

Diversity and abundance of cichlids in Ikere Gorge Reservoir, Iseyin, Oyo State, Nigeria

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Running Title: Cichlids of Ikere Gorge

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Abstract

Cichlids are highly abundant and commercially important fish in freshwater ecosystems in Nigeria. This study examined the diversity and abundance of cichlids in Ikere Gorge Reservoir. Four fishing villages were randomly selected from 12 fishing villages in Ikere Gorge Reservoir as sampling sites. Cichlids were sampled randomly and examined from fishermen catch in each selected fishing village; were identified with appropriate keys; the weight and abundance of the catches were recorded. The data obtained was subjected to descriptive statistical analysis using SPSS (Version 20.0) software to determine the abundance of fish species. Fish species diversity was carried out by using Palaeontological Statistics (PAST). Eight species of cichlids were sampled in Ikere Gorge but *Sarotherodon galilaeus* was the most abundant species while the least abundant species was *Pelmatolapia mariae*. It was observed that, cichlids were abundant in rainy season than in the dry season. Likewise, cichlids were abundant in Ikere-gorge reservoir but they have low diversity. This may be as a result of unsustainable fishing pressure and deforestation of riparian forest and sedimentation in Ikere-gorge reservoir. Therefore, to maintain sustainable fishing activities and improve cichlids population in Ikere-gorge reservoir, unsustainable activities in and around Ikere Gorge reservoir should be put under control.

Keywords: Cichlidae; freshwater species; dominant; *Sarotherodon galilaeus*; *Pelmatolapia mariae*.

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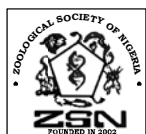
Introduction

Nigeria is blessed with over 14 million of hectares of reservoirs, lakes, ponds and major rivers capable of producing over 980,000 metric tons of fish annually (FDF, 2007). However, production from inland waters, including man-made reservoirs, is of great significance as it contributes nearly one third (over 30%) of the total fish production with an estimated 60% to the total domestic supply (Abiodun *et al* 2005). The freshwater fish faunas of Nigeria have not been well document but recent information on species diversity in Nigerian freshwater reported 260 fish species (Olopade *et al* 2017).

Cichlid is an important freshwater fish species in Nigeria. More importantly, cichlid fishes (Cichlidae) are found throughout Africa with at least 1,600 species distributed across African freshwater ecosystems. In Africa, cichlids are the most diverse freshwater fish after the Cyprinidae and account for about 13% of extant

freshwater fish diversity (Nelson 2006; Koblmüller *et al* 2015). Cichlids are highly abundant and commercially important fish in freshwater ecosystems in Nigeria. The best known genera in Nigeria are Coptodon, Hemichromis and Sarotherodon (Olopade and Rufai, 2014). Likewise, they form an important seed for fish culture in Nigeria. The dominance of Tilapia may also be connected to its prolific reproductive nature which allows it to populate water bodies especially where the population of aggressive and carnivorous species that could control its population has declined (Ataguba *et al* 2014).

Cichlids are known to inhabit various freshwater habitats that that ranges from rocky littoral zones to areas predominantly sandy with less than one tenth of area covered with rocks (Maruyama, 2011; Sweke *et al* 2013). They alternate habitats due to prevailing environmental conditions, food availability and presence of predators. Moreover, Rusuwa *et al* (2006) reported that several



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cichlid genera and species groups prefer sediment-free rocky substrates as feeding spots. Maruyama (2011) confirmed that sedimentation affects cichlid abundance and diversity to the extent that rock dwelling cichlids shift habitats in response to sedimentation. Moreover, Maruyama (2011) reported that deforestation and soil erosion in terrestrial ecosystems have an impact on aquatic ecosystems and pose particularly severe environmental problems in the aquatic communities of the African Great Lakes.

The fisher folks in Ikere Gorge depend solely on riparian forestry to generate their domestic energy. Likewise, they use forests products for the production of their fishing crafts. Charcoal production is also another common enterprise in Ikere Gorge. Therefore, there is deforestation of riparian forest around Ikere Gorge. This is observed to have caused sedimentation and siltation of the dam. Therefore, this study aims to examine the diversity and abundance of cichlids in Ikere Gorge.

Materials and methods

The study site

Ikere Gorge is a multipurpose dam located at Ikere Village, about 28 km, north-east of Iseyin in Oyo State. Ikere Gorge is located between Longitude 8°10' and 8° 20'N and Latitude 3° 40' and 3° 50'E (Figure 1).

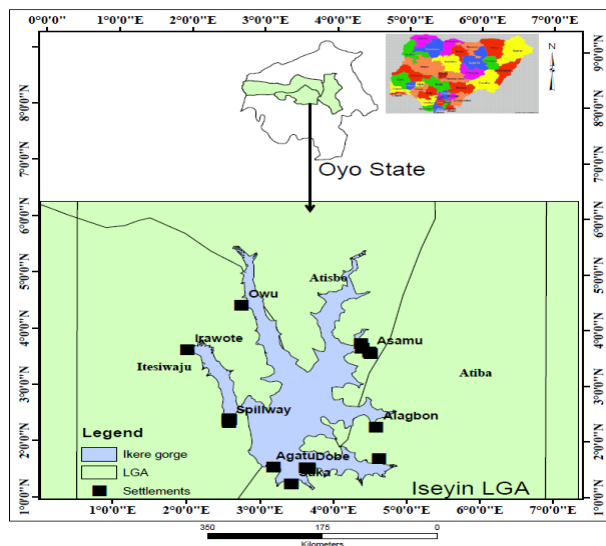


Figure 1: Map of Ikere Gorge Reservoir (showing some fishing villages), Iseyin, Oyo State, Nigeria.

There are 12 fishing villages in Ikere Gorge Reservoir. Four fishing villages were randomly selected as sampling sites. The four selected fishing villages are Asamu, Agatu, Spillway and Irawote fishing villages. The selected sampling sites were sampled monthly for a period of twenty-four months (January 2017 to December 2018). Cichlids were sampled randomly and examined from fishermen catch in each selected fishing village; the weight and abundance of the catches were recorded. The cichlids identification was

done using keys provided by Adesulu and Sydenham (2007) and Olaosebikan and Raji (2013).

Diversity indices

The diversity indices used in this study and methods employed are as follow:

$$i. \quad \text{Relative species abundance (\%)} = \frac{n \times 100}{N}$$

Where: n = Number of individual species present in the sample.

N = Total number of individual of all species in the sample.

$$ii. \quad \text{Shannon-Weiner Diversity Index (Shannon and Wiener, 1963)}$$

$$H = -\sum Pi / nPi \quad \dots 1$$

Where:

H = Shannon-Weiner index (the uncertainty of species identity).

Pi = ni/N .

ni = Number of individuals of each species in the sample.

N = Total number of individuals of all species in the sample.

$$iii. \quad \text{Simpson's Index of Dominance (Simpson, 1949).$$

$$\lambda = \frac{\sum ni(ni - 1)}{N(N - 1)} \quad \dots 2$$

λ = Simpson's Index of Heterogeneity (D): It is also called Gini coefficient.

$$D = 1 - \lambda \quad \dots 3$$

$$v. \quad \text{Buzas and Gibson's evenness: } e^{H/S} \quad \dots 4$$

$$vi. \quad \text{Margalef's richness index: } (S-1) / \ln(n) \quad \dots 5$$

Data analysis

The data obtained was subjected to descriptive statistical analysis using SPSS (Version 20.0) software to determine the abundance of fish species. Fish species diversity was carried out by using Palaeontological Statistics (PAST) Version 2.12 (Hammer 2011; Odulate *et al* 2017).

Results

Species composition and abundance

This study reported a total of 53,104 cichlids belonging to eight (8) species spatially distributed randomly among the four sampling stations in Ikere Gorge Reservoir. Table 1 shows that the most abundance cichlids was *Sarotherodon galilaeus* comprising 66.05% of the total cichlids recorded. This is followed by *Chromidotilapia guntheri* (13.09%) and *Tylochromis jentinki* (8.71%). *Pelmatolapia mariae* contributed the least percentage to the cichlids abundance in Ikere Gorge. Likewise, *Sarotherodon galilaeus* (69.64%) had the highest contribution by weight to the total cichlids, followed by *Tylochromis jentinki* (12.41%) and *Oreochromis niloticus*

(4.37%). *Hemichromis fasciatus* (1.55%) contributed the least percentage by weight to the cichlids population in Ikere Gorge Reservoir.

Table 1: Percentage composition of cichlids abundance and weight in Ikere Gorge Reservoir, Iseyin, Oyo State, Nigeria.

Cichlids	Abundance	% RA	Weight (K)	%Wt
<i>Oreochromis niloticus</i>	689	1.30	100.36	4.37
<i>Sarotherodon galilaeus</i>	35,076	66.05	1,599.68	69.64
<i>Tylochromis jentinki</i>	3,365	6.34	284.97	12.41
<i>Pelmatolapia mariae</i>	529	1.00	50.10	2.18
<i>Coptodon zillii</i>	1,588	2.99	79.17	3.45
<i>Chromidotilapia guntheri</i>	6,952	13.09	78.52	3.42
<i>Coptodon guineensis</i>	1,638	3.08	68.68	2.99
<i>Hemichromis fasciatus</i>	3,267	6.15	35.51	1.55
Total	53,104	100	2,297.0	100

Key: % RA – Percentage Relative Abundance; Wt – Weight (kg); %Wt – Percentage Relative Weight.

Figure 2 shows spatial distribution of cichlids across the sampling villages in Ikere Gorge Reservoir. Spillway contributed most in terms of percentage relative abundance and weight. This is followed by Asamu. The month of April had the highest contribution by abundance and weight to the total catch of cichlids (Figure 3). But the month of January had the least contribution by abundance and weight. Likewise, Figure 4 shows the seasonal variation of cichlids catch in Ikere Gorge Reservoir. It was observed that wet season (March-October) had higher record of cichlids catch by abundance and weight compared to dry season.

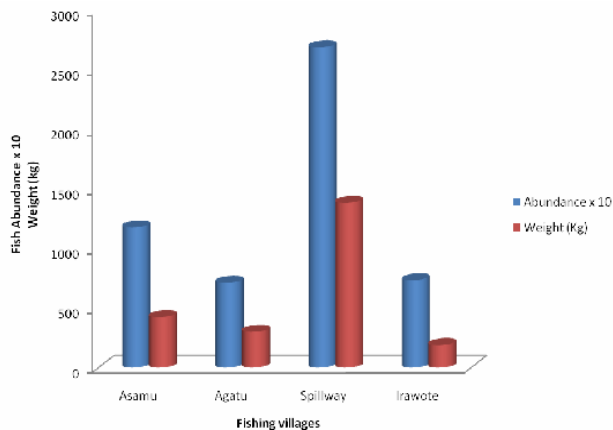


Figure 2: Spatial distribution of cichlids from the four sampling site in Ikere Gorge Reservoir, Iseyin, Oyo State, Nigeria.

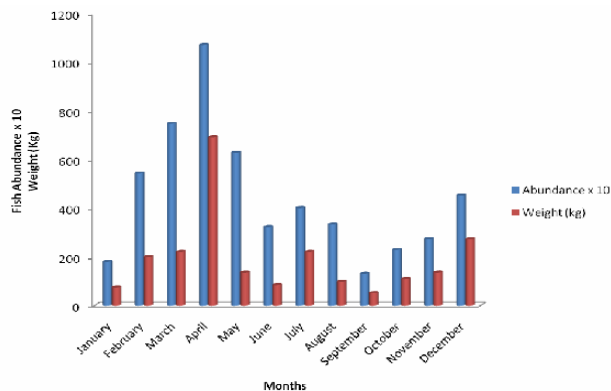


Figure 3: Monthly variation of cichlids in Ikere Gorge Reservoir, Iseyin, Oyo State, Nigeria.

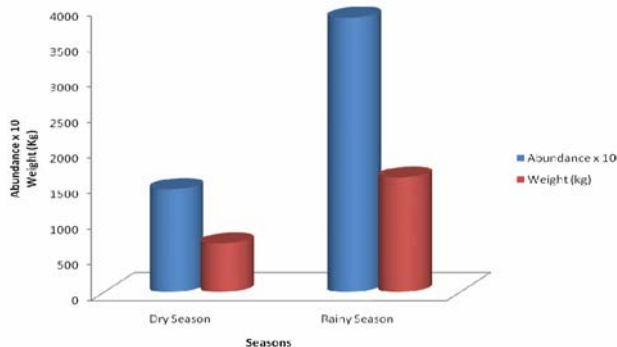


Figure 4: Seasonal variation of cichlids in Ikere Gorge Reservoir Iseyin, Oyo State.

The analysis of diversity indices of cichlids in Ikere Gorge Reservoir is presented in Table 2. It was observed that each of the fishing village had the eight cichlids. The values of Dominance (D) varied between Agatu (0.53) and Spillway (0.46); Simpson (1-D) varied between Asamu (0.56) and Agatu (0.47); Shannon (H) varied between Asamu (1.24) and Agatu (1.10); Evenness varied between Asamu (0.43) and Agatu (0.37) and Margalef varied between Agatu (0.79) and Spillway (0.69). Table 2 shows that Agatu had the highest dominant cichlids while Asamu had the least dominant cichlids. The implication of this is that Agatu had the least diversity of cichlids while cichlids were most diverse in Asamu. This is also confirmed in the values of other diversity indices in Table 2.

Table 2: Diversity indices of finfish species in Ikere Gorge Reservoir, Iseyin, Oyo State, Nigeria.

Diversity variable	Asamu	Agatu	Spillway	Irawote	Pooled (Ikere)
Taxa_S	8	8	8	8	8
Individuals	11,769	7,113	26,896	7,326	53,104
Dominance_D	0.44	0.53	0.46	0.48	0.46
Simpson_1-D	0.56	0.47	0.54	0.52	0.54
Shannon_H	1.24	1.10	1.19	1.19	1.20
Evenness_e^H/S	0.43	0.37	0.41	0.41	0.42
Margalef	0.75	0.79	0.69	0.79	0.64

Discussion

Fish species of Cichlidae family are known to be the dominant species in Nigerian freshwater. Ataguba *et al* (2014); Adaka *et al* (2016); Muhammed *et al* (2019) and Essien-Ibok and Isemin (2020) reported Cichlidae to be the dominant family in Gubi Dam, Bauchi State; in Oguta Lake; Tagwai reservoir, Minna, Niger State and in some major river in Akwa Ibom State all in Nigeria, respectively. Earlier, Adeosun *et al* (2009, 2011) reported that the most consistent genera represented in all the stations in Ikere Gorge Reservoir was the Cichlids. Adesaulu and Sydenham (2007) and Olaosebikan and Raji (2013) reported that there are over 11 genera and 19 species of cichlids in Nigerian freshwater. But Holden and Reed (1978) reported over 200 species of cichlids in West African water bodies. This study reported eight species of Cichlidae family in Ikere Gorge Reservoir. This is in agreement with report of Adeosun *et al* (2009, 2011). The number of cichlids in Ikere Gorge Reservoir is greater than the five species reported by Olopade and Rufai (2014) in Oyan Dam, Ogun State, and Balogun in Kangimi Reservoir, Kaduna, Nigeria. But, less than nine cichlids species reported by Ibim *et al* (2016) from New Calabar River, Rivers State Niger Delta, Nigeria and 10 species reported by Olopade and Dienne (2018) in the New Calabar River, Nigeria.

The abundance of cichlids in Ikere Gorge reported in this study was 53,104. This is greater than a total of 1,073 cichlids reported by Olopade and Dienne, (2018) from the New Calabar River, and a total of 547 reported by Olopade and Rufai (2014) as individual cichlids caught from Oyan Dam, Ogun State, Nigeria. The observed variation in the results may be due to differences in sampling procedure, effort, periods and ecological zones (Ataguba *et al*, 2014; Olopade and Rufai, 2014; Olopade and Dienne, 2018). It is observed that *Sarotherodon galilaeus* was the most abundance cichlid in Ikere-gorge. But Adeosun *et al* (2009; 2011) reported that *Tilapia melanopleura* was the dominant cichlids species in Ikere Gorge Reservoir. But *Tilapia melanopleura* is not reported in this study as it was not found during the field study. This shows that there is alteration of species composition cichlids in Ikere Gorge Reservoir. The cause of this was noticed by van Rijssel *et al* (2017) that eutrophication of the lake coupled with increased primary productivity can altered species composition.

This is in agreement with the report of Olopade and Rufai (2014) that the most abundant of the cichlids group in terms of number was *S. galilaeus* in Oyan Dam, Ogun State, Nigeria. Likewise, Famofo and Abdul (2020) reported that *Sarotherodon galilaeus* was the most abundant species in Iwopin fresh water ecotype of Lekki Lagoon, Ogun State, south-west Nigeria. Badejo and Oriyomi (2015) also reported that *S. galilaeus* had the highest abundance in Erinle Reservoir, Ede, Osun State, Nigeria. But, Adaka *et al* (2016) reported that *Tilapia zillii* was the most abundant species in Oguta Lake, south-east Nigeria.

Cichlids are observed to be more abundant between February and May with the highest abundant recorded in the month of April. This is consistent with the report of

Olopade and Dienne (2018) that the highest catch of cichlids was achieved between February and April in the New Calabar River, Nigeria. However, cichlids are more abundant in rainy season than the dry season. This is in agreement with the report of Olopade and Rufai (2014) that cichlids catches were abundant in the wet season than in the dry season in Oyan Dam of Ogun State, Nigeria. But, Ayoola and Kuton (2009) reported that cichlids contributed the highest number of fish in the both rainy and dry seasons in Lagos Lagoon, Nigeria.

The diversity indices used for the analysis in this study showed low or average diversity of cichlids in Ikere Gorge. This is in agreement with the observation of Olopade and Rufai (2014) for cichlids from Oyan Dam, Ogun State and Olopade and Dienne, (2018) from the New Calabar River, Nigeria. Dominance (D) showed that the diversity is on average since its conventional value according to Hammer (2011) varies between 0 (highest diversity) and 1 (no or least diversity in which only one taxa dominate). Likewise, the value of Shannon-Weiner's index reported in this study is lower than the range of 1.5 to 3.5 reported by Magurran (2004). But, Sweke *et al* (2013) also recorded a Shannon-Wiener value of 1.31 for cichlids dominated unprotected habitat in Lake Tanganyika. Maruyama (2011) reported that increase turbidity can reduce cichlid diversity in freshwater ecosystems. This can be attributed to the observed impacts of human activities especially deforestation, sedimentation, unregulated fishing and domestic pollution in Ikere Gorge (Ajagbe *et al* 2020).

Conclusion

This study examined the diversity and abundance of cichlids in Ikere Gorge. Eight species of cichlids were sampled in Ikere Gorge but *Sarotherodon galilaeus* was the most abundant species. It was observed that, although cichlids were abundant in Ikere Gorge but they have low diversity. This may be as a result of unsustainable fishing pressure and deforestation of riparian forest and sedimentation in Ikere Gorge. Therefore, to maintain sustainable fishing activities and improve cichlids population in Ikere Gorge, unsustainable activities in and around Ikere Gorge should be put under control.

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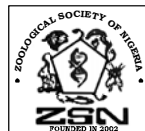
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