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Fish Species Composition and Physico-Chemical Properties of Manjekin Reservoir, Adamawa State, Nigeria

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ABSTRACT

The objective of the study was to determine fish species composition and physico-chemical properties of Manjekin reservoir between March and June 2013. Fish samples were caught in the reservoir using different fishing gears. The results showed 13 fish species belonging to 9 families present in the reservoir which was considered rich enough for that type of water body. Two families, namely, Characidae and Clariidae constituted the dominant fish species in the reservoir with 34.42% and 8.08% respectively. Other fish species with significant dominance were centropomidae (7.84%) and mormyridae (7.36). The meristic and the morphometric features of fish species caught were also determined. The results of water quality showed variations in the monthly means and station values. Despite these variations, the values obtained were within the recommended range for fish culture, which most of the tropical fresh water fishes could tolerate. There is therefore, the need to evolve strong strategies that could allow effective utilization and management of the reservoir and other water bodies for optimum fish production in the study area.

Keywords: Fish Species Composition, Physico-Chemical Properties, Manjekin Reservoir, Adamawa State, Nigeria

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INTRODUCTION

Fisheries and aquaculture play an important role in the global food supply, food security and income generation to numerous families. More than 43.5 million people earn their living directly under this sector of the economy and most of them reside in developing countries (FAO, 2006). Fish supply in Africa is in serious short fall (FAO, 2012). Per capita fish consumption in sub-Saharan Africa is the least compared to all other parts of the world (FAO, 2014). Lakes, dams and reservoirs apart from playing the noble role of providing a relatively cheap source of animal protein, it could also provide employment opportunities and to some extent reduce rural-urban drift (FAO, 2014). Other role of lakes, dams and reservoirs is to provide support, protection and nursery to the early life cycle stages of almost all commercially and ecologically important fresh water fish (World Fish Centre, 2004). Unfortunately, economic returns from African fisheries and aquaculture are declining as a result of continual reduction in fish catches, hence, incomes and livelihoods of the small-scale fisher men are grossly affected (FAO 2012).

Furthermore, the crude methods of exploitation used by most fisher men due to complete absence of established inland fisheries regulations of small dams and reservoirs in most parts of Africa is fast becoming an obstacles to increased inland fish production (Ita, 1993). The possible solution is perhaps to re-stock with hatchery breed fingerlings and well manage the existing water bodies in order to harvest more fish to meet the increasing demand. Data on fish species composition and physico-chemical properties of the reservoir and other water bodies in the study area is lacking. It is against this background that, this study was designed to investigate fish species composition and physico-chemical properties of the Manjekin reservoir.

MATERIALS AND METHODS

The Study Area

Adamawa State is located at the area where the River Benue enters Nigeria from Cameroon Republic and is one of the six states in the North-East geopolitical zone of Nigeria. It lays between latitudes 7^0 and 11^0 North of the Equator and between longitudes 11^0 and 14^0 East of the Greenwich Meridian (Mohammed, 1999). It shares an international boundary with the Republic of Cameroon to the East and interstate boundaries with Borno to the North, Gombe to the North-West and Taraba to the South-West (Adebayo, 1999; ASMLS, 2010a), as shown in Figure Ia.

Figure Ia: Map of Nigeria Showing Adamawa State

According to Adebayo and Tukur (1997), Adamawa State covers an area of land mass of about 38,741km². The state is divided into three Senatorial Zones (Northern, Central and Southern) which translates to three agricultural zones as defined by INEC (1996), which are further divided into 21 Local Government Areas (LGAs) for administrative convenience.

The State has a population of 2,102,053 persons (NPC, 1990). The main ethnic groups in the state are the Kilba, Higgi, Quadoquado, Lala, Yungur, Bwatiye, Chamba, Mbula, Margi, Ga'anda, Longuda, Kanakuru, Bille, Bura, Yandang, Fali, Gude, Verre, Fulani and Libo (Adebayo & Tukur, 1997; Adebayo, 1999; ASMLS, 2010b). The dominant religions are Christianity and Islam, although some of its inhabitants still practice African traditional religions. The major occupation of Adamawa people is farming. The soil type is ferruginous tropical soils of Nigeria based on genetic classification of soils by the Food and

Agricultural Organization of the United Nations (FAO, 1996).

The soils are a function of the underlying rocks, the seasonality of rainfall and the nature of the wood-land vegetation of the zone. The soils are derived from the basement complex, granite and gnesis that form the ranges of mountains. The mineral resources found in the state include iron, lead, zinc and limestone (Adebayo & Tukur, 1997).

The common relief features in the state are the Rivers Benue, Gongola, Yadzaram and Kiri Dam, Adamawa and Mandara mountains and Koma hills. The state has minimum and maximum rainfall of 750 and 1050 mm per annum and an average minimum and maximum temperature of 15^{0}C and 32^{0}C, respectively. The relative humidity ranges between 20 and 30% with four distinct seasons that include early dry season (EDS, October – December); late dry season (LDS, January – March); early rainy season, (ERS, April – June) and late rainy season (LRS, July – September), according to Adebayo (1999). The vegetation type is best referred to as guinea savannah (Areola, 1983; Adebayo & Tukur, 1997). The vegetation is made up of mainly grasses, aquatic weeds along river valleys and dry land weeds inter-spersed with shrubs and woody plants. Plant heights ranges from few centimeters (Short grasses) to about one meter tall (tall grasses), which form the bulk of animal feeds.

Cash crops grown in the state include cotton and groundnuts, sugarcane, cowpea, benniseed, bambara nuts and tiger nuts, while food crops include maize, yam, cassava, sweet potatoes, guinea corn, millet and rice. The communities living on the banks of rivers engage in fishing, while the Fulani and other tribes who are not resident close to rivers are pastoralists who rea livestock such as cattle, sheep, goats, donkeys few camels, horses and poultry for subsistence (Adebayo & Tukur, 1997; Adebayo, 1999).

The Study Site

The study was carried out at Manjekin reservoir, which is located 5km along Salma Maiha road, Maiha Local Government Area of Adamawa State. The site lies roughly between latitude 13^0-29^{0}E and longitude 90^0-100^{0}N. The location has a tropical climate and savannah type of vegetation which is marked by distinct dry and rainy season. It has an average rainfall of 125-150cm and the mean temperature ranges 24^{0}C-27^{0}C.

The soil is generally sandy-loam with clay in Fadama areas. The common arable crops grown in the zone include Maize, Sorghum, Millet, rice, cotton, groundnut, root and tree crops. The common livestock species include cattle, donkeys, horses, camels, sheep, goat, poultry and Fish. Maiha region is bordered in the North by Mubi South LGA, in the West by Hong LGA, in the South by Song LGA and in the South-East by the Republic of Cameroon as seen in Figure IIb (Adebayo & Tukur, 1991).

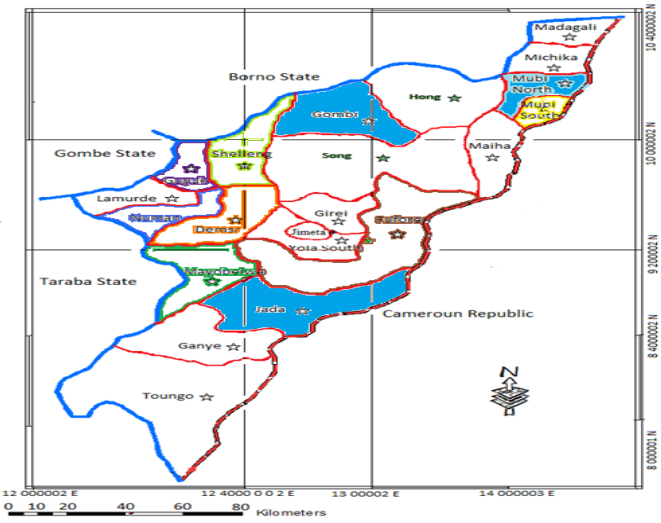

Figure Ib: Map of Adamawa State Showing the Study Area in Blue Colour

Fish Sampling and Procedure

Fish species composition and environmental data were obtained between April and July on monthly basis for the period of 4 months. Five sampling stations were selected and designated as (A,B,C, D and E) respectively. The fish species were caught with various fishing gears as described by Solomon *et al*. (2017). The fishes were taken to the laboratory

Table1: Fish Catch at Manjekin Reservoir during Period of Survey

Families name	English name	Catch No individual	% by No
Claridae	cat fish	41	9.74 **%**
Cichlidae	tilapia	187	44.42 **%**
Caracidaen	tiger fish	27	6.41 **%**
Mormyridae	bottlenose	31	7.36 **%**
Schilbeidae	African butter fish	19	4.51 **%**
Cyprinidae	labeo	20	4.75 **%**
Mochokidae	squeaker	34	8.08 **%**
Centropomidae	niger/nile perch	33	7.84**%**
Bargridae	bayad	29	**6.89%**

Table 2: Determination of Water Quality Parameters of Manjekin Reservoir in March, 2013

Sampling Station	Temperature (^oc)	DO (PPm)	Conductivity (U^S)	PH (mg/l)	Phosphate (PPm)	Ammonia (PPm)	BOD (PPm)
A	27.33^a	4.00^a	211.33^a	7.33^a	2.33^a	1.67^a	3.33^a
B	27.00^a	4.00^a	245.33^a	7.33^a	1.67^a	0.67^a	2.67^a
C	27.00^a	4.00^a	288.00^a	7.67^a	2.67^a	1.00^a	2.67^a
D	27.00^a	2.67^a	232.67^a	7.33^a	2.00^a	1.33^a	3.33^a
E	27.00^a	5.33^a	212.67^a	7.33^a	2.00^a	1.00^a	2.00^a

Means along the column with the same superscript does not differ significantly. Means along the column with different superscript differs significantly.

Table 3: Determination of Water Quality Parameters of Manjekin Reservoir in April, 2013

Sampling Station	Temperature (^oc)	DO (PPm)	Conductivity (U^S)	PH (mg/l)	Phosphate (PPm)	Ammonia (PPm)	BOD (PPm)
A	27.33^b	2.67^a	218.67^a	7.67^a	2.67^a	1.67^a	2.67^a
B	28.00^b	2.67^a	259.67^a	7.33^a	1.33^a	1.33^a	3.33^a
C	28.00^b	4.00^a	259.00^a	7.33^a	2.00^a	1.33^a	2.67^a
D	28.00^b	2.67^a	252.33^a	7.67^a	2.67^a	0.67^a	2.67^a
E	29.67^a	4.00^a	220.67^a	7.33^a	2.00^a	0.67^a	2.00^a

Means along the column with the same superscript does not differ significantly. Means along the column with different superscript differs significantly.

Table 4: Determination of Water Quality Parameters of Manjekin Reservoir in May, 2013

Sampling Station	Temperature (^oc)	DO (PPm)	Conductivity (U^S)	PH (mg/l)	Phosphate (PPm)	Ammonia (PPm)	BOD (PPm)
A	27.33[a]	2.67[a]	283.67[b]	7.67[a]	1.67[a]	1.67[a]	2.00[a]
B	26.67[b]	5.33[a]	297.67[a]	7.67[a]	1.00[a]	1.33[a]	2.67[a]
C	26.00[c]	2.67[a]	292.00[b]	7.67[a]	1.00[a]	1.33[a]	2.67[a]
D	26.00[c]	4.00[a]	296.00[a]	7.33[a]	2.33[a]	1.67[a]	2.67[a]
E	24.00[d]	2.67[a]	274.00[c]	7.33[a]	2.67[a]	1.33[a]	2.67[a]

Means along the column with the same superscript does not differ significantly. Means along the column with different superscript differs significantly.

Table 5: Determination of Water Quality Parameters of Manjekin Reservoir in June, 2013

Sampling Station	Temperature (^oc)	DO (PPm)	Conductivity (U^S)	PH (mg/l)	Phosphate (PPm)	Ammonia (PPm)	BOD (PPm)
A	27.00[a]	4.00[a]	123.33[a]	7.67[a]	0.33[a]	2.33[a]	3.33[a]
B	27.00[a]	4.00[a]	123.33[a]	7.67[a]	2.00[a]	1.00[a]	2.00[a]
C	27.33[a]	2.67[a]	133.00[a]	7.33[a]	1.67[a]	2.33[a]	2.00[a]
D	27.00[a]	1.33[a]	134.00[a]	7.67[a]	1.33[a]	0.60[ab]	3.33[a]
E	27.00[a]	6.67[a]	132.33[a]	7.33[a]	1.00[a]	0.67[ab]	3.33[a]

Means along the column with the same superscript does not differ significantly. Means along the column with different superscript differs significantly.

Table 6: Monthly Variation of Water Quality Parameters of Manjekin Reservoir

Month of the Year 2013	Temperature (^oc)	DO (PPm)	Conductivity (U^S)	PH (mg/l)	Phosphate (PPm)	Ammonia (PPm)	BOD (PPm)
MARCH	27.20[b]	5.57[b]	226.07[c]	7.27[a]	1.87[a]	1.87[a]	2.60[a]
APRIL	28.23	6.30[a]	245.20[b]	7.43[a]	1.80	1.73[a]	2.20[b]
MAY	25.50[c]	4.70[c]	268.77[b]	7.47[a]	1.60[b]	1.60[a]	1.77[c]
JUNE	27.00[a]	4.57[c]	132.60[d]	7.37[a]	2.17[a]		1.60[a]
1.80[c]							

Means along the column with the same superscript does not differ significantly. Means along the column with different superscript differs significantly.

Table 7: Meristic Features of Fish Species Caught in Manjekin Reservoir, Adamawa, Nigeria.

Species	No of Fishes	D. fin	A. fin	C. fin	P.fin
Mormyrus rume	2	81	18	28	9
Auchenoglanis occidentalis	2	7	6	25	9
Bargus bayad	2	11	12	29	5
Clarias gariepinus	2	75	31	10	6
Oreochromis niloticus	2	13	11	22	9
Hydrocynus forskalii	2	11	12	29	5
Alestes macrophthalmus	2	8	13	23	5
Hyperopisus bebe	2	12	42	19	9
Petrocepphalus ansorgi	2	19	18	24	9
Schilbe mystus	2	5	51	19	8
Hemisynodontis membranaleous	2	10	5	17	5
Synodontis budgetti	2	8	13	22	9
Lates niloticu	2	4	13	18	8

Roman Figures represent number of spines. Numerals represent number of fin rays.D. Fin : Dorsal Fin, A. Fin : Anal Fin, C. Fin : Caudal Fin, P. Fin : Pectoral Fin

Table 8: Morphometric Features of Fish Species Caught in Manjekin Reservoir, Adamawa, Nigeria.

Species	No of Fishes measured	TL	SL	HL	BD	BG
Mormyrus rume	2	203	170	50	70	150
Auchenoglanis occidentalis	2	152	130	30	40	110
Bargus bayad	2	123	112	35	32	122
Clarias gariepinus	2	ii, 165	242	72	i, 82	150
Oreochromis niloticus	2	ii, 260	222	82	i, 89	215
Alestes macrophthalmus	2	i, 109	138	55	i, 43	123
Hyperopisus bebe	2	243	231	80	i, 91	125
Petrocepphalus ansorgi	2	255	210	73	i, 62	171
Schilbe mystus	2	186	130	53	30	111
Hemisynodontis membranaleous	2	155	78	25	28	132
Lates niloticu	2	270	230	98	98	174
Synodontis budgetti	2	222	210	87	86	154
Hydrocynus forskalii	2	130	113	21	73	95

All measurements are in millimeters (mm).

TL: Total Length, SL: Standard Length, HL: Head Length, BD: Body Length, BG: Body depth.

for identification as described by Raji and Olaosebikan (2004). The meristic and the morphometric features of fish species caught were also determined following the method described by Thalwar and Jhingran (1991) and Olaosebikan and Raji (1998). Water samples were collected in triplicate and parameters determined include: water conductivity, P^H, salinity, ammonia, hydrogen ion concentration (PH), biochemical oxygen demand (BOD), temperature, transparency, dissolved oxygen, total dissolved solid and phosphate as described by Offem *et al*. (2011).

Data Analysis

All the data generated were subjected to Analysis of Variance (ANOVA) to test level of significant (P>0-0.5) among sampling stations and monthly means. The (Duncan, 2006) multiple range test were employed to separate the means.

RESULTS AND DISCUSSION

Fish Catch

The results of the survey showed that, 13 fish species belonging to nine families were common in the reservoir. Two families namely *Characidae* and *Claridae* constituted the dominant fish families in the reservoir. Characidae constituted 34.42% (187 species) to the total number of species, followed by Claridae with 8.08% (34 species), Centropomidae 7.84% (33 species), Mormyridae 7.36% (31 species) and Bargridae 6.89% (29 species). The remaining species in that order are caracidae, cyprinidae and schilbeidae with 6.41, 4.75 and 4.51% respectively as shown in Table 1.

The results agree with Welman (1948) who reported similar findings of 181 species of fish found in Nigeria inland waters with Kaduna and Sokoto-Rima Rivers having 28 and 22 species respectively while Cross River, Ogun, and Osun Rivers having 39, 23, and 23 fish species respectively. Similarly, Ita (1993) also reported that an estimate of 230 species of fish have been recorded from the Nigerian rivers. The results also corroborate that of Boulenger (1916) who reported 976 species of African freshwater fishes belonging to 185 genera and 43 families.

The meristic features and the morphometric data of two randomly selected fish samples per species were taken and these were presented in Tables 7 and 8. They were considered to be important characters on which species identification are based. In Table 7, numerals represent the number of fin rays present on individual species, while roman figures represent the number of spines present on the fins of respective species indicated. These species have spines on their fins while the other species are spineless. The catch composition shows that *Characidae* and *Clariidae* families were the most dominant in the reservoir.

However, the results of this study with respect to catch composition disagreed with other studies conducted on some lakes in Nigeria. Analysis of catch in a study in IITA Lake, Ibadan revealed that *O. niloticus* and *S. galilaeus* were the most dominant. Similarly, studies conducted on lakes Kanji and Tatabu, both in Niger State, the cichlid species were found to be the most dominant (Fapohunda and Godstate, 2006).

The variation in this study could be due to the fact that, many carnivorous fish species were in abundance in the reservoir, which feed on the cichlids thereby reducing their population. *S. galilaeus* was the fourth most abundant specie in the reservoir at the time of the survey. In addition to the fish species found in the reservoir, are some other forms of aquatic fauna. Crabs were found in large quantity as well as snails. This confirmed that, natural aquatic environment inhabits variety of aquatic lives. Similarly, the results of the meristic features also support that of Gregory *et al*. (2009) who reported similar findings in the south eastern Nigeria. However, the results of surface water temperature had relative fluctuations, with a fairly consistent thermal

regime of about 28.60^{oC} and the pH ranges between 6.5 and 7. But this also fell within the recommended value that supports aquatic life including fishes (Fapohunda and Godstate, 2006).

Water Parameters

The station and monthly values of the water conductivity, pH, temperature, dissolved oxygen, biochemical oxygen demand, ammonia and phosphate concentration of Manjekin reservoir are shown in the Tables 2 to 8. The results of water temperature of 27^{O}C recorded at the five sampling stations from March to June 2013 corroborate the actual optimum temperature range of 27^{o} to 32^{o} required by most tropical fresh water fish (Mackereth,1963). The lowest conductivity value of 132.33u^{s} of the reservoir at the five sampling stations (A, B, C, D and E) from March to June 2013 showed that, there is monthly variation in the water conductivity value. This is in agreement with Obhahie *et al.,* (2007) and Pan day, *et al.,* (2005) who reported similar variation of the specific water conductivity of Kaithkola lake from 223.60 to 278.60 μscm^{-1} and Bishurphur lake from 315.30 to 407.30 μscm^{-1} in India between summer and the monsoon to winter season. The effect of seasonal and runoff are the major causes that control the variation in water quality. However, human activities are interfering with this cycle as well.

The results of lowest and highest pH value of the reservoir do not exceed the reference value of 6.5 to 8.0 which most tropical fresh water fish could tolerate. These values were observed in the entire sampling stations and the periods. The results agree with that of Ugwu and Mgbenka (2006) who reported similar values in their studies.

The results of dissolved oxygen content of the reservoir is within the recommended values for fish production as also reported by Olabaniya and Owoyemi (2006), that the level of dissolved oxygen should not be less than 4ppm especially for freshwater fish culture in the tropics. The results show high phosphate values which could be attributed to the large volume of the surface run-off entering the reservoir. In addition, increase in the use of herbicides, pesticides and domestic waste discharge also contributed to high level of phosphate in the reservoir. By reducing phosphate inputs in to the water bodies for instance, through proper effluent/waste treatment, the number of years required to saturate the reservoir soil with phosphate can be extended.

Fish and other aquatic organisms respond differently to varying water quality. Therefore, regular determination of water quality parameters is very important in any reservoir use for both fish production and domestic water supply. The biochemical oxygen demand content of the reservoir is also within the recommended value for fish production which corroborates the report of Vivien *et al.,* (1986).

CONCLUSION AND RECOMMENDATIONS

The results obtained showed variations in fish species in the study area with characidae being the most dominant fish species in the reservoir. The meristic features and the morphometric data of the fish were considered important characteristics on which species identification are based.

Water quality parameters also showed variations though not outside the recommended reference values for fish production in the tropical environment. It is, therefore, concluded that despite the contamination of the reservoir with many effluents, the physico-chemical characteristics of the water is within the permissible range that could support aquatic life including fish.

It is recommended that, there is the need to evolve strong strategies that could allow effective utilization and management of the reservoir for optimum fish production. These strategies among others may include introduction of other culturable freshwater fish species into the reservoir. However, further assessment of the fish stock may be carried out

to further determine any species that may have not been discovered during this study. Considering the results of the physico-chemical water parameters, remediation activities should focus on the main factors such as agro-chemicals to reduce their possible effect on the level of pollution.

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