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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

Egyptian Mediterranean coast is about 1100 km extending from El-Salloum in the West to El-Arish in the East (Fig. 1) 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. Family Carangidae (order Perciformes) contains more than 200 species of marine fishes, includes such well-known forms as the horse mackerels, scads, jacks and pompanos. 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 was done to discuss and estimate the basic parameters required for assessing and managing of Mediterranean horse mackerel *Trachurus mediterraneus* stock in the Egyptian Mediterranean waters off Alexandria.

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## Material and Methods

**Collection of samples:**

A total of 903 specimens (10–26.5 cm TL) of *T. Mediterraneus* were randomly collected monthly from the commercial landings at Alexandria, Al-Maadia and Burg El-Burullus fishing ports during the period from June 2013 to June 2015.

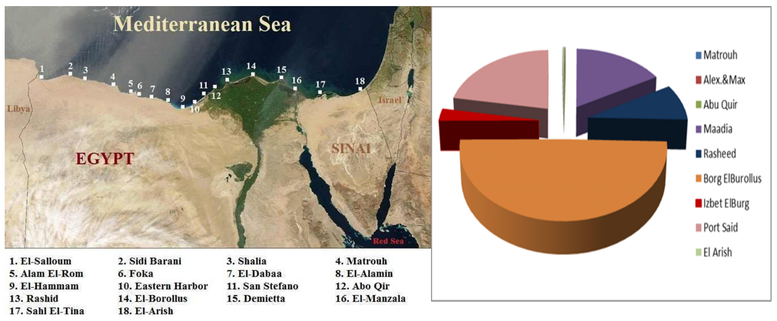


**Fig. 1: Egyptian Mediterranean Sea and horse mackerel catch by fishing area**

**Age determination:**

Age was determined using otolith readings. The relationship between the otolith radius (R) and total length (TL) was represented by the following equation:

$$TL = a + b\,R$$

The back-calculated lengths were determined by Lee (1920) equation as: $TL_n = a + (R_n / R)(TL - a)$

**Length-weight relationship:**

The length–weight relationship was described by the power function equation: $W = a\,L^b$ (Hile, 1936 and Le Cren, 1951)

**Growth parameters:**

The von Bertalanffy growth model was applied to describe the theoretical growth of *T. mediterraneus.* The constants of the von Bertalanffy model (L∞ and K) were estimated by fitting Ford (1933)-Welford (1946) plot as the follows:

$$L_t+1 = L\infty\,(1- e^{-k}) + e^{-k}\,L_t$$

**Growth Performance Index (Ø'):**

Growth performance index was computed according to the formula of Pauly and Munro (1984) as follow:

$Ø' = \mathrm{Log}_{10}\,K + 2\,\mathrm{Log}_{10}\,L\infty$

**Mortality and exploitation rates**

The total mortality coefficient "Z" was estimated using Ricker (1975) and Pauly (1983) methods. The natural mortality coefficient "M" was estimated as the geometric mean of three methods, Ursin (1967), Taylor (1961) and Djabalia et al. (1994) The fishing mortality coefficient "F" was estimated as F = Z – M, while the exploitation ratio (E) was calculated as E = F/Z (Ricker, 1975). The rate of exploitation (U) was estimated from the equation U = F/Z (1-e-Z) (Beverton and Holt 1957, Ricker 1975).

**Relative Yield and Biomass per Recruit**

The relative yield per recruit and relative biomass per recruit were estimated according to the Beverton and Holt model (1966).

## Results & Discussion

**Age composition:**

From the direct examination of the whole otolith of *T. mediterraneus* (Fig. 2), the number of annuli revealed that the maximum life span of this species was 4 years and age group one was the most frequent group in the catch.

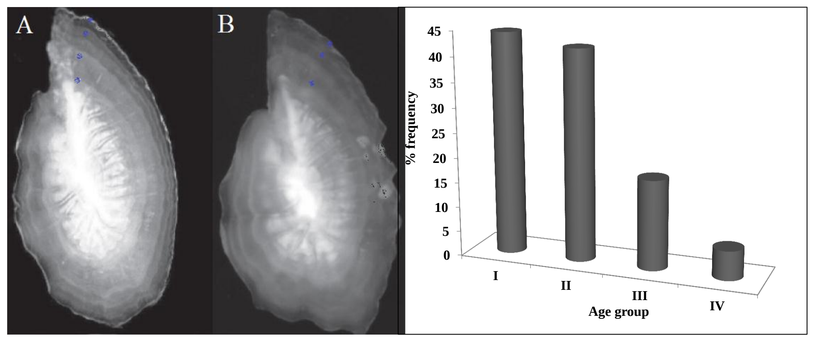


**Fig. 2: Otolith and age composition of *T. mediterraneus* (A: 4 years, 25 cm TL and B: 3 years, 22.9 cm TL)**

The Mediterranean horse mackerel attained its highest growth rate in length by the end of the first year of life, then this increment gradually decreased with the increase in age (Fig. 3)

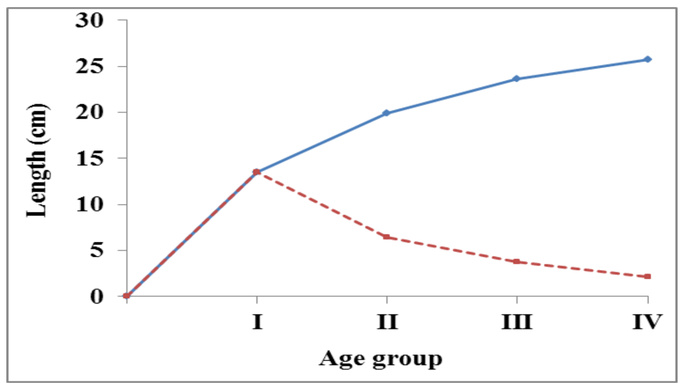


**Fig. 3: Growth in Length and annual increment of *T. mediterraneus*, from the Mediterranean Sea of Egypt.**

**Length-weight relationship:**

The length-weight relationship is considered as an essential tool in the studies of fish stock assessment and management of fisheries resources. The length-weight relationship of the Mediterranean horse mackerel was best described by the following power equations (Fig. 4):

$W = 0.0132\,L^{2.8564}$

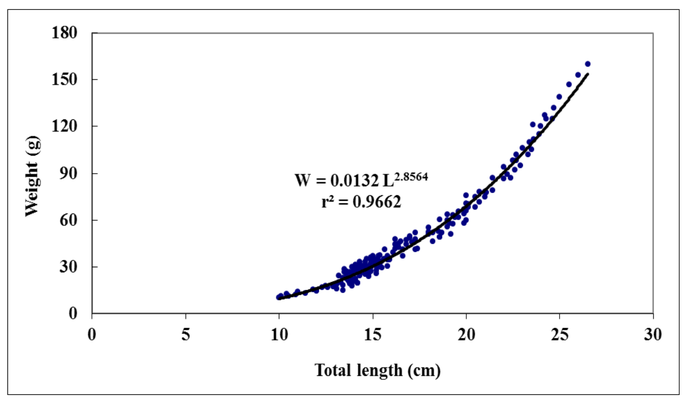


**Fig. 4: Length-weight relationship of *T. mediterraneus*, from the Mediterranean Sea of Egypt.**

**Growth in weight**

The growth in weight for *T. mediterraneus* was negative allometric where b was statistically significant differ from 3 (b= 2.8564; CI = 2.779-2.934). Based on the L-Wt relationship, the back calculated lengths were transformed to weights (Fig. 5). The growth rate in weight exhibited its higher values in age groups II.

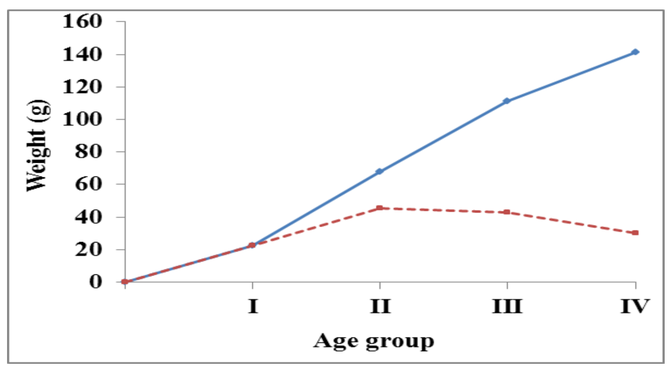


**Fig. 5: Growth in weight growth increment of *T. mediterraneus*, from the Mediterranean Sea of Egypt.**

**Growth parameters:**

The growth parameters "L∞, K, W∞ and $t_0$" for *T. mediterraneus* were TL∞ = 28.63 cm; K = 0.55 year$^{-1}$; $t_0$ = -0.3 year and W∞ = 191.35 g. The growth equations were:

For growth in length

$$Lt = 28.63\,(1 - e^{-0.55\,(t + 0.3)})$$

For growth in weight

$$Wt = 191.35\,(1 - e^{-0.55\,(t + 0.3)})^{2.8564}$$

**Growth performance index:**

The values obtained for the computed growth performance index (Ø') for the investigated species u was 2.66.

**Mortality and exploitation rates**

Mean Z = 1.7, Mean M = 0.55 , F = 1.15, E = 0.68, U= 0.47

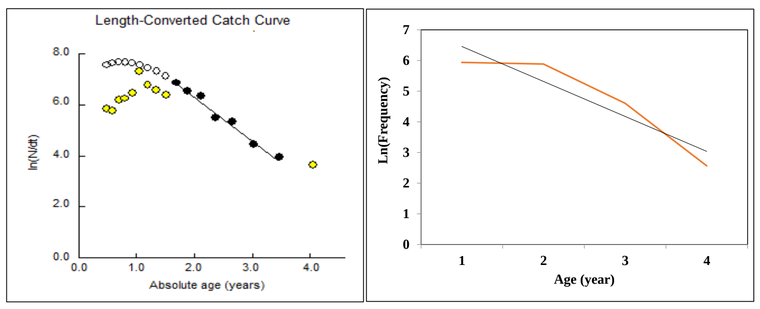


**Fig. 6: Z- estimation of *T. mediterraneus*, from the Mediterranean Sea of Egypt.**

**Relative Y/R and B/R**

**Current situation**
**E(max) = 0.59**
**E(0.5) = 0.34**
**E (current) = 0.68**

**When Lc = Lm**
**E(max) = 0.67**
**E (0.5) = 0.37**

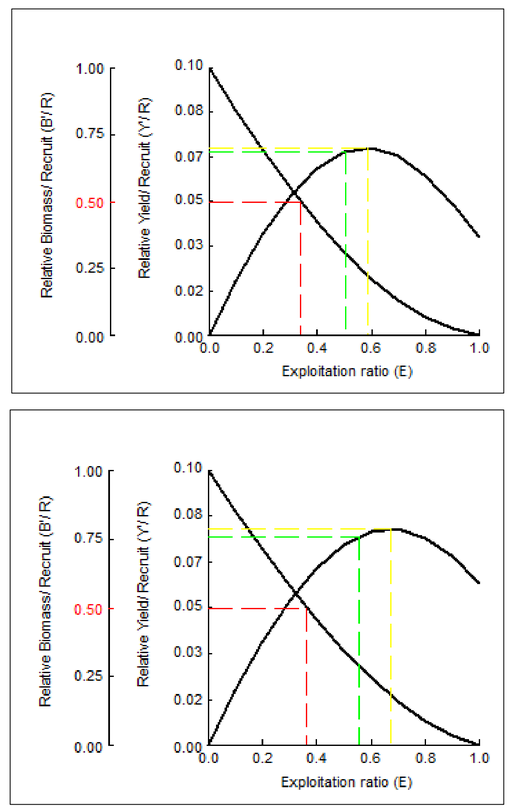


**Fig. 7: Relative yield per recruit analysis of *T. mediterraneus*, from the Mediterranean Sea of Egypt.**

**It could be concluded that the stock of Mediterranean horse mackerel in the Egyptian Mediterranean coast off Alexandria is overexploited as the current exploitation level is higher than that maintain 50% of the spawning stock biomass.**

## Recommendations

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 Lm to conserve the spawning stock. Also, the nursery and spawning grounds should be identified and protected.

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