

Age, Growth, Reproduction, Mortality of the Striped Sea bream *Lithognathus mormyrus* [Linnaeus, 1758] in the Syrian marine water

Dr: Wassem Ghanem

Doctor in marine biology- High institute of marine research, Tishreen Univsesity

Abstract: The results of the study the age, growth, length-weight relationship, reproduction and mortality of *Lithognathus mormyrus* [Linnaeus, 1758] caught from four regions of Syrian marine water were analysed during 2018. Number of studied specimens reached to [133] individuals, the total length ranged between [13.4-29.4] cm, and the total weight ranged [22.57-352.41] g. The length- weight relationship presented that there are no clear different between the longitudinal and weight variables for female and male [$a=0.011$, $b=3.097$, $R^2=0.64$] for females, and [$a=0.311$, $b= 2.72$, $R^2=0.88$] for males. Six different age groups were reported among the studied individuals [I⁺, II⁺, III⁺, IV⁺, V⁺, VI⁺, VII⁺] the age group III⁺ formed the largest percentage 30.09%, and lowest percentage VII⁺ is 0.75 %. Sexual maturity at 2 years and total length 11.5 cm, also the reproduction period extends from May to September, with the sexual maturity coefficient [RGS=5.31]. The growth rates according to Von Bertalanffy equation was found that [$L_{\infty}=37.42$ Cm, $K= 0.16$] for female, and [$L_{\infty}=32.34$ Cm, $K= 0.19$], and the maximum age [17.64] year for female, and 15 year, for male. Thus, this study was found that *Lithognathus mormyrus* suffers from overfishing, as mortality rates were high among male and female of this specie.

Keywords: *Lithognathus mormyrus*, age, growth, mortality, Syrian marine water.

Introduction

The striped seabream, *Lithognathus mormyrus* [1], is an important marine fish belonging to Sparidae. It is a demersal species, exists in groups over various types of sea bottoms muddy, rocky, sandy, and seagrass beds at depths ranging from 10 to 50 m [2]. This fish has the following morphometric details: body elongately avoid, well compressed, silvery, grey darker dorsally 14- 15 narrow. This species is common in the Mediterranean Sea, the Atlantic Ocean from the Bay of Biscay to the cape of Good Hope, the Red Sea, and the south-western Indian Ocean [3]. It is a gregarious species, entering exceptionally in coastal lagoons.[6-5-4]

This species reproductive in the summer, especially young individuals inter into shallow water and adults which migrate to sea in the following spring. The striped seabream is a protandric hermaphrodite fish .[7]

Material and Methods

Study areas and sampling

A total of 133 individuals of *Lithognathus mormyrus* were collected from commercial catches from four regions extended along Syrian coast during 2017[figure1] and analysed in 2018.

Fish were caught by gillnet on 50-100m depth with mesh size 24-32mm. and stored in ice boxes then transferred to fish laboratory in high institute of marine research then some of the measurements used in such study were taken [total length, total weight, body depth....etc.]. Length- weight relationship: the relationship between length and weight were calculated by the equation $W= a L^b$ [14], where W: is the total body weight(g), L: is the total length[cm], a: is a coefficient related to the body formed, and b: is exponent indicating isometric growth when equal to 3 [15-16], and b were estimated by linear regression on the transformed equation $\text{Log } [W]=\text{Log } [a] + b \text{ log } [L]$.

Age structure :

The age was determined by counting annual growth rings on scales [17], which were soaked in ammonium hydroxide solution [4%] for five minutes, then washed by water and cleaned, after that were examined under microscope with reflected light against a dark background, back calculation was applied as an independent means validating the scale-based age determination. $\text{Ln} = S n / S [L- a] + a$ [18] where: Ln: total length at age year [Cm], L: total length of body [Cm], S n : diameter of annual rings[mm], S: diameter of scales, A: coefficient equation.

Estimation of growth parameters:

The von Bertalanffy growth function (VBGF) was calculated to individual length and age data for each

age method using nonlinear least squares estimation procedures: $L_t = L_{\infty}[1 - e^{-k(t - t_0)}]$ [19]. L_t is the length at age t ; L_{∞} is the asymptotic length; L_{∞} is maximum length at age; K the Body growth coefficient (19), and defines the growth rate towards L ; t_0 the age of the fish; t_0 the hypothetical age at which fish would have zero length, if it had always grown in a manner described by the model. The VBGF was individually fitted to the length and age data derived using counts from whole and sectioned otoliths for each species. The resultant growth functions for each species using the different ageing techniques were compared directly using the full model maximum likelihood method of Kimura [1980], considered to be the most robust measure by Cerrato [1990]. Sex determination and sexual maturity:

After dissecting the fish, the gonads were removed and then, the sex of the individuals was determined based on the shape and development of the gonads, for the advanced age stages of the sexual maturity of the gonads and by relying on the microscope for early stages. The morphometric measurements of the gonads were made [total length [mm], weight [g], diameter [mm], it also determined the stage of sexual maturity based on Russian hexagonal scale [20], and preserved in form aldehyde [4%]. Mortality: the natural mortality was calculated based on the following equation $M = -\ln[0.01] / T_{max}$ [19], where M : is the natural mortality, T_{max} : is the maximum age of the fish at maximum length. And total mortality was calculated based on the following relationship $Z = K[L_{\infty} - L_m] / [L_m - L']$ [19] where K : is the body growth coefficient, L_{∞} : is the maximum length, L_m : average length in the sample, L' : is the minimum length in the sample, and exploitation ratio was calculated through the relation $E = F/Z$ [24], where E : is the exploitation ratio, F : is the fishing mortality, and Z : is the total mortality. [24-23]

Maximum age: the maximum age was calculated according to the following equation $T_{max} = 3/K$ [25], where T_{max} : is the maximum age, K : is the growth performance.

Results and discussion

Morphometric features: Number of individuals for *L. mormyrus* reached to 133 individuals, a total length ranged [13.4-29.4] Cm, total weight ranged [22.57-352.41]g, the number of female arrived to 79 individuals, male arrived to [42]specimens, while unspecified gender formed 9.02%. The length of most of individuals studied focus between 15-20 Cm. Table[1].



Figure[1]: fish sample collection regions during the research period

Length- weight relationship:

The results of the statistical analysis of *L. mormyrus* showed a strong relationship between longitudinal and weighted variables [$p < 0.05$], also the value of b between total length and total weight did not differ significantly between male and female, table[2]. All individuals: $\log W = -1.95 + 3.053 \log L$, $R^2 = 0.92$. Female: $\log W = -2 + 2.932 \log L$, $R^2 = 0.79$. Male: $\log W = -2.30 + 3.320 \log L$, $R^2 = 0.88$. Unspecified gender: $\log W = -2.15 + 3.191 \log L$, $R^2 = 0.91$. The results of this study are consistent with many studies conducted in the eastern basin of the Mediterranean, table [3].

Age composition and growth:

The results of the age structure in *L. mormyrus* showed six different age groups [I,II,III,IV,V,VI], age group III formed the highest percentage among individuals, while the age group VI formed the lowest percentage by 2 individual. table[4]. As for as the weighted growth rate, the age group V formed the highest rate [43.05] g. the study showed that the highest longitudinal growth rate at the studied specie was recorded during the first age group [10.47] Cm, while the longitudinal growth rate decreased to the lowest percentage in the age group VI [1.9] Cm, this is normal since the growth reaches the highest space during the first years of life table[5-6]

Table[1]: morphometric measurement of *L. Mormyrus* in the Syrian marine waters within the research.

Adjective date	Number	Total length[Cm]	Total weight[g]	Weight of gonads[g]	RGS
April	26	16.95±1.69	69.18±26.20	0.2±0.27	0.26±0.24
May	9	17.96±1.94	82.90±0.15	0.40±0.15	0.52±0.23
June	27	18.44±4.09	100.44±72.03	3.40±3.69	2.55±2.36
July	4	21.75±1.45	139.74±18.40	3.16±0.15	2.29±0.21
August	6	19.35±2.78	94.55±41.60	2.90±1.26	3.14±0.90
September	4	19.73±1.06	102.65±12.94	5.30±0.60	5.31±1.20
October	5	2.33±1.23	152.06±18.98	4.45±1.52	2.88±0.75
November	25	16.85±1.15	64.12±14.05	0.12±0.08	0.19±0.12
December	-	-	-	-	-
January	-	-	-	-	-
February	16	17.61±1.68	75.01±22.03	0.15±0.07	0.22±0.10
March	10	16.71±1.10	58.35±16.30	0.17±0.19	0.27±0.24

The results of the study of annual longitudinal growth rates at the *L. mormyrus* indicated that the highest annual longitudinal growth rate was recorded in the first age group [11.9] Cm, while the growth rate decreased to the lowest value in the age group IV [1.7] Cm .table[5]. As for the annual weight growth rate, it was the highest in the age group V [43.04] g, while the lowest was at group VI, perhaps the reason is due to the smallest number of group 6 members.

By comparing the number of age groups, which were recorded in the current study with those were found the Mediterranean, study showed that the registration of 6 age groups in the Spanish coast, and 9 age groups in the Adriatic Sea, in ways to monitor fishing or a specific environmental improvement.

Results of a study of growth factor for Von Bertalanffy:

The results of the application of growth factors for Von Bertalanffy of *L. mormyrus* show the following

Maximum length:

All individuals: $L_{\infty} = 38.57$ Cm, Females: $L_{\infty} = 37.42$ Cm, Males: $L_{\infty} = 32.34$ Cm.

Maximum weight:

All individuals: $W_{\infty} = 342.25$ g, Females: $W_{\infty} = 325.86$ g, Males: $W_{\infty} = 260.09$ g.table[6]

Table[2]: growth performance of *L. mormyrus* during the research period

sex	Total length[Cm]		Total weight(g)		b	N	R2
	min	max	min	Max			
All individual	13.4	29.4	22.57	352.41	3.053	133	0.92
female	13.4	29.4	32.1	352.41	2.932	79	0.79
male	13.8	24.3	22.57	181.3	3.320	42	0.88
Unspecified gender	15.4	18.3	46.14	89.20	3.191	12	0.91

By comparing the results of this study with other ones in different regions of the average, observed that the highest total length recorded in an ancient study in the Syrian coast was 45 Cm (Lahlah, 1999), and fish catches by the beach scene method.As observed a decrease in the value of growth factor K in the eastern coast of the average and their height in the central and western Mediterranean.

The maximum length recorded in the eastern coast is higher than that recorded in the central and western Mediterranean table [7], the differences are perhaps due to the methods of study or the number of small fish in some

samples was poorly described [Gordoa and Moli,1997].

Sex and sexual maturity:

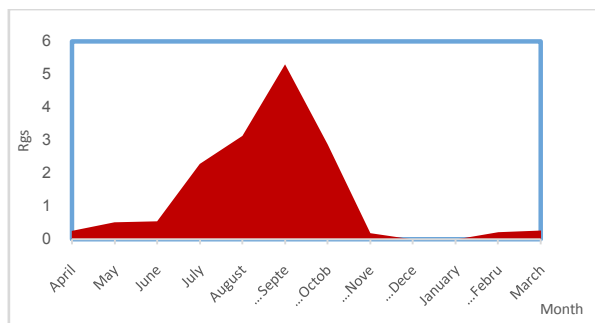
The first maturity was at 2 years, with an average total length 11.15 Cm, and total weight 42.34 g. The highest value of the sexual maturity factor was recorded during September [5.31], which indicates

that this specie lays eggs during this period, which corresponds with most Mediterranean studies on sexual maturity at the species mentioned

It seems that there is a synchronization between the laying period of eggs and the increase in the temperature of marine waters in this period of the year, in addition to the length of the lighting period, which corresponds to the requirements of reproduction .

Maximum age:

It was found through the results that the maximum age of *L. mormyrus* in the Syrian marine waters, reached to 16.64 year for female, while reached to 15 year for male. by comparing the results of this study with the results of studies carried in the Egyptian waters on the same species that the values recorded in Egypt amounted to 22.37.year for males, which higher than the values recorded in our study



Figure[2]: the value of sexual maturity coefficient of *L. mormyrus* changed during the research period.

Mortality:

Show through the study that the results of mortality at *L. mormyrus*, that the rate of natural mortality in males [0.30] is greater than in female [0.26], as the total mortality rate for females was recorded at the higher values [0.66], perhaps due to the environment or physiological reasons. Also the mortality rate resulting from catching was higher for males, by comparing the values recorded in the current study with the values recorded in a study in the Adriatic sea finds the mortality rates in our study lower than that. While the values were close to studies on the same species in the Egyptian waters.

Table[3]: comparison the changing length and weight different areas of eastern Mediterranean with current study.

Search name	Region	Log a	b	N	Length range	R ²
Abdallah,2002	Egypt	-2	3.04	197	13.4-29.4	0.98
Osman,2005	Egypt	-1.86	2.91	891	8.25	0.99
Turkmen Akyurt,200.3	Turkey	-1.95	3.046	3335	9.1-27.9	0.98
Lhlah,1999	Syria	-1.85	3.02	227	10.24-18.4	0.92
Gyhan et al,2009	Turkey	-1.90	3.034	141	14.5-32.6	0.96
Current study	Syria	-1.95	3.053	133	13.4-29.4	0.92

Table[4]:repeated distribution of the lengths of fish individuals according to the age composition of *L. mormyrus* studied during the research period

Length \ Age	Age						
	I	II	III	IV	V	VI	VII
13	4						
14	3	11					
15		9	3				
16		3	17				
17		7	21	4			
18			7	4			
19			4	3			
20				6	8		
21				5			
22				3	1		
23					4		
24					3	2	
29							1
total	7	30	52	25	16	2	1
percentage	5.26	22.55	39.09	18.79	12.03	1.50	0.75

Table[5]: the age composition and longitudinal growth rates of the individuals studied during the research period.

AG	30%	TL(CM)	TL1	TL2	TL3	TL4	TL5	TL6	TL7
1	7	5.26	13.8	11.7					
2	30	22.55	15.6	11.2	15.9				
3	52	39.09	17.2	10.9	13.6	15.2			
4	25	18.79	19.9	10.9	13.4	16.2	18		
5	16	12.03	22	11.2	13.7	16.1	17.8	20.4	
6	2	1.5	24.5	11.2	13.7	15	18	21	22.7
7	1	0.75	29.4	12.7	15.6	17.6	20.5	24.5	26.4
average		20.34286	11.9		14.6	16.3	19.3	22.7	24.5
diviation		3.717857	0.51		0.63	0.86	0.83	1.17	1.23
longitudinal increase			11.9		2.7	1.7	3	3.4	1.8
p[ercentage			41.9		9.5	5.98	10.56	11.97	6.33

Table[6]: growth coefficients of Von Bertalanffy at *L. mormyrus* during the research period.

sex \ index	L_{∞} [Cm]	W[g]	K
Male	32.34	260.06	0.19
Female	37.42	352.86	0.16
All individuals	38.57	342.25	0.15

Table[7]: comparison of growth factors for Von Bertalanffy of *L. mormyrus* studied during the research period with Mediterranean and Atlantic studied

Search	Study area	Age[year]	b	L_{∞} [Cm]	K	T_0
Suau,1970	Spanish	1-6	3.43	33.3	0.27	0.06
Kraljevic <i>et al</i> , 1995	North Adriatic	2-7	3.05	37.3	0.26	-0.39
Kraljevic <i>et al</i> , 1996	North eastern Adriatic	3-12	3.06	40.1	0.19	-0.95
Lahlah,1999	Syria	1-3	3.05	45	0	0
Osman,2005	Egypt	1-7	2.9	37.08	0.12	-1.49
Current study	Syria	1-7	3.05	38.57	0.15	0

References

[1] Linnaeus, C: Systema naturae per regna trianaturaesecondum classes ordinis genera species cum characteribus different iis synonymislocisTomus. I. Editio decima, reformata. Impensis Direct. Laurentii Salvii, Holmiae. 1758, 824 p.

[2] Pajuelo, J.G., Lorenzo, J.M., Mendez, M., Coca, J. and Ramos, A.G. 2002. Determination of age and growth of the striped seabream *Lithognathus mormyrus* [Sparidae] in the Canarian archipelago by otolith readings and backcalculation. *Scientia Marina* 66[1]: 27-32.

[3] Kallianiotis, A., Torre, M. and Argyri, A. 2005. Age, growth, mortality, reproduction, and feeding habits of the striped seabream, *Lithognathus mormyrus* [Pisces: Sparidae], in the coastal waters of the Thracian Sea, Greece. *Scientia Marina* 69: 391-404.

[4] Bauchot, M.L. and Hureau, J.C. 1986. Sparidae. In: *Fishes of the north-eastern Atlantic and the Mediterranean* [eds., P.J.P. Whitehead, M.L. Bauchot, J.C. Hureau, J. Nielsen and E. Tortonese], Volume 2, UNESCO, Paris, pp. 883-907.

[5] Nikolskii, G. V: Ecology of fishes. Moscow, High School, 1974, 367 p.

[6] Beverton, R. J. H & Holt ; A review of methods for estimating mortality rates in exploited fish populations, with special reference to sources of bias in catch sampling. *Rapp.P.-V.Réun. CIEM*, 1956, 140:67-83.

[7] Suau, P. 1970. Contribucion al estudio de la biologia de *Lithognathus [=Pagellus] mormyrus* L. [Pecesparidos]. *Inv. Pesq.* 34: 237-265.

[8] Tortonese, E. 1975. Fauna d'Italia. Osteichthyes [Pesci ossei]. Parte Seconda, Edizioni Calderini, Bologna, pp. 382-386.

[9] Bessau, L. 1990. Etude histo-cytologique de la structure sexuelle d'une population de *Lithognathus mormyrus* [L.] [Teleosteen, Sparidae]. *Rapp. Comm. Int. Mer. Medit.* 32, 262.

[10] Kraljevic, M: Rast Komarce, Sparuseurata., L., I. Pica., Diplodus puntazzo Cetti, U prirodnim I Kontroliranimuvjetima. Thesis, prirodoslovno-matematicki Fakultet U Zagrebu, 1995, 157pp.

[11] Kraljevic M & Dulcic J., 1996. Weight-length relationships for 40 fish species in the Eastern Adriatic (Croatian waters). *Fisheries Research*, 28:243-251.

[12] Suau, P. 1955. Contribucion al estudio de la herra [Pagellus mormyrus L.] [II] especialmente de la sexualidad. *Inv. Pesq.* 1: 59-66.

- [13] Lorenzo, J.M &Pajuelo, J.G &Mendiz- Villamii, M & COCA J. and RAMOS, A.G: Age, growth, reproduction and mortality of the striped sea bream, *Lithognathus mormyrus* [Pisces, Sparidae], off the Canary Islands [Central-east Atlantic]. *J. Appl. Ichthyol.* 18[3],2002, 204-209.
- [14] Turkmen, M. and Akyurt, i. 2003. Growth characteristics, sex inversion and mortality rates of striped sea bream, *Lithognathus mormyrus* L., in iskenderun Bay. *Turkish Journal of Zoology* 27: 323-329.
- [15] Lahlah, M. [1999]. A contributionary study on the biology of feeding and growth of some fish in Lattakia coastal regions. M Sc. Thesis, Faculty of Science, Aleppo Univ. , 140 P.
- [16] Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish populations. *Bull. Fish. Res. Board Can.* 191, 382.
- [17] Wootton, R.J. 1990. *Ecology of Teleost Fishes*. Chapman and Hall, Upper Saddle River, New Jersey.
- [18] Anderson, R.O. and Neumann, R.M. 1996. Length, weight, and associated structural indices. In: *Fisheries Techniques* [eds., B.R. Murphy and D. Wills], American Fisheries Society, Bethesda, pp. 447-481.
- [19] .Lagler, K. F: *Freshwater fishery biology*. W. M. C. Brown Comp., Dubuque. Iowa. 421 p, Issue[3- 4], 1956, 329 pp.
- [20] Lee, R.M: A review of the methods of age and growth determination in fishes by means of scale. *Fish. Invest.* Min. Agriculture and Fisheries Searches, 2 & 4[2],1920,1-32.
- [21] Gordo, A. and B. Moli: Age and growth of the sparids *D. vulgaris*, *D. sargus*, *D. annularis*, in adult populations and the differences in their juveniles growth patterns in the north- western Mediterranean sea. *Fish. Res.* 33, 1997, 123-129.
- [22] Beverton ,R. J. H. and Holt, S. J. [1957]: On the dynamics of population. *Fishery,Invest.*, London. Series 2[19]:533.
- [23] Nikolskii, G. V: *Ecology of fishes*. Moscow, High School,1974, 367 p.
- [24] Pauly, D: Some Simple Methods for the Assessment of Tropical Fish Stocks. *FAO Fish. Tech. Pap.* 234,1983, 1-52.
- [25] Pauly, D & David, N&Elefan, I: basic program for the objective extraction of growth parameters from length frequency data. *Neerefforchung*, 28 (4), 1981,205–211.
- [26] Abdallah, M. 2002: Length-weight relationship of fishes caught by trawl off Alexandria; Egypt. *Naga ICLARM Q.* 25[1]:19-20.
- [27] Osman, A: Age growth of *Lithognathus mormyrus*[Teleostei, Sparidae] in the Mediterranean waters off Alexandria, Egypt, *Egyptian journal of Aquatic Research*, Vol,31.2, 2005, 274-280 .
- [28] Gehan, T &Akyol, A &Erdem, M: Length-Weight relationship from Gokova Bay. Turkey,[Aegean sea].