THE WATER QUALITY AND FISH PRODUCTIVITY OF GOMBE ABBA RIVER

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ABSTRACT

Water quality determine the productivity of the river in terms of fish species. At the moment, the fish diversity and its habitats management are great challenge due to difficulties in evaluating the effects of the habitat change. Fish population requires extensive surveying before and after any changes. This study aimed at basically determining the water quality and diversity of fish species in Gombe Abba river. The river was divided into four sites according to its size and characterized the water by determining the physicochemical parameters including pH, temperature, turbidity, dissolved oxygen (DO), electric conductivity and phosphate concentration. Fish species compositions of the four sites were studied over a period of four (4) months (June to September). The mean values of most of the physicochemical parameters were found to be within the acceptable range, while less phosphate concentration was discovered. Seven (7) species of fish belonging to five (5) families were discovered with *Hydrocynus brevis* being the most dominant species. The condition factor of the fish species identified showed a result of lower and higher condition. Four species had their K values greater than 2.0 (*Hydrocynus brevis, Clarias gariepirzus, Labeo senegalensis* and *Hydrocynus vittatus*), whereas, the remaining three had their condition factor greater than 1.0 (*Hydrocynus forskahlii, Oreochromis nilolicus* and *Momyrus senegalensis*). The calculated H value (Shannon wieners species richness) and J value (Pielou"s Index for species evenness) of the present study area were 1.862 and 0.309 respectively. The J value indicates that the fish species of Gombe Abba River is not evenly distributed. The calculated 'Ma' 6.06 (Margalef's diversity index) for comparison of the sites showed variation depending upon the number of species.

Keywords: Gombe Abba river; Fish Diversity; Physicochemical Parameters

INTRODUCTION

Due to increase in human population, industrialization, use of fertilizers in the agriculture and other anthropogenic activities, many rivers are highly polluted with different contaminants. As well, it is difficult to understand the biological phenomenon because the chemistry of the water reveals much about the metabolism of the ecosystem and explain the general hydro biological relationship (Ackah *et al.*, 2012). Therefore, it is necessary that aquatic lives from such water bodies are well checked at regular time interval to avoid coming in contact with water borne diseases that led to the death of millions of people across the globe (Adefemi and Awokunmi, 2010).

Apart, knowledge of physicochemical regime of water is of great value in the determination of its productivity, usefulness and other characteristics. Such parameters can affect the water quality if their value is in higher or lower concentrations than acceptable parameters set by the world recognized agencies (Jia *et al.*, 2010). Among the aquatic organisms, fishes are the best-known species which remain the the food source harvested from natural populations. Fishes exist at or near the top of the food chain and can serve as an indicator of a balanced in aquatic ecosystem. Nowadays, fish diversity and its associated habitats management is a great challenge (Bhatnagar and Devi 3013). The ability to evaluate the effects of habitat change and other impacts on the fish

population required extensive surveying of the fish population before and after the change occur (Dudgeon *et al.*, 2006).

Condition factor is an index reflecting interactions between biotic and abiotic factors in the physiological conditions of fish. This remain an important factor toward understanding the life cycle, as well, contribute to adequate management of the fish species in their natural ecosystem. Certainly, fish diversity comprises of species richness, species abundance and phylogenic diversity. Interestingly, Nigeria is blessed with such natural water bodies with abundant fish resources (Lawson, 2010). The present study explored the diversity of the fish species in Gombe Abba river using the scale of Shannon Weiner index (H), Pielou Evenness Inde); (J) and Margalef Diversity Index (Ma). Shannon Diversity Index. (H). This was due to little research with respect to the river and also to provide information on the river quality and fisheries potentials.

MATERIALS AND METHODS

Study Sites and Water Sample Collection

Gombe Abba River is located in the West of Dukku Local Government Area of Gombe State Nigeria. The river water is used for irrigation and domestic activities. The water samples were collected for analyses from the four sampling stations within the period of four (4) months. The sites (A, B, C and D) were selected for sampling in consideration of the activities taking place including irrigation, cattle raring and other anthropogenic activities.

Temperature, PH, conductivity, Dissolved oxygen Transparency and Salinity were measured insitu using thermometer, PH meter, conductivity meter, dissolved oxygen meter and Secchi disc respectively using standard method as described in APHA (2005). The result of physicochemical parameters was subjected to chi-square test for the analysis.

Determination of Physicochemical Parameters

Physicochemical parameters water from the Gombe Abba river were determined using standard methods as earlier described by Agbaire P.O. and Oyibo P.1 (2009) and APHA (2005). Temperature and pH were measured (in-situ) at the site using their respective meters. Turbidity was determine using turbidity meter by dipping the secchi disc into the water until it disappears, then rise it slowly until it reappears for about three times prior to taking the average record. DO was determined using portable meter, while, conductivity using HANA model H19835 meter. Phosphate was determined in the laboratory by setting five (5) test tubes for each site sample and control labelled A, B, C, D and ctrl. A 5ml of samples were poured in to the tubes, lml of Ammonium Molybdate reagent and that of Metol reagent was added into each tube, then allowed to stand for 30 minutes for color development. The absorbance of all tubes was measured using Jenway 6300 spectrophotometer against the blank at 680nm for colouration (Bhatnagar and Devi 2013).

Determination of Fish Species and Diversity Index

Fish samples were collected from catches of fishermen in the field and transported to the laboratory in labelled container containing 10% formalin for preservation and subsequent identification with the aid of reference materials (Babatunde and Raji, 1998). The identified fish species were later subjected to diversity analysis such as; Shannon Weiner index (H), Pielou Evenness Inde); (J) and Margalef Diversity Index (Ma). Shannon Diversity Index. (H):

Shannon Weiner index (H)

$$H = - [(ni/N) * (In\ n/N)]$$

Where; H= Shannon Diversity Index

ni = Total Number of individuals belonging to i species

N: Total number of individuals

Pielou Evenness index (D1)

J = H/Hmax

Where; J= Pielou Evenness Index

H = Observed value of Shannon index

Hmax= In S

Margalef Diversity Index (Ma):

Ma = (S-l)/In N

Where; Ma = Margalef Diversity Index

S = Total number of species

N = Total number of individuals

Condition Factor

Number of each species caught, their total length, standard length and weight (condition factor) were calculated by Fulton's condition factor expression as follows;

K=100W/LB

Where; W = whole-body weight in grams

L = standard length in centimeters

B = 3

RESULTS

The result of physicochemical parameters of Gombe Abba River showed that pH and turbidity raise with increase in the level of the water in the river, but no significant difference. The mean water temperature ranged between 28.7°C-30.7°C with the highest recorded value in the month of June and the lowest in the month of August. The value indicated that there was no significant difference between the months. The mean pH ranged between 6-8.5 with the highest recorded value in the month of June and the lowest recorded value in the month of September. The value indicated that there was no significant difference between the months (P> 0.05). In the course of this study; no phosphate was recorded. The mean D.O ranged from 0.01mg/L to 1.16mg/L with the highest recorded value in the month of August and the lowest in September with no significant difference between the months (p> 0.05). The mean conductivity was between 90.0µS to 97.7µS with the highest in the month of June (Table 1).

Table 1: Physicochemical parameters interpretation of result

Physico-chemical parameters	June	July	August	September
Temperature (^{0}C)	30.7(±0.00)	29(±0.00)	28.7(±0.58)	28.00(±0.00)
pH	6.0 (±0.17)	6(±0.00)	7.9(±0.32)	8.5(±0.00)
Turbidity (cm)	6.2(±0.2)	11.7(±0.29)	10.5(±0.5)	10.6(±0.24)
Phosphate	0.00	0.00	0.00	0.00
Dissolved	0.02(±0.05)	0.08(±0.03)	1.16(±0.06)	0.01(±0.00)
Conductivity (µS/cm)	90.3(±0.85)	97.7(±2.00)	93.7(±4.04)	90.0(±0.8)

Table 2 shows the family and fish species identified in the river. The study revealed that seven (LI) species representing five (5) families has been identified. It also shows that family Alestidae has the highest number of species, followed by *Cyprinidae*, *Momyridae*, *Claridae* and *Cichlidae*. Family Alestidae species were *Hydrocynus brevis*, *Hydrocynus vittalus* and *Hydrocynus forskahlii*. Whereas, the remaining families have one species each as tabulated in Table 2.

Table 2: Fish Species Identified in Gombe Abba River

Family	Species Identified
Alestidae	Hydrocynus brevis
	Hydrocynus Vittatus
	Hydrocynus Forskahlii
Claridae	Clarias gariepinus
Cichlidae	Oreochromis niloticus
Momyridae	Momyrus senegalensis
Cyprinidae	Labeo senegalensis

Percentage composition of fish species identified was presented in Table 3. This indicated the richness of the diverse fish species discovered. *Hydrocynus brevis* has the highest percentage of 21.39%, followed by *Hydrocynus vittatus* 17.79, *Hydrocynus forskahlii* 17.07%, *Labeo senegalensis* 16.35%, *Momyrus senegalensis* 14.66%, *Clarias gariepinus* 7.69%, and *Oreochromis niloticus* 5.05%.

Table 3: Percentage composition of various fish species identified in Gombe Abba River

Fish Species Identified	Number of Species Identified	Percentage %
Hydrocynus brevis	89	21.39%
Hydrocynus Vittatus	74	17.79%
Hydrocynus Forskahlii	71	17.07%
Clarias gariepinus	32	7.69
Oreochromis niloticus	21	5.05%
Momyrus senegalensis	68	16.35%
Labeo senegalensis	61	14.66%
Total	**416**	**100%**

Table 4 showed the condition factor of the identified fish species including weight and length. This shows the relationship between the weight and length (condition factor) of the fish species recognized. From the condition factor of the seven (7) fish species examined, it was observed that 4 out of 7 fish species had their K values greater than IZ which includes *Hydrocynus brevis*, *Clarias gariepinus*, *Labeo senegalensis* and *Hydrocynus vitlatus*. A total of 2 fish species had their condition factor greater than 1.0 which include *Hydrocynus forskahlii* and *Oreochromis nilmicus*, while *Momyrus senegalensis* had condition factor less than 1.

Table 4: Weight – Length Relationship of Fish species identified in Gombe Abba

Fish Species	Weight (g)	Length (cm)	Condition factor (k)
Hydrocynus brevis	54	13	2.45
Hydrocynus vittatus	158	19	2.30
Hydrocynus Forshaklii	58	16	1.41
Clarias gariepinus	208	21	2.24
Oreochromis niloticus	63	18	1.08
Momyrus senegalensis	236	33	0.65
Labeo senegalensis	207	20	2.25

Table 5 shows percentage co of fish species identified. The table reveals that Hydrocynus brevis has percentage condition factor 57.14% Hydrocynus villalus has percentage condition factor 57.14% Hydrocynusforskahlii has percentage condition factor 28.57% Oreochromis nilolicus has percentage condition factor 28.57% iabeo senegalensis has percentage condition factor 57. I 4% Momyrus senegalensis has percentage condition factor l4.29% Clarias gariepinus has percentage condition factor 57.14%.

Table 5: Percentage condition factor of fish species identified in Gombe Abba River

Fish species	Condition factors	Percentage condition factor
Hydrocynus brevis	2.45	57.14%
Hydrocynus vittatus	2.30	57.14%
Hydrocynus forskahlii	1.41	28.57%
Oreochromis niloticus	1.08	28.57%
Labeo senegalensis	2.08	57.14%
Momyrus senegalensis	0.65	14.29
Clarias gariepinus	2.24	57.14%
Total		**100**

DISCUSSION

pH and turbidity raise with increase in the level of the water in the river. Such increase may be as a result of inflow of rainfall which come alone with nutrient such as nitrogen, phosphorous and decayed organic compound that were present around the river (Adefemi and Awokunmi, 2010). Equally, the domestic activities around the water body including washing and bathing also increase the level of such parameters. Apart, no phosphate was recorded, this might be due to the salt's rarity in the earth's crust (Lawson, 2011).

The study reveals seven (7) fish species representing five (5) families. The family Alestidae has the highest number of three (3) species, followed by Cyprinidae, Momyridae, Claridae and cichlidae as shown in Table 2. Shannon Wieners species richness = 1.862, Pielou "9 'ndex for species evenness= 0.309, Margalef"s diversity index = 6.06 (Mustapha, 2009). Shannon index is an index (H) applied to biological systems derived from a mathematical formula used in communication area by Shannon 40 in 1948 (Mustapha, 2009). It is the most preferred index among the other diversity indices. Its results are generally between 1.53.5 and rarely exceed 4.5 (Mustapha, 2009). Values above H = 3.0 indicate that the structure of habitat is stable and balanced, while, values under 1.0 indicate that there are pollution and degradation of habitat structure (Omowunmi, 2013). Pielou index (J) give the ratio of the observed value of H to the maximum value result (Omowunmi, 2013). When the J value is getting closer to 1 it means that the individuals are distributed equally (Mustapha, 2009). The J value obtained from the present study was not closer to 1, that means the fish species of Gombe Abba river is not consistently distributed (Mustapha, 2009). Margalef's diversity index (Ma) has no limit value and it shows a variation depending upon the number of species (Margalef, 2006).

Diversity index is a statistical method which is planned to evaluate the variety of data group consisting of different types of components (Margalef, 2006). Features of a population such as number of existing species (Richness), distribution of individuals equally (Evenness) and total number of existing individuals underlie the basis of diversity indices (Margalef, 2006). Thus, any changes in any of these three features are used effectively to determine the changes of population. The weight and length of the fish species identified indicates that most of the species had their K values greater than 2, while, few with factor less than 2.0 (Jin *et al.*, 2015). Wade (1992) stated that condition factor greater or equal to one is good (Lawson and OLusanya, 2010).

CONCLUSION

Conclusively, the presnt study revealed that most of the physicochemical parameters in Gombe Abba river within the recommended value of most water bodies, while less or no phosphate concentration was found. Of these, the river contains diverse fish species from different families. Among all, family Alestidae has the highest number of species, followed by Cyprinidae, Momyridae, Claridae and cichlidae.

RECOMMENDATION

Government should provide environmental laws that will regulate activities near rivers especially with regards to use of farm chemical to reduce the amount of nitrification in the river. It is important to regulate the human activities taking place around the river so as to improve the proper management of the water as we" as the aquatic organism.

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