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Research Article

Fish Species Composition and Physical and 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 physic and 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: Adamawa State; Fish species composition; Manjekin reservoir; Nigeria; Physical and chemical properties

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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 [1]. Fish supply in Africa is in serious short fall [2]. Per capita fish consumption in Sub-Saharan Africa is the least compared to all other parts of the world [3]. 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 [3]. 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 [4]. 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 [2].

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 [5]. 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 physic and 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 physic and 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 lies between latitudes 7º and 11º North of the equator and between longitudes 11º and 14º East of the Greenwich meridian [6]. 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 [7,8], as shown in figure 1. The state has minimum and maximum rainfall of 750 and 1050 mm per annum and an average minimum and maximum temperature of 15ºC and 32ºC, 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 [7]. The vegetation type is best referred to as guinea savannah [9]. The major occupation of Adamawa people is farming. 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 rear livestock such as cattle, sheep, goats, donkeys, few camels, horses and poultry for subsistence [7].

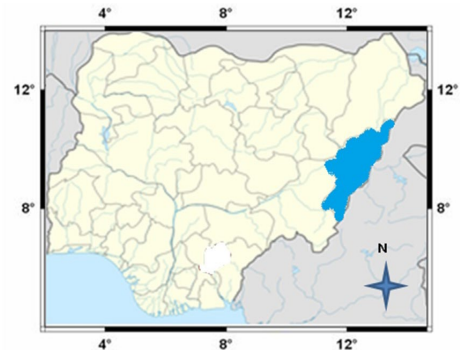

Figure 1: Map of Nigeria showing Adamawa State.

The study site

The study was carried out at Manjekin reservoir, which is located 5 km along Salma Maiha road, Maiha Local Government Area of Adamawa State. The site lies roughly between latitude 130-290E and longitude 900-1000N. 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 125-150 cm and the mean temperature ranges 240ºC-270ºC. 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 2 [10].

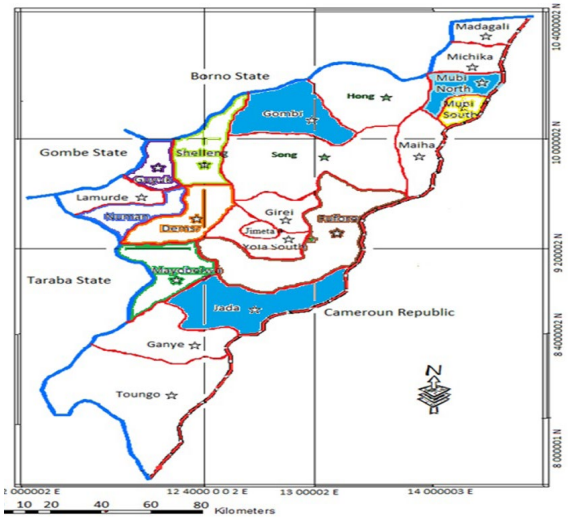

Figure 2: Map of Adamawa State showing the study area.

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 such as hook and line, mosquito net and traps as described by Solomon et al. [11]. The fishes were taken to the laboratory for identification as described by Raji and Olaosebikan [12]. The fish caught in a container were picked using wet hands to avoid damaging sensitive mucous layers. The identification began by removing larger individual fish first to reduce stress on smaller fish in the holding container. The identified fish species were recorded according to Allen et al. [13] and Kennard et al. [14].

The meristic and the morphometric features of fish species caught were also determined following the method described by Thalwar and Jhingran [15] and Olaosebikan and Raji [16]. Standard length was taken from snout to the tail-end of the vertebral column, total length from the tip of the snout to the end of the caudal fin and fork length from the tip of the snout to the center of a concave tail [13,14].

Water samples were collected in triplicate and parameters determined include: Water conductivity, pH, 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. [17].

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 [18] 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.

Families Name	English Name	Catch No Individual	% By
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 1: Fish catch at Manjekin reservoir during period of survey.

The results agree with Ita [5] who also reported that an estimate of 230 species of fish have been recorded from the Nigerian rivers. The meristic features and the morphometric data of two randomly selected fish samples per species were taken and these were presented in tables 2 and 3. They were considered to be important characters on which species identification are based. Similarly, the importance of these biological assessments is to ascertain whether the fresh water

fish production is sustainable in the changing environment like northern Nigeria. That would also help to identify areas of concern for proper planning. In table 2, 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.

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
Hemi synodontis membrane leous	2	10	5	17	5
Synodontis budgetti	2	8	13	22	9
Lates niloticus	2	4	13	18	8

Table 2: Meristic features of fish species caught in Manjekin reservoir, Adamawa, Nigeria.

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

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 ansorgii	2	255	210	73	i, 62	171
Schilbe mystus	2	186	130	53	30	111
Hemi synodontis membranae leous	2	155	78	25	28	132
Lates niloticus	2	270	230	98	98	174
Synodontis budgetti	2	222	210	87	86	154
Hydrocynus forskalii	2	130	113	21	73	95

Table 3: Morphometric features of fish species caught in Manjekin reservoir, Adamawa, Nigeria.

All measurements are in millimeters (mm). TL: Total Length, SL: Standard Length, HL: Head Length, BL: Body Length, BD: Body Depth

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 [19].

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. [20], 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 28.60ºC and the pH ranges between 6.5 and 7. But this also fell within the recommended value that supports aquatic life including fishes [19].

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 4-8. The results of water temperature of 27ºC recorded at the five sampling stations from March to June 2013 corroborate the actual optimum temperature range of 27ºC to 32ºC required by most tropical fresh water fish [13,14]. 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. [21] and Panday et al. [22], 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 [23] 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 [24], 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 phosphatein 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 [13,14].

Sampling Station	Temperature (°c)	DO (PPM)	Conductivity (US)	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}

Table 4: Determination of water quality parameters of Manjekin reservoir in May, 2013.

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

Sampling Station	Temperature (°c)	DO (PPM)	Conductivity (US)	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}

Table 5: Determination of water quality parameters of Manjekin reservoir in June, 2013.

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

Month of the Year 2013	Temperature (°c)	DO (PPM)	Conductivity (US)	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}	1.8	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}

Table 6: Monthly variation of water quality parameters of Manjekin reservoir.

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

Sampling Station	Temperature (°c)	DO (PPM)	Conductivity (US)	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}

Table 7: Determination of water quality parameters of Manjekin reservoir in March, 2013.

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

Sampling Station	Temperature (°c)	DO (PPM)	Conductivity (US)	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}

Table 8: Determination of water quality parameters of Manjekin reservoir in April, 2013.

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

Conclusion and Recommendation

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 physic and 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 physical and 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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