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PROGRESS IN STUDIES ON MYRIAPODA AND ONYCHOPHORA

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Centipede (Chilopoda) communities of three beech forests in Poland

Abstract: Of the 28 species of Chilopoda recorded from beech woodlands situated in three different zoogeographical regions of Poland, Wielkopolska (lowland) supported 19, Roztocze (upland) 13, and Pieniny (mountains) 17 species. Six very common species, all eurytopic forest-dwellers, i.e., *Lithobius mutabilis*, *L. forficatus*, *L. erythrocephalus*, *L. piceus*, *L. lapidicola*, and *Strigamia acuminata*, were shared by all three study areas. The population densities of Chilopoda in Roztocze, Wielkopolska and Pieniny averaged 17.4, 51.5, and 111 indiv./m^2, respectively. The Roztocze and Wielkopolska beech forests were similar to one another as regards both fauna and the dominance structure of Chilopoda communities. In contrast, the chilopod fauna of the Pieniny beech forest was the most distinctive one, with five rare, mountainous species or subspecies involved: *Harpolithobius anodus*, *Lithobius burzenlandicus*, *L. biunguiculatus*, *Strigamia transsilvanica*, and *S. pusilla perkeo*.

Key words: Chilopoda, beech forests, Roztocze, Pieniny, Wielkopolska

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INTRODUCTION

In 1987–1994, centipedes were investigated in three different geographical regions of Poland. Some results of the studies concerning the centipede fauna and populations of various plant communities have been presented elsewhere (LEŚNIEWSKA 1997, 1999, KACZMAREK & LEŚNIEWSKA 1998). The objective of the present work lies in comparing the Chilopoda assemblages occurring in beech forests of Wielkopolska (lowland), Roztocze (upland) and Pieniny (mountains).

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STUDY AREAS AND METHODS

The studies were carried out in Wielkopolska in 1987–1994, in Roztocze in 1987–1990, and in Pieniny in 1995–1996.

The investigated beech woods differed in plant community structure:

Wielkopolska – *Querco-Carpinetum stachyetosum silvaticae* as a variant with *Fagus silvatica*,

Pieniny – *Fagetum carpaticum*,

Roztocze – *Dentario glandulosae-Fagetum*.

The beech forests compared, though somewhat different phytosociologically, offer the centipedes similar habitat conditions. Thus, all these three areas support a rather thick layer of litter (up to several dozen centimetres) as well as numerous fallen logs, dry trunks and branches. Since all the investigated areas are protected, there is little human interference.

The studies were both qualitative and quantitative in character. The qualitative studies consisted of taking centipedes from all available microhabitats by looking under the bark of lying logs, under stones, branches, etc. The quantitative sampling techniques consisted of taking 16 or 25 square soil samples respectively, each with a side length of 25 or 20 cm, to finally reach a sampling area of 1 m^2. More details on the collecting sites and methods have been given described elsewhere (LEŚNIEWSKA 1997, 1999, KACZMAREK & LEŚNIEWSKA 1998). As the number of samples taken per locality varied, the final results were not standardised but treated collectively.

RESULTS

During the studies, a total of 28 centipede species were found in all study areas. This makes 48% of all Chilopoda species known from Poland. Faunistically, the richest was the beech forest at Wielkopolska, the poorest one the forest at Roztocze (Table I).

Regarding the species composition of Chilopoda, the greatest similarity was revealed between Wielkopolska and Roztocze (11 shared species) (Table I), followed by Pieniny and Wielkopolska (10 species in common), while the most dissimilar beech woods were those at Roztocze and Pieniny (6 shared species), with Pieniny, the mountainous beech woodland supporting 7 rare or subendemic Chilopoda species. The MARCZEWSKI-STEINHAUS (1958) species similarity index showed the following values for the centipede communities of the investigated regions: 0.5 for Roztocze and Wielkopolska, 0.4 for Pieniny and Wielkopolska, and 0.2 for Roztocze and Pieniny.

At both Wielkopolska and Pieniny, species of three orders of Chilopoda were found, yet no representative of the order Scolopendromorpha was revealed at Roztocze. All the three communities were characterised by prevalence of species of the order Lithobiomorpha. At Pieniny, as many as 6 species of the order Geophilomorpha (35.5% of the species list of this community) were identified, followed by 5 species (26.2%) at Wielkopolska, and only 3 species (23%) at Roztocze.

The dominance structure of Chilopoda in the beech forests of Wielkopolska and Roztocze showed *Lithobius mutabilis* as being superdominant, i.e. reinforcing their

Table I. Occurrence of species.

	Species	Wielkopolska	Pieniny	Roztocze
1.	*Lithobius forficatus* (LINNAEUS, 1758)	+	+	+
2.	*Lithobius piceus* L. KOCH, 1862	+	+	+
3.	*Lithobius tenebrosus* MEINERT, 1872	+	+	–
4.	*Lithobius agilis* C. L. KOCH, 1847	+	–	+
5.	*Lithobius tricuspis* MEINERT, 1872	+	–	–
6.	*Lithobius melanops* NEWPORT, 1845	+	–	+
7.	*Lithobius borealis* MEINERT, 1868	+	–	–
8.	*Lithobius cyrtopus* LATZEL, 1880	–	–	+
9.	*Lithobius pelidnus* HAASE, 1880	+	–	–
10.	*Lithobius mutabilis* L. KOCH, 1862	+	+	+
11.	*Lithobius lapidicola* MEINERT, 1872	+	+	+
12.	*Lithobius erythrocephalus* C. L. KOCH, 1847	+	+	+
13.	*Lithobius muticus* C. L. KOCH, 1847	–	+	–
14.	*Lithobius microps* MEINERT, 1868	–	–	+
15.	*Lithobius burzenlandicus* VERHOEFF, 1931	–	+	–
16.	*Lithobius biunguiculatus* LOKSA, 1947	–	+	–
17.	*Lithobius crassipes* L. KOCH, 1862	+	–	–
18.	*Lithobius curtipes* C. L. KOCH, 1847	+	–	+
19.	*Harpolithobius anodus* (LATZEL, 1880)	–	+	–
20.	*Geophilus proximus* C. L. KOCH, 1847	–	+	–
21.	*Brachygeophilus truncorum* (BERGSÖ &MEINERT, 1866)	+	+	–
22.	*Necrophloeophagus flavus* (DE GEER, 1778)	+	–	+
23.	*Strigamia acuminata* (LEACH, 1814)	+	+	+
24.	*Strigamia crassipes* (C. L. KOCH, 1835)	+	+	–
25.	*Strigamia transsilvanica* (VERHOEFF, 1935)	–	+	–
26.	*Strigamia pusilla perkeo* (VERHOEFF, 1935)	–	+	–
27.	*Schendyla nemorensis* (C. L. KOCH, 1837)	+	–	+
28.	*Cryptops hortensis* LEACH, 1814	+	+	–
	Total species	19	17	13

profound similarity (Table II, Figure). Using Morisita's coefficient as modified by HORN (1966), the similarity between the structures of domination was 0.92 for these two areas. The value this coefficient had was dramatically lower for both other pairs compared: 0.45 for Wielkopolska vs. Pieniny, and 0.43 for Pieniny vs. Roztocze. There was no superdominant at Pieniny, the community structure was fairly balanced, with *L. burzenlandicus* being dominant. In general, the most abundant species in a community are also the most frequent ones (Table II).

As regards the ecological properties of the species involved, 13 species could be termed eurytopic, the remaining 15 as forest-dwelling (Table III). The highest percentage of eurytopic species was found at Wielkopolska, forest species were the most numerous at Pieniny (Table IV).

At Pieniny the chilopod population density averaged 111 ind./m^2 (ranging from 98 to 125), at Wielkopolska 51.5 ind./m^2 (10–181), and at Roztocze 17.4 ind./m^2 (1–52).

Table II. Dominance (D) and frequency (F) structure (%) of Chilopoda communities of beech forests in Poland.

	Species	Wielkopolska		Pieniny		Roztocze	
		D	F	D	F	D	F
1	*Lithobius forficatus*	2.0	60	1.6	6.3	0.8	2.5
2	*Lithobius piceus*	1.7	40	2.1	8.3	1.2	17.5
3	*Lithobius tenebrosus*	0.1	3.3	0.5	2.1	–	–
4	*Lithobius agilis*	3.0	60	–	–	0.9	10.0
5	*Lithobius tricuspis*	0.7	20	–	–	–	–
6	*Lithobius melanops*	0.9	13.3	–	–	0.4	2.5
7	*Lithobius borealis*	1.8	26.7	–	–	–	–
8	*Lithobius cyrtopus*	–	–	–	–	3,8	17.5
9	*Lithobius pelidnus*	0.1	6.7	–	–	–	–
10	*Lithobius mutabilis*	55.4	100	18.6	37.5	67.5	67.5
11	*Lithobius lapidicola*	0.1	3.3	6.7	12.5	0.8	5.0
12	*Lithobius erythrocephalus*	0.1	6.7	0.5	2.1	0.9	2.5
13	*Lithobius muticus*	–	–	4.7	14.6	–	–
14	*Lithobius microps*	–	–	–	–	1.4	5.0
15	*Lithobius burzenlandicus*	–	–	25,4	56.3	–	–
16	*Lithobius biunguiculatus*	–	–	1.0	2.1	–	–
17	*Lithobius crassipes*	3.2	63.3	–	–	–	–
18	*Lithobius curtipes*	1.1	20	–	–	14.3	50.0
19	*Harpolithobius anodus*	–	–	2.6	10.4	–	–
20	*Geophilus proximus*	–	–	0.5	2.1	–	–
21	*Brachygeophilus truncorum*	1.2	20	1.6	6.3	–	–
22	*Necrophloeophagus flavus*	13.1	76.7	–	–	0.3	5.0
23	*Strigamia acuminata*	3.2	70	17.1	29.2	7.2	45.0
24	*Strigamia crassipes*	0.1	6.7	0.5	2.1	–	–
25	*Strigamia transsilvanica*	–	–	0.5	2.1	–	–
26	*Strigamia pusilla perkeo*	–	–	4,7	6.3	–	–
27	*Schendyla nemorensis*	10.5	76.7	–	–	0.4	5.0
28	*Cryptops hortensis*	1.5	33.3	11.4	29.2	–	–

Again, the Pieniny forest was found particularly rich in this respect, and Roztocze the poorest.

DISCUSSION

The differences in the number of species per community cannot be accounted for by insufficient knowledge of the fauna. It is true that the greatest number of species found was at Wielkopolska, where the period of study was also the longest (8 years). At Pieniny, the time of study was the shortest (2 years), but it revealed only 2 species less than at Wielkopolska. The least number of species was recorded in Roztocze, although that region was studied for 4 years. In other words, a complete species composition can be assessed already after a second year of both qualitative and quantitative

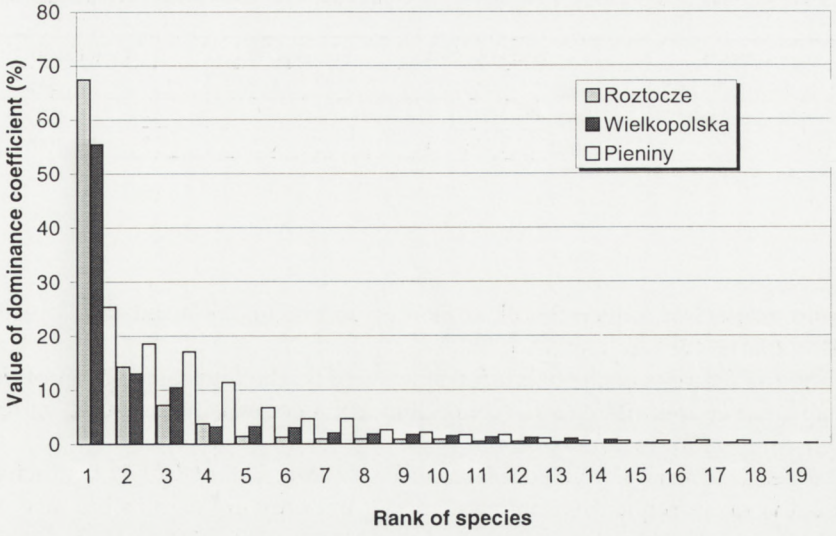

Figure. Comparison of domination structures.

sampling techniques like those used in our studies (LEŚNIEWSKA 1997, 1999, KACZMAREK & LEŚNIEWSKA 1998).

Most of the six species found in all three beech forests (Table I) appear common in Polish forests of different types (KACZMAREK 1952, 1964, 1977, 1989, WYTWER 1990, 1992), while *L. forficatus* and *L. erythrocephalus* are common in towns as well (WYTWER 1995, LEŚNIEWSKA 1996).

As expected, the mountainous beech wood at Pieniny is the most distinctive/peculiar faunistically among the three localities. Several of the centipede species or subspecies found in that area, i.e. *Harpolithobius anodus*, *Lithobius burzenlandicus*, *L. biunguiculatus*, *Strigamia pusilla perkeo* are very rare in Poland and they are only known as associated with mountains (KACZMAREK 1979, 1980). The distribution of *S. transsilvanica* in Poland is comparatively poorly known.

Table III. Ecological classification of species.

Forest species	Eurytopic species
Lithobius piceus	*Lithobius forficatus*
Lithobius tenebrosus	*Lithobius melanops*
Lithobius agilis	*Lithobius borealis*
Lithobius tricuspis	*Lithobius lapidicola*
Lithobius cyrtopus	*Lithobius erythrocephalus*
Lithobius pelidnus	*Lithobius microps*
Lithobius mutabilis	*Lithobius crassipes*
Lithobius muticus	*Geophilus proximus*
Lithobius burzenlandicus	*Brachygeophilus truncorum*
Lithobius biunguiculatus	*Necrophloeophagus flavus*
Lithobius curtipes	*Strigamia crassipes*
Harpolithobius anodus	*Schendyla nemorensis*
Strigamia acuminata	*Cryptops hortensis*
Strigamia transsilvanica	
Strigamia pusilla perkeo	

Table IV. Number and percentage participation of eurytopic and forest species in particular areas.

Element/ area	Wielkopolska		Pieniny		Roztocze	
Eurytopic species	11	58%	7	41%	7	54%
Forest species	8	42%	10	59%	6	46%
Total	19	100%	17	100%	13	100%

S. transsilvanica was discovered both at Pieniny and in an oak-hornbeam forest at Roztocze (KACZMAREK & LEŚNIEWSKA 1998).

Among the features of the beech forest at Pieniny, the high proportion of both forest species and representatives of Geophilomorpha comprising as many as four species of *Strigamia* alone is noteworthy.

In the beech forests of Wielkopolska and Roztocze, *L. mutabilis* is distinctly dominant. It is the most frequently dominant species not only in Poland's but also in continental Europe's deciduous forest belt (e.g., ALBERT 1982, FRÜND 1987, POSER 1988, KACZMAREK 1989, WYTWER 1990, TUF & OŽANOVÁ 1998). However, at Pieniny, *L. mutabilis* was less numerous than *L. burzenlandicus*.

The centipede community at Pieniny has a peculiar structure. No species has achieved there the position of a superdominant. This fact may be accounted for by a higher interspecific competition rate. On the other hand, the studies at Pieniny lasted the shortest time, covering neither early spring nor late autumn, nor winter when superiority of one species usually becomes most frequent and distinct (LEŚNIEWSKA 1997).

One of the basic indices distinguishing the three study communities is the average population density. Its high value at Pieniny suggests that the mountainous beech forest offers centipedes particularly favourable conditions. In a Polish forest, the obtained mean value of 111 ind./m^2 is very high. Yet the abundance of centipede assemblages in different plant communities in Slovenia are known to reach even higher values, up to 408 ind./m^2 (KOS 1996). The density found in the beech forest in Wielkopolska is similar to that found in beech forests in Germany (ALBERT 1982, FRÜND 1991).

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