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Hydro-ecological investigation of the Lazeshchyna River in Transcarpathian region of Ukraine

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Abstract

This paper focuses on the hydro-biological and hydro-chemical analysis of the Lazeshchyna River, one of the tributaries of the Tisza River from the cross-border territory within Rakhiv area of Ukraine's Transcarpathian region. For this purpose, we used the results of route survey, hydro-biological and hydro-chemical analysis of the Lazeshchyna River surface water samples, which were collected forhydrochemical studies in 2017-2018. On the basis of water sampling we thoroughly analyzed the hydro-chemical water quality indicators of Lazeshchyna River according to the following groups of indicators: physic and chemical features, organic matter, water mineralization, major ions, nutrients, trace elements and specific pollutants. Hydrobiological studies were conducted in 2015-2016. Based on them, the water quality was assessed according to the Trent Biotic Index bioindication.
The ratio of actual and maximum permissible concentration (MPC) hydro-chemical parameters are investigated, moreover we pointed out the seasonality in the ratio of water consumption and concentration of individual indicators. The study underlines the role of natural and anthropogenic factors for the Lazeshchyna River water quality.

Keywords: *river, hydro-chemical characteristics, hydrological regime, bioindication, water pollution*

Rezumat. Analiza hidro-ecologică a râului Lazeshchyna din Regiunea Transcarpatică a Ucrainei

Lucrarea de față se axează pe analiza hidro-biologică și hidro-chimică a râului Lazeshchyna, unul dintre afluenții râului Tisa, în zona transfrontalieră Rakhiv din regiunea Transcarpatică a Ucrainei. Materialele pentru studiu sunt oferite de analiza cursului râului, analizele hidrobiologice și hidrochimice ale probelor de apă de suprafață prelevate din râul Lazeshchyna, în 2017-2018. Pe baza acestor probe, am analizat în detaliu indicatorii de calitate hidrochimică ai râului Lazeshchyna grupați în următoarele categorii: caracteristici fizice și chimice, materie organică, mineralizare a apei, ioni majori, nutrienți, oligoelemente și poluanți specifici. Studiile hidrobiologice au fost realizate în 2015-2016. Pe baza acestora, calitatea apei a fost evaluată conform indicelui de bioindicație Trent Biotic Index.
A fost analizat raportul dintre parametrii hidrochimici reali și maxim admis, evidențiind totodată și sezonalitatea raportului dintre consumul de apă și concentrația indicatorilor individuali. Este evidențiat rolul factorilor naturali și antropici pentru menținerea calității apei râului Lazeshchyna.

Cuvinte-cheie: *râu, caracteristici hidrochimice, regim hidrologic, bioindication, poluarea apei*

Introduction

Rivers are an important component of ecosystems and, in general, crucial for the formation of microclimatic conditions and water balance of territories, which has a direct impact on the status of all natural and anthropogenic complexes within river basins. At the same time, rivers undergo major changes due to human economic activities, as they are the basis of erosion and other biotic or abiotic factors.

It is important to preserve the natural conditions of formation of the ecological status of rivers, including the mountain ones, since their hydrological and hydrochemical regime determines the ecological status of downstream waters. Thus, the ecological status of the upper part of the Tisza River basin and its tributaries directly affects the status of the Tisza ecosystems downstream in other countries. This prompted us to study changes in the ecological status of the upper part of the Tisza River within the Transcarpathian region, which we consider appropriate, given that its waters are actively used for household water supply and industrial water supply. It should also be noted that individual sections of the Tisza River serve as a border line between Ukraine and Romania, Ukraine and Hungary, and the river basin generally covers the territories of five European countries: Ukraine, Slovakia, Romania, Hungary and Serbia. This determines the transboundary nature of ecological studies of the Tisza River Basin.

The object of the research is to analyze the hydro-chemical water quality indicators of the Lazeshchyna River, a left tributary of the Chorna Tisza, which, in fact, gives rise to the Tisza River within the Rakhiv area of Transcarpathian region of Ukraine. The river originates within the Chornohora mountain range at

the altitude of 1520 m, between the highest peaks of Petros and Hoverla.

This study aims to identify the natural and anthropogenic factors, as well as regularities of the formation of ecological state of surface water, of one of the sub-basins of the Tisza River using the analysis of hydrochemical and hydrobiological indicators. The purpose of our study is to determine the role of the Lazeshchyna River and its catchment area in shaping the ecological status of the upper Tisza River within Ukraine.

In order to achieve this goal we carried out a number of route surveys of the Lazeshchyna River and its basin during 2015-2018, and took water samples for chemical analysis, as well as conducted preliminary scientific studies on the subject. We also conducted hydrobiological studies of the Lazeshchyna River using the Trent Biotic Index bioindication method.

Characteristics of the Study Area

By the nature of the water regime and the structure of the valley, the Lazeshchyna is a typical mountain river. The river valley is slightly curvy, V-shaped, sometimes in the form of a gorge, with very steep slopes, and the floodplain is found only within the lower part of the channel. According to the studies of denudation processes in the Ukrainian Carpathians (Kovalchuk et al., 2012), river bank erosion can reach 200-250 meters along the Lazeshchyna River. The channel is slightly curvy, branched, and full of rapids. The river is 21 km long, the basin area covers 159 square km, and the density of the river network is 1.33.

The terrain within the basin is mountainous and highly indented due to a lot of watercourses, (149 in total), with a total length of 212 km (Kaganer, 1978). The catchment area of the Lazeshchyna River includes part of the mountain range of Chornohora in the Ukrainian Carpathians. It consists of sandstones and tertiary conglomerates of Tertiary age of the Cretaceous period. At the top of the basin there are traces of ancient glacial relief (Palienko, 2004). The most part of the studied area is occupied by brown earth and brown mountain forest soils. With change of altitude, forest formations of beech (Fagus sylvatica) and oak (Quercus robur L.) change to formations of fir trees (Picea abies). In general, forests cover about 53% of the Lazeshchyna basin (General management of the land cadaster, 2016). Subalpine vegetation grows starting from the altitude of 1500 m and is replaced by stripes of rhododendron (Rhododendron) and sedge (Carex sempervirens) at the altitude of 1800 m. The average precipitation quantity is 1200-1400 mm per year, most of which falls in the spring-summer period, which undoubtedly affects the hydrological regime of the river and causes an increase in water consumption and frequent floods, up to 10- 12 times during the year.

Fig. 1: The origins of the Lazeshchyna River; view from Petros Mountain

Wikipedia cartographic materials and Digital Elevation Database SRTM 90m data (SRTM 90m, 2003; Wikipedia, 2011) were used to view the location and topography of the Lazeshchyna river basin. With the help of the ArcMap 10.2.2 software and selection of the appropriate tools, an action algorithm was compiled to build a digital elevation model (DEM) of the Lazeshchyna river basin: Geoprocessing> ArcToolbox> Spatial Analyst Tools> Interpolation> Topo to Raster (Fig. 2).

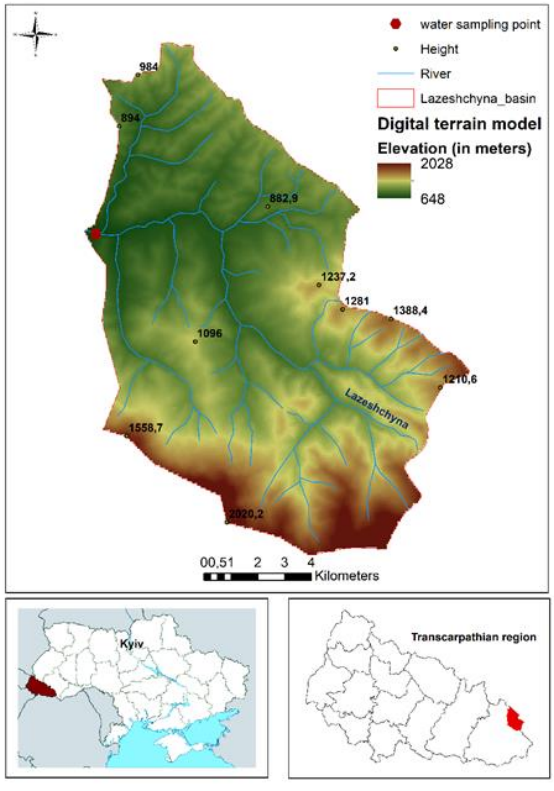

Fig. 2: Location Map of the Lazeshchyna river basin

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Human activities

The catchment area of the river is actively used in economic activities, tourism and recreation. The extent of economic load on river waters and floodplains, built up in some places or performing the function of agricultural land, is growing downstream. Such utilization of the catchment area of the upper Tisza is due to the predominance of mountainous terrain and, as a result, a small amount of land suitable for development and construction.

The economic impact on the Lazeshchyna River's basin is made mainly by agricultural crops along the river bank territories, farming, tourism and recreational activities, as well as technological load. The industrial activity is represented only by forestry enterprises. Still, livestock, especially cattle breeding, became widespread taking into account mountainous terrain, the presence of 2,000 hectares of hayfields and pastures, and historical way of life of highlanders. Grazing of sheep, cows and horses is done on 4 meadows within the studied basin. Farms and household activities are expanding and developing.

It is worth mentioning that the settlements within the catchment area of the Lazeshchyna River have no centralized water supply and sewerage systems, which causes pollution of river water by domestic runoff. Among the factors affecting the environmental status of the surface waters of the Lazeshchyna River, we mention the landfill site, located in the close vicinity to the river, as well as the fact that the garbage is collected from merely 8% of the population living there (General management of the land cadaster, 2016). It can be said that the banks of the river become landfills which during the floods flow and get accumulated downstream of the Tisza River.

Fig. 3: Landfill on the banks of the river Lazeshchyna

The tourist routes to the Chornohora mountain range including Petros and Hoverla peaks are laid through the settlements upstream. There are estates, tourist camps, and shelters that accommodate tourists throughout the year. Within the Lazeshchyna river basin, there are 35 tourist and recreational facilities, the presence of which contributes to the development of green tourism. The recreational activities are provided mainly from rural estates and the only "Kozmeshchik" recreation place.

It is also worth considering the technological load on the river. During the middle of the 20th century, there were 3 functional dams, with the help of which timber was alloyed (General map, 1910). At present, these dams are abandoned and destroyed. Today the influence on the formation of the channel is done through river bank fortification and new construction of dams. We also note that at the mouth of the river there are practically no natural banks and they are currently occupied by restaurants which also discharge sewage directly into the river. (Fig. 4).

Fig. 4: The mouth of the Lazeshchyna river

Materials and Methods

Hydrochemical studies of the Lazeshchyna River were carried out on the basis of hydrochemical measurements during 2017-2018 at a site located 0.5 km above the mouth of the river within the village of Yasinya, Rakhiv area, Transcarpathian region. Water sampling coordinates are 48°16'15.6 "N; 24°21'48.0" E. Sampling of river waters was taken in different seasons, respectively: one sample in the spring, (29.04.2017); second sample during the summer (29.08.2017); third sample in the autumn (18.11.2017); fourth samples in the winter (27.01.2018). The chemical analysis was done at the Tisza Water Basin Administration (Uzhhorod, Ukraine), hydrochemical laboratory for monitoring the waters and soils of the Tisza Water Basin Administration (Uzhhorod, Ukraine). In particular, we have identified and analyzed the following hydro-chemical parameters: pH, dissolved oxygen, permanganate oxidation, chemical oxygen demand - COD, biochemical oxygen demand - BOD5, water mineralization and major ions, N-NH4, N-NO2, N-NO3, P-PO4, Fe, Cu, Zn, Mn, Cr, Pb, the content of petroleum products, anionic surfactants (Rules for receiving wastewater, 2002).

In order for the results of the analyzed selected water samples to be of a comparative nature, we used the maximum permissible concentrations for fishery

waters (MPC) as value limits for all parameters in our study, which are adopted at the legislative level (Rules for receiving wastewater, 2002).

Water quality was also assessed by using the Bioindication Index or the Trent Biotic Index (TBI) of Woodiwiss (Semenchenko, 2004; Woodiwiss, 1964). Score rating of water quality by this index is translated into standardized categories of water quality according to the state norms of Ukraine (Arsanet.al. 2006; Methodology, 1998; Oksiyuk, and Zhukinsky 1993).

The index is based on two parameters of the benthic group: the general diversity of invertebrates that inhabit the body of water and the presence of organisms belonging to bioindicator groups. In June 2015 and July 2016, five areas of river channel of the Lazeshchyna River and two areas of the river channel of the Black Tisza River were studied in the area upstream and downstream the confluence of this tributary.

The following mathematical methods of physical geography were used to report the results of our studies: method of determining arithmetic means, ratio of quantitative indicators, statistical, tabular and graphical methods of analysis, computer processing of experimental data, synthesis and identification.

Results and Discussion

The values of the TBI index indicate that the waters of the source and middle reaches of the Lazeshchyna (from 700 m above sea level and above) are very pure (I grade water quality); within the Lazeshchyna village the water quality deteriorates to "good" (grade II); and near the confluence with the Chorna Tisza River it is slightly polluted.

The Chorna Tisza River itself is characterized by very clear waters before the confluence of the Lazeshchyna River tributary, but after the confluence the water quality deteriorates by one grade (up to "good").

In the lower reaches of the Lazeshchyna river there are no representatives of Perlidae in the benthos, which are indicators of very clear waters.

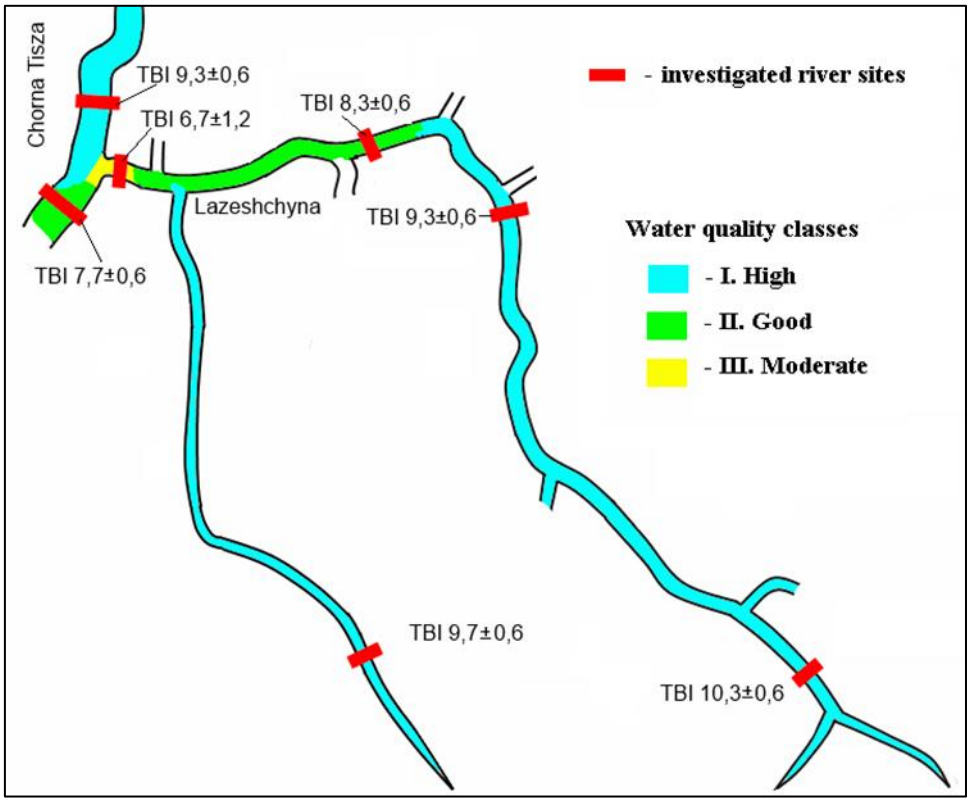

Fig. 5: Changes in the water quality of Lazenshchyna according to the TBI index

Physical and chemical indicators. Hydrogen (pH) is important for all chemical and biological processes in natural waters. During the study period, the pH oscillation amplitude was 0.5 units (7.8-8.3) which makes it possible to attribute the surface waters of the Lazeshchyna River to the category of slightly alkaline. The concentration of hydrogen ions is prone to seasonal changes.

The dissolved oxygen indicator in water is an important sanitary indicator of biological processes in streams and reservoirs. For fishery waters, the minimum dissolved oxygen content in water must be

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not less than 4 mg O2/dm3 in winter and 6 mg O2/dm3 in summer. In the waters of Lazeshchyna River, the dissolved oxygen indicator varies from 5.7 mg O2/dm3 in summer, 6.3 mg O2/dm3 in autumn and 5.9 mg O2/dm3 during the winter low water period, which allows them to be classified as polluted waters (quality categories moderate) due to exceeding the norms of MPC during the study period. Non-significant fluctuations are seasonal in nature and depend on the processes of oxygen absorption from the atmosphere, the release of vegetation in the process of photosynthesis, over-flowing with rain or thawing snow-water, and the reactions of oxygen demand on the oxidation of organic matter (BOD5, COD). This is evidenced by the results of water samples taken in autumn when the dissolved oxygen content did not reach the acceptable level.

Organic substances. Biochemical and chemical oxygen demand (BOD5, COD) are indicators that characterize the extent and dynamics of river water self-purification due to the reactions of biological, biochemical, and chemical oxygen consumption. They are expressed by the amount of oxygen spent on the oxidation of chemicals (Fe2+, Mn2+, N-NO2-, N-NH4+, CH4, H2S) and organic substances contained in water. Measurements indicate fluctuations in BOD5 and COD content within fisheries standards (MPC - 3 mg O2/dm3 and 15 mg O2/dm3).

According to the data below (Tab. 1) the increase in the chemical demand index up to 12.1 mg O2/dm3 may also be a consequence of pollution of the Lazeshchyna River by the household wastewater that, in the absence of centralized sewage, is a permanent negative contributor to both organic and inorganic toxicants. Permanganate oxidation (PO) is an indicator of the content of organic compounds readily available to aquatic organisms. The highest value (2.7 mg/dm3) of PO is during spring time, the lowest is during summer low water (1.9 mg/dm3) which indicates the dependence of the indicator on different phases of water volume.

Table 1: Seasonal variability of some hydrochemical parameters in the water of the Lazeshchyna River for the period 2017-2018

№	Indicator	Unit of measurement	Date				MPC**
			29.04.17	29.08.17	18.11.17	27.01.18	
1.	pH	un. pH	7,8	8,3	7,9	8,0	6,5-8,5
2.	permanganate oxidation	mg/dm^3	2,7	1,9	2,7	2,2	< 5,0
3.	dissolved oxygen	mgO_2/dm^3		5,7*	6,3	5,9*	> 6,0
4.	COD	mg/dm^3	5,5	10,2	11,9	12,1	< 15,0
5.	BOD_5	mg/dm^3	2,7	1,9	2,2	2,3	< 3,0

* - excess of value limits
** - MPC (Rules for receiving wastewater, 2002).

Water mineralization. The results of the studies indicate that the average rate of mineralization in the Lazeshchyna River was 170 mg / dm3.

In the studies of landscape complexes (Karabinyuk et al., 2017) water mineralization rates of 134 mg/dm3 and 179 mg/dm3 downstream were recorded. The maximum values of mineralization are characteristic for summer-autumn (183 and 167 mg/dm3, respectively) and winter boundary (172 mg/dm3), respectively during spring period it drops at least during the year values (158 mg/dm3).

Maximum mineralization values are characteristic for the summer-autumn period (183 and 167 mg/dm3, respectively) and winter low water period (172 mg/dm3) respectively, which drop by at least a year during spring time (158 mg/dm3). The general mineralization of the waters of the Lazeshchyna River indicates a low saturation of salts. The degree of mineralization is low; the category of mineralization is hypo-branched water. According to Horiev, Peleshenko, Khilchevskyi, 1995) the waters of the Lazeshchyna are moderately fresh (0.1-0.6 g/dm3), and - slightly mineralized (100-200 mg/dm3) (Alekin, 1953). Therefore, in terms of mineralization, the water from the river can be used for drinking supply.

Biogenic substances (compounds of nitrogen and phosphorus). An important set of surface water quality indicators are biogenic substances, the main of which are nitrogen compounds: N-NH4-, N-NO2-, N-NO3- and P-PO4-. Nitrogen-containing compounds are formed in water due to the ingress of humus substances, decomposition of urea and protein compounds, from precipitation, with runoff from agricultural land after the use of nitrogen fertilizers, farmland, with household waste. During the study period MPC norms were not exceeded and seasonal variability in the content of biogenic substances in the Lazeshchyna River depended on water consumption, the share of soil and surface runoff, meteorological conditions, as well as on household wastewater. Thus, the concentration of N-NH4- and P-PO4- increases in the summer-autumn period (0.14 and 0.15 mg/dm3, 0.05 and 0.06 mg/dm3, respectively) when agricultural land is being actively used because of the

glass-bottom structure of a narrow river valley, the coast line of the Lazeshchyna River is often occupied by agricultural lands. The concentration of N-NO2 in the waters of the Lazeshchyna practically does not change during the study period, but the content of N-NO3- increases with increasing water flow in the river from 1.2 mg/dm3 during the summer limit to 3.2 mg/dm3 during the passage of the watershed.

Table 2: Seasonal variability of indicators of biogenic substances in the water of the Lazeshchyna River for the period 2017-2018

№	Indicator	Unit of measurement	Date				MPC*
			29.04.17	29.08.17	18.11.17	27.01.18	
1.	$N\text{-}NH_4^-$	mg/dm^3	0,12	0,14	0,15	0,12	< 0,5
2.	$N\text{-}NO_2^-$	mg/dm^3	0,03	0,03	0,03	0,04	0,08
3.	$N\text{-}NO_3^-$	mg/dm^3	3,2	1,2	1,8	2,3	40,0
4.	$P\text{-}PO_4^{3-}$	mg/dm^3	0,05	0,05	0,06	0,04	0,17

** - MPC (Rules for receiving wastewater, 2002).

Trace elements. Trace elements are compounds of chemical elements whose concentration in water is measured in tens of micrograms per 1 dm3. In our case, they are Fe, Mn, Cu, Zn, Cr, Pb. At high concentrations, these elements can be toxic for the living organisms.

Concentration of Fe in the water of the Lazeshchyna River exceeds the MPC (0.05 mg/dm3), and it also exceeds MPC for commercial and drinking water (0.3 mg/dm3) in autumn (Fig. 6). The high concentration of iron can be explained by the processes of chemical weathering of rocks which are accompanied by their mechanical destruction and dissolution. Iron concentration has a clear seasonal variability and is also dependent on the chemical composition of the water and the pH. The studies on the content of heavy metals in the waters of the Upper Tisza basin (Lynnyk et al., 2018) show that the content of this metal can increase due to the dominance of inorganic substances.

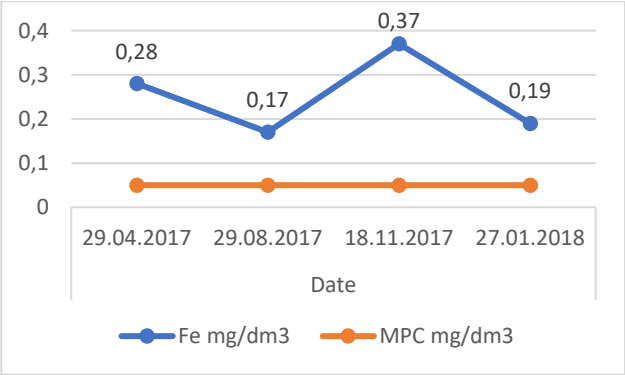

Fig. 6: Seasonal change in Fe content (mg/dm3) in the Lazenshchyna River (2017-2018)

The manganese (Mn) quantity in the water of the Lazeshchyna River in all cases exceeded the MPC (0.01 mg/dm3) (Fig.7). The highest concentrations of Mn were observed in spring and winter (0.08 mg/dm3), slightly lower in summer and autumn, respectively 0.06 and 0.07 mg/dm3. Such fluctuations in Mn content in the waters of the Lazeshchyna River indicate the dependence on water consumption (the lowest figure during the summer low water), on the increase in surface runoff in the spring and on the predominance of subsurface feeding during winter low water. Manganese in nature does not occur in free form, its high concentrations in natural waters may be due to the leaching of manganese ores and minerals, the processes of decomposition of aquatic animal and plant organisms, the reproduction of blue-green, diatomaceous algae, as well as higher aquatic plants. Given that we did not observe any excess of biogenic elements in the mountain at the Lazeshchyna River, we attribute high manganese content to leaching of this element from the rocks (Zhovinsky et al., 2008; Technical report, 2009; Lynnyk et al., (2018).

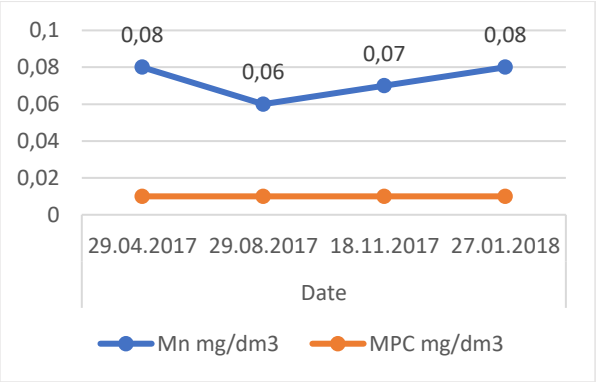

Fig. 7: Seasonal change in Mn content (mg/dm3) in the Lazenshchyna River (2017-2018)

Copper (Cu) according to Zabokrytska, Khilchevsky, and Manchenko (2006) is a widespread element, ionic form in compounds with organic and mineral substances. During 2017-2018 we recorded an excess of MPC Cu of 0.001 mg/dm3 5-6 times (Fig.

8). As in the case of Mn, high concentrations of Cu are associated with the leaching of this element from rock (Zhovinsky et al., 2008; Technical report, 2009; Lynnyk et al., 2018).

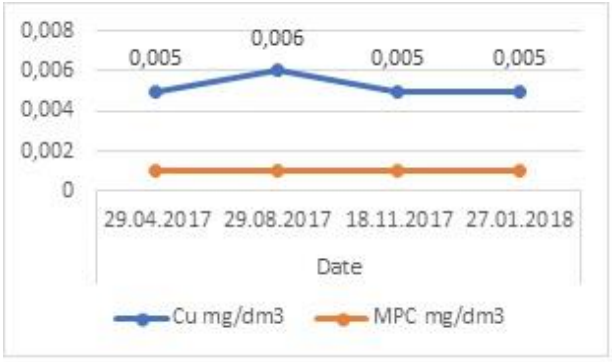

Fig. 8: Seasonal change in Cu content (mg / dm3) in the Lazenshchyna River (2017-2018)

The zinc (Zn) content was slightly higher than the summer-autumn limit and reached the MPC level in winter. Only in the spring this figure was within normal limits. Chromium (Cr) enters surface water in the process of chemical leaching of its compounds from rocks and minerals. According to the technical report (Technical report, 2009), a high Cr content in the soils of the Rakhiv district, within which the catchment area of the Lazeshchyna River is located, is also recorded. The results of four hydrochemical measurements of water samples for 2017-2018 showed a chromium content at the level of the normalized MPC value - 0.001 mg / dm3, which, given its toxicity, allows to speak about the threat of contamination, especially during the period of summer and winter. As for the concentration of lead (Pb) in the waters of the Lazeshchyna River, it does not reach the permissible standard MPC Pb of 0.1 mg / dm3, but it is in the range 0.003-0.005 mg/dm3, which allows to speak about the safety of water for the needs of fisheries (Tab.3). Increasing Pb concentration in winter and spring indicates anthropogenic impact from adjacent and adjacent territories (Zhovinsky et al, 2011).

Our studies are in line with the results of studies conducted from 1950 to 2007 by the Transcarpathian exploration expedition, which indicate that the increased content of Zn, Cu and Pb is mainly related to the natural manifestations of ore mineralization (leaching from the rocks).

Table 3: Seasonal change of Zn, Cr, Pb (mg/dm3) content in the Lazeshchyna River (2017-2018)

№	Indicator	Unit of measurement	Date				MPC**
			29.04.17	29.08.17	18.11.17	27.01.18	
1.	Zn	mg/dm^3	0,006	0,015*	0,012*	0,01	0,01
2.	Cr	mg/dm^3	0,001	0,001	0,001	0,001	0,001
3.	Pb	mg/dm^3	0,005	0,004	0,003	0,005	0,1

* - excess of value limits.
** - MPC (Rules for receiving wastewater, 2002).

Specific contaminants. Petroleum products are among the most common hazardous substances that contaminate surface water. During the sampling period, the content of petroleum products (non-polar hydrocarbons) did not exceed the regulatory value of 0.05 mg/dm3, and the level was 0.01 mg/dm3. Anionic surfactants are inorganic and organic substances that are included in detergents, emulsifiers and disinfectants, and thus come to the Lazeshchyna River with domestic sewage. Anionic surfactants content did not exceed 0.01 mg/dm3 at MPC <0.1 mg/dm3.

Given the complex terrain and low land, settlements of the Lazeshchyna basin are located along narrow valleys or high in mountainous terrain which complicates the laying of water supply and drainage network. Therefore, the population is independently provided with water at the expense of private wells or river water. This problem is particularly urgent for tourists and holidaymakers alike, as many tourist and recreational facilities use river water for domestic use, despite their inappropriateness for a number of chemical indicators. Accordingly, the absence of a centralized sewerage system causes the population to dump wastewater directly into the Lazeshchyna River.

Conclusion

Summarizing the results of our research, we can say that the main hydro-chemical indicators that exceed MPC are trace elements: iron (Fe), copper (Cu), zinc (Zn) and manganese (Mn), as well as low content of dissolved oxygen.

The values of the TBI index indicate that the waters of the source and middle reaches of the Lazeshchyna (from 700 m above sea level and above) are very pure (I grade water quality); within the

Lazeshchyna village the water quality deteriorates to "good" (grade II); and near the confluence with the Black Tisza River it is slightly polluted.

The Black Tisza River itself is characterized by very clear waters before the confluence with this tributary, but after the confluence the water quality deteriorates by one grade (up to good).

Based on the study materials, we can distinguish such types of anthropogenic influence on the Lazeshchyna River as: residential, agricultural, transport, recreational and domestic influence. The narrow river valley determines the complex nature of constructed houses and development of the banks, which in turn leads to non-observance of water protection measures, in particular for plowing, construction of structures, arrangement of landfills, contamination of fertilizers and pesticides, discharge of household waste. The combination of natural and anthropogenic factors leads to seasonal changes in the hydrochemical regime of the Lazeshchyna River as a consequence of the deterioration of water quality.

Due to the economic development of the Lazeshchyna basin, we observe a deterioration of the ecological status of the waters according to individual hydro-chemical indices and data of bioindication. Considering the fact that the upper Tisza, including part of the basin of Lazeshchyna, are key territories of the ecological network of the Transcarpathian region (Scheme of ecological network, 2013), it is necessary to emphasize the necessity of solving the problems related to the contamination of the channel and river banks, plowed banks, over-loading of recreational facilities, which, like the settlements located along the Lazeshchyna river, lack sewage systems and water treatment facilities.

Taking it is highly recommended that the Tisza Water Basin Administration (TWBA) (Uzhhorod, Ukraine), as part of the development of a new Integrated Management Plan for the Tisza River Basin within the Transcarpathian Region, take into account the results of this study to develop measures to eliminate the problems we identified and environmental loading factors on the Lazeshchyna River and its water intake territory.

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