SINAI Journal of Applied Sciences

DETERMINATION OF AGE, GROWTH AND MATURITY OF WHITE SEABREAM, *DIPLODUS SARGUS* (LINNAEUS, 1758) IN THE COAST OF NORTH SINAI

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ABSTRACT

White seabream *D. sargus* (n = 991) were caught along the Eastern Mediterranean between September 2010 and April 2012. Total length ranged from 11 to 38 cm, represented age classes between 1 and 5 years. Total weight ranged from 12 to 840 gm. The scales were used to estimate the age. Age group (I) is dominant in the catch of *D. sargus*. Growth was supported using the back-calculation method. The growth performance index (Φ) showed a relatively high growth. Length at first maturity (L_m) was 21.27 cm corresponding age (t_m) 2.68 years. Length at first capture (L_c) was 18.1 cm corresponding age (t_c) 2.08 years. So we have to increase the length at first capture to the length at first maturity in order to give fishes opportunity to spawn at first time at least.

Keywords: Eastern Mediterranean, age and growth, Diplodus sargus.

INTRODUCTION

The Mediterranean Sea is a semi-enclosed marine area with generally narrow continental shelves.It is seem as a whole has been referred to as an "evaporation basin" (**Papaconstantinou and Farrugio, 2000).** Information on stock composition and population dynamics of various fish species in Egyptian Mediterranean waters become of high importance for fisheries managers in order to increase fish production from marine areas.

There are about 64 fish families in Mediterranean waters of Egypt, which are represented by 202 species. Of these, family Sparidae is the most dominant comprising 21 species **(Ibrahim and Soliman, 1996).** Seabreams (Sparidae) live in coastal waters world-wide, and sustain important recreational and commercial fisheries **(Fischer *et al.*, 1987).** They could be found in a wide variety of marine habitats, from rocky to sand bottoms, at depths between 0 to 500 meters, although they are more common at less than 150 meters deep. **(Gonçalves, 2000; Gomes *et al.*, 2001; Sousa *et al.*, 2005 and Ribeiro *et al.*, 2006).**

White seabream, *Diplodus sargus*, was found in the commercial fisheries throughout the long coast of Sinai in the Southern East part of Mediterranean Sea. It occurs in coastal rocky reef areas **(Bauchot and Hureau, 1986**).Age information is important as it forms t he basis for the calculations of growth and

productivity estimates **(Campana, 2001),** making it essential for fisheries management **(Casselman, 1987 and Cailliet *et al.*, 2001).**The aim of this study is to establish growth key characteristics and maturity, where it is necessary for fisheries studies in the Eastern Mediterranean.

MATERIALS AND METHODS

During two seasons, 2010-2011 and 2011-2012, a total of 991 specimens of white seabream, *D. sargus*, (Total length, 11 to 38 cm, total weight, 12 to 840 grams) were collected from mixed commercial catch by El-Dabba (El-kanar) gear which represented about 95% from El-Arish Marin Seaport, and by the Long line gear 5%. Several scales (5–6) were removed from below of pectoral fin, washed and stored dry in individually labeled envelopes.

In the laboratory, scales were washed with sodium hydrochloride (5%) and cleaned with pure water and mounted dry between two glass slides, examined under a microscope (5X) to determine the age.

Also, was measured the total scale radius and the distance from the focus to each annulus using an eye piece micrometer. Total length (TL) was measured to the nearest mm and total weight (TW) recorded to the nearest one gram. Back calculations lengths done from scale measurements by using **Lea's equation (1910):**

Ln = (Sn/S) L, where, Ln is the length of fish at age "n", Sn is a magnified scale radius to "n" annulus. S: is a magnified total scale radius.

L is a fish length at capture. The relationship between length and weight was described by the potential equation as $W = a*L^b$ **(Ricker, 1975),** where (W) is proportional to a certain power (b) of the total body length (L). (a) & (b) are constants whose values were estimated by the least square methods.

Constants of **Von Bertalanffy's (1938**) growth equation calculated by applying **Gulland and Holt (1959)** method.

Growth performance index (Φ) was studied using Munro and **Pauly, (1983)** maximum growth rate formula based on some biological and empirical consideration as:

For the asymptotic length $L\infty$:

$\Phi' = \log K + 2 \log L_\infty$

For the asymptotic weight $W\infty$:

$\Phi = \log K + 2/3 \log$

$W_\infty L\infty$ is the asymptotic length, $W\infty$ is the asymptotic weight and K is the growth coefficient.

The average length at first maturity (L_m) calculated from an empirical relationship between length at first maturity and asymptotic length L_∞ **(Froese and Binohlan, 2000).**

$\text{Log } L_m = -0.1189 + 0.9157*$

$\log L_{max}$Where, L_{max}: are the maximum length reached by fishes age at first maturity (t_m) calculated from the length at first maturity using the inverse of the **Von Bertalanffy's (1938)** growth function.

The length at first capture (Lc), was determined from the accumulated catch curve as described in **Pauly (1984**).

RESULTS

1.Age and growth.

1.1.Age determination

Age determination of specimen as the annulus ring appeared as a thick dark zone.A total of five age groups were determined. The maximum group observed as 479 (48.3%) fish corresponding year of life, followed by 330 fish corresponding 2^{nd} year of life.

The 3rd, 4th and 5th were represented by 18.4% only of total groups Table. (1).

1.2. Length-Scale relationship

Microscopic examination of scales growth rings showed a linear regression between length and scale radius of *D. sargus* represented by a straight line (Fig.1), the following formula representing this relationship:

L =- 2.528 + 5.305 S, r = 0.983 where, "L" is the total length (cm) and "S" is the total scale radius (micrometer division).

1.3. Length – Weight relationship

The obtained equation found to be representing the relation between lengths and weights of *D. sargus* were:

$W = 0.011\ L^{3.165}$ r = 0.976.

This relation can be explaining graphically as in Figure. (2).The back-calculation length was determined of the white seabream *D. sargus* as 11.13, 17.57, 22.67, 27.12 and 29.82 cm for ages 1, 2, 3, 4 and 5 years respectively. It is clear that, the highest increment in length for *D. sargus* occurred at the first year of life (11.13 cm) and then declined rapidly, reaching its minimal value during the five year of life (Table1 and Fig 3) From Table (2) and Fig. (4), it is clear that the highest increment in weight for *D. sargus* occurred at the end of_ fourth year of life as increment was (163.57 gm) and then declined rapidly thereafter, the back-calculated weight of *D. sargus* was 22.60, 95.69, 214.46, 378.03 and 510.92 gm, for ages 1, 2, 3, 4 and 5 years respectively.

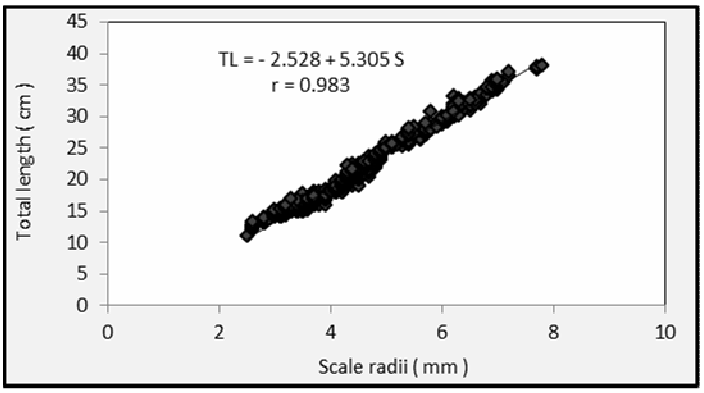

Fig.(1): Relation between length and scale radius of *D. sargus* from the Eastern Mediterranean.

Table (1): Back – calculated length of *Diplodus sargus* from the Eastern Mediterranean fishery

Age (year)	No. of Fishes	Observed length	Back calculated total length (cm)				
			1	2	3	4	5
1	479	15.88	11.13				
2	330	20.61	10.77	17.57			
3	87	27.53	11.48	17.67	22.67		
4	54	30.69	11.19	17.90	22.70	27.12	
5	41	34.55	11.81	17.89	23.08	27.50	29.82
Average			11.28	17.76	22.81	27.31	29.82
Standard Deviation			+0.39	+0.16	+0.23	+0.27	0.00
Increment			11.13	6.43	5.10	4.45	2.71
% increment			37.33	21.57	17.11	14.91	9.08

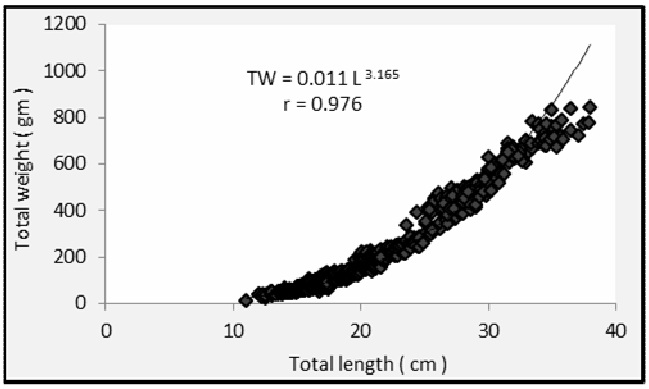

Fig. (2): Length – weight relationship of *D. sargus* from the Eastern Mediterranean.

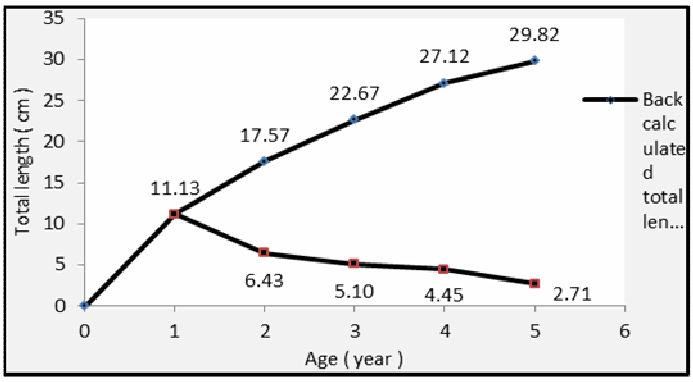

Fig. (3): Increment in length of *Diplodus sargus* from the Eastern Mediterranean fishery.

1.4 Theoretical growth in length and weight

For growth in length using the **Von Bertalanffy's** equation and we applied the **Gulland and Holt (1959**) method to estimate the **Von Bertalanffy's** equation constant such as L_∞, K and t_o Table (3) as: $Lt=40.94(1-e^{-0.2460\ (t+0.2904)})$

And for growth in weight the result of W_∞ Table (3) as:

$Wt=1392.1\ (1 - e^{-0.2460\ (t+0.2904)})^{3.165}$.

1.5.Growth performance index (Φ)

The growth performance index **(Φ)** as defined by were computed for *D. sargus* in the Eastern Mediterranean and found to be 2.617 for length and 1.488 for weight.

2.Estimation of length and age at first maturity (L_m and t_m)

Calculate age at first maturity from the length at first maturity by the inverse of the **von Bertalanffy's (1938)** growth function, for *D. sargus* in the Eastern Mediterranean the length (L_m) was 21.27 cm corresponding age (t_m) 2.68 years.

3.Estimation of length at first capture (Lc)

The length at which the probability of capture is 50%, length at first capture (Lc) of *D. sargus* was 18.1 cm corresponding age (t_c) 2.08 years, where it described graphically Fig. (5).

DISCUSSION

Knowledge of growth and growth variability is essential to the understanding of a stock's population dynamics. To achieve an accurate

assessment of these characteristics, several issues need to be addressed. The condition factor "K" which was considered another way for expressing the relationship between length and weight. Fisheries biologists study fish habitat and fish populations, learning about the natural conditions that fish live in and then extending their knowledge to determine how a fishery can be used sustainable **(Jacot, 1920; Anderson 1958).**

Scales are the most commonly used as it is easy to sample and read **(Lagler, 1956).** Also, to ease of removal and handling of scales and it can be taken without killing the fishes; as the case of studying age and growth for reared fish **(Wassef, 1978).** Data for body length and scale radius show a linear on their scatter diagram. For length-weight relationship of White Seabream in the Eastern Mediterranean fishery we found "b" parameter (b= 3.165), positive allometric growth was observed as the value of (b) was more than 3. this results was agreement with **El-Maghraby and Botros (1981**) in the Egyptian Mediterranean water (b= 3.144), **Man-Wai and Quignard, (1982)** in the Gulf of Lion (b= 3.123) and **Morato *et al.* (2001)** in the Azores (b= 3.181) for both Males and Females, but less than that results which recorded by **Mann (1992)** in the South-East coast of South Africa (b= 3.242) and higher than that recorded by **Lahlah, (2004)** in the Egyptian Mediterranean **(2007)** in the Gulf of Tunis (b= 3.051), **Mahmoud *et al.* (2010)** in Abu Qir bay (b= 2.942) **and Benchalel and Kara (2012)** in the Eastern cost of Algeria the 2.987).

Table(2): Back – calculated weight of *Diplodus sargus* from the Eastern Mediterranean fishery.

Age (year)	No. of Fishes	Observed Weight	Back calculated total weight (gm)				
			1	2	3	4	5
1	479	71.34	22.60				
2	330	170.85	20.34	95.69			
3	87	434.10	24.91	97.53	214.46		
4	54	569.28	22.95	101.58	215.29	378.03	
5	41	710.80	27.26	101.31	226.92	395.12	510.92
			23.61	99.03	218.89	386.58	510.92
Standard Deviation			2.61	2.89	6.97	12.08	0.00
Increment			22.60	73.09	118.77	163.57	132.89
% increment			4.42	14.31	23.25	32.02	26.01

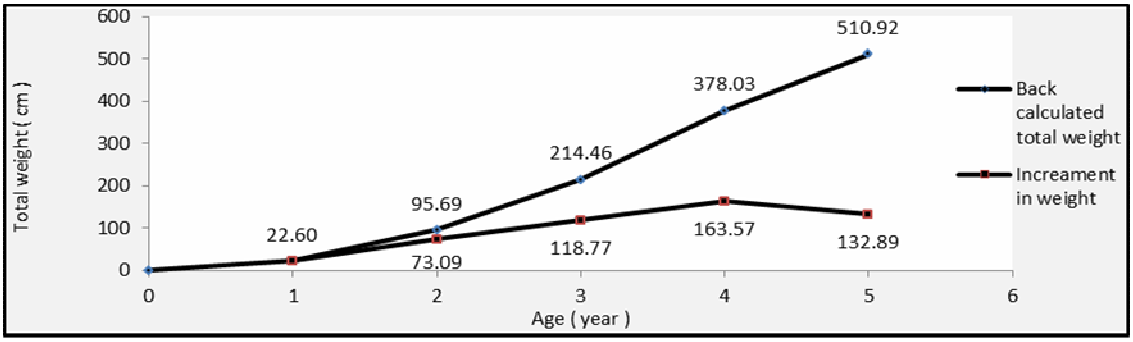

Fig. 4: Increment in weight of *D. sargus* from the Eastern Mediterranean fishery.

Table (3): Constants of Von Bertalanffy's growth equation

Constants	Gulland and Holt (1959)
L_∞	40.93
K	0.2460
t_o	-0.2904
W_∞	1392.1

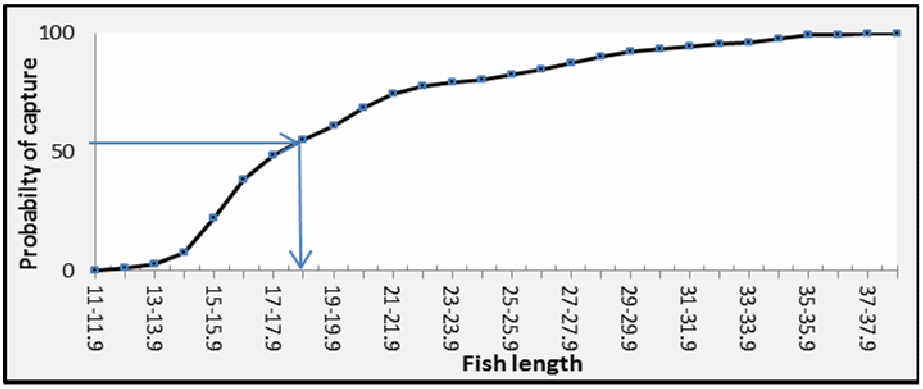

Fig. (5): Cumulated catch curve of *D. s*argus from the Eastern Mediterranean fishery.

Rosa *et al.* (2006) and Mcllwain *et al.* (2005) mentioned that the differences in length-weight relationships and growth parameters is due to age, sex, maturity and sampling period for the same species. Back-calculated methods have many advantages over the direct methods of estimating growth in fishes. This method has been widely adopted on a large number of species **(Chugunova, 1959**).

When comparing growth among species from different regions, the growth was faster in the Eastern Mediterranean area, as shown in Table (4). The back calculation of the total body weight at the end of each year of life in this study is agreement with **El-Maghraby *et al.* (1982),** more than **Man-Wai and Quignard, (1982), and Mahmoud *et al.*, (2010),** and also **Lahlah, (2004**) as in Table (5).

From that results, indicated that, the growth in the Eastern Mediterranean coast is the highest comparing with the different locations. It may be related to the suitable of environment for this species and availability of food.

Also, the growth parameters ($L\infty$, K and t_0) and the growth performance index (Φ) of *D. sargus* were affected by that the short lifespan where from the large sample (n=991) no individuals were recorded older than 5 years of age.The growth performance index for *D. sargus* was Φ= 2.617 for length and 1.488 for weight.

This results was within the range of results from investigation **of Pastor and Cuadros, (1996)** where found Φ= 2.63 and **Gordoa and Molí, (1997)** where found Φ= 2.64. Other authors studied the growth performance index as Φ= 2.42, **Man-Wai and Quignard (1982),** Φ= 2.38, **Mann and Buxton, (1997), Φ= 2.50, Pajuelo and Lorenzo, (2002),** and Φ= 2.37, **Abecasis *et al.*, (2008)** and Φ= 2.30, **Benchalel and Kara, (2012).** In present work length and age at first

maturity was (L_m= 21.27 cm and t_m= 2.68 years) other authors as Bauchot **and Hureau (1986)** found that t_m= 2 years, with length about 17 cm. **Mann and Buxton (1998)** measured the Fork length of *D. sargus* and it was 21.1 cm FL corresponded age 3 years.

Morato *et al.*, (2003) found t_m= 2.12 years, with length as 16.73 cm. **Mouine *et al.*, (2007)** found L_m= 20.5 cm for males and 21.4 cm for females, corresponded age 4 years old.

Benchalel and Kara (2012) found L_m= 20 cm for females and 20.2 cm for males corresponds to an age of 4 years.

In conclusion the length at first capture (50% of the fish are vulnerable to capture) for *D. sargus* was estimated at 18.1 cm, while it attains its first sexual maturity at 21.27 cm. It was noticed that the majority of *D. sargus* caught from the Eastern Mediterranean fishery were immature. Therefore, in order to protect this species and to enable it to share at least for one time in reproduction, an urgent increasing in mesh size of used nets as well as the evaluation of all fishing techniques in the Eastern Mediterranean fishery and prohibiting the dangerous ones must be done.

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Table (4): Back calculation length of *D. sargus* in different locations.

Author	L_I	L_{II}	L_{III}	L_{IV}	L_V	L_{VI}	Location
El-Maghraby and Botros, 1981	10.37	15.93	20.40	23.62	26.67	29.20	**Egypt Med.**
Man-Wai and Quignard, 1982	10.90	16.50	20.30	23.20	25.20	26.70	**Gulf of Lion**
Lahlah, 2004	9.44	12.47	14.86	16.67	18.33	20.43	**Egypt Med.**
Mahmoud *et al.*, 2010	11.42	15.96	19.57	22.35	24.44	25.98	**Abu Qir Bay**
Present study	11.13	17.57	22.67	27.12	29.82	-	**Eastern Med.**

Table (5): Back calculation weight of *D. sargus* in different locations.

Author	W_I	W_{II}	W_{III}	W_{IV}	W_V	W_{VI}	Location
El-Maghraby *et al.*, 1982	18.4	69.5	151.1	240.9	348.9	460.0	**Egypt**
Man-Wai and Quignard, 1982	20.0	86.0	160.0	235.0	280.0	355.0	**Gulf of Lion**
Lahlah, 2004	8.2	21.3	33.3	46.8	64.3	-	**Egypt**
Mahmoud *et al.*, 2010	26.8	71.7	130.6	193.1	251.2	300.5	**Abu Qir Bay**
Present study	22.6	95.7	214.5	378	510.9	-	**Eastern Med.**

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SINAI Journal of Applied Sciences (ISSN: 2314-6079) Vol.:(4) Is.:(1), Apr. 2015

الملخص العربى

تقـديـر العمــر، النمــو والنضج الجنســى لسمكة الشـــرغــوش في ســـــاحل شـــــمال ســيناء

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تهدف الدراسة إلى تحديد بعض الخصائص البيولوجية لسمكه الشرغوش (*Diplodus sargus*) في مصيد شرق البحر المتوسط، كالعمر والنمو بالإضافة إلى النضج الجنسى والطول عند بداية الصيد بهدف تزويد إدارة المصيد بهذه المعلومات للمحافظة علي هذا النوع من الانقراض.

بإجراء الرسومات البيانية للعلاقة بين طول السمكة و قطر القشرة وكذلك بين طول السمكة ووزنها تبين أن هناك علاقة خطية بين الطول وقطر القشرة وأيضاً وجدت علاقة الومتريه وثيقة بين الطول ووزن السمكة

وهذا يدل على أن البيئة مناسبة لنمو هذا النوع. تم تطبيق معادلة فون برتالانفي للنمو وكذلك تحقيق جميع ثوابت هذه المعادلة لحساب النمو واستخدامهم في العمليات الحسابية الأخرى. وجد أن الطول لهذه السمكة عند بداية الصيد هو ١٨,١سم وهذا الطول أقل بكثير من الطول عند النضج الجنسي وهو ٢١,٥سم ولذلك لابد أن يرتفع الطول عند بداية الصيد عن الطول عند النضج الجنسي حتى نعطي الفرصة لكي تفرخ الأسماك ولو مرة واحدة حتى نحافظ علي المخزون من هذه السمكة الاقتصادية وذات الأهمية التسويقية العالية.

الكلمات الإسترشادية: العمر، النمو، النضج الجنسي، سمكه الشرغوش.