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A STUDY OF THE PLANKTON AND BENTHOS OF EKOLE RIVER IN BAYELSA STATE, NIGERIA

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ABSTRACT

A study was undertaken to determine the plankton and benthos of Ekole River in Bayelsa State of Nigeria. Surface water and sediment samples were collected in the dry (December-January) and wet (June –July) seasons between 2003 and 2004 for plankton and benthic analyses. The water temperature ranged from 27-33°C, pH 6.30-7.5, total suspended solids (T.S.S) 110-282 mg/L, Chloride 15.40-39.6 mg/l, dissolved oxygen 4.11-10.83 mg/l and conductivity 64.5-84.55µS/cm. The total plankton count ranged between 267 x 10^3 and 11830 X 10^3 / L. Forty three and forty seven species of phytoplankton belonging to five families were identified in the dry and rainy seasons respectively. The mean zooplankton population ranged from 1954 x 10 / L in the dry to 3479 x 10 / L in the wet season while the benthic organisms ranged from 113 x 10 / L to 152 x 10 /L in the rainy and dry seasons respectively. *Bacillariophyceae* dominated the phytoplankton while the rotifers dominated the zooplankton species. Some biological indicators of pollution: larval forms of *Chironomids* ,*Odonatans* and *Ephemenopterans* were also identified in the river.

Keywords: Plankton, Benthos, Ekole River, Pollution indicators

INTRODUCTION

Increasing population, urbanization and industrialization have promoted pressures on water leading to declining benefits (Clarke, 1994). An ecosystem with a healthy biological community reflects the conditions of the watershed around it. Aquatic ecosystems are sensitive to fluctuations of physical characteristics like temperature and turbidity. These fluctuations could be amplified by human activities like deforestation, thermal discharge from industrial plants which in turn affect spawning grounds, physiological processes of aquatic organisms and the disruption of important biological communities (Ajao, 1991).

Water houses living organisms which are critical to the functioning of aquatic systems but are disturbed by pollution. The trends of such disturbances are not fully documented and this necessitates detailed scientific studies and monitoring. This work is aimed at studying the plankton and benthos of Ekole River in Bayelsa State of Nigeria which currently hosts many human activities such as oil industry activities and sewage dumping.

MATERIALS AND METHODS

The Nun River system is a bifurcation of

River Niger after Aboh with Forcados River flowing westwards through Delta State and Nun southwards through Bayelsa State into Atlantic Ocean. Ekole River flows from the Nun River down to Brass River also in Bayelsa State. The soil is sandy loam with silt and has low permeability. The study location was on Ekole River near Obama Flow Station in Bayelsa State.

Duplicate samples of water and sediments were taken at nine sites: 0, 100, 200, 400 and 500 m upstream and 100, 200, 300and 400 m downstream of an oil flow station. Water and sediment samples for microbiological studies were collected in 10ml sterilized plastic bottles and tubes respectively in dry (December-January) and rainy seasons (June –July) 2003-2004. Biological samples were sieved with 1 mm mesh sieve to sort out macro invertebrates, dyed with Rose Bengal solution and preserved in 40% formalin solution for analysis.

Plankton was collected by dragging plankton net alongside the boat for 10 minutes, with the ringed rim of the net tipped just a little above the water. It was lifted out and rinsed into the collecting bottle and sealed .The species diversity was determined based on the diversity index (WQMP, 1985):

$$\text{Diversity Index (D)} = \frac{1}{301} \sum_{i=1}^{s} \frac{ni}{N} \log \frac{ni}{N}$$

Where, D =Average diversity
ni =Total number of individuals in a family
N=Total number of organisms
S= No. of families
i = a general term for each family
The percentage species abundance was calculated as:

$$\frac{\text{Number of Individuals per species}}{\text{Total number of organisms}} \times 100$$

An Orion pH / ISE meter (model 1260, a multi-parameter environmental laboratory system) was used for *in- situ* measurements of water quality parameters such as temperature, hydrogen ion concentration (pH), dissolved oxygen (D.O), salinity, total suspended solids (T.S.S) and conductivity each using specific probes (ASTM, 1992; APHA, 1992). The data obtained were subjected to analysis of variance and least significant difference test.

RESULTS

The frequencies of the plankton and benthic organisms are presented on table 1. The water temperature ranged from 27-33° C, pH 6.3-7.5, total suspended solids (TSS) 110-282, chloride 15.4-39.6, Dissolved oxygen 4.11-10.83 and conductivity 64.5-84.5µS/cm, Phytoplankton: *Bacillariophyceae*, 37.35%; *Cyanophyceae*,18.99%; *Chlorophyceae* 19.26 % and *Pyrrophyceae* 17.86%; Zooplankton: Rotifers 41.45 %, Copepods 35.16 %, Brachiopods 23.13 % , Fish eggs, 0.01% and insect eggs 0.003 % . The Percentage abundance and frequencies of the plankton and benthic organisms are presented on Tables 1 to 4.

Table 1: Abundance and Distribution of Phytoplankton in Ekole River (Around Obama Oil Flow Station), Bayelsa State, Nigeria

Dry Season	Sampling Stations									
Family	1	2	3	4	5	6	7	8	9	Total
Pyrrophyceae	258	353	388	62	79	72	302	397	212	2113
Cyanophyceae	381	347	395	24	23	40	395	373	387	2365
Bacillariophyceae	642	646	580	92	104	204	606	646	673	4229
Chlorophyceae	322	269	375	64	90	85	347	411	315	2278
Dinophyceae	133	150	125	25	46	66	107	123	70	845
Total No ($x10^3$ / LH_2O)	1736	1765	1863	267	378	467	1757	1950	1657	
Wet Season										
Pyrrophyceae	303	236	207	250	243	372	281	221	273	2386
Cyanophyceae	335	443	551	467	422	334	183	606	366	3707
Bacillariophyceae	958	647	594	496	472	730	514	843	774	6028
Chlorophyceae	451	609	422	410	413	391	475	475	379	3737
Dinophyceae	75	158	134	318	172	57	95	144	134	1287
Total No($x10^3$ / L H_2O)	2122	2093	1905	1941	1722	1884	1548	2001	1926	17,145

Table 2: Abundance of Zooplankton in Ekole River Around Obama Oil Flow Station, Bayelsa State, Nigeria

Dry Season	Sampling Stations									Total
	1	2	3	4	5	6	7	8	9	
Rotifers	142	125	82	45	45	42	118	109	102	810
Brachiopods	36	67	90	32	4	62	45	62	54	452
Copepods	84	80	104	64	44	36	91	112	72	687
Insects	1	0	4	0	1	0	0	5	1	13
Fish eggs	1	1	0	0	0	1	1	0	0	4
Total No (x10/LH2O)	264	273	290	144	94	141	255	288	229	1966
Wet Season										
Rotifers	186	176	134	174	166	190	176	170	162	1533
Brachiopods	49	88	117	107	75	117	70	84	97	801
Copepods	111	102	140	98	128	81	140	141	131	1072
Insects	2	3	3	2	6	5	0	3	5	29
Fish eggs	5	8	7	3	5	8	3	2	3	44
Total No of organisms (x 10/L H_2O)	353	376	398	384	380	401	389	400	398	3479

Table 3 : Benthic Community in Sediment in Ekole River around Obama Oil Flow Station, Bayelsa State , Nigeria

Dry Season	Sampling Stations									Total
	1	2	3	4	5	6	7	8	9	
Annelid										
Hirudo sp	1	2	1	2	3	0	0	2	2	13
Lumbricus sp	3	1	3	1	0	0	3	4	5	20
Sub total	4	3	4	3	3	0	3	6	7	33
Insect										
Chironomid larvae	2	3	3	5	9	11	0	2	3	38
Ephemenop-teran larvae	0	1	2	0	2	0	1	7	2	15
Odonata larvae	3	4	3	2	1	1	3	2	3	22
Sub Total	5	8	8	7	12	12	4	11	8	75
Pisces										
Fish/Fish larvae	2	1	0	0	0	0	0	1	1	5
Wet Season										
Annelid										
Hirudo sp	2	6	1	4	1	0	1	2	4	21
Lumbricus sp	4	2	2	2	2	1	4	3	2	22
Sub total	6	8	3	6	3	1	5	5	6	43
Insect										
Chironomid larvae	6	5	8	8	5	8	2	5	7	54
Ephemenoptera larvae	2	3	3	2	1	2	3	3	8	27
Odonata Larvae	2	2	2	1	1	3	2	1	1	15
Sub total	10	10	13	11	7	13	7	9	16	96
Pisces										
Total No. of										

DISCUSSION

A study was undertaken of the plankton and benthos of Ekole River in Bayelsa State of Nigeria .The variations in temperature, pH and D.O. were similar to those reported by Dublin-Green (1994) for Bonny River Estuary. In the dry season the total plankton count varied between 267 x 10^3 and 1950 x 10^3/ L of water and forty

Table 4: Frequencies of Phytoplankton, Zooplankton and Benthic Organisms In Ekole River, Bayelsa State, Nigeria

Sampling Stations	Seasons	Frequency of Phytoplankton	Frequency of zooplankton	Frequency of Benthic organisms
1	Dry	347.2	52.8	3.67
	Wet	424.4	70.6	6.67
2	Dry	353.0	54.6	4.00
	Wet	418.6	75.2	6.67
3	Dry	276.6	56.0	4.00
	Wet	381.6	80.2	6.00
4	Dry	53.4	28.2	3.33
	wet	388.2	76.8	6.33
5	Dry	75.6	18.8	5.00
	wet	344.4	76.8	4.00
6	Dry	93.4	28.2	4.00
	Wet	376.8	76.8	4.67
7	Dry	351.4	51.0	2.33
	wet	309.6	77.0	4.33
8	Dry	388.0	57.6	6.00
	wet	400.4	80.0	4.67
9	Dry	331.4	70.6	5.33
	Wet	385.2	76.0	7.33

Table 5: Distribution of Organisms by Species in Ekole River , Bayelsa State, Nigeria

Phytoplankton	No .of species	Zooplankton	No. of species	Benthos	No. of species
Dry Season					
Pyrrophyceae	8	Rotifer	8	Annelids	2
Cyanophyceae	7	Brachiopod	3	Insect larvae	3
Baccillariophyceae	18	Copepods	4		
Chlorophyceae	7				
Dinophyceae	3				
Total No. of species	43		15		5
Wet Season					
Pyrrophyceae	8	Rotifer	7	Annelids	2
Cyanophyceae	9	Brachiopod	3	Insect larvae	3
Baccillariophyceae	17	Copepod	4		
Chlorophyceae	10				
Dinophyceae	3				
Total No. of species	47		14		5

three species of phytoplankton belonging to five families were identified with *Bacillariophyceae* being dominant (18 species). Others were *Pyrophyceae* (8species), *Cyanophyceae* (7) ,*Chlorophyceae*(7) and *Dinophyceae* (3). The dominance pattern of phytoplankton was:
Bacillariophceae> Cyanophyceae> Chlorophyceae>Pyrrophyceae (Table 5).
These observations were similar to an earlier study (Courant *et al.,* 1985). The stations with lowered phytoplankton diversities were very close to the oil flow station. There were significant differences ($p<0.05$) in the spatial and percentage abundances of phytoplankton in the dry and wet seasons. In the rainy season, 47 species of phytoplankton were recorded. The total phytoplankton count varied between 1548 x 10^3 and 2122 x 10^3 with *Bacillariophyceae* also dominating.

The species composition and relative abundance of the zooplankton in Ekole River (near Obama Flow station) showed that the number of organisms varied between 94 x 10 - 290 x 10 per litre in the dry season and 353 x 10- 401 x 10 per litre of water in the rainy season. The zooplankton species included Rotifers, Annelids, Copepods, larval forms of insects, and fish fry. Significant differences ($p<0.05$) were reported among the zooplankton populations at different stations. The diversity of zooplankton did not vary much with season. The zooplankton showed less species diversity and abundance than the phytoplankton. This may be related to their differences in trophic levels as primary producers and consumers respectively (Delince, 1992).

113 x 10 /L organisms were obtained from the sediment samples in the dry season. 28.8% were Annelids (*Lumbricus* and *Hirudo*). The remaining were larval forms of insects: *Chironomids,Odonatans* and *Ephemenopterans* which are biological indicators of pollution (Odiete, 1999). Fish fry contributed 4.4 % of the benthic fauna. The mean number of benthic organisms varied between 7 and 18 organisms per litre of sediment. Similar work on the sediments of the Gulf of Guinea showed a more diverse benthic community (63 species) but less(17) species of phytoplankton (Adegbie and Dublin-Green, 1998).In the wet season 152 x 10 / L organisms were identified in the benthos, 28.3 % were Annelids (*Lumbricus* and *Hirudo*), 64.4% larval forms of insects (*Chironomids, Odonatans, Ephemenopterans*). Fish eggs made up 4.4% of the benthic fauna.

CONCLUSION AND RECOMMENDATIONS

This study of the plankton and benthos of Ekole River in Bayelsa state showed less diverse plankton and benthos than an earlier study in the Gulf of Guinea (Dublin – Green and Adegbie, 1998).This could have been due to anthropogenic activities both on land and water which affected water quality. The presence of larval forms of insects like *Chironmid, Odonatan,*and *Ehpemenopteran* (biological indicators of pollution) showed that pollution could be responsible for the low diversity of plankton and benthos .The presence of increased nutrient through runoff during the rainy season may be responsible for the more diverse plankton community in the rainy season and this implies increase in primary productivity in the rainy season.

This study emphasizes the need for regular

impact assessment and monitoring of human activities. There should also be an integrated approach to the maintenance of water quality through education such as environmental literacy and responsibility especially with regards to waste disposal, oil pipeline destruction and safe oil industry activities**.** It is important to involve all stakeholders in an area in environmental decision – making and control. Governments at all levels should adopt bottom-up approaches in seeking solutions to environmental degradation as local people tend to have some traditional knowledge which could aid in providing solutions to such problems.

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