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Composition, Distribution and Diversity of Benthic Macroinvertebrates of Ona River, South-west, Nigeria.

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ABSTRACT

Macrobenthic invertebrates' fauna of Ona River at Apata, Ibadan south-west, Oyo State, Nigeria was conducted from October, 2010 to March, 2011. Benthic samples were collected from five different stations along the river. Three phyla of macrobenthic invertebrates were encountered in the river. They were Arthropoda, represented by three genera, Chironomus (Diptera), Progomphus (Odonata) and Isoperla (Plecoptera); Annelida represented by only one genus, Tubifex (Oligochaeta) and Mollusca represented by six genera of gastropods with four identified species namely, Indoplanobis executus, Melanoides tuberculata, Bulinus globosus, Biomphalaria pfferferi, Lymnaea species and Physa species. Chironomus larvae dominated the macrobenthic invertebrates with a total relative abundance of 59.1% while Isoperla larvae were the least abundant, 0.19% by number. All the macrobenthic invertebrates recorded were pollution-tolerant/Clean water species. The increase in the ecological potential of Ona River throughout the study period was best highlighted by the presence of indicator species.

Keywords: Benthic Macroinvertebrates, Composition, Diversity, Ona River, Ibadan.

INTRODUCTION

Benthic organisms are those organisms that live on or inside the deposit at the bottom of a water body [1]. These organisms play a vital role in the circulation and recirculation of nutrients in aquatic environments. They constitute the link between the unavailable nutrients in detritus and useful protein materials in fish. Most benthic organisms feed for a wide range of fishes [2] [3].

Macrobenthic invertebrates are also those organisms often retained by mesh sizes of $0.05m^2$ [4] although the early stages of many macrobenthic invertebrates species are smaller than this size. Several benthic species are relatively long lived, with life spans ranging from weeks for some opportunistic worms to months or years for larger taxa [5].

Macrobenthic invertebrate are biological quality element require for the classification of biological status of the water bodies [6]. Benthic infaunal community studies provide the 'golden standard' in terms of determining whether or not alterations in benthic communities are occurring and together with sediment, toxicity and chemistry, whether or not such changes are due to toxic contaminants in the sediments [7]. Over the last decades there has been a considerable effort to document the ecology, composition, spatial distribution and biodiversity of macrobenthic invertebrate communities of Nigerian rivers [8-14]. Researchers established a pattern of relationship between macrobenthic invertebrate fauna, depth, substrate type and organic contents of sediment. They reported that areas with high accumulation of sediment and high organic flux rates from riverine sources supported high macro infauna, abundance and biomass. Other studies using macrobenthic invertebrate as bio-indicator of anthropogenic impact on aquatic ecosystem have shown general decrease in macrobenthic invertebrate population and reduction in species

diversity and richness [8]and they possess higher ability to tolerate pollution-induced environmental stress than plankton [15].

The Ona River has been subjected to domestic, agricultural and Industrial activities. The river is the major source of drinking water to the inhabitants of these communities. This study provides a baseline data on the composition, distribution, abundance and diversity of macrobenthic invertebrates of Ona River.

MATERIALS AND METHODS

Description of Study area

The study was carried out in Ona River which is one of the major rivers in Ibadan, Ibadan south-west, Oyo State, Nigeria. . Ona River has a length of 55km^2 an area of 81.0km^2 and it flows through the low density western part of Ibadan [16]. The river flows in a north-south direction from its source at Ido Local Government Area) where it is dammed and also flows through Apata Genga (Ibadan south-west Local Government Area) to Oluyole Local Government (Figure 1). Companies located along this river include 7up Nigeria Plc, Zartech, Sumal and Interpac a paper mill industry (not in operation). Channelled effluents from these industries are connected by a network of canals channelled directly into Ona River. Ona River receives allochtonous input of organic matter from the surrounding vegetation, derived through run-offs from the surface of the soil. The water body receives a lot of wastes ranging from industrial, agricultural and domestic sources, which apart from adversely affecting the normal hydrochemistry of the river, also decreases its channel capacity at various points, and this has been largely responsible for flood disasters in the river [16]. The river is often used as a 'latrine' which makes it offensive to sight and smell and therefore not good as a natural resource.

Sampling stations

Five sampling stations (1-5) were chosen along the river course. The co-ordinates of the sampling stations were taken using Geographic Positioning System (GPS) and approximate distances of the stations were calculated, each station was 1000m apart from the other.

Station 1

This was the upstream station used as the control point because it was assumed to be unpolluted since waste/effluent was not discharge into the station. It is located at Moore plantation, Apata, Ibadan (Lat: N7^0 22' 4.81"; Lon: E3^0 50' 09.84"). In this station, there is no emergent vegetation. Bank side vegetation is predominantly melina tree (*Commelina nodiflora*). This river bed is basically coarse sand, granite and fast flowing, it appears undisturbed, unaltered and clean.

Station 2

Station 2 is the discharge point, located at Odo-Ona (Lat: N7^0 22' 4.85"; Lon: E3^0 50' 09.88"). It receives effluents from human household and wastes disposal. This is the station, in which the river at this point flows along a concrete channelled of about 5m wide and through some residential area. The river here is dirty brown and fast moving, speed was not uniform because of midstream eddies and side water friction with debris and land.

Station 3

Station 3 receives effluents from Sumal Food Company, that produces biscuit and sweet and it is located along Ring Road between Ibadan northwest and southwest L.G.A (Lat: N7^0 21' 4.89"; Lon: E3^0 51' 09.92"). The river at this station is also insensitively used for disposal of domestic waste. The river is also very dirty, contaminated with heavily disposed domestic, solid wastes and other activities are like washing of cars, clothes, bathing and human defecation.

Station 4

Station 4 receives effluents from 7up Bottling Company and also some industrial wastes around. It is located at 7up Road, Ring Road, Ibadan (Lat: N7^0 20' 4.92"; Lon: E3^0 51' 09.96"). This station; is probably turbid due to the effect of discharged effluents. The vegetation is composed mainly of trees which form a partial shade over this station, with *Panicum maximum* (Guinea grass) and some banana cover. The substratum is muddy.

Station 5

Station 5 receives effluents from Adeoyo State Hospital and also some industrial wastes around. It is located at Elewura area towards Fodasis Hospital, Ring Road, Ibadan (Lat: N7^0 19' 4.96"; Lon: E3^0 51' 09.99"). In this station, the vegetation is composed mainly of trees which form a shade over this station and the substratum is also muddy.

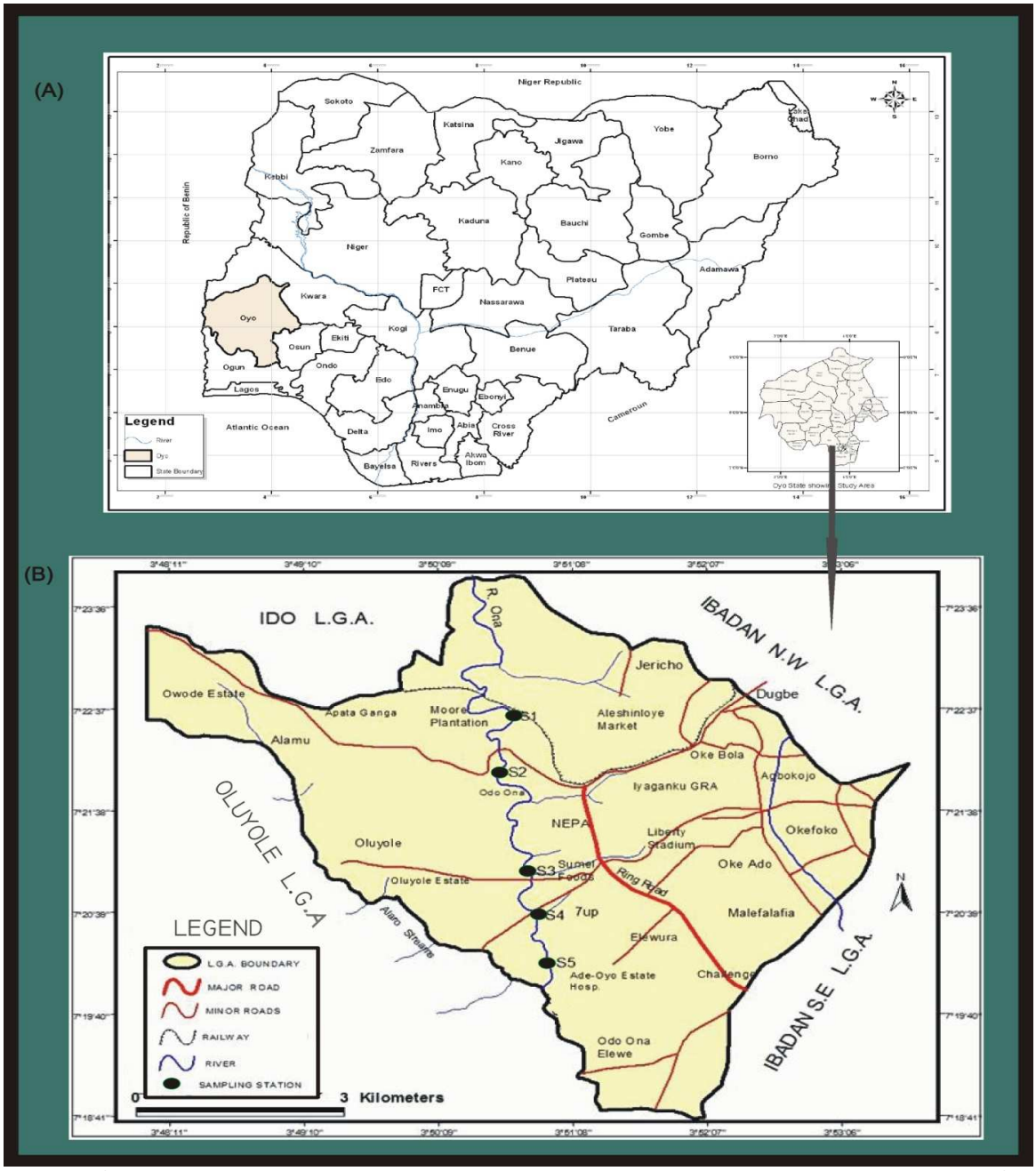

Figure 1: Map of Ibadan South-West Local Government Area Showing Ona River and Sampling Stations (1-5), (Map of Nigeria and Oyo State Inserted).

Sampling procedure

Benthic samples were collected monthly from the October, 2010 to March, 2011 at five different stations of the study area (Figure 1) using a van Veen grab, usually between 7:00am and 10:00am. For each sampling station, 3 or 4 hauls were made by sending the grab down into the buttom. The sediment collected were poured into polythene bags, labelled and brought to the laboratory for analysis. The sediments were passed through 3 sieved of 2mm, 1mm and 0.5mm mesh sizes to collect the benthos. The benthos were poured into a white enamel tray, stained with Rose Benger Solution and sorted using forceps. They were sorted out into different groups and preserved in 4% formalin. They were then identified under a compound microscope using the key guide of Environmental Protection Agency [17] and counted.

Statistical analysis

Biological indices, Margalef's index (d); Shannon-weiner index (H) and Evenness (E) were used in the calculation of taxa richness, diversity and evenness [18] [19].

Margalef's index (d): is a measure of species richness and was expressed as:

D= $\frac{S-1}{N}$ …… (1)

Where;
S was the number of spices in sample
N was the number of individuals in the sample.

Shannon and weavers index (H): is a species abundance and evenness and was expressed as:

$$H=\sum \frac{Ni}{N} \log_2 \frac{Ni}{N}$$ ……..(2)

Where;

N was the total number of individuals in the sample
Ni was the total number of individual of species the in the samples

Species equitability or evenness (E) was determined by the equation

$$E = \frac{H}{\ln S}$$ ……..... (3)

Where;
H was the Shannon and weavers index
S was the number of species in samples.

RESULTS

Table 1: Composition and relative abundance of benthic macroinvertebrates encountered in Ona River

Composition						**STATIONS**						
	1			**2**		**3**	**4**		**5**		**TOTAL**	
TAXA	No	%	No	%	No	%	No	%	No	%	No	%
ARTHROPODS												
Insecta												
Diptera												
***Chironomus* larvae**	-	-	115	57.8	90	70.8	64	57.1	40	52.60	309	59.7
Odonata												
***Progomphus* larvae**	3	75	-	-	-	-	-	-	-	-	3	0.57
Plecoptera												
***Isoperla* species**	1	26	-	-	-	-	-	-	-	-	1	0.19
ANNELIDA												
Oligochaeta												
***Tubifex* larvae**	-	-	84	42.2	28	22.04	19	16.90	11	14.5	143	27.4
MOLLUSCA												
Gastropoda												
Indoplanobis exeustus	-	-	-	-	-	-	6	5.36	4	5.26	10	1.93
Melanoides tuberculata	-	-	-	-	-	-	8	7.14	5	6.58	13	2.51
Bulinus globosus	-	-	-	-	2	1.57	4	3.57	5	6.58	11	2.12
***Physa* species**	-	-	-	-	2	1.57	4	3.57	3	3.94	9	1.73
***Lymnaea* species**	-	-	-	-	1	0.78	2	1.79	2	2.63	5	0.96
Biomphalaria pfferferi	-	-	-	-	4	3.15	5	4.46	6	7.89	15	2.86
Total number of taxa	**2**		**2**		**6**		**8**		**8**		**26**	
Total number of individual	**4 (0.77%)**		**199 (38.4%)**		**127 (24.5%)**		**76 (14.7%)**		**76 (14.7%)**		**518 (100%)**	

Where; *Station 1, 2, 3, 4, 5 is Moore Plantation, Odo-Ona, Sumal Food Industry, 7up Company, Adeoyo Hospital*

Relative abundance of the various macrobenthic invertebrate taxa encountered at the different sampling stations is presented in Table 1 while the illustration in Figure 2 shows the percentage composition of macrobenthic invertebrates' phyla of Ona River. Ten genera were identified belonging to three phyla from a total of 518 individuals collected from all the stations. Odo-Ona station accounted for the highest abundance (38.42%) by number while the Moore Plantation station accounted for the lowest abundance (0.77%) by number. The highest number of taxa (8) was recorded in 7up Company and Adeoyo Hospital stations while the lowest number (2) was recorded in Moore Plantation and Odo-Ona stations. Arthropods have the highest percentage composition (61%) by number while Mollusca were the least (12%) by number.

All the stations were dominated by insects, represented mostly by *Chironomus* larvae (59.7%) followed by the Oligochaete, *Tubifex* larvae (27.4%); but these were absent in the Moore Plantation station. Though percentage abundance of gastropods were low (0.96-2.86%), they had the highest number of taxa (6) and they included *Indoplanobis executus*, *Melaniodes tuberculata*, *Bolinus globosus*, *Biomphalaria pfferferi*, *Lymnaea* species and *Physa* species. These gastropods were not encountered in the Moore Plantation and Odo-Ona station.

Diversity and dominance indices calculated for the five stations are shown in Table 2. Taxa richness calculated as Margalef index (d) was least in Odo-ona stations (0.19) followed by the upstream station (0.72) while Adeoyo hospital station accounted for the highest diversity (1.616). The pattern was similar for Shannon diversity index (H). Equitability was least in Sumal food station (0.207) and highest in Odo-ona station (0.427). The five stations had more or less equal dominance and diversity levels.

Table 2: Diversity indices of benthic macroinvertebrates of Ona River.

STATIONS	1	2	3	4	5	TOTAL
Margalef's diversity (d)	0.72	0.19	1.032	1.484	1.616	5.042
Shannon weiner (H)	0.244	0.296	0.371	0.615	0.675	2.201
Equitability (E)	0.352	0.427	0.207	0.220	0.325	1.531

Where; *Station 1, 2, 3, 4, 5 is Moore Plantation, Odo-Ona, Sumal Food Industry, 7up Company, Adeoyo Hospital*

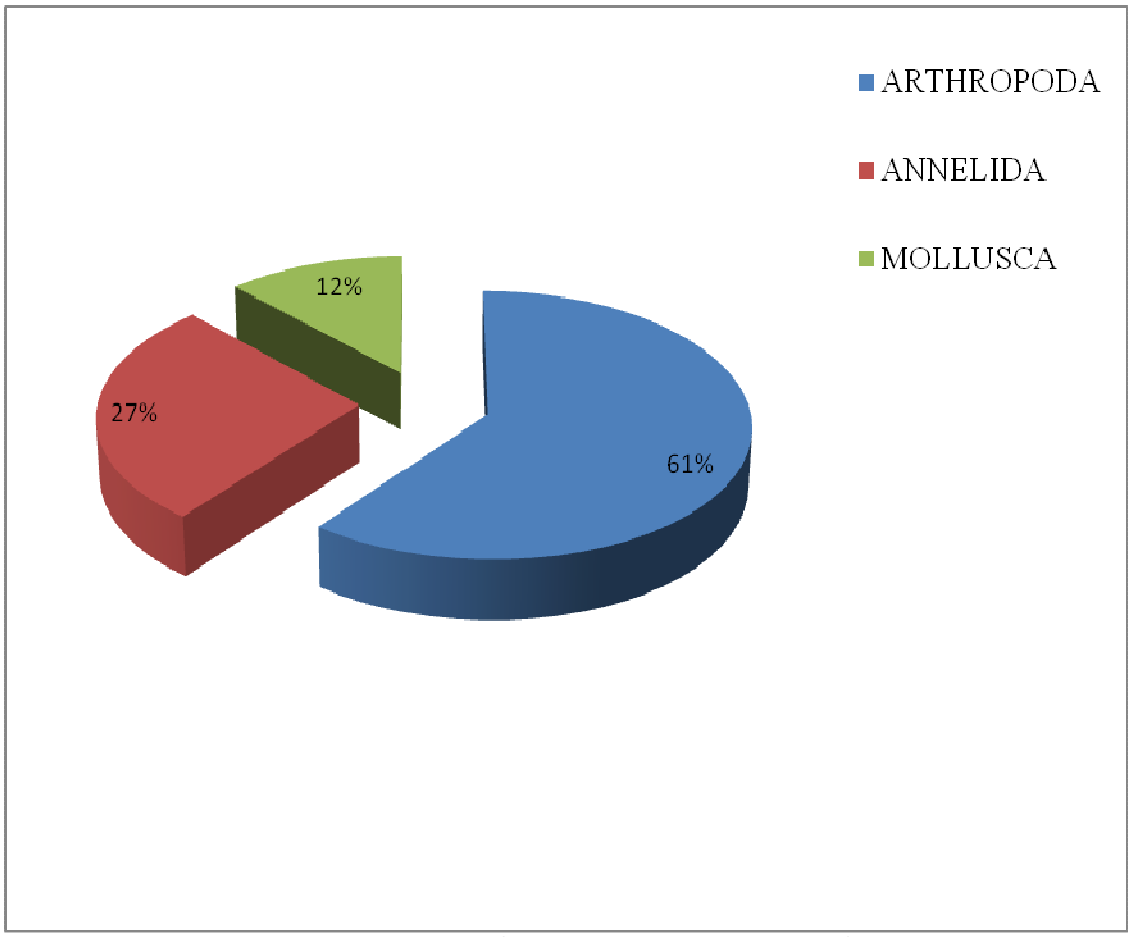

Figure 2: Percentage composition of benthic macroinvertebrates' phyla of Ona River.

DISCUSSION

The number of recorded benthic macroinvertebrates population was generally low because of some ecological imbalance arising from alterations of some important factors governing the abundance and distribution of the benthic communities. Such factors include water quality, immediate substrates for occupation and food availability [20]. According to [21] cited by [22], the bigger the size of a lotic water body the poorer the macroinvertebrate richness. In addition, high human activity around the sampling stations which released wastes into the river could also be a possible explanation. [9] reported that high biodiversity is expected in ecosystems devoid of significant anthropogenic impacts.

Results from the present study which showed that the most abundant macrobenthic invertebrate fauna throughout the study period was *Chironomus* larvae; could be attributed to the fact that this insect is known to thrive in polluted environment properly due to possession of haemogloblin a pigment that transport and store dissolved oxygen [23], also the present of *Tubifex* larvae and some gastropods recorded during this study attribute to the fact that they were transported by water current and were tolerant of the prevalent water condition. However, the presence of these indicator species suggests organic pollution from anthropogenic source.

The low species diversity could partly be due to some physico-chemical conditions also observed during the study period such as fast flow of water and low dissolved oxygen [24] probably resulting in disruption of reproductive cycle and food chain [25].

CONCLUSION

I. All the benthic macroinvertebrate fauna recorded were pollution-tolerant /clean water species.

II. Diptera were the most abundant taxonomic group in terms of numerical abundance, with *Chironomus* larvae being the most abundant.

III. It could be concluded that Ona River water is under stress due to the disruption of abiotic and biotic factors. It is polluted with organic pollutants from anthropogenic sources such as the surrounding industries and waterfront dwellers releasing raw human excreta, detergents, wastewater and cleaning agents from the industries etc.

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REFERENCES

[1] EP Odum, Fundamentals of ecology, 3rd W.B. Saunders Company. Philadelphia, **1971**; pp. 574.
[2] AM Imevbore and O Bakare, Ed. Studies, **1970**, 7, 87-98.
[3] AA Adebisi, A Report Prepared for Agro Team. Ibadan, Nigeria, **1989**; pp. 7-8.
[4] CF Mason, Biology of fresh water pollution. Longman International, New York, 1981; pp. 23.
[5] WA Bamikole, AO Ndubuisi and OO Olaronke, *Research journal of biological sciences*, **2009**, 4, 272-279.
[6] H Timm and T Mois, *Verh. Int. Verein. Limnol*, **2008**, 30, 138-140.
[7] PM Chapman and J Anderson, *Integrated Environ. Assess. Manage*, **2005**, 1, 163-173.
[8] AE Ogbeibu and R Victor, *Environ. Pollut*, **1989**, 56, 85-100.
[9] AE Ogbeibu and ABM Egborge, *Trop. Freshwater Biol*, **1995**, 4, 1-27.
[10] AE Ogbeibu and BJ Oribhabor, *Water resources*, **2006**, 36, 2427-2436.
[11] JO Olomukoro and R Victor, *Trop.J.Environ. Sci. Health*, **1999**, 2, 58-64.
[12] JO Olomukoro and ABM Egborge, *Biosci. Res. Commun*, **2003**, 15, 279-296.
[13] LI Ezemonye, JO Olomukoro and E Igbinosun, *Afr. Sci*, **2004**, 5, 181-192.
[14]FO Osemweigie and JO Olomukoro, *Trop.J. Environ. Res*, **2004**, 15, 279-296.
[15] DM Rosenberg and VII Resh, Fresh water biomonitoring and benthic macro invertebrates. New York Chapman and Hall, **1998**; pp. 488.
[16] AG Akin-Oriola, *Review biological tropica*, **2003**, 51, 7.
[17] EPA, Technical Guidance Document on Environmental Protection Agency, **1998**, 841-B-98-007.
[18] RH Green, Sampling design and statistical method for environmental biologist. John willey and Sons, Toronto, **1971**; pp. 257.
[19] AH Robinson and PK Robinson, *J. Zool land*, **1971**, 163, 25-61.

[20]KW Dance and HB Hynes, *Environmental pollution service*, **1980**, 22, 19 – 28.
[21] RO Brinkhurst, Organic pollution, In: Pollution; causes, effect and control, Ed. Harrison, R.R. the Royal Society of Chemistry, London, **1970**; pp. 103.
[22] AS Yakub and AAA Ugwumba, *the Zoologist*, **2009**, 7, 65-74.
[23] J Tyokumbur, TG Okorie and OA Ugwumba, *the Zoologist*, **2002**, 1, 59-69.
[24] MC Emere and EC Nasiru, *Journal of nature and science*, **2009**, 7, 7-9.
[25] JA Adakole and PA Annune, *Journal of aquatic science*, **2003**, 18, 85 – 92.