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SPIDER COMMUNITIES UNDER AGRICULTURAL AND INDUSTRIAL PRESSURE

Spider communities show differences depending not only on the ecosystem type but also on the landscape type, especially when the latter is under agricultural or industrial pressure.

Spiders associated with plants were compared in crop fields of the agricultural landscape near Turew /Great Poland/, forest-agricultural-industrial landscape near Knurów /Silesia/ and the forest-agricultural-recreational landscape near Mikołajki /Mazuria/ /Table 1/ /Łuczak 1980/.

Table 1

Communities of crop field spiders

Locality and landscape	Turew agricultural	Knurów forest-agric. industrial	Mikołajki forest-agric. recreational
Parameters			
Number of influent species	8	9	13
Per cent of dominant species	72	52,5	38,5
Per cent of influent species	15	24	28
Number of constant species	31	22	23
Per cent of constant species	94, 90	87, 86	61, 72
Per cent of species common to three regions	71	67	64
Proportion of Araneidae	29,5	15	34,5

In the landscape under heavy agricultural pressure /Turew/, the dominant spiders accounted for almost $3/4$ of the total community, and among them, so-called constant spiders /occurring every year/ and spiders common to the three study regions were most abundant. It should be noted that the analysed parameters of the community are higher here than in the areas under industrial pressure. In the forest-agricultural-industrial landscape of Silesia, the proportion of spiders of the family Araneidae was the lowest, and the other parameters had intermediate values between the Turew and Mikołajki regions. In the forest-agricultural landscape of Mikołajki, all the analysed ecological groups of spiders common in Poland were least abundantly represented, their proportions in the community being the lowest; consequently, the proportions of other ecological groups of spiders were higher, thus the diversity of this community was the highest.

Moreover, the abundance of individual dominant species /accounting for at least 5% of the community/ largely differed from each other in areas under agricultural /Łuczak 1979/ or industrial pressure /Turew, Knurów/, this being reflected by their proportions in the community, whereas in crop fields of the Mikołajki region their numbers showed a higher equitability, thus their proportions were similar /Fig. 1/ /Łuczak 1980/.

In 1977 - 1984, spiders were studied in the industrial landscape of the Knurów region in Silesia. Three landscape sections were selected representing all most important ecosystems: forest, mid-field clump of trees, meadow and crop field in three localities under differential industrial pressure. These were: Książęnice, located far from a coal mine and industrial plants, with the lowest dust fall / $162 \text{ t.km}^{-2} \cdot \text{year}^{-1}$ in 1981/, the lowest concentration of SO_2 / $65 \mu\text{g. m}^{-2} \cdot \text{day}^{-1}$ / and NO_2 , and the lowest proportion of heavy metals in soil; Szczygłowice, located at

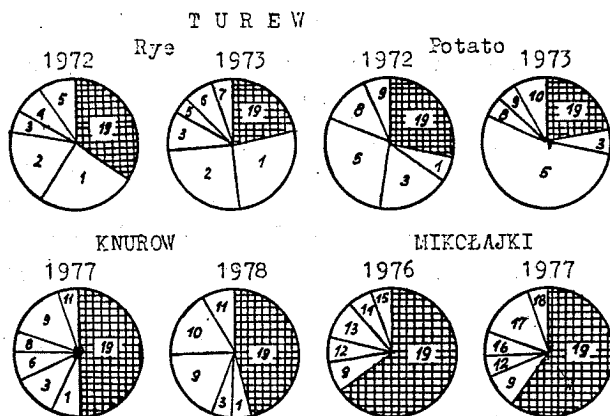


Fig.1 Dominant species and their contribution to spider communities occurring on crop fields plants

/per cent/

1-*Erigone atra* Bl., 2-*Oedothorax apicatus* /Bl./, 3-*Meioneta rurestris* /C.L.K./, 4-*Xysticus kochi* Th., 5-*Mangora acalypha* /Wlk./, 6-*Pachygnatha degeeri* Sund., 7-*Erigone dentipalpis* /Wid./, 8-*Microlinyphia pusilla* /Sund./, 9-*Tetragnatha extensa* /L./, 10-*Aculepeira ceropegia* /Wlk./, 11-*Xysticus cristatus* /Cl./, 12-*Philodromus* sp., 13-*Araneus quadratus* Cl., 14-*Linyphia triangularis* /Cl./, 15-*Singa pygmaea* /Sund./, 16-*Araniella cucurbitina* /Cl./, 17-*Theridion impressum* L.K., 18-*Tibellus oblongus* /Wlk./, 19-other species.

a coal mine /211 t, 95 μ g/, and Gierałtowice, also located at a coal mine, near a cokery plant and a plant of processing industry - with the highest industrial pollution of the environment /229 t, 95 μ g/ /Zuczak 1984/. The frequency distribution of spiders biomass was analysed in two landscape sections: in relatively clean Książenice and in heavily polluted Gierałtowice /Zuczak 1984/ /Table 2/.

Table 2

Distribution of spider biomass of 7 samples collected during the season /mg wet weight/

Ecosystem	Książenice				Gierałtowiec			
	1981		1982		1981		1982	
	biomass	per cent	biomass	per cent	biomass	per cent	biomass	per cent
Forest	8751	31	6644	43	10071	50	9007	43
Mid-field clump of trees	5866	21	3025	19	7906	40	9898	47
Meadow	11929	43	5371	35	1082	5	1763	8
Crop field	1522	5	495	3	1072	5	371	2
Total	28068	100	15535	100	20131	100	21039	100

The biomass of spiders /also their numbers/ was highest in the forest, then in the clump of trees or on the meadow /depending on local conditions/, and the lowest on the crop field. In the two study years, the biomass of spiders in the forest and in the mid-field tree clump was much higher in the heavily polluted locality, and in open habitats /meadows and crop fields/ their biomass was higher in the relatively clean /unpolluted/ locality /Table 2/. Spiders were better protected from dust in wooded sites and they less frequently visited open habitats. In "clean" Książenice, however, they readily migrated from wooded areas and abundantly settled in open ecosystems. In the polluted Gierałtowiec region the bulk of spider biomass - 90% in the two study years - occurred in the forest, whereas 10% inhabited open ecosystems; in the clean Książenice region, the respective figures were 52% and 62% in wooded ecosystems, and 48%, 38% in open ecosystems.

Differences were also observed in the mean individual body weight of spiders over the season /Table 3/.

Table 3
Average individual body weight in growing season
/mg wet weight/

Ecosystem	Locality and year			
	Książenice		Gierałtówice	
	1981	1982	1981	1982
Forest	5.04	6.22	6.82	6.51
Mid-field clump of trees	8.46	5.85	7.12	6.96
Meadow	20.18	12.66	6.80	6.60
Crop field	10.64	8.68	5.45	2.49
Mean per ecosystem	11.03	8.35	6.55	5.64

In the forests the mean body weights of spiders were similar, whereas on the meadow and the crop field in "clean" Książenice it was two times or more than two times higher /Table 3/. Only in less polluted habitats of Silesia larger species of spiders can occur.

Table 4 shows proportions of 4 main families of spiders associated with plants in Silesia, which, at the same time, represent ecological groups differing in the way of catching prey.

Table 4

Proportion of four main families in total numbers of spiders of different landscape section /in percent/

Families	Książenice		Gierałtówice		Szczygłowiec	
	1981	1982	1981	1982	1977	1978
Araneidae	41	27	17	20	21	31
Tetragnathidae	12	14	27	18	22	17
Theridiidae	22	27	9	18	12	13
Linyphiidae	14	16	39	35	32	29

In "clean" Książenice Araneidae and Theridiidae had the highest proportions in the community, whereas in polluted Gierałtowice and Szczygłowice this was the family Linyphiidae, which contained species highly resistant to industrial stresses. This is especially the case of the most abundant species of this family.

The number of species recorded from the forest at Książenice over the four-year study period was higher than that recorded from the other forests under study /Łuczak 1987/ /Table 5/. These are data from 7 samples taken every month over the growing season.

Table 5

Range of the number of species per year collected in forests during four years.

Locality	Number of species
Aniołki	35 - 40
Gierałtowice	38 - 46
Szczygłowice	30 - 47
Książenice	41 - 49

In more polluted forests, the recorded numbers of spiders per year /Table 6/ and their biomass /Table 7/ typically tended to be higher than in less polluted forests over the 4-year study period.

Local conditions and factors associated with a given landscape type largely affected numbers and biomass of spiders: the effects of agricultural stress were often heavier than the effects of a moderate industrial pressure.

Table 6

Total numbers of spiders in forests over successive study years:

Locality Year	Aniołki	Gierałtowiec	Szczygłowiec	Książenice
1981	1111	1477	795	1734
1982	1025	1386	1082	1069
1983	1950	2205	1490	1154
1984	1351	1528	955	937
Total	5437	6596	4322	4894
Average	1359	1649	1080	1223

Table 7

Distribution of spider biomass in forests as calculated in percentage of their highest biomass

Localities Years	Aniołki	Gierałtowiec	Szczygłowiec	Książenice
1982	41.0	39.2		28.9
1983	100	52.8	36.4	13.6
1984	56.0	55.1	25.0	29.4

Heavy pollution accounts for the degradation and degeneration of the vegetation and ultimately to the destruction of the ecosystem. Our studies were conducted at a moderate intensity of industrial pressure, which degraded ecosystems gradually but allowed their survival and functioning, and even enhanced a strong development of spiders within the habitats being in the course of degradation.

References:

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Decleer: Which sampling method did you use? How is it standardized?

J. Yuczak: Sweepnetting is used for all families. Previous investigations revealed that this method was quite appropriate for our study.