Age, growth and mortality of saddled bream, *Oblada melanura* (Linnaeus, 1758) in Abu Qir Bay, Egypt.

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Abstract

Age, growth, mortality rates and exploitation ratio for *Oblada melanura* in Abu Qir Bay (Egypt) were determined. The examined sample ranged between 12 and 29.2 cm total length and from 25.6 to 352 gm total weight. The length - weight relationship was found to be expressed by the equation $W = 0.017 L^{2.9342}$. Age was determined by using body scales readings. Length - scale relationship for sexes combined was represented by the linear equation $L = 1.0624 S + 1.286$. Growth in length and in weight were determined. Von Bertalanffy growth parameters were estimated ($L_\infty = 33.833$ cm, $k = 0.242$ year^{-1}, $t_0 = -0.669$ year^{-1} & $W_\infty = 522$ gm). The maximum age (t_{max}) was 12.4 year and the growth performance for length (ϕ_L) was 2.442. The coefficients of total mortality (Z), natural mortality (M) and fishing mortality (F) were 0.958, 0.563 and 0.349 year^{-1} respectively. Survival rate (S) was 0.38. Length and age at first capture were 15.68 cm and 1.90 year respectively. Length and age at recruitment were 13.95 cm and 1.53 year respectively. The estimated exploitation ratio (0.412) indicates that, this species in Abu Qir Bay is not overexploited.

Keywords: Abu Qir Bay, Age, Growth, Mortality, Sparidae, Oblada melanura.

1. Introduction

The saddled bream *Oblada melanura* (Linnaeus, 1758) is common throughout the Mediterranean and eastern Atlantic, inhabiting littoral waters above rocky bottoms and *Posidonia* beds, up to 30 m depth (Bauchot and Hureau, 1986). They feed almost exclusively on crustaceans and zooplanktonic animals, which they graze from the substrata when juveniles, but when become adults they feed mainly on vegetable matter as algae and hydrophytes (Froese & Pauly, 2009). According to Pallaoro *et al.* (2003) the saddled bream could be considered an opportunistic predator.

Family Sparidae was studied by various authors as: Erzini *et al.* (2001), Morato (2001), Morato *et al.* (2003), Abd Elbarr (2004) and Heemstra & Heemstra (2004). While few authors studied *O. melanura* such as: Zaki *et al.* (1995) who studied the reproductive biology. Pallaoro *et al.* (1998) studied some biological parameters of this species, while the feeding habits were studied by Pallaoro *et al.* (2003).

In spite of the wide distribution and commercial importance of *O. melanura*; information on their biology and ecology in the Egyptian waters is limited. The present study aims to shed some light on the basic information required for fisheries management of such fish species especially their age, growth, mortality rates and exploitation ratio in Abu Qir Bay, Egypt.

2. Materials and Methods

Random samples of *O. melanura* (477 fish) were collected from the commercial catch of Abu Qir Bay twice a month during the period from August, 2008 to August, 2009.

For each sampled fish; total length (cm) and total weight (gm) were recorded. Age was determined from the ctenoid scales, a sample of scales was selected from the left side and above the pectoral fin of each fish. Length weight relationship was estimated according to Le Cren (1951). Condition factor was calculated according to Hile (1936).

The relationship between scale radius and fish length was found to be linear. The lengths at different ages were back calculated using Lee's formula (1920).

The back calculated lengths were used to estimate the growth parameters of the Von Bertalanffy growth model (1938) by fitting the Ford (1933) and Walford (1946) plot, while t_0 was estimated by inverse Von Bertalanffy growth equation and W_∞ was estimated by converting L_∞ to the corresponding weight using length weight relationship. The maximum age was obtained according to Pauly and David (1981), and the growth performance of length was estimated according to Moreau *et al.* (1986).

The instantaneous total mortality coefficient (Z) was obtained by using the age based catch curve (Ricker, 1975).

The natural mortality (M) was calculated using Pauly empirical formula (1980):

Log M= - 0.0066 – 0.279 log L_∞ +0.6543 log K +0.4634 log T

Where, L_∞ & K are V.B.G.F. parameters and 'T' is the annual mean temperature in centigrade.

Instantaneous fishing mortality (F) was calculated by subtracting the natural mortality coefficient (M) from the total mortality coefficient (Z). The estimation of survival rates (S) was given by the equation $S = e^{-z}$ (Ricker, 1975). The exploitation ratio (E) was calculated for *O. melanura* according to Baranov (1918) formula.

Length and age at first capture (L_c & t_c) were investigated from the equation of Beverton and Holt (1956 & 1957). Length and Age at recruitment (L_r & t_r) were estimated by applying Von Bertalanffy growth equation.

3. Results

3.1. Age and growth

3.1.1. Length weight relationship and condition factor

The length - weight relationship for combined sexes of *O. melanura* in Abu Qir Bay (Figure 1) was found to be represented by the formula:

W = 0.017 L $^{2.9342}$ $R^2 = 0.9935$

The overall mean condition factor (k) value of *O. melanura* in Abu Qir Bay was found to be 1.41. Figure (2) shows the K values of the different age groups. It indicates that, the condition factor of the youngest age groups (I & II) were larger than the older age groups.

The seasonal variations in the condition factor (Table 1) shows that, the maximum value of 'K' was in summer (1.44 ± 0.063) followed by autumn (1.42 ± 0.042) and spring (1.40 ± 0.052) while the smallest K value was in winter (1.39 ± 0.063).

Table (1): Seasonal variations in the condition factor of *O. melanura* in Abu Qir Bay.

Season	No. of sample	mean K	± S.D.
Winter	110	1.39	± 0.063
Spring	124	1.40	± 0.052
Summer	129	1.44	± 0.054
Autumn	114	1.42	± 0.042

3.1.2. Growth in length

Length scale relationship was linear and represented by the following equation:

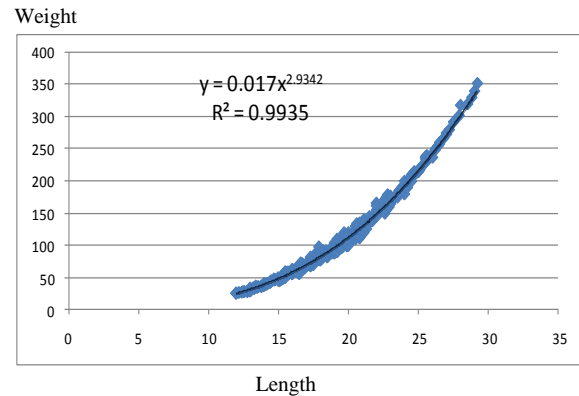L = 1.0624 S + 1.286 $R^2 = 0.9845$

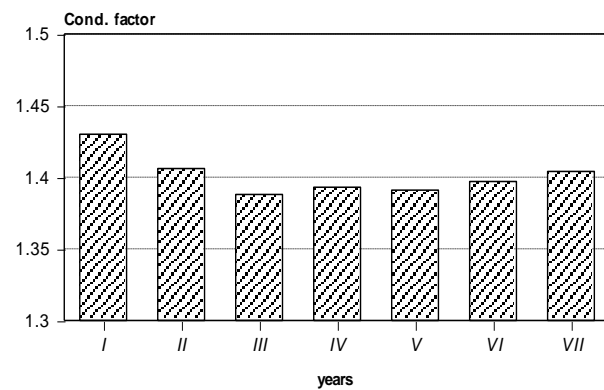Figure 1: Length weight relationship of *O. melanura* in Abu Qir Bay.

Figure 2: Condition factor of the different age groups of *O. melanura* in Abu Qir Bay.

Where, 'L' is the total length (cm) and 'S' is the total scale radius (micrometer division).

Table (2) represents the average back calculated lengths for each age group of *O. melanura*. This shows that, there are seven age groups which constitute *O. melanura* population. This species reaches 28.5 cm at seven years of age. The highest length increment occurred by the end of the first year of life and then declined rapidly thereafter.

3.1.3. Growth in weight

The back calculated weights by the end of each year of life were estimated (Table 3). It was noticed that, the annual increment of growth in weight increased with further increase in age until it reached its maximum value at age group IV (56.69 gm), after which it showed gradual decrease with further increase in age.

According to the present data, fishes of this species reach 316.34 gm after seven years of age.

3.1.4. Theoretical growth

The parameters of Von Bertalanffy growth model of *O. melanura* in Abu Qir Bay were estimated to be as follows:

Table (2): Back calculated lengths of *O. melanura* at the end of each year of life.

Age (year)	Calculated total lengths (cm)						
	I	II	III	IV	V	VI	VII
I	11.40						
II	11.34	16.22					
III	11.26	16.13	20.04				
IV	11.20	16.07	19.96	22.99			
V	11.17	15.98	19.88	22.93	25.30		
VI	11.13	15.96	19.81	22.90	25.29	27.14	
VII	11.04	15.88	19.76	22.86	25.25	27.10	28.52
Avr.	11.22	16.04	19.89	22.92	25.28	27.12	28.52
S.D.	± 0.124	± 0.124	± 0.113	± 0.055	± 0.026	± 0.028	0.00
Incr.	11.22	4.82	3.85	3.03	2.36	1.84	1.40
Inc.%	39.34	16.90	13.50	10.62	8.27	6.45	4.91

Table (3): Back calculated weights of *O. melanura* at the end of each year of life.

Age (year)	Calculated total weights (gm)						
	I	II	III	IV	V	VI	VII
I	21.46						
II	21.13	60.39					
III	20.70	59.41	112.33				
IV	20.37	58.77	111.01	168.06			
V	20.21	57.81	109.71	166.78	222.58		
VI	20.00	57.60	108.58	166.14	222.32	273.49	
VII	19.53	56.75	107.78	165.29	221.29	272.31	316.34
Avr.	20.49	58.45	109.88	166.57	222.06	272.90	316.34
S.D.	± 0.65	± 1.331	± 1.854	± 1.195	± 0.701	± 0.862	0.00
Incr.	20.49	37.97	51.43	56.69	55.49	50.84	43.43
Inc.%	6.48	12.00	16.26	17.92	17.54	16.07	13.73

$L_\infty = 33.833$ cm, $k = 0.242$ year^{-1}, $t_o = -0.669$ year^{-1} & $W_\infty = 522$ gm.

The theoretical back calculated lengths and weights at the end of each year of life as obtained by Von Bertalanffy growth constants were computed and shown in Figures (3 & 4).

It is noticed that, these values are close to those obtained by the back calculation, according to Lee's formula.

According to the present data, the maximum age (t_{max}) was computed as 12.4 year for *O. melanura* in Abu Qir Bay and the growth performance in length (Φ_L) was found to be 2.442.

Figure 3. Theoretical back calculated lengths in (cm) according to Von Bertalanffy growth constants.
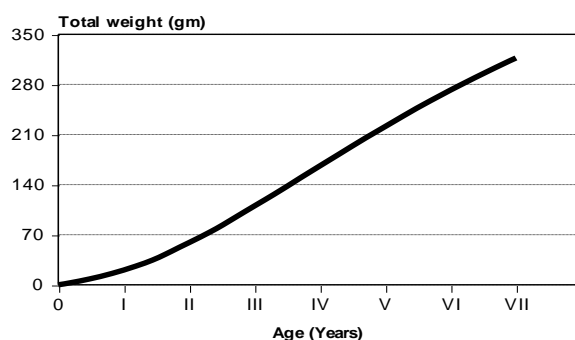

Figure 4: Theoretical back calculated weights in (gm) according to Von Bertalanffy growth constants.

3.2. Population Structure

3.2.1. Length frequency distribution

The examined sample of *O. melanura* varied in length between 12 and 29.2 cm. The most abundant length group was 19.5 cm representing 13.84% of the examined fish followed by length groups 18.5 & 20.5 cm which represented 12.58% and 11.32% of the examined samples respectively (Figure 5).
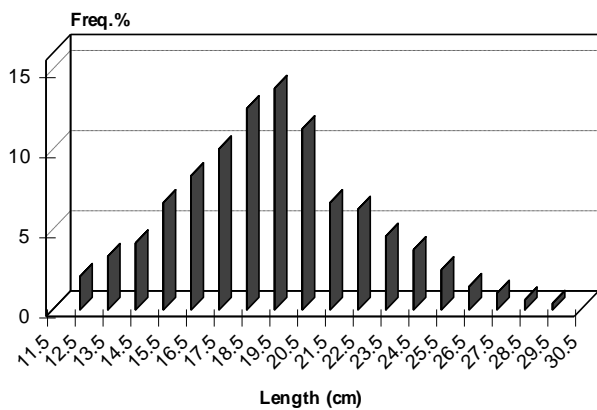
Freq.%

Length (cm)

Figure 5: Percent length frequency distribution of *O. melanura* in Abu Qir Bay.

3.2.2. Age composition

The landed catch of *O. melanura* was represented by seven age groups (Figure 6). The most abundant age groups were age group II (44.03%) and age group III (21.38%) followed by age group I (16.77%) and IV (12.58%), while age groups V, VI & VII are of very low abundance.
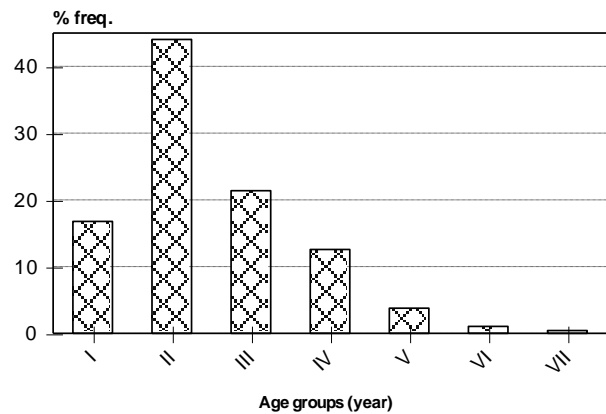
% freq.

Age groups (year)

Figure 6: Age composition of *O. melanura* in Abu Qir Bay.

3.2.3. Length distribution of age groups

The Length distribution percentages within each age group of *O. melanura* are shown in Table (4), there are obvious length overlapping between the different age groups.

3.2.4. Instantaneous mortality coefficients

The instantaneous total mortality coefficient (Z) of *O. melanura* in Abu Qir Bay was obtained by the age based catch curve (Figure 7) by taking the minus value of the slope (-b) of the straight descending portion of the curve as the value of 'Z' which is equal 0.9577 $year^{-1}$.

Natural mortality as estimated by Pauly's formula was found to be 0.5632 $year^{-1}$. Fishing mortality is therefore 0.3945 $year^{-1}$.

Table (4): Length frequency distribution percentages of each age group of *O. melanura* in Abu Qir Bay.

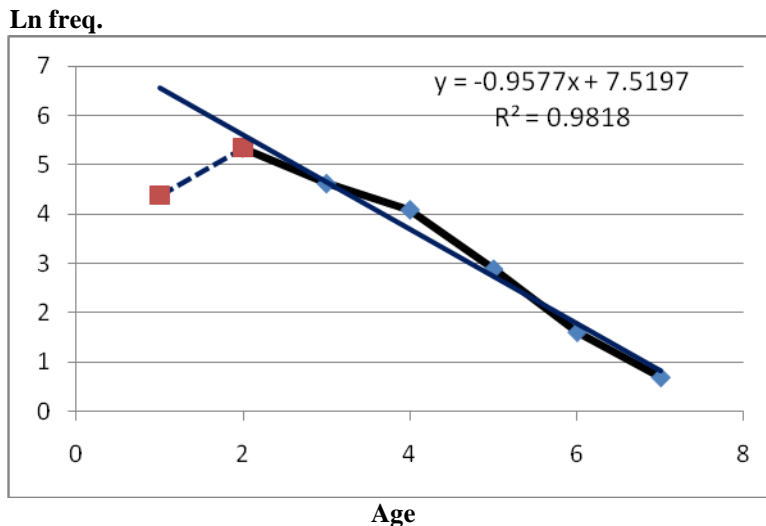| L.	I	II	III	IV	V	VI	VII
12.5	2.10						
13.5	3.35						
14.5	4.19						
15.5	5.03	1.68					
16.5	2.10	6.29					
17.5		10.06					
18.5		12.16	0.42				
19.5		9.64	4.19				
20.5		4.19	7.13				
21.5			6.71				
22.5			2.10	4.19			
23.5			0.84	3.77			
24.5				3.35	0.42		
25.5				1.26	1.26		
26.5					1.26	0.21	
27.5					0.84	0.21	
28.5						0.63	
29.5							0.42
Tot.	16.77	44.03	21.38	12.58	3.77	1.05	0.42

Ln freq.

$$y = -0.9577x + 7.5197$$
$$R^2 = 0.9818$$

Age

Figure 7: Catch curve of *O. melanura* in Abu Qir Bay.

3.2.5. Length and age at first capture and at recruitment

Length and age at first capture (L_c and t_c) as obtained in the present study were found to be 15.68 cm and 1.904 year, while length at recruitment (L_r) was 13.95 cm and the corresponding age at recruitment (t_r) was 1.53 year,

these results show that, fish of this species are recruited to the population at an age near the end of the second year of life.

3.2.6. Survival and Exploitation ratio

The survival rate of *O. melanura* in Abu Qir Bay was found to be 0.38 and the rate of exploitation was 0.412.

4. Discussion

According to the present study, the value of the exponent "b" in the length weight relationship of *O. melanura* was found to be 2.9342. This result is nearly similar to those obtained for *Diplodus sargus sargus* and *Diplodus vulgaris* in Abu Qir Bay (2.9421 and 2.9686) respectively (Mahmoud *et al*., 2010 'a & b'). Farag (2008) found 'b' values of *Pagellus erythrinus* and *Lithognathus mormyrus* in Abu Qir to be (2.912 & 2.894 respectively). On the contrary, Pallaoro *et al*. (1998) obtained the values of 'b' for males and females of *O. melanura* in the Eastern Adriatic as 3.017 and 3.123 respectively.

The condition factor of *O. melanura* was 1.41 in Abu Qir Bay, this value is lesser than those obtained for *D. sargus* and *D. vulgaris* (1.74 and 1.63 respectively) in the same bay (Mahmoud *et al*., 2010

'a & b'). According to the present study, seasonal variations in the condition factor were observed. These variations are said to be a function of the intensity of feeding and spawning (Rounsefell, 1953).

The parameters of Von Bertalanffy growth model of *O. melanura* were estimated as $L_\infty = 33.833$ cm, k = 0.242 year^{-1}, $t_o = -0.669$ year^{-1}. These parameters in the same species in Croatia (Froese & Pauly, 2009) were $L_\infty = 31.8$ cm, k = 0.233 year^{-1}, $t_o = -0.71$ year^{-1}. Pallaoro *et al*. (1998) found that the growth parameters of *O. melanura* in the Eastern Adriatic to be $L_\infty = 34.13$ cm, k = 0.208 year^{-1}, $t_o = -0.75$ year^{-1}. This shows that, the present results are within the range given for this species. They are higher than those given in Croatia and are less than those given for the Eastern Adriatic fish.

The maximum age in the present study was found to be 12.4 years while it was 11 years for the same species in Croatia (Froese & Pauly, 2009). The same authors estimated the growth performance to be 2.37 while it was 2.442 in the present study, which is not much different from those given by them.

The study of age composition of *O. melanura* in Abu Qir Bay revealed that, age group II was the dominant age group in the catch. This result is similar to the results given by Mahmoud *et al*. (2010 'a & b') who stated that, the dominant age group in the catch of *D. sargus* and *D. vulgaris* in Abu Qir Bay was age group II. While Farag (2008) found that age group I was the dominant age group in *P. erythrinus* (58.15%) and in *L. mormyrus* (52.26%) in Abu Qir Bay.

The overlap between the different age groups in the present study is clear. This is a common phenomenon in fishes due to the presence of differences in growth rates among individuals within the age groups.

Gulland (1971) suggested that the optimum exploitation ratio for any exploited fish stock is about

0.5. This ratio was found to be 0.412 for the species under study which indicates that, its rate of exploitation in Abu Qir Bay within the optimum condition.

The length or age at first sexual maturity helps in the determination of the minimum legal size that must be avoided in fishing in order to protect an adequate spawning stock and ensure at least one spawning for the mature individuals (Zaki *et al*., 1995).

The length at first sexual maturity of *O. melanura* in Abu Qir Bay was found to be 14.75 cm for females and 14.35 cm for males (These results is being delt with elsewhere). These results are in agreement with Zaki *et al*. (1995), they found all fishes of *O. melanura* which are smaller than 13 cm, are immature and all fishes larger than 17 cm are sexually mature.

The present study revealed that, the lengths at recruitment and at first capture for males and females of *O. melanura* were 13.95 and 15.68 cm. This shows that, the fisheries status of this species is still within the range of optimum exploitation. However further studies for good management are needed in order to improve its fisheries production.

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