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Influence of some abiotic parameters on the biodiversity of macroarthropods in the "lep-liye" forest stream

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Abstract
A study was carried in the locality of Ngog-mapubi. The objectif was to evaluate the spatio- temporal dynamics of macro-arthropods in relation to seasonal and physico-chemical quality of forest stream. Benthic macro-arthropods were sampled during the short dry season (SDS) and the long rainy season (LRS). Physico-chemical parameters such as temperature, oxygen and carbon dioxide fixation, oxydability of oxygen, carbon dioxide, suspended solids, nitrate, pH were measured and analyzed follow standard methods. A sampling net was used to collect macro-arthropods at (Lep1) up-stream, (Lep 2 and Lep3) med-stream and (Lep 4) down-stream.
313 macro-arthropods predominated by Hexapoda (89%) and Malacostraca (11%) were collected and mainly identified as: Odonata (43.13%), Hemiptera (15.34%), Coleoptera (13.74%), followed by Décapoda (11%), Trichoptera (8.3%), then Ephemeroptera (7.33%) and Diptera (0.98%). Concerning biocenotic analysis, the diversity and abundance index were higher during the LRS, Shannon index showed significant difference between the two seasons, while from a spatial point of view, the Mann-Whitney U-test revealed a significant difference between the coarse substrate stations compared to those with fine substrate stations.

Keywords: Abiotic parameters, macro-arthropods, Lep-liye: Forest stream, Cameroon

Introduction
A recent World Wide Fund for Nature (WWF) Planet Report released on 10.IX.20, presented a 68% decline in the Global Living Planet Index performed between 1970-2016. According to this report, the verdict would be more alarming for freshwater environments. Indeed, the biodiversity of fresh waters is decreasing much more rapidly than that of the oceans or forests. 90% of the world's wetlands have been destroyed since 1700 (WWF, 2020) [1]. In Sub-Saharan Africa, the same type of work has been carried out: in Gabon, Ivory Coast, Burkina-Faso, Nigeria and the Central African Republic (CAR) (Ngoay-Kossy *et al*., 2018) [2].
In the Central African sub-region, Cameroon is not to be left behind in this innovative movement, work on the characterization of natural waters is carried out under the impetus of many academics and researchers. This work most often concerns the waters of the major cities of the countries and very little in the remote areas where certain parts of these countries remain unexplored. These investigations are very often focused on the diversity and dynamics of living organisms such as: Zooplankton, Bacteria, Protists and Benthic Macro-invertebrates (MIB), where among the latter, arthropods are the most important group. Being the most abundant, the most diversified and the most used in the bio-evaluation of shallow watercourses (Agence de l'Eau, 2000) [3]. In Cameroon, some work has been done in this area; we can cite among others, those of: (Biram à Ngon *et al*. 2018) [4] on the ecological factors and benthic macroinvertebrates in the forest rivers of Central Cameroon and those of (Tchakonte *et al*., 2014) [5] on the peri-urban rivers of Douala.
Unfortunately, work on the dynamics of macroarthropods of shallow watercourses in forest areas is not sufficiently carried out in Cameroon, which would be necessary given their importance in the biological cycle of the species that live there, so it would be important to direct research in this direction, in order to fill this gap. For this study, the objective of which is to evaluate the spatio-temporal dynamics of macro-arthropods in relation to the seasonal

variability and the physico-chemical quality of the waters of the "Lep-liyè" stream. The choice was made on the forest watercourse at the head of the watershed: "Lep-liyè" in Libellingoï village, locality of Ngog-Mapubi located in the Nyong-et-Kellé Division, which is counted among those who received little investigation from hydrobiologists among the 10 Divisions of the Center Region of Cameroon.

Material and Methods

Presentation of the study area

The council of Ngog-mapubi is an administrative unit of the Nyong-et-Kellé Division, Center Region (Fig.1). Libellingoï is a locality of the district of Ngog-mapubi, in the department of Nyong-et-Kellé, located approximately ten kilometers from Boumnyebel. This locality represented a village which split into two parts, namely: Libellingoï-South and Libellingoï-North, and the work was carried out in the southern part. Libellingoï-South is a village with about 300 inhabitants; agriculture is at the center of economic activities, in particular the cultivation of cocoa and oil palm. Lep-liyè is a watercourse of approximately 20 km of course essentially dominated by an equatorial type forest which is often disturbed by agricultural activities. Lep-liyè is a forest stream at the head of the watershed, which flows into the "Pougue" river. The activities practiced in this watershed are: laundry, washing pistachio melons, dishes, bathing, and traditional fishing.

Description of study stations

This study was conducted during the short dry season (SDS) in the months of May, June and July and the long rainy season (LRS) in the months of August, September and October respectively. Four sampling stations were selected; Station 1 (Lep1) with geographical coordinates (03°54'12.6" North and 010°55'31.1" East) is located on the upper course, about 8 km from the source. It is located below a hill exploited for the cultivation of cocoa. It is the furthest station from dwellings, its two banks are dotted with plants and shrubs and it is not shaded enough due to anthropogenic action. Here the vegetation is very regularly undergoes clearing sessions. The bed has a heterogeneous substrate consisting mainly of various rocks and coarse sand, but also dead plant matter (debris of dead leaves, branches, etc.). This station seems to have an important role for the cocoa farmers of the region because there are several empty sachets marked "super plantomil" nearby.

The Lep2 station with geographical coordinates (03°54'09.7" North and 010°55'11.0" East) is separated from the Lep1 station by more than 1km, this station is close to dwellings and is located near an area with intense anthropogenic activities (laundry). It is shaded and its banks are dominated by vegetation consisting of grasses, tree roots and dotted here and there with oil palms. The bottom varies from muddy to sandy and is cluttered with plant debris of all kinds.

Separated from the previous one by a source of pollution, the Lep3 station with geographical coordinates (03°54'10.2" North and 010°55'10.0" East), is located about 40m from Lep2 and separated from it by a frequently used track. This station is very shaded due to the presence of tree vines, which also makes accessibility more difficult compared to other stations. The bottom is very muddy and also made up of fine sand and plant debris. The riparian forest on both banks is dominated by shrubs, trees, grasses and roots, and also a thick layer of mud. But the most obvious characteristic is at the level of the outlet, the presence of a tree trunk which crosses the station over its entire width and which seems to retain debris.

The Lep4 station with geographical coordinates (03° 53'58.6" North and 010° 54'54.1" East) is located about 13 km from the source and about 200 m from the first dwellings in the village. It is located downstream from another leaching point, which is why it was possible to see anthropogenic remains such as: empty sachets of detergent, and sometimes decomposing pistachio melons. Lep4 is also located close to the village's main road transport (Fig. 1). The bottom is mostly laterite and coarse sand; the banks are dotted with shrubs.

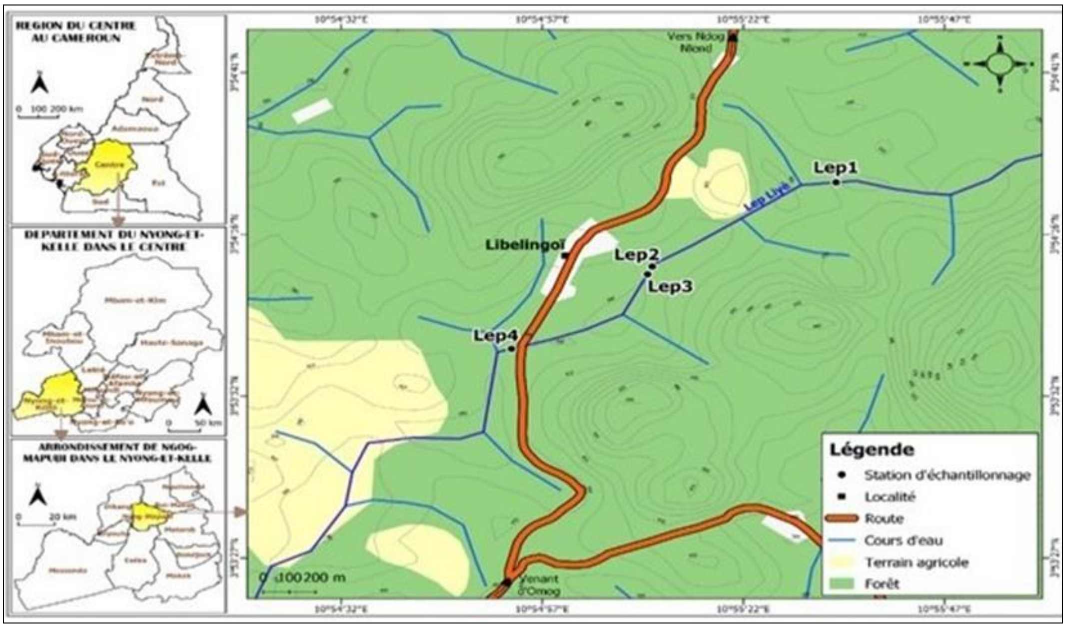

Fig 1: Geo-spatial location of sampling stations in Ngog-mapubi (Libellingoï South village).

Sampling

*Benthic arthropods were samp*led in the four stations in six campaigns, during a periodicity and during the short dry season (SDS) and the long rainy season (LRS) respectively. According to the multi-habitat approach which consists of sampling in intermediate habitats Stark *et al*. (2001) [6].

In the field: the macro-arthropods were captured using a kick net of a square metal frame with a side dimension of 30 cm equipped with a conical net of 400µ mesh opening and 50 cm depth. For each station, about twenty landing net tows were carried out each over approximately 50 cm in length, equivalent to sweeping the net of approximately $3m^2$ in area, in the various micro-habitats listed. Using entomological forceps, the specimens present were sorted. The harvested organisms were introduced into pillboxes and fixed in 10% formalin.

In the laboratory: the specimens were washed in tap water and then preserved in 70% alcohol before counting and identification operations. All of the benthic arthropods were observed using a Wild Heerbrugg binocular magnifying glass and their identification using the various identification keys, in particular: (Durand and Lévêque, 1981) [7]; (Tachet *et al*. 2010) [8] and (Moisan *et al*. 2006) [9].

Measurement of Hydromorphometric Parameters

The speed was obtained according to the formula V=d/t. To this effect, the time (t) taken by a polyethylene float to cover a section of the watercourse one meter away (d), in each of the stations, was measured. V= (speed); d= (distance between the two points in meters); t= (time necessary for the float to cover this distance in seconds).

In each station, the width (W) in meters was measured using a decameter, the measurements of the thicknesses of the water column and of the substrate were carried out using a graduated wooden stick, which was driven vertically from one bank to the other in a step of 30 cm. The burying of the stick was first done up to the water-substrate interface (depth D) and then pushed deeper to determine the thickness of the substrate. This operation was repeated 3 times in each station, which made it possible to calculate the average width (Lm) and the average depth (Pm). The wetted section Sm (in m^2) was calculated according to the formula:

$$S_m = W_m * D_m$$

Flow is the volume (V) of water that passes through a section in one second. It was calculated according to the following formula:

$$Q = S_m * V$$

The longitudinal profile was produced from the topographic map of the locality of Ngog-mapubi and its surroundings. The altitudes were measured in the field using a Garmin brand GPS, model e-trex 10. The water samples were taken from the surface of the water using a double capped polyethylene bottle with a capacity of 1000 ml and to the brim without making bubbles.

Measurement of Environmental Variables

Temperature was measured in situ using a graduated mercury column thermometer. To do this, 2/3 of the thermometer was immersed in water for about 3 minutes and the reading was made directly on the value corresponding to the graduation read on the thermometer. Hydrogen potential (pH) and conductivity were measured in the laboratory using a HANNA model HI 9829 multi-parameter. The CO_2 measurement was conducted in two steps: Fixing on the field: the CO_2 was fixed by introducing into a 200 ml volumetric flask previously containing 20 ml of NaOH of N/20 and 2 to 3 drops of phenolphthalein, the water sample, completed to the mark. A pink shift of the mix was appreciated. The mixture was stored in a 250 ml double capped polyethylene bottle and transported to the laboratory in a refrigerated flask. The titration in the laboratory was carried out by volumetry; 50 ml of the sample was titrated with N/1O HCl until complete decoloration. The operation was repeated with distilled water which was the control sample. The dissolved CO2 content in water was obtained according to the formula below.

Dissolved CO2 (mg/l) = (change in control burette level – change in sample burette level) × 17.6

The water content in orthophosphate and forms of mineral nitrogen was measured in the laboratory by colorimetry and spectrophotometry, using a spectrophotometer of brand HACH DR/2900. Ammoniacal nitrogen was measured according to the Nessler's method at 425 nm wavelength. Orthophosphates and nitrate were measured with a spectrophotometer at 530 nm and 500 nm wavelengths using the reagents Phosver III and Nitraver V respectively.

Biocenotic Analysis

Diversity takes into account not only the number of species but also the distribution of individuals within these groups. The Shannon-Wiever diversity index (H' is the most often used and the most recommended by various authors Grall and Coic, (2005) [10]. It allows diversity to be expressed by taking into account the number of species and the abundance of individuals of all species in the sample. It is calculated by the following formula:

$$H' = -\sum_{i=1}^{S} \text{Pi} \log 2 \text{ Pi}$$

Where: Pi = proportional abundance of species (i): pi = ni /N; S = total number of species; ni= number of individuals of one species (i) in the sample, N= total number of individuals of all species in the sample.

The Piélou evenness of a sample represents the ratio of the specific diversity observed to the theoretical maximum diversity that can be obtained with the same number of species (Dajoz, 1982) [11].

$$J = \frac{H'}{\log 2\ S}$$

Finally the Sörenson's similarity index (SI) was calculated to estimate the degree of resemblance in the biological community of macro invertabrates between the different stations on one hand, and between the dry season and the rainy season according to the formula: SI=2C/ SA+SB. where SA is the number of species in community A, SB the number of species in community B and c the number of species common to both communities A and B

Then in each station, mean (average) of each parameter was calculated and compared by using pairwise comparison by student test with P-value< 0,05

Results

Hydro-Morphometric Parameters

The values of the average speed oscillated between the highest measured in the Lep1 station (5.50 m/s) and the lowest recorded in the Lep3 station (3.67 m/s). With regard to the flow, there was a consequent variability of the averages between the different stations, the highest flow was observed in the Lep3 station (8.86 m3/s) while the lowest was recorded in the Lep1 station with 0.9 m3/s (Table 1). Overall, the H-test showed that these parameters did not vary significantly between stations (*p*>0.05).

Table 1: Structures of the substrates and averages of the hydro-morphometric parameters in the four stations

Evaluation criteria	Stations			
	Lep1	Lep2	Lep3	Lep4
Bed structure	**Sand, block, laterite**	**sand, silt**	**Slime, silt, fine sand**	**Laterite, coarse sand**
Width (m)	2.13	3.45	2.98	3.80
Speed(m/s)	5.50	5.05	3.67	5.15
Flow (m3/s)	0.9	6.43	8.86	4.82
Altitude (m)	402	396	377	373
Slope (%)	2.95	2.77	2.76	2.62

Environmental Parameters

The average values of the physicochemical parameters varied in time and space (Table 2). Indeed, the temperature varied very little between the stations, with values oscillating between 23.75 ± 2.3 °C in the lep2 station and 26.66 ± 2.85 °C in the lep4 station. A slightly acidic pH was recorded during the dry season with a value of 6.82 ± 0.054UC. With a dissolved oxygen rate fluctuating between 77.50 ± 3.59% and 88.33 ± 3.29%, it appears that the oxygenation of the waters was very much above average. During the rainy season, an increase in orthophosphate and conductivity was observed with values that fluctuated from 0.15 ± 0.04 mg/l to 0.27 ± 0.20 mg/l and from 203.75 ± 120.86 µS/cm to 226.91 ± 114.23 µS/cm respectively (Table 2).

Table 2: Physicochemical variables of the Lep stream during the phase study

Physicochimical parameters	lep1	lep2	lep3	lep4	SDS	LRS
Temperature (°C)	23.83± 2.26^{a}	23.75± 2.31^{a}	23.83± 2.40^{a}	26.66± 2.85^{a}	25.37± 2.92^{a}	23.66± 1.89^{a}
pH (UC)	7.27± 0.38^{a}	7.00± 0.35^{a}	7.17± 0.37^{a}	7.07± 0.36^{a}	6.82± 0.05^{a}	7.39± 0.4^{a}
O2 dissolved (%)	88.33± 3.29^{a}	82.83± 3.43^{a}	77.50± 3.59^{b}	81.66± 3.57^{a,b}	80.66± 0,67^{a,b}	84.50± 0,13^{a,b}
CO2 dissolved (mg/l)	16.85± 5.92^{a}	17.20± 6.72^{a}	14.26± 6.89^{a}	13.79± 2.23^{a}	15.35± 1,41^{a}	15.71± 0.77^{a}
PO4 3- (mg/l)	0.10± 0.04^{a}	0.11± 0.07^{a}	0.33± 0.20^{b}	0.30± 0.22^{a,b}	0.15± 0.04^{a}	0.27±0.20^{a,b}
Conductivity (µS/cm)	154.16± 91.67^{a}	192.16± 84.55^{a}	338.25± 210.75^{a}	176.75± 88.37^{a}	203.75± 120.86^{a}	226.91± 114.23^{a}

Short Dry Season (SDS) and Long Rainy Season (LRS); letter in superscript indicate in the same line difference or similitude of index parameters between in pairs sites or seasons after pairwise comparisons

Biocenotic Parameters

Of the 24 samples taken, a total of 313 individuals were collected, divided into 2 classes, 7 orders (Fig. 2), 29 families (Fig. 3) and 44 genera. Most of the benthic arthropods counted belong on one hand to the class of Hexapods (89%) made up of six orders (Fig.2). The order of Odonata was the most represented and richest (43.13%), with the largest number of families (9 families), followed respectively by those of Hemiptera (15.34%) represented by 4 families, Coleoptera (13.74%) represented by 6 families, Decapods (11.2%) with 2 families, Trichoptera (8.3%) by 3 families, Ephemeroptera (7.33%) by 4 families, and Diptera (0.96%) by 2 families and on the other hand to the class Malacostraca (11%), represented only by the order Decapods. In terms of relative abundance, the following families were the most represented: Libellulidae (24.6%), Atyidae (8%), Naucoridae (7.7%), Dipseudopsidae (7.3%), Calopterygidae (6.7%) (Fig.3).

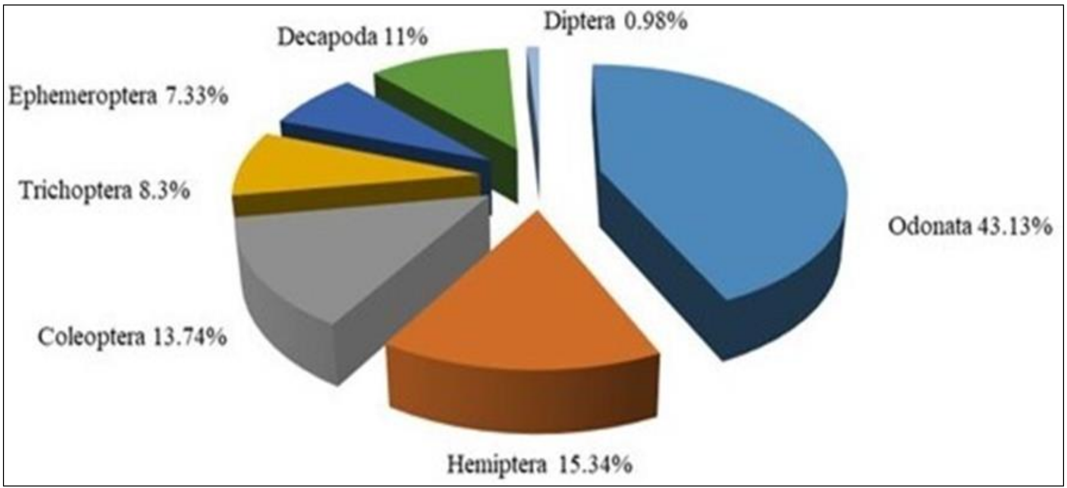

Fig 2: Relative abundance of differents macro-arthropods orders

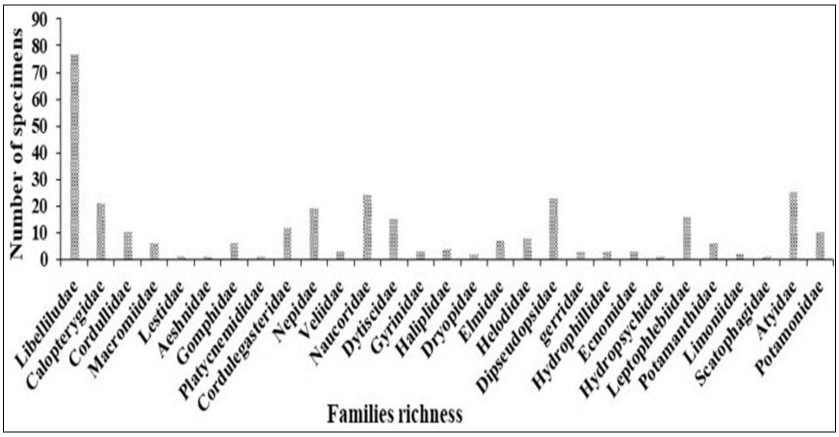

Fig 3: Families macro-arthropods abundance

Biocenotic metrics variation or diversity of macroarthropods: Spatially, mean of specimens, taxonomic richness, Shannon diversity indices (H') were higher in the upstream station (Lep1), against the lowest values observed in the middle station (Lep2) where, moreover, no significant difference was observed in these three parameters (Table III) with the station (Lep3). Comparing the variation of the parameters between the stations, the results show that the number of individuals of macro invertebrates was average in the stations Lep3 and Lep4 lower (9.17±3.13) in the station (Lep2) whose value was significantly different with that of Lep1 (18.17±5.28). As for species richness, no significant variation was noted. However, the value of the Shannon index varied significantly between the stations (Lep2 and Lep3) and the Lep1 station, while the equitability index only shows a difference between the Lep1 and Lep 3 stations (Table 3).

Seasonally, despite the difference in numbers noted between the two seasons, the average of 123 individuals (42.67±3.51) in the SDS and 190 (65.33±22.01) in LRS was not significantly different. The taxonomic richness and the Shannon diversity index varied significantly between these two seasons, which showed low communities in the dry season unlike those observed in the rainy season (Table III). The taxonomic richness (S) as well as the Shannon index of macroinvertebrate communities increased from one season to another. Their values were low during the Short dry season (SDS) with 19 families for taxonomic richness and represented by 123 individuals or 39% of the population against 28 families in the Long Rainy Season (LRS) represented by 190 individuals (61%).

Table 3: Spatial and temporal variation of the mean of individuals, taxonomic richness, Shannon diversity indices (H') and indices (J)

Parameters	Lep1	Lep2	Lep3	Lep4	SDS	LRS
ẋ	109(18.17±5.28)^{b}	56(9.17± 3.13)^{a}	60(9.83± 3.31)^{ab}	88(14.5±7.29)^{ab}	123(42.67±3.51)^{c}	190(65.33±22.01)^{c}
S	19(8.33±2.80)^{a}	14(5.5±0.55)^{a}	14(5.67±1.86)^{a}	17(6.33±3.83)^{a}	19(13.33±0.94)^{b}	28(20.33± 4.93)^{c}
H’	1.89±0.13^{b}	1.55±0.07^{a}	1.58±0.13^{a}	1.57±0.24 ^{ab}	1.46±0.15^{a}	1.83±0.18^{b}
J	0.90±0.02^{a}	0.91±0.03^{ab}	0.94±0.01^{b}	0.93±0.01^{ab}	0.92±0.025^{ab}	0.92±0.032^{ab}

Legend: ẋ= abundance; S= specific richness; H’= Shannon-Weiver index; J= Pielou index; different letter in superscript indicate in the same line difference or similitude of index parameters between in pairs sites or seasons after pairwise comparisons and numbers in the bracket () are th e mean of the parameters

Spatial and temporal similarities: Spatially, the results show that the population of macroarthropods is made up of the same families regardless of the collection point. Whether between close stations like Lep1 and Lep2 (IS= 67%) and Lep2 and Lep3 (IS=71%) (Fig. 4a); or those distant from each other such as Lep1 and Lep 4 (IS=67%), the Sorensen similarity index greatly exceeds 50%. As with the stations, macroarthropods communities varied only slightly from one season to another (Fig.4b). This explains the very high value of the resemblance of families of macroarthropods of the order of 77%.

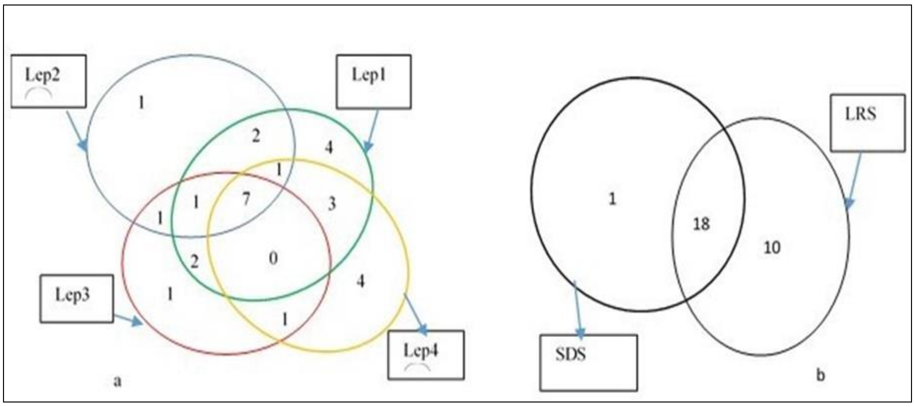

Fig 4: Venn diagram: a) spatial representative of species richness; b) temporal similarity representation

Principal Component Analysis (PCA)

The Principal Component Analysis applied to the different physico-chemical and biological variables has made it possible to show on one hand that there is a resemblance between the families. Core 1 (N1) showed the dominance of pollution tolerant families (Fig.5) consisting of: Libellulidae, Veliidae, Helodidae. In core 2 (N2), the families Naucoridae, Dytiscidae, have been grouped together. Finally, core 3 (N3) was especially marked by the dominance of pollution-sensitive orders such as Ephemeroptera (Leptophlebiidae) and Trichoptera (Dipseudopsidae). And on the other hand, affinities have been revealed between the physicochemical parameters and the biological parameters.

In the first axis, orthophasphate correlated positively with Halodidae (Fig.5) but negatively with the family Gomphidae. Dissolved carbon dioxide correlated positively with families Nepidae and Cordullidae but negatively with family Dipseudopsidae, and dissolved oxygen correlated positively with families Atyidae and Veliidae but negatively with family Cordulegasteridae.

For the second axis, the temperature correlated significantly and positively with the polluosensitive families of leptophlebiidae, calopterygidae, but negatively correlated with the families of Libellulidae, Nepidae. Electrical conductivity correlated significantly and negatively with the family Cordulegasteridae and positively with the family Atyidae.

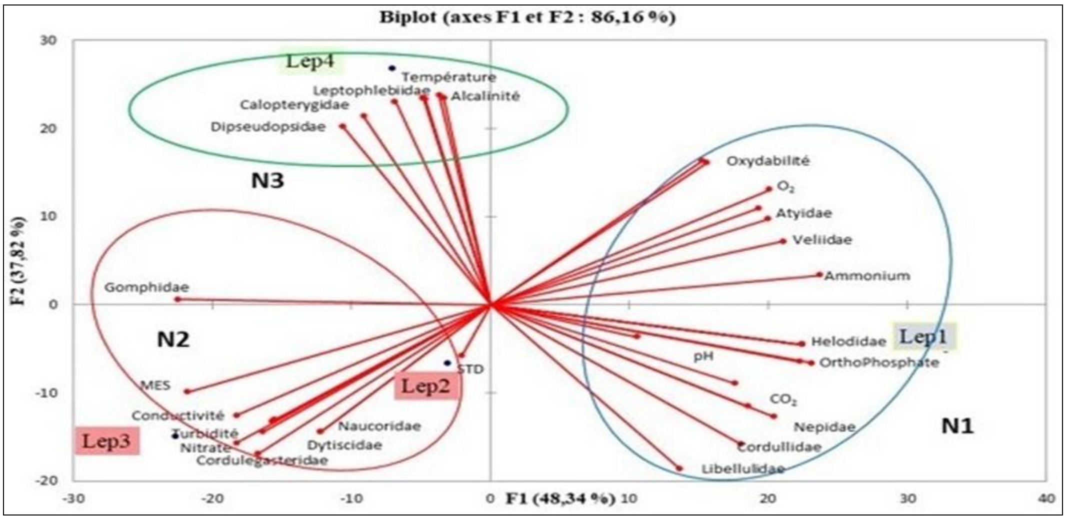

Fig 5: Principal Component Analysis groups showing affinities between the physicochemical parameters and the biological parameters: N1 the dominance of pollution tolerant families; N3 the dominance of pollution-sensitive families.

Discussion

Variation of hydro-morphometric and physico-chemical parameters

The level of the water column is high during the rainy season, so the dynamics of the hydraulic gradient oscillate according to the elements of seasonality and the rain regime (ONEMA, 2015) [12]. The relatively low average temperature in the Lep-liyè stream would be linked to the presence of forest which would obstruct the sun's rays, this result is similar to that obtained by (Ngoay-Kossy *et al*. 2018) [2] in the Nguitto forest stream in the CAR which had also obtained a low average temperature, this was justified by some authors by the presence of the canopy which limits incident solar radiation, the main source of contribution energy in hydro-systems (Ngoay-Kossy *et al*., 2018; Webb and Zhang, 2004; Vannote, 1980) [2, 13, 14].

The overall pH showed a trend towards neutrality but becoming slightly acidic during the short dry season, this may be due to the presence of humic acid released during the decomposition of plant debris. In the rainy season, runoff water would raise the pH, thus tending it towards neutrality. The humic substances are amphiphilic and bears carboxylic functions capable of liberating Hydrogen ions thus modifying pH. (Gueu Soumaho, 2019) [15].

The low value of electrical conductivity would be the consequence of low mineralization. To this end, (Amoros and Petts, 1993) [16] noted that in small watersheds, the specific electrical conductivity varies from 35 µS/cm to 1200 µS/cm which characterizes an absence of organic pollution. Furthermore, at the level of the various stations, the low values of nitrate and orthophosphate compared to the quality grid of the SEQ-Water of the decree of 25.I.03 (MEDD & Water Agency, 2003) [17], would be due on one hand to the assimilation of these compounds by the riparian vegetation, indeed, according to (Roland Kagan, 2017) [18], the riparian forests provides first degree of purification of phosphates and nitrates by absorbing these compounds at their roots.

Biological variables

Two orders, namely: Odonata and Hemiptera are the most represented, from the population of macroarthropods in the lep-liyè stream, dominated by the Libellulidae family. These results are similar to those of (Ngameni *et al*. 2017) [19] who also revealed that the orders of Odonata and Hemiptera were the most representative of the arthropod community in areas with little human activity. Also, the omnipresence of the order Odonata in small forest streams would be normal according to (Abdoulaye 2010) [20], Odonata have various modes of locomotion: they are climbers and live in aquatic vegetation; crawlers and live at the bottom of the water; burrowers and live in the sediments. In the same vein, he continues to say that certain Odonates are thermosensitive, that is to say that they live in very specific temperature ranges, and therefore are perfectly adapted to forest areas where the temperature varies very little. Two crustacean taxa have been recorded (Atyidae and Potaminidae) which is similar to the results of (Ajeagah *et al*. 2018) [21] who found 3 taxa (Atyidae, Paleamonidae and Potamonidae); this could be due to the fact that the two studies were conducted in the same type of ecosystem.

Also, life abounds during the rainy season which could be due to an abundance of nutrients in the environment during this period. This observation corroborates with the results of (Mbassi, 2020) [22] in the Lékié stream, who had also observed a spatio-temporal increase in terms of diversity and abundance of the arthropod group during the rainy season and according to (Ajeagah *et al*.2014) [23], a population of macro-invertebrates is more accentuated during the rainy season due to the mobilization of assimilable resources. Rainfall would have a positive impact on the abundance of MIB (Foto *et al*. 2010) [24].

Spatially, the fact that the macroarthropod community in the Lep1 station presents a large index of diversity upstream would be due to the multiple micro-habitats shaped by many plants present, and which constitute an ideal living environment for MIBs. Many arthropods nest on the emerged strata of seagrass or along the banks (Durand and Lévêque, 1981) [7]. The strong similarity between the Lep2 and Lep3 stations would be due to the proximity relationship less than 100 m while that observed between the distant stations Lep1 and Lep4 would be due to the similarity of the substrate of the two sites. Indeed, the coarse grain size observed in these last two stations, would be conducive to the development of certain arthropods and in particular the caddisflies that were captured in large numbers in these stations. The low density of arthropods in the Lep2 station would be justified by human activities which would be more accentuated in this area and would influence the development of certain families. Lep2 and Lep3 are near the village; then many activities such as washing cloths and dishes, bathing are daily practiced in this watershed. This result is similar to that obtained by (Dzavi, 2014) [25] in the Konglo stream. MIBs have variable sensitivities to different stresses such as pollution or habitat modification, (Moisan, 2006) [26].

Biocenotic indices

An increase in the specific richness (S) and the abundance of macroarthropods was observed during the LRS, this trend was also noted on the Shannon index (H'). The increase in the index (H') in the rainy season would be due to a development of organisms due to an overabundance of water in the environment, thus resulting in an even distribution of individuals during this period. On the other hand, the drop in this index recorded in the dry season would be due to the dominance of the Libellulidae family, which alone represents 20% of the population. The Shannon H' index takes on low values when a taxon supplants the entire community (Barbault, 2008) [27].

Conclusion

The regime of the Lep-liyè stream in the study area is that of small streams. The physico-chemical parameters revealed a neutral pH but which tends to become slightly acidic in the dry season, good oxygenation, a generally low temperature, greatly influenced by the forest. A low content of nitrogenous and phosphorus components. In this watercourse, macro-arthropods were more abundant during the long rainy season and the faunal community is predominated by the order Odonata and particularly by the family Libellulidae. The spatial variation of the diversity of macroarthropods would result more from: (1) bed structure coutse of dtrea anthropic activities than from abiotic factors of stream then then macroarthropods communities of Lep1 and Lep4 (same bed structure) are more similar and (2) anthropic activities than from other abiotic factors of the environment which undoubtedly induce temporal or seasonal variations.

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