

## PRELIMINARY STUDIES ON THE BIODIVERSITY OF FISH SPECIES IN GWARAM AND SHELAN RIVERS IN MISAU, BAUCHI – NIGERIA

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### ABSTRACT

Preliminary studies were carried out in Rivers Gwaram (RG) and Shelan (RS) in Misau Local Government of Bauchi State, Nigeria in order to determine the biodiversity of fish species in the Rivers. Samples of fish species were randomly obtained from catches of artisanal fishers twice a week from October to December, 2016. Relative abundance was calculated using percentages and biodiversity indices were determined. The results showed that 12 fish species representing 7 families which comprised 8706 individuals were identified in RG and 9 fish species belonging to 6 families and 8395 individuals were recorded in RS. The family Alestidae had the highest number of 3 species while the lowest families were Cichlidae, Cyprinidae and Malapteruridae with 1 species each with the species having varying relative abundance. The diversity of fish species in RG ( $H'_G = 1.981$ ) was significantly ( $P < 0.05$ ) higher than that of RS ( $H'_S = 1.911$ ). RG species richness (1.21) was better than that of RS (0.88). The two Rivers were similar in terms of fish species diversity: Sorenson's and Jaccard's indices were 0.86 and 0.75 respectively. Similar research should be carried out in more water bodies in Bauchi state and Nigeria at large.

**Keywords:** Evenness Index, Shannon-Wiener index, Simpson's Dominance Index, *Brycinus nurse*

### INTRODUCTION

According to Adeyemi *et al.*, (2010) majority of Nigerian's population live near Rivers, reservoirs and other water bodies, these invaluable ecological resources serve many human needs by providing a lot of opportunities. Rivers support large proportion of fish species of varying composition, these fish species serve as source of food and protein to the surrounding communities. Prasad (2010) stated that, biodiversity can be measured in terms of genetic diversity and it can be a measure of the variety of different fauna and flora species within a community and their relative abundance. 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. A lot of researches have been done on diversity assessment, abundance and distribution and stock assessment of fish in numerous water bodies but yet to be carried out in Rivers Gwaram and Shelan in Misau Local Government of Bauchi State, Nigeria. Ita (1993) find out that, 268 different fish species in 34 well known Nigerian fresh water. These fresh water bodies constitute about 12% of Nigerian's total surface area of about 98,185,000ha.

The impact of environmental pollution and other human activities on biodiversity cannot be over emphasized (Oguntade *et al.*, 2014). The addition of materials such as metals, organic chemicals and suspended sediments usually found

in industrial and home wastes that are discharged directly into water bodies affect fish species by weakening them, killing them or affecting their ability to carry out essential biological functions (reproducing, feeding, migration and so forth). Nutrients like nitrogen and phosphorus which often originate as run-off from fertilizers applied on agricultural fields, stimulates rapid growth of algae and aquatic plants that are present in low quantity, this will ultimately limits the amount of oxygen and light available to fish fauna and thus, affecting the fish species richness. Overfishing can affect fish species richness through overharvesting of fish population and introduction of exotic fish species. Bunn and Arthington (2002) reported that, damming and abstraction have substantial effect for the maintenance of biological diversity in many Rivers. Contractions of dam obstruct the migration of fish spawning or feeding ground and thus, contribute to the decline of fish species.

There is paucity of information on fish species diversity of River Gwaram and River Shelan in Bauchi State. Therefore, there is a need to study the biodiversity of fish species in these water bodies. 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 assessment of fish stocks to improve and develop conservation and management strategies in the water bodies. According to Leidy and Moyle (1992) fish fauna from different parts of the world are in serious decline and in need of immediate

protection. Odo *et al.* (2009) stated that, the decline of these fisheries has been attributed to a wide range of causes ranging from inadequate management of the fisheries resources to environmental degradation of the water bodies.

The goal of this research is to investigate the fish biodiversity in Rivers Gwaram and Shelan by determining fish species composition, diversity and abundance in the rivers and to determine the similarities of fish species in the Rivers.

### Study Area

The study was conducted in Gwaram and Shelan Rivers, Misau local Government, Bauchi state, Nigeria. River Gwaram is twenty seven (27km) kilometers (11 27'58''N and 10 35'23''E) and River Shelan is eighteen (18km) kilometers (11 12'52''N and 10 22'33''E) away from Misau town. The mean annual rainfall is 800mm while the mean temperature range from 26°C during the harmattan (December – February) to 34°C during the hot months of April and May (Abdullahi, 2012). Subsistence and commercial fishing activities are carried out on the Rivers.

## MATERIALS AND METHODS

### Sampling Techniques

Field visit to the Rivers were conducted twice a week between 7 – 8am (Monday and Saturday) from the months of October to December, 2016. Fish species caught by randomly selected two artisanal fishers fishing in Gwaram and Shelan Rivers using nets and Traps were collected counted and recorded as samples.

### Identification of Fish Species

The fish species were identified by obtaining their local names and reference was made to the earlier identifications keys of Reeds *et al.* (1967) for their scientific names and some fish species were identified with the aid of 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 in order to obtain fish species composition and relative abundance.

### Biodiversity Indices

Biodiversity indices and similarity indices were used to evaluate fish species diversity in the two rivers. Species richness and evenness, diversity, Simpson's dominance index, Simpson index, Sorenson's index (qualitative and quantitative) and Jaccard's index were obtained using the following formulae (Ogbeibu, 2005):

$$\text{Margalef species richness (d)} = \frac{S-1}{\ln N} \quad \dots 01$$

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

$$\text{Evenness Index (E)} = \frac{H}{H_{max}} \quad \dots 02$$

Where H = Shannon-Wiener index and  $H_{max} = \log S$

$$\text{Shannon-Wiener index (H)} = \frac{N \log N - \sum f_i \log f_i}{N} \quad \dots 03$$

Where N = Total number of individuals;  $f_i$  = number of species

$$\text{Shannon Index (H')} = - \sum p_i X \ln p_i \quad \dots 04$$

Where  $p_i$  = proportion of individuals found in the  $i$ th species ( $p_i = n_i/N$ , N being total abundance).

$$\text{Simpson's Dominance Index (D)} = \frac{\sum n_i(n_i-1)}{N(N-1)} \quad \dots 05$$

Where  $n_i$  = number of individuals in the  $i$ th species; N = Total number of individuals in the sample

$$\text{Simpson's Reciprocal Index (D')} = \frac{1}{D} \quad \dots 06$$

Where D = Simpson's Index

$$\text{Sorenson Index (Cs)} = \frac{2j}{a+b} \times 100 \quad \dots 07$$

Where j = number of species common to both sites being compared; a = number of species in site A; b = number of species in site B

$$\text{Sorenson Quantitative Index (C_N)} = \frac{2jN}{(aN+bN)} \quad \dots 08$$

Where aN = Total number of individuals in site A; bN = total number of individuals in site B;  $j_N$  = the sum of the lower of the two abundances recorded for species in both sites

$$\text{Jaccard's Index (Cj)} = \frac{j}{a+b-j} \quad \dots 09$$

Where j = number of species found at both two stations being compared; a = number of species found in station 1; b = number of species found in station 2

The t – test was used to determine the level of significant difference between the diversity of Rivers Gwaram and Shelan using the following formula (Magurran, 1988):

$$t = \frac{H_1 - H_2}{\sqrt{S^2 H_1 + S^2 H_2}} \quad \dots 10$$

Where H = Shannon-Weiner index;  $S^2 H$  = Variance of H and

$$Df = \frac{(S^2H_1+S^2H_2)^2}{\frac{(S^2H_1)^2}{N_1} + \frac{(S^2H_2)^2}{N_2}} \dots 11$$

**RESULTS**

The twelve (12) fish species belonging to seven (7) families that were identified in Rivers Gwaram and Shelan with their English common names were shown in Table 1. Fish species composition and abundance in Gwaram and Shelan Rivers were in Table 2. *B. nurse* (33.44%), *B. baremose* (10.43%) were the more abundant fish species caught in River Gwaram while the less abundant species were *L. senegalensis* (0.98%), *H. bidorsalis* (0.38%) and *M. electricus* (0.60%). In River Shelan, *B. nurse* (30.67%), *B. baremose*

(15.79%) and *C. gariepinus* (12.76%) were the more abundant fish species caught while *S. nigrita* (2.12%) and *M. electricus* (0.56%) were the less abundant fish species in the River.

The biodiversity indices of Gwaram and Shelan Rivers are as shown in Table 3. The diversity of fish species in River Gwaram ( $H'_G = 1.981$ ) is significantly higher ( $P < 0.05$ ) than that of River Shelan ( $H'_s = 1.911$ ). River Gwaram fish species richness (1.21) is better than that of River Shelan (0.88). However, the fish species in River Shelan were more evenly distributed (0.87) than those in River Gwaram (0.79). The two Rivers were similar (Sorenson's index = 0.86 and Jaccard's index = 0.75) in terms of fish species diversity as shown in Table 4.

**Table 1: Fish species identified in Rivers Gwaram and Shelan, Misau - Nigeria**

Family	Species	English common name
	<i>Brycinus nurse</i>	Nurse tetra
Alestidae	<i>Brycinus baremose</i>	Silver sides
	<i>Brycinus imberi</i>	Spot tail
Claridae	<i>Clarias gariepinus</i>	North African Catfish
	<i>Heterobranchus bidorsalis</i>	African Catfish
Cichlidae	<i>Oreochromis niloticus</i>	Nile tilapia
Cyprinidae	<i>Labeo senegalensis</i>	African Carp
Malapteruridae	<i>Malapterurus electricus</i>	Electric Catfish
Mochokidae	<i>Synodontis shall</i>	Wahrindi
	<i>Synodontis nigrita</i>	Catfish
Mormyridae	<i>Petrocephalus bane ansorgei</i>	Elephant fish
	<i>Hyperospisus bebe occidentalis</i>	Elephant fish

**Table 2: Fish species composition and abundance in Rivers Gwaram and Shelan**

Species	River Gwaram		River Shelan	
	No. of sample fish caught	Percentage (%) composition	No. of sample fish caught	Percentage (%) composition
<i>B. nurse</i>	2911	33.44	2575	30.67
<i>C. gariepinus</i>	908	10.43	1070	12.75
<i>B. baremose</i>	1109	12.74	1324	15.76
<i>B. imberi</i>	776	8.91	495	5.90
<i>O. niloticus</i>	751	8.63	988	11.77
<i>S. shall</i>	325	3.73	678	8.08
<i>S. nigrita</i>	270	3.10	178	2.12
<i>P. bane ansorgei</i>	1313	15.08	1040	12.39
<i>H. bebe</i>	173	1.93	0	0
<i>occidentalis</i>				
<i>L. senegalensis</i>	85	0.98	0	0
<i>H. bidorsalis</i>	33	0.38	0	0
<i>M. electricus</i>	52	0.60	47	0.56
Total	8706	100	8395	100

**Table 3: Biodiversity and Dominance indices of Rivers Gwaram and Shelan**

Parameters	River Gwaram	River Shelan
Species richness index (d)	1.21	0.88
Evenness index (E)	0.79	0.87
Shannon-Weiner index (H)	0.86	0.82
Shannon index (H')	1.98	1.91
Simpson's index (D)	0.179	0.174
Simpson's Reciprocal index (D')	5.587	5.747

**Table 4: Similarity indices of River Gwaram and Shelan (October – December, 2016)**

Parameters	Values
Sorenson's Index (C <sub>s</sub> ) Qualitative	86%
Sorenson's Index (C <sub>N</sub> ) Quantitative	0.86
Jaccard's Index (C <sub>j</sub> )	0.75

## DISCUSSION

The fish diversity in River Gwaram as in Table 1 is similar to the 12 species of fish reported for Gbedikere Lake by Adeyemi *et al.* (2010). The species diversity of River Shelan is similar to the eight species reported for Gubi dam, Bauchi state by Abdulkarim *et al.* (2005). However, Fish species diversities of the two rivers were higher than six fish species belonging to four (4) families identified by Nadama *et al.* (2015) from the commercial catches in Waya dam but relatively low compared to that of species diversity of Asa dam in Ilorin which had a richer diversity of 21 species and 15 species identified in Dadin Kowa dam, Gombe state as reported by Nazeef and Abubakar (2013). The varying diversities of the fish species in these water bodies may probably due to age of the water bodies; natural succession pattern and colonization of the fish species or fishing pressure due to human exploitation of the fish as renewable resources. However, further studies may reveal these contributing factors and others with more certainty.

Twelve (12) fish species representing 7 families were identified in River Gwaram and 9 fish species had been identified in River Shelan (Table 2). Anyawa *et al.* (2013) obtained 8 fish species representing 6 families in Lake Tagwai, Minna. According to Aduroja (2012), 20 fish species belonging to 12 families were caught in Ogun River. These generally indicate that the freshwater fish species of this part of Nigeria were relatively abundant. The family Alestidae had the highest fish species; *B. nurse*, *B. baremose* and *B. imberi* this was followed by Claridae; *C. garipepinus* and *H. bidorsalis*, Mochokidae; *S. shall* and *S. nigrita* and Mormyridae; *P. bane ansorgie* and *H. bebe occidentalis*. Family with the least fish species were Cichlidae; *O. niloticus*, Cyprinidae; *L. senegalensis* and Malapteruridae; *M. electricus* in the Rivers, Nigeria. These findings corroborate that of Aduroja

(2012) who reported that *B. nurse* was most numerous accounting for 21.9% of the total catch composition in his study of Fin fish composition of Ogun River, while *M. electricus*, *B. occidentalis*, *H. odoe* and *P. obscura* were lesser in number.

Yem *et al.* (2011) observed that fish species diversity was highest in Oguta (0.5) than in Lake Opi (0.1) but even the highest species diversity reported was lower than the lowest one reported in this studies (Table 3). Ibim and Igbani (2014) stated that, the variation of diversity and abundance of fish species was mostly due to differences in physicochemical parameters and fishing pressure. However, the results of the dominance indices in Gwaram (D = 0.179) and Shelan (D = 0.174) Rivers indicated that both Rivers had high diversity. Simpson index (D') was higher for both Rivers: Gwaram (5.587) and Shelan (5.747) indicating greater diversity as Magurran (1988) stated that index D' increases with increasing diversity.

The fish species similarity indices in Table 4 for the two Rivers were similar. This is evident from the samples collected in the sense that all the nine species in River Shelan were found in River Gwaram in addition to three species found in the latter.

## CONCLUSION

A total of 8706 represented by seven (7) families and twelve (12) fish species were recorded in River Gwaram while a total of 8395 individuals, six (6) families and nine (9) fish species were recorded in River Shelan. River Gwaram was more diverse than River Shelan. However, both rivers were similar in terms of fish species diversity. Base on the findings of this research, it is recommended that there is need to carry out stock assessment of the fish species in the Rivers in order to evaluate the fishing pressure on the fishes and to further study the physicochemical parameters of the rivers. Also,

similar research should be carried out in more water bodies in the state and Nigeria at large.

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