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Similarities between epigeic spider communities in a peatbog and surrounding pine forest: a study from southern Lithuania

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Abstract
Epigeic spider communities of an open raised bog, pine bog and surrounding dry pine forest were studied in southern Lithuania during 1999. The research was carried out by means of pitfall traps. A total of 108 spider species were registered. Large differences in species composition were revealed in spite of very similar numbers of species. Only nine species occurred in all three habitats. The highest similarity was found between the open raised bog and pine bog communities. The similarity between the open bog and dry pine forest communities was low. Only *Haplodrassus signifer* and *Agroeca brunnea* can be stated as common for both habitats. Some rare spider species were found (*Centromerus unidentatus*, *Zornella cultrigera*, *Euophrys westringi*). Altogether 15 spider species were registered as new for the Lithuanian fauna.

Key words: Araneae, peatbog, pine forest, communities, Lithuania

INTRODUCTION

Peatbogs and other wetlands are very sensitive and endangered ecosystems in Central Europe (Raeymaekers 1999, Succow 2000). The same situation exists in Lithuania where 6685 peatlands have been recorded (Janukonis 1995). Some peatbogs have remained in a natural state, but most of them have been drained and become highly fragmented, isolated, or naturally overgrown by forest. Some small undisturbed peatbog fragments exist on the edges of large excavated peatlands.

Anthropogenic impact leads to changes in plant and animal communities of peatbogs (Succow & Jeschke 1990). A negative human impact on spider communities has been studied by Hiebsch (1973, 1985), Hänggi & Maurer (1982), Platen (1989), Schikora (1993) and Albrecht (1998). The fauna of spiders living in Central European peatbogs is well known (Hänggi et al. 1995). However, there is little information regarding the relationship between spider communities living in peatbogs and surrounding areas. Moreover, the increasing fragmentation and uniformity of peatbog fragments following anthropogenic influence on the landscape, make these questions urgent. Some studies concentrated on the relationship between spider and other arthropod communities in forests, agricultural fields, and the surrounding areas (Duelli et al. 1990; Kromp & Steinberger 1992; Kajak & Lukasiewicz 1994; Luczak 1995; Downie et al. 1996; Topping 1997, 1999; Hänggi & Baur 1998; Riecken 1998). Questions relating to the edge effect, dispersal, isolation and fragmentation have been studied. Some questions on species communities and distribution of species between peatbogs and

surrounding habitats have been analysed too (Almquist 1984; Vilbaste 1980; Freudenthaler 1989). However, diverse wetland habitats have mostly been studied, and no special attention has been paid to surrounding non-wetland habitats. Information on the relationship between peatbogs and surrounding non-wetland habitats can be obtained from papers of Koponen (1979), Hiebsch (1980), Vilbaste (1981), Löser et al. (1982), Schikora (1997) and Rupp (1999).

At present, peatbogs and other wetland fragments are mainly surrounded by drier habitats such as forests or meadows. We started the research into the epigeic spider fauna in various types of peatbogs and surrounding habitats in Lithuania. The aim was to evaluate the diversity and community structure of spiders in relation to peatbog size, level of isolation, anthropogenic impact, etc. In order to evaluate the 'naturalness level' of spider communities in small peatbogs or their fragments, comparative investigations were also carried out in protected areas, as well as in large intact and strictly protected peatbogs. This paper deals with the relationship between epigeic spider communities in the peatbog and surrounding forest in the largest mire complex of Lithuania.

MATERIALS AND METHODS

The research was carried out in the northwestern part of the Čepkeliai State Strict Nature Reserve (54°01' N, 24°26' E). It is located in southern Lithuania on the border with Belarus. Čepkeliai (5858 ha) is the largest mire complex in Lithuania. More than 50% is covered by large open sphagnum bogs, while the rest of the territory consists of fens, transitional bogs, small lakes and forested islands. Mires occur on sandy fluvioglacial lowland. The bog is surrounded by large dry pine forests.

Three study sites were chosen: pine bog (*Pinus sylvestris-Ledum palustre-Sphagnum* spp. community), open sphagnum bog (*Calluna vulgaris-Eriophorum vaginatum-Sphagnum rubellum*), and dry pine forest dominated by *Pinus sylvestris-Vaccinium myrtillus-Pleurozium schreberi* communities bordering the bog.

Pitfall traps were used for collecting the material. Six plastic jars (volume 300 ml, depth 10 cm, diameter 7 cm) filled with 100 - 120 ml of 5% formaldehyde solution mixed with detergent were used at each locality. The distance between traps, disposed in a line, was ca. 5 m. The distance between the dry pine forest and the pine bog was 150 m, and the sites in the open bog and the pine bog were located at a distance of 120 m. The traps were in operation from 14 April to 11 October 1999. They were emptied once every three weeks.

The Sørensen coefficient of similarity (QS) was calculated for the whole set of species, and for the sets of species making up more than 0.5% (>5 individuals) of specimens in each community. If more than 0.5% of specimens of common species was found in each community, they were assumed to belong to the same population spread over all compared habitats.

The nomenclature of spiders follows Platnick (1993).

RESULTS

General overview of the material

The material collected comprised 2577 specimens of spiders representing 108 species. Of these, 55 species (965 specimens) were registered in the open bog; 57 species (882 specimens) in the pine bog, and 54 species (730 specimens) in the dry pine forest (Table 1). Despite the similar numbers of captured species, very low species similarities between communities were found (Table 2). Nine species: *Alopecosa pulverulenta, Agroeca brunnea, Agroeca proxima, Agyneta cauta, Diplocentria bidentata, Walckenaeria alticeps, Haplodrassus signifer, Zora spinimana*, and *Zelotes latreillei* (8.3% of all species) occurred in all habitats. Five of these species clearly had their highest abundance in one community (Appendix 1). Only *Agroeca brunnea* was represented by more than 2 specimens in all three habitats. No marked differences in the abundance of *Agyneta cauta* were registered in the open bog and pine bog. The abundance of

Table 1. The main parameters of spider communities investigated in Čepkeliai Reserve (southern Lithuania) in 1999. All species found were used in the calculations.

Habitat	Number of species	Number of specimens	Species found only in this community		Species represented by 1-2 specimens		No. of species (>0.5%) with max. abundance in this habitat
			No.	%	No.	%	
Open bog	55	965	18	32.7	30	54.5	13
Pine bog	57	882	11	19.3	28	49.1	11
Dry pine forest	54	730	30	55.5	27	50.0	22

Table 2. Sørensen similarity coefficients (QS) of the peatbog and pine forest spider communities studied in southern Lithuania in 1999. QS_{all}: all species were included. $QS_{0.5\%}$: only species with > 0.5% relative abundance.

Habitats compared	QS_{all}	$QS_{0.5\%}$	No. species in common	No. species (>0.5% of all ind.) in common
Open bog - pine bog	60.7	26.8	34	15
Open bog - dry pine forest	22.0	3.61	12	2
Pine bog - dry pine forest	37.8	5.42	21	3

Zora spinimana was similar in the pine bog and dry pine forest. The highest relative abundance of any species registered in all communities was not more than 5%. More than 49% of all species were represented by only 1 or 2 specimens in each community (Table 1). Fifteen species found during the research were new to the Lithuanian fauna (Appendix 1).

Similarities between communities

High similarity of species composition in the communities of the open bog and pine bog (*Sphagnum* spp. dominating the ground layer in both), and also of the pine bog and dry pine forest (*Pinus silvestris* and shrub vegetation) was expected.

The open bog and pine bog had the most similar species compositions of spiders (Table 2). High numbers of shared species (34), and shared species making up more than 0.5% of all specimens in each community (15) showed very close similarity between these two communities. It can be inferred that the populations of these 15 species inhabited both of the studied bog habitats. Most of these species had their highest abundance in one community. *Scotina palliardi, Pirata insularis*, and *Gnaphosa nigerrima* were most abundant in the open bog, while *Pirata uliginosus* and *Gnaphosa microps* dominated the pine bog. Of *Notioscopus sarcinatus*, 24 specimens were trapped in the pine bog, while only one in the open bog. The abundance of some species (*Pardosa sphagnicola, Aulonia albimana, Gonatium rubens, Walckenaeria nodosa*, and *Centromerus arcanus*) was similar in both communities. *Pardosa sphagnicola, Aulonia albimana*, and *Scotina palliardi* made up more than 5% of all specimens in both bog communities. Three species (*Agroeca brunnea, Agroeca proxima*, and *Agyneta cauta*) occurring in all three communities had maximum abundance in the pine bog. *Trochosa spinipalpis* and *Pardosa hyperborea* occurred only in the open bog, the latter was a dominant species (12.8%).

The similarity of species composition in the pine bog and dry pine forest was lower (Table 2). These habitats had 21 species in common, but only three species (*Agroeca brunnea, Zora*

spinimana, and *Agyneta subtilis*) made up more than 0.5% of all specimens in each community. Only *Zora spinimana* did not show differences in abundance between the pine bog and pine forest. *Zelotes clivicola, Centromerus sylvaticus*, and *Zelotes subterraneus* were clearly represented in the pine forest, while only singletons occurred in the pine bog. *Haplodrassus signifer, Diplocentria bidentata*, and *Walckenaeria alticeps* were registered in all studied communities, but their abundance was highest in the pine forest. The latter two species were rare in bog communities.

The lowest species similarity was registered between the open bog and dry pine forest communities. These habitats had 12 species in common. Three of them were registered only in these habitats (Appendix 1). Only two common species (*Agroeca brunnea* and *Haplodrassus signifer*) represented more than 0.5% of specimens in each community. Both species were captured in the pine bog too.

DISCUSSION

The data show that there were some similarities between spider communities of the peatbog habitats and dry pine forest, but they were minimal, manifested mostly as shared species occurring in the pine bog and dry pine forest. It can be assumed that populations of such species are spread over both habitats. Only *Agroeca brunnea* showed no great specificity in habitat selection. Typical pine forest species occurring in the pine bog (*Centromerus sylvaticus*), or in both bog habitats (*Diplocentria bidentata* and *Walckenaeria alticeps*), were represented here only by low numbers of specimens and could be considered accidental. It can be concluded that the dispersal of spiders from dry pine forests has no major influence on the peatbog spider communities. Hiebsch (1980) stressed low similarities between the communities of bogs and pine forests too. Our results show that the number of woodland species was low in the intact pine bog habitat. The presence of pine trees and a shrub layer in the pine bog seemed to be insufficient to make this habitat suitable for most of the epigeic woodland species. Löser et al. (1982), Freudenthaler (1989) and Rupp (1999) found that a typical woodland species *Trochosa terricola* was an important element of peatbog spider communities. In the present case, all specimens (161) of this species occurred in the dry pine forest. It can be expected that dry pine forests separating or bordering small peatbog fragments may prevent dispersal of spiders between peatbog fragments and recolonisation following extinction of typical peatbog species.

Only a very few species preferring open habitats other than wetlands were found during the present investigation (3 specimens of *Pardosa prativaga*, 2 *Pardosa pullata*, 1 *Metopobactrus prominulus*, 1 *Xysticus ulmi*, 2 *Xysticus cristatus*, 7 *Pachygnatha degeeri*, and 1 *Meionta rurestris*). It can be supposed that large pine forests function as a barrier to some of these species, especially because open areas are sparse in this forest region. On the other hand, similar results revealing low occurrence of such species in peatbogs surrounded by various habitats have been presented by other authors (Almquist 1984; Freudenthaler 1989; Schikora 1993, 1997). This supports the assumption that peatbogs are not, in general, suitable habitats for this group of species.

Schikora (1997) found low similarity between spider communities of a peatbog and surrounding lime (*Tilia cordata*) forest. Rupp (1999) noticed high species similarity between a peatbog and surrounding wet meadows, but low similarity between a peatbog and adjacent *Alnus-Fraxinus* riverine forest. Löser et al. (1982) revealed very different spider communities in peatbogs and surrounding *Luzulo-Fagetum* habitat, where only *Trochosa terricola, Lepthyphantes pallidus, Lepthyphantes cristatus*, and *Micrargus herbigradus* were common in both habitats. All these studies, as well as the present one, show low similarities between spider communities in peatbogs and surrounding woodland habitats.

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Appendix 1. Composition of three peatbog and pine forest communities of spiders studied in Southern Lithuania in 1999. *: species new to Lithuania (also known from other localities, unpublished). **: species new to Lithuania found only in this study area.

	Open bog		Pine bog		Dry pine forest	
	No. ind.	%	No. ind.	%	No. ind.	%
Pardosa hyperborea (Thorell)	124	**12.8**				
Trochosa spinipalpis (F.O.P.-Cambr.)	19	2.0				
Taranucnus setosus (O.P.-Cambr.)*	3	0.3				
Ceratinella brevis (Wider)	3	0.3				
Pardosa prativaga (L. Koch)	3	0.3				
Hypsosinga sanguinea (C.L. Koch)	2	0.2				
Centromerus unidentatus Miller**	2	0.2				
Meioneta mossica Schikora**	2	0.2				
Walckenaeria dysderoides (Wider)	2	0.2				
Episinus angulatus (Blackwall)	2	0.2				
Drassyllus pusillus (C.L. Koch)	2	0.2				
Centromerus levitarsis (Simon)	1	0.1				
Metopobactrus prominulus (O.P.-Cambr.)	1	0.1				
Clubiona stagnatilis Kulczynski	1	0.1				
Dolomedes fimbriatus (Clerck)	1	0.1				
Drassodes pubescens (Thorell)	1	0.1				
Drassyllus lutetianus (C.L. Koch)	1	0.1				
Xysticus ulmi (Hahn)	1	0.1				
Pardosa sphagnicola (Dahl)	212	**22.0**	162	**18.4**		
Aulonia albimana (Walckenaer)	188	**19.5**	164	**18.6**		
Scotina palliardi (L. Koch)	107	**11.1**	47	5.3		
Gonatium rubens (Blackwall)	23	2.4	18	2.0		
Lepthyphantes angulatus (O.P.-Cambr.)	21	2.2	10	1.1		
Pachygnatha degeeri Sundevall	6	0.6	1	0.1		
Antistea elegans (Blackwall)	6	0.6	1	0.1		
Agyneta decora (O.P.- Cambr.)*	5	0.5	2	0.2		
Theonoe minutissima (O.P.-Cambr.)*	2	0.2	1	0.1		
Phrurolithus minimus C.L. Koch**	2	0.2	1	0.1		
Pirata insularis Emerton	34	3.5	19	2.2		
Gnaphosa nigerrima L. Koch	13	1.3	5	0.6		
Walckenaeria nodosa O.P.-Cambr.*	7	0.7	6	0.7		
Pirata uliginosus (Thorell)	20	2.1	159	**18.0**		
Gnaphosa microps Holm*	29	3.0	58	6.6		
Centromerus arcanus (O.P.-Cambr.)	41	4.2	43	4.9		
Notioscopus sarcinatus (O.P.-Cambr.)	1	0.1	24	2.7		
Pocadicnemis pumilla (Blackwall)	2	0.2	6	0.7		
Walckenaeria atrotibialis (O.P.- Cambr.)	2	0.2	6	0.7		
Tallusia experta (O.P.- Cambr.)	2	0.2	3	0.3		
Walckenaeria cuspidata Blackwall	1	0.1	3	0.3		
Walckenaeria nudipalpis (Westring)	1	0.1	3	0.3		
Cnephalohotes obscurus (Blackwall)	4	0.4	4	0.5		
Pardosa pullata (Clerck)	1	0.1	1	0.1		
Neon reticulatus (Blackwall)	1	0.1	1	0.1		
Alopecosa pulverulenta (Clerck)	20	2.1	7	0.8	1	0.1
Agroeca brunnea (Blackwall)	11	1.1	40	4.5	13	1.8
Agyneta cauta (O.P.- Cambr.)	12	1.2	19	2.2	2	0.3
Agroeca proxima (O.P.- Cambr.)	3	0.3	11	1.2	1	0.1
Diplocentria bidentata (Emerton)	2	0.2	1	0.1	26	3.6
Walckenaeria alticeps (Denis)	2	0.2	2	0.2	19	2.6
Haplodrassus signifer (C.L. Koch)	6	0.6	1	0.1	14	1.9
Zora spinimana (Sundevall)	1	0.1	6	0.7	7	1.0
Zelotes latreillei (Simon)	2	0.2	1	0.1	1	0.1
Robertus lividus (Blackwall)			6	0.7		
Lepthyphantes cristatus (Menge)			3	0.3		

Appendix 1, continued. Composition of three peatbog and pine forest communities of spiders studied in southern Lithuania in 1999. *: species new to Lithuania (also known from other localities, unpublished). **: species new to Lithuania found only in this study area.

	Open bog		Pine bog		Dry pine forest	
	No. ind.	%	No. ind.	%	No. ind.	%
Mangora acalypha (Walckenaer)			2	0.2		
Stemonyphantes lineatus (Linnaeus)			2	0.2		
Micrargus herbigradus (Blackwall)			2	0.2		
Pirata hygrophilus Thorell			2	0.2		
Floronia bucculenta (Clerck)			1	0.1		
Neriene radiata (Walckenaer)			1	0.1		
Hahnia pusilla C.L. Koch			1	0.1		
Dictyna arundinacea (Linnaeus)			1	0.1		
Neon valentulus Falconer			1	0.1		
Agyneta ramosa Jackson			5	0.6	1	0.1
Zora silvestris Kulczynski*			4	0.5	1	0.1
Cercidia prominens (Westring)			2	0.2	1	0.1
Zelotes clivicola (L. Koch)			1	0.1	39	5.3
Centromerus sylvaticus (Blackwall)			1	0.1	21	2.9
Agyneta subtilis (O.P.- Cambr.)			4	0.5	12	1.6
Zelotes subterraneus (C.L. Koch)			1	0.1	7	1.0
Cicurina cicur (Fabricius)			1	0.1	3	0.4
Micrargus apertus (O.P.- Cambr.)*			1	0.1	2	0.3
Saaristoa abnormis (Blackwall)*			1	0.1	2	0.3
Pachygnatha listeri Sundevall			2	0.2	2	0.3
Zelotes petrensis (C.L. Koch)			1	0.1	1	0.1
Trochosa terricola Thorell					161	**22.1**
Walckenaeria cucullata (C.L. Koch)					77	**10.5**
Zora nemoralis (Blackwall)					45	6.2
Pardosa lugubris (Walckenaer)					40	5.5
Tapinocyba pallens (O.P.- Cambr.)					38	5.2
Centromerus aequalis (Westring)					37	5.1
Haplodrassus soerenseni (Strand)					26	3.6
Alopecosa aculeata (Clerck)					22	3.0
Zornella cultrigera (L. Koch)**					20	2.7
Macrargus rufus (Wider)					16	2.2
Minyriolus pusillus (Wider)					15	2.1
Gnaphosa muscorum (L. Koch)					10	1.4
Macrargus carpenteri (O.P.- Cambr.)					8	1.1
Xysticus erraticus (Blackwall)					8	1.1
Araneus angulatus Clerck					4	0.5
Xysticus luctuosus (Blackwall)					3	0.4
Centromerita bicolor (Blackwall)					2	0.3
Porrhomma pallidum Jackson					2	0.3
Walckenaeria acuminata Blackwall					2	0.3
Philodromus cespitum (Walckenaer)					2	0.3
Euophrys westringi (Thorell)*					2	0.3
Segestria senoculata (Linnaeus)					1	0.1
Metellina mengei (Blackwall)					1	0.1
Araneus diadematus Clerck					1	0.1
Nuctenea umbratica (Clerck)					1	0.1
Lepthyphantes mansuetus (Thorell)**					1	0.1
Meioneta rurestris (C.L. Koch)					1	0.1
Pelecopsis elongata (Wider)					1	0.1
Agelena labyrinthica (Clerck)					1	0.1
Clubiona subsultans Thorell					1	0.1
Euryopis flavomaculata (C.L. Koch)	1	0.1			1	0.1
Xysticus cristatus (Clerck)	1	0.1			1	0.1
Euophrys petrensis C.L. Koch*	2	0.2			3	0.4