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Practical aspects of environmental assessment of water bodies transformation

Liudmyla Arkhypova*
Doctor of Technical Sciences, Professor
Ivano-Frankivsk National Technical University of Oil and Gas
76019, 15 Karpatska Str., Ivano-Frankivsk, Ukraine
https://orcid.org/0000-0002-8725-6943
Marta Korchemlyuk
PhD in Technical Sciences, Senior Researcher
Carpathian National Nature Park
78500, 6 Vasyl Stus Str., Yaremche, Ukraine
https://orcid.org/0000-0003-3417-2962
Hanna Rashevska
PhD in Biological Sciences, Assistant
Kryvyi Rih State Pedagogical University
50086, 54 Universytetskyi Ave., Kryvyi Rih, Ukraine
https://orcid.org/0000-0001-9350-9030
Ihor Vynnychenko
PhD in Georafical Sciences, Associate Professor
Taras Shevchenko National University of Kyiv
02000, 60 Volodymyrska Str., Kyiv, Ukraine
https://orcid.org/0000-0003-3709-5528
Inna Tyshchuk
PhD in Economics Science, Associate Professor
Lesya Ukrainka Volyn National University, Ukraine
43025, 13 Voli Ave., Lutsk, Ukraine
https://orcid.org/0000-0003-1042-9495

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Abstract. One of the components of the environmental assessment of the state of transformation of surface water bodies is hydromorphological assessment, which has recently been applied in Ukraine as a necessary component of the implementation of the implemented international environmental legislation. The aim of the article was to provide a practical application of hydromorphological assessment methods on the example of two objects with artificially constructed structures. The hydromorphological assessment was carried out according to a certified methodology developed by the

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*Corresponding author

Ukrainian Hydrometeorological Institute of the State Emergency Service of Ukraine and the National Academy of Sciences of Ukraine. A number of hydromorphological indicators were monitored according to the methodology. The hydromorphological assessment included field surveys of each water body, database development, including mapping, digitisation of the results and preparation of reports. From 09 to 24 September 2024, experts surveyed two unnamed streams of the IV and V orders of the Danube River basin within the settlements of Karapachiv and Nova Slobidka in the Vyzhnytsia and Dniester districts of Chernivtsi Oblast. Based on the results of the survey and analysis of the studied indicators using environmental assessment methods that comply with the European Union Water Framework Directive, such criteria as river continuity and runoff correspond to the lowest assessment for both sites. Taking into account the principle of European water legislation, according to which a criterion indicating that there is a risk of a surface water body not achieving good ecological status automatically places it in the "at risk" category. Therefore, hydromorphological assessment is critical for integrated river basin management, implementation of action programmes, in particular, to restore the free flow of watercourses and ensure conditions for maintaining their good ecological status and potential. The study further developed the practice of environmental assessment of water body transformation

Keywords: European Union Water Framework Directive; Danube River Basin; surface water body; risk criteria; hydromorphological assessment

INTRODUCTION

Environmental assessment of the transformation of water bodies, as noted by V. Khilchevskyi *et al*. (2022), does not have a long tradition in the field of water management. In fact, only a few European Union member states had relevant survey and assessment schemes in place before the EU Water Framework Directive (EU WFD) came into force. According to the authors M. Hirschnitz-Garbers *et al*. (2022), most EU Member States have environmental assessment systems that are available for the entire national river network. For the first river basin management plans in 2009 and within the framework of river basin analyses in Ukraine and the EU at the beginning of the 21st century, an analysis of anthropogenic pressures and impacts was conducted, which led to the conclusion that transformational changes put most river basins in Europe at risk, as noted by M. Korchemlyuk and L. Arkhypova (2016) in their previous works and confirmed by official sources (European Environment Agency, 2025). According to O. Shumilova *et al*. (2023), the types of transformational changes differ between EU Member States, but hydromorphological changes such as interruption of river continuity and fish migration by artificial barriers are a common problem, as noted in the EU Guidance Documents. In Ukraine, according to the conclusions of the updated river basin management plans, in accordance with the water strategy (Order of the Cabinet of Ministers of Ukraine dated December No. 1134-p, 2022), significant financial efforts are required in the future to restore the changed hydromorphological conditions of river water bodies to achieve good status no later than 2027.

Given the active phase of implementation of the EU Water Framework Directive in Ukraine, the need to develop a full-fledged national hydromorphological monitoring system is becoming particularly relevant, which will allow for the identification of "highly modified" water bodies, timely implementation of environmental restoration measures, and promotion of sustainable water management at the local and transboundary levels. As shown in P. Arulbalaji *et al*. (2019), anthropogenic changes in the hydrology and morphometry of aquatic ecosystems affect the functioning of lakes and rivers in various ways. Initially, they have a profound impact on coastal communities, and eventually, as Prykhodko *et al*. (2020) point out, they lead to changes in the ecosystems of the entire water body.

This is especially important in the context of climate change adaptation, increasing anthropogenic pressure on small rivers, and the need to provide ecosystem services to local communities, as proven by M. Prykhodko *et al*. (2023). The development and application of adapted methodologies in combination with geoinformation technologies, digital mapping and databases will help improve the quality of decision-making and fulfil Ukraine's international obligations in the field of water protection. As stated in the Order of the Ministry of Environment of Ukraine No. 313 (2020), in this context, it is important not only to analyse the hydromorphological state, but also to take into account the relationship with physicochemical and biological parameters, which will allow for an integrated assessment of the state of water bodies in accordance with European standards.

Testing of methods for improving the practical application of environmental assessment of water body transformation was the objective of this research, with the aim of disseminating the results obtained for widespread use in the practice of environmental protection institutions and environmental education. The practice of hydromorphological assessment is a component of risk analysis and classification of the ecological state, analysis of anthropogenic pressures and impacts, as well as planning and design of environmental

improvement measures, as can be seen in research funded by the World Wildlife Fund (WWF Report, 2024). Much effort has been put into developing environmental assessment methods and management measures that focus primarily on eutrophication, while hydromorphological pressures have not been adequately addressed. Therefore, the aim of the study was to analyse the application of hydromorphological assessment methods on the example of two water bodies with artificial hydraulic structures.

MATERIALS AND METHODS

The methodological recommendations for hydromorphological monitoring of surface water bodies used in this study were developed by scientists of the Hydromorphological Monitoring Laboratory at the Department of Systemic Hydrometeorological Research of the Ukrainian Hydrometeorological Institute of the State Emergency Service of Ukraine and the National Academy of Sciences of Ukraine within the framework of Research work 6/18 "Development of a scientific and methodological basis for hydromorphological monitoring of surface water bodies of Ukraine" (Hydromorphological assessment, 2019). The recommendations were developed based on the work of Slovak and Croatian scientists S. Poikane *et al.* (2019) and M. Kijowska-Strugala *et al.* (2021) to determine the degree of change in river hydromorphology According to Appendix V, the EU WFD (Directive 2000/60/EC of the European Parliament…, 2000) requires the assessment of the following hydromorphological elements to assess high, good and moderate status (Table 1).

***Table 1**. Determination of high, good and satisfactory ecological status in rivers based on hydromorphological parameters*

Item	High status	Good status	Satisfactory status
Hydrological regime	The amount and dynamics of runoff and the corresponding connection to groundwater fully or almost fully reflect undisturbed conditions.	The biological quality elements achieve their respective values in accordance with the EU WFD.	The biological quality elements achieve their respective values in accordance with the EU WFD.
River continuity	The continuity of the river is not disturbed by anthropogenic activities and ensures free migration of aquatic life and transport of sediments.	The biological quality elements achieve their respective values in accordance with the EU WFD.	The biological quality elements achieve their respective values in accordance with the EU WFD.
Morphological condition	Channel structures, changes in width, depth, flow velocity, substrate conditions, and riparian zone structure and condition are completely or almost completely undisturbed.	The biological quality elements achieve their respective values in accordance with the EU WFD.	The biological quality elements achieve their respective values in accordance with the EU WFD.

***Source:** Directive 2000/60/EC of the European Parliament… (2000)*

Table 1 shows that hydromorphological pressure is only indirectly estimated for good and moderate condition. This becomes particularly important for pressure and impact analysis and risk assessment, and thus requires a representative analysis approach, which is proposed in this study. In this study, the assessment was carried out using the following approach: analysis of the risk of water bodies failing to meet their objectives due to hydromorphological changes by implementing the proposed risk criteria using: the results of the survey of selected sites and hydromorphology assessment; existing national information on hydromorphological and related loads presented in O. Ostapenko *et al.* (2020), V. Khilchevskyi and V. Karamushka (2022).

Both sources of information for the analysis were carefully collected to ensure success. The approach is based on the application of expert judgement used in M. Perschke *et al.* (2023), C. Kupferschmidt *et al.* (2024) and assumes that experts working on hydromorphological assessments are largely familiar with the datasets, natural conditions and loads in the basin, and their appropriate combination during risk assessment. Any gaps in knowledge about the loads and impacts in the pilot basins need to be highlighted and sought to be filled. The on-site surveys serve to collect the missing information, fill in the gaps and complete the pressure and impact analysis and risk assessment further. As for the other parameters, when it comes to hydromorphology, anthropogenic pressure has different effects depending on the size of the river or its catchment area. In risk assessment, this fact should be taken into account, in particular, when establishing and applying risk criteria, according to S. Avdullahi and A. Hajra (2023) and L. Arkhypova *et al.* (2022). Different methodologies are used to address this issue (UNENGO "MAMA-86", 2014; Resolution of the Cabinet of Ministers of Ukraine No. 758, 2018). To facilitate implementation, this approach used river size categories based on the typology shown in Table 2.

***Table 2**. River types for hydromorphological assessment depending on their size*

Size of the river	Description of the river type	Size of the catchment area
Small	Mountain "gravel" river type	10 km^2 – 100 km^2
Medium	Semi-mountainous "gravel" river type	100 km^2 – 1000 km^2
Large	Lowland river type	> 1000 km^2

***Source:** Guidance document addressing hydromorphology and physico-chemistry... (2014)*

Based on experience with EU WFD risk assessments, the approach is to use the most relevant types of hydromorphological pressure rather than using every element that is part of a hydromorphological study. For each of the five identified pressure types, risk criteria are proposed to be implemented using available data and expert opinion to determine whether water bodies are at risk from hydromorphology according to the three risk categories. The five pressure types for which criteria are proposed are listed in Table 3.

The criteria for assessing the risks of failure to achieve environmental goals are presented in Table 4.

***Table 3**. Anthropogenic factors leading to hydromorphological risks*

Pressure group	Type of pressure, including display of factors
Disruption of the continuity of aquatic habitat along the river	Disruption of habitat continuity along the river and fish migration routes
Artificial structures in the channel, disruption of connection with groundwater	Water retaining structures for hydropower; drinking water reservoirs; irrigation intake structures; other barriers;
Factors leading to the depletion of water bodies	Water abstraction may result in the formation of river sections affected by depletion in certain periods of the year (danger to hydrobionts sensitive to environmental flows)
Hydrological changes in channel width, depth, flow velocity and sediment transport	Factors: bank protection, dredging, gravel-sand extraction, irrigation; hydropower; water intake and discharge; aquaculture, etc.
Morphological changes in channel structure, substrate condition, and riparian zone structure and condition	Storage/impact of reservoirs/backwater: river sections affected by altered flow conditions upstream of artificial barriers (change of river character to lake character) and due to dredging of the channel.

***Source:** compiled by the authors*

***Table 4**. Criteria for assessing the failure to achieve environmental goals*

Risk category	Category justification
1	A water body "at risk" is at risk of failing to fulfil the environmental objective of the EU WFD. There is one or more significant hydromorphological change (barriers, reservoirs, water abstraction). The morphology of the river is "significantly altered or heavily modified". Water bodies in this group should be classified as highly modified.
2	A water body "possibly at risk" is at risk of not meeting an EU WFD environmental objective. Data sets are insufficient to apply the criteria, so gaps need to be filled. Or no significant hydromorphological changes (barriers, reservoirs, water abstraction, hydropics) have been assessed. However, the river morphology (if available) is "moderately modified". This group is temporary because a decision on whether these water bodies should be classified as "temporary SSSIs" cannot be made and requires additional data and research. There is no reliable information on the functioning of the fish passage There is no reliable information on water intake. There is no reliable information on the length of the backwater zone or the total length of several backwater zones is 10-30% of the total length of the surface water body.
3	The "no risk" water body is not at risk of failing to meet the EU WFD environmental objective. No significant hydromorphological changes (barriers, reservoirs, water abstraction, hydropics) have been assessed. The river morphology is "almost natural" or "slightly modified". The water bodies in this group should be considered as natural river bodies in terms of hydromorphology. However, other types of pressure can be assessed.

***Source:** Guidance document addressing hydromorphology and physico-chemistry... (2014)*

An important part of the hydromorphological monitoring was the pre-field work (data collection and preparation of the field survey). From 09 to 24 September 2024, specialists from the Prut and Siret River Basin Water Resources Management Authority surveyed two unnamed streams of the IV and V orders of the Danube River basin within the settlements of Karapachiv and Nova Slobidka in the Vyzhnytsia and Dniester districts of Chernivtsi Oblast. Many of the functions and parameters were assessed prior to the

field survey, which improved the quality of the field data collection. The following materials were used to prepare the field surveys:

- terrain plans, used by the authors also in R. Kravchynskyi *et al.* (2021);
- historical maps of the 19th century and topographic maps of 1970-1980 (1:100,000) to determine modern hydromorphological forms;
- satellite imagery to analyse land use in the floodplain, riparian zone and within the catchment, as shown in J. Feher *et al.* (2012);
- online maps from various online resources (e.g. OpenStreet maps, Google maps);
- other materials on water abstraction, water management, etc. as shown in T. Garbowski *et al.* (2023).

During the field surveys, the following hydromorphological elements were considered in accordance with (Methodology for assigning a surface water body..., 2019) and the requirements of Directive 2000/60/EC of the European Parliament (2000): disruption of river continuity and habitat; hydrological changes; change in river morphology. In addition, the information (photographs, field diaries) obtained during the fieldwork was useful for the hydromorphological assessment of the survey units. More specific parameters were also investigated, including channel geometry, substrate composition, channel vegetation and organic debris, bank structure and associated changes, flow conditions, interruption of longitudinal continuity by artificial structures, vegetation type, adjacent land use and channel-floodplain interactions. Changes in river morphology were taken into account for the preliminary pressure analysis. A five-point scale was used to assess each hydromorphological feature. According to this scale, the assessed surface water bodies (SWBs) were assigned to one of the classes. The classes were indicated by the following colours: blue – 'almost natural', green – 'slightly modified', yellow – 'moderately modified', orange – 'significantly modified' and red – 'highly modified' (Table 5).

***Table 5**. Classification periods for the five classes (Score Group A)*

Score Range	Class	Description	Colour
From 1 to < 1.5	1	Almost natural	Light Blue
From 1.5 to < 2.5	2	Slightly modified	Green
From 2.5 to < 3.5	3	Moderately modified	Yellow
From 3.5 to < 4.5	4	Significantly modified	Orange
From 4.5 to 5.0	5	Heavily modified	Red

***Source:** Hydromorphological assessment (2019)*

In cases where three classes are used to describe the hydromorphological status of surface water bodies in the "Rivers" category, the definitions provided in Table 6 shall be applied, and the indicated classes must be represented on maps (if required) using the corresponding colour scheme for presenting results.

***Table 6**. Classification definitions for the three classes (Score Group B)*

Score Range	Class	Description	Colour
From 1 to < 2.5	1	Close to natural to slightly modified	Light Blue
From 2.5 to < 3.5	3	Slightly to moderately modified	Yellow
From 3.5 to 5.0	5	Heavily modified to very heavily modified	Red

***Source:** Hydromorphological assessment (2019)*

Hydromorphological assessment is an important component of environmental assessment, as it allows to determine the ecological state of surface water bodies and serves as a basis for making appropriate management decisions to ensure the principles of integrated river basin management. This is especially important when applied to transboundary water bodies, which include all water bodies in the area of the Danube River Basin, Europe's largest, and whose preservation in good condition is a key to sustainable development not only for Ukraine but also for all nineteen countries that share the Danube River Basin.

RESULTS AND DISCUSSION

This study assessed the hydromorphological modification of two surface water bodies in the Danube River basin. To put the above guidelines into practice, a hydromorphological analysis of an unnamed stream,

which is a left tributary of the Hlybochok River and belongs to the Prut sub-basin (Danube River Basin), was carried out. The water body is located in the village of Karapchiv, Vyzhnytsia district, Chernivtsi region (Fig. 1).

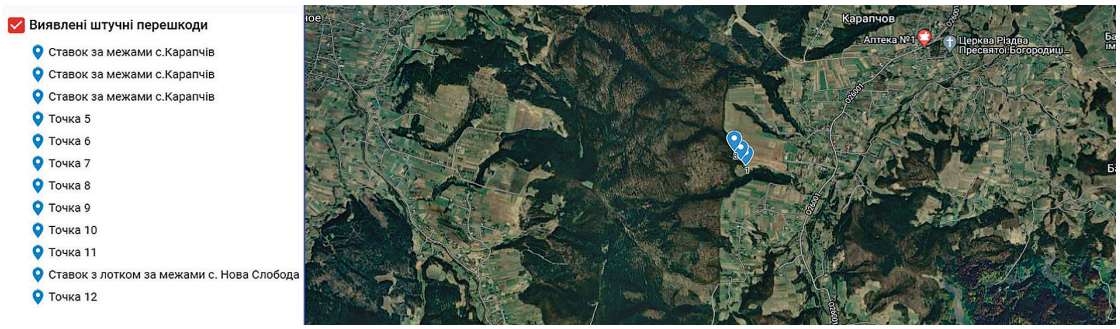

***Figure 1**. Geographical reference of the 3 survey points of the detected artificial structures outside Karapchiv village*
***Source:** Google map with mapped survey points*

The channel of the studied water body is a low-flowing channel with a catchment area of 0.3 km^2. Its width ranges from 0.5 m to 1.5 m, depth from 0.02 m to 0.05 m, and average width is 0.8 m. The channel of the water body is composed of silt and clay with the remains of trees. Artificial ponds have been constructed here, which contributed to the change of the stream channel. Its floodplain is weakly defined with natural vegetation (Fig. 2). The constructed hydraulic structures on the ponds, which are more than 1 m high, are silted up, and therefore have a negative impact on the continuity of the stream flow, impeding the migration of aquatic life and the transport of suspended sediments.

***Figure 2**. Unnamed stream (Karapchiv village)*
***Source:** photo materials from field research*

The graphical results of the hydromorphological assessment of the unnamed stream (Karapchiv village) by three-digit code and in accordance with the zone are presented in Fig. 3 and Fig. 4.

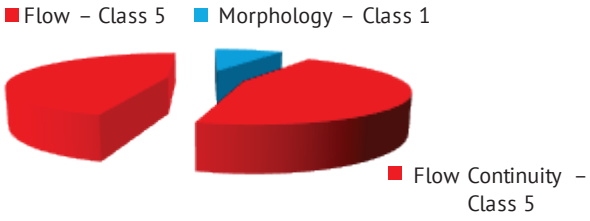

***Figure 3**. Quality classes according to hydromorphological assessment of an unnamed stream in Karapchiv village by three-digit code*
***Note:** 1 - slightly changed, 5 - heavily changed*
***Source:** compiled by the authors*

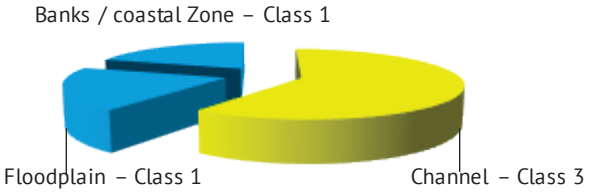

***Figure 4**. Quality classes by hydromorphological assessment of an unnamed stream in Karapchiv village in accordance with the zone*
***Note:** 1 - slightly changed, 5 - heavily changed*
***Source:** compiled by the authors*

According to the European classification, this indicates a risk of not achieving good ecological status and automatically places the site (an unnamed stream in the village of Karapchiv) in the "at risk" category.

A generalised hydromorphological assessment of the unnamed river in the Karapchiv village settlement is presented in Table 7.

***Table 7**. Generalised results of hydromorphological assessment of the unnamed river in Karapchiv settlement*

Scorecard	Score value	Score Range
Single point	2,34	2
3-digit code	Morphology – 1.83	2
	Flow – 5.00	5

Table 7. Continued

Scorecard	Score value	Score Range
3-digit code	River continuity – 5.00	5
	Unique code based on the assessment results – 255	
In accordance with the zone	River channel – 3.3	3
	Banks/coastal zone – 1.15	1
	Floodplain – 1.27	1
	Unique code based on the assessment results – 2_1_1	

Note: *IPV code: UA_R_16_S_1_Si. Coordinates of the beginning of the DO: latitude: 48°19′15.92′′; longitude: 25°25′58.02′′. River name: no name. Name of the area: Karapchiv*
Source: *compiled by the authors*

The results obtained indicate the need to implement measures to restore the free flow of the watercourse and improve the ecological condition and potential of the unnamed stream. By analogy, a hydromorphological analysis of another water body, an unnamed stream in the village of Nova Sloboda, Dniester District, Chernivtsi Region, which is a tributary of the Dratiste River (Prut sub-basin, Danube basin), was carried out (Fig. 5). The channel of the unnamed stream in the village of Nova Sloboda was winding and overgrown. Its width ranged from 2.0 m to 4.0 m. It is composed of silt and clay. The channel dries up in the low water period. The floodplain of the stream is low, overgrown with bushes and grass (Fig. 6).

Figure 5*. Geographical reference of 9 survey points for detection of artificial structures outside Nova Sloboda village*
Source: *Google map with mapped survey points*

Figure 6*. Unnamed stream (overgrown), (Nova Sloboda village)*
Source: *photo materials from field research*

The water body under study has undergone significant anthropogenic impact due to the construction of artificial ponds in the channel. Hydraulic structures on the ponds are silted up, and therefore they are an obstacle that affects the continuity of the stream, the nature of erosion and sedimentation, and impede the migration of all types of biota and sediment transport. The hydromorphological assessment of the unnamed stream (Nova Sloboda village) by three-digit code and according to the zone is presented in Fig. 7 and Fig. 8 and in Table 8.

According to the European classification, this indicates a risk of not achieving good ecological status and automatically places the object – an unnamed stream in the village of Nova Sloboda – in the "at risk" category.

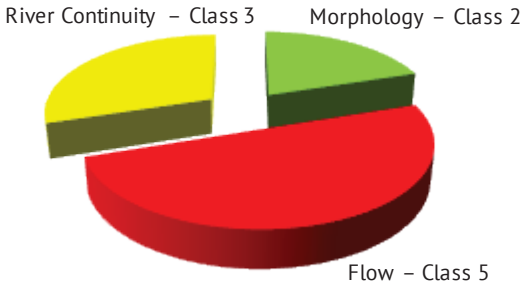

***Figure 7**. Quality classes according to hydromorphological assessment of an unnamed stream in the village of Nova Sloboda by three-digit code*
***Note:** 2 – slightly modified, 3 – moderately modified, 5 – heavily modified*
***Source:** compiled by the authors*

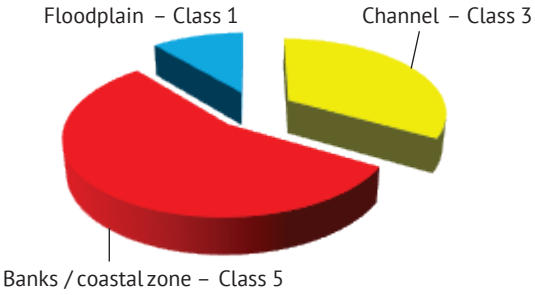

***Figure 8**. Quality classes according to hydromorphological assessment of the unnamed stream in Nova Sloboda village in accordance with the zone*
***Note:** 1 - slightly modified, 3 - moderately modified, 5 - heavily modified*
***Source:** compiled by the authors*

The results obtained indicate the need to implement measures to restore the free flow of the watercourse and improve the ecological condition and potential of the unnamed stream in the village of Nova Sloboda.

***Table 8**. Summary of hydromorphological assessment results of an unnamed stream in Nova Sloboda village*

Scorecard	Score value	Score Range
Single point	2.33	2
3-digit code	Morphology – 2.02	2
	Flow – 5.00	5
	River continuity – 3.00	3
	Unique code based on the assessment results – 253	
In accordance with the zone	River channel – 3.03	3
	Banks/coastal zone – 2.00	2
	Floodplain – 1.33	1
	Unique code based on the assessment results – 3_2_1	

***Note:** IPV code: UA_R_16_S_1_Si. Coordinates of the beginning of the DO: latitude: 48°24´50.20´´, longitude: 27°11´17.24´´. River name: no name. Name of the place: Nova Sloboda*
***Source:** compiled by the authors*

Both streams have critical flow and continuity problems: a score of 5 for flow indicates depletion of the watercourse during dry periods. The sites automatically fall into the 'at risk' category according to Directive 2000/60/EC of the European Parliament... (2000). Despite similar overall assessments, Nova Sloboda shows a worse condition of the riparian zone, and Karapchiv shows a more critical disruption of the river's continuity. Comparative results of the hydromorphological assessment of the two unnamed streams are presented in Table 9.

***Table 9**. Comparative results of hydromorphological assessment*

Option	Stream (Karapchiv)	Stream (Nova Sloboda)
Single point	2.34 (class 2)	2.33 (class 2)
Morphology	1.83	2.02
Flow	5.00	5.00
River continuity	5.00	3.00
Channel	3.3	3.03
Banks / coastal zone	1.15	2.00
Floodplain	1.27	1.33
General category	255 (at risk)	253 (at risk)

***Source:** compiled by the authors*

Thus, the following differences in the hydromorphological elements of the studied unnamed streams were found.

1. River continuity:

- Karapchiv: severe impairment (grade 5, the worst).
- Nova Sloboda: moderate impairment (grade 3).

In Karapchiv, the waterworks (ponds) have a higher height and degree of siltation, which completely prevents the flow and migration of aquatic life.

2. Banks / coastal zone:

- Karapchiv: better condition (1.15).
- Nova Sloboda: worse condition (2.00).

In Karapchiv, the natural vegetation of the coastal zone has been preserved, while in Nova Sloboda, overgrowth and development are changing the natural landscape.

3. Morphology and channel: in both cases the channel is altered, but in Karapchiv the morphology is slightly better. In both cases, the channel dries up in the low water period, is silted and clayey, with artificial structures.

Both water bodies have a high level of anthropogenic impact, mainly due to hydraulic structures that change the natural regime of the watercourse.

It is recommended to implement restoration measures, such as clearing, dismantling or reconstructing barriers and restoring floodplains. These are critical for achieving good ecological status. Streams are an example of highly modified surface water bodies and should be taken into account in the management plans for the Prut sub-basin and the Danube basin as a whole.

The surveyed water bodies are small rivers. UA_R_16_S_1_Si (small river in lowland silicas) of the IV and V orders of the Danube River basin (Prut sub-basin) within the settlements of Karapachiv and Nova Slobidka. In the study by T. Garbowski *et al.* (2023) assessed the hydromorphological state of 10 watercourses (30 measurement sites) in Poland on the basis of a multimetric hydromorphological index for rivers based on a proposed new approach to the definition of river valleys (small watercourses). This study is distinguished by an adapted practical component of hydromorphological assessment. In many studies in recent years, such as J. Wang *et al.* (2023), D. Shanafelt *et al.* (2023), hydromorphological changes are considered as important water management issues, in addition to organic pollution, nutrient pollution, and pollution caused by hazardous substances. The authors S. Zaborowski *et al.* (2023), based on their research, managed to determine the size, dynamics and scale of changes occurring in the river under different conditions of its transformation, including as a result of anthropogenic pressure. In this study, and in Ukraine in general, hydromorphological changes are considered to be part of river basin management plans (Order of the Cabinet of Ministers of Ukraine dated December No. 1134-p, 2022).

Although the list of hydromorphological assessment elements presented is extensive and in line with the EU WFD, a gap in the assessment that prevents a full analysis of anthropogenic pressures and impacts is that field studies were conducted exclusively for a selected sample of water bodies and did not cover the entire length of the river network. The focus was rather on identifying a reference location as a basis for condition assessment, but not necessarily on pressure and impact checks. However, the information gathered from the field surveys, which has so far been carefully prepared by experienced experts and staff of the Prut and Siret River Basin Water Resources Management (Prut and Siret River Basin Water Resources Management, n.d.), is considered a very valuable basis for complementing and completing the pressure and impact analysis using this approach for integration into the Danube River Basin (Prut sub-basin) management plan.

Guided by the provisions of the EU WFD, Z. Odnorih *et al.* (2020) elements used to determine the high ecological status of water are biological quality elements, chemical quality elements, general physico-chemical quality elements, and hydromorphological quality elements. According to N. Gomelia *et al.* (2018), this means that a water body can have a high status only if its hydromorphology and physical and chemical indicators demonstrate a high status. According to O. Mandryk *et al.* (2021), I. Klymchuk *et al.* (2022), the elements used to determine the good status of water are biological quality elements, chemical quality elements and general physico-chemical quality elements. This means, according to V. Strokal (2021), K. Stefanidis *et al.* (2024), that good status can be achieved in a water body even if hydromorphological indicators indicate a lower status. Also N. Glibovytska *et al.* (2024) emphasise that any assessment of a status lower than good, which is satisfactory, bad or very bad, is based solely on the assessment of biological quality elements and chemical quality elements. Kolesnik *et al.* (2017) and S. Vikhryst *et al.* (2018). However, according to C. Skoulikaris and A. Zafirakou (2019) and L. Simkiv *et al.* (2021), both hydromorphology and general physicochemistry of water bodies play a crucial role in assessing pressures and impacts, as their change can affect the state of the aquatic ecosystem This means that pressures on both hydromorphological and general physicochemical elements can consistently affect biological quality elements and, therefore, according to V. Kopei *et al.* (2020), change the respective status of a water body.

In the above context, according to E. Soule *et al.* (2023), altered hydromorphological, general physical and chemical parameters and the impact of significant anthropogenic pressure on them serve as indicators to assess whether a water body is at risk of losing its designated water status and reducing the level of ecosystem services. H. Zelinska *et al.* (2021), V. Kopei *et al.* (2023) state that the introduction and implementation of risk criteria and/or thresholds for hydromorphological and general physicochemical elements can be used to

assess significant pressures and impacts on the state of water as a component of sustainable development. A well-known study by M. Kijowska-Strugala *et al*. (2021) compares the quality of mountain stream habitats in areas without visible anthropogenic integration and those permanently altered by human activities between mountainous areas in different climatic zones. The fieldwork was conducted using the British River Habitat Survey (RHS) method. In contrast, this study involved a set of field works with a full-scale survey of water bodies, photography, the formation of a digital database, mapping and preparation of reports presenting the results of hydromorphological assessment.

According to S. Poikane *et al*. (2019), hydromorphological pressure is the second most common type of pressure on aquatic ecosystems in European countries (after eutrophication). Ukrainian researchers V. Khilchevskyi *et al*. (2022) also argued that anthropogenic changes in the hydrology and morphometry of aquatic ecosystems affect the functioning of lakes and rivers in various ways. Initially, they have a profound impact on coastal communities such as macrophytes, benthic invertebrates and fish fauna. Finally, as Z. Odnorih *et al*. (2020), they lead to changes in the ecosystems of the entire water body. The importance of hydromorphological assessment is related to the need to establish the ecological status of surface water bodies and make appropriate management decisions based on it, in particular, to prepare an appropriate programme of measures as part of river basin management plans. This is especially important in the case of transboundary water bodies, which include all water bodies in the area of the largest European Danube River Basin, whose preservation in good condition is a key to sustainable development not only for Ukraine but also for all nineteen countries whose territory lies within the Danube River Basin.

CONCLUSIONS

As a result of the research, the practice of environmental assessment of the transformation of small water bodies was improved. According to the results of the hydromorphological assessment in accordance with the requirements of the EU Water Framework Directive of two unnamed small watercourses of the IV and V orders of the Danube basin (Karapchiv and Nova Sloboda villages in Chernivtsi Oblast), both water bodies under study fall into the lowest category according to such criteria as river continuity and runoff. In accordance with the EU WFD principle, when determining the category of a surface water body, the rule is applied that if at least one of the criteria is assessed as "at risk", the entire body is classified as such. In view of the above, both streams are significantly modified water bodies and belong to Class V – highly modified.

Both streams have critical problems with flow and continuity: a score of 5 for flow indicates depletion of the watercourse during dry periods. In Karapchiv village, the waterworks (ponds) have a higher height and degree of siltation, which completely impedes the flow and migration of aquatic life. Despite similar general assessments, the stream in Nova Sloboda village shows a worse condition of the riparian zone, and in Karapchiv village - a more critical violation of the river continuity. Both water bodies have a high level of anthropogenic impact, mainly due to hydraulic structures that change the natural regime of the watercourse. It is recommended to implement restoration measures, such as clearing, dismantling or reconstructing barriers and restoring floodplains. These are critical for achieving good ecological status. Streams are an example of highly modified surface water bodies and should be taken into account in the management plans for the Prut sub-basin and the Danube basin as a whole.

The prospect of further research is to expand the application of the methodology to a wider network of small watercourses of different geomorphological types in Ukraine, its digitalisation, integration of hydromorphological parameters with bioindicative methods for assessing the state of aquatic ecosystems, and the creation of a full-fledged national database of hydromorphological monitoring as a tool to support management decisions in the field of water resources protection.

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CONFLICT OF INTEREST

None.

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Практичні аспекти екологічної оцінки трансформації водних об'єктів

Людмила Архипова
Доктор технічних наук, професор
Івано-Франківський національний технічний університет нафти і газу
76019, вул. Карпатська, 15, м. Івано-Франківськ, Україна
https://orcid.org/0000-0002-8725-6943
Марта Корчемлюк
Кандидат технічних наук, старший дослідник
Карпатський національний природний парк
78500, вул. Василя Стуса, 6, м. Яремче, Україна
https://orcid.org/0000-0003-3417-2962
Ганна Рашевська
Кандидат біологічних наук, асистент
Криворізький державний педагогічний університет
50086, просп. Університетський, 54, м. Кривий Ріг, Україна
https://orcid.org/0000-0001-9350-9030
Ігор Винниченко
Кандидат географічних наук, доцент
Київський національний університет імені Тараса Шевченка
02000, вул. Володимирська, 60, м. Київ, Україна
https://orcid.org/0000-0003-3709-5528
Інна Тищук
Кандидат економічних наук, доцент
Волинський національний університет імені Лесі Українки
43025, просп. Волі, 13, м. Луцьк, Україна
https://orcid.org/0000-0003-1042-9495

Анотація. Однією з складових екологічної оцінки стану трансформації поверхневих водних об'єктів є гідроморфологічна оцінка, яка нещодавно почала застосовуватись в Україні як необхідна складова виконання імплементованих міжнародних документів екологічного законодавства. Метою статті було практичне застосування методик гідроморфологічного оцінювання на прикладі двох об'єктів, які мають штучно збудовані споруди. Гідроморфологічне оцінювання проводилося згідно атестованої методики, розробленої Українським гідрометеорологічним інститутом Державної служби України з надзвичайних ситуацій та Національної академії наук України. Моніторингу підлягали визначений методикою ряд гідроморфологічних показників. Гідроморфологічне оцінювання включало польові обстеження кожної ділянки водних масивів, формування бази даних, включно з картуванням, оцифрування результатів та підготовку звітів. Фахівцями з 09 по 24 вересня 2024 року було обстежено два безіменних струмка IV і V порядків басейну р. Дунай в межах населених пунктів Карапачів та Нова Слобідка Вижницького та Дністровського районів Чернівецької області. За результатами обстеження та аналізу досліджуваних показників із застосуванням методик екологічної оцінки, що відповідають Водній Рамковій Директиві Європейського Союзу, такі критерії, як неперервність течії річки та стік, відповідають найнижчій оцінці для обидвох об'єктів. Беручи до уваги принцип Європейського водного законодавства, згідно з яким критерій, що вказує на наявність ризику недосягнення доброго екологічного стану ділянки поверхневого водного масиву, автоматично відносять її до категорії «під ризиком». Тому гідро морфологічне оцінювання є критично важливими для інтегрованого управління річковим басейном, впровадження програм заходів, зокрема, з відновлення вільної течії водотоків та забезпечення умов підтримки їх доброго екологічного стану та потенціалу. В роботі дістала подальшого розвитку практика екологічної оцінки трансформації водних об'єктів

Ключові слова: Водна Рамкова Директива Європейського Союзу; річковий басейн Дунаю; масив поверхневих вод; критерії ризику; гідроморфологічна оцінка