

# FRAGMENTA FAUNISTICA

Fragm. faun.	Warszawa, 14.07.1997	40	1	1-13
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## **Potworm communities (*Enchytraeidae*, *Oligochaeta*) in different types of forest in Puszcza Kampinoska.**

**Abstract.** 24 potworm species have been found in the forest habitats studied in Puszcza Kampinoska. Species diversity of *Enchytraeidae* decreases with deteriorating trophic and moisture conditions. Potworm communities in alder swamps and mixed forests have a characteristic species composition and structure. Linden-oak-hornbeam forests with a variety of habitats present accommodate a number of distinct potworm communities.

**Key words:** Enchytraeidae, alder swamp, linden-oak-hornbeam forest, mixed coniferous forest, Kampinos National Park

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### 1. INTRODUCTION

The area of Kampinos National Park is characterised by considerable diversity and a patchwork pattern of habitat arrangement. In this relatively small area diverse types of forest and open-area habitats can be found, differing in trophic and moisture conditions, which promotes faunal richness (ANDRZEJEWSKI, CHUDZICKA et al. 1995).

Constant deterioration of water relations in the entire area of Kampinos National Park has led to domination of more or less transformed replacement plant associations, including forest as well as open-area types. With decreasing soil moisture in some areas, alder swamps are changing into ash-alder forest, while mixed coniferous forests are becoming similar to linden-oak-hornbeam forests (SOLON 1996). The resultant alterations in the biocenoses undoubtedly affect the fauna.

Potworms are influenced both by soil conditions (soil type and fertility) as well as by forest habitat type, the latter determining the nutrient substrate obtained from falling leaves and the occurrence of characteristic microhabitats.

Potworms are one of the most poorly studied taxa in this area. Their species composition in various forest habitats (ash-alder forest, linden-oak-hornbeam forest, mixed coniferous forest, pine forest) has been studied by MAKULEC (1983), while data on the structure of enchytraeid communities are still lacking. Neither have potworms been studied in alder swamps, a habitat so characteristic of Puszcza Kampinoska.

Faunal knowledge about various forest habitats in Polish is also patchy and usually nothing more than a list of species is available (MOSZYŃSKI 1928, KASPRZAK 1977a, 1979). Here, credit should necessarily be given to papers describing the structure of enchytraeid communities in alder swamps and linden-oak-hornbeam forests (KASPRZAK 1975, 1977b, 1981).

The aim of this paper is:

- to compare the structure of enchytraeid communities in swamp alder forest, linden-oak-hornbeam forest and mixed coniferous forest – ecosystems differing in trophic and moisture conditions
- to assess structural similarity of enchytraeid communities in these habitats as compared to other habitats in the Polish Lowlands.

## 2. AREA OF STUDY

Study areas were situated in the Sieraków Reserve and included three types of adjoining forest associations:

Stand I, division 68. Swamp alder forest (*Ribo-Alnetum*) on a low peat soil

Stand II, division 94. Linden-oak-hornbeam forest (*Tilio-Carpinetum*) on a black earth soil.

Stand III, division 93. Mixed coniferous forest (*Quercu-Pinetum*) on a podzolic soil.

The two years of study (1993–1994) differed in total rainfall and average temperature (January–October). Total precipitation was 424 mm in 1993 and 502 mm in 1994, while average temperature was 9.0 °C in 1993 and 10.0 °C in 1994. The above values have been obtained from data collected by A. Wierzbicki of the "Pożary" Integrated Environment Monitoring Base Station in Kampinos National Park.

## 3. MATERIAL AND METHODS

Every year two series of samples were taken in May and September, when the abundance of enchytraeids was high. Each series consisted of 20 samples, 20 sq. cm in area and 16 cm deep. Specimens were extracted using O'CONNOR's method (1955). A total of 11709 specimens were obtained and life-



determined. These included 2330 potworms from the alder swamp stand, 4934 potworms from the linden-oak-hornbeam stand and 4445 potworms from the mixed coniferous forest stand.

A species diversity index and Sørensen's index of species composition similarity were used to determine community diversification in terms of species composition.

The following indices were used to describe the communities:

1. index of frequency
2. index of dominance
3. Morisita index of dominance structure similarity, modified by HORN (1966)

$$M = \frac{2 \sum_{i=1}^s x_i y_i}{\sum_{i=1}^s x_i^2 + \sum_{i=1}^s y_i^2}$$

where  $x_i$ ,  $y_i$  are dominance indices of species  $i$  at stand  $X$  and  $Y$ , and  $s$  is the total number of species.

4. index of homogeneity (RIEDL 1963)

$$HD = \sum_{i=1}^s \left( \sum_{j=1}^k \frac{D_{ij}}{k} \right) \frac{D_{\min_i}}{D_{\max_i}}$$

where  $D_{ij}$  is the dominance index of the  $i$ th species at the  $j$ th stand with a total of  $s$  species and  $k$  stands.

5. Shannon and Weaver's index of general diversity

#### 4. ANALYSIS OF THE ENCHYTRAEIDAE COMMUNITIES OF PUSZCZA KAMPINOSKA

##### 4.1. Potworm community of the swamp alder forest

20 potworm species were found in the soil at this stand (Table I). Only two of these: *Mesenchytraeus armatus* and *Cernosvitoviella atrata*, prefer moist soils. The other species show considerable habitat valency, inhabiting biotopes markedly differing in fertility and moisture conditions. *Cognettia sphagnetorum* is a dominant (Fig. 1) at this stand, accounting for 33% of the community. Seven other species, belonging to the genera *Fridericia*, *Henlea*, *Buchholzia* and *M. armatus*, account for 1–6% of the community.

*C. sphagnetorum* has the highest frequency (an euconstant species). Accessory species include *Henlea perpusilla*, *M. armatus*, *Buchholzia fallax* and *Fridericia maculata*. The other 15 are influents species. It is worthwhile to note a high frequency of potworms of the genera *Fridericia* and *Mesenchytraeus* (Fig. 2).

Community density in the soil of the swamp alder forest site is higher in spring than in autumn, as observed in both study seasons. In the first year

with lower total precipitation the density was higher at  $16.5 \times 10^3$  ind.  $\times$  m<sup>-2</sup> than in the second, moister year ( $12.6 \times 10^3$  ind.  $\times$  m<sup>-2</sup>) (Table. II).

Table I. Species composition and average abundance (indiv./m<sup>2</sup>) in 1993 and 1994  
R-A – alder swamp, T-P – linden-oak-hornbeam forest, Q-P – mixed coniferous forest

species	R-A	T-P	Q-P
<i>M. armatus</i> (LEV.)	487.5		
<i>M. pelicensis</i> ISSEL.	12.5	37.5	37.5
<i>C. atrata</i> (BRET.)	31.3		
<i>B. appendiculata</i> (BUCHH.)	506.3	12.5	
<i>B. fallax</i> MICH.	850.0	6.3	
<i>C. glandulosa</i> (MICH.)	6.3		6.3
<i>C. sphagnetorum</i> (VEJD.)	4825.0	28425.0	24556.3
<i>M. argentea</i> (MICH.)	25.0	6.3	
<i>E. buchholzi</i> VEJD.	31.3		
<i>F. bisetosa</i> (LEV.)	181.3		
<i>F. bulboides</i> NIEL. et CHRIST.	18.8		
<i>F. galba</i> (HOFFM.)	25.0		
<i>F. gracilis</i> BULOW.	6.3		
<i>F. hegemon</i> (VEJD.)	43.8		
<i>F. leydigi</i> (VEJD.)	37.5		
<i>F. maculata</i> ISSEL.	643.8	6.3	
<i>F. ratzeli</i> EIS.			12.5
<i>H. nasuta</i> EIS.	950.0		
<i>H. perpusilla</i> FRIEND.	418.8		
<i>H. similis</i> NIEL. et CHRIST.	12.5		
<i>A. affinis</i> NIEL. et CHRIST.	6.3		
<i>A. bohémica</i> (VEJD.)		6.3	18.8
<i>A. camerani</i> (COG.)		81.3	168.8
<i>A. eiseni</i> VEJD.		125.0	68.8
<i>Mesenchytraeus</i> sp. EIS.	1406.3	243.8	75.0
<i>Cernovitoiella</i> sp. NIEL. et CHRIST.	56.3		
<i>Buchholzia</i> sp. MICH.	150.0	12.5	
<i>Marionina</i> sp. MICH.	431.3	6.3	
<i>Enchytraeus</i> sp. HENLE	143.8		
<i>Fridericia</i> sp. MICH.	2912.5	18.8	25.0
<i>Henlea</i> sp. MICH.	125.0		
<i>Achaeta</i> sp. VEJD.	93.8	1856.3	2812.5
number of species	20	9	7
mean density indiv.*m <sup>2</sup>	14437.5	30837.5	27781.3
index of species richness	2.45	0.94	0.71
index of general diversity H'	0.92	0.16	0.2

#### 4.2. Potworm community of the linden-oak-hornbeam forest

This community consists of 9 potworm species (Table I). There is marked dominance of *C. sphagnetorum* (92%) (Fig. 1), while the percentages of the other species not exceed 1%. The dominant is also an euconstant species at this stand, while the others are classed as influents.

Species with a high frequency at this stand include individuals of the genera *Achaeta* (constant) and *Mesenchytraeus* (accessory) (Fig. 2).



The density of enchytraeids in the linden-oak-hornbeam stand was lower in the drier year 1993 ( $18.2 \times 10^3$  ind.  $\times$   $m^{-2}$ ) than in 1994, when total precipitation was higher and the density was  $43.5 \times 10^3$  ind.  $\times$   $m^{-2}$  (Table II).

#### 4.3. Potworm community of the mixed coniferous forest

7 species of *Enchytraeidae* were recorded at this site (Table I). It is similar to the linden-oak-hornbeam community in that there is marked dominance of *C. sphagnetorum* (88%) (Fig. 1). In terms of frequency the species is classified as an euconstant, while the other species are influents. Only individuals of the genus *Achaeta* are classified as constant (Fig. 2).

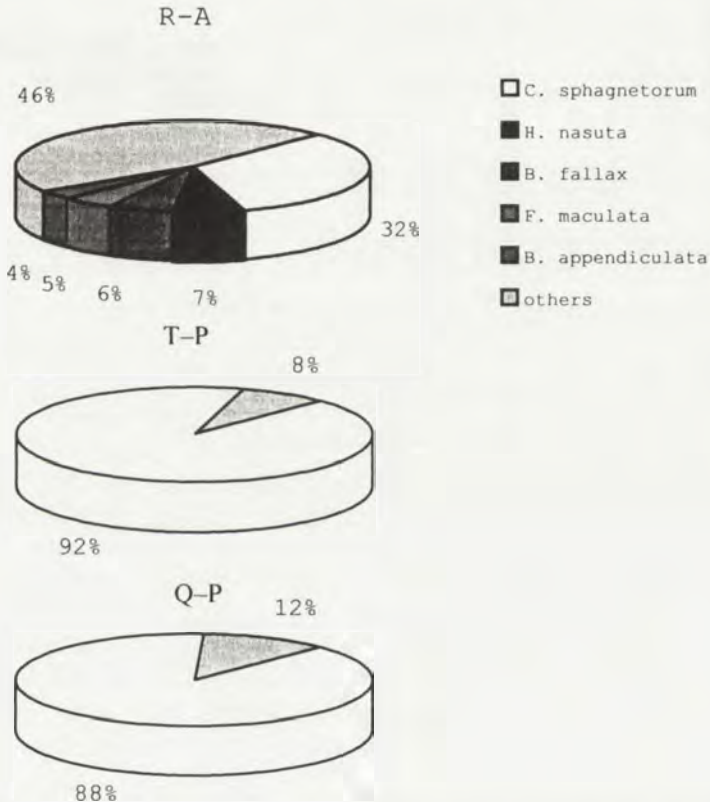


Fig. 1 Structure of dominance of potworm communities in swamp alder forest, linden-oak-hornbeam forest and mixed coniferous forest

In 1993, the year with smaller total rainfall, average density of *Enchytraeidae* was lower, at  $24.9 \times 10^3$  ind.  $\times$   $m^{-2}$ . In the more moist year 1994 the figure was  $30.6 \times 10^3$  ind.  $\times$   $m^{-2}$  (Table II).

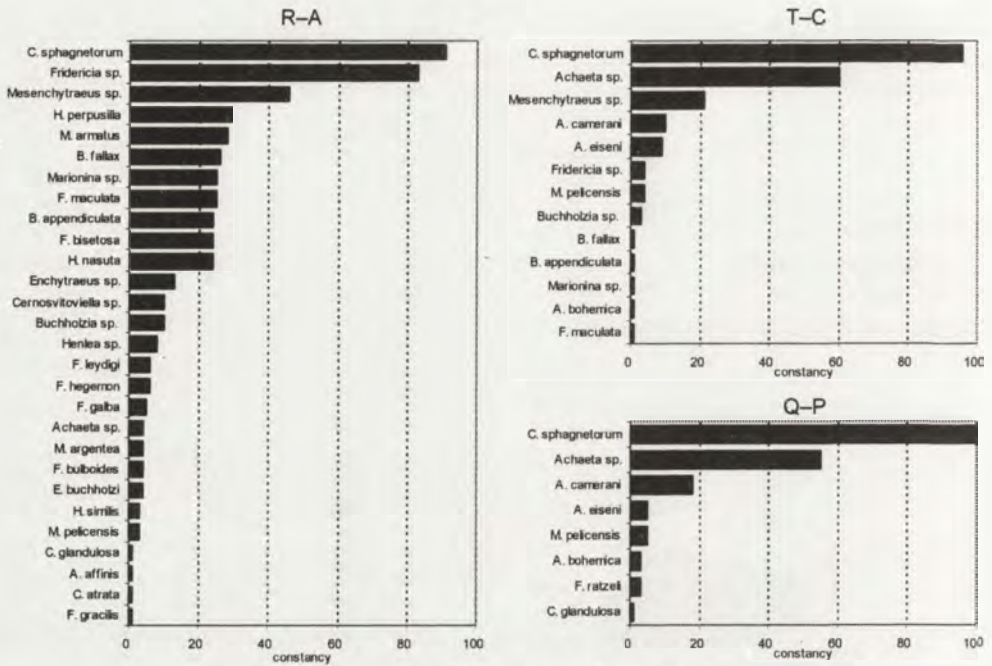


Fig. 2 Frequency of potworm at the study sites

## 5. COMPARISON OF ENCHYTRAEIDAE COMMUNITIES IN DIFFERENT FOREST HABITATS IN KAMPINOS NATIONAL PARK.

### 5.1. Species composition

A total of 24 potworm species were registered in the soil at the 3 stands under investigation. The number of species in the soil of the swamp alder forest was twice as high as at the linden-oak-hornbeam stand and almost three times as high as at the mixed coniferous stand (Table I). Only two species (*Mesenchytraeus pelicensis* and *C. sphagnetorum*) occurred at all the stands. *C. sphagnetorum* inhabits diverse biotopes, but shows a preference for forest habitats and is most abundant in coniferous forests. *M. pelicensis* is a forest species, characteristic of coniferous forests, but it is also found in deciduous forests.

Table II. Average density (indiv.  $\times 10^3/\text{m}^2$ ) of potworm communities at the study sites

	V 1993	X 1993	V 1994	X 1994	average
R-A	20.8	12.2	17.9	7.3	14.6
T-P	20.7	15.6	40.6	46.4	30.8
Q-P	16.2	33.6	28.7	32.6	27.8

A comparison of the species composition of the potworm communities of the swamp alder and linden-oak-hornbeam sites found 6 common species out of a total of 23 species registered there. Thus the common forms account for 26% of the species content of these two communities.



Species occurring almost exclusively in the swamp alder forest include nearly all species of the genera *Fridericia* and *Henlea* registered in the area and also

*Mesenchytraeus armatus* and *Cernosvitoviella atrata*, the latter two preferring moist soils.

The differences in species composition between the swamp alder and mixed coniferous forest are even greater than between the two sites just analysed, with only 3 common species out of 24 (only 12.5% of the species composition).

The communities of the linden-oak-hornbeam and mixed coniferous stands are much more similar in species composition with 5 common species out of 11 (45% of species composition). Only at these two stands are found nearly all species of the genus *Achaeta* preferring sandy soils. The other species are adapted to a wide range of soil moisture and structure changes.

The values of the Sørensen index confirm the similarity of species composition of the

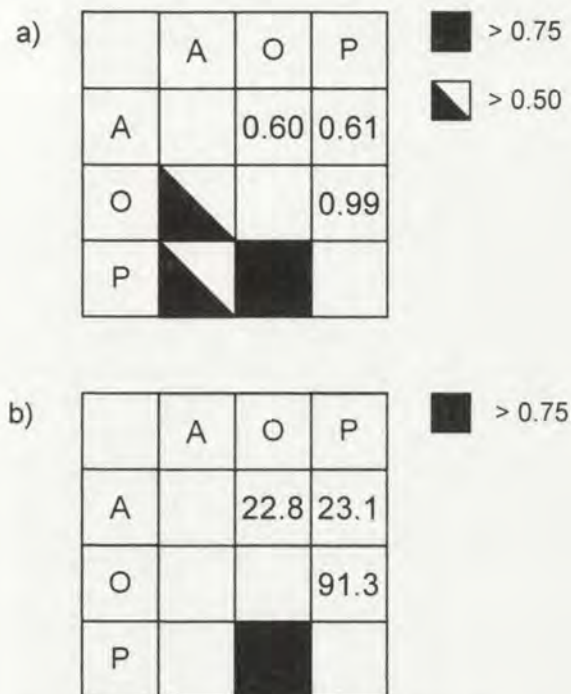


Fig. 3 Pótworm communities: similarity diagrams

a. Morisita index

b. Riedel's homogeneity

potworm communities from the linden-oak-hornbeam and mixed coniferous stands, while the other two pairs (linden-oak-hornbeam – swamp alder and swamp alder – mixed coniferous) are different, dissimilar (Fig. 3).

The index of species richness is the highest for the swamp alder community of potworms, at 2.45, while in the linden-oak-hornbeam and mixed coniferous sites it is much lower, at 0.94 and 0.71 respectively (Table I).

## 5.2. Frequency

The species with the highest frequency (the euconstant class) is *C. sphagnetorum*, at all stands. There are 4 accessory species in the soil at the swamp alder stand and the other 15 species are influents. It is worth noting that individuals of the genera *Fridericia* and *Mesenchytraeus* have a high frequency there. At the linden-oak-hornbeam and mixed coniferous forest sites, the frequency of species is low and all species, with the exception of *C. sphagnetorum*, are classed as influent species. The individuals of genus *Achaeta* has a high frequency at these two stands (Fig. 2).



### 5.3. Structure of dominance

*C. sphagnetorum* was the dominant species at all the sites. In the gradient of the study sites, in the most fertile and moist soil (alder swamp site), the dominance is not so marked with *C. sphagnetorum* accounting for 33% of the community on average.

At the other two sites, less fertile and drier, the dominance of *C. sphagnetorum* is well marked, exceeding 85% (Fig. 1). The fact that the dominance index of *C. sphagnetorum* is slightly higher at the linden-oak-hornbeam site than at the mixed coniferous site is attributable to soil overdrying and a reduction of the dominant with an accompanying increase of species occurring at greater depths in the soil.

The percentages of the next 7 species exceed 1% at the swamp alder site, while at the linden-oak-hornbeam and mixed coniferous sites the total proportion of all other species does not exceed 1%. At the linden-oak-hornbeam and mixed coniferous sites, the following places in the structure of dominance are occupied by species of the genus *Achaeta* and *M. pelicensis*. In the swamp alder forest, the second and following places in the dominance structure are occupied by two species of each of the following genera: *Henlea*, *Buchholzia*, *Fridericia* and *M. armatus*. Thus, the core of the community in the swamp alder forest is formed by different species than in the linden-oak-hornbeam forest and the mixed coniferous forest. At the swamp alder site, individuals of the genus *Fridericia* also contribute significantly to the structure of dominance. The same can be said for the genus *Achaeta* at the linden-oak-hornbeam and mixed coniferous sites. Thus, when the swamp alder forest community is compared to the other two communities studied, differences can be seen both in shape and make-up, the latter referring to the other species registered. On the other hand, the structures of dominance of the communities in the linden-oak-hornbeam and mixed coniferous forest show considerable similarities both in shape and make-up.

The dissimilarity of dominance structures of the potworm communities studied is reflected in the values of Shannon and Weaver's index of general diversity (Table I), which is much higher for the alder swamp community than for the other two. Thus, as the biocenosis and habitat grow poorer, species diversity also decreases.

In the year 1993, when moisture conditions were worse, the response of the dominant *C. sphagnetorum*, which inhabits upper soil horizon, to the increase in soil moisture in autumn could be seen both in the linden-oak-hornbeam forest and in the mixed coniferous forest, where its proportion in the community increased. In the year 1994, with higher total precipitation, *C. sphagnetorum* responds to decreasing moisture in autumn by diminishing its proportion, while there is a rise in the proportion individuals of genus *Achaeta*, living deeper in the soil.

The dominance of *C. sphagnetorum* in the soil at all the study sites is of great importance. Due to its mode of reproduction, the species responds quickly and accurately to all significant changes in the soil. Under favourable



trophic and moisture conditions, it can multiply its abundance and so accumulate substantial amounts of energy and biogenes.

At the linden-oak-hornbeam and mixed coniferous sites, the proportions of this dominant are similar, amounting to 92% and 88% respectively. In the swamp alder forest community, its proportion is much lower (33%) (Fig. 1).

Similarity of the dominance structures are confirmed by the Morisita index (Horn 1966) and the homogeneity index (RIEDL 1963). Their values are relative to the number of common species, with the Morisita index attaching greater importance to the dominant species, while the homogeneity index takes a more proportional account of accessory and influents. The values of both indices also demonstrate a close relationship between the linden-oak-hornbeam and mixed coniferous sites and the dissimilarity of the swamp alder forest community (Fig. 3).

#### 5.4. Abundance

Soil moisture is one of the most important abiotic factors influencing potworm community density. When comparing data on community density from each study year, this factor, conveniently expressed as total rainfall and distribution of rainfall, turns out to present a significant influence. In 1993 total rainfall was approximately 20% lower than in the next year. Good moisture conditions in the soil were the main reason for a substantial increase of potworm community density at the linden-oak-hornbeam and mixed coniferous sites in 1994 and a simultaneous reduction observed at the swamp alder site, where high moisture limited the development of potworms. The linden-oak-hornbeam and mixed coniferous forest potworm communities were nearly twice as abundant in the second study year, while at the swamp alder site the proportions were reversed with a similar peak in the first year. High soil moisture also favourably affects the survival rate of regenerating forms of *C. sphagnetorum* (MAKULEC 1983). In summary, in periods of intense rainfall, community density in alder swamp decreases while it rises in the other two habitats (Table II).

## 6. DISCUSSION

### 6. 1. Similarity of potworm communities of the forests of Puszcza Kampinoska and the Polish Lowlands.

The only data available on potworm communities of swamp alder forests have been collected in the Wielkopolsko-Kujawska Lowlands (KASPRZAK 1975). The community was made up of 24 species. *C. sphagnetorum* was the dominant, but it accounted only for 26% of the community. That community and the one described in this paper have 13 species in common. They are similar both in species composition, with a Sørensen index of 61%, and in structure (Morisita index = 0.82). In the community described by Kasprzak the density was much lower than at the swamp alder site in Puszcza



Kampinoska, while both communities displayed the same pattern of seasonal density changes.

Linden-oak-hornbeam forests embrace a variety of habitats, and the potworm communities to be compared inhabit different types of soils. A comparison of the data on the linden-oak-hornbeam community described above with data by MAKULEC (1983) obtained in the years 1976–1977 from a linden-oak-hornbeam forest in Puszcza Kampinoska growing on a brown soil shows 6 common species. Makulec registered 11 species, with *C. sphagnetorum* as a dominant (95%). The number of species in the community described in this paper is lower by 18%. The two communities are similar, as the value of Sørensen's index equals 60%.

When the community described in this paper (linden-oak-hornbeam forest in Puszcza Kampinoska growing on black earth) is compared to a community from Białołęka Dworska (brown soil), described by KASPRZAK (1981), considerable differences can be observed. The two communities are not similar either in species composition or structure. The index of species composition similarity is 33% and the Morisita index is 0.0. A comparison with another community, living in a lessivé soil in Puszcza Białowieska shows a lack of similarity both in species composition (41%) and structure (0.17).

The data on the potworm community in the mixed coniferous forest studied have been compared to the results of a 1976–1977 study of potworms living in the same forest type and also on a podzolic soil in Puszcza Kampinoska (MAKULEC 1983). That research registered 8 species, with *C. sphagnetorum* as dominant (91%). The two communities were similar in terms of species composition (53%).

Potworm communities inhabiting mixed coniferous forests in Puszcza Kampinoska and Puszcza Białowieska are similar in terms of species composition, with Sørensen's index equalling 77%. The similarity of community structure, measured as the Morisita index, is also high, at 0.98. Soil conditions play a more important role here than the type of coniferous forest.

When comparing average densities of potworm communities in the linden-oak-hornbeam forest and the mixed coniferous forest in the years 1993–1994 and 1976–1977 (Makulec 1983), a correlation with total rainfall can be observed. The difference in total rainfall between 1976 and 1977 – 281 mm – is much higher than between 1993 and 1994 – 78 mm. Against this background, changes of the density of potworm communities at the linden-oak-hornbeam and mixed coniferous sites investigated become really evident. In the more moist years – 1977 and 1994 – the density rose at a similar rate, by approximately 2.5 times in linden-oak-hornbeam forests. In mixed coniferous forests the difference in total rainfall correlates well with density. With a much smaller difference in total rainfall in the years 1993 and 1994, a minor increase in density was observed, while in the years 1976 and 1977, where the difference in rainfall is much higher, a more-than-threelfold increase in density occurred. In the drier habitat of mixed coniferous forests,



variations in soil moisture influence potworm community density to a greater extent than in linden-oak-hornbeam forests.

#### 6. 2. Changes in the species composition of potworm communities over a 20-year period.

With the results of the 1976–1978 study on potworm communities in Puszcza Kampinoska (MAKULEC 1983), it is possible to compare changes in species composition only in communities from mixed coniferous forests because the soil type is also the same there, with podzolic soils at both sites.

4 previously noted species were registered in the community analysed in this paper. *B. ehlersi*, *B. appendiculata*, *E. buchholzi* and *H. bifurcatus* reported by Makulec were not registered. At the same time, 3 new species were observed: *M. pelicensis*, *C. glandulosa* and *F. ratzeli*. Thus, species composition changed by 50% over 20 years and the number of species fell by 13%. The data, however, come from two sites only, so the tendencies need to be further confirmed.

#### 6. 3. The effect of trophic conditions and soil moisture on potworm communities

The choice of the forest habitats studied – their arrangement along a gradient – made it possible to verify the connection between species richness and diversity of *Enchytraeidae* on the one hand and soil fertility on the other. As the biocenosis and habitat grow poorer, the species diversity of potworms decreases. This regularity has also been confirmed by an analysis of data by ABRAHAMSEN (1972), DÖZSA-FARKAS (1973), KASPRZAK (1975), GÓRNY (1975) and PILIPIUK (1993).

A high similarity between the communities inhabiting the linden-oak-hornbeam and mixed coniferous forest probably shows that soil degradation is taking effect in the former: the soil becomes acidified and overdried in its upper layers thus resembling the soil in a mixed coniferous forest. The two adjacent sites are probably more closely related in terms of habitat than stands of linden-oak-hornbeam forest growing on different soils in Puszcza Kampinoska. A conclusion could be drawn then that the structure of a community is more influenced by soil type and fertility than by the type of habitat, that is the type of nutrient in falling leaves and the occurrence of characteristic microhabitats. It also shows our inability to pinpoint a community type characteristic of linden-oak-hornbeam forest, due to the substantial diversification of this forest type. On the other hand, a potworm community inhabiting a meadow on black earth (RYL 1980) differs from the linden-oak-hornbeam community, with a species composition similarity of 30% showing the importance of habitat type. Unfortunately it is not possible to compare two forest communities of potworms in the same manner.

The presence of more stable soil conditions in various types of coniferous forest makes it possible for habitat-specific potworm communities to develop. This is confirmed not only by comparing mixed coniferous forests in Puszcza Kampinoska and Puszcza Białowieska, but also by a high similarity between pine forest potworm communities in different parts of Poland (PILIPIUK 1993).



The high similarity of the alder swamp potworm communities compared may be due not only to the type of soil but also to the specific conditions resulting from periodical flooding of this habitat.

The changes that have occurred in Kampinos National Park over the last 20 years, the degree of transformation, and the prevalence of replacement habitats have also influenced the fauna. This may explain the significant differences that can be observed when data on potworm communities of mixed coniferous forest collected 20 years ago are compared to current data. The unification of habitat conditions taking place in certain areas is simultaneously reflected in the similarity of communities from linden-oak-hornbeam and mixed coniferous forest. Thus, potworms could become a useful monitoring tool. The results obtained so far show them to be sensitive to habitat changes. However, comparative studies performed in different soil types are needed to ascertain that.

#### 7. SUMMARY

The analysis of species composition, structure of dominance and abundance carried out in this paper serves to describe and interpret changes taking place in potworm communities in Puszcza Kampinowska. The species richness and diversity of this taxon were shown to be greatly influenced by soil conditions. As the habitat grows poorer, species diversity of potworms decreases. The structure of the potworm community in a fertile wet alder swamp is different from the communities in linden-oak-hornbeam and mixed coniferous forest, the latter two being considerably similar to each other. An analysis of similarities between potworm communities inhabiting the same habitat types at various sites in the Polish Lowlands showed the existence of habitat specific communities of swamp alder and mixed coniferous forest in terms of species composition and structure. The soils of linden-oak-hornbeam forests are inhabited by diverse potworm communities, the soils themselves being much diversified. The transformation of habitats in Puszcza Kampinowska secondary to drainage of the area and the accompanying succession changes has affected the development of potworm communities. The example of the potworm community from mixed coniferous forest shows that species richness has decreased considerably

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## STRESZCZENIE

[Tytuł: Zgrupowania wazonkowców (*Enchytraeidae*, *Oligochaeta*) w różnego typu lasach Puszczy Kampinoskiej]

Badano skład gatunkowy i strukturę zgrupowań wazonkowców na 3 stanowiskach w Puszczy Kampinoskiej. Stanowiska te w olsie, grądzie i borze mieszanym różniły się troficznością i wilgotnością. Stwierdzono występowanie 24 gatunków. Na wszystkich stanowiskach dominuje *C. sphagnetorum*. Zgrupowanie w olsie jest bardziej różnorodne jak zgrupowania z grądu i boru mieszanego. Zróżnicowanie gatunkowe maleje wraz z zubożeniem siedliskowym. Zgrupowania z grądu i boru mieszanego są podobne do siebie pod względem składu gatunkowego i struktury zgrupowań, zgrupowanie z olsu jest od nich odrębne. Podobieństwo zgrupowań z grądu i boru mieszanego jest wynikiem pewnej unifikacji warunków środowiskowych. Analiza zgrupowań z różnych stanowisk leśnych niżej Polski wykazała, że olsy i bory zasiedlają typowe dla tych środowisk zgrupowania. Znacznie zróżnicowane siedliskowo grądy zasiedlają odmienne zgrupowania wazonkowców.