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Structure of Odonata populations in the riparian strips of the Bumbu River watershed in Kinshasa /RD Congo

Edouard Mbungu Sisa [1, *], Jean-Claude Tshijik Kamb [1], Victor Kiamfu Pwema [2], Déogratias Hytis Mutambel [1] and Norbert Pata Mayala Bunda [1]

[1] *Hydrobiology Laboratory, National Pedagogical University (NPU) B.P. 8815 Kinshasa I, DRC.*

[2] *Limnology Laboratory, Hydrobiology and Aquaculture, Kinshasa University B.P. 190 Kinshasa XI. DRC.*

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Abstract

The study of the structure of the Odonata populations was undertaken during the dry season 2021, in the watershed of the Bumbu River. After capture with an entomological net, identification and enumeration, 393 individuals were collected and are divided into 2 suborders and 8 families. Several biotic indices were used to study the structure of the population on the one hand, and its diversity on the other. Raw abundance, relative frequency, taxonomic richness, Shannon and Weaver diversity, Jaccard's similarity index, Piélou's equitability and riparian strip quality index were calculated. The evaluation of the biotic indices in the different stations showed that there is a parallelism between them. The Libellulidae family was the most represented with 161 individuals or 40.9% of the total abundance and 15 species. It is followed by the families Lestidae with 97 individuals and 4 species, Coenagrionidae with 87 individuals and 5 species, , Corduliidae with 23 individuals and 3 species, Gomphidae with 15 individuals and 3 species, Platycnemidae with 9 individuals and 2 species, Chlorocyphidae with 6 individuals and 2 species and Calopterygidae with 1 individual and 1 species. The relative abundance of the species *Chalcpstephia flavifros, Ceriagrion corallinum, Lestes virgatus, Lestes ictericus* and *Lestes tridens* can be explained by the aquatic vegetation which serves them as perches and shelters.

Keywords: Bumbu; Inventory Systematic; Odonata; Abiotic Parameters

1. Introduction

Inland waters cover less than 1% of the Earth's surface and are home to 10% of known animal species, 60% of which are aquatic insects. This diversity now numbers nearly 100,000 described species [1]. This is probably an underestimate and, together with the taxonomic deficit, biased towards insects. [2] estimate that aquatic insects may well have more than 200,000 species and thus account for 80% of aquatic animal diversity.

Aquatic insects spend one or more stages of their life cycle in water, with the majority living in water as eggs and larvae and moving to terrestrial habitats as adults. They have important ecological roles in both the aquatic and terrestrial realms as primary consumers, scavengers, predators and pollinators. The ecology of many groups is well studied, due to their role as bioindicators or disease vectors, but freshwaters have been largely overlooked as a focus of diversification, despite their high contribution to global biodiversity [2]. According to [3] Mayhew (2007), very few examples of aquatic insects are considered when conducting an insect species inventory. Freshwater habitats are widely recognized as the most endangered on the planet, so the survey of aquatic insects is timely [4].

* Corresponding author: Edouard Mbungu Sisa

Hydrobiology Laboratory, National Pedagogical University (NPU) B.P. 8815 Kinshasa I, DRC

Of the many taxonomic groups supported by wetlands, odonata (dragonflies) are among the most threatened and most concerned with conservation issues [4, 5]. Indeed, a large number of specialists now consider that the disappearance or degradation of continental aquatic environments is the main cause of the rarefaction of odonata populations [5, 6]. Because of their fundamental ecological role in the trophic chains of aquatic and terrestrial ecosystems, dragonflies are recognized as an essential environmental link in the proper functioning of wetlands [7, 8]. They are, moreover, a currently highly prized indicator group, whose use of adults has expanded widely in recent decades for monitoring wetland quality [9, 10, 11].

The city of Kinshasa has a dense hydrographic network. It is built on the left bank of the Congo River over a length of 35 km (from Maluku to Kinsuka) [12]. Its hydrographic network is made up of the Congo River, tributary rivers and local rivers, the most important of which are the N'djili and the N'sele. Besides these, there are also the Gombe, Kinkusa, Lukunga, Bitshaku-Tshiaku, Kalamu, Lukaya, Mango, Tshwenge, Funa, Bumbu and Mangengenge rivers [13]. The waters of the latter, like those of all the other rivers that flow through the major African cities, are used for multiple purposes: These include watering of vegetable crops, bathing, washing, and they also receive domestic and industrial effluents. These multiple uses of water alter its quality and disturb the balance of the local biocenosis as well as the general functioning of the ecosystem [14, 15, 13].

However, the characterization of the Odonata populations of most of the rivers of the city-province of Kinshasa is still embryonic. Thus, this study is a contribution to the deepening of knowledge on the structure of the odonate populations of the watershed of the Bumbu River in Kinshasa in the Democratic Republic of Congo.

It aims to characterize the structure of the odonata biocenosis in the watersheds of this hydrosystem in order to understand the mode of distribution of these species and to explain the elements at the basis of its structuring. More specifically, it is a question of:

- to appreciate the quality of the riparian strips
- to note the influence of these strips on the taxonomic diversity of Odonates;
- to inventory the fauna of odonates that inhabit these watersheds and finally;
- to evaluate the diversity of these populations.

2. Study environment

The Bumbu River constitutes the main hydrosystem of the Selembao commune. It has its source at 015° 15' 59'' East longitude and 04° 26' 18'' South latitude at an altitude of about 345 meters and is about 11 km long. According to Schum's classification [16], it is of order 3 and flows into the Funa River in the commune of Kalamu [17].

Its watershed is located largely in the hill area of Kinshasa and according to Van Caillié [18], it sits top to bottom on the following geological formations:

- reworked sandy layer;
- more or less clayey sand (kaolinous) ;
- polymorphic sandstone ;
- soft white or pink sandstone;

Altered sandstone shale belonging to the INKISI series [19].

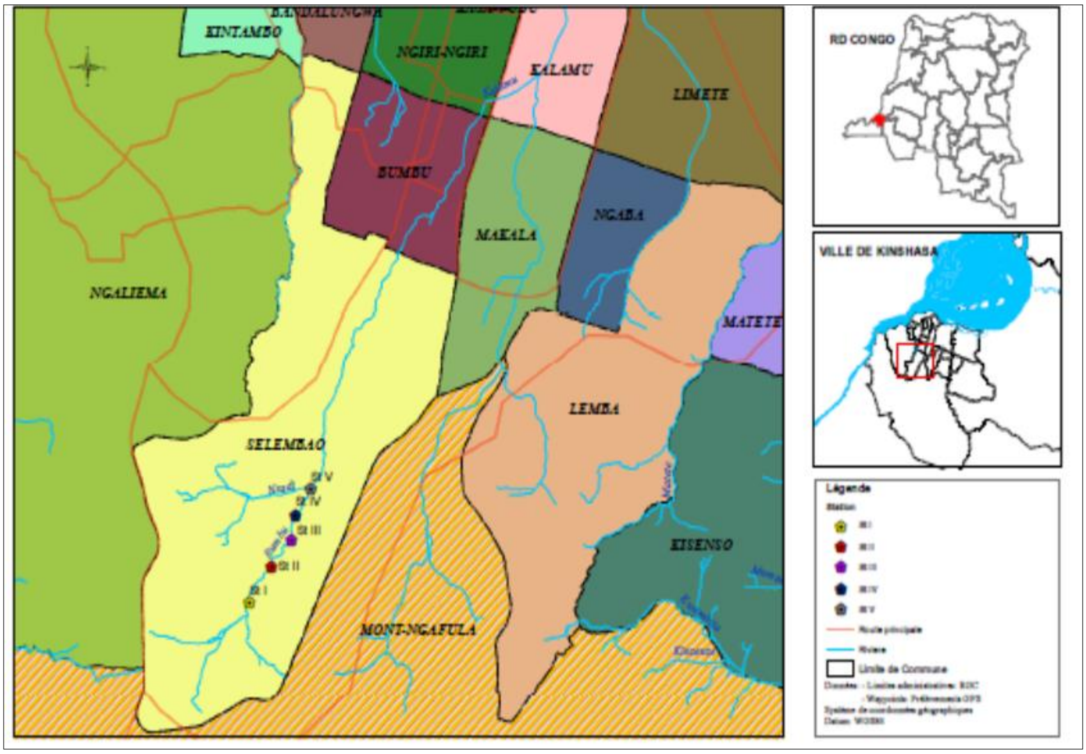

Figure 1 Location of sampling stations and the Bumbu River

3. Material and methods

3.1. Measurement of biological parameters

3.1.1. Riparian Quality Index (RQI)

Riparian strip quality is generally related to the biotic quality of a hydro system. The riparian buffer consisting primarily of vegetation is an intermediate zone between the terrestrial and aquatic environment [13](Kamb, 2018). The characterization and evaluation of its ecological condition allows a direct relationship between the habitat quality of the riparian ecosystem and that found in the rivers [20].

In the rivers studied, the five stations selected corresponded to the riparian strip sectors. Thus, an area of 100 m by 50 m was obtained on which the percentage of cover of each component was visually evaluated, the sum of cover having to equal 100%.

The data thus collected were combined to obtain information on the station [20].

For each station in the river, the Riverbank Quality Index (RQI) was calculated using the formula proposed by Jacques Cartier basin Corporation [21]:

$$RQI = \frac{[\sum(\%i.Pi]}{10}$$

With:

i: nth component;

%i: percentage of the station covered by the nth component;

Pi: weighting factor of the nth component (Appendix 3).

The different values of the Riparian Strip Quality Index (RSQI) were compared to the scale of the capacity of the riparian strip to perform its ecological functions [21]. Table 1 presents the riparian buffer rating scale.

Table 1 Riparian buffer capacity rating scale [21]

RQI	Capacity of the riparian buffer to perform its ecological functions
≤19	Very Low
19 à 46	Low
47 à 58	Medium
59 à 74	Good
75 à 100	Excellent

3.1.2. Sampling and conservation of Odonata

The multihabitat approach was adopted for collecting specimens at each study station. Two parallel strips of the watershed, were set in each station, one comprising the wetted bed of two banks and the other, the streamside vegetation [22, 23, 13].

Adult odonates were captured using a 40 cm diameter entomological net with a 1.5 meter long handle. The net consists of a circular frame to which a conical net made of soft fabric is attached [24].

On the two parallel strips of each station studied, two transects of 20 m by 100 m were traced. All the specimens present in the determined area were captured by precise and rapid movements of the net [25].

Captured specimens were preserved in acetone, with the wings gathered above their body, in stamp envelopes [26].

3.1.3. Identification

Collected specimens were identified using the determination keys proposed by [25, 27, 28, 29, 30, 31, 32, 33, 34]; under stereo-slice, and occasionally with a microscope at 10X objective for some specific details.

3.2. Data processing

The data referring to the structure of the Odonata populations of the Lukunga River were subjected to various statistical treatments. The method with simple variables was adopted due to the insufficient number of reference stations [13].

In addition to the different metrics inherent to the method with simple variables, the data on Odonata were correlated, on the one hand, to the presence of vegetation in the different rivers studied and, on the other hand, to different abiotic parameters. This correlation was carried out using Principal Component Analysis (PCA) [13]. These are:

- Species richness (S) : this is a simple count of the number of species present in the sample ;
- Simpson's index (1-D): this index corresponds to the probability that two individuals drawn at random belong to the same category (species). When diversity is maximum, its value is 0, when diversity is minimum it is 1, which sometimes hinders its interpretation. It is an index independent of a distribution. To obtain more intuitive values, the diversity index represented by 1-D is used, with the maximum diversity represented by the value 1 and the minimum by zero. The index gives more weight to abundant species than to rare species. It is given by the expression:

$$\boldsymbol{D} = \sum_{i=1}^{k} \frac{\mathbf{1}}{\boldsymbol{pi}^2}$$

(Pi): proportion of the total number of individuals. This expression poses a problem in terms of the weight of abundant species, which may be difficult to collect. Hence the use of the following formula: $\boldsymbol{D = 1 - \sum_{i=1}^{s} Pi^2}$ [35].

- Shannon index (H') According to [36], this index is used in ecology to measure specific diversity. It is expressed by the following formula: $\boldsymbol{H'} = -\sum_{i=1}^{S}\left(\frac{ni}{N}\right)\ln\left(\frac{ni}{N}\right)$

Where: (S) is the total number of species present; (ni) the number of species i in the sample and (N) the total number of species.

H' varies between 0 (in the case where the stand consists of only one species) and H' maximum (H'max = $\log_2$.S) in the case where all the species present are present with equivalent abundance.

- Equitability index (R) : this index measures the equilibrium (or regularity) or evenness of the species in the stand in relation to a theoretical equal distribution for all species [37]: R = H'/Hmax
- R varies between 0 (one species dominates) and 1 (all species have the same abundance). The different indices were calculated globally by considering all the data taken together.
- JACCARD similarity index (J): this was used to measure the degree of similarity between stands. Its formula is:

$$\boldsymbol{J} = \frac{Nc}{Nx+Ny-Nc}$$

With : Nc: number of taxa common to both stations; Nx and Ny: number of taxa present at stations x and y respectively. The JACCARD similarity index varies from 0 to 1.

Principal Component Analysis (PCA): is a multifactorial analysis widely used in the processing of ecological data. It allows a simplified expression of the information contained in a multivariate table from a reduced number of variables [38]. In this work, Principal Component Analysis was performed in order to establish a classification of the sampling stations according to their physical and chemical quality and biotic variables. All data were first normalised (LOG (X+1)) and then centred and reduced; the aim of the normalisation being to transform the distribution of the raw data into a normal distribution. The transformed data are centred reduced to standardise the different environmental factors that are not expressed in the same order of magnitude [13]. The software PaSt : Paleontological Statistics version 2.16 [39, 40, 41, 42, 43] was used to determine the correlation between abiotic and biotic variables. For the interpretation of the axes, variables whose contribution is exclusively higher than the mean contribution ($> 1/\sqrt{p}$), where p is the number of variables) were retained [44].

4. Results

4.1. Evaluation of the Riverine Quality Index (RQI)

Table 2 Quality Index of the Bumbu River riparian zone in the dry season in 2021

Stations	Riparian buffer components (%)								IBRQ	Riparian capacity
	Forest	Shrub	Grass	Crop	Wasteland Lawn	Bare soil	Bedrock	Infr		
St I	0	5	40	50	0	5	0	0	37.6	Low
St II	0	0	70	30	0	0	0	0	46.3	Low
St III	0	0	70	30	0	0	0	0	46.3	Low
St IV	0	0	40	40	0	0	0	20	34.6	Low
St V	0	0	45	45	10	0	0	0	37.6	Low

Table 2 informs that in the dry season, the riparian strip is characterized by natural grasses that occupied proportions of 70% at the St II and St III stations, 45 at St V and 40% at St I and St IV; crops took proportions ranging from 50% at the St I station, 30% at St II and III, 40% at St IV and 45 at St V. Infrastructure occupied only 20% of the riparian buffer at the St 4 station. The capacity of this strip to perform its ecological functions is low from top to bottom. The highest riparian capacity index was recorded at the St III stations (RBQ=46.3) and the lowest at the St IV station which had an RBQ=34.6.

4.2. Population distribution of odonata in the Bumbu River in the 2021 dry season

Table 3 Station distribution of odonata in the Bumbu River in the 2021 dry season

Family	Spece	St I		St II		St III		St IV		St V		N'
		ni	ni/N	ni	ni/N	ni	ni/N	ni	ni/N	ni	ni/N	
Chlorocyphidae	*Chlorocypha aphrodite*	1	0.019	2	0.013	0	0	0	0	0	0	3
	Stenocypha tenuis	0	0	1	0.006	2	0.018	0	0	0	0	3
Calopterygidae	*Umma saphirina*	0	0	1	0.006	0	0	0	0	0	0	1
Platycnemidae	*Allocnemis mitwabae*	0	0	2	0.013	1	0.009	0	0	0	0	3
	Mesocnemissingularis	0	0	0	0	6	0.054	0	0	0	0	6
Coenagrionidae	*Ceriagrion glabrum*	7	0.135	5	0.032	5	0.045	0	0	3	0.083	20
	Ceriagrion suaves	0	0	0	0	5	0.045	0	0	6	0.167	11
	Ceriagrion corallinum	11	0.212	20	0.129	10	0.089	0	0	6	0.167	47
	Mesocnemissingularis	0	0	0	0	6	0.054	0	0	0	0	6
	Pseudagrion isidromorai	2	0.038	1	0.006	0	0	0	0	0	0	3
Lestidae	*Lestes virgatus*	10	0.192	18	0.116	8	0.071	0	0	0	0	36
	Lestes tridens	6	0.115	8	0.052	9	0.08	3	0.079	1	0.028	27
	Lestes dissimulans	0	0	1	0.006	0	0	0	0	0	0	1
	Lestes ictericus	0	0	20	0.129	9	0.08	2	0.053	2	0.056	33
Cordiliidae	*Cordulia aenea*	1	0.019	4	0.026	2	0.018	4	0.105	0	0	11
	Epathica bimaculata	2	0.038	1	0.006	0	0	0	0	0	0	3
	Cordulegaster baltonii	0	0	1	0.006	0	0	8	0.211	0	0	9
Libellulidae	*Palpoleura lucia*	2	0.038	0	0	0	0	1	0.026	0	0	3
	Palpoleura portia	0	0	4	0.026	3	0.027	1	0.026	0	0	8
	Orthetrum africanum	0	0	1	0.006	1	0.009	0	0	0	0	2
	Orthetrum austeni	0	0	6	0.039	4	0.036	0	0	0	0	10
	Orthetrum abbotti	0	0	2	0.013	2	0.018	0	0	1	0.028	5
	Orthetrum camerunense	1	0.019	3	0.019	1	0.009	2	0.053	2	0.056	9
	Orthestrum vulgatum	0	0	0	0	4	0.036	0	0	0	0	4
	Orthestrum danae	0	0	7	0.045	2	0.018	0	0	0	0	9
	Acisoma trifidum	0	0	1	0.006	2	0.018	3	0.079	0	0	6
	Chalcostephia flavifrons	8	0.154	14	0.09	16	0.143	11	0.289	8	0.222	57
	Hemistigma albipunctum	1	0.019	7	0.045	3	0.027	0	0	3	0.083	14
	Acisoma inflatum	0	0	3	0.019	3	0.027	0	0	0	0	6
	Tetrathemis polleni	0	0	10	0.065	5	0.045	2	0.053	4	0.111	21
	Libellula quadrimaculata	0	0	2	0.013	2	0.018	1	0.026	0	0	5
	Crocothemis erythraea	0	0	2	0.013	0	0	0	0	0	0	2
Gomphidae	*Ceratogomphus pictus*	0	0	1	0.006	3	0.027	0	0	0	0	4

	Cornigomphus mariannae	0	0	2	0.013	0	0	0	0	0	0	2
	Gomphidia bredoi	0	0	5	0.032	4	0.036	0	0	0	0	9
N		52		155		112		38		36		393
S		12		30		25		11		10		
H		2.13		2.92		2.96		2.08		2.11		
J’		0.86		0.86		0.92		0.87		0.92		

Legend

ni: Number of individuals per species; N': Sum of ni within a species in the 5 stations; N: Number of individuals per station; ni/N: Relative abundance per station; S: Number of taxa per station; H': Shannon-Weaver diversity index per station; J': Piélou equitability index per station

4.2.1. Specific richness S

The station St II contained the greatest number of species (30), followed by the station St III (25), followed by the station St I (12), and followed by the station St IV (11) and finally the station St V with (10).

4.2.2. Gross abundance and relative abundance

Table 3 informs that three hundred and eighty-six (392) individuals were caught in the Bumbu River.

The St II station recorded a higher gross abundance than the others, with 155 individuals. This was followed by the St III station with 112 individuals, then the St I station with 52 individuals, then the St IV station with 38 individuals, and finally the St V station with 36 individuals of all the Odonata collected in the Bumbu River during the rainy season.

At the St I station, the species *C. corallinum* was the most abundant with 21.2% of individuals collected. It was followed by the species, *L. virgatus* (19.2, %), *C. flavifrons* (15 .4%), *C. glabrum* (with 13.5%), *L tridens* (with 11.5%), the three species have respectively 3. 8 *E. bimaculuta* (3.8%), *P. lucia* with (3.8 %) and *P. isidromorai* the four with 1.9 % each, *C. aphrodite*, *C. aenea, O . camerunense* and *H. albipunctum*.

At the station St II the peak of collected individuals was observed in the species *L. ictericus* and *C. corallinum* with 12.9% each on the sum of specimens that were collected there. And then come L. tridens (with (5.2%), *H. albipunctum* (with 4.5%), then *O. austeni* (with 3.9%) and The species have respectively *C. glabrum* and *G. bredoi* with 3.2 then The species *C. aenea* and *P. portia* have each (2, 6%). The following species *O. cameruneuse* and *A. inflatum* have each (1,9%) then The following species have, *C. Aphrodite, A .mitwabe, O . abbotti, L. quadrimaculuta, C . erythraea* and *C. mariannae* have respectively (1,3) and finally *S. tenuis*, *U saphirina*, *P isidromarai*, *L. dissimulans, E. bimiculata, C. baltonii, O. africanum, A. trifidum and C . pictus* have respectively (with 0,6%).

The species *C. flavifrons* recorded a large number of individuals collected at the St III station, representing 14.3% of the total specimens caught there. Followed by *C. corallinum* (with 8.9%), then the species *L. tridens* and *L. ictericus* (with 8%), followed by *L. virgatus* with (7.1) and *Mesocnemis singularis* with (5.4). The species *C. glabrum*, *C. suaves* and *T. polleni* with 4.5% The species *O. austeni*, *G. bredoi* and *S. vulgatum* have each, (3.6) the species *P. Portia*, *H. albipunctum, C. pictus and A. inflatum* have each 2 .7 % The species *S. tenuis*, *C. Aenea*, *O. abbotti*, *A. trifidum* and *L. quadrimaculta* have each (1 .8 %) Finally the species *A. mitwabe*, *O. africanum*, *O. cameruneuse* have each (0 .9 %).

The St IV station is characterized by a high relative abundance of the species *C. flavifrons* (with 28.9%) followed by the species C. baltonii (with 21.1%) of individuals collected. These species were followed by the species *C. aenae* with 10.5%; the species *L. tridens*, and *A. trifidum* had each (7.9%) then the species *L. ictericus, O. cameruneuse* and *T. polleni* had each (5.3%) finally the species *P. lucia*, *P.portia* and *L. quadrimaculata* had each 2.6% of the harvest.

The species *C. flavifrons* was the most represented at the St V station with 22.2%. It was followed by the species *C. suaves* and *C. corallinum* (with 16.7%) then *T. polleni* with (11.1%) then the species *C. glabrum* and *H. albipunctum* with (8.3%) followed by the species *L. ictericus* and *O. camerunensis* with (5.6%) and finally the species *L. tridens,* and *O. abbotti* have each (5.6%).

The enumeration of individuals collected in all the study stations of the Bumbu River during the rainy season, revealed that the species *L. virgatus* is the most abundant with 16.57% of the total specimens collected. It is followed by *C. coralinum* (15.48%), *L. tridens* (14.67%), *C. glabrum* (7.06%), *C. baltonii* (with 5.7%), *S. donea* (with 5.16%), *L. depressa* (4.89%), *L. uncifer* (4.61%), C. anea (3.8%), *C. suave* (3.53%), *S. metridionale* (3.53%), *O. bruneum* (2.98%), *L. quadrimacilata*, *M. singularis*, *O. concelatum* and *S. vulgatum* with 2.71% each, *C. erythrea* (2.17%), *H. africana* (1.35%), *E. bimacilata* (1.35%) and *S. sanguneum* (1.08%).

4.2.3. Taxonomic diversity

The stationary study of the biodiversity of Bumbu in dry season, informed that St III (H'=2.96) is more diversified than St II (H'=2.92), St I (H'=2.13), St V (H'=2.11) and St V (H'=2.08).

4.2.4. Equitability of Piélou

Analysis of the equilibrium in the distribution of Odonata within the stands present at the different stations, indicated that at the St III and St V stations (J'=0.92) individuals are better distributed than at the St IV (J'=0.87) and St I and St II (J'=0.86) stations.

4.3. Correlations between odonates and riparian buffer components

Figure 2 shows that the first 2 principal components (axis 1 and 2) were retained since they are responsible for 80.38% of the total variance; axis 1 explained 67.79% of the dispersion of the variables and axis two 12.59%.

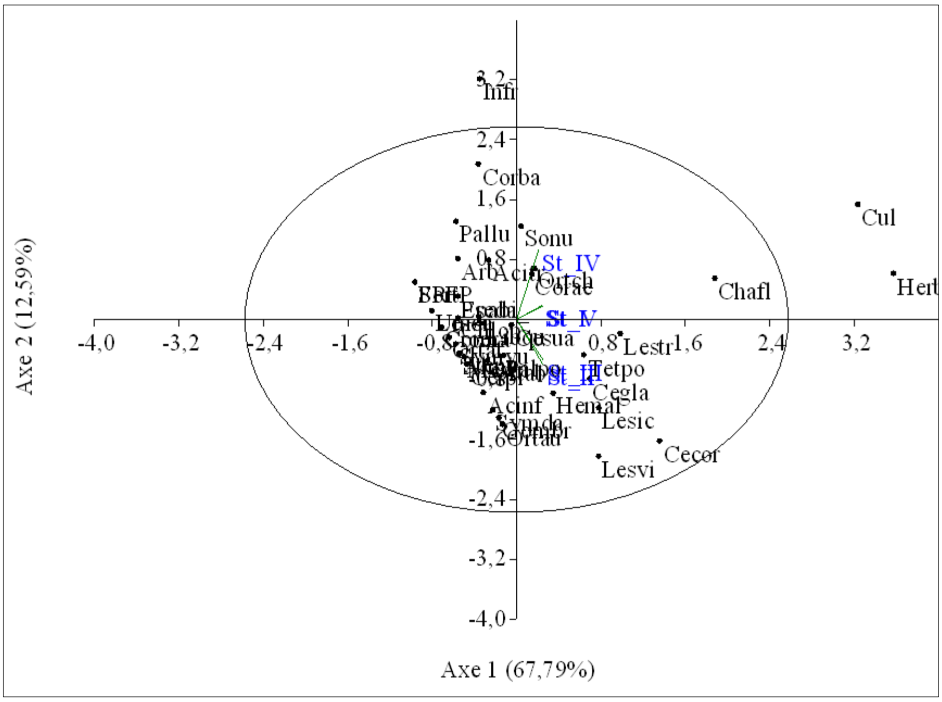

Figure 2 Correlations between odonata and riparian zone components in the Bumbu River in the 2021 dry season

Axis 1 presented was constructed by the natural grass (r=6.577), crop (5.9548) and bare soil (r=0.07631) components and *C. glabrum* (r=1.2726), *C. corallinum* (r=2.4923), *L. virgatum* (r=1.4299), *L. tridens* (r=1.8056), *L. ictericus* (r=1.4306), *C. flavifrons* (r=3.4571), *T. polleni* (r=1.169).

Regarding the affinity between odonata species and the components of the riparian strip, on the one hand, the following species: *C. glabrum, C. corallinum, L. virgatum, L. tridens, L. ictericus, C. aenea, O. camerunense , H. africana, C. flavifrons, T. polleni* showed positive correlations with the following components: natural herbaceous, cultivation, and bare soil, and on the other hand, they were negatively correlated with the following components: forest, shrub land, wasteland, rocky outcrop, and infrastructure.

Negative correlations were observed between the following riparian buffer components: natural grasses, crops and bare soil with the following odonate species: *C. aphrodite, S. tenuis, U. saphirina, A. mitwabae, C. suave, M. singularis, P.*

isidromorai, L. dissimulans, E. bimaculata, C. baltonii, P. lucia, P. portia, O. africanum, O. austeni, O. abbotti, S. vulgatum, S. danae, A. trifidum, A. inflatum, L. quadramaculata, C. erythraea, C. pictus, C. mariannae and *G. pupillata*.

In contrast, the above species showed affinities with the following riparian components: forest, shrub land, wasteland, ratchet base and infrastructure.

5. Discussion

In the Bumbu River, the relative abundance of *Chalcpstephia flavifrons, Ceriagrion corallinum, Lestes virgatus, Lestes ictericus, Lestes tridens* is explained by the aquatic vegetation that serves as their perches and shelters. The more varied this vegetation is, the more it will be able to satisfy the needs of resting or refuge areas, feeding, monitoring or mating [45].

As for low abundances of the species *Chlorocypha afrodite, Stenocypha molindica, Elatoneura lliba, orthetrum gunneense, Orthetrum julia, Orthetrum austeni, Orthetrum stemmale, Zygonoides occidentis, Hemistigma albipunctum, Phyllogomphus selysi, Epathica bimaculata and Helineschna cynthiae* and *Hadrothermis defecta* is explained by the conditions created by the abundance of crops and natural grasses. This is supported by [45, 46] who state that aquatic or bank vegetation is the place of egg maturation. After hatching, aquatic plants provide support and shelter for larvae in all their developmental stages and thus are a defining component of larval habitat. Larvae also need to find sufficient prey in their immediate environment to ensure their full growth.

The low gross abundance of odonata in this study period in this hydrosystem is justified by unfavorable conditions (habitat diversity and sunshine) less offered in season make that the Odonatofauna does not prosper enough. These conditions could be at the origin of the hatching of individuals of other zoological groups that could serve as prey to these Odonata. This is supported by [45] who explain that Odonata are sensitive to sunlight and are ectothermic. With the return of sunny weather, access to light promotes rapid warming of the water body and associated environments within which these individuals evolve, promoting their return to activity.

The average values of the Shannon-Weaver index obtained in the Bumbu River watershed during the dry season indicate that the watershed is highly diversified [47]. This could be explained by the fact that the different parameters vary between the main types of habitats, but also in a finer way locally: they define in the same environment various "microhabitats". These are essential to maintain a significant Odonatological diversity: a heterogeneous environment allows many species (with different requirements) to find the conditions that are favorable to them [45].

The average values of Piélou's equitability index calculated for the same river show an equitability close to 1. This justifies a balance between taxa in this hydrosystem [48]. This is explained by the fact that wetlands, combining aquatic environment and gradient of terrestrial vegetation more or less hygrophilic, offer to dragonflies all the elements allowing them to ensure their entire life cycle [48].

Negative correlations were observed between the majority of species captured in the watershed and the crop, wasteland and infrastructure components. This is affirmed by [45], who stipulate that the landscape context in which wetlands are located therefore influences Odonata assemblages and may also condition the ecological parameters of aquatic environments such as water physicochemistry and shading.

The calculation of Jaccard's similarity index based on the taxa collected in the five stations during the study period revealed the similarity values between the stations St II and St III as well as St I and St V. The difference of similarities between these stations is explained by the degree of occupation of their riparian strips and to the morphological characteristics of the aquatic environment (surface, depth, profile of the banks, substrate of the bottom...). Because they influence the hydraulic functioning (current velocity) and the development of vegetation [49, 13].

6. Conclusion

The study of the structure of Odonata populations on the one hand and their diversity on the other hand the Bumbu watershed has shown that the latter presents favorable environments for Odonata where these insects can settle and develop despite the anthropic pressure that this hydrosystem knows.

The quality of the odonata individuals collected in this river is explained by the characteristics of its environment, by the nature of the aquatic vegetation that colonizes its bed and by the diversity of microhabitats.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

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