The role of reproductive strategies in recovery and success of selected fish species of Lake Victoria,Tanzania.

Chande, A.I. and Mhitu, H.A.
Tanzania Fisheries Research Institute,
P. O. Box 9750, Dar es Salaam

Abstract

Breeding success differs among fish species and within species depending on various aspects including selection of mates, parental care, environmental conditions, clutch size, gonadal maturation and genetic differences in fitness. The present study which started in 1997 investigated factors which favour the reproduction of three fish species, *Lates niloticus, Oreochromis niloticus* and *Schilbe intermedius*. The factors investigated included parental care, clutch size, resource mobilization from the environment and gonadal maturation. The results show that *Oreochromis niloticus* spawns a few eggs about 3,550 in relation to its size (about 57cm in total length). Its success is ensured by being a mouth breeder which is the highest parental care. The other fish species *L. niloticus* and *S. intermedius* have no parental care to the laid eggs but spawn large number of eggs in relation to their sizes. Regarding the gonadal maturation the results show that *L. niloticus* and *S. intermedius* males have shown to attain sexual maturity much earlier than females. This is a strategy to have many mature males to fertilize the eggs of any female which attains sexual maturity.

Key words: Reproduction, Strategies, Brooding, Clutch, Maturity

Introduction

Differences in the reproductive strategies of different sexes may ultimately be consequences of the relative gamete sizes of females and males (Williams, 1975; Dawkins, 1976). Reproduction is a complex process both to the parent stock and the offspring. It is assumed that reproduction is associated with the subsequent survival of the parent and its future reproductive performance (Calow, 1979). Normally there is an inverse relationship between clutch size and egg size, that is for a given reproductive output, a female could produce a few large eggs or many small ones. However, individuals with large amounts of reproductive resources may produce both larger eggs and larger clutches than those with a smaller total reproductive output.

Determining the strategies of reproduction of a species is important because it forms an integral part of the description of its biology. This is the case because the number and timing of spawning during a year may affect their recruitment and consequently many interactions. The present decline of biodiversity in Lake Victoria have been attributed to various reasons apart from environmental changes and overfishing. The success or decline of species in Lake Victoria could be associated with differences in reproductive tacts.

The Present study investigated the role played by different reproductive strategies which lead to the success of *Lates niloticus* and recovery of *Schilbe intermedius* and *Oreochromis niloticus* in Lake Victoria, Tanzania.

Materials and methods

Sample Collection

Samples of *L. niloticus* and *Schilbe intermedius* were obtained from Speke gulf while those of *Oreochromis niloticus* were obtained from EminPasha gulf (Fig. 1). Samples were collected using a stern trawler R.V. TAFIRI II with 150 HP operating a trawl net of 30mm cod end. Sampling concentrated in inshore waters of depths ranging between 3 and 20 metres. Each trawl operation took 30 minutes, on retrieval of the net the target fish species were randomly picked including all size ranges for examination of parental care, clutch size, gonadal maturation and food items taken. A total of 50 individuals for each species were examined. Sampling was carried out in March, July and December 2000.

Data Collection

After taking individual length and weight the following parameters were examined; Maturity status according to Hopson (1972) for *L. niloticus* and modified from Hopson (1972) for *Oreochromis niloticus* and *Schilbe intermedius*. The maturity status gave the size at first maturity. The variety of food items taken was also investigated. Another aspect investigated was the clutch size (fecundity). Ripe ovaries were collected and preserved in 10% formaldehyde. In the laboratory a pair of ovaries were weighed to get the total weight. Then sub sample weights of 0.01g for *L. niloticus* and 0.1g for *O. niloticus* and *S. intermedius.* Were taken in triplicates from which the sample number was obtained. The total number of eggs was calculated from which the sample number was obtained. The total number of eggs was calculated from the following equation:

$$F = \frac{OW}{SW} \times SN \qquad (1)$$

Where: F = fecundity
OW = total ovary weight
SW = ovary sample weight
SN = the number of eggs from the sample.

The parental care of the fish species was obtained from the available literature.

Results

Parental care and Clutch size

Two types of parental care exist, namely *Oreochromis niloticus* is a mouth brooder while *L. niloticus* and *S. intermedius* spawn in open waters. Regarding the clutch size the results show that *Lates niloticus* ranging from 81.0 to 153.0 cm produced eggs ranging from 800,000 to 17,336,000 with a mean diameter of about 0.51 $\pm$ 0.1mm. *Oreochromis niloticus* of about 26.8 – 56.0 cm had eggs ranging between 1,240 and 6,600 with a diameter of about 2.2 $\pm$ 0.39mm. *Schilbe intermedius* of about 11.0 – 34.0 cm produced eggs ranging between 2,770 and 10,500 with a mean diameter of 1.0 $\pm$ 0.1mm.

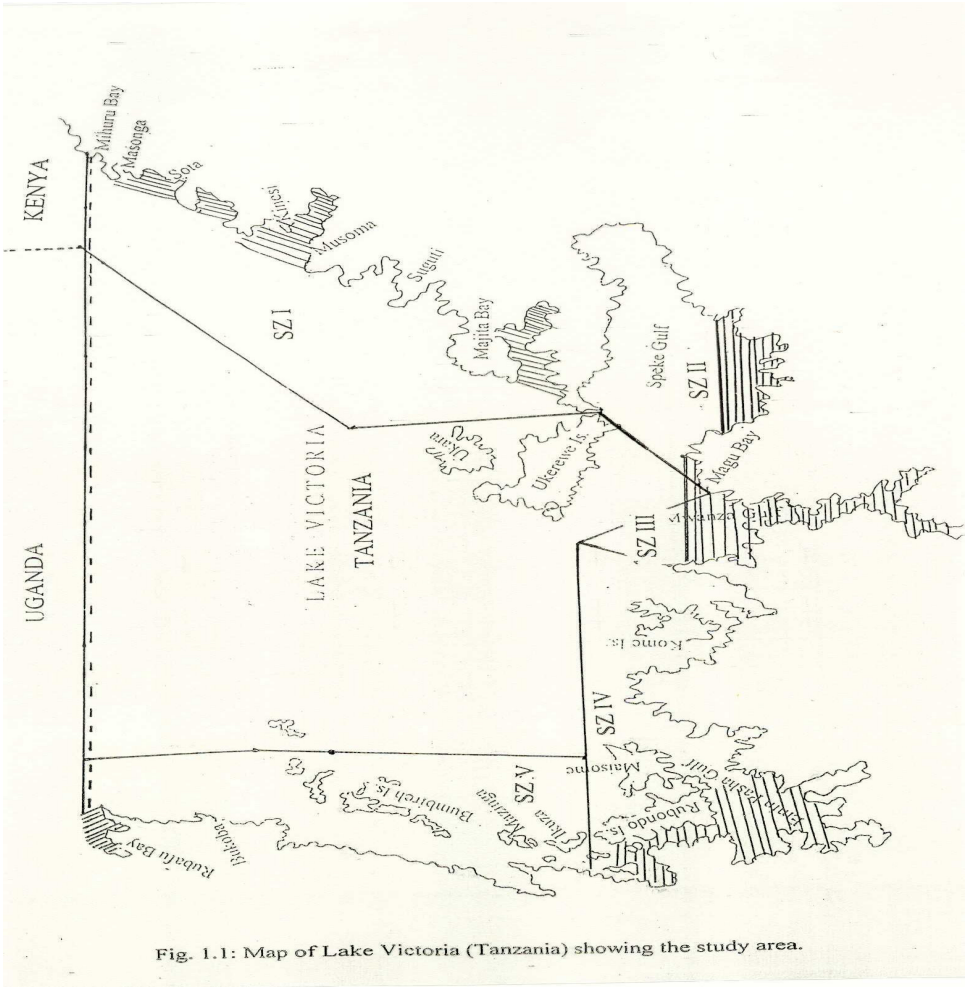

Fig. 1.1: Map of Lake Victoria (Tanzania) showing the study area.

3.1 Environmental factors

The foraging ability on various food resources is the most important environmental factor influencing reproductive ability. Table 1 shows the different food items taken by the fish species. It can be seen that, *Lates niloticus* is exclusively carnivorous feeding on a variety of food items including *Caridina nilotica*, *Haplochromis* species, *Rastrineobola argentea*, insect larvae, fish species, gastropods and worms. Cannibalism was also evident in *L. niloticus. Schilbe intermedius* fed on *Haplochromis* species, *Caridina nilotica*, fish and other invertebrates. *Oreochromis niloticus* fed on phytoplankton, detritus materials and *Caridina nilotica.*

Table 1: Food items consumed by different fish species from Lake Victoria, Tanzania

	FISH SPECIES		
Food items	L. niloticus	S. intermedius	O. niloticus

Caridina	X	X	X
Haplochromis spp.	X	X	
R. argentea	X		
Fish remains	X	X	
Insect larvae	X	X	
Gastropod	X		
Worms	X		
Phytoplankton			X
Detritus			X
Cannibalism	X		

X = Food item present

Size at First Maturity

The size at first maturity of *Shilbe intermedius* is presented in Fig. 2. The results show that males reached sexual maturity at a smaller size (18.0 cm) than females (22.0 cm). Male *L. niloticus* also reached sexual maturity at a smaller size (67.0 cm) than females (95.0 cm) as presented in Fig. 3.

Discussion

Parental Care and Clutch Size

The parental care was higher in *Oreochromis niloticus* as a mouth brooder which increases the chances of hatching the eggs. The number of eggs produced could depend on the size of the individual, size of the eggs and nature of the parental care. The big clutch size of *L. niloticus* and *S. intermedius* with small eggs (0.51mm and 1.0 mm in diameter respectively) is an adaptation to the hash environment to which the eggs are exposed to without any parental care (Bayne *et al.*, 1983). Under such environment the eggs suffer from predation, fungal infection and suffocation in stagnant water (Avyle, van Den, 1984). *Oreochromis niloticus* produces a small number of eggs which are large with an average diameter of 2.2mm because there is a high parental care. Generally brood size decreases with an increase in offspring survival (Morris, 1987).

Environmental Factors

The results show that *L niloticus* has high range of foraging ability taking many food items and occupying different niches. Basically *Lates niloticus* is a bottom dwelling species but it has been reported that it also stays and forages in the pelagic environment. This phenomenon is probably related to the fact that the fish has a relatively high demand for oxygen (Fish, 1956). As such *Lates niloticus* has enough or surplus energy source for reproduction, this is quite common in long lived species (Ware, 1984).

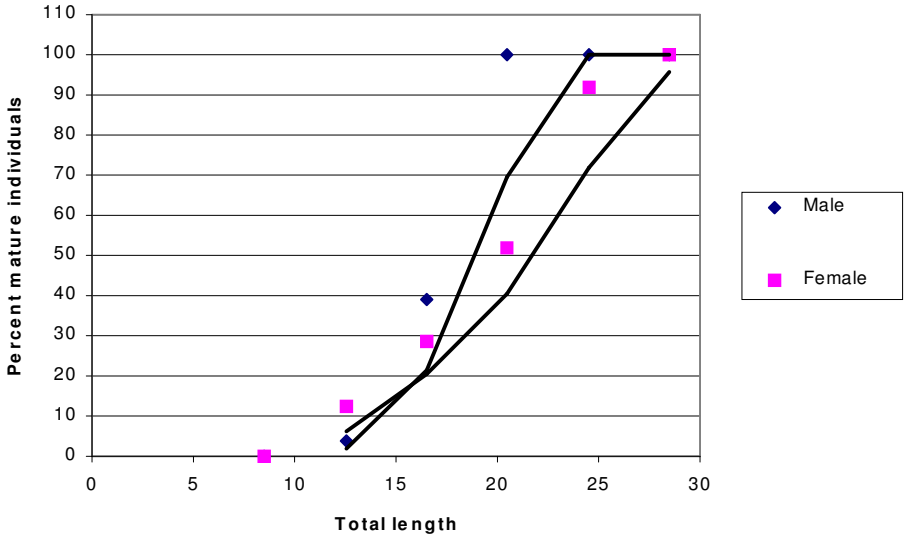

Figure 2: Size at first maturity of *Schilbe intermedius* of Tanzania waters from Lake Victoria during 2000.

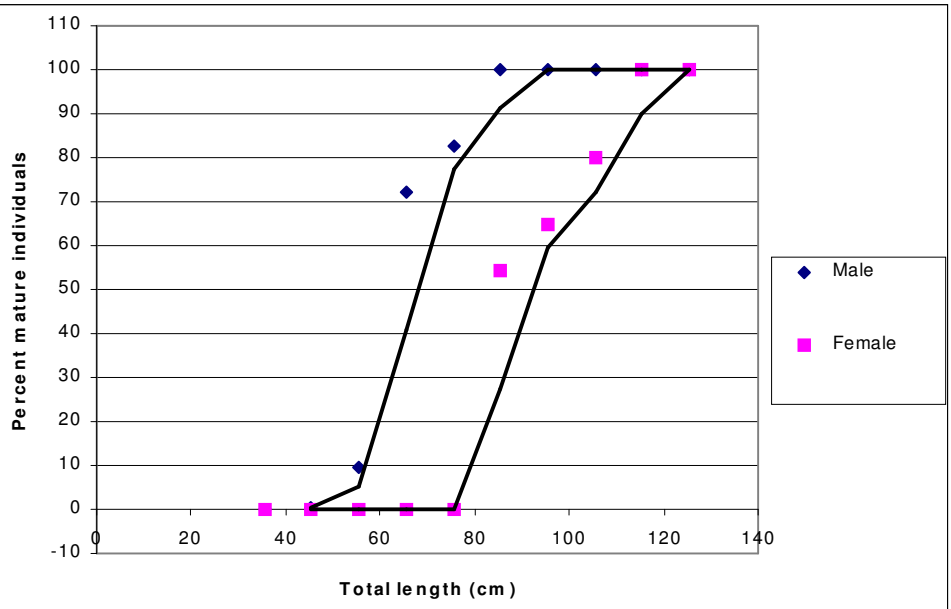

Figure 3: Size at first maturity of *L. niloticus* of Tanzania waters from Lake Victoria

The fact that the fish practices cannibalism also becomes a reproductive strategy. Cannibalism minimizes time spent foraging and maximizes time spent on activities that increase the probability of initiating and successfully completing one or more reproductive cycles (Hyatt and Ringler, 1989). Although the benefits of cannibalism are most obvious for populations breeding under conditions where food supplies limit their potential reproductive output, the benefits may still apply even under conditions where alternative prey sources appear to be abundant (Hyatt and Ringler, 1989). The importance of food sources in reproduction lies on gamete production (MacDonald and Thompson, 1985). Normally brood size increases with an increase in energy investment (Morris, 1987).

The recovery of *S. intermedius* in the environment could also be a result of its ability to forage on a variety of food items. Probably this has enabled it avoid from being preyed upon by *L niloticus* by occupying different ecological niches at times.

Size at First Maturity

The results show that male *L. niloticus* and *S. intermedius* reached gonadal maturity at a smaller size than females. This could be a reproductive strategy, to have many mature males to fertilize the eggs of any female which attains sexual maturity. Males determine the breeding success and normally they are very variable (Howard, 1979).

Conclussion and recommendation

Food source for the fish species are found to be very important in improving the reproductive output. Since *L. niloticus* and *S. intermedius* forage on many fish species including juveniles it is recommended that a closure system of the habitats and time be imposed in the bays to reduce fishing pressure. This would in turn provide enough prey items to the predators.

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