CURRENT STATE OF THE FISH STOCKS OF LAKE VICTORIA (Uganda)

ABSTRACT

A total of 561 hauls were taken during experimental bottom trawl surveys in the Uganda sector of Lake Victoria during the period November 1997 to December 1999 to estimate composition, distribution and abundance of the major fish species in waters 4-60 m deep. Seventeen fish groups were caught with Nile perch, *Lates niloticus* (L.), constituting 90.02% by weight. Haplochromines and *L. niloticus* occurred in all areas sampled while Nile tilapia, *Oreochromis niloticus* (L.), and other tilapiines were restricted to waters <30 m deep. The mean trawl catch rate in the zone where artisanal fishermen operate (i.e. in waters <30 m depth) was 169.94 kg hr^{-1}, of which 90.24% was *L. niloticus*. Species diversity and relative abundance decreased with increasing water depth.

Key words: FISH STOCKS OF LAKE VICTORIA, UGANDA

INTRODUCTION

Until the 1970s, Lake Victoria had a multi-species fishery dominated by the tilapiine and haplochromine cichlids. There were important subsidiary fisheries for more than 20 genera of non-cichlid fishes, including catfishes (*Bagrus docmak* (Forskall), *Clarias gariepinus* (Burchell), *Synodontis* spp and *Schilbe intermedius*), the lungfish (*Protopterus aethiopicus* (Heckel)) and *Labeo victorianus* (Kudhongania & Cordone 1974). Stocks of most of these species declined and others disappeared following the introduction of four tilapiines (*Oreochromis niloticus*, *Oreochromis leucostictus*, *Tilapia rendalli* and *Tilapia zillii* (Grevais)) and Nile perch (*Lates niloticus*) during the 1950s. Since then the fishery has been dominated by Nile perch, Nile tilapia and the native cyprinid species, *Rastrineobola argentea* (Mukene).

Lake Victoria is an important source of fish only local for consumption but also for export. A number of fish processing plants have been constructed along the shores of the lake, 11 of which are licensed to operate in Uganda (Odongkara & Okaronon 1999). The fishing capacity in the Uganda sector increased from about 3 200 fishing canoes in 1972 to 8 000 by 1990 (Okaronon 1994) and was estimated to be about 10 000 canoes in 1998 (C. Dhatemwa, personal communication).

This increase in fishing effort and investment was made without clear knowledge of the magnitude of the stocks. There are indications that the fishery yield has declined from 135 000 tons in 1993 to 107 000 tons in 1997 (Odongkara & Okaronon 1999). The only previous extensive stock assessment exercise undertaken was from 1969 to 1971, before the Nile perch upsurge (Kudhongania & Cordone 1974). The current stock assessment programme, which commenced in 1997, is designed to generate information to underpin management decision making for the fishery. This includes estimating the current composition, distribution, abundance, population structure and biomass of the major fish species. The objective of this paper is to provide an overview of the current state of the fish stocks in the Ugandan portion of Lake Victoria.

MATERIALS AND METHODS

Experimental bottom trawling surveys were carried out monthly in the Uganda sector of the lake using the research vessel R.V. IBIS. Because of the large size of the Uganda sector of the lake, it was divided into three zones: Zone I- Tanzania/Uganda border to Bukakata (Bugoma Channel), Zone II- Bukakata to Kiyindi (Rosebury Channel), and Zone III- Kiyindi to Uganda/Kenya border (Fig. 1). The sector was further divided into grids of 5 nautical miles square. The bottom trawl surveys using these grids became operational during 1999. The grids surveyed included those with transects surveyed in earlier operations of 1993-1998. Each zone was surveyed quarterly between November 1997 and December 1999. A monthly sampling exercise comprised 4-6 hauls per day on average for 10 days. On some occasions the sampling was curtailed because the research vessel broke down. No survey was carried out in February 1999 because the R.V. IBIS was being used for the lake-wide hydroacoustic survey.

A total of 561 hauls of 30 minutes duration were made using a 25.4 mm codend mesh size trawl net in transects (within grids) where the waters were 4-60 metres deep. A new trawl net with a head rope of 24.4 m long was used with effect from November 1998. The net used in the previous surveys had a head rope of 26.5 m long. Fish catches were sorted into species; individual weights (g) and lengths (TL, cm) were recorded. The fish were sexed, reproductive state noted, and the contents of the stomach assessed. Where possible, every fish in the catch was individually measured. For large catches, the Nile perch above 35 cm TL were measured individually and the smaller fish were subsampled. To achieve this subsampling in unbiased manner, the catch was mixed thoroughly and a subsample of approximately three shovelfuls of approximately 200 fish were taken for measurement of the biological characteristics. The results of the subsample were raised by the proportion of the subsample against the total catch by weight (excluding the larger fish).

RESULTS

Distribution of hauls by zone and depth

Of the 561 hauls made from November 1997 to December 1999, 48% were taken in Zone II, 40% in Zone III and 12% in Zone I (Table 1). The low number of hauls in Zone I was primarily because of breakdown of the research vessel and, to a certain extent, rough weather. The majority of the trawl hauls (72%) were made in waters between 10 m and 30 m deep, while 18% were in shallower waters (Table 1).

Fish species composition and distribution

During the current survey of November 1997 to December 1999, 17 fish species groups (14 genera) were recorded (Table 2). These groups included species complexes such as haplochromine cichlids. *L. niloticus* dominated the catches (90% by weight) followed by *O. niloticus* (5.1%), haplochromines (3.2%); the other species groups contributed less than 2% (Table 3).

The highest catches were obtained in Zone II, where an average of 191.7 kg hr^{-1} was recorded followed by Zone I (142.4 kg hr^{-1}) and the least was 135.4 kg hr^{-1} in Zone III (Table 4). Fish species diversity was greatest in the depth range 10-20 m, and declined markedly with increasing depth (Table 2). A high proportion of the fish (94%) was found in waters <30 m deep (Tables 3 and 4). *L. niloticus* and haplochromines occurred in all areas sampled while *O. niloticus* and other tilapiines were restricted to waters less than 30 m deep (Tables 2, 3 and 4). Few fish were caught in depths greater than 40m, and these were restricted to *L. niloticus*, haplochromines and *Barbus profondus* (Greenwood).

The mean catch declined from 208.3±37.0 kg hr^{-1} in the 4-10 m depth zone to 3.0±4.0 kg hr^{-1} (Table 3, Fig. 2). A mean catch rate of 169± 26.0 kg hr^{-1} was recorded in the 4-30 m depth zone where the artisanal fishermen operate.

The mean catch rate of bottom trawling in the artisanal fishing zone showed a marked decline since the surveys of 1969 (Fig. 3). This decline was most rapid in the early 1980s when catches dropped from 595 kg hr^{-1} in 1981 to 155 kg hr^{-1} in 1985.

Population characteristics of Lates niloticus

Length frequency analysis was carried out on 29 345 fish caught between November 1997 and June 1999 (Fig. 4). The fish length range was 2 to 137 cm total length. 50% of the fish had length between 4 – 16 cm total and 73% of the fish were 5 – 26 cm total length. The modal length was 10 cm.

DISCUSSION

During the lakewide bottom trawl survey of 1969-1971, 24 fish species belonging to 21 genera were encountered and haplochromine cichlids were the most abundant. There were remarkable changes in species composition by depth with the maximum species diversity in the shallow waters. The *Haplochromis* species complex contributed 83% by weight, *B. docmak* (4.2%), *Clarias gariepinus.* (4.1%), *O. esculentus* (3.8%), *P. aethiopicus* (2.8%), *O. niloticus* (0.5%), and *S. victoriae* (0.4%). *L. niloticus* catches were insignificant (<0.1%). A mean catch rate of 797 $kghr^{-1}$ was estimated for waters between 5 m and 29 m deep (Fig. 3). The mean total length of some fishes (*Haplochromis* spp, *S. victoriae* Boulenger, *Xenoclarias eupogon*) increased with depth.

Bottom trawling in the Ugandan waters of Lake Victoria during 1981-1985 (Okaronon *et al.* 1985; Okaronon and Kamanyi 1986) yielded all but two of the non-cichlid species *Gnathonemus longibarbis* and *Brycinus* sp. found in the 1969/71 survey. Haplochromines in the trawl declined from 91.4% in 1981 to almost zero in 1985, while the contribution of *L. niloticus* increased from 5% to 96% during the same period. The mean catch rates for all fish species combined declined from 595 kg hr^{-1} in 1981 to 355 kg hr^{-1} in 1983 and to 155 kg hr^{-1} in 1985 (Fig. 3).

During the survey of May 1993 to October 1997, *L. niloticus* contributed 96.5% of the total catch by weight. Fish diversity and abundance decreased with increasing water depth. About 60% of the total fish catch was in waters less than 30 m deep. The mean annual catch in the 4-29 m depth zone was 150 $kghr^{-1}$.

Three fish species groups recorded during the 1993/97 survey (*B. altianalis, O. variabilis* and *X. eupogon*) were not caught in 1997/98, suggesting a further decline in fish species diversity. More fish (about 95% of total catch by weight) were recorded in waters less than 30 m deep during 1997/1998 compared to about 60% during 1993-1997. During 1999 surveys, three additional fish species, *Aethiomastacembelus frenatus, S. intermedius* and *T. rendalli,* were found. These species were absent during 1997/98 survey period. The experimental trawl CPUE has shown a continuous marked decline since the trawling survey of 1969. CPUE in waters less than 30 m was on the average 797 kg hr^{-1} over the 1969-1971 survey period and declined to 115 kg hr^{-1} in 1997/1998. The average catch in the 1999 surveys increased to 225±60 kg hr^{-1}, but this increase was probably due to the change of experimental trawl gear effective November 1998 coupled with heavy rains during 1998/1999 and the curtailing destructive use of fishing gears/methods during early 1999. The fish species composition in 1969-1971 was very different from the 1999 survey. The different behaviour and possible net avoidance of *L. niloticus* presently targeted by the trawl net may be partially responsible for the apparent decline in fish stocks in the experimental trawl catches. The apparent four-fold decline in stock abundance compared to 1999 estimated relative abundance is of major concern.

ACKNOWLEDGEMENT

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Table 1: Distribution of hauls during bottom trawling in the variou depth ranges in the Uganda sector of Lake Victoria.

PERIOD	DEPTH INTERVAL (metres) ZONE I						ZONE II						ZONE III				
	4-10	10-20	20-30	30-40	40-50		4-10	10-20	20-30	30-40	40-50		4-10	10-20	20-30	30-40	40-50
1997 NOV.							7	12	9	3	5						
DEC.													4	11	10	5	1
1998 JAN.																	
FEB.	1	15	6	4			1	1									
MAR.							6	9	10	3			1	1			
APR.													2	14	6	1	
MAY																	
JUN.							13	15	14								
JUL.																	
AUG.													3	12	11	3	1
SEP.													1	24	1		
OCT.							3							5			
NOV.							1	2	8		2						
DEC.		12	4	2			8	9	1								
1999 JAN.													3	10	18		1
FEB.																	
MAR.							6	13	5	3							
APR.		4					9	9	10	4	1						
MAY													3	6	7	3	
JUN.							12	10	12	3	1						
JUL.			2	3													
AUG.													1	12	1	1	
SEP.	3	5	8				1	2									
OCT.																	
NOV.							7	6	9	2	1						
DEC.													6	*20*	*11*		1
TOTAL:	4	*36*	*20*	*9*	0	0	74	*88*	*78*	*18*	*10*	0	24	*115*	*65*	13	4
:By zone			*69*						*268*						221		

Jan
Feb
Mar
Apr
May
June

Table 2a: Distribution of fish caught during bottom trawling in the various depth ranges in the Uganda sector of Lake Victoria.

	DEPTH INTERVAL (metres)														
Fish			ZONE I					ZONE II					ZONE III		
species	4-10	10-20	20-30	30-40	40-50	4-10	10-20	20-30	30-40	40-50	4-10	10-20	20-30	30-40	40-50
Af											O				
Bd						$									
B2		*	*			$	$	$	$		O	O	O	O	
B3						$									
Cg		*				$						O			
Ha	*	*	*	*		$	$	$	$	$	O	O	O	O	O
Lv	*														
Ln	*	*	*	*		$	$	$	$	$	O	O	O	O	O
Mk												O			
Ol						$					O				
On	*	*				$	$				O	O			
Ov															
Pa							$								
Si									$						
Sa						$	$	$	$		O	O	O		
Sv							$	$	$	$		O			
Tr							$								
Tz						$					O	O			
Xe															
Total	3	5	3	2		10	8	6	6	3	8	9	4	3	2
Total (zone)			5						14				11		
Total (sector)								17							

Af = *Aethiomastacembelus frenatus*
Bd = *Bagrus docmak*
B2 = *Barbus spp*
B3 = *Brycinus spp*
Cg = *Clarias gariepinus*
Ha = *Haplochromis spp*
Lv = *Labeo victorianus*
Ln = *Lates niloticus*
Mk = *Mormyrus kannume*
Ol = *Oreochromis leucostictus*
On = *Oreochromis niloticus*
Ov = *Oreochromis variabilis*
Pa = *Protopterus aethiopicus*
Si = *Schilbe intermedius*
Sa = *Synodontis afrofischeri*
Sv = *Synodontis victoriae*
Tr = *Tilapia rendalli*
Tz = *Tilapia zillii*
Xe = *Xenoclarias eupogon*

Table 2b : Distribution of fish caught during bottom trawling in the various depth ranges in the Uganda sector of Lake Victoria.

Fish species	1969-1971 survey								1994-1997 survey					1997-1999 survey					
	Water depth (10 m intervals I.e. 4=4-10 m, 10=10-20 m, 20=20-30 m, etc.)																		
	4	10	20	30	40	50	60	70	4	10	20	30	40	4	10	20	30	40	50
Aethiomastacembelus frenatus	$	$	$											*					
Bagrus docmak	$	$	$	$	$	$	$	$	O	O				*					
Barbus altianalis	$	$	$	$	$					O	O								
Barbus spp									O	O				*	*	*	*		*
Brycinus spp	$								O					*					
Clarias gariepinus	$	$	$	$	$	$	$	$	O					*	*				
Haplochromines	$	$	$	$	$	$	$	$	O	O	O	O	O	*	*	*	*	*	*
Gnathonemus longibarbis	$	$	$																
Labeo victorianus	$	$	$							O					*				
Lates niloticus	$	$	$						O	O	O	O	O	*	*	*	*	*	*
Mormyrus kannume	$	$	$	$	$	$	$	$		O					*				
Oreochromis esculentus	$	$	$	$															
O. leucostictus	$	$							O	O				*					
O. niloticus	$	$							O	O				*	*				
O. variabilis	$	$	$						O										
Protopterus aethiopicus	$	$	$	$	$	$			O	O					*				
Schilbe intermedius	$	$	$	$	$	$	$	$									*		
Synodontis afrofischeri	$	$	$	$	$	$	$	$	O	O				*	*	*	*		
S. victoriae	$	$	$	$	$	$	$	$		O					*	*	*	*	
Tilapia rendalli															*				
T. zillii	$									O				*	*				
Xenoclarias eupogon	$	$	$	$	$	$	$	$	O										
Total	20	18	16	11	10	9	8	8	12	13	3	2	2	11	12	7	6	3	3
Total (survey period)					20						16					17			

Table 3 : Mean catch rates (kg hr^{-1}) for fish caught during bottom trawling in the various depth ranges in the Uganda sector of Lake Victoria (November 1997 to December 1999).

	DEPTH INTERVAL (metres)								
FISH SPECIES	4-10	10-20	20-30	30-40	40-50	50-60	4-30	Total (kg hr^{-1})	Percen-tage
Aethiomastacembelus frenatus	0.00						0.00	0.00	0.00
Bagrus docmak	0.01						0.01	0.01	0.00
Barbus spp	0.03	0.01	0.03	0.03	0.08	0.01	0.02	0.02	0.01
Brycinus spp		0.00					0.00	0.00	0.00
Clarias gariepinus		0.09					0.04	0.04	0.02
Haplochromis spp	4.43	4.11	8.35	1.22	0.98	0.05	5.56	5.12	3.15
Labeo victorianus		0.00					0.00	0.00	0.00
Lates niloticus	173.72	139.45	160.00	116.93	1.68	4.83	153.19	146.37	90.02
Mormyrus kannume		0.01					0.01	0.00	0.00
Oreochromis leucostictus	0.01						0.01	0.00	0.00
Oreochromis niloticus	24.81	8.63					9.14	8.25	5.07
Protopterus aethiopicus		0.39					0.18	0.16	0.10
Schilbe intermedius					0.00		0.02	0.00	0.00
Synodontis afrofischeri	0.04	0.02	0.01	0.00			0.01	0.02	0.01
Synodontis victoriae		0.00	0.01	0.24	0.13		0.01	0.03	0.02
Tilapia rendalli		0.02					0.01	0.01	0.00
Tilapia zillii	0.01	0.12					0.06	0.05	0.03
Xenoclarias eupogon									
Number of species caught	9	13	5	5	5	3	17		
Mean catch (kg hr^{-1})	208.25	153.70	168.58	135.18	2.98	5.08	169.76	162.61	
Confidence level of the mean (95%)	37.27	22.37	38.85	66.31	3.46	12.45			
Number of hauls	104	237	165	39	13	3	506	561	

Table 4: Mean catch rates (kg hr^{-1}) during bottom trawling in the Uganda sector of Lake Victoria (November 1997 to December 1999).

		DEPTH INTERVAL (metres)													
Fish		ZONE I				ZONEII					ZONE III				
species	Period	4-10	10-20	20-30	30-40	4-10	10-20	20-30	30-40	40-50	4-10	10-20	20-30	30-40	40-50
ALL	1997					118.38	274.99	85.66	140.87	0.28	95.44	80.29	52.70	69.86	0.42
	1998	125.70	195..26	17.81	7.06	164.79	145.74	64.37	114.31	3.64	155.87	103.64	66.15	2.37	
	1999	118.53	173.22	220.82	28.03	224.77	251.15	339.30	309.84	10.94	382.80	130.20	217.42	136.57	3.70
Mean (kg hr^{-1})		120.32	191.59	119.32	14.05	188.32	210.82	185.56	245.52	3.40	268.72	112.81	151.21	74.75	4.20
Aver. (kg hr^{-1})				142.43				191.66					135.37		
Total hauls		4	30	20	9	76	87	79	17	9	24	120	66	13	4
Lates	1997					110.22	173.46	87.54	138.69	0.16	84.29	67.25	54.39	.69.79	0.00
niloticus	1998	105.50	185.86	15.00	6.82	138.89	142.08	66.48	114.01	2.24	136.04	94.92	66.03	1.90	0.02
	1999	78.90	151.90	234.91	27.82	179.52	219.39	308.11	303.38	10.64	360.50	109.33	229.74	135.51	2.40
Mean (kg hr^{-1})		85.55	180.55	124.96	13.82	154.91	180.62	171.44	240.85	3.40	249.00	99.16	158.44	74.18	1.21
Aver. (l (kg hr^{-1})				134.58				168.49					129.08		
Total hauls		4	30	20	9	76	87	79	17	9	24	120	66	13	4
Oreochr.	1997					7.64	0.53	0.03	0.00	0.00	8.33	10.36	0.00	0.00	0.00
niloticus	1998	19.40	1.00	0.00	0.00	15.15	1.72	0.00	0.00	0.00	20.04	7.49	0.00	0.00	0.02
	1999	33.47	1.56	0.00	0.00	45.40	21.47	0.04	0.00	0.00	10.50	11.37	0.00	0.00	0.00
Mean (kg hr^{-1})		29.95	1.08	0.00	0.00	28.29	10.28	0.02	0.00	0.00	12.92	9.45	0.00	0.00	0.01
Aver. (l (kg hr^{-1})				2.87				11.37					6.36		
Total hauls		4	30	20	9	76	87	79	17	9	24	120	66	13	4

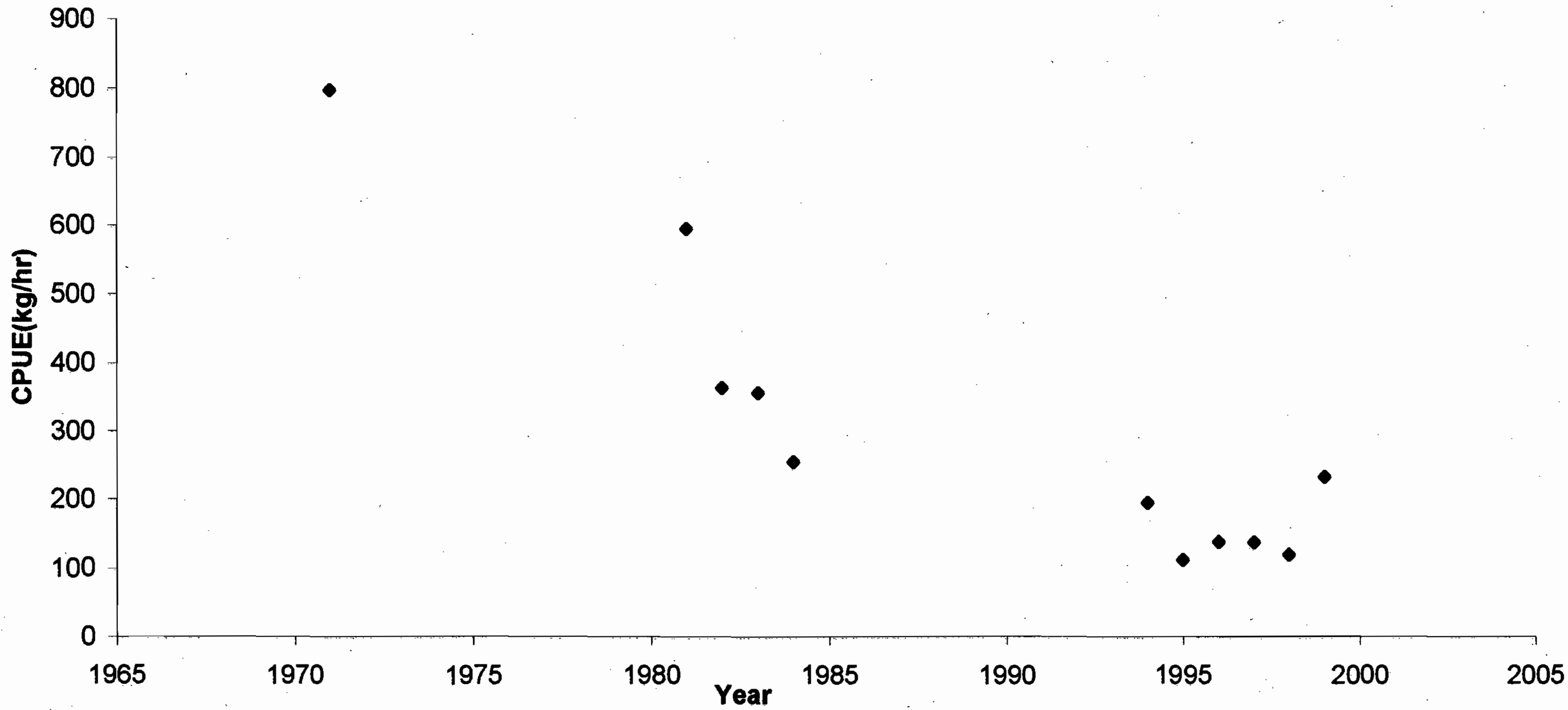

Fig 3.Change in mean catch per unit of effort from experimental trawling in 4-30 m depth zone since 1969.

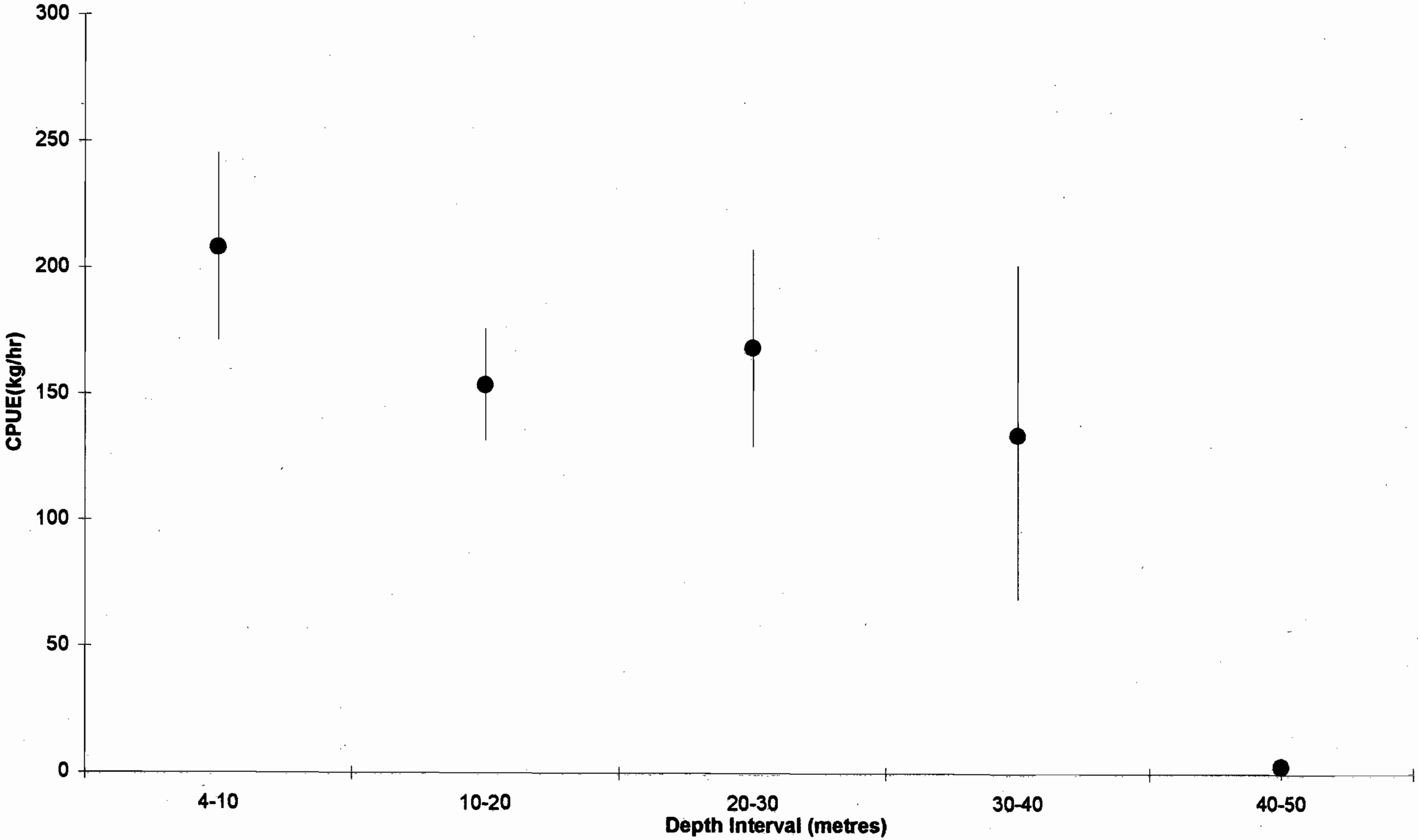

Fig.2. Mean Catch rate from bottom trawling in Lake Victoria (Uganda), November 1997 to December 1999

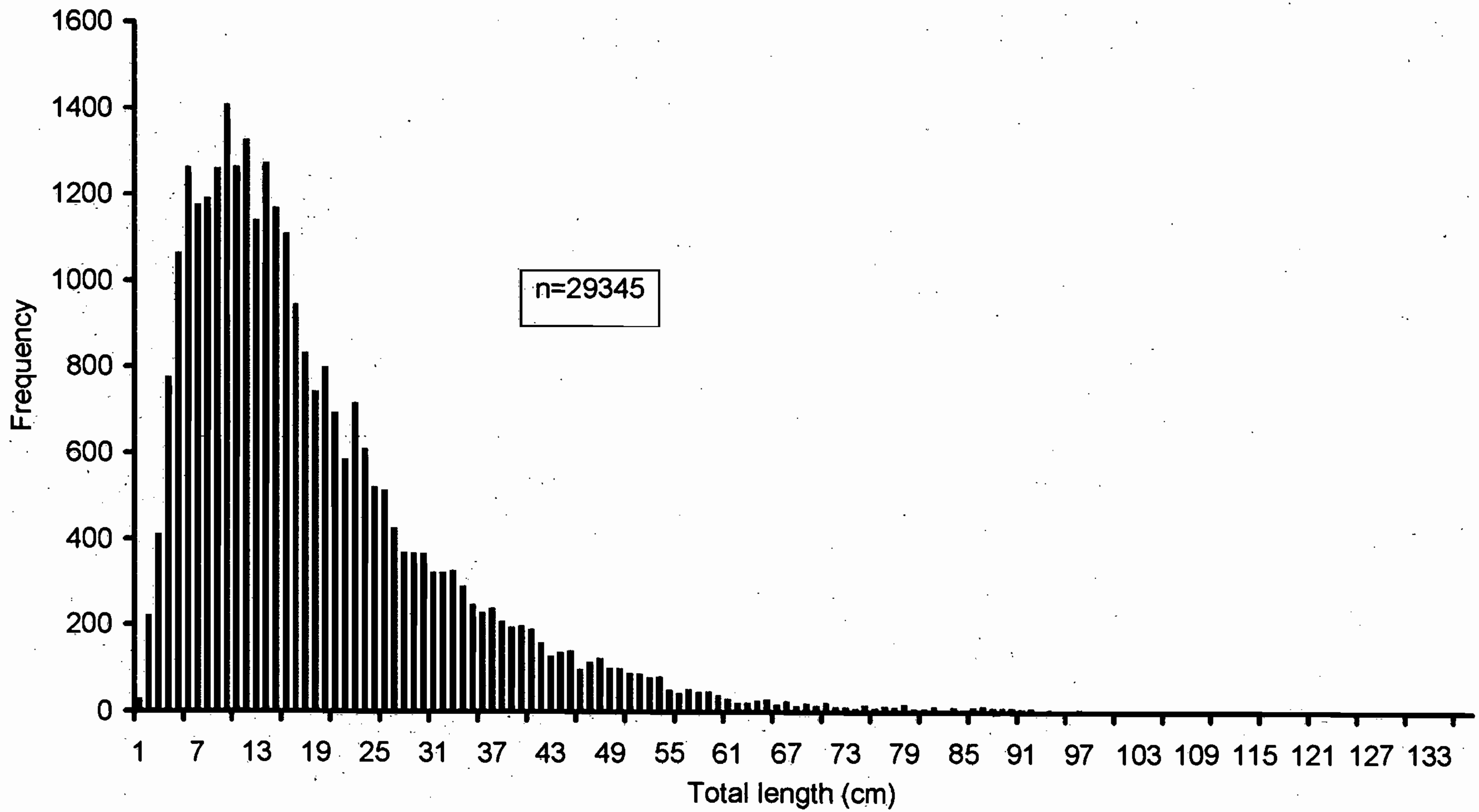

Fig. 4: Length frequency distribution for *Lates niloticus* from bottom trawling in Lake Victoria (Uganda), November 1997 to June1999.

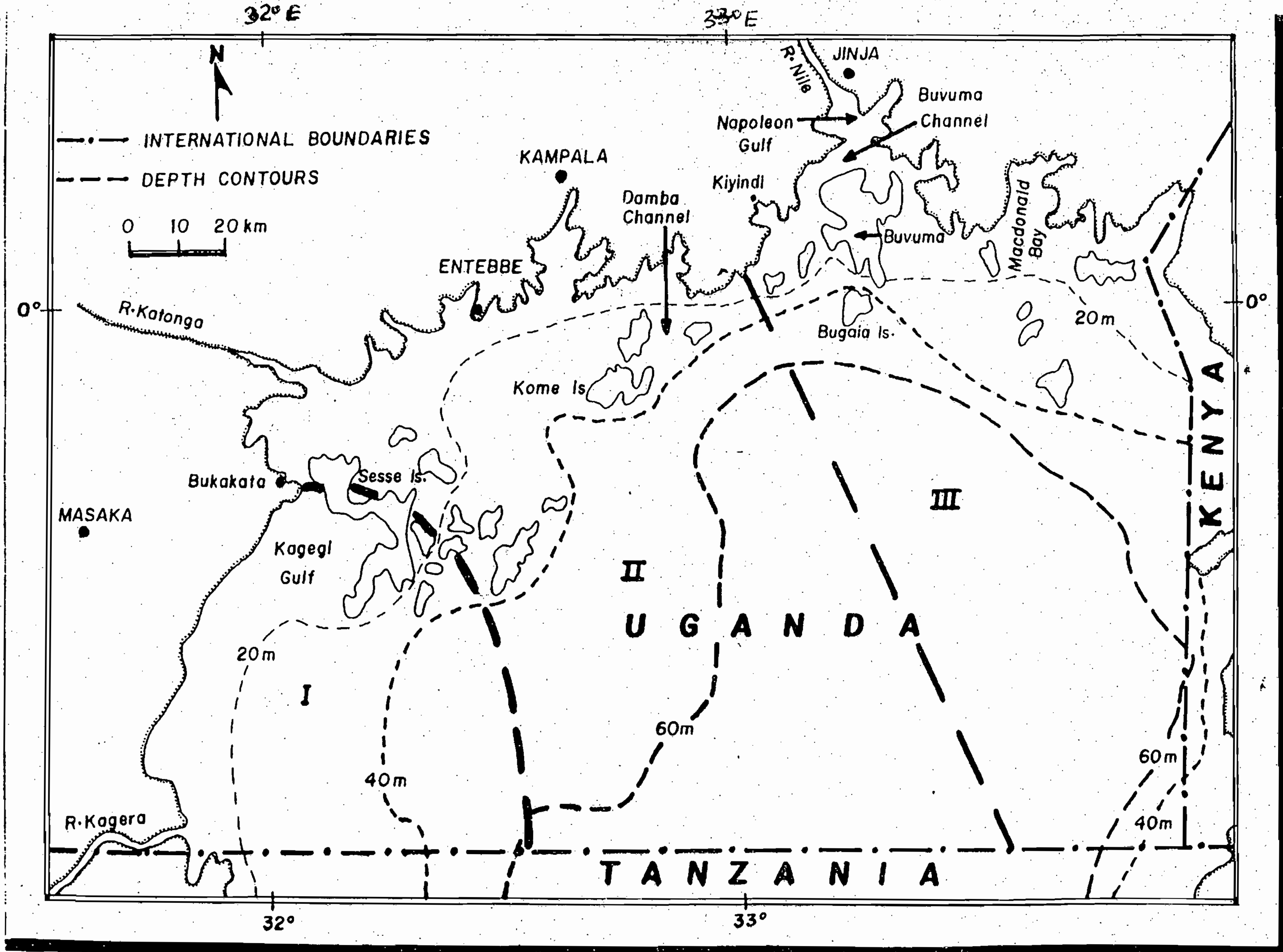

Fig 1. Sampling zones for Lake Victoria, Uganda.