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ASSESSMENT OF MACROINVERTEBRATES OF LAKE GERIYO, YOLA, ADAMAWA STATE, NIGERIA

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ABSTRACT

Macro-invertebrates composition of Lake Geriyo, Yola, Adamawa State, Nigeria were investigated from January to December, 2019. Macro-invertebrates samples were collected from three different sites using Van Veen Grab method. Three phyla of macro-invertebrates were encountered in the Lake. They were Arthropoda represented by nineteen genera such as Ameletus, Callibaetic, Baetis (Ephemeroptera); Diura, Ostrocera and Leuctra (Plecoptera); Hydrobius, Agabetes and Stelelmis (Coeloptera); Macrostermum, Hydroptica and Setodes (Trichoptera); Chaobrus, Simulium, Chelifera, Odontomesa and Chironomus (Diptera); Ischnura(Odonata)Hesperocorixa (Plecoptera); Annelida represented by four genera such as Biomphalaria , Volvata, Bulinus and Helisoma; Mollusca represented by six genera such as Eclipidrilus, Stylodrilus, Isochaetidefreyi L, imnodrilus, Potomothrix and Tubifex. A total of 993 macroinvertebrates were recovered. Twenty-nine taxa were recorded. The higher number of taxa (28) were recorded at site II and III. The abundance of individuals was highest at site III. Arthropoda have the highest percentage composition (68.49%) by number followed by Annelids (20.04%), while Mullusca was the least (11.48%) by number. Variations in distribution of these organisms could be as a result of differences in local environmental conditions. All the macro-benthic invertebrates represented were pollution-tolerant and clean water species.

Keywords: Macro-invertebrates, Assessment, Lake Geriyo

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INTRODUCTION

In Nigeria most of these Lakes have been subjected to an increasing pollution load from contaminated urban run-off water originating from industrial, agricultural, residential, commercial and recreational areas and institutions such as schools and hospitals (Adakole and Annune, 2003). Ogbogu and Hassan (1996) pointed out the effects of contaminants usually flushed into Lakes especially in areas of high human activities. The adverse effects of human impactson the aquatics include water – borne diseases, alteration of aquatic biota composition, eutrophication and reduction or destruction of ecosystem integrity (Oduwole, 1997; Ekpo *et al*., 2012; Abed-nego and Adedolapo, 2016)

Macroinvertebrate organisms form an integral part of an aquatic environment and are of ecological and economic importance as they maintain various levels of interaction between the community and the environment (Anderson and Sedel, 1979). According to Marques *et. al.* (2003) knowledge of the structure of the benthic macroinvertebrate community provides precise and local information on recent events, which can be seen in their structuring. The use of invertebrates and fish as bioindicators of water quality has been advocated by several researchers (Victor and Ogbeibu, 1985; Ofojekwu *et. al.*, 1996; Edokpayi and Osimen, 2001; Adakole and Annune, 2003). Macroinvertebrates, which were utilized inaquatic pollution studies, include: Mayflies (Ephemeroptera), caddisflies (Trichoptera), stoneflies (Plecoptera), beetles (Coleoptera), crayfish and amphipods (Crustaceans), aquatic snails (Mollusca), biting midges (Chironomids) and leeches (Hirudinea) in Nigeria, North America and Europe (Tampus *et al*., 2012).

Biomonitoring programmes that employ indices andmetrics of community structure (Udoidiong and King, 2000) had been used to assess the potential impacts or non-impacts of these alternations on the aquatic ecosystem. The richness of macroinvertebrate community composition in a water body can be used to provide an estimate of water body health (Argerich *et al*., 2004). The physical and chemical qualities of water and of substratum occupied by macroinvertebrates determine their occurrence and distribution (Danes and Hynes, 1980; Abed-negoand adedolapo, 2016). Macroinvertebrates play an important role in aquatic community which includes mineralization, mixing of sediments and flux of oxygen into sediment, cycling of organic matter and also in assessing the quality ofinland water (George *et al*., 2009). This study is designed to assess macroinvertebrates of lake geriyo, and this will provide information on the health status of this water body.

STUDY AREA

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Lake Geriyois situated in Jimeta-Yola Adamawa state capital and located on latitude 09°18’11” N and longitude 12°25’36”E (Fig.1). Lake Geriyois the lake which is flooded by the River Benue. Lake Geriyo occupies natural depression near the upper Benue River in north eastern Nigeria. The lake is flooded by the river during the raining season spanning the months of May to September (UBRBDA, 1985).

According to the information from the head of the local fishers, the lake was formed naturally from River Benue that was cut off as a result of heavy siltation about 60 years ago, thereby forming a small gully. The gully was later filled with water from the rains and flooding from River Benue. It is a shallow water body with a mean depth of about 2 metres. Aquatic vegetation on the lake consist of mass of flooding weeds such as water hyacinth, typha grass, water lily and wild guinea corn which move around the lake surface due to the prevailing winds. The major commercial genera in the lake are Clarias and Tilapia (UBRBDA, 1985).

The Lake site I is found to be a great domestic and industrial wastes dump and agricultural activities, site II is found to be the fishing landing site, washing of utensil, clothes and agricultural activities and site III intense agricultural activities, where agrochemicals may have been applied on both rainy and dry seasons. The Lake receives a lot of dissolved substances through runoff, soil drainage and soil erosion from its tributaries from far and surrounding Yola metropolis. All these are believed to cause devastating effect on the aquatic fauna and flora.

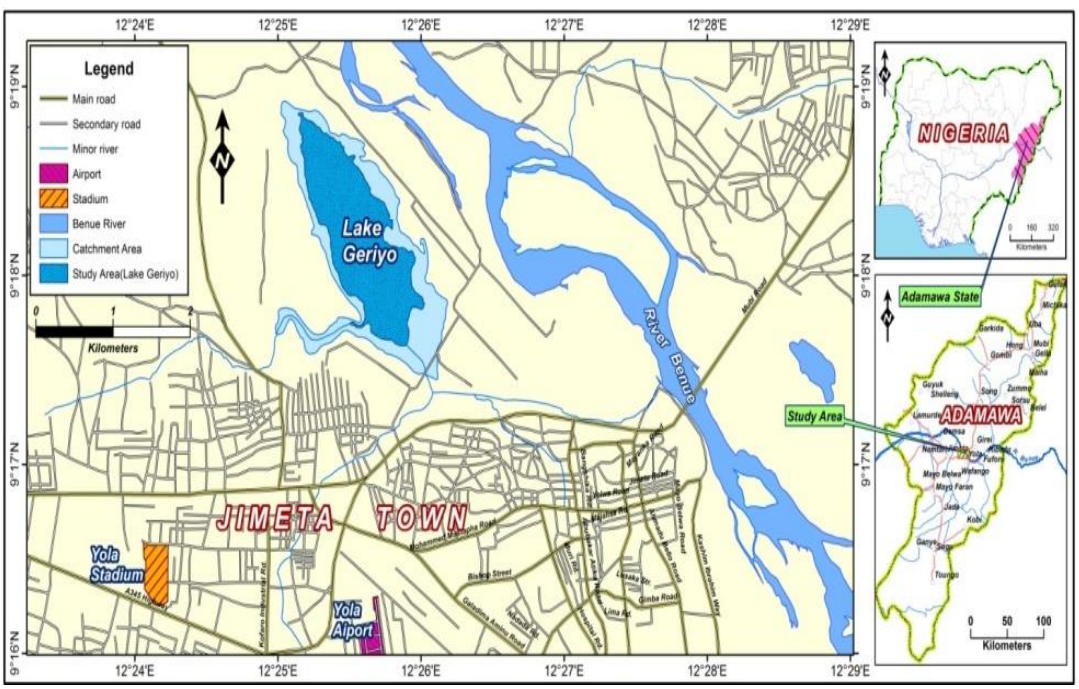

Fig. 1: Map of the study Area

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Collection of Macro Invertebrates Samples

Macroinvertebrates Samples were collected using modified Ekman grab sampler as described by Maitland (1978). The grab was lowered into the Lake bed at the sampling site. When the grab reached the bottom of the Lake, the content was emptied into a labeled polythene bag. Macroinvertebrates samples were preserved with 10% formalin and transported to the laboratory for Identification with aid of dissecting microscopes and hand lens. In the laboratory the samples were sieved in order to remove fine sediment and any other unwanted materials. Each sediment sample collected was washed three times through three set of sieves to collect the macro invertebrates (2mm mesh size, 1mm and the 0.5mm). Macroinvertebrates collected were poured into a white enamel tray, sorted out and specimens were identified to the lowest possible taxonomic level and counted (George *et al.*, 2009; Andrews (1972).

DATA ANALYSIS

The mean values of data were calculated and presented in tables. Biological indices such as Margalef's index (d); Shannon-Weiner Index (H) and Evenness (E) were used in the calculation of taxa richness, diversity and evenness. Margalef's Index (D) is a measure of species richness and is expressed as;

$$D = \frac{S-1}{N} \quad \text{..................(1)}$$

Where;

S is the number of species in sample

N is the number of individuals in the sample

Shannon Weiner's Index (H'): is a species abundance and evenness and is expressed as;

$$H' = \frac{N \ln N - (ni \ln ni)}{N} \quad \text{...............(2)}$$

Where;

N is the total number of individuals in the sample,

ni is the total number of individual species in the samples,

ln is natural logarithm.

Species Equitability or Evenness (E) were determined by the equation

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$$E = \frac{H'}{\ln S} \qquad \ldots\ldots\ldots\ldots(3)$$

Where;

H is the Shannon and wiener’s index

S is the number of species in sample.

Shannon and wiener (1949); Margalef (1967).

RESULTS

Macro-Invertebrates Composition and Abundance

Summary of the relative abundance of the various macro-invertebrates taxa encountered at the different sampling Sites is presented in Table 1.Twenty nine genera were identified belonging to three phyla from a total of 993 individuals collected from all the sites. Site III accounted for the highest abundance (34.04%) by number follow by Site II which accounted for (33.64%) by number and Site I accounted for the lowest abundance (32.33%) by number. The highest number of taxa (28) was recorded in Sites II and III while Site I recorded the lowest number of taxa (27). Arthropoda have the highest percentage composition (64.49%) by number followed by Annelida (29.04%) while Mollusca was the least (11.48%) by number.

Though percentage abundance of Arthropods was high (1.21-10.07%) and also had the highest number of taxa (19) and these fall into different orders; Ephemeroptera which includes Ameletus species, Callibaetic species and Baetis species; Plecoptera which includes Diura species, Ostrocera species and Leuctra species; Coeloptera which includes Hydrobius species, Agabetes species and Stelelmis species; Trichoptera which includes Macrostermum species, Hydroptica species and Setodes species; Diptera which includes Chaobrus species, Simulium species, Chelifera species, Odontomesa species and Chironomus species. Ischnura species were single encountered in Sites I, II, and III while Hesperocorixa were single encountered in Sites II and III.

Diversity Indices of Benthic Macro-Invertebrates

A summary of the diversity and dominance indices calculated for the three sites is shown in Table 2. Taxa richness calculated as Margalef index (d) was least in site III (1.000) followed by site II which accounted for (1.001) while the site I accounted for the highest diversity (1.002). The pattern was similar for Shannon diversity index (H), site III was least (0.762) followed by site II which accounted for (0.796) while site I accounted for the highest diversity (0.919).

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Equitability was least in site III (0.229) and highest in Site III (0.279). The three sites had more or less equal dominance and diversity levels with insignificantly different indices values.

DISCUSSION

The number of recorded macro-invertebrates population was relatively low because of some ecological imbalance arising from alterations of some important factors governing the abundance and distribution of the benthic communities. The result recorded was low when compared with over 55 taxa reported for tropical streams (Edokpayi *et. al.*, 2000; Ogbeibu 2001; Adakole and Annune, 2003) and 33 taxa recorded by John and Abdurrahman (2014) in wetlands Southern Nigeria but higher than 27 taxa recorded by Emere and Nasiru (2009) in River Kaduna. Similar result was also reported by Andem *et al*. (2013) in Stream communities such factors include water quality, immediate substrates for occupation and food availability. According to Yakub and Ugwumba (2009), the bigger the size of a lotic water body the poorer the macroinvertebrate richness. In addition, high human activity around the sampling sites which released wastes into the lake could also be a possible reason, similar observation was also made by Andem *et al*. (2013) in water bodies in the Okomu forest reserve (sanctuary) in southern Nigeria and he reported that high biodiversity is expected in ecosystems devoid of significant anthropogenic impacts.

The number of macro-invertebrate taxa recorded in the sites could be ordered as II>III>I, while the abundance pattern in these sites could be summarized as III>II>3>I. The macro-invertebrates community composition, structure, density and diversity and horizontal distribution have been greatly affected by the presence of the less homogenous environment within the lake, which reduces the number of colonizing taxa. The dominance of the Arthropods in terms of taxa representation is attributable to the freshness of the lake in the study area. This conforms to Okorafor *et al*. (2012) in the Shore of Great Kwa River, Calabar, Nigeria. The presence of various clean water indicator insect orders such as Odonata and Ephemenoptera each represented by many species indicate relatively stress-free environmental condition in the study.

The low Shannon-Weiner diversity value (2.477) and a relatively high Margalef diversity level (3.003) recorded were due to the fact that the former incorporates evenness of distribution while the later only measures species richness. Thus, the low Shannon-Weiner diversity value was as a result of the much higher relative abundance of the Arthropods taxa than other macro-invertebrate taxa. The comparable number of macro-invertebrate taxa as well as insignificantly different macro-invertebrates abundance and diversity levels of sites indicates uniform distribution of macro invertebrate fauna in the study area. The low species diversity may be attributed to fluctuation in some physicochemical parameters. These factors could probably

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cause disruption of life cycle, reproductive cycle, food chain and migration or imposed physiological stress oneven the tolerant Macro fauna (Adakole and Annune, 2003).

The presence of Chironomus species as the predominant macro-invertebrate taxa as well as occurrence of various clean water indicator insect orders such as Odonata, Plecopterans, Trichopterans, Hemipterans, Coleopterans and Ephemenoptera as well as Gastropods (Annelida) each represented by many species indicate relatively stress-free environmental condition in the study area. Ogbogu and Olajide (2002); Tyokumbur *et al*. (2002) and Okorafor *et al.* (2014) listed Odonata, Plecopterans, Trichopterans, Hemipterans, Coleopterans and Ephemenopterans as well as some Gastropods as pollution sensitive macro-invertebrates.

CONCLUSION

The macro-invertebrates at Lake Geriyo during the study period were dominated by three phyla Arthropoda, Annelida and Mollusca. The occurrence of pollution tolerant species and pollution sensitive species in the water body is an indication of increase in environmental stress through anthropogenic activities, which may in turn facilitate the biodegradation of the Lake.

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Table 1: Composition and Relative Abundance of Macro-invertebrates encountered in Lake Geriyo (Jan. To Dec.., 2019)

S/no	Taxa/Species Identified	ST-I NO	%	ST-II NO	%	ST-III NO	%	Total NO	%
1	**Mullusca**								(**20.49**)
	Biomphalaria Sp	13	4.05	12	3.59	12	3.55	37	3.73
	Volvata Sp	11	3.43	14	4.19	8	2.37	33	3.32
	Bulinus Sp	9	2.80	11	3.29	-	-	20	2.01
	Helisoma Sp	14	4.36	-	-	10	2.96	24	2.42
2	**Annelida**								(**11.48**)
	Eclipidrilus Sp	12	3.74	11	3.29	9	2.66	32	3.22
	Stylodrilus Sp	13	4.05	10	2.99	11	3.25	34	3.43
	Isochaetidefreyi	13	4.05	9	2.96	8	2.37	30	3.02
	Limnodrilus Sp	11	3.43	10	2..99	12	3.55	33	3.32

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	Potomothrix Sp	9	2.80	7	2.10	8	2.37	24	2.42
	Tubifex Sp	18	5.61	13	3.89	15	4.44	46	4.63
3	**Arthropoda**								**(68.49)**
	Ephemeroptera(mayflies)								
	Ameletus Sp	9	2.80	8	2.40	17	5.03	34	3.43
	Callibaetic Sp	10	3.12	11	3.29	14	4.14	35	3.52
	Baetis Sp	8	2.49	13	3.89	9	2.66	30	3.02
	Odonata (dragon and damsel flies)								
	Ischnura Sp	12	3.74	8	2.40	9	2.66	29	2.92
	Hemiptera								

	Hesperocorixa Sp	-		7	2.10	5	1.48	12	1.21
	Plecoptera (Stone Flies)								
	Diura Sp	12	3.74	9	2.50	11	3.25	32	3.22
	Ostrocera Sp	8	2.49	10	2.99	13	3.85	31	3.12
	Leuctra Sp	-		6	1.80	13	3.85	19	1.91
	Coeloptera (bettles)								
	Hydrobius Sp	16	4.98	11	3.29	11	3.25	38	3.83
	Agabetes Sp	9	2.80	8	2.40	9	2.66	26	2.62
	Stelelmis Sp	11	3.43	12	3.59	7	2.07	30	3.02
	Trichoptera								
	Macrostermum Sp	9	2.80	15	4.49	12	3.55	36	3.63

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	Hydroptica Sp	13	4.05	9	2.50	10	2.96	32	3.22
	Setodes Sp	16	4.98	11	3.29	12	3.55	39	3.93
	Diptera (True flies)								
	Chaobrus Sp	11	2.43	15	4.49	14	4.14	40	4.03
	Simulium Sp	13	4.05	17	5.09	16	4.73	46	4.63
	Chelifera Sp	13	4.05	11	3.29	11	3.25	35	3.53
	Odontomesa Sp	9	2.80	12	3.59	15	4.44	36	3.63
	Chironomus Sp	19	5.92	44	13.17	37	10.95	100	10.07
	Number of species	27	100	28	100	28	100	29	100
	Number of Individuals	321	32.33	334	33.64	338	34.04	993	100

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Table 2: Diversity indices of Macro-invertebrate of Lake Geriyo, Jan.To Dec. 2019.

SITES	Site I	Site II	Site III	TOTAL
Margalef's Index (d)	1.002	1.001	1.000	3.003
Shannon-Wiener Index (H′)	0.919	0.796	0.762	2.477
Equitability Index (E)	0.279	0.239	0.229	0.747

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