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Length-weight, condition factors, age, and growth of *Scomber japonicus* (Houttuyn, 1782) from the Egyptian Mediterranean Sea

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ABSTRACT

Length-weight, condition factors, age, and growth of *Scomber japonicus* were investigated. The specimens were collected monthly from Alexandria landing centers during 2017 and caught using night purse seine ranging from 12.9 to 34.4 (TL) (average, 21.00 ± 4.1) cm and from 15.10 to 391.49 (TW) (average, 92.81 ± 59.17) g. The exponent "b" of the length-weight relationships were ">3" for females (b = 3.24), males (b = 3.25), and all samples (b = 3.15), reflecting the positive allometric mode of growth. Moreover, the positive allometric mode of growth was observed for the relationship between forked length (FL) and standard length (SL) with weight. The annual average of absolute condition was 0.89 ± 0.06, with the highest value during April (0.96 ± 0.05). The annual average relative condition was 1.01 ± 0.06, with the highest value (1.10 ± 0.10) during August. The absolute condition (Kc) increased with the increasing length. However, the relative condition showed an inverse trend. The age of *S. japonicus* was determined using length-frequency analysis giving five age groups at mean lengths of 14.09, 19.29, 23.82, 28.25, and 31.76 cm for the 1st, 2nd, 3rd, 4th, and 5th age groups, respectively. The third age group (III) was the most frequent one (38.89%). The estimated growth parameters were L∞ of 38.11 cm; W∞, 534.74; K, 0.33 year-1; growth performance (Ø), 2.68; and t-max, 8.89 years. In conclusion, the present data reflected a good stock status with the suitability of living habitats. Further continuous monitoring is recommended for better fishery management and conservation.

INTRODUCTION

The Chub mackerel *Scomber japonicus* (Houttuyn, 1782) is a famous species of the family Scombridae living between 0 and 300 m depth primarily as a coastal pelagic species. However, they are usually abundant at within 50–200 m in subtropical waters of approximately 10°C–27ºC **(Castro, 2000).** Chub mackerel is widely distributed over the continental shelves of the tropical and subtropical regions of the Pacific, Indian, and Atlantic Oceans and adjacent Seas **(Collette and Naunen, 1983).** This species usually ranked the important commercial importance in its habitat **(FAO, 2010).** In Egypt, it represented an important fishery in both the Red and Mediterranean Seas **(GFARD, 2018).** Chub mackerel forms one of the primary and commercial fish species in purse seine fishing operations in the Red Sea and Gulf of Suez **(Mehanna, 2002, 2004)** and the Mediterranean Sea of Egypt **(Faltas, 1983; Akel, 2009 and Farrag *et al.*, 2014).** Hence, detailed and continuous information should be obtained for effective fisheries management.

Fish age and growth are also necessary to evaluate the biological aspects, such as productivity, yield per recruit, prey availability, habitat suitability, and even feeding kinematics **(Campana, 2001; Robinson & Motta, 2002 and Farrag *et al.*, 2014).** An item of length-weight relationship is among the growth studying items needed to appreciate the suitability of the fish environment and play an important role in fishery management **(Richter *et al*., 2000).** Other factors such as the environmental conditions required to describe the plumpness or well-being of the fish are based on the hypothesis that heavier fish of a particular length is a better physiological condition **(Bagenal and Tesch, 1978).** Condition factors are also a useful index to monitor the feeding intensity, age, and growth rates in the fish **(Ndimele *et al*., 2010).** Although the importance of these commercially available fish has been known, a few studies were conducted for *S. japonicus* in the Mediterranean Sea, Egypt (**Faltas & Rizkalla, 1995; Rizkalla & Faltas, 1997 and Rizkalla, 1998)** Moreover, the recent study of **El-Aiatt and Shalloof, (2020**) was conducted on the another species under the same genus of *Scomber* known as *S. scombrus*. Therefore, this study aimed to explore the age and growth of the common chub mackerel *S. japonicus* from the Egyptian Mediterranean Waters to support its conservation and further management.

MATERIALS AND METHODS

Study area and sampling

The total length (TL) of 511 specimens ranged from 12.9 to 34.4 cm of "chub mackerel" *S. japonicus* (Fig. 1), which was collected monthly from Alexandria landing centers in 2017. The specimens were randomly obtained from the catch of the fishing vessels (purse-seine using light), which operated at a depth from 40 to 60 m in the Egyptian Mediterranean water-off Alexandria (Fig. 1). At the NIOF laboratory Alexandria branch, the specimens were dissected and sorted based on sex and maturity stages of each fish, and then the TL, standard length (SL), and forked length (FL) of each fish were measured to the nearest centimeter (cm), while the total weight (TW) of each fish was weighed to the nearest gram.

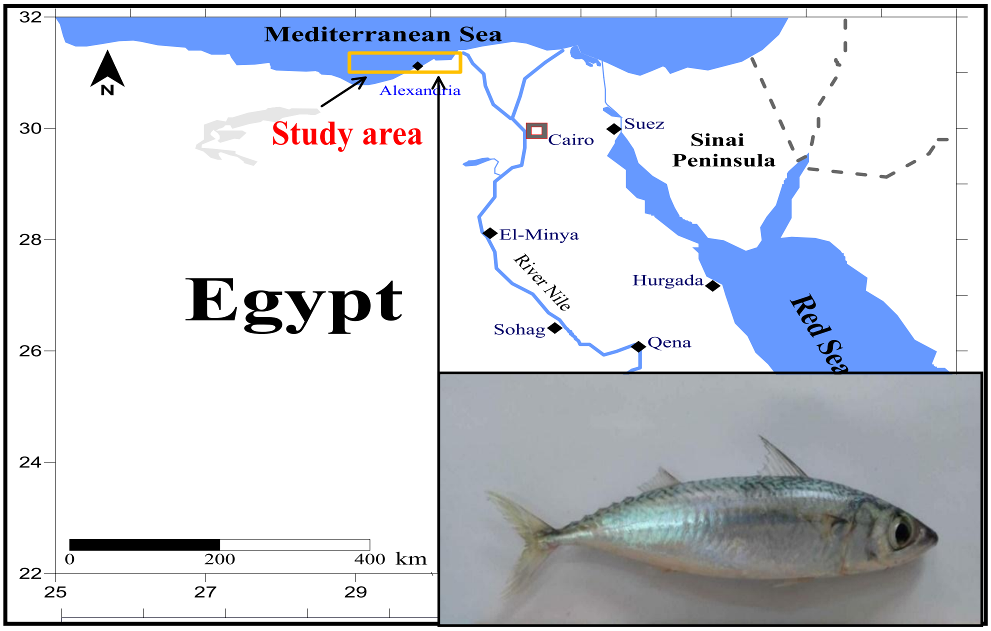

Figure 1. Study area at Alexandria coast, Mediterranean Sea, Egypt, with the photo of chub mackerel, *S. japonicus*.

Length-weight relationship and condition factors

The length-weight relationship was calculated by applying an exponential regression equation $W=a\ L^b$, where W is the TW (g), L is the TL (cm), a and b are constants **(Ricker, 1973).**

The absolute condition factor (Kc) was estimated based on the cube law **(Bagenal and Tesch, 1978)** as $K = 100 \times W \setminus L^3$. The relative condition (Kn) was determined as $Kn = W / W`$ **(Le Cren, 1951)** where W is the TW (g) and W` is the calculated weight, which was estimated from the length-weight relationship.

Age determination

Age was determined by analyzing the length-frequency data of 511 specimens using the standard statistical method of **Bhattacharya (1967**) in the subroutine of the Fi-SAT software **(Gayanilo *et al*., 1997),** which allow the conversion of length-frequency data into age groups.

Growth parameters

The Von Bertalanffy growth parameters (VBGF) including the asymptotic or maximum size of the fish were used to estimate L∞ and growth coefficient (K). The growth performance index Φ' was estimated according to $\Phi = \log(k) + 2\log(L\infty)$ (**Pauly and Munro, 1984)**. The potential longevity of age (t_{max}) was estimated $t_{max} = 3/k + t_o$ according to **Pauly (1983)**, where $t_o = -a/b$. The presented data were statistically analsyzed using Microsoft Excel, and t-tests were conducted in Statistica software (2007).

RESULTS

Length-weight relationship

The length of all samples used for this calculated item ranged from 12.9 to 34.4 (average, 21.00 ± 4.1) cm (TL) and from 15.10 to 391.49 (average, 92.81 ±59.17) g (TW). For males, the size varied from 18.6 to 32.6 (average, 25.00) cm, whereas for females, the size varied from 18.6 to 34.4 (average, 23.8) cm. The relationship between length and weight of *S. japonicus* from Alexandria was estimated using different length measures, including the TL, SL, and FL. For the TL in cm and TW in g, the results illustrated that the exponent b was >"3" for males (b = 3.25), females (b = 3.24), and all samples (b = 3.15), reflecting the positive allometric mode of growth for all categories. A similar trend of positive allometric mode of growth was observed while using FL or SL instead of TL with weight (Table 1).

Condition factors (Kc and Kn).

Both the absolute condition factor (kc) and relative condition (Kn) were analyzed for all samples. According to the month (Figure, 2), both condition factors display a fluctuation during the year. For the absolute condition, the highest value was recorded during April (0.96 ± 0.05), whereas the lower absolute condition was recorded during June (0.80 ± 0.07). The annual average was 0.892 ± 0.06. The kn, recorded in the annual average, was 1.01± 0.06 with the highest value (1.10 ± 0.10) during August, whereas the lowest one (0.93 ± 0.07) was during February.

Table 1. Length-weight relationships for *S. japonicus*. ((TL/TW, FL/TW, and SL/TW)

Length-weight relationships for *S. japonicus* ($W = a L^b$)									
Sex	**N**	**Total length (TL cm)**		**Total weight (g)**		**Parameters and mode of growth**			
		Min.	**Max.**	**Min.**	**Max.**	**a**	**b**	**R^2**	**Allometry**
Females	239	18.6	34.4	54.97	391.49	0.0041	3.24	0.96	Positive
Males	200	18.6	32.6	56.02	342.22	0.004	3.25	0.97	Positive
All samples	511	12.9	34.4	15.1	391.49	0.0056	3.14	0.98	Positive
Sex	**N**	**Fork length (FL cm)**		**Total weight (g)**		--			
		Min.	**Max.**	**Min.**	**Max.**	**a**	**b**	**R^2**	**Allometry**
Females	239	17	31.5	54.97	391.49	0.006	3.21	0.98	Positive
Males	200	17	29.8	56.02	342.22	0.006	3.2	0.98	Positive
All samples	511	11.8	31.5	15.1	391.49	0.006	3.22	0.99	Positive
Sex	**N**	**Standard length (SL cm)**		**Total weight (g)**		--			
		Min.	**Max.**	**Min.**	**Max.**	**a**	**b**	**R^2**	**Allometry**
Females	239	15.7	29.4	54.97	391.49	0.006	3.27	0.96	Positive
Males	200	15.7	27.4	56.02	342.22	0.005	3.34	0.97	Positive
All samples	511	10.9	29.4	15.1	391.49	0.008	3.19	0.98	Positive

According to length bases (Figure 3)**,** the absolute condition (Kc) increased with increased length. The lowest condition (0.84 ± 0.08) was recorded at the lowest length group (L 12.0–17.0 cm), whereas the largest condition was recorded as 0.95 ± 0.05 at the largest length groups (L 28.1–34.4 cm). The relative condition showed the highest conditions at length groups (L 17.1–21.0 cm), which decreased as the length groups increased in an inverse trend.

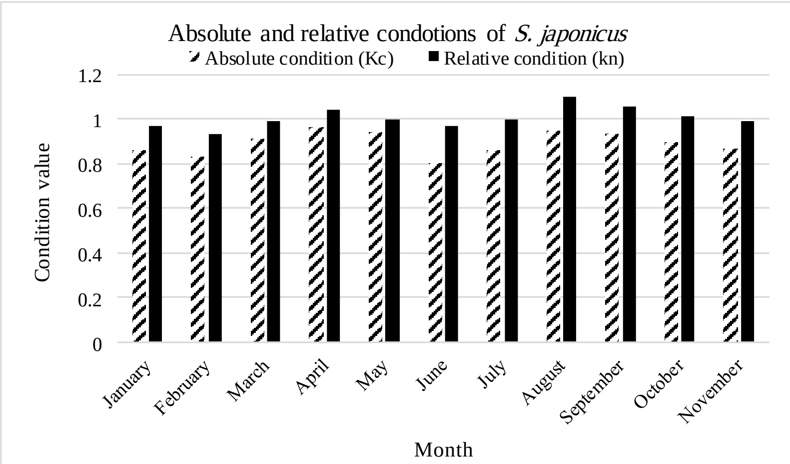

Figure 2. Monthly mean variations of absolute condition (Kc) and relative condition (Kn) for all samples of *S. japonicus*.

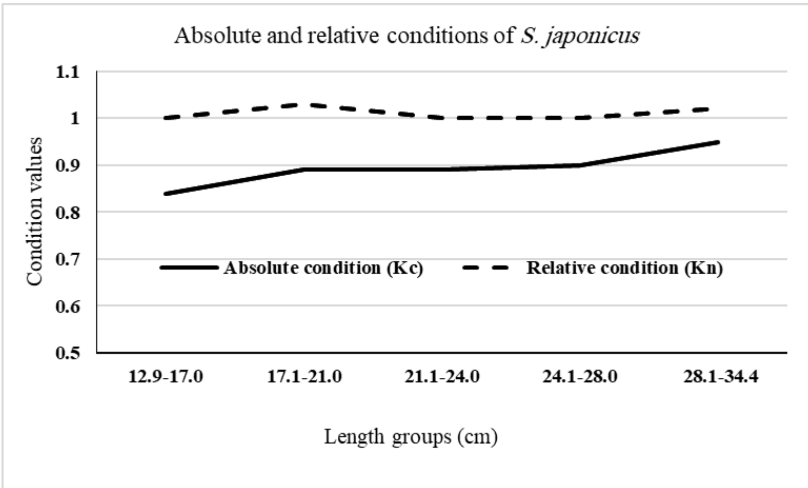

Figure 3. Variations in means of absolute condition (Kc) and relative condition (Kn) with length groups for all samples of *S. japonicus*.

Age determination

The age of *S. japonicus* was determined using length-frequency analysis for all samples showing five age groups (Figure 4). The third age group (III) most frequently constituted 38.89%, followed by the second age group (II) with 33.33%. The estimated lengths of each age group are presented in Table 2, with the mean lengths of 14.09, 19.29, 23.82, 28.25, and 31.76 cm for the 1st, 2nd, 3rd, 4th, and 5th groups, respectively.

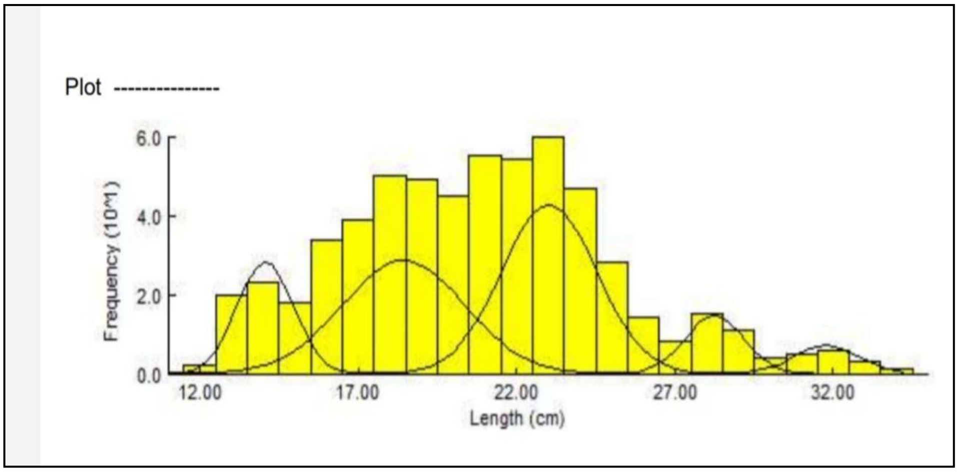

Figure 4. Length frequency distribution for all samples of *S. japonicus* from the Egyptian Mediterranean waters using the Bhattacharya method.

Growth in length and weight at age and growth parameters

Growth in lengths and weights of *S. japonicus* are shown in Table 2 and presented in Figure 5. The highest increment in length was observed at the end of the first age group, and then the annual increment gradually decreased with the increase toward the 5th age group. The increase in weight acquired the lowest values during the first year of life of 23.28, and the annual increment increased with the increasing age until it reached the maximum weight in the 5th age group (301.17g). The calculated weights for each age group were estimated to be 23.28, 62.62, 121.70, 208.26, and 301.17 g for the 1st, 2nd, 3rd, 4th, and 5th years of life, respectively (Table 2 and Figure 5 a, b).

Table 2. Estimated lengths and annual increment of growth in length and weight for all samples of *S. japonicus* from the Egyptian Mediterranean water.

Age group	%	Estimated Length	Increment (cm)	Estimated weight	Increment (gm)
I	15.22	14.09	14.09	23.28	23.28
II	33.33	19.29	5.2	62.62	39.34
III	38.89	23.82	4.53	121.70	59.07
IV	9.18	28.25	4.43	208.26	86.56
V	3.38	31.76	3.51	301.17	92.91

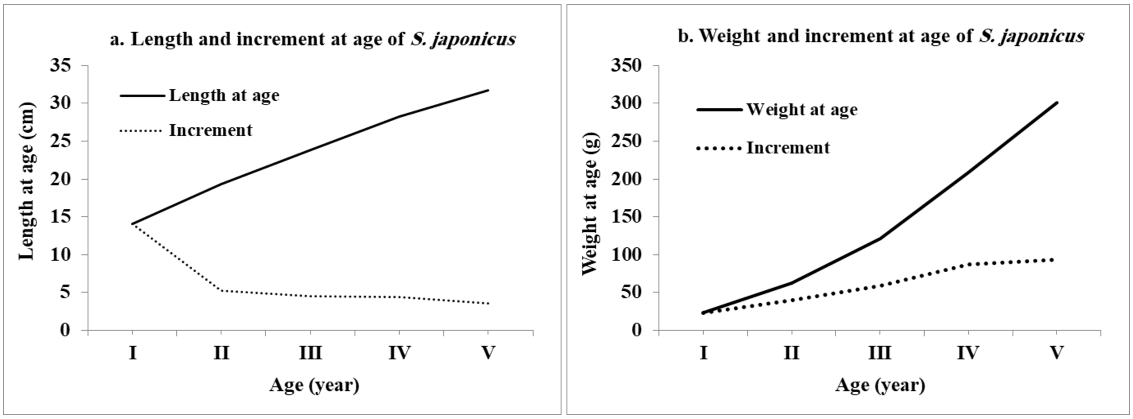

Figure 5 a, b. Estimated lengths and annual increment of growth in length and weight for all samples of *S. japonicus* (a: lengths, b: weights).

To confirm the results of calculated lengths and weights, the growth model was fitted based on the results of length-frequency methods. The calculated and estimated values of lengths and weights from all samples are shown in Table 3, and their graphical presentations are shown in Figure 6 a, b. A close agreement and obvious confirmation between the estimated and calculated lengths and weights particularly after the second year of life were observed. The growth model parameters of the Bertalanffy growth model **(**L∞, W∞, and K) were estimated as L∞ = 38.11 cm; W∞ = 534.74; and K = 0.33 at year 1. The growth performance index (Ø) of *S. japonicus* was found to be 2.68 for all samples derived using the Bhattacharya methods. The longevity of age (T max) was 8.89 years.

Table 3. Estimated and calculated lengths at the age of all samples of *S. japonicus* from the Egyptian Mediterranean water.

Age	Growth in length		Growth in weight	
	L.F	VBGL	L.F	VBGL
I	14.09	12.46	23.28	20.88
II	19.29	19.67	62.62	78.51
III	23.82	24.85	121.7	154.73
IV	28.25	28.57	208.26	232.04
V	31.76	31.25	301.17	300.91

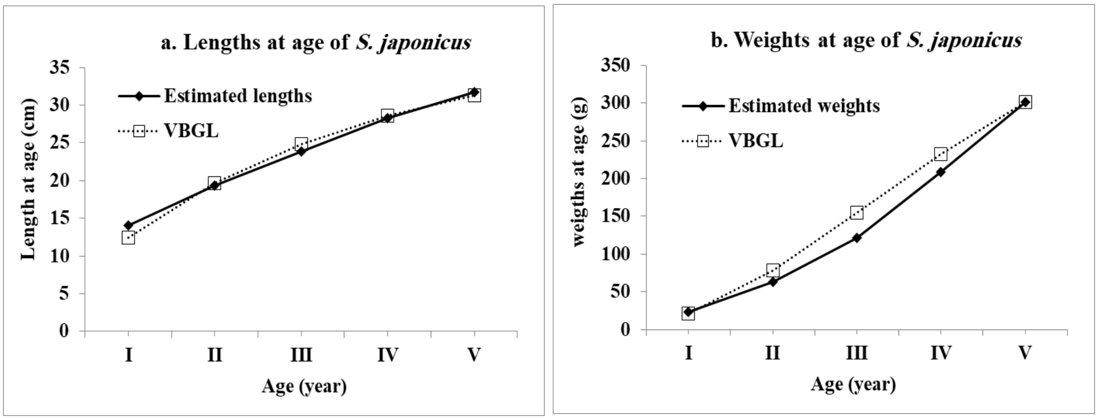

Figure 6, a, b. Estimated and calculated lengths at the age of all samples of *S. japonicus* (a: lengths, b: weights).

DISCUSSION

Growth is the most important characteristic feature and specific for each fish species. Fish growth is also necessary to evaluate several other biological aspects **(Campana, 2001 and Robinson & Motta, 2002).** For applied ichthyological studies, the length-weight relationship is an important parameter in estimating the population growth mode through its value of the slope "b" (**Le Cren 1951).** The present value of (b) was higher than "3," giving a positive allometric model of growth for males, females, and all samples. Different results of *S. japonicus* from several areas are shown in Table 4. The present exponent "b" was almost similar to those calculated by **Rizkall (1998), Santos *et al*. (2002), Mendes *et al*. (2004), Sinovčić *et al*. (2004), Karakulak *et al*. (2006), Bayhan (2007), İşmen *et al*. (2007), Gang *et al*. (2008), Hwang *et al*. (2008), Vasconcelos *et al*. (2011), Cengiz (2012),** and **Jurado-Ruzafa *et al*. (2017).** As it disagreed with those of **Özaydın and Taşkavak (2006), Allaya *et al*. (2013)**, and **Daley (2018),** the b-value of < 3 was considered a negative allometric growth. These differences may be due to variations in habitats, biological, environmental conditions, and geographical variation.

Condition factor (k) is an indicator of the well-being degree and relative robustness of the fish population, which can vary in length, weight, season, and habitat for the same species **(Lagler, 1956).** The present annual average absolute (0.89 ± 0.06) and relative condition (1.01 ± 0.06) were noticed to be around "1" as indications for suitable conditions for the species growing in the Egyptian Mediterranean waters. The present results disagreed with those of **Ghailen *et al*. (2010), Allaya *et al*. (2013), and Bal & Türker (2019)** for absolute conditions (Table 5). The authors in this study reported values higher than the present values. The relative conditions showed the same decreasing trend during the spawning season with a higher value than absolute conditions. The relative conditions were in agreement with those reported by **Langøy *et al*. (2012) and Jurado-Ruzafa *et al.* (2016).** Differences between two indices (absolute and relative) are known in several species. Moreover, differences between values for the same index may be attributed to varied habitats and physiological status and could be influenced by certain extrinsic factors, such as temperature and photoperiod changes **(Samat *et al*., 2008)**. Regarding the fluctuation in conditions during the spawning period, the decline in the present work may correlate with the requirements and energy release through spawning without the need for power to the livers. The present findings during spawning disagreed with those of **Rizkalla (1998)** for the same species at the same habitats, where he reported the minimum condition in August following the end of the spawning season. This difference may be due to different length range used where this study used a wider length range including mature and immature specimens, which played a role in increasing/decreasing the condition during spawning.

Based on the length, the absolute condition increased as the length increased, reflecting the health status of fish following their requirements of fast movement and spawning activity for these large length groups. The relative condition is another indicator of the well-being of species and comparative indices between the same species from different habitats. According to **Le-Cren (1951)**, the values equal to/or greater than "1" reflect good growth conditions. In this study, the values of the mean relative conditions were approximately equal to "1" for all samples, indicating that this species presented good growth mode and condition in its habitats. Moreover, the relative condition illustrated no obvious trend at a certain season for all individuals, indicating good fitness for the year. The study on the growth pattern of *S. japonicus* indicated that their highest increment in length was achieved at the end of the first year of life, after which the annual increment decreased gradually as the age increase until it reached its minimum growth at the end of the 5th year of life. The poor growth rate in length after the first year of life may be associated with the onset of maturity, which often causes discontinuation of the growth curve **(Beverton and Holt, 1957).** The growth performance index is used to compare the growth rate of fish species with other species **(Pauly and Munro, 1984).** Table 4 shows the parameters of *S. japonicus* from different localities. Such differences may be due to different habitats, methods used length range, and number of specimens. The growth performance index (Ø) of 2.68 was higher than some previous studies (**Aguayo & Steffens,1986; Kiparissis *et al.*, 2000 and Cengiz 2012**), but lower than others (**Tuggac, 1957; Mendo, 1984; Perrotta, 1992, Lorenzo *et al.*, 1995, Perrotta *et al.*, 2005, Gang *et al.*, 2008 and Samuel *et al.*, 2016**). Differences in habitats were correlated with increasing age at the high growth performance shown in the table, whereas the present index and others with lower values were slightly similar to the same/lower age groups.

Table 4. Some available studies on length-weight relationship and length range of *S. japonicus* from different localities.

References	Locality and Sampling Gears	Ages(y)	Sex	LT	L_{min}	L_{max}	b	r^2	L∞	k	t_0	Φ'
Tuggac (1957)	Marmara Sea	1 – 7 (Otolith)	Σ	FL	-	-	-	-	33	0.47	-	2.71
Krivospitchenko (1979)	Morocco	-	Σ	-	-	-	-	-	44.1	0.32	-0.83	2.8
Martins and Serrano-Gordo (1984)	Morocco	-	Σ	-	-	-	-	-	51.2	0.2	-1.56	2.72
Mendo (1984)	Peru	1-7 (Otolith)	Σ	FL	-	-	-	-	40.6	0.41	-0.05	2.83
Aguayo and Steffens (1986)	North of Chile	1 – 7 (Otolith)	Σ	FL	-	-	-	-	44.3	0.16	-1.54	2.5
Perrotta (1992)	Argentine Sea	0 – 10 (Otolith)	Σ	TL	-	-	-	-	46	0.28	-1.54	2.77
Lorenzo *et al.* (1995)	Canary Islands	1 – 13 (Otolith)	Σ	-	-	-	-	-	49.2	0.21	-1.4	2.71
Rizkall (1998)	Alwxandria, Medit. Sea, Egypt	1-4 (Vertebrae)	Σ	TL	26	34	♂ 2.73 ♀ 3.086		39.42			
Kiparissis *et al.* (2000)	Hellenic Seas	-	Σ	-	-	-	-	-	47.6	0.15	-2.18	2.53
			♀	-	-	-	-	-	34.5	0.3	-1.53	2.55
			♂	-	-	-	-	-	46.4	0.16	-1.88	2.54
Santos *et al.* (2002)	Algarve coast (southern Portugal) – by all gears Gill net-Longline-Pound net Trammel net-Trap-Trawl	-	Σ	TL	15.1	47.2	3.41	0.98	-	-	-	-

Mendes *et al.* (2004)	Portuguese west coast- by Gill net- Trammel net	-	Σ	TL	19.5	46.4	3.44	0.96	-	-	-	-
Sinovčić *et al.* (2004)	Adriatic Sea (Croatia)- by Beach seine- Purse seine	-	Σ	-	19.6	38.8	3.14	0.91	-	-	-	-
			♀	-	20.1	38.2	3	0.82	-	-	-	-
			♂	-	19.6	38.4	3.25	0.9	-	-	-	-
Perrotta *et al.* (2005)	NE Mediterranean	0 – 9 (Otolith)	Σ	TL	11	39	-	-	-	-	-	-
	SW Atlantic	0 – 7 (Otolith)	Σ	TL	14	45	-	-	44.2	0.32	1.38	2.8
Karakulak *et al.* (2006)	Gökceada Island by Gill net- Trammel net	-	Σ	TL	18.1	31.2	3.1	0.97	-	-	-	-
Özaydın and Taşkavak (2006)	Izmir Bay by Beach seine- Bottom trawl Gill net- Trammel net	-	Σ	FL	12.5	26	2.94	0.98	-	-	-	-
Bayhan (2007)	Izmir Bay Purse seine	1-4 Σ (Otolith)	Σ	FL	12.5	27.2	3.4	0.98	29.8	0.2	-0.36	2.25
			♀	FL	13	27.2	3.41	0.97	27.1	0.26	-0.48	2.28
			♂	FL	12.5	26.2	3.39	0.96	29.6	0.23	-0.39	2.3
İşmen *et al.* (2007)	Saros Bay by Bottom trawl	-	Σ	TL	12.2	22	3.52	0.97	-	-	-	-
Gang *et al.* (2008)	East Chine- Yellow Sea	-	Σ	FL	21.5	41.1	3.2	0.99	40.4	0.49	-0.9	2.9
Hwag *et al.* (2008)	Korea By Purse seine	-	Σ	FL	-	-	3.69	0.97	-	-	-	-
Vasconcelos *et al.*(2011)	NE Atlantic By Purse-seine	0 – 4 (Otolith)	-	TL	13	41.7	3.38	-	-	-	-	-
Cengiz (2012)	Saros Bay by Gill net- Handline- Purse seine	1 – 5 Σ (Otolith)	Σ	TL	13.8	31.1	3.1	0.96	39	0.2	-2.13	2.48
			♀	TL	13.8	31.1	3.12	0.97	37.3	0.22	-1.93	2.49
			♂	TL	15.1	30.8	3.08	0.96	41.4	0.17	-2.37	2.46
Allaya *et al.* (2013)	Tunisian Sea by purse seine, light fishing, gill nets, longlines, pelagic trawl and beach seine).	-	Σ	FL	16.3	31.8	3.02	0.96	-	-	-	-
			♀	FL	17	31.8	2.99	0.97	-	-	-	-
			♂	FL	16.3	27.3	3.07	0.96	-	-	-	-
Samuel *et al.* (2016)	Eastern coastline of Ghana by multifilament fishing gears.	-	Σ	-	-	-	-	-	26.78	1.3	-0.13	2.97
Jurado-Ruzafa *et al.* (2017)	NE Atlantic By trawl	0 to 7 (Otolith)	-	TL	12.4	49	3.46	-	-	-	-	-
Daley (2018)	NW Atlantic	0-7	-	TL	17.7	39.7	2.72	-	33.56	1.75	0.07	-

	By trawl	(Otolith)										
Present study	Alex. Coast, Medi. Sea, Egypt. By night purse seine	1 to 5 Σ (L. frequency)	Σ	TL	12.9	34.4	3.15	0.98	38.11	0.186	-	2.68
				FL	11.8	31.5	3.23	0.99	-	-	-	-
				SL	10.9	29.4	3.19	0.98	-	-	-	-
			♀	TL	18.6	34.4	3.24	0.96	-	-	-	-
				FL	17	31.5	3.21	0.98	-	-	-	-
				SL	15.7	29.4	3.27	0.95	-	-	-	-
			♂	TL	18.6	32.6	3.25	0.98	-	-	-	-
				FL	17	29.8	3.12	0.98	-	-	-	-
				SL	15.7	27.4	3.34	0.97	-	-	-	-

Table 5. The mean absolute and relative conditions of genus *Scomber* from various locations.

References	Area	Sex	Kc	Kn
Ghailen *et al.* (2010)	Gulf of Gabes (Southern Tunisia, Central Mediterranean)	**Σ**	0.92 ± 0.24	-------
		♀	0.93 ± 0.65	------
		♂	0.87 ± 0.45	-------
Allaya *et al.* (2013)	Tunisian waters Mediterranean Sea)	♀	1.15	-------
		♂	1.2	-------
Bal and Türker, (2019)	Sea of Marmara	**Σ**	0.95 ± 0.09	--------
		♀	0.94 ± 0.11	-------
		♂	0.91 ± 0.10	---------
Langøy, *et al.*, (2012)	Water masses in the Norwegian Sea	Σ 2004 Arctic	----------	1.03 ± 0.09
		Σ 2004 Atlantic	----------	1.00 ± 010
		Σ 2004 Coastal	------------	0.99 ± 0.10
		Σ 2006 Arctic	------------	0.96 ± 0.08
		Σ 2006 Atlantic	------------	1.00 ± 0.08
		Σ 2006 Coastal	----------	0.81 ± 0.08
Jurado-Ruzafa *et al*, (2016)	Canary Islands (NE Atlantic, Spain)	Σ 2013	---------	1.003
		Σ 2014	---------	1.021
		Σ 2015	---------	1.006
This study	Alex. Coast, Medi. Sea, Egypt.	Σ	0.89 ± 0.06	1.01 ± 0.08
		♀	0.72 ± 0.05	0.82 ± 0.05
		♂	0.73 ± 0.05	0.82 ± 0.05

CONCLUSION

In conclusion, data on age and growth of chub mackerel fish *S. japonicus* from the Egyptian Mediterranean water showed a positive allometric mode of growth and good condition indices. Furthermore, the estimated age and expected maximum length reflected suitability of habitats of this important species. Monitoring the fishery should be performed for further management.

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