19. The Fishes and Fisheries of the Victoria Nile

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19.0. Introduction

Rivers have formed nuclei for human civilization from the origins of mankind. They provide drinking and irrigation water, supply fish, serve as human and industrial waste depositories, and help in transport from one point to another. In East Africa, riverine ecosystems are recognised more as sources of food (fish) and water than any other use. Fish in Uganda is the cheapest source of (and accounts for 50%) animal protein supply (Bugenyi).

River Nile receives it's waters from Lake Victoria and drains into Lake Kyoga. Apart from the Nile system, which includes the Victoria Nile, Aswa, Semiliki and Kagera Rivers, few rivers in Uganda support commercial fisheries. These, together with the minor rivers, provide favourable habitats at the estuaries for adults and juveniles of fish. Many fishes, especially *Barbus* spp., Mormyrids, *Labeo victorianus* (Ningu) and *Schi/be* sp. spend their adult life in lakes, migrate up rivers to spawn and spend their early life, and only return to the lakes after passing through the early stages of development (Worthington, 1966; Greenwood, 1966; Balirwa, 1990). In his study of the river fisheries in the Nyanza region of Kenya, Whitehead (1959a) observed that the river fisheries and those of the lake are both complementary and closely linked, and that any biological disturbance on the main lake will have a direct effect on the river fishes and thus on the fisheries also.

Human activity has affected rivers and streams the world over to the extent that it is extremely difficult to find any stream or river which has not been in any way altered (Hynes, 1970). In the absence of basin management, deforestation and farming on marginal lands have led to increased erosion and silt loads of rivers resulting in rapid modification of lowland reaches of rivers. Recently Ugandan lake and river fisheries had problems of fish poisoning, species introductions *(Eicchomia crassipes* and *Lates ni/oticus)* that could have led to species reductions, and overfishing that led to the destruction of the *Labeo* fishery (Cadwalladr, 1965; Ogutu-Ohwayo, 1990). Construction of dams along some rivers may increase the problem. Dam construction changes water regime and ultimately fish catch.

Fish catches on some Ugandan rivers have declined due to the use of destructive fishing gears and methods such as small-mesh gillnets, beach seines, and traps which crop immature fish especially at river mouths. The *L. victorianus* fishery, that was the most important riverine fishery on the rivers of the Lake Victoria basin, was destroyed by intensive gillnetting and basket trapping of gravid females at river mouths during breeding migrations (Cadwalladr, 1965; Ogutu-Ohwayo, 1990). *Barbus* spp. and *A/estes* spp. were similarly affected. Like in Lakes Kyoga and Victoria, the Victoria Tilapias

(Oreochromis escu/entus and *Oreochromis variabi/is)* have virtually disappeared from the Victoria Nile estuarine fishery.

All groups and nearly all genera and species of the fishes which inhabit freshwater are to be found at times in rivers and streams (Hynes, 1970). The Victoria Nile originally had a very rich fauna dominated by riverine species. These included Nine *Barbus* species *(Barbus a/tiana/is* radcliff, B. *bynii,* B. *amphigramma,* B. *pa/udinosis,* B. *somereni,* B. *cercops,* B. *yongei,* B. *magda/enae,* B. *ap/eurogramma)*; Seven Mormyrid species *(Mormyrus macrocephalus*, M. *kannume*, *Petrocepha/us catastoma*, *Marcusenius nigricanus*, M. *grahami*, *Gnathonemus victoriae*, G. */ongibarbis)*; as well as *Labeo victorianus*, *Gara johnstonii*, *Rastrineobo/a argentea*, *A/estes (Bricynus) jacksonii*, *A/estes (Bricynus) sad/eri*, *Bagrus docmac*, *Schi/be intermedius*, *C/arias gariepinus*, C. *carsonii*, *Synodontis victoriae*, S. *afrofischeri*, *Amphi/ius jacksonii*, *C/ariallabes petrico/a*, *Oreochromis escu/entus* and 0. *(Nyasa/apia) variabi/is* (Greenwood, 1958). Of these species, *Labeo victorianus*, *Barbus a/tiana/is*, and Mormyrids were commercially the most important species. Fishery surveys of the Nile system in Uganda since 1987 indicate that the Victoria Nile is still dominated by many species which were once a major fishery of Lakes Victoria and Kyoga (Balirwa, 1990).

19.1. General Objective

To identify and quantify the variation in fish species diversity, distribution and size structure in the Upper Victoria Nile.

19.1.1. Specific Objectives

- To determine the fish species composition
- To establish the fish species diversity of the river.
- To establish the longitudinal distribution of the fish species in the river.
- To determine population characteristics of the major fish species in the river.

19.2. Materials and Methods

Study Area

The Victoria Nile Rivers forms part of a network of rivers that make up the Lake Kyoga Basin. River Nile has its source at the point where Lake Victoria used to spillover the Ripon Falls. The Nile channel is incised through a gently undulating plateau that has been subjected to intense tropical weathering. As a result the river channel of the Nile often lies along the fresh rock interface. The river valley consists of a combination of steep slopes and relatively flat river terraces. Below the Ripon falls there are many rocks and rapids which continue for some 50Km. (Hurst, 1925).

From Namasagali to Lake Kyoga the river is slow-flowing and 300-600m wide with fringes of papyrus and occasional lagoons covered with water lilies. About 50Km below Namasagali the Victoria Nile enters Lake Kyoga (Hurst, 1925). The area around the Victoria Nile has an equatorial climate, with annual rainfall of about 1585mm with no pronounced dry season (NEMA, 1994). Before the construction of the Owen Falls Dam in the Victoria Nile near Jinja in 1954 the outflow from Lake Victoria was controlled by the Ripon Falls and therefore related to lake levels (Kite 1981 as cited by Ruud 1993). Since the construction of the Owen Falls Dam flows have matched the internationally agreed curve of water level v flow at the Ripon Falls, the source of the Nile (NEMA, 1994).

19.2.1. Study sites

The river was divided into four sampling zones: Source; Upstream, Midstream, and River Mouth. Sites associated with the different sampling zones are: Source- Nalufenya; Upstream- Kalange, Buyala, and Kirindi; Mid-river- Mbulamuti and Namasagali; and River mouth- Gaba and Kasato (Figure 2.1).

19.2.2. Sampling methods:

Experimental fishing using multi-filament gillnets and a beach seine was carried out. Commercial/fisherman's catch was also sampled. Three fleets of gill nets comprising pieces of mesh sizes 1" to 5.5" in 0.5 increments, and 6-8 inches in 1" increaments were set overnight and retrieved in the mornings. Beach seining was carried out during day.

Catch and biometric data were taken on the spot. Fish were sorted according to mesh size, identified and separated into species. Measurements (weight in g, TL and SL in cm) were taken. Sex of those fish whose gonads were big enough to enable identification as either male or female was determined. Gonad condition was based on scale I to VII according to the method of Bagenal and Brown (1978).

19.3. Data analysis

Catch Composition was computed as percentage contribution of each taxa to the overall total of all the taxa. Because commercial landing statistics do not provide a true indication of species composition nor of biomass (Balirwa, 1998), only the fish caught in experimental gillnets were used in the determination of diversity indices. Species richness was determined as the number of different species recovered. Fish species diversity index was determined using the Shannon-Weaver diversity index (HI). $HI = -\sum P_i \ln P_i$; where Pi = Proportion of individuals found in the i^{th} species = (n/N).Fish species evenness was calculated from the Shannon evenness using the formula: E = HI/lnS; where E = evenness, HI = Shannon -Weaver diversity index, and lnS = natural log of number of species.

Presence or absence of a given fish species in each of the study sites was used to determine the longitudinal distribution of the fish species encountered in the river by comparing the percentage composition of the species in all the sites sampled. Percentage composition of a given fish was then plotted against sampling site in order to show the areas of the river where different fish species contribute more to the total catch.

The major fish species were grouped according to size classes, the number in each size group recorded, and a length-frequency curve plotted.

19.3. Results

19.3.1. Catch composition

Overall catch composition
6,395 fish were collected from both experimental and commercial / fisherman's catch. Twenty-five non-haplochromine species were encountered from eleven families were caught. (Figure 3.1). Thirteen fish species were encountered at the source, twenty-three upstream, twenty-one midstream, and seventeen at the river mouth.

19.3.1.1. Experimental catches

Twenty-four fish species from ten fish families were represented in experimental catches. The most abundant species in terms of numbers were *L. ni/oticus* (27.2%), Haplochromine species 21%, M. *kannume* (14.6%), S. *victoriae (4.8%),* S. *afrofisheri* (12.0%), *T. zillii* (2.6%), others 14.6%. (Figure 3.2). According to weight, the percentage compositions were *L. ni/oticus* (33.0%), M. *kannume* (35.8%), S. *victoriae* (3.9%), S. *afrofisheri* (3.3%), *T. zillii* (2.1%), 0. *ni/oticus* *(6.9%), Marcusenius grahami* (0.5%) and Haplochromines (2.7%).

Source
By number the fish species with the highest percentage composition was Haplochromine species (30.5%), *L. ni/oticus* (28.8%), M. *kannume* (13.2%), S. *victoriae* (8.8%), and 0. *ni/oticus* (4,8%), others (8.8%). The dominant species according to weight were *L. ni/oticus* (53.25), M. *kannume* (18.65), S. *victoriae* (8.6%), O. *ni/oticus* (6.4%), Haps (5.5%), Others 7.8%.

Upstream
Haplochromines contibuted 33.8% of the catch in terms of numbers, followed by *L. ni/oticus* (28.6%), M. *kannume* (23.5%), S. *afrofisheri* (3.2%), B. *a/tiana/is* (1.7%), and *T. zillii* (1.6%). Others species contributed 7.5% of the catch. According to weight the most dominant fish species was M. *kannume (46.9%),* followed by *L. ni/oticus* (14.4%), B. *a/tiana/is* (13.3%), P. *aethiopicus* (8.1%), B. *docmak* (4.4%), and Haplochromine cichlids (4.3%). Others fish species contributed 8.6%.

Midstream
S. *afrofisheri* was the most dominant fish species in terms of numbers. It contributed up to 34.3% of the catch. Next was *L. niloticus* (12.7%), followed by the Haplochromine cichlids (11.9%), S. *victoriae* (9.6%), M. grahami (7.1%), and M. *kannume*. M. *kannume* contributed most (23.4%) to the total weight of the fish species caught in the midstream section. Next to it was 0. *niloticus* (13.2%), B. *altianalis* (12.9%), *L. niloticus* (12.1%), S. *afrofisheri* (11.4%), and S. *victoriae* (8.8%). Other fish species contributed 18.3% of the total weight.

Mouth
The most dominant fish species by number was *L. niloticus* (44.6%). Next was S. *afrofisheri* (15.2%), followed by Haplochromine cichlids (8.3%), *T. zillii* (5.9%), S. *victoriae* (5.4%) and B. *altianalis* (5.1%). Other fish species contributed 15.4%. *L. niloticus* (53.9%) was the most dominant fish species in terms of weight. Next to it was 0. *niloticus* (13.2%), C. *gariepinus* (8.5%), B. *altianalis* (6.9%), M. *kannume* (6.6%), and M. *macrocephalus* (6.4%). Other fish species contributed 9.2%.

19.3.1.2. Commercial catch

Sixteen fish species from seven fish families were encountered in the commercial catch examined. These included *Barbus altianalis, Bagrus docmak, Clarias gariepinus, Gnathonemus longibarbis,* Haplochromine cichlids, *Lates niloticus, Labeo victorianus, Mormyrus kannume, Mormyrus macrocephalus, Oreochromis esculentus, Oreochromis esculentus, Oreochromis leucostictus, Oreochromis niloticus, Oreochromis rendalli, Oreochromis variabilis, Protopterus aethiopicus,* and *Tilapia zillii.* The five most common species in order of prominence, as illustrated in figure were: O. *niloticus,* 67.7% by number and 70.7% by weight; *L. niloticus* 14.1% by number and 12.3% by weight; M. *kannume*, 8.2% by number and 7.1% by weight; and *T. zilli,* 2.9% by number and 1.4% by weight. *Rastrineobola argentea* was encountered in lampara net catches at the river mouth.

Source

Six fish species were encountered at the source. The percentage composition is illustrated in Figure 3.2. These were, in order of importance, *Oreochromis niloticus* (58% by number and 63.77% by weight); *Lates niloticus* (30.76% by number and 26.52% by weight); *Mormyrus kannume* (8.44% by number and 6.49% by weight); *Bagrus docmak* (1.41% by number and 2.9% by weight); and O. *leucostictus* (0.7% by number and 0.66% by weight).

Upstream
The dominant species in terms of numbers were *L.* niloticus (24.4%), M. *kannume* (24.0%), 0. *niloticus* (22.5%), *T. zillii* (9.7%), and *B.docmak (6.0%).* Other fish species contributed 13.5%. In terms of weight, 0. *niloticus* contributed

most (25.1%), followed by M. *kannume* (23.4%), *L. niloticus* (23.0%), B. *docmak* (9.4%), and B. *altianalis* (6.2%). Other species contributed 12.8%.

Midstream

Eight fish species were identified in commercial catches examined in the midstream section of the river. O. *niloticus* (92.2%) was the most dominant fish species in terms of numbers. It was followed by O. *leucostictus* (4.8%), B. *altianalis* (1.3%), *L. niloticus* (0.7%), and M. *kannume* (0.4%). Other fish species contributed 0.6% of the catch. In terms of weight, the dominant fish species was O. *niloticus* (84%). Next was *L. niloticus* (5.9%), B. *altianalis* (4.5%), C. *gariepinus* (2.8%), and O. *leucostictus* (1.5%). Other fish species contributed 1.3% of the total weight of the catch.

Mouth

Seven fish species were encountered in commercial fish catches examined at the river mouth. The dominant species were O. *niloticus* (93.65% by number and 93.12% by weight) and *L. niloticus* (5.42% by number and 5.88% by weight). The third most abundant fish species in terms of numbers was M. *macrocephalus* (0.3%), followed by *T. zillii* (0.2%). Other species contributed 0.1%. In terms of weight the third most dominant fish species was P. *aethiopicus* (0.6%), followed by M. *macrocephalus* (0.2%), and *T. zillii* (0.1 %). Other fish species contributed 0.04%.

19.3.2. Diversity

Species richness is an unambiguous and straight forward index of species richness giving a total number of species within a substratum. In terms of species richness it was observed that Namasagali had the highest number of fish species while Kirindi had the least. The high number of fish species in Namasagali could be due to the location of the site between two zones in the river. Immediately upstream of Namasagali is the shallow and rocky section of the river which is characterised by high flow velocities, and below the site is a section which has a relatively deeper water level with slow flow velocity. Therefore the fish species found in Namasagali could be a mixture of those which prefer the upper section of the river and those that prefer the lower section of the river.

There is a decrease in diversity from the source to the upstream section of the river (Fig. 3.4a), followed by an increase to the midstream, and then a drop at the mouth. Generally, the midstream section of the river has a higher Shannon diversity index as compared to the source and mouth. A closer look at the diversity indices (Figure 3.4b) reveals that Mbulamuti had the highest diversity index followed by Namasagali. Buyala had the lowest diversity index. When the diversity of the river is compared with that of the Lakes Victoria and Kyoga, it's observed that the river environment generally has a diversity index higher than that of the lakes.

It was found that the diversity of two sites, Buyala and Kirindi, was less than 1.5 and therefore of low diversity. This was even indicated by the low number of fish species found there. The mid-river section and the source had a moderate diversity. However, when they are compared with the other sites they have a high diversity. It does not follow that a higher species diversity index can be interpreted as being a high quality habitat (Spellerburg, 1991). Habitats with low species diversity may signal a special habitat as opposed to being highly disturbed (Mafabi and Taylor, 1993). Therefore, although the upstream section has a fairly lower shannon index than the other sites, it's the section of the river whereby the typical riverine fish species seem to feature prominently.

19.3.3. Species Distribution

The fish species were found to be distributed as illustrated in Figure 3.5. Some of the fish species such as *L. niloticus,* M. *kannume,* and the Haplochromine species were observed to be distributed along the whole length of the river. *L.. victorianus* and M. *grahami* were only encountered in the lower section of the river (between Kirindi and Bukungu), whereas B. *docmak* was only encountered in the upper section (Nalufenya-Kirindi). *T. zillii,* S. *victoriae* and S. *afrofisheri* were encountered both in the upper and lower sections of the river.

However, a closer examination of the percentage composition of the fish species (Figure 3.6.), along the study sites reveals that much as a fish species may be distributed along the whole length of the river, it's relative abundance is not evenly distributed along the whole length of the river. There are certain sites/areas of the river where the percentage contribution of a fish to the total catch, in terms of numbers, is higher relative to the other sites. For example, even if M. *kannume, L. niloticus,* S. a*frofisheri,* and Haplochromine cichlids are located along the whole river length there are some sites/sections along the river where they occur in larger numbers as compared to the other sites. M. *kannume* and Haplochromines are found to be prevalent in the upstream section of the river; and S. *afrofisheri* occurs most in the midstream section of the river (Namasagali).

The distribution of fish is influenced by the physical habitat and the presence of other organisms and plants, particularly those used for food and shelter. Fish may be territorial in streams and rivers and often remain in one small reach for most of their lives (Horne and Goldman, 1994). It is therefore possible that fish tend to be found in higher numbers in localities where the conditions favour them most. Studies in North America have stressed that fish species occur in more or less well-defined zones (Hynes, 1970).

The higher occurance of S. *afrofisheri* in Namasagali in the midstream section of the river could be due to the change in the velocities and vegetatiion cover of the river from the faster and relatively more sparse vegetation in the upper section of the river to the slower and papyrus covered shoreline from Namasagali downstream. Haplochromines are mainly rock dwellers. The section of the river from the source to Mbulamuti at the midstream section is characterised by rapids i.e a rocky outcrops, conditions which normally provide refuge to the haplochromines. M. *Kannume* is a typical riverine fish species. It is prevalence in the upper sections of the river could be due to the typical riverine conditions present in this section of the river.

When the number of fish species encountered in the different zones of the river are examined, fourteen fish species were found at the source, 23 species Upstream, 21 species midriver, and 17 species at the river mouth. It is therefore evident that the upstream and midstream sections of the river have more fish species than the mouth and source, i.e the middle sections of the river are more species rich compared to the source and mouth.

19.3.4. Size structure

Oreochromis niloticus

Of the 98 fish of the species 0. *niloticus* caught in experimental gillnets, the majority of individuals (20.4%) were of the length 31 - 35 cm as (Figure 3.6). The second-most abundant class interval was 16 - 20 cm (18.3%), followed by 26 - 30 cm (17.2%). No fish exceeding 50 cm TL was caught in the experimental gillnets.

Of the 2,068 fish of the species 0. *niloticus* examined from commercial catches, 31% were in the size class 26-30cm, 17.75% in 21-25cm size class, 17.5% in the 21-25cm class interval, 4.35% in the 41-45cm size class, and 2.22% in the 16-20cm class interval (Figure 3.7). Other size classes were either not represented in the commercial catch.

Lates niloticus

Eight hundred twenty eight fish were caught in experimental gillnets. The size class 21-25cm had the most individuals (25.8%), followed by 16 - 20cm (24.3%), and 11 - 15cm (18.4%) (fig 3.8). There was no fish of TL greater than 80 cm. From commercial catches, Figure 3.9., the size class 26-30cm had the highest number of individuals (31%). Next was 31-35cm (25.2%), 21-25cm (12.7%), and 36 - 40cm (11.3%).

Mormyrus kannume

Most of the fish examined from experimental catches were of the length class 21-25cm (24.7%) (Figure 3.10). Next was the class interval 26 - 30 cm (17.6%), followed by 16 - 20cm (15.2%). When the length frequency distribution of the specimens caught for commercial purposes was plotted (Figure 3.11), it was found that the size class 41 - 45cm had the highest frequency (25.6%), followed by 36 - 40cm (22.2%), 31 - 35cm (18.5%), and 46 - 50cm (18.2%). The size classes 11 - 15cm, 61 - 65cm and 71 - 75cm had no representatives.

It is evident that the experimental gillnet catches generally have a wider distribution in size classes as compared to the commercial catches. This is because the commercial catches are targeted at a certain size class and therefore are size specific. It is also evident that as compared to the O. *niloticus* catches, the commercial catches of the Nile perch are mainly juveniles. This could be because they are mainly a by-catch since the fishery seems to be targeted at the Nile Tilapia (O. *niloticus)*.

Conclusion

- The Upper Victoria Nile has a diverse array of fish species.
- Two groups of fish were encountered in the Upper Victoria Nile, the typical riverine species *(M. kannume,* B. a*ltianalis)* and those that occur in Lakes Victoria and Kyoga.
- Some of the endangered fish species such as B. *docmak* are still found in the Upper Victoria Nile.
- The keystone species in the Upper Victoria Nile are *L. niloticus, M. kannume,* S. *afrofisheri* and O. *niloticus*.
- Sixteen fish species from seven fish families comprise the commercial fisheries of the Upper Victoria Nile.
- The dominant commercial fish species in the Upper Victoria Nile are O. *niloticus, L. niloticus* and *M. kannume.*
- Different sections of the Upper Victoria Nile favour different fish species.

Recommendations

There is need for the conservation of some of the sections of the Upper Victoria Nile so as to preserve some of the riverine fish species such as *M. Kannume* (Kasulu) and B. *docmak* (Semutundu).

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Figure 2.1 : Sampling zones and their characteristics.

Characteristic	ZONE			
	Source	Upstream	Midstream	Mouth
Flow velocity	• High	• High	• Moderate	• Slow
Bottom	• Rocky	• Rocky	• Rocky / Muddy	• Muddy
Vegetation	• Scattered • Vossia	• Scattered but thicker than at the source • Vossia	• Wide and thick papyrus mat interspersed with Vossia grass. • *Eicchornia crassipes* present	• Thick • Papyrus interspersed with Vossia, Phragmites and water hyacinth
Channel	• Narrow when compared with midstream and mouth	• Narrow; has a number of Islands	• Wider than Source and Upstream	• Wide (2-3Km) • Floating Islands of papyrus, water hyacinth or Vossia occasionally encountered
Slopes	• Steep hills	• Steep	• Moderately steep	• Gentle

Fish species encountered in the Upper Victoria Nile.

FAMILY	FISH SPECIES
Bagridae	*Bagrus docmak*
Centropomidae	*Lates niloticus*
Characidae	*Brycinus sadleri, Brycinus jacksonii*
Cichlidae	*Tilapia zillii, Oreochromis esculentus, Oreochromis leucostictus, Oreochromis niloticus, Oreochromis rendalli, Oreochromis variabilis, Astatoreochromis alluaudi, Haplochromine spp.*
Claridae	*Clarias qariepinus*
Cyprinidae	*Barbus altianalis, Labeo victorianus, Rastrineobola arqentea*
Cyprinodontidae	*Aplocheilichthys sp.*
Mochokidae	*Synodontis afrofisheri, Synodontis victoriae*
Mormyridae	*Petrocephalus catastoma, Mormyrus kannume, Mormyrus macrocephalus, Gnathonemus longibarbis Gnathonemus victorianus, Marcusenius grahami*
Protopteridae	*Protopterus aethiopicus*
Schilbeidae	*Schilbe intermedius*

SPECIES	Zone						
	Source	Upstream			Midstream		Mouth
	Nalufenya	Kalange	Buyala	Kirindi	Mbulamuti	Namasagali	Bukungu
Astatoreochromis alluaudi							
Aplocheilichtys sp.							
Barbus altianalis							
Bagrus docmak							
Bricynus jacksonii							
Bricynus sadleri							
Clarias gariepinus							
Gnathonemus longibarbis							
Gnathonemus victorianus							
Haplochromine sp.							
Lates niloticus							
Labeo victorianus							
Marcusenius grahami							
Mormyrus kannume							
Mormyrus macrocephalus							
Oreochromis esculentus							
Oreochromis leucostictus							
Oreochromis niloticus							
Oreochromis rendalli							
Oreochromis variabilis							
Protopterus aethiopicus							
Petrocephalus catastoma							
Rastrineobola argentea							
Synodontis afrofisheri							
Schilbe intermedius							
Synodontis victoriae							
Tilapia zillii							

Note Shaded areas indicate where the species are present, and non-shaded areas indicate absence of a species

Figure 3.5. Longitudinal distribution (presence/absence) of the fish species encountered in experimental and commercial catches

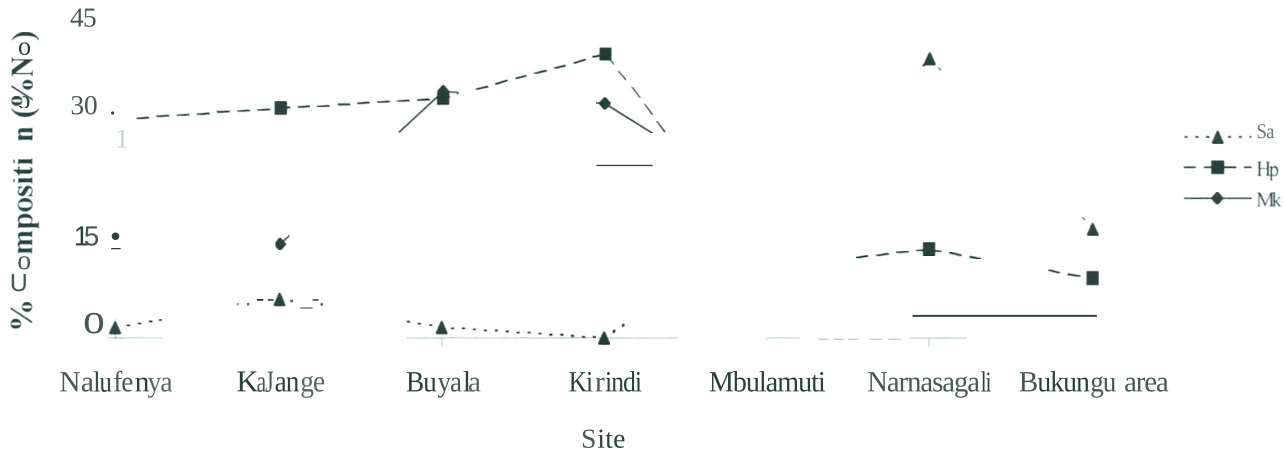

Figure 3.6. **Zonation of some of the fish species caught in experimental gillnets in the Upper Victoria Nile**