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The spider fauna (Arachnida: Aranei) in various types of pine forests in the Berezinsky State Biosphere Reserve, Belarus

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Lichen, moss, heather, sphagnum pine forests, spiders, density of activity, species composition, biogeocenosis

Abstract. The goal of the study is to investigate comparatively spiders in various types of pine forests, growing on soils with different moisture contents. Objects of the study were lichen, heather, moss and sphagnum pine forests. In the study 981 spiders of 65 species from 13 families were collected. Among them, 11 species were recorded in the territory of the Berezinsky Reserve and three species in Belarus for the first time. Specific complexes of species were found to correspond to each of the biogeocenoses studied. The greatest similarity between the complexes is found in the lichen and sphagnum forests and the smallest, in the lichen and heather ones. The spider complexes in the pine forest types studied differ in dominants, their abundance and the number of rare species.

INTRODUCTION

Pine forests constitute 57.6% of the present-time forest cover in Belarus and are subjected to human impact to a greater extent than the others. Under ever increasing human pressure comprehensive research is necessary to be carried out in undisturbed or slightly disturbed biogeocenoses to obtain information that could be used as a reference standard in studies of the human impact on forest biogeocenoses.

The present studies were carried out in the Berezinsky State Biospheric Reserve (BSBR), which is located in the north-eastern coolest and moistest part of Belarus. After the Reserve was chosen as a standard natural area and was given the status of biospheric, it has become necessary to start more thorough and regular research of above-ground animals, including spiders. Although spiders are numerous in forests and meadows, the largest number of their species occurs in pine forests (Khotko et al., 1982). In the BSBR they occupy 45.3% of the total area of the forests. In the protected area spiders that are an important component of all biogeocenoses are studies inadequately, although a large number of publications has appeared in the last decade (Litvinova, Shlyakhtenok & Ovcharenko, 1980, 1981; Shlakhtenok, 1986; Khotko & Zhukovets, 1988).

The goal of this study was to carry out a comparative investigation of spider complexes in various types of pine forests.

Table 1. Five-point logarithmic scale bounded from above used for estimation of relative abundance of species. N is the total number of individuals of all species.

Point score	ranges of class interval		abundance
1	1	$N^{0.2}$	units
2	$N^{0.2} + 1$	$N^{0.4}$	scarce
3	$N^{0.4} + 1$	$N^{0.6}$	medium
4	$N^{0.6} + 1$	$N^{0.8}$	numerous
5	$N^{0.8} + 1$	N^{1}	ample

MATERIALS AND METHODS

The species composition, density of activity, and distribution of spiders were investigated in four forest biogeocenoses, namely, lichen, heather, moss and sphagnum pine forests that are an ecological series. In the series every subsequent biogeocenosis differs by one grade from the previous one in the degree of moisture participation in formation of the soil and phytocenosis. Lichen and heather pine forests are in the group of atmospheric humidification with a low groundwater level. In the lichen pine forest the groundwater level (GWL) is lower than 5.0 m and in the heather pine forest it is at 3.5–3.7 m. The forests occur on sandy-podzolic sandy soils with a low podzol content. The moss pine forest is in the group with a medium GWL (1.5–1.8 m). The soil is sandy-podzolic with temporal extensive humidification. The sphagnum pine forest is characterized by the highest water encroachment and in May the GWL is on the surface of the soil. The soil is peaty-humus-gley.

Spiders that occur on the soil surface were caught with Barber's (1931) traps, filled to 1/3 of the volume with 4% formalin solutions. During the subsequent handling the spiders were placed into test-tubes filled with 70% ethyl alcohol.While processing the material, the relative abundance of the species was calculated from Pesenko's (1982) nomogram, plotted on a five-point finite logarithmic scale, which is shown in Table 1. Jaccard's (1901) coefficient was used to estimate the composition of the biogeocenoses.

RESULTS

In the studies 981 animals of 65 species from 13 families were collected altogether. Of them 11 species were recorded for the first time in the Berezinsky Reserve and three species in Belarus.

In the lichen pine forest spiders are represented by 298 specimens of 37 species from ten families (Table 2). *Alopecosa aculeata* (19.5%) and *Trochosa terricola* (15.4%) dominate in this type of pine forest.

Percentage of *Haplodrassus soerenseni* and *Agyneta subtilis* is substantial, amounting to 7.7% and 7.4%, respectively. Here nine species that we have not encountered in the other pine forests have been recorded.The composition of spiders in the lichen pine forest comprises four geographic groups. European and Palearctic species are most numerous (79.4%). Euro-Siberian and Holarctic species are much less numerous.

The heather forest is characterized by the presence of 11 families, including 25 species (299 specimens). *Haplodrassus soerenseni* and *Pardosa lugubris* dominate in the number, amounting to 23.1% and 18.1%, respectively. Apart from the dominants, it is necessary

Table 2. Abundance (%) of the spiders in the pine forests of the Berezinsky State Biosphere Reserve. * species new for the Berezinsky State Biospere Reserve, ** species new for the Belarus.

	Pine forests			
	Lichen	Heather	Moss	Spagnum
Segestriidae				
Segestria senoculata (Linnaeus, 1758)	1.3	—	—	—
Tetragnathidae				
Tetragnatha obtusa C. L. Koch, 1837	—	0.3	—	—
Pachygnatha listeri Sundevall, 1830	—	—	—	4.7
Linyphiidae				
Walckenaeria acuminata Blackwall, 1833*	0.3	—	—	—
W. alticeps (Denis, 1952)	—	—	—	1.5
W. antica (Wider, 1834)	0.3	0.7	—	—
W. cucullata (C. L. Koch, 1836)	1.0	—	0.7	0.3
W. melanocephala (O. P.-Cambridge, 1881)	—	—	—	2.3
W. nudipalpis (Westring, 1851)	1.3	—	—	—
Dicymbium nigrum (Blackwall, 1834)	—	—	—	0.3
Moebelia penicillata (Westring, 1851)*	—	0.3	—	—
Pocadicnemi pumila (Blackwall, 1841)*	—	—	—	1.2
Trichopterna cito (O. P.-Cambridge, 1872)**	—	1.0	—	—
Trematocephalus cristatus (Wider, 1834)	—	—	0.7	—
Tapinocyba pallens (O. P.-Cambridge, 1872)	2.0	—	—	0.3
Minyriolis pusillus (Wider, 1834)	—	—	—	0.3
Gongylidiellum latebricola (O. P.-Cambridge, 1871)*	—	—	—	0.8
Diplocentria bidentata (Emerton, 1882)	0.7	2.3	—	—
Agyneta cauta (O. P.-Cambridge, 1902)	0.3	—	—	3.4
A. conigera (O. P.-Cambridge, 1863)*	0.7	—	—	—
A. ramosa (Jakson, 1914)*	—	—	0.7	—
A. subtilis (O. P.-Cambridge, 1863)	7.4	—	5.6	10.9
Meioneta rurestris (C. L. Koch, 1836)	0.3	—	—	—
Centromerus incilium (L. Koch, 1881)*	1.0	—	—	—
Macrargus rufus (Wider, 1834)	4.0	—	—	—
Stemonyphantes lineatus (Linnaeus, 1785)	—	0.3	—	—
Lepthyphantes angulipalpis (Westring, 1851)	—	—	—	0.3
L. pallidus (O. P.-Cambridge, 1871)	0.3	—	—	—
Theridiidae				
Euryopis flavomaculata (C. L. Koch, 1836)	—	—	0.7	—
Steatoda phalerata (Panzer, 1801)	3.5	0,3	—	0.3
Robertus lividus (Blackwall, 1836)	—	—	—	0.3
Lycosidae				
Pardosa lugubris (Walckenaer, 1802)	6.7	18.1	3.9	8.1
P. prativaga (L. Koch, 1870)	—	—	—	0.3
Xerolycosa nemoralis (Westring, 1861)	—	2.0	—	—
Alopecosa aculeata (Clerck, 1757)	19.5	16.1	27.7	10.9
Trochosa terricola Thorell, 1856	15.4	17.1	33.3	8.5
Pirata hygrophilus (Thorell, 1872)	—	—	—	0.8
P. uliginosus (Thorell, 1856)	—	—	0.7	20.2

Table 2. (cont.)

	Pine forests			
	Lichen	Heather	Moss	Spagnum
Hahniidae				
Hahnia nava (Blackwall, 1841)	—	0.3	—	—
Liocranidae				
Agroeca brunnea (Blackwall, 1833)	1.3	0.3	0.7	1.2
A. proxima (O. P.-Cambridge, 1871)	—	—	—	1.2
Clubionidae				
Phrurolithus festivus (C. L. Koch, 1835)*	—	0.3	0.7	0.3
Clubiona subsultans Thorell, 1875	—	0.3	—	—
Gnaphosidae				
Gnaphosa bicolor (Hahn, 1831)*	0.3	0.7	0.7	—
Haplodrassus cognatus (Westring, 1862)*	0.7	—	—	0.3
H. signifer (C. L. Koch, 1839)	3.4	1.7	1.5	1.2
H. soerenseni (Strand, 1900)	7.7	23.1	1.5	7.4
H. umbratilis (L. Koch, 1866)	0.7	0.3	—	—
Zelotes clivicola (L. Koch, 1870)*	2.3	4,3	1.5	0.3
Z. electus (C. L. Koch, 1839)	—	—	1.5	—
Z. subterraneus (C. L. Koch, 1833)	—	—	1.5	—
Z. lutetianus (L. Koch, 1866)	—	—	—	0.3
Zoridae				
Zora nemoralis (Blackwall, 1861)	6.4	5,4	1.5	7.8
Z. spinimana (Sundevall, 1833)	0.3	—	—	1.2
Philodromidae				
Philodromus collinus (C. L. Koch, 1835)	1.3	—	—	—
Thomisidae				
Misumena vatia (Clerck, 1757)	—	—	—	0.3
Xysticus audax (Schrank, 1803)	1.7	—	0.7	0.3
X. luctuosus (Blackwall, 1836)	3.7	—	5.6	0.8
X. obscurus Collet, 1877**	0.7	0.7	0.7	0.3
X. robustus (Hahn, 1831)**	1.0	—	—	—
Oxyptila atomaria (Panzer, 1801)	0.3	—	2.3	—
Salticidae				
Neon reticulatus (Blackwall, 1853)	0.3	—	—	0.3
Euophrys erraticus (Walckenaer, 1825)	0.3	0.3	—	0.3
E. frontalis (Walckenaer, 1802)	—	1.0	—	—
Evarcha falcata (Clerck, 1757)	1.3	2.8	5.6	0.8

to indicate some subdominants, namely, *Trochosa terricola* (17.4%) and *Alopecosa aculeata* (16.1%). We have found eight species, characteristic of this biogeocenoses alone. The species complex of spiders is mainly composed by Palearctic (37.5%) and European (33.3%) species.

Spiders of the moss pine forest are represented by 126 specimens of 23 species from ten families. There are no abundant species in this biotope. Among numerous species we can mention *Trochosa terricola* (33.3%) and *Alopecosa aculeata* (27.7%). The number of rare species decreases, being only three in this biotope. They are *Trematocephalus cristatus, Agyneta ramosa* and *Euryopis flavomaculata.* Just like in the previous biogeocenosis, the spiders are represented by European (50%) and Palearctic (27.3%) species.

In the sphagnum pine forest 258 spider specimens of 36 species have been collected. *Pirata uliginosus* (20.2%), *Agyneta subtilis* and *Alopecosa aculeata* (in 10.9%) dominate there. It should be noted that 13 species have been found only in this pine forest. The spider fauna in this biogeocenosis is also characterized by the presence of four geographic groups. Species of the European (38.2%) and Palearctic (32.4%) groups prevail.

Thus, analysis of the fauna of spiders in the pine forests of the biogeocenoses of the BSBR has revealed its substantial diversity as it includes all the most representative families.

The highest species diversity has been found in the lichen and sphagnum pine forests (37 and 36 species, respectively), the lowest species diversity has been recorded in the moss pine forest (23 species). Communities of spiders in the biogeocenoses studied are characterized by different density of activity. The highest density of activity of spiders has been found in the lichen and heather pine forests, the lowest—in the moss forest. Representatives of the Linyphiidae family (38.5%) dominate in the number of species and spiders of the Lycosidae family (50%) prevail in the number of specimens caught (Fig. 1). Spiders from the Gnaphosidae family are the second largest in the number of species and in the number of specimens caught. Most of the spider species from the biogeocenoses studied belong to the forest ecological group. The spider fauna in the pine forests studied comprises six geographic groups. Representatives of the European (48.4%) and Palearctic (25.8%) groups are the most numerous. The Holarctic (11.3%) and Euro-Siberian (11.3%) groups are a little less numerous.

DISCUSSION

It has been found that specific species of spiders are inherent in each of the biogeocenoses studied. Although they occur in the other pine forests too, their highest density of activity has been found only under specific conditions of a particular biogeocenosis. The species complexes are the most similar in the lichen and sphagnum forests and the least

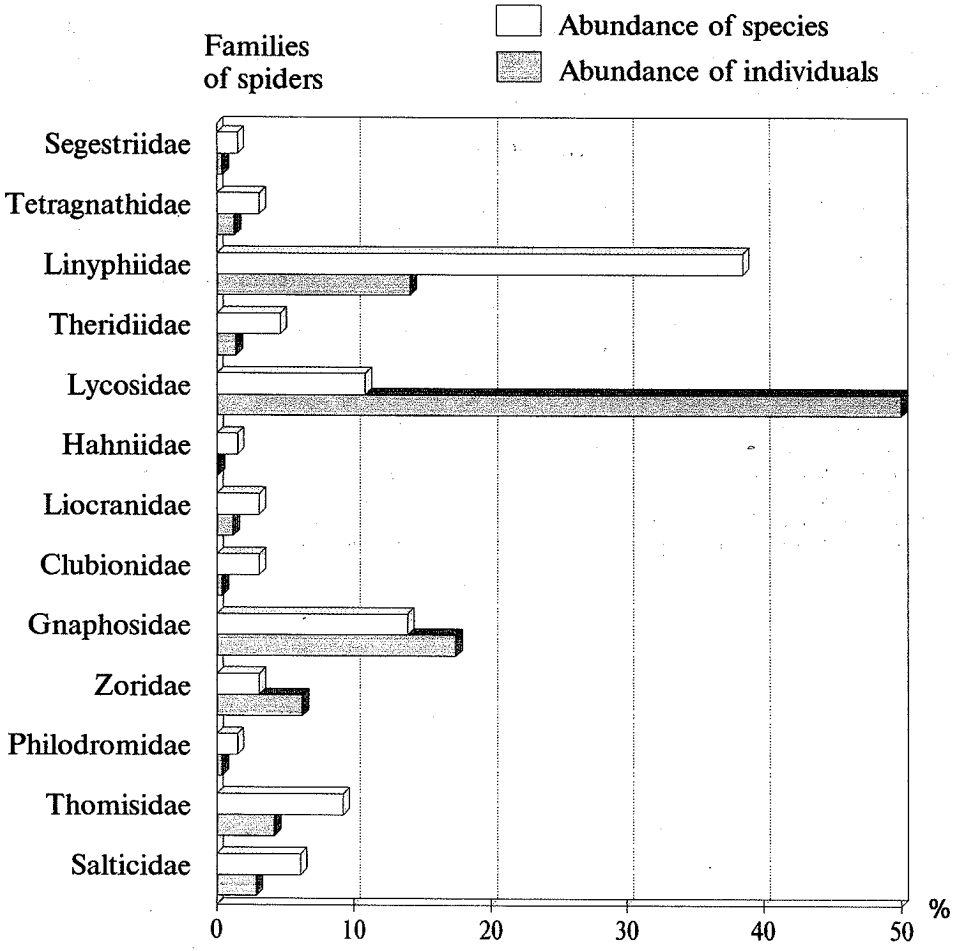

Fig. 1. Abundance of species and individuals of spiders in the various pine forests of the Berezinsky State Biosphere Reserve.

similar in the lichen and heather pine forests. The complexes of the spider species in the pine forests studied have different dominants, abundances of species and rates of occurrence of rare species.

Since one technique (Barber's traps) was used for catching of spiders, in our collections representatives of the Lycosidae family prevailed, and most of species from the Gnaphosidae family are typical inhabitants, of the soil surface.

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