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Conceptual approach to the monitoring programme for the wetland of international importance Prut River Headwaters

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Abstract. Functioning as a flood regulator and a freshwater reservoir, the Prut River Headwaters Wetland, protected under the Ramsar Convention, is a crucial hub of biodiversity, including endemic, rare, and threatened species listed in the national and global Red Lists. There are gaps regarding site management issues, including a lack of an integrated wetland monitoring system. Therefore, the objective of this research was to organise the processes involved in the comprehensive planning of wetland monitoring. To achieve this, the study utilised the conceptual framework for monitoring developed by the expert group of the UNESCO Chair on Sustainable Management of Conservation Areas. By employing the method of information-analytical research, a model for the water monitoring programme focused on the Prut River Headwaters Wetland was developed. A combination of physicochemical and hydrobiological assessments has been designed and partly tested. The method was used to test the universality of the proposed methodology in a specific studied area that requires sustainable management, and for the purpose of studying the perspective of application to other wetlands or valuable natural complexes in nature conservation areas. For the Conceptual Phase of the monitoring programme development, the key elements of river basin management of the Water Framework Directive of the European Union were used in synergy with the provisions of the Ramsar Convention. During the Implementation Phase, field and laboratory investigations of water bodies within the testing site at seven control points were conducted (measuring physicochemical parameters with portable equipment). All parameters' values were within the limits of permissible norms. A primary database of results stored in the SMART software has been created. The practical implementation of the water monitoring plan is anticipated to contribute to the evaluation of the wetland ecosystem's condition and support the administration of the Carpathian National Nature Park in the sustainable management of the wetland area

Keywords: Carpathian National Nature Park; Ramsar site; monitoring global guideline; multilevel water monitoring programme; database

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Introduction

Wetlands are very valuable ecosystems that play a crucial role in performing a wide range of substantial benefits for human welfare, wildlife, and the maintenance of environmental stability. Some wetlands have been recognised for their international conservation importance. One of the key wetlands' ecosystem services is their capacity to maintain and improve water quality. However, this function is decreasing due to human activities and extreme weather conditions, which have a significant impact on water flows, nutrient balance, and biodiversity.

E. Duku *et al*. (2022) noted that in a rapidly urbanised socio-ecological landscape, the Ramsar site has an increasing trend of anthropogenic and natural stresses that affect the relationship between ecosystem services and human wellbeing. The researchers V. Kyyak *et al*. (2021) emphasised that intensive recreation negatively impacts the biological communities, which are located along the popular tourist trails, and systematic violations of the protection regime are observed in the Ukrainian Carpathians. The challenge is how to avoid the destruction of those landscapes from anthropogenic influence and how to retain their values in terms of ecosystem services. Governance is a very difficult task. Good governance is very much about participatory culture, and it is true that it is time and resource consuming. It is also about short term perspective. Numerous individuals and organisations have dedicated their efforts to prevent further wetland loss. It was a necessary and important first step, but a range of external pressures can lead to a decline in the natural condition of the wetlands. For instance, changes in hydrological regime, water pollution, nutrient enrichment, and invasion by weeds can lead to biodiversity degradation and threats to wetland functioning. J. Bai *et al*. (2022) recognised that water pollution occurs when pollutant concentration exceeds a water body's potential self-purification.

The particular focus of this study is the Prut River Headwaters Wetland that was designated in 2019 by the Ramsar Secretariat as a wetland of international importance. This site is located within the Carpathian National Nature Park (CNNP), Ukraine. I. Danylyk & B. Prots (2019) argued that this site is crucial for the natural functioning of the Prut River basin, playing a significant role in flood control and mitigation. It serves as an important reservoir, accumulating water seasonally for the protected areas within the park and downstream. A previous study conducted by K. Matiyiv *et al*. (2022) drew attention to numerous tourist routes passing within the wetland, causing anthropogenic pressure on certain components of ecosystems (trampling, littering, and unauthorised collection of biological resources). The most destructive effect on vegetation and soil is observed following visits from large groups of people. The collection of water parameters is intended to become the basis of regular monitoring to determine the dynamics of wetland ecosystem change. For wetland wise use and planned measures, the monitoring can be improved after revision and in accordance with the identified risks. Scientifically-based long-term monitoring is the basis for the development of management plans.

As emphasised by D. Abdul Malak *et al*. (2019), the Ramsar Convention notes that downward trends in wetlands on a global scale occur due to increased human use of wetlands and the lack of specific policy goals and objectives, particularly on a regional scale, to address wetland degradation and propose clear measures for restoration and conservation. D.T. Dalton *et al*. (2023) proved the fact that for effective site management, applied monitoring should be carried out using innovative techniques. Scientifically based monitoring is used in order to generate new knowledge and improve methodologies, instruments, and tools. In general, most of the studies implemented in Ukraine were aimed at carrying out a basic wetland inventory. Assessment and monitoring processes within the wetlands in Ukraine in the context of the Ramsar Convention are in the initial stage. This is one of the reasons for the lack of management plans that are based on the results of assessment and monitoring.

Due to international obligations under the Ramsar Convention, Ukraine is obliged to update data on the wetlands after two years following its registration. Taking into account the main stress factors for the wetlands of the CNNP, including tourism, recreation, and climate change, a water monitoring plan can significantly contribute to improving the park monitoring system and creating preconditions for wise wetland use in the future. The objective of the research was to organise the processes involved in the comprehensive planning of wetland monitoring. This study and its results indicate that the topic is relevant and important in a broad context of nature conservation through management issues, including comprehensive monitoring of water resources in valuable ecosystems. The research has scientific value and demonstrates the novelty of approaches and tools for solving a scientific task.

Materials and Methods

The following methods were used in this research: information-analytical, expert evaluation, field study, statistical analysis, measurement, and modelling. Data collection is carried out in the Microsoft Excel environment and spatial monitoring and reporting tool (SMART) software; the geographic information system (GIS) in the QGIS environment has been used for cartographic modelling. The conceptual framework for biodiversity monitoring in conservation areas of the UNESCO Chair of Sustainable Management of Protected Areas at the Carinthia University of Applied Sciences (CUAS), Austria, was applied and adapted for the water monitoring plan within the wetland, taking into account local conditions. This manual was used as the basis for developing the water monitoring plan, combining biotic and abiotic parameters. The process of monitoring plan development was provided in four phases: the Preparatory Phase, the Conceptual Phase, the Implementation Phase, the Re-evaluation Phase. The synergy of the EU Water

Framework Directive (WFD), in particular Horizontal Guideline No. 12 on the role of wetlands in the WFD, was explored, allowing the application of key elements of the river basin management plan as a tool for the development of a wetland monitoring plan. The Ramsar Information Sheet was used as an initial source of information about the Prut River Headwaters Wetland (Danylyk & Prots, 2019).

Surface water body (WB) delineation within the wetland was conducted according to the WFD approach and based on the methodological adaptation of expert guidance addressing hydromorphology and physic-chemistry for a pressure-impact analysis/risk assessment according to the EU WFD. WBs differentiation involved dividing into three types of surface waters: river (RWB), lake (LWB), and artificial WB (AWB). Surface WBs were divided into sections, taking into account hydromorphological conditions and possible anthropogenic threats. The principles of the Driver-Pressure-State-Impact-Response (DPSIR) methodology were used to recognise pressure and the possible impact of anthropogenic factors on the water ecosystem (point and diffuse sources of pollution, water abstraction, and hydromorphological alterations). Taking into account the pressure and impact on the water ecosystem identified by a group of experts, M. Korchemlyuk *et al.* (2019), the formulation of the monitoring statement has been done in order to ensure ecological stability and wise use of the wetland. A multi-level monitoring plan was developed based on the WFD approach.

Water quality testing in the Prut River at designated monitoring points was carried out by employees of the Measuring Laboratory of Analytical Control and Monitoring of the CNNP. The most representative WBs with identified anthropogenic pressure were selected for the monitoring testing programme. The following parameters were investigated: mineralisation, temperature (T), acidity (pH), dissolved oxygen (DO), biochemical oxygen demand for 5 days (BOD_5), and nitrates (NO_3^-). Four expeditions were made between May 2022 – February 2023. The research was conducted in the main hydrological seasons, covering high-water and low-water periods. For measuring parameters portable equipment has been used, such as a pH meter with an automatic temperature measurement function, a salinity meter with an automatic temperature measurement function, an oximeter, and a nitrate meter. The obtained results were entered into the SMART software database. It combines GIS with database tools and digital field assessment. The SMART system consists of three components: SMART Mobile, for a phone with the Android operating system; SMART Desktop, for a personal computer; and SMART Connect, for a server.

Results and Discussion

In the framework of the Preparatory Phase the synergy between the Ramsar Convention and the EU WFD has been studied. Both documents acknowledge the ecological significance of wetlands and their vital contribution to a range of ecosystem services, including water purification, flood regulation, and biodiversity habitat. They also emphasise the importance of adopting sustainable water management practices and incorporating environmental considerations into decision-making processes. In fact, the Prut River basin within the Hoverla Scientific Nature Protection Department of the CNNP and the Prut River Headwaters Wetland are one and the same territory. The Prut River Headwaters Wetland is a component of the hydrological continuum of the Prut River basin; therefore, it can significantly affect their condition. It means that application of both International Agreements is justified. Moreover, their synergies can assist in the development of new interdisciplinary research. The process of delineating and defining surface water bodies has involved dividing them into distinct sections and parts, considering hydromorphological conditions and potential threats based on the following criteria: WBs without any anthropogenic influence (reference conditions); WBs with known anthropogenic influence; the first-order tributaries of the Prut River; man-made/artificial ponds. Three types of 18 surface WBs were identified within the wetland and proposed for the water monitoring programme (Fig. 1): 16 RWBs – Prut River and tributaries of the first order; 1 LWB – Nesamovyte Lake; 1 AWB – the complex of the artificial water ponds for fish breeding that are on private property, but currently they are out of operation. The DPSIR methodology was used to identify the pressure and potential impacts of anthropogenic factors on the water ecosystem, including point and diffuse sources of pollution, water abstraction, and hydromorphological alterations (Table 1).

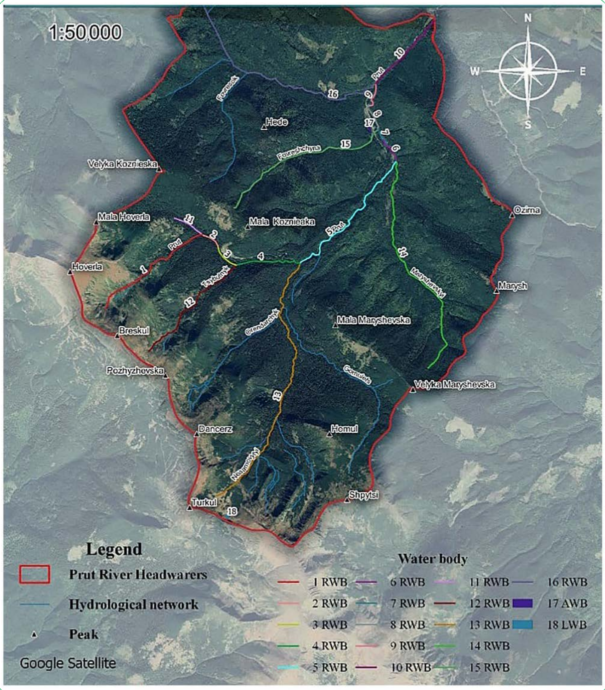

Figure 1. Water bodies delineated for water monitoring of the Prut River Headwaters Wetland

Source: created by the authors

Table 1. The DPSIR principle linking drivers and possible impacts on water bodies of Prut River basin within the wetland

Type of influence	Driver forces	Pressures	State	Impacts	Responses
Diffuse sources pollution	Tourism/ recreation	Solid waste/illegal dumping	Chemical pollution of surface water (SW) and ground water (GW)	Reduction of WB status, decreasing of biodiversity	Design of monitoring, tailor-made programme of measures
Diffuse sources pollution	Tourism/ recreation	Waste water discharges from sanitary and hygienic building	Chemical pollution of SW and GW	Deterioration of the ecological status of WBs	Tailor-made programme of measures (modernisation of waste water treatment plan (WWTP))
Point sources pollution	Tourism/ recreation	Waste water discharges from sport complex Zarosliak	Chemical and microbiological pollution of SW and GW	Deterioration of the ecological status of WBs	Tailor-made programme of measures (modernisation of WWTP)
Hydrological alteration	Water abstraction	Insufficient ecological flow	Changes the natural flow pattern and the amount of water in the environment	Deterioration of the hydrobionts' habitat	Design of monitoring programme
Hydrological alteration	Habitat continuity interruption	Altered flow conditions	Interruption of river continuity and fish migration routes	Deterioration of the hydrobionts' habitat	Design of monitoring programme

Source: created by the authors

After analysing the factors affecting the ecological status of the water resources of the wetland, the impact of tourism and recreation, which causes both point and diffuse sources of water pollution, was particularly obvious. Recognised anthropogenic impact on water resources revealed another problem – the management issues. General wetland management is carried out by the CNNP administration, but part of the land belongs to two other owners: the Vorokhta territorial community and the Vorokhta branch of the Forests of Ukraine State Enterprise. These parts of land are called "land without expropriation". These two institutions conduct their activity towards tourism and forest exploitation. Lack of cooperation between them led to the missing of very important management issues, such as prevention of point and diffuse pollution of the Prut River within the protection zone from wastewater from the Zarosliak sport base and souvenir market. As a result of Preparatory Phase, a general mission statement for water monitoring within the wetland was formulated as follows: "To enable the detection and response to changes or likely changes in wetland ecological character from anthropogenic pressure". Within the Conceptual Phase legislative base for a multi-level water monitoring programme was analysed. Taking into account the Resolution of the Cabinet of Ministers of Ukraine No. 758 "On Approval of the Procedure for State Water Monitoring" (2018), three types of monitoring were planned for the water monitoring programme within the Prut River Headwaters Wetland: surveillance, operational, and investigative (Fig. 2).

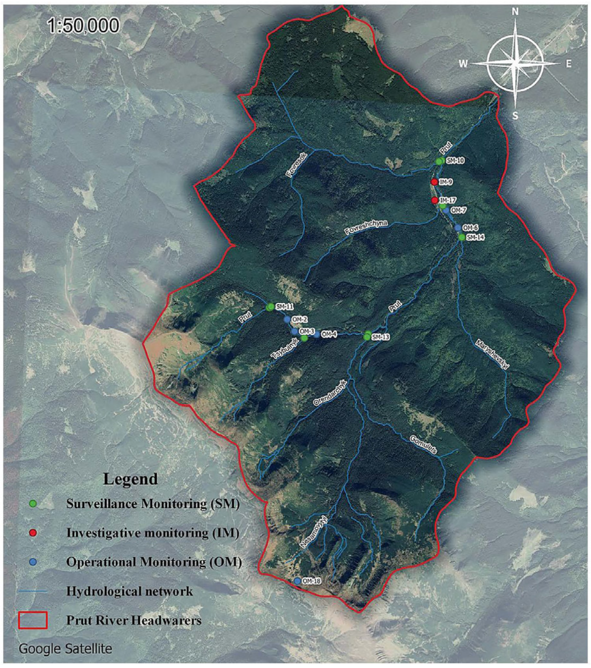

Figure 2. Multilevel monitoring sample points within the Prut River Headwaters Wetland
Source: created by the authors

For each type of monitoring, separate mission statements and monitoring sheets were developed. The example of the worksheet for the operational monitoring is presented in Table 2. The mission concept of the surveillance monitoring was proposed as next: "Supplementing and verifying of the reference condition within the Prut River Headwaters Wetland"; for the operational monitoring: "Evaluation of long-term trends (the assessment of long-term alterations in natural conditions resulting from the anthropogenic activities) within the Prut River Headwaters Wetland"; and for the investigative monitoring: "To assess the scale and degree of diffuse pollution from fish breeding ponds within the Prut River Headwaters Wetland" (in case of re-operation).

Table 2. Operational monitoring sheet for the Prut River Headwaters Wetland

Monitoring concept mission: detection of long-term trends (the assessment of long-term changes in natural conditions resulting from the anthropogenic activities) within the Prut River Headwaters Wetland					
WHY?	**WHAT?**	**WHERE?**	**WHEN?**	**WHO?**	**HOW MANY RESOURCES?**
Supplementing and validating risk assessments of the water bodies that are influenced by point and diffuse sources of pollution Monitoring outcomes: collected data of hydrochemical parameters Methods of database processing (paper, Microsoft Office ACCESS, SMART system) Monitoring results will be used for ecological assessment of the water bodies and for the data exchange with monitoring institutions	Hydrochemical parameters: temperature, dissolved oxygen, pH, conductivity, hardness, alkalinity, calcium, sodium, magnesium, colour, chlorides, sulphate, phosphates, nitrates, ammonia, total suspended solids, BOD_5, chemical oxygen demand (COD – dichromide)	Sample points: WBs 2, 3, 4, 6, 7, 8, 18	Monitoring frequency – one time/month (in the accessible period of the year); during low-water and high-water periods	The staff of the Laboratory of Analytical Control and Monitoring The Laboratory of Water Monitoring of the Western Region (Ivano-Frankivsk)	Human resources: as minimum 2 people for the field study and 1 person for conducting laboratory analyses Resources and equipment for the field trip and conducting analyses by staff of the Laboratory of Water Monitoring of the Western Region: laboratory glassware, portative equipment for parameter measurement; photoelectric colorimeter, 1 smartphone with SMART software, 1 GPS Garmins, 1 personal computer with SMART-office software Transport (1 time per month) Fuel – 30 l per trip Financial support for trainings, salary, and equipment
HOW?				**SYNERGIES/RE-EVALUATION**	
Using national standards: DSTU ISO 5667-3-2001 (2001), KND 211.1.1.106-2003 (2003)				Using the existing database of water monitoring (CNNP and other scientific institutions) Re-evaluation after 6-year period (in accordance with EU WFD and Water Code of Ukraine)	

Source: created by the authors

During the Implementation Phase field and laboratory investigations of water bodies within the testing site at seven control points were conducted (measuring physicochemical parameters with portable equipment). Water sampling points are presented in Figure 3. Case studies within the Prut River Headwaters Wetland combined field and laboratory research and presented in the next results: seven sampling sites for water monitoring, namely: No. 1, No. 4, No. 6, No. 9, No. 12, No. 16; 18 samples; field investigated parameters: mineralisation, T, pH, DO, and NO_3^-;

laboratory investigated parameter: BOD_5. All indicators of water quality did not exceed the permissible limits, except for the pH indicator in WB No. 1, which is obviously related to geological conditions because this WB is outside of any anthropogenic influence. Hydrochemical research within the wetland was entered into the SMART system (SMART-mobile and SMART-office). Collected data is available for analysis and for interdisciplinary interpretation. Figure 4 provides screenshots of the newly created database for hydrochemical monitoring within the Prut River Headwaters Wetland. After accumulating a certain database in the SMART-Desktop version, an analysis can be conducted (queries, reports based on queries, tables, or map generation) (Fig. 5).

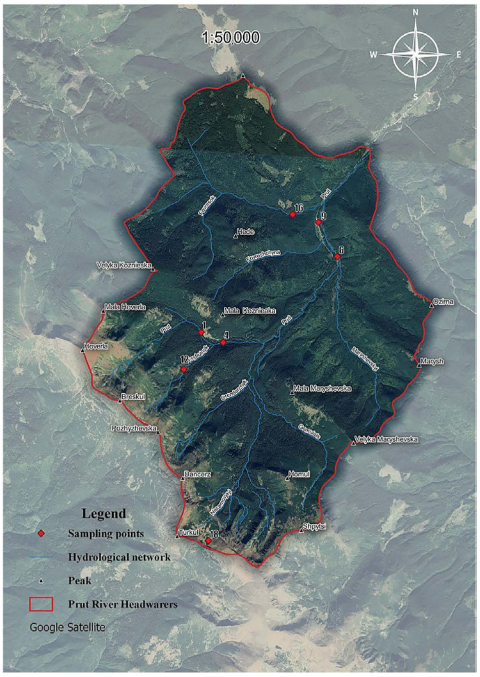

Figure 3. Testing water sampling sites within the Prut River Headwaters Wetland
Source: created by the authors

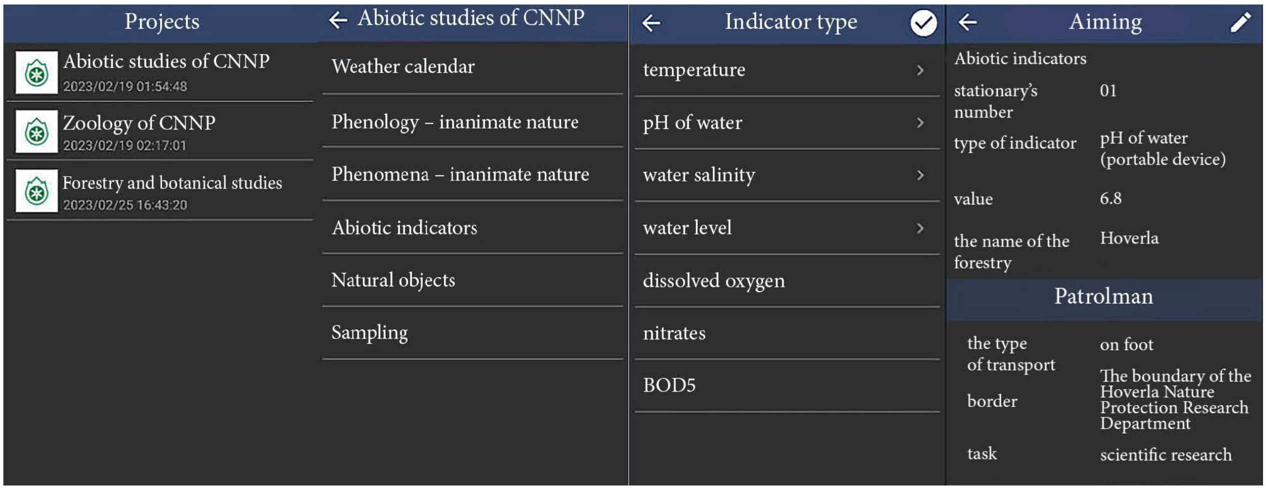

Figure 4. Example of field data collection of water parameters within the Prut River Headwaters Wetland using SMART-Mobile
Source: created by the authors

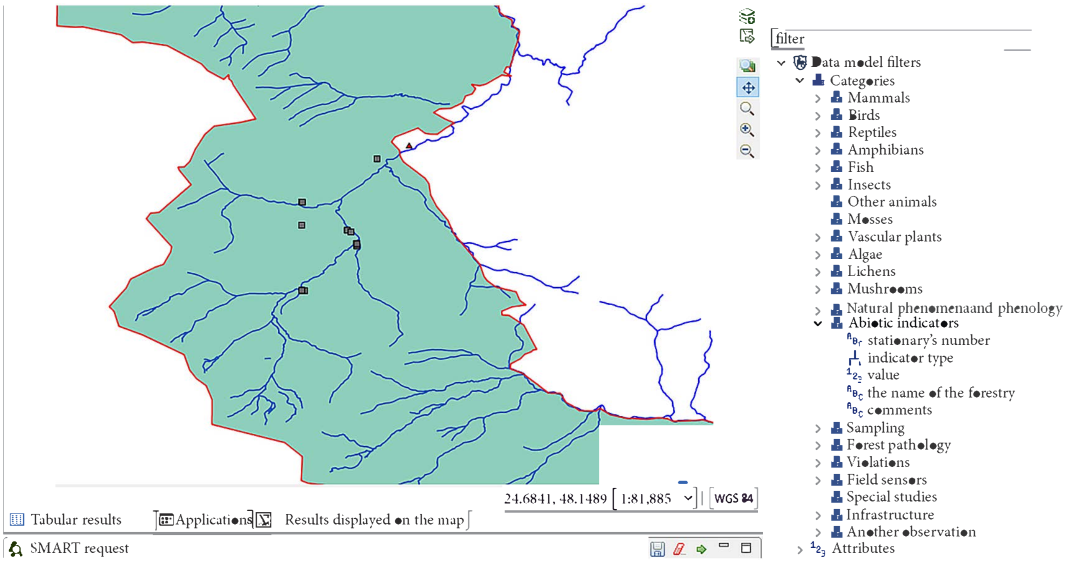

Figure 5. Examples of data request (map) within the Prut River Headwaters Wetland using SMART-Desktop
Source: created by the authors

Within the Implementation Phase the initiate database of wetland water parameters was formed. It is reliably stored in the cloud environment and can be used for various scientific or management purposes. Collected data is available as well and for interdisciplinary interpretation. Re-evaluation Phase will be conducted after long term monitoring studies. The monitoring plan can be revised and improved in the future in accordance with the identified risks or in case of estimation of implemented measures. The study showed that the planning process of wetland monitoring is not simple. N. Job *et al.* (2020) observed that in biodiversity-rich protected areas of developing nations, the management of wetlands is frequently hindered by insufficient time, personnel, and specialised knowledge, primarily due to a scarcity of data regarding the scope and characteristics of wetland resources. At the same time, as W. Kleindl *et al.* (2023) pointed out, there are more than 700 approaches to the assessment of aquatic ecology worldwide that meet the specific requirements of institutional goals. T. Dube *et al.* (2023) in their scientific paper analysed literature about wetland vulnerability that encounters numerous risks and possible deterioration, underscoring the necessity for robust monitoring and evaluation systems to safeguard their ecological and hydrological processes.

Monitoring is one of the important tools of proper management planning. Q. Demarquet *et al.* (2023) emphasised that managers and scientists require instruments to describe and oversee wetland areas, structure, and functions over extended periods, as well as at regional and global levels, and to evaluate the impacts of planning policies on their conservation status. As highlighted by P. Kumar *et al.* (2021), monitoring involves the systematic measurement, recording, and comparison of accomplishments with a predetermined set of objectives, thus providing project outcomes to managers and policymakers to aid in decision-making. D.T. Dalton *et al.* (2021) recognised new technologies as transforming the approaches of protected area managers to monitoring and implementing effective strategies that enable more efficient data collection while facilitating adherence to conservation requirements. The authors argued that choosing and using the right tools is improving options for adaptive management. H. Xu *et al.* (2019) noted that enhancing the speed and precision of monitoring changes in wetlands offers benefits for environmental protection and the scientific management of wetland resources. Ultimately, it aids in harmonising the relationship between humans and the planet. The CNNP administration is responsible for the Prut River Headwaters Wetland management in order to ensure stability of ecological character. S.L. Maxwell *et al.* (2020) highlighted that governments, policymakers, and many members of the conservation community have long held that protected areas are a fundamental cornerstone of biodiversity conservation.

Implementation of the water monitoring programme is the first practical measure that it can provide. It means that the collection of water parameters within the wetland will become the basis of regular monitoring to determine the dynamics of changes in wetland ecosystems and management issues towards wetland "wise use". The same statement was presented by S.A. Dar *et al.* (2022). They highlighted the significance of water quality monitoring in assessing the safety and appropriateness of water for different intended purposes. Most physical parameters of water quality are typically assessed through *in situ* measurements using contemporary testing equipment or field testing kits. The incorporation of hydrochemical and biological parameters within wetland ecosystems is vital. P.J. Stephenson (2020) points out that evidence-based decision-makingin natural resource management and conservation is frequently hindered by the absence of comprehensive biodiversity data. The study proved that modern technologies and tools can be very effective for data collection and storage. The SMART tool is a good example of reliable data storage and processing of information. Another example is environmental DNA (eDNA) analysis recommended by R.A. Erickson *et al.* (2019) and T. Minamoto *et al.* (2021) or GIS remote sensing images as proposed by Q. Cheng & C.N. Dang (2022). M. Boiaryn *et al.* (2023) used ArcGIS Pro for environmental mapping of the Pripyat River basin. The CNNP experts supported the idea of inclusion in the wetland monitoring programme water biological indication, in particular, with the eDNA method. This activity is planned for 2024. Therefore, modern technologies can contribute significantly to wetland monitoring. For the hydromorphological and hydrobiological monitoring, it is necessary to invite external experts for training of CNNP staff. For comprehensive physicochemical monitoring, the Laboratory of Water Monitoring of the Western Region (Ivano-Frankivsk) can be involved in the worst season for water – during hydrological draught.

According to the International Union for the Conservation of Nature definition, monitoring is defined as the long-term collection and analysis of information that is used by management and partners in order to track progress of the implemented measures, achievement of objectives, and use of resources (Monitoring, n.d.). The monitoring concept should be part of the research concept and should be regularly updated, as well as closely relate to the conservation objectives and be linked with the management plan. Ensuring data storage, quality, and ongoing analysis must be guaranteed. A perspective for improving wetland monitoring and "wise use" is the current participation of the CNNP representatives, the author of this study in particular, with Prut and Siret Rivers Council that are responsible for development of the Prut River basin management plan with WFD requirements. Being a cross-cutting issue of this directive, the Ramsar site should be in focus of the management plan, including the monitoring programme and the elaboration of programme of measures.

Conclusions

The main focus of the study was the wetland of international importance – the Prut River Headwaters – that belongs to the CNNP. Water resources of the wetland are represented by a dense hydrological network that plays a crucial role for biodiversity and human wellbeing. Due to the fact that the site was designated relatively recently – in 2019 – proper site management has not yet been organised, and an effective monitoring programme has not been developed in order to fulfil the main Ramsar Convention goal – wetland "wise use". In order to organise the processes of comprehensive planning of water monitoring within the wetland, a conceptual monitoring framework developed by a group of experts from the UNESCO Chair of Sustainable Management of Conservation Areas from CUAS was applied. This objective was achieved by planning the monitoring programme through four consecutive phases: preparatory, conceptual, implementation, and re-evaluation. In this research, the first three stages are developed in detail, with a special focus on the Preparatory Phase.

Wetlands play a crucial role in river basin management. Analysis of the EU WFD and Ramsar Convention synergy proved that key elements of a river basin management plan can be used for conceptualisation of water monitoring for the Prut River Headwaters Wetland. Therefore, within the Preparatory Phase, delineation of surface waters was carried out, as a result of which 18 water bodies were obtained for the monitoring programme. DPSIR methodology was used to identify the anthropogenic loads on the water ecosystem, including point and diffuse sources of pollution, water abstraction, and hydromorphological alterations. Taking into account identified pressure, the monitoring statement was formulated within the Conceptual Phase as follows: "To enable the detection and response to changes or likely changes in wetland ecological character from anthropogenic pressure". This general mission can be reached through three types of monitoring: surveillance, operational and investigative. During the Implementation Phase, field studies of the seven WBs were conducted (measuring physicochemical parameters in 7 control points with portable equipment) with collecting and storing data through SMART-mobile and SMART-office software. Re-evaluation Phase was proposed to be revised after long-term implementation of the monitoring programme. In the near future, a new management plan for the CNNP will be designed for ten years. It is planned to include management of the CNNP Ramsar sites in the separate chapter with a detailed description of long-term monitoring of biotic and abiotic parameters.

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Conflict of Interest

None.

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Концептуальний підхід до програми моніторингу водно-болотного угіддя міжнародного значення «Витоки річки Прут»

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Анотація. Функціонуючи як регулятор паводків і резервуар прісної води, водно-болотне угіддя «Витоки річки Прут», що охороняється Рамсарською конвенцією, є важливим осередком біорізноманіття, включно з ендемічними, рідкісними видами, видами, що перебувають під загрозою зникнення, та занесені до національного й глобальних Червоних списків. Існують прогалини щодо питань управління ділянкою, зокрема відсутність інтегрованої системи моніторингу водно-болотного угіддя. Тому метою цього дослідження було організувати процеси комплексного планування моніторингу водно-болотного угіддя. Щоб досягти мети, використано концептуальну основу для моніторингу, розроблену групою експертів кафедри ЮНЕСКО зі сталого управління природоохоронними територіями. За допомогою методу інформаційно-аналітичного дослідження розроблено модель програми моніторингу вод водно-болотного угіддя «Витоки річки Прут». Було розроблено та частково протестовано поєднання фізико-хімічних та гідробіологічних оцінок. Метод використовувався для перевірки універсальності запропонованої методики на конкретній досліджуваній території, що потребує сталого управління, та з метою вивчення перспективи застосування до інших водно-болотних угідь, чи цінних природних комплексів природоохоронних територій. Для проміжних етапів розробки програми моніторингу використовувалися ключові елементи управління річковим басейном Водної рамкової директиви ЄС в синергії з положеннями Рамсарської конвенції. На етапі реалізації проведено польові та лабораторні дослідження водних масивів у межах ділянки в 7 контрольних точках (вимірювання фізико-хімічних показників портативним обладнанням). Усі значення параметрів були в межах допустимих норм. Створено первинну базу даних результатів, що зберігається в програмному забезпеченні SMART. Очікується, що практична реалізація плану моніторингу води сприятиме оцінюванню стану екосистеми водно-болотних угідь та підтримці адміністрації Карпатського національного природного парку в сталому управлінні водно-болотними угіддями

Ключові слова: Карпатський національний природний парк; Рамсарське угіддя; глобальна моніторингова настанова; багаторівнева програма моніторингу вод; база даних