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Inventory and Distribution of Benthic Macroinvertebrates, Indicators of Water Quality in Four Forested Watercourses in Centre Region of Cameroon

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Abstract

The inventory of benthic macroinvertebrate species was carried out in some streams of the Mefou catchment area, from August 2021 to August 2022, in order to determine the biological groups that make up the population and characterise these environments. The dataset acquired during this study made it possible to update the existing database and contribute to the knowledge of the biological groups associated in these environments, and to provide additional information on the existing ones in relation to bioindication. Overall 80 families were identified and, on the basis of frequencies of occurrence greater than 75%, 22 families were retained as potential biological indicators. The remarkable diversity of insects and the low abundance of Diptera reflect the low degradation of environments and the good quality of water. The high diversity indices obtained reflect the maintenance of the favourable ecological conditions that favours the development of a balanced and, integrated biological community capable of adapting to changes.

Keywords

Benthic Macroinvertebrates, Bioindicators, Biological Quality, Forest Watercourse, Cameroon

1. Introduction

Considered as an ecosystem with several functions, forest streams constitute an excellent environment for biodiversity conservation because they host a large fauna that provides information on the multiple events occurring over time. In order to gain a good understanding of the functioning and maintenance of ecological balance of this environment, it is, therefore, necessary to carry out regular inventories to monitor the evolution of various biological groups that inhabit these environments and characterise them. Although the monitoring of aquatic environments integrity has long been based on abiotic components, which only provide specific information, the increasingly important combination of biological approaches in most hydrobiological studies makes it possible to provide more complete information, since the physico-chemical properties of water quality associated with that of aquatic habitats can be used to assess water quality [1]. It is therefore necessary to integrate the study of biological communities in forest environments, which can be used as reference points to characterise aquatic environments. In urban areas, the development of agricultural and industrial activities contributes to the settlement of humans and exerts a real tropism on new populations [2]. However, demographic densification and agricultural intensification remain the major causes of degradation of aquatic ecosystems [3]. Indeed, contaminants from anthropogenic activities have adverse effects on the development of the biota present and overall disturbance of aquatic ecosystems is very often felt at the level of biological communities. This concern implies that adequate measures be taken to permanently monitor the quality of aquatic environments, and more specifically forest milieu, which are capable of constituting a veritable niche of precise biological information for assessing the health condition of watercourses. Thus, the monitoring of aquatic ecosystems integrity is now based on measurements relating to the biological communities in place, and in particular macroinvertebrates. These organisms, which are widely distributed in different water, are characterised by their differential pollutant sensitivity, a main characteristic used in the bioindication of aquatic ecosystems [4] [5]. This study constitutes an informative data bank that can be used as a basis for comparison for further studies and a certain reference state for knowing the diversity of benthic macroinvertebrates as bioindicators of the state of environment. The analysis of the results obtained will make it possible to highlight aquatic macroinvertebrate taxa of ecological interest or even bioindicators of the biological quality of these water bodies.

2. Materials and Methods

2.1. Study Site

The ecological region of the Central-Southern forest of Cameroon is located between 3˚30' - 3˚58' North latitude and 11˚20' - 11˚40' East longitude. Four sub-catchments (Abouda, Nga, Fam, and Nkoumou) were selected for this study and 12 sampling points were chosen on the basis of accessibility, riffles, flats and microhabitats. With an average altitude of around 750 m, its relief is generally uneven and the urban area extends over several hills 25 to 50 m above the plateau. The climate is equatorial with bimodal rainfall, characterised by moderate rainfall (1576 mm/year) varying between 1500 and 1700 mm per year, with temperatures that vary little over time. There are four seasons, unevenly distributed and of varying length from one year to the next. The vegetation is of the dense secondary forest type and the hydrographic network is dense with water flowing towards the Nyong River [6].

2.2. Sampling of Macroinvertebrates

Macroinvertebrates were collected using a 30 × 30 cm kick-net with a 400 µm mesh size. Care was taken to include all possible habitats over representative sections of the stream (100 m long), according to multihabitat sampling procedure proposed by [7]. The organisms collected were put in polyethylene tubes containing 10% formalin. In the laboratory, the organisms were washed with water, handpicked from samples and preserved in 90˚ alcohol for subsequent counting and identification up to the family level using a stereoscopic microscope of the brand Wild M 5. The identification keys of [8] [9] and [10] were used. The taxonomic level retained was the family.

2.3. Statistical Analyses

The abundances obtained were weighted by the effective scanning area (3 m^2) to calculate the densities of benthic macroinvertebrates (number of individuals per m^2).

$$\text{Benthic density} = \frac{\text{Number of individuals collected}}{3\ \text{m}^2} \tag{1}$$

The Past software (PAleontological Statistics), Version 2.16 [11] was used to construct the hierarchical classification dendrogram for the discrimination of watercourses. The Euclidean distance was used as the link of the distance.

The frequency of occurrence (F) of a taxon is the ratio between the number of samples (Pa) of a station where the taxon is present by the total number (P) of samples. Four groups are thus defined by [12]: "very frequent" taxa with F ≥ 50%; "frequent" taxa with 25% ≤ F < 50%; rare taxa with F < 25% and absent taxa with F = 0%.

Shannon-Weaver Index (H') and Piélou Equitability Index

The Shannon and Weaver [13] diversity index is given by the formula

$$H' = -\sum_{i=1}^{s} p_i \ln p_i \tag{2}$$

$$p_i = N_i / N$$

N_i: number of individuals of a given taxon, i ranging from 1 to S (total number of taxa). N: total number of individuals. H' is minimal (=0) if all individuals in the stand belong to one and the same taxon, H' is also minimal if in a stand each species is represented by one individual, except for one taxon which is represented by all other individuals in the stand. The index is maximal when all individuals are equally distributed over all taxa.

The Shannon index is often accompanied by the Piélou equitability index J'

$$J' = H'/H'_{max} \quad (3)$$

$$H'_{max} = \log S \quad (S = \text{total number of species}) \quad (4)$$

The equitability index measures the distribution of individuals within species, independently of species richness. Its value varies from 0 (dominance of one of the species) to 1 (equidistribution of individuals within the species).

The rarefaction methods consist of estimating the number of species for a certain number of individuals. The results are independent of the sample size and can be represented by a rarefaction curve where the ordinate can represent the number of species and the abscissa can represent time, distance from a pollution source, number of individuals [14].

3. Results

A total of 13,436 individuals were collected. 4491 individuals were obtained in Abouda watercourse, 2715 individuals in Fam watercourse, 2574 individuals in the Nkoumou watercourse and 4356 individuals in Nga watercourse. These individuals are divided into 3 phyla (Annelida, Mollusca and Arthropoda), 6 Classes (Acheta, Oligocheta, Gasteropoda, Lamellibrancha, Crustacea and Insecta), 14 orders and 80 families. Insects dominate the benthic fauna with 9498 individuals (71.03%) of the total abundance. They are followed by Crustacea with an abundance of 2923 or 21.86%. Bivalva, Gasteropoda, Oligocheta and Acheta are the least represented groups with 343 individuals or 2.56%, 367 individuals or 2.74%, 156 individuals or 1.16% and 259 individuals or 1.94% respectively.

3.1. Aquatic Insects

Represented by 7 orders, namely Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Hemiptera, Diptera and Odonata, these organisms were collected in all the watercouses.

3.1.1. Order Ephemeroptera

The families of Ephemeropera identified are Siphonuridae, Potamanthidae, Heptageridae, Ephemeridae, Ephemerellidae, Leptophlebidae, Ameletidae, Polymitarcidae. The individuals were sampled in the grass beds and under the roots of macrophytes. These individuals form one of the most diverse groups with a relative abundance of (16.67%) of the total number. The quantitative distribution of families within this order indicates a fauna dominated by the Ephemerellidae (18.02%), followed by Beatidae (14.59%), Ephemeridae (14.41%) and Siphlonuridae (9.95%). The other families are poorly represented with relative abundances below 10%.

3.1.2. Order Plecoptera

Three families were sampled: Perlidae, Perlodidae and Chloroperlidae. The Plecoptera represent 4.8% of the individuals collected overall and 6.43% of the insects. Perlidae and Perlodidae presented the highest abundances of the Plecoptera fauna with (42.79% and 39.53%) respectively. Abouda and Nga watercourses recorded the highest abundance of Plecoptera with 208 individuals (32.25%) and 221 individuals (34.26%) respectively.

3.1.3. Order Trichoptera

Represented by 11 families, namely Polycentropodiidae, Brachycentridae, Glossossomatidae, Hydropsychidae, Leptoceridae, Limnephilidae, Philopothamidae, Phryganeidae, Hydroptilidae, Ecnomidae and Goeridae, this order contributes 13.47% of the total benthic macroinvertebrate fauna and 18.05% of the insects collected. The most representative families are the Glossossomatidae with 426 individuals (23.54%), followed by Hydropsychidae with 387 individuals (21.38%), Philopothamidae with 278 individuals (15.36%), Polycentropodiidae with 240 individuals (13.26%), Brachycentridae with 207 individuals (11.44%) and Leptoceridae with 146 individuals (8.06%). The other families are poorly represented with less than 100 individuals. The observation of the colonisation of individuals shows that Abouda and Nga watercourses recorded the highest abundance with respectively 623 (34.42%) and 578 (31.93%).

3.1.4. Order Coleoptera

12 families of Coloptera namely Curculionidae, Dytiscidae, Chrysomelidae, Dryopidae, Elmidae, Gyrinidae, Hydraenidae, Halipidae, Hydrophilidae, Hydroscaphidae, Notoridae and Hygrobiidae were collected during this study and recorded an abundance of 1495 individuals (11.13%). These individuals represent 14.91% of the insect fauna obtained. The most abundant families were Gyrinidae with 195 individuals (13.04%), followed by Hygrobiidae with 178 individuals (11.91%), Chrysomelidae with 161 individuals (10.77%), Curculionidae with 149 individuals (9.97%), Dytiscidae with 146 individuals (9.76%), Hydraenidae with 147 individuals (9.83%) and Hydrophilidae with 132 individuals (8.83%). The analysis of the colonisation of the watercourses shows that Abouda has a high abundance with 512 individuals (34.25%) followed by Nga with 426 individuals (28.5%) and Nkoumou with 366 individuals (24.48%).

3.1.5. Order Hemiptera

The families of Hemiptera present are Nepidae, Naucoridae, Pleidae, Corixidae, Hydrometridae, Notonectidae, Gerridae, Veliidae, Micronectidae, Halobatinae, Mesoveliidae, Aphelocheridae and Belostomatidae. These families represent 14.92% of the benthic macroinvertebrate fauna and 19.99% of the insects obtained. The most representative families is Pleidae with 340 individuals (16.97%), Naucoridae with 255 individuals (12.72%), Mesoveliidae with 226 individuals (11.28%), Veliidae with 186 individuals (9.28%), Nepidae with 160 individuals (7.98%), Belostomatidae with 144 individuals (7.18%) and Micronectidae with 127 individuals (6.34%). The other families although present, recorded relatively low abundances. The analysis of the abundances allows us to note that Abouda and Nga watercourses recorded the highest abundances with respectively 688 individuals (34.33%) and 553 individuals (27.59%).

3.1.6. Order Diptera

Eight families including Tipulidae, Blephariceridae, Ceratopogonidae, Chironomidea, Chrysomelidae, Dixidae, Tipuloidae and Simulidae constitute this order. These organisms represent 3.29% of the benthic macroinvertebrate fauna and 4.41% of the insects sampled, and are one of the least dominant groups in this aquatic fauna. However, Dixidae, Chiromidae, Chrysomelidae, Ceratopogonidae and Tipulidae are the groups with relatively high abundances. Nkoumou (32.58%), Nga (23.98%) and Fam (29.18%) watercourses have high abundances.

3.1.7. Order Odonata

Ten families namely Aeshnidae, Calopterygidae, Coenagrionidae, Gomphidae, Lestidae, Libellulidae, Platycnemiidae, Macromiidae and Corduliidae form this order. They represent 10.32% of all benthic organisms and 13.84% of the insects collected. The most represented families are Platycnemididae with 240 individuals (17.31%), followed by Calopterygidae with 217 individuals (15.65%), Libellulidae with 197 individuals (14.2%), Aeshnidae with 164 individuals (11.82%), Macromiidae with 145 individuals (10.45%), Corduliidae with 123 individuals (9.52%) and Coenagrionidae with 108 individuals (7.78%). The distribution of these animals in the watercourses shows that Nga and Nkoumou record the highest abundances with 430 individuals (31%) and 417 individuals (30.06%) respectively.

3.2. Crustacea

Represented by the order of Decapoda, this class is the largest contributor in terms of abundance of individuals in this study. The families that constitute it are Atyidae with 2432 individuals (83.2%) and Potamonidae with 491 individuals (16.79%). Nga and Abouda watercourses recorded highest abundance with 994 individuals (34.01%) and 945 individuals (32.33%) respectively.

3.3. Lamellibranchia

Represented by a single order of Lamellibranchia and a single family Sphareidae, they contribute to 2.55% of the total abundance of organisms collected. Nga recorded the highest number of 196 individuals (57.14%).

3.4. Gasteropoda

They are represented by the order Basomatophora and two families including Planorbidae and Limneidae. They contribute 2.73% to the total abundance of organisms collected. Planorbidae are the most represented family with an abundance of 322 individuals (87.74%) and Limneidae have 45 individuals (12.26%). The colonisation of watercourses by these organisms shows that Fam watercourse records highest abundance with 152 individuals (41.42%), followed by Nga with 98 individuals (26.7%) and Abouda with 85 individuals (23.16%). Nkoumou recorded a low abundance with 32 individuals (8.72%).

3.5. Oligocheta

Represented by two orders (Lumbriculida and Haplotaxida) and four families (Lumbriculidae, Haplotaxidae, Sparganophilidae and Tubificidae), they account for 1.16% of overall abundance of benthic organisms sampled. The analysis of colonisation shows that Nkoumou and Nga watercourses record similar abundances, respectively 55 individuals (41.98%) and 51 individuals (38.93%). However, in Abouda and Fam streams, the abundances are identical with 25 individuals each (19.08%).

3.6. Acheta

The Acheta are represented by two orders (Rhynchobdellida and Archynchobdellida) and two families (Glossiphonidae and Erpobdellidae) with an abundance of 259 individuals (1.93%). Glossiphonidae are the major contributors in this group with an abundance of 220 individuals (1.64%). The colonisation of the environments indicates a high abundance in Nga and Abouda watercourses with respectively 102 individuals (39.38%) and 91 individuals (35.14%).

On the taxonomic level represented by the orders, the quantitative organisation of individuals indicates a predominance of Decapoda (21.75%), followed by Ephemeroptera (16.67%), Hemiptera (14, 92%), Trichoptera (13.47%), Coleoptera (11.13%), Odonata (10.32%), Plecoptera (4.6%), Diptera (3.29%), Basomatophora (2.73%), and Eulamellibrancha (2.55%). The other orders (Arhynchodblelida, Lumbriculida and Haplotaxida) each have a relative abundance of less than 1% (Figure 1).

3.7. Seasonal Variation of Macroinvertebrate Density

The densities of benthic macroinvertebrates obtained in the four watercourses are presented in Figure 2. From this observation, it can be seen that benthic densities show maximum values in the dry season (Long dry season for Abouda,

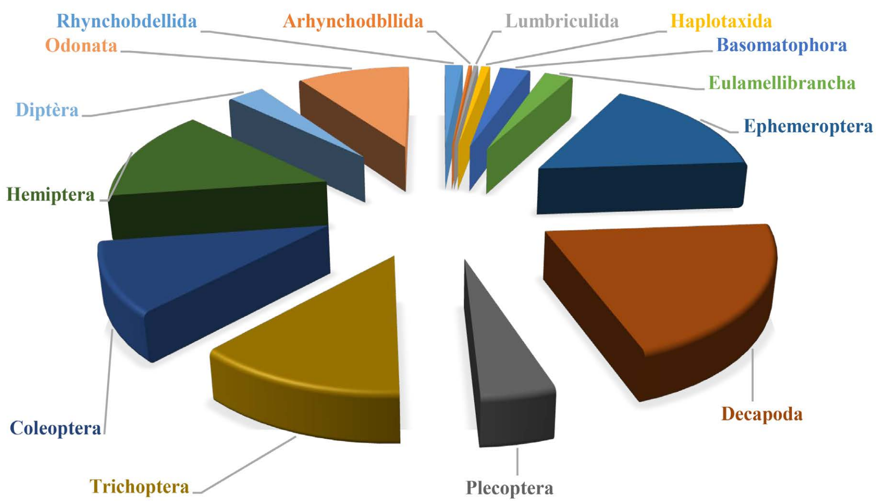

Figure 1. Distribution of the different orders of benthic macroinvertebrates.

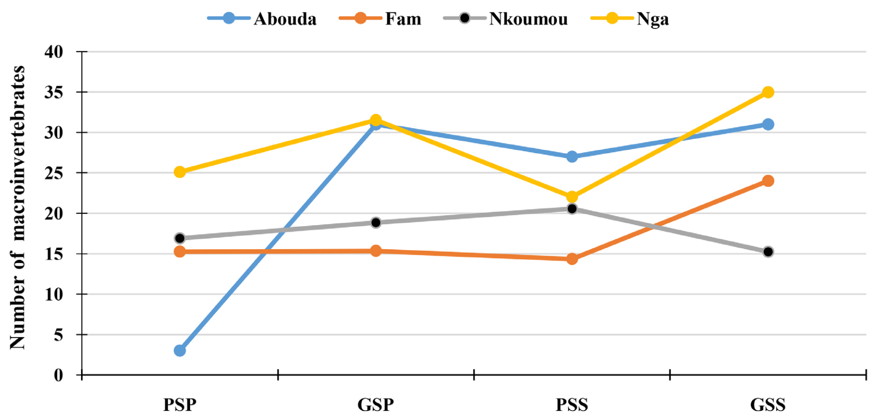

Figure 2. Evolution of the density of benthic macroinvertebrates in watercourses according to the seasons. PSP = Short raining season; GSP = Long raining season; PSS = Small dry season; GSS = Long dry season.

Fam, Nga and Short dry season for Nkoumou). The peak periods were observed in Nga (35 individuals per m^2) with an average of 23 ± 13.47; 32 individuals per m^2 in Abouda an average of 17.23 ± 4.54; 24 individuals per m^2 in Fam with an average of 17.87 ± 2.31 and 34.97 individuals per m^2 with an average of 28.41 ± 5.89. Analysis of the t-test results (Table 1) indicates that there is no significant difference between these means. In fact, since the probabilities are greater than 0.05, the average benthic densities of the four rivers are not statistically different.

3.8. Assessment of Macroinvertebrate Diversity

3.8.1. Frequency of Occurrence (F)

80 families of macroinvertebrates were identified, 71 families were identified in Abouda stream, 72 in Fam stream, 76 in Nkoumou stream and 74 in Nga stream. 22 families are very frequent in the four streams and recorded the frequency occurence above 75%. These are the families of Ephemeridae, Ephemerllidae, Beatidae, Perlidae, Perlodidae, Hydropsychidae, Phylopothamidae, Polycentropiidae, Brachycentridae, Gyrinidae, Hygrobiidae, Chrysomelidae, Pleidae, Naucoridae, Platycnemididae, Calopterygidae, Coenagrionidae, Atyidae, Potamonidae, Sphaeridae, Planorbidae and Hydrophilidae. The following families had recorded the occurrence frequency of 50%. They are Lumbriculidae, Haplotaxidae, Sparganophilidae, Siphonuridae, Potamanthidae, Heptageridae, Leptophlebidae, Ameletidae, Polymitarcidae, Chloroperlidae, Glossossomatidae, , Curculionidae, Dytiscidae, Dryopidae, Elmidae, Hydraenidae, Halipidae, Hydroscaphidae, Notoridae, Nepidae, Hydrometridae, Notonectidae, Gerridae, Veliidae, Microveliidae, Halobatinae, Mesoveliidae, Aphelocheiridae, Belostomatidae, Chironomidae, Chrysomelidae, Dixidae, Aeshnidae, Cordulegasteridae, Gomphidae, Lestidae, Libellulidae, Macromiidae and Cordulidae. In contrast, Glossiphonidae, Erpobdollidae, Limneidae, Tubificidae, Prosopistomatidae, Odontoceridae, Caenidae, Leptoceridae, Limnephilidae, Phrygarneidae, Ecnomidae, Corixidae and Tipulidae, Georidae and Ceratopogonidae, Blephereceidae and Tipuloidae, although not present in all the rivers, recorded a frequency of occurrence of 10%.

Table 1. Results of the t-test of benthic macroinvertebrate density means.

Sites	Abouda/Fam	Nkoumou/Nga	Abouda/Nkoumou	Fam/Nga
t test mean	6.97	4.3935	7.975	4.082
p (mean)	0.0907	0.14247	0.079	0.153

p being the probability that the means are statistically different.

3.8.2. Shannon and Weaver Diversity (H') and Piélou Equitability (J')

Analysis of the values of Shannon-Weaver diversity index and Piélou's equitability shows that these indices evolve in a spatially synchronous manner and vary from $H' = 3.87$ bit/ind and $J' = 0.89$ (Abouda) to $H' = 4.05$ bit/ind and $J' = 0.93$ (Nkoumou). In terms of time, these indices range from from $H' = 3.54$ bit/ind and $J' = 0.82$ (GSP) to $H' = 4.04$ bit/ind and $J' = 0.93$ (PSS) (**Figure 3**). Overall, Nkoumou and Nga rivers and the PSS and PSP seasons showed high values of diversity indices. Despite the variations observed, no significant differences were observed, reflecting an equitable distribution of benthic macrofauna in the different rivers.

3.9. Seasonal Variation of Macroinvertebrate Families

Based on the abundance of benthic macroinvertebrate families, it appears that in all the rivers, the curves show the same evolution. Abouda stream shows the peak of families in Long dry season and Short dry season, in Fam, this peak is reached in Short raining season, Nkoumou notes its family peak in Long dry season with almost similar numbers in the other seasons. Nga showed its family ceiling in Short raining season and Long dry season (**Figure 4**). The analysis of the similarity dendrogram of the forest streams shows two groups on Nkoumou stream and on the Abouda, Fam and Nga streams on the other hand (**Figure 5**). These groups show strong similarities among them and support the almost similar evolution of the indices of appearance of specimens in the watercourses.

4. Discussion

With 13436 individuals recorded, this study is one of the most important databases of the benthic macrofauna of the forested rivers of Central South ecological region of Cameroon available to date. This survey made it possible to organise the data into 3 phyla, 6 classes, 14 orders and 80 families identified. These results are similar to those of [5] [15] who obtained a high diversity in few Mefou turbutary. This would be due to the fact that the surveyed rivers are located far from anthropogenic disturbances and are in the same ecological zone and contrast with those of [4] [11] in the Bagré dam lakes and the Volta basin in Burkina Faso which are environments disturbed by anthropogenic activities. The high taxonomic richness obtained in the different rivers and, the presence of several phyla would be due to the presence in these ecosystems of a remarkable diversity of microhabitats, essential for the development of a rich and diversified benthic fauna [16]. In addition, the class of insects predominates the benthic

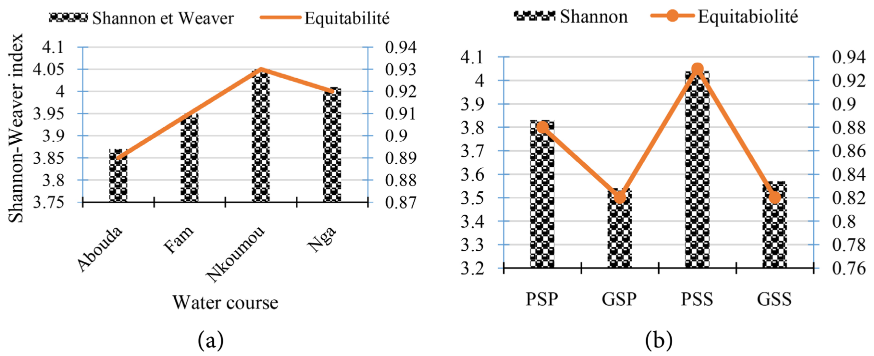

Figure 3. Spatial (a) and temporal (b) variation of the Shannon and Weaver index and equitability of piélou.

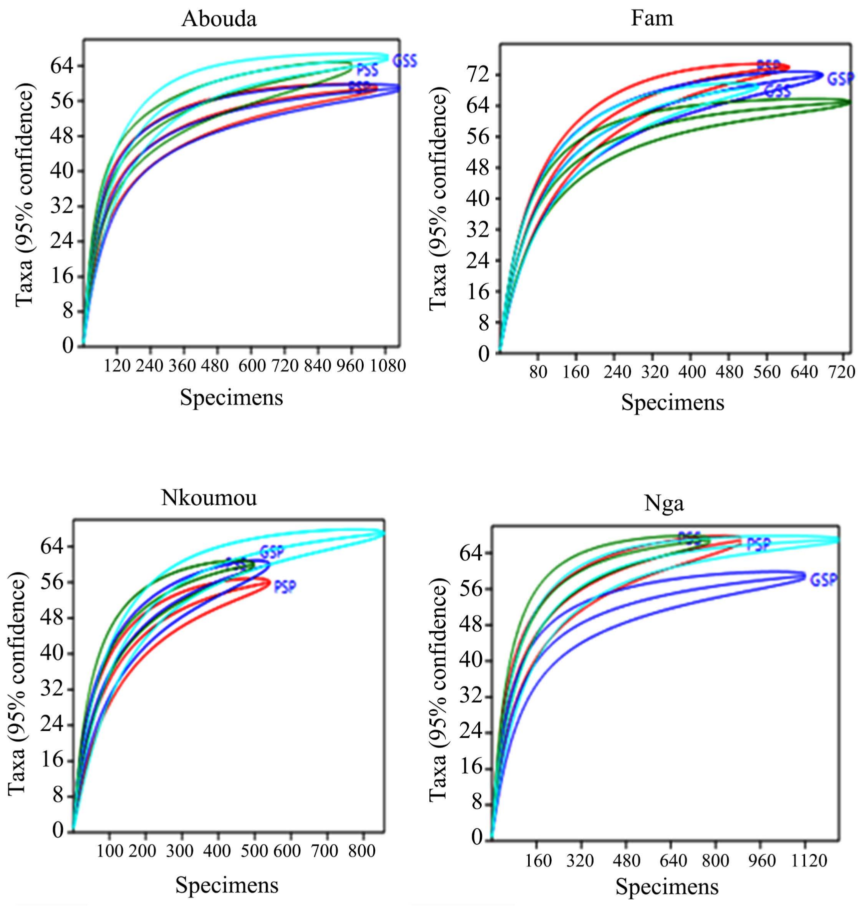

Figure 4. Seasonal variation of rarefaction curves of macroinvertebrate families in rivers.

fauna with an abundance of 9498 individuals (71.03%), with a remarkable representation of the EPT (Ephemeroptera, Plecoptera, Trichoptera) complex, which stands out with 26 families and contributes for 32.62% of total abundance. This quasi-dominance of insects and also the presence in all watercourses the EPT that are considered as the most sensitive to pollution by [17], translates the fact that these environments have stable conditions and good water quality, which makes it possible to confer on these ecosystems the character of reference

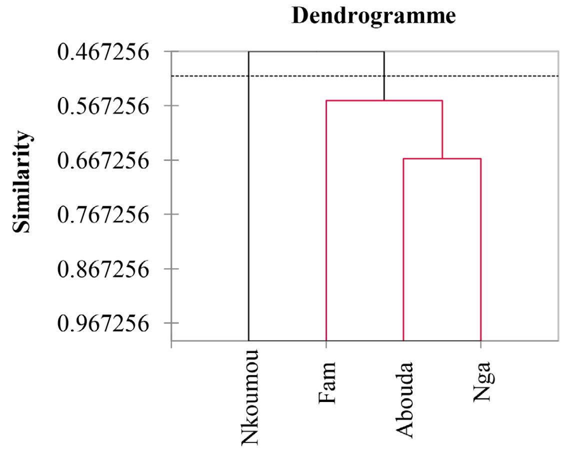

Figure 5. Grouping of rivers according to their affinity.

environments. In this respect [18] point out that in aquatic environments, insects are very sensitive to pollution and environmental modification. Crustaceans constitute the second most important class in terms of abundance with 2923 individuals (21.75%) of all benthic organisms. The family Atyidae is the most represented and was collected synchronously with the EPT and confirms the character of the dominant family of forest streams. This observation corroborates the work of [15] and [19] who indicated a predominance of Atyidae in the few forest streams of Cameroon. This remarkable proliferation of Crustacea would be due to the good oxygenation of waters which is a criterion of good water quality. To this effect, [8] affirmed that Crustacea Decapoda thrives in well oxygenated environments and is very sensitive to the decrease in dissolved oxygen content. According to [14], the study of an environment should not only focus on the absence or presence of a few key species, but should take into account all the species present in the community. It therefore appears that the Decapoda, Hemiptera and the EPT complex would be good biological tools for assessing the biological quality of forest aquatic environments.

From a temporal side, the taxonomic composition did not vary significantly from one season to another, despite the variations observed here and there. However, the Short dry season recorded the highest value for the family scarcity index and diversity index. This would be due to the low quantities of water and current observed at this season, thus favouring a better collection of organisms in the different microhabitats. This observation is in contrast with the conclusions of [15] who observed a high diversity during the rainy months. Indeed, the rainy seasons constitute periods of instability of the environment during which, most of benthic invertebrates are carried away by the strong currents. [20] strongly affirms in this respect that, in aquatic environments, floods create conditions of instability of the bottoms and provoke the drifting of populations. The observation of the colonisation of watercourses shows that Abouda and Nga recorded highest specific richness, and the values of diversity indices remain high. These high values of diversity indices would be the result of the perfect integrity of these hydrosystems. These observations are in agreement with [12] [21] [22] [23] who affirm that a diversity index is higher when the environmental conditions favour the installation and maintenance of a balanced, integrated biological community capable of adapting to changes. The resemblance dendrogram remains of interest for our bioindication-oriented study. Its analysis reveals that the use of the family as a taxonomic level makes it possible to discriminate between watercourses on the basis of their similarity. This taxonomic level is widely used in the calculation of the biological quality index of watercourses at the European level [22] and [23]. This study, which is one of the first concerning the inventory of benthic macroinvertebrates in four Cameroonian forest streams, the observations of the groups present in the samples coupled with their frequency of occurrence make it possible to identify macroinvertebrate taxa that can be described as pollution-sensitive. Indeed, these taxa are from the four watercourses with frequencies of occurrence greater than 75%. They are, among others, Ephemeroptera (Ephemerellidae, Beatidae, Ephemeridae), Plecoptera (Perlidae and Perlodidae), Trchoptera (Hydropsychydae, Phylopothamidae, polycentropodiidae, and Brachyentridae), Coleoptera (Gyrinidae, Hydrobiidae and Chrysomelidae), Hemiptera (Pleidae and Naucoridae), Diptera (Chironomidae), Odonata (Platycnemididae, Calopterygidae and Coenagrionidae), Crustacea (Atyidae and Potamonidae), Eulamellibrancha (Sphaeridae) and Gasteropoda (Planorbidae). The other families with a frequency of less than 50% can be considered as pollution-resistant and could be of interest for the bioindication of these hydrosystems.

5. Conclusion

The benthic communities of macroinvertebrates in the four watercourses selected for this study remain largely dominated by insects with 71.044% of all the organisms sampled. These insects are very diversified with 7 orders, Ephemeroptera being the most diversified. Quantitative observation of the orders indicates a predominance of Decapoda (21.75%), Ephemeroptera (16.67%), Hemiptera (14.92%), Trichoptera (13.47%), Coleoptera (11.13%), Odonata (10.32%) and Plecoptera (4.6%). On a family basis, Atyidae are highly represented with a relative abundance of 18.2%. The high presence of EPT and the low abundance of Diptera reflects the low anthropic-nature of the different catchment areas and the good quality of their waters. The analysis of the frequencies of occurrence of families in different watercourses has made it possible to highlight macroinvertebrate taxa that could be potential bioindicators of these forest hydro systems. These bioindicators will undoubtedly constitute a solid base on which future investigations will be based and will allow the development of biological indices well adapted to the Cameroonian environment.

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Conflicts of Interest

The authors declare that there is no conflict of interest about the publication of this document.

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