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Abundance and biomass of Cladocera (Crustacea) in Vaya Lake

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Abstract. The number and biomass of Cladocera in Vaya Lake during the period 2003 - 2007 was studied under the conditions of increased anthropogenic pressure. The total number of cladocerans by station and by species, as well as their biomass, was determined. A dendrogram of similarity in species and quantitative composition of Cladocera was made. St. 1 and St. 5 are distinguished by the equal and lowest abundance of *D. magna*, and the very similar and highest abundance of *M. micrura*. Stations 3, 4, 11, and 12 had the highest Cladocera abundances, which were mainly due to close *D. longispina* and *M. micrura*. St. 9, 8, 2 and 7 form one group with more than 83% similarity. They show similar abundances of *D. pulex*. The dendrogram of similarity in species composition and biomass for the cladocerans showed 75% similarity among all stations except st. 5, which clearly stands out with the lowest total biomass.

Key words: zooplankton, anthropogenic pressure, eutrophication

Introduction

The first studies on the invertebrate fauna of Vaya Lake were carried out by Valkanov, A. (1936). Zashev and Angelov (1958) made the first systematic studies of the lake and found that the species composition of the organisms living in it was limited in number, but instead their development was massive. Dimov (1967) made more in-depth studies on the seasonal and annual dynamics of the zooplankton biomass of Vaya and defined Vaya Lake as one of high productivity. The author found that in 1965-1966, Cladocera had the highest biomass. Later, Pandourski (2001) studied the zooplankton in Vaya Lake during the period 1999-2000 and reported the highest biomass in March 2000. Eutrophication in the basin is characterized by abundant zooplankton. In terms of numbers and biomass, Vaya Lake exceeds twice the values for Mandra Dam.

Material and Methods

A total of 167 quantitative plankton samples were collected. Quantitative zooplankton samples were collected by direct filtration of water (dm^3) through an Apstein-type mesh. Standard sampling methods for limnological practice in Bulgaria and worldwide were used (National Biomonitoring Programme of Bulgaria, 1999). Biomass was calculated on the basis of individual standard weights according to Chislenko (1968) and others.

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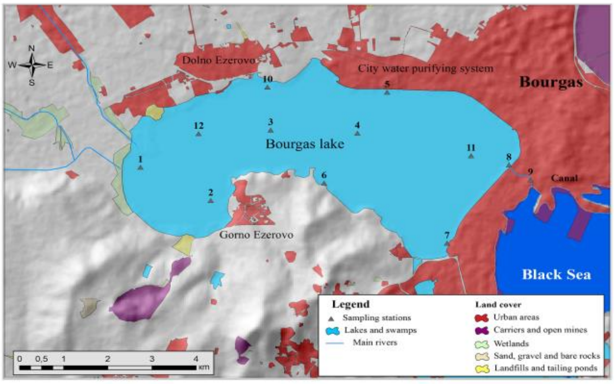
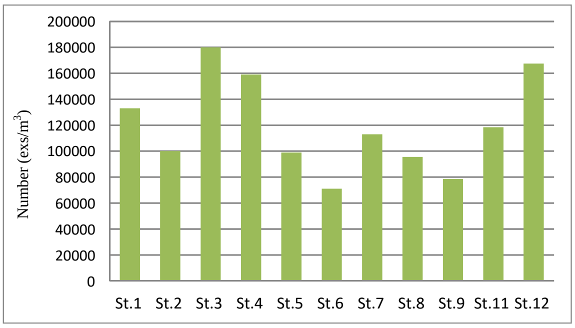


Fig. 1. Map of Vaya Lake with the number of stations.

Results and Discussion

The dynamics of the total number of cladocerans detected per station is presented in **Fig. 2.** The number of cladocerans by species is presented in **Fig. 3.**



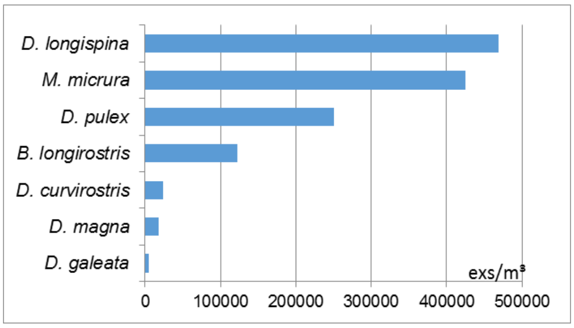
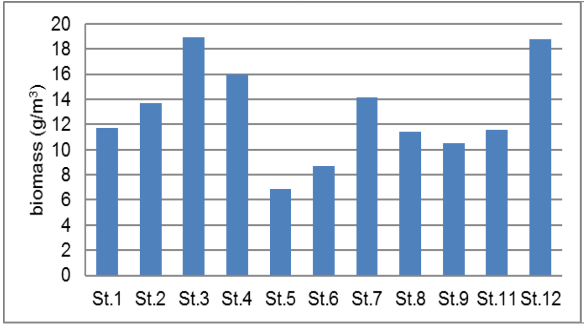


Fig. 2. Distribution of total cladocerans abundance by station (exs/m³).

Fig. 3. Total number of cladocerans by species (exs/m³)



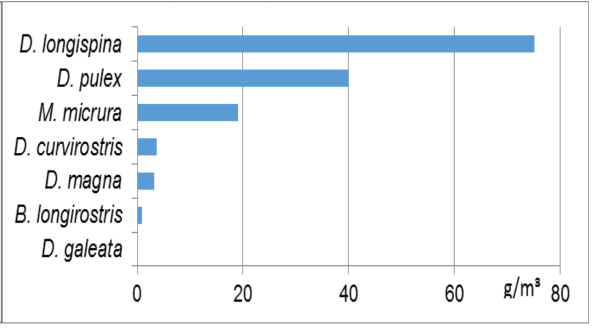


Fig. 4. Cladocera biomass dynamics (mg/m³) by station (mg/m³).

Fig. 5. Total biomass of Cladocera by species

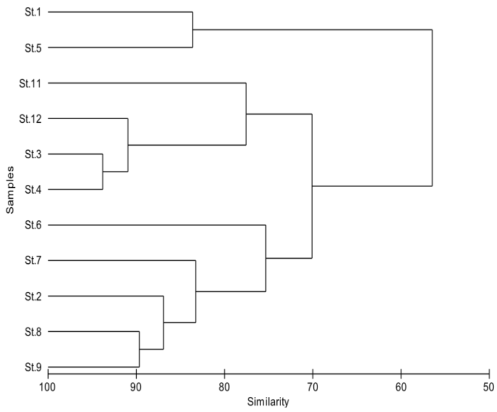
The total number is highest in the stations located along the central axis of the reservoir (3, 12 and 4), with the largest total number recorded in station 3, and the lowest in station 6 and station 9. The number in the central stations is about 2.5 times greater than that in the peripheral stations. Although the lake is generally shallow, the relatively deeper stations in the center create more stable conditions for zooplankter development. Peripheral stations are, on the one hand, shallower, and cladocerans in shallower locations do not have good pelagic refuges against predators (Irvine et al., 1990). On the other hand, they are in greater proximity to domestic and industrial impacts, which changes the chemistry at these points and this creates unfavorable conditions for some zooplankters.

In eight of the stations, the dominant species is *D. longispina*. The weakest representation is *D. galeata*, which was found only in autumn and not in all stations.

Rohrlack et al. (1999) experimentally established the toxic effect of *Microcystis aeroginosa* on *D. galeata*, and Lampert (1981) examined the inhibitory and toxic effect of blue-green algae on *Daphnia* sp. This negative influence of part of the phytoplankton probably affected the abundance of this species. According to Webster & Peters (1978); It is well known by Gliwicz & Lampert (1990) that a high concentration of filamentous forms of cyanoprokaryotes can affect the feeding of cladocerans, by clogging the filtering apparatus of the animals, which reduces the rate of capture and feeding and increases energy expenditure and thus reduces growth and reproduction. In this respect, Cladocera are more affected by copepods and rotatorians in lakes with a strong development of cyanoprokaryotes, such as Vaya Lake.

From Fig. 4 it can be seen that the largest biomass is reported in st. 3, 12 and 4. But the biomass by stations shows a change in relation to the number in relation to some of the stations. This is due to the greater participation in the biomass of large species such as *D. magna*. The ratio of species in relation to their participation in the total biomass changes, in relation to their participation in the number. From Fig. 5 it can be seen that *D. longispina* retains first place in terms of total biomass – 75.12 g/m^3. But while *M. micrura* was in second place in terms of numbers, in terms of biomass the second place goes to *D. pulex* (40.08 g/m^3), and *M. micrura* is in third place with a total biomass of 19.15 g/m^3, due to the smaller individual weight. *D. curvirostris* and *D. magna* displace *B. longirostris*.

A dendrogram was made for similarity in species composition and number of Cladocera (Fig. 6) as well as in species composition and biomass for all pairs of stations for Cladocera (Fig.7).



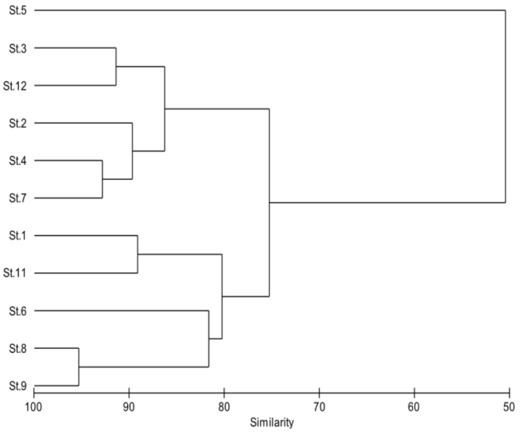


Fig. 6. Similarity dendrogram by species and quantitative composition of Cladocera (Bray-Curtis index).

Fig. 7. Similarity dendrogram by species composition and biomass of Cladocera (Bray-Curtis index).

In Fig. 6, two cluster groups are formed. The first includes item 1 and item 5 - with high similarity (83.6%). These two stations created specific conditions in which *D. magna* was found at the lowest abundance and *M. micrura* at the highest abundance. The low values of electrical conductivity and the possible predatory pressure on the large D. magna create the most unfavorable conditions for the existence of the species in st.1 and st.5. *D. galeata* is absent in site 5, in contrast to site 1, where this species was found with relatively the highest numbers.

The second cluster includes two subgroups. One is composed of stations 3, 4 and 12, which are 90% (very high) similar to each other in terms of species composition and numbers. The highest numbers of cladocerans are observed in them. The species *B. longirostris*, *D. longispina*, *D. pulex* and *M. micrura* occur in these stations with close values. Art. 11 joins this subgroup with about 77% similarity (high similarity on the scale used). *D.*

galeata is also present at this station, and *B. longirostris* was found in smaller numbers. In these stations, the most favorable conditions for the development of cladocerans are created. The second subgroup includes the remaining stations - 9, 8, 2, 7 with over 83%, i.e. high similarity. All these stations are peripheral, shallow and the living conditions for cladocerans are less favourable.

In Fig. 7, one large cluster is formed with two subgroups, between which the similarity is high (75%). The dendrogram shows a very high (85%) similarity between the stations in the first subgroup - 4,7,2,3 and 12, which have close values of total biomass. For these stations, the evenness coefficient (E) is high, with not very high species diversity (H) and a low dominance coefficient (C). The relatively high values of the biomass of these species in the mentioned stations are related, on the one hand, to the more favorable conditions for the life of cladocerans in the central and deeper stations, as well as to the fact that the biomass is of larger species, with more large individual weights, especially of *D. magna*. In these stations, high values of phytoplankton biomass were recorded in summer and autumn.

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