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# A STUDY ON THE MACROINVERTEBRATE FAUNA OF LOWER OGUN RIVER AT ISHASI, OGUN STATE, SOUTH-WEST NIGERIA

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## Abstract

The composition, distribution and abundance of macroinvertebrate fauna of Lower Ogun River were studied at Ishasi from January 2006 to December 2007. Bank-root macroinvertebrates were sampled using kick sampling and scooping gear while Ekman grab were used to sample the mid-channel from three stations with 200m intervals on monthly basis. Physico-chemical parameters were also measured and found to be within the ranges suitable for normal aquatic life. A total of 27,005 macroinvertebrate individuals from forty-five taxa were collected from the entire study area (pooled data of the three stations). Three *Macrobrachium* species dominated the macroinvertebrate fauna. Class Insecta had the highest number of representations with thirty-three taxa cutting across eight orders including the pollution sensitive/clean water ones (Odonata, Trichoptera, Plecoptera and Ephemenoptera). Margalef species richness and Shanon-Wiener diversity indices levels of 4.41 and 1.18 respectively were recorded from the study area. The three sampling stations had insignificantly different physico-chemical parameters, macroinvertebrate abundance and diversity levels ($p>0.05$), which indicate uniform ecological conditions within the study area. The findings indicate a relatively stress free environmental condition within the study area.

**Key words:** Macroinvertebrates, Physico-chemical parameters, Species composition, Diversity, Abundance.

## Introduction

Macroinvertebrates constitute a major and important bio-community in aquatic ecosystems. Apart from the socio-economic values of some of them such as the decapod crustaceans (Shrimps and prawns) and molluscs, macro-invertebrates serve as food for other economically important macrofauna such as finfish and shellfish (Fagade and Olaniyan, 1973; Ajao and Fagade 2002). Indeed, the macroinvertebrate community consists of integrated populations whose structure reflects the abiotic conditions in the stream ecosystem. Occurrence and distribution of macro-benthos are governed mostly by the physico-chemical conditions of water and immediate substrate of occupation (Ogbeibu 1987).

Macroinvertebrates are fairly stationary, easy to collect and responsive to human disturbance. These together with the sensitivity or tolerance of some of them to perturbation make them a suitable bio-monitoring candidate in assessing the health status of any aquatic environment (Victor and Dickson, 1985; Horsfall and Spiff, 2001; Tyokumbur, 2002; Yakub, 2004; Abowei and Sikoki, 2005).

Ogun River is one of the two principal rivers in the Ogun-Osun River Basin of

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Nigeria. The river supports a major artisanal fisheries activity especially in Ogun and Lagos States of Nigeria. Syndeham (1977) studied the qualitative composition and longitudinal zonation of fish fauna of the river. Adebisi (1981) investigated the Physico-chemical hydrology in the upper course of the river. Meanwhile, there is dearth of information on the ecological characteristics of the Lower Ogun River especially with respect to the assemblage and dynamics of macroinvertebrate community of the river. In an attempt to fill this gap, this study investigated the compositions, distributions and abundance of macroinvertebrate fauna in Ishasi area of Lower Ogun River for effective and sustainable management of the water body and biodiversity conservation.

**Study area**

The study was carried out in Ishasi area within the lower course of Ogun River. The entire study area lies on Longitude 3°16′E and Latitude of between 6°40′N and 6°41.5′N (Fig. 1). The area represents a typical rainforest belt with rainy season starting from April through November and dry season commencing from December through March (Adebisi, 1981). The mid-channel of Lower Ogun River is more or less devoid of higher macrophytes, while the vegetation towards the bank ranged from floating higher plants such as duck weed (*Lemna* spp.), water lettuce (*Pistia*) and water hyacinth (*Eichhornia crassipes*) and rooted plants such as Elephant grass (*Pennisetum*), Giant star grass (*Cynodon*) and Bamboo (*Bambusa*).

Artisanal fishing activities both for finfish and the fresh water prawns, *Marobrachium* were the major human activities observed in the study area. The neighbouring communities also depend on the river as a source of water for domestic use.

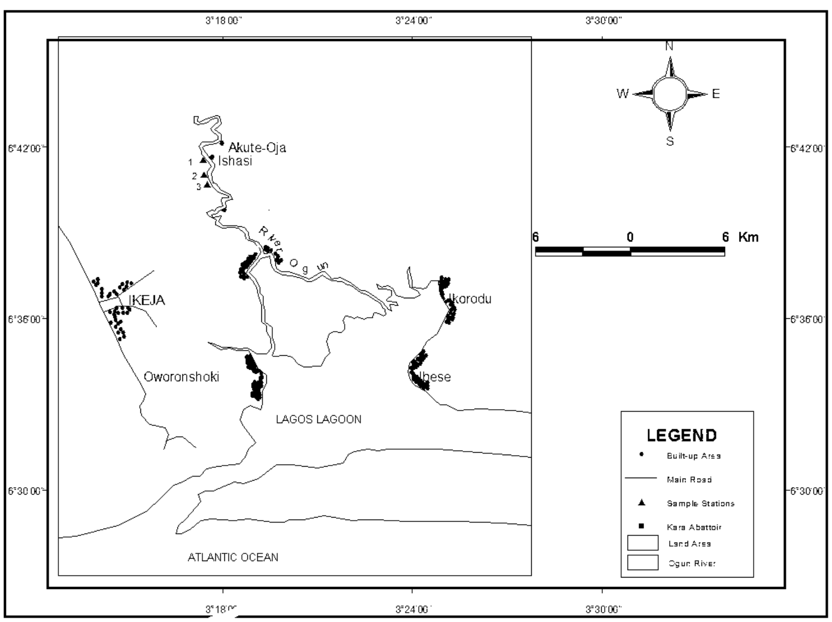


**Fig. 1. Map of Lower Ogun River showing the study area**

## Materials and methods

Macroinvertebrate samples were collected form three stations (1, 2 and 3) at 200m intervals (Fig. 1) monthly between January, 2006 and December, 2007.

Kick sampling method was used to collect macroinvertebrates of the riverbank sediments, by using a stick to agitate $0.09m^2$ area of the substratum. The dislodged macroinvertebrates that moved downstream were collected in a net bag held firmly against the substratum (Ogbeibu, 1987; Nelson and Lieberman, 2002).

The shore-line drifting and vegetation-associated macroinvertebrate were collected with ascooping gear made of 0.5m-diameter circular mosquito net bag. The scooping gear was used as a miscellaneous device as recommended by APHA (1985) for qualitative sampling of macroinvertebrates. A distance of 1m was swept with the bag net using the handle from a canoe. The organisms collected were preserved immediately in 4% formalin. For mid-channel benthic macro-invertebrates, three random samples were collected from each station using 15 x 15cm Ekman Grab Sampler (APHA, 1985). The grab samples were washed through a series of graduated sieves, followed by sorting of the macro-invertebrates, which was facilitated by staining of the organisms, using rose Bengal dye (Mason, 1981; APHA, 1985).

Samples collected from various biotopes were composited as a macroinvertebrate fauna sample of each station. The macro-invertebrate specimen were counted and identified under compound microscope to either species or genus level using standard identification guides such as Barnes (1974), Pennak (1978), APHA (1985) and Yoloye (1994).

Surface temperature, dissolved oxygen, pH, dissolved $CO_2$, Alkalinity and Ammonia Nitrogen were measured in-situ using 'LARMORTE' Fresh Water Analysis Kit (Model 3633-03). Transparency and electrical conductivity were also measured in-situ using a 15cm diameter Sechi disc and Conductivity meter of 'HANNA' Instrument (H19812). Biological Oxygen demand ($BOD_5$) was determined after five days incubation while Nitrate and Phosphate were measured spectrophotometrically following the procedures of APHA (1985).

Sampling of surface water for these physico-chemical parameters was also done monthly from January 2006 to December 2007.

Data obtained from species identification and numbers of individuals were used to compute macroinvertebrate compositions, distributions and abundance for each station as well as for the entire study area (pooled data of the three stations). Relative abundance of every taxa for the entire study area was also computed. Also, Simpson's Dominance (C), Margalef species richness diversity (d) and Shanon-Wiener (H) indices levels of macroinvertebrate fauna of each station as well as for the entire study area were computed as described by Ogbeibu (2005) using a computer software package, 'Past' by Hammer and Harper (2005). Diversity levels of the three stations were compared also with the software package.

Physico-chemical parameters as well as macroinvertebrate abundance levels of the three stations were compared, using 'ANOVA-Two Factor Without Replication' (Ogbeibu, 2005) under Microsoft Excel. Monthly macroinvertebrate abundance levels in entire study area were plotted on a line graph using Microsoft Excel.

**Results**

The mean values of the physico-chemical parameters of each station are presented in Table 1. For every physico-chemical parameter determined, the levels recorded at the three stations were not significantly different ($p>0.05$).

**Table 1. Mean values of physico-chemical parameters within Ishasi area of lower Ogun River (January 2006-December 2007)**

| | Station 1 | Station 2 | Station 3 |
|---|---|---|---|
| Surface water Temp. (°C) | 26.2 ± 2.67 | 26.17 ± 2.74 | 26.09 ± 2.8 |
| Transparency (m) | 0.69 ± 0.37 | 0.69 ± 0.38 | 0.68 ± 0.38 |
| Dissolved Oxygen (mg/L) | 5.61 ± 1.16 | 5.55 ± 1.06 | 5.61 ± 1.17 |
| Biochemical oxygen demand$_{5days}$ (mg/L) | 2.59 ± 0.92 | 2.37 ± 0.82 | 2.48 ± 0.80 |
| pH | 7.68 ± 0.72 | 7.74 ± 0.71 | 7.81 ± 0.77 |
| Alkalinity (mg/L) | 74.71 ± 18.22 | 75.21 ± 19.78 | 75.42 ±18.57 |
| Dissolved $CO_2$ (mg/L) | 8.69 ± 2.46 | 8.75 ± 2.56 | 8.93 ± 2.94 |
| Electrical Conductivity (μohms) | 137.54 ± 81.89 | 137.88 ± 81.28 | 141.29 ± 86.14 |
| $NH_3$ (mg/L) | 0.46 ± 0.54 | 0.44 ± 0.51 | 0.45 ± 0.51 |
| $NO_3$ (mg/L) | 0.26 ± 0.20 | 0.25 ± 0.21 | 0.27 ± 0.22 |
| $PO_4$ (mg/L) | 0.13 ± 0.06 | 0.13 ± 0.06 | 0.16 ± 0.15 |

Mean temperature, dissolved oxygen, biochemical oxygen demand and pH were 26.09–26.2°C, 5.55–5.61mg/L, 2.37–2.59mg/L and 7.74-7.81 respectively for the three stations. The composition, distribution and relative abundance of macroinvertebrate fauna of each station and for the entire study area (pooled data of the three stations) are presented in Table 2. Stations 1, 2 and 3 had 9,034, 9,140 and 8,831 macroinvertebrate individuals respectively, making a total of 27,005 individuals in the entire study area.

A total of forty-five macroinvertebrate taxa were recorded during the study, of which 33, 35 and 33 were represented at stations 1, 2 and 3 respectively. The three stations had three species of *Macrobrachium* prawn as the dominant macroinvertebrate taxa. *Macrobrachium vollenhovenii*, *M. marobrachion* and *M. felicinum* had relative abundance of 40.75%, 27.57% and 30.36% respectively in the entire study area. In terms of representation, insects had the highest number of representations with 33 taxa across eight orders.

The entire study area had Simpson dominance, Margalef and Shanon-Wiener diversity indices of 0.334, 4.41 and 0.07 respectively. The three stations had more or less equal dominance and diversity levels with insignificantly different indices values (Table 2).

As illustrated in Fig. 2, highest macro-invertebrate levels were recorded in September and October while the lowest were recorded in May both in 2006 and 2007. Relatively high macroinvertebrate abundance levels were also recorded in December of both years.

**Table 2. Composition, relative abundance (number) and diversity of macroinvertebrate fauna of Ishasi area of Lower Ogun River from January 2006 to December 2007**

(Values in parenthesis represent percentage composition)

| Taxa | Station1 | Station2 | Station3 | TOTAL (Pooled data) |
|---|---|---|---|---|
| | Abundance | Abundance | Abundance | Abundance |
| **ARTHROPODA** | | | | |
| **CRUSTACEA** | | | | |
| **Decapoda** | | | | |
| *Macrobrachium vollenhovenii* | 3690 | 3697 | 3619 | 11006 (40.75) |
| *M. macrobrachion* | 2496 | 2547 | 2404 | 7447 (27.57) |
| *M. felicinum* | 2728 | 2787 | 2685 | 8200 (30.36) |
| **Isopoda** | | | | |
| *Asellus aquaticus* | 3 | 2 | 5 | 10 (0.04) |
| **INSECTA** | | | | |
| **Odonata** | | | | |
| *Lestes* | 5 | 2 | 1 | 8 (0.03) |
| *Hagenius* | 1 | 0 | 4 | 5 (0.02) |
| *Macromia* | 4 | 4 | 2 | 10 (0.04) |
| *Helocordulia* | 0 | 1 | 0 | 1 (0.004) |
| *Coenagrion* | 0 | 2 | 0 | 2 (0.008) |
| *Gomphus* | 2 | 2 | 1 | 5 (0.02) |
| *Aeschan* | 2 | 0 | 0 | 2 (0.008) |
| **Plecoptera** | | | | |
| *Isoperla* | 2 | 9 | 2 | 13 (0.05) |
| *Neoperla* | 3 | 1 | 1 | 5 (0.02) |
| **Trichoptera** | | | | |
| *Amphypsyche* | 0 | 3 | 0 | 3 (0.01) |
| *Ecnomus* | 2 | 3 | 1 | 6 (0.02) |
| *Limnephilus combinatus* | 2 | 0 | 3 | 5 (0.02) |
| **Ephemenoptera** | | | | |
| *Adenophlebiodes* | 1 | 0 | 2 | 3 (0.01) |
| *Baetis* | 2 | 5 | 1 | 8 (0.03) |
| *Caenis* | 2 | 0 | 7 | 9 (0.03) |
| *Cloeon* | 2 | 0 | 0 | 2 (0.008) |
| *Ephemerella* | 10 | 10 | 8 | 28 (0.10) |
| *Pseudocloeon* | 0 | 0 | 1 | 1 (0.004) |
| *Siphlonisca* | 5 | 3 | 0 | 8 (0.03) |

| | Abundance | Abundance | Abundance | Abundance |
|---|---|---|---|---|
| **Hemiptera** | | | | |
| *Abedus* | 1 | 0 | 0 | 1 (0.004) |
| *Gerris* | 11 | 10 | 8 | 29 (0.11) |
| *Hydrometra* | 0 | 1 | 1 | 2 (0.01) |
| *Lethocerus* | 5 | 5 | 6 | 16 (0.06) |
| *Nepa apiculata* | 6 | 5 | 8 | 19 (0.07) |
| *Notonecta* | 5 | 5 | 5 | 15 (0.06) |
| *Pelocoris femoratus* | 1 | 0 | 0 | 1 (0.004) |
| *Ranatra fusca* | 0 | 2 | 3 | 5 (0.02) |
| *Sigara* | 6 | 5 | 12 | 23 (0.09) |
| **Lepidoptera** | | | | |
| *Paraponyx maculalis* | 0 | 1 | 0 | 1 (0.004) |
| **Diptera** | | | | |
| *Chironomus* | 0 | 4 | 0 | 4 (0.02) |
| *Culex* | 5 | 0 | 5 | 10(0.04) |
| **Coleoptera** | | | | |
| *Berosus* | 6 | 7 | 2 | 15 (0.06) |
| *Dysticus* | 5 | 0 | 0 | 5 (0.008) |
| **ARACHNIDA** | | | | |
| **Acarina** | | | | |
| *Hydrachna* | 0 | 2 | 4 | 6(0.02) |
| **MOLLUSCA** | | | | |
| **Gastropoda** | | | | |
| *Biomphalaria* | 1 | 1 | 0 | 2 (0.008) |
| *Lanestes ovum* | 9 | 4 | 5 | 18 (0.07) |
| *Lymnaea* | 0 | 1 | 2 | 3 (0.01) |
| *Melanoides tuberculata* | 0 | 1 | 2 | 3 (0.01) |
| *Pleucocera* | 5 | 1 | 13 | 19 (0.07) |
| *Physa* | 0 | 6 | 6 | 12 (0.04) |
| Total Abundance | 9034a | 9140a | 8831a | 27006 |
| Number of Taxa | 33 | 35 | 33 | 45 |
| Simpson Dominance (C) | 0.3344 | 0.3342 | 0.3345 | 0.334 |
| Margalef Diversity (d) | 3.513 | 3.728 | 3.522 | 4.41 |
| Shanon Diversity (H) | 1.183a | 1.176a | 1.185a | 1.18 |

Similar alphabet indicates insignificant differences in the indices values ($p>0.05$)

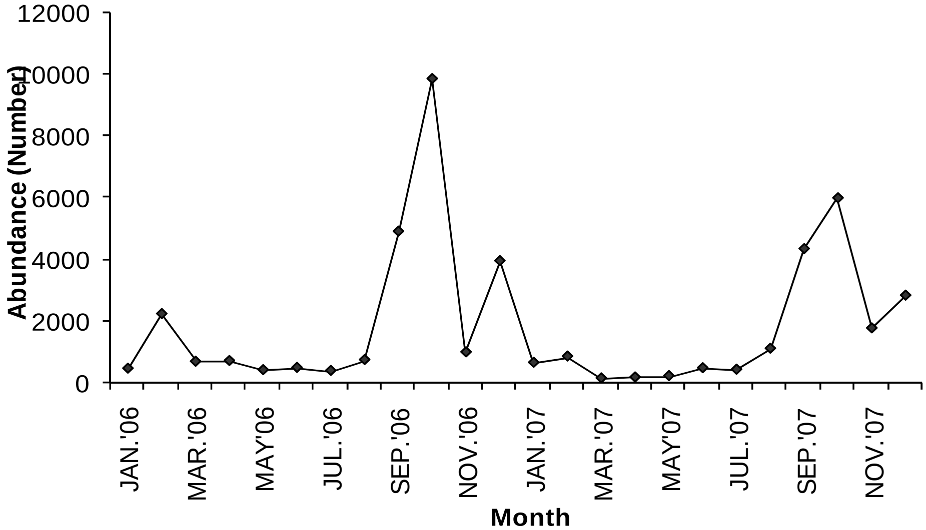


**Fig. 2. Monthly distribution of macroinvertebrate abundance of Ishasi area of Lower Ogun River (January 2006-December 2007)**

**Discussion**

The mean values recorded for the physico-chemical parameters at each station are within the ranges stipulated by Federal Ministry of Environment to be suitable for aquatic life (Horsfall and Spiff, 2001). Adebisi (1981) recorded similar desirable levels in the Upper Ogun River. Several other workers (Tyokumbur *et al*., 2002; Yakub, 2004; Emere and Nasiru, 2007) have reported similar physico-chemical conditions in unpertubed areas of some Nigerian lotic water bodies. The mean electrical conductivity (<600µmhos) recorded in this study places Lower Ogun River among the most dilute African fresh waters, that are said to be poor in nutrients (Emere and Nasiru, 2007). The insignificant spatial variations recorded in the physico-chemical parameters within the study area show uniform water quality conditions.

The predominance of the insects in terms of taxa representation is attributable to the relatively low BOD level and freshness of the river in the study area. This conforms with Umeozor (1995) in the New Calabar River, Port Harcourt, Niger Delta. The presence of the fresh water prawns, *M. vollenhovenii*, *M. macrobrachion* and *M. felicinum* as the dominant macroinvertebrate taxa as well as the occurrence of various clean water indicator insect orders such as Odonata, Plecoptera, Trichoptera and Ephemenoptera as well as Gastropoda each represented by many species indicate a relatively stress-free environmental condition in the study area. Marioghae (1982), D'Abramo *et al*. (1995) and Abowei *et al*. (2006) reported *Macrobrachium* prawns to be highly sensitive to deteriorated water quality condition, while Ogbogu and Olajide (2002), Tyokumbur *et al*. (2002), Ezemonye *et al.* (2004) and Emere and Nasiru (2007) listed odonates, plecopterans, trichopterans, hemipterans, coleopterans and ephemenopterans as well as some gastropods as pollution sensitive macroinvertebrates.

The low Shanon-Wiener diversity value (1.18) and a relatively high Margalef diversity level (4.41) recorded were due to the fact that the former incorporates evenness of distribution while the later only measures species richness. Thus, the low Shanon-Wiener diversity value was as a result of the much higher relative abundance of the three *Macrobrachium* species than other macroinvertebrate taxa. The comparable number of macroinvertebrate taxa as well as insignificantly different macroinvertebrate abundance and diversity levels of upstream and downstream stations indicate uniform distribution of macroinvertebrate fauna in the study area.

According to Brinkhurst (1965) the bigger the size of a lotic water body, the poorer the macroinvertebrate richness. The total of forty-six macroinvertebrate taxa encountered in this study is relatively high. Tyokumbur *et al*. (2002) and Emere and Nasiru (2007) respectively recorded sixteen and twenty-seven macroinvertebrate taxa in smaller streams in Ibadan and Kaduna respectively, while fourteen taxa were encountered in the middle reaches of Imo River by Sikoki and Zabbey (2006). Generally, high biodiversity is expected in ecosystems devoid of significant anthropogenic impact (Ogbeibu and Egborge, 1995).

The marked increase in macroinvertebrate abundance in the rainy season months of September and October could be attributed to the life history and population dynamics of the fresh water prawns, *Macrobrachium* species that constituted the dominant macroinvertebrate taxa in this study. According to APHA/AWWA/WPCF (1985), although, the composition and density of macroinvertebrates in an unperturbed aquatic environment are reasonably stable, seasonal fluctuations associated with life cycle dynamics of individual species may cause extreme variation within any year.

The life cycle of *Macrobrachium* prawns entails migration of the planktonic larvae spawned in fresh water downstream to brackish water bodies, where further developmental stages are passed before a backward migration to the fresh water end where they live a more or less a benthic life (D'Abramo *et al*., 1995). The large-scale migration back to the fresh water is more pronounced in the rainy than dry season (Maroghae, 1990; Abowei *et al*., 2006). Abohweyere *et al*. (2008) identified the rainy season months of October-November as the major peak period for recruitment of young *M. vollenhovenii* population in the Lagos-Lekki Lagoon system. However, Umeozor (1995) and Sikoki and Zabbey (2006) recorded higher macro-invertebrate abundance in the dry than rainy season in New Calabar and the middle reaches of Imo Rivers respectively. These authors attributed this to unstable bottom sediments caused by rains, which leads to dislodgement of the benthic animals. In the present study, *Macrobrachium* species (that constituted the dominant macroinvertebrate taxa) associated more with the river-bank macrophytes than the bottom sediments. Perhaps, the growth of the river-bank macrophytes is much more pronounced during the rainy than dry season. Ogbogu (2001) reported a similar significantly higher abundance during rainy than dry season for various species of Caddis fly in an intermittent Reservoir outflow at Ile-Ife, western Nigeria. The author attributed this to the bloom of moss, a bryophyte with which caddis flies associate during the rainy season.

The desirable physico-chemical conditions and relatively high macroinvertebrate diversity of Lower Ogun River in Ishasi area are indicative to a relatively desirable environmental condition in the area. This could be attributed to the relatively low anthropogenic activities that would normally lead to perturbation of the river.

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