



Government of Malawi  
Department of Fisheries

# **Analysis of Catch and Effort Data for the Fisheries of Lake Chiuta 1976-1999.**

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## Table of Contents

Introduction .....	2
Methods of data collection.....	2
Results and Discussion .....	3
Total Catch.....	3
Analysis by gear.....	5
Gear ownership.....	5
Gill nets .....	6
Fish traps .....	8
Long-lines .....	9
Analysis by Species .....	11
Makumba .....	11
Mlamba .....	11
Surplus production model.....	12
Conclusions and recommendations.....	13
Acknowledgements .....	13
References .....	14
Appendix I: Catch, effort and CPUE tables for Lake Chiuta, 1979 – 1999. ....	15

## Introduction

Lake Chiuta is a permanent lake (Tweddle, 1983) covering a mean area of 199km<sup>2</sup>, oscillating between a minimum area of 93km<sup>2</sup> and a maximum of 304km<sup>2</sup> according to season and rainfall. The depth of Lake Chiuta varies with season and the lake has a maximum depth of 3 to 4 metres. Found in Machinga District and Traditional Authority Chief Kawinga, it lies on the Malawi-Mozambique border between latitudes 14°40' and 14°56', and longitudes 35°47' and 35°55' a few kilometres to the north of Lake Chilwa. The lake is separated from Lake Chilwa by a sand bar some 15 – 25m higher than the present lake levels and has several terraces indicating higher water levels in the past. Lancaster (1979) suggests that Lake Chilwa became isolated from Lake Chiuta by the sand bar between 8,000 and 15,000 years ago. Dawson (1970) discussed the geology of Lake Chiuta area. Although the lake is smaller than Lake Chilwa, it has more fish species than the latter. The difference may be a result of a combination of high salinity, turbidity and other factors in Lake Chilwa, which may restrict the distribution of most species to the rivers and areas of fresher in-flowing water around the periphery of the lake during the rains.

According to the 1999 Frame Survey (Weyl *et al*, 2000), Lake Chiuta had 801 fishermen using 416 canoes and one plank-boat without an engine. The number of gear owners and crewmembers has declined by 28% and 80%, respectively, between 1995 and 1999. Similarly, the number of dugout canoes has declined from 812 in 1995 to 416 in 1999. The current gear utilisation in Lake Chiuta with the exception of 4 mosquito nets and 78 hand-lines is totally reliant on passive gears (Weyl *et al*, 2000). Tweddle (1982) reported that the development of a fishery on a large commercial scale was not feasible on Lake Chiuta, as engines could not be used since the entire lake was full of plants, which would necessitate frequent clearance of the propeller. The entire southern area of the lake is covered with emergent vegetation interspersed with channels permitting passage of canoes only. The only suitable fishing methods in this area are the passive gears such as gillnets, long-lines and fish traps owing to the plants and muddy bottom which prevent the use of other gears such as large seine nets.

The purpose of this report is to give an account of the catch and effort data in Lake Chiuta and to determine general trends in the fishery.

## Methods of data collection

Lake Chiuta is divided into two minor strata, 10.1 and 10.2 (Figure 1). Catch and effort data has been monitored on the lake since the late 1970's and assessment of the catch has been done using the Catch Assessment Survey (CAS) developed by Bazigos (1972) and implemented by Walker (1974; 1976). This utilises a stratified sampling procedure and is boat based. The method for the system and its associated problems are documented and presented elsewhere (Bazigos, 1972, Walker, 1974; 1976). Total catch and fishing effort for each area are estimated by combining data obtained in the monthly catch assessment surveys (CAS) and in annual frame surveys. All catch and effort data by species group and gear for the period 1979-1999 are presented in Appendix 1. It should be pointed out however that data collection in Lake Chiuta has not been systematic. In other years, data was reported for one minor stratum only and also not covering the whole year. In such scenarios, data was extrapolated from other data.

To obtain estimates for maximum sustainable yield (MSY), techniques described in Sparre and Venema (1992) were applied to fit Schaefer (Graham 1935) and Fox (Fox 1970) surplus production models to catch and effort data.

**Table 1.** Names of fish species recorded by beach recorders in Lake Chiuta

Name	Species
Makumba	<i>Oreochromis shiranus shiranus</i> .
Matemba	Various small <i>Barbus</i> spp. and <i>Alestes imberi</i>
Mlamba	<i>Clarias gariepinus</i> and <i>Clarias theodorae</i>
Others	All other species including <i>Synodontis</i> spp., <i>Astatotilapia</i> sp., <i>Tilapia rendalli</i> and <i>Marcusenius macrolepidotus</i>

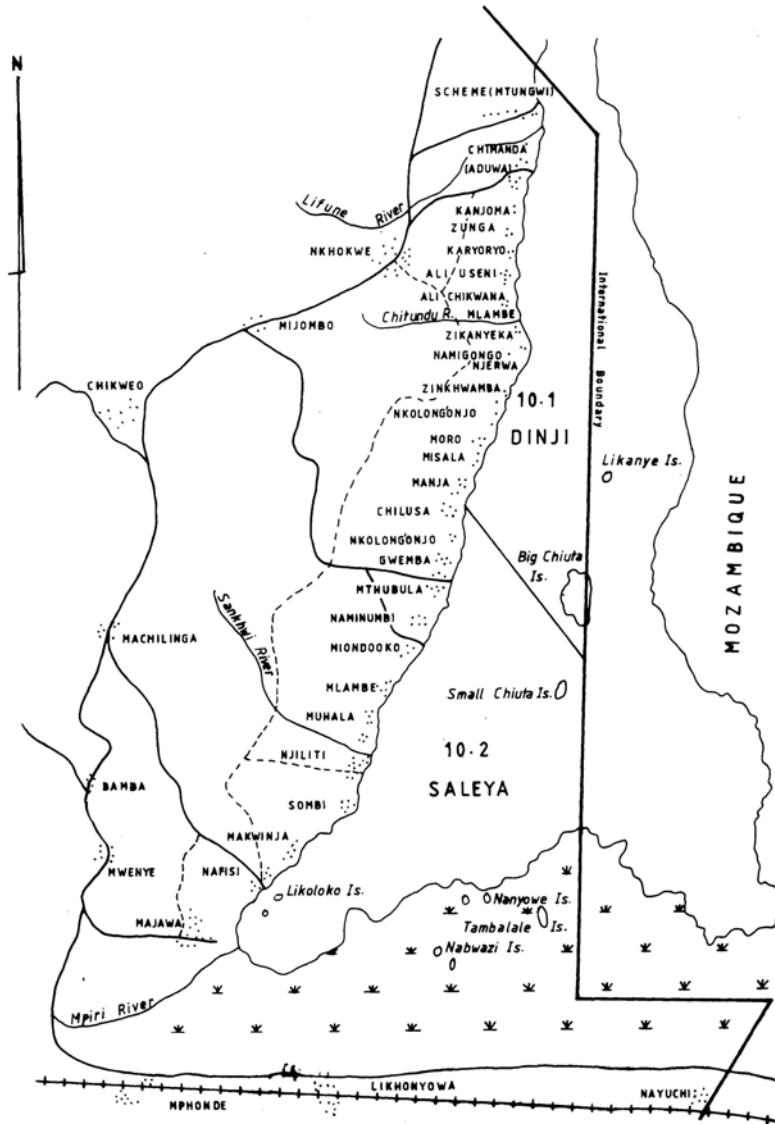


Figure 1. Map of statistical strata in Lake Chiuta

## Results and Discussion

### Total Catch

Tarbit, 1972 first roughly assessed the fishery of Lake Chiuta. He noticed only 36 fish trader establishments and estimated that they were exporting some 60 tons of *Oreochromis shiranus* (makumba) per month, while mormyrids, catfish and *Barbus* were being utilised by the locals. Chipwete (1973) did a detailed survey relating to the size structure and area distribution of the fishery in November 1973 and results were analysed by Walker in 1974. Snucins' (1975) report made many useful observations on the actual methods of fishing for the various gears, which was not available on Chipwete's 1973 frame survey.

The Department of Fisheries has monitored the fisheries of Lake Chiuta since the late 1970s. Since then, the fishery has undergone dramatic changes both in gear ownership, utilisation and catch composition. Total estimated catch over the 21-year period show an increasing trend (Figure2). Estimated catches ranged from some 700 tons to 5000 tons with an average of 2000 tons. Makumba dominated the total catch with a mean contribution of 76% (Figure 3). The contribution of mlamba to the total catch has increased from the 1990s (Fig.2)

The main contributors to the total catch were gillnets and fish traps (Figure 5), contributing 95% and 3% respectively. Contribution of the other gears to the total catch has changed over time. Gillnets were the main gears in the early 1980s. Fish traps and other gears' contribution increased in the late 1980s and by the early 1990s, their contribution was almost similar to that of gillnet (Figure 4).

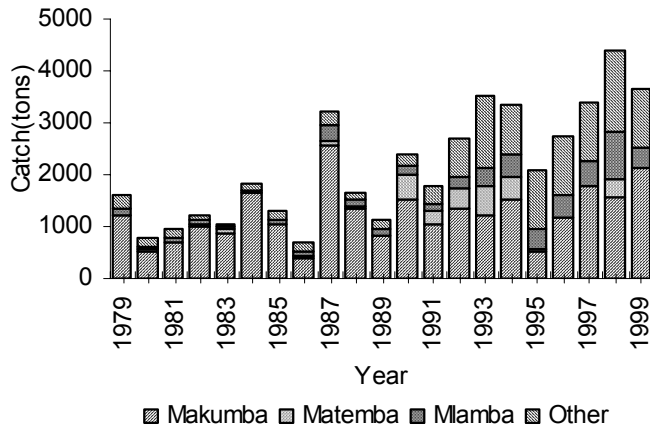


Figure 2. Total annual catch by Species group for all gears in Lake Chiuta 1979-1999.

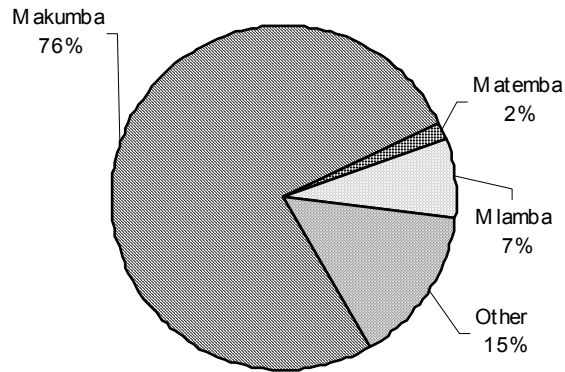
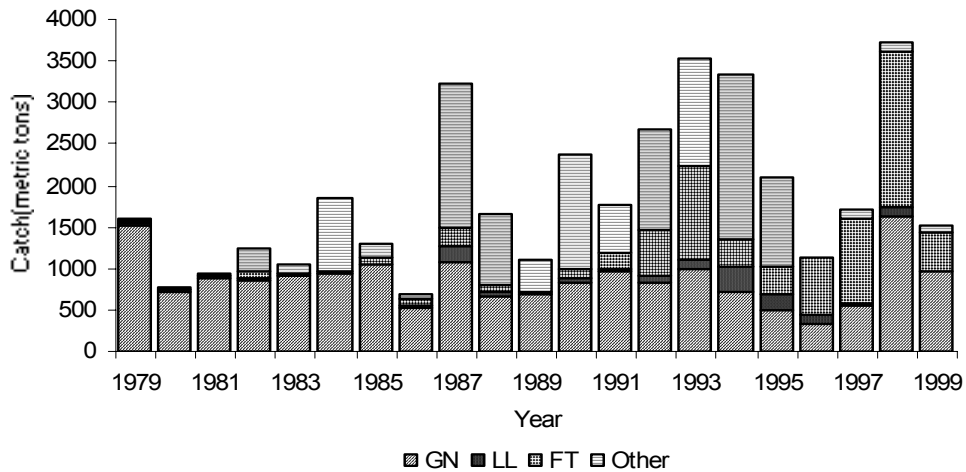
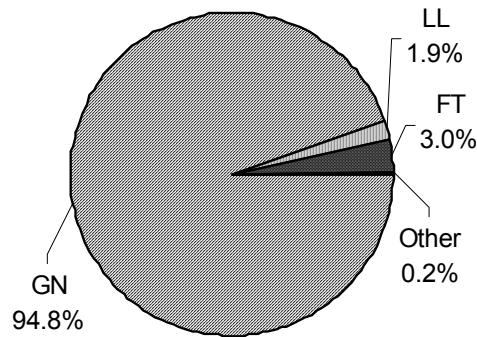


Figure 3. Species group contribution to the total lake Chiuta catch 1979-1999.



**Figure 4.** Contribution of the different fishing gears to the total catch 1979-99

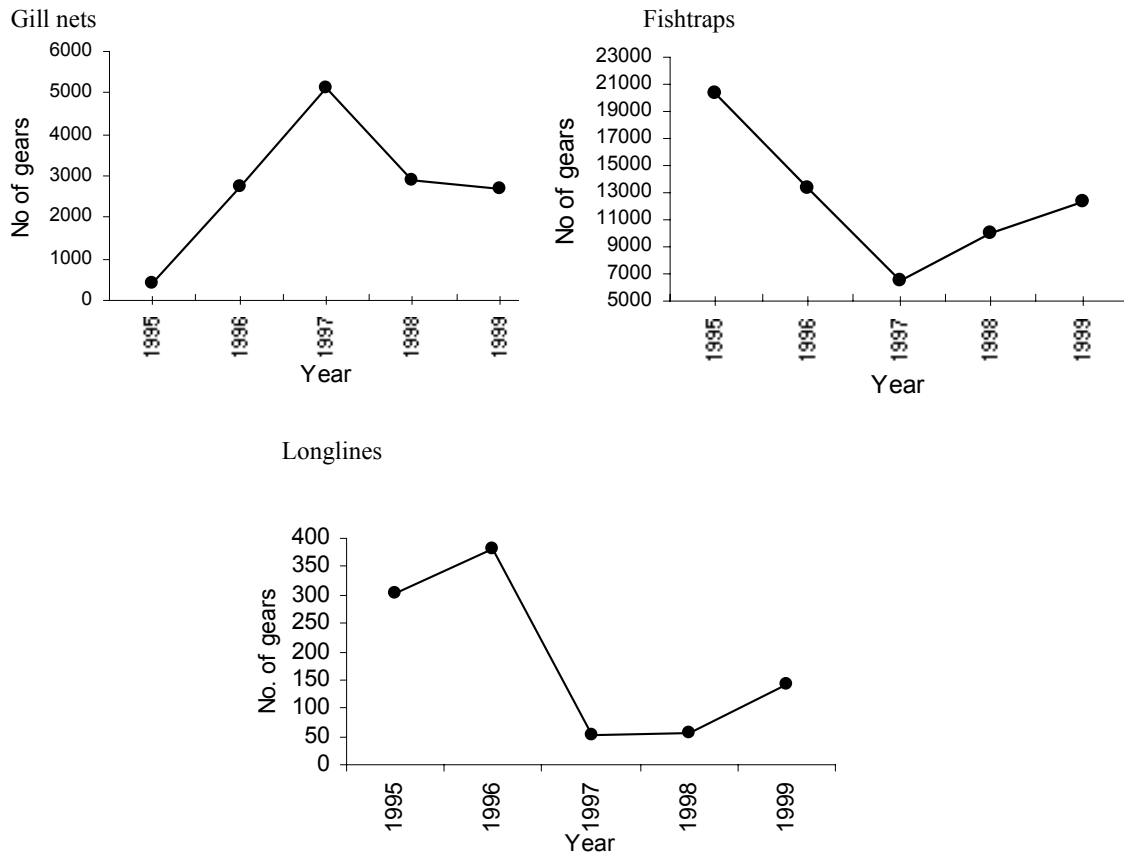


**Figure 5.** Percentage contribution by different gears to the total Lake Chiuta catch 1979-99

### Analysis by gear

#### Gear ownership

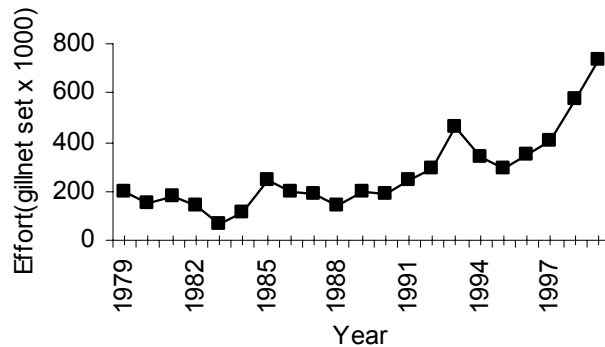
Trends in the number of fishing gears in Lake Chiuta are shown in Figure 6. In the gillnet fishery, an increasing trend in gear ownership in the mid 1990s was followed by a sudden decline from 5000 nets in 1997 to 2000 in the following year and has remained stable afterwards. Hand-line and Long-line ownership has fluctuated very much, the number has increased from none in 1995 to 78 in 1999 for hand-lines and a decrease from 304 in 1995 to 142 in 1999 for the long-lines. A declining trend in the ownership of fish traps in the mid 1990s was followed by an increase in the late 1990s. The number declined from 20 thousand in 1995 to 6 thousand in 1997 and increased in the following years to 12 thousand in 1999. There is however an abrupt increase in the numbers of Chomanga and Kwakwaza from none in 1995 to a thousand in 1999. This could be due to non-recording of the gears prior to 1997 (Weyl *et al.* 2000). The 1998 frame survey, counted 1020 kwakwaza and in 1999 frame survey, 1950 chomanga were recorded.



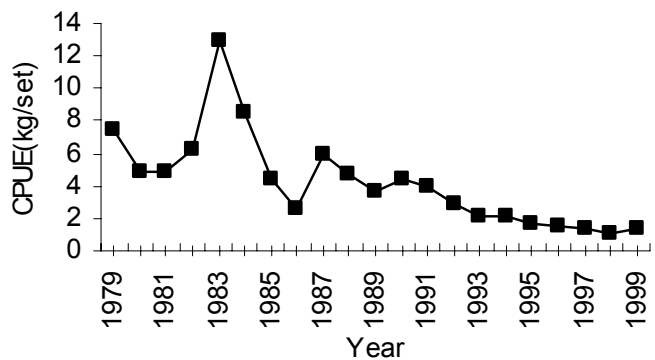
**Figure 6.** Temporal trends in the number of major fishing gears in Lake Chiuta 1995-99

**Gill nets**

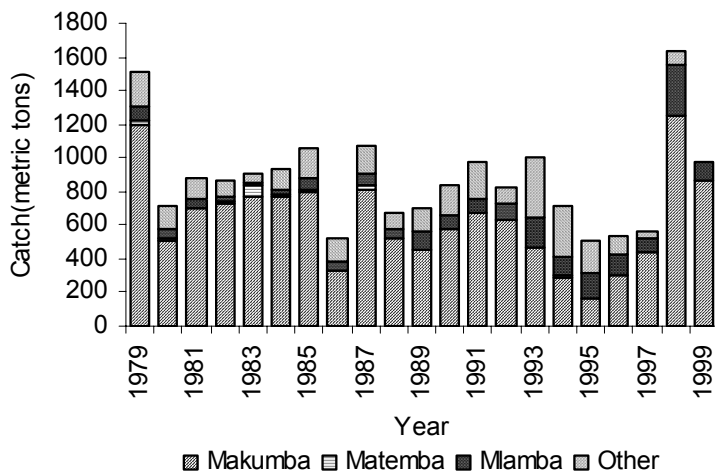
The current utilisation of gillnets in Lake Chiuta is as a passive gear (Weyl *et al.* 2000). The number of gillnets has increased almost seven-fold from 399 in 1995 to 2680 in 1999 (Figure 6), although the highest number was recorded in 1997 (5143). Annual effort, CPUE estimates and catch composition are shown in Figures 7,8 & 9. Total gillnet annual catches have remained relatively stable over the 21-year period although 1995 recorded the lowest catch (Figure 9). This is because recording was only done for one minor stratum. Makumba fishery dominated the total Lake Chiuta catch (80%) Figure 10. The increase in ownership of this fishery has also a very remarkable influence on its annual effort and CPUE (Figure 6). Effort shows an overall increase over the 21-year period (Figure 7). Estimates of gillnet CPUE shows an overall declining trend in the 1990s from previously high levels in the early 1980s (Figure 8). This could mainly be attributed to increasing fishing pressure in the 1990s. A plot of CPUE against effort in the gillnet fishery shows a declining catch per unit effort (CPUE) with an increase in effort (Figure 11).



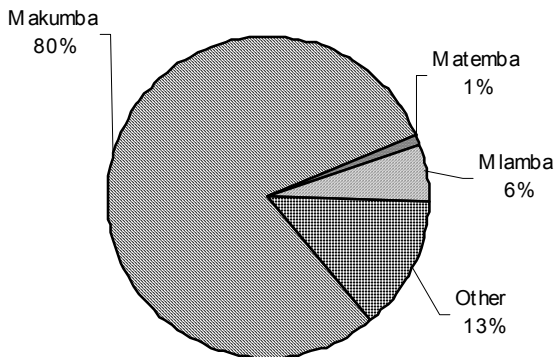
**Figure 7.** Annual effort, in gillnet sets for the period 1979-1999 in Lake Chiuta.



**Figure 8.** CPUE (kg/gillnet set) for the period 1979-1999 in Lake Chiuta

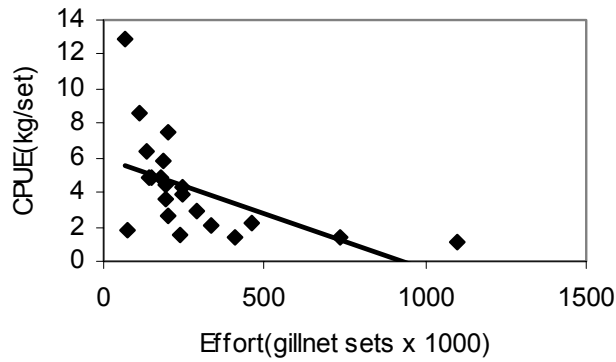


**Figure 9.** Total catch and species composition in the gillnet fishery of L.Chiuta 1979-99



**Figure 10.** Gillnet Catch by species for the period 1979 - 1999

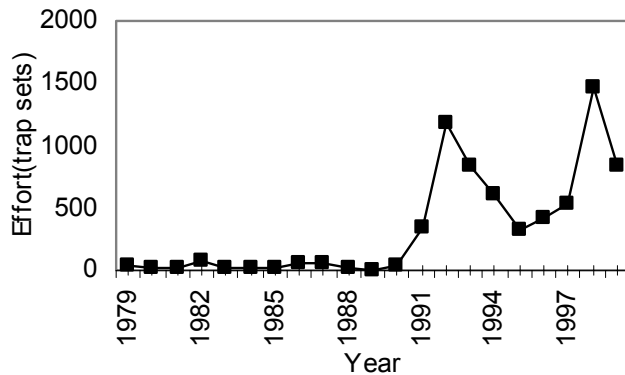




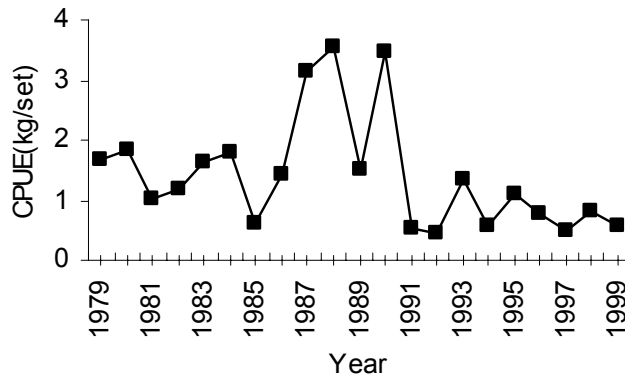
**Figure 11.** Relationship between gillnet CPUE (kg/ set) and effort (gillnet sets x 1000)

### Fish traps

Fish traps are generally funnel-valve traps and are set in shallow riverine or lake areas (Weyl *et al.* 2000). The number of fish traps has remained relatively stable in the region of some 12000 units (Figure 6) although 1997 recorded the lowest number of units (792). Annual effort, CPUE and catch composition, are shown in Figures 12, 13 & 14. Total fish trap catches have increased from an average of 64 tons in the 1980s to 670 tons in the 1990s (Figure 14). Effort has also increased from low levels in the 1980s to high levels in the 1990s (Figure 12). It is evident therefore that the increase in total catch in fish traps is a result of the increasing effort. Catch per unit effort (CPUE) increased considerably in the mid 1980s but declined rapidly in the early 1990s and has remained at that low level (Figure 13). The species composition of the fish trap fishery shows that other species, which have very little commercial importance (Figure 15), dominate the catch (63%).



**Figure 12.** Fish trap annual effort for the period 1979 – 1999 in Lake Chiuta.



**Figure 13.** Fish trap CPUE (kg/ fish trap set) for Lake Chiuta for the period 1979-99

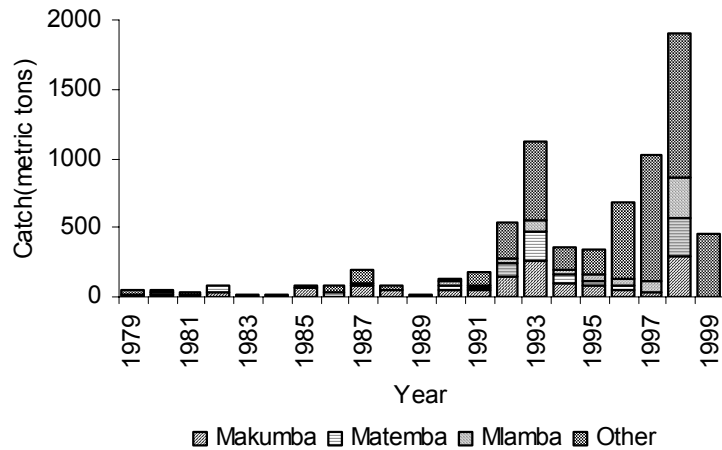


Figure 14. Fish trap annual catch by species for Lake Chiuta for the period 1979-99.

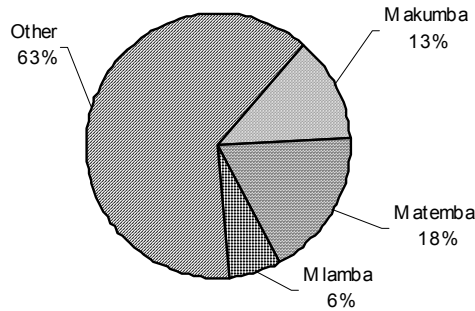


Figure 15. Contribution by species to the total catch in fish traps in L. Chiuta 1979-99.

### Long-lines

Long-lines are passive gears that are weighted to the bottom, set overnight and lifted the following morning (Weyl *et al.* 2000). The number of long-lines has halved from 304 in 1995 to 142 in 1999 (Figure 6). Annual effort, CPUE and catch composition, are shown in figures 16, 17 & 18. Effort in long-lines has generally been very low (Figure 16). The high values in the early to mid 1990s, is a direct reflection of the increase in ownership of the gear within the same period. CPUE has responded inversely to effort trends i.e. declining CPUE with increasing effort and increasing CPUE with declining effort (Figure 17)

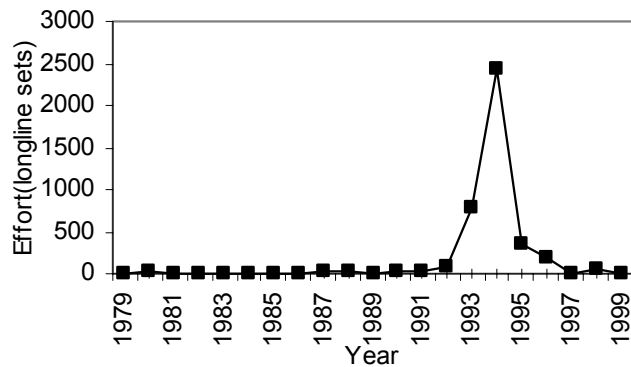


Figure 16. Long-line annual effort (100 hook set) for the period 1979-1999 in Lake Chiuta

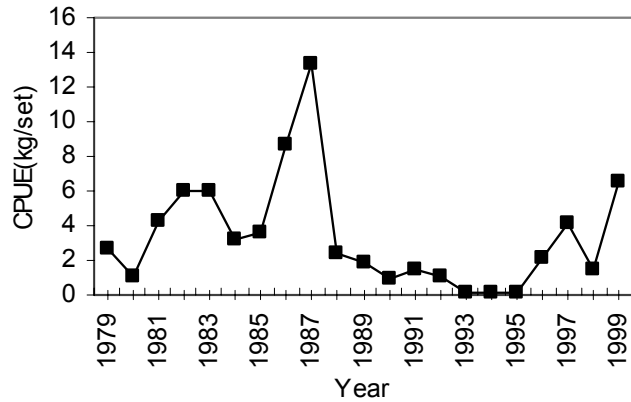


Figure 17. Long line annual CPUE (Kg per 100 hook set) for the period 1979- 1999 in Lake Chiuta

Total annual catches in long-lines have fluctuated very greatly (Figure 18). Catches were very low in the 1980s with an average catch of 35 tons. Catches improved in the 1990s and reached an average of 93 tons. Species composition of the long-lines shows that mlamba dominates the total catch with an average contribution over the 21-year period of 67% (Figure 19).

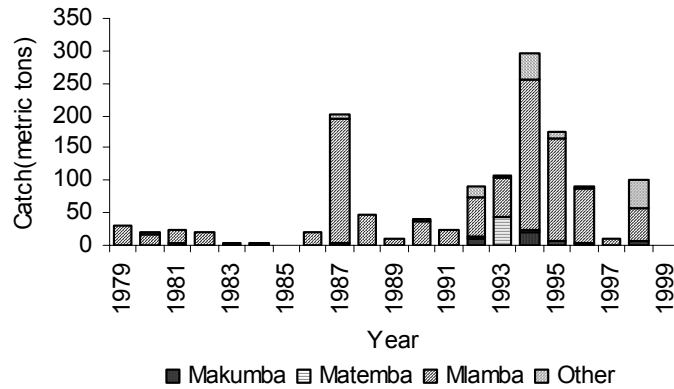


Figure 18. Long-line catch by species for Lake Chiuta from 1979-1999

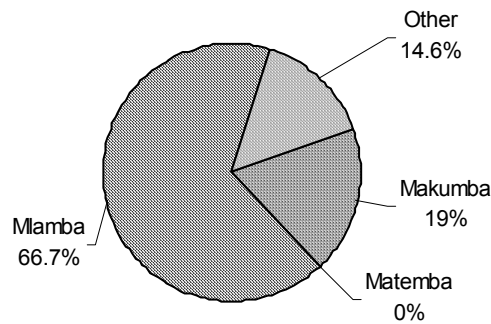


Figure 19. Contribution by species to long-line total catches for the period 1979-1999

## Analysis by Species

### Makumba

The main harvesting gear for makumba in Lake Chiuta were the gill nets and contributed over 90% to the total makumba catch (Figure 20). Makumba species have been the dominating catch in all the years in Lake Chiuta. Catches have been relatively stable i.e. an average of 700 tons in the 1980s and 660 tons in the 1990s although in other years, catches have been low. Trends in CPUE in the makumba fishery of Lake Chiuta are shown in figure 21. Catch per unit effort for makumba in the gill net fishery, have declined in the 1990s from high levels in the 1980s. The stability in the total catch for makumba is a result of high effort levels in the main harvesting gears.

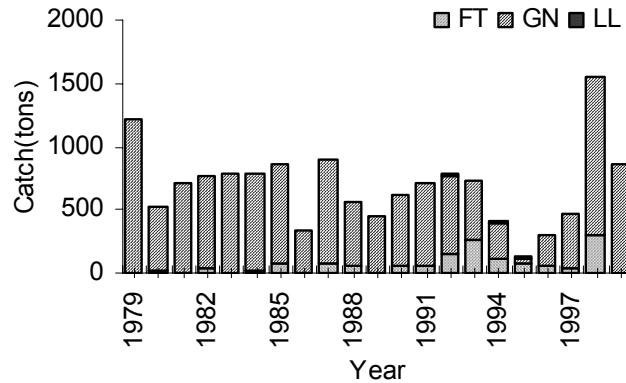


Figure 20. Total Makumba catch by gear in Lake Chiuta from 1979-1999

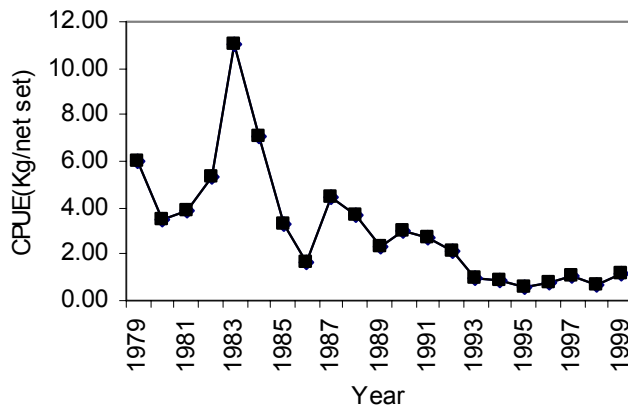


Figure 21. Makumba CPUE in the gillnet fishery in L. Chiuta

### Mlamba

The main harvesting gear for mlamba were the gill nets and the longlines, which contributed over 95% to the total mlamba catch (Figure 22). On the overall, mlamba catches have increased from an average of 92 tons in the 1980s to 250 tons in the 1990s and fish trap contribution has increased (Figure 23). CPUE was very high in the mid 1980s but declined drastically in the late 1980s to early 1990s (Figure 24)

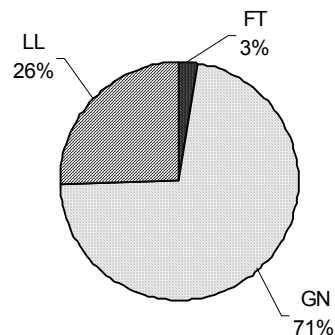


Figure 22. Contribution by gears to the total mlamba catch in Lake Chiuta for the period 1979-1999.

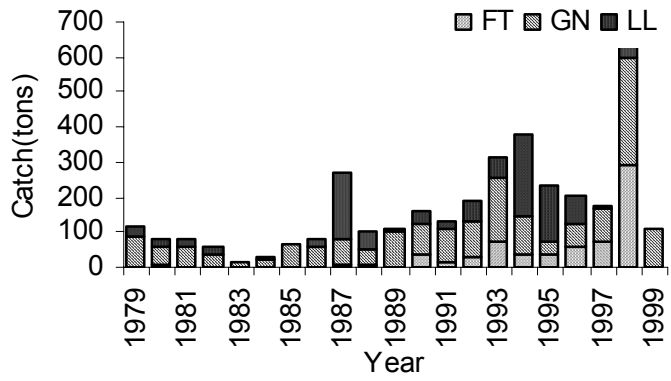


Figure 23. Total Mlamba catch by gear in Lake Chiuta from 1979-1999

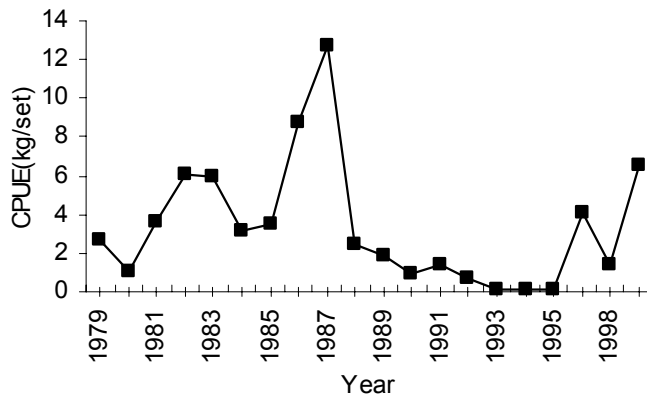


Figure 24. Mlamba CPUE (Kg per net set) in the long-line fishery in L. Chiuta from 1979-1999.

**Surplus production model**

Fox surplus production model for CPUE and effort for the fishery of Lake Chiuta over the 21-year period gives a significant plot ( $p < 0.05$ ,  $r^2 = 0.41$ , Figure 25). The resulting catch-effort plot is shown in figure 26. Maximum sustainable yield (MSY) is estimated at 2339 tons, which is reached at an effort level  $f_{MSY}$  of 5000. It is however evident that MSY of 2000 tons and effort of 5000 was exceeded in the late 1980s and early 1990s. Effort declined from 1994 but has also increased since 1996 with minimal effect on the catch.

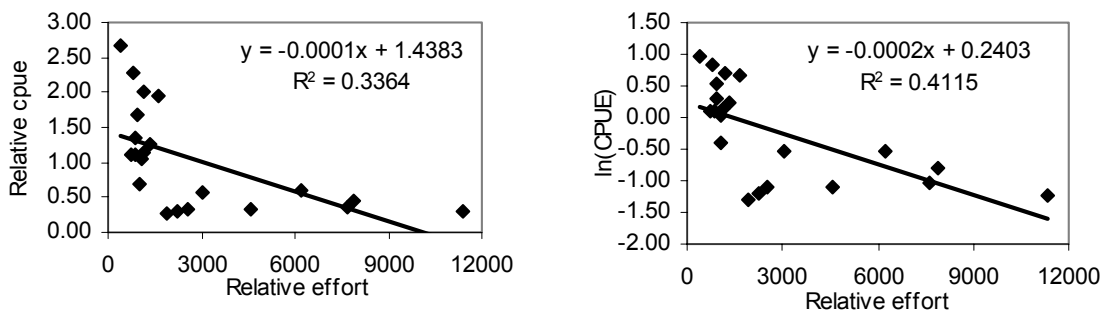


Figure 25. Regressions of CPUE and ln (CPUE) against effort in the Makumba fishery of Lake Chiuta

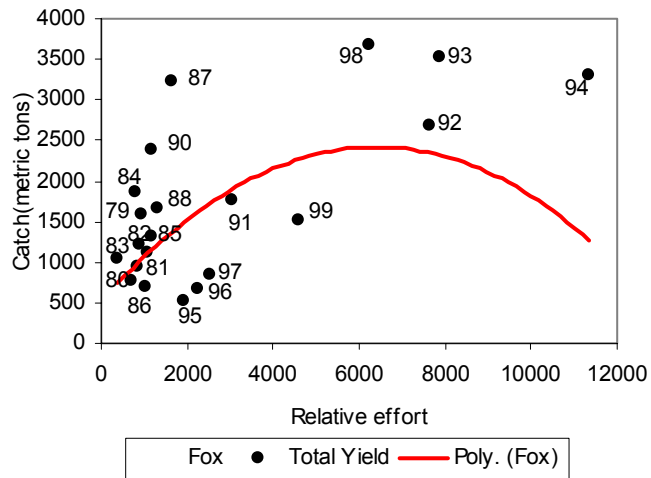


Figure 26. Fox model fit to catch and effort data for Lake Chiuta 1979-1999.

### Conclusions and recommendations

Total catch in Lake Chiuta appears to be increasing from some 700 to 5000 tons. The main contributors were the gill net fisheries and makumba seemed to have dominated the catch. Catches increased in the late 1980s and remained high in the 1990s with an exception of 1995 when a sudden decline was observed.

Effort in the 1980s remained at a low level until in the 1990s when it increased to, much higher levels.

CPUE, on the other hand has declined to, much low levels. Although low CPUE has been experienced, catches have remained high. This is mainly due to high effort increases in the fishery. The current level of exploitation however may not be sustainable. Therefore a reduction in effort in order to restore fish stocks is recommended. It should be noted however that data for the Mozambican side of the lake is not available.

There is a need to find proper ways of reducing effort since the fishery is open entry although a licence is formally needed for operation.

Technically, the minimum mesh size for gill nets operating in Lake Chiuta is 64mm (2½”), beach seines and nkacha are prohibited gears

### Acknowledgements

This work would not have been possible had it not been for the good work and assistance of the Zomba District and MAFRI statistics personnel. Your assiduous work has not been taken for granted. The publication of this report has been made possible and facilitated by the GTZ supported National Aquatic Resource Management Programme (NARMAP)

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**Appendix I: Catch, effort and CPUE tables for Lake Chiuta, 1979 – 1999.**

**Notes for tables**

CPUE=	Catch Per Unit Effort expressed as kg per unit effort
Catch & Total catch=	tons
GN=	Gill net; effort in net sets
FT=	Fish trap; effort in net sets
LL=	Long line; effort in 100 hook sets

Local and Scientific names of some of the fish species found in Lake Chiuta

<u>Local name</u>	<u>Scientific name</u>
Makumba	<i>Oreochromis shiranus shiranus</i> (Boulenger)
Matemba	<i>Barbus paludinosus</i> (Peters)
	<i>Alestes imberi</i> (Peters)
Mlamba	<i>Clarias gariepinus</i> (Burchell)
	<i>Clarias theodorae</i> (Weber)
Others	
Nkholokolo	<i>Synodontis spp.</i>
Chidondolo	<i>Astatotilapia sp.</i> (Günther)
Chinguni	<i>Tilapia rendalli</i> (Boulenger)
Mphuta	<i>Marcusenius macrolepidotus</i> (Peters)
	<i>River Goby</i>



**Appendix I: Catch, effort and CPUE tables for Lake Chiuta, 1979 – 1999.**

Year	Gear	Statistic	Makumba	Matemba	Mlamba	Other	TOTAL	comment
1979	FT	Catch	6.24	8.80	3.04	30.15	48.23	
1979	FT	Effort	28842.00	28842.00	28842.00	28842.00	28842.00	
1979	FT	CPUE	0.22	0.31	0.11	1.05	1.67	
1979	GN	Catch	1202.24	17.77	84.65	202.41	1507.07	
1979	GN	Effort	200272.00	200272.00	200272.00	200272.00	200272.00	
1979	GN	CPUE	6.00	0.09	0.42	1.01	7.53	
1979	LL	Catch	0.58	0.00	30.20	0.00	30.78	
1979	LL	Effort	11317.00	11317.00	11317.00	11317.00	11317.00	
1979	LL	CPUE	0.05	0.00	2.67	0.00	2.72	
1979	Total catch		1209.06	26.57	117.89	232.56	1586.08	
1980	FT	Catch	24.25	6.51	6.94	3.48	41.18	
1980	FT	Effort	22540.00	22540.00	22540.00	22540.00	22540.00	
1980	FT	CPUE	1.08	0.29	0.31	0.15	1.83	
1980	GN	Catch	506.69	9.65	54.15	145.46	715.95	
1980	GN	Effort	146542.00	146542.00	146542.00	146542.00	146542.00	
1980	GN	CPUE	3.46	0.07	0.37	0.99	4.89	
1980	LL	Catch	0.31	0.00	17.31	1.48	19.10	
1980	LL	Effort	17305.00	17305.00	17305.00	17305.00	17305.00	
1980	LL	CPUE	0.02	0.00	1.00	0.09	1.10	
1980	Total catch		531.25	16.16	78.40	150.42	776.23	
1981	FT	Catch	6.73	8.73	0.72	12.62	28.80	
1981	FT	Effort	27960.00	27960.00	27960.00	27960.00	27960.00	
1981	FT	CPUE	0.24	0.31	0.03	0.45	1.03	
1981	GN	Catch	694.72	2.25	56.77	127.46	881.20	
1981	GN	Effort	179877.00	179877.00	179877.00	179877.00	179877.00	
1981	GN	CPUE	3.86	0.01	0.32	0.71	4.90	
1981	LL	Catch	2.90	0.00	21.59	0.61	25.10	
1981	LL	Effort	5885.00	5885.00	5885.00	5885.00	5885.00	
1981	LL	CPUE	0.49	0.00	3.67	0.10	4.27	
1981	Total catch		704.35	10.98	79.08	140.69	935.10	
1982	FT	Catch	37.69	38.31	2.80	8.13	86.93	
1982	FT	Effort	73390.00	73390.00	73390.00	73390.00	73390.00	
1982	FT	CPUE	0.51	0.52	0.04	0.11	1.18	
1982	GN	Catch	735.05	3.13	34.02	92.22	864.42	
1982	GN	Effort	136900.00	136900.00	136900.00	136900.00	136900.00	
1982	GN	CPUE	5.37	0.02	0.25	0.67	6.31	
1982	LL	Catch	0.00	0.00	21.06	0.00	21.06	
1982	LL	Effort	3500.00	3500.00	3500.00	3500.00	3500.00	
1982	LL	CPUE	0.00	0.00	6.02	0.00	6.02	
1982	Total catch		772.74	41.44	57.88	100.35	972.41	
1983	FT	Catch	8.81	5.59	1.45	1.62	17.47	
1983	FT	Effort	10581.00	10581.00	10581.00	10581.00	10581.00	
1983	FT	CPUE	0.83	0.53	0.14	0.15	1.65	
1983	GN	Catch	773.35	63.97	12.31	56.47	906.10	
1983	GN	Effort	69955.00	69955.00	69955.00	69955.00	69955.00	
1983	GN	CPUE	11.05	0.91	0.18	0.81	12.95	
1983	LL	Catch	0.00	0.00	3.83	0.00	3.83	
1983	LL	Effort	641.00	641.00	641.00	641.00	641.00	
1983	LL	CPUE	0.00	0.00	5.98	0.00	5.98	
1983	Total catch		782.16	69.56	17.59	58.09	927.40	
1984	FT	Catch	16.65	0.03	0.59	0.52	17.79	
1984	FT	Effort	9903.00	9903.00	9903.00	9903.00	9903.00	
1984	FT	CPUE	1.68	0.00	0.06	0.05	1.80	
1984	GN	Catch	772.35	12.03	22.67	127.88	934.93	
1984	GN	Effort	109399.00	109399.00	109399.00	109399.00	109399.00	
1984	GN	CPUE	7.06	0.11	0.21	1.17	8.55	
1984	LL	Catch	0.00	0.00	4.00	0.00	4.00	
1984	LL	Effort	1263.00	1263.00	1263.00	1263.00	1263.00	
1984	LL	CPUE	0.00	0.00	3.17	0.00	3.17	
1984	Total catch		789.00	12.06	27.26	128.40	956.72	

**Appendix I: Catch, effort and CPUE tables for Lake Chiuta, 1979 – 1999.**

Year	Gear	Statistic	Makumba	Matemba	Mlamba	Other	TOTAL	comment
1985	FT	Catch	66.94	6.68	2.03	6.62	82.27	
1985	FT	Effort	25399.00	25399.00	25399.00	25399.00	25399.00	
1985	FT	CPUE	6.09	0.61	0.18	0.60	0.62	
1985	GN	Catch	801.87	6.37	66.33	182.71	1057.28	
1985	GN	Effort	242411.00	242411.00	242411.00	242411.00	242411.00	
1985	GN	CPUE	3.31	0.03	0.27	0.75	4.36	
1985	LL	Catch	0.00	0.00	0.22	0.00	0.22	
1985	LL	Effort	62.00	62.00	62.00	62.00	62.00	
1985	LL	CPUE	0.00	0.00	3.55	0.00	3.55	
1985	Total catch		868.81	13.05	68.58	189.33	1139.77	
1986	FT	Catch	4.92	31.87	0.45	48.70	85.94	
1986	FT	Effort	60833.00	60833.00	60833.00	60833.00	60833.00	
1986	FT	CPUE	0.08	0.52	0.01	0.80	1.41	
1986	GN	Catch	324.90	0.95	58.52	136.43	520.80	
1986	GN	Effort	197566.00	197566.00	197566.00	197566.00	197566.00	
1986	GN	CPUE	1.64	0.00	0.30	0.69	2.64	
1986	LL	Catch	0.00	0.00	19.80	0.00	19.80	
1986	LL	Effort	2276.00	2276.00	2276.00	2276.00	2276.00	
1986	LL	CPUE	0.00	0.00	8.70	0.00	8.70	
1986	Total catch		329.82	32.82	78.77	185.13	626.54	
1987	FT	Catch	77.77	17.46	8.46	94.94	198.63	
1987	FT	Effort	62898.00	62898.00	62898.00	62898.00	62898.00	
1987	FT	CPUE	1.24	0.28	0.13	1.51	3.16	
1987	GN	Catch	817.16	15.58	73.09	170.67	1076.50	
1987	GN	Effort	183663.00	183663.00	183663.00	183663.00	183663.00	
1987	GN	CPUE	4.45	0.08	0.40	0.93	5.86	
1987	LL	Catch	1.52	1.46	190.98	7.11	201.07	
1987	LL	Effort	15067.00	15067.00	15067.00	15067.00	15067.00	
1987	LL	CPUE	0.10	0.10	12.68	0.47	13.35	
1987	Total catch		896.45	34.50	272.53	272.72	1476.20	
1988	FT	Catch	50.09	1.79	3.75	31.53	87.16	
1988	FT	Effort	24680.00	24680.00	24680.00	24680.00	24680.00	
1988	FT	CPUE	2.03	0.07	0.15	1.28	3.53	
1988	GN	Catch	519.37	7.07	50.91	94.19	671.54	
1988	GN	Effort	140348.00	140348.00	140348.00	140348.00	140348.00	
1988	GN	CPUE	3.70	0.05	0.36	0.67	4.78	
1988	LL	Catch	0.00	0.00	46.44	0.57	47.01	
1988	LL	Effort	19326.00	19326.00	19326.00	19326.00	19326.00	
1988	LL	CPUE	0.00	0.00	2.40	0.03	2.43	
1988	Total catch		569.46	8.86	101.10	126.29	805.71	
1989	FT	Catch	4.99	0.30	0.52	3.50	9.31	
1989	FT	Effort	6121.00	6121.00	6121.00	6121.00	6121.00	
1989	FT	CPUE	0.82	0.05	0.08	0.57	1.52	
1989	GN	Catch	449.53	6.06	103.06	142.68	701.33	
1989	GN	Effort	195094.00	195094.00	195094.00	195094.00	195094.00	
1989	GN	CPUE	2.30	0.03	0.53	0.73	3.59	
1989	LL	Catch	0.00	0.00	9.43	0.00	9.43	
1989	LL	Effort	5068.00	5068.00	5068.00	5068.00	5068.00	
1989	LL	CPUE	0.00	0.00	1.86	0.00	1.86	
1989	Total catch		454.52	6.36	113.01	146.18	720.07	
1990	FT	Catch	52.10	24.29	34.68	16.86	127.93	
1990	FT	Effort	36856.00	36856.00	36856.00	36856.00	36856.00	
1990	FT	CPUE	1.41	0.66	0.94	0.46	3.47	
1990	GN	Catch	571.44	2.66	86.51	170.79	831.40	
1990	GN	Effort	190320.00	190320.00	190320.00	190320.00	190320.00	
1990	GN	CPUE	3.00	0.01	0.45	0.90	4.37	
1990	LL	Catch	0.00	0.00	38.59	0.25	38.84	
1990	LL	Effort	39883.00	39883.00	39883.00	39883.00	39883.00	
1990	LL	CPUE	0.00	0.00	0.97	0.01	0.97	
1990	Total catch		623.54	26.95	159.78	187.90	998.17	

Year	Gear	Statistic	Makumba	Matemba	Mlamba	Other	TOTAL	comment
1991	FT	Catch	47.03	24.80	17.56	96.74	186.13	
1991	FT	Effort	349827.00	349827.00	349827.00	349827.00	349827.00	
1991	FT	CPUE	0.13	0.07	0.05	0.28	0.53	
1991	GN	Catch	667.97	2.60	90.03	213.25	973.85	
1991	GN	Effort	248100.00	248100.00	248100.00	248100.00	248100.00	
1991	GN	CPUE	2.69	0.01	0.36	0.86	3.93	
1991	LL	Catch	0.00	0.00	22.20	0.14	22.34	
1991	LL	Effort	15577.00	15577.00	15577.00	15577.00	15577.00	
1991	LL	CPUE	0.00	0.00	1.43	0.01	1.43	
1991	Total catch		715.00	27.40	129.79	310.13	1182.32	
1992	FT	Catch	141.86	105.15	30.25	261.90	539.16	
1992	FT	Effort	1185646.00	1185646.00	1185646.00	1185646.00	1185646.00	
1992	FT	CPUE	0.12	0.09	0.03	0.22	0.45	
1992	GN	Catch	629.27	2.22	97.42	102.27	831.18	
1992	GN	Effort	290812.00	290812.00	290812.00	290812.00	290812.00	
1992	GN	CPUE	2.16	0.01	0.33	0.35	2.86	
1992	LL	Catch	11.16	0.78	60.95	18.38	91.27	
1992	LL	Effort	82726.00	82726.00	82726.00	82726.00	82726.00	
1992	LL	CPUE	0.13	0.01	0.74	0.22	1.10	
1992	Total catch		782.29	108.15	188.62	382.55	1461.61	
1993	FT	Catch	263.16	214.44	72.23	572.59	1122.42	
1993	FT	Effort	843228.00	843228.00	843228.00	843228.00	843228.00	
1993	FT	CPUE	0.31	0.25	0.09	0.68	1.33	
1993	GN	Catch	462.93	0.78	179.48	353.97	997.16	
1993	GN	Effort	457210.00	457210.00	457210.00	457210.00	457210.00	
1993	GN	CPUE	1.01	0.00	0.39	0.77	2.18	
1993	LL	Catch	0.00	43.83	60.11	3.28	107.22	
1993	LL	Effort	772718.00	772718.00	772718.00	772718.00	772718.00	
1993	LL	CPUE	0.00	0.06	0.08	0.00	0.14	
1993	Total catch		726.09	259.05	311.82	929.84	2226.80	
1994	FT	Catch	104.95	57.05	33.44	155.76	351.20	
1994	FT	Effort	613587.00	613587.00	613587.00	613587.00	613587.00	
1994	FT	CPUE	0.17	0.09	0.05	0.25	0.57	
1994	GN	Catch	292.99	6.52	112.58	299.82	711.91	
1994	GN	Effort	336484.00	336484.00	336484.00	336484.00	336484.00	
1994	GN	CPUE	0.87	0.02	0.33	0.89	2.12	
1994	LL	Catch	21.44	1.90	232.94	40.48	296.76	
1994	LL	Effort	2419891.00	2419891.00	2419891.00	2419891.00	2419891.00	
1994	LL	CPUE	0.01	0.00	0.10	0.02	0.12	
1994	Total catch		419.38	65.47	378.96	496.06	1359.87	
1995	FT	Catch	76.64	39.80	38.12	188.04	344.60	Data projected to
1995	FT	Effort	315256.00	315256.00	315256.00	315256.00	315256.00	12 months from 3
1995	FT	CPUE	0.25	0.13	0.12	0.60	1.09	
1995	GN	Catch	40.49	0.40	38.28	46.63	125.80	Data projected to
1995	GN	Effort	288716.00	288716.00	288716.00	288716.00	288716.00	12 months from 3
1995	GN	CPUE	0.56	0.01	0.53	0.65	1.74	
1995	LL	Catch	5.20	0.00	159.64	9.92	174.76	Data projected to
1995	LL	Effort	363447.00	363447.00	363447.00	363447.00	363447.00	12 months from 3
1995	LL	CPUE	0.00	0.00	0.11	0.01	0.12	
1995	Total catch		122.33	40.20	236.04	244.59	645.16	
1996	FT	Catch	53.74	19.90	56.70	554.82	686.16	Average of catch
1996	FT	Effort	424219.00	424219.00	424219.00	424219.00	424219.00	in 1995 & 1997
1996	FT	CPUE	0.13	0.06	0.08	0.51	0.79	
1996	GN	Catch	239.10	0.20	64.73	37.25	341.27	Average of catch
1996	GN	Effort	346904.00	346904.00	346904.00	346904.00	346904.00	in 1995 & 1997
1996	GN	CPUE	0.82	0.00	0.38	0.36	1.56	
1996	LL	Catch	2.60	0.00	84.98	4.96	92.54	Average of catch
1996	LL	Effort	182035.00	182035.00	182035.00	182035.00	182035.00	in 1995 & 1997
1996	LL	CPUE	0.00	0.00	2.13	0.00	2.13	
1996	Total catch		295.44	20.10	206.41	597.03	1119.97	

**Appendix I: Catch, effort and CPUE tables for Lake Chiuta, 1979 – 1999.**

Year	Gear	Statistic	Makumba	Matemba	Mlamba	Other	TOTAL	comment
1997	FT	Catch	30.84	0.00	75.28	921.60	1027.72	Data projected to
1997	FT	Effort	533182.00	533182.00	533182.00	533182.00	533182.00	12 months from 3
1997	FT	CPUE	0.01	0.00	0.04	0.43	0.48	
1997	GN	Catch	437.70	0.00	91.18	27.86	556.74	Data projected to
1997	GN	Effort	405092.00	405092.00	405092.00	405092.00	405092.00	12 months from 3
1997	GN	CPUE	1.08	0.00	0.23	0.07	1.37	
1997	LL	Catch	0.00	0.00	10.32	0.00	10.32	Data projected to
1997	LL	Effort	623.00	623.00	623.00	623.00	623.00	12 months from 3
1997	LL	CPUE	0.00	0.00	4.14	0.00	4.14	
1997	Total catch		468.54	0.00	176.78	949.46	1594.78	
1998	FT	Catch	294.59	270.33	294.67	1036.57	1896.16	Data projected to
1998	FT	Effort	1464257.00	1464257.00	1464257.00	1464257.00	1464257.00	12 months from 9
1998	FT	CPUE	0.44	0.43	0.44	0.77	0.80	
1998	GN	Catch	1250.95	0.00	304.62	77.22	1632.79	Data projected to
1998	GN	Effort	569690.50	569690.50	569690.50	569690.50	569690.50	12 months from 9
1998	GN	CPUE	0.65	0.00	0.29	0.11	1.06	
1998	LL	Catch	8.04	0.00	50.12	41.76	94.56	Data projected to
1998	LL	Effort	59705.00	59705.00	59705.00	59705.00	59705.00	12 months from 9
1998	LL	CPUE	0.03	0.00	1.38	0.00	1.41	
1998	Total catch		1553.58	270.33	649.41	1155.55	3623.51	
1999	FT	Catch	2.93	3.26	0.42	456.47	463.08	
1999	FT	Effort	832256.00	832256.00	832256.00	832256.00	832256.00	
1999	FT	CPUE	0.00	0.00	0.00	0.55	0.56	
1999	GN	Catch	858.97	0.00	110.22	4.62	973.81	
1999	GN	Effort	734289.00	734289.00	734289.00	734289.00	734289.00	
1999	GN	CPUE	1.17	0.00	0.15	0.01	1.33	
1999	LL	Catch	0.00	0.00	0.56	0.00	0.56	
1999	LL	Effort	86.00	86.00	86.00	86.00	86.00	
1999	LL	CPUE	0.00	0.00	6.51	0.00	6.51	
1999	Total catch		861.90	3.26	111.20	461.09	1437.45	