THE BIOLOGY AND ECOLOGY OF LAKE VICTORIA FISHES:
THEIR DEVELOPMENT AND MANAGEMENT

(UGANDAN VERSION)

Edited By: Ogutu-Ohwayo, R., and. Wandera S.B.,
National Agricultural Research Organisation,
Fisheries Research Institute,
P. O. Box 343, Jinja, Uganda

December 2000
<table>
<thead>
<tr>
<th>Title of Chapter and Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. The biology, ecology and fishery of (Mukene) Rastrineobola argentea [Wandera S.B.]</td>
</tr>
<tr>
<td>4. The biology, ecology and impact of introduced tilapiines especially the Nile tilapia, Oreochromis niloticus in lakes Victoria and Kyoga [Nagayi, J.]</td>
</tr>
<tr>
<td>7. The Food of haplochromine species surviving in the nearshore stations of Lake Victoria with specific reference to the Napoleon Gulf. [Namulemo, G.]</td>
</tr>
<tr>
<td>8. Trophic structure and diversity of haplochromines among Kyoga minor lakes [Mbabazi, D.]</td>
</tr>
<tr>
<td>10. The role of Yssichromis species in the trophic ecology and food-webs of Lake Victoria [Ebong, I., Wandera, S.B. and Ogutu-Ohwayo, R.]</td>
</tr>
<tr>
<td>11. Impact of fishing gears and methods and the consequences of using different mesh sizes of gillnets on the fisheries and on biodiversity of lakes Victoria and Kyoga [Ogutu-Ohwayo, R., Wandera, S.B.]</td>
</tr>
</tbody>
</table>
CHAPTER 10

The Role of *Yssichromis* Species (Pisces: Cichlidae) in the Trophic Ecology and Foodwebs of Lake Victoria

By: Ebong Ivan, SB Wandera and Richard Ogutu-Ohwayo,

*Fisheries Research Institute, P.O. Box 343, Jinja*

Abstract

Many haplochromine cichlids coexisted in Lake Victoria before the upsurge of Nile perch. The introduction of the Nile perch led to depletion of many haplochromines and other fish species in Lake Victoria. The impact of Nile perch predation on haplochromines differed for different haplochromine trophic groups. *Yssichromis fusiformis* (G) and *Yssichromis laparogramma* (G) are among the species that have survived in the lake. *Yssichromis* spp. was studied with the aim of determining their trophic role, food and feeding habits. Samples were collected from Bugaia, Buvuma channel and Napoleon Gulf in the northern part of Lake Victoria. The food of *Yssichromis* spp. varied with size of fish. Both *Y fusiformis* and *Y laparogramma* fed on Copepods, Cladocerans, *Chaoborus* and Chironomids. Juvenile *Yssichromis* spp. fed exclusively on zooplankton comprising Cyclopoid copepods, Calanoid copepods and Cladocera. The relative importance of Chironomid larvae and Calanoid copepods was higher in Bugaia than in Buvuma channel while Cyclopoid copepods and Chironomid pupae were relatively less important in Bugaia. The main food items that *Yssichromis* spp. fed on in Buvuma channel were Chironomid larvae Cyclopoid copepods, Cladocerans and Calanoid copepods. In Napoleon Gulf, fish caught from commercial fishery of *Rastrineobola argentea* (P) had fed on *Chaoborus* and Chironomids. Overall, *Yssichromis* spp. fed on more zooplankton in Buvuma than in Bugaia. *Yssichromis* spp. and *R. argentea* are presently the most abundant zooplanktivores in the northern part of Lake Victoria and are playing an important trophic role as major consumers of zooplankton and insect larvae in the food web of the lake ecosystem. *Yssichromis* spp. are bridging the transfer of energy from the lower to the higher trophic levels as secondary consumers. The fishery is still not contributing to the direct conversion of the primary products, the phytoplankton and detritus that were efficiently utilised by the diverse haplochromine trophic groups that existed before the Nile perch boom.

Introduction

Lake Victoria, the second largest lake in the world is a major source of high quality animal protein (fish) and clean water; is used for transport & recreation; and is a source of revenue and employment for the population in it’s basin. In the first half of this century, Lake Victoria had a very diverse fish fauna comprising 28 genera (Greenwood 1974). The majority (300+) of these species were haplochromine Cichlids (Greenwood 1974, 1981; van Oijen et al. /1981; Witte & van Oijen 1990). Haplochromines occupied virtually all habitats of the lake and fed on nearly all food sources in the lake, each
species or group of species having a specific habitat, diet and feeding behaviour (Witte et al. 1992a; Wanink 1991). These fishes fed on the dominant bloom forming algae and detritus and this prevented eutrophication.

The haplochromines were particularly important as primary and secondary consumers (Witte 1981; Witte & van Oijen 1990). They were the major players in the trophic interrelationships that involved major energy pathways starting from the phytoplankton and bottom deposits (detritus) via the haplochromines to the piscivorous catfishes and haplochromines, zooplankton and insect larvae to zooplanktivorous haplochromines and Raslirneobola argenlea (P) to piscivores, insect larvae to various fish taxa and via molluscs to various fish taxa (HEST 1988).

Up to the beginning of 1960s, the then multispecies fishery of Lake Victoria had declined due to over fishing and this decline in the fisheries led to the introduction of exotic tilapiines (Oreochromis leucosticus (T), Oreochromis niloticus (L), Tilapia zillii (G) & Tilapia rendalli (B) and Nile perch (Lales niloticus) (L) in the 1960s to augment the declining stocks (Welcomme 1964, 1966, Ogutu-Ohwayo 1990).

Nile perch was expected to prey on the small haplochromines not fished to their full potential, thus making this source of protein more available for human harvest. The stocking of exotic species in the lake increased the total catch (Welcomme 1966, Fryer 1973) and in the early 1980s, an explosive increase of Nile perch took place in Lake Victoria. Simultaneously, stocks of other species declined in several areas of the lake (Hughes 1983, Barel et al. 1985, Ogutu-Ohwayo 1990, Witte et al. 1992b. The increase in Nile perch population corresponded with a rapid decline of the haplochromine stocks. The loss of phytoplanktivores has left excess biomass produced due to increased nutrient accumulation unconsumed thus contributing to anoxia in deep waters. Algal biomass has increased 4-5 times higher than the mean value of the 1960s and phytoplankton production doubled (Mugidde 1993, Hecky 1993). Oxygen concentration in the hypolimnion during the period of stratification decreased and anoxia started occurring for longer periods and was elevated in the water column (Hecky et al. 1994). The composition of aquatic invertebrates has also changed. Zooplankton composition has changed from predominance of Calanoid copepods to a dominance of Cyclopoid copepods (Mwebaza-Ndawula 1993). The benthic invertebrates are dominated by Chironomids, Chaoborids and Caridina nilolica which can tolerate low oxygen tensions (Ogutu-Ohwayo et al. 1997).

Large haplochromines were more susceptible to extinction than small and abundant species. The piscivores were the first to disappear while the detritivores and zooplanktivores persisted for longer periods (Witte & van Oijen 1990). Out of 80% of the demersal ichthyomass in Lake Victoria in the 1970s, 16% of the demersal fish in the sub-littoral regions consisted of zooplanktivorous haplochromines (Kudhongania & Cordone 1974). The pelagic zooplanktivorous and littoral dwelling detritivorous species showed the slowest rate of decline. The least affected were haplochromines that lived between boulders and rock crevices. Despite their less common occurrence, the zooplanktivores persisted longer in the catches than the detritivores (Witte 1984,
Goldschmidt et al. 1990). After the haplochromines had declined, Nile perch switched to other prey such as the prawn *Caridina nilotica*, the cyprinid *R. argentea* and its own young (Gee 1969; Okedi 1971, Hughes 1986, Ogari & Dadzie 1988, Ogutu-Ohwayo 1990).

Not all fish species decreased after the increase of Nile perch. The abundance, (measured as catch per unit effort) of the pelagic zooplanktivorous cyprinid, *R. argentea*, which has a small habitat overlap with the benthic Nile perch, increased in the period between 1982 and 1987 (Wanink 1991, Witte et al. 1992a). At present, this fish species ranks among the top three commercial species exploited in Lake Victoria (Ogutu-Ohwayo et al. 1997).

The currently dominant Nile perch and *R. argentea* are mainly secondary and tertiary consumers. The trophic system is now relatively simple with the bulk of the biomass within the fish community being shifted from primary consumers (detritivorous/phytoplanktivorous haplochromines) to the top predator (*Lates*) which now operates mostly as a secondary and tertiary consumer with extensive cannibalism within its own population (Ogutu-Ohwayo 1990, Ligtvoet & Mkumbo 1990).

Although the strong increase of Nile perch seemed a favourable economic development, recent returns show that Lake Victoria is entering yet another period of ecological changes because Nile perch catches peaked in the period of 1985-90 and are now declining while fishing effort is still increasing (Pitcher & Bundy 1994, Reidmiller 1994). Witte and Witte-Mass (1987) predicted that high densities of the Nile perch might very well be temporary. A decrease of these densities in future might allow certain haplochromines to increase in numbers. Kenyan and Tanzanian Fisheries records showed increase in numbers of haplochromines in shallow waters (Achieng 1990). In Lake Kyoga where Nile perch densities have fallen following heavy fishing pressure and the increase in aquatic macrophytes particularly the Water hyacinth (*Eichhornia crassipes*) which provide refuge and reduce predation losses, the haplochromines have increased (Ogutu-Ohwayo 1994).

Trawl surveys in the open waters of Lake Victoria (Tumwebaze 1997) indicated abundance of *Yssichromis* spp. and the same species has been observed as significant by-catch in the *R. argentea* fishery (Wandera per.com.).

**Objective**

The objective of this study was to provide information on the abundant haplochromine taxa especially the food, feeding habits and their role in the trophic ecology of Lake Victoria.

**Materials and Methods**

This study was conducted in three areas of the Northern waters of Lake Victoria (Fig. I). This included three characteristic areas: Bugaia, open water 40-60m deep, Buvuma
channel, 20-30m deep and Napoleon gulf, a shallow sheltered littoral area with water depth less than 20m. Samples collected by FIRI researchers on their regular cruises in other parts of the Ugandan sector of the lake were also examined.

Sampling was done using a mid-water beam trawl. The trawl was operated either from the 180 HP research vessel MV Ibis or the 125 HP MV Mputa. The beam trawl had a metallic frame opening of 3x3m, a conical bag of graded stretched mesh size of 152-25.4 mm and codend of 5 mm mesh net. The samples were collected between December 1996 and October 1997. The trawl depth was adjusted by changing the vessel speed and measuring the angle of warps using a wooden protractor fitted with a spirited level to measure the depth indirectly. An echosounder was used to locate the depth of fish schools according to echo traces on the echogram. On retrieval of the beam trawl, Yssichromis were preserved in 4-5% formalin, labelled with date, time and place of capture for laboratory analysis. All the sampling was conducted between 09.00 hrs and 18.00 hrs.

Y. lupurugrammu and Y. fusiformis were isolated and identified in the laboratory according to Greenwood and Gee (1969) (Fig. 2). The total length (TL) of individual fish was then measured to the nearest 1 millimetre using a measuring board. Fish were grouped into 10 mm length groups. A random sample of 10 fish was then picked from a length class for biometric data examination. Standard length of individual fish was recorded to the nearest 1 mm and the weight recorded to the nearest 0.1 g on a biometric data sheet.

The specimen were dissected, stomach fullness recorded and food analysis (with modification from Hynes (1950) method) treated as follows:

a) The food of those fishes where it had been possible to distinguish the two species precisely was examined first to give an idea of what the different species fed upon;
b) Data for both species and that of those cases where it had not been possible to isolate the two species were then analysed together to give an idea of the trophic role of the group;
c) This was followed by analysis of the food of combined data between the inshore (Napoleon) station, the mid-depth (Buvurna) station and the offshore (Bugaia) station to provide information on the difference that might exist between the stations;
d) Finally, the major food categories encountered (Zooplankton and Insects) was analysed to provide information on how the group channelled these categories of food through the food web of the lake.

Results

Food of Yssichromis fusiformis

The type of food ingested varied with the size of the fish. Y. fusiformis of 30-39 mm SL fed almost exclusively on zooplankton comprising Cyclopoid copepods (37%), Calanoid copepods (36%) and Cladocerans (27%) (Fig. 7). Larger fish fed on zooplankton and
insects. The insects ingested included Chironomid larvae and pupae and *Chaoborus* larvae. The proportion of Calanoid copepods in the diet decreased from 36% in fish of 30-39 mm to 14% in fish of 40-49 mm while that of Chironomid larvae increased to 13% in fish of 40-49 mm. Fish of >60 mm standard length ingested 50% Cyclopoid copepods, 28% Calanoid copepods, 12% *Chaoborus* larvae and 8% Chironomid larvae. Overall, Cyclopoid copepods contributed 38% followed by Calanoid copepods (17%), Cladocerans (17%), *Chaoborus* larvae (11%), Chironomid pupae (9%) and Chironomid larvae (8%) (Figure 9a).

**Food of *Yssichromis laparogramma***

*Y. laparogramma* generally fed on zooplankton and insects (Fig. 8). *Y. laparogramma* of 30-39 mm standard length had fed on Cyclopoid copepods (30%), Calanoid copepods (10%), Cladocera (13%), Chironomid larvae (33%) and Chironomid pupae (14%). Specimen of 40-49 mm SL fed on *Chaoborus* larvae (35%), Chironomid pupae (28%), Cyclopoid copepods (22%), Cladocerans (10%) and Calanoid copepods (4%). Specimen >60 mm SL fed exclusively on *Chaoborus* larvae and Chironomid pupae. Overall, Cyclopoid copepods contributed 27% followed by *Chaoborus* larvae (19%), Chironomid larvae (16%), Chironomid pupae (15%), Cladocerans (12%) and Calanoid copepods (11%) (Figure 9b).

**Overall food of *Yssichromis* species***

The major food items found in the stomachs of both species of *Yssichromis* were mainly zooplankton and insects (Fig. 10). Zooplankton consisted of Cladocerans, Cyclopoid copepods and Calanoid copepods while the dominant insects were Chironomids and Chaoborids. The type of prey eaten varied with size of the fish. From 20-29 mm SL, *Yssichromis* fed exclusively on zooplankton comprising Cyclopoid copepods (55%), followed by Cladocerans (31%) and Calanoid copepods (14%). Between 30 & 39 mm SL, the food items ingested were Cyclopoid copepods (29%), Calanoid copepods (28%), Cladocerans (26%) Chironomid larvae (12%) and Chironomid pupae (4%). Between 40-49 mm, there was increase in the relative importance of insects in the diet of *Yssichromis* species especially Chironomids (26%) and Chironomid pupae (11%). Between 50-59 mm, there was a general decrease in relative importance of zooplankton especially Cyclopoid copepods from 24% to 14% and Cladocerans from 16% to 12% while *Chaoborus* larvae increased from 3% to 11% and other unidentified materials from 2% to 10%. Traces of algae (2%) were recorded in this length class. From 70 mm to 89 mm standard length, there was substantial increase in the amount of Cyclopoid copepods (10% to 40%) and *Chaoborus* larvae (15% to 40%) ingested. Overall, Cyclopoid copepods contributed 27% followed by *Chaoborus* larvae (19%), Chironomid larvae (16%), Chironomid pupae (15%), Cladocerans (12%) and Calanoid copepods (11%) (Figure 11).
Comparison of the food for combined *Yssichromis* species between sampling stations.

**Bugaia**

Cyclopoid copepods were the predominant food item (60%) in the diet of fish 20-29 mm standard length, followed by Calanoid copepods (30%) and Cladocera (10%). Between 30-49 mm, the amount of Cyclopoid copepods ingested decreased from 45% to 4.1%, Cladocerans from 45% to 10.2% while the contribution of Calanoid copepods increased from 10% to 24.5%, Chironomid larvae from 0% to 51%. Between 50-59 mm, the diversity of food items ingested increased with *Chaoborus* larvae contributing 22.5%, Calanoid copepods 22.1%, Chironomid larvae 20%, Cladocerans 8%, Chironomid pupae 7.5%, Cyclopoid copepods 6.4% and *Chaoborus* pupae 2.8%. Overall, Chironomid larvae contributed 37% followed by Calanoid copepods (22%), Cyclopoid copepods (10%), Chironomid pupae (7%), *Chaoborus* larvae (7%), *Chaoborus* pupae (5%) and Cladocerans (5%) (Figure 15b). Generally the major food categories ingested by *Yssichromis* in Bugaia were insects (55%) and zooplankton (38%).

**Buvuma channel**

Fish of 20-29 mm standard length fed on Cyclopoid copepods (54.2%) followed by Cladocerans (35.3%) and Calanoid copepods (10.5%) (Fig. 12). Between 30 and 69 mm standard length, the contribution of Cyclopoid copepods decreased from 26.7% to 10.6%, Calanoid copepods from 29.7% to 8.9%, Cladocerans from 23.1% to 8.7% while the contribution of Chironomid larvae increased from 15% to 27.2%, Chironomid pupae from 5.6% to 15.7% and *Chaoborus* larvae from 0% to 13.8%. Between 70 and 79 mm, Cladocerans contributed 23.5% followed by Chironomid pupae 20.6%, *Chaoborus* pupae 14.4%, Calanoid copepods 13.5%, Cyclopoid copepods 12.4%, Chironomid larvae 9.4%, *Chaoborus* larvae 4.7% and others 1.5%. Overall, Chironomid larvae contributed 23% followed by Cyclopoid copepods (22%), Cladocerans (16%), Calanoid copepods (15%), Chironomid pupae (10%), *Chaoborus* larvae (5%), *Chaoborus* pupae (3%) and others (6%) (Figure 15a). The major food categories ingested by *Yssichromis* spp. in Buvuma were zooplankton (53%) and insects (41%).

**Napoleon Gulf**

Adult *Yssichromis* specimen between 60 & 79 mm SL which had been caught as by-catch of *R. argentea* had 80% of the stomachs full (Fig. 14). Overall, *Chaoborus* larvae contributed 34% followed by Chironomid larvae (16%), Cyclopoid copepods (10%), Calanoid copepods (10%), Cladocerans (5%), Chironomid pupae 5%, *Chaoborus* pupae (3%) and other materials which could not easily be identified contributed 17% (Figure 15c). The major food categories were insect larvae (56%) and zooplankton (26%).

Comparing the food of *Yssichromis* species between stations, the relative importance of Chironomid larvae (37%) and Calanoid copepods (22%) was higher in Bugaia than in
Buvuma channel while Cyclopoid copepods (10%) and Chironomid pupae (7%) were relatively less important in Bugaia than Buvuma channel. *Yssichromis* spp. relatively fed on more zooplankton in Buvuma channel (53%) than in Bugaia (38%).

In Napoleon Gulf the fish caught as by-catch from the commercial light fishing of *R. argentea* had fed mainly on *Chaoborus* (34%) and Chironomid (16%) larvae. Generally, fish caught at night in Napoleon Gulf had fed on more insects (56%) than zooplankton (26%) (Figure 16).

The major food categories of *Yssichromis* species

*Yssichromis* fed mainly on zooplankton and insects (Fig. 17). The fish of 20-29 mm SL fed exclusively on zooplankton. Between 30 & 39 mm standard length, insect larvae and pupae (16%) were incorporated with zooplankton (84%) into the diet. The ingestion of insect larvae and pupae increased between 40 & 79 mm SL from 40% to 54% while that of zooplankton decreased from 59% to 37%. Phytoplankton (6%) and other unidentified materials (10%) did not form a major part of the fish diet but seemed to have been taken in the process of ingesting zooplankton and insects. When all the sizes of fish are considered, the relative importance of the two major food categories was as follows; zooplankton (48%) and insects (45%) (Fig. 18).

Generally, most of the fish captured from Bugaia and Buvuma channel in the late afternoons had empty stomachs or few zooplankton food items while those sampled in the early hours of the day (0900hrs-1200hrs) had mainly the insect larvae. Often the two food types (Zooplankton and Insect larvae) were clustered in different parts of the stomach. This could indicate that the fish fed on insect larvae in the night and zooplankton during the day. Some fish scales, eye remains and eggs were found in very few stomachs. Few cases of endoparasites (Cestoda) were observed among the juveniles. It's apparent that the quantity and type of food item ingested mainly depended on size of fish and time of feeding.

Discussion

The general ecology of *Yssichromis* spp.

*Y fusilormis* and *Y laparogramma* are pelagic zooplanktivorous haplochromines which are recovering in the presence of Nile perch. Zooplanktivores are known to be pelagic and perform vertical migration in the water column, staying deeper during daytime and towards the surface during the night.

Vertical migration, the swimming upward during sunset and then downward during sunrise is a very common behavioural characteristic of zooplankton (Hutchinson 1967). Migration of zooplankton is mediated by changing light intensities as the sun rises and sets and some planktivorous fish join in at least part of this daily excursion (Haney and Hall 1975).
Cichlids search their food mainly by vision (Fryer & lies 1972). In Napoleon Gulf, specimen of *Yssichromis* spp. collected from the commercial *R. argentea* fishery had 80% of their stomachs full and this was attributed to aggregation of fish food due to the use of light for fishing. It is likely that horizontal as well as vertical migration of *Yssichromis* spp. is influenced by the migration of its zooplankton food. In the Mwanza gulf, zooplanktivorous haplochromines were found to feed almost exclusively on zooplankton during the day and mainly on *Chaoborus* larvae at night (Goldschmidt et al. 1990). By day, the insect larvae live in the bottom mud and are not accessible to most fishes (McDonald 1956). However at night, these larvae migrate towards the water surface to feed on zooplankton, and may become available to fish. This concurs with the findings from Napoleon Gulf in this study.

There are indication lakefly swarms have increased since the second half of the 1980s (Kaufman 1992, Mbahinzireki 1992, 1993). The possible cause has been diminished predation pressure due to decline of haplochromines and other insectivorous fishes. Since this food source appears to be abundant, then competition has not been a limiting factor to the survival of *Yssichromis* species. Although *Yssichromis* spp. showed a definite preference for zooplankton, the degree of predation upon them decreased with the increase in the size of the fish. The preference for insect larvae by adult *Yssichromis* spp. may be due to ecological benefits derived from eating larger prey.

The ability to incorporate mainly larger zooplankton and insect larvae, particularly the adult fish could have reduced the competition for smaller zooplankton with the cyprinid *R. argentea* which in addition to Cyclopid copepods, also feed on rotifers and diaptomids (Mwebaza - Ndawula 1998). Hence, the extent to which the diet of the two species overlap does not warrant any conclusion that the supply of food is a limiting factor. Also, the switching by *Yssichromis* spp. from small zooplankton prey such as Cladocerans and Copepods to the larger insect larvae at night enables the species to use optimal energy in foraging.

**The trophic role of pelagic zooplanktivores in the present foodweb of Lake Victoria fish community.**

The reduction of the haplochromines resulted in the upsurge of *R. argentea* biomass through much reduced interspecific competition due to the feeding pattern (Wanink et al. 1988). Adult fishes stay near the bottom of the lake during day light hours and move to near the surface at night. A similar pattern has been observed with *Yssichromis* sPP: in the Mwanza Gulf (Witte 1981). This behavioural pattern could be associated with depth related biotic and abiotic factors like dissolved oxygen in the water column, light penetration, food abundance, competition, predation and parasitism (Katunzi 1992).

The prey composition of *R. argentea* includes dead floating adult insects (from water surface), pelagic crustaceans, zooplankton and rotifers and benthic elements such as Chironomid larvae and the prawns, *Caridina nilotica* (Mwebaza - Ndawula 1998).

*Yssichromis* species feed on zooplankton and insect larvae. Judging from the prey
composition of *Yssichromis* spp. and *R. argentea*, there is a clear indication that confirms the important trophic role these fishes play as major consumers of zooplankton and insect larvae in the foodweb of the lake ecosystem. Presently, *R. argentea* is a major food of the Nile perch, an opportunistic top predator feeding on secondary and occasionally tertiary consumers (Ligtvoet *et al.* 1989, Ogutu-Ohwayo 1994). The two main flows of energy formerly transferred via haplochromines are currently the detritus food chain via the prawn, *C. nilotica* and insect larvae culminating in the Nile perch and the phytoplankton food chain via zooplankton and zooplanktivores (*Yssichromis* spp. & *R. argentea*) and small Nile perch culminating in adult Nile perch (Figure 26).

In the Mwanza Gulf in 1984, before the Nile perch boom, there was presence of high species diversity of haplochromine trophic groups (Goldschmidt 1996). Fish-eaters comprised 134 species, zooplanktivores 21, insectivores 29, the unknown 53, prawn-eaters 13, molluscivores 21, detritivores 13, phtoplanktivores 3, algae-eaters 10, crab-eaters 1, plant-eaters 2 and parasites 2.

In Napoleon Gulf, an inshore habitat, studies showed the presence of fewer haplochromine trophic groups, mainly the insectivores which comprised 13 species (Namulemo 1997). Others included the prawn eaters 2, snail-eaters 2 and the unknown 4. The detritivores, phtoplanktivores, algae-eaters, crab-eaters, plant-eaters and parasites that were recorded in the Mwanza Gulf were absent.

In this study, *Yssichromis* species was caught as bycatch of the *R. argentea* in the inshore (Napoleon Gulf) waters and the species was found to be the most abundant pelagic haplochromine in the offshore (Bugaia) waters. The diversity of the haplochromine trophic groups has therefore decreased both in the inshore and offshore waters. Basing on the diet of *Yssichromis* spp. comprising zooplankton (48%) and insects (45%), the species can be considered one of the few surviving members of the zooplanktivorous haplochromine trophic group in Lake Victoria which is not exclusively zooplanktivore.

*Yssichromis* spp. is serving an indirect bridging role in the transfer of energy from the lower (Zooplankton and insects) to the higher trophic (fish) levels as a secondary consumer. The fishery is not contributing to the direct conversion of the primary products, the phytoplankton and detritus that were efficiently utilised by the diverse haplochromine trophic groups that existed before the Nile perch boom (Figure 27).

**Conclusions**

- *Yssichromis* spp., currently the most abundant haplochromine is feeding on zooplankton and insects.
- Most of the primary energy products are apparently channelled through the invertebrate loop (Insects and Zooplankton).
- The fishery is not contributing to the direct conversion of the primary products (phytoplankton and detritus) into fish.
Recommendation

Intense exploitation of this zooplanktivorous group, particularly *R. argentea* will make *Yssichromis* spp. very vulnerable to predation by Nile perch and will tantamount to a simplified foodweb with subsequent increase in cannibalism by the top predator. *Yssichromis* spp. therefore can not yet sustain a commercial fishery like *R. argentea* but needs to be conserved inorder to play the bridging role in the foodweb of the lake ecosystem.

References


HEST, 1988. Fish stocks and Fisheries in Lake Victoria. A hand book to the HEST/TAFIRI & FAO/DANIDA regional seminar- Mwanza January/February,
1989. Report of the Haplochromis Ecology Survey Team (HEST) and the
Tanzanian Fisheries Research Institute (TAFIRI) No. 53. Leiden, The
Netherlands.


Ogutu-Ohwayo, R. 1990. The decline of the Native fishes in Lake Victoria and Kyoga (East Africa) and the impact of introduced species, especially the Nile perch. *Lates niloticus* and the Nile *tilapia*, *Oreochromis niloticus*. Env. Biol. Fish. 27: 81-96.
Welcomme, R.L. 1964. Notes on the present distribution and habits of the non-endemic species of *Tilapia* which have been introduced into Lake Victoria - Rep. E.A.


Figure 1: Map of Lake Victoria showing study area
Fig. 2: Drawings of *Yssichromis fusiformis* (a) and *Yssichromis laparogramma* (b).
(From Greenwood and Gee, 1974).
Figure 7: Relative importance of food items to different sizes of *Yssichromis fusiformis*
Figure 8: Relative importance of food items to different sizes of *Yssichromis laparogramma*
Fig. 9: Overall relative importance of food items to the diet of *Yssichromis fusiformis* (a) and *Yssichromis laparogramma* (b).
Figure 10: Overall relative importance of food items to different sizes of combined Yssichromis spp.
Fig. 11: Overall relative importance of food items to the diet of *Yssichromis* species.
Figure 12: Relative importance of food items to different sizes of *Yssichromis* spp. in Bugaia.
Figure 13: Relative importance of food items to different sizes of *Yssichromis* spp. in Buvuma channel.
Figure 14: Relative importance of food items to different sizes of *Yassa*chromis* spp. from commercial catches in Napoleon Gulf.
Fig. 15: Overall relative importance of food items to the diet of *Yssichromis* species between sampling stations.
Fig. 16: Overall relative importance of major food categories to the diet of *Yssichromis* species between sampling station
Figure 17: Overall relative importance of the major food categories to different sizes of *Y. anilus* species.
Food of *Yssichromis* species in the Northern part of Lake Victoria 1996/1997


Fig. 27: Comparison of the number of haplochromine trophic groups from Mwanza Gulf, Napoleon Gulf (inshore) and the relative importance of major food categories to the diet of *Yssichromis* species in the Northern part of Lake Victoria.
Figure 26: Changes in the Lake Victoria food-web before and after the Nile perch boom