

Age, growth and maturity of false scad *Caranx rhonchus* in the Central Aegean Sea (Teleostei: Carangidae)

Orta Ege Denizi'nde kral balığı *Caranx rhonchus*'un yaş, büyüme ve eşeyssel olgunluğu (Teleostei: Carangidae)

Burak Altay^{1*} • Dilek İlhan²

¹ Ege University, Faculty of Fisheries, Department of Marine-Inland Waters Sciences and Technology, 35040, Bornova, İzmir, Türkiye

<https://orcid.org/0000-0003-0410-896X>

² Ege University, Faculty of Fisheries, Department of Marine-Inland Waters Sciences and Technology, 35040, Bornova, İzmir, Türkiye

<https://orcid.org/0000-0003-1228-105X>

*Corresponding author: burakaltaytr@gmail.com

Received date: 12.01.2022

Accepted date: 06.04.2022

How to cite this paper:

Altay, B., & İlhan, D. (2022). Age, growth and maturity of false scad *Caranx rhonchus* in the Central Aegean Sea (Teleostei: Carangidae). *Ege Journal of Fisheries and Aquatic Sciences*, 39(2), 104-110. DOI: [10.12714/egejfas.39.2.03](https://doi.org/10.12714/egejfas.39.2.03)

Abstract: This study investigates the age, growth and maturity of false scad (*Caranx rhonchus* Geoffroy Saint-Hilaire, 1817) in the İzmir Bay, the Central Aegean Sea. The total length of 392 fish varied between 12.8-36.0 cm and their weights were measured as 23.51-455.44 g. Sex ratio was 1:0.8 (F:M). Sagittal otoliths were used for age determination. Fish were between I-V age groups in the bay. The length-weight relationships were calculated as $W=0.0145L^{2.8911}$ for females; $W=0.0168L^{2.8425}$ for males, and $W=0.0132L^{2.9259}$ for all fish. The von Bertalanffy growth parameters were found as $L_{\infty}=40.86$ cm, $K=0.2181$ years⁻¹, $t_0=-1.0584$ years for females; $L_{\infty}=39.54$ cm, $K=0.2156$ years⁻¹, $t_0=-0.963$ years for males; and $L_{\infty}=41.12$ cm, $K=0.2061$ years⁻¹, $t_0=-1.0548$ years for all fish, respectively. The growth performance index values (Φ) were 2.532 for females, 2.555 for males, and 2.542 for all fish. The length at first maturity was calculated as 18.53 cm for females, and 18.95 cm for males.

Keywords: Length-weight relationship, length at first maturity, age-length relationship, İzmir Bay

Öz: Bu çalışmada, Orta Ege Denizi, İzmir Körfezi'ndeki kral balığı (*Caranx rhonchus* Geoffroy Saint-Hilaire, 1817)'nin yaş, büyüme ve eşeyssel olgunluğu araştırılmıştır. 392 balığın total boyları 12,8-36,0 cm arasında değişmekte olup ağırlıkları 23,51-455,44 g olarak ölçülmüştür. Cinsiyet oranı (D:E) 1:0,8'dir. Yaş tayininde sagittal otolitler kullanılmıştır. Balıklar körfezde I-V yaş grupları arasında bulunmuştur. Boy-ağırlık ilişkisi sırasıyla, dişiler için $W=0,0145L^{2,8911}$, erkekler için $W=0,0168L^{2,8425}$ ve tüm balıklar için $W=0,0132L^{2,9259}$ olarak hesaplanmıştır. Von Bertalanffy büyüme parametreleri sırasıyla, dişiler için $L_{\infty}=40,86$ cm, $K=0,2181$ yıl⁻¹, $t_0=-1,0584$ yıl; erkekler için $L_{\infty}=39,54$ cm, $K=0,2156$ yıl⁻¹, $t_0=-0,963$ yıl ve tüm balıklar için $L_{\infty}=41,12$ cm, $K=0,2061$ yıl⁻¹, $t_0=-1,0548$ olarak bulunmuştur. Büyüme performans indeks değerleri (Φ) dişilerde 2,532, erkeklerde 2,555, ve tüm balıklarda 2,542'dir. İlk eşeyssel olgunluk boyu dişilerde 18,53 cm ve erkeklerde 18,95 cm olarak hesaplanmıştır.

Anahtar kelimeler: Boy-ağırlık ilişkisi, ilk eşeyssel olgunluk boyu, yaş-boy ilişkisi, İzmir Körfezi

INTRODUCTION

The *Carangidae* family is represented by 148 species belonging to 30 genera in the world (Fricke et al., 2021). In Turkish waters, 16 species belonging to 11 genera were reported for this family (Bilecenoğlu et al., 2014). The *Carangidae* family has economically important fish species and one of them is *Caranx rhonchus* in the study area.

Variability in size has important implications for many aspects of fisheries and stock assessment which include the modeling of growth, estimation of growth parameters, estimation of age frequencies from length frequencies, size-based demographic modeling, sampling, length frequency analysis, and size-based stock assessment methods (Erzini, 1994). Knowledge of the relationship between length and weight of a fish species in a given geographic region is useful for the estimation of length-at-age, between-regions and life-

history comparisons, and it is a practical index of the condition of fish (Petrakis and Stergiou, 1995).

From this perspective, scarce studies were done on *Caranx rhonchus* in the Mediterranean. A study of traditional and experimental floating fish aggregating devices (T/E-FADs) was conducted in the Gulf of Castellammare (NW Sicily). Together with results from catches and visual observations, they reported that *Caranx rhonchus* is one of the most common and abundant species in their study area (D'Anna et al., 1999). Bektas and Belduz (2009), were reported PCR-based identification and discrimination of *Caranx rhonchus* based on nuclear and mtDNA sequences. Ketata Khitouni et al., (2010), have studied variations of the chemical composition of five coastal catch fish species of the Gulf of Gabès (Tunisia) and one of them was *C. rhonchus*. Kožul and Antolović (2013),

reported a short communication of the occurrence of the false scad, in the Adriatic Sea. [Raya and Sabatés \(2015\)](#), have conducted a study about the diversity and distribution of early life stages of carangid fishes in the northwestern Mediterranean. [Sley et al., \(2008\)](#), have studied the diet composition and food habits of *Caranx rhonchus* from the Gulf of Gabes. [Sley et al., \(2013\)](#), have reported a comparative study between parameters of reproduction of *C. crysos* and *C. rhonchus*. [Sley et al., \(2015\)](#) have reported the annual reproductive cycle, spawning periodicity and sexual maturity of false scad from the South-Eastern Mediterranean. [Sley et al., \(2016\)](#) have reported morphometric and meristic characteristics of the species from the Gulf of Gabes. A study on the relationships between fish and jellyfish in the northwestern Mediterranean also includes *Caranx rhonchus* ([Tilves et al., 2018](#)). The length-length and length-weight relationships of the *C. rhonchus* were included in research covering some other fish species in the North Aegean Sea ([Karachle and Stergiou, 2008](#)) but the age and growth properties have not been studied yet.

Considering the scarcity of biological information about *Caranx rhonchus*, the purpose of the study is to contribute information about the age, growth, and maturity of *C. rhonchus* from İzmir Bay in the Central Aegean Sea.

MATERIAL AND METHODS

A total of 392 *C. rhonchus* were collected seasonally from commercial fishermen between September 2017 and July 2018 in the İzmir Bay, the Central Aegean Sea. Samples were collected from the fishing port on the same fishing day and transported to the laboratory as fresh. Specimens were measured to the nearest 0.1 cm (total length, TL), weighed to the nearest 0.01 g (total weight, W), and dissected in the laboratory. The sex and maturity stages were determined by macroscopic and microscopic examination of the gonads. The sex ratio was calculated for the entire study period, and its significance was tested by Chi-square (χ^2) test ([Nikolsky and Birkett, 1963](#)).

Sagittal otoliths were removed, cleaned and stored dry in U-plates. Before age determinations, otoliths were cleaned in 4% NaOH. Otoliths were transferred in an alcohol series (from 30% to 70%) for approximately ten minutes making them more transparent. In this way, opaque and hyaline zone discrimination is facilitated. Age was read from whole otoliths immersed in glycerin (25%) and alcohol (75%) mixture. They were viewed with Olympus SZ-61 models stereo binocular microscope, under reflected light against a black background ([Figure 1](#)). To minimize reading errors, the number of opaque rings outside the nucleus was independently evaluated by two readers. 9 otoliths were excluded from evaluation because the readings did not coincide. The allometric growth equation, $W=a*L^b$, was used to examine length-weight relations ([Bagenal, 1978](#)), where W is the total weight (g), L is the total length (cm), and a and b are the regression constants. The von Bertalanffy growth parameters were used to describe the

growth of fish species ([Sparre et al., 1989](#)); $L_t=L_\infty(1-e^{K(t-t_0)})$ where L_t is the fish length at age t ; L_∞ represent the asymptotic length, K is a brody growth coefficient and t_0 is the theoretical age when the fish length is zero. To compare the calculated growth parameters with other studies, growth performance index values (Φ value) were calculated as $\Phi=\log_{10}K+2*\log_{10}L_\infty$ ([Pauly and Munro, 1984](#)) where K and L_∞ are the von Bertalanffy growth parameters. The hypothesis of isometric growth was tested by Student's t -test ([Ricker, 1975](#)).

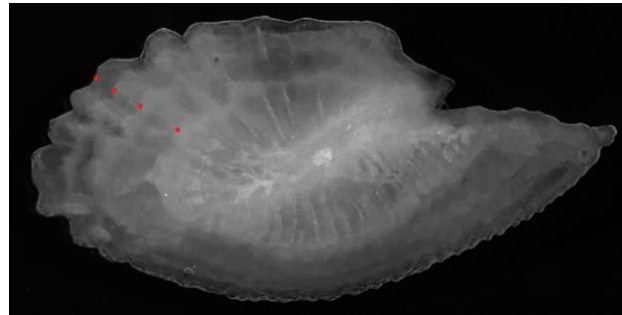


Figure 1. Right sagittal otolith of a 4-years old *C. rhonchus* (27.8 cm TL, 197.2 g) from İzmir Bay

Gonad stages were classified on the modified empirical scale of [Holden and Raitt \(1974\)](#) in both sexes; 1=immature, 2=maturing, 3=ovipositing, and 4=postoviposition, and seems more discriminate and less subject to interpretative error than other scales. To estimate the mean lengths at 50% maturity, a logistic function was fitted to the proportion of the mature individuals by size class using nonlinear regression. The function used was $P=1/1+e^{-r(L-L_{50})}$ where P is the proportion of mature fish per size class, L is the average total length corresponding to the proportion (P), r is the slope of the curve, and L_{50} (length at first maturity) is the total length at 50% maturity ([King, 2013](#)).

RESULTS

In the current study, a total of 392 fish were examined. 184 of them were females (46.94%), 149 were males (38.01%), and 59 (15.05%) were unidentified because they were immature or their gonads were not distinguishable. The female to male ratio was calculated as 1:0.8 and found that it was not statistically significant ($\chi^2_{cal}=3.67$, $\chi^2_{th}=3.84$).

Total length distribution for females, males, and all fish was shown in [Figure 2](#). As a result of measurements, females ranged with an average of 20.18 ± 0.53 cm, between 13.3 and 32.2 cm. Males 20.47 ± 0.6 cm ranged between 12.8 and 36.0 cm. All fish ranged with an average of 20.59 ± 0.38 cm, between 12.8 and 36.0 cm. The length-weight relationships were calculated as $W=0.0145*L^{2.8911}$ for females; $W=0.0168*L^{2.8425}$ for males, and $W=0.0132*L^{2.9259}$ for all fish. The von Bertalanffy growth parameters were calculated as $L_\infty=40.86$ cm, $K=0.2181$ years⁻¹, $t_0=-1.0584$ years for females. It was $L_\infty=39.54$ cm, $K=0.2156$ years⁻¹, $t_0=-0.963$ years for males, and $L_\infty=41.12$ cm, $K=0.2061$ years⁻¹, $t_0=-1.0548$ years for all fish. The growth performance index values (Φ) were 2.532 for females, 2.555

for males, and 2.542 for all fish. The female, male, and all fish showed negative allometric growth throughout the year (Table 1). Fish that have negative allometry, get weight more slowly than the length.

Gonads' distinguishes were not clear in small fish and likewise in large fish at the end of the spawning season. The sample size increased when the consideration of individuals whose gender could not be determined. Thus, the b value calculated for all fish may have been found to be higher than the b value calculated for different genders.

Table 1. Length-weight relationship parameters of *C. rhonchus* in the Izmir Bay (a, intercept; b, the regression coefficient (slope); n, number of specimens studied; SE(b), standard error of the slope; R², coefficient of determination; GT, growth type; A(-), negative allometric)

Sex	a	b	n	SE (b)	R ²	t-test'	GT
Females	0.0145	2.8911	184	0.0424	0.965	2.563	A(-)
Males	0.0168	2.8425	149	0.0433	0.967	3.630	A(-)
All fish	0.0132	2.9259	392	0.0267	0.968	2.772	A(-)

$t_{(183)}=1.66, p<0.05; t_{(148)}=1.65, p<0.05; t_{(391)}=1.66, p<0.05$

A total of 383 otoliths were used for the age determination. 183 were female, 144 were male, and 56 were unidentified (Table 2). Age groups of *C. rhonchus* ranged from I to V in the Izmir Bay for all fish. The most observed age group was 2 for all fish (45.4%). The mean length of 2 years old females was 19.7±0.54 cm males was 20.1±0.53 cm. For the 2 years of age groups, there was no statistically significant difference between females and males ($t_{(1)} = -3.2196, p= 0.19$).

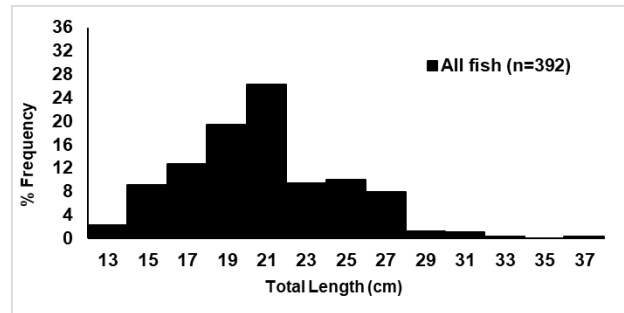
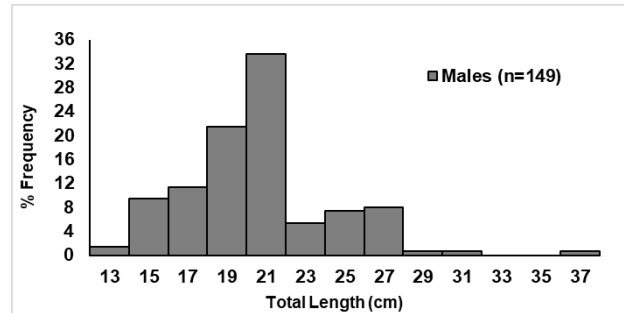
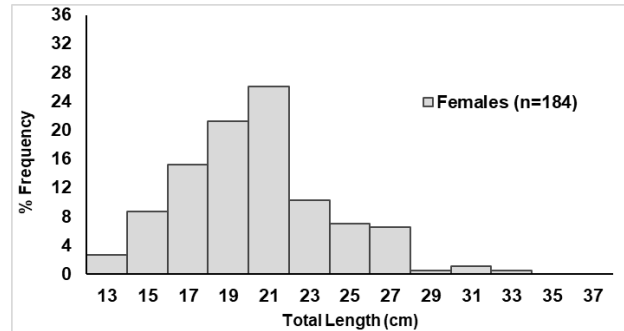


Figure 2. Length distribution of *Caranx rhonchus* in the Izmir Bay

Table 2. The age-length key of *C. rhonchus* from the Izmir Bay (TL, Total length; T, Total; n, the number of specimens; n%, number of percentages; SD, Standard deviation)

TL (cm)	Female							Male					All Fish						
	I	II	III	IV	V	T	I	II	III	IV	V	T	I	II	III	IV	V	T	
12							1						1	1					1
13	5					5	1						1	8					8
14	5	2				7	4	1					5	13	3				16
15	6	3				9	6	3					9	12	8				20
16	4	7				11	4	4					8	8	11				19
17	7	9	1			17	5	2					7	13	13	1			27
18	6	9	3			18	3	8	3				14	9	18	6			33
19	7	8	6			21	1	11	4				16	8	20	12			40
20	1	24	8			33	3	19	8				30	4	44	16			64
21	2	6	6			14	2	15	3				20	5	23	10			38
22	2	8	5			15	2	1	1				4	4	11	8			23
23		1	3			4		3	1				4		9	5			14
24		3	3	1		7		4	3	1			8	9	10	3			22
25		2	4			6			3				3		2	15			17
26		1	7	1		9			6				6	1	18	1			20
27			2	1		3		1	5				6	2	8	1			11
28									0						1				1

Table 2. Continued

TL (cm)	Female						Male						All Fish						
	I	II	III	IV	V	T	I	II	III	IV	V	T	I	II	III	IV	V	T	
29				1		1			1			1			3	1			4
30			1	1		2			0	1		1			1	3			4
31																			
32				1		1										1			1
36												1					1		
n	45	83	49	6		183	32	72	38	2		144	85	174	114	10			383
%n	24.6	45.4	26.8	3.3			22.2	50.0	26.4	1.4			22.2	45.4	29.8	2.6			
Min	13.3	14.0	17.4	24.8			12.8	15.1	18.6	24.7			12.8	14.0	17.4	24.0			
Max	22.2	26.0	30.2	32.2			22.5	27.1	29.0	30.6			22.5	27.1	30.2	32.2			
Mean	17.3	19.7	22.6	28.5			17.3	20.1	23.3	28			17.1	20.1	23.4	28.0			
SD	2.4	2.5	3	2.5			2.5	2.3	3.2	3			2.5	2.6	3.1	2.8			

Utilizing the total length values of the specimens in all age groups, the von Bertalanffy growth equations' parameters were computed as indicated in Table 3.

Table 3. The von Bertalanffy growth parameters for *C. rhonchus* from the İzmir Bay (n, the number of specimens; K, The Brody growth coefficient; t_0 , theoretical age of fish before hatching; L_∞ , asymptotic length; Φ , growth performance index)

Sex	n	K	t_0	L_∞	Φ
Females	183	0.2156	-0.9632	39.538	2.555
Males	144	0.2181	-1.0584	40.863	2.532
All fish	383	0.2061	-1.0548	41.119	2.542

The data displayed in Figure 3 present the percentage of matured individuals in all fish in a given size class. The length at first maturity was estimated as 18.95 cm and 18.53 cm for males and females respectively.

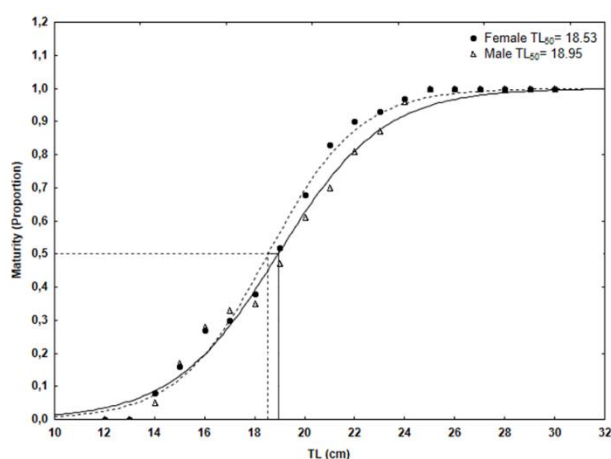


Figure 3. Length at first maturity of female and male *C. rhonchus* from the İzmir Bay

DISCUSSION

Studies on *Caranx rhonchus* have been reported from West Africa and the Mediterranean. It is possible to consider these regions as independent ocean and marine habitats. The effect of the up-welling current on the west African coast should be considered in this context. An evaluation of the current study is presented with a few other studies.

Sley et al., (2015) reported the sex ratio of *C. rhonchus* was 1.04:1 (F: M) in the Gulf of Gabès. They have examined 1313 individuals of whom 668 were females and 645 were males. Females ranged from 3.1 cm to 29.5 cm (TL), and males ranged from 3.0 cm to 30.6 cm (TL) in their study. Although the range was differing, similar results were found in the current study (F: M= 1:0.8). This situation could be evaluated as the similarity of conditions in the Mediterranean. Another group of results was reported from the coasts of the Senegal region. The numerical proportion of the sexes was in favor of females on the coasts of Senegal and Mauritania, albeit the ratio is not specified. (Camarena Luhrs, 1986; Lawal and Milnikov, 1988). The difference between the Senegal-Mauritania region and the Mediterranean region might be due to the occurrence of various conditions in the ocean and marine environment. Besides, the difference in fish size distribution for these two regions should also be taken into account.

The length-weight relationship parameters of *C. rhonchus* reported by different authors are as in Table 4. Torres et al., (2012) reported that the total length was in the range of 28.3–37.0 cm in the Gulf of Cadiz, and larger than the current study (12.8-36.0 cm). The reason for this could be, that the fishing depth they use was up to 800 meters, and the mesh size they use was 20 mm. Also, the fishes were sampled only during the spring and autumn (Torres et al., 2012).

Table 4. Length-weight relationships of *C. rhonchus* in different localities as reported by various authors (n, number of specimens; a, intercept; b, the regression coefficient; R², coefficient of determination; SE, standard error)

Author	Research Area	Length	n	Length Range	a	b	R ²	SE(b)
Karachle and Stergiou (2008)	North Aegean	TL	16	18.0-19.8	0.0099	2.997	0.79	0.412
Overko (1979)	Cap Blanc Cap Verde	FL	-	-	0.0200	2.880	-	-
Boely et al. (1973)	Coast of Senegal and Mauritania	TL	-	-	0.0065	3.097	-	-
Fréon et al. (1979)	Senegal	FL	1956	-	0.0124	3.055	0.99	0.0136
Santos et al. (2002)	Coast of southern Portugal	TL	100	15.7-37.6	0.1222	2.241	0.88	0.084
Torres et al. (2012)	Gulf of Cadiz-Spain	TL	32	28.3-37.0	0.0328	2.610	0.92	-
Maxim (1995)	Mauritania	-	-	-	0.0350	2.731	-	-
Do Chi (1994)	Senegal	FL	-	7.0-38.0	0.0123	3.061	-	-
This study	İzmir Bay	TL	392	12.8-36.0	0.0132	2.9259	0.97	0.0267

The length-weight relationship shows negative allometric growth for both sexes (Table 1). The regression coefficients of this species vary between 2.241–3.097 in studies conducted in different regions. These values were reported as 3 from the coast of Senegal (Table 4). This result indicates that this species' growth isometric in that region. Santos et al., (2002) reported the mean total length for *C. rhonchus* was 30.7±2.6 cm, the regression coefficient was 2.241 and the growth type was negative allometric. Although the length range was similar to the current study, the low regression coefficient may be due to regional differences or the low value of the coefficient of determination. The coefficients of determinations that were calculated for the current study are close to one (Table 1).

The mean total lengths of age groups were compared with other studies in Table 5. Overko (1979) reported similar age

groups in the Cap Verde/ Cap Blanc region. Boely et al., (1973) reported larger age groups on the coast of Senegal and Mauritania. Evaluating these differences was difficult because the methodologies of these two studies were not clearly explained. We suggest that the species could not reach larger sizes due to the scarcity of prey in the İzmir Bay compared to the upwelling areas. On the other hand, there is a possibility that smaller individuals may be caught due to the local fisheries pressure in İzmir Bay. Besides, the fishing method could be different and the selectivity of the fishing gear might be low so the smaller individuals could be caught. Differences in mean length values may be caused by due to the regional biotic (abundance of prey, predation, etc.) and abiotic (temperature, salinity, etc.) factors, as well as the differences in the methodology of age determination.

Table 5. Comparison of the mean length (cm) of the age groups of *C. rhonchus* populations in various seas

Author	Research Area	Length Type	Age Groups									
			I	II	III	IV	V	VI	VII	VIII	IX	X
Overko (1979)	Cap Blanc/ Cap Verde	FL	12.2	17.9	22.3	26.0	29.7	-	-	-	-	-
Boely et al. (1973)	Coast of Senegal and Mauritania	TL	16.0	24.2	29.2	33.7	36.8	39.0	40.6	41.8	42.7	43.4
This study	İzmir Bay	TL	17.1	20.1	23.4	28.0	-	-	-	-	-	-

Table 6 shows the von Bertalanffy growth parameters of *C. rhonchus* from different areas. The L_∞ values were found lower in the current study, compared to others. The growth performance index (Φ) calculated from K and L_∞ was found as

2.542. All these differences might be related to the relatively smaller size of the mean length of the sampled fish. In addition, it is thought that all these differences may be due to methodological differences.

Table 6. The von Bertalanffy growth parameters of *C. rhonchus* in different areas (L_∞, asymptotic length; K, The Brody growth coefficient; t₀, theoretical age of fish before hatching; Φ, growth performance index)

Author	Research Area	Length Type	L _∞	K	t ₀	Φ
Overko (1979)	Cap Blanc /Cap Verde	FL	48.57	0.160	0.800	2.577
Boely et al. (1973)	Coast of Senegal and Mauritania	TL	45.30	0.303	0.515	2.794
Maxim (1995)	Mauritania	-	55.69	0.136	-1.295	2.625
This study	İzmir Bay	TL	41.12	0.206	-1.055	2.542

Overko (1979) and Camarena Luhrs (1986) stated that the first maturity of false scad was 19.7 cm and 20.0 to 21.0 cm FL in the Eastern Atlantic and on the Senegal coast, respectively. Lawal and Milnikov (1988) and Chavance et al., (1991)

reported 19.0 cm (FL) as the first maturity length of false scad for the Mauritanian coast. Fischer et al., (1980) reported the first maturity length of *C. rhonchus* 22.0 cm FL in the Mediterranean. In Tunisian waters, the length of the first

maturity was reported between 16.4 cm (TL) and 20 cm (SL) (Ben Salem and Ktari, 1980, 1994; Ould Mohamed Abdallahi, 1999; Sley et al., 2013, 2015). In this study, the first maturity length of the false scad in the Central Aegean Sea was estimated as 18.95 cm for males and 18.53 cm for females (TL). As stated by Olsen et al., (2004), genetic effects, environmental factors such as temperature, salinity, and food availability, and differences in sampling procedure such as sampling gear and location may affect the sexual maturity length.

In conclusion, the current research investigates the age, growth and maturity of *C. rhonchus* for the first time in the Central Aegean Sea. We suggest that the minimum fishing length should be at least 19 cm (TL) for the sustainability of *C. rhonchus* in İzmir Bay. The literature review showed a need for more detailed and up-to-date information on the biology of this species. We hope the results of this research will contribute to management strategies and regulations needed for the stocks of the *Caranx rhonchus*.

ACKNOWLEDGEMENTS AND FUNDING

The present study was supported by Ege University Scientific Research Project Coordination for MSc thesis of the corresponding author (Project No: 18-SÜF-010).

REFERENCES

- Bagenal, T. (1978). *Methods for Assessment of Fish Production in Fresh Waters*. Blackwell Scientific Publications. Oxford.
- Bektas, Y., & Belduz, A.O. (2009). PCR-based identification and discrimination of *Caranx rhonchus* (Pisces, Carangidae) based on nuclear and mtDNA sequences. *Journal of Animal and Veterinary Advances*. 8(3), 518-525.
- Ben Salem, M., & Ktari, M.H. (1980). Présentation des espèces du genre *Trachurus* (Rafinesque, 1810) et *Caranx* (Lacepède, 1801) (Poissons, Téléostéens, Carangidae) des côtes tunisiennes: morphologie et Biologie. (in French with English abstract). *Bulletin de l'Institut National Scientifique et Technique d'Océanographie et de Pêche de Salammbô*, Tunisia. 4(1), 155-168.
- Ben Salem, M., & Ktari, M.H. (1994). Sexualité et reproduction des espèces du genre *Trachurus*, Rafinesque, 1810, des côtes tunisiennes (Poissons Téléostéens Carangidae). (in French with English abstract). *Bulletin de l'Institut National Scientifique et Technique d'Océanographie et de Pêche de Salammbô*, Tunisia. 21, 88-103.
- Bilecenoğlu, M., Kaya, M., Cihangir, B., & Çiçek, E. (2014). An updated checklist of the marine fishes of Turkey. *Turkish Journal of Zoology*. 38, 901-929. DOI: [10.3906/zoo-1405-60](https://doi.org/10.3906/zoo-1405-60)
- Boely, T., Wysokinski, A., & Elwertowski, J. (1973). Les chinchards des cotes sénégalaises et mauritaniennes. Biologie-déplacements-ressources. *Documents Scientifiques. Centre de Recherches Oceanographiques de Dakar-Thiaroye, ORSTOM*, (46): 47 p.
- Camarena Luhrs, T. (1986). *Les principales espèces de poissons pélagique côtiers au Sénégal: Biologie et évaluation des ressources*. PhD thesis, University of Western Brittany. Brest, France, 187.
- Chavance, P., Ba, I., & Krivospitchenko, S. (1991). Les petits poissons pélagiques côtiers de la Zone Économique Exclusive mauritanienne. *Bulletin du Centre National de Recherches Océanographiques et des Pêche*, Nouadhibou 23, 28–72.
- D'Anna, G., Badalamenti, F., & Riggio, S. (1999). Traditional and experimental floating fish aggregating devices in the Gulf of Castellammare (NW Sicily): results from catches and visual observations. *Scientia Marina*. 63(3-4), 209-218. DOI: [10.3989/scimar.1999.63n3-4219](https://doi.org/10.3989/scimar.1999.63n3-4219)
- Do Chi, T. (1994). Groupe de travail ad hoc sur les Sardinelles et autres especes de petits pelagiques cotiers de la zone nord du copace (Eds.), *Comite Des Peches Pour L'atlantique Centre-Est COPACE/PACE/Ser. No. 91/58*. (pp 295) Rome, FAO.
- Erzini, K. (1994). An empirical study of variability in length-at-age of marine fishes. *Journal of Applied Ichthyology*. 10, 17-41.
- Fischer, W., Bianchi, G., & Scott, W.B. (1980). Fiches F.A.O d'identification des espèces pour les besoins de la pêche. Atlantique Centre-Est Zones de pêche 34 et 47 (en partie). Publication préparé par la F.A.O et le Gouvernement canadien (Projet GCP/INT/180/CAN). 2 pp.
- Fréon, P., Boely, T., & Stequert, B. (1979). Les Poissons Pelagiques Cotiers Au Senegal: Relations Taille/Poids Des Principales Especies D'interet Commercial. Project for Development of Fisheries in the Eastern Central Atlantic. *F.A.O. CECAF/ECAF Series/78/10*. Annex 13.
- Fricke, R., Eschmeyer, W.N., & Van der Laan, R. (2021). Eschmeyer's catalog of fishes: genera, species, references. (http://researcharchive.calacademy.org/research/ichthyology/catalog/fish_catmain.asp). Electronic version accessed 09.12.2021.
- Holden, M.J., & Raitt, D.F.S. (1974). Manual of fisheries science. Part 2. Methods of recourse investigation and their application. *FAO Fisheries and Aquaculture Technical Paper* No. 115, Rev. 1: 214 p.
- Karachle, P.K., & Stergiou, K.I. (2008). Length-length and length-weight relationships of several fish species from the North Aegean Sea (Greece). *Journal of Biological Research*, (Thessalon) 10, 149–157.
- Ketata Khitouni, I., Abdelmouleh, A., Bouain, A., & Boudhrioua Mihoubi, N. (2010). Variations of the chemical compositions of five coastal catch fish species of the Gulf of Gabes (Tunisia). *Cybiurn*, 34(2), 175-183.
- King, M. (2013). *Fisheries biology, assessment and management, 2nd edition*. John Wiley & Sons. DOI: [10.1002/9781118688038](https://doi.org/10.1002/9781118688038)

AUTHORSHIP CONTRIBUTIONS

All authors contributed to the idea and design of the study. Material preparation and research were carried out by Burak ALTAY and Dilek İLHAN. The article was written and edited by Burak ALTAY and all authors have read and approved the article.

CONFLICTS OF INTEREST

The authors declare that there is no known financial or personal conflict that may affect the research (article).

ETHICS APPROVAL

The material used in the article was obtained from commercial fishermen and the research was conducted according to the National Ethics Committee for Animal Experiments (HADMEK, HADYEK) guidelines.

DATA AVAILABILITY

The datasets created and/or analyzed during the current study will be provided by the responsible author upon the request of the editor or reviewers.

- Kožul, V., & Antolović, N. (2013). Occurrence of the false scad, *Caranx rhonchus* Geoffroy Saint-Hilaire, 1817 in the Adriatic Sea. *Journal of Applied Ichthyology*, 29 (2), 449-450. DOI: [10.1111/jai.12086](https://doi.org/10.1111/jai.12086)
- Lawal, H.S., & Milnikov, N. (1988). Contribution à l'étude de la relation tailles-poids, de la reproduction et du sex-ratio des principales espèces pélagiques en Mauritanie. Rapports du groupe de travail CNROP-CRODT-ISRA sur les ressources pélagiques côtières (Mauritanie-Sénégal). *Bulletin du Centre National de Recherches Océanographiques et des Pêche*, Nouadhibou, 253 pp.
- Maxim, C. (1995). Horse mackerel and false scad stock assessment, and catch projections, CECAF Divisions 34.1.3 and 34.3.1. *Scientia Marina*, 59 (3-4), 611-627.
- Nikolsky, G.V., & Birkett, L. (1963). *Ecology of Freshwater Fish* (Vol. 352). London: Academic Press.
- Olsen, E.M., Heino, M., Lilly, G.R., Morgan, M.J., Brattey, J., Ernande, B., & Dieckmann, U. (2004). Maturation trends indicative of rapid evolution preceded the collapse of northern cod. *Nature* 428: 932 – 935. DOI: [10.1038/nature02430](https://doi.org/10.1038/nature02430)
- Ould Mohamed Abdallahi, K. (1999). *Systématique et biologie of Caranx rhonchus* (Geoffroy Saint-Hilaire, 1817, Téléostéens; Carangidae) des côtes tunisiennes et mauritaniennes, PhD thesis, University of Tunis, Faculty of Science of Tunis, Tunisia, 206 pp.
- Overko, S.M. (1979). Morpho-biological characteristics of *Caranx rhonchus* in the Eastern Central Atlantic. Project for Development of Fisheries in the Eastern Central Atlantic. F.A.O. CECAF/ECAF Series/78/10. Annex 14.
- Pauly, D., & Munro, J.L. (1984). Once more on the comparison of growth in fish and invertebrates. *ICLARM Fishbyte*, 2(1), 1-21.
- Petrakis, G., & Stergiou, K.I., (1995). Weight-length relationships for 33 fish species in Greek waters. *Fisheries Research*, 21, 465-469.
- Raya, V., & Sabatés, A. (2015). Diversity and distribution of early life stages of carangid fishes in the northwestern Mediterranean: responses to environmental drivers. *Fisheries Oceanography*, 24 (2), 118-134. DOI: [10.1111/fog.12097](https://doi.org/10.1111/fog.12097)
- Ricker, W.E. (1975). Computation and interpretation of biological statistics of fish populations. *Journal of the Fisheries Research Board of Canada*, 191, 1-382.
- Santos, M.N., Gaspar, M.B., Vasconcelos, P., & Monteiro, C.C. (2002). Weight-length relationships for 50 selected fish species of the Algarve coast (Southern Portugal). *Fisheries Research*, 59(1-2), 289-295. DOI: [10.1016/S0165-7836\(01\)00401-5](https://doi.org/10.1016/S0165-7836(01)00401-5)
- Sley, A., Jarboui, O., Ghorbel, M., & Bouain, A. (2008). Diet composition and food habits of *Caranx rhonchus* (Carangidae) from the Gulf of Gabes (Central Mediterranean). *Journal of the Marine Biological Association of the United Kingdom*, 88(4), 831-836. DOI: [10.1017/S0025315408001379](https://doi.org/10.1017/S0025315408001379)
- Sley, A., Jarboui, O., & Bouain, A. (2013). Comparative study between parameters of reproduction of two species of <Carangidae>: <*Caranx crysos*> and <*Caranx rhonchus*> of the gulf of Gabes. *Bulletin de l'Institut National des Sciences et Technologies de la Mer*, 40 (0330-0080), 15-25.
- Sley, A., Hadj Taeib, A., Jarboui, O., Ghorbel, M., & Bouain, A. (2015). Annual reproductive cycle, spawning periodicity and sexual maturity of false scad *Caranx rhonchus* (Geoffroy Saint-Hilaire, 1817) (Pisces, Carangidae) from the South-Eastern Mediterranean (Gulf of Gabès, Tunisia). *Journal of Applied Ichthyology*, 31(3), 437-441. DOI: [10.1111/jai.12675](https://doi.org/10.1111/jai.12675)
- Sley, A., Jawad, L.A., Hajje, G., Jarboui, O., & Bouain, A. (2016). Morphometric and meristic characters of blue runner *Caranx crysos* and false scad *Caranx rhonchus* (Pisces: Carangidae) from the Gulf of Gabes, Tunisia, Eastern Mediterranean. *Cahiers de Biologie Marine*, 57, 309-316.
- Sparre, P., Ursin, E., & Venema, S.C. (1989). Introduction to tropical fish stock assessment, Part 1, Manual, *FAO Fisheries and Aquaculture Technical Paper*, No:306.1 Roma, Fao, 337 p.
- Tilves, U., Sabatés, A., Blázquez, M., Raya, V., & Fuentes, V.L. (2018). Associations between fish and jellyfish in the NW Mediterranean. *Marine Biology*, 165(8), 1-14. DOI: [10.1007/s00227-018-3381-4](https://doi.org/10.1007/s00227-018-3381-4)
- Torres, M.A., Ramos, F., & Sobrino, I. (2012). Length-weight relationships of 76 fish species from the Gulf of Cadiz (SW Spain). *Fisheries Research*, 127-128, 171-175. DOI: [10.1016/j.fishres.2012.02.001](https://doi.org/10.1016/j.fishres.2012.02.001)