DIURNAL FEEDING PATTERNS AND FOOD HABITS OF *LATES NILOTICUS* IN THE SPEKE GULF, LAKE VICTORIA

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ABSTRACT

Twenty four hour sampling sessions were conducted to investigate the feeding patterns and food habits of Lates niloticus *in the Speke Gulf, Lake Victoria during January/February, July/August and December 2002. Feeding activity was more pronounced during daytime mostly in morning hours than during the night. The most dominant food item was haplochromines. There was a significant difference in the occurrence of food items in the gut of* L. niloticus *with time. However, there was no significant difference in the occurrence of food items in the habitat at different times. The study concludes with a recommendation for fishermen to set their nets at midnight and haul them early in the morning preferably at 08.00 hours in order to avoid spoilage of the catch when setting is done early in the evening.*

INTRODUCTION

The Nile perch *Lates niloticus* was introduced into Lake Victoria between the 1950s and early 1960s (Hamblyn 1961, Arunga 1981, Welcomme 1988) for the purpose of converting the less valuable haplochromine cichlids into high quality table fish (Wanink and Witte 2000). Within a few years after the increase in abundance of the Nile perch, about 200 offshore species of haplochromines probably have become extinct and many inshore species decreased in abundance (Witte et al. 1992, Seehausen et al. 1997). Also, most of the non-cichlid fishes in offshore waters also showed a strong population decrease (Ogutu-Ohwayo 1990a, Witte et al. 1992, Gouswaard and Witte 1997). There were several factors that caused the population decrease. These include overfishing, competition, environmental degradation and predation pressure.

Earlier studies on food and feeding habits in Tanzania waters of Lake Victoria (Mkumbo and Ligtvoet 1992, Goudswaard and Witte 1997, Mhitu and Chande 2003) revealed that *L. niloticus* was exclusively carnivorous, feeding mainly on *Caridina nilotica*, haplochromines, *Schilbe intermedius, Brycinus jacksonnii, B. sadleri, Synodontis victoriae, Clarias gariepinus, Rastrineobola argentea, Protopterus aethiopicus,* Gastropods, bivalves, insect larvae, worms and occasionally on *Oreochromis niloticus*. Cannibalism was also found to be a common phenomenon. *L. niloticus* was also found to take some food items according to their size (Mhitu and Chande 2003). Individuals whose size was between 1.0 and 30.0 cm fed on *C. nilotica*. Then food preference shifted to the haplochromines and *R. argentea* at the size ranging between 21.0 and 50.0 cm. Those individuals above 50.0 cm preferred other food items including juvenile *L. niloticus*.

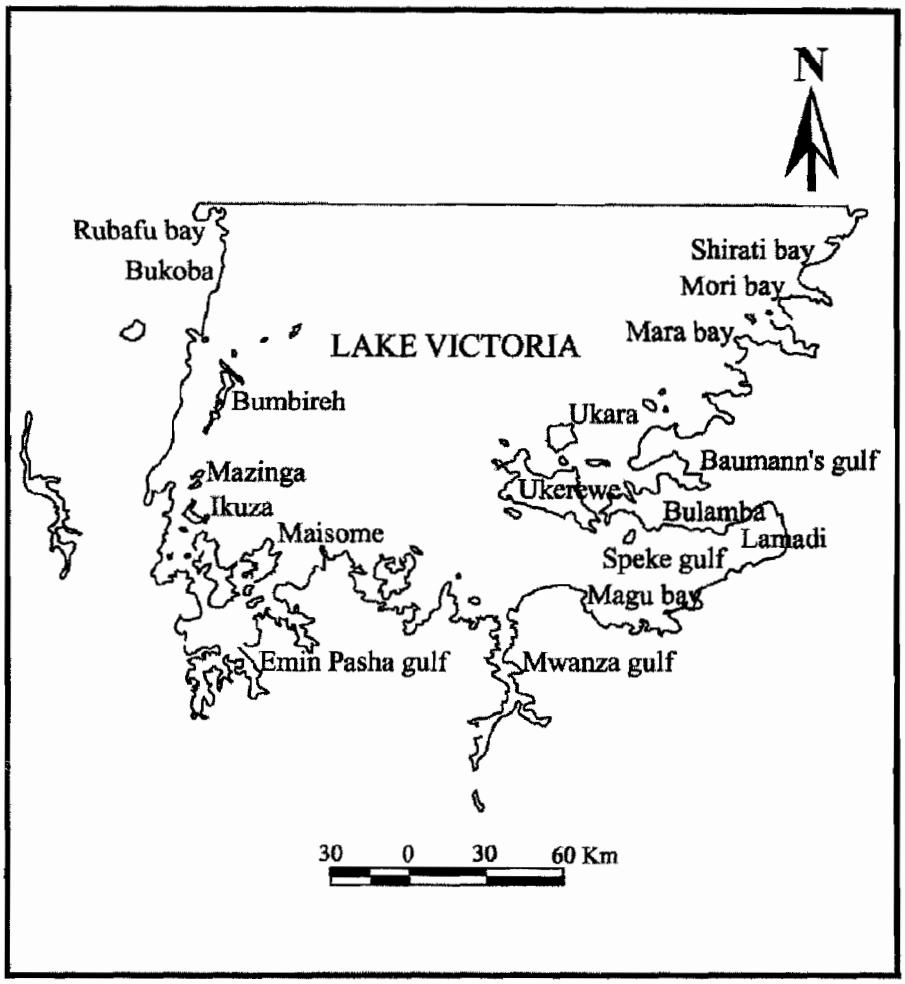

Figure 1: Map of Lake Victoria showing sampling stations

Mkumbo and Ligtvoet (1990) investigating on the diurnal feeding patterns of *L. niloticus* caught by a trawl net in the Mwanza Gulf showed that the species consumed *C. nilotica* during the day and fish during the night. Bwathondi et al. (1990) using beach seine nets at Shirati observed two feeding peaks; one in the morning and the other in the evening. None of these studies tried to relate the occurrence of food items in the gut of *L. niloticus* at different times of the day relative to their occurrence in the habitats. This study therefore tried to establish if there was any relationship between feeding patterns of *L. niloticus* and the availability of the prey items in the Speke Gulf.

MATERIALS AND METHODS

Study area

Lake Victoria, the biggest tropical lake and the third biggest lake on earth, is situated on

the East African plateau at 1134 m above sea level. It stretches across the equator, extending from 00o 02'N to 03o 00'S and is surrounded by three countries, Tanzania (49% of lake surface), Uganda (45% of lake surface) and Kenya (6% of lake surface). The climate is equatorial with two wet seasons, one between October and December, the other between February and April. The lake basin morphology is basically saucer shaped with a large open water body of between 60 and 100 m depth. Apart from the open waters and the wind and wave exposed western and eastern shore lines, the lake has relatively more sheltered shore lines along the Emin Pasha, Mwanza and Speke Gulfs, which act as breeding and nursery grounds for most fish species in the lake. In the present study, samples were collected at Bulamba and Lamadi inshore waters of Speke Gulf (Fig. 1).

Methodology

A trawler RV TAFIRI II, with 150 Horse Power, equipped with a bottom trawl net of 38 mm mesh cod-end was used for sampling at depths ranging between 4 and 20 meters. Fishing was carried out on a 24 hour sampling basis after every 3 hours during January/February, July/August and December 2002. A total of 8 trawls of 30 minutes duration were made on each day during the surveys. The trawls were evenly spread during day and nighttime. The catch was divided into several equal portions, one portion was taken as a sample.

The sample was weighed and sorted into species. Individuals of each fish species were counted and weighed. The individual stomachs of *L. niloticus* were split open and examined for fullness and food items, which were then sorted and counted. Scores were made for each food item from the stomachs of each fish in the sample and expressed as a percentage of the total number of stomachs examined for each trawl operation. Stomach fullness was estimated as full, 3/4 full, 1/2 full, 3/4 full and empty. Finally, the percentage of stomach fullness of *L. niloticus* was calculated for each trawl operation. The number of some individual food items caught in each trawl operation was recorded and expressed as a percentage of all food items in that trawl operation in order to assess variation of prey items in the habitat at different times of the day.

RESULTS

Results show that individuals with full stomachs peaked at 07.00 hours (Fig. 2). There was a substantial decline in the number of full stomachs thereafter. There were no individuals with full stomachs recorded at 13.00, 16.00 and 11.00 hours trawl hauls. Individuals with 1/2 full stomachs were found in samples collected from 19.00 hours. Individuals with empty stomachs peaked at 16.00 hours. Individuals with 3/4 full stomachs followed the same trend, but the changes were very steady as compared to individuals of 1/2 full stomachs. The 3/4 full stomach individuals did not show any trend.

There was a significant difference ($F_{(7,7)} = 12.192$; $P<0.05$) in the occurrence of food items in the gut at different times as revealed by data for three dominant food items; haplochromines, fish remains and *Caridina nilotica* (Table 1) which were first transformed into square root to meet the assumptions of Analysis of Variance (Zar 1996). *Rastrineobola argentea* and juvenile *L. niloticus* occurred only once in the morning at 07:00 hours both recording 3.1%. During this time, all the food items were encountered in the gut of *L. niloticus*.

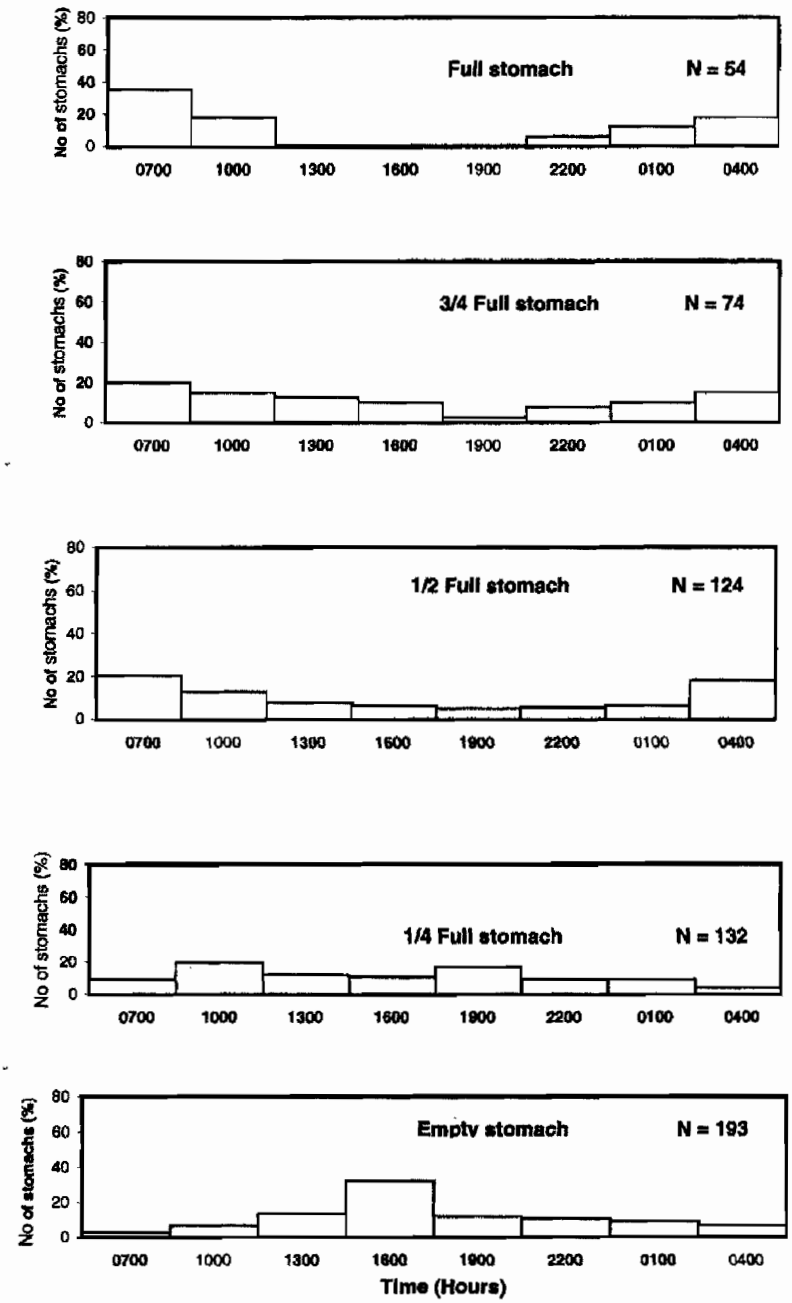

Figure 2: Percentage of stomachs at different fullness of *L. niloticus* at different times of the day

There was no significant difference in the occurrence of food items in the habitat at different times of the day ($F_{(1,7)} = 1.223$; $P>0.05$) as revealed by data for two dominant food items; haplochromines and *L. niloticus* (Table 2) that were transformed into square root to meet the assumptions of Analysis of Variance (Zar 1996). Haplochromines were the most dominant during all throughout ranging from 68.8% at 01.00 hours to 91.5% at 16.00 hours. *Lates niloticus* also occurred throughout ranging from 8.5% at 16.00 hours to 24.3% at 13.00 hours. The greatest number of food items was recorded in the morning at 07.00 hours. The least was recorded in the afternoon between 13.00 and 16.00 hours. *Rastrineobola argentea* which appeared in the gut of *L. niloticus* was not recorded in the samples because the trawl net was not the appropriate gear for capturing them.

Table 1: Occurrence of food items in *L. niloticus* stomachs at different times of the day

Food item	0700	1000	1300	1600	1900	2200	0100	0400
Haplochromines	81.3	82.8	66.7	82.8	70.0	85.0	100	69.2
L. niloticus	3.1	0	0	0	0	0	0	0
R. argentea	3.1	0	0	0	0	0	0	0
Fish remains	6.3	6.9	33.3	6.9	30.0	10.0	0	7.7
C. nilotica	3.1	3.4	0	0	0	5.0	0	23.1
Gastropods	3.1	6.9	0	10.3	0	0	0	0

Table 2.: Occurrence of the various food items in the habitat at different times of the day

Food item	0700	1000	1300	1600	1900	2200	0100	0400
L. niloticus	13.0	17.1	24.3	8.5	14.4	10.1	15.6	20.2
O. niloticus	1.3	0	0	0	0.8	0	15.6	5.4
B. sadleri	0.6	0.6	0	0	0	0	0	0
S. intermedius	3.7	0	0	0	0	0.7	0	0
S. victoriae	0.6	0	0	0	1.5	0	0	3.1
B. docmak	0	0.6	0	0	0	0	0	0
Haplochromines	80.8	81.8	75.7	91.5	83.3	89.2	68.8	71.3

DISCUSSION

The feeding activity of *L. niloticus* was more intense during morning hours and less so at other hours of the day. Mkumbo and Ligtvoet (1990) observed that feeding of *L. niloticus* in the Mwanza Gulf was more intense in the morning at 10:00 hours and less so at night. The feeding peak of *L. niloticus* during the morning hours could be due to low light intensity that might promote visibility, thus allowing efficient hunting, and additionally the availability of food items that were taking refuge during the night..

Mkumbo and Ligtvoet (1990) showed that *L. niloticus* in the Mwanza Gulf, consumed *C. nilotica* during the day but fed on fish at night. The high occurrence of the haplochromines in the gut of *L. niloticus* suggests that the species is an opportunistic feeder preferring the most abundant food item in the Speke Gulf. Similar observations have been reported elsewhere (Acere 1985, Ogari 1985, Hughes 1986, Ogutu-Ohwayo 1990b, Mkumbo and Ligtvoet 1992). However, dietary preferences differ from place to place since *L. niloticus* is capable of switching prey items depending on their relative abundance in the area.

No significant difference in the abundance of food items at different times of the day was detected, suggesting that there was no direct relationship between the feeding activity of

L. niloticus and the abundance of food items in the lake. This implies that other factors might play a key role in influencing *L. niloticus* to feed actively during the morning.

Bwathondi et al. (1990) observed two feeding peaks at Shirati, in the morning and evening, respectively. No evening peak was recorded in the present study probably due to the prey species taking refuge at this time of the day. The evening peak could be associated with the availability of the most abundant food item in the habitat. Therefore, it is recommended that fishermen be advised to set their nets at midnight and haul them in the morning at around 08.00 hours. This would avoid spoilage of fish when nets are set early in the evening.

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REFERENCES

Acere TO 1985 Observations on the biology of the Nile perch *L. niloticus* (Linne) and growth of its fishery in the northern waters of Lake Victoria. *FAO Fisheries Report.* **335**: 42 – 61.

Arunga JO 1981 A case study of the Lake Victoria Nile perch *Lates niloticus* (Mbuta) fishery. *Proceedings of the workshop of the Kenya Marine and Fisheries Institute on Aquatic Resources of Kenya.* Nairobi, pp. 165 – 184.

Bwathondi POJ, Chande AI and Msuku BS 1990 Gillnet selectivity and diurnal feeding of *L. niloticus* (L.) in southern part of Lake Victoria (Tanzania). A report submitted to the International Development of Research Cooperation (IDRC), Canada. 32 pp.

Goudswaard PC and Witte F 1997 The catfish fauna of Lake Victoria after the Nile perch upsurge. *Environmental Biology of Fishes.* **49**: 21–43

Hamblyn EL 1961 The Nile perch project. In: *Annual Report* 1960 of East African Freshwater Fisheries Research Organization, Jinja, pp. 26 – 32.

Hughes NF 1986 Changes in the feeding biology of the Nile perch *Lates niloticus* (L) (Pisces: Centropomidae), in Lake Victoria, East Africa since its introduction in 1960, and its impact on native fish community of the Nyanza Gulf. *Journal of Fisheries Biology* (London). **29**: 541–548

Mhitu HA and Chande AI 2003 Food, feeding habits and trophic relationships of selected fish species of Tanzania waters of Lake Victoria. In: Ndaro SGM and Kishimba M (eds) *Proceedings of the LVEMP Tanzania 2001 Scientific Conference.* Jamana Printers, Dar es Salaam, pp. 111-116.

Mkumbo OC and Ligtvoet W 1990 The biology of Nile perch- condition factor, growth, reproduction and food/feeding in Mwanza Gulf- Lake Victoria. In: Bwathondi POJ (ed) *Proceedings of the workshop on the prevailing activities on the Lake Victoria Basin with particular reference to the fisheries of the lake.* Mwanza, Tanzania, pp. 24-35.

Mkumbo OC and Ligtvoet W 1992 Changes in the diet of Nile perch, *Lates niloticus* (L.) in the Mwanza Gulf, Lake Victoria, *Hydrobiologia.* **232**: 79– 84.

Ogari J 1985 Distribution, food and feeding habits of *Lates niloticus* in the Nyanza

gulf of Lake Victoria (Kenya). In: CIFA. Report of the third session of the sub-

committee for the Development and Management of the Fisheries, 4-5

October 1984, Jinja. *FAO Fisheries Report.* **335**: 68-80.

Ogutu-Ohwayo R 1990a The decline of the native fishes of Lake Victoria and Kyoga(East Africa) and the impact of introduced species especially the Nile perch, *Lates niloticus* and the Nile tilapia, *Oreochromis niloticus*. *Environmental Biology of Fishes.* **27**: 81–96.

Ogutu-Ohwayo R 1990b Changes in the prey ingested and the variations in the Nile perch and other fish stocks of Lake Kyoga and the northern waters of Lake Victoria (Uganda). *Journal of Fisheries Biology* **37**: 55– 63

Seehausen O, Witte F, Katunzi EF, Smits J and Bouton N 1997 Patterns of the remnant cichlid fauna in southern Lake Victoria. *Conservation Biology.* **11**: 890-904.

Wanink JH and Witte F 2000 The Use of Perturbation as a natural Experiment: Effects of Predator Introduction on the Community Structure of Zooplanktivorous Fish in Lake Victoria. *Advances in Ecological Research.* **31**: 553-570

Welcomme RL 1988 International Introduction of inland fish species. *FAO Fisheries Technical Paper.* **294**: 1-318.

Witte F, Goldschmidt T, Goudswaard PC, Ligtvoet W, Oijen MJP van and Wanink JH 1992 Species extinction and concomitant ecological changes in Lake Victoria. *Netherlands Journal of Zoology.* **42**: 214-232

Zar JH 1996 Biostatistical Analysis. Prentice Hall, Inc., Englewood Cliffs, New Jersey.