



CONDITION OF BORZHAVS'KIY RIVER TRIBUTARIES IN VINOGRADIVSKY DISTRICT OF TRANSCARPATHIAN REGION (UKRAINE)

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Abstract:

Quality of waters of the small rivers of a river basin of Borzhava of Vinogradivsky district was investigated. By results of researches waters of the rivers Sal'va, Bel'va, Verbovets', Onok they does not meet standard requirements.

Keywords:

chemicals pollution, water, rivers, Transcarpathia.

INTRODUCTION

The quality of the water of major rivers and its level are known to depend upon their tributaries – small rivers. It is minor watercourses and rivers that form the water resources being an indispensable part of natural sceneries [1, 2]. The state of the small rivers reflects the level of culture and science, and character of the industrial and environmental activities in the area.

Therefore, estimation of the ecological situation and preservation of small rivers remains a crucial priority task within the protection system of large watercourses.

In Ukraine, the ecosystems of small rivers are most harmfully affected by human activity. As a result, these rivers become useless as the sources of potable water, while their surrounding sceneries cannot be used for recreation purposes [3].

Zakarpatska Oblast (Transcarpathia) is one of the most watered regions in Ukraine, for over 9,400 rivers and streams [4]. The length of the four major Transcarpathian rivers (the Tysa or Tisza, the Borzhava or Borzsa, the Uzh and the Latorytsia) exceeds 100 km, that of other 148 rivers exceeds 10 km, and 9 277 rivers are less than 10 km long. The main waterway in Transcarpathia is the river Tysa [5].

From year to year increases the number of the rivers with broken water intake schedule [6]. These rivers are often used as wastewater and solid waste reservoirs; along their banks spontaneous building activity is flourishing. The anthropogenic activity combined with the climatic factors cause changes in the hydrographic characteristics of the river nets, which in its turn affects the relief of the adjacent territories. All these result in aggravation of the ecological problems in the Transcarpathian ecosystems, negatively affecting the living conditions of the local population.

The purpose of our study has been to identify the pollution level of the following minor rivers of the Borzhava basin: the Salva, the Belva, the Onok and the Verbovets, flowing in Vynohradiv Rayon (District), Zakarpatska Oblast (Transcarpathia).

MATERIALS AND METHOD

The whole territory of Transcarpathia belongs to the catchment area of the river Tysa whose length within the area equals to 220 km. Within Transcarpathia, the Tysa intakes waters of the tributaries of



the Borzhava, the Rika, the Tereblia, the Black and White Tysas. In summer, these rivers are filled up mainly at cost of rains, in spring – of precipitation and melted snow, and in autumn – of rains and subterranean waters. Lately, the mean yearly water level in the Transcarpathian rivers has fallen significantly.

Vinogradivsky area (rayon) belongs to the areas with heightened risk of flooding. The drained lands make approx. 37,500 ha; there are 350 waterworks in the area. Along the rayon, flow the Tysa (36 km) and the Borzhava (21 km) [5,7,8]. The hydrographic network of the Borzhava basin in the area under study consists of the river Salva and its 5 tributaries: the Onok, the Belva, the Verbovets, the Szemerdek and the Rotar. The total length of the Salva together with its tributaries within the drained lands block is about 70 km. The Borzhava flows into the Tysa 11 km from the source of the Salva.

For the purpose of the study, part of the Borzhava basin located in the north-western corner of Vinogradivsky Rayon (District) was taken. This area is distinguished by a dense hydrographic network. The beds of the rivers and springs cross agricultural areas and run across the villages of Shalanky, Velyki Komiaty, Onok, Oleshnyk and Pushkinovo.

We have analyzed the waters of the Salva and its tributaries – the Verbovets, the Belva and the Onok (Figure 1).

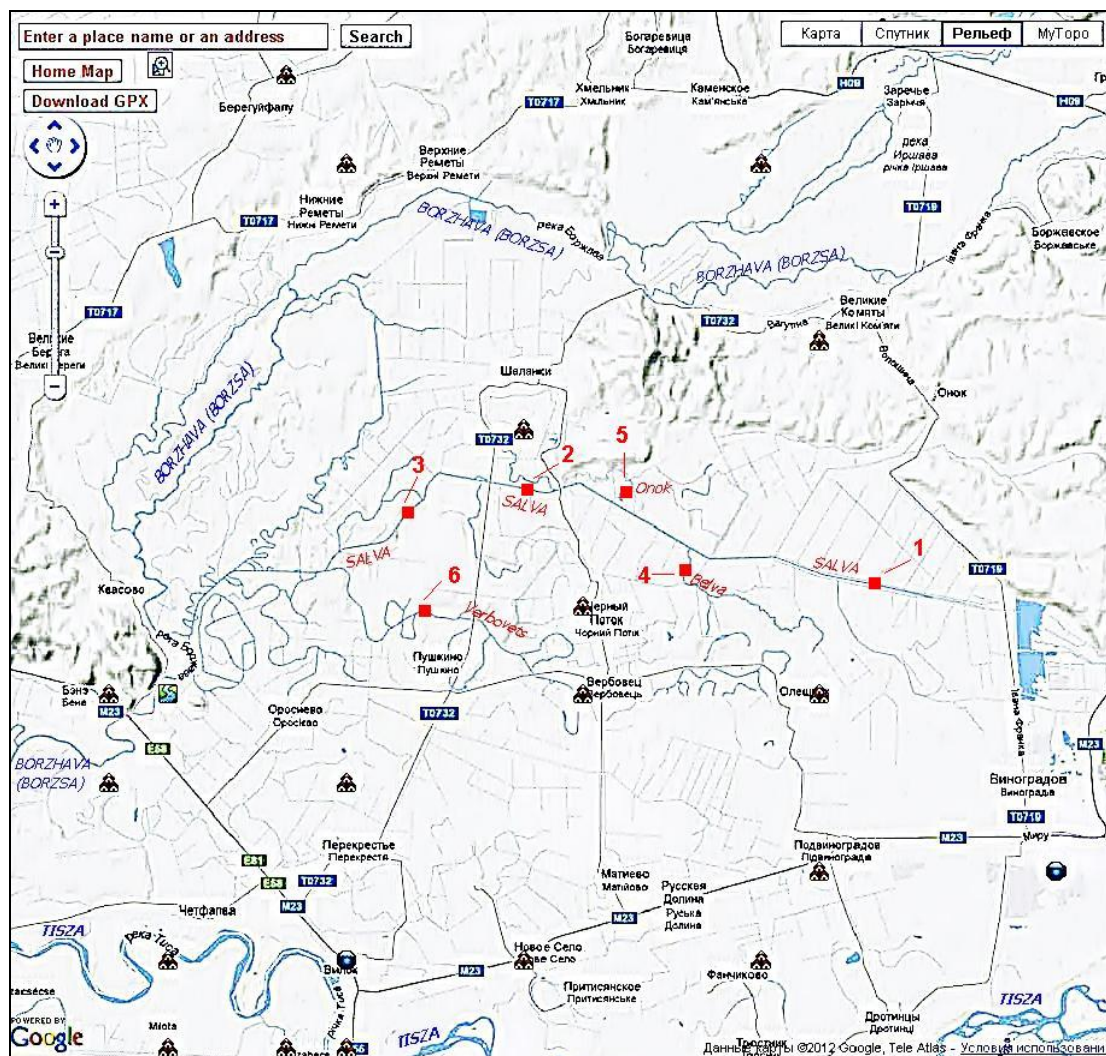


Figure 1: Map of region and layout of plots, which conducted water sampling study rivers:
1-3 – Salva, 4 – Belva, 5 – Onok, 6 – Verbovets

The water samples were taken on the spot of the fastest current in the upper third of the total depth (as a rule, 20 – 30 cm down from the surface), once in the volume of 1 dm³. They were not exposed to conservation, for the analyses were carried out within 24 hours from sampling. The contents of ammonium, nitrate, nitrite, phosphate ions, suspended substances were determined using the methods of photometric analysis, chemical oxygen demand and biochemical oxygen demand indices were determined of titration [9].

RESULTS

Having analyzed the decennial data obtained from the Laboratory of Zakarpatska Oblast Administration of the State Committee for Water Management of Ukraine, we detected insignificant fluctuations of certain hydrochemical indices within the Borzhava basin. For instance, no significant changes were observed in the contents of dissolves oxygen, dry particles and ammonium nitrogen in the Borzhava waters during 1990 – 2001. The concentrations of nitrites, nitrates and phosphates varied much more, due to the application of fertilizers into the soils of Transcarpathian and their further migration with surface and subterranean waters towards main watercourses of the river systems.

The water of the river Salva was shown to contain a significant amount of ammonium ions (0.12 – 0.21 mg/dm³), thereby being referred to moderately polluted according to the quality criteria set for the surface waters (Table 1).

Table 1: The results of hydrochemical analysis of water samples of the river Salva

<i>Indicators</i>	<i>Units</i>	<i>The analysis of samples №</i>			<i>Standards of quality drinking water</i>
		<i>1</i>	<i>2</i>	<i>3</i>	
Transparency	cm	24	22	22	-
Odor	points	1	1	1	before 2**
Color (for 4 cm ³)	degrees	10	10	10	before 20**
Suspended solids	mg/dm ³	7.7±0.8	9.6±0.9	8.6±0.8	-
pH	-	7.6±0.5	7.5±0.4	7.6±0.6	6.0-9.0**
Ammonium ions	mg/dm ³	0.14±0.01	0.21±0.01	0.12±0.01	<0.1*
Nitrite ions	mg/dm ³	0.04±0.01	0.05±0.01	0.03±0.01	before 3.3*
Nitrate ions	mg/dm ³	10.12±1.20	11.96±0.92	6.53±0.63	45**
Phosphate ions	mg/dm ³	0.05±0.01	0.06±0.01	0.05±0.01	-
Chemical oxygen demand	mg/O ₂ /dm ³	5.0±0.5	5.2±0.5	4.9±0.4	<5*
Biochemical oxygen demand (5 days)	mg/O ₂ /dm ³	3.1±0.1	3.3±0.2	3.0±0.1	<3*
Dissolved oxygen	mg/O ₂ /dm ³	10.9±0.5	10.8±0.7	11.1±0.6	>4*
Floating impurities	-	no	no	no	<0.25*

* - standard rates for II and III categories of surface water quality – clean water;

** - standard quality of drinking water in accordance with ГОСТ 2874-82 “Drinking water. Hygiene requirements, quality control”.

It was the river section near the Dubky Recreation Complex that was identified as the most polluted with ammonium compounds.

By the pH index, the water of the river Salva may be classified as moderately alkaline. It has a very slight odour, imperceptible for consumers, but detectible by specialists. Its colouring shows that the water contains a significant amount of humus substances and trivalent iron compounds.

The observed indices of chemical and biochemical oxygen demands also cause great concern. Their exceeding the norms set for clean water proved that by the quality categories the studied water may be referred only to Category IV, i.e. moderately polluted water. It means that this water contained a significant amount of organic substances highly resistant to oxidation.

Water analysis of the Belva, Onok and Verbovets showed that the Onok was the most polluted by the contents of ammonium ions, and the Belva – by the biochemical oxygen demand₅ (Table 2).

Table 1: The results of hydrochemical analysis of water samples of the rivers Verbovets, Bel'va, Onok (12 may 2009 year)

<i>Indicators</i>	<i>Units</i>	<i>The analysis of samples №</i>			<i>Standards of quality drinking water</i>
		<i>4</i>	<i>5</i>	<i>6</i>	
Transparency	cm	22	23	24	-
Odor	points	2	1	1	before 2**
Color (for 4 cm ³)	degrees	15	15	10	before 20**
Suspended solids	mg/dm ³	4.2±0.4	3.9±0.3	3.5±0.3	-
pH	-	6.6±0.7	7.2±0.5	6.5±0.4	6.0-9.0**
Ammonium ions	mg/dm ³	0.14±0.01	0.21±0.01	0.17±0.02	<0.1*
Nitrite ions	mg/dm ³	0.20±0.02	0.08±0.01	0.25±0.02	before 3.3*
Nitrate ions	mg/dm ³	10,60±1.50	7.53±0.74	12.95±1.21	45**
Phosphate ions	mg/dm ³	0.14±0.01	0.12±0.01	0.09±0.01	-
Chemical oxygen demand	mg/O ₂ /dm ³	3.4±0.3	3.0±0.2	3.2±0.3	<5*
Biochemical oxygen demand (5 days)	mg/O ₂ /dm ³	6.4±0.3	4.8±0.5	5.2±0.5	<3*
Dissolved oxygen	mg/O ₂ /dm ³	9.8±1.0	10.2±0.9	9.9±0.8	>4*
Floating impurities	-	no	no	no	<0.25*

* - standard rates for II and III categories of surface water quality – clean water;

** - standard quality of drinking water in accordance with GOCT 2874-82 “Drinking water. Hygiene requirements, quality control”.

It explains the cause of excess of pollutant levels observed along the section No.2 of the river Salva, into which the both rivers flow. The studied sections of the Belva and Verbovets also showed excess of the contents of ammonium compounds against the norms for surface waters quality categories II or

III.

It is worth noting that in comparison with the water of the river Salva, its tributaries showed a significantly lower total level of such compounds as salts Fe^{2+} , Mn^{2+} , NO_2^- , NH_4^+ and H_2S , proving a moderate level of chemical oxygen demand. Much more oxygen was consumed on biochemical oxidation (breathing of bacteria, oxygen consumption needed for decomposition of organic substances). Oxygen deficiency is known to be more often observed in aquatic objects with high concentrations of pollutants and in eutrophicated water bodies with a great number of biogenic and humus substances.

By colorimetric scale, the waters of the Belva and Onok were more colored (stained) than that of the Salva, but the former had much less contents of suspended matters than the latter. In comparison with the others, the water of the river Belva emitted appreciable odour (2 points) and had much more nitrate salts, though still not exceeding the admissible levels. We believe that such odour may have been caused by high contents of decomposing organic substances in the water.

DISCUSSION

The anthropogenic load on the Borzhava basin within Vinogradivsky rayon was assessed taking into account residential, agrarian, transportation, industrial, land improvement, recreational, etc. loads.

It is agriculture that creates most ecological load on the studied area. It is caused by a high share of tilled lands within the structure of the land reserves, and use of floodable areas as arable land. The total area of tilled lands in Vinogradivsky rayon is 1,400 ha. Their negative environmental impact lays in excessive application of fertilizers and pesticides. In 1997, 31.4 tons of pesticides were applied in the rayon; 22,800 ha of crops were exposed to different treatments, including 10,100 ha – with herbicides, 6,800 ha – with insecticides, and 5,900 ha – with fungicides. Pesticide load per hectare in the orchards and vineyards equaled to 10.4 kg/ha, at the tilled soils – 1.5 kg/ha.

Presence of ammonium compounds in concentrations of about 1 mg/dm^3 is known to lower the oxygen-binding capacity of fish hemoglobin. So, the heightened contents of ammonium compounds in the river Salva were indicators of deterioration of the sanitary condition of the water body and pollution of the surface waters, mainly with agricultural and household wastewaters. In clean surface waters, presence of ammonium ions was related mainly to the processes of biochemical decomposition of proteins and urea.

The Recreation Complex “Dubky” contributes to the river pollution of ammonium compounds by discharging its untreated wastewaters into it.

Resulting from a dramatic decrease of concentration of dissolved oxygen, the rich colour of the Salva's water worsens the organoleptics of the water, and affects negatively the development of aquatic flora and fauna.

By the contents of nitrites, nitrates and phosphates, the studied water may be referred to Category II, i.e. clean water.

So, the water of the river Salva was observed to be moderately polluted by the following indices: contents of ammonium ions, level of chemical and biochemical oxygen demands. It means that a certain part of the pollutants flow into the river Borzhava together with the water of the Salva, its tributary.

Phosphatic concentrations in surface waters are not restricted by admissible concentration limits, but it is generally considered that the values lower than 0.05 mg/dm^3 correspond to pure watercourses, and those exceeding this value – to polluted water bodies. The excess phosphor was evidently entering the water from the fields as the washouts of phosphatic manures, with the household wastewaters, and due to decomposition of the detritus of animal and plant organisms. So, regarding the contents of phosphor compounds, the studied tributaries of the river Salva may be classified as polluted.

As follows from the above, among the studied tributaries of the river Salva it was the river Belva that was proven the most polluted with organic compounds and phosphatic salts. It may be explained by the fact that the inhabitants of the villages along which this river flows, apply unreasonable land cultivation techniques and pollute the riverbed with household wastes.

CONCLUSIONS

It has been established that the surface waters of the Belva, Onok and Verbovets in the territory of Vinogradivsky area are polluted with organic compounds and hydrophosphates due to unreasonable use of land-improvement chemicals.



Among the studied rivers, the Belva (the Salva's tributary) has appeared to be the most polluted.

By the contents of ammonium ions, level of chemical and biochemical oxygen demand, the river Salva has proved to be moderately polluted along all sections.

The pollution level of the small rivers of the Borzhava basin in Vinogradivsky area threatens to deteriorate the ecological condition of the river Borzhava. All these lead to significant ecological losses and have negative environmental effects.

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