



**ANALYSIS OF FISH SPECIES BIODIVERSITY AND ABUNDANCE OF  
GANGAM DAM, GWARAM, JIGAWA STATE, NIGERIA**

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**ABSTRACT**

The fish diversity and abundance of Gangama dam were studied for the period of twelve months from July 2018 to June 2019. The study investigated 16 species of fish belonging to 10 families which showed that Cichlidae was the most abundant and dominant family with ( 5605; 76.07%) consisting of four species of Hemichromis bimaculatus (1942; 26.36%, a dominant), Oreochromis aureus (1813; 24.61%), Sarotherodon melanocheilus (1073; 14.57%) and Sarotherodon galilaeus (776; 10.53%) while monthly abundance revealed Oreochromis aureus (793; 43.74%) in January 2019, The family Arapaimidae was the least abundant represented by only one (1) specie (Heterotis niloticus (4; 0.05%). Using Shannon-Weiner index of general diversity (H), monthly species diversity between months were 0.78; 0.74; 0.79; 0.82; 0.87; 0.60; 0.706; 0.42; 0.52; 0.67; 0.68; 0.66. Relative abundance (RA) calculated had a total number of 7366 fish and Simpson's index of dominance (D) showed that Gangama dam was shared by all species since the result was 0.1 and monthly index of dominance range were 0.17; 0.21; 0.21; 0.16; 0.15; 0.26; 0.27; 0.44; 0.64; 0.24; 0.22 and 0.20. The research recommended that frequent restocking measure and avoidance of over fishing should be considered to prevent species extinction

**Keywords:** Analysis, Biodiversity, Species, Abundance, Fish.

**INTRODUCTION**

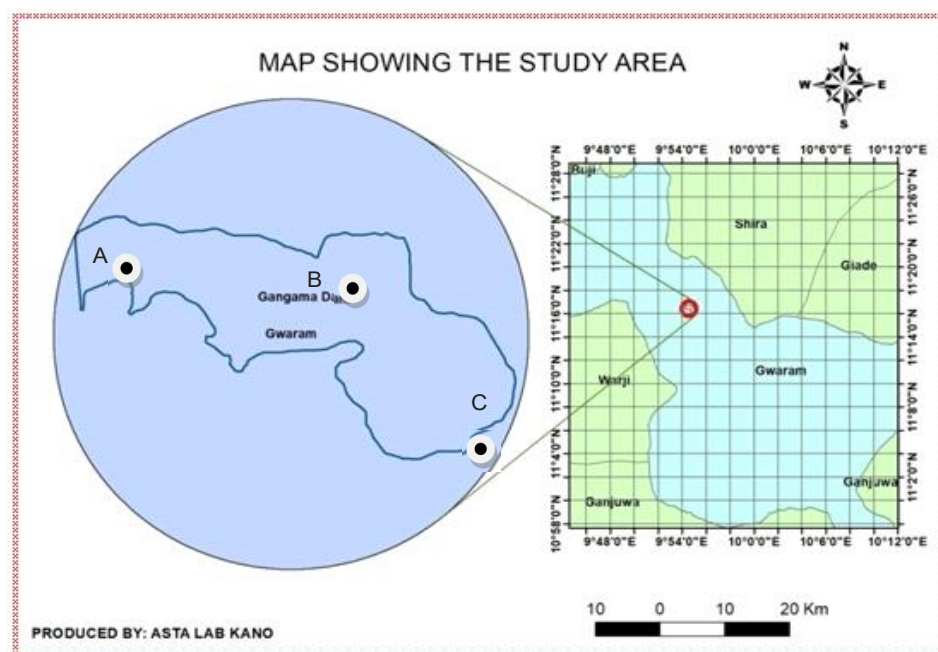
West African inshore water is rich in fish resources in quantities that can support commercial exploitation on a sustainable basis. However, later development in fisheries studies has pointed the depletion of the fish stock due to over exploitation, deterioration of water qualities among others. Among organisms, fishes are the best known species of aquatic organisms and consider as food source harvested from natural populations. Fish diversity comprises of species richness i.e. number of species in a given defined area. Fish abundance means relatively number of species in a defined area. Today the fish diversity and associated habitat management is the great challenge and the ability to evaluate the effect of habitat change and other impacts of the population required extensive surveying of the fish population before and after change occur. In the recent years, several broad scale studies have identified modification and loss of aquatic habitat as primary factor threatening the conservation of freshwater fishes and communities (Hewitt, *et al.*, 2008). Fish abundance is a measure of the number or amount of a fish in a given area. Scientist usually collect both count and size data. Abundance is then presented in terms of Biomass (total weight of fish per unit area). The fish diversity community structure and species assemblages in the streams and rivers are interdependent on many abiotic and biotic factors. These factors determine the success and failure of fish species assemblages in rivers or streams within the range of spatial distribution limit. Parameters such as species composition, species richness, abundance have been used in many studies for describe and assess fish community and diversity (Hewitt, *et al.*, 2008). Zainudin (2005) who claimed that fish species diversity can be used as a biological indicator or show the level of aquatic population contributing to environmental quality. Gangama dam serve much purposes, such as irrigation, fishing

as well as a source of drinking water for Gwaram and villages around as well as migrant fishermen use this water body as their sources of food and income for serving families. There was a report of rapid declining of fish population species diversity and abundance in this dam resulting from over fishing over fishing, daily increases of fishermen, over dependent on the dam, poor fishing practices, washing of chemical spraying equipments by farmers affects the water quality and fish. Against these problems the research designed to study and finds out the fish species biodiversity and abundance of Gangama Dam. The result of this research provide basic information how per the mentioned problems impact the fish species biodiversity and abundance, will be helpful for fishers, government and interested bodies for possible ecosystem management also will serves as body of knowledge for future researchers.

## **MATERIALS AND METHODS**

### **The Study Area**

Gangama dam is in Jigawa state Nigeria and was constructed between 1971 and 1974 by the Kano state government to supply water to Gwaram and villages around with attempt to improve food security through irrigation projects and fishing. The dam has a total surface area of 3km and is located at Gwaram about 480m opposite Gwaram local government secretariat, which lies on Latitude  $11^{\circ} 14' 38.17$  N and Longitude  $9^{\circ} 54' 1.86$  E. Rainfall is the main source of the water, with an outlet from the west embankment across Malaji road.



**Figure 1:** Map showing Gangama Dam and sampling stations A, B and C.

### **Sampling Stations**

After preliminary survey, three sampling stations were established and marked at intervals based on water level, distance of the dam, fishing and public activities. Station A at the western end of the dam on Malaji road, station B about 1km away from station A likewise station C to Sabon Garin Gadala landing site.

### **Fish Sampling and Identification**

The fish biodiversity and abundance of Gangama dam was assessed using catches collected from the fishermen, on every sampling day, fish species landed were identified, grouped based on families and species and finally counted to find out the abundance. However, families and species identification was used by a Field guide to Nigeria freshwater fisheries by Olaosebikan and Raji



(2013) and also achieved based on color pattern, specific sports and marks on their body surface, shapes, structures of their fins and with the experiences of local fisher men.

### **Estimation of Fish Species Abundance and Biodiversity**

#### **Shannon Weiner Index of Diversity (H)**

This equation shows the greatest species diversity of sampling site. The higher the value the greater the diversity.

$$H = \sum (n_i/N) \log (n_i/N)$$

Where:

H= Shannon-Weiner index of general diversity

$n_i$ = Total number of individuals of a particular species

N= Total number of individuals of all species

Shannon and Weiner (1963).

#### **Relative Abundance (RA)**

This equation for the relative abundance, tell us what proportion of the total abundance is constituted by each species.

$$RA = SA/TA \times 100\%$$

Where:

RA= Relative abundance of each species (%)

SA= Species abundance

TA= Total abundance for all species

#### **Simpson's Index of Dominance (D)**

The index of dominance is useful in determining whether or not a particular fish species dominate the water. The value for the index of dominance, fall between 0.0 and 1.0. Water with index close to 1.0 is said to be dominated by a few species. When values are low it means dominance is shared by all species and calculated using the below formula.

Where:

D= Simpson's index of dominance (D)

$n_i$ = Total number of individual of each species in the sample

N= Total number of individuals of all species in the sample

Simpson (1949)

## **RESULTS AND DISCUSSION**

### **Fish Species Biodiversity and Abundance**

The summary of fish biodiversity of Gangama dam recorded throughout the period of the study of twelve months from July 2018 to June 2019 discovered sixteen species belong to ten families. Table 1 showed the all fish families and species encountered and their common names. The result of monthly species diversity indices represented on graph in figure 2. The monthly trend of Shannon-Wiener index for Gangama dam can be depicted as November(0.87)>October(0.82)>September(0.79)>July>(0.78)>August(0.74)>January(0.70)>may(0.68)>June(0.66)>December(0.60)>March(0.52)>February(0.42)>April(0.6)). The maximum value of species diversity is 0.87 which was recorded in November whereas the minimum is 0.6 which recorded in April. Likewise, between stations as station 2(0.84)> station 3 (0.78)> station 1(0.73).

The numbers and percentages of families and species abundance as show in Table 2 revealed that the family of Cichlidae is the most abundant and dominated other families with relative number 5604 (76.07) with four species of Hemichromis bimaculatus was the most abundant specie with 1942 (26.36%) followed by Oreochromis aureus with 1813 (24.61%), Sarotherodon melonotheron 1073 (14.57%) and Sarotherodon galilaeus 776 (10.53%). Clariidae family with 1180 (16.01%) other dominated families includes Clariidae family with 1180 (16.01%) with three species of Clarias gariepinus 367 (4.98%), Clarias anguillaris 499 (6.77%) and 314 (4.26%), Schilbeidae family 187 (2.54%) with two species of Siluranodon auritus 95 (1.29%) and Schilbeuranoscopus 92 (1.25%), Protopteridae: Protopterus annectens 7 (0.09), Malapteruridae: Malapterurus minjirya 9 (0.12%), Cyprinidae: Barbus stigmatopygus 331(4.49%), Clarotidae: Claroteslaticeps 12 (0.16%), Alestidae:



*Micraletes humilis* 26 (0.35%), Mochokidae: *Synodontis violacea* 6 (0.08%) and Arapaimid: *Heterotis niloticus* 4 (0.05%) as the most least abundant family.

However, in terms of monthly abundance, Table 3 showed that *Oreochromis aureus* was the most abundant in January with 793 also *Sarotherodon melanotheron* in April with 464 and *Hemichromis bimaculatus* in February 168, March 69 May 169, June 118 and August 212, September 116, October 142 November 134 and December 178 and *Clarias gariepinus* in July 2018 with 99 Nevertheless, *Malapterurus minjirya*, *Protopterus annectens*, *Synodontis violacea* and *Heterotis niloticus* were the least abundance in every month observed. Thus, Figure 15 shows the rank of abundance on bar graph in which long bar depicts species being more abundance in the community. The Y axis indicated level of abundance while X axis indicated monthly species recorded. Figure 16 showed the result of monthly Simpson's index of dominance of Gangama dam which revealed that Gangama dam dominated by all species.

**Table 1: Fish Families and Species Encountered in Gangama Dam July 2018 to June 2019**

| s/n | Family         | Species                          | Common Name                    |
|-----|----------------|----------------------------------|--------------------------------|
| 1   | Cichlidae      | <i>Hemichromis bimaculatus</i>   | Jewel fish                     |
| 2   |                | <i>Oreochromis aureus</i>        | Blue tilapia                   |
| 3   |                | <i>Sarotherodon melanotheron</i> | Black chin tilapia             |
| 4   |                | <i>Sarotherodon galilaeus</i>    | Mango tilapia                  |
| 5   | Clariidae      | <i>Clarias gariepinus</i>        | North African catfish          |
| 6   |                | <i>Clarias anguillaris</i>       | Mud fish                       |
| 7   |                | <i>Sarotherodon melanotheron</i> | Mud fish                       |
| 8   | Schilbeidae    | <i>Siluranodon auritus</i>       | Stripped African glass Catfish |
| 9   |                | <i>Schilbe uranoscopus</i>       | Butter cat fish                |
| 10  | Protopteridea  | <i>Protopterus annectens</i>     | West African long fish         |
| 11  | Cypinidae      | <i>Barbus stigmatopygus</i>      | Barbs                          |
| 12  | Malapteruridae | <i>Malapterurus minjirya</i>     | Electric cat fish              |
| 13  | Clarotidae     | <i>Clarotes laticeps</i>         | Wide head cat fish             |
| 14  | Alestidae      | <i>Micraletes humilis</i>        | Turkana robber                 |
| 15  | Arapaimidae    | <i>Heterotis niloticus</i>       | African bony tongue            |
| 16  | Mochokidae     | <i>Synodontis violacea</i>       | Squeaker                       |



**Table 2:** Families and Species Abundance of Gangama Dam July 2018 to June 2019

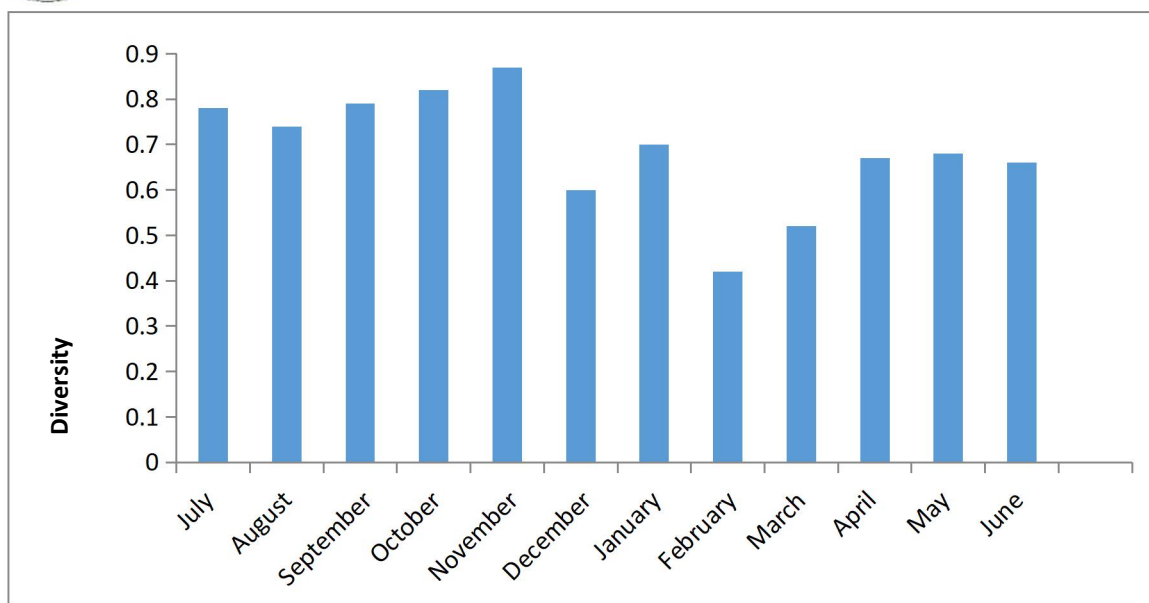
| S/n | Family         | Species                         | Individual No. | Percentage % |
|-----|----------------|---------------------------------|----------------|--------------|
| 1   | Cichilidae     | <i>Hemichromis bimaculatus</i>  | 1942           | 26.36%       |
| 2   |                | <i>Oreochromis aureus</i>       | 1813           | 24.61%       |
| 3   |                | <i>Sarotherodon melanothron</i> | 1073           | 14.57%       |
| 4   |                | <i>Sarotherodon galilaeus</i>   | 776            | 10.53%       |
|     | Total          |                                 | 5604           | 76.07%       |
| 5   | Clariidae      | <i>Clarias gariepinus</i>       | 367            | 4.98%        |
| 6   |                | <i>Clarias anguillaris</i>      | 499            | 6.77%        |
| 7   |                | <i>Sarotherodon melanothron</i> | 314            | 6.26%        |
|     | Total          |                                 | 1180           | 16.01%       |
| 8   | Schilbeidae    | <i>Siluranodon auritus</i>      | 95             | 1.29%        |
| 9   |                | <i>Schilbe uranoscopus</i>      | 92             | 1.25%        |
|     | Total          |                                 | 187            | 2.54%        |
| 10  | Protopteridea  | <i>Protopterus annectens</i>    | 7              |              |
|     |                |                                 | 7              | 0.09%        |
| 11  | Cypinidae      | <i>Barbus stigmatopygus</i>     | 9              |              |
|     |                |                                 | 9              | 0.12%        |
| 12  | Malapteruridae | <i>Malapterurus minjirya</i>    | 331            |              |
|     |                |                                 | 331            | 0.49%        |
| 13  | Clarotidae     | <i>Clarotes laticeps</i>        | 12             |              |
|     |                |                                 | 12             | 0.16%        |
| 14  | Alestidae      | <i>Micraletes humilis</i>       | 26             |              |
|     |                |                                 | 26             | 0.35%        |
| 15  | Arapaimidae    | <i>Heterotis niloticus</i>      | 6              |              |
|     |                |                                 | 6              | 0.08%        |
| 16  | Mochokidae     | <i>Synodontis violacea</i>      | 4              |              |
|     |                |                                 | 4              | 0.05%        |
|     | Total          |                                 | 7366           | 100%         |



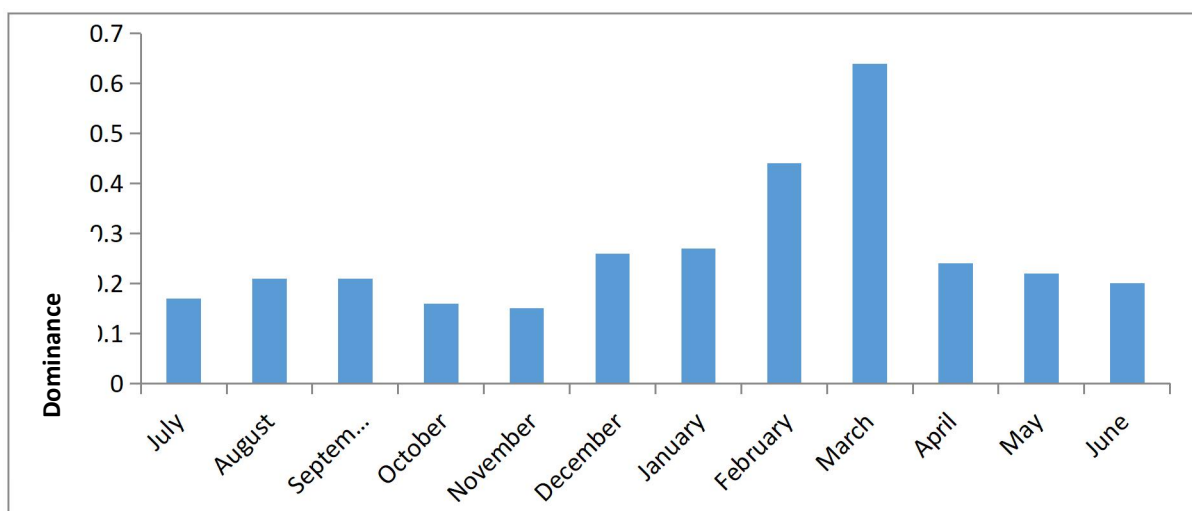


**Table 3:** Monthly fish Species Abundance of Gangama Dam July 2018 to June 2019

| S / N     | Fish species                      | July | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Total |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------|-----------------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1         | . <i>Hemichromis bimaculatus</i>  | 9    | 1   | 2   | 1   | 2   | 1   | 6   | 1   | 4   | 2   | 1   | 6   | 9     | 1 | 1 | 8 | 1 | 9 | 4 | 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2         | . <i>Oreochromis aureus</i>       | 5    | 7   | 9   | 6   | 1   | 1   | 0   | 8   | 8   | 1   | 0   | 0   | 9     | 5 | 7 | 9 | 3 | 9 | 8 | - | 2 | 0 | 5 | 1 | 1 | 8 | 5 | 3 | 1 | 8 | 1 | 3 |   |   |   |   |   |   |   |   |   |
| 3         | . <i>Sarotherodonmelanotheron</i> | 1    | 2   | 6   | 8   | 5   | 5   | 7   | 8   | 1   | 1   | 9   | 1   | 1     | 1 | 4 | 7 | 6 | - | - | - | 4 | 6 | 4 | 7 | 1 | 4 | 2 | 1 | 0 | 7 | 3 |   |   |   |   |   |   |   |   |   |   |
| 4         | . <i>Sarotherodon galilaeus</i>   | 9    | 9   | 9   | 8   | 3   | 8   | 5   | 4   | 1   | 6   | 8   | 0   | 3     | 0 | 2 | 1 | 0 | 1 | 7 | 9 | 1 | 2 | 3 | 4 | 7 | 7 | 7 | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5         | . <i>Clariasgariepinus</i>        | 9    | 9   | 3   | 2   | 1   | 8   | 5   | 3   | 2   | 4   | -   | 1   | 2     | 4 | 1 | 5 | 4 | - | - | - | - | - | - | 7 | 3 | 6 | 7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 6         | . <i>Clarias anguillaris</i>      | 9    | 5   | 4   | 9   | 2   | 8   | 1   | 6   | 6   | -   | -   | 2   | 4     | 4 | 1 | 6 | 2 | 8 | - | 2 | - | - | 3 | 3 | 4 | 4 | 9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 7         | . <i>Clariasalbopunctatus</i>     | 2    | 6   | 1   | -   | 4   | -   | 2   | 0   | -   | -   | -   | 2   | 6     | 2 | - | - | - | 1 | - | - | - | - | - | - | 3 | 1 | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 8         | . <i>Siluranodon auritius</i>     | -    | -   | -   | -   | 2   | 9   | 2   | 3   | -   | 4   | 3   | -   | -     | - | - | - | - | - | - | - | - | - | - | - | 9 | 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 9         | . <i>Schilbe uranoscopus</i>      | -    | -   | -   | -   | 1   | 8   | 3   | -   | 2   | -   | -   | -   | -     | - | - | - | - | - | - | 8 | - | - | - | 9 | 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 10        | . <i>Protopterus annectans</i>    | 2    | -   | 2   | -   | 2   | -   | -   | -   | -   | -   | -   | -   | -     | - | - | - | - | 1 | - | - | - | - | - | - | 7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 11        | , <i>Malapterurus minjirya</i>    | 1    | -   | 1   | -   | 1   | -   | 5   | -   | -   | -   | -   | -   | -     | - | - | - | - | - | - | - | - | - | - | - | 9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 12        | . <i>Barbus stigmatipygus</i>     | -    | -   | -   | 1   | 6   | 3   | 1   | 3   | 0   | 5   | 0   | 5   | 1     | 7 | 1 | - | - | 1 | 1 | 0 | 4 | 3 | 2 | 8 | 3 | 3 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 13        | . <i>Clarotes laticeps</i>        | -    | -   | -   | 3   | -   | -   | 9   | -   | -   | -   | -   | -   | -     | - | - | - | - | - | - | - | - | - | - | - | 1 | 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 14        | . <i>Micraletes humilis</i>       | -    | -   | -   | 1   | 5   | 1   | 1   | -   | -   | -   | -   | -   | -     | - | - | - | - | - | - | - | - | - | - | - | 2 | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 15        | . <i>Synodontis violacea</i>      | -    | -   | -   | -   | -   | -   | 5   | -   | -   | -   | -   | -   | -     | 1 | - | - | - | - | - | - | - | - | - | - | 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 16        | . <i>Heterotis niloticus</i>      | -    | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | -     | - | - | - | - | 2 | - | 1 | - | 1 | - | 4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| T o T a l |                                   | 4    | 8   | 1   | 5   | 7   | 5   | 4   | 7   | 1   | 5   | 0   | 3   | 5     | 2 | 9 | 4 | 9 | 0 | 1 | 7 | 2 | 0 | 2 | 9 | 2 | 8 | 7 | 1 | 3 | 1 | 1 | 3 | 5 | 3 | 3 | 2 | 9 | 7 | 3 | 6 | 6 |



**Figure 2:** Monthly Fish Species Index of Diversity of Gangama Dam July 2018 to June 2019



**Figure 3:** Monthly Fish Species Index of Dominance of Gangama Dam July 2018 to June 2019

In terms of fish families and species diversity Gangama dam is said to be low compared with the study of Kumar, *et al.*, (2013) who recorded twenty three species and nine families from Mahandi peninsular region of India; thirteen families and twenty six species were identified by Solomon, *et al.*, (2012). Undoidoing (1991) reported seventeen species representing ten families in Odum stream; nineteen species representing twelve families in mission stream, Onuoha, *et al.*, (2010) recorded twenty six species belonging to seven families during the study of NtakInyang stream, Sokoki *et al.*, (2008) recorded seventeen species of eleven families in Onu-Iyi-Ukwu stream.

In terms of similarities, however, fish families and species diversity of Gangama dam is similar with species or families of some water bodies. Example, species diversity of Alau dam carried out by Jaafaru, *et al.*, (2015). Ataguba, *et al.*, (2014) in study of species and abundance of Gubi dam shows low families with six and high species with eighteen, similarly, Kumari and Sivakami (2017) reported same species diversity from Temple pond of Tituchirappalli district, Tamil Nadu, India with the present research of fish diversity and abundance of Gangama dam, Jigawa state Nigeria. Likewise, Omotosho (1998) in study of fish diversity and abundance of Asam dam in Ilorin reported the same



families with high species of twenty-one also Adeyemi (2010) revealed twelve species and similar families of ten in Gbedikere reservoir.

In terms of species abundance in this study Cichlidae (tilapia) is the most abundance family that constituted the large population of fish species in the area by total number which covered 76.07% of the total fish observed (caught) throughout the period of the study from July 2018 to June 2019. This comprised predominantly with four species i.e. *Hemichromis bimaculatus*, *Oreochromis aureus*, *Sarotherodon melanotheron*, *Sarotherodon galilaeus* the second in abundance is the family of Clariidae with three species of *Clarias gariepinus*, *Clarias anguillaris* and *Clarias albofuntatus* other families includes Schilbeidae with two species of *Schilbe uranoscopus* and *Siluranodon auritus* other families each with only one specie includes Cyprinidae( *Barbus stigmatopygus*), the families of Protopteridae (Protopterus annectens), Malapteruridae (Malapterurus minjirya), Clarotidae(Clartotis laticeps), Alestidae (Micraletes humilis), Mochokidae (Synodontis violaceae) and Arapaimidae (Heterotis niloticus) as the least in abundance. However, the high catches was recorded in the month of January which revealed *Oreochromis aureus* as most abundant specie and *Schilbe uranoscopus* as the most least in abundance. The absent of other species, could be attributed with intensive pressure of catches making it difficult for the species to be in abundance. This is similar with different research works like Ataguba, et al., (2014) which recorded Cichlidae as most abundance family in Gubi dam. Cichlidae (tilapia) dominate the population of Gangama dam that constituted 76.12% over the period of the study. This is due to the fact that when the management of the dam experienced serious declined of population through low catches the dam restocked i.e. seed introduced to prevent being extinction in 2017, Cichlidae and very few Clariidae and other families applied. According to Ataguba, et al., (2014) this may be due to fact that in fisheries resources, aggressive and competitively dominated fish are often first to be overfished and are often in the habit of preventing subordinates from taking baits as observed by McClanahan, et al., (2010). The dominance of tilapia also may be due to its prolific reproductive nature which allow it to populate the water in a short period of time especially where there is availability of food, adequate temperature required good breeding ground and where the population of carnivores are low or absent. So far Gangama dam gives an indication of being a tilapia community. Bankole, et al., (1994) explained that Cichlidae are found to breed about four times in the year. There is report of dominance Cichlidae family in Tiga dam and similar report by Bologun, et al., (2000) in Zaria reservoir; Kingim dam Bologun and Auta (2011) and Ero reservoir Kester, et al., (2007). Jaafaru et al., (2015) reported that tilapia is the dominant in Alau dam all in line with the present study Cichlidae dominated Kubanni reservoir, Zaria among nine species comprising four families reported by Annune and Bako (1998). Mshelia (2015) reported that Cichlidae dominated the catches in Alau am during the study period. Abubakar and Yakasai (2013) also reported that Cichlidae is the dominant fish family in Nguru wet land.

## CONCLUSION AND RECOMMENDATION

During the period of the study sixteen fish species belonging to ten families were recorded and Cichlidae is the most divers, abundance and dominant family with four species of *Hemichromis bimaculatus*, *Oreochromis aureus*, *Sarotherodon melanotheron*, *Sarotherodon galilaeus* while *Heterotis niloticus* was most least abundant dominated by all other species found during the study. Finally, there is the need for proper management strategies to be put in place to ensure sustainability of the Dam for better and healthier fish output, Fishers and farmers should be fully educated on the effect of obnoxious fishing methods.

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