OLIGOCHAETA COMMUNITY AS INDICATOR OF EUTROPHICATION IN LOWER STREAM OF RIVER TISZA

N. Djukic, S. Maletin and B. Miljanovic

Djukic, N., Maletin, S. and Miljanovic, B. (1993): Oligochaeta community as indicator of eutrophication in lower stream of river Tisza . - Tiscia 27, 49-52.

Abstract. Analyses of Oligochaeta community in Backwater Tisza (during 1983-1991) and lower stream of river Tisza (from 1985 to 1991) established a rapid increase in number and biomass, especially for species which are indicators of eutrophic environment. According to relative abundance in Backwater Tisza, *Limnodrilus hoffmeisteri* (up to 50 %) and *Brachiura sowerbyi* (13 %) were dominants. Average annual number of individuals ranged from 88.8 (in 1983) to 12,457 (in 1990) ind/ m^2, and biomass from 0.3 to 29.15 g/ m^2. The significant increase of population density in river Tisza was stated upstream from the dam which is a consequence of slower flow and enrichment of substrate with organic compounds. Maximum number of individuals ranged up to 2,908 ind/m^2 and biomass up to 10.21 g/m^2 with predomination of genera *Limnodrilus* and *Branchiura* . Disturbed relationship in the structure of Oligochaeta community, rapid increase of individual number and biomass, and high rate of eutrophic species indicate a rapid process of eutrophication.

Key word: backwater, river-bed, population, density, biomass.

N. Djukic, S. Maletin, B. Miljanovic, Institute of Biology, Faculty of Sciences, University of Novi Sad, 21000 Novi Sad, Yugoslavia

Introduction

Scientists have begun to be interested in the problem of eutrophication of stagnant waters at the beginning twentieth century (Weber, 1907). Lots of papers have shown that eutrophication develops in large mountain lakes as well in Switzerland, Sweden, USA and other countries (Milbrink, 1980; Lang and Lang-Dobler, 1980; Lang and Hutter, 1981; Lang, 19484; Goldman and Byron, 1986). Investigation of Oligochaeta community and estimation of eutrophication in Backwater Tisza until 1987 are shown by Dukic (1989) indicating accelerated eutrophication process in this environment. However, hydrotechnical measures in river Tisza bed, as various regulations including locks and dams, slowering the water flow, decreasing the water quality and increasing eutrophisation process, too. In lots of papers it was clarified that the construction of reservoirs and other anthropogenic influences have caused changes in the bottom fauna (Petran and Kothe, 1975; Russev, 1982; Herzig, 1984; Djukic and Kilibarda, 1985). Therefore new assignments are posed to investigators including research on occurence of eutrophisation in rivers (Owens, 1970; Guseva and Anisimova, 1971; Kozova, 1974; Labutina, 1974; Chernogolovska, 1974; Lee and Jones, 1978; Sirenko and Gavrilenko, 1978).

Investigations of Oligochaeta community in this sector of Tisza valley are continued so this work gives insight to results obtained for stagnant and running water.

Methods

Samples were collected seasonally in 1983-1991 period for analysis of Oligochaeta fauna from Backwater Tisza and river Tisza (near the bank). Study site at Backwater Tisza is situated near Curug village, and those at river Tisza vere near Martonos (border profile), Novi Becej (dam) and Titel (at the mouth). Mud was taken by "Ekman-Bridge" dredge. Collected material was prepared in laboratory by American standard methods. Determination was carried out on live Oligochaeta specimens. Number

of individuals is given as average annual value per m^2 of surface examined, and biomass as fresh mass of specimens in g/m^2.

Results

Two families, Naididae and Tubificidae, and seven genera were identified by qualitative analysis of Oligochaeta community in Backwater Tisza. During the last three years of investigated period, eutrophic species dominated. According to relative abundance analysis, percent share of *Psammoryctides barbatus* decreased, and that of *Limnodrilus hoffmeisteri* increased up to 50 %. *Branchiura sowerbyi* species was not recorded in previous period, but it was found in further researches with average share of 13 %. All these data are in favour of conclusion that this river lake is rich in organic compounds and eutrophic (Fig. 1).

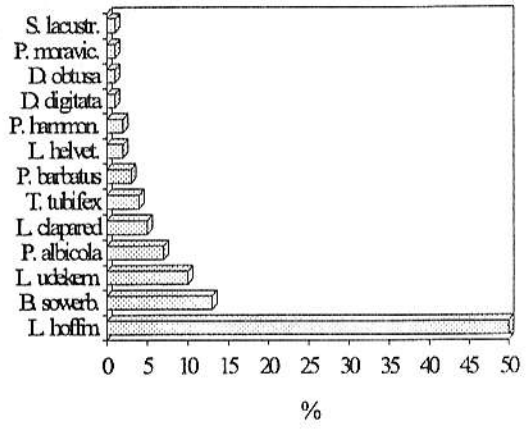

Fig. 1. Average percentage presence values of Oligochaeta species. Period: 1988-1990.

Examination of quantitative Oligochaeta share in benthic community shows distinct increase in number of individuals -- from 88.8 ind/m^2 in 1983 to 12,457 ind/m^2 in 1990 (Fig. 2). At the same time, biomasss ranged from 0.3 g/m^2 in 1983 to 29.15 g/m^2 in 1990 (Fig. 3). Number of individuals increased 141-fold, and biomass 97-fold, which is characteristic for eutrophic waters.

The differences between these extreme values are highly significant ($p<0.01$), as well as majority inter alia years, especially in consideration for first three years in relation to the next period.

In qualitative analysis of Oligochaeta community in lower stream of river Tisza, 16 species were found from 10 genera and 2 families, Naididae and Tubificidae (Table 1). Changes in percent share of certain species were noted on locality near Novi Becej, close to dam. On this section species from Tubificidae family are dominant from genera *Limnodrilus* and *Brachiura*. Percent share of these species ranges up to 50% in comparison to other species in the Oligochaeta community.

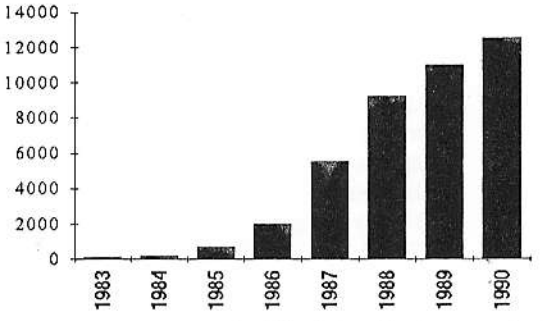

Fig. 2. Mean annual values (ind/m^2) of the Oligochaeta number in backwater Tisza.

The period of investigation (1985-1991) is characterized by visible increase of individual number. Extremely high values were found upstream from the dam. Maximum number ranged up to 2,908 ind./m^2 which represents 44-fold increase in comparison to results from 1976, and 4.3-fold in comparison to maximum value from 1984. At the same time, maximum average annual biomass was recorded in 1990 (10.21 g/m^2). These increases are also significant ($p<0.05$), particularly in comparison to values at the beginning (1985) and the end (1991) of studied period. The increased dynamics in number of individuals and biomass is discernibly connected to time when dam begun to function (Fig. 4 and 5).

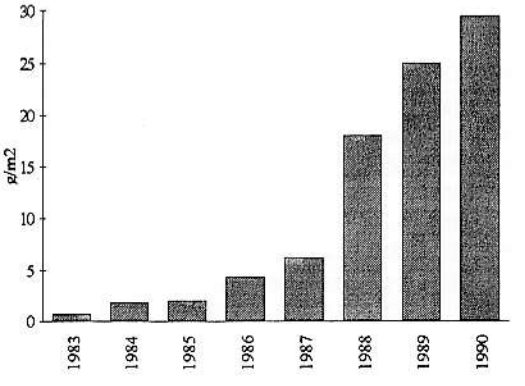

Fig.3. Mean annual values of the Oligochaeta biomass.

Table 1 Qualitative analysis of Oligochaeta in lower stream of river Tisza (1985-1991).

Species	Localities		
	Martonos	Novi Becej	Titel
NAIDIDAE			
Dero digitata	+	+	+
Dero obtusa	+	+	+
Nais communis	+		
Nais elinguis	+		
Paranais litoralis	+		
Uncinalis uncinata	+		
TUBIFICIDAE			
Branchiura sowerbyi	+	+	+
Limnodrilus claparedeanus	+	+	+
Limnodrilus hoffmeisteri	+	+	+
Limnodrilus udekemianus	+	+	+
Peloscolex velutinus	+		
Potamothrix hammoniensis	+		+
Potamothrix moldaviensis	+		
Psamorictides barbatus	+		+
Tubifex montanus	+		
Tubifex tubifex	+		+

Discussion

Oligochaeta community of Backwater Tisza was investigated as a very good indicator of eutrophication level (Djukic, 1989). In vicinity of backwater, agricultural fields are located, influencing nutrient content of the water, as well as increasing of primary and secondary production. Drastic increase of Oligochaeta number and biomass is a warning that equilibrium in the community is disturbed.

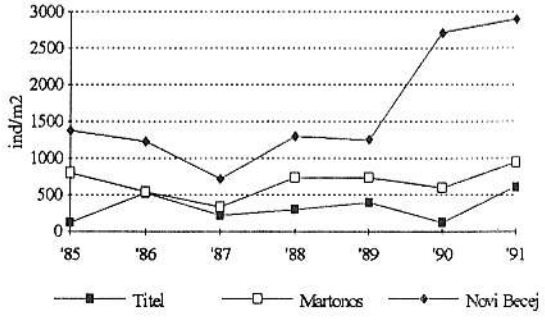

Fig.4. Mean annual values of Oligochaeta number

This highly productive ecosystem should be used more rational. It is suggested that planned stocking of benthophagic fish species (*Cyprinus carpio* and *Tinca tinca*) would enhance exploitation of this part of food resource. In that way, existing food chains, established by permanent introduction of planctophagic fish species as well as predators, would be supplemented.

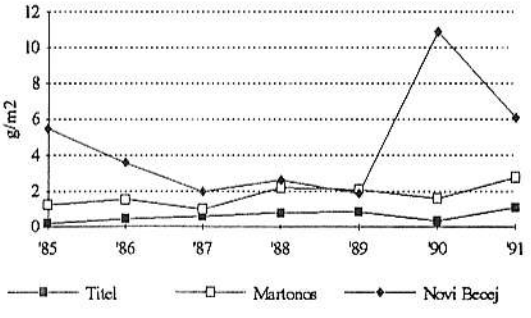

Fig. 5. Mean annual values of Oligochaeta biomass

First data on Oligochaeta from lower stream of river Tisza were published by Pujin and Maric (1961). They stated that river bottom was sandy and clayey with small amount of organic compounds and sparse number of Oligochaeta in bottom fauna. On the basis of complex physico-chemical and hydrobiological investigations, they concluded that this river was not polluted, water quality ranging within limits of ß-mesosaprobic, even oligosaprobic, during summer. Twenty years later Djukic and Kilibarda (1985) foun that dam, built in 1977, caused significant change in number of Oligochaeta individuals. Slower river stream and enrichment of

substrate in organic compounds contributed to intensive increase of individual number. At the same time, number of species found during the analyzed period has not changed significantly in comparison to former results (Djukic and Stanojevic, 1981, 1983; Djukic and Kilibarda, 1985). However, these species (from genera *Limnodrilus* and *Branchiura*) are very numerous in waters which are rich in organic compounds. According to Carroll and Dorris (1972), waters with slower flow and high organic compounds content are favourable for growth and development of *Branchiura sowerbyi*.

Disturbed relationships in Oligochaeta community structure, increase of number of individulas and biomass, and dominace of eutrophic species, are warning of accelerated process of eutrophication in studied water ecosystems.

Conclusion

Investigations of Oligochaeta community in Backwater Tisza during 1983-1990 and in lower stream of river Tisza from 1985 to 1991 show that this hydroecosystems have very accelerated eutrophication process. The significant increase of individual number and biomass was established in analyzed backwater, as well as in river Tisza upstream (near dam), which is consequence of slowed water flow and substrate enriched in organic compounds. In the whole research period, eutrophic Oligochaeta species dominated, therefore they are characteristic for this environment. This points to disturbance of biological equilibrium in this part of Tisza valley. Authors suggest that this backwater should be used more rationaly by increase of fish production of benthophagic fish species. All facts considered in the case of lower stream of river Tisza point out on disturbance of biological ballance and increased eutrophication process, especially in river part upstream from dam.

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