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GROWTH AND MORTALITY OF LONGSPINE SEABREAM, *ARGYROPS SPINIFER* (TELEOSTEI : SPARIDAE) IN THE ARABIAN GULF WATERS OFF QATAR

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ABSTRACT

Age, growth and mortality of longspine seabream, *Argyrops spinifer* in the Arabian Gulf waters off Qatar were investigated. The study was conducted on 664 fish obtained from Qatar National Fishing Company. The results revealed that the maximum age of studied fish was 18 years. The length/scale relationship was TL = -7.1478 + 0.232TS (r=0.925). The relationship between total length and total weight was best fit by a curvilinear equation: $TW = 0.0398TL^{2.7376}$. The von Bertalanffy growth equation obtained from back-calculated data was : $L_t = 81.01\ [1-e^{-0.094\ (t+1.08)}]$. The rates of growth in length and weight (% increment) were highest at the end of the first year of life, followed by a gradual decrease throughout the fish life. The instantaneous total mortality estimate (Z), natural mortality (M) and fishing mortality (F) were 0.43, 0.29 and 0.14, respectively, while survival rate was 0.65.

INTRODUCTION

FISHES of family Sparidae are among the most important fishes in the world. They are highly esteemed in the Arabian Gulf region (Morgan 1985; Samuel and Mathews 1987; El-Sayed, 1992). The annual catch of sparid fishes in Qatari waters is represented mainly by three species; *Mylio bifasciatus, Crenidens crenidens* and *Argyrops spinifer*. These fishes are highly demanded in Qatari fish market.

Despite the economic importance of sparid fishes in the Gulf region, little is known on their biology, feeding habits, reproduction patterns, abundance and population dynamics. The present study throws light on the age, growth and mortality of the longspine seabream, *Argyrops spinifer* in the Arabian Gulf waters off Qatar.

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MATERIALS AND METHODS

The study was conducted on 664 fish (both sexes) collected from November 1992 through October 1993. Monthly random samples representing *A. spinifer* population in Qatari waters were obtained from Qatar National Fishing Company (QNFC). A wide range of sizes (14-74.5 cm total length) were sampled. For each fish, the total length (cm), total weight (g) and sex were recorded.

The fish ages were determined using the scale-reading methods. Scales were taken from the left side of the fish, beneath the tip of the pectoral fin. They were soaked in 10% ammonia solution for 12 hrs, rubbed between fingers to remove chromatophores, integument and dirts and washed in tap waters. After drying with filter paper, 3-5 scales from each fish were mounted between two clean glass slides. The

clearest scale was used for age determination using a steriomicroscope equipped with an eye micrometer. Scales were read from the nucleus along the anterior radius. Several examined scales have shown various degrees of resorption, and in turn, were not used for age determination. In addition, fish greater than 70 cm in length were not aged because it was extremely difficult to read their scales.

The length/scale (L/S) relationship was derived by plotting the total scale length (TS) on total fish length (TL). The intercept value (a) of the regression equation was used to back-calcuate the fish length at the end of each year of life according to Lee (1920).

The length/weight (L/W) relationship was determined by fitting a least square logarithmic regression to the data using the following equation: $TW = aTL^b$, where, TW = total weight (g) TL = total length (cm), a and b = constants.

Growth parameters were obtained from back-calculated data and were used to calculate the von Bertalanffy (1938) growth equation (VBGE) :

$L_t = L_\infty [1-e^{-K(t-t_o)}]$, where:

L_t = total fish length at age t, L_∞ = maximum attainable length, K = growth coefficient and t_o = hypothetical age at which the fish length is zero. The Bertalanffy curve was fitted using Beverton's method (Beverton, 1954).

A simple catch curve was used for estimating fish mortality. The $\log_e$ of numbers of catch at each age were plotted, and a least squares regression was fitted to the descending right limb. The slope of the line equals the instantaneous rate of mortality (Z), while the survival rate (S) = e^{-Z}. Since no information is available on natural mortality (M) of these fish, an indirect method was adopted to predict its value using Alverson and Carney (1975) equation:

$t_{max} \times 0.38 = (1/K) \ln [(M + 3K)/M]$,

where: t_{max} = maximum fish age and K = growth coefficient.

RESULTS

Growth

The relationship between total fish length and weight was best fit by the following curvilinear equation:

$TW = 0.0398TL^{2.7376}$

$\log TW = -1.3999 + 2.7376 \log TL$, r = 0.999.

while a linear relationship was found between total scale radius and total fish length (TL = -7.1478 + 0.232 TS, r = 0.925). The value of the intercept (-7.1478) was used to back-calculate fish length and growth increment at the end of each year of life. The back-calculated lengths and weights are given in Table 1.

TABLE 1. *Back-calculated total lengths (TL., cm), weights (TW, g) and increment (Inc. (%) of A. spinifer in Qatari waters.*

Age	Number	TL	Inc.(%)	TW	Inc. (%)
1	33	14.39	—	59	—
2	171	20.36	41	152	128
3	148	25.81	27	292	92
4	81	30.76	19	472	62
5	49	35.26	15	685	45
6	33	39.40	12	929	36
7	27	43.11	9	1187	28
8	12	46.50	8	1462	23
9	9	49.60	7	1744	19
10	5	52.40	5	2028	16
11	4	55.00	5	2314	14
12	3	57.31	4	2590	11
13	2	59.44	4	2862	11
14	1	61.17	3	3096	08
15	1	63.13	3	3375	09
16	1	64.74	3	3616	07
17	1	66.16	2	3838	06
18	1	67.52	2	4057	06

The growth rates in length and weight of *A. spinifer* were steady over their life span (table 1). The annual growth increment (%) was highest at the end of the first year. A gradual decrease was then observed from the second year onward (Fig. 1).

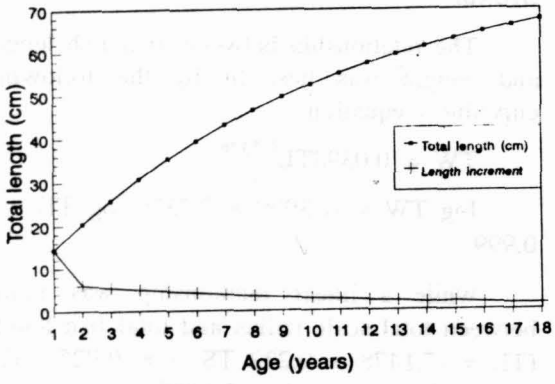

FIG. 1. Growth curve of *A. Spinifer* fitted by VBGE

The VBGE representing the estimates of growth parameters, obtained from scales readings were:

$$L_t = 81.01\ [(1- e^{-0.094\ (t+1.08)}]$$

Mortality

A. spinifer are fully recruited, and in turn, fully vulnerable to fishing at age 3. Mortality estimates were determined from the catch curve (Fig. 2). Because only few fish older than 14 years of age were caught, mortality rate (Z) was calculated based on fish aging 3 to 14 years. The estimate of total instantaneous rate of mortality was 0.43 (Y=5.61-0.431X, r = -0.996). The survival rate (S) was 0.65 ($S = e^{-0.44}$). This value indicataes that 64% of the fish survive per year after the third year of fish life. The natural mortality (M) was 0.29. Fishing mortality was then 0.14 (0.43 - 0.29 = 0.14). The annual morality was 1-S = 0.35.

DISCUSSION

Age

Sparid fishes, in general, are long lived, displaying a steady and slow rate of growth (Manooch and Huntsman, 1977; Morgan, 1985; Samuel and Mathews, 1987; El-Sayed and Abdel-Bary, 1993). According to the present study, the maximum age of *A. spinifer* was 18 years. This however, appears to be an underestimate of the maximum attainable age,

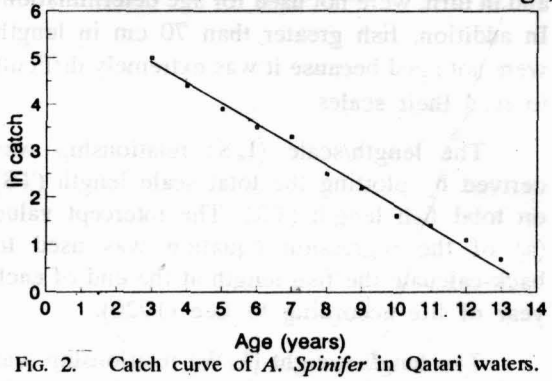

FIG. 2. Catch curve of *A. Spinifer* in Qatari waters. First two values were not used in the regression.fitted by VBGE

since fish more than 70 cm in length were excluded. The low value of growth coefficient K (0.094) indicates that these fish need many years to reach thier L_∞. Therefore, it would be safe to assume that this fish can live up to 20 years or more. Individuals of the same species have been living in Qatar National Marine Aquarium for about 19 years (personal communication). Moreover, a maximum age of 21 years has been reported for another sparid; *Acanthopagrus bifasiatus* in Kuwaiti waters (Samuel and Mathews, 1987).

It should be mentioned that various degrees of resorption of scales have been noted during scale readings. Resorbed scales should not, therefore, be used for age determination. The phenomena of scale resorption, regeneration and false annuli have been reported on the sparids *Chrysophrys auratus* (Paul 1968), red porgy *Pagrus pagrus* (Manooch and Huntsman, 1977) and *M. bifasiatus* (El-Sayed and Abdel-Bary, 1993).

Growth

The value of the slope (b) of the length/weight regression of *A. spinifer* in the

present study compares favourably with the values reported on *Pagrus sedecim* (Dias *et al*, 1972), *P. pagrus* (Manooch and Huntsman, 1977) and *A. latus* (Samuel and Mathews, 1987) (Table 2). The maximum attainable length (L_∞ = 81.01) appears somewhat realistic, since a 75 cm fish was caught in May, 1993. In addition, a number of *A. spinifer* measuring about 75 cm (TL) are currently kept alive in Qatar National Marine Aquarium (Personal communication). A maximum size of 79 cm was also recorded in the Gulf of Oman (FAO/UNDP, 1981). Furthermore, the maximum attainable length of another sparid; *A cuvieri*, was 81.86 (Samuel and Mathews, 1987). Generally, the maximum length of sparid fishes in the Arabian Gulf ranges from about 35 to 82 cm (Table 3).

TABLE 2. *Estimates of length/weight relationships of sparid fishes.*

Species	a	b	Reference
P. sedecim	0.0000697	2.7385	Dias et. al. (1972).
P. pagrus	0.0000252	2.8939	Manooch & Huntsman (1977).
P. erythrinus	0.0000270	2.9302	Vassilopoulou et. al. (1986).
A. cuvieri	0.01165	3.03737	Samuel and Mathews (1987).
A. latus	0.02874	2.79198	Samuel and Mathews (1987).
A. berda	0.01713	3.01578	Samuel and Mathews (1987).
A. bifasciatus	0.01763	3.00075	Samuel and Mathews (1987).
M. bifasciatus	0.01727	3.01621	El-Sayed and Abdel-Bary (1993)
A. spinifer	0.03980	2.73761	Present study.
Boops boops	0.01112	2.9166	Hassan (1990).
B. salpa	0.01079	3.0560	Hassan (1990).

Mortality

The rates of instantaneous mortality and survival of *A. spinifer* in the present study are comparable to those of *P. pagrus* (Manooch and Huntsman, 1977), *A. cuvieri* and *A. latus* (Samuel and Mathews, 1987) and *M. bifasciatus* (El-Sayed and Abdel-Bary,

TABLE 3. *Growth and mortality estimates of sparid fishes*

Species	L_∞	K	t_o	Z	S	t^1max	Reference
P. pagrus	76.30	0.096	-1.88	0.44	0.64	15	Manooch and Huntsman (1977).
A. latus	43.00	0.20	—	0.97	0.38	—	Morgan (1985).
A. latus	40.48	0.26	-0.97	0.60	0.55	14	Samuel and Mathews (1987).
A. berda	37.35	0.33	-0.35	0.39	0.68	14	Samuel and Mathews (1987).
A. cuvieri	81.86	0.28	-0.55	0.36	0.70	11	Samuel and Mathews (1987).
A. bifasciatus	34.90	0.19	-2.24	0.037	0.96	21	Samuel and Mathews (1987).
M. bifasciatus	47.12	0.14	-1.70	0.40	0.67	14	El-Sayed and Abdel-Bary (1993)
A. spinifer	81.01	0.094	-1.08	0.43	0.65	18	Present study

t^1max = maximum reported age.

1993). However, this rate was much lower than that reported in *A. latus* (Morgan, 1985) and much higher than that of *A. bifasciatus* (Samuel and Mathews, 1987). These discrepancies may have resulted from sampling problems and / or sample sizes. For example, Morgan (1985) conducted his study on *A. latus* ranging from 19 to 30 cm only. This segment of the population represented three to six-year old fish. Therefore, an extremely high mortality rate was obtained. On the other hand, Samuel and Mathews (1987) estimated the rate of mortality of *A. bifasciatus* on only 21 fish sample. The result is questionable, since adequate numbers of fish representing all age groups are needed for reliable estimates of growth and mortality rates.

It is clear from the present study that fishing mortality F is very low compared to natural mortality M. This concludes that the current landing of this fish is lower than what the fishery can sustain, as has been reported by El-Sayed (1992). Therefore, increase in fishing effort for this fish is recommended.

As stated earlier, mortality estimates were based on fish aging 3-14 years. Fish older than 14 years were excluded from the catch curve analysis. Since old fish, generally, have higher mortality rates than smaller fish, the value of Z may, then, be an underestimate. Therefore, mortality and survival estimates reported in the present study should be carefully interpreted.

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