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The fishes of akomoje reservoir drainage basin in lower River Ogun, Nigeria: Diversity and Abundance

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ABSTRACT
Fish species composition, abundance, and diversity of Akomoje reservoir drainage basin in Lower River Ogun, Nigeria were studied from June to November, 2017. Water quality parameters were also monitored *in-situ* and *ex-situ* using standard methods and kit. One thousand and twelve fish specimen comprising of 14 fish species from 9 families were identified. The Bagrids were the most abundant fish family in the reservoir basin and *Chrysichtys nigrodigitatus* constituted the most dominant (60.28 %) species and *Schilbe mystus* was the least abundant species by number (0.59%) and weight (0.74%).. other common species included *T. zilli, O. niloticus, C. gariepinus, C. auratus* and *Malapterurus electricus* representing 91.3% while *Synodontis budgetti, Tilapia mariae, Schilbe mystus* and *S. schall* etc. constituted occasional (6.53%) and rare (2.17%) species Diversity indices estimates were Simpson's Index (D) = 0.39, Simpson's Index of diversity (1-D) = 0.61, Simpson's Reciprocal Index (1/D) = 2.56, Shannon-Diversity Index (H) = -1.5749, Shannon's equitability (EH) or Evenness (E) of = -0.5968. Results of physical and chemical parameters measured were air temperature (29.23±1.27), water temperature (26.9±0.37^{0}C), dissolved oxygen (6.12±0.70mg/l), and pH (7.6±0.39). There was no significant difference ($p > 0.05$) in temperature, BOD and phosphorus all though the study period. Negative correlation was determined between water quality parameters and between water quality parameters and fish abundance. The study concluded that the water quality parameters of the study location measured were still within tolerable range for fish survival, however, with the negative correlation obtained between fish abundance and water quality parameters, human activities around this river should be monitored to prevent pollution of the water body. The fish population of this river basin has been well depleted and thus more attention should be paid to the resource to prevent extinction of important fish species.

INTRODUCTION

The freshwater ecosystem, though rich in biodiversity, with variety of plant and animal species, may be the world's ecosystem in greatest danger of biodiversity loss of its fish populations. This is of great concern as decline in species richness is much more greater than in most of the terrestrial ecosystems also affected (Sala *et al*., 2000).

Major causes of threats to global freshwater plant and animal life are water pollution, flow modification, destruction or degradation of habitat, and invasion by exotic species (Dudgeon *et al*., 2006). Also, overexploitation of the resource is a major threat as fish play a vital role in human and animal nutrition providing large proportion of the populace the essential animal protein and also trickle up the economy of any nation (Worldfish, 2015).

Several studies had been carried out on the biodiversity of various inland waters of Nigeria. Adeosun *et al*. (2010) researched on the fin fish assemblage of Ikere gorge dam, Oyo State Nigeria. Lawson *et al*. (2013) investigated on the fish assemblage of Majidun Creek, Lagos, Nigeria. Odulate (2016) also researched into the ichthyofauna diversity of Asejire Lake, Southwest, Nigeria. Other studies include that of Adeosun (2012) who investigated the fin fish assemblage of this particular water body; however, all of these studies reported the effect of water quality and anthropogenic activities on the biodiversity of these water bodies. Furthermore, changes in the global environmental, for example nitrogen deposition, global warming, shifts in precipitation and runoff patterns occurring exacerbated these threats (Galloway *et al*., 2004).

Recent activities around and within the water are thought to have altered the species composition. In view of the dynamic nature of activities around this water body, there is need to carry out frequent researches into the biodiversity of the fisheries resources so as to provide up to date information that will assist fisheries managers in making policies that can protect the fisheries and also educate the farmers on the state of the fisheries resources of the water. Knowledge of the taxonomy and distribution of fish of any body of water is necessary in assessing its productivity but will also permit a better understanding of the population and life cycle of the fish community in the presence of environmental stress such as low dissolved oxygen, high temperature and high ammonia.

The study was therefore designed to investigate the fish resources of Akomoje reservoir drainage basin with special focus on composition, abundance, diversity and the prevailing environmental factors in the water body.

MATERIALS AND METHODS

Study area

The study was carried out in Akomoje reservoir drainage basin, lower River Ogun, Abeokuta, Ogun state. The reservoir is located in Abeokuta North Local Government of Ogun state and lies between longitude 3°21′S and latitude 7°21′E North of Abeokuta covering a land area of 1000 hectares. Ogun River is a perennial river in Nigeria, which has a coordinate of 3°28′E and 8°41′N from its source in Oyo State to 3°25′E and 6°35′N in Lagos state where it enters Lagos Lagoon. The dry season was between November to March while the wet season is between April to October. The annual rainfall ranges from 900 mm in the North of the River to 200 mm towards the South. Total annual potential evapotranspiration is 1600 mm and 190 mm. Ogun River catchment area is located in South West Nigeria, bordered geographically by latitude 6°26′N and 9°10′N and longitude 2°28′E and 4°4′E. The land is about 230 km^2. The relief is generally low, with the gradient in the North-south direction. The water source is from the Igaran hills at an elevation of about 540 m above the sea level and flows directly southward over a distance of 480 km before it discharge into the Lagos Lagoon. The major tributaries of the river are Ofiki River and Opeki River Figure 1.

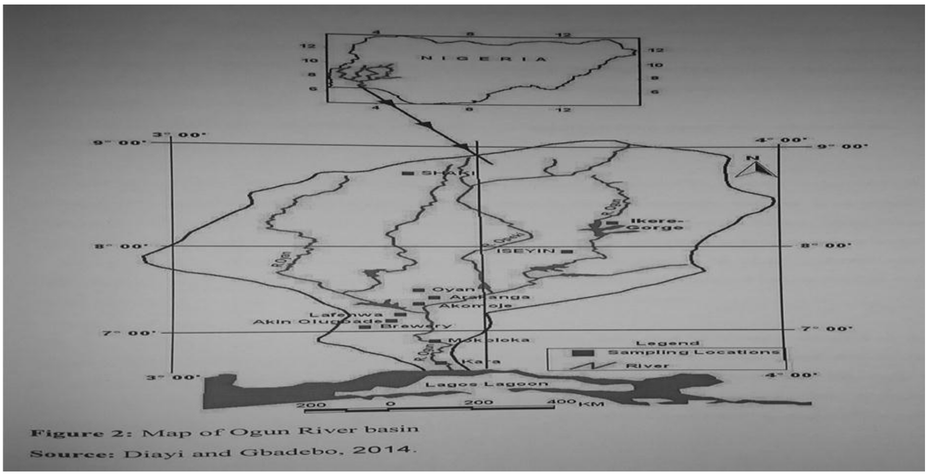

Fig. 1: Map of River Ogun basin

Collection of Fish Samples

Fish were collected from catches landed by artisanal fishermen using cast nets and gill nets (Mesh sizes: 12-25.4mm and 20- 45mm respectively). The sampling was done forth nightly for six months from June indicating peak of the rains – November indicating the dry months of 2017.

Laboratory procedures

Fish specimens were conveyed in ice box to the Wet laboratory in the Department of Aquaculture and Fisheries Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria for further investigations. The specimens were removed from the ice box and mopped with clean dried towel. The specimens were sorted to the lowest taxonomy level and identified following Olaosebikan and Raji (1998). The fish were weighed to the nearest 0.1 gram using a weighing pan balance (Mettler Toledo, PL3001-S Accurate scale).

Monitoring of Physical and Chemical Parameters of Water

Physical and chemical parameters of the water were monitored *in situ* and *ex situ*. Water samples were collected in sample bottle from the surface of the water in each location on each sampling visit. Temperature, total dissolved solids (TDS), pH and electrical conductivity (EC) were measured using water quality parameter kit (HANNA HI 9810). Dissolve oxygen using Winkler's titrimetric method. Transparency was determined with a secchi disc. The concentration of phosphate in water was measured using Vanado-molybdate colorimetric method (Ademoroti, 1996). Sodium salicylate (colorimeter) method (Ademoroti, 1996) was used to measure the concentration of nitrates in water sample collected

Data analysis

Number of individuals (n) of a species was monitored monthly from the pool of the bi-monthly catch. Sample size (N) represents the total sum of all individuals of the different species encountered in the study. Equations for calculations were adopted from the study of Lawson *et al.* (2013).

$N = \Sigma\ (n_1 + n_2 + n_3 + n_4 + \ldots + n_i$

where, 1, 2, 3, 4,……and i are index numbers for the different species 1, 2, 3, 4…….. and i of the sample.

Frequency of abundance was calculated as the percentage of the number of individuals that made up each species (n) relative to total number of individuals of all fish species that were encountered in the study (N). Thus:

$$\text{Frequency of abundance} = n \times \frac{100}{N}$$

Species biomass was taken as total weight of individuals of a species while the percentage biomass was percentage of each species biomass relative to sum total biomass of all fish species encountered in this study. Thus:

$$\%\text{Biomass} = \frac{\text{Total biomass of individuals of a species}}{\text{Sum total biomass of all fish species captured}} \times 100$$

Classification of fish species based on frequency of occurrence was described using a subjective acronym (COR) adopted from the study of Lawson *et al*. (2013): (C) common, (O) occasional and (R) rare species. Fish species are described as common, when a species occurred above 20 individuals; occasional, when often below 20 individuals and rare, when not found often usually less than 10 individuals.

Fish diversity, a measure of species richness and distribution evenness was calculated using the following indices:

Simpson's index (D) = Σn (n-1) / N(N-1)

Simpson index of diversity = (1-D)

Simpson's reciprocal index = (1/D)

Shannon Diversity index (H) = Σpilnpi

Shannon's Equitability (E_H) = H/1nS

Evenness (E) = e^H/S

where, N is Total number of organisms of all species found, n is number of individuals of a particular species, D is diversity index, i is an index number for each species present in a sample, pi = ni/N is the number of individuals within a species i divided by the total number individuals (N) present in the entire sample. Σ is sum the values for each species and S is total number of species.

Microsoft Office Excel and the Statistical Package for Social Sciences (SPSS) software were used to analyze results. Means were separated using Duncan multiple range test (Duncan, 1955). Correlation between water parameters was by linear regression. All the statistical analyses were considered at significance level of 5% ($p<0.05$).

RESULTS

Fish species identification and monthly composition

Taxonomic identification of 1012 fish samples caught revealed a total of 14 species belonging to 9 families. The families included the following; Clariidae, Cichlidae, Bagridae, Malapteruridae, Schilbedae, Mormyridae, Osteoglossidae, Channidae and Mochokidae with each of the families represented by various species Table 1. Monthly composition of catch is shown in Table 2.

Table 1: Fish species identification

S/N	Family	Species
1.	**Mochokidae**	*Synodontis budgetti* (Boulenger, 1911),
		Synodontis schall (Bloch and Schneider, 1801)
		Synodontis batensoda (Rüppell, 1832)
2.	**Cichlidae**	*Tilapia mariae* (Boulenger, 1899),
		Oreochromis niloticus (Linnaeus, 1758)
		Tilapia zilli (Linnaeus, 1758)
3.	**Bagridae**	*Chrysichthys nigrodigitatus* (Lacépède, 1803)
		Chrysichthys auratus (Bleeker ‹1858)
4.	**Channidae**	*Parachanna obscura* (Gunther, 1861)
5.	**Clariidae**	*Clarias gariepinus* (Burchell, 1822)
6.	**Malapteruridae**	*Malapterurus electricus* (Gmelin, 1789)
7.	**Schilbedae**	*Schilbe mystus* (Linnaeus, 1758)
8.	**Mormyridae**	*Mormyrus rume* (Valenciennes in Cuvier and Valenciennes, 1847)
9.	**Osteoglossidae**	*Heterotis niloticus* (Cuvier, 1829)

Table 2: Monthly composition of species

S/N	Species	June	July	Aug.	Sept.	Oct.	Nov.
1.	*Chrysichtysnigrodigitatus*	45	68	223	74	161	39
2.	*Chrysicthysauratus*	4	4	14	7	16	6
3.	*Tilapia zilli*	14	10	34	11	33	11
4.	*Oreochromisniloticus*	7	4	20	3	22	6
5.	*Tilapia mariae*	2	1	8	2	4	1
6.	*Portunusvalidus*	1	1	1	3	--	2
7.	*Penaeusmonodon*	4	3	18	7	16	4
8.	*Schilbemystus*	1	--	2	2	1	--
9.	*Mormyrusrume*	2	2	4	--	2	1
10.	*Synodontisbatensoda*	--	1	--	3	4	3
11.	*Synodontisbudgetti*	--	2	--	5	4	--
12.	*Synodontisschall*	--	--	4	1	3	--
13.	*Heterotisniloticus*	1	1	2	--	2	2
14.	*Clariasgariepinus*	8	8	11	3	22	4
15.	*Malapteruruselectricus*	4	2	10	4	8	4
16.	*Parachannaobscura*	2	--	5	22	4	2
	TOTAL	**93**	**104**	**354**	**138**	**302**	**81**

Source: Field Survey

Abundance of fish species

The abundance in number and weight composition of fish species in the Akomoje reservoir drainage basin of Lower Ogun River during the study months are presented in Table 3. Members of the family Bagridae were the most abundant fish family in the reservoir basin and *C. nigrodigitatus* were the most dominant species contributing 60.28 % of the fish population. There were variations in biomass from one species or family to another. Fish species biomass varied between 0.4 Kg and 0.59% in *S. schall* and *S. batensoda* with 8 and 11 individuals to 26.5 Kg and 39.38% in *C. nigroditatus* with 610 individuals.

Table 3: Abundance and weight of fish species in Akomoje reservoir drainage system

Fish species	TOTAL		Relative Percentage (%)	
	Abundance	Wt(kg)	Abundance	Weight
Clarias gariepinus	56	14.3	5.53	21.25
Chrysichtys nigrodigitatus	610	26.5	60.28	39.38
Tilapia zillii	113	5.8	11.17	8.62
Synodontis budgetti	11	2.5	1.09	3.72
Heterotis niloticus	8	5.2	0.79	7.73
Chrysichtys auratus	51	5.4	5.04	8.02
Synodontis schall	8	0.4	0.79	0.59
Synodontis batensoda	11	0.4	1.09	0.59
Schilbe mystus	6	0.5	0.59	0.74
Oreochromis niloticus	62	2.5	6.12	3.72
Malapterurus electricus	32	0.7	3.16	1.04
Mormyrus rume	11	1.0	1.09	1.49
Parachanna obscura	15	1.2	1.48	1.78
Tilapia mariae	18	0.9	1.78	1.34
Total	**1012**	**67.3**	**100**	**100**

Fish species occurrence

Summary of occurrence of fish species in the Akomoje reservoir drainage basin is given in Table 4. Of the total number of individuals and 14 fish species encountered during the study, 924 individuals from 6 species, 66 individuals from 5 species and 22 individuals representing 3 species were categorized as common, occasional and rare species, respectively. Common species are *C. nigroditatus, T. zillii, O. niloticus, C. gariepinus, C. auratus* and *Malapterurus electricus* representing 91.3% while occasional and rare species represented 6.53% and 2.17% of the fish population.

Table 4: Summary of the species occurrence of Akomoje Reservoir drainage system, Nigeria

S/N	Family	Species	Occurence		
			Common (C)	Occassional (O)	Rare (R)
1.	Mochokidae	*Synodontis budgetti*		11 (1.09)	
		Synodontis schall			8 (0.79)
		Synodontis batensoda		11 (1.09)	
2.	Cichlidae	*Tilapia mariae*		18 (1.78)	
		Oreochromis niloticus	62 (6.12)		
		Tilapia zilli	113 (11.17)		
3.	Bagridae	*Chrysichthys nigrodigitatus*	610 (60.28)		
		Chrysichthys auratus	51 (5.04)		
4.	Channidae	*Parachanna obscura*		15 (1.48)	
5.	Clariidae	*Clarias gariepinus*	56 (5.53)		
6.	Malapteruridae	*Malapterurus electricus*	32 (3.16)		
7.	Schilbedae	*Schilbe mystus*			6 (0.59)
8.	Mormyridae	*Mormyrus rume*		11 (1.09)	
9.	Osteoglossidae	*Heterotis niloticus*			8 (0.79)

Fish species diversity indices

Table 5 showes the diversity indices of fish species in the Akomoje reservoir drainage basin. The indices estimates were Simpson's Index (D) = 0.39, Simpson's Index of diversity (1-D) = 0.61, Simpson's Reciprocal Index (1/D) = 2.56, Shannon-Diversity Index (H) = -1.5749, Shannon's equitability (EH) or Evenness (E) of = -0.5968.

Table 5: Diversity indices of fish species in Akomoje Reservoir drainage system, Nigeria

Diversity index	Values
Number of species (S)	14
Total number of individual species (N)	1012
Simpson's index (D) = Σn (n-1) / N(N-1)	0.39
Simpson index of diversity (1-D)	0.61
Simpson's reciprocal index = (1/D)	2.56
Shannon Diversity index (H) = Σpi ln pi	-1.5749
Shannon's Equitability or Evenness (E_H) = H/1nS	-0.5968

where,
"N" is Total number of organisms of all species found,
"n" is number of individuals of a particular species,
"D" is diversity index,
"I" is an index number for each species present in a sample,
"pi" = ni/N is the number of individuals within a species i divided by the total number individuals (N) present in the entire sample.
"Σ" is sum the values for each species and
"S" is number of species.

Monitored physical and chemical water parameters of Lower Ogun River

The physico-chemical parameters of water samples in Akomoje reservoir drainage basin in Lower River Ogun throughout the study period are presented in Table 6. Significant differences ($p<0.05$) was observed in some of the water quality parameters: salinity, between the months, however, there were no significant difference ($p>0.05$) in air temperature, water temperature, DO. Correlation was observed between the water quality parameters (Table 7). Negative correlation was basically observed between the water quality parameters of the study area and fish abundance during the study period (Table 8).

Table 6: Mean water quality parameters at lower River Ogun, Akomoje (June – November)

Months	**Air temp (^{o}C)**	**Water temp (^{o}C)**	**Transp (NTU)**	**TDS (mg/l)**	**pH**	**EC (mS/cm)**	**DO (mg/l)**	**BOD (mg/l)**	**Org. P (mg/l)**	**Nitrate (mg/l)**
June	26.87±1.36^{a}	28.5±0.79^{a}	20.5±2.63^{de}	103.3±6.45^{a}	6.9±0.24^{cd}	193.3±10.49^{ab}	6.2±0.76^{ab}	2.90±0.84^{a}	0.04±0.20^{a}	1.48±1.05^{ab}
July	31.33±0.76^{de}	27.4±0.32^{a}	26.3±3.17^{bc}	80.0±5.89^{ef}	6.6±0.31^{d}	166.67±8.99^{bcd}	7.6±1.28^{a}	3.47±0.71^{a}	0.01±0.17^{a}	0.03±0.12^{e}
August	30.67±0.76^{cd}	26.1±0.33^{a}	23.0±2.86^{d}	96.7±7.42^{bcd}	7.5±0.38^{bcd}	145.00±4.86^{d}	5.5±0.71^{c}	3.20±0.45^{a}	0.10±0.14^{a}	0.85±0.57^{cd}
September	29.33±1.07^{d}	25.5±0.00^{a}	27.7±1.59^{bcd}	92.3±5.37^{ab}	8.7±0.49^{ab}	186.33±7.55^{bc}	4.96±0.97^{cd}	2.53±0.74^{a}	0.04±0.20^{a}	0.31±0.69^{de}
October	28.83±1.02^{ab}	26.7±1.02^{a}	26.5±0.71^{bc}	82.0±5.38^{d}	8.2±0.45^{b}	200.33±8.05^{a}	6.7±0.69^{ab}	3.03±0.74^{a}	0.01±0.00^{a}	0.86±1.09^{cd}
November	28.33±0.56^{b}	27.3±1.03^{a}	27.9±0.78^{ab}	90.3±5.18^{bc}	7.8±0.41^{bc}	185.67±7.61^{bc}	5.8±0.57^{bc}	2.93±0.61^{a}	0.01±0.01^{a}	1.33±0.98^{bc}
Mean	**29.23±1.27**	**26.9±0.37**	**25.3±1.15**	**90.8±5.47**	**7.6±0.39**	**179.56±4.51**	**6.12±0.70**	**3.01±0.56**	**0.04±0.19**	**0.81±0.75**

Mean values with the same superscripts along the columns were not significantly (P>0.05) different. Temp = temperature, Transp = Transparency, TDS =Total Dissolve Solids, EC =Electrical conductivity, DO =Dissolve oxygen, BOD =Biological Oxygen Demand, Org. P = organic phosphate

Table 7: Correlation between water quality parameters in Lower River Ogun, Akomoje, Abeokuta. Ogun state.

	Air temp(^{o}C)	**Water temp (^{o}C)**	**Transp (NTU)**	**TDS (mg/l)**	**pH**	**EC (mS/cm)**	**DO (mg/l)**	**BOD (mg/l)**	**Org. P (mg/l)**	**Nitrate (mg/l)**	
Airtemp		1									
Watertemp		-.504	1								
Transparency		.324	-.500	1							
TDS		-.560	.202	-.719	1						
pH		-.132	-.750*	.561	-.072	1					
EC		-.745*	.300	.190	-.074	.338	1				
DO		.266	.558	-.049	-.597	-.688	.042	1			
BOD		.592	.316	-.166	-.436	-.740*	-.542	.784*	1		
PhosW		.171	-.374	-.559	.641	.038	-.656	-.548	-.051	1	
NitrW		-.815*	.517	-.473	.628	-.049	.328	-.259	-.245	.119	1

Source: Field Survey. **Key:** Air temp –Air temperature, Water temp – water temperature, Transp – Transparency, TDS – Total dissolved solids, EC – Electrical conductivity, DO – Dissolved oxygen, Org. P = organic phosphate

Table 8: Correlation between fish abundance and water quality parameters in Lower Ogun River, Akomoje, Abeokuta. Ogun state

	Air temp	**Water temp**	**Transp**	**TDS**	**pH**	**EC**	**DO**	**Org. P**	**Nitrate**
Chrysichthys *nigrodigitatus*	-0.397	0.258	0.680	-0.489	0.156	-0.491	-0.405	-0.285	-0.186
Chrysichthys *auratus*	0.004	-0.151	0.588	-0.604	-0.178	-0.526	-0.224	-0.415	-0.392
Tilapia zilli	-0.229	0.035	0.629	-0.487	0.122	-0.447	-0.343	-0.167	-0.108
Oreochromis niloticus	-0.184	-0.017	0.598	-0.542	0.086	-0.494	-0.245	-0.174	-0.123
Tilapia mariae	-0.436	0.268	0.497	-0.326	0.258	-0.323	-0.437	-0.081	0.013
Schilbe mystus	0.049	-0.124	0.284	0.245	0.045	0.306	-0.716*	0.067	0.039
Mormyrus rume	-0.808	0.635	0.496	-0.281	0.659	-0.378	-0.292	0.183	0.348
Synodontis batensoda	0.801	-0.731*	-0.052	-0.439	-0.890*	-0.292	0.403	-0.663	-0.793
Synodontis budgetti	0.521	-0.403	0.409	0.029	-0.467*	0.082	-0.304	-0.447	-0.540
Synodontis schall	-0.225	.0790*	0.621	-0.479	0.025	-0.443	-0.392	-0.308	-0.245
Heterotis niloticus	-0.233	0.068	0.085	-0.759*	-0.027	-0.727	0.429	-0.219	-0.144
Clarias gariepinus	-0.064	-0.093	0.740	-0.417	0.119	-0.393	-0.271	-0.115	-0.090
Malapterurus electricus	-0.175	-0.018	0.441	-0.460	0.032	-0.394	-0.294	-0.173	-0.128
Parachanna obscura	0.518	-0.414	-0.063	0.298	-0.466	0.388	-0.339	-0.239	-0.349

Key: Air temp –Air temperature, Water temp – water temperature, Transp – Transparency, TDS – Total dissolved solids, EC – Electrical conductivity, DO – Dissolved oxygen, Org. P – Organic phosphate

DISCUSSION

The fish families and species identified from this water body during the study revealed a decline in the fish assemblage of this water body as there were differences when compared to the findings of Adeosun *et al*. (2012) who recorded thirty-two species from thirteen families from this same water body. This variation could be due to low fish productivity, human activities on and around the water body resulting to either overfishing of the resource or pollution of the water body and environmental degradation which could inturn result to depletion of the fish abundance. This decline in the fish species assemblage was also confirmed by the study of this water body as reported in the undergraduate research work of Oyerogba (2011) and published in the University Journal. This finding also corroborated earlier studies on the effects of anthropogenic activities on fish and aquatic environment (Bukola *et al.,* 2015), aquatic ecosystem (Oribhabor, 2016) and macrobenthic assemblage (Moslen and Ameki, 2018).

Total abundance of species by number revealed the high presence of the Bagrid species with 661 samples from two species followed by the Cichlids with 193 samples from three species. This however agreed with the findings of Adeosun *et al.* (2012) who reported the dominance of the Bagrid *C. nigrodigitatus.* Also, Adeosun *et al*. (2010) and Odulate (2016) reported similar findings in their study of both Ikere gorge, Oyo State and Asejire Lake, Ogun State both in the South West of Nigeria. Falaye *et al*. (2015) reported that of the total catch from Erelu Reservoir, Oyo State, 72% were dominated by *O. niloticus, Raiamas senegalensis, C. nigrodigitatus, Sarotherodon melanotheron, S. mystus* and *T. marie*. This finding implies the high number and dominance of these families in the South West, Nigeria. However, differences in fish composition of this water body and that reported by Falaye *et al*. (2015) could be attributed overexploitation of *C. nigrodigitatus* from Erelu Reservoir. It could also be due to migration, recruitment, differences in time, gear and climatic condition.

The dominance of *C. nigrodigitatus* in this study indicated that they are among the major river pelagic fish, most valuable and abundant in the artisanal fisheries of Nigeria. Ellenbroek (1987) opined that the dominant species in a community largely determine the structure and the functioning of the community. Also, the richness of the species throughout the sampling period could also be attributed to its successful adaptation within its environment due to its diverse feeding habits and low predation. It could also be due to its ability to tolerate to some extent adverse environmental conditions. The abundance of *C. nigrodigitatus* and other fish species recorded in the month of August indicated food abundance from primary productivity and nutrient influx from agricultural and domestic runoff. It could also be that the water condition was suitable for the species.

The diversity indices of any water body give an idea of how rich the water body is in terms of fish species and the state of the water. Akomoje drainage basin has high species diversity; however, this rich diversity is not evenly distributed. The high diversity of the water body could be due to the excellent condition of the water. It could also be due to variety of habitat, abundance of water and food resources, competition, vegetation diversity which affects the food chains and the geography of the location. The more varied the habitats, the more the population when compared to less variable habitat. Others causes of the rich diversity include latitudes (solar radiation) and longitudes. The diversity observed in this water body agreed with the findings of Lawson *et al*. (2013). Similar findings were reported by Sweke *et al.* (2013) in Lake Tanganyika

Also, the high distribution of all species observed in the offset of the rains (August and October) (Table 5) could be due to the migration pattern of fish during the wet months into the reservoir resulting to more fish harvest by fishermen. This corroborated the findings of Offem *et al*. (2011) who reported higher number of species in the dry season than wet. However, the findings of this study were not in agreement with that reported by (Lawson and Olusanya 2010) who reported high fish species abundance in the wet month of July.

The fluctuations observed in the water parameters throughout the study indicated steady influx of nutrients and particles into the drainage basin during this period. However, DO was observed to have direct relationship with temperatures. Dimowo (2013) reported similar relationship between DO and temperature. However, levels of pH were observed to drop with rise in temperature during the study. Mean temperature was comparable to the one reported by Adeosun *et al*. (2014) for this water body, but the level of DO was however, lower in their study than observed in this study. Dimowo (2013) reported similar temperature level as observed in this study. High levels of phosphate and nitrate recorded during the study especially in the month of August also confirms the influx of dissolved nutrients from runoff into the water resulting to increased primary productivity and corresponding increased in fish composition.

Negative correlation obtained between some water quality parameters indicated that increase in one parameter, will result to corresponding decrease in another. Of importance, the high negative correlation between water temperature and pH of the study area indicated that any increase in the water temperature or pH will cause a decrease in either one. This could be very lethal to the fish life present in the water body as pH levels 4 and below and 9 above could be very detrimental to the life in the water. Similar correlation obtained for BOD and EC could also be bad for the fish life hence, there is need to constantly monitor these parameters to save the fish life. Also, negative correlation obtained between water quality parameters and fish abundance in the study area indicated that any further increase in the water quality parameter than the recorded value will lead to a corresponding depletion in the species richness of the lower Ogun Reservoir drainage basin, Akomoje.

The fish species abundance of the lower River Ogun Reservoir drainage basin, Akomoje, comprised of 1012 fish species from 9 families and 14 species. The most dominant fish species were the Bagrids, Cichlids, Clariids and Malapteruridae represented by *C. nigroditatus, T. zilli, O. niloticus, C. gariepinus, C. auratus* and *Malapterurus electricus.* The study further concludes that the water quality parameters of the study location measured during this study were still within tolerable range to fish survival, however, with the negative correlation obtained between fish abundance and water quality parameters, human activities around this river should be monitored to prevent pollution of the water body. Finally, the fish population of this river basin has been well depleted.

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REFERENCES

Ademoroti, C.M.A. (1996). Standard Methods for Water and Effluent Analysis (pp. 29-118). Foludex Press Ltd., Ibadan.

Adeosun, F.I.; Omoniyi, I.T.; Samsons, Y.A. and Agbon, A.O. (2010). The fin fish assemblage of Ikere gorge, Oyo State Nigeria. In: proceedings of Fisheries Society of Nigeria (FISON) Ascon, Badagry 25th-29th October 2010. 266-271 pp.

Adeosun, F.I. (2012). The Fin Fish Assemblage of Lower Ogun river, Akomoje Ogun state Nigeria. Nigerian J. Animal Sci., 14: 174-180.

Adeosun, F.I.; Akin-Obasola, B.J.; Oyekanmi, F.B. and Kayode, J.O. (2014). Physical and Chemical Parameters of Lower Ogun River Akomoje, Ogun State, Nigeria. Fisheries Aquacul. J., 5: 1-5. doi:10.4172/2150-3508.1000088

Bukola, D.; Zaid, A.; Olalekan, E.I.; Falilu, A. (2015). Consequences of Anthropogenic Activities on Fish and the Aquatic Environment. Poult Fish Wildl Sci 3: 138. doi:10.4172/2375-446X.1000138.

Dimowo, B.O. (2013). Assessment of Some Physico-chemical Parameters of River Ogun (Abeokuta, Ogun State, Southwestern Nigeria) in Comparison With National and International Standards. Int. J. Aquacul., 3: 79-84. Doi: 10.5376/ija.2013. 03.0015

Dudgeon, D.; Arthington, A.H.; Gessner, M.O.; Kawabata, Z.; Knowler, D.J.; Lévêque, C.; Naiman, R.J.; Prieur-Richard, A.; Soto, D.; Stiassny, M.L.J. and Sullivan, C.A. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. Biologia Revista, 81:163-182.

Ellenbroek, G.A. (1987). Ecology and Productivity of an African Wetland System. The Kafue Flats, Zambia. In: Geobotany (pp. 33-43). Springer Netherlands.

Falaye, A.E.; Ajani, E.K.; Kareem, O.K. and Olanrewaju, A.N. (2015). Assessment of Ichthyofaunal Assemblage of Erelu Reservoir, Oyo, Nigeria. Ecol., 5: 43-53.

Galloway, J.N.; Dentener, F.J.; Capone, D.G.; Boyer, E.W.; Howarth, R.W.; Seitzinger, S.P.; Asner, G.P.; Clevelandm, C.C.; Green, P.A.; Holland, E.A.; Karl, D.M.; Michaels, A.F.; Porter, J.H.; Townsend, A.R. and Vörösmarty, C.J. (2004) Nitrogen cycles: past, present, and future. Biogeochem., 70: 153-226.

Idodo-Umeh, G. (2003). Freshwater fishes of Nigeria: Taxonomy, Ecological notes, Diet and Utilization. 232 p. Idodo Umeh Publisher, Benin, Nigeria, ISBN-13: 9789788052012.

Lawson, E.O.; Doseku, P.A. and Ajepe, R.G. (2013). Fish Assemblage of Majidun Creek, Lagos, Nigeria. J. Biol. Sci., 13: 577-586. DOI: 10.3923/jbs.2013.577.586

Moslen, M. and Ameki, C.F. (2018). Impacts of Human activities on the MacroBenthic Assemblage of a Stream in the Niger Delta, Nigeria. SF J Environ Earth Sci., 1(1): 1011-1017.

Odulate, D.O. (2016). Ichthyofauna diversity in Asejire Lake, Southwest, Nigeria. 5th International conference on Biodiversity, Madrid, Spain. J. Ecosys. Ecograph., 6: 61. http://dx.doi.org/10.4172/2157-7625.C1.024

Offem, B.O.; Ayotunde, E.O.; Ikpi, G.U.; Ochang, S.N. and Ada, F.B. (2011). Influence of Seasons on Water Quality, Abundance of Fish and Plankton Species of Ikwori Lake, South-Eastern Nigeria. Fisheries Aquacult. J., 2011: FAJ-13.

Olaosebikan, B.D. and Raji, A. (1998). Field Guide to Nigerian Freshwater Fishes. Federal College of Freshwater Fisheries Technology, New Bussa, 106 p.

Oribhabor, B.J. (2016). Impact of Human Activities on Biodiversity in Nigerian Aquatic Ecosystems. Sci. Int., 4: 12-20

Oyerogba, O.O. (2011). The fin fish assemblage of the freshwater reaches of the lower Ogun River, Ogun State, Nigeria. An undergraduate project write-up of the Department of Aquaculture and Fisheries Management, Federal University of agriculture, Abeokuta. 34p.

Sala, O.E.; Chapin, F.S.; Armesto, J.J.; Berlow, R.; Bloomfield, J.; Dirzo, R.; Huber-Sanwald, E.; Huenneke, L.F.; Jackson, R.B.; Kinzig, A.; Leemans, R.; Lodge, D.; Mooney, H.A.; Oesterheld, M.; Poff, N.L.; Sykes, M.T.; Walker, B.H.; Walker, M. and Wall, D.H. (2000). Global biodiversity scenarios for the year 2100. Sci., 287: 1770-1774.

Sweke, E.A.; Assam, J.M.; Matsuishi, T. and Chande, A.I. (2013). Fish Diversity and Abundance of Lake Tanganyika: Comparison between Protected Area (Mahale Mountains National Park) and Unprotected Areas. International Journal of Biodiversity, 1:10 pages. https://doi.org/10.1155/2013/269141.

Worldfish (2015). Why fish? Retrieved from https://www.worldfishcenter.org/why-fish 5/03/2019.