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Age and growth of the needlefish, *Tylosurus imperialis* (Rafinesque, 1810) from the Levantine coast, North-Eastern Mediterranean

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Abstract. The present study is the first to determine the age and growth parameters of the needlefish *Tylosurus imperialis* in the Northeastern Mediterranean. A total of 320 specimens of *T. imperialis* were caught by gill nets from Turkish coasts (Iskenderun Bay) in the Northeastern Mediterranean between October 2020 and September 2021. The maximum age was 5 years for both sexes combined, and the age group 3-4 comprised 77.5 % of the samples. The total length distribution of *T. imperialis* was 60 to 109 cm, and the weight distribution was 309 to 1985 g. The b value was between 3.20 and 3.31 for females and males, respectively. The parameter b from the length-weight relationship characterizes a positive allometric growth. Growth equations were calculated as $W=0.0006xL^{3.2026}$ (R^2= 0.912) for females, $W=0.0004xL^{3.3163}$ (R^2= 0.896) for males, and $W= 0.0005xL^{3.2456}$ (R^2=0.904) for all specimens. Von Bertalanffy growth parameters were L_∞= 139.29 cm, K= 0.119 year^{-1}, t_0= -1.819 year for females, L_∞= 138.50 cm, K= 0.113 year^{-1}, t_0= -1.834 year for males and L_∞= 138.33 cm, K= 0.112 year^{-1}, t_0= -1.839 year for all specimens. The spawning period of *T. imperialis* was determined to be between April and August for both sexes. This data will be useful for the fisheries management of needlefish stocks in our study area and elsewhere.

Keywords: needlefish, growth properties, Iskenderun Bay, Eastern Mediterranean, Türkiye.

Introduction

The needlefish, *Tylosurus imperialis* (Rafinesque, 1810), belongs to the genus *Tylosurus* from the Belonidae family. This genus is currently represented by three species, namely *Tylosurus acus imperialis* (Rafinesque, 1810), *Tylosurus choram* (Rüppell, 1837), and *Tylosurus crocodilus* (Péron & Lesueur, 1821), in the Mediterranean Sea (Collette & Parin 1986, Collette et al. 2015, Froese & Pauly 2024).

The needlefish *T. imperialis* is a marine epipelagic fish species generally distributed in the Eastern Atlantic subtropical waters from the Cape Verde Islands to Morocco and the Mediterranean Sea (Collette & Parin 1990, Golani et al. 2006, Froese & Pauly 2024). In tropical marine waters, it has a depth range of 0 - 10 m (Fricke et al. 2011) and usually swims in small groups or solitarily near the surface zone (Golani et al. 2006). This species feeds mainly on small teleost fishes and crustaceans (Collette 1981, Chaari et al. 2016).

Although the checklist of the marine fishes of Türkiye mentioned *T. imperialis* as *T. acus* (Bilecenoğlu et al. 2002) or *T. acus imperialis* (Fricke et al. 2007) in the Mediterranean Sea and Aegean Sea (Akyol & Kara 2011, Türker Çakır & Zengin 2013) in previous years, *T. imperialis* was mainly accepted as a subspecies of *T. acus imperialis* in the literature (Collette & Parin 1990). However, in recent years, *T. imperialis* has been considered a provisionally accepted name until more scientific works are conducted on *T. acus* subspecies (Froese & Pauly 2024). Based on the phenotypic characteristics and genetic identification of the specimens analyzed in the study, the examined samples were confirmed to be *T. imperialis* by Turan et al. (2025).

There is also little information in the literature about the morphological characteristics of the needlefish, *i.e.*, morphometrics and meristics (Collette & Parin 1986, Bauchot 1987, Bello 1995, Akyol & Kara 2011, Türker Çakır & Zengin 2013, Minos et al. 2015, Zorica et al. 2016, Ketsilinis-Rinis & Koutsidi 2020) in Mediterranean waters.

Age and growth determination of a species provides necessary input data for assessing marine fish stocks and their biology (Hilborn & Walters 1992, Ergüden & Doğdu 2020, Uyan et al. 2024). To date, biological information on *T. imperialis* is very scarce. Data on the distribution, age and growth, mortality, and reproductive biology of the population in certain parts of the Central Mediterranean (Tunisian coast) and from the Suez Canal (Egypt) were provided by Chaari et al. (2014) and Sabrah et al. (2018). Some aspects of sexual maturity and the weight-length relationship of *T. imperialis* in Greek waters (North Aegean Sea) were described by Kokokiris et al. (2014) and Minos & Kokokiris (2015). Also, the diet of *T. imperialis* from the Tunisian coast was studied by Chaari et al. (2016).

In the Northeastern Mediterranean coast along Iskenderun Bay, the needlefish species is mainly caught by purse seiners, a multi-gear fishing fleet, mostly with trammel nets and gill nets. To date, there has been little or no information on the biological parameters of *T. imperialis* in Iskenderun Bay. Therefore, growth and mortality determination of fish species provide important input data for assessing fish stocks and their biology (Hilborn & Walters 1992).

Although the needlefish *T. imperialis* is found in the Central and Eastern Mediterranean Sea and includes Turkish marine coastal waters, there has been no comprehensive study on the growth characteristics of *T. imperialis* from the Turkish coast. Thus, the present study constitutes the first information on the age and growth data of *T. imperialis* from the Northeastern Mediterranean waters.

Materials and methods

Area of study and laboratory processes

A total of 320 needlefish used in this study were collected by a commercial fishing boat from a depth of 1-10 m using gill nets between October 2020 and September 2021 in Iskenderun Bay, the Northeastern Mediterranean Sea. Specimens were placed on crushed ice and transported to the laboratory for further processing. Total length (TL) and total weight (TW), as well as the sex of each fish, were recorded.

The sex and gonadal development of the specimens were determined with a binocular microscope. Sagittal otoliths were used for age determination. Specimen otoliths were cleaned and dried before being embedded in a black plastic labeled mold. The sagittal otoliths were determined by two readers otoliths, being placed in glycerol and examined under a stereo zoom microscope (Olympus SZX-7) equipped with a camera at 10× magnification under reflected light and against a dark background.

Diagnostic characters and characteristic features of needlefish

Dorsal fin rays 20-27; Anal fin rays 18-24; Pectoral fin rays 12-14. Gill rakers are absent on the arch. The number of vertebrae is between 93 and 96 (Collette 2016). The needlefish *T. imperialis* can be distinguished from other needlefish by the following characteristics: Anterior lobes of the dorsal and anal relatively low (respectively 10.5-13.3 and 9.7-11.7 times in body length), and pectoral and pelvic relatively short (respectively 8.0-12.4 and 10.0-14.1 times in body length). Pre-dorsal scales (in front of the dorsal fin) are numerous and tiny, 267 to 430.

Data processing and statistical tests

Length-weight parameters were determined using a power function of $W = a \times L^b$, where W is the total weight in g, L is the total length in cm, a is the intercept, and b is the slope of the linear regressions. The relationship between total length and total weight for all specimens was calculated for males and females separately.

Parameters of linear regressions of length-weight relationship were analyzed with ANOVA (Zar 1999). The parameters a and b were calculated using least-squares regression as the coefficient of determination (R^2).

An estimate of b equal to 3 indicates isometric growth, whereas a greater or lesser value indicates either positive or negative allometric growth, respectively. To verify if the results differed significantly from 3, the b values for each male, female, and total specimens were tested using a *t-test* at the 0.001 significance level. Slopes of the regression lines and mean length for each sex were compared using a *t-test* (Zar 1999).

The sex ratio F: M (Female: Male) in all age groups was tested by a $\chi 2$ independence test.

Von Bertalanffy's (1938) growth parameters were estimated separately for males and females using the FAO-ICLARM Stock Assessment Tools (FISAT II) Software package (Gayanilo et al. 2005). The growth function was of the form $L_t = L_\infty \times [1 - \exp^{-K \times (t - t_0)}]$, where Lt is the total length at age t (years), L_∞ is the average asymptotic total length, K is the growth coefficient, determining how fast the fish approaches L_∞ , and t_0 is the hypothetical age where length is zero. Overall growth performance was estimated by the index Φ' (phi-prime test) (Pauly & Munro 1984), $\Phi' = lnL + 2lnL_\infty$. All calculations were performed using the IBM SPSS Statistics Version 22 Software package.

The Gonadosomatic Index (GSI) was estimated monthly by the equation (Gibson & Ezzi 1978): $GSI = (Wg / We) \times 100$. Wg is the gonad weight, and We is the eviscerated weight.

The total mortality coefficient was calculated as $Z = k(L_\infty - \bar{L}) / (\bar{L} - L_c)$ (Beverton & Holt 1956) where k and L_∞ are the growth coefficient ($year^{-1}$) and asymptotic length (cm), respectively, Lc is the length at which 50% of the fish entering gear are retained, $\bar{L}$ is the mean length of all fishes at and above L.

Results

Of the 320 specimens sampled, 171 (53.44%) were females, and 149 (46.56%) were males. The overall female-to-male sex ratio was 1.00:0.87. The chi-square test (χ^2) showed that the sex ratio was significantly different from the expected 1:1 ratio (χ^2, $P < 0.05$).

Females ranged in total length from 63.0 to 109.0 cm (mean: 79.94±0.67) and males from 60.0 to 105.0 cm (mean: 81.41±0.61). Female and male specimens were present in the largest size classes, but the largest specimen recorded was a female of 109.0 cm, while the largest male sampled had a total length of 105.0 cm (Table 1). Total weight varied from 330.0 to 1985.0 g, with a mean of 787.36 ± 23.54 g for females and from 309.0 to 1835.0 g, with a mean of 818.09 ± 22.43 g for males, respectively (Tables 1 and 2).

Table 1. Descriptive statistic and length-weight relationships for *T. imperialis* from Levantine coast, Northeastern Mediterranean (N: sample size; L, length (cm); W, weight (g); SE: standard error, CI., confidence interval, a: intercept of the relationship, b: slope of the relationship; R^2: coefficient of determination)

		Length (cm)		Weight (g)		Parameters of the L-W relationship			
Sex	N	L_{Min} (Mean±SE)	L_{Max}	W_{Min} (Mean±SE)	W_{Max}	*a*	*b*	*95% CI of b*	R^2
Females	171	63.0 (79.94 ± 0.67)	109.0	330.0 (787.36 ± 23.54)	1985.0	0.0006	3.2026	3.052-3.304	0.912
Males	149	60.0 (81.41 ± 0.61)	105.0	309.0 (818.09 ± 22.43)	1835.5	0.0004	3.3163	3.127-3.506	0.890
All specimens	320	60.0 (80.63 ± 0.46)	109.0	309.0 (806.12 ± 5.47)	1985.0	0.0005	3.2456	3.129-3.362	0.904

Table 2. The number of samples (N), total length (TL, cm), and total weight (W, g) values determined in the present study and previous studies conducted with *Tylosurus* species

References	Species	Location	Number of samples (N)	TL_{min}-TL_{max} Mean TL±SE (cm)	W_{min}-W_{max} Mean TW±SE (g)
Bello (1995)	*T. acus imperialis*	Adriatic Sea	2	87.4-96.5	728.0-1315.0
Akyol & Kara (2011)	*T. acus imperialis*	Aegean Sea, İzmir Bay	2	84.3-107.0	-
Türker Çakır & Zengin (2013)	*T. acus imperialis*	Marmara Sea, Edremit Bay	3	66.5-91.0	319.8-848,4
Chaari et al. (2014)	*T. acus imperialis*	Central Mediterranean, Tunisia	126	29.7-110.5 (80.5 ± 4.4)	20.7 -2.231 (715.4 ± 94.2)
Minos & Kokokiris (2015)	*T. acus imperialis*	North Aegean Sea, Greek waters	112	59.0-111.6	232.0-2054.0
Zorica et al. (2016)	*T. acus imperialis*	Adriatic Sea, off Mjet Island	1	111.4	2048.11
Sabrah et al. (2018)	*T. acus*	Suez Canal, Egyptian coast	210	37.6-77.7 (56.36 ± 8.68)	87.0-687,6 (3136.0 ± 145.6)
	T. choram	Suez Canal, Egyptian coast	169	43.0-94.4 (61.13 ±11.70)	85.1-1600.0 (386.8 ± 283.0)
	T. crocodilus	Suez Canal, Egyptian coast	250	35.6-98.6 (63.18 ± 15.92)	77.2-1950.0 (564.1 ± 425.4)
Ketsilinis-Rinis & Koutsidi (2020)	*T. imperialis*	Ionian Sea, Hellenic waters	4	87.3-108.70	615.0-1413.0
This study	*T. imperialis*	Northeastern Mediterranean, İskenderun Bay	320	60.0-109.0 (80.63 ± 0.46)	309.0-1985.0 (806.12 ± 15.47)

The length-frequency distribution for females and males of *T. imperialis* shows that the catch was composed mainly of specimens between 78.0 and 82.9 cm TL. The highest total length range distribution was observed in 80.0-80.9 cm for females and males (Fig. 1).

The exponent of the *b* parameter of females, males, and all specimens demonstrated positive allometry and showed a statistically significant difference from 3 ($P < 0.05$) (Table 1). A strong correlation was obtained between the length and weight in the female, male, and all specimens ($P < 0.001$; $R^2 > 0.89$) (Table 1 and Table 4).

Length-weight relationship regressions were calculated separately for females, males, and all specimens (Table 1). In our study, length-weight relationships were determined as $W= 0.0006xL^{3.2026}$ ($R^2= 0.912$) in females, $W = 0.0004xL^{3.3163}$ ($R^2= 0.896$) in males, and $W= 0.0005xL^{3.2456}$ ($R^2=0.904$) in all specimens. Length-weight relationships are shown in Fig. 2.
In the present study, the maximum age was determined to be 5 years. Most females were between 3 and 4 years (73.68%), and males were between 3 and 4 years (81.88%). In the female age class, 3 (46.20%) was dominant, followed by 4 (27.48%), 2 (14.62%) classes, 1 (7.02%), and 5 (4.68%) similarly in the male age class, 3 (50.34%) was dominant, followed by 4 (31.54%), 2 (11.41%), 5 (4.02%) and 1 (2.69%) classes (Table 3).

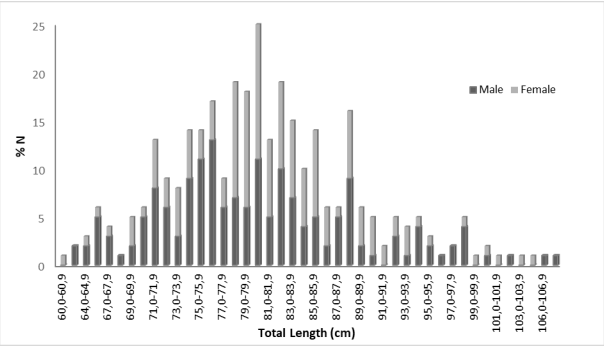

Figure 1. The length frequency distribution for females and males of *T. imperialis* from Iskenderun Bay (Northeastern Mediterranean)

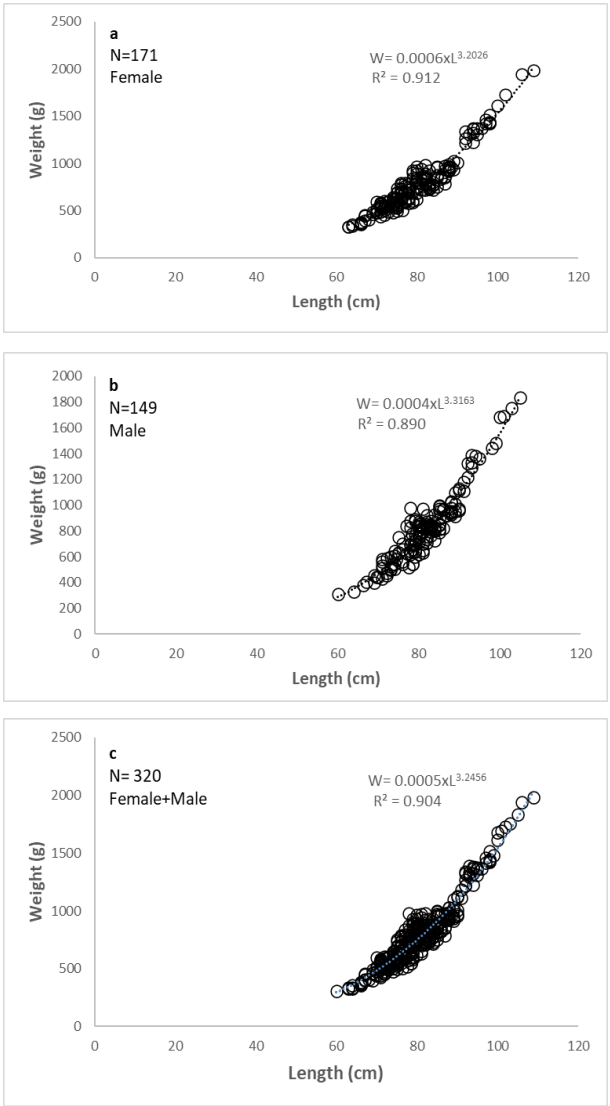

Figure 2. Length-weight relationships of *T. imperialis* from Iskenderun Bay (Northeastern Mediterranean)- a. Female, b. Male, c. Both sexes

Table 3. Age-length structure of *T. imperialis* caught in the Northeastern Mediterranean, Türkiye

Length Intervals (cm)	Age groups					Total
	1	2	3	4	5	
60,0-60,9	1					1
63,0-63,9	2					2
64,0-64,9	4					4
66,0-66,9	6					6
67,0-67,9	3					3
68,0-68,9		1				1
69,0-69,9		5				5
70,0-70,9		6				6
71,0-71,9		13				13
72,0-72,9		9				9
73,0-73,9		8				8
74,0-74,9			14			14
75,0-75,9			14			14
76,0-76,9			17			17
77,0-77,9			9			9
78,0-78,9			19			19
79,0-79,9			18			18
80,0-80,9			25			25
81,0-81,9			13			13
82,0-82,9			19			19
83,0-83,9			6	9		15
84,0-84,9				10		10
85,0-85,9				14		14
86,0-86,9				6		6
87,0-87,9				6		6
88,0-88,9				16		16
89,0-89,9				6		6
90,0-90,9				5		5
91,0-91,9				2		2
92,0-92,9				5		5
93,0-93,9				4		4
94,0-94,9				5		5
95,0-95,9				3		3
96,0-96,9				1		1
97,0-97,9				2		2
98,0-98,9					5	5
99,0-99,9					1	1
100,0-100,9					2	2
101,0-101,9					1	1
102,0-102,9					1	1
103,0-103,9					1	1
105,0-105,9					1	1
106,0-106,9					1	1
109,0-109,9					1	1
Total	16	42	154	94	14	320
Percentage (%)	5.0	13.12	48.12	29.38	4.38	100
Females (% n)	12 (7.02)	25 (14.62)	79 (46.20)	47 (27.48)	8 (4.68)	171 (100)
Males (% n)	4 (2.69)	17 (11.41)	75 (50.34)	47 (31.54)	6 (4.02)	149 (100)
F: M	1:0.33	1:0.68	1:0.95	1:1	1:0.75	1:0.87

Table 4. Summary of length-weight relationship parameters of needlefish species from different areas (F: Females, M: Males)

Author(s)	Species	Sex	Location	*N*	*a*	*b*	R^2	Growth type
Crawford (1993)	*T. acus*	F+M	Florida, USA	-	0.0025	3.000	-	Isometry
Claro & García-Arteaga (1994)	*T. crocodilus*	F+M	Cuba	-	0.0013	3.080	-	Allometry (+)
Letourneur et al. (1998)	*T. crocodilus*	F+M	New Caledonia	-	0.0008	3.205	-	Allometry (+)
Kulbicki et al. (2005)	*T. crocodilus*	F+M	New Caledonia	-	0.0006	3.285	-	Allometry (+)
Minos & Kokokiris (2015)	*T. acus imperialis*	F	Aegean Sea, Greece	31	0.0008	3.119	0.97	Isometry
		M		81	0.0003	3.319	0.96	Allometry (+)
		F+M		112	0.0003	3.308	0.97	Allometry (+)
Chaari et al. (2014)	*T. acus imperialis*	F	Central Mediterranean, Tunisia	54	0.0027	2.832	-	Allometry (-)
		M		72	0.0026	2.827	-	Allometry (-)
Sabrah et al. (2018)	*T. acus*	F+M	Suez Canal, Egypt	210	0.0005	3.260	0.944	Allometry (+)
	T. crocodilus	F+M	Suez Canal, Egypt	250	0.0007	3.210	0.956	Allometry (+)
This study	*T. imperialis*	F+M	Northeastern Mediterranean, Iskenderun Bay, Türkiye	320	0.0005	3.245	0.904	Allometry (+)

The mean length of specimens from each age group was used to fit the von Bertalanffy growth parameters for males, females, and both sexes (Fig. 3). Von Bertalanffy growth parameters were calculated as L_∞ = 139.29 cm, k = 0.119 year^{-1}, t_0 = -1.819 years for females; L_∞ = 138.50. cm, k = 0.113 year^{-1}, t_0 = -1.834 years for males; L_∞ = 138.33 cm, k = 0.112 year^{1}, t_0 = -1.839 years for all specimens. The estimated von Bertalanffy parameters are presented in Table 5. The growth performance index (Φ') was estimated for females, males, and both sexes as 3.335, 3.363, and 3.331, respectively (Table 5).

The GSI results revealed that the spawning period of needlefish *T. imperialis* from the Northeastern Mediterranean coast (Iskenderun Bay) appeared to be from April to August, with a peak in July (Fig. 4). The GSI value shown for males in Figure 4 is lower than for females.

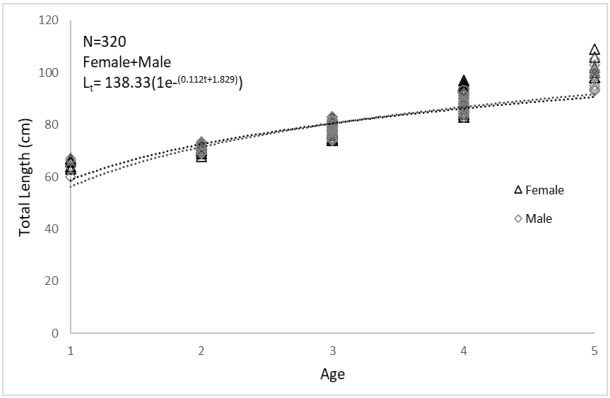

Figure 3. Growth of *T. imperialis* from Iskenderun Bay (Northeastern Mediterranean)

Table 5. Summary of growth parameters of needlefish species from different geographical areas

Author(s)	Species	Sex	Location	*N*	L_∞	*K*	t_0	Φ'
Chaari et al. (2014)	*T. acus imperialis*	Female	Central Mediterranean, Tunisia	54	123.78	0.20	-2.28	3.49
		Male		72	92.28	0.50	-1.16	3.63
		F+M		126	122.03	0.20	-2.49	3.47
Sabrah et al. (2018)	*T. acus*		Suez Canal, Egypt	210	79.85	0.44	-0.58	3.45
	T. crocodilus			250	113.0	0.30	-0.46	3.58
This study	*T. imperialis*	Female	Northeastern Mediterranean, (Iskenderun Bay), Türkiye	171	139.29	0.119	-1.819	3.33
		Male		149	138.50	0.113	-1.834	3.36
		F+M		320	138.33	0.112	-1.829	3.33

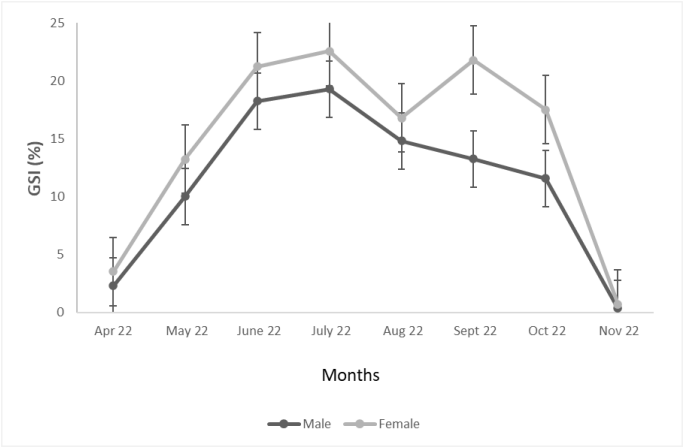

Figure 4. Monthly average GSI values for females and males of *T. imperialis*

Discussion

Previous data on the population structure of *T. imperialis* in the Mediterranean Sea and Suez Canal have been very scarce (Chaari et al. 2014, Sabrah et al. 2018). The present data is important in revealing the status of the needlefish stock in our study area and providing the opportunity to compare with needlefish species in other regions.

The female-to-male sex ratio was determined as 1.00:0.87 in this study. Female specimens dominated the needlefish population from Iskenderun Bay (Northeastern Mediterranean). Similarly, Chaari et al. (2014) reported that the *T. a. imperialis* population from the Tunisian coast (Central Mediterranean) has a male-to-female ratio of 1.00:0.75. Zorica et al. (2011) stated that possible reasons for needlefish sex ratio fluctuation in size may be sexual dimorphism, gear selectivity, sampling strategies, and spawning migrations.

In the present study, the total length range of the needlefish determined that females are larger than males (Table 1). Similarly, Chaari et al. (2014) stated that the length range was smaller for males than for females for the *T. a. imperialis* population. However, our data showed a slightly lower length range than previous studies conducted in the Mediterranean Sea (Akyol & Kara 2011, Chaari et al. 2014) and Aegean Sea (Minos & Kokokiris 2015, Ketsilinis-Rinis & Koutsidi 2020). Nevertheless, the length range was higher than those reported from the Adriatic Sea (Bello 1995), Suez Canal (Sabrah et al. 2018), and Marmara Sea (Türker Çakır &

Zengin 2013) (Table 2). The length and weight values determined in studies conducted with *Tylosurus* species in previous years are given in Table 2. Differences in length composition between various geographical regions and within regions may be due to different age classes and growth periods

The age compositions determined were 1 to 5 years in the present study (Table 3). Similarly, Sabrah et al. (2018) mentioned that the age range of *T. acus* specimens from the Egyptian coast and Suez Canal ranged from 1 to 5 years. Chaari et al. (2014) reported the age range of *T. a. imperialis* specimens they examined on the coast of Tunisia (Central Mediterranean) as 0-6. However, Chaari et al. (2014) determined 0 and 6 years of age in only one female specimen. For male specimens, they reported the age range to be 2-4 years.

Our result was that length-weight relationship equations were greater than 3, and positive allometric growth was detected (Table 1). The slopes (*b* values) of the length-weight regressions were significantly different between sexes (*t-test, p<0.05*). A comparison between the length-weight relationships summarized in the present study and those from previous studies is presented in Table 4. Similar to our results, Sabrah et al. (2018) estimated the length-weight relationship for *T. acus* as b = 3.260. They reported positive allometric growth from the Suez Canal in Egypt, which is consistent with the present study's findings. At the same time, Minos and Kokokiris (2015) stated a positive allometric *b* value for *T. a. imperialis* along the coast of Greece. However, Chaari et al. (2014) reported negative allometric growth for the species along the Tunisian coast. A survey of the extant literature reveals a preponderance of studies identifying a positive allometric trend in length-weight relationships (see Table 4).

Von Bertalanffy growth parameters calculated in this study indicate that males grew slower than females, which has also been reported for fish of the same genus (Table 5). Similar results were obtained in a previous study of *T. a. imperialis* in the Central Mediterranean Sea, Tunisia (Chaari et al. 2014), and the Suez Canal, Egypt (Sabrah et al. 2018). The results reported on the growth parameters of von Bertalanffy for different *Tylosurus* species show some differentiations (Table 5), which can be attributed to temporal and geographical variations. According to Wootton (1990), fish populations of needlefish species from different geographical regions may exhibit highly variable specimen growth rates.

In this study, the calculated *Φ' value* for females was slightly higher than for males, so females grew relatively faster than males. However, females of *T. a. imperialis* from Tunisian coast had a slower growth rate (*Φ' = 3.49*) than males (*Φ' = 3.63*) (Chaari et al. 2014) for the, determined that. Results from our study show that *T. imperialis* is a fast-growing species that cannot live for a long time like other *Tylosurus* species. Sabrah et al. (2018) found similar growth values for *T. acus* (*Φ'= 3.45*) and for *T. crocodilus* (*Φ'= 3.58*) along the coast of Egypt (Table 5). Santic et al. (2002) mentioned that factors affecting growth parameters of the population are size, nutritional quality, and the effect of water temperature. These factors can be considered important for the growth of this species in this region.

Our results show that the needlefish *T. imperialis* had a spring-summer spawning period (May- June- July). Bauchot (1987) and Chaari et al. (2014) stated that *T. a. imperialis* populations spawn in the Mediterranean in the summer. Bello (1995) found that the spawning period for other *Tylosurus* species on the southwestern Adriatic coast is also in the summer. Sabrah et al. (2018) reported that the spawning period of the needlefish species *Tylosurus acus* and *Tylosurus crocodilus* along the Egyptian coast (Suez Canal) occurs in spring. Similarly, Liao and Chang (2011) conducted a study on *T. acus* along the southwestern coast of Taiwan, determining that the spawning period extends from April to August, with a peak in June. The present study's findings are consistent with the aforementioned studies and observations made on other *Tylosurus* species.

There are no comprehensive bio-ecological studies on this species in the Northeastern Mediterranean Sea. Thus, data on age, growth, and reproduction of *T. imperialis* presented here are of great importance and will be useful for fisheries management of needlefish stocks in the Eastern Mediterranean basin.

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