

Full Length Research

Post-impact Analysis of Sediments and Macro Bottom Fauna of Osondu River in Okigwe, Imo State, Nigeria

¹Ogwo, P. A.* and ²Okereke, I. J.

¹ Department of Environmental Management and Toxicology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

² Department of Environmental Resource Management, Abia State University, Uturu, Nigeria.

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Sediment characteristics and macrobottom fauna of Osondu River in Okigwe, Imo State, Nigeria were sampled and analyzed. The sampling was done in January and June 2012 as part of post impact study of a massive road construction and demolition activities that took place in Okigwe. The aim of the study was to survey the river in order to determine the grain size distribution of the sediments and the associated macro fauna. Benthic macrofauna was sampled using an improvised core of cylindrical stainless steel pipe and an open iron frame with an attached net bag. Results showed that sediments consisted of mud made up of silt and clay. The macrobenthic fauna consisted of annelids, molluscs and arthropods. The diversity indices signified low density. It is concluded that Osondu River is susceptible to pollution effects from construction and demolition runoffs. We therefore recommend that adequate measures be taken through legislation to regulate dumping of wastes in to the river.

Key words: Post-impact analysis, macrobenthic fauna, Osondu River, sediments, okigwe.

INTRODUCTION

Okigwe Urban, Imo State, Nigeria has witnessed a lot of road construction and demolition activities since the beginning of 2012. Runoffs carry a lot of materials from the surroundings during the rainy season into Osondu Rivers. The study was carried out to characterise sediments and macro bottom fauna of Osondu River. Runoff from road construction and demolition activities could contain numerous chemicals and cause elevated levels of sediments load in receiving water bodies (Uwadiae, 2010; Edokpayi *et al.*, 2010). Sediment is the loose sand, silt, clay and other soil particles that settle at the bottom of a body of water. Sediment sources in aquatic ecosystem include: soil erosion, decomposition of plants and animals and discharge of effluents (USEPA, 2002). Wind and water help to carry these particles to rivers. Soil disturbance due to massive road construction and demolition of structures in Okigwe could significantly increase the load of sediments of Osondu River. The

sediments are contaminated with different pollutants from effluent discharges and run off into the Osondu Rivers. The percentage of silt and clay in river sediments can impact on both the structure of the biotic assemblage and the bioavailability of certain contaminants to local biota. Benthic macrofauna are widely accepted as useful biomonitoring tools for assessing impacts of pollution in aquatic ecosystems (Habeeba *et al.*, 2012; Edokpayi *et al.*, 2010). Benthic macrofauna are those organisms that live on or inside the deposit at the bottom of a water body. They include several species of organisms including: annelids, coelenterates, molluscs, arthropods and chordates (George *et al.*, 2010).

The functions/roles of benthic macrofauna in aquatic ecosystem include:

- i. Circulation and recirculation of nutrients in aquatic ecosystems.
- ii. Constitute a link between the unavailable nutrients in detritus and useful protein materials in fish and shellfish.
- iii. Serve as food for a wide range of fishes.
- iv. They accelerate the breakdown of decaying organic

*Corresponding authors. Email: pfaikon78@yahoo.com

matter into simpler inorganic forms such as phosphates and nitrates.

v. Are useful bio-indicators, providing a more accurate understanding of changing aquatic conditions than chemical and microbiological data.

vi. Useful bio-assessors of water quality.

This paper discussed the characterization of the sediments and macro bottom fauna of Osondu Sediments and macro bottom fauna of Osondu Rivers in Okigwe, Imo State, Nigeria.

MATERIALS AND METHODS

The Study Area

The study was carried out in Okigwe, Imo State, Nigeria between January and June 2012. The study area was Osondu River, N 05° 49' 33.4'' and E 007° 20' 49.0''.

Field Procedures

Field observations were visually made and documented in field notebooks and digital camera. The dry season sampling was done in January 2012 while the wet season sampling was conducted in June 2012. The two seasons sampling were carried out to determine the seasonal variation in the sediments and physico-chemical characteristics of the study area. Sampling points coordinates were N 05° 49' 33.4'' and E 007° 20' 49.0'', N 05° 49' 53.9'' and E 007° 21' 00.8''.

Sediment samples were collected with a 25mm cylindrical stainless steel pipe and an open iron frame with an attached net bag from three stations in Osondu River at two weekly interval from January to June, 2012. The samples were stored in a labelled polythene bags and kept in an ice-chest box before transferred to the laboratory. The air dried samples were further crushed to fine texture in a ceramic mortar, re-packaged in labelled polythene bags and stored in the laboratory for some relevant physico-chemical parameters (pH, electrical conductivity (Ec); total organic carbon, TOC, total organic matter, % sand, % silt, % clay).

The sediment samples were sieved using 2mm mesh sized sieve for pH and particulate size and 0.5mm sieve for other analyses. Surface water samples were collected and analyzed for temperature, turbidity and transparency using Extech Instruments.

In situ measurements and collection of Samples

In situ measurements of surface water temperature (°C), pH dissolved oxygen (mg/l) and electrical conductivity (mScm⁻¹) were conducted using battery operated.

Horiba U10 water quality checker model, the sampling

stations were positioned using GARMIN GPS receiver model GPS map 76CSx. Total dissolved solids (TDS) and salinity were determined using Extech Instruments Exstik II EC500

Estimation of macrobenthos

Diversity of the benthic fauna was determined using Shannon. Weaver index (1963) and Margalef index (1967), Pielou's index of evenness was used to calculate the relative diversity.

Shannon _ Weaver index was expressed as

$$H_s = \sum \frac{N_i}{N} \log_2 \frac{N_i}{N}$$

Where H_s = Shannon_ Weaver index

N = total number of individuals in the sample

N_i = the number of individual species in the sample

Margalef – value was expressed as

$$D = \frac{S - 1}{\log_e N}$$

Where D = Margalef Value

S = number of species collected

N = total number of individuals in the sample

Data were analyses using analyses of variance with using SAS (2003) and mean were compared with Duncan multiple range test. Pearson correlation coefficient and descriptive statistics was done.

RESULTS AND DISCUSSIONS

Physical and chemical parameters of Osondu River are shown in Table 1. Salinity ranged between 23.1 and 25.4ppm. Atmospheric temperature was between 20 and 34°C while Surface water temperature was highest (34°C) in April and lowest (20°C) in January. Water depth was lowest (10cm) in March and highest in February (22cm). Phosphate values ranged between 0.067 and 0.79mg per litre. Nitrate values ranged from 2.40 to 5.80mg per litre. Electrical Conductivity was between 46.2 to 49.7us. The pH values ranged between 7.50 and 8.35. dissolved oxygen ranged between 7.69 and 7.74ppm. Chemical Oxygen Demand values was lowest (34mg/l) in January and highest (56mg/litre) in April. Density values ranged from 0.894 to 1.49gcm⁻³ while transparency ranged between 6 and 26 cm.

The Sediment characteristics of Osondu River are shown in Table 2. The sediments consisted of mud made up of silt and clay. Silt content ranged between 68%

Table 1. Variation of physico-chemical parameters in Osondu River, Okigwe, Imo State, Nigeria between January and June, 2012.

Parameter	January	February	March	April	May	June	Mean	SE
pH	7.3	7.8	8.0	8.1	7.9	8.3		
Salinity %	22.2	26.1	23.2	23.0	17.8	5.5		
Electrical Conductivity	36.0	45.3	38.9	61.0	33.0	44.1		
Density gcm ⁻³	1.0	1.2	1.0	0.96	0.98	1.0		
Depth (cm)	30	29	18.0	17	31	41		
Surface water temperature	27	28	32	32	29	27		
COD mg/l	33.0	41	45	53	39	35		
Phosphate mg/l	0.71	0.40	0.32	0.32	0.34	0.1		
Nitrate mg/l	4.55	5.80	5.68	5.41	5.62	2.86		

Table 2. Sediment analysis of Osondu River, January to June , 2012.

Parameter	January	February	March	April	May	June	Mean	SE
TOC %	15.4	14.9	14.4	13.9	16.8	15.1		
Clay %	28.0	24	20	28	26	20		
Silt %	72.0	76	80	72	74	80		

Table 3. Composition and Abundance of Macrobenthic fauna per 0.5m² collected from Osondu River.

Species	January	February	March	April	May	June	Mean	SE
<i>Netritina glabrata</i>	2	5	5	4	2	6		
<i>Tympanotonus fuscatus var radula</i>	6	13	16	25	41	16		
<i>Aloidis trigona</i>	1	2	1	2	1	1		
<i>Pachymelania aurita</i>	6	3	9	7	4	5		
<i>Clibinarius africanus</i>	2	3	2	1	3	4		
<i>Nereis succinea</i>	1	2	3	-	-	-		

Table 4. Diversity Indices for Osondu January to June, 2012.

Index	January	February	March	April	May	June	Mean	SE
Margalef	1.58	1.36	1.25	1.17	1.15	1.12		
Shannon and Weaver	1.44	1.20	1.39	1.13	1.29	1.21		
Lloyd and Ghellardi	0.76	0.57	0.72	0.53	0.76	0.78		

(January and April) and 80% (June) whereas clay was between 20% (March and June) and 28% (January and April). Total Organic carbon (TOC) varied between 13.9% in April and 16.8% in May.

Table 3 shows the composition and abundance of macrobenthic fauna per 0.5m² sampled from Osondu River. Macrobenthic fauna consisted of Annelids, Molluscs and Arthropods.

Table 4 shows the diversity indices of Osondu River from January to June, 2012. Diversity indices signified low density and diversity of macrobenthic fauna. Species richness was high in January while evenness of spread of

individuals among the species present was highest in May.

Conclusion

Anthropogenic perturbations have contributed to the low diversity of benthic macrofauna in osondu River, Imo State Nigeria. Osondu river is susceptible to pollution effects from massive construction and demotion run-offs other human activities such as dumping of wastes may also have accounted for the low species diversity.

It is therefore recommended that adequate measures be put in place through legislation, to regulate dumping of wastes and municipal runoffs into the river.

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