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Benthic Macro-Fauna Composition and Abundance in Sombreiro River, Niger Delta, Nigeria

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Abstract: The benthic macro-fauna composition and abundance in sombreiro was studied for a period of two years (August 2007 - July2009). A total of twenty-eight species belonging to fourteen (14) families, six (6) classes and three (3) phyla were recorded in Sombreiro River. The phylum Annelida dominated with two classes (Oligochaeta and Polychaeta). Oligochaeta was represented by two families (Naididae and Lumbricidae) and seven species having 25% by composition. Polychaeta was represented by seven families (Nereidae, Nepthyidae, Capitellidae, Eucinidae, Glyceridae, Arenicolidae and Syllidae) and thirteen species having 46.4% by composition. The Phylum arthropoda was represented by two classes (Crustacea and inseita). Two families (Gammaridae and Penaidae) having two species consisting of 7.2% were recorded, for the class crustacea. The class insecta was represented by one family (Chironomidae) with one species consisting of 3.6%. The phylum Mollusca was represented by two classes (Gastropoda and Bivalvia). Gastropoda had two species with 7.2% composition and Bivalvia has three species with10.7% composition. Oligochaeta was the highest and constituted 62.0%. The others were Polychaeta (23.9%), Insecta (6.7%), Gastropoda (3.9%), Bivalvia (2.2%) and Crustacea (1.3%). The mean diversity(S) ranged between 11 species. Mean abundance of individuals (N) was 985. Mean Margalef index (d) value was 1.339. The mean value for Shannon-Wienner (H) was 0.956. Mean Pielou's index of relative density or evenness index (E) was 0.986. Mean SimpsIn's Dominance index (C) was 0.623.

Key words: Abundance, benthic macro-fauna, composition, Sombreiro River, Niger Delta, Nigeria

INTRODUCTION

Benthic macro fauna are those organisms that live on or inside the deposit at the bottom of a water body (Barnes and Hughes, 1988; Idowu and Ugwumba, 2005). Several species of organisms which cut across different phyla of annelids, coelenterates, mollusks, arthropods and chordates are found in the brackish water ecosystem, where they play a vital role in the circulation and distribution of nutrients in aquatic ecosystems. They form the link between the unavailable nutrients in detritus and useful protein materials in fish and shell fish. Most benthic organisms feed on detritus that settle on the bottom of the water and in turn serve as food for a wide range of fishes (Imevbore and Bakare, 1970; Adebisi, 1989; Ajao, 1990; Oke, 1990; Idowu and Ugwumba, 2005). They accelerate the breakdown of decaying organic matter into simpler organic forms such as phosphates and nitrates (Gallep *et al*., 1978). All forms of aquatic plants, which are the first link of several food chains existing in aquatic environments, can utilize the nutrients. These organisms therefore form a major link in the food chain as most estuarine and marine fishes, birds and mammals depend directly or indirectly on the benthos for their food supply (Barnes and Hughes, 1988).

Marco-benthic invertebrates are useful bio-indicators providing a more accurate understanding of changing aquatic conditions than chemical and microbiological data, which at least give short-term fluctuations (Ravera, 1998, 2000; Ikomi *et al*., 2005). The most popular biological method in assessment of freshwater bodies receiving domestic and industrial wastewaters is the use of benthic macro-invertebrates (Odiete, 1999). The composition, abundance and distribution of benthic macro-invertebrates can be influenced by water quality (Imevbore, 1967; Haslam, 1990; Greenberg *et al*., 1998; Odiete, 1999). They all reported that variations in the distribution of macro-benthic organisms could be as a result of differences in the local environmental conditions.

The structure of macro-invertebrate communities has been the subject of much research in river systems (Miserendiro, 2001) Potential benefits of research on

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macro-invertebrates include the quick assessment of biological resources for conservation purposes and the detection of pollution through differences between predicted and actual faunal assemblages (Ormerod and Edwards, 1987). The fauna of marine sediments is more difficult to describe in general terms because more phyla are well represented and there is more diversity within each phylum (Lopez, 1988). The polychaetes are very diverse and are often the single most important group in marine muds (Lopez, 1988). Decapod crustaceans are important arthropods in marine sediments. Insects are rare and restricted to the intertidal zone. Marine bivalves are also highly diverse and often dominant members of marine muds (Lopez, 1988). Salinity is the major environmental factor restricting the distribution of marine and lacustrine taxa resulting in the well known poverty of species in brackish and freshwater (Ramane and Schlieper, 1971).

Low biomass of macro-benthic fauna of some intertidal areas in Java, Indonesia was attributed to abiotic stress factors such as instability of the substratum, occurrence of toxic substances or drastic salinity fluctuations (Eretemeijer and Swennen, 1990). They reported that the mud flats in the Serewean Estuary and Porong Delta consisted of bare soft mud with a low biomass of benthic macro-fauna. In the Serewean Estuary the benthic macro-fauna consisted of only small polychaetes. Towns (1979) surveyed the macro-invertebrate fauna of Waitakere River and its tributaries, a Northern New Zealand Kauri forest stream and reported 144 taxa. He also stated that the small number of species obtained else-where in New Zealand is probably partly due to imprecise identification and partly the result of poor taxonomic coverage of many groups. Down stream changes in species composition and parallel change in the number of insect families occurred. Towns (1979) reported that in most streams throughout the world the largest number of species in the invertebrate fauna is comprised of Diptera, dominated by Chironomidae.

Longitudinal changes in the available habitats in rivers have been seen as influences on species composition and community structure (Friberg *et al*., 1977; Minshall *et al*., 1985; Statzner and Higler, 1985, 1986). The management of water systems based on multiple needs has become an important focus of many Federal, State, local and private authorities (Nelson and Lieberman, 2002). These social needs include mandated water deliveries, by hydroelectric power production, recreation and requirements for fish and wildlife benefits. The task of balancing these compelling demands is sometime difficult for management agencies because they lack the information needed to make sound decisions, especially for fish and wildlife. Alterations in downstream lotic communities, such as aquatic invertebrates, may result from these operational changes (Vinson, 2001). Considerable evidence exists that hydraulic conditions are driving forces affecting distribution and abundance patterns of benthic invertebrates. There is theoretical and empirical support from stream ecology studies for a strong relationship between environmental variation (environmental gradients) and macro-invertebrate community composition (Faith and Norries, 1989).

This theme is most strongly developed in the work on the River Continuum Concept (RCC) (Vannote *et al*., 1980); Minshall *et al*., 1985; Statzner and Higler, 1985), in which streams are conceptualized as continua with predict Table responses of communities to environmental gradients corresponding to stream order. In addition, biological monitoring studies using macro-invertebrates (Moses, 1987) have produced a range of predictive models successfully relating community composition to various Physico-chemical variables.

Sombreiro River is connected to other rivers via creeks in the coastal areas of the Niger Delta (Ezekiel, 1986). This makes the mouth of the river a brackish and tidal environment. Formal comparison of marine and freshwater benthos can substantially enhance our understanding of benthic systems (Lopez, 1988). This study provides baseline data on the benthic macro fauna in Sombreiro River for management decisions in managing the water body and similar aquatic systems.

MATERIALS AND METHODS

Study area: The study was carried out in Sombreiro River, in the Niger Delta of Nigeria for a period of two years (August, 2007 - July, 2009). It is one of the rivers that drain the western part of Rivers State. The river provides nursery and breeding grounds for a large variety of fish species (Ezekiel *et al*., 2002). Four sampling stations were established along the length of the Sombreiro River whenever, it was accessible by road. Sombreiro River is located in three local government areas of Rivers stale - Ogba/Egbema/Ndoni and Degema between Latitude 6º30′ and 7º0′ E and Longitude 4º12′ and 6º17′ N. It is a distributary of the River Niger which arises from northern boundary of Rivers State with Imo State. It is one of the series of the Niger Delta rivers which drain into the Atlantic Ocean and is connected to other rivers via creeks in the coastal area of the Niger Delta (Ezekiel, 1986, 2001).

The river is narrow and steep as it flows southwards, it widens and the steep sidedness gradually disappears starting from the middle reaches. The system is lotic throughout the year; the lotic period reaches its peak in January to February (dry season) when the water level has fallen to the maximum. In August - September (wet season), the lotic nature of the river is reduced due to flooding (Ezekiel, 1986). The river is contained within the tropical rainforest although the lower reach is within the brackish mangrove zone.

From upstream the river bed consists of stones and gravels, the middle zone tending to be sandy with the sand bed giving way to a muddy one at the lower reach of the river (Ezekiel, 1986). A part from areas of human disturbance, the river is fringed by riverine forest. Numerous human activities such as fishing, sand nuning, dredging, mangrove cutting, logging of timber and transportation. These may be potential sources of pollution to the environment. Public toilets were observed at each of the sampling stations. Also observed were refuse dumps and run-offs into the river from the rivernie communities. The wastes from the comities may constitute source of pollution to the river.

Four sampling stations were established along the length of Sombreiro River. Stations were chosen in a such a manner to provide for even spread for effective sampling. Each of the stations was visited once a month, usually between the 15th and 22nd. Photographs were taken of each station to illustrate the habitat. Only qualitative description of stations were made in order to classify the stations according to general habitat types. The four stations investigated in this study are described below on the basis of personal visual observations.

Station 1 (Degema): This is the largest of all the sampling stations. The vegetation fringing the river at the left and right banks consists of mangrove plants such as Rhizophora, Avicennia and Nypha Fruticans (Nypa palm), arising from a characteristic muddy substrate that produces a foul odor. The water is highly turbid in the rainy months and clear in the dry months. This station is a brackish and tidal environment. There is no observable unidirectional flow of the water at this station due to the very wide nature of the river; thus the surface current is not very distinct to be determined. The bed of the river at this station is a mosaic mud and sand. No farmland was observed at this station but there were public toilets which discharge human wastes directly into the river.

Station 2 (Ogbele): At station 2, mangrove vegetation is replaced by riverine forest consisting mainly of *Raphia*, *Pandanus*, *Sanderiana*, *Calamas* sp. (swamp cane), *Khaya* sp. (Mahogany), *Vapaca* sp., *Ficus Vogeliana* and *Triculia*. african. Aquatic marcophytes include *Nymphace* sp., *Eichornia crassipes*, *Sagittana* sp., *Pistia stratictes*. The station was flooded in the rainy season when the current velocity is slow. The station has a little tidal influence from the immediate tidal mangrove zone. The bed of the river at this station consists of sand and small gravel. No farmland was noticed but there were public toilets which discharge human wastes directly into the river.

Station 3 (Ihuaba): The vegetation fringing the river at this station is a mixture of riverine and terrestrial vegetation although no farmland was seen. The common plants noticed here are the Raphia and *Elaeis guineensis* (palm trees.). The aquatic macrophytes include *Typha lotifolia* (cat tail) and Potamogetom sp (pond weed). The station was flooded from August to October with the flood receding from November to February. The speed of the current is slow in the rainy season. The bottom of the river at this station consists of sand and gravel of various sizes. No farmland was observed but there were public toilets which discharge human waste into the river.

Station 4 (Odiemudie): The vegetation consists of a terrestrial vegetation in which can be seen farmland, and riverine vegetation extending into a large area of swamps. Some include Raphia, Pandanus Sanderiana *Elaeis guineensis* (palm trees) Aquatic macrophytes include/*Pomea aquatica*, *Lemna* sp. (duck weed), *Utricularia* sp., *Nympaea* sp. and *Pistia stratiotes* (water lettuce). Current is moderate in the rainy months, becoming fast in the dry months when the flood recedes. The water is clear and the bottom consists of small stones, gravel of various sizes and sand.

Sample collection: The benthic samples for the analysis of benthic organism, sediment particle size and sediment Physico-chemical parameters were collected using an Eckman grab of 10 cm diameter and 12 cm long. Three hauls were made at each sampling station by sending the grab down into the bottom and using the messenger to close and grab some quantity of sediment. The benthic samples were collected monthly from each station. Composite samples were composed from each station and put into labeled polythene bags for the determination of the sediment particle sizes. The remaining benthic samples were washed through seize of 1mm x 1mm mesh size to collect the benthic organisms. The washed sediment with macro-invertebrates were poured into a wide mouth labeled plastic container and preserved with 10% formalin solution to which Rose Bengal (dye) had been added. The Rose Bengal dye strength of 0.1% selectivity colored all the living organisms in the sample (Claudiu *et al*., 1979; Zabbey, 2002; Idowu and Ugwumba, 2005). The preserved samples were taken to the laboratory for further analysis.

The washed and preserved sediment with the benthic macro-invertebrates were poured into a white enamel tray and sorted in the laboratory. For effective sorting, moderate volume of water was added into the container to improve visibility. Forceps were used to pick large benthos while smaller ones were pipetted out. The benthos were sorted into their different groups and preserved in 5% formalin. The preserved benthos were later identified to their lowest taxonomic group under light and stereo dissecting microscope and counted. The identification was done using the keys by Day (1967), Pennak (1978) and Hart (1994). The monthly percentage occurrence and relative numerical abundance of

Table 1: Benthic Macro-fauna phylum,classes, families and species in Sonibreiro River, Niger, Delta Nigeria

S.No.	Phylum	Class	Family	Genus/Species
1	*Annelida*	*Oligochaeta*	*Naididae*	*Ophidonais serpentina*
				Dero sp.
				Paranais sp.
				Uncinais uncinata
				Styleria lacustris
			Lumbricidae	*Eiseniella tetrahida*
				Lumbricus variegates
		Polychaeta	*Nereidae*	*Nereis virens*
				Nereis diversicolor
				Nereis pelagic
			Nephthyidae	*Nephthys hombergi*
			Capitellidae	*Capitella capitata*
				Notomastus tenuis
				Notomastus tetericeus
			Eunicidae	*Marphysa* sp.
			Glyceridae	*Glycera capitela*
				Glycera convolute
			Arenicolidae	*Arenicola marina*
				Polydora capensis
			Syllidae	*Sylls prolifera*
2	*Arthropoda*	*Crustacea*	*Gammaridae*	*Gammarus lacusta*
			Penaidae	*Peneus notialis*
		Insecta	*Chironomidae*	*Chironomis* sp.
3	*Mollusca*	*Gastropoda*	*Potamidae*	*Tympanotonus fuscatus*
				Pachymelania fusca
		Bivalvia	*Tellidae*	*Tellina nymphalis*
				Loripes sp.
				Tegalus andersoni

Table 2: Benthic macro-fauna composition in sombreiro River (Aug. 2007-July 2009)

Class	Total no. of families	Total no. of species	Percentage species composition
Oligochaeta	2	7	25.0
Polychaeta	7	13	46.4
Crustacea	2	2	7.2
Insecta	1	1	3.6
Gastropoda	1	2	7.2
Bivalvia	1	3	10.7
Total	14	28	100.1

macro-invertebrates were estimated. The densities of abundant species were analysed for each of the sampling stations using the formula:

$$\text{Density} = \frac{\text{Total Number of Organisms}}{\text{Area of sampling unit}} \quad (1)$$

RESULTS

A total of twenty-eight species belonging to fourteen (14) families, six (6) classes and three (3) phyla were recorded in Sombreiro River (Table 1). The phylum Annelida dominated with two classes (Oligochaeta and Polychaeta). Oligochaeta was represented by two families (Naididae and Lumbricidae) and seven species having 25% by composition. Polychaeta was represented by seven families (Nereidae, Nepthyidae, Capitellidae, Eucinidae, Glyceridae, Arenicolidae and Syllidae) and thirteen species having 46.4% by composition.

The Phylum arthropoda was represented by two classes (Crustacea and insecta). Two families (Gammaridae and Penaidae) having two species consisting of 7.2% were recorded, for the class crustacea. The class insecta was represented by one family (Chironomidae) with one species consisting of 3.6%. The phylum Mollusca was represented by two classes (Gastropoda and Bivalvia). Gastropoda had two species with 7.2% composition and Bivalvia has three species with10.7% composition (Table 2). Oligochaeta was the highest and constituted 62.0%. The others were Polychaeta (23.9%), Insecta (6.7%), Gastropoda (3.9%), Bivalvia (2.2%) and Crustacea (1.3%).

Table 3: Mean species diversity and richness indices of benthic macro-invertebrate community composition in Sombreiro River

Total no. of Species (S)	11
Total no. of Individuals (N)	985
Margalef index (d)	1.339
Shannon-wienner index (H)	0.956
Pielous' evenness(E)	0.986
Simpsins dominance (C)	0.623

Table 3 shows the mean species diversity and richness indices of benthic macro-invertebrate community composition. The mean diversity(S) ranged between 11 species. Mean abundance of individuals (N) was 985.

Mean Margalef index (d) value was 1.339. The mean value for Shannon-Wienner (H) was 0.956. Mean Pielou's index of relative density or evenness index (E) was 0.986. Mean SimpsIn's Dominance index (C) was 0.623. The species were evenly distributed.

DISCUSSION

Twenty-eight species belonging to 14 families, 6 classes and 3 phyla of macro-invertebrates were recorded in the study area. The faunal composition was dominated by polychates with 13 species from 7 families (46.4%) in terms of the species richness. Oligochaeta had 2 families and 7 species (25%), Bivalvia had 1 family and 3 species (10.7%). Crustacea was represented by 2 families and 2 species, Gastropoda had one family 2 species and insecta had 1 family and one species constituting 7.2, 7.2 and 3.6% of the species richness respectively. The low diversity of the benthic macro-invertebrates in this study is not unusual in the Niger Delta. Umeozor (1995) reported 23 species from New Calabar River; Hart and Zabbey (2005) reported 30 species belonging to 20 families and 5 classes; Ansa (2005) reported 28 families, 6 classes and 5 Phyla and George *et al*. (2010) reported 19 species from Okpoka creek sediments.

The results of the benthic macro-invertebrate composition in this study are also similar to other studies of benthic macro-invertebrates from other water bodies in Nigeria. Victor and Dickson (1985) recorded only 9 species from Ikpoba River and Edokpayi and Osimen (2001) reported 84 species from Ibiekuma River. Nkwoji *et al*. (2010) have also reported low macro benthic abundance and composition from the Lagos Lagoon. The differences in species composition and abundance may be attributed to the ecological differences of the different habitat locations and period of investigation water quality, immediate substrate for occupation and food availability may also affect the abundance and distribution of the macro-invertebrates communities (Dance and Hynes, 1980).

The observed dominance of Polychaeta in this study is in agreement with the report of (Umeozor 1995; Hart and Zabbey, 2005; Eretemeijer and Swennen, 1990; George *et al*., 2010). The dominance of Polychaetes in the brackish water station (Degema) may be attributed to their level of pollution tolerance (Edokpayi and Nkwoji, 2007). However, the numerical numbers of the individual species recorded in this study were low. This suggests that he mud flat of station one is not grossly polluted presently.

The diversity of benthic macro-invertebrates in the study area estimated by the Margalef, Shannon-Wienner, Pielou and Simpsin's Dominance indexes in the stations were generally low and compared favorably with Nkwoji *et al*. (2010) who reported low values for Margalef's species richness and Shannon - Wienner diversity Index.

CONCLUSION

- Twenty-eight species belonging to 14 families, 6 classes and 3 phyla of macro-invertebrates were recorded in the study area.
- Polychates with 13 species from 7 families (46.4%) was dominant. Gastropoda with one family 2 species and insecta with 1 family and one species constituting 7.2, 7.2 and 3.6% of the species richness respectively were relatively few.
- Generally, the benthic macro-invertebrate composition in this study is also similar to other studies.
- The low diversity of the benthic macro-invertebrates in this study is not unusual in the Niger Delta.

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