A study of impacts of fishing pressure on Nile perch fishery on Lake Victoria (Uganda) using fisher folk community collected data

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Abstract

Fishery management on Lake Victoria in Uganda is constrained by lack of an effective fishery monitoring and regulatory mechanism, coupled with inadequate budgetary allocations to the fisheries sub-sector. This has led to high fishing pressure and a decline in the fishery. This paper presents a preliminary analysis of fisher-folk data collected over a period of one year at four landing sites in four districts along Lake Victoria in Uganda under a co-management pilot project aimed at addressing some of the problems in the fishing industry. Gear type and size and catch size of Nile perch in the different gear types/sizes was examined. Results indicated a declining fishery. Around 62.7% of the fishing canoes that target Nile perch on the lake were using fishing gears and methods that catch high proportions of immature Nile perch. Around 7.1% of the canoes caught Nile perch that was predominantly immature and illegal. Some 43.4% of the Nile perch in the overall sample was smaller than the size at first maturity for males and around 99.7% was below the size at first maturity for females. Expansion of the project in space and time, together with a revision of the current fishery regulatory law is recommended to improve the fishery management on Lake Victoria.

Key words: Fishing pressure, Nile perch fishery, Lake Victoria-Uganda, co-management

Introduction

The fishing industry makes significant contribution to the welfare of Ugandans in terms of employment, food security, government revenue and foreign exchange earnings. Overall contribution to the gross domestic product (GDP) during the 1990's has been between 2-3% (State of the Environment Report - Uganda 1998). This contribution comes from an estimated annual production of some 200,000 to 250,000 metric tonnes of capture fisheries from a resource base of mainly lakes Victoria, Kyoga, Albert, Edward and George and River Nile and a few of the 165 minor lakes of western Uganda, rivers, dams, ponds and wetlands. Since the late 1980's Lake Victoria has been making the highest contribution (48%) to the country's annual production. However, the sustainability of the fisheries of this lake is uncertain due to unregulated increase in fishing effort leading to high fishing pressure. The fisheries of the lake are declining and fish stocks are being threatened with depletion. Ineffective monitoring, irregular assessment of the state of the fishery and lack of enforcement of fishery regulations abet high fishing pressures.

Commercial fishermen using prohibited fishing gears and methods are landing immature fish. Use of large mesh sized gillnets has been declining while that of small sized gillnets is on the increase. There is a marked presence of destructive fishing gears and methods. Number of gillnets of 203 mm have reduced from 45% in 1989 to only 2.7% in 2000. Around 23.2% of the fishing gears and methods on the lake are gillnets below 127 mm stretched mesh size, beach seines, cast nets and basket traps (Frame Survey 2000 Report; Kamanyi and Okaranoni, 1989).

These gears collectively catch relatively high proportions of immature fish and are indicative of a declining fishery (Ogutu-Ohwayo, 1994; Ogutu-Ohwayo *et al.*, 1997). Fishing effort has been rising, while catches are showing a decline. This suggests that maximum sustainable yield could have been exceeded and the fishery is moving to a state of stock depletion. Figure 1 summarizes the trends in fishing effort and total annual catches from Lake Victoria since 1970. There was an explosive increase in fishing effort in the late 1980's following the apparent explosive increase in stocks after establishment of the Nile Perch. Nile perch, together with Nile tilapia were introduced in Lake Victoria in the late 1950's and early 1960's. They gradually established themselves, with Nile perch becoming the most important in commercial catches by the late 1980's, followed by Nile tilapia (Ogutu-Ohwayo, 1994). Effort rose from less than 4000 fishing canoes in 1988 to over 8000 in 1990 and over 15000 in 2000 (UFD- Frame Survey 2000). Annual total catches also increased explosively. Catches rose from about 55,000MT in 1985 to about 132,000MT (an increase of 140%) in 1989 representing around 32% and 62% respectively of the national production. However, the catches declined after 1989, from 132,000 to 103,000MT in 1994 and have stabilized around that figure despite the increasing effort.

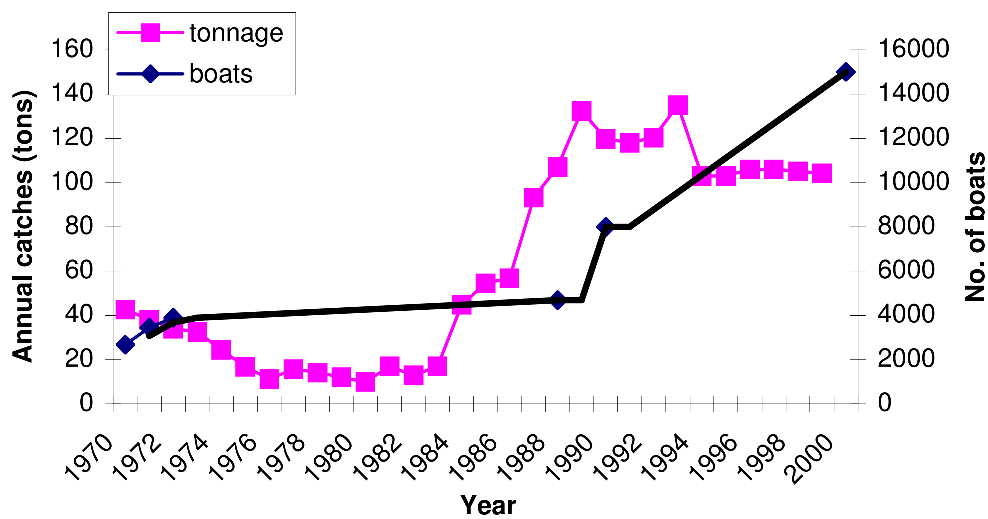

Figure 1. Trends in fish catches and fishing effort

The observed trends in effort and catches pertain to the hypothetical situation described in Sparre and Venema (1992). In a hypothetical situation, increase in effort leads to an increase in catch yields until up to a level of maximum sustainable yield (MSY). Once this level is reached any increase in effort will not result in increase in yields, but may instead result in a decline in yields and catch per unit of effort (CPUE). This indicates that the rate of renewal (individual body growth and recruitment) of the resources cannot keep up with the rate of removal by fishing. Decline in yields and in catch per unit of effort (CPUE) usually leads to fishermen deploying more canoes and a shift to use destructive fishing gears and methods (Ogutu-Ohwayo *et al.,* 1997). The overall result is a condition of high fishing pressure leading to over-fishing and depletion of stocks. There is enough evidence from observations on gear usage and catch/effort trends to suggest that the current commercial fishery is declining and the stocks are heading towards depletion.

High fishing pressure on Lake Victoria is a result of high demand for employment due to rapid population increase in the area (Ogutu-Ohwayo *et al*., 1997). It could also have been a result of high demand for the lake's resources due to improved marketing opportunities on one hand, and a decline in the capture fisheries in Lake Kyoga (Twongo, 1994). However, the main cause of high fishing pressure is lack of an effective mechanism for enforcement and monitoring of fishery regulations, coupled with poor budgetary allocations to the fisheries sub-sector.

The regulatory law (Fish and Crocodile Act of 1951) and the subsequent amendments were enacted without serious consideration to the biological and ecological dynamics of the fisheries resources of Lake Victoria. There are no restrictions on the level of effort. The law is silent on most fishing gears and methods that are destructive to the fishery.

The only prohibition is landing of Nile perch and Nile tilapia of less than 46cm and 28cm total length respectively (Fish and Crocodile Act 1964; Instrument No. 15 of 1981) and use of beach seines. The legally set minimum size of 46 cm for commercial Nile perch landings is less than the size at first maturity.

The fisheries monitoring system leaves a lot to be desired. There is no direct linkage between the collection and management of data on catch and effort and data on observations on the fish in the catches. Lack of integrated data collection and management is a hindrance to assessment of the state of the fishery. Fishery data on catches and effort are deficient in both coverage and reliability. Only estimates of annual yields have been recorded regularly. Other observable aspects like length and weight have not been regularly recorded (Okemwa, 1994). Without such data making sound management decisions is difficult. Observations on catch, effort and the fishery, together with observations on the fish (ecology and biology) in commercial catches can tell the state of the fishery and the effectiveness of the fishery regulations (Witte and Densen, 1995). A reduction in average size of fish in commercial catches would mean over-exploitation (Okemwa, 1994). Appropriate management decisions such as introduction of catch quotas; minimum mesh size, closed areas and socio-economic controls can only be taken based on such observations.

The Fisheries Resources Department (FRD), which is mandated with sustainable management of the fisheries resources, lacks adequate resources (personnel, financial and technical resources) to efficiently carry out its obligations. The department is quite often under-funded, and as a result operates below par. Functions such as catch data statistics are at times neglected (Fisheries Departmental Summary for the Minister in Charge of Fisheries, 1993). Lack of awareness and participation of the fisher-folk in the fisheries management processes makes the situation worse.

In an attempt to find a way to overcome the constraints, the Uganda Fisheries Resources Department - UFRD in 1999, under the Fisheries Management Component of LVEMP decided to undertake a pilot project in which the local fisher-folk were empowered to collect data on the Nile perch, under a co-management arrangement. This was after a recommendation by the 1999 World Bank supervisory team. The project was intended to provide adequate data for assessment of the state of the fishery at reduced costs and also promote fisher-folk participation in management processes of the fishery.

This report presents a preliminary analysis of the impacts of fishing pressure on Nile perch fishery on Lake Victoria in Uganda using data obtained from sampling commercial Nile perch landings by community beach collectors. The study specifically examines the distribution of canoes using different gear types/sizes and the size distribution of Nile perch catches caught by the different gear types/sizes. The report also makes suggestions and recommendations on areas that need improvement in order to achieve the project objective of providing reliable lake wide data for continuous assessment of the state of the fisheries.

Materials and methods

Data collection was done by trained community fisher-folk data collectors during the year 2000 at each of the four landing sites of Misonzi, Namirembe, Kiyindi and Lwanika in Kalangala, Masaka, Mukono and Mayuge (formerly Iganga) districts respectively. The landing sites were selected on the basis of predominance of Nile Perch fisheries and the accessibility of roads by vehicles. Districts were selected in such a way as to give a broad representation of the Ugandan portion of the lake. Two collectors selected directly from each landing site by the landing communities themselves were trained in the basic concepts of fish measurements, sampling, data recording and equipment handling and were left to continue with biometric and fishery data collection. Fisheries staff at the districts supervised the collectors. Fisheries headquarter staff made monthly checks whenever resources could permit to check on progress. Non–qualitative supplementary field data was obtained by direct observations and discussions with various fisher-folk during the headquarter staff monthly supervisory visits. Specially designed data forms were used for this purpose.

The completed data forms were collected monthly and information entered into EXCEL computer program for subsequent analysis using both EXCEL and SPSS computer programs at Makerere University Institute of Statistics and Applied Economics. Gear distribution was determined as percentage numbers of fishing canoes using a particular gear type/gillnet size. Data on total length of fish caught in each gear type/gillnet size were sorted into 3 cm class interval length-frequency distributions.

Results

A total of 5451 fish specimens were sampled from 464 fishing canoes. Gear encountered in the sample included gillnets, hooks and “other gears”. “Other gears”, wherever mentioned refers to basket traps, beach seines and cast nets. Gillnets are the most common gear in the current fishery, with gillnets of 127 mm as the most abundant. Gillnets account for 93.4% of all the canoes that were sampled; and of the 93.4%, 54.7% are gillnets of 127 mm. The rest of the gear accounted for only 6.6%; i.e. hooks, 4.7% and “other gears”, 1.9%.

The distribution of canoes using different gear types/sizes may slightly be different. Some fishermen who land fish using gillnets of less than 127 mm mesh size and “other gears” tended to hide, falsely declare, disguise them with other gear and/or at times land away from authorized landing sites for fear of their gear being confiscated by policing authorities. There was also a tendency for locally woven gear to have varying size of meshes within the same net. A number of fishermen used gillnets of different mesh sizes in a single round of fishing.

Fish specimens ranged from an average size of 21 cm TL to over 100 cm TL; the most common size of fish, i.e. the modal size fell between 48 and 51 cm TL; and the average total length was 46.9 cm. All the length frequency distributions of catches from each gear type/ size and for the whole sample tended to have normal distribution and each has its own specific distribution characteristics. The numerical values of the distribution characteristics of Nile perch from the different gear types/sizes generally became smaller and smaller when moving from hooks and large mesh sized gillnets towards small mesh sized gillnets and "other gears" and vice -versa. The upper and lower values of the size range of Nile perch catches dropped from 30 - 100 cm for hooks to 21 – 48 cm for "other gears". The size of Nile perch at the modal class dropped from 84 – 87 cm for hooks to 30 – 33 cm for "other gears". The average size of the catches dropped from 87.2 cm TL for hooks to 32. 2 cm TL for "other gears."

Analysis of catch size distribution showed that there was a relationship between the size of Nile perch caught and the distribution of the gear types/sizes being used in the current Nile perch fishery. A plot of average size of fish in centimetres against the mesh size of gillnet in inches tended to a linear relationship (Figure 2), with a linear-regression curve equation: $y = 8.571 + 6.756x$, S.E.= 1.06 and $r = 0.954$.

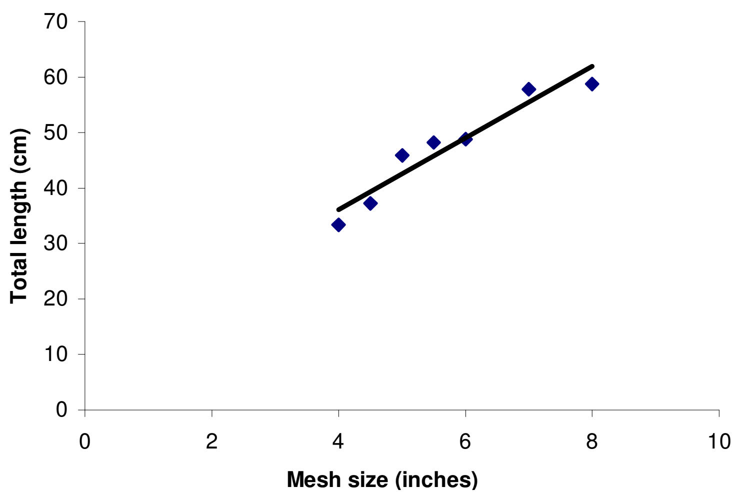

Figure 2: Gillnet mesh size/ total length relationship

The distribution of fish of small size groups could be different from what has been recorded. Most fishermen would come with fish already separated from the nets. The small fish of non-commercial value was usually thrown back into the lake as by-catch. The target market tended to dictate the minimum size declared by the fishermen.

Discussion

In fisheries management, the size limit of fish that should be cropped is normally set at size at first maturity, that is, the size at which 50% of the members of that species are mature (Beverton and Holt, 1957). This allows 50% of the fish to breed before they are harvested. The size at first maturity for Nile perch is 50 cm total length for males and 95-110 cm for females (Ogutu-Ohwayo, 1988). The regulatory law in Uganda, the Fish and crocodile Act CAP 254, 1951 and subsequent amendments, puts the size limit of fish to be landed by commercial fishermen at 46 cm TL. The fishery law also prohibits use of beach seines and trawl fishing on Lake Victoria waters. Therefore, landing of Nile perch below 46 cm TL and use of beach seines in commercial fisheries is both destructive and illegal. Also, many research scientists (e.g. Ogutu-Ohwayo, 1988; Ogutu-Ohwayo, 1994;) strongly discourage use of basket traps, cast nets and gillnets of less than 5 inches stretched mesh size. These fishing gears and methods are also destructive to the fishery.

Despite the existing law and the scientific research recommendations immature and illegal sized Nile perch are being landed by commercial fishermen in canoes using prohibited and discouraged fishing gears and methods, in large quantities.

This study shows that a fairly high proportion (43.4%) and almost 100% (99.7%) of the Nile perch are caught below size at first maturity for Nile perch males and females respectively; and around 31.2% are caught below the minimum legally permitted size. The proportions of immature and illegal sized fish varied from one gear type/gillnet size to another.

Gillnets of less than 127 mm mesh size and "other gears" caught very high proportions of immature and illegal sized Nile perch, with an average of 90.5% and 84.2% of the catches smaller than 50 cm TL and 46 cm TL respectively; and all the catches were below 95 cm TL. These gears constituted 7.1% of the fishing canoes in the sample. Gillnets of 127 mm, 139.7 mm and 152 mm caught fair proportions of immature and illegal sized Nile perch, with an average of 30.6% and 27.3% of the catches smaller than 50 cm TL and 46 cm TL respectively; and all the catches were below 95 cm TL. These gears constituted 76.9% of the fishing canoes in the sample. Gillnets of 177.8 mm and 203.2 mm and hooks caught quite low proportions of immature and illegal sized Nile perch, with an average of only 8.1% and 6.8% of the catches smaller than 50 cm TL and 46 cm TL respectively; and at least 7.4 % the catches were above 95 cm TL. These gears constituted 15.9 % of the fishing canoes in the sample.

The use of gillnets of less than 127 mm-mesh size and "other gears" should be prohibited. Apart from catching high proportions of immature and illegal sized Nile perch, some of them ("other gears") also disrupt the biological and ecological processes of the fishery during their operation (Ogutu-Ohwayo, *et al.,* 1997). Although Gillnets of 127 mm, 139.7 mm and 152 mm showed fair proportions of immature and illegal sized Nile perch, there is need to find out their impacts on the recruitment potential of the Nile perch.

They are the most popular with the highest distribution among the sampled canoes. Exploitation without research could be dangerous and can lead to gross over fishing. This is more so among the females, which mature at 95- 110cm total length. Gillnets of more than 152 mm and hooks have been shown to catch quite good Nile perch their use should be encouraged, if possible the users could be given economic incentives.

Excessive use of gears that catch large numbers of small sized fish is not only destructive to the fishery but also leads to reduced overall catch yields. The results have shown that the average size of individual Nile perch generally became smaller and smaller when moving from hooks and large mesh sized gillnets towards small mesh sized gillnets and "other gears" and vice -versa (Table 1). Regression analysis on gillnet mesh size and size of fish showed that average total length TL in centimeters increases with increase in mesh size of gillnet M in inches by 8.571 + 6.756M, S.E.= 1.06 and r = 0.954. This implies that the higher the proportion of canoes using small mesh sized gears the higher the number of small sized Nile perch and the poorer the total catch yields. This could perhaps explain the declining levels of annual fish catches despite the increasing effort on the lake.

Table 1: Summary of impacts of different gear types/sizes on size of Nile Perch catches

(key to the table 1 a =gear type/ size; b =average tl; c = % of fish below 46 cm tl; d = % of fish below 50 cm TL; e = % of fish above 95 cm TL

A	B	C	D	E
'OTHER GEARS"	32.2	90	90	0
GN4	33.4	93.2	95.5	0
GN4.5	37.2	69.4	86.1	0
GN5	45.9	32.2	45.5	0
GN5.5	48.2	26.6	48.2	0
GN6	48.8	23.5	35	0
GN7	57.8	4.7	8.5	4.7
GN8	58.8	10	10	0
HOOKS	87.2	5.8	5.8	17.4
WHOLE SAMPLE	46.9	31.2	43.4	0.3

Most management techniques applied in regulation of the fishery are meant to protect the fishery from over-fishing and disruption of biological and ecological processes. The techniques include restrictions on gears and size of catches, closed seasons and areas and restrictions on fishing effort. Very few of these options have been applied on the fisheries of Lake Victoria in Uganda. The lake is more like an open fishery. This relaxed regulatory practice coupled with poor monitoring practices, has resulted in the declining trends in the Nile perch fishery.

The falling trends in annual catch yield despite the rising effort and use of destructive gears and methods and the big proportion of immature and illegal sized Nile perch in the sample is a clear manifestation that the stocks have considerably declined.

The situation is likely to continue unless the constraints that are causing high fishing pressure are checked. This pilot project presents an opportunity for addressing some of the constraints such as lack of fisher-folk participation in the management processes. Most important, it provides a data collection and management system that integrates data on catches and catch per unit effort, and observations on the fish in the catches. There is also urgent need to review the current fishery regulations to include clauses that will protect the Nile perch from the destructive fishing practices.

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