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The Composition, Distribution and Abundance of Macroinvertebrates in the Shores of the Great Kwa River, Cross River State, South-east, Nigeria.

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ABSTRACT

Macroinvertebrates of the shores of the Great Kwa River were sampled monthly between August 2011 and January 2012 using the kick sampling technique and Van Veen Grab methods. The distribution of organic matter, substratum texture and current velocity were accounted for the variations of species composition, taxonomic richness and total abundance at the two stations. The most dominant taxonomic order was Decapoda represented mostly by Litopaenaeus vannamei (84.3%) followed by Johngarthia logostoma (4.45%) and Lymnaea species (4.85%) in Gastropoda. The abundance of Litopaenaeus vannamei is attributed to the fact that they are filter feeders that feed on the mud particles. High human activities around station two which released waste into the River accounted for the poor species richness.

Keywords: Composition, Distribution, Macroinvertebrates, Great Kwa River, Nigeria.

INTRODUCTION

The composition and structure of macroinvertebrates communities has been the subject of much research in river system. Benefits of research on macroinvertebrates include the quick assessment of biological resources for the conservation purpose and the detection of pollution through the differences between predicted and actual faunal assemblages [1].

Macroinvertebrate are biological quality element required for the classification of biological status of the water bodies [2]. 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 [3]. Over the last decades, there has been a considerable effort to document the ecology, composition, spatial distribution and biodiversity of macroinvertebrate communities of Nigerian river [4-10]. Researchers established a pattern of relationship between macroinvertebrate 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 macroinvertebrate as bio-indicator of anthropogenic impact on aquatic ecosystem have shown general decrease in macroinvertebrate population and reduction in species diversity and richness [4] and they possess higher ability to tolerate pollution-induced environmental stress than plankton [11].

Macroinvertebrates are useful bio-indicators providing a more accurate understanding of changing aquatic conditions than chemical and microbiological data, which only gives short term fluctuations [12]. Studies on macroinvertebrates of African Lotic waters are few in literature [13] and until recently has not received much attention in Nigeria [14]. The structure and macroinvertebrates composition of the Great Kwa River is poorly known.

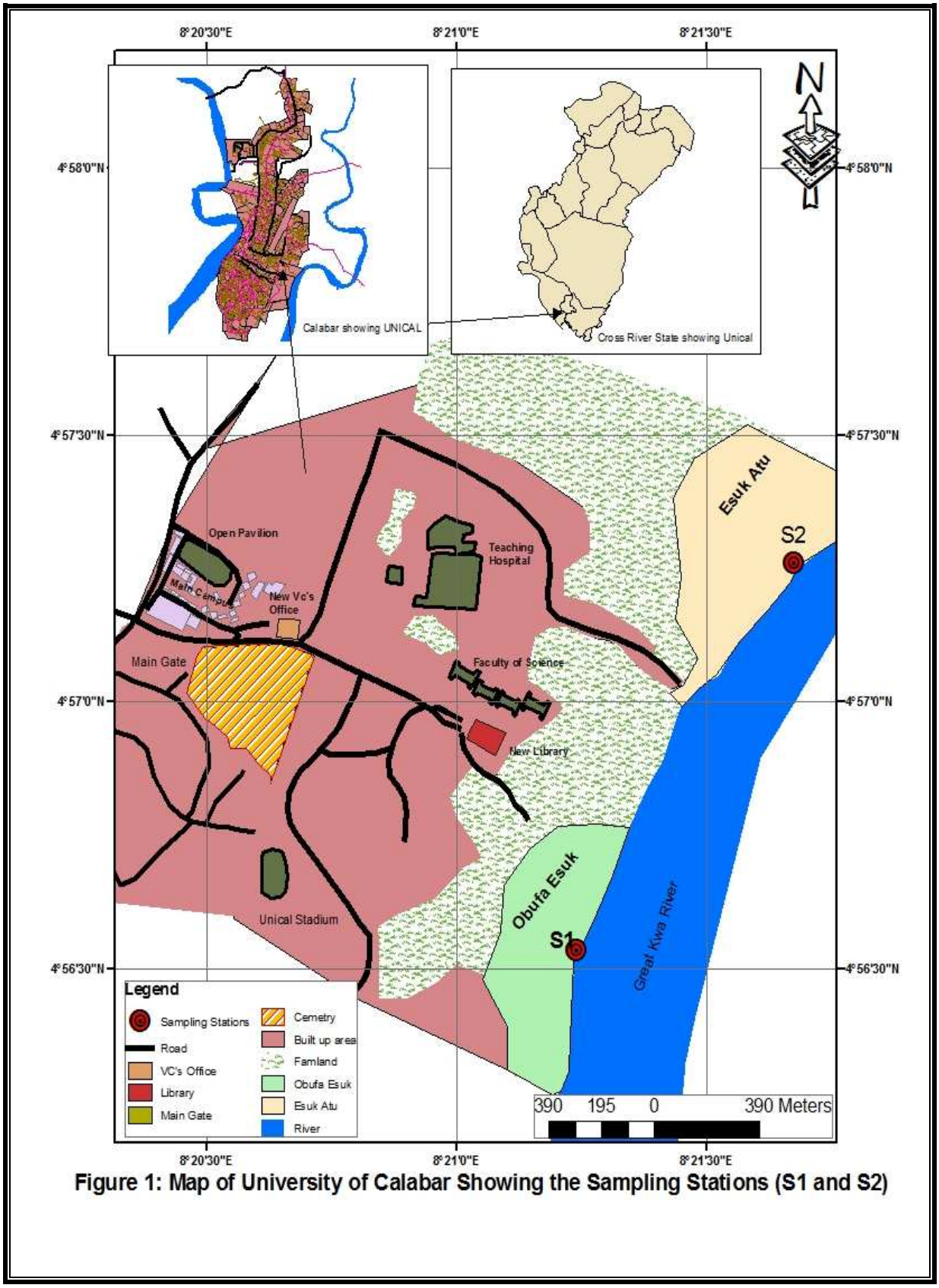

Figure 1: Map of University of Calabar Showing the Sampling Stations (S1 and S2)

The Great Kwa 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 and abundance of macroinvertebrates of Great Kwa River.

STUDY AREA

The Great Kwa river, Cross River State is located between latitude 8^0 15'E and 8^0 30'E and longitude 4^0 45'N and 5^0 15'N. It has an estimated length of 56km and is about 2.8km wide at the mouth where it empties into the cross river estuary. Two climatic seasons wet and dry prevail in the study area. The wet season is characterized by high rainfall while the dry experiences occasional downpours. The shorelines are lined with dark mud plates usually exposed during low tides, the water at the shore being brackish and rich in macroinvertebrates and debris. The banks are also surrounded by lush evergreen, forest vegetation with different species of trees, shrubs and grasses.

Sampling Stations

Two sampling stations were demarcated along the River bank.

Station 1: This station is located at Obufa Esuk, close to the university of Calabar staff quarters. The substratum here is covered by mud or clay with an average depth of 0.2m. It is swift-flowing and has a low transparency. The vegetation here includes fan palm (*Hyphaene petersiana*) and grasses.

Station 2: This station is located at Esuk Atu, close to the biological science and teaching hospitals areas of the University of Calabar. Substratum here is covered with coarse sand and mud with an average depth of 0.2m. It is swift-flowing and his medium transparency. Vegetation here includes elephant grasses, palm trees and fan palms (*Hyphaene petersiana*).

MATERIALS AND METHODS

Sampling Procedure

Sampling of macroinvertebrates was carried out for six (6) months at monthly intervals between August 2011 and February 2012. During this period, sampling was done between 0700 and 1200 hours on each sampling day. Water depth was determined using a calibrated straight wooden pole fixed at a particular portion. Macroinvertebrate sampled were collected using a van veen grab. For each station, 3 or 4 hauls were made by sending the grab down into the bottom. The sediment collected were poured into polythene bags and taken 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 macroinvertebrates 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 [15] and counted.

Statistical analysis

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 richens [16] and was expressed as:

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

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 [17] and is expressed as:

$$H = \sum \frac{Ni}{N} \log_2 \frac{Ni}{N} \quad \ldots \ldots \ldots (2)$$

Where;

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

Species equitability or evenness (E) [18] was determined by the equation

$$E = \frac{H}{\text{In } S} \quad \ldots \ldots \ldots (3)$$

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

RESULTS

Relative abundance of the various macroinvertebrates taxa encountered at the different sampling stations is presented in Table 1 while the illustration in Figure 2 shows the percentage composition of macroinvertebrate phyla of Great Kwa River. Eight (8) genera were identified belonging to two phyla from a total of 185 individuals collected from all the stations. Obufa Esuk station accounted for the highest abundance (58.9%) by number while the Esuk Atu station accounted for the lowest abundance (41.08%) by number. The highest number of taxa (6) was recorded in both stations. Arthropods have the highest percentage composition (92%) by number while Mollusca were the least (8%) by number. All the stations were dominated by Crustaceans, represented mostly by *Litopenaeus vannamei* (84.3%) followed by *Johngarthia logostoma* (4.45%) and *Lymnaea species* (4.85%) in gastropoda. Though percentage abundance of arthropoda was low (0.54-1.08%) and they included *Chironomus* larvae, *Leutra species* and *Belostoma species*.

Diversity and dominance indices calculated for the two stations are shown in Table 2. Taxa richness calculated as Margalef's index (d) was least in Obufa Esuk stations (1.065) while Esuk Atu station accounted for the highest diversity (1.154). Taxa evenness and species abundance calculated as Shannon diversity index (H) was least in Esuk Atu station (0.381) while Obufa Esuk station accounted for the highest diversity (0.911). Equitability was least in Esuk Atu station (0.088) and highest in Obufa Esuk station (0.197). The two stations had more or less equal dominance and diversity levels with insignificantly different indices values.

Table 1. Composition and Relative Abundance of Macroinvertebrates encountered in the Great Kwa River.

Composition			**Stations**			
	Station 1		**Station 2**		**Total**	
TAXA	**No**	**%**	**No**	**%**	**No**	**%**
ARTHROPODA						
INSECTA						
Diptera						
Chironomus larva	-		2	2.63	2	1.08
Plecoptera						
Leutra species	1	0.91	-		1	0.54
Hemiptera		1.83				
Belostoma species	2		-		2	1.08
CRUSTECEAN						
Decapoda						
Johngarthia logostoma	6	6.00	3	3.95	9	4.85
Callinectes sapidus	-		1	1.32	1	0.54
Litopenaeus vannamei	98	89.9	58	76.1	156	84.3
MOLLUSCA						
Gastropoda						
Lymnaea species	1	0.91	8	10.5	9	4.85
Viviparous species	1	0.91	4	5.26	5	2.70
Total Number of Taxa	**6**		**6**		**12**	
Total Number of Individual	**109 (58.9)**		**76 (41.08)**		**185 (100)**	

Where; Station 1 is Obufa Esuk and Station 2 is Esuk Atu

Table 2: Diversity Indices of Macroinvertebrates of Great Kwa River

STATIONS	**STATION 1**	**STATION 2**	**TOTAL**
Margalef diversity (d)	1.065	1.154	2.107
Shannon weiner (H)	0.911	0.381	0.299
Equitability (E)	0.194	0.088	0.057

Where; Station 1 is Obufa Esuk and Station 2 is Esuk Atu

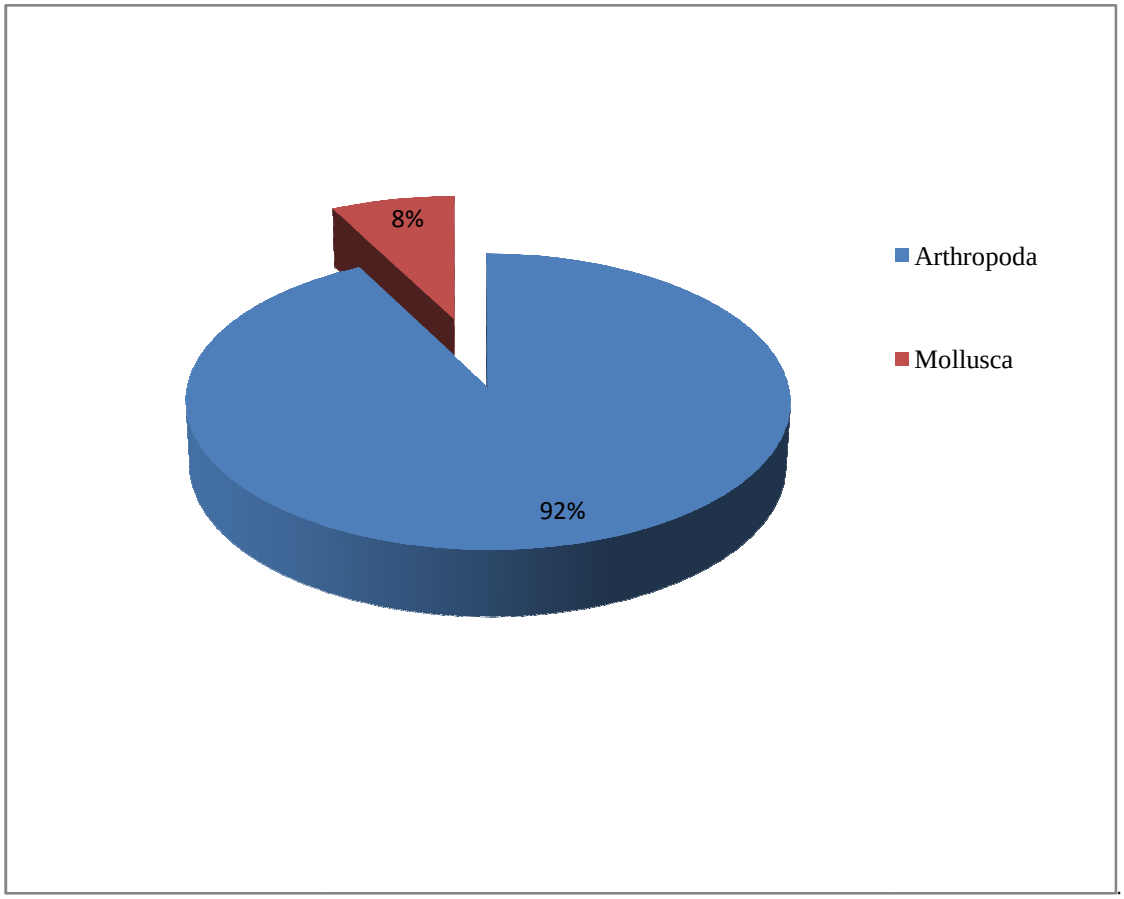

Figure 1: Percentage Composition of Macroinvertebrate Phyla of the Great Kwa River.

DISCUSSION

The number of recorded 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 [19]. According to [20] cited by [21], the bigger the size of a lotic water body, the poorer the macroinvertebrate richness. In addition, high human activities around the sampling stations which released wastes into the river could also be a possible explanation [5] reported that high biodiversity is expected in ecosystems devoid of significant anthropogenic impacts.

Results from the present study showed that the most abundant macroinvertebrate fauna throughout the study period was *Litopenaeus vannamei*. This could be attributed to the fact that these crustaceans are filter feeders. They extract indiscriminately from the mud particles [22] also gastropods recorded during this study attribute to the fact that they were transported by water current and were tolerant of the prevalent water condition [23]

The low species diversity observed in this study could partly be due to some physico-chemical conditions like fast flow of water and low dissolved oxygen probably resulting in disruption of reproductive cycle and food chain [24].

CONCLUSION

All the benthic macroinvertebrate fauna recorded were clean water and pollution-tolerant species.Crustaceans were the most abundant taxonomic group in terms of numerical abundance, with *Litopenaeus vannamei* being the most abundant.

The general diversity index, taxa richness and evenness index showed that station 1 had high taxa richness, diversity and evenness. This is an indication that the substratum was more stable here than the other stations studied and that the human activities were tolerant to perturbation arising from human activities. The low evenness and diversity recorded in station 2 is indicative of an unstable environment and substratum due to the relatively high current velocity.

Our survey therefore points to the need for more intensive study on the entire length of the River to fully comprehend the general fauna assemblages of the river.

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