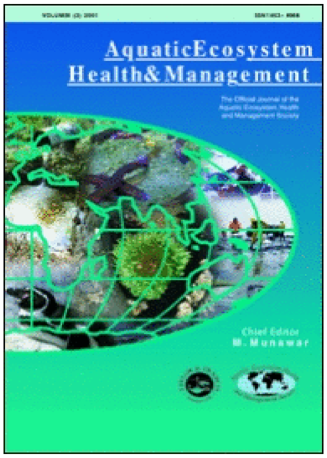

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Towards sustainable exploitation of Nile perch consequential to regulated fisheries in Lake Victoria

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Understanding fluctuations in the abundance and distribution of fishery resources over space and time is fundamental in order to address concerns about their sustainability and the basis for their management. Stock assessment studies were conducted on Lake Victoria from 1997 to 2001, with the aim to assess the status of the stocks, in particular of Nile perch. This paper summarises the findings for the Tanzanian part of the lake and makes reference to the Kenyan and Ugandan national waters for comparison. Both fisheries independent data from bottom trawl surveys and fisheries dependent data from catch assessment and frame surveys were used. Current exploitation levels and practices are analysed and linked to growth, mortality and reproductive characteristics of the stock. Abundance estimates and distribution patterns are discussed in relation to the exploitation levels, and key threats to the sustainability of the resources highlighted. Options are provided for a sustainable management of the Nile perch fishery.

The 2000 frame survey revealed an intensive fishing effort. In addition, the Nile perch fishery was found to depend largely on juvenile fish. The size at first maturity was at 54.3 cm TL (1.6 yr) and 76.7 cm TL (2.5 yr), for males and females, respectively. Over 80% of the commercial catch was below the size at first maturity for males and 99% below that for females. Bottom trawl data (88% juveniles) suggest good recruitment to the stock, but yield per recruit modelling indicates unsustainable exploitation tendencies. The current annual yield (estimated at 138 324 ± 6 229 t) is well above the estimated sustainable level (109 000 t). It is recommended to reduce the exploitation rate by 50% and to increase the size at first capture. Co-management is considered to be the most effective option to implement monitoring, control and surveillance strategies.

Keywords: Stock assessment, Fisheries independent and dependent data, fishing effort and co-management

Introduction

The sustainable use of Lake Victoria's resources is the main objective in the strategic vision of Lake Victoria Fisheries Organisation (LVFO), the organization responsible for coordinating and harmonizing the management of the lake's ecosystem (LVFO, 1999). The information summarised in this paper was gathered within the framework of the Lake Victoria Fisheries Research Project (LVFRP), a European Union funded project active on the lake from 1997 to 2001. The project specifically aimed to

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create and develop the knowledge base required for the rational management of the fisheries of Lake Victoria. Management of the Nile perch as a sustainable resource is crucial for the welfare of the local communities and the national and the international arena at large. Following a five-fold increase in Nile perch (*Lates niloticus* L.) catches in the early 1990s, the fishing industry in Lake Victoria attracted unprecedented levels of national and international capital investment. Nile perch became the backbone of the fisheries in the three countries, contributing more than 60% to the total landings (including the marine sector) (CIFA, 1992). The fisheries of the lake constitute an important source of protein for local communities, a source of foreign earnings through exports. In addition, they have created employment opportunities in the harvesting, processing and marketing sectors of the industry. All investment in the industry was done without prior knowledge of the resource base, and without effective and reliable monitoring systems.

Data collection

Fisheries dependent data

Fisheries Department catch statistics for 1970 to 1995 were used to assess the characteristics and changes in the fishery. These were: annual catch records (t yr^{-1}) together with the numbers, type and sizes of gears used and the number of fishing canoes deployed.

The fishing effort was assessed on the basis of a frame survey conducted in Tanzania in 1998. In 2000, a similar survey was conducted lake-wide, covering 596 landing sites in Tanzania, 597 in Uganda and 297 in Kenya. Such surveys were repeated in 2002 and 2004, but of the latter, only results from Kenya were used.

To establish catches per unit effort (CPUE), and estimate the annual total catch, a catch assessment survey was conducted on a monthly rotational basis at six selected beaches in each of the three regions of Tanzania (Mwanza—Zone A, Musoma—Zone B and Bukoba- Zone C) (Figure 1). Thus, each region was covered once in a quarter from February 1999 to December 2000. Of the six selected beaches, two specialized in catching *Lates niloticus*, two in *Rastrineobola argentea* (Pellegrin) and two in *Oreochromis niloticus* (L.). Depending on the number of active fishing boats and the size of the catch, a maximum number of boats was sampled and there the means of propulsion, type of gear, mesh size and number of nets per boat was recorded. The catch

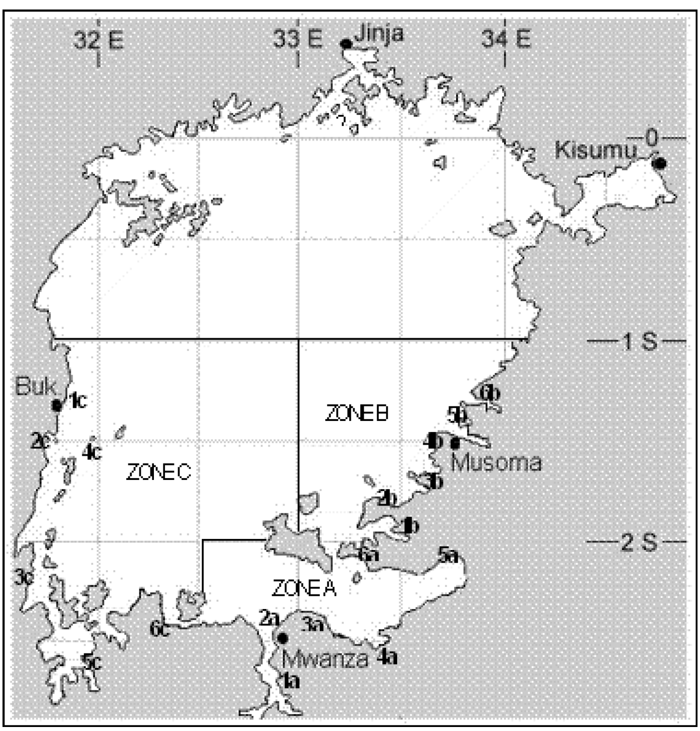

Figure 1. Map of Lake Victoria showing the zonation of Tanzanian waters and the landing sites (see numbers) sampled during the catch surveys of 1999 and 2000.

of each boat was sorted into species and weighed (kg). Lengths and weights of individual fish were recorded and related to the principal gear used. Depending on the volume of the catch, either the total or a sub-sample was measured. The annual catch was estimated as follows:

$$Catch = CPUE_{\text{pergear}} {}^{*}\text{Proportion of boats fishing}$$
$$^{*}\text{Total number of boats recorded}^{*}365\text{days.}$$

Total annual catch was obtained by summing the estimated catch by gear and species. Note that 365 days were used to estimate the total catch as the proportion of operational fishing boats accounted for days when some vessels were not operational.

Fisheries independent data

Fisheries independent data were collected by trawling with a net with a 24 m head rope and a cod-end of 25 mm mesh, pulled by the research vessel *R.V. Victoria Explorer* (length of 17 m and a 250 HP engine). A Garmin GPS Satellite Navigator was used to record the vessel's position and speed. Towing speed was 3.4–3.6 knots and trawling duration was approximately 30 minutes. Sampling stations were allocated within each zone (Figure 1), using gridlines of five nautical miles-squared based on degrees and minutes of latitude and longitude on hydrographical charts. Harmonised surveys with standardised gears were conducted at the same time in the Kenyan (Getabu and Nyaundi, 1999) and Ugandan (Okaronon et al., 1999) waters of Lake Victoria. Two quarterly surveys covering all of the Tanzanian waters were also conducted in November, 2000 and April, 2001.

From the monthly bottom trawl surveys, biological samples were obtained to determine seasonal patterns in the length and age at maturity (Lm_{50}). Individual gonads were removed and sex and maturity status determined based on the Hopson's classification (1972).

Estimation of population parameters

A total of 283,323 fish were measured during fisheries independent surveys between March, 1999 and July, 2000, and 13,507 fish during fisheries dependent surveys from February, 1999 to December, 2000. Data analysis was based on length frequency distributions using the Electronic Length Frequency Analysis (ELEFAN 1) routine of the FiSAT (Gayanilo et al., 1996) and FiSAT II for Windows (Gayanilo and Pauly, 2001) programs.

Summary of results and discussion

Exploitation levels and structure of the fishery

Status of the fishery: Trends in landing statistics and current estimated catch

The contribution of Nile perch to the total landings in the three countries (Figure 2) reflects the evolution of its abundance over time and the exploitation levels (Cowx et al., 2003). In the early 1990s, Nile perch made up 60% of the total landings in Tanzania and this increased to 80% in 1995. By the end of the 1990s, Nile perch contribution declined to a mere 40% and *R. argentea* catches expanded to some 49% of the total estimated catch (Mkumbo, 2002). Haplochromines, which had virtually disappeared from the fishery in the mid 1990s, were again recognised in the catches. CPUE decreased from 110 kg canoe^{-1} in 1988 (Ligtvoet and Mkumbo, 1990) to about 70 kg canoe^{-1} for motorized gillnet canoes in 2000; when canoes with sails and paddles were included, the CPUE dropped to 40 kg canoe^{-1} in 2000. Between 1997 and 2000, catches per net dropped by 67%. The fishers had meanwhile changed their fishing method by reducing the mesh size of their gill nets and by joining nets in vertical panels or by introducing active gillnetting. Such responses typically reflect the declining abundance of a targeted stock (FAO, 2001; Borgstrøm, 1992).

The estimated MSY of 81,947 t yr^{-1} (Mkumbo, 2002) is some 40% lower than the actual catches recorded for 2000 (138 324 $\pm$ 6 229 t), indicating the need for an active management of the fishery. In Kenya, peak production was reached in 1991 with Nile perch contributing 57% to the total landings. Kenya had invested more heavily in the Nile perch fishery, being the first to develop fish processing factories (SEDAWOG, 1999a). As a result, the first decline in Nile perch catches was experienced there. Catches declined from a peak of 122,780 t in 1991 to 61,416 t in 1998. As early as 1995, the contribution of Nile perch dropped to 47%, almost equal to the contribution of dagaa (44%). The CPUE decreased from 180 kg boat day^{-1} in 1989 to 80 kg boat day^{-1} in 1999 (Othina and Tweddle, 1999).

In Uganda, where the industry had developed later, the same decline in Nile perch catches was recorded, although not to the level experienced in the other two countries. Annual yields declined from 120,000 t in 1991 to 103,000 t in 1994 and to about

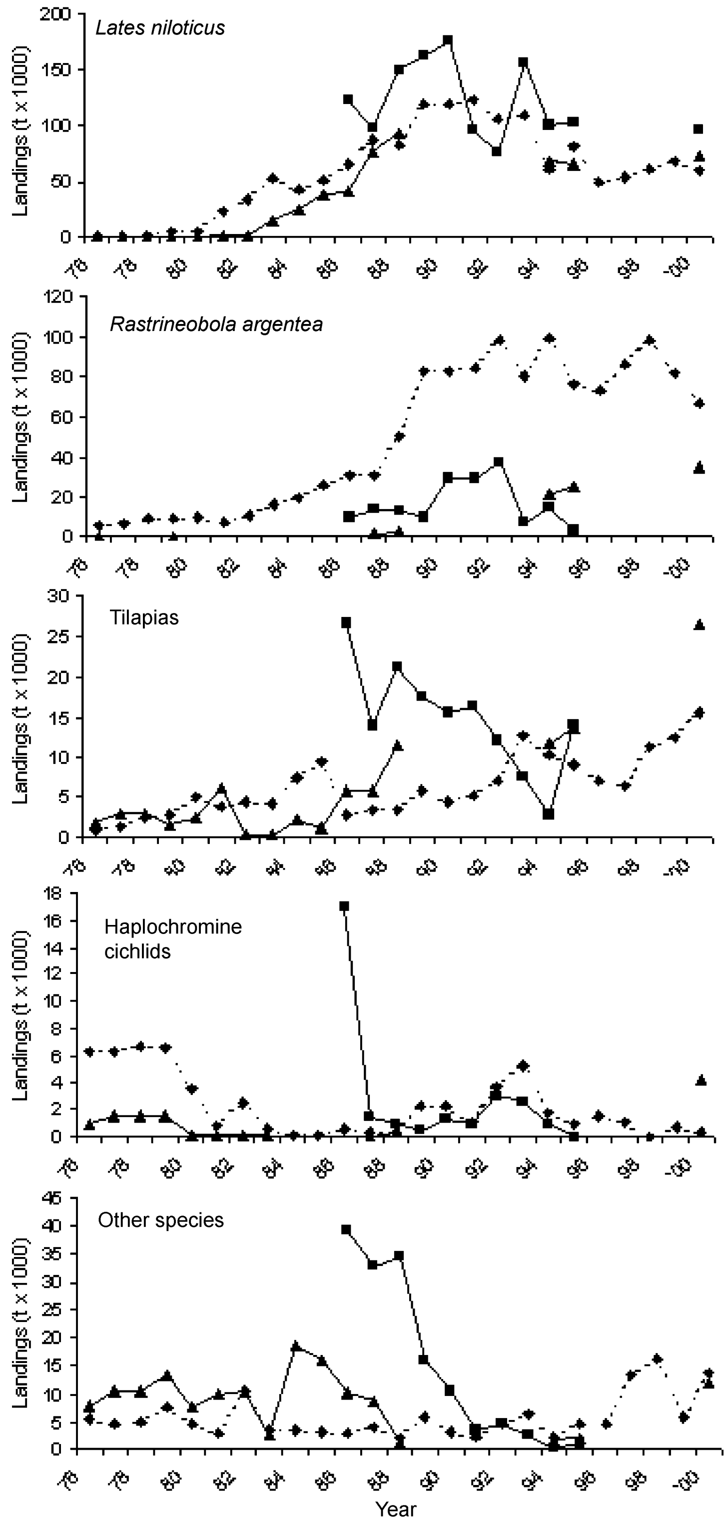

Figure 2. Trends in landings (t) of the main fish species and species groups in the riparian countries of Lake Victoria (♦ Kenya; ■ Tanzania; ▲ Uganda).

72,632 t in 1999, with a CPUE of about 72 kg boat day^{-1} (Okaronon, 1994; Muhoozi and Ogutu-Ohwayo, 1999).

Characteristics and structure of the fishery

Composition and distribution of fishing effort

Fishing effort increased along with the rapid increase in the Nile perch stocks in the 1980s. In Tanzania, the number of canoes (fishing craft) increased from 4,457 in 1979 to 7,757 in 1989, and to 15,533 in 2000, which represented 38% of all (41,091) canoes deployed in the lake (Figure 3). In 2002, the number of canoes further rose to 20,278 (Frame Survey Report, 2003). The same increase was recorded for the other two countries. In Uganda, canoe numbers increased from 8,000 in 1989 to 15,544 in 2000 (38% of the total), while in Kenya an increase was noted from 5,500 in 1989 to 10,014 canoes in 2000 (24% of the total number). Numbers of fishermen and landing sites also increased proportionally. The effort appeared to stabilize in the Kenyan waters between 2002 and 2004 (Figure 3).

The increased fishing effort was also visible in the number of gears used. Gillnets for example increased from 87,778 in 1991, of which 50% where of mesh sizes 7 inches and above, to 226,063 in 2000,

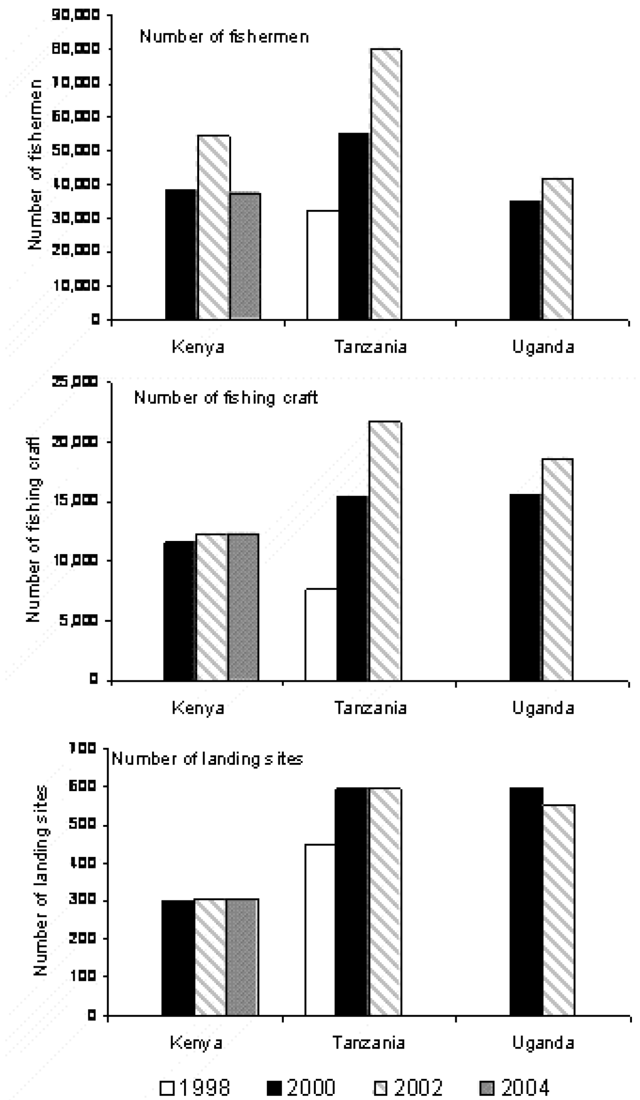

Figure 3. Changes in the number of fishers, fishing craft and landing beaches in different sectors of Lake Victoria between 1998 and 2004.

of which only 15% were of mesh sizes 7 inches and above. In 2002 the number of gillnets almost doubled to 408,236.

Tanzania had most of the long line hooks (2,201,901 = 65%), while Kenya had 28% and Uganda 7% of the total number of 3,443,385 hooks recorded in the 2000 frame survey (LVFO, 2000). These virtually doubled in Tanzania in 2002, when the numbers of long line hooks recorded in frame survey was 4,398,682. Variations in effort between the riparian countries are an important aspect to consider in any attempt to regulate fishing efforts in Lake Victoria.

Population structure and size at maturity

Fisheries independent surveys revealed a predominance of juveniles in the Nile perch population, indicating a good recruitment to the stock (Figure 4; Mkumbo et al., 2002). However, their abundance showed a marked decline in the 2003 surveys (Mkumbo et al., 2003) indicating reduced recruitment.

Almost 98% of the Nile perch caught in bottom trawls was below 54 cm TL. Fisheries dependent surveys indicated that their modal length in gillnets was 43 cm TL, 46 cm TL in long lines and 19 cm TL for the beach seine fishery. The modal length for the legal mesh size of 5 inches was 48 cm TL (Figure 5). Modelling through Virtual Population Analysis indicated that the Nile perch fishery indeed depends on juvenile fish. Highest catches by weight were at 47–50 cm TL, while the maximum yield would be reached at a size of 135 cm TL (Mkumbo, 2002).

The size at first maturity for males was 54.2 cm TL and 76.4 cm TL for females, having decreased from 60 cm TL for males and 95–100 cm TL for females in the early 1990s (Ligtvoet and Mkumbo, 1991). This may well result from over fishing. Long-lived fish species like *L. niloticus* ($t_{max} = 18$ years) sustain very high yields at the beginning of a fishery, but once the size classes are fished down, the stock is not given time to build up (Hilborn and Walters, 1992; Turner, 1996). The current decline in the Nile perch fishery was therefore to be expected, but it is doubtful whether the juveniles will support a sustainable fishery.

Given the high demand for fish from both the factories and the local market, at decreasing catch rates, fishermen have been innovative in modifying catching techniques to increase their efficiency. Gillnets are joined to form nets up to 3 km long, which are dragged through the water from canoes with outboard engines, locally referred to as 'tembea.' Passive gillnetting has thus made way to active fishing, which destroys other passive nets and snags long lines. This practice affects the stocks and is a source of conflict between fishermen (SEDAWOG, 1999b). Gillnets are also increasingly joined vertically; these can be joined up to six panels deep. This represents an enormous increase in effort, which is not noticeable in the frame survey results.

Stock abundance and distribution

In 1999/2000, the Nile perch stock size was estimated lake-wide, using the swept area method, at 685,082 t with an average CPUE of 10 t km^{-2}. The mean standing crop was higher for the Kenyan waters (12 t km^{-2}) than for Tanzania and Uganda (about 10 t km^{-2}). By late 2001, the standing stock had declined to 540,000 t (Mkumbo, 2002). A declining trend in the biomass was also visible in the results of the hydro-acoustic surveys, from 1.6 to 0.89 million tonnes between 2000 and 2001 (Getabu et al., 2003).

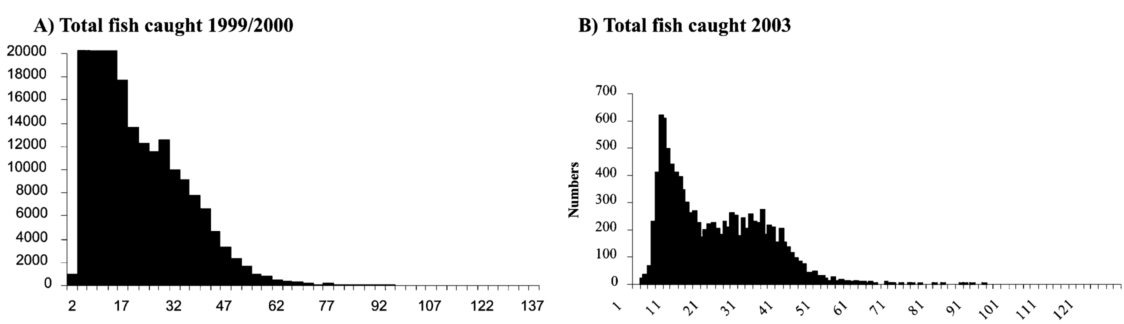

Figure 4. Length frequency distribution of Nile perch caught by bottom trawl in Tanzanian waters during the 1999/2000 (a) and 2003 (b) surveys.

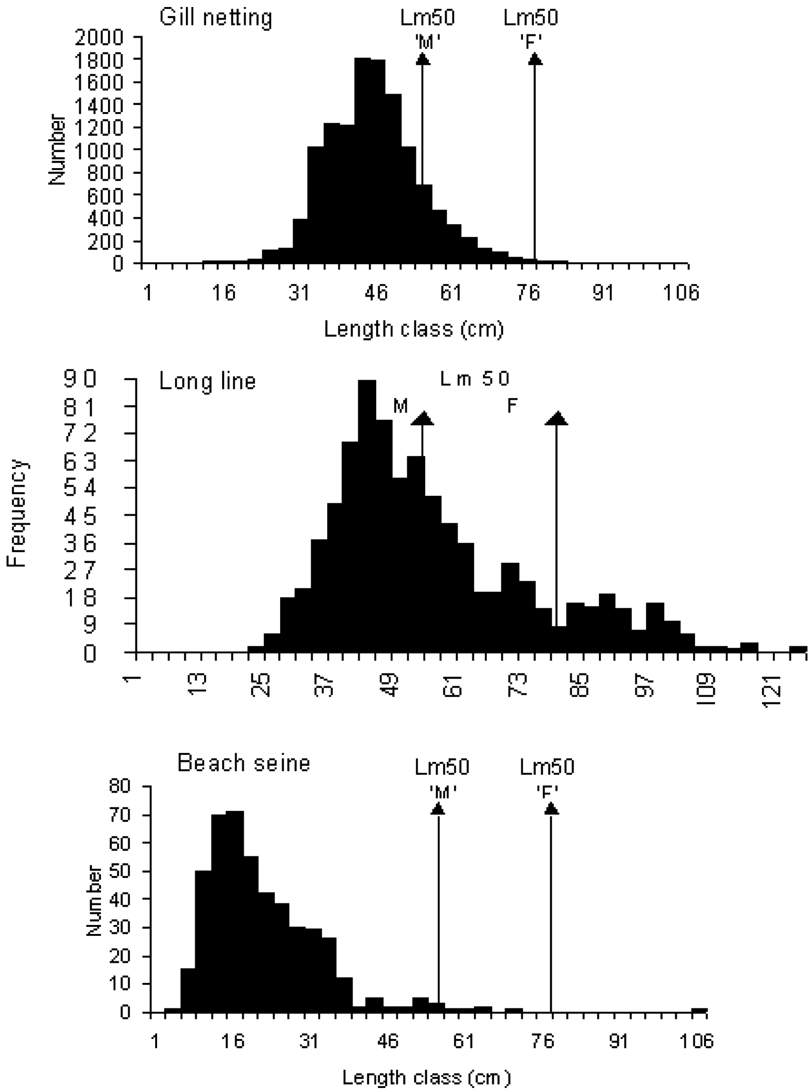

Figure 5. Length frequency of Nile perch caught by the main fishing gears in the Tanzanian part of Lake Victoria.

Before its peak production in the lake in 1985, Nile perch biomass was estimated at 17 t km^{-2} (Moreau, 1995). The current assessment therefore shows a drastic decline in Nile perch abundance, which had effectively been predicted using the ECOPATH IV model (Villanueva and Moreau, 2002). However, the decline was not as severe as predicted by Pitcher and Bundy (1995).

Marked variations in fish densities were observed between different sampling areas and seasons, suggesting a tendency for the Nile perch to aggregate seasonally. This poses another threat as it makes the stock periodically more vulnerable to overexploitation (Hilborn and Walters, 1992). Areas of high densities were localised and quite temporary. Pockets of high density could be found in either very shallow or offshore deep waters, and at different depths in the water column depending on oxygen concentrations (Mkumbo, 2002).

The ability of the Nile perch stock to withstand high fishing pressure over the years, instead of collapsing as predicted is associated with the high turnover or the production/biomass ratio, which has also increased over the years. The dominance of juveniles in the population supports this argument. Because of the high fecundity and the high recruitment rates of the Nile perch stock, which is resilient to fishing, recruitment over-fishing may not be an immediate threat to the fishery. However, increasing the size at first capture will allow more fish to spawn. Continued monitoring is needed for management purposes to understand the dynamics of recruitment, stock size and the effects of fishing.

Management options and strategies for sustainability of the Nile perch fishery

The increases in the intensity of fishing effort and the widespread use of destructive fishing practices present a threat to the sustainability of the Nile perch fishery of Lake Victoria. A variety of regulations designed to rectify this situation are already in place, many of which have been on the statute book for some time. Consideration must be given to augmenting and updating these and in ensuring their implementation, by providing adequate support for the co-management system that is currently being developed. There may eventually be a need for access control.

Control/reduction of fishing effort

Existing regulations call for: (i) a minimal gill net mesh size of five inches (127 mm); (ii) complete eradication of beach seines and other illegal fishing practises, such as tembea fishing; (iii) a slot size for Nile perch (50 – 85 cm TL); and (iv) closed areas and seasons.

Further measures that should be considered include: (i) updating and regional harmonisation of the regulations on closed areas and seasons; (ii) controlling entry to the fishery, such that each boat owner should be allowed a maximum number of canoes, with extra canoes already owned being subject to an increased tax; and (iii) imposing a maximum number of gillnets per boat.

Management options and implementation

Regulations have value only as far as they are observed and, on a lake so large and with a fishery as valuable as in Lake Victoria; this means that effective Monitoring Control and Surveillance (MCS) is essential. Previous MCS regimes on the lake, based on the philosophy of centralised command and control, were unable to cope with the scale or administrative complexity of the task at hand even before the dramatic expansion of the fishery (Fryer, 1972 and 1973). As a result, the riparian states are currently instituting a regionally harmonised system of co-management. This will be based on a lakewide network of Beach Management Units (BMU—local organisations of boat owners, crew and artisanal fish processors operating at the landing sites). These are being encouraged to (i) register all fishers, boats and gears and to undertake the management of the fishery within their immediate area and (ii) to associate into higher level organisations that can both address shared problems and contribute to a wider decision making process that includes other players within the sector (local government, civil society and fish processing factories), as well as central government agencies and research organisations.

Expanding the number of actors in decision making will help many resource users to develop a sense of ownership of agreed regulations, improving compliance, and establish BMUs as an effective body at the grass-roots level capable of enforcing local restrictions and co-operating with higher level MCS efforts.

Conclusions

The aggregation behaviour of Nile perch and its long life span imply that the fishery could be profitably overexploited for an extended period of time, before swiftly and suddenly collapsing. Were such a collapse to occur, this would bring significant social and economic disruption around the lake to the millions of people whose welfare depends on the capture, processing and trade of this fish. It would also pose a threat to the stocks of tilapias and dagaa, as former Nile perch fishers will no doubt switch their effort to target these species.

While the available evidence on stock size and the pattern of recruitment does not suggest that a collapse is imminent, the size composition of the population (fisheries independent data) and structure of the catch (fisheries dependent data) indicate a stock that could become increasingly threatened, if the current level and pattern of fishing efforts were to continue unchecked. The two main driving factors behind this excessive effort are the growing demand for raw material for the export market and the open access system; of these, only the latter can be influenced by management.

Controlling the level and pattern of effort at an appropriate level in such a large artisanal fishery is a major scientific, institutional and social challenge. But it is not insurmountable. Enforcing the slot size regulation and developing an effective MCS system in conjunction with communities under co-management arrangements are important options. But, in the longer term, limits to the levels of effort (boats and gears) through control of access to the lake will be essential.

Acknowledgements

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References

Borgstróm, R., 1992. Effect of population density on gillnet catchability in four allopatric populations of brown trout (*Salmo trutta).* Canadian Journal of Fisheries and Aquatic Science 49, 1539–1545.

CIFA, 1992. Report of the Sixth Session of the Sub-Committee for the Development and Management of the Fisheries in Lake Victoria. 1992 February 10–13, Jinja, Uganda. FAO Fisheries Report 475.

Cowx, I. G., Van der Knaap, M., Muhoozi, L. I., Othina, A., 2003. Improving fishery catch statistics for Lake Victoria. Journal of Ecosystem Health and Management 6, 299–310.

FAO, 2001. *Inland Fisheries: Ecology and Management*. Compiled by R. L. Welcomme. Fishing News Books, Blackwell Scientific Publications Ltd, UK.

Fryer, G., 1972. Conservation of the Great Lakes of East Africa: a lesson and a warning. Biological Conservation, 4(4), 256–262.

Fryer, G., 1973. The Lake Victoria fisheries: some facts and fallacies. Biological Conservation 5, 304–308.

Gayanilo, T. C. Jr., Sparre, P., Pauly, D., 1996. FAO-ICLARM stock assessment tools. User's manual. FAO Computerized Information Series, No. 8: Fisheries.

Gayanilo, T. C. Jr., Pauly, D., 2001. FISAT II version 0.1.0 Software. FAO-ICLARM Fish Stock Assessment Tools. FAO, Rome, Italy.

Getabu, A., Nyaundi, J., 1999. Relative abundance and distribution of fish in Kenyan waters of Lake Victoria. In: I.G. Cowx, Tweddle D. (Eds.), LVFRP Technical Document 7, 63–77.

Getabu, A., Tumwebaze, R., MacLennan, D. N., 2003. Spatial and temporal distribution of fish populations in Lake Victoria. Aquatic Living Resources 16, 159–165.

Hilborn, R., Walters, C. J., 1992. *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainity.* Chapman and Hall, London.

Hopson, A. J., 1972. A study of the Nile perch, *Lates niloticus* (L.), in Lake Chad. HMSO Overseas Research Publications 19, Foreign and Commonwealth Office, London.

Ligtvoet, W., Mkumbo, O. C., 1990. Synopsis of ecological and fishery research on Nile perch (*Lates niloticus*) in Lake Victoria, conducted by HEST/TAFIRI. p. 35–74. In: CIFA Report of the fifth Session of the Sub-Committee for the Development and Management of the Fisheries in Lake Victoria, 1989 September 12–14, Mwanza, Tanzania. FAO Fisheries Report 430.

Ligtvoet, W., Mkumbo, O. C., 1991. A pilot sampling survey for monitoring the artisanal Nile perch (*Lates niloticus*) fishery in southern Lake Victoria (East Africa). In: I.G. Cowx (Ed.), *Catch Effort Sampling Strategies. Their Application in Freshwater Fisheries Management*, pp. 349–360. Fishing News Book, Blackwell Scientific Publications Ltd., UK.

LVFO, 1999. Strategic vision for Lake Victoria (1999–2015). The Lake Victoria Fisheries Organisation, Jinja Uganda.

LVFO, 2000. Results of the first regional frame survey on Lake Victoria conducted in 2000. The Lake Victoria Fisheries Organization, Jinja, Uganda.

Mkumbo, O. C., 2002. Assessment and management of Nile perch (*Lates niloticus* L.) stocks in Tanzanian waters of Lake Victoria. PhD Thesis, University of Hull.

Mkumbo, O. C., Ezekiel, C. N., Budeba, Y. L., Cowx, I. G., 2002. Analysis of exploitation patterns for Nile perch, *Lates niloticus*, in Lake Victoria. In: I. G. Cowx (Ed.), *Management and Ecology of Lake and Reservoir Fisheries,* pp. 84–95. Fishing News books, Blackwell Scientific Publications Ltd., UK.

Mkumbo, O. C., Mlaponi, E., Waya, R., Ezekiel, C. N., Mrosso H. D. J., 2003. Trawl surveys and environmental monitoring in Lake Victoria. LVFO –IFMP Report.

Moreau, J., 1995. Analysis of species changes in Lake Victoria using ECOPATH, a multispecies trophic model. In: T.J. Pitcher, P. J. B. Hart (Eds.), *The impact of species changes in African Lakes,* pp. 137–161. Chapman and Hall, London.

Muhoozi, L. I., Ogutu-Ohwayo, R., 1999. The relationship between boat size and fish catches in the gillnet fishery of Lake Victoria, Uganda. In: I. G. Cowx, D. Tweddle (Eds.), LVFRP Technical Document No. 7, 63–77.

Okaronon, J. O., 1994. Current composition, distribution and relative abundance of the fish stocks of Lake Victoria, Uganda. African Journal of Tropical Hydrobiology and Fisheries 5, 89–100.

Okaronon, J. O., Muhoozi, L. I., Bassa, S., 1999. Current status of the fish stocks of Lake Victoria (Uganda). In: I.G. Cowx, D. Tweddle (Eds.), LVFRP Technical Document No. 7, 10–25.

Othina, A., Tweddle, D., 1999. The status of the artisanal fishery of Lake Victoria, Kenya, with notes on improvements to the catch data collection system. In: I. G. Cowx, D. Tweddle (Eds.), LVFRP Technical Document No. 7, 78–91.

Pitcher, T. J., Bundy, A., 1995. Assessment of the Nile perch fishery in Lake Victoria. In: T. J. Pitcher, P.J.B. Hart (Eds.), *The impact of species changes in African Lakes,* pp. 163–180. Chapman and Hall, London.

SEDAWOG, 1999a. Marketing study of the Working Group on Socio-Economic Data. LVFRP Technical Document No. 2.

SEDAWOG, 1999b. The survey of Lake Victoria's Fisheries. Working Group on Socio-Economic Data. LVFRP Technical Document No. 5.

Turner, G. F., 1996. Maximization of yields from African lakes. In: I. G. Cowx (Ed.), *Stock Assessment in Inland Fisheries*, pp. 465–481. Fishing News Books, Oxford.

Villanueva, M. C., Moreau, J., 2002. Recent trends in the Lake Victoria fisheries assessed by ECOPATH. In: I. G. Cowx (Ed.), *Management and Ecology of Lake and Reservoir Fisheries*, pp. 96–111. Fishing News Books, Oxford.