

Source: Author's calculation in the SPSS program based on the data from Table 1



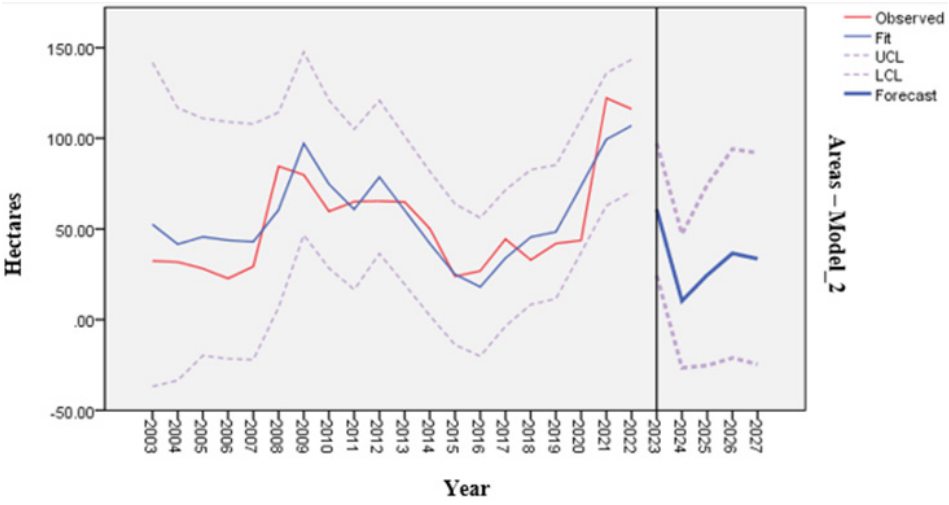
Graph 5. Correlogram results for the residuals of the estimated model 2

Based on Graph 5, it can be concluded that the residuals do not contain significant correlations on any of the lags, i.e. the residuals follow the pattern of white noise.

Table 5. Estimation of newly planted vineyards with local grape vine varieties in the Republic of Serbia based on the ARIMA model (5,0,3)

Years	Estimated newly planted vineyard areas	Confidence interval of 90% of the estimated newly planted vineyard areas	
		Lower bound	Higher bound
2023	60.76	24.29	97.24
2024	10.30	-26.56	47.15
2025	24.59	-25.27	74.45
2026	36.54	-21.05	94.14
2027	33.63	-24.68	91.93

Source: Author's calculation in the SPSS program based on the data from Table 1



Graph 6. Newly planted vineyards with local grapevine varieties in the period 2003–2022 and the amounts estimated according to the ARIMA model for the next five years

Based on the defined ARIMA modeling for the local grapevine varieties, Graph 6 shows the trend of newly planted vineyard areas with local grapevine varieties in the period 2003–2022, as well as the trend of newly planted vineyard areas according to the ARIMA model. Based on the graphical representation, it can be deduced that the defined ARIMA model aligns very well with the actual figures of newly planted vineyard areas with local grapevine varieties, indicating that the defined model is reliable. Moreover, the defined ARIMA model forecasts the amount of newly planted vineyard areas with local grapevine varieties for the next five years (2023–2027). The obtained forecasted data suggest that there will be no significant changes in terms of newly planted vineyard areas with local grapevine varieties, with the trend of planting remaining within the range of 10–60 hectares annually.

CONCLUSION

After a gradual decrease, vineyard areas in the world have been stabilized on around 7.3 million hectares. The European Union to a certain extent limits planting of new vineyards, to avoid oversupply of wine and to ensure the competitiveness of EU wine. In Serbia, a country that imports wine, the situation is quite different, where despite considerable government incentives, there have not been enough newly planted vineyards. It is particularly case when it comes to 31 old local varieties that could be important for rural development and for promoting wine-growing areas, and geographical indications of the Republic of Serbia.

The ARIMA models forecasted the dynamics of planting new vineyards for the next five years (period 2023–2027). These models determined that the trend of planting new vineyards with all grapevine varieties would range 230–300 hectares annually. Although the models showed there would be a mild decrease in planting of new vineyards, the forecasted hectares were somewhat higher than the overall average for the last twenty-year period (2003–2022).

Based on the trend of planting vineyards in the previous period, the forecast was also made for the dynamics of planting new vineyards with local grapevine varieties for the next five years (period 2023–2027). The ARIMA models forecasted that newly planted vineyards with local varieties would increase the area for only 10–60 hectares annually. Such values are within the overall average for vineyards with local varieties in the previous twenty-year period (2003–2022).

Presuming that the circumstances affecting the trend in planting vineyards in the last twenty years (2003–2022) would remain the same or similar, the forecasts of the dynamics of planting vineyards with all grapevine varieties and with local varieties by using ARIMA modeling indicates\ that hectares of future newly planted vineyards in Serbia will not be enough to obtain a proper self-sufficiency in terms of grapes, wine (wine products) and spirit drinks originating from grapes. It is particularly true when it comes to vineyards with local grapevine varieties, and it is therefore necessary to pay special attention to this matter and launch numerous measures and activities to increase hectares under vineyards with local grapevine varieties.

ACKNOWLEDGEMENT

This paper is a result of the research conducted within the contract on the implementation and financing of scientific research in 2024, between the Institute for Science Application in Agriculture, Belgrade, and the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, contract number: 451-03-66/2024-03/200045.

REFERENCES

Dabetić S (2016): *Primena matematičko-statističkih metoda u istraživanju ponude i tražnje mesa*. Doctoral dissertation, Novi Sad: University Business Academy, FIMEK.

Hyndman RJ, Athanasopoulos G (2021): *Forecasting: principles and practice*. 3rd edition, OTexts: Melbourne, Australia. Available to: https://otexts.com/fpp3/

Ilić I, Jovanović S, Janković-Milić V (2016): Forecasting Corn Production in Serbia Using Arima Model. *Economics of Agriculture* 4: 1141–1156. [https://doi.org/10.5937/ekoPolj1604141l]

Jakšić D (ed.) (2019): *Vinogradarstvo i vinarstvo Srbije*. Niš: Centar za vinogradarstvo i vinarstvo.

Jakšić D, Bradić I, Beader M, Milić R, Ristić M. (2019): *Autohtone i regionalne sorte vinove loze*. Niš: Centar za vinogradarstvo i vinarstvo.

Jeftić M (ed.) (2023): Izveštaj o stanju u poljoprivredi u Republici Srbiji u 2022. godini, knjiga II – Pregled tržišta, Ministartvo poljoprivrede, šumarstva i vodoprivrede. Available to: http://www.minpolj.gov.rs/korisna-dokumenta-i-linkovi/?script=lat.

Joksimović M, Ivanović S, Janković-Šoja S (2020): Production and Tendency in Milk Processing in Montenegro. *Economics of Agriculture* 67: 391–404. [DOI: https://doi.org/10.5937/ekoPolj2002391J]

Korović P (2016): *Prognoziranje vremenskih serija – Modeli i izbor modela*. Master thesis. University of Belgrade, Faculty of Mathematics.

Lipovina-Božović M (2014): *Ekonometrijski modeli za prognozu makroekonomskih indikatora na primjeru Crne Gore*. Doctoral dissertation. Podgorica: University of Montenegro, Faculty of Economics.

Mladenović Z, Nojković A (2015): *Primenjena analiza vremenskih serija*. Belgrade: University of Belgrade, Faculty of Economics.

MPŠV [Ministarstvo poljoprivrede, šumarstva i poljoprivrede] (2019): Konkurs za programe sertifikacije sadnog materijala i klonsku selekciju voćaka, vinove loze i hmelja za 2019. godinu. Available to: http://www.minpolj.gov.rs/wp-content/uploads/datoteke/konkursi_2019/Konkurs%20sertifikacija%20i%20klonska%20selekcija%202019-06.08..pdf?script=lat.

Mutavdžić B, Drinić Lj, Novković N, Ostojić A, Roković G (2014): Forecasting of vegetable production in Republic of Srpska. *DETUROPE* 6: 50–64.

OIV (2017): Distribution of the world's grapevine varieties. Focus OIV 2017. Available to: https://www.oiv.int/public/medias/5888/en-distribution-of-the-worlds-grapevine-varieties.pdf.

OIV (2022): State of the world vine and wine sector in 2022. Available to: https://www.oiv.int/sites/default/files/documents/OIV_State_of_the_world_Vine_and_Wine_sector_in_2022_2.pdf.

Regulation (EU) No 1308/2013 of the European Parliament and of the Council of 17 December 2013.

Službeni glasnik Republike Srbije, broj 49/23: Pravilnik o podsticajima za investicije u fizičku imovinu poljoprivrednog gazdinstva kroz podršku podizanja višegodišnjih proizvodnih zasada vinove loze.

ОРИГИНАЛНИ ЧЛАНАК
Примљен: 2. 10. 2023.
Прихваћен: 23. 11. 2023.

ПРЕДВИЂАЊЕ ПОДИЗАЊА ВИНОГРАДА СА ЛОКАЛНИМ СОРТАМА ВИНОВЕ ЛОЗЕ У РЕПУБЛИЦИ СРБИЈИ КОРИШЋЕЊЕМ „ARIMA" МОДЕЛА

Младен С. ПЕТРОВИЋ[1], Бојан В. САВИЋ[2], Дарко Д. ЈАКШИЋ[1]

[1] Институт за примену науке у пољопривреди (ИПН)
Булевар деспота Стефана 86б, Београд 11060, Србија
[2] Универзитет у Београду, Пољопривредни факултет,
Немањина 6, Београд 11080, Србија

РЕЗИМЕ: У односу на претходни период, површине винограда у Републици Србији су значајно смањене. Иако се садња нових винограда субвенционише дужи временски период, ипак се не сади довољно винограда како би се обезбедиле довољне количине домаћег грожђа, вина (производа од вина) и алкохолних пића пореклом од грожђа. Ово посебно важи за винограде са локалним сортама винове лозе, које могу бити од великог значаја за рурални развој и промоцију. У овом раду је коришћена анализа временских серија, конкретно моделовање ауторегресивног интегрисаног покретног просека (ARIMA) за предвиђање динамике новозасађених површина винограда са свим сортама винове лозе и локалним сортама винове лозе на основу података из претходних 20 година (период од 2003. до 2022. године). Циљ је да се прогнозирају трендови новозасађених површина винограда, како за све сорте винове лозе, тако и за површине винограда са локалним сортама винове лозе, за период од 2023. до 2027. године. Временска серија се односи на структурирани низ посматрања. Често се структурирање врши у смислу временских интервала. Предвиђање података временских серија, или одређивање будућих трендова, један је од најважнијих циљева анализе временских серија. На основу такве анализе могуће је предвидети обим површина винограда за наредни период. ARIMA модели могу помоћи да се утврди петогодишњи тренд за податке о новозасађеним површинама винограда. Прогноза у овом раду показала је да ће се нове површине винограда са свим сортама винове лозе кретати у интервалу од око 230 до 300 хектара годишње у наредних пет година. Прогноза будуће годишње садње за исти период (2023–2027) винограда са локалним сортама винове лозе креће се у распону од свега 10 до 60 хектара. Добијени прогнозирани резултати на основу ARIMA моделовања, посебно за прогнозе засада винограда са локалним сортама винове лозе, показују да је овом проблему потребно посветити посебну пажњу и покренути бројне мере и активности како би се повећале површине винограда са локалним сортама винове лозе у Републици Србији.

КЉУЧНЕ РЕЧИ: предвиђање, виногради, локалне сорте винове лозе, ARIMA моделовање

EDITORIAL POLICY

The journal MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES is dedicated to publishing original scientific papers presenting new results of fundamental and applied research, review articles as well as brief communications from all scientific fields as referred to in the title of the journal. Review articles are published only when solicited by the editorial board of the journal. Manuscripts that have already been published in extensor or in parts or have been submitted for publication to other journal will not be accepted. The journal is issued twice a year.

The manuscripts should be written in correct English language regarding the grammar and style. The manuscripts should be submitted electronically as a separate file to vnikolic@maticasrpska.org.rs and enclosed with the author's written consent for the publishing of the manuscript.

Upon the reception of the manuscript, the author shall be assigned with a manuscript code, which has to be referred to in any further correspondence. The authors will be notified about the manuscript reception within seven days and about the reviewers' opinion within two months from submission. All submitted manuscripts are reviewed and proofread.

MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES is an Open Access journal.

Contributions to the Journal should be submitted in the English language, with an abstract also in Serbian.

MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES is available in full-text at the web site of Matica Srpska and in the following data bases: Serbian Citation Index, EBSCO Academic Search Complet, abstract level at Agris (FAO), CAB Abstracts, CABI Full-Text, Thomson Reuters Master Journal List and DOAJ (Directory of Open Access Journals).

Editorial responsibilities

The Editor-in-Chief and the Editorial Board are responsible for deciding which articles submitted to MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES will be published. The Editor-in-Chief and the Editorial Board are guided by the Editorial Policy and constrained by legal requirements in force regarding libel, copyright infringement and plagiarism.

The Editor-in-Chief reserves the right to decide not to publish submitted manuscripts in case it is found that they do not meet relevant standards concerning the content and formal aspects. The Editorial Staff will inform the authors whether the manuscript is accepted for publication within two weeks after receiving from authors manuscript revised following reviewers comments.

The Editor-in-Chief and members of Editorial Board must hold no conflict of interest with regard to the articles they consider for publication. If an Editor feels that there is likely to be a perception of a conflict of interest in relation to their handling of a submission, the selection of reviewers and all decisions on the paper shall be made by the Edittor-in-Chief.

The Editor-in-Chief and members of Editorial Board shall evaluate manuscripts for their intellectual content free from any racial, gender, sexual, religious, ethnic, or political bias.

The Editor-in-Chief and the Editorial Staff must not use unpublished materials disclosed in submitted manuscripts without the express written consent of the authors. The information and ideas presented in submitted manuscripts shall be kept confidential and must not be used for personal gain.

The Editor-in-Chief and members of Editorial Board shall take all reasonable measures to ensure that the reviewers remain anonymous to the authors before, during and after the evaluation process.

Author's responsibilities

Authors warrant that their manuscript is their original work, that it has not been published before, and is not under consideration for publication elsewhere. Parallel submission of the same paper to another journal constitutes a misconduct, and eliminates the manuscript from consideration by MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES.

The Authors also warrant that the manuscript is not and will not be published elsewhere (after the publication in MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES) in any language without the consent of the Editorial Board.

In case a submitted manuscript is a result of a research project, or its previous version has been presented at a conference in the form of an oral presentation (under the same or similar title), detailed information about the project, the conference, etc. shall be provided in Acknowledgements. A paper that has already been published in another journal cannot be reprinted in MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES.

It is the responsibility of each author to ensure that papers submitted to MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES are written with ethical standards in mind. Authors affirm that the article contains no unfounded or unlawful statements and does not violate the rights of third parties. The Publisher will not be held legally responsible should there be any claims for compensation.

Reporting standards

A submitted manuscript should contain sufficient detail and references to permit reviewers and, subsequently, readers to verify the claims presented in it. The deliberate presentation of false claims is a violation of ethical standards. Book reviews and technical papers should be accurate and they should present an objective perspective.

Authors are exclusively responsible for the contents of their submissions and must make sure that they have permission from all involved parties to make the data public.

Authors wishing to include figures, tables or other materials that have already been published elsewhere are required to be referred on the reference used, or to have permission from the copyright holder(s). Any material received without such evidence will be assumed to originate from the authors.

Authorship

Authors must make sure that only contributors who have significantly contributed to the submission are listed as authors and, conversely, that all contributors who have significantly contributed to the submission are listed as authors. If persons other than authors were involved in important aspects of the research project and the preparation of the manuscript, their contribution should be acknowledged in a footnote or the Acknowledgments section.

Acknowledgment of Sources

Authors are required to properly cite sources that have significantly influenced their research and their manuscript. Information received in a private conversation or corre-

spondence with third parties, in reviewing project applications, manuscripts and similar materials must not be used without the express written consent of the information source.

Plagiarism

Plagiarism, where someone assumes another's ideas, words, or other creative expression as one's own, is a clear violation of scientific ethics. Plagiarism may also involve a violation of copyright law, punishable by legal action.

Plagiarism includes the following:

• Word for word, or almost word for word copying, or purposely paraphrasing portions of another author's work without clearly indicating the source or marking the copied fragment (for example, using quotation marks);

• Copying equations, figures or tables from someone else's paper without properly citing the source and/or without permission from the original author or the copyright holder.

Please note that all submissions are thoroughly checked for plagiarism.

Any paper which shows obvious signs of plagiarism will be automatically rejected and those authors will not be permitted to submit papers to MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES for three years.

In case plagiarism is discovered in a paper that has already been published by the journal, it will be retracted in accordance with the procedure described below under Retraction policy, and authors will not be permitted to submit papers to MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES for three years.

Conflict of interest

Authors should disclose in their manuscript any financial or other substantive conflict of interest that might have influenced the presented results or their interpretation.

Fundamental errors in published works

In the event that an author discovers a significant error or inaccuracy in his/her own published work, it is the author's obligation to promptly notify the journal Editor or publisher and cooperate with the Editor to retract or correct the paper.

By submitting a manuscript the authors agree to abide by the MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES's Editorial Policies.

Reviewer responsibilities

Reviewers are required to provide written, competent and unbiased feedback in a timely manner on the scholarly merits and the scientific value of the manuscript.

The reviewers assess manuscript for the compliance with the profile of the journal, the relevance of the investigated topic and applied methods, the originality and scientific relevance of information presented in the manuscript, the presentation style and scholarly apparatus.

Reviewers should alert the Editor to any well-founded suspicions or the knowledge of possible violations of ethical standards by the authors. Reviewers should recognize relevant published works that have not been cited by the authors and alert the Editor to substantial similarities between a reviewed manuscript and any manuscript published or under consideration for publication elsewhere, in the event they are aware of such. Reviewers should also alert the Editor to a parallel submission of the same paper to another journal, in the event they are aware of such.

Reviewers must not have conflict of interest with respect to the research, the authors and/or the funding sources for the research. If such conflicts exist, the reviewers must report them to the Editor without delay.

Any selected referee who feels unqualified to review the research reported in a manuscript or knows that its prompt review will be impossible should notify the Editor without delay.

Reviews must be conducted objectively. Personal criticism of the author is inappropriate. Reviewers should express their views clearly with supporting arguments.

Any manuscripts received for review must be treated as confidential documents. Reviewers must not use unpublished materials disclosed in submitted manuscripts without the express written consent of the authors. The information and ideas presented in submitted manuscripts shall be kept confidential and must not be used for personal gain.

Peer review

The submitted manuscripts are subject to a peer review process. The purpose of peer review is to assists the Editor-in-Chief, Editorial Board and Consulting Editors in making editorial decisions and through the editorial communications with the author it may also assist the author in improving the paper. Scientific papers, review papers, short communications are subjected to the review process.

Reviews are anonymous (single-blind procedure), and at least one positive review should be obtained for a positive decision – acceptance of the paper after minor or major revision. In case MAJOR changes are demanded by reviewer(s), the revised version of the paper will be sent again to the reviewer(s) for their FINAL OPINION. Reviewers are not paid for their reviews.

The choice of reviewer(s) is at the discretion of the Editor-in-Chief and members of Editorial Board. The reviewers must be knowledgeable about the subject area of the manuscript; they must not be from the authors' own institution and they should not have recent joint publications with any of the authors. Editors and the Editorial Staff shall take all reasonable measures to ensure that the reviewers remain anonymous to the authors before, during and after the evaluation process.

All of the reviewers of a paper act independently and they are not aware of each other's identities. If the decisions of the two reviewers are not the same (accept/reject), the Editor may assign additional reviewers.

During the review process Editors may require authors to provide additional information (including raw data) if they are necessary for the evaluation of the scholarly merit of the manuscript. These materials shall be kept confidential and must not be used for personal gain.

The Editorial team shall ensure reasonable quality control for the reviews. With respect to reviewers whose reviews are convincingly questioned by authors, special attention will be paid to ensure that the reviews are objective and high in academic standard. When there is any doubt with regard to the objectivity of the reviews or the quality of the review, additional reviewers will be assigned.

Procedures for dealing with unethical behavior

Anyone may inform the editors and/or Editorial Staff at any time of suspected unethical behavior or any type of misconduct by giving the necessary information/evidence to start an investigation.

Investigation

• Editor-in-Chief will consult with the Subject Editors on decisions regarding the initiation of an investigation.

• During an investigation, any evidence should be treated as strictly confidential and only made available to those strictly involved in investigating.

• The accused will always be given the chance to respond to any charges made against them.

• If it is judged at the end of the investigation that misconduct has occurred, then it will be classified as either minor or serious.

Minor misconduct

Minor misconduct will be dealt directly with those involved without involving any other parties, e.g.:

• Communicating to authors/reviewers whenever a minor issue involving misunderstanding or misapplication of academic standards has occurred.

• A warning letter to an author or reviewer regarding fairly minor misconduct.

Major misconduct

The Editor-in-Chief, in consultation with the Subject, and, when appropriate, further consultation with a small group of experts should make any decision regarding the course of action to be taken using the evidence available. The possible outcomes are as follows (these can be used separately or jointly):

• Publication of a formal announcement or editorial describing the misconduct.

• Informing the author's (or reviewer's) head of department or employer of any misconduct by means of a formal letter.

• The formal, announced retraction of publications from the journal in accordance with the Retraction Policy (see below).

• A ban on submissions from an individual for a defined period.

• Referring a case to a professional organization or legal authority for further investigation and action.

When dealing with unethical behavior, the Editorial Staff will rely on the guidelines and recommendations provided by the Committee on Publication Ethics (COPE).

Retraction policy

Legal limitations of the publisher, copyright holder or author(s), infringements of professional ethical codes, such as multiple submissions, bogus claims of authorship, plagiarism, fraudulent use of data or any major misconduct require retraction of an article. Occasionally a retraction can be used to correct errors in submission or publication. The main reason for withdrawal or retraction is to correct the mistake while preserving the integrity of science; it is not to punish the author.

Standards for dealing with retractions have been developed by a number of library and scholarly bodies, and this practice has been adopted for article retraction by MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES: in the electronic version of the retraction note, a link is made to the original article. In the electronic version of the original article, a link is made to the retraction note where it is clearly stated that the article has been retracted. The original article is retained unchanged; save for a watermark on the PDF indicating on each page that it is "retracted."

Open access policy

The MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES journal is funded by Matica srpska and does not charge any fees to authorsis free of charge for authors.

Self-archiving Policy

The MATICA SRPSKA JOURNAL FOR NATURAL SCIENCES allows authors to deposit Author's Post-print (accepted version) and Publisher's version/PDF in an institutional repository and non-commercial subject-based repositories, such as arXiv or similar) or to publish it on Author's personal website (including social networking sites, such as ResearchGate, Academia.edu, etc.) and/or departmental website, at any time after publication. Full bibliographic information (authors, article title, journal title, volume, issue, pages) about the original publication must be provided and a link must be made to the article's DOI.

Disclaimer

The views expressed in the published works do not express the views of the Editors and Editorial Staff. The authors take legal and moral responsibility for the ideas expressed in the articles. Publisher shall have no liability in the event of issuance of any claims for damages. The Publisher will not be held legally responsible should there be any claims for compensation.

Articales are available in full-text at the web site of Matica Srpska, Serbian Citation Index, CABI, EBSCO, Web of Science Master Journal List, AGRIS FAO (abstracts)

INSTRUCTIONS FOR AUTHORS

1. General remarks

1.1. Matica Srpska Journal for Natural Sciences (short title: Matica Srpska J. Nat. Sci.) publishes manuscripts and review articles as well as brief communications from all scientific fields as referred to in the title of the journal. Review articles are published only when solicited by the editorial board of the journal. Manuscripts that have already been published in extenso or in parts or have been submitted for publication to other journal will not be accepted. The journal is issued twice a year.

1.2. The manuscripts should be written in correct English language regarding the grammar and style. The manuscripts should be submitted electronically as a separate file to ljdrazic@maticasrpska.org.rs and enclosed with the author's written consent for the publishing of the manuscript.

1.3. Upon the reception of the manuscript, the author shall be assigned with a manuscript code, which has to be referred to in any further correspondence. The authors will be notified about the manuscript reception within seven days and about the reviewers' opinion within two months from submission. All submitted manuscripts are reviewed and proofread.

2. Planning and preparing of the manuscript

2.1. Type the manuscripts electronically on A4 (21 × 29.5 cm) format with 2.5 cm margins, first line indent, and 1.5 line spacing. When writing the text, the authors should use Times New Roman size 12 font and when writing the abstract, key words, summary, and footnotes use font size 10.

2.2. First name, middle initial and last name should be given for all authors of the manuscript and their institutional affiliations, institution name, and mailing address. In complex organizations, a full hierarchy should be mentioned (e.g. University of Novi Sad, Faculty of Sciences – Department of Biology and Ecology). The institution of employment of each author should be stated below the author's name. The position and academic degrees should not be cited. If there is more than one author, indicate separately institutional affiliation for each of the authors. Put the name and mailing address (postal or e-mail address) of the author responsible for correspondence at the bottom of the first page. If there is more than one author, write the address of only one author, usually the first one.

2.3. Structure the text of the original articles into Abstract, Key Words, Introduction, Material or Methods, or Material and Methods, Results or Results and Discussion, Discussion, Conclusion, References, Summary and Key Words in Serbian language, and Acknowledgement (if there is one). Original articles should not be longer than 10 pages, including the references, tables, legends, and figures.

2.4. Titles should be informative and not longer than 10 words. It is in the best interest of the authors and the journal to use words in titles suitable for indexing and electronic searching of the article.

2.5. The authors should submit the title of the article with last name and the initials of the first author.

(if the article has more than one author, et al. should be used for other authors) and running title of not more than five words.

2.6. List up to 10 key words using words and phrases that describe the content of the article in the best way and that allow indexing and electronic searching of the paper. List the key words alphabetically and divided by commas.

2.7. The Abstract in English language and Summary in Serbian language should be a short and informative presentation of the article. Depending on the length of the article, the Abstract may have from 100 to 250 words. Summary written in Serbian language can be 1/10 length of the article and should contain the title of the article, first, middle initial, and last names of the authors, authors' institutional affiliation and address, and key words.

2.8. Write the information about financial support, advices, and other forms of assistance, if necessary, at the end of the article under the Acknowledgement. Financial support acknowledgement should contain the name and the number of the project, i.e. the name of the program from which the article originated, and the name of the institution that provided the financial support. In case of other forms of assistance the author should submit the first name, middle initial, last name, institutional affiliation, and the address of the person providing the assistance or the full name and the address of the assisting institution.

3. Structure the Review articles in Abstract, Key Words, Text of the manuscript, Conclusion, and References; submit Summary and Key Words in Serbian language.

4. Write brief communication according to the instructions for original articles but not be longer than five pages.

5. References

5.1. List the References alphabetically. Examples:

(a) Articles from journals: Last name CD, Last name CD (2009): Title of the article. Title of the journal (abbreviated form) 135: 122–129.

(b) Chapters in the book: Last name ED, Last name AS, Last name IP (2011): Title of the pertinent part from the book. In: Last name CA, last name IF (eds.), Title of the book, Vol.4, Publisher, City

(c) Books: Last name VG, Last name CS (2009): Title of the cited book. Publisher, City

(d) Dissertations: Last name VA (2009): Title of the thesis. Doctoral dissertation, University, City

(e) Unpublished articles: designation "in press" should be used only for papers accepted for publishing. Unpublished articles should be cited in the same way as published articles except that instead of journal volume and page numbers should write "in press" information.

(f) Articles reported at scientific meetings and published in extenso or in a summary form: Last name FR (2011): Proceedings, Name of the meeting, Meeting organizers, Venue, Country, 24–29.

(g) World Wide Web Sites and other electronic sources: Author's last name, Author's initial. (Date of publication or revision). Title, In: source in Italics, Date of access, Available from: <Available URL>. Use n.d. (no date) where no publication date is available. Where no author is available, transfer the organization behind the website or the title to the author space.

5.2. References in the text should include author's last name and the year of publishing. When there are two authors both should be cited, but in case of three or more authors, cite the first author only and follow with et al.

5.3. If two or more articles of the same author or authors published in the same year are cited, designate the publishing years with letters a, b, c, etc., both in text and reference list.

5.4. The names of the periodicals should be abbreviated according the instructions in the Bibliographic Guide for Authors and Editors (BIOSIS, Chemical Abstracts Service, and Engineering Index, Inc.).

5.5. Do not translate references to the language of the article. Write the names of cited national periodicals in their original, shortened form. For example, for the reference in Serbian language, put (Sr) at the end of the reference.

6. Units, names, abbreviations, and formulas

6.1. SI units of measurement (Système international d'unités) should be used but when necessary use other officially accepted units.

6.2. Write the names of living organisms using Italics font style.

6.3. Abbreviated form of a term should be put into parenthesis after the full name of the term first time it appears in the text.

6.4. Chemical formulas and complex equations should be drawn and prepared for photographic reproduction.

7. Figures

7.1. Authors may use black-and-white photographs and good quality drawings.

7.2. A caption with the explanation should be put below each figure.

8. Tables

8.1. Type tables on separate sheet of papers and enclosed them at the end of the manuscript.

8.2. Number the tables using Arabic numerals.

8.3. Above each table, write a capture with table explanation.

8.4. On the left margin, indicate the place of the tables in the text.

9. Electronic copy of the article

9.1. After the acceptance of the article, send a CD with final version of the manuscript and a printed copy to facilitate technical processing of the text. Articles should be written in Microsoft Word format and sent to the Editorial office of the Matica Srpska Journal for Natural Sciences, 1 Matica Srpska Street, 21000 Novi Sad (Uredništvo Zbornika Matice srpske za prirodne nauke, Matice srpske 1, 21000 Novi Sad).

9.2. Before printing, the manuscripts shall be sent to the authors for the approval of final version. Corrections of the text prepared for printing should be restricted to misspelling and printing errors as much as possible. For major changes of the text, a fee will be charged. Corrected manuscript should be returned to the Editorial office as soon as possible.

Зборник Матице српске за природне науке издаје Матица српска
Излази двапут годишње

Уредништво и администрација:
Нови Сад, Улица Матице српске 1
Телефон: (021) 6615798

Matica Srpska Journal for Natural Sciences
Published twice a year
Editorial and publishing office:
1 Matica Srpska Street, 21000 Novi Sad, Serbia
Phone: +381 21/6615798

E-mail: ljdrazic@maticasrpska.org.rs
zmspn@maticasrpska.org.rs
Website:
https://www.maticasrpska.org.rs/category/katalog-izdanja/naucni-casopisi/zbornik-matice-srpske-za-prirodne-nauke/

The editors of the *Matica Srpska Journal for Natural Sciences*
completed the selection for Issue 146 (1/2024) on February 21, 2024

For Publishers: Prof. Dragan Stanić, PhD
Editorial Staff Secretary: Ljiljana Dražić, Msr
Language editor: Ljiljana Tubić
Proof Reader: Vladimir M. Nikolić
Technical design: Vukica Tucakov

Published in Mart 2024
Computer set: Vladimir Vatić, GRAFIT, Petrovaradin
Printed by: SAJNOS, Novi Sad

Публиковање овог Зборника помогло је Министарство науке,
технолошког развоја и иновација Републике Србије

Publication of this volume was supported by the Ministry of Science,
Technological Development and Inovation of the Republic of Serbia

CIP – Каталогизација у публикацији
Библиотека Матице српске, Нови Сад

5/6(082)

ЗБОРНИК Матице српске за природне науке = Matica Srpska Journal for Natural Sciences / главни и одговорни уредник Ивана Максимовић. – 1984, св. 66– . – Нови Сад : Матица српска, Одељење за природне науке, 1984– . – 24 cm

Два пута годишње. – Наставак публикације: Зборник за природне науке. – Текст на енг. језику, резимеи на енг. и на срп. језику.

ISSN 0352-4906

COBISS.SR-ID 5845250