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Age and Growth Parameters of Red Bandfish (*Cepola rubescens* L., 1766) in İzmir Bay

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Abstract: The age and growth parameters of red bandfish (*Cepola rubescens* L.,1766) were determined from the specimens collected in İzmir Bay (Aegean Sea) between January 1996 and February 1997. Mean length at age data from otolith readings were used to estimate the growth parameters of the von Bertalanffy equation: for females, L_∞=78.48 cm, K=0.17 y^{-1}, t_0=0.0972 y, W_∞=110.00 g, K=0.10 y^{-1}, t_0=0.1033 y and for males L_∞= 83.22 cm, K=0.16 y^{-1}, t_0=0.0888 y ; W_∞=129.83, K=0.0818 y^{-1}, t_0=-0.4117 y. Length-weight relationships was estimated for males and females to be $W=0.07723\ L^{1.11217}$ and $W=0.029154\ L^{1.38434}$, respectively. The observed mean total length and weight were in accord with the theoretical estimated values. Four distinct age groups in the population of males and five age groups in females were identified.

Key Words: Red bandfish, age, growth, İzmir Bay, Aegean Sea.

İzmir Körfezi'ndeki, Kurdela Balıkları (*Cepola rubescens* L., 1766)'nın Yaş ve Büyüme Parametreleri

Özet: Kurdela balıklarının yaş ve büyüme parametreleri, 1996 Ocak ve 1997 Şubat arasında İzmir Körfezi'nden toplanan örneklerden tahmin edilmiştir. Yaşlara ait ortalama boylar, otolit okunarak; büyüme parametreleri ise Von Bertalanffy denklemi ile: Dişiler için, L_∞=78.48 cm, K=0.17 yıl^{-1}, t_0=0.0972 yıl , W_∞=110.00 g, K=0.10 yıl^{-1}, t_0=0.1033 yıl , erkekler için, L_∞= 83.22 cm, K=0.16, t_0=0.0888 yıl, W_∞=129.83, K=0.0818 yıl^{-1}, t_0=-0.4117 yıl olarak hesaplanmıştır. Boy-ağırlık ilişkileri erkek ve dişiler için hesaplanmış ve sırası ile $W=0.029154\ L^{1.38434}$ ve $W=0.07723\ L^{1.11217}$ değerleri bulunmuştur. Gözlenen ortalama total boy ve ağırlıklar ile teorik olarak hesaplanan değerler uyum içindedir. Erkek populasyonunda dört, dişi populasyonunda ise beş yaş grubu ayırt edilmiştir.

Anahtar Sözcükler: Kurdela balığı, yaş, büyüme, İzmir Körfezi, Ege Denizi.

Introduction

The red bandfish is a demersal species inhabiting soft and muddy bottoms at depths ranging mainly from 15 to 200 m (1-3). It occurs in both temperate and subtropical waters and is known to be distributed in the eastern Atlantic from the British Isles to the north of Senegal (4,5). It is also common throughout the Mediterranean, as well as in Turkish seas, but not in the Black Sea (2, 5-7). The red bandfish has economical importance in Spain and Italy (3, 8), but no commercial value in Turkey.

Biological aspects of the red bandfish have been studied by several authors (3,8-18), especially in its westwards distribution in the Mediterranean. However, published data on its biology in Turkish seas is not currently available, except for data on its distribution (6,7,19-24).

The aim of the present study was to give information on age and growth of red bandfish from İzmir Bay located in the Aegean Sea.

Materials and Methods

Sampling was carried out on board R.V/ K. Piri Reis, equipped with a 20 mm mesh size (knot-to-knot) trawl

net at the cod-end, at three stations in İzmir Bay (Figure 1) with seasonal intensity. Sampling took place between January 1996 and February 1997 at depths ranging from 20 to 50 m during daytime. A total of 275 *C. rubescens* were sampled during the study period.

The specimens were measured in total length (TL) to the nearest 1 cm and weighed to the nearest 1.0 g. Sex was determined macroscopically in the field whenever possible, and microscopically in the laboratory right after each cruise. Sagittal otoliths were used for age determination following the methodology proposed by Chugonova (25). Age estimates were obtained by reading whole otoliths against a black background under reflected light.

The length-weight relationship was determined according to the equation given below (26):

$W=aL^b$

Where, W=Body weight (g), L=Total length (cm), a and b are constants.

Growth was expressed in terms of von Bertalanffy's equation (27). The parameter values were estimated by

$L_t = L_\infty [1-\exp^{-K(t-t_0)}]$

Where:

L_t= total length at the age of t, L_∞= maximum asymptotic length, K= Brody's Growth Constant, t_o= computed age at the time of hatching. These parameters were estimated according to von Bertalanffy's plot (28).

The same function is used to describe growth in weight :

$W_t = W_\infty [1-\exp^{-K(t-t_0)}]^b$

Where:

W_t= total weight at the age of t, W_∞= maximum asymptotic weight, K= Brody's Growth Constant, t_o= computed age at the time of hatching.

The non-linear regression procedure in the Statgraphics program ver. 6.0 (Statistical Graphics Corporation) was used to estimate the growth parameters L_∞ , K and t_o in the von Bertalanffy equation. The models were fitted to the raw data obtained from 275 specimens.

One-way Analysis of Variance was applied to determine whether there were statistically significant differences between the female and male total length groups.

A chi-square (χ^2) test was used to detect differences in sex ratios of sampled fish.

Results

Length frequency distribution

The length of females ranged from 11.5 to 45.6 cm and in males ranged from 19.8 to 47.1 cm. The length frequency distribution of both sexes revealed that females were mainly concentrated within the length group of 23.0-25.0 cm whereas males were dominant in the 31.0-33.0 cm and 42.0-44.0 cm groups in equal proportions

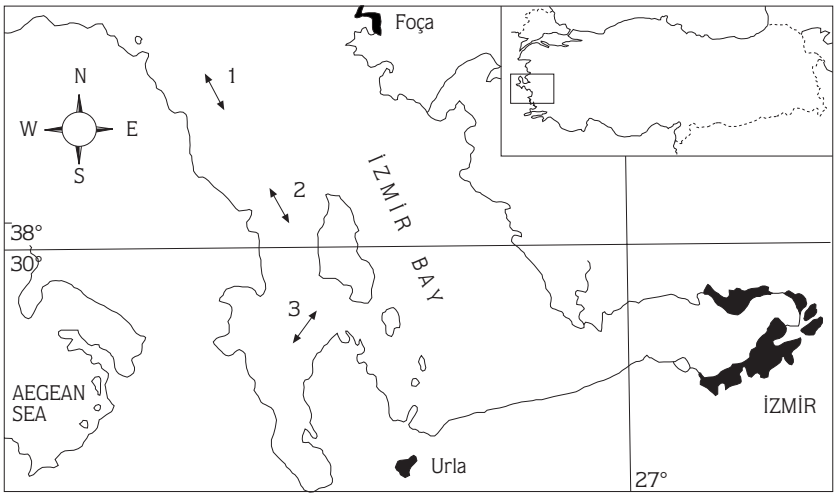

Figure 1. Sampling stations in Izmir Bay.

(Figure 2). Male specimens were found to be greater in total length when compared with the females. Consequently, the result of $F_{cal} > F_{tab}$ ($P<0.05$) showed that there was a statistically significant difference between female and male total length groups (Figure 3).

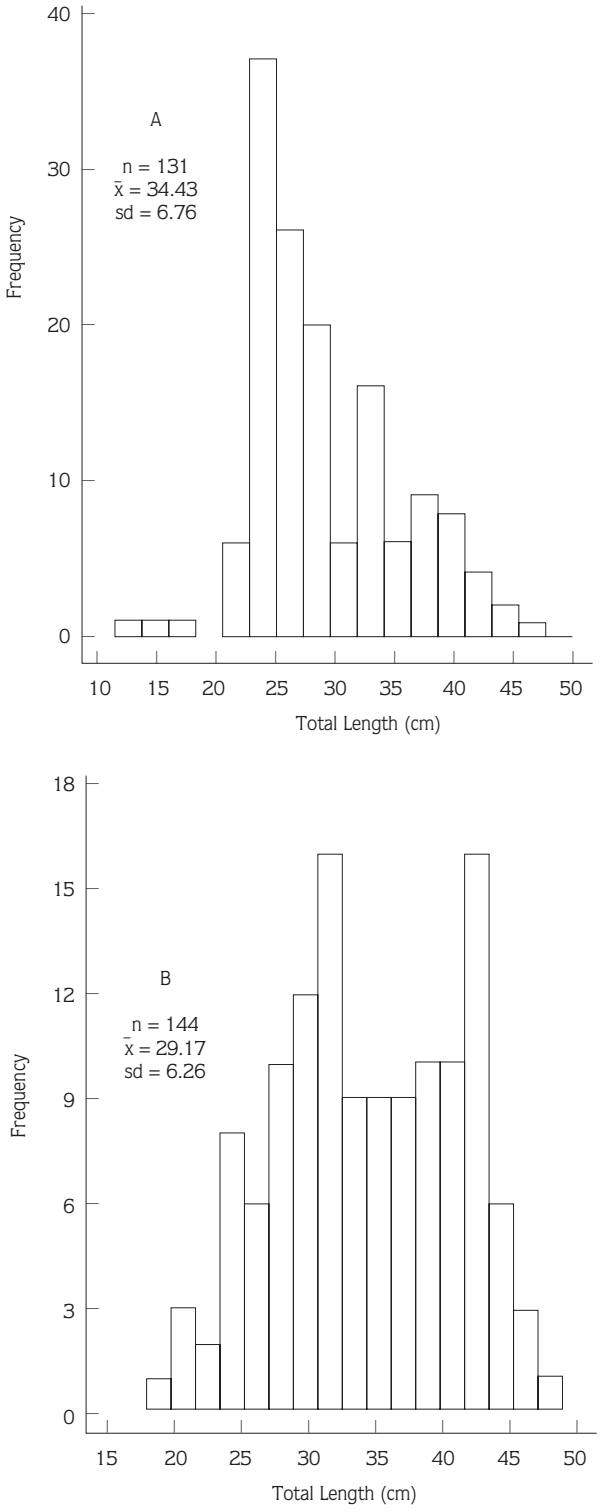

Figure 2. The length frequency distribution (A-Females, B-Males).

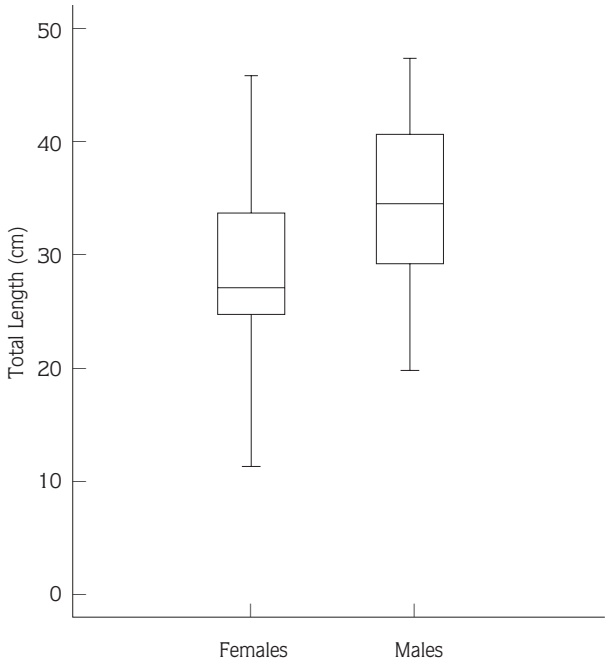

Figure 3. Box-Whiskers plots to the total length of males and females (Tukey One-way Analysis of Variance, Fcal 41,251 > Ftab 3.86).

Length-weight relationship

The length-weight relationship was calculated separately for males and females, as given in Figure 4. The calculated parameters of length-weight relationships are presented in Table 1.

Table 1. The calculated length-weight relationship parameters (a:İntercept, b:Slope, r: Corre- lation coefficient, R^2 = percentage of Correlation coefficient, se=Stnd.Error of b).

	Length-Weight Relationship Parameters				
Sex Groups	a	b	r	R^2	se
Females	0.3288	1.2699	0.89	79.21	0.1371
Males	0.2154	1.3843	0.90	81.00	0.1378

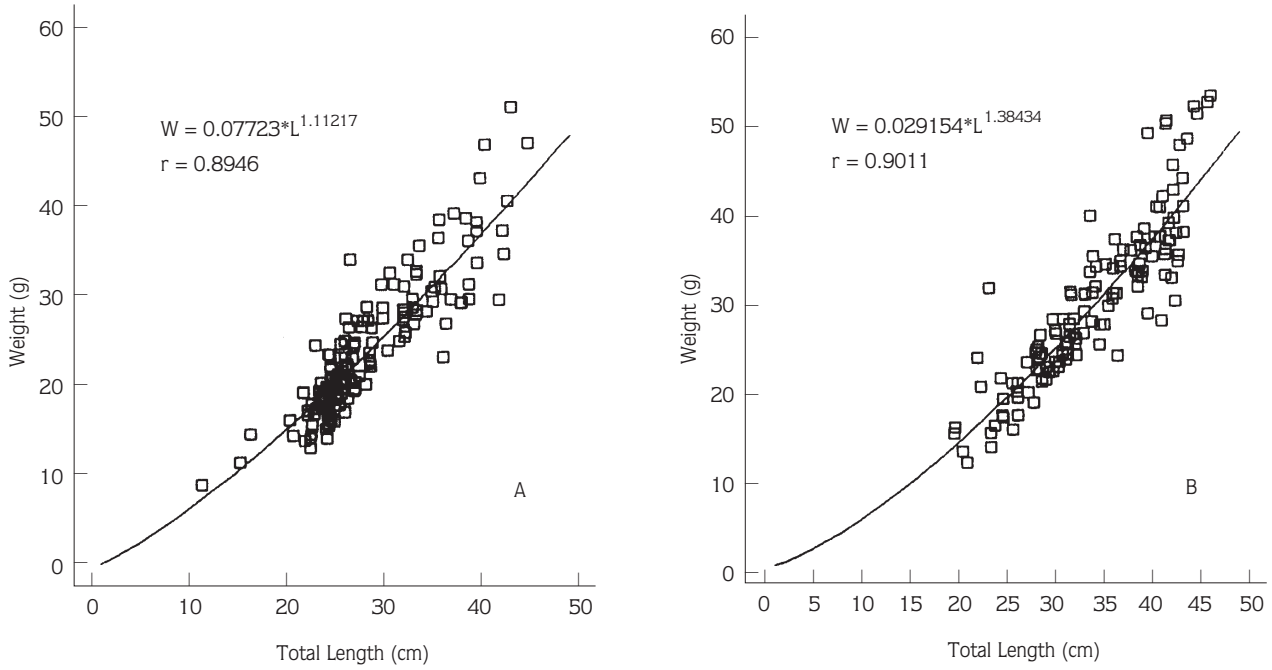

Figure 4. The length-weight relationships (A-Females, B-Males).

Age

Otoliths removed from 275 fish were all readable with distinct annual marks in both the anterior and lateral otolith fields. The oldest individual was estimated to be 5 years old and the modal age was 3 for both sexes (Figure 5).

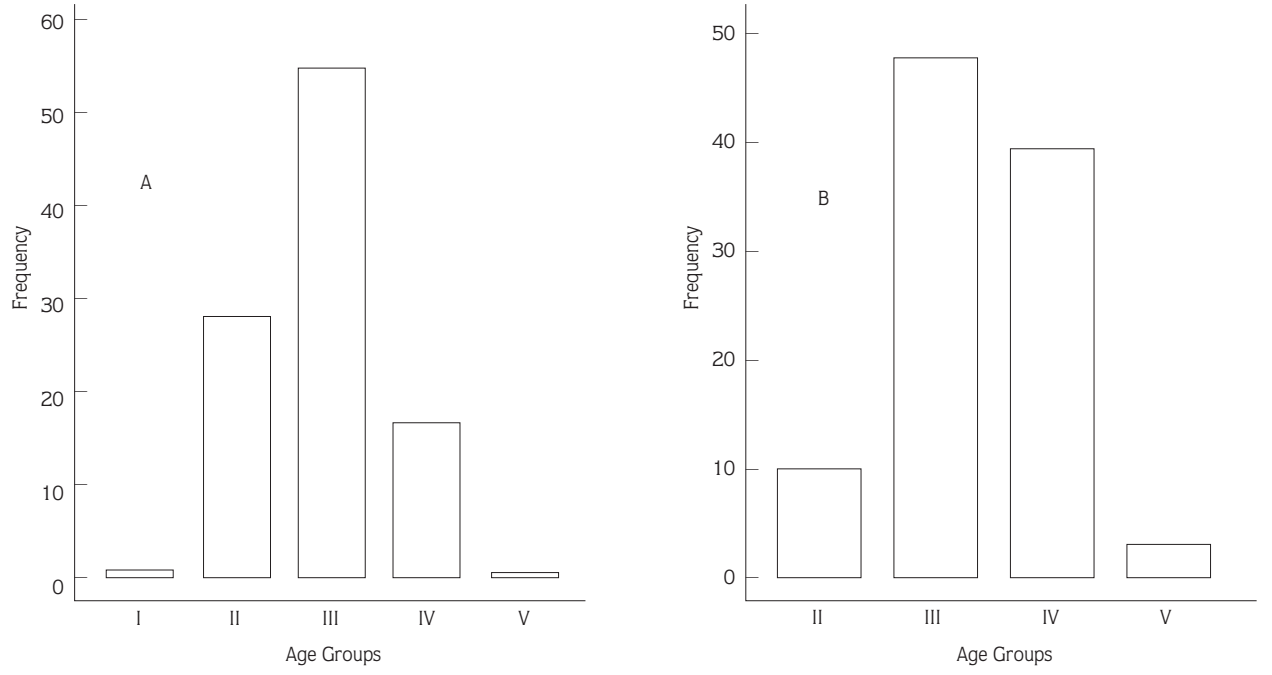

Figure 5. The percentage age distribution of the females (A) and males (B).

Growth

The Von Bertalanffy growth parameters were calculated as follows: L_∞=78.48 cm K=0.17 y^{-1} and t_o=0.0972 y and W_∞=110.00 g, K=0.10 y^{-1} and t_o=0.1033 y in females. In males; L_∞=83.22 cm, K=0.16 y^{-1} and t_o=0.0888 y and W_∞=129.83 g, K=0.0818 y^{-1} and t_o= -0.4117 y. The observed lengths and weights of individuals assigned to each age group were used to fit the Von Bertalanffy growth model and then compared with the estimated values (Table 2).

Sex ratio

Among the 275 specimens sampled, 131 were female (47.6 % of the sample) and 144 were male (52.4 % of the sample). The female:male ratio (0.90) revealed no statistical significance from the ideal 1:1 proportion (χ^2 = 0.37, P >0.05).

Discussion

Age composition of *C. rubescens* was previously studied by Vives et al. (9), Atkinson et al. (10), Pastore et al. (29) and Stergiou et al. (3). Nevertheless, although exclusively based on otolith readings, all the above-mentioned studies revealed different results. Vives et al. (9) proposed two age classes for males and one for females. Atkinson et al. (10) examined the otoliths of 10 specimens from the British Isles and found these specimens to be 4 to 8 years old. Pastore et al. (29) identified four age classes (sexes combined) from the 475 fish sampled. The most comprehensive study was carried out by Stergiou et al. (3) within two regions (both with different conditions prevailing) in the western Aegean Sea. The maximum age was estimated to be 8 for males and 7 for females in the first region, whereas in the second region, both sexes were found to reach age 5, which agrees with the results of the present study.

The most striking feature between males and females was the absence of the 1 year age group in males and its low proportion (0.7 %) in the females, which in fact may probably be due to the selectivity of the trawling net used during the study.

The present data indicates that males attain a greater length than females for ages greater than 2 years. The same has also been suggested by Atkinson et al. (10) and Stergiou et al. (3). However, the length-weight regression slope was found to be smaller in females (b= 1.11217) than in males (b=1.38434), which also indicates slower growth in females. The growth curvature parameter was also higher in females (K=0.17) than in males (K=0.16).

Stergiou et al. (3) estimated the following growth parameters of *C. rubescens* in the western Aegean Sea: L_∞= 67.61 cm, W_∞=90.9 g, K=0.214 y^{-1} (for sexes combined). The values obtained in the present study, for L_∞ for both sexes were much greater than those reported by Stergiou at al. (3), although the maximum observed total lengths in present study were smaller than those reported by Stergiou et al. (3). This can be related to the temperature, the food availability and high fishing pressure or a manifestation of different metabolic activity in the study area, both of which influence fish growth.

The proportion of sexes determined in the present study (females, 47.6 %; males, 52.4 %) was quite similar to that reported by Stergiou et al. (8).

Table 2. The estimated and observed mean total length (TL cm) and weigth (W g) values in each age group.

Age Groups	Observed				Estimated			
	Female		Male		Female		Male	
	TL	W	TL	W	TL	W	TL	W
I	11.50	8.90	-	-	11.16	8.46	-	-
II	22.80	17.10	22.90	16.20	21.68	18.05	21.92	23.24
III	31.10	29.20	32.00	23.30	30.56	26.80	30.98	31.61
IV	39.00	35.60	39.62	35.40	38.05	34.71	38.71	39.33
V	45.50	42.60	46.20	48.30	44.37	41.88	45.29	46.43

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