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Small-scale fisheries in the southern Black Sea: Which factors affect net profit?

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Abstract

Small-scale fisheries (SSF) is a local and community-based activity that can be traced back to ancient times, and thus, closely related to the history of humankind. However, large-scale fisheries have grown tremendously, approaching an industrial sector in the last century, due to their socio-economic and political properties, including both national and international aspects. This progress towards industrial-scale fisheries led to the involvement of scientific research, first aiming to improve production efficiency, and then, to protect ecosystems as resources exploited for fisheries activity, by mitigating their adverse impacts. During this evolutionary progress, SSF was usually neglected because of their limited production ability, and thus minimal economic contribution, until the later phase when the protection of ecosystem resources gained sufficient importance. As a result of this, many countries lack data on SSF, undermining efforts for the creation of proper policies for this type of fisheries. The aim of this study was to evaluate the productivity and the effects of some demographic characteristics, boat structures, and some cost (input) items on the net profit of SSF in the Black Sea. The eligible sample for this study consisted of 5575 small-scale fishing boats in the Black Sea. The number of fishers to be surveyed was determined as 315 using the "Simple Random Sampling" method, based on operators of boats < 12 m, i.e., boats in the SSF. Questionnaires were conducted face-to-face with fishers. In this study, it was tested if six parameters were investigated to determine whether they had a significant effect on net profit in SSF. These parameters were: (1) engine power; (2) number of fishing days; (3) boat length; (4) consumption of fuel in fishing; (5) education level of fishers; and (6) overall professional experience of fishers. To do so, Simple Linear Regression Analysis was performed to determine the effect of the data considered as independent variables when the net profit was set as the dependent variable. Atlantic bonito, *Sarda sarda* (Bloch, 1793); whiting, *Merlangius merlangus* (Linnaeus, 1758); rapa whelk, *Rapana venosa* (Valenciennes, 1846); and turbot, *Scophthalmus maximus* (Linnaeus, 1758) were the most important commercial fish species for small scale fishing. When catch per boat in SSF was evaluated, Kırklareli province ranked first with 97 007 kg, with Atlantic bonito (44 778 kg) being the most common species caught. Samsun had the second-largest catch per boat with 91 761 kg. The total net profit of 303 boats was calculated as €1 794 938 and the mean net profit per boat was €5924. The highest per boat mean net profit (€25 909) was in Kırklareli. According to the results of the study, the number of days at the sea, boat length, engine power, and fuel cost had a significant effect on the net profit while education level and professional experience were not important in productivity. The economically-fragile SSF sector may need some kind of supporting subsidy. It would be beneficial to provide support to the majority of fishers active in the SSF in terms of complementary alternative employment opportunities in the regions where they are located.

Keywords

Black Sea, net profit, productivity, revenue, small-scale fisheries, total cost

Introduction

Small-scale fisheries (SSF) is not considered as an economic sector. In their own right since SSF tend to be closely related to local communities, traditions, and values (Kolding et al. 2014). SSF catch is usually for direct consumption in the local community and trading is mainly dependent on irregular opportunities such as unexpectedly successful catch performance and the availability of proper logistics for market delivery. Many SSF, which may have important conservation values, are overseen by self-governing mechanisms, but they are under increasing pressure. For example, the Food and Agriculture Organization of the United Nations (FAO) estimated that around 90% of all the people who work in fishery sectors are active in the SSF around the world, which collectively contribute to almost half of global fish catches (FAO 2018) and this contribution increases by two-thirds when the proportion directly used for human consumption is considered. Given the importance of SSF in the human food supply, the attention of both scientists and decision-makers has been drawn to the challenges faced by SSF for sustainable fishery management. Studies have shown that SSF can make a significant contribution to nutrition, food security, sustainable livelihood, and poverty reduction, in addition to being more eco-friendly features than industrial or large-scale commercial fisheries (Berkes et al. 2001; Béné et al. 2007). According to the FAO (2020), about 90% of the 35 million people recorded worldwide as fishers are classified as small-scale and a further 20 million people are estimated to be involved in the small-scale post-harvest service sectors.

The amount of main SSF marine products used for human consumption, such as fish flesh, roe, fins, etc. is around 30 million tons/year (Jacquet and Pauly 2008). Other products of industrial fisheries, such as fish-meal and fish oil which are not produced for direct human consumption, yield about 35 million tons/year. Crowder and Murawski (1998) reported that approximately 40 million tons of fuel is consumed per year in industrial fishery, with 1 to 2 tons of target species and 8 to 10 tons of discarded bycatch species per 1 ton of fuel, although a global rate for bycatch rate is difficult to estimate. In the case of SSF, annual fuel consumption is around 5 million tons with a product: fuel ratio ranging between 4:1 and 8:1 and much lower discarded bycatch (Jacquet and Pauly 2008). These authors also estimated that 25 to 27 million dollars of subsidies are annually provided to industrial fisheries worldwide, whereas this value is around 5 to 7 million dollars for SSF. Such a comparison clearly demonstrates the level of importance of small-scale fishery in the overall fishery sector. However, not much is known about product-related processes, such as capture, preservation, value-adding, and marketing, which are highly variable, and difficult to track through an established value chain chart compared to a well-established organization (Staples et al. 2004). It has been emphasized that global SSF activities, which involve more than 12 million fishers for the subsistence of their households, have not been managed sustainably due to their lower visibility. The contribution of SSF to gross national domestic product (GNDP) has been underestimated because of the difficulty of following a product's value chain from catch to the market.

Due to the inherent variability, complexity, and uncertainty, it is difficult to create a consensus definition that would be applicable to all global SSFs. Therefore, sectoral-based definitions for SSF have to be general. SSF has been defined as a dynamic and developing sub-sector of fisheries, using labor-intensive catching, processing, and distribution technologies to take advantage of marine and inland fishing resources (Staples et al. 2004). Nonetheless, the general perception of SSF implies characteristics, namely that it is predominantly artisanal, local, coastal, traditional, small, subsistence, non-industrial, low-tech, and poor (Natale et al. 2015).

Fisheries, in general, is defined as an activity that involves the catching, preservation, processing, transporting, and marketing of the product. Additionally, there are bilateral related sectors, such as construction and repair/maintenance of fishing gear, boats, and engines. There is no doubt that SSF plays a prominent role in the value chain, in the fishery market as a product supplier, and in the industrial and service sectors as a dependent customer. All these associated sectors, together with fish production, create the total contribution of the fishery sector to national, regional, and local economies.

The aim of this study was to analyze the socio-economic status of the SSF in the Black Sea. A set of socio-economic indicators were investigated that enabled an estimate of their significance to net profit in the SSF so that these results can be exploited to enhance the management of fisheries in the region. The following SSF fleet composition will provide the required data and information.

Data from 2017 reported a total of 14 479 fishing boats operating in Turkey. Of these, 12 983 (89.7%) have a boat length less than 12 m and thus constitute the SSF fleet active throughout the coasts of Turkey. These proportions are similar in the Black Sea, with 5575 fishing boats, of which 5141 (88.6%) are shorter than 12 m (TURKSTAT 2017; GDAR 2018).

These numbers indicate that the majority of boats involved in the Black Sea fishing are actually part of the Black Sea SSF, both in terms of structure and function. Although the number of boats in the SSF fleet is known, data and information concerning the socio-economic properties are scarce and limited. As result, it is almost impossible to predict their potential socio-economic performance. Such predictions are essential for developing efficient management strategies and solutions, considering both the sustainability of SSF activities and ecosystem resources and thus achieving a more rational use of resources and sustainable levels of the fishery.

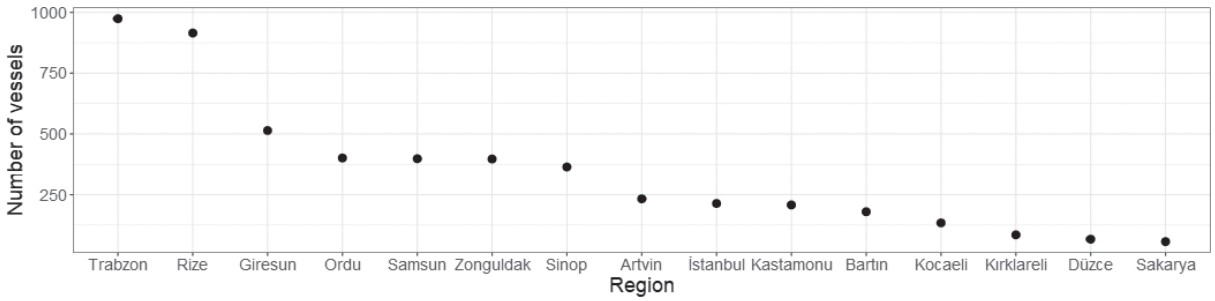

Figure 1. The number of SSF boats off the Turkish Black Sea coasts by region.

Material and methods

The sample was drawn from the SSF in the Black Sea. These numbered 5141 (88.6%) with a boat length < 12 m of a total of 5575 fishing boats operating in the Black Sea (TURKSTAT 2017; GDAR 2018). The majority of these smaller boats (59%) were located and operated in the eastern provinces of Ordu, Giresun, Trabzon, Rize, and Artvin. The coastal waters of these eastern provinces were closed for bottom-pelagic trawling and hydraulic dredge fishing in the 1980s, which may have resulted in such an SSF profile in the area (Fig. 1) (Mısır et al. 2020). Of the 5141 boats, 196 (3.8%) are C licensed (10–12 m) whilst the rest are D licensed (< 10 m). Regardless of their licenses, 447 of these boats (8.7%) were out of operation for various reasons, 1322 of them (25.7%) use only long lines, and the remaining 3372 boats (65.59%) used at least one or more extension gill nets or circular nets (Mısır et al. 2020).

The study was based on a field survey, to be conducted by face-to-face interview, in order to collect data via a specifically prepared questionnaire. The number of fishers to be surveyed was determined by using the simple random sampling method, using the following equation (Yamane 1967).

$$n = \frac{N(zC)^2}{Nd^2 + (zC)^2}$$

where, n is the number of boats surveyed; N refers to the total population of boats (5575); z is the standard normal distribution value corresponding to the desired confidence level (95%); C is the coefficient of variation; and d is the margin of error (±10%), accepted in the study.

In order to arrange the meetings with fishers, a series of informative meetings was first organized with the regional authorities, including the departments of Provincial Directorates of the Ministry of Agriculture and Forestry and Fisheries Cooperatives in order to prepare the work program schedule for each fishing port where the project personnel would meet with fishers who were boat owners in order to conduct the surveys.

The questionnaire forms were used to create the main data resource. The survey consists of three sections, each of which has a set of questions on: a) the social status of the boat owners; b) information on boats and fishing operations; and c) the economic features of their fishing operations.

Considering the possible variations due to demographic or technological differences which can influence the comparability of the analysis leading to bias, a set of parameters free from such bias were selected for evaluating the efficiency of SSFs in the Black Sea. Costs and revenue figures were converted to Euro equivalents (€) for standardization purposes at the exchange rate quoted by the Central Bank of the Republic of Turkey for 2015 (CBRT 2021).

There were six parameters selected to test for their influences on the net profit in SSF. These were: (1) engine power, (2) numbers of days at sea, (3) length of boat, (4) fuel costs, (5) education level, and (6) professional experience of fishers. Once these parameters were selected and the data associated was collected, collated, and compiled for analysis, a simple linear regression analysis (SLRA) was performed in SPSS, version 13.0 (IBM Inc., Armonk, NY, USA). This was done to determine the effect when data from the selected parameters were designated independent variables and the net profit was designated as the dependent variable. The SLRA is a statistical test that predicts the relations between the independent and the dependent variables and the nature of the relation (Nakip 2005). The calculation to determine revenue generated was performed prior to performing the SLRA. This calculation was made by multiplying the catch for each species by the mean sale price for that year. The unit price of fish caught by SSF is usually higher than that caught by industrial fishery, due mainly to the freshness of the product. After estimating the value of the catch, the net profit was calculated by subtracting the total costs including fuel, boat, and fishing gear maintenance and repair, clothing, documents, and registration expenses from this catch value (EC 2001).

Results and discussion

Even though the calculated number of fishers to be surveyed was 284, face-to-face interviews were carried out with 315 boat owners from 15 provinces including

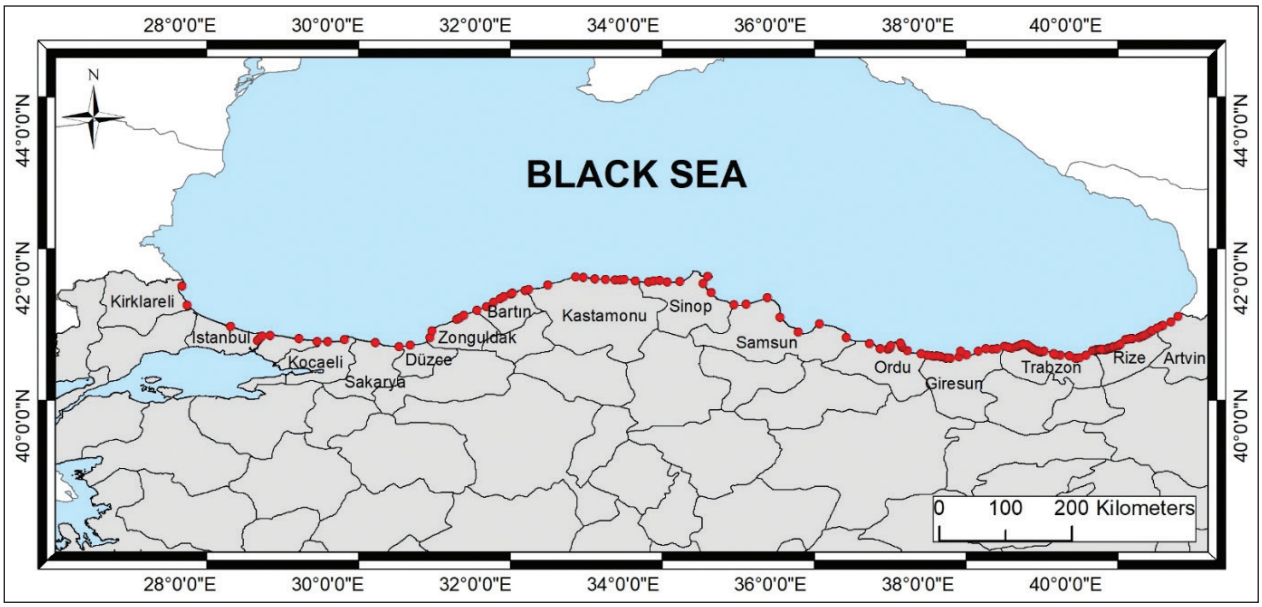

Figure 2. Areas with SSF's shelters in the Black Sea.

(eastern) Giresun, Ordu, Artvin, Rize, Trabzon, (central) Samsun, and (western) Bartın, Zonguldak, Kastamonu, Sinop, Sakarya, Kırklareli, İstanbul, Kocaeli, and Duzce (Fig. 2). However, the data collected from 12 participants were not suitable for analysis due to incomplete information and incorrect answers and was not included. Consequently, the total number of questionnaires used in the analysis was 303.

During the study, 32.3% of the respondents were in the age group aged 50–59 years with the mean value of 49.7 ± 11.4 years while the range was 21–78 years. Dağtekin (unpublished) in a study carried out in Trabzon province reported that 42% of the boat owners were in the 40–49 years age group. Similarly, Uzmanoğlu and Soylu (2006) stated that 35.7% of the fishers in Karasu were between the ages of 40–49 years. Çeliker et al. (2006) determined that the age of fishers in the Black Sea varied between 25 and 70 years and the mean age was 46.45 years. In a later report from the Aegean Region, Çeliker et al. (2008), found that the ages of the fishers varied between 19 and 73 years. Another study conducted along the Mediterranean coasts of Turkey (Taşdan et al. 2010), revealed that the mean age was 40 years while Güngör et al. (2012) stated that the largest age grouping of fishers in the Marmara Sea was between 41 and 50 years (34.2%).

The fishers' education level was predominantly primary school level (48.6%). This proportion for Turkish fishers showed a slight improvement on earlier studies. The proportion who were primary school graduates in earlier studies were: 58.44% in the Black Sea (Çeliker et al. 2006), 78.6% in Karasu, a coastal town in the western Black Sea (Uzmanoğlu and Soylu 2006), 70.1% for the Aegean Sea (Çeliker et al. 2008), 60.7% along the Mediterranean coasts of Turkey (Taşdan et al. 2010), 60% in Trabzon on the Black Sea coast (Dağtekin unpublished), and 64% for the Sea of Marmara (Güngör et al. 2012). Thus, it appears that the education level of the fishers operating in the Turkish SSF is mainly elementary school.

In the presently reported study, the mean number of years of experience of the fishers surveyed was 29.4 ± 12.7. The household population of fishers varied between 2 and 7 family members. The corresponding mean values were 3.38 in the Aegean region (Çeliker et al. 2008), 3.8 in the Mediterranean (Taşdan et al. 2010), and 3.68 in the Black Sea region (Çeliker et al. 2006). In a study conducted in the Marmara region, it was reported that 88.4% of fishers were married (Güngör et al. 2012) while another study determined that 81% of the fishers in the Eastern Black Sea were married (Özbek unpublished). The maximum number of children at home was 5, but the mean value was 2.14 (Table 1). Similar figures were reported in previous studies, including 2.2 for the Black Sea region (Çeliker et al. 2006), 1.7 for the Aegean Region (Çeliker et al. 2008), and 1.9 for the Mediterranean coasts of Turkey (Taşdan et al. 2010). The number of individuals living in households in the Black Sea Region was higher than the other fishing communities in Turkey. The majority (78.3%) of fishers have social security. The ratio of fishers who have a second revenue source was 43.9%. The number of children who also engaged in the fishing profession was 19%. Although 51.4% of the fishers reported being moderately satisfied with their job, the majority of (87.7%) of the interviewed fishers intended to continue their profession in the future. Despite the difficulties of fishing as a profession, their preference for continuing their job mainly stems from the lack of other job opportunities, experience relating only to fishing, and their passionate love for the profession. Nevertheless, 68.5% of fishers were not satisfied with the legal regulations, which are currently in the notification (Table 1).

The analyses of the distribution of catch by species, the net profit by province, and the relation between inputs

Table 1. Socio-demographic characteristics of fishers on the Turkish Black Sea coasts.

Category	Variable	[%]
Age (years)	20–29	4.2
	30–39	15.7
	40–49	26.2
	50–59	32.3
	60–69	18.5
	≥70	3.2
Marital status	Single	10.5
	Married	89.5
Number of children	0	13.2
	1	15.8
	2	39.2
	3	21.9
	4	8.0
	5	1.9
Level of education	Primary school	48.6
	Secondary School	21.1
	High school	25.9
	Associate degree	2.6
	University	1.9
Social security	With social security	78.3
	Without social security	21.7
Second revenue	Fishing only	56.1
	Having a second revenue	43.9
Fishing experience (years)	1–10	8.4
	11–20	25.0
	21–30	24.4
	31–40	26.6
	41–50	7.5
	>50	8.1
Number of children engaged in fishing profession	Yes	19.9
	No	80.1
Satisfaction	Satisfied	34.8
	No Satisfied	13.4
	Moderate level satisfied	51.8
Do you plan to continue the profession in the future?	Yes	87.7
	No	11.4
Are you satisfied with the legal regulations?	Yes	31.5
	No	68.5

and net profit of SSF were performed using data from fishing operations in one season along the Black Sea coastline of Turkey. Kırklareli, the westernmost province, was where the maximum yield (97 007 kg) of fish was caught. Atlantic bonito, *Sarda sarda* (Bloch, 1793), was more frequent and one of the most important species in the populations studied. The mean value of the catch of Atlantic bonito was 44 778 kg/boat in Kırklareli and 22 977 kg/boat in Samsun. Moreover, Atlantic bonito was also the top species caught by the boats in Kocaeli province (19 183 kg) whilst anchovy (10 500 kg) was the second species caught most often by boats (Table 2). Every year, Atlantic bonito migrates for reproduction and nursery from the Mediterranean Sea through the Turkish Strait System, consisting of the Straits of the Dardanelles, Sea of Marmara, and the Straits of the Bosphorus, to the Black Sea and return through the same path for feeding (Genç et al. 2019). Due to its migration pattern, the Atlantic bonito catch is greater in provinces close to the Bosphorus. Rapa whelk was also an important catch species for SSF. When the regions are compared with each other, the revenue obtained from rapa whelk in the Samsun region was higher than the other regions, in terms of higher landing volume [kg] and thus revenue. It should also be noted that prices for rapa whelk vary with the mean length and this is an effective factor for changing the revenue level in disparities between regions. Turbot, *Scophthalmus maximus* (Linnaeus, 1758), stocks in the Black Sea were overexploited (GFCM 2019). Therefore, the landing volume per boat was far lower than historical records show. The total number of gillnets and entangling nets in the boats comprised 107 331 panels in the Turkish Black Sea coasts. The number of gillnets and entangling nets for turbot, whiting, *Merlangius merlangus* (Linnaeus, 1758), Atlantic bonito, and red mullet, *Mullus barbatus* Linnaeus, 1758, constitute 91% of the total number of nets (Dağtekin et al. 2019).

The total and mean net profits of the 303 boats surveyed were, respectively, €1 794 938.00 and €5924.00. Total catch earnings of the 10 active boats in one year in Kırklareli amounted to €259 090. Fishers from Kırklareli reported both the highest revenue and the highest mean net profit among the provinces included in this study. However, many provinces had comparatively low net

Table 2. Landing volume by region mean per boats [kg].

Region	Target species												Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Artvin		2487	5015	1500	9029	6300	3378	500	1500	3437			3750	36 896
Bartın		4820	8465	250	200	3000	790	6250		750		17 050	300	41 875
Düzce		15 500	18 817	1602		3200	3000			24 000		10 000	2000	78 119
Giresun		1656	4642	200	21 552	2025	2640	2850	235	1500		10 000	2000	49 300
İstanbul		4332	9573	3831		3900	3875	4750	300	1917		26 000	18 112	76 590
Kastamonu		2252	13 732	3308	1150	5475	1588	683	325	993	250	10 200	3972	43 928
Kırklareli		19 857	44 778	10 643	750	3360	2950	700	100	1483		5486	6900	97 007
Kocaeli	10 050	1399	19 183	3439	8833	8950	5350	750	8000			6583	2333	74 870
Ordu		2225	13 905		34 911	6190	7291		1010	5360		4600	3000	78 492
Rize		2672	4638	1375	6000	839	1995	500	150	3451	3417		3500	28 537
Sakarya		1710	11 800	5540	1500		2733		550			8775	3300	35 908
Samsun		2592	22 977	4862	3100	11 312	4500	1687	6967	2718	3000	23 225	4821	91 761
Sinop		400	14 723	3933	9583	2887	4570	762	1208	2818	150	1717	1150	43 901
Trabzon	187	1910	8485	2934	11 572	3144	2998	700	1804	1325	200	16 900	2192	54 351
Zonguldak		1039	5962	2992	4267	16 667	7927	7877		500	2250	10 230	12 740	72 451

Abbreviations: (1) anchovy *Engraulis encrasicolus*, (2) horse mackerel (*Trachurus mediterraneus*), (3) Atlantic bonito (*Sarda sarda*), (4) bluefish (*Pomatomus saltatrix*), (5) whiting (*Merlangius merlangus*), (6) turbot (*Scophthalmus maximus*), (7) red mullet (*Mullus barbatus*), (8) scorpion fish (*Scorpena porcus*), (9) shad (*Alosa immaculata*), (10) grey mullet (*Liza aurata* and *Mullus cephalus*), (11) sea bass (*Dicentrarchus labrax*), (12) rapa whelk (*Rapana venosa*), (13) Others.

Table 3. Total and mean revenue, net profit, and total costs of boats by provinces.

Province	Number of total boats	Interviews number of boats	Total net profit [€]	Mean net profit [€]	Mean total revenue [€]	Mean total costs
Artvin	233	13	111 341	8565	11 596	3031
Bartın	180	12	36 766	3064	5458	2394
Düzce	67	7	78 271	11 182	15 618	4436
Giresun	514	27	58 988	2185	6184	3999
İstanbul	214	21	108 035	5145	8791	3646
Kastamonu	208	16	128 899	8056	10 928	2872
Kırklareli	85	10	259 090	25 909	30 703	4794
Kocaeli	134	19	189 101	9953	12 832	2879
Ordu	401	20	200 855	10 043	19 007	8964
Rize	915	39	43 835	1124	4573	3449
Sakarya	57	7	89 215	12 745	18 501	5756
Samsun	398	23	173 980	7564	11 850	4286
Sinop	364	23	103 244	4489	7938	3449
Trabzon	974	46	84 323	1833	6626	4793
Zonguldak	397	20	128 994	6450	10 605	4155
Total	5141	303	1 794 938	5924	10 108	4184

profit in one season: the mean were €1124 in Rize; €1833 in Trabzon, and €2185 in Giresun per boat (Table 3). The migration of pelagic fishes (Genç et al. 2019), which is important for SSF, was an effective factor in the differences between regions. The low number of active fishing boats in the region compared to other regions increased the catch weight per boat while the high number of boats in the eastern Black Sea decreased the mean revenue. Revenue and net profit were generally found to be low in studies conducted in various regions of the Turkish SSF (Çeliker et al. 2006; Çeliker et al. 2008; Taşdan et al. 2010; Ünal and Franquesa 2010; Zengin et al. 2017; Birkan and Öndes 2020).

The reported boat engine power was highly variable, ranging from only 2.98 kW to 261 kW, with a mean value of 45.54 kW. The number of days at sea also varied widely, from 10 to 310 days, with a mean of 159 days. The length of boats ranged between 4.4 to 12 m, with a mean of 7.47 m. Fuel cost varied, as expected by both engine power and the number of days of fishing, with a mean of €1325 (Table 4). In a study covering the EU's 54 fishing fleets from 2002 through 2008, it was stated that the proportion of total expenses made up of fuel costs varied between 17% and 29%. The mean annual fuel consumption of a boat in the EU fleet was reported to range between 1.570–1.055 tons annually according to the status of the fishing (Cheilari et al. 2013). The price of the fuel during the year and the number of days at sea were the main factors involved in the change of the rate in the total costs.

Table 4. Boat features, number of fishing days, and fuel costs.

Parameters	Min.	Max.	Mean	SD
Engine power [kW]	2.98	261.00	45.54	42.50
Number of days at sea	10.00	310.00	159.08	79.06
Length of boat [m]	4.40	12.00	7.47	1.63
Fuel costs [€]	66.00	9917.00	1482.50	1325.28
Age of boat	1.00	45.00	14.95	9.89

Each of the six selected parameters had some effect on net profit, with the exceptions of professional experience and education level (see Table 5). The variable with the strongest effect was the length of the boat (19%). A moderate effect was found for both fuel consumption while fishing (11%) and boat engine power (8%), whilst the weakest was the number of days at sea (3%).

The management of SSF is important not only for the protection of natural resources but also for the sustainable living standards of the citizens whose subsistence is dependent on this activity. We estimate that a total of 26 800 people are reliant on the Black Sea SSF made up of approximately 6700 crew, who are directly dependent on fishing, on the Black Sea coastline of Turkey on 3372 active boats, and including the number of people in their households. Thus, it would be reasonable to assume that the numbers reliant to some extent on the Black Sea SSF will exceed 100 000 when the sectors related to the fishery, such as wholesalers and retailers, equipment manufacturers of engines and the fishing gear are also considered. Nonetheless, the focus of this study was to analyze only the profitability of fishing performance of the boats smaller than 12 m, as they compose the core of the SSF fleets. A further aim was to raise awareness of the sustainable use of fishing resources as a social responsibility, which goes far beyond simple environmental issues

Table 5. Relations between engine power, number of fishing days, fuel consumption, boat size, and net profit.

Relation of variables with net profit	Model summary table			Coefficient table	
	R^2	F	Sig.	β	Sig.
Engine power [kW]	0.084	20.180	$P < 0.05$	547.520	$P < 0.05$
Number of days at sea	0.030	9.309	$P < 0.05$	322.161	$P < 0.05$
Length of boat [m]	0.196	73.371	$P < 0.05$	16.179	$P < 0.05$
Fuel costs [€]	0.109	36.832	$P < 0.05$	29.657	$P < 0.05$
Professional experience of fishers	0.010	0.290	$P > 0.05$		
Education level	0.010	0.198	$P > 0.05$		

Conclusion

The number of days that the boats of SSF fleet spend at sea is low. According to FAO criteria, the boat is considered active when it is at sea fishing even for one day. Therefore, when the mean revenue and catch per boat is reported, it is unlikely to reflect the status of the active boats throughout the year.

The mean age of fishers in this study was late middle age. As SSF is an active form of artisanal fishing, if this sector is to be encouraged then it will be necessary to provide support to attract younger people into the SSF, as has been reported previously (Çeliker et al. 2006, 2008; Taşdan et al. 2010; Dağtekin unpublished).

The majority of the fishers were primary school graduates. When the reasons for practicing SSF were examined, it was found that this job was sought around 20% of the time as either a hobby or as a post-retirement activity. This finding would also explain why some of the boats reported relatively few active days. The mean net profit was €5924 per fisher per season. This figure will have been influenced by the fifth of respondents who considered their activity in the SSF as part-time. However, it would be beneficial to provide support to the majority of fishers active in the SSF in terms of complementary alternative employment opportunities in the regions where they are located.

Almost all settlements along the Black Sea coast have traditional shipbuilders who build, repair the boats, and provide maintenance services. With an investor group of at least two people in a fishing port and shelter, a new employment opportunity can be created for the fishing sector, so that coastal fishers will be able to access services for boat maintenance, repair and construction works with less cost in their local settlements. There are some examples that have been applied and successfully managed around the Gulf of Gökova, in the Aegean Sea SSF (Ünal and Kızılkaya 2019). The SSF sector can also be supported by other means. For instance, stocks of turbot, sturgeon, etc. can be restored by releasing hatchery-produced juveniles within the frame of a well-designed and executed stock enhancement program (Charles et. al. 2003). Also, SSF boats can also be utilized for tourism purposes (Lai et al. 2016). Viable suggestions are continuously forwarded and promoted by FAO and EC via workshops and reports for strengthening of SSF (EC 2018; FAO 2020).

Within the value chain, different systems should be investigated to increase the fisher's revenue. With cooperation, all scenarios can be developed, including e-commerce, which has come to the fore during the recent pandemic. Moreover, any changes to the legal standards for fishing gear may cause an acute increase in overall operational costs for SSF fishers who are not able to adapt due to their vulnerable economic status. Thus, a subsidy program will be needed and recommended when such changes in the legal standard for fishing gear are proposed and implemented. The overall evaluation of the results suggests that the Black Sea SSF in Turkey is not sustainable under current circumstances, like many other countries.

Recently, marine cage culture systems have been increasing in the Black Sea. It is very likely to pose some potential conflicts with the capture fisheries sectors. These include over-exploitation of marine areas as well as supply to local markets. Nevertheless, a well-designed marine spatial planning program can result in a symbiotic existence for the SSF and aquaculture, large-scale fisheries, ports and shipping in the Black Sea, instead of destructive competition.

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References

Béné C, Macfadyen G, Allison EH (2007) Increasing the contribution of small-scale fisheries to poverty alleviation and food security. FAO Fisheries Technical Paper, No. 481. FAO, Rome, 125 pp.

Berkes F, Mahon R, McConney P (2001) Managing small-scale fisheries: Alternative directions and methods. International Development Research Centre, Ottawa, 320 pp.

Birkan R, Öndes F (2020) Socio-economic characteristics of small-scale fisheries in the Aegean Sea, Turkey (eastern Mediterranean). Acta Ichthyologica et Piscatoria 50(3): 257–268. https://doi.org/10.3750/AIEP/02840

CBRT (2021) Türkiye cumhuriyet merkez bankası. [Electronic data delivery system of Central Bank of Republic of Turkey.] http://evds.tcmb.gov.tr [Accessed on 2020-12-17] [In Turkish]

Çeliker SA, Dönmez D, Gül U, Demir A, Genç Y, Kalanlar G, Özdemir G (2006) Karadeniz bölgesi'nde su ürünleri avcılığı yapan işletmelerin sosyo-ekonomik analizi. [Socio-economic analysis of fishing enterprises in the Black Sea region.] Agricultural Economics Research Institute, Ankara, 122 pp. [In Turkish]

Çeliker SA, Demir A, Gül U, Dönmez D, Özdemir G, Kalanlar G (2008). Ege bölgesi'nde su ürünleri avcılığı yapan işletmelerin sosyo-ekonomik analizi. [Socio-economic analysis of fishing enterprises in the Aegean region.] TEAE, No: 168, Agricultural Economics Research Institute, No: 168. Ankara, 107 pp. [In Turkish]

Charles E, Boude JP, Murray A, Paquotte P (2003) Coastal fishing: Resource's enhancement and preservation. Ocean and Coastal Management 46(5): 421–437. https://doi.org/10.1016/S0964-5691(03)00016-4

Cheilari A, Guillen J, Damalas D, Barbas T (2013) Effects of the Fuel Price Crisis on the Energy Efficiency and the Economic Performance of the European Union Fishing fleets. Marine Policy 40: 18–24. https://doi.org/10.1016/j.marpol.2012.12.006

Crowder LB, Murawski SA (1998) Fisheries bycatch: Implications for management. Fisheries 23(6): 8–17. https://doi.org/10.1577/1548-8446(1998)023%3C0008:FBIFM%3E2.0.CO;2

Dağtekin M, Ozyurt CE, Mısır DS, Altuntas C, Cankaya A, Misir Balçık G, Aydin E (2019) Rate and causes of lost gillnets and entangling nets in the Black Sea coasts of Turkey. Turkish Journal of Fisheries and Aquatic Sciences 19(8): 699–705. https://doi.org/10.4194/1303-2712-v19_8_08

EC (2001) Green paper on the future of the Common Fisheries Policy. Commission of the European Communities, Brussels. https://op.europa.eu/en/publication-detail/-/publication/7e960b14-f73a-44b5-ada8-ed058374f623/language-en [Accessed on 2021-05-21]

EC (2018) European Commission (DG MARE), Workshop on digital tools for small-scale fisheries. https://ec.europa.eu/fisheries/press/outcomes-workshop-digital-tools-small-scale-fisheries-brussels-4-5-december-2018_en [Accessed on 2018-09-14]

FAO (2018) The State of world fisheries and aquaculture. Food and Agriculture Organization of the United Nations. http://www.fao.org/3/i9540en/i9540en.pdf [Accessed on 2018-09-14]

FAO (2020) Small-scale fisheries. Food and Agriculture Organization of the United Nations. http://www.fao.org/fishery/fishcode-stf/activities/ssf/en [Accessed on 2021-02-25]

GDAR (2018) Balıkçılık ve Su Ürünleri Genel Müdürlüğü, Su Ürünleri İstatistikleri. [General Directorate of Fisheries and Aquaculture In Turkeyv] https://www.tarimorman.gov.tr/BSGM/Belgeler/Icerikler/Su%20%C3%9Cr%C3%BCnleri%20Veri%20ve%20D%C3%B6k%C3%BCmanlar%C4%B1/Su-%C3%9Cr%C3%BCnleri-%C4%B0statistikleri.pdf [Accessed on 2021-05-21-] [In Turkish]

Güngör H, Güngör G, Zengin M, Demirkol C (2012) Marmara Denizi balıkçılığının sosyal profili ve balıkçılığı etkileyen dinamikler. [Social profile of Marmara Sea fisheries and dynamics affecting fisheries.] Marmara Sea Fisheries: Management of Resources, Sectoral Problems, and Strategies for the Future Panel. 02 October 2010, Silivri, Istanbul. Proceedings Book, Silivri Municipality, 113–122. [In Turkish]

Jacquet J, Pauly D (2008) Funding priorities: Big barriers to small-scale fisheries. Conservation Biology 22(4): 832–835. https://doi.org/10.1111/j.1523-1739.2008.00978.x

Kolding J, Béné C, Bavinck M (2014) Small-scale fisheries: Importance, vulnerability and deficient knowledge. In: Garcia SM, Rice J, Charles A (Eds) Governance of marine fisheries and biodiversity conservation, 317–331. https://doi.org/10.1002/9781118392607

Lai MB, Cicia G, Del Giudice T (2016) Pescatourism, a sustainable tourist experience. Journal of Cleaner Production 133: 1034–1042. https://doi.org/10.1016/j.jclepro.2016.05.013

Mısır DS, Altuntaş C, Çankaya A, Özyurt CE, Dağtekin M, Başçınar NS, Balçık Mısır G, Üstündağ E, Erbay M, Genç Y, Kasapoğlu N, Özkaya E, Özaydın E, Şahin C (2020) Karadeniz balıkçılığında uzatma ağları ve etkilerinin araştırılması. [Investigation of gillnets and effects in Black Sea fisheries.] TAGEM /HAYSUD/2015/A11/P-09/02, Central Fisheries Research Institute, Trabzon, 109 pp. [In Turkish]

Nakip M (2005) Pazarlama araştırmalarına giriş (SPSS destekli). [Introduction to marketing research (Supported by SPSS).] Sales and Marketing Series: 2nd edn., Ankara, Turkey. [In Turkish]

Natale F, Carvalho N, Paulrud A (2015) Defining small-scale fisheries in the EU on the basis of their operational range of activity The Swedish fleet as a case study. Fisheries Research 164: 286–292. https://doi.org/10.1016/j.fishres.2014.12.013

Staples D, Satia B, Gardiner PR (2004) A research agenda for small-scale fisheries: FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication No. 2004/21 and FIPL/C 10009, 42.

Taşdan K, Çeliker SA, Arisoy H, Ataseven Y, Dönmez D, Gül U, Demir A (2010) Akdeniz bölgesi'nde su ürünleri avcılığı yapan işletmelerin sosyo-ekonomik analizi. [Socio-economic analysis of fishing enterprises in the Mediterranean Sea.] TAGEM/HAYSÜD/2009/09/04701, Agricultural Economics Research Institute, No: 179, Ankara, 120 pp. [In Turkish]

TURKSTAT (2017) Türkiye İstatistik Kurumu Su Ürünleri İstatistikleri. [Turkish Statistical Institute, Fishery Statistics.] https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim-111&dil=1 [In Turkish]

Ünal V, Franquesa R (2010) A comparative study on socio-economic indicators and viability in small-scale fisheries of six districts along the Turkish coast. Journal of Applied Ichthyology 26(1): 26–34. https://doi.org/10.1111/j.1439-0426.2009.01346.x

Ünal V, Kızılkaya Z (2019) A long and participatory process towards successful fishery management of Gökova Bay, Turkey. In: Krueger CC, Taylor WW, Youn SJ (Eds) From catastrophe to recovery: Stories of fishery management success. American Fisheries Society, 509–532. https://doi.org/10.47886/9781934874554

Uzmanoğlu S, Soylu M (2006) Karasu (Sakarya) bölgesi deniz balıkçılarının sosyo-ekonomik yapısı. [Socio-economic structure of sea fishers in Karasu (Sakarya) region.] Ege Journal of Fisheries and Aquatic Sciences (EgeJFAS) 23(Suppl. 1/3): 515–518. [In Turkish]

Yamane T (1967) Elementary sampling theory: Prentice-Hall, Englewood Cliffs.

Zengin M, Güngör H, Güngör G, İnceoğlu H, Düz G, Benli K, Kocabaş E, Ceylan T, Dağtekin M, Demirkol C, Çolakoğlu S (2017) Marmara denizi balıkçılığının sosyo-ekonomik yapıısı ve yönetim stratejilerinin belirlenmesi. [Socio-economic structure of marmara sea fisheries and determination of management strategies.] TAGEM/HAYSÜD/2008/09/04/01. Central Fisheries Research Institute, Trabzon, 417 pp. [In Turkish]