# PRELIMINARY ASSESSMENT OF PLANKTON COMMUNITY OF AKOR RIVER, IKWUANO, ABIA STATE, NIGERIA.

**[1]Odo, S.N., [1]Egesi, O.C. [3]Anyanwu, E.D., [3]Adaka, G. S., and [1]Ndukwe, J.**
[1]Department of Fisheries and Aquatic Resources Management, Michael Okpara University of Agriculture, Umudike, Nigeria.
[2]Department of Zoology and Environmental Biology, Michael Okpara University of Agriculture, Umudike, Nigeria.
[3]Department of Fisheries and Aquaculture Technology, Federal University of Technology Owerri, Imo State, Nigeria
**Corresponding Author**: revadaka@gmail.com +2348037838049

**Abstract**
The research was carried out to investigate the distribution and abundance of plankton in Akor River, Nigeria. Between March and August 2019, monthly samples were collected from three stations. Thirty-one (31) species of zooplanktons resulting to individual number of 557 from four phyla were recorded; cladocera (9), copepod (10), protozoa (5) and rotifer (7) with relative abundance of 27.8%, 30.9%, 17.2% and 24.1% respectively. The most abundant species of zooplankton obtained during the sampling period were *Diaphanosoma brachyurum*, *Difflugia lebes*, *Sinodiaptonussarsi* and *Chromaglaster testudo*. Among the **C**ladocera, *Diaphanosoma brachyurum*, *Allonella excise* and *Diaphanosoma pausipinosum* were found abundant. Copepoda group was dominated by *Sinodiaptonus sarsi*,*Eucyclops speratus* and *Microcyclops albidus*. *Diffugia lebes*, *Amoeba radiosa and Brachionus leyoligi* were domnatants among the Protozoa. Among the Rotifera, *Chromaglaster testudo*, *Brachionus plicatilis* and *Chromaglaster ovalis* were observedto be dominated species.Phytoplankton population was made up of twenty- eight (28) species belong to six phyla. Cyanophyta dominated the phytoplankton with relative abundance of 28.7%, followed by chlorophyta(24.3%), Euglenophyta(16.9%), Bacillariophyta (16.5%), Xanthophyta (11.1%) and Chrysophyta(2.5%). Among the Cyanophyta, *Anabaena spiroides* was dominated species. *Tabellaria binalis and Cosmarium aruserum* were observed as the most abundant species among the *Bacillariophyta and Clorophyta* respectively.The overall abundance of zooplankton population was in the following order: Copepoda > Cladocera> Protozoan > Rotifera. Phytoplankton population in this study followed: Cyanophyta > Chlorophyta>Euglenophyta > Bacillariophyt > Xanthophyta >Chryophyta.Station 3 recorded highest in all the index in terms of species evenness, Shannon diversity, Simpson diversity and Margalef diversity index for both zooplankton and phytoplankton.

**Keyword:** plankton, abundance, distribution, community structure, biodiversity

## Introduction

Anthropogenic activities such as farming, washing of clothes, motorcycles, plates, fermenting of breadfruits, cassava, manual sand mining and water extraction influence water quality and possibly the community structure of phytoplankton. Human activities around or in water body may cause damage to individual species and population including the natural biological communities (Adedeji *et al*., 2019). The floating movements of plankton are so feeble that any little changes in water current influences both the movement and composition of the organisms (Adelayo and Ifeanyi, 2019). Many studies have identified different factors based primarily on the nature of anthropogenic activities predominate in the area to influence phytoplankton growth, composition and abundance (Poongodi *et al*., 2009; Ewa *et al*., 2013; Adelayo and Ifeanyi, 2019)

The quality of water body especially surface water can be evaluated from the species diversity and abundance of its plankton community (Poongodi *et al*., 2009; Adelayo and Ifeanyi, 2019). The richness of plankton in an ecosystem shows an indication of the physico-chemical characteristics of the water body. Aquatic macro and microorganisms such as zooplankton and macro-invertebrate population have been used as biological indicators in the monitoring of quality aquatic ecosystem (Onwudiwe, et al., 2018; Ukaonu *et al*., 2015; Maneechan and Prommi, 2015; Kwen *et al*., 2019). Studies have shown that there is a close link between the abundance and diversity index of plankton and pollution level in any aquatic system. High abundance and diversity of plankton in any water body especially freshwater reveals clean water.

## Materials and Methods

### Description of Study Area

Akor River took its source from Bende in Abia State and passes through many communities (including Nkanu Nta, Obuoru and Itunta) before discharging into River Cross at Itunta. The stretch of Akor River studied is between Station 1 and Itunta in Ikwuano area of Abia State; about 4.25km in length. It is located between latitude 5°26.854' and 5°28.031' N and Longitude 7°37.860' and 7°38.838' E (Ukagwu and Deekae, 2016). The river was divided into three stations for the purpose of this study. Station 1 is the upstream and control station, located in Ikwuano area.

The station was relatively sandy substrate with numerous activities such as extraction of water for drinking, swimming, washing of clothes, kitchen utensils, processing of breadfruits, manual sand mining, lumbering and transportation of woods and firewood. Station 2 is located at Itunta, about 2.3km downstream of station 1. It is located between latitude 5°26.854' and 5°28.031' N and Longitude 7°37.860' and 7°38.838' E. It is shallow, sandy with numerous human activities like extraction of water for drinking, washing and bathing, nursing of seedlings, lumbering, and extraction of water for moulding of blocks, manual sand mining, processing of breadfruits, and washing of motorcycles. Station 3 is also located at Itunta, about 740m downstream of station 2. It is located between latitude 5°26.854' and 5°28.031' N and Longitude 7°37.86' and 7°38.83'E. The station was deep with minimal human activities. Station 3 is surrounded with farmland with vegetable crops and coco plantation

**Plankton Sampling and Analysis**

The plankton samples were collected from undisturbed sections of the river by filtering 100litres of water through a Wisconsin conical plankton net (65 µm mesh size). Samples were transferred into 120 ml screw cap plastic container and preserved with 70% ethanol before transported to the laboratory. One ml of the preserved sample was taken using a pipette into Sedgwick- rafter counting chamber and viewed under different magnifications (x100 and x400) using a light binocular microscope (Nikon 400 binocular microscope). Planktons were sorted into different taxonomic groups and the cells per ml were counted. Identification work was done using key literatures by Jeje and Fernando (1986); Janse van Vuuren *et al* (2006) and Dang *et al.* (2015). The identification was made to lowest practicable taxonomic level.The community structures of the plankton were determined using PAST statistical package (Hammer *et al*., 2001) for Margalef (D), Shannon-weiner (H) and Evenness (E) indices

## Results and Discussion

### Distribution and Abundance of Phytoplankton

Table 1 shows result of phytoplankton distribution and abundance. A total number of **459** individual phytoplankton from 28 species belonging to six phyla (Bacillariophyta, chlorophyccac, chrysophyta, cyanophyta, euglenophyta and xanthophyta) was identifies throughout the six months' study period. Numerically, cyanophyta dominated other phyla with relative abundance 28.7% resulting from 129 individual species, followed by chlorophyta having individual species totaling 109 with relative abundance 24.3% whereas Chrysophyta recorded least individual population of 11 with relative abundance of 2.5% (Table 3 and Figure 1). Phytoplankton abundance in the Akor River thus, followed the order cyanophyta > chlorophyta >euglenophyta>Bacillariophyta>xanthophyta>chrysophyta.

Spatially, the highest individual populations of phytoplankton species (207) with relative abundance of 45.1% was identified in Station 3 whereas Station 1 station had a total number of one hundred and forty-nine (149) individual species with relative abundance of 33. 0%, and the least number of individual species (104) with relative abundance 23.1% was observed in Station 2 station. Station 3 recorded highest in all the family of phytoplankton with exemption of bacilariophyta, which was highest in station1 where there was manual sand mining. This result revealed that bacillariophyta population was relative higher in the stations were sand mining was going on.The diversity indices of Phytoplankton showed that a high Shannon-Wiener index (H) ranged between 3.144 and 3.077. Station 2 recorded the highest (3.144) compared to 3.125 and 3.077 recorded in Station 2 and Station 1 respectively (Table 4). Station 1 recorded the highest Magalef Species Richness (5.813) while Station 1 and Station 2 recorded 5.003 and 4.876 respectively. Evenness Index ranged between 0. 859 and 0.813 with the lowest (0.813) and highest (0.859) values recorded in Station 2and 1 respectively. The range of Shannoe-Wiener index (H) obtained in this study s within the result obtained by Honggang *et al.* (2012) who recorded phytoplankton diversity indices between 2.11 and 4.06 in the intertidal wetlands of the Pearl River estuary, China.

**Table 1: Phytoplankton Distribution and Abundance in Akor River**

| Group | Taxa | Station 1 | Station 2 | Station 3 | Total | RA (%) |
|---|---|---|---|---|---|---|
| **Cyanophyta** | *Anabaena spiroides* | 13 | 8 | 15 | 36 | 7.8 |
| | *Anabaena affinis* | 8 | 3 | 8 | 19 | 4.1 |
| | *Phormidium mucicola* | 4 | 2 | 4 | 10 | 2.2 |
| | *Oscillatoria cacustris* | 4 | 7 | 8 | 19 | 4.1 |
| | *Spirulina sustolissima* | 2 | 1 | 3 | 6 | 1.3 |
| | *Mycrocystis aeruginosa* | 3 | 1 | 11 | 15 | 3.3 |
| | *Nostoc planctonum* | 5 | 3 | 10 | 18 | 3.9 |
| | *Dactylococ capsisirregulatis* | 0 | 1 | 5 | 6 | 1.3 |
| | ***Total*** | **39** | **26** | **64** | **129** | **28.1** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Xanthophyta** | *Batryococ cusbrounii* | 13 | 5 | 16 | 34 | 7.4 |
| | *Ophiocytium cochleare* | 10 | 5 | 11 | 26 | 5.7 |
| | ***total*** | **23** | **10** | **27** | **60** | **13.1** |
| **Chrysophyta** | *Chrysococcusrefescens* | 2 | 3 | 6 | 11 | 2.4 |
| | ***Total*** | **2** | **3** | **6** | **11** | **2.4** |
| **Chlorophyta** | *Clostorium parrutum* | 6 | 6 | 16 | 28 | 6.1 |
| | *Pediastrum srinples* | 3 | 7 | 9 | 19 | 4.1 |
| | *Cosmarium aruserum* | 13 | 5 | 11 | 29 | 6.3 |
| | *Voluox aurcus* | 4 | 5 | 9 | 18 | 3.9 |
| | *Pandorinanorum* | 4 | 4 | 7 | 15 | 3.3 |
| | ***total*** | **30** | **27** | **52** | **109** | **23.7** |
| **Euglenophyta** | *Astasia websii* | 10 | 1 | 12 | 23 | 5.0 |
| | *Euglena wangi* | 3 | 1 | 9 | 13 | 2.8 |
| | *Urogleno psisapuculata* | 7 | 7 | 10 | 24 | 5.2 |
| | *Euglena oxyuris* | 6 | 3 | 2 | 11 | 2.4 |
| | *Stauratum franale* | 0 | 1 | 4 | 5 | 1.1 |
| | ***total*** | **26** | **13** | **37** | **76** | 16.6 |
| **Bacillariophyta** | *Asterionella Formosa* | 3 | 4 | 4 | 11 | 2.4 |
| | *Fragilaria oceania* | 3 | 1 | 4 | 8 | 1.7 |
| | *Tabellaria binalis* | 10 | 7 | 5 | 22 | 4.8 |
| | *Cyclotella comta* | 4 | 7 | 4 | 15 | 3.3 |
| | *Melosira grannlata* | 2 | 3 | 3 | 8 | 1.7 |
| | *Cymatopleura solea* | 2 | 1 | 0 | 3 | 0.7 |
| | *Vitzschia closterium* | 4 | 2 | 1 | 7 | 1.5 |
| | *total* | **28** | **25** | **21** | **74** | 16.1 |
| | **Total** | **148 (32.2%)** | **104 (22.7%)** | **207(45.1%)** | **459** | **100** |

Diversity indices represent how rich and productive a surface is in terms of zooplankton species. Higher Shannon-Wiener index (H) obtained in this study is an indication that Akor River rich in terms of primary productivity and can support aquatic organisms. Virtually, all the study sites had a stable and balanced habitat structure (H' > 3.0). Margalef's index values >3.0 indicate clean conditions (Akindele and Adeniyi, 2013) and in this study the values across the sampled stations are greater than 3; thus indicating that Akor River is a clean surface and support aquatic plant growth.

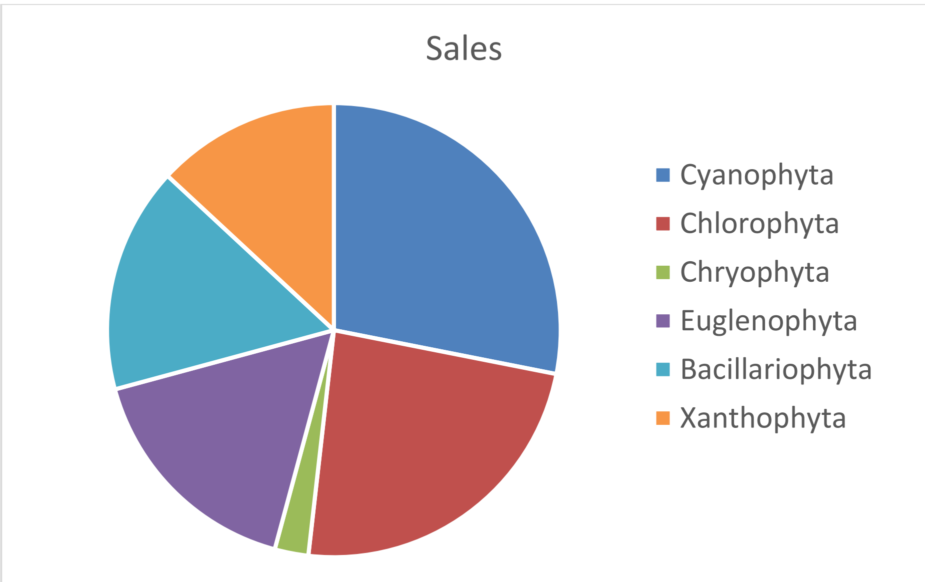


**Figure 1: Relative Abundance of phytoplankton in Akor River**

Cyanophyta species at the sampled stations are normally distributed (p-value 0.214) and the variances are equal for the relative abundance of Cyanophyta in the 3 stations (p-value 0.321) at 95% confidence level. Both the mean relative abundance between the species of Cyanophyta with p-value (0.291) and between the three stations with the p-value (0.598) were not significantly difference at 95% confidence level.

**Table 2: Ecological Index of Phytoplankton in Akor River**

| Station | Station 1 | Station 1 | Station 3 |
|---|---|---|---|
| **Taxa_S** | 26 | 28 | 27 |
| **Individuals** | 148 | 104 | 207 |
| **Dominance_D** | 0.0536 | 0.04974 | 0.04791 |
| **Simpson_1-D** | 0.9464 | 0.9503 | 0.9521 |
| **Shannon_H** | 3.077 | 3.125 | 3.144 |
| **Evenness_e^H/S** | 0.8342 | 0.8128 | 0.8589 |
| **Margalef** | 5.003 | 5.813 | 4.876 |

**Normality and constant variance of Phytoplankton**

The high population of cyanophyta across the three indicated a high inflow of nutrient into the river.Notable bio-indicator phytoplankton species recorded were *Anabaena spiroides*, *Anabaena affinis*,*Microcystisaeruginosa*,and Oscillatoria *casuistries* and all these bio-indicator were higher in station 3. These bio-indictors produce algal toxic that can harmful to both humans and some other mammals (Adeniyi, *et al*., 2019). *Closteriumparrutum*, *Euglenawangi* and *Euglena oxyuris* were other pollution indicators species recorded in this study. The presence of these harmful and pollution indicators across the three stationsuggests likelihood of pollution in Akor River Ugwumba *et al*., 2013). The analysed results in this study indicated that anthropogenic activities did not impact/alter the community structure and population distribution of Cyanophyta.

Chlorophyccae species at the 3 different river stations are normally distributed (p-value 0.4248) and the variances are equal for the relative abundance of Chlorophyccac in the 3 stations (p-value 0.1777) at 95% confidence level. Both the mean relative abundance between the species of Chlorophyccac and between the three stations was not significantly difference with the p-value (0.291) and the p-value (0.598) at 95% confidence level. Euglenophyta Phytoplankton species across three-sampled river stations were normally distributed (p-value 0.968) and the variances were equal for the relative abundance of euglenophyta in the 3 stations (p-value 0.0.541) at 95% confidence level. The results of two-way ANOVA for both the mean relative abundance between the river stations (p-value (0.555) and the mean relative abundance between the species of Euglenophyta Phytoplankton species (p-value 0.14) reveal no significant difference (p>0.05)**.**

The normal, equalityin the relative abundance and no significant difference (p>0.05) across stations may be attributed to almost uniform anthropogenic activities in and around the sampled stations. The results revealed that anthropogenic activities within and around the river has no effect on community structure and population distribution of both chlorophyte and Euglenophyta species. The Bacillariophyta phytoplankton species across three sampled stations were normally distributed with p-value 0.9675 and the variances were equal for the relative abundance of the Phytoplankton species across the three stations (p-value (0.1047)) at 95% confidence level. The normal and equal for relative abundance in across stations may be attributed to almost uniform anthropogenic activities in and around the sampled stations. The two way ANOVA result shows that the mean relative abundance between the three stations with the p-value (0.598) is greater than 0.05 show no significant difference while the mean relative abundance between the species of the Bacillariophyta phytoplankton species (p-value = 0.0234) differed greatly (p<0.05). The post-hoc test conducted on the mean relative abundance between the species of the Bacillariophyta Phytoplankton species showed that there is significant difference in mean relative abundance only for *Tabellaria binalis* and *Gyrosigua altenuatum* species since their adjusted p – value (0.0259) < 0.05. The results of this study revealed that anthropogenic activities in and around the Akor River have adversely impacted and altered community structure and population distribution of Bacillariophyta. In addition, the population distribution of *Tabellaria binalis* and *Gyrosigua altenuatum*within Bacillariphyta were also altered by numerous human activities going on within and around the river.

Table 3 shows result of zooplankton distribution and abundance with their relative percentage abundant. A total of 553 individuals of zooplankton were recovered in this study throughout the study period. These comprised four groups of zooplankton species, namely cladocerans, copepods, protozoan and rotifers. Numerically, copepods were the most dominant accounting for 31.1% of the total plankton. The protozoans were numerically, the least important accounting for only 17.4% of the plankton (Table I and Fig. 2). Zooplankton abundance in the Akor River thus, followed the order Copepoda > Cladocera >Rotifera > Protozoa. Spatially, there was an even distribution of zooplankton in all the three stations, although Station 1 station had the highest individual population of zooplankton (198) with relative abundant of 35.8%., Station 2had total population of 179 species of zooplankton with relative abundance of 32.4% and station 1 recorded the least population (176) with relative abundance of 31.8%. Within station, Station 1 station was mostly dominated by copedoda group with total of individual species of 63 with percentrelative abundance of 31.8%, followed, Cladocera group with individual species population of 50 with percentage relative abundance of 25.3%, rotifer group with individual population of 49 with percentage relative abundance of 24.7% and protozoa group recorded individual population of 36 with percentage relative abundance of 18.2%. Station 2station was dominated by Copepoda group (67) with relative abundance of 38.1% followed by Cladocera group (39) and Rotifera (38) with relative abundance of 22.2% and 21.6% respectively whereas Protozoa recorded the least individual population of 32 with relative abundance of 18.2%. Station 2was dominated by Cladocera group (66) followed with Rotifera (47), Copepoda (42) and Protozoa (24) with relative abundance of 36.1%, 25.7%, 23.0% and 15.3% respectively.

The numbers of zooplankton species recorded from this study were common in several other rivers in Nigeria and elsewhere (Imoobe, 2011; Adedeji *et al*., 2019). The result of this study revealed that Akor River is highly enriched with zooplankton, the present study recorded higher zooplankton population of 557 belonging to four classes unlike Adedeji *et al*. (2019) that recorded only 56 zooplankton species from six classes in River Shasha, Southwestern, Nigeria. Akindele and Olutona (2014) who identified a total of 37 species of zooplankton A total of 37 species of zooplankton in Aiba Reservoir Headwater Streams, Iwo, Nigeria.

Copepoda was most dominant among the zooplankton class recorded during the study period in Akor River agrees with the results obtained in Lake Victoria by Waya and Mwambungu (2004), Semyalo *et al*. (2009) and Ngupula *et al*. (2010). With respect to their dominance, Savitha and Yamakanamardi (2012) concluded that freshwater and marine habitats are usually dominated by copepods, a dominant zooplankton class which plays a vital role as primary consumers in the aquatic ecosystem. The high dominance of copepods at Akor River may be attributed to their relatively small size and being successful feeders. In addition, copepods are notable for their toughest exoskeleton, the longest and the strongest appendages among all zooplankton species (Savitha and Yamakanamardi, 2012). This body structure aids them to swim faster in search of food and escaping from predator than any other zooplankton species.

**Table 3: Zooplankton distribution and abundance**

| PLANKTON | Population | | | | % Relative abundant | | |
|---|---|---|---|---|---|---|---|
| | Station 1 | station 1 | Station 3 | Total | Station 1 | Station 2 | Station 3 |
| **CLADOCERA** | - | - | - | - | - | - | - |
| ***Diaphanosoma brachyurum*** | 9 | 6 | 12 | 27 | 4.5 | 3.4 | 6.6 |
| ***Daphnia magna*** | 5 | 3 | 5 | 13 | 2.5 | 1.7 | 2.7 |
| ***Ceriodaph niasetosa*** | 6 | 6 | 2 | 14 | 3.0 | 3.4 | 1.1 |
| ***Chydonus gibbus*** | 4 | 1 | 13 | 18 | 2.0 | 0.5 | 7.1 |
| ***Allonella excise*** | 10 | 4 | 7 | 21 | 5.1 | 2.3 | 3.8 |
| ***Legoligaacanthocercoides*** | 3 | 5 | 1 | 9 | 1.5 | 2.8 | 0.5 |
| ***Diaphanosomapausipinosum*** | 7 | 4 | 10 | 21 | 3.7 | 2.4 | 5.5 |
| ***Diaphanosoma sarsi*** | 3 | 5 | 11 | 19 | 1.5 | 2.8 | 6.0 |
| ***Ploesomacenticulare*** | 3 | 5 | 5 | 13 | 1.5 | 2.8 | 2.7 |
| **Total population** | **50** | **39** | **66** | **155** | **25.3** | **22.2** | **36.9** |
| **COPEPODA** | - | - | - | | | | |
| ***Eucyclopssperatus*** | 11 | 5 | 6 | 22 | 5.6 | 1.5 | 3.4 |
| ***Microcyclopsalbidus*** | 8 | 10 | 3 | 21 | 4.0 | 5.7 | 17 |
| ***Carpthocarptusstaphylinus*** | 3 | 8 | 3 | 14 | 1.5 | 4.5 | 1.7 |
| ***Cyclops strenus*** | 5 | 5 | 5 | 15 | 2.5 | 1.5 | 2.8 |
| ***Sinodiaptonussarsi*** | 9 | 9 | 7 | 25 | 4.5 | 5.1 | 3.9 |
| ***Mesocyclopshyalinus*** | 5 | 6 | 2 | 13 | 2.5 | 3.4 | 1.1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Canthocamptusstaphylinus*** | 5 | 8 | 2 | 15 | 2.5 | 4.5 | 1.1 |
| ***Mesochrasuifunensis*** | 6 | 4 | 7 | 17 | 3.0 | 2.3 | 3.9 |
| ***Mesocyclopsleuckarti*** | 6 | 8 | 5 | 19 | 3.0 | 4.5 | 2.8 |
| ***Mesocyclopsvaricans*** | 5 | 4 | 2 | 11 | 2.5 | 2.3 | 1.1 |
| **Total population** | **63** | **67** | **42** | **172** | **31.8** | **38.1** | **23.5** |
| **PROTOZOA** | - | - | - | - | | | |
| ***Difflugi alebes*** | 12 | 9 | 5 | 26 | 6.1 | 5.1 | 2.8 |
| ***Amoeba radiosa*** | 9 | 7 | 5 | 21 | 4.6 | 4.0 | 2.8 |
| ***Brachionusleyoligi*** | 6 | 7 | 6 | 19 | 3.1 | 4.0 | 3.4 |
| ***Vorticella radians*** | 4 | 3 | 2 | 9 | 2.0 | 1.7 | 1.0 |
| ***Arcellanitrata*** | 5 | 5 | 6 | 16 | 2.6 | 2.8 | 3.4 |
| **Total population** | **36** | **32** | **24** | **96** | **18.2** | **17.6** | **13.4** |
| **ROTIFERA** | - | - | - | | | | |
| ***Astylozoonfaurei*** | 10 | 3 | 6 | 19 | 5.1 | 1.7 | 3.4 |
| ***Chromaglaster testudo*** | 11 | 9 | 5 | 25 | 5.6 | 5.1 | 2.8 |
| ***Synchaetatrenula*** | 4 | 4 | 6 | 14 | 2.0 | 2.3 | 3.4 |
| ***Brachionus plicatilis*** | 8 | 5 | 10 | 23 | 4.0 | 2.8 | 5.6 |
| ***Phomphilyxsulcata*** | 7 | 3 | 9 | 19 | 3.6 | 1.7 | 5.0 |
| ***Chromaglasterovalis*** | 6 | 9 | 6 | 21 | 3.1 | 5.1 | 3.4 |
| ***Ascomorphaecaudis*** | 3 | 5 | 5 | 13 | 1.5 | 2.8 | 2.8 |
| **Total population** | **49** | **38** | **47** | **134** | **24.7** | **21.5** | **26.3** |
| **Total number of individuals** | **198** | **176** | **179** | **553** | **-** | **-** | **-** |

The fast swim trait of Copepods makes them the most successful grazers and predators among zooplankton species (Waya and Mwambungu, 2004). Their dominance in Akor River may be attributed to their body structure, relatively smaller size, and effective feeding capacity and above attributes.

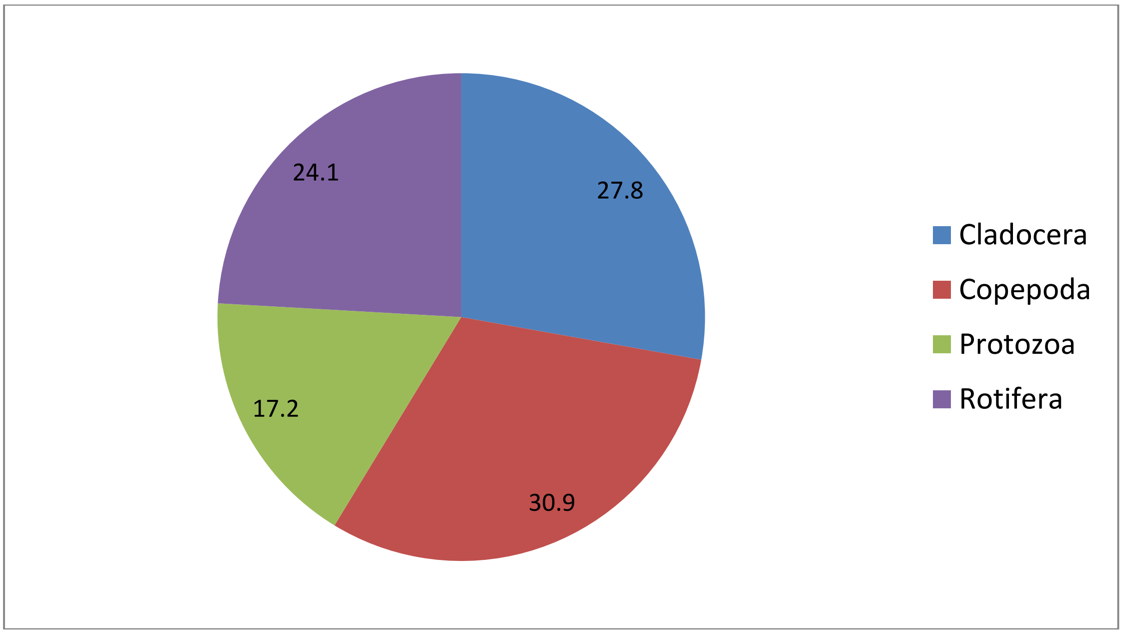


**Figure 2: Relative Abundnce of zooplankton Group Abundance in Akor River**

Diversity indices show the degree of primary productivity of surface waterbody. Water bodies with zooplankton Shannon-wiener diversity index 3 clean. Tables 4 show a summary of the taxa richness, diversity, evenness and dominance indices of zooplankton. Relatively high taxa richness (Margalef index) and diversity index were recorded in across the sampled stations. Relatively high evenness was recorded in Station 2 and Station 1. Similarly, Shannon-H index was relatively higher in Station 1 and Station 2as compared to Itunta 3. Simpson dominance index value was very high in the three stations, although Station 1 and Station 2 recorded higher values than Station 3.The ecological index Zooplankton obtained in this present study were higher than the values recorded by Arimoro *et al*.(2018) in a tropical stream. The Simpson's index of diversity revealed a high spatial diversity of 0.959 to 0.963 and the result was similar obtained by Adelayo and Ifeanyi (2019) in Ede-Erinle Reservoir in Osogbo, Nigeria. The results of most ecological index in this study are higher than results obtained in Nigerian water bodies (Akindele and Adeniyia, 2013; Arimoro *et al*.2018; Adelayo and Ifeanyi, 2019).The higher ecological index of zooplankton obtained in this study attributed to sustainable farming system; thus making Akor River unpolluted and stable balanced.

**Table 4: Ecological Index of Zooplankton in Akor River**

| Station | Station 1 | Itunta 1 | Station3 |
|---|---|---|---|
| **Taxa_Species** | 31 | 31 | 31 |
| **Individuals** | 198 | 176 | 179 |
| **Dominance_D** | 0.0377 | 0.037 | 0.041 |
| **Simpson_1-D** | 0.9623 | 0.9628 | 0.959 |
| **Shannon-Wiener Index (H)** | 3.351 | 3.354 | 3.296 |
| **Evenness Index** | 0.920 | 0.924 | 0.871 |
| **Margalef Index** | 5.673 | 5.809 | 5.783 |

**Field Survey 2019**

**Normality and constant variance of zooplankton**

The results of normality and constant variance for Cladocera zooplankton species at 95% confidence level at the 3 different river stations are normally distributed with p-value of 0.8053 greater than 0.05, and the variances are equal for the relative abundance of Cladocera Zooplankton in the 3 stations at 95% confidence level with p-value (0.4558). There is no significant difference between the mean relative abundance of the species (Cladocera) at 95% confidence level across the three sampled stations, likewise the mean relative abundance between the stations(p-value = 0.136). These findings were indication that various anthropogenic activities didnot influence cladocera population structures and distribution across the sampled stations. Although, cladocera group was more in station 3 where there was stable condition of water and minimum anthropogenic activities. Copepoda species at the three different stations are normally distributed (p-value 0.5567) and the variances are equal for the relative abundance (p-value (0.383) at 95% confidence level. The mean relative abundance between species of Copepoda shows no significant difference with p-value (0.1827) at 95% confidence level while the mean relative abundance between the three stations shows a significant difference with p-value (0.1827) at 95% confidence level**.** The analyzed results revealed that copepod group relatively distributed across three the stations; thus pointing out that all the human activities including application of pesticides on the farmlands along the river banks have impacted/ altered the community structure and pollution distribution of the organisms. Station 1 and 2 recorded more population than station 3 where there was no washing of breadfruits and other kitchen utensils. This finding is a projection showing that copepod could depend somehow on remnants from these human actions for livelihood.

Protozoa species at the three different stations are normally distributed (p-value =0.9302)) and the variances are equal for the relative abundance of protozoa species (p-value, 0.2e915) in the 3 stations at 95% confidence level. Both mean relative abundance between the species p-value 0.0243) and between the river stations (p-value, 0.2334) are significantly difference at 95% confidence level. In addition, the post-hoc test showed that there is significant difference in mean relative abundance only for *Difflugia lebes* and *Vorticella radians* species (p – value, 0.0161).Rotifera species at the 3 different river stations are normally distributed with a p-value 0.4746 and their variances (p-value 0.9127) are equal for the relative abundance for 95% confidence level. Both the mean relative abundance between the species ofRotifera with the p-value (0.477) and the mean relative abundance between the 3 stations with a p-value of 0.655 were highly difference at 95% confidence level. The findings of this study pointed out that anthropogenic activities influenced the population of *Difflugia lebes* and *Vorticella radians* species only among others species with protozoa family. The community structure and population distribution of both protozoa and rotifer were equally altered by the human activities within and around the river.

**Conclusion**

**T**he presence of *Anabaena spiroides*, *Anabaena affinis,Microcystisaeruginosa*, Oscillatoria *casuistries,Closteriumparrutum*, *Euglenawangi* and *Euglena oxyuris* which can serve as indicators of water quality and trophic status indicates that Akor riveris an oligotrophic water body.This shows that anthropogenic activities including farming activities have not adversely impacted or altered community structure and population distribution of some of plankton.

Investigation of physico-chemical and heavy metals characteristics as well as diversity and population structure of macro fauna and flora should be carried out in Akor river.

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