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CATCH ASSESSMENT SURVEY IN ZAMBIAN WATERS
OF LAKE TANGANYIKA IN 1994

by

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PREFACE

The Research for the Management of the Fisheries on Lake Tanganyika project (LTR) became fully operational in January 1992. It is executed by the Food and Agriculture organization of the United Nations (FAO) and funded by the Finnish International Development Agency (FINNIDA) and the Arab Gulf Programme for the United Nations Development Organization (AGFUND).

LTR's objective is the determination of the biological basis for fish production on Lake Tanganyika, in order to permit the formulation of a coherent lake-wide fisheries management policy for the four riparian States (Burundi, Tanzania, Zaïre and Zambia).

Particular attention is given to the reinforcement of the skills and physical facilities of the fisheries research units in all four beneficiary countries as well as to the build-up of effective coordination mechanisms to ensure full collaboration between the Governments concerned.

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1. INTRODUCTION

Catch assessment and frame surveys were conducted in June and July 1994, along the Zambian shore of Lake Tanganyika by LTR Mpulungu (FAO) working together with the Department of Fisheries of Zambia (DOF). The findings of the frame survey are reported elsewhere (Mwape, in preparation)

The results of the catch assessment survey (CAS), for the artisanal fishery, extrapolated over the whole of 1994. Optimally, three or four CAS's should be carried out each year to get a better estimate of the catches in this part of the lake. However, due to time and money constraints, only one CAS was done in 1994. It is evident that all results should be considered with caution as it is known that the number of fishermen and catches can fluctuate widely during the year (Pearce, 1992). The catch composition presented for the whole year, by artisanal fishermen, is speculative but does indicate the general trend of the fishery.

A continuous CAS has been undertaken for all the industrial fishing units based at Mpulungu. Results are briefly described here for 1994 to compare them with the artisanal fishery.

2. ZAMBIA CAS RESULTS FOR 1994

2.1 The CAS method in Zambia

The Zambian waters were divided in four areas (Fig. 1). In each area, two fisheries assistants surveyed 9 villages. Each village was surveyed during 3 days. This work thus involved 8 people during 27 days (from 16/6/94 to 9/7/94).

Forms used by DOF in previous surveys were slightly modified for homogeneity, following the recommendations of the First Workshop on the Coordination and Standardization of Fisheries Statistics, held in July 1993 in Bujumbura and organized by LTR (Coenen, 1993b).

2.2 Definition of units of effort

The units of fishing effort used for each gear are defined as:

Kapenta seine: one draw
Beach seine : one draw
Gill net : one net of 90 m average.
Hand lines : one pull
Long lines : one line with 100 hooks
Lift net : one lift of the net
Chiromilla : one draw
Traps : one trap

2.3 Gears and catches per unit of effort

Each type of gear used and the corresponding catches per unit of effort during the 1994 CAS are presented below. Comparisons are made with previous information given by Hoekstra and Lupikisha (1992) whenever possible. More information on the gears can be found in the report dealing with the frame survey of 1994 (Mwape, in preparation).

2.3.1 Kapenta seines

A kapenta seine is a draw net, similar to a beach seine but without a cod end and made of netting with a stretched mesh size of 4–8 mm. The legal minimum mesh size is 10 mm. The average length of the kapenta seine is 90 m and is typically 10–15 m deep. The kapenta seine is the most commonly used artisanal gear. A total of 103 kapenta seines were recorded during the 1994 frame survey (Mwape, in preparation). They are used with lights during the night. The lights are paraffin pressure lamps made in China (Tilley lamps). Sometimes kapenta seines are used during the day when a shoal of fish is sighted inshore. The gear is operated by an average of 9 fishermen.

The fishermen move from one area to another following the fish. From 1 June to 5 November, the Chisanse fishing camp, situated in Nsumbu National Park, is open to the fishermen and many using kapenta and beach seines move to the camp during this period (Lukwesa, personal communication).

The kapenta seine mainly catches the two clupeids (90%) *Limnothrissa miodon* (65%) and *Stolothrissa tanganicae* (25%) (Table 1) (Kapenta is the local name in Zambia for the clupeids).

The gear is generally not used during the full moon period (about 7 nights per month). It is estimated that one gear is used for 281 nights per year. The average number of hauls per night is 1.7.

Average catch per unit of effort (CPUE) recorded during the 1994 CAS was 131 kg (Table 1). However important differences between areas were recorded at the time of the survey, average CPUE was 324 kg in area 1, 46 kg in area 2, 189 kg in area 3 and 77 kg in area 4 (Table 2).

2.3.2 Beach seines

Classical beach seines (used during the daytime) are relatively uncommon. Sixteen beach seines were recorded during the frame survey (Mwape, in preparation). This gear is operated by about 9 people. Most beach seines have a small cod end with mesh sizes of 4–8 mm. This is a substantial decrease from the 37 mm reported by Hoekstra and Lupikisha (1992). The mesh sizes on the wings are larger but they also have tended to decrease in size over recent years.

Beach seine are normally much longer than kapenta seines. The average length is 150 m and the cod end is 10–20 m. Hoekstra

and Lupikisha (1992) stated that beach seines were banned in all fisheries in Zambia except for Lake Tanganyika. The exception was based on evidence that their use was not harmful to the commercial stocks. Considering the recent use of extremely small mesh sizes, this exception seems no longer suitable for the Lake Tanganyika fishery.

The beach seines catch 'miscellaneous' fishes such as cichlids (*Lamprologus*, *Tropheus*, etc.) (34%) (Table 1). The category "others" (53%) recorded for this gear included also small cichlids that were too numerous to be separated individually (Lukwesa, personal communication).

Catch per unit of effort data show significant differences between areas. Area 1 had the highest average CPUE of 107 kg (87 kg for the category "others") compared to areas 2, 3 and 4 of 61, 11 and 7 kg respectively (Table 2). In area 2 there were large catches of cichlids (CPUE = 51 kg).

The average number of hauls per day is 1.9. considering the time taken for rest (estimated to be 4 days per month), the number of days of operation for the beach seine per year is 317 days.

2.3.3 Gill nets

Gill nets are commonly used in the Zambian waters of Lake Tanganyika. The number recorded during the 1994 frame survey was 1113 (Mwape, in preparation). Gill nets are sold in standard lengths of 90 m but fishermen often modify the nets by cutting or joining them. Gill nets are usually set on the bottom overnight. A wide range of mesh sizes is in use from 50 mm to 250+ mm (Hoekstra and Lupikisha, 1992).

Another way of employing the gill nets is the method locally referred to as "Ukutumpula" which consists of laying the nets in circles and frightening the fish into them. This method is uncommon because of the unsuitable nature of the coastline and depth of water and it is also illegal in Zambia. Accurate figures of how widespread it is practiced are unobtainable.

Gill net CPUEs (Table 1) show that a variety of fishes is caught by gill nets. The category "others" accounts for 53%, *Hemibathes* (19%), *Lates mariae* (9%), *Clarias* spp (6%), Bagridae (5%) , etc.

From June to July, gill net fishermen from Kassakalawe and Kapoko move to Mbita Island because they can obtain good catches of *Hemibathes* (locally called mpande) at this time of the year (Lukwesa, personal communication).

The gill nets are fished throughout the year and, after subtracting days of rest, each net is used about 317 nights per year. We recorded an average of 3 nets per fishermen. An average of 2.3 fishermen operate together but there are differences between areas, 1.7 fishermen in area one, 3.1 in area two, 1.8 in area three and 2.8 in area four. Concentrations of fishermen seem to be linked with the density of the population and the

availability of workers.

2.3.4 Hand lines

Hand lines are particularly long in Zambian waters. They have several hooks, the average is 14 hooks. A hand line is generally used during the day but night fishing near a light is sometimes carried out. The bait is generally clupeid fish. Seventy one hand lines were recorded during the frame survey of 1994 (Mwape, in preparation).

From the CAS in 1994, it was observed that hand lines caught mainly *Lates stappersii* (63%), miscellaneous cichlids (16%), *Boulengerochromis* (12%), *Bathybates* (8%) and *L. mariae* (2%). However, it is known that the main species generally caught by hand lines are *Cyphotilapia frontosa* and *Boulengerochromis*. *C. frontosa* is particularly fished by hand line near Mutondwe Island where fishermen operate over a deep rocky bottom (Hoekstra and Lupikisha, 1992) but this species is commonly caught by hand lines in other areas as well (Mwape, personal communication). It would appear that the CAS of 1994 is not representative of the species composition normally caught by hand lines. This is probably due to the low number of hand lines sampled during this survey.

Sometimes, many more hooks are used (up to 80) and *L. stappersii* is then an important targeted species with this gear. This is not common however (Mwape, personal communication).

Hand lines are used throughout the year (Milindi and Chomba, personal communication).

2.3.5 Long lines

Not many long lines are fished. They are generally left in the water for a day. No use of long lines were recorded during the CAS of 1994. They are probably used in other places and during other periods than those investigated in the CAS of 1994. Mwape (in preparation) notes that 16 long lines were recorded during the frame survey.

2.3.6 Lift nets

Lift nets which are popular in other parts of Lake Tanganyika began to be fished in Zambian waters in 1986 after being promoted by DOF. About 20 units were developed before the technique was more or less abandoned. Only 8 units were recorded during the 1994 frame survey (Mwape, in preparation). However at some times of the year many lift nets (30 to 40 observed units), apparently coming from Tanzania, are fishing in Zambian waters. This was observed in August 1994 mainly between Mutondwe and Mbita Islands (personal observation). There were large shoals of clupeids in the area as observed by night dives during the same period (Verburg, personal communication) and shrimps were particularly numerous near the surface during the night. This was the dry season, characterized by a southerly wind, upwelling, nutrient increase, lower transparency and higher catches of clupeids (Plisnier *et al.*, in preparation). The gear

has generated a lot of discussion among fishermen over its advantages or disadvantages compared to the normal kapenta seine (Hoekstra and Lupikisha, 1992). The cost of its operation might be a reason for it not being fully adopted in Zambia (Mwape, personal communication).

The lift nets surveyed during the 1994 CAS caught exclusively clupeids, *L. miodon* (69%) and *S. tanganicae* (31%).

There are an average of 4 draws of the lift net per night. As the lift net does not operate during a full moon, a gear of this type is estimated to be used about 281 nights per year.

2.3.7 Traps

Traps of various types are fished. The most common type is small and is laid in shallow water to catch small littoral cichlids. Another trap, called the "Chisowe", is suspended in midwater with a bait of grass or reeds. This trap specifically targets *Dinotopterus cunningtoni* which may find the vegetation a suitable substrate for laying eggs on (Hoekstra and Lupikisha, 1992). Traps were not recorded during the 1994 CAS.

2.3.8 Chiromilla nets

The Chiromilla net is a type of seine used generally in open water. It does not have rings the bottom of the net. The chiromilla net can be an efficient gear as sometimes one tonne of fish can be caught in one night (Chomba, personal communication). However a low number of gears (8 units) was counted during the frame survey (Mwape, in preparation).

The species caught by the Chiromilla net during the CAS survey of 1994 were exclusively *L. miodon* (50%) and *S. tanganicae* (49%) (Table 1)

The average number of draws of the Chiromilla net per night is 4.3 and the gear is used for about 281 nights a year (no fishing during full moon periods).

3. TOTAL CATCHES IN 1994

3.1 Artisanal fishery

Extrapolation of the results from one survey to the whole year can only provide very approximate estimates of catches as observed by Pearce (1992). Since no other CAS are available for 1994, the survey provides the only possible data although its limitations must be remembered. The catches of the artisanal fishery are therefore approximate. It is probable that an overestimation has been made since the month of June had higher catches of clupeids and was generally a good fishing period for these fish. Future CAS on a weekly basis (3 times per week near Mpulungu) would enable a better estimation of the actual level of artisanal catches in this part of the lake.

An estimate of the total catch by artisanal fishermen, based on the CPUE (Table 2), was 9104 tonnes for 1994. However, the frame survey has recently shown a reduction in artisanal fishermen numbers and gears (Mwape, in preparation).

Details of total catches from each gear are given in Table 3 and Fig. 2. The artisanal fishery represented 73% of all catches in Zambia (Table 4 and Fig. 3). The dominant species caught was *L. miodon* (3973 tonnes or 42% of the total artisanal catches) followed by *S. tanganicae* (1964 tonnes or 22%). The clupeid catch represented 63% of the total artisanal catches. It is possible that catches of *S. tanganicae* in particular are overestimated. However, the percentage of clupeids (63%) is lower than previously reported, 78% in 1992 and 73% in 1980 (Lupikisha, 1993). The fluctuations in number of clupeids during the year can be important. The catch of category "others" was 1878 tonnes (21%). Other species are less important such as *Hemibathes* (423 tonnes, 5%), others cichlids (351 tonnes, 4%), *Lates angustifrons* and *L. mariae* (216 tonnes, 2%).

There was greater yearly variation in artisanal total catches than in industrial catches (Fig. 3).

3.2 Industrial fishery

Total catches of the industrial fisheries have been decreasing since 1989 (Fig. 3).

The total catch from the industrial fishery (boats based in Mpulungu) was 3298 tonnes in 1994. The fishery is almost monospecific, as the main species targeted is *L. stappersii* (3176 tonnes or 96%). Only 67 tonnes of clupeids were caught by industrial fishery in 1994 (2% of the industrial catch). The details of clupeid catches in 1994 have been extrapolated from the percentage composition recorded during September to December 1994 only. They show that *L. miodon* is the main clupeid caught by the industrial fishery. The fishing companies of Mpulungu do not target clupeids since their abundance is generally low in Zambian pelagic waters. Low abundance and the behaviour of fishermen probably account together for the small catches in the area.

A few others species are caught, *L. angustifrons* and *L. mariae* (29 tonnes or 0.9%), *Lates microlepis* (8 tonnes or 0.2%). Others fishes account for only 17 tonnes (0.5%) (Table 3).

4. DISCUSSION

The target species are different between the artisanal and industrial fishermen. The clupeids, particularly *L. miodon*, are mainly caught by the artisanal fishermen, along the coast with kapenta seines, while *L. stappersii* is the major species captured by industrial fishing using purse seines in pelagic areas. Both types of fishing are carried out at night and usually with the aid of light attraction.

The industrial fishery produces about 3 times less in total catch by weight than the artisanal fishery (3298 tonnes compared to 9104 tonnes). It is still a very significant component of the Zambian fisheries, especially when compared to the decline of industrial fishing in northern parts of the lake (Coenen *et al*, 1994). There has been a disturbingly large increase in the fishing effort of the industrial fishery in Zambian waters in the last few years. The number of industrial fishing vessels has reached 30 units. Out of these, only 24 were fishing in 1994 and on an average night only 19 were active (Mwape, personal communication). In 1991 only 13 units were recorded (Pearce, 1992). If all units were active, this means that the industrial effort has increased by a factor of 2.3 since 1991 in Zambian waters.

The decrease of mesh size of kapenta seines could have a direct negative effect on clupeid abundance because there is now strong selection for juveniles thus reducing the future, potential, spawning population. Nevertheless, it should be remembered that recruitment success of small pelagic species (which often have high fecundity) is often strongly influenced by natural causes such as predation, food availability and an environment favourable to reproduction in general.

Indirectly, the fishing of juvenile clupeids by kapenta seines might affect the food of *L. stappersii*, the main target of the industrial fishery. However, it seems that in the south of the lake, near Mpulungu, the shrimps are a more important food item for *L. stappersii*. The decreasing catches per unit of effort of these predators may not be related to the reduced number of clupeids caused by artisanal fishing.

Banning of kapenta seines made of small mesh sizes (below those authorised) should be enforced as these gears are generally destructive, inappropriate for sustainable exploitation and it would be a wise measure for the protection of the clupeids. These fishes should be caught at the adult stage by alternative fishing methods such as Chiromilla, purse seine or lift nets. Importation of illegal nets should also be stopped. The mesh sizes in use in 1994 and the legal mesh sizes are summarised as follows:

Gears	Mesh size in use (mm)	Minimum authorised mesh size (mm)
Kapenta seine	4-6-8	10
Beach seine cod end sides	4-6-	10
	8-10-12-37-50	10

Table 5: Comparison of mesh sizes used and authorised in 1994 for kapenta seines and beach seines in Zambian waters of Lake Tanganyika (bold figures indicate common sizes).

The beach seines are used with a much smaller cod end now than historically (Table 5). Even if these beach (4 to 8 mm)

seines do not appear harmful for clupeids, because they are mainly used by day, they are threatening the biodiversity of cichlids especially when some populations have very restricted habitats. The use of beach seines should be strongly discouraged and if possible forbidden. It would help conserve the biodiversity of Lake Tanganyika, for which there is world interest and concern, and might in turn expand the economy by encouraging tourism. Alternative, more appropriate techniques do exist and education of fishermen should be undertaken as well as exchanging existing, illegal gears with authorised ones.

5. SUMMARY

The artisanal fish catch was estimated at 9104 tonnes in 1994. This is about 3 times more than that from the industrial fishery of 3298 tonnes.

Artisanal fishing is coastal for most of the year. The main species caught are the clupeids, locally called kapenta. Among these, *L. miodon* is mainly fished by the Zambian artisanal fishermen (3793 tonnes or 42%). The catches of *S. tanganyicae* were 1964 tonnes (22%) in 1994 but this weight could be overestimated. Interannual fluctuations of this species are particularly well marked in the artisanal fishery.

The industrial fishery is generally pelagic. The target species is almost exclusively *L. stappersii* (96%). Clupeids used to be fished more intensively by industrial fishermen but the abundance of *S. tanganyicae* has decreased in recent years.

The main problem concerning the artisanal fishery is the use of beach seines with small mesh sized cod-ends. Smaller mesh sizes (4, 6 and 8 mm) than used historically for both beach, fished during the day, and kapenta seines, fished at night, are increasingly being employed. Juveniles of clupeids and other species are often caught. It is highly advisable that this technique should be banned, if possible. Education of fishermen and alternative ways of fishing could forerun an eventual strict control of these destructive gears. Cooperation of the fishermen is essential.

The main problem of the industrial fishery is the increase of fishing units, by a factor of 2.3 in three years. The catch per unit of effort has fallen from 1989 to 1994. Strict measures are required to insure the sustainability of the fishery. As recommended by Pearce, the number of units should not increase further. Some boats could be directed towards less heavily exploited fishing grounds such as at Nsumbu. A collapse of the industrial fishery would be very harmful, not only for availability of food but also for the subsistence of many workers, their families and the persons associated in the distribution and marketing of the fishes in Zambia. Such a collapse has actually been observed in Burundi.

The artisanal and industrial fisheries are among the most important economical activities of the Northern Province of Zambia. The development of this part of Zambia could be

adequately supported by a rational exploitation of the fish resources of Lake Tanganyika on a regional and national level.

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	Kapenta seine		Beach seine		Gill nets		Hand lines		Lift nets		Chiromilla	
	CPUE	%	CPUE	%	CPUE	%	CPUE	%	All	%	All	%
<i>Lates stappersii</i>	0.10	0.1	0.04	0.1	0.00	0.1	1.78	62.8	0.00	0.0	0.00	0.0
<i>Lates microlepis</i>	0.03	0.0	0.1	0.1	0.02	0.6	0.00	0.0	0.00	0.0	0.00	0.0
<i>Lates mariae</i>	0.04	0.0	0.51	0.7	0.37	8.5	0.06	2.0	0.00	0.0	0.00	0.0
<i>Lates angustifrons</i>	0.14	0.1	0.7	1.0	0.12	2.8	0.00	0.0	0.00	0.0	0.3	0.5
<i>Stolothrissa</i>	32.92	25.1	0.00	0.0	0.00	0.0	0.00	0.0	2.63	30.9	27.99	49.2
<i>Limnothrissa</i>	85.66	65.2	0.00	0.0	0.00	0.0	0.00	0.0	5.89	69.1	28.54	50.2
<i>Tilapia spp</i>	0.05	0.0	1.08	1.5	0.02	0.5	0.00	0.0	0.00	0.0	0.00	0.0
<i>Boulengerochromis</i>	1.07	0.8	3.87	5.5	0.05	1.1	0.32	11.5	0.00	0.0	0.00	0.0
<i>Cyphotilapia frontosa</i>	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Bathybathes</i>	0.23	0.2	0.44	0.6	0.08	1.9	0.21	7.5	0.00	0.0	0.00	0.0
<i>Hemibathes</i>	0.11	0.1	0.24	0.3	0.83	18.9	0.00	0.0	0.00	0.0	0.00	0.0
Others cichlids	1.80	1.4	24.12	34.3	0.13	3.0	0.46	16.2	0.00	0.0	0.00	0.0
<i>Clarias spp</i>	0.02	0.0	0.57	0.8	0.26	5.9	0.00	0.0	0.00	0.0	0.00	0.0
Bagridae	0.01	0.0	1.38	2.0	0.2	4.6	0.00	0.0	0.00	0.0	0.00	0.0
Others	9.11	6.9	37.33	53.1	2.29	52.1	0.00	0.0	0.00	0.0	0.00	0.0
Total	131.3	100.0	70.36	100.0	4.39	100.0	2.83	100.0	8.53	100.0	56.82	100.0

Table 1: Catch per unit of effort (kg/unit and %) for the main types of artisanal gear surveyed during the catch assessment survey of 1994 along the Zambian coast of Lake Tanganyika .

CPUE - gill nets (gear N°11)						CPUE - Kapenta seine with light (gear n° 72)					
	Area						Area				
	All	1	2	3	4		All	1	2	3	4
<i>Lates stappersii</i>	0.00	0.03	0.00	0.00	0.00	<i>Lates stappersii</i>	0.10	0.00	0.05	0.32	0.00
<i>Lates microlepis</i>	0.02	0.07	0.00	0.00	0.13	<i>Lates microlepis</i>	0.03	0.29	0.00	0.00	0.00
<i>Lates mariae</i>	0.37	0.15	0.36	0.79	0.34	<i>Lates mariae</i>	0.04	0.29	0.00	0.04	0.00
<i>Lates angustifrons</i>	0.12	0.00	0.15	0.02	0.34	<i>Lates angustifrons</i>	0.14	1.39	0.00	0.00	0.00
<i>Stolothrissa</i>	0.00	0.00	0.00	0.00	0.00	<i>Stolothrissa</i>	32.92	06.58	5.66	77.58	10.60
<i>Limnothrissa</i>	0.00	0.00	0.00	0.00	0.00	<i>Limnothrissa</i>	85.66	18.42	29.69	07.23	66.26
<i>Tilapia spp</i>	0.02	0.09	0.00	0.03	0.00	<i>Tilapia spp</i>	0.05	0.45	0.00	0.03	0.00
<i>Boulengerochromis</i>	0.05	0.13	0.02	0.02	0.10	<i>Boulengerochromis</i>	1.07	4.73	4.35	0.19	0.19
<i>photilapia frontosa</i>	0.00	0.00	0.00	0.00	0.00	<i>Cyphotilapia frontosa</i>	0.01	0.00	0.00	0.00	0.01
<i>Bathybathes</i>	0.08	0.12	0.02	0.14	0.38	<i>Bathybathes</i>	0.23	0.79	0.04	0.5	0.01
<i>Hemibathes</i>	0.83	0.09	0.85	0.25	2.84	<i>Hemibathes</i>	0.11	1.08	0.00	0.00	0.00
Others cichlids	0.13	0.37	0.05	0.22	0.07	Others cichlids	1.80	1.23	5.82	3.46	0.19
<i>Clarias spp</i>	0.26	0.17	0.34	0.07	0.18	<i>Clarias spp</i>	0.02	0.24	0.00	0.00	0.00
Bagridae	0.20	0.07	0.20	0.11	0.56	Bagridae	0.01	0.06	0.00	0.02	0.01
Others	2.29	1.80	2.08	1.87	5.09	Others	9.11	88.98	0.4	0.02	0.09
Total	4.39	3.09	4.07	3.51	10.03	Total	131.3	24.51	46.02	89.39	77.36

CPUE - Beach seine. no light (Gear N° 20)						CPUE - Hand lines (gear n° 32)					
	Area						Area				
	All	1	2	3	4		All	1	2	3	4
<i>Lates stappersii</i>	0.04	0.09	0.00	0.00	0.00	<i>Lates stappersii</i>	1.78		0.00	2.74	0.00
<i>Lates microlepis</i>	0.1	0.2	0.03	0.00	0.00	<i>Lates microlepis</i>	0.00		0.00	0.00	0.00
<i>Lates mariae</i>	0.51	0.98	0.02	0.72	0.00	<i>Lates mariae</i>	0.06		0.00	0.09	0.00
<i>Lates angustifrons</i>	0.7	1.4	0.26	0.00	0.00	<i>Lates angustifrons</i>	0.00		0.00	0.00	0.00
<i>Stolothrissa</i>	0.00	0.00	0.00	0.00	0.00	<i>Stolothrissa</i>	0.00		0.00	0.00	0.00
<i>Limnothrissa</i>	0.00	0.00	0.00	0.00	0.00	<i>Limnothrissa</i>	0.00		0.00	0.00	0.00
<i>Tilapia spp</i>	1.08	0.66	2.01	0.32	0.00	<i>Tilapia spp</i>	0.00		0.00	0.00	0.00
<i>Boulengerochromis</i>	3.87	3.76	4.7	2.57	2.38	<i>Boulengerochromis</i>	0.32		0.00	0.23	0.64
<i>photilapia frontosa</i>	0.00	0.00	0.00	0.00	0.00	<i>Cyphotilapia frontosa</i>	0.00		0.00	0.00	0.00
<i>Bathybathes</i>	0.44	0.63	0.03	1.18	0.25	<i>Bathybathes</i>	0.21		0.00	0.21	0.28
<i>Hemibathes</i>	0.24	0.55	0.00	0.00	0.00	<i>Hemibathes</i>	0.00		0.00	0.00	0.00
Others cichlids	24.12	9.49	51.55	4.1	2.00	Others cichlids	0.45		5.67	0.00	0.00
<i>Clarias spp</i>	0.57	1.33	0.00	0.00	0.00	<i>Clarias spp</i>	0.00		0.00	0.00	0.00
Bagridae	1.38	0.98	1.58	1.63	2.25	Bagridae	0.00		0.00	0.00	0.00
Others	37.33	86.75	0.39	0.00	0.00	Others	0.00		0.00	0.00	0.00
Total	70.36	06.82	60.57	10.52	6.88	Total	2.83		5.67	3.28	0.92

CPUE - Lift net (gear n° 7)						CPUE - Chiromilla (gear n° 77)					
	Area						Area				
	All	1	2	3	4		All	1	2	3	4
<i>Lates stappersii</i>	0.00				0.00	<i>Lates stappersii</i>	0.00				0.00
<i>Lates microlepis</i>	0.00				0.00	<i>Lates microlepis</i>	0.00				0.00
<i>Lates mariae</i>	0.00				0.00	<i>Lates mariae</i>	0.00				0.00
<i>Lates angustifrons</i>	0.00				0.00	<i>Lates angustifrons</i>	0.3				0.3
<i>Stolothrissa</i>	2.63				2.63	<i>Stolothrissa</i>	27.99				27.99
<i>Limnothrissa</i>	5.89				5.89	<i>Limnothrissa</i>	28.54				28.54
<i>Tilapia spp</i>	0.00				0.00	<i>Tilapia spp</i>	0.00				0.00
<i>Boulengerochromis</i>	0.00				0.00	<i>Boulengerochromis</i>	0.00				0.00
<i>photilapia frontosa</i>	0.00				0.00	<i>Cyphotilapia frontosa</i>	0.00				0.00
<i>Bathybathes</i>	0.00				0.00	<i>Bathybathes</i>	0.00				0.00
<i>Hemibathes</i>	0.00				0.00	<i>Hemibathes</i>	0.00				0.00
Others cichlids	0.00				0.00	Others cichlids	0.00				0.00
<i>Clarias spp</i>	0.00				0.00	<i>Clarias spp</i>	0.00				0.00
Bagridae	0.00				0.00	Bagridae	0.00				0.00
Others	0.00				0.00	Others	0.00				0.00
Total	8.53				8.53	Total	56.82				56.82

Table 2 : Catch per unit of effort (kg/unit) for each type of artisanal gear surveyed in the four areas Zambian coast of Lake Tanganyika in 1994 (gear codes following Zambian classification are shown).

Total catches - Beach Seine with light (gear n° 72)					
	Area				
	All	1	2	3	4
<i>Tilapia spp</i>	2 890	2 567	0	323	0
<i>Lates stappersii</i>	4 054	0	673	3 347	35
<i>Boulengerochromis</i>	88 934	27 092	56 134	1 973	3 736
<i>Lates mariae</i>	2 017	1 645	0	372	0
<i>photilapia frontosa</i>	277	0	0	0	277
<i>Bathybathes</i>	10 481	4 511	561	5 271	138
<i>Hemibathes</i>	6 230	6 181	0	49	0
<i>Lates angustifrons</i>	7 951	7 951	0	0	0
<i>Clarias spp</i>	1 396	1 396	0	0	0
<i>Lates microlepis</i>	1 670	1 670	0	0	0
<i>Bagridae</i>	641	324	0	162	156
<i>Stolothrissa</i>	1 712 020	610 953	72 946	815 369	212 753
<i>Limnothrissa</i>	3 518 148	678 837	382 967	1 126 931	1 329 413
<i>Others cichlids</i>	122 232	7 028	75 088	36 363	3 753
<i>Others</i>	517 250	510 084	5 159	243	1 764
Total	5 996 191	1 860 239	593 528	1 990 400	1 552 025
Total catches - Gill nets (gear N°11)					
	Area				
	All	1	2	3	4
<i>Tilapia spp</i>	3 310	2 093	485	732	0
<i>Lates stappersii</i>	653	592	61	0	0
<i>Boulengerochromis</i>	15 540	2 823	4 605	549	7 563
<i>Lates mariae</i>	130 583	3 435	83 255	19 283	24 609
<i>photilapia frontosa</i>	273	0	182	92	0
<i>Bathybathes</i>	37 560	2 685	3 636	3 509	27 730
<i>Hemibathes</i>	414 576	2 053	198 746	5 980	207 797
<i>Lates angustifrons</i>	60 056	0	34 841	366	24 849
<i>Clarias spp</i>	97 463	3 751	78 650	1 617	13 445
<i>Lates microlepis</i>	11 324	1 481	0	0	9 844
<i>Bagridae</i>	92 359	1 599	47 081	2 624	41 055
<i>Stolothrissa</i>	0	0	0	0	0
<i>Limnothrissa</i>	0	0	0	0	0
<i>Others cichlids</i>	31 083	8 430	12 603	5 248	4 802
<i>Others</i>	941 903	40 532	482 807	45 706	372 857
Total	1 836 683	69 476	946 951	85 706	734 551
Total catches - Hand lines (gear n° 32)					
	Area				
	All	1	2	3	4
<i>Tilapia spp</i>	0	0	0	0	0
<i>Lates stappersii</i>	29 021	0	0	29 021	0
<i>Boulengerochromis</i>	5 974	0	0	2 470	3 504
<i>Lates mariae</i>	926	0	0	926	0
<i>photilapia frontosa</i>	0	0	0	0	0
<i>Bathybathes</i>	3 782	0	0	2 249	1 533
<i>Hemibathes</i>	0	0	0	0	0
<i>Lates angustifrons</i>	0	0	0	0	0
<i>Clarias spp</i>	0	0	0	0	0
<i>Lates microlepis</i>	0	0	0	0	0
<i>Bagridae</i>	0	0	0	0	0
<i>Stolothrissa</i>	0	0	0	0	0
<i>Limnothrissa</i>	0	0	0	0	0
<i>Others cichlids</i>	51 708	0	51 708	0	0
<i>Others</i>	0	0	0	0	0
Total	91 411	0	51 708	34 666	5 037
Total catches - Beach seine, no light (Gear N° 20)					
	Area				
	All	1	2	3	4
<i>Tilapia spp</i>	6 989	3 168	3 626	194	0
<i>Lates stappersii</i>	423	423	0	0	0
<i>Boulengerochromis</i>	33 894	18 120	8 486	1 546	5 742
<i>Lates mariae</i>	5 182	4 716	31	435	0
<i>photilapia frontosa</i>	0	0	0	0	0
<i>Bathybathes</i>	4 426	3 052	62	709	602
<i>Hemibathes</i>	2 657	2 657	0	0	0
<i>Lates angustifrons</i>	7 219	6 746	474	0	0
<i>Clarias spp</i>	6 425	6 425	0	0	0
<i>Lates microlepis</i>	1 026	964	62	0	0
<i>Bagridae</i>	13 966	4 702	2 860	984	5 421
<i>Stolothrissa</i>	0	0	0	0	0
<i>Limnothrissa</i>	0	0	0	0	0
<i>Others cichlids</i>	146 161	45 731	93 143	2 469	4 818
<i>Others</i>	418 716	418 018	698	0	0
Total	647 085	514 722	109 442	6 338	16 583

Table 3 (a) : Total catches (kg) for each type of gear surveyed in the four areas of Zambian coast estimated for 1994 (extrapolated from CAS) of Lake Tanganyika.

Total catches - Chiromilla (gear n° 77)					
	Area				
	All	1	2	3	4
<i>Tilapia spp</i>	0	0	0	0	0
<i>Lates stappersii</i>	0	0	0	0	0
<i>Boulengerochromis</i>	0	0	0	0	0
<i>Lates mariae</i>	0	0	0	0	0
<i>photilapia frontosa</i>	0	0	0	0	0
<i>Bathybathes</i>	0	0	0	0	0
<i>Hemibathes</i>	0	0	0	0	0
<i>Lates angustifrons</i>	2 508	0	0	0	2 508
<i>Clarias spp</i>	0	0	0	0	0
<i>Lates microlepis</i>	0	0	0	0	0
Bagridae	0	0	0	0	0
<i>Stolothrissa</i>	236 700	0	0	0	236 700
<i>Limnothrissa</i>	241 405	0	0	0	241 405
Others cichlids	0	0	0	0	0
Others	0	0	0	0	0
Total	480 613	0	0	0	480 613
Total catches - Lift net (gear n° 7)					
	Area				
	All	1	2	3	4
<i>Tilapia spp</i>	0	0	0	0	0
<i>Lates stappersii</i>	0	0	0	0	0
<i>Boulengerochromis</i>	0	0	0	0	0
<i>Lates mariae</i>	0	0	0	0	0
<i>photilapia frontosa</i>	0	0	0	0	0
<i>Bathybathes</i>	0	0	0	0	0
<i>Hemibathes</i>	0	0	0	0	0
<i>Lates angustifrons</i>	0	0	0	0	0
<i>Clarias spp</i>	0	0	0	0	0
<i>Lates microlepis</i>	0	0	0	0	0
Bagridae	0	0	0	0	0
<i>Stolothrissa</i>	14 781	0	0	0	14 781
<i>Limnothrissa</i>	33 130	0	0	0	33 130
Others cichlids	0	0	0	0	0
Others	0	0	0	0	0
Total	47 911	0	0	0	47 911
Total catches - Artisanal fisheries					
	Area				
	All	1	2	3	4
<i>Tilapia spp</i>	13 189	7 828	4 111	1 250	0
<i>Lates stappersii</i>	34 151	1 016	734	32 367	35
<i>Boulengerochromis</i>	4 342	48 035	69 225	6 537	20 545
<i>Lates mariae</i>	138 708	9 796	83 286	21 016	24 609
<i>photilapia frontosa</i>	550	0	182	92	277
<i>Bathybathes</i>	56 249	10 248	4 259	11 738	30 004
<i>Hemibathes</i>	423 463	10 892	198 746	6 029	207 797
<i>Lates angustifrons</i>	77 734	14 696	35 315	366	27 357
<i>Clarias spp</i>	105 283	11 571	78 650	1 617	13 445
<i>Lates microlepis</i>	14 020	4 114	62	0	9 844
Bagridae	106 967	6 625	49 941	3 769	46 632
<i>Stolothrissa</i>	1 963 501	610 953	72 946	815 368	464 234
<i>Limnothrissa</i>	3 792 682	678 837	382 967	1 126 931	1 603 948
Others cichlids	351 185	61 190	232 543	44 080	13 373
Others	1 877 868	968 634	488 664	45 948	374 622
Total	9 099 894	2 444 436	1 701 629	2 117 109	2 836 720

Table 3 (b) : Total catches (kg) for each type of gear surveyed in the four areas of Zambian coast estimated for 1994 (extrapolated from CAS) of Lake Tanganyika.

	Artisanal fishery		Industrial fishery		Total catches	
	Tonnes	%	Tonnes	%	Tonnes	%
<i>Lates stappersii</i>	34	0,4	3 176	96,3	3 210	25,9
<i>Lates microlepis</i>	14	0,2	8	0,2	22	0,2
<i>Lates spp</i>	216	2,4	29	0,9	246	2,0
Clupeidae	(5757)	(63)	(67)	(2)	(5826)	(47)
<i>Stolothrissa</i>	1 964	21,6	4	0,1	1 968	15,9
<i>Limnothrissa</i>	3 793	41,7	63	1,9	3 856	31,1
<i>Tilapia spp</i>	13	0,1	0	0,0	13	0,1
<i>Boulengerochromis</i>	144	1,6	0	0,0	144	1,2
<i>C. frontosa</i>	1	0,0	0	0,0	1	0,0
<i>Bathybathes</i>	56	0,6	0	0,0	56	0,5
<i>Hemibathes</i>	423	4,7	0	0,0	423	3,4
Others cichlids	351	3,9	0	0,0	351	2,8
<i>Clarias spp</i>	105	1,2	0	0,0	105	0,8
Bagridae	107	1,2	0	0,0	107	0,9
Others	1 878	20,6	17	0,5	1 895	15,3
Total	9 100	100	3 297	100	12 396	100,0

Table 4 : Total catches of artisanal fishery (extrapolated from CAS of June 1994) and industrial fishery in Mpulungu (from continuous statistics recording) in 1994

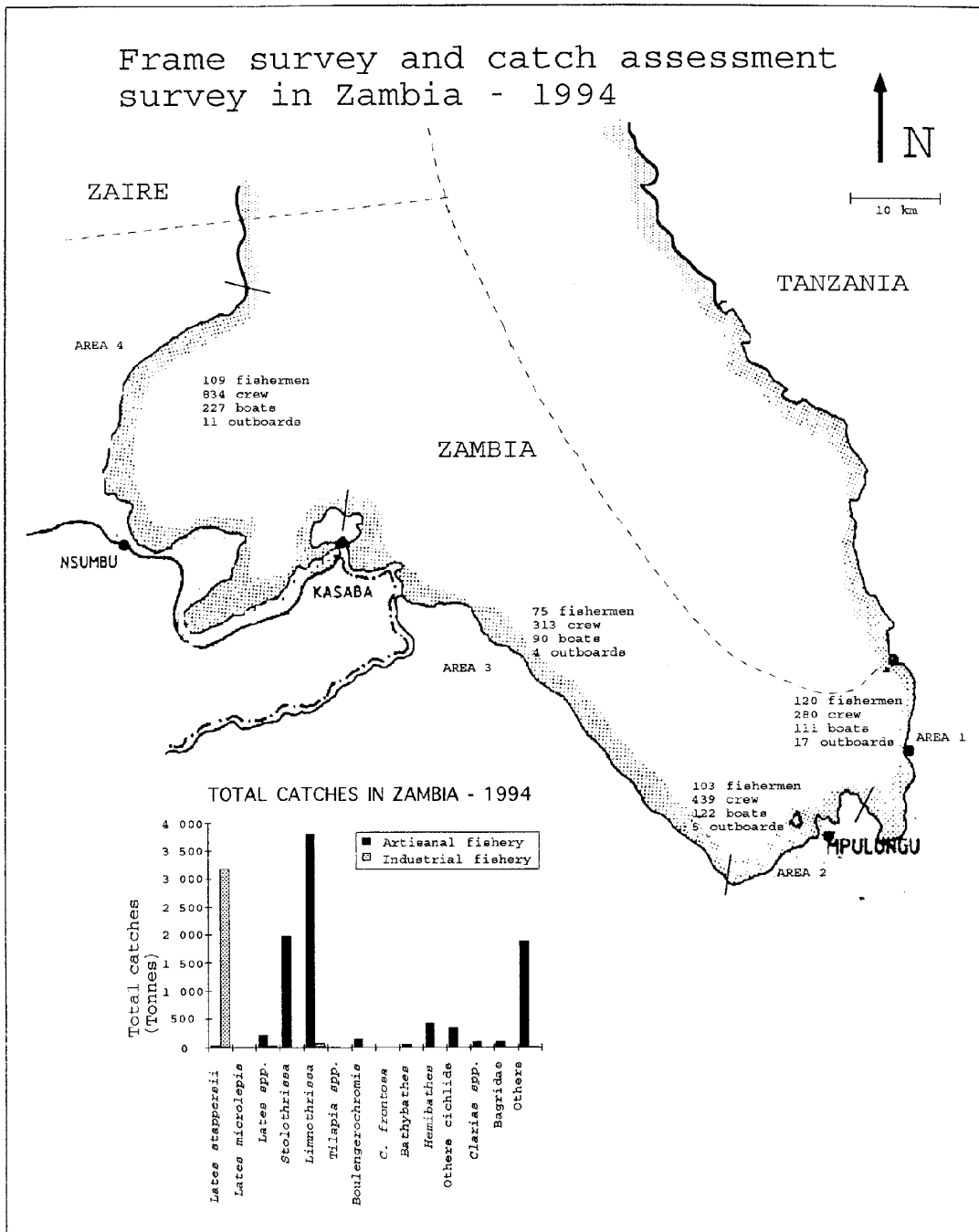


Figure 1 : Map showing areas used during the Frame Survey and Catch Assessment Survey in Zambia and some details of the artisanal fisheries by area; catches of artisanal (all areas) and industrial fisheries (Mpulungu) in 1994 are shown (in tons) below.

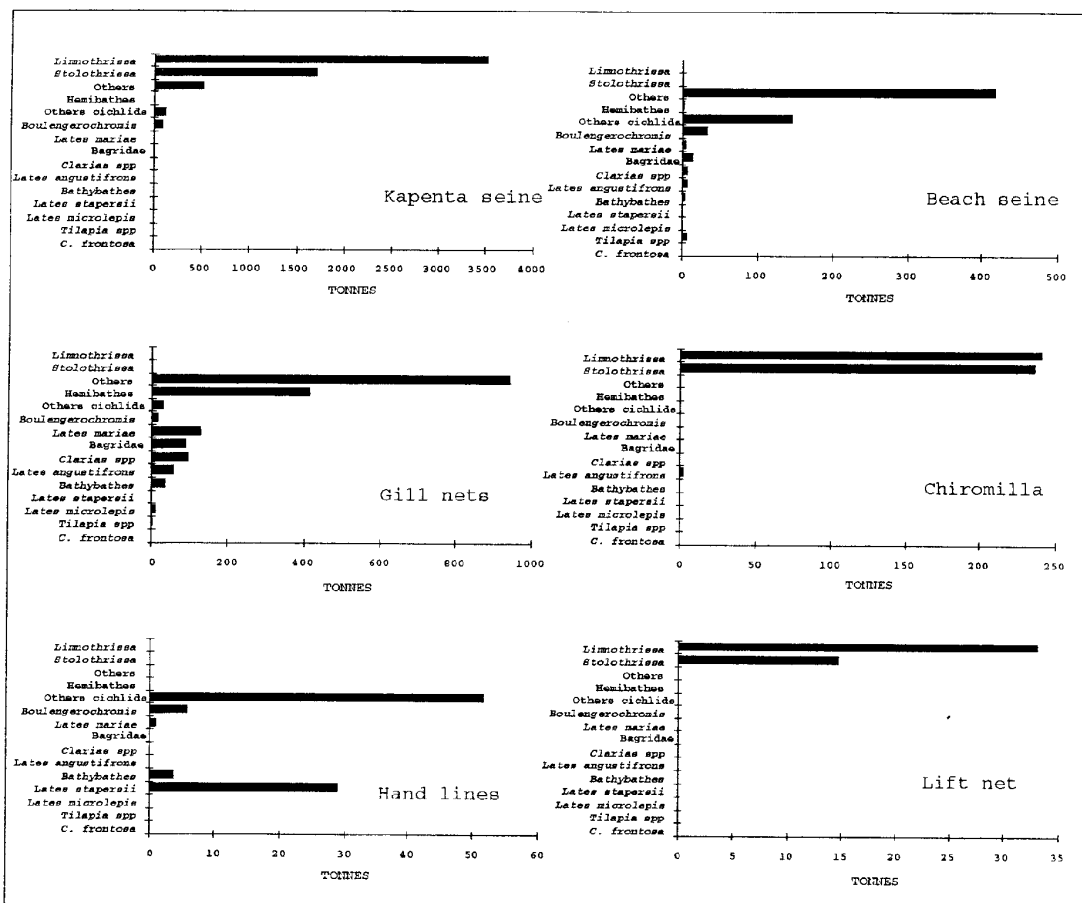


Figure 2 : Total catches (in tonnes) estimated for 1994 by artisanal gears in Zambian waters of Lake Tanganyika

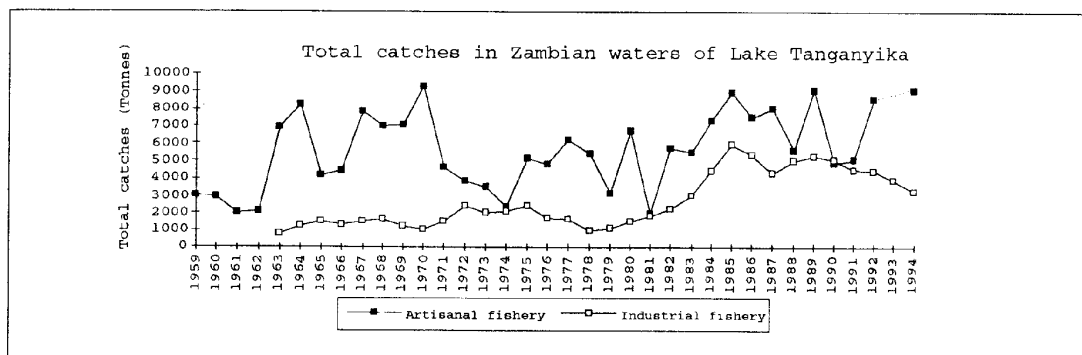


Figure 3 : Evolution of total catches by artisanal and industrial fisheries in Zambian waters of Lake Tanganyika (Data from PEARCE, 1992; LUPIKISHA, 1993 and LTR).