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IDENTIFICATION AND TRACKING COSTS IN ORGANIZATION

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Abstract: *Lake Skadar is located on the Yugoslav-Albanian border. The lake is the largest at the Balkan and has a surface area which fluctuates seasonally from 370 to 600 km2. Although its precise origin is unknown, the lake probably for¬med during the Tertiary and/or Quaternary periods by disso¬lution of limestone in an active tectonic basin. The present day lake, a subtropical body of water lying 5 m above sea level, has a 5490 km2 drainage basin.The area of Skadar Lake basin and the lake itself, with all their specific features, was and still is a challenge for various researchers. However, in spite of all that, the water status of the Skadar Lake has not been defined in the light of "EU Guideline for water".Regarding it, in this work are emphasized the basic aims of aforementioned guideline, with retrospective view on their practical implementation. The available database of the current monitoring of the Skadar lake waters is shown in this work in order to distinguish the necessity for operative monitoring in the direct lake basin and research monitoring of the Skadar Lake waters, according to defined elements.The processed data show the impact of pollution sources in the basin (waste waters in the settlements and industries, where the Aluminium plant in Podgorica is dominant and uncontrolled usage of fertilizers) on Skadar Lake waters quality, but it is not still enough to define the Skadar lake waters status according to elements from the Guideline.*
Keywords: *research monitoring, status, water, Skadar Lake*

1. INTRODUCTION

Treating the water potential as a foundation for sustainable development in XXI century and regarding its long-lasting vision, the "General EU Guideline for water" has exceptional political, economic and social significance. There is given the classification methodology for water subjects of the EU members, and it are also recommended for states that are waiting to join EU. According to it, the creating of strategy and classification of water subjects is restricted to 2015. That is why the attention is on the opportune implementation of its aims, according to defined, unique and coherent strategy for environment and water management [1].

The essence of the"EU General Guideline for water" is to maintain and/or increase the water resource and to return the their natural balance, based on integration concept as it is the key for water protection management in the basin. It can be seen in the following basic aims of its implementation:

Protection of all waters with implementation of integral management for water resources.

- Achieving good water status in 15 days, according to defined criteria and hydro morphological, chemical and biological standards;
- Integral economy and management of river basins;
- Water quality control and control of polluted water bleeding;
- The appropriate water prize, regarding the key principals:"consumer pays"-"polluter pays"-"total charge indemnity";
- Public information, consulting and taking part in decision-making process.

From all above mentioned, it can be concluded that the main aim of the guideline conception is integral, ecologically oriented estimation and classification of surface water status, and there is a desire to achieve in a limited period of time.

As for water quality and quantity, the monitoring system [2,3] allows numerous procedures, regarding the fact that it should give all information about all elements that define the status of water subject in accordance to national aims.

In spite of due implementation approach of emphasized aims [4], by applying the simple methodology as done in Serbia and in surrounding states, we are currently working on "Master plans" according to methodological approach of the experts from European Agency for Reconstruction and Ministry for Spatial Planning and Ecology in the Government of Montenegro. The absence of domestic experts approach is due to fact that besides other factors in Montenegro there isn't, more than ten years, an institutional form that deals with hydraulicity. The above mentioned Guideline, besides other things, encourages the proclamation of sensitive areas and their suitable and more strict standards, especially from the aspect of nutrients and micro polluters, opposite the strategy of "Master plans", with accent on setting up the national standards on the level of less strict EU standards.

Starting with the specific aims of the Guideline and with numerous unknown issues about the Skadar lake basin and the Lake itself, it can be presumed, regarding the applied approach, that promoters of the "Master plans" have not achieved to understand the current state of water quality and the purpose of the lake water as potential source of potable water, inter-state water. Of course as far as we don't want to legalize the existing water pollution in the Lake basin, which, however, has not been defined yet from the quality aspect.

This supposition is justified by the absence of water monitoring in order to perform the sanitation of polluted waters in the near and wider surrounding of the Aluminium plant in Podgorica. For example, it has been postponed more then four decades because of financial support absence. Respectively, there is such aim in the Guideline and it should not be difficult to implement it in a legal state we are gravitating towards. That is also one of prerequisites for Montenegro to become the EU member.

Hypothesis: Considering the specific the area of Skadar lake basin, the lake itself and mediterranean's karst, it is assumed that the planned investigations quality characteristics of water will provide better knowledge on reactions of the basin in question, from the aspect of contamination, which will also enable to propose the appropriate measures for the protection of the waters of Skadar lake, as an invaluable water treasure.

2. EXPERIMENTAL PROCEDURES

As the given regulations have not been applied yet on the national level, and it hasn't been even done an obligatory publishing of the Guideline 2000/60/EC regarding water protection, in this work it was done everything to make people see its conception more clearly and to advice our scientific society about its content.

Here are shown certain results based on database (64 samples from April to November of 2008) of the current Skadar lake monitoring. It is very important to say that during the monitoring there were taken '*temporary*' samples of surface water for physical-chemical and microbiological research, and there weren't hydrological monitorings and other quality aspects.

Monitoring was done in the following locations: Kamenik-1: Virpazar-2, Vranjina-3, Plavnica-4, the middle of the lake-5, Starcevo-6, Moracnik-7 and Ckla-8. Regarding the fact that the monitored area is limited due to limited financial support, at the end of July and at the beginning of August of 2009 additional researches were done. The terrain measurement was done (t^0, pH, EC_{25} ,O_2) taking the individual samples from the water surface to the bottom in aforementioned locations as well as in Poseljani, Radus and Petrova ponta. There were formed composite samples that were filtrated (0,45μm) acidified in order to get some heavy metals (Cd, Cu, Cr, Pb) and to determine total organic carbon (TOC) according to standard methods of water examining [5].

The average values of basic indicators of water physical-chemical properties are shown in the table 1 with the illustration of Na values in the role of 'tracer' of the impact of the activity in the Aluminium plant in Podgorica on the Skadar Lake water quality -graphic presentation (figure 2). The values of heavy metals (μg/dm^3) are shown in the graphic presentation (figure 3). The average values of the presence indicators of the organic substances in water are shown in the table 2. The correlation coefficient for certain parameters (O_2 – NO_3 and PO_4): R (NO_2 fecal colif. in 100ml) and R (detergents - fecal colif. in 100ml) are shown in graphic presentations (figures 4,5,6).

3. RESULTS AND DISCUSSION

The average temperature value of the lake water shows that in littoral locations (Vranjina and Virpazar) were determined lower values (19.6°C and 21.3°C) than those measured in other locations (table 1).

Extreme temperature values were between 11.5°C (Vranjina. 29.11.2002) and 29.5°C(water in the middle of the Skadar Lake. 5.08.2003). In the same littoral points pH value of the water was insignificantly lower than average pH in other locations. It would be interesting to point out that average pH value in Plavnica (8.15) is almost identical with pH value measured in Kamenik (8.10).

This location represents the influence of the lost river Karatuna, trough that is poured out part of the losing waters of the river Moraca, downstream of the Aluminium plant in Podgorica.

The Na value, as indicator of the activity impact of the Aluminium plant in Podgorica shows that on water quality of this area influence the water which swill out the area of Zeta valley as well as certain underwater and surface waters of the rivers Moraca and Cijevna, that go into Lake trough some smaller rivers with shorter flows such as Plavnica. The average value of water temperature and pH value, the values of hydro carbonate in locations (table 1) indicate that there is hydrological connection between locations Kamenik and Plavnica, reflected in their almost identical basic water ingredients.The changing of the Na values, depending on location,is followed by values (0.53:0.55:0.57:0.50.0.52) determined ration between EC_{20} and dry residue ($S.O_{105}$ **).**

Table 1 . Average values of basic indicators of the Skadar lake water

PARAMETERS	LOCATIONS							
	Kamenik	**Virpazar**	**Vranjina**	**Plavnica**	**Sredina jezera**	**Starčevo**	**Moračnik**	**Ckla**
Temperature, ^0C	22.0	21.3	19.6	22.9	22.7	23.0	23.2	23.5
pH	8.10	7.99	8.03	8.15	8.30	8.28	8.33	8.35
El. conductivity (EC_{25}), μS/cm	276	272	289	229	226	225	220	221
Dry residue (SO_{105}), mg/l	148	137	152	125	121	117	125	120
Total hardness, ^0dN	8.1	7.9	8.2	6.6	6.5	6.4	6.4	6.6
Ca^{2+}, mg/l	42.0	45.9	49.7	36.7	37.3	35.3	35.5	37.0
Mg^{2+}, mg/l	7.48	6.41	5.39	6.70	5.89	6.33	6.23	6.04
Na^+, mg/l	2.91	2.59	2.54	3.43	2.65	2.81	2.90	2.93
K^+, mg/l	0.31	0.30	0.30	0.28	0.34	0.34	0.31	0.34
HCO_3^-, mg/l	172	163	182	143	141	142	145	142
Cl^-, mg/l	5.3	9.8	6.4	6.6	5.6	6.7	6.6	6.5
SO_4^{2-}, mg/l	6.7	7.6	5.1	6.3	4.9	6.0	5.0	7.0
NO_3^-, mg/l	1.02	0.93	0.68	1.89	1.80	1.55	0.52	0.79
PO_4^{3-}, mg/l	0.006	0.015	0.030	0.005	0.011	0.003	0.001	0.014
Relation EC_{25}/SO_{105}	0.53	0.50	0.52	0.55	0.54	0.52	0.57	0.54

Reciprocal relation between basic water ingredients indicates that pollution transmission is the most expressed in the locations: Kamenik-Poseljani-Plavnica-Radus-the middle of the Lake-Moracnik, In other words the activity of the Aluminium plant in Podgorica influences great deal on the Skadar Lake waters, regardless its favorable hydrological factor. This possibility can be confirmed by individual pH values (8.90) that were higher than average in the locations: Plavnica-Radus, Kamenik-Poseljan’s bay and there were also discovered higher than average values of Na up to 5.8mg/dm^3 resulting in decrease of hydro carbonate value, i.e. carbonate sedimentation in the water (6.0-12.8mg CO_3/dm^3).

Comparing the data for pH values and Na with literature data [6,7,8,9] it can be noticed that in the Skadar lake water the values of those water quality indicators increased (above pH value and Na>1.5mg/dm^3) regardless the territory. Their increase reflects in lower values of total water hardness (table 1). Literature data [7,8] indicates the higher values of total water hardness regarding the previous determined values (2.3). Such phenomenon is important from toxicological aspect, because soft water is favorable for micro polluters accessibility to living organisms (National Academy of science 1973). Locations Vranjina-Virpazar are exception, because the electrolyte and natrium values in those locations are lower and that makes the hardness value to be higher for 1° than average value. Reciprocal comparison of water ingredients in these locations confirms the fact that they represent the Moraca surface water quality, in other words the impact of the polluters, transferred into Skadar Lake.

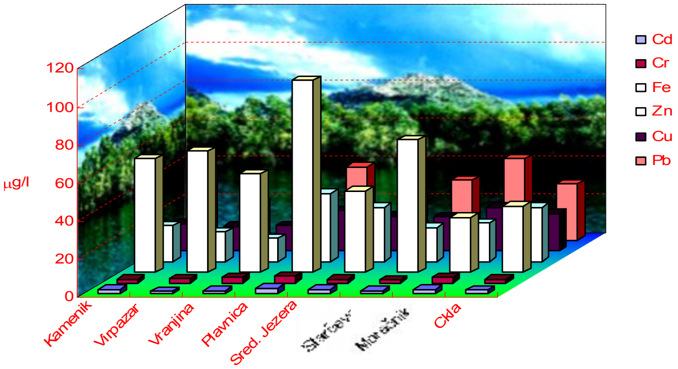

Figure 1. Average values of dissolved hard metals in the Skadar lake water

Consequently, we refer to values of heavy metals (figure 1) in the lake water as follows: Fe>Pb>Zn>Cu>Cr>CD. By comparing the shown data with previous determined data [6] in the lake water on the Albanian territory, it can be said that metal levels are approximate, except the Pb values that are lower (1.24μg/dm^3) than in the research period.The obtained levels are also approximate to those measured in the mid 1980s, when it is also determined their accumulation in sediments and nature ecosystem [8]. By measuring the nutrients content in locations, it was noticed that algae participate in the process happening during summer, because they keep index values of saturation with oxygen, i.e. super saturation (table 1, 2). Differences between locations show the different correlation coefficient values between them.

The significance of the correlation coefficient values R between pairs (%O_2 with PO_4 and NO_3) is shown by following sequence: Kamenik (0.80): Virpazar (0.73): Vranjina (0.73): Plavnica (0,44): The midlle of the Lake (0.04) Moracnik (0,76): Ckla (0.78).

The values of determined relation of saturation index and phosphate R (%O_2 with PO_4 and NO_3) are with smaller deviations in locations as follows: Kamenik (0.34): Virpazar (0.34): Plavnica (0.05) The middle of the Lake (0.15): Starčevo (0.00): Moračnik (0.26): Ckla (0.53) .The greater significance of the ration between nitrate – phosphate with the saturation index in the location Ckla, can be explained due to contribution of the water from the Albanian territory [6] because of its position. We will also present the indicators of organic pollution in the Skadar Lake water (table 2).

Table 2 . The indicator of the organic pollution in the water of the Skadar Lake

PARAMETERS	LOCATIONS							
	Kamenik 1	Virpazar 2	Vranjin 3	Plavnica 4	Sredina jezera 5	Starčevo 6	Moračnik 7	Ckla 8
O_2, mg/l	8.76	8.87	9.53	9.18	8.99	9.33	9.45	9.16
NH_4^+, mg/l	0.21	0.21	0.14	0.18	0.18	0.17	0.12	0.18
NO_2^-, mg/l	0.003	0.004	0.005	0.003	0.002	0.001	0.001	0.001
Phenol, μg/l	1	1	2	1	1	1	1	2
Detergent,mg/l	33	52	80	31	21	37	12	28
BOD_5/COD	1.67	1.23	1.00	1.63	0.94	0.90	0.65	0.90
TOC, mg/l	1.9	1.2	1.4	2.1	1.5	1.6	1.7	1.0
Tot. num.of lives micr. in 1ml	207	240	294	374	74	184	126	99
Tot. numb of fec. micr. 100ml	27	40	226	189	0	14	5	14
Tot.numb. of colli in 100ml	3945	3487	3795	3286	1800	1914	1315	2958

As shown the values of the ratio between O_2 from BOD_5/COD (from $KMnO_4$) differs in locations. They are the most marked in the water of locations Kamenika (1.67): Plavnica (1.63): Virpazar (1.23) Vranjine (1.00) while they are less marked in the water of Skadar Lake. This sequence indicates that transport of Zn to the pollution source (Aluminium plant in Podgorica) is followed by some undiscovered synthetic micro pollutants of organic origin, biodegradable in a significantly longer period, or they deposit more dangerous polluters, for example PCB-es. Consequently, there are higher values of TOC in those locations and lower average values of dissolved oxygen (table 2). Besides, the lower index values of oxygen saturation have to be pointed out and they are on the level (4.7mg O2/dm^3) of biological minimum, in water with sediment, in locations Kamenik-Poseljani-Plavnica.

Cation detergents were discovered in all locations, against the results of previous researches where they were registered only in costal points. It indicates that those effects are related to inefficient underdimensined equipment for filtration of wastewaters in Podgorica. Their dominant transport in the lake is mostly trough main tributary river Morača, towards Virpazar-Plavnica-Moračnik.

We will also show the content of nitrate and ammonia azote, always present in the water of Skadar Lake, besides detergents. Opposite the fact that those pollutants were below the level of settling limit their average values (table 2) and correlation coefficient (figure 5, 6) indicate their permanent presence in the water, and there were determined significant contents.

Nitrates with fecal microbes were found in the greatest quantity in Plavnica (0.82) and in the middle of the Lake (0.55), while in other locations they are less marked (0.11 – 0.43). The correlation coefficient of ammonia with fecal and other researched microbes indicates the dual origin of ammonia: from wastewater in settlements and azote fertilizers. This statement is based on lowest dependence between ammonia and coliform bacteria (figure 2) in the middle of the lake, and the most marked dependence in location Ckla, where values of calium (0.3-0.4mg K/dm^3) are the most equilized, opposite to other locations.

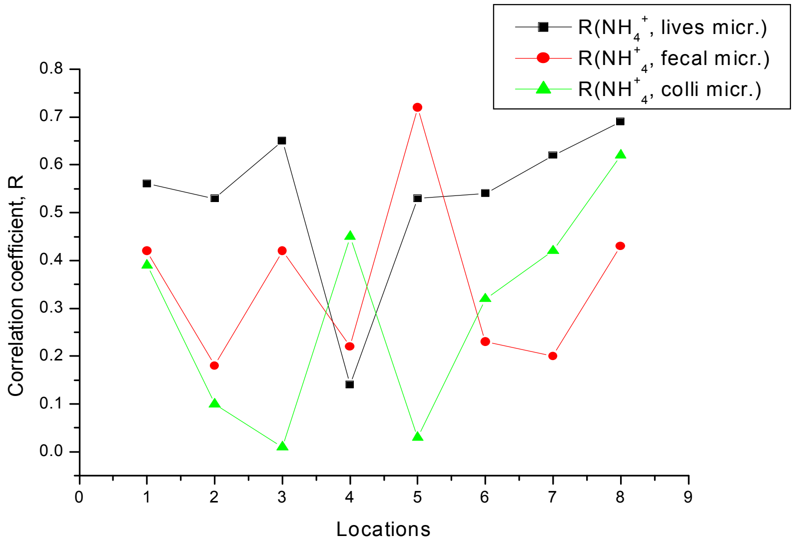

Figure 2. Correlation coefficient of ammonia with microbes in the water of Skadar Lake

It has to be mentioned that in the research period were determined lower contents of phenol in range, from settling limit <1 to 4μg/dm^3, related to previous period .

After all afore mentioned facts, can be concluded that there is obvious disturbance of natural equilibrium of the Skadar Lake ecosystem, caused by polluters related to insufficient filtration of waste waters, by activity of Aluminium plant in Podgorica and uncontrolled usage of fertilizers. The value of saprobe index (S=1.6) and estimated β- mezosaprob properties of the lake water, except some waters in sublacustic springs indicate such quality status.The available database does not allow the classification of the Skadar lake status, and this imposes the need for realization of researching monitoring [1] in the light of "EU General Guide line for water

4. CONCLUSION

The obtained results aim to show the necessity of the quantification of the contamination sources, which emit various pollutants, that significantly influence the deterioration of water quality Skadar lake, which was confirmed hypothesis.

Imposed as necessary to the municipal and industrial wastewaters that gravitate basin area of Skadar lake implement measures of quality purification. The ultimate goal of treatment must be complete mineralization of organic matter, to prevent water of Skadar lake from eutrophication process.

It is evident the unconcern for the contaminants in the area of the basin in question, so the question is which way the waters of the Skadar lake have to be protected. The answer can be obtained by further investigations in order to promote the method for water protection of the presented basin area, in accordance with the aims of the EU Water Framework Directive.

The Water Framework Directive aims to achieve good ecological and chemical status of waters by 2015. Therefore, it is necessary to do a reliable analysis of present and future water condition. For that purpose, the automatic monitoring stations have great role and importance, as a reliable management element in defining and taking necessary protection measures, especially in situations of accidental water contaminations.

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