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ECOLOGICAL EFFECTS OF RIVER SATESKA AND ITS TRIBUTARIES ON ANSCIENT LAKE OHRID

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Lake Ohrid,
River Sateska,
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Barbus m. petenyi Heck

SYNOPSIS

Our paper is focused on the quantification of different pollutants in the River Sateska, tributary of Lake Ohrid, and on the investigation of their impacts on the water quality of the lake and on the fish populations' health. Water quality is presented through following physico-chemical parameters: dissolved oxygen, biochemical oxygen demand, organic loading, and concentration of nutrients (total phosphorus and total nitrogen). The samples for analysis are done with a seasonal dynamics during 2000 - 2005, and categorization is according to OECD regulations, positive by law regulations of Republic of Macedonia. Investigations are done according to standard limnological methods. During the investigated period a total 25 specimens of *Barbus m. petenyi* Heck. from reservoir ,,Slatino" have been investigated using standard histopathological analysis. The microscopic analysis displayed presence of steatosis in the liver of barbel from locality Slatino, which could be normal finding in spawning period.

INTRODUCTION

Lake Ohrid is one of the oldest lakes world-wide and it is located isolated in a mountainous region. Several endemic species exist in flora and fauna and some of them are considered to be relics or “living fossils”. The wildlife inhabiting Lake Ohrid displays an endemic character due to the old age of the lake, and on the other side due to the previous disruption of links of this aquatic system with other such systems in this region, which fact contributed to the creation of a great number of evolution series of cognate species, subspecies and races by means of inlacustrine speciation in the lake (Stankovic, 1960). In 1980, the UNESCO declared the Macedonian part of Lake Ohrid as a “site of cultural and natural values of the global patrimony”

The watershed of Lake Ohrid belongs to three countries, Albania, Greece and Macedonia and covers more than 2000 km^2, including Lake Prespa. The surrounding mountains exceed heights of 2000 m a. s. l. Two thirds of the lake belongs to Macedonia, one third to Albania. The average depth of the lake is 164 m and the maximum depth is 289 m.

River Sateska is one of the most important rivers with watershed about 411,47 m^2 and it is not a natural tributary of Lake Ohrid. From the whole surface of the Ohrid Lake watershed, 39,36 % belongs to this river. Flowing directly to Crni Drim in the North of the lake, it was diverted to the lake in 1962 in order to reduce the sediment transport of Crni Drim and to facilitate the regulation of its discharge (Figure 1).

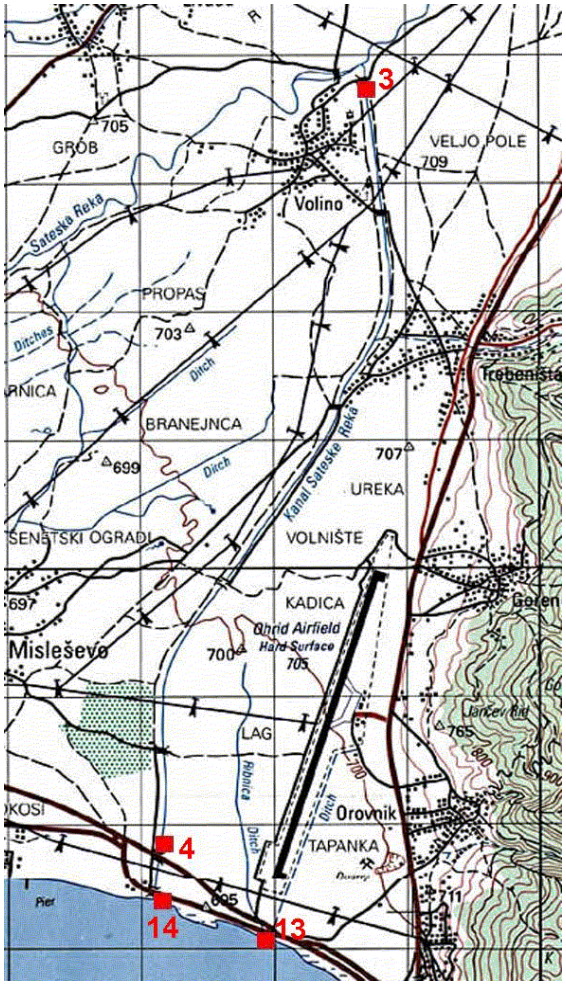

Figure 1. Downstream of the diversion between natural bed and artificial channel (by Herrman & Striebel, 2003)

The beginning of the watershed of River Sateska is in mountain area, but in the middle of the river and end of its' basen lies on lowland area. This river brings a lot of inorganic erozion drift. That river passes through agricultural land which is treated with chemicals and by the water they are drenazed in to Lake Ohrid.

The goal of this work is to show what the River Sateska and its tributaries means for the Lake Ohrid according to physical, chemical and biological parameters.

For the purpose of finding local hot spots of nutrient concentrations and health of barbell's fish population, sampling was done at littoral of Lake Ohrid, downstream of River Sateska and its tributaries, River Pesocka, River Mramorecka and reservoir "Slatino". The reservoir "Slatino", represents an artificial reservoir constructed on River Mramorecka, which further inflows in River Sateska. The maximum depth of the reservoir is 9,7 m and it encompasses an area of 0.28 km^2.

MATERIAL AND METHODS

According to investigated parameters dissolved oxygen was measured by Winkler method (Standard Methods, 1980, APHA-AWWA-WPCF), dissolved biodegradable organic matter was determined as KMnO4 consumption by Kubel-Tiemann titration. Total phosphorus was determined with spectrophotometrical method by Menzel & Corwin and Stricland & Parsons, on 885 nm. Organic nitrogen was determined by Kjeldahl method (Standard Methods, 1980, APHA-AWWA-WPCF), amonium-nitrogen by Solorzano, 1969, nitrogen-nitrite and nitrogen nitrate with spectrophotometrical method (Standard Methods, 1980, APHA-AWWA-WPCF).

In this study livers of 25 individuals of barbel (*Barbus meridionalis petenyi* Heck.) were examined. Fishes were collected during june-august 2001 from Reservoir Slatino. Each fish was dissected according to the following protocol: measurement of the fish length, dissection by opening the abdominal cavity, determination of the sex, dissection of the digestive tract and taking the liver in the end. Tissue specimens with diameter of 3-5 mm were fixed in 10% formalin and processed according to a standard paraffin procedure. The 5μm paraffin sections were stained with Hemalaun & Eosin method and approximately 2-4 sections of each individual fish were analyzed by light microscope.

RESULTS AND DISCUTION

During the investigated period 2000-2004 years concentration of dissolved oxygen depends of river's water flow. The highest oxygen concentration was registered in winter period 2003 (12,72 mg/l O_2), and the lowest was in summer period the same year (6,34 mg/l O_2) (Figure 2). This is a result of intensive oxidative processes and reduced inflow of fresh water.

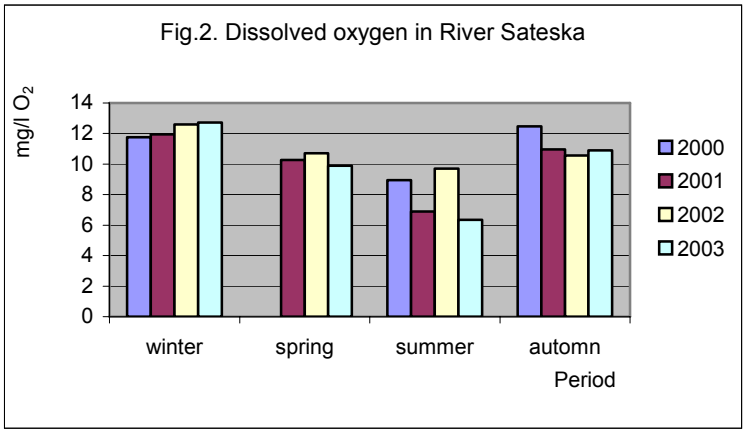

Figure 2: Mean seasonal values for dissolved oxigen in River Sateska

Opposite, about organic loading (Figure.3) the highest values were registered in summer periods. The highest concentration was registered in summer period 2000 (14,28 mg/l $KMnO_4$), and the minimal concentrations was registered in winter period 2002 (4,43 mg/l $KMnO_4$).

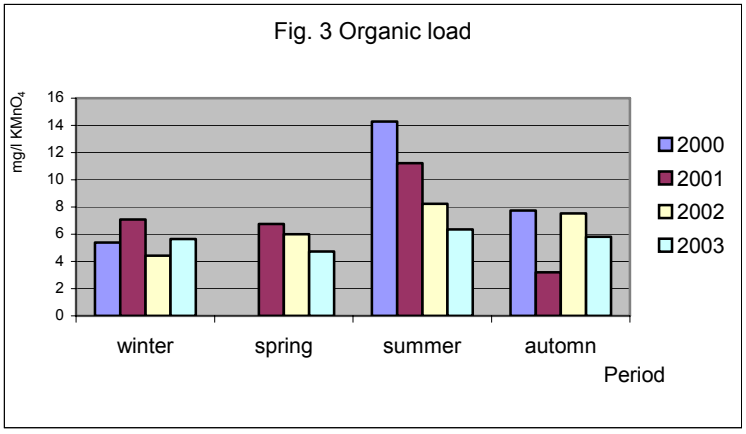

Figure 3: Mean seasonal values for demand of permanganat in water of River Sateska

Pictures 4 and 5 represent values for overloading the river's ecosystem with total phosphorus and total nitrogen. Four-years interval of total phosphorus was from 9,33 to 30,32 µg/l TP (Figure 4), while for total nitrogen was from 1371 to 407,54 µg/l. (Figure 5).

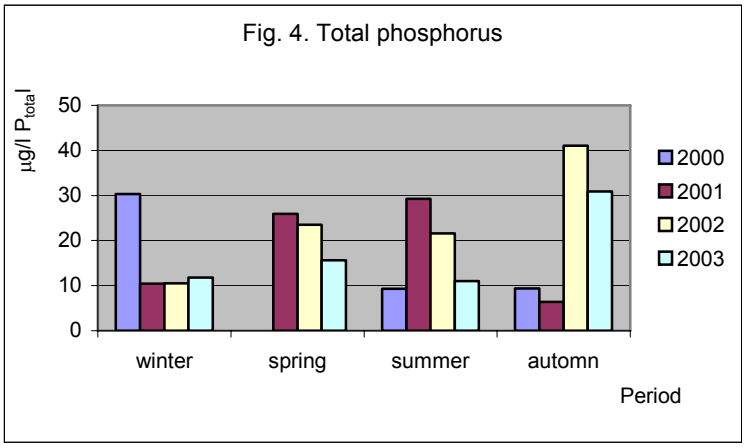

Figure 4: Mean seasonal values for total phosphorus in water of River Sateska

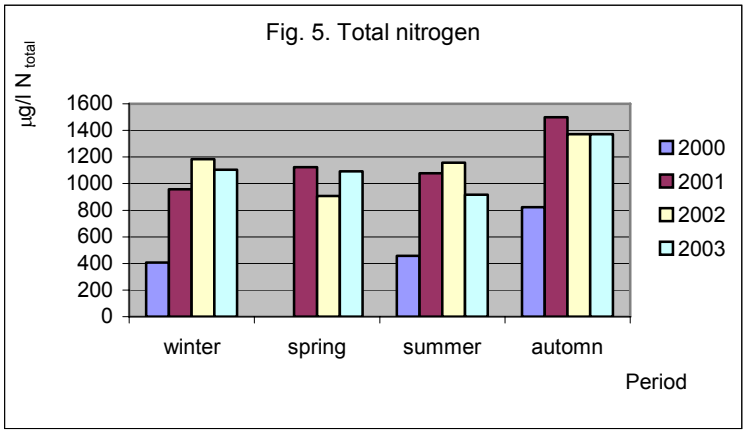

Figure 5: Mean seasonal values for total nitrogen in water of River Sateska

River Sateska passes through few villages with unsolved infrastructure, and through the agricultural land. Several small tributaries of River Sateska bring a lot of erosion drift in to the River, also. There are many sources of loading and is totally unexpectable which kind of pollution will be dominant. According to investigated parameters in the investigated period the water quality was between II and IV class.

Our results are showing minimal inflow in summer periods when the river is used for irrigation the agricultural soil. In other period of the year river has large amounts of water. One years water flow with River Sateska is 128,64 x 10^6 m^3/year. In the same period with average amount of suspended materials of 0,0145 g/l , with river are entered cca 1869 t of suspended materials.

The main pollution problem is the transport of suspended solids in the river and their discharge into Lake Ohrid (Herrmann & Striebel, 2003). The suspended solids are not heavily polluted, but they cause an increase of sedimentation rates near the

outlet. It is assumed that there are negative impacts on the reed and fish breeding zones (Djordjevic & Trendafilov 1996, Watzin et al. 2002).

The microscopic analysis of the histolological preparations obtained from the samples caught in this reservoir displayed a relatively normal histological picture of the hepatic tissue. The presence of steatoses changes in certain representative samples was evidenced which could appear as normal in period of spawning. According to certain investigations the high fats and glycogen content in hepatocytes is a common and normal occurrence in fish in the course of the spawning period and is in function of the normal hepatic metabolic activity (Talikina, 1985).

The transport of suspended solids into Lake Ohrid cause an increase of sedimentation rates near the outlet and they have negative impact to barbel health because the Barbus species is a typical benthophagous fish feeding on zoo benthos and plant. A number of other studies have reported changes in the liver of fish populations collected from littoral regions of Lake Ohrid (Roganovic-Zafirova & Jordanova, 1997; Velkova-Jordanoska, 2005). Analysis displayed a presence of parasite infestation and granulomatous inflammation on a level of hepatocelular parenchyme and cholangiofibrosis, bile duct proliferation and bile duct epithelium necrosis on a level of hepatic bile duct (Velkova-Jordanoska, 2002; Roganovic-Zafirova et al., 2003).

CONCLUSIONS

In the researching period, there are no significant changes in rivers water quality in comparation with previous researching period.

While oxigen parameters point out I, I-II class water, which is expected for such water system, nutrient and phosphorus loading point out water with II-IV class quality. This follows that loading of lake system by River Sateska is not for detraction as well as all warnings by experts for the activities that should be taken in that purpose.

Continuous loading with organic and inorganic material, during the whole period of diversing of River Sateska into the lakes basen has its own consequences. That is way, we concider that all planed movements for this river are in function for Ohrid Lake protection.

Although Lake Ohrid generally resists the negative influences of the anthropogenic factor for the time being, certain tributaries, like River Sateska, display loading with contaminants from the ground, especially in the course of the summer period. This implies the need of a greater seriousness in terms of protection of the lake and more efforts towards eliminating the constant sources of pollution.

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