International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS
International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2017; 4(2): 43-46
Received: 19-11-2016
Accepted: 20-12-2016

Oyediran Ajiboye Gabriel
Department of Fisheries Technology, Federal College of Agriculture, Ishiagu, Ebonyi State Nigeria

Ebeniro Lawrence Azubuike
Department of Fisheries Technology, Federal College of Agriculture, Ishiagu, Ebonyi State Nigeria

Ayodele Omotade Paul
Department of Fisheries Technology, Federal College of Agriculture, Ishiagu, Ebonyi State Nigeria

Olaoti Khalid Sayfullah
Department of Fisheries Technology, Federal College of Agriculture, Ishiagu, Ebonyi State Nigeria

Nwoga Peter Tochukwu
Department of Fisheries Technology, Federal College of Agriculture, Ishiagu, Ebonyi State Nigeria

Correspondence
Oyediran Ajiboye Gabriel
Department of Fisheries Technology, Federal College of Agriculture, Ishiagu, Ebonyi State Nigeria

Abundance and distribution of macro-benthic invertebrates as bio-indicators of water quality in Ikwo River, Ishiagu, South-Eastern Nigeria

Oyediran Ajiboye Gabriel, Ebeniro Lawrence Azubuike, Ayodele Omotade Paul, Olaoti Khalid Sayfullah and Nwoga Peter Tochukwu

Abstract
A study on the abundance, distribution and diversity of macro benthic invertebrates of Ikwo River, Ishiagu, South-Eastern Nigeria was conducted from January to December, 2014 in five sampling stations along the river to evaluate the water quality of the river. A total of 1381 macro benthic invertebrate individuals from seventeen (17) taxa were recovered. Station 5 recorded the highest number with 12 taxa while the abundance of individuals were highest at station 3 with 38.02%, followed by station 5 with 29.25% and the least being station 1 with 8.69%. The most abundant and dominant species encountered was *Melanoides tuberculata*, which was distributed in all the stations, accounting for 93.8%, followed by *Lumbricus rubellus* and *Chironomus sp* accounting for 1.1% each; while every other species collected were each less than 1% of the total individuals. The Shannon-Wiener's diversity index indicated a maximum of 2.47 at station 5 (with less anthropogenic activities) compared to stations 3 and 2 with a minimum Shannon-Wiener mean value of 0.00 and 0.45 respectively (with lots of anthropogenic activities). The variations in taxa and number of individuals among stations were not significantly different (P>0.05). Correlation analysis showed that there was a significant different in the species abundance between the dry season and wet season. The low diversity, abundance and distribution recorded were indicators of a poor water quality in Ikwo River. Hence, there should be strict measures in regulating the discharges with particular emphasis on acid mine drainage (AMD) from the mining operations that constituted pollution in the water body.

Keywords: macro-benthic invertebrates, water quality, anthropogenic activities, bio-indicator

1. Introduction
Studies on water quality management using benthic macro-invertebrates in evaluating the impact of pollution in an aquatic environment have been reported [1-4]. Water qualities are those physical, chemical and biological factors that influence species composition, diversity, stability, production and physiological conditions of indigenous populations of a water body [5-6]. Benthic macro-invertebrate fauna are those organisms that live on or inside the deposit at the bottom of a water body [7]. Benthic macro-invertebrates have been identified and the highest species number recorded near tributaries due to the availability of food while the lowest are in the impacted areas where there are pollution discharge and gravel excavation [8].

The occurrence and distribution of macro-invertebrates are governed mostly by the physical and chemical quality of water and the immediate substrate of occupation [9]. The distribution of macro invertebrates communities are highly correlated with the type of sediment which is related to a wider set of environmental conditions such as current speed and organic and inorganic content of the sediment [10]. Macro-invertebrates play an important role in aquatic community which includes mineralization, mixing of sediment, and flux of oxygen into sediment.

Macro-benthic-invertebrate species exhibit a wide variation of response to disturbances and have been extensively monitored in water bodies to evaluate water quality and complement physico-chemical surveys [12]. The most popular biological method in the assessment of freshwater bodies is the use of benthic macro-invertebrates [13]. In the same vein, their composition, abundance and distribution can be influenced by water quality. The distribution of macro-benthic organisms could be as a result of differences in the local environmental condition [14].

Ikwo River is one of the most important rivers in Ishiagu, South-Eastern Nigeria. It serves several purposes such as domestic use, irrigation and as a discharge point for industrial waste especially the mining effluents (AMD). Little or no attention has been given to the ecological inspection of different sources of pollution in the upcoming urban centres like Ishiagu as Ikwo River is a tributary to Ivo River with a lot of discharge points. Therefore, this survey is a cost effective bio-monitoring approach and it will also provide essential tools in formulating policies for regulating the various activities within and around similar aquatic environment.

2. Material and Methods

Ikwo River in Ishiagu, Ebonyi State lies on longitude $7^0$34'60" E to $7^0$35'60'' and latitude $5^0$55'60" N to $5^0$57'20'' and elevation of 43 metres above sea level, in the South Eastern part of Nigeria. The river takes its source from a marshland in Lokpa village in Abia State, Nigeria and joins other rivers' inlets which empty into Ivo River in Ishiagu. The river is at some points surrounded by farmlands and major discharge points for acid mine drainage (AMD). Other major anthropogenic activities in the catchment area are the presence of automobile workshops, car wash, laundry, concrete block moulding industry.

Five sampling stations were chosen for the study which conformed to the different activities in these stations. Station 1 was located upstream. Station 2 was close to tarmac near the bridge, Station 3 was surrounded by rice and vegetables farmland. Station 4 was marked with the fetching of water, bathing and washing; Station 5 was located close to a domestic dump site.

Macro-benthic invertebrates sample collections were conducted monthly over a period of 12 months (January to December, 2014), covering wet and dry seasons, between 1100 hours and 1600 hours for the five sampling stations. At each sampling station, three replicates samples of benthic macro-invertebrates were collected using 0.1m^2 Van Veen Grab. The sediment samples were washed through three sets of sieves first 2mm then 1mm and finally 0.5mm mesh size sieve to collect the macro-benthic invertebrates in them. The retained macro-benthos were poured into white enamel tray and stained with Rose Bengal [14]. They were sorted using forceps, identified using [15-18], and counted. The residues in the sieve for each station were preserved in 10% formalin solution and kept in the labeled plastic containers for further laboratory analysis [12].

The species richness and diversity at each of the stations were determined for the entire one year study period using data obtained from identification and counting.

The Shannon-Wiener diversity index (H^1) which estimates both species richness and evenness of individual distribution among the species (1, 19) was employed.

$$H^1 = \frac{N\log N - \sum fi \log fi}{N} \quad (1)$$

Where
N = Total number of organisms
fi = Total number of individuals for every species
H^1 = Shannon-Weiner diversity index
Species Equitability or Evenness

$$E = \frac{H^1}{\ln S} \quad (2)$$

Where,
H^1 = Shannon and Weiner index
S= Total number of species
Spearman's correlation coefficient and significant testing were used to examine the relationship between the dry season and the wet season.

3. Results

A total of 17 taxa were identified from 1381 individuals collected (Table 1). Station 1,2,3,4 and 5 had 5,7,9,8 and 12 taxa respectively. Samples from station 3 had the highest number of individuals (38.02%), followed by station 5 (29.25%) whereas station 2 had 13.29%. The least number of individuals were in station 1 (8.69%). The most dominant macro benthic invertebrates encountered were *Melanoides tuberculata* which was evenly distributed in all the stations. Others were *Chironomus sp.*, *Lumbricus rubellus* and *Sympetrum striolatum*. Considering the numbers of species recorded, it was evident that the Mollusca were the most dominant with 4 species, followed by Odonata with 3, Hemiptera, Ephemeroptera and Coleoptera had 2 species each, whereas Haplotaxia, Diptera, Trichoptera and Nematomorpha recorded one species each. Among the Mollusca, *Melanoides tuberculata* dominated, accounting for 99.31% of the total number of individuals collected, followed by *Lumbricus rubellus* and *Chironomus sp*, while *Sphaerium cardiidae*, *Balostoma sp*, *Eristalis sp* (larva), *Paragordius tricuspidatus*, *Ameletus inopinatus* and the larva of *Hydrocanthus sp* were the least. The species diversity was highest in station 3 with 12 species while station 1 had the least number of species (5) as shown in Fig 2.

Table 2: Overall Abundance and Distribution of Macro benthic invertebrate at the Study Station of Ikwo River

Taxa Mollusca	Station 1		Station 2		Station 3		Station 4		Station 5		Total No	Overall %
	No	%	No	%	No	%	N0	%	No %			
Melanoide tuberculata	103	85.8	171	92.9	502	95.6	134	90.5	386	95.5	1296	93.8
Margaritifera cardiidae	*	*	*	*	1	0.2	1	0.7	3	0.8	5	0.4
Viviparus contectus	*	*	*	*	1	0.2	1	0.7	1	0.2	3	0.2
Sphaerium cardiidae	1	0.8	*	*	*	*	*	*	*	*	1	0.1
ANNELIDA												
Lumbricus rubellus	*	*	7	3.8	6	1.1	*	*	2	0.6	15	1.1
NEMATOMORPHA												
Paragordius tricuspidatus	*	*	*	*	*	*	*	*	1	0.2	1	0.1
ODONATA												
Sympetrum striolatum	3	2.5	*	*	1	0.2	7	4.7	2	0.5	13	0.9

Aphylla sp	*	*	1	0.6	3	0.6	1	0.7	*	*	6	0.4
Eristalis sp (larva)	*	*	*	*	*	*	1	0.7	*	*	1	0.1
HEMIPTERA												
Nepa apiculata	*	*	2	1.1	1	0.2	1	0.7	2	0.6	6	0.4
Balostoma sp	*	*	1	0.6	*	*	*	*	*	*	1	0.1
EPHEMEROPTERA												
Ameletus inopinatus	*	*	*	*	*	*	*	*	1	0.2	i	0.1
Baetis fuscatus	*	*	*	*	3	0.6	*	*	*	*	3	0.2
TRICHOPTERA												
Philopotamus lusificatus	1	0.9	*	*	*	*	*	*	1	0.2	2	0.1
COLEOPTERA												
Hydrocanthus sp (larva)	*	*	1	0.5	*	*	*	*	*	*	1	0.1
Psepherus sp	*	*	1	0.5	7	1.3	*	*	3	0.8S	11	0.8
DIPTERA												
Chironomus sp	12	10	*	*	*	*	2	1.4	1	0.2	15	1.1
S	=	5		7		9		8		12		
N	=	120		184		525		148		404		1381

S: Number of species; N: Total number of individuals *: Benthic macroinvertebrates were not encountered

4. Discussion

The total number of 17 taxa reported in the present study is low compared with over 55 taxa reported for tropical streams [20-22]. These may be as a result of different environmental conditions such as water quality and movement, substrate instability, salinity regime and food availability [9].

Gastropods and Bivalves are relatively tolerant of physical and chemical variations in the environment and are usually present in a broad range of habitats [23]. It is therefore, not surprising that they dominated the macro-benthos of the study area. Similar observation was made by [24] who recorded Gastropods as the dominant benthic fauna in Lagos Lagoon.

The high value of Shannon – Wiener's diversity and evenness value in station 5 indicated high species diversity. The low Shannon – Wiener's value with low evenness in station 3 and 2 indicated low species diversity. The longer a locality has been in the same condition, the richer in the biotic community and the more stable it is [25]. Therefore, low diversity in stations 2 and 3 may be an indication of stress (pollution) in the environment as a result of various human activities while the relative high diversity in station 5 may be a reflection of stress – free and stable environment [23]. The presence of high number of pollution-tolerant macro benthic invertebrates such as *Chironomus sp* in station 1 depicted pollution threat in the station and this could be attributed to the effect of domestic wastes and AMD being discharge into the river.

In the same way, all the macro benthic invertebrates reported in this study during the months the dry season belong to the tolerant classes in the water bodies which indicated high levels of organic pollution. However from this current study, these groups of pollution tolerant species did not show the expected pattern of opportunistic population, that is, few species and large number of individual except that of *Melanoides tuberculata* (1, 25). On the other hand, few species of Odonata and Ephemeroptera fauna associated with clean water quality were only recovered during the months of rainy season. This could be due to the dilution of the river water during the rains or life history timing, which caused some improvement in the water quality [26].

The low Shannon – Wiener's diversity value in stations 2 and 3 indicated that, they were highly polluted. These were because of the numerous human activities that have been taking place around station 2 which connects to station 3, thereby washing the pollutants to these stations. This is evidenced by the high number of *Melanoides tuberculata* collected in the station. According to [27], the increase in the Gastropod species could be attributed to the life history and population dynamics as they are noted to be adapted to unstable water bodies and exploits brief periods of favorable conditions, lasting only for few months to reproduce rapidly and build up dense population. Diversity only tends to be low in physically disturbed ecosystem [28]. Therefore, Ikwo River may be classified as a physically disturbed ecosystem, hence polluted.

5. Conclusion

The majority of macro benthic invertebrates encountered in Ikwo River within Ishiagu environment such as *Melanoides tuberculata, Chironomus sp, Lumbricus rubellus, Sphaerium cardiidae* and *Balostoma sp* have been used as indicators of organic pollution in the water body. These observations confirmed Ikwo River to be polluted and this calls for a sustainable approach in handling the discharges into the river.

6. References

1. Ogbeibu AE. Distribution, Density and Diversity of Dipterans in a Temporary Pond in Okomu Forest Reservoir, Southern Nigeria. Journal of Aquatic sciences. 2001; 16:43-52.
2. Hart AI, Zabby W. Physio-chemistry and benthic fauna of Woji creek in the Niger Delta Nig. Environ and Ecology. 2005; 23(2):361-368.
3. Arimoro F, Ikomi R. The influence of Sawmill wood waste on the distribution and population of macro-invertebrates at Benue River Niger Delta Area, Nigeria. Chemistry and bio-diversity. 2007; 3:578-592.
4. George ADI, Abowei JFN, Daka ER. Benthic macro invertebrate fauna and physio-chemical parameters in Okpoka creek sediments, Niger Delta, Nigeria. International Journals of Animal and Veterinary Advance. 2009; 1(2):65-59.
5. Boyd CE. Water quality in warm fish ponds. Auburn University Agricultural Experiment Station Auburn, Alabama USA. 1982.
6. Sharma S, Dubeys CR, Dave V. Marine invertebrates community diversity in relation to water quality status of Kaunda River. M.P India discovery. 2003; 3(9):40-46.
7. Idowu EO, Ugwumba AAA. Physical, chemical and benthic fauna characteristics of a Southern Nigeria Reservoir. The Zoologist, 2005, 15-25.

8. Beqiraj S, Licaj P, Luotonen AH, Pritzl G. Situation of benthic quality and Macro-invertebrates in Vjosa river-Albania and their relationships with water environmental state, 2006.
9. Dance KW, Hynes HBN. Some effects of agricultural land use on stream insect communities. Environmental Pollution Series A. 1980; 22:19-28.
10. Gert VH, Steven D, Magda V. Macro-benthic community structure of soft-bottom Sediments at the Belgian continental shelf. Estuarine coastal and shelf science. 2004; 59:599-613.
11. Lydeard C, Cowie RH, Ponder WF, Bogan AE, Bonchet P. The global decline of non-marine mollusks. Bioscience. 2004; 54:321-330.
12. Uwadiae RE, Oni O, Egue OE, Idowu T, Ezekwe FE, Afor A *et al*. patterns and determinants of benthic macro-invertebrates functional assemblages function – environment. Interrelationship in a Lagoon Ecosystem. World Journal of Biological Research. 2004; 005(2):67-73.
13. Odiete WO. Environmental physiology of animal and pollution. Diversity resources Lagos Nigeria, 1999.
14. Holme NA, Mclntyre AD. Methods for the study of marine Benthos. Oxford. London, Edunburgh UK. Blackwell Scientific Publisher, 1984.
15. Macan TT. A Guide to Freshwater Invertebrate animals. Longman, England, 1959.
16. Pennak R. Fresh water invertebrate of the United State. 2nd ed. John Wiley and Son NY, 1978.
17. Needham JG, Needham PR. A Guide to the freshwater biology. 5th ed. San Francisco, Califonia. Holden-Day, Inc, 1970.
18. Edmund J. Sea shells and other Molluscs found on West African coast and Estuarines. Accra. Ghana University Press, 1978.
19. APHA. Standard method for examination of water and waste water.22nd ed. NY. America Publication health Association Inc. 2002.
20. Victor R, Ogbeibu AE. Macro-benthic invertebrates of a steam flowing through farmland in Southern Nigeria. Environmental pollution series A.198; 39:333-347.
21. Edokpayi CA, Osimen EC. Hydrobiogical studies on Ibiekuma River and Ekpoma, Southern Nigeria, After Impoundment: the fauna characteristics. African Journal of Science Tech. 2001; 2(1):72-81.
22. Adakole JA, Anunne PA. Benthic macrovertebrates as indicators of environmental quality of an urban stream in Zaria, Northern Nigeria. Journal of Aquatic Science. 2003; 18:85-92.
23. Esenowo IK, Ugwumba AAA. Composition and abundance of macro-benthos in Majidun River Ikorodu Lagos State, Nigeria. Research Journal of biological sciences. 2010; 5(8):560-556.
24. Ajao EA, Fagade SO. A study of sediment communities in Lagos lagoon, Nigeria. Journal of Oil chemical. Pollution. 1990; 7:85-117.
25. Mackie GL. Applied Aquatic Ecosystem Concepts. University of Guelph Custom Coursepack. Canada.1998.
26. Emere MC, Nasiru CE. Macro invertebrates as indicator of the water Quality of an Urbanized stream, Kaduna Nigeria. Nature and Science. 2009; 7(1):1-7.
27. Woolhouse ME, Chandiwana SK. Population dynamics model for *Bulinus globosus*, intermediate host for *Schistosoma haematobium*, Acta Tropical. 1990; 47:60-151.
28. Odum EP. Fundamentals of Ecology. 3rd ed. W.B Saunders Company, Philadelphia. 1990.