ASSESSMENT OF BIODIVERSITY AND RELATIVE ABUNDANCE OF FISH AT TIGA RESERVOIR, KANO: CURRENT STATUS

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ABSTRACT

*A study on the diversity and relative abundance of fish was conducted to determine their current status at Tiga Reservoir, Kano State, Nigeria.. The fish specimens were collected from three landing sites (Tiga, Rurum and Tarmai) between 8:00 – 11:00am with the help of artisanal fishermen using various assorted fishing gears (monofilament and multifilament gill nets). They were collected monthly from Nov. 2018 to Oct. 2019. The Relative abundance and biodiversity indices were calculated. The result shows that the reservoir harbours seventeen (17) species of fish belonging to ten (10) families, six (6) orders and seventeen (17) genera. The family Cichlidae is represented by four (4) species, the family Mormyridae is represented by three (3) species, the family Claroteidae and Alestidae each comprises of two (2) species while the family Bagridae, Clariidae, Malapteruridae, Protopteridae, Schilbedae and Cyprinidae are each represented by one (1) specie only. The most dominant family is the Cichlidae (31.36%) followed by the family Claroteidae (16.24%) and family Mormyridae (14.34%). The least is the family Protopteridae (0.03%). The most dominant species is the Coptodon zilli making up about 16.77% followed by Bagrus bajad (13.29%) while the least specie is Protopterus annectens (0.03%). Shannon weiner index (H) and Simpson index (D) of 4.0021 and 0.21903 at Site I showed that the fish were more diverse at Site I than Site II and III. Chi square (13.13) reveals a significant difference at the sites ($p<0.05$). This study provides an up-to-date information on the current status of Tiga reservoir with respect to the biodiversity and relative abundance of the fish species. There is the need for a frequent assessment of fish stock because population size, structure and distribution fluctuate in response to environmental variation.***

Keywords: *Tiga, Biodiversity, Relative abundance, Diversity indices*

INTRODUCTION

Tiga Reservoir which is a man-made lake play a very crucial role in the geochemical cycling of elements as they tend to influence the chemical composition and transfer of materials in a water body. Reservoirs are of high ecological, economic and recreational importance as they fulfill some basic human needs by serving as sources of water for drinking, irrigation, industrial use, flood control, hydro power generation, fishing, inland navigation and recreation (Basavaraja *et al.*, 2014).

Over the years, there have been a decline in the number of fish caught from most inland water bodies in Nigeria as documented by many researchers (Oguntade *et al.*, 2014; Iyiola *et al.*, 2018). In water bodies where heavy demand is placed on freshwater (rivers and lakes for instance), many fish species tend to become highly endangered. Thus a rapid decline in fish biodiversity, relative abundance and distribution can be attributed to the impact of anthropogenic activities, habitat degradation, inadequate management of fisheries, exotic species introduction, water diversions, pollution and global climate change. Therefore, the impact of environmental pollution and other human activities on fish diversity cannot be overestimated because fishes are sensitive to water chemistry as a result of different anthropogenic activities (Basavaraja *et al.*, 2014; Iyiola *et al.*, 2018).

Environmental conditions tend to influence fish distribution, communities and seasonal movements as research has shown that species typically favour areas that optimize their physiological processes as reported by Lomeli, 2011, Uspenskiy *et al.*, 2022 and Loera-perez *et al.*, 2020. Several studies in estuarine water bodies have shown correlations between fish occurrences and specific physicochemical parameters (Lomeli, 2011). Some notable physicochemical parameters which were reported in studies of fish communities include water temperature, salinity, dissolved oxygen, pH, turbidity, tidal state, depth, eel grass habitat, substrate, presence of structure, distance of estuarine mouth and prey density. These factors were reported for structuring fish distribution (Lomeli, 2011, Uspenskiy *et al.*, 2022 and Loera-perez *et al.*, 2020).

Frequent assessment of fish stock may be necessary because population size, structure and distribution tends to fluctuate in response to environmental variation. A 'Fish Stock' is referred

to as a portion of a population, or a sub-population. Stock Assessment and Population Assessment are often used interchangeably by fisheries biologists and fisheries managers. 'Stock Assessment' is referred to as that portion of the fish population that is exploitable by a fishery. Due to the fact that complete knowledge of a population is rare or impossible to obtain, managers therefore attempt to acquire as much information about a population as resources allow (Pope *et al.*, 2010).

MATERIALS AND METHODS

Study Area:

Tiga Reservoir is located in about 70km South of Kano city. It has an embankment height of about 48m above the river bed level. The reservoir* has a full storage capacity of 527.3m (WC/LCBC, 2002). Three (3) landing sites are selected for the study based on accessibility, convenience and security. Site I is called Tiga which is located within the coordinates of $11^0$28'12.078"N and $8^0$22'0.906"E, Site II is called Rurum and it's located within the coordinates of $11^0$23'32.592"N and $8^0$28'22.854"E, while Site III is called Tarmai located within the coordinates of $11^0$23'11.076"N and $8^0$30'16.08"E. All the three sampling sites have an elevation of 530 meters above sea level as shown by a GPS instrument (GPSMAP 64s, GARMIN model).

Sampling and Identification:

The fish specimens were collected from Tiga Reservoir from three landing sites (Tiga, Rurum and Tarmai) between 8:00 – 11:00am with the help of artisanal fishermen using various assorted fishing gears (including monofilament and multifilament gill nets). They were collected on a monthly basis for a period of twelve (12) months (November, 2018 to October, 2019). These were transported to the Laboratory of Biological Sciences, Bayero University, Kano in cold box (ice box). They were sorted and identified to the species level with the aid of standard reference texts of Reed *et al*, (1967) and Olaosebikan and Raji (2013). Thus, a total of 3,214 fish specimens belonging to nine (09) families were obtained for this study

Determination of Fish Diversity and Abundance in Tiga Reservoir (Stock Assessment)

* The Fish Diversity Indices (Shannon, H and Simpson, D) were calculated as per standard method (Shannon & Weaver, 1963**,** Negi & Sheetal, 2013 and Ogbeibu, 2005):

Shannon Index (H):

$$H = -\sum_{[=]}^{S} P_I \ln(P_I)$$

Simpson Index (D):

$$D = \sum^{\frac{1}{}} (P_I)^2$$

Where:

$$P_I = \frac{\text{No. of individuals of a particular species}}{\text{Total no. of individuals (Organisms)}}$$

The Relative Abundance (RA) of fish species was calculated by the following formula:

$$R.A\ (\%) = \frac{\text{No. of specimens of a particular species x 100}}{\text{Total no. of specimens of all species}}$$

RESULTS

The different fish species at Tiga reservoir and the percentage composition (relative abundance) are presented in table 1. The result shows that the reservoir supports seventeen (17) species of fish belonging to ten (10) families, six (6) orders and seventeen (17) genera. The family Cichlidae is represented by four (4) species belonging to the genera Coptodon, Oreochromis, Sarotherodon and Tilapia. The family Mormyridae is represented by three (3) species, the family Characidae comprises of two (2) species while the family Bagridae, Clariidae, Malapteruridae, Protopteridae, Schilbedae and Cyprinidae are each represented by one (1) specie only. Hence, from table 1, it can be seen that the most dominant family is the Cichlidae (31.36%) followed by the family Claroteidae (16.24%) and family Mormyridae (14.34%). The least is the family Protopteridae (0.03%). The most dominant species is the *Coptodon zilli* making up about 16.77% followed by *Bagrus bajad* (13.29%) while the least specie is *Protopterus annectens* (0.03%).

Table 2 shows the composition and distribution of the fish species by Families at Site I, II and III of Tiga reservoir during rainy and dry season. Most species were found during the rainy season and they were predominant at Site I. Site II has the least abundance of fish species. Some species like the *Malapterurus electricus* and *Protopterus annectens* were found only during the rainy season at Site I. They were absent at Site II and III. It can also be seen that all the families (10) were found present at Site I while at Site II and III, only

eight (8) families were found with the exception of family Malapteruridae and Protopteridae. Thus, from the result, it can be seen that Site I has the bulk of the fish species (1,719 individuals) followed by Site III (888 individuals) while Site II has the least species (607 individuals). Chi square analysis (2.333) reveals a significant difference at the three sites ($p<0.05$).

Shannon–weiner Index of Diversity (H) and Simpson's Index of Diversity (D) were used to calculate the diversity indices of the fish species at the three sites (I, II and III). The result indicates that the fish species are more diverse at Site I than Site II and III following a high Shannon index value of 4.0021 and a low Simpson's index value of 0.21903 respectively as shown in Table 3.

Table 1: Biodiversity and Relative Abundance of Fish Species at Tiga Reservoir (Nov. 2018 – Oct. 2019)

S/N	Order	Family	Genus	Species	English name	Local name	N	(%)
1	Siluriformes	Bagridae	Bagrus	*Bagrus bajad*	Silver catfish	Ragon ruwa	427	13.29
							427	**13.29**
2	Siluriformes	Claroteidae	Auchenoglanis	*Auchenoglanis occidentalis*	Giraffe catfish	Kurungu	427	13.29
	Siluriformes	Claroteidae	Chrysichthys	*Chrysichthys cf. auratus*		Kurungu	271	08.43
							251	07.81
							522	**16.24**
3	Cichliformes	Cichlidae	Coptodon	*Coptodon zilli*		Tsaki	539	16.77
			Oreochromis	*Oreochromis niloticus*		Karfasa	251	07.81
			Sarotherodon	*Sarotherodon galileaus*		Farar wala	215	06.69
			Tilapia	*Tilapia spp*		Bakin gurbi	03	00.09
							1,008	**31.36**
4	Siluriformes	Clariidae	Clarias	*Clarias gariepinus*	African catfish	Tarwada	192	06.00
							192	**6.0**
5	Siluriformes	Malapteruridae	Malapterurus	*Malapterurus electricus*	Electric catfish	Minjirya	08	00.25
							08	**0.25**
6	Ceratodontiformes	Protopteridae	Protopterus	*Protopterus annectens*	African lungfish	Gaiwa	01	00.03
							01	**0.03**
7	Characiformes	Alestidae	Hydrocynus	*Hydrocynus brevis*	Tiger fish	-	03	00.09
		Alestidae	Alestes	*Alestes nurse*	-	Kawara	261	08.10
							264	**8.19**
8	Siluriformes	Schilbeidae	Schilbe	*Schilbe intermedius*	Glass catfish	Rampai	197	06.13
							197	**6.13**
9	Osteoglossiformes	Mormyridae	Pollimyrus	*Pollimyrus isidori*	-	Faya	271	08.43
			Mormyrus	*Mormyrus tapirus*	Trunk fish		110	03.42
			Hyperopisus	*Hyperopisus bebe*	Mormyrid		80	02.49
							461	**14.34**
10	Cypriniformes	Cyprinidae	Enteromius	*Enteromius perince*		Kursa	134	04.17
							134	**4.17**
						Total	**3214**	**100**

Families = 10, Order = 06, Genera = 17, Species = 17

Table 2: Composition and Distribution of Fish by Families at Site I, II and III of Tiga Reservoir based on seasons (Nov. 2018 – Oct. 2019)

S/N	Family	Site I		Site II		Site III		Total	
		Rainy n (%)	Dry n (%)	Rainy n (%)	Dry n (%)	Rainy n (%)	Dry n (%)	N	%
1	Bagridae	135 (31.62)	88 (20.61)	58 (13.58)	28 (6.56)	75 (17.56)	43 (10.07)	**427**	**100**
2	Claroteidae	165 (32.00)	104 (19.92)	70 (13.41)	35 (6.70)	94 (18.01)	54 (10.00)	**522**	**100**
3	Cichlidae	357 (35.42)	188 (18.65)	131 (13.00)	59 (5.85)	185 (18.35)	88 (8.73)	**1,008**	**100**
4	Clariidae	64 (33.33)	43 (22.40)	19 (9.90)	11 (5.73)	36 (18.75)	19 (9.89)	**192**	**100**
5	Malapteruridae	05 (62.5)	03 (37.5)	00 (00)	00 (00)	00 (00)	00 (00)	**08**	**100**
6	Protopteridae	01 (100)	00 (00)	00 (00)	00 (00)	00 (00)	00 (00)	**01**	**100**
7	Alestidae	78 (29.55)	65 (24.62)	30 (11.36)	22 (8.33)	48 (18.18)	21 (7.95)	**264**	**100**
8	Schilbedae	57 (28.93)	47 (23.86)	20 (10.15)	17 (8.63)	33 (16.75)	23 (11.68)	**197**	**100**
9	Mormyridae	147 (31.89)	98 (21.26)	51 (11.06)	37 (8.03)	72 (15.62)	56 (12.15)	**461**	**100**
10	Cyprinidae	53 (39.55)	21 (15.67)	12 (8.96)	07 (5.22)	30 (22.39)	11 (8.21)	**134**	**100**

Chi-square (x^2) =13.13, P(<0.05) = 0.0014, significantly different across the sites at 5%

Table 3: Diversity Indices of Fish Species at Site I, II and III of Tiga Reservoir (Nov. 2018 – Oct. 2019)

Sites	Rainy Season (n)	Dry Season (n)	Total No. of Species (N)	Diversity Index (D)	(H)
I	1,062	657	1,719	**0.21903**	**4.0021**
II	391	216	607	**0.23196**	**1.6445**
III	573	315	888	**0.22013**	**1.6898**
Total (N)	**2,026**	**1,188**	**3,214**		

D = Simpson's Index, H = Shannon Index

DISCUSSION

This current study on the biodiversity of freshwater fishes of Tiga reservoir revealed the presence of seventeen (17) species belonging to ten (10) families and six (06) orders being distributed across the three Sites (Site I, II and III) of the Study Area. The predominant species by family is the Cichlidae which made up 31.36% of the total catch and it comprises of four (4) species (*Coptodon zilli, Oreochromis niloticus, Sarotherodon galileaus* and *Tilapia species*) followed by the family Claroteidae which accounted for 16.24% and comprises of two (2) species (*Auchenoglanis occidentalis* and *Chrysichthyes cf. auratus*) while the least is the family Protopteridae which accounted for 0.03% of the total catch comprising of one (1) species only which is the *Protopterus annectens.* Among the different species encountered, *Coptodon zilli* was found to be the most abundant (16.77 %) while *Protopterus annectens* appeared to be the least species (0.03%). This is similar to the findings of Balogun (2005), Abubakar (2013), Mohammed *et al.,* (2019), Nazeef *et al.,* (2018) and Nazeef *et al.,* (2021) where Cichlids were found to dominate African lakes/reservoirs like Kainji, Bakalori, Tagwai and even Tiga. Mohammed *et al,* (2019) reported that the fact that the family Cichlidae dominated the reservoir could be as a result of their feeding habit as well as their high rate of reproduction. Most species were found during the rainy season and they dominated Site I and some species of fish like *Malapterurus electricus* and *Protopterus annectens* were found only during the rainy season at Site I. They were absent at Site II and III during both rainy and dry season. A high Shannon-weiner index (H) of 4.0021and a low Simpson's index (D) of 0.21903 at Site I revealed that the fish were more diverse at Site I than Site II and III. It should be noted that a higher value of H indicates higher biodiversity and vice-versa while a lower value of D indicates higher biodiversity and vice-versa (Ogbeibu, 2005). A chi-square analysis (13.13) revealed a significant difference in the different families at Site I, II and III ($p<0.05$) likewise chi-square analysis (2.33) also showed a significant difference at the Sites during the rainy and dry season ($p<0.05$).

But the findings of this current study is in contrast with the findings of Abdulkarim *et al.,* (2020) who encountered nine (9) different fish species belonding to seven (7) families in Tiga reservoir where he reported *Oreochromis niloticus* (family Cichlidae) as the most abundant fish specie (49.18%). Lomeli (2011) reported some factors that help in structuring fish distribution in a water body and these include water temperature, salinity, Dissolved Oxygen (D.O), pH, turbidity, tidal state, depth, eel grass habitat e.t.c. among others. This current study can be compared with the findings of other reservoirs like Challawa Gorge reservoir, Dadin kowa reservoir, Kanye dam, Wase reservoir e.t.c. Mohammed *et al.,* (2019) reported seven (7) different fish species belonging to five (5) families at Tagwai reservoir, Minna, Niger State where he found that the most dominant fish by family was the family Cichlidae (22.86±2.86). Nazeef *et al.,* (2021) recorded a total of 28 fish species belonging to fourteen (14) families in Dadin kowa reservoir where the family Cichlidae was the most dominant. *Oreochromis niloticus* was the most abundant fish species while the family Malapteruridae was the least with only 0.88% of the total abundance. Ibim and Igbani (2014) recorded a total of 36 species belonging to 29 families in lower New – Calabar River, Rivers State with diversity highest in the family Cichlidae (11%) and least in Cyprinodontidae (2.8%). Nazeef *et al.,* (2018) recorded a total of ten (10) species representing nine (9) families in Challawa Gorge reservoir where he reported that the family Cichlidae and Mormyridae had the highest representation in terms of species and number of individuals.

CONCLUSION

This study provides an up-to-date information on the current status of Tiga reservoir with respect to the biodiversity and relative abundance of the fish species. Thus the result shows that Tiga reservoir harbours seventeen (17) fish species belonging to Six (6) orders, ten (10) families and seventeen (17) genera. The family Cichlidae was the predominant (31.36%) while the family Protopteridae was the least (0.03%). Shannon weiner index (H) and Simpson index (D) of 4.0021 and 0.21903 at Site I showed that the fish were more diverse at Site I than Site II and III whereby chi-square analysis ($p<0.05$) revealed a significant difference at the three sites (13.13).

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