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Zooplankton functional traits as indicators of the ecological status of sectors IV and V of the Ébrié lagoon, Côte d'Ivoire

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Abstract

The present study aims to assess the ecological status of Sectors IV and V of the Ébrié Lagoon using zooplankton functional groups at five sampling stations located in these sectors. Zooplankton was sampled monthly over a one-year period in the Ébrié Lagoon using a plankton net with a 64-µm mesh size. Physicochemical parameters were measured using a multiparameter probe. Water samples for nutrient analysis were collected using a 2.5 L Niskin bottle. Nutrient concentrations were determined in the laboratory using a UV 2700 molecular absorption spectrophotometer. A total of 48 zooplankton species belonging to three taxonomic groups (rotifers, copepods, and cladocerans) were identified in the Ebrié Lagoon and classified into five functional groups (RF, RC, SCF, MCF, and MCC). The low spatial and seasonal variability of environmental parameters and functional group biomass suggests a relatively homogeneous ecological structure across the lagoon. Zooplankton functional group densities did not differ significantly between the rainy (45.11 ind. L^{-1}) and dry seasons (54.88 ind. L^{-1}). During the rainy season, the highest densities were observed for small-sized filter feeders (SCF) at Mopoyem (28.31 ind. L^{-1}), while during the dry season, maximum values were recorded for filter-feeding rotifers (RF) at Layo (17.3 ind. L^{-1}). Phosphate and nitrate concentrations were positively associated with RF and medium-sized carnivorous copepods and cladocerans (MCC), whereas SCF were mainly influenced by ammonium concentration and water depth. This functional approach improves understanding of trophic dynamics and ecosystem functioning in tropical lagoons and provides a valuable baseline for future ecological monitoring and management.

Keywords: Zooplankton; Functional groups; Environmental variables; Ebrié Lagoon

1. Introduction

Tropical lagoons are transitional ecosystems characterized by high biological productivity and play a critical role in hydrological regulation, nutrient recycling, and the maintenance of aquatic biodiversity [1, 2]. They also provide essential ecosystem services to surrounding human populations, particularly in fisheries, agriculture, and water supply [1]. However, their ecological functioning is strongly influenced by seasonal fluctuations in physico-chemical parameters as well as by the intensity of anthropogenic pressures, especially in densely urbanized areas.

Within lagoon ecosystems, zooplankton occupies a pivotal position in aquatic food webs by mediating the transfer of matter and energy from primary producers to higher trophic levels. Owing to its short life cycle and high sensitivity to

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environmental conditions, zooplankton responds rapidly to changes in water physico-chemical characteristics, making it a reliable bioindicator of the ecological status of aquatic ecosystems [3, 4].

In Côte d'Ivoire, the Ébrié Lagoon constitutes the largest lagoonal system in the country. It extends across the Autonomous District of Abidjan, an area marked by intense urbanization and industrial activity, which exposes the lagoon to substantial inputs of nutrients and organic matter originating from domestic, industrial, and agricultural discharges [5, 6]. These inputs, combined with seasonal hydrological variability, alter water quality parameters, including temperature, pH, dissolved oxygen, and nutrient concentrations and subsequently influence the structure and dynamics of biological communities, particularly in sectors IV and V.

Previous investigations of zooplankton in the Ébrié Lagoon have predominantly relied on descriptive taxonomic approaches, focusing on species richness, abundance, and spatio-temporal distribution patterns [7, 8]. While these studies have provided valuable information on dominant zooplankton groups, they remain limited in their capacity to interpret ecological responses of communities to environmental gradients, especially when seasonal variations in physico-chemical conditions are moderate or statistically non-significant.

In this context, functional trait-based approaches offer a particularly relevant and complementary analytical framework. These approaches are based on the analysis of morphological, physiological, and behavioural traits, such as body size, trophic strategy, reproductive mode, mobility, and tolerance to environmental stressors that determine the functional roles of organisms within ecosystems [9, 4]. By linking species traits directly to ecological processes, functional approaches go beyond taxonomic descriptions and enable the detection of functional responses of zooplankton communities to environmental variability, even in the absence of pronounced seasonal differences in overall abundance [10; 11].

In tropical lagoon ecosystems subjected to chronic nutrient enrichment, nutrient gradients (phosphates, nitrates, ammonium) and hydrological parameters (water depth and transparency) act as key drivers structuring zooplankton functional groups. Examining the relationships between these environmental variables and the distribution of functional groups allows the identification of functional signatures associated with eutrophication processes, hydrological stability, or environmental stress conditions.

Against this background, the present study aims to assess the ecological status of sectors IV and V of the Ébrié Lagoon using zooplankton functional traits. Specifically, the objectives are to (i) characterize the functional composition of zooplankton communities and their spatial and seasonal variability, and (ii) examine the relationships between functional group densities and water physico-chemical parameters in order to identify the main environmental drivers structuring these communities in a tropical lagoon system subjected to anthropogenic pressures**.**

1.1. Study area and sampling design

Ébrié Lagoon is a tropical lagoonal system (566 km^2) located in southern Côte d'Ivoire and crossing the Abidjan District, the country's main urban and industrial center [12]. It is separated from the Atlantic Ocean by a sandy barrier (1-8 km wide) breached by the Vridi Channel, opened in 1951, which constitutes the sole hydrodynamic connection with the marine environment [13]. The lagoon receives freshwater inputs from the Comoé River and the Agnéby, Mé and Banco rivers, as well as urban effluents, resulting in strong anthropogenic pressures [14.]

This study focused on Sectors IV and V (5°13′–5°19′ N; 4°14′–4°27′ W) [8]. Sector IV is influenced by both freshwater inflows and tidal forcing, leading to marked seasonal salinity variability (0.04–30‰), whereas Sector V exhibits more stable, oligohaline conditions with limited seasonal variability [15]. Five sampling stations were selected based on accessibility, year-round water permanence and contrasting levels of anthropogenic influence (Figure 1).

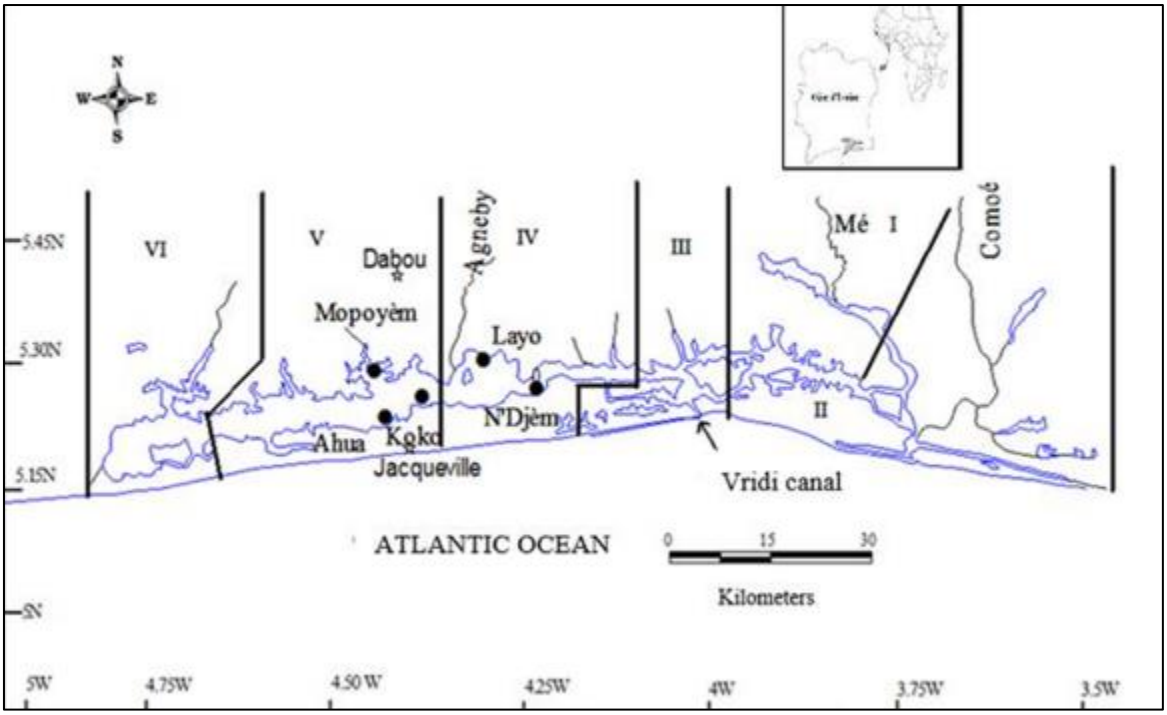


Figure 1 The localization of sampling stations (●) in the Ebrié Lagoon (Côte d'Ivoire, West Africa) [8]

1.2. Sampling and laboratory analysis

Zooplankton samples were collected using a plankton net and a 10-litre bucket. The plankton net was a conical net (65 cm long) with a 64 µm silk mesh filter and a collecting cup at the end. A 13 cm diameter circular frame was used to mount the net.

In the field, the zooplankton samples were preserved in labelled vials containing buffered formaldehyde (5%, borax-buffered) to which sucrose, liquid soap and neutral red dye had been added to enhance preservation and staining of the organisms.

In the laboratory, taxonomic identification and enumeration were carried out using a Dolfuss counting chamber under a stereomicroscope (Leica WILD M3C), at magnifications of ×160, ×250 and ×400. Sample handling and subsampling were performed using graduated cylinders and Eppendorf micropipettes (1- and 5-mL capacity).

1.3. Zooplankton sampling and analysis

Zooplankton was sampled by filtering 100 L of water using a plankton net, with successive hauls performed using a 10-L bucket. Samples were collected in labeled vials (date, time and station) and treated with 1–2 mg sucrose, 2 mL liquid soap and neutral red to minimize organism deformation and improve visibility under stereomicroscopy [16, 17]. Samples were preserved in 5% borax-buffered formaldehyde.

Zooplankton organisms were identified and counted using standard taxonomic keys [18, 19, 20, 21, 22]. Individual density was calculated according to the formula:

$$\mathbf{D} = (n \times v) / V,$$

where *D* is organism density (ind. L^{-1}), *n* the number of individuals counted, *v* the total volume of the analysed sample, and *V* the volume of water filtered in the field [23].

The sampled zooplankton species were classified into five functional groups based on their body size/length and mode of feeding [24]. For each identified taxon, functional traits related to feeding mode were assigned following the frameworks proposed by Litchman et al. [10] and Benedetti [25]. The habitat preference of each species was also considered as a functional trait. Total densities (ind. L^{-1}) of each functional category were calculated per station, and their relative contributions were used as indicators of dominant ecological functions within the system [26]. Spatial

variations in zooplankton densities were assessed using the non-parametric Mann–Whitney U test, performed with Statistica 5 software.

2. Results

2.1. Environmental variables

Physico-chemical parameters exhibited moderate seasonal variations between the rainy and dry seasons, with amplitudes differing among variables (Table 1). Mean water temperature was slightly higher during the rainy season (29.4 ± 1.3 °C) than during the dry season (28.9 ± 1.8 °C). Salinity showed similar values between seasons (3.02 ± 2.2 in the rainy season and 3.2 ± 2.4 in the dry season), indicating limited seasonal variability. In contrast, pH increased from 7.2 ± 0.6 during the rainy season to 7.9 ± 0.52 in the dry season; however, no significant seasonal differences were detected overall (Mann–Whitney U test, $p > 0.05$).

Electrical conductivity remained stable between seasons (0.56 ± 0.42 S m^{-1} in the rainy season and 0.57 ± 0.40 S m^{-1} in the dry season). Total dissolved solids (TDS) were slightly higher during the rainy season (0.30 ± 0.60 g L^{-1}) than during the dry season (0.22 ± 1.60 g L^{-1}), with pronounced intra-seasonal variability, particularly in the dry season. A significant seasonal difference was observed for TDS (Mann–Whitney U test, $p < 0.05$).

Mean dissolved oxygen concentration decreased from 6.7 ± 2.21 mg L^{-1} in the rainy season to 5.9 ± 2.2 mg L^{-1} in the dry season. Water depth was slightly greater during the dry season (1.6 ± 0.76 m) than during the rainy season (1.4 ± 0.6 m). Water transparency showed a marked seasonal contrast, increasing from 0.8 ± 0.3 m in the rainy season to 83.8 ± 33.7 cm in the dry season.

Nutrient concentrations were generally low. Phosphate levels remained comparable between seasons (0.07 ± 0.10 mg L^{-1} in the rainy season and 0.06 ± 0.04 mg L^{-1} in the dry season). Nitrate concentrations increased from 0.6 ± 0.54 mg L^{-1} to 0.95 ± 1.42 mg L^{-1}, whereas nitrite concentrations decreased from 0.4 ± 0.49 mg L^{-1} to 0.22 ± 0.32 mg L^{-1}. Sulfate concentrations were high and similar between seasons (91.6 ± 52.8 and 94.8 ± 49.7 mg L^{-1}), while ammonium concentrations remained low and comparable (0.14 ± 0.10 and 0.12 ± 0.08 mg L^{-1}).

Table 1 Seasonal variation of physico-chemical parameters in the study area (mean ± SD)

Parameter	Rainy season	Dry season
Temperature (°C)	29.4 ± 1.3[a]	28.9 ± 1.8[a]
Salinity	3.02 ± 2.2[a]	3.2 ± 2.4[a]
pH	7.2 ± 0.6[a]	7.9 ± 0.52[a]
Conductivity (S m^{-1})	0.56 ± 0.42[a]	0.57 ± 0.40[a]
Total dissolved solids (TDS, g L^{-1})	0.30 ± 0.60[a]	0.22 ± 1.60[b]
Dissolved oxygen (mg L^{-1})	6.7 ± 2.21[a]	5.9 ± 2.20[a]
Depth (m)	1.4 ± 0.6[a]	1.6 ± 0.76[a]
Water transparency (m)	0.80 ± 0.30[a]	0.84 ± 0.34[a]
Orthophosphate (PO_4^{3-}, mg L^{-1})	0.07 ± 0.10[a]	0.06 ± 0.04[a]
Nitrate (NO_3^-, mg L^{-1})	0.60 ± 0.54[a]	0.95 ± 1.42[a]
Nitrite (NO_2^-, mg L^{-1})	0.40 ± 0.49[a]	0.22 ± 0.32[a]
Sulfate (SO_4^{2-}, mg L^{-1})	91.6 ± 52.8[a]	94.8 ± 49.7[a]
Ammonium (NH_4^+, mg L^{-1})	0.14 ± 0.10[a]	0.12 ± 0.08[a]

Note: Values are mean ± standard deviation. Different superscript letters within a row indicate significant seasonal differences (Mann–Whitney U test, $p < 0.05$).

2.2. Qualitative zooplankton composition

The list of zooplankton taxa and their density are shown in Table 2. A total of 45 zooplankton taxa were identified in Ébrié Lagoon, comprising 31 rotifer taxa, 11 copepod taxa and 3 cladoceran taxa. Filter-feeding rotifers (RF) were the most diverse group, with 28 taxa, accounting for 62.2% of the total taxonomic richness. Within this group, the family Brachionidae was the most represented, with 15 taxa (53.6% of rotifer taxa). The genus *Brachionus* was the most diverse among filter-feeding rotifers (seven taxa), followed by *Keratella* and *Filinia*, with five and four taxa, respectively.

Three carnivorous rotifer taxa (RC) were recorded, namely *Asplanchna* sp., *Anureopsis fissa* and *Hexarthra intermedia*. Medium-sized filter-feeding copepods and cladocerans (MCF) were represented by nine taxa: *Acartia clausi*, *Eucyclops* sp., *Euterpina acutifrons*, *Oithona brevicornis*, *Paracalanus parvus*, *Pseudodiaptomus hessei*, *Alona* sp., *Camptocercus* sp. and *Ceriodaphnia* sp. Small-sized filter-feeding copepods and cladocerans (SCF) comprised harpacticoids and nauplii. Medium-sized carnivorous copepods and cladocerans (MCC) included *Ergasilus* sp., *Mesocyclops* sp. and *Thermocyclops neglectus*.

2.3. Seasonal and spatial variation of zooplankton functional groups

The density of zooplankton functional groups did not differ significantly between the rainy season (45.11 ind/L) and the dry season (54.88 ind/L) (figure 2).

During the rainy season, mean densities were 0.146 ± 0.07 ind. L^{-1} for medium-sized carnivorous copepods and cladocerans (MCC), 1.60 ± 1.37 ind. L^{-1} for medium-sized filter feeders (MCF), 0.14 ± 0.18 ind. L^{-1} for carnivorous rotifers (RC), 1.29 ± 1.86 ind. L^{-1} for filter-feeding rotifers (RF), and 8.04 ± 11.47 ind. L^{-1} for small-sized filter feeders (SCF). The highest densities recorded during this season were observed for SCF at Mopoyem (28.31 ind. L^{-1}) and for RF at the same station (4.45 ind. L^{-1}).

In the dry season, mean densities reached 0.084 ± 0.05 ind. L^{-1} for MCC, 3.76 ± 2.34 ind. L^{-1} for MCF, 0.03 ± 0.04 ind. L^{-1} for RC, 4.76 ± 8.36 ind. L^{-1} for RF, and 5.98 ± 6.17 ind. L^{-1} for SCF. Maximum values during the dry season were recorded for RF at Layo (17.3 ind. L^{-1}), while SCF peaked at Koko (15.31 ind. L^{-1}) and Mopoyem (9.08 ind. L^{-1}).

Table 2 The list and the density (ind. L^{-1}) of zooplankton taxa and functional groups in Ébrié Lagoon

Group	Taxon	Functional group	Rainy season	Dry season
Cladocerans	*Camptocercus* sp.	MCF	0.09	0.00
	Alona sp.	MCF	0.00	0.10
	Ceriodaphnia sp.	MCF	0.00	0.10
Copepods	*Acartia clausi*	MCF	3.30	7.64
	Ergasilus sp.	MCC	0.10	0.10
	Eucyclops sp.	MCF	0.15	0.44
	Harpacticoids	SCF	0.66	0.34
	Mesocyclops sp.	MCC	0.19	0.00
	Nauplii	SCF	10.11	8.13
	Oithona brevicornis	MCF	0.18	0.61
	Pseudodiaptomus hessei	MCF	0.35	0.74
	Thermocyclops neglectus	MCC	0.16	0.11
	Euterpina acutifrons	MCF	0.00	0.20
	Paracalanus parvus	MCF	0.00	0.64
Rotifers	*Anureopsis fissa*	RC	0.09	0.00
	Asplanchna sp.	RC	0.90	0.00
	Brachionus angularis	RF	1.01	1.28

	B. calyciflorus	RF	0.59	0.22
	B. caudatus	RF	4.51	2.10
	B. dichotomus	RF	0.07	0.00
	B. falcatus	RF	11.19	8.58
	B. plicatilis	RF	0.26	0.49
	B. quadridentatus	RF	0.09	0.00
	Collurella sp.	RF	0.20	0.00
	Epiphanes sp.	RF	0.10	0.00
	Filinia comacela	RF	0.10	0.00
	F. longiseta	RF	0.45	0.17
	F. opoliensis	RF	7.92	6.69
	F. terminalis	RF	0.00	0.10
	Hexarthra intermedia	RC	0.06	0.00
	Keratella cochlearis	RF	0.00	0.10
	K. lenzi	RF	0.14	0.13
	K. procurva	RF	0.67	0.00
	K. quadrata	RF	0.00	0.11
	K. tropica	RF	0.23	14.49
	Kellicottia sp.	RF	0.00	0.01
	Lecane luna	RF	0.10	0.00
	Lecane spp.	RF	0.29	0.21
	Mytilina sp.	RF	0.07	0.00
	Plationus patulus	RF	0.09	0.00
	Platyias quadricornis	RF	0.20	0.90
	Synchaeta sp.	RF	0.30	0.00
	Rotaria sp.	RF	0.00	0.10
	Testudinella sp.	RF	0.10	0.00
	Trichocerca sp.	RF	0.11	0.07

MCF = medium-sized filter feeders; SCF = small-sized filter feeders; MCC = medium-sized carnivores; RF = filter-feeding rotifers; RC = carnivorous rotifers.

At the station scale, Ahua consistently exhibited low densities across all functional groups (<3.8 ind. L^{-1} in both seasons). At Koko, MCF densities increased from 1.79 ind. L^{-1} in the rainy season to 6.81 ind. L^{-1} in the dry season, while SCF increased from 5.92 to 15.31 ind. L^{-1}. At Layo, RF densities increased markedly from 1.48 ind. L^{-1} in the rainy season to 17.3 ind. L^{-1} in the dry season, whereas other groups remained below 2 ind. L^{-1}. At Mopoyem, SCF densities peaked during the rainy season (28.31 ind. L^{-1}) and declined during the dry season (9.08 ind. L^{-1}). At N'Djem, MCF densities increased from 1.52 ind. L^{-1} in the rainy season to 5.48 ind. L^{-1} in the dry season, while other groups remained below 3.3 ind. L^{-1}.

Overall, MCC and RC consistently displayed the lowest mean densities (<0.15 ind. L^{-1}), whereas SCF exhibited the highest seasonal means and the greatest variability. No significant seasonal differences were detected among functional groups (Mann–Whitney U test, $p > 0.05$).

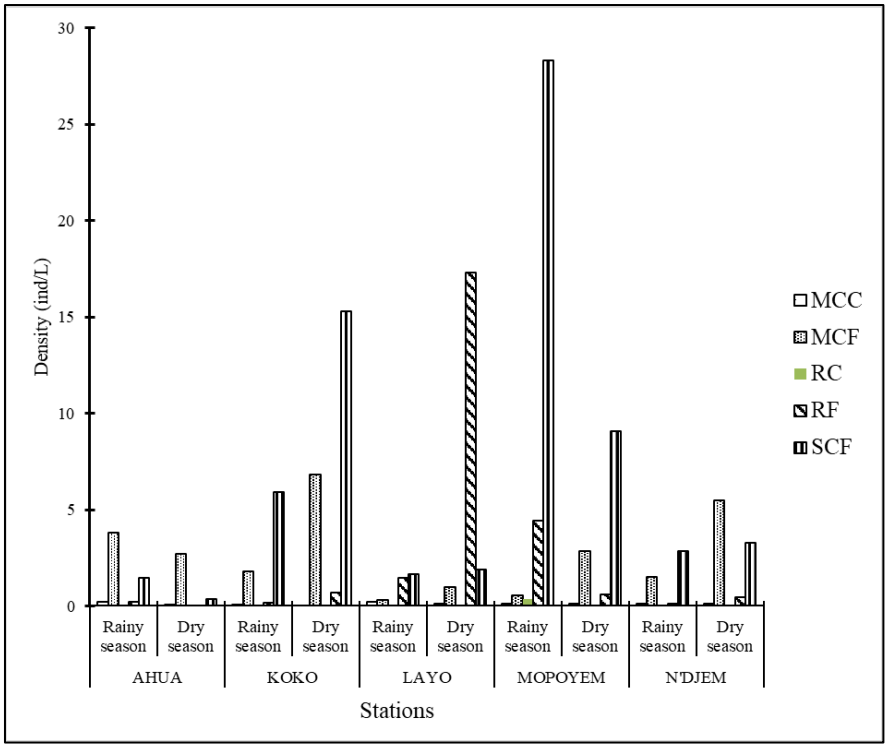
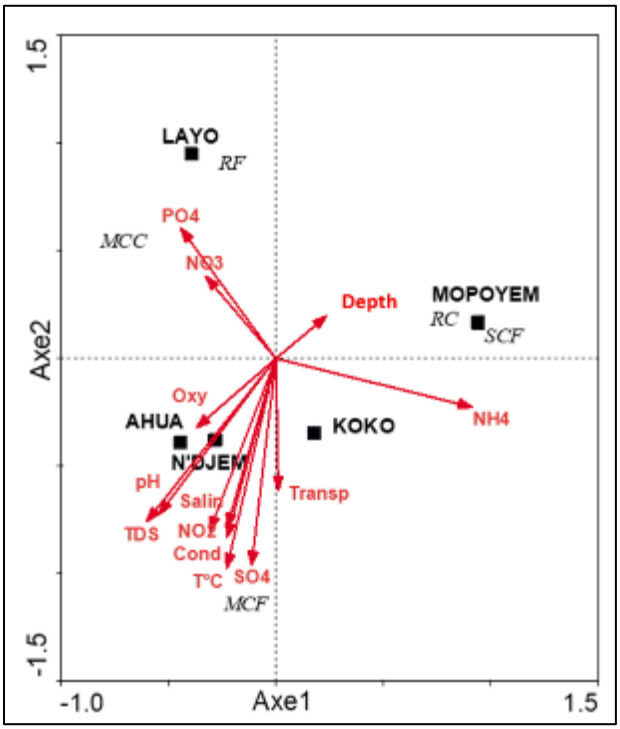


Figure 2 Spatio-temporal variation in the density of the functional group of zooplankton

2.4. Environmental variables related to zooplankton functional group density



Salin: salinity, **Transp** : transparency, **NO_2**, Nitrite, **NO_3**: Nitrate, **T°C**: temperature, **TDS**: Total Dissolved Solid, **Cond** : Conductivity, **pH**: hydrogen potential, **NH_4**: ammonium, **PO4** : orthophosphate, **Oxy**: dissolved oxygen; filter-feeding group (MCF) exhibited negative relationships with water temperature, conductivity, salinity, sulfate, nitrite, total dissolved solids (TDS), pH and dissolved oxygen.

Figure 3 Redundancy analysis ordination diagram applied to environmental variables and zooplankton abundance

The redundancy analysis (RDA) ordination illustrating the relationships between zooplankton functional group densities and environmental variables is presented in Figure 3. The first two RDA axes explained 99.9% of the total

variance in the relationship between functional groups and environmental parameters, with axis 1 accounting for 87.5% and axis 2 for 12.4% of the explained variance.

Densities of filter-feeding rotifers (RF) and medium-sized carnivorous copepods and cladocerans (MCC) were strongly and positively correlated with phosphate and nitrate concentrations. Carnivorous rotifers (RC) and small-sized filter feeders (SCF) showed positive associations with ammonium concentration and water depth. In contrast, the medium-sized

3. Discussion

The physico-chemical results of the present study indicate a relative seasonal stability for most measured parameters, including temperature, salinity, pH, conductivity and dissolved oxygen. Such stability is commonly reported in tropical lagoonal systems, where hydrological variability is buffered by the combined effects of continental freshwater inputs, exchanges with the marine environment and internal hydrodynamic processes [14, 27].

The analysis of the zooplankton community in Ébrié Lagoon revealed a total of 45 taxa, with rotifers representing the most diverse group. This pattern is consistent with previous observations in West African lagoonal and floodplain systems, including Nokoué Lagoon (Benin) [28]. Ébrié Lagoon [8]. and floodplain lakes in Nigeria ([29]. However, the total taxonomic richness recorded in this study is lower than that previously reported for Ébrié Lagoon (59 taxa; [8]). This discrepancy likely reflects methodological differences, particularly the strict focus on permanent zooplankton in the present study, excluding temporary or meroplanktonic forms.

The strong dominance of filter-feeding rotifers (RF), mainly represented by the family *Brachionidae* and especially the genus *Brachionus*, constitutes a well-established indicator of environments enriched in organic matter and bioavailable nutrients. These taxa are characterized by high ecological tolerance, short life cycles and a strong capacity to rapidly exploit phytoplanktonic and bacterial resources [30, 31]. Their pronounced dominance, particularly during the dry season at Layo station, is consistent with the observed increases in pH, water transparency and nitrate concentrations, conditions that promote primary production and consequently enhance food availability for filter feeders. The RDA ordination revealed a strong positive correlation between RF densities and oxidized nutrients (NO_3^- and PO_4^{3-}), highlighting the tight coupling between nutrient enrichment and the proliferation of filter-feeding rotifers. Similar patterns have been widely documented in tropical lagoons subjected to diffuse continental and anthropogenic nutrient inputs [32]. As RF species primarily feed on bacteria and detrital particles, their abundance is likely favored by elevated concentrations of total phosphorus and total nitrogen [33].

Small-sized filter-feeding copepods and cladocerans (SCF), dominated by nauplii and harpacticoids, exhibited the highest mean densities and the greatest spatial and seasonal variability. Their maximum abundance during the rainy season at Mopoyem suggests a rapid response to increased organic matter inputs and higher turbidity, conditions that are particularly favorable to tolerant and opportunistic larval stages [3]. Comparable trends have been reported in Nokoué Lagoon, where periods of intense rainfall promote the dominance of juvenile copepods and small opportunistic filter feeders [28]. In that system, copepod nauplii dominate zooplankton assemblages during periods of strong continental inputs, in response to nutrient enrichment and enhanced microbial and phytoplankton production. The absence or low abundance of planktivorous fish predators may further contribute to the high densities of SCF observed in lagoonal environments. These results contrast with those of Mwagona et al. [29], who reported a dominance of RF in the Xiquanyan Reservoir (northeastern China), highlighting the strong context-dependence of zooplankton functional structure.

The positive correlation between SCF densities, ammonium concentration and water depth indicates a preferential exploitation of deeper zones enriched in reduced nitrogen forms, often associated with active organic matter mineralization. This relationship underscores the key trophic role of nauplii as an intermediate link between microbial and phytoplankton production and higher trophic levels, particularly fish larvae [34].

Medium-sized filter-feeding copepods and cladocerans (MCF), including *Acartia clausi*, *Oithona brevicornis* and *Pseudodiaptomus hessei*, exhibited a marked increase in density during the dry season at several stations (Koko and N'Djem). However, RDA results revealed negative associations between this group and most physico-chemical variables, including temperature, salinity, conductivity, pH, TDS and sulfate. This pattern suggests that MCF taxa occupy a more stable ecological niche, less directly influenced by short-term environmental fluctuations, or that they exploit specific microhabitats within the lagoon that buffer them from seasonal variability in the water column. Such ecological behavior is commonly observed among lagoonal calanoid and cyclopoid copepods, which display both behavioral and physiological adaptations to fluctuating environmental gradients [35].

Carnivorous groups, including carnivorous rotifers (RC) and medium-sized carnivorous copepods and cladocerans (MCC), exhibited consistently low densities (<0.15 ind. L^{-1}) across seasons. This low abundance likely reflects the trophic structure of the system, which is dominated by primary producers and primary consumers, as well as strong predation pressure exerted by fish larvae, which are typically abundant in lagoonal environments [36]. The particularly low density of RC may also result from predation by MCC and larger carnivorous zooplankton. Nevertheless, the positive correlation observed between MCC densities and nutrient concentrations (NO_3^- and PO_4^{3-}) suggests that their distribution remains indirectly linked to overall system productivity through the availability of potential prey.

Despite the observed variations in mean and maximum densities of zooplankton functional groups, the absence of statistically significant differences between the rainy and dry seasons ($p > 0.05$) indicates that spatial heterogeneity within seasons outweighs the effect of seasonal climatic variability. This finding is consistent with previous studies in tropical lagoonal systems, which emphasize that local environmental conditions and anthropogenic pressures can mask broader seasonal signals [28].

4. Conclusion

In this study, a total of 48 zooplankton species belonging to tree taxonomic categories (rotifers, copepods and cladocerans) were identified and grouped into five functional groups, RF, RC, SCF, MCF and MCC. The limited spatial and seasonal variability of environmental variables and zooplankton functional group biomass reflects a relatively homogeneous ecological structure within the Ebrié Lagoon. The density of zooplankton functional groups did not differ significantly between the rainy season (45.11 ind/L) and the dry season (54.88 ind/L). The highest densities recorded during this season were observed for SCF at Mopoyem (28.31 ind/L). Maximum values during the dry season were recorded for RF at Layo (17.3 ind. L^{-1}). Phosphate and nitrate concentrations were strongly and positively associated with the densities of filter-feeding rotifers (RF) and medium-sized carnivorous copepods and cladocerans (MCC). Small-sized filter feeders (SCF) showed positive associations with ammonium concentration and water depth. This study provides a functional characterization of zooplankton communities in the Ebrié Lagoon and highlights their relationships with key environmental drivers. The results improve our understanding of trophic dynamics and ecosystem functioning in tropical lagoons and offer a valuable baseline for future ecological monitoring and management. More broadly, this functional approach contributes to the scientific community by enhancing the comparability and predictive capacity of zooplankton-based ecological assessments.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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