ICHTYOFAUNA COMMUNITY STRUCTURE OF THE FINIMA NATURE PARK LAKE, BONNY ISLAND, RIVERS STATE, NIGERIA.

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ABSTRACT
A study to determine the Community structure of the fish fauna was carried out. The aim of the study was to identify and document the Ichtyofauna community. A four-month survey was carried out. Fish samples were caught using traps of various types and sizes, and cast nets of 2mm mesh size. The diversity, composition, and abundance of the fishes from the Lake was assessed using standard methods. The results revealed a composition of 7 species (Hemichromis fasciatus, Coptodon guineensis, Coptodon zilli, Sarotherodon melanotheron, Sarotherodon galilaeus, Parachana obscura and Hydrocynus brevis) from 3 families (Cichlidae, Alestidae and Channidae). The Shannon Weiner diversity index revealed the family Cichlidae as the most diverse (84%) with 5 species, followed by Alestidae (13%) with 1 species, and Channidae (2%) with 1 species. The relative abundance revealed the Cichlidae as most abundant family, and the Hemichromis fasciatus species with 54.74% as most abundant species, while the Coptodon guineensis (2.1%) and P. obscura, (2.1%) were the least abundant. In conclusion, the fish community status is poor, as almost all the species therein are extremely low (rare), except for H. fasciatus which itself is "few".

Keywords: Abundance, Composition, Diversity, Fish species

INTRODUCTION

The Finima Nature Park (FNP) Lake is an artificial freshwater impoundment surrounded by a natural forest area. It is in the Finima Nature Park (FNP) situated in Finima town, Bonny Island, in the Niger Delta Wetland Area. The FNP was created by the NLNG, an oil and gas installation situated in Finima town, Bonny, Rivers State, in 1999 (Godfrey and Luca, 2009), as a result of the establishment of their oil and gas installations at the old Finima town, and the consequent relocation of human settlement to the southerly forested area. The creation of the FNP was targeted at preventing loss of biodiversity (FCNL 2004, 2006) in the Finima section of the Niger Delta Wetland which already requires much management (conservation and protection) of its flora and fauna that are rapidly being depleted due to various legal and illegal activities.

Aquatic biodiversity conservation and management has generated a lot of interest lately among researchers (Sugihara, 1980; Marais, 1998; Thiel *et al*., 1995; Jordan *et al*., 2010), and has become a major source of concern in recent years (Abowei, 2010). King (1995), reported that, the fish fauna assemblage of a watershed and the natural management and conservation of the fish resources are both important resources. Thus, fish populations or communities in their environment are described and assessed using several parameters among which are, species composition, species richness, and abundance (Hewitt *et al*., 2008)., King (1995) stated that, the fish fauna assemblage of a watershed and the natural management and conservation of the fish resources are both based on the critical survey of the composition of the fish fauna. Information on the species abundance is essential to determine the effects of fishing, various human activities, natural climatic variations, and detect changes in a fish population (Jalal *et al*., 2012), and also gives insight into less obvious aspects of the aquatic ecosystem such as, competition and predatory behaviors of fish in the ecosystem (Thompson *et al*., 2015; Galib *et al*., 2013; Tahir, 2013). Pino-Del-Carpio *et al.* (2014) reported that, the diversity and community structure of fishes in any water body are important for conservation and management purposes. Biodiversity is important for stabilization of ecosystems, protection of the environmental quality, understanding the intrinsic worth of all species on earth, and it is essential for the future sustainability of fisheries resource in order to conserve and increase the needs for fish population (Ehrlich and Wilson, 1991).

There are several inland waters in Nigeria, rich in a diversity of finfish and shellfish. Impoundments and lakes are homes to several fish species, a characteristic common to other inland water bodies due to the diversity in the physical environment. Smith (1966), reported that the greater the variation in the physical environment the more numerous are the species since there are more numerous microhabitats available and more niches to fill.

Wetlands and their associated lakes are amongst the most vulnerable ecosystems (Finlayson *et al*., 1992; Finlayson & Moser, 1992; Dugan, 1993). Benech (1992) stated that local extinctions occurred in the Lake Chad for fish species such as *Heterotis niloticus* and *Hydrocynus brevis* and only "marshy" species were favored by natural selection to adapt and survive in the harsh environments with dominant species including: *Protopterus annectens*, *Polypterus senegalus*, *Oreochromis niloticus*, *Oreochromis aureus*, *Sarotherodon galilaeus*,

Brienomyrus niger and *Clarias* species. Ataguba (2018), confirmed that anthropogenic activities such as sand mining, logging and waste disposal have negative impacts on the quality of the water as well as fish faunal diversity in the Gubi Dam, Bauchi State, Nigeria.

A number of researchers have investigated fish populations in lentic and lotic water bodies. Teugels and Powell (1993), reviewed group of fishes in the Niger basin, a region of high richness, reported 243 primarily freshwater species from 36 families.

Ita (1993), reported 268 different fish species in 34 well known Nigeria freshwater rivers, lakes and reservoirs which constitute about 12% of Nigeria's total surface area of about 98,185000 ha. Ezealor (2002), reported that fish species in Lake Chad exhibited a wide distribution within the lake and its tributaries with species including: *Lates niloticus, Synodontis schall, Labeo senegalensis, Distichodus rostratus, Hydrocynus forkalii* and *Schilbe mystus*. In the Niger Delta, Alfred-Ockiya and Otobo (1990) reported 22 families of fish in Ofonitorubuo Lake. Despite the importance of the FNP Lake as a reference point to the Niger Delta Wetlands management, and conservation, no study has been carried out on this water body, to elucidate the fish community structure. The investigation of the Composition, Abundance and Diversity of fishes in this aquatic habitat is important, as it will give information on the available species, which will be essential in profiling the lake species, monitoring changes in the lake and its community structure, to prevent threats to conservation, build knowledge, and support appropriate management of the fish community and their environment.

MATERIALS AND METHODS

Study Area

The study was carried out at the Finima Nature Park Lake, located in Bonny Local Government area of Rivers State (Figure 1), Nigeria.

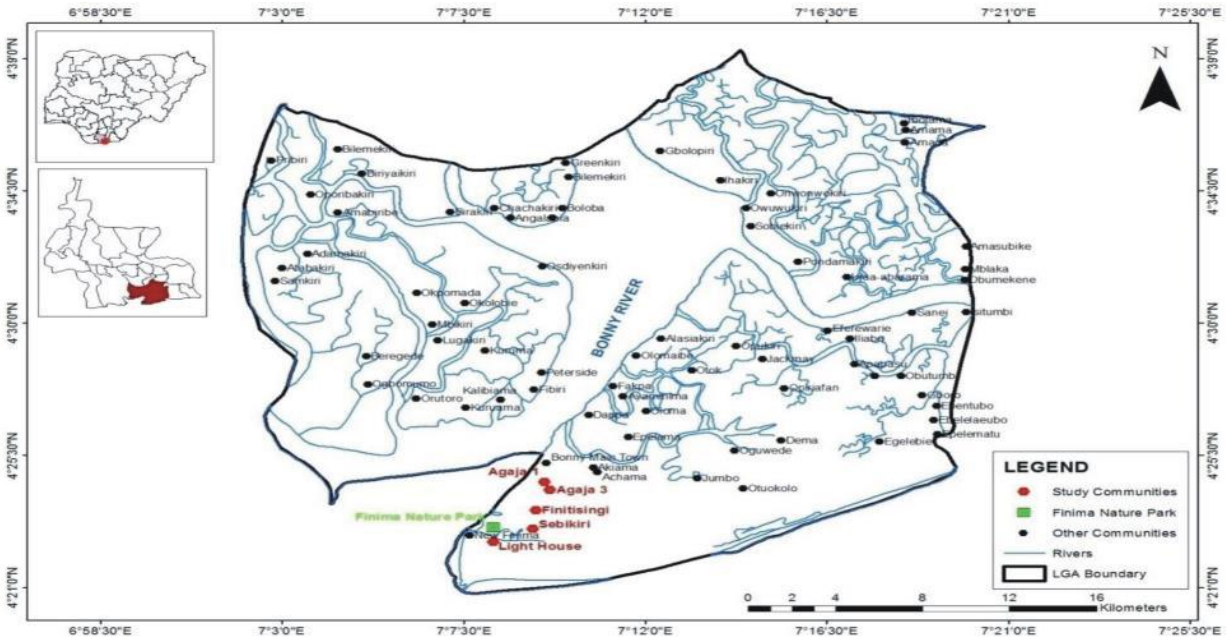

Figure 1: Map of the study area, Finima Nature Park, Bonny Island (Source: Ijeomah and Duke, 2016).

It lies between latitude 7º3`0`` and 7º16`30``E and longitude4º21`0`` and 4º30`0``N. The Park covers a land area of 1000 hectares of fresh water swamp forest lying along Nigeria's southernmost coastal area (Ijeomah and Duke, 2016).

The reserve area is covered by tropical rain forest and mangrove swamps, some parts contain sand with freshwater ponds and tall timber between the swamps and the beaches.

The vegetation around the water impoundment include, freshwater macrophytes such as *Clistipholis pholis, Xalopia spp and Aconia cultifera* also exist.

The water is lentic, black, dense with vegetation, shallow at some points but deep at other points. The climate in which this water impoundment exists is tropical, with 2 main seasons, the wet and dry seasons. However, rainfall occur almost all year round in the wet season, with a brief dry spell in the dry season.

Experimental Design and Sample Collection

The experiment was carried out for a period of 5 months with bi-weekly sampling for the duration. Three sampling points were located in the water body for fish sampling, where fish were collected using a 2cm and 4cm mesh size cast net and basket traps. The nets and traps and methods of used ensured minimal mortality of the fishes.

Samples collected from landed fish were separated into different species. The fishes caught were counted, sorted, measured, snapped, identified to species level and released back into the water body.

Data Collection

Fish Composition Determination.

The total landed fish from each fishing exercise were counted and total fish count recorded. Secondly, fish were sorted into varying species and preserved in 4% formalin and taken to the laboratory for proper identification. The identification of individual fish was done with the assistance of fish identification keys (Adesulu and Syndeham 2007, Babatunde and Aminu 1998, Froese and Pauly, 2010). The composition was then recorded for all families and species.

Fish Diversity Determination

i. Fish diversity was determined using Shannon-Wiener Diversity index (H')

$H' = -\sum_{i=1}^{S} Pi\ InPi$

Where, Pi= proportion of individuals found in the i^{th} species

(I.e. Pi = ni/N)

In = natural Logarithm

N = total abundance

ni= number of individual species

Fish Abundance Determination

The relative abundance method ($Pi = \frac{ni}{N} \times 100\%$) which involves estimations of the total number of fish species caught per sample site per time was used to determine abundance. Following the laid down criteria of Allison *et al*; (1997) the relative abundance score of the species was determined as 1-50=Rare (R), 51-100=Few (F), 101-200=Common(C), 201-400=Abundant (A), and >400= Dominant (D).

Data Analysis

This was carried out using the Microsoft word Excel package. ANOVA at probability (<0.05) was used to compare the physico-chemistry, relative abundance and diversity of fish species between weeks to identify the significance of the values.

RESULTS

Table 1: Checklist of total fish at the Finima Nature Park Lake, Bonny Island, Rivers State, Nigeria.

S/N	SPECIES	GENUS	FAMILY	ORDER
1	*Hemichromis fasciatus*	*Hemichromis*	*Cichlidae*	*Perciformes*
2	*Coptodon zilli*	*Coptodon*	*Cichlidae*	*Perciformes*
3	*Sarotherodon galilaeus*	*Sarotherodon*	*Cichlidae*	*Perciformes*
4	*Sarotherodon melanotheron*	*Sarotherodon*	*Cichlidae*	*Perciformes*
5	*Coptodon guineensis*	*Coptodon*	*Cichlidae*	*Perciformes*
6	*Hydrocynus brevis*	*Hydrocynus*	*Alestidae*	*Characiformes*
7	*Parachanna obscura*	*Parachanna*	*Channidae*	*Anabantiformes*

Table 2: Fish Composition at Finima Nature Park Lake, Bonny Island, Rivers State, Nigeria.

S/N	**Species**	Total Number Of Fish Caught	Total Bi Weekly Catch 1	2	3	4	5	6	7
1	*Hemichromis fasciatus*	52	8	6	8	2	18	3	7
2	*Coptodon zilli*	7	2	2	-	2	-	1	-
3	*Sarotherodon galilaeus*	5	-	-	-	-	4	1	-
4	*Sarotherodon melanotheron*	14	2	3	3	-	6	-	-
5	*Coptodon guineensis*	2	-	-	1	1	-	-	-
6	*Hydrocynus brevis*	13	5	7	-	-	-	1	-
7	*Parachanna obscura*	2	-	-	-	-	-	2	-
	Total	95	17	18	12	5	28	8	7

Table 3: Fish Species and Family Diversity, of the Finima Nature Park Lake, Bonny Island, Rivers State, Nigeria.

S/N	Species	Shannon-Wiener Index (H')	Percentage diversity (%)	Fish Families	Shannon-Wiener Index (H')	Percentage diversity (%)
1	*Hemichromis fasciatus*	0.33	23.9	Cichlidae	1.03	74.7
2	*Coptodon zilli*	0.19	13.8			
3	*Sarotherodon galilaeus*	0.15	10.9			
4	*Sarotherodon melanotheron*	0.28	20.3			
5	*Coptodon guineensis*	0.08	5.8			

6	*Hydrocynus brevis*	0.27	19.6	Alestidae	0.27	19.6
7	*Parachanna obscura*	0.08	5.8	Channidae	0.08	5.8

Table 4: Abundance of the Fishes at the Finima Nature Park Lake, Bonny Island, Nigeria.

S/N	Species	Family	Total Nos. of Fish Caught	Relative Abundance (%)	Abundance Score
1	*Hemichromis fasciatus*	*Cichlidae*	52	54.74	F
2	*Coptodon zilli*	*Cichlidae*	7	7.37	R
3	*Sarotherodon galilaeus*	*Cichlidae*	5	5.26	R
4	*Sarotherodon melanotheron*	*Cichlidae*	14	14.74	R
5	*Coptodon guineensis*	*Cichlidae*	2	2.1	R
6	*Hydrocynus brevis*	*Alestidae*	13	13.68	R
7	*Parachanna obscura*	*Channidae*	2	2.1	R
			95		

Table 5: Analysis of Variance of Species Diversity and Abundance in the FNP Lake, Bonny Island, Rivers State.

Weeks	Diversity	Abundance
1	1.22 ± 0.058^{b}	4.25 ± 1.44^{b}
2	1.28 ± 0.005^{b}	4.50 ± 1.19^{b}
3	0.82 ± 0.012^{d}	4.00 ± 2.08^{d}
4	1.06 ± 0.006^{c}	1.67 ± 0.33^{c}
5	0.89 ± 0.001^{d}	9.33 ± 4.37^{d}
6	1.49 ± 0.001^{a}	1.60 ± 0.40^{a}
7	1.49 ± 0.002^{a}	1.60 ± 0.00^{a}

Fish Composition

The fish composition through the sampling period recorded a total of 95 fishes consisting of 7 species belonging to 6 genera, 3 families and 3 orders from the impoundment as shown in the checklist of fish species (table1) and total fish composition (table 2). At the family level, the Cichlidae was the dominant family, as they recorded the highest representation of fishes with 5 species (*Hemichromis fasciatus, Coptodon zilli, Sarotherodon galilaeus, Sarotherodon melanotheron, and Coptodon guineensis*) belonging to 3 genera (*Hemichromis, Coptodon* and *Sarotherodon*). They were followed by the families Alestidae and Channidae, each having only one species (*Hydrocynus brevis* and *Parachanna obscura* respectively).

Fish Diversity

The Ichthyofauna diversity (table 3) among the families recorded during this study showed that the family Cichlidae with shannon wiener diversity (H) of 11.03 and percentage 74.4%, was the most diverse, comprising of 5 different species (*Hemichromis fasciatus, Coptodon zilli, Sarotherodon galilaeus, Sarotherodon melanotheron, Coptodon guineensis*). The remaining two families, the Alestidae and Channidae, recorded lower (H) diversities (0.27 and 0.08 respectively), 1 species each (*Hydrocynus brevis* and *Parachanna obscura* respectively).

Among the species however, *Hemichromis fasciatus* recorded the highest diversity (H) of 0.33. The least diverse species were the *Coptodon guineensis* and *Parachanna obscura* which both recorded diversity (H) of 0.08.

Fish Abundance

The family abundance as indicated in table 4, reported the family Cichlidae as the most abundant/dominant with a total relative abundance of 84.21%, followed by Alestidae with 13.68% and Channidae with 2.1%.

However, the relative abundance of the species (table 4) showed that *Hemichromis fasciatus* was the most abundant/dominant with a contribution of 54.74% to the total catch. This was followed in descending order by *Sarotherodon melanotheron* 14.74%, *Hydrocynus brevis* 13.68%, *Coptodon zilli* 7.37%, *Sarotherodon galilaeus* 5.26%; and *Coptodon guineensis* and *Parachanna obscura* 2.1% each. Thus, not all the Cichlids were abundant. The abundance score (Table 4) revealed that the dominant(D) species in the water impoundment was *Hemichromis fasciatus*, which itself was few (F), while *Coptodon zilli, Sarotherodon galilaeus, Sarotherodon melanotheron, Coptodon guineensis, Hydrocynus brevis* and *Parachanna obscura* were all rare (R) species.

Analyzed Data

The Analysis of variance (ANOVA) at a probability, $P<0.05$ (table 5) for diversity and abundance both varied between the weeks in a similar pattern. The ANOVA for both the diversity and abundance showed that, each group of weeks 1

and 2, 3 and 5 and, 6 and 7 were similar and not significantly different within themselves. However, these groups are significantly different from each other group. Also, Week 4 was significantly different from all the groups.

DISCUSSION

The family and species composition of the fishes were low with a total of 95 fishes caught through the study period, having seven (7) species belonging to three (3) families. There is no work on this impoundment for comparison, but this low composition is similar to the situation in the Tagwai Lake where only 8 species were encountered (Ayanwale *et al*., 2013).This can be attributed to the fact that these artificial water bodies naturally do not contain species of their own, rather they are stocked with species that can survive environments like theirs; or they contain species that were trapped in, only when the impoundments were constructed as reported in Tagwai Lake. The low composition recorded, is also similar to a close-by Creek, the Amadi creek, in the Bonny River which likely feeds the impoundment, that also recorded a low composition of 4 species in 3 families (Ibim and Njoku, 2018). However, it is in contrast to several other works on impoundments, dams and reservoirs in Nigeria, such as the Asejire Lake which documented 41 species (Akinyemi, 1985),Shiroro dam which recorded 19 species from 9 families (Ikomi and Sikoki, 1998), Eleyele reservoir with 17 species (Olaniran, 2003), the Oyan which recorded 38 species (Ikenweiwe *et al*., 2007), the Owena reservoir with 14 species (Fapohunda and Godstates, 2007), the Oyun reservoir which recorded 18 fish species (Mustapha, 2010), among others. The result also is in contrast with works on water bodies in Nigeria in close proximity to the impoundment such as, the Lower Bonny River and its connecting Creeks which recorded 57 species from 25 families (Chindah and Osuamkpe, 1994), Elechi Creek with35 species from 20 families (Allison *et al*., 1997),the Lower Nun River with 57 species, from 15 families (Sikoki *et al*., 1998) and the Urie Creek in Igbide, Niger Delta, which is relatively farther away with45 species from 24 families (Meye and Ikomi 2008). This low catch experienced during the period of study could be attributed to the commencement of the rains resulting in large water volume in the Lake, making catch difficult. Also, the rains resulted in poor catch of fish fauna because previously available fish could now disperse/ migrate into previously unavailable dry parts of the impoundment, and some even to submerged shorelines and grasslands. In Eleyele Wetland and Eleyele lakes, Ayoola and Ajani (2009) and at Asejire, Omitoyin and Ajani (2007), reported more catches during the dry seasons and attributed it to low level of water at that time. This result however contradicts the findings of Olopade and Rufai (2014) who reported more catch in wet season in Oyan Dam. Also, several works have reported that higher rainfall leads to higher catch and vice versa. (Ita, 1978; Elliot, 1986; Araoye, 1997; Mustapha, 2010).

It was also reported that, the rainy season which brings about a high level of water and subsequent flood elicits reproductive activities and migration, causing a restricted daily movement of the fish thereby making them less vulnerable to capture (Offem *et al*., 2011). The *Parachanna obscura* is a good example as it was reported during the rainy season alone. This mud-loving fish was not caught during the dry season because they do hibernate in holes made in muddy bottom. Once it rains, they troop out of the flooded vegetated shore areas into the open waters for oxygen (Bolarinwa, 2015).

The diversity was low as similarly reported in the Tagwai lake where only 8 species were encountered (Ayanwale *et al*., 2013), and in the close-by Amadi Creek, in the Bonny River, with a composition of 4 species in 3 families in the wet season (Ibim and Njoku, 2018). However, it is in contrast to several other works on impoundments, dams and reservoirs in Nigeria, such as the Asejire Lake. The reason for this low diversity is not known but it may be as a result of the existence of only a few fresh water fish species, in the fresh water swamps that were entrapped in the impoundment.

Though the diversity was low, however, it varied widely for the Ciclidae family which was the most diverse during the sampling period with 5 species (*H. fasciatus, S. galileaus, S. melanotheron, C. guineensis and C. zilli*). This is similar to the work by Ikenweiwe *et al*. (2007) who documented six species of Cichlids in Oyan dam. Olaniran (2003), Balogun (2005), Komolafe and Arawomo (2008), Mustapha (2010), Ibim and Gogo (2013) and, Ibim and Bongili (2017) also recorded similar findings. Ibim *et al*. (Unpublished), in the "Transition period", in Amadi Creek also reported this high number of Cichlids. This high diversity in Cichlid fishes in most habitats was attributed to their ability to tolerate a wide range of environments and environmental degradation, hardiness, utilize a wide range of foods in the lower trophic level as herbivores and planktivores, as well as their high fecundity and prolific nature (Welcome, 1979; Pullin and Lowe-McConnell, 1982; Awiti, 2011).

Finally, the significantly varied diversity between the weeks, though some weeks were similar, could be attributed to the fluctuation in temperature and rainfall, as the early rains commenced and increased gradually from the beginning of the study to the end (Soyinka *et al.*, 2009; Ibim and Douglas, 2016).

The abundance revealed the Cichlid family, especially the *Hemichromis* species as dominant in the lake throughout the study period. The dominance of the family Cichlidae in the impoundment compares favorably with other African lakes/reservoirs such as Kainji, Tiga, Bakolori, where cichlids are known to dominate (Pike and Gay, 1965; Petr, 1966; Reynolds, 1973; Ita, 1978; Ita and Balogun, 1982 and Balogun, 1986). It also agrees with works on water bodies around the FNP Lake such as the Elechi Creek (Allison et al., 1997), and Amadi Creek (Ibim and Njoku, 2018), in the Niger Delta Wetland. The significant concentration of the Cichlids in the impoundment indicates that the impoundment is capable of providing enough food, shelter and breeding sites for the littorally-inhabiting fish species (Balogun, 2005). However, unlike the dominance of *Sarotherodon galilaeus* and *Oreochromis niloticus* in Lakes Kainji, Tiga and Bakolori, *Hemichromis fasciatus* dominated the cichlids in the impoundment. This is also in contrast to observed dominance of *Sardinella maderensis* in Okpoka Creek (Davis, 2009) and the Sombriero River (Ibim and Douglas, 2017). The abundance of *Hemichromis fasciatus* in the lake could be attributed to their feeding habits, as they are more carnivorous than other Cichlid species (Lawson and Olusanya, 2010), and stagnant waters such as this Lake was seen to have high number of insects. While *O. niloticus* and *S. galilaeus* are phytoplankton feeders, *H. fasciatus* are zooplankton feeders (Akintunde, 1976). There is probably a possibility of high zooplankton population in the lake. It can also be attributed to their behaviour and population among other species. Also, there could be other factors that favour their higher numbers when compared to other cichlid species. Gear selection and choice of area of habitation in the lake could also have played a vital role in the higher numbers caught. However, the abundance between the weeks varies significantly.

Finally, the abundance score reveals that, all species are rare with exception of the *H. fasciatus* which is also just few. This is in contrast to reports of high ichthyofauna presence on Eleyele reservoir (Olaniran, 2003) and Gbedikere Lake, Kogi State, Nigeria (Adeyemi *et al.*, 2010).

CONCLUSION AND RECOMMENDATION

The Freshwater impoundment, Finima Nature Park Lake, in Finima Nature Park, Bonny Island, generally recorded a low fish fauna family and species composition, and a generally low diversity of seven (7) species belonging to three (3) families. It also records a low abundance from only a total of 95 fishes caught through-out the study duration.

The Cichlid family as compared to the other families (Alestidae and Channidae) in this impoundment, recorded a dominant composition and a higher abundance and diversity. However, among species, *H. fasciatus* recorded the highest abundance and diversity far above all other species available in the Lake. All the other species recorded in the Lake had very low diversity and abundance, and were in fact rare by their score rating. This rarity of a majority of the fish population is of great concern as it reveals that the fish fauna of the FNP Lake are threatened.

Thus, there is an urgent need to identify the real reason for this situation, in order to nip it in the bud, to ensure fish Community sustainability, and eventually species conservation which is the main concern for this Lake, is achieved for this wetland area. This preliminary study serves as a reference point for further research, profiling/documentation of fish community, management/conservation efforts, knowledge building and tourism development of the FNP Lake.

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