The biology, ecology and fishery of *Oreochromis esculentus* in the Lake Victoria Basin

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Abstract

Oreochromis esculentus an indigenous tilapiine species in Lake Victoria has become extinct due to a number of factors. These include, introduction of a more competitive species (*Oreochromis niloticus*), eutrophication and over exploitation through gill-nets. *Aulocosira* an important food item for the species was displaced by the blue-green algae that were less nutritive. The species has however remained in the satellite lakes where in some cases it supports the fisheries of the riparian communities. The paper reviews some aspects of distribution, feeding and reproduction of *Oreochromis esculentus* in selected satellite lakes.

Keywords: Indigenous species, satellite lakes, eutrophication, exotic species, phytoplankton.

Introduction

The early gill-net fishery in Lake Victoria was based on *O. esculentus* and *O. variabilis* (Graham, 1929). With time, the fishery started to decline due to a number of factors such as intensive exploitation by deployment of efficient and increased gill-net fishery, and introduction of non-native tilapiines that performed better than the native species. These included *Oreochromis niloticus*, *O. leucostictus* and *T. zilii*. The introduction of these alien species further suppressed the survival of *O. esculentus.* The introduced species being competitively superior gradually eliminated the native *O.esculentus* due to unequal sharing of limited ecological requisites. (Fryer and Iles, 1972).

In Lake Victoria, the fish was confirmed to water less than 20m deep and was most abundant in sheltered gulfs and bays where the lake bottom comprised of soft algaceous mud. However in Satellite lakes, the species is confined to both inshore and offshore areas. In the main lake, the species fed essentially on phytoplankton (Graham, 1929; Worthington, 1929; Fish, 1955; Lowe, 1956). However, insect larvae and planktonic crustaceous could be part of diet of young fish. Greenwood (1974) recorded most of the fishes to be sexually mature at a length of 25 to 26 cm, and the modal adult size to be from 30 – 32cm.However cases occurred when specimen ranging between 40-50cm long could be caught particularly in the southern waters of Lake Victoria. It is of wide distribution in satellite lakes where it is still unknown as to whetrhe the species is indigenous or has been introduced.

O. esculentus once a delicacy of the riparian communities is completely lacking in L. Victoria. The surveys that have been going on in the catchment of L. Victoria, revealed that *O. esculentus* is occurring in a number of isolated water bodies. These are not only caught through sport fishing but in some cases the species form a big fishery that support the riparian communities like at Lake Burigi. The paper reviews the distribution of the species, the fishery in selected satellite lakes, food and some aspects of reproduction.

Materials and methods

Satellite lakes within the Lake Victoria basin were visited once every four months in which case samples of *O.esculentus* were collected from the catches made by the fishermen. However, a number of specimen were independently caught using a set of nets ranging between 2.5 mesh to 8.75cm at 1.25 interval. Though *O.esculentus* is of wide occurrence in many ponds and other small water bodies in the basin, the species is only found in exploitable levels at Lakes Malimbe Ikimba and Burigi where samples for detailed analyses of lengths, weights and gonads of individual fishes were taken from.

At each Lake, samples from either the fishermen or the independent fishing by the author were analyzed for weight, length, and gonad maturity stages. For the analysis of food item consumed, samples were stored in formalin and later in alcohol for further analysis.

Analysis of the modal lengths, lengths at 50% maturity and length weight relationships for the fishes caught at the three lakes of Malimbe Burigi and Ikimba were made to provide information on the appropriate mesh for the exploitation of the species. Also the gut contents were analyzed to investigate the food consumed by the species.

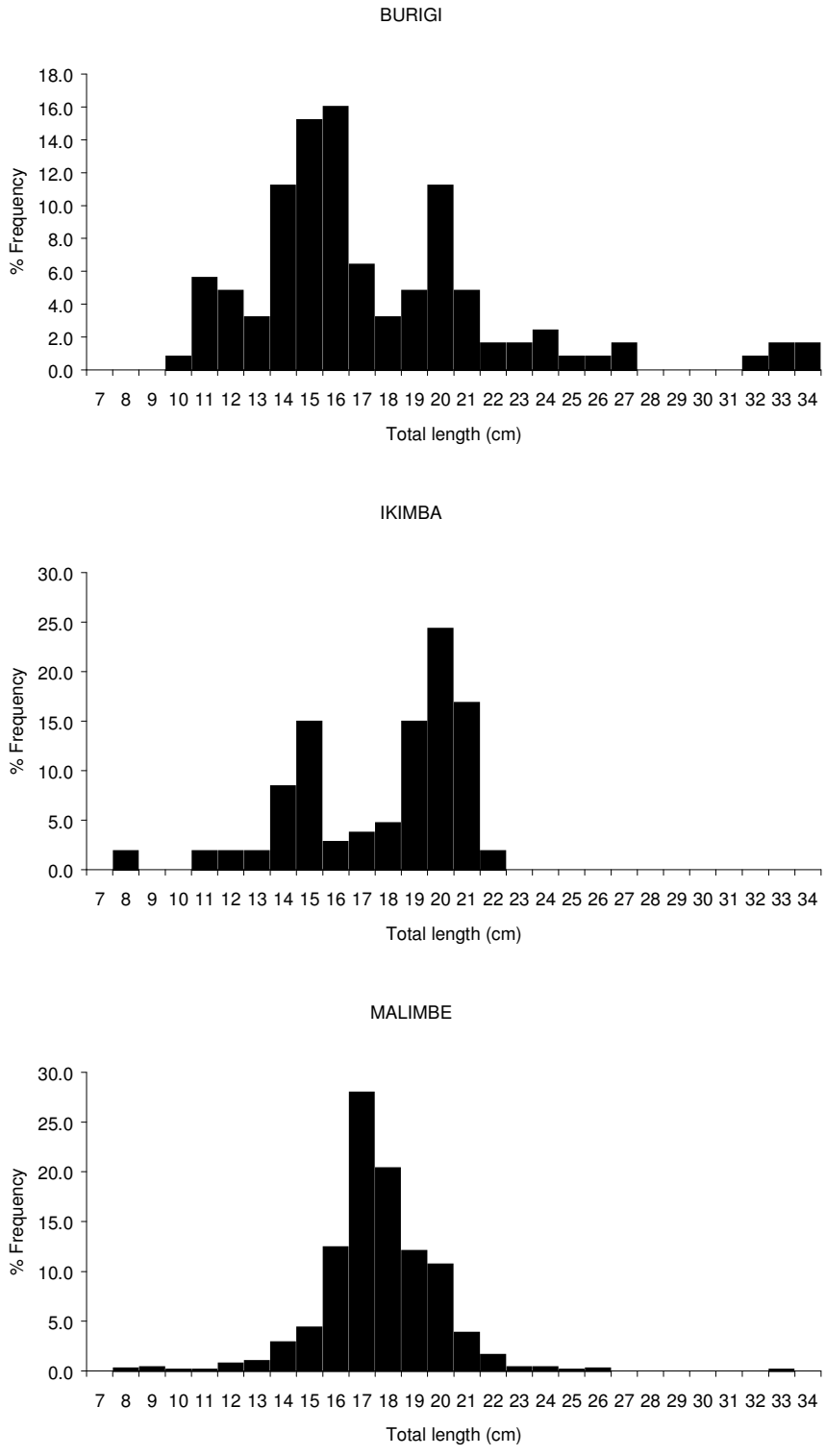
Results

Distribution

Although *O.esculentus* is indigenous to Lake Victoria, it has not been possible to catch the fish in the lake. However, the species has been found in satellite lakes, rivers and floodpools in varying amounts and in some lakes, the species is commercially exploited and contributes to the fishery in the respective lakes. For instance, the contribution by weight in some lakes have been recorded as follows; Lake Ikimba 79.4%, Lake Malimbe 72.1%. Lake Burigi 44.7%, Lake Kubigena 8.2%, Lake Kirumi 2.4%, Lake Katwe 2.2%. The size range of the individual fish varied from one lake to the other. For instance at Lake Burigi the size structure of the exploitable population ranged from 15-33cm. The distribution of exploitable sizes at Lake Malimbe varied between 7-30cm, For Lake Katwe the sizes ranged between 11-29cm. At Lake Ikimba the size range was 7-21cm.

Fig. 1 shows the distribution pattern of the exploitable part of the population at lakes Burigi, Ikimba and Malimbe. In Lake Burigi the fishermen deploy gill-nets of mesh sizes ranging between 50.8 – 88.9 cm (2-3 ½"). A prominent peak exists at 16 cm total length. From Fig 2, the length at 50% maturity for the male and females is between 16.50cm and 16.58 cm, respectively. It becomes obvious that the fishery is exploiting much of the breeding population without providing room for the young population to breed. The fishery independent data collection with gillnet ranging from 38.6 –88.9 cm (1.52" -3.5") depicted progressive modes indicating that although the species is a continuous breeder, modal peaks are associated with different mesh sizes (Fig.3).

Fig.1 Length frequencies of the exploited part of the population



At lake Ikimba, the peak for the exploited part of the population was observed at 20cm. The lengths at 50% maturity for both males and females was 16.23 and

16.65cm respectively Figs.1 & 2. The average catch per boat is below 2kg. At lake Malimbe where *O.esculentus* comprise over 70% of the fish landings, the mesh sizes deployed by the fishermen is 7.5cm. The exploited part of the population occurred with a peak of 17cm. However, the length at 50% for male and female occurs at 17.51 and 18.56 cm, respectively.

O.esculentus is essentially a phytoplankton feeder. A list of food items is shown in Table1. below.

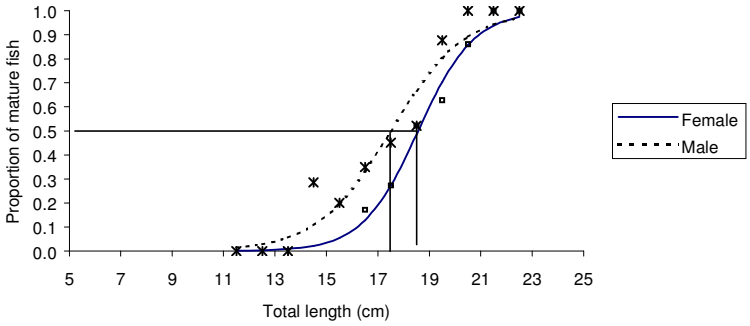
Table1: A list of phytoplankton species found in the stomachs of *O.esculentus*

Chlorophyceae (Green algae)	**Cyanophceae** Blue-green algae)	**Bacillariophyceae** (Ditoms	**Xanthophycea** (Yellow-green algae)	**Rhodophycea** (Red algae)
Ankistrodesmus	*Anabaena*	*Aulocoseira*	**Botrydium**	*Porphridium*
Botryococus	*Microcystis*	**Navicular**		
Coelastrum	**Lynbrya**			
Microcystis				
Tetraedon				
Scedesmus				
Sprirogyra				

Aulocoseira, Botryococus and *Porphyridium* have been found in large quantities suggesting their relative importance in the diet of the species. Higher plant materials and small quantities of other phytoplankton materials like *Tetradon* sp.*Chlorella, Oocyst* have also been found in small quantities in the stomachs of *O.esculentus*, *Chrolophycea* items were numerous. *Botryococus* appeared with very high frequency particularly at Lake Katwe

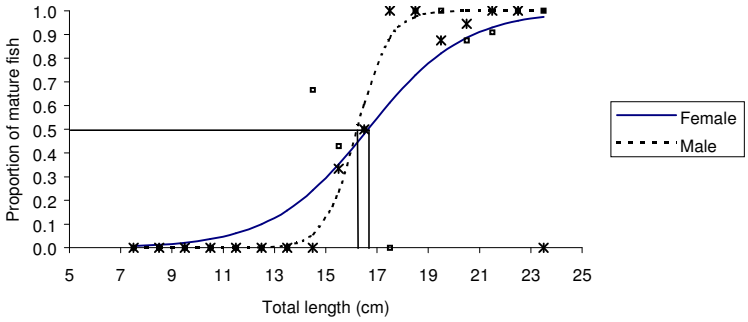
Fig. 2 Maturity ogives for O. esculentus from 3 satellite lakes

MALIMBE



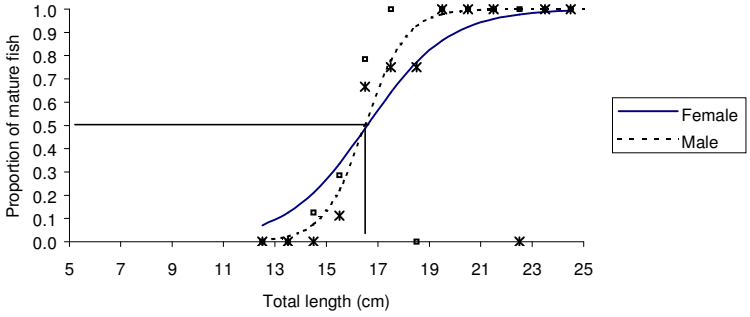
L_{50}	
Female	Male
18.56	17.51

IKIMBA



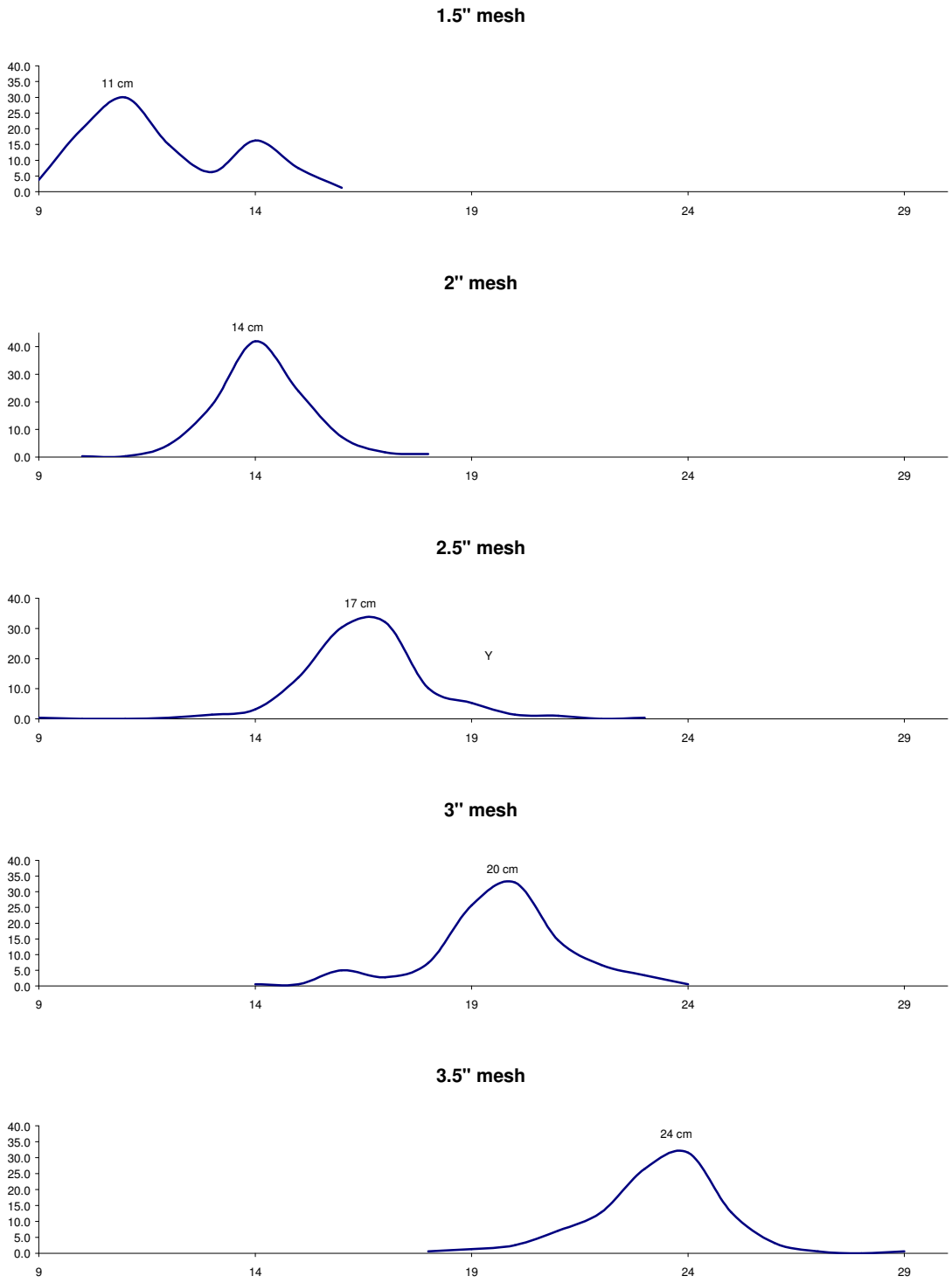
L_{50}	
Female	Male
16.65	16.23

BURIGI



L_{50}	
Female	Male
16.58	16.50

Fig.3 Mesh selectivity for O.esculentus in Lake Burigi



Discussion

In Lake Victoria, *O. esculentus* fed on planktonic material particularly the diatoms (Fryer and Iles, 1972; Lowe-Mc-Connel 1956). Stomachs of adult specimen comprised about 48.7% *Aulocoseira*.

Silicon conservation that is vital for phytoplankton growth, is thought to have been adversely affected due to increased inputs of phosphorus and sedimentation of silicon. The growth of *Melosira (Aulacoseira*) which was the main food of *O. esculentus* largely depended on silicon. This resulted in changes of dominance of *Aulacoseira* to *Nitzchia*. The phytoplankton population changed to dominance of cynobacteria that are low in energy content and hence poor food source (Lampert, 1981; Harney, 1987). This decrease in *Aulocoseira* may have contributed to disappearence of *O. esculentus* in Lake Victoria

In a given environment, the sexes are known to mature at the same time and are known to grow at the same rate. (Lowe, 1956; Garrod, 1956). The sizes at first maturity ranged between 20-21 cm. The sexual maturity in both sexes occurred at lengths of 25-27 cm TL (Graham, 1929; Greenwood, 1966). Sizes at first maturity in the early 1950's was 19-23 cm TL and 50% at 22 – 28 TL (Lowe-McConnel, 1956; Fryer and Iles, 1972). In the present situation the 50% maturity in all the lakes visited ranged between16.23 to18.58.cm indicating that either the conditions in the satellite lakes might be limiting or the heavy exploitation has suppressed the growth of the species. The prevailances of low mesh sizes of gill nets deployed in the satellite lakes remain a threat and may need revisiting. There is no baseline data on catches of satellite lakes to compare with the present size structure of fish caught but the proportion of fishes caught in relation to 50% maturity indicates sign of overexploitation. At Ikimba both male and female had L50 of 16.23 and 16.65 cm, respectively. The exploited population had a mode of 20 cm exploited by gill-nets of 7.5cm.

The description of the feeding mechanism of *Oreochromis* was based on *O. esculentus.* Other researchers (Fish, 1951; 1955; Lowe-McConnel, 1956; Welcome, 1967; Bailey, *et al.,* 1978) confirmed the species to be a planktonic feeder using the mucus trap mechanism with the action of the pharyngeal teeth. The species was non-selective in as far as the food organisms are being retained by this method, but is selective in that the gut contents analyzed comprised of diatoms Gee and Gilbert, (1967). In the satellite lakes *O.esculentus* has remained a phytoplankton feeder. The food constituent and pattern of selection for the species differs depending on the availability and location. But selectivity has biased towards feeding on *Aulocoseira, Botryococcus* and *Porphridium.*

Conclusion

Ecological aspects and survival of *O. esculentus* in Lake Victoria may be attributed to some environmental changes taking place in the lake. The species being a phytoplankton feeder may have been affected by the eutrophication resulting from an increase in

nutrient drainage especially phosphorus and nitrogen into Lake Victoria. The source of nutrient being the atmospheric deposition and runoffs from the catchments.

Silicon conservation that is vital for phytoplankton growth, is thought to have been adversely affected due to increased inputs of phosphorus and sedimentation of silicon. The growth of *Melosira (Aulacoseira*) which was the main food of *O. esculentus* largely depended on silicon. This may have resulted in changes of dominance of *Aulacoseira* to *Nitzchia*. The phytoplankton population changed to dominance of cynobacteria that are low in energy content and hence poor food source. This decrease in *Aulocoseira* may have contributed to disappearence of *O. esculentus* in Lake Victoria.

References

Bayley, B.P., 1977. Changes in species composition of the yield and catch per effort during, the development of the fisheries of Lake Turkana, Kenya. Arch. *Hydrobiol.* 79 (**1**): 111-132.

Fish, G.R., 1951. Digestion in *Tilapia esculentus***.** ***Nature*** *Lond*. **167**: 900-901.

Fish, G.R., 1955. The food of *Tilapia* in East Africa. ***Uganda J*.** **19**(1) 85-89.

Fryer, G. and Iles, T.D., 1972. *The cichlid fishes of the Great lakes of Africa*. Oliver and Boyd, Edinburg.

Gee, J.M. and Gilbert, M.P., 1967. The establishment of a commercial fishery for Haplochromis in Ugandan waters of Lake Victoria. Occ. Pap. Mo5E. *Afr. Fresh wat. Res. Org*.39pp.

Graham, M., 1929. The Victoria Nyanza and its fisheries. A report on the fish survey of Lake Victoria 1927-28. *Crown agents for the colonies***,** London. 225p.

Havey, J.F., 1987. Field Studies of zooplankton cynobacteria interactions. *New Zealand Journal of Marine and Freshwater Research* **21**:467-475

Lampert, W.1981. Inhibitory and toxic effects of blue green algae on *Daphnia Internationale Revúe der gesanten Gydrobiologic* **66**:285-298

Lowe-McConnell, R.H., 1956. The breeding behavior of Tilapia species (Pisces; cichlidae) in natural waters; observations on *I. Karomo*

Welcomme, R.L., 1966. Pleriminary studies on the food of Tilapia esculenta. Granam. Rep. *E.afr. freshwat. Fish. Res. Org*. for 1966: 16.22

Worthington, E.B., 1929. A report on the fishing survey of Lakes Albert and Kyoga. March-July, 1928. *Crow Agents, London.* 136pp.