

INVESTIGATION OF SOIL ARTHROPODS IN THE KRAGUJEVAC BASIN, SERBIA

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ABSTRACT: During the period September-December 2004, material was collected from an oak forest in the Šumarice Park (Kragujevac). The abundance and diversity of soil arthropods were monitored, as well as factors that influence their variability. Separated from the material were members of Arachnida (Aranea, Acari, and Pseudoscorpiones), Myriapoda (Diplopoda and Chilopoda), and Insecta, including both: Apterygota (Protura, Diplura, and Collembola) and Pterygota (adults of Formicidae and Forficulidae; adults and larvae of Curculionidae, Carabidae, and Staphylinidae; larvae of Elateridae and Chironomidae; and larvae of other Diptera).

KEY WORDS: Soil fauna, Arthropoda, Apterygota, Pterygota, Serbia

INTRODUCTION

The soil system represents a complex of abiotic and biotic factors that influence the biological community. Optimal conditions for its survival are determined by temperature, moisture and depth of soil where it is present, and the soil structure and covering.

The aim of the present study was to investigate the dynamics of soil arthropods in an ecosystem such as an oak forest and determine which factors are crucial for their distribution.

Because field work is planned for a period of more than one year, we present here only preliminary results that will direct our further investigations.

MATERIAL AND METHODS

Investigations on the territory of Kragujevac (Šumarice Park), were performed in an oak forest, during the period September-December, 2004. The field work included monitoring of five different points, where we collected three samples each (20x20x20 cm), special attention being paid to maintenance of a regular time interval between sampling. Temperature of the air was measured, as well as soil temperature at a depth of 20 cm. Also, soil samples were taken for determination of moisture and pH, in the laboratory. There we used a Tullgren-Berlese apparatus to separate animals. The separated individuals were preserved in 70% ethanol until determination which was conducted to the level of family and order.

RESULTS AND DISCUSSION

During the given period, a total number of 70053.67 individuals/m² was collected, among which we established 16 groups of soil Arthropoda. The presence of Arachnida was 23.36%, Myriapoda 1.04%, Apterygota 70.32%, adults of Pterygota 1.65%, and their larvae 3.6% (Fig. 1). On the basis of these results, it can be concluded that members of Apterygota (Insecta) were the most abundant. Most members of orders of this group are part of the pedofauna and fauna of litter, confirming that detritophages play as important role in the functioning of forest ecosystems.

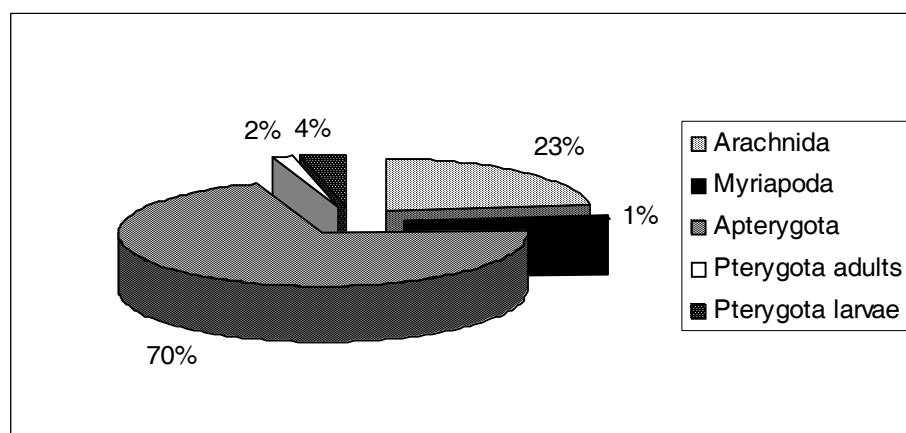


Fig. 1. Total abundance of arthropods in the period September-December, 2004

By comparative analysis of data for four months (September-December), it was established that variations of temperature (Fig. 2) and soil moisture (Fig. 3) influence the distribution of soil Arthropoda. Generally, deterioration of environmental conditions caused a decrease abundance of most groups of the followed organisms.

Determination of three orders of Apterygota was carried out. Among Apterygota, the most

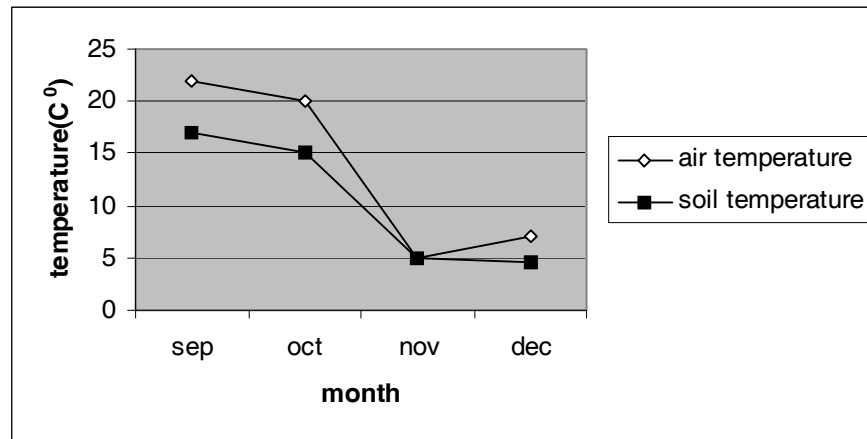


Fig. 2. Temperature diagram

numerous group was Collembola. Members of the following families of this order were found: Isotomidae (37.18%), Entomobryidae (13.79%), Poduridae (2.95%), Onychiuridae (8.7%) and Sminthuridae (0.54%). The total presence of individuals of the given order was 63.18%. These data confirm that collembolans are very dominant organisms, ones which can be used as an ecological indicator of the environment where they are present (DE BRUYN *et al.*, 2000). USHER (1970) reported that vertical migration of Collembola during winter is in correlation with low soil temperature. Our results confirmed this fact, since factors other than temperature were not substantially changed.

Protura (6.38%) and Diplura (fam. Campodeidae – 0.6%, fam. Japygidae – 0.1%) are the

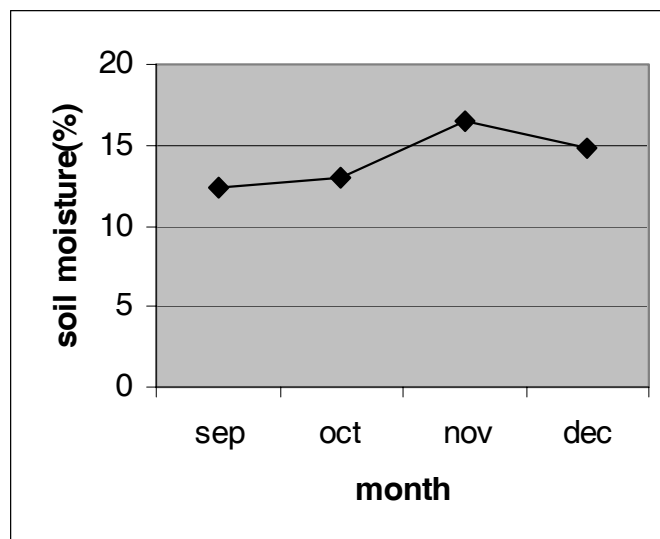


Fig. 3. Soil moisture diagram

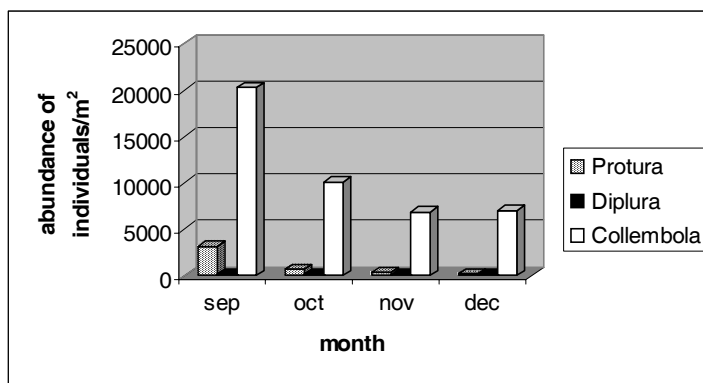


Fig. 4. Diagram of Apterygota abundance.

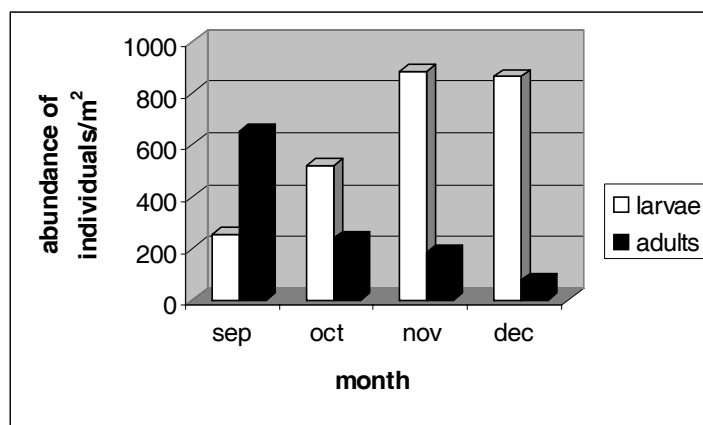


Fig. 5. Diagram of Pterygota abundance.

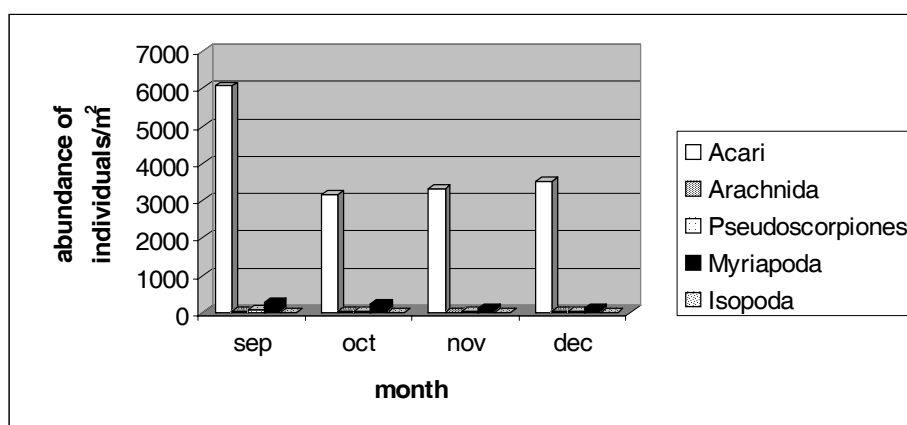


Fig. 6. Diagram of abundance of other arthropods.

other two groups of Apterygota, but the data show that they are distributed in smaller numbers (Fig. 4). These two groups have been less studied in our area (BLESIC, 1989, 1995, 2005).

The abundance of adult Pterygota decreased during the studied period, but that of larvae increased (Fig. 5). These changes are probably present because most insects start preparation for the winter season, that is, they lay eggs at different intervals, whereupon larvae appear. Among adults, we found members of the following families: Formicidae (1.59%), Curculionidae (0.01%), Carabidae (0.03%), Forficulidae (0.004%) and Staphylinidae (0.01%). These results indicate dominance of Formicidae. This can be attributed to the well developed pedologic layer (PETROV, 1986). Ants are very important members of all soil communities and the most abundant predators among invertebrates (PETROV, 1992). On the territory of our country, myrmecofauna has still been very poorly investigated.

Among larvae of Pterygota, Chironomidae stand out (1.51%). This state can be explained by increase of their number after oviposition. After that, in winter, their abundance slowly decreases, and in spring adults appear (FROUZ, 2001). During winter, after a rainy period, some of them gather around thin layers of lichens, which they use as food (DELETTRE, 2004). Other larvae are present in very small percentages: Curculionidae (0.09%), Carabidae (0.24%), Staphylinidae (0.57%) and Elateridae (0.53%).

Other arthropods of the soil fauna include the following: order Aranea (0.16%), order Pseudoscorpiones (0.25%), group Myriapoda (1.04%), and order Isopoda (0.02%). The most abundant among them are Acari (22.94%), which together with Collembola represent the dominant community (Fig. 6). From the viewpoint of biological diversity, they can be considered bioindicators of deterioration in biodiversity. They are also important as makers of humus in forest ecosystems (PETANOVIĆ AND STOJNIC, 1995). Since soil moisture did not change significantly, their vertical migration apparently is caused by decrease of temperature (MARAUN AND SCHEU, 2000).

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ИСТРАЖИВАЊЕ ЗЕМЉИШНИХ *ARTHROPODA*

У КРАГУЈЕВАЧКОЈ КОТЛИНИ

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Током периода септембар-децембар 2004. године сакупљен је материјал у храстовој шуми у Шумарицама (Крагујевац). Праћена је бројност, разноврсност земљишних *Arthropoda*, као и фактори који условљавају њихову варијабилност. Из материјала су издвојени претставници *Arachnida* (*Aranea*, *Acari*, *Pseudoscorpiones*), *Myriapoda* (*Diplopoda*, *Chilopoda*), инсеката и то: *Apterygota* (*Protura*, *Diplura*, *Collembola*) и *Pterygota* (имага *Formicidae*, *Forficulidae*; имага и ларве *Curculionidae*, *Carabidae*, *Staphylinidae*; ларве *Elateridae*, *Chironomidae*, и поред њих и осталих *Diptera*).

У овом периоду прикупљено је укупно 70053,67 јединки/m², при чему је установљено присуство 16 група земљишних *Arthropoda*. Процентуална заступљеност *Arachnida* износила је 23,36%, *Myriapoda* 1,04%, *Apterygota* 70,32%, имага *Pterygota* 1,65%, а ларви 3,6%. Код *Arachnida* најбројнији су били *Acari* (22,94%), а од *Myriapoda* представници рода *Geophilus* (0,41%). У оквиру *Apterygota* својом бројношћу су се истакле *Isotomidae-Collembola* (37,18%). Међу *Pterygota*-ма бројне су биле ларве *Chironomidae* (1,51%), док су од имага најзаступљеније биле *Formicidae* (1,59%).

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