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*ₖ) was 18.1 cm corresponding age (*t*ₖ) 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, *Diplopus 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 the 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):

\[ Ln = \frac{Sn}{S} L \]

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

\[ W = aL^b \]  (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 \( W_\infty \):

\[ \Phi = \log K + 2/3 \log W_\infty \]

\( W_\infty \) 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 \( L_\infty \) (Froese and Binohlan, 2000).

\[ \log L_m = -0.1189 + 0.9157 \log L_{max} \]

\( L_{max} \): 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 2nd year of life.
The 3\textsuperscript{rd}, 4\textsuperscript{th} and 5\textsuperscript{th} 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 \textit{D. sargus} represented by a straight line (Fig.1), the following formula representing this relationship:

\[ L = 2.528 + 5.305S, \quad r = 0.983 \]

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 \textit{D. sargus} were:

\[ W = 0.011 L^{3.165}, \quad r = 0.976. \]

This relation can be explaining graphically as in Figure. (2). The back-calculation length was determined of the white seabream \textit{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 \textit{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 \textit{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 \textit{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 \textit{D. sargus} from the Eastern Mediterranean.](image)

![Table (1): Back – calculated length of \textit{Diplodus sargus} from the Eastern Mediterranean fishery](table)

<table>
<thead>
<tr>
<th>Age (year)</th>
<th>No. of Fishes</th>
<th>Observed length</th>
<th>Back calculated total length ( cm )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>479</td>
<td>15.88</td>
<td>11.13</td>
</tr>
<tr>
<td>2</td>
<td>330</td>
<td>20.61</td>
<td>10.77</td>
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<tr>
<td>3</td>
<td>87</td>
<td>27.53</td>
<td>11.48</td>
</tr>
<tr>
<td>4</td>
<td>54</td>
<td>30.69</td>
<td>11.19</td>
</tr>
<tr>
<td>5</td>
<td>41</td>
<td>34.55</td>
<td>11.81</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>11.28</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td></td>
<td></td>
<td>+0.39</td>
</tr>
<tr>
<td>Increment</td>
<td></td>
<td></td>
<td>11.13</td>
</tr>
<tr>
<td>% increment</td>
<td></td>
<td></td>
<td>37.33</td>
</tr>
</tbody>
</table>
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 \( L_\infty \), \( K \) and \( t_0 \) Table (3) as:

\[
L_t = 40.94 \left( 1 - e^{-0.2460 \left( t + 0.2904 \right)} \right)
\]

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

\[
W_t = 1392.1 \left( 1 - e^{-0.2460 \left( t + 0.2904 \right)} \right)^{3.165}
\]

1.5. Growth performance index (\( \Phi \))

The growth performance index (\( \Phi \)) 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 (\( L_c \))

The length at which the probability of capture is 50%, length at first capture (\( L_c \)) 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.

<table>
<thead>
<tr>
<th>Age (year)</th>
<th>No. of Fishes</th>
<th>Observed Weight</th>
<th>Back calculated total weight ( gm )</th>
<th>Standard Deviation</th>
<th>Increment</th>
<th>% increment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>479</td>
<td>71.34</td>
<td>22.60</td>
<td>20.34</td>
<td>24.91</td>
<td>22.95</td>
</tr>
<tr>
<td>2</td>
<td>330</td>
<td>170.85</td>
<td>95.69</td>
<td>378.03</td>
<td>395.12</td>
<td>510.92</td>
</tr>
<tr>
<td>3</td>
<td>87</td>
<td>434.10</td>
<td>214.46</td>
<td>215.29</td>
<td>378.03</td>
<td>510.92</td>
</tr>
<tr>
<td>4</td>
<td>54</td>
<td>569.28</td>
<td>378.03</td>
<td>510.92</td>
<td>510.92</td>
<td>510.92</td>
</tr>
<tr>
<td>5</td>
<td>41</td>
<td>710.80</td>
<td>510.92</td>
<td>510.92</td>
<td>510.92</td>
<td>510.92</td>
</tr>
</tbody>
</table>

Fig. 4: Increment in weight of D. sargus from the Eastern Mediterranean fishery.
Table (3): Constants of Von Bertalanffy's growth equation

<table>
<thead>
<tr>
<th>Constants</th>
<th>Gulland and Holt (1959)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_\infty$</td>
<td>40.93</td>
</tr>
<tr>
<td>$K$</td>
<td>0.2460</td>
</tr>
<tr>
<td>$t_0$</td>
<td>-0.2904</td>
</tr>
<tr>
<td>$W_\infty$</td>
<td>1392.1</td>
</tr>
</tbody>
</table>

Fig. (5): Cumulated catch curve of $D. sargus$ from the Eastern Mediterranean fishery.

Rosa et al. (2006) and Mellwain 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 ($\Phi$) 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 $\Phi= 2.617$ for length and 1.488 for weight.

This results was within the range of results from investigation of Pastor and Cuadros, (1996) where found $\Phi= 2.63$ and Gordon and Molí, (1997) where found $\Phi= 2.64$. Other authors studied the growth performance index as $\Phi= 2.42$, Man-Wai and Quignard (1982), $\Phi= 2.38$, Mann and Buxton, (1997), $\Phi= 2.50$, Pajuelo and Lorenzo, (2002), and $\Phi= 2.37$, Abecasis et al., (2008) and $\Phi= 2.30$, Benchalel and Kara, (2012). In present work length and age at first
maturity was \( L_m = 21.27 \text{ cm} \) and \( t_m = 2.68 \text{ years} \) other authors as Bauchot and Hureau (1986) found that \( t_m = 2 \text{ years}, \) with length about 17 cm. Mann and Buxton (1998) measured the Fork length of \( D. \text{sargus} \) and it was 21.1 cm FL corresponded age 3 years.

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

Benchalel and Kara (2012) found \( L_m = 20 \text{ cm} \) 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 \( D. \text{sargus} \) was estimated at 18.1 cm, while it attains its first sexual maturity at 21.27 cm. It was noticed that the majority of \( D. \text{sargus} \) 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.

**REFERENCES**


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

<table>
<thead>
<tr>
<th>Author</th>
<th>( L_i )</th>
<th>( L_{II} )</th>
<th>( L_{III} )</th>
<th>( L_{IV} )</th>
<th>( L_V )</th>
<th>( L_{VI} )</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man-HWai and Quignard, 1982</td>
<td>10.90</td>
<td>16.50</td>
<td>20.30</td>
<td>23.20</td>
<td>25.20</td>
<td>26.70</td>
<td>Gulf of Lion</td>
</tr>
<tr>
<td>Mahmoud et al., 2010</td>
<td>11.42</td>
<td>15.96</td>
<td>19.57</td>
<td>22.35</td>
<td>24.44</td>
<td>25.98</td>
<td>Abu Qir Bay</td>
</tr>
<tr>
<td>Present study</td>
<td>11.13</td>
<td>17.57</td>
<td>22.67</td>
<td>27.12</td>
<td>29.82</td>
<td>-</td>
<td>Eastern Med.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Author</th>
<th>( W_i )</th>
<th>( W_{II} )</th>
<th>( W_{III} )</th>
<th>( W_{IV} )</th>
<th>( W_V )</th>
<th>( W_{VI} )</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>El-Maghrraby \textit{et al.}, 1982</td>
<td>18.4</td>
<td>69.5</td>
<td>151.1</td>
<td>240.9</td>
<td>348.9</td>
<td>460.0</td>
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<tr>
<td>Man-HWai and Quignard, 1982</td>
<td>20.0</td>
<td>86.0</td>
<td>160.0</td>
<td>235.0</td>
<td>280.0</td>
<td>355.0</td>
<td>Gulf of Lion</td>
</tr>
<tr>
<td>Lahlah, 2004</td>
<td>8.2</td>
<td>21.3</td>
<td>33.3</td>
<td>46.8</td>
<td>64.3</td>
<td>-</td>
<td>Egypt</td>
</tr>
<tr>
<td>Mahmoud \textit{et al.}, 2010</td>
<td>26.8</td>
<td>71.7</td>
<td>130.6</td>
<td>193.1</td>
<td>251.2</td>
<td>300.5</td>
<td>Abu Qir Bay</td>
</tr>
<tr>
<td>Present study</td>
<td>22.6</td>
<td>95.7</td>
<td>214.5</td>
<td>378</td>
<td>510.9</td>
<td>-</td>
<td>Eastern Med.</td>
</tr>
</tbody>
</table>


data at unequal time intervals. 


ElBeak, et al.


الملخص العربي

تقدير العمر، النمو والنضج الجنسي لمجموعة التشريش-غوش في محيط شمالي سيناء

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2- كلية العلوم الزراعية البيئية بالعرش - جامعة قناة السويس.
3- الهيئة العامة للتنمية الثروة السمكية.

هذ الدراسة تتضمن بعض الخصائص البيولوجية لمجموعة التشريش-غوش (Diplodus sargus) وتهدف إلى تحديد الظروف البيولوجية والبيئية التي تؤثر على النمو والتطور الجنسي للعديد من هذه المجموعات تزويدها بنتائج مفصلة لتنفيذ تطوير إدارة الموارد السمكية في محيط شمالي سيناء. 

وقد جرى استخدام الأساليب الكيميائية والبيولوجية في تحديد نسب النمو والتطور الجنسي للمجموعة. 

الكلمات الإرشادية: العمر، النمو، النضج الجنسي، سمكة التشريش-غوش.

المحكمين

23- د. ه.د. جابر دوسوقي إبراهيم
24- د. عبد الحميد محمد صالح عيد