Observations on Gillnet Catches of Kariba Tilapia, *Oreochromis mortimeri*, from Bumi Basin of Lake Kariba, Zimbabwe

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Abstract

Gillnet catches of *Oreochromis mortimeri* (Trewavas) were studied in the Bumi Basin of Lake Kariba in 1988 and 1989. Total length (TL) was positively correlated with standard length (SL). The linear relationship between TL and SL was TL=1.91 + 1.22 · SL (r^2=0.982). The relationship between SL and weight in g (W) was of the form W = 0.12 $SL^{2.67}$. Maximum standard length (L_{max}) was 33 cm and asymptotic length (L_∞) was 34.7 cm. Monthly ratios of male to female varied between 0.6:1 and 13:1. The mean ratio was 57.4% male: 42.6% female. Monthly condition factors varied between 3.19 and 5.11 in males, and between 3.18 and 5.14 in females. Catches were higher in 1989 compared to 1988 and possible reasons for these differences are discussed.

Introduction

The Kariba tilapia, *Oreochromis mortimeri* (Trewavas 1966), is important for the artisanal gillnet fishery in Lake Kariba. In a number of fishing areas, the species constitutes more than 18% by weight of the total annual landings. This species has been studied in specific areas of the lake by other authors (Balon and Coche 1974; Mabaye 1994). This report is based on gillnet studies that were carried out in the Bumi/Matusadonha area (Bumi Basin) of Lake Kariba (Fig. 1).

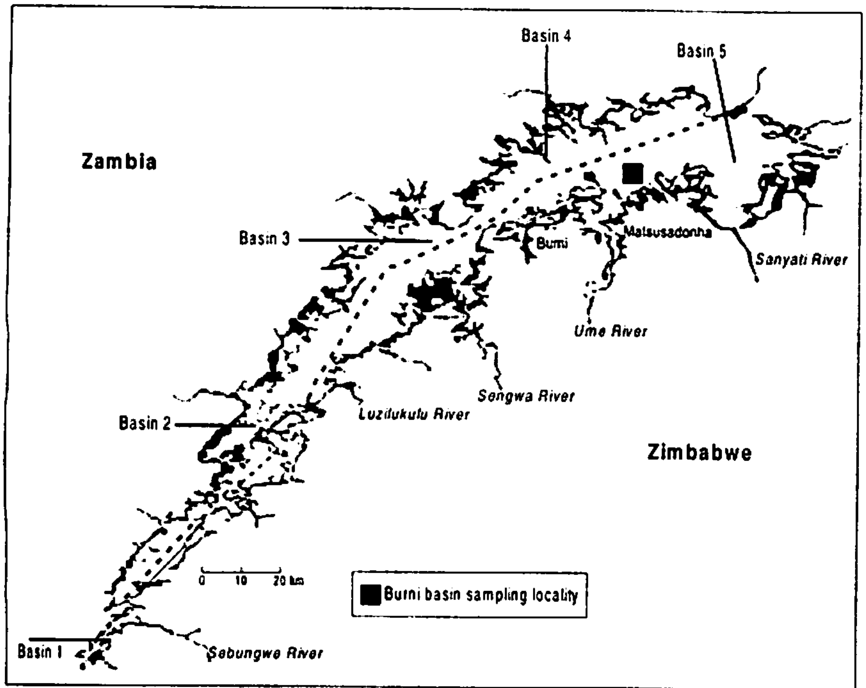

Fig. 1. Map of Lake Kariba showing different hydrological basins. The sampling location is indicated.

The objectives of this study were to determine: (a) the total length/standard length (TL/SL) and the length-weight relationship; (b) the monthly sex ratios and condition factors; and (c) the monthly catch and catch per unit of effort (CPUE).

Materials and Methods

Lake Kariba is a man-made reservoir created in 1958 by the damming of the Zambezi River at the Kariba Gorge. The lake has a length of 240 km, a mean width of 40 km and a mean depth of 29 metres (Balon and Coche 1974). The lake has five distinct hydrological basins (Fig. 1). There is a gradual change in the hydrology of the basins; Basin 1 being the most riverine while Basin 5, the most lacustrine. The current study was carried out in the Bumi Basin (Basin 4). Five stations were sampled; four stations were located in the littoral zone of the lake while the fifth station was on the Ume River.

Sampling was conducted on a monthly basis from May 1988 to November 1989. In 1989, there was no sampling in February, March and April. Sampling was carried out using multifilament gillnets with stretched mesh sizes of 54, 70, 76, 89, 102 and 127 mm. The 70 mm gillnet was used from January 1989 to June 1989. In all the other months, it was replaced by the 76 mm gillnet. Each station was sampled twice in each month. The nets were set overnight. The water depth in the areas in which the nets were set did not exceed 18 m. In the evening, the nets were set between 1600 h and 1800 h and were lifted between 0600 hours and 0730 hours the next morning.

Data collected for each individual fish included TL, SL, wet (ungutted) weight (g), sex and gonad (maturity) stage.

The Lotus 123 regression routine was used in the computation of the TL-SL relationship, the SL-W relationship and condition factor. The condition factor (cf) was determined using the equation:

$$cf = (100 \cdot W)/SL^3. \quad ...1)$$

Results

SL was positively correlated to total length. The Spearman rank correlation (for nonparametric data) had a coefficient of determination of 0.989 (n=487). SL was related to TL according to the formula:

$$TL = 1.91 + 1.22 \cdot SL$$
$$(n=485 \text{ and } r^2 = 0.982) \quad ...2)$$

The ratio of TL to SL was 1.313. The TL/SL ratio obtained in this study is different from that reported by Torres (1992). Using data from studies carried out in Lake Kariba, Torres obtained a ratio of 1.284. The difference is probably due to the significant difference in sample sizes. The sample size for the current study was 485, compared to 10 in the Torres study. It is noted that there were different study areas, and hence spatial variation could also be a factor in the observed differences.

The SL-W relationship (both males and females combined) was of the form:

$$W = 0.12\ SL^{2.67}\ (n=485) \quad ...3)$$

The value of the exponent b in the SL-W relationship in this study is lower than the 3.06 reported by Torres. There are a number of possible reasons for these differences. In this study, the range of gillnet mesh sizes was relatively limited and hence the gear may have selected against both very large and very small fish. The absence of very large and very small fish has a direct influence on the slope of the regression line. Another possible reason is that since the studies were conducted in different localities and in different years, there are likely to be differences due to temporal and spatial variations.

The smallest fish caught in the 54 mm mesh had a TL of 12.5 cm and a SL of 9.5 cm and it weighed 40 g. In the 102 mm mesh, the smallest fish caught had a TL of 21.3 cm, SL of 16.0 cm, and a wet weight of 144 g. The largest fish caught had a SL of 33 cm (L_{max}). Taylor (1958 cited in Pauly 1984) noted that to estimate asymptotic length (L_∞), the equation:

$$L_\infty \approx L_{max}/0.95 \quad ...4)$$

can be used as a rough rule of thumb. From the above equation, the asymptotic length (L_∞) was 34.7 cm.

The monthly cf for males and females from May 1988 to November 1989 is presented in Fig. 2. Variations in the monthly cf within each sex group are probably linked to factors such as food availability and breeding activity. Lake Kariba is oligotrophic and highly dependent on inflow of nutrients from the catchment so availability of food will vary during the year. During the months when availability is limited, the fish are likely to have a lower cf.

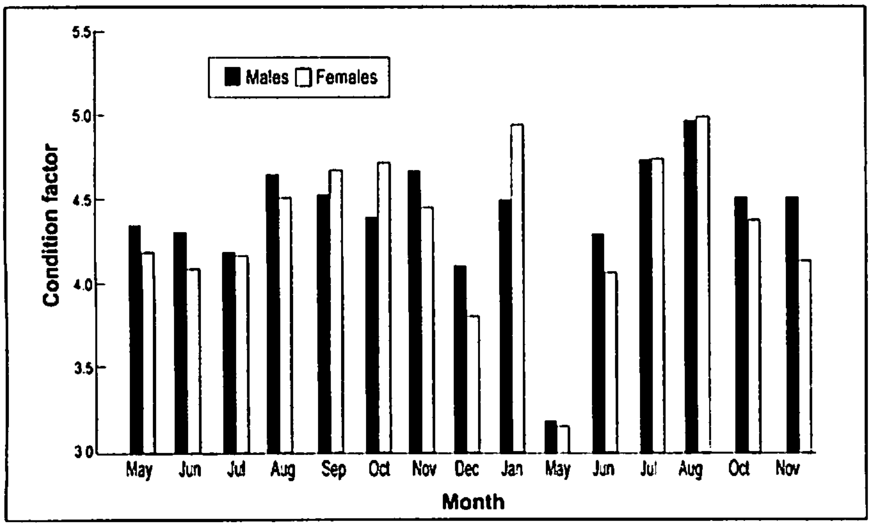

Fig. 2. Monthly condition factor of O. mortimeri from May to November 1989.

The difference in condition between males and females is likely to be related to breeding behavior. Females channel a lot of their stored energy towards gonadal development (egg production). When the eggs are finally released from the body, the female loses a lot of weight. Males lose comparatively less energy when they release milt, and hence they are likely to be in better condition than females during the same period. Differences in the accumulation of fat deposits in the body between males and females could also be a contributing factor. A study of body composition could confirm whether this factor is significant.

Females were shown to be in better condition during certain months. It is probable that prior to the onset of breeding, the females build up their energy reserves more than the males and hence are in better condition than the males during those few months of the year. No distinct trend was observed in the inter-annual variation in cf. The variations may have been masked due to the fact that the fish were from different sites. Cichlids are known to be fairly sedentary. Mabaye (1994) noted that the maximum distance covered by *Tilapia rendalli* and *Serranochromis (Sargochromis) codringtonii* in the eastern basin of Lake Kariba was 4 km.

The monthly sex composition is illustrated in Fig. 3. Table 1 summarizes the monthly sex ratio. The monthly sample size in 1988 was quite small (less than 10 most months). Consequently, the sex ratios may be biased due to this factor.

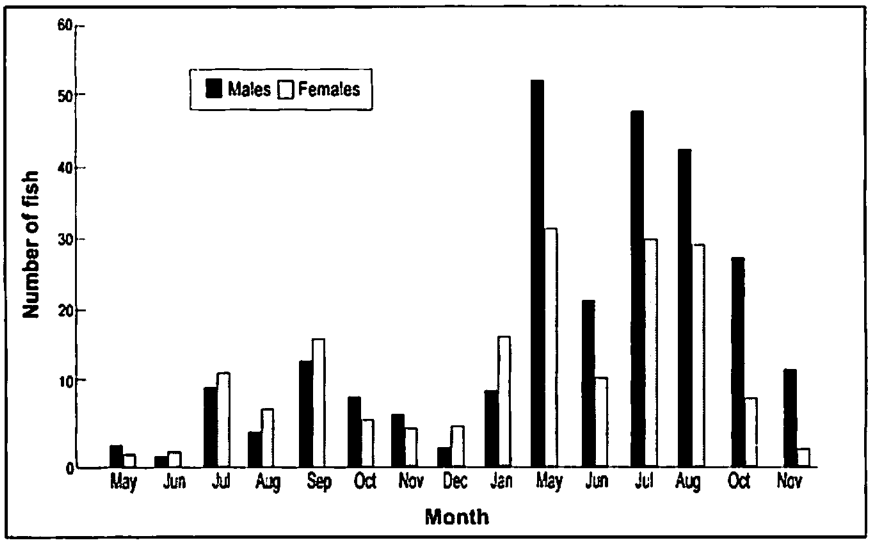

Fig. 3. Monthly sex composition of O. mortimeri *from May 1988 to November 1989.*

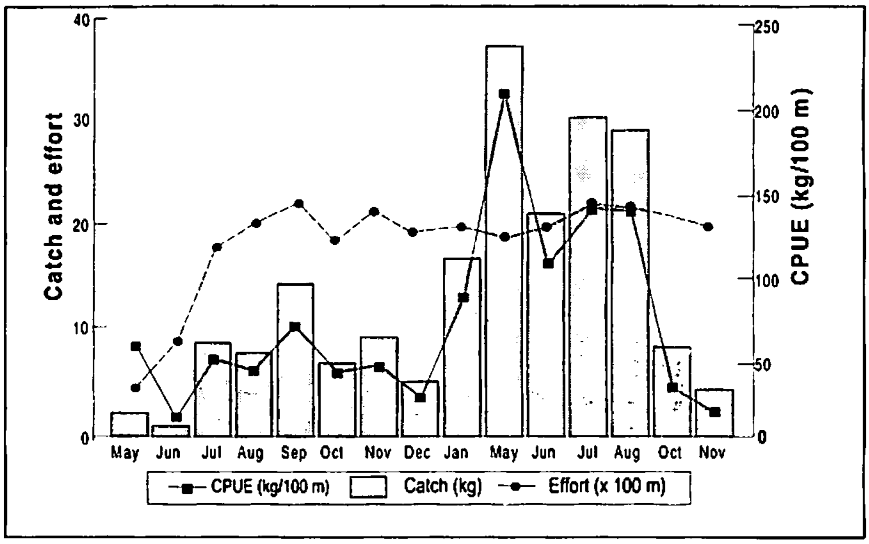

Fig. 4. Monthly catch and effort and CPUE of O. mortimeri *in Bumi Basin, Lake Kariba, from May 1988 to November 1989.*

Data on fish observed to be in the breeding stage (i.e., gonads either having well-developed eggs or full of milt) is presented in Table 2. In this study, the fish showed signs of sexual maturity when they reached a SL of about 18 cm. The data set in this study was inadequate for the determination of peak breeding seasons. However, some breeding activity was observed in the period from July to December in 1988. During 1989, breeding activity was only observed in January and May. In a study of *O. mortimeri* from the Sinazongwe area of Lake Kariba, 60% of the fish caught during the months of January, March, August, November and December were in the breeding state (Uchida, unpublished report).

The monthly catch and effort and CPUE were also studied as

Table 1. Monthly sex ratio of O. mortimeri.

	1988								1989						
Month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	May	Jun	Jul	Aug	Oct	Nov
Ratio (M:F)	1.5:1	1:1	1:1	0.6:1	0.8:1	13:1	1.4:1	0.5:1	0.6:1	1.6:1	1.8:1	1.6:1	1.5:1	3:1	4.7:1
Sample size	5	4	26	13	23	14	17	9	30	87	37	82	76	40	17

Table 2. Length and weight data for fish in the breeding stage.

Total length (cm)	35	34.1	36.6	33.5	33.5	36.2	29	27
Standard length (cm)	28	26.4	28.2	26.4	26.4	28	23	23.1
Sex	M	M	M	F	M	F	M	F
Weight (g)	1 000	500	800	300	780	1 000	580	435

shown in Fig. 4. Monthly catches showed marked variations, although apart from the first two months of sampling, there was not much variation in effort. The monthly CPUE fluctuated considerably. In 1989, the total catches (by weight) in May, June, July and August were much higher than those in 1988 during the same period.

It can be observed from Fig. 5 that fewer fish were caught each month in 1988 than in the same months in 1989. The monthly mean weights were lower in 1988 than in 1989 partly because of the small sample sizes in 1988.

The low catches in 1988 may have been a result of poor recruitment due to adverse environmental conditions. Karenge and Kolding (1993) reported that there was a strong correlation (r=0.772) between the change in lake level and the recruitment of *O. mortimeri*. The mean annual lake level between 1986 and 1988 had dropped to about 479 m above sea level (a.s.l.). However, by 1989, it had risen to 482 m a.s.l. (Karenge and Kolding 1993). Since the species inhabits littoral areas, the marked lake level fluctuations have a large impact on the availability of food and nursery sites. A rise in lake level results in flooding of vegetation on the lakeshore, thereby providing food as well as shelter from predators. This in turn may lead to increased recruitment.

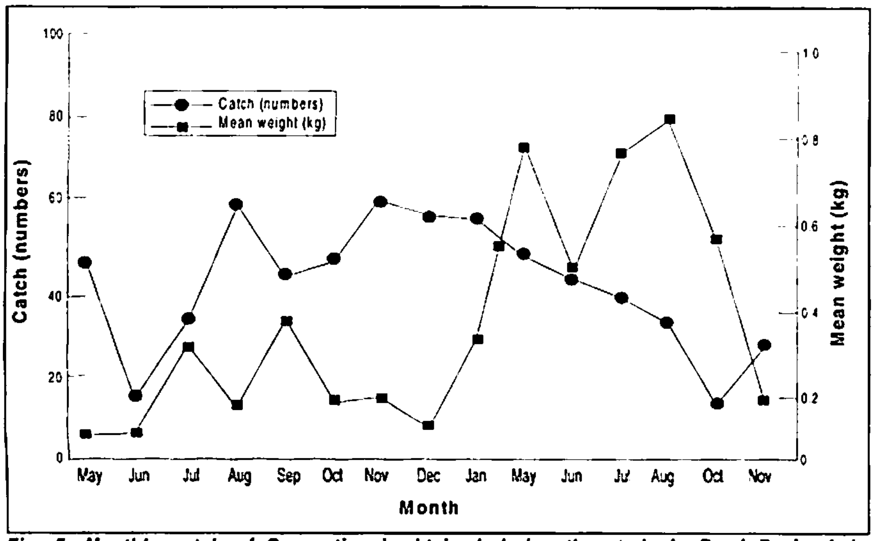

Fig. 5. Monthly catch of O. mortimeri obtained during the study in Bumi Basin, Lake Kariba, from May 1988 to November 1989.

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