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Assessment of Fish Diversity in Relation to Fishing Gear Efficiency in Tagwai Lake, Minna, Nigeria

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ABSTRACT

The fish fauna of Tagwai Lake, Niger State, Nigeria was studied between February and August, 2016. The catch assessment was conducted at the landing site bi-weekly. Simple descriptive statistical tools such as simple percentage, frequency counts were used to analyze data obtained. A total of 53,442 fishes belonging to 7 families and 8 species were identified namely: *Tilapia zill, Sarotherodon galilaeus, Alestes dentex, Auchenoglanis occidentalis, Clarias gariepinus, Mormyrus hasselquisti, Chrysichthys auratus, and Odaxothrissa mento.* In terms of number, the Family: Clupeidae dominated the catch, and contributed 46.98% to the total catch. This was followed by the Cichlidae (43%), Alestidae (7.03%), Bagridae (2.08%), Clarotidae (7%), Claridae (0.42%), Mormyridae (0.00%). In terms of weight, the Cichlidae family was dominant (40.84%) for the total weight of fish caught. Cichlidae was also the most diversified family, represented by 2 species. The results showed the species abundance to be: *Tilapia zillii (21.96), Sarotherodon galilaeus* (21.04%), *Odaxothrissa mento* (46.98%), *Alestes dentex* (7.033%) and *Auchenoglanis occidentalis* (2.08%) in Tagwai Lake. Cast nets and gill nets were the most productive fishing gear with a total catch of 33, 555 and 7095 fishes respectively. Hook-and-line yielded no catch. The predominantly used gear between the month of July and August were Trap nets (Wire trap and the Gura Malian trap) The dominant species in cast net collections was *T. galilaeus* (32.60%) while that of Gill net was *O. mento* (59.48%). As a management strategy for this Lake, fishing activities should be monitored periodically to avoid the use of inappropriate gear for fishing.

Key words: Fish Catch, Assessment, Fishing Gear, Tagwai Lake.

INTRODUCTION

Fisheries sector play a vital role in the agro-based economy of Nigeria through its contribution to employment and income generation, providing food and nutritional security for the people. Fish and fishery products constitute the cheapest sources of animal protein (Mickiewicz and Wolos, 2012), but according to Balogun (2005), they constitute only 40% of the diet of an average Nigerian. In many parts of Nigeria, Niger State inclusive, the demand for fish and fishery products has continuously outweighed the supply. The annual fish consumption/demand in Nigeria has been estimated to be over 1.3million metric tonnes while the total domestic production is just about 450,000metric tonnes per annum (Tsadu *et al*., 2006). Anko and Eyo (2006) reported that Nigeria has vast potentials for fisheries development, being endowed with marine area of 46, 300km, an exclusive economic zone (EEZ) area of 210,900km^2 and inland waters of 12.5million hectares. Amazingly, in spite of the huge endowment, the current production level of 400,000metric tonnes is at 50% deficit to meet Nigeria's fish need per annum of at least 1.5million metric tons.

Nigeria is blessed with abundant natural aquatic resources in marine, estuarine and freshwater environment. The freshwater bodies of Nigeria, with over 270 fish species, are the richest in fish diversity in West Africa (Tobor, 1992). Niger State is blessed with vast wetland resources totaling over 72,234 hectares of water surface area (Ita *et al*., 1993). Among the people of this state, fish constitute a major percentage of their protein intake. The primary occupation of the inhabitants of Tunga Gori where Tagwai Lake is located is fishing and farming. Fishing is practiced on a very small scale, mainly for subsistence (Gabriel, 2000). Fish activities in these water bodies are intense all-year-round, with anglers using different types of fishing gear to increase their catches (Idodo-Umeh, 2003). Seasonal changes, both in species distribution and abundance necessitate the deployment of varied gear at different times of the year. Thus, different gear are used by different anglers depending on the season and period of the year (Idodo-umeh, 2003). This study assessed the catch and fish diversity with respect to fishing gear in Tagwai Lake, Minna, Nigeria.

MATERIALS AND METHOD

Study Area

Tagwai Lake is located within longitudes 6° 39'E and 9°44'E and latitudes 9° 34'N and 9° 37'N (on the outskirts of Minna the capital city of Niger State in North-Central Nigeria). The area has a tropical climate with mean annual temperature of 30.20°C, relative humidity of 61% and annual rainfall of 1334mm. The vegetative cover reflects that of Savannah zone, dominated by grass but with scattered tree species. There are two distinct seasons in this area namely: a rainy season (April and October) and dry season (November and March). The rainfall pattern of this area is characterized by peaks usually in May and August.

The Dam, impounded in the rainy season of 1978, is 25m high and 1.8km long. The Reservoir has a capacity of 28.3million cubic meters and serves purposes of fisheries, recreation, wild life conservation and social upgrading of the project area. The occupation of people living around the Lake is principally fish farming. Fishing activities in the Lake is characterized by the use of different fishing gear.

Fish Sampling
Routine sampling of fish from Tagwai Lake was conducted bi-weekly for seven months. Fish sample collection involved the actual count and weighing of the fishes caught by the local anglers at the major landing site. The catches made by local canoe fishers utilizing all major gear were randomly sampled for 7months between February 2016 and August 2016. On each sampling occasion, catches of individual fishes was sorted by species and gear. Fish weights were taken using a 20kg capacity spring scale. The fishing gear were also recorded.

Fish identification
Fish samples were identified to families and species levels using Guides, identification keys and monographs by Edwards *et al.* (2001) and Olaosebikan and Raji (2013).

Data Analysis
Chi square was used to determine the productivity of the gear; alongside questionnaires administered to local anglers to access the gear type used, portion of the Dam where fish were caught, fish abundance, and how long they have been in the profession. Data obtained were subjected to statistical packages of social sciences (SPSS) version 20.0. Monthly data of different fish species, gear types and average number of fishes caught were all subjected to Analysis of Variance (ANOVA) coupled with Duncan Multiple Range Test (DMRT). Data were represented by the means and standard errors of their replicates. All analysis were considered significant at $P<0.05$ level of significant.

RESULTS
Table 1 shows a list of fish species identified during the study period. Eight fish species belonging to seven families were recorded with a total number 53,442. The highest number of species (46.98%) was observed in the family: Clupeidae, followed by Cichlidae (43%), Alestidae (7.03%), Bagridae (2.08%), while Claridae, Claroteidae and Mormyridae constituted less than 1% of the total catch. The three most dominant species of fish encountered were *T. zilli, S. galilaeus* and *O. mento* having a relative abundance of (21.96%), (21.04%) and (46.98%) respectively. The sub- dominant species included the *A. dentex* and *A. occidentalis* with (7.03%) and (2.08%) respectively. While the occasional and rare species were the *C. gariepinus* (0.42%), *C. auratus* (0.48%) and *M. rume* (0.00%).

Table1: Abundance and Relative Abundance (%) of Fish Fauna of Tagwai Lake, Minna, Nigeria (February-August, 2016)

Family	Species	Total Catch	Relative Abundance (%)
Cichlidae			
	Tilapia zillii	11736	21.96
	Satherodon galilaeus	11245	21.04
Alestedae			
	Alestes dentex	3759	7.03
Bagridae			
	Auchenoglanis occidentalis	1110	2.08
Claridae			
	Clarias gariepinus	223	0.42
Claroteidae			
	Chrysicthys auratus	258	0.48
Mormyridae			
	Mormynus rume	2	0.00
Clupeidae			
	Odaxothrisa mento	25109	46.98

Gear Selectivity
Table 2 shows the species composition of fish harvested with the different gear used. The gill net recorded the highest number of individuals (33555) distantly followed by cast net (7095), the local traps (6446) and calabash (70). Hook and line yielded no catch during the study period. *T. zilli, S. galilae, A. occidentalis* and *A. dentex* were vulnerable only to cast net; *T. zilli, S. galilae, A. dentex*, and *O. mento* were vulnerable to gill net while *C. gariepinus* were vulnerable to local traps. During the study period, the fish species encountered or caught were not vulnerable to hook and line.

Table 2: Gear Selectivity of Fish Species in Tagwai Lake

Gear Type	*T. zilli*	*S. galilaeus*	*A. dentex*	*A. occidentalis*	*C. gariepinus*	*M. rume*	*C. auratus*	*O. mento*	Total
Gill net	5605	4556	2911	268	52	0	204	19,959	33555
Cast net	2313	3418	560	110	44	0	40	610	7095
Calabash	31	19	0	13	7	0	0	0	70
Hook and line	0	0	0	0	0	0	0	0	0
Malian tarp	245	358	8	149	54	0	4	0	818
Wire trap	3003	2305	41	212	55	0	12	0	5628
Sub-total	11197	10656	3520	752	212	0	260	20,569	47166

X2cal=14135; X2tab=49.802; Df=35; P>0.05

Table 3: Fish Species Abundance by Number (February-August, 2016)

Fish Species	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	TOTAL
T. zilli	506.00 ±181.00^{a}	712.50 ±161.50^{f}	579.50 ±27.50^{f}	528.50 ±217.50^{f}	865.00 ±56.00^{f}	1425.50 ±29.5^{f}	1251.00 ±181.00^{e}	5868.00 ±854.00
S. galilaeus	427.00 ±272.00^{f}	634.00 ±70.00^{e}	300.00 ±50.00^{e}	1188.00 ±547.00^{g}	735.00 ±15.00^{e}	1240.00 ±294.00^{f}	1098.50 ±173.50^{e}	5622.50 ±1421.50
A. dentex	150.50 ±104.50^{d}	395.50 ±40.50^{d}	381.00 ±57.00^{d}	376.50 ±258.50^{e}	479.00 ±129.00^{d}	57.50 ±5.50^{d}	39.50 ±14.50^{c}	1879.50 ±609.50
A. occidentalis	39.00 ±10.00^{c}	23.00 ±13.00^{c}	23.00 ±4.00^{c}	43.50 ±2.50^{d}	20.00 ±6.00^{c}	302.00 ±188.00^{e}	104.50 ±19.50^{d}	743.00 ±609.50
C. gariepinus	16.50 ±9.50^{b}	7.50 ±3.50^{b}	8.00 ±2.00^{b}	18.00 ±4.00^{b}	8.00 ±0.00^{b}	14.50 ±7.50^{c}	39.00 ±9.00^{c}	111.50 ±35.50
M. rume	1.00 ±1.00^{a}	0.00 ±0.00^{a}	0.00 ±0.00^{a}	0.00 ±0.00^{a}	0.00 ±0.00^{a}	0.00 ±0.00^{a}	0.00 ±0.00^{a}	1.00 ±1.00
C. auratus	16.50 ±4.50^{b}	30 ±12.50^{c}	7.50 ±2.50^{b}	29.00 ±1.00^{c}	28.00 ±28.00^{c}	1.50 ±1.50^{b}	11.00 ±3.00^{b}	129.00 ±53.00
O. mento	354.50 ±54.50^{e}	850.00 ±750.00^{g}	3650.00 ±450.00^{g}	1075.00 ±125.00^{g}	2750.00 ±950.0^{g}	2350.00 ±150.00^{g}	1525.00 ±425.00^{f}	12554.50 ±2904.50
Sub-Total	1511.00 ±637.00	2658.00 ±1051.00	4949.0 ±593.00	3240.5 0±115.50	4885.00 ±1184.00	5391.00 ±676.00	4068.5 ±825.50	26703.00 ±6122.00

Values followed by the same superscript alphabet on the same column are not significantly different at P> 0.05 probability level.
Values are represented in mean ± standard error of mean of two determinations.

The mean weight of the different fish species showed the family: Cichlidae dominated, contributing (368.20±46.10) to the to mean weight of the fish caught, followed by Alestidae (65.90±16.60), Bagridae (40.50), Clupeidae (31.00±10.70), Clari (18.45±4.25) and Claroteidae (10.20±4.90). The highest mean weight was recorded in the month of July (143.50±10.30) w the lowest recorded in the month of February (60.25±27.65). By species, *Sarotherodon galilaeus*>*Tilapia zilli*>*Alestes da and Auchenoglanis occidentalis* dominated the fish catches representing 201.50±32.10, 166.70±14.00, 65.90±16 40.50±12.00 respectively by mean weight.

Figure 1 shows the fishing frequency of the fishers of Tagwai Lake, most of the fishers; fish daily (93%), fish irregularly (7 and no fishing weekly or monthly.

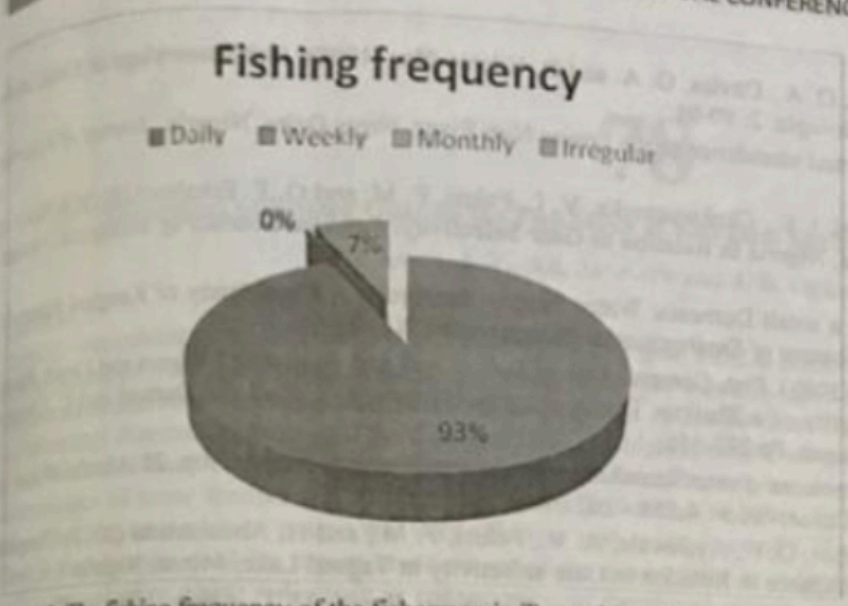

Figure 1: The fishing frequency of the fishermen in Tagwai Lake

DISCUSSION

The fish species that exist in the Lake was the primary objective of this survey and perhaps, elucidate the factors governing their abundance. However, according to Benech *et al.* (1983), gear selectivity and sampling strategies are usual sources of these biases as documented by Meye and Ikomi (2008). Despite these obstacles, attempt was made to compare data obtained in this study with works of Linus (2015), in Lake Ribadu in Adamawa State and Meye and Ikomi (2008), in Delta State. It was observed that, most of the anglers in Tagwai Lake fish daily which may have resulted in the reduction of fish species due to overfishing.

The total number of fishes recorded in this study was higher than it was in the same area earlier showed by Chukwuemeka *et al.* (2014), who recorded a total of 6,839 fishes and Anyawale *et al.* (2010), who recorded a total of 1669 fishes in the same Lake. These differences in fish catch could probably be due to the differences in duration of the sampling periods or due to fish habitat modification and intense anthropogenic activities, resulting in poor biota diversity. However this value was also low when compared to other water bodies in the country like Elechi Creek in Rivers State which had 35 species from 20 families (Allison *et al.*, 1997). The dominance of the Cichilidae family in this study agreed with study of Kontagora Reservoir (Ibrahim *et al.*, 2000); Zaria Reservoir (Balogun *et al.*, 2005); Tagwai Lake (Ayanwale *et al.*, 2013); Lower Usuma Reservoir (Dan-Kishiya, 2012). The dominance could be attributed to their adaptation to lentic aquatic environmental qualities, productivity of the Lake and changes in the hydrological regime of the Lake, their high prolific breeding nature (Dan-Kishiya, 2012) coupled with their good parental care which gives considerable advantage in the colonization of their habitats. This compared favorably with the findings of Komolefe and Arowomo (2009); Chukwuemeka *et al.* (2013). *Sarotherodon galilaeus* topped the cichlidae family in terms of weight.

Cast net and gill net were most sensitive to fish species and accounted for more than 60% of fish individual collected during the study period. This result may be due to the traditional mechanisms of action of cast and gill nets (Ayanwale, 2013). The catch in this study were dominated by cichlids; this result agreed with those of Meye and Ikomi (2008) and Chukwuemeka *et al.* (2014). The gill nets had high selectivity, which may be connected with the morphometric projections on the body of most fish species and the presence of scales (Meye and Ikomi, 2008). Chukwuemeka *et al.* (2014) stated that, the insensitivity of hook-and-line fishing gear to any of the species caught by the other two gear types may be due to the feeding behavior and restricted period of activity which, perhaps, does not favour encounter and/or attraction to the bait- hook and line. The difference in seasonal abundance was also observed during the study; the highest numerical abundance of fish was recorded during the wet season which was similar to the report of Idodo-Umeh (2003), and Ikomi and Sikoki (1998). In terms of diversity, the family: Cichlidae was the most diversified, having two species dominated by *T. zilli*. The families: Alestedae, Bagridae, Claridae, Clupeidae, Clarotidae and Mormyridae were represented by one species each thus, the least diversified.

CONCLUSION AND RECOMMENDATION

From this study, Tagwai Lake can be said to have seven fish families with 8 species. From the species composition, *Tilapia zilli, Sarotherodon galilaues, Alestes dentex and Odaxothrissa mentoa* were the dominant species, *Auchenoglanis occidentalis* and *Chrysichthy auratus* were rare species and *Mormyrus hasselquistii* endangered; at the verge of going into extinction in the Lake. Tagwai Lake like most inland water bodies in Nigeria has great potentials for fisheries exploitation if properly managed and utilized. There is need for further study to understand fish catch control in relation to fishing gear for sustainable control measures on fish catch.

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