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Fish Biodiversity and Abundance of Thomas Dam, Danbatta Local Government Area of Kano State, Nigeria

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ABSTRACT
Thomas Dam is one of the largest reservoirs in Kano, Nigeria and supports diverse fish species. Present study was carried out to assess the fish diversity status of the reservoir. Fish sampling was done monthly for a period of twelve months (January-December, 2022) using gill nets, cast nets, long lines, and different traps. A total of 1,318 fishes belonging to 6 families and 10 species were recorded during the study period. The results indicated Cichlidae as the dominant family represented by 4 species while Clariidae had representation with 2 species. Alestiidae, Mormyridae, Latidae, and Protopteridae were represented by 1 species each. Monthly fish diversity analyzed using nMDS (stress=0.06031) indicated influence of seasonality on the biodiversity of the Dam. The analysis of similarity (ANOSIM, $P < 0.008$, $R = 0.47$) show significant difference in fish assemblage structure between rainy season (June-September) and dry season (October-May). Also, Similarity percentage (SHRIMPER) analysis indicated 74.40% cumulative dissimilarity among the two Seasons contributed by five species; *Protopterus annectens* (29.85%), *Brycinus nurse* (15.47%), *Oreochromis aureus* (12.56%), *Late niloticus* (8.44%) and *Sarotheroden galilaeus* (8.08%). The fish diversity indices were calculated using PAST (version 3.22) software. Result of the diversity indices indicated Simpson's diversity Index (1-D) and Shannon-Wiener index (H) values were highest during the months of rainy season of (1-D=0.85-0.89, H=2.06-2.24) indicating influence of the season on the fish diversity. The study concluded on the fact that changes of seasons have impact on the fish abundance and distribution of the Dam.

Key words: Thomas Dam; fish biodiversity; biotic indices

INTRODUCTION
Biodiversity is the amount, assortment and distribution across biological scales running through hereditary qualities and life types of populaces, species, communities and biological systems (Mace *et al.*, 2005). Biodiversity is consistently used as a proportion of the soundness of biological diversity. However, territory misfortune and natural corruption causes quick decrease in organic variety which is difficult for the cutting edge period (Vyas *et al.*, 2012). Freshwater biodiversity is by and by in a state of crisis, as consequence of human manhandling streams, rivers and Dams with over fishing, contamination and advancement exercises. Debasement of stream and riverine climate makes extreme obliteration the construction and capacity of stream biota (Stoddard *et al.*, 2006).

Waterway has a restrictive oceanic biological system which upholds huge numbers of types of plants, fish and different creatures. this load of living beings, fish are the main component which have a significant and likely commitment in the agro-based financial turn of events (5 to 6% in GDP), poverty alleviation, employment and providing of Animal protein (63%), and procuring the unfamiliar money (Dof, 2005) for the public area. In any case, the biodiversity and appropriation status of fish of this stream is as yet unclear, unmanaged and unmonitored.

This is due to its geographic distance from the nation's primary fish research foundation habitats as well as its limited ability to test some difficult-to-reach locations. The aims and objective of the study is to study the biodiversity and biotic indices of Thomas Dam in other to provide qualitative baseline data to address some of the problem threatening fish diversity. Fish biodiversity in Dam is very dynamic in both temporal and spatial scale. Dams plays a fundamental part in habitats and their values to plants and animals stretches far beyond the surface area they cover. There is a possibility diversity of species among immigrants from different regions. Such diversity requires appropriate comprehension about the population for diversity estimate purpose which is one of the reason for study. It is also important to analyze the role of fisheries resource utilization on for effective administration structure. The population of fish in the dam may experience decline due to number of factors such as increasing fishing pressure which is due to increase in human population and Physio-chemical Parameters of the Dam. For conservation and upkeep of the fisheries assets, logical administration based on the population studies is the most important issue.

MATERIALS AND METHODS

STUDY AREA

Thomas Dam is located within Sudan savannah zone of Nigeria (12˚ 16 44" N - 21˚ 18'35N and (8˚30'5''E - 8˚ 31'34''E) with two distinct wet and dry seasons. The rainy season lasts from May to October and dry season runs from November to April (Shitu, 2006). The Dam is about 585 square meters, while its depth is about 30m. The dam is sited near Danmarke village of Dambatta Local Government area of Kano State, 30km away from the ancient Kano City (Kutama *et al*., 2013).

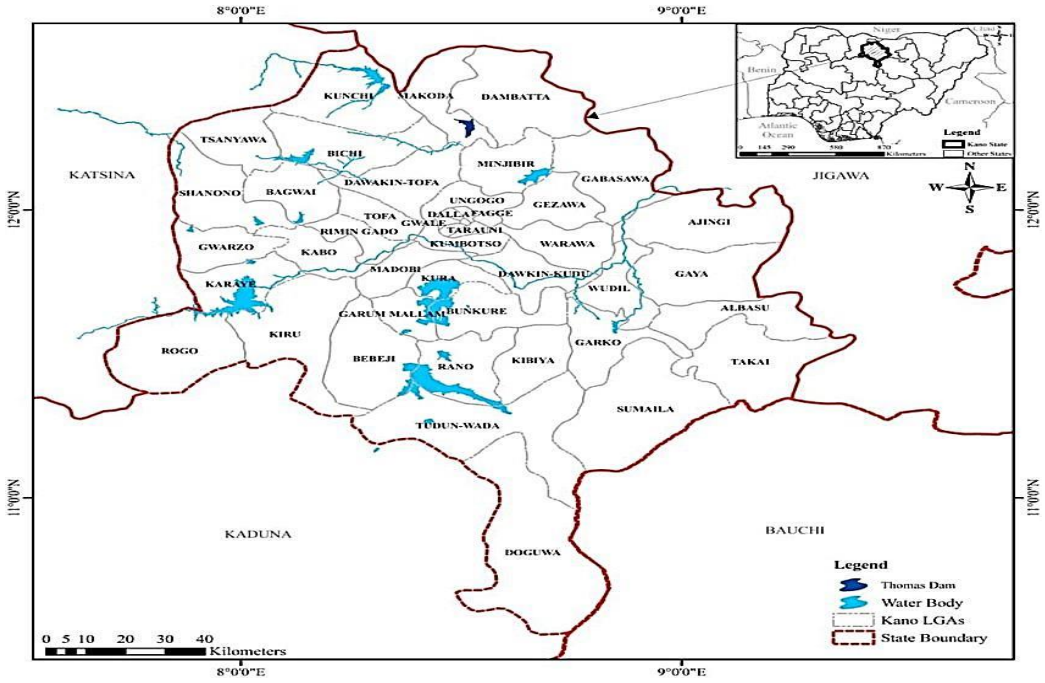

Figure 1: Map showing the location of the Study Area (Source: Department of Geography, BUK)

Fish Specimen Collection and Identification

Fish sampling was done from the catches of the local fishermen at the landing sites. Gillnet, cast net, hook and line and traps were the fishing gears used, Photograph image of the fish samples were taken *in situ*. Identification guide by Olaosebikan and Aminu (2013) was used for fish Identification to species level. Fish ichthyologists were consulted in the Department of Fisheries and Aquaculture (BUK).

Data Analysis

Data of Fish bio-diversity were recorded in Excel. Paleontological Software Statistics (PAST) version 3.22, a software package for paleontological data analysis was used for calculation of Diversity Indices. 'R' software version 3.6.2 was used to perform: one-way analysis of variance (ANOVA), One-way analysis of similarities (ANOSIMS), Principal component analysis (PCA), Similarity percentage (SIMPER), Non-metric multidimensional scaling (NMDS) and length and weight relationship of the species communities in the Dam (Clarke and Warwick, 2001).

$$\text{Relative abundance} = \frac{\text{Frequency} \times 100}{\text{Frequency of all species}}$$

Shannon Wiener Diversity Index (H)

$$H = -\sum[\left(ni/N\right) * \ln(\frac{ni}{N})]$$

Mergalef's Richness Index (d)

$$d = \frac{\boldsymbol{S-1}}{\boldsymbol{\ln N}}$$

Gibson's Evenness Index (E)

$$E = \frac{\boldsymbol{e}^{-\sum\left[\frac{\boldsymbol{ni}}{\boldsymbol{N}} * (\boldsymbol{ni/N})\right]}}{\boldsymbol{S}}$$

Simpson Dominance Index (D)

$$D = \frac{\sum[\boldsymbol{ni}(\boldsymbol{ni-1})]}{\boldsymbol{N}(\boldsymbol{N-1})}$$

Where, N is total number of organisms of all species found, ni is number of individuals of a particular species, i is an index number for each species present in a sample, S is the number of species of a single population, In is the natural log of the number and ∑ is the sum values for each species (Magurran 2004).

RESULTS AND DISCUSSION

Table 1: Monthly fish Caught and % Composition of Species in Thomas Dam (Jan-Dec, 2022)

English Name/ (Hausa)	Scientific Name	Monthly Catches of Species													
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Specie
Catfish (tárwàdáá)	*Clarias gariepinus*	5	7	2	3	3	8	5	13	3	3	3	12	67	5.0
Catfish (tárwàdáá)	*Clarias anguillaries*	9	3	7	4	4	4	3	12	4	1	2	2	55	4.2
Tilapia (Sakiya)	*Oreochromis niloticus*	16	27	28	23	25	23	22	22	21	23	22	22	274	20.9
Mango Tilapia (fárin wala)	*Sarotheroden galilaeus*	28	10	15	18	18	17	14	17	22	20	18	17	214	16.2
Blue Tilapia (Duguru)	*Oreochromis aureus*	28	25	27	10	10	19	23	23	17	19	20	13	234	17.8
Redbelly Tilapia (Karfasa Shuri)	*Tilapia zilli*	15	14	15	13	15	13	12	15	16	13	16	15	172	13.0
Nile perch (gííwár-rúwáá) (báríyàà)	*Late niloticus*	4	8	6	4	4	3	10	13	4	4	14	13	87	6.6
African tetras (ááwàráá)	*Brycinus nurse*	0	3	8	3	2	14	13	14	2	3	3	4	69	5.2
West African Lungfish (gáiwáá)	*Protopterus annectens*	0	0	0	0	0	11	22	21	15	12	0	0	81	6.1
Elephant Fish	*Pollimyrus isidori*	8	5	3	6	4	4	6	5	7	6	4	7	65	5.0
Total number of individuals		113	102	111	84	85	116	130	155	111	104	102	105	1318	100
% Composition of individuals		8.6	7.3	8.4	6.4	6.5	8.8	10.0	12.0	8.4	7.9	7.7	8.0	100	

Source(s) of Local names; Idodo-Umeh (2003); Olaosebikan and Raji (1998) and Pauly and Froese (2014).

A total of 1318 fish samples (Table 1) belonging to 6 families and 10 species were recorded during the study period of January, 2022 to December, 2022. The family Clariidae was represented by 2 species: *Clarias gariepinus* (Burchell, 1822) and *Clarias anguillaris* (Linnaeus, 1758). Alestiidae was represented by 1 species: *Brycinus nurse* (Ruppell, 1832). Mormyridae was represented by 1 species: *Pollimyrus isidori* (Taverne, 1971). The Cichlidae was represented by 4 species: *Oreochromis niloticus* (Linnaeus, 1758), *Tilapia zillii* (Gervais, 1848), *Oreochromis aureus* (Steindachner, 1864) and *Sarotheroden galilaus* (Ruppell, 1852). Latidae was represented by 1 Species: *Late niloticus* (Linnaeus, 1758). Protopteridae was represented by 1 species: *Protopterus annectens* (Owen, 1839).

The monthly fish species catches (Table 1) revealed that *Oreochromis niloticus* was highest in numbers (274, 20.79%) and *Clarias anguillaries* (55, 4.2%) was lowest.

The highest monthly fish catch (155 fishes, 12.0%) was caught in August, while the least numbers of fish caught (84 fishes, 6.4%) was in April.

Utilizing Non-metric Multidimensional Scaling (NMDS), the monthly data displayed a distinct seasonal trend in the fish biodiversity of the Dam as depicted in (figure 2), with a favorable stress value of 0.06031. The analysis revealed significant similarities in fish biodiversity between the rainy months of July, August and September as well between the dry months of February, November, and December.

Cumulative Contributions of most Influential species Among Season. The analysis of similarity (ANOSIM, $P < 0.008$, $R = 0.47$) showed significant differences in assemblage structure among months and seasons were in the Dam (figure 2). According to Similarity percentage (SHRIMPER) analysis (Table 2), 74.40% similarity were found among the Seasons and major contributing species are *Protopterus annectens* (29.85%), *Brycinus nurse* (15.47%), *Oreochromis aureus* (12.56%), *Late niloticus* (8.44%) and *Sarotheroden galilaeus* (8.08%).

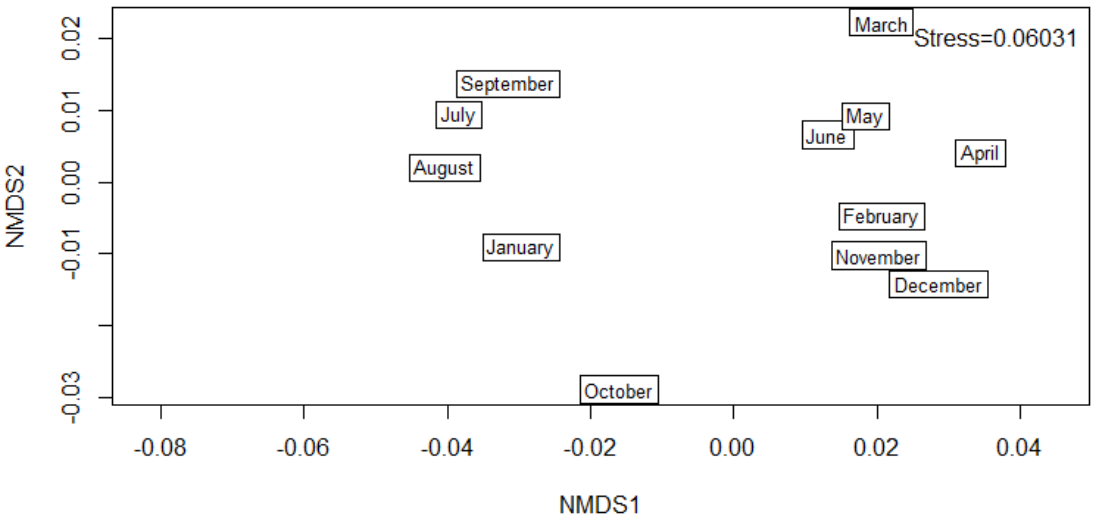

Fig. 2: Non metric multi-dimensional (NMDS) scaling showing monthly similarity/dissimilarity of fish in Thomas Dam.

Relative distance among the months represent the relative similarity/dissimilarity of abundance of fish based on the presence and absence of data.

Table 2: Cumulative Contributions of most Influential species Among Season using (SIMPER) analysis.

Species (74.4%)	Average dissimilarity	% contribution
Protopterus annectens	0.067	29.85
Brycinus nurse	0.036	15.47
Oreochromis aureus	0.029	12.56
Late niloticus	0.019	8.44
Sarotheroden galilaeus	0.018	8.08

Diversity, Richness and Evenness Indices of Thomas Dam

The values of Dominance indices, Simpson`s index of diversity (1-D), Shannon-Weaver diversity (H), Evenness (E) indices and Margalef Richness indices (M_R) were calculated on monthly basis and the average was calculated for each of the indices as shown in Table 3. Considering all the samples studied within the present survey on Thomas Dam, the values of D, 1-D, H, E and M_R were 0.15, 0.81, 1.83, 0.80 and 1.78 respectively. The value of H varied from 0.11 to 0.18, 1-D varied from 0.82 0.88, H varied from 1.88 to 2.14, E varied from 0.73 to 0.86 and M_R varied from 1.48 to 1.89. Simpson's index and Shannon-Wiener index diversity values showed that the diversity of fish abundance was highest within the month of August. The utmost variety of fish species was recorded throughout this time while the lowest variety of species diversity was recorded within the month of May. The highest Dominance index diversity was recorded in January and May, the lowest was recorded in August, while that of Margalef Richness was highest in the month of October and lowest in the month of January.

The highest Evenness index was recorded in the month of August and lowest in the month of May (Table 3).

Table 3 Dominance indices, Simpson`s index, Shannon-Wiener index, Evenness, and Margalef Richness indices in each sampling month of Thomas Dam

Months	No. of species	No. of Individuals	D	1-D	H	e^H/S	M_R
Jan.	8	113	0.18	0.83	1.89	0.82	1.48
Feb.	9	102	0.17	0.83	1.94	0.77	1.73
Mar.	9	111	0.17	0.83	1.92	0.76	1.70
Apr.	9	84	0.17	0.83	1.94	0.78	1.80
May	9	85	0.18	0.82	1.88	0.73	1.80
June	10	116	0.13	0.87	2.13	0.84	1.89
July	10	130	0.12	0.88	2.14	0.86	1.85
Aug.	10	155	0.11	0.89	2.24	0.94	1.79
Sep.	10	111	0.14	0.85	2.06	0.78	1.91
Oct.	10	104	0.15	0.86	2.01	0.74	1.94
Nov.	9	102	0.16	0.84	1.93	0.77	1.73
Dec.	9	105	0.14	0.84	2.05	0.86	1.72
Total	10	1318	0.15	0.81	1.83	0.80	1.78

D- Dominance indices, 1-D- Simpson`s index of diversity, H- Shannon-Wiener index, e^H/S- Evenness, M_R- Margalef Richness indices.

DISCUSSION

Between January 2022 and December 2022, 1318 fish samples from Thomas Dam were collected and identified, representing 6 families and 10 species. The fish diversity discovered was in agreement with research conducted at Thomas reservoir, Kano, Nigeria, by Abdullahi and Mukhtar (2015) and Nafiu *et al.,* (2017). The fluctuation in the number of families may be related to the reservoir's improved breeding capacity, higher plankton availability, minimal predation, and ideal spawning grounds. Similar findings were found by Dankishiya *et al.,* (2012) in Lake Geriyo, Yola, and Adamawa State, Nigeria, and by Nazeef et al. (2018) in Dadin Kowa Dam, Balogun (2005) in Kangimi Reservoir, Kaduna. The current findings are at odds with the writings of the same writers according to Nazifi et al. (2018) and Ataguba *et al.,* (2014), ecological zone.

The ten fish species distinguished in the Dam have likewise been seen by a few fisheries‟ laborers and specialists (Ita *et al.,* 1984; 1985; Akinyemi, 1987; Sikoki *et al.,* 1998; Allison and Okadi, 2013; Oguntade *et al.,* 2014) remembering species for different families, and found to comprise the significant fisheries of inland waters in Nigeria, because of their capacity to adjust to the physico-compound boundaries of the water bodies.

The results of numerous other studies conducted in Nigeria, including those by, Solomon *et al.,* (2017), Dienye *et al.,* (2018) from the Omuechi stream, Pius *et al.,* (2020), Abdulkarim *et al.,* (2020), Olopade (2020), Oladipo *et al.,* (2021) and Omoike, (2021), all recorded the dominance of cichlids. This domination of cichlids is due to a variety of noteworthy features, including their tremendous proliferation and status as the second most diversified family of freshwater fish with a widespread range (Seehausen, 2015). Leveque (1997), who claimed that "cichlids are the most diverse fish family in Africa," backed up this claim in Olopade (2020). High rates of juvenile survival, adult survival, and excellent competitive capacities are all indicators of good parental care (mouth brooding, which is observed in some species, such as *Tilapia galilaeus*) (Olapade *et al.,* 2019). *Oreochromis niloticus* is regarded as having distinctive characteristics that justify its dominance, including a variety of feeding strategies, high population in response to predation and other forces of population decay, adaptation to both lotic and lentic ecosystems, productivity, and changes to hydrological regimes (Oladipo *et al.,* 2021). As a feeding source (ecological niche) for other trophic levels, such the African pike (*Hepsetus odoe*), *Brycinus nurse* also exhibit comparable living strategies to that of the schilbeids, which ensures their diverse sustainability (Abdulkarim *et al.,* 2020).

The dominance of African lungfish (*Protopterus annectens*) at the start of the rainy season, are due to the fact that they begin to reproduce during the start of the rainy season. They dig mud-filled burrows or nests to house their eggs, which they subsequently defend from predators. The young look like tadpoles when they first hatch and only later develop lungs and start breathing air (Goudswaard *et al.,* 2002).

In order to endure prolonged periods of drought (which can last several months), aestivating lungfish stay buried in mud cocoons and rely only on air. Lungfish are occasionally placed in settings where their watery habitat dries up or has low oxygen levels. Their out pocketing of the gut, similar to the swim bladder of other fishes which serves as a lung, is an adaptation for coping with these conditions. The lungfishes of Africa require air to survive.

In general, it can be understood that fish species abundance and its potential fluctuations are related to fish harvest intensity, gears used, downstream migration, commercial and domestic water usage, fish shelter and spawning, habitat morphology and hydrology (including water retention and recession), unethical fishing practices like the use of tiny mesh-size nets, targeting of spawning biomass (especially mega-spawned fish), and other factors (Omoike *et al.*, 2021). Any fish community, even those in reservoirs, can change due to these conditions (Gebremedhin et al., 2021).

CONCLUSION

A total of 10 species were found during the study period, Fish species in this Dam were decreasing due to Human activities on and around the Dam (Overfishing) might have some level of influence on the variations observed. The monthly biodiversity indices were significantly varied among the months, compared to Nafiu et al., who found out 11 species. The highest values were found in Rainy season in August, Dominance (0.11), 1- Dominance (0.89), Shannon Index (2.24), Evenness (0.94) and Richness was highest in October (1.94) while the lowest was recorded during the dry season, Dominance (0.14), 1- Dominance (0.84), Shannon Index (2.04), Evenness (0.86) and Richness was highest in April and May (1.80).

Further overview of fish species variety and overflow ought to be done for a more drawn out period for a bigger scope for a careful evaluation of the water body and its fishery potential. Improper management of the fishery assets in the Dam should be tended to by the applicable specialists and NGOs utilizing coordinated programs with the perspective on preserving and supporting the fishery assets of Thomas Dam from future abuse.

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