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AGE AND GROWTH STUDIES OF PICARELS (*SPICARA FLEXUOSA* AND *SPICARA SMARIS*) IN THE EGYPTIAN MEDITERRANEAN WATERS

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ABSTRACT

*Age and growth of the Egyptian Mediterranean picarels (**S. flexuosa** and **S. smaris**) were examined by means of otolith readings. Both species live only up to four years. The growth rate of **S. flexuosa** from age I to IV was: 11.49, 13.57, 15.80 & 17.29 cm whereas for **S. smaris** 11.30, 13.58, 15.67 & 16.83 cm respectively. A marked difference in the calculated weights was observed between sexes of both species indicating that males are much heavier than females. The estimated values of von Bertalanffy parameters for **S. flexuosa** (combined sexes) were $L\infty$ = 27.51 cm, $W\infty$ = 228.48 g, K= 0.1524 & t_0= 2.53 whereas for **S. smaris**: $L\infty$ = 20.78 cm, $W\infty$ = 77.60 g, K= 0.2968 & t_0= 1.63.*

INTRODUCTION

Picarels (Centracanthidae) are little known species, however they are very common in the Mediterranean basin. They are found in the littoral zone inhabiting Posidonia beds and muddy bottoms (Hureau & Monod, 1979; Whitehead *et al.*, 1986 and Fischer *et al.*, 1987). Egyptian picarels are found to occupy a distinct position among the catches of demersal fishes. It contributed about 29.8% of the total weight of commercial landings obtained by big trawlers (Al-Zahaby *et al.*, 1992). Three species of picarels out of four are present in the Egyptian Mediterranean waters : ***Spicara flexuosa, Spicara smaris*** and ***Spicara maena.*** The first two species are more common in the catch

of trawlers and usually caught throughout the year (Rizkalla, 1994). Very little have been reported on the biology of picarels (Hattour ***et al.***, 1985 and Tsangridis & Filippousis, 1992).

The aim of the present work is to provide information about age and growth of ***S. flexuosa*** & ***S. smaris***. This will be useful in managing the rapidly developing fishery of these species in the Egyptian Mediterranean waters.

MATERIALS AND METHODS

Random samples of ***S. flexuosa*** and ***S. smaris*** were taken monthly from the catch of trawlers operating off Alexandria and covered the period from January to December 1993. The work was based on 834 specimens ***of S. flexuosa*** and 735 of ***S. smaris*** having total length 8.0-21.0 and 8.0-17.0 cm respectively. For each specimen, total length (cm), total & gutted weight (g) and sex were recorded. The sagittal otoliths were extracted and cleaned for age determination. The radius of the otolith (the distance from the centre of focus to the posterior margin of the otolith) and annular distances (the distances from the centre of the focus to the outer margin of each annulus) were measured on the micrometer scale. The length-weight relationship was computed using the formula: $W_c = aL^b$ given by Le Cren (1951) where: W_c=gutted weight (g), L=total length (cm) and a & b are the regression parameters. Theoretical growth study was performed using von Bertalanffy growth equations developed by Beverton and Holt (1957) and their parameters ($L\infty$, $W\infty$,K & t_o) were calculated by Gulland›s method (Gulland, 1965). Maximum length (L_{max}) was calculated using the formula $L_{max}=0.95\ L\infty$ (Beverton, 1963). The statistical analyses, viz., mean, standard deviation, standard error, student t-test and analysis of covariance were employed according to Snedecor and Cochran (1982) for high precision interpretation of the data.

RESULTS

- Body-otolith relationship

The otolith radii (R) were plotted on total length (L) and a linear relationship was found to exist between them (Fig. 1). The regression equations expressing this relationship were as follows:

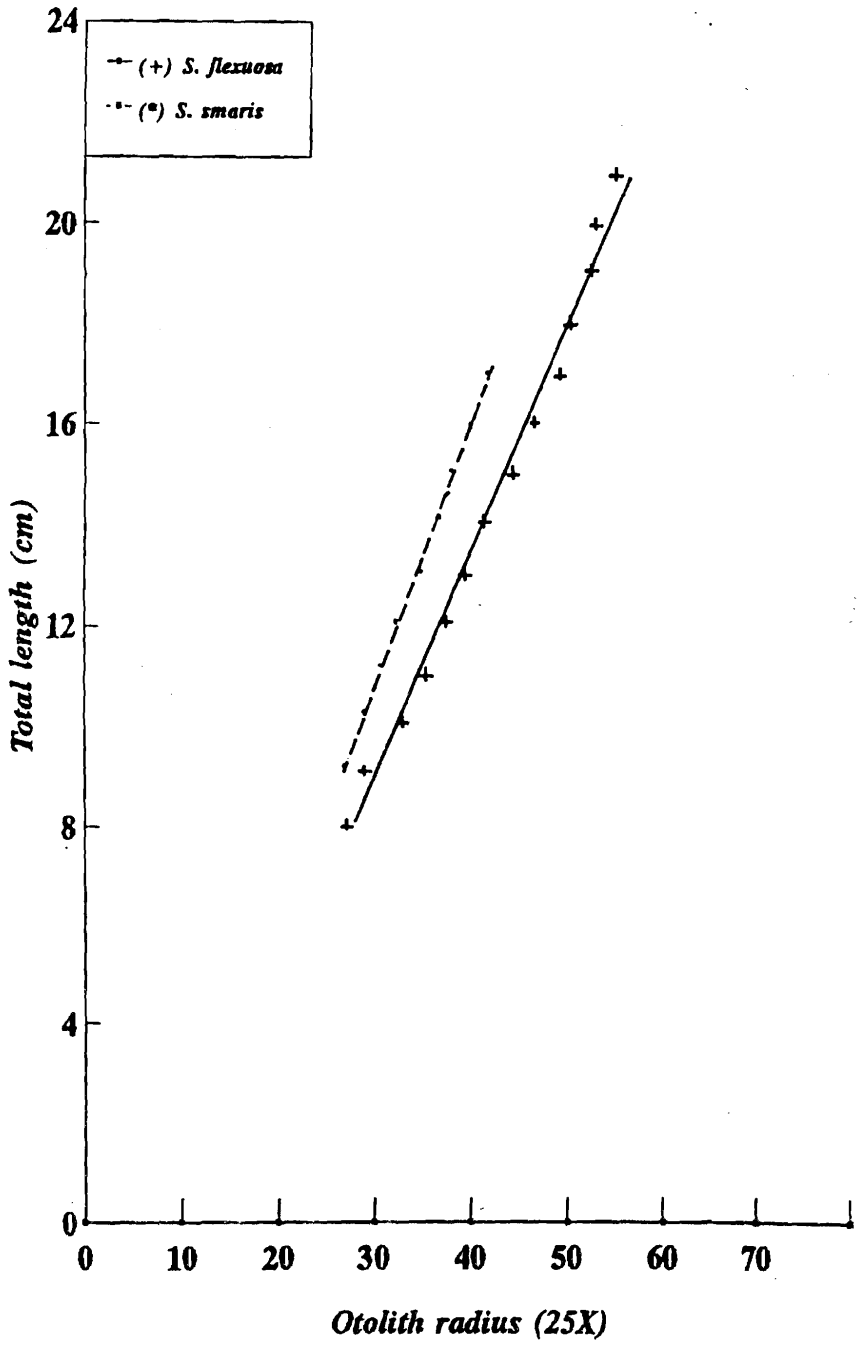

Fig. (1): Relationship between otolith radius and total length of *Spicara flexuosa* and *Spicara smaris* in the Egyptian Mediterranean waters.

For ***Spicara flexuosa*** (combined sexes) :

$L = -5.0993 + 4.7828\ R$ (N= 668, r= 0.9936).

For ***Spicara smaris*** (combined sexes) :

$L = -5.9997 + 5.6603\ R$ (N= 436, r= 0.9986).

- Growth in length

The back-calculated lengths for each year of life for ***S. flexuosa*** and ***S. smaris*** were given in Tabs 1&2. It was shown that the ages for both species of picarels did not exceed more than four years old. The highest annual length increments for males & females of ***S. flexuosa*** (66.08% & 67.93%) and ***S. smaris*** (63.45% & 71.68%) were recorded during their first year of life. The t-test analysis showed no significant difference between the growth of males and females of the same species and of the same age group.

- Length-weight relationship

The equations represented this relation were as follow:

For *Spicara flexuosa*:

Males $W_c = 6.73\ 10^{-3}\ LT^{3.1562}$ (N=115, r= 0.996)

Females $W_c = 7.17\ 10^{-3}\ LT^{3.1243}$ (N=719, r= 0.999)

Combined sexes $W_c = 6.96\ 10^{-3}\ LT^{3.1378}$ (N=834, r= 0.999)

For ***Spicara smaris***:

Males $W_c = 1.055\ 10^{-2}\ LT^{2.9152}$ (N=132, r= 0.997)

Females $W_c = 4.39\ 10^{-3}\ LT^{3.2285}$ (N=603, r= 0.999)

Combined sexes $W_c = 5.38\ 10^{-3}\ LT^{3.1562}$ (N=735, r= 0.998)

It was observed that the calculated weights for males ***S. flexuosa*** and ***S. smaris*** were greater than of females of equal sizes indicating that males are much heavier than females (Figs. 2&3). This was confirmed by using covariance analysis which showed significant differences ($P<0.01$) between sexes within each species.

- Growth in weight

The calculated weights for the various years of life were given in Tables (1&2). It was obvious that the maximum annual increment for ***S. flexuosa*** was recorded during its first year of life (male: 27.05% & female: 29.88%); whereas for ***S. smaris*** was recorded during the second year of life for male (37.59%) and the first year of life for female (34.11%).

Table (1): Back-calculated lengths (cm) and weights (g) at different age groups and those predicted from von Bertalanffy (v.B) equations for ***Spicara flexuosa*** in the Egyptian Mediterranean waters. (Percentage in parenthesis)

Sex	*Age*			
	I	*II*	*III*	*IV*
Males:				
Number of fish	9	36	51	18
Length range (cm)	11.5 - 14.9	13.0 - 17.7	14.8 - 20.0	16.7 - 21.0
Mean length (cm)	12.59 ± 0.3276	15.03 ± 0.1784	16.87 ± 0.1644	18.34 ± 0.2999
Back-calculated length (cm)	11.73	14.04	16.17	17.75
Increment in length (cm)	11.73 (66.08)	2.31 (13.01)	2.13 (12.0)	1.58 (8.90)
Length predicted weights v.B (cm)	11.72	14.11	16.11	17.78
Back-calculated weights (g)	15.96	28.15	43.96	59.00
Increment in weight (g)	15.96 (27.05)	12.19 (20.66)	15.81 (26.79)	15.04 (25.49)
Weights predicted from v.B. (g)	15.90	28.58	43.42	59.28
Females:				
Number of fish	169	197	101	21
Length range (cm)	8.5 - 14.5	11.3 - 17.5	13.5 - 18.3	16.2 - 19.3
Mean length (cm)	12.39 ± 0.0833	14.15 ± 0.0787	16.12 ± 0.1001	17.39 ± 0.1
Back-calculated length (cm)	11.48	13.49	15.61	16.90
Increment in length (cm)	11.48 (67.93)	2.01 (11.89)	2.12 (12.54)	1.29 (7.63)
Length predicted weights v.B (cm)	11.43	13.64	15.46	16.95
Back-calculated weights (g)	14.69	24.32	38.37	49.17
Increment in weight (g)	14.69 (29.88)	9.63 (19.58)	14.05 (28.57)	10.8 (21.96)
Weights predicted from v.B (g)	14.52	25.22	37.26	49.65
Combined sexes:				
Number of fish	178	233	152	39
Length range (cm)	8.5 - 14.9	11.3 - 17.7	13.5 - 20.0	16.2 - 21.0
Mean length (cm)	12.40 ± 0.0808	14.28 ± 0.0746	16.37 ± 0.0914	17.83± 0.18120
Back-calculated length (cm)	11.49	13.57	15.80	17.29
Increment in length (cm)	11.49 (66.45)	2.08 (12.03)	2.23 (12.90)	1.49 (8.62)
Length predicted weights v.B (cm)	11.44	13.71	15.66	17.33
Back-calculated weights (g)	14.78	24.92	40.16	53.29
Increment in weight (g)	14.78 (27.73)	10.14 (19.03)	15.24 (28.60)	13.13 (24.64
Weights predicted from v.B. (g)	14.58	25.73	39.05	55.70

Table (2): Back-calculated lengths (cm) and weights (g) at different age groups and those predicted from von Bertalanffy (v.B) equations for ***Spicara smaris*** in the Egyptian Mediterranean waters. (Percentage in parenthesis)

Sex	***Age***			
	I	***II***	***III***	***IV***
Males:				
Number of fish	8	16	48	9
Length range (cm)	10.0 - 12.0	13.7 - 15.9	14.5 - 16.8	16.5 - 18.0
Mean length (cm)	11.11 ± 0.3553	14.88 ± 0.1609	16.00 ± 0.0696	16.99 ± 0.1448
Back-calculated length (cm)	10.78	14.59	15.83	16.99
Increment in length (cm)	10.78 (63.45)	3.81 (22.42)	1.24 (7.30)	1.16 (6.83)
Length predicted weights v.B (cm)	10.40	14.49	16.20	16.92
Back-calculated weights (g)	10.80	26.09	33.10	40.68
Increment in weight (g)	10.80 (26.55)	15.29 (37.59)	7.01 (17.23)	7.58 (18.63)
Weights predicted from v.B. (g)	9.70	25.55	35.40	40.17
Females:				
Number of fish	138	142	8	2
Length range (cm)	10.0 - 13.4	11.2 - 15.5	14.2 - 15.9	16.0 - 16.2
Mean length (cm)	11.85± 0.0792	13.87 ± 0.0761	14.90 ± 0.2018	16.10 ± 0.100
Back-calculated length (cm)	11.54	13.48	14.74	16.10
Increment in length (cm)	11.54 (71.68)	1.94 (12.04)	1.26 (7.83)	1.36 (8.45)
Length predicted weights v.B (cm)	11.55	13.39	14.87	16.06
Back-calculated weights (g)	18.81	19.51	26.04	34.62
Increment in weight (g)	11.81 (34.11)	7.7(22.24	6.53 (28.57)	8.58 (24.78)
Weights predicted from v.B. (g)	11.88	19.10	26.77	34.33
Combined sexes:				
Number of fish	146	158	56	11
Length range (cm)	10.0 - 13.4	11.2 - 15.9	14.2 - 16.6	16.0 - 18.0
Mean length (cm)	11.81 ± 0.0781	13.97 ± 0.0721	15.84 ± 0.0924	16.83 ± 0.1200
Back-calculated length (cm)	11.30	13.58	15.67	16.83
Increment in length (cm)	11.30 (67.14)	2.28 (13.55)	2.09 (12.42)	1.16 (6.89)
Length predicted weights v.B (cm)	11.26	13.70	15.52	16.87
Back-calculated weights (g)	11.34	20.26	31.83	39.88
Increment in weight (g)	11.34 (28.44)	8.92 (22.37)	11.57 (29.01)	8.05 (20.18)
Weights predicted from v.B. (g)	11.22	20.86	30.90	40.21

± Standard error

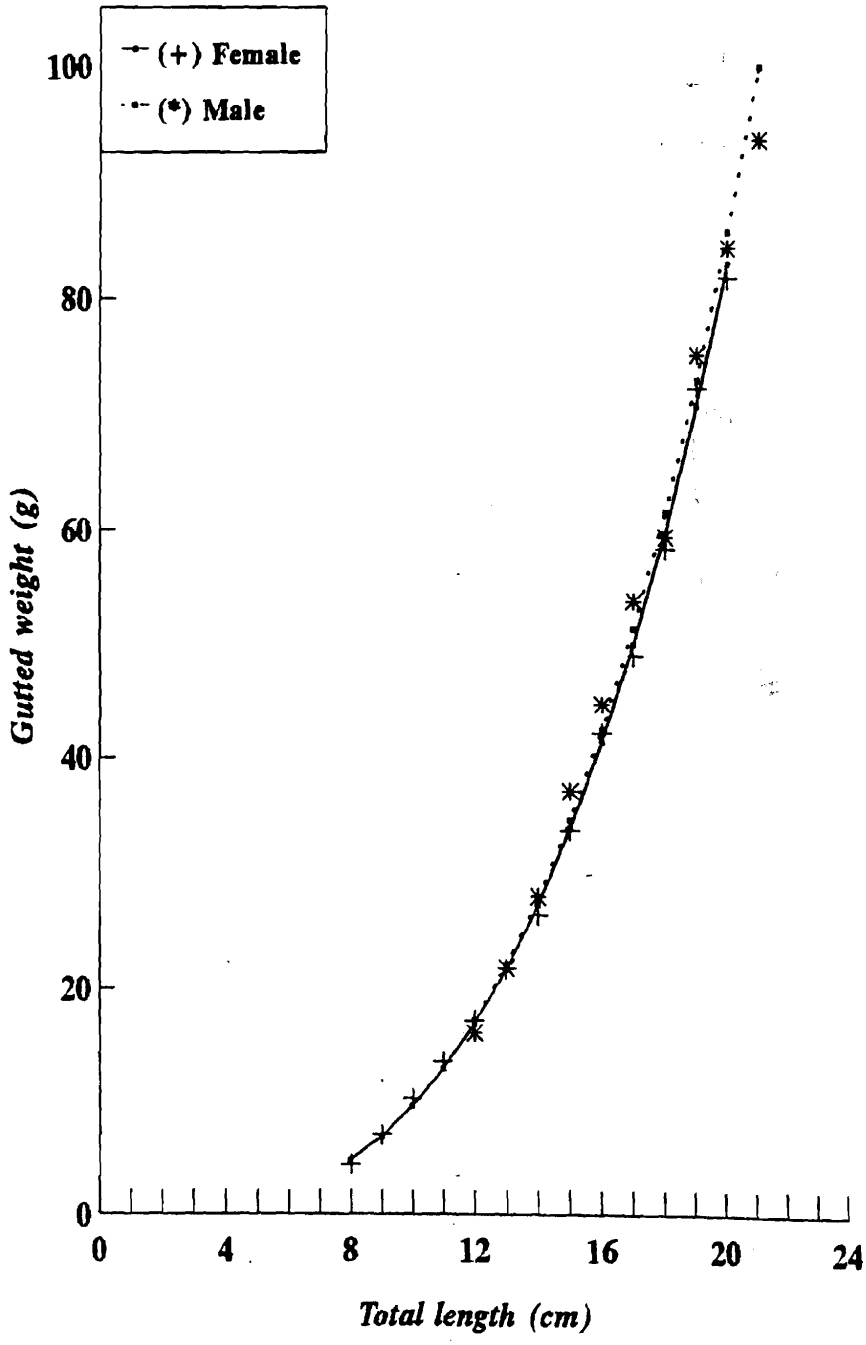

Fig. (2): Relationship between total length and gutted weight for male and female *Spicara flexuosa* in the Egyptian Mediterranean waters.

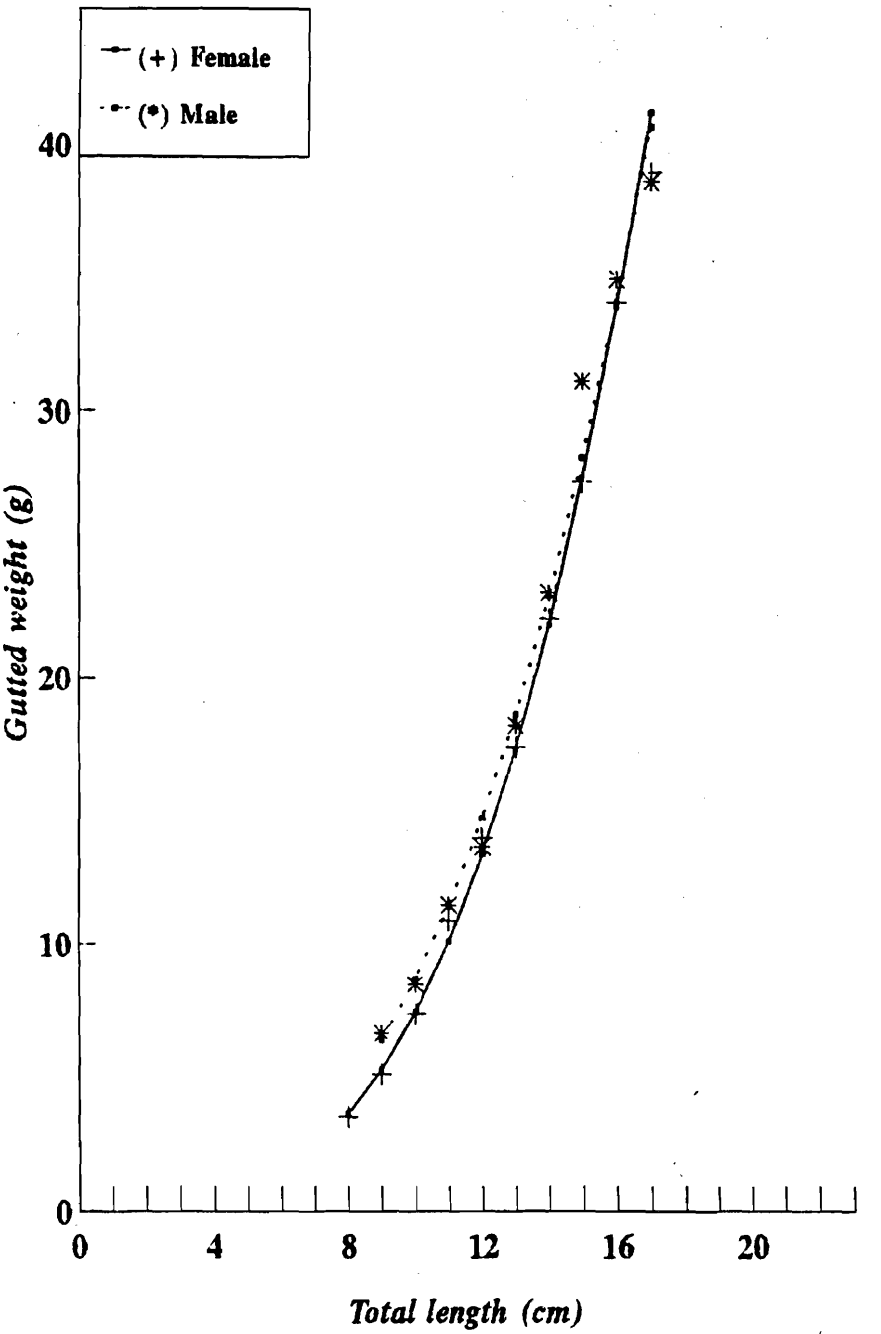

Fig. (3): Relationship between total length and gutted weight for male and female *Spicara smaris* in the Egyptian Mediterranean waters.

- Theoretical growth rate

Growth models were fitted to the back-calculated otolith data using von Bertalanffy growth formula (VBGF). The VBGF applied for ***S. flexuosa*** and ***S. smaris*** were expressed by the following equations:

For ***Spicara flexuosa***:

Male $L_t = 26.28\ [1 - e^{-0.1794\ (t + 2.29)}]$

$W_t = 203.36\ [1 - e^{-0.1795\ (t + 2.29)}]^{3.1562}$

Female $L_t = 23.77\ [1 - e^{-0.1975\ (t + 2.32)}]$

$W_t = 142.66\ [1 - e^{-0.1977\ (t + 2.32)}]^{3.1243}$

Combined sexes $L_t = 27.51\ [1 - e^{-0.1523\ (t + 2.53)}]$

$W_t = 228.48\ [1 - e^{-0.1524\ (t + 2.53)}]^{3.1378}$

For ***Spicara smaris***:

Male $L_t = 17.43\ [1 - e^{-0.8724\ (t + 0.04)}]$

$W_t = 43.84\ [1 - e^{-0.8714\ (t + 0.04)}]^{2.9152}$

Female $L_t = 21.03\ [1 - e^{-0.2149\ (t + 2.71)}]$

$W_t = 81.8\ [1 - e^{-0.2153\ (t + 2.71)}]^{3.2285}$

Combined sexes $L_t = 20.78\ [1 - e^{-0.2968\ (t + 1.63)}]$

$W_t = 77.60\ [1 - e^{-0.2968\ (t + 1.63)}]^{3.1562}$

From Tables 1&2, it was clear that lengths and weights at different ages predicted by von Bertalanffy growth equations showed negligible differences with those obtained by back-calculation.

- Maximum length (L_{max})

It has been observed, that generally in nature, the oldest fishes of a stock grow to reach about 0.95 of their asymptotic length (Beverton, 1963). Thus the maximum lengths computed for male & female of ***S. flexuosa*** and ***S. smaris*** were: 24.97, 22.58 and 16.56, 19.98 cm respectively.

DISCUSSION

The present study shows that the two main species of Egyptian picarels (***S. flexuosa*** and ***S. smaris***) live only up to four years. This finding agrees with that given by Tsangridis and Filippousis (1992) for ***S. smaris*** in Greece waters while it contradicts with that given for ***S. flexuosa*** in Tunisian waters, where its life span extends up to 12 years (Hattour ***et al.***, 1985). Analysis of covariance in the present work reveals significant differences in length-weight relationship between males of ***S. flexuosa*** & ***S. smaris*** ($F= 37.4$, $df= 1, 16$ $P<0.01$) and females ***S. flexuosa*** & ***S. smaris*** ($F= 126.8$, $df= 1, 20$ $P<0.01$). Such differences show that ***S. flexuosa*** are much plumper than ***S. smaris***. This finding agrees with the present observation, as ***S. flexuosa*** has large body depth as compared to that of ***S. smaris*** having the same size.

The back-calculated lengths at age estimated for males and females of the two species of picarels in the present study indicate non difference in growth in length whereas the growth in weight exhibits differential growth between sexes of both species from age I upward, as male fish have higher growth rate than females of the same age. Comparison of the growth rate of ***S. flexuosa*** in the present work with that given by Hattour ***et al.*** (1985) reveals that the growth rate of the Egyptian type from age I to IV (11.49, 13.57, 15.80 & 17.29 cm respectively) is greater than that found in Tunisian waters (7.29, 10.36, 13.03 & 15.31 cm respectively), while for ***S. smaris*** the growth rate of the Egyptian one shows lower values (11.30, 13.58, 15.67 & 16.83 cm respectively) as compared with that given by Tsangridis and Filippousis (1992) in Saronikos Gulf (13.9, 15.9, 18,4 & 19.9 cm respectively). This indicates that the environmental conditions of the Egyptian waters seem to be more favourable for the growth of ***S. flexuosa*** rather than for ***S. smaris***.

From Table (3) the estimated parameter of L in von Bertalanffy growth model for ***S. flexuosa*** in the present work (27.51 cm) is in close agreement with Hattour ***et al.*** (1985) in Tunisian waters ($L = 27.98$ cm). The same has been reported for ***S. smaris*** in the present work ($L = 20.78$ cm) and for that given by Tsangridis & Filippousis (1989) in Saronikos Gulf ($L = 21.24$ cm). It is worthy to mention that the estimated value of "K" parameter for Egyptian male ***S. smaris*** ($K= 0.8724$) is greater than for female ($K= 0.2149$). This result agrees with that given by Passeligue (1974) [cited from Dremiere (1981)] in Marseille

Table (3): Growth parameters of von Bertalanffy for ***S. flexuosa*** and ***S. smaris*** in the present study and in other areas of the Mediterranean basin.

Author	*Area*	*Method*	*Sex*	*Growth parameters* $L\infty$ *(cm)*	*K*	t_o
1- Spicara flexuosa						
Hattour et al. (1985)	Tunisian waters	Scale	combined	27.98	0.165	-0.967
Present work (1993)	Egyptian Medit. waters	otolith	male	26.28	0.1794	-2.29
		otolith	female	23.77	0.1975	-2.32
		otolith	combined	27.51	0.1523	-2.53
2- Spicara smaris						
Passelaigue (1974)	Marseil	otolith	male	24.8	0.89	-0.21
[cited from Dremiere (1981)]	(France)	otolith	female	23.3	0.50	-0.43
Tsangridis & Filippousis (1989)	Saronikos Gulf (Greece)	length frequency	combined	21.24	0.608	---
Tsangridis & Filippousis (1992)	Saronikos Gulf (Greece)	otolith	combined	18.73	0.929	-0.317
Present study (1993)	Egyptian Medi. waters	otolith	male	17.43	0.8724	-0.04
		otolith	female	21.03	0.2149	-2.71
		otolith	combined	20.78	0.2968	-1.63

waters where "K" for male= 0.89 and for female= 0.50, suggesting the presence of different growth rates for both sexes of this species .

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