Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 26 (4): 1039 – 1051 (2022)
www.ejabf.journals.ekb.eg

Age Composition, Growth and Mortality of Spotted Weever (*Trachinus araneus*- Cuvier, 1829) and Greater Weever (*Trachinus draco*- Linnaeus, 1758) from the Western Egyptian Mediterranean Sea

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ARTICLE INFO
Article History:
Received: July 19, 2022
Accepted: Aug. 2, 2022
Online: Aug. 24, 2022

Keywords:
Trachinus araneus,
Trachinus draco,
Age,
Growth,
Mortality,
Western Egyptian Mediterranean Sea

ABSTRACT

The present study addressed the age composition, growth and mortality of spotted weever *Trachinus araneus* (Cuvier, 1829) and the greater weever *Trachinus draco* (Linnaeus, 1758). A total number of 536 *T. araneus* and 460 *T. draco* samples were collected from the Western Egyptian Mediterranean Sea using the bottom trawl during the period from August 2018 to August 2019. Total lengths ranged from 10.9-30.0 cm and from 11.8 to 27.6 cm for *T. araneus* and *T. draco*, respectively. The calculated length–weight relationship showed a negative allometric growth pattern for the two species (males, females and total samples). In the present study, *T. araneus* reached six years, while *T. draco* had only five years. The von Bertalanffy Growth parameters for the total samples were L_∞ = 32.55 cm, W_∞ = 210.6 g, k = 0.41 y^{-1}, t_o = -2.55 y for *T. araneus*, and L_∞ = 27.3 cm, and W_∞ = 147.16 g, k = 0.5 y^{-1}, t_o = -3.29 y for *T. draco*. The growth performance index (Φ) was 2.64 and 2.727 for *T. araneus* and *T. draco*, respectively. Total, natural and fishing mortality rates were 0.803, 0.761, 0.042 for *T. araneus* and 0.931, 0.835, 0.096 for *T. draco*. For the exploitation rate, E = 0.052 and 0.103 for *T. araneus* and for *T. draco*, respectively, which indicates that the stock of these species is unexploited in the Egyptian Mediterranean Sea.

INTRODUCTION

The spotted weever *Trachinus araneus* (Cuvier, 1829) and the greater weever *Trachinus draco* (Linnaeus, 1758) are venomous species belonging to family Trachinidae that are widely distributed on the eastern Atlantic coastline, Mediterranean, Aegean and Black Seas **(Turan, 2007)**; present mainly on sandy or muddy substrate at depths ranging from 15 to 150m **(Frosese and Pauly, 2007)**. They feed on small invertebrates and fish **(Morte *et al.*, 1999)**. However, these species are found in the bycatch and have no commercial value; they are interring in the food chain equilibrium and ecosystem balance. Moreover, as result in the decline in the fishery products, the human demands for a protein of high value needs a renewability of fish resources i.e., using of the by-catch ones (Trachinidae) **(Portillo *et al.*, 2008)**. Very limited studies are available about *T. araneus.* **Hamed and Chakroun (2016)** studied its morphometric characteristics;

Heneish and Rizkalla (2021) studied its biometric characters. On the other hand, many authors studied some aspects about *T. draco* such as length-weight relationship **(Dorel, 1986; Coull *et al.*, 1989; Dulčić and Kraljević, 1996; Gonçalves *et al.*, 1997; Merella *et al.*, 1997; Abdallah, 2002; Moutopoulos and Stergiou, 2002; Mendes *et al.*, 2004; Karakulak *et al.*, 2006; Sangun *et al.*, 2007; Kınacigil *et al.*, 2008; Ak *et al.*, 2009)**. In addition, species distribution **(Nelson, 1994)**, feeding aspects **(Morte *et al.*, 1999)**, growth **(Bagge, 2004; Ak and Genç, 2013; Buz and Basusta 2015; Hamed and Chakroun, 2017)** were addressed. Furthermore, eggs and larvae distribution **(Dehnik, 1973; Ferreiro and Labarta, 1988; Yüksek, 1993; Ak and Hoşsucu, 2001; Rodriguez *et al.*, 2001; Satılmış, 2001; Çoker, 2003; Ak, 2004; Ak, 2009; d'Elbée *et al.*, 2009)** were evaluated.

The present study aimed to shed the light on some biological aspects of the *T. araneus* and *T. draco* for the first time in the Western Egyptian Mediterranean Sea as they have very important ecological role.

MATERIALS AND METHODS

A total of 536 *T. araneus* and 460 *T. draco* samples were monthly collected from the Western Egyptian Mediterranean Sea using the bottom trawl from August 2018 to August 2019 **(Fig.1)**. For each specimen, the total length (TL, ≈0.1 cm) and the total weight (W, ≈0.01 g) were measured. Lengths of the individuals were classified in 1 cm group intervals. The sex was recorded and the data were used to draw annual length frequency diagrams for the two species (male, female, total sample).

Fig. 1. Map of the study area, the Western Egyptian Mediterranean Sea.

The length weight relationship for each species was estimated by using the power equation: W= aL^b **(Ricker, 1975)**, Where, "W" is the total weight in g, "L" is the total length in cm, "a" and "b" are constants according to **Snedecor (1956)**.

The modal progression analysis (MPA) **(Bhattacharya, 1967)** was used to separate length groups from modal distribution curves. Differences in mean lengths at the age obtained from the different models were tested using Tukey's multiple comparison test **(Zar, 1984)**.

The **von Bertalanffy (1938)** growth model was used to fit growth curve to the length frequency data. The von- Bertalanffy growth parameters: asymptotic length (L_∞), the growth coefficient (K) and the theoretical age at length zero (t_o) were estimated using ELEFAN I program **Pauly (1984) and Wetherall's (1986)** method implemented by FISAT II Program. The asymptotic weight "W∞" was derived from the growth in length by applying the length- weight relationship.

The growth performance index was calculated by the following equation ($\Phi = \log_{10} K + 2 \log_{10} L_\infty$) according to **Pauly and Munro (1984)**.

The instantaneous total mortality rate (Z) was estimated by two methods depended on the length composition as follows: The method of **Beverton and Holt (1956)** which is expressed as follows**:** Z= K {(L∞ - ḸĹ)/ (ḸĹ - Ĺ)} Where Ḹ is the mean length of fish of length L′ and larger; L′ is a length such that all fish of that length and larger are fully selected by the fishery, and the method of **Ault and Erhardt (1991)** which is expressed as follows: Z= {(L- Lmax)/ (Ḹ- L')}Z/K, where, L_∞ is the asymptotic length, K is the growth coefficient, the cut-off length (L'), the mean length (Ḹ) and the maximum length (L_{max}).

The estimation of fishing mortality was F = Z – M, where M is the natural mortality rate which was obtained by using, the formula of **Rikhter and Efanov (1976)** as**:** M= {1.521/t_{mass}.0.72} - 0.155, where t_{mass}: is the massive maturation, and by the **Pauly (1984)** Empirical equation as**:** $\log M = -0.0066 – 0.2790 \log L_\infty + 0.6543 \log K + 0.4634 \log T$, where L_∞: is the asymptotic Length, K: Growth coefficient, and T: the average annual sea surface temperature of Mediterranean waters. (T = 16.5 ^oC). the exploitation rate (E) was calculated using the expression: E = F/Z, **(Gulland, 1971)**.

RESULTS

1. Frequency

The total length of *T. araneus* ranged between 10.9 - 30.0 cm, with mean length of 19.87 ± 5.43 cm. The most abundant length intervals lay between 16.0 to 23.9 cm, constituted the highest percentage 72.56 % of the total samples. The terminal lengths from 24.0 cm to 30.0 cm contributed 18.23%, while the length groups (10.9-15.9) represented 9.21% of the total sample (**Fig.2).**

On the other side, **Fig. 2** clarify that the *T. draco* total length ranged from 11.8 to 27.6 cm with an average length of 17. 85±4.23 cm. Where, the most abundant length groups were between 15 cm and 21.9 cm with high percentage of 82.51 %. The terminal lengths from 22.0 cm to 27.6 cm contributed 11.45%. While, the length groups from 11.9 and 14.9 cm represented by 6.26% of the total sample.

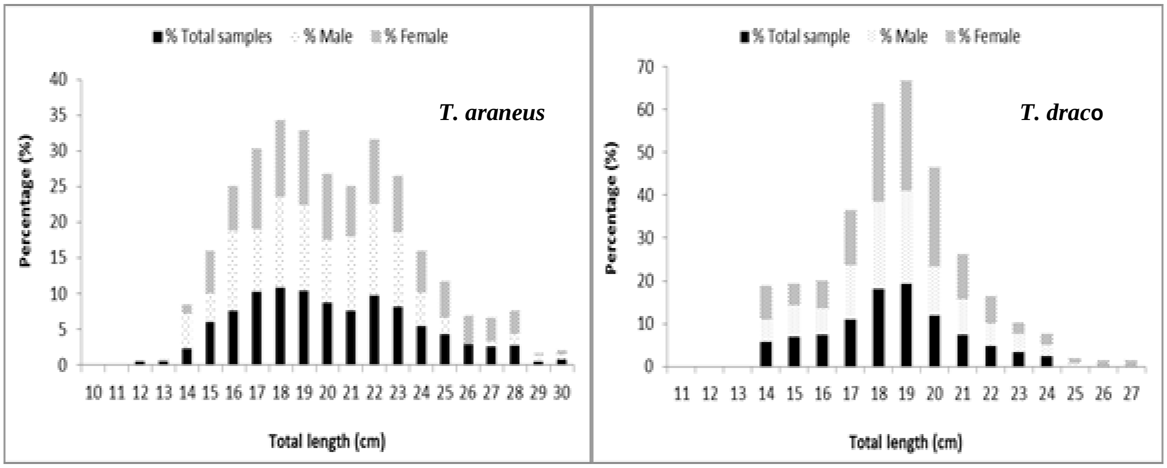

Fig. 2 Length frequency distribution for females, males and total samples of *T. araneus* and *T. draco* from the Egyptian Mediterranean Sea.

2. Length- weight relationship (LWR)

536 specimens of *T. araneus* were collected from the Western Egyptian Mediterranean Sea, contains 390 females, 136 males and 10 unsexed; the total length ranged from 10.8 cm to 30.0 cm, while the weight ranged from 11.0 to 157.0 g. Otherwise, 460 specimens of *T. draco* consist of 102 females, 346 males and 12 unsexed; the total length ranged from 11.8 cm to 27.6 cm, while the weight ranged from 11.0 to 157.0 g.

Table 1 and Fig. 3 clarified that the length- weight relationship constant "b" value is less than "3" indicating negative allometric growth pattern for the two species. This means that, the fish increase on length by a higher rate than its growth in weight.

Table 1. *T. araneus* and *T. draco* length-weight relationship parameters from the Western Egyptian Mediterranean Sea.

Species	Sex	No.	Length range (cm)	Weight range (gm)	a	b	r
T. araneus	Male	136	14- 27	19- 127	0.0072	2.9503	0.9806
	Female	390	13.9- 30	18- 158	0.0073	2.9544	0.9718
	Total	536	10.9- 30	11- 157	0.0075	2.941	0.9746
T. draco	Males	346	11.8- 25	10- 95	0.0072	2.9477	0.9547
	Female	102	14- 27.6	17- 116	0.0062	2.9926	0.9816
	Total	460	10.8- 27.6	10- 116	0.0068	2.9629	0.9616

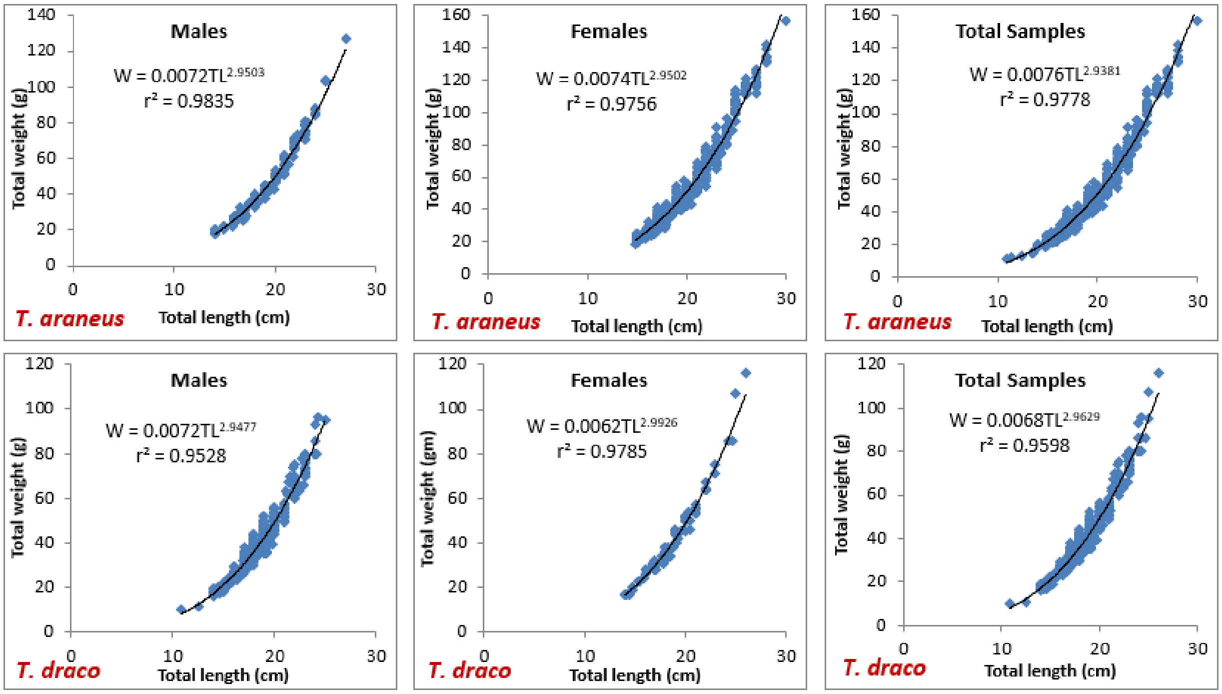

Fig. 3. *T. araneus and T. draco* length-weight relationship from the Western Egyptian Mediterranean Sea.

3. Age and growth

T. araneus reached to six years (ranging from I to VI years) where *T. draco* have only five years (ranging from I to V years). For the two species it was clear that the age group II and III were the most dominant age groups in the fishery (**Table 2)**. Growth parameters calculated according to the von Bertalanffy Growth Equation for all samples were L_∞ = 32.55 cm, W_∞ = 210.6 g, k = 0.41 y^{-1}, t_o = -2.55 y for *T. araneus*, and L_∞ = 27.3 cm, and W_∞ = 147.16 g, k = 0.5 y^{-1}, t_o = -3.29 y for *T. draco* **(Table 3).** The growth performance index (Φ) was 2.64 and 2.727 *T. araneus* and for *T. draco*, respectively.

Table 2. *T. araneus and T. draco* mean length, standard division, population number and separation index (S.I.) for each age group estimated by Bhattacharya method

T. araneus						***T. draco***					
Age Group	**Length**	**Increment**	**S.D.**	**Population No.**	**S.I.**	**Age Group**	**Length**	**Increment**	**S.D.**	**Population No.**	**S.I.**
I	12.48	12.48	2.060	64	n.a.	I	12.53	12.48	2.010	34	n.a
II	18.05	5.57	1.820	242	2.870	II	18.61	6.08	0.750	213	1.940
III	22.49	4.44	1.140	129	3.000	III	22.46	3.85	1.370	145	2.230
IV	25.44	2.95	0.850	56	2.960	IV	24.49	2.03	1.540	65	2.100
V	27.67	2.23	0.650	41	2.970	V	25.5	1.01	0.750	3	2.090
VI	29.50	1.83	0.960	4	2.270						

Table 3. *T. araneus and T. draco* von Bertalanffy Growth parameters (K, L_∞, W_∞, t_o) and growth performance from the Western Egyptian Mediterranean Sea.

Parameters \ Species	*T. araneus*	*T. draco*
K	0.41	0.5
L_∞	32.53	29.05
W_∞	210.16	147.16
t_o	-2.55	-3.29
Φ	2.64	2.27

4. Mortalities and exploitation rates

Table 4 shows the instantaneous rate of natural mortality (M) that estimated by different methods with mean values "M" 0.761 and 0.835 year^{-1} for *T. araneus and T. draco*, respectively. Otherwise, total mortality (Z) extracted from different methods with mean values 0.803 year^{-1} for *T. araneus* and 0.931 year^{-1} *T. draco*. The fishing mortality (F) estimated by substraction of Z and M, was 0.042 and .096 year^{-1} for *T. araneus and T. draco*, respectively. The evaluated exploitation rate (E) was 0.052 for *T. araneus* and 0.10 for *T. draco*.

Table 4. *T. araneus and T. draco* (Natural mortality- total mortality) estimated by different methods, fishing mortality and exploitation rate from the Western Egyptian Mediterranean Sea

Parameters \ Species	Method	*Species*	
		T. araneus	***T. draco***
M	Rikhter and Efanov's	0.760	0.760
	pauly's M equation	0.761	0.910
Mean of values (M)		0.761	0.835
Z	Beverton and Holt model	0.823	0.946
	Ault & Ehrhardt method	0.783	0.916
Mean of values (Z)		0.803	0.931
F		0.042	0.096
E		0.052	0.103

DISCUSSION

Age and growth are very important tools for the fisheries development and management as they contribute in the estimation of the production, stock size, recruitment and mortality of a fish population (**Maceina and Sammons, 2006**). Furthermore, accurate determinations for the age and growth help us to understand the fisheries biology and successful management of the most economical fish species, in addition to, use for comparisons of life histories of a certain species between different regions (**Binohlan and Pauly 1998; Hurley *et al.*, 2004; LaBay and Lauer, 2006**).

Length-weight relationship is needed to appreciate the suitability of the environment for fish and plays an important role in fishery management (**Richter *et al.*, 2000**).

Table 5 in the current study represent (*T. araneus* and *T. draco*) length range and length weight relationship compatible with that recorded in other regions by several authors. The present result of *T. araneus* and *T. draco*, males; females and total samples "b" values are within the expected range 2.3-3.5 proposed by **Bagenal and Tesch (1978); Koutrakis and Tsikliras (2003**) and showing a negative allometric growth (b< 3). The variation in the (b) value between our results and some of the other areas could be related to the differences in the sampling area or differences in the samples length range as well as the variation in the environmental conditions **(Le Cren, 1951; Weatherley and Gill, 1987).**

Table 5. *T. araneus and T. draco* length range and length weight relationship in the present study compatible with that recorded in other regions by several authors.

Author	Area	Sex	No.	L (min-max)	a	b
Dorel (1986)	Bay of Biscay, France	All	176	7.0-38.0	0.00927	2.874
Dulčić and Kraljević (1996)	Eastern Adriatic	All	22	9.2-26.8	0.0213	2.934
Merella *et al.* (1997)	Balearic Islands, Spain	All	14	9.6-24.2	0.0074	2.930
Gonçalves *et al.* (1997)	South coast, Portugal	All	497	14.0-34.0	0.0164	2.930
Stergiou and Moutopoulos (2001)	Greece	All	85	14.5-32.0	0.00441	3.120
Abdallah (2002)	Mediterranean Sea, Egypt	All	170	10.0-23.0	0.0114	2.800
Mendes *et al.* (2004)	Portugal	All	65	22.0-36.8	0.0035	3.173
Karakulak *et al.* (2006)	Gökceada Island, Turkey	All	32	4.4-35.2	0.0243	2.578
İsmen *et al.* (2007)	Saros Bay, Turkey	All	1025	15.0-37.0	0.00366	3.202
Sangun *et al.* (2007)	Mediterranean, Turkey	All	54	9–20	0.0052	3.090
Kınacigil *et al.* (2008)	Aegean Sea, Turkey	All	94	15.3-36.6	0.005	3.137
		Female	52		0.004	3.138
		Male	36		0.004	3.211
Gökçe *et al.* (2010)	Mediterranean Sea, Turkey	All	2	20,6	0.0064	2.997
Ak and Genç (2013)	Black Sea	All	336	5-25.8	0.0069	3.005
		Female	306	10-25.8	0.0064	3.033
		Male	319	5-22.5	0.0079	2.952
Hamed and Chakroun (2016)	Gulf of Tunis, Tunis	All	314	10-32	0.0063	3,009
Present study (*T. araneus*)	Mediterranean Sea, Egypt	All	536	10.9-30	0.0075	2.941
		Female	390	13.9-30	0.0073	2.9544
		Male	136	14-27	0.0072	2.9503
Present study (*T. draco*)	Mediterranean Sea, Egypt	All	448	11.8-27.6	0.0064	2.9629
		Female	102	14-27.6	0.0062	2.9926
		Male	346	11.8-25	0.0072	2.9477

In the present study, six age groups "from I to VI" years were identified for *T. araneus* and five age groups "from I to V" years were observed in *T. draco*. Comparable to the previous studies there is no information about *T. araneus* age or growth parameters and mortality rate, otherwise, few studies were carried out by several authors for *T. draco* (**Table 6)**. The differences occurs between each region and the other, may be attributed to the variations in the food abundance, the difference in size composition of the stock or other environmental and ecological factors (**Naish *et al*., 1991**; **Beckman and Wilson, 1995**).

Table 6. *T. araneus and T. draco* Von Bertalanffy growth parameters in the present study compatible with that recorded in other regions by several authors.

Author	Area	Sex	No.	L_∞	W_∞	K	t_o	ϕ
Bagge (2004)	Kattegat waters (Denmark)	All Female Male	- - -	- 38.30 35.10	- 370.20 278.90	- 0.15 0.16	- -1.08 -0.51	- - -
Ak and Genç (2013)	Black Sea (Turkey)	All Female Male	319 306 636	28.62 29.31 32.62	164.55 232.5 180.21	0.28 0.18 0.17	-0.89 -1.74 -2.28	2.364 2.298 2.76
Buz and Başusta (2015)	Iskenderun Bay North-eastern Mediterranean Sea	All Female Male	245 287 532	46.45 43.99 40.27	- - -	0.076 0.087 0.099	-3.29 -3.04 -2.80	- - -
Present study (*T. draco*)	Mediterranean Sea, Egypt	All	448	46.45	147.16	0.076	-3.29	2.27
Present study (*T. araneus*)	Mediterranean Sea, Egypt	All	536	46.45	210.60	0.076	-3.29	2.64

The instantaneous rate of natural mortality (M = 0.761 $year^{-1}$ for *T. araneus* & 0.835 $year^{-1}$ for *T. draco*) is a little bit lower than the instantaneous rate of total mortality (Z = 0.803 $year^{-1}$ for *T. araneus* and 0.931 $year^{-1}$ for *T. draco*). These results gives very insignificant fishing mortality rate (F = 0.042 $year^{-1}$ for *T. araneus* & 0.096 $year^{-1}$ for *T. draco*) and exploitation rate (E= 0.052 for *T. araneus* & 0.103 for *T. draco*. This means that there is no fishing pressure on *T. araneus* and *T. draco* as a by-catch species, and their stock is unexploited. This results is in accordance with that reported by **Hamed *et al.* (2019)** for *T. araneus* in the Gulf of Tunis where, the natural mortality rate (M) = 0.429 $year^{-1}$, total mortality rate (Z) = 0.453 $year^{-1}$, fishing mortality rate (F) = 0.024 $year^{-1}$ and exploitation rate (E) = 0.053.

CONCLUSION

The fishing pressure on *T. araneus* and *T. draco* as a by-catch species and their stock is null. More studies need for the fish resources renewability *i.e.,* using of the by-catch ones (Trachinidae) as the human demands for protein of high value increase where the fishery productivity decline.

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