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

1- Gear Selectivity:

The percentage distribution of fish lengths, and the trammel net selection curves were shown in figure 1. By examining these, it appeard 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 Y. 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.
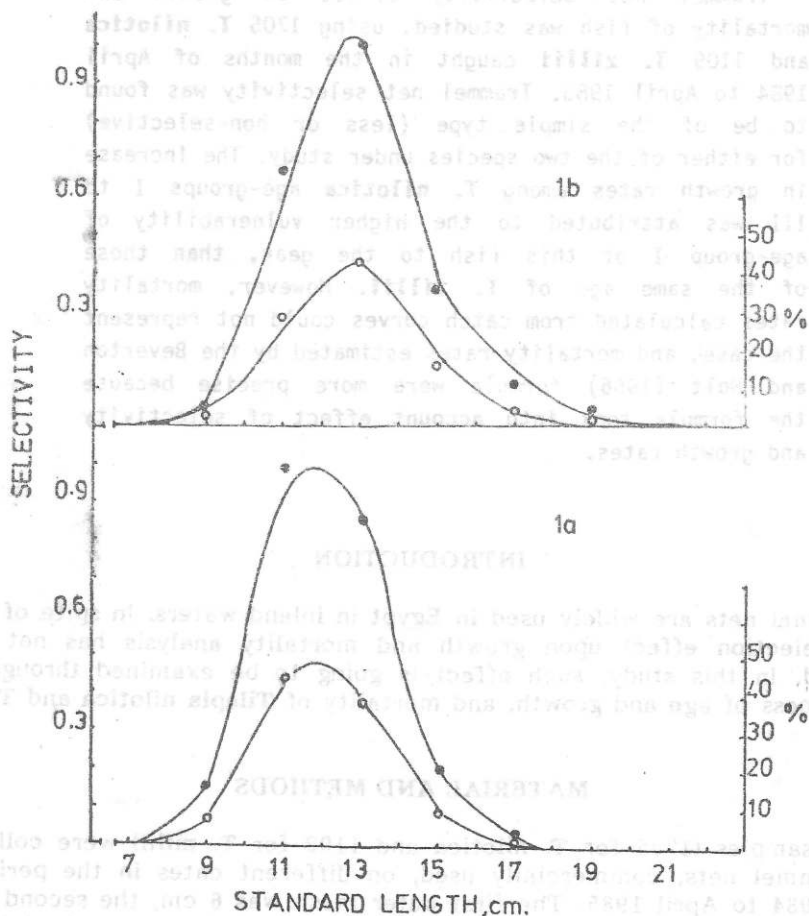

Fig. 1
Percentage composition of different lengths (Open circles)
and trammel net selectivity (Closed circles) of
a. **T. zillii**, and b. **T. nilotica**.

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2 – Growth

2.1. 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 & b). The regression equations for these relationships were predicted as follows:

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

where L_z, L_n are standard lengths for T. zillii and T. nil otica respectively, and $S_r =$ scale radius in micrometer divisions (1 division where L_z, L_n are 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:

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

where, L_{xz} and 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.

2.2. 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 appeard continuous and complete in the scale.

2. Year rings were verified by examining annuli in 70 fish vertebrae and did 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).

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

2.3. 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 result 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.

On considering the length increments, age-groups I to III of T. nilotica and I and II of T. zillii had higther growth rates when compared with the older ages. This was even more emphasized for T. nilotica when the instantaneous rates of growth in length was examined.
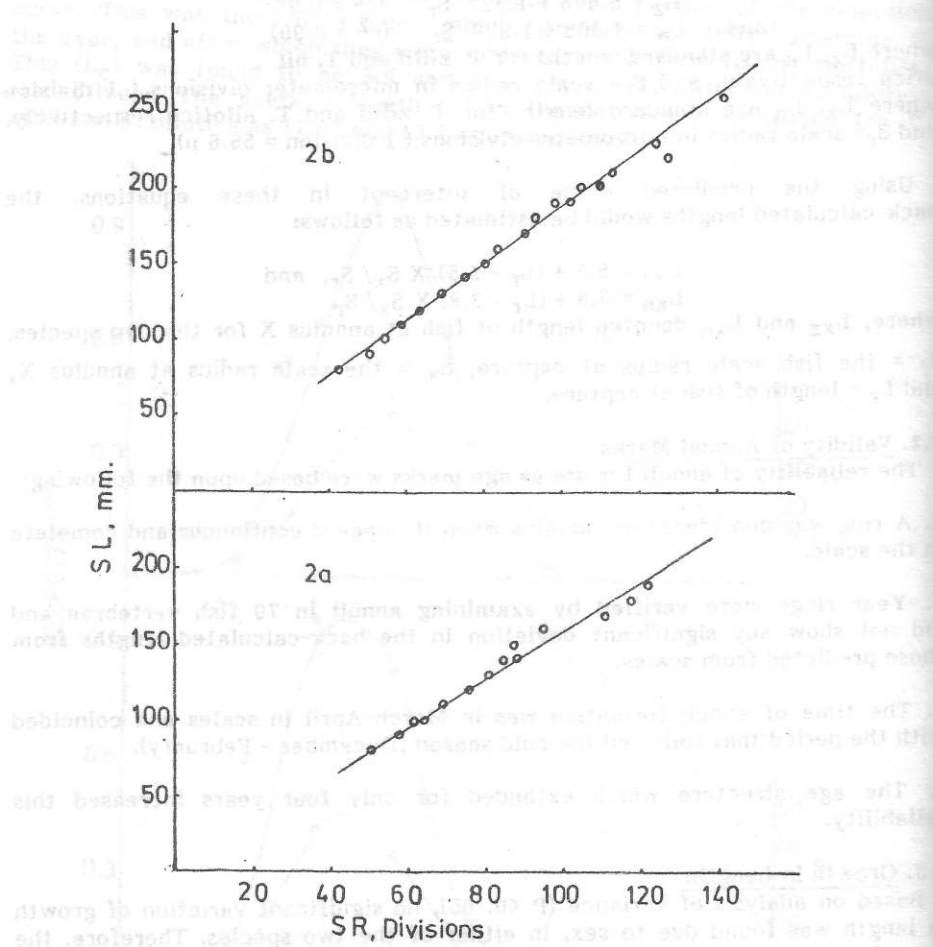
Fig. 2
Scale radius (divisions, 1d = 55.6 µ) and fish
standard length (mm) relation a. **T. zillii** and b. **T. nilotica.**

TABLE 1
Average observed and calculated lengths (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
Calcualted	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	0.15
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.

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

$$L_t = L_\infty (1-e^{-k(t-t_0)}), \text{ and}$$
$$L_{t+1} = L_\infty .e^{-K} + e^{-K}. L_t$$

were used, where L_t, L_{t+1} were length of fish at age t and age t+1, L_{oc} =
asymptotic length; a theoritical length beyond which growth ceased; K=
growth coeffecient, and t_0 = theoritical time at which the fish had zero
length. These were calculated and found to be as follows:

$$\text{for T. zillii: } L_t = 19.5 (1-e^{-0.49(t-0.03)}),$$
$$L_{t+1} = 75.3 + 0.62 \ L_t$$

and for **T. nilotica:**

$$L_t = 28.8 (1-e^{-0.29(t-0.02)}) \text{ and}$$
$$L_{t+1} = 72.9 + 0.75 \ L_t$$

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

3- 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 motality "Z". This would be equal to minus the slope
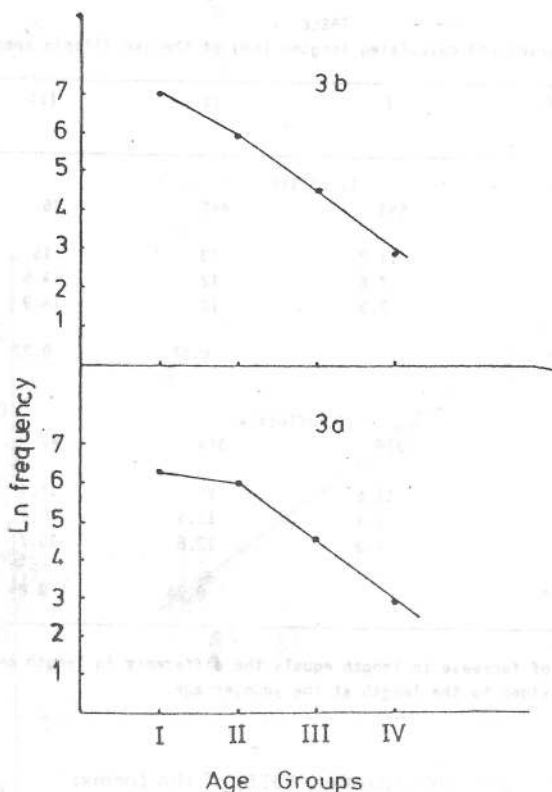of the equated line. The predicted regression equations for either species
were as follows:

Fig. 3
Catch curve of a. T. zillii and b. T. nilotica.

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 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 have a value that was close to the straight line. This was found to be 0.69 which was more than three times higther than that of T. zillii. On the contrary, T. nilotica overall mortality average was less than that of T. zillii by 5 percent.

TABLE 2

Annual survival, moratlity and instantaneous mortality rates
of the two Tilapia species.

Age group	Survival rate	Mortality rate	Instantaneous motality 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:

$$Z = K (L_{\infty} - L)/ L - L_c$$

where K, L_{oc} 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 fromation was in accordance with the early predicted value for other fish species in Egyptain waters (El-Bollock and Koura, 1960; El-Zarka, 1961 and 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 verification 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 lengths 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 appeard that the latter speciess 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. One the contrary, the overall average mortality of T. nilotica did not reflect that finding was lowerr 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 respone 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 vulnerability that **T. nilotica** age-group I showed towards the fishing gear represented a natural tendency or behavioral occurrence in the vicinity of the gear. As a 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.

ACKNOWLEDGMENT

REFERENCES

Beverton, R.J.H. and Holt, 1956. A review of methods for estimating mortality rates in exploited fish populations, with special reference to sources of bais in catch samoling. Rapp. P.V. Reun. Cons. Perm. Int. Explor. Mer, Vol. 140 (1): 67-83.

Brothers, Edward B., 1982. Summary of round table discussions on age validation. NOAA Tech. Rep. NMFS 8: 35-44.

El-Bollock, A. R. and R. Koura, 1960. Age, growth and breeding season of Tilapin zillii Gervias in Egyptain Experimental Ponds. Notes and Memories of Inst. of Fresh water Biol., Cizira, Cairo, Vol. 49: 1-36.

El-Zarka, S. E. 1959. Fluctuations in the population of yellow perch, Perca flavescens (Mitchill), in Saginaw Bay, Lake Huron. U. S. and Wildlife Ser. Fish .Bull. Vol. 59. 151.

El-Zarka, S.E., 1961. Tilapia fisheries invesetigation in Egyptain Lakes. 1. Annulus fromation on the scales of the cichlid fish Tilapia zillii (Gervias) and its validity in age and growth studies. Notes and Memories of Inst. Fresh water Biol. Gizira, Cairo, Vol. 62: 1-18.

Culland, J. A., 1969. Manual of methods for fish stock assessment. Part 1. Fish population analysis. FAO, Rome.

Khallaf, Elsayed A., 1977. Studies on family Schilbeidae from Lake Nasser. M. SC. Thesis, Fac. Sci., Azhar Univ., Cairo.

Ricker, W. E., 1975. Computation and interpretation of Biological statistics of fish populations. J. Fish. Res. Bd. Can., Vol. 191.