Population characteristics and growth of *Spicara maena* (Linnaeus, 1758) inhabiting in Babadillimani Bight (northeastern Mediterranean-Turkey)

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Abstract:

This study was carried out between May 1999 to April 2000 in Babadillimani Bight. A total of 1380 specimens were trawled by monthly sampling and examined. It was found that age composition of *Spicara maena* (blotched picarel) varied from I to IV and they were composed of 78.12% females and 21.88% males. The measured mean total length and weight values for females, males and combined sexes were 9.68±2.36cm-11.42±8.61g, 13.64±1.40cm-29.20±9.54g and 10.55±2.74cm-15.31±11.48g respectively. In addition to this, the calculated length-weight relationships were $W=0.0075*L^{3.1397}$ for females, $W=0.0093*L^{3.0654}$ for males and $W=0.0076*L^{3.1374}$ for pooled data. The von Bertalanffy growth parameters were estimated for combined sexes were: L_∞=21.72cm, K=0.385year^{-1} and t_o=-0.135year. According to monthly changes of Gonadosomatic Index and Fulton's Condition Factor values spawning were occurred between March and May.

Key words: *Spicara maena*, blotched picarel, Northeastern Mediterranean, growth, length-weight relationship

INTRODUCTION

Spicara maena is a commercial species inhabiting in the Mediterranean, Black Sea, and along the European and African coast of Atlantic, from Morocco to Portugal and Canary Islands [1]. This species commonly inhabit over posidonia beds and sandy or muddy bottoms, and distributes up to 100 m depth. *S. maena* feeds on mainly zooplankton. It is a protogynous hermaphrodite and a total spawner from August to October [2].

There is a limited study carried out on the biology and ecology of this species. Only one comprehensive study was published on the age, growth, size at sex inversion and mortality in the Adriatic (Croatian waters) [3]. Some authors were presented data on length-weight relationship all around the Mediterranean coasts [4-8]. Arculeo et al. [9] studied about protein differences among the Mediterranean species of the genus Spicara. Therefore the main objective of present study was to estimate the age, growth and reproduction of *S. maena* distributed in the Babadillimani Bight-northeastern Mediterranean coast of Turkey.

MATERIAL AND METHODS

This study was carried out in Babadillimani Bight (33°23′36′′-33°32′57′′N; 36°07′00′′-36°09′39′′E) located in the Cilician Basin, northeastern Mediterranean at monthly sampling interval using a commercial bottom trawl net from May 1999 to April 2000. Fishes were caught from 20 to 100m depth ranges by using typical Mediterranean deep trawl net with 6mm cod end mesh size, and tow duration was restricted with 1 hour. A total of 36 hauls were analyzed during the sampling period. Samples were collected randomly from each haul as recommended by Holden and Raitt [10] and preserved in 4% formaldehyde solution buffered by borax. In the laboratory, the total length (TL), total weight (TW) and total gonad weight (TGW) measurements were made with the nearest 0.1 cm, 0.01 g and 0.0001 g respectively.

The sagittal otoliths were examined under the stereo binocular microscope for the age determination. The length-weight relationship (LWR) was calculated by using the formula $W=a*L^b$ for females, males, and the combined sexes because of males and females may have different growth models [5,6]. In order to test the possible significant differences between sexes, t-test was used to comparison of two slopes. The parameters "a" (proportionality constant) and "b" (regression coefficient) of the LWR were estimated by the Least Square Regression Method [11], and the growth type was identified by the t-test using the SPSS computer program. The growth parameters "K", "L_∞" and "t_o" were estimated using the Least Square Regression Method recommended by Sparre and Venema [11].

In order to estimate the spawning season, monthly mean Gonadosomatic Index (GSI) values were calculated by using the formula given by Gibson and Ezzi (12) as GSI=(GW/TW-GW)*100. The Fulton's Condition Factor (CF) was calculated by using the formula $CF=W/L^3*100$ to assess the maturity and condition of the specimens.

RESULTS

Sex ratio

A total of 1380 specimens sexed, among them 1078 were females (78.12%) and 308 were males (21.88%). The overall female:male ratio was 3.57:1, and χ^2 analysis showed that there was a significant difference between 1:1 ratio and calculated one. Examination of the female ovaries indicated that the sexual maturation was started at age group I. Sex inversion which realized from female to male was observed over 10.9 cm total length.

Age composition

A total of 905 specimens were aged, and age of *S. maena* varied from I to III for females, II to IV for males and I to IV for combined sexes. The age frequency distributions for females, males and combined sexes were was presented in Table 1. As can be seen in Table 1, age I was dominant for females and combined sexes, and dominancy decreases with increasing age. According to percentage occurrence, age group I was dominant for combined sexes, and it was followed by the age groups II, III and IV.

Table 1. Age-frequency distribution for females, males and combined sexes

Age groups	Females		Males		Combined sexes	
	n	%	*n*	%	*n*	%
I	423	59.00	---	---	423	46.74
II	273	38.07	123	65.43	396	43.76
III	21	2.93	63	33.51	84	9.28
IV	---	---	2	1.06	2	0.22
Total	717		188		905	---

Length-frequency distribution

Mean total length for each age group and growth rate between subsequent age groups were presented in Table 2. As can be seen Table 2, total length of all individuals varied from 5.3 to 17.8cm and mean total length calculated as 9.68±2.36cm (5.3-16.5cm) for females, 13.64±1.40cm (10.9-17.8cm) for males and 10.55±2.74cm for combined sexes (Table 2). Mean annual growth rate in length was highest during the first year and followed by year 2 and subsequent years. While dominant length group was 7cm for females and all individuals, 14cm for males.

Table 2. Minimum, maximum, mean total length (TL, cm) and growth rate (GR) between the subsequent age groups for each sexes

Age	Females		Males		Combined Sexes	
Group	TL	GR	TL	GR	TL	GR
I	7.68±1.49 (5.3-19.5)	53.91	---	---	7.68±1.15 (5.3-10.5)	58.73
II	11.82±1.25 (8.7-15.5)	26.83	12.99±0.99 (10.9-14.7)	17.40	12.19±1.29 (8.7-15.5)	24.45
III	14.99±0.64 (13.9-16.5)	---	15.25±0.99 (14.0-16.8)	13.44	15.20±0.69 (13.9-16.8)	14.04
IV	---	---	17.30±0.71 (16.8-17.8)	---	17.30±0.71 (16.8-17.8)	---
Total	9.68±2.36 (5.3-16.5)	---	13.64±1.40 (10.9-17.8)	---	10.55±2.74 (5.3-17.8)	---

Weight-frequency distribution

Mean total weight in weight for each age group and growth rate between subsequent age groups were presented in Table 3. As summarized in Table 3, the total weight was ranged from 1.71 to 46.39g for females, 14.14 to 59.65g for males and 1.71 to 59.65g for combined sexes. The mean weight for females, males and combined sexes were calculated as 11.42±8.61g, 29.20±9.54g, and 15.31±11.48g respectively. The mean annual growth in weight between the first and second year was highest followed by subsequent years.

Table 3. Minimum, maximum and mean total weight (TW, g) and growth rate (GR) between the subsequent age groups for each sex

Age	Females		Males		Combined Sexes	
Group	TW	GR	TW	GR	TW	GR
I	4.82±2.43 (1.71-10.87)	279.88	---	---	4.82±2.43 (1.71-10.87)	318.47
II	18.31±6.04 (8.69-33.93)	103.71	24.31±5.32 (14.16-33.59)	67.79	20.17±6.45 (8.69-33.93)	97.92
III	37.30±4.15 (32.10-46.39)	---	40.79±5.86 (33.75-54.51)	43.69	39.92±5.67 (32.10-54.51)	47.82
IV	---	---	58.61±1.47 (57.57-59.65)	---	57.61±1.47 (57.57-59.65)	---
Total	11.42±8.61 (1.71-46.39)	---	29.20±9.54 (14.16-59.65)	---	15.31±11.48 (1.71-59.65)	---

Length-weight relationship

Length-weight relationship parameters for females, males and combined sexes were presented in Table 4. It is clearly shown in Table 4 parameter "b" values were estimated as 3.1397, 3.0654 and 3.1374 for females, males and combined sexes respectively. All of the values were over the 3 and also result of the t-test, estimated "b" values significantly different from 3, and type of growth was positive allometry.

GROWTH

von Bertalanffy growth equation parameters in length and weight were presented in Table 4. The estimated von Bertalanffy growth constants were: $L\infty$=25.35cm, K=0.267year-1 and to=-0.352year for females, $L\infty$=37.32cm, K=0.098year-1 and to=-3.388year for males and $L\infty$=21.72cm, K=0.385year-1 and to=-0.135year for combined sexes. As can be seen from Table 4, theoretical maximum length and weight for males were higher than that of females.

Calculated mean length and weight for each age group of each sexes using length-weight relationship were presented in Table 5. When taken into consideration measured values for each age group of each sex and their pooled data given in Table 2 and calculated values from the Table 6, then it could be reported that, there were very close correlation between measured and calculated length and weight (R=0.99).

Table 4. Length-weight relationship parameters and von Bertalanffy growth parameters in length and weight for females, males and combined sexes (+A: positive allometry)

Parameters	Females	Males	Combine Sexes
N	1078	302	1380
a	0.0075	0.0093	0.0076
b	3.1397	3.0654	3.1374
SE of b	0.016	0.012	0.010
95% Confidence intervals of *b*	3.078-3.140	3.138-3.186	3.118-3.157
r^2	0.982	0.991	0.987
Type of Growth	+A	+A	+A
L_∞(cm)	25.35	37.32	21.72
W_∞(g)	191.93	612.51	118.87
t_o (year)	-0.352	-3.388	-0.135
K($year^{-1}$)	0.267	0.098	0.385

Table 5. Calculated mean length and weight for each age group of females, males and combined sexes

Age Groups	Females		Males		Combined Sexes	
	Length	Growth rate	Length	Growth rate	Length	Growth rate
0	3.74	0.45	4.69	0.91	4.09	0.59
I	8.55	5.91	8.75	6.35	8.63	6.09
II	12.02	17.06	11.88	16.48	11.99	16.93
III	14.51	30.72	14.29	29.32	14.46	30.38
IV	16.30	44.18	16.15	42.91	16.28	43.98

Monthly changes to the mean Fulton's Condition Factor (CF) and Gonadosomatic Index (GSI±SD) values were shown in Fig. 1. As can be seen from the Fig. 1 it can be claimed that, spawning was occurred in between of March to May in the eastern Mediterranean for *S. maena*. Indeed, GSI values started to increase from November with the producing gonads and reach the highest value on March. Because of the starting spawning, GSI values decreased sharply until May. In contrast the GSI values, CF started to increase after the spawning (March).

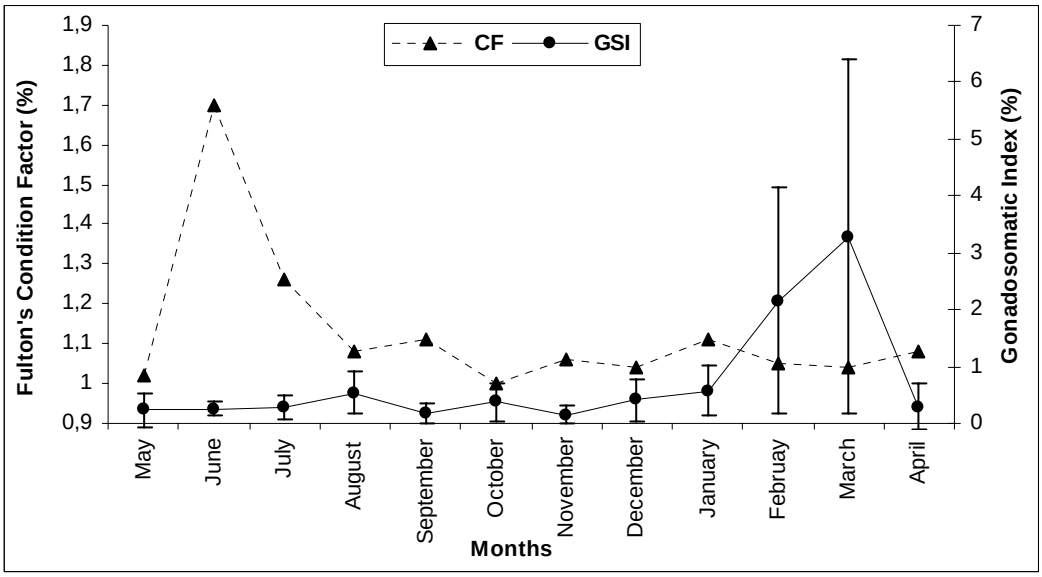

Figure. 1. Monthly changes of Fulton's condition factors and gonadosomatic index

DISCUSSION

Length-weight relationship constants studying for *S. maena* inhabiting along the Mediterranean was shown in Table 6. As can be seen from Table 6, "b" values varied from 2.663 to 3.2618 with a median value 3.0649. In this study "b" value was estimated as 3.1374 and it is determined that there was no significant differences between this value and median (t-test, $p>0.05$). Geographic location and associated environmental conditions, such as seasonality (date and time of capture), stomach fullness, disease and parasite loads can effect length-weight relationship [13]. As can be seen from Table 6, length range for each study was very different for each study. Length range for the estimation of length-weight relationship can also effect the length-weight relationship estimation.

Table 6. Estimated length-weight relationships for *Spicara maena* distributed along the Mediterranean coasts

n	Length	a	b	r^2	Location	Author
33	11.7-18.4	0.000083	2.663	0.90	Greece	Petrakis and Stergiou, 1995
-	-	0.0122	3.037	0.872	Croatia	Dulcic and Kraljevic, 1999
1130	7.8-27.5	0.00895	3.12	0.991	Croatia	Dulcic et al. 2000
808	14.3-26.0	0.0104	3.096	0.88	Greece	Moutopoulos and Stergiou, 2002
92	4.7-21.2	0.00543	3.262	0.997	Spain	Vale et al. 2003
86	12.5-19.9	0.0113	3.065	0.905	Spain	Morey et al. 2003
1380	5.3-17.8	0.0076	3.137	0.987	Turkey	This study

The length-weight relationships reveal that males are heavier than that of females for a given length. This may be explained by protogynous hermahproditism, because females predominated in smaller size classes and males larger ones. Similar results have been reported for *Pagellus erythrinus* which is a protogynous hermahprodit fish species [14].

In this study, sex inversion was started from 10.9 cm total length. Salekhova [15] reported that sex inversion for this species was between 12.1 and 15.0cm for the area of Island Lampedusa, and Dulcic et al. [3] was observed over 16.0cm for Croatian waters. The overall female:male ratio was observed 3.57:1 in this study. Previous studies female:male ratio was reported over the 1:1 and this situation was explain as a result of protogynous hermahproditism [3].

Hureau [1] reported that spawning of *S. maena* was occurred from August to October. But, according to monthly changes of GSI and CF values, it was observed that spawning were occurred between March and May in the studied area.

REFERENCES

[1]. Hureau JC. (Ed.) 1996. Fishes of the North-eastern Atlantic and the Mediterranean, World Biodiversity Database CD-ROM Series. Version 1.0, UNESCO.

[2]. Froese R, Pauly D. (Editors) 2005. FishBase, World Wide Web Electronic Publication. www.fishbase.org, Version (03/2005).

[3]. Dulcic J, Kraljevic M, Grbec B, Cetinik P. 2000. Age, growth and mortality of blotched picarel *Spicara maena* L. (Pisces: Centracanthidae) in the eastern central Adriatic. Fisheries Research. 48: 69-78.

[4]. Petrakis G, Stergiou K. 1995. Weight-length relationships for 33 fish species in Greece waters. Fisheries Research. 21 (3-4): 465-469.

[5]. Dulcic J, Kraljevic M. 1996. Weight-length relationships for 40 fish species in the eastern Adriatic (Croatian waters). Fisheries Research. 28 (3): 243-251.

[6]. Moutupoulos DK, Stergiou KI. 2002. Length-weight and length-length relationships of fish species from the Aegean sea (Greece). Journal of Applied Ichthyology. 18: 200-203.

[7]. Valle C, Bayle JT, Ramos AA. 2003. Weight-length relationships for selected fish species of the western Mediterranean Sea. Journal of Applied Ichthyology. 19: 261-262.

[8]. Morey G, Moranta J, Massuti E, Grau A, Linde M, Riera F, Morales-Nin B. 2003 Weight-length relationships of littoral to lower slope fishes from the western Mediterranean. Fisheries Research. 62**:** 89-96.

[9]. Aruleo M, Mauro A, Scelsa G, Lo Brutto S, Cammarata M, Parrinello N. 1996. Protein differences among the Mediterranean species of the genus Spicara. Journal of Fish Biology. 49 (6): 1317-1372.

[10]. Holden M. J. and Raitt, D. F. S. (1974) Methods of fisheries resource investigation and their application. Part 2, Manual of Fisheries Science. FAO Fisheries Tech. Pap. Rev. 1, 214p.

[11]. Sparre P, Venema SC. 1992. Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fish. Tech. Pap. No. 306. 1. Rev. 1. Rome, 376p.

[12]. Gibson RN, Ezzi IA. 1978. The biology of a Scottish population of Fries' goby, *Lesuerigobius friessi*. Journal of Fish Biology. 17: 371-389.

[13]. Begenal TB, Tesch FW. 1978. Age and growth. In: Methods for assessment of fish production in freshwaters (eds T. B. Begenal). IBP Handbook, Vol: 3, Blackwell Scientific Publications, London, 101-136.

[14]. Pajuelo JG, Lorenzo JM. 1998. Population biology of the common pandora *Pagellus erythrinus* (Pisces: Sparidae) off the Canary Islands. Fisheries Research. 36: 75-86.

[15]. Salekhova LP. 1979. Picarels *(Spicara spp.)* in the Mediterranean Basin. Kiev Academy of Science. 1-172 (in Russian).