Age and growth of *Boops boops* (L.) from Egyptian Mediterranean waters off Alexandria

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ABSTRACT

A study of age and growth of Mediterranean bouge; *Boops boops* (L.), from Egyptian Mediterranean coast off Alexandria was carried out during the period from April 2003 to March 2004 by examining the growth increment on their otoliths. The individuals of *B. boops* fall into 4 age groups (I to IV). The weight – length relationship was estimated as $W = 0.0254L^{2.6604}$. The growth parameters were estimated according to the Von Bertalanffy growth model as follows: L_∞ =30.105 cm, K = 0.1511 and t_o =1.5083, W_∞ - 218.07g. The growth performance index Φ' was found to be 2.136.

Key words: *Boops boops*, Mediterranean bouge, age, growth, otolith.

INTRODUCTION

Boops boops (L), (Mediterranean bouge) is a commercially important sea bream belonging to Family Sparidae. It is the most dominant teleost family observed in commercial landing from Alexandria coast (Ezzat *et al*., 1993). *Boops boops* is the most abundant species in the local market at Alexandria all the year round, where Abdel-Rahman (2003) found that it dominated the sparid catch through out the whole year. It is a pelagic species living on various kinds of bottoms (sand, mud, rocks and seaweeds) to about 350 m depth. Feed on sponges, small crustacea (isopods, amphipods) and seaweeds. They are caught by bottom trawls, purse seines; beach seines and trammels nets. *Boops boops* constitutes 2.3% of the Egyptian Mediterranean catch in the last 5 years (GAFRD, 2003).

Aging of fish is very important issue in biology, and accurate knowledge about age and growth is required to mange fisheries of fish populations (Panfili *et al*., 2002). Age of bouge has been estimated by methods based on length frequency analysis (Girardin & Quignard, 1986;Tsangridis & Filippousis, 1991; El-Haweet *et al*, 2005) or sclerochronology based on analysis of growth marks such as scale annuli (Soliman *et al*., 1982; Anato & Ktari, 1986; Girardin &

Quignard, 1986; Hassan, 1990; Allam 2003) or rings of otoliths (Anato & Ktari, 1986; Alegria Hernandez, 1989; Gordo, 1996; Khemiri *et al.*, 2005; Monteiro *et al.*, 2006). Age can be reliably estimated by examining skeletal elements, such as fin rays (Boujard & Meunier, 1991; Meunier *et al.*, 2002), vertebrae (Clay, 1982; Panfili & Loubens, 1992), or the opercular bone (Lecomte *et al.*, 1993).

The objective of this study is to determine age by reading growth bands on otoliths, and to estimate growth parameters of a commercially important sparid *B. boops* from Egyptian Mediterranean waters off Alexandria for better understanding of life cycle and population dynamics of this species to mange its fisheries.

MATERIALS AND METHODS

Samples of *B. boops* were collected monthly from the commercial catch of the Egyptian Mediterranean waters of Alexandria during the period from April 2003 to March 2004.Total length to nearest cm, total weight to nearest g and otolith were taken for each individual specimen.

Age determination was carried out by reading annual rings on 920 *B. boops* otoliths. After the otolith is removed and immersed in xylol with a black back ground, examining under a binocular microscope with reflected light, at a magnification of x15. The total otolith radius 'OR' and the distance between the focus of the otolith and the successive annuli were measured by ocular micrometer and recorded for each fish. The relationship between otolith radius (OR) and total fish length (TL) was determined by least square method, where TL = a + b (OR). The value of intercept (a) was used as a correction factor for back – calculated lengths at the end of each year of life from otolith measurements by Lee's equation (1920) as follows:

$L_n = O_n / O_t (L_t - a) + a$ where,

L_n = calculated length at the end of n years (cm)

L_t = total length at capture (cm)

O_t = Total otolith radius (micrometer divisions)

a = Correction factor, determined from the relationship of length and otolith – radius. The total length was used to determine weight of *B. boops* from the relationship between weight and length. The exponential equation is $W = aL^b$, or the logarithmic form log W = log a+ b log TL, where W= fish weight in g and TL = total length in cm.

Back-calculated lengths and weights at different ages were fitted to Von Bertalanffy's growth equations:

$L_t = L_\infty (1-e^{-k(t-t_0)})$, $W_t = W_\infty [(1-e^{k(t-t_0)}]^b$, where: L_t and W_t are the length (cm), weight (g) at age t (years). L_∞ and W_∞ is the asymptotic length (cm) and weight

(g) .K is the growth coefficient, t_o is the oretical time when length was zero, b is a parameter computed from length - weight relationship. The reliability of the growth parameters , k and L_∞ was tested using phi – prime index (Φ') (Moreau *et al.*, 1986) to estimate growth performance index according to the following equation: $\Phi' = \log k + 2 \log L_\infty$. The longevity of the fish species ($t_{max} = 3/k + t_0$) was estimated using the corrected value of growth coefficient K according to Pauly (1983).

RESULTS AND DISCUSSION

Age determination & Growth in length:

It is important to establish a definite relationship between the growth of otolith and the entire body for the reliability of the otolith for age determination. In the present study, the variation of fish length and otolith radii were positively correlated by a linear relationship (TL = - 1.0575 + 3.5771 OR; r^2= 0.9887). Age and growth are very important parameters of biological aspects for any fish population; they play a prime role in formation and assessment of fisheries management and policy development. In this study *B.boops* from eastern Mediterranean waters off Alexandria coast was aged by otolith reading which revealed the presence of four age groups for *B. boops,* the average calculated lengths at end of each year of life were 9.59, 12.66, 15.01 and 17.07 cm for age groups I, II, III and IV respectively as seen in Table (1):

Table (1): Mean back calculation lengths of *B. boops* at different age groups from Mediterranean coast off Alexandria (2003 – 2004).

Age groups	No	Length at the end of each year of life (cm)			
		L1	L2	L3	L4
I	216	9.41			
II	292	9.70	12.47		
III	324	9.28	12.64	14.73	
IV	88	9.97	12.88	15.28	17.07
Average length (cm)		9.59	12.66	15.01	17.07
Annual increment		9.59	3.07	2.35	2.06
% of increment		56.18	17.98	13.76	12.07

The maximum growth in length was noticed at the end of first year of life (56 .18%) after which a decrease in growth rate was noticed with increase of age reaching 12.07%. Soliman *et al.*, (1982) used otolith in aging, and he reported the same result on the same species of *B. boops*. Livadas (1989) obtained the same number of age groups for *B. boops*, but using scales in aging fish samples. On the other hand, some other authors determined five age groups for the same species from other Mediterranean areas (Table 2); they used variety of methods in aging *B. boops*. Hassan (1990) and Abdel-Rahman (2003) aged *B. boop* from eastern Mediterranean by scales; they estimated six age groups. This finding was closely related to the finding of El-Haweet *et al.*, (2005) of the same species from Western – Mediterranean by scales and Bhattacharya methods. The present results were slightly varied from other estimates of Eastern Alexandria samples (Allam, 2003) and Adriatic samples (Alegria-Hernandez, 1989). Such difference might be due to sampling size or length groups distribution. Khemiri *et al.*, (2005) studied otoliths of *B. boops* from four areas off Tunisian coast, determined seven age groups indicated the importance of environmental conditions especially water temperature and food availability with genetic and epigenetic factors in growth.

Table (2): Length-at-age of *B. boops* estimated by different methods at different areas of Mediterranean Sea.

Methods	Age groups						Authors Areas
	I	II	III	IV	V	VI	
Otoliths		14.7	17.5	20	22	23.8	Alegria-Hernanez,1989 (Adriatic)
Bhattacharya		14.1	17	19.4	21.5	23.2	Alegria-Hernanez,1989 (Adriatic)
Scales	12.8	14.7	17.2	20			Livadas,1989 (Cyprus)
Otoliths	11.2	14.9	17.8	20.1			Soliman *et al*,1982 (Egypt)
Scales	10.2	13.3	15.93	18.3	20.2	21.7	Hassan,1990 (Egypt)
Scales	11	14	16.35	18.6	20.5		Allam,2003 (Egypt)
Scales	9.3	11.3	13.3	14.9	16.4	17.9	Abdel-Rahman,2003 (Egypt)
Scales	9.7	12.9	15.5	17.6	19.5	21.4	El-Haweet *et al*,2005 (Western -Egypt)
Bhattacharya	9.5	13.4	16.2	18.4	20.5	22.5	El-Haweet *et al*,2005 (Western-Egypt)
Otoliths	9.59	12.66	15.01	17.07			Present study, (Alexandria-Egypt)

Length-weight relationship &growth in weight:

In the present study the computed length– weight equations were as follows:

$W = 0.0254L^{2.6604}$

$\text{Log } W = -1.5952 + 2.6604 \text{ Log TL}$ $(r^2 = 0.965)$

The estimation of growth in weight for each year of life for *B.boops* was obtained by applying the calculated total length to the length –weight equation as seen in Table (3).

Table (3): Mean back calculation weights of *B. boops* at different age groups from Mediterranean coast off Alexandria (2003 – 2004).

Age groups	No	Weight at the end of each year of life (g)			
		W1	W2	W3	W4
I	216	9.88			
II	292	10. 72	20.91		
III	324	9.53	21.67	32.56	
IV	88	11.53	22.79	35.90	48.20
Average weight (g)		10.42	21.79	34.23	48.20
Annual increment		10.42	11.37	12.44	13.97
% of increment		21.62	23.59	25.81	28.98

The results indicated that the annual increment in weight was slow by the end of the first year of life (21.62%) and reached its maximum value at IV year reaching (28.98%) of the maximum weight. The result in the present study reveals that the growth in weight relative to length was isometric .The exponent (b) is (2.6604). Botros *et al.*, (1985) found that exponent (b) was 3.1125 for the same species from the Western Libyan waters. He revealed that the change in fish weight in relation to that of length is of the positive allometric type. While Anato & Ktari (1986) revealed that (b) was 2.8874 for combined sexes *B.boops* and the linear and weight growth of females exceeds lightly males 'one during the first four years of life. Alegria-Hernandez (1989) mentioned that Adriatic bogue showed allometric growth for both males and females, but it was nearly isometric for females.

Theoretical growth rates in length and weight:

The Von Bertalanffy growth parameters were estimated and the obtained equations were as follows:

$L_t = 30.105[1-e^{-0.1511\,(t+1.5083)}]$

$W_t = 218.07[1-e^{-0.1511\,(t+1.5083)}]^{2.6604}$

The Von Bertalanffy parameters, revealed that L_∞ and W_∞ were 30.105cm and 218.07g while K = 0.1511 and t_0 = 1.5083. The estimated L_∞ in the present study was lower than the value recorded for the whole Mediterranean (36 cm) by Bauchot and Hureau, 1986. 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 Table (4). Several factors may cause the variability in growth including biotic factors related to the genotype or physiological condition of the fish (Khemiri *et al.*, 2005).

Growth performance

The estimated index of growth performance (Φ') of *B. boops* was 2.136.A comparison of growth performance index (Φ') of *B. boops* with those of the same species from different localities in Mediterranean Sea was given in table (4). When the growth performance (Φ') increases in value from site to another it is be better than the other. In the present study the longevity (t_{max}) was found to be 20 years. The growth coefficient K is related to the longevity of the fish (i.e.) as K being lower as longer lived fish.

Table (4): Growth parameters, growth performance and aging methods for *Boops boops* from different localities in Mediterranean Sea.

Region	Growth parameters					
Country	L_∞	K	t_0	Φ'	Aging method	Author
Algeria	25.40	0.29	---	2.27		Chali-Chabane,1988
France	30.20	0.18	---	2.22		Campillo,1992
Morocco	32.00	0.29	---	2.47	Length-frequency	Mennes,1985
Adriatic	33.2	0.168	-1.481	2.28	otolith	Alegria-Hernandez,1989
Adriatic	33.9	0.155	-1.460	2.20	Bhattacharya	Alegria-Hernandez,1989
Greece	36.00	0.40	---	2.71	Length-frequency	Tsangridis&Filippousis,1991
Tunis	32.27	0.11	-1.688	---	Otolith	Anato&ktari,1986
North Tunis Gulf of Tunis East Tunis South Tunis	28.70 24.30 26.70 23.50	0.20 0.23 0.22 0.21	-1.41 -1.65 -1.43 -1.98	2.22 2.13 2.20 2.06	Otolith	Khemiri *et al*,2005
South Portugal	28.06	0.22	-1.420	---	otolith	Monteiro *et al*,2006
Cyprus	24.00	0.53	-0.450	---	Scales	Livadas,1989
Egypt	29.80	0.18	-1.330	2.20	Scales	Hassan,1999
Egypt	31.70	0.15	-1.780	2.19	Scales	Allam,2003
Egypt	33.50	0.09	-2.640	2.00	Scales	Abdel-Rahman,2003
Egypt	31.90	0.15	-1.530	2.18	Scales	El-Haweet *et al*,2005
Egypt	29.90	0.25	-0.700	2.34	Bhattacharya	El-Haweet *et al*,2005
Egypt	30.11	0.15	-1.508	2.14	Otolith	Present study

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