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Research Article

Age, growth and mortality of the European Seabass, (*Dicentrarchus Labrax*) in Bardawil lagoon, North Sinai, Egypt

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Abstract

Age, growth, and mortality of European Seabass (*Dicentrarchus labrax*) were studied from a small-scaled fishery of Bardawil lagoon, (North Sinai, Egypt). 181 specimens (16.6 to 35 cm total Length and 39.8 to 367.2 g total weight). The relationship between length and weight was $W = 0.0054L^{3.1428}$. Age was determined by otoliths and age groups I to IV years were observed. Growths in length and weight at the end of each year were calculated. The growth parameters of von Bertalanffy equation were calculated as (L_{∞} = 48.69 cm, K = 0.1677 yr^{-1} and t_0 = -0.447 yr^{-1}). Growth performance index was calculated (φ = 2.60 for length and 1.25 for weight). Mortality rates were 0.867 yr^{-1}, 0.25 $yr^{1}$and 0.617 yr^{-1} for total, natural and fishing mortality, respectively. The currently exploitation rate E = 0.712 yr^{-1} indicating that, the population of this species is being heavily exploited.

Introduction

European Seabass, (*Dicentrarchus labrax*) belongs to family Moronidae. It is common fish in the Mediterranean Sea, the Black sea, along the Eastern Atlantic coasts and Eastern North Atlantic from Southern Morocco to the Norwegian littora. These species are demersal fish and it found in marine to slightly brackish environments [1,2].

Abdel-Hakim, *et al*. 2010 [3] mentioned that, they are one of the important marine fishes in Bardawil Lagoon and have a great economic in Egypt. It the main demersal target of hand lines, long lines and trolling fisheries operating.

GAFRD 2018 [4] mentioned that, the total production of sea bass in Bardawil Lagoon increased to about 124 tons during the fishing season of 2016, as compared with 26-90 tons during 2003-2015 fishing seasons.

The some properties of *Dicentrarchus labrax* were investigated by researchers [3,5-9].

Age determination is essential for studies of growth and population biology of Fisheries research. Also, the data on age structure can indicate the health of the population, mortality and survival rate [10-12].

The length-weight relationship is very crucial in estimating the standing stock biomass and discusses the development history of fish population from various regions [13]. It is an important fishery management tool and it is very beneficial for cultivators and fisheries managers to determine the growth of the species [14].

The current work amid to identify the biological aspects and exploitation rates of *D. labrax* in Bardawil lagoon recognizing age groups estimate growth rate and growth parameters, estimate mortality and utilization rates, and aims to develop

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an appropriate management plan to maintain this valuable fish resource. That could be useful for management of this important species.

Material and methods

The study area

Bardawil lagoon is a shallow (0.3 to 3 m depth) and hyper-saline lagoon on the northern coast of Sinai. It lies between Lat 33°0', Lon 31°9' and covers an area of about 650 km2, with about 85 km length and a maximum width of 22 km. It is separated from the sea by a sandbar that varies in width between 100m and 1km. Three openings connect the lagoon with the sea; two artificial openings at the West side (Boughaz I and Boughaz II) and one natural opening at the East (El-Zaranik). Bardawil lagoon, particularly at Zaranik, has been identified as one of the most important wetlands for water-birds in the whole Mediterranean region (Figure 1).

Sampling

Monthly, random samples of European Seabass, (*Dicentrarchus labrax*) were collected from the mixed catch of the main landing site at the Bardawil lagoon. The sampling period lasted during the fishing season 2020-2021. The total length of 181 individuals of *D. labrax* from the tip of the snout to the end of the caudal fin was measured to nearest centimeter, total weight was measured to the nearest 0.1 gram. Otoliths were removed, of 181 individuals cleaned and stored dry in labeled vials, and examined calcified rings under the microscope to determine age groups.

Data analysis

For age determination, the Otoliths were cleaned by 8 % HCl, and then dried. The otoliths were cleared in a mixture of 50 % ethyl alcohol and 50% glycerin and they were examined using microscope. The opaque and transparent rings were counted from the nucleus to the margin along the longest axis of the otolith. One opaque zone together with one transparent zone was considered to be an annual increment. Each annual increment represents one year of the fish age [15]. The number of fish in each age group was calculated, and then the proportion of the different age groups of the fish in the catch was used to calculate the age composition of *Dicentrarchus labrax*. Lengths by age were back-calculated using [16] equation: Ln = (Sn/S) L, where: Ln = is length of fish at age "n ", Sn = is magnified otolith radius to "n "annulus, S = is magnified total otolith radius, L = is fish length at capture.

The relation between the total length (L) and total weight (W) was computed using the formula of [17] ($W = a L^b$, where: a and b are constants whose values were estimated by the least square method).

Theoretical growth in length and weight was obtained by fitting the von Bertalanffy growth model, using the [18,19] method [20] for theoretical growth in length can be written in the form: $L_t = L_\infty [(1 - e^{-k(t - t_0)})]$

Where: L_t = the length at age t, L_∞ = the asymptotic length at t_∞, K = growth coefficient and t_0 = age at which the length is theoretically nil.

The calculation of constants of the Von Bertalanffy growth model by Ford – Walford method can be derived as follows: $K = - Ln\ b\ L_\infty = a / 1 - b$

Then, the constant to can be calculated by the following equation: $t_0 = t + 1 / k\ Ln (L_\infty - Lt) / L_\infty$

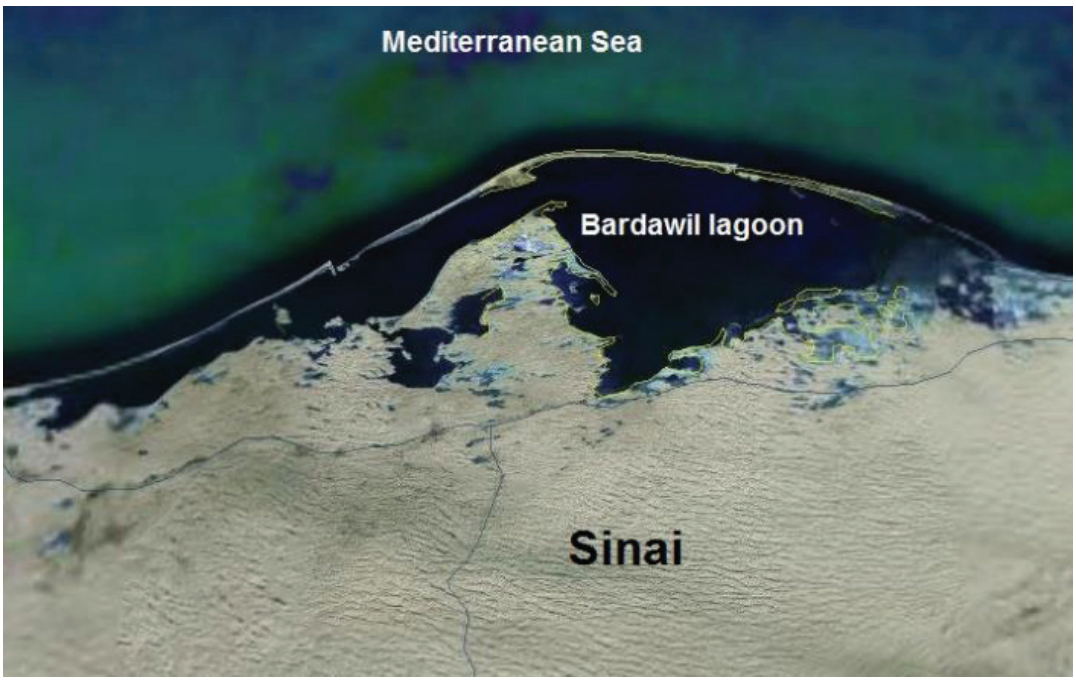

Figure 1: Map of Bardawil lagoon.

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The growth performance index (Φ) was estimated as: Φ = log K + 2 log L_∞ [21] where: K and L_∞ are parameters of von Bertalanffy).

Total mortality can be estimated using [22] method the following equation:

S = ∑ N - No / ∑ N – Nx Z = - Ln S

Where: T = N1 + 2 N2 + 3 N3 + ……..x Nx; Notes ∑ N = No + N1 + N2 + ……..Nx; No is the number of fish in age – group I; Nx is the number of fish in age – group IV

Natural mortality coefficient (M): M=1.5k [23]; Fishing mortality (F): It was calculated as F=Z-M; Exploitation rate (E): the value of (E) was calculated after (Gulland, 1971) where E = F/Z.

Results and discussion

Total of 181 European Seabass, *Dicentrarchus labrax* were measured as a total length (cm). With lengths from 16.6 to 35 cm with weights ranging between 39.8 and 367.2g. The equation derived in respect of length-weight relationship is

As: Pooled: $W = 0.0054L^{3.1428}$ ($R^2 = 0.9764$).

The relationship equation showed a positive allometric in which b= 3.1428.These result agree with that of [5] estimated the value of (b) as 3.142 in the England water [6] b value was 3.0551 and [24] resulted that, the value of (b) equals 3.2379. [9] found that, b= 3.0067 in Bardawil lagoon Figure 2.

On the other hand, the result disagree with that of [25] found that, the value of (b) equals 2.8241 in the Mediterranean Sea, In Bardawil lagoon; [26] found that, the value of (b) was 2.8241; [27] mentioned that, the value of (b) at 2.7977 and 2.7316 during 2000 and 2001 respectively. And disagree with [28] estimated the b- value as 2.7977 and 2.69 during 2001 and 2002, respectively In Mediterranean Sea, Port Said, region [3] resulted that, the slope (b value) of the length weight relationship was 2.824.

The (b) values in fish is species specific and varies with sex, age, seasons, physiological conditions, growth increment and nutritional status of fish, health, habitat, nutrition, environmental conditions (such as temperature and salinity), area, degree of stomach fullness, differences in the length range of the caught specimen, maturity stage and techniques of sampling fishing gear [10,17].

In the present work, the age determination of *Dicentrarchus labrax* was based on the otolith reading. 181 combined sexes using otolith. Age ranged from 1 to 4 years, ranged from 16.6 to 35 cm as a total length and from 39.8 to 367.2 g as a total weight. The mean fish length and the average otolith radii per each length group were given with the ratio of fish length in the total length / otolith radius relationship Figure 3.

Age composition of *D. labrax* in Bardawil lagoon during season 2020-2021 were constructed of combined sexes Tables 1 and Figure 4 show that the specimens of combined sexes belong to age group I to IV generally the different age groups cover wide length ranges.

These results disagree with both [8,9] they found that, Age distribution of *D. labrax* samples from Bardawil Lagoon ranged from 0 to 6 years.

The age of *D. labrax* was determined by the annual rings of otolith of 181 specimens. Four age groups were observed. The average back-calculated lengths of European Seabass are given in Table 2 as were 9.89, 12.53, 14.23 and 15.58 cm and increment in length of age as were 9.89, 2.64, 1.70 and 1.35 for the 1st, 2nd, 3rd and 4th year of life, respectively. The highest annual increment occurred during the first year of life, while a noticeable decrease was observed in the second year, reaching to minimal value during the fourth year of life (Figures 3,5).

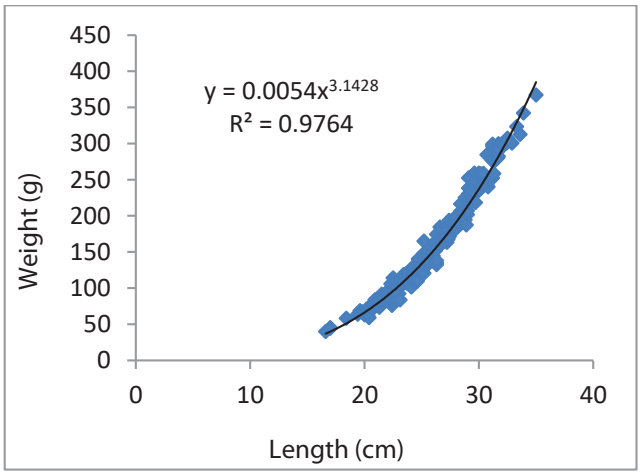

Figure 2: Length-weight relationship *D. labrax* (♂♀) collected from Bardawil lagoon during season 2020-2021.

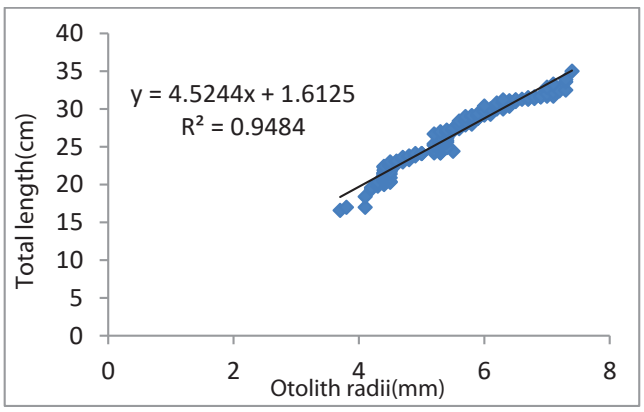

Figure 3: The relationship between total length (TL) and otolith radius of combined sexes (♀♂) of *D. labrax* collected from Bardawil lagoon during season 2020-2021.

Table 1: Age composition of *D. labrax* collected from Bardawil lagoon during season, 2020-2021.

Age group	Sexes combined	
	number	%
age1	6	3.3
age2	109	60.2
age3	48	26.5
age4	18	9.9
	181	

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[9] mentioned that, the back-calculated lengths recorded in Bardawil lagoon for *D. Labrax* were 22.3, 28.3, 34.0, 38.4, 42.6 and 46.5 cm for age groups 1, 2, 3, 4, 5 and 6 years, respectively.

In present study, The growth parameters of von Bertalanffy for European Seabass, (*Dicentrarchus Labrax*) were as follow; L_∞ =48.69cm, K = 0.1677 year-1 and t_0 = -0.447 year^{-1} [29] mentioned that the differences in growth parameters were due to age, sex, maturity and sampling period for the same species.

In Bardawil lagoon, (Egypt) by [9] growth parameters where found as L_∞, K and t_0 was 75.31 cm, 0.1221 yr^{-1} and -1.8703 yr^{-1} respectively. The growth parameters of von Bertalanffy for European Seabass, (*Dicentrarchus Labrax*) were as follow; L_∞ = 70.82 cm, K = 0.35 yr^{-1} and to = -0.217 yr^{-1}by [7,8]. resulted that, growth parameters where found as L_∞, K and t_0 was 76.36 cm, 0.29 yr^{-1} and -0.19 yr^{-1} respectively.

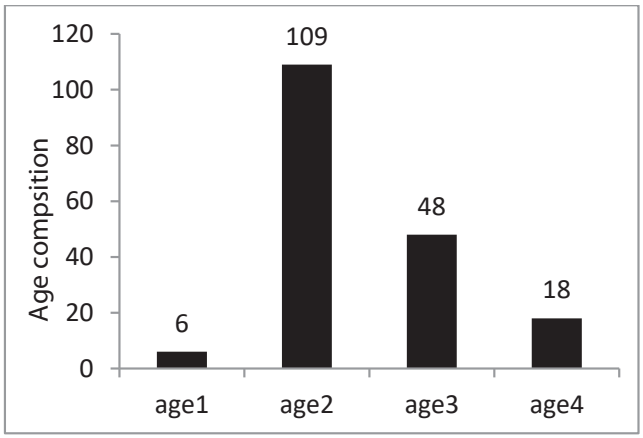

Figure 4: Age composition of combined sexes of *D. labrax* collected from Bardawil lagoon during season, 2020-2021.

Table 2: Back-calculation length at the end of different life years of, combined *D. labrax* collected from Bardawil lagoon during season 20-2021.

Age	No. of fish	Observed length (cm)		Observed weight (gm.)	Average back calculated lengths at the end of each year (cm)			
					I	II	III	IV
combined sexes (♀♂)								
I	6	18.0	53.4	83.8	15.48			
II	109	24.0	118.8	141	12.93	20.62		
III	48	29.6	232.6	193.8	12.99	19.63	24.84	
IV	18	32.3	300.5	242.1	12.01	18.63	23.35	28.55
				Increment	15.48	5.14	4.22	3.71

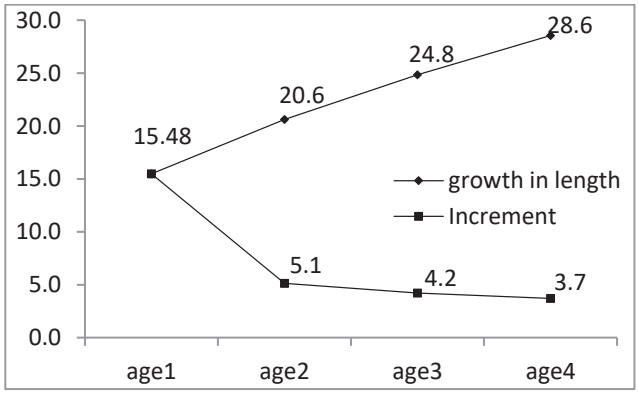

Figure 5: Growth and annual increment in length (♀♂) of *D. Labrax*.

Growth performance index (Φ) of the same species reflects its adaptations to the environment factors. In current present, the growth performance index of *D. labrax* was 2.60 and 1.25 for length and weight, respectively. The growth performance index (Φ) defined as 2.84 and 1.4943 for length and weight, respectively [9]. Bardawil lagoon is better for the growth of *D. labrax* under study. Such differences may be attributed partially from the different techniques used, but more likely reflect slight environmental differences such as food availability and contents, height salinity in the lagoon and rise of temperature during 6 months at least [30].

The total mortality (Z) was calculated for *D. labrax* was 0.867 year^{-1}, the natural mortality coefficient (M) was 0.25 year^{-1}, fishing mortality (F) was 0.617 year^{-1}. The exploitation level of this species was higher than the optimum one where the current E was0.712 indicating that, the population of this species is being heavily exploited.

[3] resulted that, the rates of total mortality Z, natural mortality M, fishing mortality F and exploitation rate (E) were 1.54, 0.36, 1.18 and 0.766yr^{-1} respectively for the same species in Bardawil lagoon. [9] found that, Z, M, and F values were 0.8786, 0.3153 and 0.5633 year^{-1}, respectively. E value was recorded as 0.64 year^{-1}.also [8], found that, total, natural and fishing mortality rates were 1.03 yr^{-1}, 0.39 yr^{-1} and 0.64 yr^{-1}, respectively. The current exploitation rate (E = 0.6229).

According to [31,32] the M value represents deaths from all occasion, except mans fishing involving predation, senility, epidemics, pollution, etc.

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