

# Annual Pattern on Abundance and Sex Ratio Distribution of Selected Fish Fauna of Ikere Gorge Reservoir, Oyo State, Nigeria

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## ABSTRACT

Sex ratio affects the growth of wild population, thus, with the declining wild fish population, the study was designed to determine the effect of seasons on the sex ratio of fish population from Ikere Gorge, Nigeria for 18 months. Fish composition, diversity, distribution and abundance were determined according to standard methods. Sexes were determined and sex ratio was calculated using a standard method. A total of 5,823 fish specimens were caught during the period. The captured fish species were identified and classified into 34 species belonging to 13 families. The species richness was higher in the dry months than in the wet months. Fish diversity indices and evenness revealed a better diverse and even ecosystem in the wet season than the dry season. A marked significant difference ( $p < 0.05$ ) was observed between the species in the dry months than the wet season. *Chrysichthys nigrodigitatus* ( $35.07 \pm 7.59a$ ) was significantly ( $p < 0.05$ ) more abundant than the other species in the dry season. The sex ratio was skewed in favour of the female populations for *C. nigrodigitatus*, *Tilapia melanopleura* and *Sarotherodon galilaeus* but the reverse was the case for *L. niloticus* population. No monthly variation was observed in sex ratio of the species. The fish fauna from Ikere Gorge showed marked variations in the catch composition between the dry and wet months. *C. nigrodigitatus* and the Cichlids (*Hemichromis fasciatus*, *S. galilaeus*, *Tilapia macrocephala* and *T. melanopleura*) were present all year.

Keywords: *Chrysichthys nigrodigitatus*, fish composition, *Lates niloticus*, *Sarotherodon galilaeus*, *Tilapia melanopleura*

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## INTRODUCTION

Sex population is the estimation of the abundance of any sex at any particular time under natural condition (Grayson *et al.*, 2014). Sex ratio is a biological parameter that affects the growth rates and ecology of wild populations (Dyson & Hurst, 2004), and it is fundamental to a sexually reproducing population (Gusmão *et al.*, 2013). Adult sex ratio, that is the proportion of sexually mature males and females in a population, is a key demographic parameter (Le Galliard *et al.*, 2005). There had been several reports on the skewedness of sex ratio in favour of either male or female population.

Food availability, predation, differential parental care, sex-specific differences in longevity or mortality, and even sex change can affect sex determination and resulting sex ratios (Jiménez-Melero *et al.*, 2014; Fryxell *et al.*, 2015). Skewed sex ratios are often observed in nature, across the

tree of life and reasons attributed to the aforementioned. Also, among the various traits of natural populations, sex ratio is one of the most studied, and the theory of sex allocation is one of the most successful theories in evolutionary ecology (Gusmão *et al.*, 2013).

Previous documentation on the reproductive biology of wild fish species had been reported. Reichard *et al.* (2014) on female bias in the adult sex ratio of African annual fishes. Seasonal changes in size, sex-ratio and body condition of the damselfish, *Chromis chromis* in the central Mediterranean Sea (Bracciali *et al.*, 2014). Mian *et al.* (2017) on some reproductive aspects of freshwater Garfish, *Xenentodon cancila* from North-East Bangladesh. Adite *et al.* (2017) reported on the reproductive biology and life history patterns of the Claroteid, *Chrysichthys nigrodigitatus* from a man-made Lake in Southern Benin.

Sex ratio can be used to determine the population growth rates and ecology trajectories of a wild population. Thus, gaining a better understanding of the population structure of the fish abundance as well as of the sex variations occurring throughout the year may be very useful in ensuring the early detection of environmental changes. This could also be useful for devising better management and conservation practices of natural water bodies. Also, knowledge of the sex ratio of fishes is important and provides information necessary in assessing the reproductive potential of any population (Jega *et al.*, 2017). There is however, paucity of information on the distribution of fish sexes from the Ikere Gorge. Thus, there is a need to estimate the sex proportion of the fish species in this water body. This study was designed to estimate the annual pattern in the sex ratio of some economically important fish species

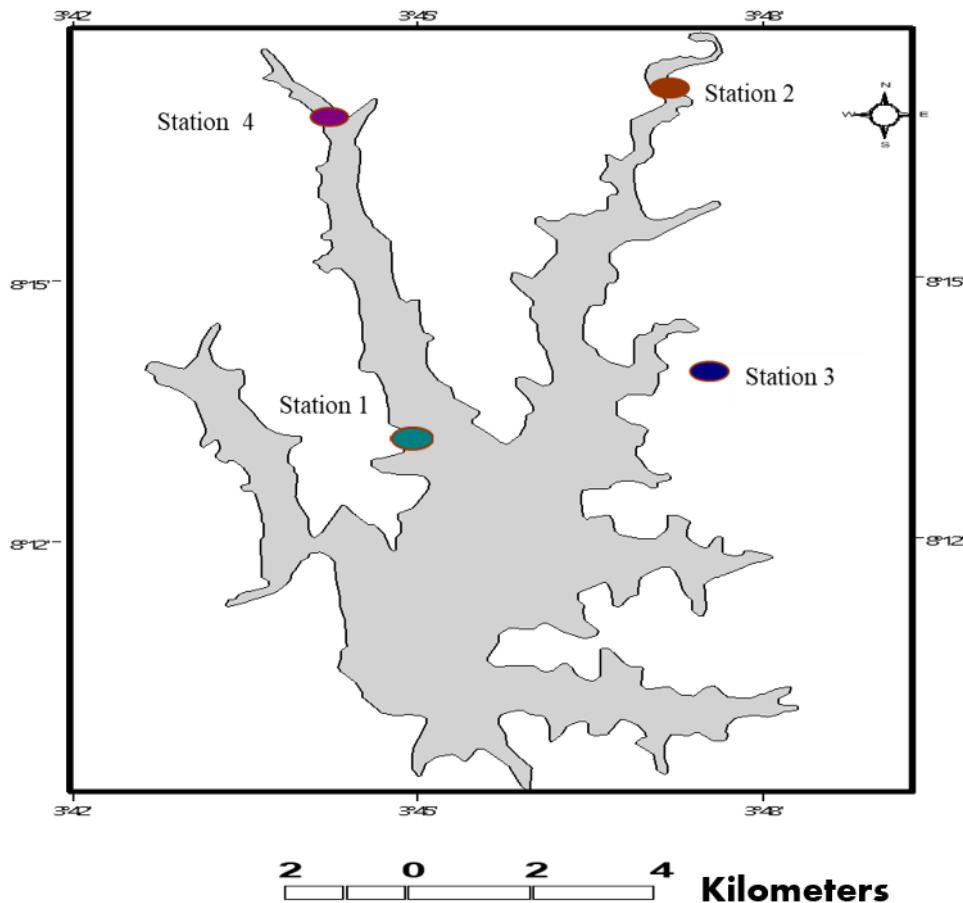
from Ikere Gorge, Oyo State.

## MATERIALS AND METHODS

### Study area

Ikere Gorge is a man-made lake located in Ikere river, 8 km east of Ikere village and 30 km North east of Iseyin in Oyo state, Nigeria. Ikere river takes its source between longitude 8°10' and 8°20'E and latitude 3°40' and 3°50'N. The reservoir has a capacity of 690 million m<sup>3</sup> and a surface area of 47 km<sup>2</sup>.

Samples were collected from four locations in the study area (Figure 1) using ecological (flora and fauna) and hydrological characteristics (high and low water and water flow) and high intensity of fishing activity as selection criteria.



**Figure 1.** Map of Ikere Gorge showing sampling locations

Station 1. This is the dam site of the gorge. It is characterized by high water and high fishing activities. This station is characterized by high flora and fauna community. Fishing villages selected were: Benue camp, Ilaje camp and Egun camp.

Station 2. Covers the Ikere river channel, which consists of flooded bush patches. It is characterized by low water with constant water flow and low water. Fishing villages selected include Abugaga, Elelu, Idoma and Hausa camp.

Station 3. This is open water that covers the in-shore and area occupied by the central or middle portion of the gorge. It covers about 70% of the lake surface area with an average depth of 10.8metres. It is characterized by extend flood plain which is seasonally exposed during the draw- down period. This station is known for its high fishing activities. It has rich fauna and flora community. Fishing villages selected include Aba-asamu and Togolis camp.

Station 4. Covers the shallow bays location of the gorge, this is an intake tower of the gorge. It has a characteristic rich fauna and flora community and fishing activities always ongoing. The two fishing villages selected were: Bendel and Agatu camp, respectively.

### Sampling Method

Sampling locations were selected using purposive sampling. Sampling of each station for fish composition and abundance was done on a monthly basis using a fleet of 8 graded experimental gillnets (mesh sizes 25.4, 38.1, 50.8, 63.5, 76.0, 88.5, 126.4 and 177.2 millimeters) and cast net (50.8 mm) of surface area 50 square meter deployed at 5 m depth. Samples were taken on the first three days of the first week of every month covering eighteen calendar months of wet (April - September) and dry months (October - March). Gears were set at dusk and retrieved at dawn in all stations. Fish species identification and identification of sexes were carried out from landing sites. The nets were set in different ecological zones: in open water, flooded bush patches and shallow bays. Catches were also collected from long-lines, fish traps, and hollow cylinders made from bamboo and set hooks to provide a comprehensive picture of fish species in the lake.

### Water Quality Assessment

Temperature, dissolved oxygen and hydrogen ion concentrations of the various locations were measured in situ using the HANNA Multiparameter pH/ORP/DO/Pressure/Temperature Waterproof Meter, Model HI98196.

### Fish Composition, Distribution and Abundance

Catch from landings were enumerated, examined, sorted to species level, and weight, length and biomass number of fish species recorded. Catches were labeled according to locations as station 1, 2, 3, and 4 and conveyed to the laboratory of the Department of Aquaculture and Fisheries Management in ice-chest for further studies. Fish samples were identified using taxonomic keys (Olaosebikan & Raji, 1998). Species representation in each station and seasons were analyzed using statistical tools. Biodiversity of the water body was also investigated using the Simpson and Shannon-Weiner diversity indices.

### Sex Ratio

Sexes of species of economic importance (*Chrysichthys nigrodigitatus*, *Lates niloticus*, *Tilapia melanopleura*, and *Sarotherodon galilaeus*) were determined according to Bahrami *et al.* (2015). The sexes of the sampled fish species were visually determined by the inspection of the gonads. While some samples could easily be discerned by mere observation of the reproductive organs, others were observed by making slits on the ventral side of the fish to expose the gonads. For juveniles and immature specimens, magnifying glasses were often used. Records of observations were kept.

### Data analysis

One-way Analysis of Variance (ANOVA) followed by Duncan Multiple Range Test (DMRT) was carried out using Statistical Package for Social Science (SPSS) to analyze for mean and standard error of the mean of the fish species compositions in various stations. Percentage was used for monthly catch. Biodiversity indices were estimated using the equations adopted from Adeosun *et al.* (2019).

$$\text{Simpson index (D)} = \frac{\sum n(n-1)}{N(N-1)}$$

$$\text{Simpson index of diversity} = (1-D)$$

$$\text{Simpson's reciprocal index} = \frac{1}{D}$$

$$\text{Shannon Index (H)} = - \sum P_i \ln P_i$$

$$\text{Shannon's Equitability (EH)} = H/\ln S$$

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,

$p_i = n_i/N$  is the number of individuals within a species i divided by the total number individuals (N) present in the entire sample.

$\Sigma$  is sum of the values for each species

S is total number of species.

Water parameters and sex ratio were analyzed

using the Microsoft Excel.

## RESULTS

### Water quality parameter indices

Figure 2 shows the temperature range in all the locations all through the study period between 22-30°C with least temperatures observed in location 2 and in the month of January, 2005. Temperatures as low as 24°C were also observed in locations 1, 3 and 4 irrespective of season. Figure 3 shows DO content ranging from 2.2 mg/l in location 4 to 9.1 mg/l in location 2 while pH fluctuated all through the study and in all the locations ranging from 6.04 – 8.5 (Figure 4).

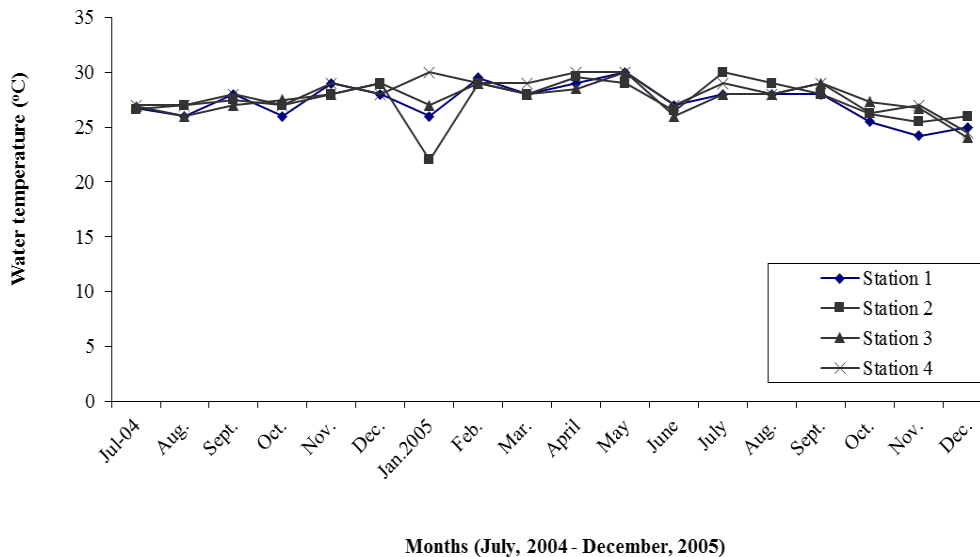


Figure 2. Monthly variations in the water temperature of Ikere Gorge

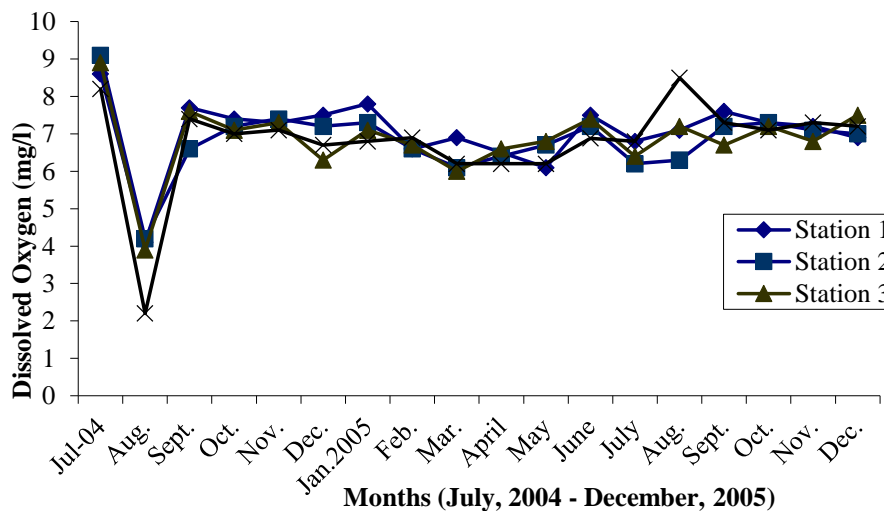
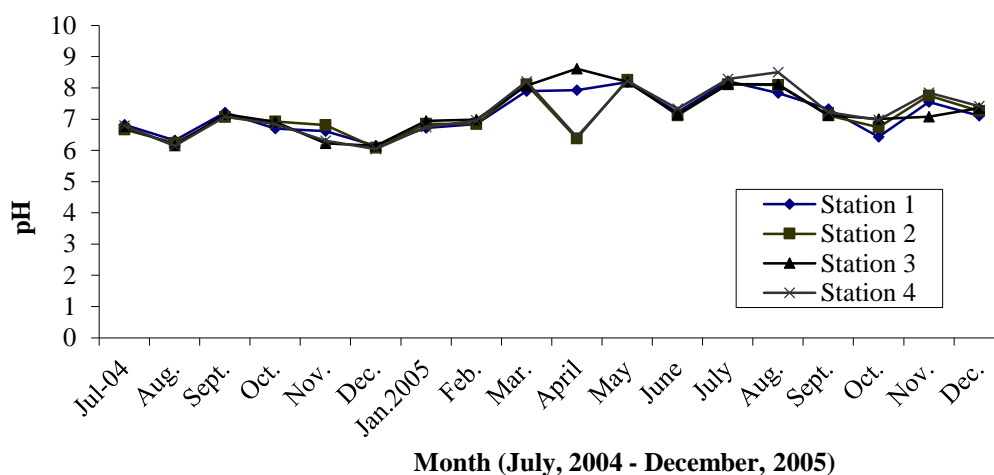


Figure 3. Monthly variations in dissolved oxygen of Ikere Gorge



**Figure 4.** Monthly variations in pH level of Ikere Gorge

### Fish Species and Harvest Composition

A total of 5,823 fish specimen were caught during the 18 months of study. Station 4 had the highest catch 1,672 in number while the highest monthly catch was recorded in the months of December and January (Table 1). The captured fish were identified and classified into 34 species belonging to 13 families (Table 2). In the four stations of the study area, over 29 fish species were encountered in station 3, followed by 27 fish species in station 4, 26 fish species in station 1 and 24 in station 2.

A few fish species whose identification were not known and whose utility were highly negligible were however not included in the result. Species richness was higher in the dry months than in the wet months. Fish diversity indices and evenness revealed a better diverse and even ecosystem in the wet season than the dry season (Table 3).

### Monthly Distribution and Relative Abundance of Selected Species

Marked significant difference was observed between the species in the dry months than the wet season (Table 4). *L. niloticus* was significantly lower than all other species in the dry season. *C. nigrodigitatus* was significantly ( $p < 0.05$ ) more abundant than the other species in the dry season. No significant difference was observed between

*C. nigrodigitatus* and the Cichlids in the wet season. This was not the case in the dry season.

Figure 5 shows monthly variation in abundance of the six selected commercial fish species. All six species were observed to be present in all sampling months. *C. nigrodigitatus* was more abundant in the dry months especially December - January. Presence of *L. niloticus* was almost zero especially at the onset of the rains. The Cichlids were in abundance in the wet months but more at the onset than in the dry months.

Figure 6 represents abundance of individual species in the different season. The figure reveals a significant difference ( $p < 0.05$ ) in the population of *C. nigrodigitatus* and *T. macrocephala* with the highest number observed in the dry season than the wet season.

### Sex Ratio of the commercial species of the study area

#### *C. nigrodigitatus*

A total of 1423 specimens of *C. nigrodigitatus* were examined. In total, 606 were males while 817 were females. Figure 7 shows monthly variation in sex ratio during the sampling period.

**Table 1.** Monthly biomass and number of fish caught in Ikere Gorge

	No. of fish	Weight (g)	No. of fish	Weight (g)	No. of fish	Weight (g)	No. of fish	Weight (g)
July 04	113	5,995	38	2,064	82	2,561	42	1,255
Aug.	42	870	67	1,954	56	2,269	72	2,094
Sept.	45	1,498	77	5,026	62	4,150	60	3,935
Oct.	55	2,160	68	3,508	78	2,622	100	2,392
Nov.	68	3,791	16	1,408	95	1,997	60	1,143
Dec.	105	5,454	74	3,268	90	4,202	283	7,104
Jan. 05	342	5,532	73	1,721	94	2,659	77	1,976
Feb.	88	1,556	128	2,796	175	1,742	66	2,097
March	71	2,946	77	3,356	21	1,189	42	2,436
April	60	3,662	96	2,799	44	1,628	160	2,070
May	77	2,280	104	4,277	71	1,519	112	1,828
June	110	5,490	68	4,178	86	4,363	198	9,885
July	91	3,491	56	1,782	68	1,780	44	1,923
Aug.	85	2,975	69	2,441	95	3,720	115	2,668
Sept.	33	1,527	30	801	30	2,038	72	6,239
Oct.	53	3,320	52	2,768	45	1,304	40	1,578
Nov.	90	2,969	57	1,913	46	1,660	63	1,540
Dec.	98	4,598	81	6,357	56	2,541	66	1,318

**Key:** Jan. – January, Feb. – February, Aug. – August, Sept. – September, Oct. – October, Nov. – November, Dec. – December

**Table 2.** Percentage species composition by number and weight for each station (July 2004 – 2005 December pooled)

Station	1		2		3		4	
	No.	Wt. (g)	No.	Wt. (g)	No.	Wt. (g)	No.	Wt. (g)
<b>BAGRIDAE</b>								
<i>Chrysichthys nigrodigitatus</i>	26.80	31.64	20.11	28.32	19.87	33.73	29.98	40.82
<i>Bagrus docmac niger</i>	0.37	1.24	0.81	0.38	1.74	1.02	0.54	0.30
<b>CENTROPOMIDAE</b>								
<i>Lates niloticus</i>	3.64	3.00	2.69	1.39	3.81	2.58	1.92	1.37
<b>CHARACIDAE</b>								
<i>Brycinus chaperi</i>	8.32	2.14	11.81	3.45	8.36	4.62	7.84	2.53
<i>Brycinus macrolepidotus</i>	0.18	0.36	1.47	2.87	0.08	0.14	0.48	1.56
<b>CHANNIDAE</b>								
<i>Parachanna obscura</i>	0.49	5.17	0.81	5.63	0.50	3.40	0.36	1.27
<b>CICHLIDAE</b>								
<i>Hemichromis fasciatus</i>	5.05	2.03	12.38	3.44	8.61	2.90	12.39	3.70
<i>Sarotherodon galilaeus</i>	8.81	10.83	10.59	12.58	6.62	7.97	4.67	4.59
<i>Tilapia melanopleura</i>	7.39	10.57	11.48	13.37	14.98	17.89	9.22	14.42
<i>Tilapia zillii</i>	4.93	1.19	3.82	1.15	4.14	1.21	15.96	4.03
<i>Tilapia melanotheron</i>	0.68	0.58	0.41	0.62	0.91	0.94	0.66	0.73
<i>Tilapia mariae</i>	0.31	0.81	0.32	0.49	0.17	0.64	0.36	1.07
<i>Tilapia monody</i>	0.06	0.03	0	0	0.25	0.16	0	0
<i>Oreochromis niloticus</i>	0.62	4.06	0.98	2.94	0.99	4.65	0.54	3.85

<i>Continue Table 2</i>								
<b>CLARIIDAE</b>								
<i>Clarias gariepinus</i>	0.62	5.10	1.29	6.48	0.41	1.90	0.48	10.29
<i>Heterobranchus bidorsalis</i>	0	0	0.49	2.37	0	0	0	0
<b>CYPRINIDAE</b>								
<i>Labeo coubie</i>	0.06	0.06	0	0	0.66	0.68	0.18	0.18
<i>Barbus occidentalis</i>	5.05	1.75	3.57	0.59	12.16	3.23	5.08	1.03
<i>Gara water loti</i>	0.19	0.26	0	0	0	0	0	0
<i>Barilius senegalensis</i>	0	0	0.08	0.11	0.17	0.14	0.06	0.03
<i>Barilius loati</i>	0.18	0.17	0	0	0.47	0.29	0.18	0.14
<b>HEPSETIDAE</b>								
<i>Hepsetus odoe</i>	0.55	1.86	0.98	2.11	1.08	3.64	0.36	1.62
<b>ICTHYOBORIDAE</b>								
<i>Phago loricatus</i>	0	0	0	0	0.17	0.05	0	0
<b>MOCHOKIDAE</b>								
<i>Synodontis membranaceus</i>	0.99	2.80	0.81	3.74	0.33	0.64	0.06	0.29
<i>Synodontis nigrita</i>	0	0	0.08	0.09	0	0	0	0
<b>MALAPTERURIDAE</b>								
<i>Malapterurus electricus</i>	0	0	0	0	0.08	0.60	0	0
<b>MORMYRIDAE</b>								
<i>Mormyrus rume</i>	0	0	0.16	0.14	0.17	2.15	0.12	0.46
<i>Mormyrus deliciosus</i>	0.12	0.14	0	0	0.49	0.38	0.89	0.58
<i>Hyperopisus bebe occidentalis</i>	0.56	4.51	0.57	2.45	0.17	0.21	0.24	0.92
<i>Marcusenius isidori</i>	22.18	7.36	13.29	3.36	11.83	3.16	6.75	2.90
<i>Marcusenius psittacus</i>	0.06	0.05	0	0	0	0	0	0
<i>Gnathonemus senegalensis</i>	0	0	0	0	0	0	0.06	0.11
<i>Gnathonemus cyprinoides</i>	0	0	0	0	0.08	0.08	0.06	0.05
<b>SCHILBEDAE</b>								
<i>Schilbe mystus</i>	1.79	2.30	1.22	1.88	0.74	1.01	0.66	1.29
Total no. of spp. that occurred	26		24		29		27	

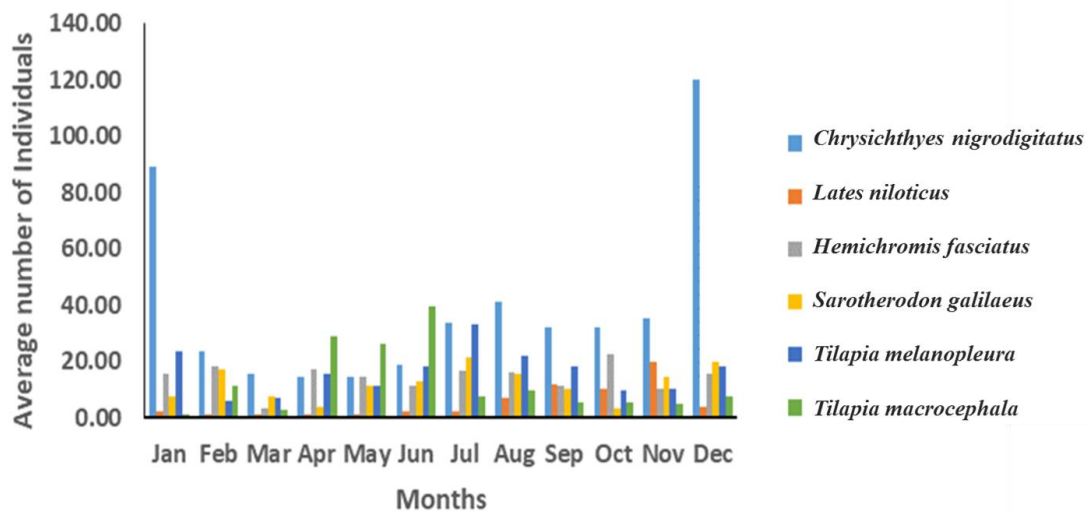
**Table 3.** Seasonal diversity of Ikere Gorge Dam

	<b>Wet</b>	<b>Dry</b>
Number of species	24	30
Number of individuals	1958	2173
Simpson's index	0.112	0.154
Simpson's index of diversity	0.888	0.846
Simpson's reciprocal index	8.929	6.506
Shannon_H	2.326	2.130
Shannon equitability index (EH)	0.7318	0.6261

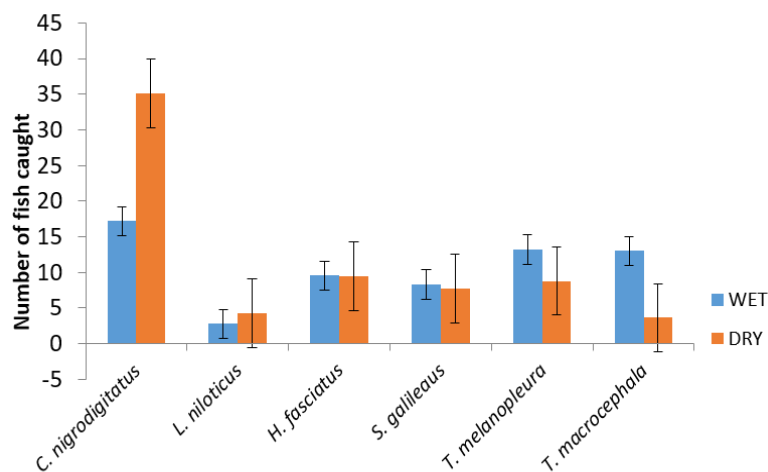
**Table 4.** Annual variations in number of six commercial fish species economic importance from Ikere gorge

Fish species	Wet	Dry
<i>Chrysichthyes nigrodigitatus</i>	17.20±1.40 <sup>a</sup>	35.07±7.59 <sup>a</sup>
<i>Lates niloticus</i>	2.80±0.46 <sup>b</sup>	4.33±0.30 <sup>b</sup>
<i>Hemichromis fasciatus</i>	9.57±2.08 <sup>ab</sup>	9.43±1.00 <sup>b</sup>
<i>Sarotherodon galilaeus</i>	8.30±0.25 <sup>ab</sup>	7.70±0.15 <sup>b</sup>
<i>Tilapia melanopleura</i>	13.20±1.40 <sup>a</sup>	8.30±1.25 <sup>b</sup>
<i>Tilapia macrocephala</i>	13.00±6.79 <sup>a</sup>	3.63±0.56 <sup>b</sup>

<sup>ab</sup>Means with different superscript along same column are significantly different (p<0.05).



**Figure 5.** Seasonal variation in abundance of the six commercial fish species of the gorge



**Figure 6.** Differences in abundance of individual species in the wet and dry months



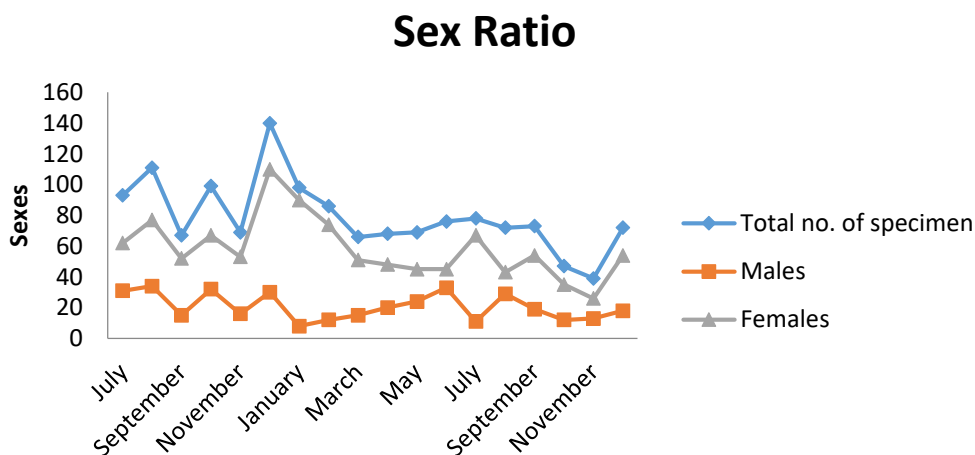


Figure 7. Seasonal variation in sex ratio of *Chrysichthys nigrodigitatus*

***L. niloticus***

*L. niloticus* commonly known as Niger/Nile Perch is endemic to Ikere River before its impoundment and it was successfully established throughout the gorge after impoundment. A total of 170 specimens of *L. niloticus* were examined whereby 93 were males while 77 were females. Figure 8 shows monthly variation in sex ratio during the sampling period. The result shows that more male predominates throughout the months of the year. However, increase in the number of

females were observed during the months of August to December.

***T. melanopleura***

Sex ratio of *T. melanopleura* pooled from all four stations was very close to 1. A total number of 596 specimens of *T. melanopleura* were examined. Throughout the sampling period, the numbers of females were always higher than that of the males (Figure 9). All the examined fish samples had observable gonads. There were fluctuations in the sex ratio from month to month.

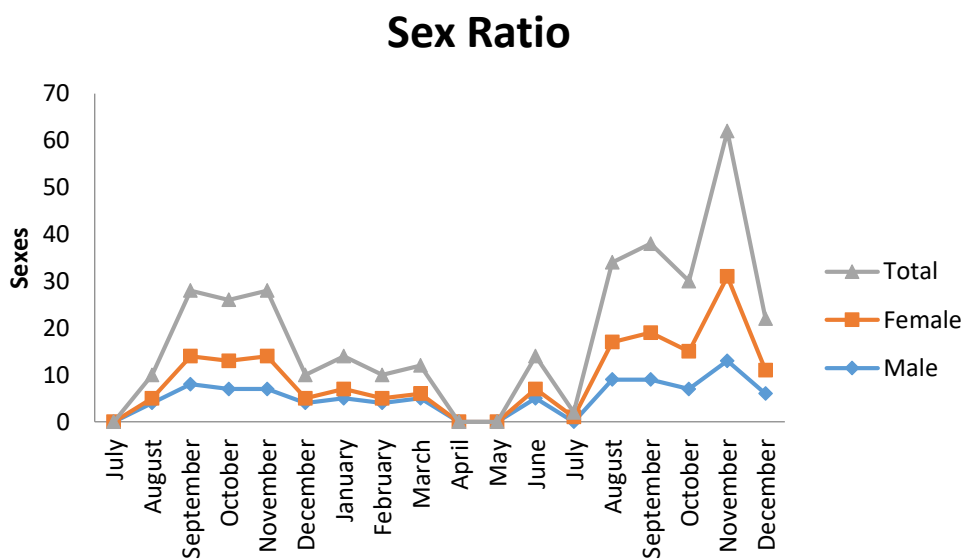


Figure 8. Seasonal variation in sex ratio in *Lates niloticus* in Ikere Gorge

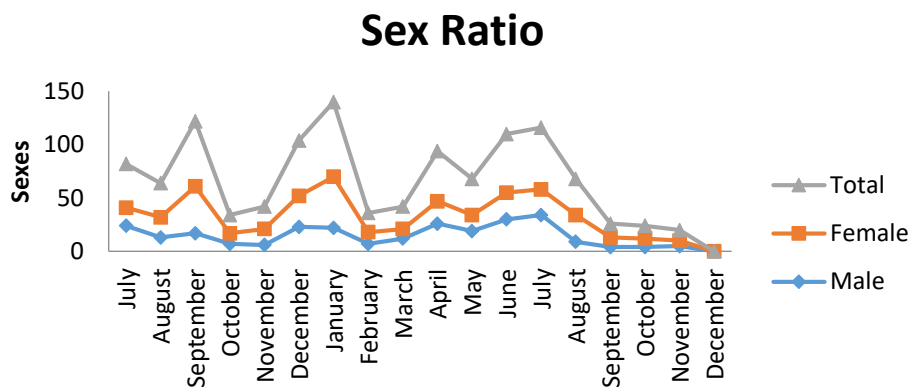


Figure 9. Seasonal variation in sex ratio of *Tilapia melanopleura* during the study

***S. galilaeus***

Figure 10 shows that the sex ratio of *S. galilaeus* from all four stations was very close to 1 of 432 specimens of *S. galilaeus* examined, 154 were males while 278 were females. Most often during the sampling period, the number of females was always higher than that of the males. All the examined fish samples had observable gonads.

**DISCUSSION**

Species richness was observed to be higher in the dry months than the rainy months could be attributable to the migration pattern of the fish species and also the stable water condition in this water body during the study. However, high species richness during the dry months did not reflect in the diversity of the fisheries as Simpson and Shannon diversity indices revealed better diversity in the wet months than

in the dry months. The seasonal pattern of species richness and abundance recorded in this study is consistent with the findings of Tremain & Adams (1995). Similar finding was also reported by Olukolajo & Oluwaseun (2008) that species richness of the fin fishes in Ologe Lagoon was better in the dry than wet season. The study of Ayoola & Kuton (2009) though similar with the report on species richness and abundance was not similar in terms of diversity as they reported better diversity in the dry months than the wet months.

*C. nigrodigitatus*, *L. niloticus* and some species of Cichlids of economic importance were observed in the catch all year round indicating the suitability of the water characteristics for their growth and survival. It could also be attributed to the availability of food to meet their nutrient requirements. This finding

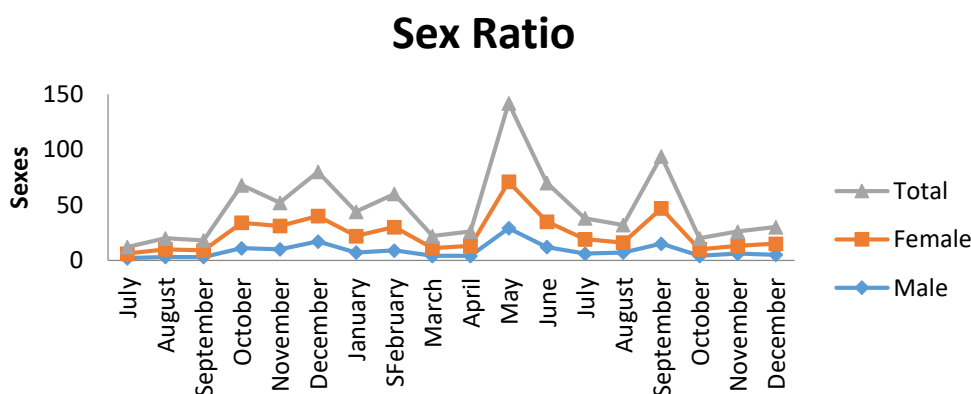


Figure 10. Seasonal variation in sex ratio of *Sarotherodon galilaeus*

corroborated with that reported by Oluwajoba *et al.*, (2017) for the species from the Lagos lagoon. However, in terms of species richness, *C. nigrodigitatus* was more abundant in the dry months than in the wet month which was not the case with the report of Olukolajo & Oluwaseun (2008) who reported the presence of *C. nigrodigitatus* from Ologe lagoon in South-West, Nigeria only in the wet months of the year. The reasons for this variation may be attributed to the differences in the water quality parameter especially temperature and DO levels of the water body which were consistent within the range for optimum primary productivity, and thus food abundance all year round as in this study.

Other species that were highly abundant at the peak of the dry season is *Marcusenius isidoris*, though not a commercial fish species, was observed to be high in abundance in the dry months (October - March) and at the onset of the rainy months (April and May) than at the peaks of the wet months. The high abundance of the species in these months could be because the species is not of commercial importance in the study area and thus not overfished. The reason could also be attributed to its spawning behavior as the species is reported to spawn every 5-8 days at sexual maturity (Kirschbaum & Schugardt, 1995). Akongyuure *et al.* (2017) reported all year abundance of the species in the Tono reservoir, Northern Ghana.

The Cichlids *Hemichromis fasciatus*, *Sarotherodon galileus*, *Tilapia melanopleura* and *Tilapia macrocephala* though available in the catch all year round, were more abundant during the wet season than the dry season. This could be correlated to the breeding season of these species which has been reported to occur all year round (Faunce, 2000; Mireku *et al.*, 2016). The result from this study is in agreement with the findings of Ayoola & Kuton (2009) who reported the presence of the Cichlids all through the year in the Lagos lagoon with the highest abundance in the two seasons. Also, Olapade & Dienye (2018) reported the distribution and abundance of the Cichlids from February – June in the New Calabar River, Nigeria.

Female predominated throughout the months of the year among the commercial fish species in the area with exception of *Lates niloticus*. However, there were variations in the monthly sex ratio monitored all through the study as both high and low ratios were observed in both wet and dry months of the study. Thus, the observed variations cannot be attributed to seasonal variations. This

was, however, not the case in the study of Komolafe & Arawomo (2011), who reported higher male to female sex ratio among the Cichlids from Erinle reservoir, Osun State, Nigeria. Skewed sex ratio in favour of one sex has been reported to be a sign of declining wild populations and threat of extinction of the species (Grayson *et al.*, 2015).

*C. nigrodigitatus* revealed highest preponderance toward female sex in the month of January and lowest ratio of male to female was recorded in June. This showed that more females were present than males and concur with the result of Kusemiju & Olaniya (1989) who reported a sex ratio of 1 male to 1.27 females in Lagos lagoon while Imevbore (1970) who obtained a sex ratio of 1 male to 1.40 females. This result was however in disagreement with the findings of Akintade *et al.* (2016) who reported higher male populations of the silver catfish (*C. nigrodigitatus*) and for *Tilapia melanotheron* from Badagry creek, Lagos. Offem *et al.* (2008) also reported similar findings from a water body in Cross River, Nigeria.

## CONCLUSION

The fish fauna from Ikere Gorge showed marked variations in the catch composition from the various locations sampled and between wet and dry seasons. *C. nigrodigitatus* and the Cichlids (*H. fasciatus*, *S. galilaeus*, *T. macrocephala* and *T. melanopleura*) were present all year round. There were no seasonal variations in the sex ratio of these species, however, preponderance of female was recorded for the species of commercial interest with exception of *Lates niloticus*.

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