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CHANGES OF ZOOCOENOTIC STRUCTURE IN LOWER REACH OF RIVER TISZA

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Abstract. Hydrotechnical constructions on rivers Danube (Hydroelectric plant Djerdap I and II) and Tisza (Dam Novi Bečej), as well as general industrial development in the Tisza valley caused deterioration of physico-chemical quality of water of river Tisza. The slowing down of its flow and increased inflow of waste water led to a decrease in dissolved oxygen concentration and affected the structure of zoocoenosis. The number of zooplankton species characteristic of smooth waters and tolerant to oxygen depletion increased. These conditions affected, as well, both the composition of bottom fauna and ichthyofauna. Analysis of Oligochaeta community has indicated a sharp reduction in the number of species and decrease in the numbers. The abundance of sterlet and predator fish species has been decreasing as well as phytophils. A slow decrease in carp population occurred despite a permanent stocking with fingerlings. Special changes appear in fish community in relation to introduced species, especially Prussian carp. The decrease in dissolved oxygen concentration below biological minimum caused fish dying in recent years .

Keywords: zooplankton,Oligochaeta, ichthyofauna, hydroecosystem, degradation

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Introduction

The long-term investigations of the lower Tisza river have resulted in awareness of various changes of its physical and chemical properties concurrently affecting its zoocoenoses structure (Pujin and Rajković 1979, Djukić and Stanojević 1981, Kojčić *et al.* 1988, 1989, Pujin 1987, 1989, Djukić *et al.*, 1993). Since fish kills and death of other organisms have been reported frequently so far, the aim of the paper was to document structural changes of zoo*coeno*ses in the lower Tisza caused primarily by anthropogenic influence.

Material and methods

Investigations included the composition and dynamics of zooplankton, oligochaeta fauna, and ichthyofauna during the period 1990-1994. Sampling was done by use of standard techniques (planctonic nets, Ekman-Birge dredge, electro-fishing, and fishing nets) and standard methods (Felföldy 1980, American Standard Methods 1985).

Results and discussion

In the investigated period the qualitative composition of the zooplankton was as follows (Table 1.).

The analysis shows a total of 88 zooplankton species with an expected dominance of Rotatoria (Table 2.). Variations of the species numbers were associated with year, seasons, and locality resembling to some extent already published results (Ratajac 1979, Pujin 1989, 1992). Those investigations reported on changes caused by building a dam on the Tisza and hydroelectric power plant Djerdap I on the Danube that resulted in a slower water flow as well as an increased influence of waste waters.

Table 1. Qualitative composition of zooplankton of the lower Tisza in 1990-1994.

Species	1990	1991	1992	1993	1994
Protozoa					
Actinosphaerium eichhorni	+	+	-	-	-
Arcella vulgaris	+	+	-	-	-
Aspidisca costata	+	+	+	+	+
Carchesium polypinum	+	+	+	+	+
Chilodonella cucullus	+	+	+	+	+
Colpidium colpoda	+	+	+	+	+
Dileptus anser	+	-	-	-	-
Epistylis plicatilis	-	+	+	+	+
Paramecium aurelia	+	+	+	+	+
P. bursaria	+	-	-	-	-
P. caudatum	+	+	+	+	+
P. trichium	-	+	+	+	+
Tintinnidium fluviatile	+	+	-	-	-
Tintinnopsis lacustris	+	+	+	+	-
Tokophrya quadripartita	+	-	+	-	-
Vorticella campanulata	+	+	+	+	+
V. convallaria	+	-	-	-	-
V. microstoma	+	+	+	+	+
Rotatoria					
Anureopsis fissa	+	+	+	-	-
Asplanchna brightwelli	+	+	+	+	+
A. girodi	+	-	-	-	+
A. priodonta	+	+	+	+	+
Brachionus angularis	+	+	+	+	+
B. budapestinensis	+	+	+	+	+
B. calyciflorus	+	+	+	+	+
B. calyciflorus f. anureiformis	+	+	+	+	+
B. calyciflorus f. amphiceros	+	+	+	+	+
B. diversicornis	+	+	+	-	-
B. falcatus	+	+	-	-	-
B. forficula	-	+	-	-	-
B. leydigi	+	+	+	+	+
B. urceolaris	+	+	+	+	+
B. urceolaris var. rubens	+	+	-	+	+
Cephalodella cetellina	+	+	-	-	-
C. gibba	+	+	-	-	-
Colurella coluris	+	+	-	-	-
Dissotrocha aculeata	+	+	-	-	-
Epiphanes senta	+	+	+	+	+
Euchlanis dilatata	+	+	-	-	-
Filinia longiseta	+	+	+	+	+
F. opoliensis	+	+	-	-	-
Keratella cochlearis	+	+	+	+	+
K. cochlearis var. tecta	+	+	+	+	-
K. paludosa	+	+	-	-	-

Species	1990	1991	1992	1993	1994
K. quadrata	+	+	+	+	+
K. testudo	+	+	-	-	-
K. valga	+	+	-	-	-
K. valga monospina	+	+	-	-	-
Lecane bulla	+	+	-	+	-
L. luna	+	+	-	-	-
L. lunaris	+	+	-	-	-
Lepadella ovalis	+	+	+	+	+
Liliferotrocha subtilis	+	+	-	-	-
Mytilina mucronata	+	+	-	-	-
Notholca squamula	+	+	+	-	-
Polyarthra dolichoptera	+	+	+	+	+
P. vulgaris	+	+	-	-	+
Pompholyx complanata	+	+	+	+	+
Rotaria neptunia	-	-	+	+	+
R. neptunoidea	-	-	+	+	+
R. rotatoria	+	+	+	+	+
Synchaeta oblonga	+	+	-	+	-
S. pectinata	+	+	-	-	-
Trichotria tetractis	+	+	-	-	-
Trichocerca capucina	+	+	-	-	+
T. dixon-nuttalli	+	+	-	-	-
T. similis	+	+	-	-	-
T. weberi	+	+	-	-	-
Cladocera					
Alona quandragularis	+	-	+	-	-
Bosmina longirostris	+	+	+	+	+
Ceriodaphnia quandrangula	+	-	+	-	-
Chydorus sphaericus	+	+	+	+	+
Daphnia longispina	+	+	+	-	-
D. magna	-	+	+	+	+
Diaphanosoma brachyurum	+	-	-	-	-
Graptoleberis testudinaria.	+	-	-	-	-
Moina micrura	+	-	-	-	-
Macrothrix laticornis	+	-	-	-	-
Scapholeberis kingi	-	+	-	-	-
Copepoda					
Acanthocyclops robustus	+	+	+	+	+
A. vernalis	+	+	+	+	+
Cyclops vicinus	+	+	+	-	-
Diacyclops bicuspidatus	+	-	-	-	-
Eucyclops serrulatus	+	-	-	-	-
E. speratus	+	+	-	-	-
Eudiaptomus gracilis	+	+	-	-	-
Mesocyclops leuckarti	+	+	+	+	+
Thermocyclops crasus	+	+	+	+	+

Table 2. The number of zooplankton species according to analyzed groups.

Groups	1990	1991	1992	1993	1994	Total
Protozoa	16	14	12	10	10	18
Rotatoria	46	47	25	20	21	50
Cladocera	9	7	5	4	4	11
Copepoda	9	7	5	4	4	9
Total	80	73	48	37	38	88

Zooplankton composition, in the period under consideration, showed the occurrence of species characteristic of slower steams and more tolerant of alterations in oxygen status (Kojčić *et al*. 1988, 1989, Pujin 1987, 1989). The influence of water impound upon the structure of zoocoenoses was also reported for certain Danube sections (Pujin 1990, Gulyas 1994). Such a water control has resulted in an

increased threat of waste waters and, concurrently, significantly changing the zooplankton composition in the Tisza river.

Significant qualitative and quantitative changes were found in the Oligochaeta fauna of the littoral zone of the Tisza river. Oligochaeta was found in all the analyzed samples where they dominated when compared with other hydrobionts. Our earlier investigations of the qualitative composition of the Oligochaeta community in the period 1974 to 1984 showed the occurrence of 16 species from the two families (Djukić and Kilibarda 1985, Djukić *et al.* 1993). In the period 1990-1994 however, only 13 species belonging to two families were recorded (Table 3). In the whole period under consideration dominant species were *Limnodrilus hoffmeisteri* and *Branchiura sowerbyi*, the indicators of organic load and slower streams.

Table 3. Qualitative composition of Oligochaeta community.

	Period		
Species	1974-1984	1985-1990	1990-1994
Naididae			
Dero digitata	+	+	+
D.obtusa	+	+	+
Nais communis	+	+	-
N.elinguis	-	+	+
Paranis litoralis	+	+	-
Uncinais uncinata	+	+	-
Stilaria lacustris	-	+	-
Chaetogaster sp.	-	-	+
Tubificidae			
Branchiura sowerbyi	+	+	+
Limnodrilus claparedeanus	+	+	+
L.hoffmeisteri	+	+	+
L.helveticus	+	-	-
L.udekemianus	+	+	+
Peloscolex velutinus	+	+	+
Potamothrix hammoniensis	+	+	+
P.moldaviensis	-	+	+
Psamorictides barbatus	+	+	+
Iliodrilus perieri	+	-	-
Isochaeta michaelseni	+	-	-
Tubifex montanus	-	+	-
T.tubifex	+	+	+

Not only a reduced number of species, but also quantitative analysis have indicated a sharp decrease in the Oligochaeta numbers when compared with former periods. Mean annual numbers for period 1991 to 1994 ranged from 260 to 1,272 ind/m^2, while maximum was ten times as low as the average annual numbers in 1990 (Fig. 1). The phenomenon is associated with changes in the environment, representing a consequence of building dams which slow streams and increase matter deposits.

A quantitative analysis of the fish community including total catch data during the investigation period shows uniform annual values amounting approx. 100,000 kg/year. The highest percentage of the fish community belongs to lithophilous species (*Acipenser ruthenus*, *Barbus barbus*, and certain Abramidinae and Percidae), as well as *Carrasius auratus gibelio* with values exceeding 50% at certain sections. Qualitative analysis of the ichthyofauna structure shows certain changes when compared with the investigated period 1984 to 1988, primarily reflected by the reduction of numbers of certain phytophilous species such as *Esox lucius*, the majority of Cyprinidae, and certain Percidae possibly due to a constant reduction of the flood zone and low water level (Maletin *et al.* 1990). Also, a significant reduction of phytophils, as well as certain drop in numbers of *A. ruthenus* and *Silurus glanis* was reported (Djukić *et al.* 1994). The percentage of *C. carpio* in total catch was found to be 20%, decreasing slowly, despite a permanent stocking. It should be emphasized that these changes are less evident at the Tisza II section (from the river mouth to the dam near Novi Bečej) due to a greater stability of water level and larger flood zone.

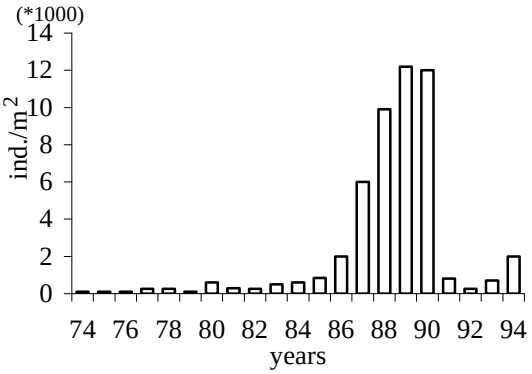

Fig. 1. Mean annual abundances of Oligochaeta community in river Tisza.

Both qualitative and quantitative changes in the fish community inhabiting the Yugoslavian portion of the Tisza are even greater when compared with the period 1974-1983. The average annual catch was app. 120,000 kg twenty years ago with significant mass percentages of *S. glanis* (27.49), *E. lucius* (13.42), *A. ruthenus* (10.28), and *Stizostedion lucioperca* (6.27). At the same time percentage of *C. auratus gibelio* amounted only app. 7% (Budakov *et al.* 1985, Table 4). In the past twenty years significant changes in sex structure, namely a constant increase in male percentage, was recorded in the population of Prussian carp.

Table 4. Structure of total catch in lower Tisza river (in %)

Period	*A. ruthenus*	*S. glanis*	*S. lucioperca*	*C. carpoi*	*E. lucius*	*C. auratus*	Other	Total
74-80	10.28	27.49	6.27	18.50	13.42	7.39	16.65	100
81-83	4.20	10.60	7.00	7.53	5.13	22.70	42.94	100
84-88	4.00	6.12	3.84	10.63	4.28	40.71	30.42	100
90-94	3.68	2.88	3.64	8.15	1.39	50.61	29.65	100

The majority of other introduced species showed a slow (*Ctenopharyngodon idella*, *Hypophthalmichthys molitrix* and *H. nobilis*), or a more rapid increase in their numbers (*Pseudorasbora parva*) during the investigated period. An exception was *Ictalurus nebulosus* characterized by locally dependent stagnation or slow decrease in population numbers.

From the biological and ecological aspects, such a distinct degradation of zooplankton structure, Oligochaeta community, and ichthyofauna, of the lower Tisza river is obviously due to an intensive influence of a complex of anthropogenic factors slowing streams and contributing to the water pollution. A culmination of the negative effect of the total spectrum of the abiotic and biotic factors upon the investigated zoocoenoses is recorded during summer (most frequently in August) when fish kill was regularly recorded in the past four years.

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