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SPIDERS (ARANEAE) OF THE DELIBLATO SANDS (SERBIA)

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Abstract

The Special Nature Reserve "Deliblato Sands" in Serbia is the largest European continental sand area situated between the Danube River and western Carpathian slopes. Forestation, agriculture and fire are the main threats to this landscape. While plants and vertebrates are well known in this area, spiders were researched for the first time. Collecting with pitfall traps, sweep nets and beating in four different habitat types during a whole vegetation period yielded 1120 adult specimens and 96 species. Eight species represent first records for the Serbian fauna: *Atypus muralis* Bertkau, 1890, *Gnaphosa muscorum* (L. Koch, 1866), *Zelotes segrex* (Simon, 1878), *Mecopisthes peusi* Wunderlich, 1992, *Oxyopes heterophthalmus* (Latreille, 1804), *Heliophanus lineiventris* Simon, 1868, *Simitidion simile* (C. L. Koch, 1836) and *Xysticus mongolicus* Schenkel, 1963. In our study, six of these species were restricted to the open sandy habitat, highlighting the special importance of this unique habitat type.

KEY WORDS: faunistic research, Serbia: Vojvodina province, new national records

Introduction

The Special Nature Reserve "Deliblato Sands" in Serbia (Official Gazette of RS, no. 3/2002 and 81/2008) is the largest European continental sand area situated between the Danube River and western Carpathian slopes (44°48'- 45°1'N; 38°36'- 38°58' E) (Fig. 1). It has an elliptic shape and it is oriented from southeast to northwest, covering over 300 km². It was formed during the Pleistocene from vast layers of silica-carbon sand. Finally, the east wind called "košava" formed a clear dune relief that rises between 70 and 200 m a.s.l. (INC Serbia, 1998).

Figure 1. Special Nature Reserve "Deliblato Sands" (green) in Serbia. Red point indicates the location of the four investigated localities.

The climate is semi-arid continental Pannonian, with large diurnal and annual fluctuations in temperature (-30 and +42 °C), relatively low annual precipitation (633 mm), and an absence of surface watercourses (Popović *et al.*, 2012). During summer and particularly in the hottest month (August), climate conditions show a tendency toward aridity since soil temperatures can reach over 60 °C during the day, and water loss in the soil of about 25 % of the total precipitation can occur (Kadović *et al.,* 2014). These conditions have generated a unique mosaic of ecosystems that contain typical species of flora and fauna, many of which are rare and/or endemic or subendemic (INC Serbia, 1998).

The main parts of Deliblato Sands are dune habitats with steppe-grassland plains, pastures, steppe-forest, and a few remaining desert and semi-desert areas (INC Serbia, 1998). Though not a part of our investigated habitats, we would like to add that the protected area also includes a part of the Danube River course, its marshes and islets. Water bodies with high densities of fish and a number of hatcheries represent an important gathering point and mass wintering ground for waterfowl. This was one of the main reasons why Deliblato Sands was designated an Important Bird Area (IBA) in 1989. As in many areas in Serbia, human influence is present in the form of reforestation on dunes and steppes, plowing of the remaining steppes for agriculture, as well as intentional fires (Popović *et al.*, 2012).

For the locality Deliblato Sands itself, no historical findings of spiders exist. There are only a few records from the nearby village of Deliblato. In 1981, Nikolić & Polenec reported 3 spider species: *Cheiracanthium pelasgicum* (C. L. Koch, 1837), *Araneus marmoreus* Clerck, 1757 and *Ero tuberculata* (De Geer, 1778).

The aim of this study was to provide a first list of spider species for this important site of nature protection, and to give some suggestions for the management of the protected area.

Materials and Methods

Environmental protection regime at study area

According to the Regulation on the Protection of Special Nature Reserve Deliblato Sands (Official Gazette of RS, no. 3/2002 and 81/2008), the protection regime is divided into 3 levels:

Level I: Total protection (core area, 6.53 % of the area): this part covers the most valuable areas in terms of environmental protection. Only activities that are permitted here are related to the conservation and enhancement of natural species, scientific research and sanitary hunting and fishing. Our investigated localities, Heronje (sandy area) and Crni Vrh (oak wood), were situated in this highly protected area.

Level II: Moderate protection (buffer zone, 23.75 % of the area): Special measures are undertaken to improve and preserve indigenous natural resources. Controlled educational excursions and special forms of tourism (eco-tourism), as well as controlled hunting and fishing are permitted.

Level III protection as in a Special Nature Reserve transition zone (69.72 % of the area): human development and economic use are allowed on condition it is in socio-cultural and ecologically sustainable limits. Tourist and recreational activities, hunting, fishing and food production (traditional forms) are allowed within clearly defined limits.

Locality descriptions

Material was collected in three localities with four sampling plots that correspond to the following four different habitat types typical for Deliblato Sands:

SA: sandy area with loose semi-cohesive sand with a steppe grassland community at Heronje (Fig. 2a) (N44 53.087 E21 04.829), I level of protection.

SC: xeric shrubland on sandy ground with common juniper, hawthorn, and black locust at Heronje (Fig. 2b, background) (N44 53.030 E21 04.931), I level of protection.

JW: open juniper wood with old wild eastern red-cedar (*Juniperus virginiana*) at Čardak (Fig. 2c) (N44 52.718 E21 04.131), II level of protection.

QW: mixed oak wood, mostly presented as *Rhamno-Quercetum virgilianae* (Fig. 2d) (N44 54.589 E21 07.445), I level of protection.

Heronje – The landscape at this locality is a mosaic of open sandy habitats and mixed shrubs. The sandy area (sampling plot SA) is a sharp relief of loose semi-cohesive sand with a minimum quantity of organic matter (Fig. 2a). The typical grassland community is *Festuceum vaginatae deliblaticum* Stjep.-Ves. The natural value of the site is based on numerous endemic plants (e.g. *Helichrysum arenarium*) and insects (e.g. *Tentyria frivaldszkii* Kraatz, 1865) as well as some species of antlions (e.g. *Myrmecaelurus trigrammus* (Pallas, 1771)) that are also present in North Africa (INC Serbia, 1998). The shrubs area (sampling plot SC) consist of common juniper (*Juniperus communis* L.), hawthorn (*Crataegus monogyna*) and black locust (*Robinia pseudoacacia* L.) (Fig. 2b, background). Impenetrability is the basic characteristic of this landscape. The vegetation cover at ground level is about 5-25 %, with clearly visible loose yellow sand. In the past, this

locality was sporadically forested with pine trees that all burned down in 1996. The whole locality suffered a great deal after the fire, but has recovered remarkably well (INC Serbia, 1998).

Čardak – this locality is very large and heterogeneous, with steppes, open sands, planted woods and a settlement for children recreation. Our sampling plot (JW) was an island of 70-year-old wild eastern red-cedar wood (*Juniperus virginiana*), one of the oldest planted woods on Deliblato Sands (INC Serbia, 1998). This is the only part of Deliblato Sands that was not burned down during the great fire in 1996 (pers.comm. Marius Oldja). The size of the wood is around 0.405 hectares, at 153 m a.s.l. Vegetation cover at ground level is 0-5 %. Only some small patches of moss could be observed. The shrub layer is very dense (INC Serbia, 1998). The *Juniperus* wood is surrounded by mixed shrubs (juniper, hawthorn, and black locust), some small clearings and mixed deciduous woods (pers.comm. Marius Oldja).

Crni Vrh – this is one of the most important areas at Deliblato Sands, protected since 1912 as a Natural Monument. The basic landscape characteristic of this locality is a well-preserved natural succession from open sandy areas over steppes to a forest. This unique hill goes up to 198 m a.s.l. and represents one of the highest points of Deliblato Sands. In the center of the locality there is a mixed oak wood association (*Rhamno-Quercetum virgilianae*). At the drier parts, it is mixed with shrubs (*Cotinus coggygria*, *Crataegus monogyna* and *Juniperus communis*) and grasslands with *Chrisopogonetum pannonicum* and *Festuco-Potentilletum arenaria* as the last remains of autochthonous communities of the Pannonian plain (INC Serbia, 1998). The litter layer is well developed, vegetation cover at ground level is 50-75 %, while the shrub layer is very poorly developed. We only had one sampling plot at this area in the mixed oak wood (QW).

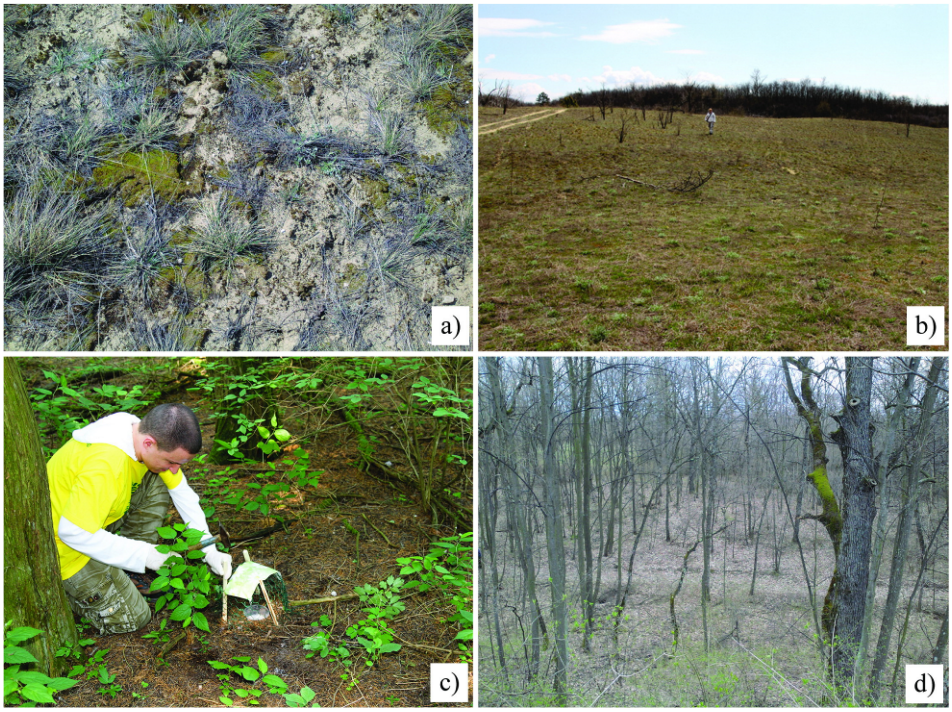

Figure 2 (a-d). Sampling plots in Special Nature Reserve "Deliblato Sands" in Serbia. a) sandy area (SA) at Heronje, b) in the background xeric shrubland (SC) in Heronje, c) open juniper wood (JW) in Čardak showing type of pitfall trap with wire mesh and plastic roof and d) mixed oak wood (QW) at Crni Vrh.

Sampling method

Spiders were collected using three techniques: pitfall traps, sweep netting, beating. Pitfall traps were made of plastic 50-cl cups, with a roof of wire mesh (to protect small vertebrates), a plastic folium as a roof against the rain and wooden sticks to fix the roof and the wire mesh (Fig. 2c). Trapping liquid was 40 cl of formalin (4 %) with a small amount of detergent added. In total, 20 traps were placed, 5 traps per plot were positioned in a row, with a 10-m distance between each trap. Sampling started on 21st June 2013 and ended on March 1st 2014. In the summer period till 16th November 2013, traps were emptied every 14 days; the traps were then left open over the winter period and emptied one last time on March 1st 2014.

Sweep netting and beating were applied only to complete the species list with no standardized procedure. Sweep netting was applied only at the sandy area (SA), while beating was applied in the sandy area (SA), the *Juniperus* wood (JW) and the *Quercus* wood (QW).

The collected material was preserved in 70 % ethanol. Determination of species was largely based on the website *Araneae – Spiders of Europe* (Nentwig *et al.,* 2019). Further literature for individual groups or species was also used but is only mentioned where species are discussed. Reference collections are deposited in Switzerland in the Naturhistorisches Museum Basel in Basel, and in the personal collection of the first author. The nomenclature follows The World Spider Catalogue (WSC, 2019).

Results

A total of 2 737 individuals were caught (685 males, 425 females and 1 627 juveniles) and 96 species from 22 families were identified (Table I). The most diverse families in the material were Linyphiidae with 19 species (19.8 %), followed by Theridiidae (12, 12.5 %), Gnaphosidae (10, 10.4 %) and Araneidae, Thomisidae and Salticidae with 9 species each (9, 9.4 %). Ten families were represented with only one species. The most numerous species was *Agroeca cuprea* (281 individuals, 10.3 %) from the family Liocranidae, followed by *Tenuiphantes flavipes* (132, 4.8 %) from Linyphiidae. Other species were present with less than 100 individuals, while 46 species (47.9 %) were represented by only one or two individuals.

The following eight species represent first records for the Serbian fauna. Only the most important references are listed in the comments about our findings. For a complete list of taxonomic literature, see Nentwig *et al.* (2019) and the WSC (2019).

Table I. Species of spiders caught at four habitats in the Special Nature Reserve "Deliblato Sands" (Serbia) by pitfall traps, sweep netting and beating. First records for Serbian fauna are in grey. Unique species for every habitat are also in grey (M-male, F-female).

Family / species	Pitfalls	Beating & Sweepnet	Total	SA: sandy area		SC: shrubland		JW: juniper wood		QW: oak wood	
				M	F	M	F	M	F	M	F
Agelenidae											
Allagelena gracilens (C. L. Koch, 1841)	1	0	**1**			1					
Urocoras longispina (Kulczyński, 1897)	55	0	**55**							52	3
Anyphaenidae											
Anyphaena accentuata (Walckenaer, 1802)	0	1	**1**								1
Araneidae											
Agalenatea redii (Scopoli, 1763)	0	1	**1**	1							
Araneus angulatus Clerck, 1757	0	2	**2**					1	1		
Araneus diadematus Clerck, 1757	0	4	**4**					2	2		
Araneus marmoreus Clerck, 1757	0	1	**1**		1						
Argiope bruennichi (Scopoli, 1772)	0	2	**2**	1	1						
Argiope lobata (Pallas, 1772)	0	4	**4**	2	2						
Cyclosa conica (Pallas, 1772)	0	1	**1**								1
Gibbaranea bituberculata (Walckenaer, 1802)	1	0	**1**				1				
Zilla diodia (Walckenaer, 1802)	1	4	**5**						1	4	
Atypidae											
Atypus muralis Bertkau, 1890	4	0	**4**	2				2			
Clubionidae											
Clubiona comta C. L. Koch, 1839	1	0	**1**								1
Clubiona terrestris Westring, 1851	1	0	**1**			1					
Dysderidae											
Dysdera longirostris Doblika, 1853	20	0	**20**			1	13		4	1	1
Harpactea rubicunda (C. L. Koch, 1838)	58	0	**58**	1		11	23	4	12	3	4
Eutichuridae											
Cheiracanthium elegans Thorell, 1875	0	1	**1**							1	
Gnaphosidae											
Drassodes lapidosus (Walckenaer, 1802)	2	0	**2**			1	1				
Gnaphosa muscorum (L. Koch, 1866)	14	0	**14**	6	8						
Nomisia aussereri (L. Koch, 1872)	9	0	**9**	4	5						
Phaeocedus braccatus (L. Koch, 1866)	1	0	**1**			1					
Zelotes apricorum (L. Koch, 1876)	31	1	**32**			8	11	2	1	5	5
Zelotes aurantiacus Miller, 1967	1	0	**1**			1					
Zelotes erebeus (Thorell, 1871)	2	0	**2**	1		1					
Zelotes longipes (L. Koch, 1866)	7	0	**7**	7							
Zelotes segrex (Simon, 1878)	14	0	**14**	5	7		2				
Zelotes subterraneus (C. L. Koch, 1833)	2	0	**2**						1		1
Linyphiidae											
Abacoproeces saltuum (L. Koch, 1872)	1	0	**1**						1		
Agyneta fuscipalpa (C. L. Koch, 1836)	3	0	**3**	2	1						

Table I – continued

Family / species	Pitfalls	Beating & Sweepnet	Total	SA: sandy area		SC: shrubland		JW: juniper wood		QW: oak wood	
				M	F	M	F	M	F	M	F
Agyneta rurestris (C. L. Koch, 1836)	35	3	**38**	25	7	1	1	1	1	1	
Araeoncus humilis (Blackwall, 1841)	2	0	**2**	2							
Centromerus sylvaticus (Blackwall, 1841)	27	0	**27**			6	1	1	1	17	2
Ceratinella brevis (Wider, 1834)	1	0	**1**				1				
Drapetisca socialis (Sundevall, 1833)	1	0	**1**					1			
Incestophantes crucifer (Menge, 1866)	19	0	**19**			10	7		1	1	
Lepthyphantes leprosus (Ohlert, 1865)	1	0	**1**								1
Linyphia triangularis (Clerck, 1757)	1	4	**5**					2	2		1
Mecopisthes peusi Wunderlich, 1992	1	0	**1**	1							
Megalepthyphantes collinus (L. Koch, 1872)	2	0	**2**				1				1
Neriene radiata (Walckenaer, 1841)	1	0	**1**								1
Palliduphantes alutacius (Simon, 1884)	3	0	**3**					3			
Palliduphantes istrianus (Kulczyński, 1914)	31	0	**31**			11	13	2		4	1
Pelecopsis loksai Szinetar & Samu, 2003	3	0	**3**	1		2					
Tenuiphantes flavipes (Blackwall, 1854)	132	0	**132**			13	15	35	37	15	17
Thyreosthenius parasiticus (Westring, 1851)	2	0	**2**						2		
Trichoncoides piscator (Simon, 1884)	7	0	**7**	5				1	1		
Liocranidae											
Agroeca cuprea Menge, 1873	283	0	**283**	4		38	15	81	20	87	38
Lycosidae											
Alopecosa fabrilis (Clerck, 1757)	17	0	**17**	11	6						
Alopecosa farinosa (Herman, 1879)	4	0	**4**	4							
Arctosa lutetiana (Simon, 1876)	15	0	**15**			6	2	4	1	2	
Aulonia albimana (Walckenaer, 1805)	4	0	**4**				3		1		
Hogna radiata (Latreille, 1817)	2	0	**2**		2						
Pardosa alacris (C. L. Koch, 1833)	13	0	**13**				4		3		6
Trochosa terricola Thorell, 1856	29	1	**30**	1		4	10	5	4	1	5
Miturgidae											
Zora spinimana (Sundevall, 1833)	8	0	**8**				2			3	3
Oxyopidae											
Oxyopes heterophthalmus (Latreille, 1804)	0	7	**7**	1	6						
Oxyopes lineatus Latreille, 1806	1	7	**8**	1	6				1		
Philodromidae											
Philodromus rufus Walckenaer, 1826	0	1	**1**								1
Thanatus pictus L. Koch, 1881	15	0	**15**	15							
Tibellus macellus Simon, 1875	0	1	**1**	1							
Phrurolithidae											
Phrurolithus festivus (C. L. Koch, 1835)	17	0	**17**				1	1		7	8
Pisauridae											
Pisaura mirabilis (Clerck, 1757)	0	1	**1**		1						
Salticidae											
Evarcha arcuata (Clerck, 1757)	0	1	**1**					1			

Table I – continued

Family / species	Pitfalls	Beating & Sweepnet	Total	SA: sandy area		SC: shrubland		JW: juniper wood		QW: oak wood	
				M	F	M	F	M	F	M	F
Evarcha falcata (Clerck, 1757)	5	6	**11**			3		6	1	1	
Heliophanus cupreus (Walckenaer, 1802)	0	2	**2**		2						
Heliophanus flavipes (Hahn, 1832)	0	1	**1**	1							
Heliophanus lineiventris Simon, 1868	0	7	**7**	5	2						
Leptorchestes berolinensis (C. L. Koch, 1846)	0	1	**1**		1						
Neon reticulatus (Blackwall, 1853)	1	0	**1**				1				
Pellenes nigrociliatus (Simon, 1875)	3	0	**3**		3						
Philaeus chrysops (Poda, 1761)	0	1	**1**		1						
Theridiidae											
Dipoena melanogaster (C. L. Koch, 1837)	0	1	**1**		1						
Enoplognatha ovata (Clerck, 1757)	0	1	**1**							1	
Episinus angulatus (Blackwall, 1836)	1	0	**1**						1		
Episinus truncatus Latreille, 1809	5	0	**5**			2				3	
Euryopis quinqueguttata Thorell, 1875	0	1	**1**		1						
Neottiura bimaculata (Linnaeus, 1767)	0	2	**2**						2		
Parasteatoda lunata (Clerck, 1757)	0	2	**2**							1	1
Phylloneta impressa (L. Koch, 1881)	1	2	**3**		3						
Platnickia tincta (Walckenaer, 1802)	1	4	**5**				1		4		
Simitidion simile (C. L. Koch, 1836)	0	2	**2**		1				1		
Steatoda albomaculata (De Geer, 1778)	3	0	**3**	3							
Theridion varians Hahn, 1833	0	1	**1**						1		
Thomisidae											
Ebrechtella tricuspidata (Fabricius, 1775)	0	5	**5**					5			
Misumena vatia (Clerck, 1757)	0	1	**1**	1							
Ozyptila praticola (C. L. Koch, 1837)	47	18	**65**			1		52	7	4	1
Synema globosum (Fabricius, 1775)	0	2	**2**		2						
Thomisus onustus Walckenaer, 1805	0	3	**3**	2	1						
Tmarus piger (Walckenaer, 1802)	0	6	**6**	2	3				1		
Xysticus kochi Thorell, 1872	0	2	**2**		2						
Xysticus luctator L. Koch, 1870	6	0	**6**			2	1	2			1
Xysticus mongolicus Schenkel, 1963	0	3	**3**	3							
Titanoecidae											
Titanoeca schineri L. Koch, 1872	5	0	**5**	1		3				1	
Uloboridae											
Hyptiotes paradoxus (C. L. Koch, 1834)	0	4	**4**						4		
Zodariidae											
Zodarion germanicum (C. L. Koch, 1837)	10	0	**10**			1	2	5	1		1
Individuals	994	126	**1120**	122	76	129	132	219	121	215	106
Species total	62	44	**96**	45		34		39		34	
Species pitfalls				24		34		28		26	
Species sweep net and beating				24				16		8	

Atypidae

Atypus muralis Bertkau, 1890

Records: 2 ♂♂, 23.07.2013, JW; 2 ♂♂, 23.07.2013, SA.

Determination: Schwendinger (1990).

Global Distribution (WSC 2019): Central Europe to Turkmenistan.

Note: *A. muralis* is a typical representative of xerothermic habitats. Based on its known European distribution, it was expected in Serbia. An interesting fact about this record is that the species was found at a locality that burned down almost totally in the great fire in 1996. It seems that the species survived on a small island of *Juniperus* wood that survived the fire.

Gnaphosidae

Gnaphosa muscorum (L. Koch, 1866)

Records: 5 ♂♂, 2 ♀♀, 05.07.2013, SA; 1 ♀, 23.07.2013, SA; 4 ♀♀, 18.08.2013, SA; 1 ♀, 13.10.2013, SA.

Determination: Marusik & Omelko (2014), Grimm (1985).

Global Distribution (WSC 2019): North America, Europe, Caucasus, Russia (Europe to Far East), Kazakhstan, China, Korea.

Note: *G. muscorum* was only caught in the sandy habitat, but according to Nentwig *et al.* (2019), it can also be found in open and dry coniferous forests and heathland, under moss, bark or stones during the day, up to 2500 m a.s.l. In correlation to its European distribution, the species was to be expected for the Serbian fauna.

Zelotes segrex (Simon, 1878)

Records: 1 ♀, 05.07.2013, SA; 2 ♂♂, 7 ♀♀, 23.07.2013 SA; 1 ♀, 01.08.2013, SA.

Determination: Senglet (2004), Grim (1985) (sub *Z. declinans*).

Global Distribution (WSC 2019): Europe, Turkey, Caucasus, Russia (Europe) to Central Asia.

Note: This is a further new record for Serbia of a species that was only caught in the sandy habitat. Looking at its European distribution, it was not surprising that the species would be detected in Serbia if looked for in the right xerothermic open habitats.

Linyphiidae

Mecopisthes peusi Wunderlich, 1972

Records: 1 ♂, 16.11.2013, SA.

Determination: Millidge (1978).

Global Distribution (WSC 2019): Europe, Israel.

Note: The ecology of this species is not yet clear. In Nentwig *et al.* (2019) (based on Russel-Smith *et al.*, 2011), “moist grassland in a clay quarry” is mentioned. Miller & Svaton (1978) found it in the litter of needles at the edge of a mixed forest (*Abieto-Fagetum*). Both these findings represent rather humid microhabitats, while our record comes from a very xerothermic site.

Oxyopidae

Oxyopes heterophthalmus (Latreille, 1804)

Records: 1 ♀, 21.06.2013, SA (SW); 1 ♂, 2 ♀♀, 11.07.2013, SA (SW); 1 ♀, 23.07.2013, SA (SW). 1 ♀, 01.08.2013, SA (SW); 1 ♀, 18.08.2013, SA (B).

Determination: Azheganova (1968), Roberts (1995).

Global Distribution (WSC 2019): Europe, North Africa to Middle East, Turkey, Caucasus, Kazakhstan, China.

Note: One more representative of arid habitats. According to its known European distribution, it was expected in Serbia.

Salticidae

Heliophanus lineiventris Simon, 1868

Records: 3 ♂♂, 31.08.2013, SA (B + SW); 1 ♂, 1 ♀, 15.09.2013, SA (SW); 1 ♂, 1 ♀, 27.09.2013, SA (SW).

Determination: Thaler (1987), Wesołowska (1986).

Global Distribution (WSC 2019): Europe, Turkey, Caucasus, Russia (Europe to Far East), China, Mongolia, Korea, Japan.

Note: In former versions of Nentwig *et al.* (2019), the species was already reported for Serbia. The reason is probably the misinformation that was downloaded from Fauna Europaea (van Helsdingen, 2018) where it is mentioned for the former Yugoslavia without details concerning the actual countries. In Deltshev *et al.* (2003), the species is not mentioned and in all subsequent literature on Serbian spiders there is no note of it.

Thomisidae

Xysticus mongolicus Schenkel, 1963

Records: 1 ♂, 31.08.2013, SA (B); 1 ♂, 15.09.2013, SA (SW); 1 ♂, 27.09.2013 SA (SW).

Determination: Utochkin & Savelyeva (1995), Fomichev (2015).

Global Distribution (WSC 2019): Ukraine, Russia (Europe to Central Asia), Azerbaijan, Kazakhstan, Mongolia, China.

Note: Deliblato sand is by far the westernmost occurrence of this species. It was registered only in the sandy habitat and collected by beating or sweeping the shrubs. No female was captured.

Theridiidae

Simitidion simile (C. L. Koch, 1836)

Records: 1 ♀, 15.09.2013, JW (B); 1 ♀, 13.10.2013, SA (B).

Determination: Knoflach (1996), Le Peru (2011).

Global Distribution (WSC 2019): Canada, Europe, North Africa, Turkey, Israel, Caucasus, Central Asia.

Note: As for *H. lineiventris*, the species was already reported for Serbia in previous versions of Nentwig *et al.* (2019), probably for the same reasons as given above.

There are several other species of special faunistic interest in Serbia. Some of the previous findings of these species are more that 100 years old and go back to the catalogues of Nikolić & Polenec (1981) and Deltshev *et al.* (2003):

Argiope lobata (Pallas, 1772): recorded on Mt. Fruška Gora by Chyzer & Kulczyński (1897).

Euryopis quinqueguttata Thorell, 1875: recorded at Negbina, nr. Užice by Stojićević (1929); once more at Negbina, nr. Užice by Drensky (1936).

Zelotes erebeus (Thorell, 1871): first records by Stojićević (1929) at the village Donja Ribnica, on Mt. Zlatibor and at Novi Hadžibegovac, nr. Smederevo; then again on Mt. Zlatibor with no precise locality by Drensky (1936).

Thanatus pictus L. Koch, 1881: first record by Bresjančeva (1907) at Topčider Park, Belgrade; then at Radovašnica, nr. Šabac and Rogot, nr. Kragujevac by Stojićević, (1929); last records mostly from the same places: Kragujevac, Kruševac, Šabac, and Topčider Park by Drensky (1936).

Titanoeca schineri L. Koch, 1872: single record by Nikolić & Polenec (1981) but with no precise locality.

Results from pitfall traps

Using pitfall traps, 620 ♂♂ and 374 ♀♀ out of 62 species were caught. The number of species per habitat is, with 24 to 34 species, rather uniform, but still shows big differences in the species compositions. In Table I, species unique to each habitat are highlighted. E.g., 58 % of the species in the sandy habitat were found only here (14 species out of 24), and several of them were in quite high abundance. In the *Quercus* wood, 15 % of species were found only there (4 species out of 26) and only one of these was in high abundance. The other two habitats also had some "specialists". In *Juniperus*, there were 7 species out of 28 (25 %) and in shrubs, 9 out of 34 (26 %), but all these species were caught only in very low numbers, mostly singletons. Only 28 species were found in more than one habitat. Of these "common" species, 18 (64 %) were restricted to shaded habitats (woods and shrubs). These results underline the specialness of the sandy habitat SA.

Results from sweep netting and beating

The application of these techniques was done only additionally, but nonetheless provided 126 individuals of 44 species. Only 10 of these species were also caught by pitfall traps. The use of these techniques also increased the number of first records for Serbia by 4 species: *Heliophanus lineiventris* Simon, 1868, *Oxyopes heterophthalmus* (Latreille, 1804), *Simitidion simile* (C. L. Koch, 1836) and *Xysticus mongolicus* Schenkel, 1963.

From the total of 44 species that were collected by sweep netting and beating, 21 were caught exclusively in the sandy habitat, 8 only in the *Juniperus* wood and 6 only in the *Quercus* wood. Among the 21 species unique for the sandy area, 13 seemed to be strongly adapted to dry or very dry habitats (xerophilic).

Despite the fact that sweep netting and beating were performed only rudimentarily, the information gathered significantly contributes to the general knowledge of these species and highlights the uniqueness of the spider fauna of the sandy place at Heronje.

Discussion

The results of our collecting techniques show that the locality "sandy area at Heronje" is highly unique. More than 50% of the recorded spider species of this habitat were found exclusively there. The majority of these

species are xerothermophilic with rather restricted distribution in Europe. In addition, all the eight species that are recorded for the first time for Serbia were found in this special habitat and five out of the eight species were found only here.

The Heronje locality is a touristic hotspot of the Deliblato region, although it is in the I level of protection. Buses stop here and in guided tours, the specialness of Deliblato Sands and its natural values are explained. Since education is an important part of the protection of this nature area, we would like to suggest that information about the unique spider fauna should be included in touristic information. As an example, the existing information table at this locality could be updated with photos and explanations about the unique, but mostly unnoticed spider fauna. Many of the visitors are schoolchildren, running around and playing in the area. Some small places in the locality could be fenced in to protect the animals and their habitats, supplemented with information on the role of spiders in the ecosystem and the factors endangering them. One such place could be an area where *Atypus muralis* lives, a rare species with an uncommonly long-life span of up to 8 years (Nentwig *et al.*, 2019) (Fig. 3.). The aim of such efforts should be to present important information about the hidden biodiversity, seldomly recognized, which also deserves to be protected, as are all the big birds, mammals and plants.

Furthermore, since most spiders are very small and some of them are active only during the night, the majority of people will never notice them. But at this locality, four of the typically xerothermophilic species can easily been recognized in the field: *Atypus muralis, Argiope lobata, Euryopis quinqueguttata* and *Steatoda albomaculata*. These species could be suggested for monitoring the spider community at Deliblato Sands in the future.

Finally, it should be underlined that even if none of the species recorded in this study belongs to the list of protected spiders of Serbia (Official Gazette of RS, no. 5/2010, 47/2011, 32/2016 and 98/2016), the uniqueness of Deliblato Sands is obvious. We would like to suggest that this list should be reviewed and some new awareness about Serbian spiders should be included.

Figure 3. Spider species *Atypus muralis* first record for Serbia (Deliblato Sands, Heronje locality), photo by Geza Farkaš.

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ПАУКОВИ (ARANEAE) ДЕЛИБЛАТСКЕ ПЕШЧАРЕ (СРБИЈА)

ГОРДАНА ГРБИЋ, АМБРОС ХЕНГИ, ИГОР ГАЈИЋ, СЛАВИЦА ВАСЕЛЕК И СЛОБОДАН ИВКОВИЋ

Извод

Специјални резерват природе “Делиблатска пешчара”, је највећа европска континентална пешчара која се налази између реке Дунав и западних Карпатских падина. Пошумљавање, пољопривредне активности и пожари су главне претње за овај предео. Биљке и кичмењаци су добро проучени, међутим ово је прво истраживање паукова на пешчари. Сакупљањем помоћу клопки, кошењем и трешењем, на четири различита типа станишта, током целог вегетационог периода, укупно је ухваћено 1120 одраслих јединки које представљају 96 врста. Од укупног броја забележених врста, осам представља нове налазе за Србију: *Atypus muralis* Bertkau, 1890, *Gnaphosa muscorum* (L. Koch, 1866), *Zelotes segrex* (Simon, 1878), *Mecopisthes peusi* Wunderlich, 1992, *Oxyopes heterophthalmus* (Latreille, 1804), *Heliophanus lineiventris* Simon, 1868, *Simitidion simile* (C. L. Koch, 1836) и *Xysticus mongolicus* Schenkel, 1963. У нашој студији шест од ових врста су забележене само на отвореном пешчаном простору, што истиче посебан значај овог јединственог станишта.

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