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Inventory and distribution of macroinvertebrates associated with invasive aquatic vegetation in the Baya River (Northeastern Côte d'Ivoire)

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Abstract

The bed of the Baya River is currently overrun with large clumps of invasive aquatic plants. These invasive plants provide ideal refuges for aquatic macroinvertebrates, which serve as food for many fish and amphibians. The overall objective of this study was therefore to improve our understanding of the influence of these invasive aquatic plants on the macroinvertebrate community of the Baya River. To collect macroinvertebrates, a 1 mm mesh vacuum net was passed through the water column beneath each of the five different types of aquatic plant communities. A correspondence factor analysis was performed to highlight the affinity of macroinvertebrates for the different types of aquatic vegetation. A total of 1115 aquatic macroinvertebrate individuals were captured. These individuals were classified into 2 classes, 6 orders, and 18 families. In terms of taxonomic abundance, the class Insecta is the most represented, with 1030 individuals distributed across 16 families, the most abundant of which is the Chaoboridae, with 236 individuals. The *Ludwigia palustris* community the largest number of macroinvertebrates, with 273 individuals. Analysis of the factorial plan revealed four groups of macroinvertebrate families, each with a preference for different plant communities as their preferred habitat. Given the important ecological role of invasive plants as habitat for macroinvertebrates, it is necessary to control the spread of these invasive plants to maintain good aquatic biodiversity in the Baya River.

Keywords: Macrophytes; Invasive aquatic plants; Water body; Aquatic invertebrates; Baya River

1. Introduction

The proliferation of invasive aquatic plants resulting from various forms of water pollution is a key indicator of eutrophication and reflects the poor ecological condition of waterways [1]. Several studies have demonstrated that invasive macrophytes such as *Eichhornia crassipes*, *Potamogeton pectinatus*, and *Nymphaea lotus* proliferate when the environment is excessively enriched with nutrients [2]. Consequently, these invasive aquatic plants represent a significant threat to aquatic biodiversity [3]. Furthermore, clumps of invasive aquatic plants that cover the surface of waterways hinder navigation, thereby impacting fishing activities [4]. However, in addition to the harm caused by invasive aquatic plants to aquatic environments, these plants provide vital shelter for many species of macroinvertebrates [5]. This aquatic fauna plays a major role in the food web of an aquatic ecosystem [6]. In fact, aquatic macroinvertebrates serve as food for many fish, amphibians, and birds [7]. In the field of aquatic system quality assessment, it has been demonstrated that macroinvertebrates are the most widely used bioindicators for biomonitoring and tracking the overall health of water bodies [8].

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In northeastern Côte d'Ivoire, on the outskirts of the town of Koun-fao, flows the Baya River, a tributary of the Comoé River. This waterway, whose riparian forest has largely been converted into farmland, is currently facing a severe invasion of its water surface by invasive aquatic plants. These plants hinder navigation and constitute an obstacle to fishing in the Baya River. Given the harmful effects of invasive plants on water bodies and their role as habitat for aquatic macroinvertebrates, it is necessary to take appropriate measures for a more efficient and rational control of invasive aquatic plants in the Baya River. Consequently, improved management cannot be achieved without knowledge of the macroinvertebrates associated with the aquatic vegetation proliferating on the water's surface. Furthermore, it should be noted that no study on aquatic macroinvertebrates has been conducted on the Baya River. In order to address these gaps by providing the first data on aquatic macroinvertebrates in the Baya River, we will attempt to answer the following main question: What is the effect of the proliferation of invasive aquatic plants on the diversity and distribution of macroinvertebrates in the Baya River? Indeed, the primary objective of this study is to improve our understanding of the influence of invasive aquatic plants on the macroinvertebrate community of the Baya River. Specifically, the objectives are: (1) to determine the taxonomic richness and abundance of macroinvertebrates associated with the various aquatic plant communities colonizing the Baya River, and (2) to characterize the distribution of these macroinvertebrates in relation to invasive aquatic plant species.

2. Methodology

2.1. Study area

The Baya River flows through the subprefecture of Koun-fao, located in northeastern Côte d'Ivoire in the Gontougo region. The Baya River flows specifically near the town of Koun-fao, making it an integral part of the river's watershed (Figure 1). In the region, the rainy season generally extends from June to October with heavy rainfall, particularly intense between June and September, while the dry season lasts from November to May, characterized by a sharp decrease in precipitation [9]. Due to human activities, part of the riparian vegetation along the waterways has been replaced by agricultural crops and plantations, notably cashews, cocoa, and coffee, which are major cash crops in the region [10].

2.2. Data Collection

Five different types of aquatic plant communities from which macroinvertebrates were collected were selected based on the type and abundance of characteristic macrophyte species. These are: (1) the *Commelina diffusa* community, which is a community dominated by a single species of helophyte; (2) the *Ludwigia palustris* community, which is also a community dominated by a specific helophyte species; (3) the *Pistia stratiotes* community, which is

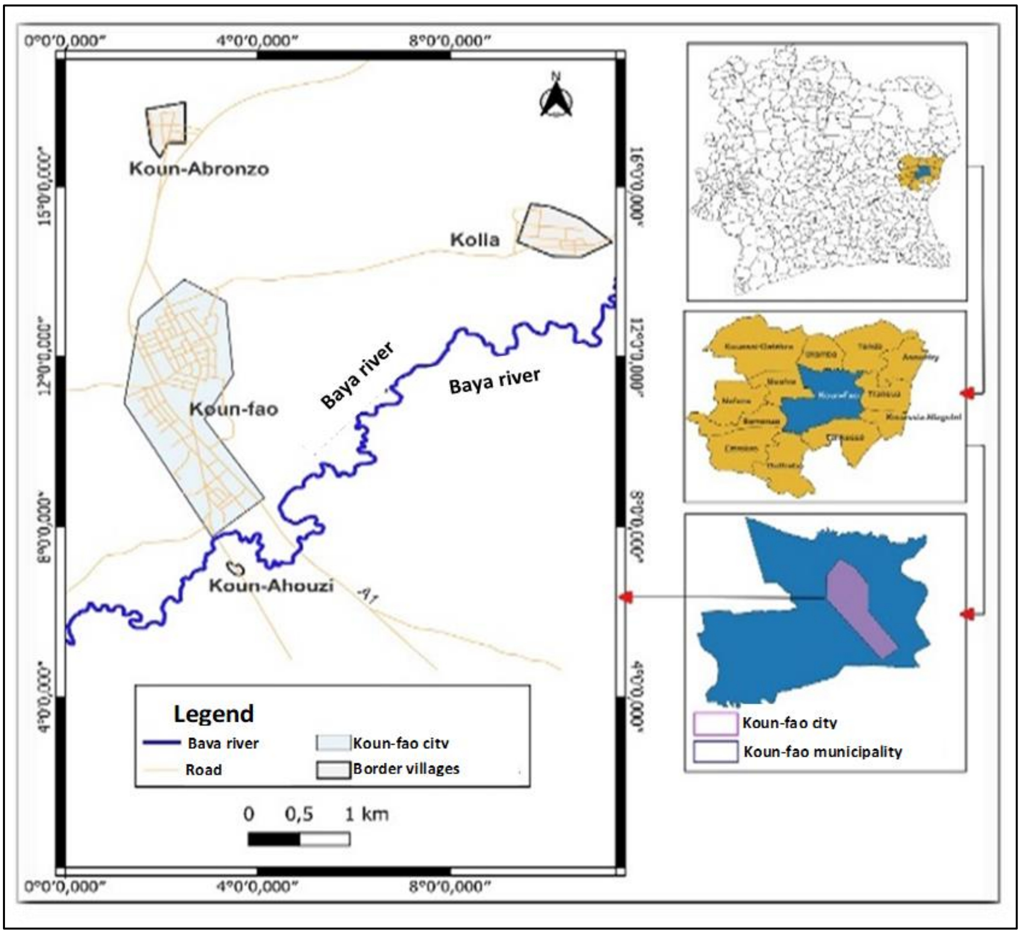

Figure 1 Geographical location of Baya river

community dominated by a specific strict hydrophytic species that floats freely on the surface; (4) the mixed community of *Ludwigia palustris* and *Pistia stratiotes*, which is a community dominated by two species, respectively of the helophyte type and the strict hydrophytic type floating freely on the surface; and (5) the mixed *Ceratophyllum demersum* and *Lemna aequinoctialis* community, which is a community consisting of a strictly hydrophytic species floating submerged and a strictly hydrophytic species floating freely on the surface. Macroinvertebrate sampling involved submerging and dragging a 1 mm mesh vacuum sieve through the water column against the current over a distance of 2 meters beneath each type of aquatic vegetation. This sieving operation was performed 10 times. For each type of aquatic vegetation, sampling was conducted at three different points spaced at least 5 m apart to capture a wide diversity of taxa [11]. The contents of the sieve were then transferred to labeled jars and preserved in 10% formaldehyde. In the laboratory, macroinvertebrate specimens were sorted and then identified to the family level under a binocular magnifying glass using the identification keys of [12] and [13].

2.3. Data Analysis

In this study, three diversity parameters were determined: (1) taxonomic richness represents the number of taxa present in a given ecosystem; (2) taxonomic abundance defines the number of individuals of a species or taxonomic group in a given sample; (3) Frequency of occurrence (% F) is the ratio of the number of samples in which an organism *i* was found to the total number of samples. Its formula is as follows: $\% F = \frac{Pi}{Pt} \times 100$

Pi = number of samples containing taxon (i) and *Pt* = total number of samples collected. According to [14], three groups of taxa are defined based on the value of F: very frequent taxa (F ≥ 50%), frequent taxa (25% ≤ F < 50%), and rare taxa (0% ≤ F < 25%).

2.4. Statistical data processing

In this study, correspondence analysis (CA), an ordination method, was used to visualize, on a factor map, the affinity of macroinvertebrates for different types of aquatic vegetation. This multivariate analysis was performed using R software version 3.4.2.

3. Results

3.1. Taxonomic diversity and abundance of the macroinvertebrate community associated with the aquatic vegetation of the Baya River

A total of 1,115 macroinvertebrates were collected from all sampling sites. These individuals were classified into 2 classes, 6 orders, and 18 families. The class of insects was the most represented with 1,030 individuals, or 92.4%, while the class of gastropods contained 85 individuals, or 7.6%. Within the class of insects, the most abundant orders are: Odonata with 251 individuals distributed across 2 families, Diptera with 241 individuals distributed across 2 families, and Coleoptera with 217 individuals distributed across 5 families. This class of insects is represented by 16 families, among which the most significant in terms of numerical percentage are: The Chaoboridae with 236 individuals, or 21.2%; the Cordulegasteridae with 180 individuals (16.1%); and the Naucoridae with 120 individuals (10.8%) (Table 1). The least numerous families are the Dyptidae with 2 individuals (0.2%), and the Haliplidae, Héleidae, and Nepidae with 4 individuals each, or 0.4%. The distribution among aquatic plant communities shows that the *Ludwigia palustris* community contains the largest number of individuals, with 273 individuals (24.5%). This community provides the most shelter for the Coenagrionidae family, with 55 individuals (20.1%) belonging to the order Odonata. Next, the mixed community of *Ludwigia palustris* and *Pistia stratiotes* is the most abundant with 265 individuals (23.8%), primarily harboring the Chaoboridae family with 62 individuals (23.4%). The mixed community of *Ceratophyllum demersum* and *Lemna aequinoctialis* ranks third with 231 individuals (20.7%), also predominantly hosting the Chaoboridae family with 54 individuals (23.4%), followed by the *Pistia stratiotes* vegetation community with 201 individuals (18%), under which the Cordulegasteridae are the most represented with 84 individuals (41.8%), and finally the *Commelina diffusa* community with 145 individuals (13%), where the Chaoboridae family is also the most abundant with 78 individuals (53.8%) (Table 1). In terms of taxonomic richness, the *Ludwigia palustris* community is the richest, with 14 families of macroinvertebrates, followed by the *Pistia stratiotes* community, the mixed community of *Ludwigia palustris* and *Pistia stratiotes*, and the mixed community of *Ceratophyllum demersum* and *Lemna aequinoctialis*, each with 11 families, and finally the *Commelina diffusa* community with 10 families. Seven (7) families are common to all 5 plant communities. These are the Chaoboridae, Coccinellidae, Cordulegasteridae, Gyrinidae, Naucoridae, Physidae, and Planorbidae.

Table 1 Abundance and percentage of macroinvertebrate families in the 5 types of aquatic plant communities

Orders	**Families**	**Plant communities**											
		Co-di	**%**	**Lu-pa**	**%**	**Pi-st**	**%**	**Lu-pa/ Pi-st**	**%**	**Ce-de/ Le-ae**	**%**	**Total Abundance**	**%**
Bsommatophora	*Physidae*	7	4.8	12	4.4	7	3.5	14	5.3	1	0.4	41	3.7
	Planorbidae	1	0.7	11	4.0	5	2.5	12	4.5	12	5.2	41	3.7
Coléoptères	*Coccinellidae*	4	2.8	18	6.6	12	6.0	16	6.0	8	3.5	58	5.2
	Diptidae	2	1.4	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2
	Gyrinidae	4	2.8	54	19.8	14	7.0	9	3.4	17	7.4	98	8.8
	Halipiidae	0	0.0	9	3.3	0	0.0	46	17.4	0	0.0	55	4.9
	Haliplidae	0	0.0	4	1.5	0	0.0	0	0.0	0	0.0	4	0.4
Diptères	*Chaoboridae*	78	53.8	12	4.4	30	14.9	62	23.4	54	23.4	236	21.2
	Heleidae	0	0.0	5	1.8	0	0.0	0	0.0	0	0.0	5	0.4
Ephemeroptères	*Ameletidae*	0	0.0	26	9.5	20	10.0	0	0.0	39	16.9	85	7.6
	Caenidae	4	2.8	0	0.0	0	0.0	0	0.0	5	2.2	9	0.8

	Leptophlebiidae	0	0.0	0	0.0	1	0.5	20	7.5	0	0.0	21	1.9
Hétéroptères	*Naucoridae*	21	14.5	6	2.2	23	11.4	20	7.5	50	21.6	120	10.8
	Nepidae	0	0.0	0	0.0	4	2.0	0	0.0	0	0.0	4	0.4
	Notonectidae	5	3.4	34	12.5	0	0.0	13	4.9	14	6.1	66	5.9
	Pleidae	0	0.0	8	2.9	0	0.0	0	0.0	11	4.8	19	1.7
Odonates	*Coenagrionidae*	0	0.0	55	20.1	1	0.5	15	5.7	0	0.0	71	6.4
	Cordulegasteridae	19	13.1	19	7.0	84	41.8	38	14.3	20	8.7	180	16.1
	Total abundance	145	13.0	273	24.5	201	18.0	265	23.8	231	20.7	1115	100

Legend: Lu-pa = *Ludwigia palustris* ; Pi-st = *Pistia stratiotes* ; Co-di = *Commelina diffusa* ; Le-ae = *Lemna aequinoctialis* ; Ce-de = *Ceratophyllum demersum*

3.2. Frequency of occurrence

Table 2 indicates that the 18 macroinvertebrate families identified across all aquatic plant communities are divided into 3 groups, of which 8 families are very frequent with (F≥ 50%), 6 families are frequent with (25% ≤F <50%) and 4 families are rare in the samples with (0% ≤F <25%).

Table 2 Frequency of occurrence of different families of macroinvertebrates

Families	**Frequency**
Ameletidae	++
Caenidae	++
Chaoboridae	+++
Coccinellidae	+++
Coenagrionidae	++
Cordulegasteridae	+++
Diptidae	+
Gyrinidae	+++
Halipiidae	++
Haliplidae	+
Heleidae	+
Leptophlebiidae	++
Naucoridae	+++
Nepidae	+
Notonectidae	+++
Physidae	+++
Planorbidae	+++
Pleidae	++

Legend: Very frequent taxa (+++) ; Fréquent taxa (++) ; Rare taxa (+)

3.3. Distribution of macroinvertebrates based on their affinity for different types of aquatic plant communities

Using correspondence analysis (CA), the affinity of macroinvertebrate families for different plant communities was demonstrated. The Chi-square (χ^2) test of independence indicates that

the relationship between plant community type and macroinvertebrate families is significant (χ^2 = 827.2; P < 0.001). In the factor plot, 71.5% of the variance in the relationships between the variables is explained by the first two axes, 1 and 2. Examination of the factor plan reveals four groups: Group G1 is described in the positive plane of axis 1. This group consists of the families Dyptidae and Chaoboridae, which are associated with the helophytic vegetation dominated by *Commelina diffusa* as their preferred habitat (Figure 2). Group G2, described in the negative plane of axis 1, is represented by the Gyrinidae, Notonectidae, Heleidae, and Haliplidae. These families prefer helophytic vegetation dominated by Ludwigia palustris. Group G3 is characterized on the positive plane of axis 2. It includes the families Naucoridae, Nepidae,

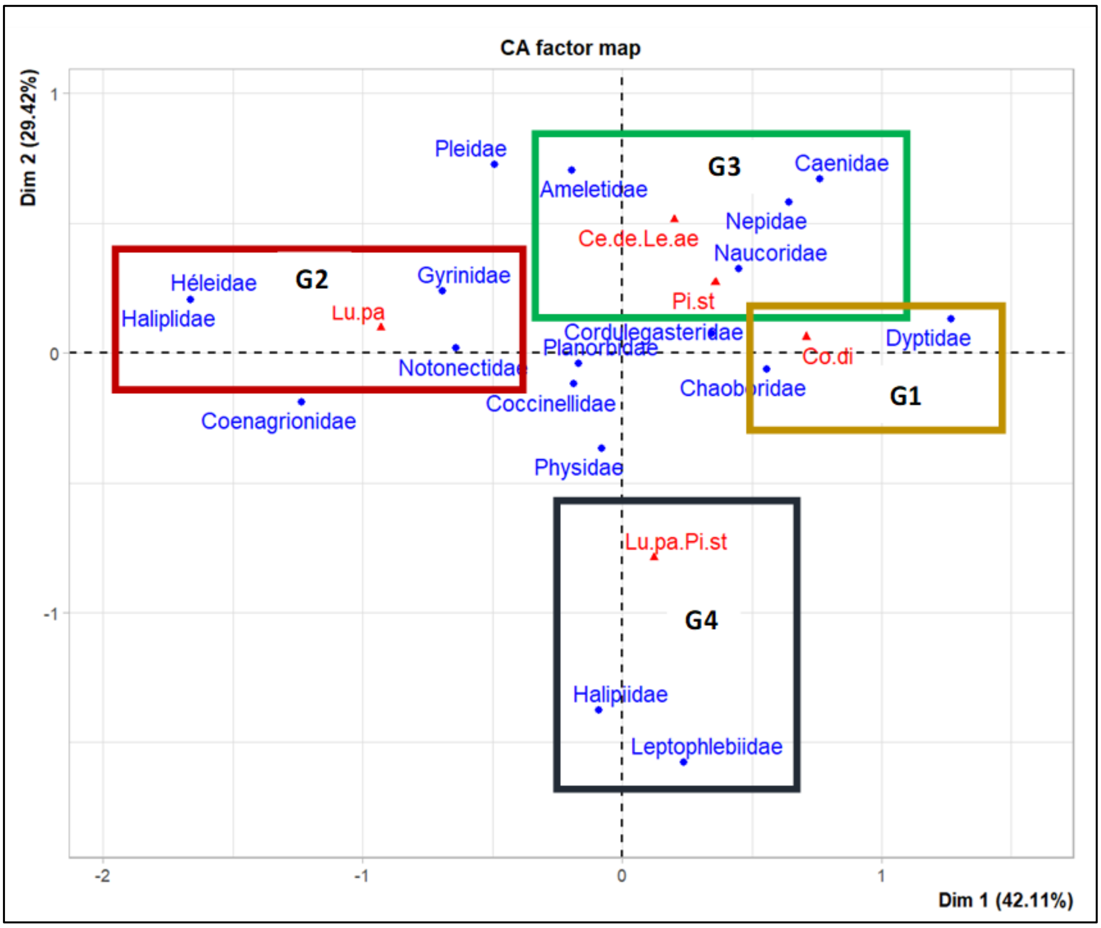

Figure 2 Distribution of macroinvertebrate families by type of aquatic plant community

Caenidae, and Ameletidae, which show a strong affinity for strictly hydrophytic communities dominated by Pistia stratiotes and for strictly and mixed hydrophytic communities dominated by Ceratophyllum demersum and Lemna aequinoctialis. The G4 group, represented on the negative plane of axis 2, includes the Halipiidae and Leptophlebiidae families. These families, for their part, prefer mixed aquatic vegetation consisting of *Ludwigia palustris* and *Pistia stratiotes* as their refuge habitat.

4. Discussion

Sampling yielded 1 115 macroinvertebrate individuals from all the aquatic plant beds growing in the Baya River. This taxonomic abundance is lower than that reported by [5], which recorded 4 815 macroinvertebrate individuals under the *Azolla pinnata* R. Br. beds and other macrophytes such as *Ceratophyllum demersum* L., *Nymphea lotus* L., *Oryza barthii* A. Chev., *Pistia stratiotes* L., and *Trapa natans* L., which invade the water body of the Bala hippopotamus pool in Burkina Faso. The difference in these abundances is likely due to the method used to collect the macroinvertebrates and the duration of sampling. In fact, compared to the work by [5], whose sampling lasted six months and was conducted in both the water column and the benthos, the present study was carried out over approximately one month, and specimens were collected solely in the water column beneath the aquatic plants. The entire population of macroinvertebrates collected from the Baya River is dominated by the class of insects, which account for 92.4% of the total number of individuals captured. Numerous studies have shown that insects predominate in aquatic environments, notably the work of [15] in Gabon, [16] in the Democratic Republic of the Congo, [6] in Congo-Brazzaville, and [17]in Côte d'Ivoire. [13] noted that insects constitute the dominant group of animals in terms of abundance and represent two-thirds of the entire animal kingdom. These insects, which live beneath the aquatic and semi-aquatic vegetation cluttering the water surface of the Baya River, are dominated by the orders Odonata, Diptera, and Coleoptera. These results are consistent with those of [18], [16] and [5], who noted the quantitative and qualitative importance of these orders of macroinvertebrates in fish ponds in southern Côte d'Ivoire, in Lac Vert in the DR Congo, and in the Bala hippopotamus pool in Burkina Faso, respectively. [19] demonstrated that insects belonging to these orders are detritivorous predators, meaning they feed on plant debris, which could explain their abundance beneath aquatic vegetation. The results of the present study showed that the Chaoboridae represent the most abundant family of macroinvertebrates under all the submerged vegetation in the Baya River. This is inconsistent with the results of studies conducted by several authors, notably [5, 20, 21], who reported an abundance of the Chironomidae family. In fact, all these studies have shown that the Chironomidae family remains dominant among the benthic macroinvertebrates of the water bodies, whereas sampling in this study was conducted solely in the water column just below the aquatic vegetation and not in the benthos. Indeed, the abundance of the Chaoboridae family could be explained by the fact that the larvae of certain taxa, such as Chaoborus, are voracious predators of zooplankton consisting of organisms drifting in the water column [22]The percentage of occurrence of macroinvertebrate insect families showed that the number of very frequent families is higher across all five aquatic plant communities. This reflects the richness of the Baya River in microhabitats, thus providing an environment conducive to the establishment and development of these families. This result is similar to that of [23] in Cameroon. Indeed, [24] noted that aquatic plants in general are an important component of insect ecology. An affinity was observed between certain families of macroinvertebrates and specific types of aquatic vegetation. The Dyptidae, Chaoboridae, Gyrinidae, Notonectidae, Heleidae, and Haliplidae preferentially inhabit helophytic plant beds. The Naucoridae, Nepidae, Caenidae, and Ameletidae prefer a habitat consisting of strict hydrophytic plants, whether floating or submerged. These results corroborate the work of [25] and [26], who demonstrated that the species richness of most invertebrates is positively correlated with species diversity, morphological diversity, and the coverage level of macrophytes on water bodies. Similarly, [27] noted that in vegetated areas, macroinvertebrate communities vary depending on the structure of the vegetation whether floating, emergent, or submerged. Indeed, [28] have shown that emergent macrophytes are essential for the final larval stage of certain insect species, as these insects use these plants as climbing aids to undergo metamorphosis in the aerial environment. In addition, aquatic plants continue to grow significantly and proliferate on the water's surface by absorbing nutrients. Thus, although these plants provide vital refuges for macroinvertebrates, they may eventually lead to a drastic reduction in the water volume of the Baya River due to evapotranspiration. Consequently, it is urgent to implement measures to control the spread of these invasive aquatic plants. However, this study has limitations due to the very short sampling period, as it is recommended to sample invertebrates at least twice a year, in the spring and fall, to ensure the most comprehensive biodiversity monitoring possible [29].

5. Conclusion

This study made it possible to inventory and determine the distribution of macroinvertebrates associated with the invasive aquatic vegetation proliferating in the Baya River. It should be noted that the various aquatic plant communities cluttering the surface of this river's water body harbor a population of macroinvertebrates whose taxonomic composition, richness, and abundance are far from exhaustive due to the very limited sampling effort. Macroinvertebrate families exhibit a preference for specific types of aquatic vegetation as their preferred habitat. Given that these invasive plants provide potential shelter for macroinvertebrates, an effective control policy is necessary to preserve the aquatic biodiversity of the Baya River.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors have not declared any conflict of interest.

References

[1] Priso RJ, Oum GO, Din N. Use of macrophytes as indicators of water quality in the Kondi River in the city of Douala (Cameroon, Central Africa). J. Appl. Biosci. 2012; 53:3797-3811.

[2] Dembélé M, Dagno K, Doumbia B, Diawara B, Karembé M, Sarra S. Analysis of invasive aquatic flora in the irrigation networks of the Office du Niger in Mali. Afrique SCIENCE. 2023; 23(6):72-83.

[3] Simberloff D, Martin J, Aronson JL, Courchamp F, Galil B, Garcia-Berthou E, Genovesi P, Maris V, Pascal M, Pysek P, Sousa R, Tabacchi E, Vila M, Wardle D. Impacts of biological invasions what's what and the way forward. Trends in Ecology & Evolution. 2013; 28(1):58-66. DOI: https://doi.org/10.1016/j.tree.2012.07.01

[4] Zuazo A, Fournier L, Dutartre A, Bertrin V. Native and Exotic Macrophytes: Better knowledge for Better Management. Environmental Dynamics. International Journal of Geosciences and the Environment. 2019; 43-44 :50-73. DOI: https://doi.org/10.4000/dynenviron.3613

[5] Sanogo S, Compaore I, Santi S, Bazemo E, Kabre T. The Importance of Azolla pinnata R. Br. in the Structure of Macroinvertebrate Populations in the Bala Hippopotamus Pond (Burkina Faso). Int. J. Biol. Chem. Sci. 2023; 17(1):13-27. DOI: https://dx.doi.org/10.4314/ijbcs.v17i1.2

[6] Mbeté VC, Ibala-Zamba A, Mbeté P, Mamonekene V. Inventory and distribution of benthic macroinvertebrates in the Loya Lagoon, Pointe-Noire Department, Congo-Brazzaville. Africa SCIENCE. 2020; 17(5):124-136.

[7] Sanogo S, Compaoré I, Senou I, Somda MB, Ouédraogo RB, Ouattara B, Kabre T. A Comparative Study of the Community Structure of Benthic Macroinvertebrates in Urban and Peri-Urban Watercourses in Western Burkina Faso. International Journal of Development Research. 2021; 11(01):43173-43184.

[8] Sanogo S, Kabré TJA, Cecchi P. Inventory and temporal distribution of bioindicator macroinvertebrates in three water bodies of the Volta Basin in Burkina Faso. International Journal of Biological and Chemical Sciences. 2014; 8(3):1005-1029.

[9] N'Guettia GK, Mangoua JMO, Aboua NK, Douagui AG, Goné LD. Hydrogeochemical characterization of groundwater in the Baya watershed, eastern Côte d'Ivoire. International Journal of Biological and Chemical Sciences. 2019; 13(1):774-785.

[10] FIRCA. Interprofessional Fund for Agricultural Research and Advisory Services, Ginger Sector. Research Report; 2020. 14 p.

[11] Moisan J, Pelletier L. Sampling Protocol for Freshwater Benthic Macroinvertebrates in Quebec: Shallow Waterways with Loose Substrate. Environmental Monitoring Branch, Ministry of Sustainable Development, Environment, and Parks; 2011. 39 p.

[12] Dejoux C, Elouard JM, Forge P, Maslin JL. Illustrated Catalog of Aquatic Insects of Côte d'Ivoire. Report of the Office for Overseas Scientific and Technical Research (ORSTOM). 1981; 42:178 p.

[13] Tachet H, Richoux P, Bourneau M, Usseglio-Polatera P. Freshwater Invertebrates: Systematics, Biology, Ecology. Editions CNRS, Paris; 2000. 588 p.

[14] Dajoz R. A Handbook of Ecology. 7th ed. Dunod, Paris; 2000, 615 p.

[15] Koumba M, Mipounga HK, Koumba AA, Koumba CRZ, Mboye BR, Liwouwou JF, Mbega JD, Mavoungou JF. Family diversity of macroinvertebrates and water quality in the Moukalaba-Doudou National Park (southwestern Gabon). Faunistic Entomology. 2017; 70:107-120.

[16] Cubaka KA, Cirimwami BL, Bora UH, Lwambo KJ, Baguma BG. Initial inventories of the diversity of aquatic macroinvertebrates in Lake Vert, Goma/North Kivu, Democratic Republic of the Congo. Journal of Applied Biosciences. 2019; 140:14268-14280. DOI: https://dx.doi.org/10.4314/jab.v140i1.6

[17] Aime SL, Berte S, N'da Sylvie A, Kone N. First Inventory of Aquatic Macroinvertebrates in Several Small Dams in Central and Northern Côte d'Ivoire. European Scientific Journal. 2022; 18(24):165-185. https://doi.org/10.19044/esj.2022.v18n24p165

[18] Yapo ML, Aste BC, Kouassi P. Inventory of aquatic insects in fish-farming ponds in southern Côte d'Ivoire. Journal of Applied Biosciences. 2012; 58:4208-4222.

[19] Tachet H, Bournaud M, Richoux P. Introduction to Freshwater Invertebrates. French Association of Limnology, University of Lyon. Ecology of Fluvial Hydrosystems, Geolab; 2009. 199 p.

[20] Kabré TA, Diguingué D, Bouda S. Effect of shrinking water surface area on macroinvertebrates in the Comoé Dam Lake, southwestern Burkina Faso. Science and technology, Natural Sciences and Agronomy series. 2002; 26(1):37-49.

[21] Moisan J. Guide to Biological Monitoring Based on Freshwater Benthic Macroinvertebrates in Quebec: Shallow Waterways with Coarse Substrate. Environmental Monitoring Branch 2013, Ministry of Sustainable Development, Environment, and Parks; 2013. 98 p.

[22] Diomandé D, Bony KY, Edia OE, Konan KF, Gourène G. Diversity of Benthic Macroinvertebrates in the Agnéby River (Ivory Coast; West Africa). European Journal of Scientific Research. 2009; 35(3):368-377.

[23] Fotsing KJ. Bioassessment of watercourses in western Cameroon using benthic macroinvertebrates and development of a regional multimetric. Doctoral dissertation, University of Yaoundé I, Cameroon; 2018. 174 p.

[24] Allouko JR, Bony KY, Edia OE, Konan KF. Composition, Distribution and Abundance of Macroinvertebrates in Aghien lagoon (Ivory Coast; West Africa). International Journal of Innovative Research in Science, Engineering and Technology. 2016; 5(6):10104-10111.

[25] Hassall C, Hollinshead J, Hull A. Environmental correlates of plant and invertebrate species richness in ponds. Biodiversity and Conservation. 2011; 20(13):3189-3222.

[26] Walker PD, Wijnhoven S, Van Der Velde G. Macrophyte presence and growth form influence macroinvertebrate community structure. Aquatic Botany. 2013; 104:80-87.

[27] Suren AM, Lambert P, Image K, Sorrell BK. Variation in wetland invertebrate communities in lowland acidic fens and swamps. Freshwater Biology. 2008; 53(4):727-744.

[28] Nyakabeji MB, Mushagalusa EM, Mashimango BJ-J, Basabose KA., "Diversity of Benthic Macroinvertebrates in Rivers of Northeastern Idjwi Island, Democratic Republic of the Congo. VertigO [Online], Fields, published online on July 28, 2023. URL:http://journals.openedition.org/vertigo/40649;DOI:https://doi.org/10.4000/vertigo.40649

[29] Hill MJ, Sayer CD, Wood PJ. When is the best time to sample aquatic macroinvertebrates in ponds for biodiversity assessment. Environmental Monitoring and Assessment. 2016; 188(3):194. DOI: 10.1007/s10661-016-5178-6