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EFFECT OF SELECTIVITY OF TRAMMEL NETS UPON GROWTH AND MORTALITY OF TWO TILAPIA SPECIES.

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ABSTRACT

Trammel net selectivity effect on growth and mortality of fish was studied, using 1705 T. **nilotica** and 1109 T. **zillii** caught in the months of April 1984 to April 1985.

Trammel net selectivity was found to be of the simple type (Less or non-selective) for either of the two species under study.

The increase in growth rates among **T. nilotica** age-groups I to III was attributed to the higher vulnerability of age-group I of this fish to the gear, than those of the same age of T. **zillii**. However, mortality rates calculated from catch curves could not represent the case, and mortality rates estimated by the Beverton and Holt (1956) formula were more precise because the formula took into account effect of selectivity and growth rates.

INTRODUCTION

Trammel nets are widely used in Egypt in inland waters. In spite of that, their selection effect upon growth and mortality analysis has not been assessed. In this study, such effect is going to be examined through out the process of age and growth, and mortality of **Tilapia nilotica** and **Tilapia zillii.**

MATERIAL AND METHODS

Fish samples (1705 for **T. nilotica** and 1109 for **T. zillii**) were collected by trammel nets, commercially used, on different dates in the period of April 1984 to April 1985. The first outer mesh was 6 cm, the second outer mesh was 26 cm and the inner mesh was 6.2 cm. The area of study was within five kilometers in Bahr Shebeen; a major branch of Alrayah Almenofi. Fish scales were collected behind the pectoral fin and kept in envelopes, with records on weight, length, sex and date of capture. A number of vertebrae were collected (From 70 fish of either species) below the dorsal fin, for validation of annuli on scales.

RESULTS

Gear Selectivity

The percentage distribution of fish lengths, and the trammel net selection curves were shown in Fig. 1. By examining these, it appeared that the gear selectivity curves were quite close to the simple type described by Gulland (1969). Consequently, the mean selection length L_c would be measurable as the 50% length in the right hand portion of the selection curve. This was the length below which fish were not fully vulnerable to the gear, and after which they were subjected to uniform fishing mortality. This (L_c) was found to be 9.9 and 10.7 cm for **T. zillii** and **T. nilotica** respectively. The average length (L) in the catch was estimated for **T. zillii** and **T. nilotica** as 12.07 and 13.1 cm respectively.

Growth

a. Scale Radius and Fish Length Relationship

The relationship between fish standard length and scale radius was found to be following a straight line for either species (Fig. 2 a & b). The regression equations for these relationships were predicted as follows:

$$L_z = 5.495 + 1.527\ S_r \qquad (r^2 = 0.98),$$
$$\text{and}\quad L_n = 3.808 + 1.807\ S_r \qquad (r^2 = 0.99)$$

where L_z, L_n were standard lengths for **T. zillii** and **T. nilotica** respectively, and S_r = scale radius in micrometer divisions (1 division = 55.6 μ)

Using the predicted value of intercept in these equations, the back-calculated lengths would be estimated as follows:

$$L_{xz} = 5.5 + (L_r - 5.5)/\ X\ S_x/S_r, \quad \text{and}$$
$$L_{xn} = 3.8 + (L_r - 3.8)\ X\ S_x/S_r$$

where, L_{xz}, L_{xn} denoted length of fish at annulus X for the two species, S_r = the fish scale radius at capture, S_x = the scale radius at annulus X, and L_r = length of fish at capture.

b. Validity of Annual Marks

The reliability of annuli for use as age marks were based upon the following:

1- A ring was considered an annulus when it appeared continuous and complete in the scale.
2- Year rings were verified by examining annuli in 70 fish vertebrae and not show any significant deviation in the back-calculated lengths from those predicted from scales.
3- The time of annuli formation was in March-April in scales and coincided with the period that followed the cold season (December-February).

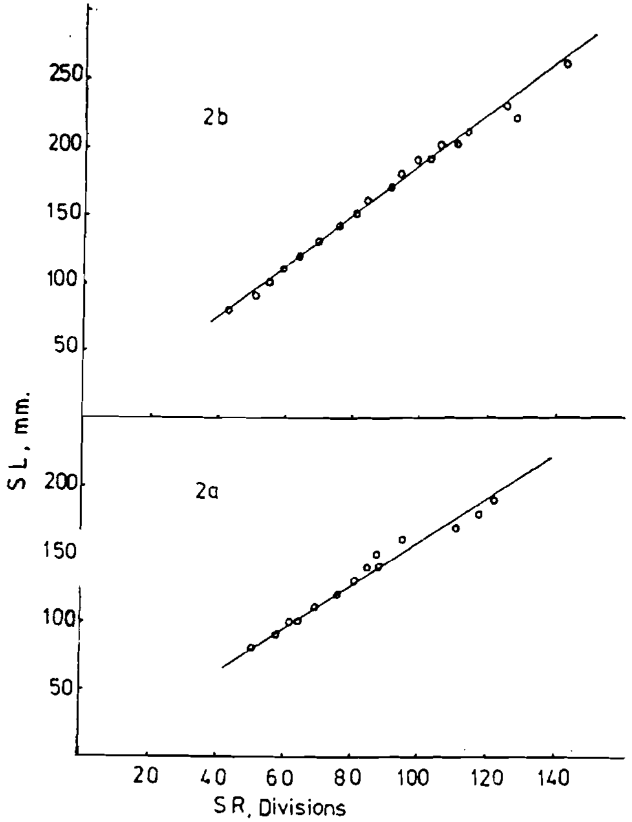

FIG. 2
Scale radius (divisions, 1d = 55.6 μ) and fish standard length (mm) relation
a. **T. zillii** and b. **T. nilotica**

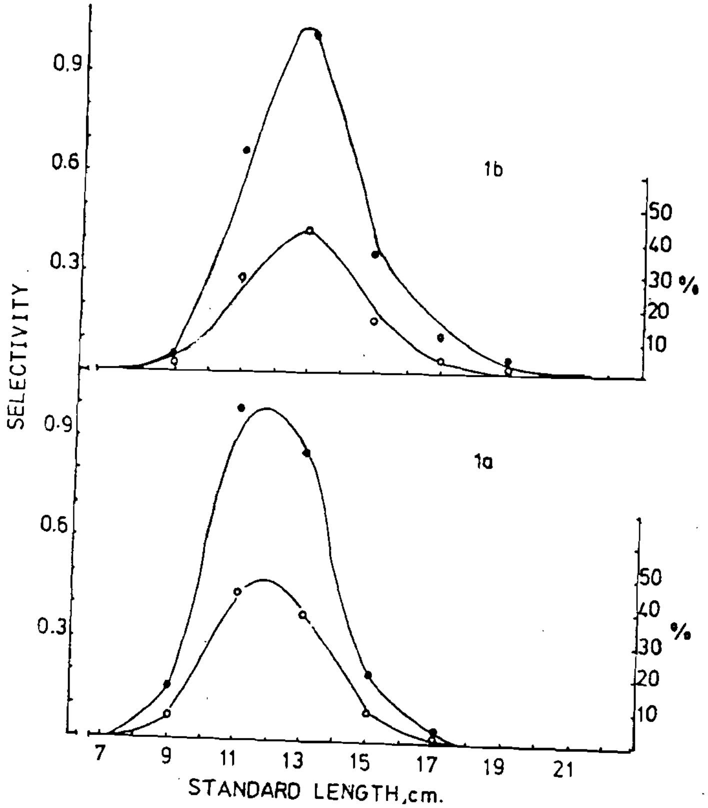

FIG. 1
Percentage composition of different lengths (open circles) and trammel net selectivity (closed circles) of
a. **T. zillii**, and b. **T. nilotica**.

4- The age structure which extended for only four years increased this reliability

c. Growth In Length

Based on analysis of variance ($P < 0.05$), no significant variation of growth in length was found due to sex, in either of the two species. Therefore, the data for both species were combined (Table 1). The results indicated that either species had the maximum increase in calculated lengths in the first year of life. This was 45% and 36% of the fish length at age IV, for **T. zillii** and **T. nilotica** respectively. When the average observed lengths were considered, the percentage of increase in length reached 65 and 57 percent respectively.

TABLE 1
Average observed and Calculated length (cm) of the two Tilapia species.

Age - group	I	II	III	IV
	T. zillii			
Number of fish	553	442	96	18
Average length:				
Observed	11.2	13	15	17.1
Calculated	7.6	12	14.6	16.8
Von Bertalanffy	7.3	12	14.9	16.7
Instantaneous rate of increase in length*		0.58	0.22	0.55
	T. nilotica			
Number of fish	1216	379	92	18
Average length:				
Observed	11.5	15	17.9	20.2
Calculated	7.1	12.5	17.0	19.7
Von Bertanlanffy	7.2	12.6	16.7	19.8
Instantaneous rate of increase in length*		0.75	0.85	0.16

* Instantaneous rate of increase in length equals the difference in length between two successive ages divided by the length at the younger age.

On considering the length increments, age-groups I to III of **T. nilotica** and I and II of **T. zillii** had higher growth rates when compared when the older ages. This was even more emphasized for **T. nilotica** with the instantaneous rates of growth in length was examined.

The Von. Bertalanffy equation (Ricker, 1975) of the forms:

$$L_t = L \ \ [1-e^{-K(t-t_o)}], \quad \text{and}$$
$$L_{t+1} = L \ \ . e^{-K} + e^{-K}.L_t$$

were used, where L_t , L_{t+1} were length of fish at age t and age t+1, L = asymptotic length; a theoritical length beyond which growth ceased; K = growth coeffecient, and t_o = the theoritical time at which the fish had zero length. These were calculated and found to be as follows:

for **T. zillii** : $L_t = 19.5\ [1-e^{-K(t-t_o)}]$, and
$L_{t+1} = 75.3 + 0.62\ L_t$

and for **T. nilotica**: $L_t = 28.8\ [1-e^{-0.29(t-0.02)}]$ and
$L_{t-1} = 72.9 + 0.75\ L_t$

As indicated in Table 1, the predicted lengths at different ages were very close to the back-calculated ones.

Mortality

Following Gulland (1969) and Ricker (1975), the straight portion in the catch curve of either species (Fig. 3) had been used to calculate the instantaneous rate of mortality "Z". This would be equal to minus the slope of the equated line. The predicted regression equations for either species were as follows:

for **T. zillii**: $\log_e$ frequency = 9.315 - 1.6 age ($r^2 = 0.99$) and
for **T. nilotica** : $\log_e$ frequency = 8.625 - 1.405 age ($r^2 = 0.99$).

Therefore, Z was used as 1.6 and 1.4 for the two species respectively. Annual survival (S) and mortality (a) rates could be calculated by the relationship:

$$e^{-Z} = S = 1-a$$

the results , together with the between ages Z (calculated as minus the logarithmic difference between two successive ages) were shown in Table 2. Thus, although age-groups II to IV, in either species had comparable mortality rates, age-group I had a conspicuous difference. **T. nilotica** of age-group I were having a value that was close to the straight line. This was found to be 0.69 which was more than three times higher than that of **T. zillii**. On the contrary, **T. nilotica** overall mortality average was less than that of **T. zillii** by 5 percent.

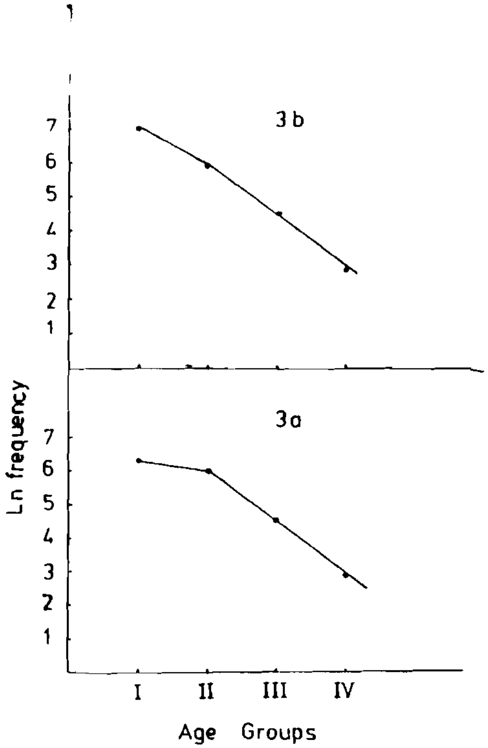

FIG. 3
Catch curve of a. **T. zillii** and **T. nilotica**.

TABLE 2
Annual Survival, Mortality and Instantaneous Mortality Rates of the two Tilapia species.

Age-group	Survival rate	Mortality rate	Instantaneous mortality rate
	T. zillii		
I - II	0.80	0.20	0.22
II - III	0.22	0.78	1.53
III - IV	0.19	0.81	1.67
By regression	0.20	0.80	1.60
	T. nilotica		
I - II	0.31	0.69	1.16
II - III	0.24	0.76	1.42
III - IV	0.20	0.80	1.63
By regression	0.25	0.75	1.40

The Beverton and Holt (1956) formula for calculating Z was as follows:

$$Z = K(L - L)/ L - L_C$$

where K and L were predicted by the Von Bertalanffy equation, L and L_C were the average length and the mean selection length. Using this equation, Z was found to be 1.68 and 1.90 for **T. zillii** and **T. nilotica** respectively. Therefore, the mortality rate for these two species was 0.81 and 0.85.

DISCUSSION

The time of annulus formation was in accordance with the early predicted value for other fish species in Egyptian waters (El-Bollock and koura 1960, El-Zarka 1961, Khallaf , 1977). In addition, the predicted length values by the Von Bertalanffy equation were close to the back-calculated lengths at different ages, and this brought vertification to the method of back-calculation as indicated by Brothers (1982). The validity of annuli from scales was also fartherly emphasized by those read from vertebrae; which was important for the subsequent reliability of those annuli for ageing the fish.

In the range of length examined, the catch curves (Fig. 3 a & b) indicated that there was no irregularity that could be attributed to the gear selectivity.. In other words, the fish were subjected to uniform mortality rate in the straight portion of the curve (Ricker 1975). However, although the mean selection length of **T. zillii** began at 9.9 cm compared to 10.7 cm for **T. nilotica,** it appeared that the latter species age-group I was more vulnerable to the fishing gear. This was exhibited by the age-group I mortality of 69% as calculated by the catch curve. On the contrary, the overall average mortality of **T. nilotica** did not reflect that finding and was lower by 5% than that of the other species. The Beverton and Holt formula for Z could be more precise and showed higher mortality for **T. nilotica** than **T. zillii**, because it considered the gear selectivity as well as growth parameters.

Fluctuation in growth rates in response to fishing effect was discussed by many authors (e.g. El-Zarka, 1959 and Ricker, 1975). In these studies, the increase of fishing effect (lowering size limit, or increasing effort) would increase the fish growth rates, and vice versa. Since both species were subjected to the same uniform rate of fishing, as indicated by selectivity and catch curves, the gear catch would reflect their real abundance. Thus, the more vulnerbility that **T. nilotica** age-group I showed towards the fishing gear represented a natural tendency or behavioral occurrence in the vicinty of the gear. As result, a major portion of the fish was caught before spawning; mature fish were less than 30% below 13 cm (unpublished data). This would be similar to lowering size limit for this species, and in response the fish had the increased growth rates during the first three years of life.

In conclusion, trammel net catches would be used to describe abundance, growth and mortality taking into account that mortality estimates should include parameters on selectivity and growth.

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