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Earthworms (*Lumbricidae*, *Oligochaeta*) of pine forests in Poland

[With 1 Table in text]

Abstract The earthworms occurrence in pine forests was analyzed. The communities of earthworms in studied areas are characterized by poor species composition and low density. *D. octaedra* was the dominant.

Earthworms (*Lumbricidae*) are a group of soil macrofauna well-known for their considerable contribution in organic matter mineralization. Due to low densities of their communities, the animals do not play a significant role in the flow of energy through the ecosystem in oligotrophic pine forests. The communities which they form in these areas are usually poor and consist of a few species.

The data concerning earthworms association in Polish pine forests have been gathered from studies by GÓRNY (1976), JOPKIEWICZ and PLISKO (1975), PILIPIUK (1981), PLISKO (1969), SZUJECKI (1983). Unpublished data by JOPKIEWICZ and MAKULEC have also been used. All these data, however, concern other forest areas than those described in this paper.

A thorough study of earthworm's occurrence in pine forests on sandy soils situated south of Moscow was provided by TICHOMIROVA, RYBALOV and ROSSOLIMO (1979). MATVEEVA, MANKOVA and PISANOV (1984) described earthworm communities in pine forests grouped according to decreasing underground water levels. MATVEEVA, NOSOVA (1983) studied earthworm communities in pine forests on soddy-podzolic soils.

In a number of papers information is given about earthworms living in other types of coniferous forests. The examples are: PEREL (1965), PEREL and KARPACHEVSKY (1971), KRYLOVA (1985) - on *Lumbricidae* in spruce forests; PEREL (1962) - on lumbricids in mixed forests; PIERCE (1971) - on earthworms in larch forests.

A large number of papers concerning the ecology of lumbricids inhabiting pine forests was written by Scandinavian authors. ABRAHAMSEN (1972) described earthworm associations in Norway, NORDSTRÖM and RUNDGREN (1973) – earthworms in southern Sweden. NORDSTRÖM also studied (1975) seasonal differences in activity of earthworms; NORDSTRÖM and RUNDGREN (1974) – influence of various environmental factors on their associations, and RUNDGREN (1975) – vertical distribution.

Some papers treat the problem of changes in earthworm communities due to various silvicultural practices (MAKESCHIN 1985, HUHTA 1979, HUHTA, KARPINEN et al. 1967, HUHTA, KUMALA 1985, SZUJECKI 1983), forest fires (MATVEEVA 1985) and industrial pollution (GÓRNY 1976).

The aim of this paper was to examine the species composition and the abundance of earthworm communities in timber pineforest stands in various regions of Poland.

The research was done in five selected pine forests. Three of them, including research areas in Roztocze National Park, Bory Tucholskie and Babimost forest district, were identified as suboceanic pine forest – *Leucobryo-Pinetum*, while the remaining two – Puszcza Białowieska and Puszcza Biała – are representatives of the subcontinental pine forest *Peucedano-Pinetum*. In each of them three timber stands (90–100 years old) were chosen.

Materials were collected from October 1986 to April 1988 twice a year – in spring and autumn. Every time ten soil subsamples were taken, each being 0.1m² in size and 10 cm deep. The ground was sifted by hand. Apart from this, in Roztocze 0.3% of formalin solution was poured into the pits where the subsamples had been drawn. This method, however, did not serve to obtain more material than the former. Small numbers of *Lumbricidae* were obtained from additional litter siftings. Some lumbricids were caught in the litter.

Only four *Lumbricidae* species were found in studied forests. Soil samples showed the presence of *Dendrobaena octaedra* (SAV.) and *Aporrectodea* sp. OERLEY, while supplementary qualitative samples revealed *Dendrodrillus rubidus* (SAV.) and *Lumbricus rubellus* HOFFM. All of those species were found in Białowieska Puszcza. *D. octaedra* and *D. rubidus* were reported to inhabit Bory Tucholskie and Roztocze National Park. *D. octaedra* alone was found in Puszcza Biała and Babimost forest distr.

SZUJECKI (1983), too, registered only *D. octaedra* in timber forest stands. He compared species composition of earthworm communities in forest stands of different ages. In young stands (2–14 years old) he also found *L. rubellus*, *Lumbricus castaneus* (SAV.) and *Aporrectodea caliginosa* (SAV.). *A. caliginosa* and *L. rubellus* were found to inhabit a *Peucedano-Pinetum* pine forest in Białoleka Dworska (PILIPUK, 1981).

Earthworm associations of pine forests are poor in species composition. *D. octaedra* is found in nearly every pine forest stand. Only MATVEEV (1985) and ZICSI (1985) did not find this species in their researches outside Poland. *L. rubellus* and *D. rubidus* are often found, too. *A. caliginosa* is also reported to live in many forest stands. The remaining species appear sporadically, and are reported by two authors or one author only (Tab. I).

Table I. Comparison of earthworm species and densities in pine forests registered in various studied

| Pine forest | | Species | | | | | | | | | | | | | | N/m ² |
|--|------------------|---------|---|---|---|---|---|---|----|----|----|----|----|----|----|------------------|
| Stand | Stand forest age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| P. Białowieska <i>Peucedano-Pinetum</i> | 90-100 | + | + | + | | + | | | | | | | | | | 4-15 |
| P. Biała <i>Peucedano-Pinetum</i> | 90-100 | + | | | | | | | | | | | | | | 2-12 |
| Roztocze National Park <i>Leucobryo-Pinetum</i> | 90-100 | + | + | | | | | | | | | | | | | 5-9 |
| B. Tucholskie <i>Leucobryo-Pinetum</i> | 90-100 | + | + | | | | | | | | | | | | | 0-1 |
| Babimost forest distr. <i>Leucobryo-Pinetum</i> | 90-100 | + | | | | | | | | | | | | | | 2-18 |
| Białoleka Dworska <i>Peucedano-Pinetum</i> (PILPIUK 1981) | 70-80 | | | + | + | | | | | | | | | | | 6 |
| Puszcza Kampinoska <i>V. myrtilli-Pinetum</i> (PLUSKO 1969) | | + | | | | | | | | | | | | | | |
| P. Kampinoska (JOPKIEWICZ, PLUSKO 1975) | | + | + | + | + | | | | | | | | | | | 18-39 |
| Surroundings of Puławy (GORNY 1976) | | + | + | + | + | | | | | | | | | | | 20-21 |
| P. Borecka <i>Peucedano-Pinetum</i> (JOPKIEWICZ unpubl.) | | + | | + | | | | | | | | | | | | 4 |
| Surroundings of Ilawa <i>Peucedano-Pinetum</i> (MAKULEC unpubl.) | 50 | + | + | | | | | | | | | | | | | 153 |
| Niedźwiady forest distr. <i>Leucobryo-Pinetum</i> (SZYJECKI 1983) | 2-14 18-98 | + | | + | + | | + | | | | | | | | | 0-6 |

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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|--|-------|---|---|---|---|---|---|---|----|----|----|----|----|----|----|---------|
| Pine cultures | 80-85 | | | | | | | | | | | | | | | |
| (MATVEEVA, NOSOWA 1983) | | + | | + | + | + | + | | | | | | | | | 201-612 |
| (MATVEEVA, MANKOVA, PISANOV 1984) | | + | | | | | | | | | | | | | | 10-30 |
| (TICHOMIROVA, RYBALOV, ROSSOLINO 1979) | | + | | + | + | | | | | | | | | | | 0-5 |
| (MALEVIC, MATVEEVA 1964) | 20 | + | | | | | | + | | | | | | | | 15 |
| (LAVROV 1985) | 80 | + | | | | | | | | | | | | | | 33 |
| (MAKESCHIN 1985) | | + | | + | | | | | | | | | | | | |
| (ZCSI 1985) | 30 | | | + | + | | | | | | | + | + | + | + | 35 |
| (TERCHIVUO, VALOVIRTA 1978) | | + | + | + | + | | | | | | | | | | | |
| <i>Vaccinio-Pinetum</i> | | | | | | | | | | | | | | | | |
| (ABRAHAMSEN 1972) | | + | + | | | | | | | | | | | | | 1 |
| (NURMINEN 1967) | | + | | + | | | | | | + | | | | | | |
| (NORDSTROM, RUNDGREN 1973) | 12-25 | + | + | + | + | + | | | | | | | | | | 28-105 |
| (HUHTA, KARPINEN et al. 1967) | | + | | + | | | | | | | | | | | | 4-10 |
| (HUHTA, KUMALA 1985) | | + | | + | | | | | | | | | | | | |
| (MATVEEV 1985) | | | | | | | | | + | | | | | | | |

Species:

- 1 - *Dendrobaena octaedra* (SAV.)
- 2 - *Dendrodrilus rubidus* (SAV.)
- 3 - *Lumbricus rubellus* (HOFFM.)
- 4 - *Aporrectodea caliginosa* (SAV.)
- 5 - *Aporrectodea* sp. (EIS.)
- 6 - *Lumbricus terrestris* L.
- 8 - *Bimastos tenuis* (EIS.)
- 9 - *Eisenia nordeskiöldi* (EIS.)
- 10 - *Dendrodrilus subrubicundus* (EIS.)
- 11 - *Lumbricus polyphemus* (FITZ.)
- 12 - *Fitzingeria platyura* (FITZ.)
- 13 - *Aporrectodea rosea* (SAV.)
- 14 - *Octolasion lacteum* (DERLEY)

The density of earthworm populations in the five studied forests ranges from 0 to 18 individuals per m². It is generally very low in this type of forest stands. Different authors usually find it to range from 0 to 30 individuals per m². Only three authors note densities from 100 to 612 individuals per m².

The highest densities were registered in a mixed spruce forest site in 80-85-years-old pine cultures, (MATVEEVA, NOSOVA 1983). NORDSTRÖM, RUNDGREN (1973) report on such densities in about 30-years-old stand of trees growing on formerly arable soil. In Poland, a high density of earthworm population in a 50-years-old *Peucedano-Pinetum* forest was noted by MAKULEC in his unpublished data.

According to the data from the five stands mentioned in this research as well as from the majority of the stands described in the items in the bibliography, *D. octaedra* is the dominant earthworm species in these stands. *L. rubellus* and *D. rubidus* may also have a major share in the structure of dominance. *D. octaedra* individuals constitute from 45% up to 100% of the population in different forests. *L. rubellus* individuals may account for 38%, *D. rubidus* may constitute up to 19% of the whole association (PLISKO 1969, JOPKIEWICZ, PLISKO 1975, SZUJECKI 1983). *A. caliginosa* individuals form 1-3% of the community (JOPKIEWICZ, PLISKO 1975), but in younger stands they may account for 25% (SZUJECKI 1983).

Earthworms communities in various types of pine forests outside Moscow (MATVEEVA, NOSOVA 1983) exhibit a completely different dominance structure. Here, the dominant species are *Aporrectodea rosea* (SAV.) which constitutes 27-59% of the whole association, *A. caliginosa* - 22-52% and *L. rubellus* - 9-33%. ZICSI (1983) also noted a different dominance structure in a 30-years-old pine forest in Hungary, *Octolasion lacteum* (OERLEY) (37%) and *A. rosea* (31%) being the dominant species there.

The differences in the species composition and the structure of dominance in these two cases are probably due to nontypical habitat conditions. In the former it is pine growing in a spruce forest site, in the latter - pine growing in a linden-oak-hornbeam forest habitat. The age of the stand is important, too (NORDSTRÖM, RUNDGREN 1973, SZUJECKI 1983, ZICSI 1985).

Typically, the densities of earthworm associations of pine forests do not extend 40 individuals per m². The community abundance increases significantly when the moisture conditions in the soil are improved or when there are more than usual deciduous trees, owing to which better food (more easily assimilable litter) appears.

Pine forests, which the aforementioned five forests belong to are characterized by small numbers of *Lumbricidae* species, low density of their communities and the dominance of *D. octaedra*.

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STRESZCZENIE

[Tytuł: Dżdżownice (*Lumbricidae*) borów sosnowych Polski]

Badano zgrupowania dżdżownic w borach świeżych wchodzących w skład pięciu kompleksów leśnych. Stwierdzono występowanie czterech gatunków *Lumbricidae*. Gatunkiem dominującym była *D. octaedra*. Zagęszczenie analizowanych zgrupowań wahało się od 0 do 18 osobn./m². Z porównania z danymi innych autorów odnoszącymi się do zgrupowań *Lumbricidae* borów sosnowych Polski oraz Europy wynika, że istnieją pewne różnice w składzie gatunkowym i strukturze dominacji. Występują one w zgrupowaniach z borów sosnowych na nietypowych siedliskach i zależnie od wieku drzewostanu. Stwierdzane niekiedy zwiększenie liczebności dżdżownic w borach sosnowych należy wiązać z korzystniejszymi warunkami wilgotnościowymi lub pojawieniem się lepszego pokarmu w postaci bardziej przyswajalnej ściółki.

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