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DYNAMICS OF THE PRIMARY PRODUCTION IN ACCUMULATION "STREZEVO" IN THE REPUBLIC OF MACEDONIA

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Abstract

The level and dynamics of the primary production in accumulation "Strezevo" were investigated during the period from March until October 2009. Based on the obtained results from our investigation, the level of the primary production in the accumulation varies and indicates clear seasonal fluctuations. The highest level of the primary production was 9.29 mg/l water and was observed during the summer on the first investigated locality, where the river Shemnica flows into the accumulation, and the lower level was near the floodgate and was from 3.62 to 6.45 mg/l. During the autumn months the primary production level was higher in all profiles, mainly at the beginning of the accumulation and was 12.49 mg/l.

Keywords: *accumulation "Strezevo", primary production, water quality.*

INTRODUCTION

The research of the accumulation Strezhevo employed physico-chemical analysis of the water quality, as well as hydrobilogical, microbiological and ichthyological investigations. The goal of the research was finding a solution to the existing problem with the accelerated eutrophization of the accumulation lake Strezhevo through bilogical way, which means: improving water quality; inclusion of the excessive primary production into regulated processes of matter's circulation; reduction of the risk of unclean water penetration into the water supply system thus enabling permanent supply of quality drinking water for the population of Bitola City and the surrounding villages.

The water from the accumulation primarily used for watering the arable land in Bitola part of Pelagonia, in a great deal enables solving the problem of water supply of Bitola and the surrounding villages with drinking water. The use of the accumulation as a drinking water reservoir in great deal restricts the opportunities for direct action and demands solving the problem in a natural, biological way (without using chemicals and algaecides), with the use of biomanipulation methods. Biomanipulation is a practical biological method applied exactly in solving the eutrophization problem. In the last two decades this is a process that is intensively studied and applied with the goal of suppressing the development of macrophitae vegetation and plankton production in stagnant waters.

Biomanipulation can be defined as restructuring the biological communities with the goal of achieving favorable reaction, most often reduction of algae biomass and getting clean water. The term originally connects more techniques (Shapiro, 1990), however, today it is typically used when it comes to "top-down" manipulation with fish communities. For example, reduction of zooplantophaga and bentivora species or stimulation of piscivora species (Lammenes et al., 1990). Biomanipulation ought to be used in the theoretical context of two extremes of a stable equilibrium, as an extreme perturbation that requires elimination of the phitoplanktonic dominant state. Understanding of the nature and the mechanisms responsible for "turbid" water is crucial (important) if we want the biomanipulation to be successful. In the world literature it is suggested that only by sufficit of information it is possible certain fish community components to be part of biomanipulation. In principle, the goal of the biomanipulation in the accumulations is creation of a period of clean water in sufficient duration of time. For this purpose, it is the best the biomanipulation to be conducted in winter and in early spring, in order to create clean water as early as possible in the season.

The concept of biomanipulation is ingrained in the ecological theory and is based on the concepts of two alternative stable trophic states (Irvine et al., 1989; Scheffer, 1990; Scheffer et al., 1993). At high concentrations of nutrients the phitoplankton is abundant, the water is turbid, and in the fish community populations of zooplanktivora and/or bentivora species prevail. In Europe these populations are most often ciprinidae like *Rutilus rutilus*, *Alburnus alburnus* and *Abramis brama*. At low concentration of nutrients with high illumination in the clean water the submergeous macrophitae dominate, and in the fish community there is a high percentage of piscivora and planktivora-bentivora fish species, most often *Perca fluviatilis* and *Esox lucius* (Persson et al., 1991; Jeppesen et al., 1997).

In the state of turbidity, zooplanktivora fish directly influence enhancing the phitoplankton by reducing the pass pressure on the phitoplankton (Brooks & Dodson, 1965), whereas bentivora fish can resuspend the sediment and pump phosphorus, which influences development of algae, directly into the water column (Tatrai and Ištvanović, 1986; Breukelaar et al., 1994).

Biomanipulation can have dramatic effects on the ecosystem and not all of them can be predictable (Bendorf, 1992; Meijer et al., 1994a; Moss et al., 1996). Quite often discussions arise as to whether the biomanipulation is efficient or not (Reynolds, 1994). It is considered that there shouldn't be any doubt whether the biomanipulation works or not, but it is quite another question whether it is performable or not in a given situation and how it is performed. Many setbacks in biomanipulation presented in the literature are generally a result of bad planning, inadequate or wrong goal-setting, technical and nonecological limitations, as well as little knowledge of the processes (Martin et al., 1997).

By plannned stocking with fish and catching the fish the nutritive resources can be used rationally, and in the same time it is possible to significantly improve the water quality. In comparison with the other solutions offered this one requires means which are a negligible investment.

The field activities were organized in seasonal intervals, and special attention was paid in the critical months (June, July, August) with the goal of following the dynamics of changes in the accumulation. Also, more attention was paid to the ichthyological investigations oriented to determining: all the fish species that live in the accumulation; the rate of fish growth in length and in weight; the provision with food; the condition and the reproductive characteristics of fish.

MATERIALS AND METHODS

Determination of biomass, i.e. of the primary algae production in Strezhevo accumulation, was performed following standard methods for determining chlorophyll in algae (Standard Methods, APHA, 19^{th} Edition, 1995). The water was being taken from nine points (three points with three profiles – accumulation's middle, and both left and right banks). The samples of 0.5 l of water were concentrated in as short as possible time and the phytoplankton was isolated via membrane filtration using glass filter (Wathman GF/C), then the chlorophyll was extracted into acetone. The filter with the filtrate was macerated and centrifuged at 500 rpm in duration of 20 minutes. Then the extract was decanted and transferred into quartz kivettes for spectrophotometring. The corresponding absorbents with precisely defined wavelengths (662 nm and 644 nm) were read out on the spectrophotometer.

Chlorophyll *a* is a photosynthetic pigment specific to all green plants, both low-life (algae) and high-life (macrophyta). The role of the pigments, in the first place of the chlorophyll, is absorption of light and its transformation into chemical energy, and that's the base of the photosynthesis. The indirect method for determining the biomass i. e. the primary production of the low-life plants (phytoplankton), is determination of chlorophyll *a* whose content serves as a main parameter for algae's biomass.

RESULTS AND DISCUSSIONS

Data of the content of the chlorophyll *a* in the water of the Sterezevo accumulation during summer and autumn season are presented in Table 1.

Table 1. Chlorophyll *a* contents in Strezhevo accumulation (mg/l)

Sites		SI 1	SI 2	SI 3	SII 1	SII 2	SII 3	SIII 1	SIII 2	SIII 3
Season	summer	8.02	9.29	8.12	5.48	4.30	9.29	4.79	6.45	3.62
	autumn	8.97	9.31	9.12	10.21	10.00	10.26	12.29	12.49	12.20

The examined Strezhevo accumulation is an aquatic ecosystem of microphitic type, so that algae i.e. the phytoplankton are the main and only primary producers since macrophytic vegetation is not present at all.

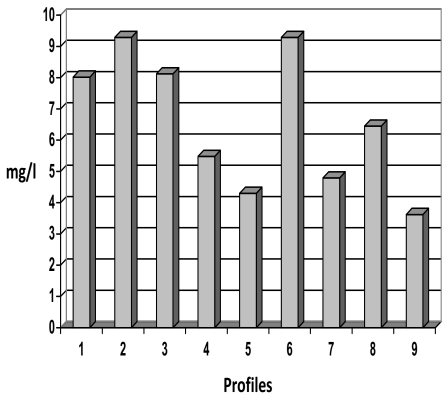

Figure 1. Chlorophyll *a* contents in Strezhevo accumulation in summer

From the Table (or the chart) it is evident that SI profile is of greatest productivity. At this point the river Shemnica flows in carrying various suspended matters of organic origin, this way burdening the accumulation. Here chlorophyll *a* content ranges up to 9.29 mg/l of water. At SII profile the primary production is something lower (5.48 mg/l and 4.3 mg/l) compared to the aforementioned profile, with significantly increased chlorophyll *a* concentration at the point SII3 (9.29 mg/l). The profile SIII, located at the dam, has something lower chlorophyll *a* concentration (from 3.62 to 6.45 mg/l).

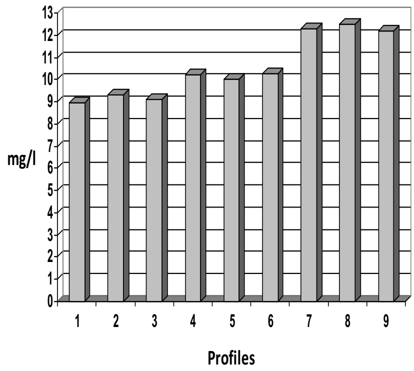

Figure 2. Chlorophyll *a* contents in Strezhevo accumulation in autumn

In the autumn period relatively higher chlorophyll *a* contents were registered on all three profiles, especially at the beginning of the accumulation by the water intake tower where the content of chlorophyll *a* is as high as 12.49 mg/l of water.

CONCLUSIONS

The present study presents results of the dynamics of the primary production in the accumulation Strezevo. In conclusions, the level of the primary production in the accumulation varies and indicates clear seasonal fluctuations. The highest level of the primary production was during the summer on the first investigated locality, where the river Shemnica flows into the accumulation, and the lower level was near the floodgate. During the autumn months the primary production level was higher in all profiles, mainly at the beginning of the accumulation.

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