Research Journal of Applied Sciences, Engineering and Technology 3(4): 264-271, 2011
ISSN: 2040-7467

Received: January 05, 2011 Accepted: February 11, 2011 Published: April 20, 2011

The Distribution and Seasonality of Benthic Macro-Invertebrates in Sombreiro River, Niger Delta, Nigeria

[1]E.N. Ezekiel, [1]A.I. Hart and [2]J.F.N. Abowei
[1]Department of Animal and Environmental Biology, Faculty of Science, University of Port Harcourt, Choba, Port Harcourt, Nigeria
[2]Department of Biological Sciences, Faculty of Science, Niger Delta University, Wilberforce Island, Nigeria

Abstract: The distribution and seasonality of benthic macroinvertebrates in Sombreiro River was studied for a perion of two years (August, 2007 - July, 2009). Of the twenty-eight (28) species observed in the area, all the species of the class Oligochaeta did not occur in station1 (Degema) but occurred in the remaining three stations 2 (Ogbele), 3 (Ihuaba) and 4 (Odiemudie). The species recorded were relatively abundant in stations 2, 3 and 4. In station 2 (Ogbele) *Paranais* sp. (Naididae) was the highest 40.5%; *Styleria lacustris* (Naididae) 40.6% in station 3 and *Uncinais uncinata* (Naididae) in station 4.All the species of the class Polychaeta occurred only in station 1 (Degema) but did not occur in the remaining three stations. In terms of percentage all species had 100% but numerically *Nephthys hombergi* (257) was the highest followed by *Notomastus latericeus* (124).The only species of the family chironomidae (*Chironomus* sp.) did not occur in station 1 but occurred in the remaining three stations. The highest percentage occurrence (49.1%) was recorded at station 3 (Ihuaba). *Tympanotonus fuscatus* and *Pachymelania fusca* (Potomidae) occurred only in station1 (Degema). *Tellina nymphalis*, *Loripes* sp. and *Tegalus andersoni* occurred only in station 1 (Degema). Station 1 (Degema) had twenty (20) species while stations 2, 3, and 4 had 8species each. The result showed that *Ophidonais sapentina* had the highest mean value 20.917±11.147, (August 2007 - July 2008); 20.500±7.891 (August 2008 - July 2009). This was followed by *Eiseniella tetrahidra* 17.917±9.179 (August 2007 - July 2008); 17.417±7.476, (August 2008 - July 2009) and *Uncinais uncinata* 14.667±6.443 (August 2007 - July 2008), 14.417±5.017 (August 2008 - July 2009). The least was *Tellina nymphalis* 0.583±1.505 (August 2007 - July 2008); 0.333±0.651, (August 2008 - July 2009). There was no significant variation in the mean values of the two years studied 5.900±0.4168 (August 2007 - July 2008). 5.717±0.3704 (August 2008 - July 2009). Seasonal variations occurred in the abundance of *Dero* sp. (11.00±5.20 wet, 17.71±3.72 dry), *Stylera lacustris* (11.82±5.15 wet, 18.50±10.57 dry) and *Eiseniella tetrahidra* (18.76±9.16 wet, 15.00±4.69 dry). The other species did not show significant variation. However, there was significant variation between the mean of the wet season and that of the dry season 5.32±0.30 wet and 6.99±0.58, respectively. The result showed that *Ophidonais sapentina* had the highest mean value 20.917±11.147, (August 2007 - July 2008); 20.500±7.891 (August 2008 - July 2009). This was followed by *Eiseniella tetrahidra* 17.917±9.179 (August 2007 - July 2008); 17.417±7.476, (August 2008 - July 2009) and *Uncinais uncinata* 14.667±6.443 (August 2007 - July 2008), 14.417±5.017 (August 2008 - July 2009). The least was *Tellina nymphalis* 0.583±1.505 (August 2007 - July 2008); 0.333±0.651, (August 2008 - July 2009). There was no significant variation in the mean values of the two years studied 5.900 ± 0.4168 (August 2007 - July 2008). 5.717±0.3704 (August 2008 - July 2009). Seasonal variations occurred in the abundance of *Dero sp.*(11.00±5.20 wet, 17.71±3.72 dry), *Stylera lacustris* (11.82±5.15 wet, 18.50±10.57 dry) and *Eiseniella tetrahidra* (18.76±9.16 wet, 15.00±4.69 dry). The other species did not show significant variation. However, there was significant variation between the mean of the wet season and that of the dry season 5.32±0.30 wet and 6.99±0.58, respectively.

Key words: Benthic Macro-invertebrates, distribution, seasonality, Sombreiro River, Niger Delta, Nigeria

INTRODUCTION

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).

Corresponding Author: J.F.N. Abowei, Department of Biological Sciences, Faculty of Science, Niger Delta University, Wilberforce Island, Nigeria

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).

Benthic macro invertebrate organisms 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; APHA/WWA/ WEF, 1998; Odiete, 1999).

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

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 (Statzner *et al*., 1988).

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. This article is aimed at providing information on the distribution and seasonality of benthic macro-invertebrates in Sombreiro River for the management of the River Fishery and similar water bodies. It will also compliment existing literature for further research.

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 drains 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 $4^0$12′ and $6^0$17′ 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 such a manner to provide for even spread for effective sampling. Each of the stations was visited once a month, usually between the 15^{th} and 22^{nd}. 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 odour. 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 astes 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.,

Table 1: Summary of distribution and relative abundance of benthic macro-invertebrates in stations of Sombreiro River

			Stations			
	Family	Species	1 Degema	2 Ogbele	3 Ihuaba	4 Odiemudie
1	Naididae	*Ophidonais serpentina*	0 (0)	161 (32.6)	172 (34.8)	161 (32.6)
2.		*Dero* sp.	0 (0)	97 (30.3)	129 (40.3)	94 (29.4)
3.		*Paranais* sp.	0 (0)	98 (40.5)	69 (28.5)	75 (31)
4.		*Uncinais uncinata*	0 (0)	114 (33.2)	113 (32.9)	116 (33.8)
5.		*Styleria lacustris*	0 (0)	87 (25.1)	141 (40.6)	119 (34.3)
6.	Lumbricidae	*Eiseniella tetrahida*	0 (0)	143 (34.8)	144 (35)	124 (30.2)
7.		*Lumbricus variegatus*	0 (0)	91 (36)	78 (30.8)	84 (33.2)
8.	Nereidae	*Nereis virens*	72 (100)	0 (0)	0 (0)	0 (0)
9.		*Nereis diversicolor*	66 (100)	0 (0)	0 (0)	0 (0)
10.		*Nereis pelagic*	73 (100)	0 (0)	0 (0)	0 (0)
11.	Nephthyldae	*Nephthys hombergi*	257 (100)	0 (0)	0 (0)	0 (0)
12.	Capitellidae	*Capitella capitata*	20 (100)	0 (0)	0 (0)	0 (0)
13.		*Notomastus tenuis*	30 (100)	0 (0)	0 (0)	0 (0)
14.		*Notomastus latericeus*	124 (100)	0 (0)	0 (0)	0 (0)
15.	Eunicidae	*Marphysa* sp.	16 (100)	0 (0)	0 (0)	0 (0)
16.	Glyceridae	*Glycera capitata*	20 (100)	0 (0)	0 (0)	0 (0)
17.		*Glycera convoluta*	50 (100)	0 (0)	0 (0)	0 (0)
18.	Arenicolidae	*Arenicola marina*	36 (100)	0 (0)	0 (0)	0 (0)
19.		*Polydora capensis*	101 (100)	0 (0)	0 (0)	0 (0)
20.	Syllidae	*Syllis prolifera*	103 (100)	0 (0)	0 (0)	0 (0)
21.	Gammaridae	*Gammarus lacusta*	16 (100)	0 (0)	0 (0)	0 (0)
22.	Penaidae	*Peneus notialis*	33 (100)	0 (0)	0 (0)	0 (0)
23.	Chironomidae	*Chironomus* sp.	0 (0)	77 (28)	135 (49.1)	63 (22.9)
24.	Potamidae	*Tympanotonus fuscatus*	50 (100)	0 (0)	0 (0)	0 (0)
25.		*Pachymelania fusca*	101 (100)	0 (0)	0 (0)	0 (0)
26.	Tellidae	*Tellina nymphalis*	11 (100)	0 (0)	0 (0)	0 (0)
27.		*Loripes* sp.	60 (100)	0 (0)	0 (0)	0 (0)
28.		*Tegalus andersoni*	14 (100)	0 (0)	0 (0)	0 (0)
Total no. of species per station				20	8	88

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.

RESULTS

Table 1 shows the distribution patterns of benthic macro-invertebrates species and their relative abundance in the different stations. Of the twenty-eight (28) species observed in the area, all the species of the class Oligochaeta did not occur in station1 (Degema) but occurred in the remaining three stations 2 (Ogbele), 3 (Ihuaba) and 4 (Odiemudie). The species recorded were relatively abundant in stations 2, 3 and 4. In station 2 (Ogbele) *Paranais* sp. (Naididae) was the highest 40.5%; *Styleria lacustris* (Naididae) 40.6% in station 3 and *Uncinais uncinata* (Naididae) in station 4.

All the species of the class Polychaeta occurred only in station 1 (Degema) but did not occur in the remaining three stations. In terms of percentage all species had 100% but numerically *Nephthys hombergi* (257) was the highest followed by *Notomastus latericeus* (124).The only species of the family chironomidae (*Chironomus* sp) did not occur in station 1 but occurred in the remaining three stations. The highest percentage occurrence (49.1%) was recorded at station 3 (Ihuaba). *Tympanotonus fuscatus* and *Pachymelania fusca* (Potomidae) occurred only in station1 (Degema). *Tellina nymphalis*, *Loripes* sp. and *Tegalus andersoni* occurred only in station 1 (Degema). Station 1 (Degema) had twenty (20) species while stations 2, 3 and 4 had 8species each. The annual and seasonal variations of the benthic macro-invertebrates are presented in Table 2 and 3. The result showed that *Ophidonais sapentina* had the highest mean value 20.917±11.147, (August 2007 - July 2008); 20.500±7.891 (August 2008 - July 2009). This was followed by *Eiseniella tetrahidra* 17.917±9.179 (August 2007 - July 2008); 17.417±7.476, (August 2008 – July 2009) and *Uncinais uncinata* 14.667 ± 6.443 (August 2007 - July 2008), 14.417±5.017 (August 2008 - July 2009)The least was *Tellina nymphalis* 0.583±1.505 (August 2007 - July 2008); 0.333±0.651, (August 2008 - July 2009). There was no significant variation in the mean values of the two years studied 5.900 ± 0.4168 (August 2007 - July 2008). 5.717±0.3704 (August 2008 - July 2009).

Table 2 shows that seasonal variations occurred in the abundance of *Dero sp.*(11.00±5.20 wet, 17.71±3.72 dry), *Stylera lacustris* (11.82±5.15 wet, 18.50±10.57 dry) and *Eiseniella tetrahidra* (18.76±9.16 wet, 15.00±4.69 dry). The other species did not show significant variation. However, there was significant variation between the mean of the wet season and that of the dry season 5.32±0.30 wet and 6.99±0.58, respectively.

Table 2: Annual mean variance of benthic macro-invertebrate species abundance from Sombreiro River

Species		Year 1	Year 2
1.	*Ophidonais serpetina*	20.917 ± 11.147^{a}	20.500 ± 7.891^{a}
2.	*Dero* sp.	12.417 ± 6.444^{cd}	13.500 ± 5.00^{cd}
3.	*Paranais* sp.	10.000 ± 6.179^{d}	10.166 ± 4.509^{e}
4.	*Uncinais uncinata*	14.667 ± 6.443^{bc}	14.417 ± 5.017^{c}
5.	*Styleria lacustris*	13.792 ± 8.809^{cd}	13.750 ± 6.482^{cd}
6.	*Eiseniella tetrahida*	17.917 ± 9.179^{ab}	17.417 ± 7.476^{b}
7.	*Lumbricus variegatus*	10.000 ± 4.285^{d}	11.083 ± 2.937^{de}
8.	*Nereis virens*	2.250 ± 2.454^{e}	3.417 ± 2.466^{gfh}
9.	*Nereis divericolour*	2.333 ± 2.309^{e}	2.750 ± 2.179^{gfh}
10.	*Nereis pelagica*	2.333 ± 1.435^{e}	3.667 ± 1.775^{gfh}
11.	*Nephtys hombergi*	10.666 ± 10.307^{cd}	10.750 ± 4.692^{de}
12.	*Capitella capitata*	1.000 ± 2.486^{e}	0.667 ± 1.497^{gh}
13.	*Notomastus tennis*	1.333 ± 2.309^{e}	1.667 ± 1.585^{gh}
14.	*Notomastus latericeus*	5.250 ± 2.832^{e}	5.083 ± 2.065^{f}
15.	*Marphysa* sp.	0.500 ± 1.000^{e}	0.917 ± 1.0505^{gh}
16.	*Glycera capitata*	1.000 ± 1.414^{e}	0.667 ± 0.984^{gh}
17.	*Glycera convoluta*	2.083 ± 2.968^{e}	1.250 ± 1.658^{gh}
18.	*Arenicola marina*	1.5000 ± 1.977^{e}	1.500 ± 1.678^{gh}
19.	*Polydora capensis*	4.917 ± 6.037^{e}	3.500 ± 3.965^{fgh}
20.	*Syllis prolifera*	4.667 ± 6.386^{e}	3.917 ± 4.440^{fg}
21.	*Gammarus lacusta*	0.750 ± 1.356^{e}	0.750 ± 1.138^{gh}
22.	*Peneus notialis*	1.500 ± 2.354^{e}	1.250 ± 1.712^{gh}
23.	*Chironomus* sp.	12.000 ± 6.849^{cd}	9.750 ± 5.610^{e}
24.	*Tympanotomus fuscatus*	2.166 ± 4.018^{e}	2.000 ± 2.628^{fgh}
25.	*Pachymelania fusca*	5.083 ± 2.274^{e}	3.333 ± 1.497^{fgh}
26.	*Tellina nymphalis*	0.583 ± 1.505^{e}	0.333 ± 0.651^{h}
27.	*Loripes* sp.	3.000 ± 3.302^{e}	2.000 ± 2.256^{fgh}
28.	*Tegalus andersoni*	0.583 ± 0.996^{e}	0.583 ± 0.900^{gh}
Mean + SEM		5.900 ± 0.4168^{a}	5.717 ± 0.3704^{a}

Means with the same superscripts are not significantly different, $p<0.01$

Table 3: Seasonal Variation of Benthic Macro-Invertebrates (Mean) in Sombreiro River

Species		SeasonWet	Dry
1.	*Ophidonais serpetina*	17.71 ± 4.71^{a}	28.00 ± 13.97^{a}
2.	*Dero* sp.	11.00 ± 5.200^{c}	17.71 ± 3.72^{b}
3.	*Paranais* sp.	10.00 ± 5.91^{c}	10.28 ± 3.77^{cde}
4.	*Uncinais unacinata*	14.76 ± 5.52^{b}	14.00 ± 6.37^{bc}
5.	*Styleria lacustris*	11.82 ± 5.15^{c}	18.50 ± 10.57^{b}
6.	*Eiseniella tetrahida*	18.76 ± 9.16^{a}	15.00 ± 4.69^{bc}
7.	*Lumbrius variegatus*	10.47 ± 4.09^{c}	10.71 ± 2.42^{cd}
8.	*Nereis virens*	2.35 ± 1.80^{defg}	4.00 ± 3.55^{fg}
9.	*Nereis divericolour*	1.59 ± 1.42^{efg}	4.86 ± 2.11^{efg}
10.	*Nereis pelagica*	2.71 ± 1.69^{defg}	3.71 ± 1.70^{fg}
11.	*Nephtys hombergi*	8.88 ± 6.23^{c}	15.14 ± 9.95^{bc}
12.	*Capitella capitata*	1.18 ± 2.32^{fg}	0.00 ± 0.00^{g}
13.	*Notomastus tennis*	1.71 ± 2.14^{efg}	0.14 ± 0.37^{g}
14.	*Notomastus latericeus*	4.94 ± 2.70^{d}	5.71 ± 1.60^{defg}
15.	*Marphysa* sp.	1.00 ± 1.41^{fg}	0.00 ± 0.00^{g}
16.	*Glycera capitata*	0.24 ± 0.56^{g}	2.29 ± 1.11^{fg}
17.	*Glycera convoluta*	0.71 ± 1.49^{fg}	4.00 ± 2.64^{fg}
18.	*Arenicola marina*	1.00 ± 1.50^{fg}	2.71 ± 1.97^{fg}
19.	*Polydora capensis*	3.18 ± 4.71^{defg}	6.71 ± 5.31^{def}
20.	*Syllis prolifera*	3.65 ± 5.89^{def}	5.86 ± 3.84^{defg}
21.	*Gammarus lacusta*	0.82 ± 1.29^{fg}	0.57 ± 1.13^{g}
22.	*Peneus notialis*	1.47 ± 2.29^{efg}	1.14 ± 1.21^{fg}
23.	*Chironomus* sp.	9.88 ± 6.41^{c}	13.29 ± 5.43^{bc}
24.	*Tympanotomus fuscatus*	2.47 ± 3.84^{defg}	1.14 ± 1.21^{fg}
25.	*Pachymelania fusca*	4.41 ± 2.37^{de}	3.71 ± 1.11^{fg}
26.	*Tellina nymphalis*	0.59 ± 1.33^{fg}	0.14 ± 0.37^{g}
27.	*Loripes* sp.	1.29 ± 1.79^{fg}	5.43 ± 2.76^{defg}
28.	*Tegalus andersoni*	0.35 ± 0.70^{g}	1.14 ± 1.21^{fg}
Mean+SEM		5.32 ± 0.70^{b}	6.99 ± 0.58^{a}

Means with the same superscripts are not significantly different, $p<0.01$

The annual and seasonal variations of the benthic macro-invertebrates are presented in Table 2 and 3. The result showed that *Ophidonais sapentina* had the highest mean value 20.917± 11.147, (August 2007 - July 2008); 20.500±7.891 (August 2008 - July 2009). This was followed by *Eiseniella tetrahidra* 17.917±9.179 (August 2007 - July 2008); 17.417±7.476, (August 2008 - July 2009) and *Uncinais uncinata* 14.667±6.443 (August 2007 - July 2008), 14.417±5.017 (August 2008 - July 2009). The least was *Tellina nymphalis* 0.583±1.505 (August 2007 - July 2008); 0.333±0.651, (August 2008 - July 2009). There was no significant variation in the mean values of the two years studied 5.900±0.4168 (August 2007 - July 2008). 5.717±0.3704 (August 2008 - July 2009).

Table 2 shows that seasonal variations occurred in the abundance of *Dero sp.*(11.00±5.20 wet, 17.71±3.72 dry), *Stylera lacustris* (11.82±5.15 wet, 18.50±10.57 dry) and *Eiseniella tetrahidra* (18.76±9.16 wet, 15.00±4.69 dry). The other species did not show significant variation. However, there was significant variation between the mean of the wet season and that of the dry season 5.32±0.30 wet and 6.99±0.58, respectively.

DISCUSSION

The distribution pattern of the study area macro-invertebrates showed a striking longitudinal zonation between the freshwater stations of Ogbele, Ihuaba and Odiemudie and the brackish water station of Degema. Many species of the macro-invertebrates did not extend into the freshwater stations. Longitudinal changes in available habitats in rivers have been seen as influences in species composition and community structure (Friberg *et al.*, 1977; Minshall *et al*., 1985; Statzner and Higler, 1986). In this study, all the Oligochaetes and *Chironomus* sp. (Insecta) were common in the freshwater stations of Ogbele, Ihuaba and Odiemudie and were evenly distributed while all the Polychaetes, Molluscs and Crustacea were common in the brackish water station of Degema. The observed faunal discontinuities is similar to the report of Lopez (1988) that the faunas of marine and freshwater sediments are similar at the level of phyla, both being characteristically dominated by annelids, arthropods and Molluscs. Each Phylum is represented by different classes in marine and lacustrine habitats. This trend was observed in Sombreiro River.

The occurrence of Oligochaetes and *Chironomus* sp. in the freshwater stations is normal as Statzner and Higler (1986) had reported that *Chironomids* and Oligochaetes dominate freshwater muds. Bailey (1978) had earlier reported that Oligochaetes and leeches are common in Penbrokeshire River and widespread in British freshwaters Similarly, the occurrence of all the Polychaetes in the brackish water station in also normal as Lopez (1988) had reported that Polychaetes are very diverse and are often the single most important group in marine mud flats. This is further affirmed by the report of Bailey (1978) that Polychaetes replace Oligochaetes in the estuary. Further more, Eretemeijer and Swennen, (1990) reported that benthic macro-fauna consisted of only Polychaetes in the Serewean estuary (Indonesia). The presence of the arthropod crustacean - *Gammarus lacustra* and *Peneus notialis* in station one is not unusual because it is the only brackish water station. Bailey (1978) reported that the group crustacean was more diverse and numerous in the estuary and the group *Gammarus* has brackish and freshwater species. Molluses also occurred only in station one. This compares favourably with the reports of Nwadiaro (1987) and Umeozor (1995) that the distribution of Molluscs in the lower Niger Delta was limited to the neutral/slightly alkaline brackish water zone.

The occurrence of the bivalves *Tellina nymphalis*, *Loripes* sp. and *Tegalus andersoni* in station agrees with the report of Lopez (1988) that marine bivalves are highly diverse and often the dominant members of marine muds. The distribution patterns of the benthos are attributed salinity, water quality and local environmental conditions. Ramane and Schlieper (1971) had reported that salinity is the major environmental factor restricting the distribution of marine and lacustrine taxa resulting in the poverty of species in brackish and freshwater. 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). There is the need for further research into the benthic community of Sombreiro River because of the importance of water quality. Miserendiro (2001) had earlier reported that the structure of macro-invertebrates has been the subject of much research in river systems. The potential benefits of 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). This is especially true in the Niger Delta were pollution is an annual occurrence in the rivers and creeks.

There was no significant variation in the mean values of macro-invertebrates for the two years of study. This may be due to substrate stability, good water quality and availability of micro-habitat in the study area. Seasonal variations occurred in the abundance of *Dero* sp., *Styleria lacustris* and *Eiseniella tetrahida.* The other species did not show seasonal variation. The non seasonality of macro-invertebrate composition and abundance of some species in this study is in agreement with the report of George *et al*. (2010) from Okpoka Creek, Niger Delta.

Significant seasonal variation occurred between the mean values of wet season and the dry season. The dry season had higher value than the wet season. This agrees with the reported studies of (Umeozor, 1995; Hart and Zabbey, 2005) in the Niger Delta and Nkwoji *et al.* (2010) in the Lagos Lagoon who reported higher dry season values than the wet season. The higher dry season value of mean macro-invertebrate abundance of this study is also in agreen with the reported values of other water bodies in Africa and West Antartic Pennisula (Mathooko and Mavati, 1992 (Kenya); Sumida *et al*., 2010 (Uganda); Tumwesigye *et al*., 2000 (West Antartic Pennisula). Differences in local environmental conditions may be responsible for the variations. There is a theoretical and empirical support from stream ecology studies for a strong relationship between environmental variation (environmental gradients) and macro-invertebrate community composition (Faith and Norris, 1989).

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 favourably with Nkwoji *et al*. (2010) who reported low values for Margalef's species richness and Shannon - Wienner diversity Index.

The Pearson product correlation matrix between benthos abundance and sediment physico-chemical parameters showed a negative correlation between conductivity and benthos abundance and a positive correlation between benthos abundance and organic carbon. No significant correlation existed between benthos abundance and pH, nitrate, phosphate, sulphate, total hydrocarbon content. There was also no significant correlation between benthos and sand, silt and clay in the sediment. Mclachlan and Mclachlan (1971) have correlated sediment physico-chemical parameters and the result obtained in this study is similar to their findings. The positive correlation between benthos and organic carbon obtained in this study agrees with the work of Mclachlan and Mclachlan (1971) who reported a positive correlation between winter faunal biomass and organic carbon in Lake Kariba. Similarly, the Pearson correlation matrix between benthos abundance and water physico-chemical parameters showed a positive correlation between biochemical oxygen demand and benthos abundance while a negative correlation existed between salinity, conductivity and benthos abundance. There was no significant correlation between benthos abundance and temperature, pH and dissolved oxygen. Some scientists such as Ajao and Fagade (1991), Matagi (1996) and Ogbogu (2001) have reported similar relationship in the correlation between physico-chemical parameters and the distribution of organisms.

CONCLUSION

- The distribution pattern of the study area macro-invertebrates showed a striking longitudinal zonation.
- There was no significant variation in the mean values of macro-invertebrates for the two years of study.

- Significant seasonal variation occurred between the mean values of wet season and the dry season. The dry season had higher value than the wet season.

ACKNOWLEDGMENT

We are grateful to University of Port Harcourt for the opportunity to carry out the research. We are also very grateful to Justice I.W. Obuzor, Engr. Ochieze Otto and Chukwu Gospel for their financial support. However To GOD be the Glory.

REFERENCES

Adebisi, A.A., 1989. Planktonic and benthic organisms in some ponds on the olupona fish farms, Olupona, Oyo State, Nigeria. A Report Prepared for Agro Team S. R. I. Ibadan, Nigeria, pp: 64.

Ajao, E.O., 1990. The influence of domestic and industrial effluents on population of sessile and benthic organisms in Lagos Lagoon. Ph.D. Thesis, University of Ibadan, pp: 411.

Ajao, F.A. and S.O. Fagade, 1991. A study of sediment communities in Lagos Lagoon, Nigeria. J. Oil Chem. Pollut., 7: 85-105.

Greenberg, A.E., L.S. Clesceri and A.D. Eaton, 1998. Standard Methods for the Examination of Water and Waste Water. 18th Edn., America Public Health Association, American Water Works Association, Water Environment Federation.

Barnes, R.D. and S. Hughes, 1988. An Introduction to Marine Ecology. 2nd Edn., Blackwell Scientific Publications, UK., pp: 351.

Bailey, R.G., 1978. A field course investigation of a Pembrokeshire River. J. Biol. Educ., 12(2): 67-81.

Eretemeijer, P. and C. Swennen, 1990. Densities and biomass of marcobenthic fauna of some intertidal areas in Java, Indonesia. Wallaceana, pp: 59-60.

Ezekiel, E.N., 1986. Longitudinal zonation of ichthyofauna of the River Sombreiro, Rivers State. B.Sc. Project Rivers State University of Science and Technology, Port Harcourt, pp: 74.

Ezekiel, E.N., 2001. Comparative studies of the flood plains and major rivers in Odiokwu-Ekpeye, Niger Delta. M.Sc. Thesis, University of Port Harcourt. Choba, pp: 77.

Ezekiel, E.N., J.F.N. Abowei and A.I. Hart, 2002. The fish species assemblage of Odiokwu-ekpeye flood plains, Niger Delta. Int. J. Sci. Tech., 1(1): 54-59.

Faith, D.P. and R.H. Norries, 1989. Correlation environmental variables with patterns of distribution and abundance of common and rare freshwater macro-invertebrates. Biol. Conserv., 50: 17-98

Friberg, F.L., M. Nilsson, C. Otto, P. Sjostromn, B.W. Svensson, B. Svensson and S. Ulfstrand, 1977. Diversity and environments of benthic invertebrate communities in South Swedish streams. Arch. Far. Hydrol., 81: 129-154.

Gallep, G.W., J.F. Kitchell and S.M. Bartell, 1978. Phosphorous release from Lake Sediments as affected by chironomid. Ver. Inter. Vere Limnol., 20: 458-465.

George, A.D.I., J.F.N. Abowei and M.E. Allison, 2010. The sediment characteristics of Okpoka Creek, Niger Delta, Nigeria. Asian J. Agric. Sci., 2(1): 9-14.

Hart, A.I. and N. Zabbey, 2005. Physico-chemical and benthic fauna of Woji Creek in the Lower Niger Delta, Nigeria. Environ. Ecol., 23(2): 361-368.

Haslam, S.M., 1990. River Pollution - An Ecological Perspective. Belhaven Press, London, pp: 253.

Idowu, E.O. and A.A.A. Ugwumba, 2005. Physical, chemical and faunal characteristics of a Southern Nigeria Reservoir. The Zoologist, 3: 15-25.

Ikomi, R.B., F.O. Arimoro and O.K. Odihirin, 2005. Composition, Distribution and abundance of macroinvertebrates of the upper reaches of River Ethiope, Delta State, Nigeria. The Zoologist, 3: 68-81.

Imevbore, A.M.A., 1967. Hydrology and plankton eleleye reservoir, Ibadan, Nigeria. Hyrdobiologia, 30: 154-174.

Imevbore, A.M.A. and O. Bakare, 1970. The food and feeding habits of non-cichlid fishesof the River Niger in the Kainji Reservoir Area in Kainji - A Nigerian Man-Made Lake. Kainji Lake Studies, Ecology, 7: 87-98.

Lopez, R.G., 1988. Comparative ecology of the macrofauna of freshwater and marine muds. Limnol. Oceanogr., 33(No.4 Part 2): 946-962.

Matagi, S.V., 1996. The effect of pollution on benthic macro-invertebrates in a Ugandan stream. Arch. Hydrobiol., 137(4): 537-549.

Mathooko, J.M. and K.M. Mavati, 1992. Composition and seasonality of benthic invertebrates and drift in the Naro Moru River, Kenya. Hydrobiologia, 232(1): 47-56.

Mclachlan, A.J. and S.M. Mclachlan, 1971. Benthic fauna and sediments in the newly created Lake Kariba (Central Africa). Ecology, 52: 800-809.

Minshall, G.W., K.W. Cummins, R.C. Peterssen, C.E. Cushing, D.A. Bruns, J.R. Sedell and R.L. Vanote, 1985. Developments in stream ecosystem theory. Dynam. Ecol. Monogr., 53: 1-25.

Miserendiro, M.L., 2001. Macro-invertebrate assemblages in Andean Pentagonian Rivers and streams: Environmental relationships. Hydrobiologia, 444: 14-158.

Moses, B.S., 1987. The influence of flood regime on fish catch and fish communities of the cross river flood plain ecosystem, Nigeria. En. Bio. Fishes, 18: 51-85.

Nelson, S.M. and D.M. Lieberman, 2002. The influence of flow and other environmental factors on benthic invertebrates in the Sacrament River, U.S.A. Hydrobiologia, 489: 117-129.

Nkwoji, J.A., A. Yakub, G.F. Ajani, K.J. Balogun, K.O. Renner, J.K. Igbo, A.A. Ariyo and B.O. Bello, 2010. Seasonal variations in water chemistry and benthic macroinvertebrates of a South Western Lagoon, Lagos, Nigeria. J. Am. Sci., 6(3): 85-92.

Nwadiaro, C.S., 1987. The longitudinal distribution of macroinvertebrates and fish in the Lower Niger Delta River (Sombreiro River) in Nigeria. J. Aquat. Sci., 7(1): 18-25.

Odiete, W.O., 1999. Environmental Physiology of Animals and Pollution. Diversified Resources Lagos, Nigeria.

Ogbogu, S.S., 2001. Assessment of water quality and macro-invertebrates abundance in Opa-Stream reservoir system, Ile-Ife. Global J. Pure Appl. Sci., 17(3): 517-521.

Oke, O.O., 1990. Limnology and macrobethos of owena Reservoir. M. Phil. Thesis, University of Ibadan, Ibadan, Nigeria.

Ormerod, S.J. and R.W. Edwards, 1987. The ordination and classification of macro-invertebrate assemblages in the catchment of rivers wye in relation to environmental factors. Freshw. Biol., 17: 533-546.

Ramane, A. and C. Schlieper, 1971. Biology of Brackish Water. Willey, pp: 211.

Ravera, O., 1998. Utility and limits of biological and chemical monitoring of the aquatic environment. Annali Dichimica, 88: 909-913.

Ravera, O., 2000. Ecological monitoring for water body management. Proceedings of Monitoring Tailor-Made III. International Workshop on Information for Sustainable Water Management, pp: 157-167.

Statzner, B. and B. Higler, 1985. Questions and comments on the river continum concept. Can. J. Fish. Aquat. Sci., 42: 1038-1044.

Statzner, B. and B. Higler, 1986. Stream hydraulics as a major determinant of benthic invertebrate zonation patterns. Freshw. Biol., 16: 127-139.

Statzner, B., J.A. Gore and V.H. Resh, 1988. Hydraulic stream ecology: Oberved patterns and potential applications. JN Am. Benthol. Soc., 7: 307-60.

Sumida, P.Y.G., A.F. Bemarchino, V.P. Stedall, A.G. Glover and C.R. Smith, 2010. Temporal Changes in Benthic Megafaunal Abundance Across the West Antarctic Pennisula Shelf: Results from Video Surveys Modified September, pp: 1.

Towns, D.R., 1979. Composition and zonation of benthic invertebrates in a New Zealand Kauri Forest Streams: Environmental relationships. Hydrobiologia, 444: 14-158.

Tumwesigye, C., S.K. Yusuf and B. Makanga, 2000. Structure and Composition of Benthic Marco-invertebrate of a Tropical Forest Stream. River Nyanweru, Western Uganda. Afr. J. Ecol., 38(1): 72-77.

Umeozor, O.C., 1995. Benthic fauna of New Calabar River, Nigeria. Trop. Fresh. W. Biol., 4: 41-51.

Vannote, R.L., G.W. Minshall, K.W. Cummins, J.R. Sedell and C.E. Cushing, 1980. The river continum concept. Can. J. Fish. Aquat. Sci., 37: 130-137.

Vinson, M.R., 2001. Long-term dynamics of an invertebrate assemblage downstream from a large dam. Ecol. Appl., 11(3): 711-730.