

Inventory, biodiversity of benthic macro invertebrates and evaluation of water biological quality of the Drader river (Morocco)

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Abstract

The present study focuses on the assessment of the biological quality of Drader river waters, the main watercourse of the Drader-Souier basin located in northwestern Morocco. The study focused on carrying out the benthic macro invertebrate inventory from three stations and the calculation of biotic indices: Shannon and Weaver diversity index and the Belgian Biotic Index. The analysis of the results makes it possible to distinguish:

- An upper (temporary) watercourse, characterized by a rich and diversified fauna attesting to the excellent quality of the water of this section.
- Permanent middle and lower watercourses with a significant decrease in biodiversity that can be attributed to intensive agricultural activity in this area and the nature of the substrate and habitat.

Keywords: macro invertebrates, biodiversity, water quality, Drader river, Morocco

1. Introduction

Rainfall in Morocco is characterized by spatial heterogeneity and temporal irregularity. Water is highly vulnerable to both climate change and the harmful effects of human activities (abstraction, pollutant release, etc.). Indeed, population growth accompanied by rapid urbanization causes many disturbances to natural environments ^[1]. In addition, the industrialization, the unsustainable use of fertilizers and pesticides and the lack of awareness of the population towards the protection of the environment lead to an imbalance of the ecosystem and generate pollutants that can affect the quality of the environment. -chemical and biological aquatic receiving environments ^[2], but also alter the uses of water (water abstraction, swimming, etc.) ^[3].

The objective of the present work is to evaluate the biological quality of the waters of Drader River, main-river of the Drader- Souier basin and emissary of Merja Zerga, wetland registered as a Ramsar site since 1980. This work done on the

Drader River is original, since no hydro biological research was done there before, and it contributes to a better knowledge of the rivers of the Drader - Souier basin.

1.1 Presentation of the Study Environment and Choice of Stations

Drader River is a river that drains the Drader - Souier watershed. The upper course of this river, of North - South direction, is temporary and is in the form of a small stream, whereas its middle and lower course, of East - West direction, is permanent and profits from the spills of resurgences of the river tablecloth of Dhar El Hadechi on its right bank and El Fahis on the left bank ^[4]. The average discharge of the Drader River in the vicinity of the Merja Zerga is of the order of 1 m³/s, whereas during the low water period its flow drops to 600 l/s. 30% of the annual contributions of the Drader river are attributed to the emergence of the water table ^[4].



Fig 1: Location of the Drader - Souier watershed on the Gharb map ^[5].

To carry out a biological characterization of the water quality of Drader River, three stations were chosen. Tables 1 and 2

present the characteristics of the stations studied.

Table 1: Average morph dynamic of studied stations.

Station	Altitude (m)	Lambert coordinates	Width (m)	Depth (m)	Speed (m/s)
S1	63	- N 34.929 - W -6.109	12	0.3	00.00-0.2
S2	14	- N34.84 - W -6.118	7	1.2	0.3
S3	10	- N 34.856 - W- 6.242	13	0.7	0.07

Table 2: Characteristics of the studied stations.

Stations	Substrate background (Abiotic habitat)	Aquatic vegetation (Biotic habitat)	Observations and reason to be
S1	-Meso and microlithal (pebbles with gravel and sand) - Psammal, Pelal and Argyllal (silts and vases, clay)	- Phytal 1: Hydrophytes less dense (macrophytes) - Phytal 2: filamentous algae	- located upstream (El Mellah). - Reference site, little affected by anthropogenic nuisances.
S2	- Psammal, Pelal and Argyllal (silts and vases, clay)	- Hydrophytes of the herbaceous and shrub layer.	- located at the confluence of tributaries from the water table with the main watercourse (Df. Anabsa).
S3	- Sands - Psammal, Pelal and Argyllal (silts and vases, clay)	- Phytal 1: hydrophytes, including macrophytes and mosses. - Xylal: dead wood	- located downstream (Merja Zerga). - Estimate the quality of the waters arriving at Lake My Bousseham.

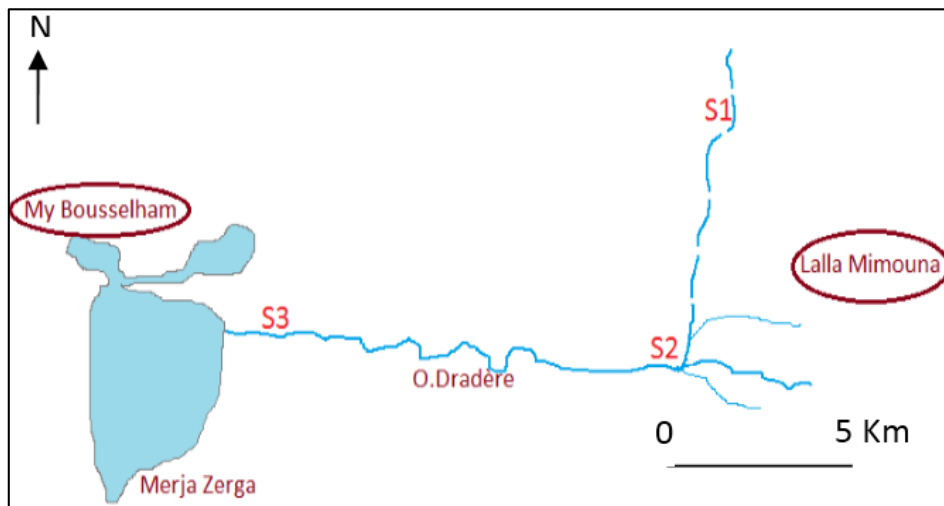


Fig 2: Benthic macroinvertebrates sampling stations rates for Drader river Waters.

2. Materials and Methods

Sampling and determination of biological indices Sample collection

The benthic macroinvertebrate samples are taken bi-monthly upstream (station S1), at the confluence of the upper watercourse of Drader river and the tributaries (station S2) and downstream of Drader river (station S3) over a period from April 2016 to February 2017.

The samples of invertebrate fauna were taken, in calm water with the help of a troubleau, in a current medium using a Surber net of 500µm of mesh size and small dimensions 10 x 20 Cm, better adapted temporary environments and their different biotopes [6]. The collected samples are fixed at 40% formalin; then kept in 10% formalin water. Zoological groups are separated in pillboxes containing 70% alcohol [7]. The determination of benthic macroinvertebrates was made by reference to the work of TACHET *et al.*, [8], Kraim [9] and GAGNON *et al.*, [10].

Data Processing

The quantitative and qualitative study of the benthic fauna is based on the analysis of the relative abundance and frequency

of taxa, as well as the calculation of various indices:

- The index of SHANNON and WEAVER (1948) [11]; allows to calculate the level of diversity of species in a given environment.

$$H' = - \sum_{i=1}^S p_i \ln p_i$$

Where;

H': biodiversity index

I: a species from the study environment

S: specific wealth

P_i: Proportion of a species i relative to the total number of species (S) in the study medium (or specific richness of the medium), which is calculated as follows:

$$P(i) = n_i / N$$

Where;

n_i is the number of individuals of species i and **N** is the total number (individuals, of all species).

- The Belgian Biological Index (BBI) which combines a quantitative measure of diversity with a qualitative

measure based on the presence or absence of pollutant macro invertebrates ^[12].

3. Results and Discussion

Taxonomic richness and frequency

The analysis of the taxonomic richness (Table 3) shows that the S1 and S3 stations have a number of cumulative taxa (27 for S1 and 23 for S3) which is clearly greater than the number of taxa cumulated in the S2 station which is 19.

On the other hand, in the whole of the river, the increase in the number of taxa is recorded during the sampling of the months of April and June 2016. This could be explained by the favorable conditions for the development of the organisms during this period (water flow, water T °, dissolved oxygen ...).

Sampling in August and October was not carried out in Station S1 due to the drying up of the upper watercourse, which is temporary during the low-water period of the year.

Table 3: Results of the Fauna Inventory and Calculation of Biological Indices

Stations	S1						S2						S3					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Taxons																		
Cl. INSECTA																		
O. Plecoptera																		
Leuctridae	2						1						2					
Perlidae	3	1																
O. Trichoptères																		
Leptoceridae	3	1											1					1
Odontoceridae	1					1	2						1					
O. Odonata																		
Lestidae	1	2				1	2	1	2			1	2	1	1			1
Libellulidae	4	3				2	2	1	1			3	3	2	3	2	1	2
O. Heteroptera																		
Notonectidae	1	3				1		1										
Gerridae	3	1					1		1					3	2			
Hydroptilidae	1												2					
O. Coleoptera																		
Gyrinidae	1						1	2					1	2				
Dytiscidae	6	3				2	4	4					3	1				
Elmidae	3	2					1	2					2	2	1			1
Sphaeriidae	1							1					2	1		1		
O. Ephemeroptera																		
Baetidae	9	6				3	3	5		1			5	4				3
Heptageniidae	1													1				
Caenidae	1																	
O. Diptera																		
Thaumaleidae	1																	
Empididae	1	1						1					2					
Tipulidae	2	1						1					2	1		1		
Chironomidae	6	3				2	5	7				3	6	8	6			4
Cl. Gasteropodi																		
O. Prosobranchia																		
Physidae	12	6			3	6												
Lymnaeidae	6	8			4	7	11	10	10	6	5	7	39	31	34	32	19	26
Planorbidae		1											2	3	2			2
Cl. Bivalves																		
O. Eulamellibranchia																		
Syphridae													2	3	3	2	1	2
Cl. Crustace																		
Gammaridae	1	2				1	2	1		1				1		1		1
Cl. Oligochetes																		
O. Prosopores																		
Tubificidae		2						1						1	2	1		
Lumbricidae	3	4			2	4	2	3	3	4	1	2	5	6	8	6	3	5
Cl. Arachnides																		
O. Hydracarina																		
Hydrachnidae	5	6					2	3	2	1			3	2	5	2		
Total	78	57			9	30	39	44	19	13	6	16	85	74	66	48	24	49
Nb de taxons	24	19			3	11	14	16	6	5	2	5	18	19	11	9	4	11
H'	2.07	2.4	-	-	1.06	2.31	2.3	2.27	1.39	0.94	0.44	1.4	1.2	0.09	1.69	0.93	0.5	1.75
IBB	10	8	-	-	4	7	8	8	5	5	4	4	10	8	6	5	4	7

H': Diversity index of Shannon and Weaver, IBB: Belgian Biotic Index.

The calculation of the frequency of occurrence (F, all samples taken at each station) gave the following results:

- Very common taxa ($80 \leq F \leq 100\%$) : Libellulidae, Lumbricidae and Lymnaeidae
- Frequent taxa ($50 \leq F < 80\%$): Lestidae, Elmidae, Baetidae, Gammaridae, Thaumalidae, Chironomidae and Hydrachnidae.
- Quite frequent taxa ($20 \leq F < 50\%$): Odontoceridae, Notonectidae, Sphaeriidae, Physidae, Planorbidae, Siphonidae, Empididae, Tipulidae and Tipulicidae.
- Rare taxa ($5 \leq F < 20\%$): Leuctridae, Perlidae, Leptoceridae, Hydroptilidae, Heptageniidae and Thaumalidae.
- Accidental taxa ($F < 5\%$): Absent.

The density of the stands varies from one station to another, it seems to be related to the biotic and abiotic characteristics of the stations and to the drying up of the upper stream during the dry summer period.

Study of diversity

The average values of the Shannon and Weaver diversity index are greater than 2 for the months of April and June in stations 1 and 2, reflecting good diversity. For the other months, the values are low reflecting a low diversity and a decrease of stands especially during the winter period. This is explained by the conditions that become unfavorable to the development of the majority of macro invertebrates. It is also noted that molluscs, dipterans and oligochaetes are ubiquitous.

By applying the method of determination of the Belgian Biotic Index (BBI) represented in Annex table1, the BBI for the three stations was calculated. The highest values are recorded during the spring. Thus the values of the biotic index for the months of April and June are respectively 10 and 8 for stations 1 and 3 and 8 for station 2.

Referring to the water classification table (Annex table 2), we can say that the waters of stations S1 and S3 are little or no polluted, while the waters of station 2 are not very polluted. These results are consistent with the results of the physicochemical analysis of Drader river waters^[13]. In these results highlight the purifying power of the waters of this watercourse.

4. Conclusion

The biological study of Drader River reveals a spatiotemporal variation of the benthic invertebrate macrofauna. The taxonomic richness is important in the waters of the temporary upper watercourse (S1) characterized by IBB index values attesting to an excellent quality of these waters. The S2 stations are characterized by a significant biodiversity a decrease of the values of the BBI, indicating a slight degradation of the water quality of Drader river which can be attributed to the intensive agricultural activity that knows this area.

Downstream from Drader River, the Shannon-Weaver index is lower, indicating a decrease in diversity, although the biological quality is good. Indeed, the distribution of macroinvertebrates may be influenced by other factors such as the nature of the substrate and habitat, which may affect biotic indices.

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