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THE SYSTEMATIC AND ECOLOGICAL CONTRIBUTION OF THE BENTHIC FAUNA IN THE DRINO RIVER

SUMMARY

Identification and evaluation of natural and biological resources of the rivers, it's very important and necessary for the protection, usefulness, and refinement of their condition. The usage of benthic macroinvertebrates in the monitoring of water quality of rivers is considered an efficient method according to the Water Framework Directive (WFD, 2000).

This research is conducted in the course of the year 2019 in the Drino River where its purpose was to assess its biological diversity regarding to index -Simpson and also to estimate the river's water quality using Family Biotic Index - FBI. The method used for sampling was based in technique Kick net with mesh size 500 micron. From the sampling taken in three stations, 1084 individuals were collected that belong to 25 families.

The values of the FBI for the station I (FBI = 4.69) belong to the third class of the quality "Good," meanwhile station II (FBI = 2.95) and station III (FBI = 3.38) belong to the first class of quality "Excellent". Simpson Diversity Index where represents with value D = 0.84 showing a high level of diversity. The evaluation of the water quality according to the FBI as "Excellent" quality at two stations and "Very good" at one station was associated with the highest biological diversity according to "Simpson Index". We detect also correlation between the two ecological parameters taken under consideration.

In the first station was observed a lower good water quality and a lower number of sampled individuals compared to the other two stations. This situation indicates possible organic pollution.

Keywords: Biotic Index, Bioclassification, FBI, Simpson index.

INTRODUCTION

Knowing and evaluating the natural and biological resources of rivers is very important and necessary for the protection, use and improvement of their condition (Hey, 1993; Harper, 1995). Biotic indices allow us to understand the state of a river's flow because through their calculation we obtain information on its physico-chemical state and ecological composition (WFD 2000; Pepa, 2014). The frequency of distribution of taxa and their sensitivity to pollution allows us to evaluate the quality of waters through the calculation of bio indices (Tachet, 2002).

Based on the EU Water Directive, biological assessments of water bodies use, among other elements, benthic organisms as one of their most important components. Macroinvertebrates are parts of the water monitoring systems suggested in the EU Directive as well as in the Water Frame Directive (Environmental Protection Agency EPA, USA), Directive, 2000/60/EC 2000 (WFD 2000).

Drinos River is a main branch of Vjosa River. During last years the agricultural use and urbanization of its basin is very intensive where negative impact on the quality of water is expected (Pepa, 2014).

In this work, benthic macroinvertebrates sampled in the Drino River were used to evaluate its water quality and biodiversity. By analyzing the results of the calculated FBI index, the assessment of water quality was carried out. Biodiversity was assessed by calculating the Simpson biotic index. Macroinvertebrate populations clearly and timely reflect changes in water quality in aquatic ecosystems (Paaristo, 2009).

MATERIAL AND METHODS

Study area

This study was conducted in the Drino River (Fig. 1). This river has its beginnings in Greece, on the western slopes of Mount Elatos. It enters Albania between Radat and Kakavija and follows a straight NW course through a relatively regular valley. It is about 84 km (Pan, 2008; Mezini, 1985). It flows between two mountain ranges, on one side Shëndëlli – Lunzhëri – Bureto and on the other side the highlands of Kurvelesh – Wide Mountain – Stugare. Its general extent is JL-LP.

Sampling was carried out at three stations. The determination of the sampling points was carried out taking into account several factors such as: terrain morphology, proximity to inhabited centers, human activities and clean water supplies from streams and springs (Beqiraj, 2007; Piro, 2014). The sampling stations are: Station 1 - Gjirokastër; Station 2 - Picar; Station 3 – Cold Water, Tepelen**.**

Fig. 1- Watersheed of Vjosa river. Sampling stations in the Drinos River: a) St. 1 Gjirokastra, b) St. 2 Picar, c) St 3 Cold Water, Tepelen.

For benthos sampling we operate through the methods of Campaioli *et al*., 1994. The technique we used was the kick-net sampling technique (digging with kicking) where a grid with a rectangular structure with dimensions of 480 x 250 mm and a hole spacing of 500 μm was used. We took the collected materials from the net and put them in a 250 ml plastic bottle. Each bottle is marked with the name of the respective station. The samples were preserved with alcohol and transported to the laboratory where they were cleaned and taxon identification was performed (Richard, 2003; Tachet, 1980).

Calculation of biodiversity and biotic index

The Simpson diversity index was used to assess the biodiversity of freshwater benthic macroinvertebrate populations. The FBI biotic index was used to assess the water quality of the Drino River.

- **Simpson diversity index**

Simpson's Diversity Index is a measure of diversity. In ecology, it is often used to determine the biodiversity of a habitat (Simpson, 1949). It takes into account the number of species present, as well as the number of individuals of each species.

$$D = 1 - (\Sigma [ni (ni - 1)/N (N - 1)])$$

- n is the number of individuals of a species,
- N is the total number of individuals

The Simpson index score ranges between 0 and 1. A high score indicates high

diversity and a low score indicates low diversity. When the diversity index is 0, the community contains only one species (no diversity). As the number of different species increases and the distribution of species in the population becomes more equal, the diversity index increases and approaches 1.

- **FBI biotic index**

The Biotic Index of Families is an index modified by Hilsenhoff, 1988, adapted from Bode, 1988 (Hilsenhoff, 1988). This index considers the density of individuals for all taxa identified in the samples and the tolerance value for each taxon. Although the FBI can be applied to toxic pollutants, it has been evaluated for organic pollutants (Tab. 1).

$$FBI = \Sigma(xi*ti)/(n)$$

Where, xi = number of individuals of a taxon
ti = taxon tolerance value
n = total number of individuals sampled

Tab. 1 -Assessment of water quality using the Biotic Index at household level (Hilsenhoff, 1988).

Family Biotic Index	**Water Quality**	**Degree of Organic Pollution**
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very Good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

RESULTS AND DISCUSSION

The main households identified in the three stations

After sorting all species under a stereo microscope were identified up at least to the family level, in accordance with purpose of this study (Tab. 2). The identified families belong to the orders Trichoptera, Plecoptera, Ephemeroptera, Diptera, Coleoptera, Haplotaxida, Hoplonemertea. These orders belong to the type Annelida, Arthropoda and Nemerthea; class Oligochaeta and Insecta. The largest number of orders belongs to the class of water insects. In total, 25 families present in the Drino River have been identified, where some are frequent at all 3 stations, some

at two or 1 station. There are 14 families present in the first station, 12 families present in the second station and 18 families present in the third station.

Tab. 2 -Families identified in each station.

Orders	Families	St. 1	St. 2	St. 3
Ephemeroptera	Ephemerellidae	16%	29%	17.9%
	Caenidae	0.6%	3.9%	12%
	Oligoneuridae	0%	2.2%	13%
	Heptagenidae	10%	40%	20%
	Baetidae	0.6%	9.9%	5%
Plecoptera	Nemouridae	6%	0%	0%
	Chloroprelidae	0%	0%	0.2%
Trichoptera	Hydropsychidae	2%	7.9%	14.6%
	Hydroptilidae	4%	1.6%	3%
	Rhyacophilidae	0%	0%	2.4%
	Glossosomatidae	0.6%	1%	0%
Diptera	Thumaliidae	7.5%	0%	0%
	Blephoriceridae	0%	0%	0.2%
	Simuliidae	0%	0%	3%
	Ceratopogonidae	6%	0.4%	0.6%
	Chironomidae	24%	2.9%	3.5%
	Tabanidae	0%	0%	0.6%
	Athericidae	0%	0%	0.4%
	Empididae	0%	0%	0.6%
	Limonoidae	0%	0.2%	0%
Coleoptera	Haliplidae	2.7%	0.2%	0%
	Scirtidae	0%	0%	0.2%
	Elmidae	0%	0%	0.6%
Haplotaxida	Lumbricidae	17%	0%	0%
Hoplonemertea	Tetrastemmatidae	0.6%	0%	0%

FBI Biotic Index

FBI biotic index values were calculated for the three sampling stations of the Drino River (Tab. 3). According to the value of this index, the water quality at the beginning of station II (Picari village) (FBI = 2.95) and III (Tepelene) (FBI = 3.38) is within the "Excellent" bioclassification. Meanwhile, at station I (Gjirokastër)

this index is within the "Good" bioclassification (FBI = 4.69). Station I, since it is located near the beginning of the flow of the Drino river, should theoretically have a better water quality than the real value. But the low level of water flow and the proximity to the city of Gjirokastra affects the quality reduction. In the other part of the river's course, we have the presence of water sources which affect the increase of the water level and the improvement of its quality.

Tab. 3 -Calculation of FBI biotic index values.

Orders	**Families**	**Tolerance**	**FBI**		
			St. 1 (xi*ti)	**St. 2 (xi*ti)**	**St. 3 (xi*ti)**
Ephemeroptera	Ephemerellidae	1	24	141	82
	Caenidae	6	6	114	336
	Oligoneuridae	2	0	22	122
	Heptagenidae	3	45	579	279
	Baetidae	5	5	240	125
Plecoptera	Nemouridae	2	18	0	0
	Chloroprelidae	0	0	0	0
Trichoptera	Hydropsychidae	4	12	152	268
	Hydroptilidae	4	24	32	32
	Rhyacophilidae	1	0	0	11
	Glossosomatidae	1	1	5	0
Diptera	Thumaliidae	5	55	0	0
	Blephariceridae	0	0	0	0
	Simuliidae	6	0	0	90
	Ceratopogonidae	6	54	12	18
	Chironomidae	8	288	112	128
	Tabanidae	5	0	0	15
	Athericidae	4	0	0	8
	Empididae	6	0	0	18
	Limonoidae	5	0	5	0
Coleoptera	Haliplidae	5	20	5	0
	Scirtidae	5	0	0	5
	Elmidae	4	0	0	12
Haplotaxida	Lumbricidae	5	125	0	0
Hoplonemertea	Tetrastemmatidae	8	8	0	0
			Σ(xi*ti)/ (n)=4.69	**Σ(xi*ti)/ (n)=2.95**	**Σ(xi*ti)/ (n)=3.38**

Simpson diversity index

From the data calculation (Tab. 4), it appears that the Simpson's Index (D) for this group is 0.158 and the Simpson's Diversity Index (1-D) for this group is 0.84. From the value obtained from the calculation of the Simpson diversity index, which is close to 1, it shows that this river has a high number of species, so it has a high diversity.

Tab. 4 -Calculation of the Simpson index of diversity.

Orders	Families	Number of individuals	$(n / N)^2$
Ephemeroptera	Ephemerellidae	247	0.05192
	Caenidae	76	0.00491
	Oligoneuridae	72	0.00441
	Heptagenidae	301	0.0771
	Baetidae	74	0.00466
Plecoptera	Nemouridae	9	0.00006
	Chloroprelidae	1	0.0000008
Trichoptera	Hydropsychidae	108	0.00992
	Hydroptilidae	28	0.00066
	Rhyacophilidae	11	0.0001
	Glossosomatidae	6	0.00003
Diptera	Thumaliidae	11	0.0001
	Blephoriceridae	1	0.0000008
	Simuliidae	15	0.00019
	Ceratopogonidae	14	0.00016
	Chironomidae	66	0.0037
	Tabanidae	3	0.000007
	Athericidae	2	0.000003
	Empididae	3	0.000007
	Limonoidae	1	0.0000008
Coleoptera	Haliplidae	5	0.00002
	Scirtidae	1	0.0000008
	Elmidae	3	0.000007

Haplotaxida	Lumbricidae	25	0.00053
Hoplonemertea	Tetrastemmatidae	1	0.0000008
		1084	0.1583988

CONCLUSIONS

This study was conducted during 2019 in the Drino River (Albania). Sampling was carried out in three stations, in total 1084 individuals were sampled. In total, 25 present families have been identified, which belong to the phyla Annelida, Arthropoda and Nemerthea; class Oligochaeta and Insecta. From the calculation of the FBI biotic index, station I has bioclassification "Good" (FBI = 4.69), station II (FBI = 2.95) and III (FBI = 3.38) is within the bioclassification "Excellent". According to the value of the Simpson index (D) for this group is 0.16 and the Simpson Diversity Index (1-D) for this group is 0.84, this shows that we have a high diversity. Referring to the calculation of the FBI biotic index where a light organic pollution is observed in only one of the sampling stations and the value of the Simpson diversity index, which goes towards 1, shows that the Drino River has a very good water quality.

REFERENCES

Beqiraj S., Liçaj P., 2007 - Preliminary data on the macrozoobenthos of the Vjosa River, *Mikroteza*, FSHN. Tirana.

Campaioli S., Gheti P. F., Minelli A., Ruffo S, 1994 - *Manuale per riconoscimento dei Macroinvertebrati delle acque dolci italiane*. Vol. **1**. Provincia Autonoma di Trento: 9-14, 27-190.

Harper D., Smith C., Barham P., Howell R., 1995 - The Ecological Basis for the Management of the Natural River Environment. In: *The Ecological Basis for River Management* (Eds Harper D. M. and Ferguson J. D), 219 - 238, John Wiley & Sons Ltd, Chichester, Uk.

Hey R. D., 1993 - Environmentally sensitive river engineering, in: *The Rivers Handbook*, (Eds. Calow P. and Petts G. E), Blackwell, London, vol. **1**: 274-283.

Mezini B., 1985 - The Drino Valley and the surrounding mountains (physico-geographic view). *The geographical study ERPS Academy of Sciences of Albania*. Tirana.

Pano N., 2008 - Water resources of Albania. *Academy of Sciences of Albania*. Tirana.

Paparisto A., Halimi E., Keci E., Hamzaraj E., Laknori O., 2009 - Using insects as Bioindicators to asses Water Quality of Albanian rivers. *Environmantal application & Science* JIEAS **4** (3): 246-252.

Pepa B., 2014 - Determining the biological diversity of benthic macro-invertebrates of Shkumbin, Devoll and Osumi rivers in the central part of Albania and the evaluation of these water bodies based on their use as bioindicators. *PHD*, University of Tirana, Faculty of Natural Sciences, Department of Biology.

Piro Ç., 2014 - Monitoring of microbial pollution of the Drino – Vjoše rivers at their point of intersection, *PHD*, University of Tirana, Faculty of Natural Sciences, Department of Biotechnology.

Richard A. Lillie, Stanley W. Szczytko, and Michael A. Miller 2003 - *Macroinvertebrate Data Interpretation Guidance Manual*, Wisconsin Department of Natural Resources.

Simpson E H., 1949 - *Measurement of diversity*, Nature, Vol.**163**, 688.

Tachet H., Bournaud M., Richoux P., 1980. Introduction á l'étude des macro invertebres des eaux douces. C. R.D.P. Lion 130-150, UNECE - *The United Nations Economic Commission for Europe.*

Tachet H., Richoux P., Bournaud M., Usseglio-Polatera P., 2002 - Invertebres d'Eau Douce Systematique. Biologie, Ecologie, *CNRS Edtions*. Paris, France.

WFD (2000). *The EU Water Framework 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, L 327, 22.12.2000. Brussels, Belgium: EU.