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Contribution to the Knowledge of the Diversity of Benthic Macroinvertebrates in the Affon River in Benin

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Abstract: ***The preservation of water quality is a major challenge not only for the sustainable management of the environment but also for that of biodiversity because of the strong and increasing human pressures that are exerted there. In the process of bio-monitoring of our aquatic ecosystems, a study was conducted in the Affon River in Benin. The purpose of this study is to present the benthic invertebrate biodiversity of this river. The purpose of our work is to establish a complete list of invertebrates that colonize this environment. In addition, our study focused on benthic macroinvertebrates in order to contribute to the framing of biodiversity and a specific catalog of benthic macrofauna in Benin. Sampling of these macroinvertebrates was done according to the IBGN standard in 8 stations along the river. A total of 11, 220 individuals belonging to 4 major classes, 54 families and 13 orders. The class of insects was best represented 94.17% with several orders including Ephemeroptera 4.30%, Heteroptera 1.21%, Odonata 4.859%, Lepidoptera 0.11%, Trichoptera 8.0%, Coleoptera 1.01%, Diptera 74.61% and Plecoptera 0.09%.***

Keywords: Benthic macroinvertebrates - biodiversity - Upper Ouémé - water quality

1. Introduction

Water is clearly a natural need: everyone needs water and there are few economic activities that not depend on it in one way or another [1]. As noted [2], "without it nothing grows, without it life is not possible". Water resources therefore occupy a prominent place in the development of the different sectors of the economy of a country. Unfortunately, Benin, a country in West Africa, is one of contries identified by the [3] that are particularly vulnerable to climate change. As a result, people's livelihoods and the development of national economies are threatened by vulnerability to climate change, which is exacerbated by mismanagement of natural resources [4]. This climate change often combines with extreme weather events and according to [3], these extremes have changed in frequency and / or intensity over the last 50 years, resulting in devastating floods, droughts, storms and changes. Sudden temperatures. This is why man has always learned to readjust his behavior according to the availability of water resources. It is in this perceptive, that we used the biological method by using the macroinvertebrates to appreciate the quality of the water of our ecosystems. The main advantage of using these macroinvertebrates lies in the fact that they are sensitive to physicochemical variables and environmental disturbances [5]. In Benin, benthic macroinvertebrates are gradually being known with the studies that have already been done on the southern rivers that are subjected to significant organic pollution. It is mainly the work of [6] on lake Nokoue and [5] on the lagoon of Porto Novo and the coastal lagoon. In streams of the northern basin, macroinvertebrate stands are still poorly known. However studies like those of [7] on the upper part of Ouémé, [8] on the Okpara dam and those of [9] on the Niger basin have already been the subject of scientific studies. To characterize the diversity and structure of their benthic macrofauna, the identification of these collected organisms is based on keys developed for temperate environments that do not respond to the climatic realities of tropical environments. Certainly many indices have been developed around the world, but each territory has unique characteristics and is home to a life of its own. Importing the application from one territory to another must be done with care [10]. It is therefore recommended to calibrate with the results obtained in the region studied, and to develop an index adapted to the territory and the studied problematic [11].

The purpose of this work is to study the benthic invertebrate biodiversity of the Affon River in order to establish a complete list of invertebrates that colonize this environment in 2019. In addition, our study focused on benthic macroinvertebrates in order to contribute the development of a framework of biodiversity and a specific catalog of the benthic macrofauna of Benin.

2. Material and Methods

2.1- Description of the study area

The Affon River is a tributary of the Oueme River. It has its source in the municipality of Copargo at the foot of Mount Tanéka. With a length of 152 km, its watershed covers an area of 4, 320 km^2. The river is located in the Sudano-Guinean zone and subject to the influence of the Sudanese climate, with a long rainy season (April to October) and a long dry season (November to March) [12]. Vegetation around the river is characterized by forests and savannahs associated with fields. Agriculture is the main activity around the river. The cultivated crops are: cotton, corn, yam, rice, cowpea / bean, groundnut, etc. Fishing, on the other hand, is practiced much more by foreigners coming from neighboring countries (Nigeria, Burkina Faso, Mali).

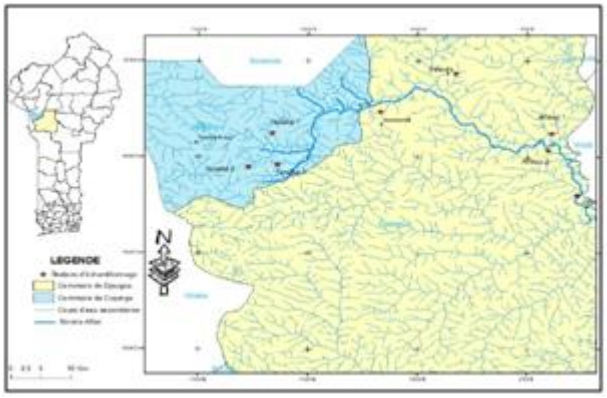

Figure 1: Map of the study area

2.2- Sampling of benthic macroinvertebrates

Table 1: Characteristics of sampling stations

N°	Stations	Code	Geographic coordinates		Altitude
1	Tanéka 1	Tan 1	N: 9°51"21'	E: 01°32"34'	484
3	Tanéka 2	Tan 2	N: 9°52"40'	E: 01°30"80'	429
2	Tanéka 3	Tan 3	N:9°53"89'	E: 01°47"48'	410
4	Pébouko	Péb	N:9°53"94'	E: 01°47"44'	415
5	Kolokondé	Kol	N:09"57'17	E:01°51"43'	363
6	Aféou 1	Afé 1	N:09"57'46	E: 01°51"78	348
7	Aféou 2	Afé 2	N:09°57"15'	E:01°51"43'	365
8	Affon	Aff	N°09°56"58'	E: 01°50"54'	369

Macroinvertebrate harvest was conducted following the standard recommended by the IBGN method [11]. Sampling was carried out in particular environments considering the substrate, the low current velocity and the depth of water less than 1 meter. In each habitat, the organisms were sampled using a Suber net of 20 cm x 25 cm, ie a surface of 500 cm^2 and a vacuum of 500 µm mesh. Samples are taken by placing the sampler (Suber) on the bottom of the bed with the net facing the stream and scraping the substrate, which has the effect of causing the invertebrates in the net. A total of twelve samples were taken at each station in the following order: 4 in marginal substrates (<5% overlap) biogenic (roots, litter, macrophyte, etc.), 4 in dominant substrates (> 5 % recovery) biogenic and finally 4 complementary will be taken in the dominant substrates according to their representativeness (% recovery). The organisms thus harvested are formalin fixed at 10% in the field. In the laboratory, the specimens are rinsed on a sieve with a mesh size of 100 µm and then stored in 70 ° alcohol.

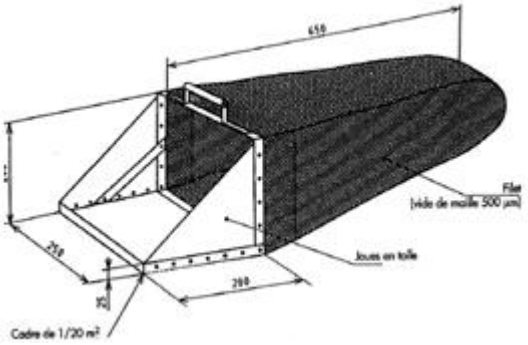

Figure 2: Suber sampler net

2.3 Sorting and identification of macroinvertebrates

The harvested macroinvertebrates were sorted and identified as precisely as possible, under a binocular of the Discovery V8 model, Zeiss. This made it possible to group the organisms by taxon of the class up to the family using the determination keys. Among those used are the Benthic Macroinvertebrates of New Caledonian Rivers [13], the Guide for the Identification of Quebec's Principal Freshwater Benthic Macroinvertebrates [11]; freshwater invertebrates: systematic, biology, ecology [14] and Aquatic entomology [15]. After identification, the samples were kept in the laboratory in alcohol in pillboxes and a faunistic list per station was drawn up.

3. Results

3.1- Different classes of macroinvertebrates harvested in the river Affon

The identification of the fauna collected in the Affon River allowed to classify the macroinvertebrates in 4 large classes (Figure 3). Insects are the most abundant class with 10566 individuals or 94.17% of the total harvest. This class is represented by 8 orders and 41 families. With only 21 individuals (0.18%), molluscs constitute the minority class of this macrofauna.

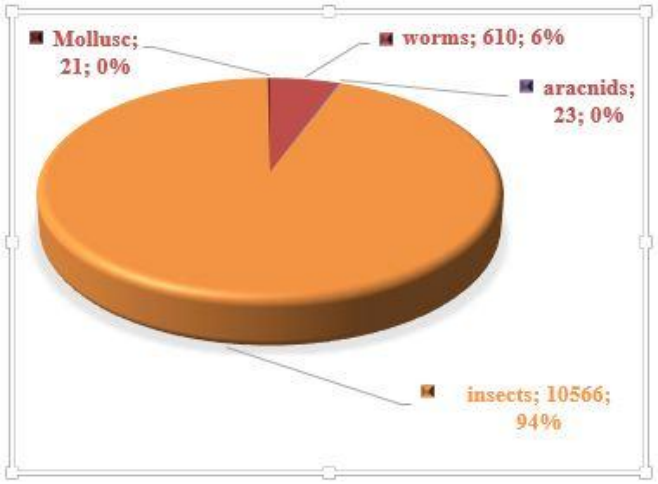

Figure 3: Quantitative distribution of the different classes of macroinvertebrates harvested

3.2- Spatial variation of taxonomic richness and abundance

The maximum taxonomic abundance was found at the kolokonde station (2940 individuals) and the minimal taxonomic abundance is observed at Tanéka 1 with 70 individuals (Fig 4).

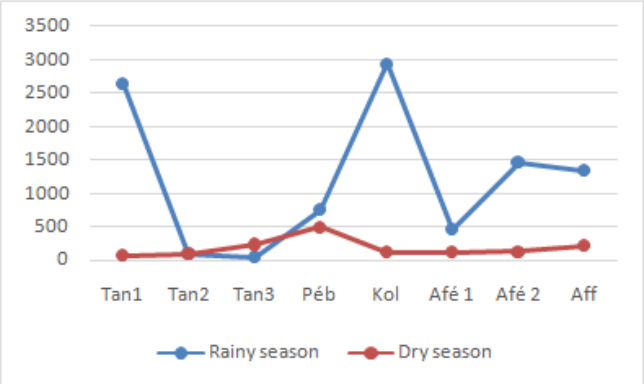

Figure 4: Taxonomic abundance of harvested macroinvertebrates.

3.3- Distribution of macroinvertebrate species according to habitats

Table 2 gives a more detailed information on the composition and especially on the habitat distribution of the macroinvertebrates collected.

Table 2: Composition and distribution of the macroinvertebrates

Class	Order	Famillies	Sampled habitats				TOTAL
			Litter	Benthos	Macrophyte	stone	
Insects	PLECOPTERA	Nemouroidae	0	1	0	0	1
		Perlidae	0	0	0	2	2
		Perlodidae	1	5	0	0	6
		Taeniopterygidae	0	0	0	1	1
	TRICHOPTERA	Beraeidae	0	0	4	0	4
		Hydropsychidae	254	512	105	15	886
		Leptoceridae	0	0	3	0	3
		Rhyacophilidae	0	3	0	2	5
	EPHEMEROPTERA	Baetidae	4	21	5	8	38
		Caenidae	28	0	8	0	36
		Ephemerellidae	37	28	20	26	111
		Ephemeridae	0	0	0	14	14
		Heptageniidae	0	0	0	1	1
		Leptophlebiidae	5	4	6	14	29
		Potamanthidae	16	27	21	181	245
		Isonychiidae	1	0	0	7	8
		Tricorytidae	0	1	0	0	1
	HETEROPTERA	Corixidae	4	52	9	5	70
		Gerridae	0	6	7	8	21
		Nepidae	7	1	9	0	17
		Notonectidae	1	0	1	1	3
		Veliidae	7	8	10	0	25
	COLEOPTERA	Dytiscidae	19	12	54	15	100
		Elmidae	0	2	0	1	3
		Eubriidae	3	0	0	0	3
		Gyrinidae	1	1	1	0	3
		Hydrophilidae	0	1	1	0	2
		Hydrophiloidae	0	0	1	0	1
	DIPTERA	Ceratopogonidae	19	54	42	26	141
		Chaoboridae	1	0	0	0	1
		Chironomidae	2354	1860	1680	1968	7862

		Culicidae	8	0	5	0	13
		Sciomyzidae	13	3	23	0	39
		Simuliidae	28	48	165	63	304
		Tabanidae	0	1	0	0	1
		Tipulidae	3	1	1	0	5
		Not identified	3	2	0	0	5
	ODONATA	Aeschnidae	0	8	1	12	21
		Gomphidae	9	19	68	36	132
		Lestidae	81	64	93	0	238
		Libelludiae	59	40	16	36	151
		Platycnemididae	0	2	0	0	2
	LÉPIDOPTERA	Pyralidae	1	1	9	1	12
Molluscs	GASTROPODS	Bithynidae	0	0	1	0	1
		Hydrobiidae	6	0	3	0	9
		Limnaeidae	1	0	0	0	1
		Physidae	3	0	2	1	6
		Viviparidae	2	0	2	0	4
WORMS	ACHETA	Glossiphoniidae	0	4	3	0	7
		Hirudidae	0	1	4	0	5
	OLIGOCHAETA	Oligochaeta	102	265	105	48	520
	NEMATHELMINTH		9	23	46	0	78
Arachnids	ARANEAE	HYDRACARIEN	0	1	3	0	4
		Spiders	0	0	19	0	19
Total			3090	3082	2556	2492	11220

4. Discussion

The study of the macroinvertebrates of the Affon River yielded 11, 220 individuals belonging to 4 major classes, 54 families and 13 orders. The family Chironomidae is the most harvested with a total abundance of 7862 individuals. The abundance of individuals collected is much higher than that found in the Ouémé delta [5]. However, the number of orders identified corresponds to the result of [7] which also found 13 orders and 4 groups in the upper Ouémé basin. In contrast, on the Comoé River in Côte d'Ivoire, 49 families were captured [16]. Similarly, 49 families of macroinvertebrates were recorded on the Alibori River in Benin [17]. The similarity with all these previous studies is that insects are the majority class. Better still, the abundance of chironomidae recognized as pollutant-resistant taxa would certainly reflect poor water quality in the study area [7]. As for the ETP (Ephemeroptera, Plecoptera and Trichoptera) they have been poorly represented and they have the reputation of living in environments well oxygenated, little polluted. Anything that suggests a pollution of the waters of Upper Ouémé. Numerous studies such as those of [18], [19], [20], [21], [22], [23] mention that bivalves live in well-oxygenated high-altitude running waters. Their absence thus confirms the threat of certain pollution in the Upper Oueme basin. In the same way, our study addressed the distribution of species according to their habitat. The results show that macroinvertebrates live much more in the litter. This same

situation was observed by [24] on the Gombe, Kinkusa and Mangengenge rivers in Kinshasa. In fact, this abundance is explained by the fact that organic matter is one of the links in the trophic chain of the latter. We observed a weak presence of macroinvertebrates in pebbles. These results are in line with those obtained by [25] which explains that organic matter concentrations are higher in fine sediments than in coarser sediments such as sand and pebbles.

5. Conclusion

The present study on benthic macroinvertebrates made it possible to establish an inventory of species richness in the Affon river in Benin. These different results will be used to build a reliable database to create a biotic index specific to tropical environments in the assessment of the quality and health of our hydrosystems.

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