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Research article

Assessment of Biodiversity, Physicochemical water parameters, Length-weight Relationship and Condition factor of fish species in Tiga Lake, Kano State, Nigeria

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Abstract

Timely assessment of fisheries resources provides updated information crucial for the formulation of management strategies that ensures its sustainability. The study investigated the physicochemical water parameters, biodiversity, length-weight relationships (LWRs), and condition factors of fish species in Tiga Lake, Kano State, Nigeria, with a focus on seasonal variations. Physicochemical parameters such as temperature, dissolved oxygen (DO), pH, total dissolved solids (TDS), and electrical conductivity (EC) of surface water were evaluated during both dry and wet seasons. Fish and water sampling were conducted at Tiga and Rurum sections of the lake utilizing catches from local fishers. Total length and body weight were measured in centimeters and grams respectively to assess Length-Weight Relationships (LWRs) and condition factor of fish species. The assessment of the physicochemical water parameters indicated consistent seasonal trends in DO, pH, EC, and TDS values. Biodiversity indices, estimated using Margalef, Shannon, and Simpson indices, indicated higher values in wet season, suggesting increased abundance and distribution during this period. The fisheries were dominated by Cichlids, comprising 49.1% of the total fish composition. Temporal patterns in fish biodiversity, analyzed through Non-metric Multidimensional Scaling (NMDS) and Analysis of Similarities (ANOSIM), indicated no significant difference ((R=-0.0129, p=0.05) between dry and wet seasons. LWRs analysis revealed significant differences ($p \leq 0.05$) among species, indicating variability in size-weight associations. The estimated condition factor indicated temporal variations, with certain species demonstrating higher values during the dry season. In conclusion, the water quality parameters of Tiga Lake support fish survival, contributing to the high abundance and diversity.

Keywords: Allometric, Ecosystem, Fisheries, Irrigation, and Inland.

INTRODUCTION

Fresh water ecosystems support wide range of species of plants and animals. Fish inhabiting freshwaters comprise 25% of living vertebrates (about 55,000 described species) and represent 13-15% of the 100,000 freshwater animal species of the world (Kopf *et al*., 2017). In Africa, a large proportion of the inland fisheries are located along the shores of lakes, but the continent's vast river systems are also rich in fish and may produce up to one-half the total catch from inland waters. Because inland fisheries often supply only the domestic market and contribute little to the export economy of most developing nations, and because the quantity of fish harvested is often overshadowed by that of marine fisheries, riverine fisheries are often not given due priority by national governments (Lynch *et al*., 2016; Lynch *et al*., 2017).

An important aspect of these ecosystems is the diversity of species and their abundances, known as species richness and diversity. The diversity of biological species in a water body correlates strongly with the diversity of its habitat parameters (Islam *et al*., 2022).

It is usually claimed that freshwater ecosystems are the most endangered ecosystems in the world affecting both species diversity and abundance (Darwall *et al.,* 2018).

Aquatic ecologists are curious about how fish assemblages, in terms of their abundance and compositions, are influenced by changes in environmental factors. Studies have shown that things like water quality strongly influence fish well-being, whether in freshwater or the ocean (Duque *et al.,* 2020). Changes in fish habitats could affect not only their composition and abundance but also their biomass growth, which is essential in the evaluation of the yield of any fisheries stock. Such understanding helps in fashioning better measures for managing fisheries resources (de Mutsert *et al*., 2016).

The consideration of temporal changes in aquatic biodiversity dynamics is as important as its spatial variations (McMeans *et al.*, 2020). Seasonal changes directly affect water parameters, impacting the availability and diversity of biota in different sub-habitats (Szabó, 2016). In temperate regions, winter causes significant temperature variations, reducing light penetration and oxygen availability due to ice cover, affecting the foraging, growth, and reproduction of aquatic biota (Shuter *et al*., 2012). Fish with colder thermal preferences maintain higher activity levels, while others adopt a strategy of suppressed activity (Lianthuamluaia *et al.*, 2019; Watson *et al*., 2019). Seasonal variations, even in the tropical regions also influence fish abundance, recruitment, breeding patterns, and feeding habits (Sanches *et al*.,, 2016). Given the dynamic nature of reservoir ecosystems, acquiring baseline information on fish assemblages and diversity patterns is essential for developing management strategies to maintain ecological integrity and sustainable fisheries activity (Lianthuamluaia *et al.*, 2019)

In every study that focused on understanding the diversity of fish communities, employing diversity indices becomes crucial for assessing and quantifying their diversity status (Robiul Awal *et al*., 2017). Furthermore, these indices give estimates of the biological and ecological quality of an ecosystem based on the community's structure. They also stand as potential indicators for monitoring environmental pollution levels of an ecosystem (Malvandi *et al*., 2021).

Fisheries management addresses economic, social, and biological factors affecting fish stocks to develop strategies that meet societal food needs without overexploiting fish resources. Key tools for investigation and management include biometric studies, providing information on fish species for estimating their biomass (Famoofo and Abdul, 2020). Many studies emphasize the importance of determining length-weight relationships (LWRs) in fish, as they offer insights into growth patterns, general health, habitat conditions, life history, fish fitness and condition, and morphological characteristics (Kareem *et al*., 2015; Egbal *et al*., 2017; Getso *et al*., 2017).

In order to contribute to the effective management of the fisheries resources of Tiga Lake, this study investigated the physicochemical water parameters, abundance and composition, length-weight relationships and condition factors of the inhabiting fish species. Outcomes from this study could be of importance to the fisheries managers during management planning activities of the fisheries.

MATERIALS AND METHODS

Study Area

Tiga Lake is situated between latitude 11° 15’ to 11° 29’ N and Longitude: 8° 16’ to 8° 38’ E, It was constructed between 1971 and 1974. This Lake serves as a significant reservoir along the Kano River, a primary tributary of the Hadejia River. It covers an area of 178 square kilometers (69 sq mi) with a maximum capacity of nearly 2,000,000 cubic meters (71,000,000 cu ft). The Lake plays a crucial role in supplying water to both the Kano River Irrigation Project and the city of Kano (Mohammed *et al.*, 2020).

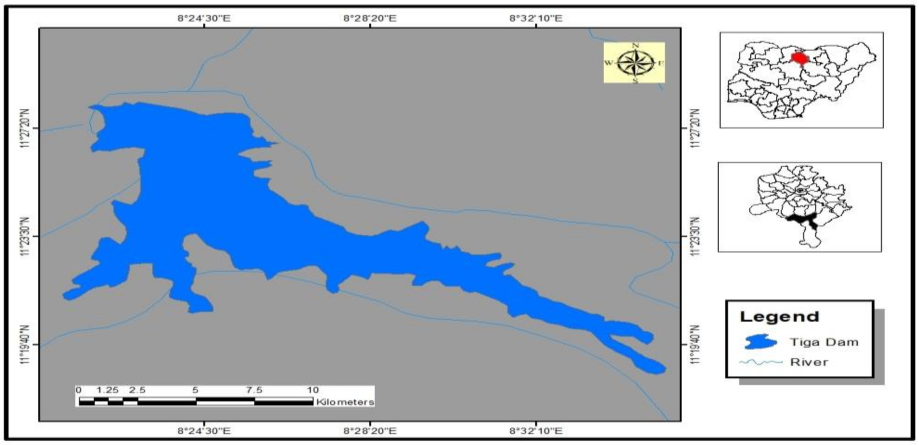

Figure 1: Map Showing the Location of the Tiga Lake.

Study Period and Sampling Locations

The study was conducted between November, 2022 to October, 2023 on Tiga Lake (Figure 1). Water and fish sampling was done on monthly basis for the physicochemical water analysis, fish biodiversity evaluation and the length weight relationship estimations. Two sites i.e., Tiga and Rurum were identified on the Lake. Three points were chosen at random for the water sampling and three landing sites for fish sample collections were identified at each of the two sites (i.e., Tiga and Rurum).

Determination of Physicochemical Parameters

Four physicochemical parameters were measured *in situ* which consist of temperature, pH and Electrical conductivity (EC) measured using Extech digital meter (Exstik@11) and Dissolved oxygen (DO) measured with Milwaukee digital meter (MW600). Water samples were randomly collected in triplicates within each sampling location into 1L sampling plastic bottles and electrode inserted for the reading. Calibration of the meters was done before commencing the measurements at each site.

Fish Sample Collection and Identification

Fish samples collection was based on the catches of the local fishermen. Fishing gears commonly used for fishing include; Gill nets, Cast net, Long line, Clap net and Malian trap. Identification of the specie was done using the fish identification guide by Olaosebikan and Raji (1998). The fish were identified into their respective species, image scanning of representatives of each species was done for further confirmation of their identity. Fish were sorted into their distinct species, member of each species were counted and recorded accordingly.

Length-Weight Relationships (LWRs)

Total length and body weight of each fish species were measured using measuring ruler (in centimeters) and digital weighing scale (in grams). The respective measurements were recorded in Microsoft Excel and Log transformed for further analysis.

The Length-Weight Relationships (LWRs) was calculated using the equation:

$$W = a L^b$$ (Le Cren, 1951)

The equation was natural log transformed as:

$$\log (W) = \log (a) + b \log (L),$$

Where *W* is the weight of the fish (g), *L* is the total length of the fish (cm). *a* represents the intercept while *b* stands as the regression gradient representing the allometric coefficient.

Condition Factor (K)

The Condition Factor is frequently used in fish biology study, as it gives important information related to fish physiological condition, based on the principle that individuals fish of a given length, exhibiting higher weight are in a better condition (Ajibare *et al.*, 2020)

The following equation was used to calculate the condition factor, or "K," which indicates the fish's level of well-being in their habitat:

$$K = \frac{W}{L^3} X\ 100$$

Where: *K* is the condition factor. W is the weight of the fish measured in grams (g). L^3 is the cubic total length of the fish measured in cm.

Data Analysis

Data on Physicochemical water parameters' were analyzed using paired T-test to test for significant differences ($p \leq 0.05$) between seasonal variations among each of the parameters using R statistical Software (R Core Team, 2023). Fish composition and abundance were expressed in frequencies and their percentages were calculated as follows;

$$\% \text{ Composition of Species (A)} = \frac{\text{Number of species A}}{Total\ number\ of\ individuals} \times 100$$

Paleontological Software Statistics (PAST) package was used in the visualization of the fish biodiversity pattern between the dry and wet Seasons using Non-metric multidimensional scaling (NMDS) technique. Subsequently, one way analysis of similarities (ANOSIM) was performed to check for significant difference (p<0.05) between fish biodiversity of the two Seasons.

Species Diversity Indices

The estimation of fish species diversity indices were calculated using Paleontological Software Statistics (PAST). The calculated indices were graphically expressed in Bar Chats for visualization. The estimated indices are listed below with their formulae:

Shannon Wiener Diversity Index (H)

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

Mergalef Index (d)

$$d = \frac{s-1}{\text{In}\ N}$$

Simpson Index (D)

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

Where, N is total number of fish 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.

RESULTS AND DISCUSSION

Physicochemical Parameters of Tiga Lake

The assessment of water quality through its physicochemical characteristics offers valuable insights into the lake's condition, productivity, and sustainability (Duque *et al.*, 2020). Variations in these metrics were used as indicators of water quality, elucidating the sources of variation and potential impacts on reservoir function and biodiversity.

The physicochemical parameters of Tiga Lake water during both the dry and wet seasons are summarized in Table 1. The assessment of physicochemical water qualities in Tiga Lake unveiled noticeable seasonal fluctuations. The study revealed significant ($p \leq 0.05$) seasonal variations in Dissolved Oxygen (DO), pH, Electrical Conductivity (EC), and Total Dissolved Solids (TDS). Conversely, no significant difference (p>0.05) was recorded in temperature between the dry and wet seasons. These findings give valuable insight in to the dynamic nature of water quality at Tiga Lake across the distinct seasons.

In the wet season, the elevated EC of the lake water indicates an increased presence of dissolved particles, influencing its suitability for irrigation (Mandal *et al.*, 2019). DO levels above 4.0 mg/l was recorded during both seasons, the condition favours optimal fish thriving throughout the year (Wedemeyer, 1996). However, the TDS levels in both dry (67.76) and wet (76.08) seasons are still within favourable ranges for freshwater fish well-being and safe as drinking water for man (WHO, 2011; Adhena *et al.*, 2015).

Table 1: Season Variation of Water Parameters Analyzed with Student's Paired T-test.

	Season		
Parameter	Dry	Wet	P-Value
Temp. (°C)	19.94±0.31	20.75± 0.24	0.518
DO (mg/l)	6.019±0.221	7.354±0.24	0.022
pH	8.827±0.06	9.933±0.18	0.000
EC (µS/cm)	134.7±1.23	160.6±2.09	0.000
TDS (mg/l)	67.76±0.41	76.08±0.79	0.000

Note: Mean±SEM; SEM=Standard error of mean

Fish Species Composition

The fish species composition within the lake exhibited dominance by *Cichlidae*, *Bagridae*, and *Claridae* species, with *Cichlidae* accounting for nearly half of the fisheries (49.1%). *Bagridae* and *Claridae*, were at 13.6% and 10.6% respectively, also contributed significantly to the overall fish diversity of the water body. In contrast, *Cyprinidae* fish species demonstrated the lowest representation in the lake, constituting 1.3% of the observed fish species (Table 2).

The fish biodiversity assessment in Tiga Lake revealed a total of 18 fish species belonging to 11 families, with cichlids emerging as the dominant group in the fish population (Table 2). This finding aligns with investigation on Tagwai Lake in North-Central Nigeria by Muhammed *et al*. (2019) who reported the dominance of cichlids in the fish communities. Cichlids were also found to dominate the fisheries of Lake Asejire in Oyo State, Nigeria (Ipinmoroti & Iyiola, 2022).

The fish species composition in the studied ecosystem demonstrated notable seasonal variations. *Oreochromis niloticus*, a member of the *Cichlidae* family, constitutes 37.2%, exhibiting a higher representation in the Wet season (153) compared to the Dry season (257). In contrast, *Sarotherodon galillaus* and *Tilapia zillii*, both Cichlids, exhibits higher representation during the Dry season than the Wet season. *Bagrus bayad*, a Siluriformes species, was the second highest in composition in the Dry season (88) and in the Wet season (62). *Schilbe mystus*, another Siluriformes species, maintains a relatively balanced representation in the two seasons. During the Dry season, *Clarias gariepinus* of the Claridae family was the third highest in fish composition, totaling (79) and accounting for 10.6% of the total fish composition of the water body. Conversely, the species *Hyperopisus occidentalis* of *Mormyridae* family, exhibits the lowest count during the Dry season, with one (1) representation (0.6%).

Table 2: Composition and Classification of Fish Species Sampled in Dry and Wet season from Tiga Lake

Order	Family	Species	Total	%	Season Dry	Wet
Perciformes	Cichlidae	*Oreochromis niloticus*	410	37.2	257	153
Perciformes	Cichlidae	*Sarotherodon galillaus*	60	5.4	38	22
Perciformes	Cichlidae	*Tilapia zillii*	72	6.5	44	28
Siluriformes	Schilbeidae	*Schilbe mystus*	29	2.6	15	14
Perciformes	Alestidae	*Hydrocynus Vittatus*	40	3.6	25	15
Siluriformes	Bagridae	*Bagrus bayad*	150	13.6	88	62
Osteoglossiformes	Mormyridae	*Mormyrops anguilloides*	11	0.9	4	7
Osteoglossiformes	Mormyridae	*Mormyrus rume*	59	5.3	31	28
Siluriformes	Mockokidae	*Synodontis schall*	36	3.2	17	19
Osteoglossiformes	Mormyridae	*Hyperopisus occidentalis*	7	0.6	1	6
Osteoglossiformes	Arapaimidae	*Heterotis niloticus*	17	1.5	6	11
Siluriformes	Claridae	*Clarias gariepinus*	117	10.6	79	38
Osteoglossiformes	Gymnarchidae	*Gymnarchus niloticus*	40	3.6	13	26
Siluriformes	Malapteruridae	*Malepterurus minjyiriya*	13	1.1	9	4
Osteoglossiformes	Mormyridae	*Mormyrus hasselquistii*	11	0.9	10	1
Cypriniformes	Cyprinidae	*Labeo coubie*	9	0.8	5	4
Cypriniformes	Cyprinidae	*Labeo senegalensis*	6	0.5	2	4
Characiformes	Alestidae	*Brycinus leuciscus*	15	1.3	10	5
Totao=5	11	*18*	1,102	100.0	654	447

Temporal patterns in fish biodiversity within the lake were explored using the Non-metric Multidimensional Scaling (NMDS) technique, using the Bray Curtis dissimilarity metric for visualization (Figure 2). The NMDS plot depicts an overlap in the fish distribution during both the Dry and Wet seasons. To assess the statistical significance of these observed patterns, a subsequent Analysis of Similarities (ANOSIM) was carried out. The results of the ANOSIM analysis revealed no significant difference (p=0.527, R=-0.0129) in fish distribution between the two seasons.

This lack of significant difference between fish distribution during the Dry and Wet seasons suggests a relatively level of consistency or similarity in the composition and abundance of fish species over time. The NMDS technique, along with the ANOSIM analysis, provides a detail understanding of the temporal dynamics in fish biodiversity, highlighting stability of the fish community structure across different seasons in Tiga Lake. These findings gives insights into the ecological resilience and adaptability of the lake's fish population in response to seasonal variations.

Fish Biodiversity Indices of Tiga Lake

The fish biodiversity indices, demonstrated in bar charts, indicated higher values during the Wet season compared to the Dry season. The number of sampled fish species during the Wet season was 18, surpassing the 16 in the Dry season (Figure 3). Similarly, the estimated values for the Shannon-Weiner, Margalef, and Simpson indices were higher in the Wet season, measuring 2.273, 2.786, and 0.837 respectively. In contrast, the Dry season values were slightly lower at 2.066, 2.278, and 0.812 respectively (Figure 4, 5, and 6). The overall indices give a Shannon-Weiner index of 2.183, a Margalef index of 2.404, and a Simpson index of 0.825.

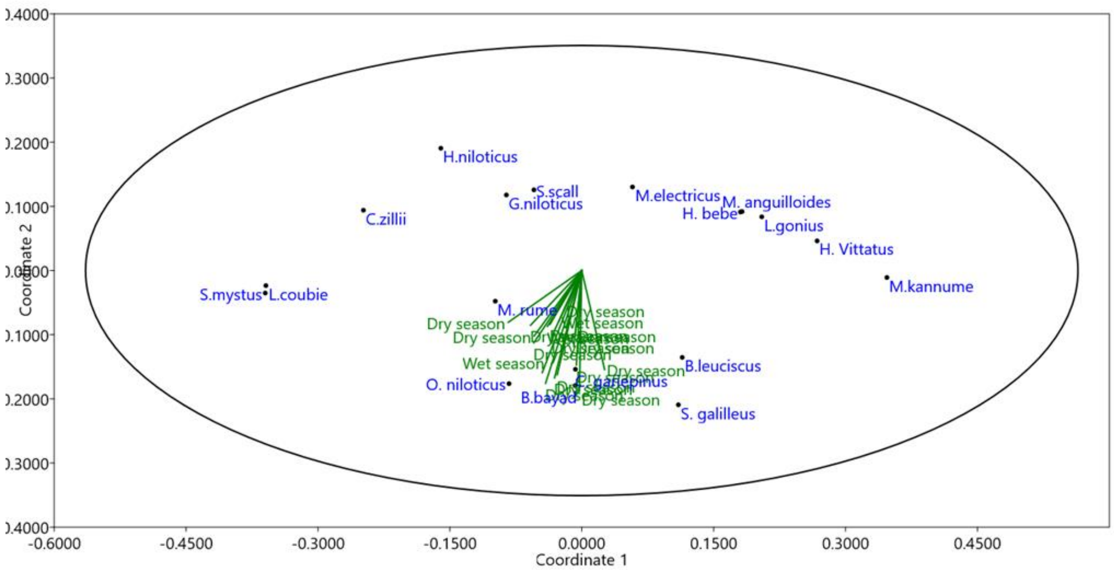

Figure 2: Non-Metric Multidimensional Scaling (NMDS) of Fish Species of Tiga Lake based on Season.

The comparison between the sampled 16 fish species in the Dry season and 18 in the Wet season underscores the fish species richness of the lake. The estimates of the indices collectively indicate a higher diversity and richness of fish species in the Tiga Lake during the Wet season. This implies increased abundance and distribution of fish species, potentially influenced by factors like resource availability and conducive environmental conditions (Jisr *et al.*, 2018).

Evaluating the Shannon-Wiener index (H') across the fish species in Tiga Lake throughout the study period revealed values ranging from 2.06 to 2.18. These figures surpassed those documented by Offem *et al*.(2011) for the fish biodiversity of Ikwori Lake during the Wet season. In a similar vein, Emmanuel and Modupe (2010) reported slightly lower values ranging between 1.869 and 2.015 in three tributaries of River Ore. This variability can be attributed to distinctions in ecological zones. The consistent H' values observed in both seasons suggest a well-distributed species diversity within Tiga Lake. Furthermore, the Shannon-Weiner diversity index of Tiga Lake in the present study is higher than that reported for three tributaries of the Anambra River (0.82, 1.10, & 0.78) by Odo *et al*. (2009) The referenced study, which recorded 51-52 fish species compared to the 18 species in the present study, indicates a proportional underrepresentation in various sections of the river.

Nevertheless, the Shannon-Wiener index (H') derived from this study aligns with the findings of Suleiman *et al*. (2018) on Challawa Gorge Dam in Kano State, which reported a value of 2.28. The close similarity in the diversity index is attributed to the similarities in the locations, purpose of establishment, and mode of exploitation of Tiga and Challawa Lakes, despite variations in their species richness. This difference in species richness is reflected in the calculated Margalef index of 1.07 for Challawa Lake, in contrast to the 2.404 estimated for Tiga Lake in this study.

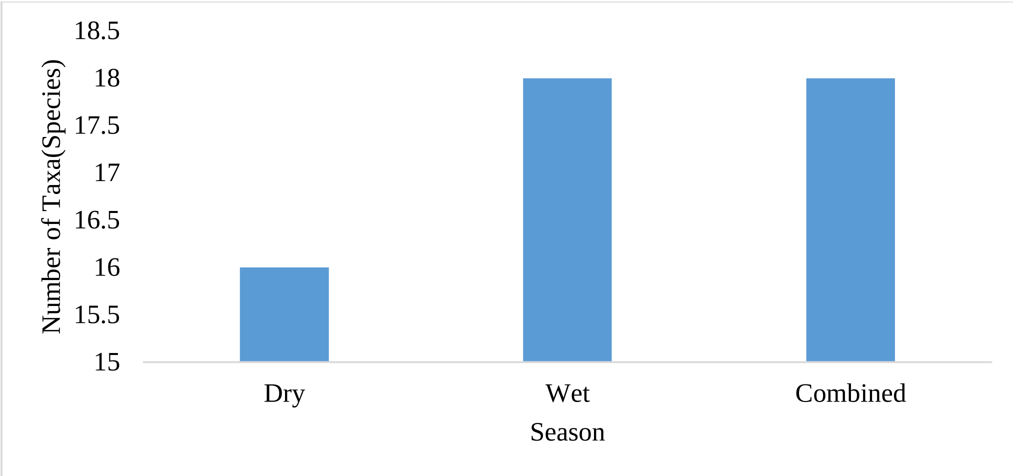

Figure 3: Total Number of Fish Species Sampled During Dry and Wet Seasons at Tiga Lake.

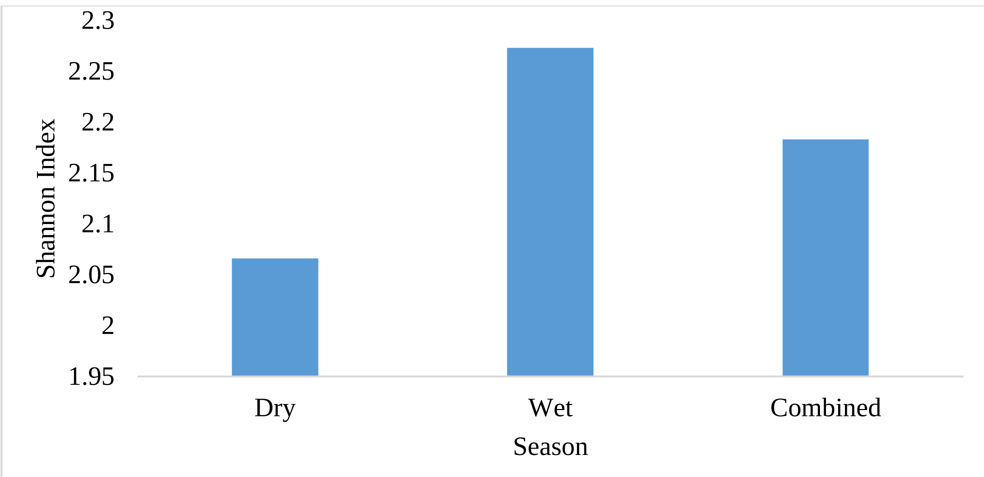

Figure 4 : Shannon-Wiener Index(H) for Fish Species Diversity in Tiga Lake

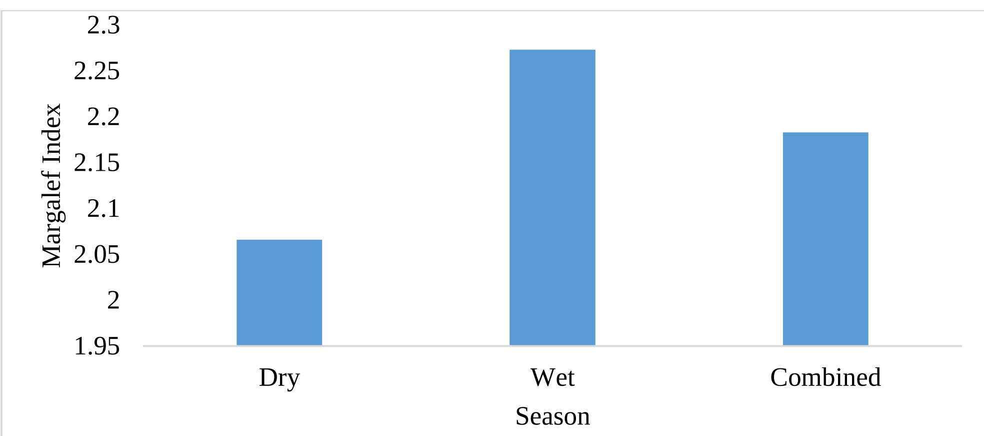

Figure 5: Margalef Index for Fish Species Richness of Tiga Lake

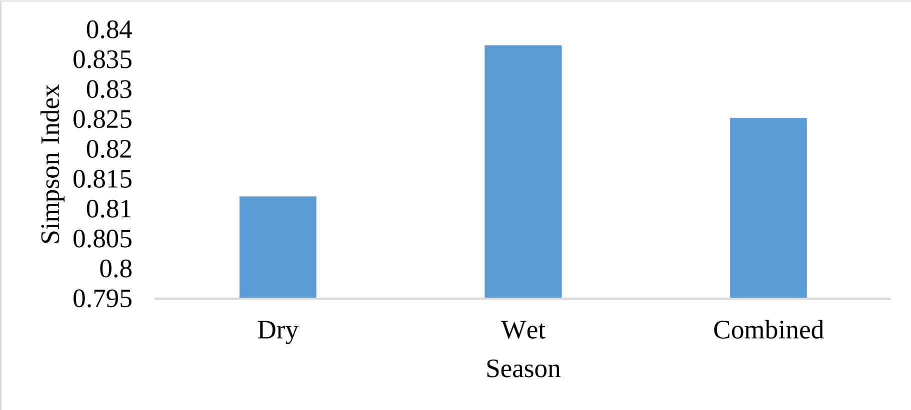

Fig 6: Simpson Index of fish species at Tiga Lake

Length-Weight Relationship and Condition factors of Fish Species of Tiga Lake on Seasonal Basis.

Results from the estimation of length-weight relationships (LWRs) and condition factors (K) parameters are presented in Table 3. Significant differences ($p \leq 0.05$) were observed among LWRs parameters for various species, indicating variability in their size-weight relationship. The regression coefficient 'b' gives higher values during the wet season for species such as *S. mystus* (3.586), *C. gariepinus* (2.299), *M. rume* (3.571), *G. niloticus* (3.861), *M. angulloides* (3.396), *B.bayad* (2.971), and *O.niloticus* (2.976). Conversely, higher 'b' values were exhibited during the dry season by species such as *S.schall* (1.982), *L.coubie* (1.602), *M.minjiriya* (0.884), *H.vittatus* (2.803), *H.niloticus* (2.954), and B.leuciscus (1.668). The overall combined 'b' values ranged between 0.411 and 3.614, with the highest values observed in *M. rume* (3.504), *G. niloticus* (3.614), and *M. anguilloides* (3.321).

The assessments here indicates fish species exhibit varying LWRs influenced by size range, reproductive activity, and environmental condition such as temperature, water quality, food availability, disease, and competition (Famoofo and Abdul, 2020).. The length-weight relationship parameters (a and b) and the coefficient of determination (R^2) gives insights into the growth patterns of fish. The 'b' values, depicting growth pattern, ranged from 0.884 to 3.481 and 0.395 to 3.861 for dry and wet seasons, respectively. These results is in contrast with previous studies reported by Egbal *et al*. (2011), of 'b' values within the range of 2.278 and 3.680 for fish species in Atbara River and Khashm elGirba reservoir in Sudan. Similarly, Nafiu *et al*. (2017) reported 'b' values ranging from *0.9 to 2.7* for seven species sampled from Thomas Dam in Kano State, Nigeria. In contrast with some species in the findings of this study, species such as *S.mystus*, *M. rume*, *G.niloticus* and *M. anguillodes* exhibited either isometric or a mild positive allomeric growth. However, as variations in 'b' values estimated from the two studies can be attributed to environmental factors such as fish physiology, sex, season, feeding rate, gonadal development, and growth phase. The variation could also be as result of inherent body shape specific to species (Jisr *et al.*, 2018).

Fish species condition factor estimates (K) also demonstrated temporal variation between the seasons. Higher condition factors during the Dry season were exhibited by Species such as *L. coubie* (1.261), *M. rume* (1.291), *S. galillaus* (2.560), *T. zillii* (2.155), and *O. niloticus* (2.592). The overall combined K values for all the species ranged from 0.703 to 2.603, with *O. niloticus* exhibiting the highest condition factor and *C. gariepinus* the lowest.

The Condition factors (K) employed indicated species such as *A. occidentalis*, *S. mystus*, *H. vittatus*, *H. niloticus*, *C. gariepinus*, *B. bayad*, and *M.hasselquistii* exhibited condition factors (K) less than one, suggesting potential challenges in the Tiga Lake. Conversely, species with $K \geq 1$, includes *M. rume*, *L. coubie*, *M. minjiriya*, *L. senegalensis*, *O. niloticus*, *G. niloticus*, *S. galilleus*, *M. anguilloides*, and *T. zillii*,

Table 3: Estimates of Length-Weight Relationships and Condition Factors of Fish Species.

Species	**Season**	**N**	**A**	**B**	**R^2**	**P-Value**	**Growth type**	**K**
A.occidentalis	Dry	17	-1.762	1.982	0.947	≤0.050	-A	0.916
	Wet	19	-1.369	1.787	0.833	≤0.050	-A	0.779
	Combined	36	-1.577	1.887	0.884	≤0.050	-A	0.857
S.mystus	Dry	15	-4.222	2.784	0.962	≤0.050	-A	0.000
	Wet	7	-6.499	3.586	0.910	≤0.050	+A	0.868
	Combined	22	-4.652	2.934	0.938	≤0.050	I	0.780
M.rume	Dry	29	-6.449	3.481	0.996	≤0.050	+A	1.129
	Wet	28	-6.844	3.571	0.992	≤0.050	+A	1.065
	Combined	57	-6.569	3.504	0.993	≤0.050	+A	1.100
L.coubie	Dry	5	0.328	1.602	0.880	0.048	-A	1.261
	Wet	4	4.342	0.395	0.554	0.445	-A	1.426
	Combined	9	3.553	0.640	0.674	0.046	-A	1.337
M.minjiriya	Dry	7	3.486	0.884	0.627	0.132	-A	1.904
	Wet	4	4.087	0.715	0.942	0.058	-A	1.942
	Combined	11	3.684	0.829	0.670	0.024	-A	1.917
H.vittatus	Dry	19	-4.168	2.803	0.953	≤0.050	-A	0.785
	Wet	15	-4.183	2.785	0.986	≤0.050	-A	0.918
	Combined	34	-4.310	0.411	0.974	≤0.050	-A	0.845
L.senegalensis	Dry	2	-1.386	1.472			-A	1.453
	Wet	4	-1.836	1.825	0.912	0.087	-A	1.466
	Combined	6	-2.688	2.221	0.934	0.006	-A	1.493
H.niloticus	Dry	6	-4.552	2.954	0.982	0.000	A+	0.895
	Wet	9	-0.501	1.852	0.915	0.000	-A	0.792
	Combined	15	-1.631	2.162	0.883	≤0.050	-A	0.833
C. gariepinus	Dry	100	-1.754	1.999	0.834	≤0.050	-A	0.686
	Wet	38	-2.638	2.299	0.937	≤0.050	-A	0.738
	Combined	138	-2.076	2.106	0.864	≤0.050	-A	0.703
O. niloticus	Dry	263	-3.444	2.872	0.989	≤0.050	-A	2.592
	Wet	153	-3.454	2.876	0.986	≤0.050	-A	2.600
	Combined	416	-3.449	2.874	0.988		-A	2.603
G.niloticus	Dry	14	-6.336	3.432	0.954	≤0.050	+A	0.998
	Wet	18	-7.766	3.861	0.933	≤0.050	+A	1.048
	Combined	32	-6.941	3.614	0.941	≤0.050	+A	1.027
B.bayad	Dry	88	-4.781	2.952	0.948	≤0.050	I	0.907
	Wet	62	-4.851	2.971	0.975	≤0.050	I	1.040
	Combined	150	-4.825	2.964	0.964	≤0.050	I	0.960
S.galillaus	Dry	24	-3.777	2.964	0.984	≤0.050	I	2.560
	Wet	22	-3.500	2.860	0.950	≤0.050	-A	2.125
	Combined	46	-3.774	2.955	0.972	≤0.050	I	1.976
B.nurse	Dry	10	-0.781	1.668	0.823	0.003	-A	1.293
	Wet	5	1.260	0.971	0.836	0.077	-A	1.478
	Combined	15	-0.253	1.492	0.771	0.000	-A	1.355
M.anguilloides	Dry	3	-5.339	3.201	0.992	0.079	+A	1.190
	Wet	7	-5.969	3.396	0.946	0.001	+A	1.200
	Combined	10	-5.719	3.321	0.962	≤0.050	+A	1.197
T.zilli	Dry	38	-2.394	2.346	0.935	≤0.050	-A	2.155
	Wet	27	-2.540	2.398	0.954	≤0.050	-A	1.99
	Combined	65	-2.432	2.358	0.944	≤0.050	-A	2.089
M.hasselquistii	Dry	10	-2.457	2.399	0.978	0.179	-A	0.942
	Wet							
	Combined	11	-2.357	2.375	0.974	0.033	-A	0.951
H.occidentalis	Dry							
	Wet	6	0.891	0.845	0.827	0.041	-A	1.488
	Combined	7	1.010	0.789	0.792	0.033	-A	1.433

N=Number of fish, a=intercept index, b= the gradient or growth index, R^2=Regression coefficient, -A=Negative Allometric, +A=Positive Allometric and I=Isometric growth, K= Condition Factor indicating favourable thriving conditions in the Tiga Lake. These observations align with studies by Getso *et al*. (2017) on *C. gariepinus* in River Wudil and Imam *et al*. (2010) on *O. niloticus* from Wasai Reservoir. The variations in condition factors may be ascribed to differences in nutrient composition and feed availability between water bodies (Jisr *et al.*, 2018). The condition factor for *O. niloticus* corresponds with the findings of Azubuike (2016), while the estimate for *T. zillii* aligns with Ahmad *et al.* (2015).

CONCLUSION

In conclusion, the evaluation of Tiga Lake's water quality unveils values within the recommended limits for fish survival, likely responsible for the relatively high abundance and diversity of fish in the water body. The fluctuating fish species composition across seasons signifies a dynamic ecosystem influenced by changing environmental conditions. Certain species, such as *Oreochromis niloticus*, indicated season-specific preferences likely influenced by factors such as temperature, food availability, or reproduction habits. The evaluation of length-weight relationships and condition factors provided good insights into the dynamics of the ecosystem. This study recommends further studies on the dynamism of the fisheries of Tiga Lake so as to provide adequate information needed for effective management. Consideration of influence of seasons on the abiotic and the biotic components of the ecosystem during such studies would give more temporal specific information of the ecosystem. Such would provide insight as to better management measure to be taken at various times,

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