

**RESEARCH ON THE FAUNA OF EARTHWORMS
(ANNELIDA: OLIGOCHAETA) OF SOKOBANJA**Jovana Sekulić^{1*}, Mirjana Stojanović², Tanja Trakić², Filip Popović², Gorica Cvijanović¹¹University of Kragujevac, Institute for Information Technologies Kragujevac, Department of Science, Kragujevac, Serbia²University of Kragujevac, Faculty of Science, Institute of Biology and Ecology, Kragujevac, Serbia

*contact author: jovanas034@gmail.com

INTRODUCTION

The most important biological component in the soil is microorganisms that make up 0.1 to 5% of the total organic matter of the soil. The activity of macrofauna in the soil, primarily earthworms, has a significant influence on their number and activity. Earthworms make up 12% of living organisms in the soil and, are one of the most important organisms of terrestrial ecosystems. They are often presented as bioindicators of soil quality (Klemens et al., 2003). It is important to note that different types of earthworms have different effects in the soil. The basic division includes three ecological forms: epigeic, endogeic, and anecic species. That is why it is extremely important to know their diversity, ecology and distribution. Although Eastern Serbia is generally considered to be well studied, there are parts that are not. There is very little data on the earthworms from this area. Therefore, the aim of this paper is to present new data on the earthworm fauna of Sokobanja and to summarize the published data. The list underlines earthworm diversity and provides a general overview of their distributions, zoogeographical positions, and ecological categories.

MATERIALS AND METHODS

The study was carried out in Sokobanja (between 43°38'N, 21°52'E), in the middle of the Balkan Peninsula. It is located at an average altitude of 400 meters. Sokobanja is located between the Carpathian-Balkan Mountains, Rtanj and Ozren. Through Sokobanja flows the river Sokobanjska Moravica. Also, it is located thermal and geothermal groundwater resources. The climate is moderate continental. Earthworms were collected using the diluted formaldehyde method complemented with digging (0.4x0.4 m²) and hand sorting as well as turning over rocks, debris and logs. Species identification and zoogeographic analysis were made according to the literature data (Mršić (1991), Csuzdi et al. (2011)).

RESULTS AND DISCUSSION

We analyzed a total 39 individuals, of which 28.21% were adults and 71.79% were juveniles. Starting from the total number of earthworms listed by Šapkarev (1980) and Stojanović (1996) and taking into account our research, the total number of earthworm species in Sokobanja comprises 7 taxa belonging to 7 genera. Classification of ecological categories and zoogeographic distribution type are shown in Table 1. Our analysis showed that almost all species are peregrines (six out of seven). The only species of *Dendrobaena byblica byblica* (Rosa, 1893) is Circum-Mediterranean. In our research, we found three new species for this area (*Aporrectodea rosea* (Savigny, 1826), *D. byblica byblica*, *Eisenia fetida* (Savigny, 1826)).

Extensive research on the flora and fauna of the Balkan Peninsula has indicated that this area is exceptional biodiversity (Griffiths et al., 2004). If we take into account that 54 species of earthworms were found in eastern Serbia (Stojanović et al., 2017), then the number species in Sokobanja is very low. However, the earthworm fauna of Sokobanja has been sparsely researched. Nevertheless, it is worrying that endemic species have not been found, and almost all are peregrines. On the other hand, living organisms provide the best reflection of the true state ecosystems and changes in them. The ecological form of each species provides reliable information about ecological and climatic conditions in the biotope in which the species lives.

The Lumbricidae fauna of Sokobanja, with several cosmopolitan species, is fairly uniform. However, the investigations are still insufficient and the earthworm inventory of Sokobanja is far from complete. Also, in order to protect the biodiversity, we need to increase our knowledge of biological diversity, especially considering its link to the soil functioning.

Table 1. List of the earthworm taxa with habitat, ecological category and zoogeographic type.

Species	Habitat	Ecological category	Zoogeographic type
<i>Aporrectodea rosea</i> (Savigny, 1826)	forest (authors' data, 4 exp., 30.04.2016.)	endogeic	Peregrine
<i>Bimastos rubidus</i> (Savigny, 1826)	under the rock (Šapkarev 1980)	epigeic	Peregrine
<i>Dendrobaena byblica byblica</i> (Rosa, 1893)	forest (authors' data, 1 exp., 30.04.2016.)	epigeic	Circum-Mediterranean
<i>Eisenia fetida</i> (Savigny, 1826)	forest (authors' data, 1 exp., 30.04.2016.)	epigeic	Peregrine
<i>Eiseniella tetraedra</i> (Savigny, 1826)	under the rock (authors' data, 1 exp., 30.04.2016.); forest (Šapkarev 1980); meadow (Stojanović 1996)	epigeic	Peregrine
<i>Lumbricus terrestris</i> Linnaeus, 1758	forest (authors' data, 1 exp., 30.04.2016.); meadow (Šapkarev 1980)	anecic	Peregrine
<i>Octolasion lacteum</i> (Örley, 1881)	forest (Šapkarev 1980); meadow (Stojanović 1996)	endogeic	Peregrine

ACKNOWLEDGMENT

This work was supported by the Serbian Ministry of Education, Science and Technological Development (Agreement No. 451-03-9/2021-14/200378 and 451-03-9/2021-14/200122).

REFERENCES

- Csuzdi, C., Pop, V.V., Pop, A.A., 2011. The earthworm fauna of the Carpathian Basin with new records and description of three new species (Oligochaeta: Lumbricidae). *Zoologischer Anzeiger*, 250, 2–18.
- Griffiths, H.L., Kryštufek, B., Reed, M., 2004. *Balkan Biodiversity. Patterns and processes in the European hotspot*. Kluwer, Boston/London, pp.357.
- Klemens, E., Stierhof, T., Dauber, J., Kreimes, K., Wolters, V., 2003. On the quality of soil biodiversity indicators: abiotic and biotic parameters as predictors of soil faunal richness at different spatial scales. *Agr. Ecosyst. Environ.* 98, 273-283.
- Mršić, N., 1991. Monograph on earthworms (Lumbricidae) of the Balkans I, II. *Slovenska Akademija Znanosti in Umetnosti, Razred za Naravoslovne Vede, Opera*, Ljubljana, 31, 1–757.
- Šapkarev, J., 1980. Prilog poznavanju kišnih glista (Lumbricidae) SR Srbije. *Zbornik radova faune Srbije*, 1, 165–179.
- Stojanović, M., 1996. Faunističko-ekološka studija Lumbricida (Oligochaeta) Srbije. Ph.D. thesis, Faculty of Science, University of Kragujevac, Serbia.
- Stojanović, M., Sekulić, J., Trakić, T., 2017. A nonparametric approach in quantifying species richness of Lumbricidae in East Serbia, Balkan Peninsula. *Turk. J. Zool.* 41: 487-494.