

LONG TERM CHANGES IN SPIDER (ARANEAE) COMMUNITIES IN NATURAL AND DRAINED FENS IN THE BIEBRZA RIVER VALLEY

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Abstract

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The density and diversity of spiders were compared in three periods: I – 1955, II – 1978-1983, III-1996-1998. The quadrat method was applied to estimate the density of spiders, and the Shannon-Wiener index was used to calculate species diversity. A decrease in spider species diversity, through time, was detected in managed grasslands. It was accompanied by a decrease in the number of families. This tendency was not found in natural fens. Spider density was similar in the compared periods. In period III, spider diversity and total density were positively correlated with soil moisture, abundance of microhabitats in an area and landscape heterogeneity, measured by the distance to shrubs. A negative correlation was found between the density of spiders and the intensity of management practice (mowing by heavy machines and grazing by cattle), and the bulk density of the soil. Plant diversity (H' based on the proportion of the area covered by each plant species) did not influence the diversity of spiders. The proportion of species connected exclusively with the field layer decreased with time. The effect of management on spider mobility was positive.

Introduction

The objective of our study was to analyse changes in spider species diversity and density in fens, over time and over environmental gradients. Impoverishment of a community is considered an indicator of the deterioration of habitat quality. Spider communities are a reliable source of information concerning the condition of habitats, because of their sensitivity to environmental conditions, their high number of species, and their tendency to occur abundantly in various ecosystems (DUFFEY, 1978; MAELFAIT et al., 1997; HÄNGGI et al., 1995). This problem is especially relevant to peatlands, which are endangered habitats, due to their dimin-

T a b l e 1. Number of study sites in natural and managed grasslands, on soil formed from sedge moss (A), tall sedge (B), or alder (C) type of peat, analysed for three periods.

Period (Years)	Sites				
	Natural		Managed		
	A	B	A	B	C
I 1955	–	2	2	–	–
IIa 1978-1979	1	2	1	3	1
IIb 1982-1983	1	2	1	3	2
III 1996-1998	1	2	2	2	2

ishing area. They are becoming fragmented, and are vulnerable to any changes in the water supply.

Our investigations were carried out in grasslands on fens, in the valleys of the two rivers Narew and Biebrza. This area is located in north- eastern Poland (53°10′-53°30′N and 22°30′-23°60′E), in one of the last, extensive fen areas in Europe. During the past hundred years this peatland was partially drained and cultivated

T a b l e 2. Characteristics of study sites in natural (N) grasslands in period III. Data after SZUNIEWICZ, CHRZANOWSKI (in press), KAMIŃSKI (in press).

Parameter	A	B
Peat origin	sedge-moss	Sedge
Mean soil moisture (% by volume)	85.0	83.9-87.6
Soil bulk density (g.cm ⁻³)	0.154	0.151-0.160
Thickness of peat deposit (cm)	150	70-170
Yield (g.dwt.m ⁻³)	350	200-250

T a b l e 3. Characteristics of study sites in managed grasslands, analysed in period III. Data after PASTERNAK-KUŚMIERSKA et al.1997, SZUNIEWICZ, CHRZANOWSKI (in press), KAMIŃSKI (in press).

Parameter	A	B	C
Peat origin	sedge-moss	sedge	alder
Mean soil moisture (% by volume)	78-82	68-79	59-71
Soil bulk density (g cm ⁻³)	0.198-0.209	0.229-0.371	0.256-0.332
Thickness of peat deposit (cm)	400	140-400	80-265
Yield (g d.wt m ⁻²)	460	350 - 395	264 - 900

T a b l e 4. Spider species diversity and mean density (ind.m⁻²) in natural and managed peat grasslands.

Period	Natural grasslands		Managed grasslands		P	
	Density	H'	Density	H'	1-2	3-4
	1	3	2	4		
I	19.0 ± 1.0	4.42 - 4.54	12.6 ± 0.7	3.90 - 4.45	<0.0001	
II b	449.4 ± 62.4	2.97 - 3.37	123.2 ± 25.9	3.01 - 3.83	<0.0001 p < 0.01	
III	399.9 ± 18.3	4.21 - 4.72	181.87 ± 15.8	2.95 - 3.77	<0.0001	
II b-III	n.s.	n.s.	n.s.	<0.05		

for use as hay meadows and pastures. Other parts were included in the Biebrza National Park and left without human interference. We tried to analyse how spider communities changed in both natural (N) and managed (M) grasslands by comparing (1) species diversity, (2) total density, and (3) community structure, from three sampling periods (Table 1).

Material and methods

All study sites were located on peat soils originating from the three plant communities, which are most common in the valley. These were: A. sedge-moss communities (*Caricetum limoso-diandrae*) in the emersion zone of the valley, B. tall sedge communities (*Caricetum elatae* and *Peucedano-Caricetum paradoxae*), in immersion, flooded zone, or C. alder carr (*Carici elongatae -Alnetum*), which border the valley (Table 1). The soil properties, such as soil moisture content, decomposition rate of peat deposits, and soil texture, depend considerably on the origin of peat (Table 2 and 3). Soils formed from the sedge-moss community were characterised by a well-developed moss layer, the highest water-holding capacity of the soil and relatively stable moisture level throughout the year, in natural and drained grasslands (Table 2 and 3). The lowest moisture content was found in soils originating from alder peat (C). They were mineralised at the highest rate after drainage. Soils formed from tall sedge peat were intermediate in respect to water content and decomposition rate of peat deposits (Table 2 and 3).

In most cases managed grasslands (M) were mown 2-3 times a year by heavy machines, and the hay was immediately removed. The drainage system was extended for hundreds of hectares between period I and II. Presently drained grasslands accounted for 62% of the area of organic soils in the valleys (OKRUSZKO, 1990). In period I small patches of cultivated grasslands were surrounded by extensive areas of natural fens (N). In Period II management was intensified. The drainage induced rapid mineralization of organic matter accumulated in peat, and the thickness of peat deposits declined gradually. A characteristic feature of drained fens is high variability of soil properties and of plant and animal communities. The system is subjected to secondary succession. More information about the grasslands studied is given in KAJAK (1962), KACZMAREK (1991), STEPÁ, PALCZYŃSKI (1991).

In all periods compared, the quadrat method was applied to assess spider density. The effectiveness of collecting spiders improved with time. In period I, spiders were hand-collected from large frames (0.25 m² in area). 16 samples were taken per site on each sampling date. In the next two periods (II and III) spiders were collected from smaller frames (0.0625 m²), 10 samples per site were taken. Starting in 1982 (Period II b), samples were cut out of grassland turf and shaken several times over a plastic sheet until no more spiders could be seen. In each period samples were taken from May until October (190–250 per site in period I, 40–190 in period II, 60 in period III).

Species diversity was calculated by using the Shannon-Wiener diversity index H' , the t-test was applied to estimate significance of differences between the values obtained. The number of specimens used in calculations ranged from 150 to 850 from particular sites and periods. In calculating the diversity index (H') for plants, the per cent of area covered by each plant species was used. The data after KOTOWSKA et al. (1998) and KAMIŃSKI (in press) were used in calculations.

The Wilcoxon signed rank test was applied to compare differences in diversity between periods in pooled spider data, and the Mann-Whitney U test to compare differences between natural and managed grasslands. The Kendall rank correlation coefficient was used to analyse the correlation between spider diversity and habitat properties (soil moisture, plant species diversity, plant complexity and distance to the nearest shrubs) in period III. An analysis of covariance was applied to estimate density response to the same environmental factors. In the ranking of the grasslands studied with respect to plant complexity (number of microsites per area), the highest rank was given to grassland with a thick layer of mosses and litter and a multi-layered sward, formed by sedges and grasses with an admixture of forbes. The lowest rank was assigned to a grassland with low vegetation and patches of bare ground. The distance to the nearest shrubs was treated as a measure of landscape heterogeneity. This distance ranged from several meters to hundreds of meters in particular sites.

Table 5. Correlation coefficients (Kendall tau) between spider species diversity index (H') and environmental factors (Period III).

Variable	tau	N	P
Soil moisture	0.64	12	0.002
Plant species diversity	0.11	16	0.27
Number of microhabitats	0.68	16	0.0003
Intensity of management	-0.71	8	0.007
Landscape heterogeneity	0.78	8	0.0012

Table 6. Number of spiders belonging to various families as a percentage of the total number of spiders during three periods in natural peat grasslands. *Symbols of sites: N – natural fen, A- grassland located on sedge-moss peat, B- grassland located on tall sedge peat.

Family	Periods					
	I		II		III	
	Study sites*					
	NB ₁	NB ₂	NA	NB ₃	NA	NB ₃
Araneidae	11.5	22.1	0.3	0.1	0.1	0.8
Linyphiidae	10.1	11.6	68.0	70.6	69.3	57.8
Lycosidae	37.1	29.1	13.5	2.0	19.6	23.4
Tetragnathidae	10.1	4.4	0.6	0.2	1.4	0.4
Thomisidae	0.85	3.8	4.0	4.5	2.1	5.3
Philodromidae	7.5	11.0	0.4	0.4	0.2	1.4
Salticidae	4.2	3.8	10.7	18.4	0	1.3
Clubionidae	4.7	5.1	2.1	3.6	1.1	3.3
Gnaphosidae	4.5	2.0	0	0	0	0.2
Theridiidae	1.8	0.4	0.2	0.2	1.3	1.5
Hahnidae	9.8	2.15	0	0	3.6	1.8
Dictynidae	2.4	1.2	0.2	0	0.7	1.3
Zoridae	0.2	1.7	0	0	0.2	1.0
Liocranidae	0	0.1	0	0	0.4	0.3
Pisauridae	0	2.0	0	0	0	0
Mimetidae	0	0	0	0	0	0.2
No. of families	13	15	10	9	12	15

Results and discussion

Species diversity and composition

Species diversity ranged from 2.95 to 4.72 for the periods and sites compared (Table 4). Species diversity was significantly higher in natural fens than in managed grasslands ($P < 0.01$),

Table 7. Number of spiders belonging to various families as a percentage of the total number of spiders in three periods in managed grasslands. *Site symbols: M – managed grassland site, A- soil formed from sedge-moss peat, B –soil formed from tall sedge peat.

Family	Periods					
	I		II a		III	
	Study sites*					
	MA ₁	MA ₂	MB ₁	MA ₁	MB ₁	MA ₁
Araneidae	25.9	15.0	0	0	0.6	0.7
Linyphiidae	16.5	24.5	59.1	71.4	36.3	73.1
Lycosidae	6.4	9.3	21.3	2.8	35.6	5.2
Tetragnathidae	39.8	32.4	13.6	25.8	13.0	3.2
Thomisidae	6.4	7.0	3.3	0	13.2	12.4
Philodromidae	1.9	1.9	0	0	0	0
Salticidae	0.4	0.4	1.3	0	0	0
Clubionidae	0.4	5.1	0	0	0	0
Gnaphosidae	0.4	5.7	0	0	0	0
Theridiidae	1.9	3.2	0.7	0	0.6	5.4
Hahnidae	0	0.2	0.7	0	0.4	0
Dictynidae	0	0.2	0	0	0.3	0
Zoridae	0	0.2	0	0	0	0
No. of families	10	13	7	3	8	6

Mann-Whitney U test). The trend of decreasing diversity with respect to time was found for managed grasslands only. In managed sites compared in successive periods, lower index values were found in the later period ($P < 0.05$, Wilcoxon matched pairs signed ranks test). When comparing diversity indices for the same site, in two periods, significant differences (t-test) were found in 4 sites out of six analysed. In natural grasslands such a time effect was not detected. The diversity indices were as high in period III as in period I. Spider species diversity depends on soil moisture, the number of microhabitats offered by the area, and landscape heterogeneity (distance to the nearest shrubs). No correlation was detected between spider and plant species diversity (Table 5).

The number of families occurring in managed grasslands also decreased with time (Table 6 and 7). In period I, spiders belonging to 10 or 12 families were recorded, in the grasslands compared. In period III, this number only reached 6 to 8 families. It is possible that in these grasslands, habitat quality deteriorates with time. In natural grasslands the number of families recorded was similar in periods I and III.

Three families dominate – Linyphiidae, Lycosidae and Tetragnathidae. They constitute >80% of all specimens collected on both natural and managed grasslands. According to the estimations for period I, these families accounted for 50% of the spider community in natural grasslands and for about 60% in managed grasslands (Table 6 and 7). The changes in methods of spider collecting may have influenced and exaggerated these differences between periods, but similar values were noted also in period II a, when the method of spider collecting was similar to that used during period I. A decrease in the proportion of spiders

Table 8. Correlation coefficients (r) (analysis of covariance) between total spider density and environmental factors (Period III).

Variable	r	F	P
Soil moisture	0.337	67.292	<0.0001
Soil bulk density	-0.276	43.213	<0.0001
Plant species diversity	0.121	7.811	<0.01
Number of microhabitats	0.436	123.259	<0.0001
Intensity of management	-0.450	133.350	<0.0001
Distance to shrubs	-0.276	70.937	<0.0001

Table 9. Correlations (analysis of covariance) between total spider density and environmental factors in drained grasslands (Period III).

Variable	r	F	P
Soil moisture	0.33	41.79	<0.01
Soil bulk density	-0.12	5.38	<0.01
Plant species diversity	-0.04	0.44	n.s.
Number of microhabitats	0.38	56.81	<0.01
Intensity of management	-0.32	39.15	<0.01
Distance to shrubs	-0.23	18.89	<0.01

spending their life cycle in the field layer was noted (Araneidae, Clubionidae and Philodromidae) (Table 6 and 7). In period I several species from these families were classified as predominants (KAJAK, 1960,1962). These spider species were affected by management, the use of heavy machines for mowing and the gathering of hay immediately after cutting. They still exist in unmown margins. A decreasing proportion of field layer spiders was also recorded in natural grasslands. This tendency is difficult to explain.

Total spider density

A comparison of spider density between periods is difficult, because of changes in the efficiency of spider collecting, starting from

period II b. Comparing the density in two shorter periods, namely I with IIa and IIb with III in which spiders were collected in a similar way, no decrease in spider density was detected. In all periods, density was higher in natural, than in managed grasslands ($P < 0.0001$, ANOVA in period III).

Based on data from period III, the relationship between spider density and environmental factors was analysed. A covariance analysis showed that there was a highly significant, positive correlation ($P < 0.0001$) between spider density and soil moisture (range of seasonal mean for study sites was 58.9-89.2% by volume), as well as between density and the number of microhabitats in a grassland. Similarly the density increased significantly with landscape heterogeneity, measured by the distance to the nearest shrubs (Table 8). The correlation between density of spiders and plant diversity was not so high ($P < 0.01$). Negative response in spider density was related to the intensity of management and soil bulk density ($P < 0.0001$). All these correlations (except plant species diversity) were also applicable when calculated for managed grasslands only (Table 9).

Soil moisture was found to be one of the most important factors determining diversity and density of spiders in natural as well as in drained fens. This variable is connected with other site properties e.g. wet grasslands are as a rule not utilised by man and are covered by mosses, so soil moisture influences other environmental components that are important for spider communities. Several authors have stressed that soil moisture is an important factor,

which can determine spider abundance and community composition (DE KEER et al., 1989; RUSHTON, EYRE, 1992; MAELFAIT et al., 1997; MERKENS, 1997). The other important factors influencing spider density are management practice (DUFFEY, 1978; DE KEER et al., 1989; DECLER, 1990; RUSHTON, EYRE, 1992; MAELFAIT et al., 1997; MERKENS, 1997) and plant complexity (DUFFEY, 1978). Authors have shown that certain species prefer managed or unmanaged patches. In our data, the negative effect of mowing and grazing, on total spider density and species richness is very clear. According to the results of this paper, plant species diversity is less important for the diversity of spiders, than is plant complexity (abundance of microhabitats in an area). This result is in an agreement with UETZ (1979), who showed, experimentally, the relationship between spider density and litter thickness. He considered litter complexity to be the primary factor influencing the structure of spider communities. We observed a similar importance of the moss and litter layer in the range of grasslands analysed in this paper.

Properties of dominant species

In all the grasslands compared, the family Linyphiidae was of greatest significance. Different members of this family dominated in natural and managed grasslands, and there were only a few common species (Appendix 1). Those dominating in managed grasslands can be characterised according to HÄNGGI et al. (1995), as an eurytopic species. They are abundant in arable fields, urban areas, fens, shrubs, permanent meadows and leys. The species dominant in natural grasslands were categorised by HÄNGGI et al. (1995) as occurring in raised bogs, fens, wet meadows and the shores of inland waters. Among them some endangered species were found.

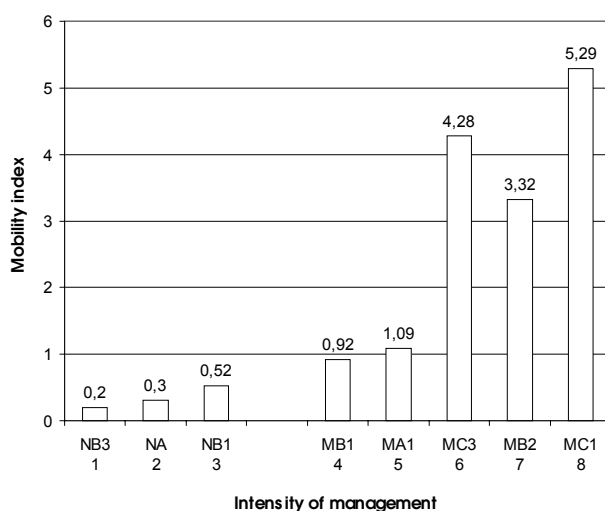


Fig. 1. Relationship between mobility index (ratio of number of ind. captured per pitfall trap per 10 days to number of ind. per m²) and intensity of grassland management. 1-8 – study sites; symbols A,B,C denote peat origin (explained in table 1), N – natural grasslands, M – managed grasslands.

Appendix 1. Species composition. **Dd** – dominant species in drained fens; **Dn** – dominant species in natural fens; **R** – rare species

MIMETIDAE			
<i>Ero cambridgei</i> KULC.	R		
THERIDIIDAE			
<i>Crustulina guttata</i> (WIDER)			
<i>Enoplognatha ovata</i> (CL.)			
<i>Euryopis flavomaculata</i> (C. L. K.)			
<i>Robertus arundineti</i> (O. P.-C.)			
<i>Robertus insignis</i> O. P.-C.	R		
<i>Robertus neglectus</i> (O. P.-C.)			
<i>Theridion bimaculatum</i> (L.)			
<i>Theridion sisyphium</i> (CL.)			
LINYPHIIDAE			
<i>Agyneta decora</i> (O. P.-C.)	R		
<i>Allomengea vidua</i> (L. K.)			
<i>Aphileta misera</i> (O. P.-C.)			
<i>Araeoncus crassiceps</i> (WEST.)	R		
<i>Araeoncus humilis</i> (BL.)			
<i>Baryphyma gowerense</i> (LOCK.)	R		
<i>Baryphyma trifrons</i> (O. P.-C.)	R		
<i>Bathyphantes approximatus</i> (O. P.-C.)			
<i>Bathyphantes gracilis</i> (BL.)	Dn		
<i>Bathyphantes parvulus</i> (WEST.)			
<i>Bathyphantes setiger</i> O. P.-C.			
<i>Bolyphantes luteolus</i> (BL.)			
<i>Carorita limnaea</i> (CROS. ET BISH.)	R		
<i>Centromerita bicolor</i> (BL.)			
<i>Centromerus incilium</i> (L. K.)			
<i>Centromerus semiater</i> (L. K.)			
<i>Centromerus sylvaticus</i> (BL.)			
<i>Ceraticelus sibiricus</i> ESKOV	R		
<i>Ceratinella brevipes</i> (WEST.)			
<i>Ceratinopsis stativa</i> (SIMON)			
<i>Dicymbium nigrum</i> (BL.)	Dd		
<i>Entelecara omissa</i> O. P.-C.	R		
<i>Erigone atra</i> BL.	Dd		
<i>Erigone dentipalpis</i> (WIDER)	Dd		
<i>Erigone longipalpis</i> (SUND.)			
<i>Glyphesis cottonae</i> (LA TOUCHÉ)	R		
<i>Gnathonarium dentatum</i> (WIDER)			
<i>Gongylidiellum murcidum</i> SIMON	Dn		
<i>Hypomma bituberculatum</i> (WIDER)	Dn		
<i>Kaestneria pullata</i> (O. P.-C.)			
<i>Lophomma punctatum</i> (BL.)			
<i>Maso gallicus</i> SIMON	R		
		<i>Meioneta affinis</i> (KULC.)	
		<i>Meioneta rurestris</i> (C.L. K.)	Dd
		<i>Meioneta tenera</i> (MENGE)	
		<i>Metopobactrus prominulus</i> (O. P.-C.)	
		<i>Micrargus subaequalis</i> (WEST.)	
		<i>Microlinyphia pusilla</i> (SUND.)	
		<i>Microneta viaria</i> (BL.)	
		<i>Notioscopus sarcinatus</i> (O. P.-C.)	
		<i>Oedothorax apicatus</i> (BL.)	
		<i>Oedothorax fuscus</i> (BL.)	
		<i>Oedothorax gibbosus</i> (BL.)	Dn
		<i>Oedothorax retusus</i> (WEST.)	
		<i>Pelecopsis parallela</i> (WIDER)	
		<i>Pocadicnemis juncea</i> LOCK. ET MILL.	
		<i>Pocadicnemis pumila</i> (BL.)	
		<i>Porrhomma pygmaeum</i> (BL.)	Dn
		<i>Savignya frontata</i> BL.	Dn
		<i>Silometopus elegans</i> (O. P.-C.)	
		<i>Silometopus reussi</i> (TH.)	
		<i>Tallusia experta</i> (O. P.-C.)	
		<i>Taranucnus setosus</i> (O. P.-C.)	
		<i>Tiso vagans</i> (BL.)	Dd
		<i>Walckenaeria kochi</i> (O. P.-C.)	
		<i>Walckenaeria nodosa</i> O. P.-C.	
		<i>Walckenaeria nudipalpis</i> (WEST.)	
		<i>Walckenaeria unicornis</i> O. P.-C.	
		<i>Walckenaeria vigilax</i> (BL.)	
		TETRAGNATHIDAE	
		<i>Pachygnatha clercki</i> SUND.	
		<i>Pachygnatha degeeri</i> SUND.	Dd
		<i>Tetragnatha extensa</i> (L.)	
		ARANEIDAE	
		<i>Araneus quadratus</i> CL.	
		<i>Hypsosinga heri</i> (HAHN)	
		<i>Hypsosinga pygmaea</i> (SUND.)	
		<i>Larinioides cornutus</i> (CL.)	
		<i>Mangora acalypha</i> (WALC.)	
		<i>Neoscona adianta</i> (WALC.)	
		<i>Singa hamata</i> (CL.)	
		LYCOSIDAE	
		<i>Alopecosa cuneata</i> (CL.)	
		<i>Alopecosa pulverulenta</i> (CL.)	
		<i>Arctosa leopardus</i> (SUND.)	
		<i>Hygrolycosa rubrofasciata</i> (OHLE.)	

Appendix 1.

<i>Pardosa amentata</i> (CL.)			CLUBIONIDAE	
<i>Pardosa lugubris</i> (WALC.)			<i>Clubiona diversa</i> O. P.-C.	
<i>Pardosa maisa</i> HIPPA ET MANN.	R		<i>Clubiona rosserae</i> LOCK.	R
<i>Pardosa paludicola</i> (CL.)			<i>Clubiona stagnatilis</i> KULC.	
<i>Pardosa palustris</i> (L.)	Dd		<i>Clubiona subtilis</i> L. K.	
<i>Pardosa prativaga</i> (L. K.)			GNAPHOSIDAE	
<i>Pardosa pullata</i> (CL.)			<i>Drassodes lapidosus</i> (WALC.)	
<i>Pardosa sphagnicola</i> DAHL			<i>Zelotes electus</i> (C. L. K.)	
<i>Pirata latitans</i> (BL.)	Dn		<i>Zelotes latreillei</i> (SIMON)	
<i>Pirata piraticus</i> (CL.)	Dn		ZORIDAE	
<i>Pirata piscatorius</i> (CL.)			<i>Zora armillata</i> SIMON	R
<i>Pirata tenuitarsis</i> SIMON			<i>Zora spinimana</i> (SUND.)	
<i>Pirata uliginosus</i> (TH.)	Dn		PHILODROMIDAE	
<i>Trochosa ruricola</i> (DE GEER)			<i>Thanatus striatus</i> C. L. K.	
<i>Trochosa spinipalpis</i> (F. O. P.-C.)			<i>Tibellus maritimus</i> (MENGE)	
<i>Xerolycosa miniata</i> (C.L. K.)			THOMISIDAE	
PISAUROIDAE			<i>Ozyptila gertschi</i> KURA.	R
<i>Dolomedes fimbriatus</i> (CL.)			<i>Ozyptila trux</i> (BL.)	
HAHNIDAE			<i>Xysticus cristatus</i> (CL.)	
<i>Antistea elegans</i> (BL.)	Dn		<i>Xysticus erraticus</i> (BL.)	
<i>Hahnia pusilla</i> C.L. K.			<i>Xysticus kochi</i> TH.	
DICTYNIDAE			<i>Xysticus ulmi</i> (HAHN)	
<i>Argenna albopunctata</i> (MENGE)	R		SALTICIDAE	
<i>Argenna subnigra</i> (O. P.-C.)			<i>Evarcha falcata</i> (CL.)	
<i>Dictyna arundinacea</i> (L.)			<i>Heliophanus flavipes</i> (HAHN)	
<i>Dictyna uncinata</i> TH.			<i>Neon reticulatus</i> (BL.)	
LIOCRANIDAE			<i>Neon valentulus</i> FALC.	R
<i>Agraecina striata</i> (KULC.)			<i>Phlegra fasciata</i> (HAHN)	
<i>Agroeca dentigera</i> KULC.	R		<i>Sitticus caricis</i> (WEST.)	
			<i>Sitticus floricola</i> (C.L. K.)	

Spiders occurring in natural fens are less mobile than those from managed grasslands. Mobility index values are <1 in natural fens, and ranged from 1-5 in managed grasslands. Mobility increases when management is intensified (Fig. 1). A similar tendency was found for herbivorous fauna (Auchenorrhyncha) in the same area (ANDRZEJEWSKA, 1991) and for spiders in period II, in managed grasslands (KAJAK, 1993).

Conclusions

Differences between natural and managed grasslands increase with time (diversity, species composition). Now, in managed grassland communities eurytopic species, characteristic of arable fields, dominate.

The diversity and density of spiders increase with soil moisture, and abundance of microhabitats in the ecosystem. They decrease with intensity of management, soil compactness, and increasing distance to shrubs. The diversity of spiders is hardly affected by plant species diversity.

Diversity and density of spider communities can be improved by leaving grassland margins uncut and by increasing the heterogeneity of the landscape.

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