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Composition, abundance and diversity of the Family Cichlidae in Oyan Dam, Ogun State, Nigeria

OLANIYI ALABA OLOPADE[1,♥], OLUSEUN PETER RUFAI[2]

[1]Department of Animal Science and Fisheries, University of Port Harcourt, Rivers State, East/West Road PMB 5323 Choba, Rivers State, Nigeria. Tel: +234 (0)837154911; ♥email: oaolopade@yahoo.com.

[2]Department of Animal Production, Olabisi Onabanjo University, Ago Iwoye, Nigeria.

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ABSTRACT

*Olopade OA, Rufai OP. 2014. Composition, abundance and diversity of the Family Cichlidae in Oyan Dam, Ogun State, Nigeria. Biodiversitas 15: 195-199.*This study was conducted to determine status of the family Cichlidae in Oyan Dam, Nigeria, during the wet and dry seasons of 2011. Samples were collected using multi-mesh gillnets ranging between 30 mm to 80 mm. Simpson's Diversity Index was used to determine the species richness, while dominance and evenness were given by Shannon's index. A total of 547 individuals were caught from Imala (S1) and Ibaro (S2) sites of the dam. Species collected include *Sarotherodon galilaeus* (42.60%), *Oreochromis niloticus* (17.92%), *Tilapia zillii* (25.41%), *Hemichromis fasciatus* (10.61%) and *Tilapia mariae* (3.48%). Juveniles and sub-adults and adults were among the catch, the sizes were as big as 12.85±0.29cm SL, 109.22±6.00g BW in *Tilapia zillii* and small as 6.09±0.05cm SL and 8.07±0.15g BW in *Hemichromis fasciatus*. The diversity indexes showed that the diversity of Cichlids was lower in the two sites observed in Oyan Dam. The estimates of diversity indexes showed lower value for site 1 (0.284) than for site 2 (0.294); Simpson's diversity index was 0.716 for site 1 and 0.703 for site 2 while reciprocal indexes for site 1(3.521) was slightly lower than site 2 (3.367). Shannon-Wiener's Index recorded in the site 1 (1.36) was slightly lower than site 2 (1.37). Pielou's Index value recorded for site 1 was 0.845 and 0.852 for site 2. *Sarotherodon galilaeus, Oreochromis niloticus, Tilapia zillii* and *Tilapia mariae* exhibited a positive allometric growth pattern while only *Hemichromis fasciatus* showed a negative allometric growth.

Key words: Allometric growth pattern, Cichlidae, diversity index, Nigeria, Oyan Dam, Simpson's diversity index.

INTRODUCTION

Cichlids are fishes from the family Cichlidae in the Order Perciformes. Cichlids fishes are the most species rich family of all teleost fishes, and their diversity is centered in the Great African Lakes where more than 2000 species (Turner et al. 2001). As of 2006, there were 200 genera recognized and covered by FishBase (Froese and Pauly 2006a). They are one of the largest vertebrate families, new species are discovered annually and many species remain undescribed (Froese and Pauly 2006b). Endemic Cichlids make up most of the fauna in the African Lakes, for example Lakes Malawi has about 20 Cichlids (all but 4 endemic), Lake Victoria has about 170 (all but endemic) and Lake Tanganyika has 126 (all endemic) (Gupta and Gupta 2006). Cichlids are particularly well known for having evolved rapidly into a large number of closely related but morphologically diverse species within large lakes (Meyer 2005). It is estimated that Africa alone hosts at least 1,600 species (Nelson 2006). Cichlids are highly abundant and commercially important fish in natural and man-made lakes in Nigeria. The best known genera in Nigeria are *Tilapia* (Fagade and Olaniyan 1971), *Hemichromis* (Fagade 1983) and *Sarotherodon* which was reported by Trewavas (1983).

Overfishing and habitat degradation can lead to a gradual process of extinction of fish species. These stressors, along with climate variability, can synergistically contribute to the degradation of biological diversity at the species, genetic and/or habitat-ecosystem level (Pimm et al. 1995; IPCC2001; UNEP 2001). Little information exists regarding the diversity and status of cichlids in reservoirs in Nigeria. The lack of information on this family undoubtedly limits ability to carry out effective conservation measures and given the economic and ecological roles of cichlids. This study is designed to investigate diversity, composition and abundance of the family Cichlidae in Oyan Dam.

MATERIALS AND METHODS

Study area

Oyan Dam is owned and operated by the Ogun-Osun River Basin Development Authority (O-ORBDA) and has a surface area of 4000 ha. It is located 7°15' North latitude and 3°16'East longitude at an elevation of 43.3m above sea level on the confluence of Oyan and Ofiki rivers, both tributaries of Ogun River (Ofoezie et al. 1991; O-ORBDA 1998). It has a catchments area of approximately 9,000km² within the southern climatic belt of Nigeria. It is influenced by a rainy season which starts in the middle of March and till late October while the dry season is from November to February. The range of rainfall was between 1600mm and

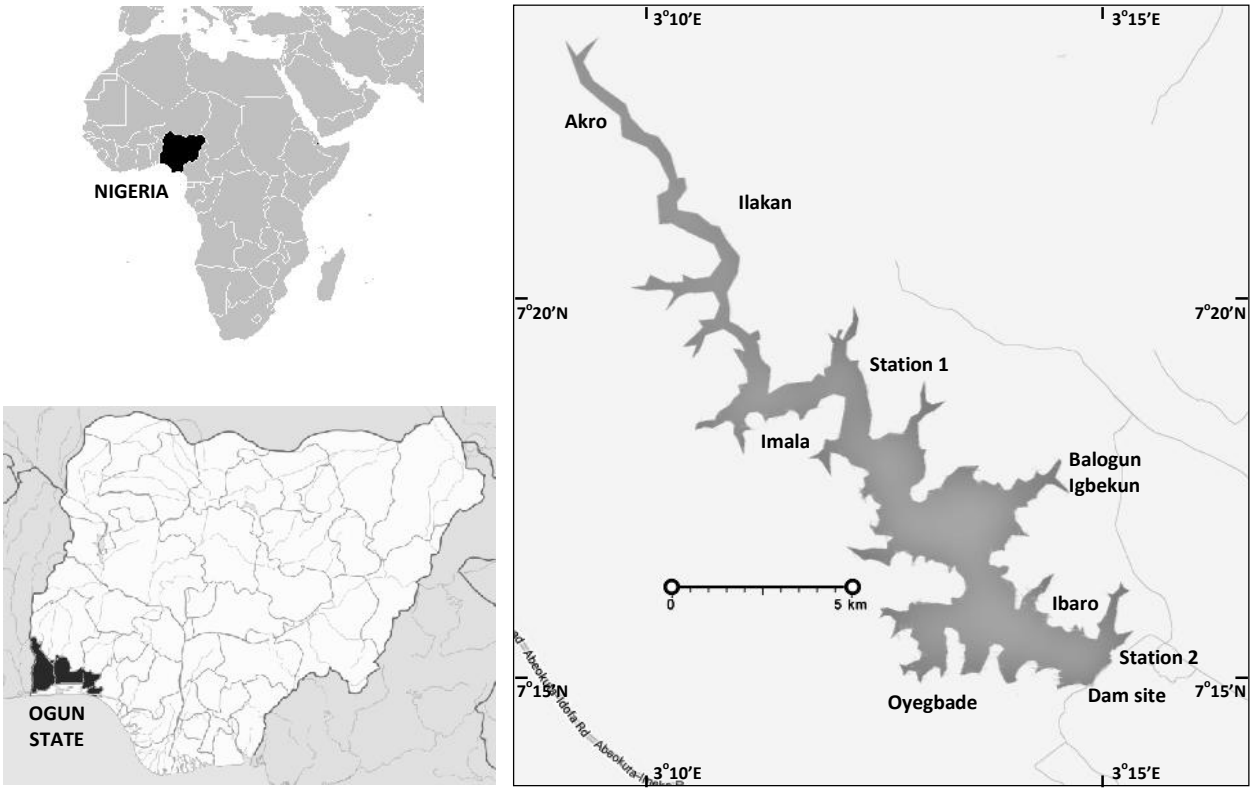

Figure 1. Map showing Oyan Dam (area of study), Ogun State, Nigeria.

2900mm. It was constructed for supply of water, for irrigation purposes and the generation of 9 megawatts of hydroelectric power which never materialized. The dam currently supports a thriving fishing industry which offers enormous opportunities for increasing freshwater fish production in the region.

Fish sampling

Two sampling stations (Site 1, Imala and Site 2, Ibaro) were selected based on their high level of fishing activities by the fishers (Ikenweiwe et al. 2007). Routine sampling was conducted and specimens of cichlid species were collected monthly in the months of March, April and May (representing the dry season) and the months of July, August and September (representing the wet season) 2011 from the catches of artisanal fishermen in Oyan Dam using gill nets of different mesh sizes ranging from 30mm-80mm (laterally stretched) mesh sizes. Sampled specimens were measured for Total length (TL) and Standard length (SL) to the nearest 0.1 cm and Body Weight (BW) to the nearest 0.1 g. Identifications of the fish species were carried out using Holden and Reed (1972).

Data analysis

A number of ecological indices were used to describe the diversity of Cichlids in Oyan Dam. These were:

The relative species abundance % = (n/N) X 100 …. (1)

Which refers to the relative representative of a species was determined by dividing the number of species (n) from each catch by the total number of species (N) from the total catch recorded.

The length-weight relationship was described by the equation:

$BW = aSL^b$ ..... (2)

Where W= total body weight (g), L= total length (cm), b= growth exponent.

Simpson's index:

$$d = \frac{\sum n(n-1)}{N(N-1)} \quad \ldots\ldots (3)$$

Where n = number of individuals of a particular species, d = diversity index and N = the total number of individuals present in the entire sample.

Simpson's index of diversity = (1-d)

Simpson's reciprocal index = (1/d)

Shannon-Weiner's Index (H') of species diversity (Shannon and Weiner 1963):

$H' = -\sum Pi \ln Pi$ ..... (4)

Where *Pi* = the proportion of the total number of individuals occurring in species *i*, 'n' is the number of individuals of each species, and N is the total number of individuals.

Pielou's Index (J) for species evenness (Pielou 1969):

J = H'/ln S ……...…… (5)

Where H' is the species diversity index and S is the number of species/species richness.

RESULTS AND DISCUSSION

Composition of the Family Cichlidae in Oyan Dam

A total of 547 fish specimens were caught during the study period belonging to five species (Table 1). Composition of species showed the presence of the following species of the family Cichlidae; *Sarotherodon galilaeus, Oreochromis niloticus, Tilapia zillii, Hemichromis fasciatus* and *Tilapia mariae.* The most abundant of the cichlid group in terms of number was *S. galilaeus* accounting for 42% of the total catch followed by *T. zillii* (25.41%) and *O. niloticus* (17.92%) while the least abundant species was *T. mariae* which had 3.48% of the fish population.

Seasonal distribution of Cichlids in Oyan Dam

The seasonal distribution of cichlid caught during the study is presented in Table 2. The results showed that *S. galilaeus, O. niloticus* and *T. zillii* were recorded both in dry and wet seasons. *H. fasciatus* was more abundant in the dry season than the wet season while *T. mariae* was encountered during the wet season and rare in the dry season. The overall monthly abundance by number (Table 2) ranged from 11.92% in March to 21.35% in July. The catches were abundant in the wet season than in the dry season. The relative abundance (by number) increased gradually from March (11.92%) to July (21.45%).Table 2 shows that *S. galilaeus, O. niloticus* and *T. zillii* were abundant, common and most frequent fish species in Oyan Dam during the study period.

Length-weight relationship of Cichlids species in Oyan Dam

The various sizes of Cichlidae in Oyan Dam (Table 3) showed that majority of catch ranged from juvenile to adults in the fish population. The sizes ranged from 12.85±0.29cm SL (standard length), 109.22±6.00g BW (body weight) in *T. zillii* to 6.09±0.05cm SL and 8.07±0.15g BW in *H. fasciatus.* In terms of body eight *T. zillii* (109.22±6.00) had the highest, followed by *S. galilaeus (*103.32±4.99) and *O. niloticus* (85.82±6.33) while *H. fasciatus* (8.07±0.15) weighted the least. In terms of standard length, *T. zillii* was the longest (12.85±0.29), followed by *S. galilaeus* (12.44±0.23) and *O. niloticus* (11.75±0.33) while *H. fasciatus* had the least standard length (6.09±0.05). Sample size (N), minimum and maximum values of lengths and weights, mean standard deviations value of lengths and weights , as well as parameters a and b of the length-weight relationships, 95% confidence intervals for b, a and the coefficient of determination (r^2) are presented for each species in Table 3. Positive allometry was found in *S. galilaeus, O. niloticus, T. zillii* and *T. mariae* with b-values of 3.138, 3.325, 3.102 and 3.012 respectively whereas negative allometry was found in *H. fasciatus* (Table 3).

Diversity indices

The diversity indexes of Cichlids indicated low diversity in the two sites during the period of investigation (Table 4).The Simpson's index of diversity were 0.716 and 0.703 for site 1 and site 2 respectively while Simpson's reciprocal index in site 1 (3.521). The Shannon-Weiner index shows that site 2 (1.37) was slightly higher than site 1 (1.36) while the Pielou's index for site 2 (0.852) was slightly higher than that of site 1 (0.845).

Table 1. Percentage composition of Cichlids in Oyan Dam, Nigeria.

Species	S1	S2	Number	Percentage
Sarotherodon galilaeus	106	127	233	42.6
Oreochromis niloticus	53	45	98	17.9
Tilapia zillii	61	78	139	25.4
Hemichromis fasciatus	34	24	58	10.6
Tilapia mariae	3	16	19	3.5
Total	257	290	547	

Note: S1 = site 1 (Imala), S2 = site 2 (Ibaro)

Discussion

The study revealed only five species of Cichlids in Oyan Dam. These include *S. galilaeus, O. niloticus, T. zillii, H. fasciatus* and *T. mariae.* Lowe-McConnell (1975) and Ita et al. (1982) reported that family Cichlidae is particularly abundance in many African reservoirs. Holden and Reed (1972) reported over 200 species of Cichlids in

Table 2. Summary of seasonal variation of Cichlids in Oyan Dam, Nigeria.

Fish species	Common name	Dry season (Jan, Feb, March)			Wet season (June, July, Sept)		
S. galilaeus	White tilapia	24	32	41	44	52	40
O. niloticus	Nile Tilapia	11	28	15	18	16	10
T. zillii	Redbelly Tilapia	17	20	32	21	24	25
H. fasciatus	Banded Jewelfish	14	5	17	15	3	4
T. mariae	Spotted Tilapia	1	-	3	7	7	1
Total		67	85	108	105	102	80
Percentage		12.2	15.5	19.2	21.4	18.1	14.2

Table 3. Length-Weight relationship of Cichlids species in Oyan Dam, Nigeria.

Fish species	N	SL range (cm)	Mean ±SE	W range (g)	Mean ±SE	a	95% C.I of a	b	95% C.I of b	r^2
S. galilaeus	233	5.6-19.2	12.4±02	8-375	103.3±4.9	0.0063	0.0058-0.0068	3.138	3.112-3.152	0.985
O. niloticus	98	5.8-17.7	85.8±0.3	9-245	85.8±6.3	0.0052	0.0049-0.0057	3.325	3.217-3.331	0.955
T. zillii	139	5.4-19.0	12.9±0.3	7-345	109.2±6	0.0071	0.0058-0.0086	3.102	2.916-2.348	0.987
H. fasciatus	58	5.5-7.2	6.1±0.1	7-12	8.07±0.2	0.0028	0.0017-0.0029	2.015	2.011-2.214	0.718
T. mariae	19	5.9-16.3	9.9±0.1	10-180	52.5±11.3	0.0043	0.0034-0.0056	3.012	2..268-3.212	0.941

Table 4. Diversity indexes of fish species in two sites of Oyan Dam, Nigeria.

Diversity Index	S1	S2
Number of species	5	5
Number of individuals	257	290
Simpson's index	0.285	0.295
Simpson's index of diversity	0.716	0.703
Simpson's reciprocal index	3.521	3.367
Shannon-Weiner index	1.36	1.37
Pielou's index	0.845	0.852

Note: S1 = site 1 (Imala), S2 = site 2 (Ibaro)

West African water bodies. Similarly Daddy et al. (1991), Bankole et al. (1994) and Olopade (2010) reported Cichlidae to be the dominant family in Tatabu Lake in Niger State, Alau Lake in Borno State and Oyan Dam in Ogun State all in Nigeria. The number encountered in the present study was lower than the results of Ikenweiwe et al. (2007) who recorded six species of Cichlids in Oyan Dam. The number of species will vary depending upon differences in the sampling methods and sampling effort, as well as fish abundance. The most abundant of the cichlids group in terms of number was *S. galilaeus*. The dominance of *S. galilaeus* in large freshwater body in Nigeria has already been reported by Adesulu and Sydenham (2007). Akintunde (1976) reported similar results in Lake Kainji between 1971 and 1976, where *S. galilaeus* formed 91.4% by number and 88.12% by weight of the total cichlids. The least abundant species was *T. mariae* which had 3.48% of the fish population. *Tilapia mariae* occurs in coastal areas and the lower courses of rivers. Fagade and Olaniyan (1974) reported the occurrence of the species in the Lagos Lagoon when the water is either fresh or recording low salinities (less than $1^{o}/_{oo}$).This species possess abroad salinity tolerance (Schwanck 1987). In the present study, the smallest length of captured fish among the five species was 6.09±0.05cm in Standard length with a minimum weight of 8.07±0.15g for *H. fasciatus*. Adesulu and Sydenham (2007), in the description of that species, reported a relatively small fish with the largest specimen caught so far is about 30cm. Komolafe and Arowomo (2011) also reported *H. fasciatus*, with 4.9 cm standard length and weight of 3.0 g, as the smallest fish in Erinle reservoir. The feeding habit of the fish (piscivorous) could be responsible for its size. Some researchers have used fish size to estimate the relative probability that fish of various sizes will encounter the nets (Rudstam et al. 1984; Spangler and Collins 1992). Comparatively, the food consumed by the populations of *H. fasciatus* in Tarkwa bay and the Lagos lagoon in Nigeria (Ugwumba 1988) consisted principally of fish.

All the species were present during the dry and wet seasons with more individual species recorded in wet season. Dry season in south west Nigeria, is a period characterized by poor water quality, reduced water level, high temperature and salinity (Lawson and Olusanya 2010), under these conditions, migrations of the species of fish may be responsible for the low catch recorded during these period. Seasonal differences in fish movement can be very important in determining the likelihood of encounter of gillnet and changes in movement in response to weather, or any other stimulus, can influence encounter probability (Portt 2006). The presence of Cichlids in both seasons described their abundance and diversity in Africa. Their abundance may be the result of natural history trait such as high reproductive rates, high rate of juvenile and adult survival, or strong competitive abilities that allow them to dominate other species (Van Dyke 2003).The differences in catch seasonally could be probably attributed to fish abundance. It is well known that passive net catches depend on the activity and density of fish which are, in addition, influenced by the season of year, weather, water temperature and transparency, depth for net setting and other factors (Sechin et al. 1991).

Sarotherodon galilaeus, O. niloticus, T. zillii and *T mariae* exhibited a positive allometric growth pattern that is the length and body of fish grows in the same proportion. The findings are more similar to the findings of Haruna (2006) on the length-weight relationship of four fish species cichlids from Magaga Lake, Kano, Nigeria. However, with respect to *H. fasciatus* the negative allometery was caused by the capture of mainly young individuals. *H. fasciatus*, with mean standard length of 7.2cm and weight of 12g was the smallest Cichlids recorded during the study. The calculated allometric coefficient *b* varied among the species from a minimum of 2.015 for *H. fasciatus*, to a maximum of 3.325. These values are within the limits (2 and 4) reported by Tesch (1971) for most fishes.

The estimates of diversity indices showed slightly higher values for site 2 than for site 1. Mwangi et al. (2012) reported that community structure (species diversity, richness and evenness) were generally higher in the middle and lower reaches of River Kisian and Awach in Kenya which was attributed to their proximity to Lake Victoria. This was anticipated since sources of water to the dam are from two big rivers namely Oyan and Offiki tributaries of River Ogun. Indications are that the dam gets stocked by migratory fish from annual flooding of the two rivers. The

Simpson's index values range from 0 to1, with 1 representing perfect evenness (all species present in equal number).In this study Simpson's indices were less than 1 indicating imperfect evenness. The value of Shannon diversity is usually found to fall between 1.5 and 3.5 and only rarely it surpasses 4.5. The Shannon- Weiner index indicates low species diversity of cichlids in the study area. The low diversity could be attributed to occurrence of seasonal floods as result of environmental change.

CONCLUSION

The results of this study showed that the family Cichlidae was represented by five species namely *S. galilaeus, T. zillii, T. mariae, O. niloticus* and *H. fasciatus.* The more abundant in the two seasons was *S. galilaeus* while the least was *T. mariae. T. zillii* had the highest mean body weight and longest mean length. Almost all the species were present in both seasons with *S. galilaeus, O. niloticus* and *T. zillii* abundant, common and frequently observed in the dam. There is selective mortality towards smaller fish size. This implies that juvenile individuals are the target of the fishery. The high vulnerability of juvenile fish capture by gear would result in the reduction of the future yield of cichlids. The various diversity indices of the species composition indicated low diversity in the two sites indicating the unhealthy nature of the reservoir. Fish stocking has proven to be one of the most successful tangible tools in reservoir fisheries management (An 2001) therefore, Oyan Dam should be stocked with more Cichlids fishes in order to improve the stock.

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