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MODERN SCIENCE: TRENDS, CHALLENGES, SOLUTIONS

PROCEEDINGS OF IV INTERNATIONAL SCIENTIFIC AND PRACTICAL CONFERENCE NOVEMBER 13-15, 2025

LIVERPOOL 2025

MODERN SCIENCE: TRENDS, CHALLENGES, SOLUTIONS

Proceedings of IV International Scientific and Practical Conference

Liverpool, United Kingdom

13-15 November 2025

Liverpool, United Kingdom

2025

UDC 001.1

The 4th International scientific and practical conference "Modern science: trends, challenges, solutions" (November 13-15, 2025) Cognum Publishing House, Liverpool, United Kingdom. 2025. 732 p.

ISBN 978-92-9472-191-4

The recommended citation for this publication is:

Ivanov I. Analysis of the phaunistic composition of Ukraine // Modern science: trends, challenges, solutions. Proceedings of the 4th International scientific and practical conference. Cognum Publishing House. Liverpool, United Kingdom. 2025. Pp. 21-27. URL: https://sci-conf.com.ua/iv-mizhnarodna-naukovo-praktichna-konferentsiya-modern-science-trends-challenges-solutions-13-15-11-2025-liverpul-velikobritaniya-arhiv/.

Editor
Komarytskyy M.L.
Ph.D. in Economics, Associate Professor

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e-mail: liverpool@sci-conf.com.ua

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GEOGRAPHICAL SCIENCES

UDC 556.3:504.06(477.82)

ASSESSMENT OF THE HYDROGEOECOLOGICAL STATE OF THE PRIPYAT RIVER BASIN

Vovk Oleksandr Pavlovych,
PhD (Geology), Associate Professor
Polyansky Serhiy Volodymyrovych
PhD (Geography), Associate Professor
Shut Bohdan Volodymyrovych
Second-year Master's student
Lesya Ukrainka Volyn National University, Lutsk, Ukraine

Abstract. This article highlights the principal directions of research concerning surface and groundwater within the Prypiat River basin. The groundwater monitoring network is currently in a critical state. Insufficient and delayed funding of hydrogeological programs has resulted in the decline of systematic groundwater observations. The natural functioning of the basin is further disrupted by the ongoing military conflict in Ukraine caused by the armed aggression of the Russian Federation. As surface water pollution continues to increase, groundwater is expected to play a growing role in water supply due to its generally better quality and higher natural protection from contaminants. Nevertheless, under strong anthropogenic influence, groundwater remains vulnerable to degradation. Such circumstances threaten Ukraine's overall ecological security and underline the urgent need to modernize national water monitoring and management systems in line with the EU Water Framework Directive [1, 2].

Keywords: groundwater, surface water, Prypiat River basin, hydrogeoecological condition, monitoring, reclamation, anthropogenic load, pollution, international agreements.

Introductions. Situated in northwestern Ukraine, the Prypiat River basin plays a key role in sustaining the hydrological balance of Polissia and is one of the main tributaries of the Dnipro River. Its water resources are shaped by both natural conditions – geological structure, wetlands, and forest cover – and human activities, including agriculture, industry, and land reclamation [1, 5]. The basin is also subject to the cumulative effects of warfare, industrial pollution, and the long-term aftermath of the Chornobyl disaster, which together pose serious risks to water quality and ecological stability [3, 4].

Aim. The purpose of this study is to evaluate the current hydrogeoecological condition of the Prypiat River basin, determine the main factors influencing the quality and quantity of surface and groundwater, and develop recommendations for sustainable water management under current environmental and socio-economic challenges.

Materials and methods. The assessment relied on long-term hydrogeological monitoring data from the State Enterprise "Geoinform of Ukraine" [5], open data from the State Register of High-Risk Facilities [3], and results from scientific publications focusing on hydrological, hydrochemical, and reclamation processes in the Polissia region [6–8]. Geostatistical and GIS-based analyses were used to trace spatial trends in groundwater quality and to optimize the monitoring network [6]. Comparative evaluation followed EU directives and international guidelines for the sustainable conservation of peatlands and mires [1, 2, 9].

Results and discussion. The research area lies within the Prypiat River basin, which has experienced strong anthropogenic pressure due to drainage reclamation, agricultural practices, and industrial expansion. Over recent decades, these factors have considerably altered the basin's hydrological regime, affecting groundwater composition and the ecological stability of wetlands [7, 10].

Analysis of hydrological and hydrochemical data shows that the most vulnerable territories are reclaimed lands and settlement zones with dense drainage networks and high agricultural load [8, 11]. The deterioration of groundwater quality is mainly associated with increased concentrations of nitrates and ammonium ions

caused by agricultural runoff and domestic wastewater infiltration [6, 8].

According to recent findings, groundwater in the Volyn region is increasingly exposed to both natural and human-induced stressors, demanding comprehensive protective and management measures [5, 12]. O. Vovk et al. (2023) noted that groundwater quality in Volyn varies spatially depending on geological and anthropogenic conditions, with several areas already requiring restoration and rational use strategies [13].

Similar challenges are observed in the Prypiat River itself, where water quality deterioration has been recorded in the lower reaches. As reported by Vovk and Khomuk (2021), the river's self-purification ability has declined due to eutrophication and large-scale drainage works, making cross-border cooperation essential for improving its ecological status [14].

Geostatistical results further demonstrate uneven spatial coverage of the monitoring network, indicating the necessity to reorganize and densify observation points for more accurate representation [3]. Enhancing ecological monitoring and rehabilitating peatlands and drained wetlands could help restore hydrological balance and reduce negative environmental impacts [1, 9].

The ecological condition of the Prypiat–Stokhid National Nature Park remains particularly sensitive to both climatic fluctuations and human activity [4, 11, 15]. Therefore, maintaining groundwater reserves and improving water quality within the basin must become regional priorities under the framework of sustainable water management and ecological security [12, 16].

Conclusions.

The conducted analysis shows that the hydrogeoecological state of the Prypiat River basin is currently critical and demands urgent and coordinated measures. The combination of long-term anthropogenic pressure, intensive land reclamation, agricultural pollution, and industrial impact has led to a marked degradation of both surface and groundwater quality. The hydrological network of the basin, which once functioned as a natural regulator of water balance, has been severely disturbed. As a result, wetlands and peatlands are drying out, groundwater levels are declining, and

the overall resilience of local ecosystems has weakened.

Restoration of the groundwater observation network should therefore be considered a priority task. Reliable and systematically updated information is essential for identifying vulnerable zones, predicting changes under climate variability, and planning effective mitigation measures. Alongside monitoring improvement, it is necessary to introduce environmentally sound land-use practices and modern water treatment technologies, particularly in agricultural and industrial sectors. Reducing the inflow of nutrients and pollutants into both surface and groundwater will help stabilize hydrochemical parameters and improve ecological safety across the region.

Equally important is the harmonization of national and regional water management policies with the EU Water Framework Directive. The implementation of integrated water resources management principles will enable a more balanced use of surface and groundwater, ensuring that economic development does not come at the expense of environmental degradation. Transboundary cooperation within the Prypiat basin should also be intensified, given that this river system extends beyond Ukraine's borders and plays a strategic role in the Dnipro River basin.

In the broader perspective, the sustainable recovery of the Prypiat River basin requires a combination of scientific, technical, and organizational efforts. Enhancing institutional capacity, developing regional water protection programs, and engaging local communities in environmental decision-making will significantly strengthen the basin's ecological resilience. Only through consistent and scientifically grounded management can stable hydrological conditions be restored, ensuring safe and sustainable water use for future generations [10-12, 17].

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