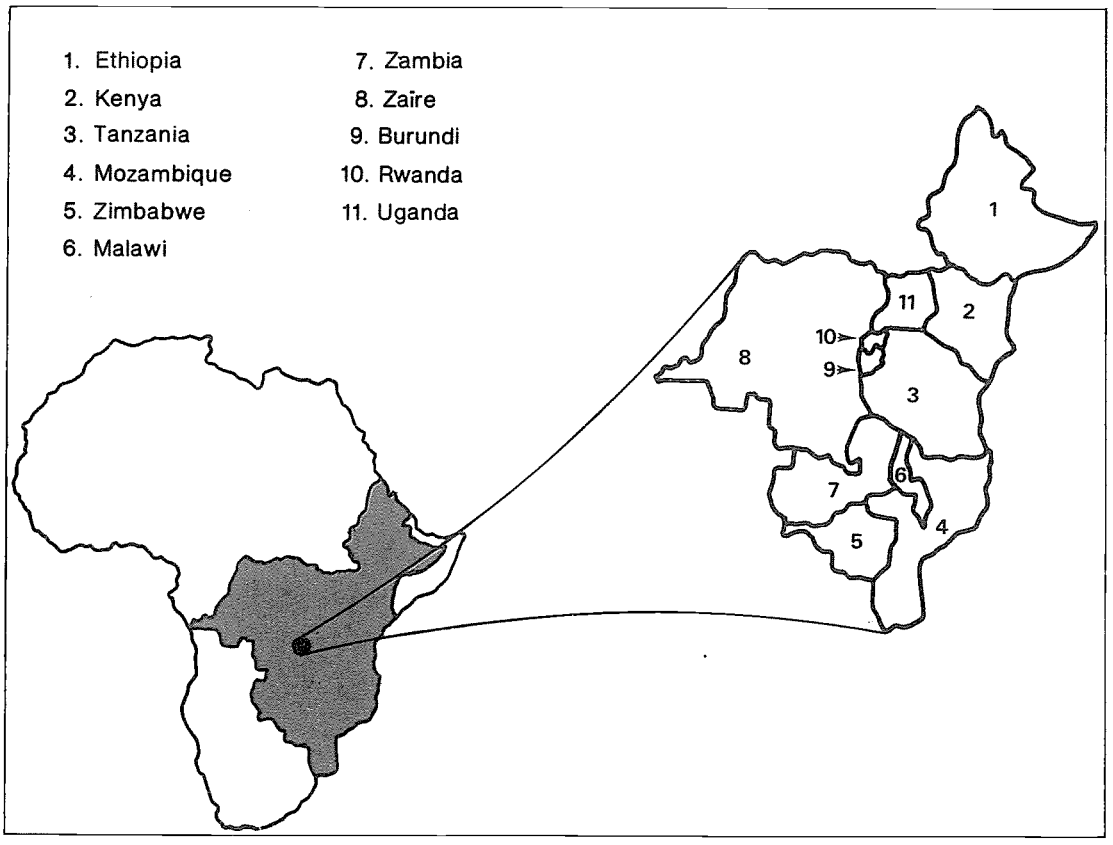
REGIONAL PROJECT FOR INLAND FISHERIES PLANNING, DEVELOPMENT AND MANAGEMENT IN EASTERN/CENTRAL/SOUTHERN AFRICA (I.F.I.P.)

IFIP PROJET

RAF/87/099-WP/05/89 (En) December 1990

Proceedings of the Symposium on Socio-economic aspects of Lake Victoria Fisheries.

Volume 1 (unedited papers 1-7).



UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

UNDP/FAO Regional Project
for Inland Fisheries Planning
Development and Management in
Eastern/Central/Southern Africa

RAF/87/099-WP/05/89 (En)

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Bujumbura, December 1990

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PREFACE

The IFIP project started in January 1989 with the main objective of promoting a more effective and rational exploitation of the fisheries resources of major water bodies of Eastern, Central and Southern Africa. The project is executed by the Food and Agriculture Organisation of the United Nations (FAO), and funded by the United Nations Development Programme (UNDP) for a duration of four years.

There are eleven countries and three intergovernmental organisations participating in the project: Burundi, Ethiopia, Kenya, Malawi, Mozambique, Uganda, Rwanda, Tanzania, Zambia, Zaire, Zimbabwe, The Communauté Economique des Pays des Grands Lacs (CEPGL), The Preferential Trade Area for Eastern and Southern African States (PTA) and the Southern African Development Coordination Conference (SADCC).

The immediate objectives of the project are: (i) to strengthen regional collaboration for the rational development and management of inland fisheries, particularly with respect to shared water bodies; (ii) to provide advisory services and assist Governments in sectoral and project planning; (iii) to strengthen technical capabilities through training; and (iv) to establish a regional information base.

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The present document consists of seven out of twelve papers which were presented at the Symposium on Socio-economic aspects of Lake Victoria Fisheries or prepared for the Symposium by Tanzanian researchers who due to unforeseen circumstances could not attend. The Symposium was held in Kisumu, Kenya from 25 to 27 april 1990. It was sponsored by the UNDP/FAO Inland Fisheries Planning (IFIP) project and organized in the interval of time seperating the Fifth and the Sixth Session of the CIFA Sub-committee for Lake Victoria. The papers presented here are unedited and therefore do not imply the expression of any responsibility for the contents nor any opinion on the part of IFIP.

After the Report of the Symposium, this is the second publication following from the Symposium. The other papers presented at or prepared for the Symposium will be issued in Volume 2.

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INFLUENCE OF BEACH AND MOSQUITO SEINES ON THE FISHERIES OF THE NYANZA GULF

by

A. Asila, S.O. Dache and C.O. Rabuor

ABSTRACT

Site visits, trawl surveys and seining experiments were made in six selected beaches within the Nyanza Gulf. For the purpose of data collection, the beaches were selected based on the proximity to the laboratory and the intensity of the beach and mosquito seines being operated at the fishing sites. The catches were analysed on the basis of length-frequency distributions of the species landed. The results from the commercial landings were compared with the seining experiments and trawl survey. The landings of the Lates niloticus and Oreochromis niloticus juveniles were significantly high in all the beaches.

Gear contributions to the landings of Lates niloticus and Oreochromis niloticus were analysed and compared. The results indicated that the use of beach and mosquito seines are on the increase in the beaches within the Kenyan waters of Lake Victoria.

INTRODUCTION

Nyanza gulf has had a multispecies fishery exploited by small scale fishermen operating various assortment of gears. Choice of the gears depend on the target species and investment capability of the individual fishermen. Fishing activities has traditionally been undertaken by the population living along the lake shores (Butcher and Colaris, 1975; Kongere, 1979; Jensen, 1973). From the recent past fishing activities have shifted from subsistence to commercial. This development was necessitated by scarcity of agricultural land along the lake shore, lack of alternative employment opportunities, specialization of the population living along the lake on fishing activities and demand for more fish from the industrial sector. These factors led to increase in the fishing effort within and outside the gulf thus creating heavy pressure on the fishery.

Along with the increase in the number of fishing boats is the adoption of different gears particularly the small meshed nets in order to conform to the reducing sizes of fish. These changes have induced socio-economic constraints in harvesting policies. This study conducted investigations to determine to what extent the usage of these nets were being influenced by the socio-economic constraints and the probable effect on the fish stocks.

Study Area

The study area is shown in figure 1. The following beaches were sampled within the Nyanza Gulf: Usoma (Michinjio), Dunga, Kusa, Sango Rota, Rakware and Kamwala. Choice of these beaches were based on the proximity to the laboratory and earlier preliminary surveys. During the surveys, juveniles of Lates niloticus and Oreochromis niloticus were observed in large numbers spread out in these beaches. These beaches were also observed to have high concentration of beach and mosquito seines.

Method of Data Collection

Spot sampling, trawl surveys and interviews were carried out at the six sampled beaches. Spot samplings mere conducted to obtain data from the commercial landings in order to compare against the trawl survey data. Trawl data were to act as a control to give the picture of the true population. Interviews were conducted to determine the investment level and financial benefits of the gears to the fishermen. Cost of investment on the materials required, labour and mending were netted by gear in order to determine profitability of these gears.

Total length of fish specimen were measured to the nearest centimeter to determine the seise composition of the fish species. Juveniles proportion in the samples were estimated from the size composition and projection inferred for the sampled beaches. Comparison of landed wet weights within the Nyanza gulf and the open waters were make between 1986 and 1989.

Results

Landing Composition

Catch assessment data from the complete 21 landing beaches in the Kenya waters of Lake Victoria between 1986 to 1989 are presented in table 1. The table shows what Lates niloticus still dominates the catches followed by

Rastrineobola argentea, Oreochromis niloticus, then other tilapine species. Between 1986 and 1989, a downward trend in the catches was observed.

Lates niloticus landing dropped from 62.3% in 1986 to 54.3% in 1989, Oreochromis niloticus from 2.4% in 1986 to 1.7% in 1989. However, the landing of Rastrineobola argentea rose from 29.3% to 38.5% during the same period.

During the same period, the contribution of the beaches within the Nyanza Gulf showed a general decline compared with the beaches in the open waters which is showing an upward trend (table 2).

Length-Frequency Distribution

Data on length-frequency distributions from the six sampled beaches in the Nyanza Gulf are presented in figures 5 to 10. The figures show that the mean lengths of lates niloticus and Oreochromis niloticus landed were 4.5 cm and 3.4 cm respectively, while the modal lengths of the same species were 4 cm and 2 cm at Michinjio/Usoma (fig. 5), 4 cm and 2 cm at Masat river mouth (fig. 6), 5cm and 6 cm at Rakware/Kamwala (fig. 9) and 6 cm and 4 cm at Kibos river mouth (fig. 10).

These mean length are comparable to the mean lengths of fish species during the mosquito seine trials at Kasat river mouth and trawl surveys at Kibos river mouth.

Gear Contributions

Figures 2 to 4 presents gear contribution to the fish landings from 1987 to 1989. The percentage contribution of beach and mosquito seines to the landings of Lates niloticus in the Kenya waters of Lake Victoria has shown a steady increase. In 1986, beach seines and mosquito seines contributed 6% and 5% respectively to the landings of Lates niloticus (figure 2). A substantial increase was observed in 1989, when beach and mosquito seines contributed 26% and 25% respectively to the landings Lates. It was further observed that gillnet contributions showed a general trend of decrease between the same period of time. Similar trend was observed for the landings of Oreochromis niloticus (figure 3). From figure 4, it is evident that mosquito seines contributed upto 90% to the total landings of the mixed species which is dominated by the Lates niloticus juveniles. However, beth gillnets and beach seines have shown a negligible contribution towards the landing of the mixed species.

Cost/Benefit Analysis

Table 3 gives the total earnings within the first year of investment in the fishery. It should be noted that the cost of labour in mosquito seine and beach seine is higher than in the longlines and gillnet. The crew to the boats equipped with mosquito seine and beach seine share the gross earnings on 50 per cent basis with the gear owners while in a gillnet and longline their share lies between 20 per cent and 30 per cent with the gear owners. Investments ratio is higher in the mosquito seine and beach seine fishery, Rate of returns in gillnet fishery is higher in the subsequent years as opposed to the other gears.

DISCUSSION

Dominant species in the landings of Kenya waters are (in order of decreasing magnitude); Lates niloticus, Rastrineobola argentea and tilapine species.

Over half by total weight of the landings come from open waters. haplochromines and clarids have increased in their landings which concurs with similar observations in the past (CIFA 1987).
Species diversity from casual observations in beaches is still higher inside the gulf compared to outside the gulf.

Contributions of beach seines and mosquito seines are higher than combined contributions of gillnet and long-line in 1989. Probable reasons for the increase are: availability of ready labour for beach seines and mosquito seines fishery because of high returns realised by the crew from the fifty per cent sharing, high investment returns to the boat owners within the shortest time, area of fishing (mainly inshore) requires little rowing time since mosquito seine and beach seine operate within the same area. Other factors are the cost of gillnets (each unit @ $ 44 (Ksh 1,000/=) and frequent theft of gillnets, divisibility of beach seine and Mosquito seine catches which makes them popular with the buyers as opposed to the catch of gillnet and longline, demand for specific species of fish which are in abundant is shalow depths which are fishable using seine nets.

Asila and Ogari (1988) observed the fifty per cent maturity for males and females of Lates niloticus were 72 cm TL and 104 cm TL respectively. Compared to the modal length of fish in this study it tends to suggest growth overfishing which might lead to recruitment overfishing due to the absence dof spawners.

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Table 1 Species composition of the fish (% by weight) landed in the sampled beaches in L. Victoria (Kenyan Waters): 1986 - 1989

Species	1986	1987	1988	1989
Lates niloticus	62.8	69.6	59.5	54.3
Rastrineobola argentea	29.3	24.7	36.7	38.5
Oreochromis niloticus	2.4	2.0	1.7	1.7
Other tilapiines	1.7	0.3	0.3	1.1
Other species	3.8	3.4	1.8	4.4

Table 2 Percentage catches by weight from the sampled beaches

Gulf beaches	1986	1987	1988	1989
Dunga	3.2	2.8	3.2	1.9
Usoma	2.6	2.9	2.3	3.2
Kaloka	2.2	2.2	1.7	2.4
Kusa	2.3	2.0	1.3	2.0
Sango Rota	4.2	2.0	0.7	0.3
Rakwaro	2.8	3.4	3.4	3.9
Kendu Bay	6.8	2.7	1.4	0.6
Obaria	2.2	2.3	2.6	–
Ngegu	3.4	3.3	1.9	1.4
Homa Line	0.5	1.0	1.2	1.7
Asembo Bay	1.5	2.0	1.6	2.0
Homa Bay	1.8	0.5	0.6	1.5
SUB TOTAL	33.5	27.1	21.9	20.9
Open water Beaches				
Mbita	5.0	0.4	2.9	2.0
Sori Karungu	11.0	5.1	7.9	3.9
Misori	15.1	7.6	7.5	10.5
Lwanda Konyango	5.3	8.1	4.3	3.0
Lwanda Kotieno	6.4	4.8	4.0	4.6
Wichlum	0.6	9.8	5.7	3.8
Usenge	6.8	5.4	7.0	16.2
Uhanya	9.4	29.0	53.0	31.6
Port Victoria	2.6	2.0	2.4	2.5
Sio Port	2.3	0.5	0.7	0.6
Sub Total	66.5	72.9	78.1	79.1

Table 3 Cost benefit analyses by gear

	LONGLINE	GILLNETS	MOSQUITO SEINE	BEACH SEINE
NO. of hooks/nets	500	30	6	12
Length of the line/net (m)	1500	30 x 70	6 x 30	6 x 27
Mean catch per boat day (kg)	64	76	163	334
Price of fish (Kshs/kg)	5	5	4	4
No. of crew	2	2	4	4
Half yearly income	58240	69160	118664	24315
Yearly income	116480	138320	237328	48630
Cost of investment on gear	1150	31470	6310	4880
Labour (annual)	36000	42100	59440	24315
Cost of baits	18000	-	-	-
Half year earnings	30090	16640	53022	7277
First year earnings	61330	64750	112354	19435
Lifespan of gear (years)	1 1/2	4	2/3	2

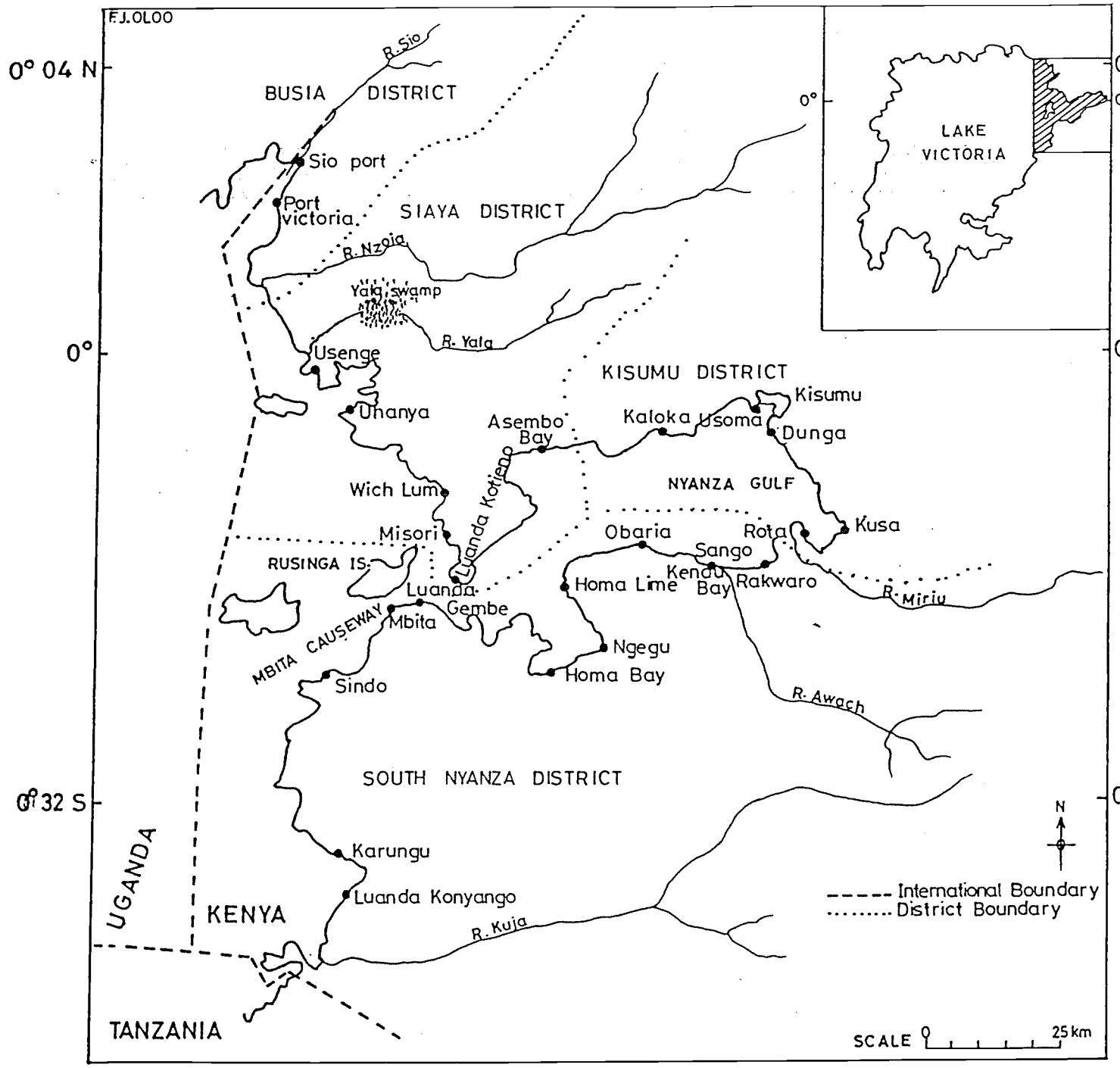


Fig. 1. The map showing the Kenyan waters of Lake Victoria and the location of the primary sampling units (Landing sites)

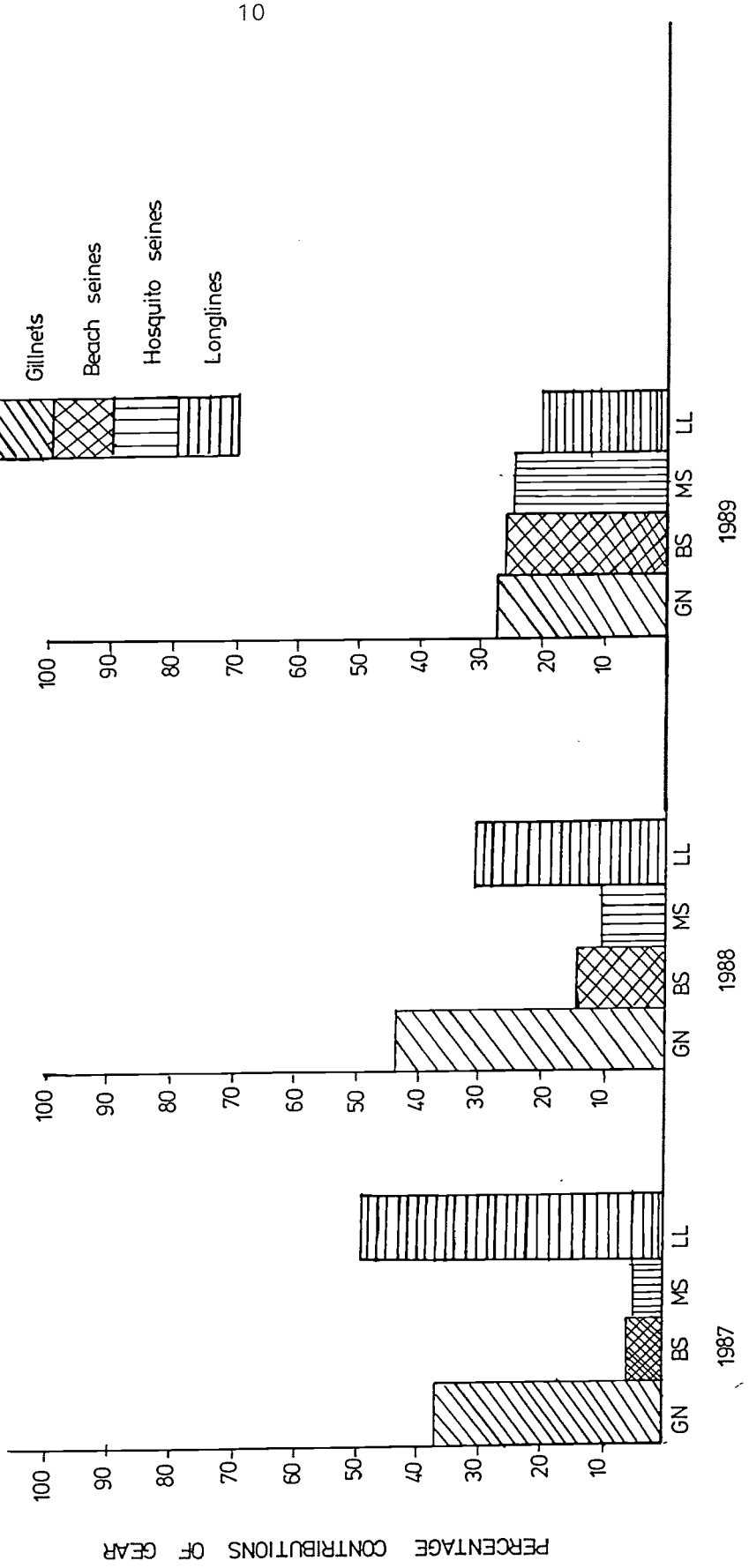


Figure 2: Percentage contributions of the gear to the landings of lates niloticus in the Lake Victoria (Kenyan Waters): 1987-1989

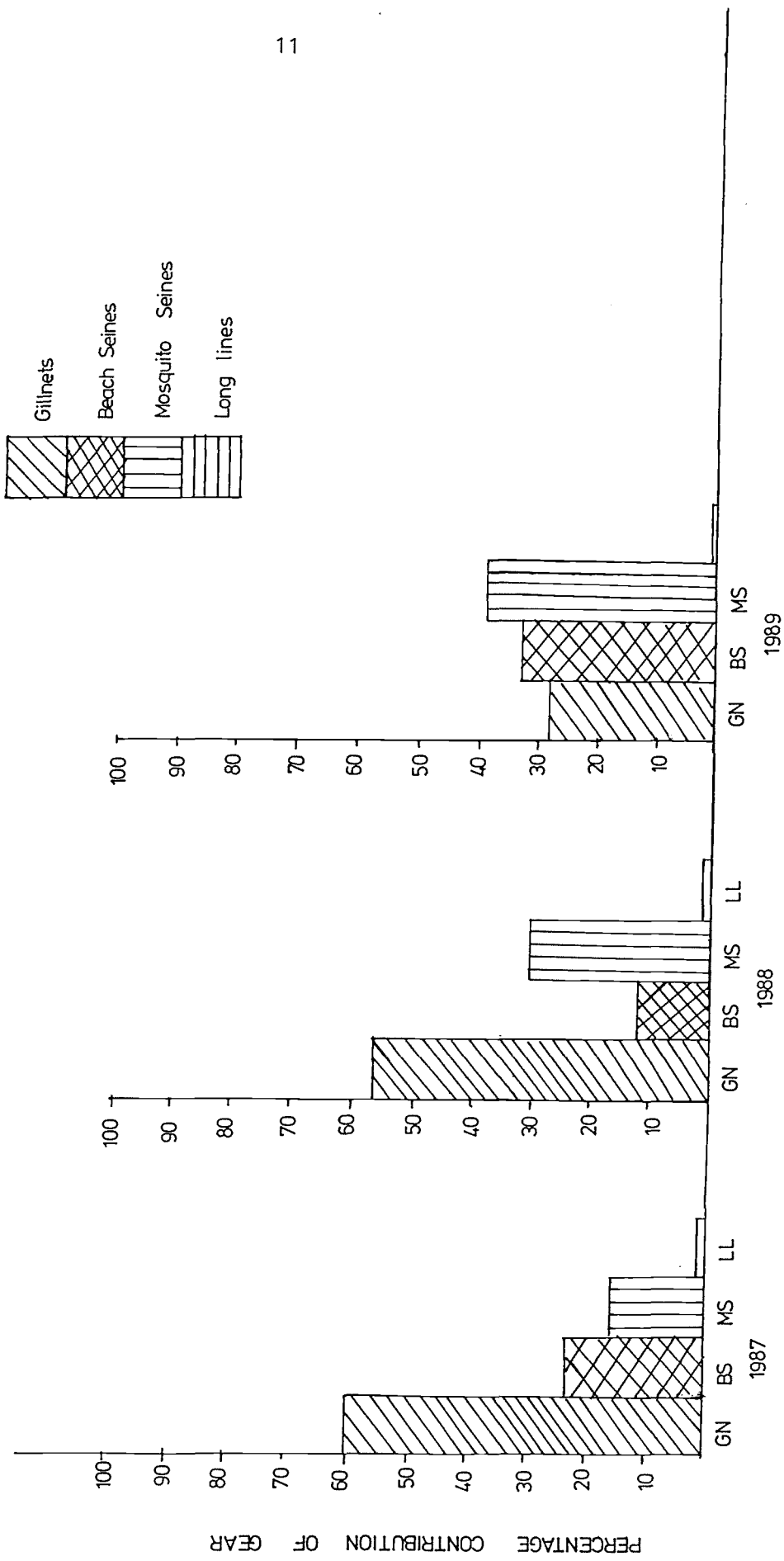
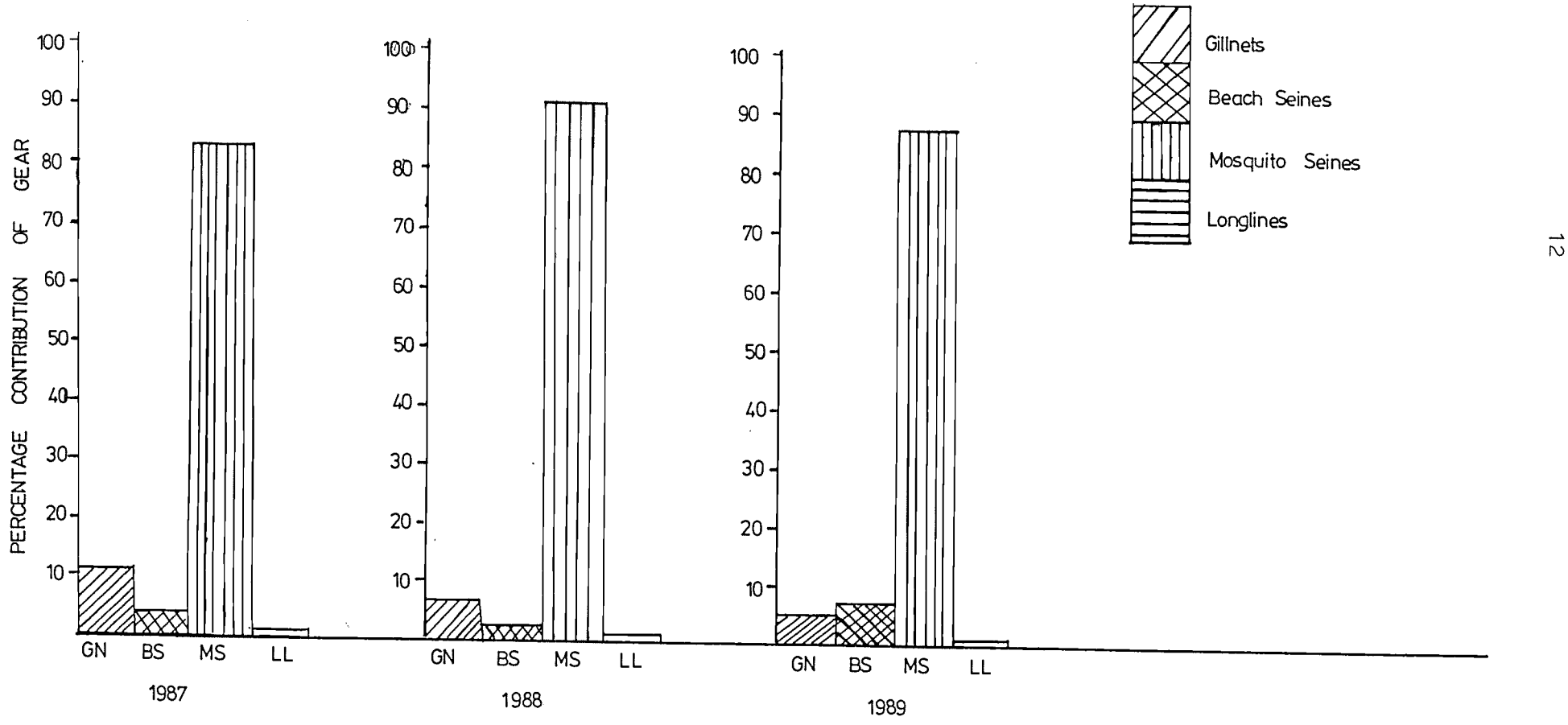


Figure 3: Percentage contribution of the gear to landings of Oreochromis niloticus in Lake Victoria (Kenyan Waters): 1987 - 1989

Figure 4: Percentage contributions of the gear to the landings of the mixed species in Lake Victoria (Kenyan Waters): 1987 - 1989



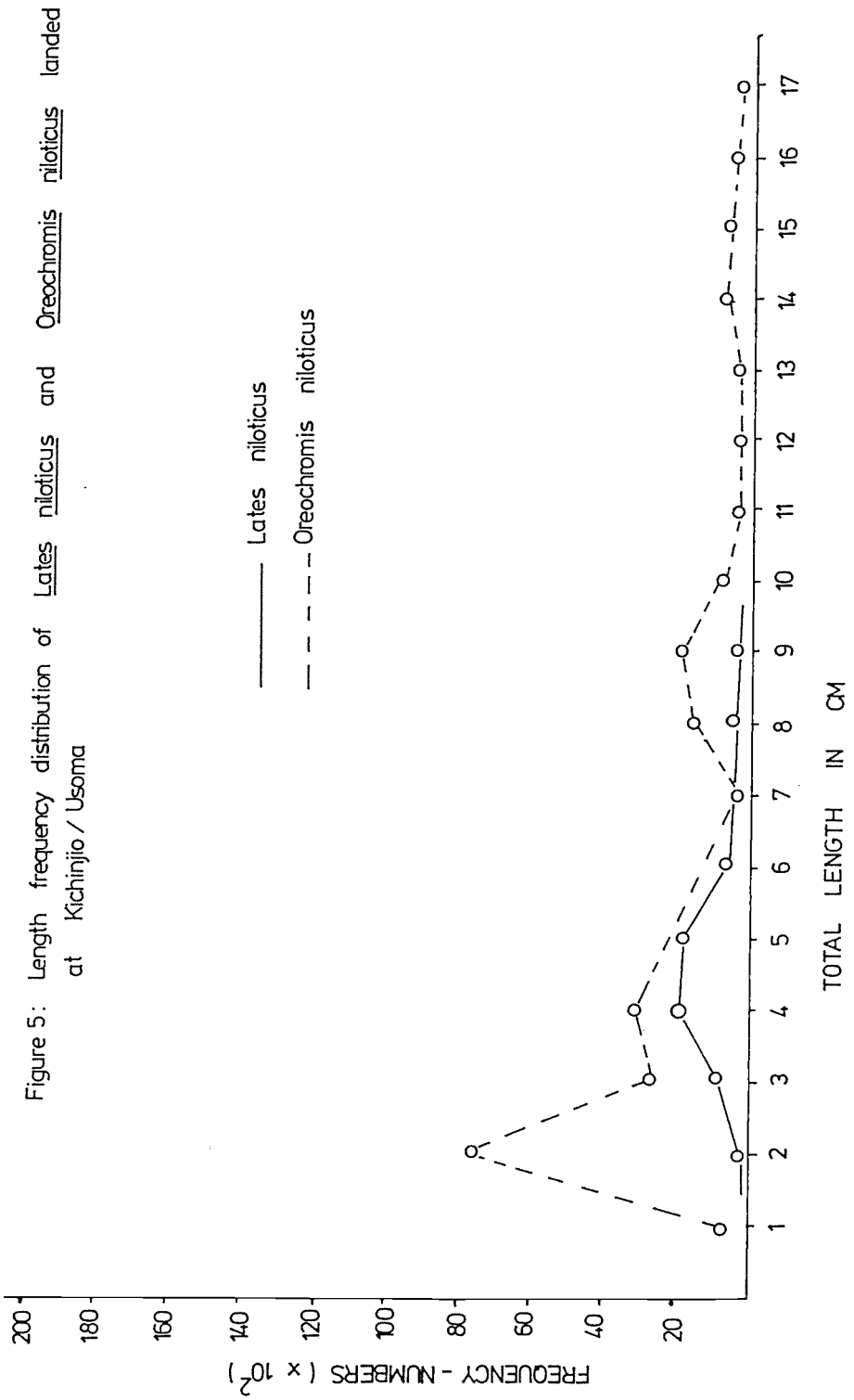


Figure 5: Length frequency distribution of Lates niloticus and Oreochromis niloticus landed at Kichinjio / Usoma

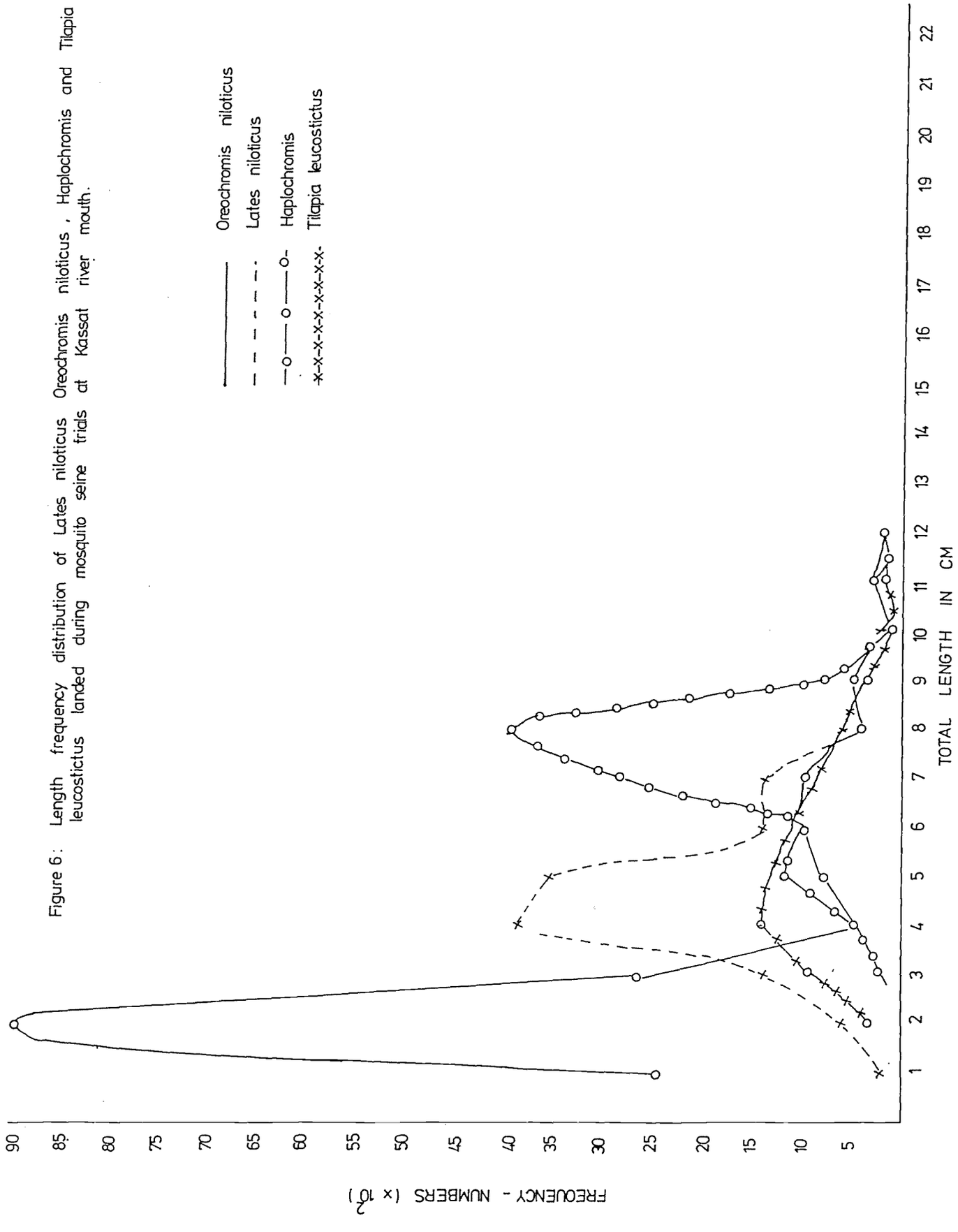


Figure 6: Length frequency distribution of Lates niloticus Oreochromis niloticus , Haplochromis and Tilapia leucostictus landed during mosquito seine trials at Kassat river mouth.

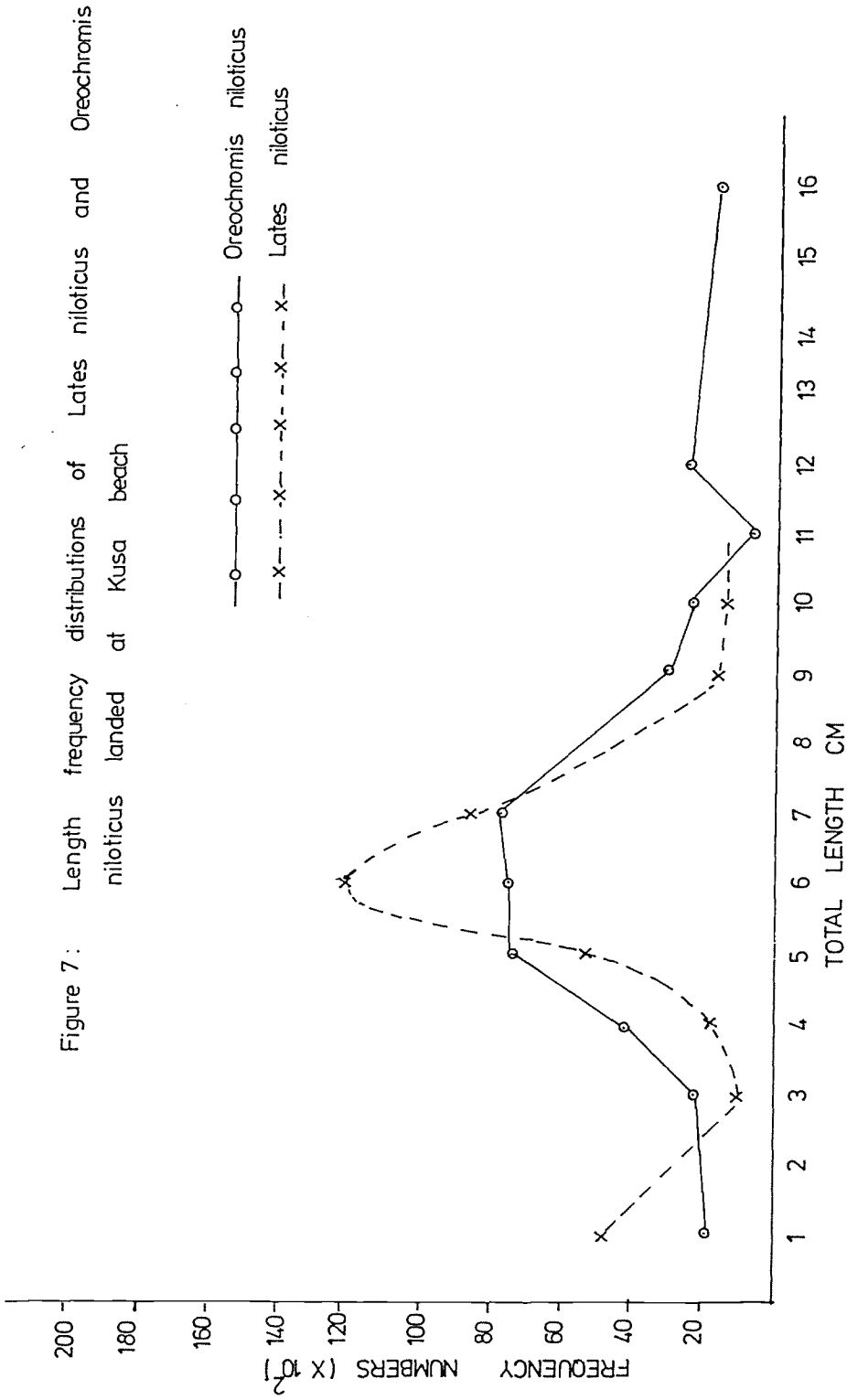


Figure 7: Length frequency distributions of Lates niloticus and Oreochromis niloticus landed at Kusa beach

Figure 8 : Length frequency distribution of Lates niloticus and Oreochromis niloticus landed at Sango-Rota beach.

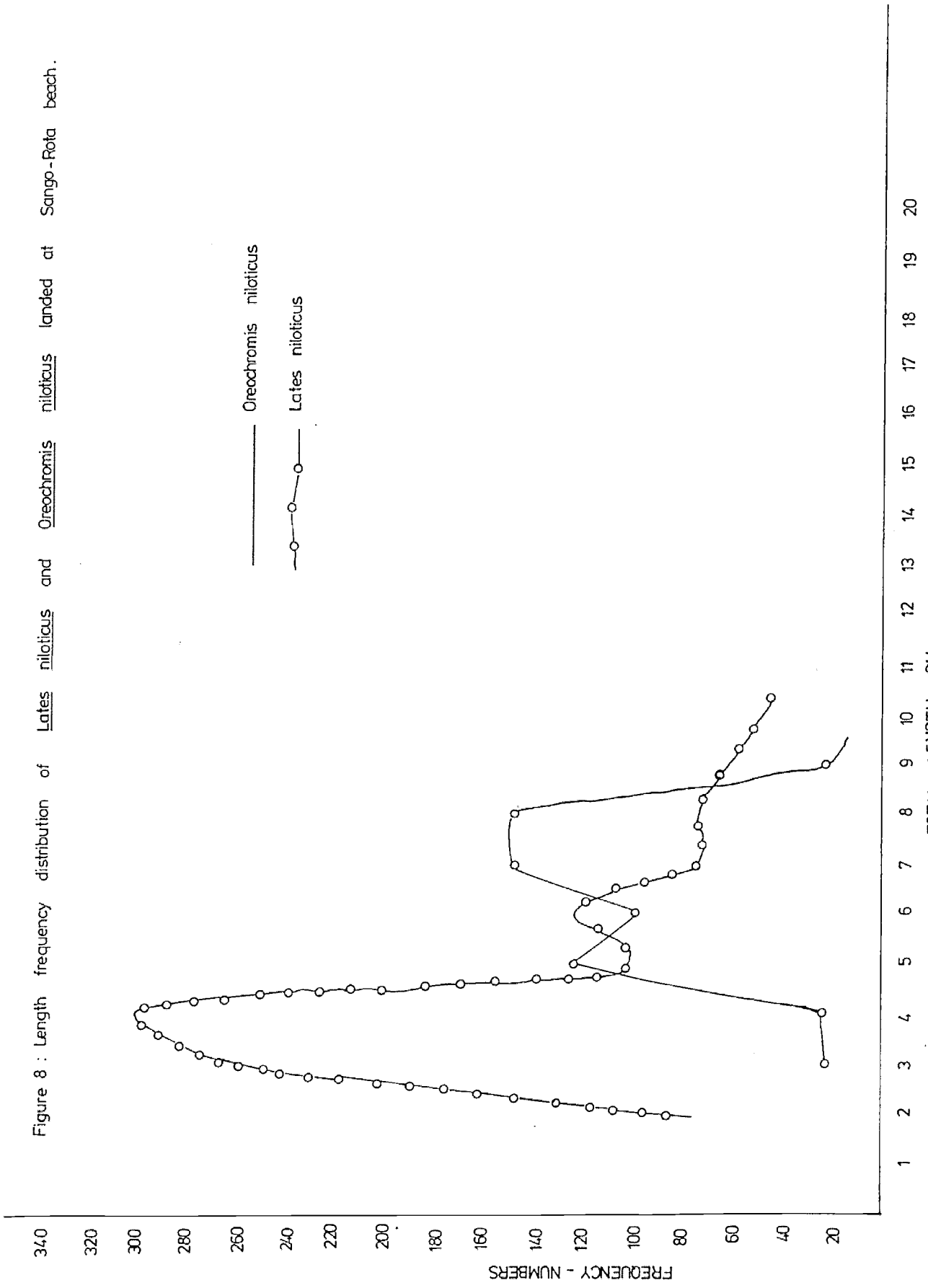


Figure 9: Length - frequency distributions of Lates niloticus and Oreochromis niloticus landed Rakwaro / Kamwala beach.

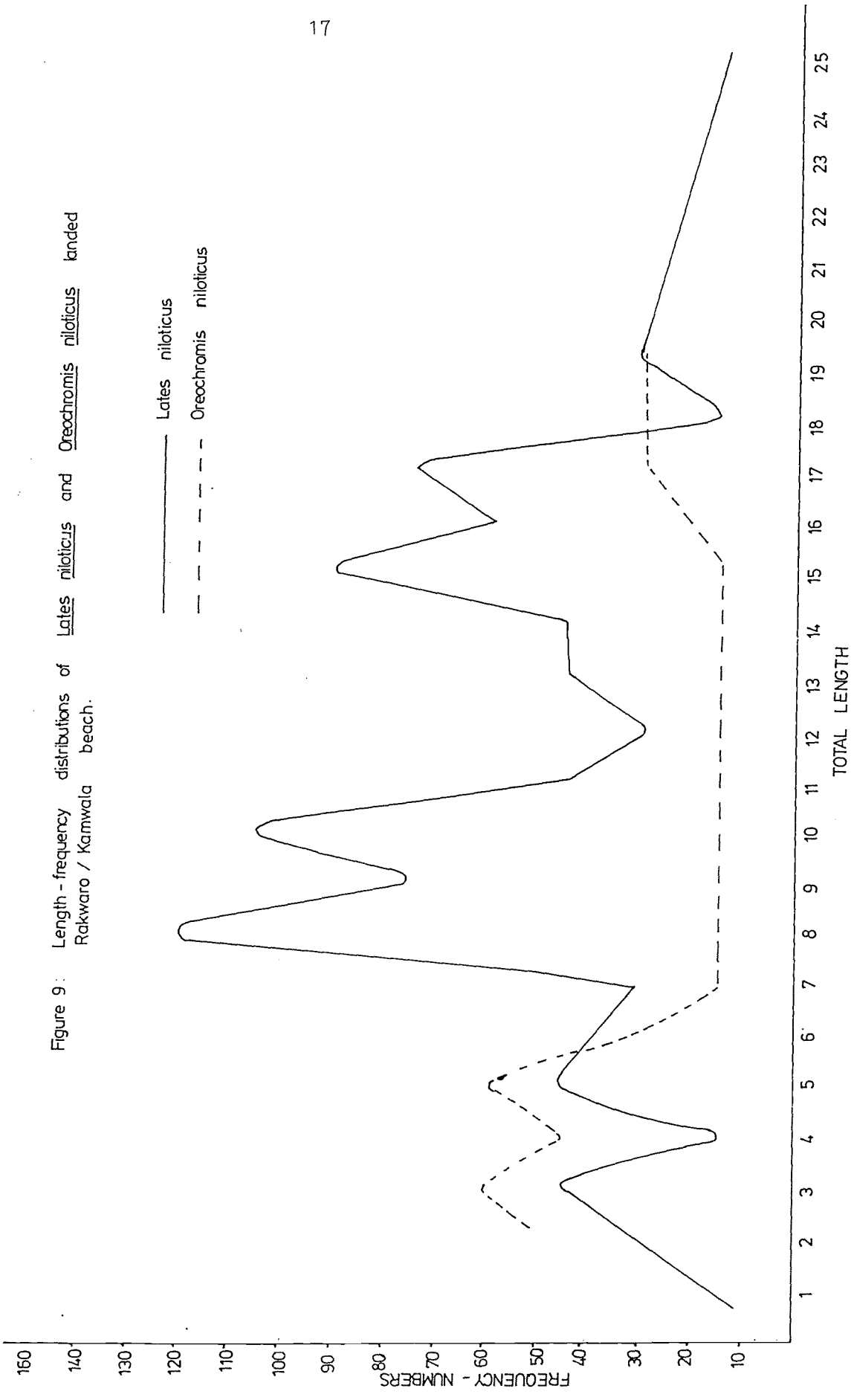
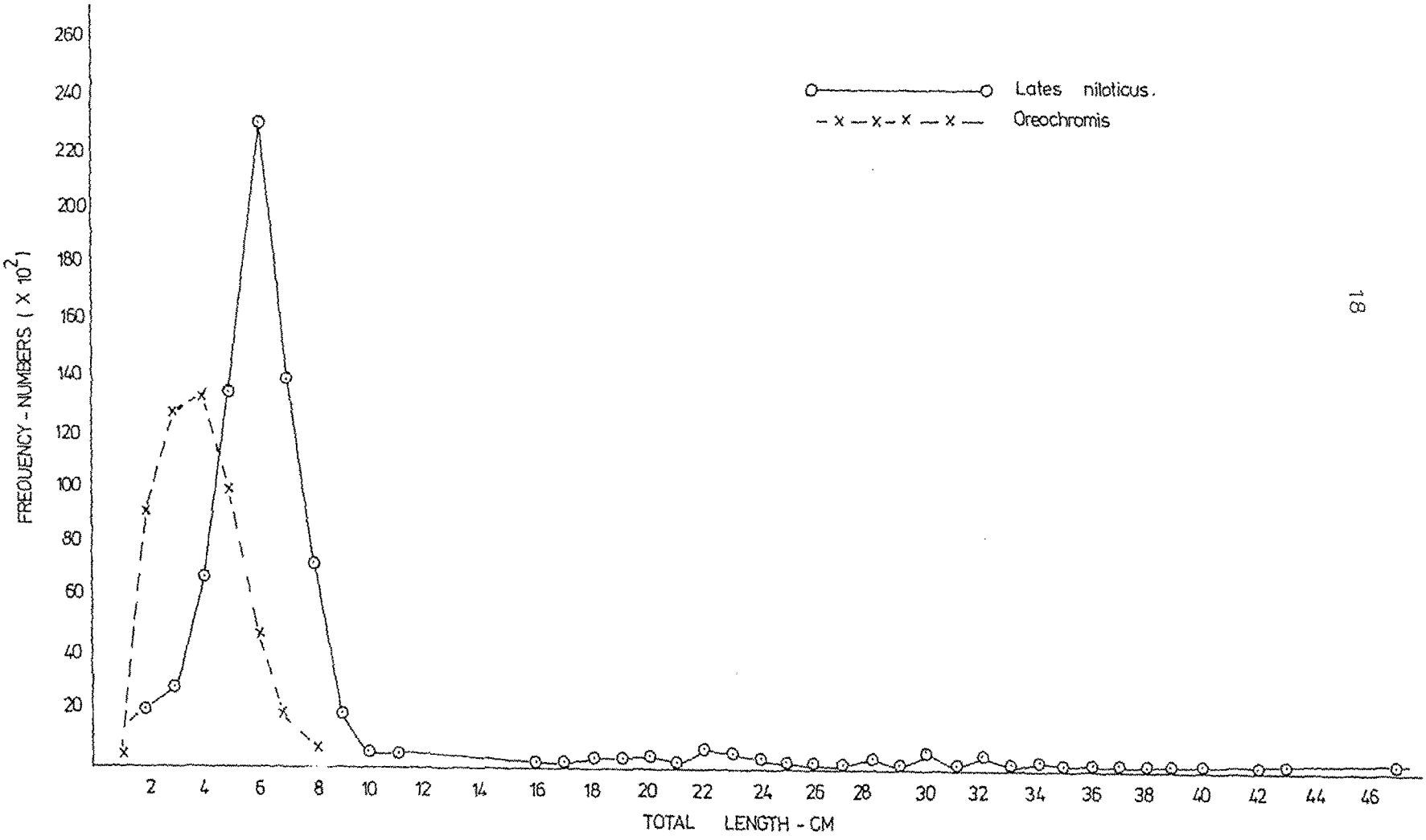


Figure 10: Length - frequency distributions Lates niloticus and Oreochromis niloticus landed during trawl survey at Kibos river mouth.



GENERAL EVOLUTION OF THE FISHERIES SYSTEMS IN LAKE VICTORIA

by

Rashid B. Hoza

ABSTRACT

This paper analyses the evolution of fisheries systems of Lake Victoria for the past eleven years (1979 - 1989) taking into consideration the major changes which have occurred in the fisheries of the lake before and after the introduction of Nile perch (Lates niloticus). Changes in the type of gear used, the amount of fishing effort applied, the annual catch and earning per fisherman, the markets and the distribution systems of the lake's products have been taken into account.

1. INTRODUCTION

Tanzania has a juridisction of 49% : about 34,700 km^2 of the total 69,000 km^2 area of Lake Victoria (Welcome 1972). The mean contribution of the lake to the total national production of fish (both fresh and marine) is about 27%.

The development of the fisheries systems in Lake Victoria is being determined by the subsistence requirements of the people affected by the lake both near and far. Before the introduction of Nile perch (Lates niloticus) the fauna consisted of many Haplochromine species, Tilapiine species as well as a number of non-cichlid fishes. The introduction of Nile perch in the early sixties has been cited as the main cause of the decline of these endemic species, and as such have brought about socio-economic changes to people affected by the lake. (Aruga 1981, Okemwa 1984, and Bwathondi 1985).

Lake Victoria fish resources are mainly being exploited by artisanal fishermen who face many problems related to production, distribution and fluctuation in the price of gear. Most fishing vessels are canoes, the most common fishing gear used are gillnets although beach seines and longlines are also used.

As far as the total annual landings of Lake Victoria fish are concerned, there has been a general increase in annual catches for both fisherman and vessels accompanied by an increase in annual earning per fisherman. There has been several projects operating in the lake regions to improve and develop the fisheries.

2. EFFORT AND EARNING

Available statistics for the last five years show a rising trend in number of fishermen and fishing vessels for Mwanza and Kagera regions and fluctuations in both aspects for Mara region (Table 1a to 1c). In Mwanza region there was a total number of 50,312 fishermen and 13,012 vessels. In Kagera region there was a total number of 4,379 fishermen and 9,466 vessels. In Mara region there was a total number of 23,544 fishermen and 4,463 vessels.

The earning per fisherman, generally showed an increase in the last 5 years in the three regions (Table 1a-1c). In Mara region the amount has increased from Tshs 25 000 to 61 000, in Mwanza region the amount has increased from Tshs 40 000 to 211,000, and in Kagera region the amount has increased from Tshs 49 000 to 129,000, Mwanza region showing the highest increase in earnings.

The effort applied to the total fisheries of Lake Victoria and earnings for the last nine years have been summarised in Table 1d. Generally the number of fishermen and fishing vessels fluctuated for the last nine years. The catch per vessel (CPUE) and catch per fisherman has increased from 12.9 metric tons in 1979 to 29.23 metric tons in 1986; the catch per fisherman has increased from 2.75 metric tons in 1979 to 8.9 metric tons in 1986.

3. CATCH

The catch composition of Lake Victoria fisheries is composed of different species of economic importance such as Haplochromis spp., Rastrineobola argentea, Tilapiine species, Lates niloticus, Protopterus, Bagrus, Clarias, Synodontis, etc. All these species are traditionally landed in all lake regions (i.e. Mwanza, Mara and Kagera).

The annual landings of fish caught in metric tons by species for every region in 1984 to 1987 is summarised in Table 2a to 2c.

In Mara region, (Table 2a) the catch of Haplochromis species has decreased from 1011.2 metric tons in 1984 to 5.49 metric tons in 1987. The catch of Lates niloticus has increased from 8841 metric tons in 1984 to 15,708.1 metric tons in 1987.

In Mwanza region (Table 2b) the Haplochromis species fluctuated: the total landings have dropped to 716.8 metric tons in 1987. The catch of Lates niloticus has increased from 16452.5 metric tons in 1984 to 97,728 metric tons in 1986, the catch of R. argentea fluctuating.

In Kagera region (Table 2c) the landings of Haplochromis species showed a decline from almost 5000 metric tons to 700 metric tons and the landings of Lates niloticus fluctuated.

Table 2d shows the total landings recorded for the last nine years. Generally the landings fluctuated. For Haplochromis species the landings dropped to 1488 metric tons in 1987 from 25000 metric tons in 1980. For Lates niloticus the landings increased from 15 metric tons in 1980 to 123,895 metric tons in 1986. The catch records for R. argentea were poor but show a rising trend from 1095 metric tons 1979 to 9825 metric tons in 1986 (Fisheries Division 1987).

4. OBSERVATIONS

From the data (Table 2d) it was observed that the increase in landings of Lates niloticus was accompanied by a decrease in landings of Haplochromis species. From a biological point of view it can be deduced that the introduction of Lates niloticus to Lake Victoria has brought about an ecological shift to the fauna of the lake, reducing the traditionally most abundant stock of Haplochromis spp.. Economically the introduction of Lates niloticus has brought both negative and positive socio-economic effects. The negative aspects include people who were forced to quit both fishing and fishmeal processing industry of Haplochromis due to dwindling stocks. The positive aspects include the increase in employment due to the development of the Nile perch industry.

A survey made at Kariakoo market in Dar es Salaam (Table 3b) revealed that Lates niloticus started to appear in the early eighties but were first recorded in 1985, with landing weight increasing from 20 metric tons in 1985 to 487 metric tons in 1989. Table 3b shows R. argentus from Lake Victoria has

increased from 128.7 metric tons in 1984 (with a value of Tshs 3 835 800) to 673.2 metric tons in 1987 (with a value of Tshs 37 044 700).

5. SUPPLY OF GEAR

The resources of Lake Victoria are mainly exploited by artisanal fishermen using canoes as fishing vessels, gillnets as their basic gear. They also use beach seines, longlines etc. There are several projects operating all over the country in order to support the fishery such as Tanzania Fishnet Industries Ltd. (Dar es Salaam), Mwanza Fishnet Industry (Mwanza) and local manufactures of fishing gear scattered all over the country (Reynold J.E. and Greboval D.F. 1981). This paper will only focus on the Tanzania Fishnet Industries Ltd (TFI Ltd).

5.1 TFI Ltd.

The TFI Ltd. started to operate in 1969 with a production capacity of 150 tons of fishnets and produces gillnets, seine nets, purse seine nets, dagaa nets, shark nets and trawlnets. The production figures from 1979 to 1989 are summarised in Table 4a. The figures show a declining trend in production of fish nets from 78 tons in 1979 to 69 tons in 1988 (with the lowest production of 42 tons in 1984). The low productivity is due to both old age of the plant machinery and lack of foreign exchange which results in inadequate inflow of raw materials. The company is only operating at 40% capacity and hence the company's production targets are not achieved (TFI Ltd. Annual Report).

It is clear that although the government has removed tax on the importation of fishing gear, the industry is not getting enough Tanzanian shillings to meet its foreign exchange requirements for the importation of raw materials and spare parts. This is due to low output and high production costs.

5.2 Market Position

The market is grossly undersupplied with a current demand of fishnets at about 1,000 tons and an annual growth rate of 2.5%. As far as the management of TFI Ltd. is concerned the price of fishnets is not expected to decrease because of high production costs despite the government having removed the importation tax of fishing gear. The importation of ready made fishnets has not affected their market because the demand of fishnets is still high i.e. the internal and external supply is low compared to the demand of fishnets.

The company's products are distributed in the market through appointed agents and dealers in all regions of Tanzania. This system of distribution ensures equitable distribution of fishnets and accessories throughout the country.

5.3 Rehabilitation of the Plant

The main objectives of a rehabilitation programme was to increase the production of fishing gear so as to alleviate the problems of gear supply in the country.

A study on the rehabilitation programme, divided into two phases, was undertaken in 1986 and sent to the government with the following considerations:

- An additional source of gear supply will be needed to meet the anticipated increase in demand for nets as the artisanal fisheries continue to develop and to avoid the tendency for a monopolistics situation;

- The rehabilitation is necessary in the context of preserving foreign currency of the country.

At the moment the plant has received machines for phase 1; after rehabilitation the expected production is as follows:

- Annual production of 146 tons to 270 tons of fishnets;

- " " " 58 tons to 120 tons of polyethylene products.

6. CONCLUSION

1. There was no defined trend in the effort applied to the fishery for the last nine years but the catch per vessel and catch per fisherman had risen and the earning per fisherman had increased in all regions.

2. The landings of Haplochromis species showed a decline while the landings of Nile perch rose in the last nine years.

3. The introduction of Nile perch has brought both positive and negative socio-economic effects to the people of Tanzania.

4. The price of fishnets is not expected to decrease due to high production costs.

7. RECOMMENDATION

The government should increase incentives to artisanal fishermen in order to promote this sector as well as to improve their standard of living by guaranteeing the availability and reducing the price of fishing gear and equipment.

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TABLE 1a. SUMMARY OF FISHERY STATISTICS FROM MARA REGION

	1983	1984	1985	1986	1987	TOTAL	AVERAGE
NO.FMEN	5091	4059	4844	4457	5093	23544	4708
NO.VES	962	888	675	885	1053	4463	892.6
WT. FISH	12857.2	15845	16001	17148.55	20348.7	82200.5	16440.1
WT.F/MAN	2.5	3.9	3.3	3.8	4.0	17.5	3.5
WT.F/VES (CPUE)	13.4	17.8	23.7	20.0	19.3	94.24	18.85
VAL.F (x 1000)	129643.7	112594.9	47000.8	263042.1	311259	863540.5	172708.1
VAL.F/MAN (x 1000)	25.0	27.7	30.3	59.0	61.1	203.3	40.7
VAL/VES.	134.7	126.8	217.7	307.6	295.9	1082.68	216.5

Source: Annual statistics Report.
Fisheries Division Hq.

TABLE 1b. MWANZA REGION

	1983	1984	1985	1986	1987	TOTAL	AVERAGE
NO.FMEN	7699	9906	9143	12171	11393	50312	10062.4
NO.VES	1808	2186	2184	3253	3581	13012	2602.4
WT. FISH	35229.2	50280	54508	159789.9	113075	412882.3	82576.5
WT.F/MAN	4.6	5.1	5.9	13.1	9.9	38.6	7.7
WT.F/VES (CPUE)	19.5	5.1	24.9	49.1	31.6	130.2	26
VAL.F (000'S TSHS)	312352.4	614111.5	780748	2375778.7	2358208	6441198.4	1288239.7
VAL.F/MAN (000'S TSHS)	40.6	61.9	85.3	195.1	211.7	594.6	118.9
VAL/VES.	172.7	280.9	357.4	739.3	673.6	2214.9	442.9

TABLE 1c. KAGERA REGION

	1983	1984	1985	1986	1987	TOTAL	AVERAGE
NO.FMEN	2404	3062	3099	7613	5721	4379	4379.8
NO.VES	1371	1576	1189	3296	2034	9466	1893.2
WT. FISH	24498.5	31564.1	26922.6	39468.5	26491.5	148945.2	29789.5
WT.F/MAN	10.2	10.3	8.6	5.1	4.6	38.8	7.7
WT.F/VES (CPUE)	17.9	20	22.6	11.9	13.0	85.4	17.1
VAL.F (000'S TSHS)	120160.9	146231.2	280232	983187.9	44844.1	1574655.7	314931.1
VAL.F/MAN (000'S TSHS)	49.9	47.7	90.4	129.1	100.6	417.7	83.5
VAL/VES.	87.6	92.8	235.6	298.2	282.9	997.1	199.4

TABLE 1d.

SUMMARY OF FISHERY STATISTICS FROM THE TERRITORIAL WATERS OF LAKE VICTORIA

YEAR	NO.FMEN	NO.VES	CATCH M.T	CATCH/VES (CPUE)	CATCH/MAN.
1979	20937	4457	57517	12.9	2.7
1980	20587	3997	67483	16.9	3.3
1981	20787	4199	70621	16.8	3.4
1982	18263	4245	63996	15.1	3.5
1983	15194	4141	73087	17.6	4.8
1984	17827	4650	97818	21.0	5.5
1985	17556	4160	98906	23.8	5.6
1986	24241	7404	216407	29.2	8.9
1987	22207	6667	159915.2	23.9	7.2
TOTAL	177599	43920	905750.2	177.4	44.9
AVER.	19733.2	4880	100638.9	19.7	4.9

THE WEIGHT OF FISH CAUGHT IN METRIC TONS

TABLE 2a. MARA REGION

	1984	1985	1986	1987	TOTAL	AVERAGE
T.esculentus	-	13.3	528.7	-	541.9	270.9
T.Variabilis	1245.4	1326.4	0.4	-	2572.2	857.4
T.zillii	-	90.8	296.9	-	387.7	193.8
T.niloticus	545	1566.1	4740.6	3815.5	10667.2	2666.8
Haplochromis	1011.2	2501.5	233.4	5.5	3751.6	937.9
Labeo	223.7	15.9	1.4	0.1	241.1	60.3
Bagrus	793.1	788.5	139.8	34.9	1756.3	439.1
Clarias	359.1	379.5	438.5	361.4	1538.4	384.6
Synodontis	1536.3	434.4	497.5	7.8	2475.9	618.9
Barbus	793.1	5.2	2.1	16.8	817.2	204.28
Alestes	-	2.7	0.01	-	2.7	1.3
Schilbe	997.6	413.2	263.6	244.1	1918.5	479.6
Mormyrus	83.4	21.1	5.0	5.1	114.7	28.7
Lates	8841.3	9691.9	9765.0	15708.1	44006.3	11001.6
Dagaa	-	-	-	-	-	-
Protopterus	200.3	290.1	244.9	149.4	884.7	221.2
Others	-	-	-	-	-	-

Source: Annual statistics report.
Fisheries Division Hq.

TABLE 2b. MWANZA REGION

	1984	1985	1986	1987	TOTAL	AVERAGE
T.esculentus	1127.0	875.9	1966.1	1290.4	5259.4	1314.8
T.variabilis	1839.1	2276.6	1183.5	1148.0	6447.2	1611.8
T.zillii	134.5	574.6	2139.2	504.2	3352.5	838.1
T.niloticus	2677.2	2400.3	4293.5	4879.9	14250.8	3562.7
Haplochromis	10700.4	3740.0	16008.3	716.8	31165.5	7791.4
Labeo	398.9	360.3	302.9	164.8	1226.9	306.7
Bagrus	2557.4	4574.0	6669.9	2225.6	16025.9	4006.5
Clarias	2153.2	2662.1	4067.3	4450.3	13332.8	33333.2
Synodontis	2646.0	8814.7	6543.2	3442.4	21446.3	5361.6
Barbus	2557.4	28.5	85.7	10.1	2681.6	670.4
Alestes	318.1	15.8	90.2	-	424.1	141.4
Schilbe	3413.6	1150.2	3319.4	1297.4	9180.6	2295.2
Mormyrus	120.0	146.8	219.8	143.4	629.9	157.5
Lates	16452.5	21925.6	97728.0	71864.2	207970.3	51992.6
Dagaa	-	209.0	9348.5	4063.5	13620.9	3405.2
Protopterus	3314.5	2078.5	2098.4	1687.4	9178.8	2294.7
Others	1218.6	2666.3	1966.1	1290.4	7141.4	1785.3

TABLE 2c. KAGERA REGION

	1984	1985	1986	1987	TOTAL	AVERAGE
T.esculentus	613.5	230.5	151.25	135.9	1131.2	282.8
T.variabilis	228.4	770.2	357.8	598.4	1954.8	488.7
T.zillii	164.6	161.3	422.9	319.4	1068.2	267.1
T.niloticus	246.7	368.1	1550.3	1243.7	3408.7	852.2
Haplochromis	3410.5	5330.6	734.9	766.2	10242.2	2560.5
Labeo	512.5	168.2	58.2	60.4	799.3	199.8
Bagrus	5541.1	3852.0	10652.0	5415.6	25460.7	6365.2
Clarias	2861.4	2518.6	5889.5	3699.6	14969.1	3742.3
Synodontis	1.2	28.6	428.2	1161.9	1619.9	404.9
Barbus	5541.1	368.0	821.0	673.6	7403.7	1850.6
Alestes	68.8	198.4	-	-	276.2	133.6
Schilbe	12.0	13.1	-	-	25.1	12.6
Mormyrus	449.2	184.9	751.6	585.1	1970.8	492.7
Lates	16320.0	6050.7	16400.3	9906.4	48677.4	12169.3
Dagaa	-	5010.2	476.5	-	5486.7	2743.4
Protopterus	348.5	1681.7	774.1	1925.1	4729.5	1182.4
Others	355	-	-	-	355	355

Source: Annual statistics report.
Fisheries Division Hq.

TABLE 2d. ALL REGIONS COMBINED

	1979	1980	1981	1982	1983	1984	1985	1986	1987	TOTAL	AVERAGE
T.escul.	1188	1875	4422	1997	916	1740	1119	2646	1426	1729	1925.4
T.varib.	5987	4476	4418	5187	3901	3313	4373	1541	1746	34942	3882.4
T.zillii	443	200	3929	3336	1887	299	826	2859	823	14602	1622.4
T.nilot.	7474	421	492	123	49	3469	4334	10584	9939	36885	4098.3
Haploc.	20764	25036	24593	24022	21624	15122	11572	16966	1488	161187	17909.7
Labeo	16755	3435	1638	1606	923	1135	544	362	225	26623	2958.1
Bagrus	6877	4143	12180	11700	11601	8891	9214	17462	7675	89743	9971.4
Clarias	5135	4108	2934	2719	2528	5374	5560	10395	8511	47264	5251.5
Synod.	4273	8661	1938	2523	2478	4183	9278	7468	4612	45414	5045.0
Barbus	1264	256	216	291	849	8891	401	909	700	13777	1530.8
Alestes	-	-	2	-	34	387	217	90	-	730	146.0
Schilbe	3875	1704	2624	3113	2317	4423	1576	3583	1541	24756	2750.7
Morayrus	237	314	163	130	197	652	353	976	733	3755	417.2
Lates	-	15	274	2040	16425	41614	37668	123895	97478	319409	39926.1
Dagaa	1095	1517	-	-	3153	-	5219	9825	4063	24872	4145.3
Protop.	1389	6129	7080	2948	3705	3863	4050	3117	3762	36043	4004.8
Others	2879	1332	3718	2259	-	1573	2666	3725	15188	33340	4167.5

SOURCE: Annual statistics Report.
Fisheries Divisision Hq.

THE IMPORTANCE OF FISHERY ECONOMICS IN THE UNDERSTANDING OF FISHERY SYSTEMS

by

P.N. Karuhanga

ABSTRACT

There is sometimes only partial appreciation of the very important role which fisheries economics as a discipline can play both at the conceptual and practical levels, in the unravelling of the internal workings of fishery systems. This role extends to the formulation of management, development and research strategies, the assessment of the impact of intervention measures, and so on.

The complexity and diversity of the inter-related variables that dominantly control the behaviour of fishery systems, mean that our understanding and knowledge of the system structure remains incomplete if it omits a subset of important social-economic variables.

The paper uses Lake Victoria data, econometric models and a listing of these social-economic variables to highlight their importance in explaining fishery input-output quantity, quality and system variability. The study focuses on variables other then direct fishery inputs and ecological factors in explaining fluctuations in catches.

INTRODUCTION

In a world of fishery research, management and development dominated almost entirely by biologists, there is sometimes partial appreciation of the potential role and the contribution which fisheries economics can play, both at the conceptual and practical levels, in the unravelling of the internal workings of fishery systems and the development of the fishing industry.

And yet the full understanding of the country's resource potential, the formulation of management and development strategies and policy options, the definition of objectives and priority rankings, the setting of targets, the assessment of the impacts of intervention measures, and the interpretation of research data, require the recognition of this important role.

Presently this area still attracts only a minimum of research and other resources, and remains unattractive to prospective researchers.

Inadaquate social-economic information can sometimes lead to poorly planned, unco-ordinated and unintegrated development, deficient management regimes, inefficiency in resource use and failure to realise its potential, superficial understanding of fishery system dynamics, misquided research priorities, failure of regulatory measures, failure of investment projects, and so on.

Economic issues are involved in any attempts to improve fishery technology and production capacity, to take advantage of potential new investment, to improve the incomes of fishing communities, and in general the improve the performance of the industry,

To a certain extent the issues in the on - going debate about whether the Nile perch success story has been a boon or bane (Reynolds, 1988) are clouded by inadequate information on the extent of its social-economic impact. The main focus of attention has been on its ecological ramifications.

THE CONCEPTUAL LEVEL

The fishery problem has never, of course, been a purely biological problem, whether at the level of stock assessment, exploitation levels, species mix, sustainability, fishery technologies or at post- harvest levels. The problem has always had an economic dimension, in recognition of the fact that natural resources are not really resources at all unless they benefit man. Even management objectives such as increasing the annual sustainable yield or reducing the environmental impact of fishing cannot be accurately described as being purely biological. Even biological models that pre-occupy themselves mainly with natural phenomena in the ecosystem, ignore other fishery system components at the risk of their credibility.

Clearly, therefore, while the need to involve other disciplines is obvious, they are not always involved.

Yet the complexity and diversity of the interrelated variables that dominantly control the behaviour of fishery systems mean that our level of

understanding and knowledge of the system structure remains incomplete if it omits a subset of important economic and other variables.

For example the characteristics of Lake Victoria fisheries are such that fluctuation of certain magnitudes in catch figures in a given period may be quite normal and totally unrelated to the state of the fish stocks in the fishery and its ability or otherwise to sustain particular exploitation levels, (Table 2).

An input of economic research can, therefore, also help researchers and managers avoid making erroneous deductions and assuming that current conditions or changes in the fishery are caused by, for instance, overfishing when in fact they may be a result of factors outside the fishery, or what may be termed as exogenous variables.

This is all important for policy formulation and implementation, deciding on different management strategies, in assessing the effect of particular development or regulatory measures, etc.

A comprehensive listing and understanding of the wide range of variables that enter the wider fishery input - out put system, the way they affect and interact with each other, and their individual behaviour is very crucial. Some of the variables of the fishery system are endogenous, systematic, and deterministic, operating directly and explicitly within the system. Others are exogenous and predetermined operating outside the fishery system. Some of these may be policy or control variables, for instance the number of fishing licenses, if used as an instrument of control. Some of the variables may be current or lagged. Some are subject to natural variablity and measurement errors of an indeterminate nature, others are not. Some are primary or causal in their effect.

Some of the variables explain observable variability in the input-output relationships directly, others in more subtle ways. Some of the variables are stochastic or random while others are deterministic. A fishery manager may for instance want to reduce the effects of random factors without ignoring systematic variables which may reflect normal or trend growth effects in the fishery. Understanding the nature of stochastic factors and sources of stochastic variation is important in the understanding of fishery system mechanics.

Random factors in the explanation of variation in a fishery system variable set may be more important than in comparable rural economic activities or other natural resource systems.

Some of these variables, systematic or otherwise may be quantifiable and others may be purely qualitative. The effect of the latter may be of an indeterminate nature. Some of the factors may not be strictly variable and may remain constant over a period of time.

The focus of this study is the importance of variables other than direct fishery inputs and ecological factors, in the explaining of variations in total catch on a lakewide basis, by landing, by district or region. Over and above the systematic influence of direct inputs, and natural changes, exogenous variables can also have very important direct or indirect effect on the performance of the fishery. Unless these possible effects are well understood and the behaviour of these latter variables known, some of the

changes that may occur in the fishery, including those brought about by natural phenomena, or changes in the quantities and qualities and direct inputs and their combinations, can be misinterpreted or missed altogether, and erroneous conclusions made. Fishery management may also fail to counter or promote the effects of these variables.

MODEL OUTLINE

Table 1 below lists variables that can be said to affect Lake Victoria fishery productivity (output) other than direct inputs and ecological factors. The variables may roughly be considered as being exogenous. The check list is probably not exhaustive. It should be noted that most of these variables are of an economic nature, to re-emphasize the important role of fishery economics. The list is in part based on problems identified by fishermen during survey interviews conducted in 1989. By way of clarifying the importance of these exogenous variables, a model outline is employed here.

Without worrying too much about the mathematical properties of a fishery bio-economic model or a technical production fuction model, the estimation of its parameters or the quality and quantity of data that would go into such a model, consider the following model:

$$X = Y\alpha + Z\beta + U \quad \ldots\ldots\ldots\ldots (1)$$

Where:

X is an nx1 vector of observations on a dependent variable (in this case, catch by weight, value, landing, per unit effort, etc.)

Y is an nxh matrix of observations on current endogenous variables (here different gear types and sizes, boats, fishermen, and perhaps some index of stock abundance)

Z is an nxm matrix of observations on exogenous variables (some of which here may be termed control or policy variables)

α is an hxl vector of structural coefficients attached to Y.

β is an mxl vector of structural coefficients attached to Z.

U is a vector of disturbances with specific assumptions on its distribution.

Using a widely-used, single - equation method of estimation for simultaneous systems, the two-stage least square method, and on the basis of prior knowledge about the workings of the fishery system, each structural relation in the system of equations, specifies the behavioural or technological forces determining a specific variable which becomes the dependent variable.

Direct application of OLS to equation (1) may be erroneous since Y may be correlated with U. The 2SLS method replaces Y with a computed matrix Y which may be free of the stochastic element, followed by an OLS regression of X on Y and Z.

In the second stage X is regressed on Y and Z.

Johnston (1972, page 381) using different notations derives the estimating equations as:

$$\begin{bmatrix} Y'Y & Y'Z \\ Z'Y & Z'Z \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} Y' X \\ Z' X \end{bmatrix} \quad \ldots\ldots\ldots\ldots (2)$$

where $\begin{bmatrix} a \\ b \end{bmatrix}$ denotes thes 2SLS estimate of $\begin{bmatrix} \alpha \\ \beta \end{bmatrix}$

The main interest here as far as the exogenous variables are concerned is the vector of estimated co-efficients b. Depending on how many of these variables have been included and their importance, these structural system parameters would explain the variability in the dependent variable accordingly.

Consider further the model below to high light the potential importance of some qualitative exogenous variables.

A regression analysis study (Karuhanga, 1981) used the following estimating equation:

$$X_o = X_{1a1} X_2^{a2} X_3^{a3} X_4^{a4} X_5^{a5} X_6^{a6} e^E \quad \ldots\ldots\ldots\ldots (3)$$

where X_o is the value of landed catch and X_1 to X_6 are various physical units of different sizes and types of gear, man hours and boats, (Narlove, 1965). Using monthly data of four major landings, namely Majanji, Bugoto, Masese and Kigungu, first separately and then pooled together to constitute a fishing industry production function for Lake Victoria, important structural and other differences between the five regressions came to light. In the study an attempt was made to investigate landing effects and other exogenous determinants of the explained sum of squares as well as whether it is meaningful to talk of an industry production function.

This involved the decomposion of the total sum of squares around the mean of X_o into the explained sum of squares attributable to the independent variables and the residual sum of squares. The explained sum of squares was further separated into that due to a subset of explanatory variables and the incremental sum of squares attributable to the remaining independent variables.

Variations in X_o within landings were used to assess the variation of the landing means. The total variation in X_o was expressed as the sum of the variations between landings and the variations within landings.

Using the data set

$$x_{oij} \qquad \begin{matrix} i = 1, --, p \\ j = 1, --, m \end{matrix}$$

Where p shows the number of landings (= 4) demoted the number of monthly observations per landing the F test for the significance of the variation between landing means was calculated as:

$$Fi = \frac{(x_{oi} - x_o)^2/(p-1)}{(x_{oij} - x_{oi})^2/p(m-1)} \quad \ldots\ldots\ldots (4)$$

and Fo.99 = 9.23 for (3,120) degrees of freedom was found to be the minimum value for F_i so that all the F_i values for the four landings were significant.

This test, however, is valid only if the within-landing sum of squares is a good indicator of the random variations within X_o against which significant effects are being tested. But X_o may well be affected by other exogenous variables which cannot be standardized within the four landings. This means that the simple withing - landing sum of squares over - estimates the random element in X_o and, in addition, the difference between landing means will express not only possible landing influences but also the influence of possible differences in the values assumed by the variables that cannot be standarized for comparison at different landings.

With some recent improvements in the quality and quantity of data on Lake Victoria's fishery statistics, and using the data set:

$$X_{oij},\ X_{rij},\ r = z, \ldots\ldots\ldots, k,$$

Where there are (k-1) explanatory variables

$X_2, \ldots\ldots\ldots\ldots, X_k$, an extension of the simple model

$$X_o = X\alpha + u \quad \ldots\ldots\ldots\ldots \quad (5)$$

to a more generalised model of the form:

$$X_o = D\beta + X\alpha + u \ldots\ldots\ldots\ldots (6)$$

Where D is a matrix of dummy variables, and incorporating more exogenous explanatory variables and more landings, is planned.

The general model can incorporate and correct statistically for the effects of "external" unstandardized variables, and can test whether the data matrix of explanatory variables has the same effect on X_o , that is, the same regression coefficients at the various landings. Tests for differences in intercepts assuming the slopes to be constant or tests for differences in slopes between landings can be carried out.

Such a model can handle the determination of the existence or otherwise of landing effects in the form of different intercepts. The intercepts can be allowed to vary from one landing to ahother. Its is planned to investigate whether there may also be location effects over and above the within - landing effects connected with where the landing is situated. This would bring out any unique effects attributable to the geographical characteristics of the location.

The dummy matrix should be able to cater not only for landing and location effects but also for month, season, and year effects, over and above the influence of the set of explanatory variables. This is a recognition of the likelihood that there can be differential shifts in the function between

landing and locations, between months seasons and years. The time - variable effects in the dummies are only those of a non - ecological nature. Possible interaction effects between different sets of dummy variables will also be investigated.

The use of optimization techniques which minimize or maximize a specific management objective will also be investigated, as a further development of the above model.

CONCLUSION

Economic variables influence the processes that determine the nature of fishery systems, and their proper understanding is very important. These variables should, therefore, not be lost sight of at all stages of fishery improvement. Only then can full resource potential be tapped.

TABLE 1 Variables that can explain variability in Lake Victoria's fishery productivity (output) other than that due to direct inputs and natural phenomena.

1. - Extant of involvement in agriculture by fishermen

2. - Quality of land transport and communications facilities to landinds

3. - Efficiency of on - lake transport to/from islands

4. - Nature of services available at landings such as schools, dispensaries, shops, petrol pump, repair facilities, etc.

5. - Distribution pattern of landings.

6. - Nature of incentives to fishing crews, nature of labour market and the opportunity cost of labour.

7. - Orientation, structure, adaptability and elasticity of markets

8. - Size of markets near landings

9. - The importance of active fishermens associations

10. - Extent to which community in a given landing is settled or transient and nomadic (Marriott, 1988)

11. - Ownership pattern and degree of concentration of capital assets in the lands of a few people, and average size of fishing enterprises.

12. - Extent of community cencept within fishery

13. - Seriousness of the net theft problem

14. - Existence or otherwise of excess boat capacity within fishery.

15. - Average number of fishing pays per boat, per landing, per month, and within - enterprise efficiency.

16. - Seriousness of selling fish on the lake

17. - Adequacy of processing facilities at landings

18. - Motivation of fishermen as economic agents, as profit maximizers, as satisficing agents, full or part time participants.

19. - Availability of extension services and nature of staff deployment.

20. - Literacy levels among fishermen.

21. - Investment opportunities for fishery incomes within landings.

22. - Investment opportunities outside fishing industry.

23. - Availability of formal credit.

24. - Level of inflation in the national economy

25. - Growth rates of national economy

26. - Trends in the prices of substitute animal proteins

27. -

28. - Prices and supply of inputs (mainly gillnets) in a previous period.

29. - Fish prices in a previous period

30. - Legal and development policy framework within which the industry operates. (Development means more than technical provision of inputs Panayotou 1982).

31. - The size of government subsidies and other assistance programmes to fishermen.

32. - Management policy on effort levels and role of licenses and other regulatory instruments (Smith, 1983)

33. - Attitude of fishermen towards management.

34. - Role of women

35. - Month, season and year effects

36. - Irregular factors.

Table 2

TOTALS OF FISH LANDED AT MASESE BY SPECIES (OCT. 1988 - OCT. 1989)

Month	O. niloticus	Lates	Rastrineobola	Clarias	Protopterus	Bagrus
OCT. 1988	63068	174929	165060	126	532	131
NOV. 1988	87496	188600	226980	222	777	294
DEC. 1988	96042	219526	253416	287	659	-
JAN. 1989	82022	152968	283374	326	277	7
FEB. 1989	105845	147517	502320	306	610	-
MAR. 1989	115152	146788	418002	112	181	-
MAY. 1989	38953	197925	289731	273	769	-
JUNE 1989	798559	245362	298806	726	391	-
JULY 1989	90087	258622	377208	569	346	-
AUG. 1989	64794	150182	306150	228	170	-
OCT. 1989	65887	531129	254746	14	152	-

Source: U F F R O

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SOCIO-ECONOMIC ASPECTS OF LAKE VICTORIA FISHERIES RESEARCH AND DEVELOPMENT ACTIVITIES

By

E. F. B. Katunzi

ABSTRACT

Lake Victoria is a vast fisheries resource and therefore attracts the riparian states to explore the possible ways of identifying the optimal use of its resources.

The lake being in a transient state requires an immediate review of the management and fishery objectives through well planned research programmes that will cater for the requirements of the immediate countries concerned.

Development activities like transport, industrial application, urban development and agricultural practices along the lake affect and are affected by the fish stocks and the fisheries. The role of research should harmonise the social and economic benefits in order to avoid conflicts by the possible users of the lake. The results should aim at evaluating the state of the fishery and its long term potential production.

This paper analyses the research and development activities along the Tanzanian side of Lake Victoria and summarising the major programmes and results. In addition it makes an evaluation of the socio economic effects of these activities and concludes with future recommendations.

1. INTRODUCTION

Lake Victoria, with a surface area of about 69.000 km^2 is the largest lake in Africa. Traditionally the fisheries of Lake Victoria were multispecies exploited by artisanal and small scale fishermen using mostly canoes and gillnets. It is estimated that fish stocks of the lake are exploited by more than 50,000 small scale artisanal fishermen. In the 1970's, the entire fishery was dominated by small haplochromine cichlids of more than 250 different species (Oijen et al. 1981) along with 11 other genera (CIFA 1984). The tilapine cichlids, have for a long time been highly exploited. This has resulted in drastic reduction in catch (CIFA 1982, Mann 1970, Ogutu-Ohwayi, 1988). Several other species including Bagrus, Clarias, Rastrineobola, Protopterus, Mormyrus, Synodontis and the anadromous: Labeo, Schilbe, Alestes and Barbus, were also exploited. Nile perch which constituted more than 80% of lakes' biomass, remained for most of the time underutilised due to the very low demand (FAO 1973, Dhatemwa 1982, Nyholm and Whiting 1975).

However due to the decline of the traditional fishery tilapia and Nile perch were introduced to boost the lakes production, the effects of which showed up at the end of 1980. (Okemwa 1984; Goudswaard & Witte 1985; Goudswaard & Ligtvoet 1988).

Changes in the lake over the last decade have been attributed to a variety including environmental variation, increased fishing intensity and the stresses arising from Nile perch. (Ssentongo and Welcomme 1985).

The effect of establishment of Nile perch coincided with drastic changes in species composition of the haplochromines resulting in a different food chain (Ligtvoet 1989). Other environmental effects like of blue-green algal blooms and mass mortalities of fish (as a result of deoxygenation) became common (Ochumba 1989).

At present the fishery is based on three species: 1) Nile perch (Lates niloticus), 2) dagaa (Rastrineobola argentea); 3) introduced Nile tilapia. (Oreochromis niloticus). Over the last three years, the annual total production estimate ranges between 300,000 to 400,000 tons. As a result of Nile perch (Gréboval 1989) there has been an average of 150,000 tons surplus over the last 10 years. For Kenya, Uganda and Tanzania, this means an increase a total fish production, a most valuable source of food and a large change in the socio-economic state of the fishery.

The recent developments in the Rastrineobola and introduced Oreochromis niloticus fishery have also boosted fish production and provided extra jobs and income (Reynolds & Gréboval 1988).

The biggest challenge to these countries is to devise a concerted management strategy in order to avoid the possible consequences of over-exploitation and loss of the socio-economic benefits gainied from the new fisheries regime.

As a result, a well planned research programme is needed in order to monitor and evaluate the fishing industry for the benefit of the riparian states. The paper discusses the major research and development activities on the Tanzanian side of Lake Victoria.

2. RESEARCH ACTIVITIES

In Tanzania the body entrusted with the task of conducting fisheries research is the Tanzania Fisheries Research Institute the major tasks of which are:

- promoting, conducting and coordinating fisheries research in Tanzania;
- improving and protecting the fishing industry through developing and promoting better methods and techniques of fishing, fish farming, processing of fish and fish products;
- investigating fish diseases, so as to develop ways of controlling or preventing their occurrence;
- documenting and disseminating research findings for use by government, public institutions and persons or bodies of persons engaged in the fishing industry on the practical application of findings of research done by or on behalf of the Institute;
- promoting and providing facilities for instruction and training of local fisheries research and management personnel in cooperation with the Government or any other person within or outside Tanzania.

The recent changes in the fishery need immediate attention to identify the resource base in order to define a substainable level of exploitation. Fish production is in the hands of artisanal fishermen and future recommendations for the fishery must take this into account.

The research activities in the Tanzania sector, a joint venture between TAFIRI and HEST (lasting 10 years), have had to become flexible to cater for the dynamics of the fishery: the original multispecies fishery turned into a fishery for Nile perch, pelagic Rastrineobola and herbivorous Oreochromis niloticus. The research programme addressed itself to the following issues.

2.1 Monitoring Programme

The research vessel R.V.Kiboko conducted routine surveys in the Mwanza Gulf, Bukoba, Ukerewe and Ukara Islands and Speke Gulf to monitor changes in abundance, species composition and size structure of the Nile perch population. Results from the surveys indicated:

1) a sharp decline in Haplochromines species;
2) the species composition in the catches changed;
3) a decrease in size at maturity for certain species, attributed to the high commercial fishing activities in the area;
4) the Haplochromine stocks in offshore areas (> 20 m) were smaller than those found during the surveys at the beginning of the 70's; (in the later years, the trawlable haplochromine stock vanished completely and was attributed to predation by the Nile perch). As a result of this, all commercial Haplochromine fishing by trawlers of the Nyanza Fishing and Processing Company e.g. sundrying as all other activities stopped;
5) by 1988, the Nile perch had become the most abundant stock;

6) present research indicate a decrease in catch rate of the Nile perch with an increase in pelagic Rastrineobola argentea and Oreochromis niloticus;
7) A variety of other species are still represented but with a very low occurrence rate. These included Bagrus, Clarias, Synodontis, Schilbe, Barbus, Labeo, Alestes, and Mormyrus;
8) the size structure of the Nile perch population from Bukoba showed a big difference from that observed in the Mwanza Gulf attributed to heavier fishing pressure in the Mwanza Gulf in Bukoba. This indicated the impact of artisanal fishery on the stocks;
9) Beach seines and dagaa seines are also of wide use but are found at particular sites. Rastrineobola fishery is intensified along the Island. Beach seines are operated at open beaches like Semba and Igombe.

2.2 Catch and effort data collection at the landing beaches

To get the characteristics of the fishery, information on catch effort data is necessary. Regular visits to selected beaches were made and information on types of gear, catch composition and fishing vessels were gathered. It was established that:

1) The fishing activities in the Tanzanian part is fully operated by artisanal fisherman;
2) Gill nets are the popular gear in use with meshes ranging between 6 - 10";
3) Beach seine of length up to 900 m and longlines are used;
4) Gill nets with mesh sizes of 6-10 are effective of catching Nile perch of 60-90 selectively (Ligtvoet 1988);
5) Beach seines and long lines were less selective and have been found to catch Nile perch from 20-160 cm (mostly 35-55 cm) and 30-120 cm (40-65 cm) respectively;
6) By early 1987 the catch per unit of effort per boat varied according to the fishery:
   - the gill net fishery : 80 kg/canoes/day;
   - the beach seine fishery : 240 kg/canoes/day;
   - the long line : 40 kg/canoes/day.

A big constraint on the use of gill nets was availability and nets were found to be scarce. However fishermen had resorted to manufacturing their own nets from tyre materials and fibres from fertiliser bags. These locally made nets gained popularity due to durability: the factory manufactured nets were abandoned because of their small ply.

2.3 Gill net selectivity

The gill net selectivity experiment revealed a relationship between mesh size (M) and mean total length TL of the Nile perch the nets retained. TL = 0.35M + 4.94 (mesh size in mm and TL in cm) (Ligtvoet et al 1988).

2.4 Tagging experiment

Tagging exercises were meant to provide information on growth. The recapture exercise did not produce useful information however as only three fish showed good growth increments. The recovery of tagged fish was not been very successful and a lot of fish died during tagging.

2.5 Recent Research and Activities

Over the past years, the emphasis had been on investigating the shift in the fish community and the fisheries.

The development of such a cost effective monitoring survey needed background ecological information. How big a sample size should be in order to represent the size structure of a population requires a combination of ecological and biological knowledge eg. distribution patterns, information from the trawl survey eg. manpower and fuel. The ecological and biological data so far collected is adequate enough to design and improve on cost effective fish surveys which can be conducted on a regular basis.

As a follow up of the HEST/TAFIRI/FAO/DANIDA seminar in Mwanza (Jan/Feb 1989) information on Rastrineobola, and Oreochromis is being collected and investigated. Special attention is being made to define fishing effort and inventorise the fishery .

The outcome of all these activities will be compiled in a handbook to be circulated among the riparian states. Within the handbook a strong need for improvement of reliable and additional data is stressed. The central theme for the handbook would be formulated as "What else beside estimates of total output per species and per country, together with the conducted fishing effort, is needed in order to monitor and improve the management of the fishery and how could all this information be made available as easy and quick as possible?

The handbook will specifically describe the situation in the Tanzanian part of the Lake; the information from the other two countries will be incorporated as soon as they are obtained.

Management is very difficult if knowledge on the extent and development of fishing effort is not available. The present fish survey is aimed at predicting short term developments in fish stocks and the fishery, the recruitment of new cohorts, fishing efforts and effective gear in use. Also the programme is meant to accumulate knowledge on the status of the fish stocks under different management regimes. Bearing in mind the level of inputs and personnel available for the programme, the surveys costs should be minimal but still secure the maximum information.

Another important aspect of the current programme is to develop an efficient way of disseminating the information to the relevant bodies which is required for decision making for investment programmes, control of fishing effort, prescription of mesh sizes, landing facilities, training programmes etc. There is also a need for the development of a monitoring system as an instrument for fisheries management to be used in the long term.

3. DEVELOPMENT ACTIVITIES

Apart from providing food and employment opportunities for the people around the lake, water from Lake Victoria supplies water for domestic and industrial use as well as a medium for transportation and for recreational purposes (Bugenyi 1989). Some parts along the lake have become centres for development as a result of easy access to social anemities.

The rapid expansion and need to increase food through agriculture and industrial output, coupled with urbanisation programmes has greatly increased the demand for water resources. The urban centres of Bukoba, Mwanza and Musoma are engaged in industrial development activities that calls for the attention of ecologists and conservation biologists. The sewage systems also drain into the lake. Agricultural activities along the lake, have grown and in certain localities forests have been cleared to get more land for cultivation. Use of pesticides, agrochemicals and fertilizers to increase the agricultural yield has greatly increased. Pesticide use has lead to an unfavourable increase of chemicals the soil which later find their way in to the food chain (Bugenyi 1989). A comprehensive programme of research and data collection is now urgently needed to manage the human impact and devise a strategy for optimal use.

TAFIRI and HEST having realised the shortage of netting material in Lake Victoria fisheries, recommended that the governments of Tanzania and Netherlands support the fishnet factories in Tanzania. This came up as communique at the special meeting on the effect of Nile perch on the Lake Victoria fisheries (held in January 1986 in Leiden, The Netherlands). As an initiative from Tafiri, the Government of Tanzania approached the Netherlands government to assist in the purchase of the netting materials which resulted in the Netherlands Government giving Dfl 2,000,000 to the Tanzanian fishnet factories greatly alleviating the shortage of nets.

The dynamic change that has taken place due to the boom of the Nile perch industry has attracted donor agencies to provide assistance in terms of gear and fishing equipment. The Canadian International Development Research Centre (IDRC) is funding a programme in Musoma region on the biology and ecology of the Nile perch. This is complementary to the joint programme by Tafiri and Hest at Mwanza. Technical assistance in the form of gear and fishing vessels have been provided for the research.

Similarly the European Economic Community (EEC) is funding a fisheries project under the financial agreement 3635/PR for the three riparian states of Tanzania, Uganda, and Kenya. The project is meant to strengthen the research Institutions in the three countries, stimulate research cooperation among the scientists, improve on data collection and to disseminate the scientific information. The procurement of facilities as stipulated in the agreement is currently on going and funds for the project have been released. Currently a regional research programme is being prepared to involve the three countries so as to tackle the lake as a single entity.

The IDRNI in collaboration with Tafiri have constructed trial kilns in Mwanza, Ukerewe Islands, Bukoba and Musoma. These are meant to reduce the use of firewood by almost 50%. The results are positive and more of the same type are expected to spread to more rural areas.

Wotro a dutch based agency is planning to start a multipurpose project on the sustainable use and conservation of the land-water zones on the Tanzanian side of Lake Victoria. The project will concentrate on ecological investigations of the land water zones focusing on relationships between fish communities, vegetation and land use. It will aim at the sustainable use, conservation and assessment of littoral regions to establish principles for the management of these areas.

Certain factors still need improvement in order to develop the fishing industry. Most of the roads from the landing sites are impassable especially during the rainy season increasing post-harvest loss and hampering sale. Most of the landing sites also require improved infrastructure where auctioning can be easily done without fish spoilage.

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FEATURES OF THE DEVELOPING ARTISANAL NILE PERCH (Lates niloticus) AND DAGAA (Rastrineobola argentea) FISHERIES IN SOUTHERN LAKE VICTORIA

by

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ABSTRACT

In the early 1960's the Nile perch (Lates niloticus), a large predator, was introduced to Lake Victoria. By the end of the 70's, following the enormous and sudden expansion of this stock an artisanal fishery for Nile perch rapidly developed.

Before the increase of the Nile perch stock, a small dagaa (Rastrineobola argentae), fishery had been progressively developing. (Dagaa is the Tanzanian name for this small pelagic Cyprinid.) Presently the Nile perch and dagaa stocks dominant the lake, supporting the most important commercial fisheries.

The main features of the three major Nile perch fisheries (gill netting, long lining and beach seining) and the three major dagaa fisheries (lift netting, scoop netting and beach seining) are described.

The need to assess the exploitation pattern using Catch Per Unit Effort (CPUE) per type of fishery and the incorporation of length measurements are discussed.

1. INTRODUCTION

In the early 1960's the Nile perch (Lates niloticus), a large predator, was introduced into Lake Victoria. By the end of the 70's, following the enormous and sudden expansion of this stock, an artisanal fishery for Nile perch had rapidly developed. Presently the Nile perch stock is the dominant fish stock in the lake, supporting the most important commercial fishery. Although the absolute figures produced by the statistical data collection services of the three riparian states Kenya, Uganda and Tanzania, to some extent may be disputed (CIFA, 1988; Bernacsek, 1986), the estimated annual yields presently lie around 200,000 - 300,000 tons (CIFA, in press).

Before the increase of the Nile perch stock, a small dagaa (Rastrineobola argentea) fishery had been progressively developing. (R. argentea, a small cyprinid is known as "dagaa" in Tanzania.) The total length of dagaa rarely exceeds 10 cm and it has a short lifespan of 1 - 2 years (Wanink 1989). Dagaa began to prominently appear on the Kenyan and Tanzanian markets in the 1960's (Okedi 1974). In 1978 a beach sampling program was conducted in the Ukerewe district (Okedi 1981), on a group of islands in the south-eastern part of Lake Victoria where the dagaa fishery is concentrated. In this area an annual yield of 3500 metric tons (fresh weight) was recorded (Okedi 1981). A dagaa trader operating at Kirumba, the harbour of Mwanza and the major trading place for dagaa in the Tanzania part of Lake Victoria, estimated that about 6000 metric tons of dried dagaa was transported through the harbour of Mwanza in 1989 (personal communication).

For the adequate management of the new and evolving fisheries, the need for increased research directed towards describing and monitoring the developments in both the stocks and their fisheries was evident (CIFA 1985, 1988).

In Tanzania, a fishery statistics collection system exists under the authority of the Fisheries Department. Enumerators record the daily catch per species, per canoe and per type of gear for as many days per month as possible. In the eventual data analysis, however, the information on the catch per canoe, per gear type is not acknowledged and on an annual basis only a "mean catch per canoe" is calculated, irrespective of gear type. Since for the design of an efficient and adequate beach sampling system, the basic characteristics of the concerned fisheries and especially the variations in the catches need to be known (cf. Bazigos 1974, Caddy & Bazigos 1985), pilot beach sampling programs, covering a restricted area, were set up which had the following main objectives:

i) to provide a basic description of the main types of Nile perch and dagaa fisheries;

ii) to collect data on catch and effort (CPUE) and exploitation pattern of the main types of Nile perch and dagaa fisheries;

In the present paper, which is largely based on Ligtvoet & Mkumbo (in press) and Mous et al. (in press), the main features of the three major Nile perch fisheries (gill netting, long lining and beach seining) and the three major dagaa fisheries (lift netting, scoop netting and beach seining) are described.

A key parameter in assessing the state of exploitation in the various fisheries is the catch per unit effort (CPUE). By following the CPUE through time a good insight is gained in the developments of the fisheries. In this paper, an average CPUE was calculated for the various types of Nile perch and dagaa fisheries. On the basis of data collected in 1987 and 1988 the average CPUE for the various types of Nile perch fisheries could be followed throughout this period.

Another parameter which is easy to establish and which also gives important clues about the state of exploitation is the mean length in the catch. When over-exploitation occurs, the first signs come from decreasing mean size of the catch; usually fishermen react to this by lowering their mesh size. For Nile perch, the mean length in the catch together with the pattern of used mesh-sizes was followed throughout 1987 and 1980. The results are included in this paper.

2. METHODS

All data were collected by means of an extensive beach sampling program in which measurements on actual catches ("real measurement approach", Bazigos, 1974) were combined with data obtained by interviewing the fishermen ("fishermen's estimate approach"; Bazigos 1974).

2.1. Nile perch

In Mwanza Region (the most densely fished area in Tanzanian waters), five landing sites for regular sampling were chosen; each landing site, defined by Bazigos (1974) as a "Primary Sampling Unit". The basic characteristics of the sampled landing sites are given in Table 1.

The area covered 100 km of shore line and contained fishing grounds ranging from shallow inshore waters (depths less than 4 m) inside the Mwanza Gulf to offshore waters (with depths up to 40 m).

5-10 boats at each landing site were randomly sampled, each boat constituting one sampling unit which concurs with the "Fishing Economic Unit" consisting of a fishing craft, fishing gear and fishermen (Bazigos 1974). The sampling frequency was once per month and the sampling was carried out by a team of two people. From each boat sampled, the total or sample number and total length (to the nearest cm below) of each Nile perch caught was recorded. An estimate of the catch weight of Nile perch landed per boat was obtained by converting the length measurements into weight, using the length-weight equation $W = 0.000006 \times L^{3.17}$ (Ligtvoet & Mkumbo 1990). By taking a "boat-night" as the unit of effort (Ligtvoet & Mkumbo, in press) these catch weights represent the CPUE.

Table 1. Summary of basic characteristics of five landing sites monitored over the years 1987 - 1988

landing site	fishing ground	average no. of canoes	target species	dominant fisheries
Busisi	inshore; depth-4 m	5-10	Nile perch Tilapia Lungfish	gill nets beach seine long line
Kirumba	in/offshore depth 10-40 m	10-15	Nile perch	gill nets
Semba	inshore depth-ca. 10 m	1	Nile perch	beach seine
Igombe	offshore: depth -40 m	10-35	Nile perch	gill nets
Busulwa	offshore: depth -30 m	10-30	Nile perch	gill nets

2.2 Dagaa

In the Mwanza region two landing sites were chosen for the beach sampling: Igaragara and Igombe (Fig. 1). Both landing sites have sandy beaches with some scattered vegetation. Igaragara is located in a small bay and is sheltered while Igombe is more exposed to the wind. During the months October - February 1989 a team of three people paid regular visits to Igaragara and Igombe. During these visits information on catch and effort were gathered. The unit of effort was defined as lamp hours (Mous et al., in press). Results provided information on variability in catch per unit of effort (CPUE).

3. RESULTS OF THE DIFFERENT TYPES OF FISHERIES

3.1 Nile perch

3.1.1 General

The three most important types of Nile perch fishing methods are gill netting, long lining and beach seining. The fishermen generally use non-motorized planked canoes up to ca. 10 m long, mostly powered by paddles or sails. The gill net fishery constitutes the most important fishery of all (inshore and offshore). Long lining is mainly restricted to the shallow inshore waters (e.g. Busisi; Table 1) where other long line target species (especially Protopterus) are still of commercial interest. In these areas almost 40% of the canoe landings were recorded from long line fishermen. At

the other landing sites long lining played an insignificant role. Beach seines targeting specifically for Nile perch are mainly found on beaches along open water. The relative importance of this type of fishery is difficult to assess because the landings normally are sold on the spot and not brought to the same landing sites as the catches of gill nets and long lines. In the vicinity of Igombe, three beach seines are known to operate.

3.1.2 Gill netting

A fishing unit using gill nets consists of one canoe with 3 - 5 fishermen. The number of gill nets per canoe vary greatly from about 10 to 100 or even more, but the majority of the canoes were found to operate with 30 - 50 nets. The nets are generally set late in the afternoon and hauled in at dawn the next morning. Fishermen operating offshore fishing grounds often only collect the fish from the nets and then leave their nets in the water.

Due to the shortage of genuine netting materials, various other types of twine are used in the manufacture of gill nets. At first split nylon rope: polyethylene fibres (obtained by unravelling fertilizer bags) and twine used in the car-tyre manufacture, were common substitutes (cf. Ligtvoet et al., 1988), but presently webbing of the tyre twine, which are considered by the fishermen to be the best material, are found predominantly . The mostly home-made gill nets are not of standardized dimensions. Fishermen claimed to use nets ranging in length from 15-90 m; the lengths most reported were between 30 - 60 m.

The specialized Nile perch fishermen use 6-10 inch mesh nets although originally in the early development of the fishery, 12-16 inch mesh nets were used. The gill net fishery appears to be rather uniform and exploits mainly the 60-80 cm TL length group. Nile perch strongly dominates the catch, with by catches contributing to less than 2% of the total catch in numbers.

2.1.3 Long lining

A long line fishing unit generally consists of one boat with 2-4 fishermen. On average 500-1000 hooks are used, baited mostly with live Haplochromines (obtained by angling on rocky shores), fresh dead 'dagaa' (Rastrineobola argentea) or pieces of fish meat (Nile perch). Long lines are used mainly as demersal lines set near the bottom or in midwater. They are set late afternoon and hauled up the following morning. Besides Nile perch, fishermen using long lines also target for Protopterus (inshore waters), and the catfishes Bagrus and Clarias (in the offshore fishing grounds). At Busisis, these species contributed not more than 25% of the total catch in numbers. With long lines a much broader spectrum of the Nile perch population is exploited, with the size group of 40-80 cm TL contributing most to the catch.

3.1.4 Beach seining

A beach seine fishing unit consists of two wooden canoes, a large beach seine, the owner, a number of fishermen permanently employed and a varying number of persons to assist in pulling in the net. The beach seines are of the type with a bag (or codend) mounted between the two identical wings. Mesh sizes used in the wings range from 3" to 1.5"; the codend mesh is 1.5". Poles are used at either end of the net to keep the wing netting open vertically. The total length of the beach seines seen in operation was - as claimed by the

owner - 800 and 1000 m, with pulling ropes of ca. 800 m. One haul per night is made, which may take 8 - 10 hours and involve around 30-40 men.

The large beach seines targeting for Nile perch capture Nile perch from 25 to over 140 cm total length, with the bulk between 40 and 70 cm.

3.2 Dagaa

3.2.1 General

In the Tanzanian part of Lake Victoria, three main types of dagaa fishery were encountered: a beach seine fishery, a scoop net fishery and a lift net fishery.

During another study in Tanzanian waters a boat operated encircling net was encountered, but this type of fishery seems to be of minor importance (Prado, personal communication). Within each type of fishing there is considerable variability in the fishing operation.

The three main types of the dagaa fishery share the following features:

- they are based on the attraction of dagaa by an artificial light source during the night. The lamps are pressure lamps, locally known as "karabai". The fuel consumption is about 0.2 litre/hr.

- since fishing is based on light attraction, fishing is not conducted for a period of 7 to 10 days during full moon.

- the dagaa is dried on the beaches by the fishermen. A minor part, about 20%, of the catch is sold fresh. The catch is left on the beach for 1 to 3 days, depending on the weather conditions. In the rainy season the catch sometimes cannot be dried properly. This results in low quality dagaa which is sold separately as chicken food for about half the price of the high quality dagaa. A 30 kg gunny bag of high quality dagaa cost about Tsh 2800[1] in February 1990.

- the unit of measurement for the quantity of fresh dagaa is the "debe", a tin which can contain about 20 kg of dagaa. Dried dagaa is sold per gunny bag of about 30 kg (high quality) or of about 30-40 kg (low quality). A gunny bag of low quality dagaa is heavier because of the higher water and sand content of the product.

- the fishermen operate in groups. Catches of a group are divided among the fishermen and are dried separately. The entrepreneur receives about 1/2 to 3/4 of the revenue. Several groups may live together in one camp and sometimes they even share a net and/or a boat in case of a beach seine or a scoop net fishery, but the catches are always kept apart.

- most fishermen are migratory. They tend to shift to other sites when catches are not satisfactory or if conditions are not favourable, for instance rough water at an exposed beach.

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[1] The official rate in February 1990 was Tsh 190 for US$ 1.

3.2.2 Beach seining

In the beach seine fishery, the lamps are attached on locally made rafts, and are anchored in a straight line approximately perpendicular to the shoreline. The distance between the lamps varies between 10 and 20 m. Approximately 3 hours after setting the lamps are hauled slowly, till they are grouped together close to the shore. Next, the beach seine is set around the lamps and the net is hauled in by 3 to 6 men. The length of the beach seine varies between 40 and 100 m. If the fishermen are fishing from their home beach, the catch is spread on the beach for drying immediately after a haul. This type of fishery is only conducted at sandy beaches. In some cases the fishermen make several hauls at different places. If so, the catch is put in the canoe and is spread on the home beach after the fishing night has ended. The canoe may be equipped with an outboard engine. It seems that the beach seine fishery is still the most common type of fishery in Mwanza region and Ukerewe.

3.2.3 Scoop netting

In the scoop net fishery, the lamps are set on rafts similar to the beach seine fishery. The lamps are concentrated near the canoe and the fish is scooped and put in the canoe. There is little variation in the dimensions of the scoop net; the diameter is about 1.3 m, and the total length of the net about 4.5 m. One scoop net is handled by one man.

3.2.4 Lift netting

The lift net vessel is composed of two boats, connected to each other as a catamaran. The net is situated under the catamaran, and it is kept open by outriggers on the catamaran. The lamps are attached on the catamaran and while attracting fish are placed in the middle of the two boats. After attracting the fish, the net is hauled in. The depth of the net is about 10 m, the surface area of the water column above the net is about 25 m^2 (Nedelec 1975). About half of the lift net groups encountered used outboard engines (HP).

3.3 Catch per unit effort (CPUE)

3.3.1 Nile perch.

The average CPUE over the sampling period 1987 and 1988 (Ligtvoet & Mkumbo, in press) proved to be significantly different for: i) the three major Nile perch fisheries, and ii) the gill net fisheries operating in littoral and offshore waters (Table 2, Fig. 2). Treating these types of fisheries separately, the CPUE through time is depicted in Fig. 3.

The total length frequencies of the gill net and long line fisheries for 1987 and 1988 and of the beach seine fishery for 1987 are given in Fig. 4, 5 and 6. The development in the use of the different mesh-sizes throughout the sampling period can be seen in Fig. 7.

Table 2. Estimates of mean total length (TL in cm), catch weight (CW in kg) and the coefficients of variation (CV) in Nile perch catches recorded from different types of fisheries in 1987 an 1988.

Fishery	Fishing ground	Year	n	TL mean	TL CV	CW n	CW mean	CW CV
gill net	offshore	1987	1883	70.5	10	41	107	51
		1988	4662	67.6	9	71	118	42
gill net	inshore	1987	202	68.3	10	31	31	69
		1988	407	63.7	13	28	32	68
long line	inshore	1987	238	65.2	36	20	69	64
		1988	288	71.0	36	17	60	67
beach seine	inshore open water	1987/ 1988	6940	56.2	25	12	1140	51

3.3.2 Dagaa.

The average CPUE over the sampling period November-December 1989 proved to be significantly different for the different types of dagaa-fisheries (t-test, $P<0.01$), as indicated in Fig.8 and Table 3.

Table 3. CPUE statistics. X indicates that the fishery is not present at that site. CV = coefficient of variation.

	Beach seine			Scoop net			Lift net		
	Mean	CV	n	Mean	CV	n	Mean	CV	n
Nov./Dec.									
Igaragara	5.5	85.6	12	9.15	137.7	13	X	X	X
Igombe	7.8	102.3	7	X	X	X	44.1	69.5	14
Dec./Jan.									
Igaragara	6.4	64.2	16	4.3	47.9	10	X	X	X
Igombe	3.6	53.5	6	X	X	X	6.7	77.5	10

4. DISCUSSION

For the dagaa fishery as well as the Nile perch fishery strong differences have been found in the CPUE of the different types of fisheries

(Table 2, 3; Fig. 8). This implies that in monitoring the developments in the CPUE, the catches of these different types cannot be lumped together, but should be dealt with separately. The Tanzanian Fisheries Department calculates an overall annual average catch per canoe, irrespective of gear type. It is not likely that this method produces figures representative and reliable enough to assess the status of the fishery. An adequate assessment based on the data of the statistical service is further hampered by the absence of data on the length frequency distribution of the catch. As shown below this type of information is highly valuable in assessing the trends in the fisheries.

During our two-year sampling program on Nile perch, the development in the gill net fishery proved to be a good illustration of how useful it is to incorporate length measurements in the sampling routine. As already stated, changes in the exploitation pattern may, at an early stage, give a warning of overfishing; when over-exploitation occurs, the first signs come from decreasing mean sizes in the catch (and usually fishermen react to this by lowering their mesh size). In our two-year sampling program, a slight shift of modal length in the gill net catches was noted (Fig. 4) and this was correlated to a shift in the use of smaller mesh sizes (Fig. 7). In February and March 1990, the average length of Nile perch in the catch had declined further and at Igombe an average TL was measured at 63.9 cm (sd. 12.8), together with an almost complete disappearance of the 8" gillnets from the fleet. The average catch per canoe amounted to not more than 40 kg, versus 107 and 118 kg in 1987 and 1988 (Table 2).

There are two explanations possible: i) the developments are indeed due to overfishing, or ii) fishermen lower their mesh sizes anticipating the exploitation, already in an early stage, of an upcoming strong cohort. Trawl surveys in the area, however, do not show signs of a particular successful cohort, but instead indicate a substantial decrease in the exploitable biomass of Nile perch for 1990 (P.C. Goudswaard, pers. comm.). This information supports the view that the noted shifts in the fishery possibly are signals of overfishing.

Incorporation of length measurements in the data collection system of the Fisheries Department therefore is strongly recommended. Especially, because little extra effort and equipment is required.

Acknowledgements

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FIGURE 1

Schematic map of the southern part of Lake Victoria.

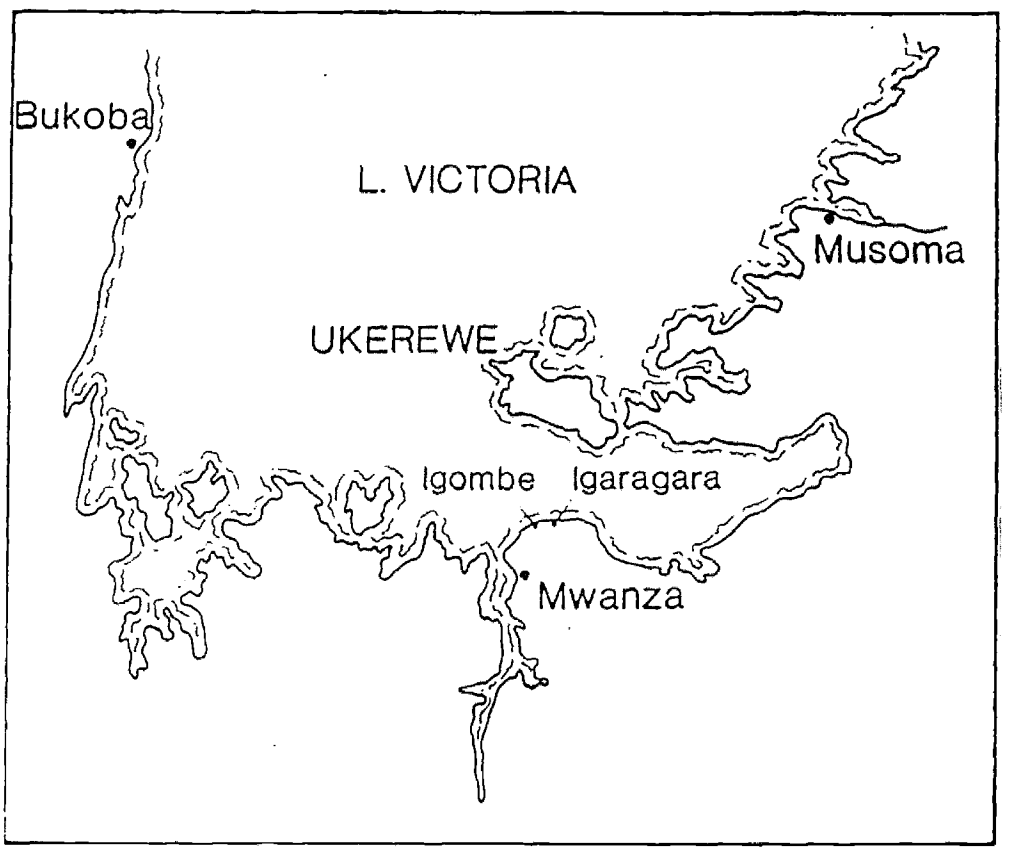


FIGURE 2

Average catch per unit of effort for Nile perch throughout the sampling period (1987/88) for the different types of fisheries.

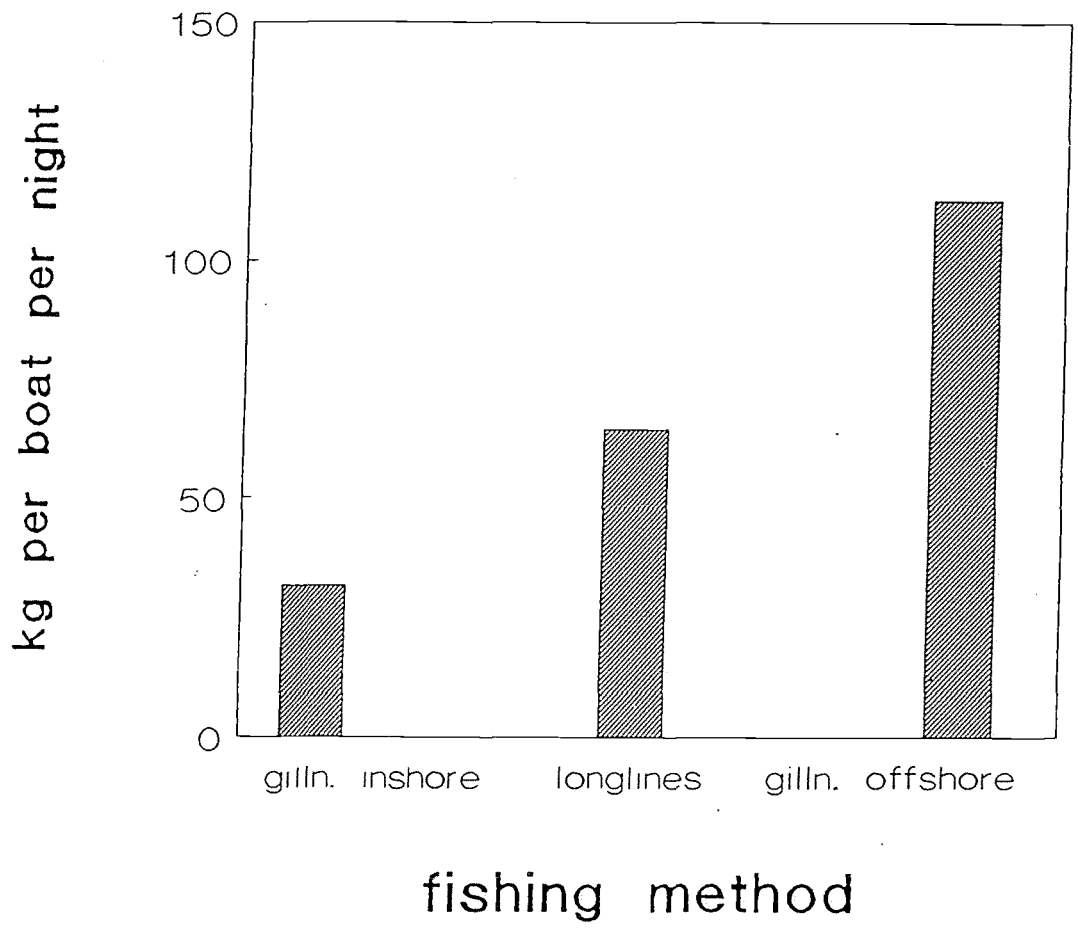
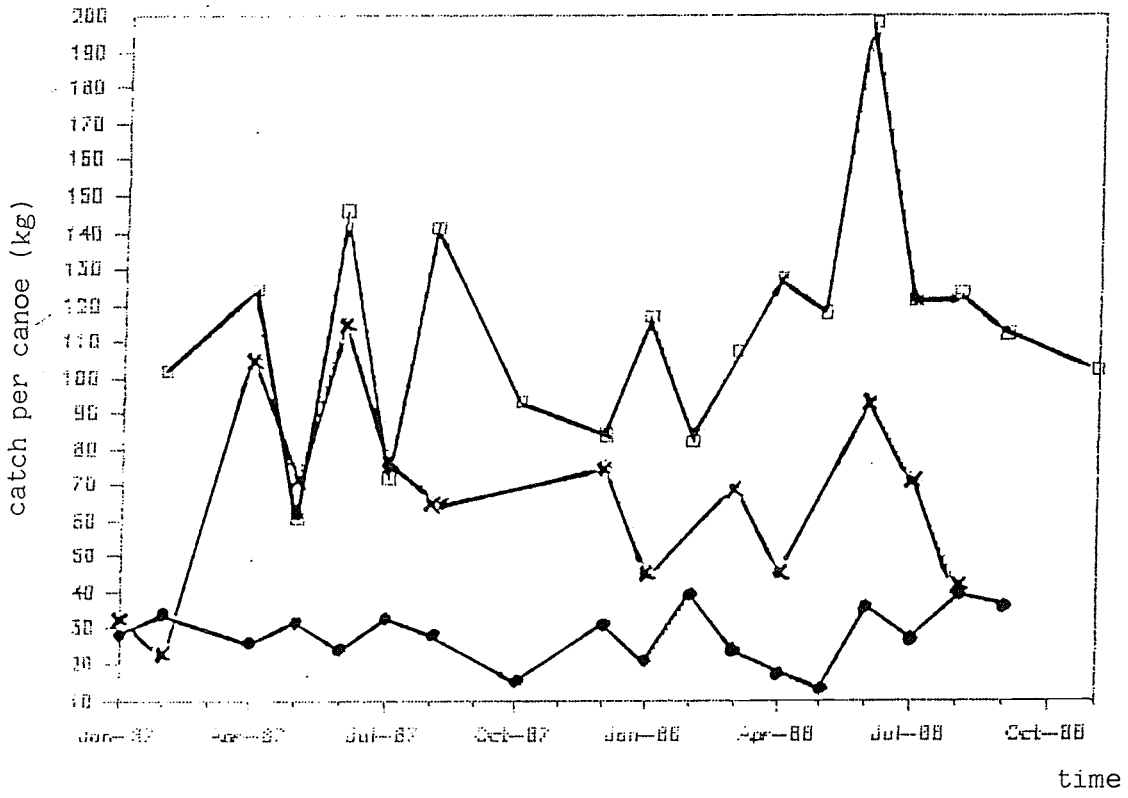


FIGURE 3

Average catch per unit of effort for Nile perch throughout the sampling period (1987/88) for the different types of fisheries.



□ Gill nets offshore
● Gill nets littoral
× Long lines littoral

FIGURE 4

Length-frequency distribution for Nile perch caught with gill nets in 1987/88 at Lgombe

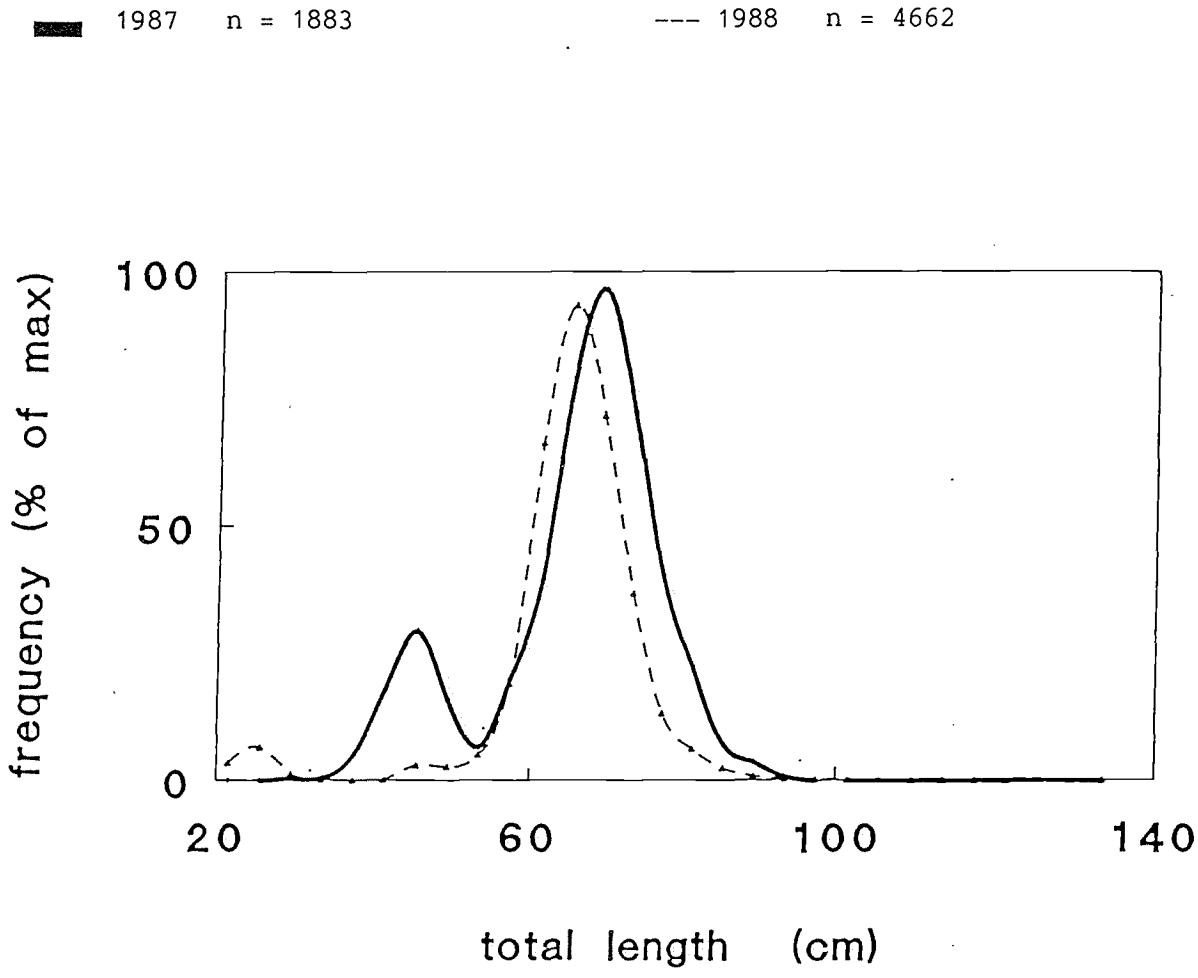


FIGURE 5

Length-frequency distribution of Lates
caught with longlines in littorial in 1987/88

--- 1987 n = 218 ▬ 1988 n = 288

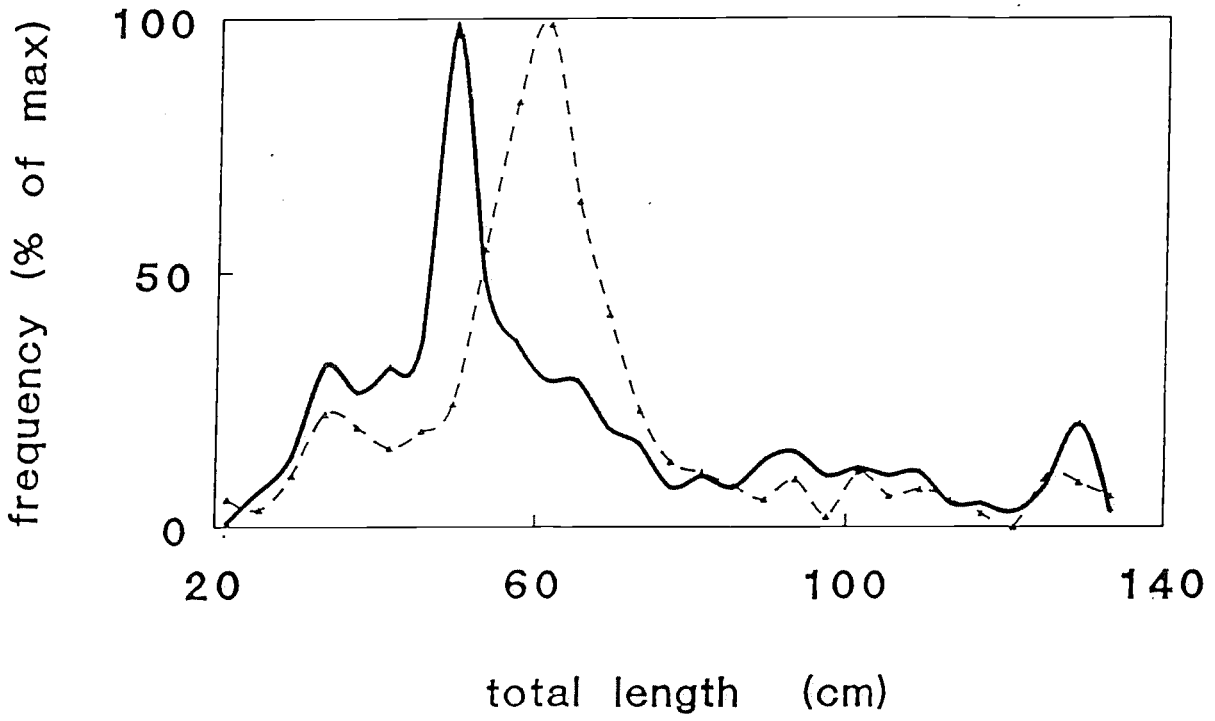


FIGURE 6

Length-frequency distribution of Lates caught with a large beach seine (1987)

n = 5622

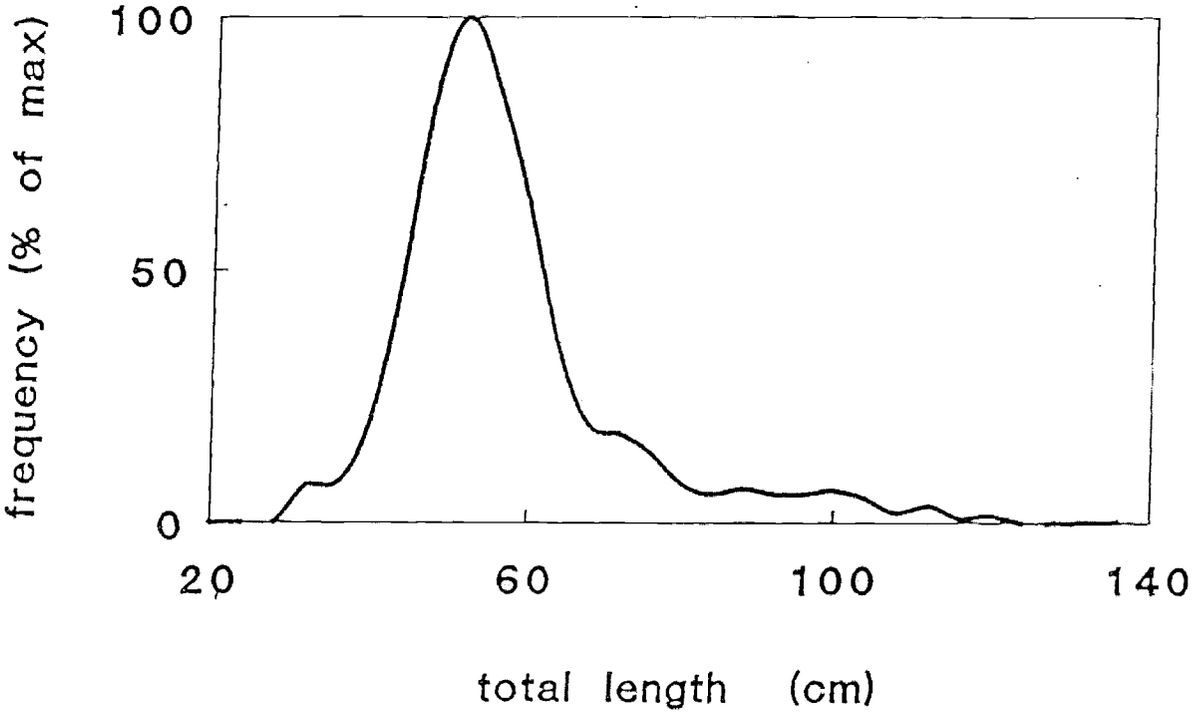


FIGURE 7

Percentage fishermen using mesh sizes from 2 - 12 inches in the Nile perch fishery in 1987 (black) and 1988 (striped)

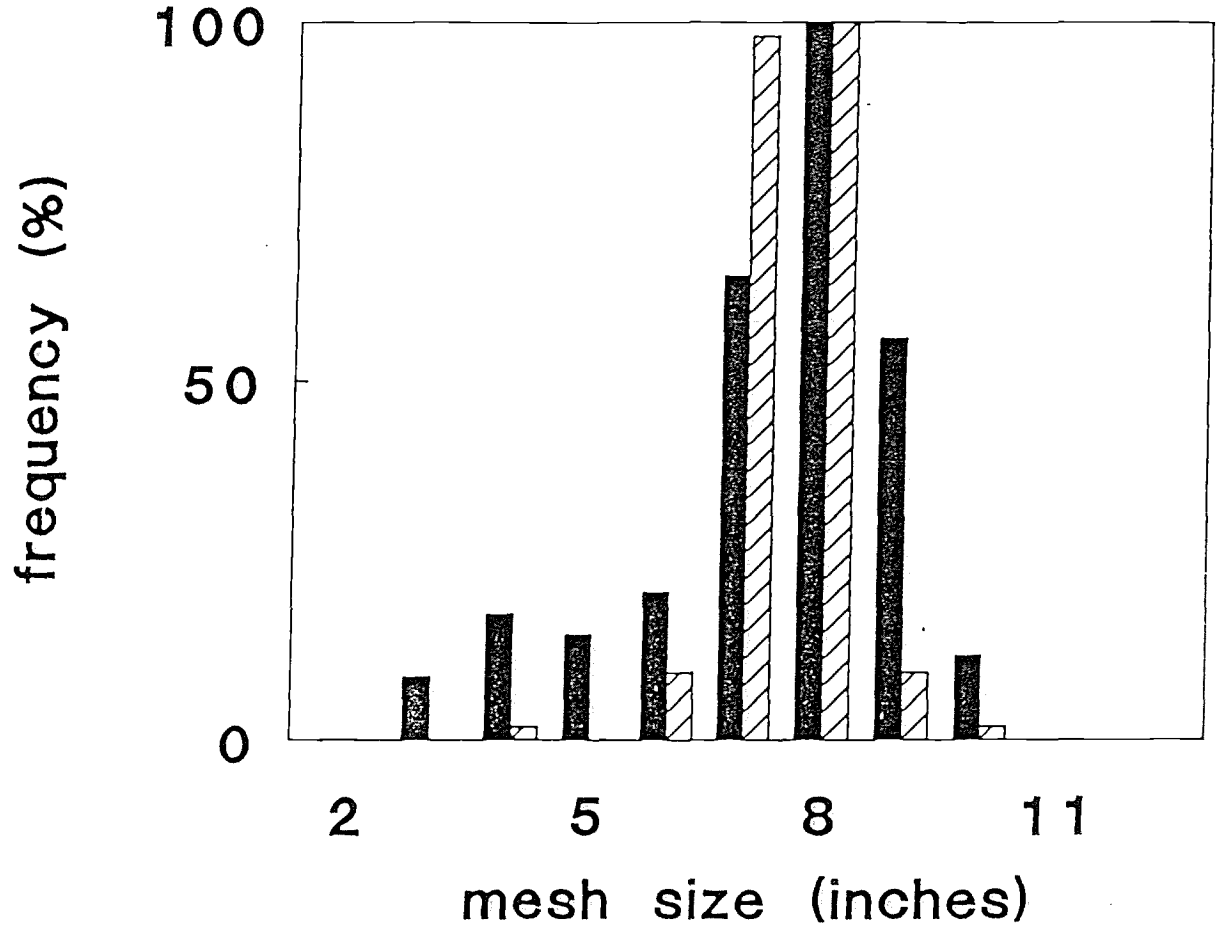
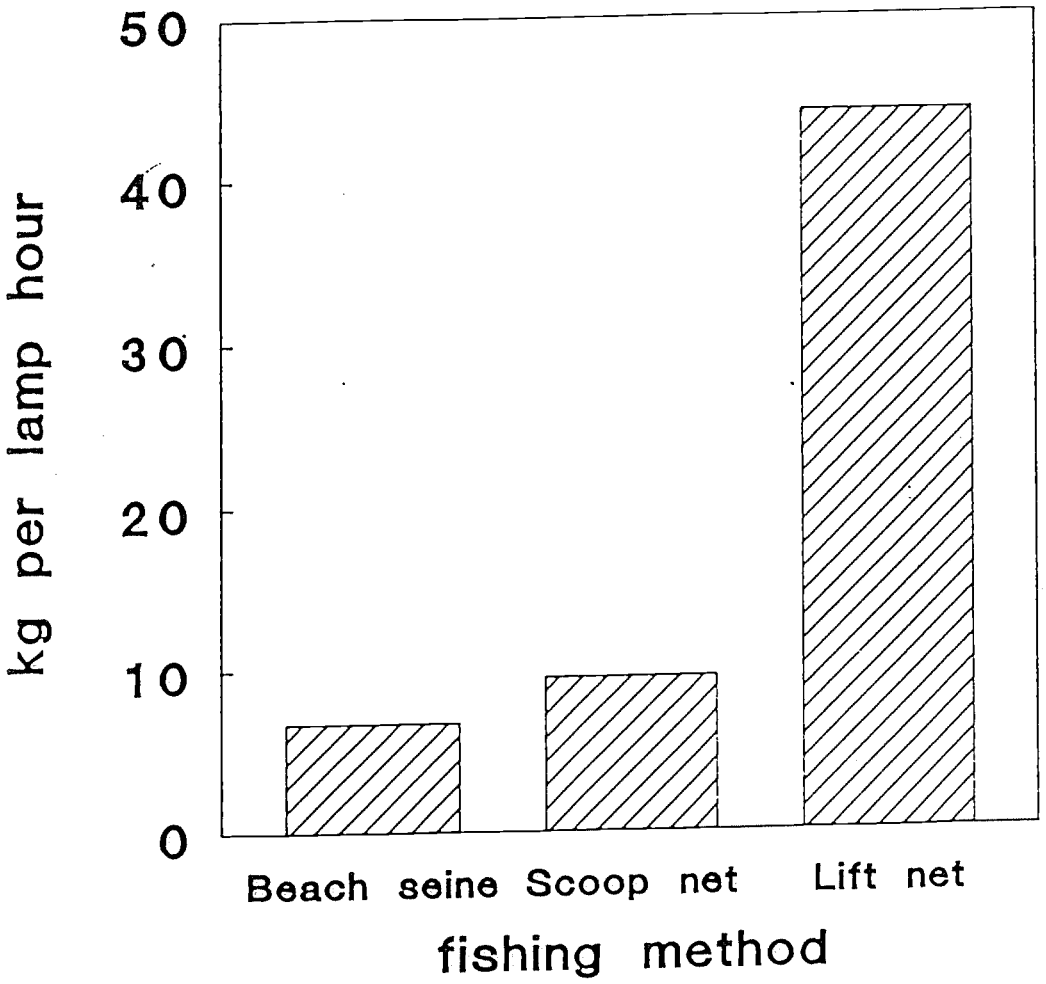


FIGURE 8

Average catch per unit of effort for dagaa throughout November and December 1989 for the different types of fisheries



A REVIEW OF THE MAIN CHARACTERISTICS OF LONG DISTANCE FISH TRADE FROM LAKE VICTORIA, TANZANIA

by

T.W. Maembe

ABSTRACT

The review focuses on describing major product flows, prices, marketing systems and practices. Development prospects and constraints are also discussed in relation to major fish products from the Lake.

The document was prepared in the context of a concultancy financed by the IFIP project.

1. INTRODUCTION

The aim of the consultancy was to review the main characteristics of long distant fish trade from Lake Victoria to other parts of Tanzania and neighbouring countries. This review was to focus on describing major flows, routes, average price at ex-vessel wholesale and retail level, product quality, major marketing systems and practices, development prospects and constraints of the major products.

In recognition of the important social, economic, nutritional and financial roles played by the fisheries of Lake Victoria and in order to fulfil the projects' terms of reference - several field surveys were carried out covering selected areas representing:

a) fishing, fish handling and processing centres in Mara, Mwanza and Kagera regions, Ukerewe Island and Kerebe Island (the latter an important fishing island of the Kagera region);

b) fish handling, collection, processing, transportation and distribution by large scale operators like Tanzania Fisheries Corporation (TAFICO) Mwanza, Tanzania Railway Corporation (TRC), Air Tanzania Corporation (ATC) and Freshwater Fisheries Institute Nyegezi, Mwanza;

c) fish freezing and transporting companies like Afriline Transporters Limited; MWACOTRA;

d) licensed fish traders in urban and rural markets and fish exporters;

e) regional authorities responsible for fish trade, policy and monitoring including trade offices, customs and sales tax officers, marine police, immigration officers and market supervisors;

f) urban and rural fish markets in Kagera, Mwanza and Mara regions with a test check of retail markets in Dar es Salaam;

g) fish landing sites: Kirumba (regional fisheries office), Igombe and Mwanza North port (Mwanza region); Nyamukazi (customs), Kabindi, Kemondo, Nyamirembe and Chato (Kagera region); Bulamba, Guta, Kinesi, Kirongwe and Musoma town beach (Mara region);

h) border markets at Rusumo, Kabanga (Kagera region) and Shirati, Sirari and Borega (Mara region);

i) users of dagaa for the manufacture of feeds: Tanzania Feeds Company, (a subsidiary of National Milling Corporation: NMC); Shirika la Uchumi na Kilimo: SUKITA (an economic wing of the ruling party Chama Cha Mapinduzi:CCM); Rajani Industries Limited; Coast Feeds Company and Interchick.

In addition, interviews were held with administration officials, extension workers, fishermen, fish traders, fish processors, market men and women and fish buyers.

The information and views obtained through both the surveys and interviews, supplemented with literature available from the Fisheries Division forms the basis for the contents of this report.

2. BACKGROUND

The fisheries of the Tanzania territorial waters of Lake Victoria has in recent years assumed an important position in providing protein food, employment, income and generating foreign exchange especially after the launching of the ongoing Economic Recovery Programme. The Nile perch (Lates niloticus) locally named "Sangara" or "Chengu" and the freshwater sardines (Rastionebola argentea, earlier and known as Engraulicypris argentea) with the local name of "dagaa" have increased in abundance with time from early in 1980. They now contribute to the bulk of the catch followed by tilapias and other fish species. Nile perch and dagaa now form major commodities of fish trade from Lake Victoria to internal as well as external markets.

The shortage of fishmeal which was earlier imported or produced from the then abundant cichlid Haplochromis species, "Furu", by the now non-operational Nyanza Fishing and Processing Company Limited fishmeal plant in Mwanza has increased the demand for dry dagaa which has been found to be a good substitute for industrial fishmeal. Present estimates reveal that over eighty percent of the Lake Victoria dry dagaa sold in the internal markets is used for the manufacture of feeds. The increase in demand for dagaa has also encouraged the supply of low quality dagaa.

Internal marketing and export of Nile perch in different forms of (i.e. fresh/frozen, smoked, fried, salted and dried) has increased. Local markets known as "Guliro" operate in the different regions surrounding Lake Victoria on specified days. These markets sell fish as their main commodity. Border markets close to Burundi at Mabanda, and Rwanda at Rusumo have become increasingly important in dealing with smoked Lake Victoria Nile perch and dry dagaa. It is known that from the border markets the bulk of the fish moves to markets in the neighbouring states.

3. REPORT LIMITATIONS

The mission has not been able to establish the extent of unrecorded fish trade taking place between Tanzania and neighbouring states and especially trade using undefined routes. This is because of the lack of data and the time limitations involved. To achieve this it would have been necessary to establish a long term monitoring system on the border routes to establish true fish flow across the border points. However the establishment of such a system may have proved expensive, cumbersome and unproductive when considered under the prevailing circumstances where:

a) the border population is formed by people of the same ethnic and cultural characteristics with very close blood relationship; which encourages movement of people and goods from one part of the border and vice versa. This trend cannot easily be controlled;

b) it is socially and culturally acceptable to serve populations across the border at border markets (Guliro): a potential source of unrecorded fish;

c) there is an illegal night time trade in goods (including fish) through both unmanned entry points and by water transport. Dagaa is suspected to flow to Kenya in large consignments this way;

d) transport (by foot and bicycle) of small quantities of fish used for personal consumption in a neighbourhood across the border cannot be checked as it would be interpreted as harassment;

There is no firmly established system of recording and reporting fish trade in internal or external markets. However some information on fish trade may be available from transport agencies, customs and sales tax officers and market supervisors.

4. FISH PRODUCTION AND MARKET POTENTIAL

The mission's visits to fish landing sites, markets and fish trading centres in Mwanza, Kagera and Mara regions and the islands of Ukerewe and Kerebe confirmed earlier observations that Lake Victoria is a rich multi-species fishery area, exploited by artisanal fishermen using canoes and various gear like gillnets, seine nets, traps and longlines. Recently in Geita and Sengerema districts (Mwanza region) and Biharamulo and Bukoba rural districts (Kagera region) there is an increase in illegal fishing using toxic substances.

The fish stock abundance and composition has changed from the 1970's which was dominated by Haplochromines (80%) and other cichlids (20%). The present stock is now dominated by Nile perch (68%), tilapias (9.7%), followed by other fish species. (See Table 1: Fish production from Lake Victoria for the years 1985-1988). The perceived percentage composition of dagaa is low because it is mostly caught and processed on the islands and is not recorded.

The mission has examined the moisture content of dry dagaa and has estimated that for each kilogramme of dry dagaa landed three kilogrammes of fresh dagaa is sundried. It is consequently considered necessary to use a raising factor of three to convert the quantities of dry dagaa received in the main landing beaches to their fresh-weight equivalent. Using this conversion gives due recognition to the importance and position of dagaa in the Lake Victoria fish production.

The commercial importance of Nile perch has locally earned it the respectful name of "saviour" (mkombozi) because it was caught in abundance and marketed at the time of severe economic hardship in the early eighties. Although it was considered unpopular to the fish consumers close to the lake and was accused of depleting tilapias, it is now contributing immensely to:

a) providing cheap local fish around lake Victoria;

b) providing cheap fish to market in all regions of the country;

c) stimulating internal fish trade and fish exports from Lake Victoria: (the number of individuals taking up Lake Victoria fish export licences has increased from 18 in 1985 to 37 in 1988);

d) providing additional employment to fish handlers, processors and small scale fish traders and transporters: (women have taken up Nile perch processing by frying as an economic activity);

e) providing by-products like fish oil which was valued for fish frying and making soap during the time when traditional oil was scarce. Presently Nile perch oil is sold around the lake for those frying similar fish with a lower oil content. The air-bladder (mabondo) initially thrown away is now collected, washed and sundried for sale to middlemen who in turn export it as fish offal.

The market for fresh and processed fish from Lake Victoria is vast, self sustaining and reaches most parts of the country. Fishermen sell their catch - fresh or processed - to middlemen, commonly referred to as fishmongers, immediately on landing. The market for fresh fish exists close to the fishing ground and may extend into the hinterland for up to 50 kilometres radius. Most tilapias are marketed and consumed as fresh or chilled fish and transported to markets in urban centres, especially Dar es Salaam, where the demand is greatest .

The mission estimates that 20% of Nile perch and other fish species (except dagaa) is marketed in fresh or chilled form. The remaining 80% is processed by smoking, sundrying, frying or salting before it enters the market chain. Dagaa is processed 100% by sundrying and enters the market in this form.

The middlemen in the fish market chain sell the fish they have bought (in small quantities or bulk) to other middlemen or to small scale fish traders (who own stalls on the market or road side) who then sell it to consumers. On the islands the bulk of the catch is processed by the fishermen before sold to middlemen who transport it for sale on the mainland landing-beach markets like Kemondo (Kagera region), Kirumba (Mwanza region) and Mwigobero (Mara region).

Middlemen are considered an important element of the fishing industry because market access by the small scale fishermen is impeded by time constraints, credit, capital and means of transportation. In addition, they lack the organisation to influence the market. Furthermore, the lack of adequate fish landing and processing facilities exacerbates heavy fish losses and wastage and makes it difficult for the fishermen to sell fresh fish beyond the local landing site. In the rainy seasons, post harvest fish losses as high as 30 percent have been reported.

The mission recommends that concerned action should be taken to increase fish utilization as food for direct human consumption by reducing post harvest losses and wastage.

5. PAST AND PRESENT FISH MARKETING FACILITIES

The mission, in addition to assessing the state of traditional fish processing in the Lake Victoria area, identified and reviewed existing fish

marketing facilities with a view to advising them on how to maximize utilization to increase fish supplies. Facilities available in the lake area which contribute to the marketing of fresh and frozen fish include:

5.1 Major fish receiving stations

Government involvement in catering for fish marketing and preservation goes back to the 2nd Five Year Development Plan when a project on port terminal facilities to cover the whole country was initiated. In the Lake Victoria area a number of units were established. Kagera region has a fish receiving station (close to the custom area) with a cold room for 10 tons of fish . The station has not operated since its construction. Efforts are being made to lease it to a private trader who will carry out the necessary repairs and put it into full operations. At Nyamirembe, a fish receiving station with a 3 tons coldroom was constructed. It is equipped with two generators but has not been operating continuously due to scarcity of the refrigerant.

The mission has the opinion that the operation of the station at Bukoba and Nyamirembe will facilitate preservation of fresh fish which arrives late in the day and cannot be immediately sold or processed. At Nyamirembe, it would act as a holding ground for Tilapias to be transported to Mwanza where there is a high demand.

In Ukerewe (Mwanza region), the government has established a fish receiving station with storage capacity for 3 tons and ice machines with a capacity for 500 kg/day. A new generator has been acquired but the compressor needs to be repaired. Operation of the station would boost the daily flow of tilapia to Mwanza on the railway ship. At present, fresh tilapia to be transported to Mwanza and other distant markets is purchased immediately the ship docks.

Mwanza town is the centre and starting point for over 90% of the fresh and processed fish moving from Lake Victoria to distant markets. As such it has more fish preserving and marketing facilities than Kagera and Mara region. These include:

5.2 Freshwater Fisheries Institute Nyegezi

This dates back to 1967 when it was established with assistance from the Dutch Government to improve the traditional fish processing methods. Fish marketing related facilities available are:

a) two coldrooms, each of 1 ton capacity. These were out of order during the visit;

b) plate freezer with a capacity for 20 kg/15 minutes. This has been out of order for some years;

c) chillroom of 0.5 ton capacity. This has not been working because of a faulty compressor and motor;

d) ice plant with a capacity to produce 500 kg/day. The plant has a faulty pump;

e) insulated truck of 7 tons capacity. Presently it is broken down and it would be expensive to repair.

The institute utilizes the facilities when in operation to freeze and store fish for local consumption. It also provides ice, freezing and storage services to small fish traders.

5.3 Tanzania Fisheries Corporation (TAFICO)-Mwanza

Tanzania Fisheries Corporation has recently acquired from the liquidator of the National Cold Chain Operations (NCCO) the fish receiving station in Mwanza where it is offering freezing and storage services to small scale traders. The station has the following facilities:

a) two flake ice making machines each with a capacity to produce 2.5 tons of flaked ice per day. One machine has been repaired and was operating during the mission's visit. The second one needs repairs;

b) a contact plate freezer with the capacity to freeze 150 kg/8 hours. It needs total refurbishment;

c) a blast freezer tunnel of 20 cubic metre capacity which can freeze 2 tons of fish every 8 hours. It is operating but needs complete overhaul;

d) four cold storage rooms with 183 cubic metre capacity which can store a total of 34.8 tons/day. They are all in operation but one needs repairs;

e) the station is supported by three offices and a processing hall with tables for handling and preparing fresh fish for icing and freezing.

The mission recommends an assessment of the state of the station with a view to carrying out major repairs to enable it fulfil its objective of providing services to its customers.

TAFICO's immediate plan is to fully activate the machinery and make use of the station by providing ice, freezing and storage space to small scale fishermen and traders. Experience gathered since the take over of the station shows that service to small scale fishermen/traders would only amount to freezing and storage of 1.5 tons/day. The corporation would negotiate medium term agreements with large scale fish traders to rent the additional freezing/storage rooms.

5.4 Fish Product Supplies Ltd

This is a private company operating 3 wooden trawlers to fish for table fish. Presently the company operates 2 freezing/storage containers on its site and has smoking kilns with a capacity for smoking one ton of fish/day. The company is able to supply an average of 10 tons of frozen Nile perch to Dar es Salaam every two weeks using one refrigerated container which is carried by railway.

The company also provides freezing and storage facilities to small scale traders. The company sells Nile perch in Dar es Salaam at whole sale prices of Tshs 120/kg [2]. Retail sales were found to have high overheads and are now discouraged. Under a whole sale arrangement the company is able to sell the consignment of 10 tons in about 5 days. To ensure the quality of the fish on transit the container is transported under escort and normally takes a maximum of 4 days to arrive in Dar es Salaam. On the way back the container can take up to 3 weeks to arrive back in Mwanza. The company is charged Tshs 8,000/day by the railway authorities to retain the carriage. Fish which cannot be frozen is smoked and transported for sale in Dar es Salaam.

The company has no storage facilities in Dar es Salaam for frozen fish. Frozen fish awaiting sales is stored in private storage facilities at a cost of Tshs 15/kg/day. The company considers this rate to be reasonable when compared to charges of Tshs 40/kg/day charged on facilities operated by the liquidator of National Cold Chains Operations at Kurasini, Dar es Salaam.

5.5 Nyanza Fishing and Processing Company

This company was initially established with the objective of reducing haplochromines to fishmeal. The sudden disappearance of haplochromines compelled the company to diversify. It established a coldroom with a capacity of three tons enabling the company to store table fish that cannot be sold immediately.

5.6 H H Sheraly Transport Company (MWACONTRA)

This is a private company which has recently installed a refrigerator system to freeze 1 ton of fish per day. It has also a 12 tons refrigerated truck which is hired out to transport frozen fish to Zaire and Burundi. Presently the company charges Tshs 10 for freezing 1 kg of fish. The truck is hired for Tshs 250,000 for a trip to Burundi and Tshs 300,000 for a trip to Zaire. A round trip takes 5 days.

The owner reported that refrigeration facilities were in high demand in Mwanza but, due to the difficulty of obtaining spares and refrigerants, traders were discouraged from investing in coldrooms.

5.7 Afriline General Transport

This is a private transport company which has a freezing room with capacity to produce 3 tons of fish/24 hours. Due to the high demand for refrigerated trucks, the company has purchased one refrigerated truck of 5 tons capacity and is in the process of rehabilitating 2 others. The company offers freezing facilities at the rate of Tshs 10/kg and hires the truck to traders transporting Nile perch to Burundi and Zaire.

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[2] US$ 1 = Tshs 193

5.8 Other fish receiving stations

Magu district council has a 3 tons coldroom at Nassa which cannot be operated because the generator initially installed here has been moved for use elsewhere.

In Mara region, a fish receiving station initially operated by the regional fishing company SAMARA is now managed by a private company: Victoria Products Limited. The station has a flake ice machine, tunnel freezer and cold storage rooms which were out of operation at the time the mission visited. Victoria Product Management has installed 2 refrigerated containers one for freezing 300 kg of Nile perch/day and the other for storing up to 10 tons of frozen fish. The company has an established market for Nile perch fillets in hotels in the Serengeti National Park and Arusha where they supply an average of 1.5 tons of fillet per month.

Additional cold storage rooms are situated at Bulamba in Bunda district and Sota Tanzania Fisheries Research Institute Centre with a capacity of 3 tons each. While the Bulamba coldroom lacks funds to operate it, the SOTA coldroom has no generator.

The mission concludes that Lake Victoria has cold storage facilities distributed in all regions surrounding the lake and that if these were put into operation and well maintained they would contribute enormously to reducing fish spoilage and wastage and increase utilization of fresh fish around the lake as well as the amount of fresh/frozen fish supplied to distant markets.

6 FISH FLOW PATTERNS

Fishermen who fish close to the mainland sell their catch at recognized landing beaches. Fishermen from the islands land and process their own catch which is then sold to traders who transport it to the mainland wholesale markets. On the lake, fish is moved by using transport boats or by fishermen using their own fishing vessels. The movement routes of fish from Lake Victoria to other destinations is shown on Map 1.

The distance fresh fish is transported is limited by the transportation methods used which include transportation by: foot, bicycle, hand drawn cart, pick up, lorry and passenger bus. In this way fresh fish from Lake Victoria flows up to 100 km from the lake shore.

Fresh fish which has to be transported to distant markets is either iced (and kept in insulated containers) or frozen and transported by motor vehicle, air or rail.

Main fish species transported fresh to distant markets are Nile perch followed by tilapias. The main destination being Dar es Salaam followed by other urban centres.

Mwanza municipality is the central point receiving fresh and processed fish. The main types of fish are dagaa, Nile perch, tilapias and fish species from the islands. From Mwanza the processed fish is transported to other

destinations mainly by rail and road although small quantities are occasionally flown by air.

The direction of fish flow from Mwanza and other points on the lake is towards the main population centres and the western border where there is, in general, higher purchasing power and higher demand for fish. This is because of its lower price when compared to other source of protein and also, a general preference for fish.

6.1 Fish transportation by air

The national airline, Air Tanzania Corporation, provides two weekly flights to Kilimanjaro International Airport (KIA) which serves Kilimanjaro, Arusha and to a limited extend Tanga regions. Each flight carries as cargo an average of 1 ton of fish making an estimated 104 tons of fish per year. Fifty percent of the fish transported by KIA is fried or smoked. The remaining portion is made up of fresh/frozen whole fish and small quantities of fillets.

The corporation operates 4 flights a week to Dar es Salaam with room for an estimated 2.5 tons of fish on each flight making a total of 520 tons per annum. The consignments to Dar es Salaam consist mainly of frozen Nile perch and small quantities of tilapias.

Additional quantities of fresh/frozen fish is carried by most passengers to Dar es Salaam as part of their allocated weight allowance. The demand for air transportation of fish from Mwanza to Dar es Salaam is so high that Air Tanzania Corporation authorities have been compelled to keep a priority list on a first come first served basis. (The list made available to the mission on 18 March 1990, indicated that allocation available on flights to Dar es Salaam was already booked up to the third week of April 1990.)

Fish is transported at the owners own risk. However, ATC authorities have reached an agreement with fish traders to have concessional rates for transporting fish. The freight cost of transporting fish by air as of 8 March 1990 were as follows:

a) Tshs 40/kg to Dar es Salaam (minimum 500 kg). Fish less than 500 kg is charged at the general cargo rate of Tshs 112/kg;

b) Tshs 27/kg to Kilimanjaro International Airport (minimum 500 kg);
Tshs 55/kg between 45 kg and 500 kg;
Tshs 40/kg if the fish is less than 45 kg.

The total cost of air freight includes a handling charge of Tshs 4 per kg and an air way bill cost of Tshs 600 per consignment.

The corporation has a one ton capacity coldroom at Mwanza airport terminal to serve its customers. This storage space is considered too small when compared to the high demand in existance.

The mission has not made an estimation of the daily demand of air transportation for fish but ATC past experience show they could airlift up to 10 tons/day from Mwanza to Dar es Salaam and other markets if, they had enough

flights and, cold storage space to hold such quantities was available around Mwanza.

The popularity of air transportation is based on:

a) short delivery time once loaded on the flight;

b) less risk of spoilage;

c) a better quality of final product (as compared with other methods of transportation);

d) better prices obtained compared to fresh/frozen fish transported by road or railways.

The mission was informed that previously when the flight to Rukwa from Mwanza through Tabora was operational, consignments of fresh/frozen Nile perch averaging 200 kg/week were transported. In Sumbawanga, 1 kg of Nile perch is sold for up to Tshs 400 (personal communication with regional Chairman). Presently there are no cargo charter flights from Lake Victoria but the mission was informed ATC would favourably consider operating a charter flight if they were approached to provide such a service. The costs for such a flight could not be established.

6.2 Tanzania Railways Corporation (TRS)

Tanzania Railways Corporation plays a big role in moving fresh/frozen and processed Nile perch and sundried dagaa to different destinations in the country. Dry dagaa from Kemondo Bay port is transported by rail to Mwanza South to link with fish landed in Mwanza from the islands and other fishing grounds.

The mission examined Tanzania Railways data on dagaa transported out of Mwanza to different destinations for the year 1989. It concluded that over 3,000 tons of dagaa was transported from Mwanza to other places (see Table 2). It is estimated that 35% of the dagaa transported by rail ends up in Dar es Salaam where about 90% is used for poultry feed manufacture.

6.3 Road transport

Road transportation is important in moving fish to areas which are not served by railways. The mission has not been able to estimate the amount of fish moved by road from Mwanza and Kagera regions because of lack of records. Field interviews revealed that lorries are frequently hired to carry dry dagaa to Arusha, Dar es Salaam, Mbeya, Iringa and Rwanda/Burundi border markets. At the time the mission visited the Rusumo market, a total of 32 vehicles (18 lorries and 14 pick ups) had been hired to bring in fish. Fish not sold at Rusumo is moved the following day (by the same vehicle) to Kabanga market. Traders confirmed that they hired a vehicle from Mwanza or Bukoba to cover a round trip to Rusumo, Kabanga and Mabanda. The length of the trip is determined by the trader being able to sell all the fish at a good price.

Fried Nile perch is transported to Arusha, Moshi and Tanga on passengers buses. The mission estimated that during the peak Nile perch season a bus to Arusha/Moshi was carrying an average of 1/2 ton of fried Nile perch per trip.

6.4 Fish movement from Kirumba market

Kirumba market (managed by Mwanza municipality) is the most important fish landing beach market on Lake Victoria receiving over 90 percent of the fresh and processed fish coming from the Ukerewe region, islands and other Kagera fishing grounds in Geita and Sengerema districts.

Table 3. summarizes the quantities of processed fish handled through Kirumba market from October 1989 to February 1990.

The mission concludes that over 90 percent of the processed fish handled by Kirumba market beach is dry dagaa originating from Ukerewe, Sengerema and Kagera region. Other fish species sold include smoked Nile perch (3 percent) and tilapias (less than 1 percent). Kirumba market is estimated to handle an average of 300 tons of dried fish a month.

Data on fresh fish available from Mwanza Municipal Council indicates that Kirumba beach market handles 90 percent Nile perch, 4 percent Clarias sp, 2 percent tilapia, 2 percent dagaa, 1.5 percent Protopterus sp, 0.3 Mormyrus sp, and 0.2 percent other species.

The mission reviewed the destination of fish sold at Kirumba market and concluded as follows:

a) up to 10 kg of fresh fish of all types is carried and sold by bearfoot traders on the street or on a door to door delivery;

b) wheelbarrows, hand drawn carts, bicycles and pick ups act as major means of moving fish to the retail markets in town or to a processing site. Elsewhere on the lake bicycles move fish up to 30 km from the landing beach.

The fish destined for distant markets, mainly dry dagaa and Nile perch, is transported by hired lorries. Traders with access to rail transport fish south to Mwanza. Due to the difficulty of acquiring wagons most traders hire lorries which transport the fish to Iringa, Dar es Salaam, Singida and Mbeya. Fish moving to the northern regions besides being transported by lorries is also loaded on buses which move it to Shinyanga, Singida, Arusha, Moshi and Tanga. Fish from Kirumba is mainly destined for Dar es Salaam.

Smoked Nile perch from Kirumba market and fried Nile perch from the processors in Mwanza town is mainly transported by passenger train to the urban centres already mentioned. It may then move further into rural areas.

The mission has studied the documents available from the railways on consignments of smoked and fried fish transported as parcels for the period of April 1989 to January 1990. It concluded that, on average, 20 tons of smoked/fried Nile perch leaves Mwanza to distant destinations within the country every month. Due to the limited shelf life (keeping time) of fried Nile perch there has been an observed serious drop in the amount of fried Nile perch leaving Mwanza to other destinations.

6.5 Kemondo Bay beach market

This market in Kagera region is considered the second most important beach market (after Kirumba in Mwanza region) for fish from Lake Victoria, originating from the islands, and destined for distant markets. It operates once a week. The mission made two visits to the market to assess it's level of activity.

Based on boat loads, the number of boats and interviews with the levy collectors and fish traders it is estimated that this market handles over 30 tons of processed fish per market day making an annual total of 1,950 tons. Dagaa forms an estimated 60 percent of the fish marketed here. Fish from Kemondo moves to internal markets in Kagera region and the border markets of Rusumo and Kabanga in Ngara district and Mabamba in Kibondo district Kigoma region.

7. PRICING MECHANISM AND FISH PRICES

Historically the price of fish from Lake Victoria has been controlled by supply and demand for each particular market. Auctioning of fish is not practised around Lake Victoria but negotiations can take place between the fishermen and the trader/middleman/fishmonger to establish the price to be paid. The price of fresh fish is fixed based on the purchase price of a whole fish. The price of processed fish are fixed based on piece per split whole fish. The price of dagaa is fixed per sack of between 30-35 kg. The mission found that the fishermen and traders that bring dagaa for sale at beach markets tended to pack fish in bags of less than 30 kg and sell this for the same price of a 35 kg sack.

Middlemen transport fish to the market where they generally sell small fish whole and larger fish in pieces. Dagaa on the retail market is sold in heaps of 100-150 gms. Processed fish is sold in pieces or whole split fish. Bulk purchase price is not acceptable. The trader establishes the price of each piece forming a lot and the customer is required to pay the price charged for each price even when the purchase made is for many pieces. For a trader buying fresh Nile perch in bulk he may have to pay the same price for a fish of 8 kg and one weighing 5 kg. Except for very large Nile perch grading to establish the price based on size is not accepted. In this way smaller Nile perch mixed with larger Nile perch command the same price.

Fishermen/traders prefer grading tilapias into large (over 2 kg), medium (0.5 - less than 2 kg) and small (less than 0.5 kg) before setting the price. The larger tilapia are priced higher than the medium and small. In general larger fish of all species when bought singly are priced higher.

In Kagera region Bagrus sp.and Labeo sp. are culturally popular and normally purchased by consumers with good incomes and higher status in society. Fresh and processed Bagrus sp. is the highest priced fish in Kagera region.

In Mara region the lung fish (Protopterus aethiopicus) locally called Kamongo is very popular with the Luo and is the highest priced fish in the area.

Tilapias are very popular throughout the country and are sold on the road sides and markets as fried fish ready for immediate consumption. It is also the fish most commonly served in hotels and restaurants.

Retail sells of fish take into account the purchasing power of the consumer by the fishmonger/retailer trader cutting large fish into pieces to ensure low income consumers buy a piece that meets their choice and money.

Processed fish pricing is done in the same manner as for fresh fish. Larger pieces and high valued fish species like Bagrus and Protopterus cost more.

The mission concludes that in general the pricing of fish is determined by:

a) quality of fish: high quality fish commands a better price that low quality fish;

b) the type of fish and the area: Bagrus commands a very high price in Kagera region while Protopterus commands a very high price in Tarime District where the Luo consider it a delicacy;

c) quantity available for sale: when catches are high or there is a large supply of fish at the market, prices go down and vice versa. It is important to note that fresh fish which cannot be sold at a good price is processed rather than being sold at a low price;

d) season: in the rainy season it is difficult to process fish. This situation compels fishermen and traders to reduce the prices so that they can sell as much as possible to avoid spoilage and wastage;

e) distance from the landing beach to the market: the price of fish increases as it moves away from the beach to the hinterland. The normal formula is for the trader to get a mark up of not less than 25%. Nile perch purchased for Tshs 50 - 60/kg at Kirumba beach sells for Tshs 100 - 120/kg at Mwanza town market and Tshs 120 - 180/kg at Kariakoo Market in Dar es Salaam. Prices for the main fish species at the beach and in different markets is shown on Table 4: fresh fish, Table 5: processed fish.

f) transportation: on isolated landing beaches like Kasenyi (Ukerewe), Nassa (Magu) and Namirembe (Biharamulo), boat prices for the different fish species are low. The same prices increase by up to 100 percent when transport is available. The Nile perch is the cheapest priced fish with boat prices as low as Tshs 15 - 20/kg at Igombe in Mwanza region; 20 -30/kg at Kerebe island and 25 - 30/kg at Nansio (Ukerewe Island). These low prices are considered high when compared to two years ago. The increase in prices has been caused by the expansion of the market. Boat prices for tilapias vary from Tshs 50 - 60/kg at Nassa and 30 - 50/kg at Nyamirembe.

Dagaa from Lake Victoria and Lake Tanganyika is priced at Tshs 200/kg and Tshs 500/kg respectively. This is because dagaa from Lake Tanganyika is historically more accepted.

Only spoiled Lake Tanganyika dagaa is considered for use in preparing animal feed. This is mainly due to its high demand for human consumption and as a consequence, the high price it fetches.

The beach prices for tilapia are lowest in Nyamirembe because of its inaccessibility. At Nyamirembe the boat price for tilapia increases from Tshs 30/kg to Tshs 50/kg on Wednesday when the railway/passenger boat leaves with tilapia for sale in Mwanza. Similarly at Nansio the boat price increases from Tshs 100/kg to Tshs 150/kg when the passenger boat is due to leave for Mwanza.

Bagrus sp. have a boat price of Tshs 50 - 60/kg at Kerebe Island where they are caught in large quantities. Due to the popularity of Bagrus in Bukoba, middlemen operate a daily transport boat from Bukoba town to collect fresh Bagrus. The boat price of the same fish when delivered at Bukoba customs is Tshs 380 - 400/kg. The higher price is applicable on a days when Bagrus supply is low.

The mission recommends the encouragement of investment in transport boats used to move fresh and processed fish from inaccessible areas to market centres. This would result in an increase in supplies and at the same time ensure the fishermen fetch a better price for their fish.

8. FISH EXPORTS

Fish exports from Lake Victoria have increased from a total export of over 5 tons in 1986 to over 870 tons in 1989. The main fish species exported are dry dagaa and Nile perch mainly to Zaire and Burundi.

Small consignments of Nile perch have been exported to Rwanda. The mission was informed of trials made by some experts in Mara region to export dagaa to Kenya but this was found to be unattractive and was abandoned. Nile perch is exported fresh, chilled, frozen, smoked and salted. Salted Nile perch finds a good market in Zaire. The mission was informed that salted Nile perch and dry dagaa exported to Zaire fetches a good price in the mines.

Mwanza is a leading export centre for Lake Victoria fish with 37 licensed exporters in 1989 followed by Kagera (6 exporters) and Mara (4 exporters).

Export reports for 1989 indicated that fish exported from Lake Victoria earned US$ 330,641 (which is about 14 percent of US$ 2,386,614, the total foreign exchange earnt for the export of fish and fishery products). Table 6 shows a summary of available data on fish exports from Lake Victoria to neighbouring countries.

The mission learned that, although many export licences had been granted for Lake Victoria, only a few individuals were able to export to neighbouring countries. Exports to Europe have not been pursued. However recently export of Nile perch air bladders (mabondo) to the Far East has been increasing.

The mission investigated the reasons for the low level of fish exports from Lake Victoria and concluded as follows:

a) small scale exporters with no previous experience in the export of perishables dominate. Personal communications with exporters revealed that:

   i) they took up a licence without a clear knowledge of the market, export procedures or documentation;

   ii) they had no knowledge on the prices, quality requirements and strategies to sustain export markets;

   iii) they had no proper facilities for handling, processing and storing the product whilst awaiting shipment;

b) most of the small scale exporters would like to have their payment in cash. Present export procedure requires the exporter to operate through the official banking system by opening an Irrevocable Letter of Credit (ILC). This procedure is considered cumbersome;

c) illegal exporters sell to the same markets at a reduced price which makes it difficult for a licensed exporter to compete;

d) the minimum export prices established to curb under invoicing seems to discourage some exporters who say they cannot realise higher prices;

e) some of the exporters have not been paid fully for the product they have exported. Traders in Mwanza region (as of January 1990) had uncollected foreign earnings amounting US$ 122,194;

   The regional authorities in Mwanza have established a committee to follow up export revenue returns with the regional Development Director as chairman. Other members of the committee are representatives from the Bank of Tanzania - Mwanza, National Bank of Commerce, Mwanza regional customs and sales tax office, regional trade office, regional planning office and the regional fisheries office. The committee meets frequently to receive reports on exports and foreign exchange earnings and directs on measures to be taken to maximize foreign exchange earnings.

f) lack of infrastructure to facilitate handling, processing, storage and transportation of fish for export to markets in Europe is the main constraint hampering the expansion of export of Nile perch.

The mission recognizes the potential of Lake Victoria Nile perch earning the country more foreign exchange. It recommends the need to establish the necessary infrastructure to handle, process, pack, store and transport fish in fresh/frozen/processed condition for sale in internal markets as well as for export.

9. FISH TRADE IN BORDER MARKETS

Data on Lake Victoria fish trade in border markets is scanty and very unreliable. Main markets exist on the border with Rwanda at Rusumo and Kabanga, and on the border with Burundi at Mabanda. Small retail markets exist

at Mutukula border with Uganda and weekly markets at Shirati, Sirari and other villages close to the border serve customers from across the border. Border population at Kirongwe continuously move fish from Tanzania to Kenya and the number of bicycles increases on the market day.

9.1 Border with Kenya and Uganda

At Kirongwe, on the border with Kenya, the mission was able to count 65 bicycles carrying between 40-60 kg of fish crossing the border to Kenya. The mission followed some of the traders across the border and established that the fish carried across is sold to Tagache Cooperative Society in Kenya. On the day of the visit, fishmongers bringing fish across the border were paid Tshs 5.40/kg for Nile perch and Tshs 14 - 16/kg for tilapia. There was no dagaa seen crossing the border.

The customs and immigration officials confirmed that there was a continuous flow of fish to Kenya through Kirongwe and Kokaja borders. The mission agreed with the officials that it would not be in the interests of social and cultural justice to interfere with movement of small commodities across the border because they are considered for personal consumption. The mission estimated that an average of 50 bicycles cross the border at Kirongwe carrying an estimated 60 kg of fish each. This would mean 3 tons of fresh fish per day increasing on market day at Shirati.

At Sirari the weekly market attracts a lot of customers from Kenya who come in to buy up to 20 kg of processed fish mainly Nile perch and dagaa. It is known that this fish crosses the border for retail sales to the population on the other side of the border. Sirari also operates a daily market for retail sales of processed Nile perch and dagaa. The market receives and sells fresh tilapia and Nile perch in the evenings. Customers from across the border come in to buy fish without any problem.

In Kagera region at Mutukula, Lukunyu and Kabindi it is known that small quantities of fish cross the border for immediate consumption in Uganda. The mission was informed that there is illegal movement of fish especially dagaa to neighbouring states by water transport and other means at night. The mission could not establish the quantities of fish involved. The mission was also informed that at Kirongwe, illegal fish trade across the border is encouraged by lack of an established collecting and marketing system.

Fishermen and fish traders find it easier to transport fish for sale across the border where they are paid cash. They use the money so obtained to import items which they can quickly sell and make a good profit.

Government action taken to establish a regional trading company at Sirari to provide the people with their needs has not managed to control the movement of fish and other commodities across the border.

The mission concludes that the movement of fish in small quantities across the border should be absorbed as a socio-economic activity in the area. A strategy to ensure an equitable transfer of valuable goods from the other side should be worked out in consultation with the neighbours.

The mission would consider recommending neighbouring countries to agree on foreign exchange arrangements that will induce across the border trade without financial or economic loss to any of the concerned states.

9.2 Rusumo market

Rusumo market is in Ngara district, less than 1/2 km from the Rusumo Falls on the tarmac road leading to Rwanda from Tanzania. The market is held once a week and serves over 1,000 people, the majority of which cross on foot from Rwanda. Other customers come from Ngara. Smoked Nile perch and dry dagaa are the main commodities sold.

The mission estimated that the market handles over 5 tons of Nile perch and dagaa on market day making a total of over 260 tons a year. This would prove that the statistics available with the District Fisheries Office as presented on Table 7 is only a small portion of the actual fish sold in this market.

The District Council values this market as a revenue generator through the levy charged on fish. The council collects between Tshs 80,000 - 150,000 as levy on a market day.

10. QUALITY OF FISH AND FISH PRODUCTS

The quality of fish from Lake Victoria earmarked for human consumption is technologically debatable. Traditionally the catching, handling, processing, packaging, storage and transportation of fresh and processed fish has the following factors that affect quality:

a) catching: the fish is mainly caught by gillnets and hooks which are set and left overnight. Fish caught in the early hours is already in an advanced stage of spoilage at the time of collection due to high tropical water temperatures. Some fishing grounds are more than 4 hours of sailing time away. However the fish landed is reasonable; what cannot be sold fresh is processed;

b) handling: fish is roughly handled by being placed on the bottom of the canoe or on the deck where it is exposed to contamination and the sun. No method is used for keeping the temperature low to reduce bacterial and chemical deterioration. Fatty fish deteriorate quicker under these conditions.

   At the landing beach some fishermen unload fish, especially Nile perch, by throwing it from the boat to the beach. This act ruptures some fish and induces rapid spoilage.

   Immediate gutting of fish is not practised. This may encourage catalytic enzyme action leading to spoilage;

c) processing: dagaa is sundried on sand where it is subject to contamination. However the traditional processors claim that drying on sand gives the best product for human consumption. In Kagera region, dagaa is dried on a mats or grass. The culturally important grass "Eyojwe" (Blepharoglumis kageransis) is used. Dagaa dried on grass retains a lot of grass on drying and is normally sold for animal feed.

Nile perch and other species of large fish are smoked. Fish is prepared for smoking by gutting and then splitting or cutting into small pieces. The guts, blood and scales are left on the processing ground and attract flies. Fish are rarely washed afterwards.

Fish smoking is carried out in pit ovens or simple mud built ovens which use a lot of fuelwood. The top oven where the fish to be smoked is placed is not cleaned either before and after smoking. Spoiled Nile perch which cannot be smoked is dry salted.

Due to the scarcity of fuel wood around Lake Victoria and the high cost of purchasing and transporting wood from elsewhere in Kagera region the grass Blepharoghlumis kageransis (Eyojwe) is used. The grass is placed under the oven below the fish and lit. The resulting fire scorches the fish in a few minutes. Although the fish continues to remain on the oven the resulting case-hardening does not allow further reduction of the water content in the fish. Scorched fish is subject to rapid spoilage and must be sold immediately.

In Kagera region scorched fish finds a market in Muleba and Karagwe districts where there is a high demand for fish. In Mwanza and Mara regions the use of grass as a source of fuel is not practised.

Scorched fish sells for Tshs 50, 80 - 100 and 120 - 150 per 250 gms in the islands, at Kemondo Beach market and at Karagwe respectively. Processors interviewed indicated that they would use wood instead of grass for fuel if there was a prior agreement with a trader to pay for the extra cost.

In general the traditional ovens in use exhibit the following problems:

i) temperature control: this is difficult to achieve resulting at times in a charred product;

ii) contamination: hygienic and sanitary conditions surrounding the smoking area are poor;

iii) limited capacity: they have small and limited capacity and are not able to cope with sudden increases in catch;

d) packaging: traditional packages are available for processed fish depending on the locality and fish species. In general there is no package for carrying fresh fish from the fishing grounds.

Smoked Nile perch and other fish species are packed in a bundle of 50 to over 100 pieces per bundle. The bundle is wrapped with grass or other suitable material available in the area. A bundle is cylindrical in shape and may have a height of 50 cm or more. The top and bottom side edges of the bundle are normally strengthened with a rim made of sticks tied together with sisal or other locally available ropes. In this way a bundle is kept intact and firm to resist impact during transportation.

At the market a bundle is opened for inspection by the buyer and once bought may be repacked in the same manner for further transportation.

Where gunny sacks are available they may be used as additional wrapping on the bottom and top of bundles. This is considered to be an added protection from dust and prevents the grass from rapid disintegration.

Dry dagaa is normally packed in sacks. The popular package for fried Nile perch is: cartons for small quantities and baskets (locally "matenga") for large quantities;

e) transport: there is no transport designated specifically for conveyance of fresh and processed fish. Where refrigerated trucks do exist they are out of order or inadequate to cope with the fish available;

f) storage: The only facilities that exist are out of order. Fish which cannot be processed in the islands has to be thrown away.

Smoked fish is left in ovens or stored in baskets. Dagaa is packed in sacks and left outside, exposed to the elements, where they are susceptible to insect infestation and loss of quality.

The mission concludes that the quality of Lake Victoria fish available is technologically low but traditionally and culturally of acceptable standard and fetch a good price in the local market. To promote export of Lake Victoria fish, especially to European markets, all aspects of fish processing from catching to final retail have to be improved.

11. MAJOR CONSTRAINTS

Marketing and distribution of Lake Victoria fish to distant markets face the following problems:

a) fishermen and fish processors operate in remote isolated areas. Road access to landing beaches is very poor or non existent. Hired transport is expensive and not readily available.

As such, movement of fish from the lake to internal and external markets at the right time and in good quality and quantity cannot be guaranteed. Rail transport is limited and takes too long for a round trip from Mwanza to Dar es Salaam. Air transportation is expensive and has limited capacity;

b) fish processed in the islands where fuel wood is scarce is of poor quality and can only keep a few days. As such, it cannot be moved to distant markets;

c) the traditional fish processing methods in use can only deal with small quantities of fish. In the rainy season and when Nile perch and dagaa landings are high, fish which cannot be processed is wasted;

d) cold storage facilities installed in different parts around the lake to provide fishermen, fish processors and fish traders with ice and cold store space have not made any impact since most of them are out of order and cannot be operated;

e) the high tropical temperatures in the area catalyse the spoilage of fresh fish; fish caught in distant fishing grounds may reach the landing beach 4 - 8 hours after being caught;

f) promotion of fish exports, especially Nile perch to Europe, has not succeeded because of lack of infrastructure and other logistical support. Export trade has up to now concentrated on movement of fish to neighbouring states. 100% of the foreign exchange earned cannot be accountedfor. Reasons given by the exporters are:

   i) unreliable importers who cannot be traced to repay the outstanding export bills;

   ii) many small scale traders lack experience with export documentation and bank transactions. They prefer payment for export outside the banking system. Under this arrangement the foreign exchange realised is spent by the exporters to import items which they can sell at a good profit in the local market. Foreign exchange earned is not reinvested to boost the fish export market;

   iii) lack of follow up and reconciliation of foreign exchange earnings from fish exports by the banks has encouraged laxity of exporters in remitting foreign exchange earned for what is actually exported. It is felt that strict follow up could increase earnings of foreign exchange;

g) the minimum export prices introduced to curb under invoicing seem to affect legal exports as illegal traders selling in the same markets set lower prices than is officially achieved. Well established exporters do not seem to have a problem with pricing as they have long term market price agreements with their importers.

12. DEVELOPMENT POTENTIAL

The Nile perch fishery in Lake Victoria appears to be approaching its maximum sustainable level(MSY). The need now is to concentrate on making good use of the investments which already exists on the lake to ensure what is caught can be utilized. There is every reason to believe that there is an opportunity to develop a small export trade of fresh/frozen fish including fish fillets if fish receiving facilities and transport from the lake to Dar es Salaam or Arusha can be guaranteed.

The stocks of the dagaa fishery have not been assessed but based on annual catches, it is estimated that there is room to raise dagaa production if the necessary inputs are provided. Lake Victoria dagaa will continue to act as good raw material for the animal feed industry where there is an estimated demand of over 3,000 tons per year (personal communication with feed companies).

Tilapias and the remaining fish species have to be exploited with caution as they show signs of decline. The mission does not advocate increasing investment targeting at tilapias and other fish species but would

urge the need to consolidate the existing level of exploitation and optimize utilization. Effort should be aimed at maximizing the utilization of whatever is caught by improving the infrastructure.

Traditional fish processing can be improved by the introduction of smoking ovens that economize on fuel, are able to handle greater quantities of fish and achieve a better quality product.

13. SUMMARY AND RECOMMENDATIONS

Fish trade from Lake Victoria is small scale and is predominantly concerned with fresh, chilled/frozen and traditionally processed fish.

The main fish species involved in local and distant trade are Nile perch, dagaa and tilapias. Other fish species are available in small quantities and are mostly sold in markets close to the landing sites.

Nile perch is mainly distributed fresh, chilled/frozen, smoked and fried. Frying of Nile perch is predominantly carried out by women. Tilapia is presently sold fresh and frozen and occasionally smoked.

The flow of fish to distant markets is hindered by access roads and water transport systems. In the rainy season it is difficult to handle large quantities of fish resulting in excess catches of Nile perch and dagaa being wasted. The mission recommends the need to improve on the existing road system and the operation of ice making machines and cold rooms existing in Kagera, Mwanza and Mara regions, to form a nucleus for ensuring fish spoilage is minimized. The railway should be encouraged to increase the number of refrigerated containers to stimulate movement of fresh/frozen fish to distant markets and promote export of quality fish from Lake Victoria. Within the islands it is considered appropriate to introduce a collecting system that will ensure all the fish caught reaches the consumer.

The existing scarcity of fuel wood for smoking fish compels some fish processors to use grass or cow dung as a source of fuel. This produces a product of poor quality and limited shelf life. The mission recommends the introduction of improved ovens which have been successfully tested by Freshwater Fisheries Institute Nyegezi, Mbegani Fisheries Development Centre and FAO under the Cooperative Research Programme in Africa.

Fish exports to neighbouring countries is on the increase and can be doubled with moderate improvement of the road network and rehabilitation and operation of some of the existing fish receiving stations. Border trade in fish and fishery products should be formalized.

Presently fish is sold in large quantities in the popular open markets found in all regions surrounding Lake Victoria. These markets have no social facilities although the local authorities are collecting levy on the fish sold there. In Ngara district the Rusumo market which deals mainly in fish is the leading revenue earner for the district.

The mission recommends that local authorities should allocate funds to construct proper markets that would provide better hygienic and sanitary

conditions and at the same time provide storage space for fish awaiting sale or transportation.

14. CONCLUSION

The fisheries of the territorial waters of Lake Victoria are very dynamic and are now dominated by Nile perch, dagaa and tilapias. At present there is a good market for Nile perch and tilapias in the country and in neighbouring states. With improved infrastructure, it is likely that exports to Europe could be initiated. The demand for dry dagaa for feed preparation has increased and prices of good Lake Victoria dagaa have reached Tshs 200 in Dar es Salaam.

In order for the fisheries to play a more positive role in fulfilling one of the objectives of the National Fisheries Development Policy: the provision of protein food, income, employment and foreign exchange earnings, greater attention has to be paid to improving the infrastructure and providing the small scale fisheries and traders with necessary inputs. Emphasize should be placed on raising productivity of the small scale fishermen rather than industrial fisheries to ensure maintenance of the fish stocks as well as raising utilization of fish through improved processing, storage and transportation.

Main routes of fresh and processed fish from Lake Victoria

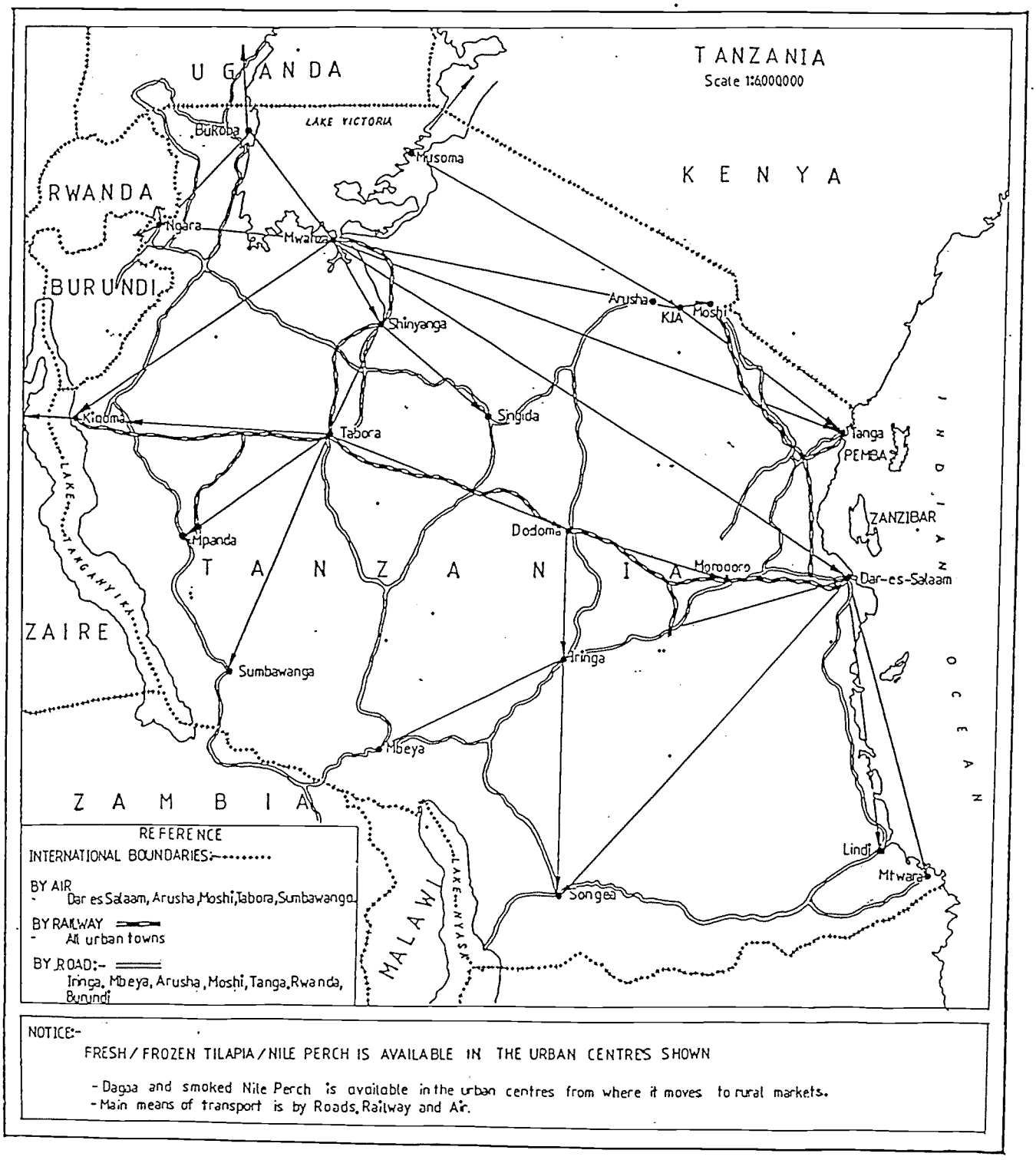

TABLE 1

FISH PRODUCTION BY SPECIES FROM LAKE VICTORIA

FOR THE YEARS 1985 - 1988 (METRIC TONNES).

FISH SPECIES	YEAR OF PRODUCTION							
	1985	%	1986	%	1987	%	1988	%
Tilapias	10,651	10.8	7,631	8.1	13,935	8.7	21178.2	9.7
Lates	37,668	38.1	123,895	57.3	97,478	60.9	148563.2	68.0
Dagaa	5,219	5.3	9,825	4.5	4,062	2.5	13164.8	6.0
Bagrus	9,214	9.3	17,462	8.1	7,675	4.8	9923.5	4.5
Clarias	5,560	5.6	10,395	4.8	8,511	5.3	10973.9	4.8
Proto-pterus	4,050	4.1	3,117	1.4	3,762	2.3	3465.8	1.6
Haplo-chromis	11,572	11.7	16,966	7.8	1,541	0.9	998.1	0.5
Labeo	544	0.5	362	0.2	225	0.2	1492.3	0.7
Synodon-tis	9,278	9.4	7,469	3.5	4,612	2.9	3106.0	1.4
Mormyrus	353	0.4	976	0.5	734	0.5	1469.7	0.7
Schilbe	1,576	1.6	3,583	1.7	1,541	1.0	2889.9	1.3
Alestes	217	0.2	90	0.04	-	-	223.3	0.1
Barbus	401	0.4	909	0.4	700	0.4	1393.1	0.6
Others	2,666	2.7	3,725	1.7	15,187	9.5	200.7	0.7
Total	98,969	100%	216,405	100%	159,963	100%	218442.8	100%

Source: Fisheries Division Statistics.
(Figures have been rounded off)

Note: Tilapias have included Oreochromis niloticus and Oreochromis esculentus which form the bulk of the tilapia.

TABLE 2

DESTINATION OF LAKE VICTORIA DAGAA

TRANSPORTED BY TANZANIA RAILWAYS IN 1989

DESTINATION	NO of Bags	Weight in Kg	Value in T Shs	Comments
Dar es Salaam	35,209	1,135,551	62,340,000	Mainly used for feed manufacture
Tanga	31,415	833,562	44,609,000	Consumption in Sisal Estate
Morogoro	18,008	515,449	32,575,000	Consumption in Sisal Estate
Kigoma	11,292	398,582	19,256,000	Exported to Zaire and used by refugees
Iringa	7,396	211,114	10,465,000	For feeds and consumption
Songea	2,595	72,664	4,701,000	For consumption
Mbeya	2,611	72,104	3,401,000	For feeds and consumption
Mtwara	260	7,490	622,000	For consumption
Rukwa	177	4,425	239,000	For consumption
	108,963	32,509,941	178,208,000	

Source: Tanzania Railways Corporation Mwanza South Port.

TABLE 3

QUANTITIES OF PROCESSED FISH HANDLED AT KIRUMBA MARKET

OCTOBER 1989 - FEBRUARY 1990.

MONTH	FISH SPECIES QUANTITY IN KG		
	DAGAA	NILE PERCH	TILAPIA
October	151,500	10,000	500
November	165,000	9,000	-
December	207,300	10,000	700
January	465,210	4,500	-
February	366,000	9,500	400
TOTAL	1,355,010	43,400	1,600

Source: Mwanza Municipal Council Statistics (Figures rounded off)

TABLE 4

VARIATION OF PRICES OF LAKE VICTORIA FRESH FISH, FEBRUARY - MARCH 1990

REGION	MARKET PLACE	PRICES FOR THE MAIN FISH SPECIES IN Tshs/KG					PRICES OF OTHER SOURCES OF PROTEIN IN Tshs/KG		
		Nile Perch	Tilapia	Bagrus	Protopterus	Clarias	Beef	Chicken	Beans
Mwanza region	Kirumba	50-80	-	-	-	-	-	-	-
	Town Market	100-120	250-300	180-200	-	160-180	220	350	75-80
	Ukerewe (Nansio)	25-30	100-150	-	-	-	180	250	100
	Igombe	15-20	150-170	-	-	-	220	240	70
	Magu (Nassa)	20-30	50-60	-	-	-	180	200	60
Kagera region	Bukoba Customs	60-80	200-250	350-400	-	-	-	-	-
	Nyamkazi	40-60	-	200-250	-	-	-	-	-
	Kabindi	40-50	-	-	-	80-90	-	-	-
	Bukoba Town	80-100	300-350	400-450	-	-	230	280	80-100
	Nyamirembe	10-30	30-50	-	8-15	100	150	300	50
	Biharamulo	100	120-150	-	-	150	160	250	15-20
	Kirebe Isl.	20-30	-	50-60	-	-	-	-	-

cont. TABLE 4

REGION	MARKET PLACE	PRICES FOR THE MAIN FISH SPECIES IN Tshs/KG					PRICES OF OTHER SOURCES OF PROTEIN IN Tshs/KG		
		Nile Perch	Tilapia	Bagrus	Protopterus	Clarias	Beef	Chicken	Beans
Mara region	Sirari (border)	120-150	200-250	-	400-500	-	200	280	120-130
	Shirati	70-100	60-80	-	150-200	-	160	320	120
	Kirongwe (border)	25-50	135-145	-	350-400	-	180	350	100-120
	Tarime Town	50-60	200	-	250-300	-	160	250-300	100
	Musoma	60-80	180-200	-	240-260	-	190	250	80
	Bunda	70	150-180	-	-	-	180	250	100
	Sota	25	40-50	-	200-250	-	160-180	250	80-100
Dar es Salaam	Kariakoo Market	120-180	250-300	-	-	-	280	350-450	120

Source: Field Survey February-March 1990

TABLE 5

VARIATION OF PRICES OF LAKE VICTORIA PROCESSED FISH, FEBRUARY-MARCH 1990 IN Tshs/KG

REGION	MARKET PLACE	PRICES FOR THE MAIN FISH SPECIES					
		Nile Perch	Dagaa	Tilapia	Bagrus	Protopt.	Clarius
Mwanza region	Kirumba	90-100	45-60	-	180-200	120	180
	Town Market	100-120	80-100	200	250-300	-	150
	Ukerewe (Nansio)	55-70	30-40	-	-	-	-
	Kasenyi	25-35	10-20	-	65-75	-	30
	Magu	60-80	25-50	100-200	-	-	-
Kagera region	Bukoba Customs	80-100	45-60	-	250-300	-	-
	Nyamukazi	75-90	28-35	-	240-280	-	-
	Kamondo	50-60	30-50	-	300-400	-	-
	Kabindi	100-120	25-40	-	-	-	-
	Bukoba town	50-60	45-50	-	450-500	-	-
	Nyamirembe	100-120	60-80	200-220	-	-	-
	Biharamulo	100-120	120-150	-	-	-	-
	Kerebe Isl.	55-65	15-35	80-120	-	-	-
	Rusumo	180-200	65_75	-	-	-	-
Mara region	Sirari	140-150	120-150	150-300	-	350-400	-
	Shirati	180-200	60-20	-	-	-	-
	Kirongwe	-	100	-	-	-	-
	Tarime	100-120	100	150-160	-	350-400	-
	Musoma	150-160	80-100	200-240	-	250-300	-
	Bunda	70-100	50-100	180-200	-	-	-
Dar es Salaam	Kariakoo Market	-	200	-	-	-	-

Source: Field Survey February-March 1990

TABLE 6

AVAILABLE DATA ON FISH EXPORTS

FROM LAKE VICTORIA 1986-1989

YEAR	WEIGHT IN KGS	FOB VALUE IN T SHS	FOREX U.S.$.	REMARKS
1986	5,200	97,000	1817	Export to Zaire and Rwanda
1987	3,500	38,160	720	Export to Zaire
1988	37,200	1,660,968	12,987	Export to Zaire, Rwanda & Burundi
1989	870,261	31,457,848	330,641	Export to Zaire, Rwanda & Burundi

Source: Fisheries Division and Customs and Sales Tax Records

TABLE 7

DATA ON PROCESSED FISH SOLD

AT RUSUMO MARKET 1988-1989 IN KGS

PLACE OF ORIGIN	1988		1989	
	NILE PERCH	DAGAA	NILE PERCH	DAGAA
Biharamulo	21,945	-	241,170	30,510
Muleba (Kemondo)	600	600	109,564	43,810
Mwanza	12,945	-	30,000	12,460
Sengerema	-	-	5,400	-
Bukoba	1,470	5,170	-	960
TOTAL	36,655	5,770	38,458	87,740

Source: Ngara District Fish Market Statistics

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SMALL SCALE FISHERY OF THE LOWER SONDU-MIRIU RIVER

by

Manyala, J.O. and Ochumba, P.B.O.,

ABSTRACT

The present document reviews the major social and cultural features, the gear and the general impact of the small scale fishery found on the lower Sondu-Miriu river.

The composition of the fisheries population was found to be made up of 64% river fishermen and 30% lake fishermen; 64% of the fishermen had other sources of income. 86% were young people below the age of 30 and fishing is associated with a high percentage of drop-outs from primary school age.

Peak seasons for catch fell within the established annual rainfall pattern for the area (March - April and August - December).

Catches in the river were dominated by the catfish Schilbe mystus. Decline in species abundance was realized for Labeo victorianus, Alestes spp., Bagrus docmac, Oreochromis leucostictus and Barbus neglectus. It was thought that the introduction of exotic Nile perch (Lates nilotcus) had not been beneficial to the fishery.

Fishing gear used include hooks, traps, gill nets and beach seine nets. Other gear had been tried but had been less successful.

It is proposed that fishery management along the river could be enhanced through clans, co-operative societies, party elders and social organizations.

1. INTRODUCTION

The Sondu-Miriu river is characterized by annual flooding, displacing several families from the floodplain. Displaced families always return to their homes after the floods recede. It is a general belief by the fishing community that the floods enhance the fishery. Thus it is thought that the proposed hydro-electric project on the Sondu-Miriu river will definitely reduce the flood regime and hence the fishery.

Continued decline in the population of riverine fishes over the last 30 years has prompted the Government to initiate the setting up of an artificial hatchery at Sangoro. These developments have necessitated a survey to gauge the effect of a hatchery. The investigations involved finding out:

- how many people will be affected;
- the types of fishing practices currently used;
- the outcome expected from the hatchery;
- the influence of strong clanism and other social organizations, and the impact of enforceable regulations on the river fishery.

2. STUDY AREA

The study area (latitude 0°17'S 22°S and longitude 34°04'E 34° 49'E) is shown in Fig. 1. The geology of the study area consists of volcanic footridges and lacustrine plains that have developed from basic igneous basalts and pheolites. They are well drained, extremely deep and dark reddish brown in colour that contributes to the colour of the water. The river system includes two tributaries; the Yunith and Kipsonoi and covers and area of 3470 km^2.

The rivers' gradient falls by more than 100 m over a distance of 14 km in the lower reaches forming a V-shape valley intersected by gorges. The upper reaches by Apuko Hill are characterised by rock and stone aggregate. As the river descends the aggregate decreases in size from gravel to sand and finally mud/silt in the last 4 km in the river mouth.

Fringing vegetation consists of papyrus swamp dominated by Phragmites spp., Typha spp. and Cyperus spp. for the last 3 - 4 km which blocks the main river channel. The main floodplain is characterized by floating vegetation (Pistia stratiotes, Azolla nilotcus and Lemna perpusilla).

The annual rainfall distribution in the area has a double peak pattern and varies between 479 mm and 1410 mm (Ogalo, 1981). 30% of the total rainfall occurs in the long rainy season (March-May) and 15% falls in the short rainy season (August - October) (see Fig. 2). The mean monthly discharge varies from 13.7 to 58.1 m^{3s-1} $s-^{1}$ with an annual mean of 41.6 m^{3-s1}.

3. METHOD

A few communities near the proximity of the lower Sondu-Miriu directly influenced by the river were chosen and a survey was conducted during the period 1988 based on a key informant interview and standard sampling system (Stevenson et. al., (1982)). A questionnaire was designed to determine the migratory pattern of the fishermen during floods, the fishing gear they used, the clans which influence the fishery, the general socio-economic conditions of the fishery and the alternative opportunities open to the fishermen. They were interviewed at the various fishing sites. Information was obtained about alternative source of income, catch rates, age of fishermen, types of species caught, market demand, problems met while fishing and their fishing experiences. The field recorders were trained at Sangoro Riverine Laboratory on specific information analysis and how to obtain it.

4. RESULTS AND DISCUSSION

A total of 1652 people were interviewed. 64% were fishermen from the river while 30% were fishermen from Lake Victoria. There is a population density of 268 people per sq. mile (LBDA, 1985); 120 people per sq. km (Ogutu, 1987). There is on average 8 people per family. The floods affect 200 families directly disrupting their livelihood and causing physical damage to their property, livestock and crops.

Catches along the river ranged from 0 - 20 kg per fisherman per day while in the lake, catches of up to 100 kg per fisherman per day were common (see Table 1). A brief examination of gear revealed only 4 types of gear used in the river: hooks, traps, gillnets and beach seines. On the lake, these are used also in addition to long lines and mosquito seines nets. 63% of the fishermen on the lake and 66% of the fishermen along the river are satisfied with the gear they use (Table 2). 75% of the fishermen on the lake and 52% of the fishermen from the river had tried different gear. This clearly indicates the fact that most fishermen are not satisfied with the yields from their particular fishing gear.

The decline in the abundance of different species from the river and lake (as reported by the fishermen) is shown in Table 3. It is apparent that the number of species caught by the fishermen (a total of 6) is far smaller than the possible number of 28 species (gathered from an experimental survey: (see Table 4 (Ochumba and Manyala - rpt. in preparation)). Using the present gear, the species range vulnerable to exploitation in the river is limited. While Nile perch continues to dominate the Lake Victoria fishery, the Sondu-Miriu river is dominated by Schilbe mystus. Decline in river catches has been attributed to predation, migration and intensive fishing. Similar observations have been made elsewhere (Whitehead, 1959; Van Someren, 1959) while Balirwa and Bugenyi, 1980; Ochumba and Kibaara, 1989; have attributed decline in catches to environmental degradation.

92% of the fishermen have a family lineage in fisheries and fishing techniques have been passed down from generation to generation; 8% did not come from fishing backgrounds. Traps and hooks have played the major role in the traditional river fishery to date.

It was evident in the past that Tilapiines and Haplochromines had dominated the lake fishery whilst Labeo victorianus had dominated the river fishery. 94% of the river fishermen disliked Lates niloticus while the lake fishermen are divided over its benefits and disadvantages. All fishermen observed the closed season and at least 95% from both localities responded to increased catch rate as a result. Higher catches were actually obtained from adjoining beaches: Kusa and Rakwaro as well.

The current fishing regulations seem to be popular with many fishermen but a few are of the opinion that it proves too expensive as it requires the use of specific and different gear at specific times of the year. Most problems encountered by fishermen include theft of nets, menace from hippos, lack of capital and the interference of snared fish from wild animals.

5. SUMMARY

The flood regime along the Sondu-Miriu river adversely affects more than 200 families despite the fact that all these families are wholly or partially dependant on the river for their livelihood. The proposed hydroelectric power station and dam may prevent flooding during its filling phase but a full reservoir cannot reduce river flow below flood levels (Andersen, 1988), the predicted flood protection may not be thus achieved and instead, the amount of damage may actually increase.

There has not been much evolution in gear type and fishing method in the river over the last few decades despite the fact that most fishermen along the river are not satisfied with their catches. Fishing activity along the river has increased incidences of school drop-outs in the area.

The amount of fishing effort should be reduced by the licensing of gear and a minimum mesh size limitation imposed, both activities of which should be regulated through co-operatives, clans, party elders and social organizations.

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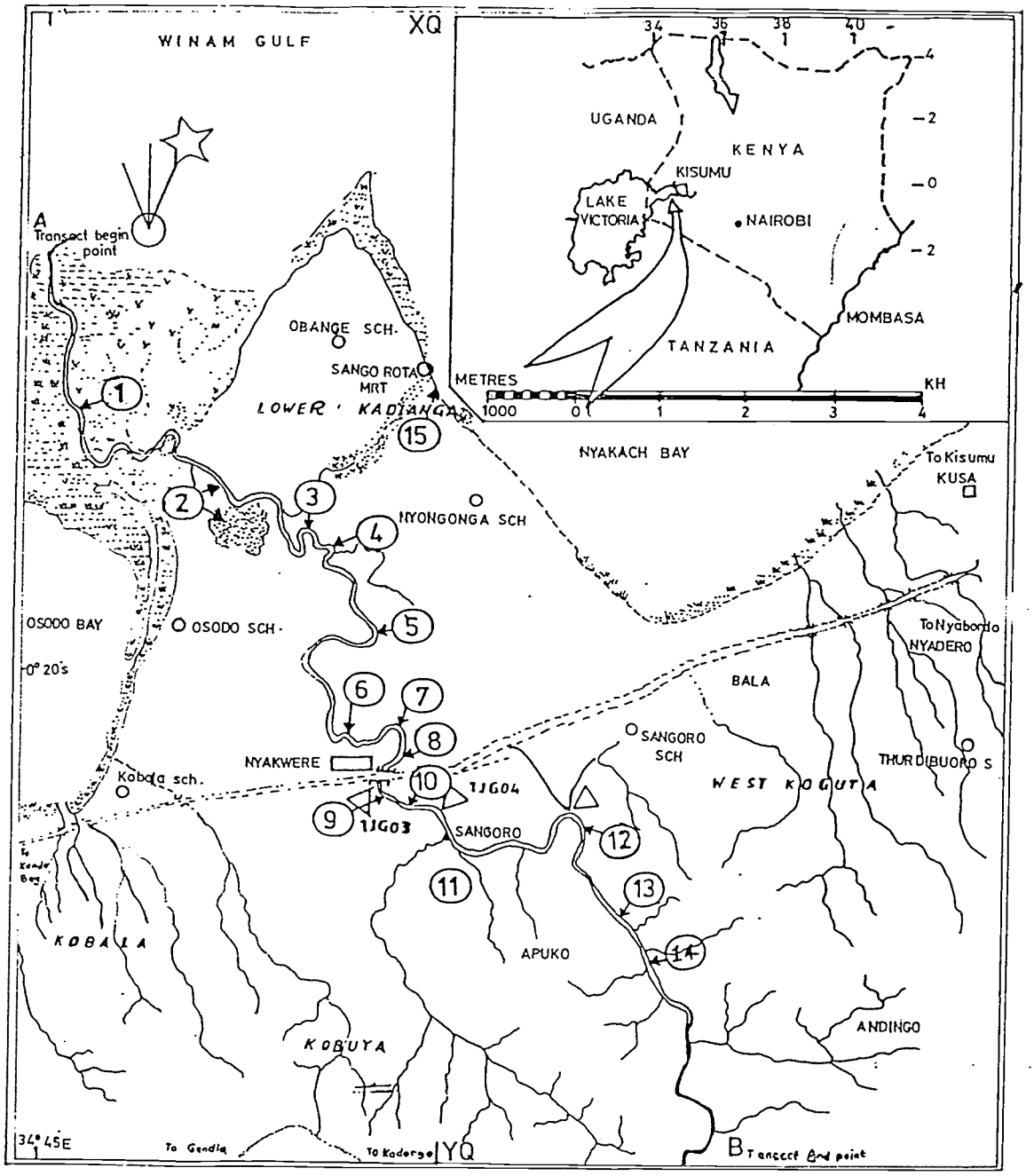
FIGURE 1

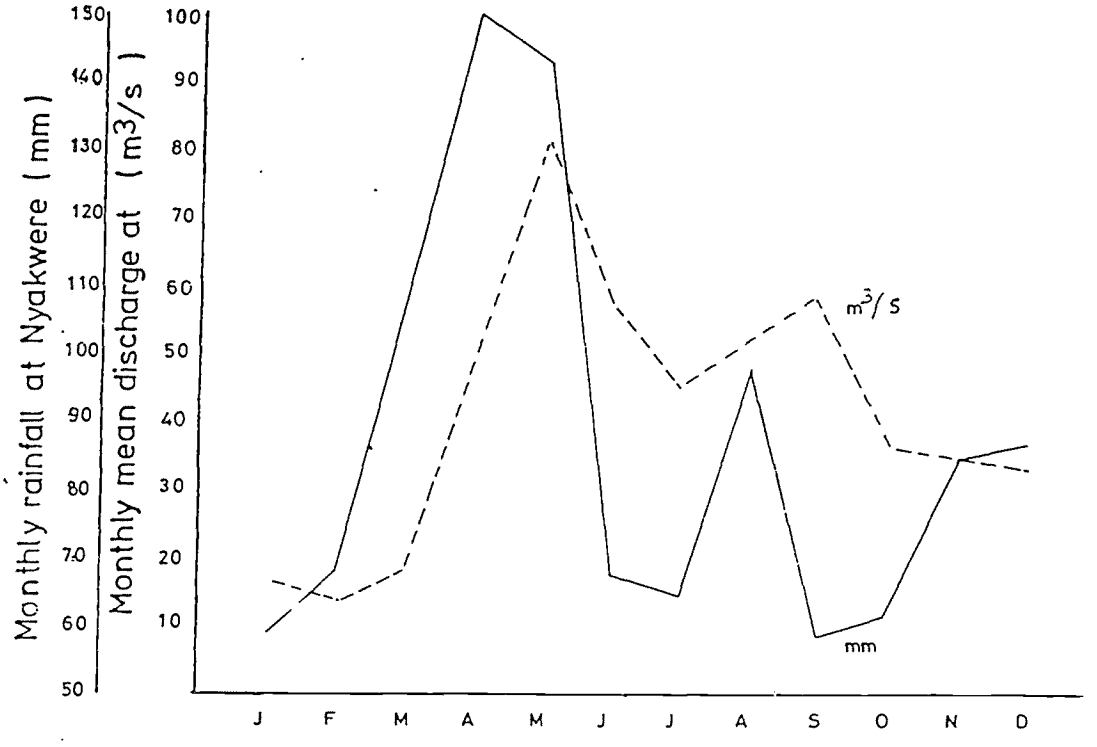
The Lower Sondu Miriu River with sampling points number 1 – 15.
IJG 03 and 4 are river ganging stations.



main river channel
marshland
floodplain - - -
villages
road

FIGURE 2

Mean monthly discharge of river Sondu Miriu at station IJG02 from 1946-83 and the mean monthly rainfall at Nyakwere from 1955-83.



Source: Ministry of Water Development

TABLE 1

A breakdown of the Sondu Miriu floodplain fishermen population

No. of fishermen		165
No. of families		1652
Fishermen along the river (%)		64
Fishermen on the lake (%)		30
Fishermen with other sources of income (river) %		64
Fishermen with other sources of income (lake) %		20
Young fishermen along river (30 yrs old) %		86
Older fishermen along river (30-70 yrs old) %		14
Population density (No/km2)	(LBDA 1985)	268
	(Ogutu 1987)	120
Catches (kg/day) river		0 - 20
lake		15 - 150

TABLE 2

Types of gear used in the river Sondu Miriu fishery as compared to Lake Victoria fishery in order of importance

River	Hooks Traps Gill nets Beach seine	Alternative gear include keks (Fish cages - fixed) (52%)
Lake	Gill nets Mosquito seine Long lines (75%) other traps Beach seine Hooks	Alternative gear by individuals

TABLE 3

Mean monthly catch rates by numbers of fish sampled in the Sondu Miriu river from May 1986 - May 1988

	J	F	M	A	M	J	J	A	S	O	N	D
Lates niloticus	65	49	85	52	686	4	114	12	66	184	172	136
Clarias gariepinnis	24	28	-	6	32	20	424	120	12	52	136	22
Schilbe mystus	275	1345	1780	515	85	15	16	32	40	130	354	240
Bagrus docmac	5	3	4	1	1	-	2	5	13	14	7	4
Oreochromis niloticus	64	120	12	104	154	176	734	302	76	32	84	104
" variabilis	76	30	20	104	20	136	800	748	70	68	562	160
" leucostictus	4	2	6	32	20	11	53	131	14	72	6	16
Tilapia zilli	4	-	-	26	11	9	40	184	5	4	5	6
Barbus neglectus	10	10	4	18	12	-	436	64	30	32	62	48
" altianalis	8	4	43	53	12	5	9	72	16	4	11	48
" jacksoni	-	-	2	5	32	-	11	-	-	-	-	-
" kerstenii	-	-	-	-	1	2	-	4	-	-	-	-
Labeo victorianus	20	6	57	46	37	4	20	5	-	71	13	101
Synodontis victoriae	22	15	181	137	116	6	29	8	38	118	164	265
S.afro fischeri	10	-	-	38	15	5	18	101	10	14	6	12
Alestes sadleri	8	-	-	5	12	14	34	8	-	-	-	-
A. Jachsonii	2	24	22	22	12	77	31	10	-	4	-	1
Xenoclarias	-	-	-	1	44	-	-	1	-	-	-	-
Mastucembelus frenatus	-	-	-	-	-	4	-	-	-	-	-	1
Ctenopoma muriei	3	-	-	-	-	1	5	9	-	-	-	-
Haplochromis spp	10	10	12	24	154	5	628	208	6	-	42	32
Aplocheil. eduardis	-	-	-	-	2	3	1	-	-	-	-	-
Micropterus salmoides	-	-	-	-	-	1	-	4	-	-	-	-
Protopterus aethiopicus	-	-	-	7	23	10	-	1	-	-	-	-
Mormyrus kannume	-	1	6	-	2	-	-	2	-	-	-	-
Petreophalus cutostoma	-	-	-	-	2	4	-	3	-	-	-	-
Gnathonemus longiberbis	-	-	13	3	1	-	-	-	-	-	-	-
Marcusenius grahami	-	-	37	-	-	-	-	-	-	-	-	-

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