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ARTICLE

Some reproductive characteristics of the blotched picarel *Spicara maena* (Perciformes: Centracanthidae) from Saros Bay, Northern Aegean Sea, Turkey

Algunas características reproductivas del trompero *Spicara maena* (Perciforme: Centracanthidae) de la Bahía Saros, al norte del Mar Egeo, Turquía

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Resumen.- Este estudio se llevó a cabo mensualmente en la Bahía de Saros (norte del mar Egeo, Turquía) entre enero y diciembre 2015. Se analizó el índice gonadosomático (IGS) y la fecundidad absoluta (F_a) del trompero *Spicara maena*. Los valores de IGS sugirieron que el período de desove de *S. maena* fue de abril a junio. Las relaciones entre la fecundidad absoluta y la longitud total (TL), el peso total (TW) y la edad (A) de las hembras del trompero se estimaron como F_a= 287.52TL1.40, F_a = 153.33TW + 6,680.9 y F_a = 2,407.5A + 5,289.6, respectivamente. El presente estudio contribuye a la biología reproductiva de *S. maena* al determinar los primeros datos sobre la fecundidad de la especie para el Mar Egeo.

Palabras clave: *Spicara maena*, período de desove, fecundidad, Bahía de Saros

Abstract.- This study was carried out, monthly, in the Saros Bay (Northern Aegean Sea, Turkey) between January 2015 and December 2015. The gonadosomatic index (GSI) and absolute fecundity (F_a) of the blotched picarel (*Spicara maena*) were analyzed . GSI values suggested the spawning period of *S. maena* was from April to June. The relations between the absolute fecundity and total length (TL), total weight (TW) and age (A) of the blotched picarel females were estimated as F_a= 287.52TL1.40, F_a= 153.33TW + 6,680.9 and F_a= 2,407.5A + 5,289.6, respectively. The present study contributes to the reproductive biology of *S. maena* by reporting the first data about the fecundity of the species for the Aegean Sea.

Key words: *Spicara maena*, spawning period, fecundity, Saros Bay

INTRODUCTION

The reproductive biology of a species is a central aspect of providing sound scientific advice for fisheries management and it plays an important role in determining productivity (Morgan 2008). Estimation of fecundity and GSI of a fish is essential for evaluating the commercial potentialities of its stock, life history, practical culture and actual management of the fishery (Rahimibashar *et al.* 2012).

Saros Bay, which is situated in the Northeastern Aegean Sea, is connected to the North Aegean with a depth of approximately 600 m to the west. The shelf extends at a water depth of 90-120 m. The length of the bay is about 61 km and the width at the opening to the Aegean Sea is about 36 km (Eronat & Sayın 2014). As Saros Bay had been closed to bottom trawl fishing since 2000 (Cengiz *et al*. 2011) and no industrial activity was prevalent in the area (Sarı & Çağatay 2001), the bay can be considered as a pristine environment (Cengiz *et al*. 2013).

Blotched picarel *Spicara maena* (Linnaeus, 1758) is a commercial species inhabiting the Mediterranean Sea, the Black Sea, and the European and African coasts of the Atlantic Ocean, from Morocco to Portugal and the Canary Islands. This species mostly occurs over *Posidonia* beds and sandy or muddy bottoms, and distributes up to 100 m depth. *S. maena* feeds on mainly zooplankton and is a protogynous hermaphrodite (Froese & Pauly 2019).

There are various studies on *S. maena* all over the world. Arculeo *et al.* (1996) studied the protein differences among the Mediterranean species of the genus *Spicara*. Matić-Skoko *et al.* (2004) gave first information on its fecundity. The feeding habits of the blotched picarel were studied by Karachle & Konstantinos (2014) in the North Aegean Sea. While Dulčić *et al.* (2000) published the age, growth, and mortality of this species in the Adriatic, Çiçek *et al.* (2007), Soykan *et al.* (2010) and Saygılı *et al.* (2016) from the Turkey Seas presented its growth and reproduction. In addition, Moutopoulos & Stergiou (2002) reported data on the length-weight relationship in the Greek waters, as did Valle *et al.* (2003) in the western Mediterranean Sea, Dulčić & Glamuzina (2006) for the eastern Adriatic estuarine systems, Karakulak *et al.* (2006) from the Gökçeada Island, İşmen *et al.* (2007) in the Saros Bay.

Information on the reproduction of this species in the Aegean Sea is extremely scarce and incomplete (Soykan *et al.* 2010, Cengiz *et al.* 2014). For this reason, the objectives of the present study were: (1) to provide the preliminary information on the spawning period of the blotched picarel in the Saros Bay (Northern Aegean Sea, Turkey); (2) to contribute to the reproductive biology of *S. maena* by reporting the first data about the fecundity of the species for the Aegean Sea; and (3) to compare these results with those of the previous studies.

Materials and methods

Sampling

This study was carried out, monthly, in the Saros Bay between January 2015 and December 2015. The samples were collected with the handlines and gill nets at depths ranging from 0 m to 40 m by the commercial fishermen (Fig. 1).

Laboratory activities

A total of 620 individuals were measured to the nearest 1 mm (total length, TL), weighed to the nearest 0.01 g (total weight, TW). The chi-square (χ^2) test was used to detect the differences in the sex ratio. The Student's *t*-test was used to analyze the differences in the mean length and weight of the sexes. Following removal, the sagittal otoliths were first soaked in 5% HCL and 3% NaOH solutions, respectively, and washed in distilled water and subsequently dried. The sagittal otoliths, placed in watch glass filled with the water, were read using a stereoscopic zoom microscope under reflected light against a black background. Opaque and transparent zones were counted; one opaque zone plus one transparent zone was assumed to be one year (Cengiz *et al.* 2013).

Sex was determined by examining the gonads macroscopically. Maturity stages were assessed according to Gunderson's (1993) scale: stage I immature, stage II resting, stage III developing, stage IV ripe, and stage V spent. The spawning period was estimated by analysing, monthly, the changes of the gonadosomatic index (GSI) using the equation:

$$GSI= (W_g \times (W - W_g)^{-1}) \times 100$$

where W_g is the gonad weight (g) and W is the total weight (g) of fish (Avşar 2005).

Gravimetric method was used for fecundity estimates (Bagenal & Braum 1978). In order to calculate fecundity, the ovaries of mature females (prior to the reproductive period) were weighed the nearest 0.0001 g (total weight), three sub-samples were taken from the front, middle and rear sections of each ovary, weighed and then immersed separately in Gilson's fluid. These ovaries were frequently shaken to ensure the separation of oocytes from ovarian

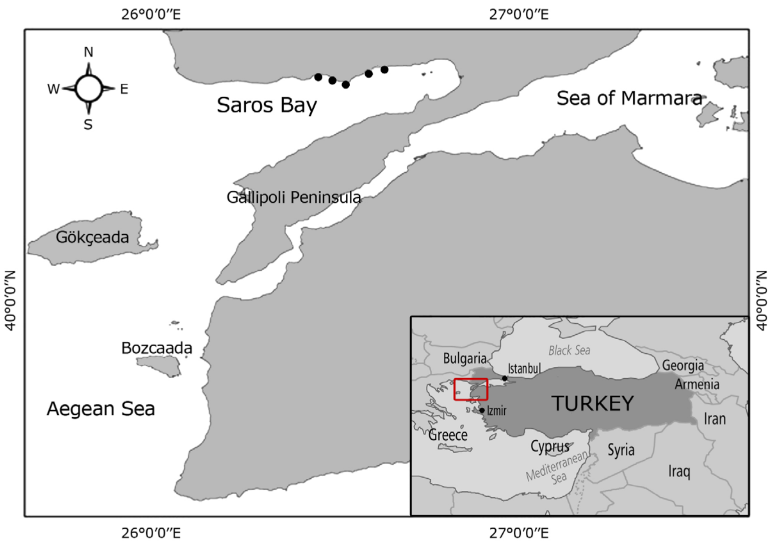

Figure 1. Location of the sampling stations (black circles) in Saros Bay, Turkey / Ubicación de las estaciones de muestreo (círculos negros) en Bahía Saros, Turquía

tissues. All oocytes were counted directly under stereoscopic zoom microscope. The total number of eggs in each ovary sub-sample was then estimated by using the equation provided by Yeldan & Avşar (2000):

$$F_1 = (W_g \times N) \times W_s^{-1}$$

where F_1 is the total number of eggs in ovary sub-sample 1, W_g is the gonad weight, N is the number of eggs in the sub-sample, and W_s is sub-sample weight. Later, by taking the mean number of three sub-sample fecundities (F_1, F_2, and F_3), the absolute fecundity (F_a) for each female fish was estimated as:

$$F_a = (F_1 + F_2 + F_3)^{-3}$$

Hereby, the relations between absolute fecundity (F_a) and total length (TL), absolute fecundity (F_a) and total weight (TW), as well as absolute fecundity (F_a) and age (A) were estimated as $F_a = a \times TL^b$, $F_a = a + b \times TW$ and $F_a = a + b \times A$, respectively, where *a* (intercept) and *b* (slope) are the parameters of the equation (Avşar 2005).

Results

From 620 specimens examined, 500 (80.6%) were females, and 120 (19.4%) males. The sex ratio (F:M) was 1:0.24, which is significantly different from equipartition (χ^2 test: $P < 0.05$). The mean ± standard error (and range) of total length were 12.9 ± 0.11 (8.7-18.1) cm TL for females 14.9 ± 0.15 (9.6-18.6) cm TL for males (Fig. 2) and total weight were 41.78 ± 2.16 (11.19-86.83) g for females and 27.83 ± 0.56 (5.39-87.01) g for males. The student's *t*-test showed significant differences between the mean lengths and weights of the both sexes (all $P < 0.05$).

The reproductive cycles of female and male individuals was synchronized. The variations in GSI values throughout the study period presented a pronounced peak in April for both sexes. While GSI values ranged between 0.21 and 5.80 for females, these ones were between 0.12 and 2.09 for males. The GSI values suggested the spawning period was from April to end of May (Fig. 3).

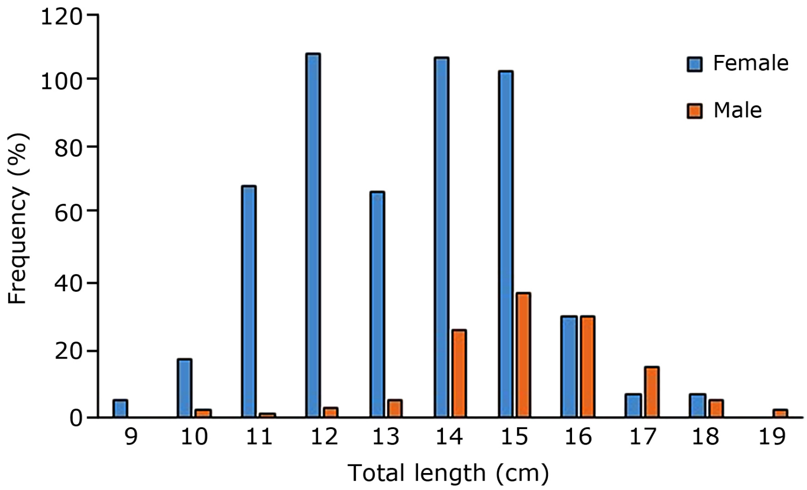

Figure 2. The length-frequency distribution for females and males of blotched picarel *Spicara maena* from Saros Bay, Turkey / Distribución de frecuencia de longitud de hembras y machos del trompero *Spicara maena* de Bahía Saros, Turquía

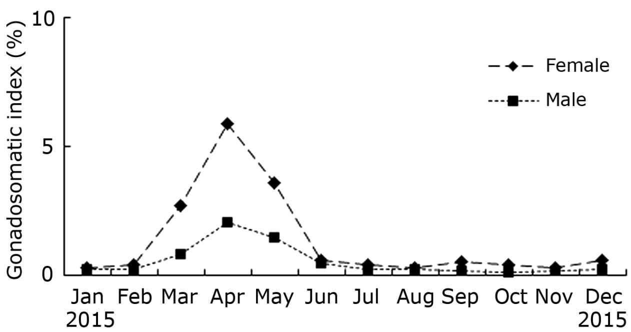

Figure 3. The mean gonadosomatic index (%) values for females and males of blotched picarel *Spicara maena* from Saros Bay, Turkey / Media de los valores del índice gonadosomático (%) de hembras y machos del trompero *Spicara maena* de Bahía Saros, Turquía

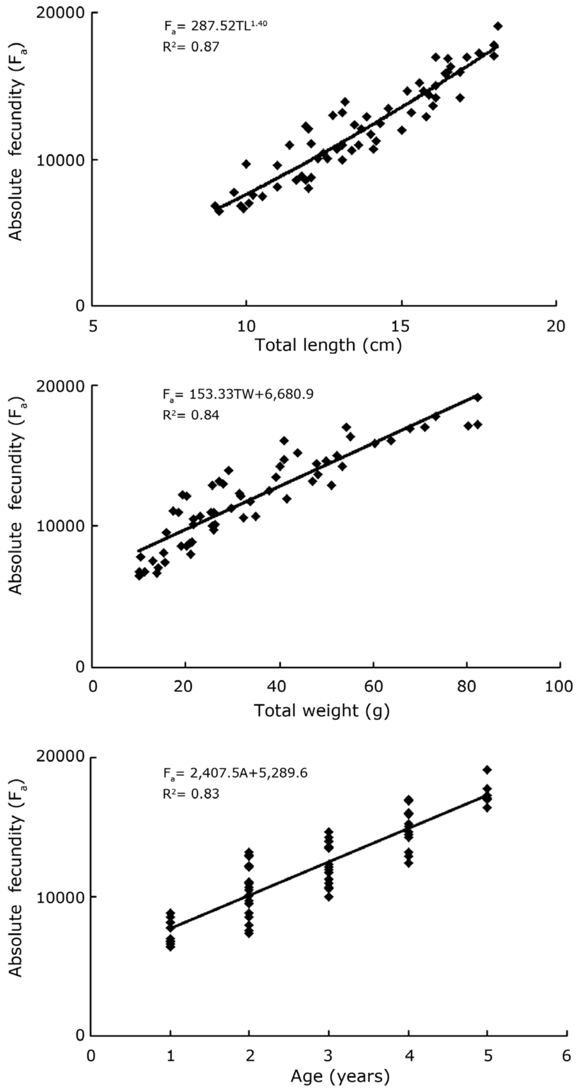

Figure 4. The relations between the absolute fecundity and total length, total weight and age of the blotched picarel females *Spicara maena* from Saros Bay, Turkey / Relación entre la fecundidad absoluta y la longitud total, peso y edad de las hembras del trompero *Spicara maena* de Bahía Saros, Turquía

The absolute fecundity (F_a) was estimated for 72 ripe females (age 1 to 5) caught in March. A maximum value of 19123 eggs was recorded in 5 year-old fish weighing 82.23 g (17.8 cm TL) and a minimum value of 6389 eggs for 1 year-old fish weighing 11.32 g (9.6 cm TL). The mean value ± standard error of absolute fecundity was 12,039 ± 431. The relations between the absolute fecundity and total length, total weight and age of the blotched picarel females were estimated as $F_a = 287.52TL^{1.40}$, $F_a = 153.33TW + 6,680.9$ and $F_a = 2,407.5A + 5,289.6$, respectively (Fig. 4).

Discussion

The spawning period has long been a central issue in fisheries biology, ecology, and management because of its importance for the recruitment (Beaugrand *et al.* 2003), survival (Garvey *et al.* 2002), and stock biomass, and thus the fishery yield (Kjesbu & Witthames 2007). Therefore, the reproductive studies may be used for quantification of the reproductive capacity of fish (Murua *et al.* 2003). The reproductive biology of *S. maena* has been investigated for the first time in the Saros Bay. Matić-Skoko *et al.* (2004) and Dulčić *et al.* (2000) reported that the breeding was from September to October for the eastern central Adriatic (Crotia). While Çiçek *et al.* (2007) suggested that spawning period occured between March and May in Babadillimani Bight (Turkey), Soykan *et al.* (2010) observed it was between March and June in Izmir Bay (Turkey). In addition, Cengiz *et al.* (2014) stated that the breeding season occured between April and June for Gallipoli Peninsula (Turkey). The spawning period has a close relationship to the ecological characteristics of the water system in which the species live (İlkyaz *et al.* 2010) and apparently varies from area to area because of the differences in hydrographic and climatic conditions (İlhan *et al.* 2010).

The published data on fecundity of this species are extremely scarce and the fecundity results in this study represent the first data of *S. maena* for the Aegean Sea. Matić-Skoko *et al.* (2004) from eastern central Adriatic Sea reported the absolute fecundity (F_a) varied from a minimum of 42,140 eggs for a 2 year-olds to a maximum of 80,509 eggs for 3 year-olds and the relations between the absolute fecundity-total length, the absolute fecundity-total weight and the absolute fecundity-age were $F_a = 33.4TL^{2.60}$, $F_a = 560.2W + 15,874$ and $F_a = 4,100A^{0.43}$, respectively. The knowledge of fecundity is useful in investigating the population dynamics of a fish species (Dulčić *et al.* 1998) and the marked differences in fecundity among species often reflect different reproductive strategies (Murua & Saborido-Rey 2003). Within a given species, fecundity may vary as a result of different adaptations to environmental habitats (Witthames *et al.* 1995). Even within a stock, fecundity is known to vary annually, undergo long-term changes (Rijnsdorp 1991). For a given size, females in better condition exhibit higher fecundity (Kjesbu *et al*. 1991). Fish size and condition are, thus, key parameters to properly assess fecundity at the population level. However, the fecundity-size relations has been used principally as a rapid means of predicting the fecundity of fish (Dulčić *et al.* 1998).

Efficient fisheries management and enforcement regulations are known to be necessary to protect natural resources and provide their sustainability. Regular monitoring of the stock status is vital for optimal fishing and stock management, both related to sustainable fisheries (Kara & Bayhan 2015). If some legal regulations are not implemented (determination of minimum landing size, selectivity studies, catching quote, fishing effort control, efficacious monitoring and surveillance systems, etc.), the sustainability of stock can be at risk as time goes by. Consequently, the present study provides preliminary information on the spawning period of *S. maena* for the Saros Bay, however, it presents the first data about the fecundity of the species for the Aegean Sea, which will thus be useful for fish biologists and fisheries managers in future.

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Literature cited

Avşar D. 2005. Fisheries biology and population dynamics, 332 pp. Nobel Press, Adana.

Arculeo M, A Mauro, G Scelsa, S Lo Brutto, M Cammarata & N Parrinello. 1996. Protein differences among the Mediterranean species of the genus Spicara. **Journal Fish of Biology** 49: 1317-1372.

Bagenal TB & E Braum. 1978. Eggs and early life history. In: Begenal T (ed). Methods for assessment of fish production in freshwaters, 106 pp. Blackwell Scientific, Oxford.

Beaugrand G, KM Brander, JA Lindley, S Souissi & PC Reid. 2003. Plankton effect on cod recruitment in the North Sea. Nature 426: 661-664.

Cengiz Ö, A İşmen, U Özekinci & A Öztekin. 2011. An investigation on fish fauna of Saros Bay (Northern Aegean Sea). Afyon Kocatepe University Journal of Sciences 11: 31-37.

Cengiz Ö, U Özekinci, A İşmen & A Öztekin. 2013. Age and growth of the four-spotted megrim (*Lepidorhombus boscii* Risso, 1810) from Saros Bay (Northern Aegean Sea, Turkey). Mediterranean Marine Science 14: 36-44.

Cengiz Ö, U Özekinci, A Öztekin & A Alparslan. 2014. Determination of reproductive and growth characteristics of the blotched picarel (*Spicara maena* Linnaeus, 1758) in Gallipoli Peninsula. In: V. Eastern Anotolia Region Fisheries Symposium, 31 May-02 June, Elazığ, Turkey, 423 pp. [In Turkish].

Çiçek E, D Avşar, H Yeldan & M Manaşırlı. 2007. Population characteristics and growth of *Spicara maena* (Linnaeus, 1758) inhabiting in Babadillimani Bight (northeastern Mediterranean-Turkey). International Journal of Natural and Engineering Sciences 1: 15-18.

Dulčić J & B Glamuzina. 2006. Length-weight relationships for selected fish from three eastern Adriatic estuarine systems (Croatia). Journal of Applied Ichthyology 22: 245-256.

Dulčić J, N Skakelja, M Kraljević & P Cetinić. 1998. On the fecundity of the Black Sea bream, *Spondyliosoma cantharus* (L.), from the Adriatic Sea (Croatian coast). Scientia Marina 62: 289-294.

Dulčić J, M Kraljević, B Grbec & P Cetinić. 2000. Age, growth and mortality of blotched picarel *Spicara maena* L. (Pisces: Centracanthidae) in the eastern central Adriatic. Fisheries Research 48: 69-78.

Eronat C & E Sayın. 2014. Temporal evolution of the water characteristics in the bays along the eastern coast of the Aegean Sea: Saros, İzmir, and Gökova bays. Turkish Journal of Earth Sciences 23: 53-66.

Froese R & D Pauly. 2019. FishBase. World Wide Web electronic publication. <http://www.fishbase.org, version (02/2019)>

Garvey JE, TP Herra & WC Leggett. 2002. Protracted reproduction in sunfish: the temporal dimension in fish recruitment revisited. Ecological Applications 12: 194-205.

İlhan D, S Akalın, Z Tosunoğlu & O Özaydın. 2010. Growth characteristics and reproduction of comber, *Serranus cabrilla* (Actinopterygii, Perciformes, Serranidae), in the Aegean Sea. Acta Ichthyologica et Piscatoria 40: 55-60.

İlkyaz AT, G Metin, O Soykan & HT Kınacıgil. 2010. Age, growth and sexual development of solenette, *Buglossidium luteum* (Risso, 1810), in the central Aegean Sea. Journal of Applied Ichthyology 26: 436-440.

İşmen A, Ö Özen, U Altınağaç, U Özekinci & A Ayaz. 2007. Weight-length relationships of 63 fish species in Saros Bay, Turkey. Journal of Applied Ichthyology 23: 707-708.

Kara A & B Bayhan. 2015. Age and growth of *Boops boops* (Linnaeus, 1758) in Izmir Bay, Aegean Sea, Turkey. Journal of Applied Ichthyology 31: 620-626.

Karachle PK & S Konstantinos. 2014. Diet and feeding habits of *Spicara maena* and *S. smaris* (Pisces, Osteichthyes, Centracanthidae) in the North Aegean Sea. Acta Adriatica 55: 75-84.

Karakulak FS, H Erk & B Bilgin. 2006. Length-weight relationships for 47 coastal fish species from the northern Aegean Sea, Turkey. Journal of Applied Ichthyology 22: 274-278.

Kjesbu OS & PR Witthames. 2007. Evolutionary pressure on reproductive strategies in flatfish and groundfish: Relevant concepts and methodological advancements. Journal of Sea Research 58: 23-34.

Kjesbu OS, J Klungsoyr, H Kryvi, PR Withamess & M Greer-Walker. 1991. Fecundity, atresia, and egg size of captive Atlantic cod (*Gadus morhua*) in relation to proximate body composition. Canadian Journal of Fisheries and Aquatic Sciences 48: 2333-2343.

Matić-Skoko S, M Kraljević & J Dulčić. 2004. Fecundity of blotched picarel, *Spicara maena* L. (Teleostei: Centracanthidae), in the eastern central Adriatic Sea. Acta Adriatica 45: 155-162.

Morgan MJ. 2008. Integrating reproductive biology into scientific advice for fisheries management. Journal of Northwest Atlantic Fishery Science 41: 37-51.

Moutopoulos DK & KI Stergiou. 2002. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). Journal of Applied Ichthyology 18: 200-203.

Murua H & F Saborido-Rey. 2003. Female reproductive strategies of marine fish species in the North Atlantic. Journal of Northwest Atlantic Fishery Science 33: 23-31.

Murua H, G Kraus, F Saborido-Rey, PR Witthames, A Thorsen & S Junquera. 2003. Procedures to estimate fecundity of marine fish species in relation to their reproductive strategy. Journal of Northwest Atlantic Fishery Science 33: 33-54.

Rahimibashar MR, V Alipour, P Hamidi & B Hakimi. 2012. Biometric characteristics, diet and gonad index of Lizardfish (*Saurida tumbil* Bloch, 1795) in North of the Persian Gulf. World Journal of Fish and Marine Sciences 4: 1-6.

Rijnsdorp AD. 1991. Changes in fecundity of female North Sea plaice (*Pleuronectes platessa* L.) between three periods since 1990. ICES Journal of Marine Science 48: 253-280.

Sarı E & MN Çağatay. 2001. Distributions of heavy metals in the surface of the Gulf of Saros, NE Aegean Sea. Environment International 26: 169-173.

Saygılı B, A İşmen & MA İhsanoğlu. 2016. Age and growth of blotched picarel (*Spicara maena* Linnaeus, 1758) in the Sea of Marmara and Northern Aegean Sea. Ege Journal of Fisheries and Aquatic Sciences 33: 143-149.

Soykan O, AT İlkyaz, G Metin & HT Kınacıgil. 2010. Growth and reproduction of blotched picarel (*Spicara maena* Linnaeus, 1758) in the central Aegean Sea, Turkey. Turkish Journal of Zoology 34: 453-459.

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

Witthames PR, M Greer Walker, MT Dinis & CL Whiting. 1995. The geographical variation in the potential annual fecundity of Dover sole, *Solea solea* (L.) from European shelf waters during 1991. Netherlands Journal of Sea Research 34: 45-58.

Yeldan H & D Avsar. 2000. A preliminary study on the reproduction of the rabbitfish (*Siganus rivulatus* Forsskal, 1775) in northeastern Mediterranean. Turkish Journal of Zoology 24: 173-182.

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