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Original Research Paper

How do Environmental Factors Influence Zooplankton Diversity in the Peri-Urban Amagba-Okoroma River?

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Abstract

Rivers are renowned for the provision of essential ecosystem services; and their presence in peri-urban and rural areas play and essential part in supporting their welfare and development. The zooplankton diversity in the Amagba-Okoroma River located in a peri-urban area in Benin City, Nigeria was investigated to provide foundational data on the ecological state of the river. Zooplankton and water samples were collected and analysed seasonally, three times each in the month of March and July, 2023 from three stations using standard methods. Principal component analysis shows that out of the 20 environmental factors, seven significantly influenced the zooplankton community. Three zooplankton groups comprising a total 360 individuals from 23 taxa were recorded. Of these, 11 species of rotifers, 8 cladocerans and 4 copepods were the predominant species found. Ecological indices suggested that species diversity were heterogeneous in favour of stations 2 and 1, as opposed to 3 being the least diverse. The zooplankton population was numerically higher in the dry season than in the wet season, albeit statistically similar. Cluster analysis showed that the organisms were grouped by stations into 2 clusters. Canonical correspondence analysis demonstrated a robust correlation between zooplankton and the physico-chemical parameters of the peri-urban river, with species such as *Diaphanosoma sarsi* and *Euryalona orientalis* being responsive, suggesting positive connection with BOD_5 and DO. Whereas species like *Moina micrura, Mesocyclops aspericornis* and *Mesocyclops salinus* were tolerant. Generally, the studies show that the zooplankton diversity is influence by the physico-chemical factor of the river, and hence can be used as a biomonitoring tool for water quality.

Keywords: Ecological indices, Environmental factors, Peri-Urban River, Zooplankton Diversity, Amagba-Okoroma River

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1. Introduction

Rivers are aquatic environments characterized by varying conditions over time and continuous, one-way movement of water (Kang and Kazama, 2014; Angela et al., 2015). These environments can be seen as intricate networks comprising main channels and smaller streams that intersect (Thorp et al., 2010; Angela et al., 2015). They serve as extremely varied environment that support a wide array of organisms, including zooplankton and macroinvertebrates, which possess adaptations enabling them to supply numerous ecosystem services (ESs). These services benefit humans through both direct and indirect impacts (MEA, 2005). Nevertheless, a significant bulk of rivers worldwide are affected by urbanization, mainly due to greater impervious surfaces that change the hydrological patterns (Konrad and Booth, 2005), particularly noticeable in large urban areas like Benin City, Nigeria. Rivers on the outskirts of urban areas are vital for providing ecosystem services that contribute to the development and welfare of both city and suburban regions (Rozas-Vásquez et al., 2022). Understanding the

biogeochemical processes of minor rivers flowing via peri-urban areas is challenging due to diverse inputs from multiple sources that can alter their characteristics (Ivanovsky et al., 2016).
Several studies indicate that urbanization alters the runoff entering streams and rivers, affecting the rate, volume, and timing of streamflow, which in turn affects the composition and structure of riverine communities (Miltner et al., 2004; Konrad and Booth, 2005; Angela et al., 2015; Egun and Oboh, 2023). The flow regime performs a crucial part in shaping river habitats because it closely correlates with the environmental condition of rivers and streams (Tetzlaff et al., 2005). Urban development also impacts low-order streams by modifying peak flows, total runoff, stream morphology, and water quality, thereby altering nutrient inputs and uptake by organisms. The extent of these changes depends on how urbanization is spatially arranged (Jacobson, 2011). Urban rivers and streams are particularly susceptible to rapid and short-term increases in runoff, largely due to combined sewer overflows and stormwater discharge (Tetzlaff et al., 2005; Egun and Oboh, 2022).

Considering the specific circumstance where urban growth influences both water quality and the structure of zooplankton communities in peri-urban rivers, it is crucial to recognize the interplay between ecological and social factors within these ecosystems. Human activities can significantly impact peri-urban rivers and underscore the importance of their conservation (Walsh et al., 2005; Biose et al., 2024). Hence, establishing a set of easily measurable hydrological and biological indicators, such as zooplankton, is crucial for assessing current river conditions, maintaining watershed health, and sustainably managing water resources (He et al., 2000). Zooplankton indicators serve as valuable tools for monitoring environmental changes, understanding the scale of such changes and impacts on ecosystem services and human health, while also informing strategic planning, freshwater policies and management practices (He et al., 2000). Various studies have utilized zooplankton as a bioindicator to assess river water quality in urban and peri-urban settings in Nigeria (Anyanwu et al., 2013; Ikhuoriah et al., 2015; Abdul et al., 2016; Edegbene et al., 2022, but none in Nigeria has investigated the Amagba-Okoroma River.

The river under study is a tributary that flows along the boundary between the Amagba and Okoroma communities in Benin City, Nigeria. These rivers hold considerable importance for the residents within their catchment areas. Thus, our objective was to examine how zooplankton distribution and community structure correlate with the environmental conditions of a peri-urban river.

2. Materials and Methods

2.1 Description of study area and sampling stations

This area is located between 6°.12′50′′N and 6°.13′40′′ N latitude and 5°.34′50′′E and 5°.35′20′′E longitude in the peri-urban area of Benin City along the stretch of Amagba - Okoroma River, (**Figure 1**). The river receives water from the Ogba River and flows into Ossiomo River. Sampling Station 1 (upstream Amagba River, latitude 6°13′12.56″ N and longitude 5°35′7.69″ E) is the reference station for the study. This station is located by the bridge around the boundary of Amagba Community. The major anthropogenic activities comprise bathing, laundry, and washing of tricycle and bike. Station 2 (mid-stream Okoroma River, latitude 6°13′13.12″ N and longitude 5°35′4.68″ E) is at the boundary of Okoroma Community and it is about 2km from station 1. The major human activities include laundry, car wash, rituals, recreational swimming. Station 3 (downstream Okoroma River, latitude 6°13′21.94″ N and longitude 5°35′6.31′′ E). This station is located after the bridge at Okoroma community. It is 500 metres from station 2. Activities in station 3 include cattle grazing and solid waste disposal. The sampling was executed in the three selected stations of the river during the dry (March and April 2023) and rainy season (June and July 2023).

The climate features distinct humid tropical dry and wet seasons. The rainy season typically occurs from April to October, with the highest relative humidity and lowest temperatures observed between July and August during peak rainfall. The dry season last from November to March, characterized by low relative humidity and high atmospheric temperatures. The mean yearly temperature ranges from 21°C to 35°C.The river is bordered by secondary rainforest vegetation, including species such as water lily (Nymphaea lotus), Awolowo weed

(*Chromolaena odorata*), *Calopogonium mucunoides*, palm trees (*Elaeis guineensis*), signal grass (*Urochloa panicoides*), elephant grass (*Pennisetum purpureum*), and various shrubs.

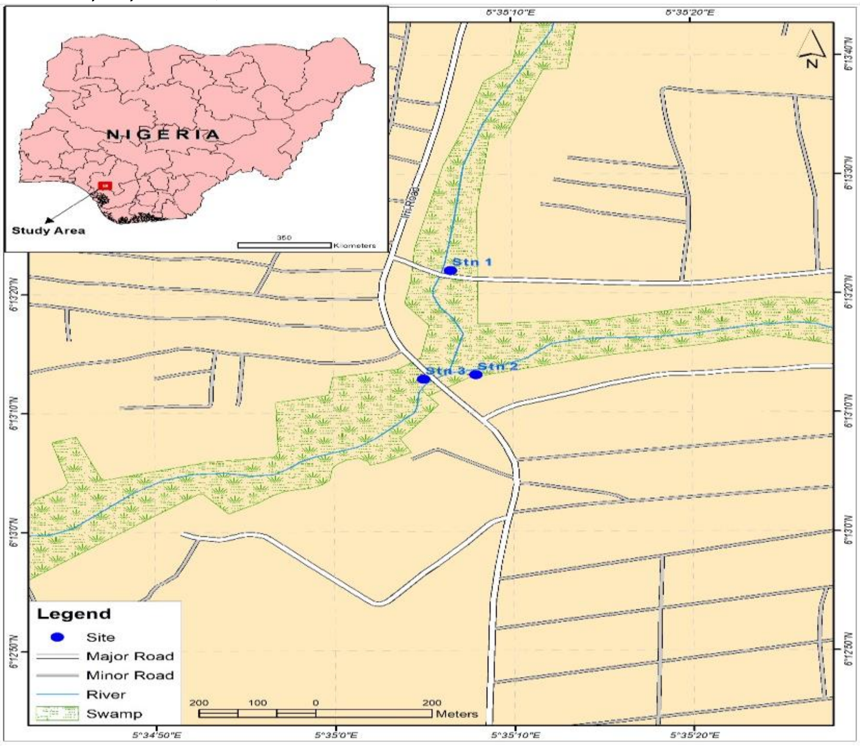

Figure 1. Map of Amagba-Okoroma River showing the three sampling stations

2.2 Water physico-chemical parameters in Amagba-Okoroma River

Surface water from three stations along the Amagba-Okoroma River was collected three times in march (dry season) and June (wet season) 2023 each to examine the following parameters: air and water temperature, river depth, velocity, transparency (transp.), pH, electrical conductivity (EC), and total dissolved solids (TDS), which were measured directly at the collection sites (in-situ). Other parameters that were considered were nitrate (NO3-N), ammonium (NH4-N), phosphate (PO4), sulphate (SO4), dissolved oxygen (DO), and biological oxygen demand over 5 days (BOD5) using water samples that were conveyed from the sites to the laboratory where they were analyzed according to the techniques described in the American Public Health Association manual (APHA) (1998).

2.3 Sample collection and analyses

Zooplankton were sampled using a modified hand-trawling tool. At each station's shoreline, we conducted trawls using a 55-µm mesh size plankton net as described by Yagit (2006). Each trawl session lasted 15 minutes per station (Edegbene et al., 2022). Subsequently, collected water samples were transferred into labeled plastic bottles, preserved individually in 4% formalin, and conveyed to the laboratory for analysis. Using 1 mL from each of the three samples per station, a small drop from each sample was put on a glass slide under a coverslip and examined using a compound microscope (magnification: 10×10 for initial examination and 10×40 for validation) through manual counting. Identification of zooplankton species followed established guides (Jeje and Fernando, 1986; Shiel, 1995), and their abundance was estimated accordingly.

2.4 Data Analyses

Each physico-chemical parameter measured at every station were summarized as means and standard errors. Statistical differences in average values between stations were evaluated using a one-way analysis of variance (ANOVA), followed by the Tukey post hoc test mean separations. Principal component analysis (PCA) was conducted on the water quality data from the peri-urban river to determine the most significant parameters across the dataset. Diversity indices for zooplankton were calculated. Canonical correspondence analysis (CCA) was employed to explore connections between significant environmental factors and the composition and abundance of zooplankton species. Spatial similarities among sites based on zooplankton composition were evaluated using cluster analysis conducted with PAST software (Hammer et al., 2001, version 4.0). All statistical analyses were performed using the Paleontological Statistical Package (PAST) software.

3. Results

3.1 Physico-chemical parameters of Amagba-Okoroma River

Shown in **Table 1** are the water physico-chemical parameters of Amagba-Okoroma River with significant difference in air temperature, depth, transparency, and turbidity ($p < 0.05$). Results showed that station one was more electrically conductive (20.00 ±8.94) than the downstream stations two and three; and the river was slightly more turbid. From stations one to three respectively, the observed turbidities were 15.33 ± 4.32, 13.17 ± 2.99, 18.00 ±13.14. There were much more dissolved solids (TDS) at station one than stations two and three (**Table 1**). Sulphate values were highest in station 2 (14.12 ± 2.88) followed by station 1 (11.77±5.76) and station 3 (6.67±1.21); with Chloride showing similar trend, spatially.

Principal component analysis reveals seven principal drivers namely, DO, BOD5, EC, TDS, turbidity, sulphate and chloride that shape the zooplankton community structure in the Amagba-Okoroma River (**Table 2**). Two components of PCA analysis showed 100% of the observed variance in the data set, as the eigen vectors classified the 20 physico-chemical variables into two groups (i.e., PC1 and PC2). The PC1 explains 75.07% of the variance and is contributed significantly by air temperature, DO, BOD5, EC, TDS, turbidity, sulphate and chloride. These variables were shown to be correlated in the correlation matrix air temperature, DO, BOD5, and turbidity had a negative participation in PC1. PC2 explains 24.93% of the variance and is contributed significantly by air temperature, BOD5, EC, TDS, turbidity, sulphate and chloride.

Table 1. Summary of measured surface water physico-chemical parameters (n = 6) in Amagba-|Okoroma River . *Nigeria Industrial Guideline (NIS) 2015: *World Health Organisation (WHO) 2017*)*

Parameters	Stn 1	Stn 2	Stn 3	P value	F value	*Guideline
AT (°C)	**27.42AA±0.58**	**27.7AA±1.0**	**29.08BB± 0.66**	**0.004**	8.027	Ambient
	(26.5-28)	(26-28.5)	(28-30)			
WT (°C)	25.67±0.41	26±0.55	26±0.32	0.335	1.176	Ambient
	(25-26)	(25-26.5)	(25.5-26.5)			
DP (m)	**0.42AA±0.071**	**0.52AA±0.07**	**0.67AB±0.06**	**0.0001**	19.65	
	(0.34-0.5)	(0.44-0.6)	(0.6-0.75)			
FV (m/s)	0.125±0.096	0.055±0.03	0.2±0.21	0.201	1.79	
	(0.01-0.3)	0.02-0.09)	(0.3-0.5)			
Transp. (m)	**0.41AA±0.06**	**0.52BB±0.07**	**0.53CB±0.04**	**0.003**	8.470	
	(0.34-0.5)	(0.45-0.6)	(0.5-0.6)			
DO (mg/L)	1.8±0.83	2.2±1.10	2.5±1.38	0.570	0.580	7.5
	(0.5-2.8)	(0.8-3.4)	(1.2-4.8)			
BOD5 (mg/L)	2.57±1.91	2.68±0.59	3.07±0.93	0.778	0.254	6
	(1-6.1)	(2-3.6)	(2.2-4.8)			
EC (uS/cm)	20±8.94	11.67±4.08	11.67±4.08	0.050	3.670	1000
	(10-30)	(10-20)	(10-20)			
Turb. (NTU)	**15.33±4.32**	**13.17±2.99**	**18±13.14**	**0.600**	**0.526**	**5**
	(12-24)	(8-17)	(8-44)			
TDS (mg/L)	10.4±4.65	6.07±2.12	6.07±2.12	0.050	3.670	500
	(5.2-15.6)	(5.2-10.4)	(5.2-10.4)			
pH	**5.52±0.26**	**5.35±0.25**	**5.35±0.21**	**0.400**	**0.970**	**6.5-8.5**

Table 1. Cont'd

Parameters	Stn 1	Stn 2	Stn 3	P value	F value	*Guideline
	(5.2-5.9)	(4.9-5.6)	(5.1-5.6)			
NO3-N (mg/L)	0.72±0.92	1.05±0.77	0.75±0.88	0.760	0.274	50
	(0.01-2.35)	(0.06-1.9)	(0.04-2.1)			
NH4-N (mg/L)	0.12±0.02	0.09±0.07	0.05±0.06	0.190	1.830	2
	(0.09-0.15)	(0.02-0.21)	(0.011-0.15)			
PO4 (mg/L)	0.17±0.10	0.11±0.05	0.13±0.013	0.224	1.655	3.5
	(0.06-0.35)	(0.02-0.19)	(0.114-0.149)			
SO4 (mg/L)	11.77±5.76	14.12±2.88	6.67±1.21	0.169	2.002	
	(7.06-21.18)	(1-8)	(5-8)			
Cl (mg/L)	10.59± 3.87	14.12±4.47	3.866±4.47	0.133	2.317	200-250
	(7.06-14. 12)	(7.06-14. 12)	(14. 12 -21.18)			
Cd (mg/L)	BDL	BDL	BDL			0.003
Cr (mg/L)	**0.136±0.081**	**0.173±0.036**	**0.141±0.041**	**0.67**	**0.53**	**0.05**
	(0.065-0.228)	(0.298-0.194)	(0.071-0.183)			
Cu (mg/L)	**0.347±0.025**	**0.336±0.036**	**0.335±0.019**	**0.707**	**0.354**	**0.01**
	(0.297-0.365)	(0.298-0.396)	(0.325-0.374)			
Pb (mg/L)	0.008±0.004	0.003±0.004	0.004±0.005	0.154	2.121	0.01
	(0.009-0.045)	(0-0.008)	(0-0.009)			
Zn (mg/L)	**0.683±0.083**	**0.637±0.051**	**0.651±0.038**	**0.415**	**0.931**	**0.3**
	(0.582-0.753)	(0.574-0.698)	(0.618-0.722)			

Table 2. Eigenvector and eigenvalues on the correlation matrixes of concentration of physico-chemical parameters in Amagba-Okoroma River, Benin City

Water variables	PC 1	PC 2
Air temperature	**-0.121**	**-0.044**
Water temperature	-0.011	-0.033
Depth	-0.015	-0.012
Flow velocity	-0.009	0.005
Transparency	-0.004	-0.011
Dissolved oxygen	**-0.038**	**-0.043**
BOD_5	**-0.035**	-0.015
EC	**0.277**	**0.836**
Turbidity	**-0.319**	**0.162**
TDS	**0.144**	**0.434**
pH	0.006	0.017
NO_3-N	0.013	-0.030
NH_4-N	0.004	0.003
PO_4	0.000	0.006
SO_4	**0.525**	**-0.152**
Cl	**0.712**	**-0.239**
Cr	0.001	-0.003
Cu	0.000	0.001
Pb	0.000	0.000
Zn	0.000	0.004

3.2 Zooplankton community structure in Amagba-Okoroma River

Three zooplankton groups namely, Cladocera, Rotifera and Copepoda comprising of 23 taxa were encountered in this study. Rotifers was the most frequently seen group with eleven taxa (31%). Cladocera was represented with eight taxa (47%), while Copepods was represented with four taxa (22%) **Table 3** and **Figure 3**.

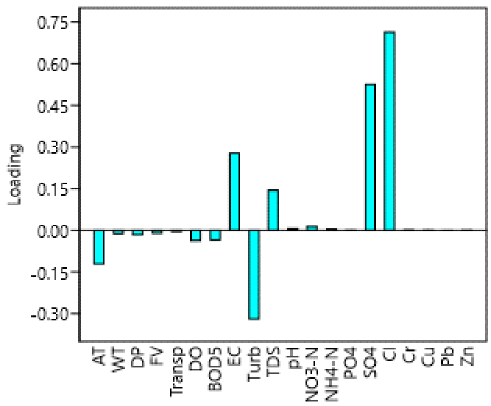

Figure 2. PCA loading

Table 3. Distribution and abundance of zooplankton in Amagba-Okoroma River, Benin City

Group	Taxa	Code	Stn 1	Stn 2	Stn 3	%
Cladocera	*Diaphanosoma sarsi*	Dia	0	10	30	47
	Euryalona orientalis	Eur	0	10	30	
	Ilyocryptus spinifer	Ily	10	10	10	
	Kurzia longirostris	Kurz	10	0	0	
	Macrothrix spinosa	Mac	10	0	0	
	Moina micrura	Moi	20	0	0	
	Moinodaphnia macleayi	Moim	10	0	0	
	Moina reticulata	Moir	0	10	0	
Copepoda	*Mesocyclops aspericornis*	Mesa	10	20	0	22
	Mesocyclops rarus	Mesr	10	0	0	
	Mesocyclops salinus	Mess	10	20	0	
	Thermocyclops neglectus	Therm	10	0	0	
Rotifera	*Anureopsis fissa*	Anu	0	10	0	31
	Asplanchnopus multiceps	Asp	10	0	0	
	Brachionus urceolaris	Bra	10	0	0	
	Brachionus angularis	Braa	0	10	0	
	Euchlanis dilata	Eucd	0	10	0	
	Euchlanis incisa	Euci	0	10	0	
	Hexarthra mira	Hexa	0	10	0	
	Lapedella patella	Lap	0	10	0	
	Oxyurella singalensis	Oxy	0	10	0	
	Proales decipiens	Pro	0	10	0	
	Trichocerca elongata	Tri	0	10	0	
Total			**120**	**170**	**70**	

3.3 Diversity indices of zooplankton in Amagba-Okoroma River, Edo State Nigeria

Station 2 had the highest abundance of zooplankton species richness (15 species). Taxonomic dominanace was higher at station 3 (0.39) than the other stations. Station 2 also had the highest Shannon diversity index (2.67) and Margalef's index (2.73), while station one had the most evenly distributed species in collected samples with an Evenness index of 0.97 as shown in **Table 4**.

Table 4. Ecological indices of zooplankton in Amagba-Okoroma River, Benin City

Diversity indices	St 1	St 2	St 3
Taxa richness	11	15	3
Number of Individuals	120	170	70
Taxonomic dominance *(D)*	0.10	0.07	0.39
Shannon Weiner index *(H)*	2.37	2.67	1.00
Evenness *(E)*	0.97	0.96	0.91
Margalef's *(d)*	2.09	2.73	0.47

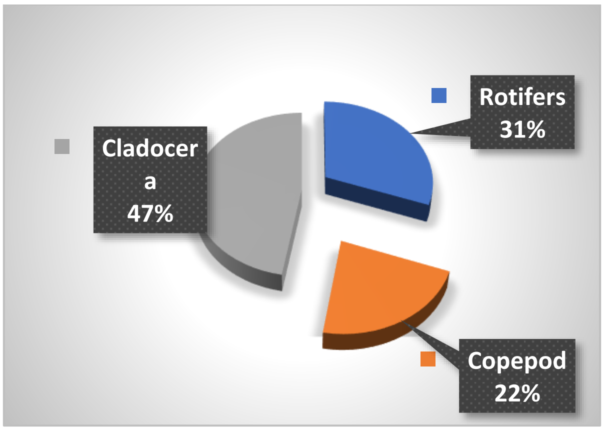

Figure 3. Percentage composition (abundance) of major zooplankton group across the study stations in Amagba-Okoroma River, Edo State Nigeria

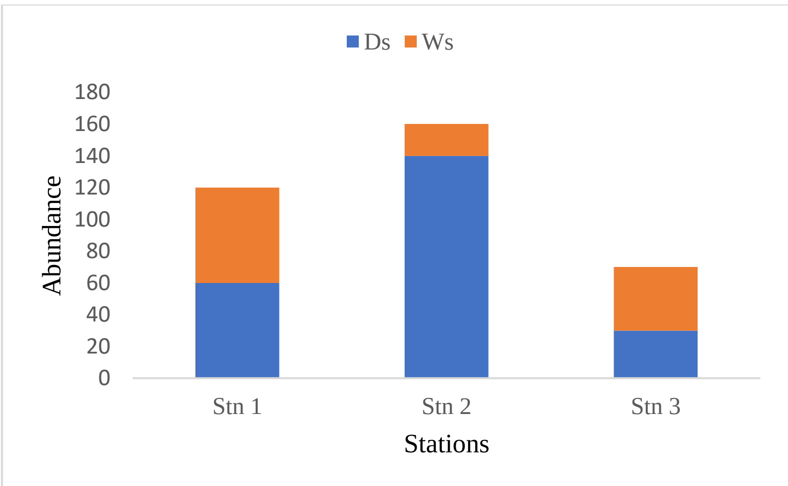

Figure 4. Seasonal variation of zooplankton (abundance) across the study station during dry season (DS) and wet season (WS) in Amagba-Okoroma River, Edo State Nigeria

3.4 Zooplankton assemblage response to the physico-chemical

The zooplankton communities in Amagba-Okoroma River Edo State Nigeria showed a strong link with the mean physico-chemical parameters measured at the Amagba- Okoroma River (**Figure 4**). CCA ordination Axis 1 account for 75.07% of species variation with eigen value of 0.71, while Axis 2 showed 24.93% species variation with eigen value of 0.23 as shown in **Table 5**. All the physico-chemical parameters showed a strong negative association to axis 1. Zooplankton was more associated with axis 2 compared to axis 1. *Moina micrura* and *Euryalona orientalis* were associated with axis 2. While *Moina micrura* show a strong positive association with the electrical conductivity and total dissolved solids in station 1, *Diaphanosoma sarsi* and *Euryalona orientalis* showed strong positive correlation BOD5, DO and a negative association with electrical conductivity, total dissolved solids, sulphate and chloride in station 3. *Mesocyclops aspericornis* and *Mesocyclops salinus* were positively associated with sulphate and chloride. Cluster analysis (Bray Curtis similarity) revealed that the zooplankton assemblage was grouped mainly by stations into 2 clusters (**Figure 5**).

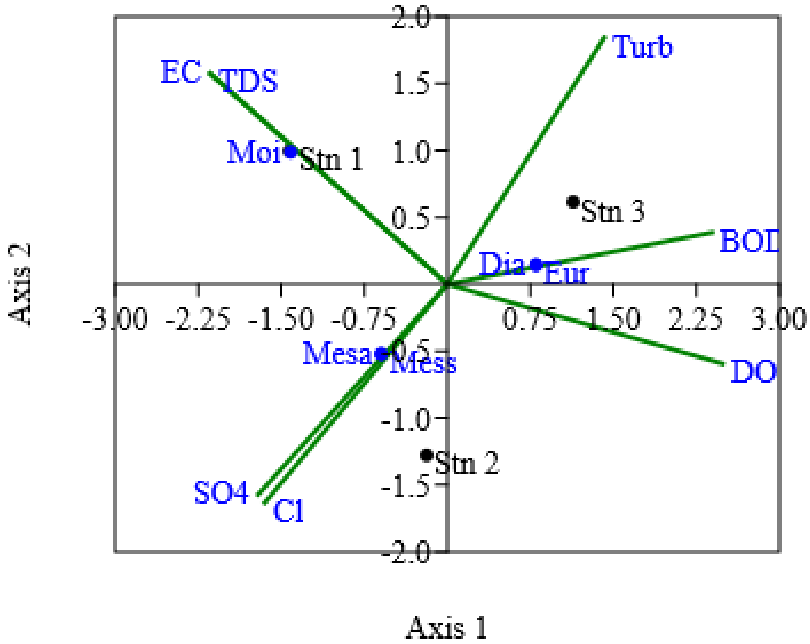

Figure 5. CCA triplot depicting relationship between sample stations, significant environmental variable, and zooplankton. Relationships between variables or similarity of samples are indicated by close clusters of points. The full names of the zooplankton taxa are given as Dia (*Diaphanosoma sarsi*), Eur (*Euryalona orientalis*), Mesa (*Mesocyclops aspericornis*), Mess (*Mesocyclops salinus*), Moim (*Moina micrura*)

4. Discussion

In this study, the physico-chemical properties recorded in Amagba-Okoroma River during is akin to previous studies (Ikhuoriah and Oronsaye, 2016; Edegbene et al., 2022). Principal component analysis reveal that four physico-chemical parameters, namely electrical conductivity, total dissolved solids, sulphate and chloride were identified as the key drivers sharpening the zooplankton communities in the river. Sulphate and chloride were highest in stations 2 compare to stations 1 and 3. This could have accounted for the acidic pH recorded in station 2 and may have been occasioned by influx of detergents arising from car washing activities by the river shore. Principal component analysis reveals seven principal drivers that shape the zooplankton community structure in the peri-urban river.

Three groups of zooplankton were encountered in the present study namely Cladocera, Rotifera and Copepoda. These zooplankton have been previously reported in Nigeria in land waters (Ikhuoriah et al., 2015; Edegbene et al., 2022; Ekpo et al., 2022). The predominance of rotifers over and above the other group in terms of species richness followed by cladocera and copepod is not unusual to Nigeria freshwater (Imoobe, 2011; Abdul et al., 2016). The present study recorded this trend as the survey was carried out seasonally between March and July. Akin-Oriola (2003) ascribed the prevalence of Rotifera to their short developmental rates under favourable conditions, while Imoobe and Adeyinka, (2010) attributed it to be due to predation pressure from planktivorous fishes that selectively prey on larger sized zooplankton. Furthermore, elsewhere in Iraq, Abdulwahab and Rabee (2015) also attributed the dominance of Rotifera over other zooplankton groups to their parthenogenetic pattern of reproduction. This pattern is not uncommon in tropical freshwater systems (Neves et al., 2003). On the other hand, many research in Nigeria have revealed the preponderance of Cladocera over other taxonomic groups (Akindele and Olutona, 2014; Ikhuoriah et al., 2015). More zooplankton abundance was recorded during the dry season when the water level and flow were very low before the rains.

Table 5. Summary statistics of first two axes of correspondence analysis CCA of the relationship between physico-chemical and zooplankton communities collected in the Amagba-Okoroma River

Variable	Axis 1	Axis 2
Eigen values	0.71	0.23
Variance (%)	75.07	24.93
DO	0.99	-0.24
BOD_5	0.96	0.15
Electrical Conductivity (mg/L)	-0.86	0.63
Total dissolved solids (mg/L)	-0.86	0.63
Turbidity	0.57	0.74
Sulphate mg/L (mg/L)	-0.68	-0.63
Chloride (mg/L)	-0.66	-0.65

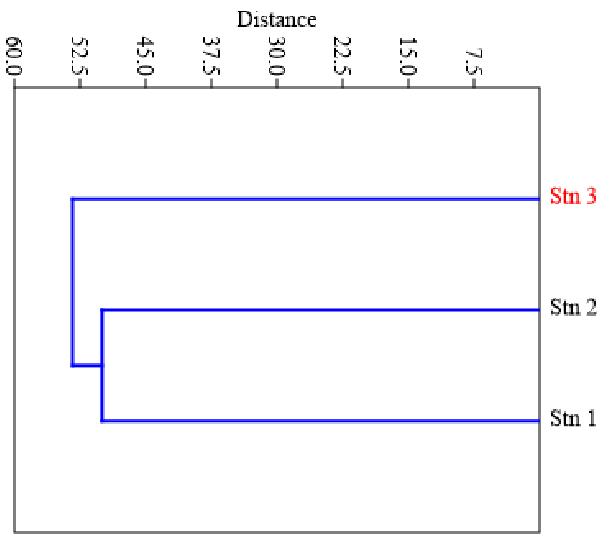

Figure 6. Cluster dendrogram showing the grouping stations based on zooplankton abundance data in the Amagba-Okoroma River Edo State Nigeria

Fluctuating number of zooplankton species richness and populations have been reported in Nigeria. Ikhuoriah et al., (2015) reported 22 species comprising of 11 cladocera, 6 copepoda and 5 rotifera in River Ossiomo. Abdul et al. (2016) reported 28 species comprising of 12 rotifera, 7 copepoda, 8 cladocera, and 1 ostracoda in tropical coastal estuary. The variability in the number of zooplankton species observed in this study may be due to fluctuation in prevailing environmental factors and the seasons of sampling.

The recorded zooplankton species richness in the Amagba-Okoroma River is less than the 57 species accounted for by Arazu and Ogbeibu (2017) in the River Niger at Onitsha Stretch, 37 species reported by Akindele and Olutona (2014) in the Aiba Reservoir and 79 species reported by Arimoro and Ogoanah (2010) in Orogodo River, all in southern Nigeria but is higher than 19 species reported by Edegbene et al., (2022) in the River Kafin Hausa, and 13 species reported by Mohammed et al., (2016) in the Wushishi Dam. It is similar to the 23 species documented by Anyanwu et al., (2023) in the Anambra River.

The strong link between zooplankton and environmental factors in the CCA analysis may connote that the zooplankton community structure was robustly sway by certain number of current environmental condition. Different investigations had previously accounted for the impact of physico-chemical factors on the zooplankton assemblage in Nigeria river system (Edegbene et al., 2022; Ebesi et al., 2022). In the present study, we noticed varying reactions of zooplankton to environmental parameters; with species, for instance *Moina micrura* displaying strong positive relationship with electrical conductivity and total dissolved solids in station 1. *Diaphanosoma sarsi* and *Euryalona orientalis* which showed a strong positive correlation with BOD5 and DO and negative correlation with electrical conductivity, total dissolved solids, sulphate and chloride in station 3 have been recommended as sentinel species of excellent water quality. *Moina micrura, Mesocyclops aspericornis* and *Mesocyclops salinus* were tolerant species with strong positive correlation with electrical conductivity, total dissolved solids, sulphate and chloride.

5. Conclusion

In sum, peri-urban rivers like the Amagba-Okoroma River are vital for urban and rural ecosystems, offering essential ecosystem services. The findings of this current study on zooplankton diversity and environmental influences underscore their potential as biomonitoring indicators, emphasizing the river's ecological significance and management implications.

Declarations

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