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AGE AND GROWTH OF *EPINEPHELUS TAUVINA* (TELEOSTEI; SERRANIDAE) IN ARABIAN GULF, QATAR

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ABSTRACT

Data for length-weight relationships, age and growth were analyzed for *Epinephalus tauvina* in the area of the Arabian Gulf. Total length ranged between 24 cm and 97 cm and the gutted weight from 200 to 14550 gm. The length-weight relationship was determined for combined sexes ($W = 0.0082 L^{3.12}$). Age was determined by scale readings. Growth in length was expressed by Von Bertalanffy growth equation. Growth constants of VBGF were ($L\infty$ =136.26 cm, K = 0.059, t_o = -1.68 year).

1. INTRODUCTION

Epinephelus tauvina is a highly valued Serranid fish; it is widely distributed in the Arabian Gulf and is one of the most economically important species there. However, few studies were made on the age and growth of this species in such area. Some investigations were made on the growth parameters L_∞, K and to (Edwards *et al.*, 1985; Mathews and Samuel, 1987; Lee and Al-Baz, 1989 and Jeyaseelan, 1998). Accordingly, the present study is trying to give a new initiation to study the age and growth estimating the growth parameters for that species of economic importance in the area.

Some previous studies were made on the length-weight relationship of *Epinephelus tauvina* (Edwards *et al.*, 1985; Yanagawa, 1994). The present study aims to estimate the growth parameters of *Epinephelus tauvina* in Arabian Gulf, Qatar which is useful for making possible management studies in separate publications.

2. MATERIAL AND METHODS

The present study is conducted on 863 grouper fish (*E. tauvina*) collected from the commercial catch of Qatari fisheries, on a monthly basis. Random samples representing a wide range of total lengths (24 to 97 cm) and weights (200 g to 14.5 kg) were collected from commercial fishermen. For each fish, the total length (L) to the nearest mm and total weight (W) to the nearest gram was recorded. Scales were also collected from 343 specimens, and used for age estimation. Scale samples were taken from behind the pectoral fin above the lateral line. Scales were examined by a binocular microscope at a magnification power X4. Scale radius was measured as the distance from the focus to the anterior margin of the scale.

2.1. LENGTH WEIGHT RELATIONSHIP AND CONDITION FACTOR

The general power equation $W = aL^b$ was used to describe the length-weight relationship (Ricker, 1975). Absolute condition factor (Fulton, 1904; Hile, 1936; Freon, 1979) and relative condition factor (Le Cren, 1951) were estimated.

2. 2. LENGTH SCALE RELATIONSHIP

The age of grouper was determined by scale reading. The relationship between the scale radius and the total body length was represented by the following equation:

$$L = a + b\,S$$

Where, L is the total body length of the fish in cm, S is the total scale radius in micrometer division, a and b are constants determined by linear regression analysis.

2. 3. FISH GROWTH

Back-calculated lengths by the end of each year of life were calculated using the Lee's equation (Lee 1920). The Von Bertalanffy's growth model was computed according to Ricker (1975). The growth parameters, L_∞ and K were estimated according to Ford (1933)-Walford (1946) method and used to estimate the theoretical growth in length and weight.

3. RESULTS

3.1. LENGTHWEIGHT RELATIONSHIP AND CONDITION FACTOR

The length-weight relationship was calculated for the combined sexes (Fig. 1), the equation representing this relationship was:

$$W = 0.0082\,L^{3.12}$$

The value of the constant "b" indicates that this species shows isometric ponderal growth. The values of absolute condition factor (Kc) and relative condition factor (Kn) (Table 1) revealed a significant monthly variation in both factors (absolute: $F=10.879$, $df = 10$, $p < 0.01$ and relative: $F=8.711$, $df= 10$, $p < 0.01$). There was also a significant difference between the absolute and relative condition factors ($t = 180.006$, $df = 841$, $p < 0.01$). The mean absolute and relative condition factors were 1.321 and 1.001, with a mean difference between them 0.052).

3. 2. LENGTHSCALE RELATIONSHIP

As shown in Figure (2), the length-scale relationship of grassy grouper *E. tauvina* in Qatari waters is a linear relationship represented by the following equation:

$$L = 13.49 + 0.0067\,S \quad (r^2 = 0.980,\ p < 0.01)$$

Where: L is the total length in cm and S is the scale radius, measured in micrometer divisions.

3.3. BACK CALCULATED LENGTHS AND WEIGHTS

The back calculated lengths and weights up to 12 years (the maximum age in the sample) were estimated and used to draw the growth and increment curves (Fig 3). At the first year of age, *E. tauvina* had a back-calculated length of 24.2 cm and back-calculated weight of 169.4 g. The maximum rate of growth in length was recorded in the first year, followed by 7.7 cm in the second year of age. Growth rates in length decreased progressively with age after age group 9, with a minimum rate of growth being recorded at age 12, which was the oldest observed age in the sampled fish. Growth rate in weight increased year after year up to the age group 10 years then decreased again.

Table (1): Monthly variations in absolute (Kc) and relative (Kn) condtion factors for *Epinephelus tauvina* from Arabian Gulf, Qatar (1993) (mean values and standard errors).

Month	Absolute Condtion factor (Kc)	Relative cndition Factor Kn
February	1.348±0.106	1.024± 0.049
March	1.274±0.014	0.959±0.010
April	1.253±0.011	0.946±0.008
May	1.299±0.013	0.982±0.009
June	1.361±0.015	1.0280.011
July	1.389±0.020	1.046±0.014
August	1.356±0.018	1.029±0.013
September	1.349±0.014	1.032±0.011
October	1.376±0.015	1.043±0.012
November	1.367±0.021	1.047±0.014
December	1.366±0.024	1.032±0.018

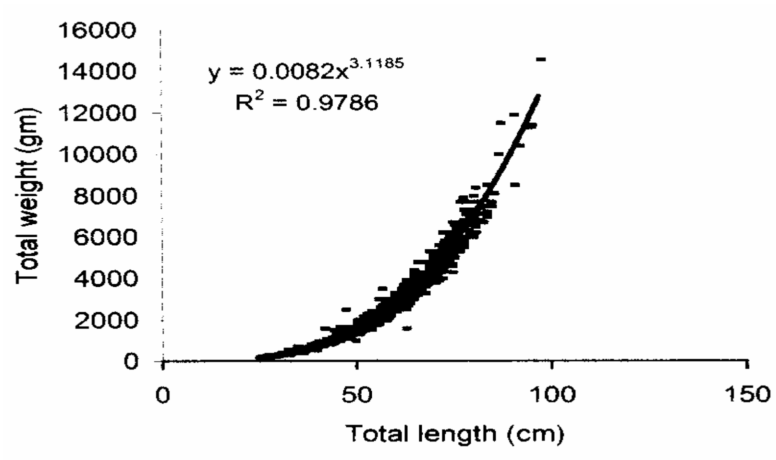


Fig. (1): Scatter diagram showing the length-weight relationship of *Epinephelus tauvina* from Arabian Gulf, Qatar.

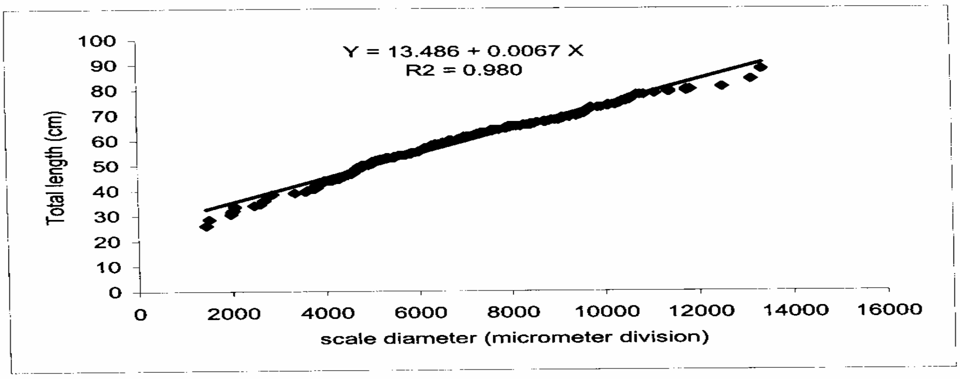


Fig. (2): Scattar diagram showing the length-scale relation of *Epinephelus tauvina* from Arabian Gulf, Qatar.

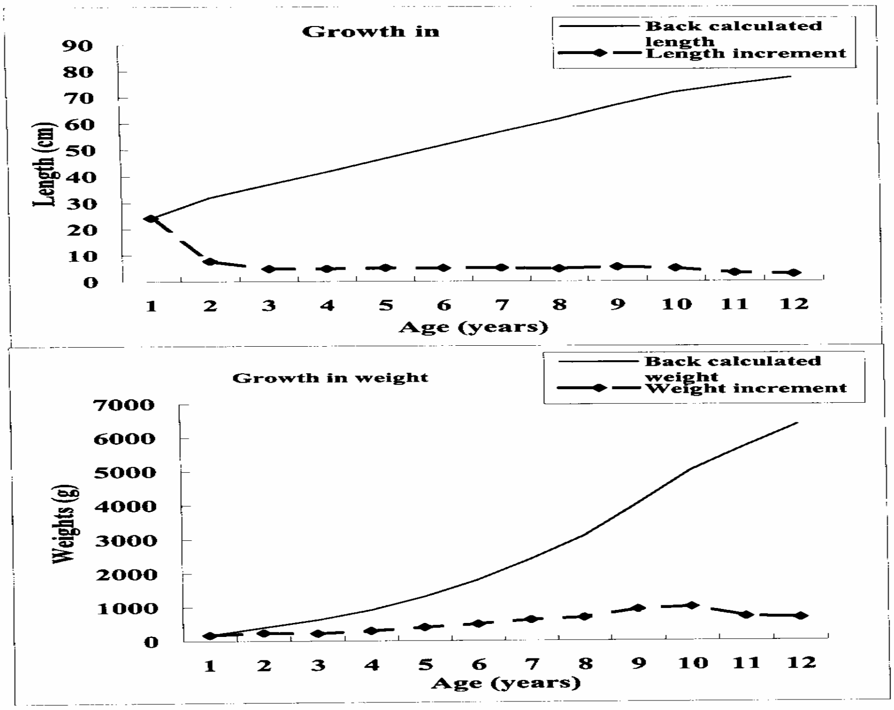


Fig (3): Growth Curves in length and weight for *Epinephelus tauvina* from Arabian Gulf, Qatar based on estimated back calculated length and weights.

3. 4. GROWTH PARAMETERS AND THEORETICAL GROWTH

The growth parameters of Von Bertalanffy were obtained by Ford-Walford method. The Von Bertalanffy equation representing these growth parameters was:

$L_t = 136.26\ [\ 1\text{- } e^{-0.059\ (t + 1.68)}]$

$W_t = 37045.17\ [\ 1\text{- } e^{-0.059\ (t + 1.68)}]^{3.12}$

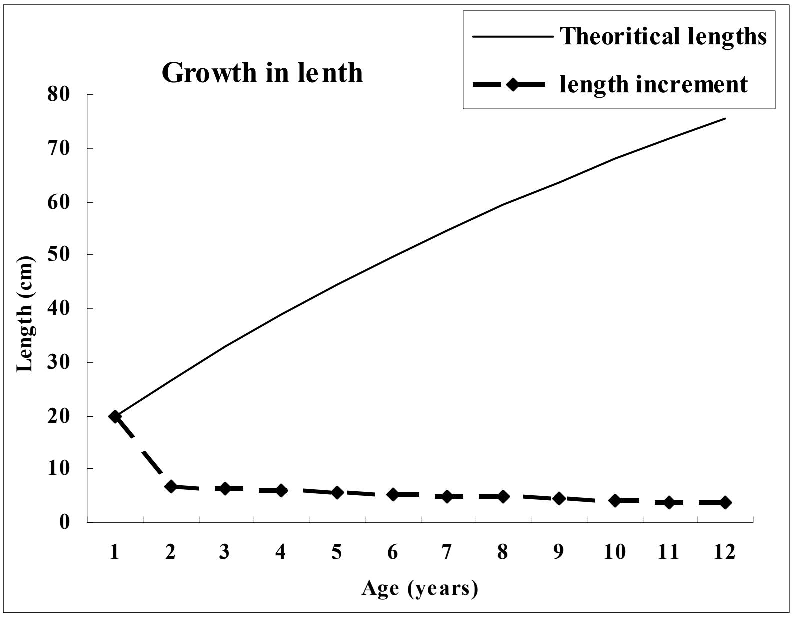
Using these models theoretical growth in length and weight were calculated as graphically represented shown in Figure (4). Statistical analysis showed that there was no significant difference, neither between back-calculated lengths and theoretical lengths (*F Ratio = 0.172; p > o.1*) nor between back-calculated weights and theoretical weights (*F Ratio = 0.165; p > o.1*).

4. DISCUSSION

The study of age and growth in fishes is an important method studying fishery biology, population dynamics and stock assessment (Sparre and Venema, 1998). The analysis of length-weight relationship for *E. tauvina* showed a curvilinear relationship. There are clear variations in the value of the constant (a) of the length-weight relationship from different localities and even within the same locality. The values of the constants of the length-weight relationship have been shown to differ from year to year, indicating a possible annual variation in this relationship (Le cren, 1951). The values of the exponent "b" of the length- weight relationship in the present study shows a nearly isometric growth and this is in accordance with the values obtained by Hussain & Abdullah (1977) in Kuwait and Mathews & Samuel (1987) also in Kuwait, (Table 2). The variation in the value "b" could be attributed to the differences in age, stage of maturity, sex, geographic location and environmental conditions (Le cren, 1951; Bagenal & Tesch, 1978).

The condition factor is a measure of the well-being and fatness of the fish (Lagler, 1956). It also can indicate the suitability of the environmental conditions for a certain species, i.e. measure the impact of environmental conditions on that species (Rounsefell and Everhart 1953; Lagler 1956; Sparre and Venema, 1998). The condition factor in the present study showed a seasonal fluctuation, with the absolute condition factor showing significant monthly variations. The same trend was true for the relative condition factor. The lowest values of K_c and K_n were recorded in spring months, i.e. during the spawning season. According to El-Sayed and Abdel Bary (1999) reported that *E. tauvina* in Arabian Gulf off Qatar spawn from late May to June. The highest values of both condition factors were recorded in the summer months. This may be attributed to the increase of feeding rate and food quantities compensate the energy that it had lost during the spawning season and to repeat the reproductive cycle. Seasonal variations in condition factor have been also recorded by several authors (Keys, 1928; Le Cren, 1951; Rounsefell and Everhart, 1953; Mehanna, 1996; Millan, 1998; Morkor and Rovrik, 2001).

The length-scale relationship of *Epinephelus tauvina* in the present study was found to be linear ($r^2 = 0.980$, p (b) < 0.0067), with a theoretical length of 13.49 cm before scale formation. The age these fish ranged from 1 – 12 years. The Von Bertalanffy growth model (VBGM) was used for the estimation of theoretical growth in length and weight of the fish. The value of L_∞ in the present study was slightly lower than the values reported by Edwards *et al.* (1985) in the Gulf of Aden (Table 2). However, this value was higher than the values recorded by Mathews and Samuel (1987) in Kuwaiti waters.



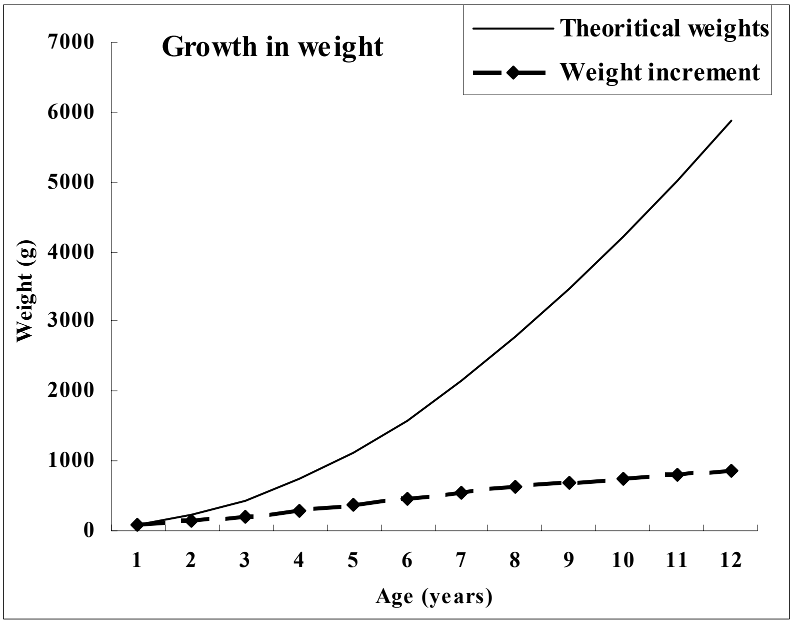


Fig (4): Theoretical growth curves for *Epinephelus tauvina* from Arabian Gulf Qatar.

Table (2): Values of "a" and "b" constants in the length-weight relationship and Von Bertalanffy growth parameters "K", "L∞" and "to" in various regions by various authors.

Area	Author	K (per year)	L_∞ (cm)	t_o (year)	a	b
Kuwait	Hussain&Abdullah,1977	-	-	-	0.0228	3.021
Kuwait	Lee&Al-Baz ,1989	0.15	99.1	-	-	3
Kuwait (sampling year 1983)	Mathews&Samuel ,1987	0.171	92	-0.82	-	-
Kuwait (sampling year 1982)	Mathews&Samuel, 1987	0.121	102	-1.38	-	3.024
Gulf of Aden (Yemen)	Edwards *et al.* , 1985	0.09	150	0.007	0.031	2.84
Thailand	Yanagawa, H., 1994	-	-	-	0.0156	2.957
Arabian Gulf (Qattar)	Present study	0.059	136.26	-1.68	0.0082	3.12

These discrepancies may have been related to variations in environmental conditions, sample size, sampling techniques and computations (Algeria-Hernandez, 1986 and 1989) and sampling locations and season. For example, Bruton (1990) reported that the variations in population parameters of *E. tauvina* in different areas are related to food conditions and prevailing temperatures.

The value of K in the present study was also lower than those reported on the same fish in Kuwaiti waters, indicating that the rate of growth of *Epinephilus tauvina* in the Qatari waters is slower than their growth in Kuwaiti waters and Gulf of Aden (Lee & Al-Baz, 1989; Edwards *et al.*, 1985; Mathews & Samuel, 1987). This is may be due to the effect of oil pollution after The Gulf War 1990.

The variations in population parameters of *E. tauvina* in different areas, and even in the same area, can be due to food availability and environmental conditions, especially prevailing temperatures (Bruton, 1990). Water temperature can affect fish growth directly by affecting the physiology of the fish (Weatherley and Gill, 1987). Ross (1988) observed that cool waters produce larger, older and later maturing individuals of species than warm waters.

It is should be mentioned that in the present study and by using the statistical analysis ANOVA it appeared that there were no significant differences neither between back-calculated lengths and theoretical lengths nor between the back-calculated weights. This is approving the correctness of the growth parameters obtained and the models used in the calculations.

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