STUDIES ON THE FISHERIES AND BIOLOGY OF *OREOCHROMIS UROLEPIS* (PISCES: CICHLIDAE) IN THE MTERA RESERVOIR (TANZANIA)

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ABSTRACT

The fisheries and some aspects of the biology of Oreochromis urolepis *of the Mtera Reservoir (Tanzania) were examined in August 2002. It was observed that there was no proper management of the reservoir's fisheries. Beach seine fishing dominated the fishery. Nearly all the* O. urolepis *caught by this type of gear were juveniles. The number of fish caught by the beach seines was very high, some times up to 4,000 fish per haul. The beach seines also destroy the spawning sites for the tilapias. Mean total lengths of* O. urolepis *caught in gillnets of legal mesh sizes (ranging from 88 mm and 114 mm), ranged between 22.0 cm and 27 cm. Their mean weights were between 236 g and 433 g. Most of the fish caught were sexually immature. Ninety three per cent of the fish from the 88 mm gillnets were immature, while only 28% of those caught in the 114 mm mesh nets were mature. The smallest mature female had a total length of 24.0 cm.* O. urolepis *is a very fecund tilapiine species. A female weighing 450 g was found to contain about 3250 eggs. It was also found that the species is a phytoplankton feeder, taking in diatoms, green and blue green algae.*

INTRODUCTION

The Mtera reservoir (Fig. 1) is the largest man-made lake in Tanzania and was formed after the closure of the Great Ruaha river in December, 1980 (Johansson 1997). The reservoir was expected to fill in one to two years period, depending on the amount of rainfall in the catchment area (Johansson, 1976). At Full Supply Level (FSL), the reservoir has a surface area of 660 km2, with a mean depth of 6.2 m (Ekstrand et al. 1997).

In pre-impoundment studies, Petr (1974) recorded 27 fish species belonging to eight families in the Great Ruaha river. The families found in the river included: Cyprinidae, Mormyridae, Characinidae, Bagridae, Clariidae, Citharinidae, Mochocidae and Cichlidae. In experimental gillnet fishing, the cyprinids constituted about 41% of the fish biomass (Petr op. cit.). These consisted of: *Barbus macrolepis*, *B. paludinosus* and two *Labeo* species.Next in importance were the characinids, *Alestes affinis* and *Hydrocynus vittatus*. Citharinids were represented by *Distichodus* species. The cichlid *Oreochromis urolepis* appeared only in small proportions.

The creation of the artificial lake has attracted a number of fishermen and at present fishing is a very important industry. For example, in 1992 there were about 4200 fishermen, who landed more than 10,000 metric tonnes of fish wealth more than US$ 3.4 million (Tamatamah & Benno 1997). It is unfortunate that there are no published records of fish catches from the reservoir after 1992 (Mr. Isaac per. com.). The Fisheries Department is understaffed and it is the District Councils which are responsible for the management of the reservoir. The main concern of the councils is revenue collection rather than proper management of the fisheries. As a result, beach seines are the main fishing gears in the reservoir.

By 1984, *O. urolepis* comprised about 92% of fishermens' landings at Chamsisiri (Chale & Mwaya 1984), while in 1992, the species constituted about 71% of the total fish landings for the reservoir (Tamatamah & Benno 1997). It has been shown that in newly formed man-made lakes there is the tendency of changes in species composition of fish. The population of the species which were normally dominant in the river decline and those of lacustrine species, such as the cichlids, increase (Petr 1974). Examples of such changes have been reported for the Volta lake in Ghana (Petr 1970) and the Nyumba ya Mungu Dam (Petr 1975). The filling of an impoundment is associated with increased nutrient levels which will stimulate phytoplankton growth leading to increased populations of phytoplankton feeding fish (Petr 1981).

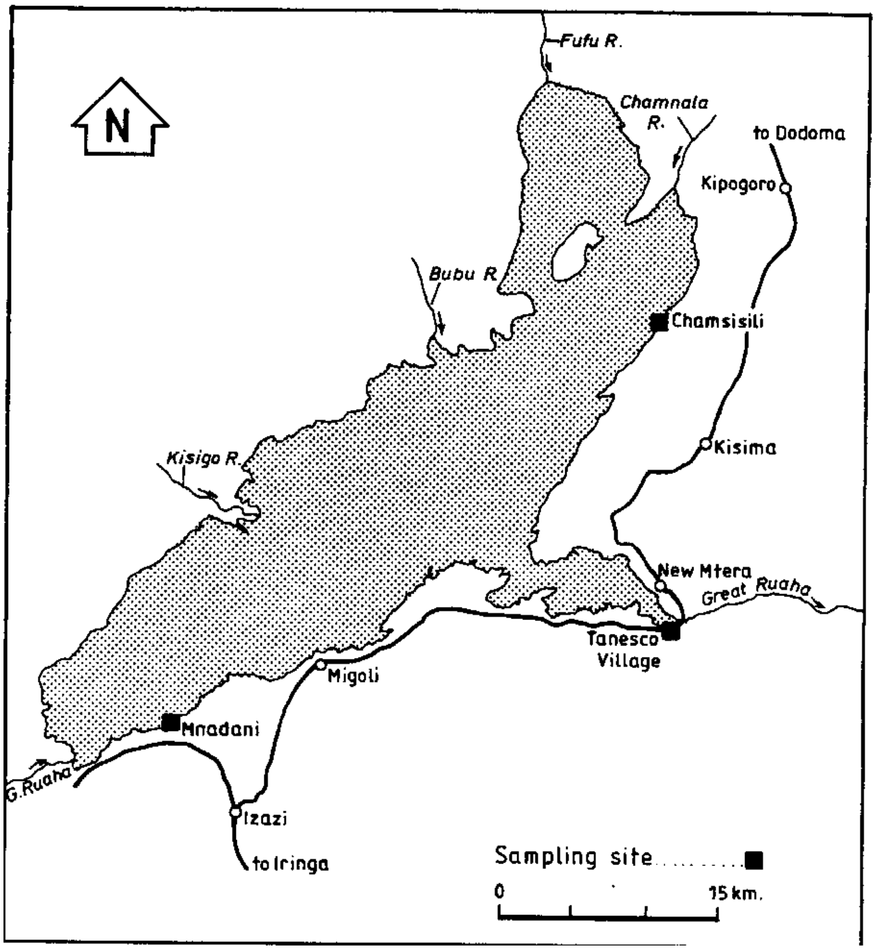

Fig. 1: Map of the Mtera Reservoir showing sampling locations.

Petr (1974) reported that *O. urolepis* was omnivorous, feeding on aquatic plants, worms and insects. Johansson (1997) showed the predominance of filamentous cyanobacteria in the Mtera reservoir. Other important groups included diatoms, green algae and euglenoids.

In this paper, results on the fisheries and biology of *Oreochromis urolepis* are presented. The studies were carried out in August, 2002.

MATERIALS AND METHODS

The study was carried out at three locations (Fig. 1). Chamsisiri represents a truly lacustrine environment, while the area around the dam site is deep and narrow. The third sampling location is close to the mouth of the Great Ruaha river and is influenced by the river to some extent.

Fishermen's catches of *O. urolepis* from beach seines, gillnets of 88 mm, 101 mm and 114 mm mesh sizes were examined for catch rates, size distributions and sexual maturity.

For size distribution and sexual maturity studies subsamples were randomly taken from the catches. Total lengths were measured with a measuring board to the nearest 1 cm, while weights were read to the nearest 5 g (Lagler 1986). After taking the lengths and weights of the fish, the samples were dissected and the gonads examined for maturity. The maturity stages were determined according to Lagler (1956). Eggs from ripe females were preserved in Gilson's fluid for later laboratory analyses (Bagenal & Braum 1986).

In the laboratory, the eggs were scraped off from the attached tissue, washed thoroughly with distilled water until no odour of the preservative was detected and then dried at $105^{O}C$ to constant weight. A subsample of the dried eggs was weighed and the number of eggs in the subsample counted. Then the total number of eggs was estimated from the subsample (Bagenal & Braum 1986).

Fish samples for food analysis were collected using a beach seine of 63 mm mesh size. Full stomachs were removed and preserved in 4% formalin. In the laboratory, the stomach contents were emptied into glass petri dishes (Windell & Bowen 1986). Subsamples of the stomachs were examined under a compound microscope. Phytoplankton types and dominance were determined using the key by Prescott (1970).

RESULTS

The beach seines caught a lot of fish, in many cases, more than 3500 per haul from a seine net of about 30 m long. *Oreochromis urolepis* constituted more than 95% of the fish caught. The mean total length of the *O. urolepis* in the beach seines was 19.3 cm and the mean weight was 156 g. All fish from the seine nets were sexually immature.

Gillnets of 101 mm stretched mesh sizes constituted the majority (81.8%) of the legally allowed nets, followed by those of 88 mm mesh size (15.1%). The remaining 3.1% were those of 114 mm mesh. The average catch rate of *O. urolepis* in the 88 mm mesh gillnets was 7.24 fish per net, while for the 101 mm mesh nets, it was 6.45 fish, and the mean catch rate for the 114 mm mesh gillnets was 3.85 fish.

Table 1: Length frequencies of *Oreochromis urolepis* according to gillnet mesh size (%)

Total length (cm)	**Mesh size (mm)**		
	88	101	114
< 18.0	0	0	0
18.1 – 20.0	12	3	0
20.1 – 22.0	31	16	6
22.1 – 24.0	35	27	12
24.1 – 26.0	18	27	39
26.1 – 28.0	2	22	41
28.1 – 30.0	1	4	2
30.1 – 32.0	1	1	1
> 32.1	0	0	0
N =	410	280	110

NB: N is sample size

Table 1 shows the length frequencies of *O. urolepis* for the three gillnet mesh sizes. It can be observed that the modal total length for the 88 mm mesh nets was between 22 and 24 cm, and it was calculated that the mean total length was 22.0 cm. The majority of the fish (54%) caught in the 101 mm mesh gillnets had total lengths between 22 and 26 cm (Table 1). Fish from the 101 mm mesh nets had a mean total length of 24.8 cm. The modal total length of fish in the 114 mm mesh size gillnets was about 27 cm (Table 1), while the mean length was 26.8 cm.

In Table 2 the weight frequencies of *Oreochromis urolepis* are presented. Eighty one percent of the fish caught in the 88 mm mesh gillnets weighed less than 300 g, while for the 101 mm mesh nets fish with less than 300 g accounted for 46%, and it was 7% for those from the 114 mm mesh nets. The mean weights were 236 g, 353 g and 433 g, for the fish from 88 mm, 101 mm and 114 mm mesh nets, respectively.

Table 2. Weight frequencies of *O. urolepis* according to gillnet mesh size (%)

Weight (g)	**Mesh size (mm)**		
	88	101	114
<100	0	0	0
100.1–200.0	28	5	1
200.1–300.0	53	41	6
300.1–400.0	14	27	48
400.1–500.0	5	13	34
500.1–600.0	0	11	10
> 600.1	0	3	1
N =	410	280	110

Most of the *Oreochromis urolepis* landed were sexually immature. Only about 7% of those from the 88 mm mesh gillnets, 24% from the 101 mm nets and 28% from the 114 mm nets were sexually mature. The smallest mature female had a total length of 24 cm.

The fecundity of *O. urolepis* was found to be very high (Table 3).

Table 3. Fecundity of *O. urolepis* according to weight

Weight (g)	**Number of Eggs**
225	667
280	750
300	833
300	1333
310	833
350	1250
370	912
380	1500
400	1417
450	3250

Examination of the stomach contents revealed that *O. urolepis* was a phytoplankton feeder. The diatom *Nitzschia* sp. and blue green algae, *Microcystis* sp. dominated the food items, followed by the diatom, *Navicula* sp. and the green algae, *Merismopedia* sp. *Cosmarium* sp. and *Pediastrum* sp., and the nitrogen fixing blue green algae, *Anabaena* sp. were also present. Since no analysis was done of the intestinal contents, it is difficult to state which of the phytoplankton species was ingested by the fish.

DISCUSSION

Although gillnets of 101 mm stretched mesh size formed the bulk of the legal fishing gears in the reservoir, the illegal beach seines dominate. The beach seines have a mesh size of 63 mm. These beach seines exploit heavily juvenile *Oreochromis urolepis*, a species which seems to spawn in the littoral zone. It is not surprising to find a single haul of a beach seine of less than 30 m long, catching 4,000 juvenile *O. urolepis*. It was learnt that the juvenile cichlids were more profitable than big fish. At the landings, three juvenile *O. urolepis* are sold for Tshs. 10/= when fresh, but the same three fish are bought at Tshs. 100/= at Kyela, Mbeya and Songea. An *O. urolepis* from a 101 mm mesh gillnet is sold at Tshs. 80/= at the beach and at Tshs. 200/= at the outlets. The heavy beach seine fishery in the reservoir may lead to the decline of the *O. urolepis* stocks. Tamatamah and Benno (1997) reported that in 1992 about 10,000 metric tonnes of fish were landed and *O. urolepis* comprised about 71%. With the current fishing practices, it may be possible that the tonnage of fish landed is higher than that reported for 1992. But since it is the juvenile fishes which are heavily exploited, the fishery may collapse in the very near future. In Lakes Victoria and Kyoga, for example, the indigenous tilapiine species, *Oreochromis esculentus* and *O. variabilis*, fisheries collapsed even before the introduction of the predacious *Lates niloticus* (Marten 1979). Overfishing of the stocks was the cause of the collapse (Ogutu-Ohwayo 1990). Similarly, in the Nyumba ya Mungu reservoir in northern Tanzania, its fishery collapsed only two years after reaching its peak of 28,500 tonnes in 1970 (Petr 1975). Like the Mtera reservoir, its fisheries were dependent on tilapiine species. By 1972 the fish landed amounted to only 7,230 tonnes (Petr op.cit.).

Although fish from gillnets with legally allowed mesh sizes were of good table sizes (Tables 1 & 2), most of them were immature. The smallest mature female had a total length of 24 cm, which was only one centimetre longer than that reported for *O. esculentus* in Lake Victoria (Garrod 1958). If the minimum mesh size was raised, the fish could grow to larger sizes.

O. urolepis was found to be a very fecund cichlid species (Table 3). Since the data on fecundity was limited, there is need for further studies. From the number of eggs per female, it is likely that the species guards its eggs.

In the Mtera reservoir, *O. urolepis* was found to feed mostly on phytoplanktons. In the Great Ruaha river, *O. urolepis* was reported to be omnivorous (Petr 1974). The species seems to have changed its feeding habits. Diatoms, green algae and blue green algae were all found in the fish guts. Since no analysis was done on the intestinal contents, it is not known which phytoplankton types are ingested. In Lake Victoria, for example, *O. esculentus* had been reported to digest only diatoms (Fish 1951, Greenwood 1953, Welcome 1966). Blue green and green algae were observed to pass through the gut undigested. Willen (1989) cataloged the phytoplankton species of the Mtera reservoir. Unfortunately the samples were collected using a plankton net. The nannoplanktons may not have been recorded as they would have passed through the plankton net. In the reservoir, plant nutrient levels are high (Chale & Mwaya 1984, Ekstrand et al. 1997). Because of the availability of nutrients it is expected that phytoplankton would be high to sustain high populations of phytoplankton feeding fish.

CONCLUSION

The fisheries of the Mtera Reservoir are not properly managed. Beach seines, whose use in freshwaters is banned through out the country, are the main fishing gears. These catch immature *O. urolepis*, a species which the reservoir's fishery depends on. Even with the gillnets of legal mesh sizes, more than 72% of the tilapias caught were immature. If proper management of the fisheries is not instituted, overfishing is likely to occur. Raising the minimum gillnet mesh size to 127 mm would allow the fish to grow to larger sizes. Since *O. urolepis* is a very fecund species, and since there seems to be enough food in the reservoir in the form of phytoplanktons, the fishery could be sustained for a long time to come if the larger 127 mm mesh size gillnets were to be used instead of the smaller mesh sized nets.

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