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First Findings of Deciduous Woody Plant Leaf Miners in Serbia

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ABSTRACT

Leaf miners are small insects from the orders Coleoptera, Diptera, Hymenoptera, and Lepidoptera. Their larvae consume the leaf mesophyll, leaving the epidermis intact. During their feeding, many species cause significant damage to plants. According to previous studies, 222 leaf miners species of leaf miners have been identified on deciduous woody plants in Serbia. As a significantly higher number of species was recorded in the fauna of neighboring countries, field research was undertaken to determine how many more species are present in Serbia. Sample collection was performed in the period from 2015 to 2021 on 107 localities in Serbia. Two hundred twenty-eight species of leaf miners, of which 65 are new to Serbian fauna, were determined by the analysis of the collected material. By summarizing the literature and own data, it was determined that 287 species of leaf miners that feed on deciduous woody plants are present in Serbia. The newly identified leaf miners were found on 49 host plant species. As the number of deciduous woody plant leaf miner species has risen by about 29% in this study, it is expected that there are even more species to be found in Serbia.

Keywords: Coleoptera, Diptera, Hymenoptera, Lepidoptera, species richness, leaf miner fauna.

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INTRODUCTION

Leaf miners are minute insects from orders Coleoptera, Diptera, Hymenoptera, and Lepidoptera (Csóka, 2003; Ellis, 2020; Hering, 1957). They got their name because their larvae live and feed within leaf tissue thus creating specific cavities - mines (Csóka, 2003; Ellis, 2020; Hering, 1957). So far, about 10000 leaf miner species have been identified in the world (Connor & Taverner, 1997), and about 2500 in Europe (Ellis, 2020).

The first data on leaf miners in Serbia were published in 1910 (Abafi-Aigner, 1910). In the period from 1910 to 1996, the research was mainly focused on individual species, so there are not many papers regarding their fauna. The biggest contribution to the study of deciduous woody plants leaf miner fauna in Serbia was made by Prof. dr Nenad Dimić who, in his papers published from 1996 to 2000, lists around 140 species (Dimić, 1996; Dimić, Mihajlović, Krnjajić, Perić, & Cvetković, 1998; Dimić, Graora, Magud, & Perić,1999; Dimić, Perić, & Cvetković, 2000; Dimić, Perić, & Vukša, 2000). The previous research on deciduous woody plant leaf miners in Serbia was mainly focused on agriculture and forestry pests and invasive species (Ciglar, 1981; Dulić & Injac, 1981, 1982; Injac & Dulić, 1981; Marković & Stojanović, 2012; Marković, Kanjevac, Perišić, & Dobrosavljević, 2024; Pagliarini & Spasić, 1984; Poljaković-Pajnik, Drekić, Kovačević, & Vasić, 2012; Simonović & Gaora, 2020; Stojanović & Marković, 2004, 2005; Tosevski et al, 2011; Živanović, 1967). This trend has been maintained even today because many species became significant with the processes of climate change and globalization (Bale et al, 2002; Jaworski & Hilszczański, 2013; Kirichenko, Augustin, & Kenis, 2019; Roques et al, 2015; Skendžić, Zovko, Živković, Lešić, & Lemić, 2021). Before this study, 222 species of leaf miners that feed on deciduous woody plant have been identified in Serbia (Dobrosavljević & Marković, 2017; Dobrosavljevic, Markovic, & Bojic, 2017; Dobrosavljević, Marković, & Marjanović, 2023; Dobrosavljević, Marković, Marjanović, & Milanović, 2020; Drekić et al, 2016; Jović, 2005; Marković, Dobrosavljević, Vujičić, & Cebeci, 2021; Pešić, 1997, 2012; Simonović & Gaora, 2020; Stanković, Žikić, & Ilić, 2010; Tomić, Žujović, Karadžić, Milijašević, & Glavendekić, 1992). Compared to the neighbouring countries such as Bosnia and Herzegovina, and Slovenia (respectively 253 and 356 species (Dimić, 2003; Maček, 1999), a relatively low number of deciduous woody plant leaf miner species has been recorded in Serbia. That is why this study to determine how many, and which species are present in Serbia was conducted.

MATERIAL AND METHODS

Firstly, the literature regarding leaf miners in Serbia was collected and analyzed to determine which species have been identified previously. After that, the fieldwork was conducted on 107 randomly selected localities in Serbia (Table 1). Randomly selected leaves with mines were collected from the infested trees at each locality. The collected material was packed into plastic bags and transported to the Entomological laboratory of the Faculty of Forestry, University of Belgrade. Where it was possible,

mines were immediately used for species identification. After identification, they were herbarized and deposited in the collection of the Chair of Forest Protection of the Faculty of Forestry, University of Belgrade. A part of the mines with insect material in them was dissected, and the larvae or pupae present in them were extracted and deposited in 70% alcohol. The rest of the mines were used for rearing adult leaf miners. Rearing was conducted in Petri dishes, where the petioles of the leaves with mines were wrapped up in moist wadding and kept at room temperature until eclosion. The reared adults were prepared using standardized entomological methods and were deposited to the collection of the Chair of Forest Protection of the Faculty of Forestry, University of Belgrade. The fieldwork was conducted in the period from 2015 to 2022. Identification of the leaf miners was performed by Jovan Dobrosavljević by using the papers: (Csóka, 2003; Digweed et al, 2009; Doorenweerd, Van Haren, Schermer, Pieterse, & Van Nieukerken, 2014; Ellis, 2020; Haarder & Liston, 2018; Hering, 1951, 1957; Kimber, 2021; Koštál & Caldara, 2013; Langmaid, 2019; Laštůvka & Laštůvka, 2014; Laštůvka, Laštůvka, Liška, & Šumpich, 2018; Lepiforum, 2019; Liston, 1994; Liston, Luzern, & Liston, 1993, Liston, Mutanen, & Viitasaari, 2019; Liston, 1993, 2007; Needham, Frost, & Tothill, 1928; Patočka & Turčani, 2005; Smith, 1989; Spencer, 1972; Triberti, 2007; van Nieukerken, 1985; Van Nieukerken et al, 2018; Van Nieukerken & Johansson, 2003; Wheeler, 2021), based on the characteristics of the mines, eggs, larvae, pupae, cocoons, larval cases and adult insects. Leaf miners were classified by the nomenclature of de Jong et al (2014), Ellis (2020); GBIF.org (2023). The following abbreviations are used when listing the identified species of leaf miners: MI - mine, LA - larva, PU - pupa, MLA - mine with larva, MPU - mine with pupa, CO - cocoon, AD - adult, LCA - larval case.

Table 1. Investigated localities with coordinates of their midpoints and elevation at those midpoints.

Location	Locality	Coordinates		Elevation (m)
		N	E	
Aleksinac	Porodin	43°24'15"	21°35'32"	370
Mt Avala	Pinosava	44°41'45"	20°30'27"	380
Bajina Bašta	Lug	43°57'41"	19°33'6"	335
Bajina Bašta	Ovčinja	44°4'41"	19°39'51"	900
Bajina Bašta	Višesava	43°57'48"	19°33'41"	290
Barajevo	Lipovica forest	44°38'11"	20°23'38"	250
Batočina	Rogot	44° 8'40"	21° 5'30"	110
Belgrade	Ada Ciganlija	44°47'21"	20°23'53"	75
Belgrade	Faculty of Forestry Arboretum	44°46'56"	20°25'32"	110
Belgrade	Bajford Forest	44°45'58"	20°28'32"	175
Belgrade	Bele vode	44°44'57"	20°24'40"	140
Belgrade	Hajdučka česma	44°45'57"	20°26'8"	135
Belgrade	Jajinci Memorial Park	44°43'52"	20°29'19"	220
Belgrade	Košutnjak	44°46'19"	20°25'55"	195
Belgrade	Košutnjak - Pionirski grad	44°45'37"	20°26'18"	185
Belgrade	Košutnjak - Repište	44°45'46"	20°25'30"	185
Belgrade	Košutnjak - Trim track	44°45'57"	20°25'52"	200
Belgrade	New Belgrade	44°48'36"	20°25'2"	75
Belgrade	Ostružnica - embankment	44°44'24"	20°18'37"	70
Belgrade	Topčider Park	44°46'54"	20°26'24"	80

table continued

Location	Locality	Coordinates		Elevation (m)
		N	E	
Belgrade	Trešnja	44°36'24"	20°34'14"	250
Belgrade	Great War Island	44°49'59"	20°25'48"	75
Bor	Brestovačka banja	44° 3'35"	22°2'39"	350
Mt Crni vrh	Gornje Komarice - Drenak	44°0'34"	21°3'18"	530
Mt Crni vrh	Gornje Štiplje	44°0'46"	21° 6'23"	600
Mt Crni vrh	Kalenovac	43°59'59"	21°8'7"	400
Mt Crni vrh	Mišević	43°58'54"	21° 3'42"	510
Debeli lug	Center	44°22'5"	21°54'40"	300
Debeli lug	Todorova reka	44°21'27"	21°53'5"	450
Despotovac	Obložine	44°7'9"	21°26'14"	250
Despotovac	Vrbaci	44° 6'39"	21°26'0"	180
Đjake	Đavolja varoš	42°59'32"	21°23'51"	700
Mt Fruška Gora	Crveni čot	45°9'3"	19°42'39"	530
Mt Fruška Gora	Grgeteg	45° 8'22"	19°54'1"	300
Mt Fruška Gora	Iriški venac	45°9'0"	19°49'48"	450
Mt Fruška Gora	Ledinci lake	45° 9'50"	19°48'14"	365
Mt Fruška Gora	Ležimir	45°7'51"	19°34'25"	230
Mt Fruška Gora	Stražilovo - Branko's grave	45°9'59"	19°54'49"	300
Mt Fruška Gora	Zmajevac	45°9'25"	19°46'48"	420
Mt Goč	Cvetne livade	43°33'39"	20°44'20"	885
Mt Goč	Gvozdac	43°33'33"	20°45'10"	875
Mt Goč	Kamenica	43°35'7"	20°41'7"	650
Mt Goč	Brezna	43°33'22"	20°44'55"	855
Jagodina	Ćelijan	43°56'30"	21°14'38"	200
Jagodina	Đurđevo hill	43°57'50"	21°16'1"	150
Jagodina	City Park	43°58'51"	21°15'43"	120
Jagodina	Industrial zone	43°58'53"	21°16'20"	115
Jagodina	Ribare	44°1'28"	21°18'9"	110
Jagodina	Trnava	43°57'43"	21°15'9"	125
Jagodina	Trnava - Ćelijan	43°57'21"	21°15'29"	150
Jastrebac	Klisurica	43°21'29"	21°34'34"	670
Jastrebac	Ribarska Banja	43°25'24"	21°30'7"	620
Mt Juhor	Kolare	43°52'40"	21°16'5"	600
Mt Kablar	Summit	43°54'45"	20°11'31"	830
Kalna	Bigar	43°21'16"	22°26'33"	470
Mt Kopaonik	Crna Glava	43°22'40"	20°47'0"	830
Mt Kopaonik	Jošanička Banja - Đorov most	43°21'57"	20°44'14"	700
Mt Kopaonik	Jošanička Banja - Velež	43°23'2"	20°44'59"	580
Mt Kopaonik	Kadijevac	43°19'16"	20°45'44"	1425
Kučevo	Mišljenovac	44°32'53"	21°34'35"	120
Kučevo	Kučajna - Fatovi	44°26'25"	21°36'37"	400
Kučevo	Ravnište	44°25'48"	21°37'15"	370
Kučevo	Ravnište - Krst	44°25'20"	21°36'53"	520
Kupinovo	Kupinske grede	44°42'33"	20°0'55"	70
Kuršumlija	Rudare	43°3'39"	21°19'6"	385
Lazar's Canyon	Zlot	44°1'33"	21°56'7"	700
Majdanpek	Avion	44°28'18"	22°0'31"	670
Majdanpek	Bunari	44°21'20"	21°58'6"	480
Majdanpek	Rajkovo	44°26'28"	21°58'9"	530
Majdanpek	Ravna reka	44°24'50"	21°59'11"	470

table continued

Location	Locality	Coordinates		Elevation (m)
		N	E	
Majdanpek	Starica	44°26'25"	21°55'50"	700
Majdanpek	Ujevac	44°25'17"	21°52'20"	390
Majdanpek	Valja Lupjaska	44°26'47"	21°57'20"	520
Majdanpek	Valja Prerast	44°21'47"	21°59'34"	310
Majdanpek	Veliki Zaton	44°26'23"	21°56'43"	460
Mladenovac	Kovačevac	44°26'10"	20°43'18"	210
Niš	Čegar	43°21'56"	21°56'34"	350
Obrenovac	Crni lug	44°42'17"	20°12'25"	80
Obrenovac	Mislođin	44°39'16"	20°12'49"	75
Odžaci	Deronje - Branjevina	45°26'56"	19°11'34"	80
Paraćin	Center	43°52'5"	21°24'19"	130
Progar	Bojčin Forest	44°44'16"	20°8'52"	80
Prokuplje	Borovnjak	43°14'11"	21°34'57"	350
Prokuplje	Džigolj	43°20'28"	21°33'37"	535
Prokuplje	Hisar	43°13'37"	21°34'48"	320
Prokuplje	Rastovnica	43°12'39"	21°36'16"	300
Prolom Banja	Center	43° 2'36"	21°24'7"	600
Mt Rtanj	Mt Rtanj	43°46'18"	21°54'0"	900
Sićevo Gorge	Sićevo	43°20'20"	22° 5'40"	400
Mt Stara planina	Babin zub	43°22'34"	22°37'7"	1400
Mt Stara planina	Ćuštica	43°22'22"	22°33'5"	930
Mt Stara planina	Dejanovac	43°30'23"	22°24'46"	795
Mt Stara planina	Golema reka	43°24'55"	22°38'38"	1330
Mt Stara planina	Jabučko ravnište	43°21'56"	22°35'14"	1470
Mt Stara planina	Mali Izvor	43°44'23"	22°23'45"	850
Mt Stara planina	Suvodol Monastery	43°41'59"	22°21'11"	390
Mt Stara planina	Ošljane	43°39'21"	22°21'34"	300
Mt Stara planina	Radičevac - Kruška	43°35'54"	22°27'44"	1050
Mt Stara planina	Radičevac - Rasovati kamen	43°36'37"	22°29'20"	830
Mt Stara planina	Selačka	43°41'55"	22°23'40"	770
Mt Stara planina	Tatrasnica	43°28'40"	22°31'18"	1150
Svilajnac	Grabovac	44°11'49"	21°16'3"	130
Mt Tara	Predov krst	43°56'28"	19°18'35"	1080
Valjevo	Mijači	44°12'42"	19°42'56"	400
Valjevo	Tubravić	44°11'52"	19°43'6"	705
Velika plana	Novo Selo	44°16'5"	21° 5'14"	105
Zarožje	Pašina ravan	44°8'89"	19°39'56"	925

RESULTS

After analyzing the collected material, 228 deciduous woody plant leaf miner species from 4 orders, 17 families, and 48 genera, were identified. Among the identified species, 65 are the first findings for Serbian fauna. Most of the newly discovered species for Serbian fauna belong to the order Lepidoptera (48), respectively to the families Nepticulidae (15), Gracillariidae (13), Coleophoridae (8), Heliozelidae (3), Eriocraniidae (2), Incurvariidae (2), Tortricidae (2), Bucculatricidae (1), Lyonetiidae (1) and Yponoumetidae (1). All the species from the order Hymenoptera belong to the family Tenthredinidae (7), from the order Diptera to the family Agromyzidae (7),

and from the order Coleoptera to the family Curculionidae (3). These species were identified on 49 host plant species from 16 families and 10 orders. Most of them were identified on the plants from the orders Fagales (27), Rosales (21), and Malphighiales (6); on the plants from families Betulaceae (22), Rosaceae (15), and Salicacea (6); and from genera *Betula* (10), *Alnus* (6), *Corylus* (4), and *Salix* (3).

Order Coleoptera

Family Curculionidae

Anoplus plantaris (Naezen,1794)

Distribution in Europe: Great Britain, France, Italy, Germany, Poland, Russia, Slovakia (Alonso-Zarazaga, 2022).

Material examined: Mt Goč: Kamenica 22.05.2016. *Betula pendula*, Roth. 1MI, 1LA, 2MLA.

Orchestes betuleti (Panzer, 1795)

Distribution in Europe: Bulgaria, France, Italy, Moldavia, Germany, Poland, Russia, Slovakia, Slovenia, Sweden, Ukraine (Alonso-Zarazaga, 2022).

Material examined: Belgrade: Bajford Forest 29.04.2016. *Ulmus minor* Mill. 1MI, 1AD.

Orchestes calceatus Schoenherr, 1835

Distribution in Europe: North, West, Central and Eastern Europe, Italy, Greece (Koštál & Caldara, 2013).

Material examined: Jagodina: Trnava 15.05.2020. *Betula pendula,* 1AD.

Order Diptera

Family Agromyzidae

Agromyza alnivora Spencer, 1969

Distribution in Europe: Austria, British Islands, Czech Republic, Denmark, Finland, France, Germany, Lithuania, Norway, Poland, Romania, Slovakia, Sweden, The Netherlands (Pape & Beuk, 2022).

Material examined: Mt Kopaonik: Crna glava 27.06.2016. *Alnus glutinosa* (L.) Gaertn 1MI; Bajina Bašta: Ovčinja 21.07.2016. *A. glutinosa* 3MI, 1MLA; Debeli lug: Center 25.07.2016. *A. glutinosa* 3MI; Kalna: Bigar 15.09.2018. *A. glutinosa* 1MI.

Agromyza idaeiana Hardy, 1853

Distribution in Europe: Austria, Belgium, British Islands, Czech Republic, Denmark, East Palearctic, Estonia, Finland, France, Germany, Hungary, Ireland, Lithuania, Nearctic region, Norway, Oriental region, Poland, Romania, Sardinia, Slovakia, Spain, Sweden, The Netherlands (Pape & Beuk, 2022).

Material examined: Mt Kopaonik: Kadijevac 27.06.2016. *Rubus idaeus*, L. 3MI, 2MLA, 1MPU; Mt Stara planina: Babin zub 21.07.2017. *R. idaeus* 7MI, 4MLA, 21.08.2018. *R. idaeus* 1MI; Tatrasnica 31.08.2017. *R. idaeus* 4MI, 1MLA; Jabučko ravnište 23.08.2018. *R. idaeus* 1MI.

Agromyza spiraeoidearum Hering, 1954

Distribution in Europe: Czech Republic, East Palaearctic, Germany, Lithuania, Nearctic region, Norwegian mainland, Oriental region, Poland, Slovakia, Sweden, The Netherlands (Pape & Beuk, 2022).

Material examined: Mt Stara planina: Radičevac - Kruška 14.09.2018. *Spiraea chamaedryfolia*, L. 8MI, 1LA.

Amauromyza fraxini (Beiger, 1980)

Distribution in Europe: Bulgaria, France, Italy, Moldavia, Romania (Ellis, 2020; Pape & Beuk, 2022).

Material examined: Mladenovac: Kovačevac 05.08.2016. *Fraxinus angustifolia*, Vahl. 26MI; Velika plana: Novo Selo 05.08.2016. *F. angustifolia* 2MI; Jagodina: **Đurđevo** hill 06.08.2016. *F. angustifolia* 2MI; Svilajnac: Grabovac 07.08.2016. *F. excelsior*, L. 1MI; Batočina: Rogot 21.06.2018. *F. excelsior* 3MI; Belgrade: Ada Ciganlija 13.10.2018. *F. angustifolia* 21MI.

Aulagromyza cornigera (Griffiths, 1973)

Distribution in Europe: British Islands, France, Germany, Nearctic region, Poland, Spain, The Netherlands (Pape & Beuk, 2022).

Material examined: Mt Rtanj: Mt Rtanj 02.06.2018. *Lonicera xylosteum*, L. 20MI, 2LA, 4MLA, 1MPU; Belgrade: Faculty of Forestry Arboretum 17.04.2020. *L. purpusii*, Rehder, 8MI, 1LA, *L. xylosteum* 8MI, 1LA, 2PU; Košutnjak 21.04.2020. *L. xylosteum* 3MI, 1CO.

Aulagromyza hendeliana Hering, 1926

Distribution in Europe: British Islands, Denmark, Finland, France, Germany, Ireland, Lithuania, Norway, Oriental region, Poland, Spain, Sweden, Switzerland, The Netherlands (Pape & Beuk, 2022).

Material examined: Belgrade: Košutnjak 07.06.2017. *Lonicera xylosteum* 4MI, 2LA, 1PU; Faculty of Forestry Arboretum 17.04.2020. *L. xylosteum* 3MI, 1LA.

Aulagromyza tremulae (Hering, 1955)

Distribution in Europe: British Islands, Denmark, Germany, Ireland, Lithuania, Norway, Poland (Pape & Beuk, 2022).

Material examined: Majdanpek: Rajkovo 04.06.2015. *Populus tremula* L. 1MI; Prolom Banja: Center 17.08.2016. *P. tremula* 2MI; Mt Crni vrh: Mišević 18.09.2016. *P. tremula* 1MI; Gornje Komarice - Drenak 18.09.2016. *P. tremula* 5MI.

Order Hymenoptera

Family Tenthredinidae

Fenusa altenhoferi (Liston, 1993)

Distribution in Europe: Austria, Germany, Switzerland, Italy, British Islands (Taeger, Blank, & Liston, 2006; van Achterberg, 2022).

Material examined: Belgrade: Faculty of Forestry Arboretum 21.04.2016. *Ulmus minor* 1MI, 1LA; Košutnjak 25.04.2016. *U. minor* 1MI, 24.04.2017. *U. minor* 6MI, 2MLA, 21.05.2018. *U. minor* 8MI,

21.04.2020. *U. minor* 04.05.2020. *U. minor* 50MI, 9LA, 17MLA, 15.05.2020. *U. minor* 11MI; Košutnjak - Trim track 11.05.2016. *U. minor* 5MI, 1LA, 1MLA; Košutnjak - Repište 29.05.2016. *U. minor* 1MI, 1LA; Ada Ciganlija 25.04.2017. *U. minor* 18MI, 4LA, 11MLA, 17.05.2020. *U. minor* 7MI; Hajdučka česma 11.06.2017. *U. laevis* Pall. 1MI; Topčider Park 21.05.2018. *U. minor* 3MI; New Belgrade 30.05.2018. *U. pumila*, L. 11MI, 2MLA; Jagodina: Trnava - Ćelijan 06.08.2016. *U. minor* 1MI; Ćelijan 02.09.2018. *U. minor* 3MI; Prokuplje: Borovnjak 13.08.2016. *U. minor* 3MI; Jastrebac Klisurica 14.08.2016. *U. minor* 2MI; Despotovac: Obložine 22.04.2018. *U. minor* 5MI; Batočina: Rogot 17.05.2018. *U. minor* 2MI, 1LA; Odžaci: Deronje - Branjevina 18.05.2018. *U. minor* 4MI; Mt Stara planina: Suvodol Monastery 23.05.2018. *U. minor* 1MI; Selačka 23.05.2018. *U. minor* 3MI; Mt Fruška Gora: Iriški venac 15.06.2018. *U. glabra* Huds. 2MI; Niš: Čegar 08.07.2019. *U. minor* 2MI.

Fenusa dohrnii (Tischbein, 1846)

Distribution in Europe: Austria, Belgium, British Islands, Bulgaria, Central European Russia, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Luxembourg, Nearctic region, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, The Netherlands, Ukraine (van Achterberg, 2022).

Material examined: Mt Kopaonik: Jošanička Banja - Velež 27.06.2016. *Alnus glutinosa* 10MI, 1LA, 4MLA; Bajina Bašta: Ovčinja 21.07.2016. *A. glutinosa* 2MI; Debeli lug: Center 25.07.2016. *A. glutinosa* 7MI, 1LA, 1MLA; Todorova reka 26.07.2016. *A. glutinosa* 5MI, 1LA, 1MLA; Prokuplje: Rastovnica 16.08.2016. *A. glutinosa* 3MI; Đjake: Đavolja varoš 17.08.2016. *A. glutinosa* 5MI; Prolom Banja: Center 17.08.2016. *A. glutinosa* 2MI; Belgrade: Topčider Park 01.10.2016. *A. glutinosa* 3MI, 2MLA, 21.05.2018. *A. glutinosa* 1MI; Majdanpek: Valja Prerast 13.07.2017. *A. glutinosa* 5MI, 2MLA; Bor: Brestovačka banja 10.07.2018. *A. glutinosa* 1MI.

Fenusella glaucopis (Konow, 1907)

Distribution in Europe: Belgium, British Islands, Central European Russia, Croatia, Czech Republic, Finland, France, Germany, Italy, Poland, Sweden (van Achterberg, 2022).

Material examined: Majdanpek: Rajkovo 04.06.2015. *Populus tremula* 5MI, 1MLA; Belgrade: Košutnjak - Repište 22.04.2016. *P. alba* L. 9MI, 1LA, 2MLA; Ada Ciganlija 13.05.2016. *P. alba* 3MI; Faculty of Forestry Arboretum 21.04.2017. *P. x canescens*, Sm., 1MI, 16.05.2018. *P. tremula* 1MI; Košutnjak 24.04.2020. *P. alba* 8MI, 5LA, 3MLA; Mt Goč: Brezna 23.05.2016. *P. tremula* 11MI, 2LA, 6MLA; Đjake: Đavolja varoš 17.08.2016. *P. tremula* 1MI; Mt Rtanj: Mt Rtanj 02.06.2018. *P. tremula* 1MI.

Heterarthrus nemoratus (Fallén, 1808)

Distribution in Europe: Austria, Belgium, British Islands, Czech Republic, Estonia, Finland, France, Germany, Ireland, Kaliningrad Region, Latvia, Poland, Romania, Sweden, Switzerland, The Netherlands, Ukraine (van Achterberg, 2022)

Material examined: Mt Kopaonik: Kadijevac 27.06.2016. *Betula pendula* 1MI, 1LA.

Hinatara excisa (Konow, 1885)

Distribution in Europe: Belgium, Germany, Czechia, Switzerland, Austria (Ellis, 2020; van Achterberg, 2022).

Material examined: Mt Goč: Brezna 23.05.2016. *Acer pseudoplatanus* L. 5MI, 1LA, 2MLA; Cvetne livade 07.05.2018. *A. pseudoplatanus* 10MI, 3LA; 21.06.2019. *A. pseudoplatanus* 1MI; Mt Rtanj: Mt Rtanj 02.06.2018. *A. pseudoplatanus* 2MI; Lazar's Canyon: Zlot 10.07.2018. *A. monspessulanum* L. 4MI, 1LA.

Metallus albipes (Cameron, 1875)

Distribution in Europe: Austria, British Islands, Central European Russia, Czech Republic, Estonia, Finland, Germany, Hungary, Italy, Poland, Sweden, The Netherlands (van Achterberg, 2022).

Material examined: Mt Tara: Predov krst 21.07.2016. *Rubus idaeus* 3MI, 2LA, 1MLA; Mt Stara planina: **Ćuštica** 18.07.2017. *R. idaeus* 1MI, 1LA.

Parna apicalis (Brischke, 1888)

Distribution in Europe: From Finland and Poland to Britain, the Pyrenees and Alps (Ellis, 2020).

Material examined: Belgrade: Jajinci Memorial Park 10.05.2015. *Tilia tomentosa* Moench. 4MI, 16.05.2016. *T. tomentosa* 1MI, 12.04.2017. *T. tomentosa* 2MI, 2LA, 17.04.2017. *T. tomentosa* 3MI, 2LA, 24.04.2017. *T. tomentosa* 6MI, 1LA; Košutnjak 12.04.2016. *T. tomentosa* 1MI, 22.04.2016. *T. tomentosa* 1MI, 25.04.2016. *T. tomentosa* 6MI, 21.05.2018. *T. tomentosa* 7MI, 17.04.2020. *T. tomentosa* 1MI, 1MLA, 21.04.2020. *T. tomentosa* 3MI, 1LA; 22.04.2016. *T. platyphyllos* Scop. 1MI, 21.05.2018. *T. platyphyllos* 2MI, 28.04.2019. *T. platyphyllos* 1MI, 21.04.2020. *T. platyphyllos* 3MI, 1LA, 21.05.2018. *T. cordata* Mill. 1MI; Bajford Forest 17.06.2016. *T. platyphyllos* 1MI; Faculty of Forestry Arboretum 21.04.2018. *T. cordata* 10MI, 7LA, 3MLA; Topčider Park 21.05.2018. *T. tomentosa* 1MI; Mt Juhor: Kolare 30.04.2016. *T. tomentosa* 3MI; Mt Goč: Kamenica 22.05.2016. *T. platyphyllos*1MI, 1MLA; Brezna 23.05.2016. *T. tomentosa* 2MI, 2MLA; Mt Rtanj: Mt Rtanj 02.06.2018. *T. tomentosa* 1MI, *T. platyphyllos* 3MI; Bor: Brestovačka banja 10.07.2018. *T. tomentosa* 1MI, 1MLA.

Order Lepidoptera

Family Bucculatricidae

Bucculatrix cidarella (Zeller, 1839)

Distribution in Europe: Austria, Belarus, Belgium, British Islands, Central European Russia, Croatia, Czech Republic, Denmark, East European Russia, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Kaliningrad Region, Latvia, Lithuania, Macedonia (former Yugoslav Republic), Northwest European Russia, Norway, Poland, Romania, Slovakia, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Mt Kopaonik: Crna glava 27.06.2016. *Alnus glutinosa* 11MI; Mt Kopaonik: Jošanička Banja - Velež 27.06.2016. *A. glutinosa* 15MI; Prokuplje: Rastovnica 16.08.2016. *A. glutinosa* 2MI.

Family Coleophoridae

Coleophora adjectella Hering, 1937

Distribution in Europe: Austria, British Islands, Czech Republic, Denmark France, Germany, Greece, Italy, Near East, Norway, Poland, Sardinia, Sicily, Slovakia, Spanish mainland, Sweden (van Karsholt & Nieukerken, 2022).

Material examined: Mt Goč: Brezna, 23.05.2016., *Prunus domestica* L. 16MI, 1LA, 1LCA; Svilajnac: Grabovac, 07.08.2016., *P. domestica*, 1MI, 1LCA.

Coleophora ahenella Heinemann, 1877

Distribution in Europe: Austria, Belgium, British Islands, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Norway, Poland, Portugal, Romania, Slovakia, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Mt Rtanj: Mt Rtanj, 02.06.2018., *Viburnum lantana* L., 7MI.

Coleophora badiipennella (Duponchel, 1843)

Distribution in Europe: Austria, Belgium, British Islands, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Italy, Latvia, Near East, Nearctic region, Norway, Poland, Portugal, Romania, Slovakia, South European Russia, Spain, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Barajevo: Lipovica forest 17.04.2016. *Ulmus minor* 1MI, 1LCA; Mt Fruška Gora: Ležimir 15.07.2016. *U. minor* 3MI, 2LCA; Kučevo: Mišljenovac 25.07.2016. *U. minor* 3MI, 1LCA; Mt Crni vrh: Gornje Komarice - Drenak 18.09.2016. *U. minor* 9MI, 1LCA; Mt Goč: Gvozdac 07.05.2017. *C. avellana* 4MI, 1LCA.

Coleophora currucipennella Zeller, 1839

Distribution in Europe: Austria, Belgium, British islands, Central European Russia, Croatia, Czech Republic, Denmark, East Palearctic, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Macedonia, (former Yugoslav Republic), Near East, North European Russia, Norway, Poland, Romania, Slovakia, Slovenia, South European Russia, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Mt Kopaonik: Jošanička Banja - Đorov most 27.06.2016. *Corylus avellana* L. 48MI, 1LCA; Mt Stara planina: Selačka 23.05.2018. *Fagus sylvatica* L. 1AD, 1LCA; Mali Izvor 22.08.2018. *F. sylvatica* 3LCA.

C. orbitella Zeller, 1849

Distribution in Europe: Austria, Belgium, British islands, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, North European Russia, Norway, Poland, Slovakia, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Trešnja 11.10.2016. *Carpinus betulus* L. 6MI, 1AD, 1LCA.

Coleophora potentillae Elisha, 1885

Distribution in Europe: Belgium, British Islands, Czech Republic, Denmark, Estonia, Finland, France, Ireland, Latvia, Norway, Poland, Sweden, The Netherlands, Ukraine, Germany (van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Košutnjak 04.07.2016. *Spiraea vanhouttei* (Briot) Zabel 6MI, 1LCA.

Coleophora spinella (Schrank, 1802)

Distribution in Europe: Austria, Belgium, British Islands, Central European Russia, Croatia, Czech Republic, Denmark, East Palearctic, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Lithuania, Near East, Nearctic region, Norway, Poland, Romania, Slovakia, South European Russia, Spain, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Mt Goč: Kamenica 22.05.2016. *Prunus avium* (L.) L. 3MI, 1AD, 1LCA; 09.05.2017. *P. domestica* 41MI, 1AD, 7LCA; Despotovac: Obložine 15.04.2018. *Crataegus monogyna* Jacq. 34MI, 1LCA.

Coleophora spiraeella Rebel, 1916

Distribution in Europe: Austria, Czech Republic, Germany, Hungary, Italy, Poland, Romania, Slovakia, Slovenia (Ellis, 2020; van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Ada Ciganlija 27.07.2016. *Spiraea vanhouttei* 8MI, 2LCA; Jagodina: City Park 06.08.2016. *S. vanhouttei* 7MI, 1LCA.

Family Eriocraniidae

Eriocrania semipurpurella (Stephens, 1835)

Distribution in Europe: Austria, Belarus, Belgium, British Islands, Central European Russia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Kaliningrad Region, Latvia, Lithuania, Luxembourg, North European Russia, Northwest European Russia, Norway, Poland, Romania, Slovakia, South European Russia, Spain, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Mt Goč: Gvozdac 08.05.2017. *Betula pendula* 3MI, 1LA, 2MLA; Kamenica 09.05.2017. *B. pendula* 1MI.

Paracrania chrysolepidella (Zeller, 1851)

Distribution in Europe: Austria, Belgium, British Islands, Czech Republic, Denmark, Estonia, France, Germany, Ireland, Italy, Latvia, North European Russia, Poland, Romania, Sweden, Switzerland (van Karsholt & Nieukerken, 2022).

Material examined: Majdanpek: Valja Lupjaska 17.05.2015. *Carpinus betulus* 2MI; Jagodina: Trnava 29.05.2018. *Corylus colurna* L. 1MI; Barajevo: Lipovica forest 11.05.2019. *C. betulus* 1MI.

Family Gracillariidae

Caloptilia elongella (Linnaeus, 1761)

Distribution in Europe: Albania, Austria, Belgium, Bosnia and Herzegovina, British Islands, Bulgaria, Central European Russia, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Near East, Nearctic region, North European Russia, Northern Ireland, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Bajina Bašta: Ovčinja 21.07.2016. *Alnus glutinosa* 1MI; Debeli lug: Center 25.07.2016. *A. glutinosa* 1MI; Prokuplje: Rastovnica 16.08.2016. *A. glutinosa* 1MI.

Chylopoetic robustella Jäckh, 1972

Distribution in Europe: Austria, Belgium, British Islands, Central European Russia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Obrenovac: Crni lug 09.06.2016. *Quercus robur* L. 1MI; Batočina: Rogot 17.05.2018. *Q. robur* 2MI, 07.06.2018. *Q. robur* 3MI, 1PU, 1AD; Belgrade: Košutnjak 21.05.2018. *Q. robur* 2MI.

Phyllocnistis extrematrix Martynova, 1955

Distribution in Europe: France, Czech Republic, East European Russia, Slovakia, Romania, South European Russia (Ellis, 2020; van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Great War Island 08.07.2016. *Populus nigra* L. 1MI, 4PU; Ostružnica - embankment 27.07.2019. *P. nigra* 3MI, 2MPU; Despotovac: Vrbaci 07.08.2016. *P. nigra* 1MI; Obrenovac: Mislođin 28.06.2019. *P. nigra* 2MI, 1MPU; Jagodina: Industrial zone 30.06.2019. *P. nigra* 1MI, 1MPU; Ribare 26.08.2019. *P. nigra* 2MI, 1MPU.

Phyllocnistis ramulicola Langmaid & Corley, 2007

Distribution in Europe: British Islands, Czech Republic, Italy, Portugal, Spain, Switzerland (Ellis, 2020; van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Ada Ciganlija 27.07.2016. *Salix alba* L. 1MI; Valjevo: Tubravić 15.09.2016. *S. fragilis* L. 1MI; Belgrade: Trešnja 11.10.2016. *S. fragilis* 1MI.

Phyllocnistis valentinensis M. Hering, 1936

Distribution in Europe: Austria, Belgium, Bulgaria, Germany, Greece, Near East, Spain, The Netherlands (Ellis, 2020; van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Great War Island 05.07.2016. *Salix alba* 2MI, *S. fragilis* 1MI, 08.07.2016. *S. alba* 11MI, 1PU, 1MCO; Kučevo: Mišljenovac 25.07.2016. *S. fragilis* 5MI, 1MPU, 2MCO; Mladenovac: Kovačevac 05.08.2016. *S. alba* 4MI, 1MPU, 1MCO, *S. fragilis* 2MI; Despotovac: Vrbaci 07.08.2016. *S. alba* 7MI, 1PU; Obložine 06.08.2017. *S. alba* 1MI, *S. purpurea* L. 2MI, 1MPU; Valjevo: Tubravić 15.09.2016. *S. fragilis* 6MI.

Phyllonorycter acaciella (Duponchel, 1843)

Distribution in Europe: Austria, Bulgaria, Czech Republic, France, Hungary, Italy, Moldova, Near East, Slovakia, South European Russia (van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Košutnjak 21.05.2018. *Ulmus minor* 2MI, 1PU, 1MCO.

Phyllonorycter connexella (Zeller, 1846)

Distribution in Europe: Austria, Central European Russia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Near

East, Northwest European Russia, Poland, Slovakia, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Debeli lug: Center 25.07.2016. *Salix fragilis* 1MI; Kučevo: Mišljenovac 25.07.2016. *P. nigra* 2MI; Aleksinac: Porodin 14.08.2016. *S. fragilis* 1MI, 1PU.

Phyllonorycter coryli (Nicelli, 1851)

Distribution in Europe: Austria, Belarus, Belgium, British Islands, Bulgaria, Central European Russia, Croatia, Czech Republic, Denmark, East European Russia, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Moldova, Near East, Northern Ireland, Northwest European Russia, Norway, Poland, Romania, Slovakia, Slovenia, South European Russia, Spain, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Majdanpek: Starica 04.06.2015. *Corylus avellana* 1MI; Veliki Zaton 09.06.2015. *C. avellana* 3MI, 1MLA; Valja Lupjaska 24.06.2015. *C. avellana* 1MI; Debeli lug: Todorova reka 24.07.2015. *C. avellana* 6MI, 18.08.2015. *C. avellana* 5MI; Center 25.07.2016. *C. avellana* 1MI; Mt Kopaonik: Jošanička Banja - Đorov most 27.06.2016. *C. avellana* 2MI; Mt Tara: Predov krst 21.07.2016. *C. avellana* 1MI; Zarožje: Pašina ravan 21.07.2016. *C. avellana* 1MI; Mt Stara planina: Radičevac - Rasovati kamen 25.06.2018. *C. avellana* 6MI; Golema reka 13.09.2018. *C. avellana* 1MI; Kalna: Bigar 15.09.2018. *C. avellana* 1MI.

Phyllonorycter heegeriella (Zeller, 1846)

Distribution in Europe: Austria, Belgium, British Islands, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Near East, Norway, Poland, Romania, Slovakia, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Lazar's Canyon: Zlot 10.07.2018. *Quercus pubescens* Willd. 21MI, 2PU, 6MLA.

Phyllonorycter joannisi (Le Marchand, 1936)

Distribution in Europe: Austria, Belgium, British Islands, Bulgaria, Central European Russia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Moldova, Northwest European Russia, Norway, Poland, Slovakia, Slovenia, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Mt Kopaonik: Jošanička Banja - Đorov most 27.06.2016. *Acer platanoides* L. 2MI; Belgrade: Faculty of Forestry Arboretum 11.07.2016. *A. platanoides* 2MI; Bele vode 11.11.2016. *A. platanoides* 1MI, 1PU, 1AD, 1MPU; Mt Fruška Gora: Ledinci lake 15.07.2016. *A. platanoides* 3MI, 2MLA; Iriški venac 15.06.2018. *A. platanoides* 7MI; Grgeteg 15.06.2018. *A. platanoides* 3MI, 1PU; Bajina Bašta: Lug 21.07.2016. *A. platanoides* 1MI; Kučevo: Kučajna - Fatovi 25.07.2016. *A. platanoides* 2MI; Majdanpek: Avion 26.07.2016. *A. platanoides* 3MI .

Phyllonorycter lantanella (Schrank, 1802)

Distribution in Europe: Austria, Belgium, British Islands, Central European Russia, Croatia, Czech Republic, Estonia, Finland, France, Germany, Hungary, Italy, Northwest European Russia, Poland, Romania, Slovakia, South European Russia, Spain, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Despotovac: Obložine 04.08.2015. *Viburnum lantana* 1MI; Progar: Bojčin Forest 25.06.2016. *V. lantana* 1MI; Prokuplje: Borovnjak 13.08.2016. *V. lantana* 4MI; Hisar 17.08.2016. *V. lantana* 3MI; Belgrade: Faculty of Forestry Arboretum 25.10.2020. *V. lantana* 9MI.

Phyllonorycter stettinensis (Nicelli, 1852)

Distribution in Europe: Austria, Belgium, British Islands, Bulgaria, Central European Russia, Corsica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Northwest European Russia, Norway, Poland, Romania, Slovakia, Slovenia, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Bajina Bašta: Ovčinja 21.07.2016. *Alnus glutinosa* 1MI; Debeli lug: Todorova reka 26.07.2016. *A. glutinosa* 1MI; Prokuplje: Rastovnica 16.08.2016. *A. glutinosa* 2MI; Đjake: Đavolja varoš 17.08.2016. *A. glutinosa* 2MI; Bor: Brestovačka banja 10.07.2018. *A. glutinosa* 4MI.

Phyllonorycter trojana Deschka, 1982

Distribution in Europe: Greece, Macedonia (former Yugoslav Republic), Montenegro (Ellis, 2020).

Material examined: Belgrade: Faculty of Forestry Arboretum 12.05.2018. *Quercus trojana* Webb. 1MI, 1PU, 1AD.

Family Heliozelidae

Antispila petryi Martini, 1898

Distribution in Europe: British Islands, Czech Republic, Denmark, Estonia, Germany, Hungary, Poland, Portugal, Slovenia, Sweden, The Netherlands (Van Nieukerken et al, 2018).

Material examined: Mt Fruška Gora: Ledinci lake 15.07.2016. *Cornus sanguinea* L. 3MI; Debeli lug: Todorova reka 26.07.2016. *C. sanguinea* 1MI; Majdanpek: Ujevac 26.07.2016. *C. sanguinea* 1MI; Jagodina: Trnava - Ćelijan 06.08.2016. *C. sanguinea* 3MI; Despotovac: Vrbaci 07.08.2016. *C. sanguinea* 1MI; Jastrebac: Ribarska Banja 14.08.2016. *C. sanguinea* 1MI; Mt Crni vrh: Gornje Štiplje 18.09.2016. *C. sanguinea* 2MI, 1LA, 1MLA; Belgrade: Hajdučka česma 11.06.2017. *C. sanguinea* 1MI; Košutnjak 15.05.2020. *C. sanguinea* 1MI, 1CO; Batočina: Rogot 07.06.2018. *C. sanguinea* 3MI, 21.06.2018. *C. sanguinea* 1MI, 1CO.

Coptodisca lucifluella Clemens, 1860

Distribution in Europe: North American species, identified in Europe in 2015 in Italy (Bernardo et al., 2015), in Hungary (Takacs, Csaba, & János 2017), in Ukraine (Pályi, Takacs, & Szaboky 2019), in Bulgaria (Tomov, 2020) and in Romania (Chireceanu, Mustățea, & Teodoru, 2022).

Material examined: Despotovac: Obložine 03.06.2018. *Juglans regia* L. 6MI, 2LA; Jagodina: Trnava 02.09.2018. *J. regia* 3MI; Niš: Čegar 08.07.2019. *J. regia* 1MI.

Heliozela resplendella (Stainton, 1851)

Distribution in Europe: Austria, Belgium, British Islands, Central European Russia, Corsica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Kaliningrad Region, Latvia, North European Russia, Northern Ireland, Norway,

Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, The Netherlands (Corley, Maravalhas, & Passos de Carvalho, 2006; Ellis, 2020; Laštůvka & Laštůvka, 2014; van Karsholt & Nieukerken, 2022).

Material examined: Majdanpek: Valja Prerast 13.07.2017. *Alnus glutinosa* 1MI; Bor: Brestovačka banja 10.07.2018. *A. glutinosa* 1MI.

Family Incurvariidae

Incurvaria oehlmanniella (Hübner, 1796)

Distribution in Europe: Albania, Austria, Belgium, British Islands, Bulgaria, Central European Russia, Croatia, Czech Republic, Denmark, East European Russia, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Kaliningrad Region, Latvia, Luxembourg, North European Russia, Northwest European Russia, Norway, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Majdanpek: Bunari 23.07.2015. *Cornus sanguinea* 16MI, 1LA.

Phylloporia bistrigella Haworth, 1828

Distribution in Europe: Austria, Belgium, British Islands, Central European Russia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iberian Peninsula, Ireland, Kaliningrad Region, Latvia, Lithuania, Luxembourg, North European Russia, Northern Ireland, Northwest European Russia, Norway, Poland, Romania, Slovakia, Sweden, Switzerland, The Netherlands (Ellis, 2020; van Karsholt & Nieukerken, 2022).

Material examined: Mt Stara planina: Tatrasnica 25.06.2018. *Betula pendula* 8MI, 2LA.

Family Lyonetiidae

Leucoptera aceris (Fuchs, 1903)

Distribution in Europe: Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Latvia, Macedonia (former Yugoslav Republic), Poland, Portugal, Spain, Slovakia, Yugoslavia (Ellis, 2020; Laštůvka & Laštůvka, 2014; van Karsholt & Nieukerken, 2022).

Material examined: Kučevo: Ravnište - Krst 25.07.2016. *Acer campestre* L. 1MI.

Family Nepticulidae

Ectoedemia atricollis (Stainton, 1857)

Distribution in Europe: Austria, Belgium, Bosnia and Herzegovina, British Islands, Central European Russia, Corsica, Croatia, Czech Republic, Denmark, East Palaearctic, Estonia, France, Germany, Hungary, Iberian Peninsula, Ireland, Italy, Latvia, Lithuania, Moldova, Norway, Poland, Romania, Slovakia, Slovenia, Sweden, Switzerland, The Netherlands, Ukraine, Yugoslavia, Yugoslavia (Ellis, 2020; van Karsholt & Nieukerken, 2022).

Material examined: Mt Fruška Gora: Crveni čot 15.07.2016. *Staphylea pinnata* L. 1MI; Mt Fruška Gora: Stražilovo - Branko's grave 15.07.2016. *S. pinnata* 1MI; Zarožje: Pašina ravan 21.07.2016. *Crataegus monogyna* 2MI; Đjake: Đavolja varoš 17.08.2016. *Prunus domestica* 10MI, 1MLA; Valjevo: Mijači 15.09.2016. *C. monogyna* 2MI, *P. avium* 2MI; Mt Crni vrh: Gornje Komarice - Drenak 18.09.2016. *P. avium* 2MI; Gornje Štiplje 18.09.2016. *P. domestica* 2MI; Mt Kablar: Summit 20.09.2020. *Pyrus communis* L.11MI.

Ectoedemia occultella (Linnaeus, 1767)

Distribution in Europe: Austria, Belarus, Belgium, British Islands, Bulgaria, Central European Russia, Corsica, Croatia, Czech Republic, Denmark, East European Russia, East Palaearctic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Kaliningrad Region, Latvia, Lithuania, North European Russia, Northwest European Russia, Norway, Poland, Portugal, Romania, Sicily, Sicily, Slovakia, Slovenia, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Mt Crni vrh: Gornje Štiplje 18.09.2016. *Betula pendula* 1MLA.

Simplimorpha promissa (Staudinger, 1871)

Distribution in Europe: Austria, Bosnia and Herzegovina, Bulgaria, Corsica, Croatia, Cyprus, France, Greece, Hungary, Italy, Moldova, Near East, Portugal, Romania, Sardinia, Sicily, Slovakia, Slovenia, Spain, Ukraine, Yugoslavia (van Karsholt & Nieukerken, 2022).

Material examined: Lazar's Canyon: Zlot 10.07.2018. *Cotinus coggygria* Scop. 5MI.

Stigmella alnetella (Stainton, 1856)

Distribution in Europe: Austria, Belgium, British Islands, Corsica, Croatia, Czech Republic, Denmark, East European Russia, Estonia, Finland, France, Germany, Hungary, Italy, Kaliningrad Region, Lithuania, Norway, Poland, Portugal, Romania, Sardinia, Sicily, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, Ukraine, Ukraine, Yugoslavia (van Karsholt & Nieukerken, 2022).

Material examined: Debeli lug: Todorova reka 26.07.2016. *A. glutinosa* 8MI, 1LA .

Stigmella betulicola (Stainton, 1856)

Distribution in Europe: Austria, Belgium, British Islands, Central European Russia, Croatia, Czech Republic, Denmark, East European Russia, East Palaearctic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, North European Russia, Northwest European Russia, Norway, Poland, Romania, Slovakia, Slovenia, Sweden, Switzerland, The Netherlands, Ukraine, Ukraine, Yugoslavia (van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Košutnjak - Pionirski grad 29.07.2016. *Betula pendula* 8MI; Mt Stara planina: Ošljane 23.08.2018. *B. pendula* 1MI.

Stigmella continuella (Stainton, 1856)

Distribution in Europe: Austria, Belgium, British Islands, Central European Russia, Czech Republic, Denmark, East Palaearctic, Estonia, Finland, France, Germany,

Hungary, Ireland, Lithuania, North European Russia, Norway, Poland, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Bajina Bašta: Višesava 21.07.2016. *Betula pendula* 1MI.

Stigmella crataegella (Klimesch, 1936)

Distribution in Europe: Austria, Belgium, British Islands, Croatia, Czech Republic, Denmark, East Palaearctic, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Macedonia (former Yugoslav Republic), Near East, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands (van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Košutnjak - Repište 29.05.2016. *Crataegus monogyna* 18MI; Košutnjak 21.05.2018. *C. monogyna* 14MI; New Belgrade: 30.05.2018. *C. laevigata* (Poir.) DC. 1MI; Kupinovo: Kupinske grede 07.06.2016. *C. laevigata* 1MI; Obrenovac: Crni lug 09.06.2016. *C. laevigata* 2MI; Progar: Bojčin Forest 25.06.2016. *C. laevigata* 1MI, 27.05.2018. *C. monogyna* 1MI; Mt Fruška Gora: Zmajevac 15.07.2016. *C. monogyna* 3MI; Valjevo: Mijači 21.07.2016. *C. monogyna* 1MI; Majdanpek: Ravna reka 26.07.2016. *C. laevigata* 1MI; Jagodina: Trnava - Ćelijan 06.08.2016. *C. monogyna* 3MI; Ćelijan 02.09.2018. *C. monogyna* 1MI; Prokuplje: Borovnjak 13.08.2016. *C. monogyna* 5MI; Džigolj 14.08.2016. *C. monogyna* 1MI; Jastrebac: Klisurica 14.08.2016. *C. monogyna* 1MI; Mt Crni vrh: Gornje Komarice - Drenak 18.09.2016. *C. monogyna* 1MI; Mt Stara planina: Dejanovac 19.07.2017. *C. monogyna* 4MI; Odžaci: Deronje - Branjevina 18.05.2018. *C. monogyna* 2MI; Despotovac: Obložine 03.06.2018. *C. monogyna* 1MI.

Stigmella floslactella (Haworth, 1828)

Distribution in Europe: Austria, Belgium, British Islands, Bulgaria, Central European Russia, Croatia, Czech Republic, Denmark, East European Russia, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Majdanpek: Starica 19.09.2015. *Corylus avellana* 1MI; Mt Kopaonik: Jošanička Banja - Đorov most 27.06.2016. *C. avellana* 6MI; Zarožje: Pašina ravan 21.07.2016. *C. avellana* 5MI; Mt Avala: Pinosava 11.10.2016. *C. betulus* 2MI 2MLA; Belgrade: Mt Kablar: Summit 20.09.2020. *C. betulus* 10MI, 4MLA.

Stigmella hahniella (Wörz, 1937)

Distribution in Europe: Austria, Croatia, Czech Republic, Germany, Hungary, Italy, Slovakia (van Karsholt & Nieukerken, 2022).

Material examined: Kučevo: Kučajna - Fatovi 25.07.2016. *Sorbus torminalis* (L.) Crantz 1MI; Mt Stara planina: Mali Izvor 21.06.2017. *S. torminalis* 2MI; Bor: Brestovačka banja 10.07.2018. *S. torminalis* 2MI, 1MLA; Lazar's Canyon: Zlot 10.07.2018. *S. torminalis* 1MI.

Stigmella luteella (Stainton, 1857)

Distribution in Europe: Austria, Belarus, Belgium, British Islands, Central European Russia, Croatia, Czech Republic, Denmark, East Palaearctic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, North European Russia, Norway, Poland, Sicily, Slovakia, Slovenia, Sweden, Switzerland, The Netherlands, Ukraine, Ukraine, Yugoslavia (van Karsholt & Nieukerken, 2022).

Material examined: Mt Kopaonik: Jošanička Banja - Đorov most 27.06.2016. *Betula pendula* 1MI.

Stigmella magdalenae (Klimesch, 1950)

Distribution in Europe: Austria, British Islands, Bulgaria, Central European Russia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italian mainland, Latvia, Lithuania, Northwest European Russia, Norway, Poland, Slovakia, Slovenia, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Košutnjak 03.09.2016. *Sorbus torminalis* 2MI; Bor: Brestovačka banja 10.07.2018. *S. torminalis* 1MI; Mt Stara planina: Jabučko ravnište 23.08.2018. *S. aucuparia* L. 6MI, 2LA.

Stigmella naturnella (Klimesch, 1936)

Distribution in Europe: Austria, Central European Russia, Czech Republic, East European Russia, East Palaearctic, Germany, Hungary, Italy, Slovakia, Switzerland (van Karsholt & Nieukerken, 2022).

Material examined: Jagodina: Trnava 06.08.2016. *Betula pendula* 4MI; Belgrade: Topčider Park 21.05.2018. *B. pendula* 2MI; Paraćin: Center 08.07.2019. *B. pendula* 1MI.

Stigmella nivenburgensis (Preissecker, 1942)

Distribution in Europe: Austria, Central European Russia, Croatia, Czech Republic, East Palaearctic, Germany, Greece, Hungary, Italy, Lithuania, Poland, Romania, Slovakia, Slovenia, Spain, The Netherlands, Yugoslavia (Ellis, 2020; van Karsholt & Nieukerken, 2022).

Material examined: Belgrade: Ada Ciganlija 27.07.2016. *Salix fragilis* 1MI.

Stigmella paliurella Gerasimov, 1937

Distribution in Europe: Bosnia and Herzegovina, Bulgaria, Croatia, East Palaearctic, Greece, Italy, Macedonia (former Yugoslav Republic), Near East, Romania, Slovenia, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Prokuplje: Borovnjak 13.08.2016. *Paliurus spina-christi* Mill. 15MI; Prokuplje: Hisar 17.08.2016. *P. spina-christi* 3MI; Sićevo Gorge: Sićevo 20.08.2020. *P. spina-christi* 7MI.

Stigmella sorbi (Stainton, 1861)

Distribution in Europe: Austria, British Islands, Bulgaria, Central European Russia, Czech Republic, Denmark, East Palaearctic, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, North European Russia, Northwest European Russia, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022)

Material examined: Jagodina: Trnava 02.09.2018. *Cormus domestica* (L.) Spach 1MI.

Family Tortricidae

Acleris schalleriana (Linnaeus, 1761)

Distribution in Europe: Austria, Belgium, Bosnia and Herzegovina, British Islands,

Bulgaria, Central European Russia, Czech Republic, East European Russia, East Palaearctic, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Macedonia (former Yugoslav Republic), Nearctic region, Northwest European Russia, Norway, Poland, Portugal, Romania, Sicily, Sicily, Slovakia, Slovenia, South European Russia, Spain, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Despotovac: Obložine 04.08.2015. *Viburnum lantana* 5MI, 08.05.2016. *V. lantana* 1MI; Prokuplje: Borovnjak 13.08.2016. *V. lantana* 5MI; Hisar 17.08.2016. *V. lantana* 3MI, 1PU.

Celypha woodiana (Barrett, 1882)

Distribution in Europe: Austria, Belgium, British Islands, Czech Republic, France, Germany, Greece, Hungary, Italy, Luxembourg, Poland, Romania, Slovakia, Switzerland (van Karsholt & Nieukerken, 2022).

Material examined: Mt Goč: Gvozdac 08.04.2018. *Viscum album* L. 1MI.

Family Yponomeutidae

Atemelia torquatella (Lienig & Zeller, 1846)

Distribution in Europe: Austria, Belarus, Belgium, Bosnia and Herzegovina, British Islands, Czech Republic, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Macedonia (former Yugoslav Republic), North European Russia, Northwest European Russia, Norway, Poland, Slovakia, Sweden, Switzerland, The Netherlands, Ukraine (van Karsholt & Nieukerken, 2022).

Material examined: Mt Crni vrh: Kalenovac 18.09.2016. *Ulmus minor* 3MI, 2LA, 1MLA.

CONCLUSIONS AND DISCUSSION

During this study, 228 species of leaf miners, of which 65 are new for the Serbian fauna were identified. Of the 222 species identified in previous studies 59 were not found during the field study. The reason for this lies in the fact that some species could not be bred to the adult stage, and the identification based on the characteristics of the mine, larva, and pupa was not possible. By summing the results of the previous research and the results obtained in this study, we can conclude that there are 287 species of deciduous woody plant leaf miners in Serbian fauna. That number represents around 3% of the world, and respectively around 12% of the European leaf miner fauna (Connor & Taverner, 1997; Ellis, 2020). The ratio of newly identified species per order, family, and genera is similar to those determined in Europe (Ellis, 2020; Hering, 1951). The number of newly identified species in this study is satisfactory as only 98 species have been identified in Croatia (Matošević, Pernek, Dubravac, & Barić, 2009), 253 in Bosnia and Herzegovina (Dimić, 2003), and 356 species in Slovenia (Maček, 1999).

The new findings have increased the number of deciduous woody plant leaf miner species from the order Lepidoptera by around 27%, from the order Hymenoptera by

58%, from the order Diptera by 47%, and from the order Coleoptera by 20%. As the majority of leaf miners belong to the order Lepidoptera, it is not surprising that most of the newly identified species belong to that order. The greatest advancement was made in studying leaf miners from the order Hymenoptera. The reason for this lies in the fact that many keys for identifying those species based on the larval and pupal characteristics did not exist until recently (Digweed et al, 2009; Ellis, 2020; Haarder et al, 2018; Langmaid, 2019; Liston, 1994; Liston et al, 1993; Liston, 1993, 2007).

The majority of the newly identified species are autochthonous in Serbia but they were not recorded because of the insufficient research of this group of insects. Most of them are widely distributed in Europe, but there are also some interesting findings. The findings of *Aulagromyza tremulae* and *Hinatara excisa,* are the southernmost findings in Europe, while the finding of *Phyllonorycter trojana* is the northernmost (de Jong et al, 2014; Ellis, 2019; GBIF.org, 2023). Serbia is the third country on the Balkan peninsula where the miner *Coptodisca lucifluella* was recorded (Chireceanu et al, 2022; de Jong et al, 2014; Ellis 2019; GBIF.org 2023; Tomov, 2020). It was introduced to Europe from North America, and Serbia is the sixth European country in which it was registered (Bernardo et al, 2015; Chireceanu et al, 2022; Pályi et al, 2019; Takacs et al, 2017; Tomov, 2020). As it does not have its natural host plants (species from genera *Carya* Nutt. and *Pterocarya* Kunth) in the new habitat, it switched to European walnut (*Juglans regia*), on which it develops successfully, but it still does not cause any serious damage (Bernardo et al, 2015; Takács et al, 2020).

Of the 49 host plant species on which the identified leaf miners were found, most are autochthonous (94%), on which 95% of the newly recorded leaf miner species were recorded. Those plant species are mostly heliophilous (Cvjetićanin, Brujić, Perović, & Stupar, 2016), which indicates that a greater amount of sunlight suits the leaf miners. Most of the newly found species were identified on one species or a few closely related species from the same genus, which means that they are monophagous or narrowly oligophagous as most other European leaf miner species (Ellis, 2020; Hering, 1951, 1957; Needham et al, 1928). It is estimated that with climate changes many of the rare and endangered plant species in Europe will get extinct (Antonelli et al, 2020; Pimm, 2021; Thuiller, Lavorel, Araújo, Sykes, & Prentice, 2005), and with them the leaf miners which inhabit them. That is why more attention is needed for preserving those plant species. On the other side, many species will extend their range due to climate change and globalization and will migrate to areas where they were not present before (Antonelli et al, 2020; Hemery et al, 2010; Thuiller et al., 2005). Leaf miners will most probably follow their range expansion (Bernardo et al, 2015; Kirichenko et al, 2019; Šefrová, 2003). That is why it is necessary to monitor these changes to detect harmful and alien species in time.

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