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EcoTEK

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# Ecological Truth & Environmental Research

Editor

Prof. Dr Snežana Šerbula

## PROCEEDINGS

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## FISH DIVERSITY ASSESSMENT OF THE IBAR RIVER: A 20-YEAR PERSPECTIVE

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### Abstract

*The aim of this study was to present the diversity of the fish communities of the upper and lower reaches of the Ibar River in the last 20 years. We calculated several species diversity indices, namely the Shannon Index (H), Reciprocal Simpson's Index (1/D), Fisher's Alpha Diversity Index (A), Margalef's Index, and Pielou's Evenness Index (J). We recorded 16 fish species from 7 families between the 2003 and 2023 investigation period. The highest value of Shannon's diversity index was recorded in the upper course of the river (0.691), while the lowest was in the lower course (0.314) in 2017 and 2019. The relatively low values of diversity indices are most likely the consequence of the dominance of a few species, but they also may be the result of strong anthropogenic influence. Evenness Index ranged from 0.226 to 0.424, indicating a low level of homogeneity of fish assemblages. This study has contributed to the knowledge of fish diversity in the Ibar River and could assist in carrying out future ecological studies in line with conservation, restoration, and management strategies.*

**Keywords:** fish diversity indices, fish assemblages, Ibar River, Serbia.

### INTRODUCTION

Freshwater ecosystems are known for their high diversity, but they are also considered the most threatened ecosystems in the world. Changes in the structure and quality of aquatic habitats are the result of a large number of different anthropogenic activities such as overexploitation, pollution, flow modification, degradation of habitat, and invasive species [1]. Freshwater fish play a significant role in the diversity and functioning of these ecosystems, particularly in lotic systems where they can provide valuable information about biological structure and ecological sustainability.

The Ibar River has a specific hydromorphology that was changed by the construction of the Gazivode reservoir. Plans for the construction of nine mini-hydroelectric power raise concerns about this specific river's ecosystem. Also, the Ibar River ranks among the most polluted rivers in Serbia due to increased pollution in recent decades (industrial and municipal

wastewater) [2] That's why in the present study we analyzed the 20-year temporal changes in the taxonomic diversity of the fish using fish diversity indices.

## MATERIALS AND METHODS

The Ibar River, the largest tributary of the West Morava, is a typical mountain river with a highly branched hydrographic basin (total length of 276 km). It springs on the north side of the Hajla mountain (1360 m above sea level) in Montenegro, flows into the West Morava near the town of Kraljevo [3], and belongs to the Black Sea basin. Due to high mountain flow, the great erosion in the basin, and river fall, the Ibar River exhibits a torrential character and causes frequent floods in periods of high waters. The Gazivode reservoir (total length of 22 km, volume of 380 million m<sup>3</sup>) was formed by damming the Ibar River at its upper course [4]. After 45 years the Pavlica mini-hydroelectric power plant was built (2021) near the town of Raška. There are plans for the construction of nine more similar plants.

The ichthyological research was conducted in the period 2003–2023, to develop fisheries management plans for protection and sustainable use of fish stocks. Fishes were sampled using the electrofishing equipment (Aquatech IG 1300) and samples were identified to species according to Kottelat and Freyhof [5] and Simonović [6]. We sampled at 12 localities shown in Table 1.

Species diversity was assessed using different indices: Shannon Diversity Index (H), Alpha Diversity Index (A), Margalef Diversity Index (M), and Evenness Index (J). The Shannon Diversity Index is the most commonly used diversity index in ecology and combines species richness (S) and evenness (E) [7]. The Simpson's Index (D) was used to measure the probability that two randomly chosen specimens from a sample will belong to different fish species. Due to the potential errors during the reverse interpretation of the obtained results, Simpson's Index was expressed as Reciprocal Simpson's Index (1/D) because its value increased with greater diversity [8]. Additionally, the link between the number of species and their abundances is determined with Fisher's Alpha Diversity Index (A) [9]. Margalef's index was used as a simple measure of species richness [10] and Pielou's evenness (J) was used to compare the actual diversity value (H index) to the maximum possible diversity value (lnS). It's constrained between 0 and 1 and the more variation in abundances between different fish species within the community, the J is lower [9]. All fish diversity indices were calculated using BioDiversityPro v. 2 software [11].

## RESULTS AND DISCUSSION

The obtained results of fish diversity and Evenness indices in investigated area were summarized and presented in Table 1.

During the study period, a total number of 16 fish species belonging to 7 families were recorded. The most represented families are Leuciscidae and Cyprinidae. Our results show a change in the composition of the fish community in accordance with longitudinal fish zonation concept. The upper course of the Ibar River represents the grayling zone with the only autochthonous populations of *Thymallus thymallus* (Linnaeus, 1758), for the Morava basin. Therefore, they are especially important in terms of conservation issues [12]. The lower



course belongs to the barbel zone, which is confirmed by the dominance of typical species for this zone, *Barbus barbus* (Linnaeus, 1758) and *Chondrostoma nasus* (Linnaeus, 1758). Interesting for this region is the appearance of *Zingel streber* (Siebold, 1863), which is rare in Serbia.

*Table 1 Diversity index of fish assemblages in the upper and lower reaches of the Ibar River*

Localities	year		Species richness	Shannon Index H	Reciprocal Simpson's Index 1/D	Alpha Index A	Margalef's Index M	Evenness Index J
Crna Reka	2003	upper course	7	0.632	3.607	2.161	8.699	0.325
Above mauth in W.Morava	2003	lower course	7	0.664	4.033	2.764	9.966	0.341
Mehov krš	2011	upper course	7	0.609	3.368	1.558	7.01	0.313
Žičko polje	2011	lower course	6	0.59	3.174	1.781	8.829	0.329
Topoljak	2016	lower course	6	0.444	2.051	1.386	7.437	0.248
Miljina glava	2017	upper course	8	0.691	3.742	2.342	8.157	0.332
Topoljak	2019	lower course	4	0.314	1.635	0.946	8.305	0.226
Špiljani	2020	upper course	5	0.406	1.986	1.541	9.495	0.252
Mataruška banja	2021	lower course	5	0.568	3.242	1.663	9.966	0.353
Špiljani	2023	upper course	7	0.668	3.774	3.066	10.48	0.343
Miljina glava	2023	upper course	4	0.333	1.83	0.925	8.157	0.24
Topoljak	2023	lower course	4	0.601	4.168	0.942	8.274	0.434

Fish as indicators of aquatic habitat health are widely used through biotic ichthyological indices [12]. Based on values of Shannon's Diversity Index (H) the highest diversity of fish species was observed in the upper course of the river (Miljina glava - 0.691 and Špiljani - 0.669) and the lowest in the lower course (Topoljak - 0.314) (Table 1).

The highest value of Margalef's Index was recorded in Špiljani in 2020, while the lowest value was recorded in Mehov krš in 2011 (Table 1). Relatively low values of diversity indices are most likely the consequence of the dominance of a few species, but they also may be the result of strong anthropogenic influence.

Evenness Index ranged from 0.226 to 0.424, and both values were recorded at the same locality, Topoljak, in 2019 and 2023. Evenness indices show how homogenous is the fish community, even an ecosystem, considering different fish species' abundances [9]. Our results indicated a relatively low level of homogeneity in terms of a well-balanced fish assemblage structure.

## **CONCLUSION**

Freshwater fish conservation efforts should be focused on knowledge of regional patterns of species richness. Our results provide important information about fish diversity and evenness in the investigated area under high anthropogenic threats, which is valuable for future conservation measures and management.

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