DIVERSITY AND SPATIO-TEMPORAL DISTRIBUTION OF FISH SPECIES IN TIGA DAM, KANO STATE

[1]ABDULKARIM, M., [2]MAGAJI, I. M., [3]YUSUF, Z. A. AND [1]MAGAJI, N.S.
[1]Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Nigeria
[2]Department of Animal Science, Federal University Gashua, Yobe State, Nigeria
[3]Department of Biological Sciences, Abubakar Tafawa Balewa University Bauchi, Nigeria.
Corresponding Author: isahmuhdmagaji@gmail.com

Abstract
The study determined the composition, diversity, and Spatio-temporal distribution of fish species in Tiga dam, Kano State, Nigeria. Sampling sites were visited at an interval of two weeks during the study period (May 2018 – March 2019). Fish samples were randomly collected from Fishers fishing in headwater, middle water, and tailwater. Relative abundance and biodiversity indices were calculated. Spatio-temporal distribution of fish was evaluated using Kolmogorov-Smirnov statistics of the goodness of fit. Nine fish species representing seven families comprising 4002 individual fish were identified. The family Alestidae and Claridae had two species each while Bagridae, Cichlidae, Mochokidae, Mormyridae, and Osteoglossidae had one species each. Oreochromis niloticus (49.18%) was the most abundant fish species caught in the dam while the least abundant was Heterobranchus bidorsalis (0.30%). Alestes dentex, Bagrus docmak, Clarias gariepinus, Heterobranchus bidorsalis and Heterotis niloticus were evenly distributed while Brycinus nurse, O. niloticus, Synodontis schall, and Mormyrus rume were not evenly distributed. The dam was diverse with 0.64 and 0.32 as Evenness and Simpson's dominance indices respectively. Fishers can fish with relatively lesser efforts and catch more fish at the middle water; however, there is a need to carry out a stock assessment of the fish species in the dam.
Keywords: Biodiversity, Margalef's species richness, Shannon-Wiener index (H)

INTRODUCTION

Rivers support a large proportion of fish species of varying composition. These fish species serve as a source of food and protein to the surrounding communities. Nadama *et al*. (2015) stated that biodiversity has two basic components: the species richness which is a measure of the number of different kinds of organisms in a particular area, and species evenness which compares the similarity of the population size of each of the species present. Maintenance of species richness has become a central issue of conservation biology as habitat degradation continues on a global scale (Yerima *et al.*, 2017).

According to Basavaraja, *et al*. (2014) impact of anthropogenic activities, habitats degradation, exotic species introduction, water diversions, pollution, and global climate change are the main causative agents for the aquatic species rapid decline. Overfishing can affect fish species richness as a result of overharvesting of fish population and the introduction of exotic fish species. Bunn and Arthington (2002) reported that damming and abstraction have a substantial effect on the maintenance of biological diversity in many rivers. Constructions of dam obstruct the migration of fish spawning or feeding ground and thus, contribute to the decline of fish species.

The spatial distribution and abundance of organisms in ecosystems are of crucial importance for understanding ecosystem functioning (Rosenzweig, 1991). Fishers can strategically make informed decisions on where to catch specific fish species with relatively lesser efforts when the distribution and abundance of fish are known (Abdulkarim *et al*., 2015). This results in studies focusing on the determinants of Spatio-temporal variations of fish communities in temperate ecosystems (Kong *et al.*, 2017). There is a paucity of information on fish species diversity of the Tiga dam therefore; there is a need to study the diversity as well as the spatial and temporal distribution of fish species of the dam. This is important because more information will be made available on fish species composition and abundance and also the biological status of fish. This information may be used for the assessment of fish stocks to improve and develop conservation and management strategies of the dam. The goal of this research is to investigate the diversity and Spatio-temporal distribution of fish species in Tiga dam.

MATERIALS AND METHODS

Study Area

The study was conducted in Tiga dam, Kano State. The dam is located within latitude 11º41'39" N and longitude 8º40'97". The average annual rainfall is 600mm. Subsistence and commercial fishing activities are carried out in the dam.

Sampling Techniques

Sampling sites were visited at an interval of two weeks during the study period (May 2018 – March 2019). Fish samples were randomly collected from Fishers using gill net to fish in the specific fishing spots within the water stations classified for the studies, that is, headwater, middle water, and

tailwater. Different fish species caught were collected, counted, and recorded.

Each fisher from whom samples of fish were collected was identified to be fishing in the fishing spots within the categorised stations as either from the tail, middle, or headwater. And as such when collected at the landing sites, samples from specific stations are recorded against specific divisions of the dam.

Identification of Fish Species

The fish species were identified by obtaining their local names and reference was made to the earlier identification keys of Reeds *et al.* (1967) for their scientific names and some fish species were identified using Fish Database (Froese and Pauly, 2017).

Data Analysis

Data collected within the sampling period were tabulated and analyzed according to their families and species using percentage to obtain fish species composition and relative abundance.

Biodiversity Indices

Biodiversity indices were used to evaluate fish species diversity in the dam. Species richness and evenness, diversity, Simpson's dominance index (D) and Simpson's Reciprocal Index (D') were obtained using the following formulae (Ogbeibu, 2005):

Margalef's species richness (d) = … 01

Where S = Total number of species; N = Total number of individuals

Evenness Index (E) = … 02

Where H = Shannon-Wiener index and Hmax=Log S

Shannon-Wiener index (H) = … 03

Where N = Total number of individuals; fi = number of species

Shannon index (H') = … 04

Where pi = proportion of individuals found in the ith species (pi = ni/N, N being total abundance).

Simpson's Dominance Index (D) = … 05

Where ni = number of individuals in the ith species; N = Total number of individuals in the sample

Simpson's Reciprocal Index (D') = … 06

Where D = Simpson'sDominance Index.

Spatio-temporal distribution

Spatial and temporal distributions of the fish species in the following stations: headwater (fishing site A), middle water (fishing site B) and tailwater (fishing site C) in Tiga dam were evaluated using Kolmogorov - Smirnov (KS) statistic of goodness of fit adopted from Ogbeibu (2005). To determine even distribution of fish species in Tiga dam along the fishing stations, the following procedure was followed:

…07

Where: d1 is the Fish species distribution in the fishing stations, fi is the observed cumulative number of fish species, and Fi is the expected cumulative number of fish species in the fishing stations.

. ...08

Where: D is the calculated fish species distribution in the fishing stations, n is the number of fish species obtained in the fishing stations. D calculated was compared with the theoretical KS distribution value.

RESULTS

Table1 show that nine (9) fish species of seven families had been identified in Tiga dam. The family Alestidae and Claridae had two species each while other families were represented by one species each.

Table 1: Fish Species identified in Tiga dam

Family	Species	Common name
Alestidae	*Brycinus nurse*	Nurse tetra
	Alestes dentex	Silver sides
Bagridae	*Bagrus docmak*	Silver cat fish
Claridae	*Clarias gariepinus*	North African Catfish
	Heterobranchus bidorsalis	African catfish
Cichlidae	*Oreochromis niloticus*	Nile tilapia
Mochokidae	*Synodontis schall*	Wahrindi
Mormyridae	*Mormyrus rume*	Elephant fish
Osteoglossidae	*Heterotis niloticus*	African bony tongue

Table 2 showed that *O. niloticus* (49.18%) was the most abundant fish species caught in the dam while the least abundant was *H. bidorsalis* (0.30%). In terms of the Spatio-temporal distribution of fish, the middle water is more abundant comprising 42.30% of the fish caught.

Table 2: Composition, Spatial and Temporal Distribution of Fish Species in Tiga Dam (May, 2018- March, 2019)

Fish species	Abundance (%)	Head water	Middle water	Tail water	D	Significance
B. nurse	519(12.97)	141	229	149	0.068	P <0.05
A. dentex	60(1.50)	23	27	10	0.167	P>0.05
B. docmak	27(0.67)	4	15	8	0.185	P>0.05
C. gariepinus	984(24.59)	294	400	290	0.039	P>0.05
H. bidorsalis	12(0.30)	4	5	3	0.083	P>0.05
O. niloticus	1968(49.18)	560	799	609	0.049	P <0.05
S. schall	156(3.90)	32	83	41	0.128	P <0.05
M. rume	252(6.30)	52	122	78	0.127	P<0.05
H. niloticus	24(0.60)	3	13	8	0.208	P>0.05
Fish Abundance (%)	4002	1113 (27.81)	1693 (42.30)	1196 (29.89)		

Diversity and dominance indices were shown in Table 3 the Shannon, Shannon-Weiner index, Margalef's species richness index, Evennessindex, Simpson's index, and Simpson's reciprocal index were 1.40, 0.61, 0.96, 0.64, 0.32 and 3.08 respectively.

Table 3: Diversity and Dominance indices of Fish Species in Tiga Dam

Parameters	Values
Mergalef's species richness index (d)	0.96
Evenness index (E)	0.64
Shannon-Weiner index (H)	0.61
Shannon index (H')	1.40
Simpson's index (D)	0.32
Simpson's Reciprocal index (D')	3.08

DISCUSSION

Fish diversity studies in water bodies are important for the future sustainability of fisheries resources. Table 1 shows that nine fish species belonging to seven families had been identified in Tiga dam. Abdulkarim *et al.* (2019) reported twelve fish species from River Gwaram, Misau. Also, Abdulkarim *et al.* (2015) reported eight species of fish species belonging to five families in Gubi dam, Ganjuwa. Similarly, Anyawale *et al.* (2013) obtained eight fish species representing six families in Lake Tagwai, Minna. According to Aduroja (2012), twenty fish species belonging to twelve families were caught in Ogun River. These generally indicate that the freshwater fish species of Nigeria were moderately abundant and rich in fish species composition. Table 2 revealed composition, spatial and temporal distribution of fish species in Tiga dam, *O. niloticus* (49.18%) was the most abundant fish species caught in the dam while the least abundant was *H. bidorsalis* (0.30%). This disagrees with the findings of Aduroja (2012) who reported that *B. nurse* was most numerous accounting for 21.9% of the total catch composition in his study of finfish composition of Ogun River while *M. electricus, B. occidentalis, H. odoe* and *P. obscura* were lesser in number. Mustapha (2010) reported that *T. zilli* was the most abundant fish species with 30% population while *H. niloticus* was the least abundant with 0.82% population.

Fish caught at the middle water (42.30%) were greater than those caught at tailwater (29.89%) and headwater (27.81%). This shows that the middle water is more abundant in fish than the head and tailwater; hence, fisher could catch more fish with lesser fishing efforts compared to other stations. Unlike in the distribution of *Synodontis schall* in Asa Lake 28.40% (surface), 35.60% (shore) and 36.0% (bottom) as reported by Araoye (1999), this indicated that the shore and bottom are similar in abundance but are more abundant in fish than the surface station.

Goraw *et al.* (2010) studied the spatial and temporal distribution of commercially important fish species of Lake Tana, Ethiopia from January 2000 to December 2003 and found that there was significant variability among years and sampling sites encompassing both temporal and spatial aspects. However, in this study *A. dentex, B. docmak, C. gariepinus, H. bidorsalis and H. niloticus* were evenly distributed (P>0.05) while *B. nurse, O. niloticus, S. schall, and M. rume* were not evenly distributed (P<0.05), this is similar to the studies of Abdulkarim *et al.* (2015) in Gubi dam where four out of eight species of fish were evenly distributed. Another similar trend this study is corroborating with that of Abdulkarim *et al.* (2015) is that relative abundance of fish is independent of its being evenly distributed or not. For instance, *O. niloticus* is most abundant fish species in Tiga dam but it is not evenly distributed in the dam while *H.*

bidorsalis being the least abundant fish is evenly distributed in the dam, that is the chances of it been caught is equal with relatively similar efforts anywhere in the dam whether in the head, middle or tailwater.

Higher diversity results when many species have equal or near-equal opportunity to co-exist. Simpson's dominance index in this study was low (0.32). The evenness index was 0.64 indicating that the fish species were evenly distributed. The high evenness and low dominance indices in the study indicate high diversity of fish species in Tiga dam, since the higher the evenness the higher the diversity, and the lower the dominance index, the higher the diversity as stated by Ogbeibu and Victor (1989). Shannon index (1.40) and species richness was moderate (0.96).

CONCLUSION

Nine (9) fish species belonging to seven (7) families were encountered in Tiga dam within the period of the study. The dam was diverse with *O. niloticus* (49.18%) as the most abundant fish species caught. The following fish species; *A. dentex, B. docmak, C. gariepinus, H. bidorsalis, and H. niloticus* were evenly distributed (P>0.05) while *B. nurse, O. niloticus, S. schall and M. rume* were not evenly distributed (P <0.05) in the dam. Based on the findings of this research, five fish species can be caught with relatively similar efforts by the fishers in any of the stations but more fish can be caught with lesser efforts at the middle water. However, there is need to carry out stock assessment of the fish species in the dam to evaluate the fishing pressure on the fishes in Tiga dam.

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