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MACRO-INVERTEBRATE COMMUNITY OF OZOMU LAKE, BENIN CITY, NIGERIA

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ABSTRACT

Macrobenthic invertebrates in lakes are frequently used to evaluate the overall ecosystem health of an aquatic ecosystem and can live on all bottom types. The study was conducted along the stretch of Ozomu Lake in Edo state, between March and December 2013. It aimed at determining the macroinvertebrate community structure of the lake. Samples were collected from three micro habitats; surface water, allochthonous and bottom sediment using an Eckman grab and a D-frame net. Few drops of 100% formalin were added to samples collected and transported to the laboratory. Identification to the lowest possible taxonomic level was performed under light microscope. A total of thirty-eight (38) taxa which comprises of 2276 individuals were collected. Plesiopora accounted for 1.14%, Haplotaxida 3.29%, Cyclopoidea 0.57%, Odonata 9.62%, Ephemeroptera 13.32%, Hemiptera 20.12%, Coleoptera 9.62%, Trichoptera 0.70%, Diptera 30.71%, Araneida 8.40%, Prostigmata 2.33%, Mesogastropoda 0.18%. The family Baetidae (Ephemeroptera), Culicidae, Chironomidae (Diptera), Gerridae, Pleidae (Hemiptera), and Dytiscidae (Coleoptera) were the most abundant species. The diversity indices revealed that taxa richness was highest in station 1 and lowest in station 2. Shannon- Wiener and Evenness index were higher in stations 1 and 3 than station 2. The macro invertebrate fauna was abundant during the rainy season than the dry season because the volume of water in the lake was reduced during the dry season. The dipterans of Ozomu Lake preferred bottom sediment habitat, surface water habitat than allochthonous habitat. The highest number of macro-benthic invertebrate was recorded in stations1 and 3, where there was restriction of human activities. However, human activities disturb the community of macro-benthic invertebrates in this ecosystem.

Keyword: Allochtonous, Bottom sediment, Community, Macro-invertebrate, Ozomu Lake, Surface water.

INTRODUCTION

Macro-invertebrates are widespread and can live on all bottom types, they encompass mollusc such as clams and snails, crustacea such as crayfish, aquatic worms such as chironomids and oligochaetes, the immature forms of aquatic insect such as ephemeroptera (mayfly), plecoptera (stonefly), tricoptera (caddis fly) and dipterans (aquatic 3 wasps) (MDNR, 2002). Ogbeibu and Oribhabor, (2001) pointed out the relative stability of benthic communities and their sensitivity to changes in the aquatic environment and the use of some species as bio-indicators of water quality and to assess the total ecosystem health. Lakes are stagnant water body with unique faunal compositions (Olomukoro and Oviojie 2015) they harbor high biological diversity, provide sustenance for millions of people and face ongoing threats as a result of human activities throughout the world (Gopal and Chauhan, 2001). There are many studies in various parts of the world on the benthic Macro-invertebrates of fresh water bodies. These include the work of Lake, (2000) who observed that the ability of invertebrate to colonize available habitats is influenced by disturbance type and also by the abundance and type of taxa present in the system. Colonization of macro invertebrates following changes to the stream environment occurs rapidly through drift, oviposition, lateral movement and vertical migration. Species diversity is known to be a higher variable in stream in response to disturbances, resources availability and the presence of a suitable habitat (Fowler, 2002). Olomukoro and Eloghosa (2009) carried out an investigation on the impact of disturbance on the macroinvertebrate community in the biotope of a river catchment area, in southern Nigeria, three district patterns of seasonal affiliation among the benthos were observed monthly, variation in species diversity also occurred. The macrobenthic invertebrate community was affected by disturbances at the downstream bank – root biotope, limiting the occurrence to life forms of a few adaptable groups. Edema *et al.* (2004) investigated the fish consumable insect fauna and physico-chemical conditions of Ossiomo River. 138 individuals classified in 15 genera, 8 families and 5 orders were collected. The order Ephemeroptera (48.15%), Odonata (1.45%) and Plecoptera (3.62%) were represented by one family. Coleoptera (1.45%) was represented by two families and Diptera (44.93%) by 3 families. Not much is known about the flora and fauna of Ozomu Lake as very scanty work has been done on the impact of anthropogenic activities on the macro-invertebrate fauna of the lake which prompted the study. This research will provide a data-base on the Macro-invertebrate community of Ozomu lake. In recent time, there have been an increase in the pollution of water bodies in Nigeria which has impacted Nigeria's rich biodiversity. Hence, the need for a complete inventory, distribution and abundance of aquatic macro-invertebrate of the Lake. This work is aimed at determining the Macro-invertebrate community of Ozomu Lake.

MATERIALS AND METHODS

Study Area

This study was carried out in Ozomu Lake, between the month of March and December 2013. The Lake is situated in the interior of Ozomu village also referred to as Orogho village at Ovia North East Local government area; which is about 80km away from Benin City, Edo state Nigeria. It is a fairly small water body which extends between Latitude 6^{0}14'N and Longitude 5^{0}27' with an Altitude of 63meter at an elevation of 876m above sea level. Ozomu Lake is a natural lake used for industrial, agricultural and domestic purposes. it was for a long time the only source of water for the villagers during the dry season until the introduction of borehole water by a Church. The villagers still drink and perform a lot of activities with the water as it is believed that the lake is a medicinal lake and has helped to cure many diseases in and outside the village. The lake receives effluents from oil palm and cassava processing factories, human activities includes bathing, washing and fishing. Ozomu Lake is divided into three zones: the littoral zone, photic or open-water zone, profundal or benthic zone. The littoral region represents the most prominent part of the lake due to the extreme shallowness of the lake so that the entire lake could be said to be in the littoral region, it drains areas around the bank and extends almost to the bottom of the lake. Numerous organisms inhabit the lake; some exist in the surface water, allochthonous materials, while other takes shelter in the bottom sediment of the Lake. The lake experiences seasonal variations, the volume of water rises during the rainy season, and decreases during the dry season in response to changes in season. The fast dwindling of the lake has resulted to individual pools of scattered water bodies which look like individual lakes in themselves. Three stations were selected for sampling; selection of the stations was based on the abundance of water, and easy accessibility. The stations witnessed anthropogenic activities in the form of bathing, laundry and washing of farm products.

Macro-benthic Invertebrate Sampling

Samples were collected between 8am to 10pm at each sampling day and few drops of 100% formalin added to the samples collected from the field, and the containers were tightly covered and immediately sent to the laboratory for Analyses. Identification to the lowe

st possible taxonomic level was performed under light microscope using keys of macrobenthos and some basic texts (Olomukoro and Egborge, 2003; Mackie, 1998 and Olomukoro 1996). Specimens were snapped and measured to scale.

Fauna Diversity Indices

Estimation of total species diversity of the macrobenthic invertebrates was determined and analyzed to investigate patterns associated with environmental stress, using species diversity indices method which includes; taxa richness, general diversity and evenness.

Margalef's Index (D): this was used for the calculation of taxa richness**:**

$$D = \frac{S-1}{InN} \quad \ldots\ldots\ldots\ 1$$

Where:

S = Number of taxa

N = Total number of individual in all taxa.

In = Natural logarithms (Margaleff, 1996).

Shannon–Weiner Informative Index (H): This was used for the calculation of general diversity it is a more powerful informative index.

$$H^1 = \sum P_i InP_i - \frac{s-1}{N} + \frac{1-\sum P_i^{-1}}{12N^2} + \frac{\sum P_i^{-1}-P^2}{12N^3} \quad \ldots\ldots\ 2$$

Where:

H1= Shannon – Weiner index

N = Total number of individuals recorded

Pi = Number of individual in the ith species

S = Total number of species (Shannon and Weiner, 1963).

Evenness Index (E): this is used for the calculation of the even distribution of individuals in the various taxa recorded

$$E = \frac{H'}{Hmax} \quad \ldots\ldots\ 1$$

Where;

H = Shannon – Weiner value

Hmax = logarithm of number categories (Zar, 1984).

Data Analysis

Data obtained from the study stations were subjected to statistical analysis. Analyses carried out include Analysis of Variance (ANOVA) and multivariate analysis.

RESULTS

Community Structure

A total of twelve (12) groups comprising of thirty-eight (38) Macro-invertebrates taxa and 2,276 individuals were encountered in three microhabitats at the three stations selected. Surface water accounted for a total of 785 individuals, Allochthonous materials recorded 626 individuals while bottom sediment biotope accounted for a total of 865 as shown in Table 1.

Table 1: Macrobenthic invertebrate fauna composition, distribution and abundance in the three communities of Ozomu Lake.

TAXA	STATION 1			STATION 2			STATION 3		
	Surface Water Organism	Allochthonous Organism	Bottom sediment Organism	Surface Water Organism	Alloc htho nous Organism	Bottom Sediment Organism	Surface Water Organism	Allochtho nous Organism	Bottom Sediment Organism
ANNELIDA									
Oligochaeta									
Plesiopora									
Nais sp	-	-	11	-	-	6	-	-	2
Aulophorus sp	-	4	-	-	-	-	-	3	-
Haplotaxida									
Naidium sp	-	29	7	-	5	6	-	1	8
ARTHROPODA									
Cyclopoidea									
Bathynella natans	5	8	-	-	-	-	-	-	-
Odonata									
Lestes sp	17	-	-	5	-	6	13	-	8
Coenagrion sp	12	-	-	1	-	-	5	11	-
Enallagma sp	-	3	26	-	16	27	-	-	17
Cordulid sp	-	5	12	-	5	1	-	2	-
Aeschna sp	4	-	8	-	-	1	-	-	6
Libellula sp	16	-	-	-	-	-	4	-	7
Ephemeroptera									
Baetis sp	35	23	49	25	13	21	33	24	11
Cloeon sp	-	1	13	-	27	16	-	9	3
Hemiptera									
Hydrometra sp	22	-	-	-	-	-	4	-	-
Gerris sp	46	1	5	19	-	-	35	11	-
Renatra fusca	-	26	-	-	-	5	3	5	-
Epicordulia sp	-	-	12	-	2	5	-	17	24
pentacora sp	-	5	-	-	-	5	-	7	-
Plea striola	-	29	67	1	22	23	4	13	40
Coleoptera									
Dytiscus sp	-	59	19	-	21	28	-	41	-
Hydroporus sp	-	-	-	-	-	4	-	-	4
Promeresia sp	-	-	1	-	-	9	-	-	4
Hydrophilus sp	-	2	15	-	-	-	-	-	12
Trichoptera									
Hydroptila sp	-	-	3	-	-	-	-	-	-
Phryganea sp	3	5	-	-	-	-	7	1	-

TAXA	STATION 1			STATION 2			STATION 3		
	Surface Water Organism	Allochthonous Organism	Bottom sediment Organism	Surface Water Organism	Alloc htho nous Organism	Bottom Sediment Organism	Surface Water Organism	Allochtho nous Organism	Bottom Sediment Organism
Ablabesmyia sp	-	-	17	6	-	9	-	-	17
Chironomus sp	4	3	31	2	-	27	2	5	43
Pentaneura sp	-	13	25	-	12	26	-	6	34
Culiseta sp	9	42	-	4	23	-	7	33	-
Anopheles sp	18	-	-	17	-	-	16	-	-
Culex sp	83	-	30	60	-	11	56	-	-
Clinotanypus sp	-	-	-	-	8	-	-	-	-
Araneida									
Argyroneta sp	-	-	-	3	-	-	1	-	-
Hydrachna sp	22	-	-	27	-	-	12	-	-
Hygrobates sp	10	-	15	10	-	4	11	-	2
Hydrophantes sp	24	-	-	12	5	-	14	-	-
Acilus sp	-	1	5	-	-	3	-	2	5
Prostigmata									
Arrenurus sp	6	5	-	7	8	-	23	4	-
MOLLUSCA									
Mesogastropod									
Planorbis sp	-	-	2	-	-	-	-	-	2
Total no of taxa	**17**	**19**	**21**	**15**	**13**	**21**	**18**	**18**	**19**
Total no of individual species	**336**	**264**	**373**	**199**	**167**	**243**	**250**	**195**	**249**

Table 2: Percentage Composition of Macrobenthic Invertebrate at the different station of Ozomu Lake.

Taxa	Station 1	Station 2	Station 3	Total
Plesiopora	0.66	0.26	0.22	1.14%
Haplotaxida	1.78	0.69	0.82	3.29%
Cyclopoidea	0.57	-	-	0.57%
Odonata	4.53	2.72	3.21	9.62%
Ephemeroptera	5.32	4.48	3.52	13.32%
Hemiptera	9.36	3.60	7.16	20.12%
Coleoptera	4.22	2.72	2.68	9.62%
Trichoptera	0.35	-	0.35	0.70%
Diptera	12.08	9.01	9.62	30.71
Araneida	3.52	2.81	2.07	8.40%
Prostigmata	0.48	0.66	1.19	2.33%
Mesogastropoda	0.09	-	0.09	0.18%

Table 3: Test of difference in major taxa distribution and abundance in the study stations.

Taxa	Station 1 Mean ± SE	Station 2 Mean ± SE	Station 3 Mean ± SE	P-value
Plesiopora	7.50±1.04	6.00±1.54	2.50±0.42	P>0.05
Haplotaxida	18.00±2.45[a]	5.50±1.20[b]	4.50±0.48[b]	P<0.05*
Cyclopoidea	6.50±1.24[a]	0.00±0.00	0.00±0.00	P<0.05*
Odonata	10.30±1.55	7.75±1.08	9.13±1.06	P>0.05
Ephemoroptera	24.20±2.56[a]	20.40±2.55[a]	16.00±1.98[b]	P<0.05*
Hemiptera	23.66±2.16[a]	11.71±1.96[b]	14.82±1.65[b]	P<0.05*
Coleoptera	19.20±1.72	15.50±2.42	15.25±1.72	P>0.05
Tricoptera	4.00±1.00	0.00±0.00	4.00±0.78	P>0.05
Diptera	25.00±2.40	17.08±2.06	21.90±3.01	P>0.05
Araneida	13.33±2.05[a]	9.14±1.50[b]	6.71±1.55[c]	P<0.05*
Prostigmata	5.50±1.02[b]	7.50±1.62[b]	13.50±2.02[a]	P<0.05*
Mesogastropoda	2.00±0.96	0.00±0.00	2.00±0.65	P>0.05
Total Benthic	**159.19±11.58[a]**	**100.58±7.52[c]**	**110.31±9.65[b]**	**P<0.05**

Spatial distribution of macrobenthic invertebrates.

Station 1 recorded the highest in terms of general diversity and taxa richness, followed by station 3 and 2. Station 2 recorded the highest in the even distribution of individuals in the major taxa. Order Diptera were the most dominant and abundant benthos in the three stations as shown in Fig. 1. The order Hemiptera were also dominant in the study stations and contributed 20.12% to the total individual species encountered in the sampling stations. order Coleoptera accounted for 9.62% of the total number of individual recorded and were accorded as a subdominant group in the study, the presence of these organisms were restricted to surface water and felt in allochthonous and bottom sediment zones of the lake. The order Ephemeroptera contributed 13.32% of the total macrobenthic invertebrates encountered in the study stations. The bulk of the Ephemeropterans were obtained from the surface water and bottom sediments microhabitat. Odonata were represented in this study and contributed 10.47% to the total density of Macro-invertebrates encountered and is accorded as subdominant taxa. The highest percentage composition was recorded in station 1 and 3 and the least in station 2. Araneida accounted for 8.39% as the total number of species recorded as shown in Table 2. Table 3 shows the mean values and standard errors of all the major taxa of macrobenthic invertebrates encountered in the study stations. Order Plesiopora, Odonata, Coleoptera, Tricoptera, Diptera and Mesogastropoda showed no significant difference among stations with p>0.05. Order Haplotaxida, Cyclopoidea, Ephemoroptera, Hemiptera, Araneida and Prostigmata showed significant difference among study stations with p<0.05. There was significant difference (P<0.05) among the total major taxa encountered when subjected to a Duncan multiple range test. Station 1 was significantly different from station 2 and 3. A *posteriori'* test revealed that the abundance of benthic invertebrates at stations 1 and 3 were not significantly different from one another but slightly different from station 2. However, it was observed that there was no much significant difference in the diversity and evenness in all three stations as shown in Table 4.

Table 4: Diversity of macrobenthic fauna of the study stations.

Diversity indices	Station 1	Station 2	Station 3
Taxa_S	12	9	11
Individuals	57	49	55
Shannon_H	1.967	1.8469	1.8727
Simpson_1-D	0.8672	0.7924	0.8250
Evenness_e^H/S	0.2859	0.2880	0.2862
Menhinick	1.5862	1.4120	1.5219
Margalef	3.78	3.17	3.65
Equitability_J	0.8624	0.6452	0.8261
Fisher_alpha	7.52	6.86	7.19
Berger-Parker	0.1759	0.1059	0.1513

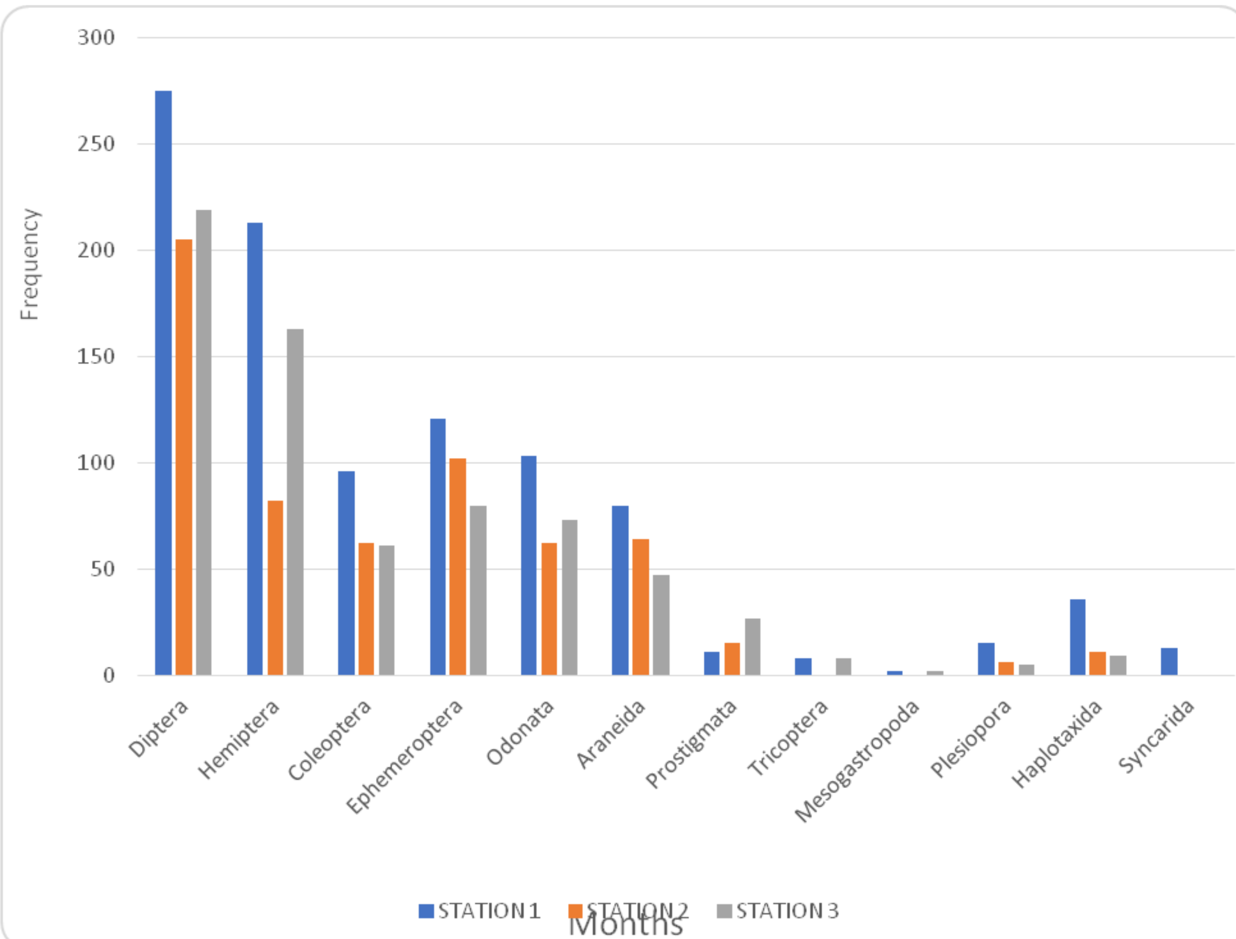

Figure 1: Temporal Variation of Macro-invertebrates Taxa in the Study Stations of Ozomu Lake

DISCUSSION

All the organisms found in this study have been variously reported elsewhere in Africa and in the tropics at large Olomukoro and Oviojie (2015). As seen from the available results the bulk of the macro-invertebrate benthic animals in the lake occurred more in the benthic community as a result of the rich sediment, followed by the surface water community and were scanty in the allochthonous community. The class insecta dominated the fauna, and were recorded in relatively high number in all the stations. This is consistence with the finding of Mackie, (1998). The overall benthic Macro-invertebrates recorded in the study area are unique in its community structure comprising of dominant groups; Diptera, and Hemiptera, subdominant groups; Ephemeroptera, Odonata, Araneida and Coleoptera, rare groups; Plesiopora, Mesogatropoda, Haploxida and Cyclopoidea. The order Diptera was the most abundant taxa with two families; the presence of *Chironomus sp* which is a pollution tolerant species is an indication of the degenerating water quality (Saliu and Ekpo, 2006). The most abundant species is the *Culex sp,* while *Pentaneura* sp, *Clinotarnypus* sp, *Anopheles sp,* and *Ablabesmyia sp* accounted low in density. The dominance of dipterans may be attributed to morphological and physiological adaptations to various communities and availability of food. Apart from the dominance of the dipterans, the order Hemiptera were also dominant in the sampling stations. The presence of Odonata, Trichoptera and Coleoptera in the study stations is an indication that the lake is unpolluted with low organic waste. Order Odonata were subdominant and were represented by the family Lestidae, Coenagroinidae, Aeschnidae, Libellulidae and Corduliidae, they were widely distributed by *Lestes sp, Enallagma sp,* and *Coenagrion sp* which were abundant in this group and sparsely distributed among the study stations. The occurrence of Oligochaetes has been associated with muddy substratum rich in organic matter. Trichoptera recorded in this study was very scanty with only two species they are mostly present in rivers which are well oxygenated when compared to Lake like in this case. Mollusca were poorly represented with only one species *Planorbis carinatus* which were restricted to stations 1 and 3 during the study period. The rest of the macrobenthic invertebrates which includes; *Hydroptilia sp, Aulophorus sp, Hydroporus sp, Promeresia sp, Pentacora sp, Acilus sp, Phryganea sp, and Nais sp, Argyroneta sp, and Clinotanypus sp* were sparsely represented in the study communities.

The diversity indices revealed that there are significant differences in species composition between stations.

CONCLUSION AND RECOMMENDATION

The highest number of macrobenthic invertebrate fauna was recorded in stations 1 and 3, where there was restriction of human activities. However, human activities can disturb the equilibrium of an ecosystem. The accessibility of station 2 of the Lake has rendered the ecosystem unstable and unsuitable for human consumption. Hence, there is a need to properly manage anthropogenic activities and proper disposal of household waste around the village to minimize organic pollution through run-off into the Lake. Alternative sources of water should be provided to restrict human activities which could pose a threat to the Lake.

REFERENCES

Edema, C.U., Ogbeibu, A.E. and Ogbeide, O. (2004). Some observations on fish-consumable Insects of Ossiomo River, Nigeria. *Tropical Freshwater Biology.* 12(13): 25 – 33.

Fowler, R.T. (2002). Relative importance of surface and subsurface movement on benthic community recovery in the Makaretic River, North Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 2002, **36**: 459 – 469.

Gopal, B. and Chauhan, M. (2001). South Asian Wetlands and their biodiversity: the role of monsoons. In: Gopal, B. Junk, W.J, Davis, J.A. (eds) *Biodiversity in wetlands: assessment, function and conservation*, 2: 257 – 256. Backhuys publishers, Leiden.

Lake, P.S. (2000). Disturbance, Patches and Diversity in Stream *J. North Am. Benthol. Soc.* 19: 573-593.

Mackie, G.I. (1998). Applied Aquatic Ecosystem Concepts University of Guelph custom course pack, Pp. 12.

Margaleff, R. (1996). Limnology Now, a Paradigm of Planetary Problems. *Elsevier, Amsterdam*. Pp. 220-222.

Missouri Department of Natural Resources (MDNR) (2003). *Semi-quantitative macroinvertebrate stream bioassessment project procedure.* Jefferson City, MO: Air and Land Protection Div., Environmental Services Program.

Ogbeibu, A.E. and Oribhabor, B.J. (2001). The Ecological impact of Stream Regulation using benthic Macro-invertebrates as indices. *Journal Aquatic Sciences*, 16(2): 139 – 143.

Olomukoro, J.O. (1996). Macrobenthic Fauna of Warri River in Delta State – Nigeria. Ph.D Thesis University of Benin. Benin City. Pp: 205.

Olomukoro, J. O. and Egborge, A. B. M. (2003). Hydrobiological studies of Warri River, Nigeria. Part 1: The Composition, distribution and diversity of macrobenthic fauna. *Bios Res. Commun.* **15**: 279 – 294.

Olomukoro J.O. and Eloghosa O. (2009) Macroinvertebrate colonisation of artificial substrates in a Nigerian river III: Cement bricks, ceramic tiles and macrophytes. *African Scientist*, **10**(1): 53-63.

Olomukoro, J.O. and Oviojie, E.O. (2015). Diversity and Distribution of Benthic Macroinvertebrate Fauna of Obazuwa Lake in Benin City, Nigeria. *Journal of Biology, Agriculture and Healthcare* www.iiste.org 5:1.

Saliu, J.K. and Ekpo, M.P. (2006). Preliminary chemical and biological assessment of Ogbe Creek, Lagos, Nigeria. *West Afri. J. Appl. Ecol.*, **9**: 12 – 18.

Shannon, C. E. and Wiener, W. (1963). *The mathematical theory of communication.* University of Illinois Press, Urban. 117 pp.

Zar, J.H. (1984). *Biostatistical Analysis* 2nd Edn. Prentice – Hall Inc., Englewood cliffs, New Jersey, USA.