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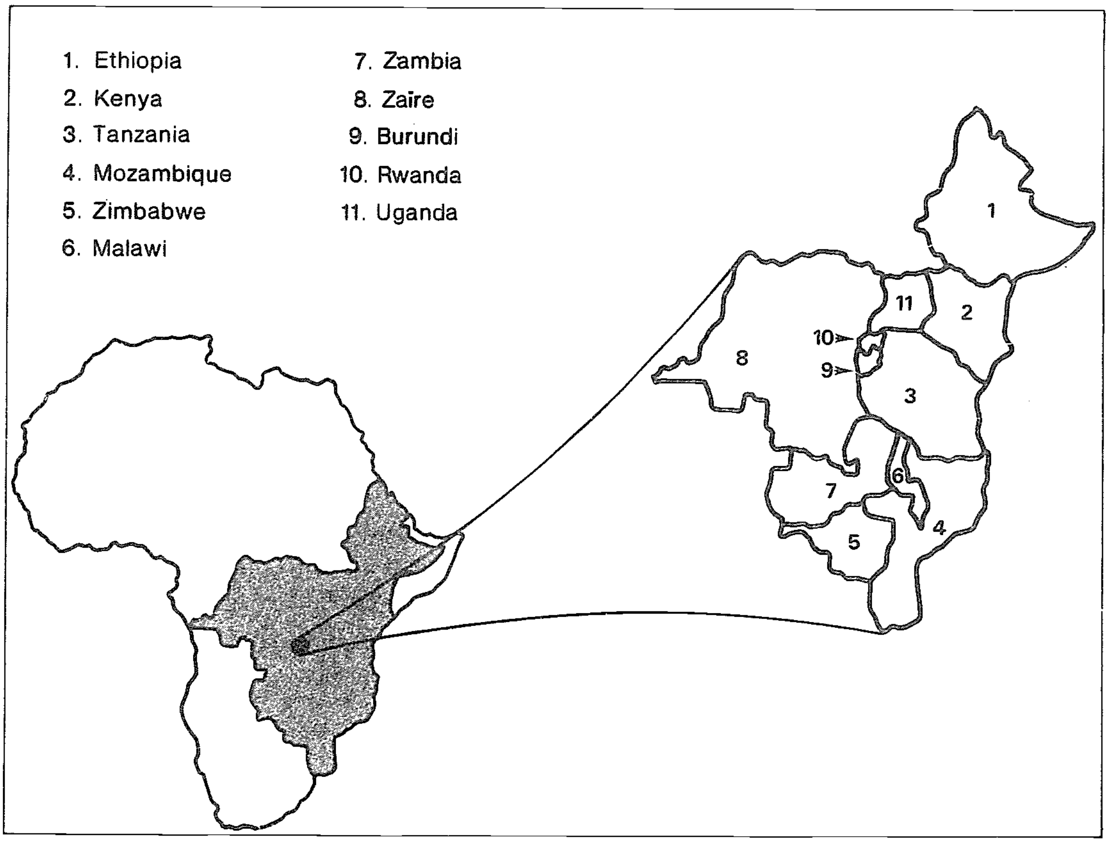
RAF/87/099-WP/16/92 (En) August 1992

The fisheries of Lake Victoria: Review of basic data



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The fisheries of Lake Victoria: Review of basic data

by

D. Grêboval and P. Mannini
- IFIP Project -

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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.

PREPARATION OF THIS DOCUMENT

The present document constitutes a review of basic data pertaining to the characteristics of the fisheries of Lake Victoria and their evolution over the last two decades. The report presents an overview of major characteristics and trends based on readily available data. It also provides a quantitative assessment of the importance of these fisheries and an indication of management issues of immediate concern. The document was prepared by Dr. D. Gréboval and P. Mannini, respectively Coordinator and APO Biologist of the IFIP project.

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Publications of the IFIP project are issued in two series:

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INTRODUCTION

The fisheries of Lake Victoria have undergone drastic changes since the late 1970's following the rapid proliferation of Nile perch (*Lates niloticus*) and its subsequent impact on the ichtyomass and fisheries systems. The fisheries of Lake Victoria are now producing over 500,000 tons of fish annually according to official statistics from the three riparian states concerned. As such they constitute by far the most important fresh water fisheries of Africa, as well as a considerable source of food and otherwise scarce animal protein for the population of the Lake basin.

In this context, the UNDP/FAO Regional Inland Fisheries Planning Project (IFIP) has focused a significant part of its programme on Lake Victoria. Various aspects of planning for the development and management of these fisheries are being addressed through cooperative investigations and regional cooperation. The approach taken by the Project has been essentially to complement on-going research programmes and to facilitate regional cooperation among riparian states (Gréboval, 1992).

For the time being, these fisheries have become extremely valuable, with unprecedented levels of production and a much expended market base. The fisheries and lake ecosystem show, however, definite signs of stress and instability. The risk of overexploitation and of rapid collapse is high in this kind of situation, especially as regards the stock of Nile perch. Thus the need to carefully monitor the evolution of key fisheries and to implement strict management measures as required.

In the present document, basic data are presented and discussed, which pertain essentially to the production sector. These data describe mostly the characteristics and evolution of the fisheries in terms of catch, effort, and employment. The primary objective of this presentation is to provide a quantitative assessment of the importance of these fisheries and an indication of the stakes of their proper management. Following a lakewide overview, country specific data are presented and commented upon. This document is concluded by a review of the issues of immediate concern for the management of the lake.

1. REGIONAL OVERVIEW

1.1 EVOLUTION OF CATCHES

According to official statistics, catches lakewide have reached in 1989 the impressive total of 500,000 tonnes (Figure 1). This constitutes an unprecedented level of production which, for the same year of reference, represented over 27% of total catch from Africa's inland fisheries. Although official data are not yet available, provisional estimates from the three countries indicate that total production has increased only slightly in 1990-91.

It has become customary in related literature to express reservation about the reliability of these statistics, especially in view of the constraints which fisheries departments are facing at data collection and compilation levels (Ssentongo, ed., 1990). Without getting into details, one would note, however, that much effort has been deployed by Uganda to rehabilitate and improve the statistical monitoring of its fisheries (especially within the context of UNDP/FAO Project 'Fisheries Statistics and Information Systems'). This country may have now the most reliable estimates and these can be used comparatively to assess data from Kenya and Tanzania. Comparing catch levels, effort (fleet size) and the respective share of coastline, this approach may indicate that the catch data of Kenya and Tanzania could be somewhat overestimated, with total production still likely to be above 400,000 for the year of reference (1989).

Such a level of production is 4 to 5 times higher than the level achieved in the late 1970's as shown in Figure 1. Indeed, since the mid-60's the pre-Nile perch fisheries of Lake Victoria had stabilized at a production level of about 100,000 tonnes (Table 1) with increasing signs of overexploitation of high value species, and increasing reliance on low value products such as haplochromines and the small pelagic Rastrineobola argentea (Reynolds and Grèboval, 1989). This considerable increase in production after 1979 is essentially attributable to the proliferation of Nile perch (Lates niloticus) and its subsequent impact on the species composition of the lake. It led indeed to a drastic and extremely rapid decrease in the stocks of haplochromines, which represented before about 90% of the biomass, and resulted in a much simpler fisheries system dominated by 3 species: Nile perch, Nile tilapia (Oreochromis niloticus) and dagaa (R. argentea).

As shown in Table 2, the catch of Nile perch has increased during the 1980's from 4,000 to 319,000 tonnes, representing by far the most important fishery. Over the same period, the catch of O. niloticus increased from 7,000 to 46,000 tonnes, and that of R. argentea[1] from 18,000 to 95,000 tonnes. Table 2 also shows that the catch of other species which supported traditional fisheries has on the other hand decreased. This is especially the case for haplochromines which landings fell from 29,000 to 5,000 tonnes over the decade. For other species, the decrease in catches has been more limited, with catches decreasing from 51,000 to 40,000 tonnes. These numbers reflect however the relative recovery of some species in the late 80's and mask significant differences from one country to another.

The contribution of the three main species to total catch is indicated in percentage terms in Figure 2. In the late 70's these species represented about 30% of total catch; by 1988-1989, this figure was close to 90%. Nile perch itself now constitutes over 60% of total catch compared with 3 to 4% in 1979-1980. The contributions of tilapiine and R. argentea do not appear to have changed significantly in percentage terms.

Figure 3 indicates the distribution of total catch by countries for selected years. Assuming a relative homogeneity of fish distribution throughout the lake, data can indicatively be compared with shoreline shares. For example, Kenya's share of the shoreline is about 22%. On the other hand, its share of total catch increased from 15% in 1970 to 24% in 1980 and 33% in 1990. This increase reflects first the comparatively high level of effort being applied to haplochromines and dagaa since the early 1970's, and the

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[1] It should be noted that while official catch data have been used in the report, a raising factor of three has been applied for R. argentea as official data for Tanzania and Uganda are reported in dry weight. In all three countries, adjustments are being made to ensure proper evaluation of landings and prices. However, recent data do show that these adjustments are not always correct, especially for value of landings.

indirect impact of a more remunerative market on transboundary fish flows. The latter is presumed, however, to be limited as far as pre-landing is concerned, and the comparatively high level of effort being applied to the Kenyan portion of the lake remains the major reason for Kenya's high contribution to total catch.

As regards Uganda, its contribution to total catch has evolved quite dramatically from 39% in 1970, to 9% in 1980, and 29% in 1989. There are two main factor behind this evolution: the situation of war and economic crisis which prevailed in the late 70's and early 80's, severely affecting the fisheries sector (as well as its monitoring); and consumer preferences. Indeed there has never been a real market for small species in Uganda, in part because medium to large size table fish has always been relatively available from the numerous lakes of the country. In the 70's, while Kenya and Tanzania rely increasingly on haplochromines and dagaa, these fisheries did not develop in Uganda. Similarly the renewed increase in dagaa landings in the late 80's occurs first in Kenya and Tanzania. In 1988, 45,000 and 29,000 tonnes are landed in Kenya and Tanzania respectively, against 6,000 tonnes in Uganda. Landings jumped, however, to 21,000 tonnes in 1989 as market conditions for fish meal continue to improve. Except for a limited market in the West Nile region, nearly all the production is used for animal feed. The evolution of Tanzania's contribution to total catch essentially reflects changes in other countries.

1.2 EVOLUTION OF FISHING EFFORT

Fishing effort data are scarce and only available lakewide in relation to fishing crafts. This constitute a very crude estimate as boat are used in various fisheries, with a range of gear type and size, and with variable intensity. However, it is to be noted that for the two periods of reference, i.e. 1972-73 and 1989-91, the fisheries of the pre and post-Nile perch can be considered as having reached some degree of effort stability. It can be noted as well that the fishing boat and gear used in the main fisheries are relatively similar (Prado *et al.*, 1991). The main difference among countries thus pertains essentially to effort allocation among species and to effort intensity per boat (rate of motorization, size of nets, management).

According to the data presented in Figure 4, the total number of boats operating in the fisheries of Lake Victoria has increased from 10,776 in 72-73 to 21,786 in 89-91 with a motorization rate of 3.4% in Kenya, 2.6% in Tanzania (including the trawlers) and of 18.4% in Uganda. This doubling of the fleet has mostly occurred since the last 10 years and limited additional investments are believed to be occurring, at least in Kenya and Uganda. The contribution of each country to the total fleet is also depicted in Figure 4, showing Uganda's share increasing from 25% to 36% over the period under consideration. While Tanzania's share remained quite similar, Kenya's fell from 38% to 29%.

Data presented in Figure 5 should be interpreted with caution as between census data are though to be quite unreliable. The only indication which can be inferred from this Figure is that investment in new boat seems to have occurred earlier and more progressively in Kenya, and that a significant increase in fleet size has occurred in Tanzania in 1987-88, as well as in Uganda in 1989.

1.3 CATCH PER UNIT OF EFFORT

The evolution of catch per unit of effort is indicated in Figure 6 in terms of tonnes/boat/year. It can be seen that from the late 70's to the late 80's, CPUEs more than doubled. The 4 to 5 fold increase in total catch from the pre- to the post-Nile perch regime thus appear to result from a doubling of both the fleet and CPUEs. Figure 6 also shows CPUEs from Tanzania to be quite systematically higher than those of Uganda and Kenya. During the 70's, this is quite understandable: the rate of exploitation in Kenya was then significantly higher, and Uganda fishermen were mostly fishing for high value species which stocks were showing increasing signs of overexploitation lakewide.

In Figure 7, CPUEs are compared for three periods of reference using the most reliable boat counts of the time series. It shows an obvious and significant increase in CPUEs under the new fisheries regime; a definite similarity in the recent evolution of Kenya's and Uganda's CPUEs; and, in general, higher CPUEs for Tanzania. Differences observed from country to country for each period may relate to differences in exploitation rates, catch composition and statistical bias. It remains that such marked differences are, a priori, difficult to explain.

2. ECONOMIC INDICATORS

Food availability

The changes which have affected Lake Victoria have had a tremendous impact on food availability in the region. Aside from haplochromines and dagaa, the overall production of table fish has indeed increased from 44,000 to 405,000 tonnes between 1975 and 1989. Although not documented, such an increase in fish production is bound to have had a significant impact on nutritional standards in a region where diets are generally deficient in animal protein. As mentioned earlier, haplochromines and dagaa have traditionally been considered a food of last resort by the riparian consumers. Related products are mostly used for animal feed in Uganda and Kenya. In Tanzania, however, significant distant markets exist in the country as well as in neighboring countries.

There is no doubt that such an increase in fish production could not have occurred over such a short period of time without a simultaneous expansion of the market base. Market expansion occurred first around the lake region and then to more distant urban centres. Such a rapid expansion was fueled by low ex-vessel prices, the fact that Nile perch was already known in the region and readily accepted by consumers (except along the Kenya shores), and by the dynamism of processors and traders (Gréboval, 1989). Benefits accrued therefore to a large number of consumers around the Lake basin and in the three countries concerned.

Exports

The development of market opportunities rapidly extended to the export markets. Kenya, benefitting from better logistical and transportation systems, took the lead in developing industrial processing plans for the export of Nile perch fillets overseas. As indicated in Figure 8, exports from Kenya already reached close to 4000 tonnes in 1987 and are now over 10,000 tonnes. There are 14 plants which processed Nile perch in Kenya, with a total capacity of about 25000 tonnes. However, some of these plants process other fisheries products.

In both Uganda and Tanzania, exports have so far consisted mostly of transborder trade in fresh (mostly to Kenya) and smoked or dry salted products (mostly to Zaire, Rwanda and Burundi). As this trade is largely unreported, its extend is not known but is believed to be limited (Ssali *et al.*, 1991; and Gréboval, 1989).

In Tanzania, a recent survey by van der Hoeven and Budeba (1992) provides for the following estimates for Nile perch exports (July 91- July 92): fillets: 3360 tonnes representing 10080 tonnes in wet weight; whole fish, fresh: 18060 and 7180 tonnes for declared and undeclared exports respectively. Total exports of Nile perch amounted to over 35000 tons, representing about 18% of total catch for this species. On the other hand, undeclared exports represented about 20% of total exports.

As indicated in Figure 8, overseas exports from Uganda are becoming significant since 1990. Actually, a fairly large processing capacity is being established and exports may have reached an annual rate of about 3000 tonnes in 1992. In this context, yearly exports of Nile perch from the three countries can be estimated for 91-92 to have reached 16000 tonnes, representing about 48000 tonnes in wet weight. This corresponds to around 15% of the total production of Nile perch for 1990. According to Gréboval (1989), overseas trade represented less than 5% of total production in 1987. The rapidly growing export market is fueled by relatively low ex-vessel price and a growing overseas demand which allows for very high marketing margins.

In view of the likely decrease in catches over the next few year, growing export trade is becoming a matter of great concern. In Uganda, new plans are being built. Even if total capacity has been limited to 50000 tonnes of fresh product, such capacity may have severe consequences on the local market, both in terms of fish prices and availability. In Tanzania, the situation is even more critical. Indeed van der Hoeven and Budeba (1992) report that the industry is now planning the build up of a filleting capacity of 308 tonnes per day (250 tonnes according to Tanzanian fisheries authorities). Using the lower estimate and conservative hypotheses (300 working days, plants used at 60% of maximum capacity), production would reach 45000 tonnes of fillets or 135000 tonnes of fresh fish. This corresponds to nearly 80% of present Nile perch production! Clearly the growth of this industry has to be carefully assessed and controlled.

Exports do represent a significant income in foreign currencies, e.g. exports of Nile perch fillets represented about USD 20 million for Kenya alone in 1991. There exists also a significant export trade in Nile perch swimming bladders (maws) in all three countries. In Kenya, this trade amounted to 242 tonnes, valued at USD 0.82 million in 1991.

Employment

In terms of employment, the fisheries sector is now employing over 300,000 people, of which about 100,000 in the primary (harvesting) sub-sector. This corresponds to a three fold increase if compared with 1975 data (Figure 9). Fisherfolk and dependents are now estimated to number well over one million people. The fisheries of Lake Victoria therefore represent an extremely important source of employment and ensure the livelihood of a significant portion of riparian dwellers.

Value of production

The total value of production at market level has been estimated at USD 270 million for 1989 (Reynolds *et al.*, 1992). According to these authors, the value added created lakewide in the fishing industry is close to the ex-vessel value of production, estimated at USD 89 million. In Kenya and Tanzania, the value of production increased by 750% and 500% respectively between 1985 and 1990 (Figure 17 and 28, in current shillings).

3. RELATED DATA: TANZANIA

Official catch data indicate a 4 fold increase in catch since the late 1970s, with landings reaching about 230,000 tonnes in 1990 (Figure 10). Data for the period 1975-1983 do not reflect any major changes in catch level and composition, but since 1983 Nile perch catches have soared to a 1990 figure of 175,000 tonnes. The catch of Nile tilapia and dagaa also increased dramatically since the late 1970's: about 3 and 4 fold respectively (Table 3). Data for 1987 show a significant reduction in the catch of most species. There is no obvious explanation for this phenomenon, but it may be related to the high variability of effort data (see Figure 15 for example) used in catch assessment.

The evolution in catch composition is shown in Figure 11 for 1976 and 1990. In 1990, 75% of the catch is composed of Nile perch and the three main species now represent 93% of total catch. The fisheries of Tanzania would thus appears, with a delay of a few years to evolve as those of Kenya and Uganda were the three main species constitute an even greater percentage of total catch. However, Table 3 clearly shows that other species are still well represented in absolute terms, and that, except for haplochromines, catches in the 80's have actually been higher than in the late 70's. A rapid downwards trend is nevertheless noticeable since 1987.

Effort and CPUE data are given in Figures 12 and 13, clearly showing that the impact of Nile perch proliferation started to be felt in 1983. Effort and CPUE raised rapidly thereafter, but with ample year to year fluctuations. Until 1982 there was an inverse relationship between CPUE and effort, most likely meaning that the fishery exploitation level was already quite high. Since when Nile perch massively appeared in the catches, in 1983, CPUE and effort were positively correlated till 1986 when wide fluctuations in effort and catch were reported. The same variability is observed in relation to other components of effort (Figures 14, 15 and 16). As one would hardly expect high year to year inverse fluctuations in such components of effort such as boat and gear (especially in a healthy fishery), it is likely that the origin of this variability would be internal to the catch assessment system. Alternatively, it could also suggest the decline of the Nile perch supported expansion phase of the fishery.

The gill net distribution (Figure 16) shows the evident shift towards larger mesh size mainly to catch Nile perch. Data for 1988-90 show clearly the distinction in focus on both the Nile perch and the Tilapia fisheries, with limited effort being applied to smaller size species. The use of selective gear, if continued in the time, and the decrease of unselective ones will have positive effects on the fishery. However, direct observations by the authors in 1991-1992 indicate that mesh sizes used in the Nile perch fishery has since decreased, even if the 7" mesh size remains the most common.

As to the evolution of total catch in value, Figure 17 show that in recent years ex-vessel value increased five fold to about 6.5 billion T.sh (approx. USD 34 million at December 1989 rate). Nile perch constitutes more than half of total value, followed by tilapiines. The three dominant species now represent around 80% of total value, i.e. significantly less than in weight terms. The evolution of prices for selected species is given in Figure 18. It shows the relative stability of Nile perch and Tilapia prices,and a significant increase in the price of dagaa (market expansion) and 'other species' (high decrease in production). The price of Tilapia is about 75% higher than the price of Nile perch, itself close to average fish price. The recent evolution of dagaa prices may reflect adjustments between dry and wet weight.

4. RELATED DATA: KENYA

The evolution of total catch in Kenya shows a tremendous and sustained increase of catches after 1978, that is about four years before Tanzania and Uganda (Figure 19). Nile perch catches have increased especially in the period 1981-83, and appear to be decreasing since the record catch of 68545 tonnes in 1987. Catches of tilapiines and dagaa are showing a less dramatic but more sustained development. Also important to note is the recent apparent recovery of other species, including haplochromines (Table 4).

Pre and post Nile perch catch composition per species is indicated in Figure 20, showing that the three main species now represent about 85% of the catch, compared to about a third in 1976. At peak Nile perch production level in 1987, this percentage had reached 99%. A new trend therefore appears to have started towards an increased diversity of the resource base. This is reflected by an increasing diversification in the gear types used by fishermen as shown in Figure 21. Although similar data are not available for the mid-1980's, a large majority of fishing units were equipped with gillnets at this time. In 1991, only half of the fleet is using gillnets, with longlines and dagaa gear being increasingly used (Hoekstra *et al.*, 1991). Figure 21 also shows that only about half the effort (boats) is targeted to Nile perch.

The rapid reduction of the Nile perch stock (CPUE) has occurred since the mid 80's in the Nyanza Gulf, and effort subsequently moved to offshore waters and to other target species. This situation is depicted in Figure 22 for 1989. The most striking difference is in the share of Nile perch (29% in the Gulf compared to 56% in open waters), and in gear use with mosquito seines being largely used in the Gulf (72%) and gillnets remaining the major gear for open waters (48%). Similar data for 1990 (Figure 23) show almost the same pattern of the previous year. To be noted, however is this significant increase in the use of beach seines, gear which is now prohibited but still widely used.

The recent evolution of catch rates and CPUE are examines in Figures 24 to 26 based on data from selected landing site. The data show a definite downward trend in fishing effort, and a consecutive increase in CPUE and catch. However, such decrease in 1989 of the effort expressed in terms of boat-days it is not so much evident from Figure 5 where effort is represented as number of fishing boats. Figure 27 indicates within year pattern in gear use. Catch by mosquito seines is the most regular indicating the constant use throughout the year of this gear. Gill net catch shows a trend which largely reflect the influence of the rainy season. Before the ban on beach seining, this gear was still widely used contributing in some months (October-December) to a very large portion of the catch, and replacing gill nets.

In undiscountinued terms the value of total catch has increased dramatically since the last 10 years (Figure 28), to reach about 650 million K.Shs (USD 30 million at December 1989 rate) in 1989. The share of Nile perch has rapidly increased to more than 60% in 1983, but has been decreasing eversince to about 40% in 1989. Tilapiines and dagaa represented about 29% and 22% respectively. The evolution of prices for selected species (Figure 29) shows a very rapid decrease in the price of Tilapia (high increase in landings), as well as a significant increase in the price of Nile perch (lower landings, impact of demand by processing plants). It is however surprising to observe such a narrowing of price differentials among species. Direct observations made by the authors in 1992 indeed confirm this phenomenon, with ex-vessel prices for Nile perch and O. niloticus respectively at about 12 and 15 K. Shs. As already indicated for Tanzania, price data for dagaa seem high and should be assessed in relation to both the fresh and dry markets.

5. Related data: Uganda

The evolution of total catch (Figure 30) shows a very sharp increase since 1983 when Nile perch started to have an impact on the fishery (Table 5). Since 1986 tilapiines constitute a continuous and fast growing component of the catch. Only in recent years R. argentea (locally known as "mukene") is significantly reported, this is partly due to the night fishing ban which is now no more enforced, and also to the irregular recording of mukene catch in the fisheries statistics.

Catch composition in pre (1976) and post (1989) Nile perch fishery regime are depicted in Figure 31. Ugandan fishery in Lake Victoria is nowadays, as for Tanzania, mainly a Lates fishery which alone makes up 70% of the production. Percentage composition of tilapiines has not changed much between 1976 and 1989, while R. argentea is reported to have reached 14% of the total catch. The contribution of all the other species has dramatically collapsed down as these have almost disappeared from the catch statistics.

National fish production (Figure 32) is dominated by Lakes Victoria and Kyoga. The enormous quantity of fish landed from Lake Kyoga in the last has strongly declined during the second half of 1980s. Most likely this is due to the diminution of the water level, as well as to the stabilization of Nile perch population at a much reduced level after excessive fishing pressure in the early 70's. The reduced production of Lake Kyoga is compensated by the landings from Lake Victoria. Figure 33 clearly shows the monospecifity of Lakes Kyoga and Victoria fisheries compared to the other main water bodies of Uganda. The evolution of landings from Lake Kyoga can usefully be compared to that of the Kenyan portion of Lake Victoria. Although the ecosystems are quite different, they have many similarities, especially in terms of species composition under both pre and post Nile perch regimes. One may incur that the fisheries of Lake Victoria may follow a similar pattern as these of Lake Kyoga if unchecked excessive fishing pressure is applied to the Nile perch stock.

Some results from CAS carried out from January to March 1989 are represented in Figures 34 and 35. During the CAS execution the most efficient gill net mesh size were those targeting on tilapiines (mainly Nile tilapia) and on medium/large sized Nile perch. There is some contradiction between the data reported in Figure 30 where Nile perch dominates the catch and Figures 34 and 35 which instead would indicate a tilapia based fishery. Recent CAS executed in 1991 (Figure 36) seems to stress again the major importance of Lates in total catch.

6. Conclusion

This overview of readily available data on Lake Victoria fisheries allows for some considerations on the present status of the main fisheries and on the need for more effective management.

Historical and recent fisheries statistics do not have yet achieved sufficient level of reliability. Unexplained brusque variations of catch and effort data between consecutive years introduce a wide margin of uncertainty in the analysis of the fishery. Also, more detailed measure of effort and CPUE should be applied to have more useful information of the status of the exploited stocks.

Nevertheless, it is a matter of fact that the total production of the Lake has increased several folds since Nile perch started to proliferate in the late 70's. The largely positive impact of this phenomenon is also well documented: in terms of increased food supply, employment, revenues to the industry, and foreign exchange earnings. Most recent statistics indicate, however, that this impressive growth in yield and associated benefits is starting to level off. Nile perch catches are at peak level and decreasing in Kenya and Uganda. This downward trend may augur of a rapid decline of the Nile perch stock, with decreasing CPUEs and mesh size being presently observed in this fishery. Particularly in Kenya where fishing effort is being applied increasingly to other species: R. argentea and O. niloticus in particular, but other species such as the small fresh water shrimp, Caridina nilotica, as well.

In this context, total catch may remain high for some years. Based on the evolution of the fisheries of Kenya (where the fisheries are more 'mature'), it is possible that R. argentea and tilapiines may sustain increased levels of effort if the Nile perch stock is significantly reduced. This seems to have occurred on Lake Kyoga. Furthermore, decreased predation by Nile perch may lead to the recovery of some other species, as occurred in the Nyanza Gulf.

However, the ecosystem is still largely unstable and the level at which it will stabilize is simply not predictable. For example, it is quite difficult to foresee at this stage the impact of reduced Nile perch predation, especially in connection to increased exploitation of its key preys: R. argentea and eventually C. nilotica. But, even if one assumes that high levels of production could be sustained in this context, it will mean that a very valuable fishery would have been replaced by one relying increasingly on dagaa and other low price species which are mostly used for fish meal production.

The management of the Nile perch fishery is therefore seen as the utmost priority. While other management measures could be considered, such as reduced fishing pressure on juveniles through the prohibition of beach seining and the promotion of more selective gear such as lift nets, the control of mesh size remains the major issue. It is indeed difficult to control nominal fishing effort in an artisanal fishery, and it may not be required if a significant proportion of the fleet switches to other fisheries as seen in Kenya. On the other hand, Nile perch is mostly harvested by gillnets, and there is already a clear tendency towards a rapid decrease in mesh size in this fishery. Nile perch being a rather monospecific fishery, it could be possible to enforce a common minimum mesh size if all effort were first concentrated on this fishery. Of course, implementation procedures would have to be carefully established.

Industrial processing and export policies are a related issue of immediate concern. Especially in view of increasing indications of a likely rapid decline in Nile perch landings. The very rapid build up of industrial fish processing plants in Tanzania and Uganda, as well as reported projects for further expansion is now largely unchecked. According to available information, it may lead to a processing capacity of 60000 to 80000 tonnes by the end of 1993. This would represent at least 180000 tonnes of Nile perch in wet weight, i.e. 55% of present peak levels of production and may soon constitute a much higher percentage if landings decline rapidly. It is recommended to freeze any further expansion of this capacity, pending a thorough assessment of the likely impact of industrial processing on food supply in the Lake region, on fish prices, and on artisanal fishermen and processors.

As noted above, the Lake Victoria ecosystem is still very much in a transition phase. Far-reaching changes have occurred in recent years, which have affected the fisheries as well as the environment of the Lake. Major changes in the Lake environment relate to increased nutrient inputs, thermal instability, and the composition of phytoplankton and zooplankton. Of concern is the resulting increase in algal biomass, and reduced oxygen levels, with evidence of anoxia in bottom waters and in some cases well into the water column. Another change of immediate concern to the three riparian states is the recent proliferation of the water hyacinth (Eichornia crassipes) along the lake shore. The weed is already well established around the lake, and constitute a real threat requiring concerted control measures (see Appendix 1).

Against this background, a very disturbing point is that monitoring and assessment research, as required for proper management, have remained limited by the lack of means at the disposal of the specialized research centres. For example, since the transformation of the ichthyofauna which followed the proliferation of Nile perch, there has been no scientific information on the status of fish stocks in the offshore waters of the lake, and no systematic stock assessment at regional level. Also disturbing is the fact that very little external support has been provided to research centres and fisheries departments in the areas of research and management: in spite of the considerable socio-economic importance of Lake Victoria's fisheries and of the growing concern of rapid decline, if not of outright collapse, expressed by many scientists from the region and from abroad.

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Table 1. Estimated total fish production by country (tonnes), 1968-1991.

Year	Tanzania	Kenya	Uganda	Total
1968	59400	16400	40509	116309
1969	53900	17400	46273	117573
1970	48300	16400	41730	106430
1971	42600	14900	38809	96309
1972	40900	16000	35301	92201
1973	49600	16800	32501	98901
1974	41700	17200	25501	84401
1975	56718	16581	13765	87064
1976	55322	18690	11120	85132
1977	70375	19332	15600	105307
1978	53088	23856	15570	92514
1979	63237	30594	16900	110731
1980	73281	26914	9999	110194
1981	78061	38177	17000	133238
1982	68513	60958	13000	142471
1983	79461	77327	17000	173788
1984	101740	71854	44792	218386
1985	115098	88589	54578	258265
1986	236057	103161	56828	396046
1987	168043	113422	97166	378631
1988	244772	125077	111157	481000
1989	225011	135431	146487	506929
1990	231547	185108	136900	553555
1991	not available	186366	145000*	331366

* Total catch by species not available, wet weight of R. argentea was estimated by using the average catch value from 1989-1990.

Table 2. Lakewide fish production (tonnes) by major species, 1975-1990.

Year	L. niloticus	R. argentea	O. niloticus	Other tilapiine
1975	301	19752	7202	6089
1976	637	12789	3302	3201
1977	663	14243	5220	4650
1978	1550	18577	7050	5018
1979	4478	17514	4220	7726
1980	4454	18140	7696	10380
1981	23893	18795	11957	11371
1982	37121	17196	6377	9201
1983	82742	26005	4785	6632
1984	106860	25320	8415	10163
1985	125023	50154	13175	8185
1986	221870	63993	24187	8358
1987	242640	51340	24757	5326
1988	301804	86455	41147	8498
1989	319671	95924	46054	9502
1990	333005	101252	49018[1]	30430[2]
Year	**P. aethiopicus**	**Haplochromis spp.**	**B. docmac**	**Other species**
1975	7844	22485	10146	13272
1976	5835	32562	11311	15495
1977	10286	43096	10621	16528
1978	6941	26991	11410	14977
1979	6445	29909	13482	26957
1980	6864	28765	8630	25265
1981	10062	25596	16487	15077
1982	8645	26642	18139	19150
1983	3864	22297	14985	12478
1984	4152	15163	26613	21700
1985	4271	11578	24293	21586
1986	3530	16970	26811	30327
1987	4174	1676	14773	33945
1988	3806	2752	10204	26334
1989	3442	5331	5786	21219
1990	1536[1]	1324[1]	594[1]	36396[1]

[1] Tanzania and Kenya only. [2] Inclusive of O. niloticus catch from Uganda. Most likely the overall 1990 tilapiine figure is biased.

Table 3. Tanzanian sector: estimated fish production (tonnes) by major species, 1975-1990.

Year	*L. niloticus*	*R. argentea*	*O. niloticus*	Other tilapiine
1975		15174		5649
1976		7107	1031	2615
1977		7539	1645	3680
1978	24	9867	2968	3384
1979		7983	1608	5949
1980	15	8697	4210	6551
1981	274	11160	3929	9332
1982	2040	6777	3336	7307
1983	16425	9516	1887	4866
1984	41614	5833		8821
1985	37608	24288	4334	6316
1986	123895	29475	10584	7047
1987	97478	12192	9939	3997
1988	148563	39495	13305	7873
1989	161604	29304	12735	4795
1990	175270	29014	10886	4686
Year	*P. aethiopicus*	*Haplochromis* spp.	*B. docmac*	Other species
1975	6180	16148	5827	7740
1976	3100	25184	5906	10379
1977	7243	36158	4570	9540
1978	4029	18810	5114	8892
1979	4603	21760	5183	16151
1980	6129	25036	4143	18500
1981	7080	24593	12180	9513
1982	2948	24023	11700	10382
1983	3705	21624	11601	9792
1984	3963	15122	8892	17445
1985	4050	11572	9215	17715
1986	3117	16967	17461	27511
1987	3762	1488	7675	31512
1988	3466	998	9923	21149
1989	2411	572	4855	8735
1990	1452	1323	581	8335

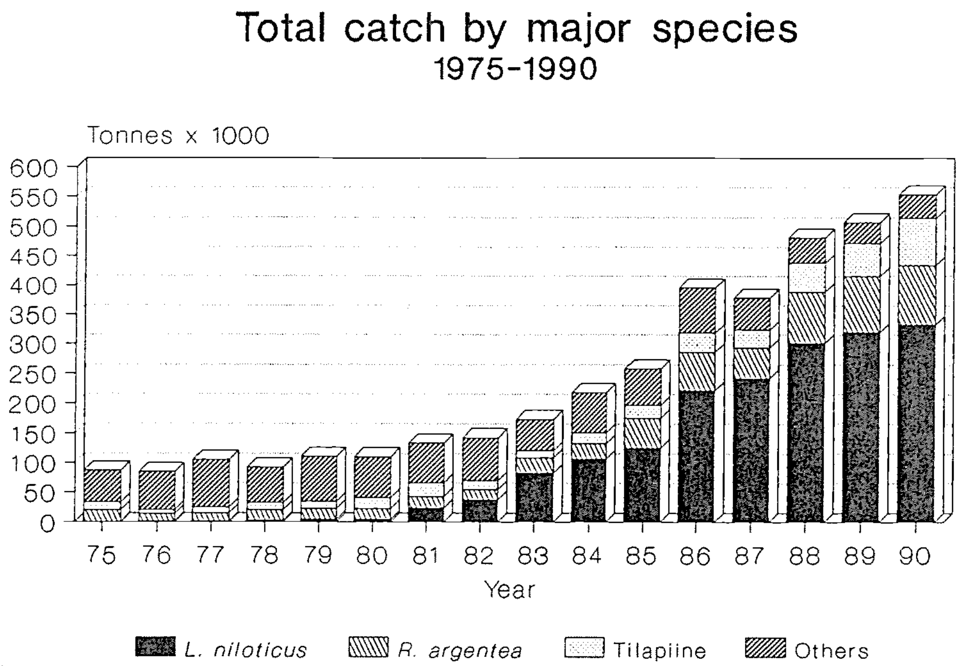
Table 4. Kenyan sector: estimated fish production (tonnes) by major species, 5-1991.

Year	*L. niloticus*	*R. argentea*	*O. niloticus*	Other tilapiine
1975	51	4548	202	440
1976	97	5652	421	586
1977	203	6704	465	970
1978	1066	8710	972	1634
1979	4286	9321	962	1777
1980	4310	9443	1184	3829
1981	22834	7635	1858	2039
1982	33134	10419	2581	1894
1983	52337	16444	2516	1766
1984	41319	19437	6136	1342
1985	50029	25866	7573	1869
1986	56975	34518	7853	1311
1987	68545	33145	9024	1329
1988	61210	40861	16272	625
1989	56810	45464	13101	4707
1990	71514	46738	38132	565
1991	57235	58028	27475	19456
Year	*P. aethiopicus*	*Haplochromis*	*B. docmac*	Others
1975	1469	4620	1389	3862
1976	935	6378	1025	3596
1977	773	5378	1141	3698
1978	612	6621	1396	2845
1979	472	6599	1769	5406
1980	370	3636	642	3500
1981	187	916	430	2278
1982	239	2546	2532	7613
1983	108	612	1243	2301
1984	81	41	88	3410
1985	150	6	61	3035
1986	150	3	62	2289
1987	58	183	40	1098
1988	25	1338	75	4665
1989	24	4759	18	10548
1990	84	1	13	28061
1991	81	3615	12	20464

Table 5. Ugandan sector: estimated fish production (tonnes) by major species, 1975-1990.

Year	L. niloticus	R. argentea	Tilapiine	B. docmac
1975	250	30	7000	2930
1976	540	30	1850	4380
1977	460		3110	4910
1978	460		3110	4900
1979	190	210	1650	6530
1980	129		2302	3845
1981	785		6170	3877
1982	1947		460	3907
1983	13980		382	2141
1984	23927		2279	17633
1985	37386		1268	15017
1986	41000		5750	9288
1987	76617	6003	5749	7058
1988	92031	6099	11570	206
1989	101257	21156	20218	913
1990	*ca.* 86200	25500	25179	n.a.*
Year	P. aethiopicus	Haplochromis spp.	Other species	
1975	195	1690	1670	
1976	1800	1000	1520	
1977	2270	1560	3290	
1978	2300	1560	3240	
1979	1370	1550	5400	
1980	365	93	3265	
1981	2795	87	3286	
1982	5458	73	1155	
1983	51	61	385	
1984	108		845	
1985	71		836	
1986	263		527	
1987	354	5	1335	
1988	315	416	520	
1989	10071		1936	
1990	n.a.	n.a.	n.a.	

* n.a. = data not available



Source: CIFA (1982, 1985); Ssentongo (1985); Fisheries Departemts, Dar es Salaam, Nairobi, Entebbe.

Figure 1

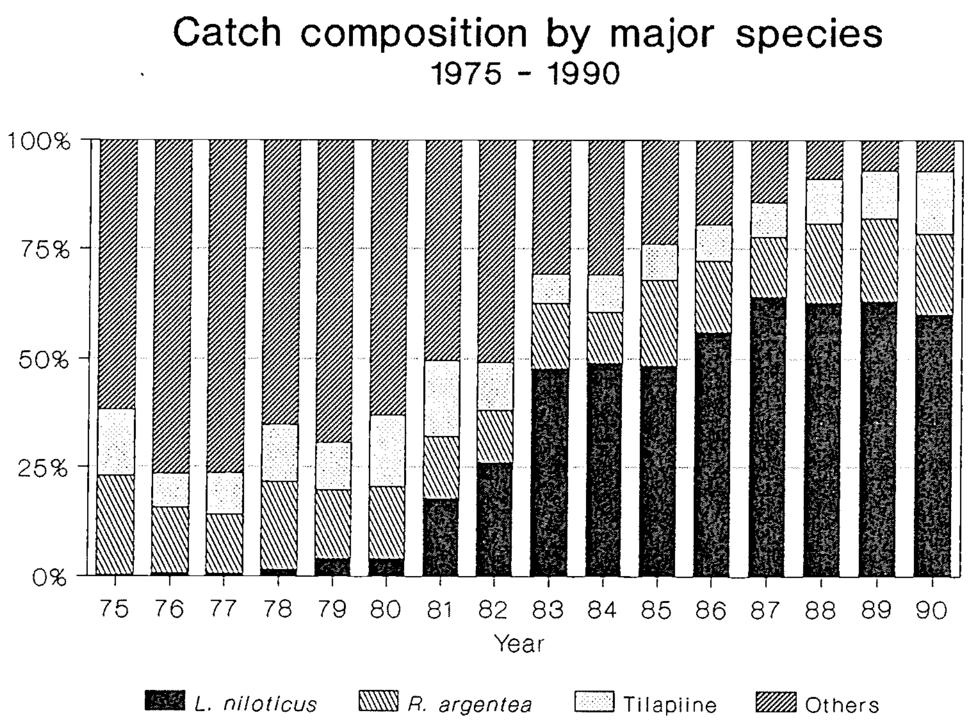


Figure 2

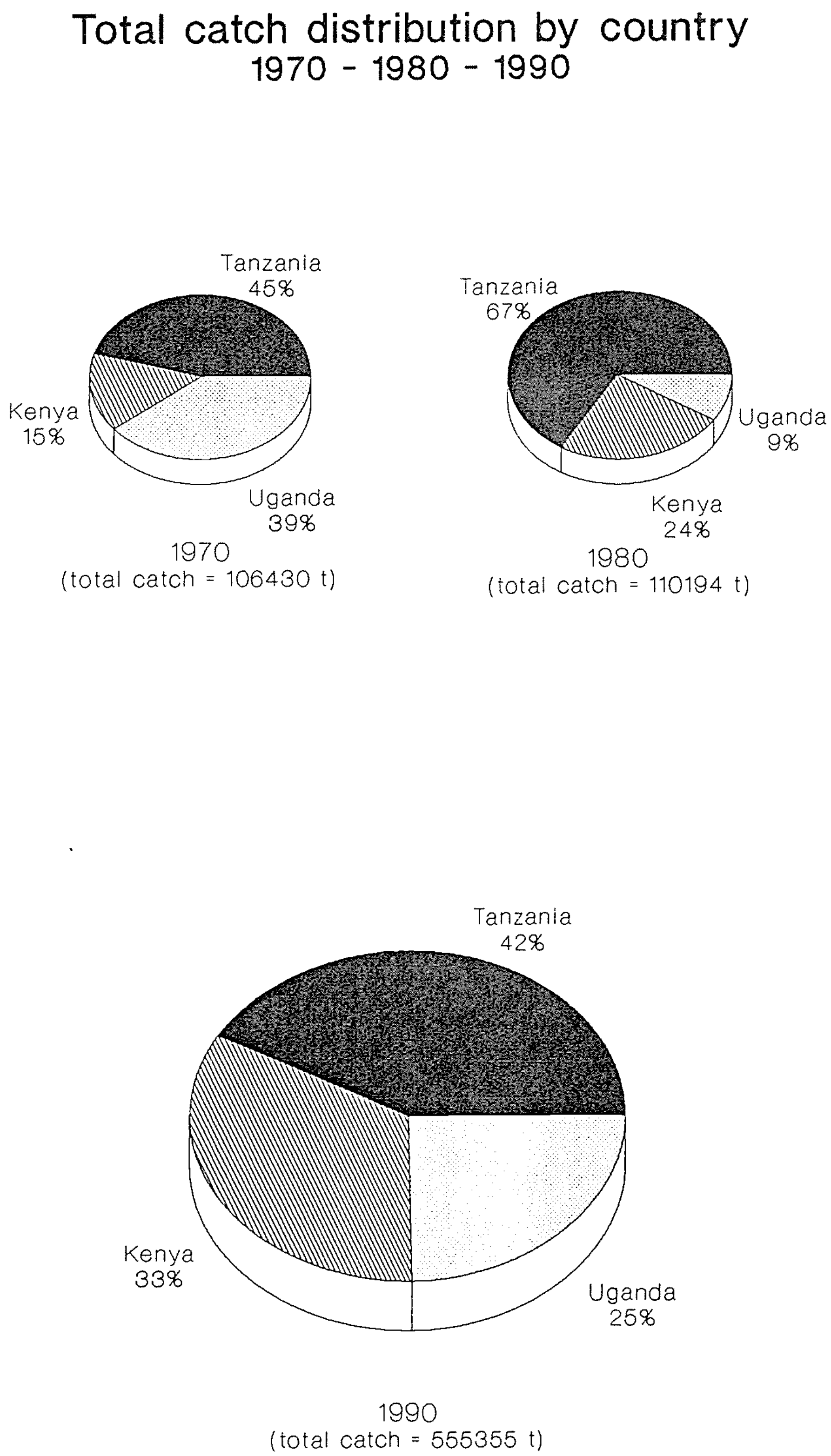
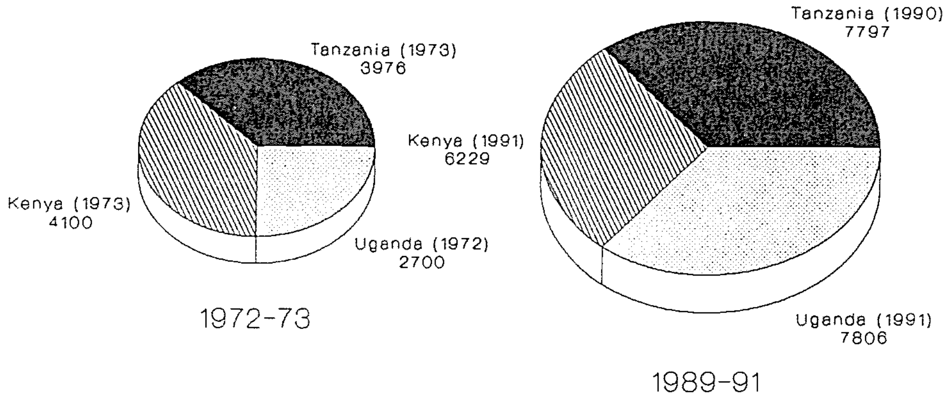

Total catch distribution by country
1970 - 1980 - 1990
Tanzania
45%
Kenya
15%
Uganda
39%
1970
(total catch = 106430 t)
Tanzania
67%
Uganda
9%
Kenya
24%
1980
(total catch = 110194 t)
Tanzania
42%
Kenya
33%
Uganda
25%
1990
(total catch = 555355 t)

Figure 3

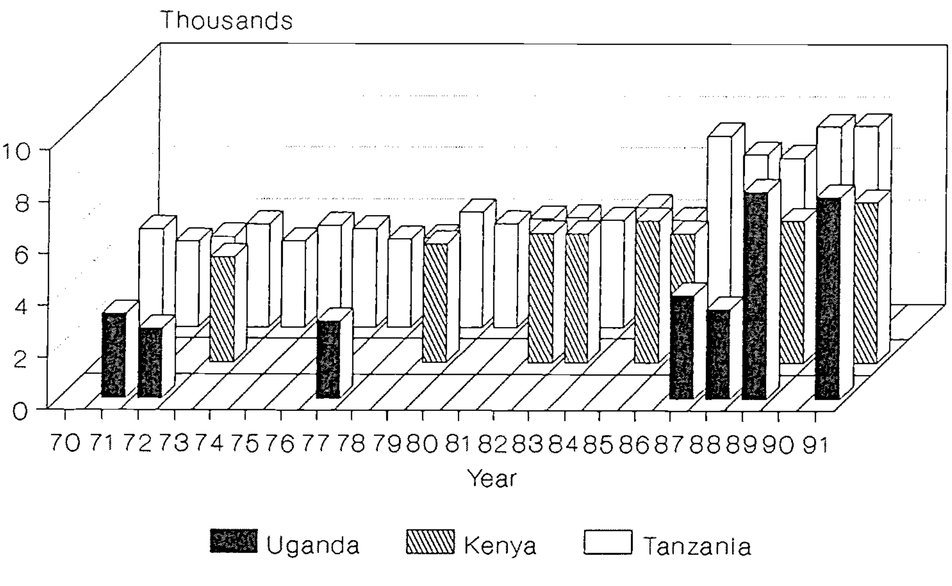
Effort distribution 1972-73 / 1990-91
(No. fishing boats)



Source: FAO (1973); Fisheries Depts. Dar es Salaam, Nairobi, Entebbe; Hoekstra *et al.* (1991); Coenen (1991).

Figure 4

Fishing effort evolution
Number of fishing boats



Source: FAO (1973); National Fisheries Departments; Hoekstra *et al.* (1991) Tumwebaza *et al.* (1991); Coenen (1991).

Figure 5

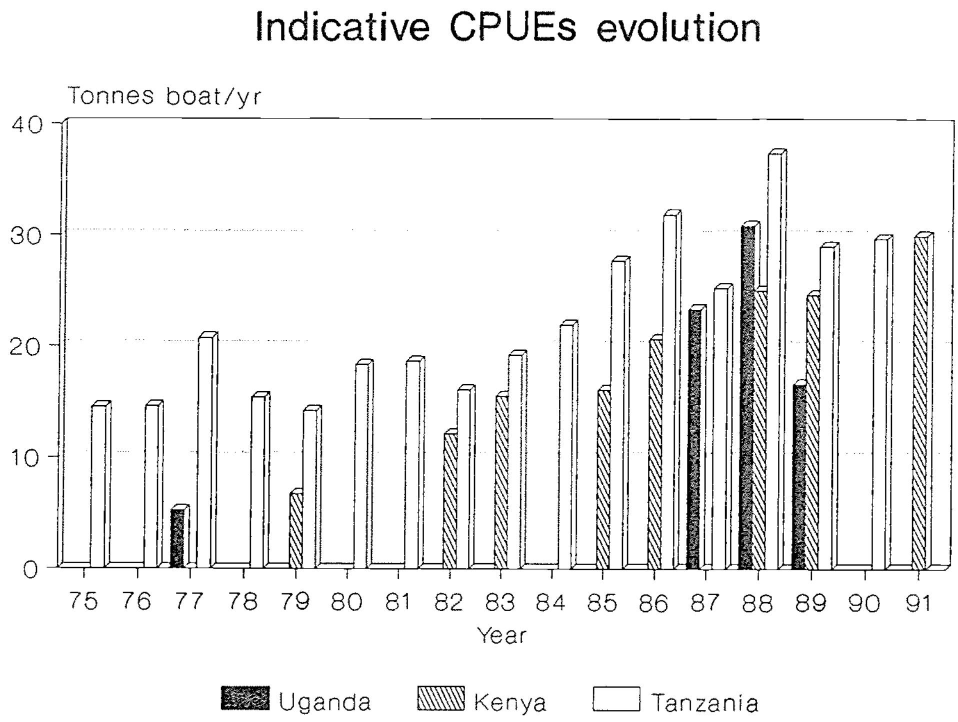


Figure 6

Source: Reynolds *et al.* (in press)

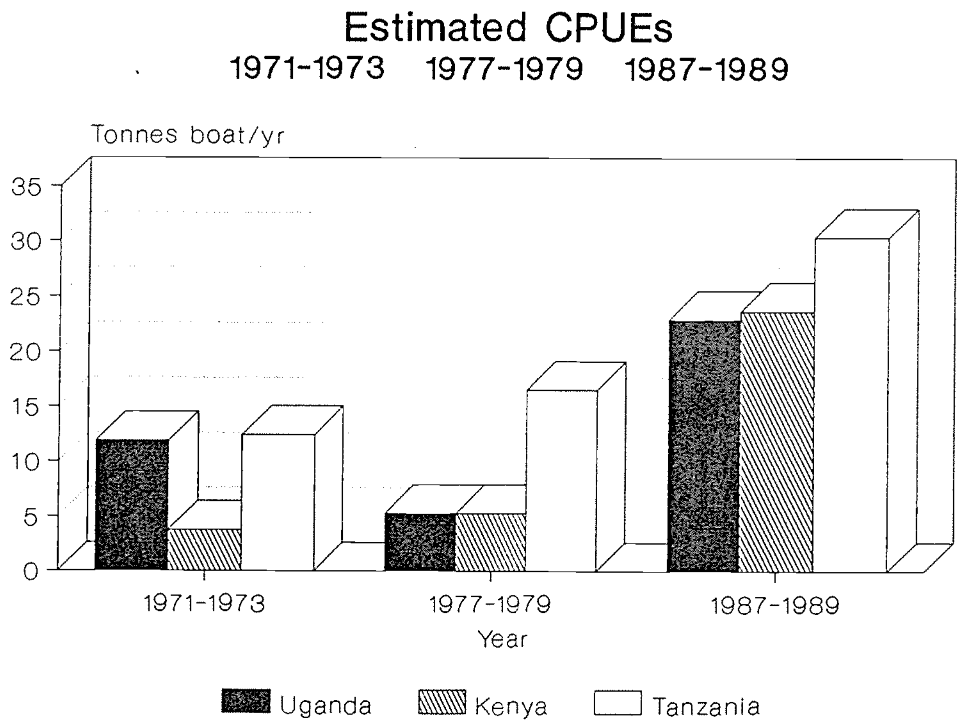


Figure 7

Overseas exports of Nile perch products
(Kenya and Uganda)

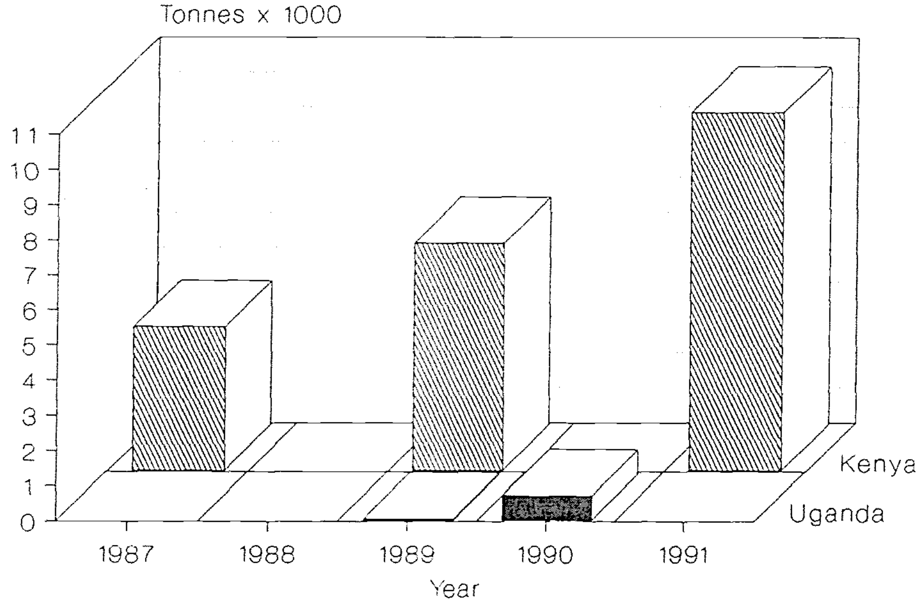


Figure 8

Source: National Fisheries Departments records.

Employment in the fisheries sector
1975 - 1989

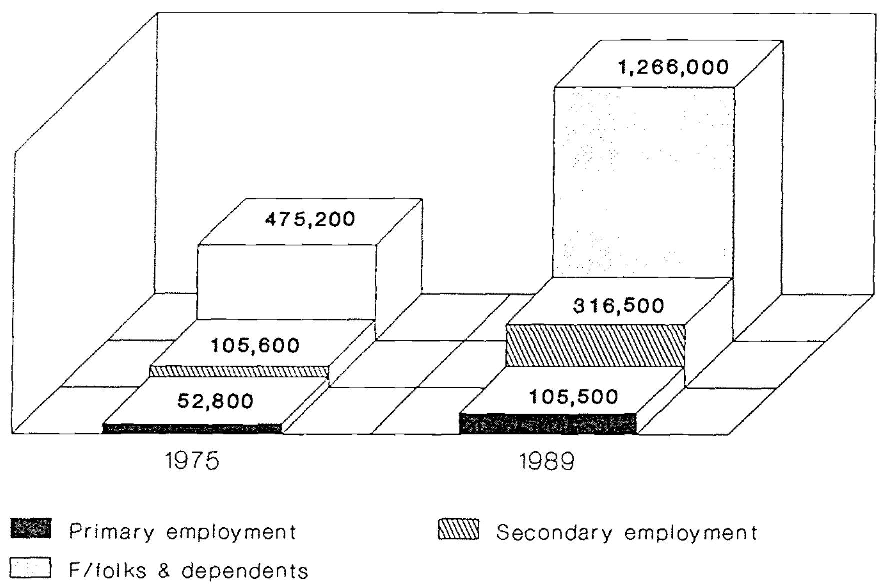


Figure 9

Source: Reynolds *et al.* (in press)

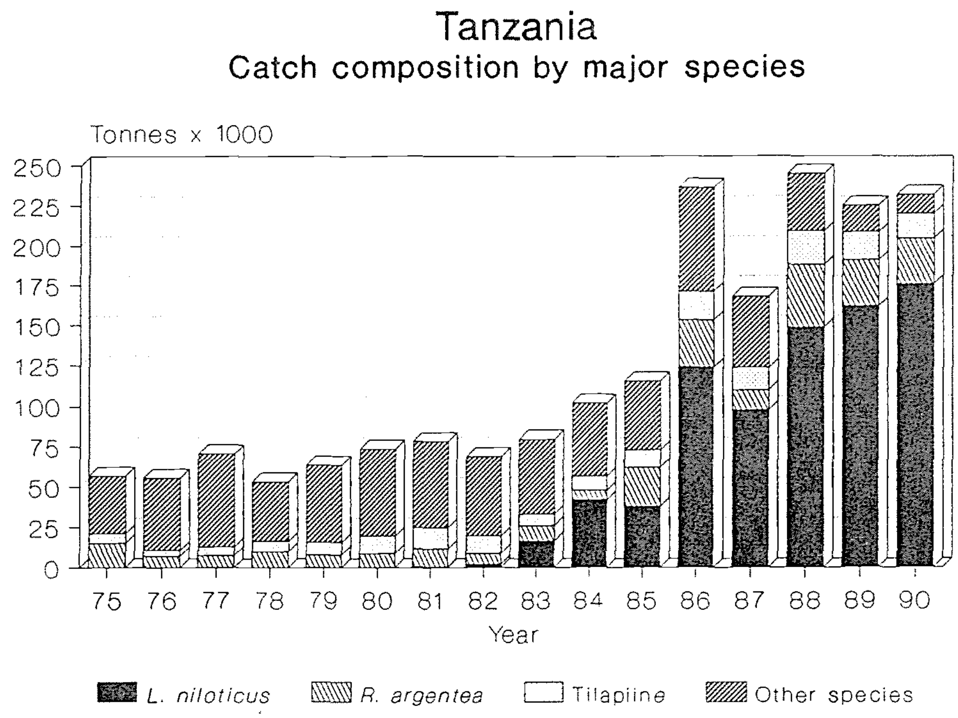


Figure 10

Source: Fisheries Div., Dar es Salaam.

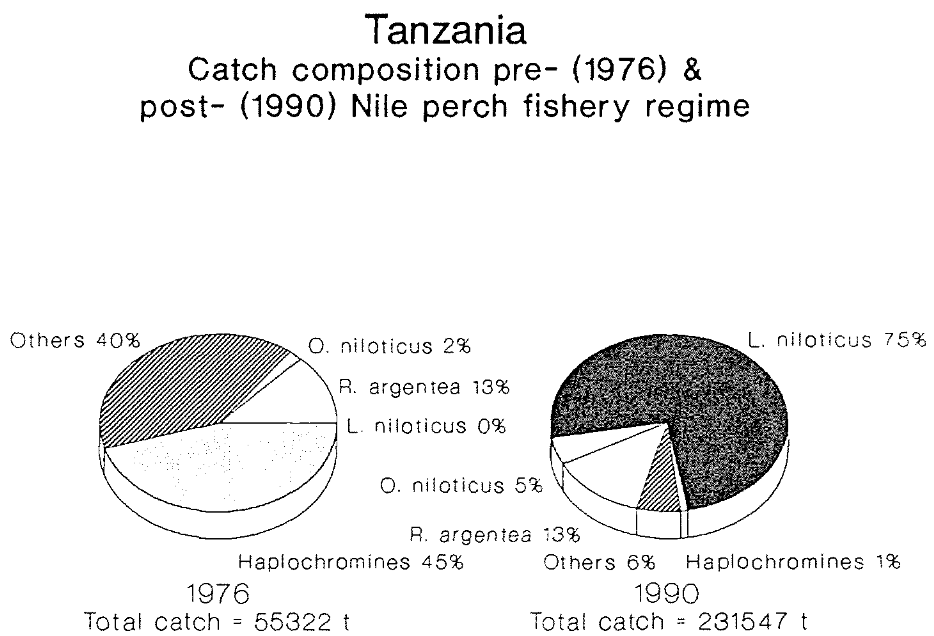


Figure 11

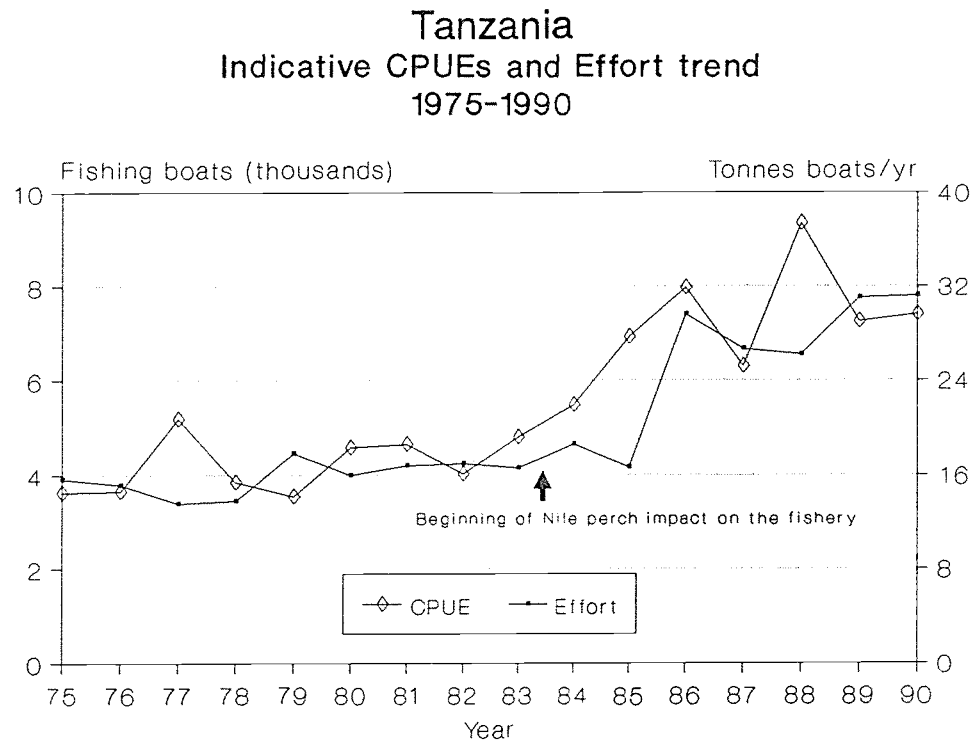


Figure 12

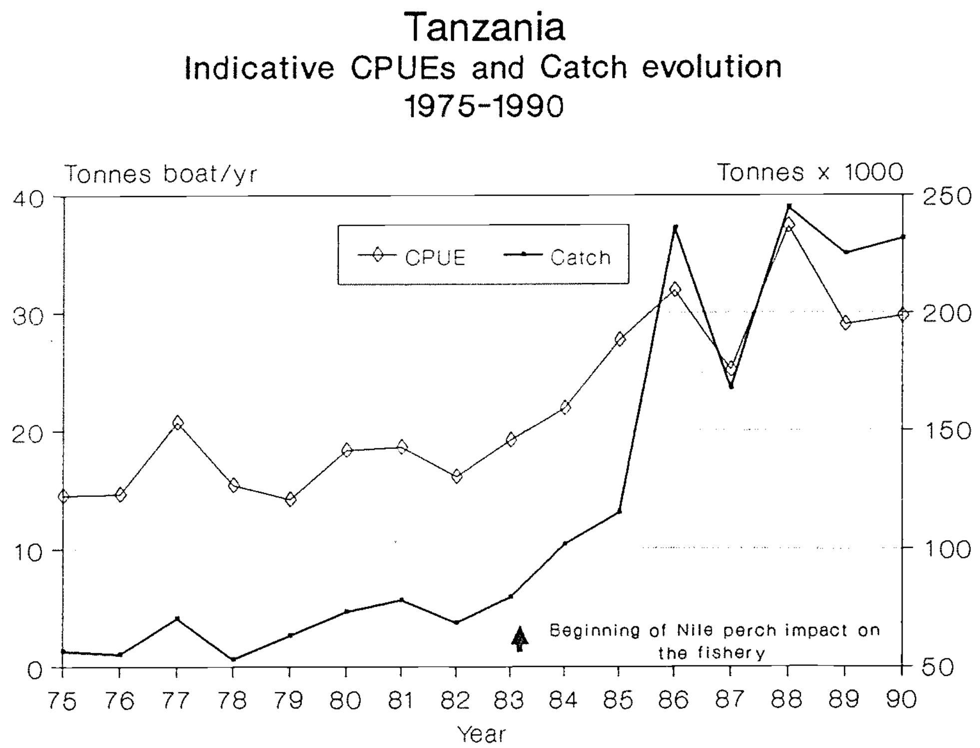


Figure 13

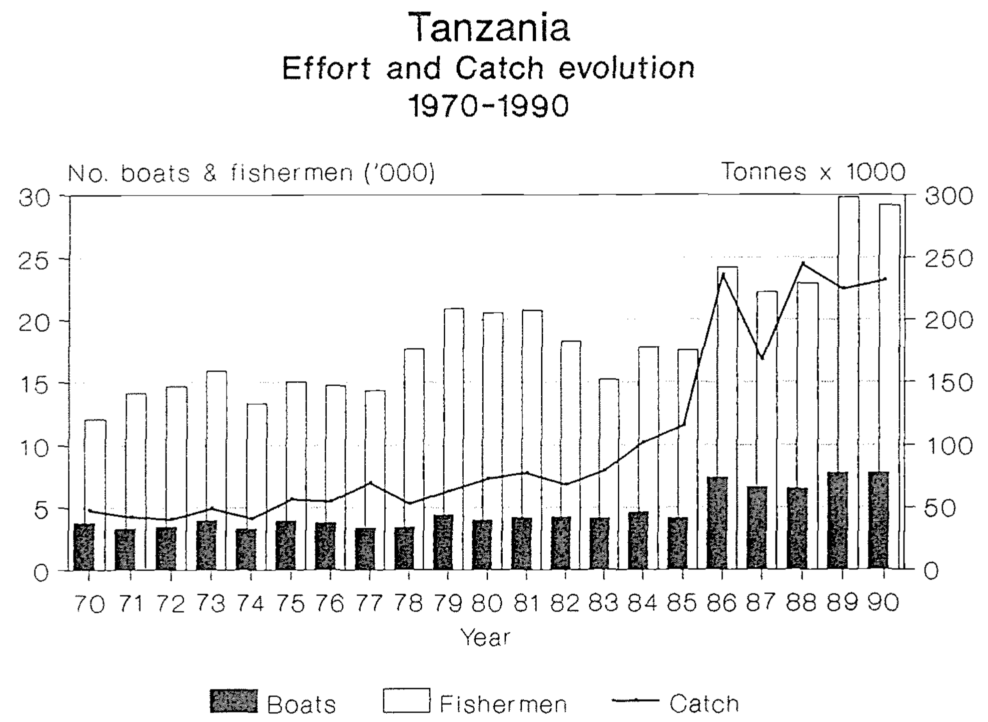
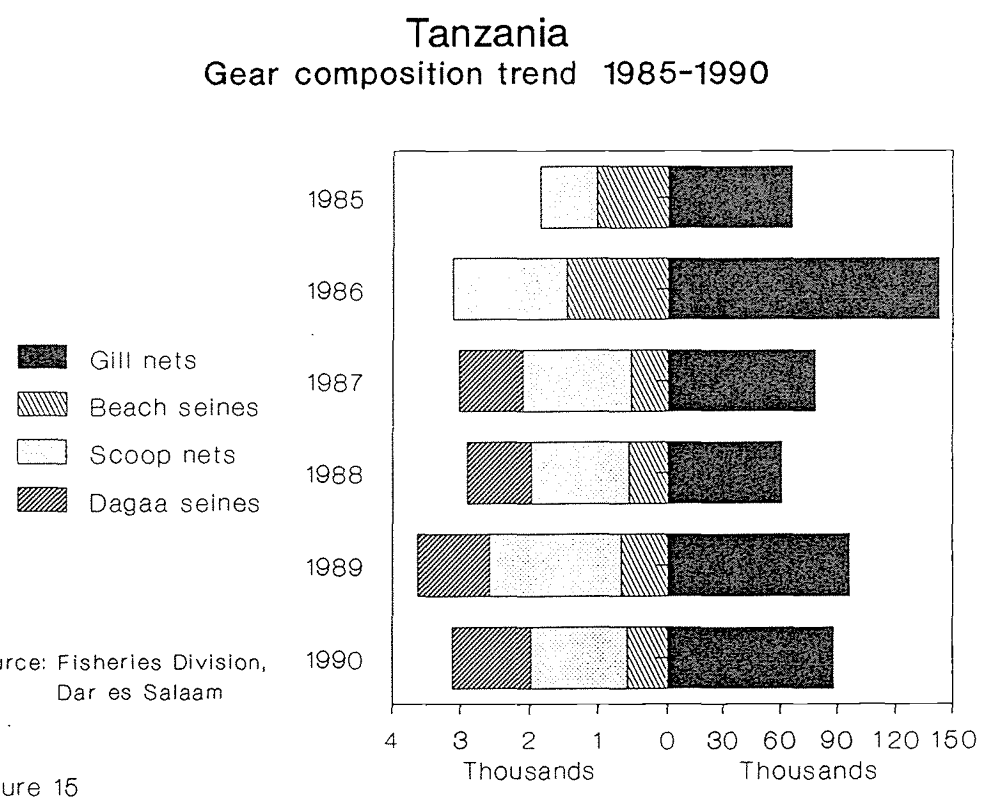
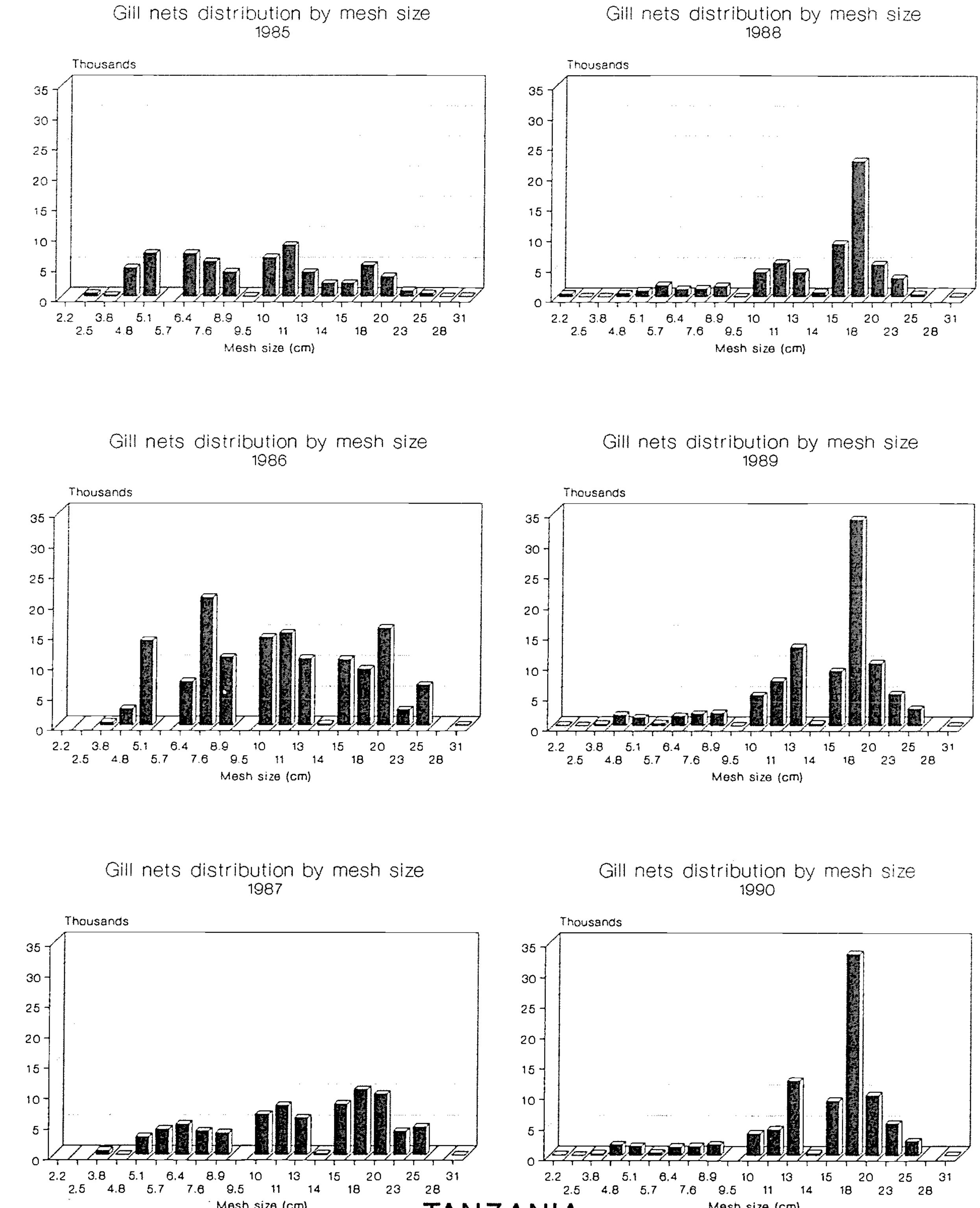


Figure 14



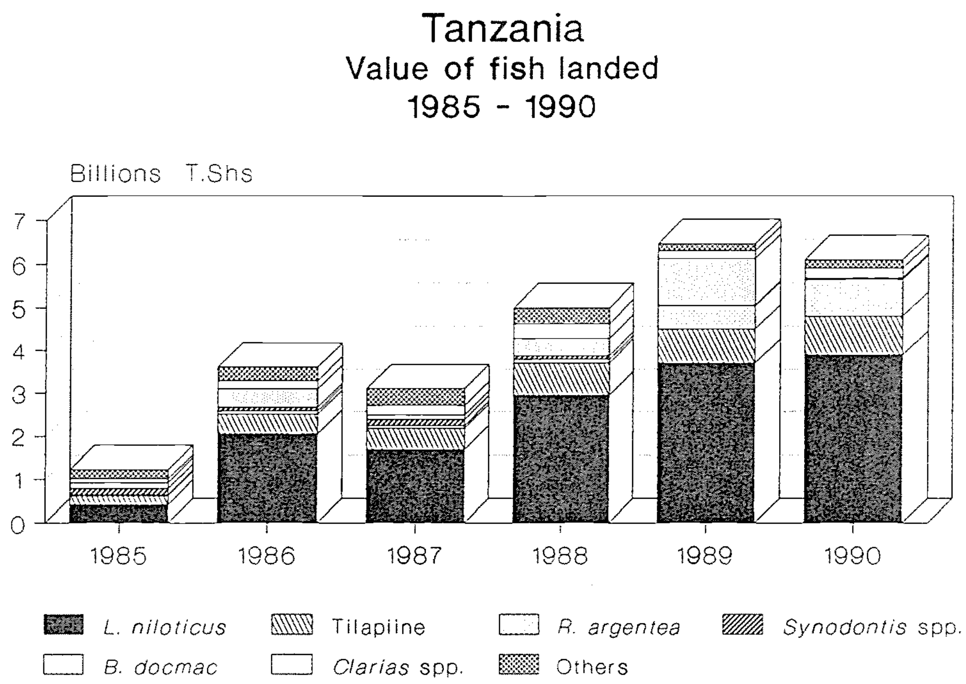
Source: Fisheries Division, Dar es Salaam

Figure 15



TANZANIA

Figure 16 **Trend in gill nets distribution by mesh size (1985/90)**



Source: Fisheries Division,
Dar es Salaam.

Figure 17

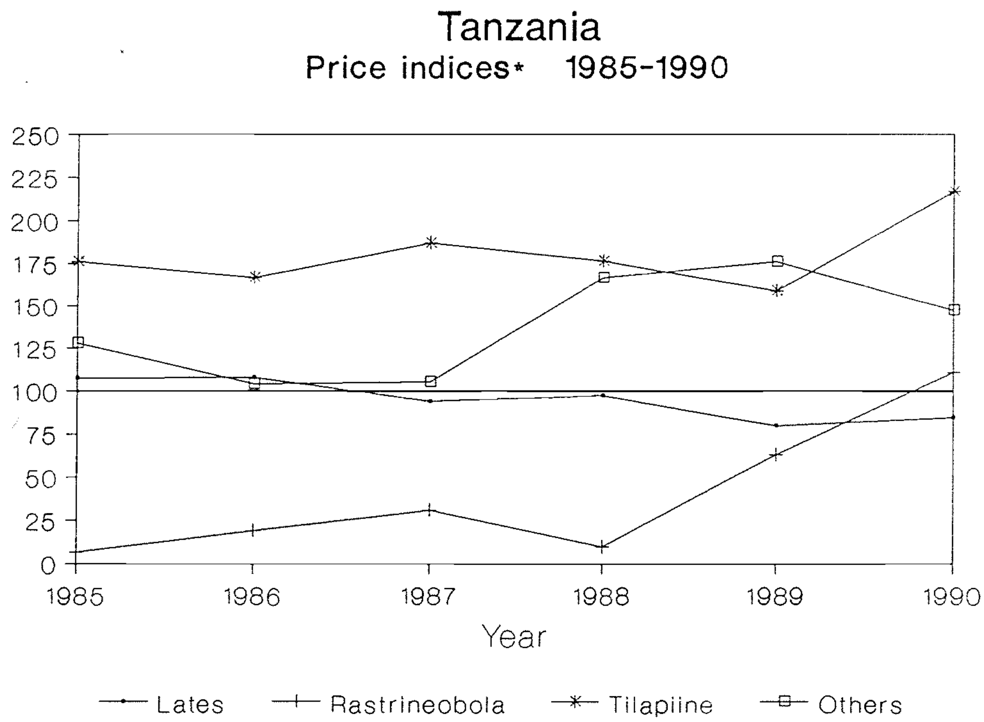


Figure 18

* Indices based on fish avg. price = 100

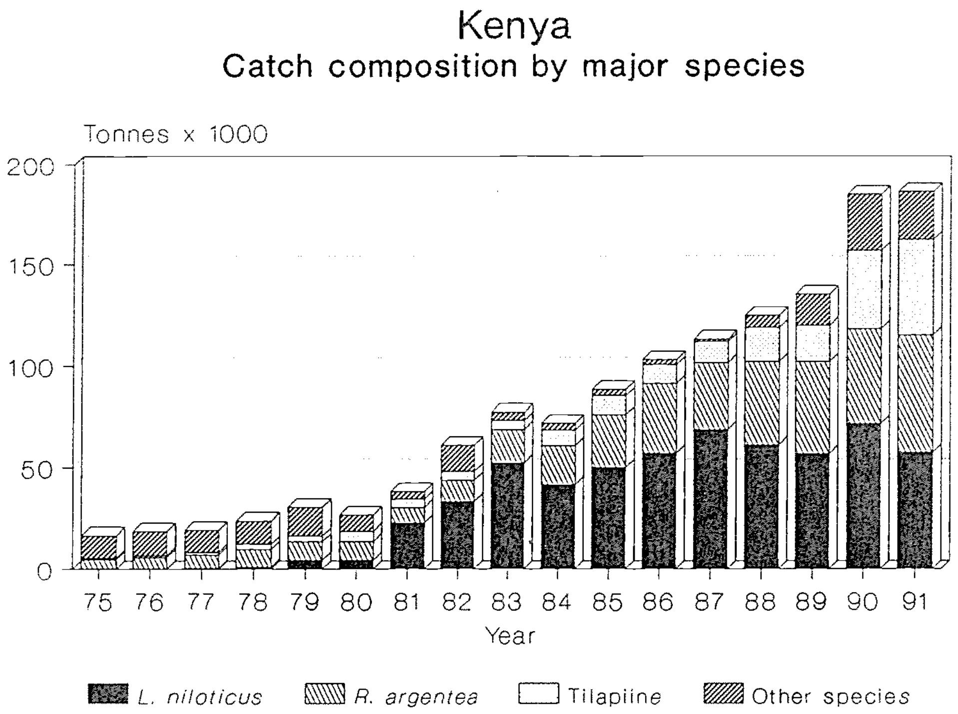


Figure 19

Source: Fisheries Department, Nairobi.

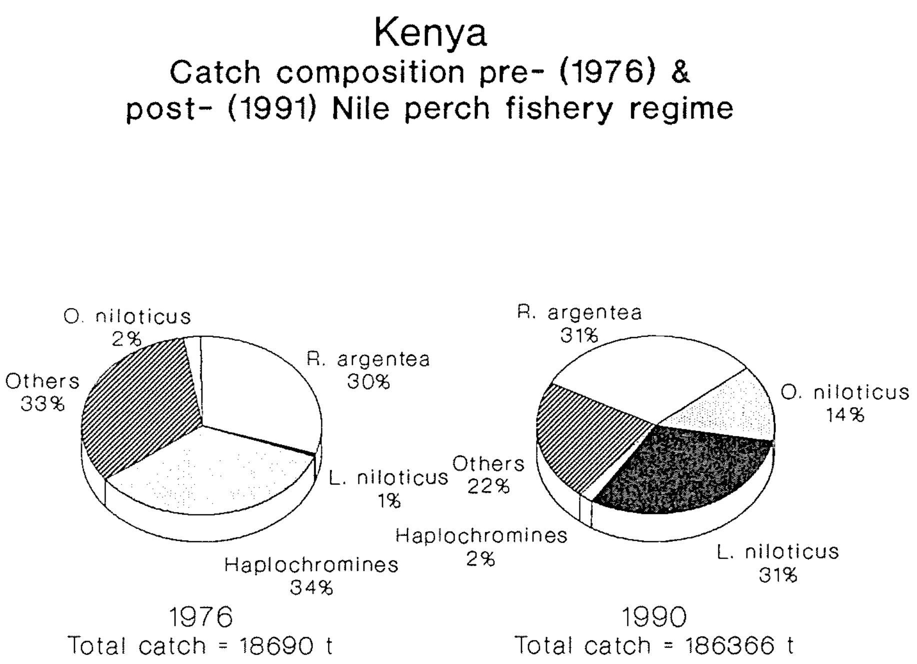
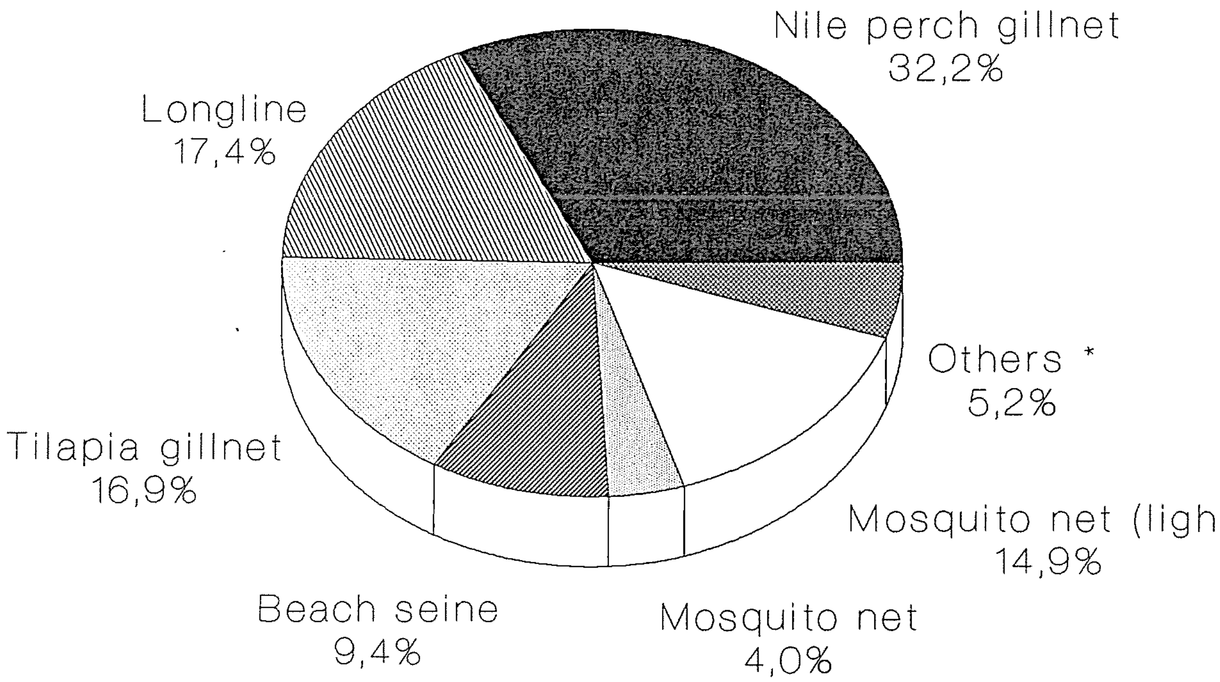


Figure 20

Kenya
Active boats by fishery type (%)
1991



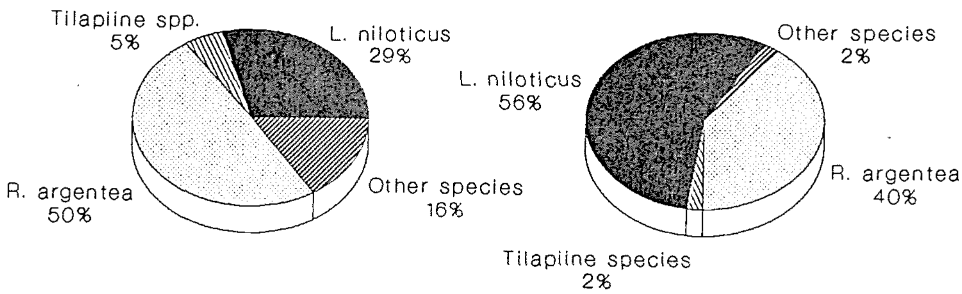
Source: Hoekstra *et al.* (1991)
* others = traps, set net, unknown gillnet, transport and unknown boats.

Figure 21

Kenya

Nyanza gulf and open water

catch composition by major spp. - 1989

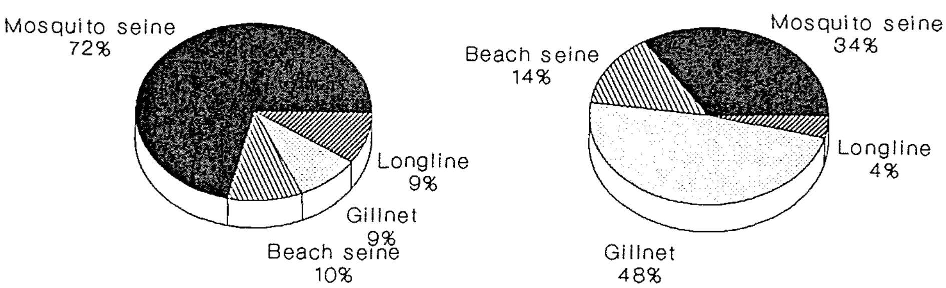


Gulf - 1669 tonnes
(11 selected landing beaches)

Open water - 13375 tonnes
(11 selected landing beaches)

Nyanza gulf and open water

catch distribution by gear - 1989



Gulf - 1669 tonnes
(11 selected landing beaches)

Open water - 13375 tonnes
(11 selected landing beaches)

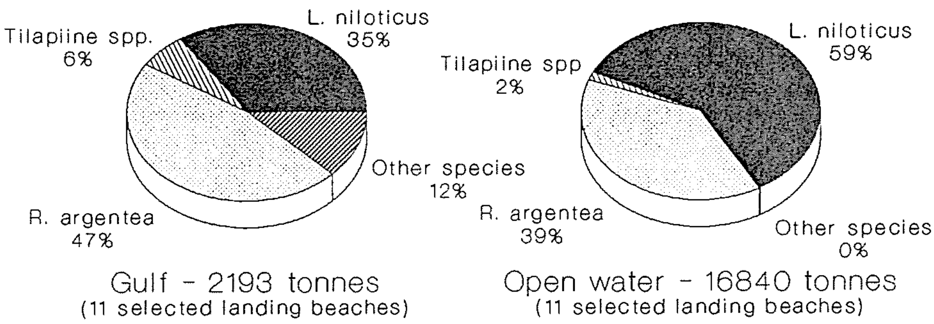
Figure 22

Source: Kenya Marine and Fisheries Research Institute, Kisumu.

Kenya

Nyanza gulf and open water

catch composition by major spp. - 1990



Nyanza gulf and open water

catch distribution by gear - 1990

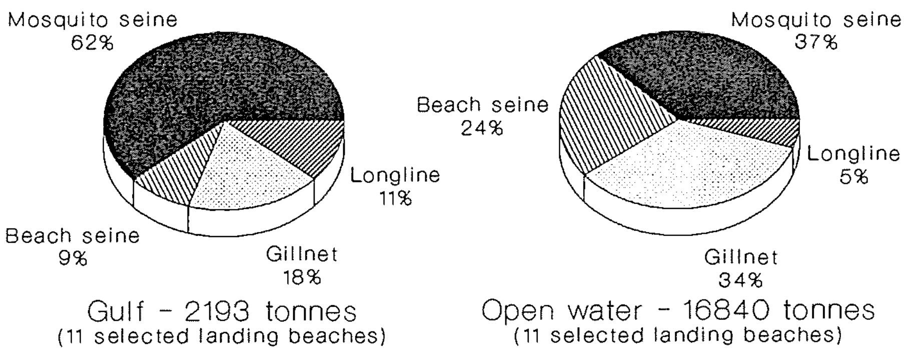


Figure 23

Source: Kenya Marine and Fisheries Research Institute, Kisumu.

Kenya
Catch rates and Effort by month
1987-1989 (22 selected landing beaches)

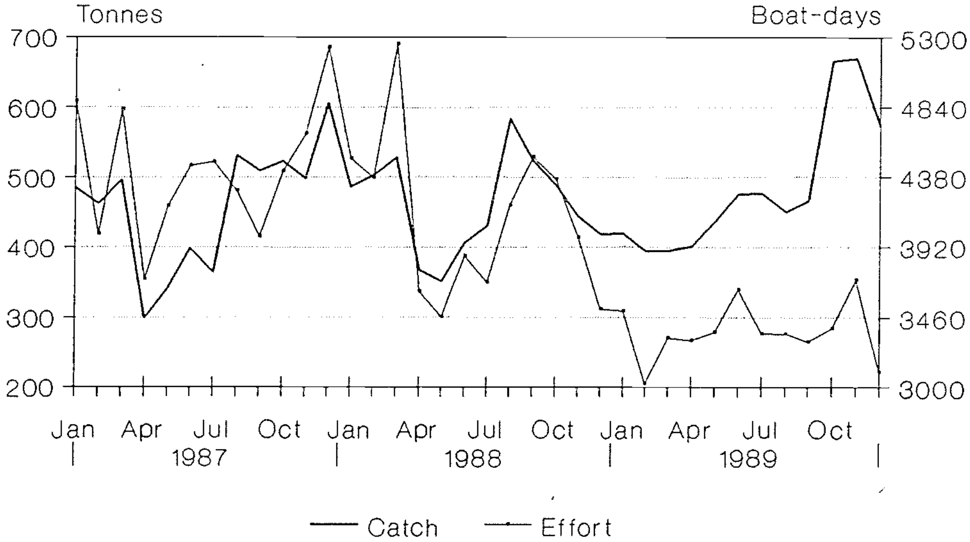


Figure 24

Source: Kenya Marine and Fisheries Research Institute, Kisumu

Kenya
CPUEs and Effort by month 1987 - 1989
(22 selected landing beaches)

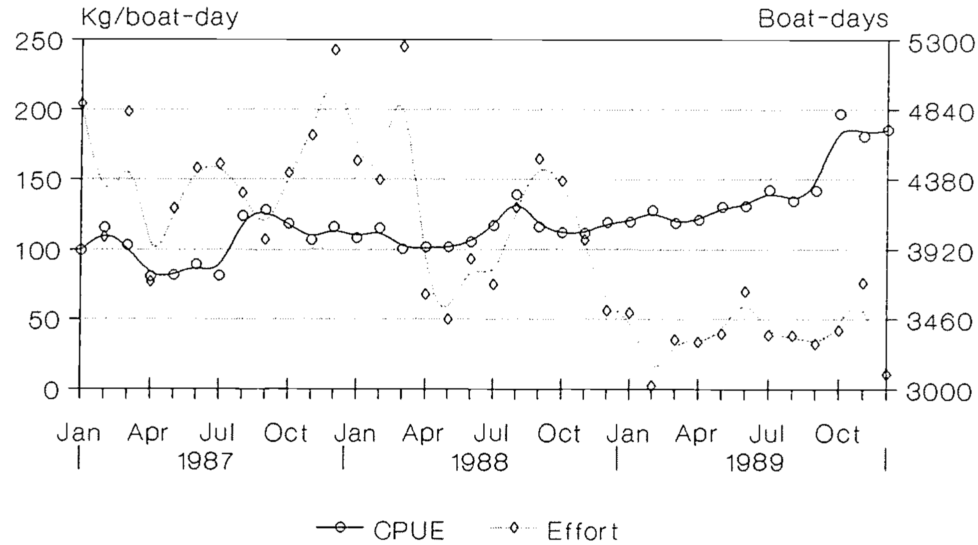


Figure 25

Source: Kenya Marine and Fisheries Research Institute, Kisumu.

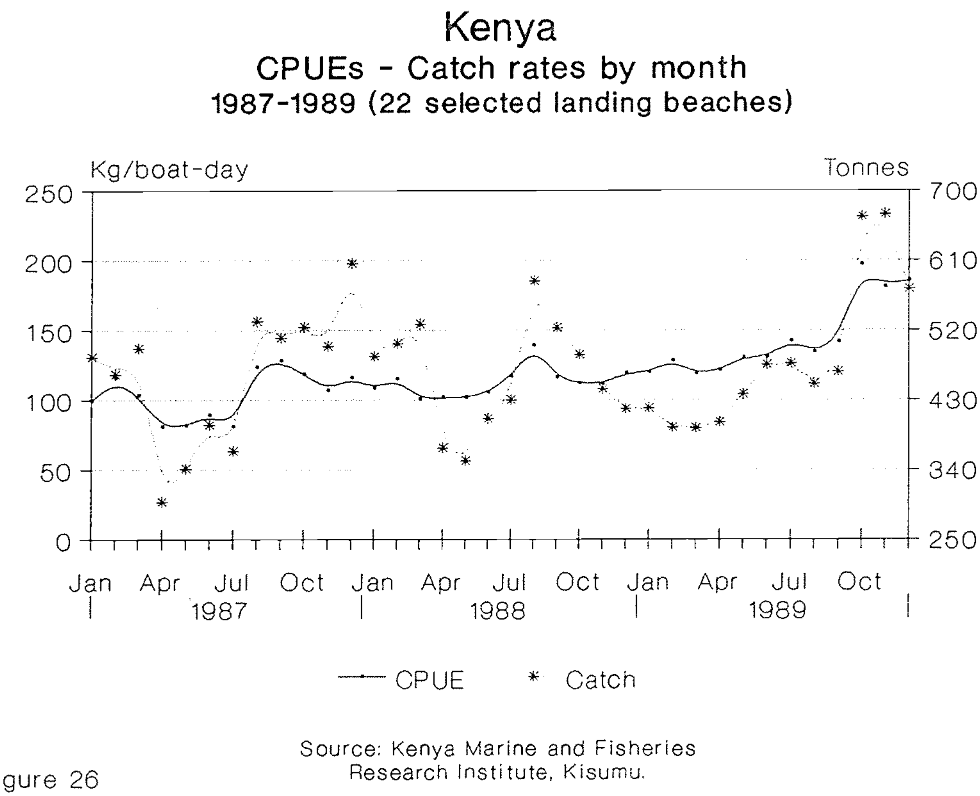


Figure 26

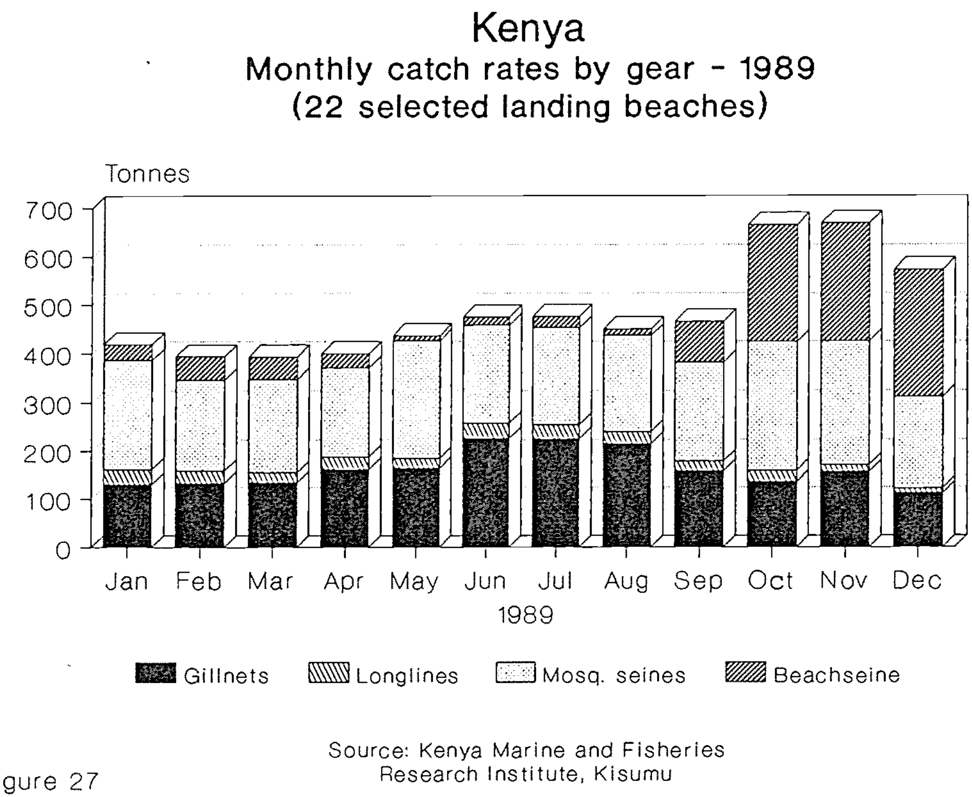


Figure 27

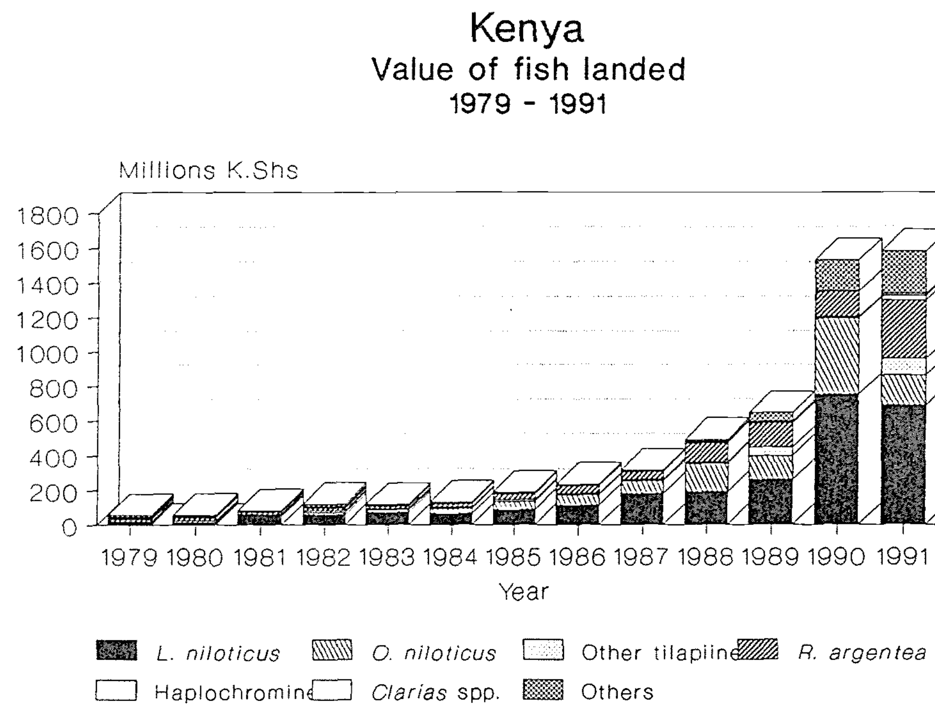


Figure 28

Source: Fisheries Department, Nairobi.

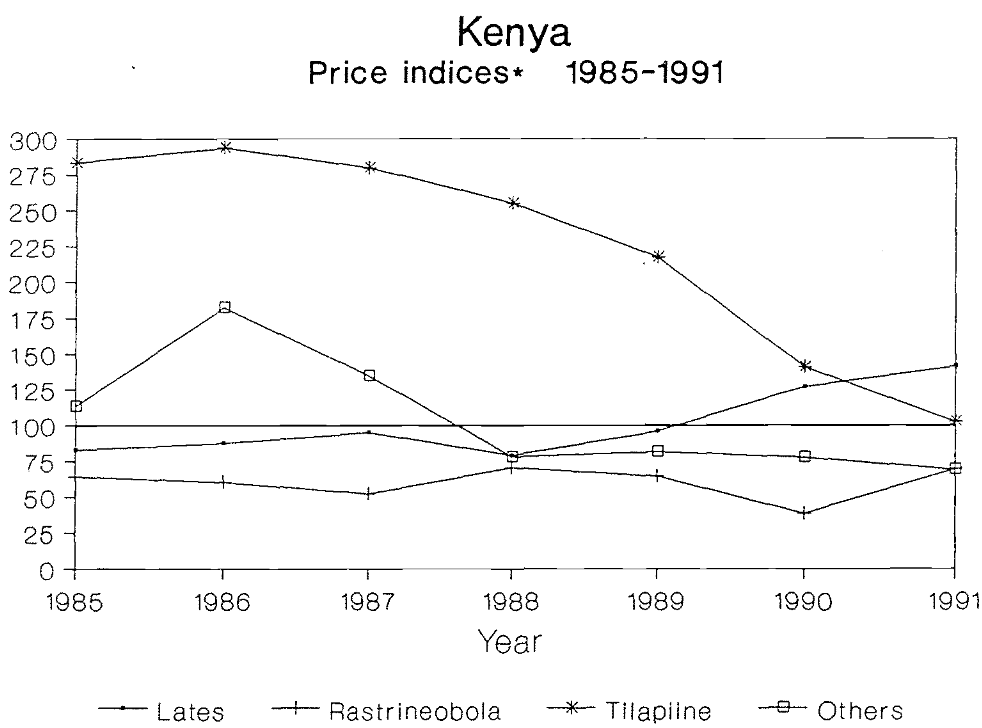


Figure 29

* Indices based on fish avg. price = 100

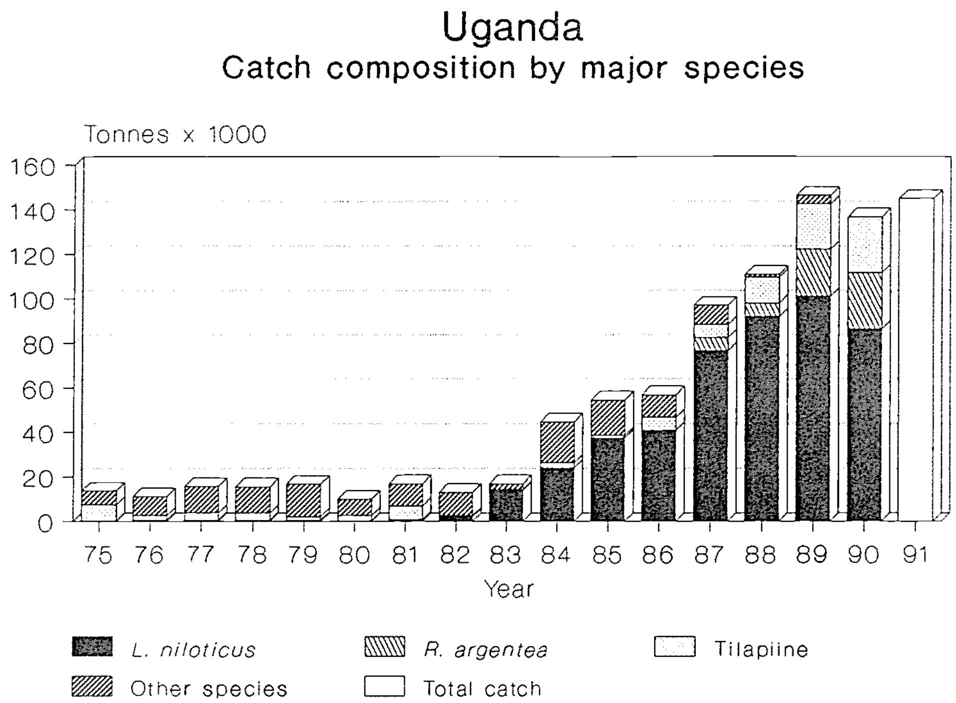


Figure 30

Source: Fisheries Department, Entebbe.

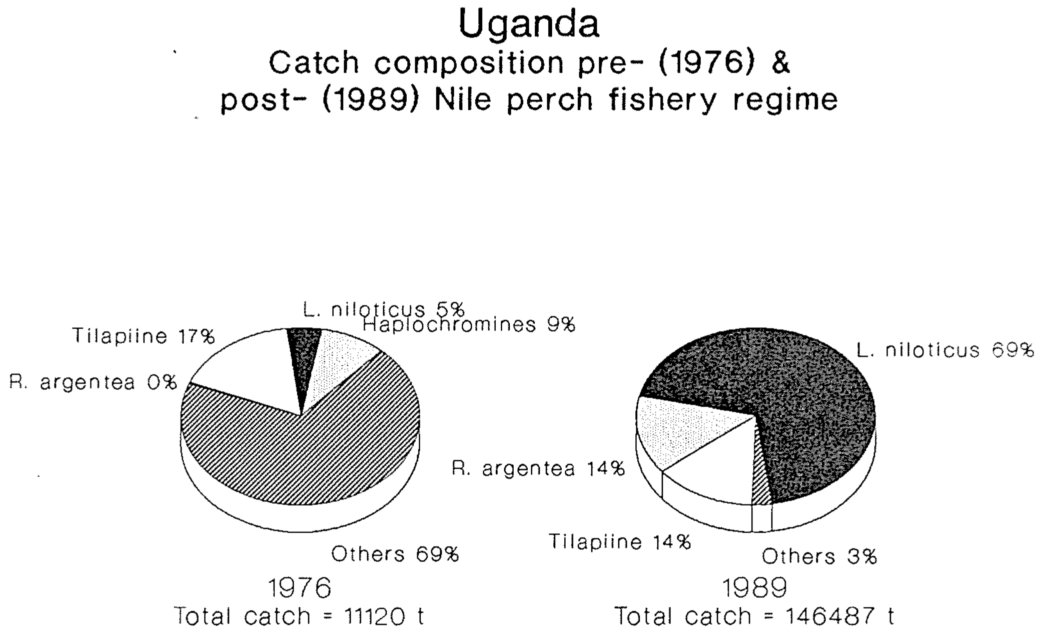


Figure 31

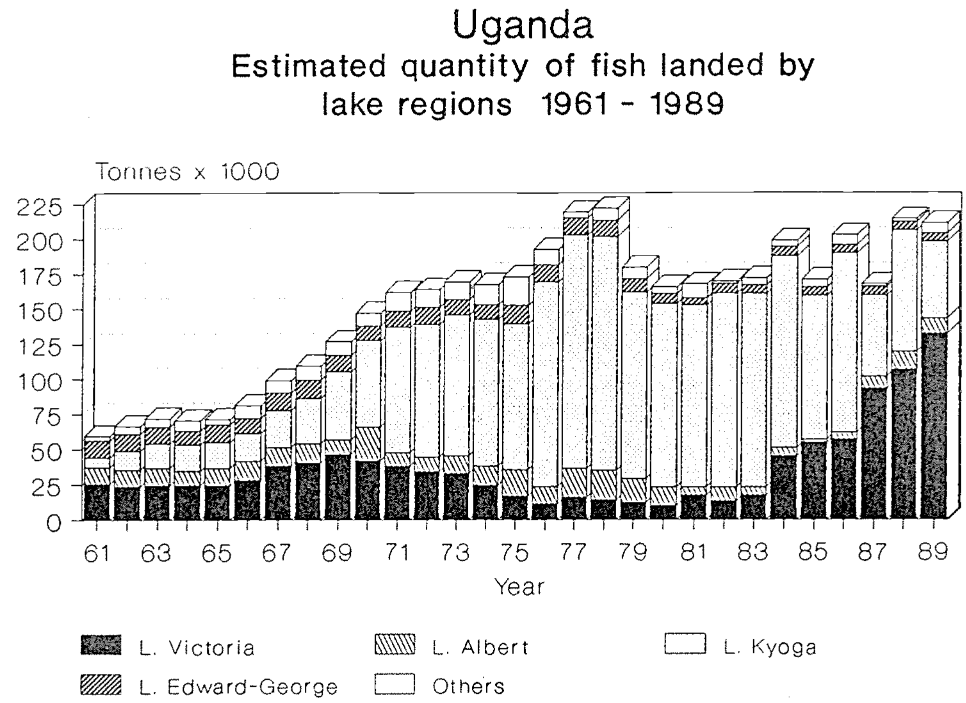


Figure 32 Source: Fisheries Department, Entebbe.

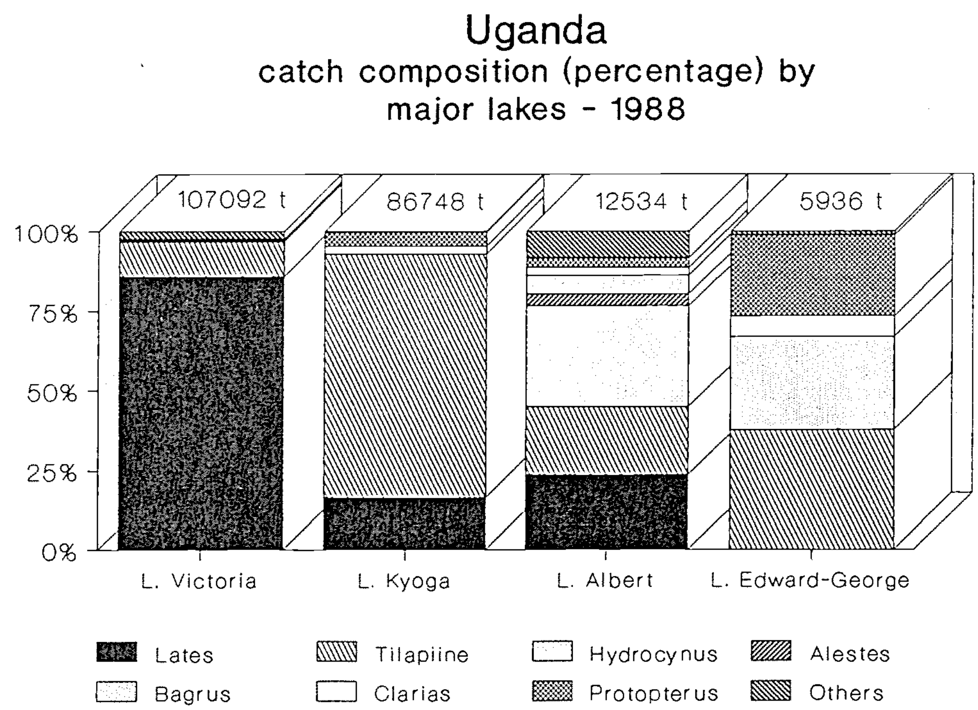


Figure 33 Source: Fisheries Department, Entebbe.

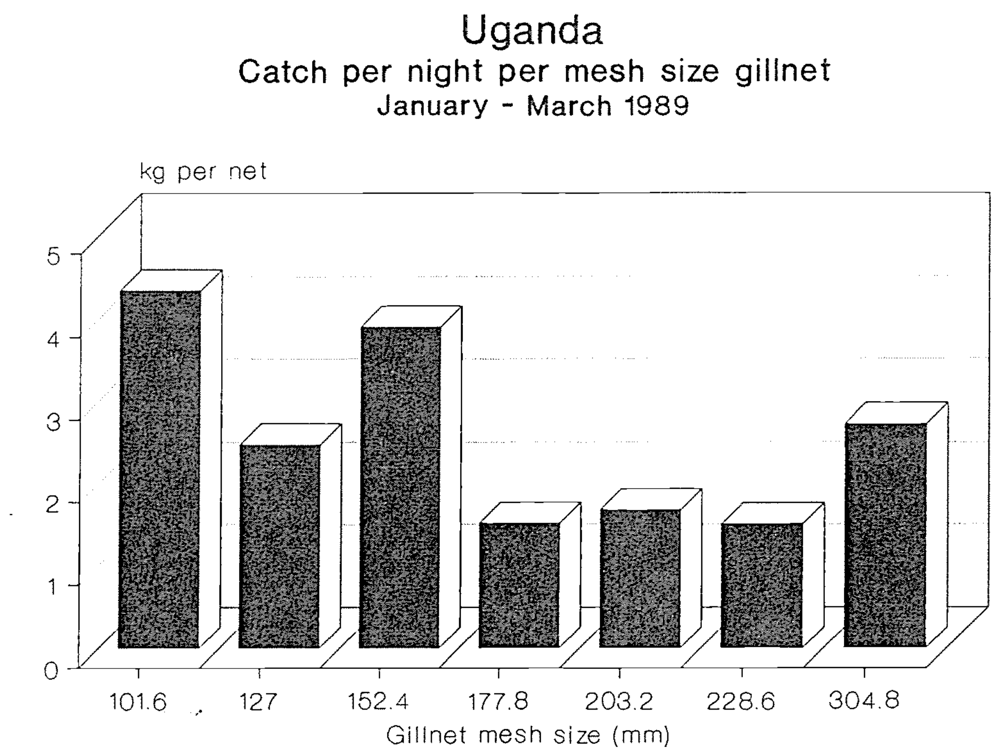


Figure 34 Source: Okaronon and Kamany (1990).

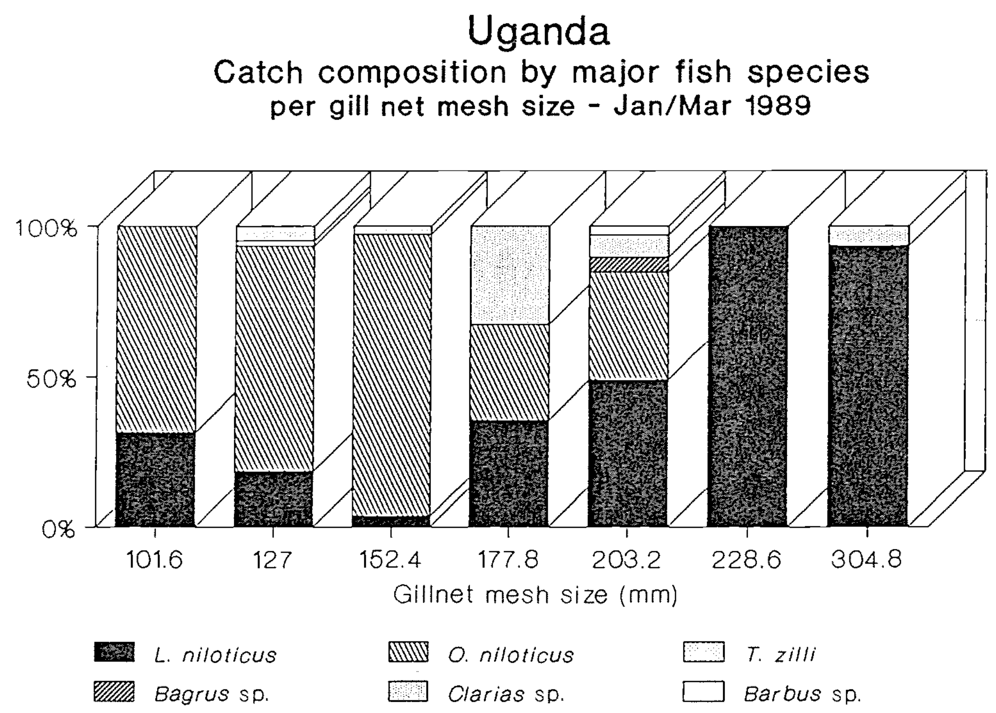


Figure 35 Source: Okaronon and Kamany (1990).

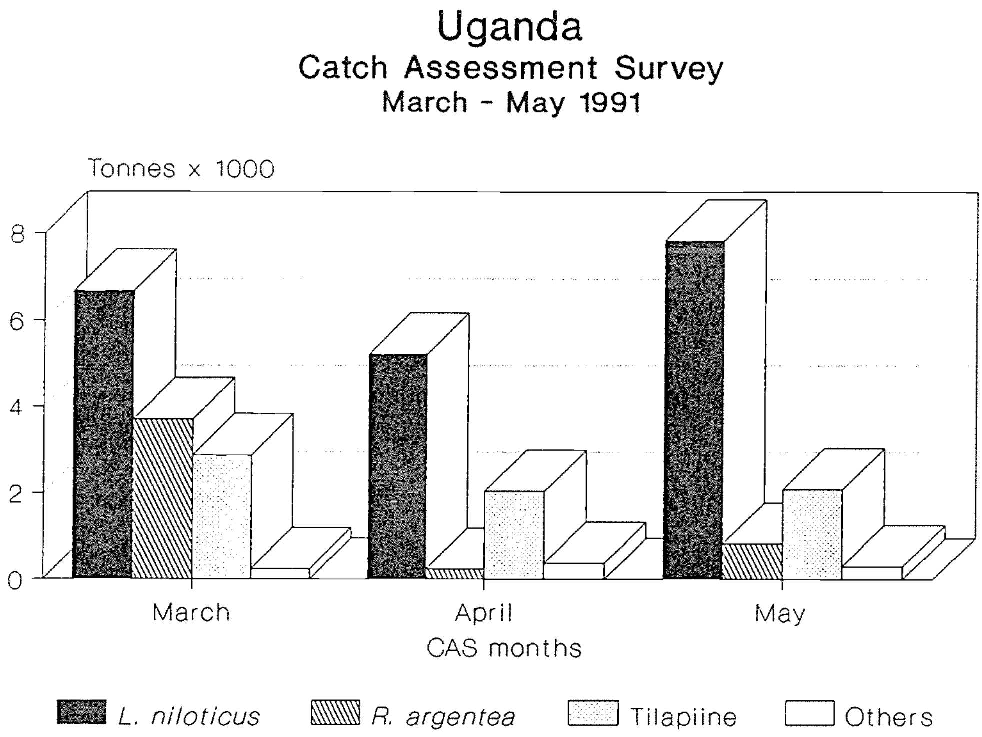


Figure 36

Source: Coenen (1991).

APPENDIX 1

The water hyacinth threat in Lake Victoria

Water hyacinth (Eichornia crassipes) is nowadays the most important exotic water weed in Africa. Its native area is the river systems of South America. Water hyacinth was first introduced in Egypt (1880) and South Africa (1910) then it spread progressively in Zimbabwe, Mozambique, Zaire River, White Nile and Senegal. In the 1980s the weed appeared on Lake Kyoga (Uganda) and Lake Naivasha (Kenya), and in 1990 dense mats of the weed were reported from the tanzanian and ugandan sectors of Lake Victoria.

The recent invasion and rapid spreading of water hyacinth cause strong concern among scientists and water resources managers. One reason is because, again, an exotic species is now interacting with a lacustrine ecosystem which has been going through drastic ecological changes during the last twenty years. Secondly, water hyacinth has been extensively reported to have marked negative impact both at the ecosystem and human activities level. Navigation, silting, water conservation, fishing, irrigation, disease transmission and biodiversity are all affected by the weed's proliferation.

Water hyacinth induces the precipitation of suspended particles by slowing the flow of water. The impressive biomass that it can reach produces large amounts of detritus contributing to establish local oxygen deficiency and anaerobic conditions which are direct causes of fish death. Large mats of water hyacinth constrain navigation and fishing operations. Water chemistry is directly affected in terms of increase in CO_2 concentration and suspended solids, and decrease of oxygen concentration, conductance and pH.

Water hyacinth has a fast growth rate requiring the use of large quantities of nitrogen and phosphorus together with other nutrients (potassium, calcium, magnesium etc.) and elements (aluminum, boron etc.). The direct negative effect is that these nutrients are not available for phytoplankton's growth, thus reducing secondary and tertiary production (i.e. zooplankton and fish stocks).

Transmission of several human diseases is facilitated by the presence of water hyacinth which develops suitable environments to the life of the snail vector of schistosomiasis and mosquito vectors of malaria and filariosis. Also the microorganism responsible for cholera epidemic, Vibrio cholera, has been reported to live well around the weed roots.

No economic assessment of the impact of water hyacinth has been carried out mainly because it is quite a recent problem whose effects are difficult to quantify. Its utilization does not seem to be economically feasible and the overall negative consequences of the weed occurrence stress more the need of strict control rather than of its utilization.

There are three approaches to control water hyacinth proliferation: physical, chemical and biological control.

Physical control is expensive and implies disposal or utilization of the removed weeds. Furthermore, removal operations must be regularly repeated as water hyacinth reproduces continuously from the remaining plants in the water.

Chemical control is less expensive than the physical one but requires continuous application and has unwanted side effects on the environment (i.e. oxygen depletion and related consequences) due to decomposition of weed biomass.

Biological control, nowadays, appears to be a relatively cheap and permanent control method successfully applied in many water weed control programmes, especially against water fern (*Salvinia molesta*). Experiences in biological control of water hyacinth are not many, positive results are reported although not yet so satisfactory as in case of water fern. A careful scientific approach is the basic requisite for the maximum success of biological control application.

Water hyacinth is a new and serious potential threat to Lake Victoria and its water resources. At the present time readily established control programmes could still anticipate the weed problem rather than react to it. Besides, the international nature of Lake Victoria necessarily requires actions concerted at regional level between the riparian states to achieve positive and cost effective results.

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