# POPULATION CHARACTERISTICS AND GROWTH OF SPICARA MAENA 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 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 mean 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: $L_\infty=21.72cm$, $K=0.385yr^{-1}$ and $t_o=-0.135yr$. According to monthly changes of Gonadosomatic Index and Fulton's Condition Factor values spawning were occurred between March and May.*

*Keywords: Spicara maena, age, growth, spawning, eastern Mediterranean*

## 1. INTRODUCTION

*S. 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 inhabiting over posidonia beds and sandy or muddy

bottoms and the species distributes up to 100m 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 along the Mediterranean coasts [4, 5, 6, 7, 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* trawled in the northeastern Mediterranean coast of Turkey.

## 2. MATERIAL AND METHODS

This study was carried out in Babadillimani Bight ($33^o23´36´´$-$33^o32´57´´$N; $36^o07´00´´$-$36^o09´39´´$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. Fishes were identified based on Hureou [1]. In the laboratory, the total length (TL), total weight (TW) and total gonad weight (TGW) measurements were made with the nearest 0.1cm, 0.01g and 0.0001g 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 sex because of males and females may have different growth models [5, 6]. In order to test for 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", "$L_\infty$" 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] by GSI=(GW/TW-GW)*100. The condition factor (CF) was calculated by using the formula CF=$W/L^3$*100 to assess the maturity and condition of the specimens.

## 3. RESULTS
## 3.1. 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 $\chi^2$ 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 (from female to male) was observed over 10.9cm total length.

## 3.2. 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 distribution for females, males and combined sexes were was presented in Table 3.1. As can be seen in the table, age I was dominant for females and combined sexes and dominancy decreases with increasing age. According to the percentage occurrence, age group I was dominant for combined sexes and it was followed by the age groups II, III and IV.

| 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 | |

*Table 3.1 Age-frequency distribution for females, males and combined sexes*

## 3.3. LENGTH-FREQUENCY DISTRIBUTION

Mean total length and growth rate for each age group were presented in Table 3.2. As can be seen the table, total length of all individual varied from 5.3 to 17.8cm and mean total length calculated as 10.55±2.74 cm for combined sexes, 9.68±2.36cm (5.3-16.5 cm) for females and 13.64±1.40cm (10.9-17.8cm) for males (Table 3.2). Mean annual growth rate in length was highest during the first year and followed by year 2 and subsequent years.

| Age Groups | Females | | Males | | Combined sexes | |
|---|---|---|---|---|---|---|
| | Length (cm) | Growth rate (%) | Length (cm) | Growth rate (%) | Length (cm) | Growth rate (%) |
| I | 7.68±1.49 (5.310.5) | 4.14 (53.91) | | | 7.68±1.15 (5.3-10.5) | 4.51 (58.73) |
| II | 11.82±1.25 (8.7-15.5) | 3.17 (26.82) | 12.99±0.99 (10.9-14.7) | 2.26 (17.40) | 12.19±1.29 (8.7-15.5) | 2.98 (24.45) |
| III | 14.99±0.64 (13.9-16.5) | | 15.25±0.70 (14.0-16.8) | 2.05 (13.44) | 15.20±0.69 (13.9-16.8) | 2.13 (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) | |

*Table 3.2: Minimum, maximum, mean total length (cm) and growth rate between age group for each sexes*

Length-frequency distribution of *S. maena* for each sex and combined sexes were shown in Chart 3.1. As can be seen from Chart 3.1, while dominant length group was 7cm for females and all individuals, 14cm for males.
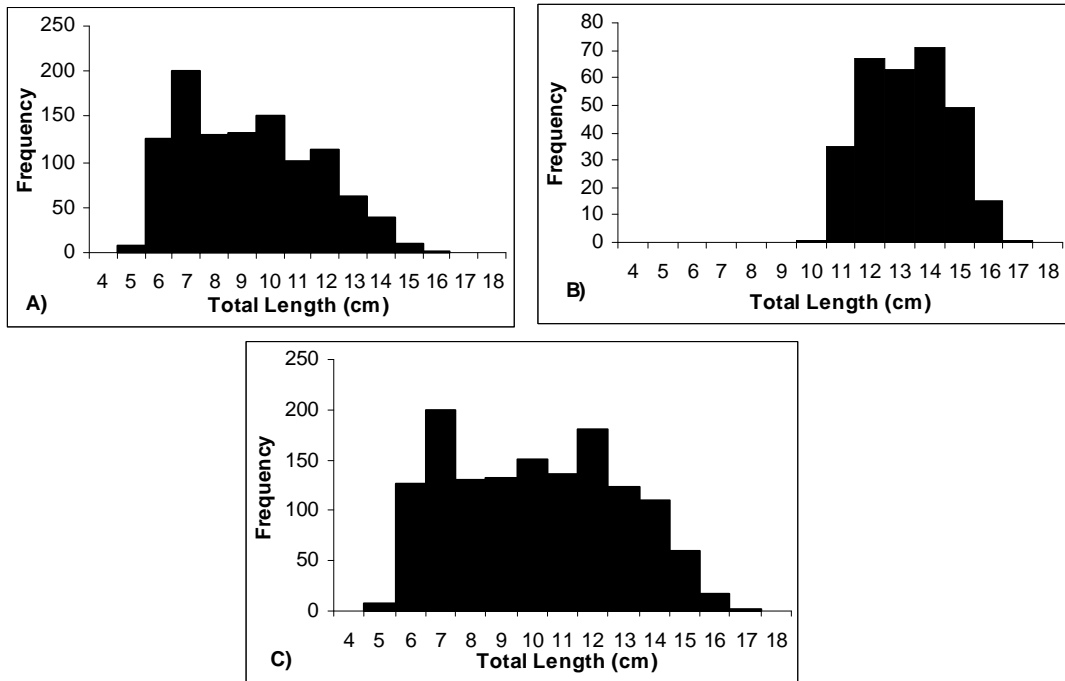
*Chart 3.1 Length-frequency distributions for females (A), males (B) and combined sexes (C)*

## 3.4 WEIGHT-FREQUENCY DISTRIBUTION

Mean total weight and growth rate in weight for each age group were presented in Table 3.3. As summarized in the table, 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 during the first year was highest followed by subsequent years.

| Age Groups | Females | | Males | | Combined sexes | |
|---|---|---|---|---|---|---|
| | Weight (g) | Growth Rate (%) | Weight (g) | Growth Rate (%) | Weight (g) | Growth Rate (%) |
| I | 4.82±2.43 (1.71-10.87) | 13.49 (279.88) | | | 4.82±2.43 (1.71-10.87) | 15.35 (318.47) |
| II | 18.31±6.04 (8.69-33.93) | 18.99 (103.71) | 24.31±5.32 (14.16-33.59) | 16.48 (67.79) | 20.17±6.45 (8.69-33.93) | 19.75 (97.92) |
| III | 37.30±4.15 (32.10-46.39) | | 40.79±5.86 (33.75-54.51) | 17.82 (43.69) | 39.92±5.67 (32.10-54.51) | 18.69 (46.82) |
| IV | | | 58.61±1.47 (57.57-59.65) | | 58.61±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) | |

*Table 3.3: Minimum, maximum and mean total length (cm) and growth rate between age groups for each sex*

## 3.5. LENGTH-WEIGHT RELATIONSHIP

Length-weight relationship parameters for females, males and combined sexes were presented in Table 3.4 and Chart 3.2. It is clearly shown that parameter "b" was 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.

| Sex | n | $a$ | $b$ | SE of $b$ | 95% Confidence Intervals of $b$ | Type of Growth | $r^2$ |
|---|---|---|---|---|---|---|---|
| Female | 1078 | 0.0075 | 3.1397 | 0.016 | 3.078-3.140 | +A | 0.982 |
| Male | 302 | 0.0093 | 3.0654 | 0.012 | 3.138-3.186 | +A | 0.991 |
| Combined sexes | 1380 | 0.0076 | 3.1374 | 0.010 | 3.118-3.157 | +A | 0.987 |

*Table 3.4: Length-weight relationship parameters for females, males and combined sexes (+A: positive allometry)*
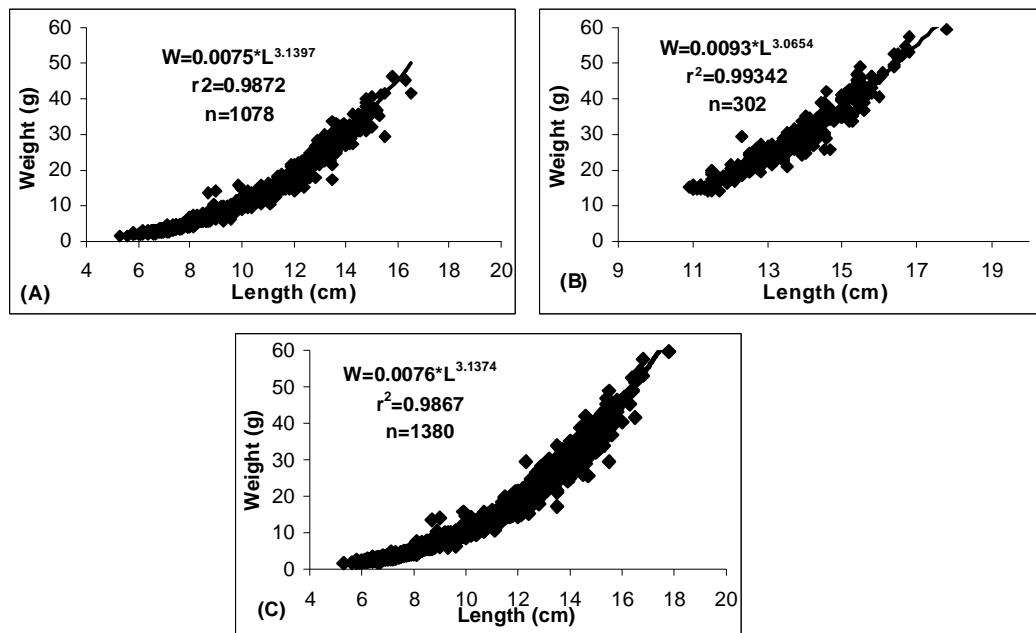


*Chart 3.2 Length-weight relationship parameters for females (A), males (B) and combined sexes (C)*

## 3.6 GROWTH

Von Bertalanffy growth equation parameters in length and weight were presented in Table 3.5. The estimated von Bertalanffy growth constants were: $L_\infty$=25.35cm, K=0.267yr^{-1} and $t_o$=-0.352yr for females, $L_\infty$=37.32cm, K=0.098yr^{-1} and $t_o$=-3.388yr for males and $L_\infty$=21.72cm, k=0.385yr^{-1} and $t_o$=-0.135yr for combined sexes. As can be seen from Table 3.5, theoretical maximum length and weight for males were higher than that of females.

| Sex | L∞(cm) | W∞(g) | to | K |
|---|---|---|---|---|
| Female | 25.35 | 191.93 | -0.352 | 0.267 |
| Male | 37.32 | 612.51 | -3.388 | 0.098 |
| Combined sexes | 21.72 | 118.87 | -0.135 | 0.385 |

*Table 3.5: von Bertalanffy growth parameters in length and weight of Spicara maena for females, males and combined sexes*

Calculated mean length and weight of *S. maena* for each age groups using length-weight relationship were presented in Table 3.6. There were very close correlation between measured and calculated length and weight (R=0.99).

| Age Groups | Females | | Males | | Combined sexes | |
|---|---|---|---|---|---|---|
| | Length (cm) | Weight (g) | Length (cm) | Weight (g) | Length (cm) | Weight (g) |
| **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 |

*Table 3.6: Calculated mean length and weight for each age group of females, males and combined sexes*

Monthly changes to the mean Fulton's Condition Factor (CF) and Gonadosomatic Index (GSI) values were shown in Chart 3.3. As can be seen from the Chart 3.3 it can be claimed that, spawning was occurred in between of April to August 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).
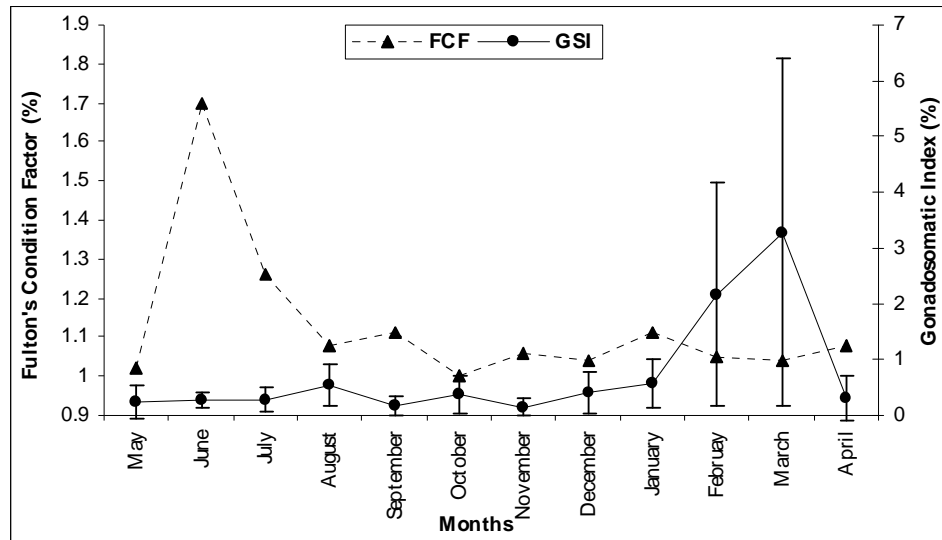


*Chart 3.3: Monthly changes of Fulton's condition factors and gonadosomatic index*

## 4. DISCUSSION

Length-weight relationship constants studying for *S. maena* inhabiting along the Mediterranean was shown in Table 4.1. As can be seen from Table 4.1, "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 Table 4.1, 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.

| n | Length (cm) | *a* | *b* | $r^2$ | Location | Authors |
|---|---|---|---|---|---|---|
| 33 | 11.7-18.4 | 0.000083 | 2.663 | 0.90 | Greece | Pertakis and Stergiou, 1995 |
| - | - | 0.0122 | 3.037 | 0.872 | Croatia | Dulcic ve 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 | 3.2618 | 0.997 | Spain | Vale et al., 2003 |
| 86 | 12.5-19.9 | 0.0113 | 3.0649 | 0.905 | Spain | Morey et al., 2003 |
| 1380 | 5.3-17.8 | 0.0076 | 3.1374 | 0.987 | Turkey | This study |

*Table 4.1: Estimated length-weight relationships for Spicara maena distributed along the Mediterranean coasts*

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 10.9cm 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 is observed that spawning were occurred between March and May in the studied area.

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