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Chilopoda Communities of the Fresh Pine Forests of Poland

by

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Abstract: Species composition of Chilopoda were studied between 1986 and 1988 in natural sites of fresh pine forests (*Vaccinio myrtilli-Pinetum*) in three forest complexes situated in different zoogeographical regions of Poland: Puszcza Bialowieska, Puszcza Biala and Roztocze. In the habitats studied a total of 15 Chilopoda species was recorded, of which 8 species were found in Puszcza Bialowieska, 7 in Puszcza Biala and 12 in Roztocze. Only 4 species occurred in all three regions, namely *Lithobius forficatus* (L.), *L. erythrocephalus* C.L. KOCH, *L. curtipes* C.L. KOCH, and *L. lapidicola* MEINERT. The density of Chilopoda estimated from litter sifts ranged from 2.2 to 4.2 ind. · m^{-2} and was smallest in fresh pine forests of Puszcza Bialowieska on account of the low abundance of Geophilomorpha, as was confirmed statistically. Results on the community structure of Chilopoda differ according to the collecting methods used, i.e. litter samples or pitfall traps.

1. Introduction:

Data on Chilopoda density in coniferous forests have been provided by several ecological studies on the soil fauna (HUHTA 1967, 1976, HUHTA & KOSKENNIENI 1975), but only a few papers give information about the species composition of the Chilopoda occurring in these habitats (ALBERT 1982, BISTRÖM & VÄISÄNEN 1988). The aim of the present work was to study the composition and structure of Chilopoda communities of fresh pine forests (*Vaccinio myrtilli-Pinetum*) in various zoogeographical regions of Poland.

2. Sites, Material and Methods of Study:

The Chilopoda material was collected in natural sites of fresh pine forests (*Vaccinio myrtilli-Pinetum*) in three forest complexes of different regions of Poland, i.e. Puszcza Bialowieska, Puszcza Biala (in the Mazovian Lowland) and Roztocze. In each of them, samples were taken in three approximately 100 year old tree stands. According to phytosociological classification, the forests of Puszcza Bialowieska and Puszcza Biala represent the association of *Peucedano-Pinetum*, occurring eastwards and northwards from the middle reaches of the Vistula river. The forests of Roztocze belong to the association *Leucobryo-Pinetum* which is floristically poorer, found in the western and partly also in the southern regions of Poland. All of these sites have sandy soils belonging to the podzolic and rusty soil types with an acid reaction. Generally, there were two types of humus: mor and moder. To obtain quantitative data, Chilopoda were collected by the following methods:

Sieving of litter on 4 occasions between April and November in 1986 and 1987. On each occasion 10 samples of 0.10 m^2 were taken down to the A_0L layer and were hand-sorted.

Soil samples, each 0.10 m^2, were taken down to a total depth of about 20 cm, n = 10 per stand and collecting date. The humus layer was sieved and then hand sorted, the mineral layer was hand sorted immediately. Soil samples were taken only twice in spring (April 1987 and 1988) and twice in autumn (September 1986 and 1987).

Pitfall traps. 10 traps in each stand, emptied every fortnight over the period April-October in 1986 and 1987. Further pitfall traps were left for the whole winter and emptied in early April 1987 and 1988 respectively.

Samples collected by hand from litter and decayed tree trunks.

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Significance of differences in values of density and activity density was examined by the t-Student test, confidence level = 0.95..

3. Species Composition:

15 Chilopoda species (Table 1) were recorded on the study sites: this is 30 % of the Chilopoda fauna of Poland. One species, *Schendyla zonalis* BROLEMANN et RIBAUT, is new for Poland (WYTWER, in prep.). 10 species had not been reported so far from Roztocze and 4 are new for the region of Puszcza Bialowieska. The highest numbers of species were observed in the stands in Roztocze (8 - 12); the stands in Puszcza Biala were poorest in species (5 - 7) and those in Puszcza Bialowieska occupied an intermediate position (7 - 8 species).

Table 1: Species of Chilopoda in the fresh pine forests (*Vaccinio myrtilli-Pinetum*) of three regions of Poland.

		P. Bialowieska	P. Biala	Roztocze
1	*Lithobius mutabilis* C.L. KOCH	+	-	+
2	*L. lapidicola* MEINERT	+	+	+
3	*L. forficatus* (L.)	+	+	+
4	*L. erythrocephalus* C.L. KOCH	+	+	+
5	*L. pelidnus* HAASE	+	+	-
6	*L. tenebrosus fennoscandius* LOHMANDER	+	-	-
7	*L. calcaratus* C.L. KOCH	-	+	-
8	*L. cyrtopus* LATZEL	-	-	+
9	*L. curtipes* C.L. KOCH	+	+	+
10	*L. crassipes* L. KOCH	-	-	+
11	*Geophilus proximus* C.L. KOCH	-	-	+
12	*Pachymerium ferrugineum* C.L. KOCH	+	-	+
13	*Strigamia acuminata* (LEACH)	-	-	+
14	*Schendyla nemorensis* C.L. KOCH	-	+	+
15	*Sch. zonalis* BROLEMANN et RIBAUT	-	-	+
	Species Totals	8	7	12

Only 4 species were found in all the regions studied: *Lithobius lapidicola, L. forficatus, L. erythrocephalus* and *L. curtipes*, the latter even occurring in all of the stands examined.

Species composition of Chilopoda communities differed notably between particular forest complexes. This was reflected in the low values of the index of MARCZEWSKI & STEINHAUS (1959), which did not exceed 0.50. This value was obtained only, when comparing Chilopoda communities from fresh pine forests of Puszcza Bialowieska and Puszcza Biala, belonging to the same plant association *Peucedano-Pinetum*. When comparing Chilopoda communities from Puszcza Bialowieska and Puszcza Biala with Roztocze, whose fresh pine forests were classified as *Leucobryo-Pinetum*, the values of the MARCZEWSKI-STEINHAUS index were 0,43 and 0,36 respectively.

The MARCZEWSKI-STEINHAUS index was also applied for comparing the species compositions of each of the stands studied (Fig. 1). Notably high values were obtained for sites from the same region. In many cases these values exceeded 0,71, whereas in all comparisons of stands from separate forest complexes the values were less than 0,50.

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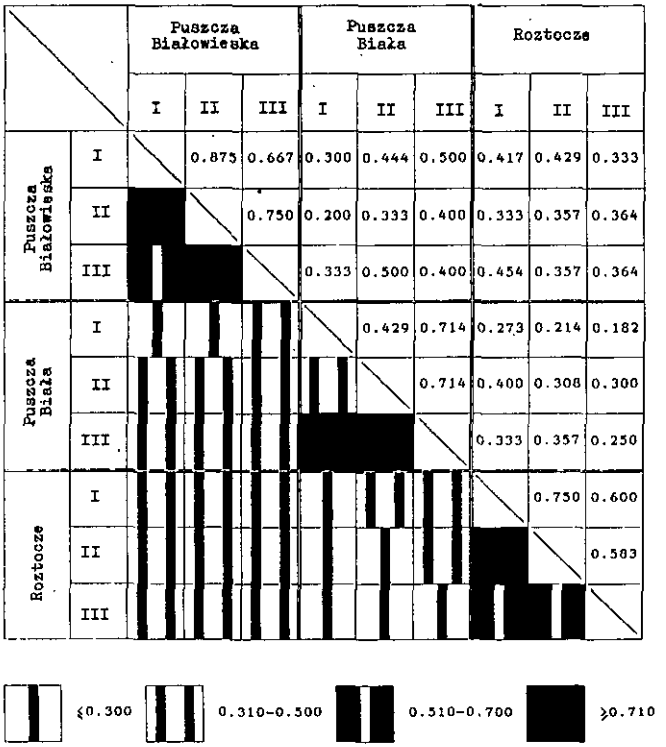

Fig. 1: Similarity of Chilopoda communities of the fresh pine forests studied according to the MARCZEWSKI-STEINHAUS index.

4. *Density and Activity Density:*

Density of Chilopoda in the fresh pine forests studied was calculated from data acquired from litter sievings and from soil samples (Fig. 2). On an average, density values estimated from soil samples were about 44 % higher at each stand than those calculated from the litter samples. The differences in values for particular stands were statistically not significant. However, when comparing the density values within a region, the differences increased and became statistically significant in the case of Puszcza Biala.

The lowest density of Chilopoda was recorded in fresh pine forests of Puszcza Bialowieska, i.e. 2,2 (3.0) ind. · m^{-2} according to litter sievings and soil samples respectively. With respect to litter samples, the density of Chilopoda in this region differed statistically from density values calculated from fresh pine forests of Puszcza Biala and Roztocze. Fresh pine forests of the other regions did not differ statistically in their values of Chilopoda density, whether obtained from litter sievings or from soil samples.

Density values of Lithobiomorpha in Puszcza Bialowieska (2,0 and 2,9 ind. · m^{-2} from litter sievings and soil samples respectively) were hardly higher than in the other complexes and did not differ statistically. On the other hand, the density of Geophilomorpha was smaller by several times in the litter sievings and by several tens of times in the soil samples. These differences were significant. Density values of Geophilomorpha in fresh pine forests of Puszcza Biala and Roztocze were similar and did not differ statistically.

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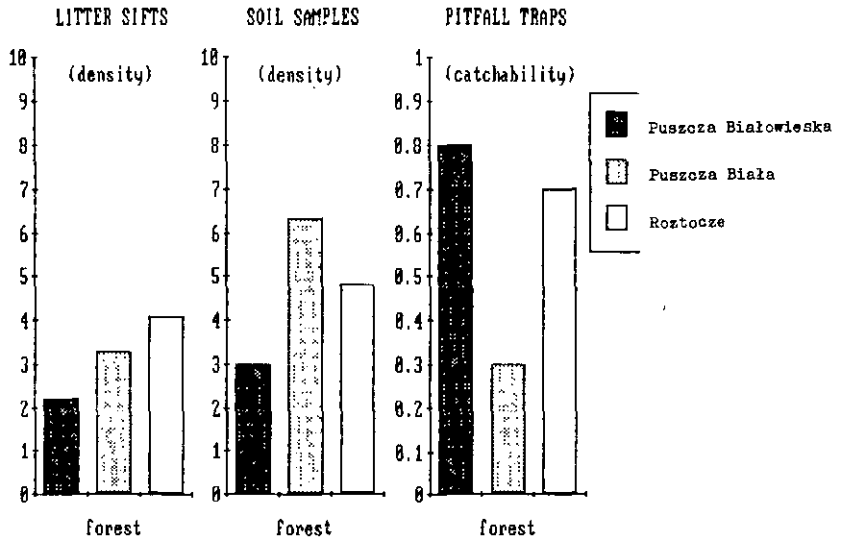

Fig. 2: Density (ind. · m^{-2}) and activity density (ind. per 10 traps and 14 days) in fresh pine forests in Poland.

Differences in the values of activity density of Chilopoda (number of specimens caught in 10 pitfall traps in 14 days) between fresh pine forests of the forest complexes (Fig. 2) were not significant either.

5. Dominance Structure:

The analysis of dominance structure of Chilopoda communities in the fresh pine forests examined (Table 2) considers 5 classes of dominance (WYTWER 1990), namely: eudominant (> 50 %), dominant (10 - 50 %), influent (5 - 10 %), recedent (2 - 5 %) and subrecedent (< 2 %). Litter and soil samples yielded a very similar dominance structure for Chilopoda communities, which was further confirmed by the values of the MORISITA index (HORN 1966), see Table 3.

The dominance structure of Chilopoda communities from different regions was only slightly similar, which was reflected by low values of MORISITA index (Table 4), epigeic Chilopoda of Puszcza Bialowieska and Roztocze excepted (IM = 0.98). Indeed, in these two regions, the common epigeic species hold nearly the same positions in dominance structure (Table 2): *L. mutabilis* being eudominant, *L. forficatus* influent, see also *L. lapidicola*, *L. curtipes*.

In case of other sampling methods (litter sieving, soil samples), the greatest similarity in dominance structure was observed between Chilopoda communities of Roztocze and Puszcza Biala. Higher values of the MORISITA index were obtained mainly due to similar dominance positions of *Schendyla nemorensis* (eudominant or dominant) and *Lithobius curtipes* (dominant or influent).

6. Discussion:

5 - 12 species of Chilopoda were found in the stands of fresh pine forests (*Vaccinio myrtilli-Pinetum*) examined. This is comparable with Chilopoda communities of deciduous forests in central Europe (KACZMAREK 1952, THIELE 1956, ALBERT 1979, FRÜND 1987). The communities studied were highly diverse with respect to species composition and dominance structure. It is quite important in this context that the stands examined belong to distant forest complexes of

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Table 2: Dominance structure [%] of Chilopoda communities of pine forests in Poland (according to different methods: **LS** sieving of litter; **SS** soil samples; **PT** pitfall traps).

		P. Bialowieska			P. Biala			Roztocze		
		LS	SS	PT	LS	SS	PT	LS	SS	PT
1	*Lithobius mutabilis*	7,7	11,4	73,7	–	–	–	7,5	13,8	72,6
2	*L. lapidicola*	5,8	5,7	7,0	5,7	1,7	8,5	3,7	–	1,8
3	*L. forficatus*	–	–	9,7	1,4	1,7	16,5	–	–	5,6
4	*L. erythrocephalus*	–	–	–	–	–	–	–	–	1,8
5	*L. pelidnus*	1,9	8,6	1,7	–	–	75,0	–	–	–
6	*L. t. fennoscandius*	–	–	6,6	–	–	–	–	–	–
7	*L. calcaratus*	–	–	–	14,2	8,5	–	–	–	–
8	*L. cyrtopus*	–	–	–	–	–	–	–	–	10,5
9	*L. curtipes*	77,0	68,6	1,3	18,7	9,2	–	7,8	6,9	4,1
10	*L. crassipes*	–	–	–	–	–	–	26,9	15,5	1,8
11	*Geophilus proximus*	–	–	–	–	–	–	2,0	1,7	–
12	*Pachymerium ferrugineum*	7,5	5,6	–	–	–	–	20,4	19,0	–
13	*Strigamia acuminata*	–	–	–	–	–	–	12,2	6,9	1,8
14	*Schendyla nemorensis*	–	–	–	60,0	78,9	–	19,4	36,2	–

Table 3: Comparison (MORISITA Index) of different methods used in studying Chilopoda communities of forest complexes in Poland.

	P. Bialowieska	P. Biala	Roztocze
Litter sieving vs. soil samples	0,99	0,95	0,88
Litter sieving vs. pitfall traps	0,12	0,01	0,28
Soil samples vs. pitfall traps	0,19	0,01	0,18

Table 4: Similarities (MORISITA Index) between Chilopoda communities of different forest complexes according to the three sampling methods.

	Litter sieving	Soil samples	Pitfall traps
P. Bialowieska vs. P. Biala	0,29	0,11	0,06
P. Bialowieska vs. Roztocze	0,21	0,21	0,98
P. Biala vs. Roztocze	0,45	0,68	0,02

Poland. Pronouncedly greater differences in species composition expressed by means of the MARCZEWSKI-STEINHAUS index were found between stands in separate forest complexes than between stands from the same region.

Only 4 species occurred in fresh pine forests of all three regions, namely *L. forficatus, L. erythrophalus, L. curtipes* and *L. lapidicola*. The first two species rank among eurytopic and very common species, recorded by KACZMAREK (1952) as most abundant in coniferous forests of Wielkopolska and in the district of Lubusk. In the fresh pine forests examined, these species were collected mainly in pitfall traps (*L. forficatus* in particular, which was dominant or influent) or by hand sampling in tree trunks (*L. erythrocephalus, L. forficatus*). The forest and litter species *L. curtipes* occurred abundantly in all study sites.

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The other species were recorded in fresh pine forests of two regions at most. Their occurrence should therefore be related to the specific conditions of a given forest complex. In many cases the species either have already been reported from the given region or may be expected to occur there from the available data (KACZMAREK 1980). An exception is *Schendyla zonalis*, which was reported for the first time in Poland from Roztocze, and which possibly may be limited to this part of the country.

Density of Chilopoda in the forests examined ranged over a small interval only, from 2,2 - 4,0 ind. · m^{-2} according to litter sievings and 3,0 - 5,0 ind. according to soil samples. The values are several times smaller than those calculated in linden-oak-hornbeam forests in Poland (KACZMAREK 1977, 1989, WYTWER 1990). They are close, however, to values of Chilopoda density supplied by ALBERT (1982) for a spruce forest (4,77 ind. · m^{-2}) and by BISTRÖM & VÄISÄNEN (1988) for a similar forest in central Finland (1,1 - 8,0 ind. · m^{-2}).

Although the differences in Chilopoda density in fresh pine forests of various regions of Poland were fairly small (Fig. 2), the lowest density was characteristic for fresh pine forests of Puszcza Bialowieska. The difference resulted primarily from a very low contribution of Geophilomorpha to the Chilopoda communities, which were only represented by *Pachymerium ferrugineum*. In Puszcza Biala, also, only one species of Geophilomorpha was found, i.e. *Schendyla nemorensis*, but in a much higher percentage which nearly equalled the Geophilomorpha total in the pine forests of Roztocze.

The dominance structures of Chilopoda according to litter sievings and soil samples were most similar in fresh pine forests of Puszcza Biala and Roztocze, although pitfall traps indicated a closer similarity between Puszcza Bialowieska and Roztocze (Table 4). It is unquestionable, however, that fresh pine forests of Roztocze were the richest in Chilopoda species and had the most complicated dominance structure in each layer of the soil profile.

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