

BIODIVERSITY OF FISH SPECIES IN ERE RIVER, ADO-ODO AXIS OF OGUN STATE, NIGERIA.

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Abstract

The purpose of this study is to determine fish species biodiversity in Ere River. Monthly collection of Fishes from fishermen was from March to August 2018. A total of 626 fish species were studied. Biodiversity indices were determined using: Simpson's index (d), Reciprocal index ($1/d$) and index of diversity ($I-d$). Water samples were collected randomly at different fishing spots on the river bi-monthly for six months for Physico-chemical analyses: temperature ($^{\circ}\text{C}$), pH, total dissolved solids (mg/L), and conductivity ($\mu\text{s}/\text{cm}$) were conducted in-situ using HANNA multi-parametric meter (Hi 98129). While Dissolved Oxygen, Nitrate, Phosphate, Alkalinity and Hardness (mg/l) were determined ex-situ using standard methods. Fish species percentage composition is 8 families, 8 genera and 10 species including *Oreochromis niloticus*, *Tilapia zilli*, and *Sarotherodon galileaus*, *Papyrocranus afer* (42%), *Heterotis niloticus*, and *Parachanna obscura* (8%), *Chrysichthys nigrodigitatus* (9%), *Clarias gariepinus* (10%), *Calamoichthys calabaricus* (7%), and *Gymnarchus niloticus* (5%). Simpson's index (d) was 0.201, Reciprocal index ($1/d$) was 4.975 and the index of diversity ($I-d$) had 0.799. The Evenness (E) was 0.2336 and Shannon-Weiner index (H) 1.804. Physico-chemical parameters and heavy metal content of the water were within the WHO recommended limit for adequate fishing. The study recommends better management of the fisheries.

Keywords: Fish biology, water chemistry, fisheries, and management

INTRODUCTION

Fish provides a variety of health benefits because of its high-protein and low-fat content. White-fleshed fish, specifically, has low fat than any other source of animal protein, and oily fish have high omega-3 fatty acids which is known to be the "good" fats. Fish are an important part of the diet since the human body cannot make considerable amounts of these essential nutrients. Fish are also low in the "bad" fats commonly found in red meat, referred to as omega-6 fatty acids. It is rich in protein, oil and other essential mineral requirements for sound and healthy body growth and also has low cholesterol level therefore in high demand all over the world. It is also a good source of omega-3 fatty acids, vitamins D and B2, calcium, phosphorus, iodine, iron, zinc, magnesium, and potassium, which are essential for healthy living (FAO, 2007). According to Asiwaju, (2011) biodiversity describes population dynamics of a location or community and a measure of the species that makes up a biological community and is considered to be one of the most important elements of community organization and structure. The former is the number of different species in a given area and this is the fundamental unit with which to evaluate the homogeneity of an environment and commonly used in conservation studies to determine the sensitivity of ecosystems and their resident species, while the latter describes how common or rare a species is relative to other species in a given community and are usually described for a single trophic level (Lawson and Olusanya, 2010).

The purpose of this study is to determine biodiversity, richness, and abundance of fish species in Ere river (Ado-Odo), Ogun state of Nigeria. The study was conducted during the dry season; therefore, a complementary study in the wet season would be necessary. Although there was increased fishing activity on this water body, there was no documented report/research; especially on the fish and fisheries of the River. Therefore, this present study serves as the first documented report on species biodiversity, Physico-chemical analysis of the water, distribution, and abundance of fish species on River Yewa.

Study Area

The Yewa River runs along the border with the Republic of Benin. The river is situated within a West African tropical climate zone, It lies approximately within latitudes $\text{N}6^{\circ} 22'$ and $6^{\circ} 36'$ and longitudes $\text{E}2^{\circ} 50'$ and $2^{\circ} 54'$ of the Greenwich Meridian and its elevation is sea level and the basin has a total catchment area of approximately 5000 km^2 . The river is an important source of fishing for local inhabitants, it is also an important factor in logging, sand mining operations and transportation, it is acts as a major smuggling route used for the smuggling of various contrabands such as rice, frozen foods, textile materials, ammunition, vegetable oil, etc into Nigeria and petrol out of Nigeria to the Republic of Benin. Ado-Odo (study area), Akabo, Apamu, Atan, Badagry, Igunnu, and Ilaro are the major towns settled along the Yewa

River in Nigeria, the inhabitants of these towns are mostly artisanal fisherfolks, farmers, hunters, traders and smugglers from Awori, Egun, Ijaw, and Ilaje tribes. The major sources of the river are the Atan and Ilaro rivers and it empties into Badagry Creek which empties in turn into Lagos Harbor.

Materials and Methods

Sampling

Physical observation of human activities around the coastline, chemical analysis both *in situ* and *ex-situ* as well as the presence of small scale fishing activities was observed in the cause of the pre-sampling period. A census of all gears operating at the study area was undertaken; frequency of usage and composition of catches of the gears was done. The gears include; seine nets, gill nets, Attalla (lift nets), bamboo trap and basket trap. Total catch by species was recorded for all gillnets, seine nets, cast nets, Long-line, Bamboo traps, and Basket traps, operating during this period. A catch assessment monitoring questionnaire developed during this study was used to acquire primary information; catch monitoring data were collected right at the landing sites weekly. Total weekly catches by gear type were estimated from their average catch rates and average number of gears recorded weekly.

Fish Sample Collection

Edible fishes were procured from the fishermen on the river monthly from March to August 2018. The sampling gears used for fishing by the fishermen include basket traps, baited long lines, cast nets and set gill net. A total of at least 12 samples of each fish species were collected for the analysis. The samples were transported in an ice chest to the Fisheries Laboratory at the Department of Fisheries, Lagos State University, Ojo, Lagos State for proper identification and examination. Fish identification was made to the lowest taxonomic level using identification guide books prepared by Holden and Reed (1972) and Olaosebikan and Raji (1998). The fish abundance was calculated as the total number of fish sampled. Sampled fish were counted for each species and recorded. Relative abundance of species was calculated by dividing number making up a species by the total number of fish sampled multiplied by 100% while the relative abundance of families is the number of each fish family divided by the total number of fish sampled multiplied by 100%. The total and standard length of fish sampled were measured using a measuring board graduated in cm. The range of the length-frequency was determined and recorded. Weight was measured using a weighing balance and the weight of Five fish samples were taken randomly from the total catch landed by each active canoe to estimate the average catch, the weight of these samples and the weight of the total catch were taken for the three days (Thursday, Friday and Saturday)

of the fieldwork in a week by using sensitive scale and weighing balance.

Laboratory procedure

The fishes were immediately preserved in formalin solution and transferred into the laboratory before the analysis. The fishes were removed from the formalin and excess water was removed from the specimen using filter paper. A total of 626 fish species were studied. The length of the fishes measures to the nearest centimeter from the tail to the tip of the mouth using a measurement ruler. Total weight for each fish specimen was carried out using Weighing Balance and Sensitive scale before dissection. Each was dissected by removing the stomach content into a Petri-dish containing little water. The stomach content was later examined under a microscope and the various food items identified and counted individually.

Condition factor (K)

It is the condition of the general wellbeing of fish species. It was studied in relationship to size. Bannister (1976) gave the equation for condition factors as follows: $k=100W / L^3$

Where K =condition factor, W =weight of the fish (g), L =length of the fish (cm)

Relative Abundance and Biomass

The average weight of these samples was used to estimate the number of individuals from the total catch for the week. The average weight of 120 samples were recorded and used to estimate the number of individuals in the recorded weights at the landing site for 6 months, except for the species with less abundance whose weight was summed directly. The estimated catch per canoe was multiplied by the number of active canoes per day, then by 30 per month, and by 6 for the period of this study. Minimum of 2 samples were usually taken from each species and preserved in formalin of 40% concentration for identification. In the laboratory, identification of these preserved samples was carried out following Olaosebikan and Aminu (2004), and Adesulu (2007). The biometric data such as total length was taken to the nearest grams.

The percentage biomass was calculated with the formulae:

$$\frac{W1 \times 100\%}{W2}$$

Where $W1$ = weight of all samples of a particular fish species $W2$ = total weight of the entire fish sample collected. Length frequency distribution is the number of times a particular length class occurred. This was obtained by counting the number of lengths of fishes falling within the same range or class.

Diversity Indices

The diversity index of fish species for this period in the Iwopin axis of Ogun estuary was calculated. The diversity using Simpson's index (d) was calculated, while the Reciprocal index as (1/d) and index of diversity (1-d). In nature, the value (d), ranges between 0 and 1 (Lawson and Olusanya, 2010), indicating finite diversity and 1, no diversity, the bigger the value the smaller the diversity, While in Simpson's index of diversity (1-d) represent the probability that 2 individual fish randomly selected from a sample will belong to deferent species. This value also ranges between 0 and 1, the greater the value the greater the sample diversity. Also, the Simpson's reciprocal index 1/d, the value of this index starts from 1 representing a community with 1 specie. The higher the value, the greater the diversity.

- Simpson's Index (d) = $\frac{1}{\sum n(n-1) / N(N-1)}$
- Simpson's Reciprocal Index = 1/d
- Simpson's Index of Diversity = 1-d
- Evenness = (E)
- Shannon-Weiner index (H) = $-\sum p_i \ln p_i$

Collection of Water Samples

Water samples were collected randomly at different points within the active fishing spots on the river bi-monthly for six consecutive months (March-August 2018) for Physico-chemical analyses. Water temperature (°C), pH, air temperature (°C), total dissolved solids (mg/L), conductivity (µs/cm) and were conducted *in-situ* with the use of HANNA Combo pH and EC multi meter Hi 98129 and Mercury-in-glass thermometer while Dissolved Oxygen (mg/L), Nitrate (mg/L), Phosphate (mg/L), Alkalinity (mg/L) and Hardness (mg/l) were determined *ex-situ* using standard methods for examination of water at the Fisheries Laboratory of Lagos State University, Ojo, Lagos State.

Statistical Analysis

Analyses of the Physico-chemical parameters of the water was subjected to One-way Analysis of Variance (ANOVA), standard length-body weight relationship was established using regression and correlation analyses. While length-weight relationships of the fish was evaluated using descriptive analysis. While the diversity indices of the fish were established using Shannon Weaver and Dominance index analysis.

Results

Relative Abundance and Biomass

Fish species composition of this study comprised of 8 families, 8 genera and 626 species as shown in Table 1. The monthly collection of sample is shown in table 2. This composition indicated the presence of fish from fresh and brackish water. A total of 626 species were examined in the study: *Oreochromis niloticus* (120), *Tilapia zilli* (80), *Sarotherodon galileaus* (62), *Papyrocranus afer* (30), *Heterotis niloticus* (51), *Parachanna obscura* (48), *Chrysichthys nigrodigitatus* (60), *Clarias gariepinus* (60), *Calamoichthys calabaricus* (45), and *Gymnarchus niloticus* (70). From March to August 2018 from Ere river, Yewa river extension, Ado Odo-Ota, Ogun State. Size composition/ Abundance of all the available species was analyzed. Monthly faunistic diversity included: Cichlidae which was represented by *Tilapia zilli*, *Oreochromis niloticus*, and *Sarotherodon galileaus*; Notopteridae by *Papyrocranus afer*, Channidae by *Parachanna africana*, Osteoglossidae by *Heterotis niloticus*, Bagridae by *Chrysichthys nigrodigitatus*, and Clariidae by *Clarias gariepinus*, Polypteridae by *Calamoichthys calabaricus* and *Gymnarchidae* by *Gymnarchus niloticus*.

Table 1: List of identified fish by families, genera, and species in Ere river, Ado Odo-Ota, Ogun State

S/N	Family	Genus	SPECIES
1	Cichlidae	Oreochromis Tilapia Sarotherodon	<i>Oreochromis niloticus</i> <i>Tilapia zilli</i> <i>Sarotherodon galileaus</i>
2	Notopteridae	Papyrocranus	<i>Papyrocranus afer</i>
3	Osteoglossidae	Heterotis	<i>Heterotis niloticus</i>
4	Channidae	Parachanna	<i>Parachanna obscura</i>
5	Bagridae	Chrysichthys	<i>Chrysichthys nigrodigitatus</i>
6	Clariidae	Clarias	<i>Clarias gariepinus</i>
7	Polypteridae	Calamoichthys	<i>Calamoichthys calabaricus</i>
8	Gymnarchidae	Gymnarchus	<i>Gymnarchus niloticus</i>

Table 2: Monthly collection of all Species

Month	<i>O. niloticus</i>	<i>T. zilli</i>	<i>S. galileaus</i>	<i>P. afer</i>	<i>H. niloticus</i>	<i>P. obscura</i>	<i>C. nigrodigitatus</i>	<i>C. gariepinus</i>	<i>C. calabaricus</i>	<i>G. Niloticus</i>
March	20	15	9	8	8	18	13	9	6	22
April	15	20	8	4	9	14	7	16	1	8
May	22	10	10	5	7	7	12	6	11	7
June	16	7	11	4	13	2	8	5	12	15

July	17	16	4	7	6	3	11	14	8	9
August	30	12	20	2	8	4	9	10	7	9
Total	120	80	62	30	51	48	60	60	45	70

Table 3: Length, Weight and K-Factor of Sampled fish in Ere River between March 2018 And August 2018

S/N	Species	Mean weight (g)	Mean Total Length (cm)	Mean Standard Length (cm)	K-Factor
1)	<i>Oreochromis niloticus</i>	543.81	22.29	17.93	4.910
2)	<i>Tilapia zilli</i>	248.86	14.66	12.37	7.899
3)	<i>Sarotherodon galileaus</i>	300.22	16.02	13.95	7.302
4)	<i>Papycrocranus afer</i>	392.21	21.2	18.3	4.116
5)	<i>Heterotis niloticus</i>	600.87	32.25	29.82	1.791
6)	<i>Parachanna obscura</i>	574.36	30.39	25.88	2.046
7)	<i>Chrysichthys nigrodigitatus</i>	100.35	15.69	16.45	2.598
8)	<i>Clarias gariepinus</i>	143.31	23.15	20.92	1.155
9)	<i>Calamoichthys calabaricus</i>	25.25	18.69	17.98	0.387
10)	<i>Gymnarchus niloticus</i>	815	51.3	47.25	0.604

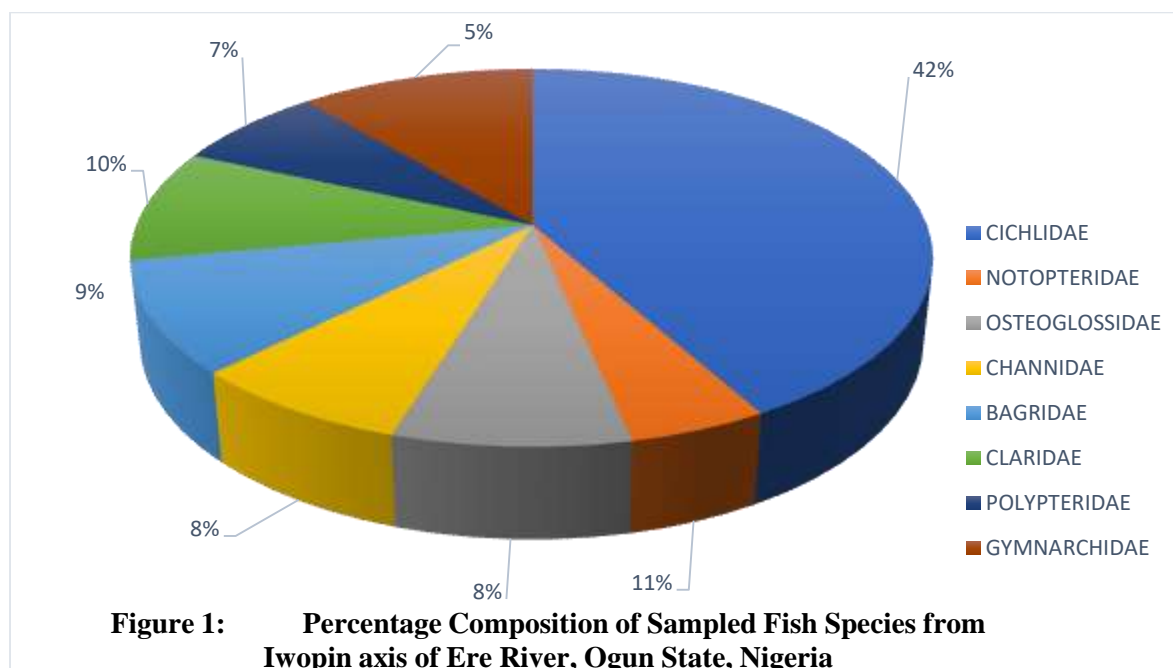


Table 3 shows length-weight relationships/status in the River and the relative condition factors as an indication of their well-being based on food availability and completion along the food chain. The most abundant group as shown in figure 1 is the cichlids family by three different species i.e. *Tilapia zilli* and *Oreochromis niloticus*. Cichlidae family as it has the highest percentage (42%) contribution to the total catch of this study period and the second most abundant is the family was Gymnarchidae with *Gymnarchus niloticus* having (11%), followed by Clariidae (10%), Bagridae (9%), Channidae and Osteoglossidae both having (8%), followed by Polypteridae (7%) and Notopteridae (5%) respectively. The summary of the fish composition of this study and their size ranges were presented while their relative abundance and their respective percentage contribution. The fish

population of this location indicated the presence of some fingerlings, juveniles, and Adults. The fish size ranges between 4.40cm and 19.2cm in Length.

The diversity index of fish species for this period indicated low fish species diversity in Iwopin axis of Ogun estuary as shown in table 4. The diversity using Simpson's index (d) was 0.201, while the Reciprocal index (1/d) was 4.975 and the index of diversity (I-d) had 0.799. Simpson's Index (d) was 0.201. Simpson's Reciprocal Index was 0.799; Simpson's Index of Diversity had 4.975. The Evenness (E) was 0.2336 and Shannon-Weiner index (H) 1.804.

The air temperature variation recorded showed minimal variation and ranged between 25.8°C and 31°C. The highest temperature value (31°C) was recorded both in November and December respectively while the lowest value

(25.8°C) was recorded in February. The average value is 28.1 and standard deviation of ±2.08. The results of the physicochemical parameters are shown in table 4. The surface water temperature variation of the Tomaro creek ranged between 25.9 and 30.5°C. The highest temperature value (30.5°C) was recorded in March while the lowest temperature value (25.9°C) was recorded in February. The lowest value recorded during the wet season was 30.5°C recorded in October and the lowest value during the dry season was 26°C recorded in February and March. The average value is 27.98 and a standard deviation of ±1.64. The transparency level showed a very wide range of variations between 25 and 174cm. The transparency level showed that the highest transparency level value of 174cm was recorded in February. The lowest value during the wet season was 25cm recorded in October and 128.5cm during the dry season in January, while the lowest transparency level value of 25cm was

recorded in October with an average value is 111.17 and standard deviation of ±44.18. The total suspended solids range between 16 and 240mg/L. The lowest value recorded was both 16mg/L in November and December respectively and the highest value recorded 240mg/L was in March. The lowest value during the wet season was 16mg/L recorded in November and 33mg/L during the dry season in January, while the average value is 24.5 and standard deviation of ±13.89 (Fig 2). The total dissolved solids steadily increased greatly with the months and the values ranged between 1716mg/L and 20472mg/L. The highest value 20472mg/L was recorded in February, while the lowest value of 1716mg/L was recorded in October. The lowest value during the wet season was 1716mg/L recorded in October and 16880mg/L during the dry season in January, while the average value is 11526.33 and standard deviation of ±8459.89 (Fig 3).

TABLE 4: Mean Monthly Variations of Physico-Chemical Parameters at Ere River (March-August 2018).

Parameters	Mar.	Apr.	May	Jun.	Jul.	Aug.	Mean	SD
Air Temperature (°C)	30.5	30	31	27.8	26	26	28.13	±2.08
Water Temperature(°C)	174	28.2	29.1	27	30.5	30.5	27.98	±1.64
Transparency(cm)	25	61.8	98.5	128.5	174	174	111.17	±44.18
pH at 26°C	7.32	7.38	7.33	7.6	7.67	7.53	7.47	±0.15
Conductivity (µS/cm)	3270	5730	19930	31000	38700	37300	22655	±15.54.
Rainfall (mm)	87.9	19.5	8.9	74.4	17.6	44.5	24.5	±13.89
Total Suspended Solids	32	16	16	102	33	240	73.17	±87.76
Total Dissolved Solids	1716	2530	8220	16880	20472	19340	11526.3	±84.89
Salinity(‰)	-	-	-	-	-	-	-	-
Acidity (mg/L)	1.8	2.9	6.6	6.5	7.5	7.5	5.47	±2.48
Alkalinity (mg/L)	70	70	385	281.2	1190	1255.1	541.88	±51.59
Total Hardness (mg/L)	764.5	843	2780	4173	7645	7880	4014.25	±71.5
Calcium (mg/L)	27.8	55.6	170	511.5	2080.1	2001.1	807.68	±97.72
Magnesium (mg/L)	170	166.3	574.4	723.9	583.2	590.4	468.03	±23.69
Zinc (mg/L)	0.006	0.008	0.02	0.007	0.011	0.022	0.01233	±0.01
Iron (mg/L)	0.11	0.14	0.16	0.19	0.1	0.25	0.15833	±0.06
Copper (mg/L)	0.002	0.003	0.002	0.003	0.005	0.004	0.0032	±0.00
Chloride (mg/L)	725	1450.3	5220	8120	12125	11000	6440.05	±47.2
Nitrate (mg/L)	5	3	3.2	4.8	0.7	4.1	3.466	±1.58
Sulphate (mg/L)	25.5	116.5	480	610.2	1112.5	1150	582.45	±47.83
Phosphate (mg/L)	1.8	0.6	0.25	3.5	1.1	0.3	1.2583	±1.24
Silica (mg/L)	1.6	3.6	2.9	4.2	3.4	3	3.12	±0.877
B O D (mg/L)	80	24	50	24	25	33	39.33	±22.29
CO D (mg/L)	260	128	505	118	188	68	211.17	±58.33
D O (mg/L)	4.2	3.6	4	3.8	5.4	4.8	4.3	±0.68
Chlorophyll- <i>a</i> (µg/L)	9	15	12	22	16	6	13.33	±5.65
Species abundance (N)	128	102	97	93	95	111	104.33	±

Rainfall data showed a distinct monthly variation ranging between 8.9 and 87.9mm. The highest amount of rainfall 87.9mm was recorded in October while the lowest amount of rainfall 8.9mm was recorded in December. The lowest value during the wet season was 8.9mm recorded in December and 17.6mm during the dry season in February. The

average value is 24.5 and standard deviation of 13.89.

DISCUSSION

From the data of the physical and chemical parameters from Ere River (Table 4), the temperature was invariably responsible for the

seasonal distribution of fish fauna as there was a slight variation from the wet to the dry season. The air and water temperatures recorded during the study are typical of the area (Emmanuel and Onyema, 2007). Air and water temperatures were relatively higher in the dry months: March-May 2018 than in the wet months: June – August 2018, which could be attributed to increase cloud cover and subsequent reduction in solar radiation. Temperature readings taken monthly for both air and water showed minimal variations and correlated with the works of Beadle (1974) that temperature is not a limiting factor in the tropics as a result of the absence of well-defined season. Thus, the rainfall pattern of a tropical south-west area like Ado Odo Ota has changed remarkably.

This report revealed that Dissolved Oxygen decreases with increased temperature and Biochemical Oxygen Demand due to increase metabolic activities of most species probably inducing bacteria and fungi which are common in polluted sites even in Lagos lagoon (Akpata and Ekundayo, 1983). The relatively high Biochemical Oxygen Demand (BOD) values and the relatively high Dissolved Oxygen (DO) values observed may be due to the photosynthesis activities which released oxygen.

However, in this study, Cichlidae (*Tilapia zilli*, *Oreochromis niloticus*, and *Sarotherodon galileaus*) are most predominant in the study area. It was observed that fishing activities are indiscriminate and no regulatory body supervises fishing activities, thus, overfishing (Growth overfishing and possibly recruitment overfishing) is noticed, concerning a large amount of fishing of juveniles; especially of *Chrysichthys nigrodigitatus*. These juvenile dominant sizes could be as a result of environmental conditions, or competitive feeding among other possible factors. Ikomi and Jessa (2003) reported negative allometric growth for the same species in Ethiopie River. The cichlids had the highest condition factor values: *Oreochromis niloticus* (4.910), *Tilapia zilli* (7.899) and *Sarotherodon galileaus* (7.302). The results presuppose that the river is rich in phytoplankton and receives lots of nutrients from the environment; because most of the species with high condition factors are microalgae feeder/ herbivorous species. Thus, suffices to conclude that other fishes with lower condition factor do not have enough food resources, within this ecosystem are fish eaters (Piscivours), and therefore do not have enough zooplankton, shrimps and small fishes to feed on.

This study agrees with Ikomi and Jessa (2003), who elucidated similar trends and that the fish, especially Piscivours were in low abundance at the beginning of the rainy season and invariably high during the dry season. In March 2017 which can be categorized as Dry season, herbivorous species availability was high with a total number of 128

while in August which tends towards the dry season, a sum of 111 was observed. However, in June and July 2018, species were invariably low in abundance as a result of the rainy season. The rainy season drive into the river lots of obnoxious and toxic substances of anthropogenic sources including soda, paint residues, domestic waste, suspended sand particles (which causes asphyxiation), various chemicals, pharmaceutical waste, etc. when these are washed into the river; it changes the chemistry, lead to bio-accumulation of heavy metals of carcinogenic interest, lead to massive fish kill, migration of resident species to better aquatic environment amongst other impacts. Most mature specimens were laden with ripe gonads during these periods, but the teratogenic nature of the influx would lead to massive recruitment failure. The species with low condition factor values may be associated with lean resource abundance and spawning activities. It was observed that the decrease in K-factor values with increasing size class indicates unfavourable environmental conditions in relation to nutrient availability. Alternatively, improved K-values with increasing size indicate better adaptation to the prevailing environmental condition for other species.

Conclusion

This study could serve as baseline data in assisting relevant bodies in the management and conservation of fisheries resources of this water body because there are dearth and inadequate information relating to fish and fisheries of the study area. It was concluded as follows: K-factor values decreased with increasing fish size, indication poor well-being of the fish species; herbivores were more abundant than the Piscivours in the River; low dissolved oxygen (DO) and relatively high Biochemical Oxygen Demand (BOD) revealed poor environmental condition. Therefore, I recommend that Laws and orders should be enforced by relevant agencies in the management and conservation of the Ere River. The young or early life stages of *Chrysichthys nigrodigitatus* could be properly managed and conserved to the reproductive stage, this resource would enhance fish production in the River.

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