
Ecotoxicological studies of surface and groundwater in the adjacent territories of the Shuakhevi HPP (Adjara AR)

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Abstract

River Adjaristskhali gorge alongside territories are refugium for third moisture Kolkhetian relictic forest eco-systems which was given UNESCO world natural heritage status. At present construction and exploitation of cascade type derivative hydroelectric stations in the gorge creates risk for fragmentation, destroy and losing of natural habitats. Elemental analysis of underground spring water by plasma atomic-emission spectrometry was carried out at Shuakhevi township location. The obtained data were compared with the results of the multi-elemental analysis of the Achariskali River. The basic macro-elements in spring water and river Adjaristskhali are Ca and Mg. in samples of river Adjaristskhali concentrations of P, Fe, Al are beyond MPC which is the verification for their anthropogenic pollutions. Besides such dangerous pollutants as Hg, Li, Pb, Ti is beyond MPC. Foreseeing the specificity, relief of Adjaristskhali it is necessary to carry serious geological and ecological examinations during construction and exploitation of Hydroelectric Stations, later - carrying periodic monitoring in order to identify problem areas and carry proper preventive measures.

Introduction.

Actuality of the topic. Ajara with its unique natural landscapes is one of the most unique regions in Georgia. It is characterized with ecosystems distinguished by their beauty, richness of relict and endemic species. Variety of ecosystems is related to diverse climate conditions, and a complex backstory of the flora and plants development. There are multiple ecosystems developed in quite a small territory, from humid deciduous forests of Kolkheti lowland to distinctive ecosystem of highland [1].

Adjaristkali river valley and its surrounding area, along with florist and coenotypic diversity, is distinguished by several relict and endemic species and the species of the Red List. A recognized research of this valley plants, multielement (heavy metals) water analysis on the the specific locations of an area surrounding Shuakhevi Hydropower Plant (HPP), is of high importance to assess biodiversity status and

current ecological conditions of the valley considering ongoing cascade hydropower plants construction [2, 3].

Research aim and objectives. The aim of the research is to develop background study of biodiversity in the Adjaristskali valley, define toxic elements in the samples of exogenous (Adjaristskali river) and underground waters (spring). The research objectives are: collect and analyze literature sources, study and assess biodiversity and ecological condition of Adjaristskali river based on the parameters like: multielement water analysis (metal content, including heavy metals, and toxic elements).

Research object. A research object for the biodiversity background study was natural habitats of Adjaristskali river territory. For the assessment of ecological condition, the water samples for a laboratory analysis were taken from village Shuakhevi, locations of Shuakhevi HPP and its water catchment building.

Research methods. We have carried a background study [4], which considered study of the research territory: identification of the forest coenotypes according to the vertical zones; assessment of conservation value of the main habitats based on the literature review and field research. We carried a multielement analysis of the water samples through plasma-atomic emission spectrometric method, equipment ICPE-9820 [5, 6].

Material-technical base of the research. The experimental research was carried in the Analytical Chemistry and Agrochemistry Laboratories of the Institute of Agrarian and Membrane Technologies at the Batumi Shota Rustaveli State University. A paper analysis of literature resources and research materials was carried in the departments of Biology and Chemistry.

Main part

Rivers and forests of mountainous Adjara are important habitats for biodiversity. The Adjaristskali river valley is distinguished by habitats having high conservation value. It creates a refugium for tertiary humidity-loving Colchian relict forest ecosystems, which were granted UNESCO natural World Heritage status [7].

The climate of the Adjaristskali River valley is distinguished by a stable air humidity during all seasons. Increased humidity in the valley is caused by relief characteristics, exogenous ground waters and precipitation. Most of the relict flora are grown on the valley slopes and are represented by original Colchian type formations rich with diversity of the species: deciduous forests (*Castanea sativa*, *Alnus barbata*, *Carpinus caucasica*, *Fagus orientalis*) chestnut (*Castanea sativa*), oak-wood (*Quercus dschorochensis*), mixed forests (*Picea orientalis*, *Pinus sosnovsci*, *Carpinus caucasica*, *Alnus barbata*, *Salix caprea*), dark coniferous forests (*Picea orientalis*, *Abies nordmanniana*), riverside forest places (*Alnus barbata*), rhododendron (*Rhododendron ponticum*) shrubs.

Rivers and forests of mountainous Adjara are natural habitats with high and middle conservation value, that are represented in the construction and operation area of hydropower plants and they are under the threat. Forest sections neighboring flooding or dam areas require cutting down.

The Adjaristskali River valley and its surrounding area is distinguished by a diversity of relict and endemic plants, also, variety of species recorded in the Red List of Georgia and Adjara. There are 23 endemic plants, including, endemic plants of Georgia: *Galanthus woronowii*, *Cirsium imereticum*, *Cirsium caput-medusae*, *Alcea transcaucasica*, *Rubus woronowii*; endemic plants of Adjara-Lazeti: *Quercus dschorochensis*, *Amaracus rotundifolium*, *Linaria adzharica*, *Cyclamen adzharicum*, *Astragalus sommieri*, *Osmanthus decorus*, *Erysimum contractum*, *Centaurea adzharica*; endemic plants of Kolkheti: *Ficus carica* (*F. colchica*), *Hedera colchica*, *Staphylea colchica*, *Buxus colchica*, *Cornus sanguinea*; endemic plants of Caucasus: *Digitalis ferruginea*, *Helleborus caucasicus*, *Tilia caucasica*. 11 species of plants are in the Georgia Red List; vulnerable species are: *Castanea sativa*, *Buxus colchica*, *Juglans regia*, *Quercus hartwissiana*, *Ulmus glabra*, *Taxus baccata*, *Staphylea colchica*, *Osmanthus decorus*. Endangered species are: *Astragalus sommieri*, *Arbutus andrachne*, *Ostrya carpinifolia* [8].

There is a diversity of birds in the Adjaristskali River valley and its surrounding area, currently there are 161 species recorded. 14 species are in the Red List of Georgia and IUCN. There are 225 species of vertebrate animals living in the target territory, out of which 63 species are protected under the Georgian legislation and international conventions, 20 are Caucasus endemic and sub-endemic species. Ichthyofauna of the Adjaristskali River valley is also important in terms of conservation value. There are 16 endemic species. Three of them are in the Georgia Red List and 6—in the International Union for Conservation and Nature (IUCN) Red List [9].

The results of the multielement analysis, that we conducted on underground spring water samples by plasma-atomic emission spectrometric method, were compared to the results of multielement analysis of the Adkaristskali River water. Based on the experimental research data, from macro-elements Calcium and Magnum are dominant in both waters, maximum permissible concentration (MPC) exceeds limits in P (0,0491), Fe (1,16), Al (3,02) - in Adjaristskali River, which obviously indicates on its anthropogenic pollution. As for toxic microelements, in Adjaristskali River MPC level exceeds in contaminants like Hg (0,0007 mg/l), Li (0,2310 mg/l), Pb (0,0203 mg/l), Ti (0,0003 mg/l).

Table 1

multielement analysis of waters

Location	Macroelements, mg/l							
	Ca	Mg	Na	K	P	Fe	Al	Si
underground spring water (village Shuakhevi)	31,6	15,61	5.26	3,76	–	0,080 4	0.137	2,76
River Adjaristskali	23,05	10,36 4	9,53	2,29	0.049 1	1,16	3.02	4,53
MPC	–	–	–	–	0,028	0,3	1,0	10,0

Table 2

Location	Microelements, mg/l , mg/l										
	Ni	B	Mn	As	Hg	Be	Cd	Li	Pb	Ti	V
underground spring water (village Shuakhevi)	–	–	–	0.0153	0.00024	–	–	0,0143	–	–	–
River Adjaristskali	0,0011	0,0063	0,0027	0,0238	0,0007	0,00016	0,0009	0,2310	0,0203	0,0003	0,0003
MPC	0,02	5,0	0,05	0,05	0,0005	0,0002	0,0005	0,03	0,01	0,0001	0,001

Conclusion

1. There are natural habitats with high and middle conservation value developed in the slopes of Adjaristskali River valley, there are 23 endemic species, 11 species are recorded in the Georgia Red List.
2. There are 161 species of birds in the Adjaristskali River valley. Vertebrate animals are represented by 229 species, out of which 61 species are protected under the Georgian legislation and international conventions, 20 are Caucasus endemic and sub-endemic species. Ichthyofauna is represented by 16 endemic species, three of them are in the Georgia Red List, 6 – in the International Union for Conservation and Nature (IUCN) Red List.
3. The main macro-elements of the underground spring water and Adjaristskali River waters are - Ca and Mg. The anthropogenic pollution of Adjaristskali was caused by the elements: P, Fe, Al, Hg, Li, Pb, Ti.

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ზედაპირული და მიწისქვეშა წყლის ეკოტოქსიკოლოგიური კვლევები
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ბათუმის შოთა რუსთაველის სახელმწიფო უნივერსიტეტი

აბსტრაქტი

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