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Spatio-Temporal Variations of Zooplankton Fauna of Oluwa River, Ilaje Local Government Area, Ondo State, Nigeria

Olaniyan RF[1]*, Ugwumba AO[2] and Ayoade AA[2]

[1]Department of Biology, Adeyemi Federal University of Education, Ondo, Ondo State

[2]Department of Zoology, University of Ibadan, Oyo State

Research Article

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***For Correspondence**

Olaniyan RF, Department of Biology, Adeyemi Federal University of Education, Ondo, Ondo State, Nigeria,Tel: +2348060083658.

E-mail: olaniyan4real_06@yahoo.com

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ABSTRACT

The study identified zooplankton composition of Oluwa River, Ilaje Local Government Area, ondo State, Nigeria, as indicators of the health of the aquatic ecosystem. The major objective of the study was to provide baseline information on aspects of the biology (taxonomic composition, occurrence, distribution and abundance) of the zooplankton. Zooplankton samples were collected with 55µm mesh size plankton net, samples were identified and counted microscopically for eighteen months (June, 2014 – November, 2015) covering both the rainy and dry seasons. A total of six sampling stations were established to represent the various sections and regime of the river. Altogether a total of thirty-eight species belonging to three groups; Rotifera, Copepoda and Cladocera. The Rotifera were represented by thirty species, four species of Copepoda and four species of Cladocera. Rotifera dominated the zooplankton groups, accounting for 87%. *Asplanchna brightwelli* (3.65%) was the most abundant, followed by *A. girodideguerne* (3.47%). The dry season abundance (3373 Org/L) was higher than the rainy season (3025 Org/L) Copepoda accounted for 2% of the percentage abundance of zooplankton. *Eucyclops macrurus* (3.64%) dominated; followed by *Pseudocalanus elongatus* with 3.57% in the relative abundance the rainy season abundance (475 Org/L) was higher than dry season (311 Org/L). Cladocera accounted for 11% of the percentage abundance of zooplankton. *Podon leucarti* (3.64%) dominated, followed by *Ceriodaphinia cornuta* (3.57%) in the relative abundance. The dry season abundance (489 Org/L) was higher than rainy season (476 Org/L). In conclusion, Oluwa River can be inferred to be rich in zooplankton fauna composition and therefore fairly clean and unpolluted.

INTRODUCTION

Oluwa River passes through many communities in Ilaje Local Government Area in south-south of Ondo State, has a coastline of about 80 km with about 50 settlements scattered around the River (tributaries that empty directly into the coast), with an increasing population size of 2.2% annually [1]. Oluwa River is used for artisanal fishing activities, transportation, domestic purposes as well as mining of silica and sand. Despite the increasing anthropogenic influences occasioned by the rapid development of Ilaje communities as one of Niger Delta areas, there is dearth of information on the composition, zooplankton of the river. Thus, this work is aimed at contributing to the studies and existing database. The major objective of this study is to update knowledge on the status of zooplankton in Ilaje Local Government Area, Ondo State, Nigeria with a particular emphasis on the composition of zooplankton in the community by: providing baseline information on aspects of the biology (taxonomic composition, occurrence, distribution and abundance) of the zooplankton.

MATERIALS AND METHODS

Study Area

The study was conducted on Oluwa River at Ilaje Local Government Area (ILGA), Ondo State, Nigeria. The river lies on latitude 4°.40/-5°.00//N and longitude 6°.00/-60.20//E **(Figure 1)**. The annual rainy season occurs from April to October with a characteristic 'August break' during which rainfall abates, while the annual dry season occurs from November to March. Meteorologi-

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cal conditions within ILGA are as follows: mean daily minimum temperature (22.1-24.4°C); mean daily maximum temperature (24.9-36.8°C); total precipitation (125.2-278.5 mm) and mean relative humidity (76-88 mm) [2]. ILGA is in south-south of Ondo State with a coastline of about 80km which runs in a northwest to southeast direction. The coastal area of Ondo State is largely found in ILGA with about 50 settlements scattered around the river tributaries that empty directly into the coast and an increasing population size of 2.2% annually [1]. The samples for zooplankton analysis were collected by straining 100 litres of water from each station through plankton net of 55 µm mesh size and each concentrated sample was preserved in 4% formalin solution in the field according to Onyema [3].

Sampling Stations

Six sampling stations (1-6) were chosen on the Oluwa River. The distance between the stations was 500-1500 m and they were purposively selected based on the human activities in the area.

Station 1

At Ebute-Ipare had less human activities. There were farming activities involving oil palm trees (*Elaeis guineensis*) plantations and planting of cassava crops in the area.

Station 2

Alape, which was about 500 m from Station 1. The major activities in this area were construction of canoes and mat-making. Stations 1 and 2 represent the upstream.

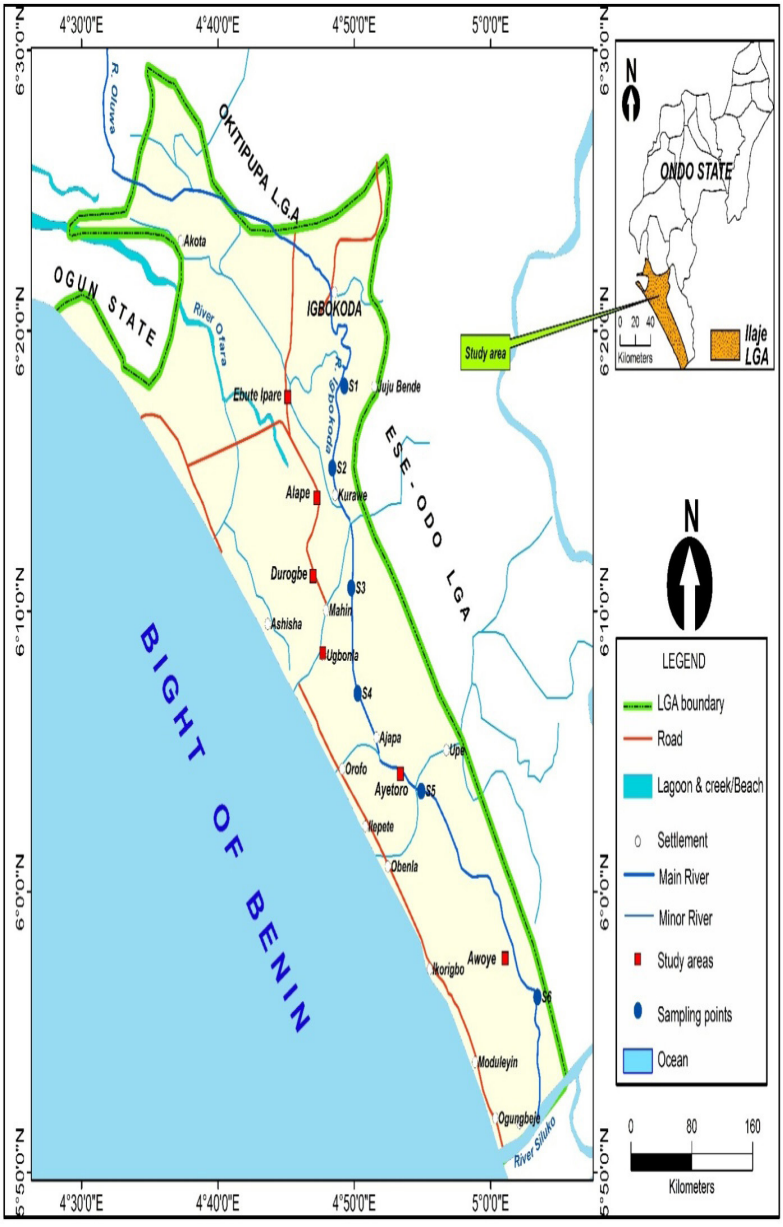

Figure 1. Map of Ilaje communities in Ondo state showing sampling stations along river Oluwa.

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Station 3

This was at Durogbe Park, which was about 700m from Station 2. Passengers board the canoes and engine boats to their various destinations on the river. Some of the vehicular wastes from engine boats were released into the river. There was a market around this station where the fishermen and fish sellers sold their fishes on the terminus under which were the dumpsites. This served as source of organic wastes into the river. Some of the passengers also used the shores of the river as their public toilets.

Station 4

This was at Ugbonla; about 500 m from Station 3. There was deposition of wastes in this place. The inhabitants used this water for bathing, washing and also release wastes, such as, cassava peels and palm kernel into the river. Also sand mining activities were not left out around this station. Stations 3 and 4 represent the midstream stations.

Station 5

Ayetoro Town is about 600 m from Station 4 with residential buildings; business activities such as, selling of fish, baskets, mats and local gins take place. The market men and women use the shore of the river as their public toilets, as most of the houses around this place lacked toilet facilities.

Station 6

Awoye was about 1500 m from Station 5. There are farming activities and local gin production. Floating plants, such as water hyacinth (*Eichhornia. crassipes*), covered the station during the rainy season. Stations 5 and 6 represent the downstream stations.

RESULTS

Zooplankton Composition

The zooplankton species encountered in Oluwa River during the period of study was made up of thirty-eight species belonging to three groups; Rotifera, Copepoda and Cladocera **(Table 1)**. The Rotifera were represented by thirty species, four species of Copepoda and four species of Cladocera. Rotifera dominated the zooplankton groups, accounting for 87% **(Figure 2)**. *Asplanchna brightwelli* (3.65%) was the most abundant, followed by *A. girodideguerne* (3.47%) **(Table 2)**. The dry season abundance (3373 Org/L) was higher than the rainy season (3025 Org/L) **(Figure 3)**. Copepoda accounted for 2% of the percentage abundance of zooplankton **(Figure 2)**. *Eucyclops macrurus* (3.64%) dominated, followed by *Pseudocalanus elongatus* with 3.57% in the relative abundance **(Table 2)**. The rainy season abundance (475 Org/L) was higher than dry season (311 Org/L) **(Figure 3)**. Cladocera accounted for 11% of the percentage abundance of zooplankton **(Figure 2)**. *Podon leucarti* (3.64%) dominated, followed by *Ceriodaphinia cornuta* (3.57%) in the relative abundance **(Table 2)**. The dry season abundance (489 Org/L) was higher than rainy season (476 Org/L) **(Figure 3)**.

Spatial Variations in Zooplankton Abundance in Oluwa River

The highest abundance for zooplankton was recorded in downstream station (2912 Org/L), while the lowest value (1856 Org/L) was recorded for upstream station during the study period **(Table 3)**.

Diversity of Zooplankton in Oluwa River

The highest Margalef (d) value (4.99), Shannon (3.64) and Evenness (0.98) were recorded upstream, while the lowest value fotr d (4.22) was obtained for downstream. The lowest H (3.61) and E (0.95) were obtained for midstream station during the study period **(Table 4)**.

Cluster Analysis of the Relationships among the Zooplankton Fauna of Oluwa River

Four clusters showed the relationships of the recorded zooplankton species at varying degrees/levels of correlation. All zooplankton species showed significant positive relationships among themselves at $p<0.05$, where $r=0.304$, except *Fililia terminalis* and *Simocephalus sp* that showed negative non-significant relationship $p>0.05$ with the other zooplankton species **(Figure 4)**.

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Table 1. A checklist of zooplankton in Oluwa river from June, 2014 to November, 2015.

Rotifera	*Asplanchna brightwelli Gosse*
	A. girodideguerne Leydig
	A. herricki De Guerne
	A. priondonta Gosse
	Brachionus bulla
	B. falcatus. Zacharias
	B. luna. Pallas
	B. quadridentatus. Hermann
	Ceratotrocha cornigera
	Cephalodella parasitica
	Filinia longiseta. Ehrenberg
	F. opoliensis. Zacharias
	F. pejleri
	F. terminalis Plate
	Gloetheca membranacea
	Horaella brehmi Donner
	Lecane tenuiseta. Turner
	L bulla Gosse
	L.luna Muller
	L. tudicola Murray
	Lepadella patella Muller
	Testudinella greeni kosti
	Trichocerca gracilis
	T. iernis
	T. musculus
	Rotaria execulis
	R. hepatica
	R. tridens
	R.neptunia Ehrenberg
	Simocephalus sp
Copepoda	*Copepod larva*
	Euclanis dilatat Ehrenberg
	Eucyclops macrurus
	Pseudocalanus elongatus
Cladocera	*Bosmina longirostris (O.E Muller)*
	Podon leucarti
	Ceriodaphinia cornuta
	Moina micrura

Table 2. Relative abundance of zooplankton organisms encountered in Oluwa river.

SPECIES	Number of Org/L	Percentage Abundance (%)
Rotifera		
Asplanchna brightwelli	267	3.36**
A. girodideguerne	254	3.20
A. herricki	171	2.15
A. priondonta	205	2.58
Branchionus bulla	233	2.93
B. falcatus	226	2.85
B. luna	198	2.50
B quadridentatus	215	2.71
Ceratotrocha cornigera	204	2.57
Cephalodella parasitica	190	2.39
Filinia longiseta	245	3.09
F. opoliensis	182	2.29

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F. pejleri	171	2.15
F. terminalis	163	2.05
Gloetheca membranacea	139	1.75*
Horaella brehmi Donner	171	2.15
Lecane tenuiseta	243	3.06
L. bulla	194	2.44
L.luna	219	2.76
L. tudicola	212	2.67
Lepadella patella	233	2.93
Testudinella greeni kosti	251	3.16
Trichocerca gracilis	246	3.10
T .iernis	231	2.91
T. musculus	198	2.49
Rotaria execulis	201	2.53
R. hepatica	201	2.53
R. tridens	244	3.07
R.neptunia	157	1.98
Simocephalus sp	196	2.47
Sub total	6,260	78.97
Copepoda		
Copepod larva	143	1.80
Euclanis dilatat Ehrenberg	157	1.98
Eucyclops macrurus	266	3.35
Pseudocalanus elongates	261	3.29
Sub total	827	10.43
Cladocera		
Bosmina longirostris (O.E Muller)	157	1.98
Podon leucarti	266	3.35
Ceriodaphinia cornuta	261	3.29
Moina micrura	156	1.96
Sub total	840	10.59
GRAND TOTAL	7,927	

Note: *= least abundance ; **=highest abundance

Table 3. Spatial variations in zooplankton abundance in Oluwa river.

Zooplankton	Upstream station	Midstream station	Downstream station
Rotifera	1614	2306	2493
Copepoda	44	45	54
Cladocera	198	277	365
Total Abundance (Org/L)	1856	2628	2912

Table 4. Diversity of zooplankton in Oluwa river.

Diversity Indices	Upstream station	Midstream station	Downstream station	OVER ALL Mean± SE
D	4.99	4.77	4.22	4.66 ± 1.23
H	3.64	3.61	3.63	3.62 ± 0.25
E	0.98	0.95	0.97	0.96 ± 1.31

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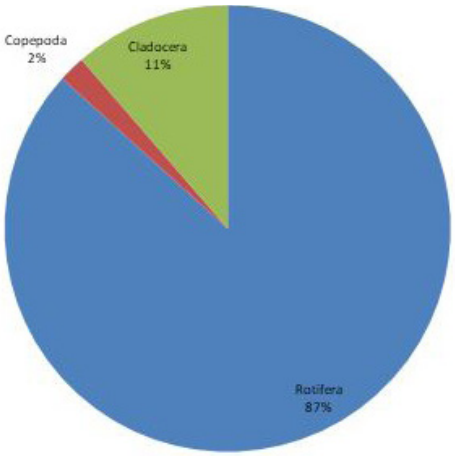


Figure 2. Percentage abundance of zooplankton in Oluwa river.

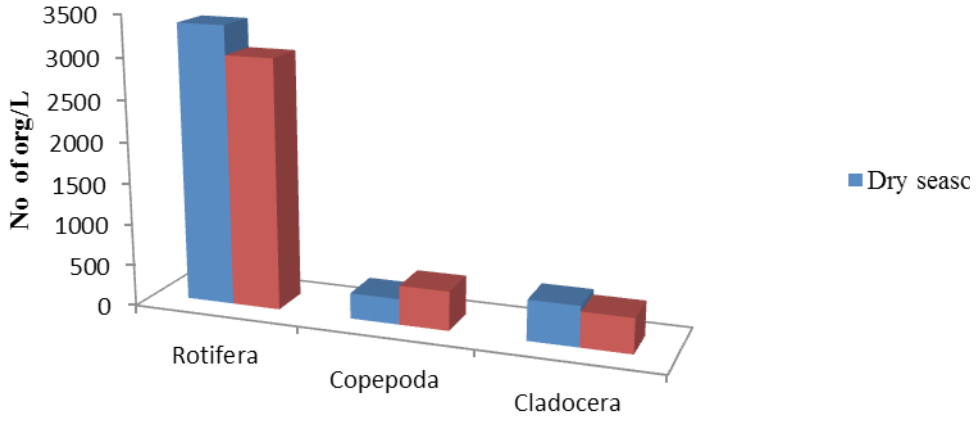
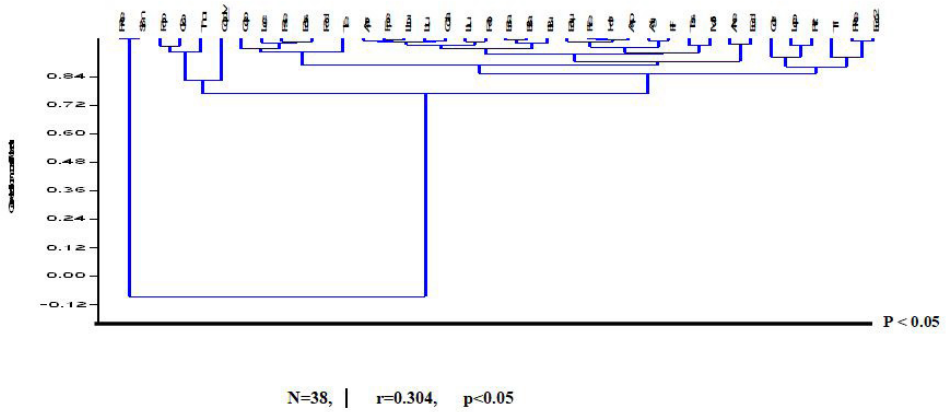


Figure 3. Relative abundance of zooplankton in the dry and rainy season in Oluwa river.



Note: Asp=*Asplanchna brightwelli, Agi= A.giradideguerne*, Ahe=*A.herricki, Apr=A.priondonta*, Bra=*Branchionus bulla*, Bfa=*B.falcatus*, Blu=*B.luna* Bqu=*B.quadridentatus,* Cer=*Ceratotrocha cornigera*, Cep=*Cephalodella parasitica*, Fil=*Filinia longiseta,* Fop=*F.opoliensis*, Fpe=*F.pejleri*, Fte=*F.terminalis*, Glo=*Glotheca membranacea, Hor=HoraellabrehmiDonner, Lec=Lecane tenuseta, Lbu=L.bulla, Llu=L.luna, Ltu=L.tudicola, Lep=Lepadella patella,* Tes=*Testudinella green Kosti,* Tri=*Trichocerca gracilis,* Tie=*T.iernis,* Tmu=*T.musculus,* Rot=*Rotaria execulis,* Rhe=*R.hepatica,* Rtr=*R.tridens*, Rne=*R.neptunia, Sim=Simocephalus sp,* Coplu=*Copepoda larva,* Euc[2]=*Euclanis dilatat,* Eud=*Eucylops macrurus,* Pse=*Pseudocalamus elongates,* Bos=*Bosmina* sp, Pod=*Podon leucarti,* Cda= *Ceriodaphninia cornuta,* Moi=*Moina micrura*

Figure 4. Cluster diagram showing the relationships between the zooplankton species of Oluwa river.

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DISCUSSION

Zooplankton

The zooplankton taxa, namely Rotifera, Copepoda and Cladocera, identified in Oluwa River have been variously reported from different Nigerian Rivers [4-12]. This study recorded 38 species of zooplankton, which is higher than 6 species recorded by Olaleye and Adedeji in palm oil effluent-impacted area in Oluwa River, Ondo State; 19 species recorded by Ogbuagu and Ayoade in Imo River [13]. 30 species reported by Nkwoji et al. in Lagos Lagoon, but less than 39 species recorded by Esenowo and Ugwumba in Majidun River in Lagos State [14]. This present observation of higher zooplankton species possibly indicates the presence of organic wastes deposition in Oluwa River, which results in increase in phytoplankton production, consequently, zooplankton productivity. The predominance of rotifers in the river in terms of species number and numerical abundance has been attributed to the fact that rotifers evolved from fresh waters [15-17]. Rotifers generally are adapted to warm water, occurring mostly in tropical water bodies, with high temperatures. The predominance of rotifers in some inland freshwaters has also been reported by Egborge in Osun River; Jeje and Fernando in Sokoto River; and Ayodele and Adeniyi in River Osun [18-20]. The abundance of the genera *Brachionus, Asplanchna* and *Filinia* showed that the rotifer-fauna was made up of a tropical assemblage. The predominance of the Brachionidae could, however, be attributed to their widespread geographical distribution and omnivorous nutrition of most of the members [21]. The increasing order of diversity and evenness are Rotifera > Copepoda > Cladocera in the upstream, midstream and downstream, respectively. This same order was observed in both seasons. This observation is similar to those of Oben in three man-made lakes in Ibadan, Nigeria [22].

Seasonal variation in the abundance of zooplankton from Oluwa River in this study showed higher abundance of Rotifera and Cladocera during the dry season [23]. Most rotifers species have been found to thrive well in warm-water conditions with high temperatures, which is usually characteristic of most Afro-tropical waters in the dry season [17].

CONCLUSION

The increasing order of diversity and evenness are Rotifera > Copepoda > Cladocera in the upstream, midstream and downstream, respectively. This same order was observed in both seasons. On the basis of zooplankton composition and abundance, Oluwa River can be inferred to be rich in zooplankton fauna composition and therefore fairly clean and unpolluted.

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