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TOWARDS MANAGEMENT OF LAKE TANGANYIKA'S FISHERIES

George Hanek,^A G.V. Everett,^B O.V. Lindqvist^C and Hannu Mölsä^C

^AFAO, B.P. 1250, Bujumbura, Burundi.

^BFAO, Viale delle Terme di Caracalla, 00100 Rome, Italy.

^CUniversity of Kuopio, PO Box 1627, 70211 Kuopio, Finland.

Summary

The characteristics of Lake Tanganyika, its fisheries and existing fisheries management practices are outlined. The 'Research for the Management of Fisheries on Lake Tanganyika' (LTR), a regional, multi-disciplinary research project is described. The project is funded by the Finnish International Development Agency (FINNIDA) and executed by the Food and Agriculture Organization of the United Nations (FAO) in close cooperation with the University of Kuopio.

The LTR's ultimate objective is to formulate a coherent lake-wide fisheries management policy based on the 'best scientific evidence'. The details of three years of sampling are discussed, together with an outline of complementary actions required to establish the Lake Tanganyika Fisheries Organization.

INTRODUCTION

Lake Tanganyika is shared by Burundi, Tanzania, DRC and Zambia. The Lake has been geographically isolated for about 20 million years; its fish species and fisheries resources therefore have special features not found elsewhere. The fisheries of Lake Tanganyika mostly target the abundant pelagic resources consisting of two clupeids and their four endemic predators (Family Centropomidae).

The unique pelagic fishery with its seasonal and inter-annual fluctuations in catches and catch composition, defies standard fisheries planning and management. Studies undertaken by FAO during the 1960s and 1970s in each of the four countries concluded that simultaneous lake-wide research was needed to understand high fish production in the apparently nutrient-poor waters (Coulter 1981). In 1977 the four countries asked FAO's Committee for Inland Fisheries of Africa (CIFA) to create a Sub-Committee for Lake Tanganyika. This body was specifically requested to formulate and find funding for a regional fisheries research project. The

(FINNIDA) Finnish International Development Agency provided the funding and a FAO-executed regional of 5 years duration commenced in 1992.

THE CHARACTERISTICS OF LAKE TANGANYIKA AND ITS FISHERIES

Lake characteristics

Lake Tanganyika (3°20'-8°48'S and 29°03'-31°12'E) lies at 773 m above mean sea level; it is 673 km long, has a surface area of 32900 km² and a maximum width of 48 km. The maximum depth is 1470 m, making it the second deepest lake in the world. The average depth is 570 m and the volume is 18 800 km³ (Coulter 1966). The percentage surface areas under jurisdiction of the four riparian States are Burundi (8%), Tanzania 41%), DRC (46%) and Zambia 6% (Coenen *et al.* 1993).

Fisheries resources

The lake is known internationally for the spectacular variety of its endemic cichlid fish fauna (Coulter 1991). It is composed of a remarkable and genetically-diverse benthic community with a contrastingly simple pelagic community. The benthic community consists of almost 300 fish species of which over two-thirds are endemic (Poll 1986). The pelagic fish community is composed of six endemic, non-cichlid species: two schooling clupeids, *Limnothrissa miodon* (Boulenger 1906) and *Stolothrissa tanganicae* Regan, 1917, and their major predators, four members of the genus *Lates* (Centropomidae), *L. stappersii*, *L. angustifrons*, *L. mariae* and *L. microlepis*.

The potential yield of Lake Tanganyika, is estimated to be between 295 000 and 460 000 t, based on 90 kg/ha/year (Mikkola and Lindqvist 1989) and 140 kg/ha/year (Coulter 1981), respectively.

Fisheries Characteristics

Most fishing is done at night as virtually all fishing methods (e.g. purse seines, lift-nets, beach seines and scoop-nets) rely on clupeids being attracted to light. Fishing activities, therefore, practically cease every month during the full moon.

There are three recognizable types of fisheries on lake Tanganyika; industrial, artisanal and traditional. The industrial fishery was started in 1954, when Greek fishermen introduced the purse seine. A typical industrial fishing unit consists of 16 to 20 m long steel vessel, a purse seine and auxiliary steel boat, 5 lamp boats and a total crew of 30-40 fishermen. Presently, there 13 units (which are semi-active) in Burundi, one in Tanzania (Kigoma), 16 in Zambia (Mpulungu) and 21 in DRC (4 in Moba and 17 in Kalemie). The number of these units is decreasing in Burundi where 23 units were active in 1976 (Bellemans 1991). It has remained almost constant in the other countries, although recently a number of Kalemie-based units moved to Zambia.

The artisanal fishery in the northern part of the lake uses mainly catamarans and to a lesser extent trimarans, although the latter have totally disappeared from Burundi (Bellemans 1991). A typical catamaran fishing unit consists of two (three for trimarans) 6-7 m long mainly wooden plank hulls, a lift-net (55 - 65 m circumference), 6-7 lamps and an average of 4.7 fishermen. There were respectively 604 and 67 active catamaran and 'Apollos' (a large catamaran: 7-9 m long canoe, lift-net of up to 100 m of opening circumference, 14-19 lamps and an average of 8-11 fishermen) in Burundi in 1992 (Coenen 1994). There were 739 catamarans in the Kigoma and Rukwa regions of Tanzania (Chakraborty *et al.* 1992) and 45 catamarans in Uvira and Fizi zones of DRC (Maes *et al.* 1991). There are very few catamarans in the southern part of the lake (e.g. five in Zambia in 1994; Mwape 1994). The majority of fishing units in the southern are beach seines operating at night, with lights, mainly to catch clupeids (Hoekstra and Lupikisha 1992).

The traditional subsistence fishery uses many different fishing gears (gill-nets, hook and line, scoop-net, longlines, traps, mosquito-nets, etc.). Although all are generally inefficient, many people are involved in their use around the lake.

The extent of lake-wide fishing pressure was estimated from the density of fishing craft observed during aerial surveys (Hanek *et al.* 1993). In total 13 976 canoes were counted. The highest density of canoes per km of shoreline was recorded in Burundi (11.3 canoes/km or a total of 1802 canoes), followed by DRC (10.3 canoes/km or 7570 canoes), Tanzania (6.0 canoes/km or 3839 canoes) and Zambia (3.6 canoes/km or 765 canoes). During the same study (*ibid*) 459 fish landing sites were recorded, 34 in Burundi, 127 in Tanzania, 257 in DRC and 41 in Zambia. The greatest number of fish landing sites around the lake (192 or 41.8%) were fewer Category II (having 11-30 canoes). There were fewer Category I (1-10 canoes) landing sites (147 or 33.3%). The largest sites (> 81 canoes) were recorded at 8 sites in Burundi.

Fishing effort, total catch, value, social and economic importance, processing and marketing

According to the October 1993 Frame Survey (FS) the fishing fleet in Burundi was composed of 13 purse seiners, 671 lift-net units (604 catamarans and 67 Apollo units) and 298 traditional fishing units. A major decline of the catch-per-unit-effort (CPUE) has been recorded over the last ten years for the industrial as well as the traditional fisheries for Burundi (Coenen and Nikomeze 1994). For example, the average CPUE/night for the industrial fishery in Burundi decreased from 1173 kg/night/unit in 1983 to 150 kg/night/unit in 1993 and now appears to be unprofitable. However, the artisanal lift-net fishery, due to the use of bigger nets, better fishing lamps and the choice of more productive fishing grounds, manages to maintain its CPUE at a profitable level. For example, the CPUE for 'Apollos' was 300 kg/night/unit in 1993 (Coenen and Nikomeze 1994).

Fluctuations in catch composition have also been determined. In 1993, the clupeids catch in Burundi accounted for 67% of the total catch, *L. stappersii* for 31.6%, other *Lates ssp.* for 0.2%. Clupeids are generally the most abundant species, although there is often an inverse

relationship in catch numbers between clupeids and *L. stappersii*. The total fish catch for Lake Tanganyika for 1992 was estimated at 167 000 t, shared as follows: Burundi 24 000t, Tanzania 80 000 t, DRC 50 000 t and Zambia 13 000 t (Coenen 1994). The value of the catch has been estimated at approximately \$US26 million in 1992 (*ibid*). Over one million people are dependent on the Lake Tanganyika fisheries including some 40 000 fishermen and their families and those involved in fish processing and marketing (*ibid*)

Considerable differences exist in the level of fisheries development around the lake. There is an extensive and costly infrastructure (cold stores, processing plants, refrigerated trucks, etc.) in Mpulungu, Zambia, and to a lesser extent in Kalemie, DRC. No such facilities are available elsewhere, notably in Bujumbura and Kigoma. While a detailed inventory of the fisheries infrastructures of Lake Tanganyika is made regularly (Hanek 1993, 1995), its overall value has not been determined.

Fish processing is not well developed; clupeids are either sold fresh or sun-dried. An improved method of washing them in brine and then drying them on racks has been introduced but is rarely used. Only in Mpulungu and in Kalemie do cleaning, brining, freezing and sometimes smoking (particularly of *L. stappersii*) take place. Recently, the canning of clupeids and *L. stappersii* was developed in Zambia (Hanek 1994). External marketing of catches in excess of local needs is difficult and complex due to transportation problems. With the exception of the very north of the lake most roads are tangential. The shores are steep and few roads link the populations around the edges of the lake, particularly the extensive shorelines of DRC and Tanzania. Fish, particularly clupeids, are thus traded along the coast by 'water-taxis' or by the ferries *M/V Liemba* and *M/V Mwongozo* at ports between Mpulungu and Bujumbura. Major outlets for dry fish are the 'Copperbelt' complex of large towns in Zambia, the DRC cities of Lubumbashi, Bukavu and Goma, and in Rwanda (Hanek 1994).

Present fisheries management status

At various times, the four riparian countries have introduced their own fisheries regulations to control fishing effort. These have never been introduced on a 'lake-wide' basis and, due to inadequate formulation and very limited enforcement capability, they have been ineffective. The authorities of each country generally agree that the fisheries of the lake must be managed on a regional basis. Regional cooperation among riparian countries exists in the context of regional, intergovernmental organizations such as the Southern African Development Community (SADC), Preferential Trade Area (PTA) and Communauté Economique des Pays des Grands Lacs (CEPGL), as well as in the context of joint bilateral commissions. However, these institutions are generally concerned more with macro-economic and political aspects and are not structured to co-ordinate specific fisheries management activities (Gréboval 1990).

The lack of a regional organization to manage the fisheries resources was discussed at the Third Meeting of the Committee for Inland Fisheries of Africa (CIFA) which consequently established, in 1977, the Sub-Committee for Lake Tanganyika. The main objective of the sub-committee was to formulate a regional research project. Subsequent CIFA meetings debated a number of issues including harmonization of fisheries legislation, collection and analysis of fisheries statistics, and the conditions of access to the fisheries. However, no real progress has

been made to date. There are three main obstacles to progress. First there are legal differences: Tanzania and Zambia possess an Anglo-Saxon legal framework, whereas Burundi and DRC operate within the roman civil law system. Second, there is a lack of biological knowledge of the fisheries resources and there are differences in fishing practices and development in the four riparian countries. Finally, Lake Tanganyika is not only a fishing ground but also a border and a place of communication and trade. It is difficult therefore for any agreement not to have wide-reaching implications (Bonnnuci 1990).

There is a great diversity among riparian countries with regard to fishing categories. Burundi classifies its fisheries into the categories used in this paper (industrial, artisanal and traditional). DRC recognizes recreational and individual fishing taking into account the type of craft and gear used. There is no comparable classification in Tanzania or Zambia, although the licence fee exacted in Tanzania depends on the type of the craft employed. Due to these differences a considerable disparity in licence fees exists, particularly for the industrial fishery. There is a considerable variation in the regulations to protect the fisheries, for example, in minimum mesh size and prohibited gear. In Burundi and DRC, mesh sizes less than 4 mm and beach seines are prohibited. In Zambia, the minimum mesh size for monofilament nets is 120 mm and 10 mm for all other types of nets but the use of beach seines is legal. In Tanzania the use of monofilament nets is prohibited in all national inland waters (Bonnucci 1990).

TOWARDS THE MANAGEMENT OF LAKE TANGANYIKA FISHERIES RESOURCES

Role of Lake Tanganyika research

The objective of LTR is to provide the data to formulate a fisheries management policy. The LTR Project Document details two phases, a 1.5 year preparatory phase and a 3.5 year execution phase. The preparatory phase, which started in January 1992, was successfully completed on schedule. The execution phase involves the co-ordination and execution of a complex multi-disciplinary research programme (SSP). Its design was fully tested and has been subsequently modified and refined. Its demanding execution started, as scheduled, in July 1993. It has six major components:

(i) *Hydrodynamics*. This involves studies of the upwelling and downwelling phenomena of the nutrient rich waters and their current measurements and the collection of meteorological data.

(ii) *Remote sensing*. Studies are undertaken of the spatial and seasonal distribution of the upwelling phenomena in relation to the surface water temperature.

(iii) *Fish and zooplankton* biology. Many variables are measured for the six targeted pelagic fish species. Intensive zooplankton sampling is carried out down to 300 m.

(iv) *Genetic structure of pelagic fish.* Studies are undertaken to determine the possible genetic discreteness of pelagic fish stocks.

(v) *Limnology and carbon/energy budget.* Most of the significant parameters are measured at regular depth intervals down to 300 m.

(vi) *Fisheries data.* These are collected and analysed, and reporting of annual Catch Assessment Surveys and Frame Surveys standardized.

The activities outlined above are complemented by hydrodynamic studies and integrated sampling surveys for other components using the project's research vessel *R/V Tanganyika Explorer*. A series of lake-wide hydroacoustic cruises continues to be conducted in order to estimate the biomass of the different target fish species.

Regular sampling and data entry/analysis occurs simultaneously in three main LTR stations at Bujumbura (Burundi), Kigoma (Tanzania) and Mpulungu (Zambia). Less detailed and less frequent sampling is also done at six LTR substations located in Karonda (Burundi), Kipili (Tanzania), Nsumbu (Zambia) and in Uvira, Kalemie and Moba (all in DRC). The sampling comprises: regular weekly sampling for hydrodynamics, limnology, zooplankton, fisheries biology and statistics; intensive sampling (over a 24 h cycle) every 6 weeks for limnology and zooplankton; seasonal sampling for limnology and fish genetics; regular surveys are organized for fisheries statistics; and lake-wide research cruises (8-9/year) using *R/V Tanganyika Explorer*.

Considerable human resources are required to execute the SSP and over 120 people are involved in data collection, analysis and reporting. The amount of data collected by LTR automatic meteorological and hydrodynamical instruments and by LTR staff is considerable. Over four megabytes of data/information are received every month. Consequently, the management of LTR's data banks is a complex task.

LTR completed three full years of sampling in July 1996. By the end of 1996 the final science report will be presented to all four participating countries. It will present the summaries of the results and conclusions of each research component, detail both the qualitative and quantitative trophic relationships (links between components), provide the application of dynamic pool, empirical and bio-economic models for the pelagic fisheries and propose initial fisheries management measures. Proposed management measures may include fishing effort (intensity, gear type, by area), closed seasons, and protected areas.

In addition LTR has initiated and provided a forum to discuss a host of relevant issues for the authorities of the four participating countries through the annual joint meetings of the LTR's Coordination and International Scientific Committees. It has proposed standardized reporting of fisheries statistical data which has now been adopted by all four countries. It has introduced the principles of fisheries management which were highlighted during the LTR Workshop on the Management of Lake Tanganyika Pelagic Stocks. Both the authorities and the representatives of artisanal and industrial fishermen of all four participating countries were invited to the workshop. The LTR has also prepared the Lake Tanganyika Fisheries Directory

which is updated annually. This provides detailed listing of all participants in the fisheries including Government, fisheries training, education and/or research institutions, the private sector, suppliers of fishing gear and material, projects and fisheries cooperatives and associations.

Biological parameters must be combined with the monitoring of economic parameters so as to assess social and economic effects contributing to optimal management of the resources. This has been proposed for the project's second phase which will last three years and will consolidate the information gained during the first phase. Management of the main fish stocks will be stressed and directed towards establishing a legal framework for the management and development of the main fisheries. Uniform legislation will be formulated together with the corresponding regulations that should be adopted by each country. Not only will national management authorities and their legislative ability need to be strengthened but a viable lake-wide management organization will have to be established.

Role of governments

The implementation of a fisheries management plan will demand a number of complementary measures ranging from agreeing and establishing the required institutional and legal framework to approving the eventual management entity. They will all require additional financial resources and all are clearly outside LTR's Terms of Reference.

It was recognized at both the last session of CIFA's Sub-Committee for Lake Tanganyika and at the Fourth Joint Meeting of LTR's Committees (Hanek and Craig 1995), that the major constraint to the management of the lake's fisheries is the lack of a legislative governing authority. It was recommended therefore, that the riparian countries establish the Lake Tanganyika Fisheries organization (LTFO) with a mandate to undertake research programmes, co-ordinate and implement fishery management measures, as well as to co-ordinate and enforce fisheries regulations. Many valuable lessons were learned during the establishment of the Lake Victoria Fisheries Organization (LVFO) which should be considered when forming a LTFO. Principally there must be early and careful consensus on expectations and functions of the fisheries organization. International technical, legal and financial support is essential to the overall framework of such an organization. Full-time rather than part-time participation throughout the region will hasten the process for Lake Tanganyika as it has done for Lake Victoria.

At the end of LTR involvement it should be possible to implement regional management of Lake Tanganyika's pelagic fisheries on sound biological, economic and social criteria. This will benefit the people of the area as well as the conservation of the resources is inseparable from its role as a provider to the people living on its shores.

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