

COMMUNITY STRUCTURE OF CICHLIDS IN SOME MAJOR LAKES IN NIGERIA

*¹ADEDEJI, H. A., ¹T. A., IDOWU, ²R. Y. OLADUNJOYE, AND ¹O. A. SOGBESAN

¹Department of Fisheries, Modibbo Adama University, Yola

²Department of Zoology and Environmental Biology, Olabisi Onabanjo University, Ago-Iwoye

Corresponding Author: bowaledeji@mau.edu.ng

ABSTRACT

The study was conducted to investigate the status of the Cichlidae family in some major lakes of Nigeria namely; Asejire, Oyan, Geriyo, Dadin-Kowa, Kainji, and Jebba. Samples of the cichlid group were collected bi-monthly from the study sites for six months, between July and December 2016. During the study, a total of 6,583 individuals were observed, belonging to seven species, including *Coptodon zillii*, *Pelmatolapia mariae*, *Sarotherodon galilaeus*, *Oreochromis niloticus*, *Chromidotilapia guntheri*, *Hemichromis fasciatus*, and *Hemichromis bimaculatus*. The highest composition of the six species and abundance, except for *H. bimaculatus*, was found in Asejire and Oyan lakes, followed by Kainji and Jebba lakes, which had a composition of five species, except for *P. mariae* and *H. bimaculatus*. Geriyo and Dadin-Kowa lakes had species compositions of four and three respectively. The study revealed that the species abundance was higher during the wet season, but still reasonable during the dry season, except for *H. bimaculatus*, which was generally low where it was observed. It was also observed that *O. niloticus* was dominant in abundance in four study locations compared to *S. galilaeus* which was dominant in two locations. Shannon-Weiner's diversity indices indicated that Asejire and Oyan lakes were more diverse and richer in cichlid group, while Geriyo and Dadin-Kowa lakes were less diverse and less rich in cichlid group. Similarly, Pielou's evenness showed that the cichlid group of Dadin-Kowa Lake is more even in their abundance than from other sites while the Simpson diversity index was higher in Asejire and Oyan compared to other studied sites.

Keywords: Asejire Lake, Cichlid Group, Composition and Abundance, Diversity Indices, Kainji Lakes

INTRODUCTION

Conservation and management of natural resources of any nation are crucial to the sustainable development of that nation; and among these arrays of natural resources are the aquatic resources, which include freshwater, brackish and marine resources (Ekpo and Essien-Ibok, 2013). Fishing has been a major source of food for humanity, employment opportunities and economic benefits to those engaged in it. However, with increased knowledge and dynamic in fisheries development, it was realized that living aquatic resources, although renewable, are not infinite and need to be properly managed, if their contribution to the nutritional, economic and social well-being of the growing world's population was to be sustained (Kocher, 2004; Ekpo and Essien-ibok, 2013). The decline in global fish production in recent years which is been brought about by overfishing and continuing environmental degradation called for improved proper management schemes and sustainable utilization of aquatic resources.

Tilapia group of the family cichlid is of major importance to artisanal fisheries in Africa (Kocher, 2004) and their widespread introduction has led to the establishment of tilapia fisheries in

areas in which they were not native (Blanco *et al.*, 2007) or not historically an important component of the catch (Balirwa, 1992) They have also been reported to be critically important to world aquaculture, as attested to by the reports of Costa-Pierce and Rakocy, (1997) and Fitzsimmons, (1997). Over the years, the compositions and abundance of total fish species in lakes, ponds, rivers etc have been researched by different researchers which include but are not limited to the work of Yem, *et al.* (2011) from different water bodies in Nigeria, Olapade and Rufau (2014) from Oyan Lake, Oyo State, Olufeagba, *et al.* (2015) from Kainji Lake, Niger State, Falaye, *et al.* (2015) from Erelu Lake, Oyo State, Zira, *et al.* (2017) from Kiri Dam, Adamawa State, Adedeji, *et al.* (2017) from Ribadu Lake, Adamawa State, Sani, *et al.* (2019) from Bonda River, Kwali Area Council, Abuja, Essien-Ibok and Isemin (2020) from major water bodies in Akwa-Ibom State, Nazeef *et al.* (2021) from Dadin-Kowa Lake, Gombe State.

However, only a few of these ichthyofauna studies pay special attention to the cichlid group having been reported to constitute about thirty percent of the fish composition of any environment they occupy (Adeyemi *et al.*, 2010; Adaka *et al.*,

2014; Adedeji *et al.* 2017). Due to the importance of this group of fish to aquatic ecosystem structure and function, fisheries and aquaculture, it is critically important to study their diversity and abundance in some major lakes in Nigeria for effective and efficient management and conservation of the cichlidae. The objectives of the study were to determine the compositions and community structures of cichlids from the selected major Lakes in Nigeria using some ecological diversity indices,

MATERIALS AND METHODS

Characteristics of the study locations

Asejire Lake: Asejire Lake is a man-made lake that was constructed over River Oshun in 1972 and lies on latitude 07° 2'N and longitude 04° 07'E. It is located about 30 km east of Ibadan, Oyo State, Nigeria. The lake is Y-shaped with two unequal arms of the Y. Catchment area above the dam is 7,800 km² and the impounded area is 2,342 hectares (Ayoade *et al.*, 2006). The lake has a gross storage capacity of 7,403 million litres of water with an elevation of 137 m. It has a relative humidity of 73.4 - 79.1, transparency range between 0.7 - 1.72 m, surface water temperature of 24 - 31.5°C, dissolved oxygen 5.1 - 8.9 mgL⁻¹ and pH 6.2 - 8.5 (Ayoade *et al.*, 2006).

Oyan Lake: This is also a man-made lake constructed on the Oyan River in 1983 with an estimated average annual flow of about 1,770 million. It lies on latitude 07° 15'N and longitude 03°16'E. It covers 4,000 hectares and has a catchment area of 9,000 km². It has an average length of 1044m, height of 30.4m with an elevation of 150m above the sea level. Average annual temperature and rainfall are 24.3°C and 102.6 mm respectively with a total capacity of about 270 million (Ayoade *et al.*, 2006).

Lake Geriyo: It is a floodplain lake, located on the outskirts of Jimeta metropolis, Adamawa in North-western Nigeria. It lies between latitude 9° 18'N and longitude 12° 25'E. It is a shallow water body with a mean depth of about 2 meters and the mean annual rainfall is between 900 to 1100mm with the rainy season ranging from 150 – 160 days, usually from May to October. Temperature ranges from 20°C in December to January and intense heat with temperatures of 30°C to 42°C from March to April (Upper Benue River Basin Development Authority, 1985). It experiences some influx of water from floods during the rainy season and overflows from

river Benue which serves as a major water source to the lake.

Dandin-kowa Lake: A man-made lake that is located 5km North of Dadin Kowa village (about 37km from Gombe town, along Gombe-Biu road) in Yamaltu Deba Local Government Area of Gombe State. The area lies within latitude 10°18'N and longitude 11°32'E of the equator. The lake has a water capacity of 800 million cubes and a surface area of 300 kilometers square (Upper Benue River Basin Development Authority, 1980).

Kainji Lake: This is a reservoir on the Niger River, formed by the Kainji Dam. It lies on the latitude 10°22'N and longitude 04°32'E of the equator. The Kainji Lake basin is one of the most important inland basins in Nigeria, it is the home of the first and the largest hydro-electricity station in the country, and the woodland vegetation of the basin is the home of the first National Parks in Nigeria (Ikusemoran and Olokori, 2014). According to Ikusemoran and Adesina (2009), the impoundment of Kainji Lake on the River Niger has converted the river into a lake ecosystem and has also changed the land cover around the formed lake.

Jebba Lake: The lake lies between longitude 04°30' to 04°50'E and latitude 09°55'N (Figure 4). It has a drainage basin extending from Kainji Reservoir to the Jebba area (approximately 100 km). The six major rivers that empty into the lake are Oli, Wuruma, Moshi, Awuru on the western side and Kontangora and Eku on the Eastern part (Adesina *et al.* 2007).

Collection and Identification of Samples

The samples from Asejire and Dandin-kowa Lakes were collected at the dam site of the lake, while samples from Oyan Lake were collected at the Abule titun landing site which is very close to the dam site. Samples from Geriyo Lake were collected at the landing site of the lake while samples from Kainji and Jebba Lakes were collected at the Monai village landing site and New Awuru landing site respectively. Identification of the cichlid species was done using the field guide to Nigerian Freshwater Fishes (Revised Edition) by Olaosebikan and Raji (2013). Routine sampling was conducted and specimens of cichlid species were collected bi-monthly for six months between July and December 2016 from the catches of three contracted artisanal

fishermen from each study location using gill nets of various mesh sizes ranging from 30mm to 80mm

Data analysis

Composition and abundance were presented in tables while three different ecological indices were used to describe the diversity of

Cichlids in each of the studied reservoirs. These include:

Relative species abundance % =

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



Figure I. Map of Nigeria showing the study locations

Margalef’s index (D) for species richness (Margalef, 1968)

$$D = (S - 1) / \ln(N)$$

Where S is the number of species

N is the number of individual

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

$$H' = \sum (Pi \ln Pi)$$

Where Pi = the proportion of the total number of individuals occurring in species i, while LnPi' is the natural logarithm of this proportion

$$\text{Simpson's index: } d = \sum (n(n - 1) \div N(N - 1))$$

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

$$\text{Simpson's index of diversity} = (1 - d)$$

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

$$J = H' \div \ln S$$

Where H' is the species diversity index (Shannon wiener) and S is the number of species/species richness.

The three different ecological indices were analyzed using Microsoft excel (2010) package

RESULTS

Species Composition and Abundance

The compositions and relative abundance of cichlids from five major reservoirs in Nigeria during the sampling period are presented in Table 1. The results showed that a total of six thousand, five hundred and eighty-three individuals (6583) were sampled during the study which belong to different seven species of cichlids, which include *Coptodon zilli*, *Pelmatolapia mariae*, *Sarotherodon galilaeus*, *Oreochromis niloticus*, *Chromidotilapia guntheri*, *Hemichromis fasciatus* and *Hemichromis bimaculatus* (Figure I). Asejire and Oyan reservoirs

had the highest number of species compositions of six (6) each followed by Kainji, Jebba and Geriyo Lakes with species composition of five (5) while Dadin-Kowa lake had the least species composition of three (3) (Table 1). *C. zilli*, *S. galilaeus* and *O. niloticus* were the most common species in all the studied locations while *P. mariae* were only observed in Asejire and Oyan Lakes. Similarly, *H. fasciatus* was also common in all the studied locations except in Dadin-Kowa Lake where it was absent while *C. guntheri* was also observed in all the studied locations except in Geriyo and Dadin-kowa Lakes. *H. bimaculatus* was only observed in Geriyo and absent in other studied locations.

The results also revealed that Asejire Lake had the highest species abundant of cichlids with one thousand, four hundred and six (1406) individuals which accounted for 21.36% of the total individuals sampled and was followed by Oyan Lake, with a total species abundant of cichlid species of one thousand, two hundred and ninety-four (1294) individuals and accounted for 19.66% of the total samples observed. (Table II). Kainji and Jebba lakes had species abundant of one thousand, two hundred and twenty-one (1221) and one thousand, and thirty-three (1033) which represented 18.55% and 15.69% respectively of the total samples observed while Geriyo had eight hundred and seventy (870) of species abundant and accounted for 13.22%. Dadin-Kowa had the least total species abundant of cichlids of seven hundred and fifty-nine (759) that represented 11.53% of total observed individuals. The results also revealed that the highest species

abundance was observed in August with a total of 1284 individuals followed by July and September with a total of 1251 and 1164 individuals respectively. The lowest species abundance was observed in October with 871 individuals followed by November with 960 individuals while a total of 1053 was observed in December.

Species Diversity indices

The results showed that Asejire and Oyan Lakes had the highest species richness indices (Margalef index) of 0.568 each followed by Geriyo, Kainji and Jebba Lakes with 0.455 values each while the Dadin-Kowa Lake had the lowest species richness index of 0.227. The diversity indices of the five major lakes in Nigeria also showed that Asejire and Oyan lakes had the highest values of 1.743 and 1.725 respectively for Shannon-Weiner while Dadin-kowa Lake had the lowest value of 1.098 for Shannon-Weiner. The values of 1.203, 1.519 and 1.501 were observed from Geriyo, Kainji and Jebba lakes for Shannon-Weiner. Similarly, the highest value for Pielou's evenness (0.999) was observed from Dadin-Kowa Lake followed by Asejire (0.973) and Oyan (0.963) lakes. The lowest evenness value (0.747) was observed in Geriyo Lake. The Simpson index of diversity showed that Asejire and Oyan lakes had the highest values of 0.818 and 0.812 respectively while the Geriyo Lake had the lowest value of the Simpson index of diversity of 0.683. Kainji and Jebba Lake had values of 0.768 and 0.762 respectively.



Figure II: Samples of cichlid species encountered during the study

Table 1: Species composition and abundance of cichlids group from five major lakes in Nigeria between July and December, 2016

		Asejire	Oyan	Geriyo	Dadin-Kowa	Kainji	Jebba	
JULY	<i>C. zilli</i>	55	52	45	36	58	47	
	<i>P. mariae</i>	41	32					
	<i>S. galileaus</i>	61	63	51	42	62	51	
	<i>O. niloticus</i>	56	52	47	45	63	54	
	<i>C. guntheri</i>	35	21			25	21	
	<i>H. fasciatus</i>	31	36	6		37	21	
	<i>H. bimaculatus</i>			5				
Sub-Total		279	256	154	123	245	194	1251
AUGUST	<i>C. zilli</i>	59	56	48	43	61	49	
	<i>P. mariae</i>	43	37					
	<i>S. galileaus</i>	61	59	55	46	61	53	
	<i>O. niloticus</i>	60	54	51	49	65	51	
	<i>C. guntheri</i>	33	24			22	22	
	<i>H. fasciatus</i>	26	31	5		34	24	
	<i>H. bimaculatus</i>			2				
Sub-Total		282	261	161	138	243	199	1284
SEPTEMBER	<i>C. zilli</i>	52	51	47	41	54	50	
	<i>P. mariae</i>	39	31					
	<i>S. galileaus</i>	54	51	53	45	57	51	

	<i>O. niloticus</i>	53	49	52	46	60	52	
	<i>C. guntheri</i>	29	21			16	14	
	<i>H. fasciatus</i>	21	24	3		29	19	
	<i>H. bimaculatus</i>							
Sub-Total		248	227	155	132	216	186	1164
OCTOBER	<i>C. zilli</i>	40	38	37	40	44	36	
	<i>P. mariae</i>	25	21					
	<i>S. galileaus</i>	40	42	43	38	41	40	
	<i>O. niloticus</i>	45	37	41	40	42	41	
	<i>C. guntheri</i>	10	8			10	8	
	<i>H. fasciatus</i>	21	17			16	10	
	<i>H. bimaculatus</i>							
Sub-Total		181	163	121	118	153	135	871
NOVEMBER	<i>C. zilli</i>	38	41	40	42	50	40	
	<i>P. mariae</i>	31	25					
	<i>S. galileaus</i>	43	46	50	43	47	42	
	<i>O. niloticus</i>	46	40	43	39	49	46	
	<i>C. guntheri</i>	17	12			10	10	
	<i>H. fasciatus</i>	20	18			19	13	
	<i>H. bimaculatus</i>							
Sub-Total		195	182	133	124	175	151	960
DECEMBER	<i>P. mariae</i>	36	28					
	<i>S. galileaus</i>	46	45	52	41	51	46	
	<i>O. niloticus</i>	50	42	49	43	52	50	
	<i>C. guntheri</i>	21	17			14	11	
	<i>H. fasciatus</i>	23	25	1		21	18	
	<i>H. bimaculatus</i>							
Sub-Total		221	205	146	124	189	168	1053
Grand Total		1406	1294	870	759	1221	1033	6583

Table II: Relative Abundance and Percentage Compositions of Cichlid Group of the Lakes in Nigeria

July - Dec	Asejire (%)	Oyan (%)	Geriyo (%)	Dadin-Kowa (%)	Kainji (%)	Jebba (%)	TOTAL
<i>C. zilli</i>	289 (20.55)	286 (22.10)	261 (30)	242 (31.88)	318 (26.04)	265 (25.65)	1661(25.23)
<i>P. mariae</i>	215 (15.29)	174 (13.45)					389(5.91)
<i>S. galileaus</i>	305 (21.69)	306 (23.65)	304 (34.94)	255 (33.60)	319 (26.13)	283 (27.40)	1772(26.92)
<i>O. niloticus</i>	310 (22.05)	274 (21.17)	283 (32.53)	262 (34.52)	331 (27.11)	294 (28.46)	1754(26.64)
<i>C. guntheri</i>	145 (10.31)	103 (7.96)			97 (7.94)	86 (8.33)	431(6.55)
<i>H. fasciatus</i>	142 (10.10)	151 (11.67)	15 (1.72)		156 (12.78)	105 (10.16)	569(8.64)
<i>H. bimaculatus</i>			7 (0.81)				7(0.11)
Composition %	21.36%	19.66%	13.22%	11.53%	18.55%	15.69%	
TOTAL	1406	1294	870	759	1221	1033	6583

Table III: Diversity indices of Cichlid group from some major lakes in Nigeria

	Asejire	Oyan	Geriyo	Dadin-Kowa	Kainji	Jebba
No of Species	6	6	5	3	5	5
No of Individuals	1406	1294	870	759	1221	1033
Margalef	0.569	0.569	0.455	0.227	0.455	0.455
Shannon-Weiner	1.743	1.725	1.203	1.098	1.519	1.501
Evenness	0.973	0.963	0.747	0.999	0.944	0.932
Simpson	0.818	0.812	0.683	0.667	0.768	0.762

DISCUSSION

Cichlids are known for evolving rapidly into many closely related but morphologically diverse species within lakes (Meyer, 2005). The best-known genera in Nigeria are *Tilapia* (Fagade and Olaniyan, 1971), *Hemichromis* (Fagade 1983) and *Sarotherodon* which was reported by Trewavas (1983) and conformed to this study. Several researchers have worked on the composition of cichlids in some water bodies in Nigeria which include Morenikeji and Adepeju (2009) who reported six (6) species from Eleyele Dam, Olubunmi *et al.* (2017) and Simon-Oke (2017) reported five (5) and four (4) species from the same lake respectively. Yem *et al.* (2011) reported seven (7) species from Oguta Lake, three (3) species from Dadin-Kowa Lake, eight (8) species from Asejire and Oyan, four (4) species from Asa River and Tiga Lake and two (2) species from Opi River. Olapade and Rufai (2014) documented five species of cichlids from Oyan Dam while Olufeagba *et al.* (2015) reported four species of cichlids from Kainji Lake. Six (6) species were reported by Falaye *et al.* (2015) from Erelu Lake in Oyo State. Zira *et al.* (2017) observed three (3) species from Kiri Dam while Dan-Kishiya *et al.* (2013) reported four (4) species from Lower Usuma reservoir, Bwari Abuja. Sogbesan *et al.* (2017) documented three (3) species from Lake Geriyo and Upper River Benue while Salele *et al.* (2023) reported four (4) species from Zobe reservoir, Dutsin-ma, Kastina State.

The six species of the cichlid group identified in this study from Asejire Lake is lower than that of Yem *et al.* (2011) who reported eight species from the same study site as this present study did not observe *Pelmatochromis guntheri* and *Tilapia dageti*. However, this study observed higher species composition than the work of Ipinmoroti (2013) who recorded *C. zillii*, *S. galilaeus* and *O. niloticus* from Asejire lake. Yem *et al.* (2011) observed *T.*

melanopleura, *T. macrocephala* and *T. monody* from Oyan Lake which were not found in this study. Although, their reports did not include *C. guntheri* that was identified in the study. Olapade and Rufai (2014) documented five species of cichlid group that include those documented in the present study except *C. guntheri*. The differences in the observed species from Oyan Dam could be attributed to the differences in the sampling locations because Olapade and Rufai (2014) sampled Imala and Ibaro communities while Abule tuntun and Ibaro were the study sampling sites. Meanwhile, Yem *et al.* (2011) did not specify the sampling site in their study but presumed to be the dam site. Another possible reason that could be responsible for the variation in species compositions in Oyan Dam could be the seasonal floods which Olapade and Rufai (2014) attributed to the low diversity of cichlids observed in their findings.

The three species (*C. zillii*, *O. niloticus* and *S. galilaeus*) observed in the Dadin-kowa Lake were the same species reported by Yem *et al.* (2011) and Nazeef *et al.* (2021) from the same Lake. In Lake Geriyo, Ekundayo *et al.* (2014) documented one species (*C. zillii*), while Adedeji *et al.* (2017) and Sogbesan *et al.* (2017) reported three species (*C. zillii*, *O. niloticus* and *S. galilaeus*) compared to the six species observed from the present study. These differences could be associated with the sampling period (Adedeji *et al.* 2017), duration (Anene, 2005), sampling efforts (Olapade and Rufai, 2014) and possibly flooding from the adjacent Upper Benue River. Though, Ekundayo *et al.* (2014) sampled for a month, Adedeji *et al.* (2017) sampled for six (6) months while Sogbesan *et al.* (2017) did not specify the duration of their study. Another possible reason for the differences observed from previous studies compared to the present study in Lake Geriyo may be due to the fishing efforts as this present study sampled from the catches of three contracted artisanal fishermen. It is very important

to note that the present study is the first to report the presence of *H. bimaculatus* in Geriyo Lake even though the abundance was very low and only observed during the middle of the wet season. In Kainji, *H. fasciatus* and *C. guntheri* are additional two species reported in this study in comparison to the work of Olufeagba *et al.* (2015) on the same lake where the authors recorded only *O. niloticus*, *C. zillii*, *T. marie* and *S. galilaeus*.

The seasonal variation observed in this present study is in agreement with the findings of Olapade and Rufai (2014) who documented a similar trend in their study which indicated that the abundance of cichlid groups is higher in the wet season than dry season when compared. However, the presence of these cichlids group in both seasons described their abundance and diversity, which could be attributed to their natural history and traits such as high reproductive rates, high rate of juvenile and adult survival and strong competitive abilities that allow them to dominate other species (Van Dyke 2003).

The higher abundant of *O. niloticus* among the cichlids recorded in four out of the six study sites was a bit divergent from the submission of Adesulu and Sydenham (2007) and Olapade and Rufai (2014) that *S. galilaeus* is the most dominant and abundant species among the group in Nigerian freshwater. The diversity index, Shannon-Weiner observed in this present study was fairly higher than that of the report of Olapade and Rufai (2014) from Oyan Dam except that of Geriyo Lake (1.203) and Dadin-Kowa Lake (1.098) (2.483) with fairly low diversity of the cichlid group. The Simpson's index of diversity that ranges from 0.667 in Dadin-kowa Lake to 0.818 in Asejire Lake showed a very fair diversity in the studied areas which falls within the range reported by Adedeji *et al.* (2017) from Lake Geriyo, Adamawa State and Olapade and Rufai (2014) from Oyan Lake. The value usually ranges from 0 to 1 with greater value indicating greater diversity and index value which suggests that every two individual fish samples of the cichlid group that is randomly selected from each studied area will belong to different species. All the diversity indices in the present study with the exception of evenness are lower to the report of Adaka *et al.* (2014) who reported fair higher diversity indices of 9.007 for Margalef index, 2.965 for Shannon-weiner index and 0.940 for Simpson's index of diversity from Oramiri-Ukwa River, Southeast Nigeria. Lawson

and Olusanya (2010) also reported a higher Shannon-weiner index (2.015), a similar range of Simpson's index of diversity (0.845) and a lower evenness (0.74) from Igbesa tributary of River Ore, Ogun State. The report of Adedeji *et al.* (2017) also indicated a higher Shannon-weiner index (2.483) and Simpson's index of diversity (0.879) to the present study. However, the higher margalef index observed in Adaka *et al.*(2014) and Shannon-weiner in Lawson and Olusanya (2010) and Adedeji *et al.*(2017) compared to the present study may be connected to the facts that this present study only considered the cichlid species of the studied major Lakes while Adaka *et al.*(2014), Lawson and Olusanya (2010) and Adedeji *et al.*(2017) considered the whole species of their studied water bodies.

CONCLUSION

The results from the study revealed that Asejire and Oyan Lakes are composed of more cichlid species (six species), followed by Kainji and Jebba Lakes (5 species each) while Geriyo and Dadin-Kowa are composed of four and three cichlids species respectively. It also revealed that *C. zillii*, *O. niloticus* and *S. galilaeus* are the most common species in all the Lakes while *P. mariae* was only common to Asejire and Oyan Lakes. *H. fasciatus* and *C. guentheri* were only common to Asejire, Oyan, Kainji and Jebba Lakes while *H. bimaculatus* was only present in Geriyo Lake. Almost all the species were present both in the wet and dry seasons in all the study sites except *H. bimaculatus* which was only present towards the peak of the wet season. The various diversity indices observed across the study sites is an indication of fair diversity and distribution of the cichlid group and the very low abundance of *H. bimaculatus* in only one location and absence in others is a serious sign of their threatened and endangered status, which required immediate and necessary attention.

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