DOI: 10.2478/cjf-2025-0015

CODEN RIBAEG ISSN 1330-061X (print)
1848-0586 (online)

sciendo

ECOLOGICAL ASSESSMENT OF THE DABAR RIVER (SANSKI MOST): IMPLICATIONS FOR CONSERVATION AND MANAGEMENT

Sadbera Trožić-Borovac[1*], Adna Kararić[1], Subha Avdić[2], Berina Imamović[3], Mahir Gajević[1]

[1] *Faculty of Science, University of Sarajevo, Zmaja od Bosne 33-35, Sarajevo, Bosnia and Herzegovina,*

[2] *Biotechnical Faculty, University of Bihać, Pape Ivana Pavla II 2, 77 000 Bihać, Bosnia and Herzegovina*

[3] *Faculty of Agricultural and Food Sciences, University of Sarajevo, Zmaja od Bosne 8, Sarajevo, Bosnia and Herzegovina*

*Corresponding Author: strozic@pmf.unsa.ba

ARTICLE INFO

Received: 24 June 2025
Accepted: 14 July 2025

Keywords:
Karstic watercourse
Macrozoobenthos
Biological indices
Microbiological indicators
Sustainable management

ABSTRACT

This study presents the first comprehensive ecological assessment of the Dabar River, a small karstic watercourse in the Sanski Most area, using biological indicators focusing on the macrozoobenthos community, microbiological parameters, and ichthyofaunal composition. Sampling was conducted at three sites (headwaters, middle course, and downstream section), applying standard methods for the analysis of macrozoobenthos composition, bacterial abundance (including *Escherichia coli*), and biological indices (SI, BMWP, ASPT, EBI). The results indicate a good ecological status of the river, particularly in the headwater section, with a slight decline in water quality downstream. A rich and stable benthic fauna was identified, dominated by *Gammarus fossarum*, *Sadleriana fluminensis*, and representatives of the EPT groups. Microbiological findings revealed low to moderate levels of contamination, with no presence of fecal bacteria. Dabarska Cave, which hosts endemic subterranean crustaceans and olm *Proteus anguinus*, represents a particular ecological value of the area. Guidelines for conservation and sustainable management are proposed, including legal protection of the watercourse, pollution control, and the development of ecotourism.

How to Cite

Trožić-Borovac, S., Kararić, A., Avdić, S., Imamović, B., Gajević, M. (2025): Ecological assessment of the Dabar River (Sanski Most): Implications for conservation and management. Croatian Journal of Fisheries, 83, 141-148. DOI: 10.2478/cjf-2025-0015.

INTRODUCTION

Surface waters, including rivers, lakes, streams, ponds, and artificial reservoirs, represent one of the most important natural resources on planet Earth. Their functional role is multidimensional, encompassing ecological, economic, social, and public health aspects, positioning them as key components of sustainable development. As the primary source of drinking water for human populations, these water bodies are also indispensable for industrial production and agricultural activities. At the same time, aquatic ecosystems support highly diverse biological communities, where biodiversity often serves as an indicator of the degree of conservation and sustainability of water resources (Jakubínský and Cudlín, 2018; Niesenbaum, 2019; Hobohm, 2021). In addition to their ecological and economic functions, surface waters often hold significant historical, religious, and cultural value for local communities. Bosnia and Herzegovina stands out as a geographic area with an exceptionally rich and developed network of surface waters, which are in relatively good to moderate ecological status, but also include prominent water bodies that are under pressure from multiple sources and are included in regular monitoring programs. The Dabar River originates from Dabarska Cave near the settlement of Dabar, on the southwestern slopes of Mount Grmeč, within the municipality of Sanski Most. This watercourse has a specific flow and an important hydrological role in this part of Bosnia and Herzegovina, serving as a left tributary of the Sana River. The Dabar River is very unique because it emerges from a large underground cavity, i.e. a cave, which is characteristic of karstic rivers. The Dinaric karst is a global hotspot of subterranean biodiversity, particularly emphasizing its communities of stygobionts, stygophiles, and crenobionts (Falniowski et al., 2021). Previous research in Dabarska Cave has recorded two endemic (and newly described) crustacean species: *Niphargus dabarenzis* (Sket et al., 2006) and *Troglocaris bosniaca* (Sket and Zakšek, 2009), as well as olm *Proteus anguinus* and other stygobionts, which further highlight the biological value of this area.

The spring is located at 44°42′39″N 16°38′25″E at an elevation of 221 meters, with a flow length of 4 to 5 kilometers and a confluence upstream of the town at 44°43′02″N 16°40′34″E at an elevation of 185 meters. The Dabar River is formed from groundwater that passes through the cave and emerges to the surface, meaning the river is fed by underground sources often connected to the area's karstic systems. Given the nature of the karst relief, subterranean water flows can be highly variable, and the river's water level can fluctuate significantly depending on precipitation and other underground sources. The Dabar flows southeast, passing through karst terrain, including sinkholes and ponors, making it a typical karstic river. Its flow can be irregular and prone to drought during summer months, but also subject to sudden water level rises during rainy periods. The terrain through which the Dabar flows consists of limestone, dolomite, and other carbonate rocks typical of karst topography (Aganović et al., 1976; Trožić-Borovac et al., 2019). These rocks are susceptible to erosion by acidic groundwater, which creates cavities, caves, and underground channels through which the water flows. The cave from which the river springs is a key geological formation. Dabarska Cave plays a significant role in shaping the river's course, as the water filters through various rock layers before surfacing (Fig 1). This cave is also an important geological and hydrological feature of the region.

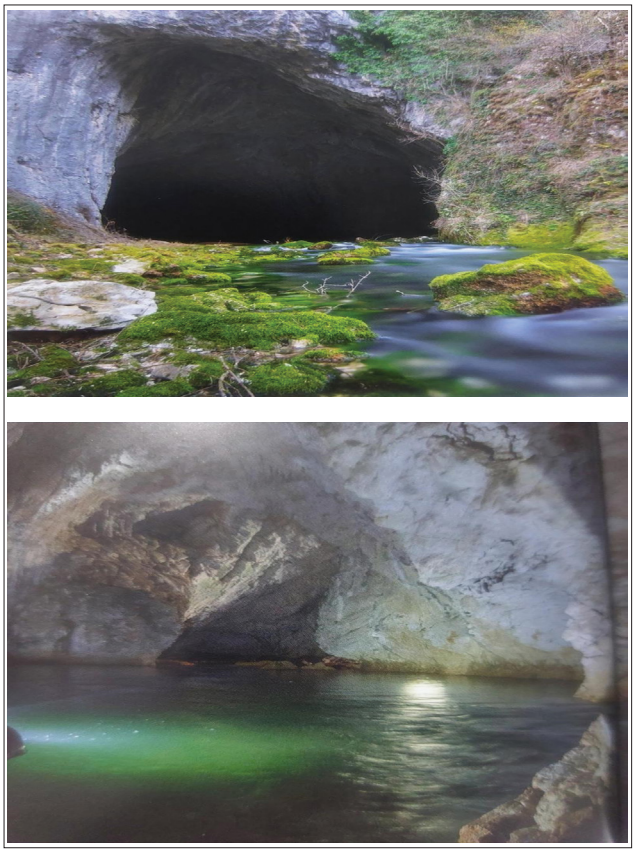

Fig 1. Dabarska Cave and the spring (karstic source) of the Dabar River

The aim of this study is to present the first comprehensive assessment of the ecological status of the Dabar River using biological indicators, with a particular focus on the macrozoobenthos community and microbiological parameters. The research includes the analysis of the structure and composition of macrozoobenthos along the river's course, as well as the determination of the presence and abundance of microbiological indicators of fecal contamination, such as fecal coliform bacteria and *Escherichia coli*. Based on the collected data, the ecological status of the river will be assessed in accordance with relevant legal and expert frameworks.

Since no similar studies have been conducted on the Dabar River to date, the results of this work can serve as an important foundation for further scientific analyses, and the protection and sustainable management of this water resource. Of particular importance is the karstic spring area where Dabarska Cave is located, which is a key element of the hydrological regime of the entire catchment. The water emerging from the cave originates from a complex underground karstic system, and its quality directly influences the condition of the entire downstream river ecosystem.

MATERIALS AND METHODS

Field research was conducted in March and May 2023 at three sampling locations along the course of the Dabar River. Water samples for microbiological analyses (March 2023) and macrozoobenthos samples were collected in the field, along with an assessment of the dominant sediment types.

The hypocrenal (headwater) site is characterized by the presence of macrolithal, mesolithal, and psammal substrates. The left bank lacks woody vegetation, while the right bank is covered with well-preserved forest vegetation typical of mesophilic deciduous forests on the slopes of Mount Grmeč (Fig 2). The ritron (middle course) section of the river retains distinctive features such as steeper banks and the presence of phytal zones in the sediment. This site is also an active fishing zone and is recognized as such. Downstream, just above the confluence with the Sana River, the Dabar River reaches its greatest depth. In this section, there is a change in sediment composition, with an increasing share of phytal zones, psammal, and fine silt fractions. This site is marked by the presence of a bridge, and the banks are partially modified due to anthropogenic influences and regular fishing activities. The riparian zone is dominated by species typical of floodplain forests, such as black alder *Alnus glutinosa*, poplar *Populus* spp., and ash *Fraxinus*. The sediment surface along the longitudinal profile is overgrown with moss species *(Fontinalis antipyretica, Rhynchostegium riparioides, Cladophora glomerata)* and higher aquatic plants (*Oenanthe aquatica, Ranunculus penicillatus*, etc.).

Water was sampled in sterile, pre-labeled containers, which were transported the same day to the laboratory of the Biotechnical Faculty at the University of Bihać for further analysis. To determine the total number of bacterial colonies at temperatures of 22 °C and 37 °C, Plate Count Agar nutrient medium was used, in accordance with APHA and ISO 4833 standards. For the detection of *Escherichia coli*, M-Endo Agar LES (HIMEDIA) nutrient medium was used. The total number of coliform bacteria was determined using the membrane filtration method. The entire procedure was conducted in accordance with BAS EN ISO 6222:2003, which defines the methodology

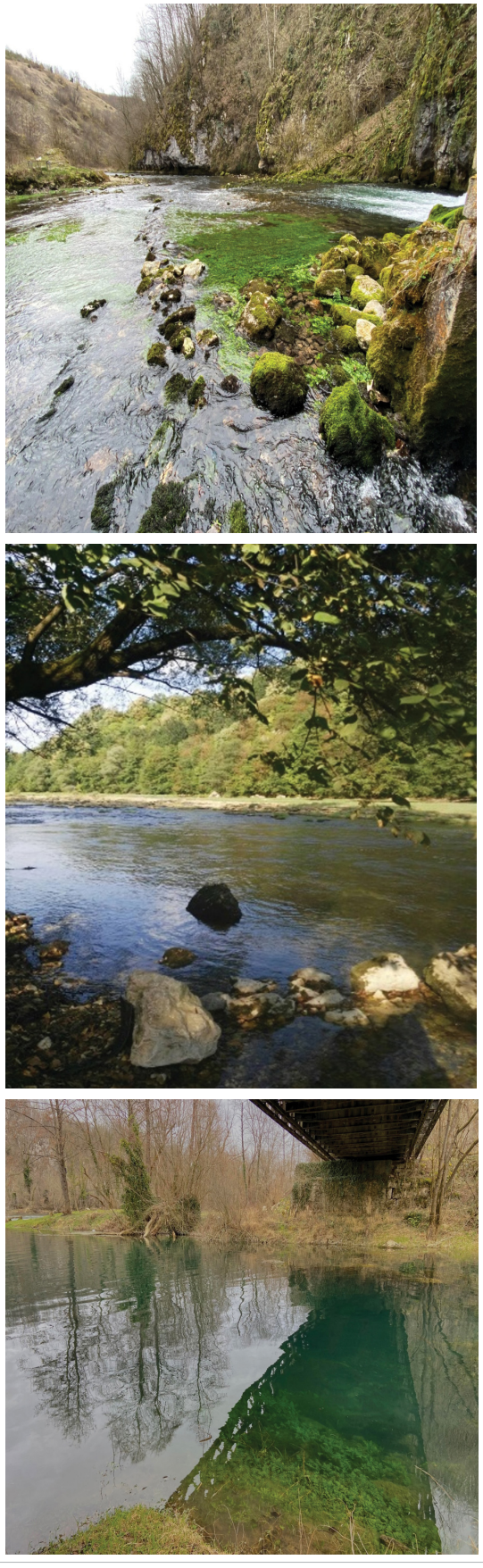

Fig 2. Hypocrenon, ritron, and the mouth section of the Dabar River

for determining the total number of aerobic mesophilic microorganisms in water.

Macrozoobenthos was sampled in May 2023 using the Multi-Habitat Sampling method. A total of 20 subsamples were collected, proportional to the representation of different sediment types along the studied sections of the Dabar River. Samples were preserved in ethanol in the field and properly labeled. Further separation and identification were conducted in the laboratory of the Faculty of Science, University of Sarajevo. For taxonomic identification, optical instruments (stereomicroscope and microscope) and appropriate identification keys were used (Bole, 1969; Hynes, 1977; Glöer, 2002; Nilsson, 1996, 1997; Studemann et al., 1992; Wallace and Philipson, 2003; Waringer and Graf, 1997, 2011, 2013).

Based on the qualitative and quantitative composition of macrozoobenthic communities, an assessment of water quality and the degree of organic pollution of the aquatic ecosystem was conducted using the following biotic indices:

- Saprobic Index (Pantle-Buck, 1955);
- BMWP (Biological Monitoring Working Party) and ASPT (Average Score Per Taxon);
- Extended Biotic Index (EBI)

The Bray-Curtis similarity/dissimilarity index was also calculated based on microbiological data and the composition of macrozoobenthos, and the results were presented using a dendrogram. Primer 5 and Excel 2021 were used.

RESULTS AND DISCUSSION

The hydromorphological characteristics of the studied watercourse indicate a natural to slightly modified state. After emerging from Dabarska Cave, the riverbed extends to the right, forming a gentle bend surrounded by rocky terrain and vegetation dominated by deciduous forests. The left bank is mainly overgrown with shrubs, lacking significant rocky structures, and is easily accessible. The river's water level is determined by underground reservoirs, which, together with precipitation, influence the hydrological and biological characteristics of this watercourse.

The number of colonies at 37 °C (Table 1), which may indicate the presence of bacteria associated with organic pollution, increases from the source (hypocrenal) section towards the mouth of the Dabar River into the Sana River. The highest value was recorded at the mouth (116 CFU/mL), suggesting slight organic loading, although values remain within the expected range for natural waters. The number of colonies at 22 °C, representing bacteria from the water, was very low in all samples (<100 CFU/mL), indicating a limited presence of saprophytic bacteria (i.e. a low degree of organic matter decomposition). Total coliform bacteria were detected in samples from the ritron and mouth zones (25 and 32 CFU/100 mL), indicating the input of allochthonous organic matter. However, *Escherichia coli* was not identified in any sample, excluding the presence of recent fecal contamination. Based on these findings, it can be concluded that, at the time of sampling, the water had low to moderate microbiological activity, without signs of fecal contamination, and was microbiologically stable.

The qualitative and quantitative analysis of the macrozoobenthos composition at the three studied sites along the Dabar River (Fig 3) showed the presence of seven taxonomic groups. The highest number of individuals was recorded in samples from the ritron zone (middle course) with 485 individuals, followed by the hypocrenal (source) samples with 420 individuals, while the fewest were found in the samples from the river mouth with 332 individuals.

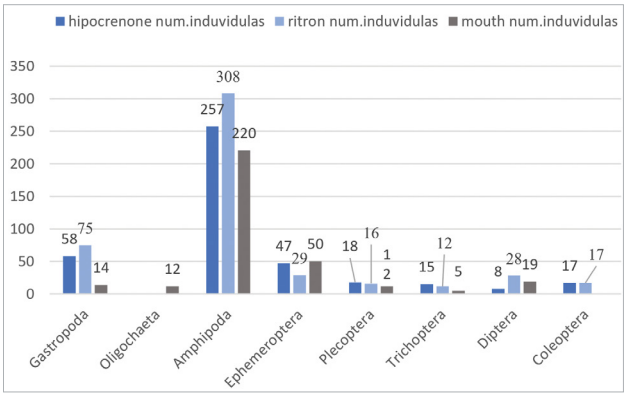

Fig 3. Display of the number of individuals and the composition of macroinvertebrates in samples from three investigated sites of the Dabar River

The number of taxa was relatively uniform: 10 at the mouth, 13 in the ritron, and 14 in the hypocrenal. The composition (Fig 4) indicates a well-developed population

Table 1. Results of the microbiological analysis of the Dabar River water samples from three investigated locations

Sample	Number of colonies at 37 °C (cfu/mL)	Number of colonies at 22 °C (cfu/mL)	Total Coliforms (cfu/100 mL)	*E. coli* (cfu/100 mL)
Hipocrenone	19	2	0	0
Ritron	39	<100	25	0
Mouth	116	<100	32	0

of the amphipod *Gammarus fossarum* in all samples, as well as the presence of snails such as *Ancylus fluviatilis, Valvata piscinalis, Theodoxus danubialis,* and *Sadleriana fluminensis*. Along the river's longitudinal profile, representatives of Ephemeroptera, Plecoptera, and Trichoptera were also recorded, along with Diptera and Coleoptera. In the hypocrenal samples, oligosaprobic indicators dominated (43%). In the downstream ritron samples, oligo- to betamesosaprobic organisms prevailed (46%), while at the mouth, there were elevated shares of betamesosaprobic indicators (23%) and organic pollution indicators (17%).

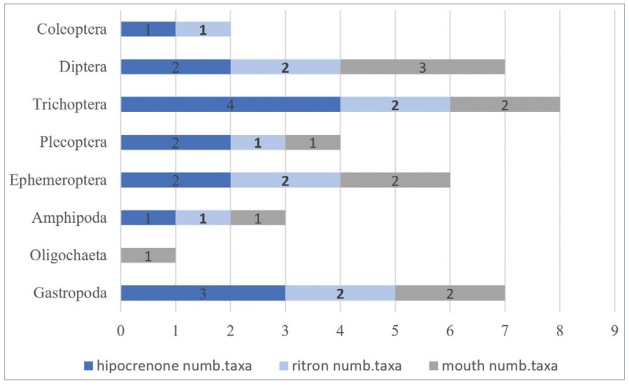

Fig 4. Display of the number of macroinvertebrate taxa in benthic samples from the Dabar River at three investigated sites

The presence of sensitive species such as the caddisfly *Odontocerum albicorne* was limited to sections with stable abiotic conditions. *O. albicorne* inhabits gravelly and sandy sediments in watercourses dominated by spring and groundwater inputs, as observed in the section of the Dabar River where individuals were recorded. This holometabolous species has larvae that are nocturnal omnivorous predators (Jensen, 2007). All caddisfly larvae play a fundamental role in the food web of running waters and are indicators of sediment stability and overall water quality (Karaouzas et al., 2024). Downstream, due to increased depth and anthropogenic influence, changes occur in the sediments and hydromorphology, leading to alterations in the macrozoobenthos composition. Anthropogenic impacts, including fish ponds, tourist activities, and planned infrastructural projects (water intakes), cause changes in biological diversity and reduce ecosystem services (Jakubínský and Cudlín, 2018). Compared to earlier studies (Aganović, 1976), no significant differences in macrozoobenthos composition were observed, except those arising from differences in methodology and taxonomic identification levels. The Zdena River shows a lower degree of similarity in macrozoobenthos composition, with common species such as *Gammarus fossarum*, *Odontocerum albicorne*, *Sadleriana fluminensis*, and *Simuliidae larvae* (Trožić-Borovac et al., 2019). These differences are further pronounced due to the presence of fish ponds, drinking water intakes, and more intense anthropogenic impacts on the Zdena watercourse. Snail *Sadleriana fluminensis* inhabits habitats with groundwater inflow in streams. This is characteristic of watercourses in northwestern Bosnia (Bole, 1969) and was recently recorded in the Trebišnjica River area during speleological research (Falniowski et al., 2021).

Using indices to assess saprobity (SI, BMWP, ASPT) and organic load (EBI), it was determined that the macrozoobenthos composition indicates relatively clean water, with saprobic values ranging from 1.6 to 2.0 at the mouth (Fig 5). Other indices follow a similar trend, with decreasing BMWP and ASPT values from the source towards the mouth. The lowest BMWP (50) and ASPT (4.55) values were recorded at the mouth. The Extended Biotic Index (EBI), which includes the dominance of preimaginal stages of two Plecoptera species, had the highest value (10) in the hypocrenal samples. In the ritron and mouth sections, a value of 8 was recorded, with a developed fauna and the presence of allochthonous organic matter.

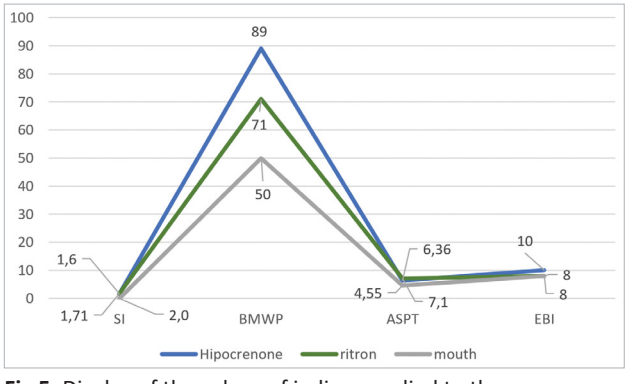

Fig 5. Display of the values of indices applied to the macrozoobenthos community (SI, BMWP, ASPT, EBI)

A clear trend of declining biological indices (SI, BMWP, ASPT, EBI) and increasing total coliforms towards the downstream sections of the river was observed, indicating a decline in water quality or a rise in saprobity to the betamesosaprobic level (Fig 6).

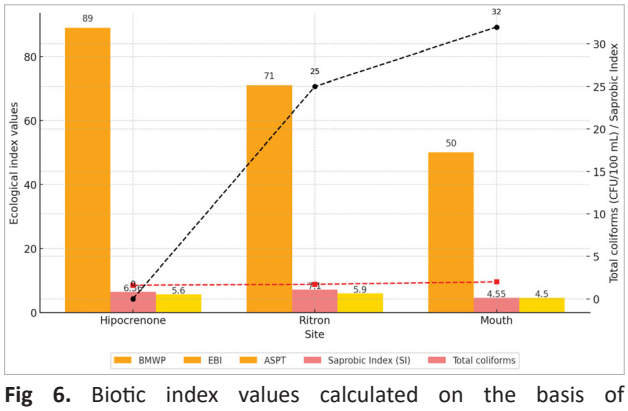

Fig 6. Biotic index values calculated on the basis of macrozoobenthos community in samples from the Dabar River at three study sites, along with total coliform bacteria

A strong negative correlation between total coliforms and biological indices confirms that greater coliform presence correlates with lower ecological water quality.

The results of the macrozoobenthos analysis show spatial differences in community composition and individual abundance. Sections of the river from the crenon to the ritron and downstream are clearly distinct in composition, as confirmed by the values of biological indices (BMWP, ASPT, EBI).

The temperature regime at the Dabar River source is more stable compared to the Zdena River, due to the natural terrain configuration. In some samples from the lower sections of the Dabar River, a slight increase in total coliform bacteria was recorded, coinciding with a decrease in BMWP, ASPT, and EBI index values. These findings suggest a slight increase in saprobity and possible presence of organic pollution, most likely caused by local and occasional anthropogenic pressures.

Using the Bray-Curtis similarity index (Fig 7), total coliform values were compared with the macrozoobenthos composition index. The results show clustering of samples from the ritron and mouth, while hypocrenal samples were clearly separated across all analyzed parameters.

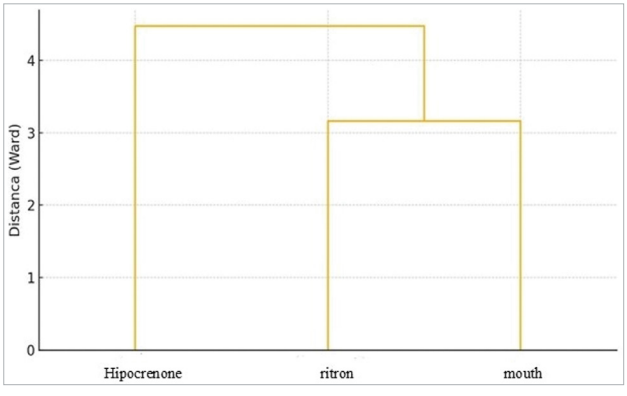

Fig 7. Cluster analysis based on Bray-Curtis distance of ecological indices (SI, BMWP, ASPT, EBI) and total coliforms

A study conducted in 1976 at two locations along the Dabar River (Fig 8) recorded the presence and dominance of brown trout *Salmo trutta* in the upper course, along with a smaller number of rainbow trout individuals (4%). In the downstream section, the total fish population was estimated at 3,687 individuals, dominated by *Chondrostoma nasus* (35%), brown trout and huchen *Hucho hucho* (each at 5%), and grayling *Thymallus thymallus* at 10%. Among the cyprinids, a significant share was held by *Rutilus pigus virgo* (25%), with barbel *Barbus barbus* and chub *Squalius svallize* at 5%. From the Esocidae family, pike Esox lucius was present with minimal representation at 2% (Aganović et al., 1976).

Recent observations by anglers have confirmed the presence of huchen, grayling, and pike. During 2018, new ichthyofaunal surveys were conducted upstream of the mouth, where chub, nase and *Rutilus pigus virgo* were recorded. Additionally, the upper course (ritron) is regularly stocked with brown trout, and this area holds the status of a sport-fishing zone.

The Dabar River is a small karstic watercourse not included in the Management Plan for the Sava River Basin subsystem, as its area is less than 10 km². A similar situation applies to the Zdena River. According to the Hydrometeorological Institute of Sarajevo (whose team of experts performed dye tracing in the karstic sinkhole near Lušci Palanka), based on the appearance of the dye at the Dabar and Zdena springs (Trožić-Borovac et al., 2018), it is assumed they share a common source from an estavelle in the Lušci Palanka area. This tracing has not been repeated, so the claim has neither been confirmed nor refuted.

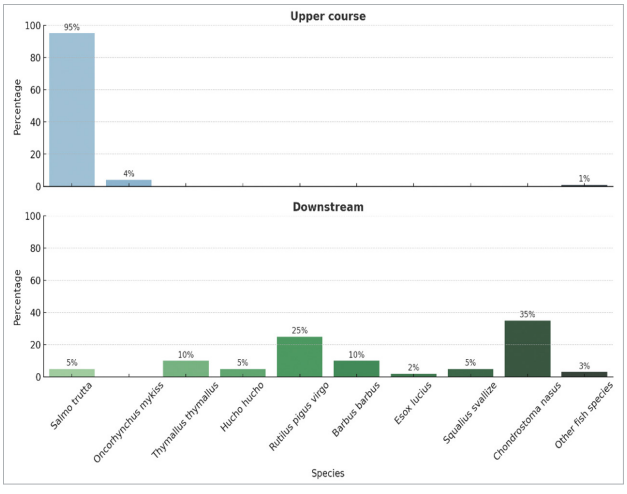

Fig 8. Fish species recorded in the upper and lower course of the Dabar River (Aganović et al., 1976)

The Dabar River, with its source in Dabarska Cave, is a classic example of a karstic river, which has long been of interest to speleologists, hydrologists, geologists, and biologists. The river's hydrological regime relies entirely on underground inflows and atmospheric precipitation, while the source area is characterized by low pollution levels. Microbiological examinations indicate a stable microbiological water status, with no presence of fecal contamination. Due to their sensitivity to environmental changes, microorganisms (particularly prokaryotes) are increasingly recognized as important bioindicators of the ecological status of aquatic ecosystems. Their use in biomonitoring is recommended in several studies (McGrane et al., 2014; Fontaine et al., 2023), particularly in the context of growing pressures related to fecal contamination.

The values of biological indices and the composition of benthic communities indicate a good ecological status of the Dabar River. Biological integrity is also confirmed by ichthyological data, as the presence of sensitive and ecologically significant species such as brown trout *Salmo*

trutta, rainbow trout, grayling *Thymallus thymallus*, pike Esox lucius, nase *Chondrostoma nasus*, *Rutilus pigus virgo*, and especially huchen *Hucho hucho* points to stable and preserved trophic networks.

The additional biological and conservation value of the area is highlighted by the presence of endemic crayfish species in the Dabarska Cave area, which survive thanks to specific microclimatic and hydrological conditions. These findings indicate a high degree of ecosystem integrity, resilience, and adaptability, as well as the need to include this area in conservation and sustainable management plans in accordance with EU directives.

The integrated approach combining macrozoobenthos data and microbiological indicators has proven to be an effective tool for valid and detailed ecological assessment and should serve as a foundation for future monitoring and conservation activities in this area.

CONCLUSION

The results of the conducted research indicate that the Dabar River possesses preserved hydromorphological characteristics and a stable hydrological regime that supports the diversity of benthic organisms along its course. Microbiological parameters confirm low to moderate organic loading without the presence of fecal contamination, while the composition of macrozoobenthos and biological indices indicate a good ecological status, with slight deterioration in downstream sections. A negative correlation between total coliforms and biotic index values further confirms the sensitivity of this aquatic ecosystem to anthropogenic pressures.

To maintain the ecological stability and functionality of this vulnerable karstic watercourse, the following management measures are recommended:

- preservation of the natural flow regime and avoidance of regulatory interventions,
- protection of the headwater area and associated subterranean biodiversity,
- establishment of regular monitoring of microbiological and biological parameters,
- control of diffuse pollution from agriculture and settlements,
- preservation of habitat structure and riparian zone integrity,
- integration of the area into spatial planning and conservation documents.
- These findings may serve as a basis for further monitoring and planning of sustainable management and conservation of the Dabar River in accordance with national and EU guidelines.

EKOLOŠKA PROCJENA RIJEKE DABAR (SANSKI MOST): IMPLIKACIJE ZA OČUVANJE I UPRAVLJANJE

SAŽETAK

Rad donosi prvu sveobuhvatnu ekološku procjenu rijeke Dabar, male krške tekućice na području Sanskog Mosta, korištenjem bioloških pokazatelja, s naglaskom na zajednicu makrozoobentosa, mikrobiološke parametre i sastav ihtiofaune. Uzorkovanje je provedeno na tri lokacije (izvorišni, srednji i nizvodni tok), pri čemu su primijenjene standardne metode za analizu sastava makrozoobentosa, brojnosti bakterija (uključujući *Escherichia coli*) i biološke indekse (SI, BMWP, ASPT, EBI). Rezultati ukazuju na dobar ekološki status rijeke, posebno u izvorišnom dijelu, uz blago pogoršanje kvalitete vode nizvodno. Identificirana je bogata i stabilna bentosna fauna s dominantnim vrstama *Gammarus fossarum*, *Sadleriana fluminensis* i predstavnicima skupina EPT. Mikrobiološki nalazi pokazuju nisku do umjerenu razinu kontaminacije, bez prisutnosti fekalnih bakterija. Posebnu vrijednost područja čini Dabarska pećina, stanište endemskih podzemnih rakova i čovječje ribice. Predložene su smjernice za očuvanje i održivo upravljanje, uključujući pravnu zaštitu vodotoka, kontrolu zagađenja i razvoj ekoturizma.

Ključne riječi: krški vodotok, makrozoobentos, biološki indeksi, mikrobiološki pokazatelji, održivo upravljanje

REFERENCES:

Aganović, M., Kapetanović, N., Kaćanski, D., Guzina, N., Zubčević, O., Čanković, M. (1976): Ribarska Osnova za slivno područje rijeke Sane /područje SO Sanski Most i SO Prijedor/. Biološki institutut Univerziteta u Sarajevu, 16-59.

BAS EN ISO 6222 (2003): Water quality – Enumeration of culturable microorganisms – Colony count by inoculation in a nutrient agar culture medium. Institute for Standardization of Bosnia and Herzegovina, Sarajevo.

Bole, J. (1969): Ključ za določevanje živali: mehkužci (Mollusca). Inštitut za biologijo Univerze v Ljubljani. Društvo biologov Slovenija, Ljubljana

Falniowski, A., Lewarne, B., Rysiewska, A., Osikowsk, A, Hofman, S. (2021): Crenobiont, stygophile and stygobiont molluscs in the hydrographic area of the Trebišnjica River Basin ZooKeys, 1047, 61-89

Fišer, C, Trontelj, P., Sket B. (2006): Phylogenetic analysis of the Niphargus orcinus species–aggregate (Crustacea: Amphipoda: Niphargidae) with description of new taxa. Journal of Natural History, 40 (41–43), 2265–2315,

Fontaine, L., Pin, L., Savio, D., Friberg, N., Kirschner, A.K.T., Farnleitner A.H., Eiler, A. (2023): Bacterial bioindicators enable biological status classification along the continental Danube river. Commun Biol., 6, 862

Glöer, P. (2002): Süßwassergastropoden Nord- und Mitteleuropas: Bestimmungsschlüssel, Lebensweise, Verbreitung. ConchBooks. Hackenheim, 1 – 327.

Hynes, H.B.N. (1977): A Key to the adults and nymphs of the British Stoneflies (Plecop-tera): With notes on their Ecology and Distribution. Freshwater Biological Association. Scientific Publication 7, 90 pp.

Hobohm, C. (2021): Environmental Indicators and Biodiversity Conservation Strategies. In: Hobohm, C. (eds) Perspectives for Biodiversity and Ecosystems. Environmental Challenges and Solutions. Springer, 159-180

Jakubínský, J., Cudlín, P. (2018): Impact of hydromorphological features of small watercourses on the quality of ecosystem services pp. 26-33. In Gastescu, P., Bretcan, P. (edit, 2018), Water resources and wetlands, 4th International Conference Water resources and wetlands, 5-9 September 2018, Tulcea (Romania), p.312

Jensen C. S. (2007): *Odontocerum albicorne* (Scopoli, 1763) (Trichoptera, Odontoceridae) in Norway. Norw. J. Entomol. 54, 19-20.

Karaouzas, I., Zamora-Muñoz, C., Sáinz Bariáin, M., Waringer, J., Holzenthal, R. W. (2024): Chapter 14 - Order Trichoptera, Editor(s): Alain Maasri, James H. Thorp, Identification and Ecology of Freshwater Arthropods in the Mediterranean Basin, Elsevier, 437-501,

McGrane, S. J., Tetzlaff. D., Soulsby, S. (2014): Assessing the influence of urban areas on the microbiological quality of rural streams. Envinmmental Monitoring and Assessmen. 186:7141:7155

Nilssen, A. (1996): Aquatic Insect of North Europe. A Taxonomic Handbook Volume 1. Technische Universitat Darmstadt FAC-Hbereich 10 — Biologie, Apollo books, Stenstrup, 427 pp

Nilssen, A. (1997): Aquatic Insect of North Europe. A Taxonomic Handbook Volume 2 Odonata - Diptera. Technische Universitat Darmstadt FAC-Hbereich 10 — Biologie, Apollo books, Stenstrup, 427 pp

Niesenbaum, R. A. (2019): The Integration of Conservation, Biodiversity, and Sustainability. Sustainability, 11(17), 4676.

Pantle, R., Buck, H. (1955): Die biologische Überwachung der Gewässer und die Darstellung der Ergebnisse. Gas- und Wasserfach, 96 (18), 604–620.

Sket, B., Zakšek, V. (2009): European cave shrimp species (Decapoda: Caridea: Atyidae), redefined after a phylogenetic study; redefinition of some taxa, a new genus and four new Troglocaris species. Zoological Journal of the Linnean Society, 155 (4), 786–818

Studemann, D., P. Landolt, M. Sartori, D. Hefti, Tomka, I. (1992): Ephemeroptera. In: Schweizerische Entomologische Gesellschaft (ed.): Insecta Helvetica – Fauna. Bd. 9, 173 pp.

Trožić-Borovac, S., Burnić, N., Borovac, B. (2018): Ekološke karakteristike rijeke Zdene (Sanski Most): Voda i mi, AVP Sava, Sarajevo, 98, 44 -52

Trožić-Borovac, S., Gajević. M., Borovac, B. (2019): Makrozoobentos krenoina (izvorišta) tekućica. Voda i mi, AVP Sava, Sarajevo, 100: 55-68

Waringer, J., Graf, W. (1997): Atlas der österreichischen Köcherfliegenlarven unter Einschluß der angrenzenden Gebiete. Facultas Universitätsverlag, Wien, 286 pp.

Waringer, J. and Graf, W. (2011): Atlas of Central European Trichoptera Larvae. Erik Mauch Verlag, Dinkelscherben, 468 pp.

Waringer, J., Graf, W. (2013): Key and bibliography of the genera of European Trichoptera larvae. Zootaxa 3640 (2): 101–151

Wallace, I.D., Wallace, B., Philipson, G. N. (2003): A key to the case-bearing caddis larvae of Britain and Ireland. Freshwater Biological Association Scientific Publication, 61, 1–259.