The River Sateska And Conseqvences Of The Its Divergion To Lake Ohrid

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Abstract

The researches point out that the River Sateska is loading up the lake's ekosistem with 10% amonium nitrogen,12% nitric nitrogen, 53% nitrat nitrogen, or a sum of 29% total nitrogen in ralation of the quantity nitrogen which are within the water course, as the 39% of the total phosphorus brought by the water course. According to the microbiological parametars river water was II-IV class.

The goal of this presentation is to show what the River Sateska means for the Ohrid Lake according to phisical, chemical and microbiologycal parametars.

Categorization is according to OECD regulations, positive by law regulations of Republic of Macedonia and criteria by Kohl (1975).

Continued loading of organic and inorganic matter during the period since divergion of the River Sateska to Lake Ohrid had significant influence. Impact of the river water to the lake water was evident, so the lake water in front of the river mouth was I to II-III class with except III and IV class during the summer period.The great amount of silt are changing the shape of the litoral where the river inlet is.

Key words: Lake Ohrid, eutrophication, River Sateska.

River Sateska watershed

The River Sateska is the largest river in the Lake Ohrid watershed. Its river basin reaches arround 411,47 km^2. From the whole surface of the Lake Ohrid watershed, 39,36% belongs to this river.

The beginning of the watershed of River Sateska (figure 1) 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. According to the fact that river passes trough the agricultural land which is treated with chemicals which with drenazed water enter in it, so together they reach in the Lake Ohrid.There are few villages which are gravitating on this river which has unsolved comunal problems, so their waste waters contribute in River Sateska polution.

Ohrid valley till the XVIII century has been considerable more covered with woods.That enabled balance of its basen and less drift in this rivers watershed. Destroing of the woods time by time had taken bigger proportions and bigger amounts of material were taken by rivers basens, which was no longer small and homogenous, but inconstancy by sized and composition.That is the way of enlarging the level of the flow and basen of the only outflow river from Ohrid Lake, river Crni Drim as well as the lake it self.

River Sateska at one time passed east from vilage Misleshevo and flow into the Lake Ohrid .Due the unbalanced nature with enormic cutting the woods and river took more various materials, so time by time river took another course while flowing in Strusko pole. River opened new basen in this area and started to flow into the river Crni Drim.Same happened here. When this river covers up its' basen wich is made natural by flowing in village Velesta, it passes trough village Volino and openes another entrance in river Drim.(*Sibinovic , 1987).*

In 1961 the River Sateska has diverged it's river bed.It's mouth has changed from the River Crni Drim into the Lake Ohrid.

There are two measurement places for following the influence of River Sateska on the Lake Ohrid, river near to the mouth in the lake and the littoral in front of the same one. Becouse of the complexness of the problem in this research there are many years which are taken for discussion.That is the period from 1996 till 2003 which results are given as mean annual values.

Figure 1. Sateska watershed

Materials and methods

Hidrobiological Institute during the period from1996 till 2005, on the River Sateska, made some researches, according to the circumstances, continuously and periodicaly.

For investigation of water quality, there were many parameters wich were folowed.This is presentation of flow, oxygen parameters (dissolved oxygen, BOD_5 , permanganate demand) and nutrient elements as total N and P, from phisycal and chemical aspects, and as well as from microbiological aspect heterotrophic bacteria and a most probable number of coliforms (MPN).

For defining of all these parameters were used standard limnological methods. Chemicals which were used were with p.a. purenes.

Results and discussion

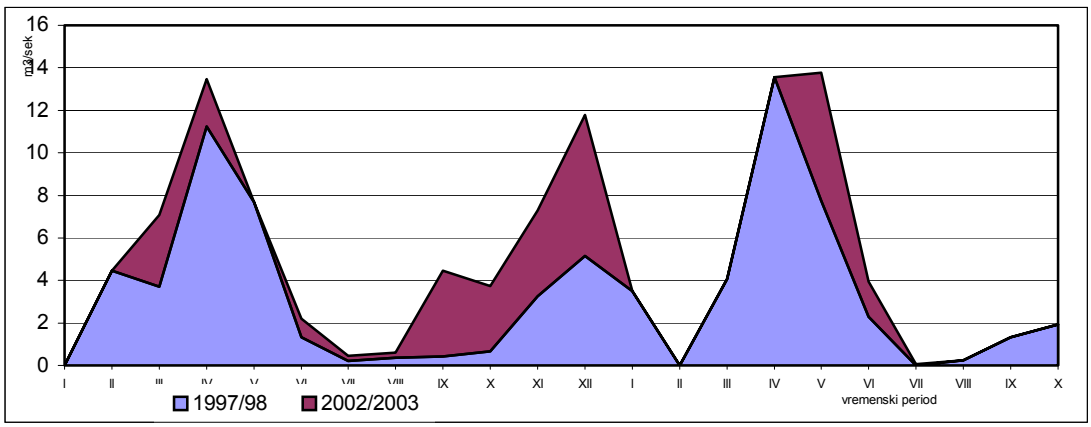

Figure 2. Average months water inflow

During the research, the water inflow of the River Sateska was performed twice (figure 2). This river never drying up. The obtained results are showing minimal inflow in summer periods when river water is used for irrigation the agricultural soil where it passes through.In other years periods river has large amounts of water. In this periods are noticed large amounts of drift which river takes into the lake. One years water flow with River Sateska, in researched period of 12 months, is 128,64 $*10^6 m^3$/year. In the same period with average amount of suspended materials of 0,0145g/ l in the lake, with river are entered cca 1869 t per year of suspended materials. It shouldn't be forgotten that the river during the summer period when it has smallest inflow, carries parts of chemicals which are used in modern agriculture (pesticides, herbicides…) which entered with drainaged water. Which are effects of the drifts which this river takes into the lake can be seen on the figure 3.

Figure 3. Mouth of River Sateska

In purpose to solve the problem with River Sateska , Institute for water economy of Republic of Macedonija in 1998 make a project for anti-erosive measures but unfortunatly becouse of the finansial problems was not realized.

From the day when the course of the River Sateska diverged into the Lake Ohrid, until nowdays, remains the dilema, does that decision and that action is the right one.There are opposite thoughts about the same, although in1998, project has been made and decision brought by the Government of Republic of Macedonia, for returning the River Sateska into it's old river bad.

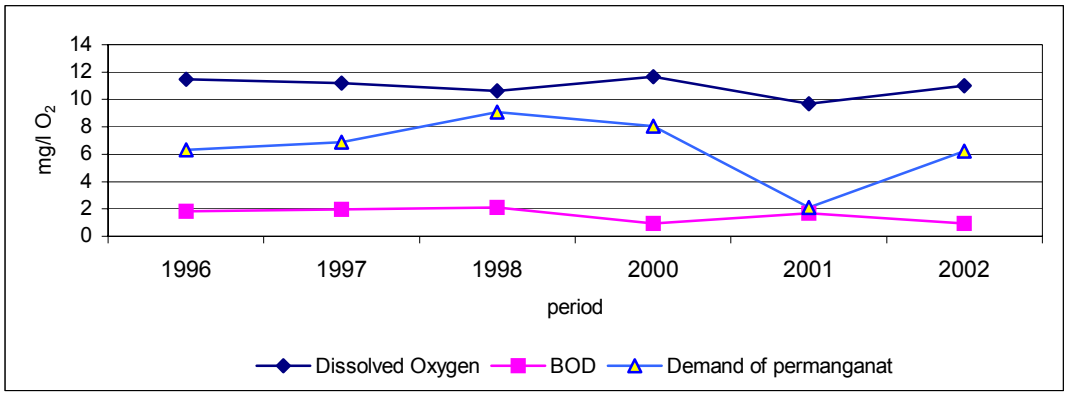

Figure 4. Mean annual values for dissolved oxygen, BPK_5 and demand of permanganat in water of River Sateska

Production and maintenance of life, as well as biochemical degradation of organic matters and chemical oxydation of organic waste are impossible in absence of oxygen.

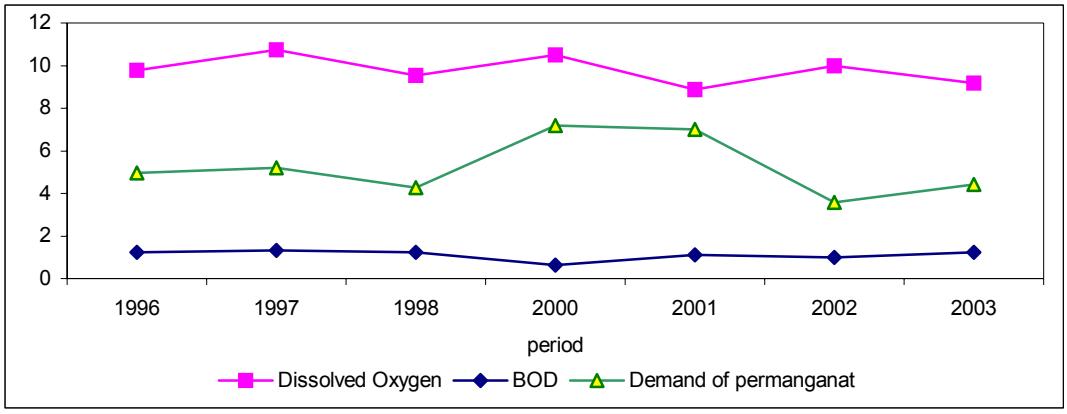

Figure 5. Mean annual values for dissolved oxygen, BPK_5 and demand of permanganat in water of Lake Ohrid Littoral.

Mean annual values for dissolved oxygen shows that river's water is very rich in oxygen. According to the biochemical demand of oxygen for 5 days and pergmanganate demand of oxygen (figure 4), the water of the River Sateska is in interval of I, I-II class by according to OECD regulations and positive laws regulations of Republic of Macedonia.

In the littoral region in front of the river there is already registered bigger organic overload which is aditionaly loaded with contaminents which enter the river water.

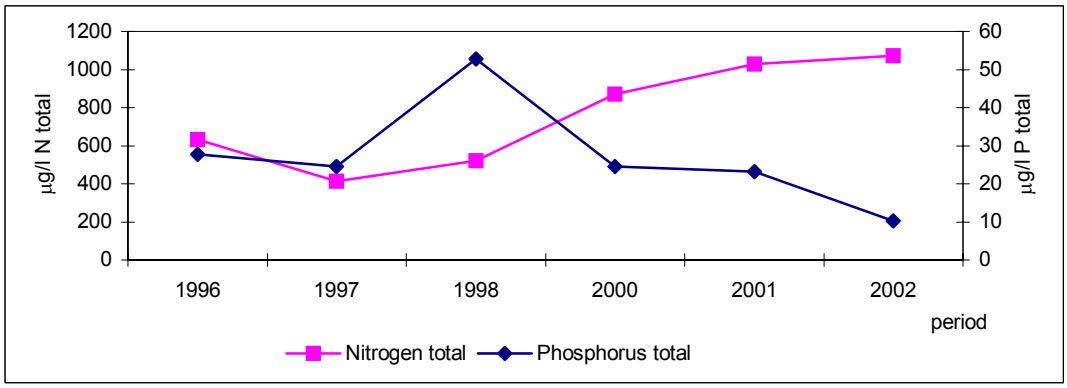

Figure 6. Mean annual values for total phosphorus and total nitrogen in water of River Sateska

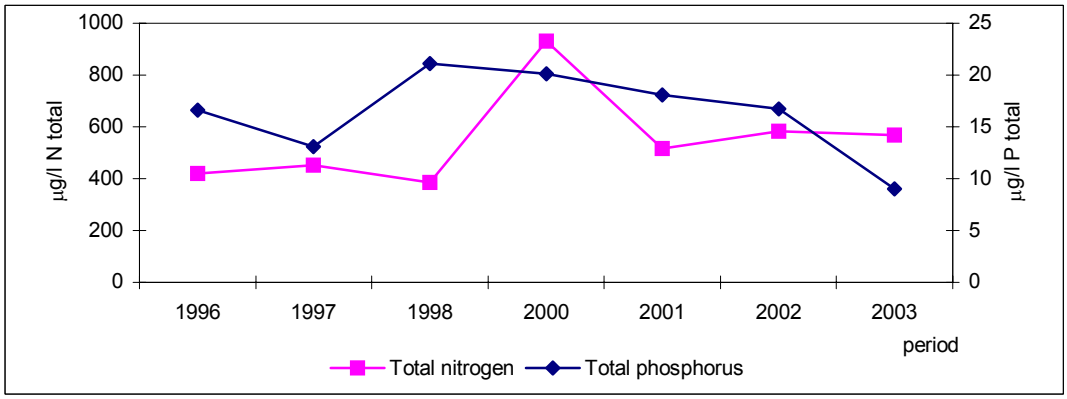

Figure 7. Mean annual values for total phosphorus and total nitrogen in water of Lake Ohrid littoral.

Picture 6 and 7 represent mean annual values for overloading of the river and the litoral in front of it with total P and total N. Interval of this median year values in river water is from 10.22 µg/l ('02) and reaches 52.81 µg/l ('98) for total P, while total N reaches from 393 µg/l ('97) to 1071 µg/l ('00). Lakes water , although in some smaller concentrations for P and N , still has no bigger deviations in rivers water quality. Here we can get totally different picture for caracteristics of the water of the river as well

as the litoral in front of it, as it recipient. So according to the results this water can be defined as water of II – IV class.

River Saterska , as it was mentioned , in its middle flows on rural area where agrculture is developed, so it is expected that situation with these nutrient elements, N and P is same as it was showed before. Bilances for total N and P shows the participation of River Sateska with 29% (136.1 t/year.) total N,(or with 10% amonium nitrogen,12% nitric nitrogen, 53% nitrat nitrogen) and 39% (5.7 t/year) total P in relation of whole amount of these nutrient elements which enters in Lake Ohrid from all water inflows in macedonian part (*M.Jordanoski 1999; E.V.Sarafiloska 2002*).

Microbiological researches are one more affirmation of validity of results from phisico-chemical researches.

According to the heterotrophic bacteria (figure 8) and categorization according to Kohl (*Kohl, W; 1975*), water in River Sateska in the period of research 1996-2000 is based to category of water with quality of II class, while in the other period is categorized in II- III class. Litoral zone among the River Sateska (according to Tumpling) belongs to first category, except in year 1996 where belongs to II category.

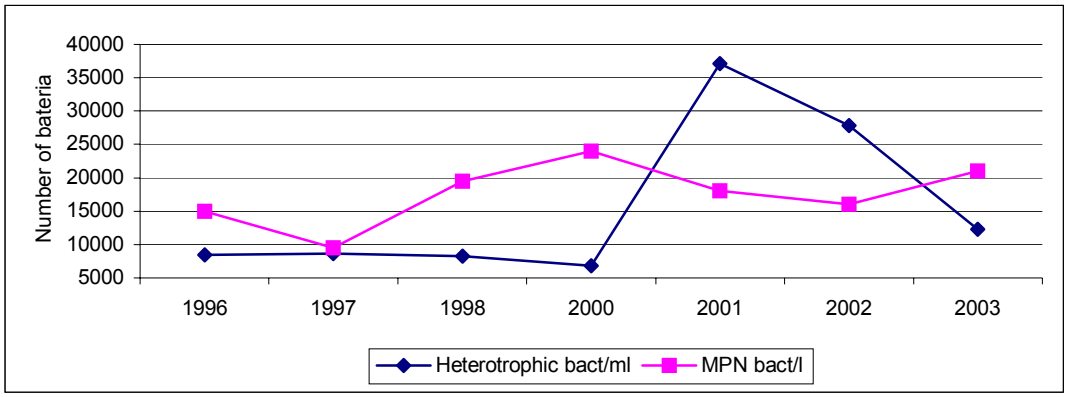

Figure 8. The number of heterotrophic bacteria (bact.ml^{-1}) and MPN in the River Sateska

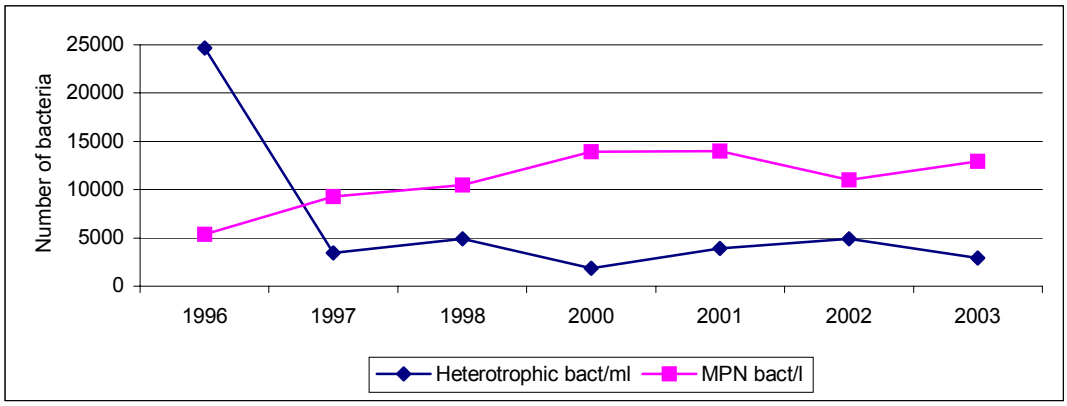

Figure 9. The number of heterotrophic bacteria (bact.ml^{-1}) and MPN in the littoral near River Sateska

The obtained results for the coliformic bacteria (figure 9) in whole research period, are showing that the rivers water is in interval of II category (period of '96, '97) while in the other period is in III category. By same categorization water of the lakes litoral belongs to II category. (*Pagnota*)

Conclusions

Results from long period researches confirm that quality of the river water there are not significanse changes in all investigation period.

Physical and chemical parameters shows that rivers' water quality is in interval of I to IV class.

According to the heterotrophic bacteria, during the investigated period, the lake water in the littoral region in the front of the River Sateska mouth was in I class. Water of River Sateska, except during the summer period (II,III), was in II class.

According to the presence of the coliform bacteria, the water of the River Sateska was in III and IV class. Impact of the river water to the lake water was evident, so the lake water in the front of the river mouth, during the summer period, was in III and IV class.

Evidented state in the littoral region in front of River Sateska mouth indicate that River Sateska, besides big amounts of deposits, brings large amounts of nutrients, that impact the trophic conditions to this region of Lake Ohrid.

For reduction of unbalanced drift has to realization of reforestation project on the flow of the River Sateska which will stop the unbalanced erozial drift too.

There is need of river bed decoration (hydrotechnical objects) which can provide acumulation of unbalanced amounts of erozial drift.

Continued loading of organic and inorganic matter during the period since divergion of the River Sateska to Lake Ohrid had significant influence. Therefore, intentions for rediversion of River Sateska in the River Crni Drim has validity.

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