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Biological Assessment of Water Quality in Ishmi River in Albania and Benthic Invertebrate Fauna Composition, During 2012

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Abstract — Ishmi River flows in central Albania; three main contributors to Ishmi River are Tirana, Terkuza and Zeza streams [29]. The geographical position and geologic composition of basin makes Ishmi River an important water source for inhabitants. The River basin is an area where many changes and developments have lately taken place. These changes have influenced the aquatic ecosystem in general and mainly impacted on the water quality. Human activity has often influenced the ecological biological elements by modifying or adapting their composition and structure [30]. Benthic macro invertebrates are defined as crucial elements and have a great magnitude in the biological assessment of water quality (Water Framework Directive - WFD). Our study aims at evaluating the benthic invertebrate fauna of Ishmi River and its water quality based to biological indicators. During the 2012 the water of the river has been monitored periodically at three sampling stations Rinas/Lana Bridge, Fushe Kruja – Zeze and Gjuricaj. The main groups of invertebrates identified in Ishmi River included: Ephemeroptera, Diptera, Oligochetae, Hirudineae, Gastropoda, etc. Mostly pollution tolerant invertebrate groups are present in the River basin.

Index Terms— **Macro-invertebrates, ecological status, water quality.**

I. INTRODUCTION

The Ishmi River is a river in central Albania. It is formed by the confluence of different important watercourses: Tirana, Terkuza and Zeza River. The Ishmi River flows through the hilly part of the country, characterised by flish formations, passes across Dajti Mountain limestone and it flows into the Adriatic Sea. Benthic macro invertebrates are considered biological indicators of water quality. Analyses of their composition presents advantages on time consuming and costs saving compared to traditional chemical and physical assessments of water quality [4]. River benthic organisms have different densities depending from water quality conditions. Pollution can strongly influence the density and abundance of aquatic species [23]. Benthic invertebrates have a double role in the transferring process and elaboration of organic material present in current waters, by directly consume (respiratory and alimentary) and fragment particle in substances simple to be assimilated by the bacteria component. Macro invertebrates are the preferred nutrition for numerous fish species. A variable macro benthic community, being able to use more efficiently the internal nutrition and to adapt better to climate changes, is a guarantee for a good depurative efficiency. The benthic invertebrates are classified as sensitive toward water pollution (mainly insects), medium tolerant and tolerant to pollution. The biological classification of water quality of Ishmi River has been carried out during one year monitoring programme in three monitoring stations based on invertebrates identified in our samples and calculation of related indexes.

II. METHODS AND MATERIALS

The sampling method of aquatic macro invertebrates is based on the methods according to [2-5-6-10-22]. Benthic invertebrates were taken from the river bottom (40 – 60 cm) with a kick - net in order to gain sufficient samples from larger depths of water. The net is held upright on the stream bed by one individual, while the stream bottom upstream of the net is physically disrupted by a second individual. Kicking and turning over rocks and logs with the feet and hands dislodges organisms which are washed into the net by the current. The samples were collected from areas of differing current speed. In very small streams or in sandy areas lacking riffles, kicks are taken from root mats, snags or bank areas. All types of benthic macro invertebrates were collected by this sampling device, but

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method emphasizes species that live in fast flowing water. This technique gives consistent results [1-14], and was used to gather the samples at three monitoring stations along the Ishmi River: Rinas – station one, Zeze – Fushe-Kruje – station two and Gjuricaj – station three (Fig:1). The monitoring stations were selected taking into account the geographic expansion of Ishmi River flow and the relations between the river stations and surrounding urban areas, including villages as they have a considerable number of inhabitants. The kick - net method takes the quantitative aspect into account, if the necessary experience is present [27]. In addition sampling plots were taken to be representative whereas within a station were taken three randomly samples, along successive seasons during 2012. The field work has been organized in daily expeditions, one for each season. About 30 sec are needed to take one sampling plot. During each field trip 3 sampling plots in different stations are taken. All benthic macro invertebrates are kept in 95% ETOH. Before mailing the jars are completely filled with alcohol to reduce damage to the specimen. They are then carefully packed to prevent breakage. Lab sheets and all the associated materials are conserved at the laboratory. The identification of benthic invertebrates is made by using a method illustrated in different publications [40-11-13-24-18-35-7-26].

Fig: 1. Monitoring stations in Ishmi River, Albania. Station I – Lana Bridge - Rinas; Station II – Zeze – Fushe-Kruje; Station III – Gjuricaj – Sukth (photo by author)

III. RESULTS AND DISCUSSION

During the monitoring period 2012, in each of the stations a total number of 4740 individuals were collected. From these individuals: 1669 were found at the first monitoring station (Rinas), 2270 at the second station (Zeze) and 801 in the third station (Gjuricaj). According to the Environmental Protection Agency- USA the benthic invertebrates are classified in three major categories based on the tolerance level of different invertebrate groups (Table: 1).

Table: 1. Aquatic biological indicators based on their tolerance level (Environmental Protection Agency- USA)

Benthos Sensitive	Medium Benthos Tolerant	Benthos Tolerant
Insecta/Plecoptera	Insecta/Odonata	Insecta/Diptera/Chironomidae
Insecta/Ephemeroptera	Arthropoda/Decapoda	Annelidae
Insecta/Coleoptera	Crustacea/Amphipoda	Annelidae/Hirudidae
Insecta/Megaloptera	Insecta/Trichoptera	Molusca/Gastropoda
Insecta/Diptera/Athericidae	Arthropoda/Isopoda	
Molusca/Bivalvia	Insecta/Diptera/Tipulidae	

Based on the above classification, the macro invertebrate groups identified in the Ishmi River are used to evaluate the overall ecological conditions of the benthic fauna and water quality as well (Table: 2).

Table: 2. Aquatic biological indicators in Ishmi River, Albania

Benthos sensitive taxons	Total no.	%
Ephemeroptera	376	7.93
Medium benthos tolerant taxons		
Trichoptera	7	0.15
Benthos tolerant taxons		
Chironomidae	2858	60.29
Olighocheta	874	18.44
Hirudidae	138	2.91
Gastropoda	487	10.27

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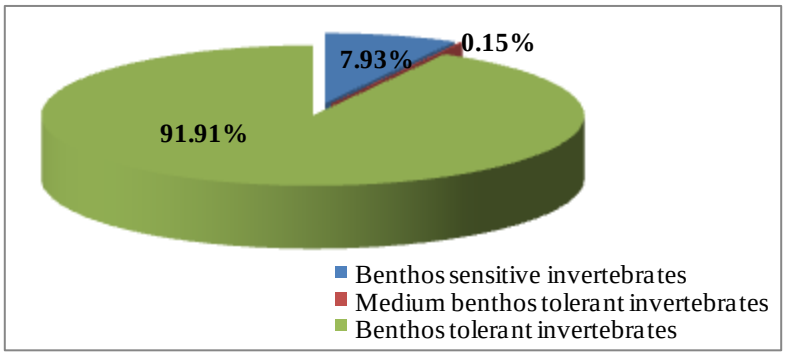
The classification of invertebrate fauna of Ishmi River, and their tolerance value toward water pollution is used to assess the water quality. Results show a low River water quality as the highest percentage of individuals found is composed by tolerant macro invertebrates (Graphic: 1).



Graphic: 1. Percentage of invertebrate taxones in Ishmi River, Albania during 2012

Benthos sensitive and medium tolerant groups are represented by an insignificant percentage compared to the Benthos tolerant groups, which include most of the invertebrate groups identified in the samples. The high frequency of tolerant macro invertebrates' shows the high level of pollution in the River.

Another classification of Ishmi River water based on Stroud Water Research Centre is presented in the table below. Biotic index according this method takes in consideration the density and the tolerance value of all the groups found in the samples [**Biotic Index = (TV x D): Density].**

Table: 3. Bio-classification of River water based on biotic index value according the Stroud Water Research Centre

BI value (S.W.R.C)	**< 3.75**	**3.76 - 5.0**	**5.1 - 6.5**	**6.6 - 10.0**
Water quality	Very good	Good	Medium	Poor

Table: 4. Biotic Index value and biological classification of water in three monitoring sites of Ishmi River (Stroud Water Research Centre)

STATION	**S.W.R.C - BI**	**BIO-CLASSIFICATION**
Rinas – Lana Bridge	6.83	Poor
Zeze – Fushe-Kruja	5.73	Medium
Gjuricaj - Sukth	7.33	Poor

Based on the S.W.R.C. Biotic Index value the water quality is classified as "bad" in the first and the third monitoring stations and as "medium" in the second monitoring station. The biological indicators identified in the samples show a high level of pollution in the river water.

Based on the above calculations, the second station present a better water quality, classified as medium – bio – class, while the first and third monitoring stations show rather poorer quality results classified as poor – bio - class. The classification presented in table 4, shows a poor quality of the water. In general water in Ishmi River is classified as very polluted. From all the calculations and analyses of data collected at the Ishmi River during 2012 we can conclude that the water quality of the river is not good.

IV. CONCLUSIONS AND RECOMMENDATIONS

- During the monitoring period 2012, in each of the stations, Rinas, Zeze and Gjuricaj, are collected a total number of 4740 individuals. From these individuals 1669 were found in the first monitoring station, 2270 in the second and 801 in the third station.
- Benthos sensitive and medium tolerant groups are represented by an insignificant percentage, 0.15% and 7.93% respectively, compared to the Benthos tolerant groups, which include the most of invertebrate groups identified in the samples, 91.91% of total individuals identified. The high frequency of tolerant macro invertebrates' shows the high level of pollution in the River.

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- Based on the S.W.R.C. Biotic Index value the water quality is water quality in the first and the third sampling station is classified in "Poor" bio class (SWRC BI value: 6.83.and 7.33 respectively), while the second station water is classified in "Medium" Bio class (SWRC BI value: 5.73). The biological indicators identified in the samples show a high level of pollution in the river water.
- From all the calculations and analyses of the data collected in Ishmi River during 2012 we can conclude that the water quality of the river is not of good quality.
- Future periodical and continuous monitoring in Ishmi River stations is recommended as the areas surrounding Ishmi River are rapidly changing and utilizing shifting land use methods.
- Chemical analyses of water nutrition elements are necessary for water quality assessment, determining the level of impact;
- Comparison among biological and chemical analyses is helpful in assessment efficiency increase.
- Monitoring in more than three stations is recommended in the future.
- Drafting of action plans for the management of river basin and aquatic species preservation.

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