



Interrelationship Age and growth of *Boops boops* (Linnaeus, 1758) in Western Mediterranean coasts of Algeria

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ABSTRACT

The present study was carried out to determine the age relationships with lengths and weights of *Boops boops* (Linnaeus, 1758). Distributions of the size frequency and estimation of the growth were analyzed every month by ELEFAN method using FISAT II software. A total of 1074 specimens of *B. boops* were collected monthly during the period of January 2012 to June 2013, from the commercial catch of Oran coast, western Mediterranean coast, a total length of sampled fish ranged from 9 cm to 26 cm and from 11.2 cm to 32.3 cm for male and female respectively. Length-weight relationships for all individuals were described by the parameters $a = 0.013$; $b = 2.878$ and $r^2 = 0.969$. The parameters of the Von Bertalanffy growth equation obtained for females were $L_{\infty} = 34.13$ cm, $K = 0.26$ cm/year, and $t_0 = -1.50$ year. For males were $L_{\infty} = 26.78$ cm, $K = 0.38$ cm/year, $t_0 = -0.75$ year. Results were similar to other geographical areas. The aim of this study is, firstly, to expand our knowledge on the age composition and growth of *Boops boops* from Western Mediterranean coast, secondly, to determine some of the first data on the above-mentioned biological parameters of this commercial sparidae specie in Western Mediterranean coasts of Algeria. These results will provide the basis for future stock assessment and management fisheries.

KEYWORDS: age, *Boops boops*, growth, ELEFAN method, Von Bertalanffy.

INTRODUCTION

The world population increases more and more, requiring important protein consumption, especially animal. The improvement of fishing techniques and the extension of fishing zones leading to increase catches helped to satisfy a part of this protein request [8, 17].

In the last five years 300 assessments have been carried out on 130 stocks involving 27 species, although this only covers 26% of landings. However, the assessments by area are unbalanced, since the central and western Mediterranean basins are much better covered than the eastern one. The results show that most of the stocks analysed are overexploited and resolute actions to redress this trend are needed to make fisheries sustainable, nature-respecting and economically and socially efficient [21].

Recent research shows the importance of fishing on withdrawals of fishery resources and a significant influence on populations of target species [30, 36]. This fishery can have an impact on exploited populations [10].

In addition, management of fish populations has become a critical issue both biological (species conservation) and economic (preservation of the fishing activity).

The present study focus on analysing the age, growth aspects of *Boops boops* [26] in Oran (North western of Algeria coast).

The bogue, *Boops boops* [26], is a teleost belonging to the Sparidae family. It is among the most common and abundant fishes along the Algerian coasts of the western Mediterranean [14, 12]. This species mainly inhabits the eastern Atlantic, from Norway to Angola, and the Mediterranean Sea, including the Black Sea [18]. It also occurs in the western Atlantic in the Gulf of Mexico and the Caribbean Sea [3].

The present study focus on analysing the age, growth aspects of *Boops boops* [26] in Oran (North western of Algeria coast).

Although, in Algeria, the biology and the exploitation of the bogue was studied by Dalouche in Oran [11], Chali-Chabane in centre Algeria [9], Bouaziz *et al.* in Algiers [6], Derbal *et al.* in the Eastern Coast of Algeria [13], Ramdane *et al.* in East coast of Algeria [31], Benina *et al.* in the bay of Bou-Ismaïl [4].

The result of the present work will contribute to the knowledge of the age composition and growth of *Boops boops* and also to demonstrate its importance in the ecosystem. Consequently, this study will be a step forward to the improvement of the fisheries assessment and management of *Boops boops* in this area where few studies have been devoted to this fishery.

MATERIALS AND METHODS

Study area:

Algeria has a coastline of about 1622 km [27], the Moroccan-Algerian border in the west to the Tunisian-Algerian border in the east. In the North West of Algeria on the Mediterranean Sea (Figure 1).

Western Mediterranean coasts of Algeria is made up of 70% of steep cliffs interspersed with rocky headlands with projections and caps, the remaining 30% are represented by sandy beaches with sand dunes and framed by volcanic outcroppings of rock [7].

Oran has two ports: 1- The port of Oran is a mixed port, Commercial and a large fishing port. It is located in the middle of a bay between the tip of the needle Jebel Kristel east and Cape Falcon northwest of Ain El -Turk. Geographic coordinates of the port of Oran are: 00°39'09"latitude north 35°43'00"longitude west.

2- The fishing port of Arzew is located at 45 Km east from Oran. The Gulf of Arzew is situated in averages on the meridian of Greenwich and 36 ° north. It extends from Cape Ivi to in Cape Carbon. Its geographical coordinates are: 35° 50' 00'' and 35°52'00'' latitude north 00°08'30'' and 00°17'00'' longitude west.

The climate of the area is typical of Mediterranean Sea, heat the summer and soft the winter, with one season dries very marked mid-June and in September, whereas October to December is sprinkled [25].

Sampling protocol:

A total of 1074 specimens of *B. boops* were collected monthly during the period of January 2012 to June 2013, from the commercial catch of Oran coast, western Mediterranean coast, including 578 females, 496 males.

Total length of all *B. boops* specimens ranged from 9 cm (sampled in May 2012) to 32.3 cm (sampled in December 2012). The weight distribution of specimens varied between 7.17g and 204.1g.

The supply of our resource was done on a locker at random. Our biological material is immediately sent to the laboratory and all the fish were processed fresh. Total length (L_T) to the nearest cm and total weight (W_T) to the nearest g was having been taken for each individual specimen. The sexes were determined by macroscopic observation of the gonads.

Statistical processing:

Growth parameters L_∞ , K and t_0 of *Boops boops* are estimated by the method ELEFFAN using the FISAT II software [33]. The index of overall growth performance Φ , proposed by Pauly and Munro [28] was used to compare growth parameters obtained for males and females.

This test provides an indication of the reliability of age estimates since it had been suggested that phi-prime test values were similar for the same species. The test was based on: $\Phi = \log K + 2 \log L_\infty$ [28].



Fig. 1: Map showing sampling localities in Oran, west coast of Algeria (red star: *Boops boops*).

Growth parameters:

Growth was expressed in terms of the Von Bertalanffy equation [5]: $L_{(t)} = L_{\infty} (1 - e^{-K(t-t_0)})$, where: L_{∞} : is the asymptotic total length; $L_{(t)}$: the total length at age t ; K : the growth curvature parameter and t_0 is the theoretical age when fish would have at total length.

Length-weight relationships:

The length-weight relationships were determined according to the allometric equation [33]: $W_T = aL_T^b$, where W_T is the total body weight (g), L_T is the total length (cm), while a and b are constants. Statistical comparison of length-weight relationships between sexes was performed with t-tests [35]. The relation is said to be isometric when $b = 3$, if $b < 3$: the allometry is minorant and when $b > 3$: the allometry is majorant [15].

Results:

The length-weight relation was $W = 0.013L^{2.878}$ ($r^2 = 0.969$) for all individuals, with minorant growth allometry observed for females and males (Table 1).

Table 1: Biometric Relations of *B.boops* [26].

$W_T = aL_T^b$		
Females	$W_T = 0.012L_T^{2.889}$	$r^2 = 0.967$
Males	$W_T = 0.013L_T^{2.863}$	$r^2 = 0.947$

The parameters of the Von Bertalanffy growth equation determined for males and females are shown in Table 2. Significant differences were found between the growth of males and females.

Table 2: Von Bertalanffy Equation.

	Von Bertalanffy Equation
Females	$L_{(t)} = 34.13(1 - e^{-0.26(t+1.5)})$
Males	$L_{(t)} = 26.78(1 - e^{-0.38(t+0.75)})$

Discussion:

The calculated growth performance index (Φ) in Oran waters was 2.48 for females and 2.43 for males. This result is in agreement with the considerable similarity between the growth performance indice (Φ) calculated for each sex. In order to compare the growth of the *B. boops* population with others, all available literature data of Von Bertalanffy growth parameters and Φ values, including results from the present study are compiled in Table 3.

In the present study the longevity of *B. boops* was found to 11 years for females and 9 years for males. The growth coefficient K is related to the longevity of the fish (i.e.) as K being lower as longer lived fish.

Table 3: Growth parameters for *B. boops* females and males

Parameters	Females				Males			
	K (cm/yr)	L _∞ (cm)	t ₀ (yr)	Φ	K (cm/yr)	L _∞ (cm)	t ₀ (yr)	Φ
Results	0.26	34.13	-1.50	2.48	0.38	26.78	-0.75	2.43

Although the difference in aging methods used by some authors, it is possible to achieve certain agreement of growth patterns of *B. boops* from different areas of the Mediterranean Sea as shown in Table (4). The similar growth was observed for *B. boops* in Tunisian coast [2], Algiers [6] and Bay of Bou-Ismaïl [4]. Several factors may cause the variability in growth including biotic factors related to the genotype or physiological condition of the fish [24]. Also, such differences of Von Bertalanffy growth parameters are due to variations in environmental conditions as well as sampling techniques and computations [20].

Table 4: *Boops boops* length weight and growth parameters in different areas of Mediterranean Sea.

	L _∞ (cm)	K (cm/year)	t ₀ (year)	Φ	a	b	Area	Source
F + M	32.27	0.1107	-1.6882	2.07	0.02423	2.8874	Tunisian coast	[2]
F + M	33.89	0.167	-1.296	2.28	6.44 × 10 ⁻⁵	3.113	Central Adriatic Sea	[20]
F + M	31.68	0.1531	-1.7838	2.19	-2.1548	3.1031	egypt	[1]
F + M	30.66	0.3	0	--	0.0155	2.85	Algiers (center of the Algerian coast)	[6]
F + M	26.66	0.33	0	--	0.016	2.798	Bay of Bou-Ismaïl (Algeria)	[4]
F + M	29.58	0.266	-1.142	2.37	0.005	3.251	Turkey (Middle Aegean)	[32]
F + M	30.79 29.87	0.239 0.243	-0.90 -0.98	2.36 2.33	0.0050	3.237	Aegean Sea, Turkey	[23]
F + M	34.13 26.78	0.26 0.38	-1.50 -0.75	2.48 2.43	0.012 0.013	2.889 2.863	Algerian west coast	Present study (2016)

The minorant growth allometry of the length weight relationship for the whole population agrees with results of other studies (Table 4 and 5). The differences between females and males, with a small difference in allometric coefficient in males than females, are probably due to the different length distributions of the two sexes.

Table 5: Total length-total weight relationships of *B. boops* reported by various studies.

Author	Region	Sex	Size range (cm)	a	b	effective
[20]	Central Adriatic Sea	♀	13.5 - 23.0	5.635 × 10 ⁻⁵	3.088	97
		♂	12.8 - 22.3	2.637 × 10 ⁻⁵	3.231	68
[34]	Grèce	-	9.6 - 24.3	0.0149	3.093	256
[16]	Egypt	-	9.59 - 17.07	0.0254	2.6604	920
[22]	Izmir Bay Turkey	♀	11.3 - 27.6	0.0044	3.272	640
		♂	13.6 - 27.00	0.0021	3.522	516
[19]	Gulf of Gabes Tunisia	-	12.6 - 22.6	0.0102	3.034	346
[31]	East coast of Algeria	♀	-	0.015	2.776	664
		♂	-	0.013	2.816	
[32]	Turkey (Middle Aegean)	-	11 - 23.8	0.005	3.251	421
Present Study (2016)	Algerian west coast	♀	11.2 - 32.3	0.012	2.889	578
		♂	9 - 26	0.013	2.863	496

Conclusion:

In conclusion, this study updates the length-weight relation and growth parameters of a commercially important sparid *Boops boops* [26] collected from Oran North western of Algeria coast.

The present results can be used for better understanding a population dynamics and management of this fishery in Western Mediterranean coasts of Algeria. Also to the improvement of the changes of the stock sizes.

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