Fisheries and Aquaculture Journal
ISSN: 2150-3508

Obiyor et al., Fish Aqua J 2017, 8:2
DOI: 10.4172/2150-3508.1000199

Research Article Open Access

Benthic Fish Fauna and Physicochemical Parameters of Otamiri River, Imo State, Nigeria

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Received date: March 14, 2017; **Accepted date:** April 27, 2017; **Published date:** May 08, 2017

Abstract

The study on the fish fauna and physicochemical characteristics of Otamiri River was carried out for six months (June to August and October to December 2015). Samples were collected monthly from three sampling stations along the river. Eckman grab, scoop net, line and hook, cast net, traps and dugout canoe were used to collect the fish samples. Samples were collected from three stations, station 1 (dumpsite in the river), station 2 (dredging section) and station 3 (vegetable farming section). A total of 129 fishes belonging to 5 species, Synodontis budgetti, S. soloni, Chrysicthys nigrodigitatus, Clarias gariepinus and Papyrocranus afer were collected. Station 3 had the highest species composition (n=4) and fish abundance, 108 (83.7%), while station 1 had the least species composition (n=2) and the least fish abundance, 10 (7.8%). Temperature variation from June to December was wide at station 1 (25-28ºC), unlike station 2 (27-28ºC) and station 3 (28-29ºC). A similar trend was replicated by Dissolved Oxygen (DO). Significant correlation of S. budgetti abundance and temperature (r=0.696, p<0.05), depth of river (r=-0.615, p<0.01) and turbidity (r=0.595, p<0.01) was observed. Similarly, a significant correlation of C. nigrodigitatus abundance and temperature (r=0.473, p<0.05), C. gariepinus abundance and depth (r=-0.481, p<0.05), P. afer abundance and temperature (r=0.530, p<0.05) was observed. Fish species abundance and composition in Otamiri River was significantly affected by anthropogenic activities.

Keywords: Otamiri river; Fish; Benthic; Abundance; Composition; Physicochemical

Introduction

The benthic macro fauna are those organisms that live at the bottom of a water body and are used to detect changes in the natural environment [1,2]. Fishes are thus referred to as benthic if they occur within or around the bottom of water bodies. The use of macro-invertebrates and vertebrates diversity for bio-assessment provides a simpler approach compared to other environmental quality assessment procedures. This is because, macro-invertebrates and vertebrates can be sampled quantitatively and the relative sensitivity or tolerance of some of them to contamination is known [3]. Species vary in their degree of tolerance with the result that under polluted conditions, a reduction in species diversity is the most obvious effect [4-6].

The lotic and lentic inland waters, as well as brackish and marine waters in the tropics are habitats for a variety of vertebrate fauna. Work on the vertebrate fauna in the tropics has shown that the quantitative collection of key species from natural aquatic habitat or that modified by man can provide a means of estimating various ecological parameters, such as richness or evenness in diversity [7]. The occurrence and distribution of macro-invertebrates and vertebrates are governed mostly by the physical and chemical quality of water and immediate substrate of occupation. Water quality parameters such as temperature, pH, dissolved oxygen and nutrients have considerable effects on the life of aquatic organisms. They affect species composition and distribution, diversity, stability, production and physiological conditions of the organisms [6].

Humans are considered the principal driver of change on the earth's surface. Such impacts shape the earth in disparate ways which may be small and subtle or big and catastrophic [8]. These effects may result in multiple consequences felt by plants, animals and even humans alike. One major natural component of the earth is the aquatic environment which is home for a vast array of organisms from those with a planktonic existence through pelagic organisms to benthic species. Human activities also interfere with this environment. Freshwater bodies contain diverse habitats which support myriads of species of both plants and animals and are important sources of water for human activities.

In some instances freshwaters have been dammed to provide portable water for urban settlements and the Otamiri River is one of such freshwater bodies which are used for domestic purposes by the generality of Nekede and Ihiagwa communities. A lot of activities that may be detrimental to aquatic and human life take place at Otamiri River yet there is little to no existing study to assess the consequences. The water is intensively and perennially dredged for sand at some sections; at some others people dump domestic and industrial wastes into the river without concern for it consequences on human and aquatic lives. Also a bridge was recently constructed on a section of the river. In view of this, this study therefore investigated the physicochemical parameters and benthic fish fauna diversity of Otamiri River as markers of pollution status of the water.

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Materials and Methods

Study area

The Otamiri River is one of the main rivers in Imo State, Nigeria and located on latitude 7° 06′ E and longitude 5° 30′ N and at an elevation of 152 meters above sea level. The river takes its name from Ota Miri, a deity which owns all the waters that are called by its name, and who is often the dominating god of Mbari houses [9]. The river runs south from Egbu past Owerri, Nekede, Ihiagwa and through Ozuzu Etche, in Rivers State, from where it flows to the Atlantic Ocean [10]. The length of the river from its source to its confluence at Emeabiam with the Uramiriukwa River is 30 kilometres (19 mi) [10]. The vegetation of the sampled area is rain forest with the watershed mostly covered by depleted rain forest vegetation. Conversion of the tropical rainforest to grassland with slashes and bush burning practices constantly degrades the soil quality. Three sampling stations were used. Station 1 was located at Owerri urban along Nekede road, where the state's refuse dump site is located and no sand mining activities occurs, while Station 2 was at No 8 Bus stop Umugwueze, Nekede, where dredging activities take place and Station 3 was at Umuezerokam village which is the home of vegetable farming (Figure 1).

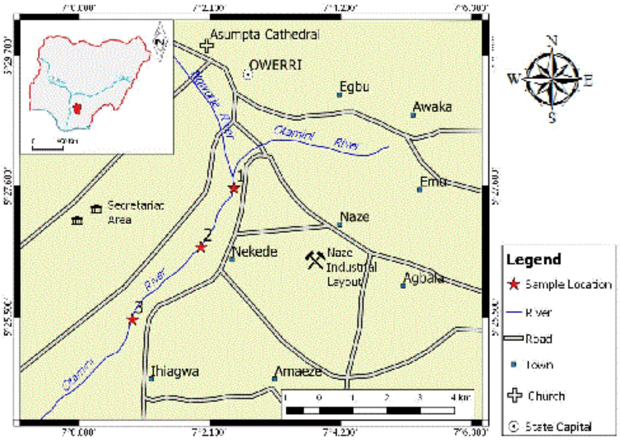

Figure 1: Map of Otamiri River showing the sampled stations. Station 1: Owerri Municipal, Station 2: No 8 Bus Stop Nekede and Station 3: Umuezerokam Village, Nekede.

Sample collection

Water samples were collected from the three stations (Stations 1, 2 & 3) within the river for six months (June-August and October-December, 2015). The samples were collected in triplicates from each sampling stations. Dugout canoes with paddles were used during sampling within the river. At the sampling stations, 250 ml Dissolve Oxygen containers to store water samples were rinsed several times with the river water. Water samples for physicochemical analysis were collected at 30 cm depth in bottles of 1000 ml capacity. Water sample was fixed separately with 2 ml each of Winkler's solution A and B (manganese sulphate, alkaliodide and conc. sulphric acid [11].

Benthic vertebrate samples were randomly collected from each sampling station with cast net of 0.5 mesh size, local trap (made from raffia palm) and hook and line, monthly for six months. Dugout canoes with paddles were used during the sampling within the river. The samples were kept in a container and labeled properly. Samples were stored in 30-40% Ethanol [12,13] and were immediately transported to the laboratory of the Department of Zoology and Environmental Biology, University of Nigeria, Nsukka for identification. Benthic vertebrates were identified by means of identification keys provided by Bouchard [14] and Dailey [15].

Determination of physicochemical parameters

The pH of water samples were measured in the laboratory using the Hanna pH meter (Hi-1922 model; Hanna Instruments Inc., USA). Turbidity of water determination was conducted in-situ at the sampling stations using a 20 cm diameter Secchi disc attached to a calibrated rope. Depth of disappearance and re-appearance was recorded and average calculated. Dissolved oxygen was estimated using the Azide modified techniques of Winkler's method [16]. Water temperature of each station was measured in degree Celsius (°C) using laboratory thermometer calibrated from 0-100°C. On each sampling day, the thermometer was dipped in water for about 5 minutes at a depth of 5 cm. Temperature was recorded as soon as the reading stabilized. The depth of the water at each sampling station was measured using a graduated rope with sinker. The rope was immersed in the water until the sinker touched the substratum. The reading was taken and recorded in meters.

Statistical analysis

Data obtained were analyzed using Statistical Package for Social Sciences (SPSS) version 20 (IBM Corp., Armonk, New York, USA). Values were expressed as mean ± SE. Two-way Analysis of Variance (ANOVA) was used to determine significant differences among means of water quality parameters across stations and months. Species diversity was calculated using Shannon wiener's index (H) using the following equation;

$$H = \sum_{1}^{N} p_i \ln p_i$$

Where: H=Species diversity index

Pi=the proportional abundance of species

n=the number of species

In=Natural log

∑=Sum of the calculation

Species dominance was also calculated using Simpson's dominance index (D) using the formula;

$$D = \frac{1}{\sum_{1}^{N} p_i^2}$$

Where: D=Species dominance index

Pi=the proportional number of species

N=the number of species

∑=Sum of the calculation

Pearson correlation (r) was used to ascertain linear relationships between physicochemical characteristics of the river and benthic fish species diversity.

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Results

Physicochemical parameters of Otamiri River

Temperature: The results of the temperature values of Otamiri River are presented in Figure 2. At station 1, temperature increased progressively from June and July till November and dropped slightly in December. The months of June, July and August had similar and least temperature values. At this station, temperature for June, July and August were significantly less than temperature for October to December (p<0.05). At station 2, a gradual increase in temperature from June to December was observed, though slight declines occurred in August and November. At this station, the peak temperature (29.03°C) for the duration of the study was recorded in December; it was also significantly higher than temperatures recorded in the other months (p<0.05). At station 3, unlike the other stations temperature was peak in June, dropped sharply in July and August, and rose gradually from October to similar levels as June by November and December. At this station, the least and highest temperature values of 27.67 ± 0.33°C and 29.30 ± 0.67°C were recorded in the months of August and June respectively. Temperature values of June, November and December were significantly higher than July and August values (p<0.05). Between stations, temperature of the river was significantly higher at station 3 than station 1 for all the month except October.

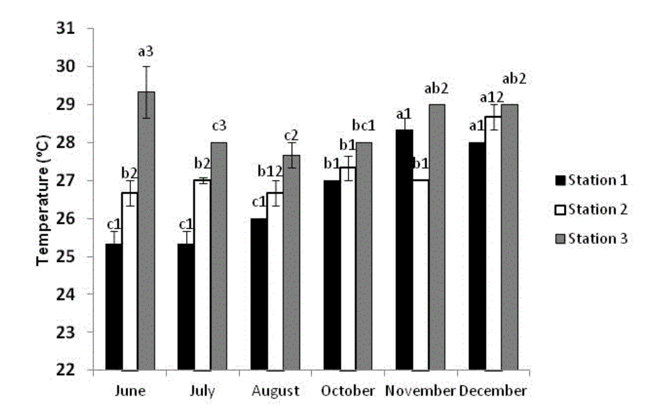

Figure 2: Mean-monthly variations in temperature (°C) of Otamiri River in the three sampled stations. Alphabet label compares variation in a given station between the months; months with different alphabet label for each station were significantly different (p<0.05). Number label compare between stations for each month; stations with different number label for each month were significantly different (p<0.05).

Depth: There were monthly variations in depth across the stations throughout the study period (Figure 3). At station 1, the highest depths were recorded in the months of June (4.21 ± 0.27 m) and July (4.19 ± 0.05 m) after which the water depth declined sharply from August attaining the least value for the duration of the study in December (0.46 ± 0.09 m). Still at station 1, depth of the river was significantly higher in June and July than the other months; August value was also significantly higher than October to December values (p<0.05). There was no significant difference in depth between October, November and December (P>0.05). At station 2, the river depth followed a similar trend observed at station 1. But the highest depth was recorded in June only (4.88 ± 0.64 m); thereafter, the depth declined sharply and significantly in July (1.27 ± 0.18 m) and remained this low till December (p<0.05). At station 3, only August and October depths were significantly lower than the other months (p<0.05). Between the three stations, in July depth at station 2 was significantly less than those of station 1 and 3; in October station 3 had a significantly higher depth than the other two stations; in November depth between the stations were significantly different in the order station 1<station 2<station 3; and in December station 1 depth was significantly less than the other stations' (p<0.05).

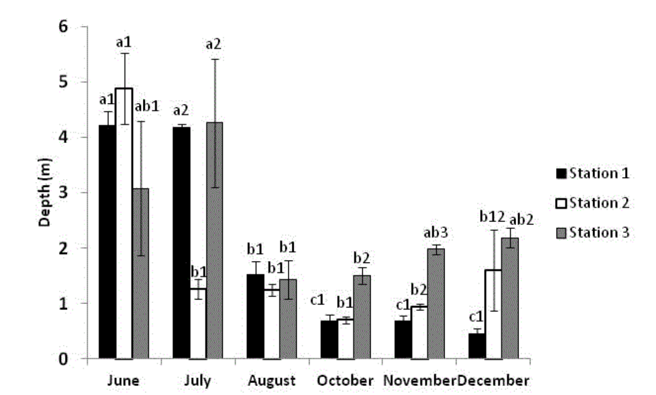

Figure 3: Mean-monthly variations in depth (m) of Otamiri River in the three sampled stations. Alphabet label compares variation in a given station between the months; months with different alphabet label for each station were significantly different (p<0.05). Number label compare between stations for each month; stations with different number label for each month were significantly different (p<0.05).

Dissolved Oxygen (DO): There were monthly variations in DO values across the stations during the study period (Table 1). In station 1, the values ranged from the least (4.57 ± 0.33 mgL^{-1}) in June to the highest (6.50 ± 0.06 mgL^{-1}) in July and October. DO at this station was significantly different between the months except for July and October. At station 2, the least DO (5.77 ± 0.33 mgL^{-1}) was recorded in the month of June and was significantly different from other months.

	Station 1	Station 2	Station 3
June	$4.57 + 0.33^{e1}$	$5.77 + 0.33^{d2}$	$5.67 + 0.33^{c2}$
July	$6.50 + 0.06^{a2}$	$6.47 + 0.03^{b2}$	$5.87 + 0.03^{c1}$
August	$5.70 + 0.00^{d1}$	$6.00 + 0.00^{c2}$	$5.80 + 0.10^{c1}$
October	$6.50 + 0.06^{a2}$	$6.20 + 0.06^{a1}$	$6.70 + 0.06^{a3}$
November	$6.00 + 0.00^{c1}$	$6.47 + 0.03^{b3}$	$6.37 + 0.03^{b2}$
December	$6.20 + 0.06^{b1}$	$6.00 + 0.00^{c1}$	$6.20 + 0.12^{b1}$

Table 1: Mean-monthly variations in Dissolved Oxygen (mgL^{-1}) of Otamiri River in the three sampled stations. Values with different alphabets superscript in a column are significantly different (p<0.05). Values with different numbers superscript in rows are significantly different (p<0.05).

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In station 3, the lowest DO value of 5.07 ± 0.03 mgL^{-1} was recorded in the month of June which was not significantly different from July and August DO values. Still at station 3, the DO for October to December were significantly higher than DO for June to August ($p<0.05$). The DO in the month of October was significantly higher than other months in this station ($P<0.05$). Across the stations, the variations in DO were dependent on months but there was no consistent trend. In the month of June, the DO values (5.87 ± 0.03 mgL^{-1}) of stations 2 and 3 were similar and significantly higher than the value recorded at station 1 ($P<0.05$). In August, DO for stations 1 and 3 were similar but significantly less than the value for station 2. In October, the DO of station 3 was significantly higher than the values for stations 1 and 2.

pH: The results of the pH values of Otamiri River are presented in Table 2. pH of the river for the duration of the study varied between slight acidity to neutrality (5.70-7.50). At station 1, the highest and lowest pH was recorded in July and August respectively. pH values for July and August were significantly different from other months at this station ($p<0.05$). At station 2, the least pH value (5.70) was recorded in June and was significantly less than values for other months ($p<0.05$). Still at this station, pH values for the months of November (6.90) and October (6.87+0.03) were significantly higher than values for other months ($p<0.05$). At station 3, the months of June and August had the least pH value (5.90), which differed significantly from other months ($P<0.05$). Across stations, the variations of pH values were monthly dependent. Pattern of variation was not consistent.

	Station 1	Station 2	Station 3
June	6.73 + 0.03^{b3}	5.70 + 0.00^{e1}	5.90 + 0.00^{e2}
July	7.37 + 0.03^{a3}	6.60 + 0.00^{c1}	6.80 + 0.00^{d2}
August	6.00 + 0.00^{c2}	6.33 + 0.03^{d3}	5.90 + 0.00^{e1}
October	6.77 + 0.08^{b1}	6.87 + 0.03^{a1}	6.97 + 0.03^{c1}
November	6.80 + 0.00^{b1}	6.90 + 0.00^{a2}	7.47 + 0.03^{a3}
December	6.70 + 0.06^{b1}	6.80 + 0.00^{b1}	7.20 + 0.00^{b2}

Table 2: Mean-monthly variations in pH of Otamiri River in the three sampled stations. Values with different alphabets superscript in a column are significantly different ($p<0.05$). Values with different numbers superscript in rows are significantly different ($p<0.05$).

Turbidity: There were variations in turbidity across the months throughout the study period (Table 3). Turbidity was highest in the months of November and December for all the stations. Except for station 2 where October turbidity value was not significantly different from November value, the turbidity for November and December were significantly higher than other months for all stations ($p<0.05$).

	Station 1	Station 2	Station 3
June	2.97 + 0.03^{d2}	2.00 + 0.00^{d1}	3.00 + 0.00^{d2}
July	4.00 + 0.06^{c1}	5.00 + 0.00^{c2}	5.00 + 0.12^{c2}
August	4.17 + 0.17^{c1}	5.12 + 0.12^{c2}	5.00 + 0.00^{c2}
October	3.00 + 0.06^{d1}	6.02 + 0.16^{b3}	5.03 + 0.03^{c2}
November	7.03 + 0.04^{a2}	6.00 + 0.00^{b1}	6.00 + 0.01^{b1}
December	5.18 + 0.03^{b1}	8.00 + 0.06^{a2}	8.00 + 0.00^{a2}

Table 3: Mean-monthly variations in Turbidity (NTU) of Otamiri River in the three sampled stations. Values with different alphabets superscript in a column are significantly different ($p<0.05$). Values with different numbers superscript in rows are significantly different ($p<0.05$).

Seasonal variations in physicochemical parameters of Otamiri River

Seasonal variation in physicochemical parameters of the river is shown in Table 4. Turbidity was significantly different between wet and dry season at all the stations ($p<0.05$). The river had higher turbidity in the dry season. pH was significantly different between wet and dry season only in stations 2 and 3 ($p<0.05$); dry season pH were higher at these stations. DO was significantly different between the two seasons at stations 1 and 3 ($p<0.05$); the dry season also had higher values at the stations. Temperature readings for wet and dry seasons were significantly different at stations 1 and 2 ($p<0.05$); also dry season values were higher. Only at station 1 was water depth significantly different between the wet and dry season ($p<0.05$); where wet season values was higher.

	Stations	Wet	Dry	t-value	P
Temperature (°C)	1	25.60 ± 0.18	27.80 ± 0.22	-7.85 (15.19)	0.00*
	2	26.80 ± 0.22	27.70 ± 0.29	-2.44 (15.02)	0.03*
	3	28.30 ± 0.33	28.70 ± 0.17	-8.94 (11.77)	0.38ns
Depth(m)	1	3.31 ± 0.46	0.61 ± 0.07	5.82 (16)	0.00*
	2	2.46 ± 0.63	1.08 ± 0.25	2.03 (16)	0.06ns
	3	2.93 ± 0.64	1.89 ± 0.12	1.58 (16)	0.13ns
DO(MgL^{-1})	1	5.59 ± 0.28	6.23 ± 0.07	-2.21 (16)	0.04*
	2	6.08 ± 0.10	6.22 ± 0.07	-1.15 (14.06)	0.27ns
	3	5.78 ± 0.04	6.42 ± 0.08	-7.65 (11.49)	0.00*

pH	1 2 3	6.70 ± 0.20 6.21 ± 0.13 6.20 ± 0.15	6.76 ± 0.03 6.86 ± 0.02 7.21 ± 0.07	-0.28 (16) -4.78 (16) -6.05 (16)	0.79ns 0.00* 0.00*
Turbidity(NTU)	1 2 3	3.66 ± 0.17 4.00 ± 0.50 4.33 ± 0.33	5.33 ± 0.60 6.67 ± 0.33 6.33 ± 0.44	-2.68 (16) -4.44 (16) -3.62 (14.89)	0.02* 0.00* 0.00*

Table 4: Seasonal variations of physicochemical parameters of Otamiri River. DO=Dissolved Oxygen, pH=Hydrogen-ion concentration. *Significant difference, ns=No significant difference.

Species composition, abundance and diversity of benthic organisms in Otamiri River

A total of 129 benthic vertebrates belonging to 5 species and 4 families were collected (Table 5). Station 3 recorded more species, 4 and had highest abundance 108 (83.7%) of benthic organisms than the other sampled stations. Station 1 had only two benthic species, and the least abundance of benthic fish fauna, 10 (7.8%). Chrysichthys nigrodigitatus was the most abundant species (32.65%) recorded in the present study as against the least that was Synodontis soloni (2.18%) which occurred only in stations 1 and 2.

Family	Species	S 1 (%)	S 2 (%)	S3 (%)	Otamiri River (%)
Mochokidae	Synodontis budgetti	8 (80.0)	5 (45.5)	7 (6.5)	20 (15.5)
Mochokidae	Synodontis soloni	2 (0.0)	3 (27.3)	0 (0.0)	5 (3.9)
Calroteidae	Chrysichthys nigrodigitatus	0 (0.0)	0 (0.0)	83 (77.9)	83 (64.3)
Clariidae	Clarias gariepinus	0 (0.0)	2 (18.2)	11 (10.2)	13 (10.1)
Notopteridae	Papyrocranus afer	0 (0.0)	1 (9.1)	7 (6.5)	8 (6.2)
		10 (7.8)	11 (8.5)	108 (83.7)	129 (100)

Table 5: Species composition and percentage abundance of fish fauna in Otamiri River. S1=Station 1, S2=Station 2, S3=Station 3.

The abundance of benthic organisms in Otamiri River were dependent on season as more benthic organisms were recovered in dry season than in rainy season. More species were recorded and with high diversity indices in the dry season than the wet season in all the sampled stations (Table 6). The diversity indices yielded high diversity in station 3 than the other two stations.

		Station 1		Station 2		Station 3	
		H'	D	H'	D	H'	D
Overall		1.52	3.83	2.24	8.5	1.83	8.35
Seasons	Wet	0.84	1.97	1.38	4	1.7	3.5
	Dry	1.95	6.33	2.25	8.68	1.83	3.77
Months	June	0.5	1.47	0	1	1.01	2.57
	July	0	1	1.09	3	1.29	2.81
	August	0.64	1.8	0	0	0.9	2.1
	October	1.47	3.77	1.88	6.23	2.11	5.27
	November	1.33	3.57	2.02	7.2	1.52	2.82
	December	1.05	2.77	1.56	4.53	1.61	3.38

Table 6: Species diversity of fish fauna in Otamiri River. H'=Shannon Wienner index, D=Simpson's dominance index.

Pearson correlation (r) of species abundance of benthic organisms with physico-chemical parameters

From the Pearson correlation analysis of species abundance of benthic organisms with some physicochemical parameters, regression plots of only significantly linear relationships were plotted (Figure 4). There was significant positive linear relationship between abundance of *S. budgetti, C. nigrodigitatus and P. affer* and water temperature (r=0.696, 0.473 and 0.530 respectively). There was significant negative linear relationship between abundance of *S. budgetti and C. gariepinus* and water depth (r=-0.615 and -0.481 respectively). Only *S. budgetti* abundance had a significantly positive linear relationship with turbidity (r=0.595, p<0.01).

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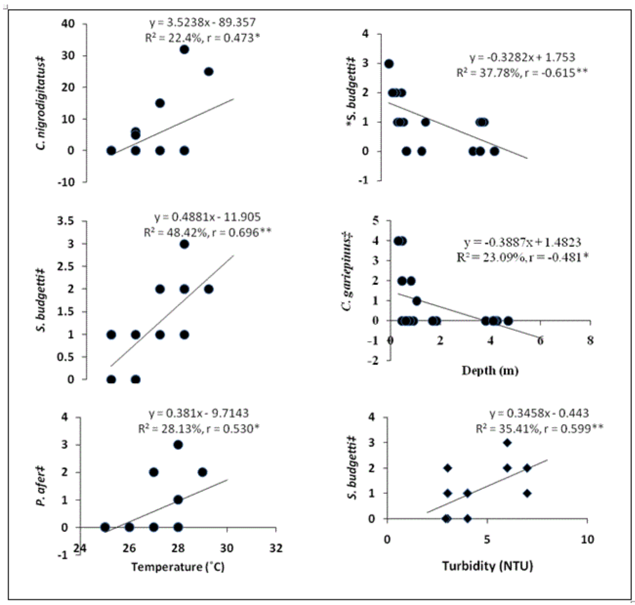

Figure 4: Regression plots of benthic fish species abundance against physicochemical parameters. ‡Species abundance of fish species, *Correlation significant at $p<0.05$, **correlation significant at $p<0.01$.

Discussion

The water chemistry of an aquatic ecosystem is dependent on the physical and geological features of its drainage basin [17,18]. The temporal variations in some of the physical and chemical parameters of the water samples at the study stations during the period of study were negligible. This is in agreement with the observations of Ajao and Fagade [19] and Nkwoji et al. [20].

In the present study, water temperature ranged between 25°C-29°C. This finding conforms to earlier works by Okeke and Adinna [21] in Otamiri River that reported a mean temperature of 27.4°C. Sharma et al. [22] and Yogesh [23] also reported similar fluctuations in Narmada River and Dahikhura Reservoir, both in India. Lower temperature during rainy season is expected; this is as increase rainfall during this period also marked by increase in the volume or depth of the river during the same season as observed from this study, results in greater requirement of heat radiation to lift water temperature.

Dissolved oxygen in natural and waste water depends on the physical, chemical and biological activities in the water body. Dissolved oxygen content plays a vital role in supporting aquatic life. It is an important limnological parameter which indicates the level of water quality and organic pollution causes in the water body. DO is susceptible to slight environmental changes. DO in water is dependent on oxygen transfer across air-water interface, water temperature, salinity and flow, wind velocity, rainfall and photosynthesis of aquatic biota [24,25]. In the present study, the concentration of DO in Otamiri River varied from 4.57 mgL^{-1} to 6.70 mgL^{-1}. The mean DO value recorded in Otamiri River was 5.33 mgL^{-1}. This meets the universal standard recommended minimum of 5 mgL^{-1} for aquatic life use [26,27]. This value is higher than earlier reported on the river by Johnbosco and Nnaji [28] who reported a mean DO value of 2.00 mgL^{-1}. The difference may have resulted from variation in sampling techniques employed. Our sampling was deeper into the water away from the shores; though it was not stated by Johnbosco and Nnaji [28], the exact distance away from the shore of their sampling point, one would expect it to be closer to the shore nearer pollution points due to their study objectives. Thus, while the points of high level of pollution noted by Johnbosco and Nnaji [28] may not support aquatic life, deeper away from it organisms live and probably flourish. Also, our study did not focus entirely at polluted sections of the river. Unpolluted areas were similarly sampled. In addition, the duration of sampling was not stated by Johnbosco and Nnaji [28]. Also, DO reported from this study are similar to reports for Otamiri River by Okeke and Adinna [21] who reported Do ranges of 2.1-6.8 mgL^{-1} in rainy season and 2.7-5.1 mgL^{-1} for the dry season.

pH is the measure of the concentration of hydrogen ions. It provides the measure of the acidity or alkalinity of a solution. In the present study the observed pH values which ranged from 5.70 to 7.47 showed that the Otamiri River varied from slight acidic to neutrality. The pH range is not detrimental to aquatic life. Adebisi [29], King and Ekeh [30] and Mama and Ado [31] attributed variations in pH to evapo-transpiration process, rainfall causing dilution of chemical substances, and biological processes in water. The mean pH value of 6.73 ± 0.10 recorded during this study falls within the recommended range of 6.5-8.5 set by the WHO and National Standard for Drinking Water Quality in Nigeria [32,33]. This value is in agreement with the report of Akaahan et al. [2] which recorded a mean pH value of 6.63 ± 0.07 in River Benue at Makurdi, Benue State Nigeria. Narasimha and Benarjee [34] reported that pH range of 6.0-9.0 is suitable for fish culture and growth.

Turbidity in the water may be due to organic and inorganic constituents. Turbidity is often determined and used as surrogate measure of the total suspended solids [35]. During this study, the mean turbidity value obtained was 2.66 ± 0.16 NTU. This value is below the recommended standard maximum of 5.00 NTU for turbidity [32,33]. Dredging and sand mining activities only minimally affected turbidity as only slight difference were observed between turbidity at station 2 (sections of sand mining and dredging activities) and station 3 (section of vegetable farming). Also refuse dumpsites at the banks of the river did not affect river turbidity much a little deeper off shore. Fast flow of water probably caused the movement of waste away from areas where it was dumped thereby result in little impact on turbidity.

A total of 4 families of benthic fauna were recorded in Otamiri River. This is similar to the 4 families reported by Ogidiaka et al. [36] in Ogunpa River in Ibadan, but fewer than the 10 families reported by Adjarho et al. [37] in Ona River, Ibadan. Otamiri River being a freshwater body was dominated by Calroteidae (36.25%). The distribution pattern of Calroteidae showed that they were more abundant in Station 3 which is the home of vegetable farming. The dominance of C. nigrodigitatus at station 3 compared to other stations indicated pollution, stress and high level of anthropogenic activities such as dredging in Stations 1 and 2.

Nwankwo and Akinsoji [38] had attributed low species abundance and diversity at some sites in a river in southwestern Nigeria to the pollution of such sites. The relative abundance of benthic fauna in each station of this study is a reflection of the level of pollution of each station. Burger and Gochfeld [39] related the abundance and diversity of the benthic fauna to the health of the water body. Stations 1 and 2 in Otamiri River recorded relatively lower number of species; this could be attributed to the resultant effect of the bridge construction and other human activities (mainly sand mining, dredging and waste disposal) ongoing at these stations. Anthropogenic activities such as dredging often result in substratum instability and increased siltation. Edokpayi and Nkwoji [40] had reported in a previous study that suspended silt has the ability to reduce light penetration and primary productivity and could clog the gills of aquatic fauna thereby smothering them. The occurrence of relatively higher number of species and individuals in station 3 may be an indication of lower degree of anthropogenic activities at the station compared to other stations. Overall diversity had been reported to be the product of all dynamic spatial and temporal changes affecting an urban stream community in Nigeria [41,42].

The abundance and diversity of benthic fauna are generally affected by the physical and chemical characteristics of water, availability of food and substrate occupation [43]. In this study, such parameters like temperature, depth, DO, turbidity were observed to have influenced the community composition of Otamiri River. This is in agreement with earlier reports of Ajao and Fagade [19], Brown and Oyenekan [43] and Edokpayi and Nkwoji [40]. The relationship between water quality parameters and composition of benthic fauna of Otamiri River showed both direct and inverse relationships with some parameters. pH had no relationship with the species composition and abundance. Surface water temperatures, depth, DO and turbidity had significant relationship with some benthic fauna such as S. budgetti, C. nigrodigitatus, P. afer, C. gariepinus and S. soloni.

The study revealed that anthropogenic activities at Otamiri river affected the fauna diversity of the area. The anthropogenic activities dredging, sand mining, bridge construction, and dumping of waste into river probably caused stress to aquatic life at the two stations (1 and 2) where such activities take place therefore resulting in reduction in benthic fish species diversity and abundance. Proper management of the river should be put in place to preserve its water quality and biodiversity for sustainable development. Refuse dumping into the river should be stopped.

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