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STUDIES ON SOME BIOLOGICAL ASPECTS OF THE LIZARDFISH, Synodus saurus; LIN. 1758 (FAMILY: SYNODONTIDAE) FROM THE MEDITERRANEAN SEA AT ALEXANDRIA. EGYPT.

By

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Key Words: Biometry, Length-Weight relationship and condition factors.

ABSTRACT

Twenty one Morphometric characters were studied for 1535 the lizardfish ***Synodus saurus*** *(Linnaeus. 1758) measuring from 12 to 39 cm. long, to clarify the indices of the fish reproduction and morphological description of this species from the Mediterranean Sea at Alexandria area - Egypt. Five meristic characters were analyzed as support for the morphometric identity of diagnostic features, which were distinctive characters for the investigated fish. Analysis of morphometric indices shows the following: (1) Reduction in head width, eye diameter and dorsal, pectoral and caudal fin-length with increasing fish length. (2) Accelerated growth of fork length, standard length, pre-anal length, head length and snout as fish grows. (3) Slackening in the growth of pre and postorbital lengths and mouth length.*

The length-weight relationship has been studied. Its exponent "n" was 3.1160 for the pooled sexes, 3.1039 for males as well and 3.1280 for females.

The value of condition factors at different lengths showed a distinct fluctuation at the length corresponding to the first maturation, spawning and recovery during the life history of the fish.

Application of condition factors with months shows that the maximum values were at May and August months which coincide well

(Pr.O.L.), 10. eye diameter (E.D.), 11. post-orbital length (Pt.O.L.), 12. snout (Sn.), 13. mouth (M.), 14. pre-pectoral length (Pr.Pec.L.), 15. pectoral fin length (Pec.F.L.), 16. pre-pelvic length (Pr.Pv.L.), 17. pelvic fin length (Pv.F.L.), 18. pre-anal length (Pr.A.L.), 19. anal fin length (A.F.L.), 20. head width (H.W.), 21, body depth (B.D.).

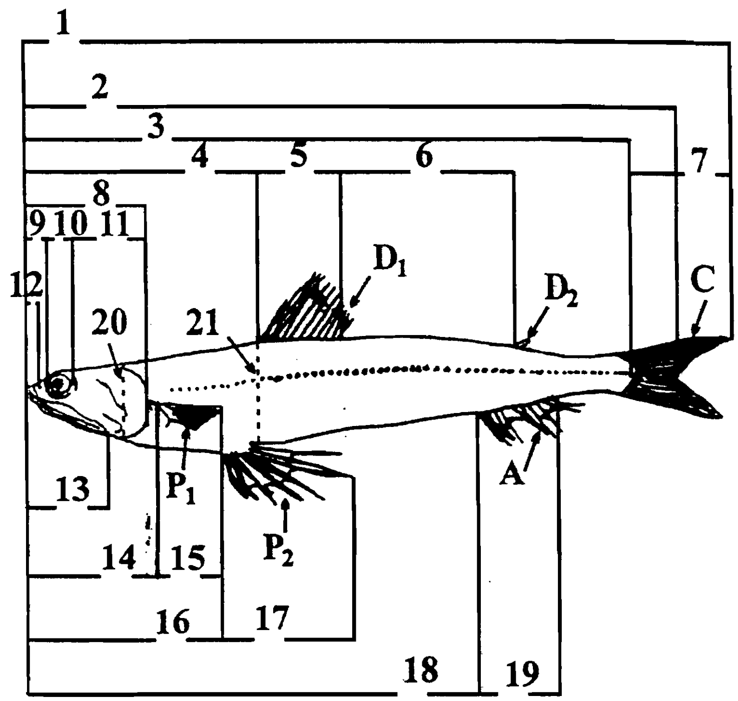

Fig. (1) : Topography of a fish ***Synodus saurus*** showing the location of structure, regions used in identification and methods of measurements. **A**, Anal fin; **C**, Caudal fin; $\mathbf{D_1}$, Dorsal fin ; $\mathbf{D_2}$, Adipose fin ;$\mathbf{P_1}$, Pectoral fin ; $\mathbf{P_2}$, Pelvic fin; 1, Total length; 2, Fork length ; 3, Standard length ; 4, Pre-dorsal length ; 5 , Dorsal fin length ; 6 , Inter-dorsal Space length; 7 , Caudal fin length ; 8 , Head length ; 9 , Pre - orbital length ;10, Eye diameter ; 11 , Post - orbital length ; 12 , Snout; 13, Mouth length; 14 , Pre-pectoral length ; 15, Pectoral fin length ; 16, Pre-pelvic length ; 17, Pelvic fin length ; 18, Pre-anal length ; 19, Anal fin length ; 20, Head width ; 21, Body depth.

The morphometric index of each measurement was calculated for each fish as a numerical a percentage of the total or head fish length by using the following formula:

$$\text{Morphometric index} = \frac{\text{Morphometric measure (cm)}}{\text{Relevant reference (cm)}} \times 100$$

The mean values of these indices and their standard deviations for different length groups were obtained.

Five meristic characters were determined on the pooled sexes for 215 individuals of 112 males and 103 females. Meristic characters including number of rays for dorsal, pectoral & anal fins and vertebrae were recorded and statistically analyzed according to Snedecor (1956) and Snedecor & Cochran (1982).

The length data were classified into length groups at one centimeter length interval, and the corresponding average weights (gram) for each length group of separate and pooled sexes were recorded. The length-weight relationship was established for males, females and pooled sexes, using the general parabola (Martin, 1949 and LeCren, 1951): $W = cL^n$

where:

W = Weight of fish in gram,

L = Length of fish in centimeter, "c" is a constant and "n" is an exponent.

The ponderal indices or the condition factors "K", (Hile, 1936 and Thompson, 1942) for each month and varying size range were derived separately for males, females and pooled sexes by employing the formulae:

$K_n = W/W^*$ (Le Cren, 1951), $K_c = W/L^3 \times 100$ (Beckman, 1948)

Where:

K_n = Relative condition factor. K_c= Fulton's (1902) condition factor

W = Observed weight W^* = Calculated weight

L = Total length

RESULTS AND DISCUSSION

1- Biometrics Analysis:

Biometrics analysis is exceedingly performed to clarify the identity of the fish population in a certain locality and the morphological description of fish species.

1.1- Morphometric Indices:

The index range, mean index and its standard deviation for twenty seven morphometric indices as referred to total fish length or head length were summarized in Table (1). Analysis of the twenty indices for size fish range (T.L.) from 12 to 39 cm. of the lizardfish, ***Synodus saurus*** L. as referred to total fish length. (Figure 2-a) revealed the following: 1- Reduction in width of the head, the eye-diameter and in length of the dorsal, pectoral, anal and caudal fins length with increasing fish size. 2 - Accelerated growth in lengthening of the fork, standard length, head length, pre-anal length and snout as fish grows. 3 - Slackening in the growth of inter-dorsal space, pre-orbital, post-orbital and mouth lengths. On the other hand, there are no appreciable differences in the growth of the body depth, pre-dorsal, pre-pectoral, pre-pelvic and pelvic fin lengths.

Analysis of seven indices as referred to the head length (Figure 2-b), reduction in the growth of head width, pre-orbital length, eye-diameter and body depth occurred while snout growth was accelerated. It is obvious that, the post-orbital index does not show any variations as the head length grows and the mouth index shows a suitable mode of stability for growth due to head length.

1.2- Morphometric Regressions:

Twenty seven regression lines for all the morphometric measurements were represented graphically in Figures (3 & 4). From the characters studied, the distance between the tip of snout and the end of caudal fin (dorsal lobe) was observed to have fastest growth rate comparing to the diameter of eye and snout length which exhibit slowest growth rate (Figure 4). The good agreement between the observed and calculated values, as well as the higher correlation coefficients (very adjacent to unity) indicate that the regression equations for each of the different morphometric measurements are the best fitting for the morphometric characters.

Table (1): Ranges and mean values (indices) of different percentages of body proportions of *Synodus saurus* in the Mediterranean Sea at Alexandria area, (1996-1997).

Morphometric Index	The Index Range		The Index Mean
	Min.	Max.	(S.D.)
F.L. / T.L.	91.00	95.72	93.17 ± 0.998
S.L. / T.L.	81.42	87.22	84.88 ± 1.268
H.L. / T.L.	18.60	22.67	21.18 ± 0.764
H.W. / T.L.	9.75	12.68	10.78 ± 0.739
B.D. / T.L.	14.12	18.53	16.21 ± 0.863
D.F.L. / T.L.	11.62	16.91	13.00 ± 1.258
Pec.F.L. / T.L.	7.82	11.47	9.51 ± 0.745
Pv.F.L. / T.L.	16.39	22.22	20.47 ± 1.025
A.F.L. / T.L.	9.35	14.37	10.87 ± 1.125
C.F.L. / T.L.	13.34	16.43	14.93 ± 0.797
Int. D.S.L. / T.L.	20.88	26.40	24.22 ± 1.101
Pr. D.L. / T.L.	31.26	38.71	35.71 ± 1.453
Pr. Pec.L. / T.L.	17.68	24.52	22.01 ± 1.386
Pr.Pv.L. / T.L.	28.00	35.00	31.78 ± 1.245
Pr.A.L. / T.L.	56.26	72.48	66.64 ± 3.514
Sn. / T.L.	2.14	3.91	3.20 ± 0.433
Pr.O.L. / T.L.	4.30	6.76	4.83 ± 0.580
Pt.O.L. / T.L.	10.94	14.29	13.07 ± 0.738
M. / T.L.	8.45	15.73	13.49 ± 1.517
E.D. / T.L.	2.82	4.69	3.52 ± 0.447
H.W. / H.L.	45.18	68.18	51.20 ± 4.965
Sn. / H.L.	10.17	18.32	15.08 ± 1.848
Pr.O.L. / H.L.	20.22	36.36	22.92 ± 3.515
Pt.O.L. / H.L.	54.12	67.82	61.77 ± 3.126
M. / H.L.	43.16	69.41	63.63 ± 5.798
E.D. / H.L.	12.79	23.54	16.73 ± 2.629
B.D. / H.L.	69.86	90.91	76.33 ± 4.337

S.D. = Standard deviation.

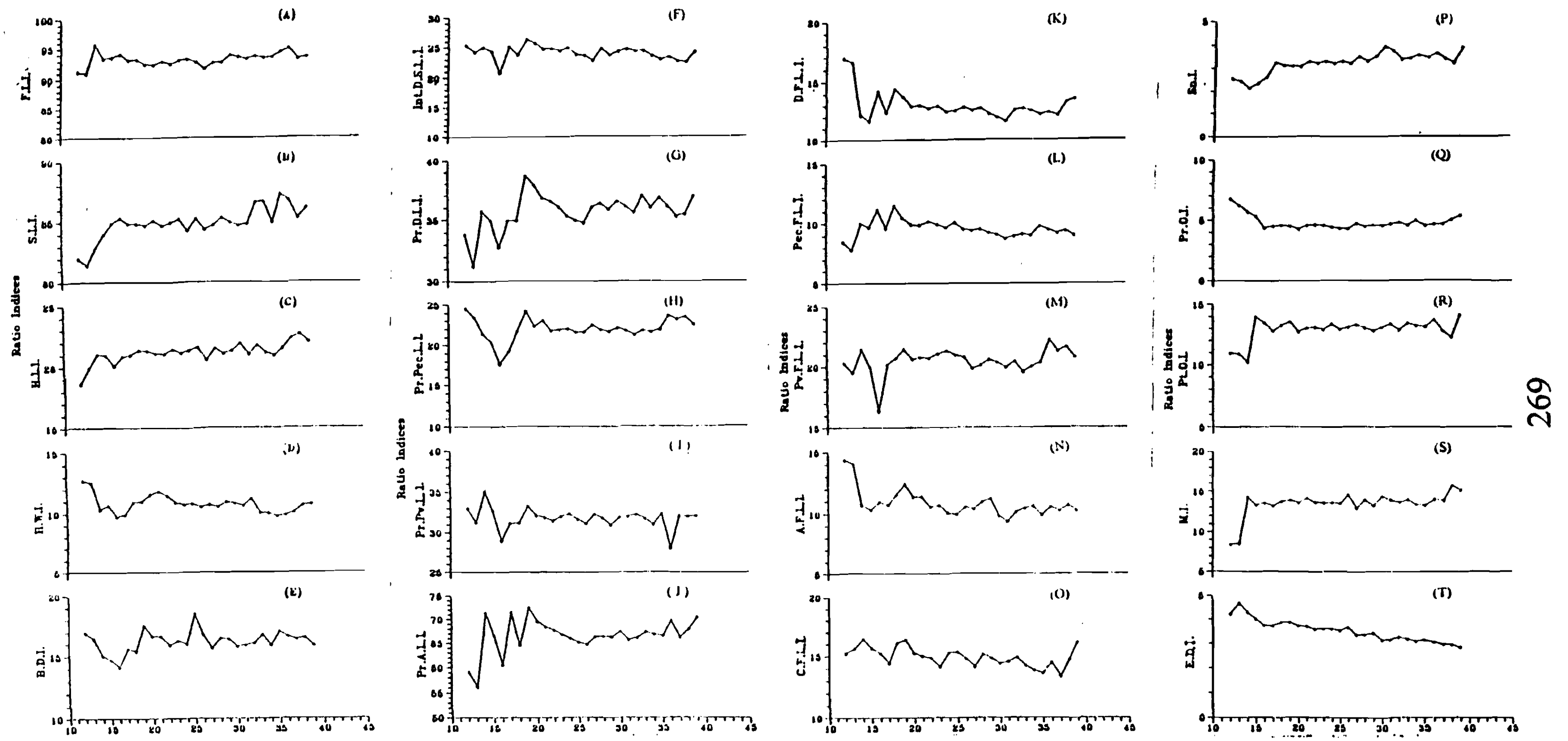

Fig. (2-a): Relationship of total fish length and different morphometric inddices for ***Synodus saurus*** in the Mediterranean Sea at Alexandria area.

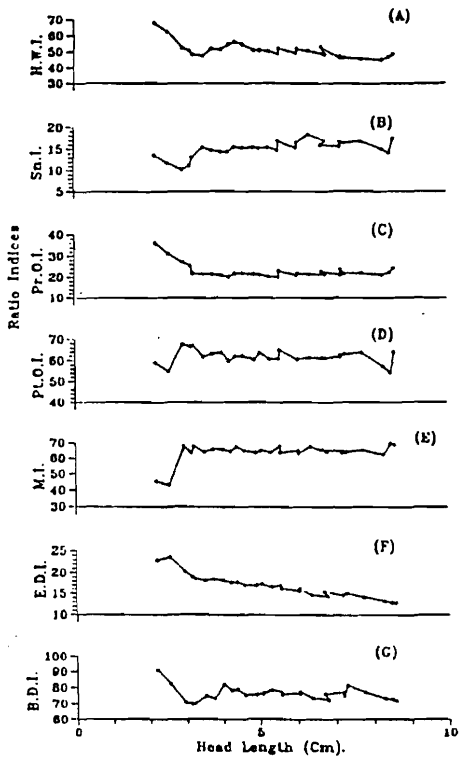

Fig. (2-b): Relationship of head fish length and different morphometric indices of ***Synodus saurus*** in the Mediterranean Sea at Alexandria area.

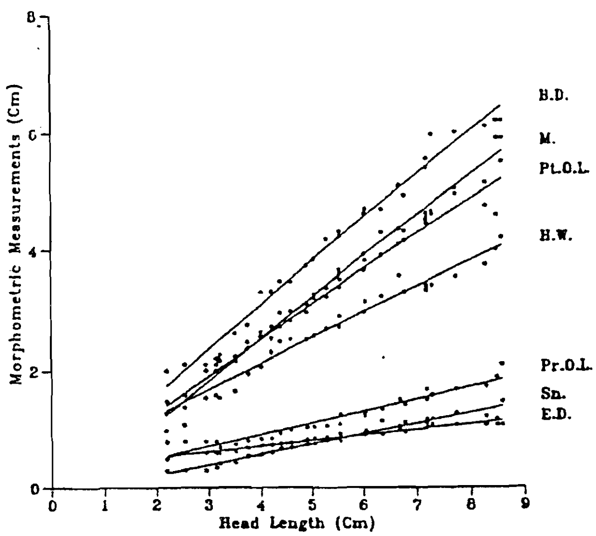

Fig. (3): Relationship of head fish length and different morphometric measurements for ***Synodus saurus*** in the Mediterranean Sea at Alexandria area.

1.3- Meristic Characters:

Five meristic characters were studied as a support for the morphometric identity of the investigated fish. Results are summarized in Table (2). The present study shows that the counting of scales on the lateral line ranges between 54 and 60 with a mean of 56.8. This is in agreement with scale numbers of the Atlantic lizardfish as given by Anderson ***et al.*** (1975). Also, as shown generally in Table (3), a comparison of two meristic data given by different authors in various localities. confirm the present findings.

Table (2): Meristic characters; frequency distribution; mean; mode; variance; coefficient of variance and standard deviation of the lizardfish, ***Synodus saurus*** in the Mediterranean Sea at Alexandria area during the period from July 1996 to June 1997.

Meristic Character	The Range Of Frequency	Number Of Fish Having Vertebral Counts Of							Mean	Mode	Variance	Coefficient of variance %	Standard Deviation
Vertebrae	56 : 59	56	57	58	59				57.28	57	0.41	1.12	±0.64
		28 (13.02)	105 (48.84)	76 (35.35)	6 (2.79)								
		Number Of Fish Having Scales Counts Of											
Scales	54 : 60	54	55	56	57	58	59	60	56.84	56	1.21	1.94	±1.10
		5 (2.33)	10 (4.65)	100 (46.51)	18 (8.37)	70 (32.56)	6 (2.79)	6 (2.79)					
		Number Of Fish Having Number Of Dorsal Fin Rays Counts Of											
Number Of Dorsal Fin Rays	11 : 13	11	12	13					11.92	12	0.31	4.61	±0.55
		52 (24.19)	129 (60.00)	34 (15.81)									
		Number Of Fish Having Number Of Pectoral Fin Rays Counts Of											
Number Of Pectoral Fin Rays	12 : 14	12	13	14					13.12	13	0.40	4.80	±0.63
		42 (19.53)	106 (49.30)	67 (31.16)									
		Number Of Fish Having Number of Anal Fin Rays Counts Of											
Number Of Anal Fin Rays	9 : 12	9	10	11	12				10.69	11	0.34	5.43	±0.58
		3 (1.40)	70 (32.56)	132 (61.40)	10 (4.65)								

Percentages are given in parentheses. Number of fish examined is 215.

Table (3): Comparison of frequency distribution of two meristic characters of the lizardfish, ***Synodus saurus*** from different authors and localities.

Author	Year	Locality	Number Of Dorsal Fin Rays		Number Of Anal Fin Rays		No. Of Fish
			Range	Mean SD	Range	Mean SD	
Fowler	1936	West Africa	13	13	11-13		
Anderson, *et al.*,	1966	West-North Atlantic	11-13	11.90±0.55	9-11	10.20±0.52	20
Maurin, *et al.*,	1977	Northern West Coast Of Africa	12	12	11	11	
Whitehead, *et al.*,	1986	Mediterranean Sea	11-13		9-12		
Fischer, *et al.*,	1987	Mediterranear Sea	11-13		9-12		
Faltas	1993	Egyptian Mediterroncar Sea	11-13	11.98±0.51	9-12	10.97±0.51	540
(Present Study)	1997	Alexandria Mediterranean Sea	11-13	11.92±0.55	9-12	10.69±0.58	215

S.D.= Standard deviation

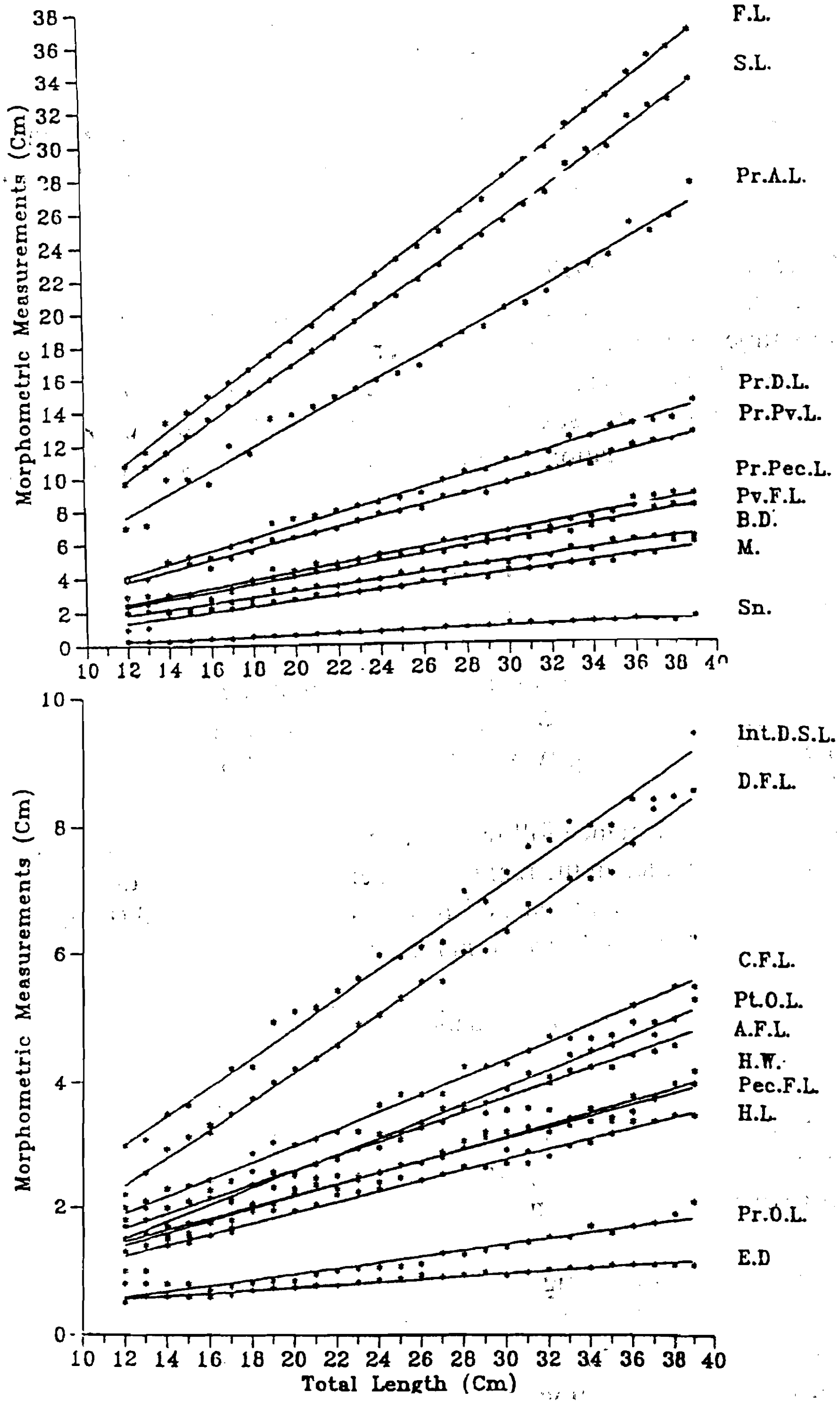

Fig. (4): Relationship of total fish length and different morphometric measurements for ***Synodus saurus*** in the Mediterranean Sea at Alexandria area.

Concerning the present results of the lizardfish. ***Synodus saurus*** (Linnaeus, 1758) from the Mediterranean Sea at Alexandria area, showed good agreement with those results given by Faltas (1993).

2 - Length-Weight Relationship:

The length-weight equation had been made for all fishes of both sexes at various times of the year, due to the interpretation of various factors (Spawning, maturation, food, ... etc.). By using logarithms, the linear equation was fitted separately for the two sexes of the lizardfish, ***Synodus saurus*** L. from the general parabolic equation (Figure 5) and the equations for the two sexes were found to be:

Males	:	$W = 0.0054\ L^{3.1039}$
Females	:	$W = 0.0051\ L^{3.1280}$

The logarithmic regression equations were estimated as:

Males	:	$\text{Log } W = -2.2676 + 3.1039\ \text{Log } L$	(r = 0.9975)
Females	:	$\text{Log } W = -2.2924 + 3.1280\ \text{Log } L$	(r = 0.9970)

Analysis of covariance following Snedecor (1956) showed that there was no significant difference in the regression coefficients between the different sexes. Hence, the length-weight data of the two sexes were pooled (Figure 6) and the equation was calculated. It was found to be:

$W = 0.0053\ L^{3.1160}$

The corresponding logarithmic equation may be written as:

$\text{Log } W = -2.2757 + 3.1160\ \text{Log } L$ (r = 0.9981)

It is observed that the coefficient of regression (n) value for the pooled sexes does not deviate significantly from its cube at 5% level. Thus, the lizardfish, ***Synodus saurus*** L. grows isometrically.

Faltas (1993) fitted roughly the length-weight curves for male and female ***Synodus saurus*** L. from the Mediterranean Sea waters and found significant differences at 5% & 1% levels between the regressions of sexes and also of Alexandria and Matruh regions.

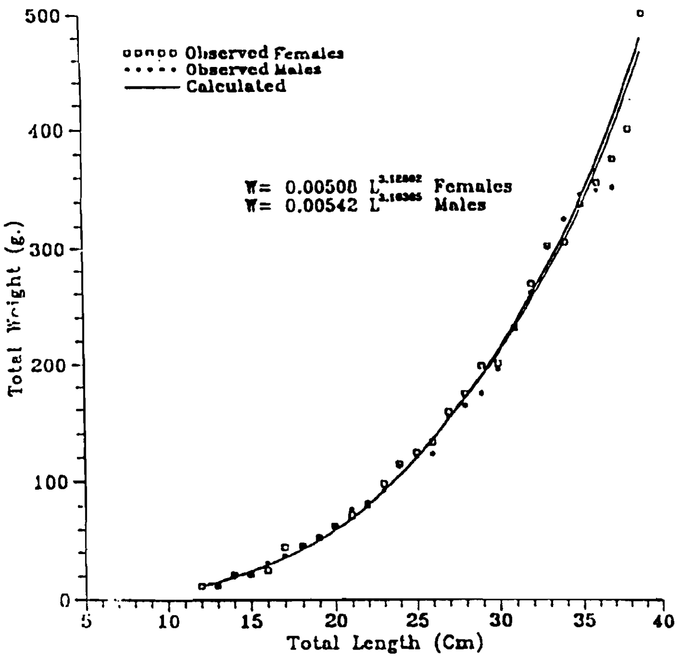

Fig. (5): Relationship between total fish length and total weight of females and males *Synodus saurus* in the Mediterranean Sea at Alexandria area.

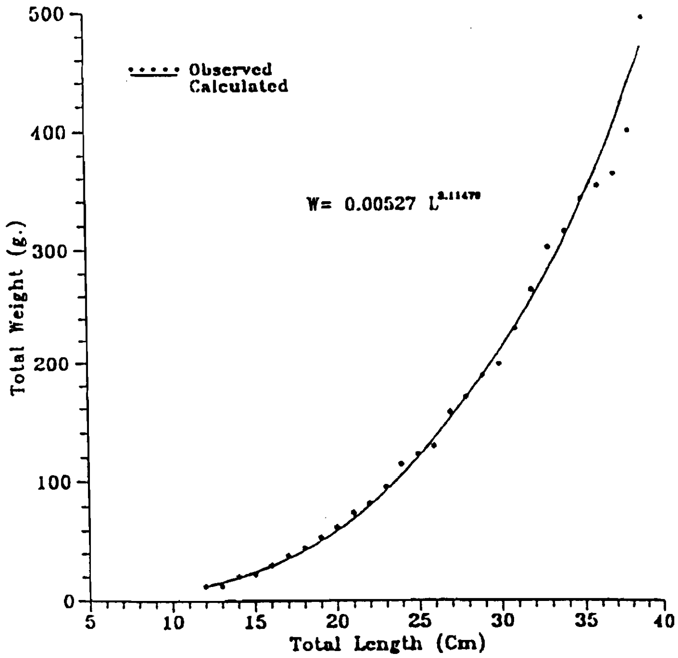

Fig. (6): Relationship between total fish length and total weight of pooled sexes *Synodus saurus* in the Mediterranean Sea at Alexandria area.

In the present study, the isometric growth was also indicated by the calculation of exponent (n) of length-weight relationship with respect to the gutted weight, which was determined in order to avoid bias caused by variations in weight of gonads and gut. This relation was represented in Figures (7 & 8). A perusal of length-weight relationship (gutted weight) made for the lizardfish, ***Synodus saurus*** L. shows that the value exponent (n) equals 3.0558, 3.0481 and 3.0335 for males, females and pooled sexes respectively, where their logarithmic equations are:

Males	: $\text{Log } W_{(Gutted)} = -2.2557 + 3.0558$	Log L	(r =0.9970)
Females	: $\text{Log } W_{(Gutted)} = -2.2661 + 3.0481$	Log L	(r = 0.9973)
Pooled sexes	: $\text{Log } W_{(Gutted)} = -2.2365 + 3.0335$	Log L	(r = 0.9978)

From the Figures (5, 6, 7 & 8). a close agreement between the observed and calculated values may be seen. Similarly, the logarithmic values of lengths and observed weights were plotted (Figure 9) and the regression line fitted to the data indicates straight line relationship. From the graphs of length-weight relationship, it is evident that, the females are slightly heavier than males of the same length, which was pronounced for large fishes.

3 - Condition Factors (K_n & K_c):

Condition factors (K_n & K_c) were calculated according to equations of Le Cren (1951) and Beckman (1948), and represented graphically in Figures (10), (11) and (12) for varying size range derived separately for males, females and pooled sexes, respectively. The monthly variations of K_n and K_c values represented graphically in Figure (13).

It is clear from the Figures (10 & 11) that K_n and K_c values with regard to size are more or less similar in both sexes, indicating almost equal metabolic activity in males and females. The average of relative condition factor K_n values were 1.0031, 1.0039 and 1.0021 for males, females and pooled sexes, respectively, while the corresponding condition factor K_c values were 0.7530, 0.7661 and 0.7618. Thus, the coefficient of condition did not vary with the sex. The increases in mean K_n values under 15.5-17.4 cm. and 16.5-18.4 cm size range for males and females, respectively indicate the first gonadal-development in the fish., since the study of gonads also indicated that the size at first maturity in both the sexes were at 15.7 cm. for males and 18.3 cm. for females. The fluctuations in the mean K_n values indicate that most fishes were gradually in spawning stage.

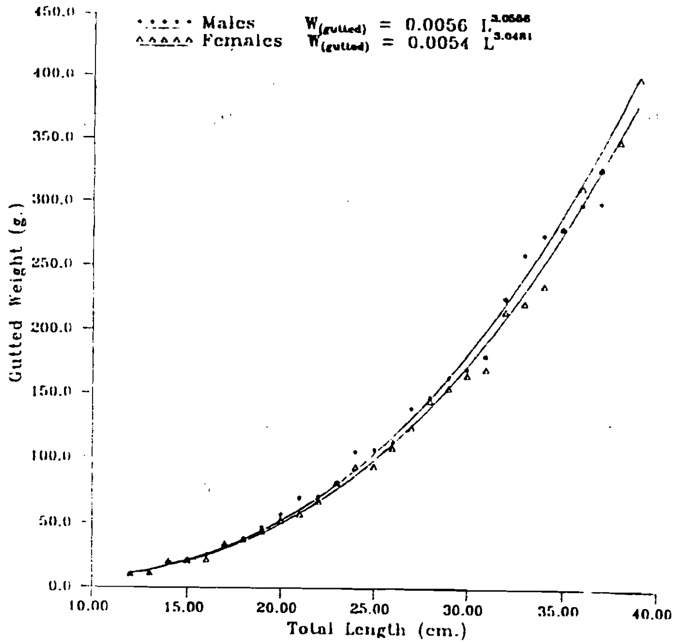

Fig. (7): The length-weight relationship (Gutted Weight) of the lizardfish *Synodus saurus* for males and females in the Mediterranean Sea at Alexandria area during from July 1996 to June 1997.

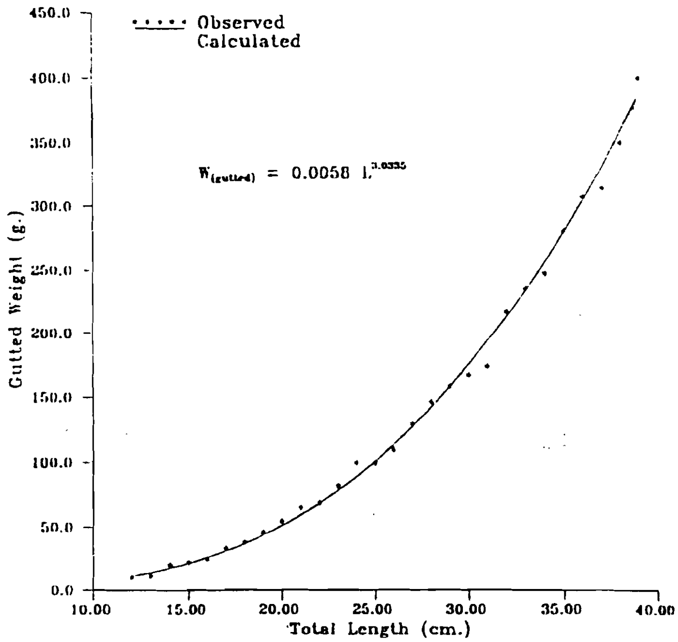

Fig. (8): The length-weight relationship (Gutted Weight) of the lizardfish ***Synodus saurus*** for pooled sexes in the Mediterranean Sea at Alexandria area during from July 1996 to June 1997.

From the Figure (12), sudden increase in K_n values from 0.90 to 1.04 in size group of 36.5-39.4 cm. might be due to recovery of fish weight after spawning. The monthly variation of K_n and K_c values (Figure 13) ranged between 0.976 and 1.134 for K_n and 0.697 and 0.848 for K_c. The highest values were recorded in May and August, coincided well with the climax of fish spawning.

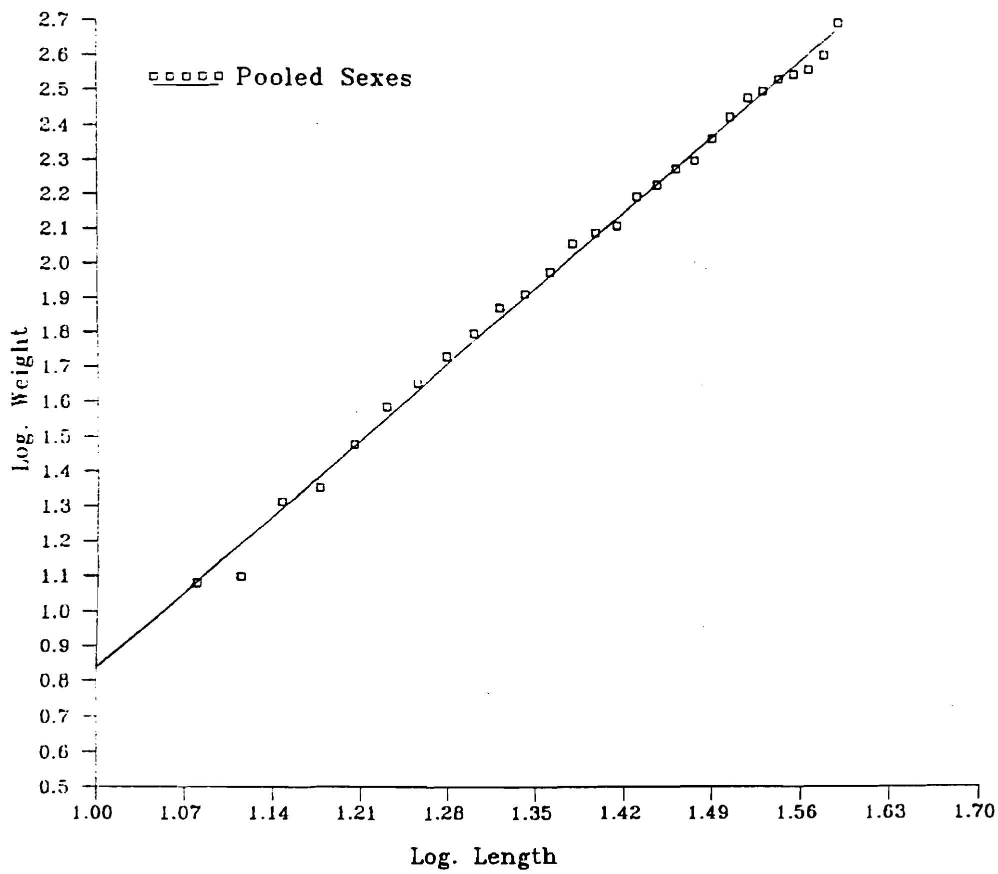

Fig. (9): Logarithmic relationship between length and weight in the lizardfish ***Synodus saurus*** (pooled Sexes) in the Mediterranean Sea at Alexandria area during from July 1996 to June 1997.

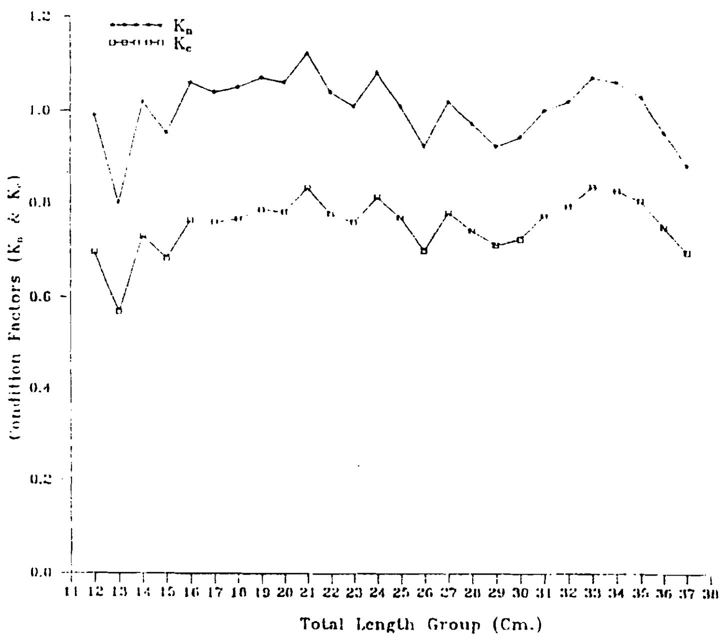

Fig. (10): Variation in Fulton's condition factor (K_c) and relative condition factor (K_n) of the lizardfish ***Synodus saurus*** (Males) according to size groups in the Mediterranean Sea at Alexandria area during from July 1996 to June 1997.

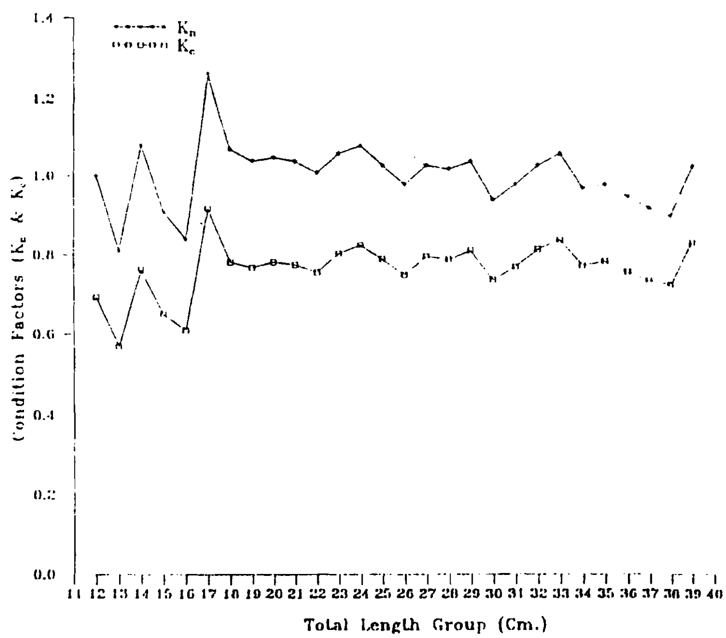

Fig. (11): Variation in Fulton's condition factor (K_c) and relative condition factor (K_n) of the lizardfish ***Synodus saurus*** (Females) according to size groups in the Mediterranean Sea at Alexandria area during from July 1996 to June 1997.

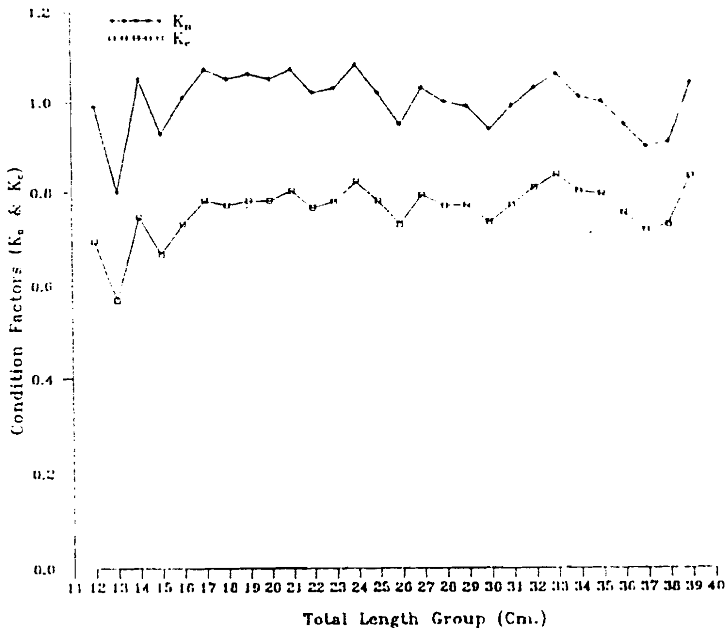

Fig. (12): Variation in Fulton's condition factor (K_c) and relative condition factor (K_n) of the lizardfish ***Synodus saurus*** (Pooled Sexes) according to size groups in the Mediterranean Sea at Alexandria area during from July 1996 to June 1997.

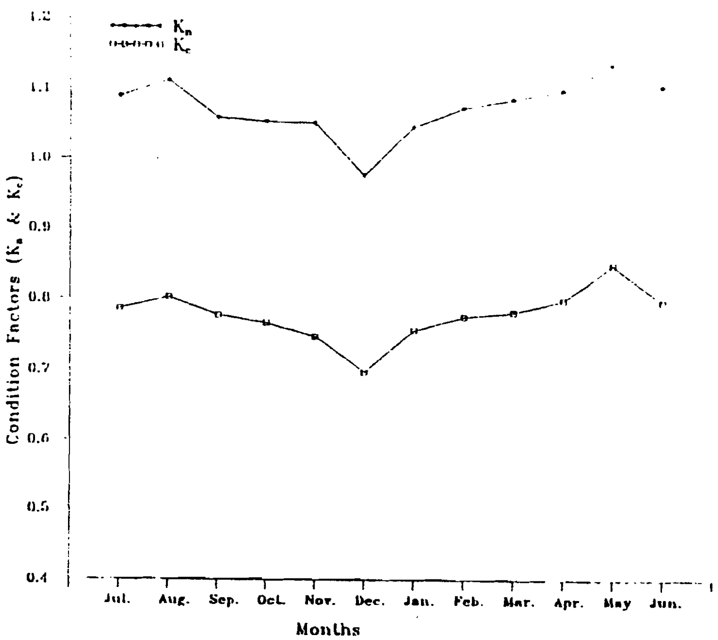

Fig. (13): Monthly variations in Fulton's condition factor (K_c) and relative condition factor (K_n) if the lizardfish ***Synodus saurus*** (Pooled Sexes) in the Mediterranean Sea at Alexandria area during from July 1996 to June 1997.

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