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Challenges for Management of the Fisheries Resources, Biodiversity and Environment of Lake Victoria

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Fisheries Resources Research Institute

Technical Document No. 2 First Edition - 2004

IDRC CANADA

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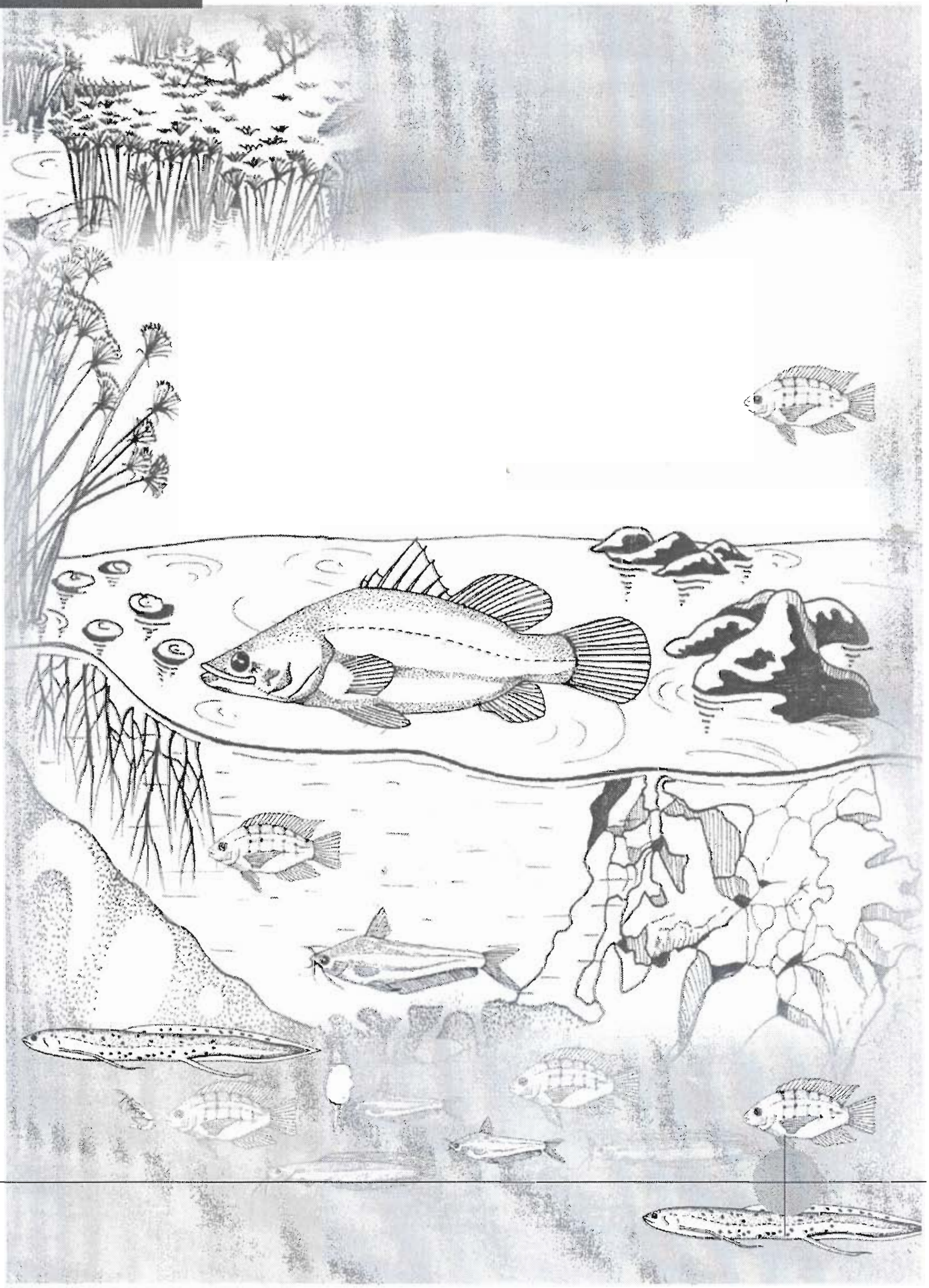
First Edition 2004
FIRRI, Jinja Uganda.

CHAPTER THREE 3

The History of Fish Communities, Biodiversity and Environment of Lake Victoria and the Lessons Learnt



3. The History of Fish Communities, biodiversity and environment of Lake Victoria and lessons learnt

R. Ogutu-Ohwayo and J.S. Balirwa

Introduction

The first fishery survey of Lake Victoria was conducted between 1927 and 1928 (Graham1929). At that time, the lake had a diverse fish fauna and the fishery was dominated by two endemic tilapiine cichlids; *Oreochromis esculentus* (Graham 1929) and *O. variabilis* (Boulenger 1906). There were a number of other species such as *Protopterus aethiopicus* Heckel 1851, *Bagrus docmac* (Forsk.) 1775, *Clarias gariepinus* (Burchell), *Barbus* species, mormyrids, *Synodontis* spp, *Schilbe intermedius* (Linn.) 1762 and *Rastrineobola argentea* Pellegrin, 1904 that were also abundant in the lake most of which made a significant contribution to the fishery (Graham 1929, Worthington 1929, 1932, Kudhongania & Cordone 1974). Haplochromine cichlids were represented by at least 300 species more than 99% of them endemic (Greenwood, 1974; Witte *et al.*, 1992 a & b). The fishery of Lake Victoria was similar to that of lakes Kyoga and Nabugabo (Worthington 1929; Trewavas 1933; Greenwood 1965, 1966; Beadle 1962, 1981).

There were also important fisheries on the inflowing rivers of Lake Victoria, the most important of which were *Labeo victorianus* and *Barbus altianalis* (Cadwallader 1965). The small sized species notably *Rastrineobola argentea* and haplochromines cichlids were not originally commercially exploited.

Human exploitation trends and their impacts

There have been major changes in the fishery of Lake Victoria since the beginning of the 20th century. Originally the fishery was exploited using basket traps, hooks and seine nets made of papyrus. These fishing methods had little impact on the fish stocks. The pressure on the fisheries increased with the introduction of more efficient gill nets in 1905. This resulted into an increase in fishing effort. Initially it was possible to catch as many as 50 to 100 *O. esculentus* fish per net of about 50 m long set each night (Jackson 1971) but the catch rate decreased with increasing effort.

The fishery survey conducted in 1928 (Graham 1929) showed that *O. esculentus* were being over-fished. The catch rates of *O.esculentus* had declined from about 25 fish per net per night at the turn of the century to about 7 fish per net per night by 1920. Scientific investigations (Graham 1929) showed that the stocks of *O. esculentus* were being over-fished and it was recommended that, in order to protect this species, gill nets of less than 127 mm (5 inches) were to be prohibited to reduce catching of immature fish. This mesh size regulation was effected in 1931. The Lake Victoria Fisheries Service (LVFS) was formed to collect statistics and enforce the mesh size regulation on the lake. A fisheries research institution, the East African Freshwater Fisheries Organisation (EAFFRO) was formed to carry out biological and ecological research to provide information to guide management options.

This effort was short lived. The fishing effort continued to increase and the catch rates further decreased due largely to the open access policy. Fishermen started using smaller mesh size gill nets to catch the smaller unexploited sizes of fish. This practice continued whenever the catch in the larger mesh size nets decreased and as a result the 127mm mesh-size regulation was repealed in both Uganda and Tanzania in 1956, and in Kenya in 1961.

Plate 3.1. The dangers of overfishing through use of small mesh gillnets continue to plague the fisheries.

This was the first blow to management of the fishery of Lake Victoria. Recommendations similar to those of Graham (1929) were made by Beverton (1959), Garrod (1960, 1961a, b) and Marten (1979) but were not followed.

After the mesh size restrictions had been removed, the LVFS was disbanded in 1960 and its role transferred to the individual national fisheries departments of Kenya, Uganda and Tanzania. There was no longer a regional mechanism to manage or coordinate management of this shared resource.

The stocks of *L. victorianus*, which formed the most important fishery along the rivers of the Victoria and Kyoga lake basins were also depleted through intensive exploitation. *L. victorianus* spend their adult life mostly in the lake but ascend the rivers to breed over a short period (days) during the rainy season (Cadwalladr 1965). This fishery was damaged through intensive exploitation of gravid females through setting nets at the mouths of the rivers at the time when the fish were migrating up the river to breed. The fishermen could timeexactly the the onset of upstream migrations and literally catch as much fish as they as they had the nets to do so. One of the management options for sustainability of this species should have been to prohibit fishing at the mouths of rivers during the breeding season but despite scientific reommendations to do so, this was not done.

As the larger species became scarce, fishermen shifted to smaller originally less exploited *O. variabilis,* haplochromines and *R. argentea*. The East African Freshwater Fisheries Research Organisation in collaboration with UNDP/FAO carried out the second major fishery survey of Lake Victoria between 1969 and 1977 (Kudhongania & Cordone 1974). This survey showed that the fish stocks were dominated by haplochromines which comprised 80% of the dermersal biomass and recommended that this could be exploited by bottom trawling. Bottom trawling was introduced in the Tanzania part of the lake in the early 1970s to exploit the haplochromines (Ogutu-Ohwayo 1990a). This too, was followed by a rapid drop in catch rates. It seems from this and the subsequent changes in haplochromines following establishment of Nile perch that haplochromines did not have the capacity to withstand heavy exploitation especially as many species' assemblages were habitat restricted. Up to this time, however, the fish were well distributed over the entire depths of the lake.

Introduction of new fish species and their impacts on fish stocks

Nile perch, *(L. niloticus)* and four tilapiine species; (*O. niloticus, O. leucostictus, T. zillii* and *T. melanopleura)* were introduced into Lake Victoria from the 1950s to improve declining stocks of large commercial species (Gee 1964; Welcomme 1966). Nile perch was introduced to feed on haplochromines and convert them into a larger fish of higher commercial value. The tilapiine species were introduced to improve stocks of native tilapiines which had declined due to over-fishing.

Stocks of the introduced species increased rapidly between 1971 and 1983. This was followed by a decline and in some cases total disappearance of some of the native species (Ogutu-Ohwayo 1990a, b; Witte *et al.,* 1992a, b). About 200 out of an estimated 500+ species of haplochromines are reported to have disappeared during this period.

Stocks of the Nile perch started to increase rapidly 1977, 1981 and 1983 respectively in the Kenyan, Ugandan and Tanzanian regions of Lake Victoria. This was followed by a reduction and, in some cases, total disappearance, of many of the native species (Ogutu-Ohwayo 1990a, b; Ogari & Dadzie 1988; Ligtvoet & Mkumbo 1990). The haplochromines, which were the most abundant species in Lake Victoria and were expected to form the bulk of the food of the Nile perch were depleted and other species became scarce. About 60% of haplochromine species are believed to have become extinct (Witte *et al.*, 1992a, b).

Examination of the food of the Nile perch showed that Nile perch contributed significantly to the decline in the fish stocks especially the haplochromines. Haplochromines formed the main food of the Nile perch following its introduction into lakes Victoria and Kyoga (Gee 1969; Hamblyn 1966; Ogutu-Ohwayo 1990a, b, 1994). Haplochromines were still abundant in Lake Victoria by the time the Nile perch got established (Kudhongania & Cordone 1974; Okaronon *et al.*,1985) but their stocks declined rapidly with increase in Nile perch stocks (Ogutu-Ohwayo 1990a).

The introduced tilapiines and especially *O. niloticus*, are also thought to have contributed to displacement especially of native tilapiines through competition or hybridization. The introduced and native tilapiines have similar feeding requirements, with the introduced *O. niloticus* having a wider food spectrum than the native tilapiines. *O. niloticus* is known to displace native tilapiines from water bodies to which it is introduced (Siddiqui 1977; Welcomme 1984).

The introduction of exotic fish species especially Nile perch resulted into rapid increases in fishery yield. In the Ugandan portion of the lake, fish catches were about 10,000 metric tones in 1980. However, as the introduced species became established, fish catches increased to 132,382 metric tonnes in 1981 due to an increase in the contribution of Nile perch. Similar increases were recorded in the Kenyan and Tanzanian parts of the lake. Fish catches lake-wide increased five fold from about 85,000 metric tonnes in 1975 to a peak of 554,000 metric tones in 1990. This made Lake Victoria the single most important source of freshwater fish in the world. During this period, Lake Victoria evolved into a fishery dominated by three species, the two introduced species *L. niloticus* and *O. niloticus* and one native species, *R. argentea*. Research and development efforts, were therefore shifted to these three species. The need to manage the emerging fishery resulted in the third major fishery survey on the lake. Research scientists from the riparian countries of Lake Victoria carried out this survey with assistance of the European Union. The results of this survey are given elsewhere in this volume.

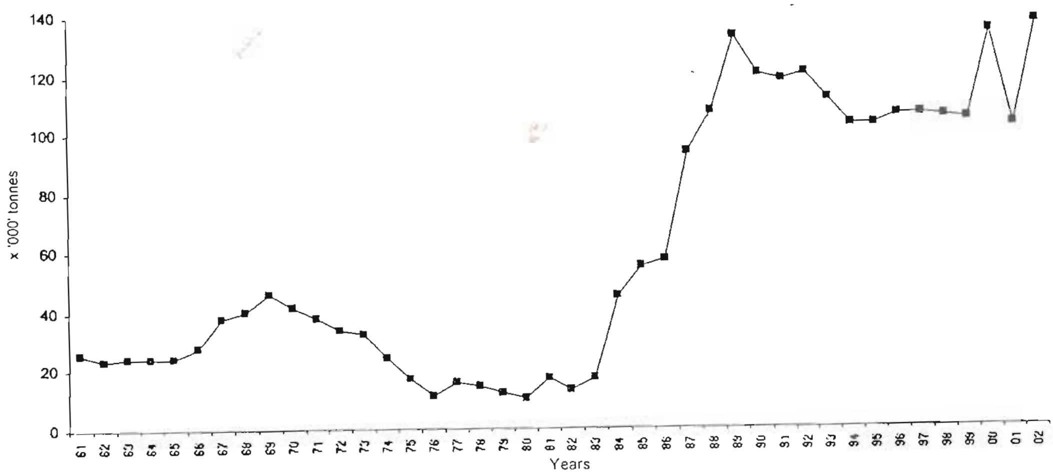


Fig 3.1. Recorded fish catch from the Ugandan part of Lake Victoria between 1961 and 2002 (source: Dept. of Fisheries Resources)

The increase of fish catches following establishment of Nile perch also led to establishment of fish processing plants which fillet Nile perch mainly for export and this stimulated increases in fishing effort. In the Ugandan part of the lake, fishing effort increased from 3,200 canoes in 1972 before the establishment of Nileperch to 8,674 canoes in 1990 and 15,462 canoes by 2000. The total number of boats on the lake was 41,000 by the year 2000. This rapid increase in fishing effort is a major threat to the fishery. There are indications that the maximum sustainable yield (MSY) has been exceeded. There is therefore need to control further expansion of the fishery through control of fishing effort.

In the shorter term, predation and fishing have been a major ecological force in shaping present day fishing communities in Lake Victoria. Through gradual anthropogenic changes in the watershed, environmental degradation has exerted its influence on water quality and fish populations over a much longer period. Prior to the 1920s, the lake was mesotrophic and was characterised by diatoms up to the 1960s. There was also a differentiation of algal communities from inshore to offshore areas. Over time, a eutrophic system emerged with blue-green algae as the dominant components of the phytoplankton (Hecky, 1993).

The change from a mesotrophic to a eutrophic system accompanied by increases in nutrient (N and P) inputs has led to a decrease in water clarity. It has now been shown that the decrease in water transparency could have caused loss of genetic and ecological differentiation among the haplochromine cichlids (Seahausen, 1997 as well as their relative abundance (Table 3.1).

Table 3.1. The effect of water clarity on haplochromine abundance in northern Lake Victoria.

Station	Water clarity by secchi depth (m)	Catch rate (no/net/hr
Napoleon Gulf	<1.5	16
Banasunvu (Itome Bay)	1.6 - 2.0	22
Meeru (Buvuma Island)	2.1 - 2.5	25
Bugaia Island	3.1 - 3.5	55
Open water Island	3.6 - 4.0	77

Source: Wandera, S.B. (2004) Unpubl.

other environmental changes in the lake have been manifested through lakeshore wetland degradation leading to fish habitat loss, siltation and invasion of the lake around 1999 by the non-indigenous water hyacinth weed (*Eichhonia crassipes*). Although the weed had negative impacts on fishing, the lakeshore finging weed mats created favourable habitats for lung fish (*Protopterus aethiopicus*) and cat fish such as (*Clarias gariepinnus*)

Conclusions and Recommendations

There are a number of lessons to be learnt from historical changes in Lake Victoria. The collapse of the native fishery of Lake Victoria can be attributed to: Failure to control fishing effort, and the shift to smaller mesh gill nets which must have resulted into capture of immature fish. Introduction of new fish species resulted into decrease in fish species diversity. There are always going to be natural impacts on the fisheries of Lake Victoria; changes in water level will occur and some of these will course changes in water quality and fish stocks. Human impacts on water quality and fish stocks may readily be monitored. However, the introduction, especially of Nile perch that is associated with fish diversity reduction, led to increased fish production, which has resulted into increased export, income and employment. The challenges currently facing Lake Victoria are how to sustain the Nile perch, Nile tilapia and the Mukene fisheries; how to conserve and restore threatened fish species and how to control degradation and further loss of the fish habitats. This requires effective research and management institutions at regional, national, local up to community level, a strong policy and legal framework and information for management of the fisheries and the fish habitat. Thus for the present, it is urgent to control fishing effort and to enforce the laws on the use of illegal fishing gears and methods. Parallel to these efforts, more systematic and sustained monitoring should be carried out .

Within the Lake Victoria basin, there are diverse zones ranging from river and stream inflows, lakeshore wetlands to the litoral, sub-littoral and offshore pelagic habitats. Some zones in the lake contain critical habitats for fish survival that should be conserved in order to sustain the fisheries for human exploitation. Systematic and sustained monitoring require resources (human and infrastructure) to avoid over-generalization of the lake fisheries and limnological conditions. Although baseline research information is the best available basis for action, improvements areal in coverage are still needed, and resources need to be made available to optimize measurements and the use of GIS.