Published by the University "St. Kliment Ohridski" - Bitola

(*) Corresponding author
Original research article
DOI: 10.20544/AISC.1.1.25.P03

#UKLO Annual International Scientific Conference 2024

ECOLOGICAL STATUS AT THE KONJSKO LOCALITY OF LAKE PRESPA ACCORDING TO THE ASPT INDEX OF BOTTOM FAUNA COMPOSITION

Biljana Budzakoska Gjoreska*
Department of benthic fauna PSI Hydrobiological Institute Ohrid, Republic of North Macedonia,
E-mail: biljanab@hio.edu.mk

Sasho Trajanovski
Department of benthic fauna, PSI Hydrobiological Institute Ohrid, Republic of North Macedonia
E-mail: trajsa@hio.edu.mk

Sonja Trajanovska
Department of hydrobotany, PSI Hydrobiological Institute Ohrid, Republic of North Macedonia
E-mail: sonjat@hio.edu.mk

Abstract

The Water Framework Directive (EU 2000) identifies macrozoobenthos as an essential component of benthic fauna in aquatic ecosystems, playing a critical role in the assessment of ecological status. This study presents findings from research conducted at the Konjsko locality in Lake Prespa, Republic of North Macedonia. The composition, richness, and diversity of macrozoobenthos were examined during July 2022 and August 2023. Sampling was performed in the Macedonian section of Lake Prespa at the Konjsko locality, adhering to the methodologies outlined in the WFD and ISO standards for macroinvertebrate sampling. A total of eight species across five taxonomic groups from the macrozoobenthos were identified at the Konjsko locality: Oligochaeta, Gastropoda, Bivalvia, Amphipoda, and Insecta. The Gastropoda represented the most diverse group, with three species accounting for 37.5% of the total identified. Oligochaetes comprised the second most diverse group, represented by two species (25%). Bivalvia, Amphipoda, and Insecta each exhibited the lowest density, with only one species per group, constituting 12.5% each of the overall diversity. Notably, the highest population density recorded was for Dreissena carinata, at 875 individuals per square meter at a depth of 2 meters within the Konjsko locality. Based on the findings, the biodiversity and abundance of macrozoobenthos indicate that the Konjsko locality in Lake Prespa possesses a moderate ecological status, as assessed by the Average Score Per Taxon (ASPT) index.

Keywords: macrozoobenhos, biodiversity, density, WFD, ecological status, Lake Prespa.

INTRODUCTION

The Prespa LakeBasin is an area of rich biodiversity that has been subject to intense pressures from human activities over the past decades (UNDP, 2012). Recently, Lake Prespa

has faced significant anthropogenic pressures, as well as the effects of climate change. The bottom fauna, or macrozoobenthos, responds to these changes in terms of population dynamics, species presence, and their composition (both qualitative and quantitative).

The main goals of the study were to ascertain the structure of the invertebrate community, the abundances of species, and the general condition of the benthic fauna from the Konjsko locality in Lake Prespa during the summers of 2022 and 2023.Research on the macrozoobenthos in Lake Prespa is crucial for assessing ecological changes and protecting this ecosystem.

MATERIALS AND METHODS

The field research took place at the Konjsko locality, which, according to previous studies, is characterized by varying intensities of anthropogenic pressure and changes in ecological status. The research was conducted using standard limnological methods byLind (1985), Wetzel (1975), Wetzel and Likens (1979); and in accordance with EU Directives (EU 2000). Samples were collected using a van Veen grab (225 cm^2) from different depths (2, 5, 10 m) and habitats, using the method of vertical transects extent ending into the macrophytic vegetation of Lake Prespa. The density values refer to the average density of individuals from two samples per unit surface area (m^2). Determination was carried outat the species level. The processed material was preserved in 96% ethyl alcohol, labeled and stored in plastic vials.The macrozobenthos species were identified using keys from the following authors: Barnes (1980), Brinkhurst& Jamieson (1978), Hadžišče (1953, 1958 II, III), Hrabe (1941), Lind (1985), Lukin (1976), Radoman (1983) and Šapkarev (1975).

To determine the ecological status of the macrozoobenthos community structure,the following structural indices were calculated: index of species richness (S), Shannon-Wiener Diversity Index (H' diversity), Pielou's index of evenness J(e) and Simpson's index (c) across different habitats and localities. The Average Score Per Taxon (ASPT) represents the average tolerance score of all taxa within the community and is calculated by dividing the BMWP score (Table 6 overleaf in Mandaville, 2002) by the number of families represented in the sample.

RESULTS AND DISCUSSION

During the summer campaign, the bottom fauna at the Konjsko locality was represented by seven species belonging to four classes (Oligochaeta, Gastropoda, Amphipoda and Insecta) (Tab.1). The highest density was recorded at a depth of 2 meters on a muddy bottom, where six species were registered with the highest population of *Pyrgohydrobia prespaensis*-200 ind/m^2.

Table 1: Composition and density of bottom fauna in Konjsko (July 2022)

Locality Konjsko				
Depth (m)	**Bottom facies**	**Class**	**Species**	**Density (ind/m^2)**
2	Muddy	Oligochaeta	*Eiseniella tetraedra*	75
			Limnodrilus hoffmeisteri	25
		Gastropoda	*Planorbis prespensis*	75
			Valvata piscinalis	125
			Pyrgohydrobia prespaensis	200
		Insecta	*Chironomus plumosus*	75
5,5	Muddy with shells	Oligochaeta	*Eiseniella tetraedra*	50
		Amphipoda	*Gammarus triacanthus prespensis*	75
		Insecta	*Chironomus plumosus*	175
10	Muddy with shells	Oligochaeta	*Eiseniella tetraedra*	25
		Insecta	*Chironomus plumosus*	175

During the summer campaign, the bottom fauna at the Konjsko locality was represented by seven species belonging to five classes (Oligochaeta, Gastropoda, Bivalvia, Amphipoda and Insecta) (Tab.2). The highest density was observed at a depth of 2 meters on a muddy bottom, where six species were registered,with the highest population of *Dreissena carinata* with 875 ind/m^2.

Table 2: Composition and density of bottom fauna in Konjsko (August 2023)

Locality Konjsko				
Depth (m)	**Bottom facies**	**Class**	**Species**	**Density (ind/m^2)**
2	Muddy	Oligochaeta	*Eiseniella tetraedra*	25
			Limnodrilus hoffmeisteri	25
		Gastropoda	*Valvata piscinalis*	100
			Pyrgohydrobia prespaensis	125
		Bivalvia	*Dreissena carinata*	**875**
		Insecta	*Chironomus plumosus*	50
5,5	Muddy with shells	Oligochaeta	*Eiseniella tetraedra*	25
		Amphipoda	*Gammarus triacanthus prespensis*	100
		Bivalvia	*Dreissena carinata*	425
		Gastropoda	*Valvata piscinalis*	25
		Insecta	*Chironomus plumosus*	75
10	Muddy with shells	Oligochaeta	*Eiseniella tetraedra*	25
		Insecta	*Chironomus plumosus*	50

Table 3: List of macrozoobenthos species composition in Konjsko, Prespa Lake (summer 2022/2023)

Class	Species
Oligochaeta	*Eiseniella tetraedra*
	Limnodrilus hoffmeisteri
Gastropoda	*Planorbis prespensis*
	Valvata piscinalis
	Pyrgohydrobia prespaensis
Amphipoda	*Gammarus triacanthus prespensis*
Insecta	*Chironomus plumosus*
Bivalvia	*Dreissena carinata*

In Konjsko locality of Prespa Lake, eight species from five systematic groups of bottom fauna were registered: Oligochaeta, Gastropoda, Bivalvia, Amphipoda, and Insecta (Table 3).

Figure 1: The most abundant species *Dreissena carinata* in Konjsko, Prespa Lake

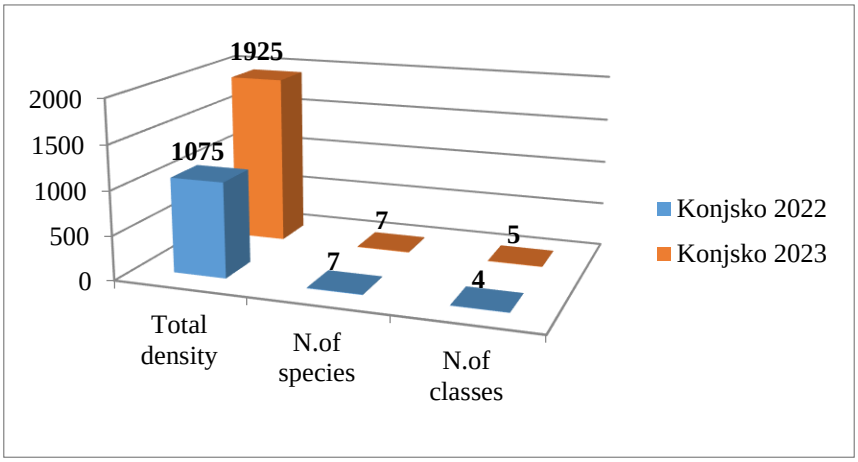

Figure 2. Density and diversity in Konjsko, Lake Prespa

Figure 2 presents a comparison between total density and diversity at the Konjsko localityof Prespa Lake during the summers of 2022 and 2023. Regarding density, similar to biodiversity, the highest number of individuals per square meter was recorded in the summer of 2023 - a total of 1925 ind/m^2. The lowest density was recorded in the summer of 2022, with 1075 ind/m^2. The most abundant species at the investigated Konjsko locality during the summers of 2022 and 2023 was *Dreissena carinata* (Fig.1).

Table 4: Ecological status of Konjsko according to the indices (summer 2022/2023)

Indices	**Locality Konjsko**	
Summer	2022	2023
N (ind/m^2)	1075	1925
Number of species S	7	7
Shannon & Weaver H	3.2	2.56
Margalef d	3.3	3.65
Pielou e	0.92	0.69
Simpson c	0.12	0.27
ASPT	3.57	4.14
ASPT	Moderate	

*red color-very heavily polluted waters; orange - heavily polluted waters; yellow -medium polluted waters; green-slightly polluted waters; blue -clean unpolluted waters.

Table 4 presents the ecological status of the sampling sites according to traditional indices. The environmental status varies from poor to very good (based on the Pielou and Simpson indices). The values of H (Shannon & Weaver diversity index) and d (Margalef index) provide a closer reflection of the real picture of the ecological status of the sampling sites.

None of the mentioned indices accurately reflect the real condition of the Lake when viewed through the prism of the bottom fauna, which is generally either very poor (Figure 1) at most localities in the Lake or includes representatives that are not sufficiently indicative. Moreover, they indicate an environmental status that does not meet the requirements for good environmental status according to the European Water Directive. Therefore, in this research and data processing, the ASPT index was utilised, as it has proven to be sufficiently indicative and has been verified in previous studies. According to this index, the locality of Konjsko has a moderate ecological status (Table 4).The ASPT index is a useful tool for biomonitoring, as it allows for a rapid assessment of water quality based on the composition of macrozoobenthos.

According to research conducted in April 2021 (Budzakoska-Gjoreska et al. 2023) greater biodiversity and density were observed in the locality of Ezerani. The most abundant species of benthic fauna was *Dreissena carinata* (Budzakoska-Gjoreska et al. 2024;Budzakoska-Gjoreska et al. 2024a). All physical and chemical parameters investigated indicate that Lake Prespa is undergoing eutrophication, and in addition to increased phosphorus levels, the water level has also decreased (ICR 2015, Stojov 2020). The diversity and abundance of the benthic fauna, as one of the key components most affected by the constant fluctuation and withdrawal of the Lake's water, have already been drastically reduced based on the latest research (2020–2023) (Trajanovski et al. 2023). According to the authors, global warming and changes in water trophic status are considered the main triggers and vectors that facilitate the transmission, acclimatization and rapid adaptation of new species. Based on this index, the locality of Konjsko has a moderate ecological status(Budzakoska-Gjoreska et al. 2024). The macrozoobenthos community structure in the summer of 2023 indicated a further decline in both population density and species diversity across localities (Trajanovski et al. 2024).

CONCLUSION

In the Konjsko locality of Prespa Lake, eight species from five systematic groups of bottom fauna were recorded:Oligochaeta, Gastropoda, Bivalvia, Amphipoda, and Insecta.The richest diversity was observed in the Gastropoda group, with three species. The Oligochaeta group was represented by two species, while Bivalvia, Amphipoda and Insectaeach had only one representative. In terms of density, similar to biodiversity, the highest number of individuals per square meter was recorded in the summer of 2023. Greater biodiversity and density were observed in the summer of 2022, while lower density and diversity were noted in the summer of 2023.The most abundant species of the bottom fauna was *Dreissena carinata*. According to the ASPT index, the Konjsko locality has a moderate ecological status. Measures are urgently needed for the protection and sustainable management of the lake's resources through the control of water sources, a reduction in the use of chemicals, and the protection of endemic species. Actions are necessary to restore the natural balance and protect the biodiversity of Lake Prespa.

ACKNOWLEDGEMENT

The authors express their gratitude to PONT for the Grant: Identification of Anthropogenic Impacts on Prespa Lake (January 2021 - June 2024) and to the main researcher Dr. Elizabeta Veljanovska Sarafiloska by Grant Agreement Number (EA0180;03-155/1).

REFERENCES

1. Barnes, R.D. 1980. Invertebrate Zoology, Saunders College, Philadelphia
2. Brinkhurst, R. O. and Jamieson, B. G. 1978. Aquatic Oligochaeta of the world. Oliver & Boyd, Edinburgh.
3. Budzakoska Gjoreska B.,Trajanovski S. andTrajanovska S. 2024a. Abundance and Depth Distribution of Macroinvertebrates in Krani, South-eastern part of Lake Prespa, Republic of North Macedonia. Acta Zoologica Bulgarica, 76 (3):393-399. (IF) 0.5
4. Budzakoska-Gjoreska B. and Trajanovski S. 2024. Macrozoobenthos community and ecological status in Prespa Lake (Otesevo, Stenje and Ezerani) in spring 2022. EcoTER'24 - 31st International Conference Ecological Truth & Environmental Research. 18-21 June, Sokobanja, Serbia. Proceedings pp. 169-175.
5. Budzakoska-Gjoreska B., Trajanovski S. and Veljanovska-Sarafiloska E. 2023. The condition of the bottom fauna in Prespa Lake (Oteshevo, Stenje and Ezerani) during 2021. International Conference "Kliment's Days 2023 - 60 years Faculty of Biology". Book of Abstracts. 9-11 November 2023, Sofia, Bulgaria. pp.49
6. EU 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, establishing a framework for Community action in the field of water policy. Official Journal of the European Communities 327, pp. 1-73.
7. Hadžišče, S.1953. Prilog poznavanju Gastropoda Prespanskog i Ohridskog jezera. Zbor. I. Kongres biologa Jugoslavije, Zagreb: 174-177.
8. Hadžišče, S. 1958. II. Prilog poznavanju gastropoda Prespanskog Jezera. Zbornik na rabotite, Hidrobiloski zavod, Ohrid. God. VI, Br. 16 (32). str. 1-6.
9. Hadžišče, S.1958. III. Prilog poznavanju gastropoda Prespanskog Jezera. Zbornik na rabotite, Hidrobiloski zavod, Ohrid. God. VI, Br. 17 (33). str. 1-4.
10. Hrabe, S., 1941. Die Oligochaeten aus den Seen Ochrida und Prespa. (Nach dem von Prof. S. Stankovic gesamme lten Materijal Bearbeitet). Zoo. Jhrb. Abt. Syst., Jena, 61: 1-62.

11. ICR-Initial characterization of Lakes Prespa, Ohrid and Shkodra/Skadar. 2015. Implementing the EU Water Framework Directive in South-Eastern Europe. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn und Eschborn, 568 S. pp.113
12. Lind, O. T. 1985. Handbook of common methods in limnology. The C. V. Mosby Company, St. Luis-Toronto-London, pp. 199.
13. Lukin, E.I. 1976. Fauna SSSR: Leeches (First part). Scientific Academy, Institute for Zoology, published by Nauka, Leningrad.
14. Mandaville S. M. 2002. Benthic macroinvertebrates in freshwaters – taxa tolerance values, metric, and protocols. (Project H-1) Soil & Water Conservation Society of Metro Halifax, 48 p. &Appendices.
15. Radoman, P.1983. Hydrobioidea, a superfamily of Prosobranchia (Gastropoda). I. Systematics. Monographs, Serb. Acad. Sci., Belgrade, pp. 1-256.
16. Šapkarev, J.,1975. Sistematika i rasprostranenje pijavica(Hirudinea)Makedonije (Taxonomy and distribution of leeches (Hirudinea) from Macedonia). Biosistematika I (1): 87-99.
17. Stojov V. Climate and anthropogenic impacts on the water reserves of the Prespa Lake (2020).*Available on the following link:* https://www.moepp.gov.mk/wp-content/uploads/2020/12/prespa_klima_antropogeni_vlijanija_20201129.pdf
18. Trajanovski S., Budzakoska Gjoreska B. and Zdraveski K. 2024. Lake Prespa: Temporal-Spatial Analysis of Macrozoobenthos and Ecological Status. International Conference Adriatic Biodiversity Protection - AdriBioPro2024 Kotor, Montenegro, Book of Abstracts pp. 14
19. Trajanovski S., Budzakoska Gjoreska B., Trajanovska S.& Zdraveski K. 2023. Lake Prespa (North Macedonia) - Horizon scanning for invasive and alien species using AS-ISK tool. Joint ESENIAS & DIAS Scientific Conference 2023 and 12th ESENIAS Workshop: Globalisation and invasive alien species in the Black Sea and Mediterranean regions-management challenges and regional cooperation. Book of Abstracts. 11-14 October 2023, Varna, Bulgaria.pp.35
20. UNDP Project FinalReport, 2012. Restoration of the Prespa Lake Ecosystem-Implmention of the Prespa LakeWatershed Management Plan.
21. Wetzel, R. G. 1975. Limnology. Saunders College Publishing, Philadelphia, 767 pp.
22. Wetzel, R. G., & Likens, G. 1979. Limnological Analyses. W. B. Saunders comp. Philadelphia, London, Toronto. pp. 263-270.