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ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol.07, Issue, 04, pp.2745-2749, April, 2016

RESEARCH ARTICLE

SCALES MORPHOMETRY AND POPULATION PARAMETERS OF *DIPLODUS VULGARIS* (GEOFFROY _ HILAIRE, 1817) IN BENGHAZI COAST, LIBYA

Anwaar M. Saeid, *Abdalla N. Elawad and Ramadan A. S. Ali

Department of Zoology, Faculty of Sciences, Marine Biology branch, Omar Al-Mukhtar University

ARTICLE INFO

Article History:
Received 30th January, 2015
Received in revised form
29th February, 2016
Accepted 04th March, 2016
Published online 27th April, 2016

Key words:
Population parameters,
Diplodus vulgaris,
Von Bertalanffy,
Benghazi coast.

ABSTRACT

Due to the economic importance of *Diplodus vulgaris* in Benghazi coast (Libya), this study is concerned to estimate the biological and population parameters required for proposing a future plan to sustain and manage this valuable fish resource. Age estimates ranged between 1+ and 8+ in both methods scale and length frequency distribution methods. The parameters of Von Bertalanffy growth model were estimated for male, female and both sex as $L\infty$ = 37.4 cm, 39.3cm, 33.3 cm, K = 0.17, 0.199, 0.113, t_o = -1.66, -2.02, -1.6 and φ' = 2.4, 2.5, 2.1 respectively. The coefficients of total mortality (Z), natural mortality (M) and fishing mortality (F) were 0.3, 0.1 and 0.2 year-1 respectively. The Exploitation rate (E) was 0.7 and survival rate was 0.7.

INTRODUCTION

With the knowledge that, in the Mediterranean Sea there are 25 species of family sparidae, of which 14 species inhabiting the Libyan coast, such as *Diplodusvulgaris* (Ibrahim, 2013). The common two-banded seabream, *D. vulgaris* is a demersal species distributed in the Mediterranean and Black Seas and along the eastern Atlantic coast from France to Senegal, including the Madeira, the Azores and the Canaries Archipelagos. It is also present from Angola to South Africa (Bauchot & Hureau, 1986, 1990). It can be found close to rocky and sandy bottoms to a maximum depth of 60 m. Juveniles often live in coastal lagoons and estuaries (Monteiro, 1989) and it is considered a resident species in artificial reefs (Santos, 1997). Mainly caught by line and hooks, generally recognize as commercial value, frequently in huge catch inhabiting the eastern coast of Libya. Despite their wide distribution range and commercial importance in eastern coast of Libya, especially from artisanal fishing in Benghazi fishing coast on the Mediterranean. No study for determining the dynamic and stock of *D. vulgaris* was such as the age, growth, mortality, Survival rate, Exploitation rate, Yield Per Recruit wasdone.

Corresponding author: Abdalla N. Elawad
Department of Zoology, Faculty of Sciences, Marine Biology branch, Omar Al-Mukhtar University

Aims of the study

The present study fill the gap, and focus on the general population dynamic characteristics (age, growth mortality, survival rate and exploitation rate) for the species D. vulgaris. The species is selected due to its commercial importance. The main aims of the present study are to estimate the population dynamic parameters, for the species (*D. vulgaris*).

MATERIAL AND METHODS

The data and information was gathered from Benghazi coast, 32°36'N and 20°03'E on the Mediterranean sea (Figure 1), because it is considered the largest port in the east coast, The port is packed with a large number of fisherman, reach 1200. Also inthe harbor allkinds of fishing were practice.

Age composition: A total of 290 fishes (random samples) of *D. vulgaris*, taken from the catch of 2015, from Benghazi coast were used for age determination based on the numbers of growth rings per scale following Hile (1941), and Peterson, (1894).

The growth parameters ($L\infty$, k and t_o): were obtained from the lengths at different ages of back calculated using Lee,,s formula (1920) as follows:

$$Ln = [(Sn / S)*(L - a)] + a$$

Where Ln is the calculated length in cm., L is the total length in cm, Sn is thescale radius from the nucleus to the annual mark, S is the total scale radius in micrometer division from the nucleus to the anterior edge of the scale and a is the intercept on the Y axis inthe length scale relationship. 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.

$Lt = L\infty \{1-\exp [-k (t-t_0)]\}$

Where: Lt, is the length at time t.L∞, is the asymptotic length, that is the mean length of individuals of a given stock if they were left to grow indefinitely. K, is growth constant.t, is the age of the fish at "Lt" length.t_0, is the age of fish at length zero.

For accuracy of the growth parameters the growth performance index (φ') was examined using Munro's formula $\varphi' = \log(k) + 2\log(L\infty)$. The total mortality (Z), was estimated using the linearized catch curve based on age composition data based on Gulland (1985) and Ricker (1975).

Ln C(t1, t2) = q-z*t (slope was = -Z).

The natural mortality rate (M) for the species studied was estimated by Taylar equation 1959.

M= (2.996*k)/(2.996+(k*to)

Where k and t_0 are Von Bertalanffy parameters growth.

The fishing mortality coefficient (F), was obtained by subtracting the natural mortality from total mortality coefficient. The survival rate (S), for the species was estimated from Ricker (1975) equation: $Z = -\log_e S$ Or $e^{-z} = S$, By using the values obtained for total mortality rate and the equation of Richer, 1975, the values of survival rates were obtained for all species. The exploitation rate (E), was estimated following Gulland (1985), E = F/Z.

RESULTS

Age composition: To summarize the age composition of *D. vulgaris*, agelength keys were constructed (Table. 1). Age estimates ranged between 1 and 8 years for scalimetry. However, the sample was mostly composed of 2,3 and 4 year-old fish at length group 13-15 cm,15-17 cm, and 17-19cm respectively, which represented 60.70% ofindividuals treated by scalimetry.

Table 1. Age and length group from scales reading of *D. vulgaris* from Benghazi coast 2015

Age of fish (year)	Length group from scale	Frequency	Percentage %
1+	11-13	24	8.3
2+	13-15	65	
3+	15-17	53	18.3
4+	17-19	58	20
5+	19-21	26	8.9
6+	21-23	40	13.8
7+	23-25	18	6.2
8+	25-27	6	2.1
Total		290	100%

Growth parameters

The parameters of the Von Bertalanffy growth equation for both sex, male and female were summarized in Table 2.Back calculated length seem to be lower than observed length for the three categories Table 3. Individuals of specie *D. vulgaris* from Figures (2), seem togrew faster during the first to four years of life for both sex, attaining approximately 60% of their maximum length. When we fit the equation of Von Bertalanffy growth Figure 2,3 and 4, the growth started to be steady at age 15 year and at length 27 cm. The growth curve fitting the Von Bertalanffy growth equation was: for both sex, $Lt = 33.3*(1-e^{(-0.113*(t+1.6))}$, For male: $Lt = 37.4*(1-e^{(-0.17*(t+1.66))}$, For female: $Lt = 39.3*(1-e^{(-0.199*(t+2.02))}$.

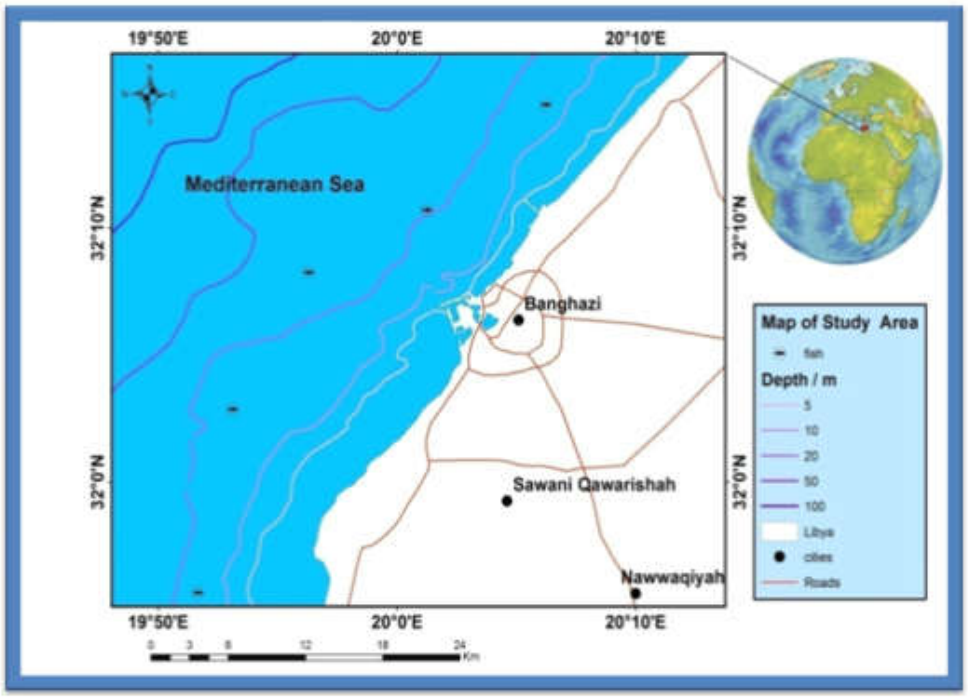

Figure 1. Showed the studied area of Benghazi coast

Table 2. The growth values parameters for male, female and both sex of *D. vulgaris* from Benghazi coast 2014-2015

Categories	Equation	A	B	L∞ (cm)	K	t_o	φ'
Male	Y =0.914x-3.038	3.038	0.914	37.4	0.17	-1.66	2.4
Female	Y= 0.914+3.379	3.379	0.914	39.3	0.199	-2.02	2.2
Both sex	Y= 0.881x+3.792	3.792	0.881	33.3	0.113	-1.58	2.1

Table 3. Showed the age groups, Observed length and back calculated length for both sex, male and female of *D. vulgaris* from Benghazi coast 2015

Age	Both sex		Male		Female	
	Observed length (cm)	Calculated length (cm)	Observed length (cm)	Calculated length (cm)	Observed length (cm)	Calculated length (cm)
1	12.6	8.5	13.1	8.4	13.1	9.0
2	14.2	11.2	15	11.14	14.9	11.3
3	16.1	13.1	16.7	12.6	16.8	14.7
4	19.1	15.5	17.2	15.05	17.5	16.0
5	21.5	18.3	18.8	17.2	18.8	18.3
6	22.5	19.5	20.7	19.1	20.2	19.5
7	23.7	20.8	21.9	20.0	22.2	21.0
8	25	22	25.2	22.3	24.3	23.3

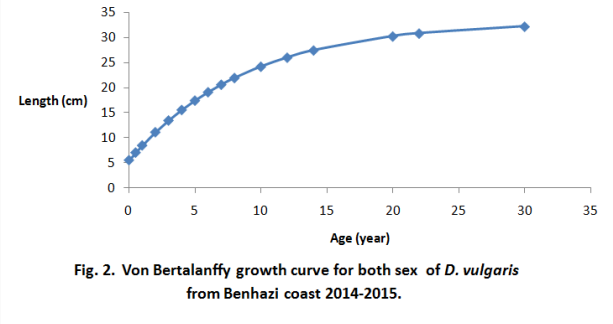

Fig. 2. Von Bertalanffy growth curve for both sex of *D. vulgaris* from Benhazi coast 2014-2015.

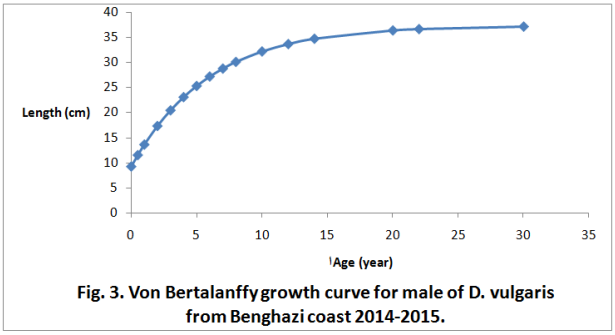

Fig. 3. Von Bertalanffy growth curve for male of D. vulgaris from Benghazi coast 2014-2015.

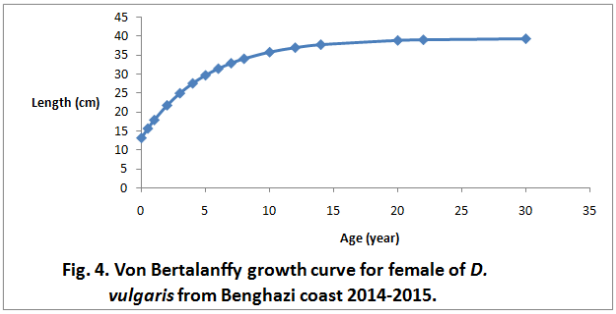

Fig. 4. Von Bertalanffy growth curve for female of *D. vulgaris* from Benghazi coast 2014-2015.

Total mortality (Z): The values of total mortality (Z) for the species study *D. vulgaris* was estimated using two different methods (catch number per years and linearized catch curve), the advantage of first method enable to get mortality per age. The two methods give the same result for the total mortality, which equal 0.3 .Natural mortality as estimated by Taylar"s formula was 0.12 per year. Fishing mortality is therefore 0.2 per year.

The survival rate value of *D. vulgaris* in Benghazi coast was found to be 0.7, while the exploitation ratio was0.7.

DISCUSSION

The methods currently in use for age- determination of fish is age marks or rings on different scales structure. The most valid method is use for determination age from hard parts of body (Tesch, 1968, and Mahmoud *et al*,. 2010). Many methods were used for ageing from hard parts of fishes body, each method has own limitations. Hence, the scale is easy to take from the fish and prepare to read under microscope (Bond, 1986). In the present study fishes ages obtained ranged between 1 and 8 years for *D. vulgarus*, the sample was mostly composed of 2,3 and 4 year-old at length group 13-15 cm,15-17 cm, and 17-19cm respectively, which represented 60.70%. however, this finding agree and disagree with those obtained by Mouine, *et al*,. (2010) from Gullf of Tunis, they stated that age estimates ranged between 1 and 12 years for scalimetry and between 1to 11 year forotolithometry. However, the sample was mostly composed of 3-4 year-old fish, which represented 58.0% of individuals treated by scalimetry and 56.3% of those treated by otolithometry.Also the oldest age in the present study (8 year), compared with the oldest fish was 9 years old in the Gulf of Gabe`s, 8 inGulf of Lion (Man-Wai, 1985), 4 year in Spain (Gordoa & Moli, 1997) and 11 year in Croatia (Dulc˘ic´ *et al.*, 2010).

The differences in results, may be due to difference in time of collection of data, abundance during the year, and effect of different fishing location and effort. Richer (1975) mentioned that abundance of species is affected by effort and location of fishing through the year, also by depth and types of bottom soil structure (Elawad 2013). The mean back calculated lengths and weights for *D. vulgaris* as obtained in the present study, range between length 8.5 cm at age 1 year to 22 cm at age 8 year, compared with Moune *et al* (2010) in Gulf of Tunis, back calculated length 9cm at 1 year and 32cm at age 12 years, and Mahmoud *et al*,. (2010) from Abu Qir Bay in Egypt,10.64cm at age 1 year to 25.52cm at age 6 years. These variation may be attributed to the different in growth parameters. In the present study of *D. vulgaris* in Benghazi coast, the parameters of the Von Bertalanffy growth equation for male were estimated at 37.4 cm, 0.17 per year, -1.66 and

2.4, for female were 39.3 cm, 0.199 per year, -2.02 and 2.5, for both sex of all individuals were estimated at 33.3 cm, 0.113 per year, -1.6 years and 2.1 for L∞, k and t0,and φ', respectively Compare by result of Dulčić *et al.* (2011) from commercial fishery catches by 'tramata' fishing (2005–2006) from Portugal, he estimated the von Bertalanffy growth parameters estimated by reading scales were: L_∞ = 48.60 cm, K = 0.112 per year and t_0= -2.366, for all specimens; L_∞ = 51.96 cm , K = 0.095 and t_0 = -2.837 for females and L_∞= 56.25 cm, K = 0.084 and t_0= -2.920 for males.

It appear that there were some agree and disagreement between two results. In the two results the values of k in Benghazi coast seem to be high than those in Portugal coast, meaning that this species grow faster than those in Portugal sea, also for the two results the values of L∞ for both sex were lower than values of L∞ for male and female. This controversy was explained to be due to the variations in the environmental conditions (Hernandez, 1986), also Ahemed (1987) and Gulland (1985) mentioned that the growth mode of fishes is controlled and affected by many factors, such as places, food availability and supply, environmental factors, and so on. The growth performance index is considered to be a convenient and robust tool for the comparison of growth parameters from different data sets (Moreau *et al*., 1986 and Pauly, 1980). The growth performance of *D. vulgaris* in the present study for both sex, (Φ = 2.10),which is lower in both sex than that observed by Man Wai, 1985 (Φ = 2.41) in Gulf of Lion and Pajuelo& Lorenzo, 2002 (Φ = 2.56) in Canary Islands while for male (Φ=2.4) and for female (Φ= 2.5) of the same species in my studied, it is higher than Girardin (1978) in North West Mediterranean (Φ = 2.26) and Abecasis *et al*. (2008) (Φ = 2.33) in Portugal water. Also female was higher in growth performance index than male. Variations in the values of the parameter of growth performance might suggest variations in the growth rate (Moreau *et al*., 1986).

In the present studied the results indicated that total mortality (0.3 per year) fishing mortalities (0.2 per year) and natural mortality (0.12 per year) were lower than those obtained byMahmoud *et al*,. (2010) from Abu Qir Bay in Egypt,were total mortality (1.049 year-1.) Fishing mortality (0.44) and natural mortality (0.6). PerSparre (1992) was stated that the fishing activities and environmental factors effect in mortality range. It was cleared that the mortality was high at age 4 and very low at age one year and three. Beverton and Holt (1959) state that fish species with a high growth rate (k) have a low natural mortality, and with low growth (k) have high natural mortality. The survival rate value of *D. vulgaris* in Benghazi coast was found to be 0.7, while the exploitation rate was 0.7.while the survival rate (0.35) and exploitation rate (0.428) of *D. vulgaris* in Abu Qir Bay was lower. These variation in results attributed to as Per Sparre (1992) mentioned that the catch number, the size of the fish, and the mesh size affect the mortality of the fish, hence the survival rate and exploitation rate are also affected. For these reasons the survival rate exploitation rate was high of the species in *D. vulgaris* in Bebghazi coast and low in the same species Abu Qir Bay in Egypt. This also may be due to proportion to stop fishing activity to the problems of security and the concentration of fishing in a limited and small area in Benghazi coast, this leads to an increase in the rate of exploitation in the area of the study. When we know that, this is a highly valuable commercial species, and together with other species of *Diplodus,* constitute the main target family of small-scale demersal fisheries in many areas.

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