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Spiders of some raised peat bogs in Poland

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Summary

The epigeic spider fauna was studied in six different raised peat bogs in north-eastern and eastern Poland. In total, 203 species were found. Comparison of spider faunas from these peat bogs revealed significant differences in the species composition and in the dominance structure. The spider species of raised peat bogs may be divided into three groups: (1) inhabiting sun-lit peat bogs (Sphagnetum magellanici), (2) occupying moderately illuminated Ledo-Sphagnetum, (3) preferring shaded peat bogs (Vaccinio uliginosi-Pinetum). The difference between the three groups is reflected by the contribution of peat-bog and forest species. The proportion of peat-bog species decreases with shading of environment, while that of forest species increases. Some similarities in species composition between various peat bogs are related to the high proportion of hygrophilous and heliophilous species common to all study sites. The rarest species and tyrphobionts occurred on the more sunlit peat bogs. Some noteworthy rare species are relatively numerous, e.g. *Arctosa lamperti* Dahl, *Pardosa hyperborea* (Thorell), *P. maisa* Hippa & Mannila and *Gnaphosa microps* Holm. *Scotina palliardi* (L. Koch) is a species new to Poland.

Introduction

Many aspects of the spider fauna of raised peat bogs in Europe have been studied by a number of researchers (Casemir, 1958, 1976; Koponen, 1968, 1979; Palmgren & Lonnqvist, 1974; Palmgren, 1977a,b; Lehtinen *et al*., 1979; Hauge & Wiger, 1980; Hänggi & Maurer, 1982; Schikora, 1994, 1997).

Most papers on the spider fauna of raised peat bogs in Poland contain only lists of species captured (Staręga, 1971, 1978, 1984, 1995; Czajka *et al*., 1981; Woźny, 1985; Dziabaszewski, 1991; Staręga & Stankiewicz, 1996). Papers reporting analyses of the dominance structure of spider assemblages in raised peat bogs are rare (Staręga, 1988; Woźny, 1992). The aim of the present study is to describe and compare epigeic spider faunas on six raised peat bogs in north-eastern and eastern Poland (Fig. 1).

Study areas

Differences in density of the tree layer or absence of trees on the investigated peat bogs has allowed us to divide the study areas into three groups.

I. Treeless, strongly sunlit, raised peat bog

1. Poleski National Park: peat bog around Moszne Lake near Jamniki village, an area of about 5 ha, UTM FC40, studied by I. Hajdamowicz from March to November 1995. The study area mainly consists of Sphagnetum magellanici with small patches of Caricetum limosae from the bank of the lake, and bordered by Ledo-Sphagnetum; *Oxycoccus quadripetalus* and *Andromeda polifolia* are dominants in the shrub layer; the moss layer is dominated by *Sphagnum magellanicum* and *S. rubellum*.

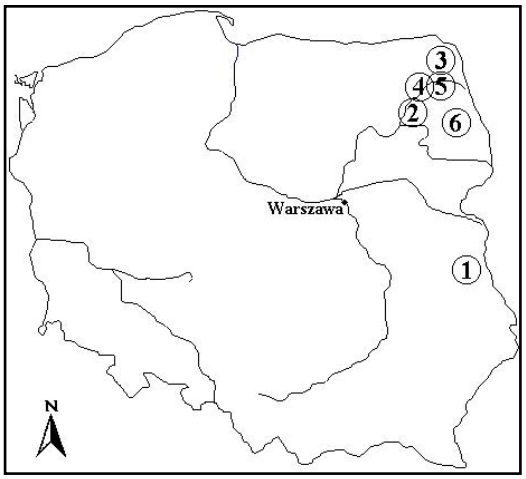

Fig. 1: Location of the study areas. 1 = Poleski National Park; 2 = Biebrza National Park I; 3 = Wigry National Park; 4 = Biebrza National Park II; 5 = Biebrza National Park III; 6 = Knyszyn Forest Landscape Park.

II. Moderately illuminated peat bogs with tree layer

2. Biebrza National Park I: near Gugny village, an area of about 5 ha, UTM FE 01, studied by J. Kupryjanowicz from April to November, 1991–94. Ledo-Sphagnetum bordered by Sphagnetum magellanici and pine greenwood on a sand-dune; *Pinus silvestris* is not numerous in the tree layer; the shrub layer consists of *Betula pubescens*, *Eriophorum vaginatum*, *Andromeda polifolia*, *Oxycoccus quadripetalus* with some *Ledum palustre*; the moss layer is dominated by *Sphagnum magellanicum*, *S. recurvum* and *S. rubellum*.

3. Wigry National Park: Suche Bagno Reserve, an area of about 20 ha, UTM FE 38, studied by A. Stankiewicz from April to November, 1993–94. Ledo-Sphagnetum located in an interior basin and surrounded by marshy coniferous forest which, in turn, is surrounded by new coniferous forest; *Pinus silvestris* is dominant in the tree layer of low density; the shrub layer consists of *Ledum palustre*, *Andromeda polifolia*, *Oxycoccus quadripetalus*, *Eriophorum vaginatum*, *Calluna vulgaris* and *Pinus silvestris*; the moss layer is dominated by *Sphagnum magellanicum* and *S. cuspidatum*.

III. Shady peat bogs with dense tree layer

4. Biebrza National Park II: Czerwone Bagno Reserve, an area of about 20 ha, UTM FE 24, studied by J. Kupryjanowicz from April to November 1995. Vaccinio uliginosi-Pinetum; *Pinus silvestris* and *Betula pubescens* are dominant in the tree layer; the shrub layer consists of *Ledum palustre*, *Vaccinium uliginosum*, *Andromeda polifolia*, *Oxycoccus quadripetalus*; the moss layer contains *Sphagnum* spp.

5. Biebrza National Park III: Czerwone Bagno Reserve, an area of about 20 ha, UTM FE 24, studied by J. Kupryjanowicz from April to November 1995. Vaccinio uliginosi-Pinetum located two kilometers from site 4; *Pinus silvestris* is dominant in the tree layer; the shrub and moss layers are similar to corresponding layers in site 4.

6. Knyszyn Forest Landscape Park: near Supraúl, an area of about 20 ha, UTM FD 59, studied by W. Staręga from April to November, 1994–95. Ledo-Sphagnetum; *Pinus silvestris* is dominant in the tree layer, *Ledum palustre* is dominant in the shrub layer; the moss layer consists of a few *Sphagnum* spp.

Material and methods

Ten pitfall traps were placed in a line in the central part of each study site. Each trap (a plastic drinking cup, 7 cm in diameter and 10 cm deep) contained a mixture of water and ethylene or propylene glycol as a preservative, with a small quantity of detergent added to prevent the spiders escaping. The traps were emptied at fortnightly intervals from March–April to November, throughout 1, 2, or 4 years in 1991–95. Altogether 13,404 specimens were collected by trapping in the six study habitats and all were identified to species. Nomenclature follows Prószyński & Staręga (1997).

To compare the studied spider assemblages, Renkonen's coefficient of similarity (Re) was used. It has been accepted that values of Re > 0.50 indicate high similarity between spider associations. The dominance groups were proposed after Woźny (1992) (Table 1).

The number of study years of spider material collected during the investigation differed between sites. However, prolongation of study years results in an increase in the number of species collected, but does not significantly change our analysis of dominance structures.

Study sites	***1***	***2***	***3***	***4***	***5***	***6***
Euryopis flavomaculata (C. L. Koch)	+	R	+		+	I
Robertus lividus (Blackwall)	+	+	+	+	R	+
Agyneta cauta (O. P.-Cambridge)	+	+	I	+	+	+
Centromerus sylvaticus (Blackwall)		+	+	D	E	+
Macrargus rufus (Wider)		+		+	R	+
Metopobactrus prominulus (O. P.-Cambridge)			I			+
Notioscopus sarcinatus (O. P.-Cambridge)	+	+	I		+	+
Pocadicnemis pumila (Blackwall)	+	I	+	+	R	I
Walckenaeria alticeps (Denis)		+	+	+	R	
Walckenaeria atrotibialis (O. P.-Cambridge)	+	+	R	R	+	R
Walckenaeria cuspidata Blackwall	+	+	R			+
Pachygnatha listeri Sundevall		+		+	I	+
Alopecosa pulverulenta (Clerck)	E	E		I	I	+
Arctosa lamperti Dahl	D		+			
Hygrolycosa rubrofasciata (Ohlert)	+		+	D	D	I
Pardosa hyperborea (Thorell)			I			
Pardosa lugubris (Walckenaer)	+	+		E	D	+
Pardosa maisa Hippa & Mannila		D				
Pardosa prativaga (L. Koch)	+	I	I			+
Pardosa pullata (Clerck)	D	I	+			+
Pardosa sphagnicola Dahl	E	E	E			E
Pirata hygrophilus Thorell				D		+
Pirata uliginosus (Thorell)	E	+	E	E	E	E
Trochosa spinipalpis (F. P.- Cambridge)	D	R	I	E	E	D
Trochosa terricola Thorell		I	+	+	+	+
Antistea elegans (Blackwall)	+	+	R			R
Cicurina cicur (Fabricius)		+	+	R	R	+
Agroeca brunnea (Blackwall)		+	I	+	+	+
Agroeca proxima (O. P.-Cambridge)	+	+	R	I	D	R
Scotina palliardi (L. Koch)	R	+	I			
Drassyllus lutetianus (L. Koch)	+	R	+			+
Gnaphosa microps Holm			I			
Gnaphosa nigerrima L. Koch	I	R				
Haplodrassus signifer (C. L. Koch)	I	R	+			+
Zelotes clivicola (L. Koch)	+	+	+	R	D	+
Zora spinimana (Sundevall)	+	R	+	I	R	+
Number of subrecedent species (other)	36	90	47	47	36	72

Table 1: Species composition and dominance.

Key:
E = eudominant (> 10%)
D = dominant (5.1–10%)
I = influent (2.1–5%)
R = recedent (1.1–2%)
\+ = subrecedent (< 1%)

Results

Species composition

In total, 203 species were found in the six habitats. The number of species and number of specimens in each habitat is given in Tables 1 and 2. The highest and the lowest number of species was found on sites 2 and 5, respectively (Table 2). Numbers of species captured in respective habitats depended on the length of the capture period. The numbers of species captured yearly were similar in all habitats. Species diversity seems to be influenced by the vicinity of different biotopes. *Trichopterna cito* (O. P.-Cambridge), *Stemonyphantes lineatus* (Linnaeus) and *Ozyptila atomaria* (Panzer) are most likely to arrive at the peat bog (site 2) from dry habitats.

Some rare species are relatively numerous: for example *Pardosa hyperborea* (Thorell) (3% in site 3), *P. maisa* Hippa & Mannila (8% in site 2), *Gnaphosa microps* Holm (3% in site 3), and *Arctosa lamperti* Dahl (7% in site 1). *Scotina palliardi* (L. Koch), which occurs in sites 1, 2 and 3 (3%, 0.03% and 4%, respectively) is a spider species new to Poland.

Rare species include: *Ero cambridgei* Kulczyński, *Theonoe minutissima* (O. P.-Cambridge), *Aphileta misera* (O. P.-Cambridge), *Centromerus semiater* (L. Koch),

Ceraticelus sibiricus Eskov, *Glyphesis cottonae* La Touche, *Meioneta mossica* Schikora, *Pirata insularis* Emerton, *P. tenuitarsis* Simon, *Clubiona norvegica* Strand, *Haplodrassus moderatus* (Kulczyński), *Zelotes aeneus* (Simon), *Zora armillata* Simon, *Heliophanus dampfi* Schenkel, *Talavera monticola* (Kulczyński), *T. westringi* (Simon).

The different study areas have distinct species (Table 1). *Gnaphosa microps* and *Pardosa hyperborea* (site 3), and *P. maisa* (site 2) are the most numerous exclusive species (Table 1). The ecology and distribution of these species are described elsewhere (Kupryjanowicz, 1995; Stankiewicz, 1995; Staręga & Stankiewicz, 1996).

Dominance

Dominance structure allows qualification and quantification of a spider assemblage in a particular association. In this paper five dominance groups were applied (Table 1).

Eudominance is the least polymorphic group among all dominance classes. It consist of 2–3 species, accounting for nearly 50% of all specimens, except for site 6, where they accounted for 57% of the specimens. The group of dominants consisted of 1–4 species (8–25% of all specimens). There were no dominants at site 3. However, influent species were well represented there (I = 9). On the other peat bogs, influents were represented by 2–4 species.

In Sphagnetum magellanici and Ledo-Sphagnetum the most numerous eudominant was *Pardosa sphagnicola* Dahl, which accounted for 24%, 32% and 34% of all spiders found at sites 1, 2 and 3, respectively. Likewise, in Vaccinio uliginosi-Pinetum, *Pirata uliginosus* (Thorell) eudominants accounted for 19% and 24% of all spiders found at sites 4 and 5, respectively. At site 6, *P.uliginosus* was an evident eudominant (39%). The other eudominant was *Pardosa sphagnicola* (18%), the most numerous in more sunlit communities. Except for the spider species mentioned above, *Trochosa spinipalpis* (F. O. P.-Cambridge) (sites 4 and 5), *Pardosa lugubris* (Walckenaer) (site 4) and *Centromerus sylvaticus* (Blackwall) (site 5) were eudominants in Vaccinio uliginosi-Pinetum.

Arctosa lamperti was dominant on the sunlit peat bog (site 1) and accounted for 8%. It also occurred in the moderately insolated peat bog (site 3), but was low in numbers (Table 1). *Pardosa maisa* was the only dominant at site 2. Shady habitats, such as Vaccinio uliginosi-Pinetum, were occupied by the following dominant species: *Centromerus sylvaticus* (site 4), *Hygrolycosa rubrofasciata* (Ohlert) (sites 4 and 5), *Pardosa lugubris* (site 5), *Pirata hygrophilus* Thorell (site 4), *Agroeca proxima* (O. P.-Cambridge) and *Zelotes clivicola* (L. Koch) (site 5) (Table 1).

Coenological comparison

The spider faunas of marshy, coniferous, Vaccinio uliginosi-Pinetum forests (sites 4 and 5) are very similar, as indicated by a high value of Re = 0.736. This is due to the relatively small distance between the areas studied and similarity of habitats. Close resemblance characterizes faunas of Sphagnetum magellanici and Ledo-Sphagnetum (sites 1 and 3, Re = 0.541). Sphagnetum magellanici and Vaccinio uliginosi-Pinetum (sites 1 and 6, Re = 0.505; Table 3) were characterized by a high proportion of species typical for marshy forests (probable influence of Ledo-Sphagnetum bordering site 1).

The lowest similarity was found between spider assemblages of Vaccinio uliginosi-Pinetum and Sphagnetum magellanici (sites 4 and 2, Re = 0.131; sites 5 and 2, Re = 0.13; Table 3). The dissimilarity is due to the

Study sites	***1***	***2***	***3***	***4***	***5***	***6***
Number of species (S)	60	119	76	67	57	101
Number of individuals (*n*)	929	3373	3405	1043	1031	3458
Rare species (%)	18.3	8.5	13.2	4.5	3.5	5.1
Individuals of rare species (%)	12.5	10.6	14.6	1.2	0.9	0.5
Tyrphobionts	6	3	5	1	–	2
Exclusive species	10	32	11	11	5	16

Table 2: Assemblage parameters. Rare species are regarded as occurring in fewer than 10 Polish localities.

differences in the illumination, as illumination and humidity are the major factors determining the occurrence of spider species in particular communities (Trezel, 1952).

The faunas of all peat bogs under study are characterized by similarly high contributions of hygrophilous species, varying from 41% to 51%. There are significant differences in the contributions of photophilous, peat-bog, and forest spiders in the three investigated groups of peat bogs. Forest spiders are the most numerous in shady peat bogs (51% in site 4, 47% in site 5, and 29% in site 6).

The lowest contribution of forest species (12%) and the highest of photophilous and peat-bog species (7% and 38%, respectively) is typical of strongly insolated peat bogs.

The group of shady peat bogs is characterized by the lowest proportion of peat-bog species (10%, 10% and 20% at sites 4, 5 and 6, respectively), a high proportion of forest species (51%, 47% and 29%, respectively), and a low proportion of photophilous ones (4%, 4% and 5%, respectively).

Forest species (21% at site 2; 29% at site 3) and photophilous species (8% at site 2; 1% at site 3) constitute spider communities in a second group of peat bogs. An intermediate contribution of peat-bog species (28% at site 2; 27% at site 3) is typical of moderately insolated peat bogs with a tree layer.

Sites	***1***	***2***	***3***	***4***	***5***
2	0.477				
3	0.541	0.484			
4	0.308	0.131	0.286		
5	0.306	0.130	0.268	0.736	
6	0.505	0.352	0.490	0.419	0.468

Table 3: Similarity according Renkonen's index.

Discussion

There are significant differences in the dominance structure between our study sites and those on Finnish, Estonian and German peat bogs known from earlier reviews (Koponen, 1968; Schikora, 1994, 1997). Some similarities are evident in the case of several peat-bog species, for example among *Gnaphosa microps* (site 1), *G. nigerrima* L. Koch (sites 1 and 2) and *Arctosa lamperti* (sites 1 and 3) occurring on Polish peat bogs, and *Gnaphosa lapponum* (C. L. Koch) and *Arctosa alpigena* (Doleschall) found on the peat bogs of Atlantic type, and in the case of two closely related species *Pardosa maisa* (site 2) and *P. nigriceps* (Thorell) (Koponen, 1968; Schikora, 1994, 1997).

A direct comparison of the dominance structure between our sites and other reports on raised peat bogs in Poland is impossible because of different capture methods (Staręga, 1988; Woźny, 1992). This report is therefore limited to the comparison of species lists. Eighteen to 27 species were found in common between the sites described herein and other Polish peat bogs (Staręga, 1971, 1978, 1984, 1995; Dziabaszewski, 1991; Woźny, 1992; Staręga & Stankiewicz, 1996).

As many as 8 species are associated with the studied peat bogs. Casemir (1976) reported 23 tyrphobiont spiders typical of raised peat bogs. According to recent data (Hänggi *et al.*, 1995), most of them are peat-bog species, like *Agyneta cauta* (O. P.-Cambridge) and *Aphileta misera* or hygrophilous species (e.g. *Drepanotylus uncatus* (O. P.-Cambridge), *Notioscopus sarcinatus* (O. P.-Cambridge) and *Pirata uliginosus*). Our data show that *Theonoe minutissima*, *Glyphesis cottonae*, *Meioneta mossica*, *Scotina palliardi*, *Arctosa lamperti*, *Gnaphosa microps*, *Heliophanus dampfi*, and *Talavera westringi* do not occur outside raised peat bogs. Therefore, we suggest supplementing the tyrphobiont list with the above species. Spiders such as *Pardosa hyperborea*, *P. maisa*, *P. sphagnicola* and *Gnaphosa nigerrima* occur not only on raised peat bogs, but also on low and transitional peat bogs. We propose to classify them as peat-bog spiders.

The spider fauna of raised peat bogs may be divided into three groups: one linked up to strongly insolated peat bogs (Sphagnetum magellanici), the second on Ledo-Sphagnetum, and the third one with shady peat bogs (Vaccinio uliginosi-Pinetum). The difference between the three groups is reflected in the contribution of peat-bog and forest species. The proportion of peat-bog species decreases with shading of the environment whilst forest species increase.

Sunlit habitats are occupied by photophilous species. Their contribution increases with the illumination of investigated habitats. Only one peat bog in Wigry National Park is the exception, due to the lowest contribution of

photophilous species with relatively high contribution of forest ones, which is probably caused by the proximity of marshy and young forests surrounding the studied peat bog. The spider fauna of raised peat bogs is relatively uniform due to the large proportion of hygrophilous species and tyrphobionts.

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