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AGE, GROWTH AND REPRODUCTION OF *Tilapia rendalli* (BOULENGER, 1896) (OSTEICHTHYES, CICHILIDAE) IN THE MONJOLINHO RESERVOIR, SÃO PAULO STATE, BRAZIL[1]

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1. INTRODUCTION

Tilapia rendalli (Boulenger, 1896) at first named *Tilapia melanopleura* (Dumeril, 1859), was brought from Africa to Brazil in 1953 and because of it great adaptative capacity this species is widely distributed in Brazil. It was introduced in the Monjolinho Reservoir at the end of the 1960 decade.

The purpose of the present investigation is to determine the growth, the spawning period and the first sexual maturation size of *Tilapia rendalli* from the Monjolinho Reservoir, as a contribution to knowledge of the biology of this fish.

2. MATERIAL AND METHODS

A total of 1,089 specimens (591 males and 498 females) were collected fortnighly at the Monjolinho Reservoir during a period of one year. All the fish were analyzed for the following parameter: total length (L_t) in mm; total weight (W_t) in g; gonad weight (W_g) in g, and gonadal maturation stage, defined by the macroscopic aspects (size, colour, presence and egg size, etc.) as: Stage I — immature or virgin; Stage II — maturing; Stage III — mature and Stage IV — spent.

Five to six scales were collected near the opercule from each specimen and prepared by the method of VAN OOSTEN (*13*).

The spawning time was determined by the maturation curve based on the mean monthly variation of the gonadosomatic index (Ig).

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The growth was determined by the time annuli formation on scales, obtained by plotting the distribution of the average length of the specimens with the same number of annuli against collection time. The growth curve in length was established using the mathematical expression of BERTALANFFY (*2*) and confirmed by the Ford-Walford transformation (*14*).

The length/weight relationship was established by the expression:

$\overline{W}_t = \phi L_t^{\Theta}$, where ϕ = condition factor related to individual fatness, and Θ = constant related to individual growth type.

Once the expressions for the growth curve in lenght and the weight/length relationship were known, the growth curve in weight was determined by the deductive method:

$W_t = W_\infty (1-e^{-kt})^{\Theta}$, where W_∞ = average maximum weight reached by the individuals.

The first sexual maturation size (Lpm) was estimated by the relative frequency of adult females and males in the sample and is defined as the size that corresponds to 50% frequency.

The time of annulus formation on the scales was obtained by plotting the distribution of the average length of the specimens with the same number of annuli against collection time.

The growth curve in length was established using the mathematical expression of BERTALANFFY (*2*), and confirmed by the Ford-Walford transformation.

3. RESULTS

The $\bar{I}_g$ values were plotted graphically and the results are shown in Figure 1. It can observed that the reproductive period for males and females occurs from August to October, when the frequency of spent males and females become higher.

The average lengths ($\bar{L}_t$) of males and females with the same number of annuli

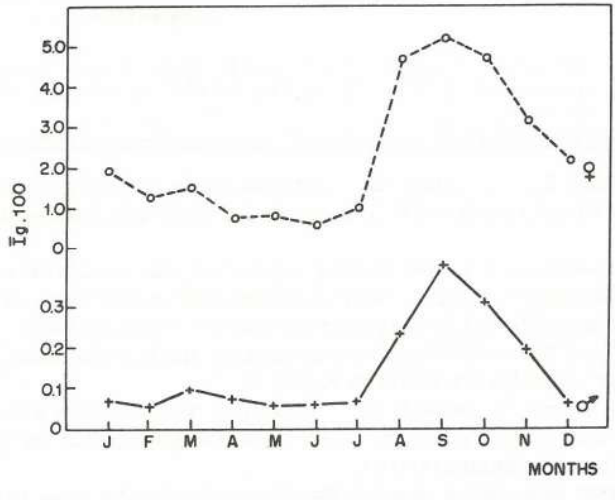

FIGURE 1 - Monthly variation of the gonadosomatic index ($\bar{I}g$) values.

in the scales, were distributed in function of the quarterly sampling times. The results for males and females are given in Figure 2.

The empirical points were not randomly distributed, but showed growth in relation to time, thus confirming that natural «age classes», i.e., periodic spawns, occur.

Figure 2 shows the appearance of a new mode during the third quarter of the year.

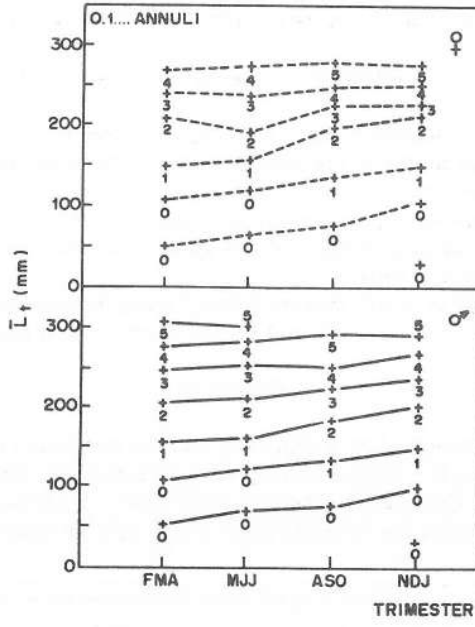

FIGURE 2 - Average length ($\bar{L}_t$) with the same number of annuli (1,2,3,...) on the scale in function of trimester.

Mean $\bar{L}_t$ and $\bar{L}_t + \Delta t$ values (Δt = 3 months) were plotted graphically for the Ford-Walford transformation (*14*). The results for males and females are shown in Figure 3a.

Once the validity of the Bertalanffy expression was confirmed by the Ford-Walford transformation, k and L^∞ were estimated. The growth curve in total length is shown in Figure 3b and is in agreement with the empirical data.

The results of the weight/length relationship as much as the linear relationship between these variables are found in Figure 3c.

Figure 3d shows the growth curve in weight, which was established by the deductive method supported by the mathematical expressions of the growth curve in length and weight/length relation.

The relative frequencies of adult females and males by total length class is shown in Figure 4 and are corroborated by the linearity of the logarithmic form of these variables. The size of *T. rendalli* at first sexual maturation (Lpm) was calculated to be 184mm for males and 163mm for females and 100% of all individuals

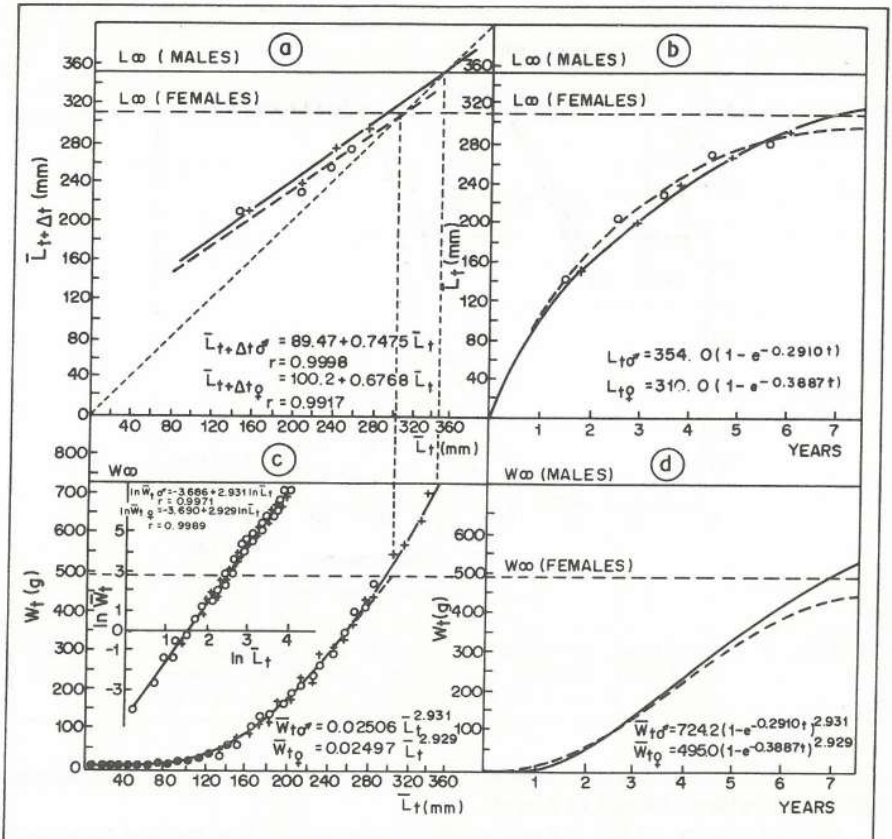

FIGURE 3 - Linear relationship between $\bar{L}_t$ curve adjusted by the Bertalanffy expression (b); total length ($\bar{L}_t$) and total weight ($\bar{W}_t$) relationship (c) and total weight growth ($\bar{W}_t$) curve (d).

are able to reproduce with a size of 230mm and 210mm for males and females respectively.

4. DISCUSSION

The reproductive period of *T. rendalli* in the Monjolinho Reservoir extends from August to December, with a higher frequency of mature fishes in September, when higher temperatures were recorded.

BARBIERI *et alii* (*1*) reported that *T. rendalli* of the Monjolinho Reservoir have a low fecundity (4,700 to 9,000 eggs) which is a characteristic of fishes that protect their eggs.

PINTO and PAIVA (*11*) found that *T. rendalli* bred in ponds (area: 1500m^2) with balanced ration had a longer reproductive period, from October to May, with a higher frequency of mature fishes in January.

According to HUET (*6*), tilapia can spawn all the year, at intervals of five to seven weeks, according to the temperature. CHACON (*4*) found for this species

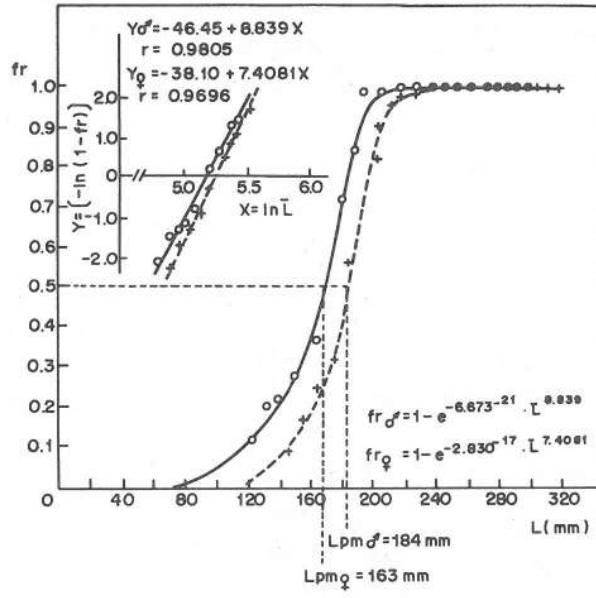

FIGURE 4 - Relative frequency (fr) of adult females and males by total length (L) class and logarithmic transformation (Lpm = first sexual maturation size).

(Ceará, Northeast of Brazil) a reproductive period lasting the whole year, due to high temperatures, except in August.

Several studies on fish age and growth by the annual ring method have been reported in the relevant literature. The validity of this method for tropical fishes, however, is still a matter of controversy. MENON (*9*) reported that determination of age and growth is difficult in tropical regions because the scales may show rings that are not necessarily annual. However, NEKRASOV (*10*) reported that annulus formation occurs once a year in tropical fishes and is linked to spawning.

In our study on *T. rendalli* we found that ring formation occurs during the months of August, September and October and coincides with the spawning season in the Monjolinho Reservoir. The formation of the first annulus occurs during the second year of life and corresponds to the first sexual maturation size (Lpm).

Rapid growth in length occurs during the first year of life of *T. rendalli*, before the fish can reach first sexual maturation size. However, the opposite occurs for growth in weight. The asymptotic length of males ($L\infty$ = 354.0mm) is greater than that of females ($L\infty$ = 310.0mm), suggesting greater female wear during the spawning season.

For the same species cultived in ponds, PINTO and PAIVA (*11*) and MELLO *et alii* (*8*) founded greater asymptotic length. According to BEVERTON and HOLT (*3*), the $L\infty$ parameter can be affected by factors such as density and food supply.

The weight/length relationship has been used to estimate the growth curve in weight and to define fish condition. According to LECREN (*7*), the condition factor (ϕ) is related to physiological condition of fishes and may vary according to fatness, suitability of environment or gonad development.

On the other hand, the Θ parameter, which is a constant for the species, defines the kind of growth peculiar to this species.

The values of these parameters found by PINTO and PAIVA (*11*) and MELLO *et alii* (*8*) agreed with our results.

T. rendalli has a Θ value of about 3.0, which characterizes an isometric type of growth.

The asymptotic weight of male ($W\infty$ = 724.2g) and females ($W\infty$ = 495.0g) presented the same variations observed in asymptotic length. PINTO and PAIVA (*11*) and MELLO *et alii* (*8*) encountered higher values of weight for males, working with cultivated tilapias.

Although *T. rendalli* was not controlled with regard to food supply and density, the results obtained suggest that this specie is well adapted to the Monjolinho Reservoir.

According to SANTOS (*12*), there is no fixed size at which individuals begin to reproduce, but frequency increases gradually with fish length. Thus, the first sexual maturation size is defined as the size that corresponds to 50% frequency.

The first sexual maturation size for *T. rendalli* females (Lpm = 163mm) and males (Lpm = 184mm) in the Monjolinho Reservoir are higher than the ones presented by PINTO and PAIVA (*11*) that stated values of 115 mm and 105 mm respectively for males and females. These results suggest that individuals in best food condition present a greater growth rate and anticipate the first sexual maturation size.

Similar feature was found by GRITSENKO (*5*) in two populations of *Salvelinus alpinus*.

In our study, females of *T. rendalli* reach a sexual maturity with a mean length slightly smaller than that of males. However, the first sexual maturation age (Lpm) is nearly the same for both males and females (second year of life). This is explained by the fact that the males grow more rapidly than the females.

All adult males and females of the Monjolinho Reservoir with size greater than 230 mm and 210 mm, respectively, are able to reproduce.

The values obtained for asymptotic weight of males ($W\infty$ = 724.2g) and females ($W\infty$ = 495.0g) were less than the ones obtained by PINTO and PAIVA (*11*) and by MELLO *et alii* (*8*).

The results of our study with *Tilapia rendalli* suggest that this specie is well adapted to the Monjolinho Reservoir, provided it receives natural food, without density control.

5. SUMMARY

This investigation attemps to study the biological behaviour of *Tilapia rendalli* in a small reservoir with special regard to growth, spawning time and first sexual maturation size. For this purpose, a total of 1,089 specimens, males and females, were collected during a period of one year. The data obtained revealed that this species from the Monjolinho Reservoir grows slowly, with the annuli formation coinciding with the reproductive period which occurs from August to October, and that reproduction starts during the second year of life. These data contrast with those obtained for the same species in culture condition.

6. RESUMO

(IDADE, CRESCIMENTO E REPRODUÇÃO DE *Tilapia rendalli* (BOULENGER, 1896) (OSTEICHTHYES, CICHILIDAE) NA REPRESA DE MONJOLINHO, ESTADO DE SÃO PAULO, BRASIL)

Durante 12 meses foram coletados 1.089 exemplares de *Tilapia rendalli* na represa do Monjolinho (São Carlos, SP), com o objetivo de estudar o desenvolvimento biológico da espécie, quanto à idade, crescimento, período reprodutivo e tamanho de primeira maturação gonadal de machos e fêmeas. Os resultados obtidos sugerem crescimento isométrico, com formação dos anéis etários nas escamas nos meses de agosto a outubro, coincidindo com o período reprodutivo da espécie. A primeira maturação gonadal ocorre no segundo ano de vida.

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