African Journal of Environment and Natural Science Research
Volume 2, Issue 1, 2019 (pp. 94-101)

www.abjournals.org

THE PHYSICOCHEMICAL, PLANKTONIC AND MACROINVERTEBRATE ANALYSIS OF ANYA STREAM IN AMAOBA TOWN, IKWUANO LOCAL GOVERNMENT AREA, ABIA STATE, NIGERIA

Okoboshi A.C, Okore Oghale and Anyanwu E.D.

Department of Zoology and Environmental Biology, Michael Okpara University of Agriculture, Umudike, P.M.B 7267, Umuahia, Abia State, Nigeria.

ABSTRACT: *The physico-chemical as well as macro invertebrate characteristics of Anya stream in Amaoba community, Abia state, Nigeria, was studied over a period of 5 months. The stream was investigated in 3 different outlined stations based on degree of human interaction and the plant community along the stream. The result indicated that human interaction influenced to an extent the Physico-chemical parameters. The phosphate values recorded between 0.67 ±0.22 and 0.77± 0.18 mg/l. Total hardness ranged from 7.66± 0.06 to 20.33 ± 9.16mg/l, while dissolved oxygen varied from 0.73± 0.13 to 3.76 ± 0.56 mg/l. The rainfall amount recorded within the period of study influenced some of the parameters. The temperature of water surface was lower in rainy months than in the dry ones. The nitrate concentration increased with the rainfall amount recorded. All parameters assessed except for pH and total phosphate varied within the acceptable standard of World Health Organization (WHO), Standard of Nigeria (SON), European Economic Community (EEC) and Federal Ministry of Environment (FMENV). Significant differences (p< 0.05) monthly concentrations of the evaluated chemical parameters where observed when subjected to Duncan and LSD analysis. However, there was no significant difference (p<0.05) among stations. The zooplanktons encountered included Branchionus plicatilis, Cyclops sp., Calanus hyperboreus and Moina sp. The phytoplanktons included Spirogyra, Euglena, Green algae, Blue-green algae while the macroinvertebrates were Water strider, Dragon flies, Damsel flies, Beetles, Water bugs, immature stages of Mosquitoes (larva, pupa) and the adults respectively. Chlorophycene (spirogyra), had the highest cell density of phytoplankton with 100.0% abundance obtained from a total of 184 cells/ml from four broad groups of phytoplankton. Based on the results and following standard criteria, the stream could be suitable for domestic, industrial and agricultural uses. However basic treatment can help improve the portability of the water especially for drinking.*

KEYWORDS: Physical Properties, Chemical Characteristics, Planktons, Macro Invertebrates

INTRODUCTION

Water is one of the most important available substances on the earth. The survival of and quality of human life depends on the availability of fresh water. The aquatic animal's life directly or indirectly depends on the water quality status. Water quality study provides current information about suitability of water designated uses. Most of the aquatic ecosystem receives million liters of municipal sewage, industrial and agricultural runoff (Bharath *et. al*., 2013). Planktonic organisms are important components in the productivity of inland waters. They are distributed among the waters in the bottom (benthic), open water (pellagic) and at

the littoral zones (vegetative sides). Planktons are the small and microscopic organisms (phyto and zoo plankton) due to their size, feebleness or immobile nature float or drift at the mercy of water current to maintain a constant position against the water tides (Lee 1980). An understanding of their ecology and distribution contribute significantly to the use and management of aquatic ecosystems. Both plankton and macro invertebrates are useful in aquatic food web, with higher trophic levels, such as fish and whales, depending nutritionally on them. They provide a crucial source of food to many large aquatic organisms in both marine and freshwater ecosystem (Lalli and Parsons, 1993). Besides food chain supports in commercial fisheries, plankton ecosystems play a major role in the biogeochemical cycles of many important chemical elements (carbon, oxygen, nitrogen, phosphorus cycles) (Falkowski, 1994). According to Emiliani (1991), plankton are primarily divided into broad functional (trophic levels) groups.

Plankton composition, distribution pattern and succession vary among lakes, streams and rivers, because each aquatic ecosystem has its physio-chemical and biological properties emanated from both the surrounding land mass, geological formation of the water, the local climate, human activities in water and drainage conditions through which run-off is received (White *et al*., 2008). In addition to its intrinsic biological importance, planktonic organisms are used in the evaluation of the productive capacity of water bodies (Umeham and Ogbonnaya, 1993). Plankton typically flow with water current while some forms are capable of independent movement and can swim hundreds of meters vertical in a single day (diel vertical migration), their horizontal position is determined primarily by the surrounding current, contrary to newton which can swim with the ambient flow and still maintain their position (Aumont and Bopp, 2006).

The role of plankton in aquatic food web and as an indicator of water quality is well known. The availability, distribution, abundance and population of certain community of plankton is an indication of the water quality of an aquatic ecosystem (Case *et al*., 2008). Water pollution by domestic, industrial and other water users as well as in lock constructions for navigation are the major causes of degradation in the water quality. However, such studies are still very limited in scope. The aim of the present study is to investigate the species composition as well as abundance of both plankton and macro invertebrates of Anya Stream. It is envisaged that this will make a remarkable contribution to the few existing checklists of the plankton and macro invertebrate composition of Nigerian waters.

MATERIALS AND METHOD

Study Area and Samplings

The study was conducted at Amaoba in Ikwuano Local Government Area of Abia State, Nigeria. The survey area is located in South eastern Nigerian (SE Nigerian) found approximately between latitude 5^0S 29^0N, longitude 74^0W and 33^0E.

Water samples from the surface of the stream were collected using 2 litres capacity sampling bottle from 3 stations on monthly basis from April 2013 through August 2013. These fixed stations represent the shore (littoral zones), the open water and the up streams (maximum length).

Samples were collected using a kick bucket by agitating the literal zone and bottom sediments. A metal screw was used in stirring and sorting the sample substrates. Sorted samples were handpicked and washed in water. Also, the substrates were further sieved through a net with mesh size of about 15mm, the same size as used to capture the insect forms on the surface of the waters. The physicochemical parameters were determined both at the site (in-situ) and in the laboratory using standardized methods.

Experimental Materials and Populations for the Study

Substrate samples of 100 mls were used from the water samples collected and fixed immediately with two (2) drops of Lugol's solution to precipitate and preserve the plankton. In the laboratory these samples were concentrated to 15 mls by centrifugation. Two drops of the concentrate were placed on a clean glass slide, covered with cover slip and viewed under a compound light microscope. This process was repeated as many times as possible so as to pick all organisms in the sample. Identification of isolated organisms was made by reference to Adeniyi (1978) and Hitchinson (1967). For Zooplankton, 100 mls of water sample was fixed with 4% formalin and concentrated to 15 mls by centrifugation and viewed under the microscope. The benthic fauna was stored and preserved in 10% formalin and observed with a light microscope.

Statistical Analysis

Data obtained from these parameters were subjected to both simple ANOVA and regression analysis using two-way factors. SPSS package was used for the data processing and presentation of results at 0.05 level of significant ($p< 0.05$).

RESULTS AND DISCUSSION

A check list of the planktonic abundance and macro invertebrates revealed a total of five zooplankton species, four phytoplankton and six macro invertebrates (see table 1a, 1b and 1c). The list of identified species of plankton (Zoo and phytoplankton) and macro invertebrate are shown in Table 1(a, b and c). A total of 194 individual Zooplanktons were of five species were identified and observed throughout the study period. They belong to four different orders; Cladocera, Ploimida,Cyclopoid and Copepoda. For the Macroinvertebrate, five order were recorded and these are shown in the table 1(b) below. Hemiptera (water striders), Coleoptera (water beetles), Odonata (dragon flies, damsel flies), Diptera (mosquito) and Heteroptera, (water bugs) were the groups of Insects recorded (Table 1b).

The relative percentage composition of the various organism found in Anya stream indicates *Daphnia* species as the most abundant, having a percentage of 31.82%, the highest recorded from the three stations. *Spirogyra* spp. was the most abundant phytoplankton recording 43.33% in station two. Dragon flies were most abundant among the macro invertebrates with 25.64% abundance followed by water bugs and beetle which recorded 20.51% in station 1 (see figure 1).

The different species of the Zooplanktons, Phytoplanktons and macro invertebrates identified in the stream are of common occurrence in other Nigerian waters (Okorie *et al*., 2014, Abowei *et al*., 2012, Khan *et al*., 1983). They also consist of the composition of

phytoplanktons identified in African water ecosystems by Hecky and Kliny (1981). A total of 184 cells/ml from four broad groups of phytoplankton were obtained. They are Chlorophyceae (*Spirogyra* spp.), Cyanophyceae (*Euglena* spp and *Spirulina* spp.*)* and Zygnemophyceae (*Microsterias* spp.). The highest cell density of phytoplankton was from *Spirogyra* spp with 56 cell/m obtained from the three different stations and the dominant class, *Chlorophycea*e which is known to be the most common species community composition of most Nigerian fresh water ecosystem (Khan *et al,* 1983 and Adeniyi, 1978). When the total individual number of species of phytoplankton (184) identified is compared with total number identified in most Nigerian waters, for example, 305 species in Kainji dam (Adeniyi, 1978), this stream can be clearly described as significantly low qualitatively in phytoplankton abundance. This may possibly be related to the nutrient composition of the stream. The result of this study showed that the presence of macro invertebrates was distributed over five insect Orders. A total of one hundred and seventeen (117) individual macro invertebrates were recovered from the five (4) Orders. Odonata which comprises of dragon flies and damsel flies recorded the highest value 54 (46.15%) respectively compared to others. This was closely followed by Suborder Heteroptera of order Hemiptera (water bugs) with 24 (20.51%). Hemiptera (water strider) and Coleoptera (beetles) recorded 16 which both comprise 13.68% of the macro invertebrates. The least number was from Diptera (mosquitoes' adult and larvae) with value 7(5.98%) which may be attributed to the fact that the stream is a lotic water (moving water). Macro invertebrates are good indicators of stream quality (Peckorsky, *et al.* 1990). Henry (2009) classified Heteroptera as a suborder of the Hemiptera (true bugs) (Table 1c).

Table 1 (a): Zooplankton of Anya Stream

s/no.	**Species**	**Order**	**Total number**
1	*Daphnia* spp.	Cladocera	56
2	*Branchionus plicatilis*	Ploimida	28
3	*Cyclops* sp.	Cyclopoida	29
4	*Calanus hyperboreus*	Copepoda	44
5	*Moina* sp.	Cladocera	37

Table 1 (b): Phytoplankton of Anya Stream

s/no.	Species	Class	Total number
1	*Spirogyra* spp.	Chlorophyceae	56
2	*Euglena*	Cyanophyceae	51
3	*Micrasterias* spp.	Zygnematophyceae	47
4	*Spirulina* spp.	Cyanophyceae	30

Table 1 (c): Macro-Invertebrates of Anya Stream (2014)

s/no.	Species	Order	Total number
1	Water strider	Hemiptera	24
2	Dragon flies	Odonata	30
3	Damsel flies		24
4	Beetles	Coleoptera	16
5	Mosquitoes (larva, pupa and adults)	Diptera	7
6	Water bugs	Suborder Heteroptera (order Hemiptera)	16

The physico-chemical and macro invertebrates attributes of Anya stream in Amaoba community, Abia state over the period of this investigation revealed a great positive regression in the abundance of plankton in the various sampling stations (see Table 1 and Figure1 and 2). The stream sampled stations based on degree of human interaction and the plant community along the length of the stream indicated that human interaction influenced to a certain extent the physico-chemical parameters of the water. This was revealed by the chemical and biological properties recorded for the stream at the various stations especially when compared with standard values (Table 2).

Table 2. Mean Variation of Physico-Chemical Parameters of Anyia River in Comparison with the Different Water Standard of FMENV, WHO,EEC and SON

Parameters	Present Study	FMENV	WHO	EEC	SON
PH	5.32	6.5-8.4	7.0- 8.5	6.5 - 8.5	65.85
TH	14.9	500		500	150
DEPTH	79.88				
TRANSPARENT	63.19				
DO	1.95		6	5	
BOD	1		5	4	50
NITRATE	8.24		45	2	
PHOSPHATE	0.72			0.3	
TA	9.42		250		
TDS	0.08				500

pH-hydrogen ion, TH- total hardness, DO- Dissolved oxygen, BOD- Biochemical oxygen demand, TA- Total alkalinity, TDS- Total dissolve oxygen.

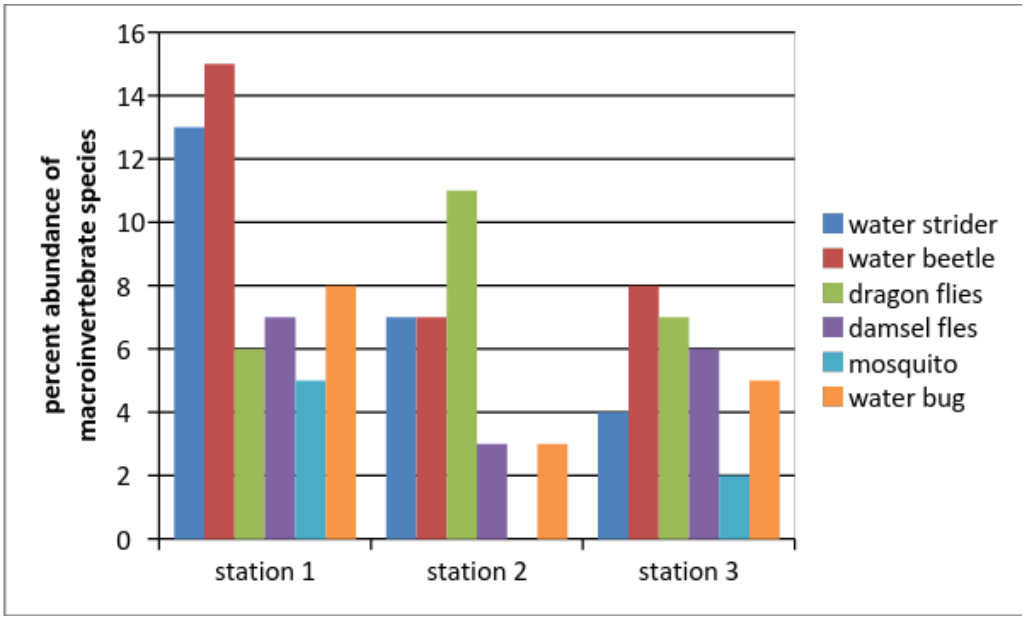

Figure 1. Common Species Name of the Various Macro Invertebrate Given Based on the Extent of Identification using the Common Name in a Multiple Bar Chat in the Various Stations

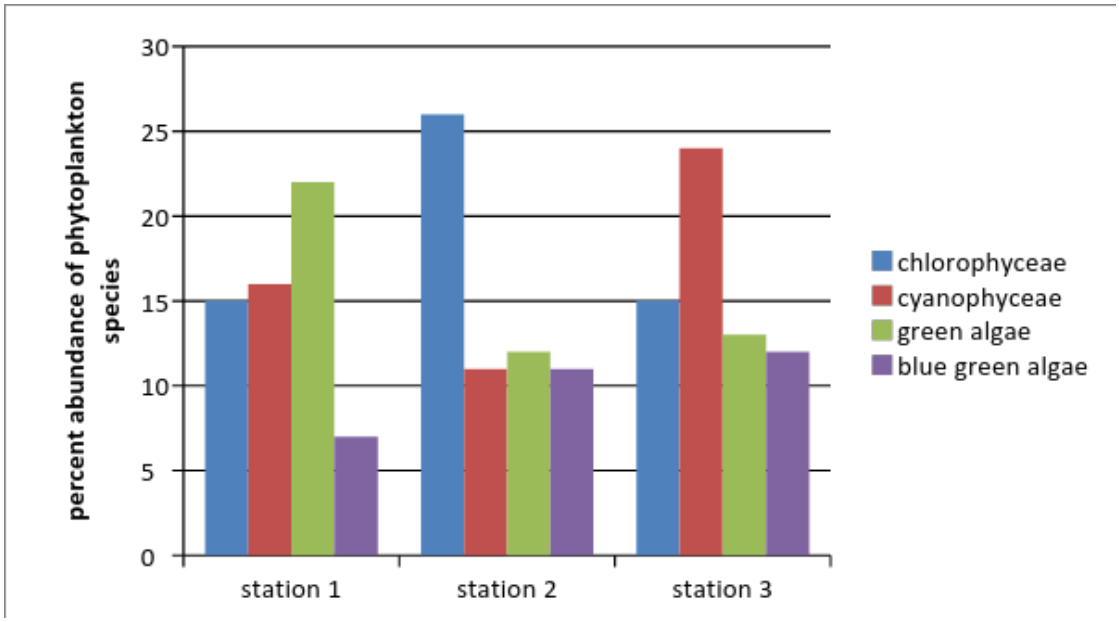

Figure 2. Group Given Based on Extent of Identification using either the Common Name or the Scientific Name in a Multiple Bar Chat in the Various Stations

The rainfall amount recorded within the period of study had influence on some of the parameters. The nitrate concentration increased with an increase in the rainfall amount recorded among other parameters. All parameters except for the pH and total phosphate varied within the acceptable standards of World Health Organization (WHO), Standard Organization of Nigeria (SON), European Economic Community (EEC) and Federal Ministry of Environment (FMENV). However, in the various stations, no significant differences were recorded.

REFERENCES

Abowei, J.F., Ezekiel, E.N. and Hansen, U. (2012). Effects of Water Pollution on Phytoplankton Species Composition in Koluama Area, Niger Delta Area, Nigeria. *International Journal of Fisheries and Aquatic Sciences* **1(2): 134-139.**

Adeniyi, H.A. (1981). circadian vertical migration of zooplankton during stratification and its significance to fish distribution and abundance in Kainji lake, Nigeria, verh. Internat. Veriein limnol. 21:1021-1024

Aguigwo, J.N. (1998)., studies on the physico-chemical parameters and plankton productivity of a productive stream. J. Aquat. Sci. 13:9-13.

Aumont, O. and Bopp, L. (2006). globalizing results from ocean in-situ iron fertilization studies*;* Global biogeochem. Cycles, 20(2).

Bharath, H. R. , Mnajappa, S., and Suresh, B. (2013). Physico Chemical parameters of Anekere Water body, Hassa district (Kamataka). *Journal of Pharmacy and Life Sciences* 4(12); 3200-3204 CODEN, USA

Case, M., Leca, E.E., Leitao, S.N., Anna, E.E., Schwamborn, R., Anthonio, T.J., (2008). Plankton community as an indicator of water quality iun tropical shrimp cultrure ponds. *Marine pollution bulletin* 56, 1343-1352

Emilliani, C. (1991). Plantic / Planktonic, nectic Benthonic. J. paleont. 65(2):392

Hecky, R.E. and kling, H.J. (1981) The phytoplankton and protozooplankton of the euphotic zone of lake tanyanyika; species composition, biomass, chlorophyll content and spatio-temporal distribution*;* limnol. Oceangr. 26(3):548-564.

Henry T.J. (2009). In: Foottit R.G., Adler P.H., eds. Insect biodiversity: Science and society. Oxford: Wiley-Blackwell: 223-263.

Hutchinson, G.E. (1967). A treatise on limnology volume 2. Introduction to lake biology and the limnoplankton. John wiley and sons publisher New York, P 1115 .

Imevbore, M.A. (2013). Hydrology and plankton of Eleyele reservoir. Hydrobiologia. 30:134-176.

Jaji, M.O., Bangbose , O., Odukayo, O.O. and Arwolo, T.A. (2007). Water Quality assessment of Ogun River, South West Nigeria, Environ. Monit. Assess. 133(1-3):447-482.

Lalli, C. and Parsons,T.R. (1993). biological oceanography; an introduction (2nd edition) Elsevier Butterworth-Heinemann Publisher, Jordan Hill Oxford. P 337.

Okorie, P. N., Popoola, ,K.O.K., Awobifa, O. M., Ibrahim, K. T. and Ademowo, G. O. (2014). Species composition and temporal distribution of mosquito populations in Ibadan, Southwestern Nigeria. *J Entomol Zool Stud.* **2(4): 164–169,**

Paul G. Falkowski (1994) The Role of Phytoplankton Photosynthesis in Global Biogeochemical cycle. *Photosynthesis Research* 39; 235-258.

Peckarsky, B.L., Fraissinet, P.R., Penton, M.A. and Conklin, D.J. (1990). Fresh water

macroinvertebrates of Northeastern of North America. Cornell Univ. Press. 7:442-447.

Qazi, A.H. and Ashok, K.P. (2012). Macroinvertebrates in streams: A review of some ecological factors. *Int. J. Fish. Aquacult*. 4(7):114-123

Umeham, S.N. and Ogbonnaya, C.I. (1993). Limnological studies of Abadaba Lake, Imo State, Nigeria; the physico-chemistry and phytoplankton productivity, *journal of Environmental and Toxicology*. 1 (1):37-41.

White, M.S.,and Xenopoulo , M.A., Hogsden, K. Metcalfe, R.A. and Dillon, P.J. (2008). Natural lake-level fluctuation and associated concordance with water quality and aquatic communities within small lakes of the Laurentian Great Lakes region. *Hydrobiologia* 613(1):21-31.

World Health Organization (WHO) (2002). Water and health in Europe; A joint report from the European Environment Agency and the WHO Regional office for Europe. WHO regional publications, European Series NO. 93.