MONITORING PROGRAMME OF WATER RESERVOIR *GRLIŠTE*

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ABSTRACT

The quality of surface waters is a very important problem incorporated in the enviroment protection, especially in water resourses. The Timok borderland hasn't got sufficient underground and surface waters. This is certificited by the International Association for Water Resourse. That was reason for building the water reservoir "Grlište". Drinking water from water reservoir "Grlište" supplies Zaječar and the surroundings.

Key words: drinking water reservoir, monitoring, water quality

INTRODUCTION

Water reservoir "Grlište" is used for providing drinking water and water sports and fishing.Water reservoir "Grlište" was build in 1989 - 1990.,from agriculture soil and rivers. Reservoir area is about 250 ha and its volume is max 11.000.000 m^3. Its depth is from 3 to 4 m at upper part from 20 to 22 m near the barrage of the reservoir. The water reservoir is formed from two rivers of Lenovac and Lasovo. Water amount is seansonly different in qualit and volume. Little amount of water in summer increse eutrophication processes--worse water qality.Reservoir basin area is 178 km^2 in this area, there are 4 villages.Waste waters from those villages merge into the reservoir. Agriculture soil is treated with pesticides and artifical trash, wich are chemical pollutans. The beginning of the water reservoir is at the confluence of the rivers of Lenovac and Lasovo. The banks are parthy agricultural soil, parthy forests and a small rocky parthy. The whole area is expased to erosion processes. There isn't sanitary safety region.
Since 1991.g. Institute for Health Protection -Timok Zaječar has beenanalysing the quality of water in the reservoir and the tributarys. Analysis of qality of water include physical, chemical, biological and microbiological analyses. Analytical results are used

for evaluation of water quality, for the changing parameters of quality and for the concentration of toxic waters.
We present analytical results obtained from a 10 years examination.Water quality is worse than years before. It is necessary to show eutrofication in reservoir water and keep quality of reservoir water and drinking water.In thiscase, Institute for Health Protection "Timok" Zaječar, with JKP "Vodovod" Zaječar and Biological Institut, PMF Novi Sad has started the project "MONITORING PROGRAMME WATER RESERVOIR "GRLIŠTE".

METHODS

Water reservior "Grlište" is one of the small numbre of reservoirs with continuos monitoring since 1991. g. Monitoring includes physicochemical, microbiological and biological analyses. Samples have been taken at three points: middle of the reservoir and at the rivers. Samples have been taken nce in a month, at some depth points (surface, 3 m, 5 m, 10 m,bottom).
Monitoring project includes great number of analyses. Great namber of analyses are taken once in a month, while some analyses are taken once in a season.

RESULTS AND DISCUSSION

The results of 10 years long investigations show that the water in the rivers of Lasovo and Lenovac is of poor qality.The quantities of iron,phosphates and sulfates appear periodically to a greater extent.Bacteriologically,coliformans bacterium are alwaus present,coliformans bacterium of the fecal originn as well as bacterium which reduce sulfate(clostridies).
As for the water reservoir itself,nitrogen,sulfates andorganic materies are registred to a greater extent,iron is present in each sample while mangan is present in some samples.At the water reservoir it is possible to make difference between two periods;winter and spring-when the water is of satisfying qality and the period of summer which lasts for five monts when the water is of less satisfying qality.
According to the so far incomplete examinations and OECD classification it is found that water reservoir"Grlište" is under the process of eutrophication. In this work,all the analysed parametres in the period of ten years are not going to be treated,the ones that aregoing to be treated are characteristic for establishing the level of trophity according to OECD classifications: the entire qantity of phosphorus,chl"a" and clearness.The quality of nitrogen that is brought into and its values in the exact water reservoir willalso be showed because nitrogen is also a limiting parametre for the development of algae and the increment of trophity. The analised values of these parametres are given partially in ables 2 to 13 for 1993, 1995 and 1999. The entire quantity of phosphorus and nitrogen are given as middle values of faund concentrations from the surfice to the 5 m dephe of water in water reservoir.The faound value for chl"a" in tables is given for the surface of 3 m and 5 m depth because of specifity. These three years are chosen as characteristic for the found values as well as for the long droughty period in 1993. and 1995. when its tributaries have been waterless for more than three months.
Analysis of the found results, from the tributaries as well as from the middle of water reservior and from the barrage, it can be said that the qality of water is:

According to the results concerning the qantity of phosphorous and nitrogen, through the tributaries of the rivers of Lenovac and Lasovo,big qantities of the organic materies are taken in the water reservoir "Grlište". The concentration of phosphorous in the river of Lenovac is about 0,88 mg/l and the concentration of nitrogen is over 2 mg/l. The registered values in the river of Lasovo are about 30-50 % less while the influx of water from this tributary is about 40 % more. Total average annual influx of water through the tributaries in the water reserviore is a little more than 1 m^3 /sec. (the fact by The Republic hydrometereological Institute of Serbia), so it's not difficult to conclude that a certain amount of tonnes is taken of phosphorous and nitrogen for the period of one years, only through the tributaries,not accounting any other sources of pollution. The big qantities of organic materies are turned into seaweeds by means of the solar energi and they make the water reserviore more trophic and make the refining of water from the water reservoire into drinking water in the water factory, more dificult and more expensive.

When we talk about the quality of water in the exact water reservoir (point I and point II-at the barrage)from the given tables we can see that according to the entire qantity of phosphorus at point II is of better qality but it is within limits of mesotrophic and eutrophic system rarely hipertrophic (mastly in 1999.). In 1995. many times the entire qantity of phosphorus is not registred at surface layers up to 5 m but then the values of chl"a" were very high which means that algae developed. It is similar with the faund concentration of nitrogene. According to the faund values chl"a" and the measured clearness water reservoire "Grlište" belongs mostly to eutrophic system, sometimes to hipertrophic and rarely to mezotrophic system mosty in the winter period without sun energy.

So high concentration of organic materies which come to water reservoir together with the merged influence of sun beams cause great development of algae at some year period. By means of point II and by means of water pipes algae come to filters of water fagtory and make heavy their work. It can be especially seen at the shortening of filter work between two washings. When algae develop greatly in the water reserviore, which is showed by analysis (lessened water clearness, increased concentration of chl"a") then filters get blocked very fast. Filters sometimes must by cleaned at every 4-5 hours which makes production of drinking water more expensive and more difficult. The usual cleaning of filters is done once in 24 hours .When the qality of water is greater, with less algae, cleaning of filters can be done in every 2 to 3 days, which is a very rare case, usually at winter period.

The qualitative and quantitative structure of phytoplanktons varies from season to season because of the cyclic changes in lake.The folloving species are present: Chlorophyta, Cyanophyta, Chrysophyta,Bacillariophyta and Euglenophyta. Zooplankton consists of the following species:Rhizopoda,Rotatoria and Cepapoda. In the samples of mud there are many Oligochaeta which are characteristic of the water reservoir with the intensive process of covering with mud.

Tab. 1. OECD classifications of lakes and accumulations

DEGREE TROPHICAL	**PHOSPHORUS** mg/m^3	**CHL "a"** mg/m^3	**CLEARNESS** m
ultra oligotrophic	<4	<1	>12
oligotrophic system	<10	<2,5	>6
mezotrophic sysrem	10 - 35	2,5 - 8,0	6 - 3
eutrophic system	35 - 100	8,0 - 25,0	3 - 1,5
hypertrophic	>100	> 25	<1,5

Tab. 2. The analysed values of characteristical parametres for the river of Lasovo in 1993.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	NU	NU	1.203	0.503	0.855	0.801	P	P	P	P	NU	NU
P (mg/l)			0.051	0.050	0.123	0.079						
chl "a" (mg/m^3)			-	4.29	1.50	2.30						

Tab. 3. The analysed values of characteristical parametres for the river of Lenovac in 1993.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	NU	NU	1.610	1.368	0.899	0.143	P	P	P	P	NU	NU
P (mg/l)			0.022	0.080	0.110	0.044						
chl "a" (mg/m^3)			-	3.54	2.30	4.80						

Tab. 4. The analysed values of characteristical parametres at point I in 1993.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	NU	NU	0.175	0.311	0.276	0.264	0.159	0.086	0.085	0.04	NU	0.106
P (mg/l)			0.050	0.050	0.052	0.013	0.051	0.022	0.035	0.051		0.060
povr{ina			19.00	50.00	11.60	5.30	10.90	58.80	40.00	31.00		50.50
chl "a" (mg/m^3) 3 m.			27.30	80.80	11.90	9.60	18.90	47.20	53.00	32.00		46.00
5 m.			29.80	79.60	11.1	1.33	10.60	10.80	36.00	28.00		30.30
clearness (m)			1.22	1.05	0.80	1.40	0.85	0.80	0.93	1.15		1.30

Tab. 5. The analysed values of characteristical parametres at point II (at the barrage) in 1993.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	NU	NU	0.085	0.301	0.098	0.054	0.048	0.103	0.086	0.000	NU	0.107
P (mg/l)			0.060	0.050	0.035	0.022	0.034	0.022	0.035	0.043		0.080
povrsina			26.00	76.80	11.90	4.30	18.90	52.00	47.00	34.00		34.00
chl "a" (mg/m^3) 3 m.			26.00	80.80	28.00	5.80	8.13	37.60	65.00	35.00		25.30
5 m.			26.00	79.60	28.80	10.30	7.10	11.10	35.00	32.00		18.20
clearnes s(m)			1.48	0.95	1.70	1.05	1.30	0.90	0.95	1.35		1.60

Tab. 6. The analysed values of characteristical parametres for the river of Lasovo in 1995.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	0.720	0.698	0.834	0.742	0.438	0.490	0.125	0.442	0.591	0.433	0.486	
P (mg/l)	0.090	0.060	0.110	0.070	0.020	0.060	0.050	0.105	0.109	0.052	0.197	NU
chl "a" (mg/m^3)	1.51	2.27	1.77	1.01	1.77	1.26	1.30	1.30	0.75	1.01	0.75	

Tab. 7. The analysed values of characteristical parametres for the river of Lenovac in 1995.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	1.218	1.205	1.538	1.417	0.728	1.600	0.076				0.185	
P (mg/l)	0.170	0.130	0.260	0.880	0.020	0.020	0.050	P	P	P	0.170	NU
chl "a" (mg/m^3)	0.76	1.01	2.78	2.53	6.92	1.78	0.75				2.35	

Tab. 8. The analysed values of characteristical parametres at point I in 1995.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	0.910	0.760	0.466		0.353	0.036	0.105	0.145	0.226	0.153	0.428	
P (mg/l)	0.079	0.000	0.020		0.000	0.020	0.000	0.079	0.044	0.035	0.175	
povr{ina	10.10	29.81	31.10		47.99	13.89	3.10	8.30	5.55	6.30	3.28	
chl "a" (mg/m^3)	9.85	29.30	30.80		49.51	32.10	10.60	7.80	16.16	19.50	3.78	
3 m.	10.35	30.56	32.58	NU	33.34	52.29	18.90	4.30	16.71	16.90	3.28	NU
5 m.												
clearness(m)	1.65	1.55	1.28		0.63	1.20	2.15	1.58	1.55	1.85	1.65	

Tab.9. The analysed values of characteristical parametres at point II (at the barrage) in 1995.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	0.895	0.745	0.480	0.516	0.467	0.226	0.172	0.128	0.201	0.194	0.065	
P (mg/l)	0.035	0.000	0.020	0.044	0.000	0.000	0.000	0.000	0.066	0.022	0.088	
povr{ina	12.63	33.10	29.30	34.86	47.99	15.66	4.80	8.10	12.38	11.60	3.56	
chl "a" (mg/m^3)	12.63	21.98	25.76	33.59	54.05	42.94	16.40	8.30	12.89	13.40	3.28	
3 m.	11.37	22.99	25.76	33.59	53.30	28.75	10.60	5.80	13.39	11.10	3.28	NU
5 m.												
clearness(m)	2.10	1.60	1.35	-	0.65	1.50	2.20	1.15	1.80	1.90	1.75	

Tab. 10. The analysed values of characteristical parametres for the river of Lasovo in 1999.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)		0.706	0.678	0.734	0.901	0.747	0.696	1.248	0.308	0.220	0.151	0.826
P (mg/l)	NU	0.010	0.000	0.000	0.038	0.012	0.113	0.005	0.017	0.045	0.022	0.005
chl "a" (mg/m^3)		2.02	1.77	1.26	1.52	1.52	1.26	-	2.52	1.26	1.26	1.52

Tab. 11. The analysed values of characteristical parametres for the river of Lenovac in 1999.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)	NU	1.305	1.438	1.101	2.033	1.646	1.622	0.529	0.818	0.173	0.202	1.232
P (mg/l)		0.017	0.000	0.040	0.072	0.077	0.133	0.004	0.055	0.122	0.065	0.103
chl "a" (mg/m^3)		0.76	9.09	2.78	2.02	2.02	1.26	-	4.29	1.52	2.27	1.26

Tab.12. The analysed values of characteristical parametres at point I in 1999.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)		0.919	0.718	0.501	0.523	0.268	0.093	0.252	0.095	0.113	0.221	
P (mg/l)		0.033	-	0.017	0.013	0.013	0.002	0.018	0.000	0.010	0.020	
povr{ina		6.57	29.05	11.37	13.13	7.58	4.80	-	5.55	12.38	7.33	
chl "a" (mg/m^3)		7.07	25.76	11.37	17.68	55.06	15.66	-	8.33	13.13	5.81	
3 m.	NU	3.54	27.03	13.39	11.37	14.65	22.73	-	9.09	13.64	5.05	NU
5 m.												
clearness(m)		1.62	1.20	1.48	1.45	1.40	1.68	2.80	2.20	1.32	2.03	

Tab.13. The analysed values of characteristical parametres at point II (at the barrage) in 1999.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
N (mg/l)		0.933	0.798	0.516	0.473	0.575	0.088	3.547	0.075	0.153	0.181	0.170
P (mg/l)		0.083	-	0.000	0.035	0.005	0.247	0.007	0.022	0.203	0.018	0.023
povr{ina		4.54	24.75	10.61	17.17	57.08	37.38	-	7.07	11.36	5.30	5.05
chl "a" (mg/m^3)		3.28	20.90	8.34	37.38	7.07	5.56	-	6.31	10.86	8.84	4.04
3 m.	NU	4.80	26.77	9.60	9.60	8.08	18.69	-	7.32	11.11	4.55	3.54
5 m.												
clearness(m)		1.65	1.20	1.60	1.45	1.38	1.70	2.75	2.10	1.66	2.10	-

P - to dry up
NU - the sample has not been sampled

CONCLUSION

The planned project -MONITORING PROGRAMME WATER RESERVOIR "GRLIŠTE" is planing for preventing eutrophication and more qality of water.
This monitoring that has been started this year is carried out in one month intervals and it will be realized in the period of one year.

The project includes hydrographic, hidrobiological, hydrochemical, hidrologic ecophisological, ecotoxiciological, fish test, floristics investigations for to completed results. After that, actions for advenced ecosystem will be recommended.
The investigations include detailed hydrographic and hydrologic research of the water reservoir and its river basin area as well as making maps.
Hydrochemical investigations include all the relevant parameters concerning the water quality, especially those which show eutrophication.
Microorganisms are analyzed from the aspect of the qality and qantity structure,then as polluters and indicators of the pollution level and the quality of water.The investigations should determine biochemical activities of microorganisms,indicators of the poolution level and estimate their role in selfpurification. The investigations of cyanobacterium and microbs from different aspects are also planned.
Floristic- phytogenetic investigations of the aquatic and terrestrial vegetation include giong ont into the field. According to the detailed inspection of the state of vegetation and certain plant species, the appropriate measures for the protection of the endangered dwelling places will be suggested.
Hidrobiological investigations include the analysis of phytoplanktons, zooplanktons and fauna of the bottom,which give the state of qality of the analyzed hydroecosystem.
The investigations of the fish settlment include theanalysis of indicators of the aquatic dwelling places quality.Special attention is paid to the determination of some metals biocumulation in the tissues and organs of fish in order to qualify and classify the hydroecosystem. The fish community is studied as an active factor in the process of selfpurification of the water ecosistem as well as from the standpoint of possibility of usage of stagnant and slowrunning hydroecosystems for the intrnsive aquculture.Special attention is paid to ichthyofauna as a relevant factor in the management of life condications by means of biomanipulation. The rivers would be stocked with those sort of fish which would have plancton for their food,especially seaweeds in order to prevent the greater extent of eutrophication and macing the water quality worse, especially during summer monts.
Basides the fieldwork and laboratory investigations, the results from the previons years investigations will be united in order to form measures for preservation and improvement of the endangered ecosystems qality.

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