

Studying of Some Biological Characteristics of Horse Mackerel *Trachurus trachurus* (Linnaeus, 1758) in Syrian Waters (Eastern Mediterranean)

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Abstract— The aim of this study was to estimate the age, the growth rate and the length – weight relationship of Horse Mackerel (*T.trachurus*). Around 401 individuals of this species were collected and analyzed from two sites of the Syrian Coast: with 198 individuals from the Ras Albasit and 203 individuals from the Burj Islam. The standard lengths of individuals in samples were 11.4-25.4 cm with average of 17.71 ± 2.76 cm, and weights were 23.53 - 301.03g with average of 111.23 ± 36.52 g. Age was estimated by the scales, applied length-weight relationship: $W = a \times L^b$ and used Von-Bertalanffy growth equation : $L_t = L(1 - e^{-k(t-t_0)})$ to estimate (L, K). Age ranged from (1- 4) years.

In Ras Albasit:

The length – weight relationship was estimated for female: $b = 2.87$ (N=104), $R^2 = 0.87$, and for male: $b = 2.79$ (N = 94), $R^2 = 0.93$. The whole sample: $b = 2.78$ (N=198), $R^2 = 0.89$ indicating that allometric growth and relationship are strong positive.

In Burj Islam:

The length – weight relationship was estimated for female: $b = 2.88$ (N=109), $R^2 = 0.84$, and for male: $b = 2.94$ (N=94), $R^2 = 0.95$. The whole sample: $b = 2.90$ (N=198), $R^2 = 0.89$ indicating that allometric growth and relationship are strong positive. Growth parameters for female: $L = 35.51$ cm, $K = 0.18$; for male: $L = 34.58$ cm, $K = 0.18$. The whole sample: $L = 34.88$ cm, $K = 0.17$ were calculated **In Ras Albasit** and in addition **in Burj Islam** $L = 32.46$ cm, $K = 0.18$; Male : $L = 33.05$ cm, $K = 0.18$; whole sample: $L = 33.57$ cm, $K = 0.17$.

Keywords— *Trachurus trachurus*, Age, Growth, Length – weight, Syrian marine waters

I. INTRODUCTION

Horse mackerel *Trachurus trachurus* (L.1758) is distributed throughout the eastern Atlantic ocean, the Mediterranean and Black Seas [1], [2] and it is a member of the large family (Carangidae) which includes many important commercial species worldwide [3]. The biology of this species has been well documented by numerous studies in the Mediterranean Sea [3], [4], [5], [6], [7], [8], but there is only one study about its biology in Syria (Lattakia Coast) which is for [9]. The *T. trachurus* is one of the marine economic fish in the Syrian coast [10]. It feeds on a wide spectrum of foods, reached up to twenty species belonging to four major groups, namely: Fish, Crustaceans, Molluscs and Annelids. The fishes had occupied the first order (with 12 species; the species *Bregmaceros nectabanus* was the most abundant with 363 individuals), followed by crustaceans (7 species; the most frequent one was *Athanas neithescens*) while the molluscs and worms were each represented by one species [11].

This paper is a contribution to the knowledge of age, growth and length – weight relationship of horse mackerel collected from Syria in the eastern Mediterranean.

II. MATERIALS AND METHODS

A total of 401 horse mackerel individuals were caught from July 2018 to June 2019 in rate of twice monthly via the Purse seines net at depths of 100 m, taken from Ras Albasit (35°51'N, 35°48'E) and Burj Islam (35°40'N, 35°45'E) (Fig 1). The standard length (SL) and the total weight (W) were measured for each individual in the laboratory. The scales of all individuals were extracted below of pectoral fins, which cleaned with solution NH₄OH with focus (4%). The Von-Bertalanffy growth equation was used in order to determine the relationship between age – length: $L_t = L(1 - e^{-k(t-t_0)})$ where L_t : is the length at age; L_∞ : is the asymptotic length (cm), K : is a growth contact. The length-weight relationship represented by the equation: $W = a \times L^b$; where a and b are regressive contacts, W: is the total weight (g) and SL: is the standard length (cm). The value of (b=3) indicates the isometric growth and allometric growth (b < 3). The degree of association between the variable was estimated by the determination coefficient (R^2) [12].

Deviations from 1:1 sex ratio null hypothesis was statistically tested by χ^2 analysis.

III. RESULTS AND DISCUSSION

*** Length – Weight relationship:**

Average standard length (cm) and total weight (g) data were given in (Table 1, Table 2).

Length - Weight relationships of *T. trachurus* found in down. b values from the results of Length - Weight relationships was found as $b < 3$ for females, males and all individuals and allometric growth was determined as following :

For Ras albasit: (Figure 2)

Females: $W = 0.0286L^{2.87}$ $R^2 = 0.874$

Males : $W = 0.0326L^{2.79}$ $R^2 = 0.935$

All : $W = 0.0353L^{2.78}$ $R^2 = 0.899$

For Burj Islam: (Figure 3)

Female : $W = 0.0271L^{2.88}$ $R^2 = 0.84$

Males : $W = 0.0211L^{2.94}$ $R^2 = 0.95$

All : $W = 0.0249L^{2.90}$ $R^2 = 0.89$

Table (3) shows Length - Weight relationships of the Horse mackerel, provided by different authors in the different regions of the Mediterranean.

*** Sex ratio:**

The sex ratios in samples from Ras Albasit and Burj Islam did not differ significantly from a 1:1 ratio (χ^2 test, $p < 0.05$). This agrees with the studies in the Black Sea [7], [20] and Adriatic Sea [13].

[14] found that the sex ratio of the Atlantic horse mackerel was close to 1:1 for the whole areas, and in Turkish Seas by [8]. similar to our samples in Syrian Coastal waters.

*** Age :**

After age analysis of the 401 sampled individuals of *T. trachurus*, it was determined that they are included in 1- 4 age groups (I^+ - II^+ - III^+ - IV^+) . (Table 4, Table 5)

This result is normal for fish in general, as the highest rate of natural metabolism is during the life stages of the fish's life.

By comparing the number of age groups recorded in this study with those registered in different regions of the world (Table 6).

***Growth:**

Calculated growth parameters by Von – Bertalanffy growth equation is given in the Ras Albasit (Table 7) and Burj Islam (Table 8).

Table (9) shows horse mackerel Growth Parameters from von- Bertalanffy equation, provided by different authors in different regions of the Mediterranean Sea.

IV. CONCLUSION

The morphometric-meristic characteristics of *T. trachurus* caught in both sites of the study showed that they were asymptotic in length and the males were larger than females.

Whereas the length - weight relationship was strongly positive correlated ($R^2 = 0.89$).

The Age of *T. trachurus* ranged between 1 until 4 years, individuals in the (II) age group recorded the highest percentage among the registered age groups, we found that differences observed may be due to overfishing, using of illegal fishing methods, and providing the food base.

Values b in the Length - Weight relationship of this species was smaller than 3 and the type of growth was (Allometric Growth), these variations from previous studies could be attributed to differences in age group, growth rate, Etc.

No significant differences of the biological factors were observed in both study areas.

V. FIGURES AND TABLES

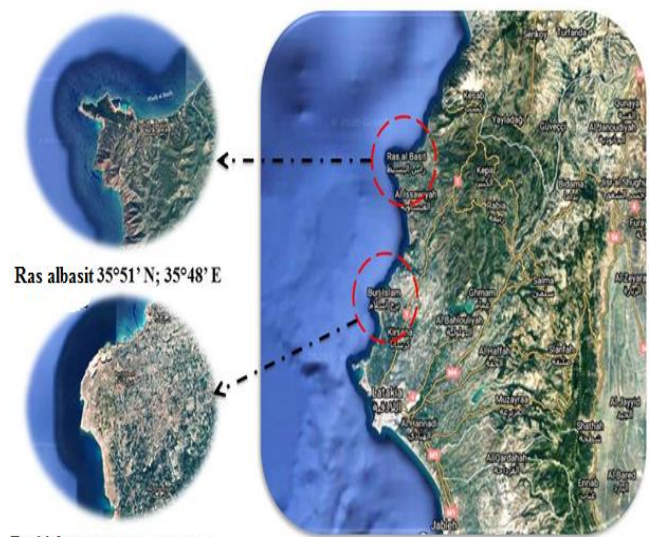
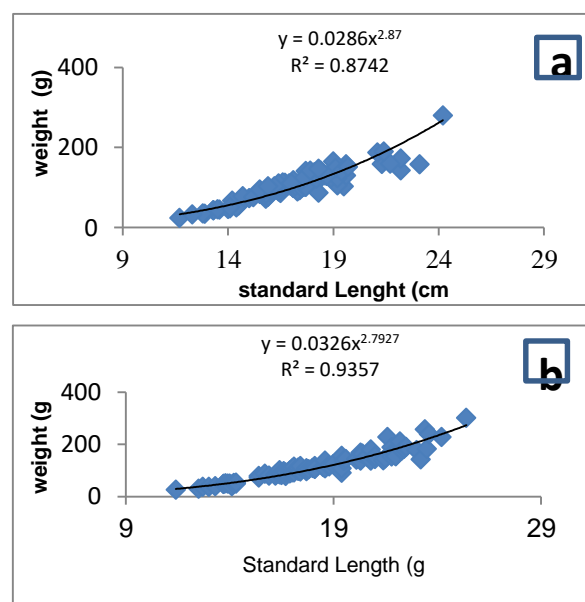


Figure 1. Location of study area (by Google Earth 2020)



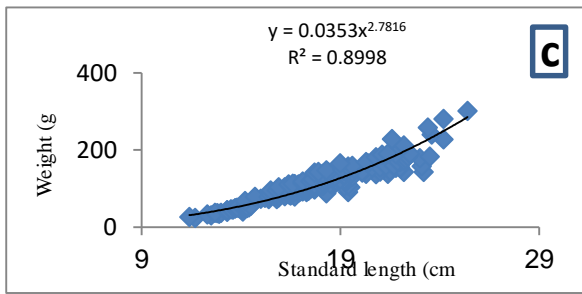
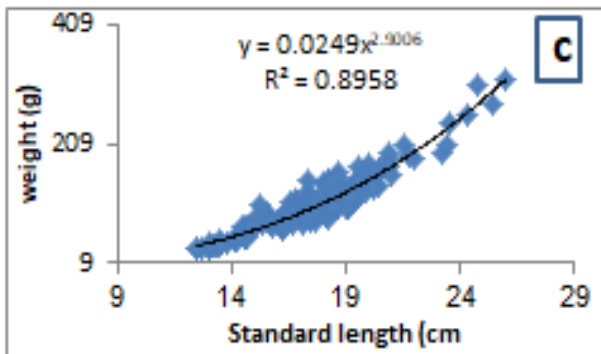
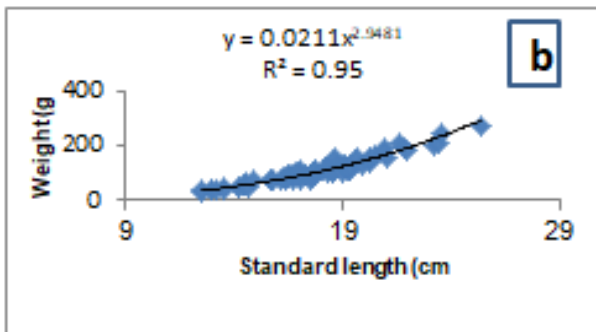
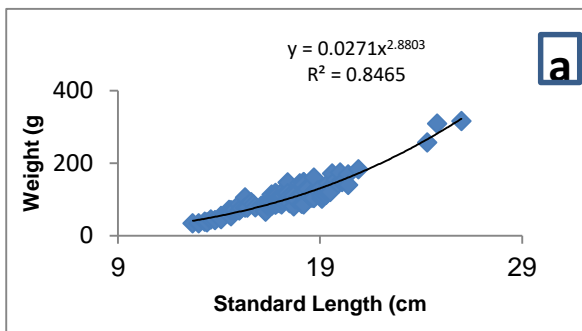


Figure 2. Length - Weight relationships of the Horse mackerel catch from Ras albasit (a: Females , b: males , c: whole sample)



Length - Weight relationships of the Horse mackerel catch from Burj Islam (a: Females , b: males , c: whole sample)

Table 1. length and weight values of female , male and whole individuals in Ras Albasit 2018 - 2019.

	Length (cm) Mean± STD	Weight (g) Mean± STD
All	17.71±2.76	111.23±46.52
Females	17.26±2.32	107.01±38.87
Males	18.20±3.12	115.91±53.57

Table 2. length and weight values of female , male and whole individuals in Burj Islam 2018 - 2019.

	Length (cm) Mean± STD	Weight (g) Mean± STD
All	17.55±2.35	107.28±44.69
Females	17.36±2.19	106.27±44.17
Males	17.78±2.52	108.91±45.49

Table 3. Length - Weight relationships of the Horse mackerel, provided by different authors in the different regions of the Mediterranean

Authors	Study area	B
[3]	Mediterranean of Morocco	3.06
[13]	NW Atlantic (Spain)	2.85
[14]	Middle Adriatic	2.91
[15]	Portuguese coast	2.88
[16]	NE Atlantic , Ireland and UK	3.12
[17]	North Sea	3.29
[18]	Greek coast	3.07
[19]	Adriatic Sea	3.00
Present study	Syrian marine waters	2.78

Table 4. The age structure and the annual longitudinal growth rate of all individuals calculated by the back calculation of reference in Ras albasit.

Age (year)	No	%	SL (cm)	L1	L2	L3	L4
1	47	23.73	14.23	12.41			
2	107	54.04	17.63	13.76	16.29		
3	39	19.69	21.31	16.05	18.32	20.35	
4	5	2.52	24.2	16.41	19.49	21.69	23.34
Average				14.65	18.03	21.02	23.34
longitudinal growth (cm)				14.65	3.38	2.99	2.32
%Percentage				62.76	14.48	12.81	9.94

Table 5. The age structure and the annual longitudinal growth rate of all individuals calculated by the back calculation of reference in Burj Islam.

Age (year)	No	%	SL(cm)	L1	L2	L3	L4
1	51	25.12	14.72	12.72			
2	122	60.09	17.81	13.95	16.46		
3	23	11.33	20.42	15.25	17.48	19.41	
4	7	3.44	24.38	14.77	17.53	20.39	21.97
Average				14.17	17.15	19.9	21.97
longitudinal growth (cm)				14.17	2.98	2.74	2.07
%Percentage				64.52	13.57	12.47	12.24

Table 6. Comparing the number of age groups recorded in this study with those registered in different regions of the world.

Authors	Area	Age
[3]	Morocco)(Bay Mdiq	6

[7]	Black Sea(ORDU)	7
[19]	Bay Saronikos(Greece)	10
[22]	European coasts	10-12
[23]	Blitvenica(Adriatic Sea)	4-5
Present study	Syrian marine waters	4

Table 7. Growth parameters of male , female and all individuals in Ras albasit.

Sex	L_{∞} (cm)	K	\emptyset	T_{max}
Male	34.58	0.18	0.80	15.78
Female	35.51	0.18	0.81	15.78
All	34.88	0.17	0.77	17.64

Table 8. Growth parameters of male , female and all individuals in Burj Islam .

Sex	L_{∞} (cm)	K	\emptyset	T_{max}
Male	33.05	0.18	0.77	16.50
Female	32.46	0.18	0.77	16.34
All	33.57	0.17	0.76	17.49

Table 9. Horse mackerel Growth Parameters from Bertalanffy equation, provided by different authors in the different region of the Mediterranean.

Authors	Study area	L_{∞} (cm)	K
[3]	Morocco	43.9	0.10
[7]	Black Sea (Ordu)	20.5	0.23
[14]	Blitvenica (Adriatic Sea)	37.55	0.21
[18]	Bay Saronikos)Greece(30.65	0.37
[23]	Adriatic Sea	37.68	0.23
Present study	Ras albasit	34.88	0.17
	Burj Islam	33.57	0.17

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