Journal of New Results in Science (JNRS)
ISSN: 1304-7981
http://dergipark.gov.tr/en/pub/jnrs
Research Article
Open Access

Volume: 9
Issue: 3
Year: 2020
Pages: 1-8

Received: 23.09.2020 ***Accepted***: 17.11.2020

Estimation of Exploitable Sprat (Sprattus sprattus, Linnaeus, 1758) Biomass along Black Sea Coasts of Turkey (Samsun Region): This Paper is Dedicated to the Memory of Sedat GÖNENER

Uğur Özsandıkçı*

Department of Fishing Technology, Faculty of Fisheries, Sinop University, Sinop, Turkey
**Corresponding author, ozsandikciugur@gmail.com*

ABSTRACT: In this study, exploitable stock biomass of sprat (*Sprattus sprattus, Linnaeus, 1758*) distributed along Samsun shelf area (SSA) was estimated for the period 01 January – 15 May 2014. "Swept Area" method was used in the study. Catch per unit area (CPUA) and stock biomass of sprat in the SSA in size 2508.395 km^2 were estimated for deeper and shallower waters than 40 meters which were accepted as the midpoint. Accordingly, CPUA values were determined as; 40018.76 ± 10852.61 kg/km^2 in shallower area than 40 meters, 27758.77 ± 4.242.07 kg/km^2 in deeper area than 40 meters and 33602 ± 6017.46 kg/km^2 for SSA. The exploitable stock size of sprat was estimated as 84287 ± 15094 tons in SSA. Average length values of sampled sprats were 7.08 ± 0.02 and it was determined that 7-7.4 cm is the densest size group in the distribution of length-frequency. The other hand, length frequency distribution with respect to depth, densest size groups as follows; 7 – 7.4 cm for shallower waters than 40 meters, 6.5 – 6.9 cm for deeper waters than 40 meters.

Keywords – *Swept area, Sprat, CPUA, Pairly pelagic trawl, Black Sea*

1. Introduction

Sprat (*Sprattus sprattus*) is one of the most abundant and commercially economic pelagic fish in the Black Sea with anchovy. It also has a significant role in ecosystem since it forms a link between plankton and predators (Prodanov et al., 1997). Thus, it helps to provide energy flow in the food chain. Sprat is a cold-tolerant fish that feeds on plankton (Bat et al., 2008). Unlike the many other pelagic and sub-pelagic fish species living in the Black Sea, sprat is a cold-water species of boreal-Atlantic origin (Keskin, 2010) and mostly spawns during the winter months (Daskalov, 1999). They form dense schools close to the coasts in spring following the spawning period (Zengin et al., 2003, Radu et al., 2013) and start to accumulate lipids (Nikolsky et al., 2009). Although the sprat fisheries have begun in 90s in Turkey, first recordings of sprat catches belong to 2000. According to Turkish Statistical Institute (TurkStat), sprat catches reached its maximum level at 87140 tons in 2011 (TurkStat, 2020) (Table 1).

Table 1. Sprat Landings in Turkey (TurkStat, 2020)

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Landings (tons)	87141	12092	9764	41648	76996	50225	33950	20057	38078

Sprat which is intensively caught by pairly pelagic trawls in Samsun region (Erdem and Özdemir, 2008; Erdem et al., 2008; Özdemir et al., 2015) is not consumed directly as human food in Turkey and almost all catch is processed in fish powder and oil plants (Kalaycı et al., 2006; Bayraklı et al., 2019) as an alternative to anchovy (Balık, 2018).

Pairly pelagic trawls are the only fishing gear targeting sprat beside other pelagic fish species in Turkey (Erdem et al., 2008, Özdemir et al., 2006). They are known as highly selective fishing gear that can be used horizontally in the water column at the desired water level (Özdemir et al., 2006). In this way, pairly pelagic trawls gain advantage over purse seining in catching fish species that form loosed schools in a wide area such as sprat (Erdem et al., 2007).

Sprat fishing, which is carried out extensively in Samsun shelf area (SSA), Turkey, starts in January following the end of anchovy fisheries and lasts until May 15. In addition to serving as a food source for large predators such as harbour porpoise (Tonay et al. 2007), sprat is also an important species in reducing fishing pressure on anchovy with its potential use in fish meal and powder industry (Bayraklı and Duyar, 2019). A previous study stated that sprat was the only fish stock found to be in a healthy state and capable of producing Maximum Sustainable Yield (MSY) among the commercial fish species caught in the Black Sea coasts of Turkey (Demirel et al., 2020). It is important to carry out continuous and systematic stock assessment studies in order to maintain and control the healthy condition of sprat stocks.
In this study, it was aimed to estimate the exploitable stock size of sprat in Samsun Shelf Area (SSA) which is known by intense sprat fisheries by pairly pelagic trawl vessels.

2. Material and Methods

The study was performed between January - May 2014 in legal fisheries zone along Samsun shelf area (SSA) with commercial pairly pelagic trawl vessels. The area is restricted by Çayağzı Cape (Yakakent, Samsun) in the west and Akçay (Ünye, Ordu) in the east (Fig. 1). Although commercial fishing vessels have been used during the study, attention has been paid to homogenous sampling in terms of region, velocity and depth. 120-140 meters depth contour was determined as the boundary in the north because it was found that there is no sprat fisheries activity beyond this depth contour after interviewing with fishermen in the region.

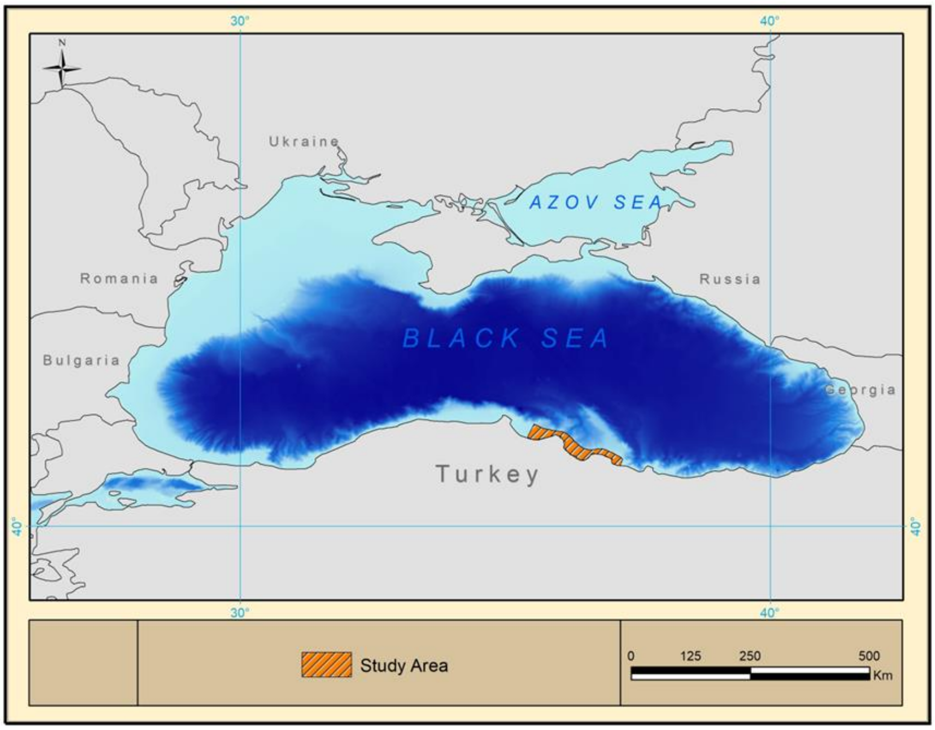

Fig. 1. Study area

From the fresh samples sorted for each hauling and moved to the laboratory, total length (TL) and body weight (W) measured to the nearest accuracy of 0.1 cm and 0.1 g, respectively. The dimensions of the midwater trawl net used in the study were as follows; length 225 meters, head rope length 100 meters and cod-end mesh size 14 mm. Swept area method was used to estimate stock biomass values (Erkoyuncu, 1995; Sparre and Venema, 1998).

$$CPUA = C / a \tag{2.1}$$

CPUA = Catch per unit area
C = Catch
a = Swept area

$$a = t \cdot v \cdot h \cdot q_2 \ (0.5) \tag{2.1a}$$

t = Haul duration
v = Velocity ($km.hour^{-1}$)
q_2= Fraction of the head rope length (0.5)

$$B = \frac{A}{q_1} . CPUA \tag{2.2}$$

B = Stock biomass
A= Total area (km^2)
q_1 = Fraction of the biomass in the effective path swept by the trawl (0.5)

ArcGIS for Desktop 10.1 software was used to mapping distribution of CPUA values within the study area and to calculate total study area. Bathymetric data were obtained from EmodNET (Marine Information Service, 2016). Mann-Whitney U test was used to compare CPUA values between months and depth. IBM Statistics 21 and Microsoft Excel softwares were used for statistical analyses.

3. Results and Discussion

3.1. Length frequency

According to data obtained in the study period, maximum and minimum length values were measured as 10.2 cm and 5.5 cm, respectively (Table 2).

Table 2. Minimum, maximum and average length-weight values of sampled sprats by months

	Length (cm)				Weight (g)			
Months	n	Min	Average	Max	n	Min	Average	Max
January	215	5.5	7.24 ± 0.05	9.5	215	0.86	2.11± 0.05	4.89
February	99	6.5	7.55 ± 0.04	8.5	99	1.66	2.63 ± 0.05	3.88
March	185	5.6	7.15 ± 0.04	10.2	185	1.18	2.48 ± 0.05	7.39
April	200	5.8	6.70 ± 0.04	8.9	200	1.11	1.86 ± 0.03	4.46
May	211	5.6	7.00 ± 0.04	8.7	211	1.23	2.63 ± 0.05	5.21
Total	910	5.5	7.08 ± 0.02	10.2	910	0.86	2.31 ± 0.02	7.39

Average length values were calculated as 7.15 ± 0.03 for samples obtained in depths shallower than 40 meters and 7.00 ± 0.03 cm for those in depths deeper than 40 meters. The difference in average lengths between depth contours was found significant ($p<0.05$) (Fig 2). Dominant length classes were found as 6.5 – 6.9 and 7 – 7.4 with a total of 54.21% representation

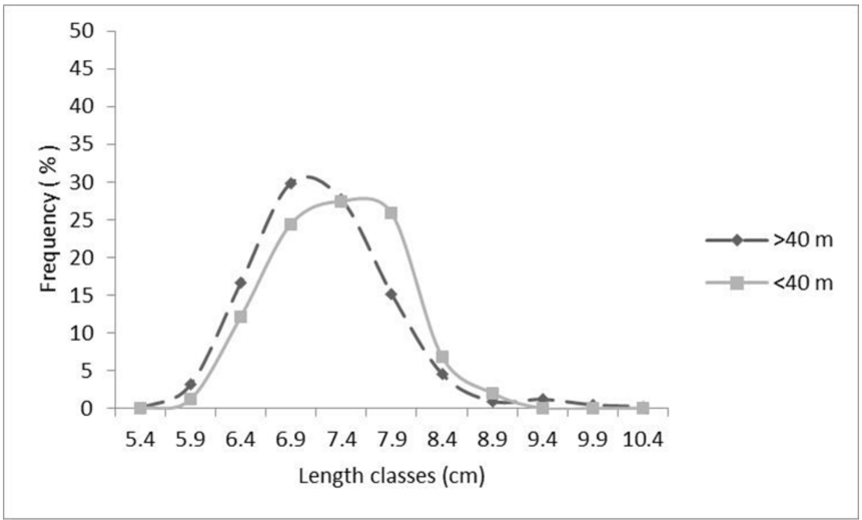

Fig. 2. Length frequency distributions according to depth contours

3.2. Catch per unit area

In total, 33.08 km² area has been swept during the study and 33 trawl operations have been performed. It was calculated that CPUA (Catch per unit area) values varied between 2320.64 kg/km² and 102637.20 kg/km². Average CPUA was 16800.99 ± 3008.73 kg/km². The highest CPUA value was obtained in March (30226.16 ± 10873.16 kg/km²) while the lowest value obtained in February (10192.94 ± 2432.68 kg/km²). Considering the monthly changes in CPUA values, there was no significant difference between months ($p>0.05$) except February and March ($p<0.05$). The other hand, CPUA values calculated based on depths were 20009.38 ± 5426.31 kg/km² in shallow waters and 13392.09 ± 2226.24 kg/km² in deeper waters. Although sprat densities in shallow waters are 49.34% greater than those in deep zone, there was not a significant difference between depths ($p>0.05$). In general, monthly changes were similar for both depths. CPUA values showing a sharp increase in March, showed a declining trend towards to May (Fig. 3). Distribution of sprat agglomerations in SSA was illustrated in Fig 4.

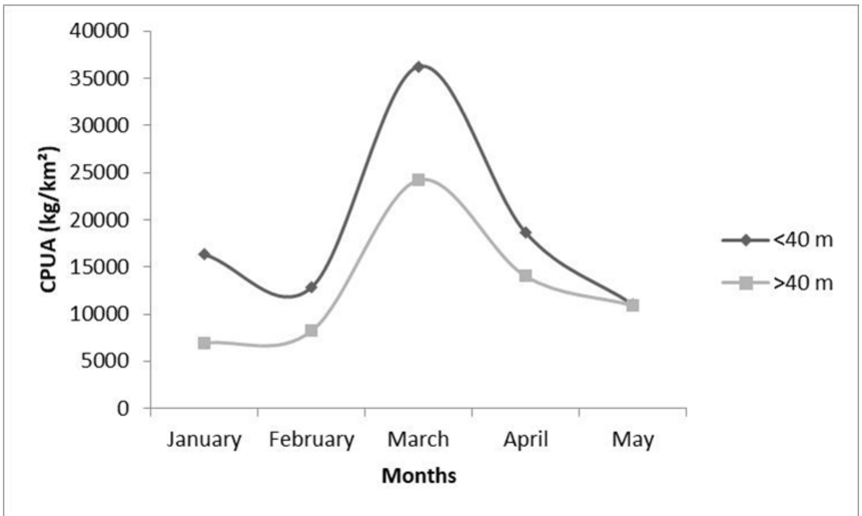

Fig. 3. Changes in CPUA values between months and depths (2014)

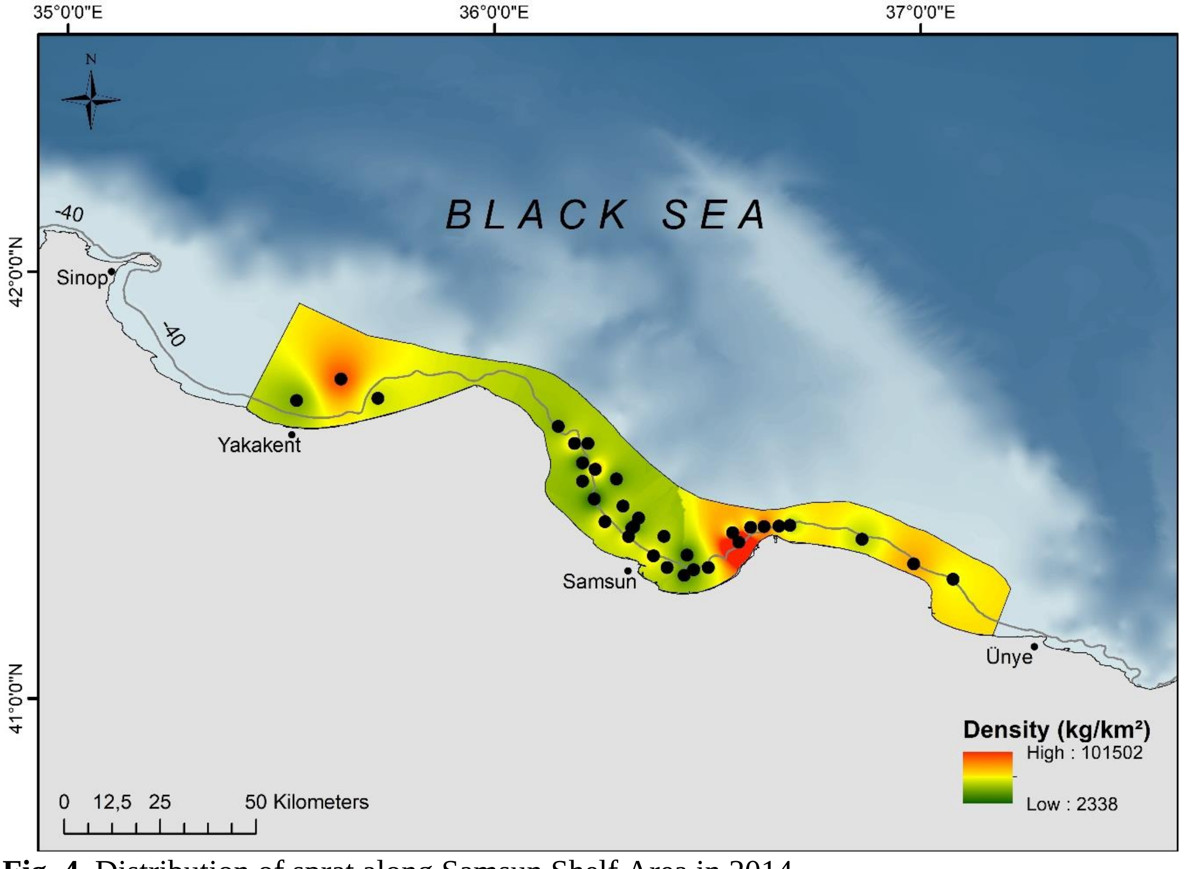

Fig. 4. Distribution of sprat along Samsun Shelf Area in 2014

3.3. Catch per unit effort

The value of Catch per unit effort (CPUE) is often used in fisheries stock assessments and is usually assumed to be proportional to the abundance of fish at sea (Panayotova et al., 2012). CPUE values were determined based on per hour and average CPUE was estimated as 3830.27 ± 692.61 kg/h. Results were similar to CPUA values (Fig. 5).

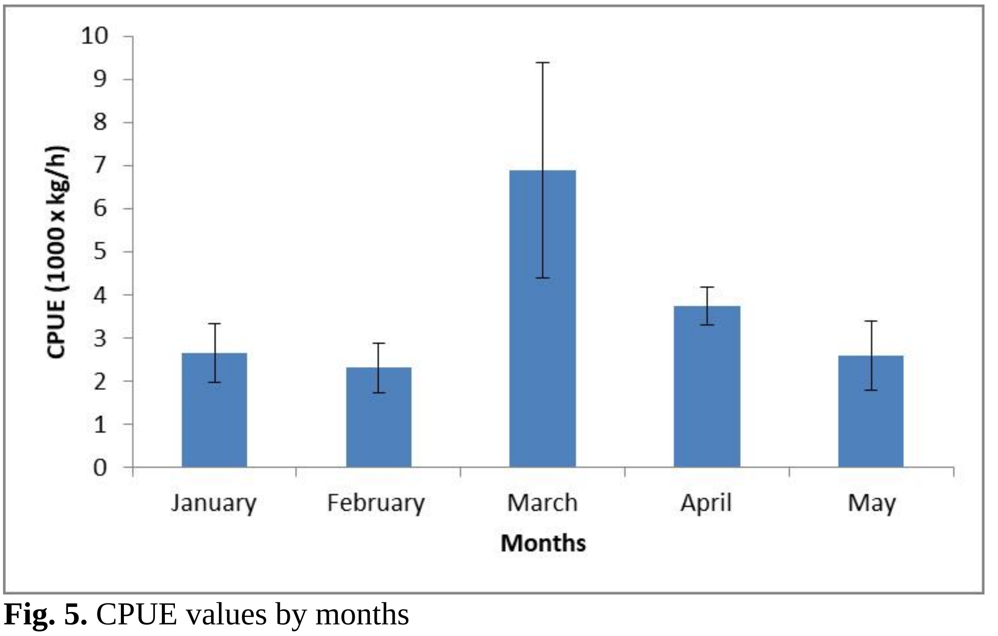

Fig. 5. CPUE values by months

3.4. Biomass

As a result of the 33-midwater trawl survey performed in SSA (≈ 2500 km²), the estimated relative biomass of sprat was 84287 ± 15094t. 44150.58 ± 11973.13 tons of this value were determined to be in shallow waters (<40 m) and 37635.73 ± 6890.81 tons were found to be in deeper waters (>40 m). Maximum values were observed in march for both depth contour (Table 3).

Table 3. Estimated biomass values by months and depth

	<40 m (t)	>40 m (t)	Total (t)
January	36011.27 ± 10289	19472.24 ± 2482.25	58318.87 ± 14979.11
Februay	28329.17 ± 12185.6	23068.03 ± 4353.6	51135.84 ± 14421.87
March	79995.55 ± 48888.21	68002.75 ± 16997	151638.29 ± 54548.33
April	41131.45 ± 5411.4	39377.01 ± 1866.56	83564.99 ± 8176.37
May	24343.48 ± 13735.57	30670.43 ± 2090.76	55109.58 ± 17146.6
Average	44150.58 ± 11973.13	37635.73 ± 6890.81	84287 ± 15094

4. Conclusion

In this study, exploitable sprat biomass in the SSA was estimated as 84.287 ± 15.094t in 2014. Maximum CPUA and CPUE values observed in March for both depth contour. Considering the length frequency distribution, it was determined that 54.21% of samples belonged to 6.5 – 6.9 cm and 7 – 7.4 cm length classes. However, it appears that sprats caught in shallower waters consisted of larger specimens compared to deep waters. In the similar study conducted in many parts of Black Sea, looking at the sampled sprat specimens obtained from Bulgaria it was found that the most intensive length group is 7 – 7.5 cm (STECF, 2014). In this sense, it is parallel to the present study. Samsun et al., (2006) reported that the sprat samples caught in Samsun region by pairly pelagic trawls between September and May are mostly distributed in the 9 cm length group. Considering the spawning period of sprat in the Black Sea is between October and April (Satılmış, 2005), it can be interpreted that the recruited specimens may have affected the length distribution particularly in the January – February period.

According to Turkish Statistical Institute (TurkStat, 2020), 41647.9 tons of sprat have been caught in 2014 (Table 1). Considering the average CPUA value of the study, estimated total sprat catch (≈ 42000 t) in the SSA (≈ 2500 km²) and the official data published by TurkStat show the great resemblance. From this point of view, if the capture coefficient (q_1) can be predicted more precisely, it is possible to make rapid and reliable biomass estimation using the current method.

Since 2008, Expert Working Group on Black Sea assessments provided by Scientific, Technical and Economic Committee for Fisheries (STECF) have been performing stock assessment studies for the fish species habits in the Black Sea including sprat and Turkey has been included into the coverage area of the surveys in 2011. Accordingly, CPUA value of sprat in the Samsun Shelf Area (SSA) was estimated as 4178.3 ± 1018.3 kg/km² in 2011 (STECF, 2012). However, they notified that the survey was performed in the 50 – 100m depth contour between March-May. In another report published by STECF (2011), in Bulgaria and Romania, CPUA values of sprat was reported to be higher in shallower waters than in deep regions similar to our work. Erdem, (2012) stated in his study conducted in 2009-2010 fishing season that the CPUA value of sprats in SSA was 25370 ± 4985 kg/km². Any assessment related to depths has not been made in the mentioned study.

Sprat together with anchovy constitutes the most important fish stocks of the Black Sea (Özdemir et al., 2018). Even so, there is no effective management plan for sprat populations in Turkey. However, after Bulgaria and Romania recently joined the European Union (EU), the sprat stocks in the Black Sea have become even more important for the EU. Therefore, sprat stocks throughout Turkish Black Sea coasts should be examined periodically and scientific data to be obtained should be taken into consideration in the process of the management plan. It is expected that the results of this study will fill the information gap and form basic knowledge for the management planning studies to be prepared for the sprat stocks in the Black Sea.

Acknowledgement

This paper is dedicated to the memory of Sedat GÖNENER (gone but never forgotten) who supervised the master thesis that is the basis of this work. We also kindly thank to Cemal MALKOÇ and "Malkoçoğlu Fisheries Company" for providing generous contributes to the study.

References

Balık, İ., 2018. Comparatively Evaluation of the Sprat (Sprattus sprattus) Fisheries in the Whole of the Black Sea and in the Turkish Coast of the Black Sea. Turkish Journal of Maritime and Marine Sciences, 4(1): 52-62.

Bat L, Erdem Y, Ustaoğlu Tırıl S., Yardım Ö. 2008. Balık Sistematiği. Nobel Yayın No: 1330, Fen Bilimler: 77, Nobel Bilim ve Araştırma Merkezi Yayın No: 31. Ankara.

Bayraklı, B., Duyar, H. A., 2019. Nutritional Composition of Fishmeal Obtained from Different Raw Materials in the Black Sea. Journal of Anatolian Environmental and Animal Sciences, 4(3): 545-550.

Bayraklı, B., Özdemir, S., Duyar, H. A., 2019. A Study on Fishing and Fish Meal-oil Processing Technology of Anchovy (Engraulis encrasicolus) and European Sprat (Sprattus sprattus) in the Black Sea. Menba Journal of Fisheries Faculty, 5(2): 9-16.

Daskalov, G., 1999. Relating Fish Recruitment to Stock Biomass and Physical Environment in The Black Sea Using Generalized Additive Models. Fisheries Research. 41(1): 1-23.

Demirel N., Zengin M., Ulman A., 2020. First large-scale eastern Mediterranean and Black Sea stock assessment reveals a dramatic decline. Frontiers in Marine Science 7: e103.

Erdem, E., 2012. Stock Assessment of the Fish Stocks Exploited by Midwater Trawl in Middle Black Sea Region. PhD Dissertation, Sinop University, Graduate School of Natural and Applied Sciences, p. 108, Sinop, Turkey (In Turkish).

Erdem, Y., Özdemir, S., Satılmış, H. H., 2007. Comparison of Night-Daytime Catch Efficiency and Size Composition of Midwater Trawl in Anchovy (Engraulis encrasicolus L.) Fishing. Erciyes University Journal of Institute of Science and Technology, 23(1-2): 230-237.

Erdem, Y., Özdemir, S., 2008. Fishing of Some Pelagic Species by Pairly Midwater Trawl in Black Sea Coast, Journal of Agricultural Faculty of Ondokuz Mayıs University, 23(2): 78-82.

Erdem, Y., Özdemir, S., Satılmış, H. H., Birinci-Özdemir, Z. 2008. Catch Efficiency and Length Composition of Anchovy (Engraulis encrasicolus L.) Fishing by Midwater Trawl at Daytime in Two Different Periods. Anadolu University Journal of Science and Technology, 9(1):17-23.

Erkoyuncu, İ., 1995. Balıkçılık Biyolojisi ve Populasyon Dinamiği (p. 265), Samsun: Ondokuz Mayıs Üniversitesi Yayınları.

Kalaycı, F., Bilgin, S., Samsun, O., Samsun, N., 2006. Researching the Place of Fisheries Industry and General State of The Sprat (Sprattus Sprattus Phalericus). Ege Journal of Fisheries and Aquatic Sciences, 23(1/3): 449-455.

Keskin, Ç., 2010. A Review of Fish Fauna in The Turkish Black Sea. Black Sea/Mediterranean Environment, 16(2): 195-210.

Marine Information Service, 2016. EMODnet Digital Bathymetry (DTM). Marine Information Service. http://doi.org/10.12770/c7b53704-999d-4721-b1a3-04ec60c87238

Nikolsky, V.N., Yuneva, T.V., Schepkina, A.M., Bat, L., Kideys, A.E., Shulman, G.E., 2009. Interannual Changes of Lipid Content in the Black Sea Sprat. Eds: Shulman, G., Öztürk, B., Kideyş, E., Finenko, G., Bat, L. Trophic Relationships and Food Supply of Heterotrophic Animals in The Pelagic Ecosystem of The Black Sea, pp. 227-245, Istanbul, Turkey.

Özdemir, S., Erdem, Y., Satılmış, H. H., Birinci Özdemir, Z., (2006). Determination of catch eficiency and lenght composition of anchovy (Engraulis encrasicolus L., 1758) caught by midwater trawl during nihgt in the Black Sea. Ege Journal of Fisheries and Aquatic Sciences, 23(3-4): 417-421.

Özdemir, S., Erdem, E., Birinci Özdemir, Z., Aksu, H., 2015. Monthly Monitoring of Length–Weight Relationships of Allis Shad (Alosa immaculata Bennett, 1835), Horse Mackerel (Trachurus mediterraneus Steindacher, 1968) and Sprat (Sprattus sprattus Linnaeus, 1758) from the Southern Black Sea, Turkey. Cahiers de Biologie Marine, 56(1): 25-30.

Özdemir, S., Erdem, Y., Birinci Özdemir, Z., Erdem, E., Aksu, H., 2018. Estimation of Growth Parameters and Mortality Rates of Sprat (Sprattus sprattus L.) and Anchovy (Engraulis encrasicolus, L.) Captured in the Black Sea. Turkish Journal of Maritime and Marine Sciences, 4(2): 106-115.

Panayotova, M. D., Raykov, V. S., Todorova, V. R., 2012. Turbot (Psetta maxima L.) Abundance Indices and Stock Dynamics of Bulgarian Black Sea Coast During the period 2006-2009. Acta Zoologica Bulgarica, 64 (1): 85-91.

Prodanov, K., Mikhailov, M., Dasklov, G., Maxim, C., Chashchin, A., Arkhipov, A., Shlyakhov, V., Özdamar, E., 1997. Environmental Management of Fish Resources in The Black Sea and Their Rational Exploitation. General Fisheries Council for the Mediterranean, FAO Studies and Reviews, 60: 100-110.

Radu, G., Maximov, V., Anton, E., Cristea, M., Ţiganov, G., Ţoţoiu, A., Spînu, A. D., 2013. State of the Fishery Resources in the Romanian Marine Area. Cercetări Marine, 43: 268-295.

Samsun, O., Kalaycı, F., Samsun, N., Bilgin, S., 2006. The Investigation on Some Biological Characteristics and Fishing Data of Pelagic Fishes Which Caught by Midwater Trawl in The Black Sea. Ege Journal of Fisheries and Aquatic Sciences, 23(1/3): 487-493.

Satılmış, H. H., (2005). Egg Production and Distribution of Egg and Larvae of Small Pelagic Fish in Sinop Coast. PhD Dissertation, Ondokuz Mayıs University, Graduate School of Natural and Applied Sciences, p. 174, Sinop, Turkey (In Turkish).

Sparre, P., Venema, S. C., 1998. Introduction to Tropical Fish Stock Assessment, Part I: Manual. FAO Fisheries Technical Papers, No 306/1 Rev.2 ISBN 92-5-103996-8.

STECF., 2011. Black Sea Assessments (STECF-OWP-11-06). Publications Office of the European Union, Luxembourg, EUR 25020 EN, JRC 67414, pp. 213.

STECF., 2012. Black Sea Assessments (STECF-12-15). Publications Office of the European Union, Luxembourg, EUR 25580 EN, JRC 76532, ISBN 978-92-79-27208-0 pp. 236.

STECF., 2014. Black Sea Assessments (STECF-14-14). Publications Office of the European Union, Luxembourg, EUR 26896 EN, JRC 92436, pp. 421.

Tonay, A. M., Dede, A., Öztürk, A. A., Öztürk, B., 2007. Stomach Content of Harbour Porpoises (Phocoena phocoena) from the Turkish Western Black Sea in Spring and Early Summer. Rapport Commission international Mer Méditerranée, 38: 616.

Turkey Statistical Institute (TurkStat), (2020). Turkish Statistical Institute Fishery Statistics https://biruni.tuik.gov.tr/medas/?kn=97&locale=en (Date of Access: 02.10.2020)

Zengin, M., Düzgüneş, E., Dinçer, A.C., Mutlu, C., Bahar, M., Tabak, İ., 2003. Karadeniz'de Orta Su Trolünün Kullanım Olanakları ve Av Verimliliğinin Araştırılması. TAGEM/HAYSUD/1998/17/03/007, Nolu Proje Raporu, T.K.İ.B. Su Ürünleri Araştırma Enstitüsü, Trabzon, Türkiye.