Acta Entomologica Serbica, 2022, 27(2): 67-81

UDC: 595.44(497.113)"2011/2012"
DOI: 10.5281/zenodo.7576487

ADDITIONAL SPIDER RECORDS FROM MT. FRUŠKA GORA (SERBIA) WITH A FIRST INSIGHT INTO WINTER SPECIES

GORDANA GRBIĆ[1*] and AMBROS HÄNGGI[2]

1 Spiders of Serbia: spider research and protection center, 21 000 Novi Sad, Serbia
2 Naturhistorisches Museum Basel, Augustinergasse 2, 4001 Basel, Switzerland
*Email: gordana.grbic.ns@gmail.com (corresponding author)

Abstract

Monitoring spiders with pitfall traps often only includes data collected during the vegetation period. Herein, we present the results of long-term sampling at Erdelj, Fruška Gora Mountain, over 19 months in 2011/2012. Special emphasis was placed on the winter period. At three sampling sites, a meadow, an area of shrubs and a deciduous forest, 1113 adult spiders of 116 species were identified. Thirty-four species are new records for the mountain; six of them are new to Serbia. The meadow yielded the highest number of species (59), with a high proportion (40%) of species collected only in this habitat type. Eleven species were found to be active mostly or exclusively in winter. Four of them were so-called rare spiders and two of them are new records for Serbia. Of all recorded species, five are on the list of strictly protected spiders in Serbia and could be used as an additional argument for environmental protection.

KEY WORDS: Vojvodina Province, new spider records, long-term sampling, pitfall traps

Introduction

The first records of spiders on Mt. Fruška Gora (Serbia) date back to Chyzer and Kulczyński in 1897 (cited in Deltshev *et al*., 2003). Since then, the number of recorded species has reached 267 (an overview is given in Grbić & Savić, 2010 and Grbić *et al*., 2015). However, the last collecting campaign faced certain challenges with the traps, and intensive sheep grazing influenced the results. Thus, Grbić *et al*. (2015) proposed that the real number for the locality and the mountain is larger.

The interrupted investigation in 2010 (Grbić *et al*., 2015) was continued in June 2011, with a different type of trap and special emphasis on winter fauna. Generally, this season is rarely investigated concerning spiders, but usually uncovers some very interesting and presumably rare species (Ingl *et al*., 2020, Käser *et al*., 2010,

Blick, 2011). The main goals of the study were: 1) to obtain more faunistic information on spiders of the Fruška Gora Mountain 2) to gain first insight in the winter fauna and 3) to present more arguments for the conservation measures of the locality.

Additionally, special attention was on the species *Pelecopsis loksai* Szinetár & Samu, 2003 and the question of whether this species is a "rare" species or only "a rarely collected" one. Originally it was described in material gathered during September and October (Szinetár & Samu, 2003). Later it was found in very few numbers in spring (Grbić *et al*., 2015) or summer (Naumova *et al*., 2021). We assume it is a winter-active species and hope to show this through our all-year sampling that included the winter period.

Materials and methods

Erdelj (45° 11' 22.0236" N, 019° 42' 30.0636" W) is one of the abandoned limestone strip mines on Mt. Fruška Gora, with oak forest, meadow-steppe and planted pine forest. The locality is situated on the northern slope of the mountain near Beočin in the Vojvodina province in the north of Serbia (Fig. 1).

The three sampling sites in this campaign represent three different habitat types: meadow, shrub encroachment and deciduous forest, representing the three different stages of succession following the abandonment of the limestone mine. For better understanding on a local level, habitat types were on the map given in Serbian language: LIVADA (meadow), ŽBUNJE (shrub encroachment) and LISTOPADNA ŠUMA (deciduous forest).

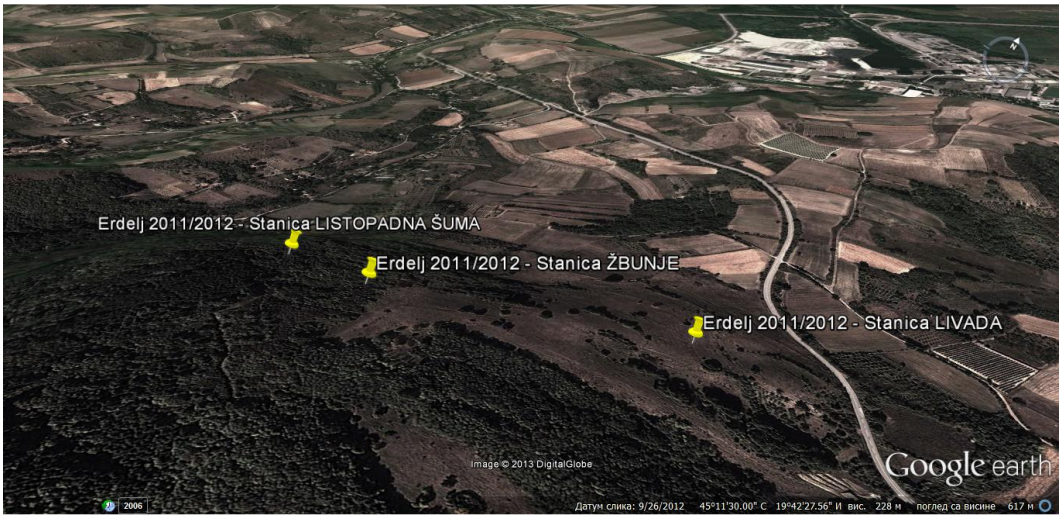

Figure 1. Erdelj, Mt. Fruška Gora, sampling plots written in Serbian language with clarification in English: LIVADA (meadow), ŽBUNJE (Shrubs) and LISTOPADNA ŠUMA (deciduous forest) during research in 2011 and 2012.

1. Meadow (45°11' 26.28"N, 19°42' 38.31"E) – a meadow-steppe, *Inulo – Chrisopogonetum grilli* biocenoses; uneven slope, inclination 6-10%; elevation from 180-360 m; irregularly grazed by a flock of 350 sheep; vegetation cover at ground level is 75-100%.

2. Shrub encroachment (shrub) (45°11' 22.57"N, 19°42' 26.70"E) – biocenoses of blackthorn with common hawthorn (*Pruno spinosae-Crataegetum*); vegetation cover at ground level is 5-75%, some areas covered with rocks and moss. This plot may be seen as a transition stage in the succession after land recultivation.
3. Deciduous forest (45°11' 25.12"N, 19°42'20.61"E) – biocenoses *Rusco-Querco-Carpinetum* with a high percentage of lime (*Tilia tomentosa*); vegetation cover at ground level is 5-25%.

A detailed description of the locality and the sampling sites is given in Grbić *et al*. (2015).

In the spring of 2011, there was a fire in the vicinity that did not impact our experiment, but in 2012, a fire devastated a large part of the meadow near the set of traps. The traps themselves were not damaged, but the fire may have affected the number of individuals captured.

Collecting protocol and determination

To get comparable results from the sites, pitfall traps were used. They were made of plastic cups: volume 2 dl, opening width 7 cm, height 5.5 cm. The cups were filled up to 4 cm with a 4% solution of formaldehyde as a fixative. To ensure the traps weren't damaged, and also to prevent small mammals and large amphibians from getting in accidentally, a hemispheric wire mesh (grid: 2.5 × 2.5 cm) was fixed with three wooden sticks. A 15 × 15 cm piece of acrylic glass was fixed above the trap (Fig. 2). At each site 4 traps were placed in line at intervals of approximately 6 m.

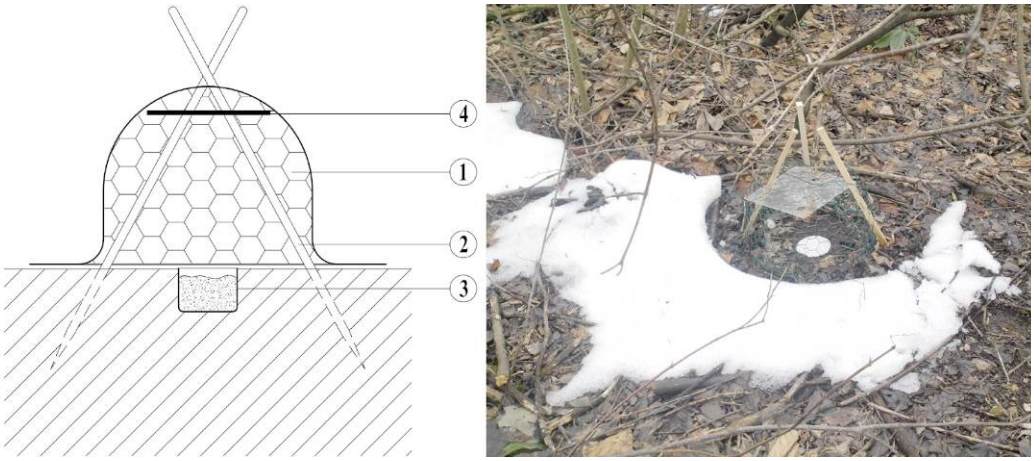

Figure 2. Construction of the pitfall trap used at Erdelj, Mt. Fruška Gora, during 2011 and 2012. 1) wire mesh, 2) wooden sticks, 3) sampling cup, 4) roof of Plexiglas. Left: technical drawing; Right: trap in situ.

The sampling period lasted for 19 months (from 30/06/2011 to 15/12/2012) and the traps were emptied every 15 days. During the hot summer months, when the fixative evaporated quickly, the traps were refilled with formalin. Special attention was given to winter collection. All collected material was transferred to 70% alcohol.

Identification of spiders was largely based on the website *araneae – Spiders of Europe* (Nentwig *et al*., 2022). Further, primary literature for individual groups or species was also used but is only mentioned where appropriate. Reference collections are deposited in the Natural History Museum, Basel (Switzerland) and in

the Grbić private collection (Serbia). Nomenclature follows The World Spider Catalogue (WSC, 2022). Data for worldwide distribution are also given according to the WSC (2022).

Results

Faunistic overview

A total of 1113 adult spiders were caught (males 848, females 265) representing 116 species of 25 families. The 692 juveniles were not determined to species level. The most diverse family, with 34 species (29.3 %), was Linyphiidae, followed by Lycosidae (14 species, 12.1 %), Gnaphosidae (10 species, 8.6 %) and Theridiidae (9 species, 7.6%). Forty-three species were represented by only one individual and 17 by two specimens. The most abundant species in the material was *Pardosa alacris* with 195 individuals (171♂♂, 24♀♀), followed by *Urocoras longispina* (132 ind., 103♂♂, 29♀♀), *Tenuiphantes flavipes* (95 ind., 48♂♂, 47♀♀), *Nemesia pannonica* (68 ind., 60♂♂, 8♀♀), *Histopona torpida* (44 ind., 19♂♂, 25♀♀) and *Pelecopsis loksai* (43 ind., 41♂♂, 2♀♀) (Table I).

Five species, *Inermocoelotes inermis*, *Porrhomma microps*, *Tegenaria campestris*, *Cicurina cicur* and *Centromerus cavernarum*, are on the list of strictly protected spider species in Serbia ("Official Gazette of RS", nos. 5/2010, 47/2011, 32/2016 and 98/2016); the first two are given under the synonyms *Coelotes inermis* and *Porrhomma lativelum*, respectively, and the other three with their current names.

Table I. List of all recorded spider species at Erdelj, Mt. Fruška Gora, during 2011 and 2012. Species with an asterisk (*) are new records for Serbian arachnofauna. Abbreviation for an ecological type (definition see in the text): m – meadow, s – scrub, w – wood.

	Habitat	ecological type	meadow		shrubs		wood		total ind.
			♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	
	Individuals		**287**	**58**	**370**	**109**	**191**	**98**	**1113**
	Species		**59**		**57**		**40**		**116**
Taxon									
Agroeca cuprea Menge, 1873		s/w			2	2	2	1	7
Agyneta fuscipalpa (C. L. Koch, 1836)			2	1					3
Agyneta rurestris (C. L. Koch, 1836)		m	5	1	1				7
Agyneta simplicitarsis (Simon, 1884)			1						1
Alopecosa aculeata (Clerck, 1757)			4	1					5
Alopecosa cuneata (Clerck, 1757)		m	12	5	1				21
Alopecosa farinosa (Herman, 1879)			3						
Alopecosa mariae (Dahl, 1908)			2						2
Alopecosa pulverulenta (Clerck, 1757)			3						3
Anyphaena accentuata (Walckenaer, 1802)							2		2
Apostenus fuscus Westring, 1851					1				1
Araeoncus humilis (Blackwall, 1841)		m	19			1			20
Arctosa leopardus (Sundevall, 1833)					1				1
Asagena phalerata (Panzer, 1801)			4	1					5
Asthenargus bracianus Miller, 1938 *					1				1
Atypus piceus (Sulzer, 1776)			2		1		1	1	5
Aulonia albimana (Walckenaer, 1805)		m/s	6	5	5	2			18

Table I – continued

Callilepis schuszteri (Herman, 1879) *				1				1
Centromerus cavernarum (L. Koch, 1872)						3	1	4
Centromerus incilium (L. Koch, 1881)				1				1
Centromerus sylvaticus (Blackwall, 1841)						1		1
Ceratinella scabrosa (O. Pickard-Cambridge, 1871)				1				1
Cercidia prominens (Westring, 1851)			1					1
Cicurina cicur (Fabricius, 1793)	w				1	9	2	12
Clubiona comta C. L. Koch, 1839				1	1	1	1	4
Clubiona terrestris Westring, 1851				1	1		1	3
*Cozyptila blackwalli (*Simon, 1875)	w			6	2	14	3	25
Crosbyarachne silvestris (Georgescu, 1973)		1						1
Dicymbium nigrum (Blackwall, 1834)							1	1
Diplostyla concolor (Wider, 1834)			1					1
Dipoena melanogaster (C. L. Koch, 1837)				1				1
Drassodes cupreus (Blackwall, 1834)		1						1
Drassyllus praeficus (L. Koch, 1866)		1	1					2
Drassyllus villicus (Thorell, 1875)				1		4		5
Dysdera longirostris Doblika, 1853				3		1	1	5
Dysdera microdonta Gasparo, 2014	s/w			6	3	4		13
Episinus maculipes Cavanna, 1876							1	1
Episinus truncatus Latreille, 1809				1		1		2
Eratigena agrestis (Walckenaer, 1802)		5						5
Erigone dentipalpis (Wider, 1834)		1						1
Erigonoplus foveatus (Dahl, 1912)		4						4
Ero furcata (Villers, 1789)				2				2
Euophrys frontalis (Walckenaer, 1802)		1						1
Euryopis flavomaculata (C. L. Koch, 1836)	s			5	2			7
Evarcha arcuata (Clerck, 1757)			1					1
Gonatium paradoxum (L. Koch, 1869)				2	1			3
Hahnia nava (Blackwall, 1841)	m/s	17	6	8		4		35
Haplodrassus signifer (C. L. Koch, 1839)		2	2					4
Harpactea rubicunda (C. L. Koch, 1838)				2				2
Harpactea saeva (Herman, 1879)						4		4
Heliophanus cupreus (Walckenaer, 1802)		2						2
Histopona torpida (C. L. Koch, 1837)	s/w			15	15	4	10	44
Hogna radiata (Latreille, 1817)		1	1					2
Iberina montana (Blackwall, 1841)							1	1
Incestophantes crucifer (Menge, 1866)					1			1
Inermocoelotes inermis (L. Koch, 1855)	s/w			3		5		8
Lasaeola prona (Menge, 1868)*		1						1
Liocranum rupicola (Walckenaer, 1830)						1		1
Mansuphantes mansuetus (Thorell, 1875)				1				1
Micaria formicaria (Sundevall, 1831)		1						1
Nemesia pannonica Herman, 1879	m	57	8	3				68
Neon reticulatus (Blackwall, 1853)				2	1	1	1	5
Neottiura bimaculata (Linnaeus, 1767)							1	1
Ostearius melanopygius (O. Pickard-Cambridge, 1880)*		1						1

Table I – continued

Ozyptila atomaria (Panzer, 1801)		2	1					3
Ozyptila claveata (Walckenaer, 1837)		3	1		1			5
Ozyptila praticola (C. L. Koch, 1837)	s			27	5			32
Ozyptila scabricula (Westring, 1851)		1						1
Pachygnatha clercki Sundevall, 1823				1				1
Palliduphantes alutacius (Simon, 1884)	w					6	3	9
Palliduphantes pallidus (O. Pickard-Cambridge, 1871)	w			1		7	4	12
Palliduphantes pillichi (Kulczyński, 1915)		2		2				4
Pardosa alacris (C. L. Koch, 1833)	s			166	23	5	1	195
Pardosa hortensis (Thorell, 1872)	m	17	6		1			24
Pelecopsis loksai Szinetár & Samu, 2003	m	40	2			1		43
Pelecopsis radicicola (L. Koch, 1872)	s			2	5			7
Philodromus longipalpis Simon, 1870 *		1						1
Phlegra fasciata (Hahn, 1826)	m	5	3					8
Phrurolithus festivus (C. L. Koch, 1835)		1	2			1		4
Phrurolithus minimus C. L. Koch, 1839	s	1		5	3			9
Pirata piraticus (Clerck, 1757)					1			1
Pisaura mirabilis (Clerck, 1757)				1				1
Poecilochroa variana (C. L. Koch, 1839)			1			1		2
Porrhomma microphthalmum (O. Pickard-Cambridge, 1871)						1		1
Porrhomma microps (Roewer, 1931)				3	2			5
Porrhomma pygmaeum (Blackwall, 1834)					1			1
Robertus lividus (Blackwall, 1836)						3	2	5
Sagana rutilans Thorell, 1875						1		1
Segestria bavarica C. L. Koch, 1843					1			1
Sibianor aurocinctus (Ohlert, 1865)		1	1					2
Steatoda paykulliana (Walckenaer, 1806)		1	1					2
Stemonyphantes lineatus (Linnaeus, 1758)		1						1
Tegenaria campestris (C. L. Koch, 1834)	s			6	2		1	9
Tenuiphantes flavipes (Blackwall, 1854)	s/w			14	14	34	33	95
Tenuiphantes floriana (van Helsdingen, 1977)	w	1		3	1	13	8	26
Thanatus arenarius L. Koch, 1872		4						4
Thanatus atratus Simon, 1875 *		1						1
Tibellus macellus Simon, 1875		2						2
Titanoeca schineri L. Koch, 1872		1						1
Trachyzelotes pedestris (C. L. Koch, 1837)				1				1
Trichoncus hackmani Millidge, 1955		2						2
Trochosa ruricola (De Geer, 1778)		3						3
Trochosa terricola Thorell, 1856	s	6		11	4			21
Urocoras longispina (Kulczyński, 1897)	s/w	6	1	44	11	53	17	132
Walckenaeria antica (Wider, 1834)				1				1
Walckenaeria corniculans (O. Pickard-Cambridge, 1875)							1	1
Walckenaeria mitrata (Menge, 1868)						2		2
Walckenaeria simplex Chyzer, 1894				1		1		2
Xerolycosa miniata (C. L. Koch, 1834)		5	1					6
Xysticus acerbus Thorell, 1872	m	11	2					13
Xysticus kempeleni Thorell, 1872		4						4

Table I – continued

Xysticus kochi Thorell, 1872	4	1				5
Zelotes erebeus (Thorell, 1871)	1		1			2
Zelotes latreillei (Simon, 1878)			1			1
Zodarion germanicum (C. L. Koch, 1837)	1					1
Zora spinimana (Sundevall, 1833)				1	2	3

Species new to Serbian fauna

Of the 116 spider species recorded in this area, 6 are new records for Serbian arachnofauna (marked with an asterisk (*) in Table I). These species are presented below.

***Asthenargus bracianus* Miller, 1938 (fam: Linyphiidae)**

Determination: Miller (1938), Thaler (1991).

Material: pitfall traps, from 14.12.2011 to 05.01.2012, shrub, 1♂.

Global distribution: Central and Eastern Europe.

Habitat: Sporadically in caves, but also in xerothermic locations, dry forests, deeper soil layers or microcavernicole habitats (Nentwig *et al*., 2022, Komnenov, 2014).

Note: Most specimens were collected in spring or autumn (Komnenov, 2014), and even in December/January (Thaler, 1991), and it is suggested that the species is active in winter (Nentwig *et al*., 2022), which corresponds to our finding. It is found in neighboring countries (Nentwig *et al.*, 2022). According to Helsdingen & Ijland (2015), this is a very rare species, seldom collected over the years, but we suggest that the recorded rareness is rather due to the winter activity of the species (see below).

***Callilepis schuszteri* (Herman, 1879) (fam: Gnaphosidae)**

Determination: Grimm (1985).

Material: pitfall traps, from 08.06.2012 to 23.06.2012, shrub, 1♂.

Global distribution: Europe, Turkey, Caucasus, Russia (Europe to the Far East), China, Korea, Japan.

Habitat: In dry meadows and rocky steppes (Nentwig *et al*., 2022, Grimm 1985), in leaf litter or on the grounds of mountainous regions (Kim & Lee, 2013), oriental hornbeam and white oak forest, oak forest, submontane beech forest (Komnenov, 2014).

Note: The biology and ecology of *C. schuszteri* are poorly known (Grimm, 1985), but its presence in surrounding countries (Nentwig *et al*., 2022, "frequent in Southeast Europe") indicated that it would be recorded eventually. The activity of males in Germany (Grimm, 1985) corresponds to our finding. In Macedonia, the species was found in the same habitat as *Callilepis nocturna* (Linnaeus, 1758), in an oak forest (*Quercetum frainetto-cerris*) (Komnenov, 2014). According to Grimm (1985), there is a possibility that the species *C. nocturna*, already recorded in Serbia, could be confused with *C. schuszteri* in older collections. But this was not possible to confirm.

***Lasaeola prona* (Menge, 1868) (fam: Theridiidae)**

Determination: Roberts (1998), Miller (1967).

Material: pitfall traps, from 12.07.2011 to 26.07.2011, meadow-steppe 1♂.

Global distribution: North America, Europe, Caucasus, Russia (Europe to South Siberia), Kazakhstan, Iran, Japan (Nentwig *et al*., 2022).

Habitat: On the ground or on low plants of sunny forest edges (Nentwig *et al.*, 2022, Hänggi *et al.*, 1995), mainly dunes and heaths, but also on soil between rocks (Roberts, 1998) or on grass in sunny, steppe habitats (Miller, 1967).

Note: According to Nentwig *et al.* (2022), this species is very rarely found, but has been reported from almost all European countries. Its biology is mostly unknown (Nentwig *et al.*, 2022). The species is adult in summer (Miller, 1967, Roberts, 1998). Its presence on the ground or grass is often cited (Hänggi *et al.*, 1995). Thus, the meadow-steppe habitat in our study, and a record from July, correspond to the data from the literature.

***Ostearius melanopygius* (O. Pickard-Cambridge, 1879) (fam: Linyphiidae)**

Determination: Roberts (1998), Holm (1962).

Material: pitfall traps, from 05.11.2011 to 19.11.2011, meadow-steppe, 1♂.

Global distribution: originally from South America, introduced to Europe, Canary Islands, Egypt, Turkey, South Africa, China, Malaysia, Indonesia and New Zealand (Nentwig *et al*., 2022).

Habitat: Frequently in scree, compost and market gardens; not on mountains (Nentwig *et al*., 2022).

Note: *O. melanopygius* was described from New Zealand, but the origin of this intensively ballooning species is thought to be South America (Holm, 1962). In Europe, it has been known since the beginning of the 20th century and its spreading is summarized by Růžička (1995). *O. melanopygius* is considered an invasive species (Rozwałka & Stachowicz, 2010, El-Hennawy *et al.*, 2016). The influence of this species on autochthonous populations of other species is unknown. Considering it was recorded within the boundaries of the National Park, it should be subject to further monitoring. Our male was recorded in winter, which also highlights the importance of year-round collecting.

***Philodromus longipalpis* Simon, 1870 (fam: Philodromidae)**

Determination: Segers (1992), Muster & Tahler (2004).

Material: pitfall traps, from 08.06.2012 to 23.06.2012, meadow-steppe, 1♂.

Global distribution: Europe, Iran, Azerbaijan (Nentwig *et al*., 2022).

Habitat: shrubs and trees (Roberts, 1998), rocky slopes (Kůrka *et al.*, 2020), indoors (Ponomarev *et al.*, 2018).

Note: Kůrka *et al*. (2020) already mentioned this species as “probably” from Serbia as an interpretation of “Yugoslavia” in Kubcová (2004). Its occurrence in the surrounding countries (Nentwig *et al*., 2022) indicated that it could be present and here is the first confirmed record. Little is known about the ecology of this species and our record in a dry meadow-steppe may well agree with the “rocky slopes” mentioned in Kůrka *et al.* (2020).

***Thanatus atratus* Simon, 1875 (fam: Philodromidae)**

Determination: Pozzi & Hänggi (1998), Szita & Samu (2000).

Material: pitfall traps, from 23.06.2012 to 07.07.2012, meadow-steppe 1♂.

Global distribution: Europe to southern Siberia, Turkey, Kazakhstan, Iran, Korea, Japan (Nentwig *et al.*, 2022).

Habitat: In dry and semi-dry steppe areas, on sea coasts and salt places (Nentwig *et al.*, 2022). Additionally, in Sub-Mediterranean forest, forest plantations and sand dunes (Kastrygina & Kovblyuk, 2013).

Note: Because of taxonomic problems with *T. vulgaris* Simon, 1870 and *T. vulgaris brevipes* Kulczyński, 1903, which is considered a synonym of *T. atratus* (Rozwałka *et al.*, 2016**)**, it is possible that the species has already been collected in Serbia but recorded as *T. vulgaris.* This could be the case with older records of *T. vulgaris* in the vicinity of Mt. Fruška Gora (Sisojević & Miller, 1979) and in the Srem region (Nikolić & Polenec, 1981, no precise locality), but this is impossible to verify. Thus, we present the first confirmed record. A similar situation was suggested for Poland by Rozwałka *et al.* (2016).

Phenology of species – winter adult

Most research into spiders and other small invertebrates is done during the vegetation period from May to August or at most from April to October. Our study was a year-round investigation with particular emphasis on winter data. We defined “winter” as the period from November to March, and the winter spiders according to Schaefer (1987), as winter mature, only reproducing during the cold season. This also corresponds to colder weather conditions and clear changes in vegetation in spring and autumn. With this definition, we determined 11 species that were found only or mostly in winter (Tab. II).

Table II. Number of males and females (m/f) of 11 winter-active species caught in pitfall traps during 2011/2012, at Erdelj, Mt. Fruška Gora and *Urocoras longispina* as a reference for a eurychrone species.

Month of capture	**Apr.**	**May**	**Jun**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**
Taxon	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**	**m/f**
Araeoncus humilis			1/0		0/1		6/0	3/0	6/0	2/0		1/0
Asthenargus bracianus										1/0		
Centromerus cavernarum			0/1								2/0	1/0
Centromerus incilium											1/0	
Centromerus sylvaticus								1/0				
Ostearius melanopygius								1/0				
Ozyptila atomaria			0/1							1/0		1/0
Palliduphantes alutacius		2/0	0/1					3/1		1/0		0/1
Pelecopsis loksai								2/0	1/0	13/1	15/1	10/0
Stemonyphantes lineatus										1/0		
Tenuiphantes floriana	0/1	0/1			2/0	1/0	4/0	5/3	5/3	0/1		
Urocoras longispina	5/1	6/6	0/2	0/11		15/2	25/1	21/1	8/2	6/0	4/1	13/2

The most abundant species in this period was *Pelecopsis loksai* (43 ind., 41♂♂, 2♀♀), followed by *Araeoncus humilis* (12 ind., 12♂♂, but 8 ♂♂ and 1♀ of this species were captured at different times during the year). All other species were recorded with only one or a few individuals. A special case appears to be *Tenuiphantes floriana*, which was captured throughout the year, but in higher numbers in winter (Fig. 3, chart B). Comparable is *Urocoras longispina*. Individuals were found all year round, but in higher numbers in autumn and spring (Fig. 3, chart B).

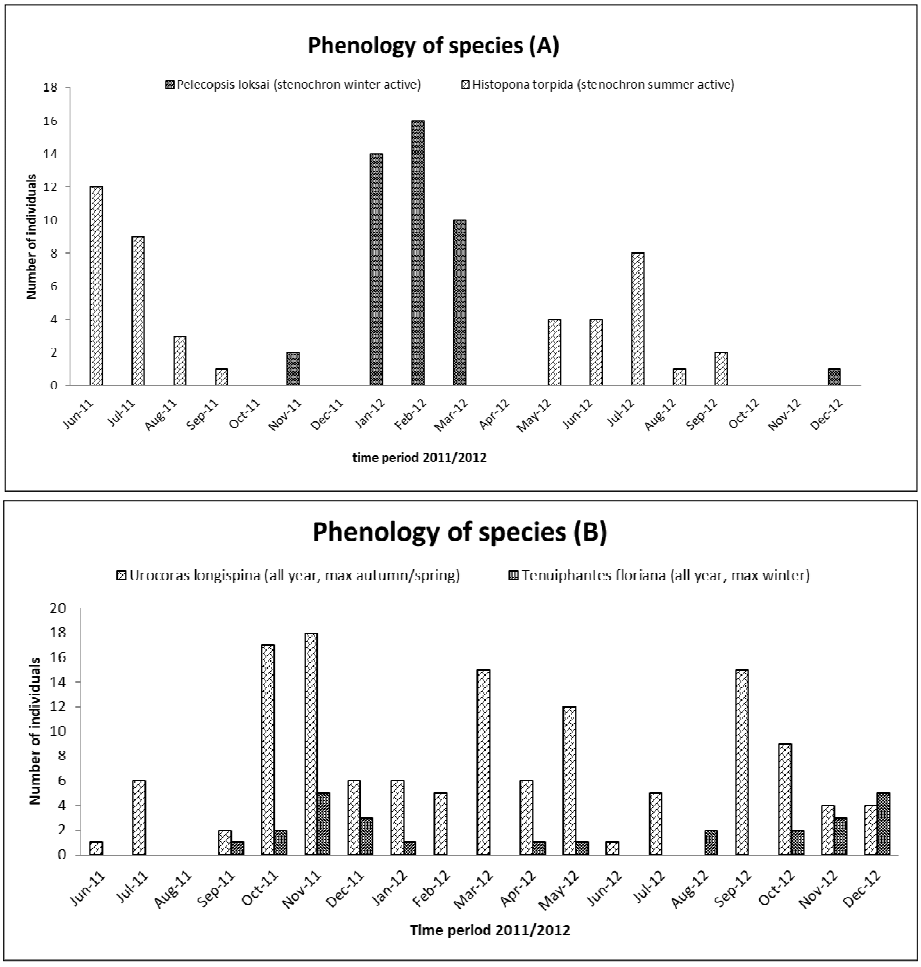

Figure 3. Four species representing different types of phenology based on pitfall trapping data: *Pelecopsis loksai* (stenochrone winter-active), in contrast with *Histopona torpida* (stenochrone summer-active) (chart A); *Tenuiphantes floriana* (eurychrone winter-active) and *Urocoras longispina* (eurychrone) (chart B).

Species composition and habitat types

In Table I, we summarized the number of males and females per habitat type and the total number of individuals. As regards ground-living spider fauna, we found nearly the same number of species in the meadow (59) and the shrubland (57), while there were only 40 in the deciduous forest. The number of individuals was highest in the shrub.

We analyzed the distribution among the three habitat types for all species with more than 6 individuals. If a clear majority of specimens of one species was found in only one habitat type, its ecological type was assigned as meadow (m), shrub (s) or wood (w). Species that occurred mainly in the open habitat (meadow) and shrubs are marked with m/s, and species with a preference for wood and shrubs with s/w. Thus, habitat preference could be assigned for 26 species.

Seven species occurred only or mainly in the meadow. Seven other species were found typically in the shrub, and in the deciduous forest there were 5 species.

Discussion

In this investigation with only three sampling sites and using only pitfall trapping, 116 is quite a high number of species. Compared to literature data (Tomić & Grbić, 2008, Grbić & Savić, 2010, Grbić *et al*., 2015), 50 species are new for Erdelj (total 171). Thirty-four represent new records for Mt. Fruška Gora, which increases the list of species to 301. In a very similar Pannonian mountain region, the Villányi Hills in Hungary, a total of 201 species of spiders has been recorded (Lajos & Vadkerti, 2004), which indicates that Mt. Fruška Gora has a greater diversity than so far recorded.

Among all species in this study, 6 represent new records for Serbia. According to their European distribution ranges (Nentwig *et al*., 2022) most of them could be expected here. But the number of newly registered species is unexpected since this is the third project at the same locality. This confirms the importance of long-term sampling that includes the winter. Further support for this is one of the “new” species, the winter-active *Asthenargus bracianus*. All these findings have already been reported but not explained in Grbić *et al*. (2021), so the total number of spiders recorded in Serbia (750) remains unchanged.

Species distribution among the three different habitats (meadow, shrub and forest) corresponds well with the expectation that the lowest number of species would be found in the deciduous forest (just ground-living species). Only seven (6%) of the more abundant species (>6 individuals) are restricted to the open habitat. One of them is the rarely collected *Pelecopsis loksai*. But if we also include the species with lower numbers of captured individuals, we have 39 more species that were found only in the open habitat. In total, this makes 47 species typical for the meadow, representing 78% of the species captured in this habitat and 40% of the species captured in all three habitats. This underlines the importance of the meadow habitat in the context of the more forest-dominated conservation area of Mt. Fruška Gora.

During the previous investigation at Erdelj in 2010, Grbić *et al*. (2015) proposed *Nemesia pannonica* as a potential indicator species for the area. In the spring of 2012, a deliberately ignited fire devastated a large part of the meadow where this species lives (although it did not directly impact the place where the traps were positioned) and affected the population. Its reproductive activity period was unchanged, but the total number of individuals captured was significantly lower than in 2010 (65 vs. 97). Since spiders react quickly to

changes in the environment (Gack *et al.*, 1999), these observations of decreased abundance could represent an indicator of negative impact at this site.

Furthermore, 5 species of strictly protected spiders in Serbia (*Inermocelotes inermis*, *Porrhomma microps*, *Tegenaria campestris*, *Cicurina cicur* and *Centromerus cavernarum*) ("Official Gazette of RS", no. 5/2010, 47/2011, 32/2016 and 98/2016) that were found here could also be used for improving conservation measures in the locality.

Concerning the winter fauna, the number of collected winter-active species in other studies vary from 26 recorded in Hungary (Ingl *et al.*, 2020), to 58 in Switzerland (Käser *et al.*, 2010) and 140 in Germany (Blick, 2011). This huge dissimilarity is mostly caused by different research patterns, collecting techniques, areas of research and other non-spider factors. In our study, 11 winter-active species, even though not comparable with other results, give us a first insight into the winter-active spider fauna in Serbia. The only common factor in these four studies is that the family Linyphiidae is the most abundant family in this period.

Looking closer in the winter period, five species (*Ozyptila atomaria*, *Stemonyphantes lineatus*, *Centromerus cavernarum*, *Palliduphantes alutacius* and *Araeoncus humilis*) were found only in small numbers over the year but more in winter than in the longer summer period. However, due to the insufficiencies of literature data, we hesitate to consider them winter species. In contrast, we qualified *Asthenargus bracianus*, *Centromerus incilium,* and *Ostearius melanopygius* as winter species, even though they were recorded with only one individual. But all these species are rarely documented and mostly found in wintertime. On the other hand, the common "whole year species" *Centromerus sylvaticus* appears in our material atypically as a winter singleton.

In closing, the appearance of the species *Pelecopsis loksai* in the winter fauna in some way resolves a dilemma as to whether this is a so-called "rare species". In our research, 43 individuals (41♂♂, 2♀♀) were found from November to March (Fig. 3, chart A). Therefore, this is actually a rarely collected and typically winter-active spider, as already proposed by Szinetár & Samu (2003), even if single specimens have been found in spring (Grbić *et al*., 2015) or summer (Naumova *et al*., 2021).

Acknowledgments

The authors are thankful to Educons University, Faculty of Environmental Protection, Serbia, for providing the necessary support for laboratory work, and to all our friends who helped during the fieldwork. We are also thankful to Sara Oakeley for linguistic improvements to the manuscript and to the two anonymous reviewers for their helpful and constructive comments.

References

Blick, T. (2011). Abundant and rare spiders on tree trunks in German forests (Arachnida, Araneae). *Arachnologische Mitteilungen*, *40*, 5-14. doi: 10.5431/aramit4002

Code on declaration and protection of strictly protected and protected wild species of plants, animals and fungi ("Official Gazette of RS", no. 5/2010, 47/2011, 32/2016 and 98/2016).

Deltshev, C., Ćurčić B., & Blagoev G. (2003). *The Spiders of Serbia*. Institute of zoology, Faculty of Biology, University of Belgrade, Belgrade, Yugoslavia, 832pp.

El-Hennawy, H. K., Mohafez, M. A., El-Gendy, A. A., & Zaher, I. A. I. (2016). The first record *of Ostearius melanopygius* (O. Pickard-Cambridge, 1879) and genus *Ostearius* Hull, 1911 (Araneae: Linyphiidae) in Egypt. *Serket, 15*(1), 63-7.

Gack, C., Kobel-Lamparski, A., & Lamparski, F. (1999). Spinnenzönosen als Indikatoren von Entwicklungsschritten in einer Bergbaufolgelandschaft. *Arachnologische Mitteilungen*, *18*, 1-16.

Grbić, G., & Savić, D. (2010). Contribution to the knowledge of the spider fauna (Arachnida, Araneae) on the Fruška Gora Mt. *Acta Entomologica Serbica*, *15*(2), 243-260.

Grbić, G., Hänggi, A., & Krnjajic, S. (2021). Spiders (Araneae) of Subotica sandland: additional arguments in environmental protection. *Acta Zoologica Academiae Scientiarum Hungaricae*, *67*(1), 15-61. doi:10.17109/AZH.67.1.15.2021

Grbić, G., Hänggi, A., & Savić, D. (2015). New faunistic records of spiders (Arachnida, Areneae) from the Fruška Gora Mt., North Serbia. *Acta Zoologica Bulgarica*, *67*(3), 479-486.

Grbić, G., Hänggi, A., Gajić, I., Vaselek, S., & Ivković, S. (2019). Spiders (Araneae) living in the Deliblato Sands (Serbia) the largest European continental sands. *Acta Entomologica Serbica*, *24*(1),79-93. https://doi.org/10.5281/zenodo.3249916

Grimm, U. (1985). Die Gnaphosidae Mitteleuropas (Arachnida, Araneae). *Abhandlungen des Naturwissenschaftlichen Vereins in Hamburg (NF), 26*, 1-318.

Hänggi, A., Stöckli, E., & Nentwig, W. (1995). *Habitats of central European spiders*. Miscellanea Faunstica Helvetiae 4. Centre Suisse de Cartographie de la Faune, Neuchâtel, 460 pp.

Helsdingen, P. J. van, IJland, S. (2015). A quick scan of the spider fauna in the surroundings of Përmet, Albania (Arachnida, Araneae) - preliminary report. *Nieuwsbrief SPINED*, *35*, 15-33.

Holm, Å. (1962). The spider fauna of the East African mountains. Part I: Fam. Erigonidae. *Zoologiska Bidrag från Uppsala, 35*, 19-204.

Ingle, K., Kaur, H., Gallé-Szpisjak, N., Bürgés J., Szabó, Á., & Gallé, R. (2020). Winter-Active Spider Fauna is Affected by Plantation Forest Type. *Environmental Entomology*, *49*(3), 601–606. doi:10.1093/ee/nvaa025

Käser, J., Amrhein, V., & Hänggi, A. (2010). Spinnen (Arachnida, Araneae) im Winter – kleinräumige Unterschiede als Folge tageszeitlicher Temperaturschwankungen. *Arachnologische Mitteilungen*, *39*, 5-20.

Kastrygina, Z. A., & Kovblyuk, M. M., (2013). A review of the spider genus *Thanatus* C.L. Koch, 1837 in Crimea (Aranei: Philodromidae). *Arthropoda Selecta*, *22*(3), 239-254. doi:10.15298/arthsel.22.3.07

Kim, S. T., & Lee, S. Y. (2013). Arthropoda: Arachnida: Araneae: Mimetidae, Uloboridae, Theridiosomatidae, Tetragnathidae, Nephilidae, Pisauridae, Gnaphosidae. Spiders. *Invertebrate Fauna of Korea*, *21*(23), 1-183.

Kubcová, L. (2004). A new spider species from the group *Philodromus aureoles* (Araneae, Philodromidae) in Central Europe. In Thaler, K. (Ed.) Diversität und Biologie von Webspinnen, Skorpionen und anderen Spinnentieren. *Denisia*, *12*., 291-304.

Kůrka, A., Naumova, M., Indzhov, S. & Deltshev, C. (2020). New faunistic and taxonomic data on the spider fauna of Albania (Arachnida: Araneae). *Arachnologische Mitteilungen*, *59*, 8-21. doi:10.30963/aramit5903

Lajos, L., & Vadkerti, E. (2004). Contributions to the ground-dwelling spider fauna (Araneae) of Villányi Hills. Kaposvár, *Somogyi Múzeumok Közleményei*, *16*, 301-312.

Law on National Parks ("Official Gazette of the RS" no 84/15).

Miller, F. (1938). Zwei neue Höhlenspinnen aus den Grotten Jugoslaviens. *Festschrift Embrik Strand*, *4*, 629-633.

Miller, F. (1967). Studien über die Kopulationsorgane der Spinnengattung *Zelotes*, *Micaria*, *Robertus* und *Dipoena* nebst Beschreibung einiger neuen oder unvollkommen bekannten Spinnenarten. *Přírodovědné práce ústavů Československé Akademie Věd v Brně* (N.S.), *1*, 251-298.

Muster, C., & Thaler, K. (2004). New species and records of Mediterranean Philodromidae (Arachnida, Araneae): I. *Philodromus aureolus* group. In Thaler, K. (Ed.), Diversität und Biologie von Webspinnen, Skorpionen und anderen Spinnentieren. *Denisia*, *12*, 305-326.

Naumova, M., Blagoev, G., & Deltshev, D. (2021). Fifty spider species new to the Bulgarian fauna, with a review of some dubious species (Arachnida: Araneae). *Zootaxa*, *4984*, 228-257.

Nentwig, W., Blick, T., Bosmans, R., Gloor, D., Hänggi, A., & Kropf, C. (2022). araneae - Spiders of Europe. Version 08.2022. Retrieved from: https://www.araneae.nmbe.ch [Accessed on 22.09.2022]. doi: 10.24436/1

Nikolić, F., & Polenec, A. (1981). *Catalogus faunae Jugoslaviae III/4 Aranea.* Slovenska Akademija znanosti in Umetnosti, Ljubljana, Yugoslavia, 135 pp.

Ponomarev, A. V., Bastaev, V. V., Dubovikoff, D. A., & Shmatko, V. Y. (2018). On a small collection of spiders (Aranei) from the Astrakhan Reserve (Russia). *Arthropoda Selecta*, *27*(3), 244-256. doi:10.15298/arthsel.27.3.09

Pozzi, S., & Hänggi, A. (1998). Araignées nouvelle ou peu connues de la Suisse (Arachnida: Araneae). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft*, *71*(1-2), 33-47. doi:10.5169/seals-402696

Roberts, M. J. (1998). *Spinnengids*. Tirion, Baarn, Netherlands, 397 pp.

Rozwałka, R., & Stachowicz, J. (2010). First record of *Ostearius melanopygius* (Cambridge, 1879) (Araneae: Linyphiidae) in the eastern part of Poland. *Przeglad Zoologiczny, 52-43*, 159-161.

Rozwałka, R., Rutkowski, T., Staręga, W., & Sienkiewicz, P. (2016). Occurrence of *Thanatus atratus* Simon, 1875 (Araneae: Philodromidae) in Poland. *Biological Letters*, *52*(1-2, 2015), 11-17. doi:10.1515/biolet-2015-0011

Růžička, V., (1995). The spreading of *Ostearius melanopygius* (Araneae: Linyphiidae) through central Europe. *European Journal of Entomology*, *92*, 723-726.

Schaefer, M. (1987). Life cycles and diapause. In: Nentwig W, (Ed.). Ecophysiology of spiders. Berlin: Springer-Verlag, 331-347.

Segers, H. (1992). Nomenclatural notes on, and redescriptions of some little-known species of the *Philodromus aureolus* group (Araneae: Philodromidae). *Bulletin of the British Arachnological Society*, *9*, 19-25.

Sisojević, P., & Miller, F., (1978). Prilog poznavanju pauka (Araneida) Fruške gore. *Zbornik za prirodne nauke*, Matica srpska, Novi Sad, *54*, 243-253.

Szinetár, C., Samu, F. (2003). *Pelecopsis loksai* sp. n., a new erigonine spider from Hungary (Araneae: Linyphiidae). *Bulletin of the British Arachnological Society*, *12*, 412-414.

Szita, É., & Samu, F. (2000). Taxonomical review of *Thanatus* species (Philodromidae, Araneae) of Hungary. *Acta Zoologica Academiae Scientiarum Hungaricae*, *46*, 155-179.

Thaler, K. (1991). Über wenig bekannte Zwergspinnen aus den Alpen – VIII (Arachnida: Aranei, Linyphiidae: Erigoninae). *Revue Suisse de Zoologie*, *98*(1), 165-184. doi:10.5962/bhl.part.79783

Tomić, V., Grbić, G. (2008). Preliminary notes on spider fauna of mt. Fruška Gora. *Invertebrates (Invertebrata) of The Fruška Gora mountain I.* Matica Srpska, Novi Sad, 57-64.

WSC (2022): World Spider Catalog. Version 20.0. Natural History Museum Bern, Retrieved from: http://wsc.nmbe.ch [Accessed on 05.09.2020]. https://doi.org/10.24436/2

ДОДАТНЕ ИНФОРМАЦИЈЕ О ПАУКОВИМА ФРУШКЕ ГОРЕ (СРБИЈА) СА ПРВИМ УВИДОМ У ЗИМСКЕ ВРСТЕ

ГОРДАНА ГРБИЋ И АМБРОС ХЕНГИ

Извод

Мониторинг паукова помоћу клопки често укључује само податке сакупљене током вегетационог периода. У овом раду представљамо резултате вишегодишњег узорковања на локалитету Ердељ, Фрушка гора, који су сакупљени током 19 месеци 2011/2012. Посебан акценат је био на зимском периоду. На три места узорковања, ливади, жбуњу и листопадној шуми, идентификовано је 1113 одраслих паукова из 116 врста. 34 врсте су нови подаци за планину, док, шест врста представља нове налазе за фауну Србије. На ливади је уловљен највећи број врста (59), са високим уделом врста (40%), сакупљених само у овом типу станишта. Утврђено је да је 11 врста активно углавном или искључиво зими. Четири зимске врсте су такозвани ретки паукови, а две врсте међу њима су нови налази за Србију (*Ostearius melanopygius* и *Asthenargus bracianus*) . Пет врста од свих забележених (*Inermocelotes inermis*, *Porrhomma microps*, *Tegenaria campestris*, *Cicurina cicur* и *Centromerus cavernarum*), налазе се на листи строго заштићених паукова у Србији и могу се користити као додатни аргумент у заштити животне средине.

Received: October 26th, 2022
Accepted: December 20th, 2022