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SPATIAL AND TEMPORAL OCCURRENCE OF PHYTOPLANKTON AND ZOOPLANKTON IN AKOMOJE WATER RESERVOIR, ABEOKUTA, OGUN STATE, NIGERIA.

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ABSTRACT

The present study was carried out to examine the monthly spatial and temporal occurrence of phytoplankton and zooplankton in Akomoje water reservoir, Abeokuta, Ogun State Nigeria. This was carried out for eighteen months between March, 2018 and August, 2019 in four different sampling stations (Odo water, Oke Dam, Odo Onigi and Odo Onigi). The diversity indices of plankton data were carried out using Shannon-wiener's index (H), Simpson's index of heterogeneity (D), Margalaf's Index (d), Reciprocal of Simpson index (Dr), Jaccard's coefficient and Sorensen Index. A total of thirty (30) species belonging to seven (7) groups were recorded for the phytoplankton and the groups were Cynophyceae, Baccillariophyceae, Euglenophyceae, Dinophyceae, Chlorophyceae, Zygnomataceae and Chanophyta while the zooplankton reported were twenty-two (22) species found in five (5) groups and the groups were Rotifera, Protozoa, Copepoda, Cladocera, and Ostracoda and they were all widely distributed in the four investigative stations. Phytoplankton indicated that Baccillariophyceae (42.53%) was the most predominant taxon, followed by Cynophyceae 21.92% and Euglenophyceae (16.97%), while the least taxon was Dinophyceae 1.32%. Zooplankton revealed that most abundant taxon was Rotifer having a relative abundance of 29.91%, and the second predominant taxon was Protozoa 24.57% followed by Cladocera 23.59% and Copepoda (20.26%), while the least taxon was Ostracoda 1.67%. It was concluded that the low compositions, diversity and abundance of plankton in the Akomoje water reservoir could be said to be moderately polluted as at the period of this study due to runoff from agriculture and human activities around the reservoir. Hence, corrective measures should be put in place on the dangerous effects of dumping untreated wastes and effluents into the water body and public enlightenment programme should be routinely organized.

Keywords: Temporal, spatial, diversity, phytoplankton, zooplankton, abundance.

INTRODUCTION

Freshwater rivers are complex and continuously changing ecosystems in which biological processes are closely linked to hydrological and environmental variability. Within these systems, planktonic organisms play a central role in driving primary production and supporting trophic interactions. **Phytoplankton**, primarily composed of photosynthetic microalgae and cyanobacteria, represent the main source of autochthonous organic matter in rivers by transforming inorganic nutrients and solar energy into biomass. This primary production forms the energetic base of riverine food webs and contributes to nutrient cycling and oxygen dynamics. **Zooplankton**, including rotifers, Cladocera's, and copepods, occupy a key intermediary position by consuming phytoplankton and transferring energy to higher trophic levels such as fish larvae and macroinvertebrates (Lair and Lair, 2008; Liu, *et al.,* 2015). The distribution and community structure of phytoplankton and zooplankton in riverine environments are regulated by multiple interacting factors, including flow regime, nutrient availability, temperature, and light conditions. Anthropogenic pressures such as nutrient enrichment, pollution, and hydrological regulation further alter these factors, often resulting in measurable changes in plankton composition and abundance. When considering the lentic ecosystems, rivers are characterized by frequent physical disturbance and strong longitudinal gradients, which limit plankton accumulation but favour species with rapid growth and dispersal capabilities. Due to their short life cycles and high sensitivity to environmental change, phytoplankton and zooplankton are widely used as **biological indicators of water quality and ecological status**. Recent studies have shown that plankton community structure closely reflects ecological condition in regulated lowland rivers, demonstrating strong relationships with water quality classifications (Bou, *et al.,* 2025). In addition, analyses of planktonic microeukaryotes along river continua indicate that both environmental filtering and dispersal processes shape community assembly, emphasizing the responsiveness of plankton to natural gradients and human disturbances (Dong, *et al.,* 2025). Understanding phytoplankton and zooplankton dynamics is therefore essential for evaluating river ecosystem health and informing sustainable freshwater management.

In Nigerian tropical rivers, seasonal variations in water quality and nutrient levels have been shown to strongly influence phytoplankton and zooplankton diversity and abundance, highlighting the applicability of plankton as bioindicators in different geographic contexts (Opeh, *et al.,* 2025). Understanding these dynamics is essential for evaluating river ecosystem health and guiding sustainable freshwater management. Many studies have revealed that phytoplankton and zooplankton can be used as indicators of water pollution (Kudari and Kanamadi, 2008; Shanthala *et al.,* 2008). When an aquatic system is considered, the planktons prove to be of great importance as the changes in the environment can portray an instantaneous response of the plankton (Thakur *et al.,* 2013 and Malik *et al.,* 2013). The plankton growth rate and development depend on various biotic as well as abiotic factors like, light, temperature, available nutrients, hydronamics, predation, oxygen concentration, pH etc (Dhar *et al.,* 2012). The phytoplankton forms the basic trophic level and are succeeded by the zooplanktons as the next level (Malik *et al.,* 2013). The analyses of such indicator organism, both qualitative and quantitative, have resulted in an aiding option to integrate the effects of a number of pollutants, unlike the physicochemical processes which have led to the identification of one pollutant at a time. Further, the indices and other systems have been utilized to determine the current status of different water bodies. The process of bio-monitoring has become an essential part of water pollution studies and contributes immensely towards the research in the field of water quality assessment (Mahadev *et al.,* 2007). Therefore, a pertinent study of the biological factors of this river is very crucial to ascertain the quality of the water in order to ensure conservation of the aquatic ecosystem.

MATERIALS AND METHODS

Description of study area

The study was carried out in Akomoje lower course of Ogun River, in Abeokuta, Ogun State. The reservoir is located in Abeokuta North Local Government of Ogun State and lies between Longitude 03° 21' and 03° 23' East and Latitude 07° 56' and 07° 58' North of Abeokuta with a size of 1000 hectares (Figure 1). Ogun River is a perennial river in Nigeria which had its source from the Sepeteri town which is few kilometres from Saki. The dry season is between November and March while the wet season is between Aprils and October. The annual rainfall ranges from 900 mm in the North of the River to 200 mm towards the South (Adeosun *et al.,* 2014). Total annual potential evapo-transpiration is 1600 mm and 190 mm.

Ogun river catchment area is located in South-West Nigeria, bordered geographically by latitude 6° 26'N and 9° 10'N and longitude 2° 28'E and 4° 4'E. The reservoir is about 230 km^2. The relief is generally low, with the gradient in the North-South direction. Akomoje reservoir stores water from stores Ogun River; the reservoir not only serves as a source of fishing, but also serves as portable water processed by Ogun State Water Cooporation (Adeosun *et al.,* 2014). Sampling was designed to capture both spatial and temporal variability in the plankton communities.

Sampling Procedures

Plankton Sampling and Microscopic identification

Plankton samples were collected using standard **plankton nets** with mesh sizes ranging from 30–55 µm, suitable for capturing microplankton and small zooplankton. Nets were deployed horizontally at the surface or near the littoral zone and towed manually for 5–10 m per replicate, following established protocols (Ajibare *et al.,* 2019; Dimowo, 2013). In areas where towing was not feasible, water was collected in buckets and filtered through the net to concentrate plankton. Surface water samples for plankton assemblages were collected in 2L plastic bottle by dipping the container bottle, sliding over the upper surface of water with it mouth against the water current to permit undisturbed passage of the water into the bottle (Tanimu, *et al.,* 2011). The samples were immediately fixed with 4% formalin solution to arrest cell activity, for sedimentation and better staining (Anene, 2003; Onyema, 2007). The samples were stored in a dark compartment in the laboratory for overnight sedimentation. In the laboratory, concentrated plankton samples were examined under **a compound light microscope** at 10×–100× magnification. Phytoplankton taxa were identified to genus or species level using standard taxonomic Keys for freshwater algae (Bellinger and Sigee, 2015). Zooplankton, including rotifers, cladocerans, and copepods, were also identified to the lowest taxonomic level possible.

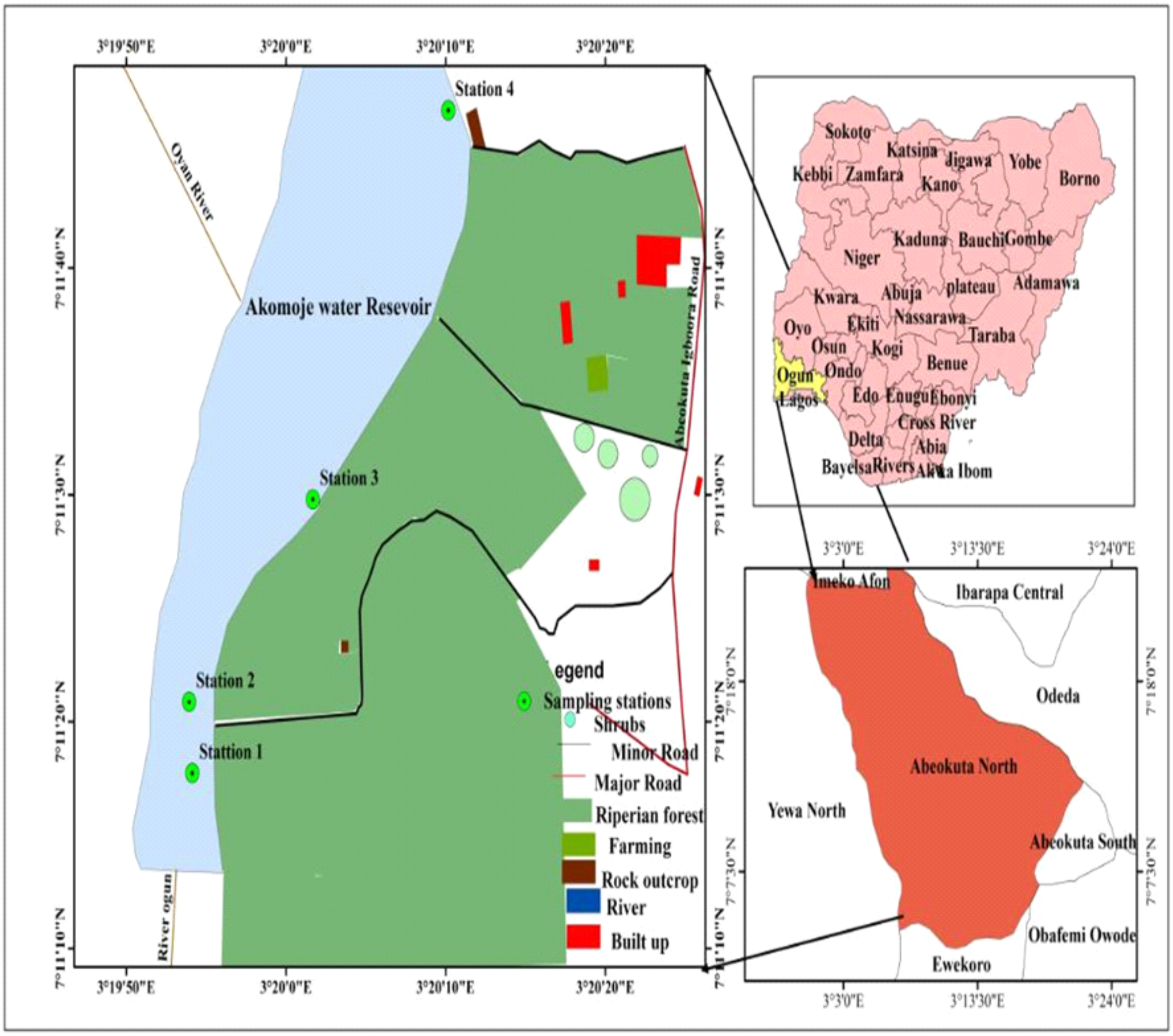

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Figure 1: Map of Akomoje water reservoir (Field survey, 2018**)**

Data Analysis

Descriptive and inferential statistical analysis were performed using SPSS Version 22.0 (PEC, 2008) and MS Excel 2010 software were used. The diversity indices of plankton data were carried out using Shannon-wiener's index (H), Simpson's index of heterogeneity (D), Margalaf's Index (d), Reciprocal of Simpson index (Dr), Jaccard's coefficient and Sorensen Index as reported by (Dinowo, 2013)

RESULTS

Distribution, abundance and community structure of phytoplankton in Akomoje water Reservoir.

The spatial distribution and relative abundance of phytoplankton occurring during the period of the study are presented in Table 1. A total of one thousand, nine hundred, and seventy-five (1,975) of phytoplankton comprising thirty (30) species and seven (7) taxa were recorded. These include; Cynophyceae which was represented by *Lyngbya martensiana, Microcystis turgid, Oscillatoria limnos, Oscillatoria sanota,* and *Spirulina platensis;* Bacillariophyceae represented by *Cyclotella spp, Cymbella affinis, Melosira granulata, Navicula cuspidate, Navicula cyptocephala, Navicula expansa, Navicula mutica, Pinnularia braunii, Pinnularia nobilis, Stephanodisus* spp, *Surirella tenera, Synedra fascicula,* and *Synedra ulna;* Euglenophyceae represented by *Euglena acus, Lepocinclis* spp, *Phacus curvicauda, Trachelomonas hisipida,* and *Trachelomonas oblonga;* Dinophyceae was represented by *Peridinium* spp*;* Chlorophyceae was represented by *Closterium spp, Gonatozygon aculeatum,* and *Straurastrum leptocladium;* Zygnomataceae was represented by *Spirogyra* spp*;* Chanophyta was also represented by *Netrium* spp. In terms of the number of species recorded per taxa, Bacillariophyceae had the highest number with 13 species, followed by Cynophyceae (6), while Dinophyceae, Zygnomataceae and Chanophyta had one species each. *Spirogyra sp* was the most common species in Station 1 and 3 (6.22% and 4.71% respectively). The least abundant species in Station 1 was *Peridinium* spp (1.00%) and Station 2 were *Closterium* spp (1.25%), station 3 were also *Melosira granulata* (0.98%) and *Synedra ulna* (1.03%) in Station 4. *Phacus curvicauda*

(6.22%), was predominant in Station 2 and *Navicula mutica* (6.58%) was most common in Station 4.

The monthly distribution of phytoplankton during the study is presented in Table 2. Most of the species were recorded throughout the study period but the least occurred species during the study period was *Synedra fascicula*. The seasonal distribution of phytoplankton, as shown in Table 3 depicted that higher number of individuals was recorded during the wet season compared to the dry season. During the dry season, *Spirogyra* appeared to be the most abundant species, while *Spirulina platensis* was the most predominant species during the wet season. *Navicula cuspidata* and *Peridinium* spp were the least abundant species in the dry and wet season respectively. Overall, the most predominant species was *Spirogyra* spp (4.25%), *Pinnularia braunii* (4.21%), *Navicula expansa* (4.17%) *and Oscillatoria limnos* (4.20%) while the least dominant was *Peridinium* spp (1.32%), *Closterium* spp (2.43%), *Gonatozygon aculeatum* (2.58%). Bacillariophyceae (42.53%) was the most predominant taxa, followed by Cynophyceae (21.92%) and Euglenophyceae (16.97%), while the least taxa were Dinophyceae (1.32%). Table 4 shows the community structure of phytoplankton in the study area. Station 3 had the highest number of individuals (510), followed by Station 1 (498), Station 4 (486) while Station 2 had the lowest number of individuals. The numbers of species were the same throughout the period of study. Margalef species richness decreased among the Stations in the order of 2>4>1>3. Shannon weiner index ranged from 3.36-3.37 while Simpson dominance was 0.04. The Pielou's evenness index was 0.99 for all the stations.

Table 1: Spatial distribution and relative abundance of phytoplankton in Akomoje water Reservoir

		Stations				
Class	Species	1	2	3	4	Total
Cynophyceae						
	Lyngbya martensiana	15(3.01)	16(3.33)	18(3.53)	21(4.32)	70(13.73)
	Microcystis aureginosa	18(3.61)	15(3.12)	17(3.33)	19(3.91)	69(13.53)
	Microcystis turgid	17(3.41)	14(2.91)	17(3.33)	17(3.50)	65(12.75)
	Oscillatoria limnos	25(5.02)	19(3.95)	20(3.92)	19(3.91)	83(16.27)
	Oscillatoria sanota	15(3.01)	16(3.33)	20(3.92)	18(3.70)	69(13.53)
	Spirulina platensis	22(4.42)	16(3.33)	20(3.92)	19(3.91)	77(15.10)
Bacillariophyceae						
	Cyclotella spp	15(3.01)	14(2.91)	15(2.94)	16(3.29)	60(11.76)
	Cymbella affinis	13(2.61)	16(3.33)	17(3.33)	16(3.29)	62(12.16)
	Melosira granulata	17(3.41)	15(3.12)	5(0.98)	15(3.09)	60(11.76)
	Navicula cuspidata	14(2.81)	15(3.12)	15(2.94)	16(3.29)	60(11.76)
	Navicula cyptocephala	17(3.41)	14(2.91)	14(2.75)	15(3.09)	60(11.76)
	Navicula expansa	12(2.41)	18(3.74)	16(3.14)	16(3.29)	62(12.16)
	Navicula mutica	12(2.41)	12(2.49)	12(2.35)	32(6.58)	52(10.20)
	Pinnularia braunii	13(2.61)	11(2.29)	17(3.33)	11(2.26)	52(10.20)
	Pinnularia nobilis	15(3.01)	21(4.37)	21(4.12)	16(3.29)	73(14.31)
	Stephanodisus spp	15(3.01)	22(4.57)	19(3.73)	14(2.88)	70(13.73)
	Surirella tenera	12(2.41)	19(3.95)	22(4.31)	16(3.29)	69(13.53)
	Synedra fascicula	20(4.02)	16(3.33)	23(4.51)	20(4.12)	86(16.86)
	Synedra ulna	22(4.42)	15(3.12)	22(4.31)	5(1.03)	74(14.51)
Euglenophyceae						
	Euglena acus	20(4.02)	15(3.12)	23(4.51)	16(3.29)	74(14.51)
	Lepocinclis spp	19(3.82)	20(4.16)	18(3.53)	18(3.70)	75(14.71)
	Phacus curvicauda	15(3.01)	29(6.03)	17(3.33)	16(3.29)	64(12.55)
	Trachelomonas hisipida	21(4.22)	16(3.33)	17(3.33)	18(3.70)	72(14.12)
	Trachelomonas oblonga	16(3.21)	18(3.74)	17(3.33)	15(3.09)	66(12.94)
Dinophyceae						
	Peridinium spp	5(1.00)	11(2.29)	13(2.55)	15(3.09)	26(5.10)
Chlorophyceae						
	Closterium spp	17(3.41)	6(1.25)	11(2.16)	14(2.88)	48(9.41)
	Gonatozygon aculeatum	13(2.61)	11(2.29)	13(2.55)	11(2.26)	48(9.41)
	Straurastrum leptocladium	13(2.61)	12(2.49)	14(2.75)	12(2.47)	51(10.00)
Zygnomataceae						
	Spirogyra spp	31(6.22)	23(4.78)	24(4.71)	16(3.29)	116(22.75)
Chanophyta						
	Netriumspp	19(3.82)	16(3.33)	13(2.55)	14(2.88)	62(12.16)
	Total	**498**	**481**	**510**	**486**	**1975**

*Percentage occurrence in parenthesis

Table 2: Monthly distribution of phytoplankton in Akomoje water Reservoir

		2018										2019							
Class	Species	Mar.	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Cynophyceae																				
	Lyngbya martensiana	6	2	3	1	1	4	1	2	2	1	2	3	3	3	2	4	4	4	48
	Microcystis aureginosa	2	3	3	4	2	5	2	6	3	1	1	1	4	4	3	5	5	6	60
	Microcystis turgids	6	4	1	2	2	4	5	6	4	2	3	3	2	2	3	5	4	4	62
	Oscillatoria limnos	5	5	1	0	2	8	1	4	4	3	1	7	4	3	6	9	6	5	74
	Oscillatoria sanota	4	3	1	4	4	1	1	2	2	4	2	1	2	2	2	4	4	5	48
	Spirulina platensis	2	4	3	4	4	6	3	5	4	3	3	5	4	5	4	6	5	5	75
Bacillariophyceae																				
	Cyclotella spp	3	5	1	1	2	9	4	4	2	1	4	7	5	4	3	6	4	5	70
	Cymbella affinis	5	3	1	6	1	4	3	2	3	3	1	4	4	3	5	4	5	3	60
	Melosira granulata	5	2	3	4	3	5	2	5	4	2	4	5	4	2	4	7	4	4	69
	Navicula cuspidata	3	3	2	3	3	6	5	3	3	2	3	5	3	4	4	5	4	4	65
	Navicula cyptocephala	4	5	3	4	3	3	2	5	4	3	1	0	2	4	4	3	6	4	60
	Navicula expansa	4	4	1	4	3	4	1	3	3	1	2	4	5	5	4	4	5	3	60
	Navicula mutica	1	5	2	4	3	5	2	5	5	3	3	0	1	3	4	4	6	6	62
	Pinnularia braunii	2	1	3	3	1	4	5	2	2	2	3	3	3	2	4	4	4	4	52
	Pinnularia nobilis	7	2	3	5	4	3	3	3	3	2	3	2	4	4	3	4	4	3	62
	Stephanodisus spp	5	3	3	2	3	7	4	5	2	3	3	5	6	5	6	9	6	6	83
	Surirella tenera	5	4	2	2	3	4	3	4	4	2	3	7	4	3	3	7	5	4	69
	Synedra fascicula	2	0	4	0	0	1	2	3	2	0	2	0	0	1	1	3	3	2	26
	Synedra ulna	3	2	1	4	3	6	4	6	3	1	2	5	3	4	3	5	4	5	64
Euglenophyceae																				
	Euglena acus	1	2	1	4	2	4	4	3	2	2	0	5	2	4	4	4	4	4	52
	Lepocinclis spp	4	4	2	2	2	7	2	6	3	2	3	6	4	4	6	4	7	5	73
	Phacus curvicauda	12	8	1	4	4	3	3	10	6	1	5	6	6	7	9	10	11	10	116
	Trachelomonas hisipida	9	4	4	1	3	7	4	4	3	1	2	3	4	4	4	7	8	5	77
	Trachelomonas oblonga	2	5	3	2	4	5	4	5	4	2	0	4	8	3	4	5	5	5	70
Dinophyceae																				
	Peridiniumspp	3	3	2	4	4	2	1	1	2	3	3	1	3	3	3	5	3	5	51
Chlorophyceae																				
	Closterium spp	4	3	4	2	3	9	4	4	3	3	0	5	4	4	3	4	4	6	69
	Gonatozygon aculeatum	5	7	6	2	3	8	2	5	4	0	1	7	6	5	6	7	7	5	86
	Straurastrum leptocladium	3	4	3	4	5	5	4	6	4	2	4	3	3	5	3	6	5	5	74
Zygnomataceae																				
	Spirogyra spp	4	4	2	0	2	7	1	5	4	2	4	7	4	3	6	7	5	5	72
Chanophyta																				
	Netrium spp	4	2	5	4	3	4	4	4	3	3	3	4	4	4	2	4	4	5	66
	Total	**125**	**106**	**74**	**86**	**82**	**150**	**86**	**128**	**97**	**60**	**71**	**118**	**111**	**109**	**118**	**161**	**151**	**142**	**1975**

Table 3: Seasonal distribution of phytoplankton and their relative abundance in Akomoje water Reservoir

Class	Species	Dry Season	Wet Season	Total	Relative Abundance (%)
Cynophyceae					**21.92**
	Lyngbya martensiana	22	48	70	3.54
	Microcystis aureginosa	24	45	69	3.49
	Microcystis turgids	36	29	65	3.29
	Oscillatoria limnos	46	37	83	4.20
	Oscillatoria sanota	25	44	69	3.49
	Spirulina platensis	22	55	77	3.90
Bacillariophyceae					**42.53**
	Cyclotella spp	35	25	60	3.04
	Cymbella affinis	20	42	62	3.14
	Melosira granulata	30	28	58	3.01
	Navicula cuspidata	14	47	61	3.07
	Navicula cyptocephala	29	31	60	3.05
	Navicula expansa	33	49	82	4.17
	Navicula mutica	32	20	52	2.63
	Pinnularia braunii	31	21	52	2.63
	Pinnularia nobilis	22	51	83	4.21
	Stephanodisus spp	37	33	70	3.54
	Surirella tenera	39	30	69	3.49
	Synedra fascicula	23	31	56	2.84
	Synedra ulna	40	34	74	3.75
Euglenophyceae					**16.97**
	Euglena acus	38	36	74	3.75
	Lepocinclis spp	40	35	75	3.80
	Phacus curvicauda	17	47	64	3.24
	Trachelomonas hisipida	25	47	72	3.65
	Trachelomonas oblonga	35	31	66	3.34
Dinophyceae					**1.32**
	Peridiniumspp	16	10	26	1.32
Chlorophyceae					**7.44**
	Closterium spp	17	31	48	2.43
	Gonatozygon aculeatum	15	33	48	2.43
	Straurastrum leptocladium	15	36	51	2.58
Zygnomataceae					**4.35**
	Spirogyra spp	55	31	86	4.35
Chanophyta					**3.14**
	Netriumspp	21	41	62	3.14
	Total	**836**	**1139**	**1975**	

Table 4: Diversity indices of phytoplankton in Akomoje water Reservoir

	Station 1	Station 2	Station 3	Station 4
Number of species	30	30	30	30
Number of individuals	498	481	510	486
Margalef species richness (d)	4.669	4.696	4.652	4.688
Simpson's dominance index	0.04	0.04	0.04	0.04
Shannon-Weiner index (H')	3.36	3.37	3.37	3.37
Pielou's evenness index (J')	0.99	0.99	0.99	0.99

Distribution, relative abundance and community structure of zooplankton

Table 5 shows the spatial distribution and relative abundance of zooplankton in the sampling stations. In Station 1, a total of 343 zooplankton specimens were recorded. In terms of abundance, *Oikomonas* was the most predominant with a relative abundance of (10.79%) followed by *Keratella quadrata* (10.50%) while the least abundant species were *Testudinella emarginula* (2.33%) and *Cypridiopsis* (1.46%) respectively. 370 individuals were recorded in station 2, *Paramecium* dominated the population with (8.11%) followed by *Keratella quadrata* with (7.84%) while the least was *Cypridiopsis* with (1.35%). Station 3 had the highest number of zooplankton individuals (412) and the most dominated species were *Keratella quadrata* with (10.68%) followed by *Polyarthra vulgaris* (7.04%) while the least was *Cypridiopsis* with (1.70%). Station 4 had the lowest number of zooplankton (316), but the most predominant species were *Amoeba* (6.96%) and *keratella quadrata* with (6.33%) while *Cypridiopsis* was the least dominated species. For the overall zooplankton abundance, *Keratella quadrata* (8.95%) followed by *Monostyla hamata* (5.20%) were the most abundance and the least species was *Testudinella emarginula* (3.12%) recorded for Rotiferaa. For the Protozoa group, Amoeba (8.26) was the highest followed by *Oikomonas* (5.76%) while the least were *Blepharisma* and *Paramecium* with (5.27%) respectively. Copepoda group had *Thermocyclops nigerians* (4.58%) as the most dominated species followed by *Mesocyclops leukarti* (4.44%) and the least of them were *Cyclops strenus* and *Diaptomus* with (4.02%) respectively. Cladocera had *Moina reticulate* (5.14%) as the highest followed by *Ceriodapnia cornuta* (4.88%) while *Scapholebris* (3.82%) was the least among the group.

The monthly distribution and relative abundance of zooplankton species in Akomoje water reservoir are presented in Table 6. A total of 1,441 specimens belonging to 22 species from five taxa were recorded during the study period. These included, the Rotiferaa which was represented by *Filinia longiseta, Keratella quadrata, Lecane luna, Monostyla hamata, Polyarthra vulgaris* and *Testudinella emarginula;* Protozoa represented by *Amoeba, Blepharisma, Oikomonas* and *Paramecium;* Copepoda represented by *Canthocamptus microstaphylinus, Cyclops strenus, Diaptomus, Mesocyclops leukarti* and *Thermocyclops nigerianus;* Cladocera represented by *Bosmina longinostris; Ceriodaphnia cornuta, Eurycerus, Moina reticulata, Polyphemus* and *Scapholebris;* Ostracoda represented by *Cypridiopsis.* The most abundant zooplankton group was Rotiferaa with a relative abundance of 29.91%, followed by Protozoa 24.57%, Cladocera (23.59%) and Copepoda (20.26%) while the least zooplankton group were Ostracoda (1.67%).

Table 7 shows the seasonal distribution in zooplankton which recorded higher numbers of specimens in the wet season compared to the dry season. *Keratella quadrata* (10.25%) and *Amoeba* (8.55%) were the most predominant species in the wet and dry seasons respectively. Table 8 shows the community structure of zooplankton in Akomoje water reservoir. The highest number of individuals was recorded in Station 3 (412) followed by Station 2 (370) and Station 1 (343) while Station 4 (316) had the lowest. Margalef's species richness index showed that Station 4 and Station 1 had the highest species richness followed by Station 2 while 3 had the least species richness. Pielou's evenness index ranged from 0.96 in Station 1 to 0.99 in Station 4. Simpson dominance index ranged from 0.05 in Station 2, 3 and 4 to 0.06 in Station 1. Shannon-weinner diversity index of the Stations descended in order of 4>3>2>1.

Table 5: Spatial distribution and relative abundance of zooplankton in Akomoje water Reservoir

Zooplankton group	Species	Stations 1	2	3	4	Total
Rotiferaa						
	Filinia longiseta	13(3.79)	12(3.24)	14(3.40)	16(5.06)	55(3.82)
	Keratella quadrata	36(10.50)	29(7.84)	44(10.68)	20(6.33)	129(8.95)
	Lecane luna	9(2.62)	16(4.32)	14(3.40)	18(5.70)	57(3.96)
	Monostyla hamate	13(3.79)	19(5.14)	26(6.31)	17(5.38)	75(5.20)
	Polyarthra vulgaris	13(3.79)	15(4.05)	29(7.04)	13(4.11)	70(4.86)
	Testudinella emarginula	8(2.33)	9(2.43)	11(2.67)	17(5.38)	45(3.12)
Protozoa						
	Amoeba proteus	35(10.20)	35(9.46)	27(6.55)	22(6.96)	119(8.26)
	Blepharisma spp	17(4.96)	24(6.49)	23(5.58)	12(3.80)	76(5.27)
	Oikomonas spp	47(10.79)	16(4.32)	18(4.37)	12(3.80)	83(5.76)
	Paramecium spp	16(4.66)	30(8.11)	18(4.37)	12(3.80)	76(5.27)
Copepoda						
	Canthocamptus microstaphylinus	14(4.08)	10(2.70)	10(2.43)	12(3.80)	46(3.19)
	Cyclops strenus	11(3.21)	12(3.24)	21(5.10)	14(4.43)	58(4.02)
	Diaptomus spp	14(4.08)	18(4.86)	16(3.88)	10(3.16)	58(4.02)
	Mesocyclops leukarti	13(3.79)	15(4.05)	21(5.10)	15(4.75)	64(4.44)
	Thermocyclops nigerianus	16(4.66)	15(4.05)	18(4.37)	17(5.38)	66(4.58)
Cladocera						
	Bosmina longinostris	11(3.21)	10(2.70)	13(3.16)	11(3.48)	45(3.12)
	Ceriodaphnia cornuta	12(3.50)	24(6.49)	15(3.64)	19(6.01)	70(4.86)
	Eurycerus spp	5(1.46)	8(2.16)	11(2.67)	14(4.43)	38(2.64)
	Moina reticulate	20(5.83)	22(5.95)	20(4.85)	12(3.80)	74(5.14)
	Polyphemus spp	13(3.79)	14(3.78)	18(4.37)	13(4.11)	58(4.02)
	Scapholebris spp	12(3.50)	12(3.24)	18(4.37)	13(4.11)	55(3.82)
Ostracoda						
	Cypridiopsis spp	5(1.46)	5(1.35)	7(1.70)	7(2.22)	24(1.67)
	Total	**343**	**370**	**412**	**316**	**1441**

*Relative abundance in parenthesis

Table 6: Monthly distribution of Zooplankton in Akomoje water Reservoir

		2018										2019							
Family	Species	Mar.	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Rotifera																			
	Filinia longiseta	2	4	5	4	3	4	3	2	3	3	1	3	1	3	2	3	4	5	55
	Keratella quadrata	7	11	2	9	6	1	3	15	17	6	5	21	5	5	2	4	4	3	129
	Lecane luna	3	3	2	6	3	3	2	8	4	4	2	2	3	3	2	4	4	4	57
	Monostyla hamate	7	2	4	10	8	1	3	8	3	6	2	3	5	3	2	2	4	2	75
	Polyarthra vulgaris	3	2	4	9	4	0	1	5	4	6	1	6	3	6	3	3	5	5	70
	Testudinella emarginula	1	2	6	4	2	3	2	1	1	3	2	4	0	4	2	2	3	3	59
Protozoa																			
	Amoeba proteus	4	10	18	13	7	10	4	6	5	5	4	9	4	5	5	4	8	6	119
	Blepharisma spp	10	3	5	4	4	2	1	10	2	4	2	3	4	3	4	5	4	6	76
	Oikomonas spp	1	0	9	8	17	3	2	3	1	9	2	5	2	6	2	3	7	3	83
	Paramecium spp	2	3	5	11	6	2	1	4	2	6	2	4	4	2	4	5	8	5	76
Copepoda																			
	Canthocamptus microstaphylinus	1	2	2	4	2	2	4	2	3	1	2	4	3	3	2	3	4	2	46
	Cyclops strenus	5	4	2	4	1	3	3	3	4	3	2	5	3	0	3	3	5	5	58
	Diaptomus spp	2	3	4	7	3	2	3	5	2	5	1	5	3	4	2	1	3	3	58
	Mesocyclops leukarti	4	3	6	4	1	3	2	4	4	4	3	5	5	1	2	1	7	5	64
	Thermocyclops nigerianus	4	4	4	4	3	3	4	2	3	3	2	7	7	2	3	2	4	5	53
Cladocera																			
	Bosmina longinostris	1	2	4	2	2	2	3	4	2	2	0	5	2	3	2	3	3	3	45
	Ceriodaphnia cornuta	4	5	4	9	4	4	0	4	2	6	1	6	6	2	2	1	6	4	70
	Eurycerus spp	2	1	2	3	1	1	2	2	3	3	1	4	3	3	2	2	2	1	38
	Moina reticulate	8	8	2	7	2	3	0	9	2	6	1	6	5	2	3	1	6	3	74
	Polyphemus spp	2	3	3	5	3	0	2	4	2	4	3	6	5	3	2	3	5	3	58
	Scapholebris spp	2	1	4	3	2	2	3	3	3	5	1	4	4	3	3	3	5	4	55
Ostracoda																			
	Cypridiopsis spp	0	0	2	4	1	0	2	1	0	1	3	3	0	1	1	1	3	1	24
	Total	**89**	**82**	**86**	**134**	**85**	**54**	**50**	**103**	**71**	**100**	**43**	**104**	**77**	**67**	**55**	**59**	**106**	**81**	**1441**

Table 7: Seasonal distribution of zooplankton and their relative abundance of Akomoje water reservoir

Family	Species	Dry Season	Wet Season	Total	%RA
Rotifera					29.91
	Filinia longiseta	21(3.66)	34(3.92)	55	3.82
	Keratella quadrata	40(6.98)	89(10.25)	129	8.95
	Lecaneluna	18(3.14)	39(4.49)	57	3.96
	Monostyla hamate	32(5.58)	43(4.95)	75	5.20
	Polyarthra vulgaris	27(4.71)	43(4.95)	70	4.86
	Testudinella emarginula	27(4.71)	18(2.07)	45	3.12
Protozoa					**24.57**
	Amoeba spp	49(8.55)	70(8.06)	119	8.26
	Blepharisma spp	25(4.36)	51(5.88)	76	5.27
	Oikomonas spp	20(3.49)	63(7.26)	83	5.76
	Paramecium spp	39(6.81)	37(4.26)	76	5.27
Copepoda					**20.26**
	Canthocamptus microstaphylinus	21(3.66)	25(2.88)	46	3.19
	Cyclops strenus	25(4.36)	33(3.80)	58	4.02
	Diaptomus spp	24(4.19)	34(3.92)	58	4.02
	Mesocyclops leukarti	31(5.41)	33(3.80)	64	4.44
	Thermocyclops nigerianus	28(4.89)	38(4.38)	66	4.58
Cladocera					**23.59**
	Bosmina longinostris	12(2.09)	33(3.80)	45	3.12
	Ceriodaphnia cornuta	29(5.06)	41(4.72)	70	4.86
	Eurycerus spp	17(2.97)	21(2.42)	38	2.64
	Moina reticulate	27(4.71)	47(5.41)	74	5.14
	Polyphemus spp	24(4.19)	34(3.92)	58	4.02
	Scapholebris spp	25(4.36)	30(3.46)	55	3.82
Ostracoda					**1.67**
	Cypridiopsis spp	12(2.09)	12(1.38)	24	**1.67**
	Total	**573**	**868**	**1441**	

*Relative abundance in parenthesis

Table 8: Diversity indices of Zooplankton in Akomoje water Reservoir

	Station 1	Station 2	Station 3	Station 4
Number of species	22	22	22	22
Number of individuals	343	370	412	316
Margalef species richness	3.597	3.551	3.488	3.649
Simpson's dominance index	0.06	0.05	0.05	0.05
Shannon-Weiner index	2.95	2.99	3.01	3.06
Pielou's evenness index (J')	0.96	0.97	0.97	0.99

DISSCUSSION

The phytoplankton community in Akomoje reservoir was characterized by seven families of thirty species. This was higher than the observation on Usman (2015) on Waman rafi lake in Kazaure, Nigeria where he reported four families made up of thirteen genera while Adesalu and Kunrunmi (2012) recorded higher 117 species belonging to ten (10) genera in Majidun creek of Lagos lagoon, Nigeria. However, the number of families recorded by this author was lower than the number recorded in this study. This study recorded phytoplankton abundance (1,975 specimens) in Akomoje water reservoir. Mustapha, (2009) recorded 13,594 number of phytoplankton specimens belonging to 20 genera in Oyun reservoir, Offa, Nigeria. Likewise, 7 genera of phytoplankton recorded in this study was very low when compared to Adon *et al.,* (2012) who also recorded 212 genera belonging to 6 families in Adozope Reservoir, South East of Cote d'Ivoire. The lower number of phytoplankton in Akomoje Reservoir could be linked to numerous anthropogenic activities around the reservoir. Higher phytoplankton abundance during the wet season agreed with Mustapha, (2009) who reported that high primary productivity is usually rainy period in tropical reservoir. Diatoms are considered as one of the most common and dominant zooplankton groups in freshwater (Belliger and Sigee, 2010).

The observation on Baccillariophceae (diatom) being the most abundant phytoplankton in the wet season agreed with the report of Ogamba *et al.,* (2005); Akoma and Imoobe (2009) and Akpan (1993). Abundance of diatoms in the rainy season might be as a result of water mixture during heavy rainfall which could have resulted in recycling of nutrients which consequentially boost the growth and abundance of the algae in the wet season (Ugwumba and Ugwumba, 1993). The Zygnemataceae (*Spirogyra spp*) generally had higher abundance during the dry season which also conformed to Ugwumba and Ugwumba (1993). This could be due to the higher temperature and transparency which favour higher photosynthesis (Altaf, 2010). The zooplankton groups during the study period consisted of Rotiferas, protozoa, copepod, cladocera, ostracoda. Zooplankton species composition and diversity gave an insight into the characteristics and quality of the water. Zooplankton contributes to the economy of the ecosystem (Umoren and Edokpayi, 2006).

Zooplankton grazes on phytoplankton and they respond to seasonal influences dictated by physical and chemical structure of the environment (Castro and Huber, 2005), coupled with the grazing stress exerted by the zooplankton). However, zooplankton have short life span than phytoplankton and there is usually a natural compensatory provision for the zooplankton to enhance reproduction capacity such that they always are present in large numbers (Prasad, 2000) But the law of predator – prey relationship is such that there is ecological interplay, in which the ones preyed upon would always be in their large numbers against the predators (Aneni and Hassan 2003). This is clearly shown in general abundance of the zooplankton during the period of study. However, higher vertebrate like the fishes strongly contributes to their low abundances of zooplanktons which they veraciously prey upon (Mann, 2000) in agreement with the previous reports of Umoren and Edokpayi (2006) and Job and Asuquo (2011). Five taxonomic groups of zooplankton were identified in this study and each group was widely distributed in all the sampling stations. However, Rotiferas dominated the species identified followed by protozoa, cladocera, copepoda, ostracoda. Similar High dominance of Rotiferas was reported by Adeyemi (2012) in Ajelo stream, Imoobe (2011) in Okhuo River, Abdul *et al.,* 2016 in tropical coatal estuary, South West, Nigeria and Omowaye *et al.* (2011) in Ojofu Lake. On the contrary, Okorafor *et al.,* (2013) reported cladocerans and copepods dominated in Calabar River.

However, the dominance of Rotifera in Nigerian aquatic ecosystems has also been documented by other authors like Abdul *et al.,* (2016) and Ogbeibu and Osokpor, (2004). The dominance of Rotifera was explained to be due to predation pressure from planktivorous fishes that selectively prey on larger sized zooplankton and their reproductive success and short developmental rates under favourable conditions in most freshwater systems (Akin-Oriola, 2003; Imoobe and Adeyinka, 2009). Varying number of zooplankton species and populations were reported by different authors in different water bodies in Nigeria. Akin-Oriola (2003) reported 49 species comprising 32 Rotifera, 6 Cladocera and protozoa and 4 copepoda in Ogunpa and Ona rivers, Imoobe and Adeyinka (2009) reported 40 species comprising 16 Rotiferas, 12 cladocerans, 12 copepods and 10 calanoids in a Forest River. However, the variability in the zooplankton species observed in this study might be attributed to changes in physico-chemical parameters and the seasons of sampling. The zooplankton observed during this study is higher than the 10 species reported by Yakubu *et al.,* (2000) from Nun River and 24 species reported by Zabbey *et al.,* (2008) from Imo River, all in the Niger Delta area, but it was less than the 66 species reported by Ekwu and Sikoki (2006) in the lower Cross river estuary. Zooplankton species identified in this study were ideal in tropical region as Imoobe and Adeyinka (2009) earlier reported the most dominant zooplankton species in West African freshwater ecosystems to be Rotiferas, copepods, cladoceras, ostracods and protozoan. In species diversity indices, Zooplankton ranged between 2.887 – 3.649 (Margalef index (d)), 2.95 – 3.06 (Shannon weaver index (H)) and 0.96-0.99 (Pelous's evenness index (J')) across Stations.

CONCLUSION

This study showed that there is low plankton compositions, diversity and abundance in the reservoir. Also, the reservoir could be said to be moderately polluted as at the period of this study due to runoff from agriculture and human activities around the reservoir. The presence of pollution indicator algal species and the relative dominance that are observed in the reservoir are evidence of pollution. This type of pollution resulted from anthropogenic activities from surrounding communities and waterfront dwellers releasing raw human excreta, detergents and wastewater. This is an indication that there is need for adequate management practices of the reservoir.

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