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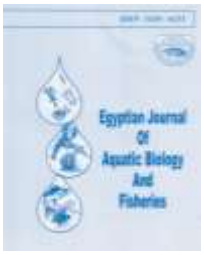

Some biological aspects and population dynamics of the gilthead sea bream from Bardawil lagoon, Sinai, Egypt.

Al-Zahaby A. S.[1]; El-drawany M. A.[1*]; Mahmoud H. H.[2] and Abdalla M.A.F.[3]

1- Department of Zoology, Faculty of Science, Zagazig University, Zagazig, Egypt
2- Fisheries Technology and Aquaculture College, Arab Academy for Science and Technology, Alexandria, Egypt.
3- Fishery Biology Lab, National Institute of Oceanography and Fisheries, Cairo, Egypt.
*Corresponding author: samy_drawany@yahoo.com

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ABSTRACT

A total of 856 gilthead sea bream, *Sparus aurata* (Linnaeus, 1758), was collected from different landing sites of Bardawil Lagoon between October 2011 to September 2012, in order to investigate its population dynamics. The age distribution covered age groups 0 to IV. Total length ranged from 10 to 34.2 cm while total weight varied from 10.8 to 568 g. The length-weight relationship parameters were a = 0.0146 and b = 3.0062. The estimated parameters of the von Bertalanffy growth function (VBGF) in length were K = 0.370 year^{-1}, L∞ = 39.17 cm and t_o = -0.65 years. The estimated total length at first capture (Lc) was 12.85 cm, while the total length at 50% maturity (Lm) was 22.7cm. The rates of total mortality (Z), natural mortality (M) and fishing mortality (F) were 1.085, 0.394 and 0.691 year^{-1}, respectively. The exploitation ratio (E) was estimated as 0.637, so the finding result revealed that the stock of *S. aurata* in Bardawil Lagoon is heavily exploited.

INTRODUCTION

It has long been known that lagoons are often very productive and yield good catches (Ben-Tuvia, 1979). This is also true for the Bardawil Lagoon. It is situated along the northern coast of Sinai, from a point about 45 km east of Port Said and extends to a point of 20 km west El-Arish. Its geographical boundaries extend from 32º 40" to 33 º 30" east longitude and from 31 º 03" to 31º 14" north latitude. Bardawil Lagoon is one of the important fish producing lagoons along the northern coast of Egypt (GAFRD, 2016).

Moreover, it is the least polluted because no drainage canals discharge water in it. Its water is highly saline showing multicolor due to the presence of different genera of biota, algae and other organic material. The colour of water varies from dark green to even violet (Khalil and Shaltout, 2006).

Gilthead Sea bream, *Sparus aurata* (Linnaeus, 1758) is a bottom dwelling, usually lives lonely or in small and movable groups and is locally known in Egypt as "denees" (Wassef 1990). It is one of the Sparids fishes found predominantly and widespread throughout the Mediterranean Sea and Eastern Atlantic coast (FAO,

2005), that constitute an important fishery resource along both coasts (Kraljevic *et al*., 2007). This fish species has been known for many years, most commonly as by-catch (Aydin, 2018). Gilthead Sea bream is commercially fished and farmed especially in Europe, with over than 100,000 tonnes reared in 2012 (FAO, 2005 and Heather *et al*., 2018). Since, it is one of the most expensive, luxury and well-liked fish, it is targeted for intensive fishing.

Gilthead Sea bream, *Sparus aurata* mainly exploited in Bardawil lagoon by trammel and gillnets as well as hand line technique and is commonly shed in by-catch of trawl fisheries (Salem, 2011). Recently, it has been generally cultured in Egypt so as in many other countries. In natural fisheries it spawns in the winter months but in aquaculture farms it is conditioned to breed all year round under controlled methods (Moretti *et al*., 1999).

So, different aspects of the biology, management and population dynamics of the investigated fish have been addressed in many early and present researches. Early, Ben-Tuvia (1979) researched the population and fisheries of this fish species also in Bardawil lagoon. Later on, Wassef (1990), Gurbet and Korkut (1992), Kraljevic and Dulcic (1997), Cetinic *et al*. (2002), Santos *et al*. (2002), Chaoui *et al.* (2006) and Emre *et al.* (2009) studied the age and growth as well as length-weight relationship of Gilthead sea bream, *Sparus aurata* (L.) in Egyptian Mediterranean waters, Homa Lagoon (Turkye), Mirna Estuary (Northern Adriatic), eastern Adriatic, Algarve coast (southern Portugal), Mellah Lagoon (north-eastern Algeria) and in Beymelek Lagon (Turkey), respectively. Likewise, Akyol and Gamsiz (2011) investigated the age and growth and estimated Growth parameters of *Sparus aurata* L. in South-eastern Aegean Sea (Turkye).

In the Bardawil Lagoon, Salem (2011) estimated the age, growth and population biology of gilthead seabream *Sparus aurata*. The length-weight relationship and population Dynamic of seabream but of other genus *Diplodus sargus* were also studied by Mahmoud *et al.* (2010), Benchalel and Kara (2013), Al-Beak (2015) and Balik and Emre (2016) in Abu Qir Bay-Egypt, eastern coast of Algeria, Coast of North Sinai and Beymelek Lagoon of Turkey, respectively.

The goal of the present study is to give additional evidence about some biological aspects and fisheries management of Gilthead Sea bream, *Sparus aurata* (Linnaeus, 1758) in Bardawil lagoon.

MATERIALS AND METHODS

About 856 individuals of *S. aurata*, showed in figure (1), of total length ranged from 10 to 34.2 cm were randomly collected monthly from three landing sites (El-Nasr, Eghzewan and EL-Telol) in Bardawil Lagoon (Fig. 2) from October 2011 to September 2012.

Fig. 1: Seabream *Sparus arauta*

Fig. 2: The study area

The samples were grouped into 1 cm length classes, each fish was measured to the nearest mm for total length and weighed to the nearest 0.1 gram total weight, and then the sex and maturity were determined macroscopically. The weight of the gonads was recorded to the nearest 0.01 gram. LFDA program was used to evaluate growth, back-calculation (lengths-at-ages) for age as recommended by Kirkwood *et al*. (2001) which was fitted to the von Bertalanffy growth model (Ricker, 1975). Gulland and Holt (1959) plot was applied to estimate the von Bertalanffy growth parameters (**L**∞ and **K**).

The length weight relationships were estimated from the allometric equation

$$\mathbf{W = a\ L^{b}.}$$ **Bagenal (1978)**

Where W is total body weight (g), L the total body length (cm), ***a*** and ***b*** are the coefficients of the functional regression between (W) and (L) which were obtained using the Newton algorithm from the Microsoft® Excel Solver routine.

The back calculated lengths were fitted to Von Bertalanffy growth Model (VBGM), $L_t = L_\infty\ [1\text{-}e^{-k\ (t\text{-}to)}]$, Where, L_t = Total length (cm) of the fish at time t. L_∞ = Expected theoretical maximum total length. K = Coefficient of growth. t = Fish age. t_o = Theoretical age at length zero. The length–weight relationship was used to estimate the back calculated total weights at various years of life.

The **length at first sexual maturity**; length at which 50% of fish reach their sexual maturity (Ni and Sandeman, 1984) was derived by fitting the maturation curve between the observed points of mid-class interval and the percentage maturity of fish corresponding to each length class interval (King, 1995).

The **mortality coefficient** was estimated for each length class and age group by using VIT software. LFDA program was used for age slicing (Kirkwood et al., 2001). However, the vector of natural mortality by age was calculated from Caddy's formula, using the PROBIOM Excel spreadsheet (Abella *et al*., 1998). VIT software was used for pseudo cohort analysis using the age distribution obtained by age slicing (Lleonart and Salat, 1992), and then the total and fishing mortalities for the different age groups were estimated.

The spawning season was detected by following the monthly variation in both Gonadosomatic index (GSI) and maturity stages. GSI was determined as:

$$GSI = WgX100/Wt.$$

Where Wg is the gonad weight and Wt is the total body weight in grams.

Gonads were staged macroscopically according to a five-stage maturity index as modified by Hjort (1910 & 1914) key.

Length at first capture L_c was computed from the equation of Beverton and Holt (1956), which applies the growth constants of Von Bertalanffy: $Lc = L\text{-} - K\ (L_\infty - L\text{-}) / Z$, Where: L- = the mean length of the catch. The corresponding age at first capture tc was calculated using the equation, $t_c = (-1 / K)\ (Ln\ ((1\text{-}\ Lc / L_\infty) + t_0)$ (Beverton and Holt, 1957).

The maximum age (t_{max}) was obtained according to Pauly (1981) equation: $t_{max} = 3/ K$, where: t_{max}= the longevity of fish species and K= the growth coefficient or the curvature parameter.

For comparing the growth performance **(*Φ*)** of the species with that of the same species in others area, the growth performance index (Φ) was estimated according the formula (Pauly and Munro, 1984): $\Phi = log\ K + 2\ log\ L_\infty$.

The **exploitation ratio** E was calculated for the whole sample collected in the present study. It describes the relation between the instantaneous fishing mortality and the instantaneous total mortality according to Baranov (1918) formula: $E = F / Z$

(Baranov, 1918), where: *F*= the instantaneous fishing mortality. *Z*= the instantaneous total mortality.

RESULTS

Length-weight relationship:

Length-weight relationship is very important for fishery biologist. It plays an important role in the practical application of fisheries management. It is used to convert the length of a fish to its weight or vice versa. It is used to measure variation from the expected weight for length of individual fish or relevant groups of individual as indication of healthy status of fish or general well-being. Further, it used in the estimation of the total yield of fish caught when length and number of fish are known. Length-weight relationship is an essential biological parameter needed to appreciate the suitability of the environment for any fish, which reflect it's important in most fishery biological studies (Fig. 3). The length-weight relationships of *S. aurata* inhabiting Bardawil Lagoon were found to be as the following:

Whole sample $\mathbf{W} = 0.0146\ \mathbf{L}^{3.0062}$ $\mathbf{R}^2 = 0.9803$

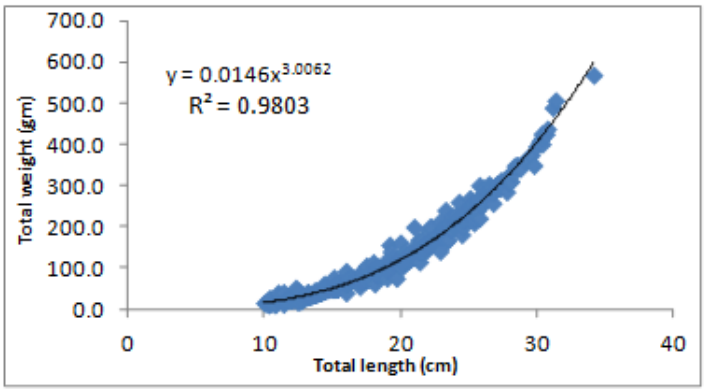

Fig. 3: Length-weight relationship for *S. aurata* from the Bardawil lagoon during the period from October, 2011 to September, 2012.

Length Frequency Distribution:

The length frequency distribution of *S. aurata* (Fig. 4) showed that, the fish length is ranged from 10 to 34 cm. The length group (18-22) representing the majority of the examined sample (about 49%), however, the length group (28-35) was the least, not exceeded than 0.12% only.

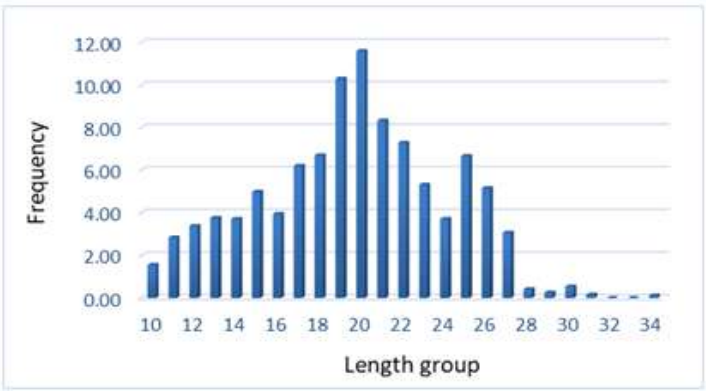

Fig. 4: Length-frequency distribution for *S. aurata* from the Bardawil lagoon

Age composition and Growth:

The obtained results revealed that the catch of *S. aurata* is composed of four age groups plus age group zero. The smaller age groups (0 and I) represent the majority of the examined sample. Age group (I) was the most dominant; representing 52% of the total catch, followed by age group (0) which represented by 29.7%. The other age groups represented by 17.2%, 0.9% and 0.1% of the total sample for Age groups (II), (III) and (IV) respectively as shown in Figure (5).

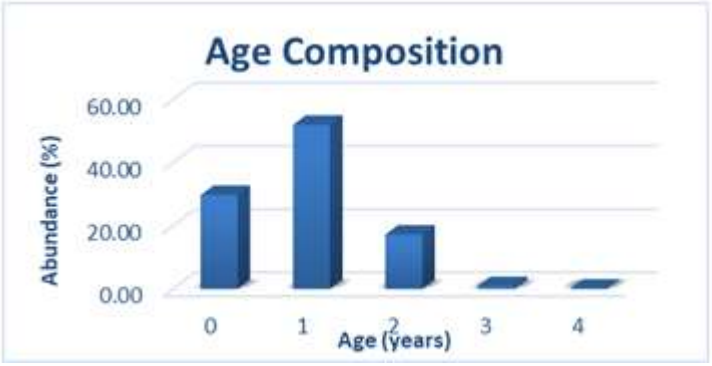

Fig. 5: Age composition of *S. aurata* from the Bardawil lagoon

Growth in length:

Samples of *S. aurata* lengths ranged from 10 to 34.2 cm with average of 19.54 cm corresponding to weights of 10.8 and 568.6 g and 138.42 g (SD= ±86.49). The mean observed lengths at different ages of *S. aurata* in the present work showed that, the fish reached 32.16 cm TL at the fourth age and the average length by the end of each year of life was 17.9, 24.48, 29.02and 32.16 cm for the four age groups of this fish. The maximum growth in length was recorded at the first year of life while the fish gain 55.7 % of its final growth at fourth year of age, then after, the fish gain 20.5%, 14.1% and 9.8 % of its final growth at the second, third and fourth year of life, respectively (Table 1 and Fig. 6).

Table 1: The length (cm) at the end of each year of life for *S. aurata*, from the Bardawil lagoon during the period from October, 2011 to September, 2012.

Age	I	II	III	IV
Average	17.9	24.48	29.02	32.16
Increment	17.9	6.58	4.54	3.14
%	55.7	20.5	14.1	9.8

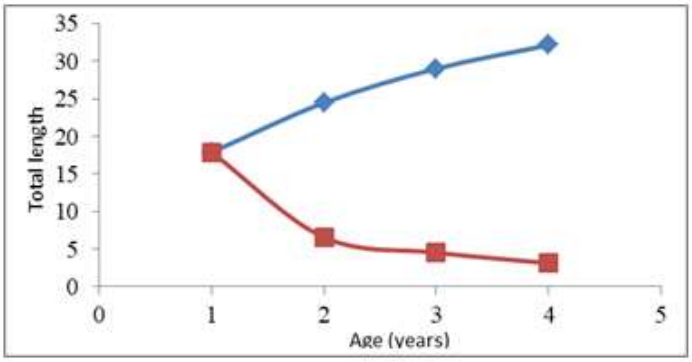

Fig. 6: Growth in length and increment at the end of each year of *S. aurata*

Von Bertalanffy growth formula:

The estimation of von Bertalanffy growth parameters was obtained by fitting the VBGE to back calculated lengths. The parameters of VBGE in the present study for the studied fish species were; K was 0.370 year^{-1}, L_∞ was 39.17cm and t_o was -0.650 year but the maximum age (t_{max}) of this fish species was 8.11 years. By applying the length-weight relationship it was found that W_∞ was equal 898 g and the value of growth performance (Ø) in length and weight were 2.75 and 1.54 respectively.

Length at first maturity:

For *S. aurata*, the length at 50 % maturity from the curve in **Figure (7)** was estimated at 20.77 cm.

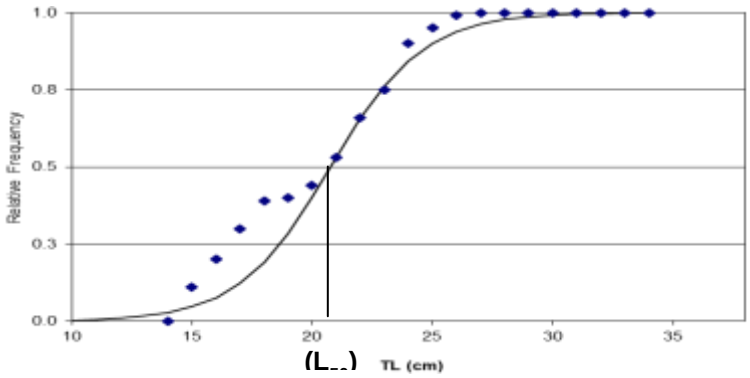

Fig. 7: Length at first sexual maturity (L_m) of *S. aurata* in Bardawil lagoon.

Derivative of the von Bertalanffy equation was applied to calculate the age at first sexual maturity (t_m) from its corresponding length (L_m) was (t_m) = 1.4 year.

Gonadosomatic Index (GSI):

A monthly variation of gonad index of *S. aurata* is represented in Figure (6). The present data showed that GSI is higher in female specimens than in males.

The minimum value GIS of the females of *S. aurata* was (0.26) during July increased gradually to reached the higher values in October (1.19), November (3.37) with a higher peak in December (5.11). As well the values of GSI of male were increased from October (0.99) and November (2.16) with maximum value of (3.88) during December, but its minimum value was recorded in June (0.12) as illustrated in Figure (8)

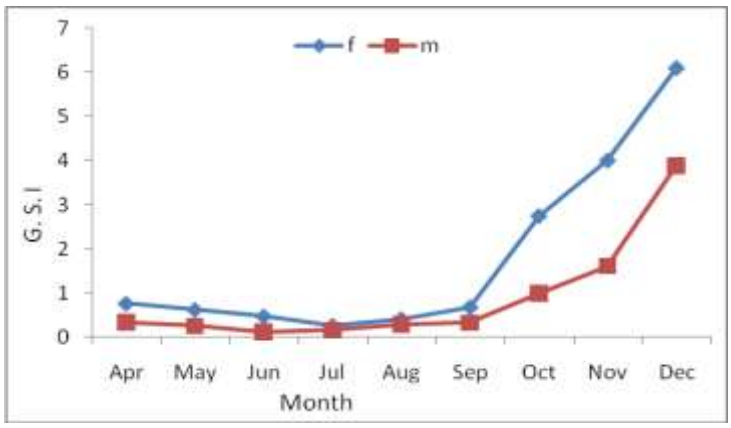

Fig. 8: Monthly variations in the Gonadosomatic index (GSI) for *S. aurata* in the Bardawil lagoon

Length and Age at Recruitment:

Length at recruitment (L_r) is defined as the smallest length at which the fish enters the fishing ground, and may become vulnerable to fishing. The obtained value of (**L_r**) of *S. aurata* in the present study was 9.59 cm and the corresponding value of age at recruitment (**t_r**) was **0.11** years.

Length and Age at First Capture:

The length at the first capture (**L_c**) is the length at which the fish may be become vulnerable to fishing gears. In the present study (L_c) for *S. aurata* was computed by using the equation of Beverton and Holt (1956). Its (L_c) value was 12.85cm, corresponding age at first capture (t_c) which marks the beginning of the exploited phase was 0.424 years. Based on these results, the *S. aurata* starts to suffer from fishing mortality at sizes bigger than 12.85 cm T.L. and we can suggested that, the exploited phase starts at ages more than 0.424 years.

Exploitation Ratio

In the present study the value of exploitation ratio (E) for *S. aurata* was 0.637. This means that its population in the Bardawil Lagoon suffers from overfishing (Tab. 2).

Table 2: the Values of some fishery indices of *S. aurata* from the Bardawil lagoon during the period from October, 2011 to September, 2012.

Parameter	*Sparus aurata*
L_c (Length at capture)	12.85 cm
L_r (Length at recruitment)	9.59 cm
T_c (Age at capture)	0.424 year
T_r (Age at recruitment)	0.11yaer
S (Survival rate)	0.34
E (Exploitation ratio)	0.637
M/K	1.065
U (Exploitation rate)	0.672

According to Gulland (1971) the optimum exploitation ratio (E) was to be around 0.5, while GFCM (2013) (The General Fisheries Commission for the Mediterranean) recommended that (E) should be equal to 0.4 and when the exploitation ratio is more than 0.5 means that the fish is overexploited, but if it is less than 0.4 this means that the fish is under exploitation according to GFCM (2013).

DISCUSSION

Length-Weight Relationship, according to Hile (1936) and Le-Cren (1951) found that, the value of "b", functional regression or coefficient varies widely from 1.34 to 3.68 according to the fish species. Ricker (1975) showed that, when the functional regression equal 3, it describes a condition of isometric i.e., a fish would have an unchanging specific gravity. If this value is greater or less than 3 a condition will be described as an allometric growth.

In the present study, the value of the exponent "b" for *Sparus aurata* value was found to be 3.0062 (Fig. 3).This result is more or less similar to the previous studies on the same species in the Bardawil Lagoon and in different water bodies as shown in Table 3.

Length Frequency Distribution analysis of *S. aurata* was done on 856 specimens ranging from 10 cm and 34 cm in the total length. Out of these 334(39.0%) specimens were females and 508 (59.3%) were male. The gonads of *S. aurata* found that the young fishes belonging to length groups of 13-16 cm were males and all fishes greater than 26 cm were females. An overlapping was observed for males and females at total lengths that ranged from 16 to 26 cm.

Table 3: Estimated Length-Weight parameters of *S. aurata* in different regions.

Location	Author	Sex	a	b
Bardawil Lagoon	**Ben-Tuvia and Golani (1979)**	M+F	0.0000373	2.81
	Ameran (1992)	M+F	0.01973	2.85
	Khalifa (1995)	M+F	0.011	3.063
	Tharwat *et al.* (1998)	M+F	0.0127	3.0347
	Abd-Alla (2004)	M+F	0.0134	3.024
		M+F	0.0138	3.0167
	Salem (2004)	M+F	0.014	3.017
	Salem (2011)	M+F	0.025	2.813
Alexandria	**Wassef (1990)**	M+F	0.00674	3.2216
Port Said	**Mehanna (2007)**	M+F	0.0123	3.0284
Croatia	**Kraljevic and Dulcic (1997)**	M+F	0.0112	3.052
France	**Lasserre and Labourg (1974)**	(Graveyron)M+F	0.0144	3.075
		(Thau) M+F	0.0121	3.064
	Mercier *et al.* (2011)	M+F	0.0105	3.081
Spain	**Suau and Lopez (1976)**	M+F	0.0000112	3.055
	Arias (1980)	M+F	0.0000071	3.12
	Ozaydin & Taskavak (2006)	M+F	0.011	3.164
	Moutopoulos *et al.* (2011)	(Klisova) M+F	0.0065	3.334
Italy	**Tancioni *et al.* (2003)**	(Caprolace) M+F	0.0000053	3.193
		(Fogliano) M+F	0.0000056	3.216
Algeria	**Chaoui *et al.*(2006)**	M+F	0.01292	3.067
Tunisia	**Hadj-Taieb *et al.* (2013)**	M+F	0.0107	3.0799

This is in accordance with the finding of Ben Tuvia & Herman (1972), who reported that the percentage of females of *S. aurata* in Bardawil Lagoon increased from 61% for age 1 to 75% at age 2 yr, 95% at age 3 yr and 100% at age 4 yr, and this species undergoes sex reversal. Tharwat *et al.* (1998) found that the young fishes belonging to length groups of 14-16 cm were males and all fishes greater than 27 cm were females. An overlapping was observed for males and females at total lengths that ranged from 16 to 27 cm also.

Age	I	II	III	IV
Average	17.9	24.48	29.02	32.16
Increment	17.9	6.58	4.54	3.14
%	55.7	20.5	14.1	9.8

Age composition and Growth: The mean observed lengths at different ages of *S. aurata* in the present work showed that, the fish reached 32.16 cm TL by the fourth age. The average length by the end of each year was 17.9, 24.48, 29.02 and 32.16 cm for the four age groups; I, II, III and IV of this fish, respectively. These results are consistent with Ben-Tuvia (1979) since, he found that the catch of *S. aurata* in the Bardawil Lagoon was composed chiefly of fish of 18–30 cm length, belonging to age groups of 0 – 4 yr based on otolith readings. While Tharwat *et al.* (1998) reported that, the total length of *S. aurata* in the catch of Bardawil Lagoon ranged from 14 to 34cm and he observed that, the longevity might be 5 years, using the scale readings.

The maximum estimated age (6 years) for *S. aurata* in Bardawil Lagoon was recorded by Khalifa (1995) during the period from 1985 to 1987. Not far away, Abd-Alla (2004) pointed out that, the total length of *S. aurata* in Bardawil Lagoon varied from 13.6 to 33.5cm and from 12.6 and 32.8 during the fishing seasons 2000 and 2001 respectively. But, Salem (2011) explain that, the specimens size ranged between 11 and 32.9 cm is due to the use of scales reading technique to determined age and state five age classes of *Sparus aurata* in Bardawil Lagoon. Wassef (1990) cleared that, this variability is linked to variations in the ecological conditions in each habitat

Von Bertalanffy Growth Parameter: Since, accurate information on the growth rates of fish is essential for fisheries stock assessment and management, empirical life history parameters (von Bertalanffy growth) are widely fitted to cross-sectional size-at-age data sampled from fish populations (Heather *et al*., 2018). This method often assumes that environmental factors affecting growth remain constant over time. The parameters of VBGE as obtained in the present study for *S. aurata*. The value of K = 0.370 $year^{-1}$. Hence, the value of L_∞ = 39.17cm. Concerning t_o it was -0.650 year. By applying the length-weight relationship W_∞ = 898 gm. In the Bardawil Lagoon the L_∞ value was coincided with data mentioned by Ameran (1992) since he determined the growth parameters as L_∞ = 38.047 cm, K = 0.246 $year^{-1}$ and t_o = -1.925 year in 1985 fishing season. Similarly, Tharwat *et al*., (1998) estimated L_∞ = 38.5 cm, K = 0.297 $year^{-1}$, t_o = -1.085 year and W_∞ = 796.3. Nonetheless, data of Abd-Alla (2004) were different from 2000 (L_∞= 34.08 cm, K = 0.583 $year^{-1}$and t_o = -0.702 year to those of 2001 (L_∞= 35.18 cm, K = 0.520 $year^{-1}$ and t_o = -0.742 year). However, Salem (2011) found that the L_∞= 36 cm, K = 0.39 $year^{-1}$ and t_o = -1.68 year.

Length at first maturity for *S. aurata*, the length at 50 % maturity was estimated at 20.77 cm. Derivative of the von Bertalanffy equation was applied to calculate the age at first sexual maturity (t_m) from its corresponding length (L_m) and found that, the age at first sexual maturity (t_m) = 1.4 year, which means that the exploited *S. aurata* in the Bardawil Lagoon must be protected till their second year of life in order to be able to spawn at least once. L_m was greater than estimated Lc, indicating growth and recruitment subjected to over-fishing. As early as Tharwat *et al.* (1998) in the Bardawil Lagoon, found that almost males and females of *S. aurata* attained their first sexual maturity at about only 20 cm total length, which corresponds to an age of 1.5 year. However, Abd-Alla (2004) found that, (L_m) of *S. aurata* during 2000 was 20.5 cm for males and 21.2 cm for females, corresponding to ages 0.85 yr for males and 0.95 yr for females. Nonetheless, during 2001 was 20.6 cm for males and 22.1 cm for females, corresponding to 0.98 yr for males and 1.17 yr for females. Salem (2004) observed that, the value of L_m for *S. aurata* in the same Lagoon was 20.6 and 22.1 cm for male and female, respectively. The same author, Salem (2011) stated that, the L_m was estimated at 20.5 and 22.8 cm which corresponding to an age of 0.47 and 0.83 year for male and female respectively. In spite of Wassef (1988) claimed Lm = 20 cm for males and 23 cm for females *S. aurata* in Alexandria fisheries and Mehanna (2007) give L_m was 25.77 cm corresponding to age was 1.67 yr in Port Said fisheries of Mediterranean off Egypt,

Gonadosomatic Index (GSI), it was known that, the spawning migration of *S. aurata* occurred from December to March, and the first of January is considered to be the birth date of year class. The very small fish enter the Lagoon from the Mediterranean Sea during the period from mid-February to mid-March and show rapid growth during the warm month since the lagoon is a good nursery site (Verdiell-Cubedo *et al*., 2013).

The reproduction of *S. aurata* at Bardawil Lagoon takes place in the Mediterranean Sea, since all the older fish (1-age group or more) leave the Lagoon during the end of October, November and the first half of December and were appear again in the catch in the second half of February. The spawning of the Bardawil Lagoon population of *S. aurata* takes place during the period from November-February with beak in December-January. Fish spawn normally as males and females but possibility of hermaphroditic spawning should be excluded (Ben-Tuvia, 1979 and Ben-Tuvia & Golani, 1979). Current results confirm this. The beak of gonado-somatic index (GSI) of the females and males of *S. aurata* was found during December (5.11, 3.88 for female and male respectively).

These results are in accordance also with those reported in previous studies of Ben-Tuvia (1984) and Tharwat *et al.* (1998) in the Bardawil Lagoon. Similarly in Egyptian Mediterranean water of Alexandria as recorded by Wassef (1988 & 1990), in Port Said by Mehanna (2007)), in Tunisia by Hadj-Taieb *et al*. (2013), in Algeria by Chaoui *et al.* (2006), and also in eastern Adriatic by Cetinic *et al.* (2002).

Length and Age at First Capture, in the present investigation, the length at first capture (L_c) was 12.85cm, and the corresponding age at first capture (t_c) which marks the beginning of the exploited phase was 0.424 years. Based on these results, the *S. aurata* starts to suffer from fishing mortality at sizes bigger than 12.85 cm T.L. so we can suggested that, the exploited phase starts at ages more than 0.424 years. The L_c in the present work is less than Salem (2011) concluded which was estimated to be 15.54 cm. He also said that, the value of L_c was considerably smaller than the length at first sexual maturity (L_m) for male (20.5 cm) and female (22.8 cm). The current sea bream catch in Bardawil Lagoon was mostly below the length at first sexual maturity (immature fish). But it must gave a chance to spawn 2–3 times before capture according to Grandcourt *et al*. (2005) by increasing the mesh size of trammel nets.

The length at first capture of *S. aurata* in the Bardawil Lagoon even is higher than in Port Said (Mehanna, 2007). She explained that, the length at first capture was estimated at 11.1 cm which corresponding to an age of 0.25 year only. The same author predicted the effects of increasing the length at first capture on the yield of *S. aurata* since the relative yield-per-recruit was estimated by applying a higher value of L_c (19 cm). The present results indicated also that an increase of L_c would be associated with an increase in yields at the existing exploitation rate, the existing (E= 0.68) was nearly the same as that which maximize yield per recruit (E_{max}= 0.68).

The value of exploitation ratio (E): According to Gulland (1971) when the exploitation ratio is more than 0.5, this means overexploitation of the fish population. The value of exploitation ratio (E) for gilthead seabream in the Bardawil Lagoon was 0.637. This means that the *S. aurata* population in the Bardawil Lagoon suffers from overfishing. This is in consistence with results of Tharwat *et al*. (1998), estimated the total exploitation ratio (E = 0.57), which indicates that the stock of the gilthead sea bream in Bardawil Lagoon is slightly overexploited. They recommended reducing F to 0.80 y^{-1} with the increase of t_c to 1.6 year and total length from 20 to 21.2 cm. Similarly, Abd-Alla (2004) remembered that, the exploitation ratio (E) using these parameters was 0.58 (2000) and E = 0.52 (2001), which indicates that the stock of the gilthead sea bream in Bardawil Lagoon is slightly overexploited. Salem (2011) postulated that, the current exploitation rate (E = 79.43 %). Mehanna (2007) said that the Exploitation rate (E) of 0.68 indicated that the population has been heavily exploited. In spite of Verdiell-Cubedo *et al*. (2013) in his studies generally showed higher abundance of *Sparus aurata* at sites closest to the inlet connecting the lagoon with the Mediterranean Sea indicating the suitability of it as a nursery area.

Otherwise, Gulland (1971) suggested that the optimum exploitation rate for any exploited fish stock is about 0.5, at F_{opt} = M. Pauly (1987) proposed a lower optimum F that equal to 0.4 M. F was higher than the two values of F_{opt} given by both Gulland (1971) and Pauly (1987**)** indicating that the stock of *S. aurata* in Port Said is overexploited.

In conclusion, the present study revealed that the exploitation rate was found to be 0.637, which means the fish suffering from high overfishing.

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