The Status of the Fish Stocks, the Environment and socio-economics of Kabaka's Lake

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March 2001

The fish Stocks of Kabaka's Lake

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Introduction

Kabaka's Lake as the name implies, is a lake that belongs to the Buganda Kingdom which is under the Kabaka of Buganda (King of Buganda) and is located in the central portion of Kampala city. At the launching of "Food for all in Buganda" campaign during November 1999 at Nfuufu in Mukono District – Uganda, National Agricultural Research Organisation (NARO) was requested to find means of reactivating the fishery potential of the lake. The lake had been stocked with the Nile perch (*Lates niloticus & T. zillii*) during 1950s and the fishery was not being efficiently exploited. After restocking, no monitoring was done and therefore it was not known whether the introduced species established themselves. Restocking was mainly aimed at enabling this lake provide a source of food and recreation. The major objective of the study therefore was to establish the present status of the fishery by determining the fish species composition, distribution, relative abundance, population structure of the major fish species, catch rates in the gill net fishery and the biology and ecology of the dominant fish species. The study was conducted during 2000.

Materials and methods

Experimental fish sampling was carried out using graded gill net mesh size nets ranging from 25.4mm (1") to 203.2mm (8"). The 25.4mm to 152.4mm (6") nets increased by 12.7mm (0.5") intervals while the rest increased by 25.4mm (1"). The three gill net fleets used were set in various locations so as to cover the different lake habitats including bareshoreline, vegetated shoreline, and open waters. The nets were set overnight and retrieved the following morning. The fish from different mesh sizes of nets and locations were sorted into their taxonomic groups (species) the number and weight of species were recorded. For each of the species, biometric data that included total length, standard length, weight of individual fish (g), sex, maturity state, stomach fullness based on scale when 1=full stomach through ¾, ¼ ½ to 0=empty. Where possible the food contents were identified in the field while others especially the tilapiines (Ngege) stomachs were preserved in 10% formalin for subsequent laboratory analysis under the microscopes. The relative importance of different food items were located points according to Hynes, 1950. Where eggs were mature as in *Clarias gariepinus* these were preserved in 50% alcohol and egg count carried out in the laboratory using an egg counter.

Results

Fish species composition

Four fish species namely *L. niloticus* (Mputa) – Nile perch, *Tilapia zillii* (Kajjansi) – Tilapia, *Oreochromis leucostictus* (Ngege) – Tilapia, *Clarias gariepinnus* (Male) –

Catfish were recorded in Kabaka's lake during 2000 experimental gill net fishing. *T. zillii* was the dominant species by number contributing 61.1% followed by *L. niloticus* (19.8%), *O. leucostictus* (17.6%) and *C. gariepinus* (1.5%) - (Fig. 1a). Based on species composition by weight, the dominant species in order of importance were *L. niloticus* (65.2%), *C. gariepinus* (20.4%), *T. zillii* (11.3%) and *O. leucostictus* (3.1%) – Fig. 1b.

Fish species distribution and relative abundance

Of the four major fish species on Kabaka's lake 57% by weight of the overall fish species caught were in the open waters followed by 22.8% in the bare shoreline and 19.6% in the vegetated shoreline Table 1. *C. gariepinus* and *L. niloticus* were mainly dominant in the open waters, while *O. leucostictus* and *T. zillii* were concentrated in the vegetated shoreline (Table 1 & 2).

Based on percentage by number, 45.3% of the overall number of fish was located in the vegetation habitats (Table 2) contributed by mainly the tilapiines especially *T. zillii* followed by open waters (32.7%) and bare vegetation (22.1%).

Size at first maturity

The size at first maturity i.e the size at which 50% of the fish in a population are mature was 17cm for *T. zillii* and 18cm for *O. leucostictus*. All the *L. niloticus* and *C. gariepinus* caught in experimental gill net catches were mature.

Sex ratio (Males: Females)

The sex ratios were 1.4:1, 4.6:1, 1.2:1 and 1:1 for *L. niloticus, O. leucostictus, T. zillii* and *C. gariepinus* respectively.

Mean catch rates

The highest mean catch rates (g/net/night) were recorded in the 127.0 mm, 177.8mm, 152.4mm mesh size nets as 4160g, 3931g, 3215g respectively (Table 3) and the catches were of *L. niloticus* and a few but large *C. gariepinus*. In the smaller mesh size nets below (88.9mm) the highest mean catch rates 704g recorded in the 76.2mm mesh size nets were contributed by *T. zillii* and a few *O. leucostictus*. The overall mean catch rate (g/net/night) was 1408g.

Size structure of the major fish species

The length frequency distribution of three major fish species on Kabaka's lake is shown in Figures 2 and 3. The size ranges of *O. leucostictus* and *T. zillii* were 8-28cm TL and 7-30 cm TL with model classes at 15cm TL and 11cm TL for *O. leucostictus* and *T. zillii* respectively (Fig. 2). The length frequency distribution of *L. niloticus* had a range of 38-78cm TL with a mode of 52cm TL (Fig. 3). There were no juvenile *L. niloticus*. All the

fish both males and females of (38-78cm TL) were mature. As with *L. niloticus*, there were no juveniles of *C. gariepinus* encountered during the experimental fishing. The 5 fish caught had a size range of 81-104cm TL and all the fish were mature. The absence of juveniles *L. niloticus* and *C. gariepinus* indicates that there is no reproduction.
Fecundity: 47,068 eggs were counted in *C. gariepinus* of 94.0 TL.

Food and feeding

The percentage contribution of different foods based on point method (Hynes, 1950) for the different food items encountered as shown in Fig 4. 55 specimens of *T. zillii* stomachs (size range 9.5 – 26.5cm TL) were examined for food. 70.9% of the stomachs had food. 21 specimens of *O. leucostictus* (size range 13.8 – 24.9cm TL) were examined and 33.3% of the stomachs had food.

The two tilapiines (*T. zillii* and *O. leucostictus*) in order of importance fed mainly on blue green algae, green algae and higher plants. Higher plant material dominated followed by detritus material, blue green algae in *T. zillii* while the dominant food items in *O. leucostictus* were blue green algae followed by detritus material, green algae and higher plant material. In addition, sand grains, chironomid larvae and pupae, chaoborus pupae and insect remains were found in the stomach contents of *T. zillii.* 50 stomach specimen of *L. niloticus* (size range 37.0 – 76.2cm TL) were examined. 36% of the stomachs had fish food mainly fish remains. The fish that could be identified included *T. zillii, Clarias* spp and Aplochyleicthys. The 4 specimens of *C. gariepinus* examined (size range 81-98cm TL) had empty stomachs.

Fecundity: the egg count of the only one female *C. gariepinus* of 94cm TL was 47,060eggs

Discussion

In terms of weight, Kabaka's lake was dominated by the introduced *L. niloticus*. *L. niloticus* in this lake lacked juveniles, which implies that there is no recruitment. This observation may not enable sustainability of the fishery if exploitation started on the lake. The excessive environmental degradation and pollution through several human activities like the lake being used as a dumping ground, washing bay for cars and clothes has led to low invertebrate diversity (Ndawula, 2000 unpublished report) thus reducing food availability to fish. Water quality management is known to be one of the most factors in ensuring a healthy fish population and affects the health and reproduction of fishes while heavy particulate matter bury the eggs and larvae of benthic organisms upon settling at the bottom of the lake thus affecting the aquatic life (Natividad, 1984). Excessive pollution can also lead to low dissolved oxygen. Nile perch requires above 5mg/L of dissolved oxygen for proper growth and reproduction. Pollution could be the major cause of restricted recruitment of the major fish species. Most fish require a minimum ideal oxygen concentration of 5mg/L (Natividad, 1984).

Conclusion

Kabaka's lake though with some fish cannot support a viable fishery at the moment due to excessive pollution and eutrophication and absence of recruitment especially in the major fishery – the Nile perch.

Recommendations

- The lake should be drained and the bottom cleared in preparation for fresh clean water after which the lake can be restocked with appropriate fry.
- The lake should be fenced off to avoid further contamination
- There is need to investigate whether the present fish in this lake is fit for human consumption

References

Hynes, H.B.N, 1950. The food of freshwater sticklebacks (*Gastostens aculeatus* and *Pygostens pungitins*) with a review of methods used in studies of the food of fishes. *J. Anim. Ecol.* 19:36-58.

Cher vinski, 1984. On water temperature (In Phillipina (BFAR) Freshwater aquaulture extension training mannual Vol. III.

Natividad J.M. 1984. Water quality management. In Philippine (BFAR) Freshwater Aquaculture Extension Training Manual volume III Pg. 53-60. Technology Bureau of Fisheries and Aquatic Resources United States Agency for International Development.

Table 1. Fish species distribution and relative abundance by weight in different habitats on Kabaka's lake (2000)

Habitat	% *Clarias gariepinus*	% *Lates niloticus*	% *Oreochromis leucostictus*	% *Tilapia zillii*	% Overall
Bare shoreline	17.4	24.2	27.3	23.1	22.8
open water	82.6	56.9	32.8	23.6	57.6
Vegetated shoreline	0.0	18.9	39.8	53.3	19.6

Table 2. Fish species distribution and relative abundance by numbers in different habitats on Kabaka's lake (2000)

Habitat	% *Clarias gariepinus*	% *Lates niloticus*	% *Oreochromis leucostictus*	% *Tilapia zillii*	% Overall
Bare shoreline	20.0	23.9	25.4	20.5	22.1
open water	80.0	56.7	37.3	22.8	32.7
Vegetated shoreline	0.0	19.4	37.3	56.6	45.3

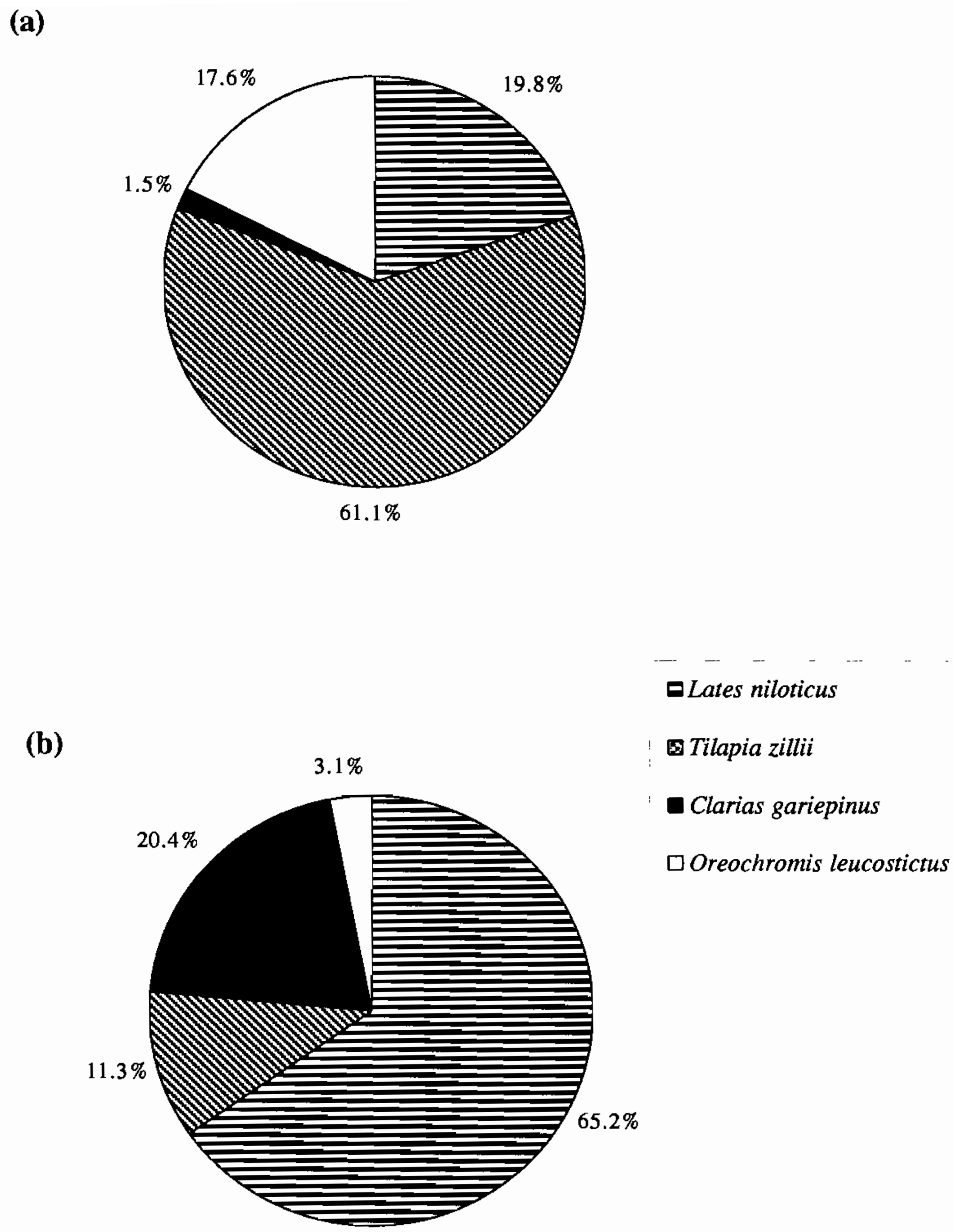

Fig. 1 Percentage composition by number (a) and by weight g (b) of the different fish species caught by gill net mesh sizes of 25.4-203 mm in Kabaka's lake (2000).

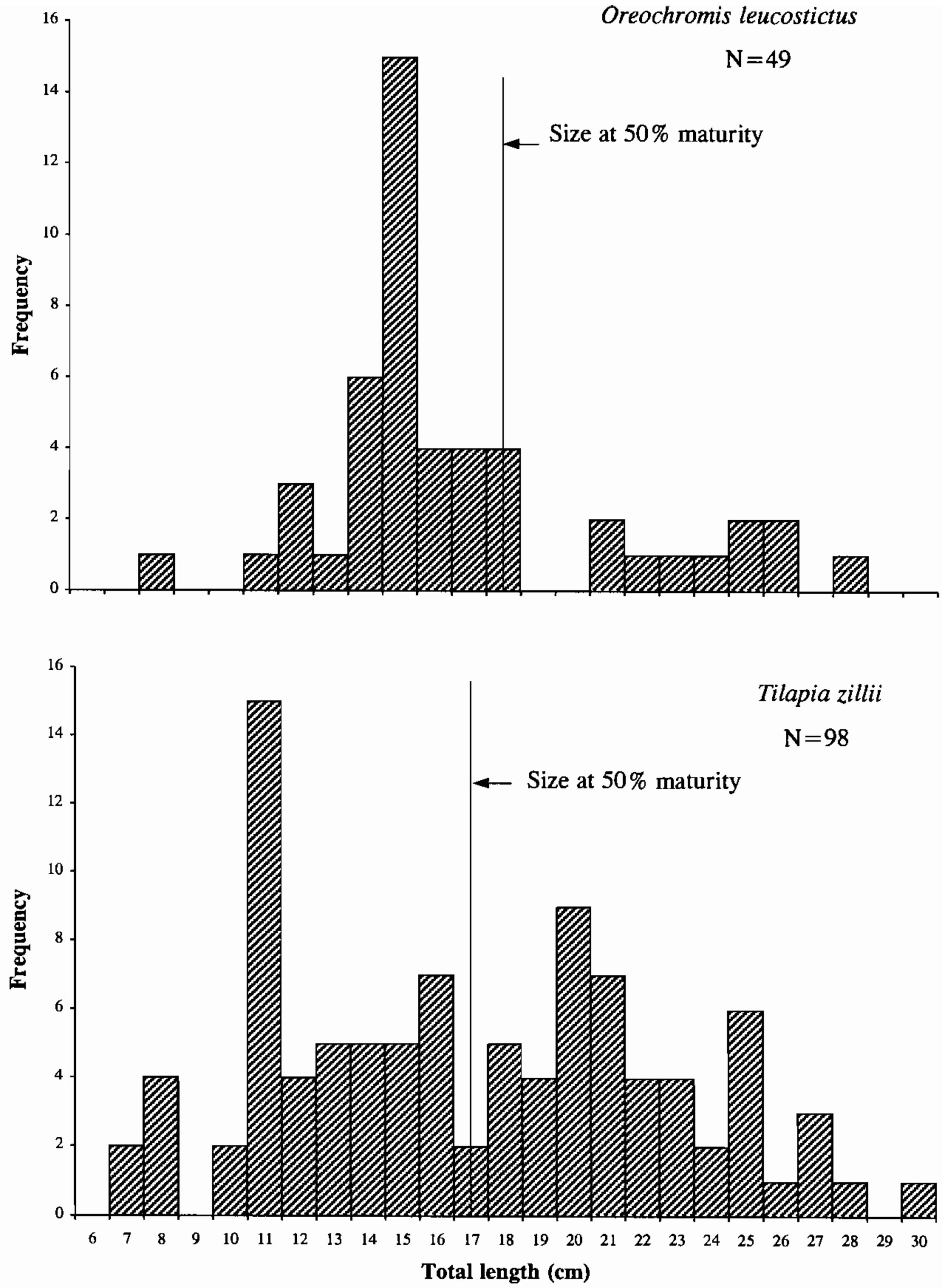

Fig.2 Length frequency distribution of *Oreochromis leucostictus* and *Tilapia zillii* caught by gill nets of 25.4-203.2 mm mesh size in Kabaka's lake.

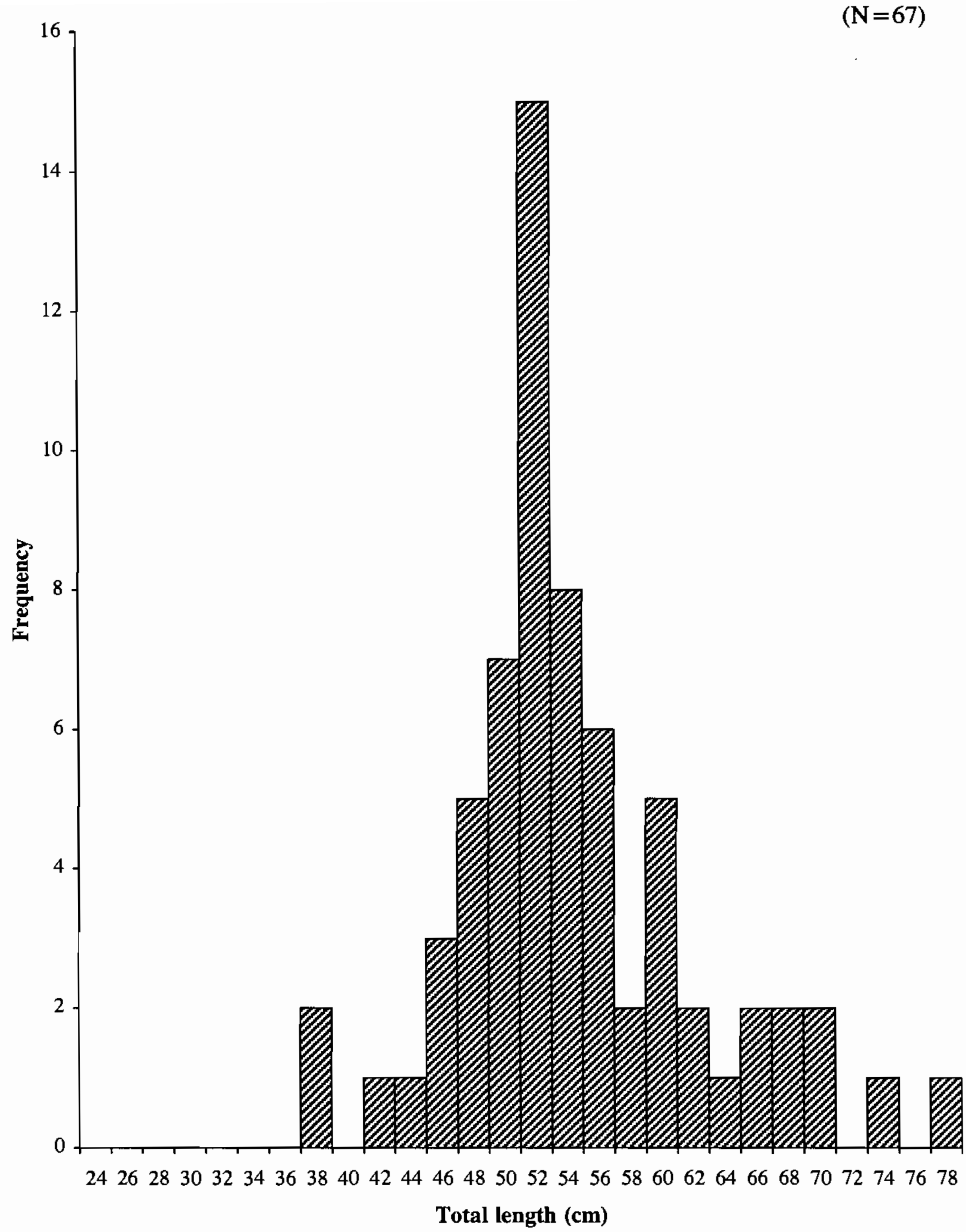

Fig.3 Length frequency distribution of *Lates niloticus* caught by gill nets of 25.4-203.2 mm mesh size in Kabaka's lake.

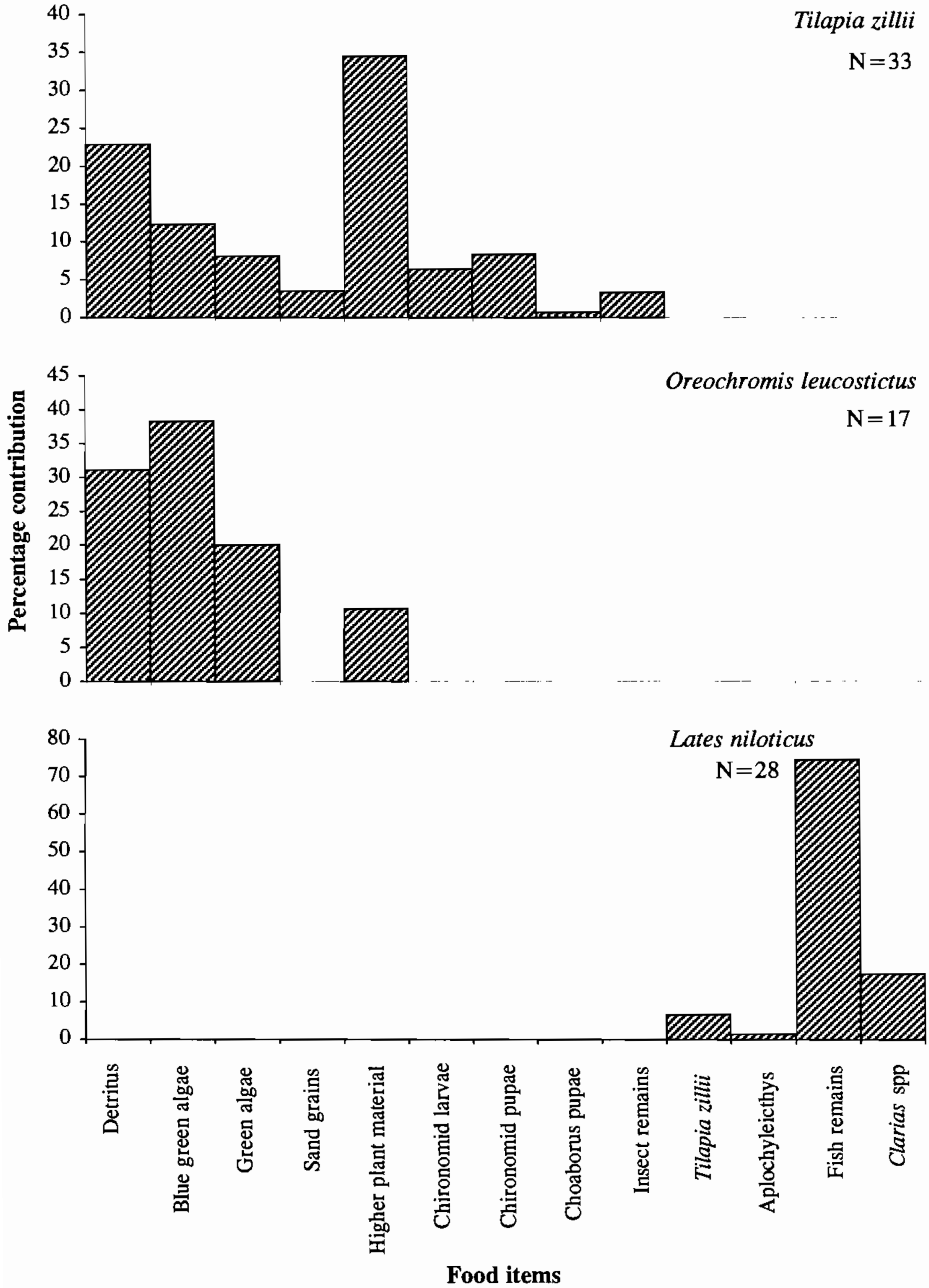

Fig 4 Percentage contribution of the different food items found in the stomachs of *Tilapia zillii*, *Oreochromis leucostictus* and *Lates niloticus* caught using gillnets in Kabaka's lake.

Table 3. Mean catch rates (grams per net per night) on Kabaka's lake (2000)

Gear size (mm)	g/net/night
25.4	75.9
38.1	243.5
50.8	619.7
63.5	251.7
76.2	703.5
88.9	513.0
101.6	841.5
114.3	1383.5
127.0	4160.0
139.7	1690.0
152.4	3215.0
177.8	3931.0
203.2	675.0

Major physio-chemical and biological properties of Kabaka's Lake

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Introduction

Kabaka's lake lies within the densely populated Kampala City. The lake is important as a reservoir of clean water for recreational and other use is being threatened by water degradation due to intense anthropogenic activities, including car-washing, around the lake. Devegatation of the shorelines and damping garbage into the lake are already contributing to undesirable water quality effects such as objectionable colour and high oxygen demand in bottom waters.

Materials and Method

Sampling for major physico-chemical parameters and phytoplankton was conducted in year 2000 and in conjunction with invertebrate and fish survey undertaken by researcher at FIRRI. Methods of analysis for nutrients followed standard procedures as described in Stainton *et al.* 1977 and Lab manual, FIRRI, 1996.

Results

High dissolved oxygen concentrations (> 8 mg/L) were often measured in surface waters (< 1 m), while corresponding bottom waters (> 1 m) remained hypoxic to anoxic throughout the day (Figure 1). The high dissolved oxygen concentrations in surface waters were a result of high photosynthetic activity as indicated by elevated rates of areal algal productivity, in the range 4470-6910 $mg.m^{-2}.h^{-1}$ (mean 5690 $mg.m^{-2}.h^{-1}$).

Daily phytoplankton primary productivity was in the range of 42 to 66 g $0_2.m^{-2}.d^{-1}$ and indicative that Kabaka's lake was one of the most productive water bodies in the world and has the potential to support a highly productive pelagic fishery. However, photosynthesis occurs within a shallow euphotic zone of < 1.0 m due to rapid light attenuation indicated by the high light extinction coefficients (4.3 -6.7 m^{-1})(Table 1). There is no doubt that the high algal biomass (41.7-240.8 $mg.m^{-3}$) contributes to the rapid light absorption in the surfaces of the lake. Besides, light absorption by a huge chloropyll-a biomass and other particulate matter can result in diurnal heating and elevated surface temperatures as observed in Kabaka's lake.

The high algal biomass and productivity in Kabaka's lake are a result of high nutrient concentrations recorded in the water column (Table 2.). There are low algal species diversity of algae in this lake and blue green algae were the most dominate group. Total phosphorus and dissolved inorganic P concentrations of Kabaka' lake were among the highest in the world. Total P varied 12-fold within the lake (Table 2) and its average value was 12 times higher compared to the average total P value of Lake Victoria. The high total P concentrations in the lake allows proportionate use of nitrogen by the algae resulting in high total N concentrations in the lake. However, the hardly measurable dissolved oxygen concentrations in mid to bottom waters threats nitrogen return to the productive euphotic zone and may have consequences for algal species composition, which in turn will affect the structure and composition of higher trophic levels. Preliminary data of sestonic ratios indicate that Kabaka's lake has one of the lowest recorded TN: TP ratios (< 2.0) for a shallow water body. Persistence of low TN: TP ratios will likely result in dominance of blue-green algae that are poor quality food for fish. (Talling *et.al* 1996)

Conclusion

High nutrient concentrations are the initial force driving high algal biomass and productivity in Kabaka's lake. Increased nutrient input to the lake will enhance proliferation of the blue green algae, which in turn undermine the water quality of the lake. However, low TN: TP indicate excess P that creates N –demand, which in turn will force the lake to get the required N loading from the atmospheric N source. Consequently blue-green algae will dominate the lake and will further undermine the use of Kabaka's lake as source of safe water.

Recomendation

Malpractice that lead to increased nutrient inputs into the lake should be minimized so as to improve and maintain an acceptable water quality for human and animal use.

Table. 1.Physical parameter of Kabaka's lake 2000. N= number of samples

	Cond(us/cm)	Do (mg/l)	Temp (°C)	PH	Secchi(m)
Min	138	0.0	23.0	6.4	0.4
Max	219	14.4	29.6	9.3	0.8
Mean	192.0	5.5	25.5	7.9	0.5
Std	13.6	3.4	1.3	0.6	0.2
N	184	189	106	105	12
Ext. coef.	4.3-6.7m^{-1}				

Table . 2. Average nutrient and chlorohyll-a concentrations of Kabakas during 2000.
N = number of samples

	TN (uM)	TP (uM)	SRP(uM)	SRSi(uM)	Chlr-a(ug/l)
Min	9.0	8.9	1.6	19.2	41.7
Max	242.9	109.7	35.0	27.4	240.8
Mean	36.6	24.1	7.8	22.2	132.5
Std	58.6	25.4	10.5	26	52.0
N	16	16	16	16	16

Table 3. Algal speceis diversity in Kabaka's lake

cynobacteria	
Merimopedia elagans	p
Merismopedia tenussima	p
Merimopedia spp	p
Microsystis aeruginosa	p
M.incerta	p
M.flosaque	p
M. wasarbagi	p
Coelespherum	p
p.circumerenta	p
Oscillatoria limnetica	p
Anabeanopsis	p
Anabeana circinalis	p
planktolyngbya	p
Chrococcus	p
Chlorophyta	
Oosytis	p
Anks.falactus	p
Scenedesmas	p
Stuarastrum	p
Tetreadron trigonum	p
pediastrum simplex	p
Cosmarium	p
Scenedesmas quadricauda	p
Scenedesmas Arcuatus	p
Scenedesmas Castato	p
Monorophidium	p
Bacillariophyceae	
Cyclotella	p
Nitzchia	p
Euglenophyta	
Trachelomonas armatus	p
phacus	p
Euglena Acus	p
pyrrophyta	
Glenodinum	p
Ceratium hirudinella	p
protozoa	
Ciliate	p
Vorticella	p
Total	34.00

Reference:

Stanton,M.P,M.J Capel and F.A J.Amstrong,1997. The chemical analysis of fresh water.Fish.Mar.Serv. Msc Spec. Publ. 25:16p.

FIRR,1996 .Laboratory manual .

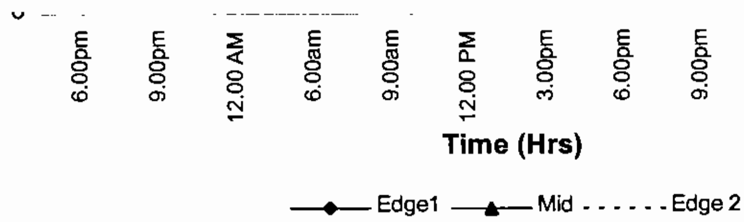

Fig.1 Disslved oxygen at 1m depth at various times in Kabaka's lake.