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Stock assessment of the Mediterranean horse mackerel, *Trachurus mediterraneus* in the Egyptian Mediterranean Coast off Alexandria

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Introduction

The Egyptian Mediterranean coast is about 1100 km extending from El-Salloum in the West to El-Arish in the East yielding about 60 thousand ton annually (GAFRD; 1985 - 2014). The main fishing gears operated in this region are trawling, purse - seining and lining especially long and hand lining. Horse mackerels are one of the most frequent fish groups in the purse-seine fishery in the Egyptian Mediterranean contributing about 5% of the total purse-seine catch and 1.5% of the total Mediterranean catch in Egypt. The catch of horse mackerels in the Egyptian Mediterranean is mainly composed of two species, Mediterranean horse mackerel *Trachurus mediterraneus* and Atlantic horse mackerel *T. trachurus* which locally known as shakhora. The present study is the first to discuss and estimate the basic parameters required for assessing and managing of Mediterranean horse mackerel *T. mediterraneus* stock in the Egyptian Mediterranean waters off Alexandria.

MATERIAL AND METHODS

Horse mackerel samples were collected monthly from the landing sites of two fishing grounds (Borg El-Burollus and El-Maadia) where up to 80% of horse mackerel were landed. In the lab, the total length to the nearest mm, total weight to the nearest 0.1 g, sex and otoliths were taken for each individual *T. mediterraneus*,

Otoliths were used for age determination and the lengths by age were back - calculated using Lee's (1920) equation. The relation between length and weight was computed using the power equation $W = a L^b$ where W is the total weight , L is the total length and a and b are

constants whose values were estimated by the least square method. The von Bertalanffy growth model $L_t = L_\infty (1- e^{-K (t - to)})$ was applied to describe the theoretical growth of *T. mediterraneus*. Ford (1933)-Walford (1946) plot was used to estimate the von Bertalanffy growth parameters. The total mortality coefficient "Z" was estimated using two different methods, Ricker (1975) and Jones and Van Zalinge (1981). The natural mortality coefficient "M" was estimated as the geometric mean of three methods, Ursin (1967), Taylor (1961) formula and Djabalia et al. (1994). The fishing mortality coefficient "F" was estimated by the equation F = Z – M, while the exploitation ratio (E) was calculated as E = F/Z (Ricker, 1975). The rate of exploitation (U) for different years was estimated from the equation $U = F/Z (1-e^{-Z})$ (Beverton and Holt 1957, Ricker 1975). Relative yield per recruit was estimated using the model of Beverton and Holt (1966).

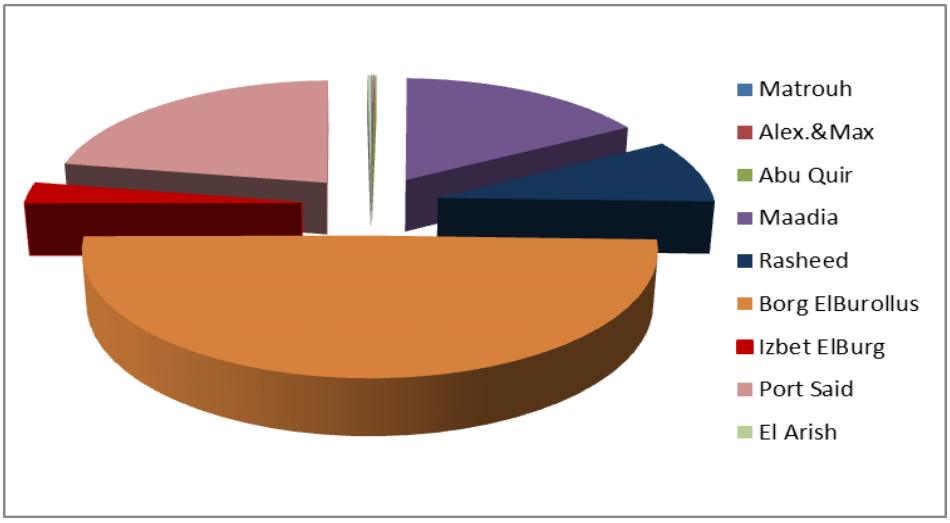

Fig.1: Horse mackerel landings according to the fishing grounds

RESULTS AND DISCUSSION

Age and growth

Otolith's readings of 825 specimens were analyzed to determine the age of *T. mediterraneus* in the Egyptian Mediterranean and the obtained results indicated that, the maximum life span of this species was four years and there is no difference in age composition between males and females. It was found that, age group I is the dominant age group in the catch constituting up to 44% followed by the age group II which constitutes 42.2% of the total catch. This means that, *T. mediterraneus* stock in the Egyptian Mediterranean is fully recruited to the purse - seine fishery at age group one (Fig. 2). Also, the estimated back-calculated lengths of horse mackerel were 13.53, 19.93, 23.66 and 25.75 cm at the end of the first, second, third and

fourth year of life, respectively. It's obvious that, horse mackerels attain their highest growth rate in length during the first year of life after which, a gradual decrease in growth increment was noticed with further increase in age (Fig. 3).

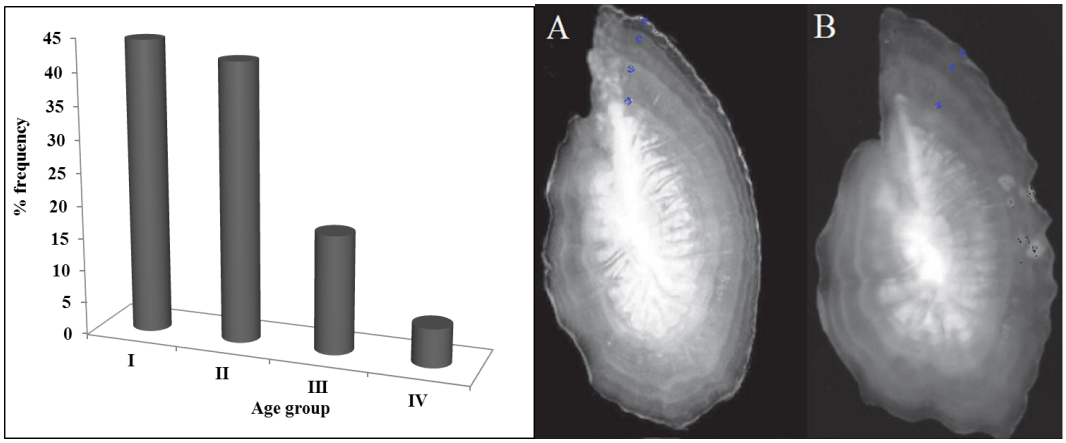

Fig. 2: Otolith and age composition of *T. mediterraneus* (A: 4 years, 25 cm TL and B: 3 years, 22.9 cm TL)

Length - Weight Relationship

The total length varied from 10 to 26.5 cm while the total weight ranged between 10.2 and 160 g. The obtained equation was: $W = 0.0132 \quad L^{2.8564}$. **T**he growth rate in weight (Fig. 3) was much slower during the first year of life, then the annual growth increment in weight increased with further increase in age until it reached its maximum value at the end of the second year of life after which, a decrease in the growth increment was observed.

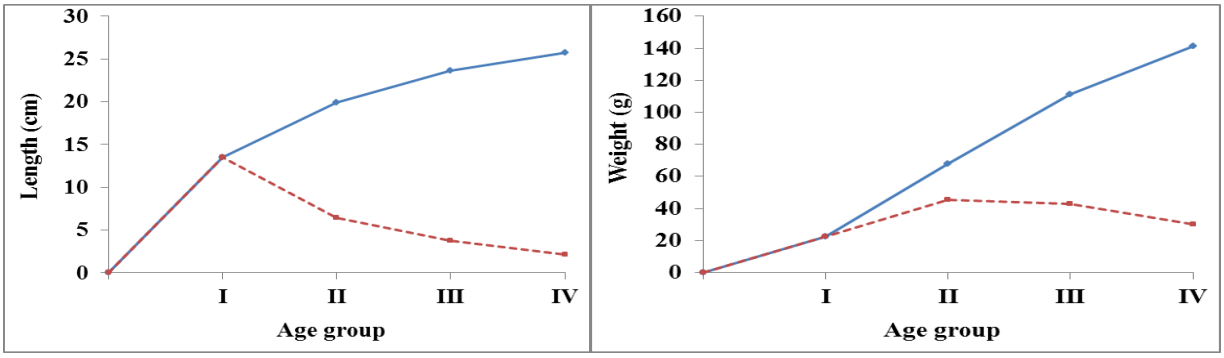

Fig. 3: Growth in weight growth increment of *T. mediterraneus*, from the Mediterranean Sea of Egypt.

Growth Parameters

The estimated von Bertalanffy growth equations for growth in length and weight were:

For growth in length $L_t = 28.63 (1 - e^{-0.55 (t + 0.3)})$

For growth in weight $W_t = 191.35 (1 - e^{-0.55 (t + 0.3)})^{2.8564}$

Mortality Rates

The instantaneous total mortality coefficient "Z" of *T. mediterraneus* in the Egyptian Mediterranean was 1.7 y^{-1} and the natural mortality coefficient "M" was estimated as 0.6. While the fishing mortality coefficient "F" value was 1.1 y^{-1}

Relative Yield Per Recruit (Y/R)'

The relative yield per recruit of ***T. mediterraneus*** from the Egyptian Mediterranean was estimated by applying the model of Beverton and Holt (1966).

The results showed that, the (Y/R)' increases with the increase of exploitation and reaches its maximum value at E = 0.59, after which, the (Y/R)' decreases with further increase in exploitation level. This means that, the present level of exploitation rate which is related to fishing mortality is higher than that which gives the maximum (Y/R)'. The results indicate also that, the present level of exploitation rate was higher than the exploitation rate ($E_{0.5}$ = 0.34) which maintain 50% of the stock biomass as spawning stock. To insure that at least 50% of the individuals can be maintained for spawning and recruitment, the present level of exploitation rate should be reduced from 0.68 to 0.34 (50%). To determine the most appropriate length at first capture, which is related to the estimation of the optimum mesh size, the (Y/R)' of *T. mediterranus* was computed using L_c equal to the length at first sexual maturity L_m. The results indicated that, the present value of L_c is unsuitable for this stock and L_c should be raised (Fig. 4).

The obtained results indicated that the horse mackerel stock in the Egyptian Mediterranean is in a situation of overexploitation and the exploitation level should be reduced by at least 50% of its current value as well as the length at first capture should be increased to up to L_m to conserve the spawning stock. Also, the nursery and spawning grounds should be identified and protected to maintain the productivity of this stock.

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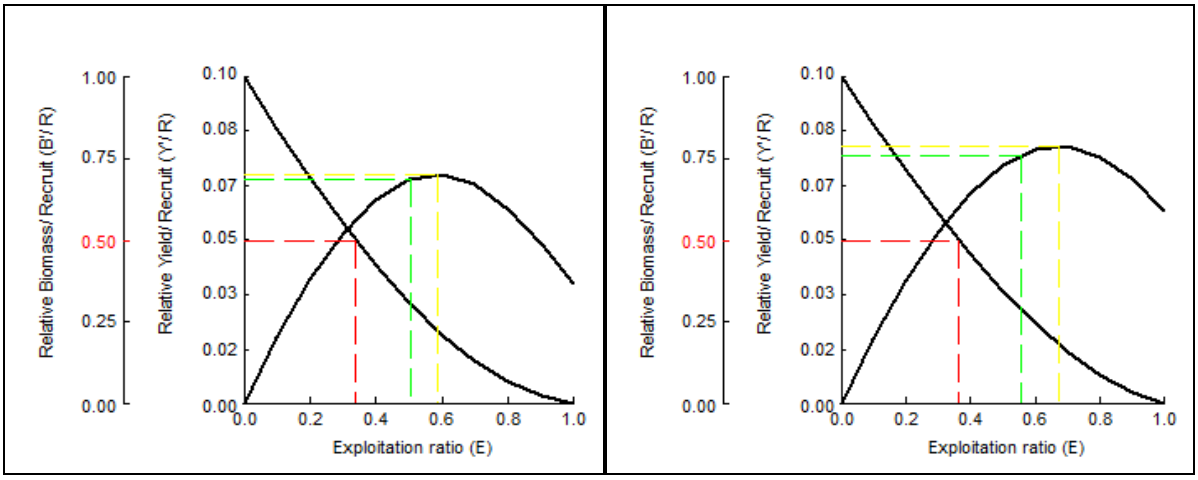

Fig. 4: Relative yield per recruit analysis of *T. mediterraneus*, from the Mediterranean Sea of Egypt (current L_c to right and L_c=L_m to left).