Adamawa State University Journal of Scientific Research
Volume 10 Issue 2, 2022; Article no. ADSUJSR-1002006
ISSN: 2705-1900 (Online); ISSN: 2251-0702 (Print)
http://www.adsujsr.com

Plankton Species Compositions and Distributions at Some Selected Sites of River Benue, Adamawa State, Nigeria

Zira, J.D., Adamu, M, and Abubakar, M.
Department of Biology, Nigerian Army University, P.M.B 1500, Biu, Borno State, Nigeria
Contact: *zirajoshuadali@yahoo.com*

(Received in August 2022; Accepted in November 2022)

Abstract
The present study assessed the plankton's species compositions and distributions of River Benue, Adamawa state. The studies were conducted for a period of nine months, from December, 2017 to August, 2018 using standard scientific methods to evaluate the potential and productivity of the river. The Phytoplankton population of River Benue was dominated by Chlorophyta 990(39.68%) and the least was Bacillariophyta 174(6.97%), while Zooplanktons was dominated by Rotifers 120(47.06%) and the least was Cladocera 63(24.71%). Phytoplanktons were represented by thirteen (13) species (*Microcystis sp, Oscilatoria sp, Gomphospaeria sp, Anabaena sp., Nostoc sp Scenedesmus sp, Spirogyra sp, and Ulothrix s., Volvox sp. Euglena sp. Cyclotella sp, Cymbella sp* and *Diatomella sp*.), while Zooplanktons were represented by ten (10) species (*Keratella sp, Branchionus sp, Monostyla sp., Euclanis sp., Pelomyxa sp, Paramecium sp., Acanthometron sp., Daphnia sp, Microcyclop sp* and *Bosmina sp*). Site D recorded high concentration of both phytoplankton and zooplankton, while Site C recorded less of both. The presence of high number of Chlorophyta in the water body shows a gradual deterioration of the water quality and this could be attributed to the different anthropogenic activities at the sites.
Keywords: Compositions, Distributions, Plankton, Phytoplankton, Zooplankton

Introduction

Plankton is a collective term used to describe all those organisms whose powers of movement are insufficient to prevent them from being moved by water currents. The term commonly refers to any drifting organisms that inhabit water bodies and serve as food base that supports aquatic life (Eyo and Paul (2015). Plankton are mostly small organism, drifting along with the water currents and unable to swim against the water waves. They are usually categorized according to their feeding mode (Phyplankton = autotrophs, Zooplankton = heterotrophs) or life cycle [holoplankton (entire life cycle in water column as plankton), meroplankton (part of life cycle as plankton)]. They can also be classified in different ways; these include whether they are true or false plankton, nutritional requirements, size, environment and their life history (Akomeah *et al*., 2010). Diversity and composition of plankton does not occur only in different depth, but also at different hours and in years in the same place and depth and constitutes the main producer in any given water body (Kusuma *et al*., 1988).

Phytoplanktons are microscopic aquatic plants, occurring as unicellular colonial or filamentous forms without any resistant to current and are free-floating or suspended in the open water (Ali *et al*., 2013). They are important water quality indicators, because of the short life cycles and ability to respond to environmental changes. The amount of phytoplankton present in water depends on the light availability and the relative proportions of nutrients (nitrogen and phosphorous) and the temperature. Phytoplankton organism is one of the initial biological component from which the energy is transferred to higher organisms through food chain (Tas and Gonolol, 2007). The density and the diversity of phytoplankton are biological indicator for evaluating water quality and degree of eutrophication (Shekhar, *et al.*, 2008). It's the primary producer in the water and also one of the life sources for all animals and dissolved oxygen producer in the water as well. In food chain, phytoplankton is eaten by herbivores (such as zooplankton) which will also be eaten by larger carnivores (fish and others). The existence of phytoplankton in the waters can be seen on the

basis of their abundance, influenced by several environmental and the physiological characteristics (Bellinger and Siege, 2010).

Zooplanktons occupy an important source of food for many species of aquatic ecosystem as they constitute the most important link in energy transfer between phytoplankton and higher aquatic fauna (Iloba, 2002). The organisms are identified as important component of aquatic ecosystems, help in regulating algal microbial productivity through grazing and in the transfer of primary productivity to fish and other consumers (Okogwu, 2010; Dejen *et al*., 2004). By grazing on phytoplankton and bacteria, Zooplankton helps in improving water quality and the amount of zooplankton in water depends generally on the amount of phytoplankton and detritus available to feed on (Okogwu, 2010; Hassan *et al*., 2010). It's an ecologically important group of aquatic organisms that occupy a wide range of habitats and they constitute essential biotic component which influences the efficiency of an aquatic ecosystem such as energy flow through various trophic interactions (Park and Shin, 2007). The Zooplankton are so closely linked to the environment and they tend to change more rapidly than do larger aquatic animal such as fish, thus these organisms have proved valuable indicator of apparent and subtle alterations in the quality of aquatic environment (Marine Biology Organization, 2007). With the increased in human activities around River Benue, which might eventually led to pollution, it is imperative to assess the planktons composition and distributions since they have been used as bio-indicator of pollution (water quality) over-time so as to determine the pollution level of the River.

Materials and Methods

Study Area

River Benue is a freshwater flowing through Nigeria and it is the second largest river in the country, which is located on Latitude $9^0$81'N and Longitude $12^0$25'E. The river originates from the Adamawa mountains of Cameroun, some bounding the Nigeria frontier and flows eastward through the Nigeria territory before joining the River Niger at Lokoja, Kogi State, Nigeria (Okayi *et al*., 2001).

Sampling and Determination of Phytoplankton Compositions and Distributions

Phytoplankton samples were collected with one litter transparent plastic bottle by dipping the container bottle, sliding over the upper surface of water with its mouth against the water current to permit undisturbed passage of the water into the bottle (Tanimu, 2011). Samples were preserved with Lugol's solution and brought to the Zoology laboratory Modibbo Adama University of Technology, Yola. Slides were prepared and observed under a binocular microscope with various magnifications. Taxonomic identification of plankton was carried out by using taxonomic keys (Emi and Andy, 2007; Edward and David, 2010; Steve *et al*., 2013). The phytoplanktons were counted from left top corner of the slide to the right corner by moving the slide horizontally.

Sampling and Determination of Zooplankton Compositions and Distributions

Zooplankton grab samples were collected using plankton net mesh size 70µm. It was towed vertically distance of one meter and haul out of the water. The sample was collected into plastic bottle tied at the end of the net, and then was emptied into the closed labeled 100ml vial bottle for identification and counting of the zooplanktons. The samples were preserved with 4% formalin. The zooplankton sample collection after condensation by sedimentation was taken for sorting and counting. A binocular microscope is used for zooplankton. Identification to genus level was performed using protocols (Yamaguchi and Bell, 2007), through which Zooplankton density (abundance) was computed.

Results and Discussion

Planktons Compositions and Distributions

Phytoplankton Compositions and Distributions

The phytoplankton community in the River Benue was characterized by four (4) phyla and thirteen species, namely; Cyanophyta (*Microcystis* sp, *Oscilatoria* sp, *Gomphospaeria* sp, *Anabaena* sp and *Nostoc* sp.), Chlorophyta (*Scenedesmus* sp, *Spirogyra* sp, *Ulothrix* sp and *Volvox*sp), Euglenophyta (*Euglena* sp.) and Bacillariophyta (*Cyclotella* sp, *Cymbella* sp and *Diatomella* sp.). The phytoplanktons species abundance were dominated by Chlorophyta with 990(39.68%) species, followed by Cyanophyta with 938(37.60%) species, Euglenaphyta with 393(15.75%) species and Bacilariophyta with 174(6.97%) species been the least (table 1). The sequences of phytoplankton, Chlorophyta < Cyanophyta < Euglenaphyta < Bacilariophyta agrees with the work by Indabawa (2005), on the

phytoplankton content of Nguru Lake. The dominating presence of Chlorophyta shows gradual deterioration of the water quality. This could be as a result of anthropogenic activities, such as chemicals, wastes washed, washing of clothes and bathing sometimes around the river. This also agrees with Anago *et al*. (2013) who reported that, in lakes where domestic, agricultural and industrial pollution is accelerated, growth of Chlorophyta and Cyanophyta results. Abubakar (2007) indicated that Euglenophta were common in environments rich in decaying organic matter, and large populations of Euglena were favored by the presence of high levels of dissolved organic compounds and high temperatures. According to Tanimu *et al*. (2011) the increase in abundance of the Cyanophyta and Euglenophyta is an indication of organic pollution. The low occurrence of Euglenophta was an indication that the reservoir does not had high level of dissolved organic matters.

Table 1: Phytoplankton Compositions and Distributions of River Benue

	Sampling stations				
Class	A **(%)**	B **(%)**	C **(%)**	D **(%)**	Total
Cyanophyta					
Microcystis sp	175(22.58)	-	-	185(22.42)	360(14.43)
Oscillatoria sp	70(9.03)	62(11.55)	38(10.61)	74(8.97)	244(9.78)
Gomphosphaeria sp	15(1.94)	12(2.23)	13(3.63)	16(1.94)	56(2.24)
Anabaena sp	50(6.45)	21(3.91)	19(5.31)	58(7.03)	148(5.93)
Nostoc sp	40(5.16)	30(5.59)	18(5.03)	42(5.09)	130(5.21)
Chlorophyta					
Scenedesmus sp	2(0.26)	1(0.19)	1(0.28)	5(0.61)	9(0.36)
Spirogyra sp	98(12.65)	80(14.90)	50(13.97)	88(10.67)	316(12.67)
Ulothrix sp	108(13.94)	87(16.20)	48(13.41)	138(16.73)	381(15.27)
Volvox sp	92(11.87)	9(6.95)	23(6.42)	78(9.45)	284(11.38)
Euglenaphyta					
Euglena sp	`103(13.29)	97(18.06)	82(22.91)	`111(13.45)	393(15.75)
Bacillariophyta					
Cyclotella sp	10(1.29)	20(3.72)	30(8.38)	13(1.58)	73(2.93)
Cymbella sp	6(0.77)	20(3.72)	25(6.98)	9(1.09)	60(2.41)
Diatomella sp	6(0.77)	16(2.98)	11(3.07)	8(0.97)	41(1.64)
Total	775(100)	537(100)	358(100)	825(100)	2495(100)

Zooplankton Compositions and Distributions

Zooplankton population in River Benue is characterized by Rotifers, Protozoa and Cladocera. They were dominated by Rotifers with 120(47.06%) species, which were represented by *Keratellasp, Branchionus* sp, *Monostyla* sp and *Euclanis* sp followed by Protozoan with 72(28.24%) species, which were represented by *Pelomyxa* sp, *Paramecium* sp and *Acanthometron* sp. While Cladocera 63(24.71%) been the least was represented by *Daphnia* sp, *Microcyclop* sp and *Bosmina* sp. (table 2). The dominance of the rotifers*;* a nutrient loving zooplanktons, might be attributed to nutrients enrichment provided by the water body as reported (Iloba and Ruejoma, 2014).The number of Cladocera in Benue River was relatively low; this may be attributed to the absence of aquatic macrophytes and it might have accelerated the rate of predation by fish. As Sarnelle (1992) suggested that fish prefer open waters to feed on zooplankton. This was further collaborated by Kemdirim, (2000); Jeppessen *et al*. (2005) and Havens, *et al.* (2002), who observed that the absence of Cladocera and the low numbers of Copepoda could be due to the effects of fish predation, which was found to be the major factor structuring zooplankton assemblages in several studie

Table 2: Zooplanktons Composition and Distribution of River Benue

Class	Sampling stations				Total
	A (%)	B (%)	C (%)	D (%)	
Protozoa	10(14.93)				
Paramecium sp		13(20.31)	14(26.92)	11(15.28)	48(18.2)
Pelomyxa sp	2 (2.99)	1(1.56)	1(1.92)	3(4.17)	7(2.75)
Acanthometron sp	5 (7.46)	2(3.13)	5(9.62)	5(6.94)	17 (6.67)
Rotifers					
Keratella sp	11 (16.42)	9(14.06)	10(19.23)	10(13.89)	40 (15.69)
Branchionus sp	5(7.46)	10(15.63)	8(15.38)	4(5.56)	27 (10.59)
Monostylan sp	8(11.94)	7(10.94)	5(9.62)	7(9.72)	27 (10.59)
Euclanis sp	7(10.45)	8(13.11)	4(7.69)	7(9.72)	26 (10.20)
Cladocera					
Daphnia sp	6(8.96)	5(7.81)	1(1.92)	7(9.72)	19(7.4)
Microcyclop sp	10(14.93)	8(13.11)	2(3.85)	13(18.06)	33(12.94)
Bosmina sp	3(4.48)	1(1.56)	2(3.85)	5(6.94)	11(4.31)
Total	67 (100)	64 (100)	52 (100)	72 (100)	255 (100)

Conclusion

In conclusion, the results revealed that, four classes of phytoplankton represented by thirteen (13) species and three classes of zooplankton represented by ten (10) species were identified at the River Benue and were dominated by Chlorophyta and Rotifers respectively. While Bacillariophyta and Cladocera were the least in term of compositions and distributions throughout the period of this study. High compositions and distributions of Chlorophyta and Rotifers were an indication that the water bodies are rich in nutrient and might deteriorate the water and make it unsafe for aquatic productions.

Acknowledgement

All materials (published and unpublished) used for the purpose of this research are hereby dully acknowledged.

References

Abubakar, K.A. (2006). A study of Aspects of Productivity and Stock Status of Oreochromis niloticus and Clarias gariepinus in Lake Geriyo, Yola Adamawa State, Nigeria. Unpublished PhD Thesis, Federal University of Technology, Yola, Nigeria.

Akomeah, P. A., Ekhator, O. and Udoka, C. (2010). Dry season phytoplankton composition of Ibiekuma Dam, Ekpoma, Edo state. *Ethiopia journal of Environment studies and management*, 3(3):36-40.

Ali, A.N., Dahanukar, R. and Raghavan, (2013). Length-weight and length-length relationship of three species of snakehead fish, *Channadiplogramma*, *C. marulius* and *C. striata* from the riverine reaches of Lake Vembanad, Kerala, India. *Journal of Threatened Taxa*, **5**(13):4769–4773.

Anago, I.J., Esenowo, I.K. and Ugwumba, A.A.A. (2013). The Physicochemistry and plankton Diversity of Awba Reservoir, University of Ibadan, Nigeria. *Research Journal of Environmental and Earth Sciences*, **5**(11):638-644.

Bellinger, E.G. and D.C. Siege (2010). Freshwater algae identification and use as bio indicators. Great Britan: John Wiley and sons, Ltd. (the atrium, southern gate, Chi Chester, west Sussex: 271-285.

Dejen E, Vijverberg J, Nagelkerke LAJ, Sibbing FA (2004). Temporal and spatial distribution of microcrustacean zooplankton in relation to turbidity and other environmental factors in a large tropical lake, Lake Tana, Ethiopia. Hydrobiologia 513:39-49.

Edward, G. B. and David, C. S. (2010). Freshwater Algae: Identification and Use as Bio indicators, Wiley-Blackwell John Wiley and Sons, Ltd. The Atrium, Southern Gate, Chi Chester, West Sussex, P019 8SQ, UK.

Emi, Y. and Andy, G. (2007). *Phytoplankton Identification Guide.* University of

Georgia Marine Education Centre and Aquarium.

Eyo, E.A and Paul, J.A (2015). Plankton abundance and diversity in Great KWA River, cross River state, Nigeria. *International journal of innovative science, engineering and technology*, 2(**9**):141-154.

Hassan, K.Y., Kutama, A.S and Ibrahim, Y (2010). Algal diversity in relation to physic-Chemical parameters of three ponds in Kano metropolis, *Nigeria Bioscience research communications* 22(**6**).

Havens, K.E. (2002). Zooplankton Structure and Potential Food Web Interactions in the Plankton of a Subtropical Chain of Lakes. Science World Journal; 2:926-942.

Iloba, K.I., (2002). Vertical distribution of rotifer in the Ikpoba reservoir in southern Nigeria. Top. Fresh water Biol., 11:69-89.

Iloba, K.I. and Ruejoma, M.G.O. (2014). Physicochemical characteristics and zooplankton of Ekpan River, Delta State, Nigeria. *International Journal of Applied Biological Research*, 6(**1**): 8-30.

Jeppesen, E., Jen P.., Martin, S. and Torben L.L. (2005). Response of Fish and Plankton to Nutrient Loading Reduction in eight Shallow Danish Lakes with Special emphasis on Seasonal Dynamics. Freshwater Biology; 50(**10**):1616-1627

Kemdirim, E.C. (2000). Diel Rhythm of Plankton and Physicochemical Parameters in Kangimi Reservoir, Kaduna State, Nigeria. Journal of Aquatic Sciences; 15(**1**):35-40.

Kusuma, M.S., Neelakanton, B. and Konnur, R.G. (1988).Plankton distribution in the Kali Estuary, Karwar central west coast of India, environment and ecology.115-119.

Marine Biology Organization (MBO) (2007a). Zooplankton retrieved from http://www.marine.bio Com/oceans/zooplankton. aspp. On 12/08/16.

Okayi, R.G., C.Y., Jeje and F.O. Fagade, (2001). Seasonal patterns in plankton community of River Benue, Nigeria. African Journal of Environmental Studies; 9-19.

Okogwu, I.O. (2010). Seasonal variations of species composition and abundance of zooplankton in Ehoma Lake, a floodplain lake in Nigeria. *International Journal of Tropical Biology*, 58(**1**):171-182.

Park, K.S. and Shin, H.W. (2007). Studies on Phytoplankton and Zooplankton Composition and its Relation to fish Productivity in a West Coast Fish Pond Ecosystem. *Journal of Environmental Biology*, 28:415-422.

Sarnelle, O. (1992). Contrasting effects of daphnia on ratios of nitrogen to phosphorus in a eutrophic, hard-water lake. Limnology and oceanography, 37(**7**):1527-1542.

Shekhar, S.T.R., Kiran, B. R., Putta'ah, E.T., Shavaraj, Y. and Mahadevan, K.M. (2008). Phytoplankton as Index of Water Quality with Reference to Industrial Pollution. *Journal of Environmental Biology*, 29(**2**):233-236.

Steve, O.N., Phillip, O.R., Boaz, K.A., Patrick, O.O. and Alfred, A.O. (2013). Spatio-temporal variations in phytoplankton community structure in small water bodies within Lake Victoria basin, Kenya. *African Journal of Environmental Science and Technology*, **7**(**9**):862-873.

Tanimu, Y., Bako, S.P., Adakole, J.A. and Tanimu, J. (2011). Phytoplankton as Bio indicators of Water Quality in Saminaka Reservoir, Northern-Nigeria. Proceeding of the 2011 International Symposium on Environmental Science and Technology. Dongguan, Guangdong province, China. Published by Science press USA; 318-322.

Tas, B. and Gonolol, A. (2007). An ecology and taxonomic study on phytoplankton of a shallow lake, Turkey. *Journal of Environmental Biology*, 28:439-445.

Yamaguchi, E. and Bell, C. (2007): Zooplankton Identification Guide, the University of Georgia Marine Education Center and Aquarium, 1-2.