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IFE JOURNAL OF SCIENCE AND TECHNOLOGY

Vol 7. No. 1 (2023) 98–114

Ichthyofauna Diversity and Abundance of Obafemi Awolowo University (Opa) Reservoir

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Abstract

Between August 2015 and July 2016, fresh adult fish samples were collected monthly using traps and gill nets to investigate the ichthyofauna diversity and abundance of fish communities in Opa reservoir. The research was to provide baseline information on fish species richness, abundance, and condition factors of the fish species in Opa reservoir since different inland waterbodies have diverse species. The fishes were identified, and morphometric measurements were recorded. A total of 387 fish samples were analyzed, comprising seven families of twelve species. The Cichlidae family dominated the reservoir with six fish species throughout the sampling period. The results revealed that more fish species were caught in the rainy season than the dry season. However, the biological index of the fish community, such as the Shannon and Simpson diversity index, showed higher diversity value in the dry season as against the rainy season. The condition factor revealed that *Hemichromis fasciatus* had the highest mean value, indicating that the fish had signs of good well-being and nutritional sufficiency while *Mormyrus rume* recorded the lowest mean value which suggests that the fish had limited amount of food resources. The abundance of *Coptodon zillii* and *Sarotherodon galilaeus* was significant ($p < 0.05$) compared to other fish species populations. The study observed that the diversity and abundance of the fish species in Opa reservoir compared favorably with other water bodies. The sex ratio of the fish species recorded showed a slight variation in the expected ratio 1:1 of male to female. However, it revealed steady population growth in a favourable environment as indicated by the condition factor of the fishes.

Keywords: Abundance; Condition factor; Fish diversity; Opa reservoir

Introduction

Reservoirs are an important method of storing water so that humans can have access to a year-round water supply and they help to maximize river abstraction (Ahmed et al., 2018). They also play vital roles in ecological, economic, and recreational (Carol et al., 2006). Many reservoirs were constructed in response to community demands for domestic and industrial purposes (Mustapha, 2011). According to numerous studies on impounded water bodies, dam construction, and water flow regulation have a significant impact on fish diversity (the most sensitive vertebrate animals) (Sá-Oliveira et al., 2015; Sultana et al., 2018). Bio-diversity, which is the most vital area of ecosystem organizations and structure, measures the species variation, (either plants or animals), in a biological community (Ahmed et al., 2018). Arthington et al. (2016) revealed that the greatest risks to fish biodiversity include reservoir construction, overfishing in water bodies, pollution of the aquatic environment, and other anthropogenic activities.

Environmental conditions, both biotic and abiotic, are the primary factors that influence fish species' occurrence and thus their communities in terms of species richness and diversity (Peres-Neto, 2004). Other factors include the condition factor, which is described as an

excellent index for monitoring fish feeding intensity, age, and growth rates, and which quantifies the level of fish well-being, fatness, or relative strength (Ogongo et al., 2014; Ndiaye et al., 2015). Furthermore, sex population, which is an estimate of the abundance of any sex at any given time under natural conditions, could result in the growth of the wild population and thus affect the diversity of the fish population (Grayson et al., 2014). As a result, the sex ratio is one of the reproductive characteristics used to predict the availability of mature males and females expected to spawn to increase the number of individuals/species (Trisyani et al., 2019).

Opa Reservoir is used for both domestic and recreational purposes and has been the subject of some research. This includes the ecological balance of the fish community (Taiwo et al., 2018), the planktonic flora and fauna of the reservoir wetlands (Adebayo et al., 2021), and the ecological status of the reservoir (Adedeji et al., 2018). Other studies include planktonic community and water quality indices (Adedeji et al., 2020), as well as temporal and geographical changes in its heavy metals (Adesakin et al., 2016). However, there is little information on the fish diversity, abundance, and condition factors of fish species in the reservoir.

Freshwater fishes, whose information in the Opa reservoir is deficient, on the other hand, are among the most diverse in the world, providing significant commercial value and vital ecosystem benefits (DeSilva, 2012). Furthermore, fish assemblages are important components of aquatic ecosystems because they are one of four biological indices used to assess water ecosystems (Yan et al., 2011). As a result, the purpose of this study is to examine fish abundance, diversity, and condition to aid in the management and conservation of the university's reservoir's fishery resources. More importantly, baseline data on the reservoir's population dynamics in terms of sex ratio and abundance.

Materials and Methods

Study site

Opa reservoir

The investigated study site is Opa reservoir in Obafemi Awolowo University, Ile-Ife, South-western Nigeria. The reservoir was impounded on river Opa which took its source from Oke-Opa Hills along Ife-Ilesha highway. Other rivers that empty into the reservoir are Obudu and Esinmirin. It was dammed to supply water to the university community. It is within longitudes 004º31' E to 004º39' E and latitudes 07º21' N to 07º35' N (Figure 1). The landscape of the reservoir is characterized by the crest which is 300 m in width and 15 m in height. The reservoir catchment has an area that stretches up to 116 km^2 with a surface area of approximately 0.95 km^2 (Komolafe & Arawomo, 1998). The reservoir's climate is divided into two seasons: dry (October to March) and wet (April to September).

Fish samples collection

Fresh adult fish samples were obtained monthly from local fishermen at Opa Reservoir in Osun State between August 2015 and July 2016. Cast nets, gill nets, and traps were used to capture fish samples. Live fish samples were placed in an ice chest and transported to the laboratory for identification. Standard keys were used to identify the fish (Paugy et al., 2003). Morphometric parameters of the fish such as total length and standard length were measured using meter-rule in centimetres.

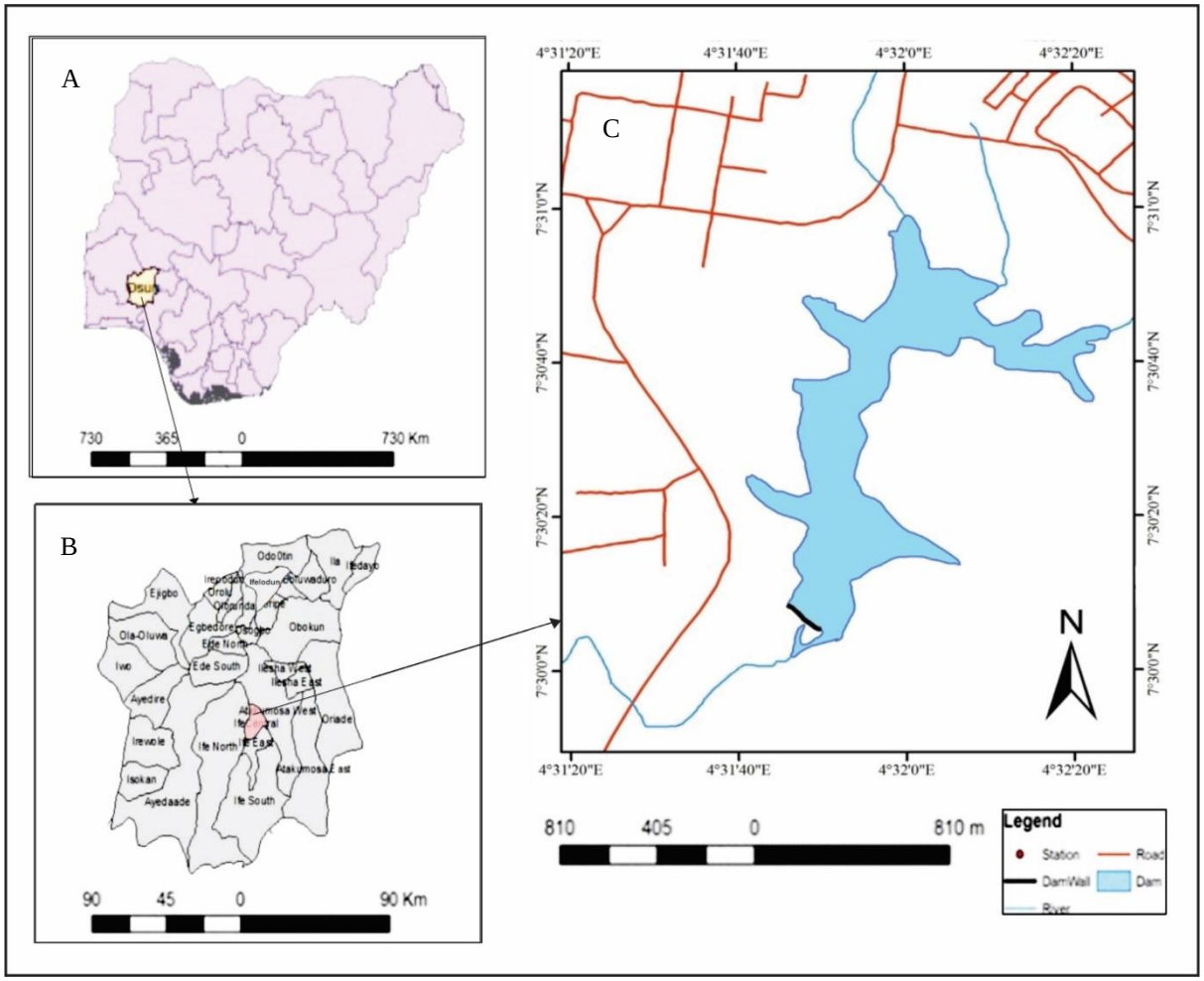

Figure 1: (a) Map of Nigeria showing Osun State, (b) Map of Osun State showing Local Government Areas, (c) Map of Opa Reservoir

and the sex of each fish sample was determined by visual inspection (Robert, 1989) while the weight of the fish were taken using the Denward weighing balance instrument in grams.

Condition factor of fish species

The condition factor expresses the well-being, fatness or robustness of a fish in the habitat concerning gonadal development and the sustainability of the aquatic environment to the feeding regime (Thant et al., 2011). The greater the condition factor, the better the fish's condition. Condition factor K was determined using the following equation,

$$K = \frac{100w}{l^3}$$ (Nash et al., 2006)

100

When W = Weight of fish

L = Length of fish

Diversity Index

The fish diversity index for the Opa reservoir was calculated using the following diversity indices:

i. Shannon-Weaver diversity index (Shannon & Weaver, 1949): The Shannon-Weaver diversity index is an indicator used to assess diverse various environments (Clarke & Warwick, 2014). Individuals were presumably selected at random from a distinct

population, and all taxa were represented in the sample (Shannon & Weaver, 1949).

$$H = \Sigma \mathrm{Pi} * \ln \mathrm{Pi}$$

Where, H' = diversity index

Pi = relative abundance (s/N),

s = number of individuals of one species

N = total number of individuals in the sample.

ii. Simpson's dominance index considered the number of species and abundance of each species. The index is frequently used to quantify habitat biodiversity (Vijaylaxmi et al., 2010). It was calculated using the formula:

$$D = 1 - \frac{\Sigma n\,(n-1)}{N(N-1)}$$ (Simpson, 1949)

Where, n = total number of individuals belonging to a species,

N = total number of all species' individuals.

iii. The Margalef's richness index: assesses the total number of species in each sample and is highly sensitive to sample size, despite its attempts to reduce the effects of sampling (Magurran, 2004). The Margalef index and the species richness were calculated using the absolute number of individuals or the density. By dividing the Margalef index acquired from the density matrix by the Margalef index obtained from the absolute number matrix, the percentage variance was calculated (Gamito, 2010).

$$d = \frac{S-1}{InN}$$

d = richness index,

S = total number of species and,

N = total number of individuals in the environment.

iv. Pielou's evenness index: The evenness index of Pielou refers to the likelihood that two individuals chosen at random from a population will belong to a different species (Dejong, 1975).

$$J' = \frac{H}{InS}$$ (Pielou, 1966)

Where, J' = similarity or index eveness,

S = total number of species in the environment,

ln = logarithm (natural) and

H = Shannon-Weaver index.

Statistical Analysis

The statistical tool SPSS 25.0 was used to analyse all the data (SPSS, USA). The tabular method was used to process the data by using simple statistical descriptive techniques such as means, standard deviation and percentages. The significance of sex ratio and abundance in the population of fish species was analysed using chi-square and significance was determined at a probability level of 0.05.

Results and Discussion

Results

Fish Checklist and Abundance and Seasonal Variations

A total of 387 fish samples comprising seven families were collected during the sampling period. As shown in Figure 2, the Cichlidae family had the highest percentage of fish population (89.66%) followed by Hepsetidae (5.7%), Alestidae (1.0%), Channidae (12.1%) and Claroteidae (1.0%). While Clariidae and Mormyridae, other families recorded, had 0.78% each of the fish population.

Family Cichlidae had six species while others had one species each. The Cichlid species

include *Coptodon zillii, Tilapia dageti, Sarotherodon galilaeus, Hemichromis fasciatus, Oreochromis niloticus* and *Chromidotilapia guntheri.* Other fish families caught during the

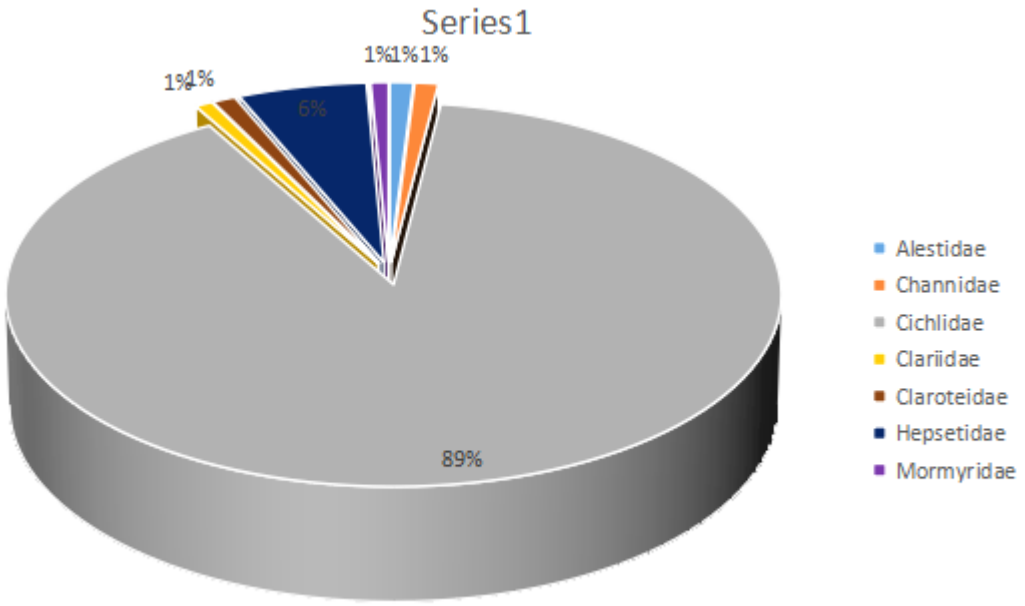

Figure 2: Composition of fish families at Opa reservoir

sampling period are *Mormyrus rume* (Mormyridae), *Parachanna obscura* (Channidae), *Clarias gariepinus* (Clariidae), *Hepsetus odoe* (Hepsetidae) *Chrysichthys auratus* (Claroteidae) and *Alestes longipinnis* (Alestidae) as shown in (Table 1). *C. zillii* was the most abundant fish species comprising 35.9% of the total catch. This was followed by *S. galilaeus* (25.3%), *T. dageti* (11.8%), *O. niloticus* (9.0%), *H. fasciatus* (6.5%). Others are *H. odoe* (5.9%), *P. obscura*, *C. guntheri*, *C. auratus* and *A. longipinis* (1.0%) each while *M. rume* and *C. gariepinus* recorded 0.8% each of the population (Table 1).

In the rainy season at Opa reservoir, *Coptodon zillii* was the most abundant fish constituting 35.2% followed by *S. galilaeus* (28.5%), *Tilapia dageti* (15.4%), *H. fasciatus* (7.1%) and *O. niloticus* (6.4%). Others are *Hepsetus odoe* (4.7%), *M. rume* and *C. gariepinus* each with 1.0% while *Parachanna obscura* had 0.7% (Table 1). In the dry season, *C. zillii* was also the most abundant with 38.20%. Also, this value was less than that of the rainy season while *O. niloticus, S. galilaeus* and *H. odoe* had 18.0%, 14.6% and 9.0%, respectively.

Table 1: Checklist, Abundance and Seasonal Variations of Fish Species at Opa Reservoir

Fish family	Species	No of fish sampled in rainy season	% of fish sampled in rainy season	No of fish sampled in dry season	% of fish sampled in dry season	Total No of Fish Sampled	% of fish sampled
Alestidae	*Alestes longipinnis*	0	0	4	4.5	4	1
Channidae	*Parachanna obscura*	2	0.7	2	2.3	4	1
Cichlidae	*Coptodon zillii*	105	35.2	34	38.1	139	35.9
	Tilapia dageti	46	15.4	0	0	46	11.8
	Sarotherodon galilaeus	85	28.5	13	14.6	98	25.3
	Hemichromis fasciatus	21	7.1	4	4.5	25	6.5
	Oreochromis niloticus	19	6.4	16	18	35	9
	Chromidotilapia guntheri	0	0	4	4.5	4	1
Clariidae	*Clarias gariepinus*	3	1	0	0	3	0.8
Claroteidae	*Chrysichthys auratus*	0	0	4	4.5	4	1
Hepsetidae	*Hepsetus odoe*	14	4.7	8	9	22	5.9
Mormyridae	*Mormyrus rume*	3	1	0	0	3	0.8

Other members of fish species which contributed to the population include *H. fasciatus, C. guntheri, C. auratus* and *A. longipinnis* with 4.5% each as presented in Table 1. Seasonally, the composition of fish families showed that the Cichlidae family contributed 92.6% and 79.8% to the total population in rainy and dry seasons respectively while Channidae contributed the least with 0.7% and 2.3% for rainy and dry seasons respectively (Table 1).
The t-test analysis shows that there was a statistically significant seasonal difference ($p<0.05$) in the population of *C. zillii, S. galilaeus,* and *H. fasciatus.* (Table 2). While the sex-related abundance for the encountered fish species showed no significant difference ($p>0.05$) (Table 3).

Table 2: T-Test Statistics of Fish Species Abundance Based on Seasons

Fish Species	Seasons		p	T
	Rainy	Dry		
	Mean±SE	Mean±SE		
Oreochromis niloticus	2.71±0.4	3.2±0.6	0.3	1.9
Coptodon zillii	10.50±1.9	4.86±1.0	*0.01	1.8
Sarotherodon galilaeus	9.44±1.8	2.60±0.5	*0.002	1.8
Hepsetus odoe	2.30±0.5	2.0±0.4	0.3	1.9
Hemichromis fasciatus	3.00±0.5	1.33±0.3	*0.01	1.9

***** Significant ($p<0.05$)

Table 3: Chi-square Statistics of Fish Species Sex Ratios

Fish Species	No of Specimen	Male	Female	χ	p-value
Oreochromis niloticus	35	18	17	0.92	0.97
Coptodon zillii	139	82	57	1.80	0.99
Sarotherodon galilaeus	98	62	36	0.95	1.00
Hepsetus odoe	22	16	6	1.67	0.89
Hemichromis fasciatus	25	17	8	0.88	0.83

Morphometric Measurements of Fish Species at Opa Reservoir

In the Opa reservoir, the morphometric measurements of fishes are shown in Table 4, the dominant fish was *Orechromis niloticus* which recorded mean total length, standard length and weight of 17.7 cm, 13.4 cm and 113 g respectively. It was followed by *Sarotherodon galilaues* with a total length which varied from 12.8 cm to 39.8 cm. The standard length of the fish ranged between 9.6 cm and 20.6 cm, and weight varied from 48 g to 1087 g. Although the two species had similar ranges in the morphometric measurements, *S. galileaus* exhibited high variation. The results also showed that *Mormyrus rume* and *Clarias gariepinus* were the least dominant fish species. The mean values for *M. rume* total length, standard length and weight were 51.8 cm, 44.2 cm and 705 g respectively. These values were higher when compared to *C. gariepinus* of the same number that recorded mean total length, and the standard-length weight of 19.6 cm, 16.4 cm and 120 g, respectively.

Table 4: Morphometric Measurements of Fishes Sampled at Opa Reservoir

Species	**Number of Fish**	**Total length range (cm)**	**Mean**	**Standard length range (cm)**	**Mean**	**Weight range (g)**	**Mean**
Coptodon zillii	139	12.1 – 28.1	17.7	9.4 – 22.7	13.4	34 – 288	113
Tilapia dageti	46	14.2 – 27.3	17.6	10.6 – 20.6	13.3	51 – 408	113
Sarotherodon galilaeus	98	12.8 – 39.8	23.4	9.6 – 31.3	18.1	42 – 1087	325
Hemichromis fasciatus	25	13.4 – 22.4	16.8	10.1 – 18.2	12.7	48 – 188	106
Mormyrus rume	03	42.4 – 64.4	51.8	37.8 – 53.7	44.2	502 – 830	705
Parachanna obscura	04	14.2 – 38.6	26.0	11.8 – 31.3	21.3	42 – 472	245
Clarias gariepinus	03	15.1 – 24.0	19.6	13.0 – 19.8	16.4	54 – 186	120
Hepsetus odoe	22	18.8 – 33.4	25.5	15.5 – 29.5	20.6	76 – 392	198
Oreochromis niloticus	35	13.5 – 26.7	18.0	10.6 – 23.2	14.2	60 – 282	125
Chromidotilapia guntheri	04	12.9 – 20.8	16.6	10.1 – 16.0	13.3	54 – 108	76
Chrysichthys auratus	04	18.9 – 28.4	22.5	15.1 – 23.2	18.1	124 – 291	190
Alestes longipinnis	04	14.1 – 14.5	14.4	10.9 – 11.2	11.1	54 – 58	55

Condition Factor and Sex ratio of fish species at Opa reservoir

In Opa reservoir, the highest mean condition factor of 2.17±0.48 was observed in *H. fasciatus* with a condition factor which varied between 1.47 – 2.90 while the least mean condition factor of 0.61±0.42 was in *M. rume* with a condition factor between 0.29 – 1.08. Similarly, the mean condition factors of other fishes include *S. galilaeus* with 2.15±0.29, *O. niloticus* with 2.11±0.35, and *C. zillii* with 2.06±0.38. Also, other fish species with substantial mean condition factors are *T. dageti* (1.89±0.14), *A. longipinnis* (1.86±0.05), *C. guntheri* (1.76±0.62), *C. auratus* (1.69±0.31), *H. odoe* (1.30±0.66), *P. obscura* (1.27±0.35), *C. gariepinus* (1.24±0.39) as shown in Table 5.

Table 5: Condition Factor of Fish Species at Opa Reservoir

Species	Number of Fish	Condition Factor Range	Mean±SD
Coptodon zillii	139	1.18 – 3.42	2.06±0.38
Tilapia dageti	46	1.54 – 2.23	1.89±0.14
Sarotherodon galilaeus	98	1.42 – 3.02	2.15±0.29
Hemichromis fasciatus	25	1.47 – 2.90	2.17±0.48
Mormyrus rume	03	0.29 – 1.08	0.61±0.42
Parachanna obscura	04	0.82 – 1.62	1.27±0.35
Clarias gariepinus	03	0.80 – 1.57	1.24±0.39
Hepsetus odoe	22	0.44 – 2.28	1.30±0.66
Oreochromis niloticus	35	1.32 – 2.76	2.11±0.35
Chromidotilapia guntheri	04	1.20 – 2.52	1.76±0.62
Chrysichthys auratus	04	1.27 – 1.98	1.69±0.31
Alestes longipinnis	04	1.81 – 1.93	1.86±0.05

The values of the sex ratio of various fish species in the Opa reservoir are shown in Table 6. Six fish species with appreciable numbers had a sex ratio which varied from 1.1:1 (male to female) in *O. niloticus* to 2.1:1 (male to female) in *H. odoe*. Others include *C. zillii* 1.4:1 (male to female); *T. dageti* 1.9:1 (male to female) while *S. galilaeus* and *H. fasciatus* had sex ratios of 1.7:1 (male to female) and 2.1:1 (male to female) respectively. Similarly, two fish species namely *M. rume* and *P. obsura* had very low numbers while no female fish was caught in respect of *C. gariepinus, C. guntheri, C. auratus* and *A. longipinnis* in the reservoir.

Diversity index of fish species at Opa reservoir

Table 7 shows the result obtained on the fish species diversity index for both rainy and dry seasons at Opa reservoir. The rainy season had a lower diversity index with a Shannon index of 1.646 and a Simpson index of 0.759 while the dry season had a higher diversity

index with Shannon index of 1.817 and Simpson index of 0.784. This shows that the dry season was more diverse in fish species than the rainy season. However, the rainy season had more individuals (298) than the dry season (89) but equal taxa of 9 were recorded in both dry and rainy seasons. The dry season's evenness was higher than the rainy season's, suggesting that the dry season's fish were more evenly distributed than the rainy season's (Table 7).

Table 6: Sex ratio of Fish Species at Opa Reservoir

Fish species	**Male**	**Female**	**Sex ratio (M/F)**
Coptodon zillii	82	57	1.4:1
Tilapia dageti	30	16	1.9:1
Sarotherodon galilaeus	62	36	1.7:1
Hemichromis fasciatus	17	8	2.1:1
Mormyrus rume	1	2	1:2
Parachanna obscura	2	2	1:1
Clarias gariepinus	3	-	3:0
Hepsetus odoe	16	6	2.7:1
Oreochromis niloticus	18	17	1.1:1
Chromidotilapia guntheri	4	-	4:0
Chrysichthys auratus	4	-	4:0
Alestes longipinnis	4	-	4:0

Table 7: Diversity Index Of Fish Species At Opa Reservoir During The Seasons

Seasons	**Taxa**	**Individual**	**Dominance**	**Simpson**	**Shannon**	**Evenness**	**Margalef**
Rainy	9	298	0.241	0.759	1.646	0.576	1.404
Dry	9	89	0.216	0.784	1.817	0.683	1.782

Discussion

Fish checklist, abundance and condition factor at Opa reservoir

Fish diversity in Opa reservoir is comparatively high with twelve fish species in seven families. This finding is similar to other close freshwater bodies, Osinmo Eeservoir with fourteen species of eight families (Komolafe et al., 2014) and Erinle Reservoir with nineteen species classified into ten families (Komolafe & Arawomo, 2011). According to (Taiwo, 2010) eighteen fish species comprising ten families were observed in the Eko-Ende reservoir while eighteen species made up of fourteen families were recorded in the Oyun reservoir (Mustapha, 2009). Also, the Cichlids family had the highest percentage of fish recorded with 89.57% of the total fish caught. Therefore, a high percentage of Tilapine species could be attributed to their high fecundity in the reservoir and the good care provided by the parent (Komolafe et al., 2016). Hence, this finding is consistent with the results in the Opa reservoir (Komolafe, 2008) and Erinle reservoir (Komolafe & Arawomo, 2011) in which a high percentage of Cichlids were recorded.

In this study, the most abundant fish species in Opa reservoir was *C. zillii* which made up 35.92% of the total catch. Similarly, this result corroborates the findings in the Tagwai reservoir (Muhammed et al., 2019), and 28.5% in the Osinmo reservoir (Komolafe & Arawomo, 2008). Also, *Hepsetus odoe,* which constituted 5.68% of the population, was 2.71% in Erinle reservoir (Komolafe & Arawomo, 2011) and 2.02% in Igun reservoir (Komolafe et al., 2016) while *Sarotherodon galilaeus* which represents 25.32% in this study was 40.72% in Erinle reservoir and 9.09% in Igun reservoir. Thus, the present findings in the Opa reservoir agree with the work carried out on fish abundance in the lower Nun River (Abowei & Hart, 2008). Conditions affecting fish abundance have been documented such as food availability, depth of water, fecundity rates, and presence of current and minimal predation have all been identified as important limiting conditions affecting the population of several fish families in Kainji Lake (Ita, 1978). Seasonal differences in fish species were reported to be higher during the rainy season than during the dry season in this study. This result was similar to the findings of (Mensah et al., 2019) which recorded a mean value abundance of 69.8 in a tropical lake Volta. Seasonal variations in fish abundance revealed significant differences in abundance, revealing that fish species were fairly distributed throughout the seasons.

The condition factors (K) of fish species were used to compare the well-being or fatness of fish (Ahmed et al., 2011), which varied from 0.29 to 3.42 showed that the condition of the fish species in the Opa reservoir was similar to what was reported in other water bodies. The results compared well with ‘K’ values of 0.91 and 8.46 obtained in nine fish species collected at Ologe Lagoon (Kumolu-Johnson & Ndimele, 2011). Also, the ‘K’ values in the range between 1.13 and 1.21 was observed for *Platycephalus indicus* of Bardawil Lagoon, North Sinai, Egypt (Ahmed et al., 2021). However, the difference in the condition factor in this study compared with other findings could be a result of differences in the

environmental variables of water bodies where the studies were carried out. Hence, the result of the condition factor in the Opa reservoir is consistent with fish species in the Kano Rivers (Suleiman et al., 2017). Certain factors have been stated to often affect the wellness of a fish which are sex, maturity stages of the gonads, and stomach content (Gupta et al., 2011). The findings observed in this study on the well-being of fish in the reservoir could probably be a result of the size of the reservoir and the abundance of food materials that support the fatness of the fish.

Sex ratio of fish species at Opa reservoir

In this study, male fish were captured more when compared to the female fish. Differences in capture based on sex could probably be a result of growth patterns and community structure of the reservoir that might favour male fish. The results of this study showed similar variations in the sex of fish species in other inland water bodies. Also, a sex ratio of 1:1.34 male to female was reported in *Parachanna obscura* in Eleyele Lake, Nigeria (Olanrewaju et al., 2018). The overall sex ratio of male to female in this study was 1.7:1. This shows that there were more male populations when compared to the female population. The knowledge of the relationship between species, the environment, and the present condition of the population requires an understanding of the sex ratio (Brykov et al., 2008). Several factors, including population adaptations, reproductive behaviour, availability of food, and environmental variables influence the sex ratio, which can vary from species to species and even within the same population at different times (Vandeputte et al., 2012). The sex ratio is needed to determine variation in the sex population of fish in the wild. A deeper understanding of the population structure of fish abundance as well as sex variations that occur throughout the year could be very important in ensuring early detection of environmental changes (Adeosun, 2019). This understanding will help in the management and conservation of fisher**y** resources of the university reservoir. Also, variation in the sex ratio of the fish population in the Opa reservoir could be a result of seasonal changes. The results of the sex ratio in this study were similar to the study conducted at Ado reservoir, male to female sex ratio was 1.5:1 in *O. niloticus* and 1:1.2 in *Clarias gariepinus* (Oso et al., 2013). A possible explanation for the sex ratio of fishes in the reservoir could be due to the reproductive potential of fishes in the reservoir.

Diversity index of fish species at Opa reservoir

The highest diversity index is associated with a large number of individuals, whereas the lowest diversity is associated with a small number of individual organisms (Tikadar et al. 2021). The values of the Simpson index in the Opa reservoir were higher than the value of 0.17 recorded in Coaracy Nunes Dam, Brazil (Sá-Oliveira et al., 2015). The values were also within the range recorded in Ganjiang River (Guo et al., 2018). Moreover, the evenness observed in this study was below the value recorded at Bodna River in Kwali Area Council, Abuja (Sani et al., 2019). Fish functional diversity is often affected by river

impoundment, with the loss of species with rheophilic, migratory, or benthic habits, as well as feeding specialists (Arantes et al., 2019). The impoundment of Opa reservoir has been impacted by various human activities such as farming along the shoreline of the reservoir which has resulted in changes in the water quality and concentrations of heavy metal in water and sediment (Adedeji et al., 2020; Adesakin et al., 2016; Taiwo et al., 2018). This could have resulted in the low level of species diversity in the habitat which is a sign of environmental degradation. Furthermore, environmental degradation such as intensive mining, agriculture, deforestation, and emissions of urban effluents would have more adverse effects on run-off into fluvial habitats than damming the river itself. The study also revealed that fish species were not distributed evenly during both dry and wet seasons.

Conclusion

This study has shown the abundance, diversity and condition of fish species in the Opa reservoir. The evidence from this study suggests that the high diversity and abundance of fish in Opa reservoir compares favourably with other fresh waterbodies. The results of this investigation also show that there are significant changes among the fish populations while condition factors of fish species in the reservoir are highly supported by the environment. Therefore, the conservation of fishery resources of the university reservoir will be achieved through a reduction in human activities and environmental degradation along the shoreline of the reservoir.

Ethical Approval

All the experimental guidelines involving fish were carried out by standard procedures.
Informed Consent Statement: Not applicable.
Data Availability Statement: The data of this study will be available based on the request from the corresponding author.
Conflicts of Interest: The authors declare no conflict of interest.

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