Feeding ecology and population characteristics of *Oreochromis niloticus* (L.) and trophic interactions in the fish community of Nyanza Gulf, Lake Victoria, Kenya

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Abstract: The diet of *Oreochromis niloticus* (L.) is now more diverse than earlier reported. *Oreochromis niloticus* was considered to be a herbivore feeding mostly on algae and plant material. The diet now consists of insects, fish, algae and plant material. The shift in diet may be due to ecological changes in the lake. Water hyacinth, *Eichhornia crassipes* (Mart.) Solms, which harbours insects in its root balls, now has extensive coverage of the lake. The native species which preyed on insects (e.g. haplochromines) have largely been eliminated and *O. niloticus* may be filling niches previously occupied by other species. The change in diet may also be related to food availability and abundance, with the fish feeding on the most easily available food items.

Introduction

Oreochromis niloticus (L.) is a tilapiine cichlid indigenous to Lakes Albert, Edward, George and various crater lakes in Uganda (Trewavas 1983). The first introduction of *O. niloticus* into Lake Victoria probably occurred in the early 1950s (Welcomme, 1967). Apart from *O. niloticus*, other tilapiines introduced into Lake Victoria between 1951 and 1962 were *Oreochromis leucostictus* (Trewavas), *Tilapia zillii* (Gervais) and *Tilapia rendalli* (Boulenger). *Oreochromis niloticus* first appeared in commercial catch records in 1960. The depth range of *O. niloticus* is 0-30 m, but it is mainly found in waters less than 10 m deep (Witte & van Densen 1995).

Oreochromis niloticus is the most commercially important tilapiine in Lake Victoria (Witte and Densen, 1995). The native species *Oreochromis esculentus* (Graham) and *Oreochromis variabilis* (Boulenger) have disappeared. *Oreochromis niloticus* supports the third most important fishery in Lake Victoria after *Lates niloticus* (L.) and *Rastrineobola argentea* (Pellegrin). *Oreochromis niloticus* is the most preferred commercial species in the lake and fetches the highest price per kg.

There is a lack of information on *O. niloticus* feeding habits in different habitats in the Kenyan waters of Lake Victoria. The species is mostly herbivorous, feeding on algae and plant material (Getabu 1994). The present study suggests there is a shift in diet preferrence of *O. niloticus* following infestation of the lake by water hyacinth, *Eichhornia crassipes* (Mart.) Solms.

Following the water hyacinth infestation, biomass of some species, including *Protopterus aethiopicus* Heckel, *Clarias* spp. and haplochromines, has increased (unpublished data). The current status of Nyanza Gulf and the entire L. Victoria ecosystem is now being assessed. The feeding ecology and population characteristics of *O. niloticus* are now being studied as part of a programme to construct an ECOPATH model for Lake Victoria.

The specific objectives are to:

- study feeding habits of *O. niloticus* in different habitats and seasons, at different sizes, and to study the daily feeding rhythm in the lake;
- establish if there has been a change in the feeding habits of *O.niloticus* in the Nyanza Gulf following water hyacinth infestation;
- study the algal preference by *O.niloticus* using electivity indices;
- estimate *O. niloticus* food consumption;
- estimate basic population parameters of *O. niloticus* (growth, mortality, recruitment) from Nyanza Gulf and open waters of Lake Victoria after water hyacinth infestation;
- construct an ECOPATH model for Nyanza Gulf and Lake Victoria.

Materials and methods

Oreochromis niloticus were caught by beach seining, hook and line, and trawling. The sampling stations were littoral zones (1-5 m deep in Kisumu Bay, Asembo Bay and Homa Bay), 5-10 m deep (Maboko and Ndere islands) and open waters (Mbita and Usenge). Immediately after capture, fish were weighed (g) and measured (TL, nearest cm). Fish were dissected and sexed. Stomachs were removed from representative samples from all sizes and habitats. Stomachs were quantitatively estimated as empty (0), ¼ full (1), ½ full (2), ¾ full (3), full (4) (Hynes 1950). Stomachs with contents were preserved in 4% buffered formalin for later analysis in the laboratory.

In the laboratory, items were sorted into categories (species if possible) and each category was assigned a number of points. Each food category was awarded points proportional to the estimated contribution to the stomach volume. A full stomach got 20 points, 3/4 full 15, 1/2 full 10,and 1/4 full 5 points (Hyslop 1980).

Length-frequency data were obtained from Kendu Bay, Homa Bay, Asembo Bay and Dunga (Kisumu Bay). Using FAO- ICLARM Stock Assessment Tool (FISAT) these data will be used at a later stage in the project to calculate population parameters (length at infinity L_∞, growth coefficient K, mortality Z, M, F, exploitation rate E) and estimation of biomass and production.

Results

The main food items for *O. niloticus* from November 1998 to March 1999 were insects, algae, fish and plant material (Fig. 1, Table 1).

In November, plant material contributed 34.9%, insects 21.1% and algae 18.4%. In December, algae constituted 47.8%, fish 31% and plant material 19.4%. In January,

insects were the most dominant food items for Nile tilapia at 47.9% of the total, plants 21.2% and algae 14.2%.

In February, the most dominant food items were insects 42.9%, algae 23% and fish 15%. In March, insects comprised 35.9% of the diet followed by fish (31%) and algae (18.5%).

Table 1. Percentage contribution of various food items to the food of *O. niloticus* in different months (November 1998 - March 1999) in Kenyan waters of Lake Victoria. * = trace.

Food items	Nov	Dec	Jan	Feb	Mar
Algae	18.4	47.8	14.2	23.0	18.5
Plant Material	34.9	19.4	21.2	1.0	5.6
Insects (unidentified)	8.8	-	38.3	27.2	16.1
Trichoptera	7.9	-	7.9	7.7	12.8
Chironomidae	-	-	*	-	-
Povilla adusta	4.9	-	1.0	8.0	5.2
Chaoborus spp.	*	-	-	-	-
Odonata	-	*	-	-	1.9
Caridina nilotica	14.2	-	-	0.7	1.6
Fish (unidentified)	7.7	31.6	12	10.6	22.8
Rastrineobola argentea	-	-	-	4.5	5.8
Haplochromines	-	-	-	-	2.6
Bivalvia	3.3	-	3.5	8.4	7.2
Cladocera	0.3	1.9	1.2	7.0	-
Copepoda	-	-	*	1.6	-
Oligochaetae	-	-	*	0.3	*
Hirudinea	-	-	-	-	*

Discussion

Oreochromis niloticus has a more diverse diet than previously reported in Nyanza Gulf. The dominant food items used to be algae and plant material (Getabu 1994). Now insects are the most dominant item in the diet. Fish (*R. argentea*), which were not previously reported as a major component of the diet, featured in this study.

Increase in insects in the diet of *O. niloticus* might be attributed to the lake infestation by water hyacinth which harbours different species of insects, but the increase in *R. argentea* in the diet cannot be attributed to this.

Balirwa (1998) found detrital material and insects, especially chironomid larvae, were the main food items of *O. niloticus* from Ugandan waters of the lake. Balirwa (1998) also found fish remains in the the fish stomach.

In both Kenya and Uganda, therefore, *Oreochromis niloticus* is more catholic in its feeding habits than previously reported. The species may be filling niches in the lake previously occupied by various cichlids and non-cichlids (McConnell 1958; Balirwa 1998).

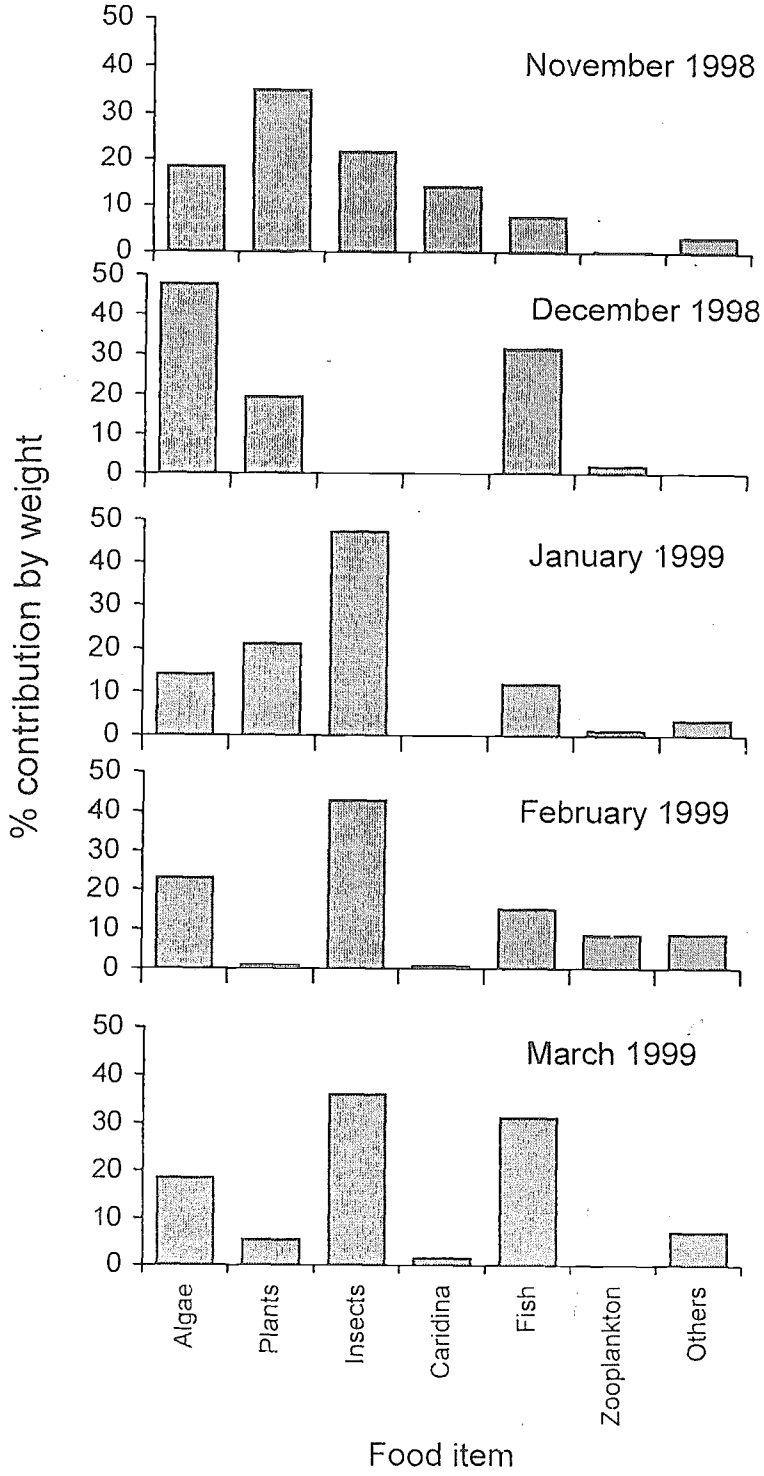

Figure 1. Percent contribution by weight for the food items found in the stomachs of *O. niloticus* from November 1998 to March 1999.

Acknowledgements

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