Research Paper

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Structure of Testate Amoebae Communities (Amoebozoa, Rhizaria) in the Kamchia Reservoir (East Bulgaria)

Zoology

KEYWORDS : abundance, distribution, dominance frequency

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ABSTRACT

The present study aims to analyse the particular features of the distribution and ecology of testate amoebae in two types of substrata: macrophytes and sediment in different depths of the Kamchia Reservoir. By the mean of some basic indices for structure of communities, a characterization of the diversity of testate amoebae was made. Conducted analysis showed that the species diversity and abundance, as well as the dominants testate amoebae vary in different biotopes of the reservoir and is associated with the availability of optimal conditions for them. With at least species richness and abundance is characterized the phytal of the reservoir. The benthal has richer and stable testate amoebae communities.

Introduction

Testate amoebae are one of the main groups of single-celled organisms constantly present in aquatic biocenoses, which are characterized by their abundance, widespread distribution, and great diversity. The presence of a shell as a taxonomical feature, its polymorphism and the formation of specific complexes of constant and dominant species in diverse ecological conditions, their ability for rapid asexual reproduction make testate amoebae important indicators of environmental change. Studies by many authors showed that the diversity and the abundance of the testate amoebae in freshwater reservoirs are significantly associated with the habitat structure and environmental heterogeneity (Jax, 1992, Vikol, 1992, Schönborn, 1996, Alekperov & Snegovaya, 1999, Snegovaya, 2001, Patterson, Dalby, Kumar & Henderson, 2002, Velho, Lansac-Toha & Bini, 2003, Roe & Patterson, 2006, 2014, Mazey & Tsyganov, 2007, Kihlman & Kaupila, 2009, Lorencova, 2009, Kurina, Preis & Bobrov, 2010).

The present study aims to analyse the particular features of the distribution and ecology of testate amoebae in two types of substrata: macrophytes and sediment in different depths of the Kamchia Reservoir.

Materials and Methods

Studied area. Situated in the Eastern Balkans (26° 52‘ 11“ E, 42° 52‘ 11“ N; 253 m a.s.l), the Kamchia Reservoir is one of the big reservoirs in Bulgaria, with a water volume of 233,55 x 10^6 m^3 and a catchment area of 1612 square km. It is 28 m long and its width exceeds 2 km in some parts. Its average depth is about 15 m. Kamchia Reservoir can be defined as a reservoir with varying oligotrophic and mesotrophic characteristics, depending on the amount of biogenic elements and organic matter in its waters. The reservoir has an open water area, low banks and shallows, covered by sparse submerged vegetation (Ministry of Environment and Waters and the Ministry of Health, 2011).

Sampling and sample analysis. The samples were collected from 30 stations located in different parts of the reservoir. The places for sample collection were selected so that they encompassed both types of substrata: macrophytes (including submerged vegetation) and sediment in varied zones and depths of the reservoir. The stations were grouped in the following biotopes: I. Phytal – samples of *Myriophyllum spicatum* L. were collected from submerged vegetation from the littoral zone; II. Benthal – benthic samples at a depth of 1 to 22 m.

Eckmann's grab was used for the collection of the samples. The samples of aquatic vegetation were washed in distillated water. Half of each sample was fixed with 4% formaldehyde. The other half was kept alive for investigation in vivo. For each sample, five preparations of 0.1 cm^3 was studied after homogenization. The number of the testate amoebae found in it was calculated in specimens/cm^3.

Data analysis. The dominance frequency was calculated by the formula: DF=d/n x 100, where d is the number of samples in which one species dominates and n is the total number of samples. The following indices were used in the analysis of species diversity: McIntosh dominance (D), Pielou evenness (E), Margalef diversity (Dmg), Shannon diversity (H), Alpha diversity (α).

Results and Discussion

A total of 100 species and varieties belonging to 22 genera of testate amoebae were found in the studied two types of substrata of the Kamchia Reservoir.

The species diversity and abundance, as well as the dominant testate amoebae species vary in different biotopes of the reservoir and is associated with the availability of optimal conditions for them.

Analysing the results in biotopes we found out that the benthal was characterized by the greatest taxonomic diversity and abundance, presented of 94 species, 22 genera and average 2243 specimens/cm^3. In this biotope was registered and the highest variability in terms of number of species and specimens per sampling location - each station contained from 8 to 25 species and between 620 and 5560 specimens/cm^3 per station (Fig. 1). The phytal was characterized by lower taxonomic diversity and population density – only 52 species, belonging to 17 genera and average 597 specimens/cm^3 were found in it. The number of found species and specimens per station in the phytal varies considerably less – between 10 and 22 species and 180 and 1930 specimens/cm^3 (Fig. 1).

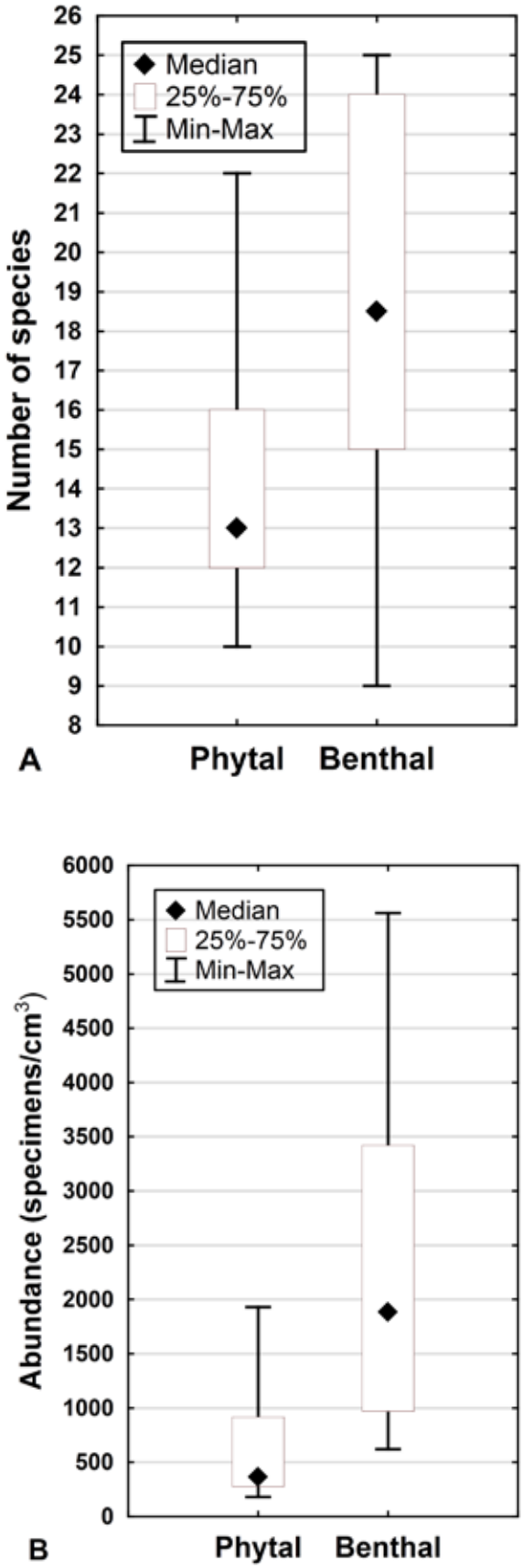

Fig. 1. Box plots comparing species richness (A) and abundance (B) of testate amoebae in different biotopes in Kamchia Reservoir.

The analysis of the results showed that only 16 of all 100 species found in the reservoir had an dominance frequency of more than 20% (Fig. 2). Ten of them were frequently dominating species (with dominance freguency equal to or higher than 25%). Their number was highest in the phytal and included seven species: *Centropyxis aculeata, C. aerophila, C. ecornis, Cyclopyxis eurystoma, Difflugiella horrida, Phryganella hemisphaerica* and *Trinema enchelys*. There were four dominant species with high frequency of occurrence in the benthal – *Corythionella georgiana*, *Euglypha rotunda, T. enchelys* and *T. lineare*. Only one species – *T. enchelys* dominate with high frequency in two biotopes at the same time.

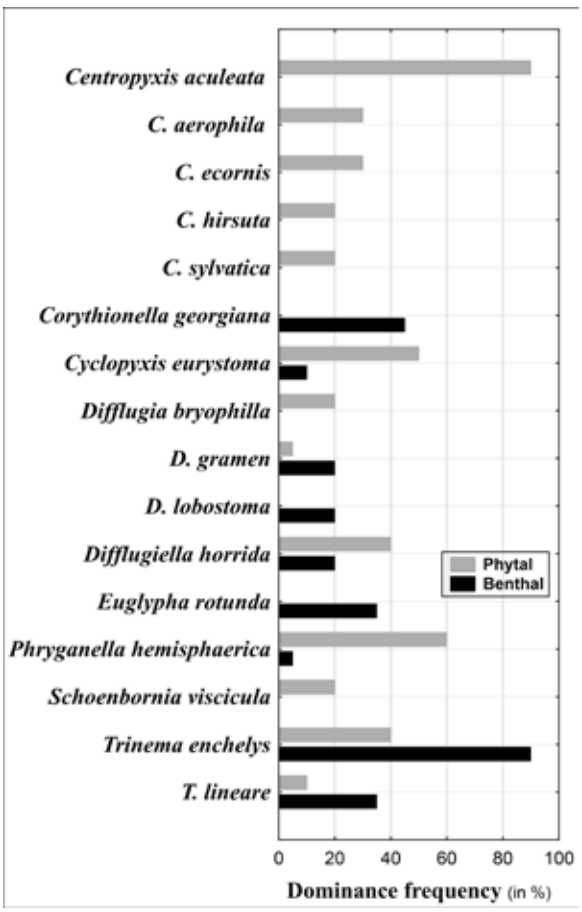

Fig. 2. Comparison between the testate amoebae with dominance frequency higher than 20% in the phytal and benthal of Kamchia Reservoir.

The use of certain indices to calculate the species structure of the communities enables us to assess the species diversity and abundance of testate amoebae fauna in the reservoir. The analysis of the values of indices by biotopes shows that the conditions for the development of testate amoebae are most favourable in the benthal (Table 1). The values of D and E indices there are lower and the indices of Dmg and H are higher compared with those in phytal. This biotope is characterized by greater species diversity, and most species have approximately the same number of specimens. The phytal of the reservoir offers less favourable conditions, and has a greater number of dominants, whereas the remaining species are less numerous.

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Table 1. Indices for structure of the communities in the studied biotopes of Kamchia Reservoir.

	Phytal	Benthal
McIntosh dominance index (D)	0.730	0.599
Pielou evenness index (E)	0.838	0.704
Margalef diversity index (Dmg)	3.561	3.775
Shannon diversity index (H)	1.716	1.836
Alpha diversity index (α)	13.699	16.116

According to Patterson and Kumar (2000) the communities which show a stable testate amoebae fauna have values of Shannon diversity index higher than 2.0 and even up to 2.5, as well as abundance of about 500 specimens/cm^3. In unfavourable conditions the values of the index are lower than 1.5. The authors also point out that in the most stable communities there is an even distribution of species neither of which is significantly dominant. In the reservoir, studied by us was established a great abundance of testacean, but the values of H, calculated for each biotope are low (Table 1). Similar lower values of diversity index of the testate amoebae in the sediments of different reservoirs are registered and by other authors (Trappeniers, Kerckvoorde, Chardez, Nijs & Beyens, 1999, Lorencova, 2009, Burdikova, Capek, Svindrych, Gryndler, Kubinova & Holcova, 2012). Taking into consideration the distribution of the number of dominants in different biotopes of the Kamchia Reservoir, as well as the values of H, which are very close to 2.0, we can assert that the benthal of the Kamchia Reservoir has rich and relatively stable testate amoebae communities. In confirmation of this statement are and higher values of Alpha diversity index in the benthal (Table 1). This is in accordance with the results of Alves, Velho, Simoes, and Lansac-Toha (2010) and Bobrov, Mazei, and Tiunov (2010) which indicate that, compared with the other habitats, aquatic sediments have highest values of α.

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