

Study of fish exploitation pattern of lake Gerio, Yola, Adamawa State, Nigeria

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Abstract

Lack of exploratory data for effective stock management, negligence on the part of the regulatory bodies with regards to data collection have made clear impossible to know precisely how much fish is taken from lake Geriyo daily, monthly, or annually and this has led to decline in the fisheries yield and reduction in the livelihood of the fishermen in this community. An investigation was carried out on Lake Geriyo between the months of April and July 2010 to know the pattern of fish exploitation. A total of fourteen (14) species of thirteen (13) families were identified during the period. The family Claridae is the only family with two species while the other families had only one specie. Mormyrus species were found to have the highest percentage (27.7%) by number while Clarias species had the lowest of 7.54%. The total numbers of species were 1140 species and the corresponding total weights were 198 kg. In the course of the study, fishermen used unregulated mesh sized less than 2 inches. And most of the fish caught were undersized ranging from 0.06 kg to 0.78 kg. The mean catch per unit effort is 3.67. The correlation coefficient, $r=0.734$ which shows that there is a high correlation between the effort and the yield. The Yield $(y)=11.143+3.560$ effort which is an evidence of overfishing.

Keywords: Fish, Exploitation, Pattern, Overfishing, Lake Geriyo

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Introduction

Tropical artisanal fisheries supply a considerable amount of animal protein to people living in developing countries (Bayley & Petrere, 1989). These fisheries are usually less impacting on fish communities than large commercial and industrial fisheries, which employ a greater fishing effort (Welcomme, 1985). Similarly, South America presents a great diversity of freshwater fishes that forms a huge available fishing stock (Böhlke *et al*, 1978; Lowe-McConnell, 1984).

Fisheries and associated activities have been a major way of life in coastal communities in Nigeria. Of an estimated 120 million people in Nigeria, about 1% engages in fisheries and over 24 million Nigerians depend on fisheries for their livelihood (Moses, 2000). Fisheries contributed about 4.5% & 0.5% respectively to the national GDP and export earnings (Moses, 2000). Total export earnings from fish was USD 50 million while the import value was USD 375.03 million in 2001 (Federal Department of Fisheries. FDF, pers.com). Fish provide cheap and quality proteins to Nigerians. However, according to Amao et al, 2006, fish contribute only 36.6 gm per day in the net protein utilization in Nigerian homes, a level still below the recommended requirement by the World Health Organization. This consumption represents only 20%-30% of the total annual protein consumed in inland states and over 80% in coastal communities (FAO, 2000a).

The demand for fish outstrips the local production. Available statistics shows that the growth in fish production is due to the increased activities in aquaculture and artisanal

fisheries. However, the increase has not been able to bridge the demand-supply gap (FAO, 2000). Aquaculture has witnessed some developments over the years with the hundreds and thousands of commercial farms and homestead fish ponds.

Nigerians consume some 1.3 million metric tons of fish a year including up to 700,000 metric tons of imported frozen fish (Miller, 2004). According to aquaculture and inland fisheries project newsletter, April 2004, Nigeria has 14 million hectares of inland water much of which lack proper management. Nigeria could be self sufficient in fish production and be a major exporter of fish if the over 14 million hectares of Nigeria's inland water bodies are developed and properly managed (Abiodun et al, 2005).

Rivers are rich aquatic ecosystems that are coming under an increasing amount of strains from human exploitation. Humans have developed a general attitude that most water exist to provide us with something. Rivers are no exception to this and are suffering directly and indirectly from the increasing pressure of man's resource exploitation. Unfortunately, strategies for managing the exploitation of fisheries resources have too often been aimed at short term gain, ignoring the long term consequences of human activities in order to maintain a sustainable usable yield from the water and associated ecosystems. It is important to realize that fish are not infinite resource. They require good long term management and protection from over exploitation.

Most artisanal Fishermen in Nigerian rivers exploit a large number of fish species using a range of fishing gear (consisting of lines, nets and traps), each adapted to particular species life stages and habitats. Use of the gear varies from season to season in such a way that nearly all life stages of species are vulnerable to capture. This type of multi species, multi gear fishery is especially difficult to survey and does not yield readily to standard mesh dependent methods of control.

The growing population density put pressure on inland fish resources and has tended to increase over the whole continent over the last 20 years (Welcomme, 2003). As fishing effort increases, fishing impacts, fish assemblages by successively eliminating the large individuals and without good management, leading to a decline in fish production in the subsequent fishery exploitation. Unfortunately, the history of management of inland fisheries worldwide shows generally low success rate in containing the growing pressure on fish stocks. This was mainly because of the centralized nature of the traditional managements whereby all the natural waters were regulated by the central governments with little attention to the differing biological and ecological needs of the fish stocks and the social and economic conditions of the fisheries.

Fishing is one of the most important and valuable marine industries. However, there are a number of growing concerns about problems with the management of fisheries resources and fishing methods which are placing excessive strain on the water ecosystems,

including rivers, which are major fishery resources. Some of the concerns are:

The increased capacity to exploit fish stocks due to increased demand and effort (time at river, number of boats) and improvement in fishing technology.

Significant decline in fish stocks seen globally and in Nigeria.

The destruction or alteration of spawning and nursery grounds through fishing practices or coastal development.

The lack of field monitoring for some fisheries and lack of information on the many species fished.

The death of many non commercial species or by-catch in some fishing fleets such as turtles. Changes in the structure of fish populations by reduction in the numbers of grazing fish or predator species may adversely affect the ecology of freshwater habitats and there is a need for some knowledge in this area.

Unsound fishing methods-trawling is regarded as one of the most environmentally dubious fishing methods.

It is estimated that 70% of the water resources is trawled at least once a year, impacting in the bottom living (benthic) communities. Compared to other fishing nations, Nigeria appear to be lagging in development of selective fishing gear.

Lack of exploratory data for effective stock management, negligence on the part of the regulatory bodies with regards to data collection have made clear impossible to know precisely how much fish is taken from lake Geriyo daily, monthly, or annually. Therefore, lack of substantial data implies poor

management. And the trend of fish catches is on the decline due to over harvesting among other factors. According to Millennium Ecosystem Assessment (2006), capture fisheries nationwide is undergoing stock depletion.

Illegal, unreported and unregulated (IUU) fishing is an economic problem that takes place in lake Geriyo. It occurs in virtually all fisheries given that some fishermen don't report their catches, their level of fishery is hard to quantify. However catches of some species are thought to be many times more than the permitted level due to IUU fishing. IUU fishing includes:

- Fishing in contravention of laws and regulations of a community, state, country or an international agreement.
- Misreporting catches to the relevant authority.
- Fishing in a way that undermines management effects to conserve species and ecosystems.

IUU fishing is often an organized criminal activity, professionally coordinated and truly global.

Indiscriminate fishing is another problem. In many cases by-catch cost fishers time and money. By-catch may be defined as anything the fisherman does not intend to catch at and may include the turtles, crabs, sharks, weed, fish, seabed debris (Earys, 2005). Sometimes this is called incidental or accidental catch. This contribute to already critical problem of overfishing, jeopardizing future revenue, livelihoods and long term food security. It is also a major killer of fisheries, putting several species at risk of extinction and drastically altering the sensitive balance of

water ecosystem. Similarly, discard is also a problem because the by-catch are released or returned to the river either dead or alive. The live ones released are somehow stressed. These problems make the conservation and management of the fisheries resources impossible.

The need to study the exploitation pattern at the lake Geriyo is highly imperative. It has been estimated that most of the world's major inland fisheries are now at their maximum level of exploitation (FAO, 1995). Furthermore, Welcomme and Bartley (1997) have indicated that catches from inland fisheries are in decline due to the deteriorating quality of the aquatic environment and poor management.

The information on the exploitation pattern at the lake Geriyo reveals the need for the conservation of the fisheries resources available for a long term sustainable exploitation because in recent years, there has been growing concern that the fisheries of north-eastern Nigeria have been increasingly overexploited (Sagua, 1989; Neiland et al, 1990; NEAZDP, 1991), leading to a reduction in socio-economic benefits for local communities and the regional economy in general. Lake Geriyo is not an exception to this. A combination of factors was thoughts to be responsible. Firstly, environmental change caused by Sahel drought and dam construction has resulted in lower fish production. Secondly, an intensification of fishing effort has been brought about by increasing commercialization, the introduction of modern gears and a breakdown of management in places.

As the human population increases the demand for fish protein increases even in exponential manner with the concomitant increase in the exploitation of fish in the natural habitat (Tobor, 1974). The desirous need to meet the demand of the teeming population leads to overexploitation of the fish in the water which often leads to inappropriate and unfriendly fishing techniques which exacerbates the decline fish yield.

Exploitation ratio gives picture of the status of a fish stock as to whether it is over fished or not on the assumption of an exploitation optimum E_{opt} of 0.5, which in turn on the basis that sustainable yield is optimized when fishing mortality coefficient is equal to natural mortality coefficient. Studies in exploitation level of fisheries in Nigeria are scarce.

One of the banes of tropical artisanal fisheries management (Gulland, 1982) is that the problem may not be unconnected among other things, with the lack of information as to population biology of the species in question, which is essential for taking management decisions. The fishery in Lake Geriyo is not an exception. Therefore the study objectives are:

- Finding out the rate of exploitation in the study area.
- The species of fish that is mostly exploited in the study area.
- The total weight of the fish species exploited in the study area.

The fishery of Lake Gerio provides employment to thousand consumers and protein to many more people living around the lake. Lake Geriyo is the lake which is flooded by the River Benue. Lake Geriyo occupies natural depression near the upper Benue River

in North Eastern Nigeria. The lake is flooded by the river during the raining season spanning the months of May to September. Fishing activities in the lakes and river provides fish for consumption by the local communities. Lake Geriyo is a natural lake situated between latitude 9 40'-10 55' north and longitude 12 20'-14' west. The lake Geriyo is about 250 hectares in size with intensive irrigation farming around it. The climate which has a total rainfall of about 60-80 cm, the study region area is about 1,548 km². The major commercial genera are *Clarias/Tilapia*. The total volume of traded fish per year is very low due to the pattern of exploitation of the fishery resources in the lake.

According to the information from the head of the local fishermen, 'Sarkin Ruwa', the lake was formed naturally from the River Benue that was cut off as a result of heavy siltation about 60 years ago, thereby forming a small gully. The gully was later filled with water from the rains and river Benue. It is a shallow water body with a mean depth of about 2 metres. Aquatic vegetation on the lake consist of mass of flooding weeds such as water hyacinth, typha grass, water lily and wild guinea corn which move around the lake surface according to the prevailing winds.

River Benue originates from the Cameroon, flows through Fufore, Yola NRS, Girei, Demsa, and Numan local Government areas down to Taraba state. Also Lake Geriyo's location is Jimeta-Yola North, has area of about 15 hectares and rich in fish.

Materials and Methods

The study was carried out during the month of April, 2010, from the 17th to 27th

when the lake was opened for fishing activities annually by the local authority (The Emirate Council). The survey relied on the fish catch from local fishermen during the fishing exercise, the different species that are exploited, and the number of canoe, the number of different species that are caught by the fishermen and the weight of the fish species at the landing site.

At the landing site, the fishermen were hauling the fish manually by recovering the net and entangled fish into the canoe. On landing, the fish were sorted out species by species. And the name of the species were recorded using the binomial nomenclature, a system whereby two names are given to fish, that is the generic name and the specific name. The identification of the different species was done using the work of Tobor et al (1979) and Schneider (1990). The weight of fish species found during the exercise were measured using the weigh balance and different weights of the species of fish sampled were recorded at the landing site.

Identification of fish to species level was made possible through the keys of Reed et al 1967, Tobor 1968, Blanches et al, Schneider, 1990. The fish catch were weighed specie by specie, the number and weight of the fish species measured and recorded were tabulated. The gears mostly used by the fishermen were cast nets. It was also noted that there are some fishermen who did not have canoe but have to wade in water and engage themselves in fishing. Furthermore, informal interview and discussion were conducted to obtain information on the fish species caught, their

local name and the preservation, processing and marketing.

Results

Table 1 shows the fish species and their families encountered in the course of study at the Lake Geriyo. A total of fourteen (14) fish species, representing thirteen (13) families were identified. The table also showed that the family *Clariidae* is the only family with two species, that is *Clarias* and *Heterobranchus* species. The other families in the table has one specie each and the other families are *Centropomidae*, *Gymnarchidae*, *Osteoglossidae*, *Clariidae*, *Citharinidae*, *Cichlidae*, *Distochontidae*, *Bagridae*, *Characidae*, *Cyprinidae*, *Malapteruridae*, *Mockokidae*, and *Mormyridae*.

Table 2 shows the number and percentages of fish species exploited per day based on sampling from canoes. From the Table 3.2, the highest number of fish species sampled were found to be *Citharinus* with 210 followed by *Clarias* with 199. Others are *Tilapia* (125), *Distichodus* (121), *Auchenoglanis* (120), *Synodontis* (116), *Labeco coubie* (61), *Heterotis niloticus* (57), *Hydrocynus* (54), *Malapterurus* (14), *Heterobranchus* (13), *Mormyrus* (11), *Gymnarchus* (6) and the lowest number of species sampled *Lates niloticus* were four (4) in number. Similarly, *Mormyrus* species were found to have the highest percentage by number of fish species sampled and the percentage number were 27.7% while *Clarias* species were found to be the lowest percentage by number of 7.54%.

Table 3 shows the proportion of fish species number exploited for five days due to sampling. The highest number of fish samples representing 217 were caught on day 5 having 19.04% by number and day 3 representing lowest number of fish samples of 189 having 16.58% by number.

Table 4 shows the weight and percentage of fish species sampled. *Heterobranchus*

species were found to have the highest weight of 40.3 kg followed by *Auchenoglanis* (31.4 kg), *Heterotis niloticus* (31.3 kg), *Clarias* (15.3kg), *Citharinus* (12.1kg), *Distichodus* (7.6kg), *Labeco coubie* (7.2kg), *Synodontis* (7.0kg), *Hydrocynus* (5.9kg), *Mormyrus* (4.4kg), *Malapterurus* (2.1kg), *Gymnarchus* (9kg), and the lowest weight is 1.3 kg of *Lates niloticus*.

Table 1: Fish species identified in Lake Geriyo

Species	
Family	<i>Centropromidae</i>
1	<i>Late niloticus</i>
Family	<i>Gymnarchidae</i>
2	<i>Gymnarchus spp</i>
Family	<i>Osteoglossidae</i>
3	<i>Heterotis niloticus</i>
Family	<i>Claridae</i>
4	<i>Clarias spp</i>
5	<i>Heretobranchus spp</i>
Family	<i>Citharinidae</i>
6	<i>Citharinus spp</i>
Family	<i>Cichlidae</i>
7	<i>Tilapia spp</i>
Family	<i>Distochodontidae</i>
8	<i>Distichodus spp</i>
Family	<i>Bagridae</i>
9	<i>Auchenoglanis spp</i>
Family	<i>Characidae</i>
10	<i>Hydrocynus spp</i>
Family	<i>Cyprinidae</i>
11	<i>Labeco coubie</i>
Family	<i>Malapteruridae</i>
12	<i>Malapterurus spp</i>
Family	<i>Mockokidae</i>
13	<i>Synodontis spp</i>
Family	<i>Mormyridae</i>
14	<i>Mormyrus spp</i>

Table 2: Number and percentage of fish species exploited per day

S/No	Species	Day 1		Day 2		Day 3		Day 4		Day 5		Total	Total
		No	%	No	%	No	%	No	%	No	%	No	%
1	<i>Lates niloticus</i>	1	25	-	-	1	25	1	25	1	25	4	100
2	<i>Gymnachus spp</i>	2	33.33	-	-	3	50	1	16.67	-	-	6	100
3	<i>Heterotis niloticus</i>	12	21.05	10	17.54	9	15.79	15	26.32	11	19.30	57	100
4	<i>Clarias spp</i>	46	23.11	40	20.10	43	21.61	55	27.64	15	7.54	199	100
5	<i>Heterobranchus</i>	5	38.46	3	23.08	2	15.39	1	7.69	2	15.38	13	100
6	<i>Citharinus spp</i>	49	23.33	39	18.57	34	16.19	50	23.81	38	18.10	210	100
7	<i>Tilapia spp</i>	25	20	20	16	18	14.4	37	29.6	25	20	125	100
8	<i>Distichodus spp</i>	26	21.49	30	24.79	17	14.05	32	26.45	16	13.22	121	100
9	<i>Auchenoglanis</i>	23	19.17	25	20.83	20	16.67	28	23.33	24	20	120	100
10	<i>Hydrocynus spp</i>	11	20.37	9	16.67	8	14.81	12	22.22	14	25.93	54	100
11	<i>Labeco coubie</i>	13	21.31	20	32.79	5	8.19	8	13.12	15	24.59	61	100
12	<i>Malapterurus spp</i>	3	21.42	2	14.29	-	-	7	50	2	14.29	14	100
13	<i>Synodontis spp</i>	31	26.72	16	13.79	29	25	18	15.52	22	18.97	116	100
14	<i>Mormyrus spp</i>	-	-	3	27.27	-	-	5	45.46	3	27.27	11	100

Table 3: Proportion of fish species by number exploited per day

	Day 1	Day 2	Day 3	Day 4	Day 5	Total
Total Number of fish sample exploited	247	217	189	270	217	1140
Percentage	21.67	19.04%	16.58%	23.68	19.04%	100.00%

Table 4: Weight and percentage of fish species exploited per day

S/No	Species	Day 1		Day 2		Day 3		Day 4		Day 5		Total	Total
		Wt kg	%	Wt kg	%	Wt kg	%	Wt kg	%	Wt kg	%	No	%
1	<i>Lates niloticus</i>	0.3	23.08	-	-	0.1	7.69	0.4	30.77	0.5	38.46	1.3	100
2	<i>Gymnachus spp</i>	0.6	31.58	-	-	0.8	42.10	0.5	26.32	-	-	1.9	100
3	<i>Heterotis niloticus</i>	8.4	26.84	7.8	24.92	3.9	12.46	7.1	22.68	4.1	13.10	31.3	100
4	<i>Clarias spp</i>	4.1	26.80	3.0	19.61	3.2	20.92	4.6	30.06	0.4	2.61	15.3	100
5	<i>Heterobranchus</i>	14.8	36.72	9.4	23.33	6.3	15.63	3.1	7.69	6.7	16.62	40.3	100
6	<i>Citharinus spp</i>	2.2	18.18	2.1	17.36	1.8	14.88	4.0	33.05	2.0	16.53	12.1	100
7	<i>Tilapia spp</i>	6.1	20.20	5.0	16.56	4.6	15.23	8.6	28.48	5.9	19.53	30.2	100
8	<i>Distichodus spp</i>	1.6	21.05	1.8	23.68	1.0	13.16	2.3	30.26	0.9	11.84	7.6	100
9	<i>Auchenoglanis</i>	5.9	18.79	6.6	21.02	5.1	16.24	7.5	23.89	6.3	20.06	31.4	100

Continue table 4

10	<i>Hydrocynus spp</i>	1.2	20.34	1.0	16.95	0.9	15.25	1.3	22.03	1.5	25.43	5.9	100
11	<i>Labeco coubie</i>	1.5	20.83	2.2	30.56	0.8	11.11	1.0	13.89	1.7	23.61	7.2	100
12	<i>Malapterurus spp</i>	0.5	23.81	0.3	14.29	-	-	1.1	52.38	0.2	9.52	2.1	100
13	<i>Synodontis spp</i>	2.0	28.57	1.0	14.29	1.7	24.28	1.0	14.29	1.3	18.57	7.0	100
14	<i>Mormyrus spp</i>	-	-	1.2	27.27	-	-	2.0	45.46	1.2	27.27	4.4	100

Table5: Proportion of fish species by weight exploited per day (kg)

	Day 1	Day 2	Day 3	Day 4	Day 5	Total
Total Weight of fish sample exploited	49.2	41.4	30.2	44.5	32.7	198
Percentage	24.85%	20.90%	15.25%	22.48%	16.52%	100.00%

Table6: Catch per unit of effort in Lake Geriyo

Day	Effort	Yield (kg)
Day 1	14 Boats	49.2
Day 2	10 Boats	41.4
Day 3	9 Boats	30.2
Day 4	11 Boats	44.5
Day 5	10 Boats	32.7
Total	54 Boats	198.0

Discussion

The rate of fisheries exploitation at the lake Geriyo is seasonal. *Citharinus* were found to be most abundant in terms of number. Therefore they were mostly exploited during the oeriod of the finding. This may be due to their fast grwth which exhibit in lakes than in rivers because of phytoplankton which they eed upon are more abundant in lakes than in rivers. Also it may be due to their activeness in the morning than in the night (Idodo-Umeh, 1987). And all the sampling were done in

the morning. *Clarias* were also found to be in abundance. It may be due to the closeness of their breeding period which usually start from May to August.

Distichodus species were also abundant. They grow faster in lakes than in rivers and they are also daylight feeders. And due to their habit as daylight feeder, they are get caught by the fishermen, fishing in the morning (Lewis, D.S.C. 1974).

Auchenoglanis species were also to be abundant in the morning during the course of the eby the fishermen react by reducing their mesh size (Ligvoet and Mkumbo, 1991). And research. This may be due to the fishing activities that have taken place over the night till day break because *Auchenoglanis* feed mostly at night.

Lates niloticus were found to be the lowest abundant species during the research with a total number of four (4) for all the days. This low number might be because of the intense fishing activities in the past which led to its decline in number because it has a high value as human food.

The low number of *Gymnarchus* might be due to the absence of natural diet which led to the adult feeding on the young because the adult are piscivorous, feeding only on fish and where this is absent they become cannibalistic, eating their young ones which would have otherwise been good for recruitment. It might be due to the fact that it is the most highly prized fish, hence it becomes the target of the fishermen. Therefore leading to the reduction in population because of overfishing. *Mormyrus* species are also not in abundance. And this might be due to their bottom dwelling and feeding nature.

Furthermore, the fish species mostly exploited in the study area were *Citharinus* species. And water pollution around the lake also affecting the ecosystem of the water negatively. Similarly, most of the fishermen were using small mesh sized gillnet because most of the fish species caught were smaller in size. This is an

evidence of overfishing when as Reverend Malthus (1766-1834) put it in the term Malthusian Overfishing that too many fishermen were chasing too few fish due to the decline in fish catch and the fishermen now fish with aggressiveness through mesh size reduction. According to the table 6, it was discovered that a total of 54 canoes and 79 fishermen were counted for the period of the study which yield a total weight of 198 kg of fish exploited in the lake.

It was observed at the lake Geriyo that the exploitation pattern of the fisheries resources were not encouraging. It was seen that the fish caught were small in size ranging from 0.06 kg to 0.78 kg, the fishermen were using small mesh size net, no preservation or processing facilities were found around the lake and the regulatory measures were not effective. In view of this the future potential fish yield of the lake is on the threat due to depletion of the stock that is continuous. Therefore, it can be concluded that there is no sustainable fisheries exploitation at the lake Geriyo. And sustainability of fisheries is a responsibility of the fishermen and the collaboration by all stake holders.

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