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DATA ON THE SPIDERS FAUNA (ARANEAE) FROM THE LEAOTA MOUNTAINS (ROMANIA)

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ABSTRACT. In this study is presented the results of the research on the spiders (Araneae) fauna from the Leaota Mountains. In the period May to September, 2016, were identified 78 species of spiders belonging to 17 families. The spiders species were grouped taking account of the biogeographical distribution and ecological preferences. From conservative point of view, two species, *Acantholycosa lignaria* (Clerck, 1757) and *Pardosa ferruginea* (C. L. Koch, 1870) are considered threatened species in some areas of the Carpathian chain.

Keywords: spiders, fauna, Leaota Mountains.

REZUMAT. Date asupra faunei de păianjeni (Araneae) din Munții Leaota (România). În acest studiu sunt prezentate rezultatele cercetării asupra faunei de păianjeni (Araneae) din Munții Leaota. În perioada mai - septembrie, 2016, au fost identificate 78 de specii de păianjeni aparținând la 17 familii. Speciile de păianjeni au fost grupate în funcție de distribuția biogeografică și de preferințele ecologice. Din punct de vedere conservativ, două specii, *Acantholycosa lignaria* (Clerck, 1757) și *Pardosa ferruginea* (C. L. Koch, 1870) sunt considerate specii periclitate, în unele zone ale lanțului carpatic.

Cuvinte cheie: păianjeni, fauna, Munții Leaota.

INTRODUCTION

In the specialized literature there were little information regarding to spiders fauna from the Leaota Mountains. One could make some assumptions about at the spiders species from the Leaota Mountains, starting with the existing data about these invertebrates from neighboring areas, especially the Bucegi and Piatra Craiului Mountains (Roșca, 1932; Fuhn & Niculescu-Burlacu, 1971; Sterghiu, 1985; Fuhn & Gherasim, 1995; Sterghiu & Dobre, 2003; Adam, 2006; Lotrean, 2006; Nae & Giurgincă, 2006).

Recently, in the period 2013-2015, in the Leaota Mountains, was realized a study about the invertebrate fauna from edaphic environment and from the subterranean superficial environment represented by several types of scree (Giurgincă et al., 2015; Popa & Dorobăţ, 2015; Nae & Dorobăţ, 2015 - unpublished data). On this occasion, 26 species of spiders was identified belonging to 9 families (Dorobăţ, 2016). Among the identified species, *Lessertinella kulczynskii* (Lessert, 1910) is mentioned for the first time in the Romanian fauna (Popa et al., 2015 - International Zoological Congress of Antipa Museum).

In 2016, a preliminary study over several groups of invertebrates from the Leaota Mountains was performed. This study pursued inventory of invertebrates species from different types of habitats, for drawing up the lists of species and for identification the protected ones, according to the national and European law. On this occasion, they were collected several species of spiders from the investigated habitats.

MATERIALS AND METHODS

The Leaota Mountains are located in the central south-eastern part of the Romania, to the eastern limit of the Meridional Carpathians (Fig. 1). Limits of the massif are: at the north and west the Dragoslavele-Bran Passage, to the south Subcarpaţii Ialomiţei and to the east the Bucegi Mountains. The Leaota Massif covers an area of approximately 336 km^2, which represents 2.24% of the Meridional Carpathians (Murătoreanu, 2009).

About three-quarters from the surface of the mountain is composed of crystalline schists, with compact appearance, less fragmented, with an average altitude of 1,262 m and slopes with gradients between 25 and 50% (Murătoreanu, 2009; Dorobăţ, 2016).

The average annual temperature ranges between 6 ^{o}C, at approximately 1,000 m altitude and 0 ^{o}C, at nearly 2,000 m height, with deviations from these values depending on exhibition. In the Leaota Mountains, the average temperature of the coldest month (January) vary between -8 ^{o}C, at heights of over 1,800 m and -4 ^{o}C, in the Dâmboviţei Valley, at the south-western extremity of the massif. The hottest months are July and August with average temperatures around 10 ^{o}C, on the main ridge and 18 ^{o}C, in the Dâmboviţa Valley (Murătoreanu, 2009).

The pluviometric regime (average annual values) varies with altitude, from less than 900 mm, in south of the region, to over 1,200 mm, at altitudes higher than 1,500 m. The lowest quantities of rainfall are recorded in January. These range between 50 mm, at altitudes lower than 1,000 m and 70 mm, to over 1,600 m height. The rainiest month is June. Rainfall recorded this month has values between 100 mm, in south-western extremity and over 160 mm, at altitudes higher than 1,400 m (Murătoreanu, 2009).

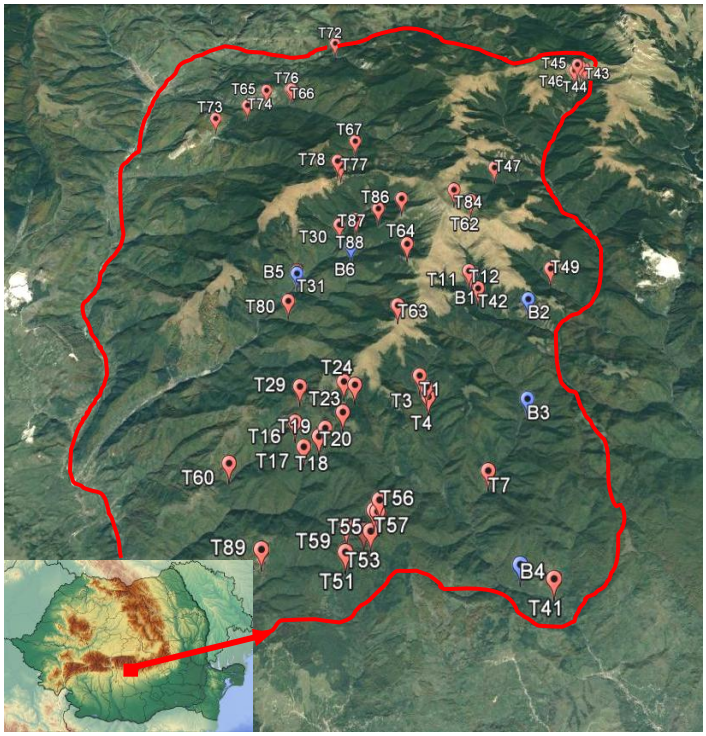

Figure 1 - The locating of the Leaota Mountains, transects (T) and pitfalls traps (B) (adapted from https://upload.wikimedia.org/wikipedia/commons/1/19/Romania_ location_map_ Topographic.png and Google Earth 2016).

The study was carried out in period May - September, 2016. Except for May, field data collection was done bimonthly. Capturing of the spiders was made concomitant with the collecting/identification to the others invertebrates species. Were used several collecting methods: cutting down from vegetation with entomological net, along a transect whit a length of about 100 m and a width of about 1-1.5 m; the prevailing of the material along of a transects with variable length, depending on the habitat and the land configuration; the length of transects was encompassed between 100 and 500 m and the width between of 10 to 20 m; the collecting was done directly, whit hand, whit tweezer or through suction, from the substrate: soil, boscage, from under rocks and tree stumps, on the plants, from under bark of the dead trees, on the surface of the rocks and from their cracks, etc.; pitfall traps (Barber traps - plastic cups of 500 ml with a height of 11.5 cm and an aperture of 9 cm, with 4% formaldehyde solution); in each collection station were placed three traps arranged in line at 10 m distance from each other; the traps remained in the ground between one and two months.

In the period May to September, traps were installed in six locations in the following types of habitats: spruce forest, spruce plantation, mixed forest (spruce

and beech) - in two locations, beech forest, riparian - the edge of mixed forest (selvage), spruce and beech (Fig. 1).

In the same time interval, May - September, 92 transects were realized, in 53 of these being identified the spiders species (Fig. 1), in the following types of habitats: spruce forest, spruce plantation, mixed forest (spruce and beech), mixed deciduous forest (beech, birch, poplar and very rarely fir and spruce), the edge of the mixed forest (spruce and beech), beech forest and the edge of the beech forest, riparian zone - edge of the mixed forest (spruce, beech and rare alder), riparian area (rare alder and beech), meadow/pasture, natural regeneration (birch and beech), the edge of the mixed forest (spruce and beech) - scree, deforestation (spruce forest). The altitude of the investigated habitats varied between 655 and 2,066 m.

For the determination of the spiders species the following sources were used: Fuhn & Niculescu-Burlacu, 1971; Sterghiu, 1985; Fuhn & Gherasim, 1995; Roberts, 1995 and online papers: Catalogue of the world spiders species published by Platnick (2014); www.araneae.unibe.ch.; https://wiki.arages.de/index.php.

RESULTS AND DISCUSSIONS

In the period May to September, 2016, in the Leaota Mountains, they were identified 78 species of spiders grouped into 17 families (Tab. 1), summing the 301 individuals. They were taken into consideration only adult specimens that have been determined up to species level.

Table 1 - List of the spiders species identified in the Leaota Mountains whit specifying the habitat from which the species were collected and its zoogeographical distribution.

No.	Taxon	S	SP	MSB	MD	EMF	EMF-Scree	BEF	R-EMF	R	M/P	NR	D	Sum	Distribution
	Class Arachnida														
	Order Araneae														
	Family Dysderidae														
1.	*Dysdera crocata* C. L. Koch, 1838					1		1						2	Cos.
	Family Theridiidae														
2.	*Asagena phalerata* (Panzer, 1801)						1				1			2	Pal.
3.	*Enoplognatha ovata* (Clerck, 1757)						1		1	1				3	Hol.
	Family Linyphiidae														
4.	*Agyneta rurestris* (C. L. Koch, 1836)		1			1								2	Pal.
5.	*Centromerus sellarius* (Simon, 1884)	2						1						3	Eu.

No.	Taxon	S	SP	MSB	MD	EMF	EMF-Scree	BEF	R-EMF	R	M/P	NR	D	Sum	Distribution
6.	*Centromerus sylvaticus* (Blackwall, 1841)				1			2						3	Hol.
7.	*Diplocephalus latifrons* (O. P.-Cambridge, 1863)	1		1										2	Eu.-Ru.
8.	*Diplostyla concolor* (Wider, 1834)							5	1					6	Hol.
9.	*Evansia merens* O. P.-Cambridge, 1900			1	1									2	Pal.
10.	*Lepthyphantes minutus* (Blackwall, 1833)	2		1										3	Hol.
11.	*Micrargus herbigradus* (Blackwall, 1854)	1		1	1			1						4	Pal.
12.	*Neriene emphana* (Walckenaer, 1841)				1		1			1				3	Pal.
13.	*Neriene montana* (Clerck, 1757)	1		2	3		1		1					8	Hol.
14.	*Neriene peltata* (Wider, 1834)						1		2					3	Pal.
15.	*Obscuriphantes obscurus* (Blackwall, 1841)	4		1										5	Pal.
16.	*Oedothorax fuscus* (Blackwall, 1834)								2					2	Eu.
17.	*Tenuiphantes alacris* (Blackwall, 1853)	3		1		1								5	Pal.
18.	*Tenuiphantes flavipes* (Blackwall, 1854)	1		4					1					6	Pal.
19.	*Tenuiphantes tenebricola* (Wider, 1834)	1		5				1						7	Pal.
20.	*Tenuiphantes zimmermanni* (Bertkau, 1890)	1		1							2			4	Eu.- Ru.
21.	*Tiso vagans* (Blackwall, 1834)										1			1	Eu.- Ru.- Mad.
	Family Tetragnathidae														
22.	*Pachygnatha degeeri* Sundevall, 1830					2					1			3	Pal.
23.	*Tetragnatha pinicola* L. Koch, 1870								2					2	Pal.
	Family Araneidae														
24.	*Aculepeira ceropegia* (Walckenaer, 1802)										2			2	Pal.
25.	*Araneus diadematus* Clerck, 1757			1		2			1		1	1		6	Hol.

No.	Taxon	S	SP	MSB	MD	EMF	EMF-Scree	BEF	R-EMF	R	M/P	NR	D	Sum	Distribution
26.	*Araniella cucurbitina* (Clerck, 1757)											2		2	Pal.
27.	*Argiope bruennichi* (Scopoli, 1772)								1		4			5	Pal.
28.	*Larinioides cornutus* (Clerck, 1757)	1							1					2	Hol.
29.	*Mangora acalypha* (Walckenaer, 1802)						1		1					2	Pal.
30.	*Parazygiella montana* (C.L. Koch, 1834)	1												1	Pal.
	Family Lycosidae														
31.	*Acantholycosa lignaria* (Clerck, 1757)		2											2	Pal.
32.	*Alopecosa pinetorum* (Thorell, 1856)					1								1	Pal.
33.	*Pardosa agrestis* (Westring, 1861)										1			1	Pal.
34.	*Pardosa alacris* (C. L. Koch, 1833)				3			7						10	Eu.- Ru.
35.	*Pardosa amentata* (Clerck, 1757)		1	1		1			4					7	Eu.- Ru.
36.	*Pardosa blanda* (C. L. Koch, 1833)										6			6	Pal.
37.	*Pardosa ferruginea* (L. Koch, 1870)	3												3	Pal.
38.	*Pardosa hortensis* (Thorell, 1872)		3						1	1				5	Pal.
39.	*Pardosa lugubris* (Walckenaer, 1802)		2	4				5	1					12	Pal.
40.	*Pardosa mixta* (Kulczyński, 1887)										1			1	Eu.-Turk.
41.	*Pardosa monticola* (Clerck, 1757)										7		1	8	Pal.
42.	*Pardosa palustris* (Linnaeus, 1758)										4			4	Hol.
43.	*Pardosa riparia* (C. L. Koch, 1833)		6							1				7	Pal.
44.	*Piratula knorri* (Scopoli, 1763)								2					2	Eu.
45.	*Trochosa terricola* Thorell, 1856					1		1	1		1			4	Hol.

No.	Taxon	S	SP	MSB	MD	EMF	EMF-Scree	BEF	R-EMF	R	M/P	NR	D	Sum	Distribution
46.	*Xerolycosa nemoralis* (Westring, 1861)		4											4	Pal.
	Family Agelenidae														
47.	*Agelena labyrinthica* (Clerck, 1757)								1					1	Pal.
48.	*Coelotes atropos* (Walckenaer, 1830)			1					1					2	Eu.
49.	*Coelotes terrestris* (Wider, 1834)	11	4	7				4		2				28	Pal.
50.	*Histopona torpida* (C. L. Koch, 1837)			1			1							2	Eu.- Ru.
51.	*Inermocoelotes inermis* (L. Koch, 1855)	2		1	2	1		1		2				9	Eu.
52.	*Tegenaria silvestris* L. Koch, 1872											1		1	Eu.- Ru.
	Family Cybaeidae														
53.	*Cybaeus angustiarum* L. Koch, 1868	1		3					1	1				6	Eu.- Azer.
	Family Hahniidae														
54.	*Cryphoeca silvicola* (C. L. Koch, 1834)	4		1										5	Pal.
	Family Dictynidae														
55.	*Cicurina cicur* (Fabricius, 1793)							1	2	1				4	Eu.-Cen. Asia
	Family Amaurobiidae														
56.	*Amaurobius ferox* (Walckenaer, 1830)							1						1	Hol.
57.	*Amaurobius similis* (Blackwall, 1861)								1					1	Hol.
58.	*Callobius claustrarius* (Hahn, 1833)			3					1	1				5	Pal.
	Family Liocranidae														
59.	*Apostenus fuscus* Westring, 1851							1	5					6	Eu.
	Family Clubionidae														
60.	*Clubiona comta* C. L. Koch, 1839			1					1	1				3	Eu.- Ru.- North Africa
61.	*Clubiona corticalis* (Walckenaer, 1802)	2		1				1						4	Eu.-Cen. Asia
62.	*Clubiona neglecta* O. P.-Cambridge, 1862								1					1	Pal.

No.	Taxon	S	SP	MSB	MD	EMF	EMF-Scree	BEF	R-EMF	R	M/P	NR	D	Sum	Distribution
63.	*Clubiona terrestris* Westring, 1851								1					1	Eu.
	Family Gnaphosidae														
64.	*Haplodrassus signifer* (C. L. Koch, 1839)										1		1	2	Hol.
65.	*Haplodrassus silvestris* (Blackwall, 1833)							3						3	Pal.
66.	*Zelotes apricorum* (L. Koch, 1876)								2					2	Eu.- Kaz.
67.	*Zelotes erebeus* (Thorell, 1871)		4						1					5	Eu.-Turk.
68.	*Zelotes latreillei* (Simon, 1878)								1					1	Pal.
	Family Philodromidae														
69.	*Philodromus aureolus* (Clerck, 1757)					1								1	Pal.
	Family Thomisidae														
70.	*Coriarachne depressa* (C. L. Koch, 1837)	2												2	Pal.
71.	*Misumena vatia* (Clerck, 1757)						3		1					4	Hol.
72.	*Xysticus erraticus* (Blackwall, 1834)							1				6		7	Eu.-Ru.
	Family Salticidae														
73.	*Evarcha falcata* (Clerck, 1757)						2		2					4	Pal.
74.	*Heliophanus tribulosus* Simon, 1868					1								1	Eu.-Kaz.
75.	*Pseudeuophrys erratica* (Walckenaer, 1826)						3	1			1			5	Pal. (introduced in USA)
76.	*Salticus scenicus* (Clerck, 1757)		1				1							2	Hol.
77.	*Sittiflor rupicola* (C. L. Koch, 1837)						1				2			3	Hol.
78.	*Sittipub pubescens* (Fabricius, 1775)						1							1	Pal. (introduced in USA)

Legend: S – spruce forest, SP – spruce plantation, MSB – mixed forest (spruce and beech), MD – mixed deciduous forest (beech, birch, poplar and very rarely fir and spruce), EMF – the edge of the mixed forest (spruce and beech), EMF-Scree – the edge of the mixed forest (spruce and beech) - scree, BEF – beech forest and the edge of the beech forest,

R-EMF – riparian area - the edge of the mixed forest (spruce and beech), R – riparian area (rare alder and beech), M/P – meadow/pasture, NR – natural regeneration (birch and beech), D – deforestation (spruce forest); Cos. – Cosmopolitan, Hol – Holarctic, Pal – Palearctic, Eu.-Ru.-North Africa – Europe, Russia, North Africa, Eu.-Ru.-Mad. – Europe, Russia, Madeira, Eu.-Ru. – Europe, Russia, Eu.-Cen.-Asia – Europe to Central Asia, Eu.-Kaz. – Europe to Kazakhstan, Eu.-Azer – Europe to Azerbaijan, Eu.-Turk. – Europe, Turkey, Eu. – European.

The most species belonged to the families Linyphiidae (23.0%) and Lycosidae (20.5%), followed by: Araneidae (8.9%), Salticidae (7.6%), Agelenidae (7.6%), Gnaphosidae (6.4%) and Clubionidae (5.1%). The other ten families had shares of less than 5% (Fig. 2). If we take into consideration the number of individuals from each family, most specimens belonged to the Lycosidae (25.5%) and Linyphiidae (22.9%) families, followed by: Agelenidae (14.2%), Araneidae (6.6%) and Salticidae (5.3%). The other families have registered a percentage of less than 5% (Fig. 2). Most specimens collected belonged to the following species: *Coelotes terrestris* (Wider, 1834) (9.3 %), *Pardosa lugubris* (Walckenaer, 1802) (3.9 %) and *Pardosa alacris* (C. L. Koch, 1833) (3.3 %).

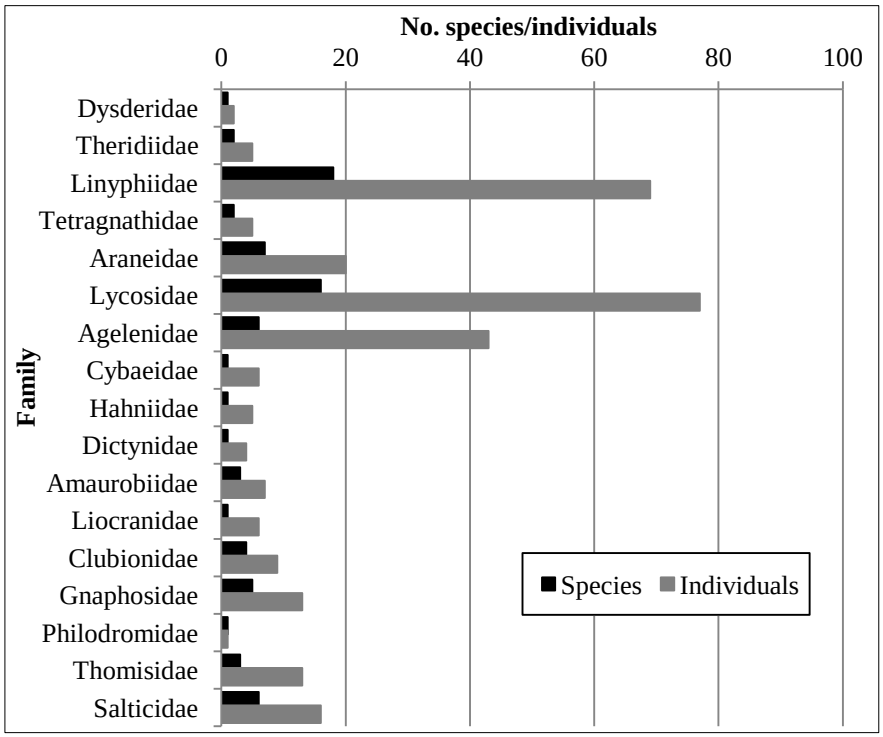

Figure 2 - The number of species and individuals in each family of spiders recorded in the Leaota Mountains.

Most species of spiders have been identified at the boundary between riparian and edge of the mixed forest (spruce and beech) (R-EMF, 39.7%). Smaller percentages were recorded at species from the mixed forest, spruce and beech (MSB, 28.2%), from the spruce forest (S, 24.3%) and from the beech forest and the edge of the beech forest (BEF, 23.0%). To the habitats mentioned above, we can add the spruce plantation (SP, 12.8%). In all of these habitats, pitfall traps were installed. For the habitats where the traps have not been installed, the number of identified spiders species, reported to the total number of species, varied between the 20.5% for the meadow/pasture (M/P) and 2.5% for the deforestation areas (D). The hierarchy previously established, with some small differences, is also preserved for the number of individuals identified in each habitat type. The habitats in which pitfall traps were installed had weightings between 9.3% (spruce plantation - SP) and almost 15% (R-EMF – riparian - the edge of the mixed forest, spruce and beech). A value of more than 10%, respectively 11.9%, was recorded for the meadow/pasture habitat (Fig. 3).

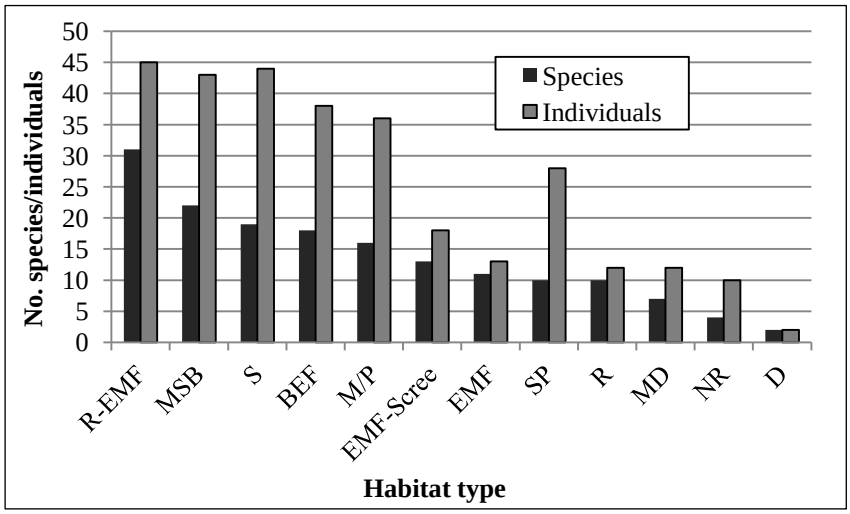

Figure 3 - The number of species and individuals of spiders identified in each type of studied habitat: R-EMF – riparian area - the edge of the mixed forest (spruce and beech), MSB – mixed forest (spruce and beech), S – spruce forest, BEF – beech forest and the edge of the beech forest, M/P – meadow/pasture, EMF-Scree – the edge of the mixed forest (spruce and beech) - scree, EMF – the edge of the mixed forest (spruce and beech), SP – spruce plantation, R – riparian area (rare alder and beech), MD – mixed deciduous forest (beech, birch, poplar and very rarely fir and spruce), NR – natural regeneration (birch and beech), D – deforestation area (spruce forest).

In accordance with their current spreading (Platnick, 2014), the all 78 species of spiders, identified in the Leaota Mountains, were classified into seven zoogeographical groups (Deltshev, 2005) (Fig. 4). We found the presence of a large number of Palearctic species (51.2%) followed the Holarctic species (19.2%)

and Siberian-European species (10.2%), together representing 80% of all identified species. The rest of the groups had weights less than 10%.

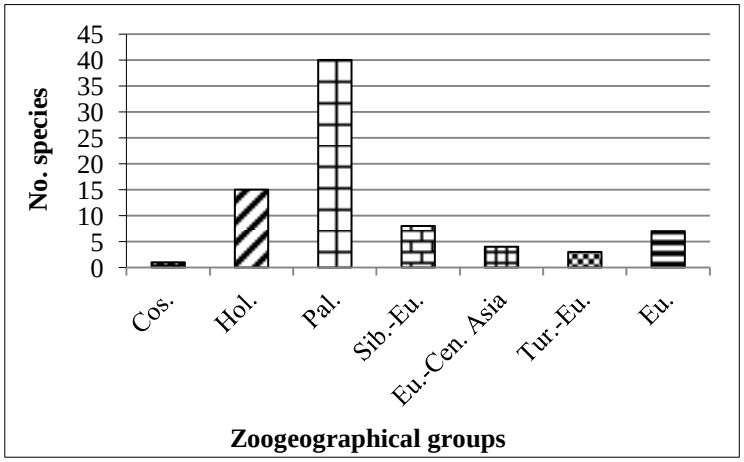

Figure 4 - Distribution of the identified spiders species, in the Leaota Mountains, taking into account of the zoogeographical groups (Cos. – Cosmopolitan, Hol – Holarctic, Pal – Palearctic, Sib.-Eu. – Siberian-European, Eu.- Cen.-Asian – European-Central Asian, Tur.-Eu. – Turanian-European, Eu – European).

Most of the identified species are found in various types of habitats and on different altitudes. Only a small number of species may be considered indicators for a particular type of habitat. *Pardosa ferruginea* (C. L. Koch, 1870) is considered a species with relatively small ecological amplitude, which prefer shady and relatively humid habitats. It is a mountainous and alpine species, usually found at higher altitudes of 1,000 m, in coniferous forests (*Picea abies* L. H. Karst.) and mountain pine thicket (*Pinus mugo* Turra) (Fuhn & Niculescu-Burlacu, 1971). In the Leaota Mountains, the species was found in the spruce forests on the Strunguliţa and Raciu Valleys, at over 1,300 m altitude, in the forests less affected by human impact, where it is relatively frequent. *Pardosa blanda* (C. L. Koch, 1833) is a mountain species, found from 1,000 m upwards. In the alpine area is present into the *Nardus stricta* L. associations. It is a species with relatively small ecological amplitude, which prefers the open and sunny places, with medium humidity (Fuhn & Niculescu-Burlacu, 1971). The species was identified on the Leaota and Romanescu peaks. *Piratula knorri* (Scopoli, 1763) is considered a relative rare species, very demanding with its habitat. It is a riparian species, encountered along the shaded torrents with gravel shores (Fuhn & Niculescu-Burlacu, 1971). The species was identified in the riparian area of the Frumușelu and Tâncava creeks, at about 1,000 m altitude.

Taking into account of the entire Carpathian chain, three species of spiders are classified into the following categories: endangered species, as *Acantholycosa lignaria* (Clerck, 1757), *Pardosa ferruginea* (C. L. Koch, 1870) and vulnerable one *Argiope bruennichi* (Scopoli, 1772) (Pawłowski, 2003). For Romania, these three

species are included in the "present but not threatened" category (Pawłowski, 2003). The *Acantholycosa lignaria* (Clerck, 1757) and *Pardosa ferruginea* (C. L. Koch, 1870) are considered the relict species (Pawłowski, 2003).

After Ján Kadlečík (Gajdoš, 2014), only *Pardosa ferruginea* (C. L. Koch, 1870) is included in the Near Threatened (NT) category, in the Carpathian Red List of spiders. The *Acantholycosa lignaria* (Clerck, 1757) is included in the endengered specis category only in the Czech Republic just like the *Heliophanus tribulosus* Simon, 1868 which is considered a vulnerable species. *Argiope bruennichi* (Scopoli, 1772) is not part of the threatened species category.

CONCLUSIONS

During the study, 78 species of spiders belonging to 17 families were identified. From these, only three spiders: *Pardosa ferruginea* (C. L. Koch, 1870), *Pardosa blanda* (C. L. Koch, 1833) and *Piratula knorri* (Scopoli, 1763) can be considered as indicator species for certain types of habitats. This situation is also reflected by the presence of a large number of species which have a wide spreading, present in several types of habitats. More than half of the identified species are Palearctic, followed by the Holarctic and Siberian-European ones.

From the conservative point of view, only two species of spiders, *Acantholycosa lignaria* (Clerck, 1757) and *Pardosa ferruginea* (C. L. Koch, 1870) are mentioned as being in danger in various areas (countries) of the Carpathian chain. In Romania, in Leaota Mountains, none of the identified species by us was classified into the category of protected species. If we consider the rapidity with which the natural habitats of the Carpathian Mountains disappear, in the absence of adequate measures, the situation may change, in the negative sense, very soon.

Considering that the study was not dedicated solely to spiders and the period during which it was done was short, relative to the size and to the heterogeneity of the investigated area, we can say that the study has a preliminary character. The data obtained from this study supplement the previously results, leaving open the list of spiders species from the Leaota Massif.

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