# LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROJECT

**FISHERIES MANAGEMENT COMPONENT**

**REPORT ON LENGTH, WEIGHT AND SEX SURVEY OF NILE PERCH (*Lates niloticus*) IN LAKE VICTORIA, TANZANIA – FEBRUARY 2004**

By

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**SUMMARY**

This report presents the length-weight relationship parameters (**a** and **b**) for 559 *Lates niloticus*, size composition, sex, maturity stages, length at first maturity and food examined during February 2004 from four landing sites and four processing industries. Estimates of "**b**" varied between 2.5045 and 3.3537 with mean of 2.8781 ($\pm$ 0.3593). The length-weight relationship was isometric. The maximum total length (TL) recorded was 109 cm while the minimum was 35cm. The modal length for combined data from all landing sites was 70 cm, which is the same as that observed from fish processing industries. The highest modal length (80 cmTL) in landing sites was observed at Kayenze station. Males outnumber females by the ratio of 2.3:1 and mature earlier at 64 cmTL than females, which attain sexual maturity at 66 cmTL. Bwai have comparatively more food for *Lates niloticus* than other areas with condition factor "**a**" equal to 0.0118. The main food for *Lates* were Haplochromines and Silver cyprinids, *Rastrineobola argentea*. Other food items eaten by Lates were *Brycinus* spp., *Bagrus dockmac* and *Caridina nilotica*. Majority of *Lates niloticus* in this survey contains empty stomachs (75%).

# 1. INTRODUCTION

## 1.1. General Overview

Information available from four last surveys (Ngowo 2002, Mzighani 2003a, b and c) has stimulated further research to be conducted in Lake Victoria areas like Landing sites and Fish Processing Industries, with the view to collect more and relevant data which will be used for stock assessment of *Lates niloticus* and establishment of growth parameters. The data which will be compared according to seasons, months and years. The fifth survey on the status of *Lates niloticus* from landing sites and fish processing industries was undertaken in February 2004.

This report will therefore present basic data for the fifth survey, which are very important in the exploitation and conservation of this important species. The data includes parameters of length-weight relationship, population structure, sex, length at first maturity and food for *Lates niloticus*.

## 1.2. Longterm Objectives

To determine the status of Nile perch (*Lates niloticus*) fishery by using length, weight and sex data. The survey will help to establish and relate the fish length and weight so that to obtain condition, growth and morphometric relationship of *L.niloticus.* Sex and maturity stage will be used to establish length at first maturity and to determine the type of sex which is dominant.

### 1.3. Specific Objectives

- To study the population structure of *Lates niloticus* within the study areas
- To determine the type of food items eaten by *Lates niloticus*
- To give recommendation on management and conservation of *Lates niloticus*

## 2. MATERIALS AND METHODS

### 2.1.Study Area

The study on the status of *Lates niloticus* was conducted at four landing sites and four processing industries in three regions bordering Lake Victoria, namely Mwanza, Mara and Kagera (Figure 1). Fish samples were collected from two landing sites in Mwanza City, namely, Igombe (Ilemela district) and Kayenze (Magu district). Others are Bwai (Musoma district) in Mara region and Nyamkazi (Bukoba district) in Kagera region. The area under study comprised different habitats, which include Sandy, Rocky, Muddy and Vegetated areas. The four processing industries include Vic Fish (Victoria Fishing Industry), TFP (Tanzania Fish Packers) in Mwanza City and Prime Catch (Exports) Limited and Musoma Processors in Mara region.

### 2.2. Sample Collection

Samples of about 88 fish individuals of different sizes were collected randomly from each site from fishermen using hook and line, longlines and gillnets. The samples from processing industries were about 43 fish individuals. Total Length was recorded by using 100 cm measuring board, while weighing scale of 20 kg (sensitive to the nearest 0.02 kg) was used to measure weights of individual fish. Each fish were gutted for sexual maturity according to Nikolsky (1963) and analysis of different types of food items and stomach size identification. The maturity stages were categorized to six stages for males and seven stages for females as described by Hopson (1972). Stomachs fullness were categorized as empty (0%), quarter full (25%), half full (50%), three quarters full (75%) and full (100%) according to Hynes (1950). The prey item in each gut was identified and counted.

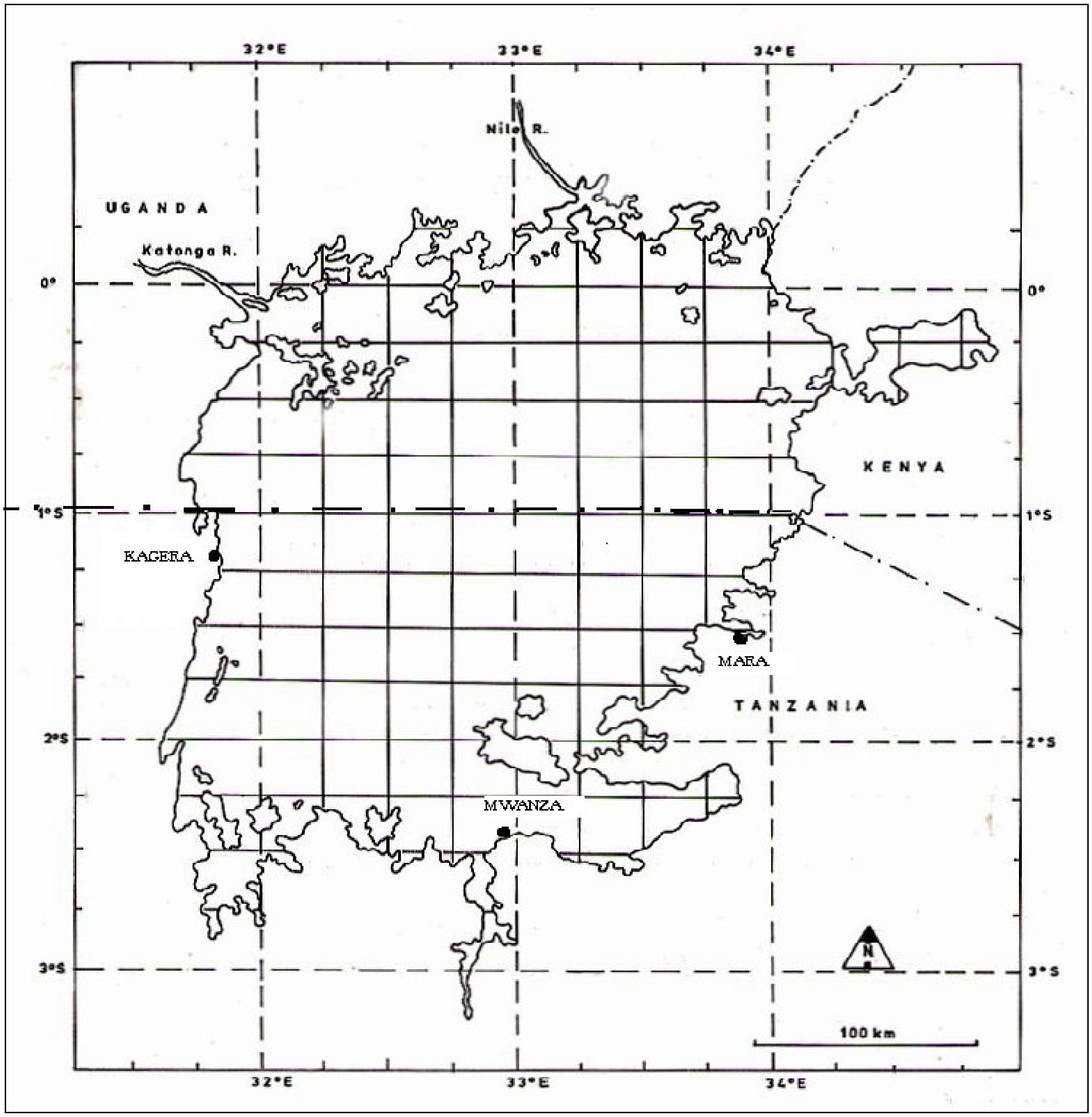


**Figure 1: Map of Lake Victoria, with sampling regions.**

### 2.3 Data Analysis

Length-weight relationships were plotted to find type of growth whether it is Isometric or Allometric growth by using slope (b), linear correlation between length and weight by using regression coefficient ($R^2$) and the well being of fish by using condition factor (a). The cubic equation form of length-weight figures derived from graphs is as follows: -

$$W = aL^b$$

Where: W = Weight of fish

L = Length of fish

a = constant known as condition factor

b = constant known as slope

Length frequency graphs were plotted for the purpose of establishing length distribution (population structure) of Nile perch in different sites and in industries. Modal length was calculated using plotted bar graphs.

## 3. RESULTS

### 3.1. Length-Weight Relationship

The parameters of length-weight relationship are summarized in Table 1. The condition factor (a), slopes (b) and regression coefficient ($R^2$) of *L. niloticus* were computed according to area, combined data from landing sites and from processing industries. All data are obtained from non-linear graphs of length-weight relationship (Figure 2) according to Le Cren (1951).

**Table 1: Parameters Used to Establish Length-Weight Relationship of *Lates niloticus* in different sites, Lake Victoria, Tanzania, February 2004.**

| Sites | Number (n) | Total Length (cm) | | L-W Relationship | | |
|---|---|---|---|---|---|---|
| | | Min | Max | a | b | $R^2$ |
| Kayenze | 85 | 41 | 94.7 | 0.0091 | 3.0600 | 0.9639 |
| Igombe | 91 | 30 | 75.1 | 0.0037 | 3.1446 | 0.9863 |
| Bwai | 69 | 41 | 80 | 0.0118 | 2.9961 | 0.9846 |
| Nyamkazi | 107 | 30 | 87 | 0.0099 | 3.3110 | 0.9523 |
| Landing sites combined data | 352 | 30 | 94.7 | 0.0079 | 3.1260 | 0.9518 |
| Processing industries | 207 | 51 | 86 | 0.0077 | 3.1102 | 0.9512 |

A total of 559 Nile perch were analyzed for length-weight relationship in this survey. The maximum and minimum total length were 94.7 cm and 30 cm respectively with the average total length of 70 $\pm$ 6.1.

Maximum condition factor (a) was observed in Bwai, which is equal to 0.0118. Igombe with 0.0037 has the lowest condition factor. Growth constants (slopes) range from 2.9961 to 3.3110. The following correlation of length and weight 0.9639, 0.9863, 0.9846 and 0.9523 were observed in Kayenze, Igombe, Bwai and Nyamkazi respectively. Regression coefficient for combined data from landing sites was 0.9518 while that of processing industries was 0.9512.

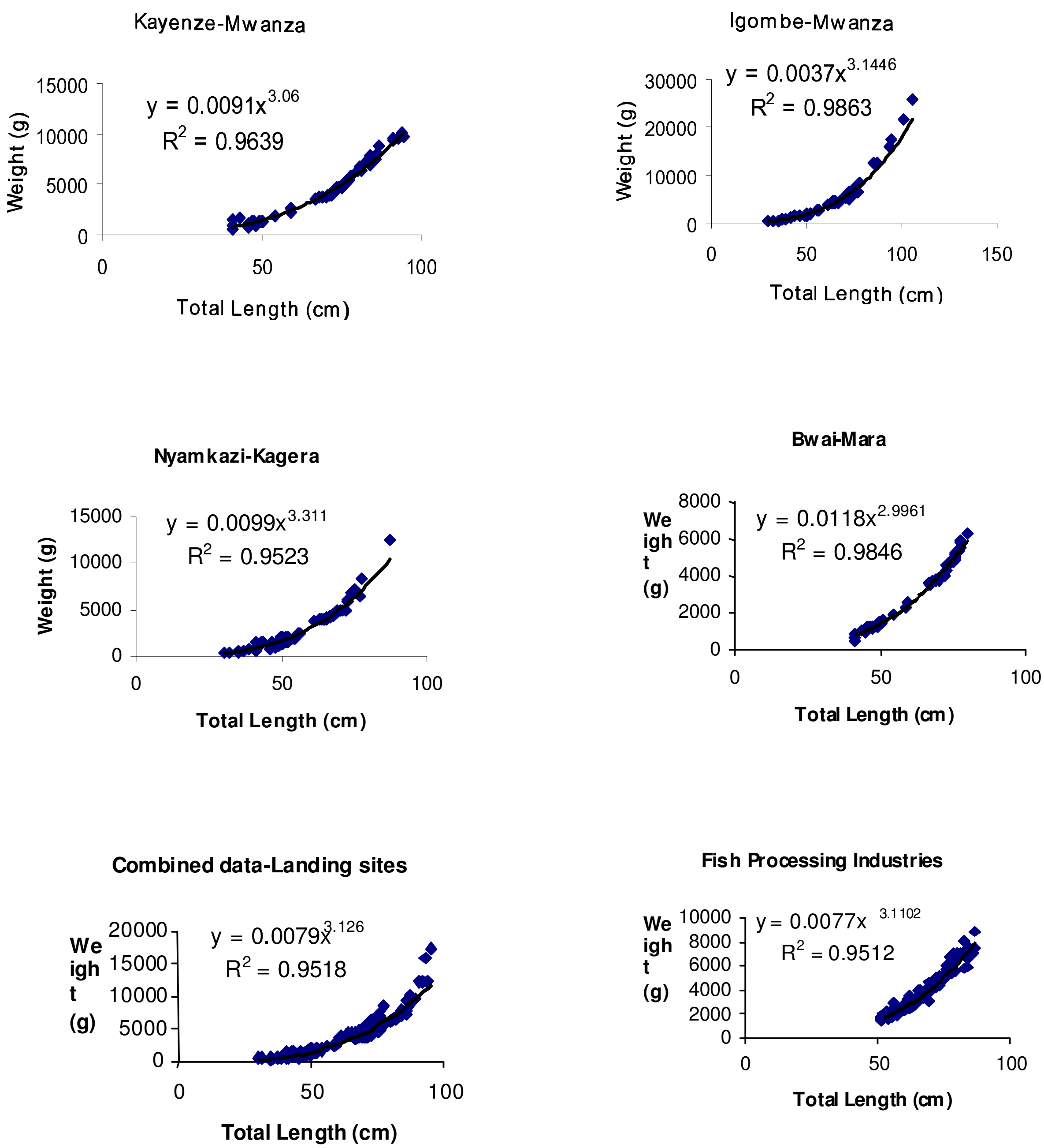


**Figure 2: Length-Weight Relationship of *Lates niloticus* in Different Sites, Lake Victoria, Tanzania, February 2004.**

### 3.2. Population Structure

Length frequency distributions of *L.niloticus* from different sites are summarized in Figure 3 and Table 1. Kayenze station had two peaks (modal lengths) at 70 cm and 80 cm with size range from 41 cm to 94.7 cm. Total length ranges from 30 cm to 75.1 cm at Igombe station with a peak at 70 cm. Bwai station had a peak at 70 cm, its size ranges from 41 cm to 80 cm. Meanwhile, at Nyamkazi station the length frequency relationship had two peaks at 50 cm and 70 cm, its size ranges from 30 cm to 87 cm. The pooled data from all landing sites had a peak at 70 cm, total length ranges from 30 cm to 94.7 cm. Processing industries had a peak at 70 cm with total length from 50 cm to 86 cm.

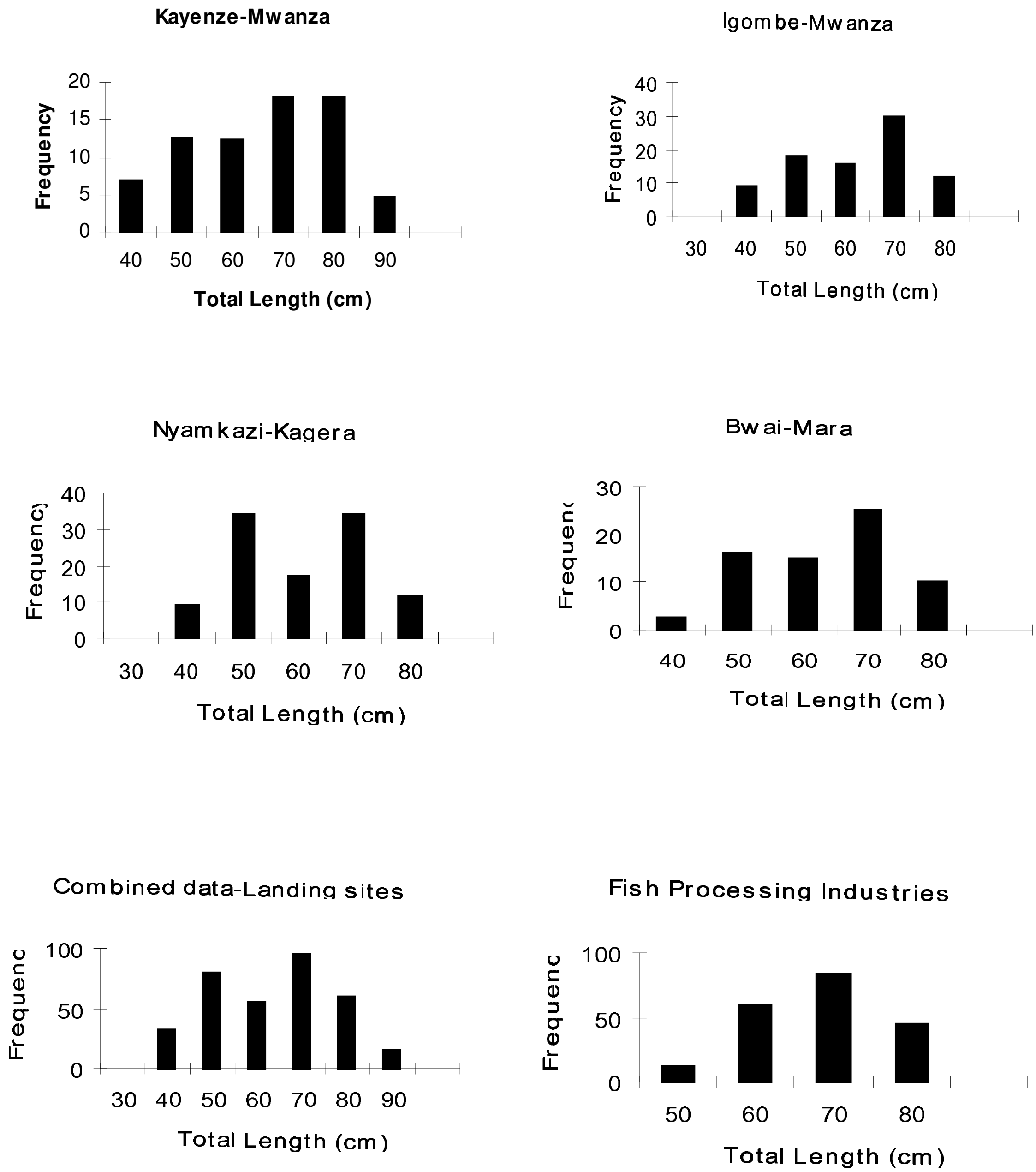


**Figure 3:Length Frequency Distribution of *Lates niloticus* in Different Sites, Lake Victoria, Tanzania, February 2004.**

### 3.3. Sex Ratio and Maturity

The sex ratio established was 2.3:1 in favour of males. Figure 4 shows the Length at first maturity (L50%) of *Lates niloticus* from combined data of both landing sites and fish processing industries. The size at first maturity for males *Lates niloticus* was 64 cm TL and for females 66 cm TL

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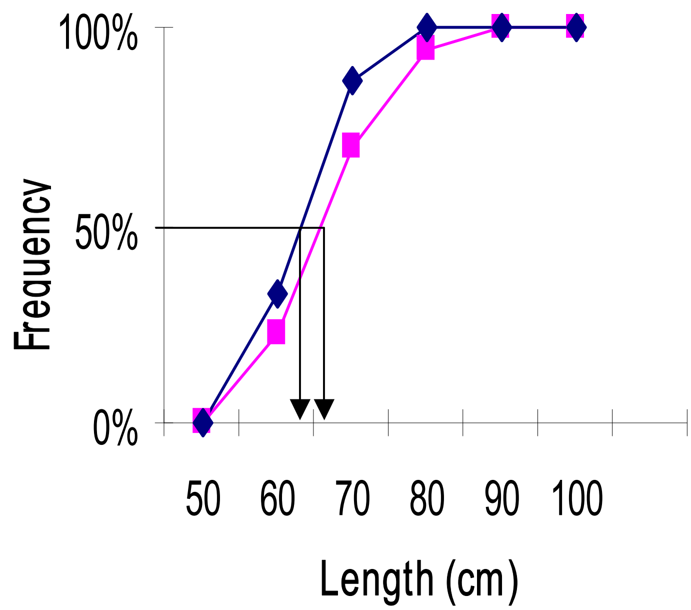


**Figure 4: Length at first maturity (L50%) of *Lates niloticus* from landing sites, Lake Victoria, Tanzania, February 2004**

### 3.4. Food and Feeding

Stomach size identification indicates that 75% were empty stomach, 15% quarter full, 7% were half full and 3% were full stomach. Figure 5 shows food items eaten by *L.niloticus* in the surveyed areas. *L.niloticus* in this study were observed to feed on haplochromines, *Rastrineobola argentea*, *Brycinus* spp. *Clarius gariepinus*, *Caridina nilotica* and *Bagrus dockmac*.

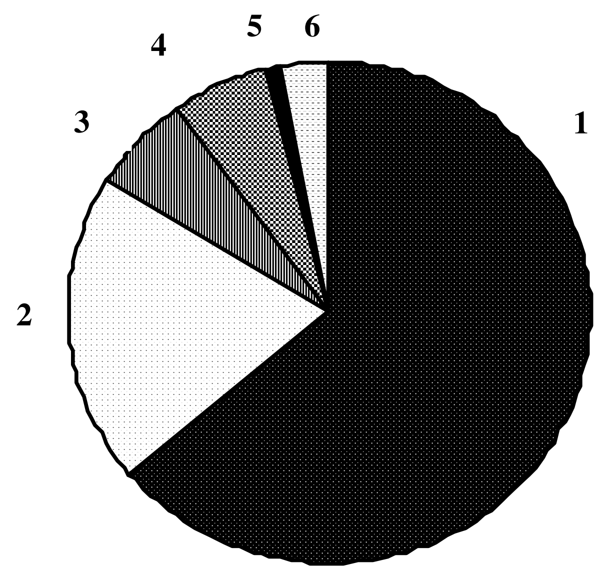


**Figure 5: Food Items eaten by *Lates niloticus* as Observed in Different Sampling Stations, Lake Victoria, Tanzania, February 2004. 1-Haplochromines 2-*Rastrineobola argentea* 3- *Brycinus spp*. 4- *Clarius gariepinus* 5- *Bagrus dockmac* 6-*Caridina nilotica***

# 4. DISCUSSION

## 4.1. Length-Weight Relationship

Condition factor "**a**" is a constant which can inform about 'well being" of a given species, therefore it is an indicator of the food abundance for the given species in a given area or time. Condition factor is influenced by availability of nutrients, sampling periods, and reproductive status. The food items for *Lates niloticus* in Bwai (Mwanza City) were relatively higher than other areas followed by Nyamkazi, Kayenze and Igombe respectively. This was deduced from condition factors estimated from length weight relationship (Section 3.1), in which this site was observed to have high condition factor than other sites. The lowest condition factor was observed at Igombe station in Mwanza City, which implies lowest food items for *Lates niloticus*. Bwai and Kayenze stations ranked the first in the last survey done in September 2003 (Mzighani 2003c) while Igombe ranked at last position. Nyamkazi station ranked the first in the survey done in May 2003, followed by Bwai and Igombe respectively (Mzighani 2003b), while in the survey done in September 2003 (Mzighani 2003c) Nyamkazi ranked at last position. The result obtained in this survey shows that there is little changes on food items in Bwai station. High change takes place in Nyamkazi where its condition factor increases. The difference in condition factor in different areas and different times implies that Lake Victoria experiences nutrient fluctuation in different areas and at different times of the year. Also the differences in the condition factor between this study and previous four studies conducted in October 2002 (Ngowo, 2002), March 2003, May 2003 And September 2003 (Mzighani 2003a, b and c) may be attributed to different sampling periods, availability of food, fishing pressure and reproductive status. King (1995) noted that the condition factor might vary with food abundance and the average reproductive stage of the stock. Average reproductive stage of the stock affects condition of the fish since during spawning season most of the energy is directed to egg production thus low "a" values are expected. Claro and Garcia Arteaga 1994 reported that the relationship between the length and the weight of fishes are related with the metabolism in each species and the environment where they live.

*Lates niloticus* grows at the same rate in all linear dimensions, i.e. growth in which increase in length, width and height are proportional to each other (Isometric type of growth). This was estimated from calculated values of 'b' which were close to three for all Lates niloticus in different areas under survey. According to King (1995), a constant slope 'b' that is nearly or close to 3, shows that the fish has an isometric growth. Garcia et al (1998) reported that biological interpretation of the numerical values of the parameters "**a**" and "**b**" is not straightforward, except that when growth is isometric, "**a**" can be interpreted as a condition factor. When growth is allometric, the role of "**a**" as the condition factor is questinable.

The correlation coefficient '$R^2$' in all sampled sites is closer to 1, this indicates that there is a high degree of correlation between total length and weight of *Lates niloticus*, suggesting that there is a significant linear relationship of the statistics for the *L.niloticus* in this survey.

### 4.2.Population Structure

According to length at first maturity established in this report (Section 3.3) males *Lates niloticus* mature earlier than females. In applying the length at first maturity of the two areas (landing sites and fish processing industries) together with modal length in each area (Section 3.2), it is deduced that mature *L.niloticus* were dominant in both landing sites and fish processing industries. Modal length from landing sites was 65 cmTL for the survey done in May 2003 (Mzighani 2003b), two peaks were observed in September

2003 survey, 50 and 60 cmTL (Mzighani 2003c) and in this survey the modal length is 70 cmTL. Fish processing industries have modal length of 60 cmTL and 70 cmTL on the survey done in May and September 2003 (Mzighani 2003b and c). The improvement in modal length shows that there is a proper management for *Lates niloticus* fishery in Lake Victoria, Tanzania.

Processing industries have very big fish than landing sites because industries are required to take fish from 50 cm TL and above. The modal length of Nyamkazi improves very well in this survey than previous three surveys (Mzighani 2003a, b and c). The increase in modal length in this area is correlated with an increase in food items as its condition factor increases and also proper management of *Lates* fishery.

**4.3. Sex Ratio and Maturity**

The sex ratio of *Lates niloticus* obtained from this survey was 2.3:1 in favour of males from 559 specimens of *L. niloticus* which were investigated for sex and maturity stages in all four sampled areas and four processing industries. The result suggests that *L. niloticus* males outnumber females for about two times. In the previous two surveys done in May and September 2003 the sex ratio established was 2.35:1 and 2.26:1 in favour of males (Mzighani 2003b and c). Chande *et al*. (2000) reported the ratio to be 3:1 in favour of males. Bayona *et al*. (2001 & 2002) reported that male to female ratio were 2:1 and 3.1 respectively. Sex ratio of *L. niloticus* has been observed to be size dependent. *L. niloticus* below 80 cm TL, the male to female ratio ranges from 10:1 to 7:1, where as above 80 cm TL the proportional of males falls rapidly (Hughes 1992, Ligtvoet and Mkumbo 1990). *L. niloticus* above 120cm generally are found to be females in River Kyoga (Ogutu-Ohwayo 1988). This skewed tendency in sex ratio can be compared to human being where males are more than females at the age below 45 years (Food and agriculture Organization-FAO Report, 1988). The reason for *L. niloticus* ratio to favour males is not well known, but it is believed to be a strategic advantage ensuring that the eggs of all females are fertilized, because the fecundity of *L. niloticus* is very high, 16 million eggs per female. There are other scientific reasons for this skewed sex ratio. Hopson (1972) assumed that the numerical superiority of larger females is the result of high mortality in the males. Sex inversion from males to females as observed in *Lates calcarifer* in Australia (Moore, 1979) and congregations of members of one sex in particular area (Hopson, 1982). Hughes (1992) comes up with an argument that *L.niloticus* is a protandrous hermaprodite, with a few fish maturing as primary females.

Males mature earlier than females in both areas as observed in the study done in May and September 2003 (Mzighani 2003b and c). This is not different from results obtained by Chande *et al*., (2000) in which males was observed to mature earlier (67 cm TL) than females (95 cm TL). Males *L.niloticus* generally attain maturity at a smaller size than females, the age at first maturity is about two years for males and four years for females (Hughes 1992).

### 4.4. Food and Feeding

Analysis for different types of food items and feeding of *Lates niloticus* was carried out. A total of 559 specimens were gutted to check their stomach fullness. Internal and external factors motivate the feeding behavioural strategies of fish. The degree of stomach fullness and other physiological parameters (Holmgreen *et. al*., 1983) are internal factors while the presence of prey of the appropriate size and species is an external factor (Hart 1993). The main food items of *Lates niloticus* were haplochromines and *Rastrineobola argentea*. Also observed to feed on *Brycinus* spp. *Clarius gariepinus*, *Caridina nilotica* and rarely *Bagrus dockmac*. This is not different from the result obtained in the previous survey, May 2003 (Mzighani 2003b), where the main foods of *L.niloticus* were Haplochromines and *Rastrineobola argentea*. Bayona *et. al*., (2001) reported that the main food items of *L.niloticus* in non-trawlable areas were

Haplochromines, *R. argentea* and *Caridina nilotica*. Other authors also show that the prey of *L. niloticus* comprised of haplochromines and *R. argentea* (Ligtvoet & Mkumbo 1990, Witte & Van Densen 1995). Cannibalism was not observed in this survey but was observed in previous two surveys done in May and September 2003 (Mzighani 2003b and c). Ligtvoet and Mkumbo (1990) reported that cannibalism is found in large individuals and seems most prominent in times when other main prey stocks decreased. Majority of samples observed to be with empty stomach because the fishing gears used in research areas were passive one. When the fish is caught it become more difficult for it to eat and at the same time digestion continues, therefore it cause to be with empty stomach.

## 5. CONCLUSSION AND RECOMMENDATION

- Improvement in modal length shows that management for *Lates niloticus* fishery have been improved in landing sites.
- Beach Management Units (BMU's) members must be facilitated and educated for proper utilization and management of Lake Victoria resources.
- Research on the status of *Lates niloticus* must be widen in other landing sites for better comparison, stock assessment and establishment of growth parameters using Von Bertalanffy growth equation.

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