GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL. 13 NO. 3 2007 : 353 - 357
 ISSN 1118 - 0579

COMPOSITION AND ABUNDANCE OF BENTHIC MACRO-INVERTEBRATES OF NTA-WOGBA STREAM, PORT HARCOURT NIGERIA

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(Received 8 February, 2006; Revision Accepted 13 October, 2006)

ABSTRACT

Benthic macroinvertebrates survey was undertaken between July 2002, and April 2003, to assess the impact of salinity, Biochemical Oxygen Demand (BOD_5) and chemical Oxygen Demand (COD) on the composition and distribution of benthic aquatic organisms along Nta-Wogba Stream, Port Harcourt. Fourteen taxa representing 12 families were recorded. The most abundant groups were gastropoda and insecta which accounted for 28.5% each for 4 of the 14 taxa recorded. Oligochaeta, Hirudinea and Crustacea has 14.3% respectively and this accounted for 3 taxa each. There was a variation in the density of macroinvertebrates from station 1 to 5, the highest density was in station 2 (196) and followed in decreasing order in subsequent stations, station 1 (162) station 3 (148), station 4(65) and station 5 (2) *Tubificid* sp was highest in station 1 (89) which decreased progressively in subsequent stations, station 2 (70), station 3 (47), station 4 (29) and station 5 (1). This amounted to a mean density of 47.2 per m^2 while *chrironomid* larvae was 32.8 per m^2 and with a mean density of $0.8m^2$. These are pollution indicator species. The results indicated that macroinvertebrates are heterogenous and pollution from municipal discharges eliminated the sensitive species while the tolerant species such as chironomid become predominant. The deterioration in water quality is evident by high BOD ($10.4mgL^{-1}$) and COD ($45mgL^{-1}$) values observed..

INTRODUCTION

The impacts of human activities near the shore and estuaries as well as the river, are strongly affecting the breeding, spawning and particularly the distribution of bottom invertebrates, which inhabit these water bodies.

The distribution of macro and meio-fauna are determined by a number of factors, since discharges resulting from the activities of man into the water body reduces transparency and light penetration which have adverse effect on the existence of benthos community (Odiete, 1999). Studies on waste discharges emanating from industrial and urban centers due to the activities of man within the Nta-Wogba swampy forest stream, have been carried out to determine the extent and magnitude of municipal discharges. However no such studies have been attempted on the benthic macro-invertebrate community of Nta-Wogba swampy forest stream and little is known about the macrofauna of the system. Recently, Reice (1980), reported an interim result from a four year study of benthic assemblages in the lower and upper portion of the estuary that focussed on potential impacts of dredged materials. Parker and Voshell (1983), reported that the observed patterns in benthic assemblages were primarily attributable to the prevailing salinity regime, and secondarily influenced by substrate type. In general, the benthic infauna were described as opportunistic species adapted to a dynamic salinity regime and variable physical conditions typical of the shallow Gulf of Mexico estuaries (Sanders, 1968, Day, 1974). Benthic species composition, abundance, biomass and distribution patterns are to a large extent determined by a mixture of interacting variable physio-chemical parameters like dissolved oxygen concentration (Young, *et al*, 1976), bio-chemical oxygen demand (Umeozor, 1966), salinity (Jones, 1987). These have been reported to cause decrease in diversity and abundance of zoobenthic community. This paper examines the composition and distribution of Benthos in Nta-wogba stream by sampling the main stream. The study is also aimed at assessing the impact of biochemical oxygen demand BOD_5) and chemical oxygen demand (COD) on the distribution of benthic organisms along the river.

STUDY AREA

The Nta-wogba stream is situated approximately between latitudes 4^0 or $3o^1$ to 4^0 38'N and longitudes 7^0 12' to 9^0 16'E. It comprises an areas that supplies sediments to the main channel. Its headwaters is located at the thick forest of Oha-mini. The river flows through several roads including, Orazi, Rumeme and Port Harcourt city to Sani Abacha, down to Olu-Obasanjo and empties into the Bonny estuary (Fig. 1).

Station 1 is marked by decaying palms of rainforest causing turbidity of water body. Station 2 has decaying raffia palms and cement factory, and covered by oil grease. Station 3 has a car-washing outfit, grease, oil petrol and detergents which are introduced into the water body thus altering its biological state. Station 4 is similar to station 3 but in addition is surrounded by motor-parts dealers. Station 5 is used as a refuse dump and has decaying vegetation.

Fig. 1 Showing mean density of Benthic macro invertebrates in the sample Area

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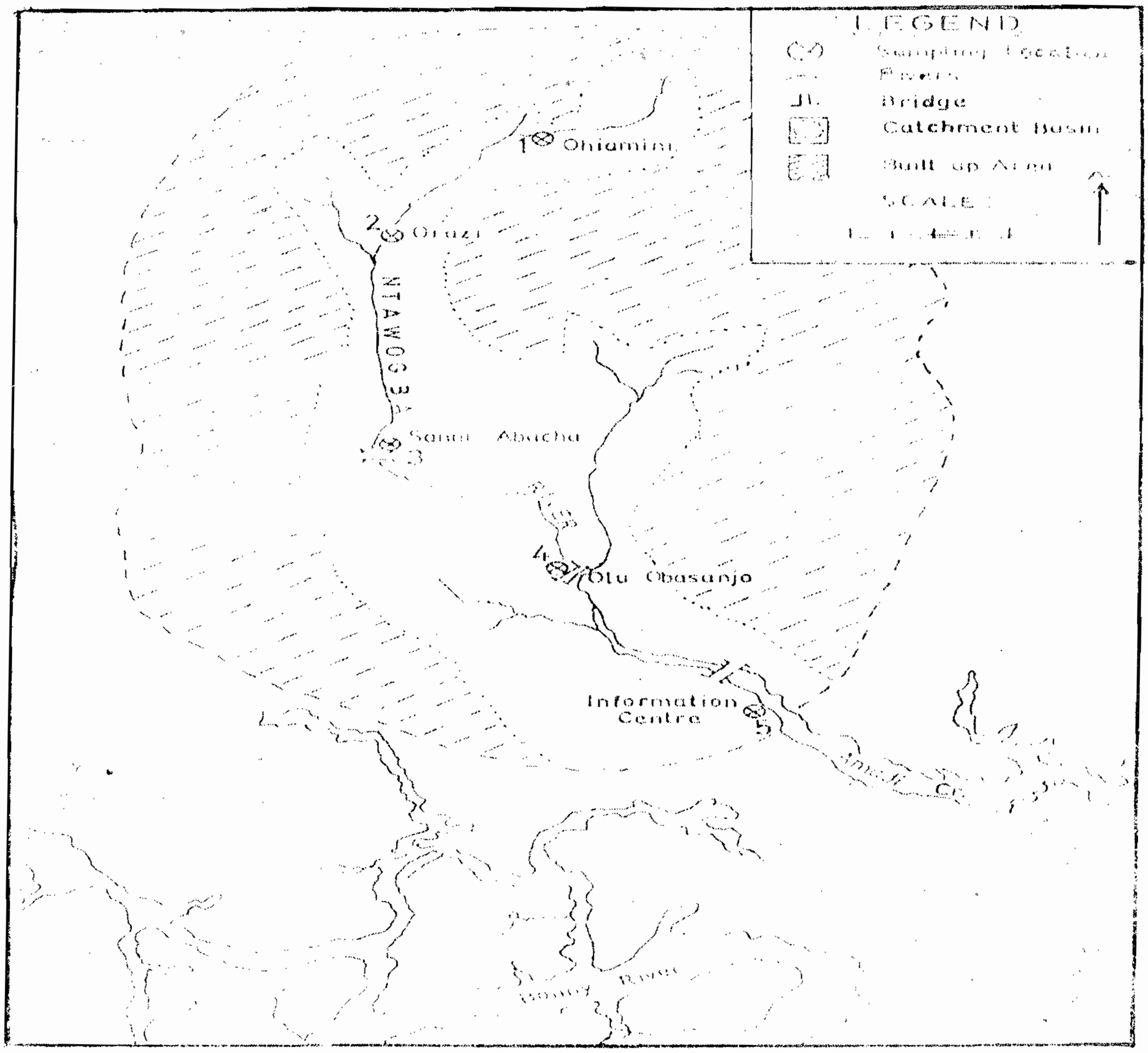

Fig. 1: Sampling Locations on Ntawogba River, Port-Harcourt.

MATERIALS AND METHODS

Three replicate samples of benthic organisms (making up composite sample) were collected at 25days intervals for 12 months between July 2002 and June 2003, from Nta-wogba stream. Five equidistant stations were selected along the stretch of the river for sample collection. For an assessment of water quality and the distribution of macroinvertebrates. (Fig. 1). The subtidal benthic samples were collected with an Ekman's grab measuring 225cm^3 (southwood, 1966). Samples from each station were washed using 0.5mm mesh screen. The residues in the sieve were then emptied into a wide mouth labeled plastic container and preserved in 10% formalin to which the vital stain, rose-bengal had been added. The dye at strength of 0.1% selectively coloured all living materials in the sample (Claudiu *et al* 1979). The preserved samples were transported to the laboratory for subsequent analysis.

Benthic invertebrates were sorted out by transferring successive quantities of preserved residue into a white plastic tray. Moderate volume of water (50-100ml) was added to improve visibility. Large benthic organisms were picked with forceps while smaller ones were pipetted out. All the sorted macroinvertebrates were then preserved in 10% formalin for further identification and counting. Benthic macro invertebrates were identified to their lowest possible taxonomic level under light and stero-dissecting microscopes using the keys of Day (1967), Mellanby (1975), Merit and Cumins (1984) and Hart (1994). The number of each identified species or taxon was counted and recorded.

In addition, two variables, biochemical oxygen demand (BOD_5) and chemical oxygen Demand (COD) were measured for each sample site per sampling period to assess the impact of these factors on benthic macro invertebrates distribution along the river. These two variables were chosen to determine the water quality and pollution effects especially from petroleum products. Water samples for the determination of BOD_5 and COD were collected from each sample site during hightides. The Argentometric method was used to measure chloride (APHA, 1985). The Azide modification method was used to determine the initial and final dissolved oxygen (DO) (APHA, 1985). BOD_5 was computed from the difference between initial and final DO, while COD determination is a measure of the oxygen equivalent of that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant.

RESULTS

A total of 14 taxa of benthic macro-invertebrates representing 12 families were recorded from Nta-wogba stream. Out of this number, 162 taxa from station 1 (Ohamini) 196 from station 2, (Orazi), 148 from station 3, (Sani Abacha), 65 from station 4, (Olu Obasanjo) and 2 from station 5 (Information center) Table 1. Two of the taxa were restricted to station 5, such as *Tubificid* sp and *Anopheline Larvae*. The significance of these results is suggestive of pollution of the stream (Table 1). Since station 4 and 5 were grossly polluted by petroleum products and refuse dumps as to inhibit all sensitive organisms with the exception of *tubificid* and *chironomos* larvae. This account for low species in these station.

Also, the predominant species was *tubidicid* sp under the class oligochaeta which has the highest mean density of 47.2m^2 as shown in (Table 1). The species was present in all the stations except station 5, where it was very few due to the polluted nature of the water body which degrades drastically the biological state of the water, eliminating a greater part of the organisms and the environment by changing both the water quality structure and composition (Mellanby, 1975). The lowest value recorded in this result, was *Afrogyrus* sp, which has the mean density of 0.8m^{-2} (Table 1).

Table 1: Mean Density (m^2) of organisms in the various sampling site/stations, in Nta-wogba stream, Port Harcourt

Species	Sample of site					
	1	2	3	4	5	
	Ohamini	Orazi	Sani Abacha	Olu-Obasanjo	Information center	**Mean (m^2)**
Tubificid sp	89	70	47	29	1	47.2
Libyodrilus sp	3	4	7	1	-	3.0
Hirudo medicinalis	4	5	5	2	-	3.2
Limnobdella australis	2	3	1	-		1.2
Lymnea natalensis	16	14	17	4	-	10.2
Pila ovata	7	12	13	2	-	6.8
Agrogyrus sp	1	1	2	-	-	0.8
Bulinus forskalii	1	2	2	1	1	1.4
Desmocaris trispinosa	-	2	3	2	-	1.4
Caridina sp	1	-	4	-	-	1.0
Chironomus larvae	38	74	37	15	-	32.8
Anopheline larvae	-	2	1	4	1	1.6
Culicine larvae	2	1	2	1	1	1.4
Ranatra sp	-	7	5	1	-	2.6
TOTAL	162	196	148	65	2	

Table 2: Percentage composition of families and species in each class of Benthic invertebrates collected.

Class	Total no of families	Total of species	Percentage species composition
Oligochacta	2	2	14.3
Hirudinea	1	2	14.3
Gastropoda	4	4	28.5
Crustacea	2	2	14.3
Insecta	3	4	28.5
Total	12	14	99.5

(July, 2002 to June, 2003)

The most dominant classes included the Gastropoda and insecta, each of which had the highest number of families (4) with 4 species. Hirudinea had a single family and was represented by two species. Other groups recorded included the Oligochacta, and crustacea made up of two species respectively. The class Gastropoda as well as insecta had the highest percentage composition (28.5%) while oligochaeta, Hirudinea and crustacea had the lowest percentage value of (14.3%) each based on all species composition. (Table 2.)

Class oligochaeta was represented by 2 species from 2 families. The species are *turbificid* and *libyodrilus* which constituted 42.7% of all the organisms. Hirudinea, Gastropoda and Crustacea had the least abundance 1.6%. Station 5 which is (information center) recorded poor number of organisms as compared to station 1 that has a total number of 162, station 2 196 species, staion 3 148 species while station 4 recored 65 species. The occurrence of *chironomous* larvae at station 5, may also be a pollution indicator.

The presence of these pollution indicator species is supported by the significant increase in BOD which ranged from 9.56mgL^{-1} to 10.4mgL^{-1} and COD, which ranged from 33.4 to 45,14mgL^{-1} in station 1-5 (Table 3).

Table 3: The level of BOD and COD on the distribution of macroinvertebrate.

Samples/station	1	2	3	4	5
BOD	9.56	10.2	9.13	9.92	10.4
COD	33.4	33.6	38.19	33.42	45.14

DISCUSSION

Most taxa were recorded from a particular station which underscores the importance of such station while other stations recorded just few species. In terms of number and diversity more *tubicifid* sp were recorded from all the stations compared with station 5 that recorded just a few species, this was due to slow water current. Watting et al. (1974) pointed out that changes in water quality conditions, such as temperature regimes and dissolved oxygen concentration, can cause a decrease in diversity and abundance of zoobenthic communities. He stated further that acute and chronic alterations in fresh water macro-benthic communities can also be caused by toxic pollutants from surface run off, sewage discharge, industrial effluents, and toxic materials such as ammonia, chlorine, heavy metals and phenols, which usually cause a decrease in the number of species and a shift in the species composition. This account for the fact that, the effect of deforestation due to dredging, erosion and habitat destruction could be responsible for the reduction in density of this organisms, since they usually occur in association with sea grasses and sea weeds in which the larvae feed. (Hart, 1994).

Cognetti (1982), observed that certain euryhaline species may be absent in one biotipe and instead be present in another and may occur in large numbers in the most ecologically unpredictable zones.

Southerland (1980), reported that both the qualitative and the quantitative results on this species indicate that organic enrichment, depth and thermal conditions (most likely associated with upwelling) are the most important factors that structure benthic communities along the stream. Hunnan, (1981), stated that availability of larvae for recruitment does not guarantee their settlement but that certain factors such as the phenomenon of larvae choosing, where to settle and settlement being controlled by hydrodynamic processes all come to play. Hence, Vermeiji (1978) categorized species and referred to opportunists as fauna with high reproductive rates, short life span, high dispensability, reduced long term competitive abilities and which occupy ephemeral or disturbed habitats.

The fact that BOD significantly affected the distribution of some Benthic organisms along the river underscores the danger posed by pollution, especially from petroleum products, to aquatic organisms. Laughlim and Neff (1980) observed that larval crabs exposed to phenanthrene (petroleum derived polycyclic aromatic hydrocarbon) showed marked decrease in growth. Odokuma and Okpokwasili (1996), observed that high and low BOD fluctuations between seasons might be attributed to additional organic matter introduced into the river as a consequence of surface run-off and soil erosion caused by increased rainfall during the rainy season. Mclusky (1989) indicated that along with the sediments being carried into estuaries are also particles of organic debris derived from excretion, death and decay of plants and animals.

BOD concentrations in the stream may serve as a measure of organic pollution. For example More and More (1976) classified water pollution whereby water bodies with BOD levels between 1 and 2 mgL^{-1} were considered clean, 3mgL^{-1} fairly clean, 5.0 mgL^{-1} doubtful and 10mgL^{-1} definitely bad and polluted. The results of the present study ranged from 9.56 to 10.4mgL^{-1} indicating gross pollution. It also revealed that majority of species decreased due to high organic waste load experienced in the water bodies (Clark 1986). This present study had a COD of 33.4 to 45.14mgL^{-1} significantly influenced the distribution of the pollution indicator species.

Information gained from this study indicates that the Benthic fauna of Nta-Wogba stream is highly diverse and that, BOD and COD influence their composition and distribution along the river

The widespread problem of identifying the fauna of tropical aquatic systems was experienced in this study. For instance, out of 14 benthic taxa recorded only 5 were identified to species level. This taxonomic problem was more pronounced in some groups such as chironomidiae and Atyidae than in others. However, the study has enhanced our knowledge of benthic organisms in the tropics especially in the lower part of Niger Delta where published information on the study is scanty.

In conclusion, pollution is due warily to petroleum products, organic matter resulting from surface run-off coupled with particulates from erosion and sediments which contribute to high BOD and decrease in water quality. Hence sensitive organisms are eliminated allowing only pollution tolerant species to survive and multiply.

ACKNOWLEDGEMENT

The authors are grateful to Mr. Otufu Pasiya for technical assistance.

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