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Ecological Survey of Macrobenthic Invertebrates of Selected Ponds in Agbede Flood Plain, Southern Nigeria

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Abstract
Ecological study on three selected ponds of Agbede flood plain was fortnightly carried out between January and June, 2007 to assess and document the macrobenthic fauna composition, abundance and distribution, as well as the physicochemical status of some parameters in water which were collected and analyzed monthly. Benthos was sampled for using the Ekman Grab operated by hand in shallow waters together with the Kick sampling method. Among the eight physicochemical characteristics investigated, pH fluctuated from slightly acidic to slightly alkaline with range of values (5.90 – 7.35) at the studied stations. Significant difference ($P<0.05$) was observed for biological oxygen demand (BOD_5) and dissolved oxygen (DO). A total of ten (10) groups comprising macroinvertebrates taxa with one thousand and thirty one (1,031) individuals were recorded in this study. Most dominant groups were represented by Coleopterans (35.79% and 374 individuals), Hemiptera (20.19% and 211 individuals) and Dipterans (18.47% and 193 individuals). Evenness was highest in pond 1 (0.4973). The highest number of macroinvertebrates were collected from pond 2 (416) where no human activities occurred and however implied that human activities can rapidly alter any previously stable communities of aquatic environments.
Keywords: Ecology, Flood plain, Macrobenthos, Ponds, Fadama, Nigeria

1.0 Introduction

Benthic macroinvertebrates are an important part of the food chain, especially for larger aquatic animals. They feed on algae and bacteria which occupy the bottom of the food chain. Some shred, eat leaves and others on organic matters that enter the waters. Studies on the benthos of lentic water bodies have not been given much attention for a long time and they are one of our primary sources of animal proteins such as fishery products. With the advent of Fadama Agriculture initiated by the Federal Government of Nigeria, colonization of natural and artificial ponds has become a phenomenon.

Only recently, ponds in Agbede wetlands are being utilized for aquacultural practice which is one of the Fadama projects. A large number of studies on benthic invertebrates and other related topics have been carried out (Ogbeibu and Egborge, 1995; Imoobe and Ohiozebau, 2009; and Olomukoro and Dirisu, 2012). Although studies on macroinvertebrates communities in ponds have not been given much attention in Nigeria and Africa in general. Ogbeibu and Egborge, (1995) recorded a total of 214 invertebrates taxa in the Okomu reserve (ie. 5 ponds and 2 streams), comprising 80 Zooplankton and 134 macrobenthic invertebrates, with pond 5 having the highest number of invertebrates. Evagelopoulos *et al.,* (2005) studied the spatial variations of both phytoplankton and macrobenthic invertebrates descriptors (composition, abundance and biomass) at 6 sampling sites in the low salinity ponds of Kalloni Saltworks, Hellas (2004) studied the macrobenthic invertebrates which comprised a total of 54 taxa belonging to 5 groups which are; Molluscans, Polychaeta, Crustacean, insect and Nemertea. Most of the taxa identified in the study area belong to Crustacean (13 species), followed by polycheata (16 species) and Mollusca (23 species).

Ecological studies on protected areas have focused mainly on the more visible faunal components while, the less conspicuous but ecologically important aquatic invertebrates have always been ignored. The urgent need for a complete inventory of fauna resources in these ponds engendered the present study. This work is the first of a series in Agbede Wetlands areas and it provides baseline information on the species composition, abundance and distribution of the macrobenthic invertebrates and the physicochemical status of some parameters.

2.0 Study Area

This study was carried out in three selected ponds of Ogwe-Edion flood plain at Agbede (latitude 7.33^{o}N and longitude 2.98^{o}E), between the months of January and June, 2007. The wetlands are about 5km from the main town of Agbede, (see fig. 1). Agbede is a town located in the Northern part of Edo State, within an attitude of 122m above sea level.

The study area has the tropical wet and dry climate regulated primarily by rainfall. The wet season stretches for a period of seven (7) months usually from April to October. Months of heavy rainfall are July (462mm) and August (359mm). The dry season is for a period of five (5) months with rainfall which ranges from 99.8 to 22.3mm. The driest months are December to February. The temperatures during this dry period were high. The mean annual temperature ranged from 25 to 33^{o}C.

The study area is primarily that of a derived Savannah. Ponds are situated between grasses and some few trees. Along the banks of the ponds are shrubs and grasses. The ponds serve as sources of water for grazing animals (Nomadic Agriculture) and also for irrigation purposes. Human activities in the ponds are fishing, washing, agriculture and herds.

3.0 Sampling Stations

Sampling was carried out fortnightly from January to June, 2007. Sampling for physical and chemical parameters and benthos was done in the three (3) ponds.

Pond 1 was located close to a farm and about 700m from Pond 2 completely shaded by dense trees canopy. Bottom sediment was clayey with varying amounts of organic matter especially dead and decaying leaves that falls from the trees. Pond 1 witnessed the most anthropogenic effects mainly in the form of using Lindane (Pesticide) (Gammalin-20) for harvesting fish. It has an average depth of 82.50cm with a dimension of 350m x 25m.

Pond 2 was next to pond 1. It was smaller than pond 1 in size and depth. The bottom was clayey, with trees such as (*Bambusa* sp) surrounding the pond. The bottom was rich in allochtonous materials. No human activity was observed during the period of sampling except, vegetable farms. Pond 2 has an average depth of 66.17cm with a probable dimension 30m x 20m.

Pond 3 was about 950m from Edion River in Agbede. Substratum consists of clay. The pond was exposed directly to rays from the sun and as a result both the ambient and water temperatures were higher than that of ponds 1 and 2. Main activity observed here was that of cattle herds. Pond 3 was treeless but overgrown with rooted, floating and submerged aquatic macrophytes (*Comelina* sp. and *Ceratophylum submersum).*

4.0 Materials and Methods

4.1 Physicochemical Characteristics

Water and benthic fauna samples were collected fortnightly from each of the three ponds understudied for 6 months, January to June, 2007; between 0800hrs to 1100hrs Nigeria time. The physical parameters such as air temperature, water temperature, pH and Conductivity were determined insitu. Temperatures were measured using the 0 - 100^{0}C mercury in glass thermometer (Kurison model – 59). pH and Conductivity were determined each using the pH-Conductivity metre, EC-500 (Extech instrument). Dissolved Oxygen (DO), Biological Oxygen Demand (BODs), Phosphate and Nitrate were determined using the standards by APHA, (1998) and thereafter transferred to the laboratory for analysis.

4.2 Benthic Fauna

Benthic fauna samples were collected using the methods earlier used by Hynes, (1971) and Olomukoro, (1996), an Ekman Grab operated by hand in shallow waters was forced into the sediment within a radius of Im^{2} to a depth of about 20cm. The content trapped by the grab was processed by using the techniques earlier described by Hynes (1971) and Olomukoro, (1996). The kick sampling method was used to sample macrophytes for benthos as earlier described by Olomukoro, (1996). Sieved and sorted organisms were preserved in 70% buffered alcohol, identification of the organisms were carried out using the appropriate keys of Olomukoro, (1996).

4.3 Data Analysis

Data obtained were subjected to statistical analysis. Physicochemical characteristics were analysed with SPSS – 16 for one-way analysis of variance (ANOVA). Biological indices such as taxa richness and evenness (E) were computed using paleontological statistics soft ware tool pack (PAST). Both the physicohemical characteristics and benthic fauna were subjected to correlation coefficient analysis.

5.0 Results

5.1 Physicochemical Characteristics

Summary of the physical and chemical characteristics are shown in table 1. All the parameters analysed had their values within federal Ministry of Environment (FMNEV) limit. pH fluctuated from slightly acidic to slightly alkaline with range of values (5.90 – 7.35) at the studied stations. Significant difference ($P<0.05$) was only observed in biological oxygen demand (BOD_5) and dissolved oxygen (DO).

5.2 Benthic fauna Structure

A total of ten (10) groups comprising 42 macroinvertebrates taxa and 1,031 individuals were collected from the period of study. These groups include Ologochaeta (4 species), Decapoda (2 species), Ephemeroptera (3 species), Odonata (9 species), Hemiptera (7 species) and Coleopterans (4 species). Others are 1 species of Trichoptera, 10 species of Dipterans, 1 species of Aranaea and 1 species of Mesogastopoda (table 2).

The most dominant group was represented by Coleopteran which constituted 35.79% and 374 individuals of the entire population. Next to this was Hemiptera 20.19% with 211individuals and closely followed by Dipterans 18.47% with 193 individuals. Ephemeroptera constituted 12.44% by composition and 130 individuals; others had rare values (table 3).

5.3 Biodiversity

Species evenness (E) was highest in station 1(0.4973) and lowest in station 2 (0.2644). Taxa richness (D) was highest in station 3 and lowest in station 1, and general diversity (D) in Pond 3 had the highest diversity while pond 2 had the lowest diversity (table 4).

6.0 Discussion

The study area under consideration is part of Agbede Wetlands in a derived Savannah zone owned by some indigenes and Edo State Government for Agricultural extension services for the cultivation of rice. Two months after the commencement of the sampling exercise, one of the ponds (Pond 1) was treated with Lindane (Gammalin-20) which caused the disruption of the diversity of the macroinvertebrates community. Pond 1, when compared to other ponds, had the lowest species richness in March when the Gammalin treatment was effected and abundance of macrobenthic invertebrates was affected. These low taxa, however, may be attributed to the Lindane treatment which impaired the diversity of the fauna and subsequent elimination of the most sensitive group in this pond. The number of taxa however, was higher than what was recorded in a tropical stream treated with pesticide (Victor and Ogbeibu, 1986), but much lower than that of other tropical streams (Bishop, 1973) and temperate water bodies (Lenat *et al.,* 1981; Evagelopoulos *et al.,* 2005) affected by inert pollutants.

Macroinvertebrates groups adversely affected by the disruption in Pond 1 were Ephemeroptera and Hemiptera. Their density of occurrence in other undisrupted ponds was relatively high as in the case of coleopteran and dipteran larval. The relative abundance of these later groups in the chemically treated pond was high compared to other groups which indicate that they were more tolerant to Gammalin-20. However, Coleopterans among other invertebrate groups have been reported to be adversely affected in a DDT methocychlor and Gammalin-20 treated aquatic systems (Victor and Ogbeibu, 1986, Fredeen, 1975). Among the dipteran larvae, the family chironomidae were relatively abundant in the study ponds. *Chironomous travalensis* were recorded only in Ponds 1 and 3 in fairly high abundance. However, dipteran larva was the most common taxonomic group and had the highest proportion of wide spread species. Wallace and Hynes (1981) observed that burrowing species which may inhabit less exposed substrate are likely to escape the immediate deleterious effects of pesticide treatment. This view seems to support the relative abundance of *chironomous* sp after Lindane (Gammalin-20) treatment in Pond 1.

The crustaceans were represented by one family only, Desmocaridae which consist of *D. trispinosa* and *D. bislineata* were absent in Pond 3. *D. trispinosa* has been previously recorded in most Nigerian waters (Ogbeibu and Egborge 1991, 1995; and Olomukoro and Egborge, 2003).

Ephemeroptera and Odonata which are the sub-dominant groups were well represented in the various ponds. Ephemeroptera were present in all the three ponds. *Baetis* sp was the dominant species. Baetids *a*re cosmopolitan in distribution and are restricted to clean fresh water environment and it is therefore not surprising to have them in low abundance in disrupted ponds. Although *Baetis* sp has been recorded in perturbed stretches of tropical rivers (Victor and Dickson, 1985; and Olomukoro and Egborge, 2003). The Odonata nymph were not evenly distributed in the ponds rather they were highly concentrated in pond 3 with the exception *Coengrion* sp and *Libellula* sp that were present in all the ponds. These two species are more cosmopolitan in distribution than any other member of the group.

Oligochaetes were more restricted in their distribution (i.e. had smaller range sizes) than the other dominant groups, and this could likely be the result of natural factors. Trichoptera, Arachnida and Molluscan had relatively low abundance. Trichoptera and Arachnida were both represented with one species each; *Polycentropus* sp and *Argynoneta aquatica* as well as one species of Mollusca, *Hydrobia* sp. The disturbance of the substratum of pond 1 after treatment with Gammalin-20 would have probably enhanced the disappearance of these taxa thereby accounting for their low abundance. Species diversity as a measure of species richness in the study area was highest in pond 1 inspite of the disruption by Gammalin treatment. Monthly variation in taxa richness indicated that pond 3 had higher richness than the other ponds. The monthly variation in evenness indices indicated that pond 1 has the highest taxa evenness with pond 2 having the lowest.

From the study, the highest number of macrobenthic invertebrates was collected from pond 2 where no human activities were observed. It however showed human activities can rapidly alter the eco-balance of any previously stabled communities of aquatic systems as seen in pond 1.

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REFRENCES

APHA, (1998). American Public Health Association: Standard Methods for the examination of water and waste water. 13th edition, Washington D. C. 874pp

Bishop, J. E. (1983). Limnologies of small Malayam River Singai Gombak. Dr. W. Sunk. Publishers. The Hague, 485pp.

Evagelopoulos, A., Spyrakos, E., Karydis, M. and Koutsoubas, D. (2005). The biological System of Kalloni Saltwork and Variations of Macrobenthic Invertebrate Community Structure along the Salinity gradient in the low Salinity ponds. *Proceedings of the annual Ecologist and the Greek Zoological Society, Mytilene,* 18: 58 – 64.

Fredeen, F.J.H. (1975). Effects of a single injection of methoxychlor black fly larvicide on Insect larvae in a 161-km (100-mile) section of the North Saskatchewan River. Canadian *Entomologist*, 107: 807-817.

Hynes, H. B. N. (1971). The ecology of running waters. Toronto University press. 555pp.

Imoobe, T. O. T. and Ohoizebau, E. (2009). Pollution status of a tropical forest river, using aquatic insects as indicator. *Afr. J. Ecol*. 48: 232 – 238.

Lenat, D. R.; Penrose, D. L. S and Eagleson, K. W. (1981). Variable effects of Sediment addition on stream benthos. *Hydrobiologia*. 79: 187 – 194.

Ogbeibu, A. E. and Egborge, A. B. M. (1995). Hydrobiological studies of water bodies in Okomu forest reserve (sanctuary) in Southern Nigeria. I. The Invertebrate fauna. *Trop. Freshwater Biol.,* 4: 1 – 27.

Olomukoro, J. O. (1996). Macrobenthic Fauna of Warri River in Delta State – Nigeria. Ph.D Thesis University of Benin, Benin City. 205pp.

Olomukoro, J. O. and Egboge, A. B. M. (2003). Hydrobiological studies of Warri River, Nigeria. Part 1: The Composition, distribution and diversity of macrobenthic fauna. *Bios Res. Commun.* 15: 279 – 294.

Olomukoro, J. O. and Dirisu, A. R. (2012). Macroinvertebrates Community of a Post Lindane Treated Stream Flowing Through Derived Savannah in Southern Nigeria. *Tropical Freshwater Biology,* 21(1): 67 – 82.

Victor, R. and Ogbeibu, A. E.(1986). Recolonization of Macrobenthic Invertebrates in Nigeria stream after pesticide treatment and associated disruption. *Environ. pollut.* (ser. A), 41: 125-137.

Victor, R. and Dickson, D. T. (1985). Macro invertebrates of a Perturbed stream in Southern Nigeria. *J. Env. Poll.,* (Series A), 38: 99 – 107.

Wallace, R. B. and Hynes, H. B. N. (1981). The effect of chemical treatment against black fly larvae on the fauna of running waters. In: Black flies, the future for biological methods in integrated control, ed. By M. Laird, Academic press, London. 327 – 358pp

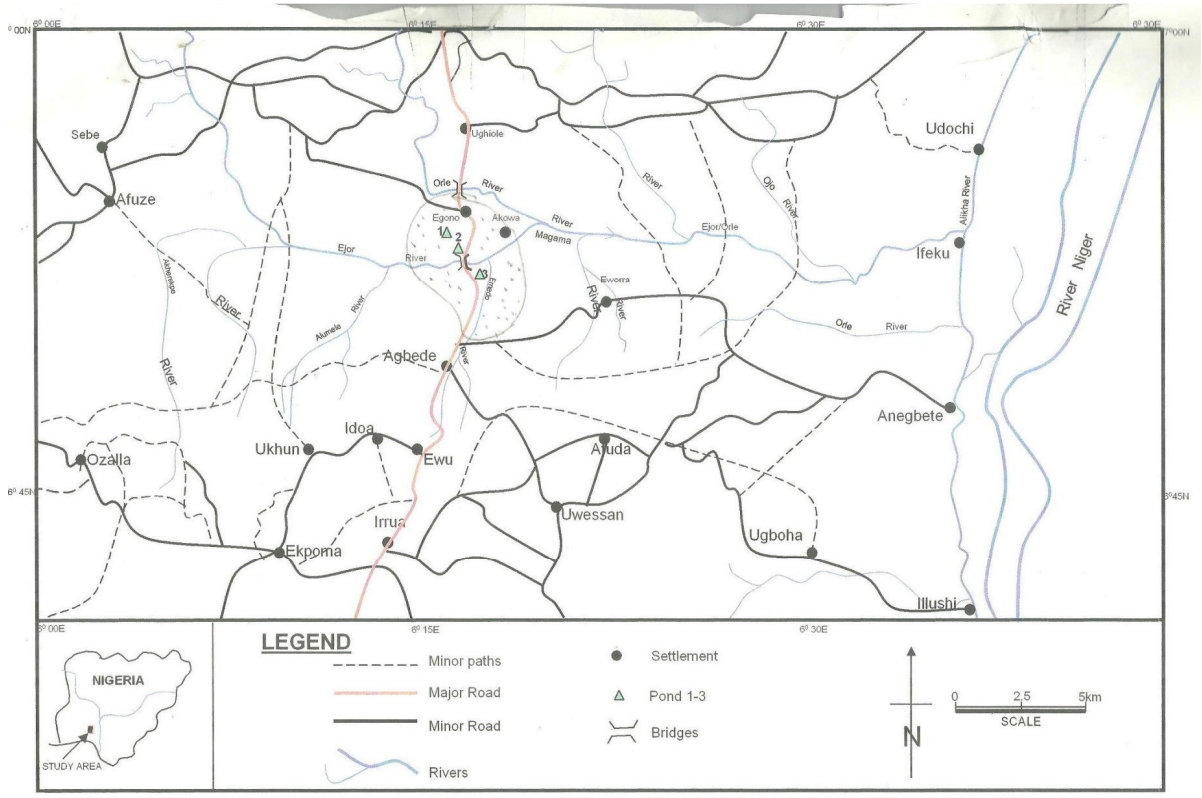

FIG. 1: MAP OF AGBEDE AND ENVIRONS SHOWING THE SAMPLED PONDS

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Table 1: Summary of the Physical and Chemical Characteristics of the Selected Ogwe-Edion Ponds in Agbede Wetlands.

		Pond 1		Pond 2		Pond 3		
Parameters	**N**	**Mean $\pm S.E$**	**Min – Max**	$Mean \pm S.E$	$Min - Max$	$Mean \pm S.E$	$Min \pm Max$	**P- Values**
Air Temp. (°C)	6	27.75 ± 1.75	22.00 – 32.00	31.17 ± 1.82	25.00 – 35.00	32.50 ± 1.38	28.00 – 36.00	0.148
Water Temp (°C)	6	24.67 ± 1.31	20.00 -28.00	25.42 ± 1.46	20.00 – 29.00	27.25 ± 1.08	25.00 – 31.00	0.372
pH	6	6.84 ± 0.09	6.50 – 7.10	7.35 ± 0.09	7.06 – 7.56	6.81 ± 0.26	5.90 – 7.35	0.065
Conductivity (μScm^{-1})	6	0.04 ± 0.01	0.02 – 0.06	0.05 ± 0.01	0.02 – 0.06	0.04 ± 0.01	0.02 – 0.05	0.523
Dissolved Oxygen (mg^{-1})	6	10.88 ± 1.03	9.00 – 15.00	4.10 ± 0.99	2.50 – 9.00	7.02 ± 1.30	3.50 – 12.20	0.002
BOD_5 (mgl^{-1})	6	5.17 ± 0.34	4.20 – 6.30	2.26 ± 0.63	1.20 – 4.24	2.74 ± 0.66	1.36 – 5.00	0.002
Nitrate (mgl^{-1})	6	1.07 ± 0.24	0.02 – 1.70	1.02 ± 0.13	0.50 – 1.40	0.98 ± 0.20	0.35 – 1.50	0.944
Phosphate (mgl^{-1})	6	0.01 ± 0.001	0.004 – 0.014	0.01 ± 0.00	0.004 – 0.020	0.010 ± 0.002	0.006 – 0.020	0.120

Table 2: Composition and Abundance of Macrobenthic Invertebrate in the three Ponds of Ogwe-Edion in Agbede (January – June, 2007)

TAXA	POND 1	POND 2	POND 3
OLIGOCHAETA			
Nais communis	-	-	13
Nais simplex	-	-	20
Nais sp.	-	-	11
Ophidonais sp	-	-	1
DECAPODA			
Desmocaris tripinosa	2	6	-
Desmocaris bislineata	5	-	-
EPHEMEROPTERA	-	-	-
Baetis sp.	4	54	27
Centroptilum sp.	3	7	8
Cloeon sp.	2	22	3
ODONATA			
Zygoptera			
Coenagrion sp.	7	1	1
Enallagma sp	2	-	-
Hesperagrion sp.	-	-	1
Lestes sp.	-	-	1
Anisoptera			
Libellula sp	4	1	31
Nannothermis sp	-	-	1
Plathemis sp	-	-	2
Cordulia sp	1	-	3
Aeschna sp	-	-	2
HEMIPTERA			
Notonecta sp	1	8	157
Nepa sp	-	2	-
Ranatra sp	8	8	4
Hydrometra sp	-	1	-
Ilyocoris sp	2	14	1
Belastoma sp	-	-	1
Rheumatobate sp	-	1	3
COLEOPTERA			
Dytiscus marginalis	64	228	12
Dytiscus sp	28	22	15
Hyphydrus sp	-	-	2
Hydrophilus sp	1	2	-
TRICHOPTER			
Polycentopus sp	-	-	1
DIPTERA			
Chironomus sp.	25	30	17
Chironomus fractilobus	17	-	25
Chironomus travalensis	14	-	15
Polypedilum sp.	-	-	2
Pseudochironomus sp	-	1	-
Cricotopus sp.	14	4	-
Tanypus sp.	-	2	-
Pentaneura sp.	-	-	2
Tanytarsus sp.	6	1	4
Culex sp.	2	1	2
ARANAEA			
Aquatica sp.	1	-	2
MESOGASTROPODA			
Hydrobia sp.	-	-	14
Total	**213**	**416**	**402**

Table 3: Relative Percentage Composition of Taxonomic Groups Including the Dominant and Sub-Dominant Groups in the Study Sites

TAXA	NUMBER OF INDIVIDUALS	% OCCURRENCE
Oligochaeta	45	4.31
Decapoda	13	1.24
Ephemeroptera	130	12.44
Odonata	59	5.65
Hemiptera	211	20.19
Coleoptera	374	35.79
Trichoptera	01	0.09
Diptera	193	18.47
Aranaea	03	0.29
Mesogastropoda	14	1.33

Table 4: Diversity Indices of the Macrobenthos of Selected Ogwe-Edion Ponds in Agbede wetlands

	Pond 1	Pond 2	Pond 3
Taxa_S	22	21	32
Individuals	213	416	402
Dominance_D	0.1416	0.3306	0.1788
Shannon_H	2.392	1.714	2.436
Simpson_1-D	0.8584	0.6694	0.8212
Evenness_e	0.4973	0.2644	0.3569
Margalef	3.917	3.316	5.17
Equitability_J	0.774	0.5631	0.7028