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Research Article

RESULTS OF ECOLOGICAL RESEARCH OF THE BLACK SEA (ADJARA TERRITORY) BASIN RIVERS

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Abstract.
The study of the sources of pollution of the Black Sea plays an important role in determining the ecological status of rivers flowing into the sea and studying the impact of anthropogenic factors on them. Eco-toxicological monitoring of surface waters and water quality control is the only way to determine the ecological condition of rivers. Determining the degree of their pollution is especially important for our country, because the nature and intensity of anthropogenic impacts on ecosystems in Georgia have changed dramatically over the last 30 years. In many cases, they are not continuously monitored by the state.

The aim of our research was to determine the ecological status of three rivers in the Black Sea basin of Georgia (Kubastskali, Adjaristskali, Bartskhana) in the spring and summer of 2020. The quality of rivers' water is assessed, key ions and hydro-chemical parameters are specified. Biogenic elements, heavy metals, physic-chemical and microbiological parameters of water are defined in water analysis samples.

Based on the results obtained, we can conclude that the increase in the concentration of ammonium ions in the rivers from biogenic elements during the summer period indicates their relatively new pollution. The high content of E-coli in the water is due to fecal contamination. Heavy metals in river water fluctuate within the MAC, which, in our opinion, is caused by the high pH of rivers (by hydrolysis processes in water). As a result of ecological monitoring of all three rivers of the Black Sea (Adjara region) basin, we can conclude that their eco-chemical-microbiological condition changes according to the seasons and pollution rates increase during the summer.

Key words: Biogenic elements, heavy metals, Kubastskali, Adjaristskali, Bartskhana, E-coli.

Introduction: The Black Sea is one of the inland seas. In terms of its pollution, a significant ecological problem is the rivers flowing into it, which carry large amounts of biogenic substances and various types of organic pollutants. Due to the above, the

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problem is especially relevant for such an important recreational region of Georgia as the Adjara region. Therefore, it is relevant to study the ecological condition of the rivers of the Black Sea basin of Georgia and to identify anthropogenic factors.

The following rivers were selected by us as the object of research: Kubastskali, Bartskhana and Adjaristskali, which flow into the Black Sea. It should be noted that hydro-chemical and microbiological research on these rivers is not constantly conducted. Monitoring is carried out episodically, mainly within foreign projects.

The river Kubastskali, which is 5.4 km long, flows from the mountainous system of Adjara-Guria. Its catchment area is 7.2 km^2, minimum flow - 0.25 m^3 / sec. The maximum flow is about 80-100 m^3 / s. Md. Kubastskali flows into the artificial concrete canal along the territory of the former Batumi oil refinery and into the Black Sea.

The river Adjaristskali, with a length of 90 km, a basin area - 1540 km, flows from the Arsiani ridge and is the right tributary of the Chorokhi. The river flows through a beautiful valley covered with humid subtropical forests of the Colchian type. Adjaristskali Hydropower Plant is located on Adjaristskali.

River Bartskhana - is a river, the right tributary of Adjaristskali. Its length is 8.6 km, average water flow - 1.3 m^3 / sec. The river Bartskhana joins the sea in the southern periphery of Batumi, in Tamar settlement, near the port. The lower reaches of the river have been experiencing severe anthropogenic loads for many years.

Research object and methods: The object of our research was three small rivers of the Black Sea basin - Kubastskali (Batumi entrance), Adjaristskali (at the Chorokhi confluence), Bartskhana (Adjaristskali confluence). The surveys were conducted in May and July 2020. Biogenic elements (NO_2-, NO_3-, NH_4 +, PO_4^3-), some heavy metals (Fe, Cu, Zn, Pb), microbiological indicators (E-coli, total coliforms, fecal streptococci), physic-chemical parameters of water were identified in the analytical samples. (pH, electrical conductivity, temperature, dissolved oxygen in water, odor, turbidity) ***(European Union Water Framework Directive (2000/60/EC))***

Hydro-chemical and microbiological analyzes are carried out using modern methods that meet and comply with European standards, such as: ion-selective chromatography (ICS-1000) ISO100304-1: 2007), spectral-photometry Specord 205ISO7150-1: 2010; Membrane filtration ISO9308-1, ISO7899-2, Atomic-absorption method-Plasma-emission spectrometer ICP-MS, field portable device Horiba ***(ISO 6058:1984; ISO 6059:1984; ISO 9297:1989)***

Results and discussion: Physic-chemical and microbiological indicators of Kubastskali, Adjaristskali and Bartskhana rivers selected as research objects are given in Tables №1-4. Fieldwork is one of the most important parts of environmental research. From a methodological point of view, their correct accomplishment significantly contributes to the reliability of the final results. Therefore, their proper planning and implementation is crucial ***(Mchedluri, 2012)***. Prior to fieldwork, all standard procedures were written by management to ensure proper sampling, storage, and transportation of samples. First of all, based on the objectives of the research, a field work plan was drawn up, the physical-geographical characteristics of the study area were specified, standard procedures for field analysis were written before the field work, and equipment and reagents were tested. Sampling and packaging were performed according to standard methods.

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Table 1. *Hydro-chemical and physic-chemical indicators of Kubistskali, Bartskhana and Adjaristskali rivers.*

Ingredients to be determined	**Kubastskali**	**Bartskhana**	**Adjaristskali**
Sampling time;	**May 2020.**		
temperature, t^0C	16.8	17.0	14.0
Smell, points	1.0	3.0	0
Turbidity, NTU	1.88	4.5	14.5
pH	7.45	7.55	7.64
dissolved oxygen, mg / l	9.0	10.4	9.5
BOD_5, mg / l	5.38	6.72	5.25
Nitrite, mg / l	0.09	0.078	0.018
Nitrate, mg / l	6.24	5.33	5.65
Ammonium, mg / l	0.28	0.37	0.31
Phosphate, mg / l	0.33	0.22	0.17
Sulfate, mg / l	8.2	5.6	18.5
chloride, mg / l	5.7	6.2	4.8
Hydro carbonate, mg / l	101.4	105.7	78.3
Potassium, mg / l	15.5	16.8	6.2
Sodium, mg / l			
Calcium, mg / l	10.5	12.4	20.8
Magnesium, mg /l	5.2	4.2	7.5
Electrical conductivity μsms/cm	235.6	188.2	260.4
mineralization, mg/l	168.8	220.5	194.8

Table 2. *Concentration of certain heavy metals in the water of the rivers*

Description	**Kubastskali**	**Bartskhana**	**Adjaristskali**
Time of taking samples	**May 2020.**		
Iron, mg /l	0.0677	0.1012	0.0677
Copper, mg /l	0.0055	0.0054	0.0042
Zinc, mg /l	0.0057	0.0032	0.0060
Lead, mg / l.	0.0070	0.0065	0.0055

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Table 3. *Microbiological indicators of Kubistskali, Bartskhana and Adjaristskali rivers*

River	Time of taking samples	E-coli	Fecal streptococci	Total coliforms
Kubastskali	May. 2020	4880	407.8	6080
Bartskhana	May. 2020	5350	444.7	7022
Adjaristskali	May. 2020	4200	450	4200

Table 4. *Hydro-chemical and physic-chemical indicators of Kubistskali, Bartskhana and Adjaristskali rivers*

Ingredients to be determined	Kubastskali	Bartskhana	Adjaristskali
Sampling time;	**July 2020.**		
temperature, t^0C	23.6	24.8	20.7
Smell, points	2.0	4.0	1
Turbidity, NTU	3.98	5.5	16.5
pH	7.95	7.64	7.94
dissolved oxygen, mg / l	7.8	8.2	8.7
BOD_5, mg / l	7.02	7.02	6.25
Nitrite, mg / l	0.10	0.088	0.038
Nitrate, mg / l	9.14	6.37	8.65
Ammonium, mg / l	0.58	0.77	0.50
Phosphate, mg / l	0.30	0.28	0.28
Sulfate, mg / l	9.8	6.6	16.5
chloride, mg / l	7.7	8.4	5.8
Hydro carbonate, mg / l	104.8	88.6	88.4
Potassium, mg / l	19.5	17.8	7.4
Sodium, mg / l	14.5	10.6	16.8
Calcium, mg / l			
Magnesium, mg /l	8.2	7.2	7.2
Electrical conductivity μsms/cm	188.2	168.5	220.2
mineralization, mg/l	132.4	158.5	174.8

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Table 5. *Concentration of certain heavy metals in the water of the rivers*

Description	Kubastskali	Bartskhana	Adjaristskali
Time of taking samples	**July 2020.**		
Iron, mg /l	0.0878	0.0922	0.1608
Copper, mg /l	0.0065	0.0068	0.0052
Zinc, mg /l	0.0067	0.0072	0.0044
Lead, mg / l.	0.0088	0.0078	0.0070

Table 6. Microbiological indicators of Kubistskali, Bartskhana and Adjaristskali rivers

River	Time of taking samples	E-coli	Fecal streptococci	Total coliforms
Kubastskali	July. 2020	6885	608.8	6490
Bartskhana	July. 2020	8856	578.4	7542
Adjaristskali	July. 2020	5800	490	5300

According to the physic-chemical data of the water (Tables 3, 5), the water quality of the rivers is satisfactory and it can be assumed that no unforeseen or sudden significant pollutant discharges have taken place in the given rivers. The results of the hydro-chemical analysis show that the water of all three rivers is a hydro-carbonate type of Ca content.

Important components are biogenic elements that reflect the degree of surface water pollution and are their indicators. The control of the contents of their individual forms in the water is of particular interest which is characterized by the intensification of processes such as fecal contamination, eutrophication, dumping of municipal and agricultural wastewater into the river, and others ***(Mchedluri, 2009)***.

The results show that ammonium ions were distinguished from the forms of biogenic elements, indicating a relatively new pollution of the river. Its concentrations in water decrease in spring (water logging, dilution factor) and its content increases in summer, when there is a sharp decrease in water in rivers (exceeds the maximum allowable concentration 1.5-2 times),

In rivers, in the late spring and early summer, there is an increase in the dissolved oxygen content in the water, which coincides with the vegetation period of the algae. At the end of the vegetation period, in July-August, the second negative environmental factor appears - hypoxia, which is manifested by a sharp decrease in the dissolved oxygen content in the water, which is an indicator of eutrophication ***(Mchedluri, 2012)***. Eutrophication does not take place in these rivers.

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As for the results of the microbiological research, during the summer, compared to the spring, there is an increase in the rates of E-coli, fecal streptococci and total coliforms.

The levels of heavy metals (iron, copper, zinc, lead) in river water are quite low in spring and summer. Their concentration exceeded the MAC in none of the samples. The ecological condition of these rivers changes slightly, but still according to the seasons.

Conclusion: As a result of ecological monitoring of Kubistskali, Bartskhana and Adjaristskali rivers of the Black Sea (Adjara region) basin, we can conclude that their eco-chemical and microbiological indicators change according to the seasons. During the summer there is an increase in the levels of ammonium ions, E-coli, fecal streptococci and total coli-forms. BOD_5 and mineralization are also increasing. The increase in the concentration of ammonium ions from biogenic elements in the rivers during the summer period indicates their relatively new pollution. The high content of E-coli in the water is due to fecal contamination. The content of heavy metals in river water is low and ranges within the maximum allowable concentration, which in our opinion is caused by the high pH of rivers (hydrolysis processes in water).

Finally, we can conclude that in the spring and summer of 2020, the ecological condition of the rivers Kubistskali, Bartskhana and Adjaristskali is favorable.

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