AGE AND GROWTH OF GILTHEAD SEA BREAM (*Sparus Aurata*) FROM BARDAWIL LAGOON, NORTH SINAI, EGYPT

Samah, A. Mokbel*; Nesreen, K. Ibrahim, M.S. Ahmed and G.D. Ibrahim Hassanen

**ABSTRACT**

A total of 688 gilthead bream *Sparus aurata* was collected from Bardawil lagoon fishery during 2017 season. Total length ranged from 10.2 to 31.0 cm while total weight ranged from 13 to 442.5 g. The length-weight relationship parameters were $a = 0.0132$ and $b = 3.0224$. Age was determined using otolith radius reading technique and the longevity of this species was found to be 5 years, and the parameters of the von Bertalanffy growth model were $K = 0.338$ year$^{-1}$, $L_\infty = 32.16$, $t_0 = 1.324$ cm and $W_\infty = 523.8$g. Growth performance index $\phi'$ was estimated as 2.5. The mortality estimates were 0.792 year$^{-1}$ for total mortality (Z), 0.153 year$^{-1}$ for natural mortality (M) and 0.554 year$^{-1}$ for fishing mortality (F). The exploitation rate ($E = 0.803$) indicates that the stock of sea bream in the Bardawil lagoon is heavily exploited. The catch of *Sparus aurata* in Bardawil lagoon composed mainly of small sized individuals where up to 54.1% of this species lie in age group 0.

**INTRODUCTION**

Gilthead seabream is a member of the Sparidae family that contains a large number of species in several genera. The Gilthead sea bream (*Sparus aurata*) is an important species in the Egyptian coasts of Mediterranean Sea and the Bardawil lagoon fisheries. It was found in a wide variety of marine habitats, from rocky to sandy bottoms, at depths between 0 to 500 m, although it is usually more common at less than 150m deep (Abecasis *et al.*, 2008).

It is an expensive good food so; it is a target for intensive fishing. Recently, it has been widely cultured in many countries including Egypt. In the wild 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, Lloris, 2005).

**MATERIALS AND METHODS**

The study was carried out in the Bardawil lagoon from May 2017 to January 2018. The lagoon covers an area of 693 km$^2$, in an arid area in the Mediterranean Sea by along narrow sand bar and it communicates with the Mediterranean Sea water by two bays. Sampling was collected from commercial trammel net between May 2017 and January, 2018.

A total of 688 individuals of *S. aurata* were randomly collected from the commercial catch of trammel net from the Bardawil lagoon. Each fish was measured to the nearest mm for total length and weighed to the nearest 0.1 gram total weight. Otoliths 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 0.001 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 equation (Lee, 1920).

The back-calculated lengths-at-ages were fitted to the von Bertalanffy growth model and Ford-Walford plot was applied to estimate the von Bertalanffy growth parameters (L∞ and K). The relationship between length and weight was described by the potential equation (W = a*Lb, Ricker, 1975), where W is the total weight (g), and L is the total length (cm), a and b are constants. The calculated weight at the end of each year was estimated by applying length-weight equation. The growth performance index (φ') was computed according to the formula of Pauly and Munro (1984) as φ' = Log10 K + 2 Log10 L∞. The total mortality coefficient Z was estimated using the method of Pauly (1983). The natural mortality coefficient M was estimated as the geometric mean of three methods; Taylor's, equation as (Taylor's, 1960) M = 3/tmax where tmax is the maximum age attainable by individual specimens in the given population, equation (Urish, 1967) and formula (Pauly, 1980). While the fishing mortality coefficient F = Z– M and the exploitation rate E was estimated as E = F/Z (Gulland, 1971).

RESULTS AND DISCUSSION

Otolith reading of Sparus aurata in Bardwell lagoon during the fishing season 2017 for 688 individuals showed five age classes. The percentage occurrence of these groups were 54.1, 28.6, 8.4, 4.1, 2.5 and 2.3% for 0, 1, 2, 3, 4 and 5 year, respectively. This indicated that, the dominate of the young fish (0 and 1 groups, illegal size) while the age groups four and five were the least age groups in the catch. This results were confirmed by Salem (2010) and Mosbh (2013). The maximum estimated age (5 years) for Sparus aurata in Bardwell lagoon was recorded by Khalifa (1995).

The mean lengths at age were back-calculated for Sparus aurata as 19.1, 23.1, 25.2, 27.0 and 28.5 cm TL the 1st, 2nd, 3rd, 4th and 5th year of life, respectively. The greatest incremental growth in length occurred during the first year and then declined rapidly thereafter (Fig. 2).

The back-calculated lengths from the present study compared with those reported in the previous studies are given in Table 1.
Fig. 2. Growth in length and growth increment of *Sparus aurata* from Bardwell lagoon

### Table 1. The length at the end of life year of *S. aurata* given by different authors

<table>
<thead>
<tr>
<th>Region</th>
<th>Total length at the end of life (year)</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandria Bardwell Lagoon</td>
<td>17.67 26.16 32.31 39.8 44.11</td>
<td>(Wassef, 1978)</td>
</tr>
<tr>
<td>Bardwell lagoon, fishing season</td>
<td>19.5 23.67 26.89 - -</td>
<td>(Ameran, 1992)</td>
</tr>
<tr>
<td>Bardwell lagoon, fishing season</td>
<td>19.36 23.67 26.29 28.39 - 32.16</td>
<td>(Khalifa, 1995)</td>
</tr>
<tr>
<td>Bardwell fishing season 2000</td>
<td>19.36 23.83 28.45 31.54 32.84 -</td>
<td>(Salem, 2004)</td>
</tr>
<tr>
<td>Lagoon fishing season 2001</td>
<td>20.2 25.2 27.6 29.8 32.3 -</td>
<td></td>
</tr>
<tr>
<td>Port Said</td>
<td>21.26 27.8 32.25 34.3 - -</td>
<td>(Mehanna, 2007)</td>
</tr>
<tr>
<td>Bardwell lagoon, fishing season</td>
<td>22.82 27.09 30.03 31.5 - -</td>
<td>(Salem, 2010)</td>
</tr>
<tr>
<td>Bardwell lagoon</td>
<td>17.5 23.5 27.3 30.10 - -</td>
<td>(Mehanna, 2014)</td>
</tr>
</tbody>
</table>

Fig. 3. Length-Weight relationship of *Sparus aurata* from Bardwell lagoon

\[ W = 0.0132 L^{3.1274} \quad R^2 = 0.9567 \]
The results are agree with Wassef (1978) and Mehanna (2007 and 2014) while the back-calculated lengths of the present study were higher than those given by Ameran (1992) and Khalifa (1995) who reported different values for the same species during the three years of study at the Bardwell lagoon.

The total length ranged from 10.2 to 31.0 cm while the total weight ranged between 13 and 442.5g. The length – weight relationship (Fig. 3) was described by the power equation as: \( W = 0.0132 \times L^{3.0224} \), the positive algometry was established as the value of \((b < 3)\). These results agrees with Tharwat et al. (1998), Salem (2004), they found that, the values of \((b)\) equals 3.03 and 3.024 for the same species, respectively in lagoon. Salem et al. (2008) and Mosbh (2013) reported that, the length – weight relationship \(S. aurata\) in Bardwell lagoon equals 2.76 and 2.822, respectively. The differences in length-weight relationship might be interpreted as being due to differences in growth and morphometry between regions (Barnabé, 1976) and it is a practical index of the condition of fish, and varies over the year according to factors such as food availability, feeding rate, gonad development and spawning period (Bagenal and Tesch, 1978).

The values of von Bertalanffy growth parameters \(L_\infty\) and \(K\) estimated by the method of Ford (1933) and Walford (1946) were \(L_\infty = 32.16\) cm, \(K = 0.338\) per year, \(t_0 = -1.324\) and \(W_\infty = 523.8\)g. Mellwain et al. (2005) mentioned that the differences in growth parameters due to age, sex, maturity and sampling period for the same species. The value of growth performance index \(\Phi'\) was calculated as 2.5. Length weight relationship and the growth parameters of \(S. aurata\) in Bardwell lagoon and different regions were illustrated in Table 2.

The total mortality coefficient \(Z\) was estimated as 0.792 year\(^{-1}\). The natural mortality coefficient \(M\) was 0.153 year\(^{-1}\), while the fishing mortality coefficient \(F\) was 0.554 year\(^{-1}\). The exploitation rate \(E\) was computed as 0.803. The present exploitation rate is higher than that optimally exploited stock (50%) according to Gulland (1971).

Table 2. Length weight relationship and the growth parameters of \(S. aurata\) in Bardawil lagoon.

<table>
<thead>
<tr>
<th>Regions</th>
<th>Constants of length-weight relationship and growth parameters</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
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<tr>
<td>Egypt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bardawil lagoon</td>
<td>0.025</td>
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<tr>
<td></td>
<td>0.014</td>
<td>2.98</td>
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<tr>
<td></td>
<td>0.024</td>
<td>2.79</td>
</tr>
<tr>
<td></td>
<td>0.012</td>
<td>3.02</td>
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<td></td>
<td>0.030</td>
<td>2.76</td>
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<tr>
<td>Port said</td>
<td></td>
<td></td>
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<tr>
<td>Other regions</td>
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<td></td>
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<tr>
<td>Thau (France)</td>
<td>0.0226</td>
<td>2.88</td>
</tr>
<tr>
<td>Ebro (Spain)</td>
<td>1.12\times10^{-7}</td>
<td>3.05</td>
</tr>
<tr>
<td>Mirna (Croatia)</td>
<td>0.0112</td>
<td>3.05</td>
</tr>
<tr>
<td>Bardawil lagoon</td>
<td>0.0132±SE</td>
<td>3.02±SE</td>
</tr>
</tbody>
</table>
Conclusion

The present work was done to estimate the basic parameters required for suggestion some regulatory measurements for management of Sparus aurata in Bardawil lagoon fishing.

REFERENCES


calculating the number of fish per cubic meter during 2010. A new graph of the results of the research was drawn.

The results of this research show that the growth rate of the gilthead sea bream is very slow, and the average length of the fish is very small, which makes them vulnerable to predation.

The main factors affecting the growth rate of the gilthead sea bream are the water temperature, depth, and salinity. The water temperature has a significant effect on the growth rate, as it affects the metabolic rate of the fish. The depth also plays a role in the growth rate, as it affects the availability of food and oxygen. Finally, the salinity affects the osmotic pressure of the fish, which can affect their growth rate.

The management of the Bardwell lagoon requires a comprehensive plan to protect the fish population and maintain their productivity. This plan should include the following measures:

- Monitoring and controlling the water quality in the lagoon, to ensure that it is suitable for fish growth.
- Controlling the harvesting of fish in the lagoon, to prevent overfishing.
- Encouraging the use of sustainable fishing methods, such as underwater fish traps, to reduce the impact on the fish population.
- Establishing a marine protected area around the lagoon, to ensure the sustainability of the fish population.

These measures will help to maintain the productivity of the Bardwell lagoon, and ensure the continued availability of fish for local consumption and export.

The results of this study can be used to improve the management of the Bardwell lagoon, and to inform the development of policies to protect the fish population. The findings can also be used to guide the development of conservation strategies for other coastal lagoons in the region.