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Survey and Identification of Macroinvertebrates Found in Some Ponds in Makurdi, Benue State Nigeria

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Abstract: Macroinvertebrates are important part of the aquatic food chain, vectors of some diseases as well as indicators of pollution in an aquatic environment. A survey of macroinvertebrates fauna of five ponds was done to identify the species present in these water bodies. The scoop net method was used and supplemented by hand picking method to collect macroinvertebrate samples. Results obtained showed that four classes of macroinvertebrates were present at the sampled sites and class insecta had the highest percentage occurrence (57.27%) followed by gastropoda (31.10%), malacostraca (6.69%) and oligochaete (4.94%) with the least occurrence. Analysis of variance showed that there was a significant difference ($p < 0.05$) between the classes of macroinvertebrates sampled at all locations. Further analysis using Post hoc test (LSD) showed that the class malacostraca and oligochaete did not differ significantly ($p > 0.05$) in distribution across all locations. Physio – chemical parameters showed no striking disparity in the water bodies sampled. The predominant aquatic flora encountered were Ipomoea aquatica, Nymphaea lotus and Graminae species. All macroinvertebrates belonged to three phylum: Annelida, Mollusca and Arthropoda.

Keywords: Macroinvertebrates, Survey, Ponds

1. Introduction

Macroinvertebrates are those animals that have no backbone and can be seen with the naked eye and can be retained by a 0.02mm mesh net [1]. Macroinvertebrates can be quite large and include organisms such as crayfish, snails, clams, mussels, limpets, beetles, caddisflies, stoneflies, mayflies, hellgrammites, dragonflies, true flies, and some moths. However most are very small. The most diverse group and commonest of freshwater macroinvertebrates are the insects which account for 70% of known species.

The presence and distribution of aquatic macroinvertebrates in fresh water habitats, both streams, ponds and lakes is dependent on geographic location, elevation, stream gradient, flow rate and substrate type [2].

Macroinvertebrates are an important part of the aquatic food chain. A good number of them are primary consumers feeding mainly on plant material such as leaves and woody material. Others are collectors or filter feeders sieving materials in suspension or on mud surfaces. The secondary consumers, the first level carnivores feed on these macroinvertebrates and thus sustaining those higher in the trophic level such as fish, they thus play a crucial role in transfer of energy from primary producers and detritus to fish [3 - 5].

These ponds are a freshwater system and provide ideal habitat for most macroinvertebrates. Some macroinvertebrates have no history of serving as intermediate host of any disease, others have been associated with the transmission of many trematode diseases of man and livestock [6-10]. Among the major diseases of which macroinvertebrates such as gastropod snails serve as

intermediate hosts are: schistosomiasis, fascioliasis and paragonimiasis. Schistosomiasis is of the greatest public health importance with about 200 million people infected in 76 endemic countries worldwide and about 600 million are at risk of infection [11].

Macroinvertebrates have been studied in Nigeria with specific bias to gastropod fauna [6, 7, 12, 11, 13, 14]. This study was aimed at surveying and identifying macroinvertebrates found in some ponds in Makurdi, Benue State, Nigeria, in order to provide information on distribution and abundance of these macroinvertebrates species within these habitats.

2. Materials and Method

2.1. The Study Area and Site Description

The study sites were five water bodies in Makurdi the capital of Benue state, North-central Nigeria. A town that lies between Latitude 7° 44'N and Longitude 8° 32'E covering an area of 820 km² with an estimated population of 348,990 people, "National Population commission of Nigeria" (2011). The main drainage system is River Benue with other smaller tributaries traversing the town. The vegetation type in Makurdi is guinea savannah with annual rainfall between 150 – 180m and temperature of 26°C – 29°C.
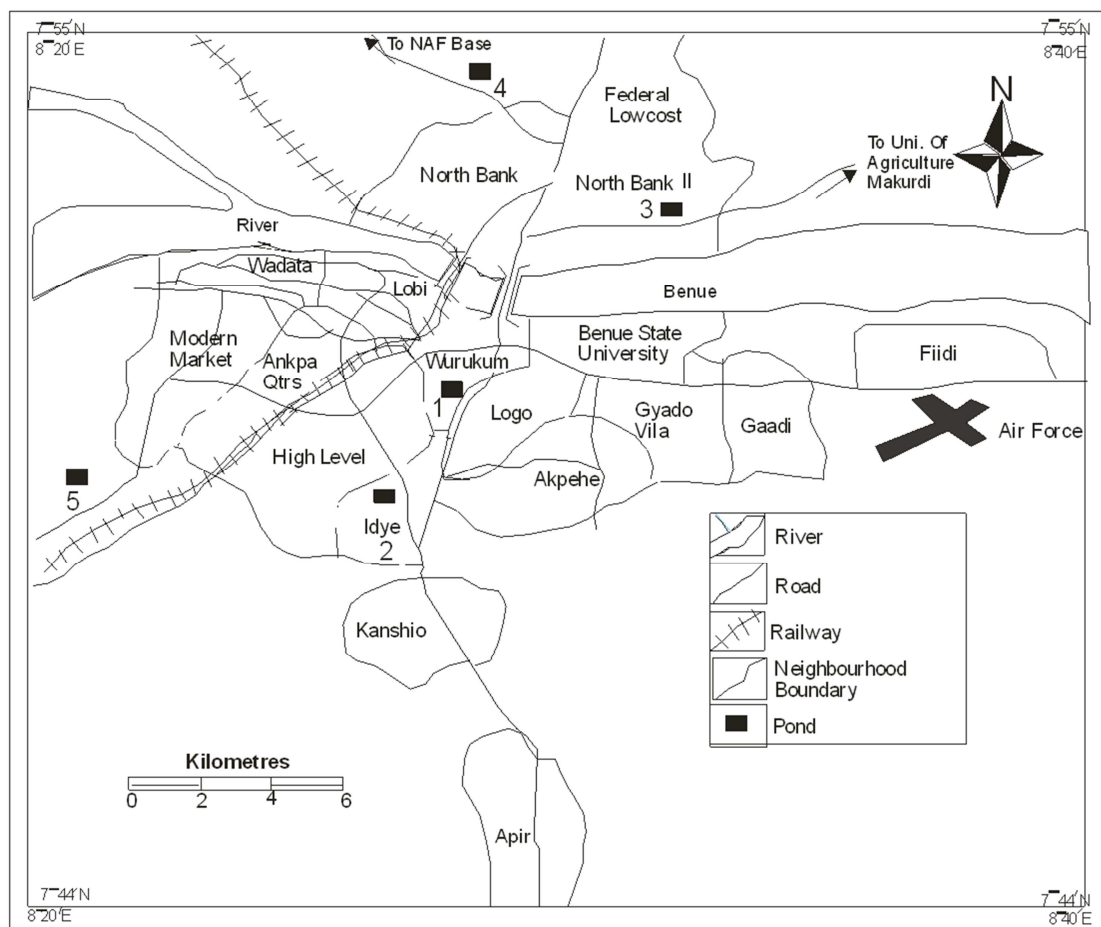

Figure 1. Map of Makurdi Town Showing Sampled Ponds.

Source: Ministry of Lands and Survey Makurdi
Legend:
Pond 1: Beside university of agriculture remedial school (U. A. R. S), Katsina-Ala street high level, Pond 2: Ishaya Bakut road before B-division police station, Pond 3: University of agriculture road, near college of advanced and professional studies (CAPS), Pond 4: Near mammy market off Lafia road north bank, Pond 5: Industrial layout off Naka road.

2.2. Macroinvertebrate Collection

The scooping net technique and hand picking of macroinvertebrates were employed. Samples were collected with a long-handled sieve net (0.6mm mesh size). The net was dragged along the bottom of the pond for some distance after which it was shaken to drain off excess water. Large debris of leaves and grasses were screened out and then the contents turned into a wide mouthed plastic bottle. The

samples were then taken to the laboratory for subsequent examination, identification and classification.

2.3. Sample Sorting and Identification Method

In the laboratory, the samples were passed through three sets of sieves 1st 1mm, then 2mm and finally 0.5mm were used [15]. Sorting was made effective by adding moderate volume of water into container to improve visibility [15].

Large macroinvertebrates were picked with forceps. A dissecting microscope was used to assist in viewing and sorting of the more minute organisms which were picked with the aid of Pipette. All sorted organisms were placed in plastic bottles containing formalin and labeled according to ponds and dates of collection. The preserved animals were identified under light and stereo and dissecting microscope and counted. Identification was carried out using keys by [16 - 20].

2.4. Data Analysis

Data was entered into excel, managed and analyzed using SPSS. Statistical analysis of variance (ANOVA) was done to ascertain the level of significance in the distribution of macroinvertebrates from all locations sampled.

3. Results

3.1. Class of Macroinvertebrates Sampled

Macroinvertebrates sampled from all locations as shown in Table 1 were 344, comprising of four classes (Malacostraca, Gastropoda, Insecta and Oligochaeta). Class insecta (197) had the highest total number of species, followed by class gastropoda (107), malacostraca (23) and oligochaete (17) with the least number of species.

3.2. Total Species Percentage Occurrence

Total species percentage occurrence is presented in Figure 2, with class insecta (57.27%) having the highest percentage occurrence and class oligochaete (4.94%) having the least. The dominance of the insects could be as a result of the location of the habitats and the presence of mud sediments while the low occurrence of the Oligochaetes could be as a result of natural factors.

3.3. Statistical Analysis

Statistical analysis of variance showed that there was a significant difference ($p < 0.05$) in the distribution of macroinvertebrates sampled at all locations. Post hoc using least significant difference (LSD) showed that class malacostraca and oligochaete did not differ significantly in distribution ($p > 0.05$).

3.4. Physio Chemical Parameters, Surrounding Vegetation and Occurrence of Macroinvertebrates at Each Pond

Physio chemical parameters and occurrence of macroinvertebrates at each site is presented in Table 2; *Lanestis libycus*, *Bulinus globosus*, *Nepa cinerea* and *Anaxipha exigua* were present at all locations. Specific species of Macroinvertebrates with their number of occurrence and distribution at each location (Table 3) revealed that *Anaaxipha exigua* had the highest occurrence (123) while *Paguristes frontalis* occurs the least (1). C. A. P. S had the highest number of species (107) sampled while Mammy had the least number of species (26) sampled. The description of each habitat, surrounding vegetation and water contact activities are presented in Table 4; Graminae was the most dominant vegetation found at most of the sample sites.

3.5. Monthly Distribution of Macroinvertebrates

In figure 3; it was observed that there was a decline in the distribution of both class malacostraca and gastropoda as the dry season approached hence in the month of December both recorded values of zero at all the sampled habitats. Class insecta and oligochaete kept increasing as we approached the dry season with the peak been during the month of November hence it could be as a result of both classes require a little amount of moisture to exist.
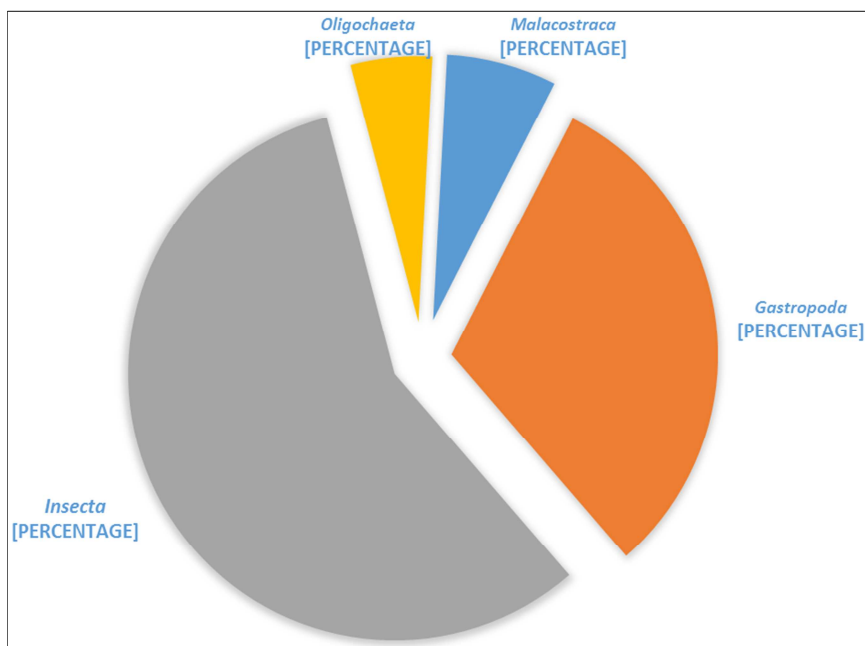

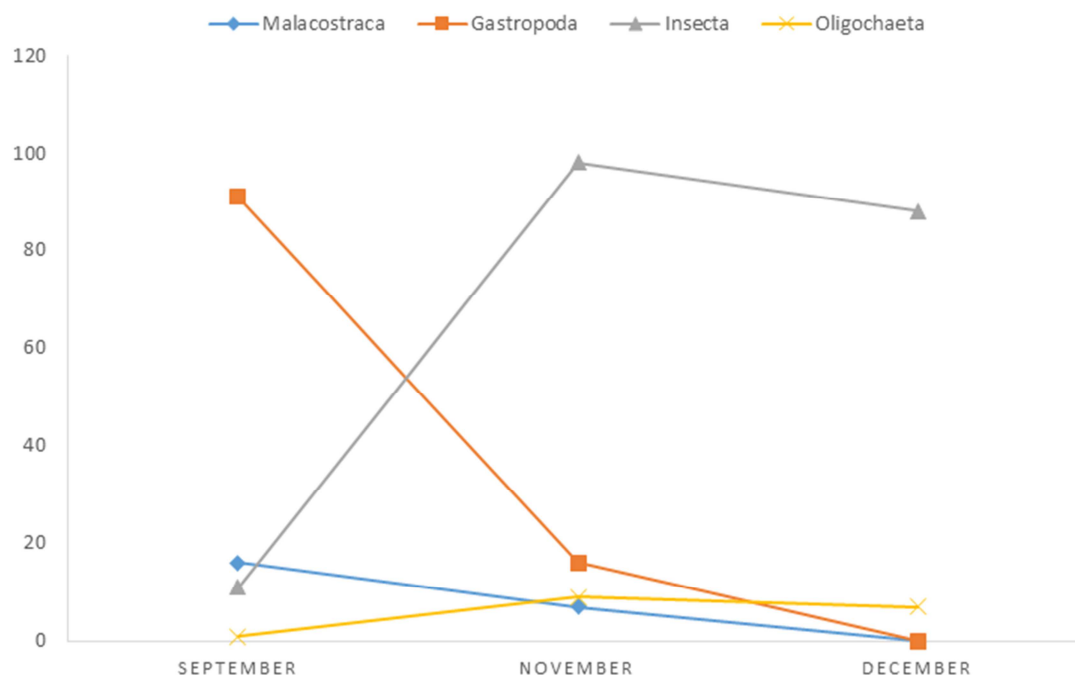**Figure 2.** *Percentage occurrence of macroinvertebrate.*

Figure 3. *Monthly distribution of the Microinvertebrates.*

Table 1. *Occurrence of Macroinvertebrates sampled at all locations.*

CLASS	University of Agriculture Remedial School	B-Division	LOCATIONS Industrial Layout	CAPS	Mammy	SPECIES TOTAL	MEAN
Malacostraca	4	0	1	16	2	23	4.6
Gastropoda	30	23	24	15	15	107	21.4
Insecta	51	25	46	66	9	197	39.4
Oligochaeta	1	3	3	10	0	17	3.4
						344	

Table 2. *Physio-chemical parameters and Macroinvertebrates occurrence at habitats.*

LOCATIONS	PHYSIO-CHEMICAL FACTORS				TYPES OF SPECIES								
	pH	T (°C)	DO$_2$ (mg/L)	WC (ppm)	*C.c*	*P.f*	*P.m*	*L.l*	*B.g*	*B.f*	*N.c*	*A.e*	*L.t*
U.A.R.S	6.80	28	1.4	257	+	-	+	+	+	+	+	+	+
B-Division	7.60	27	1.5	241	-	-	-	+	+	-	+	+	+
Industrial Layout	7.63	28	1.8	97	+	-	-	+	+	-	+	+	+
C.A.P.S	7.06	29	1.9	52	-	+	+	+	+	-	+	+	+
Mammy	8.04	29	1.3	91	-	-	-	+	+	-	+	+	-

Legend: DO$_2$ –Dissolved oxygen; W.C – Water Conductivity; T- Temperature; C.c - Cambarida camburus; P.f - Paguristes frontalis; P.m - Penaeus monodon; L.l - Lanestis libycus; B.g - Bulinus globosus; B.f - Bulinus forskalii; N.c - Nepa cinerea; A.e - Anaxipha exigua; L.t - Lumbricus terrestris; U.A.R.S – University of Agriculture Remedial School; C.A.P.S – College of Advance and Professional Studies; +Present; -Absent;

Table 3. *Specific species of Macroinvertebrates sampled.*

CLASS	SPECIES	LOCATION OF PONDS					TOTAL SPECIES
		U.A.R.S	B-DVISION	INDUSTRIAL LAYOUT	C.A.P.S	MAMMY	
	Cambarida camburus	1	-	1	-	-	2
Malacostraca	*Paguristes frontalis*	-	-	-	1	-	1
	Penaeus monodon	3	-	-	15	2	20
	Lanestis libycus	14	12	19	6	9	60
Gastropoda	*Bulinus globosus*	10	11	5	9	6	41
	Bulinus forskalii	6	-	-	-	-	6
Insecta	*Nepa cinerea*	15	16	18	23	2	74
	Anaxipha exigua	36	9	28	43	7	123
Oligochaeta	*Lumbricus terrestris*	1	3	3	10	-	17
TOTAL		86	51	74	107	26	344

Table 4. *Description of activities characteristic of each habitat and their surrounding vegetation.*

NAME OF SITE	DESCRIPTION	WATER CONTACT ACTIVITY	VEGETATION COMPOSITION
U.A.R.S	Water bank is swampy along bank road	Washing of automobiles fishing	*Imperia cylindrical Nymphae.*
B-Division	Swampy area near police B-Division	Rice cultivation, fishing, snail collection	*Ipomea, graminae, Nymphae.*
Industrial Layout	Pond located at industrial layout off Naka road	Fishing, swimming snail collection.	*Graminae, Nymphae*
Mammy	Pond located just before Army barracks mammy market.	Automobile washing, snail collection.	*Ipomea, graminae.*
C.A.P.S	Pond beside the main road just before College of Advance and Professional Studies.	Domestic use, fishing, irrigation.	*Impomea, graminae*

4. Discussion

The macroinvertebrate fauna of the ponds in Makurdi is similar to that of other Nigerian and African fresh water bodies including River Benue and its tributaries, River Galma, Ibiekuma River, Ikpoba River, Asejire reservoir [11, 15, 21, 22, 23, 24, 25] with respect to species composition. Most of the species (*Bulinus globosus*, *Lanistes libycus*, *Lymnea natalensis* and *Nepa cinerea*) recorded have been identified by other works and are known to occur in most parts of Nigeria [24, 26, 29, 30].

Class insecta had the highest occurrence (57.27%) and this is similar to the findings of Asibor [24], Adeymi *et al* [27], and Olumukoro *et al* [28] who obtained more organisms of the class insecta than any other species and asserted that the source of species was rich in fauna composition, the ponds were undisrupted and not affected by inert pollutants and fairly clean and unpolluted. The results of this survey also revealed that the macroinvertebrate community of the five (5) ponds are rich in class Gastropoda and Insecta, while Malacostraca and Oligochaeta are poorly distributed within the ponds. High abundance of the class Insecta and Oligochaeta were recorded in the month of November, when the rain has ceased and dry season just commencing while that of Malacostraca and Gastropoda species kept decreasing as the dry season sets in and both reached zero during the month of December (as shown in figure 3). Reason for these scenarios been that Insecta and Oligochaeta species need just little or moderate amount of moisture to survive while Malacostraca and Gastropoda need a lot of water to exist.

Class Malacostraca and Oligochaeta show a low conservation value (moderate to poor community of common specie), while class Gastropoda and Insecta show a high conservation value (a rich community of common macroinvertebrate specie and a number of local specie). However, C. A. P. S has more specie richness and diversity, this could be attributed to the presence of high dissolve O_2 with the pond been just subjected to domestic activities, irrigation and fishing. These attributes hence creates a littoral area which support the growth and abundance of macrophytes which serve as food source for the Macroinvertebrates [24]. Mammy the least in terms of specie richness and diversity among the five ponds surveyed. This could be attributed to the fact that the water contact activity involves the use of automobiles that are washed into the

habitat hence affecting the amount of dissolved O_2 present in the habitat due to release and reaction (with the available O_2) of chemical substances like engine oil, grease and hydraulic and therefore reducing the population of Macroinvertebrates. In terms of species occurrence *Anaxipha exigua* occurred the most (123) and highest at C. A. P. S (43), this could be as a result that *A. exigua* is known to occur in low lands and were vegetation is dense, which is a characteristics of all the habitats surveyed but most especially that of C. A. P. S [31], while *P. frontalis* occurred least (1) and found just at C. A. P. S, this could be as a result of the specie been a scavenger [32] and C. A. P. S habitat is more characterized by activities that could leave dead animals or food materials for scavenging and another reason for its low occurrence could be as a result of the period in which this research was carried out.

Physio – chemical parameters did not show any striking disparities with pH fluctuating from slightly acidic to slightly alkaline with range of values (6.80 – 8.04) at the different ponds and agrees with Olumukoro [29], and Omudu [11], however it differs from the findings of Igbinosa *et al* [14] who observed variations in the Physio – chemical parameters of freshwater Ecosystems of Ovia in Edo state, Nigeria. The most dominant vegetation (Graminae) observed agrees with the work of Omudu [11]. The *Lumbricus terrestris*, *Bulinus globosus*, *Nepa cinerea* and *Anaxipha exigua* showed no habitat restrictions as they occurred in the five ponds. Their presence might be as a result of the fact that there was no human activity recorded in the ponds during the study period. Oligochaeta can also be described as deposit feeders, as such more tolerant to silting and decomposition than other groups of macroinvetebrates which agrees with Olumukoro [29].

5. Conclusion

This study have revealed that ponds in Makurdi are a good habitat for Macroinvertebrates and there is a little variation in their distribution in the ponds surveyed. All the sampled locations have vegetation growing in or around them and factors which influenced the abundance and distribution of macroinvertebrates are the nature of the water body, habitat richness and stability, immediate substrate of occupation, tropic condition, ressource partitioning and predation. These factors, coupled with habitat differences observed in this study, acted singly or in combination, to influence the variation in identification/abundance and distribution of macroinvertebrate of the five ponds.
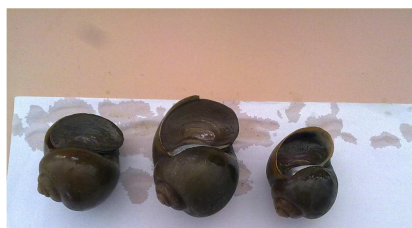
Appendix

Figure 4. *Lanistes Libycus (Snail).*

Figure 5. *Cambarida camburus (Crayfish).*

Figure 6. *Paguristes frontalis (Crab).*

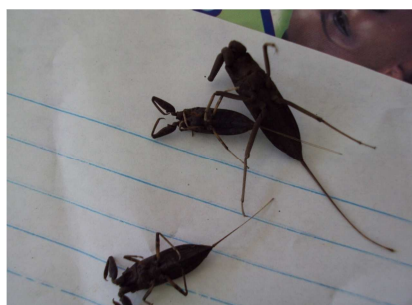***Figure 7.*** *Penaeus monodon (Prawn).*

Figure 8. *Nepa cinerea (Water scorpion).*

Figure 9. *Anaxipha exigua (Mud cricket).*

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