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BIOLOGICAL STUDIES ON THE ATLANTIC MACKEREL FISH *Scomber scombrus* OF EASTERN MEDITERRANEAN (NORTH SINAI COAST) EGYPT DURING 2016

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Abstract

The goal of the present study is to give basic information required for managing Atlantic mackerel *Scomber scombrus* L 1758 of Eastern Mediterranean (North Sinai Coast) Egypt. 2423 Samples of Atlantic mackerel *Scomber scombrus* L. 1758 (12.3 to 32.6 cm total Length and 8.6 to 259.2 gm total weight), were collected during 2016. The relationship between length and weight was $W= 0.0088L^{3.0407}$. Age was determined by otolith where age groups 1 to 5 years. Growths in length and weight at the end of each year were calculated as 16.2,19.73,22.76,25.1 and 27.01cm for the 1st, 2nd, 3rd, 4th and 5th year of life respectively. The growth parameters of von Bertalanffy equation were calculated as ($L\infty$= 35.51 cm, K = 0.2053 $year^{-1}$ and t_0 = -1.9661 year). Growth performance index (φ' = 2.413). Mortality rates were 0.9651 yr−1, 0.2945 yr^{-1} and 0.471yr^{-1} for total, natural and fishing mortality respectively. The currently exploitation rate E = 0.55. The length and age at first capture (Lc) (Tc) was 19.6 cm and 1.94 years respectively. In the end, 54.1% of the total fish catch of fish Atlantic mackerel is small and this affects the fish stocks of these fish and must not fishing until this fish to the maturity, also these fish are important in north Sinai as the catch from these fish reached 75 tons per year and their prices are affordable

INTRODUCTION

The Atlantic mackerel *(Scomber scombrus* L. 1758) is a pelagic schooling species abundant in cold and temperate waters of the northern Atlantic Ocean and Mediterranean Sea (Froese and Pauly, 2012). *Scomber scombrus* is a valuable commercial species, targeted by purse seines, midwater trawls and

longlines (FAO-FIGIS, 2005). The catch of this species declined in the Adriatic Sea at the beginning of the 1970s (Sinovcic, 2001; Azzurro *et al*., 2011; Barausse *et al*., 2011).

The Atlantic mackerel (*Scomber scombrus* Linnaeus, 1758 is an important food resource for larger pelagic predators, including sharks and marine mammals, and a variety of sea birds (Dahl and Kirkegaard, 1986). Wiedenmann (2015) found that the biological parameter of Atlantic mackerel (*Scomber scombrus*) in the northwest Atlantic was Age at recruitment (Tr =1 year), age at first capture (Tc =1.9 year), T_0=−2.42, $L\infty$=44.59 cm, k=0.2 .Villamor *et al.* (2004) studied the age, growth patterns and the interannual growth variability during the 1990–2000 period of the northeast Atlantic mackerel (*Scomber scombrus* Linnaeus, 1758) at north and northwest Spain . Age was determined by interpreting and counting growth rings on the otoliths (*sagitta*) of 7732 individuals caught during the spawning seasons by the commercial fleet and during fisheries research surveys. The parameters of the von Bertalanffy growth curve were estimated for sex combined for the whole period studied ($L\infty$=42.7 cm, k=0.268 per year , $t0$=−2.17 years) and for each year; for males ($L\infty$=42.1 cm, k=0.276 per year, $t0$=−2.15 year) and females ($L\infty$=43.0 cm, k =0.264 per year, $t0$=−2.21 year) for the whole period studied.

Length weight relationship of Atlantic mackerel (*Scomber scombrus was* $w = 0.0043L^{3.172}$ of males and $w = 0.0032L^{3.258}$ of females of the Portuguese west coast (Mendes and Campos, 2004), $w = 0.00643L^{3.079}$ of the Portuguese coast (Santos *et al.*, 2002) and $w = 0.0053L^{3.084}$ of Mediterranean (Froese and Pauly , 2003).

The level of natural mortality (M) currently being used in cohort analyses (M = 0.30) was arrived at more by compromise consensus than from data analyses in Northwest Atlantic mackerel *(Scomber scombrus*) by (Anon, 1974). and 0.48 by (Lett and Marshall, 1978) and total mortality 0.85 Northwest Atlantic mackerel (*Scomber scombrus*) by (Anderson and Paciorkowski, 1978).

The total mortality rate for of Northwest Atlantic mackerel (*Scomber scombrus*) during 1977 was estimated in the range of 0.62-0.63 and natural mortality (M = 0.38) implies a terminal Fishing mortality (F) of 0.24-0.25 in1977 (Winters, 1978).

The Atlantic mackerel fish (Skompla) are considered the most important fishes in the port of El Arish. Where production Atlantic mackerel fish *Scomber scombrus* (Skompla) arrived about 75 tons. Theses research aims to study the biological and dynamical characteristic of this species to assess the situation of this kind and to provide some information for stock management.

MATERIALS AND METHODS

Monthly, random samples Atlantic mackerel fish *Scomber scombrus* (Skompla) collected from El Arish port (North Sinai Coast). The samples were collected from January to December 2016.

The total length of 2423 individuals of Atlantic mackerel fish from the tip of the snout to the end of the caudal fin was measured to nearest centimeter, total weight to the nearest 0.1 gram Fig (1).

Fig 1. Atlantic mackerel fish *Scomber scombrus* (Skompla) collected from eastern Mediterranean (North Sinai Coast.

Total length and total weight of 2423 specimens of Atlantic mackerel fish *Scomber scombrus* were recorded monthly during 2016. The length–weight relationship described as $W = a * L^b$ where W = total weight (g), L = total length (cm) and a & b constants. The values of $L\infty$, K and t_0 were estimated by Ford, 1933-Welford method, 1946 where growth rate is plotted against the mean length during the corresponding year.

Otoliths for 1762 samples were removed, cleaned and stored dry in labeled vials. Annual rings on otoliths were counted using an optical system consisting of Nikon Zoom-Stereomicroscope focusing block, Heidenhain's electronic bi-directional read out system VRX 182, under transmitted light. The total radius of the otolith "S" and the distance between the focus of the otolith and the successive annuli were measured to the nearest 0.01 mm. The otolith's measurements from specimens were used to describe the relationship between the total length and the otolith radius. Lengths by age were back-calculated using (Lee's, 1920) equation as follows:$L_n = (L – a) (S_n / S) + a$

Where: L_n equals length of fish at formed of ring *n* (*age at n year*), *L* equals the fish length at capture, S_n equals the scale radius at fish length L_n and *S* is the total radius of scales (a: constant). The calculated weight at the end of each year was estimated by applying length-weight equation.

The growth performance index (ø) was estimated using Pauly and Munro, 1984 formula as $ø = \text{Log } K + 2 \text{ Log } L\infty$.

Total mortality were obtained by using five methods 1- (Beverton and Holt's, 1957 based on age data and as $Z= 1/(\bar{t} - t)$ where $\bar{t}$ is The age of the average length of the fish from the age of 2 and till the end and t is The age of the most frequent fish catches 2- (Beverton and Holt's, 1957 based on length data as $Z=K*((L\infty-\bar{Lc})/(\bar{Lc} -Lc))$ Where L_c The length of the fish at 50% of the catch of the catch , L_c Average fish in catches of 50% even bigger fish in the sample 3-(Chapman and Robson, 1960) as $Z= -Ln S$) and 4- Estimation of Z from a linearized catch curve based on age composition data as Z=-b and The Powell- Wetherall method (Powell, 1979) discussed in 5-(Wetherall *et al.*, 1987) as Z=1-k

Natural mortality coefficient was estimated by using two methods: 1- (Alverson and Carney, 1975 as $M = 3 * K / [\exp (t_{max} * 0.38 * K) - 1]$ 2- Hewitt and Hoenig, 2005 as $M=4.22/t_{max}$), where t_{max} is the maximum age of the fish in the sample3-Jensen (1996) as M=1.5k. Fishing mortality F=Z-M. The exploitation rate (E) by Gulland, 1971 E= f/z. Survival rate from age composition data using Ricker, 1975 equation found $S=e^{-Z}$.

Length at first capture (Lc) was calculated from the plot of the probability of capture against size. The method of Gulland, 1969 was used to predict the yield per recruit as follows:

$Y`/R = F*e^{(M(Tc - Tr))} *W\infty*[(1/Z) - (3S/Z+K) + (3S^2/Z+ZK) - (S^3/Z+3K)]$,Where $S = e^{(-k(Tc - t_0))}$. L_∞, K, and $t_0 = t_o = t + 1 / k \, Ln (L\infty - Lt) / L\infty$, Tc is age at first capture, Tr is age at recruitment, W∞ is asymptotic body weight, F is fishing mortality, M is a natural mortality and Z = F+M, is a total mortality.

RESULTS

Body length-otolith radius relationship.

The otolith –total length relationship is almost linear and can be described by the following equation L =8.1875+5.8361 S, (with R2 = 0.8796Where S is the otolith radius and L is the total length

Back-Calculations length.

The following equation was derived to obtain the back-calculation total length at the end of each year of life: Ln =(L-8.1875)(Sn/S)+8.1875. Where Ln is the length at the end of nth year, Sn is the radius of the otolith to n^{th} annulus, S is the total radius of the otolith and L is the total length at the capture.

The obtained back-calculation length at the end of each year of life are given in Fig (2). The results found that the highest increment in length for *Scomber scombrus* at the first year of life (16.20 cm) and then declined rapidly thereafter, the back-calculated length of *Scomber scombrus* are 16.20, 19.73, 22.76, 25.10 and 27.01 cm for age 1, 2, 3, 4 and 5 years respectively (Fig. 2).

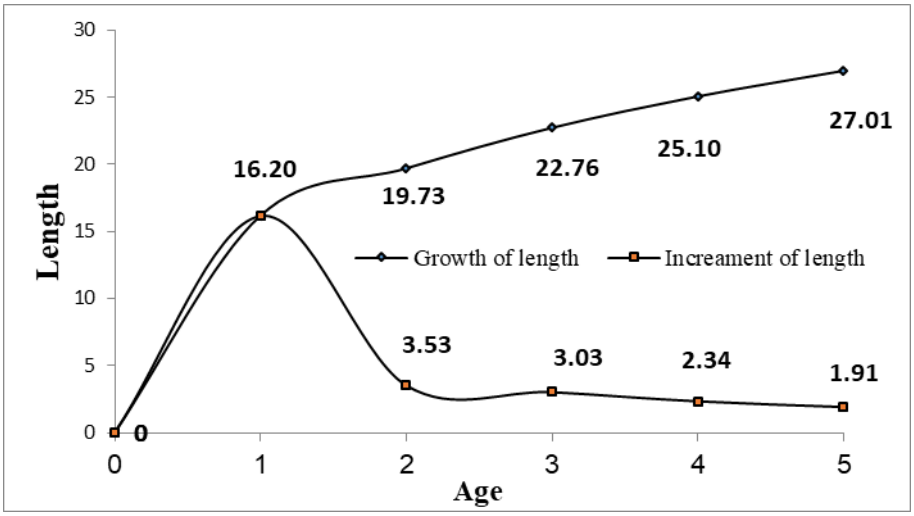

Fig 2. Growth and annual increment in length (♀♂) of *Scomber scombrus*, 2016.

Length – Weight relationship.

The length–weight relationship curve *Scomber scombrus* in Bardwell lagoon is presented in (Fig. 3), was described by the power equation as W= 0.0088*L $^{3.0407}$

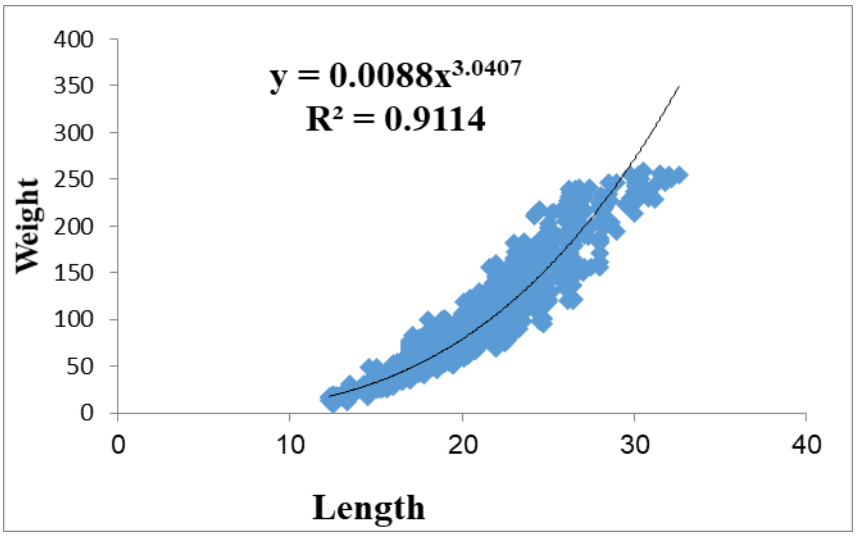

Fig 3. Length-weight relationship (♀♂) of *Scomber scombrus* collected from Mediterranean coast of Sinai 2016.

Growth in Weight.

From Fig. 4, it is clear that the highest increment in weight for *Scomber scombrus* occurred at the end of first year of life as increment was (41.88 gm) and then declined rapidly thereafter. The back-calculated weight of *Scomber scombrus* were 41.88, 76.31, 117.77, 158.60 and 198.3 gm, for age 1, 2, 3, 4 and 5 years respectively.

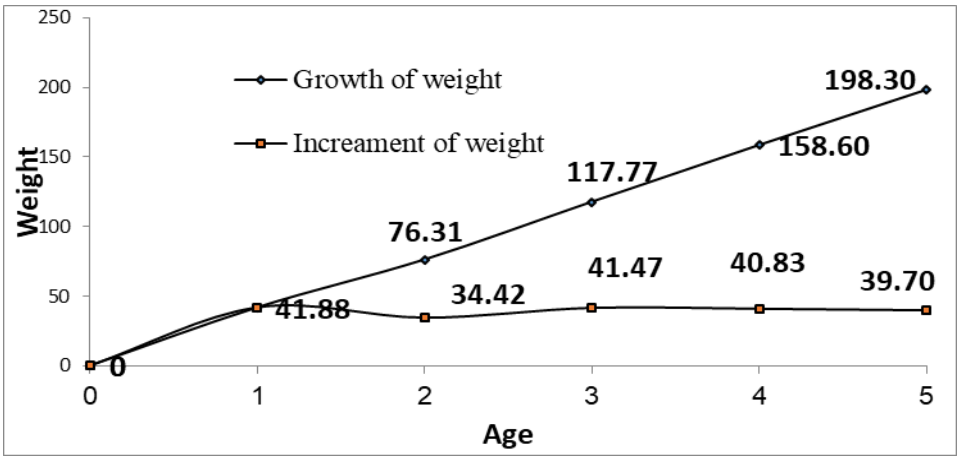

Fig 4. Back –calculation weight at the end of different years of life (♂♀) of *Scomber scombrus*, 2016.

Growth parameters.

The back-calculated length and according to the plot of Ford wel Ford 1933 the von Bertalanffy growth parameters L_∞, K, t_o and W_∞ were estimated 35.51, 0.2053, -1.9661 and 455.8 respectively the equations obtained were as follows

For length $Lt = 35.51(1-e^{(-0.2053\,(t+1.9661))})$

For weight $Wt = 455.8(1 - e^{(-0.2053(t + 1.9661))})^{3.0407}$

Growth performance index (Φ).

The growth performance index (Φ and Φ') as defined by were computed for *Scomber scombrus* in the Eastern Mediterranean and found to be 2.413 for length and 1.085 for weight.

Estimation of L_{opt}, T_{max} and Lc.

Maximum length with the highest biomass of *Scomber scombrus* in Bardwell lagoon L_{opt} was 24.001 cm, and maximum age T_{max} was 14.6 years. The length at first capture (The length at which 50% of fishes retained by the gear is the mean selection length, Lc) was estimated to be 19.6 cm (Fig 5).

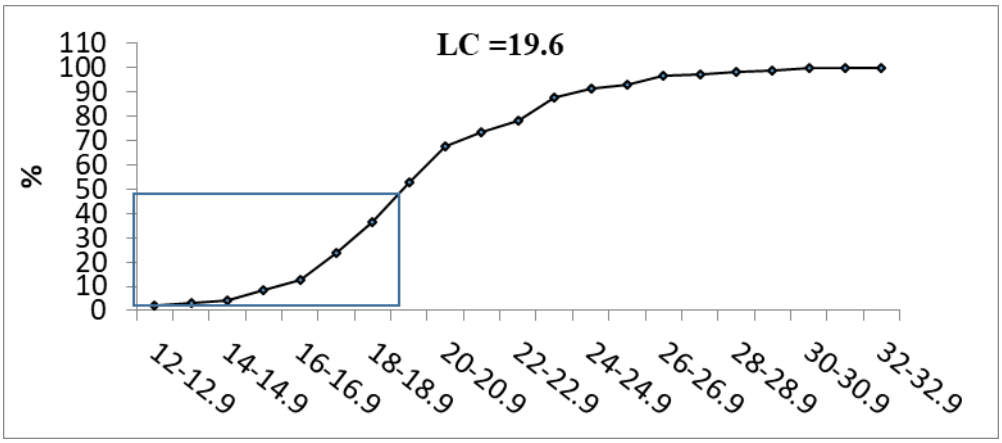

Fig. 5. Length at first capture (L_c) =19.6 cm of *Scomber scombrus* during 2016.

Age composition.

The age distribution of sample ranged from age 0 to v years for *Scomber scombrus* based results of the otolith reading (Fig. 6) the age group I was dominant (36.4%) followed by groups П (20.8%), 0 (18.2%), Ш (11.4%), IV (9.2%) and V(4%) respectively (Fig. 6).

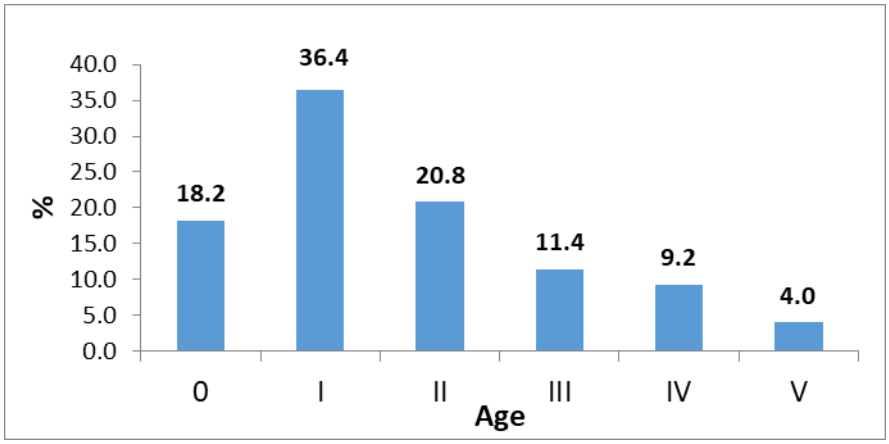

Fig. 6. Age composition of combined sexes of *Scomber scombrus* in Mediterranean coast of Sinai during 2016

Mortalities, survival and exploitation rate.

Estimation total mortility by five methods and the average results Z= 0.6951 year^{-1} of *Scomber scombrus* in bardawill lagoon during 2016 and natural mortality estimated by three methods and the average results M=0.2945 year^{-1} also fishing mortality estimated by difference between total and natural mortality F=Z-M was 0.3997 year^{-1} and Estimation the exploitation rate (E) was 0.57 year^{-1} .

Yield per recruit.

Yield per recruit Yield per recruit (Y/R) and biomass per recruit (B/R).

The yield per recruit (Y/R) and biomass per recruit (B/R) of *Scomber scombrus* in Bardawill lagoon during 2016 were found to be 44.63 gm and 48.241 gm respectively at the actual fishing mortality 0.3997 year^{-1} and 1.05 respectively. Biomass per recruit was decreased with the increasing of fishing mortality where it maximized (358.18 gm) at F=0.0 (Fig.7).

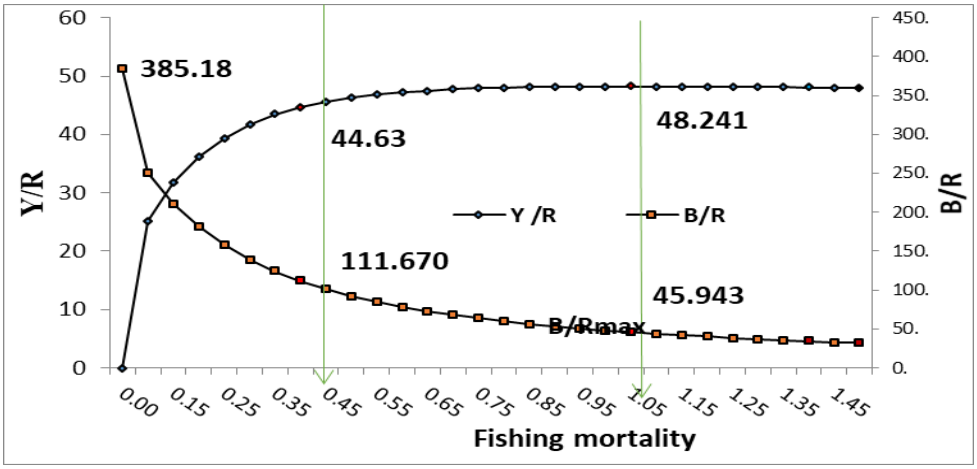

Fig 7. Yield per recruit (Y/R) and Biomass per recruit (B/R) of *Scomber scombrus* during 20162016 a function of different fishing mortality.

The effect of different values of "tc" in (Y/R) with different values of "F.

The yield per recruit of *Scomber scombrus* was calculated using tc = 1.0, 1.5, 1.94 (the present age at first capture), 2.5 and 3.0 in Fig (8) .The results indicated that the maximum yield per recruit increases when the age at first capture increases. The higher values of yield per recruit (43.56, 46.28, 48.24, 50.025 and 50.97) were with tc = 1.0, 1.5, 1.94, 2.5 and 3.0 years, respectively at fishing mortality 0.55,0.75,1.05,1.75 and 3.6, respectively.

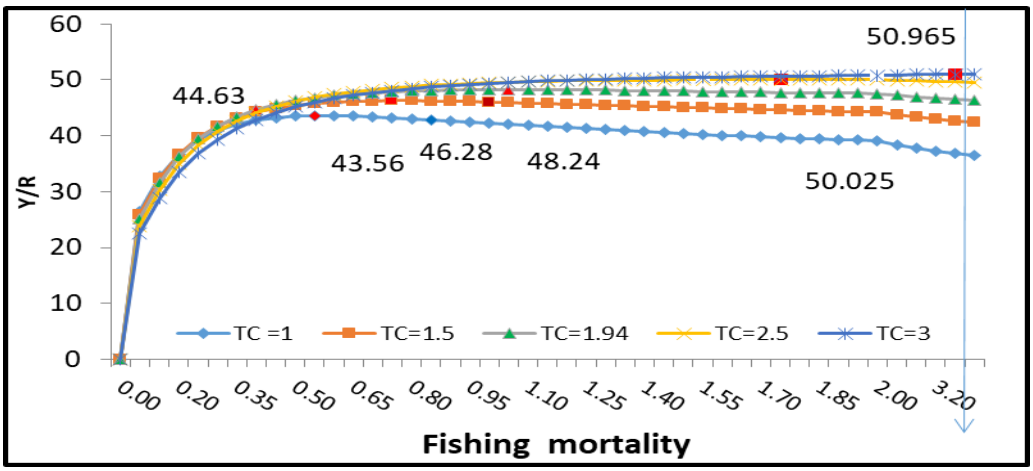

Fig 8. Yield per recruit (Y/R) of *Scomber scombrus* during 2016 a function of different fishing mortality and age at first capture

DISCUSSION

Age and growth parameters are the most important study to our understanding of the species biology was enable to control of fishing and the growth studies based on the sum of increments are held to be more descriptive of biological growth potential **(**El-Zarka, 1961).

Age was determined by means of the interpretation and counting of growth rings on the otoliths (sagitta) of 2423 individuals caught during the spawning season by the commercial fleet and on fisheries research surveys. In present study, the otoliths of, Atlantic mackerel *Scomber scombrus* were used estimate the age and growth characteristics. The sizes for all individual are ranging between 12.3-32.6 cm in total length and 8.7-259.2 g weight. The results of the present study is in conformity with the results of Meneghesso *et al.* (2013) where it ranged from 13.4 to 35.8 cm in Adriatic sea and Torres *et al*. (2012) where it ranged from 12.3 to 38.2 cm in the Gulf of cadiz but less than the results obtained from Costa, *et al*. (2017) where it renged from 16.8 to 49.5 cm in west coast of Portugal and Sinovicic (2001) the length where it ranged from 20 to 41.5 cm for Adriatic sea also Hector *et al.* (2012) in the North Sea where it ranged from 13 to 40.5 cm and finally Martins and Cardador (1996) indicated that it yanged from 17 to 41 cm in the Portuguese continental water . Crec'hriou *et al.* (2013) found that it ranged from 19 to 46 cm in French Catalan coast and Wilhelms (2013) reported that it ranged from 7.5 to 45.5 cm in the North Sea and Karakulak *et al*. (2006) reported that it ranged from 22 to 31.1 cm in Gökceada Island (northern Aegean Sea) these results may be due to probably due to environmental changes and the small-sized fish were scarcely represented in the whole sample, because of the minimum landing size of 18 cm TL allowed in the Adriatic Sea (Meneghesso *et al.* (2013) also in Egypt the nets of purse seine are narrow and there is no control on the nets.

The age composition of *Scomber scombrus* showed a five age classes. The results revealed that, the percentage occurrence of age groups as 18.2, 36.4, 20.8, 11.4, 9.2 and 4.0% for 0,1st, 2nd, 3rd, 4th and 5th age respectively. Héctor *et*

al. (2012) studied the distribution of age Atlantic mackerel *Scomber scombrus* found that it stretches for over 14 years in the North Sea but ages most presence is the years the first and second and ratios too weak ages of the 8th and 14th.

In the present study, the calculated values of 'b' for length and weight of *Scomber scombrus* was 3.0407 for combindsexes. The correlation coefficient was close to one suggesting a good adjustmeent between length and weight of Atlantic mackerel *Scomber scombrus* which were of expected range (W = 0.0088 L3.0407 (r2 = 0.9114).These presented results were equal with results obtained from Santos *et al.,* 2002 and (Froese and Pauly, 2003) where the values of b were 3.079 and 3.084 respectively also our results are lower than the results which obtained by (Mendes and Campos, (2004) and Morse, 1980) the value b were 3.258 and 3.275 respectively but much lower than that the obtained by (Sinovicic, 2001) the represented that the value b was 3.7685 may be to that in this study the proportion of small fish high . The b values in fish is species specific and varies with sex, age, seasons, physiological conditions, growth increment and nutritional status of fish, health, habitat, nutrition, environmental conditions (such as temperature and salinity), area, degree of stomach fullness, differences in the length range of the caught specimen, maturity stage and techniques of sampling fishing gear (Tesch, 1968; Le Cren, 1951; Begenal and Tesch, 1978). In the present study, environmental or habitat factors were not analyzed.

In this results, growth parameters of *Scomber scombrus* (L_∞ = 35.03, K = 0.2108 and t_o = -1.9391) were lower than of that for the same species which resulted of the north and Northwest of spain by Villamor *et al.* (2001) where the L_∞, K and t_o was 44.3 cm, 0.226 $year^{-1}$ and -2.78 $year^{-1}$ respectively. In Catalan sea by Perrota *et al.* (2005) mentioned that L_∞, K and t_o were 39.75 cm, 0.29 $year^{-1}$ and -1.41 $year^{-1}$ respectively. In the northwest Atlantic by

Wiedenmann (2015) reported that the L_∞, K and t_o were 44.59 cm, 0.20 year^{-1} and -2.42 year^{-1} respectively . Finally, in Portuguese coast Costa *et al.* (2017) mentioned that the L_∞, K and t_o were 42.6 cm, 0.245 year^{-1} and -2.73 year^{-1} respectively. On the other hand, these results of *Scomber scombrus* were higher than that recorded by Bayhan (2007) in the Aegean Sea which reported that L_∞, K and t_o were 29.87 cm, 0.20 year^{-1} and -0.36 year^{-1} respectively. This was attributed to the physiological processes through which individuals pass during their first stages of development.

Generally, fish that have small K takes a long time to reach its maximum length. The high value of K indicates the speed of the fish to achieve faster L_∞ and age Sparre and Venema (1999). The value difference is caused by internal and external factors. Internal factors influence the genetic factors, parasites, disease, and external factors influence the temperature and food availability (Effendie, 2002). The high value of K may indicate to quick recovery from the waters of fishing pressure. While the value of different K allegedly influenced by dietary factors, competition, pollution and genetic factors. Such differences are due to variations in environmental conditions as well as sampling techniques and computations (Hernandez, 1986).

The growth performance index (φ) emerges as an alternative as it has suitable dimensions of cm per year although put on logarithmic base Munro and Pauly, 1983; Pauly and Munro, 1984. The discovery by Pauly, 1979 that the relation between Log K and Log L_∞ is 2 (or 2/3 when W_∞ is used instead of L_∞) constantly across fish species, turns out to be a consequences of the so called, Beverton and Holt dimensionless life- history inversion Beverton and Holt, 1956 ; Beverton, 1992 and Charnov, 1993 which allows the comparison of growth performance index as represented by Munro and Pauly, 1983 of stocks of the same or different species, be they closely allied species or not. It also represents a potential check for the accuracy of growth parameter estimates. The growth performance index (φ) is equal within species or between closely taxa and between different stocks of the same species Moreau *et al.*, 1986.

The growth performance index (φ) for *Scomber scombrus* in the presented this study was greater than those obtained in the Aegean Sea 2.25 (Bayhan 2007). But less than the results obtained from Azores 2.823 (Carvalho *et al.*, 2002) from Spanish coast 2.65 (Villamor *et al.*, 2004), from Catalan sea 2.674(Perrota *et al*., 2005), Gulf of Cadiz 2.698 (Velasco *et al.*, 2011), SW Mediterranean 2.772 (Velasco *et al.*, 2011) and finally from Portuguese coast 2.65 (Costa *et al.*, 2017).

In the present study the annual rates of total mortality coefficient "Z", the natural mortality "M" and the fishing mortality "F" for combined sexes of Atlantic mackerel fish (Scomber scombrus) were estimated to be 0.6951, 0.2954 and 0.3997 respectively.These results agreement with that obtained by (Anon, 1974) in Northeast Atlantic where M= 0.3 and Winters (1978) in Northeast Atlantic where Z= 0.62,M= 0.38 F= 0.25. Also these results were lower than that obtained by Lett and Marshall (1978) in Northeast Atlantic where M=0.48 and Anderson and Paciorkowski (1978) in Northeast Atlantic where Z = 0.85.

This difference can be explained by a very high fishing effort and a high natural mortality. Concerning mortality estimates, comparison is difficult because of scarcity of data and the total mortality coefficient is not a species-specific parameter, but an area specific parameter. These results could be explained by a high predation or other natural causes affecting fry and juveniles. Mortality parameters depend on both physiological factors (disease, old age, etc.), environmental factors (temperature, currents ...). According to Christensen and Pauly (1997) for juveniles, predation mortality is sometimes much higher than fishing mortality. The comparison shows that the mortality estimates differ from author to author and from one region to another, the temperature and the parameters of the equation of von Bertalanffy are the main sources of variation values of natural mortality (Pauly, 1985).

Exploitation rate is the fraction of an age class that is caught during the life span of a population exposed to fishing pressure, i.e., the number caught

versus the total number of individuals dying due to fishing and other reasons. which allows one to (roughly) assess if a stock is overfished or not, on the assumption that the optimal value of E is about equal to 0.5, the use of E ≈ 0.5 as optimal value for the exploitation ratio itself resting on the assumption that sustainable yield is optimized when F ≈ M Gulland, 1971. Pauly, 1987 proposed a lower optimum F that equal to 0.4 M, so the values of fishing mortality and exploitation rate were relatively high indicating a high level exploitation. In present study the exploitation rate was 0.57 for combined sexes. Winters (1978) found that, exploitation rate (E) was 0.0.4 using value of M and F for the Northeast Atlantic.

The yield per recruit of of Atlantic mackerel fish (*Scomber scombrus)* estimated by means of Gulland (1969) equation. T_o investigate the variation in yield per recruit with changing of age at first capture T_c, this is closely related to the estimation of the optimum mesh size. The results indicated that the maximum yield per recruit is obtained with a fishing mortality coefficient F = 1.05 this means that the present level of fishing mortality coefficient is lower than the fishing mortality coefficient which produce the maximum yield per recruit. Results indicated that, the maximum yield per recruit (MYR) will be achieved at Tc = 3 year with current exploitation rate (F = 0.3997) in a long time. In addition, with a increasing of fishing mortality F = 1.05 at Tc = 2.0 year, the maximum yield per recruit will be increase. Increasing of effort (F = 0.3997) to F_{max} (F = 1.05) associated with negligible increase in the yield per recruit (48.24 – 44.63 = 3.61). This mean that increase of fishing mortality coefficient by about 163.4% from 0.3997 to 1.05 [(1.05 – 0.3997) / 0.3997] * 100 = 163.4% would increase the yield per recruit by only 8.1% [48.24 – 44.63/ 44.63 * 100 = 8.1%], this is unacceptable biologically.

RECOMMENDATION

Catches of small fish (0 and 1st, 54.6% of age groups) must be stopped to prevent growth overfishing and exploitation of large size fish (4th age, 5.8% of age groups) must be regulated to prevent recruitment overfishing.

REFERENCES

Alverson, D.L. and M.J. Carney, 1975. A graphic review of the growth and decay of population cohorts. Journal du Conseil International pour l' Exploration de la Mer , 36:133–143.

Anderson, E.D. and A.L. Paciorkowski, 1978. A review of the Northwest Atlantic Mackerel fishery. Doc. No. 11, Symposium on Biological Basis of Pelagic Fish Stock Management, Aberdeen 1978.

Anon, 1974. Report of the Mackerel Working Group. ICNAF Redbook: 31-36. 1977. Annual report of the New foundland Biological Station for 1977. 1978. Report of the Mackerel Working Group. ICES Pelagic Fish Comm. C.M. 1978.

Azzurro, E.; P. Moschella and F. Maynou, 2011. Tracking signals of change in Mediterranean fish diversity based on local ecological knowledge. PLoS One 6, e24885. doi: 10.1371/journal.pone.0024885.

Barausse, A.; A. Michieli; E. Riginella; L. Palmeri and Mazzoldi, 2011. Long-term changes in community composition and life-history traits in a highly exploited basin (northern Adriatic Sea): the role of environment and anthropogenic pressures. Journal of Fish Biology, 79: 1453–1486. doi: 10.1111/j.1095-8649.2011.03139.x

Bayhan, B., 2007. Growth characteristics of the chub mackerel (*Scomber japonicus* Houttuyn, 1782) in Izmir Bay (Aegean Sea, Turkiye). Journal of Animal Veterinary Advances, 6: 627-634.

Begenal, T. B. and F. W Tesch, 1978. Age and Growth In: T. Bagena, editor, methods for assessment of fish production in fresh waters. IBp handbook No.3 (3rded) Black well scientific publications, oxford. pp 101-136(chapter 5).

Beverton, R.J.H., 1992. Patterns of reproductive strategy parameters in some marine teleost fishes. J. Fish Biol., 41(B):137-160.

Beverton, R.J.H. and S.J. Holt, 1957. On the dynamics of exploited fish population. Fishery Invest., Lon., Ser., 2:19.

Beverton, R.J.H. and S.J. Holt, 1956. A review of methods for estimating mortality rates in exploited fish populations, with special reference to sources of bias in catch sampling. Rapp. P. V. Reun. CIEM, 140 (1): 67 – 83.

Carvalho, N; R.G. Perrotta and E. Isidro, 2002. Age, growth and maturity in chub mackerel (*Scomber japonicas* Houttuyn, 1782) from the Azores. Arquipélago Ciências Biológicas Marinhas, 19: 93-99.

Chapman, D.G. and D.S. Robinson, 1960. The Analysis of a Catch Curve. Biomertics, 16: 354 – 368.

Charnov, E.L., 1993. Life history invariants. Oxford University Press, London, 167 pp.

Christensen, V. and D. Pauly, 1997. Placing fisheries resources in their ecosystem context. EC fisheries Cooperation Bull., 10 (2):9-11.

Costa, A.M.; L. Gordo and M.M. Martins, 2017. Growth and distribution of Mackerel *Scomber scombrus* Linnaeus, 1758 from the west coast of Portugal. Cah. Biol. Mar., 58: 409-421. DOI: 10.21411/CBM.A.FCACD9B0.

Crec'hriou, R.; R. Neveu and P. Lenfant, 2013. Length-weight relationship of main commercial fishes from the French Catalan coast. J. Appl. Ichthyol., 29:1191-1192.

Dahl, K. and E. Kirkegaard, 1986. Stomach contents of mackerel, horse mackerel and whiting in the eastern part of the North Sea in July 1985. ICES-CM-1986/H: 68: 17.

Effendie, M.I., 2002. Biologi Perikanan. Yogyakarta: Yayasan Pustaka Nusantara.

El-Zarka, S.D., 1961 .Tilapia Fisheries Investigation in Egyptian Lakes: II: A Biological Studies of Fisheries of Tilapia zillii Gervcais in Lake Quarun, Egypt. U.A.R. Notes Mem, Hydrobiol, Fish, Dir, Cairo, 66: 1-14.

FAO-FIGIS, 2005. A World Overview of Species of Interest to fisheries. Chapter: Thunnus maccoyii. Retrieved on 12 July 2005, from

www.fao.org /figis /servlet /species?fid=3298. 3p. FIGIS Species Fact Sheets. Species Identification and Data Programme-SIDP, FAO-FIGIS

Ford, E., 1933. An Account of the Herring iInvestigation Conducted at Plymouth. J. Marin. Biol. Ass. U.K., 19: 305 – 384.

Froese, R. and D. Pauly, 2012. FishBase. FishBase. http://www.fishbase.org.

Froese, R. and D. Pauly, 2003. FishBase (WWW Database). World Wide Web Electronic Publication. URL: http://www.fishbase.org, Version 5, January 2004.

Gulland, J.A., 1971. The Fish Resources of the Oceans. Fishing News Books Ltd., England. 255p.

Gulland, J.A., 1969. Manual of Method for Fish Stock Assessment Par, 1 fish population analysis FAO Man. Fish Sci., 4: 154.

Héctor, P.; R. Jostein; S. Georg; R.U. Kjell and N. Leif, 2012. Cruise report on northeast Atlantic mackerel (*Scomber scombrus*) abundance and distribution in the North Sea and west of the British Isles from 1st to 20th of October 2012. Toktrapport /Havforskningsinstituttet/ISSN 1503-6294/Nr. 4 – 2012.

Hernandez, A.H.V., 1986. Study on the age and growth of bogue (*Boops boops*) from the central Adriatic Sea. Cybium, (13): 281 - 288.

Hewitt, D.A. and J.M. Hoenig, 2005. Comparison of two approaches for estimating natural mortality based on longevity. Fishery Bulletin, 103:433-437.

Jensen, A.L., 1996, Beverton and Holt life history invariants result from optimal trade-off of reproduction and survival. Canadian Journal of Fisheries and Aquatic Sciences, 53: 820-822.

Karakulak, F.S.; H. Erk and B. Bilgin, 2006. Length-weight relationships for 47 coastal fish species from the northern Aegean Sea, Turkey. J. Appl. Ichthyol., 22: 274-278.

Le Cren, E.D., 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch (Perca fluviatilis). J. Anim. Ecol., 20: 201-219.

Lee, R., 1920, A review of the methods of age and growth determination in fishes by means of scales. Fishery investigations, Series 2, Marine fisheries, Greet Britain Ministry of Agriculture, Fisheries and food 4.

Lett, P.F. and W. Marshall, 1978. An interpretation of biological factors important in the management of the Northwest Atlantic mackerel stock. CAFSAC Res. Doc. 78/17.

Martins, M.M. and F. Cardador, 1996. Abundance and distribution pattern of Spanish mackerel (S. japonicus) and mackerel (*Scomber scombrus* L.) in the Portuguese continental waters (ICES Div: IXa). ICES Document CM 1996/H: 24. 21 pp.

Mendes, P.F. and A. Campos, 2004. Weight–length relationships for 46 fish species of the Portuguese west coast. J. Appl. Ichthyol. 20 (2004), 355–361. _ 2004 Blackwell Verlag, Berlin. ISSN 0175–8659.

Meneghesso, C.; E. Riginella; M. La Mesa; F. Donato and C. Mazzoldi, 2013. Life-history traits and population decline of the Atlantic mackerel *Scomber scombrusin* the Adriatic Sea. Journal of Fish Biology, 83: 1249–1267.

Moreau, J.; C. Bambino and D. Pauly, 1986. Indices of overall fish growth performance of 100 tilapia (Cichlidae) populations. In the first Asian fisheries forum, edited by J.L. Maclean, L.B. Dizon and L.V. Hosillos, Manila, Philippines, Asian Fish. Soc. 201-6.

Morse, W.W., 1980. Spawning and fecundity of Atlantic mackerel,*Scomber scombrus*, in the middle atlantic bight. Accepted August 1979. Fishery Bulletin, 78 (1).

Munro, J.L. and D. Pauly, 1983. A simple method for comparing growth of fishes and invertebrates. ICLARM Fishbyte, 1 (1): 5 – 6.

Pauly, D., 1987. A review of the ELEFAN system for analysis of length-frequency data in fish and aquatic invertebrate. ICLARM Conf. Proa, 13:7-34.

Pauly, D., 1985. Quelques méthodes simples pour l'estimation des stocks de poissons tropicaux. FAO Doc. Tech. Pêches, (234): 5.

Pauly, D., 1979. Gill size and temperature as governing factors in fish growth: a generalization of von Bertalanffy's growth formula. Ber. Inst. Meereskd. Christian-Albrechts-Univ. Kiel, (63):156 p.

Pauly, D. and J.L. Munro, 1984. Once more on the comparison of growth in fish and invertebrates. ICLARM Fishbyte, 2 (1): 21.

Perrota, R.G.; N. Carvalho and E. Isidro, 2005. Comparative study on growth of chub mackerel (*Scomber japonicas* Houttuyn, 1782) from three different regions: NW. Mediterranean, NE and SW Atlantic. Revista de Investigación y Desarrollo Pesquero, 17: 67-79.

Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Canada, 191: 382.

Powell, D.G., 1979. Estimation of mortality and growth parameters from the length frequency of a catch. Rapp. P. -v. Réun. CIEM, 175:167-169.

Santos, M.N.; M.B. Gaspar; P.Vasconcelos and C.C. Monteiro, 2002. Weight-length relationships for 50 selected fish species of the Algarve (southern Portugal). Fish. Res., 59: 289–295.

Sinovcic, G., 2001. Population structure, reproduction, age and growth of Atlantic mackerel, *Scomber scombrus* (L.) in the Adriatic Sea. *Acta Adriat*. (00015113) 2 (2001), 42; 85-92. assessment. Part 2. Examples. Rev. 2. FAO. Fish. Rome, FAO. 94p.

Sparre, P. and S.C. Venema, 1999. Introduction to tropical fish stock assessment. Part 2. Examples. Rev. 2. FAO. Fish. Rome, FAO. 94p.

Tesch, F.W., 1968. Age and Growth in Methods for Assessment of Fishes Production. In: W.E. Ricer (Ed.), in methods for assessment of fish production in Freshwater, IBP Handbook, Blackwell Science Publication, London: 93-123.

Torres, M.A.; F. Ramos and I. Sobrino, 2012. Length-weight relationships of 76 fish species from the Gulf of Cadiz (SW Spain). Fish. Res. 127-128:171-175.

Velasco, E.M.; D.A. Juan; B. Jorge and S. Ignacio, 2011. Age and growth of the Spanish chub mackerel *Scomber colias* off southern Spain: a comparison between samples from the NE Atlantic and the SW Mediterranean Revista de Biología Marina y Oceanografía, 46 (1): 27-34.

Villamor, B.; P. Abaunza and A.C. Farina, 2004. Growth variability of mackerel (*Scomber scombrus*) off north and northwest Spain and a comparative review of the growth patterns in the northeast Atlantic. Fisheries Research, 69: 107-121.

Villamor, B.; P. Abaunza and A.C. Fariña, 2001. Age and growth of northeast atlantic mackerel (*scomber scombrus*) in waters of the north and Northwest of spain (ices divisions viiic and ixa north), 1990-2000. International council for the exploration of the sea cm 2001/ j:44 living resources. Session j.

Walford, L.A., 1946. A new graphic method of describing the growth of animals. Mar. Biol. Bull. 90 (2): 141 – 147.

Wetherall, J.A.; J.J. Polovina and S. Ralston, 1987. Estimating growth and mortality in steady-state fish stocks from length-frequency data. In: Length-based References 131 methods in fisheries research (eds D. Pauly and G.R. Morgan). ICLARM Conf. Proc., 13: 53-74.

Wiedenmann, k., 2015. Application of Data-Poor Harvest Control Rules to Atlantic Mackerel. Report to the Mid Atlantic Fishery Management Council April 17th, 2015.

Wilhelms, I., 2013. Atlas of length-weight relationships of 93 fish and crustacean species from the North Sea and the North-East Atlantic (No. 12). Johann Heinrich von Thünen Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries, 552 p.

Winters, G.H., 1978. Estimation of natural and total mortality rates Of northwest atlantic mackerel. CAFSAC Res. Doc. 78/35 22 September, 1978.

دراسات بيولوجية على أسماك الماكريل (الاسكمبلا) من شرق البحر المتوسط (ساحل شمال سيناء) مصر

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الملخـص العربـــي

الهدف من هذه الدراسة هو إعطاء المعلومات الأساسية اللازمة لإدارة اسماك الاسكمبلا فى شرق المتوسط ساحل شمال سيناء مصر. تم جمع 2423 عينات من اسماك الاسكمبلا(*Scomber scombrus* L. 1758) تقع اطوالها ما بين 12.3 الى 32.6 سم (طول كلى) ووزن من 8.6 إلى 259.2 جم (الوزن الكلي) ، من يناير إلى ديسمبر 2016 من ساحل البحر المتوسط شمال سيناء. كانت العلاقة بين الطول والوزن $W = 0.0088L^{3.0407}$. تم تحديد العمر حسب المقاييس حيث تتراوح أعمارهم بين صفر إلى خمس سنوات. تم حساب النمو في الطول والوزن في نهاية كل عام وكانت الاطوال بالحساب الرجعى فى نهاية كل سنه عمريه على النحو التالي 16.2و19.72و22.76و25.1 و27.01 سم للسنوات الأولى والثانية والثالثة والرابعة والخامسة على التوالي. تم حساب معاملات النمو لمعادلة فون بيرتلانفي ($L_\infty = 35.51$ سم ، $K = 0.2053$ و $t_0 = -1.9661$ سنة). مؤشر أداء النمو ($\varphi' = 2.413$). كانت معدلات الوفيات 0.9651، 0.2945، 0.9651،0.3997 لمعدل الوفيات الكلي والطبيعي والصيد على التوالي ومعدل الاستغلال الحالي $E = 0.57$ وكان الطول والعمر عند بداية الصيد19.6و سم و 1.94 سنه على التوالي. وفى النهاية نجد ان 54.1 % من إجمالي الصيد لأسماك الاسكمبلا اسماك صغيرة وهذا يؤثر على المخزون السمكي من هذه الاسماك ويجب العمل على عدم صيد الاسماك حتى تصل الى النضج الجنسي حيث ان هذه الاسماك مهمه فى شمال سيناء ووصل انتاجها الى 75 طن في السنه.