

Mon22-070

The network of state surface water monitoring points in the upper reaches of the Tisza River: conditions, changes, innovations

V. V. Leta (Uzhhorod National University), ***P. V. Kucher** (Lviv state university of physical culture named after Ivan Boberskyj), **M. M. Karabiniuk** (Uzhhorod National University), **M. R. Salyuk** (Uzhhorod National University), **M. M. Kachailo** (Uzhhorod specialized school 3 with extensive English learning)

SUMMARY

An important component of environmental policy in Ukraine in the context of European integration is an establishment of a state water monitoring system taking into account international standards. The system of state water monitoring in Ukraine, after the approval in 2018 of the "Procedure for implementation of state water monitoring", underwent significant changes regarding the methodology, the procedure for conducting observations, their frequency (monthly water sampling), the distribution of powers for monitoring subjects and groups of indicators.

The studies that were carried out in the headwaters of the transboundary river Tisza shows that the number of water monitoring points in the basin of the river Tisza within the Rakhiv district of Transcarpathian region decreased by 2 times after 2018. At the same time, the program of state water monitoring has become more complex, because observations must be carried out according to biological, physicochemical, chemical, and hydromorphological indicators. Modernization of state water monitoring, taking into account the international experience of observations on transboundary rivers brings the water sector of Ukraine closer to international standards, which is an important aspect of integration into the European space.



Introduction

Various environmental monitoring, such as water, soil, air, etc., is of important environmental importance for the optimal functioning of the environment. State water monitoring is an important component of the state environmental monitoring system. Water monitoring plays an important role in environmental policy formation at the regional and state level. The obtained data can also be used to study the transformation of quantitative and qualitative indicators of surface water under the influence of climate change (Khilchevskyi et al., 2020).

An important element of the formation and development of water monitoring in Ukraine is the implementation of the provisions of the EU Water Framework Directive (Directive, 2000). The implementation of new monitoring approaches in cross-border areas of river basins after the approval by the Cabinet of Ministers of Ukraine in 2018 of the "Procedure for State Water Monitoring" (Cabinet of Ministers of Ukraine, 2018) has been effective.

To analyze the changes taking place in the Ukrainian water monitoring system in the period after 2018, the upper reaches of the Tisza River basin within the Rakhiv district of Transcarpathian region were chosen. The appropriateness of the choice of the research site is also due to the close cooperation of Ukrainian and Romanian monitoring specialists within the transboundary section of the Tisza River over the past 20 years. In addition to Ukraine and Romania, the Tisza River plays an important role in the water management of three other European countries. After all, the Tisza River is one of the ways of water resources outflow' outside of the Ukraine.

Materials and research methods

The research of the network of state monitoring points of surface water in the upper reaches of the Tisza River Basin (within the Rakhiv District of Transcarpathian region) was carried out on the basis of the fund materials of the Tisza Water Basin Administration, the State Environmental Inspection in Transcarpathian region, the Transcarpathian Regional Center for Hydrometeorology, as well as our own expedition research (Leta, Pylypovych 2019; Leta et al., 2019). Methods of statistical data analysis and cartographic interpretation have also been used.

Results

State water monitoring is carried out in order to ensure the collection, processing, preservation, generalization and analysis of information on the state of water bodies, forecasting its changes and developing scientifically based recommendations for decision-making in the field of water use, protection and reproduction of water resources. The objects of state water monitoring are surface water bodies (surface water bodies or their parts), including coastal waters and zones (territories) that are subject to protection (Cabinet of Ministers of Ukraine, 2018).

The purpose of surface water monitoring in the Tisza River Basin is to develop programs of measures to optimize anthropogenic impact on surface water bodies or the river in general in the context of forming a new Management Plan for the Tisza River Basin, taking into account the requirements of the EU Water Framework Directive.

1. Conditions of water monitoring until 2018

Subjects of water monitoring within Rakhiv district are: Tisza Water Basin Administration (State Agency of Water Resources of Ukraine) – 5 monitoring points; Transcarpathian Regional Center for Hydrometeorology (State Service for Emergency Situations of Ukraine) – 3 monitoring points; The State Environmental Inspection in Transcarpathian region (Ministry of Environmental Protection and Natural Resources of Ukraine) – 2 (4 – during 2007-2011) monitoring points (Fig. 1 A).

The Tisza Water Basin Administration began the water quality monitoring of the upper reaches of the Tisza River Basin in 1994 (Table 1). The Transcarpathian Regional Center for Hydrometeorology



(Transcarpathian Regional Center for Hydrometeorology) began waters monitoring much earlier – in 1946. As is known, the national hydrometeorological service has a long history of river observations (Osadchyi et al.,2021). Instead, since the 2000, the State Environmental Inspection in Transcarpathian region (Transcarpathian SEI) has been monitoring the Tisza River waters exclusively at cross-border points, with the exception of 2007-2011, when the conditions of water in the mouths of the Black Tisza and White Tisza rivers have been additionally monitored.

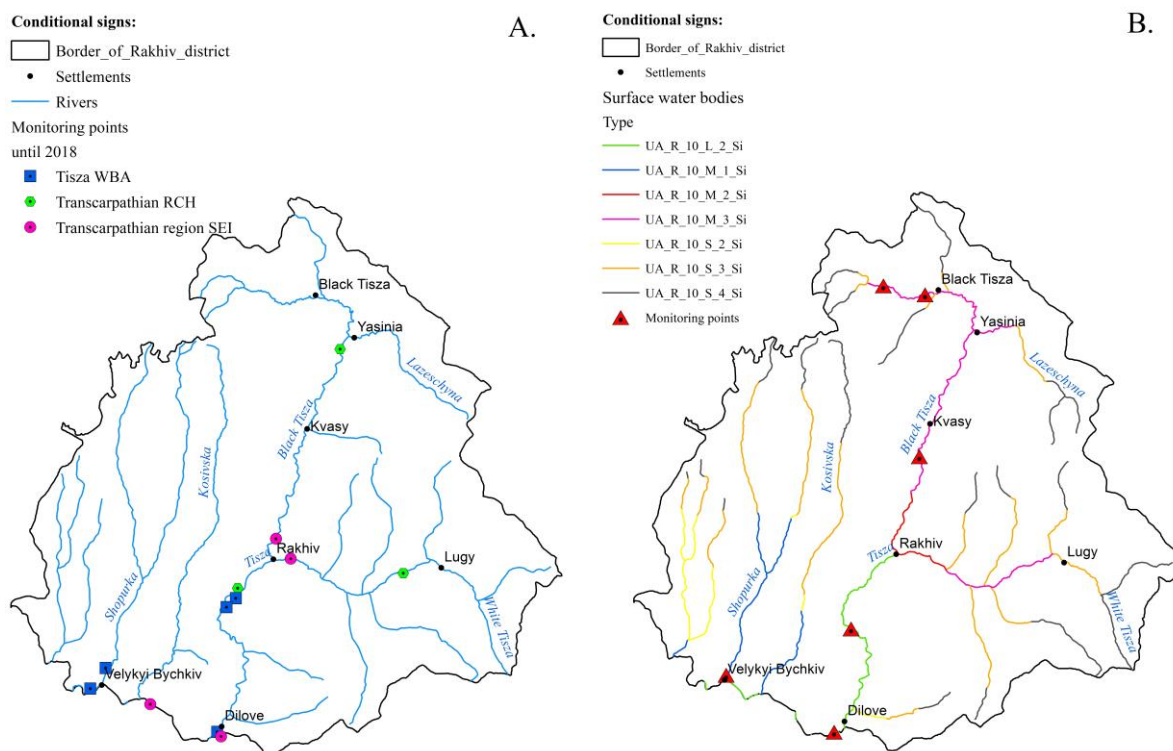


Figure 1 Maps of the water monitoring points network in the upper reaches of the Tisza River within the Rakhiv district of Transcarpathian region: A.) until 2018; B.) after 2018

Table 1 Chronology of the start of water monitoring in the upper reaches of the Tisza River by various monitoring entities

№	Water monitoring institution	Start of monitoring, year
1	Tisza Water Basin Administration (Water Resources State Agency of Ukraine)	1994
2	Transcarpathian Regional Center for Hydrometeorology (Emergency State Service of Ukraine)	1946
3	State ecological inspection in the Transcarpathian region (Ministry of Environmental Protection and Natural Resources of Ukraine)	2000

A number of problems arose as a result of the monitoring of the waters of the Tisza River basin within the Rakhiv district by several separately functioning entities. In particular, in certain periods, 3 monitoring points functioned simultaneously in the vicinity of the city of Rakhiv, and 2 in the village of Dilove, which were subordinated to different organizations. The disadvantage is also the inconsistency of monitoring programs regarding the sampling frequency and their numbers throughout the year, as well as the number of physico-chemical and chemical indicators of water quality that have been monitored. Thus, the Tisza Water Basin Administration conducts, on average, from 4 to 8 water samplings during the year, less often 12 - at the point in the village of Dilove. Water sampling conducted by the Transcarpathian Regional Municipal Health Service is also non-



systematic. Samples are taken monthly within the cross-border points on the Tisza River of Transcarpathian SEI (State ecological inspection).

Some difficulties also arise when trying to analyze and assess water quality in order to determine the dynamics of changes in the ecological conditions of the Tisza River and its tributaries within the Rakhiv district, which is due to differences in the groups of physicochemical and chemical indicators. In particular, there are practically no heavy metals in the monitoring program of Transcarpathian SEI (State ecological inspection). At the same time, the program of the Transcarpathian Regional Center for Hydrometeorology (Transcarpathian RCH) contains a limited list of oxygen regime indicators and is more focused on the study of the ionic composition of waters and mineralization. A comprehensive assessment of water quality can only be made on the basis of the materials of the Tisza Water Basin Administration "Tisza WBA".

2. Monitoring of water conditions after 2018

Conducting water monitoring within transboundary sections of river basins requires compliance with international norms and standards. Taking into account the fact that the Tisza River basin includes the territory of five states, the system of hydro-ecological monitoring of its waters has undergone changes. Thus, on January 14, 2019, the order of the Ministry of Ecology and Natural Resources No. 5 approved the "Methodology for assigning a body of surface water to one of the classes of ecological and chemical conditions of the body of surface water, as well as assigning an artificial or significantly changed body of surface water to one of the classes of ecological potential of artificial or a significantly changed body of surface water", which takes into account the environmental quality standards defined in Directive 2013/39/EU in August 12, 2013 (Directive 2013; Ministry of Ecology, 2019).

European monitoring standards implementation led to the reformation of the Ukrainian system, which was first of all reflected in the number and location of the network of monitoring points. Therefore, the system of monitoring the waters of the Tisza River in Transcarpathian region in general and Rakhiv district in particular acquired radically new features. The determining factor in creating a new network of water monitoring points is the differences in the natural conditions of the surface water masses, into which all the rivers of the studied territory are conditionally divided. Therefore, since the beginning of the introduction of new norms in Transcarpathian region, the number of monitoring points for surface water bodies has doubled: from 15 in 2019 to 30 in 2020. In 2021, new surface water bodies were determined and more 15 points were added for monitoring.

As of 2022, 6 monitoring points located along the Black Tisza and Tisza rivers are functioning within the Rakhiv district (Fig. 1 B). The network of monitoring points operating after 2018 has an important difference in the choice of water sampling location. For each large river, reference conditions are defined, which are represented by the massifs of surface waters of the Black Tisza River, which extend from the source of the river to the confluence of the Stanislav stream in the vicinity of the village of Black Tisza.

The procedure for state water monitoring, which was approved in 2018, clearly defines the division of responsibilities between monitoring subjects without duplication of powers (Cabinet of Ministers of Ukraine, 2018). New indicators of water monitoring have been also introduced, which were not determined in Ukraine previously, such as priority, hydromorphological and biological. During the determination of the surface water ecological body conditions, physicochemical and chemical indicators of the surface water bodies' quality are only auxiliary, but so far they are the only ones in the system of determination of the ecological water conditions.

Conclusions

1) The system of state monitoring of water in Ukraine after the approval in 2018 of the "Procedure for implementation of state water monitoring" underwent significant changes regarding the methodology,



the procedure for conducting observations, their frequency (monthly sampling), the distribution of powers of monitoring subjects and groups of indicators.

2) After 2018, the number of monitoring points on the state water monitoring network in the Tisza river basin within the Rakhiv district of Transcarpathian region decreased by 2 times and does not cover the massifs of surface waters of the White Tisza and Shopurka rivers.

3) At the same time, the state water monitoring program has become more complex - observations should be carried out according to biological, physico-chemical, chemical and hydromorphological indicators.

4) Modernization of state water monitoring brings the water sector of Ukraine closer to international standards, which is an important aspect of integration into the European space.

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МУКАЧІВСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ

89600, м. Мукачево, вул. Ужгородська, 26

тел./факс +380-3131-21109

Веб-сайт університету: www.msu.edu.ua

E-mail: info@msu.edu.ua, pr@mail.msu.edu.ua

Веб-сайт Інституційного репозитарію Наукової бібліотеки МДУ: <http://dspace.msu.edu.ua:8080>

Веб-сайт Наукової бібліотеки МДУ: <http://msu.edu.ua/library/>