



Government of Malawi
Department of Fisheries

Analysis of Catch and Effort Data for the Fisheries of Lake Chilwa 1976- 1999.

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Introduction

Lake Chilwa is a shallow lake which extends from longitudes 35° 30' to 36° E and from latitudes 15° to 15° 30' S in the Southern part of the Malawi adjoining the Mozambique border on the east (Figure 1). The lake is about 700 km² in area and is two to three metres deep. It is surrounded by an almost equal area of bulrush swamp (Kalk, 1970). Due to its being shallow, nutrient recycling is very efficient in Lake Chilwa and it one of the most productive lakes in Malawi (Kabwazi 1996).

Many streams from the surrounding mountains, Chikala, Zomba, Chiradzulu and Mulanje in Malawi and the mountains in Mozambique to the east flow into the lake (Kalk 1970). Only five of these rivers, the Namadzi, Domasi, Phalombe, Likangala, and Thondwe run throughout the year and are the main contributors to the inflow, while the rest of the water is contributed through precipitation in the Lake Chilwa-Phalombe plain and from some small seasonal rivers. The main inflow from the major five rivers contribute about 70% to the total water body so that the water level of Lake Chilwa is dependent on the fine balance between rainfall and evaporation. (Kabwazi 1996).

The fish stocks of Lake Chilwa are undoubtedly important for food security and employment and up to 5,000 fishermen and assistants as well as the rural communities depend on these resources for their livelihood. In good years, catches could attain 20,000 to 25,000 tonnes. (Kabwazi 1996).

Studies on the lake level of Lake Chilwa have shown that the lake has gone through moderate recession during the years 1900, 1923, 1931/33, 1943, 1949, 1953/55 and 1960/61 and severe recession resulting in a dry lake bed in 1914/15, 1966/67 and 1995 (Morgan, 1972). These greatly affected the 5000 fishermen and all the inhabitants who earn their living on the sales of fish. During these years, tilapia species, *Oreochromis shiranus chilwae* and *Tilapia rendalli* had succumbed severely to the drought and have been the last to recolonize when the lake recovered (Kabwazi, 1996).

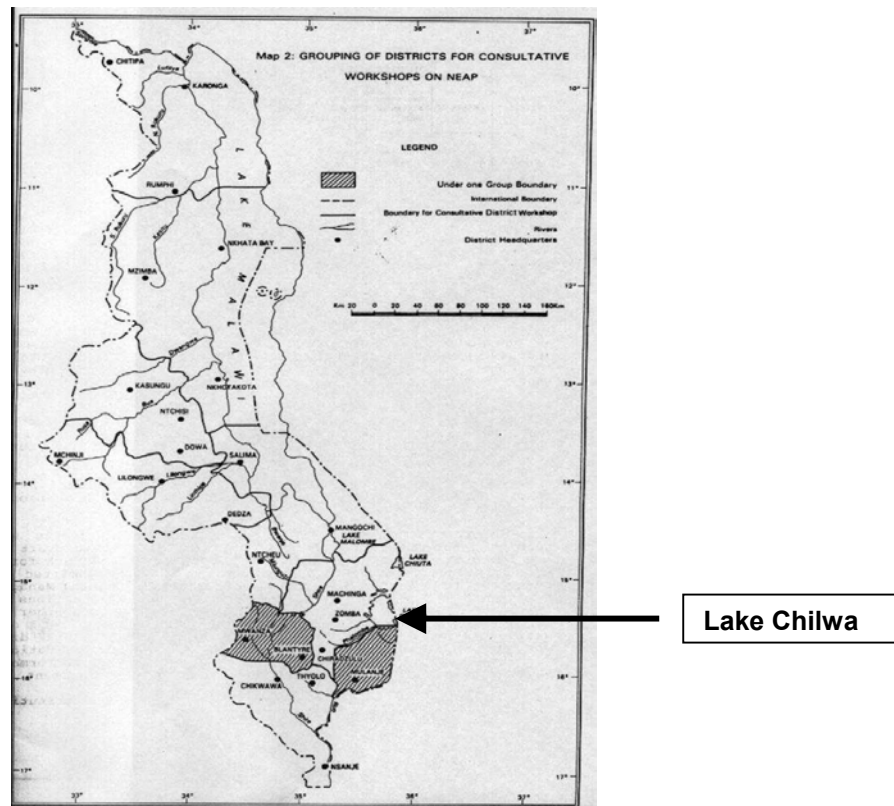


Figure 1. Map of Malawi showing the main water bodies, contours and their catchments

Methods

Lake Chilwa is divided into 7 minor strata namely Namanja, (9.1), Mposa, (9.2), Chinguma, (9.3), Chisi, (9.4), Kachulu, (9.5), Njalo, (9.6), and Mpoto Lagoon, (9.7), (Figure 2). These strata have been monitored since early 1970's and the statistical system of data collection has been the Catch Assessment Survey (CAS). The system was developed by Bazigos in 1972 and implemented by Walker in 1974. Total catch and fishing effort for all the strata in the lake was estimated from the data obtained monthly using the CAS system. The data is presented in gears and species groups which have been collected from 1976 – 1999.

Nine gears, chilimira, chomanga, fish traps, gill nets, hand lines, long lines, mosquito nets, matemba seines and scoop nets have been in use in Lake Chilwa. Descriptions of these gears can be found in Weyl *et al* 2000. Three species groups are recorded, matemba, makumba and mlamba. The fourth group, 'others', is a combination of all species not included in the previous groups. Matemba is a collective name that refers to all small *Barbus* spp., while makumba refers to *Oreochromis shiranus* and mlamba refers to *Clarias gariepinus*.

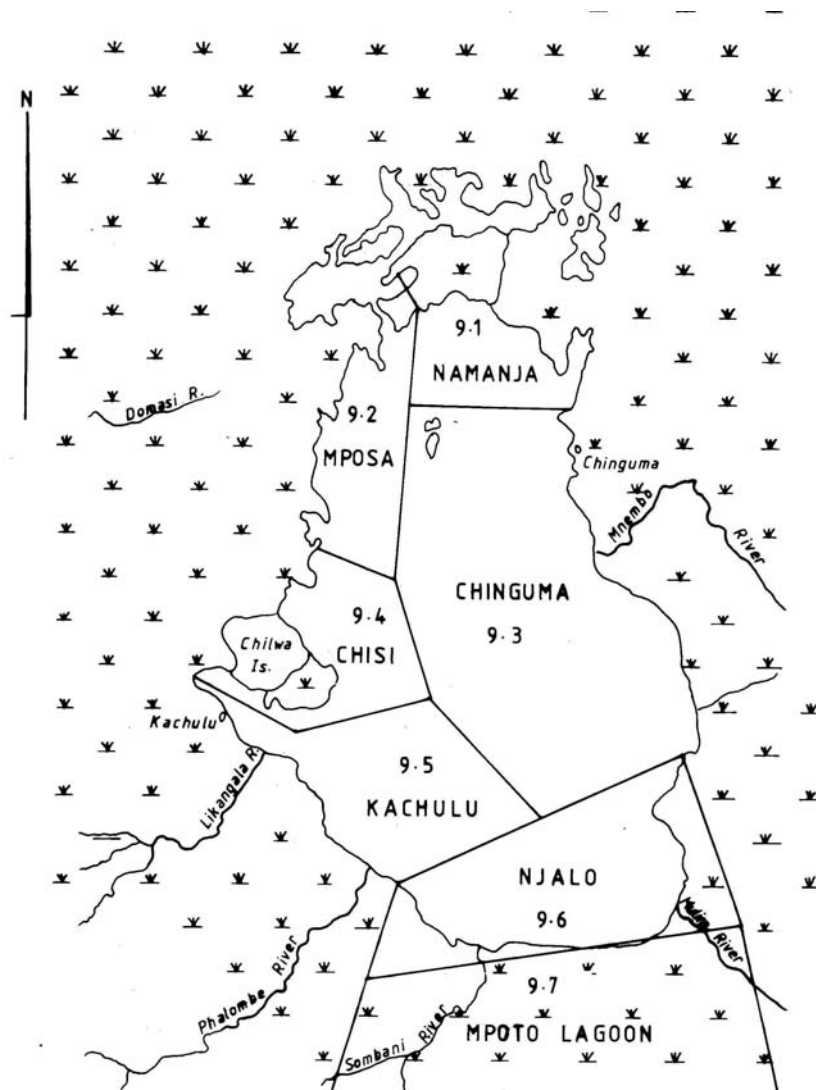


Figure 2: Lake Chilwa showing the sampled strata and the main river network in and out of the lake.

Results

Total Catch

Figure 3 gives an indication of the fluctuations in annual catches by different gears over a period of 23 years. Estimates of catches ranged from about 1000 to 24000 tons in the 1980s. Matemba seine, fish traps, gill nets and long lines have been the main contributors to the total catch. However, their contributions have changed considerably. From 1976 to 1981, fish traps dominated the catches after which, matemba seines have been the most productive fishery (Figure 3). The species composition has remained constant in Lake Chilwa. All species groups have had significant contributions towards the annual total catch for the entire period. However, matemba have been the dominant group throughout the study period followed by makumba and mlamba. In the years between 1977, 1978 and 1995 no catches were recorded as Lake Chilwa had dried up (Figure 4a).

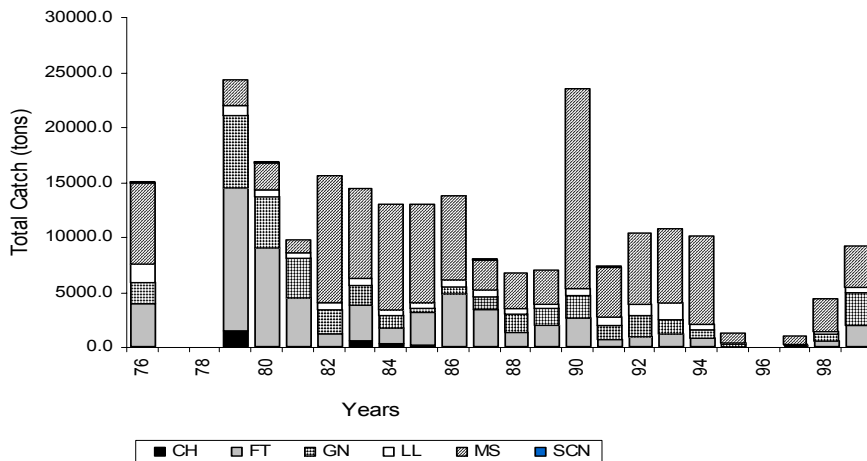


Figure 3: Graph showing catches contributions by gear for a period of 23 years (1976 to 1999)

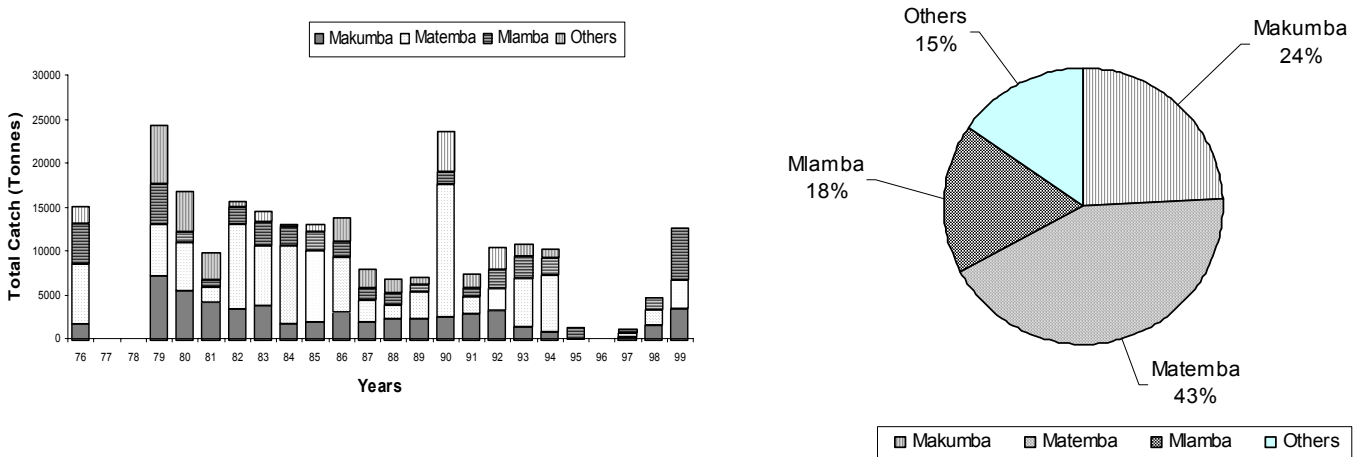


Figure 4: (a) Annual catches by species and (b) Relative catch composition by all gears for all the species in Lake Chilwa for the period 1976 – 1999.

Gear ownership

Temporal trends in the number of fishing gears in Lake Chilwa are shown in Figure 5. Gear trends for the four main contributing gears, matemba seines, gill nets, long lines and fish traps, are presented. In the matemba fishery, there has been a steady increase in the gear ownership from 1984 to 1994 when there was a sudden drop in 1996 due to the drying up of the lake. However, gear ownership increased in 1997 and has remained relatively constant until 1999. A different scenario is observed in the trends for the gill net ownership in which there has been high fluctuations through the period 1984 -1999. Effort in the long line fishery has remained relatively constant from 1984 to 1995, after which the trend shows a sudden peak in 1996, dropping in 1998 and remained stable to 1999. Trends in the fish trap ownership have been stable from 1984 to 1992, after which there was a decline between 1994 and 1996 which increased again to 1999. Except for the long line fishery, trends for the main contributing gears have been on a general increase taking into account for the years of which data is available.

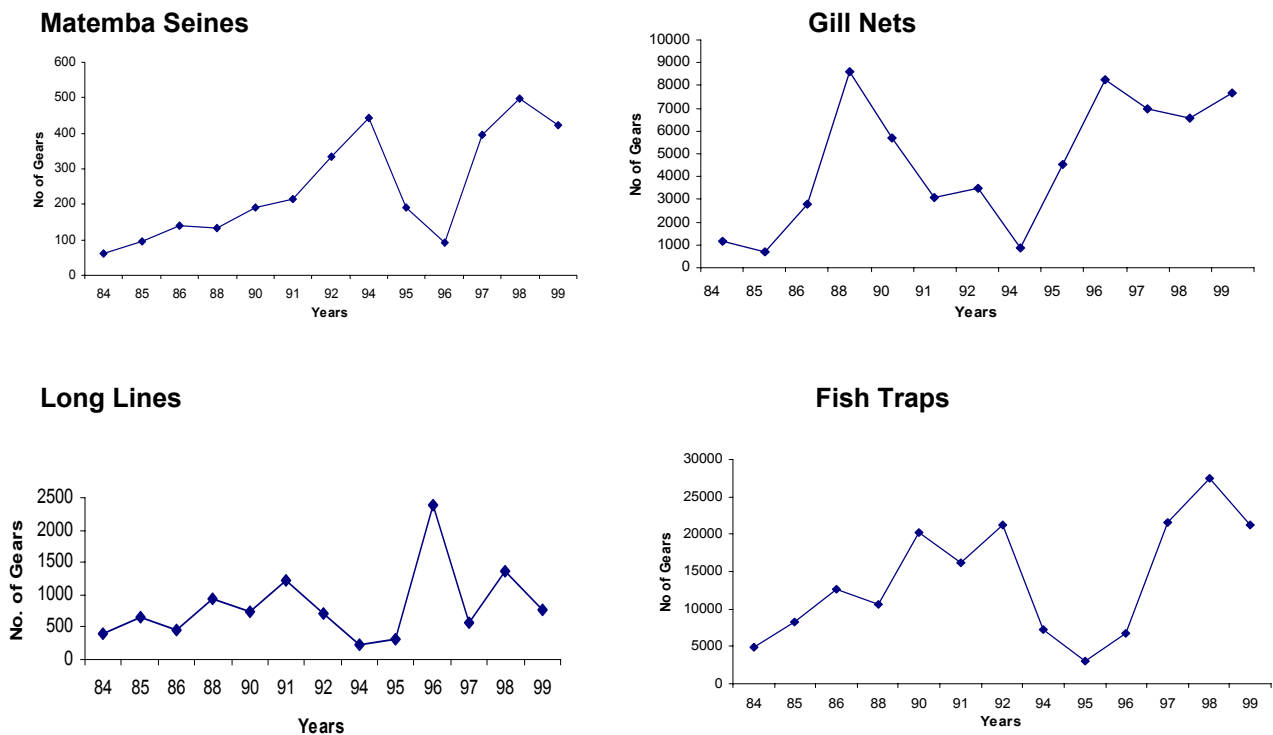


Figure 5. Temporal trends in gear ownership in the major fishing gears in Lake Chilwa from 1984 – 1999.

Matemba Seines

Using catch data obtained for the period 1976 to 1999, there is relatively poor correlation between the CPUE and effort for the matemba fishery. This indicates that matemba are subject to factors other than fishing in Lake Chilwa. This is supported by Figure 6a which in the years between 1976 and 1980, an increase in effort did not make any good in terms of catch to the fishery so that this increase resulted in the reduction in the total fish yield. This was also true in the late 1990s on the same graph. However, conditions changed dramatically between 1981 and 1995 where a reduction in effort resulted in an increase in fish yield (Figure 6a). This effect can also be reflected in Figure 6b, which depicts the catch composition for all species in this fishery.

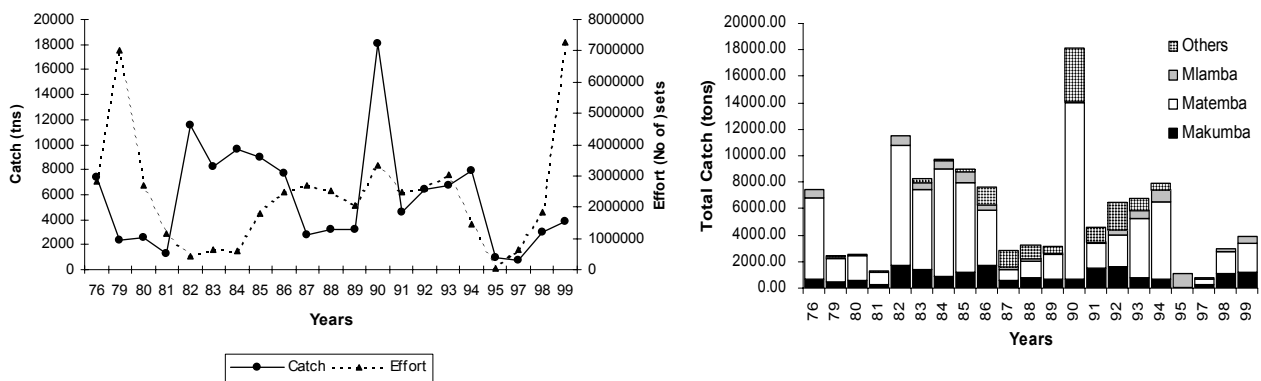


Figure 6: (a) Matemba fishery catch and effort and (b) total catch in Lake Chilwa for the period 1976 – 1999.

Fish Traps

Fish trap annual effort estimates, CPUE estimates and catch composition are shown in Figure 7. Annual efforts in this fishery had remained low from 1976 to 1990 and increased rapidly thereafter to 1994 where the effort again dropped low between 1995 and 1997. After this drop, there has been an increase. This unsteady stand in the effort estimates has a contradictory effect on the annual estimates of the fish trap CPUE which shows a rapid increase up to 1984 when the graph indicates a decline in the CPUE estimates. This could be attributed to the decline of the fish stocks since there is no indication of any increase in the effort which at this point still remained relatively stable. Even though, the effort remained stable between 1976 and 1990, the annual CPUE indicates a steady decline from 1983 and has remained low ever since. The increase in effort between 1990 and 1995 did not have any effect on the CPUE which had already been on the decline. (Figure 7a).

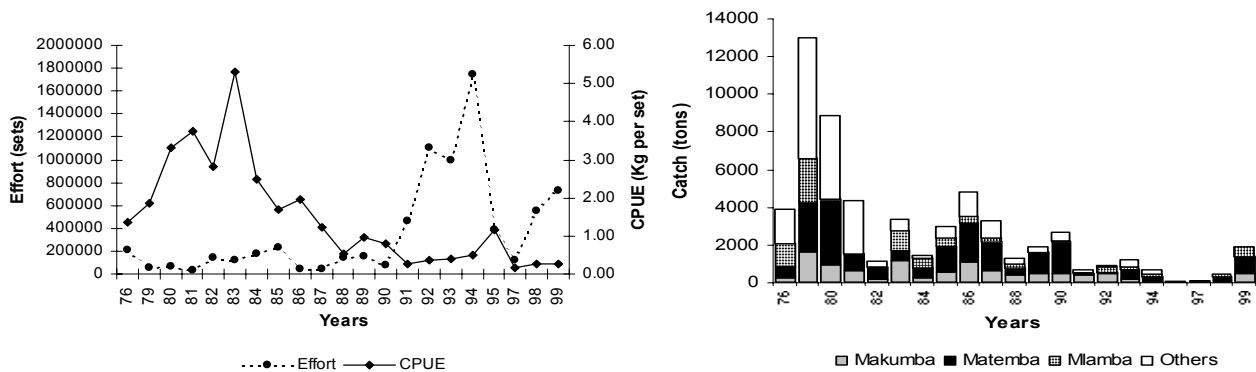


Figure 7: (a) Fish trap effort (sets per year) and CPUE (kg per set) and (b) total catch and species composition for the period 1976 – 1999 for Lake Chilwa.

Gill Nets

For the gill net fishery, annual effort estimates, CPUE estimates and catch compositions are shown in Figure 8. Annual effort in this fishery decreased dramatically from 1979 to 1985 and made steady increase to 1994. From this point, the effort further dropped low due to the drying up of the lake in 1995. to 1997 where it has made another increase since the lake started filling up. Annual estimates of this gill net fishery CPUE have showed a sudden increase between 1976 and 1979, the period when the lake filled after drying up. This increase coincides with an increase in effort. This was followed by a declining trend up to 1993 when it suddenly rose again (Figure 8a).

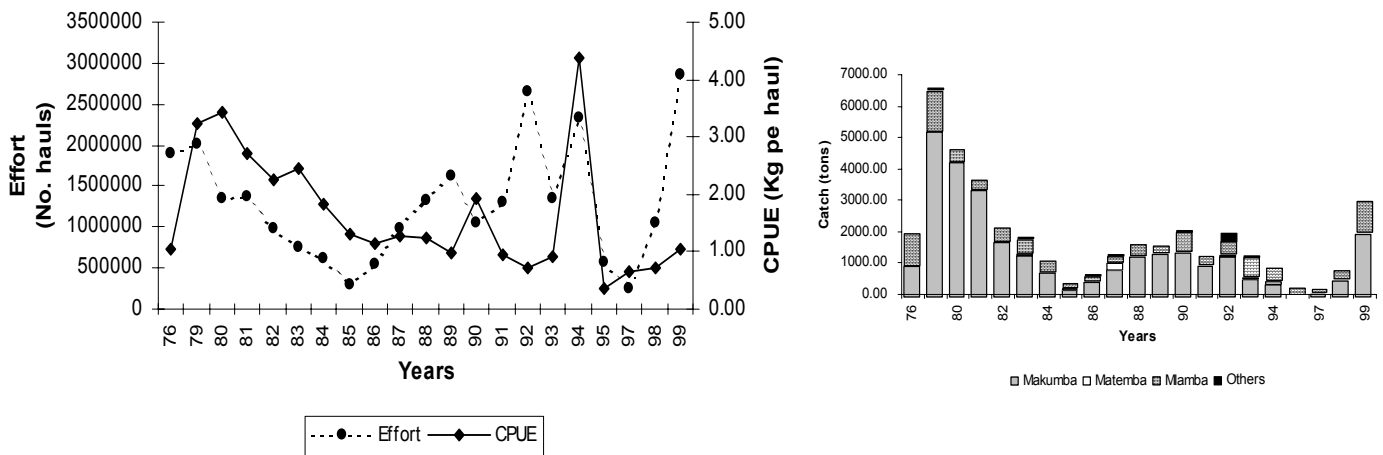


Figure 8: (a) Gill net effort (hauls per year) and CPUE (kg per haul) and (b) catch and species composition for Lake Chilwa from 1976 to 1999.

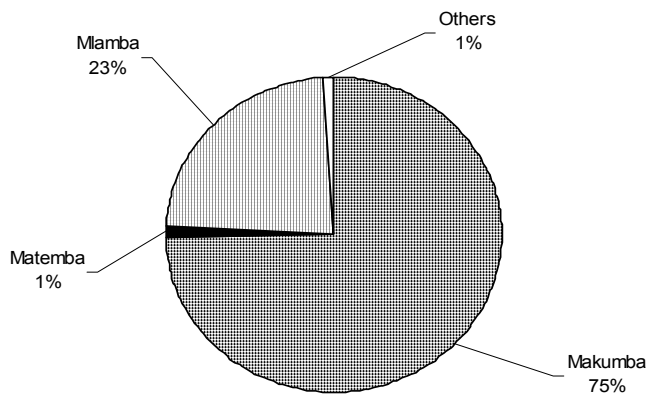


Figure 9: Relative species composition for Lake Chilwa for the period 1976 – 1999

The species composition of the gill net fishery shows that makumba makes up 75% of the total catch in the fishery. (Figure 9) This is followed by mlamba which contributed 23% of the total catch while matemba and “other” species had little contributions in the gill net fishery. High catch rates were recorded between 1979 and 1981, followed by a decrease in catches. Between 1982 and 1999, catches have fluctuated between 1, 000 tons and 3, 000 tons.

Long Line

Annual effort estimates, annual CPUE estimates and species compositions are shown in Figures 10 and 11a while relative catch compositions are outlined in Figure 11b respectively. Annual efforts in this were relatively low from 1976 up to 1992 when suddenly, effort increased to very high levels in 1993 when they reached about 4.5 million sets. This has been the highest record during the study period after which the annual effort had a steep drop to about 17,000 sets in the year 1997 and effort has remained low ever since. However, there has been no definite trend in the number of gears in this fishery which is not significant as indicated in the linear trend line in Figure 17.

Annual CPUE estimates show a different trend all together. Between 1976 and 1980, there was a steady increase on CPUE which peaked in 1980 during which the highest CPUE (2.38 kg) was recorded. There has been a decline in CPUE from 9.35 kg to less than 0.5 kg in 1995 (Figure 10).

Total catch for the long line fishery shows the highest catch was in 1976 and 1993 with 1.7 and 1.6 tons. However, between 1976 and early 1990s catches were relatively higher than between 1995 and 1999 (Figure 11a). The species composition for this fishery was dominated by mlamba which made up 91% of the total catch (Figure 11b).

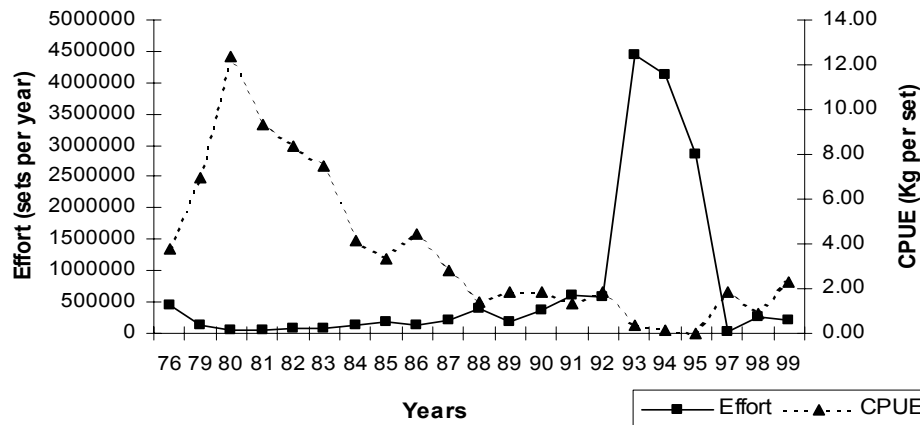


Figure 10: Effort (sets per year) and CPUE (kg per set) for Lake Chilwa from 1976– 1999

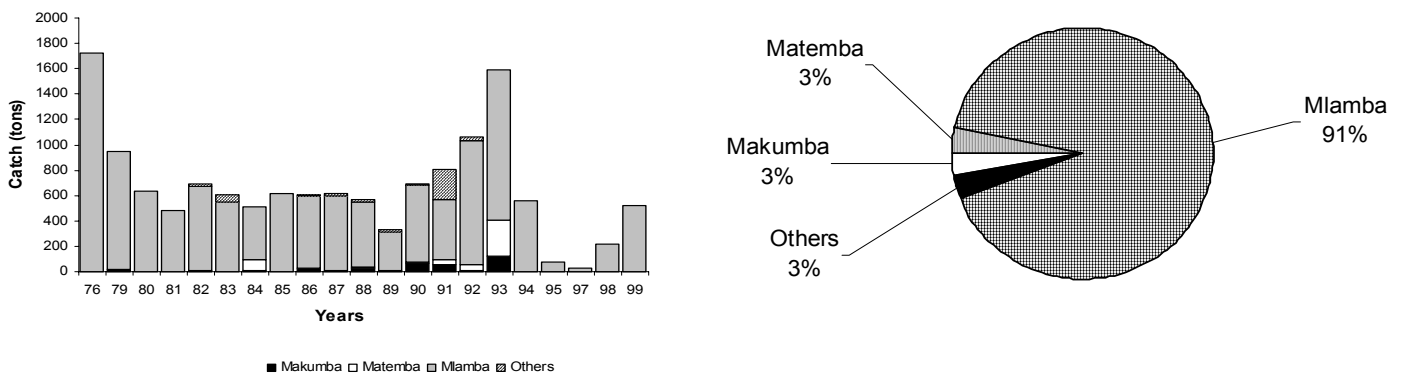


Figure 11: (a) Catch and species composition and (b) relative species composition for the long line fishery for Lake Chilwa for the period 1976 – 1999

Makumba (*Oreochromis shiranus*)

The main harvesting gear for makumba were the gill nets, matemba seines and the fish traps. Gill nets harvested about 50% of the total makumba catch whereas the matemba seines and the fish traps harvest about 31% and 17% respectively, (Figure 13b). High makumba catches were recorded in the year 1979 when the lake had just filled up from drying in 1977-78, (Fig 12a). About 7, 500 tons were recorded in this year which was the highest record and catches have fluctuated between 7.3 and 1.8 thousand tons from 1976 to 1992. The decline in total catches for makumba is a direct effect of the declining CPUE in the two main harvesting gears in the lake, gill nets and fish traps. No records were available for the 1995 and 1996, a time when the lake dried up and the fishing activities stopped. Fishing resumed in 1997 and catches have remained on the increase through to 1999. Gill nets lead in the makumba catches and these are followed by matemba seines and fish traps (Figure 13b).

Effort and CPUE have followed no definite trend over the period between 1976 and 1999 for the main contributing gears in the makumba fishery (Gill nets, Fish traps and the Matemba seines). An increase in effort

did not improve the catch rates and resulted, instead, to the decrease in catch trends. However a sudden increase in CPUE in 1985 was as a result of increased catches in fish traps and matemba seines for the makumba fishery (Figure 12b).

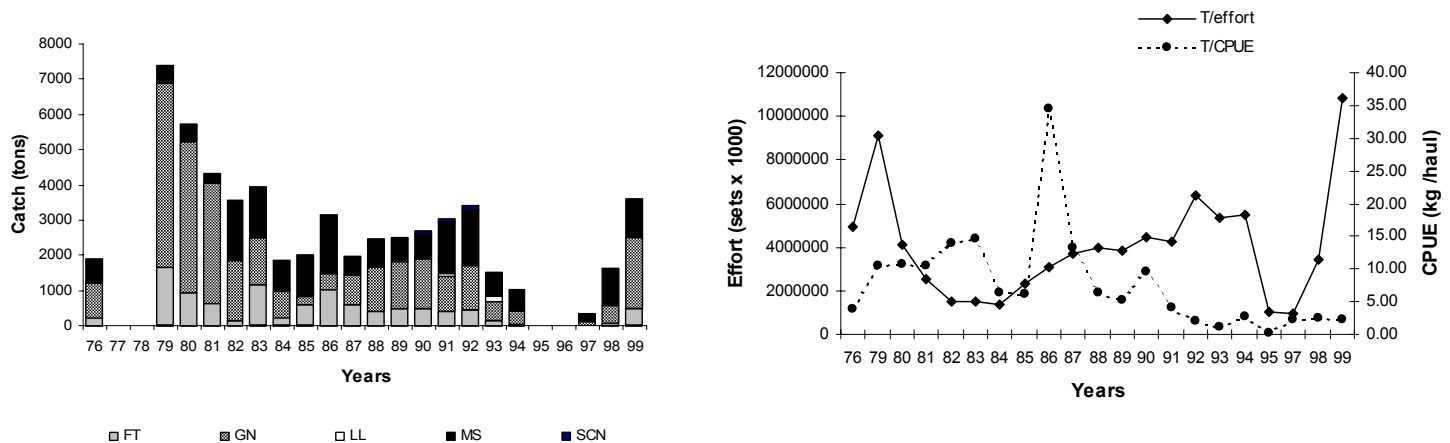


Figure 12: (a) Total *Oreochromis shiranus* (Makumba) catches and (b) effort vs CPUE for the main contributing gears (Gill nets, Fish traps & Matemba seines) between 1976 and 1999

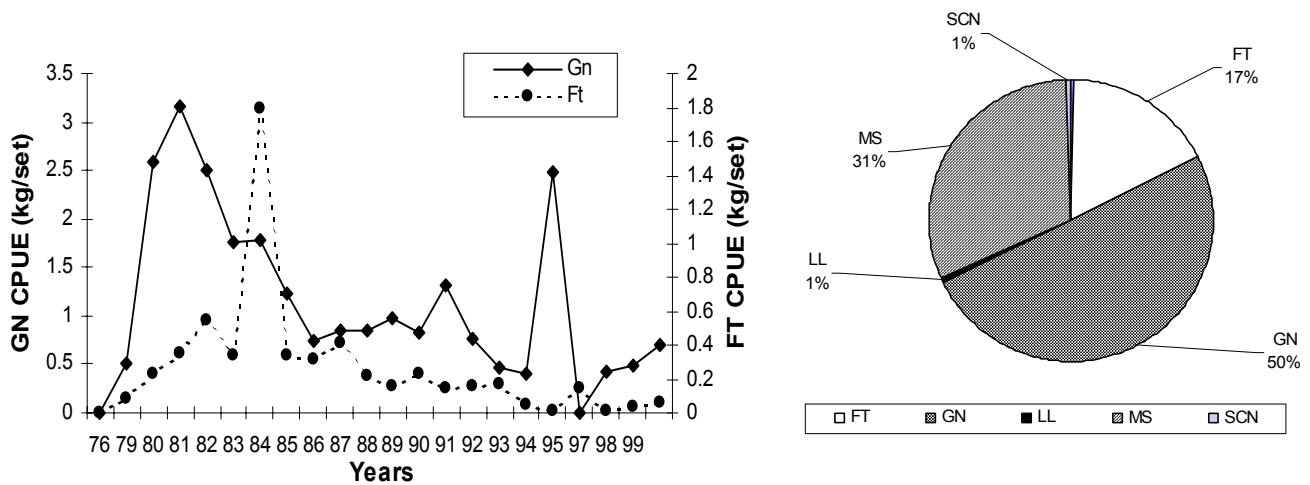


Figure 13: (a) CPUE in fish traps and Gill nets and (b) relative catch composition for the makumba fishery in Lake Chilwa for the period of 1976 to 1999.

Matemba (*Barbus* spp.)

The main harvesting gear for matemba were the matemba seines. Matemba seines harvested about 96% of the total catch in the years from 1976 to 1999 whereas gill nets, chilimira and fish traps contributed very little to the total catch (Figure 14b). Matemba catches in Lake Chilwa have not followed a definite trend from 1976 – 1999 (Figure 14a). Catches dropped from 6200 tons in 1976 to 840 tons in 1981 after which, there was a sudden rise in catches to 11,500 tons in 1982 to and have remained stable up to 1986. The highest catches were recorded in the year 1990 with the highest record of 13,400 tons, (Figure 14a). The *Barbus* are the main species harvested in Lake Chilwa and contribute about 43% of all the fish landed (Figure 4b).

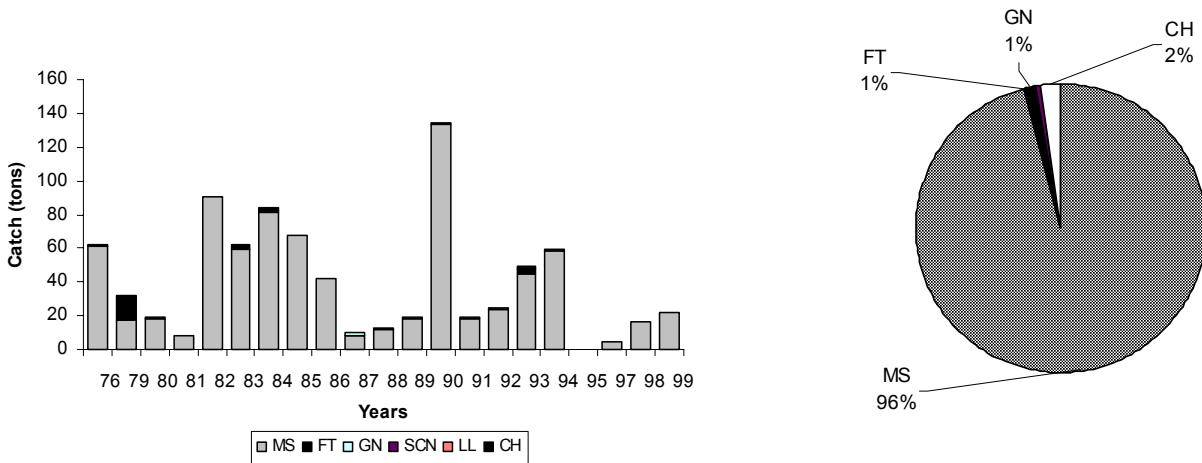


Figure 14(a) *Barbus* spp.(matemba) catches and (b) relative catches composition by the main contributing gears in Lake Chilwa over the period 1976 to 1999

Trends in CPUE in the matemba fishery in Lake Chilwa are shown in Figure 15. From 1976 to 1985, the CPUE had remained stable and rose in 1986 to about 156kg/haul and dropped again to as far as 20 kg/haul in 1989. In 1990 the highest CPUE of about 222 kg/haul was recorded. The figure also indicates that there is no direct relationship between the rise in effort and CPUE. From 1976, there was low effort in the matemba fishery which resulted into high CPUE values until 1990. The increase in effort in 1991 worsened the situation in the matemba fishery which has now collapsed. Efforts increased from 81,000 pulls in 1990 to 1,743,000 pulls in 1994 and CPUE has remained considerably low since then, (Figure 15).

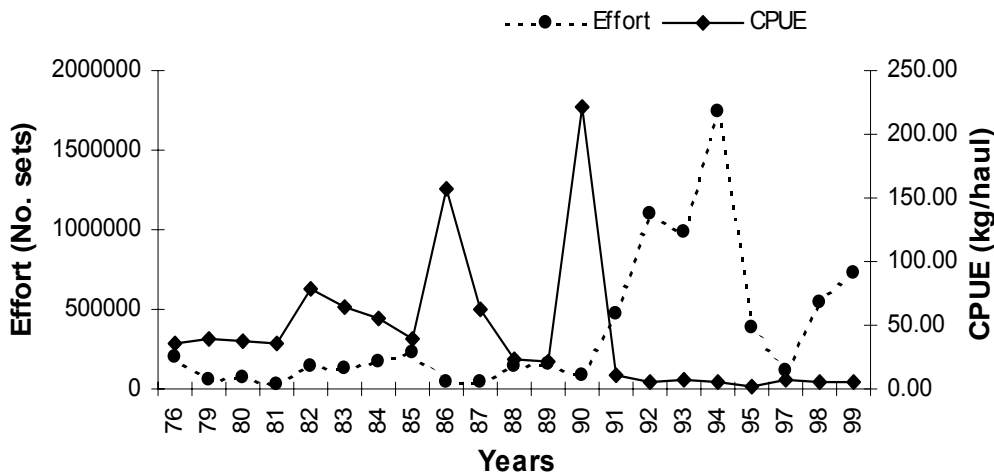


Figure 15: Matemba effort vs CPUE in matemba seines fishery in Lake Chilwa for the period between 1976 and 1999.

Mlamba (*Clarias gariepinus*)

The main harvesting gears for mlamba are the long lines, matemba seines, gill nets and the fish traps (Figure 16b). Long lines contribute about 31% of all the mlamba landings in Lake Chilwa. These are followed by matemba seines, gill nets and fish traps which contributed 21%, 21% and 19% respectively in all years (Figure 16b). Mlamba catches in Lake Chilwa have also not shown a definite trend. Catches dropped from 6200 tons in 1976 to 840 tons in 1981 and the fluctuation continued to 1999. The highest mlamba catches were recorded in the years 1976 before the lake dried up and then in 1979 when it had just refilled after another drying period. The highest record ever was 5,778 tons recorded in 1999 (Figure 16a). Mlamba contribute about 18% to the total catch in Lake Chilwa (Figure 4b).

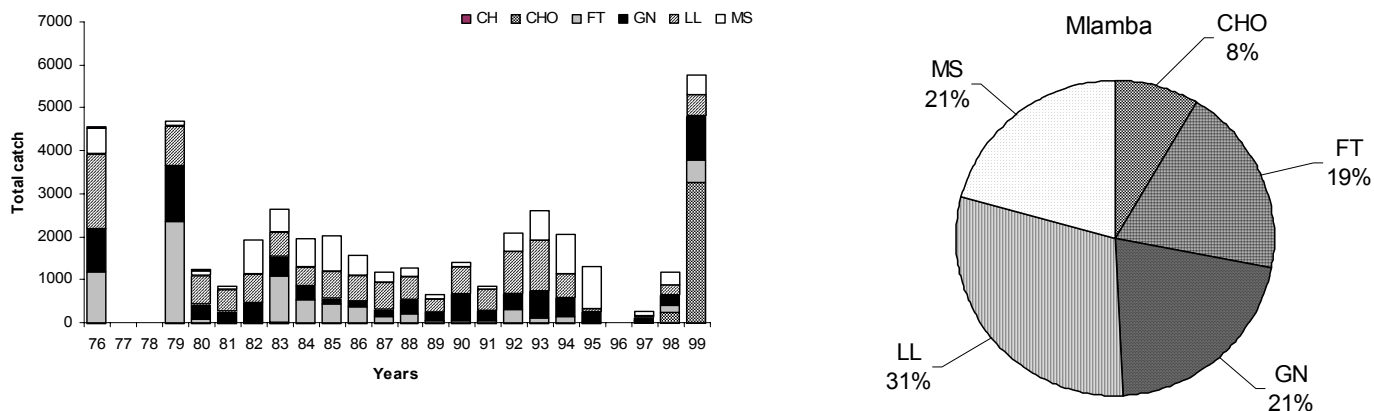


Figure 16: (a) Total *Clarias* (mlamba) catches and (b) relative catch composition in Lake Chilwa for the main contributing gears from 1976 – 1999

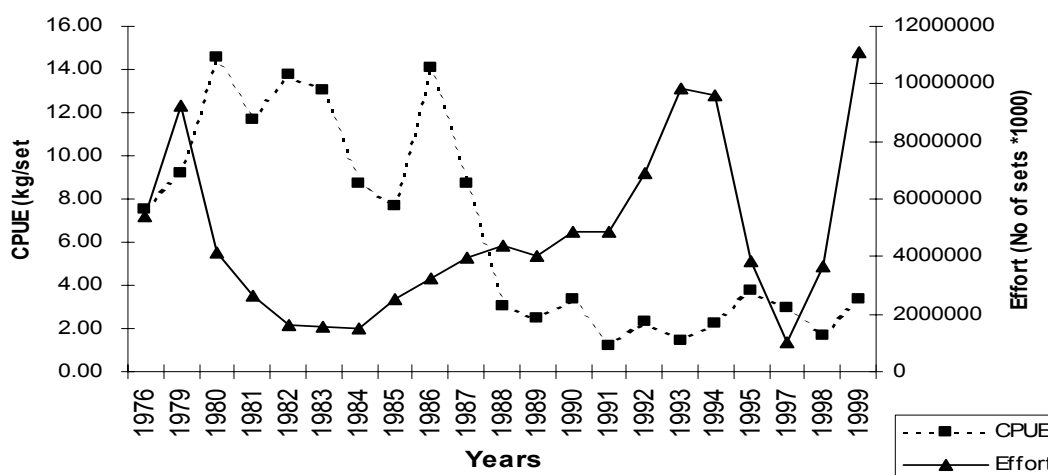


Figure 17: Mlamba effort vs CPUE in mlamba fishery in Lake Chilwa for the period between 1976 and 1999.

Trends in CPUE in the mlamba fishery in Lake Chilwa are shown in Figure 17. From 1976 to 1985, the CPUE had remained stable and rose in 1986 to about 156.7 Kg/haul. In 1989, it dropped again to 20.7 Kg/haul. The highest CPUE for the whole sampling period was 222 kg/haul in 1999 (Figure 17). From 1976, there was low effort applied in the matemba fishery which ranged between 34,000 and 207,000 pulls which resulted in high CPUE values until 1990. The increase in effort in 1991 worsened the situation in the matemba fishery which has now collapsed.

Discussion

Lake Chilwa fisheries have been monitored by the Department of Fisheries since mid 1970. Since then the fishery has undergone dramatic changes both in the catches and the utilisation of the gears available. To some extent this has been as a result of the drying-up periods that the lake has undergone. Soon before and after these periods, mlamba were caught in abundance since they were caught in some stagnant waters that remained before the lake finally dried up while other fish species were caught in the rivers that flow into the lake. Matemba have been the dominant catch increasing to over 14000 tons early 1990s. In 1981, 1987 1994 and 1995, the matemba catches were very low so much so that the fishery almost collapsed (Figure 16a). The same scenario was found in the makumba fishery (Figure 14a), mlamba fishery (Figure 18a) as well as in the other species group. However, in general, catches in Lake Chilwa have not been on the threat of collapsing except in times when the lake dries up, that the fish stocks had to be restocked.

Gear ownership for the four main harvesting gears, Matemba seines, Fish traps, Gill nets, and Long lines, has generally increased over the period between 1984 and 1999 as indicated by the linear trends in Figure 7, Figure

9, Figure11a and Figure12a. However, annual catches have fluctuated considerably over the period between 1976 and 1999. This is due to changes in the lake level and the times when the lake dried up.

The geographical affinities of the fishes of Lake Chilwa-Chiuta basin (most, if not all, of the Lake Chilwa fishes also occur in Lake Chiuta) are with the fauna of the eastward flowing rivers of Tanzania and Mozambique rather than with the fishes of Lake Malawi and the Lower Shire River (Kirk 1967a). The biology and ecology of these Lake Chilwa fishery is little known however, Jamu *et al.* (1999) has indicated that the three main species; the *Barbus* spp., *Oreochromis* spp. and *Clarias* spp. have different food preferences and spawn at different times of the year. They also spend a significant amount of time in the open waters while others are largely restricted to the marshland and effluent streams (Kirk 1967, Furse *et al.* 1979a). The data collected indicates that all the species available in Lake Chilwa contribute significantly to the general ecological health of the lake ecosystem as well as the inhabitants in support of food and economy.

Oreochromis shiranus

Oreochromis shiranus can take advantage, either directly or indirectly, of a wide variety of foods. During their three life stages, (larvae <10mm TL, juveniles 10-200mm TL and adults), they have different food preferences. Larvae target zooplankton; juveniles target detritus while adults prefer phytoplankton (Trewavas, 1983).

Spawning takes place in shallow sandy bottoms of the littoral areas of the lake, (Furse *et al.* 1979a). Breeding season extends from late August through to early May (Jamu *et al.*1999). As a mouth brooder, the male constructs and guards the nests in an attempt to entice spawning females. Fertilized eggs are gathered and hatched into the females' mouth for almost a week. However, maternal care continues for almost 2-3 weeks with the female providing refuge in her mouth.

The *Barbus* species

The most dominant are the *Barbus paludinosus* which primarily feed on micro-crustaceans but they will take advantage of a wide range of foods as they are available (Furse *et al.* 1979b). As juveniles, they target mostly zooplanktons but the diet diversifies as the fish mature (Bourn 1974).

Spawning takes place up the influent rivers during the rainy season (January-February) and then return with the juveniles back to the lake (Jamu *et al.*1999). According to Skelton (1993) migration appears to correspond to periods of heavy rainfall or flushing and the fecundity ranges from 250-800 eggs per female of 50-60mmSL up to 2500 eggs per female of 112mm SL.

Clarias gariepinus

Clarias gariepinus is highly resistant to poor water quality due to several physiological and morphological adaptations. Skelton, (1993) states four factors which contribute to this ability to adaptation: 1) the thick skin which is more or less impermeable to water loss, 2) the possession of an auxiliary breathing apparatus which, in combination with special gill modifications, permit it to breathe humid air, 3) it is able to burrow into the mud for protection and, 4) it can walk on its pectoral fins through damp grass to find deeper waters. It is therefore less affected by fluctuations in lake water levels than other species.

Clarias are generally omnivorous, eating anything from plankton to fish, (Munro 1967). However, larger individuals in Lake Chilwa tend to piscivory, especially on *Barbus* spp. (Kirk, 1967).

Spawning starts much earlier than that of *Barbus* spp. and extends later into the cool season (Furse *et al.* 1979a). At the end of the hot/dry season, the fish move into marginal areas of the lake from where, they move into the swamps to spawn at the beginning of the rains, (Bruton 1979).

Recommendations

- 1) The drying up of the lake in some years and the limitations of data collections for later years prevents any sensible assessment of the current status of Lake Chilwa fishery and therefore, no applicable recommendations are made, (Bulirani *et al.*1999). However, a means has to be put in place to intensify data collection in times when the lake fills up after a dry-up period.
- 2) Due to lack of an updated list of the species found in Lakes Chiuta and Chilwa, an itinerary for these lake species need be produced and supplied to the beach recorders. This should show both local and scientific names for easy recording and references by the beach recorders/fish scouts.

- 3) A limnological data collection update to conduct an in-depth river and lake catchment study on the effects of changes in land-use patterns by the natives on river and lake water quality and its effects on the fisheries of Lake Chilwa.
- 4) Further studies on the biology, ecology, and assessment of the Lake Chilwa ichthyofauna.

Acknowledgements

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Appendix 1

Catch, effort and CPUE for the major fisheries of Lake Chilwa 1976-1999.

List of Abbreviations

CH	Chilimira net, effort in hauls.
CHO	Chomanga, effort in hook sets.
FT	Fish Trap, effort in trap sets.
GN	Gill net, effort in 100m net sets.
HL	Hand line, effort in fishing days.
LL	Long line, effort in 100 hook sets.
MS	Matemba seine, effort in hauls
SCN	Scoop net, effort in fishing days.

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1976	FT	Effort	2840493	2840493	2840493	2840493	2840493
1976	FT	CPUE	0.084	0.210	0.423	0.646	1.364
1976	FT	Catch	237.78	596.92	1202.34	1836.2	3873.24
1976	GN	Effort	1898804	1898804	1898804	1898804	1898804
1976	GN	CPUE	0.513	0.000	0.533	0.000	1.046
1976	GN	Catch	973.18	0	1012.12	0	1985.3
1976	LL	Effort	459456	459456	459456	459456	459456
1976	LL	CPUE	0.000	0.000	3.747	0.000	3.747
1976	LL	Catch	0	0	1721.76	0	1721.76
1976	MS	Effort	206917	206917	206917	206917	206917
1976	MS	CPUE	3.238	29.443	2.835	0.241	35.756
1976	MS	Catch	670.06	6092.23	586.52	49.77	7398.58
1976	SCN	Effort	22565	22565	22565	22565	22565
1976	SCN	CPUE	0.106	4.170	0.996	0.763	6.035
1976	SCN	Catch	2.39	94.1	22.47	17.21	136.17
1976	Total Catch		1883.41	6783.25	4545.21	1903.18	15115.05
1979	CH	Effort	3783	3783	3783	3783	3783
1979	CH	CPUE	8.578	380.365	0.000	0.000	388.943
1979	CH	Catch	32.45	1438.92	0	0	1471.37
1979	FT	Effort	7012725	7012725	7012725	7012725	7012725
1979	FT	CPUE	0.233	0.370	0.340	0.907	1.850
1979	FT	Catch	1634.7	2591.75	2382.1	6363.38	12971.93
1979	GN	Effort	2022451	2022451	2022451	2022451	2022451
1979	GN	CPUE	2.591	0.000	0.638	0.014	3.243
1979	GN	Catch	5240.61	0	1289.73	28.25	6558.59
1979	LL	Effort	139513	139513	139513	139513	139513
1979	LL	CPUE	0.131	0.037	6.610	0.222	6.999
1979	LL	Catch	18.22	5.11	922.18	0	945.51
1979	MS	Effort	59186	59186	59186	59186	59186
1979	MS	CPUE	7.650	29.073	1.622	1.795	40.139
1979	MS	Catch	452.77	1697.83	95.43	106.22	2352.25
1979	SCN	Effort	618	618	618	618	618
1979	SCN	CPUE	7.023	2.298	0.146	7.298	16.764
1979	SCN	Catch	4.34	1.42	0.09	4.51	10.36
1979	Total Catch		7383.09	5735.03	4689.53	6502.36	24310.01
1980	CH	Effort	779	779	779	779	779
1980	CH	CPUE	6.008	21.579	1.990	1.001	30.578
1980	CH	Catch	4.68	16.81	1.55	0.78	23.82
1980	FT	Effort	2678029	2678029	2678029	2678029	2678029
1980	FT	CPUE	0.346	1.288	0.034	1.658	3.327
1980	FT	Catch	927.23	3449.4	91.43	4441.43	8909.49
1980	GN	Effort	1358405	1358405	1358405	1358405	1358405
1980	GN	CPUE	3.161	0.000	0.271	0.012	3.444
1980	GN	Catch	4294.28	0	368.12	16.42	4678.82
1980	LL	Effort	50944	50944	50944	50944	50944
1980	LL	CPUE	0.000	0.000	12.381	0.000	12.381
1980	LL	Catch	0	0	630.73	0	630.73

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1980	MN	Effort	420	420	420	420	420
1980	MN	CPUE	0.000	19.214	0.000	0.000	19.214
1980	MN	Catch	0	8.07	0	0	8.07
1980	MS	Effort	68512	68512	68512	68512	68512
1980	MS	CPUE	7.318	27.173	1.883	0.598	36.972
1980	MS	Catch	501.37	1861.66	128.99	41	2533.02
1980	SCN	Effort	1269	1269	1269	1269	1269
1980	SCN	CPUE	10.961	15.563	0.496	16.194	43.215
1980	SCN	Catch	13.91	19.75	0.63	20.55	54.84
1980	Total Catch		5741.47	5355.69	1221.45	4520.18	16838.79
1981	FT	Effort	1172481	1172481	1172481	1172481	1172481
1981	FT	CPUE	0.540	0.720	0.020	2.460	3.740
1981	FT	Catch	628.96	842.78	28.43	2884.56	4384.73
1981	GN	Effort	1363705	1363705	1363705	1363705	1363705
1981	GN	CPUE	2.500	0.000	0.230	0.001	2.700
1981	GN	Catch	3411	0	276.39	0.95	3688.34
1981	LL	Effort	51357	51357	51357	51357	51357
1981	LL	CPUE	0.090	0.000	9.250	0.003	9.350
1981	LL	Catch	4.68	0	475.25	0.15	480.08
1981	MS	Effort	34425	34425	34425	34425	34425
1981	MS	CPUE	7.520	24.340	2.210	2.040	36.124
1981	MS	Catch	259.04	837.94	76.13	70.28	1243.39
1981	Total Catch		4303.68	1680.72	856.2	2955.94	9796.54
1982	CH	Effort	55	55	55	55	55
1982	CH	CPUE	2.545	139.636	0.000	18.545	160.727
1982	CH	Catch	0.14	7.68	0	1.02	8.84
1982	FT	Effort	414644	414644	414644	414644	414644
1982	FT	CPUE	0.339	1.528	0.076	0.889	2.831
1982	FT	Catch	140.36	633.42	31.46	366.79	1172.03
1982	GN	Effort	976706	976706	976706	976706	976706
1982	GN	CPUE	1.760	0.000	0.469	0.000	2.239
1982	GN	Catch	1722.34	0	457.84	0	2180.18
1982	LL	Effort	82381	82381	82381	82381	82381
1982	LL	CPUE	0.092	0.000	8.036	0.262	8.390
1982	LL	Catch	7.54	0	662	21.61	691.15
1982	MS	Effort	144937	144937	144937	144937	144937
1982	MS	CPUE	11.791	62.163	5.214	0.217	79.386
1982	MS	Catch	1708.98	9009.79	755.74	31.49	11506
1982	SCN	Effort	29	29	29	29	29
1982	SCN	CPUE	0.000	302.069	0.000	0.000	302.069
1982	SCN	Catch	0	8.76	0	0	8.76
1982	Total Catch		3579.36	9659.65	1907.04	420.91	15566.96
1983	CH	Effort	1352	1352	1352	1352	1352
1983	CH	CPUE	40.429	173.499	33.284	93.787	340.999
1983	CH	Catch	54.66	234.57	45	126.8	461.03
1983	FT	Effort	629730	629730	629730	629730	629730
1983	FT	CPUE	1.796	0.843	1.707	0.954	5.299
1983	FT	Catch	1130.8	530.72	1074.79	600.57	3336.88

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1983	GN	Effort	749923	749923	749923	749923	749923
1983	GN	CPUE	1.778	0.016	0.605	0.045	2.444
1983	GN	Catch	1333.02	12.27	453.52	33.73	1832.54
1983	LL	Effort	81470	81470	81470	81470	81470
1983	LL	CPUE	0.018	0.000	6.724	0.746	7.488
1983	LL	Catch	1.49	0	547.77	60.75	610.01
1983	MS	Effort	126312	126312	126312	126312	126312
1983	MS	CPUE	11.130	47.240	4.000	2.555	64.930
1983	MS	Catch	1406.19	5966.51	505.51	322.79	8201
1983	SCN	Effort	32	32	32	32	32
1983	SCN	CPUE	0.000	186.875	0.000	0.000	186.875
1983	SCN	Catch	0	5.98	0	0	5.98
1983	Total Catch		3926.16	6750.05	2626.59	1144.64	14447.44
1984	CH	Effort	741	741	741	741	741
1984	CH	CPUE	58.475	236.127	0.000	66.478	361.080
1984	CH	Catch	43.33	174.97	0	49.26	267.56
1984	FT	Effort	592318	592318	592318	592318	592318
1984	FT	CPUE	0.337	0.948	0.922	0.266	2.474
1984	FT	Catch	199.89	561.64	546.24	157.54	1465.31
1984	GN	Effort	613497	613497	613497	613497	613497
1984	GN	CPUE	1.240	0.035	0.539	0.014	1.828
1984	GN	Catch	760.48	21.7	330.96	7.87	1121.48
1984	LL	Effort	125003	125003	125003	125003	125003
1984	LL	CPUE	0.100	0.670	3.350	0.010	4.120
1984	LL	Catch	12.29	83.19	418.14	0.81	514.43
1984	MS	Effort	172371	172371	172371	172371	172371
1984	MS	CPUE	4.864	46.952	3.900	0.314	56.030
1984	MS	Catch	838.36	8093.14	672.21	54.19	9657.9
1984	Total Catch		1854.35	8934.64	1967.55	269.67	13026.21
1985	CH	Effort	237	237	237	237	237
1985	CH	CPUE	133.755	75.696	4.979	137.511	351.941
1985	CH	Catch	31.7	17.94	1.18	32.59	83.41
1985	FT	Effort	1778710	1778710	1778710	1778710	1778710
1985	FT	CPUE	0.319	0.776	0.249	0.333	1.676
1985	FT	Catch	566.52	1380.43	442.12	591.66	2980.73
1985	GN	Effort	300914	300914	300914	300914	300914
1985	GN	CPUE	0.743	0.079	0.482	0.009	1.313
1985	GN	Catch	223.61	23.74	144.95	2.74	395.04
1985	LL	Effort	183809	183809	183809	183809	183809
1985	LL	CPUE	0.011	0.004	3.340	0.016	3.370
1985	LL	Catch	2.03	0.77	614.42	2.96	620.18
1985	MS	Effort	229634	229634	229634	229634	229634
1985	MS	CPUE	5.110	29.270	3.600	1.030	39.020
1985	MS	Catch	1173.24	6721.9	826.51	237.66	8959.31
1985	SCN	Effort	1882	1882	1882	1882	1882
1985	SCN	CPUE	0.606	0.239	0.000	0.000	0.845
1985	SCN	Catch	1.14	0.45	0	0	1.59
1985	Total Catch		1998.24	8145.23	2029.18	867.61	13040.26

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1986	CH	Effort	57	57	57	57	57
1986	CH	CPUE	17.368	14.561	0.000	0.000	31.930
1986	CH	Catch	0.99	0.83	0	0	1.82
1986	FT	Effort	2487983	2487983	2487983	2487983	2487983
1986	FT	CPUE	0.417	0.853	0.158	0.518	1.946
1986	FT	Catch	1038.21	2121.77	392.84	1287.93	4840.75
1986	GN	Effort	539866	539866	539866	539866	539866
1986	GN	CPUE	0.845	0.008	0.264	0.033	1.150
1986	GN	Catch	456.14	4.44	142.31	17.8	620.69
1986	LL	Effort	137882	137882	137882	137882	137882
1986	LL	CPUE	0.188	0.000	4.156	0.060	4.410
1986	LL	Catch	25.94	0	573.02	8.96	607.92
1986	MS	Effort	48811	48811	48811	48811	48811
1986	MS	CPUE	33.201	86.221	9.504	27.776	156.701
1986	MS	Catch	1620.55	4208.54	463.89	1355.76	7648.74
1986	Total Catch		3141.83	6335.58	1572.06	2670.45	13719.92
1987	FT	Effort	2714161	2714161	2714161	2714161	2714161
1987	FT	CPUE	0.217	0.586	0.061	0.359	1.223
1987	FT	Catch	588.55	1591.24	165.8	973.57	3319.16
1987	GN	Effort	977445	977445	977445	977445	977445
1987	GN	CPUE	0.859	0.244	0.176	0.003	1.281
1987	GN	Catch	839.53	238.12	171.69	2.72	1252.06
1987	LL	Effort	220137	220137	220137	220137	220137
1987	LL	CPUE	0.032	0.007	2.686	0.059	2.784
1987	LL	Catch	7.06	1.58	591.33	12.89	612.86
1987	MS	Effort	44586	44586	44586	44586	44586
1987	MS	CPUE	12.266	17.724	5.770	27.066	62.826
1987	MS	Catch	546.91	790.23	257.25	1206.77	2801.16
1987	SCN	Effort	727	727	727	727	727
1987	SCN	CPUE	6.740	0.000	0.000	0.000	6.740
1987	SCN	Catch	4.9	0	0	0	4.9
1987	Total Catch		1986.95	2621.17	1186.07	2195.95	7990.14
1988	FT	Effort	2516675	2516675	2516675	2516675	2516675
1988	FT	CPUE	0.158	0.137	0.087	0.140	0.522
1988	FT	Catch	398.43	344.79	217.94	352.33	1313.49
1988	GN	Effort	1326166	1326166	1326166	1326166	1326166
1988	GN	CPUE	0.967	0.006	0.255	0.002	1.231
1988	GN	Catch	1282.94	8.55	333.55	3.19	1628.23
1988	LL	Effort	403838	403838	403838	403838	403838
1988	LL	CPUE	0.064	0.031	1.270	0.033	1.424
1988	LL	Catch	25.74	12.58	512.66	13.25	575.14
1988	MS	Effort	143006	143006	146006	143006	143006
1988	MS	CPUE	5.360	8.420	1.460	7.150	22.390
1988	MS	Catch	766.69	1204.34	208.96	1022.37	3202.36
1988	Total Catch		2473.8	1570.26	1273.11	1391.14	6708.31
1989	FT	Effort	2038167	2038167	2038167	2038167	2038167
1989	FT	CPUE	0.233	0.542	0.031	0.144	0.949
1989	FT	Catch	475.09	1103.96	63.51	292.55	1935.11

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1989	GN	Effort	1627006	1627006	1627006	1627006	1627006
1989	GN	CPUE	0.828	0.013	0.117	0.007	0.965
1989	GN	Catch	1346.46	21.92	190.84	10.77	1569.99
1989	LL	Effort	178448	178448	178448	178448	178448
1989	LL	CPUE	0.051	0.000	1.693	0.126	1.870
1989	LL	Catch	9.18	0	302.08	22.41	333.67
1989	MS	Effort	152962	152962	152962	152962	152962
1989	MS	CPUE	4.216	12.237	0.651	3.542	20.646
1989	MS	Catch	644.93	1871.73	99.56	541.86	3158.08
1989	SCN	Effort	15621	15621	15621	15621	15621
1989	SCN	CPUE	1.679	0.000	0.000	0.000	1.679
1989	SCN	Catch	26.22	0	0	0	26.22
1989	Total Catch		2501.88	2997.61	655.99	867.59	7023.07
1990	FT	Effort	3320645	3320645	3320645	3320645	3320645
1990	FT	CPUE	0.149	0.492	0.019	0.139	0.799
1990	FT	Catch	495.38	1634.18	63.18	460.55	2653.29
1990	GN	Effort	1058060	1058060	1058060	1058060	1058060
1990	GN	CPUE	1.308	0.000	0.595	0.031	1.934
1990	GN	Catch	1383.54	0	629.76	33.01	2046.31
1990	LL	Effort	370208	370208	370208	370208	370208
1990	LL	CPUE	0.182	0.020	1.629	0.026	1.858
1990	LL	Catch	67.28	7.42	603.25	9.73	687.68
1990	MS	Effort	81504	81504	81504	81504	81504
1990	MS	CPUE	8.121	163.540	1.148	49.234	222.043
1990	MS	Catch	661.92	13329.16	93.53	4012.77	18097.38
1990	SCN	Effort	17698	17698	17698	17698	17698
1990	SCN	CPUE	4.202	0.005	0.160	0.000	4.367
1990	SCN	Catch	74.37	0.08	2.83	0	77.28
1990	Total Catch		2682.49	14970.84	1392.55	4516.06	23561.94
1991	FT	Effort	2498845	2498845	2498845	2498845	2498845
1991	FT	CPUE	0.160	0.027	0.027	0.049	0.264
1991	FT	Catch	400.67	67.62	68.08	122.65	659.02
1991	GN	Effort	1312068	1312068	1312068	1312068	1312068
1991	GN	CPUE	0.757	0.002	0.176	0.004	0.938
1991	GN	Catch	992.68	2.76	231.05	4.72	1231.21
1991	HL	Effort	3860	3860	3860	3860	3860
1991	HL	CPUE	2.453	0.000	1.140	0.158	3.751
1991	HL	Catch	9.47	0	4.4	0.61	14.48
1991	LL	Effort	608084	608084	608084	608084	608084
1991	LL	CPUE	0.099	0.063	0.772	0.383	1.318
1991	LL	Catch	60.4	38.56	469.69	232.63	801.28
1991	MS	Effort	466661	466661	466661	466661	466661
1991	MS	CPUE	3.167	3.929	0.186	2.546	9.828
1991	MS	Catch	1477.96	1833.41	86.97	1187.93	4586.27
1991	SCN	Effort	46370	46370	46370	46370	46370
1991	SCN	CPUE	2.088	0.000	0.004	0.000	2.093
1991	SCN	Catch	96.83	0	0.2	0	97.03
1991	Total Catch		3038.01	1942.35	860.39	1548.54	7389.29

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1992	FT	Effort	2589284	2589284	2589284	2589284	2589284
1992	FT	CPUE	0.170	0.027	0.125	0.046	0.368
1992	FT	Catch	441.33	69.68	322.83	118.83	952.67
1992	GN	Effort	2664134	2664134	2664134	2664134	2664134
1992	GN	CPUE	0.471	0.021	0.140	0.095	0.727
1992	GN	Catch	1253.93	54.67	374.13	252.78	1935.51
1992	LL	Effort	571198	571198	571198	571198	571198
1992	LL	CPUE	0.022	0.077	1.712	0.050	1.860
1992	LL	Catch	12.54	43.91	977.81	28.41	1062.67
1992	MS	Effort	1105213	1105213	1105213	1105213	1105213
1992	MS	CPUE	1.456	2.134	0.359	1.850	5.799
1992	MS	Catch	1609.32	2358.06	397.02	2044.75	6409.15
1992	SCN	Effort	215716	215716	215716	215716	215716
1992	SCN	CPUE	0.382	0.004	0.051	0.000	0.436
1992	SCN	Catch	82.3	0.76	10.93	0	93.99
1992	Total Catch		3399.42	2527.08	2082.72	2444.77	10453.99
1993	FT	Effort	3026998	3026998	3026998	3026998	3026998
1993	FT	CPUE	0.050	0.183	0.048	0.119	0.400
1993	FT	Catch	152.4	554.37	143.93	359.08	1209.78
1993	GN	Effort	1358814	1358814	1358814	1358814	1358814
1993	GN	CPUE	0.402	0.040	0.436	0.028	0.907
1993	GN	Catch	546.7	53.97	592.9	38.58	1232.15
1993	LL	Effort	4453083	4453083	4453083	4453083	4453083
1993	LL	CPUE	0.027	0.064	0.266	0.000	0.357
1993	LL	Catch	120.5	285.53	1183.14	0	1589.17
1993	MS	Effort	990652	990652	990652	990652	990652
1993	MS	CPUE	0.696	4.520	0.694	0.915	6.825
1993	MS	Catch	689.56	4477.33	687.14	906.87	6760.9
1993	SCN	Effort	14590	14590	14590	14590	14590
1993	SCN	CPUE	0.430	0.705	0.005	0.096	1.236
1993	SCN	Catch	6.28	10.28	0.08	1.4	18.04
1993	Total Catch		1515.44	5381.48	2607.19	1305.93	10810.04
1994	FT	Effort	1437342	1437342	1437342	1437342	1437342
1994	FT	CPUE	0.017	0.197	0.122	0.163	0.499
1994	FT	Catch	24.88	282.87	175.81	234.32	717.88
1994	GN	Effort	2329292	2329292	2329292	2329292	2329292
1994	GN	CPUE	2.491	0.448	1.441	0.013	4.393
1994	GN	Catch	402.04	57.28	405.97	1.75	867.04
1994	HL	Effort	93	93	93	93	93
1994	HL	CPUE	0.000	0.000	0.000	13.441	13.441
1994	HL	Catch	0	0	0	1.25	1.25
1994	LL	Effort	4116061	4116061	4116061	4116061	4116061
1994	LL	CPUE	0.000	0.000	0.135	0.000	0.135
1994	LL	Catch	0	0.15	554.96	0	555.11
1994	MS	Effort	1742951	1742951	1742951	1742951	1742951
1994	MS	CPUE	0.337	3.381	0.523	0.321	4.562
1994	MS	Catch	586.59	5893.4	911.97	559.59	7951.55

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1994	SCN	Effort	218518	218518	218518	218518	218518
1994	SCN	CPUE	0.098	0.051	0.000	0.140	0.289
1994	SCN	Catch	21.5	11.15	0	30.55	63.2
1994	Total Catch		1035.01	6244.85	2048.71	827.46	10156.03
1995	CATCH		6.37	26.47	1295.52	0	1328.36
1995	FT	Effort	33259	33259	33259	33259	33259
1995	FT	CPUE	0.144	0.131	0.885	0.000	1.160
1995	FT	Catch	4.8	4.37	29.42	0	38.59
1995	GN	Effort	582331	582331	582331	582331	582331
1995	GN	CPUE	0.001	0.000	0.374	0.000	0.375
1995	GN	Catch	0.57	0	217.85	0	218.42
1995	LL	Effort	2858996	2858996	2858996	2858996	2858996
1995	LL	CPUE	0.000	0.000	0.026	0.000	0.026
1995	LL	Catch	0	0	73.08	0	73.08
1995	MS	Effort	389060	389060	389060	389060	389060
1995	MS	CPUE	0.003	0.057	2.506	0.000	2.566
1995	MS	Catch	1	22.1	975.17	0	998.27
1997	CHO	Effort	456131	456131	456131	456131	456131
1997	CHO	CPUE	0.000	0.000	0.073	0.000	0.073
1997	CHO	Catch	0	0	33.45	0	33.45
1997	FT	Effort	623975	623975	623975	623975	623975
1997	FT	CPUE	0.015	0.076	0.047	0.025	0.163
1997	FT	Catch	9.38	47.7	29.1	15.57	101.75
1997	GN	Effort	242724	242724	242724	242724	242724
1997	GN	CPUE	0.416	0.000	0.219	0.017	0.653
1997	GN	Catch	101.06	0	53.2	4.12	158.38
1997	LL	Effort	17265	17265	17265	17265	17265
1997	LL	CPUE	0.000	0.000	1.823	0.000	1.823
1997	LL	Catch	0	0	31.47	0	31.47
1997	MS	Effort	116675	116675	116675	116675	116675
1997	MS	CPUE	1.838	3.696	0.841	0.000	6.376
1997	MS	Catch	214.49	431.24	98.14	0	743.87
1997	Total Catch		324.93	478.94	245.36	19.69	1068.92
1998	CH	Effort	1014	1014	1014	1014	1014
1998	CH	CPUE	0.000	0.000	1.223	0.000	1.223
1998	CH	Catch	0	0	1.24	0	1.24
1998	CHO	Effort	2671015	2671015	2671015	2671015	2671015
1998	CHO	CPUE	0.000	0.000	0.093	0.000	0.094
1998	CHO	Catch	0.3	0.43	249.5	0.23	250.46
1998	FT	Effort	1819242	1819242	1819242	1819242	1819242
1998	FT	CPUE	0.038	0.115	0.090	0.015	0.258
1998	FT	Catch	69.09	209.33	162.86	27.34	468.62
1998	GN	Effort	1055610	1055610	1055610	1055610	1055610
1998	GN	CPUE	0.479	0.009	0.228	0.001	0.717
1998	GN	Catch	505.67	9.39	240.85	1.09	757
1998	LL	Effort	252829	252829	252829	252829	252829
1998	LL	CPUE	0.006	0.000	0.857	0.000	0.863
1998	LL	Catch	1.47	0	216.61	0	218.08

Year	Gear	statistic	Makumba	Matemba	Mlamba	Others	TOTAL
1998	MS	Effort	547758	547758	547758	547758	547758
1998	MS	CPUE	1.910	2.966	0.529	0.011	5.416
1998	MS	Catch	1046.22	1624.83	289.81	5.77	2966.63
1998	Total Catch		1622.75	1843.98	1160.87	34.43	4662.03
1999	CHO	Effort	28187548	28187548	28187548	28187548	28187548
1999	CHO	CPUE	0.001	0.000	0.116	0.000	0.117
1999	CHO	Catch	23.64	0	3281.72	0.93	3306.29
1999	FT	Effort	7273544	7273544	7273544	7273544	7273544
1999	FT	CPUE	0.065	0.127	0.072	0.001	0.266
1999	FT	Catch	472.31	925.35	527.22	9.64	1934.52
1999	GN	Effort	2859325	2859325	2859325	2859325	2859325
1999	GN	CPUE	0.696	0.000	0.348	0.001	1.045
1999	GN	Catch	1990.72	0	994.13	2.56	2987.41
1999	LL	Effort	223123	223123	223123	223123	223123
1999	LL	CPUE	0.000	0.000	2.330	0.000	2.330
1999	LL	Catch	0	0	519.87	0	519.87
1999	MS	Effort	725522	725522	725522	725522	725522
1999	MS	CPUE	1.561	3.074	0.627	0.000	5.262
1999	MS	Catch	1132.59	2230.35	454.67	0	3817.61
1999	Total Catch		3619.26	3155.7	5777.61	13.13	12565.7