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STUDIES ON THE GROWTH AND REPRODUCTION IN THE CICHLID *Oreochromis niloticus* (LINNAEUS, 1757) IN A EARTHERN POND*.

(Estudos do crescimento e reprodução no ciclídeo *Oreochromis niloticus* (Linnaeus, 1757) em tanques de terra.)

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ABSTRACT

A total of 1,300 figerlings of *O. niloticus*, 3 months old, were stocked in a fertilized earthern pond of 1,300 m^2 at Pindamonhangaba Fish Culture Station – S. Paulo, Brazil. During the experiment period, a total of 478 fish were measured, weighed and dissected to record their sex and stage of maturity. The biometric relationships, the growth and maturation curves and the condition factor were analysed and related with water temperature. The growth in males is faster than in females and is directly related with the water temperature. The maximum spawning activity extends from September to November and there are more than one spawning action in a season. The weight of the ovaries produce significant changes in the condition factor, and this obervation suggests that, as the difference between the condition factor estimated with (K_I) and without (K_{II}) the weight of the ovaries ($K = K_I - K_{II}$) indicates the "gonad condition", and can be used as a maturity and breeding season index.

KEY-WORDS: Fish-cichlids, tilápia nilotica, growth, reproduction.

RESUMO

Um total de 1.300 alevinos de *O. niloticus*, com 3 meses de idade, foi estocado em um tanque de terra fertilizado, de 1.300m^2, na Estação de Piscicultura de Pindamonhangaba, São Paulo, Brasil. De 478 exemplares amostrados foram obtidas as medidas corporais (comprimento total, comprimento padrão, comprimento da cabeça e altura do corpo), pesados e dissecados para identificação do sexo e do estádio de maturação gonadal. Relações biométricas, as curvas de crescimento, curva de maturação e fator de condição, foram analisados e relacionados com a temperatura da água. O crescimento dos machos é superior ao das fêmeas e influenciado diretamente pela temperatura da água. O período mais intenso de reprodução se estende de setembro a novembro, apresentando a espécie, desova do tipo parcelada. O peso dos ovários provoca variações no fator de condição, de tal modo que a diferença entre os valores do fator de condição, estimados com e sem a influência do peso dos ovários, pode ser empregada na determinação do período de reprodução da espécie.

PALAVRAS-CHAVE: Peixe, tilápia nilótica, crescimento, reprodução.

1. INTRODUCTION

Tilapia is a freshwater fish of a very large family Cichlidae abouding in Africa including Madagascar and extending to Syria, India and Ceylon in Asia. It is known also in central and South America. It is a prolific fish that reaches your first maturity when at one year of age. Tilapia is an important source of food protein for Egyptians. It is abound in large quantities in the Nile River, its tributaries and in the Nile Delta Lakes. This Specie provides about 70% of the total fish production in Egypt, i.e. around 2400 tons are caught annually in Egypt (EL-ZARKA et alii, 1970a.).

The rearing of fish, specially of Tilapia species, is one of the ways to increase food production for a more constant higher demand

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due to increasing human population. With this scope, *Oreochromis niloticus* and *O. homorum* were introduced in Northeastern Brazilian region in 1971 (LOVSHIN, 1975).

In Pindamonhangaba Fish Culture Research Station, São Paulo, Brazil, a program of aquaculturel research with those species has been in progress since 1979, in order to develop adequate culture systems to the Southeast region in Brazil.

The present paper is restricted to the study of the growth and reproduction in the cichlid *O. niloticus* in a earthern pond. The biometric relationships, the growth and maturation curves and the condition factor were analysed and related with water temperature. Age and growth are extremely important in the pratical fishery for solving such biological informations as longevity, age at first maturity, catchable size, environmental suitability and other life history problems.

2. MATERIAL AND METHODS

The *O. niloticus* fishes used in this experiment were approximately 3 months old. They were produced in breeding ponds during the months of November/December of 1979. In February of 1980, when the fish were stocked, they averaged 14.4 g and 9,4 cm each.

A fertilized earthern pond of 1,300 m^2, with about one meter deep, was stocked at rate of 1.0 fish per square meter. In addition, the animals were fed a supplemental pelleted fish food, at 1% of the total fish body weight. Feeding rate was recalculated each month, based on fish sampling. During the period of one year, samples were taken at intervals of fifteen days. A total of 478 fishes (258 males and 220 females) were measured: total length (L_t), standard length (L_S), length of the head (L_H), body heigth (H) and weighed (W_t). The fish were dissected to record their sexes. Then, the ovaries were weighed (W_g) and classified according to the shape, colour, transparency, texture and the presence of apparent oocytes at naked eye.

The total length and weight frequency distributions were bimonthly plotted and the average gain in length and weight were monthly plotted, for both sexes. The morphological features: total weight, standard length, length of the head and body height, were studied in proportions of the total length by regression analysis. The Student's t-test at the 5% level of significance ($p < 0.05$) was used to compare those relationships between sexes.

The gonosomatic index (GSI) for each female was calculated as the weight of the ovaries relative to the total body weight, expressed as a percentage. The maturation curve was obtained by the monthly mean values on the gonosomatic index distribution.

The condition factor (K_I) for each female was calculated using the equation:

$$KI = \frac{W_t}{L_t^b} \cdot 100$$

where b is the exponent of the length/weight relationship.

In order to exclude the influence of the ovaries weight, the condition factor (K_{II}) was calculated by:

$$K_{II} = \frac{W_t - W_g}{L_t^b} \cdot 100$$

Finally, monthly mean values fluctuations on the condition factor were estimated with and without ovaries weight (K_I and K_{II}), and on the ΔK values.

3. RESULTS AND DISCUSSION

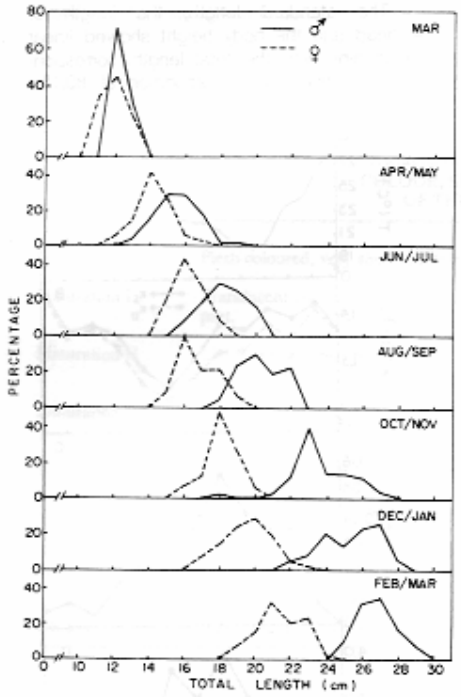

FIGURE 1 –Length frequency distribution of *O. niloticus*.

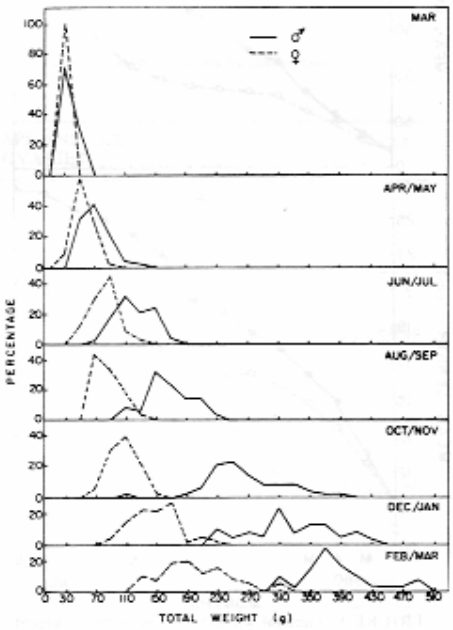

FIGURE – Weight frequency distribution of *O. niloticus*.

The total length and weight distributions (FIGURES 1 and 2) and the general growth curves (FIGURES 3A and 3B) shows that the growth in males is faster than females. The average final length and body weight were 21.7 cm and 213.7 g for females, and 26.8 cm and 388.4 g for males, respectively. These curves also indicate that the growth may be related to water temperature (FIGURE 4A), reflecting hydrological condition, as it is suggested by EL-ZARKA et alii (1970a) for *T. nilotica* in lake Mariut. In the period from June to August, when pond water temperature decreased, there was practically no increment in growth. On the other hand, when the temperature increased (from September to February) fish growth attained their maximum values.

Due to the poor growth during the cool season (June to August), it is not possible to calculate a von Bertalanffy growth curve following the methods outlined by RICKER (1958). The poor rate of growth for females extends until November, and may be also associated with the onset of maturity, which often causes a discontinuity in the growth curve (BEVERTON & HOLT, 1957).

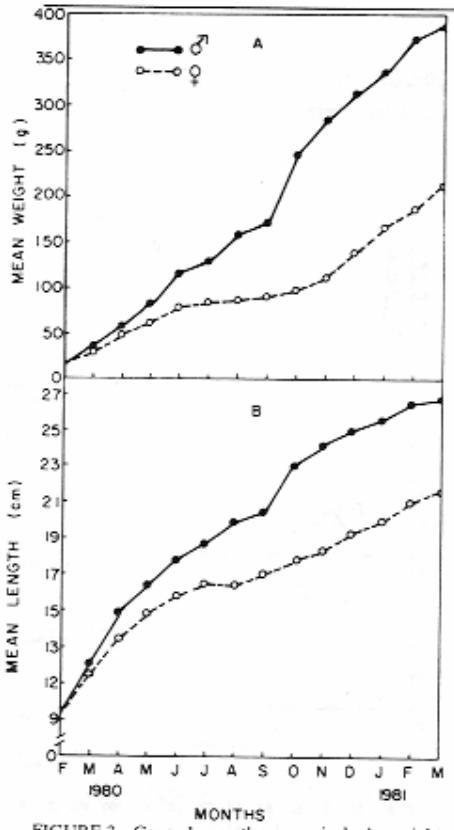

FIGURE 3 - General growth curves in body weight (A) and in total length (B) of *O. niloticus*.

The results of the regression analysis for the morphological features are expressed by the following equations:

MALE	FEMALE
$W_t = 0.0139 \cdot L_t^{3.11}$	$W_t = 0.0147 \cdot L_t^{3.09}$
$L_S = 0.801 \cdot L_t$	$L_S = 0.805 \cdot L_t$
$L_H = 0.261 \cdot L_t$	$L_H = 0.272 \cdot L_t$
$H = 0.331 \cdot L_t$	$H = 0.319 \cdot L_t$

The length/weight regression coefficients for males (3.11) and females (3.09) did not differ statistically and were close to the cube, as found by EL-ZARKA et alii (1970a) for *T. nilotica* and by SIDDIQUI (1977) for *T. leucosticta*. For *T. zilli*, DADZIE & WANGILA (1980) did not find different values for this coefficient between the sexes, but they were not close to the cube.

The standard length, the length of the head and the body height showed linear relationships with the total length, corresponding, respectively, to the proportion of 80.1%,

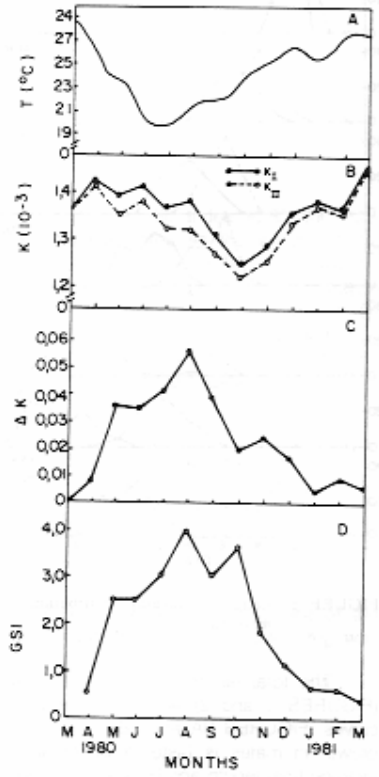

FIGURE 4 - A. Monthly variation of the water temperature.
B. Monthly variation of the mean condition factor values (K_I and K_{II}).
C. Monthly variation of the ΔK values ($\Delta K = K_I - K_{II}$).
D. Monthly variation of the mean gonosomatic index values (GSI).

26.1% and 33.1% of the fish total length for males and 80.5%, 27.2% and 31.9% for females. Statistical differences were found between sexes for the length of the head and for the body height, indicating that males are significatively higher than females.

Based on the macroscopic characteristics of the ovaries, eight maturation stages could be identified: Immature, Maturation I, Maturation II, Maturation III, Ripe, Spawning, Spent and Resting. The characteristic features of each stage are described in TABLE 1.

TABLE 1
Distinctive features of the ovaries of *O. niloticus* at different stages of gonadal maturation.

MATURITY STAGES	COLOUR, SHAPE AND SIZE OF THE OVARIES	GSI±s
Immature	Flesh coloured, very small and thin.	---
Maturation I	Translucent and elongated, a few small white oocytes visible in the median part.	0.26±0.11
Maturation II	Light yellow, enlarged, poorly vascularized, numerous small oocytes of uniform sizes.	1:31±0:48
Maturation III	Bright yellow with an orange hue, enlarged, numerous oocytes of different sizes.	3:17±0.55
Ripe	Greenish-yellow, larger and richly vascularized, distinct oocytes visible.	4.38±0.77
Spawning	Orange hue, flaccid, partially reduced in size due to release of ripen oocytes.	3.16±0.50
Spent	Hemorrhagic, flaccid, shrunken, small cream-coloured, oocytes and some with an orange hue.	1.17±0.25
Resting	Flesh coloured, no oocytes visible.	0.29±0.12

The maturation curve for females (FIGURE 4D) shows seasonal variation of the gonosomatic index. With the advancement of maturation, marked increases in GSI were observed. The highest values occurred in August and October. So, there is evidence that *O. niloticus* reaches its sexual maturity before the first year of life and the spawning season extends from August to December, when the water temperature is increasing (FIGURE 4A). EL ZARKA et alii (1970b) demonstrated that spawning for *T. nilotica* in lake Mariut, seems to be controlled by temperature. Our results and the identification of the Spawning stage, indicates that there are more than one spawning action in a season, with maximum activity from September to November.

The monthly mean values of the condition factor (K_I and K_{II}) are illustrated in the FIGURE 4B. Fluctuations in these values seem to have a particular trend: higher values in a period before the spawning season, decreasing during the spawning time and increasing just after this season.

The ΔK ($K_I - K_{II}$) values fluctuations are showed in FIGURE 4C. Although K_I and K_{II} have a similar evolution there are periods in which ΔK attains higher values (before the spawning season) and decreases continuosly during the spawning period and after the spawning season.

The weight of the ovaries produced significant increase in the condition factor during the prespawning period, demonstrated by the

maximal values of ΔK; on the other hand, minimal values of ΔK were observed in the post spawning period (FIGURE 4C). These observations suggest that, as ΔK estimates the "gonad condition" in *O. niloticus*, it can be used as a maturity and breeding season index. In opposition to the observation recorded in this paper, SIDDIQUI (1977) reported that *T. leucosticta* spawns continuously and no seasonal variation in relative condition could be expected.

4. CONCLUSIONS

The conclusion derived from this study with *O. niloticus* are:

– the growth in males is faster than in females and is directly related with water temperature.

– eight maturation stages could be identified: Immature, Maturation I, Maturation II, Maturation III, Ripe, Spawning, Spent and Resting;

– the maturation curve is directly related with water temperature and the maximum spawning activity extends from September to November;

– there are more than one spawning action in a season;

– the condition factor shows a seasonal fluctuation and the weight of the ovaries weight play an important role in this factor, indicated by the "gonad condition" and estimated by the ΔK values, used as a maturity and breeding season index.

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