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Diversity and Distribution of Benthic Macroinvertebrate Fauna of Obazuwa Lake in Benin City, Nigeria

John. O.Olomukoro Ebehiremhen.O. Oviojie
Department of Animal and Environmental Biology, University of Benin, P.M.B 1154, Benin, Nigeria
E-mail: olomsjo@yahoo.com;myebehi@yahoo.com

Abstract
Obazuwa Lake is located in Ovia North East Local government area of Edo state. This study was conducted for a period of six (6) months from January to June, to evaluate the benthic macroinvertebrate structure, abundance, distribution and diversity. The Fauna were collected seasonally and three (3) sites were sampled fortnightly. A total of 748 benthic macroinvertebrates composing of 46 taxa, 13 groups and 25 families were recorded. Dominant taxonomic taxa varied considerably; Diptera (64.77%), Hemiptera (64.56%), Coleoptera (48.43%), Mollusca (29.06%), Oligocheata (19.28%), Nematoda (16.03%) and Odonata (15.83%). The variations in taxa and number of individuals between stations were not significantly different (P>0.05). Sorenson's quotient (Q/S) indicates similarities in the species composition between the sites.
Keywords: Benthic fauna, lake, water quality, Benin City, taxa

INTRODUCTION

In the past four decades, relatively few studies on benthic macroinvertebrates in lakes have been investigated. Lakes are stagnant water body with unique faunal compositions. Organisms living in such habitats are known to show some morphological differences from those found in flowing water bodies (Vadeboncoeur *et al.*, 2002). Benthic macroinvertebrates are organisms that are found on the substrata of an aquatic ecosystem (Dernie *et al.*, 2003.) Their densities are customarily highest in regions that contain dense growth of macrophytes (Beaty, 2004). Benthic macroinvertebrates form an integral part of an aquatic environment and are of ecological and economic importance (Efitre *et al*., 2001). They play a key role in mineralization of organic matter and serve as food for economically important fish and shellfish species in most aquatic environment (Furey, 2006; Ajao and Fagade, 2002).

The relative stability of benthic communities and their sensitivity to changes in the aquatic environment have made many species as bio-indicators of water quality (Ogbeibu and Oribhabor, 2001). Their long larval-life cycles allow studies conducted by aquatic ecologists to determine any decline in environmental quality (Ajao and Fagade, 1990).

Globally speaking, many lakes have received near negligible attention in the benthic ecology research. No earlier study has been done on the benthic fauna of Obazuwa Lake. Besides, the lake serves a major source of domestic water supply to the Obazuwa community. This paper, the first of a series on this important lake, is geared towards providing comprehensive list of the benthic macroinvertebrate, and its distribution.

MATERIALS AND METHODS

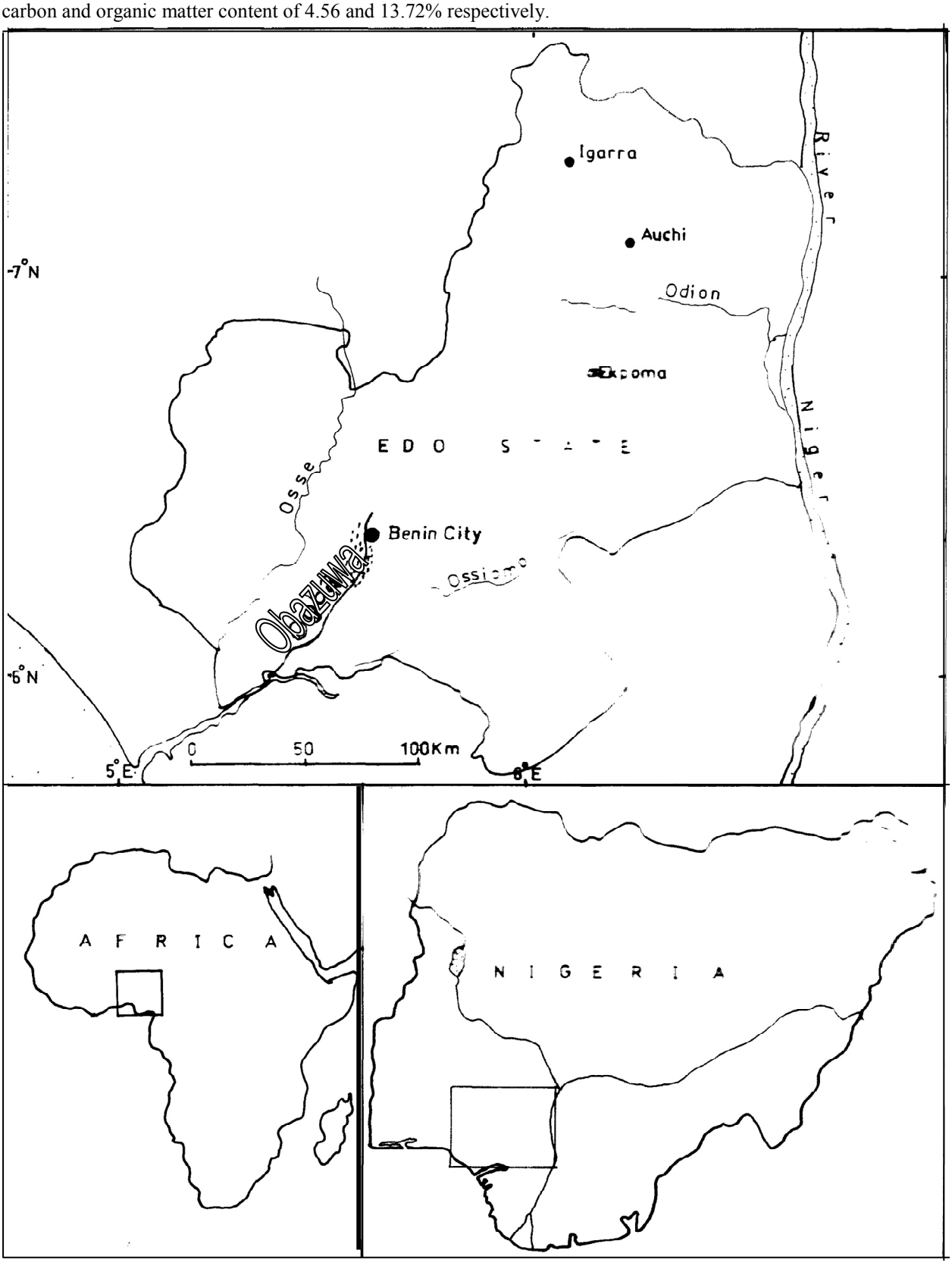
STUDY AREA

OBAZUWA Lake is located in Ovia North East Local government area of Edo State, between latitude 5^0 and 6^0E and Longitude 5^0 and 7^0N. It is an artificial lake fed by direct rainfall. Rainfall is seasonal occurring in the wet period (April-September) and dry season (October-March). It appears that the considerable water input during the rainy season is sufficient to maintain the hydrological balance of the lake. The lake is strictly bounded by laws restricting human activities such as farming, laundering and bathing. It is strictly conserved as a source of water supply for the community; hence consist of specially designed wells to retain water during the dry season of the year. The water level ranged from 4.56 to 5.20m. A dense vegetation of plants mainly that of a fresh water swamp forest consisting of *Hevea brasiliensis*, *ficus sp,* and palms like *Elaeis guineensis* is typical of this area. Marginal vegetation found includes shrubs like *Alchomelaxiflora* sp, *Nephrolepis biserrata*; herbs such as *Anacardium occidentale*, as well as water lilly, *Nymphaea* lotus and *Myriophyllum spicatum.*

Descriptions of Study Stations

Station 1: This is located about 300metres away from residential apartment. The margins are bordered by tall trees with thick canopy. The water level is about 5.20m overlaid with an entangled mesh of roots and stem macrophytes. The percentage organic carbon and organic matter content are 6.48 and 11.21% respectively.
Station 2: This is located about 60metres from station 1. The water level is about 4.48m with a muddy substratum mixed with decaying leaf litter. The percentage organic carbon and organic matter content is 7.54 and 13.14% respectively.

Station 3: This is located about 120m from station 1.The water level is about 4.56m with percentage organic carbon and organic matter content of 4.56 and 13.72% respectively.



Sampling Technique

The sampling method for benthic macroinvertebrate includes kick sampling method (Olomukoro and Ezemonye, 2000) and ekman grab sampling (Hall, 1997). The benthic macroinvertebrate was collected from three stations

(1-3) with a modified ekman grab from about 4 to 5 spot within the sample radius at each stations while Macrophytes attached to emergent vegetation in the lake were collected by distorting the vegetation with continuous 'kick' for a period of 5 minutes. Samples collected were sieved with a set of Tyler sieves of 20cm diameter and mesh sizes of 2mm, 1mm, and 150µm respectively. The remaining benthic samples were washed through a sieve of 1mm x 1mm mesh size to collect the benthos. The sieve content was washed into a poly-propylene sampling bottles containing 4% formalin.

Organisms were further subjected to sorting using American optical dissecting microscope (model 570), magnification 25-40x and stored in labelled specimen bottles containing 4% formalin for later examination. Benthic organisms were further identified to their lowest generic level. Reference text with appropriate identification keys includes; Powell (1983), Klemm (1990), Mackie (1998), Olomukoro and Egborge(2003).

Estimation of Fauna Diversity and Similarities

Fauna diversity of the macrobenthic community was determined using biological indices such as Margalef's index (d); Shannor-Weiner index (H) and Evenness (E) (Olomukoro and Victor, 2001). Application of Soreson's quotient gave a precise comparison in the faunal similarity of the stations.

Statistical Analysis

Correlation coefficient of the major groups in the stations were computed using SPSS packages. ANOVA analysis was used to test the level of significant of the major groups at 5% level of significance.

RESULT

MACROINVERTEBRATE

Community Structure

The overall macrobenthic invertebrate composition, distribution, abundance and frequency of occurrence in the study stations are shown in Table 1. Forty-six (46) taxa from a total of 748 individuals were recorded. These include 1 specie each of Trichoptera, Lepidoptera, Arachnida and Amphibia, 2 species each of Nematoda, Crustacean and Ephemeroptera, 3 species each of Oligochaeta and Mollusca. Others are 5 species of Odonata, 7 species of Coleoptera and 9 species each of Hemiptera and Diptera. A summary of the relative percentage composition of the major taxonomic groups to the overall macrobenthic population at the different stations revealed that the study area was dominated by Diptera (64.77%), Hemiptera (64.56%), Coleoptera (48.43%), Mollusca (29.06%), Oligochaeta (19.28%), Nematoda (16.03%) and Odonata (15.83%). These groups were well represented in the three stations. Other taxonomic groups that occurred in this study are Crustacea (9.80%), Amphibia (9.69%), Ephemeroptera (6.36%), Trichoptera and Lepidoptera recorded (3.23%) each, and Arachinida (3.13%),

Some dominant groups in station 1 includes Diptera (25.81%) mainly represented by *Chironomus* sp.; Hemiptera (19.35%) represented by *Ilycoris* sp. and Coleoptera (16.13%) represented by *Dysticus* sp. and *Amphiops gibbons*. The Mollusca (9.68%), Nematoda (6.45%) and Odonata (6.45%) were sub-dominant groups. The Oligochaeta, Lepidoptera and Amphibian were the rare groups each with relative percentage composition of 3.23%. In station 2, Hemiptera (21.88%) were the most dominant group followed by Diptera (15.63%) and Coleoptera (15.63%), The Oligochaeta (9.38%), Odonata (9.38%) Mollusca (9.38%) and Nematoda (6.25%) were the sub-dominant groups, while the Crustacean, Ephemeroptera, Arachnida and Amphibian each with relative percentage composition of 3.33% were the rare groups. Similarly, in station 3, the Diptera (23.35%), Hemiptera (23.33%), and Coleoptera (16.67%), were the dominant groups. Mollusca (10.00%), Crustacean and Oligochaeta each with relative percentage composition of 6.67% were the sub – dominant groups, Nematoda (3.33%) and Amphibia (3.33%) were the rare groups represented by a single genus and specie *Diplogaster* sp. and *Bufo* sp. respectively. The variations in taxa and number of individuals between stations were not significantly different ($P>0.05$).

The indices of general diversity (H), evenness (E) and dominance calculated for the three stations are presented in Table 2. Although diversity was higher at station 2 and 3; evenness, dominance and relative abundance were higher at station 3, 2 and 1 respectively (Table 2). Sorenson's Quotient of faunal similarity between the stations was correspondingly high with values greater than 50% (Table 3), and this implies that there was significant similarity in the species composition among the three stations. Similarity was observed to be highest between stations 2 and 3.

Table 1: The Overall Composition, Distribution and Abundance of Macro Invertebrates in Obazuwa Lake

Species Composition	STN 1	STN 2	STN 3
NEMATODA			
Diplogaster sp.	3	5	1
Dorylaimus sp.	4	2	-
OLIGOCHAETA			
Nais sp	11	35	14
Aulophorus vagus	4	4	3
Aulophorus furcatus	1	5	2
CRUSTACEA			
Caridina africana	-	-	1
Gammarus sp.	-	1	1
ODONATA			
Libellula sp	-	6	-
Aeschna sp	-	2	-
Enallagma sp	2	-	-
Lestes dryas	-	-	2
Unidentified sp.	-	1	3
EPHEMEROPTERA			
Cloen sp.	-	2	-
Ephemeroptera larvae	1	-	-
TRICHOPTERA			
Trichoptera larvae	4	-	-
HEMIPTERA			
Notonecta sp.	6	2	5
Ranatra fusca	-	-	2
Nepa apiculata	3	3	6
Rheumatobutes sp.	1	2	-
Plea striola	3	2	-
Ilycoris sp.	69	8	25
Mesovelia sp.	-	-	8
Merragata sp.	6	2	19
Hebrus sp.	-	1	2
LEPIDOPTERA			
Lepidoptera larvae	1	-	-
DIPTERA			
Chironomus sp.	66	34	38
Chironomus fractilobus	15	9	6
Chironomus travalensis	8	4	6
Polypedilum sp	-	2	3
Tanypus sp	5	2	-
Clinotanypus maculates	3	-	1
Tanytarsus sp	2	-	6
Cricotopus sp	3	-	2
Culex sp	2	-	-
COLEOPTERA			
Acilus sp	2	3	-
Hydrobius fuscipes	7	2	1
Hydrophilus piceus	-	1	3
Platambus sp	2	-	-
Amphiops gibbons	15	5	13
Philhydrus sp.	-	-	2
Dysticus sp.	19	10	4
ARACHNIDA			
Aquatica sp	-	2	-
AMPHIBIAN			
Bufo sp.	16	7	28
MOLLUSCA			
Planorbis contortus	4	4	-
Bulinus umbilicatus	-	4	2
Pila ovate	15	36	28
Total No. of Organism	303	208	237
No. of Species	31	32	30

Table 2: Diversity of benthic macroinvertebrate fauna in Obazuwa Lake

Indices	STN 1	STN 2	STN 3
No. of Taxa (S)	31	32	30
No. of Individuals	303	208	237
Relative Abundance (%)	40.51	27.81	31.68
Magalef's index (d)	5.25	5.81	5.30
Shannon-Wienner's index (H)	1.16	1.22	1.22
Evenness index (E)	0.78	0.81	0.83

Table 3: Estimation of similarities between the three stations (1, 2 and 3) using Sorenson's quotient.

Stations	1	2	3
1		69.8	62.3
2	69.8		71.0
3	62.3	71.0	

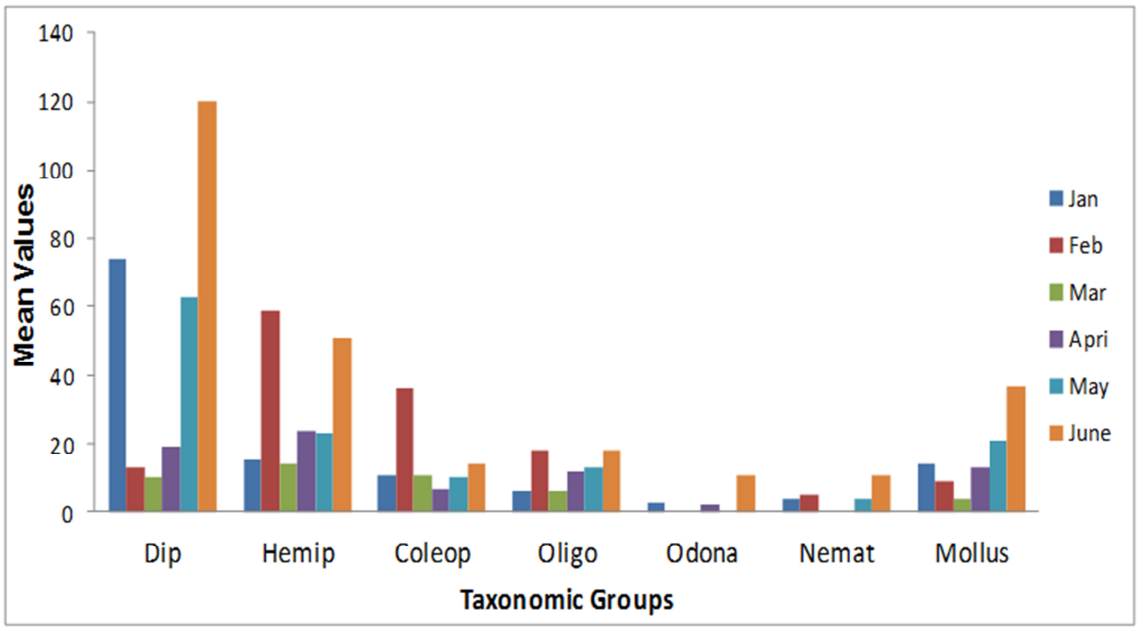


Fig. 2: Monthly Variation of the Major taxonomic groups in the Lake.

DISCUSSION

The overall benthic macroinvertebrates recorded in the study area are unique in its community structure comprising dominant groups such as Diptera (64.77%), Hemiptera (64.56%), Coleoptera (48.43%), Mollusca (29.06%), Oligocheta (19.28%), Nematoda (16.03%) and Odonata (15.83%).

Family chironomidae were relatively abundant in the lake and well represented. The chironomid larvae (filter feeder) were the most abundant diptera species collected from the lake. This might be due to high organic content of the lake as is the case of other tropical waters (Leveque *et al.*, 1983; Harrison, 1987 and Hansen *et al.*, 1998). High abundance of the diptera species was observed in the month of June, when the rain is said to be at its peak. High abundance of Hemiptera as well as the coleoptera was observed in the Lake. This is attributed to the absence of vertebrate predators like Fish (Ogbeibu and Oribhabor, 2001; Beaty, 2004). Among the hemiptera, *Ilycoris* sp. and *Merragata* sp. were high in abundance. Seasonal variations showed that Hemiptera recorded high abundance of organisms in the raining season, while Coleoptera had high abundance of organisms in dry season (February).

The Mollusca and Oligochaeta showed no habitat restrictions as they occurred in abundance in the three stations. Their abundance might be as a result of the fact that there was no human activity recorded in the lake during the study period. Oligochaeta can also be described as deposit feeders, as such more tolerant to silting and decomposition than other groups of benthic organisms (Olumukoro and Victor, 2001).

The Odonata nymhs, Anisoptera and Zygoptera were relatively low in the study stations. The species recoded at Obazuwa Lake prefer low current velocity with emergent vegetation, which is in conformity with the work of Situ, 1983. Trichoptera, Arachnida and Mollusca were relatively low in abundance. Trichoptera larvae

of Lakes and ponds are common consumers of vegetation detritus and other organic materials mostly found at the bottom (Mbagwu *et al.*, 1992 and Muli, 2005). However, irrespective of the presence of organic content in the Lake, the Trichoptera larvae occurred in low abundance. Generally, across the stations in the lake, Organisms were high in abundance in the month of June and low in the month of January and March except for Diptera and Coleoptera which recorded a high value in January and February respectively (Fig. 2).

Species diversity as a measure of species richness in the study area was generally high in the Lake with relatively similar values recorded in the stations (Table 2). The high taxa richness in this study site can be attributed to the non – disturbance of the lake by human activities as compared to those reported for temperate streams which are affected by Agricultural activities and inert pollution (Furey, 2006 and Efitre *et al.,* 2001). Also, the macroinvertebrates reported in this study belong to the sensitive classes in water bodies, which indicate non- pollution of the aquatic environment (Maryland Department of Natural Resources, 2004). Application of Sorenson's quotient indicated significant similarity in the species composition among the three stations. There was a general increase in the richness of organisms during the rainy season especially in the months of May and June; this is because of food availability (Mbagwu, 1992). Station 2 recorded the highest species richness, while station 1 showed that organisms were more in abundance as compared to other stations. However, evenness index revealed that macrobenthic organisms were evenly distributed across the stations.

In conclusion, factors which influenced the abundance and distribution of invertebrates the nature of the water body, habitat richness and stability, immediate substrate of occupation, tropic condition, resource partitioning and predation. (Mbagwu *et al.,* 1992; Ogbeibu and Oribhabor 2001). These factors, coupled with habitat differences observed in this study, acted singly or in combination, to influence the variation in abundance of macroinvertebrate of Obazuwa Lake.

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