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MACROHABITAT PREFERENCE AND SPATIO-TEMPORAL VARIATION OF MACROINVERTEBRATES IN ATAKPO RIVER, NIGER DELTA, NIGERIA

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Abstract

An investigation on the macrobenthic invertebrates seasonal fluctuation and macrohabitat preference was carried out in Atakpo River, Niger Delta area of Nigeria for a period of six (6) months; March to August, 2011. Macroinvertebrates samples were collected from three (3) designated stations using Kick sampling method, in three different macrohabitat which include; vegetative, rapid and pool zones. Hand picking was also done on the vegetation at the riparian zone for proper representation of the vegetative microhabitat. A total of 3595 benthic invertebrates comprising of 23 taxa, 14 families and 9 orders were collected during the study period. Decapoda was found to be restricted to the vegetative and rapid zone while the family Naucoridae of the order Hemiptera was restricted to the vegetative and rapid zones but was sparsely distributed among the three stations sampled. The family Libellulidae of the order Anisoptera was mainly found in the vegetative and rapid zone except *Bradinopgyna* sp. and which was sparingly restricted to the rapid and pool zone. *Lestinogomphus* sp. and *Chironomus* sp. were widely distributed in all the microhabitats. In general the vegetative zone harbours more macrobenthic than the other microhabitats. Organisms were poorly represented in the pool zone. This lend credence to the fact that macrobenthic are mainly associated with plants because the plants area usually found at the riparian zone which is usually free from much disturbance and that most macrobenthic prefer a quiet environment and also there is a kind of resource partitioning reducing interspecific competition in this zone when compared to other zones. The order Decapoda, Hemiptera, Odonata, Coleoptera, Diptera and Lepidoptera were not seasonal in distribution. More macrobenthic were collected in the month of March, followed by April and the least collection was recorded in August. More macrobenthic were collected in the dry season.

Key words: River Atakpo, Spatio-temporal, Macrohabitat, Vegetative zone, Macroinverbrates.

INTRODUCTION

River Atakpo, an important river flowing through Ibusa town in Delta state, Nigeria is one of main drainage systems of the town and a major receptor of the runoff. The river holds a large population of macroinvertebrates, provides water for domestic use and supports subsistence fishing.

An investigation on the spatial and seasonal distribution of macrobenthic invertebrates fauna by Egborge *et al*., (2003) of Udu-ughuevwen wet lands southern, Nigeria, indicated that Colepterans and Dipteran were dominant because they are capable of withstanding adverse environmental conditions. Also, they noted that the total disappearance of Plecoptera (Stoneflies) which is usually associated with clean water environment is clear evidence that the wetland was anthropogenically perturbed. The

habitat is a fundamental unit in ecology, incorporating many measurable dimensions of an organism's niche and providing a basic influence on life strategy, fitness and adaptive radiation (Ogbeibu and Aganmwonyi, 2005). Within a habitat, there are a number of smaller habitats called microhabitats. The rationale behind the utilization of the different microhabitats by aquatic animals is that they provide better living conditions that enhance their survival and success in their various ecosystems. Consequently, benthic macroinvertebrates are usually found attached to roots of macrophytes, living on and in the sediment, bank-root or any submerged objects or vegetation. When compared with unvegetated habitats, macroinvertebrates abundance and richness is typically greater among aquatic plants, for both sediment-and plant-associated fauna (Heck and Crowder, 1991; Richardson et al. 1998; Ekelemu et al. 1999; Ogbeibu and Aganmwonyi, 2005).

Different aquatic plant species and other niches in a water body support different communities of macroinvertebrates. Most importantly, the diversities of littoral macroinvertebrates and macrophytes appear to be closely related (Cheruvelli et al. 2001, 2002). Several studies have shown that the abundance and distribution of invertebrates varies greatly over time and that some plants support greater numbers, higher diversity and greater biomass of organisms than others (Feldman 2001; Colon-Gaud and Kelso 2003). The surface area of the plant and the leaf morphology may have an important effect on a plant's ability to support macroinvertebrates (Nelson et al. 1990) and chemicals secreted by the plants may also be a factor influencing the total possible number of invertebrates present.

In recent time, studies on the ecology of macroinvertebrates in Africa and Nigeria in particular has increased tremendously, but yet a great gap still exist on the investigation of microhabitat preference of these organisms. Hence, this study is aimed at providing baseline knowledge on microhabitat preference and spatio-temporal variation of macroinvertebrates in Atakpo River, Niger Delta area of Nigeria.

MATERIALS AND METHODS

Description of Study Area

River Atakpo is located in Ibusa town in Oshimili North Local Government Area of Delta State, Nigeria. The study area lies between Latitude 6^0 11^I N and Longitude 6^0 38^I E of the equator (Fig. 1). The source of the river is from Azahgba Ogwashi, it flows through Ibusa and empties at Oko – Anala where it meets with River Oboshi. The climate is tropical and it is characterized by the wet and dry season. The wet season extends from April to October with a short break during the month of August. During the wet season, the river experiences a rise in water level and flows more swiftly. The dry season occurs between October and March. The river substratum consists mainly of fine sands and pebbles. Decaying Macrophytes debris and cassava effluents also formed part of the substratum. The area is highly vegetative and lies in a valley that slopes gradually from a hilly top. River Atakpo serves as bathing and drinking water for the local populace. For the purpose of this study three designated stations were selected. Station I is popularly called Atakpo Ajudua, its depth ranges between 0.42 – 1.55m. It is the deepest of all the stations assessed in the study. The vegetation covers, includes *Bambusia vulgaris, Penthaclethra macrophylla, Raphia vinifera, Nymphae lotus, Ludwigia stolonifera, Echinochloa stagnina, Azolla africana and Typha* species. Station II, is popularly called Atakpo Pentagon; its depth ranges between 0.40 – 1.41m. The vegetation covers, includes *Bambusia vulgaris, Raphia vinifera, Symophonia* sp., *Nymphae lotus, Ludwigia stolonifera, Echinochloa stagnina, Azolla africana, Typha australlis and Pycracus polystachya* while Station III is popularly called Atakpo ADP; its depth ranges between 0.31 – 0.99m. It is the shallowest of all the stations assessed in the study. The vegetation covers, includes *Penthaclethra macrophylla, Bambusia vulgaris, Raphia vinifera, Nymphae lotus, Ludwigia stolonifera, Echinochloa stagnina, Azolla africana, and Typha australlis.*

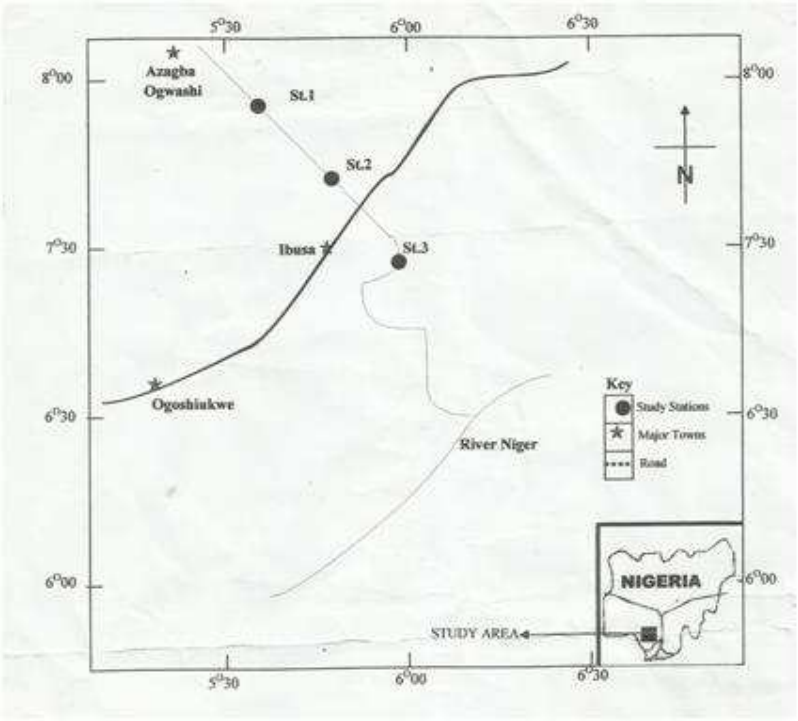

Fig. 1: Map of the study area showing the sampling stations.

Macroinvertebrates Sampling

Benthic macroinvertebrates sampling was carried out using the kick sampling technique as used by (Lazorchak et al. 1998) from March to August, 2011 from different microhabitat (including vegetative, rapid and pool zones) in the three stations. At the various sites a riffle with a depth of 10-50cm was selected. Avoiding disruption of the macroinvertebrates and facing downstream, the riffle was approached with a triangular sample net of 0.25-0.3mm mesh. This was held with the opening facing upstream. So, dislodged macroinvertebrates were carried into it by the current. The net was tightly fitted against the stream bed. The stream bed was then disturbed with the feet by digging well into the subtratum. The dislodge organisms were collected into the net. These samples were washed to eliminate fine sediment and were then emptied into a polythene bag and taken quickly to the laboratory for sorting. Uprooting of the riparian vegetations was also done for proper representation for the vegetative microhabitat.

Sorting and preserving the samples.

After sampling, live sorting was carried out into the laboratory within a few hours of collection, taking the different microhabitat into cognizance. A tablespoon was used to collect the sample from polythene bag into tray. A shallow white tray was used for sorting since it is generally easier to see the animals and can be identified according to how they move through the water. About 1-2cm of water was added to the sample before sorting. The water in the white tray was allowed to become clear before debris was sorted and as the animal move to the surface to hide under the debris, they were picked out with the use of a forceps. The sorting was done carefully and with patience as it was difficult to remove the animals that were attached to the sediments and associated debris. The sorting of the samples collected from each of the three stations was thoroughly carried out for a 3 hours period. Macroinvertebrate samples were examined and the sorted samples were then placed in a bottle preserved in 70% alcohol.

Identification of macroinvertebrates

Under a dissecting microscope, each benthic macroinvertebrate was placed for proper identification and counting. Identification key provided in Geber and Gabriel (2002), Macan (1959), Mellanby (1963) were used and identification to the lowest possible taxonomic level was done.

Data analysis was carried out using Microsoft Excel Package, 2007 version.

RESULTS

Distribution and abundance of macroinvertebrate in the different microhabitat within the three study stations of Atakpo River from March to August 2011.

The order Decapoda was restricted to the vegetative and Rapid zone and completely absent in the pool zone in all the three stations sampled. The family Naucoridae of the order Hemiptera was also restricted to the vegetative and rapid zones but were sparingly represented in all the three stations sampled. Belostomatide was present in the vegetative and rapid zone in station 3. The family Nepidae represented by *Ronatra* sp. was abundantly present in the vegetative zone with 111 individuals and 22 individuals in the rapid zone in station 1. Also, station 2 had 34 and 4 individuals in the vegetative and rapid zone respectively of the *Ranatra* sp. while station 3 had only 16 individuals of *Ranatra* sp. in the vegetative zone and completely absent in the rapid and pool zones.

The Libellulidae of the order Anisoptera was mainly found in the vegetative and rapid zone in all the stations except *Bradinopyga* sp. which was sparingly restricted to the rapid and pool zone in station 3. *Nymphulla* sp. was absent in all the zones in station 3. *Genigomphus rennei* were well represented in all the zones in station 1 and 3 and only present in the rapid zone in station 2. The *Lestinogomphus* were widely distributed in all the microhabitats in the three stations sampled. The Colopetera, *Octhebius* sp. had 20 individuals in the vegetative zone in station 1 and one (1) individual in the same vegetative zone in station 2. *Chironomus* sp. of the order Diptera was well represented in all the microhabitat in the three stations sampled.

Spatio- temporal variation in abundance of benthic macroinvertebrates in the study stations of Atakpo River from March to August, 2011.

The order Decapoda, Hemiptera and Odonata were not seasonal in distribution as they were collected in both the raining and dry season. *Lestes* sp. and *Pseudogroin* sp. were only collected in the dry month of March. The order Coleoptera represented by *Octhebius* sp. and *Chironomus* sp. of the order Diptera were also not seasonal in distribution. The taxa *Aethaloptera maxima* and *Maustemum capenses* of the order Trichoptera was sparingly present in the dry season. *Neoperla* sp. of the order Plecoptera was only collected in the month of March represented by 3 individuals in the entire study period. Lepidoptera represented by *Nymphulla* sp. was not seasonal except it's absence in the month of August.

The highest number of macroinvertebrates was recorded in the month of March, followed by April and the least number was recorded in August. This is to say more macroinvertebrates were collected in the dry season than in the raining season in the study area.

Abundance and Distribution of Macroinvertebrate in the Different Microhabitat of the Study Stations in Atakpo River from March to August 2011.

In station I, Anisoptera was the most abundant group of macroinvertebrates, followed by Diptera (Fig. 2). The vgetative zone was the most inhabited microhabitat in station 1, followed by the rapid zone. Anisoptera was the most abundant macroinvertebrates in station II and also well represented in the vegetative zone and also followed by the rapid zone (Fig. 3). The pool zone was poorly inhabited by macroinvertebrates groups in Atakpo River while Station 3 also had the same way of inhabitation of the different macroinvertebrates groups as in station I and II. Anisoptera was the most abundant, followed by Diptera and they were also restricted to the vegetative and rapid zone and fairly present in the pool zone (Fig. 4).

Table 1 : Distribution and abundance of macroinvertebrate in the different microhabitat within the three study stations of Atakpo River from March to August 2011.

	Study Stations								
	Station I			Station II			Station III		
	Microhabitats								
Taxonomic groups	Veg. Zone	Rapid Zone	Pool Zone	Veg. Zone	Rapid Zone	Pool Zone	Veg. Zone	Rapid Zone	Pool Zone
DECAPODA									
Family Atyidae									
Caridina gabonensis	57	31	-	4	24	-	6	10	-
C.niloticus	36	29	-	52	31	-	61	46	-
C. africana	30	8	-	16	14	-	31	24	-
Family Potamonantidae	18	1	-	5	4	-	14	8	-
Sudanonautes sp.									
HEMIPTERA									
Family Naucoridae									
Naucoris sp.	19	-	-	-	-	-	10	1	-
Family Belostomatidae									
Appassus sp.	111	22	-	34	4	-	16	-	-
Family Nepidae									
Ranatra sp.	-	-	-	16	-	-	21	-	-
ODONATA Sub Order									
ANISOPTERA									
Family Libelludae									
Bradrythermis	22	40	-	42	20	3	45	27	-
leucosticte	31	3	-	1	-	-	9	9	-
Urothermis sp.	-	-	-	-	-	-	-	10	3
Bradinopyga sp.									
Nymphilla sp.	-	13	-	-	5	-	-	-	-
Family Gomphidae									
Ictinogomphus sp.	-	3	-	45	6	-	48	8	2
Genigomphus rennei	20	11	5	-	10	-	6	20	1
Lestinogomphus $sp_{1.}$	48	32	9	62	34	14	66	42	37
Lestinogomphus $sp_{2.}$	61	45	36	68	54	38	78	50	37
Sub order									
ZYGOPTERA									
Family Lestidae									
Lestes sp.	-	-	-	-	-	-	5	-	-
Family Coenagriidae.									
Pseudagroin sp.	-	-	-	-	-	-	-	6	-
COLEOPTERA									
Family Hydraenidae									
Octhebius sp.	20	-	-	1	-	-	-	-	-
DIPTERA									
Family chironomidae									
Chironomus sp.	149	119	168	220	167	174	176	125	162
TRICHOPTERA									
Family Hydropsychidae									
Aethaloptera maxima	3	3	-	-	2	-	-	-	-
Mauostemum capenses	6	-	-	-	-	-	-	-	-
PLECOPTERA									
Family Perlidae									
Neoperla sp.	-	-	-	-	-	-	3	-	-
LEPIDOPTERA									
Family Crambidae									
Nymphulla sp.	14	-	-	1	2	-	-	-	-
NUMBER OF SPECIES	16	14	4	14	14	14	16	14	6

Table 2: Spatio- temporal variation in abundance of benthic macroinvertebrates in the study stations of Atakpo River, from March to August, 2011.

TAXONOMIC GROUPS	MONTHS					
	MARCH	APRIL	MAY	JUNE	JULY	AUGUST
DECAPODA						
Family Atyidae						
Caridina gabonensis	58	30	16	11	8	9
C.niloticus	82	64	43	26	11	19
C. africana	46	24	25	9	10	9
Family Potamonantidae						
Sudanonautes sp.	13	13	13	5	2	4
HEMIPTERA						
Family Naucoridae						
Naucoris sp.	13	7	2	4	3	1
Family Belostomatidae						
Appassus sp.	60	47	33	14	21	12
Family Nepidae						
Ranatra sp.	14	11	7	2	-	3
ODONATA Sub Order						
ANISOPTERA						
Family Libelludae						
Bradrythermis leucosticte	64	49	34	16	22	14
Urothermis sp.	34	8	3	3	4	1
Bradinopyga sp.	9	2	1	1	-	-
Nymphilla sp.	5	4	5	2	1	1
Family Gomphidae						
Ictinogomphus sp.	44	25	15	11	6	11
Genigomphus rennei	19	21	12	12	5	4
Lestinogomphus $sp_{1.}$	103	83	55	31	34	19
Lestinogomphus $sp_{2.}$	119	106	76	58	55	48
Sub order						
ZYGOPTERA						
Family Lestidae	5	-	-	-	-	-
Lestes sp.						
Family Coenagriidae.	6	-	-	-	-	-
Pseudagroin sp.						
COLEOPTERA						
Family Hydraenidae	5	6	4	3	2	1
Octhebius sp.						
DIPTERA						
Family chironomidae	300	307	267	206	193	187
Chironomus sp.						
TRICHOPTERA						
Family Hydropsychidae	3	2	2	1	-	-
Aethaloptera maxima	5	1	-	-	-	-
Mauostemum capenses						
PLECOPTERA						
Family Perlidae	3	-	-	-	-	-
Neoperla sp.						
LEPIDOPTERA						
Family Crambidae	8	3	2	2	2	-
Nymphulla sp.						
TOTAL	1018	813	615	417	389	343

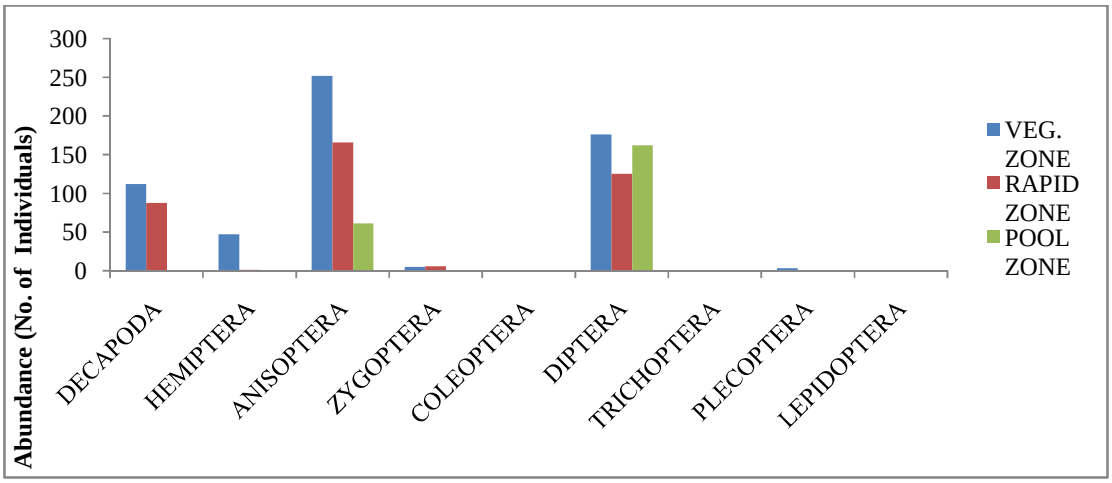

Fig. 2.: Abundance and Distribution of Macroinvertebrate in the Different Microhabitat of Station I, in Atakpo River from March to August 2011.

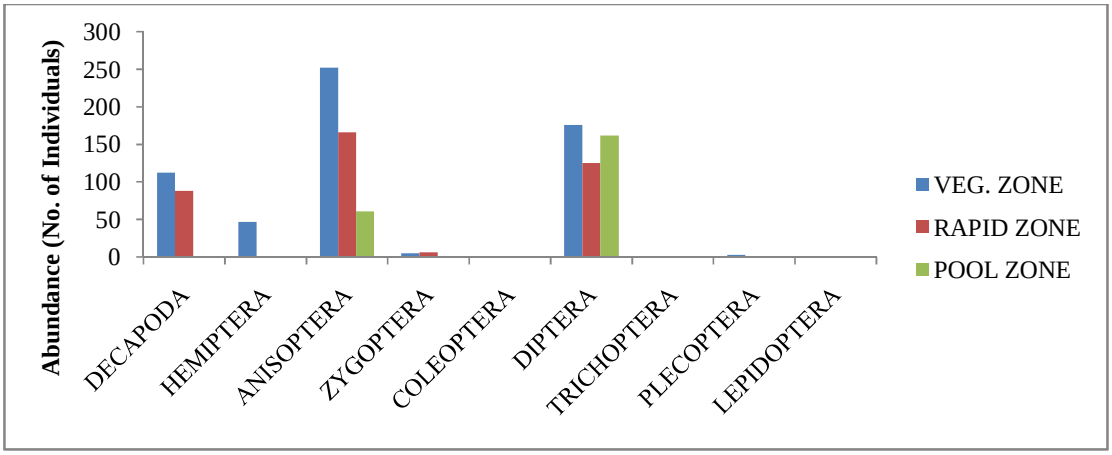

Fig. 3: Abundance and Distribution of Macroinvertebrate in the Different Microhabitat of Station II, in Atakpo River from March to August 2011.

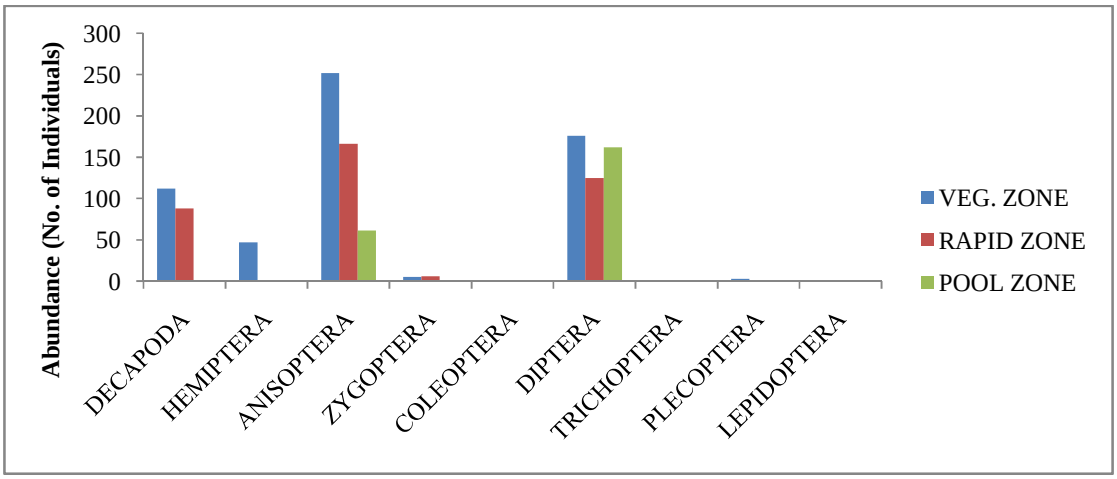

Fig. 4.: Abundance, Diversity and Distribution of Macroinvertebrate in the Different Microhabitat of Station III from March to August 2011.

DISCUSSION

Eight Odonata taxa were recorded in this present study. The Odonata nymphs are known to be macrophyte-associated. The Anisopterans inhabits muddy substratum with decomposing vegetation fragments (Carchini et al., 2004). In this present study more Odonata were encountered in the vegetative zone which conforms favourably with the earlier research by Carchini et al. (2004) and Arimoro, (2007).

The Zygoptera represented by *Lestes* sp. and *Pseudagrion* sp. were completely absent in station 1 and 2 and sparingly present in station 3 and they were restricted to the vegetative zone. Earlier, Carchini et al (2004) has reported that Zygoptera are lovers of waters of lesser current velocity with vegetation cover. The pool microhabitat usually have low flow velocity. This can be implicated to the presence of this group of macroivertebrates in the pool zone. Arimoro (2007), reported the abuandance of Zygoptera in a relatively low flow velocity site in a study conducted in Orgodo River, Delta State.

Population density in this study differed between stations due to differences in substrate types, current velocity and vegetation cover and also their seasonal variations were distinct. A significant high density of macroinvertebrates was recorded in the dry season months as compared with the rainy season months. More macroinvetebrates were collected in the vegetative zone in the dry months of March. This could be as a result of the unstable nature of the substrate during the raining season months arising from inputs of storm water thus accounting for the low density of organisms. Edokpayi et al. (2000) and Tumweisigye et al. (2000) obtained a range of macrobenthic invertebrate density of 260 -340 organisms/m^2 with a mean and standard error of 300 $\pm$ 38.6 organism/m^2 in the dry season as against only 45 – 72 organisms/m^2 with a mean and standard error of 63 $\pm$ 9.03 organisms/m^2 in the rainy season. On the contrary, Darlington (1977) in the study of temporal and spatial variations in benthic invertebrate fauna of Lake Georgia, Uganda declared no evidence for seasonal changes. Changes in composition or absolute levels of abundance was attributed to swarming behaviour or larval settlement patterns. Furthermore, quite a reasonable amount of documented information have shown dramatic seasonal changes in the benthic community which occur as a result of different life history parameters of individuals such as the growth rate, numbers of generations per year, emergence pattern, birth rate and death rate among others (Ravera, 2001).

In view of this research, it is important to recognize that plant communities play an important role in supporting macroinvertebrates populations as observed in this investigation. The fact that the vegetative microhabitat appeared to provide excellent habitat for the colonization of macroinvertebrates strengthens the belief that this River can be optimally managed.

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