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# BENTHIC MACRO-INVERTEBRATES OF NTA-WOGBA RIVER, PORT HARCOURT

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## ABSTRACT

An ecological study of benthic macro-invertebrates of Nta-Wogba stream, Port Harcourt, was undertaken monthly for 12 months (July 2002, to June 2003), to assess the composition, seasonal abundance, and distribution of the benthic fauna. The diversity of the benthos was poor, only 14 taxa were recorded. The fauna was dominated by annelids and arthropods (Oligochaeta and Insecta) which in terms of abundance. Constitute 42.7 and 32.7% respectively. The river was slightly acidic (pH 4.5 – 6.5). The students t-test of data showed significantly higher ($P<0.05$) density of organisms during the dry season than the rainy season. The lower density of organisms during the rainy season could be partly attributed to the effect of floods which destabilize the substrate at this time. In all the 12 months, the $\chi^2$ test for goodness-of-fit indicated that the negative binomial distribution model described the distribution pattern. This indicated that the spatial distribution of the benthos was contagious.


KEY WORDS: Composition-distribution-benthic macro-invertebrates, density-

## INTRODUCTION

General studies on benthic organisms colonizing substrate of streams in Port Harcourt are very rare. However, such studies are either confined to macrobenthic invertebrates or to macroinvertebrates in general (Bidwell & Clark, 1977, Nwadiaro, 1984, Victor & Ogeibu, 1991 and Hart 1994).

Also, no studies on the general benthic macroinvertebrates have been conducted previously in Nta Wogba River which is a complex ecological area in the tropical rainforest, providing a gradual transition from fresh water to brackish water. It has a low diversity of aquatic organisms. This study was therefore undertaken to provide some baseline information on the composition of the benthic macroinvertebrates of Nta-Wogba River. The study also provides information on the seasonal abundance and distribution of organisms in the study area.

## STUDY AREA

The catchments area of Nta-Wogba River is situated approximately between latitudes $4^0 32$/to $4^0 38$'N and longitudes $7^0 12$' to $7^0 16$'E. It comprises areas that supply sediments to the main channel. Its headwaters is located at the thick forest of Oha-mini. The river flows through many areas including Orazi, Rumeme, and Port Harcourt city to Sani Abacha, down to Olu-Obasanjo and finally empties into the Bonny estuary.

The influence of different kinds of pollutants along the Creeks are the result of human activities. These d include domestic sewage, industrial wastes, block industry runoffs, automobile discharges and oil effluents which are flushed into the stream. The study area (Nta-wogba) (fig I) is tidal fresh water.

## MATERIALS AND METHODS

Three replicate samples of benthic organisms (making up composite sample) were collected at 25 days interval for 12 months spanning July 2002 to June 2003, from Nta-wogba River. The stations for the collection of benthic macro-invertebrates were chosen; precisely five stations were designated for the collection to facilitate sampling (Fig 1). The subtidal benthic samples were collected with an Eckman's grab measuring $225cm^3$ (Southwood, 1966). Samples from each station were washed using 0.5mm mesh screen. The residue in the sieve was 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 (Claudin *et al* 1979). The preserved samples were transported to the laboratory for subsequent treatment.

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 macro-invertebrates were then preserved in 10% formalin for further identification and counting. Benthic macro-invertebrates were identified to their lowest possible taxanomic level under light and stero-dissecting microscopes using the keys of Day (1967), Mellanby (1975), Merrit and Cumins (1984) and Hart (1994). The number of each identified species or taxon was counted and recorded. Also during each sample period, a benthic water sampler was used to take one sample per section to determine the pH.

Student's t-test was used to determine whether any significant difference existed in the population density between the dry and rainy seasons. This analysis was based on the total number of organisms recorded per month. The monthly data were also subjected to $\chi^2$ test for goodness of fit to a negative binominal distribution. The negative binomial distribution is the most useful mathematical model that can be applied to a wide diversity of contagious distributions (Elliott, 1977). The parameter, K which is an index of aggregation in a population was calculated for each month using maximum likelihood method (Southwood, 1966, Elliott, 1977). All individuals (regardless of species) were considered part of the population in the analysis.

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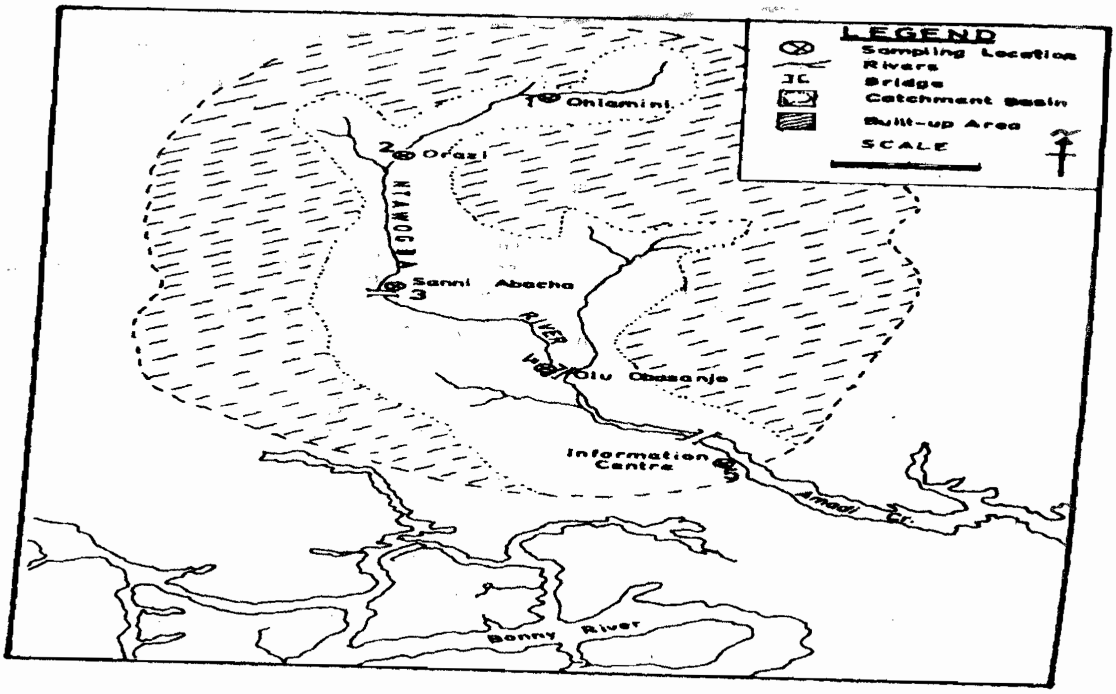


**Fig. 1: Sampling Locations on Ntawogba River, Port-Harcourt.**

## RESULTS

Fourteen taxa of benthic macro-invertebrates were identified. Checklist of the fauna is presented in Table 1. The total number of organisms per month, number of families, monthly station collections and relative species richness are shown in Table 2,3, 4 and 5.

Gastropoda and Insecta were the most dominant classes. The class Gastropoda had the highest number of families (4) with four (4) species while Insecta consisted of 3 families with 4 species. Hirudinea had a single family and was represented by two species. Other groups recorded included the Oligochaeta, made up of two families and two species. Crustacea had 2 families and 2 species. The class Gastropoda and Insecta had the highest equal percentage composition (28.5%) while Oligochaeta, Hirudinea and Crustacea had the lowest percentage value of (14.3%) each based on overall species composition.

The Oligochaeta species of *Tubificid* and *Libyodrilus* which in terms of relative abundance of individual populations accounted for 42.7% of all the organisms. Insecta was the next prominent, constituting 32.7% of overall abundance. The remaining percentage was shared by Hirudinea, Gastropoda and Crustacea. Crustacea had the least abundance 1.6%. The average pH per sample period ranged from 4.5 to 6.5. Based on the total number of organisms recorded per month (table 5) Student's t-test indicated a significantly higher ($P < 0.05$) number of organisms recorded from December to May (dry season) compared with June to November (rainy season).

**Table 1: Benthic macro-invertebrates collected from Ntawogba river, Port Harcourt.**

| | |
|---|---|
| Phylum | Annelida |
| Class | Oligochaeta |
| Family | Tubificidae |
| | *Tubificid sp* |
| Family | Eurindae |
| | *Libyodrilus sp* |
| Class | Hirudinea |
| Family | Hirudinidae |
| | *Hirudo medicinalis* |
| | *Limnobdella anstralis* |
| Class | Gastropoda |
| Family | Lymneidae |
| | *Lymanea natalensis* |
| Family | Ampullaridae |
| | *Pila ovata* |
| Family | Planorbidae |
| | *Afrogyrus sp* |
| Family | Bulinidae |
| | *Bulimus forskahi* |
| Phylum | Arthropoda |
| Class | Crustacea |
| Family | Palaemonidae |
| | *Desmocaris trispinosa* |
| Family | Atyidae |
| | *Caridinea sp* |
| Class | Insecta |
| Family | Chironomidae |
| | *Chironomus larvae* |
| Family | Culicidae |
| | *Anepheline larvae* |
| | *Culicine larvae* |
| Family | Nepidae |
| | *Ranatra sp.* |

**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)**

**Table 3: Percentage Abundance of each class of individual Benthic macro-invertebrates.**

| Class | Total number of individuals | Mean total no of individual | Percentage abundance |
|---|---|---|---|
| Oligochacta | 752 | 376 | 42.7 |
| Hirudinea | 64 | 32 | 3.6 |
| Gastropoda | 342 | 86 | 19.4 |
| Crustacea | 28 | 14 | 1.6 |
| Insecta | 577 | 144 | 32.7 |
| Total | 1763 | 652 | 100 |

**(July, 2002 to June, 2003)**

In all the 12 months, the negative binomial distribution model was a good fit to the counts of benthic fauna of the river. This was because the computed $\chi^2$ values for each month was less than the tabulated $\chi^2$ value (Table 4). On this basis, agreement with negative binomial distribution was accepted ($P<0.05$). This indicated that the spatial dispersion of benthic fauna of the river was contagious.

The parameter, K, which is an index of aggregation in a population, ranged from 0.15 to 0.64 (Table 4). This distribution of benthic macro-invertebrates of the river could be partly attributed to the influence of the habitat or substrate of the river. Different organisms predominated in different stations. This is because the physical, chemical and biological condition of the habitat or substrate is optimum for such resistant indicator species.

Southerland (1980), reported that both the qualitative and the quantitative results on species indicate that organic enrichment, depth and thermal conditions are the most important factors that structure benthic communities along the stream. The study reveals that zonation of species in all the stations was affected by untreated industrial effluents, which may have contributed to the lowered diversity and density of the community.

**Table 4: $\chi^2$ Test for goodness-of-fit of a negative binomial distribution.**

| Month | Mean | organisms/density | variance | K (Aggregation index) | Computed $\chi^2$ | Tabulated $\chi^2$ | Dfb |
|---|---|---|---|---|---|---|---|
| July | 0.57 | 25.33 | 2.59 | 0.24 | 4526 | 5.991 | 2 |
| August | 0.98 | 43.56 | 5.71 | 0.16 | 4.675 | 7.815 | 3 |
| September | 0.50 | 22.22 | 0.97 | 0.51 | 2.711 | 5.991 | 2 |
| October | 2.20 | 97.78 | 18.77 | 0.16 | 2.711 | 12.592 | 6 |
| November | 0.67 | 29.78 | 2.50 | 0.21 | 2.712 | 7.815 | 3 |
| December | 1.07 | 47.56 | 4.10 | 0.32 | 4.417 | 9.488 | 4 |
| January | 0.73 | 32.44 | 1.76 | 0.33 | 5.670 | 7.815 | 3 |
| February | 0.55 | 24.44 | 2.12 | 0.20 | 0.273 | 5.991 | 2 |
| March | 0.18 | 8.00 | 0.19 | 0.64 | 0.711 | 3.841 | 1 |
| April | 0.35 | 15.56 | 1.05 | 0.15 | 0.896 | 5.991 | 2 |
| May | 0.30 | 13.33 | 0.52 | 0.40 | 0.205 | 3.841 | 1 |
| June | 0.23 | 10.22 | 0.56 | 0.24 | 0.552 | 3.841 | 1 |

**Sample unit (225 sq.cm)/month = n=650 less than 1) -3 (Elliott 1997**
**df= (No of frequency classes after combining the tails with expected frequency.**

**Table 5: Density of organisms per month and composition of Benthic macro-invertebrates of Nta wogba stream (July 2002 – June 2003)**

| Species | July 2002 | August 2002 | Sept. 2002 | October 2002 | November 2002 | December 2002 | January 2003 | February 2003 | March 2003 | April 2003 | May 2003 | June 2003 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Tubificid sp* | 42 | 60 | 49 | 50 | 85 | 46 | 140 | 106 | 75 | 56 | 46 | 26 |
| *Libyodrilus sp* | 3 | 3 | 3 | 7 | 4 | 2 | 5 | 4 | 1 | 2 | 2 | 1 |
| *Hirudo medicinalis* | 4 | 5 | 4 | 7 | 4 | 5 | 3 | 6 | 3 | 3 | 5 | 5 |
| *Limnobdlella anstralis* | 1 | 2 | - | 4 | 2 | 3 | 4 | 1 | 2 | 3 | 10 | 12 |
| *Lymnea natalensis* | 7 | 10 | 24 | 28 | 10 | 12 | 37 | 27 | - | 12 | 10 | 12 |
| *Pila ovata* | 5 | 5 | 18 | 19 | 7 | 10 | 20 | 6 | 22 | 6 | 8 | 9 |
| *Afrogyrus sp* | 1 | 2 | 2 | 3 | 1 | 1 | 3 | 2 | 4 | 2 | 20 | 6 |
| *Bulimus forskalii* | 2 | 3 | - | 8 | 2 | 2 | 5 | 3 | - | 3 | 5 | 2 |
| *Desmocaris trispinosa* | 3 | 2 | 1 | 3 | 1 | - | 2 | 1 | 2 | 2 | 2 | 1 |
| *Cardinea sp* | 1 | - | 1 | - | 1 | 1 | 3 | 2 | 2 | 1 | 2 | 1 |
| *Chronomus larvae* | 27 | 51 | 52 | 45 | 34 | 38 | 83 | 65 | 50 | 39 | 4 | 1 |
| *Anepheline larvae* | 3 | 3 | - | 8 | 2 | 1 | 6 | 2 | 4 | 4 | 5 | 2 |
| *Culicine larvae* | 2 | 1 | 2 | 6 | 3 | - | 3 | 3 | 3 | 2 | 2 | 1 |
| *Ranata sp* | 2 | 5 | 4 | 2 | 2 | 1 | 8 | 3 | 3 | 5 | | |
| Total | 1033 | 15[illegible] | 160 | 190 | 1[illegible]1 | 122 | 322 | 231 | 171 | 140 | 136 | 78 |

## DISSCUSSION AND CONCLUSION

The low diversity of benthic fauna recorded in this study is not unusual in tropical water. For instance, in lake George, Uganda, the bottom fauna was poor in species (Burgis *et al*, 1973, Darlinaton, 1976). However, the significantly lower density of organisms during the rainy season was partly attributed to the in-direct effect of the rains on the substrate. It was pointed out that during this period, the substrate is unstable, being either washed off or submerged, especially during the flood season (September to November). The substrate in the sampled area was found to be modified during this period. During the dry season, the substrate stabilized and the populations build up (Table 5).

Southwood (1966) observed that the smaller the value of k (index of aggregation) the greater the extent of aggregation, whereas a large value indicates that the distribution is virtually random. Thus, the smaller K values observed in this study indicated a high degree of aggregation. Also many authors have observed that substrate is one of the most important factors influencing the distribution of benthic fauna (Hynes, 1970, Ward, 1975; Reice, 1980). Payne (1976), reported that the low biomass values recorded in Sierra Leon estuary may be caused by abiotic stress factors such as in-stability of the substratum, occurrence of toxic substances or drastic salinity fluctuations. In this study, the density of the benthic fauna was considered low as indicated by the monthly sample mean (Table 4). Under such a condition, a random distribution could be expected but distribution was contagious. This indicates that the low density of benthic fauna observed in this study could not override the influence of substrate in causing a contagious distribution of the population.

This study reveals that the diversity of benthic fauna of Nta-wogba river is low. A significantly higher density of organisms was recorded during the dry season than during the rainy season. It could be that the instable nature of the substrate during the rainy season contributed to the low density of organisms. The differences observed in the distribution of species indicated the dependence on prevailing environmental conditions and the ability of each organism to exploit and tolerate varied biotope. Studies of this nature are important in enabling us understand the composition of benthic populations especially in tropical waters where little is known.

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## REFERENCES

Bidwell, A and Clarke, N.V. 1977. The Invertebrate fauna of lake Kainji, Nigeria. *The Nigerian field*, 42: 104 – 109.

Burgis, M.J, Darlington, J.P.E.C Dunn, I.G, Ganf, F.G, Gwahaba, J.J., and McGowan, L.M. 1993. The biomass and distribution of organism in lake George, Uganda. *Proc. Roy. Soc. Lond.*, B184: 95-112.

Claudiu, T. Rogers, H-G and Judith, H.C. 1979. Structure, dynamics and production of benthic fauna in lake Manitoba. Hydrob. 64:59 – 95.

Darlington, J.P.E.C. 1976. Temporal and spatial variation in the Benthic invertebrates fauna of lake George, Uganda. J. 2001 London, 180, 95 – 112.

Day, J. H., 1967. A monograph on the polychaeta of southern African Part 1. Erracntia. British Museum of Natural History, London., 458p.

Elliott, J. M., 1977. Some methods for the statistical analysis of samples of Benthic invertebrates. 2nd ed. *Fresh water. Biol. Assoc. Sci. Publ.* NO. 25.

Hart, A.I. 1994. The Ecology of the communities of Benthic macro-fauna in the mangrove swamp of Port Harcourt Area of the Niger Delta. Ph.D Thesis, University of Port Harcourt, River State.

Hynes, H.B.N. 1970. The Ecology of Running waters. *Liverpool University Press Liverpool.*

Mellanby, H. 1975. Annual life in fresh water. A Guide to freshwat er Invertebrates. Chapmen and Hall, London 308p.

Merrit, R.W and Cumins. 1984. Introduction to the aquatic insects of Northern American. Pentech Press, London.

Nwadiaro, C. S., 1984. The Longitudinal distribution of macro invertebrates and fish in the lower Niger delta River (River Sombrero) in Nigeria. *Hydrobiol. Bull.* 18: 133 – 140.

Payne, A. L., 1976. The Relative abundance and feeding habits of the grey mullet species occurring in an Estuary in Sierraleone., West Africa *Mar. Biol.* 35: 275 – 286.

Reice, S. R., 1980. The role of substratum in benthic macro- invertebrate, distribution and litter decomposition in a woodland stream. *Ecol.* 61: 580 – 590.

Souther land, J. P., 1980. Dynamics of the epibenthic community on roots of the mangrove Rhizophora mangle at Balria deBuche, Vanazuela. *Mar. Biol*. 58: 75 84.

Southerwood, T.R.E 1966. Ecological methods Chapman & Hall, London. Victor, R. & Ogbeibu, A.E. 1991. Macro-invertebrate communities in the erosional biotope of an urban stream in Nigeria. *Trop.* 2001, 4:1 – 12.

Ward, J. V., 1975. Bottom fauna substrate relationships in a northern olorado trout stream: 1945 and 1975. *Ecol.*, 56: 1429 – 1434.