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THE TERRESTRIAL EARTHWORM DIVERSITY (*LUMBRICIDAE*) IN FRESHWATER LAKES' SURROUNDINGS

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Abstract: The diversity of the terrestrial earthworm community was studied at two freshwater lakes in Sofia. Eight earthworm species were found, most of them being widespread. Only two of the species are common in both of the lakes. The higher species number was recorded in the surroundings of the lakes. The size and the location of the lakes, the soil texture and the impact of the inundations of the lake surroundings are discussed as possible factors causing these differences.

INTRODUCTION

The coastal wetlands of the lakes provide diverse habitats for animals and plants (Gaudet 1974). The macroinvertebrates of coastal wetlands are an important food resource and contribute to the widespread use of wetlands (Jude & Pappas 1992). Despite the apparent importance of macroinvertebrates, comparatively little is known of their distribution and ecology in the freshwater lakes's surroundings in Bulgaria.

Soil macroinvertebrates are known to affect plant growth by enhancing mineralization of dead organic matter and modifying physical and chemical properties of soil (Bardgett et al., 2005; Lavelle, 2001). Within soil macroinvertebrates, earthworms are among the most important biotic components in the terrestrial ecosystems in terms of biomass and activity (Edwards, 2004). They have significant importance in mineralization and the breakdown of organic matter and formation of the soil structure and humus, thus providing maintenance of the soil fertility.

The earthworm diversity and activity are the key factors of the structure and function of every ecosystem (Garbeva et al., 2004; Lee, 1991; Wall et al., 2000). That's why the aim of our study was to investigate the earthworm diversity in the coastal wetlands of two freshwater lakes.

MATERIALS AND METHODS

Site Description

Boyana lake

Boyana Lake is a small semi-artificial lake, situated on the northern slopes of Vitosha Mountain, Western Bulgaria, at 1035 m above sea 1evel in oak forest habitat N 42° 38' E 23° 16'. It is situated in the Vitosha Natural Park, the first park of this kind in the Balkans.

The lake is a small ($V=5160m^3$; $A=5180m^2$) and shallow (Zmax=2.1 m, Zm=1 m) forest lake, fed by rain and groundwater, and the outflow is regulated by a small artificial channel. An ice cover, forming in mid-November persists until the end of March, and reaches a depth of up to 50 cm. The soil in the investigated area is leached cinnamonic forest soil with a slightly alkaline to acid reaction. The mechanical composition of the soil is with sandy clay texture.

Boyana Lake

Pancharevo Lake

Pancharevo Lake (total volume of 6465 x 106 m3) is an artificial lake in Western Bulgaria, at the end of the Pancharevo Gorge of the Iskar River, located at 600 m above sea level in oak forest habitat N 42° 36' E 23°24', between the Vitosha and Lozenska Mountains. It is 3 km long and up to 700 m wide, reaching a depth of 30 m, and is situated 12 km southeast of the capital city of Sofia, where the Vitoshka Bistritsa River flows into the Iskar. The climate is classified as a humid continental (humid with severe winter, no dry season with

a cool temperate moist forest biozone . The soil in the area is high in luvisols, cambisols (lv), soil with clay-enriched lower horizon, high cation exchange capacity (CEC), and high saturation of bases (FAO classification).

Pancharevo Lake

Sampling procedure

Pancharevo Lake and Boyana Lake's surroundings were chosen as sampling areas in the period between October 2010 and 2014. The samples were taken from different sampling sites, at equal distance from each other, 6 located at the Pancharevo Lake and 6 at the Boyana Lake's surroundings. The samples were collected by digging (0,4x0,4m quadrates) and hand sorting. Collected specimens were cleaned and immediately fixed in 4% formalin and transferred to 90% ethanol. Identification of species is done in accordance to: Blakemore (2004), Mršić (1991), Zicsi (1982), Šapkarev (1978), Csuzdi, Zicsi (2003) in the laboratory of Faculty of Science in Kragujevac, Serbia and in the Ecology laboratory of the Faculty of Biology of Sofia University, Bulgaria. All material was deposited in the *Oligochaeta* collection of the Faculty of Biology of Sofia University, Bulgaria.

RESULTS

In this study, the identification results of earthworm samples, collected in 6 different locations of the Pancharevo Lake and Boyana Lake's surroundings for five years, are presented. In all, 6 species belonging to 3 genera of Lumbricidae were identified.

The Boyana Lakes's surroundings showed a higher number of species, but lower number of individuals. That could be due to the more diverse type of the habitat and ecological factors, which in the half of the year are characterized with typical mountain climate conditions and in the other half of the year moderately-

continental. In 2010 these surroundings were exclusively inhabited by the species *Octolasion lacteum*. The species inhabits the mineral horizon near the soil surface and prefers moist soils (Kashian & Burton, 2000). Individuals of this species were found in each location during the whole investigated period for the first year (2010) of the survey. For 2011, 2012, 2013 and 2014 the prevalent were the *Aporrectodea* species, *A. caliginosa trapesoides* and mainly *A. rosea*, distributed in almost all of the sampling sites. *A. rosea* was the species found in every year of the investigation and the species with the highest number of individuals. 2010 was the year we registered the highest number of species and individuals in the Boyana Lake's surroundings.

Table 1. Number of collected individuals (*Lumbricidae*) for Boyana Lake's surroundings

Year / Species	**2010**	**2011**	**2012**	**2013**	**2014**
Immature	26	18	16	20	19
***Aporrectodea trapezoides* (Duges, 1828)**	2	6	4	2	
***Aporrectodea caliginosa caliginosa* (Savigny, 1826)**	3	3	3		1
***Aporrectodea rosea* (Savigny, 1826)**	3	5	4	6	8
***Aporrectodea jassyensis* (Michaelsen, 1891)**		1			
***Eiseniella tetraedra tetraedra* (Savigny, 1826)**	1		1		1
***Octolasion lacteum* (Oerley, 1891)**	7		3	4	3

In the Pancharevo Lake surroundings, we found only three species. These surroundings are exclusively inhabited by two of them – *O. lacteum* and *A. rosea*. The number of collected individuals of these species was equal during the whole investigated period of the survey. Every one of the identified species was distributed in all of the sampling sites.

Table 2. Number of collected individuals (*Lumbricidae*) for Pancharevo Lake's surroundings

Year Species	2010	2011	2012	2013	2014
Immature	29	18	26	20	19
***Aporrectodea rosea* (Savigny, 1826)**	13	5	8	6	4
***Eiseniella tetraedra tetraedra* (Savigny, 1826)**	1	5	8	4	6
***Octolasion lacteum* (Oerley, 1891)**	13	7	9	4	3

All recorded earthworm species are common in many habitats and widespread. The number of collected earthworms is higher around the Pancharevo Lake (96 mature and 112 immature individuals). This could be explained with the altitude, which is twice higher at the Boyana Lake, and the environmental conditions. Boyana Lake's surroundings are covered with snow more than 6 months of the year and provide a mountain forest climate conditions. On the other hand, the lower value is obtained in the Boyana Lake's surrounding with 71 mature and 99 immature individuals. The most abundant species of macroinvertebrates was *A.rosea*. This endogeic species shows really wide distribution. The habitat requirements resemble those *of A. caliginosa,* although, *A. rosea* prefers more stable humidity conditions and a higher humus content in the mineral soil (Hoser, 1994), which lake's surrounding gives. *A.rosea* is common across the region and its populations seem to be more evenly distributed around the both lakes in the humidity soil conditions.

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