



Original article

FISHERY DIVERSITY AND CATCH ASSESSMENT SURVEY OF JEBBA LAKE, NIGERIA

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ABSTRACT

Fishery diversity and catch assessment of Jebba Lake, Nigeria was studied for a period of five (5) months between March, 2018 and August, 2018. Four thousand, one hundred and eighty two (4,182) individual fish, which comprised of 16 species belonging to 14 families were recorded in the lake. The families Clariidae and Mochokidae were the most diverse with two (2) species each. Cichlidae was dominant with *Oreochromis niloticus* as the most abundant species. There was low fish diversity in the lake. Diversity indices showed that upstream was the richest in diversity, while downstream was the poorest. Midstream had the highest fish taxa, while Downstream was lowest and there was uneven fish population at these locations. Bulk of the fish caught was from downstream and lowest at upstream. *Oreochromis niloticus* which is a Cichlid was recorded highest at upstream, midstream and downstream. Monthly fish catch revealed highest catch at downstream in March, April and June, and at midstream in May and July on the overall. It is recommended that similar study should be done for the remaining months, continuous monitoring of the fishery should be taken seriously, there is also need to monitor the activities of fishermen as well as organize workshop on management for them, and the findings of this study could be used as baseline information for further research work in the lake and even other water bodies.

Keywords: - Diversity indices, Jebba lake, Nigeria, Cichlidae, Clariidae, *Oreochromis niloticus*

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INTRODUCTION

Nigeria is blessed with enormous natural aquatic resources in marine, estuarine and fresh water environment. According to [1], the inland water bodies of Nigeria, especially freshwater with over 270 fish species are the richest in fish diversity in West Africa. It has been reported by [2] that the current demand for fish in Nigeria stands at 3.32 million tonnes. A total of 60% of the total domestic fish supply come from freshwater sector, while marine sector contributed 40% to the fish production. Therefore, fish production from inland sector is a great significant as it contribute the major share of the protein for domestic consumption.

Fishing in Nigeria is practiced on a very low scale, mainly for subsistence purpose. Thus over the years, the demand for fish has continuously outweighed supply as in most part of Nigeria [3]. Fisheries resource have continue to decline due to over exploitation and inadequate management, and, adequate knowledge of fish species composition, diversity and relative abundance of water bodies need to be understood vigorously [4]. These knowledge is often gotten from the assessment of catches of fishermen. Catch assessment survey (CAS) is a method of collecting statistical data about fish population. [5], emphasis catch assessment survey as one of the methods of fish stock assessment that is broadly considered under the statistical design approach. It gives an estimate of the total catch and fishery effort of artisanal fisheries, as an approach to manage the fisheries in the water body. This will aid in appraising the current fisheries of water bodies for better management and development.

Jebba Lake is an important water body endowed with several fish species, which gave rise to a lot of fishing activities. However, updated information of the fisheries of the lake especially, as it relates to the diversity, composition and abundance

is sparse. Due to this situation, it is difficult to appraise the current fisheries of Jebba Lake, especially from fishermen catches, and come up with relevant management plans. Therefore, there the need to properly manage the fisheries because of its many contributions to the improvement of the livelihood, and living standard of the communities around the lake. To achieve this, information on the fishery composition, abundance and diversity from fishermen catches on the lake need to be available. The aim of this study is to determine the diversity indices, catch composition and abundance of fishes in the lake.

MATERIALS AND METHODS

Description of the study Area

This study was carried out in Jebba Lake located on Latitudes 9° 35' N and 9° 50' N and Longitudes 4°30'E and 5°00'E in the North Central area of Nigeria. The lake is man-made and was impounded in 1983, for the purpose of hydroelectric power generation, with additional opportunities for fishing, draw down farming and navigation. The lake is about 100 km long and about 12 km at its widest point. It has an estimated surface area of 303 km² (varying with seasonal fluctuations), and a volume of 3.31×10^9 m³ with a mean depth of 3.3m (max 32.5m). The lake has a shoreline length of 74km with catchments area of 0.3×10^6 km² [6].

Sampling location

Three landing locations were selected for the survey of fishing activities on the lake. This was designated as upstream, mid-stream and downstream based on stratified random sampling. Upstream (A) is dominated by Nupe people who are predominantly fishermen and farmers. The midstream (B) and downstream (C) is dominated by Nupe and Hausa that also engage in fishing and farming.

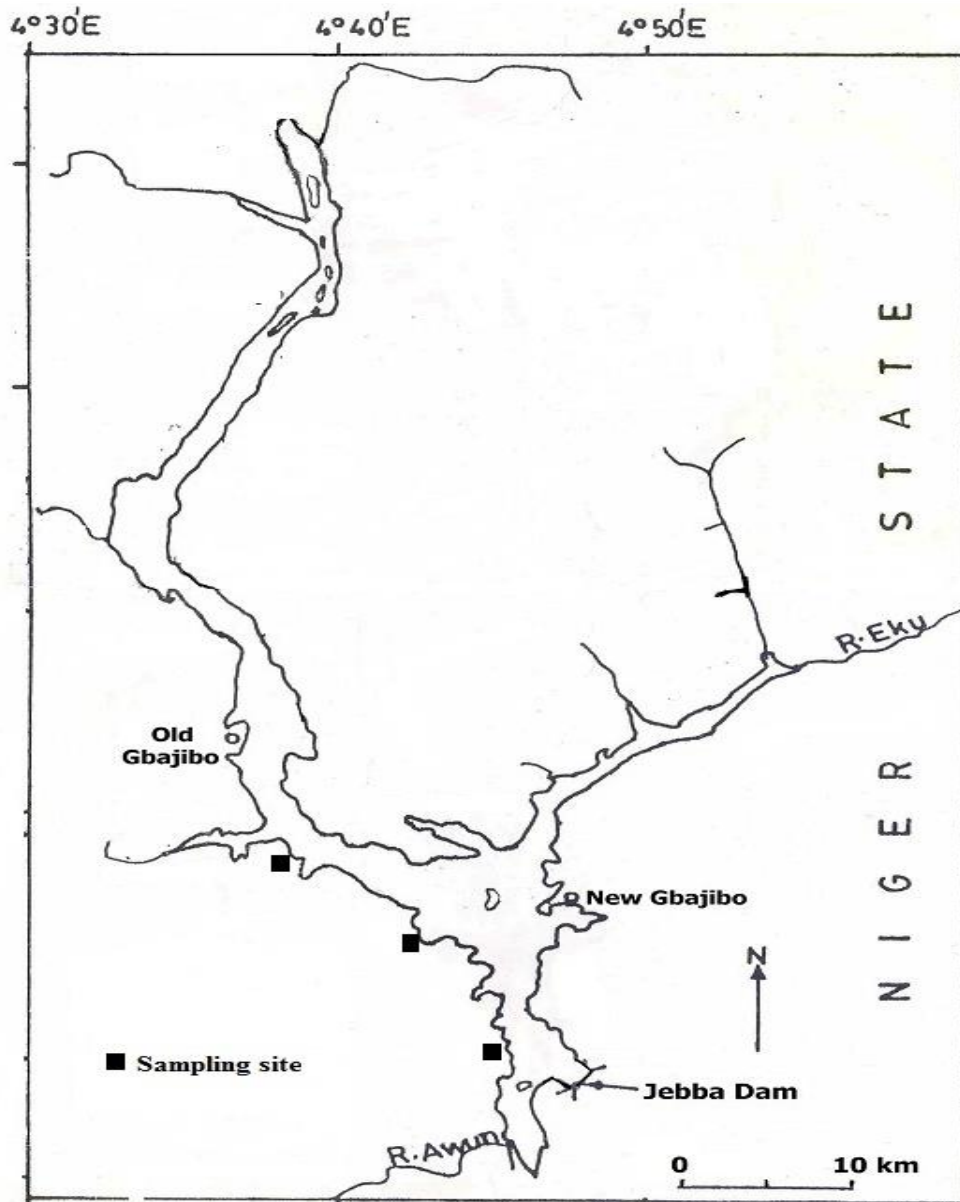


Figure 1: Showing the sampling station in Jebba Lake, Nigeria

Assessment of fishing activities

Each of these landing locations are characterized by different fishing gears and crafts. The census of gears and crafts in operation were undertaken twice in a month. The gears and craft used were identified using pictures from manuals according to [7]. The type of fishing methods employed by fishermen was also assessed.

Catch Assessment

Catch assessment monitoring data were collected right at the landing site twice every month once fishermen land with their catches. The fishing canoes were systematically sampled at the landing location so that canoe fishing near and far from such location got an equal chance of being selected. The catches from canoes sampled were sorted into species, identified, counted and recorded on the basis of fishing gears. Fish species names that were originally given locally by fishermen were translated to English with the aid of a guide according to [8]. The identity of fishes were further confirmed with the use of key provided by [9].

Duration of data collection

This study was carried out for a period of four (4) months from March, 2018 to July, 2018. This involve data collection on the various fishing activities and the fish species caught by fishermen on the lake.

Diversity indices determination

Shannon - Weaver diversity index and Gibson's index were used to evaluate species diversity using the formula below:

Shannon - Weaver diversity index;

$$H = - \sum P_i \ln P_i$$

(ii) Gibson's Evenness index;

$$e = H / \ln s$$

Where:

H = the diversity index

P_i = the relative abundance

e = similarity or evenness index

\ln = the natural logarithm.

(iii) Margalef index (d) was used to determine species richness using the formula below:

$$d = S - 1 / \ln N$$

Where;

d = the richness index

S = the number of individual for each species,

N = total number of individuals

(iv) Simpson's dominance index was used to determine if a species dominate a particular aquatic system or not.

Data analysis

Percentages (%) of fish abundance were calculated using the following formula:

$$\% \text{ Number} = \frac{\text{number of individual fish}}{\text{total number of fish}} \times 100$$

The percentage relative abundance (RA) in term of number was determined using the formula:

$$R A = \frac{\text{Number of fish species}}{\text{Total number of fishes}} \times 100.$$

RESULTS

Fourteen (14) fish family and sixteen speices were recorded in Jebba Lake. There are different fish species in Jebba Lake during the period of study. The families Clariidae and Mochokidae had the highest number of species (2) while the remaining fourteen (14) families had one (1) species (Table 1). *Oreochromis niloticus* was the highest (31.61%) in terms of number, followed by *Labeo coubie* (8.35%), then *Synodontis membranaceus* (8.32%) while the lowest was *Gymnarchus niloticus* (1.07%). The family Cichlidae had the highest number (31.61%) followed by Mochokidae (15.44%) then

Clariidae (14.68%) while the lowest was Osteoglossidae (Table 1).

Midstream recorded the highest taxa (62) while Downstream recorded lowest (57). Highest fish population was recorded at the downstream (1580) and lowest at the upstream (1103) (Table 2).

Shannon - Wiener index and Simpson values were both highest at the midstream (3.71) and (0.965) while Gibson's evenness had highest value at midstream (0.66) and lowest at upstream (0.62). The Margalef index for this study was highest at the upstream (8.42) of the lake followed by midstream (8.34), while the lowest was downstream (7.60).

Table 3 below shows percentage fish composition at the various stations in Jebba Lake. There was difference in the number of fish caught at the different locations. Downstream recorded the highest 1789 (38.40%) followed by midstream 1629 (34.90%) while the lowest was upstream 1242 (26.70%).

Oreochromis niloticus 416 (30.00%) was the highest caught upstream followed by *Synodontis membranaceus* 123 (9.90%), while *Gymnarchus niloticus* was the lowest 8 (0.60%). *Oreochromis niloticus* 439 (27.00%) was the highest caught at midstream followed by *Synodontis nigrita* 143 (8.80%), while the lowest was *Gymnarchus niloticus* 12 (0.70%).

The cichlid, *Oreochromis niloticus* 522 (30%) was also the highest caught at the downstream of the lake, followed by *Synodontis membranaceus* 160 (8.90%) and *Gymnarchus niloticus* 6 (0.30%) being the lowest.

The total fish catch, number of fishermen and crafts at the various sites on Jebba Lake, Nigeria during the period of study showed that the Midstream recorded the highest number of fishermen 22 (39.29%) followed downstream 18 (32.14%) then upstream 16 (28.57%) recorded the lowest. Highest catch was recorded at downstream in March 209 (11.70%), April 381(21.30%) and June 420 (23.50%) (Table 4). Highest catch was recorded midstream in May 396 (24.30%) and July 445 (27.30%). Within a location, July recorded the highest catch 328 (26.40%) upstream followed by May 312 (25.10%) while the lowest was March 139 (11.20%). Similarly, at the midstream, July recorded the highest catch 445 (27.30%) followed by May 396 (24.30%) and March being lowest 130 (8.00%). June 420 (23.50%) recorded the highest catch followed by July 390 (21.80%) while the lowest was March 209 (11.70%).

Table 1: Composition and relative abundance (%) of fish from fishers catch on Jebba Lake, Nigeria

Family / Species	No.	% No.
Distichodontidae		
<i>Distichodus rostratus</i>	142	3.40
Cyprinidae		
<i>Labeo coubie</i>	349	8.35
Latidae		
<i>Lates niloticus</i>	62	1.48
Clariidae		
<i>Clarias anguillaris</i>	296	7.10
<i>Heterobranchus bidorsalis</i>	317	7.58
Mochokidae		
<i>Synodontis membranaceus</i>	348	8.32
<i>Synodontis nigrita</i>	298	7.12
Mormyridae		
<i>Mormyrops anguilloides</i>	178	4.26
Schilbeidae		
<i>Schilbe intermedius</i>	94	2.25
Alestidae		
<i>Hydrocynus forskalii</i>	157	3.75
Cichlidae		
<i>Oreochromis niloticus</i>	1322	31.61
Osteoglossidae		
<i>Heterotis niloticus</i>	107	2.56
Protopteridae		
<i>Protopterus annectens</i>	138	3.29
Gymnarchidae		
<i>Gymnarchus niloticus</i>	23	0.54
Citharinidae		
<i>Citharinus citharus</i>	45	1.07
Bagridae		
<i>Bagrus docmac</i>	306	7.32
Total	4182	100

Table 2: Diversity indices of fish at sampling stations in Jebba Lake, Nigeria

Stations	Sampling station A (Upstream)	Sampling station B (Midstream)	Sampling station C (Downstream)
Taxa S	60	62	57
Individuals	1103	1499	1580
Variable			
Shannon - Wiener index (H)	3.61	3.71	3.61
Simpson (1 - D)	0.958	0.965	0.961
Gibson's evenness (E)	0.62	0.66	0.65
Margalef index	8.42	8.34	7.60

Table 3: Fish composition (%) at the various stations in Jebba Lake, Nigeria

Family / Species	Sampling station A (Upstream)		Sampling station B (Midstream)		Sampling station C (Downstream)	
	No.	% No.	No.	% No.	No.	% No.
<i>Distichodus rostratus</i>	32	2.60	57	3.50	82	4.60
<i>Lates niloticus</i>	20	1.60	19	1.20	27	1.50
<i>Clarias anguillaris</i>	98	7.90	82	5.00	153	8.60
<i>Labeo coubie</i>	79	6.40	141	8.70	146	8.20
<i>Heterobranchus bidorsalis</i>	97	7.80	128	7.90	121	6.80
<i>Synodontis membranaceus</i>	123	9.90	127	7.80	160	8.90
<i>Mormyrops anguilloides</i>	41	3.30	81	5.00	92	5.10
<i>Synodontis nigrita</i>	73	5.90	143	8.80	125	7.00
<i>Schilbe intermedius</i>	28	2.30	43	2.60	40	2.20
<i>Hydrocynus forskalii</i>	47	3.80	74	4.50	59	3.30
<i>Oreochromis niloticus</i>	416	33.00	439	27.00	533	30.00
<i>Heterotis niloticus</i>	36	2.90	30	1.80	56	3.10
<i>Protopterus annectens</i>	36	2.90	86	5.30	40	2.20
<i>Gymnarchus niloticus</i>	8	0.60	12	0.70	6	0.30
<i>Citharinus citharus</i>	73	5.90	27	1.70	14	0.80
<i>Bagrus docmac</i>	102	8.20	140	8.60	135	7.50
Grand total	1242	100	1629	100	1789	100

Table 4: Monthly total fish catch at the sampling stations in Jebba Lake, Nigeria

Month	Sampling station A (Upstream)		Sampling station B (Midstream)		Sampling station C (Downstream)	
	No.	% No.	No.	% No.	No.	% No.
March	139	11.20	130	8.00	209	11.70
April	225	18.10	320	19.60	381	21.30
May	312	25.10	396	24.30	389	21.70
June	238	19.20	338	20.80	420	23.50
July	328	26.40	445	27.30	390	21.80
Total	1242	100	1629	100	1789	100

DISCUSSION

Fish composition, abundance and diversity of any given water body is very important in terms of management. It helps to give knowledge of the fisheries and in turn used to draw management plans for sustainable utilization. Fifteen families comprising of sixteen species recorded in this study is higher than ten families but less than twenty three species reported by [10] and [11] that reported fifty one species that belong to 12 families in the same lake, which is different with the findings of this study. This may be attributed to the period of sampling, extent of coverage and dynamics of the water body, which influence fish abundance and diversity. The high abundance of the families Cichlidae (31.61%), Mochokidae (15.44%) and Clariidae (14.68%) could be due to the ability of tolerating wide range of changes in the environment, better adaptation and availability of food. Fish diversity as it is well known gives an idea of how productive a water is, which also a vital tool in fisheries management. Clariidae and Mochokidae were the most diverse in terms of species (2) whereas [12] recorded Mormyridae as the family with the most diverse with six species. [13] also reported Mormyridae as the most diverse with seven species. This indicate that the diversity of the lake is

low during the period of study. This could be attributed to overfishing or fishing and poor water quality and loss of habitat due anthropogenic activities. Even as it relates to Clariidae and Mochokidae, [13] did report three and six species respectively. *Oreochromis niloticus* is the most abundant species (31.61%) in the lake. This is similar with the works of [12] that reported *O. niloticus*, which is a cichlid as the most abundant fish species. This is a common observation in most water bodies, especially in this geographical region where the cihlids are the most dominant and abundant species of fish. This may be attributed to their prolific nature and feeding habit amongst others.

Diversity indices are important parameters used to assess the richness of fish species, the dominant species at a particular location as well as how diverse the water body is in terms of species. In terms of individual fish recorded in the lake during the period of study, Downstream (C) recorded the highest (38.40%) and Upstream (A) recorded the lowest (26.70%). This implies that bulk of the fish was from downstream but does not necessarily mean that the location is the most diverse or richest in species.

Mergalef index can be used to describe fish richness in water according to location. The variations in the index

indicate that Upstream (A) was the richest in diversity followed by Midstream (B) and the poorest was Downstream (C). This may be attributed to differences in location, availability of food for fish to eat and the topology. Shannon - Wiener index reveal intermediate fish diversity. This affect both number of species and evenness of the population, diversity increase as both increase. This means that Midstream is the most diverse in terms of location. Simpson's index represent the probability an individual fish selected randomly from a sample will belong to different species. The index range from 0 - 1 and the greater the value the greater the diversity. This implies that Midstream had the greatest diversity (0.97). Values recorded in this study were higher than that of [14] that reported 0.708. Gibson's evenness measures diversity of how even or uneven fish exist in a particular location. If the values are the same, there is an even population size. This means that species are unevenly distributed at the locations although midstream was the most even (0.66) while the lowest evenness was Upstream (0.62). The richness and composition could be influenced by geographical proximity and physico - chemical attribute.

The composition of fish at the various locations in the lake from one another, with the dominance of some species. The highest catch of *Oreochromis niloticus* in the entire chosen location indicate their dominance over other fish species. This is attributed to favorable conditions such as, food availability, high reproductive capabilities. This may also be due to the high population of the fish or the period of its abundance in the lake. The low percentage of other species of fish could be due to the non - conduciveness of the environment.

Downstream (C), which is lowest part of the lake that contributed highest catch

and Upstream the lowest catch can be attributed to their biological and limnological characteristics. In other words, due to ecological changes in the environment, which providing abundant food for fish. [11] also reported highest catch at Stratum III, which represent downstream. Monthly variations in fish catch at the locations were observed in the lake. On the overall, the highest catch downstream in March, April and June, midstream in May and July could be due to the availability of food, period of spawning, migration and water quality amongst others, which enable fish to flourish. This could also be the reasons for monthly fluctuations in catch within locations during the period of study.

CONCLUSION

Cichlidae, Mochokidae and Clariidae were the dominant of all the 15 families recorded. There was low fish diversity in the lake on the overall as well as families because the most had only two (2) species.

Diversity indices showed highest individual fish were recorded at downstream, midstream was the most diverse of the locations. There was uneven distribution of fish population in these locations. Downstream contributed highest catch with *Oreochromis niloticus* as the dominant species caught at upstream, midstream and downstream of the lake. There was monthly variations of fish catch with highest catches at downstream and midstream.

RECOMMENDATIONS

Continuous monitoring of the fishery diversity of the lake should be taken seriously because the species are depleting. There is also the need to monitor the activities as well organize training or workshop on management for fishermen. The findings of this study should be used as guide for further

research on the fisheries of the lake and even other water bodies across the country.

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