Biology and stock assessment growth and biometrics of the gilthead sea bream, *Sparus aurata* (Linné. 1758) on the coast of Kabylia: Region of Tigzirt province of Tizi-Ouzou

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Abstract

This work which relates to the study of growth and biometrics is an essential tool for a better monitoring of the stocks of the Gilthead sea bream *Sparus aurata* on the coast of Kabylia: region of Tigzirt province of Tizi-Ouzou. The results showes that the annual growth of *S. aurata* is 3.4 cm (all sexes combined) while the growth parameters calculated by the Von Bertalanffy equation are established as follows: $L\infty$=79.95 K=0.049 and t_o=-2.3. Our estimates showed that *S. aurata* would reach a weight of 165g to 22cm in total length after 3 years. Gilthead sea bream has an isometric growth proportional to the cube of the fish length. Regarding biometric parameters, the analysis of metric characters by the method of least squares made it possible to follow the relative growth of certain parameters of the body which prove acceptable because the value of the correlation coefficients is always greater than 0.90.

Keywords: Growth, biometrics, *Sparus aurata*, Tigzirt

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Introduction

The study of fish growth is of primary interest in aquaculture. The fish being poikilothermic, undergo seasonal growth variations; these are written on all the anatomical parts (scales, opercula, otoliths, etc.) in the form of enlargement streaks; fast, broad and opaque during the summer (strong mineralization); and other slow, narrow and transparent winter (weak mineralization and dense organic deposits) (Daniel, 1981). The study of weight or linear growth consists in establishing a relationship between the different measurements: size-weight and age of the fish.

The Gilthead sea bream (*Sparus aurata*) is on the pioneer list of commercially raised marine aquaculture species. Currently, its breeding has boomed especially in the Mediterranean; well positioned on the market due to its good gastronomic reputation throughout its range.

Material and methods

The growth study in fish requires the use of age data; for the determination of this parameter we made use of the direct method called "scalimetry" which consists in the observation of scales. The shells; are pieces that line the outer seed coat of the fish. They constitute reserves of mineralized substances Ca^{++} (Fig. 2).

Sampling was carried out from January until April. The sample size is 54 individuals, coming from the commercial capture of the port of Tigzirt, province of Tizi-Ouzou (Fig. 3). Faced with the impossibility of dissecting the fish, because they are intended for sale, then we confused the sexes.

Using a ruler, we took all the measurements, in order to appreciate the different lengths of the fish: total length, standard length, length of operculum, length of head, body height (Lt, Ls, Lop, Lhead, Hb); At the same time, we took 6 scales from each using a pair of forceps below the dorsal and pelvic fin, we placed them in envelopes bearing the number of each fish and then using a balance, we weighed them.
In the laboratory, we prepared the scales by placing them in KOH solutions (5%) then rinsed and rubbed between the fingers with water to remove the impurities. Then, they were dried and mounted between blade and coverslip bearing the specific number of the fish. Under a binocular magnifier we read the winter streaks (GR: X50) to determine the age of each fish.

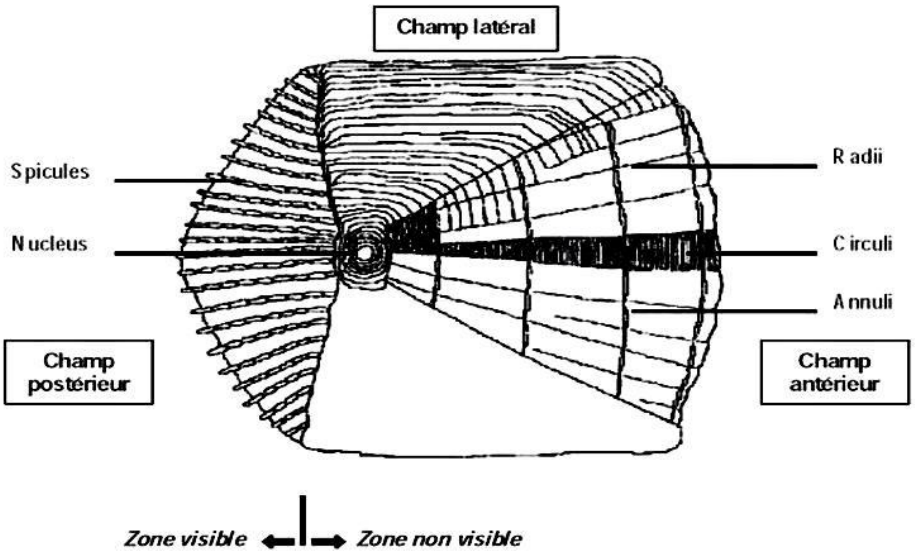

Figure 2 : The different parts of a scale (Pickett et Pawson, 1994).

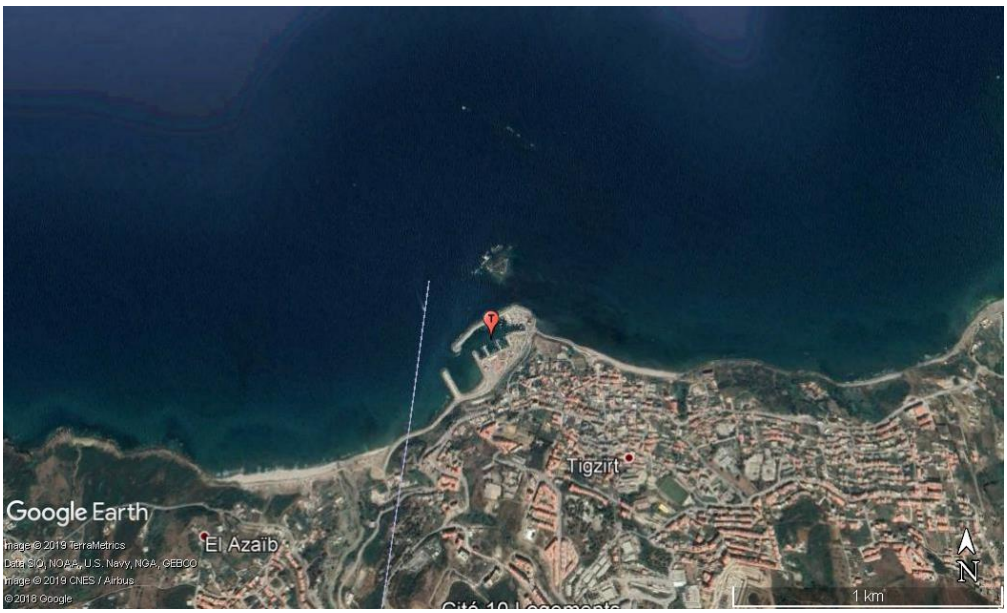

Figure 3: Satellite image of the port of Tigzirt (Google earth, 2019).

Results and discussion

Frequency-length distribution

The average fish length was 25,59cm. The best represented size classes are between 19 and 25cm (the maximum at 23cm). The frequency-size distribution curve of *S. aurata* shows three modes: the first at 21cm, the second at 31cm and the third at 37cm (Fig. 4).

Determination of the age-length key by Scalimetry

We have taken into account the standard length Ls and not the total length Lt, because of the wear of the caudal fin (Table 1).

The age-length key obtained highlights 08 age groups, with a maximum age of 10 years.

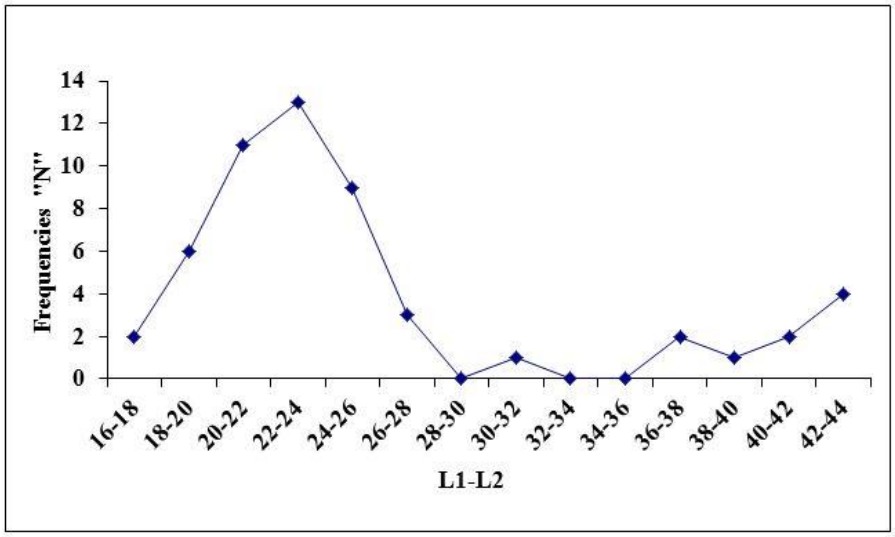

Figure 4 : Frequency-size distribution curve for *Sparus autrata* (both sexes)

Table 1: Age-length key, determined by scalimetry of *Sparus aurata* (sexes combined).

L1-L2 (cm)	Age								
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
16-18	1	1							2
18-20	1	1	3	1					6
20-22		2	8	1					11
22-24			5	7	2				14
24-26			1	5	2				8
26-28				1	1	1			3
28-30									0
30-32						1			1
32-34									0
34-36									0
36-38							1	1	2
38-40							1		1
40-42							1		1
42-44							1	4	5
Total	2	4	17	15	5	2	4	5	54
Ls avg (cm)	18	19.5	21.47	23.53	24.6	29	40	41.8	
TAA		1.5	1.97	2.06	1.07	4.40	11.00	1.80	

The age groups of 0 - 1 and 2 were not obtained; the individuals observed are older than 3 years. The differences in the ages obtained were probably due to the difficulties encountered in reading and interpreting the scales of large individuals. Likewise, the short sampling period and the absence of large individuals influence the results.

Linear growth

The equation of Von Bertalanffy (1938) is considered to be the most satisfactory for assessing linear growth (Brusle et al., 2004). It offers the advantage of being based on physiological bases which are the result of two antagonistic processes: catabolism and anabolism (Pauly and Moreau, 1997):

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

Lt: average size at time t
L∞: asymptotic size
K: growth rate
t_o: hypothetical age at zero size

We have determined the parameters L∞, k, t_o by the direct method of Ford Wald Ford F-W-F (Table 2).

Von Bertalanffy's linear growth equation is written as follows (Fig. 5):

$$Lt = 79{,}95*[1-\exp^{(-0{,}049\,(t+2{,}30))}]$$

Table 2: Determination of the parameters L∞, k, t_o by the direct method of F-W-F.

Method	Input data	L∞ (cm)	K ($year^{-1}$)	t_0 (year)
Ford Wald Ford	Age-length key	79.95	0.049	-2.30

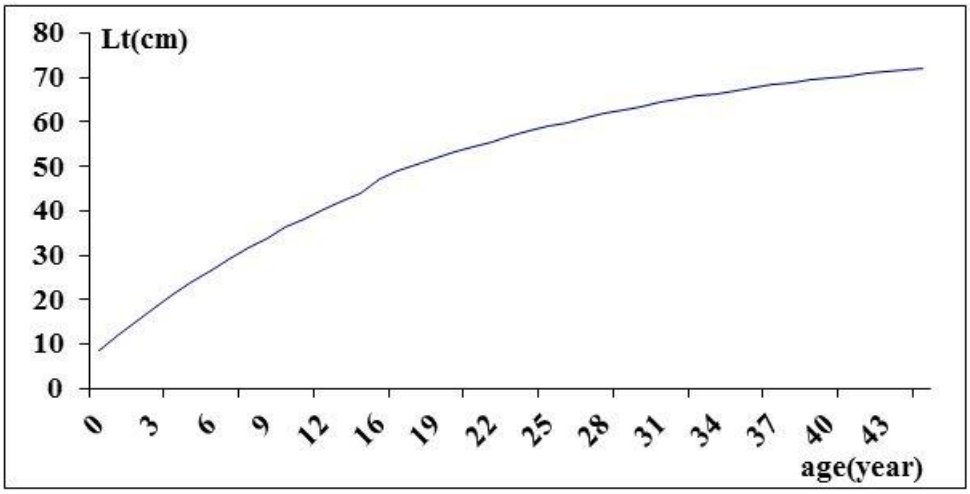

Figure 5: Linear growth curve of *Sparus aurata*.

We noted heterogeneity in the rate of growth; this cannot be attributed to ecological conditions since all fish are subject to the same environmental influences. However, certain hypotheses can explain the variations in growth speed:

- A confusion between winter rings and lying rings.
- Different ages due to the spread of the eggs.
- Different growth rates, depending on the individual.
- Exploitation of the different stock by trawlers.

According to our results, the annual growth of *S. aurata* is estimated at 3.4 cm (Sexes combined). The slice of the lengths Lt obtained goes from 22 to 53.2 cm with a main distribution between 18 and 26 cm. The growth parameters calculated by the Von Bertalanffy equation are as follows:

$L\infty=79.95$ K = 0,049 and $t_o=-2.3$.

Weight growth

By combining the linear growth equation and the height-weight relationship.

$$W = a * Lb$$

By logarithmic transformation, we can linearize this equation in the form:

$$Log\ w = b.\ log\ l + log\ a$$

Which makes it possible to calculate by the method of least squares the value of the parameters "a" (slope) and "b" (ordered at the origin) of this line (dof = 52 α = 5%) (Table 3 and Fig. 6).

The weight growth equation as a function of age is therefore written thus (Fig. 7):

$$Wt = 9226.8[1 - e^{-0.049\,(t + 2.30)}]^{2.61}$$

Table 3: Parameters of the size-weight relationship in *Sparus aurata.*

N	Weight (g)	a	b	r	|t | cal	Equation	Type of growth
54	Wt	0.097	2.61	0.995	1.004	$Wt = 0.097 * Ls^{2,61}$	Minor allometry

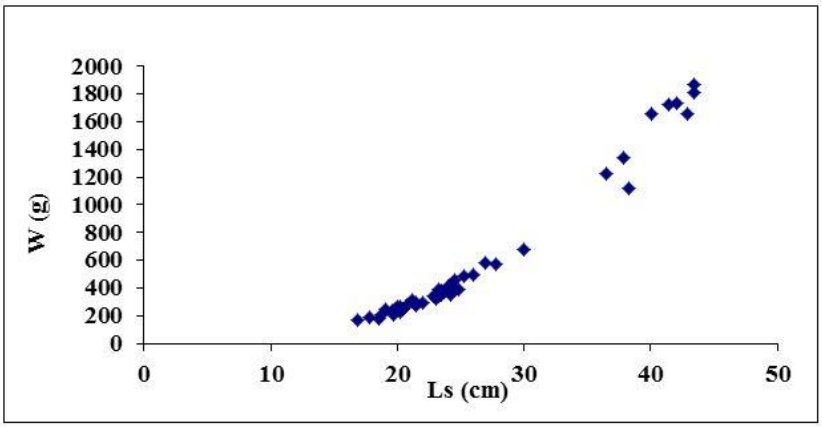

Figure 6: Size-weight relationship curve in *S. aurata.*

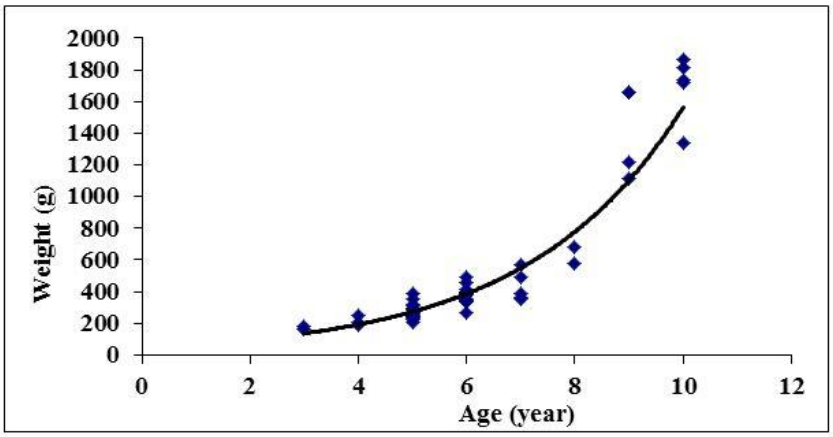

Figure 7: Weight growth curve of *Sparus aurata.*

The growth in *S. aurata* can be considered as isometric (growth proportional to the cube of the length), since the value of the exponent b=2.61 is close to 3. Furthermore, we estimated that our Gilthead sea bream would reach a weight of 165g to 22cm of Lt after 3 years. The correlation coefficient being, r =0.96 we can see that the phenomenon has a low variability.

Chauvet (1986) reported that the growth of *S. aurata* in the lagoon environment of Tunisia reaches 180g from the first year; around the age of 3 in lagoon areas, it reaches 36cm, in the delta area 32cm while in coastal areas it measures 25cm.

Biometrics study

We have related the different dimensions of its body to Lt. In the following table; we have established the equations of the curves plotted in the figures (Table 4**).**

We found the adequacy of a linear model to the four relationships obtained with a correlation coefficient greater than 0.9 and a positive slope; this allows us to conclude the isometry between Lt and the other lengths in *Sparus aurata* (Fig. 8).

Table 4: the biometric equations between Lt and the other lengths of the body of *S. aurata*.

Species	Relation	Equation	r
Sparus aurata	Lt/Ls	Ls= 0.87 Lt – 3.00	0.99
	Lt/Lop	Lop= 0.51Lt – 0.15	0.98
	Lt/Lhead	Lhead= 0.22 Lt – 0.12	0.98
	Lt/Hb	Hb= 0.24 Lt + 2.8	0.98

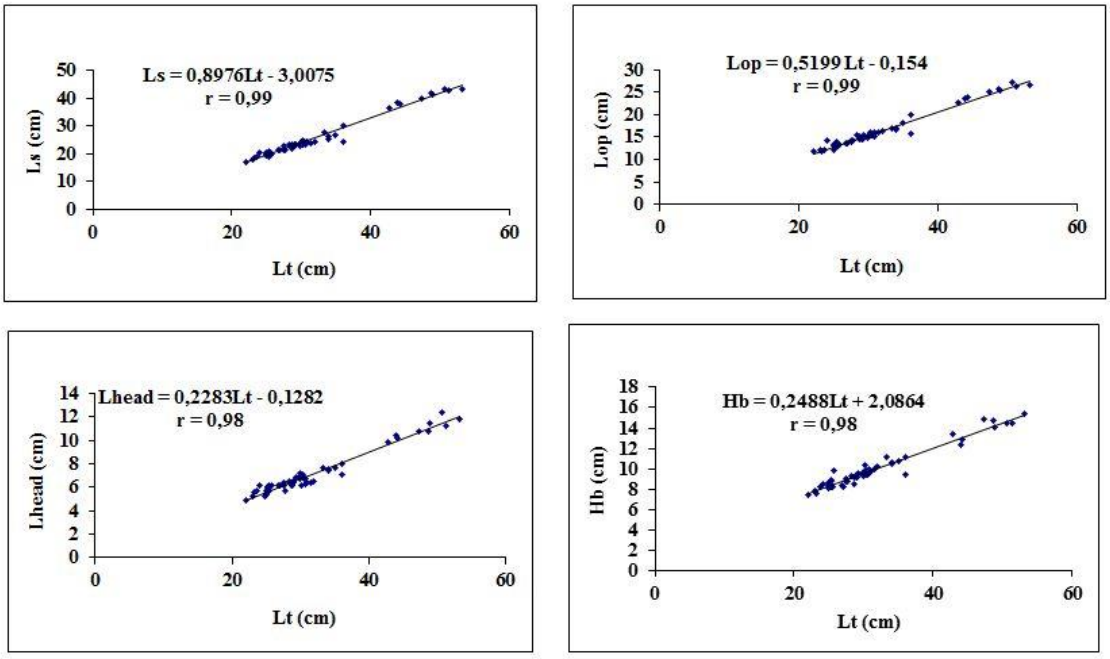

Figure 8: Curves of biometric relationships between Lt and other lengths.

The results obtained show that the annual growth of *S. aurata* is 3,4 cm (all sexes combined) while the growth parameters calculated by the Von Bertalanffy equation are established as follows: $L\infty$=79.95 K=0.049 and t_o=-2.3. Our estimates show that the Gilthead sea bream would reach a weight of 165g to 22cm in total length after 3 years.

The size-weight relationship also revealed that the sea bream has an isometric growth proportional to the cube of the length since the value of the exponent b=2.61 are close to 3. In addition, the analysis of metric characters by the method of least squares allowed to follow the relative growth of certain parameters of the body which prove acceptable because the value of the correlation coefficients is always greater than 0.90. Finally, all the results obtained show that the Gilthead sea bream in Algeria is characterized by good growth.

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