

DEVELOPMENTS IN THE COMPOSITION OF BIOCECENOSIS IN THE LOWER TISA RIVER (YUGOSLAVIA), CAUSED BY HYDROLOGICAL CHANGES

VLASTA PUJIN

Institute of Biology, Faculty of Sciences, Novi Sad

(Received September 22, 1988)

Abstract

The construction of the Hydroelectric Power Plant on the Danube and the dam on the Tisa at Novi Bečej have slowed down the flow of the river, thus causing certain changes in physical and chemical properties and in the composition of biocenoses. The saturation of oxygen decreased, BOD₅ increased as well as the concentration of ammonia ion, particularly in winter months.

In the composition of zooplankton, the number of *Rotatoria* species increased, as well as population densities of the dominant species. In the bottom fauna, the dominant group is *Oligochaeta*, represented by 10—16 species belonging to families *Naidae* and *Tubificidae*. There have also been certain changes in the composition of ichthyofauna. There is less sterlet, more predatory fishes and carp and generally less other fish.

Introduction

Research in the Yugoslav part of the Tisa river has been carried out for more than 20 years (MARIĆ, PUJIN 1962, 1969, STANOJEVIĆ, PUJIN 1973). The length of the period enabled us to point to some developments in the composition of biocenoses, caused, first of all, by certain hydrotechnical projects and other anthropogenic factors. The construction of the Hydroelectric Power Plant "Djerdap" on the Danube slowed down its flow rate, which could be felt all the way upstream to the Tisa's estuary. The construction of the dam at Novi Bečej the Tisa also made some hydrological changes which affected both the physical and chemical properties of the water and its flora and fauna. Some properties were positively affected, some were mostly unchanged and still others suffered negative changes (MILOVANOVIĆ *et al.* 1985, KOJČIĆ, STANOJEVIĆ 1985, PUJIN *et al.* 1984, PUJIN 1985, DJUKIĆ, KILIBARDA 1985, RATAJAC, RAJKOVIĆ 1985, BUDAKOV *et al.* 1985). The objective of this survey was to indicate some major developments in the basic hydrochemical parameters which brought about changes in certain components of biocenoses.

Materials and Methods

The material was collected from 1980 to 1986. The following physical and chemical parameters were studied: content of oxygen dissolved in water (O_2 mg · dm⁻³), saturation of water by oxygen ($O_2\%$), BOD₅ (O_2 mg · dm⁻³), COD (via $KMnO_4$ mg · dm⁻³) and ammonia ion NH_4^+ mg · dm⁻³). Of biocenological components, we studied the composition of zooplankton, bottom fauna and ichthyofauna. The methods applied were the currently used standard ones.

Changes in the Basic Chemical Properties

As already mentioned, the construction of the dams or storage lakes changes the hydrological regime, which affects water characteristics in various ways. With respect to the Tisa, their positive effect was detected in the improved clarity, due to the decrease of the amount of suspended mater. According to some previous studies, the lower Tisa water had been characterized by a high content of suspended materials (PUJIN, STANOJEVIĆ, 1979). In relation to pH, hardness, alkalinity phosphates, K and Na, no major changes were observed in the twenty-year period. Oxygen regime has increasingly deteriorated. Although the values varied in years, seasons and water levels, the amount of oxygen had been satisfactory in earlier years and saturation by oxygen was mostly between 80 and 90% (PUJIN, STANOJEVIĆ 1979, STANOJEVIĆ 1979). Now, this value is about 70%, and sometimes even less (Fig. 1). Seasonal

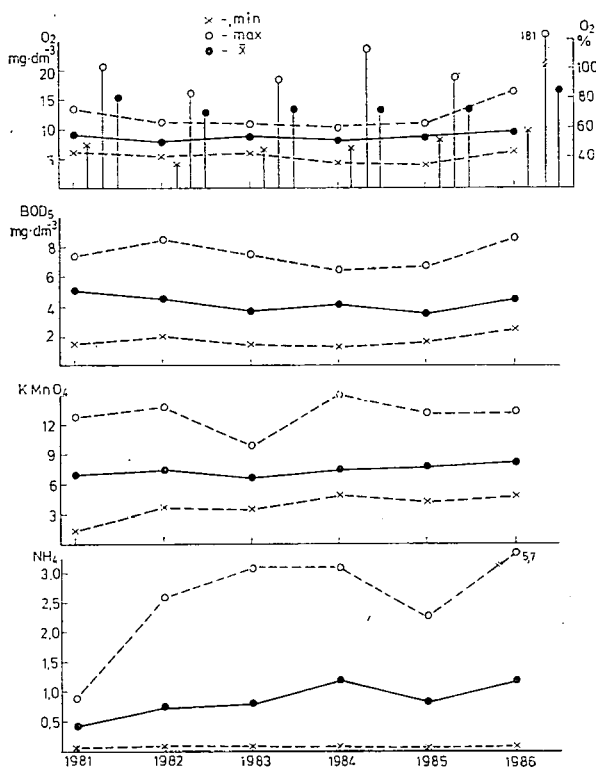


Fig. 1. Variations in the basic physical and chemical parameters in the water of the lower Tisa (1981—1986)

nal variations are evident, with particularly low values observed in summer and autumn (Fig. 2). This has recently caused massive fish deaths in certain sections, which had never happened in the Tisa before. Other chemical parameters, such as ammonia ion in particular, deteriorated. Its value in winter rises sharply (Fig. 2).

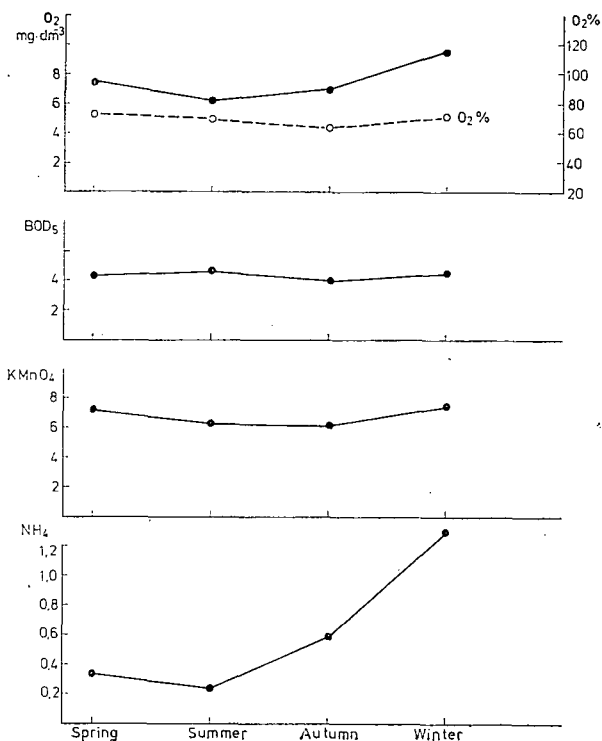


Fig. 2. Seasonal variations of the basic physical and chemical parameters in the water of lower Tisa (mean values for the period 1981—1986)

Changes in the Composition of Zooplankton and bottom Fauna

The main component in the zooplankton are Rotatoria, Cladocera and Copepoda. The most varied are Rotatoria and the number of their species varies in years and seasons. In the twenty-year-long period, it varied from 35 to 80. Until the construction of the dam at Novi Bečej, the number of species varied, on an average, from 35 to 40 (PUJIN, STANOJEVIĆ 1979, PUJIN, RAJKOVIĆ 1979, PUJIN *et al.* 1984). However, after the construction of the dam, the number of Rotatoria increased, and in the last several years it almost doubled. The species which had been present before remained, but new ones, typical of slow waters, appeared. The qualitative composition of Rotatoria is dominated, both in the number of species and in population densities, by several genera *Branchiounus*, *Keratella*, *Asplanchna* and *Trichocerca*. The others appeared in 1—2 species and a small number of individuals. This composition has also undergone certain changes in the percentage of the above mentioned genera. Before the dam was built, *Brachionus* had accounted for 27.1%, *Keratella* for 12.5%, *Asplanchna* 8.5, *Trichocerca* 6.3 and the others for 45.8%. After the dam was built, the *Branchionus* content declined and that of *Keratella* and *Trichocerca* almost doubled (Fig. 3). The content of the other species also decreased to some extent. There were no major changes in the composition of Crustacea (RATAJAC 1985).

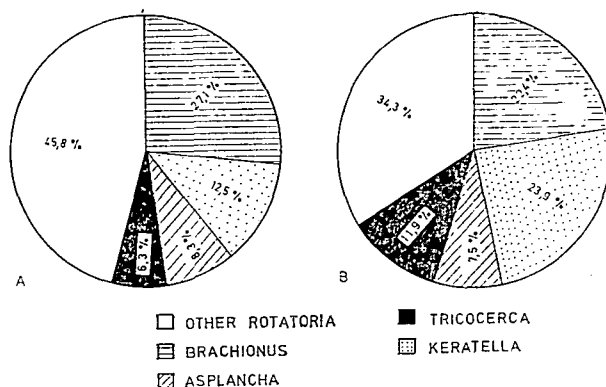


Fig. 3. Share of certain genres of Rotatoria in the qualitative composition of Rotatoria in the lower Tisa, before the construction of the dam at Novi Bečej (1974—1978, A) and afterwards (1980—1986, B)

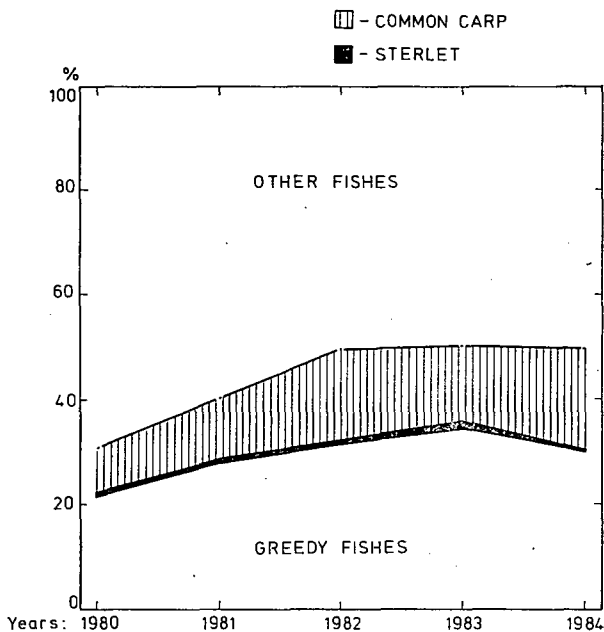


Fig. 4. Share of certain fish species in the structure of catch in the lower Tisa (1980—1984)

The river bed fauna is dominated by Oligochaeta. The number of species varies in years and seasons and ranges between 11 and 16 (DJUKIĆ 1979, PUJIN *et al.* 1984, DJUKIĆ, KILIBARDA 1985). Although the qualitative composition has not changed significantly, it should be emphasized that the number of individuals among the species of *Limnodrilus hoffmeisteri*, *Isochaeta michelsoni* and *Branchyura sowerbyi* increased. This is also associated with the slow-down of the flow and the increase in

the content of organic matter in the sediment, which is particularly important for the above mentioned species. It is necessary to note that *Branchyura sowerbyi* had not been observed in the Tisa before 1977 (DJUKIĆ 1983, DJUKIĆ, STANOJEVIĆ 1983).

The ichthyofauna in the Tisa has also been affected by the changes in the hydrological regime, probably also due to other anthropogenic influences (pollution, massive catch etc.). The fish typical of the Tisa was sterlet. However, it has accounted for only about 1% of the catch in the recent years. Predatory fishes (pike-perch, catfish, and pike) as well as carp are on an increase, while the others are disappearing. The increase in the number of predatory fishes and carp is also associated with stocking, which has been done in the Tisa for a number of years (pike-perch nests, young carp). The ratio of predatory fish and their prey is proper, with the growing the number of other fish declines, as they are mostly food for the predatory fish. The composition of ichthyofauna in the last 10 years has changed with the newly introduced fish from the Far East (*Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *H. nobilis*) which get into the Tisa in the process of stocking with young carp and also from fish-farms which use water from Tisa. These fishes have so far been well adapted to the conditions and have had a fairly good growth rate.

Conclusion

Based on the years of research in physical, chemical and biocenological properties of the lower Tisa, the following conclusions can be made:

The construction of the Hydroelectric Power Plant on the Danube and the dam on the Tisa at Novi Bečej have slowed down the flow of the river, thus causing certain changes in physical and chemical properties and in the composition of some members of biocenoses. The negative effect of these changes was observed in the oxygen regime and concentration of ammonia ion in the water. The saturation by oxygen decreased (on an average by about 10%), BOD₅ increased as well as the concentration of ammonia ion, particularly in winter months.

In the composition of zooplankton, the number of Rotatoria species increased, as well as population densities of the dominant species.

In the qualitative composition of Rotatoria, the dominant role is played by: *Brachionus*, *Keratella*, *Asplanchna* and *Trichocerca*. After the dam was built, *Keratella* and *Trichocerca* genera increased in numbers.

The compositions of Cladocera and Copepoda did not exhibit major differences.

In the bottom fauna, the dominant group is Oligochaeta, represented by 10–16 species belonging to families Naididae and Tubificidae. After the construction of the dam, the number of individuals of the species *Limnodrilus hoffmeisteri*, *Isochaeta michelsoni* and *Branchyura sowerbyi* particularly increased.

B. sowerbyi had not been found in the Tisa before 1977.

There have also been certain changes in the composition of ichthyofauna. There is less sterlet, more predatory fishes and carp and generally less other fish.

These changes are associated with those in the hydrological regime but also with other anthropogenic influences (pollution, stocking with fish, catch intensity etc.).

References

- BUDAKOV, LJ., S. MALETIN, D. KOSTIĆ (1985): Der Einfluss der Stauanlage auf die Fischfauna im unteren Theisslauf. — 25. Arbeitstagung der Int. Arbgem. Donauforschung, Bratislava 371—375.
- DJUKIĆ, N. (1979): Die Fauna der Oligochaeten in Uferregion der Theiss im Abschnitt Matronoš—Titel in den Jahren 1977—1978. — 21. Arbeitstagung der Internationalen Arbeitsgemeinschaft Donauforschung, Novi Sad 209—215.
- DJUKIĆ, N. (1983): Prilog proučavanju zastupljenost vrste *Branchyura sowerbi* BEDDARD (1891) u vodama Vojvodine (Contribution to the investigation of composition of the species *Branchyura sowerbi* BEDDARD(1892) in Waters of Vojvodins Province). — II Simpozijum o fauni SR Srbije, Beograd 63—66.
- DJUKIĆ, N., M. STANOJEVIĆ (1983): Physikalisch-chemische Eigenschaften und die Oligochaetenfauna der Theiss. — Tiscia (Szeged) 18, 59—64.
- DJUKIĆ, N., P. KILIBARDA (1985): Oligochaeta-Fauna im unteren Theisslauf in der Periode 1974—1984. — 25. Arbeitstagung der Internationale Arbeitsgemeinschaft Donauforschung, Bratislava 287—290.
- KOJČIĆ, K., M. STANOJEVIĆ (1985): Der Einfluss des Stauanlage auf die physikalisch-chemische Wassercharakteristiken im unteren Theisslauf. — 25. Arbeitstagung der Int. Arbeitsgemeinschaft Donauforschung, Bratislava 29—33.
- MILOVANOVIĆ, S., S. BELIĆ, A. VAJAGIĆ (1985): Hydrologische Veränderungen, die für die Wasserqualität eines Flusses nach dem Ausbau eines Stauwerkes von Bedeutung sind. — 25. Arbeitstagung der Int. Arbeitsgemeinschaft Donauforschung, Bratislava 350—355.
- MARIĆ, T., V. PUJIN (196): Ispitivanje stepena zagadjenosti nekih vodotoka Vojvodine (L'étude sur le degré de la pollution des cours d'eau de Vojvodina). — Zbornik Matice srpske za prirodne nauke, sv. 21, 39—73.
- MARIĆ, T., V. PUJIN (1969): Stanje zagadjenja vodnih tokova AP Vojvodine. — I Kongres o vodama Jugoslavije, Beograd 491—494.
- PUJIN, V., D. RAJKOVIĆ (1979): Die Rotatorien im unteren Theisslauf. — 21. Arbeitstagung der Int. Arbeitsgem. Donauforschung, Novi Sad 321—327.
- PUJIN, V., M. STANOJEVIĆ (1979): Hydrobiologische Untersuchungen des unteren Theisslaufs. — Tiscia (Szeged) 14, 131—138.
- PUJIN, V., RATAJAC, R., N. DJUKIĆ (1984): Zusammensetzung und Dynamik des Zooplanktons und der Bodenfauna des unteren Theisslaufs. — Tiscia (Szeged) 19, 79—87.
- PUJIN, V. (1985): Abundanz und qualitative Zusammensetzung der Rotatorien im unteren Theisslauf im Zeitraum 1974—1984. — 25. Arbeitstagung der Internationale Arbeitsgemeinschaft Donauforschung, Bratislava 310—314.
- RATAJAC, R., RAJKOVIĆ, D. (1985): Der Einfluss der Stauanlage auf die Dynamik und die Copepoda-Zusammensetzung im unterem Theisslauf. — 25. Arbeitstagung der Int. Arbeitsgemeinschaft Donauforschung, Bratislava 315—318.
- STANOJEVIĆ, M., V. PUJIN (1973): Beitrag zu Wassergüteuntersuchungen and der Theiss und ihren Nebenflüssen in Jugoslawien. — 16. Arbeitstagung der Internationalen Arbeitsgemeinschaft Donauforschung, Bratislava.
- STANOJEVIĆ, M. (1979): Physikalisch-chemische Kennzeichen des Wassers der Theiss im unteren Flusslauf in den Jahren 1977—1978. — 21. Arbeitstagung der Int. Arbeitsgemeinschaft Donauforschung der SIL. Novi Sad 341—347.

A Tisza alsó (jugoszláviai) szakasza biocönózisaiiban beállt változások a hidrobiológiai viszonyok változása következtében

VLASTA PUJIN

Egyetemi Biológiai Intézet, Újvidék

Kivonat

A vaskapui vízerőmű („Djerdap I”-Duna), valamint a törökbecsei (Tisza) vízlépcső megépítése által a Tisza folyásának lelassulása következtében beállt egyes fizikai-kémiai tényezők megváltozása, biocönózisok összetételének változását idézte elő. Nevezetesen az O₂ mennyisége csökkent, míg az OBF, valamint az ammónia-ionok mennyisége növekedett, elsősorban a téli hónapokban.

A zooplankton összetételében a Rotatóriák fajának számbeli gyarapodása, valamint domináns fajaik sűrűségének emelkedése volt kimutatható. A fenékfauna Oligochaeta csoportját a Naididae és Tubificidae család 10—16 faja képezi. Az ichtyofauna összetételében is meghatározott változás állt be. Amíg a kecsge létszáma csökkent, addig a ragadozó fajok és a ponty állománya növekedett, ami egyrészt a halasításnak tudható be.

Изменения в составе биоценоза в нижнем течении реки Тиса (Югославия), обусловленные гидрологическими изменениями

Власта Пуйин

Институт по биологии Естественного-математического факультета, г. Нови Сад

Резюме

Строительством гидроэлектростанции «Джердап» на р. Дунай, а также плота на р. Тиса у г. Нови Бечей, течение реки Тиса успокоилось, что повлияло на изменение некоторых физическо-химических характеристик, а также на изменения в составе биоценоза.

Содержание кислорода уменьшилось, а БПК₅ и ионов аммония увеличилось, особенно в зимний период.

В составе зоопланктона увеличилось количество видов *Rotatoria* а также и плотность популяций доминирующих видов. В фауне дна реки доминирующей группой является *Oligochaeta*, в которой наблюдается 10—16 видов из семьи *Naididae* и *Tubificidae*. Наблюдаются также некоторые изменения в составе иктиофауны. Улов стерляди уменьшился, а хищных рыб и карпа увеличился, что в некоторой степени является и результатом рыбоведения.

Promene u sastavu biocenoza u donjem toku reke Tise (Jugoslavija) prouzrokovanih hidrološkim promenama

VLASTA PUJIN

Institut za biologiju PMF, Novi Sad

Izvod

Izgradnjom hidroelektrane "Derdap I" na Dunavu, kao i brane na Tisi kod Novog Bečej došlo je do uspora toka Tise, što je prouzrokovalo promene nekih fizičko-hemijskih karakteristika, kao i promene u sastavu biocenoza. Sadržaj kiseonika se smanjio, a BPK₅ kao i sadržaj amonijum jona se povećao, naročito u zimskim mesecima.

U sastavu zooplanktona povećao se broj vrsta *Rotatoria*, kao i gustina populacija dominantnih vrsta. U fauni dna dominantnu grupu čine *Oligochaeta*, predstavljene sa 10—16 vrsta iz familija *Naididae* i *Tubificidae*. Takođe su zapažene izvesne promene u sastavu ihtiofaune. Ulov kečige se smanjio, a povećao ulov grabljivica i šarana, što je donekle i rezultat poribljavanja.