

Contribution to the spider fauna of the Mohoş peat bog from Transylvania, with some new data for Romania

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Abstract. The arachnofauna of the Mohoş peat bog (Transylvania, Romania) was examined between May 2003 and September 2004. The material collected with various sampling methods consists of 1593 specimens belonging to 96 species of 20 families. Most specimens and species belong to the family Linyphiidae and Lycosidae. *Cnephalocotes obscurus* (Blackwall, 1834) represents a new record for the Romanian arachnofauna and some other rare species [e.g. *Gnaphosa nigerrima* L. Koch, 1877 and *Notioscopus sarcinatus* (O. P.-Cambridge, 1872)] are also identified. Furthermore, the occurrence of two questionable species [*Scotina palliardii* (L. Koch, 1881) and *Zelotes clivicola* (L. Koch, 1870)] is proved. The list of species collected in different habitat types of the bog and their respective indicator species are presented. Non-metric multidimensional scaling ordination was performed for the comparison of spider communities. The spider community of the surrounding beech area stood out as the most individual, having only a few species in common with the other studied habitat types. In the same comparison, the Scots Pine area of the bog occupied an intermediate position between the central open area of the bog and the beech area. Based on the uniqueness of the spider communities, a more strict protection of these valuable habitats would be recommended.

Keywords: Araneae, peat bog, indicator species, taxonomy, ecology

Introduction

Raised and basin bogs are in serious decline throughout the western Palaearctic. The spiders living in these bogs have been studied thoroughly in Northern Europe, Fennoscandia and the Baltic states. There is a perceived need for reliable criteria to rank and assess the conservation value of these threatened habitats and to ensure that the most valuable sites are preserved (e.g. Coulson & Butterfield 1986, Kurka 1990, Pearson 1996, Relys et al. 2002,

Bruun & Toft 2004, Koponen 2004, Koponen et al. 2004, Scott et al. 2006).

In Romania there are several peat bogs located in the Eastern Carpathians. These are known as glacial refuges for rare, relic plant species, with high conservation value (Ruprecht & Szabó 1999, Margóczy et al. 2000). The arachnological knowledge of these bogs is poor (Gallé & Urák 2001, 2002, 2006). A previous study about the Mohoş peat bog mentioned only 6 spider species (Kolosvary 1941). A recent comparative study of the

community structure of ground dwelling carabid beetles and spiders mentioned 57 species, collected in pitfall traps (Máthé et al. 2003).

Material and methods

The Mohoş peat bog is located in Transylvania, in the central area of the East Carpathian massive (N 46° 08', E 43° 34'), 1050 m above sea level. The total area of the bog is 80 ha. Several glacial relic and other plant species of high conservation interest are present here, such as: *Drosera rotundifolia*, *D. obovata*, *Andromeda polifolia*, *Scheuchzeria palustris*, *Empetrum nigrum*, *Vaccinium microcarpum* (Pop 1956, 1960, Coldea & Plămădă 1989, Ferencz 1996).

The present studies were carried out in four different habitats: the central active peat bog area (hereafter called the "open area"), divided in two microhabitat types, one corresponding to the *Sphagnetum magellanici* (Malcuit 1929) Kästner & Flösser community (with *Scheuchzeria palustris* and *Andromeda polifolia* habiting next to the peat bog lakes) and the other more peripheral *Eriophoro vaginati-Sphagnetum recurvi* Hueck 1925 community; the birch area (referred to as

"birch") (*Vaccinio-Betuletum pubescentis* Libbert 1933); the peripheral Scots Pine area (referred to as "pine") (*Vaccinio-Pinetum sylvestris* Kleist 1929 em. Matuszkiewicz 1962) (Coldea 1997); and in the surrounding beech forest (referred to as "beech") (*Symphyto cordati-Fagetum* Vida 1963) of the adjacent mountain slope.

Spiders were sampled by pitfall traps, by hand, by sweep net, by sieving, by suction sampling (using a hand-held device: Samu & Sárospataki 1995), and by beating tray for grass and low shrubs. Pitfall traps with a lid, filled with ethylene glycol 30% solution were used. Five traps were placed in transects in each habitat type. Samples were collected monthly from 24 May to 12 October in 2003, and on two occasions in 2004, on 1 June and 11 September. Only pitfalls were used in all habitats, other methods were used in only one or two habitats (Table 1). The rationale for using these methods was to make the species list obtained by pitfall trapping more complete. All collected material was preserved in 70% ethanol and identified under stereo microscope.

The species were determined using various keys (Roberts 1985, 1987, Heimer & Nentwig 1991). We used the nomenclature from the world spider catalogue of Platnick (2008).

Table 1. Sampling effort of the applied methods in terms of species and specimen return for the different habitats.

Habitat types	Pitfall trap		Sieving		Sweep net		Suction sampling		Hand collecting	
	N	S	N	S	N	S	N	S	N	S
Open area	251	32	9	3	177	13	44	9	75	28
Pine	453	34	-	-	22	7	-	-	7	4
Birch	315	36	32	8	-	-	-	-	9	4
Beech	199	12	-	-	-	-	-	-	-	-
Total	1218	66	41	9	199	17	44	9	91	31

Abbreviations: N - number of specimens (adults and juveniles), S - number of species.

Results and discussion

The material analysed comprised of 1593 spider specimens, from which 1026 were adults, belonging to 96 species in 20 families (Table 2). Out of these species *Cnephalocotes obscurus* (Blackwall, 1834) is new for the Romanian fauna. The presence of *Scotina palliardii* (L. Koch, 1881) and *Zelotes clivicola* (L. Koch, 1870), which had been questionable in Romania, is now confirmed. These two species were included in the recent fauna list by Weiss & Urák (2000) on the basis of bibliographical data (Fuhn & Oltean 1970); however, those data could not be ascertained at that time, because of the absence of specimens in collections from Romania. The presence of other two species: *Gnaphosa nigerrima* L. Koch, 1877 and *Notioscopus sarcinatus* (O. P.-Cambridge, 1872) was confirmed recently from other Transylvanian peat bogs (Gallé & Urák 2001, 2002).

Considering catches combined from all methods (Table 2), the most species-rich families were Linyphiidae (36%), Lycosidae (11%), Araneidae (8%) and Gnaphosidae (7%). The rest of the families were represented by less than 5 species (<5%). Most specimens belonged to the family Lycosidae (36%) followed by Linyphiidae (28%) and Gnaphosidae (15%). This distribution of families and species (Fig. 1) was also determined by the ecological condition of the studied habitat types and collection methods (Table 1). Out of the 96 species, 79 were caught only by one method out of the five methods

applied. The pitfall traps captured successfully the epigeal species with an active hunter lifestyle on the soil surface. 66 species (69%) were trapped by the pitfalls, out of which 51 were caught exclusively with this method. The arboreal species, the web-builders or plant-wanderers, we presume, fall into the traps accidentally; these species were better captured by suction sampling (3 exclusive species) and sweep net (8 exclusive species). Sieving returned 3 exclusive species and by hand-collection we were able to catch 14 species that were not collected by any other method.

In the different types of habitats, by combining all methods, we found various numbers of species. The richest habitats are those situated in the central open area (64 species), followed by the birch area (44 species) and the peripheral Scots Pine area (41 species). In the beech forest only 12 species of spiders were found (Fig. 2).

We applied an Indicator Species Analysis (Dufrene & Legendre 1997), but only to the pitfall trap data, that was the most comparable across habitats. Every habitat type had its own indicator species, which proved significant (at $P = 0.05$ significance level) by Monte Carlo test (McCune & Mefford 1999). Half of these species indicated the beech forest, which was the habitat type that stood most apart from the others (Table 3).

Non-metric multidimensional scaling ordination was performed on pitfall trap data. The ordination plot (Fig. 3) indicates that beech forest,

Table 2. List of spider species collected in different habitats. Only adult specimens were determined to species level.

Nr.	TAXON	Open area	Pine	Birch	Beech	Total
I. Segestriidae						
1.	<i>Segestria senoculata</i> (Linnaeus, 1758)			1		1
II. Theridiidae						
2.	<i>Euryopsis flavomaculata</i> (C. L. Koch, 1836)	26	4	7		37
3.	<i>Neottiura bimaculata</i> (Linnaeus, 1767)		1			1
4.	<i>Robertus scoticus</i> Jackson, 1914			2		2
III. Linyphiidae						
5.	<i>Agyneta cauta</i> (O. P.-Cambridge, 1902)	7	8	13		28
6.	<i>Agyneta subtilis</i> (O. P.-Cambridge, 1863)	1	1			2
7.	<i>Bolyphantes alticeps</i> (Sundevall, 1833)			1		1
8.	<i>Centromerus arcanus</i> (O. P.-Cambridge, 1873)	5	8	4		17
9.	<i>Ceratinella brevis</i> (Wider, 1834)	1				1
10.	<i>Cnephalocotes obscurus</i> (Blackwall, 1834)	30				30
11.	<i>Dicymbium tibiale</i> (Blackwall, 1836)		3	1		4
12.	<i>Diplocephalus latifrons</i> (O. P.-Cambridge, 1863)				12	12
13.	<i>Gonatium rubellum</i> (Blackwall, 1841)	11	4	2		17
14.	<i>Gongyliidiellum latebricola</i> (O. P.-Cambridge, 1871)	3				3
15.	<i>Lepthyphantes leprosus</i> (Ohlert, 1865)				2	2
16.	<i>Lepthyphantes nodifer</i> Simon, 1884		2	2		4
17.	<i>Linyphia triangularis</i> (Clerck, 1757)	2	1	1		4
18.	<i>Macrargus rufus</i> (Wider, 1834)				1	1
19.	<i>Maso sundevalli</i> (Westring, 1851)	7				7
20.	<i>Meioneta rurestris</i> (C. L. Koch, 1836)	2				2
21.	<i>Micrargus georgescuae</i> Millidge, 1976		4			4
22.	<i>Microlinyphia pusilla</i> (Sundevall, 1830)	1				1
23.	<i>Minicia marginella</i> (Wider, 1834)		2			2
24.	<i>Neriere peltata</i> (Wider, 1834)	1		1		2
25.	<i>Neriere radiata</i> (Walckenaer, 1842)	1				1
26.	<i>Notioscopus sarcinatus</i> (O. P.-Cambridge, 1872)	1	8			9
27.	<i>Pityohyphantes phrygianus</i> (C. L. Koch, 1836)	1				1
28.	<i>Pocadicnemis pumila</i> (Blackwall, 1841)	12				12
29.	<i>Porrhomma oblitum</i> (O. P.-Cambridge, 1870)	1				1
30.	<i>Stemonyphantes lineatus</i> (Linnaeus, 1758)	1				1
31.	<i>Tapinocyba biscissa</i> (O. P.-Cambridge, 1873)				1	1
32.	<i>Tenuiphantes alacris</i> (Blackwall, 1853)	2	17	6	2	27

Table 2. (continued)

Nr.	TAXON	Open area	Pine	Birch	Beech	Total
33.	<i>Tenuiphantes cristatus</i> (Menge, 1866)	3	4	4		11
34.	<i>Tenuiphantes tenebricola</i> (Wider, 1834)				14	14
35.	<i>Walckenaeria atrotibialis</i> O. P.-Cambridge, 1878	2	41	10		53
36.	<i>Walckenaeria cucullata</i> (C. L. Koch, 1836)	5	2	3		10
37.	<i>Walckenaeria cuspidata</i> Blackwall, 1833	1	12	2		15
38.	<i>Walckenaeria mitrata</i> (Menge, 1868)			2		2
39.	<i>Walckenaeria obtusa</i> Blackwall, 1836	1		2		3
IV. Tetragnathidae						
40.	<i>Metellina segmentata</i> (Clerck, 1757)	13	3			16
41.	<i>Pachygnatha degeeri</i> Sundevall, 1830	1				1
42.	<i>Tetragnatha extensa</i> (Linnaeus, 1758)	4				4
V. Araneidae						
43.	<i>Aculepeira ceropegia</i> (Walckenaer, 1802)	2				2
44.	<i>Araneus alsine</i> (Walckenaer, 1802)	1				1
45.	<i>Araneus diadematus</i> Clerck, 1757	6				6
46.	<i>Araneus marmoreus</i> Clerck, 1757	2				2
47.	<i>Araniella cucurbitina</i> (Clerck, 1757)	2	1			3
48.	<i>Argiope bruennichi</i> (Scopoli, 1772)	1				1
49.	<i>Mangora acalypha</i> (Walckenaer, 1802)	1				1
50.	<i>Nuctenea umbratica</i> (Clerck, 1757)	1		1		2
VI. Lycosidae						
51.	<i>Acantholycosa lignaria</i> (Clerck, 1757)		1			1
52.	<i>Alopecosa aculeata</i> (Clerck, 1757)		1			1
53.	<i>Aulonia albimana</i> (Walckenaer, 1805)	30	24	16		70
54.	<i>Pardosa lugubris</i> (Walckenaer, 1802)		1	1	1	3
55.	<i>Pardosa sphagnicola</i> (Dahl, 1908)	12	9	14		35
56.	<i>Pirata hygrophilus</i> Thorell, 1872	13	72	41		126
57.	<i>Pirata latitans</i> (Blackwall, 1841)	2	1			3
58.	<i>Pirata uliginosus</i> (Thorell, 1856)			1		1
59.	<i>Trochosa ruricola</i> (De Geer, 1778)	13	1	2		16
60.	<i>Trochosa spinipalpis</i> (F. O. P.- Cambridge, 1895)	10	17	13		40
61.	<i>Trochosa terricola</i> Thorell, 1856	16	44	31		91
VII. Pisauridae						
62.	<i>Pisaura mirabilis</i> (Clerck, 1757)	1				1
VIII. Zoridae						
63.	<i>Zora nemoralis</i> (Blackwall, 1861)	1	1			2

Table 2. (continued)

Nr.	TAXON	Open area	Pine	Birch	Beech	Total
64.	<i>Zora spinimana</i> (Sundevall, 1833)	1	2	3		6
IX. Agelenidae						
65.	<i>Allagelena gracilens</i> (C. L. Koch, 1841)	2				2
66.	<i>Malthonica silvestris</i> (L. Koch, 1872)				1	1
X. Cybaeidae						
67.	<i>Argyroneta aquatica</i> (Clerck, 1757)	1				1
68.	<i>Cybaeus angustiarum</i> L. Koch, 1868		2			2
XI. Hahniidae						
69.	<i>Cryphoeca silvicola</i> (C. L. Koch, 1834)				11	11
70.	<i>Hahnia pusilla</i> C. L. Koch, 1841			1		1
XII. Dictynidae						
71.	<i>Lathys humilis</i> (Blackwall, 1855)	1				1
XIII. Amaurobiidae						
72.	<i>Callobius claustrarius</i> (Hahn, 1833)				10	10
73.	<i>Coelotes terrestris</i> (Wider, 1834)				70	70
74.	<i>Eurocoelotes inermis</i> (L. Koch 1855)	5	31	2	44	82
XIV. Liocranidae						
75.	<i>Agroeca brunnea</i> (Blackwall, 1833)			1		1
76.	<i>Scotina palliardii</i> (L. Koch, 1881)	15	3	8		26
XV. Clubionidae						
77.	<i>Clubiona kulczynskii</i> Lessert, 1905	1				1
78.	<i>Clubiona lutescens</i> Westring, 1851			1		1
79.	<i>Clubiona stagnatilis</i> Kulczynski, 1897	8				8
XVI. Corinnidae						
80.	<i>Phrurolithus festivus</i> (C. L. Koch, 1835)	2	2	3		7
XVII. Gnaphosidae						
81.	<i>Drassyllus pusillus</i> (C. L. Koch, 1833)	1		1		2
82.	<i>Gnaphosa nigerrima</i> L. Koch, 1877	2		4		6
83.	<i>Haplodrassus signifer</i> (C. L. Koch, 1839)			1		1
84.	<i>Micaria pulicaria</i> (Sundevall, 1831)		1			1
85.	<i>Zelotes clivicola</i> (L. Koch, 1870)	6	7	9		22
86.	<i>Zelotes gracilis</i> (Canestrini, 1868)	1				1
87.	<i>Zelotes petrensis</i> (C. L. Koch, 1839)			1		1
XVIII. Philodromidae						
88.	<i>Philodromus aureolus</i> (Clerck, 1757)	1				1

Table 2. (continued)

Nr.	TAXON	Open area	Pine	Birch	Beech	Total
XIX. Thomisidae						
89.	<i>Diaea dorsata</i> (Fabricius, 1777)	1				1
90.	<i>Ozyptila trux</i> (Blackwall, 1846)			1		1
91.	<i>Xysticus audax</i> (Schrank, 1803)		1			1
92.	<i>Xysticus cristatus</i> (Clerck, 1757)	1				1
XX. Salticidae						
93.	<i>Evarcha falcata</i> (Clerck, 1757)	7	4	1		12
94.	<i>Neon valentulus</i> Falconer, 1912	2		2		4
95.	<i>Sitticus floricola</i> (C. L. Koch, 1837)	3	1			4
96.	<i>Talavera aequipes</i> (O. P.-Cambridge, 1871)	1				1

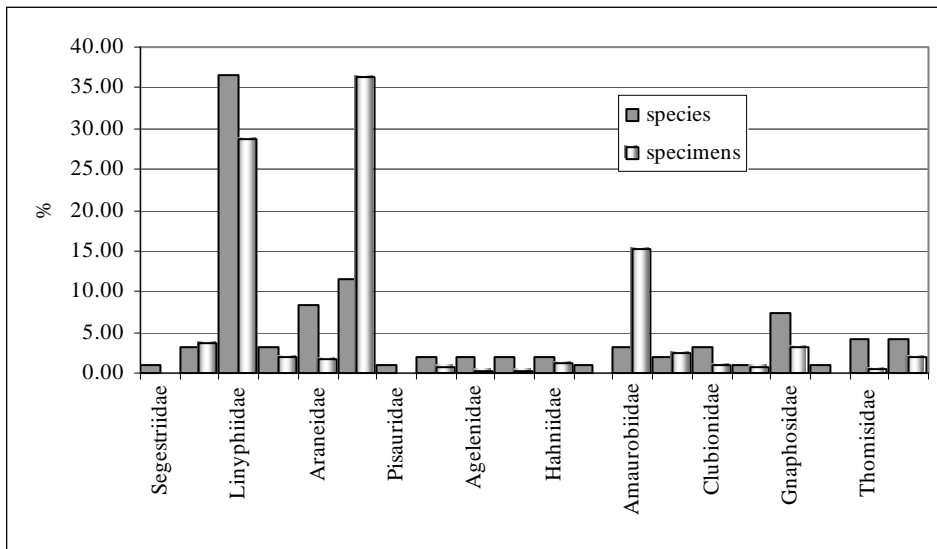


Figure 1. The percentage representation of the spider families

similarly to the Indicator Species Analysis results, is the most different in its spider community to the other habitats. The Scots Pine area within the

peat bog occupies a somewhat intermediate position between open peat areas and the beech forest. The open area spider community was the

least similar to the beech community, and was the furthest from it along axis 2, while the birch plots were in part

overlapped with the open area sampling plots, at the same time being different from them along axis 1.

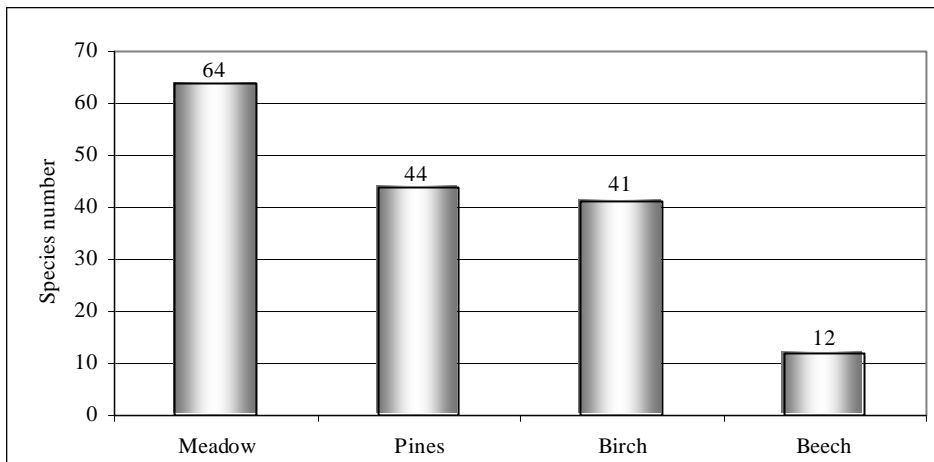


Figure 2. Species numbers by habitat type

Table 2. The indicator species in the different habitats

Nr.	Species	Habitat	IV (%)	P
1.	<i>Euryopis flavomaculata</i> (C. L. Koch, 1836)	open area	80.6	0.001
2.	<i>Pocadicnemis pumila</i> (Blackwall, 1841)	open area	80	0.001
3.	<i>Trochosa ruricola</i> (De Geer, 1778)	open area	70.1	0.001
4.	<i>Scotina palliardi</i> (L. Koch, 1881)	open area	65.1	0.002
5.	<i>Aulonia albimana</i> (Walckenaer, 1805)	open area	53.1	0.014
6.	<i>Pardosa sphagnicola</i> (Dahl, 1908)	open area	33.7	0.085
7.	<i>Tenuiphantes alacris</i> (Blackwall, 1853)	pine	42.8	0.033
8.	<i>Pirata hygrophilus</i> Thorell, 1872	birch	42.9	0.037
9.	<i>Trochosa terricola</i> Thorell, 1856	birch	40	0.079
10.	<i>Coelotes terrestris</i> (Wider, 1834)	beech	100	0.001
11.	<i>Callobius claustrarius</i> (Hahn, 1833)	beech	71.4	0.002
12.	<i>Eurocoelotes inermis</i> (L. Koch, 1855)	beech	62.9	0.002
13.	<i>Tenuiphantes tenebricola</i> (Wider, 1834)	beech	71.4	0.002
14.	<i>Cryphoeca silvicola</i> (C. L. Koch, 1834)	beech	57.1	0.009
15.	<i>Diplocephalus latifrons</i> (O. P.-Cambridge, 1863)	beech	42.9	0.023

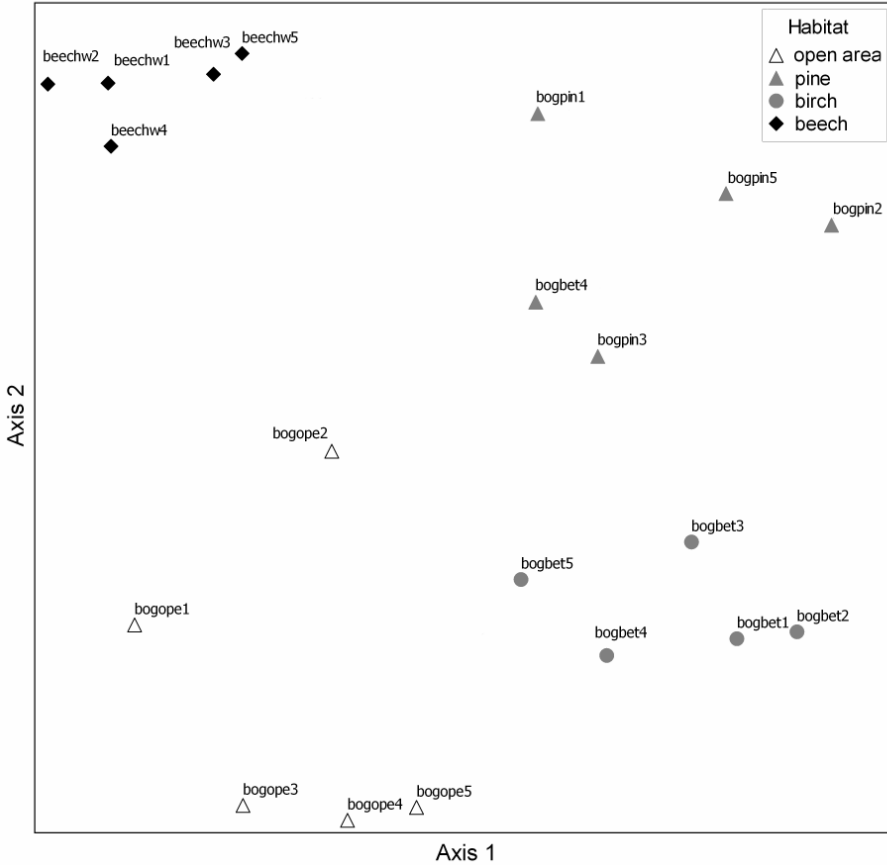


Figure 3. NMS ordination plot of the sampling locations, grouped by habitat type (indicated by symbols). (NMS, applying quantitative Sørensen distance measure, reached a 2-dimensional solution with a 15.65392 final stress.)

Conclusions

The spider faunas of isolated European peat bogs contain, in addition to widely distributed generalists, a number of bog specialist species (Coulson & Butterfield 1986, Kurka 1990, Pearson 1996, Relys et al. 2002, Bruun & Toft 2004, Koponen 2004, Koponen et al. 2004, Alan et al. 2006,

Scott et al. 2006). There seems to be sufficient basis for accepting spiders as ecological indicators for peat bogs (McGeoch 1998).

The spider fauna of the Mohoş peat bog is also rich in rare species with high conservation value. Out of the 96 recorded species, one is new to Romania (*Cnephalocotes obscurus*), in the case of two species a firm evidence of their

Romanian occurrence is given by the Mohoş data (*Scotina palliardii* and *Zelotes clivicola*), while the presence of other two bog specialist species that we found in this study (*Gnaphosa nigerrima* and *Notioscopus sarcinatus*) was indicated recently in the Romanian spider fauna (Urák 2000, Gallé & Urák 2001, 2002, 2006). The Mohoş peat bog represents well definable habitat types, all of them with specialist spiders. These habitats were shown to represent a gradient from closed forest at the edges to the open area in the central area of the bog.

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