INVESTIGATIONS OF THE PRESENT FACTORS AFFECTING THE POPULATION CHARACTERISTICS AND RELATIVE ABUNDANCE OF NILE PERCH (*Lates niloticus*) AT SELECTED TRAWLING SITES OF WESTERN PART OF LAKE VICTORIA-UGANDA, KAGEGI GULF.

BY

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A Research Report submitted to the Faculty of Agriculture and Science Technology in partial fulfillment of the requirements for the award of a Bachelor of Science Degree in Fisheries and Aquaculture, Busoga University.

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Declaration

I, Bassa Samuel, declare that this report is my original work and has never been submitted to any University or Institution for award of degree or any other qualification.

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Dedication

To my dear parents: Mrs Swaya Mirabu Namukose and Late Swaya Wilson. My sons Musamba Emmanuel W., Swaya Mike and Late Kirya Brian. Lastly to my daughter Namuganza Treasure F.

Acknowledgement

I wish to thank the Director of National Fisheries Resource Research Institute (NAFIRRI), Dr John Stephen Balirwa for granting me permission to undertake this study.

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List of Tables.

List of Figures

List of Appendices

List of Abbreviations and Acronyms

m ------------------------------ metres

DO ----------------------------- dissolved oxygen

mg/l --------------------------- milligram per litre

°C ----------------------------- degree centigrade

GPS ---------------------------- Geographical positioning systems.

LVFRP -------------------------- Lake Victoria Fisheries Research Project

IFMP --------------------------- Implementation of a fisheries Management plan.

Sops --------------------------- Standard operating procedures.

UFFCA -------------------------- Uganda Fisheries and Fish Conservation Association.

mm ----------------------------- millimetre

cm ----------------------------- centimetre

ml ----------------------------- millilitres

kpas --------------------------- kilopascals

g ------------------------------ grams

CPUA --------------------------- catch per unit of effort

TL (cm) ------------------------ Total length in centimetres

W ------------------------------ weight

t/km^{-2} ------------------------tonnes per square kilometre

Z ------------------------------ Total mortality

TIN------------------------------ Total Nitrogen

Table of Contents

Definitions of terms

Predator	–	An animal that kills and eat other animal.
Trawl	–	To fish by pulling a large net with a wide opening through the water.
Toxic	–	Poisonous
Anoxia	–	Oxygen deficiency levels

Abstract

This report is based on the investigation of the factors affecting population characteristics and relative abundance of Nile perch in selected sites of Kagegi Gulf Lake Victoria Uganda in the month of November 2006. Nine (9) stations were sampled at depth strata of 0-10, 10-20, 20-30 and 30-40 m the mean catch rates were as follows; 8.75±5.5, 4.77±2.3, 6.33±0.3 and 1.34±1.1 tonnes per square kilometer respectively. The catch rates differed at various depth levels with p-value of 0.2940 at 5% level of significance. Limnological parameters were temperature 25.15±0.28, 23.68±0.20, 24.74±0.13 and 25.3±0.20°C; pH of 8.0±0.00, 7.7±0.11, 7.66±0.33 and 6.32±0.14, dissolved oxygen 7.37±0.24, 6.44±0.30, 6.32±0.14 and 6.22±0.14 mg/l; Total nitrogen 589.82±97.2, 514.34±68.8, 690.44±257.8 and 809.03±45.02µgL-respectively with a p-value of 0.4392 at 5% level of significance. Prey type of Nile perch indicated 65.2% of haplochromine in 0-10 m depth and other strata >10 metre were dominated by *Caridina nilotica*.

Generally investigations indicated that the catch rates of Nile perch at Kagegi gulf in various depth strata probably depended on both the physical and chemical parameters mentioned above.

CHAPTER ONE

1.0 Introduction:

1.1 Background.

Nile perch (*Lates niloticus*) belongs to the family Centropomidae and the genus is *Lates*. It has very many vernacular names Sangara, Chengu, Mbuta, Mputa in the East African community. It is wide spread in Lake Victoria, L.Chad, L. Albert, L. Rudolf, River Nile, R.Tana, R. Volta and R.Zaire. (Moos P.J. *et. al* 1995). In Uganda basing on the length frequency analysis, the length at infinity was 251 cm and can achieve a total length of about 110 centimeters in 5 years (Witte and Winter 1995). It being a predator (feeding on other fish species) makes this species superior from other fish.

Nile perch was introduced in Lake Victoria between 1950s and early 1960s for purpose of converting the less valuable haplochromine cichlids into high quality table fish (Mhitu 2004).

Within a few years after the increase in abundance of the Nile perch, about 200 offshore species of haplochromines probably had become extinct and many inshore species decreased in abundance. Also, most of the non-cichlid fishes in offshore waters showed a strong population decrease (Mhitu 2004).

Nile perch that contributes high income to the country is treasured like gold. The stocks of the introduced Nile

perch in different parts of Lake Victoria increased rapidly between 1977 and 1983 (LVFO, IFMP Trawl survey SOPs, May 2005) then later on started dwindling.
For instance, in the Ugandan part of the lake, fish catches increased more than 8 times from 17,000 metric tones in 1981 to a peak of 132,000 metric tonnes by 1989 of which 77% was Nile perch (Okaranon 1994). The fishing capacity in Uganda sector increased from about 3200 fishing canoes in 1972 to 8000 by 1990 and was estimated to be 10,000 canoes in 1998 (Okaranon 1999). The total fishery yield from the lake was estimated between 400,000 and 500,000 metric tones of fish annually valued at US$ 300 to 400 million annually. Fish processing plants were established around the lake to process and export Nile perch (SOPs 2005). All this is an indication of over exploitation of the fishery in Lake Victoria, Uganda sector. And Nile perch being the most commercially important species has been hit hard in this period of the decade.

Trawl survey information carried by Lake Victoria Fisheries project under Fisheries Resource Research Institute between 1997 - 2000 indicate that catch rates decreased with increasing water depth from 229.0 ± 38.1 kg hr^{-1} for all fish species in waters 4-10 m depth zone to 5.0 kg hr^{-1} in 50-60 m depth zone. The biomass for all fish species based on the trawl method in the 4-40 m depth zone was estimated at 142,000 tonnes (t). The biomass for Nile perch and Nile tilapia in this zone were estimated at 121,000 and 15,000 tonnes respectively. The biomass figures were estimated to 694,000 t of Nile perch for whole of Lake Victoria of which 307,000 t was estimated for the Uganda portion of the lake. The standing stock of Nile perch was estimated at 9.94, 11.73 and 9.86 t km-^{2} in the Uganda, Kenya and Tanzania portions of the lake respectively with a lake-wide average of 10.01 tonnes km-^{2}. Only 29.3% of Nile perch in trawl catches were mature fish (>50 cm Total length) the bulk of Nile perch (60% by numbers) are caught in waters 4-20 m deep. The annual yield for, the Ugandan portion of Lake Victoria was estimated at 107,000 t of which about 72,000 t was Nile perch. Trawl surveys indicated that the standing stock lake-wide decreased from 694,000t to 628,000 t from 1999 to 2000 with the decrease in Ugandan water estimated at 307,000 to 266,000 t. (Ogutu-Ohwayo R. *et.al* 2002).

Considering the work done during the Lake Victoria Fisheries Project (LVFRP) and the current project which is Implementation for Management Plan Project (IFMP), the mean catches of Nile perch in all zones in the Ugandan waters declined from about 9.4 t km^{-2} during January-March 1997-2000 survey to about 7.2 t km^{-2} during the survey in March 2005; (Okaranon *et. al* 2005).

1.2. Global importance of Nile perch.

Nile perch plays a big role in the economy of Uganda. The country's fisheries maximum sustainable yield is estimated at about 300,000 tons, annually. By some estimates, exports primary of Lake Victoria products, amount to as much as US$ 100 million annually, making fishing the second largest foreign exchange earner after coffee. (UFFCA 2000).
It is estimated that about 750,000 Ugandans are involved in fisheries - related employment (around 130,000 for harvest sector as fishers, crew, and/or boat and gear owners; about 600,000 engaged in secondary or tertiary sectorial

activities relating to processing, trading and provision of miscellaneous support services (UFFCA 2000). In 2005 Uganda Fish exports earned 255 billion.(Daily Monitor 2006).

Hence a need is required to carry out a study to identify the key factors affecting the Nile perch in various strata by depth from the shallow to deeper waters.

1.2 Problem Statement.

Nile perch is highly treasured in Uganda and contributes high income to the nation. Studies done so far indicate that its relative abundance is in a decreasing trend hence investigations are needed to verify this. There are indications that the fishery yield has declined from 135,000 tons in 1993 to 107,000 tons in 1997 (Okaranon 1999). A check must be done to look at the downtrend in the Nile perch fishery and why it is happening.

Work has been done on the distribution and abundance of Nile perch on Lake Victoria Uganda (Okaranon 2002) but little on limnology was incorporated in order to defend he decline in the catches. Nitrogen status and Plankton Nitrogen Fixation in Lake Victoria Uganda (Muggide 2001) mainly focused on limnological parameters without correlating them with any fishery catches.

Hence a need is required to correlate both limnological parameters i.e. pH, Oxygen, Nitrate -Nitrogen and Food and feeding habits with relative abundance of the Nile perch in the Kagegi gulf.

1.3 Significance of the study.

Nutrients and thermal conditions are some of the major factors that control seasonal changes in biological productivity and distribution. Nutrient enrichment (eutrophication) is a key environment concern in Lake Victoria. High nutrient inputs into the lake are responsible for the increases of phytoplankton production, proliferation of macrophytes including water hyacinth, increased incidences of noxious and toxic blooms of algae, lack of oxygen (hypoxia and anoxia) and fish kills (Ogutu-Ohwayo R. *e.tal* 2002).

Scientific advise is required to be given to the managers and the local people on how the gold of Uganda the Nile perch can be maintained in the water body of lake Victoria and also be able to balance the demand and supply to both the foreign market and the local people and ensure sustainability of the fishery resources.

1.4. Objective

To investigate the factors affecting population characteristics and relative abundance of Nile perch in selected sites of Kagegi Gulf Lake Victoria Uganda.

1.4.1. Specific objectives.

(i) To investigate the present physical and chemical parameters i.e. Temperature, dissolved Oxygen, pH and Total nitrogen and relate their levels to the abundance of Nile perch in the selected trawling sites.

(ii) To investigate the present food and feeding habits of Nile perch and their contribution to the population characteristics and relative abundance.

1.5 Scope of the study.

Looking at the food and feeding habits of the Nile perch, the physical and chemical parameters mainly Nitrate-Nitrogen, Temperature dissolved Oxygen and pH should be able to indicate the relative abundance and population characteristics of Nile perch.

1.6. Research Questions.

1. Does environmental conditions like temperature; dissolved Oxygen; pH and Nitrate-Nitrogen have an effect on the relative abundance and population characteristics of the Nile perch?

2. Does the food and feeding habits affect the relative abundance and population characteristics of Nile perch?

1.7. Hypothesis.

1. H_o: Temperature, Oxygen, pH and Nitrate-Nitrogen have no effect on the relative abundance and population characteristics of the Nile perch.

2. Ho: Food and feeding (prey type) do not affect the relative abundance and population characteristics of the Nile perch.

CHAPTER TWO

2.0 Literature Review.

2.0. Relative abundance:

Relative abundance is defined as the total catches of the specific fish species in terms of weight in a specified area of the water body. This can be in kilogram per square kilometer. The mean and percentage contribution by weight per haul is calculated including standard deviation of the mean (Trawl survey SOPs 2005).

Lake Victoria is the largest fresh water lake in the tropics with a surface area of 68,680 km-2, mean depths of 40 meters, maximum depth of 80 meters and 1,134 meters above sea level (Bassa 2001).

In the early half of the last century, fishes in Lake Victoria were dominated by indigenous fish, tilapiine cichlids and the androumous *Labeo victorianus*. Following a collapse of gillnet fishery in the early 50's, several species were introduced in the 50's and early 60's including the Nile tilapia and Nile perch. The introductions did not appear to have had a major effect to begin with, and small haplochromine cichlid species still made up over 80% of the catch in the lake (Bassa 2001).

Major changes in the species occurred in early 1980's. There was an explosive population increase in the Nile perch and *Caridina nilotica,* a small benthic shrimp. It also appears that the population of Nile tilapia and indigenous small pelagic cyprinid *Rastrineobola argentae* expanded substantially at about the same time. The fishery is now dominated by Nile perch, Nile tilapia and *Rastrineobola argentae* (Bassa 2001).

A survey was done 1997 up to march 2000 by the Lake Victoria Fisheries Research Project under Fisheries Resource Research Institute and was realized that Nile perch catches were high in the western part (Bukakata to Uganda- Tanzania region) of Lake Victoria especially in waters > 20 m with 15.9 tonnes sq. km compared to eastern part (Napoleon gulf - Uganda Kenya region) registering 14.7 tonnes sq. km. (Okaranon 2001). But Limnological data was not done to know why this variation in catches existed and created a gap, which need to be addressed.

2.1. Population Characteristics of Nile Perch.

Population characteristics of Nile perch at times known as population parameters are food and feeding habits, reproductive biology, growth parameters of the fishes (SOPs 2005)
Nile perch contributes 94% by weight in Lake Victoria (Okaranon *et. al* 1999). The total mortality Z was realized to be Z=1.55 for Uganda (Okaranon *et. al* 1999) and for Kenyan waters Z= 3.69) (Getabu & Nyaundi 1999). These figures indicate how Nile perch is highly exploited in Lake Victoria.

Nile perch mostly dwell in the range of 10-20 meter depth though it can also be found in other depth ranges at minimal(Okaranon 1994). One of the characteristics of Nile perch is realized to be a predator, feed on other fish species including its young ones (Ogutu-Ohwayo R 1990b). Nile perch from sheltered shallow (<10 m) waters feed on a variety of food items like invertebrates (*Caridina nilotica*) and insects mainly Odonata nymphs and mainly small sized *Lates* <20 cm TL. Nile perch with total length >60 cm feed on mainly haplochromines followed by Rastrineobola (Unpublished).

From Napoleon gulf, Thurston and Hannington bays, on the northern portion of Lake Victoria, Nile perch ranging 20-60 cm total length mainly depended on fish for their dietary requirements (>65%) but included a relatively large proportion of Insects in their diet (>25%) in Napoleon gulf and Thurston bay compared to Hannington bay (9%). The small sizes Nile perch (< 20 cm TL) depended on fish diets (>47%) but included large proportions of millipede (25%) and Hirudiean (7%) in Hannington and Thurston bays respectively and *Caridina nilotica* contributed to the diet of Nile perch (5-15%) (Mbabazi 2004). There is need to investigate this kind of fish diet weather concurs with fishes in Kagegi gulf.

2.2. Physical and Chemical parameters.

Thermal conditions and dissolved oxygen concentration in Lake Victoria indicate that surface water temperature ranged from 24.4°C to 28.1°C and averaged 26.2°C in the lake (Muggide 2001).
Differences between surface and bottom water temperatures were small and in the range of 0.1 to 2.3°C, average

1.2°C. Maximum surface to bottom temperature differentials were in November - December in Napoleon gulf (1.8-1.9°C) and coincided with increasing Wedderburn number (>1.0) that indicate more stable thermal stratification (Muggide 2001).It is indicated that shallow <30 inshore bays and gulf have different temperature patterns and mix more frequently (Sekiranda 2006).

Information on depth profiles of dissolved inorganic nitrogen (DIN) from Bugai indicate that dissolved inorganic nitrogen varied overtime; although concentrations hardly exceeded 20µm in the water column. Surface waters (0-10m) were impoverished in DIN between September and March. The most prominent feature of the vertical distribution of dissolved N was the DIN maximum that occurred between 30 and 40 m depth in September - March.

The DIN maximum was less prominent in July and occurred below 50 m in December. A decrease in DIN concentrations as low as 2.0 µm was observed just above the ammonium nutricline beginning at 40 m depth in December. Ammonium concentrations were generally $\leq$ 2.0 µm in the surface waters and tended to decrease slightly at 10 m depth but increased below 30 m in December. Ammonium profiles show a distinct nutricline beginning at 40 m depth in December. Mid and bottom water ammonium maximum occurred below the oxycline between October and March in Bugaia (Muggide 2001).

A deeper water (50-60m) ammonium pool ($\geq$ 10 um) occurred when dissolved oxygen concentration fell to $\leq$1.0 mg l^{-1} in December. This hypolimnetic ammonium reservoir become very low ($\leq$ 2.0 µm) when dissolved oxygen concentration began to increase ($\geq$ 2.0 mg l^{-1}) in March and June -July (Mugidde 2001).

Nitrate concentrations in surface water (0-10m) were generally low ($\leq$2.0 µm) and bottom waters were equally impoverished in nitrate except in July -September and March. Deep vertical mixing allowed a build up of elevated nitrate concentrations (7.0-13.0 µm) throughout the anoxic water column of Bugai in June-July but surface water concentrations begun to decrease in September. The highest concentrations of nitrates (7-14 µm) were observed in mid waters (20-40m) in September, December and March at Bugaia (Mugidde 2001). Most recent studies conducted in early 1990's led to the conclusion that N may limit many phytoplankton species in Lake Victoria (Mugidde 2001). The findings were however, not related to fisheries production and advance cause for this study.

Dissolved oxygen (DO) measurements help understand the distribution, behaviour and growth of aquatic organisms including fish. In June -July 2005 trawl survey the oxygen ranged 3.4 mgL^{-1} to 9.0 mgL^{-1} while temperature varied between 23.7°C to 27.7°C between 0-10 m, 10-20m, 20-30m, 30-40m (Unpublished).

Hence there is need to investigate dissolved oxygen, temperature and Nitrite-Nitrogen parameters in the trawled selected site, and see how they affect the relative abundance of the Nile perch fishery.

CHAPTER THREE.

3.0 Materials and Methods.

3.1. Study Area/station

This experiment was carried out on Lake Victoria, Uganda in the western part of Kagegi gulf which lies between 0°18'S - 0° 40'S, 031°47'E-32°10'E (figure 1). Two stations were covered from 0-10m depth, three stations in 10-20 meter depth and two stations in 20-30 m depth and two stations in 30- 40 m depth. In total 9 stations in Kagegi Gulf were sampled. Each station is an area covering 771.8 square kilometre marked by geographical latitude and longitude grids. The depth of the sampled area was determined using a full mounted 'Echosounder'.

3.2. Experimental design.

3.2.1 Relative abundance data collection

In order to investigate the relative abundance of the Nile perch; data collection was done using a bottom trawl towed at 3.5 knots (1 knot = 1 nautical mile/hour = 1.852 km/hr) on Research vessel known as Ibis with the following dimensions; Backstrops (meters) 2.3, Sweep length (meters) 15 Bridle length (meters) 20 meters, Head line (meters) 24.42 Foot rope (Fishing line) (meters) 28.73 and codend mesh (mm) 25.0 as shown in figures 2 and 3. The Trawl vessel is 17.07 meters length, the beam (width) 4.88 and draft (perpendicular depth from the water line to the keel) 2.2 meters. It has a Caterpillar engine of 215 horsepower (hp) with maximum speed of 8.2 ~9.2 kilometre per hour.

Here total catches of Nile perch per trawl were weighed in different depth zones as per the set experiment. The relative abundance was determined using indices like catch per haul at 30 minute interval of the trawling period in the Kagegi gulf waters of Lake Victoria. (See figure 4)

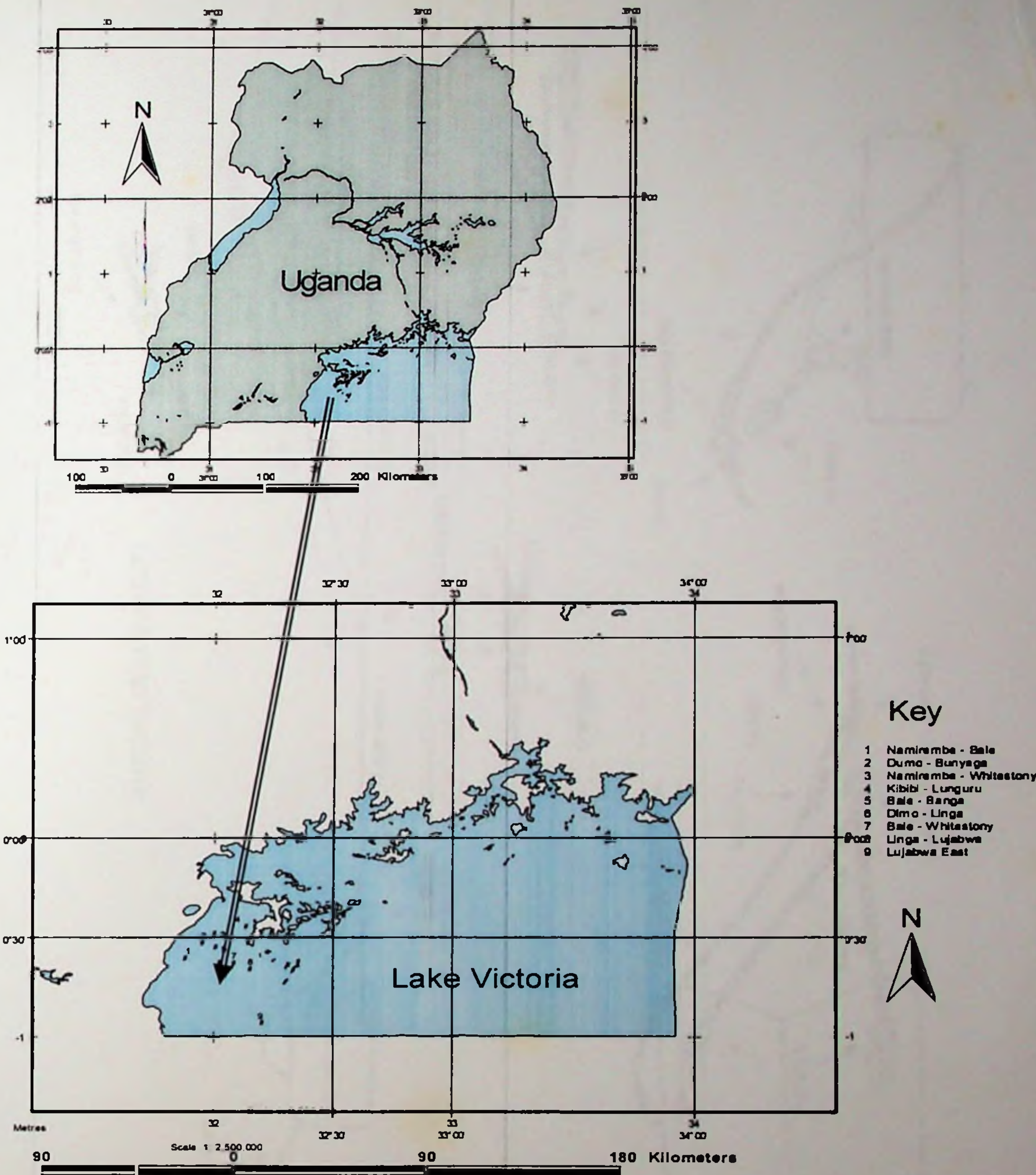

Figure 1: Map of Lake Victoria Uganda, showing where the *Lates niloticus* experimental sampling was done in November 2006 at Kagegi gulf.

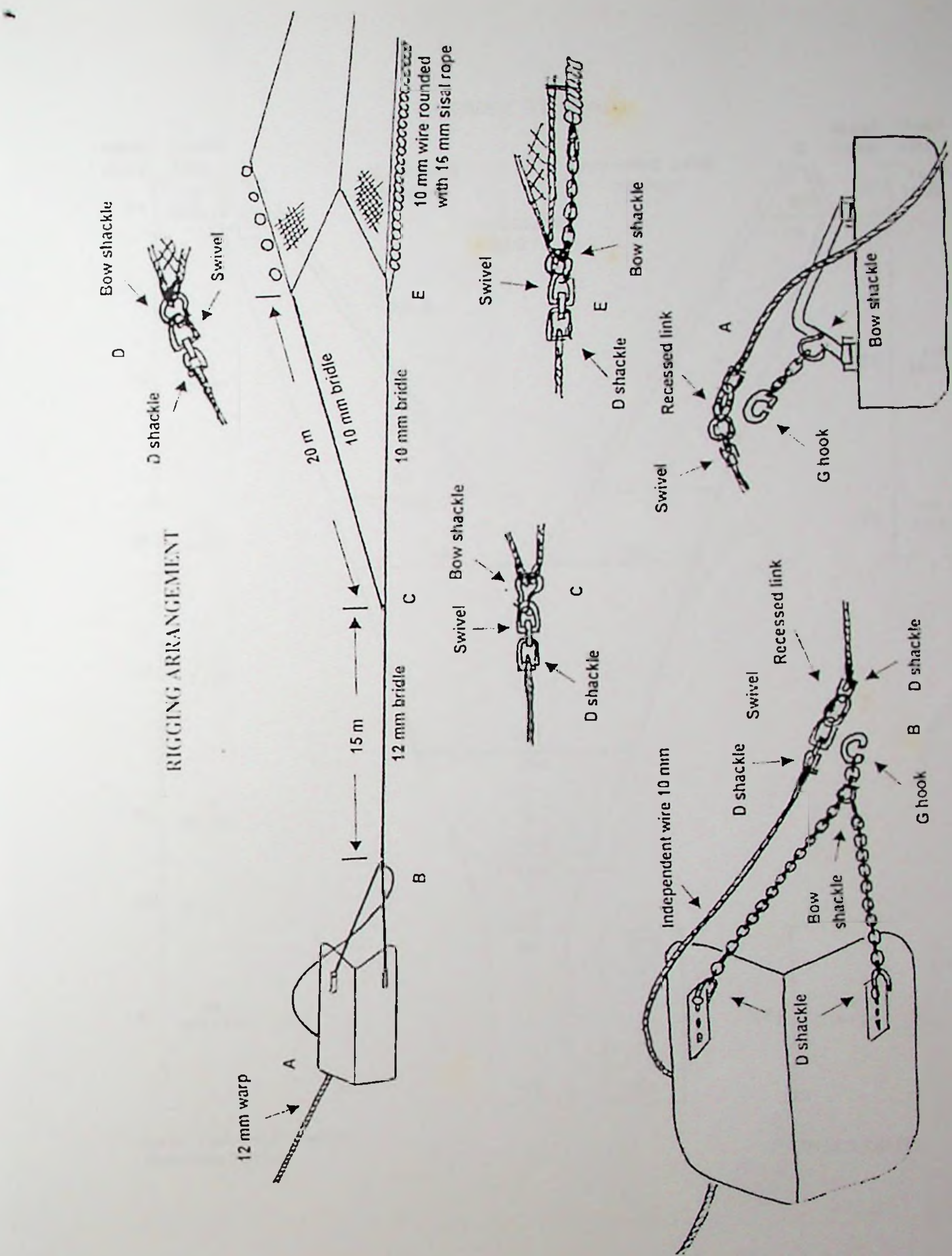

Figure 2: Rigging arrangement (Adapted from LVFRP UNECIA report)

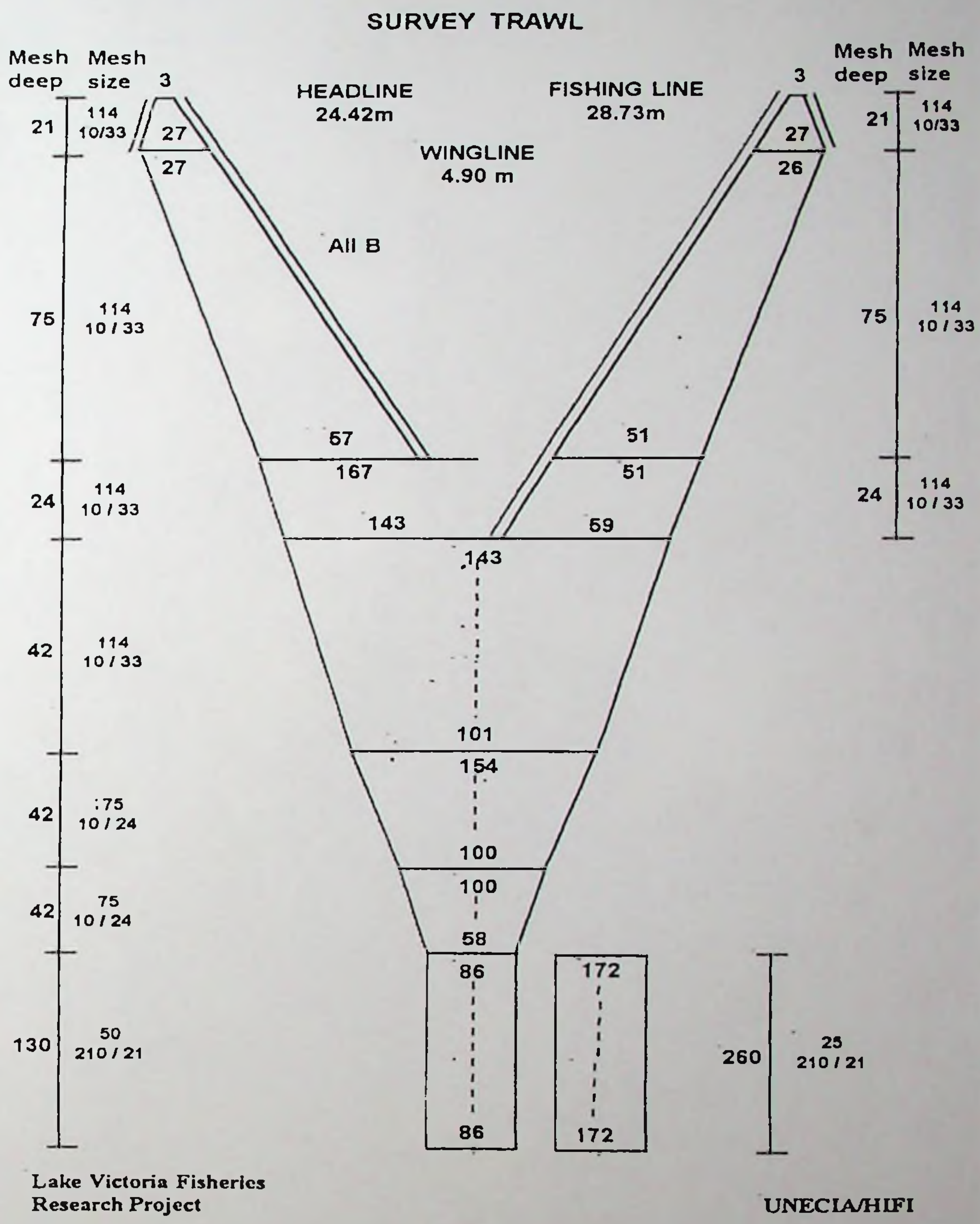

Figure 3: Survey Trawl (Adapted from LVFRP UNECIA report).

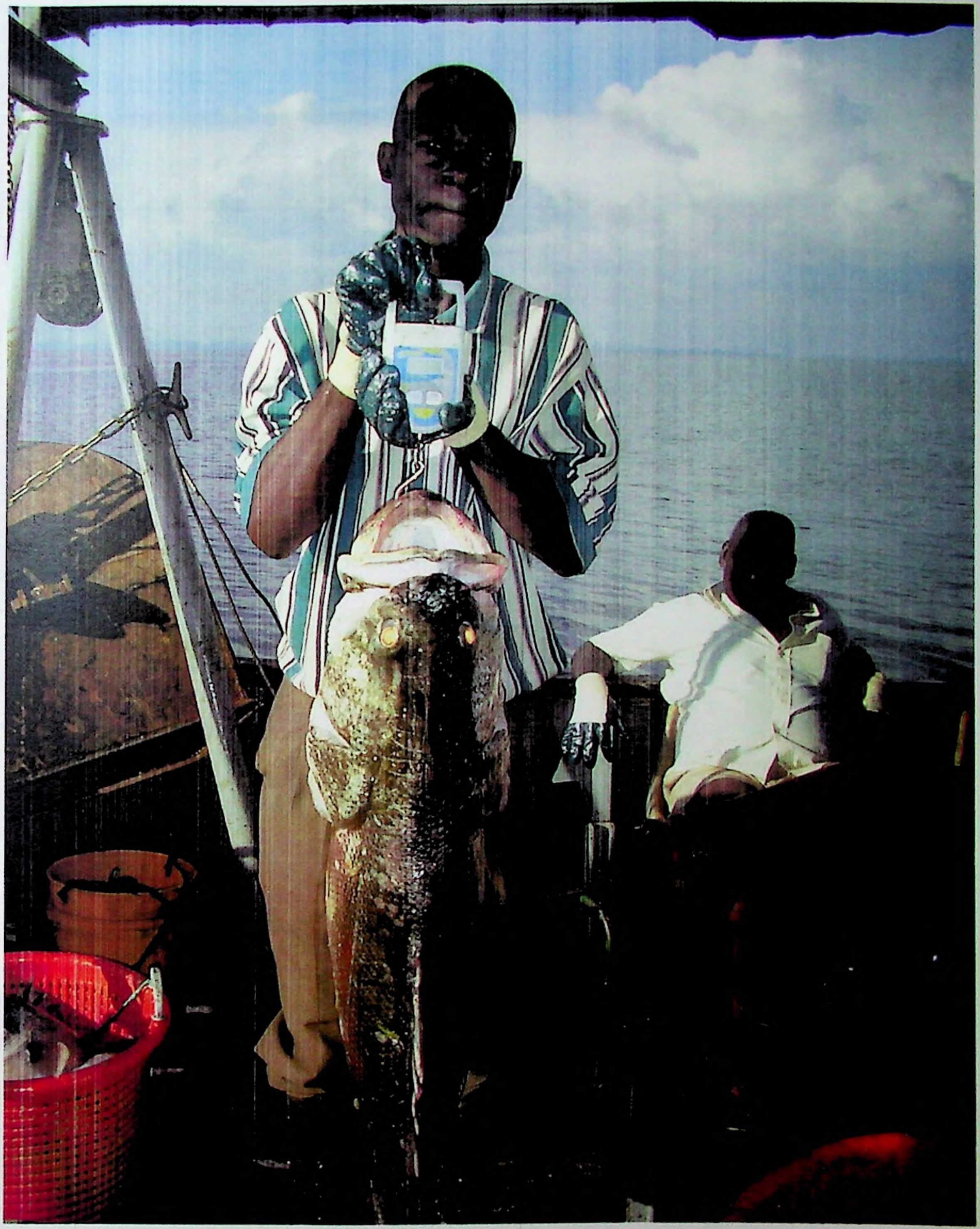

Figure 4: Taking weight of the Nile perch on RV. IBIS at Kagegi gulf, Lake Victoria Uganda using a digital balance.

3.2.2. Population characteristics of the Nile perch.

In order to investigate the population characteristics of the Nile perch the following parameters were collected; individual weight, total length in centimeters figure 5.A total number of 120 fish samples were then dissected for internal observations in each transect, stomach content analysis was done on site since most of the food items eaten by the Nile perch could be identified using the naked eyes.

Figure 5: Length, weight and Stomach data collection of the Nile perch in Kagegi gulf, Lake Victoria Uganda.

3.2.3. Physical-Chemical parameters.

In-situ physico-chemical parameters i.e. Oxygen and Temperature were determined using portable meters calibrated according to manufactures' manual. With pH litmus paper test kit was used since the meter had malfunctions. Water samples were taken at the required depths using a Van don sampler and transferred into 1 liter plastic bottles for the water chemistry analysis in the laboratory.

For analysis of Total nitrogen, the following procedure was followed as revised in the IFMP (Implementation of Fisheries Management Program) Standard Operating Procedures 2005.

10 ml of unfiltered water sample were transferred to a 25 ml Pyrex bottles to which 0.4 g of potassium persulphate were then added.

Standards were also made using 10 ml of deonised water covering the estimated sample concentration range followed by the addition of 0.4 g of potassium persulphate.

All the pyrex bottles were autoclaved at 1.2 kpas for 1 hour in the autoclave therefore after, samples were allowed to cool.

After coding, 0.25 g of Devards alloy were added to all the samples plus the standards and allowed to stand overnight at room temperature for reduction to take place.

Subsequent aliquots were then transferred to clean test tubes and diluted accordingly.

Final analysis was performed using the phenol method for the ammonia -nitrogen and concentrations calculated using the regression analysis from the standard curves.

3.2.4. Data Analysis.

Analysis of fish data was done using excel program. Estimate of fish densities (standing crop) in terms of tonnes per square kilometer (t km-2) using swept area method(Sparre and Venema, 1998) according to the formula below: -

A_{sw} = xh*xe*HL*V*t

Where *xh* is the net width factor, *xe* is the catch efficiency of the gear, HL is the headline length of the trawl, V is the towing speed, t is the duration of each haul during trawling and A_{sw} is the area trawled.

The standing crop on the trawled ground is expressed in terms of catch per unit area (CPUA).

Standing crop =CPUA=W_{mean}/(A_{sw}*vi) where W_{mean} is the mean catch weight for all hauls in the relevant area, vi is the fraction of the population sampled by the bottom trawl.

The contribution of different prey types ingested by the Nile perch was assessed by the point score method as in Ricker (1971) (Wandera 2005).

3.2.5. Limitations to the study

Sampling for fishstock densities require data collected across at least two seasons. The schedule of these activities were unable to cover two seasons in the short time of the research project therefore the results presented are from a single survey in the short rains period of November.

The portable meter used could give results of only dissolved oxygen and Temperature. The function for pH had a problem so litmus test had to be used.

CHAPTER FOUR

4.0. RESULTS AND ANALYSIS

4.1. Results.

4.1.1. Nile perch densities (standing crop)

Results indicate Nile perch densities as in the table 1 below.

Depth range (metres)	Catches (ton/km^2)	Standard Error	95% Confidence Interval
0 - 10	8.75	5.5	69.5
10 - 20	4.77	2.3	9.7
20 - 30	6.33	0.3	3.2
30 - 40	1.34	1.1	13.6

Table 1: A table showing the catch rates in metric tonnes recorded during the experimental trawl in November 2006 at Kagegi gulf, Lake Victoria, Uganda.

The table was used to draw a bar graph shown in figure 6

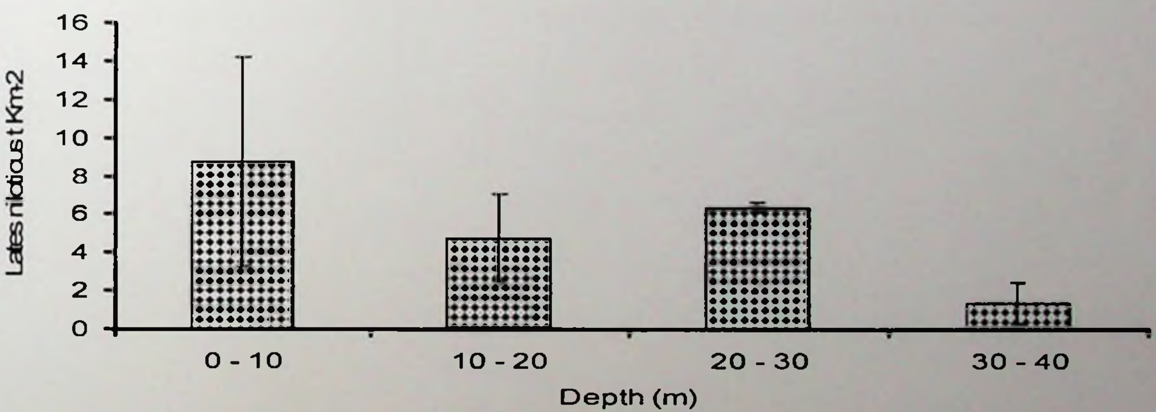

Figure 6: Densities of Nile perch (tonnes/km-^{2}$\pm$Standard Error) recorded at various depths during experimental bottom trawl sampling at Kagegi Gulf Lake Victoria Uganda, November 2006.

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Depth (m)	82.4312875	4	20.60782	1.521907	0.294073	4.120309427
Catch rates	94.78550517	7	13.54079			
Total	177.2167927	11				

Table 2: Showing One-way Anova, catch rates of Nile perch at various depth levels in Kagegi gulf sampled in November 2006.

Results of one-way Anova indicated significant difference in catch rates at various depth strata with P-value of 0.294 at 5% level of significance (see table 2).

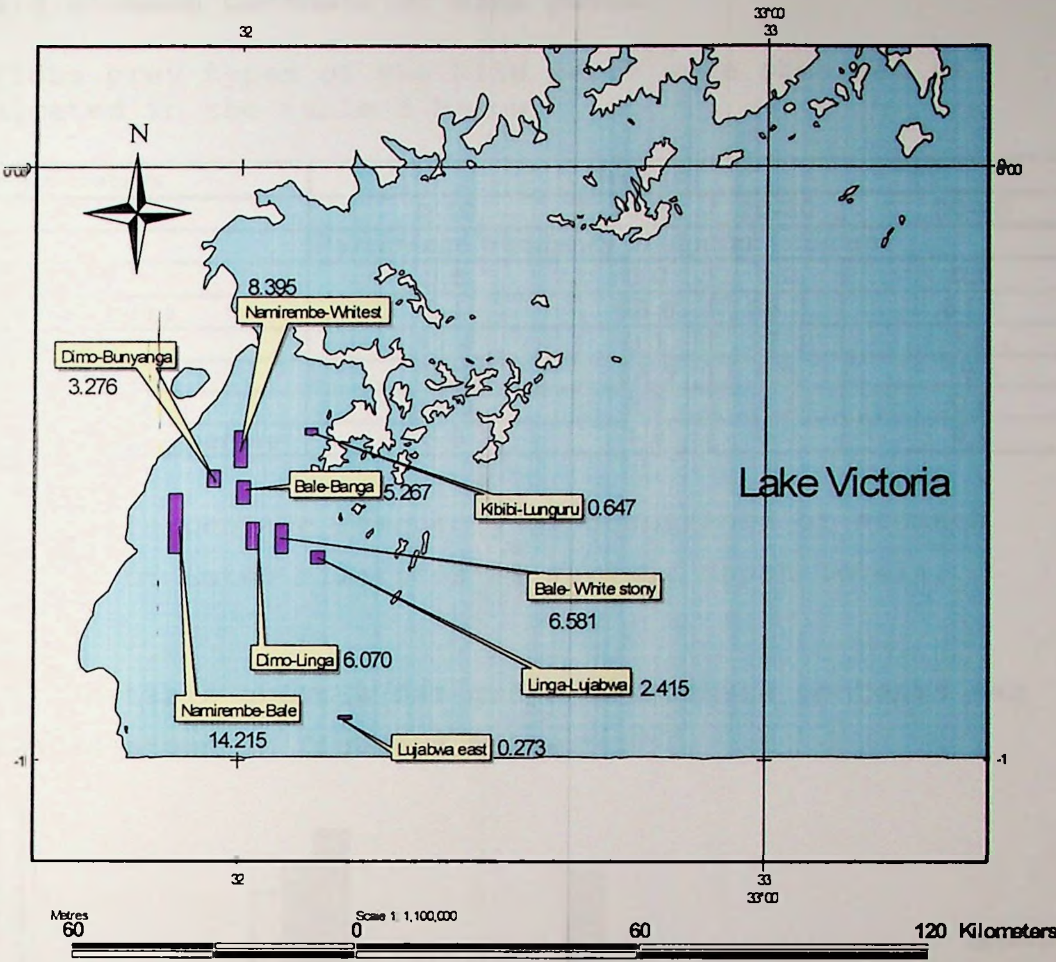

Figure 7: Map of Lake Victoria, Uganda Catch rates in showing the densities t/km^{-2} of *Lates niloticus* at the various transects sampled.

4.1.2 Stomach Contents of Nile perch

Various prey types of the Nile perch were observed as indicated in the table 3 below.

Stomach contents	Depth (m)			
	0-10	10-20	20-30	30-40
	Percentage frequency of stomach content			
Bivalve	0.5	0.0	0.0	0.0
Caridina nilotica	6.1	58.6	68.2	81.1
Fish remain	11.4	6.1	27.3	3.5
Haplochromine	65.2	34.3	0.0	15.4
Lates niloticus	11.0	0.0	4.5	0.0
Rastrineobola argentae	5.8	1.0	0.0	0.0

Table 3: Percentage frequency of occurrence of stomach contents of Lates niloticus at various depth levels.

From the table above a bar graph of stomach contents was drawn as shown in figure 8 below.

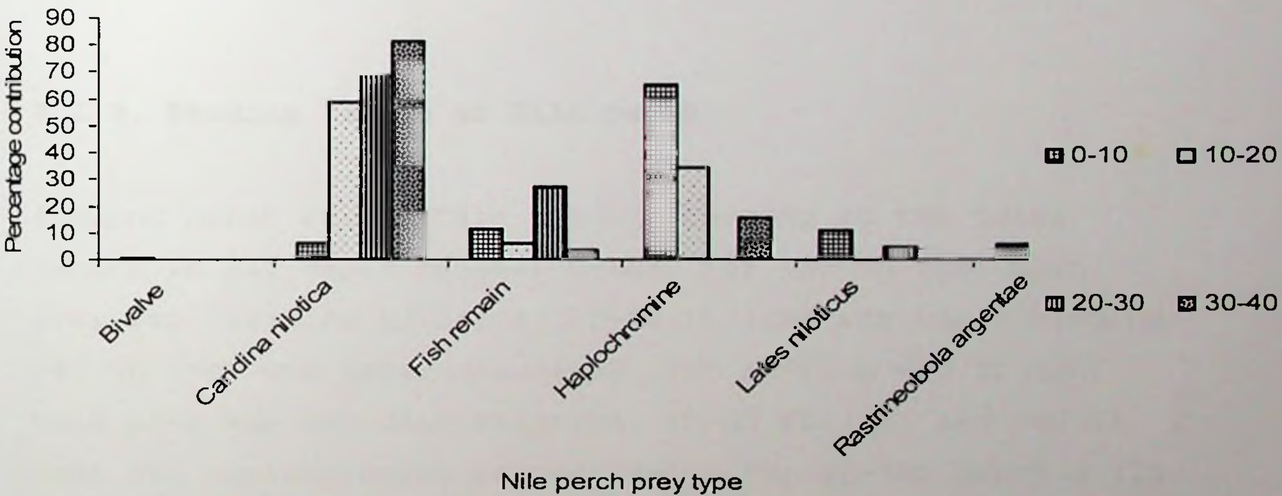

Figure 8: Percentage food type of occurrence in *Lates niloticus* stomach analysis basing on depth levels.

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Depth (m)	8734.246	5	1746.849227	4.32015	0.012354	2.901295
Food type	-1.8E-12	3	-6.0633E-13	-1.5E-15	#NUM!	3.287383
Error	6065.238	15	404.3491971			
Total	14799.48	23				

Table 4: Results showing Two-way Anova of the stomach contents of Nile perch in the various depth levels in Kagegi gulf November 2006.

Using two-way Anova on the analysis of the food types consumed by the Nile perch at various depth levels i.e. 0-10, 10-20, 20-30 and 30-40 metres at Kagegi gulf a p-value 0.012 at 5% level of significance was observed table 4.

4.1.3. Feeding habits of Nile perch

Feeding habit of the Nile perch according to the total length in all depth ranges; 0-10m, for <20 TL (cm) main prey was *Caridina nilotica,* 20-60 TL (cm) was haplochromine >60 TL (cm) was *Lates niloticus.* For 10-20 m <20 TL (cm) main prey was *Caridina nilotica,* 20-60 TL (cm) and >60 TL (cm) was haplochromine respectively. For 20-30m depth m <20 TL (cm) main prey was haplochromine, 20-60 TL (cm) was *Caridina nilotica* >60 TL (cm) was *Lates niloticus.* Lastly for 30-40 m depth <20, 20-60 and >60 the main prey was *Caridina nilotica* respectively as shown in the table 5 below.

	Depth (m)											
	0-10			10-20			20-30			30-40		
Total length (cm)	<20	20-60	>60	<20	20-60	>60	<20	20-60	>60	<20	20-60	>60
Stomach contents	Sum of scores											
Caridina nilotica	26	4		54	62		56	2	4	20	72.8	16
Fish remain	12	44	0.2		14			8		4		
Haplochromine		316	6		70	16	2				17.6	
Lates niloticus		16	38.4						16			
Rastrineobola argentae		28.8			2		2					
Bivalvaes			2.4									

Table 5: Food analysis for *Lates niloticus* at various depth levels of total length ranges Kagegi gulf, Lake Victoria Uganda using score method.

4.1.4 Physical-Chemical parameters result.

Depth Range (m)	Temperature (oC)	pH	DO (mg/l)	TIN (ugL^{-1})
0- 10	25.15+0.28	8.0+0.00	7.37+0.24	589.82+97.2
10-20	23.68+0.20	7.7+0.11	6.44+0.30	514.35+68.8
20-30	24.75+0.13	7.66+0.33	6.32+0.14	690.44+257.8
30-40	25.3+0.20	7.66+0.33	6.32+0.14	809.03+45.02

Table 6: Water quality characteristics of the Kagegi gulf, (± Standard Error) in the month of November 2006.

The above table indicates the results collected at various depth levels of dissolved oxygen, temperature, pH and total nitrogen in the month of November 2006 at Kagegi gulf, Lake Victoria, Uganda.

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Catch rates and Environmental factors	9549.685	3	3183.228	0.968839	0.439279	3.4903
Depth (m)	1310954	4	327738.4	99.74961	4.23E-09	3.25916
Error	39427.33	12	3285.611			
Total	1359931	19				

Table 7: Showing the catch rates and environmental characteristics at various depth levels using Two-way Anova.

Using Two-way Anova on the catch rates and water quality characteristics at various depth levels indicated a P-value of 0.4392 at 5% level of significance table 7.

4.2 Discussion

4.2.1. Estimate of Nile perch densities

According to figure 6 it is evident that the fish densities of Nile perch observed indicate that more catches were near the water surface. This is probably attributed by the water environmental characteristics.

At 0-10 m depth the catch rates were 8.75 ± 5.5 t/km^{-2} with dissolved oxygen of 7.37 ± 0.24 mg/l a pH value of 8 at a temperature of 25.15 ± 0.28°C with total Nitrogen of 589.82 ± 97.2. In the 10-20 metre depth level the catches decreased to 4.77 ± 2.3 t/km^{-2} this trend is likely to have been contributed by the limnological parameters which were also low compared to the 0-10 metre depth; in this case dissolved oxygen was low by 0.93 mg/l, pH 0.3, temperature 1.47°C and TIN by 75.47ugL^{-1} at the period of sampling compared to the 0-10 m depth (see table 6).

At 20-30 metre depth catches rates were high compared to the 10-20 meter area of sampling. The catches were 6.33 ± 0.3 t/km-2. This could have been due to the weather changes leading to water temperature decreasing at the surface due to rain and remaining some how constant bottom ward for all strata.

The catches at 30-40 metre depth were low with a value of 1.34 ± 1.1 t/km^{-2} . Despite the fact that other Limnological parameters were almost the same for all strata, dissolved oxygen was exceptional. i.e. it dropped from 7.37 mg/l at the surface to 5.9 mg/l which could have brought about the low catch rate. It should be noted that dissolved oxygen plays an important role in the environment for fish survival especially the Nile perch. Any slight change in the oxygen levels in the water column always affects the distribution of the fish stocks in the lake and hence the standing crop in general.

One-way Anova on the catch rates at various depth levels indicated a p-value of 0.294 at 5% level of significance which shows significant difference (table 4). While a two-way Anova on catch rates and limnological parameters at various depth strata had p-value of 0.4392 at 5% level of significance. This probably indicates that one of the factors affecting the fish densities in different depth strata is brought about by the water quality characteristics i.e. pH, DO, temperature and TIN (table 7).

4.2.2. Prey types ingested by the Nile perch

Various prey types were observed; at 0-10 m depth 6 food types were found which were dominated by Haplochromine with percentage frequency of 65.2% compared to others.
Within 10-20 m depth, 4 food types were observed and *Caridina nilotica* dominated with 58.6 %. At 20-30 m depth, also 4 food types were realised and *Caridina nilotica* overshoot the others by 68.2% and in 30-40 m depth, also *Caridina nilotica* dominated with 81.1% compared to others and had only 3 food types as in table 3.

It is most likely that haplochromine dominance in the stomachs of the Nile perch in the 0-10 meter depth could have been contributed by the high oxygen levels in this area compared to other depth strata. Haplochromine are very sensitive to oxygen levels and low levels can lead to death of these haplochromine species.

On the other hand *Caridina nilotica*, is resistant and can strive and be able to live in low oxygen levels, hence, this gives them a chance of being able to stay in depth levels of >10 metres. Therefore this made it become dominant prey in the proceeding strata.

From table 4 a P-value of 0.012 at 5% level of significant prey type of Nile perch at various depth levels indicate no statistical significance. This could be attributed by environmental factors in the areas the experiment was carriedout on the prey the Nile perch feeds.

4.2.3 Feeding habits of the Nile perch in relation to growth rate

According to the growth rate of the Nile perch, fish <20 cm in the depth strata of 0-10, 10-20, 20-30 and 30-40 highly fed on *Caridina nilotica*.Fish 20-60 cm in all depth strata fed on haplochromine respectively. Yet fish >60 cm at depth strata 0-10 and 20-30 m depended on *Lates niloticus;* 10-20 m was haplochromine and 30-40 was mainly *Caridina nilotica.*

Generally fish in <20 in all depth strata fed on mainly on *Caridina nilotica* compared to other food types. This is a clear indication that *Caridina nilotica* plays a big role as baby milk for Nile perch at the juvenile stage.

It is evident that at 0-10 metre depth the Nile perch has a variety of food types compared to other depth strata, this could have been the contributing factor to higher catches in this depth region than others (see figure 6 and 8).

CHAPTER FIVE

5.0. CONCLUSIONS AND RECOMMENDATIONS.

5.1 Introduction

This study was intended to evaluate the Nile perch distribution in Kagegi gulf, whether it can be affected by the prey type and the water quality characteristics. This chapter draws out the main issues identified and provides conclusions based on the results of the study. Recommendations and areas for future research are also proposed.

5.2 Conclusion

Investigations carried out during this experiment at Kagegi gulf in November 2006 indicate the following: -

The water environmental characteristics i.e. dissolved oxygen, pH, Temperature and Total nitrogen played a big role in the catch rates in various depth strata at Kagegi gulf. Nile perch is very sensitive to environmental conditions and any slight change in the environment can lead to high mortality and due to that this could have contributed to low catches in the deeper areas and high density in shallow regions.

The types of food consumed by Nile perch in various depth strata also contributed little to the catch rates in those regions, despite the fact that more food components were realized in the depth strata of 0-10 m than in regions >10 metres.

According to the trend of catch rates which was generally decreasing in different depth strata it can be concluded that water characteristics influence distribution since they were changing from top to bottom. However the types of foods consumed in various depth strata were probably found not to have any effect on the distribution of the Nile perch.

5.3 Recommendation

Since the distribution of Nile perch has been found to be influenced by water characteristics it is therefore recommended that measures, to preserve them be put in place i.e. control of water pollution, setting up monitoring teams for the benefit of Nile perch.

5.4 Area of Research

Seasonal variation could be used in coming up with data that determine other factors affecting Nile perch distribution.

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APPENDICES

		Grid	L.n	GPS					Av. Depth	
			wt (Kg)	Lat.	Log.	Grid	Area Km-2	Ln t km-2	(m)	
1	Namirembe-Bale	E02	182.44	-0.599	31.881	E02	0.026	14.215	7.5	
2	Dimo-Bunyanga	E03	42.05	-0.524	31.952	E03	0.026	3.276	9.0	
3	Namirembe-Whitestony	D02	107.74	-0.475	32.003	D02	0.026	8.395	12.0	
4	Kibibi-Lunguru	D03	8.3	-0.445	32.136	D03	0.026	0.647	14.5	
5	Bale-Banga	E02	67.6	-0.546	32.008	E02	0.026	5.267	15.5	
6	Dimo-Linga	E02	77.9	-0.621	32.026	E02	0.026	6.070	21.0	
7	Bale- White stony	D03	84.46	-0.625	32.083	D03	0.026	6.581	21.5	
8	Linga-Lujabwa	E03	31	-0.656	32.151	E03	0.026	2.415	30.5	
9	Lujabwa east	E03	3.50	-0.928	32.206	E03	0.026	0.273	35.5	

Appendix 1: Results indicating the 9 stations where Nile perch samples were taken with the grid references.

DO (mg/l)	0-10 m		DO (mg/l)	20-30 (m)
Mean	7.3785714		Mean	6.3625
Standard Error	0.2431875		Standard Error	0.285259
Confidence Level(95.0%)	0.5950587		Confidence Level(95.0%)	0.907824
Temp (oC)	0-10 m		Temp (oC)	20-30 (m)
Mean	25.157143		Mean	24.75
Standard Error	0.2835633		Standard Error	0.132288
Confidence Level(95.0%)	0.693855		Confidence Level(95.0%)	0.420998
pH	0-10 m		pH	20-30 (m)
Mean	8		Mean	7.666667
Standard Error	0		Standard Error	0.333333
Confidence Level(95.0%)	0		Confidence Level(95.0%)	1.434219
TIN(ugL^{-1})	0-10 m		TIN(ugL^{-1})	20-30 (m)
Mean	589.82		Mean	690.44
Standard Error	97.29		Standard Error	257.86
Confidence Level(95.0%)	418.62		Confidence Level(95.0%)	176.97
DO (mg/l)	10-20 (m)		DO (mg/l)	30-40 (m)
Mean	6.4457143		Mean	6.3275
Standard Error	0.3074539		Standard Error	0.146707
Confidence Level(95.0%)	0.7523131		Confidence Level(95.0%)	0.466887
Temp (oC)	10-20 (m)		Temp (oC)	30-40 (m)
Mean	23.685714		Mean	25.3
Standard Error	0.2086562		Standard Error	0.2
Confidence Level(95.0%)	0.5105637		Confidence Level(95.0%)	0.63649
pH	10-20 (m)		pH	30-40 (m)
Mean	7.7		Mean	7.666667
Standard Error	0.1105542		Standard Error	0.333333
Confidence Level(95.0%)	0.2500911		Confidence Level(95.0%)	1.434219
TIN(ugL^{-1})	10-20 (m)		TIN(ugL^{-1})	30-40 (m)
Mean	514.35		Mean	809.03
Standard Error	68.84		Standard Error	45.02
Confidence Level(95.0%)	1109.52		Confidence Level(95.0%)	193.74

Appendix 2: Mean physical parameters - Dissolved oxygen, Temperature, Total nitrogen and pH from experimental sampling at Kagegi gulf Lake Victoria Uganda, November 2006.

Stations sampled					
Namirembe -White stony			Depth	14m	
Depth (m)	Chem	Do (mg/l)	Temp (°C)	PH	Comment
0		7.8	24.5	8	Lake was slightly wavy 90%
0.5	x	7.34	24.5	7.5	cloud cover good catch
2		7.45	24	7.5	
12	x	6.45	23.5	7	
Namirembe - Bale			Depth	9m	
Depth (m)	Chem	Do (mg/l)	Temp (°C)	PH	Comment
0		7.4	25.5	8	Lake was calm 90%
0.5	x	7.6	25.5	8	cloud cover good catch
2		7.23	25.4	8	
7	x	6.65	24	8	
Linga - Lujabwa			Deph	31m	
Depth (m)	Chem	Do (mg/l)	Temp (°C)	PH	Comment
0		6.56	25.5	7	lake was relatively
0.5	x	6.46	25.5		cloudy cover 10% catch
2	x	6.39	25.5	8	
29	x	5.9	24.7	8	
Bale -Banga			Depth	15m	
Depth (m)	Chem	Do (mg/l)	Temp (°C)	PH	Comment
0		6.42	24	8	lake relatively calm.
0.5	x	6	23.9		
2		5.77		7.5	
14	x	5.28	23	7.5	
Dimo-Bunyanga			Depth	6m	
Depth (m)	Chem	Do (mg/l)	Temp (°C)	PH	Comment
0		8.36	26	8	Lake calm catch big.
0.5	x	7.86	25.5	8	
5		6.55	24.2	8	
Kibibi -Lunguru			Depth	14m	
Depth (m)	Chem	Do (mg/l)	Temp (°C)	PH	Comment
0		7.06	24	8	Lake wavy cloud
0.5	x	6.83	24	8	cover very poor.
14	x	5.85	24	8	
Dimo-Linga			Depth	20m	
Depth (m)	Chem	Do (mg/l)	Temp (°C)	PH	Comment
0		6.78	25.1	8	Lake calm
0.5	x	6.76	24.5		20% catches
2	x	6.35	24.8	8	
18	x	5.56	24.6	8	

Appendix 3: The limnology raw data of Temperature, pH and Dissolved oxygen collected in November 2006 at Kagegi gulf

Stratum (m)	Total Nitrogen (ugL^{-1})
0-10	
A	769.51
B	435.29
C	564.67
10-20	
A	758.72
B	607.79
C	295.14
D	478.42
E	370.61
F	575.45
20-30	
A	499.98
B	1200.75
C	370.61
30-40	
A	898.88
B	758.72
C	769.51

Appendix 4: Total nitrogen TIN results as sampled in the above mentioned stations in the month of November 2006 at Kagegi gulf.

Station	Depth (m)	Time	Season	Species	S/No.	TL/FL (cm)	SL (cm)	Wt(g)	Fat cont	Sex	Gon. State	St Full	Tot.Wt. Food (g)	Dig. State	Prey1	dig. state	% wt	prey2	Dig. state	%
3 Namirembe-Whitestony	10	11:23	wet	L.n	1	79.5	66.4	7800	F	F	4	H			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	2	58.2	47.7	2500	F	M	6	Q			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	3	35.5	28.2	575	Q	M	2	Q			FR	4	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	4	33.7	27.6	525	E	F	2	T			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	5	31.2	24.9	400	E	M	2	H			FR	4	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	6	32.4	26.8	425	E	M	2	H			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	7	24.3	19.7	180	Q	M	1	T			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	8	42.1	34.5	1100	Q	M	1	F			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	9	33.9	27.7	700	E	M	2	F			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	10	35	28.6	580	Q	M	2	T			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	11	25.9	21.1	250	E	F	1	T			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	12	35	29.5	625	Q	M	2	Q			Hap	1	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	13	34.8	28.5	580	H	M	2	T			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	14	30.2	24.6	375	E	M	1	H			Ras	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	15	31.3	25.8	450	Q	F	1	H			Hap	1	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	16	29.5	24	355	E	M	1	H			Hap	1	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	17	24.2	19.5	180	E	M	1	H			Hap	3	80	Ras	2	
3 Namirembe-Whitestony	10	11:23	wet	L.n	18	35.4	28.9	650	E	F	2	Q			Ras	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	19	38	31	800	E	M	2	H			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	20	36	29.5	750	E	M	2	F			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	21	36	30	650	E	M	2	F			Hap	2	30	Ras	3	
3 Namirembe-Whitestony	10	11:23	wet	L.n	22	48.3	40.1	1500	Q	M	3	T			Hap	3	85	Ras	3	
3 Namirembe-Whitestony	10	11:23	wet	L.n	23	48.3	40.1	1750	H	M	3	F			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	24	51	42.1	2000	E	M	3	F			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	25	41.2	34.1	900	Q	F	2	T			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	26	36.1	29.8	660	E	M	2	Q			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	27	36	30	725	E	M	2	F			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	28	32	26.8	460	E	M	2	F			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	29	33.2	27	550	E	F	2	H			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	30	29.6	24.1	375	Q	M	2	T			Hap	2	60			
3 Namirembe-Whitestony	10	11:23	wet	L.n	31	34	27.5	500	E	F	1	Q			Hap	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	32	30.8	25.2	410	E	M	2	H			Ras	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	33	20.7	16.6	125	E	F	2	H			Ras	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	34	34.2	38	550	E	M	2	H			Ras	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	35	31.3	25.6	450	E	F	2	H			Ras	2	50	Hap	1	
3 Namirembe-Whitestony	10	11:23	wet	L.n	36	29.1	19.6	185	E	M	1	T			L.n	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	37	43.3	36	1100	E	M	3	H			Hap	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	38	20.5	16.6	8.5	E	Imm		H			Car	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	39	15.3	12.5	35	E	Imm		Q			Car	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	40	11.6	9.7	15	E	Imm		T			FR	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	41	9.3	7.5	7	E	Imm		H			FR	3	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	42	9.9	8	9	E	Imm		Q			Car	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	43	12.1	9.7	15	E	Imm		Q			Car	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	44	8.6	7	8	E	Imm		H			Car	2	100			
3 Namirembe-Whitestony	10	11:23	wet	L.n	45	7	5.8	4	E	Imm		F			Car	1	100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	1	93.5	78	9900	F	F	4	F			L.n	3	100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	2	85.8	69.5	8300	F	F	4	Q			FR	4	20	Bivalve		
2 Dimo-Bunyanga	10	14:35	wet	L.n	3	88.5	74.5	7700	F	F	4	F			L.n	3	90	Bivalve		
2 Dimo-Bunyanga	10	14:35	wet	L.n	4	65.5	53.1	3300	F	M	5	Q			Hap	2	100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	5	57.7	46.7	2300	F	F	4	Q			Ras	2	100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	6	46.7	38.4	1200	F	M	3	T			FR		100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	7	63.5	51.7	3000	F	M	4	T			L.n	3	100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	8	40.2	32.7	850	H	M	4	Q			FR		100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	9	35	28.5	575	Q	M	2	H			FR		100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	10	33	27	475	Q	M	2	H			FR		100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	11	37.2	30.5	750	Q	M	2	H			FR		100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	12	21.3	17.5	155	E	M	1	H			FR		100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	13	44.8	36.5	1100	F	M	2	H			FR		100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	14	48	39.5	2600	F	F	3	T			L.n	3	100			
2 Dimo-Bunyanga	10	14:35	wet	L.n	15	40.3	33.5	1000	F	F	4	T			Hap	3	100			

Appendix 5: This indicates the biometric data collected at Kagegi gulf during the November 2006.

e-Banga	17	9:25	wet	L.n	4	34	27.5	600	Q	M	2	H			Hap	2	100			
e-Banga	17	9:25	wet	L.n	5	33	26.5	550	Q	M	2	Q			FR	4	100			
e-Banga	17	9:25	wet	L.n	6	42	32	1000	H	F	2	Q			Hap	3	100			
e-Banga	17	9:25	wet	L.n	7	27	22	310	E	M	1	H			FR	4	100			
e-Banga	17	9:25	wet	L.n	8	46.2	37.2	1250	F	F	2	Q			Hap	3	100			
e-Banga	17	9:25	wet	L.n	9	36.3	29.8	700	Q	M	2	Q			Ras	2	50	Hap	2	50
e-Banga	17	9:25	wet	L.n	10	43.3	35.5	1250	T	M	3	T			Hap	3	100			
e-Banga	17	9:25	wet	L.n	11	33.4	27.5	550	T	M	3	F			Hap	3	100			
e-Banga	17	9:25	wet	L.n	12	33.7	26.5	525	Q	M	2	Q			Hap	3	100			
e-Banga	17	9:25	wet	L.n	13	34.7	28.4	600	Q	M	2	H			Hap	3	100			
e-Banga	17	9:25	wet	L.n	14	27.8	24.5	450	Q	M	2	H			Hap	3	100			
e-Banga	17	9:25	wet	L.n	15	31.2	25.6	525	Q	M	2	H			Hap	3	100			
e-Banga	17	9:25	wet	L.n	16	28.5	23.5	520	Q	M	2	H			Hap	3	100			
e-Banga	17	9:25	wet	L.n	17	22.2	18.2	200	E	M	1	Q			Car	3	100			
e-Banga	17	9:25	wet	L.n	18	23.3	19.5	150	E	M	1	H			Car	3	100			
e-Banga	17	9:25	wet	L.n	19	17.8	14.5	100	E	Imm		F			Car	3	100			
e-Banga	17	9:25	wet	L.n	20	23.8	19.8	225	E	M	1	F			Hap	3	100			
e-Banga	17	9:25	wet	L.n	21	25.5	20.5	235	E	M	1	H			FR	4	100			
e-Banga	17	9:25	wet	L.n	22	21.5	18.5	200	E	M	1	Q			FR	4	100			
e-Banga	17	9:25	wet	L.n	23	20.5	16.5	150	E	M	1	F			Car	2	100			
e-Banga	17	9:25	wet	L.n	24	7.1	5.8	6	E	Imm		T			Car	2	100			
e-Banga	17	9:25	wet	L.n	25	10.3	8.3	10	E	Imm		F			Car	2	100			
e-Banga	17	9:25	wet	L.n	26	7.7	6.4	6	E	Imm		F			Car	2	100			
e-Banga	17	9:25	wet	L.n	27	7.5	6.5	6	E	Imm		F			Car	2	100			
e-Banga	17	9:25	wet	L.n	28	9.5	7.5	10	E	Imm		H			Car	2	100			
e-Banga	17	9:25	wet	L.n	29	12.5	10	16	E	Imm		Q			Car	3	100			
e-Banga	17	9:25	wet	L.n	30	9.5	7.5	6	E	Imm		F			Car	3	100			
mo-Linga	20.5		wet	L.n	1	62	51	2750	F	F	4	Q			L.n	3				
mo-Linga	20.5		wet	L.n	2	35.5	29.5	680	Q	M	2	Q			L.n	3				
mo-Linga	20.6		wet	L.n	3	20.5	16.6	8.5	E	Imm		H			Car	2	100			
mo-Linga	20.7		wet	L.n	4	15.3	12.5	35	E	Imm		Q			Car	2	100			
mo-Linga	20.8		wet	L.n	5	11.6	9.7	15	E	Imm		T			FR	2	100			
mo-Linga	20.9		wet	L.n	6	9.3	7.5	7	E	Imm		H			FR	3	100			
mo-Linga	20.10		wet	L.n	7	9.9	8	9	E	Imm		Q			Car	2	100			
mo-Linga	20.11		wet	L.n	8	12.1	9.7	15	E	Imm		Q			Car	2	100			
mo-Linga	20.12		wet	L.n	9	8.6	7	8	E	Imm		H			Car	2	100			
mo-Linga	20.13		wet	L.n	10	7	5.8	4	E	Imm		F			Car	1	100			
nga-Lujabwa	30	10:10	wet	L.n	1	26.2	21.5	300	E	M	2	F			Car	2	100			
nga-Lujabwa	30	10:10	wet	L.n	2	23.5	19	225	E	M	2	T			Car	2	100			
nga-Lujabwa	30	10:10	wet	L.n	3	23.5	19.5	225	E	M	2	T			Car	3	80	Hap	3	20
nga-Lujabwa	30	10:10	wet	L.n	4	28.6	23.5	350	E	F	2	T			Car	3	100			
nga-Lujabwa	30	10:10	wet	L.n	5	34.3	28.5	585	E	M	1	F			Car	3	80			
nga-Lujabwa	30	10:10	wet	L.n	6	19.5	16	150	E	M	1	F			Car	2	100			
nga-Lujabwa	30	10:10	wet	L.n	7	30.3	24.8	425	Q	F	2	H			Car	2	100			
nga-Lujabwa	30	10:10	wet	L.n	8	28.1	22.8	330	Q	M	2	H			Car	2	100			
nga-Lujabwa	30	10:10	wet	L.n	9	16.5	14.5	7	E	M	1	T			Car	2	100			
nga-Lujabwa	30	10:10	wet	L.n	10	15.3	12.7	45	E	Imm		T			Car	2	100			
nga-Lujabwa	30	10:10	wet	L.n	11	11.9	9.7	15	E	Imm		F			Car	2	100			
mo-Linga	21	11:50	wet	L.n	1	62	51	2750	F	F	4	Q			FR	4				
mo-Linga	21	12:50	wet	L.n	2	35.5	29.5	680	Q	M	2	Q			FR	4				
e-Banga	15.5	9:25	wet	L.n	1	96.5	80	13500	F	F	5	F			Hap	3	100			
Bale-Banga	17	9:25	wet	L.n	2	55	45	2250	F	F	4	Q			Hap	3	100			
Bale-Banga	17	9:25	wet	L.n	3	37	29.5	775	Q	M	2	Q			FR	4	100			

Appendix 6: This indicates the biometric data collected at Kagegi gulf during the November 2006.

Bsc. Fisheries and Aquaculture.																								
DETAILS							GPS								GPS									
	Skipper: Kibirige L.			Conded Mesh		25.4	Start								End									
							Lat				Log				Lat				Log					
No.	Station	Depth	Depth	Warp	Time	Time	deg	min	sec	dir	deg	min	sec	dir	deg	min	sec	dir	deg	min	sec	dir	Grid	Ln
		Start (m)	End (m)	Length	Start	end																		wt (Kg)
2	Namirembe-Bale	9.0	9.0	50G	13:00	13:30	0	31	27	S	31	57	8	E	0	31	59	S	31	55	11	E	E03	42.05
1	Namirembe-Whites	11	13	75W	10:50	11:20	0	28	30	S	32	0	11	E	0	29	56	S	32	0	28	E	D02	107.74
4	Linga-Lujabwa	30	31	100G	9:40	10:10	0	39	22	S	32	9	3	E									E03	31.00
8	Dimo-Linga	21	21	100wa	11:20	11:50	0	37	16	S	32	1	36	E	0	37	10	S	32	2	9	E	E02	77.90
7	Dimo-Bunyanga	8	7	50G	14:05	14:35	0	35	58	S	31	52	51	E	0	35	22	S	31	51	48	E	E02	182.44
6	Bale-Banga	16	15	75G	8:55	9:15	0	32	47	S	32	0	30	E	0	31	30	S	32	0	41	E	E02	67.60
9	Kibibi-Lunguru	15	14	50wa	9:55	10:25	0	26	42	S	32	8	11	E	0	25	36	S	32	7	45	E	D03	8.30
3	Bale- White stony	21	22	100Wa	15:30	16:00	0	32	331	S	32	4	57	E	0	32	7	S	32	6	41	E	D03	84.46
5	Lujabwa east	35	36	125W	12:05	12:35	0	42	820	S	32	12	22	E	0	43	36	S	32	12	11	E	E03	3.5

Appendix 7: This indicates the trawl raw data collected at Kagegi gulf in the period of November 2006.