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# Weight-length relationship and maximum length record of black seabream (*Spondyliosoma cantharus* Linnaeus, 1758) for entire Aegean Sea and Turkish Waters

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## Abstract

The present study was conducted between January 2020 and December 2020 off Saros Bay (Northern Aegean Sea, Turkey). A single specimen of *Spondyliosoma cantharus* with maximum length (41.0 cm in total length) and weight (1050.00 g in total weight) was caught by a commercial fisherman on 10 June 2020. Total length has been defined as the measurement taken from the anterior-most part of the fish to the end of the caudal fin rays when compressed dorso-ventrally. Total length of the fish sample was measured using the ruler on the measuring board. Photograph of the fish were taken with the ruler and the distance of 1 cm was taken as a scale in order to measure the total length precisely. The scientific name of the species was checked according to FishBase. The weight-length relationship was calculated as $W = 0.0263TL^{2.82}$ ($R^2 = 0.95$) for all samples. This study presents the maximum length and weight values of black seabream (*Spondyliosoma cantharus* Linnaeus, 1758) for entire Aegean Sea and Turkish Waters, up to the time.

**Keywords:** Maximum size; *Spondyliosoma cantharus*; Saros Bay; Aegean Sea.

## 1. Introduction

The Sparidae is a family of the order Perciformes and contains 164 species in 38 genera (Eschmeyer's Catalog of Fishes, 2020). Recently, the sister family Centracanthidae (picarels) has also been merged with the Sparidae (Santini *et al.,* 2014) while they previously were listed as distinct and separate (Nelson, 2006; Golani *et al.,* 2006; Mater *et al.,* 2011). As far as it is known, 24 Sparidae species within 13 genera (*Boops*, *Centracanthus*, *Dentex*, *Diplodus*, *Evynnis, Lithognathus*, *Oblada*, *Pagellus*, *Pagrus*, *Sarpa*, *Sparus*, *Spicara* and *Spondyliosoma*) from Turkish territorial waters were reported (Mater *et al.,* 2011) and there

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are two more species (*Crenidens crenidens* and *Rhabdosargus haffara*) in the Eastern Mediterranean (*Golani et al.,* 2006) which are lessepsian (Paruğ and Cengiz, 2020a).

The genus *Spondyliosoma* Cantor, 1849 is represented by one species in the Mediterranean Sea: the black seabream (*Spondyliosoma cantharus* Linnaeus, 1758) (Mouine-Oueslati *et al.,* 2015). This species occurs in the eastern Atlantic from Scandinavia to Namibia and around the Madeira, Cape Verde and Canary Islands (Heemstra, 1995); it is also common in the Mediterranean Sea and rare in the Black Sea. The black seabream is a relatively common fish of inshore waters on rocky and sandy bottoms (Bauchot and Hureau, 1986). Despite the wide distribution of *S. cantharus*, the majority of biological studies, in particular on reproductive aspects, have been reported from the eastern Atlantic (Perodou and Nedelec, 1980; Soletchnik, 1983; Balguerías Guerra *et al.,* 1993; Pajuelo and Lorenzo, 1999; Gonçalves and Erzini, 1998). In the Mediterranean Sea, some aspects of black seabream growth (Dulčić and Kraljević, 1996a; Neves *et al.,* 2017), feeding habit (Dulčić *et al.,* 2006) recruitment (Guidetti and Bussotti, 1997), fecundity (Dulčić *et al.,* 1998) and reproduction (Mouine *et al.,* 2011; Boughamou *et al.,* 2015) have been investigated. IUCN Red List status of *Spondyliosoma cantharus* is denoted as "Least Concern (LC)" (Nieto *et al.,* 2015) for now.

The fishing management authorities want to explore some biometric data with a view to the management and conservation of fish stocks. Data obtained from length and weight of fishes are a useful and standard result of fish sampling programs. These data are needed to estimate growth rates, length and age structures, and other components of fish population dynamics (Kolher *et al.,* 1995). Estimations about length-weight relationships allow fisheries scientists to convert growth-in-length equations to growth-in-weight in stock assessment models (Morato *et al.,* 2001; Stergiou and Moutopoulos, 2001), calculate fish condition (Petrakis and Stergiou, 1995), compare life history and morphological aspects of populations inhabiting different regions (Stergiou and Moutopoulos, 2001) and estimate biomass from length frequency distributions (Petrakis and Stergiou, 1995; Dulčić and Kraljević, 1996b). Wherefore, length-weight relationships may change temporarily and/or spatially, so these studies should be regularly updated for each separate population (Torres *et al.,* 2012).

Maximum length and weight are quite important theoretical parameters in fisheries science (Dulčić and Soldo, 2005). Directly and indirectly, these measurements enter in most of the models used in stock assessments (Borges, 2001). Notably, the size-based analyses of fishes are becoming increasingly popular methods for enhancing the understanding of community structure and function (Jennings and Dulvy, 2005) and could be used as a tool for rapid assessment of growth rates in the deficiency of primary data (Filiz and Sevingel, 2015). For these reasons, updating information about the maximum size of a species that might be commercially or recreationally exploited in the future gains importance (Navarro *et al.,* 2012). Accurate estimates of the maximum size of fish in a population are important for biologists and ecologists because biological rates and ecological functions are size-specific (Peters, 1983; Pope *et al.,* 2005). For example, metabolic rate is inversely related to body size, whereas total food intake is positively related to body

size. Size at hatch, size at sexual, maturation and longevity are directly related to maximum size of fishes (Freedman and Noakes, 2002; van der Veer *et al.,* 2003). Maximum length and/or weight is a key component in many fishery models, such as the von Bertlanffy and Gompertz growth models (Quinn and Deriso, 1999). This study presents the maximum length and weight values of black seabream (*Spondyliosoma cantharus* Linnaeus, 1758) for entire Aegean Sea and Turkish Waters up to the time, however it updates weight-length relationships of species throughout the world.

## 2. Materials and methods

The northern Aegean coasts of Turkey are divided to sub-regions as the Saros Bay, the Gallipoli Peninsula, the Gökceada and Bozcaada Islands and the Edremit Bay (Cengiz and Paruğ, 2020). The length of Saros Bay is about 61 km and the width at the opening to the Aegean Sea is about 36 km (Eronat and Sayın, 2014). As the bay had been closed to bottom trawl fishing since 2000 (Cengiz *et al.,* 2014), and no industrial activity was prevalent in the area (Sarı and Çağatay, 2001), it can be considered as a pristine environment (Cengiz *et al.,* 2015). For these reasons, Saros Bay and its coastal area were declared as a *SEPA* due to its landscape, geomorphological, ecological, floristic biogenetic and touristic properties (Güçlüsoy, 2015) (Figure 1).

Samples were obtained between January 2020 and December 2020 from catches of small-scale commercial fishermen around Saros Bay. The individuals were measured to the nearest entimeter (total length), weighed to the nearest 0.01 g (total weight). The length-weight relationship was estimated by fitting an exponential curve, $W = aL^b$ (Le Cren, 1951). The parameters *a* and *b* of the exponential curve, were estimated by linear regression analysis over log-transformed data $\log W = \log a + b\log L$, where W is the total weight (g), L is the total length (cm), *a* is the intercept, and

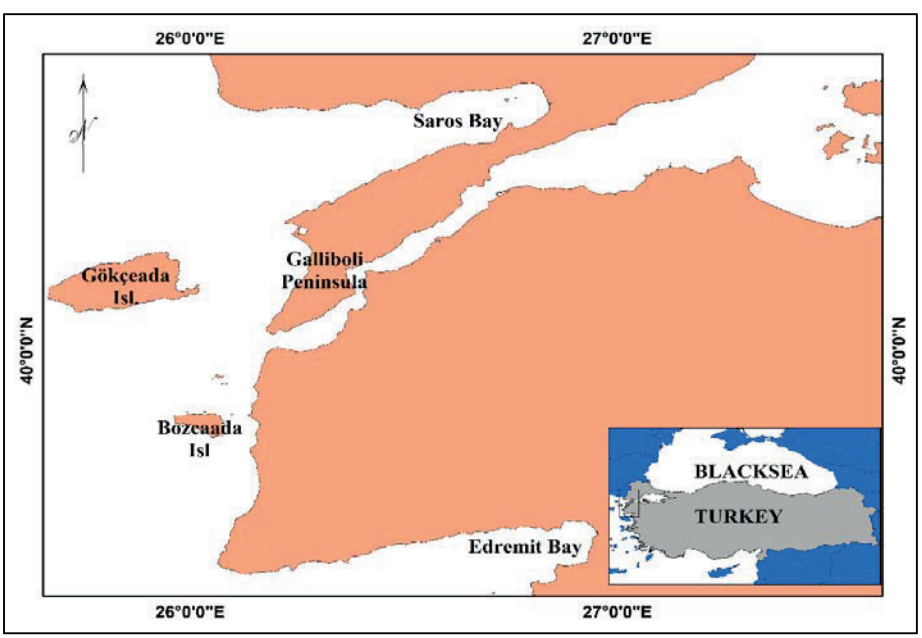


Figure 1. Saros Bay and the northern Aegean coasts of Turkey

*b* is the slope or allometric coefficient, using the least-squares method. Value $b > 3$ shows a positive allometric growth, while value $b < 3$ indicates a negative allometric growth. It is isometric growth when value *b* is equal to 3 (Bagenal and Tesch, 1978). The growth type was identified by Student's *t*-test.

A single specimen of *Spondyliosoma cantharus* was caught off Saros Bay (Northern Aegean Sea, Turkey) by a commercial fisherman from a depth of 15 m. on 10 June 2020. Total length is defined as the measurement taken from the anterior-most part of the fish to the end of the caudal fin rays when compressed dorso-ventrally (Anderson and Gutreuter, 1983). Hereby, total length of the fish sample was measured using the ruler on the measuring board. Photograph of the fish were taken with the ruler and the distance of 1 cm was taken as a scale in order to measure the total length precisely. The obtained pictures were transferred to Imaje J 1.46 software and the measurements were confirmed (https://imagej.nih.gov/ij/download. html). Using the same software, a scale bar at the ratio 1:1 was placed in the lower right corner of the fish picture. The specimen weighted to the nearest g. Unfortunately, the specimen was not preserved as it was sold by a professional fisherman at the fish market.

## 3. Results

A total of 31 individuals were collected by way of small-scale commercial fishermen around Saros Bay. The mean ± standard error (and range) of total length and total weight for all samples were 29.9 ± 0.91 (20.0 – 41.0) cm (Figure 2) and 415.17 ± 37.22 (125.00 – 1050.00) g, respectively. The length-weight relationship was estimated as $W = 0.0263TL^{2.82}$ ($R^2 = 0.95$) (Figure 3). The *b*-values and *t*-test results indicated negative allometric growth. The captured black seabream was 41.0 cm in total length and 1050.00 g in total weight (Figure 4).

## 4. Discussion

Table 1 summarizes the studies on the length-weight relationship of the species in the Aegean Sea. The allometric coefficient *b* varied from 2.82 to 3.26 for species in different regions. Generally, the *b* value obtained from LWR estimation within the same species can change depending on the degree of gonad maturity, sex, diet, sample preservation techniques, stomach fullness (Wootton, 1990), number of specimens analyzed, area/season effects, sampling duration (Moutopoulos and Stergiou, 2002), fishing gear used (Kapiris and Klaoudaos, 2011) and size selectivity of the sampling gear (İşmen *et al.,* 2007).

Size structure and maximum length of individuals within fish populations are influenced by several abiotic, biotic, and anthropogenic factors (VanderBloemen *et al.,* 2020). If a fish population within any ecosystem is exposed to overfishing, fish sizes will gradually be smaller over time. Therefore, individuals who are not subjected to overfishing could reach such a length (Filiz, 2011). However, the factors affecting growth could state as nutrient availability, feeding, light regime, oxygen, salinity, temperature, pollutants, current speed, nutrient concentration, predator density, intra-specific social interactions and genetics (Helfman *et al.,* 2009; Acarli et *al.,* 2018). It follows from these comments that the regional differences

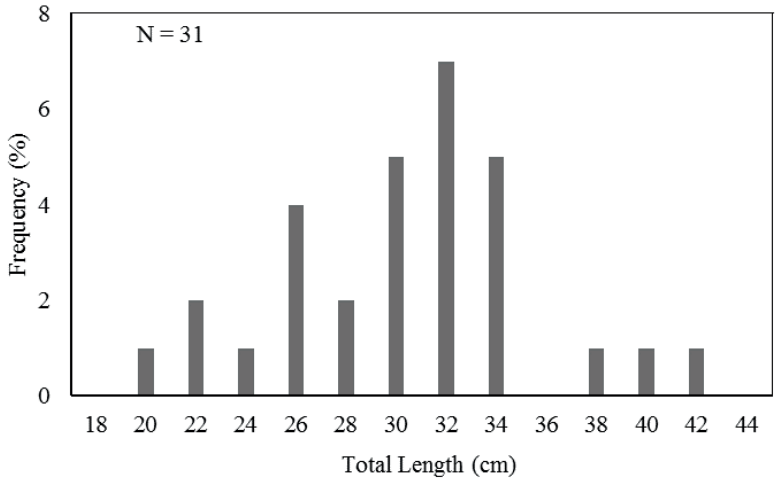


Figure 2. The length-frequency distribution of *Spondyliosoma cantharus* from Saros Bay (Northern Aegean Sea, Turkey)

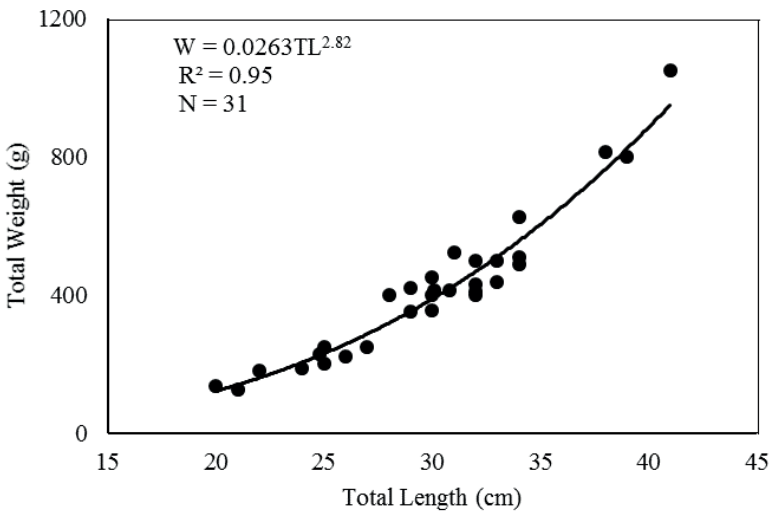


Figure 3. The length-weight relationship of *Spondyliosoma cantharus* from Saros Bay (Northern Aegean Sea, Turkey)


Figure 4. The black seabream with 41.0 cm TL and 1050.00 g TW

Table 1. Comparision of length-weight relationships of *Spondyliosoma cantharus* caught in the Aegean Sea

| Reference | Locality | N | Length range (cm) | Weight range (g) | a | b |
|---|---|---|---|---|---|---|
| Petrakis and Stergiou (1995) | south Euboikos Gulf (central Aegean Sea, Greece) | 48 | 7.4 – 15.8 | – | 0.000048 | 2.84 |
| Moutopoulos and Stergiou (2002) | Cyclades (southern Aegean Sea, Greece) | 53 | 12.6 – 39.6 | – | 0.01772 | 2.95 |
| Karakulak *et al*. (2006) | Gökçeada Island (northern Aegean Sea, Turkey) | 46 | 8.2 – 28.7 | – | 0.0192 | 2.87 |
| İşmen *et al*. (2007) | Saros Bay (northern Aegean Sea, Turkey) | 45 | 9.6 – 22.7 | 12.00 – 176.00 | 0.00902 | 3.17 |
| Özaydın *et al*. (2007) | Izmır Bay (central Aegean Sea, Turkey) | 66 | 8.4 – 18.5 | – | 0.0192 | 3.05 |
| Karachle and Stergiou (2008) | Thermaikos Gulf (northern Aegean Sea, Greece) | 82 | 9.7 – 14.0 | – | 0.0224 | 2.86 |
| Kapiris and Klaoudatos (2011) | Argolikos Gulf (central Aegean Sea, Greece) | 36 | 13.3 – 17.1 | 37.00 – 79.00 | 0.00001 | 3.00 |
| Cengiz (2013) | Gallipoli Peninsula (northern Aegean Sea, Turkey) | 156 | 9.4 – 31.7 | 12.75 – 659.18 | 0.0083 | 3.26 |
| Bilge *et al*. (2014) | southern Aegean Sea (Turkey) | 79 | 8.6 – 18.7 | – | 0.0208 | 2.99 |
| Altın *et al*. (2015) | Gökçeada Island (northern Aegean Sea, Turkey) | 29 | 5.5 – 13.7 | 2.14 – 33.58 | 0.009 | 3.17 |
| This study* | Saros Bay (northern Aegean Sea, Turkey) | 31 | 20.0 – 41.0 | 125.00 – 1050.00 | 0.0263 | 2.82 |

* maximum length and weight values for entire Aegean Sea and Turkish waters;
N: Sample size; *a* and *b*: intercept and slope of length- weight relationships.

in maximum length and weight depend on the ecological conditions and overfishing pressure. In the Mediterranean Basin, the maximum length and weight values have been reported to be 45.0 cm (TL) and 1845.00 g (TW) by Crec'hriou *et al.* (2013) in the French Catalan coast. The Mediterranean Sea is considered to be one of the most impoverished marine regions (Mazzocchi *et al.,* 1997). Within the Mediterranean Sea, there exists a west-east gradient (Krom *et al.,* 1991; Dolan *et al.,* 1999): The Eastern Mediterranean has been identified as one of the most oligotrophic areas of the world (Azov, 1986; Souvermezoglou *et al.,* 1992). The Aegean Sea is a distinct sub-system of the Eastern Mediterranean Sea due to its geographical position between the Black Sea and the other seas of the eastern basin (Ionian & Levantine Seas) (Siokou-Frangou *et al.,* 2002) and has a complex topography (Olson *et al.,* 2007). It displays considerable physiochemical variations between north and south (Zervakis and Georgopoulos, 2002). The nutrient concentrations, plankton and

benthos abundance, as well as fish catch densities, have been found higher in the North-Northwest Aegean Sea than in the South-Southeast Aegean Sea (Stergiou *et al.,* 1997). Furthermore, the Black Sea surface outflow in the Northeast Aegean Sea has been found to be enriched in dissolved organic carbon and dissolved organic nitrogen (Polat and Tuğrul, 1996). Therefore, the South Aegean Sea has been recently characterized as one of the most oligotrophic areas of the Mediterranean Sea (Ignatiades, 1998).

## Conclusion

In broad terms, the information of maximum length, weight, age, growth and weight-length relationships are required to estimate the population parameters as asymptotic length and growth coefficient of fish, which is essential for fisheries resource planning and management (De la Cruz-Agüero *et al.,* 2010). For these reasons, the information about maximum size of fish species is constantly updated both in Turkey [*Balistes capriscus* (Cerim *et al.,* 2021); *Belone belone* (Acarli *et al.,* 2018); *Diplodus sargus* (Paruğ and Cengiz, 2020); *Mullus barbatus* (Filiz, 2011); *Scomber scombrus* (Cengiz, 2020); *Siganus rivulatus* (Soykan *et al.,* 2021); *Symphodus melops* (Aydın, 2020); *Umbrina cirrosa* (Aydın and Sözer, 2020; Cengiz and Paruğ, 2021), etc] and in the World [*Balistes capriscus* (Dulčić and Soldo, 2005); *Belone belone* (Dulčić and Soldo, 2006); *Corica soborna*, *Mystus bleekeri* (Hossain *et al.,* 2017); *Esox masquinongy* (VanderBloemen *et al.,* 2020); *Scomber colias* and *Scomber scombrus* (Navarro *et al.,* 2012), etc]. In this study, new maximum values (length and weight) is introduced to the literature for *Spondyliosoma cantharus* species. Because the maximum length and/or weight is a key component in many fishery models such as the von Bertlanffy and Gompertz growth models (Quinn and Deriso, 1999), these measures from naturel habitat could ensure importance information to these calculation and stock assessments. The information presented in present study is taken into account to make a contribution to fishery managers and international scientific literature.

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## References

Acarli, D., Kale, S., and Çakır, K. 2018. A new maximum length for the garfish, *Belone belone* (Linnaeus, 1761) in the Coast of Gökçeada Island (Aegean Sea, Turkey). Cahiers de Biologie Marine, 59(4): 385-389. Doi: 10.21411/CBM.A.55A28635

Altın, A., Ayyıldız, H., Kale, S., and Alver, C. 2015. Length-weight relationships of 49 fish species from shallow waters of Gökçeada Island, Northern Aegean Sea. Turkish Journal of Zoology, 39: 971-975. Doi: 10.3906/zoo-1412-15

Aydın, M. 2020. First report of *Symphodus melops* (Linnaeus, 1758) with maximum length in the Black Sea. Marine Science and Technology Bulletin, 9(2): 125-129. Doi: 10.33714/masteb.741985

Aydın, M., and Sözer, A. 2020. The length-weight relationship and maximum length of *Umbrina cirrosa* (linnaeus, 1758). Aquatic Sciences and Engineering, 35(4): 7-10. Doi:

10.26650/ASE2020699102

Azov, Y. 1986. Seasonal patterns of phytoplankton productivity and abundance in nearshore oligotrophic waters of the Levant Basin (Mediterranean). Journal of Plankton Research, 8: 41-53.

Bagenal, T. B., and Tesch, F. W. 1978. Age and growth. In: Methods for Assessment of Fish Production in Fresh Waters. T. Bagenal (Eds). Oxford: IBP Handbook No. 3, Blackwell Science Publications, pp. 101-136.

Balguerías Guerra, E., Quintero Peréz, M. E., and González Jiménez, J. F. 1993. Características reproductivas de la chopa, Spondyliosoma cantharus (Linnaeus, 1758) del Banco Sahariano. B. Inst. Espan. Oceanog. 9: 185-201

Bauchot, M. L., and Hureau, J. C. 1986. Sparidae. In: Whitehead P.J.P., Bauchot M.L., Hureau J.C., *et al*. (eds), Poissons de l'Atlantique du Nord-Est et de la Méditerranée. Volume II. UNESCO, Paris, pp. 883-907

Bilge, G., Yapici, S., Filiz, H., and Cerim, H. 2014. Weight-length relationshions for 103 fish species from the southern Aegean Sea, Turkey. Acta Ichthyologica et Piscatoria, 44(3): 263-269. Doi: 10.3750/AIP2014.44.3.11

Borges, L. 2001. A new maximum length for the Snipefish *Macrohamphosus scolopax*. Cybium, 25: 191-192.

Boughamou, N., Derbal, F., and Kara, M. H. 2015. Age, growth and reproduction of the black sea bream *Spondyliosoma cantharus* (Linnaeus) (Sparidae) in the Gulf of Annaba (Algeria). Journal of Applied Ichthyology, 31(4): 773-779. Doi: 10.1111/jai.12714

Cengiz, Ö. 2013. Length-weight relationships of 22 fish species from Gallipoli Peninsula and Dardanelles (northeastern Mediterranean, Turkey). Turkish Journal of Zoology, 37(4): 419-422. Doi: 10.3906/tar-1205-18

Cengiz, Ö., İşmen, A., and Özekinci, U. 2014. Reproductive biology of the spotted flounder, *Citharus linguatula* (Actinopterygii: Pleuronectiformes: Citharidae), from Saros Bay (northern Aegean Sea, Turkey). Acta Ichthyologica et Piscatoria, 44: 123-129. Doi: 10.3750/AIP2014.44.2.06

Cengiz, Ö., İşmen, A., Özekinci, U., and Öztekin, A. 2015. Some reproductive characteristics of four-spotted megrim (*Lepidorhombus boscii* Risso, 1810) from Saros Bay (Northern Aegean Sea, Turkey). Journal of Agricultural Sciences, 21: 270-278. Doi: 10.15832/tbd.10768

Cengiz, Ö. 2020. The maximum length record of Atlantic Mackerel (*Scomber scombrus* Linnaeus, 1758) for Turkish Seas. Marine and Life Sciences, 2(2): 65-70.

Cengiz, Ö., and Paruğ, Ş. Ş. 2020. A new record of the rarely reported grey triggerfish (*Balistes capriscus* Gmelin, 1789) from Northern Aegean Sea (Turkey). Marine and Life Sciences, 2: 1-4.

Cengiz, Ö., and Paruğ, Ş. Ş. 2021. A new maximum size record of the shi drum (*Umbrina cirrosa* Linnaeus, 1758) for Aegean Sea. Brazilian Journal of Biology, 81(2): 461-463. Doi: 10.1590/1519-6984.230716

Crec'hriou, R., Neveu, R., and Lenfant, P. 2013. Length-weight relationship of main commercial fishes from the French Catalan coast. Journal of Applied Ichthyology, 29: 1191-1192. Doi: 10.1111/jai.12320

Cerim, H., Yılmaz, Ö., and Yapıcı, S. 2021. Maximum length record of the grey

triggerfish, (Balistes capriscus Gmelin, 1789) for Aegean Sea. Acta Biologica Turcica, 34(1): 31-34.

De la Cruz-Agüero, J., Cota-Gómez, V., and Nieto-Navarro, J. 2010. New maximum size record for the chili sea catfish *Notarius troschelii* (Siluriformes: Ariidae) from the Tropical Eastern Pacific. Marine Biodiversity Records, 3: e107. Doi: 10.1017/S1755267210000916

Dolan, J. R., Vidussi, F., and Claustre, H. 1999. Planktonic ciliates in the Mediterranean Sea: longitudinal trends. Deep Sea Research Part I Oceanographic Research Papers, 46(12): 2025-2039.

Dulčić, J., and Kraljević, M. K. 1996a. Growth of the black sea bream *Spondyliosoma cantharus* (L.) in the eastern middle Adriatic. Archive of fishery and marine research, 44: 279-293.

Dulcic, J., Kraljevic, M., 1996b. Weight-length relationships for 40 fish species in the eastern Adriatic (Crotian waters). Fisheries Research, 28: 243-251. Doi: 10.1016/0165-7836(96)00513-9

Dulčić, J., Skakelja, N., Kraljević, M., and Cetenic, P. 1998. On the fecundity of the Black Sea Bream, *Spondyliosoma cantharus* (L.), from the Adriatic Sea (Croatian coast). Scientia Marina, 62: 289-294. 294. Doi:10.3989/scimar.1998.62n3289

Dulčić, J., and Soldo, A. 2005. A new maximum length for the grey triggerfish, *Balistes capriscus* Gmelin, 1789 (Pisces: Balistidae) from the Adriatic Sea. Institute of Oceanography and Fisheries-Split Croatia, 88: 1-7.

Dulčić, J., and Soldo, A. 2006. A new maximum length for the garpike *Belone belone* (Belonidae). Cybium, 30(4): 382.

Dulčić, J., Lipej, L., Glamuzina, B., and Bartulovic, V. 2006. Diet of *Spondyliosoma cantharus* and *Diplodus puntazzo* (Sparidae) in the eastern central Adriatic. Cybium, 30(2): 115-122.

Eronat, C., and Sayın, E. 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. Doi: 10.3906/yer-1307-4

Eschmeyer's Catalog of Fishes. 2020. Species by family/subfamily in Eschmeyer's Catalog of Fishes (Online version-updated 02 June 2020). URL: http://researcharchive.calacademy.org/research/ ichthyology/catalog/SpeciesByFamily.asp#Sparidae. (06/2020)

Filiz, H., and Sevingel, N. 2015. A new maximum length for the parrotfish, *Sparisoma cretense* (Linnaeus, 1758) in the Mediterranean Sea. Journal of Aquaculture Engineering and Fisheries Research, 1: 140-143.

Filiz, H. 2011. A new maximum length for the Red Mullet, *Mullus barbatus* Linnaeus, 1758. BIBAD - Research Journal of Biological Sciences, 4(2): 131-135.

Freedman, J. A., and Noakes, D. L. G. 2002. Why are there no really big bony fishes? A point-of-view on maximum body size in teleosts and elasmobranches. Reviews in Fish Biology and Fisheries, 12: 403-416. Doi: 10.1023/A:1025365210414

Froese, R., and D. Pauly. Editors. 2021. FishBase. World Wide Web electronic publication. www.fishbase.org, version (02/2021).

Golani, D., Öztürk, B., and Başusta, N. 2006. Fishes of the Eastern Mediterranean. Turkish

Marine Research Foundation (TÜDAV), İstanbul, Turkey, 259 p.

Gonçalves, J. M. S., and Erzini, K. 1998. Feeding habits of the two-banded seabream (*Diplodus vulgaris*) and the black seabream (*Spondyliosoma cantharus*) (Sparidae) from the south-west coast of Portugal. Cybium, 22: 245-254.

Guidetti, P., and Bussotti, S., 1997. Recruitment of *Diplodus annularis* and *Spondyliosoma cantharus* (Sparidae) in shallow seagrass beds along the Italian coasts (Mediterranean Sea), Marine Life 7: 47-52.

Güçlüsoy, H. 2015. Marine and coastal protected areas of Turkish Aegean Coasts, 669-684 pp. In: Katağan, T., Tokaç, A., Beşiktepe, Ş., and ***Öztürk***, B. (Eds.) (2015). The Aegean Sea Marine Biodiversity, Fisheries, Conservation and Governance. Turkish Marine Research Foundation (TUDAV), Publication No: 41, Istanbul, TURKEY.

Heemstra, P. C. 1995. Additions and corrections for the 1995 impressions. In: Smith M.M., Heemstra P.C. (eds). Revised Edition of Smiths' Sea Fishes. Springer-Verlag, Berlin. pp. 5-15.

Helfman, G. S., Collette, B. B., Facey, D. E., and Bowen, B. W. 2009. The diversity of fishes: Biology, evolution, and ecology. Wiley-Blackwell: West Sussex, UK. 720 pp.

Hossain, M. Y., Hossen, M. A., Nawer, F., Khatun, D., Pramanik, M. N. U., Parvin, M. F., and Yahya, K. 2017. New maximum size records and length-weight relationships for two species. *Corica soborna* (Hamilton, 1822) and *Mystus bleekeri* (Day, 1877) from the Ganges River (NW Bangladesh). Journal of Applied Ichthyology, 33(3): 661-662. Doi: 10.1111/jai. 13342

Ignatiades, L. 1998. The productive and optical status of the oligotrophic waters of the Southern Aegean Sea (Cretan Sea), Eastern Mediterranean. Journal of Plankton Research, 20(5): 985-995.

İşmen, A., Özen, Ö., Altınağaç, U., Özekinci, U., and Ayaz, A. 2007. Weight-length relationships of 63 fish species in Saros Bay, Turkey. Journal of Applied Ichthyology, 23: 707-708. Doi: 10.1111/j.1439-0426.2007.00872.x

Jennings, S., and Dulvy, N. K. 2005. Reference points and reference directions for size based indicators of community structure. ICES Journal of Marine Sciences, 67: 397-404. Doi: 10.1016/j.icesjms.2004.07.030

Kapiris, K., and Klaoudatos, D. 2011. Length-weight relationships for 21 fish species caught in the Argolikos Gulf (central Aegean Sea, eastern Mediterranean). Turkish Jounal of Zoology, 35: 717-723. Doi: 10.3906/zoo-1003-122

Karakulak, F. S., Erk, H., and Bilgin, B. 2006. Length-weight relationships for 47 coastal fish species from the northern Aegean Sea, Turkey. Journal of Applied Ichthyology, 22(4): 274-278. Doi: 10.1111/ j.1439-0426.2006.00736.x

Karachle, P. K., and Stergiou, K. I. 2008. Length-length and length-weight relationships of several fish species from the North Aegean Sea (Greece). Journal of Biological Research-Thessaloniki, 10: 149-157.

Kolher, N., Casey, J., and Turner, P., 1995. Length-weight relationships for 13 species of sharks from the western North Atlantic. Fishery Bulletin, 93: 412-418.

Krom, M. D., Kress, N., Brenner, S., and Gordon, S. 1991. Phosphorus limitation of primary productivity in the eastern Mediterranean Sea. Limnology and Oceanography, 36: 24-

432.

Le Cren, E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). Journal of Animal Ecology, 20: 201-219.

Mazzocchi, M. G., Christou, E., Fragopoulu, N., and Siokou-Frangou, I. 1997. Mesozooplankton distribution from Sicily to Cyprus (Eastern Mediterranean): I. General aspects. Oceanologica Acta, 20(3): 521-535.

Mater, S., Kaya, M., and Bilecenoğlu, M. 2011. Türkiye Deniz Balıkları Atlası (4th ed). Ege Üniversitesi Basımevi, İzmir, Turkey, 169 p.

Morato, T. P., Afonso, P., Lourinho, P., Barreiros, J. P., Santos, R. S., and Nash, R. D. M. 2001. Length-weight relationships for 21 coastal fish species of the Azores, North-Eastern Atlantic. Fisheries Research, 50: 297-302. Doi: 10.1016/S0165-7836(00)00215-0

Mouine, N., Ktari, M. H., and Chakroun-Marzouk, N. 2011. Reproductive characteristics of *Spondyliosoma cantharus* (Linnaeus, 1758) in the Gulf of Tunis. Journal of Applied Ichthyology, 27: 827-831. Doi: 10.1111/j.1439-0426.2010.01518.x

Mouine-Oueslati, N., Ahlem, R., Ines, C., Ktari, M. H., and Chakroun-Marzouk, N. 2015. Age and growth of Spondyliosoma cantharus (Sparidae) in the Gulf of Tunis. Scientia Marina, 79(3): 319-324. Doi: 10.3989/scimar.04234.13A

Moutopoulos, D. K., and Stergiou, K. I. 2002. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). Journal of Applied Ichthyology, 18: 200-203. Doi: 10.1046/j.1439-0426.2002.00281.x

Nelson, J. S. 2006. Fishes of the World (4th ed). John Wiley & Sons, Inc., New York, 601 p

Navarro, M. R, Villamor, B, Myklevoll, S, Gil, J, Abaunza, P., and Canoura, J. 2012. Maximum size of Atlantic mackerel (*Scomber scombrus*) and Atlantic chub mackerel (*Scomber colias*) in the Northeast Atlantic. Cybium, 36: 406-408.

Neves, A., Vieira, A.R., Sequeira, V., Paiva, R. B., and Gordo, L. S. 2017. Modelling the growth of a protogynous sparid species, *Spondyliosoma cantharus* (Teleostei: Sparidae). Hydrobiologia, 797: 265-275. Doi: 10.1007/s10750-017-3188-1

Nieto, A., Ralph, G. M., Comeros-Raynal, M. T., Kemp, J., García Criado, M., Allen, D. J., Dulvy, N. K., and et al. 2015. European Red List of marine fishes. Luxembourg: Publications Office of the European Union

Olson, D. B., Kourafalou, V. H., Johns, W. E., Samuels, G., and Veneziani, M. 2007. Aegean surface circulation from a satellite-tracked drifter array. Journal of Physical Oceanography, 37(7): 1898-1917. Doi: 10.1175/ JPO3028.1

Özaydın, O., Uçkun, D., Akalın, S., Leblebici, S., and Tosunoğlu, Z. 2007. Length-weight relationships of fishes captured from Izmir Bay, Central Aegean Sea. Journal of Applied Ichthyology, *23*(6), 695-696. Doi: 10.1111/j.1439-0426.2007.00853.x

Paruğ, Ş. Ş., and Cengiz, Ö. 2020a. The maximum length record of the blackspot seabream (*Pagellus bogaraveo* Brünnich, 1768) for the Entire Agean Sea and Turkish Territorial Waters. Turkish Journal of Agriculture-Food Science and Technology, 8(10): 2125-2130. Doi: 10.24925/turjaf.v8i10.2125-2130.3597

Paruğ, Ş. and Cengiz, Ö. 2020b. The maximum length record of the white seabream (*Diplodus sargus* Linnaeus, 1758) for the Aegean Sea.

Acta Natura et Scientia, 1(1): 96-108.

Pajuelo, J. G., and Lorenzo, J. M. 1999. Life History of Black Seabream, Spondyliosoma cantharus, off the Canary Islands, Central-east Atlantic. Environmental Biology of Fishes, 54: 325-336. Doi: 10.1023/A:1007515301745.

Perodou, J. B., and Nedelec, D. 1980. Bilan d'exploitation du stock de dorade grise. Science et pêche, Bull. Inst. Pêches Marit. 308: 1-7.

Peters, R. H. 1983. The ecological implications of body size. Cambridge University Press, New York, NY.

Petrakis, G., and Stergiou, K. I. 1995. Weight - length relationships for 33 fish species in Greek waters. Fisheries Research, 21(3-4): 465-469. Doi: 10.1016/0165-7836(94)00294-7

Polat, Ç., and Tuğrul, S. 1996. Chemical exchange between the Mediterranean and Black Sea via the Turkish Straits. In: Briand, F. (Ed.), Dynamics of Mediterranean Straits and Channels (pp. 167-186). Bulletin de l'Institut Oceanographique, Monaco, Special No. 17, CIESME Science Series.

Pope, K. L., Wilde, G. R., and Bauer, D. L. 2005. Maximum size of fish caught with standard gears and recreational angling. Nebraska Cooperative Fish & Wildlife Research Unit-Staff Publications. 201.

Quinn II, T.J., and Deriso, R. B. 1999. Quantitative Fish Dynamics. Oxford University Press, New York.

Santini, F., Carnevale, G., and Sorenson, L. 2014. First multi-locus timetree of seabreams and porgies (Percomorpha: Sparidae). Italian Journal of Zoology, 81(1): 55-71. Doi: 10.1080/11250003.2013.878960

Sarı, E., and Çağatay, M. N. 2001. Distributions of heavy metals in the surface sediments of the Gulf of Saros, NE Aegean Sea. Environment International, 26: 169-173. Doi: 10.1016/s0160-4120(00)00097-0

Siokou-Frangou, I., Bianchi, M., Christaki, U., Christou, E. D., Giannakourou, A., Gotsis, O., Ignatiades, L., Pagou, K., Pitta, P., Psarra, S., Souvermezoglou, E., Van Wambeke, F., and Zervakis, Z. (2002). Carbon flow in the planktonic food web along a gradient of oligotrophy in the Aegean Sea (Mediterranean Sea). Journal of Marine Systems, 33-34: 335-353.

Soletchnik, P. 1983. Gestion de la dorade grise, elements de biologie. Océanis 9: 23-32.

Souvermezoglou, E., Hatzigeorgiou, E., Pampidis, I., and Siapsali, K. 1992. Distribution and seasonal variability of nutrients and dissolved oxygen in the northeastern Ionian Sea. Oceanologica Acta, 15(6): 585-594.

Soykan, O., Gülşahin, A., and Cerim, H. 2021. Maximum size of marbled spinefoot (*Siganus rivulatus* Forsskal & Niebuhr, 1775) for Aegean Sea. Aquatic Sciences and Engineering, 36(1): 42-45. Doi: 10.26650/ASE2020727909

Stergiou, K. I., Christou, E. D., Georgopoulos, D., Zenetos, A., and Souvermezoglou, A. 1997. The Hellenic Seas: Physics, chemistry, biology and fisheries. Oceanography and Marine Biology: An Annual Review, 35: 415-538.

Stergiou, K. I., and Moutopoulos, D. K. 2001. A review of length-weigth relationships of fishes from Greek marine waters. Naga ICLARM Q.,24 (1-2): 23-39.

Torres, M. A., Ramos, F., and Sobrino, I. 2012. Length-weight relationships of 76 fish species from the Gulf of Cadiz (SW Spain).

Fisheries Research, 127-128: 171-175. Doi: 10.1016/j.fishres.2012.02.001

Vander Bloemen, S. N., Gorne, J. A., Sass, G. G., and Shaw, S. L. 2020. Influence of cisco (*Coregonus artedi*, Lesueur) on muskellunge (*Esox masquinongy*, Mitchill) mean length, population size structure, and maximum size in northern Wisconsin lakes. Journal of Applied Ichthyology, 36(2): 159-167. Doi: 10.1111/jai.13997

Vander Veer, H. W., Kooijman, S. A. L. M., and van der Meer, J. 2003. Body size scaling relationships in flatfish as predicted by Dynamic Energy Budgets (DEB theory): implications for recruitment. Journal of Sea Research, 50(2-3): 257-272. Doi: 10.1016/j.seares.2003.05.001

Wootton, R. J. 1990. Ecology of Teleost Fish. Chapman and Hall, London.

Zervakis, V., and Georgopoulos, D. 2002. Hydrology and circulation in the North Aegean (eastern Mediterranean) throughout 1997 and 1998. Mediterranean Marine Science, 3(1): 5-19.