ISSN: 0001-5113 AADRAY	ACTA ADRIAT., 60 (2): 157 - 180, 2019	ORIGINAL SCIENTIFIC PAPER

Recreational Fishing on the Coastal Hot Spots of İzmir Inner Bay (Aegean Sea, Turkey): Socio-economics and Management Implications

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In this study, we analyzed social and economic dimensions of shore-based recreational fishing (RF) along İzmir Inner Bay in the Metropolitan Province İzmir of Turkey. 634 shore-based recreational fishers were interviewed via on-site face-to-face interviews during the fishing activity from January to December in 2016. Market value approach was utilized to calculate net economic values and expenses of recreational fishers along in eight coastal districts, Göztepe, Karataş, Konak, Pasaport, Alsancak, Bayraklı, Karşıyaka and Bostanlı along the coast of the inner bay. The annual fishing efforts demonstrated significant differences among districts. For example; Bostanlı fishers that have higher education levels with higher income spent higher time for RF but, finally, this attitude of Bostanlı fishers resulted in low CPUE levels. Considering the RF experience of Bostanlı fishers, they are either not likely or able to target or catch bigger or more fish. In contrast, Göztepe fishers seems much professional compared to fishers by having the highest amount of catch in shortest time compared to rest of the districts. The highest mean CPUE was observed for Göztepe, Karataş and Konak fishers even so, these CPUE amounts were much under the ones determined in previous studies in Turkey. Considering the catch composition of fishers, S. auratus was the most common catch for all fishers. Secondly, D. labrax and Mugilid species constituted the majority. High fishing related expenditures were observed in all districts, then harvesting values reached quite high levels considering the previous studies. To conclude, RF in İzmir Inner Bay of Turkey is great social and economic activity by generating increase in RF related expenditures, jobs and indirect economic activity in services sector. The results of this study provide an update information of the recreational fishers' profile to help regulate recreational fishery.

Key words: Recreational fishing, shore-based, socioeconomics, İzmir Inner Bay, Turkey

INTRODUCTION

Recreational fishing (RF) may be the most demanded marine recreational activity around the world with a considerable number of participations in many developed countries (ARLINGHAUS & COOKE, 2009). The number of recreational fishers around the world is huge and up to every one individual in ten were impacted by this recreational activity considering the previous numbers (WORLD BANK, 2012; COOKE & COWX, 2004).

The high numbers of fishers resulted in also high economic impact within the whole fisheries sector (WORLD BANK 2012; ARLINGHAUS *et al.,* 2013). Moreover, the economic impact of RF was determined to be much higher than commercial fisheries (ISAKSSON & OSKARSSON, 2002). The economic magnitude of recreational fishing developed with the targeting certain species with high economic value so that it is inevitable to observe the decrease in certain fish species. Especially, in developed countries where fishers have high RF effort because of developed fishing equipment, concerns regarding the health of marine habitats and resources increased. This case is also valid for the developing countries where there is high effort in addition to illegal, unreported and unregulated fishing.

Recreational fishers mostly target certain species with certain size (COLEMAN, 2004) that means much selective fishing compared to commercial fishers and because of this behavior, RF may result in changes in the structure and functionality of the food web (PAULY, 1995; MYERS & WORM, 2003). Also, these changes were found to be close to the changes by commercial fishing (MCPHEE *et al*., 2002; COLEMAN *et al.*, 2004; COOKE & COWX 2004; LEWIN *et al.* 2006; LLORET *et al.,* 2008) and even the same as commercial fisheries (COOKE & COWX, 2006; LEWIN *et al.,* 2006). RF has positive economic consequences apart from negative impact to the marine ecosystem (PAWSON *et al.,* 2008; MORA *et al.,* 2009; IHDE *et al*., 2011). The economic impact was previously proven by the huge numbers up to billions of euros in many developed nations (GORDOA *et al.,* 2004; PAWSON *et al.,* 2007; NOAA, 2013).

The economic and ecological impacts of RF were previously presented in few studies from the Mediterranean SEA (LLORET *et al*., 2008; ÜNAL *et al*., 2010; AYDIN, 2011; FONT AND LLORET, 2011a; FONT & LLORET, 2011b; TUNCA *et al*., 2012; AYDIN *et al*., 2013; TUNCA *et al*., 2016). Despite of the fact that RF has important economic and ecological consequences, there is lack of its management besides commercial fishing with high numbers of illegal, unreported and unregulated recreational fishing (GORDOA *et al*., 2004; LLORET *et al*., 2008; ÜNAL *et al*., 2010). The ignorance on the impact of RF may come to an end soon with increased attention by the scientists and decision makers (NRC, 2006; LUCY & STUDHOLME, 2002; COLEMAN *et al.,* 2004). The states increasingly focused to enhance their fishing resources by implementing different harvest control rules for not only commercial fishing but also recreational fishing. Here in this study we surveyed shore fishers in eight fishing hot spots along the İzmir Inner Bay of Turkey. The goal was to assess RF activity along the inner bay to serve as a reference for optimization of RF management. The results would be valuable in evaluating RF pressure in province level and in evaluating the economic magnitude of RF on the regional and national economy.

MATERIAL AND METHODS

The questionnaire survey was conducted along the inner bay from Üçkuyular to Bostanlı, considering eight important fishing districts on the coast, Göztepe, Karataş, Konak, Pasaport, Alsancak, Bayraklı, Karşıyaka and Bostanlı in 2016 (Fig. 1).

The data was collected from shore-based recreational fishermen via on-site face-to-face interviews during the fishing activity or at access points. The field surveys were regularly conducted once twice a month in 2016 along the coast during day time and night time to obtain a representative sample of fishing and socioeconomic indicators by provinces. We used snowball sampling methodology (Miran, 2003) to reach a random number of recreational fishers contacted by the methodology explained above.

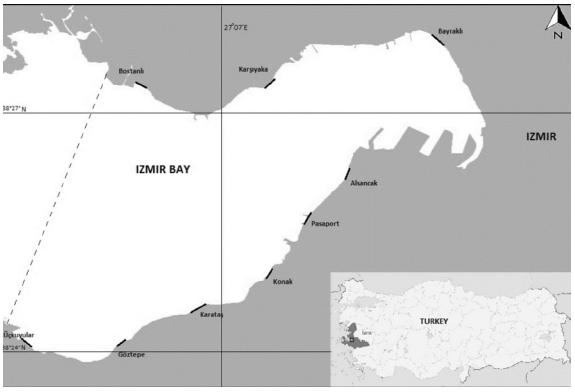

Fig. 1. Survey sites (Göztepe, Karataş, Konak, Pasaport, Alsancak, Bayraklı, Karşıyaka, Bostanlı) in İzmir Bay

However, by following this sampling strategy, we aimed to reach high number of shore-based recreational fishers to increase representativeness in 8 hot-spots in İzmir Inner Bay. Three types of information were collected by questionnaires: (1) fishers' social characteristics (gender, age, marital status, education, occupation, monthly income, means of transport, (2) fishing activity (RF experience, ownership of RF license, fishing type, release of illegal catch gear, preferred hours, daily fishing hours, annual fishing days, daily catch, annual catch by species with market values, (3) costs (transportation, fishing gear, bait, others) and catch value, and subsequently they were estimated for the survey respondents. The price per kilogram of the commercial species was used from published national Turkish statistics (TUIK, 2017).

RF fishers' social, fisheries and economic descriptors were analyzed separately by districts using methodology adopted from Tunca et al. (2016; 2018). Catch per Unit Effort (CPUE) calculation was calculated with the previous methodology (TUNCA *et al.* 2016; 2018). Euro/ Turkish Lira exchange rate was used as €1 = 4.14 Turkish Lira (OECD, 2017). For each province, the average annual effort per fisher, in fishing hours, was estimated in two steps. Firstly, for each interviewed fisher, the annual fishing hours (TAFHF) were estimated by multiplying the declared daily hours of fishing (DHF) by the annual days of fishing (ADF): $TAFHF_i = DHFi \times ADF_i$. Secondly, the annual effort per fisher (MAEF) was calculated as the average of the annual fishing hours of the interviewees:

$$MAEF = \frac{\sum_{i=1}^{n} TAFHF_i}{n}$$

The mean catches per unit effort of fishers (MCPUE), expressed as catch (kg) per hour, was estimated following the same procedure. First, the annual CPUE per interview ($ACPUE_i$) was estimated by dividing the annual catch declared per interviewee (ACF_i) by the total annual fishing hours ($TAFHF_i$):

$$ACPUE = \frac{ACF_i}{TAFHF_i}$$

Then, MCPUE was estimated as the mean over the total number of interviewees:

$$MCPUE = \frac{\sum_{i}^{n} ACPUE}{n}$$

The contribution of each commercial species to the catch was calculated by summing the catch declared by fishers and estimating their percentage with respect to the total catch:

$$\%S_j = \frac{\sum_{i=1}^{n} C_{ji}}{\sum_{i=1}^{n} ACT_i}$$

Where n = number of interviewees for each province, $C_{j,i}$ the annual catch declared by each fisher for each particular species and ACT_i the total annual catch declared by each fisher.

The economic evaluation was performed by calculating the value of the catch, the expenses of the activity and the balance between the two. The value of the catch of the reported species was estimated by multiplying the total catch per species by their corresponding market value. The sum of this catch gives the value of the total catch (VCRF) that is also equal to all catch of respondents as there was no non-commercial catch observed. The annual expenses were estimated per interviewee (EI_i) by adding the declared expenses of each item, and the annual costs per fisher were calculated averaging EI_i per district. The total expenses of

fishers (TERF) were calculated by multiplying the annual expenses per fisher (EF) by the number of the surveyed fishers. The contributions of expenditures by items were calculated by summing the costs declared by fishers on each item and their corresponding percentage to the total costs:

$$\%I_j = \frac{\sum_{i=1}^{n} I_{ji}}{\sum_{i=1}^{n} EI_i}$$

Where n = number of interviewees for each province, $I_{j,i}$ the annual costs declared by each fisher for each particular item and EI_i the total annual cost declared by each fisher.

RESULTS

Descriptive characteristics of shore recreational fishers were calculated by districts. RF was in all provinces determined as a man dominant activity. The age of shore fishers presented slight differences for each province, evaluated respondents mainly accumulated over 25 years' age groups by reaching over 61 years' age, but most respondents reached were in 26-45 and 46-60 age groups (Fig. 2). Summary of selected socio-demographic, economic and fisheries variables were given in Supplementary Table S1.

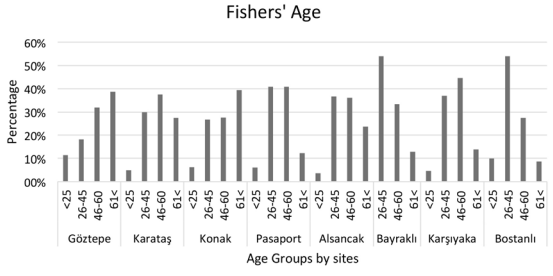

Fig. 2. Fishers' age by sites

Regarding the actual monthly income levels of fishers, there was no great differences for the mean regular income of fishers in eight districts whereas, there was a gradual increase in monthly regular incomes of fishers from Göztepe to Bostanlı Districts. The poorest and the richest fishers' profile were observed in Göztepe and Bostanlı, respectively (Fig. 3).

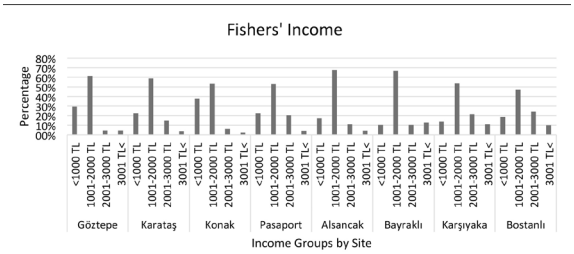

Fig. 3. Fishers' income groups by sites (Euro/TL exchange rate in 2017: €1 = 4.14 TL)

Considering the RF experiences in years (Fig. 4), less than 10 years fishing practice (experience) observed as majority in Karataş, Konak, Pasaport, Alsancak, Bayraklı, Karşıyaka whereas, more than 41 years of fishing practice got the least share in Pasaport, Bayraklı and Bostanlı Districts. 11-21 years and 21-40 years also got considerable shares for all districts.

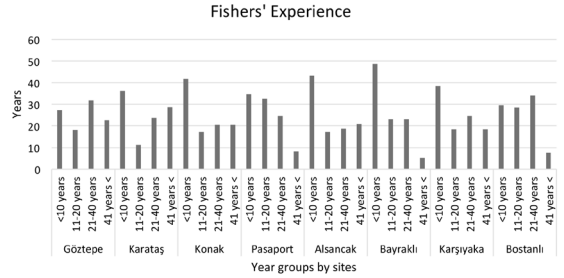

Fig. 4. Fishers' experience by sites

The results show that most fishers had a certain level of education with very low uneducated fishers except Pasaport and Bostanlı where there was no uneducated fisher surveyed. Fishers with bachelor's degree and elementary school degree got second and third biggest except Bostanlı where has the highest share in fishers having Master's degree and above as education (Table 1).

Considering the fishers' occupation, primarily, retired fishers constituted the majority in all districts. Then, self-employed fishers were the second largest group and national company workers were third among queried fishers in all districts. These three groups of occupation were followed by public servants, foreign company workers, housewives, farmers. RF license ownership was relatively higher in Bayraklı and

Table 1. Socio-demographic characteristics of shore-based fishers by sites

Characteristics		Göztepe	Karataş	Konak	Pasaport	Alsancak	Bayraklı	Karşıyaka	Bostanlı
% Surveyed Fishers		6.9	12.6	20	7.7	21.9	6.2	10.3	14.4
Number of Surveyed Fishers		44	80	127	49	139	39	65	91
Sex; % of Male		100	96.3	97.6	95.9	97.8	100	98.5	100
Mean Age		54	51	53	46	50	46	49	43
Education %	Uneducated	2.3	3.8	7.1	0	0.7	5.1	6.2	0
	Elementary School	27.9	35.4	38.1	28.6	33.1	33.3	20	14.3
	High School	25.6	16.5	19	16.3	22.3	20.5	16.9	31.9
	Bachelor's Degree	32.6	24.1	24.6	42.9	31.7	28.2	33.8	33
	Master's Degree and Above	11.6	20.2	11.2	12.2	12.2	12.9	23.1	20.8
Occupation %	Public Servant	2.3	5	2.4	4.1	1.4	5.1	9.2	14.3
	National Co.	4.5	8.8	4.7	14.3	12.2	20.5	7.7	15.4
	Retired	59.1	46.3	56.7	36.7	46	25.6	40	27.5
	Unemployed	0	1.3	1.6	0	0.7	2.6	4.6	1.1
	Student	9.1	0	0.8	4.1	2.9	0	1.5	6.6
	Self-Employed	11.4	20	26.8	22.4	23	41	26.2	25.3
	Other (foreign company, housewife and farmer etc.)	13.6	18.6	7	18.4	13.8	5.2	10.8	9.8

Table 2. Catch and economic indicators by coastal regions

Fisheries Statistics	Göztepe	Karataş	Konak	Pasaport	Alsancak	Bayraklı	Karşıyaka	Bostanlı
Annual fishing hours per fisher	347.8	589.7	568.2	668.4	692.8	526.2	583.3	781.8
CPUE (kg/h fisher)	0.2	0.2	0.2	0.05	0.09	0.13	0.11	0.04
Annual catch per fisher (kg)	69.6	117.9	113.6	33.4	62.4	68.4	64.2	31.3
Annual catch of surveyed fishers	1,492	3,677	4,886	1,418	7,536	1,462	2,098	2,247
Economic Indicators								
Mean annual market value per fisher (€)	188.5	193.7	173.8	150.3	255.6	119.2	145.9	116.5
Annual market value of all respondents' catch (€)	8,293	15,497	22,074	7,363	35,523	4,649	9,486	10,601
Mean annual expense per fisher (€)	366.9	1,016.9	585	2,599.2	1,265.45	1,835.45	761.7	2,960.2
Total annual expense of all respondents (€)	16,144.9	81,353.4	74,295.8	127,360.7	175,897.2	71,582.6	49,509.2	269,373.4
Harvesting cost (€/kg)	19.8	94.8	42.5	187.1	60.4	89.6	66.9	183.9

Table 3. Management issues of shore-based RF by sites

Characteristics	Göztepe	Karataş	Konak	Pasaport	Alsancak	Bayraklı	Karşıyaka	Bostanlı
Having RF License %	56.8	63.8	63	71.4	54	74.4	40	61.5
Carrying RF License %	43.2	53.8	46.5	75.5	49.6	69.2	30.8	64.8
Acceptance of Compulsory RF License %	84.1	72.5	65.4	71.4	68.3	66.7	56.9	74.7
Acceptance of Compulsory Training for RF License	34.1	36.3	15	22.4	14.4	7.7	20	21
Proposed mean durations for training - total days; hours per day	5; 7	8; 3	6; 9	3; 4	21; 4	11; 1	13; 5	9; 3
RF License Payment (€)	7.1	8.4	9.2	6.5	7.2	5.8	7.7	4.3
RF Organization Membership %	0	1.3	6	2.1	2.5	2.6	0	0
Voluntary Logbook %	5.7	16.9	3.6	22.7	15.6	15.8	1.8	32.5

Pasaport, but almost in all districts RF ownership percentage was quite higher being over fifty percent of all queried fishers in all districts (Table 1). Similarly, percentages for acceptance of a compulsory RF license were also relatively higher in Göztepe, Karataş, Pasaport, Bostanlı, however; acceptance rates of compulsory training for RF license were low in all districts. The willingness to pay for a compulsory one-year license ranged between € 4.3 and € 9.2 with the highest payment amount was observed in Konak followed by Karataş and Karşıyaka. Only small proportion of fishers agreed to fill a logbook voluntarily that Bostanlı fishers got the highest share as 32.5% followed by Pasaport as 22.7% (Table 3). Further, comparative visualization on relations between WTP for RF license and certain selected variables along with multiple comparison among variables were represented as Supplementary Figs. S3-S12.

The annual fishing hours varied between locations being significantly higher in Bostanlı, Pasaport and Alsancak whereas, Göztepe fishers spent the shortest time in a year. The highest CPUEs were observed in Göztepe, Karataş and Konak whereas, the lowest CPUEs were in Bostanlı and Pasaport. Also, fishers in Karataş and Konak got the highest total annual catch per fisher. Similarly, fishers in Bostanlı and Pasaport had the lowest two annual catch amounts. Total annual harvest of surveyed fishers in each district were highest for Alsancak that was followed by Konak and Karşıyaka. Mean annual market value per fisher were highest for fishers in Alsancak, Karataş and Göztepe. Fishers in Bayraklı and Bostanlı got the lowest mean annual market value of catch. All surveyed fishers in Alsancak also got the highest annual market value and were followed by fishers in Konak and Karataş, respectively. Apparently, all surveyed fishers in Bayraklı got the lowest annual market value. Mean annual expense per fisher were apparently quite higher for fishers in Bostanlı and Pasaport; However, fishers in Konak and Karşıyaka spent the lowest amount for RF. Similarly, fishers in Bostanlı and Pasaport got the highest harvesting amount (Table 2).

Consumption, releasing juveniles and other discard species were practiced by most fishers in all districts. Selling catch is not common in all districts, but small amount of surveyed fisher indicated that they sell their catch, and this amount even reached and surpassed 20 percent of surveyed fishers in Göztepe, Konak and Alsancak (Fig. 5).

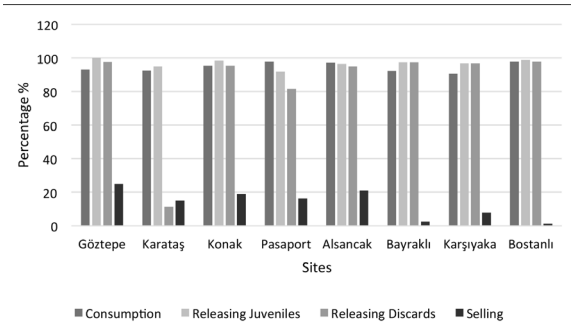

Fig. 5. Use types of catch

Considering the catch composition of fishers, *S. auratus* was the most common catch for all fishers. Secondly, *D. labrax* and Mugilid species constituted the majority. Exceptionally, *S. officinalis* was mostly caught by fishers in Konak and Mugilid species were quite common in Karşıyaka fishers. Also, *D. labrax* were relatively higher in catch of Bayraklı, Karşıyaka and Bostanlı fishers. Other species caught in small amounts were *T. trachurus, S. japonicus, B. boops, P. eriytrinus, D. annularis, D. vulgaris, L. vulgaris,* and Serranids (Fig. 6). Lastly, statistically significant differences were found for catch amounts of the species, *D. vulgaris, D. labrax, P. eriytrinus* and *B., boops*, among surveyed locations (Supplementary Table S2).

Further, statistical differences of selected certain socio-demographic, economic and fisheries variables were presented in Supplementary Table S3. Also, a heat map as Supplementary figure S1 illustrates correlation among certain socio-demographic, economic and fisheries variables that further were supported by various comparative graphs as Supplementary Figures S3-S12.

DISCUSSION

This study presents information on RF in eight districts along the İzmir Inner Bay, in Turkey. The main results of this study were comparatively analyzed with the previous similar studies in the Mediterranean. The fishing profile and socioeconomic dimensions did not show great differences among provinces. This study mainly presented fishers' social, economic and catch profiles in İzmir Province.

First, almost all fishers in the region were male as observed by the previous similar studies in the region (MORALES-NIN *et al.,* 2005; ÜNAL *et al.,* 2010; VEIGA *et al.,* 2010; TUNCA *et al.,* 2012; AYDIN *et al.,* 2013; DIOGO & PEREIRA, 2013; TUNCA *et al.,* 2016) (Table 1). Middle age fishers from 26 years to 60 years were dominant in all districts

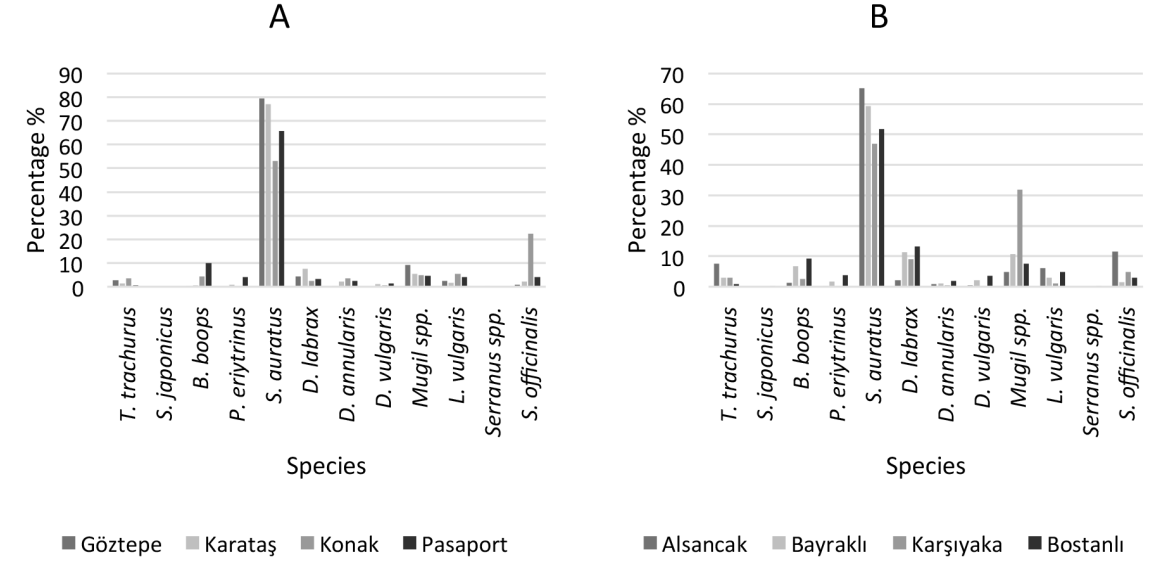

Fig. 6 A-B. Percentage catch composition by sites

Table 4. Findings on fishing attitudes and economic indicators from previous studies and current study (Adopted from Tunca et al., 2016)

Publication Year	Author /s	Country	Fishing type	Survey Year	Surveyed Fishers	Annual Fishing Days	Total Catch (x1,000 t)	Number of Species	Effort (h d^{-1})	CPUE (kg)	Annual hours per Fisher	Annual Costs per Fisher (€)	Annual Catch Value (Million €)
2007	Rangel & Erzini	Portugal	S	2001	2,081	-	0.67	35	-	0.08	-	-	-
2008	Lloret et al.	Spain	B/Bottom Rod	2006	409	-	0.23	27	4.1	0.09	-	500	0.16
			B/Fluixa			-		13		0.09			
			B/Surface			-		4		1.1			
			B/Trolling			-		8		0.91			
2010	Veiga et al	Portugal	S	2006-2007	1,321	126	0.16	48	4.7	0.21	705	-	-
2010	Ünal et al.	Turkey	S	-	190	75.5		31	4.75	0.81	359	213	6.20
			B	-		102.3		42	6.07	2.77	621	1,376	9.20
2010	Font & Lloret	Spain		2009	84	-	-	-	-	-	-	600	-
2011	Font & Lloret	Spain	S	2007	260	-	-	25	-	0.09	177	-	-
2012	Tunca et al.	Turkey	S	2011	50	143.4	0.012	12	4.74	0.42	679.7	-	0.08
2013	Aydın et al.	Turkey	S & B	2011	120	40	0.009	15	3.31	-	132	-	0.06
2013	Diogo & Pereira	Portugal	B	2004-2005	-	19.6	0.16	32	4.4	2.3	86.6	897	-
2016	Tunca et al.	Foça, Turkey	S	2013	48	68.9	0.45*	21	4.68	0.25	345	517.12	2.92
			B		82	111.9	3.18*		5.10	0.64	601.6	2,133.4	19.17
		Gökova, Turkey	S		105	85.6	0.55*	17	3.18	0.45	296	676.04	4.32
			B		25	93.2	0.14*		3.98	0.41	312.8	6,176	1.49
2018	Tunca et al.	Kastamonu	S	2018	72	100.9	0.58	19	4	0.72	476.8	183.5	1.72
		Sinop			86	110.3	0.36	19	5	0.52	540.4	210	1.15
		Samsun			79	162.2	1.31	19	5	0.34	920.4	315.9	3.95
		Ordu			120	40	0.07	19	3	0.64	130.8	55.5	3.37
		Giresun			166	41.4	0.11	12	3	0.54	130.1	18.8	0.36
		Trabzon			226	40.5	0.46	15	3	0.43	123.8	25.1	1.51
		Rize			76	38.6	0.09	12	3	0.31	119.7	55.1	0.26
		Artvin			49	44.9	0.10	16	3	0.38	123	34.2	0.38

S: Shore fishers, B: Boat fishers, "-" means that the data is not available, * indicates the values were estimated for whole region using the estimated number of fishers

as previously discussed in similar studies in the Mediterranean countries (MORALES-NIN *et al.,* 2005; LLORET *et al*., 2008; VEIGA *et al*., 2010; ÜNAL *et al.,* 2010; TUNCA, 2012; AYDIN *et al.,* 2013; TUNCA *et al*., 2016), (Fig. 2).

Significantly, less than 10 years of RF experience were observed in almost all districts whereas, between 10 to 40 years of RF experience got considerable shares differently from the ones previously discovered in Turkey (TUNCA *et al.,* 2012; AYDIN *et al.,* 2013; TUNCA *et al*., 2016). The educational level was higher for Bostanlı fishers although, the general trends in education levels of the respondents followed the results of previous studies in other Turkish coasts (ÜNAL *et al.,* 2010; TUNCA *et al*., 2012; TUNCA *et al.,* 2016).

The monthly income level of individuals in different districts were so much like each other whereas, tiny difference was observed for Göztepe and Bostanlı fishers that owned poorest and richest fishers among all respondents. RF along the bay were mostly demanded by the retired people followed self-employed in all districts. There were similar results on fishers' occupations from previous studies (ÜNAL *et al*., 2010; TUNCA *et al*., 2012; AYDIN *et al*., 2013; ARDAHAN & TURGUT, 2013). Similarly, membership rates to RF organizations were found to be same as in previous studies being very low percentages (ÜNAL *et al*., 2010; TUNCA *et al*., 2012; AYDIN *et al.,* 2013; TUNCA *et al*., 2016).

Regarding the acceptance of compulsory RF licensing, fishers in four districts, Göztepe, Karataş, Pasaport, Bostanlı, were mostly willing to accept it although willingness to join compulsory training rates were quite low in all districts. In addition, considering stated reasonable willingness to pay amounts for compulsory RF license, the implementation of a possible RF licensing would much likely to reach a success and enhance management of RF in the bay. Furthermore, future investigation on the determinants of willingness to pay amount would be help understanding fishers. The annual fishing efforts demonstrated significant differences among districts. For example; Bostanlı fishers that have higher education levels with higher income spent higher time for RF but, finally, this attitude of Bostanlı fishers resulted in low CPUE levels. Considering the RF experience of Bostanlı fishers, they are either not likely or able to target or catch bigger or more fish. In contrast, Göztepe fishers seems much professional compared to fishers by having the highest amount of catch in shortest time compared to rest of the districts.

Fishers in all districts except Göztepe fishers that had almost half of annual hours of the rest fishers, had annual fishing hours close to the ones from similar previous studies (VEIGA *et al.,* 2010; ÜNAL *et al*., 2010; TUNCA *et al*., 2012) (see Table 4). Having say that, the high percentage of retired fishers in all districts explains high number of hours allocated for fishing in the bay. The highest mean CPUE was observed for Göztepe, Karataş and Konak fishers even so, these CPUE amounts were much under the ones determined in previous studies in Turkey (ÜNAL *et al*., 2010; TUNCA *et al*., 2012; TUNCA *et al.,* 2016) but they were quite similar with other studies from the Mediterranean SEA (RANGEL & ERZINI, 2007; VEIGA *et al.,* 2010; FONT & LLORET, 2011B) (see Table 4). It is important to emphasize that commonly accepted CPUE methodology is crucial to avoid comparison biases (TUNCA *et al*., 2016).

Considering the catch composition of fishers, *S. auratus* was the most common catch for all fishers. Secondly, *D. labrax* and Mugilid species constituted the majority. Exceptionally, *S. officinalis* was mostly caught by fishers in Konak and Mugilid species were quite common in the basket of Karşıyaka fishers. Also, *D. labrax* were relatively higher in catch of Bayraklı, Karşıyaka and Bostanlı fishers. Other species caught in small amounts were *T. trachurus, S. japonicus, B. boops, P. eriytrinus, D. annularis, D. vulgaris, L. vulgaris,* and Serranids. The species catch composition among districts showed significant variances but, most of the catch were *S. auratus* followed by *D. labrax*, and Mugilid species, especially in Karşıyaka. *S. officinalis* were caught in reasonable amounts in Konak. There are no great differences in catch composition observed considering the previous small case study from İzmir Bay (TUNCA *et al.,* 2012). The number of species stayed in low numbers

considering the high biodiversity of the Aegean Sea. Even if İzmir Bay is a quite close to water currents there are many freshwater inputs especially the greater ones on the north side of the Bay. In addition, other factors such as precipitation regime, eutrophication, marine transportation, algal blooms, questionable house and industrial pollution into bay may have impact on the distribution of the species on the shoreline. Also, *S. officinalis* catch case may explain us that Konak fishers are most likely specialized for this species by using different gears. Also, habitat differences along the coastline might have resulted in changes of species distribution as in previous findings that showed habitat changes result in the change of species composition (MORALES-NIN, 2005; RANGEL & ERZINI, 2007; ÜNAL *et al.,* 2010; TUNCA *et al*., 2012; AYDIN *et al*., 2013; DIOGO & PEREIRA, 2013) (see Table 4).

High fishing related expenditures were observed in all districts, then harvesting values reached quite high levels considering the previous studies (Table 3) but, fishers are possibly under stated the actual annual amount of catch and they may increase their benefits by selling or consuming the catch. Even, fishers may be quite satisfied with their RF day and they increase their non-market marginal benefits.

To conclude, RF in İzmir Inner Bay of Turkey is great social and economic activity by generating increase in RF related expenditures, jobs and indirect economic activity in services sector. High participation rates, high catch amounts and economics value in fishing hot spots of the Bay inspiring for more future participation.

CONCLUSIONS

In all districts, RF is an important social and economic activity, especially considering the economic value, RF is generating huge economic activity. Furthermore, direct and indirect economic impacts of RF in different sectors on local and national level would be investigated under broader projects. In the last decade, the municipality of İzmir conducted projects to prevent pollution in İzmir Bay as well as biodiversity protection and increase. The personal communications with old fishers showed that there is an increase in the number of recreational shore fishers in parallel with the enhancement of water quality. This study is aimed to reflect the current social and economic impact of recreational fishers as a sample case study of İzmir Bay. Current recreational fishery regulation that was constructed decades ago for the İzmir Bay is not up to date and needs to be updated. The results of this study provide an update information of the recreational fishers' profile to help regulate recreational fishery.

ACKNOWLEDGEMENTS

This paper is the output of the research project called number of "TAGEM 2015- ARGE-15". The authors are thankful for the efforts by the officers of the fishery directorate of İzmir and researchers (Hüseyin Akbaş, Levent Özkan, Gülüşan Emanet Ergül, Erdinç Veske, Hacer Akyürek, M. Tolga Dinçer and M. Hakan Kaykaç) and Master Student/s "Esra Eryağcı". The authors are very thankful to all recreational fishers who honestly and patiently answered all questions in the forms.

This study was supported by The MARMAED project that has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 675997.

The results of this publication "Recreational Fishers along the Hot Spots of İzmir Inner Bay: Socio-economic and Management Implications" reflects only the authors' view and the Commission is not responsible for any use that may be made of the information it contains.

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Received: 14 February 2019
Accepted: 28 October 2019

Table S 1. Full summary statistics of important socio-demographic, economic and fisheries variables. Species' names indicates their catch amounts in kg.

Variables	Mean	Std.Dev	Min	Q1	Median	Q3	Max	MAD	IQR	CV	Skewness	SE.Skewness	Kurtosis	N.Valid	Pct.Valid
Age	49.4	14.3	16	38	50	60	87.0	16.3	21.8	0.3	-0.1	0.1	-0.8	634	100
Education	3.3	1.1	1	2	3	4	6.0	1.5	2	0.4	0.0	0.1	-1	631	99.5
Income €	1777.9	890	100	1200	1500	2000	7300	593	800	0.5	2.1	0.1	6.5	568	89.6
RF Experience (years)	21.9	17.5	0	7	20	33	80	19.3	25.5	0.8	0.7	0.1	-0.4	627	98.9
Annual Bait Cost €	1232.5	1658.3	0	180	700	1800	18250	948.9	1620	1.3	3.7	0.1	25.5	634	100
Annual Gear Cost €	501.8	982.7	0	50	180	600	15000	252	550	2.0	7.7	0.1	91.4	634	100
Annual Transportation Cost €	489.8	971.1	0	0	55	600	12000	81.5	600	2.0	4.8	0.1	37.6	634	100
Annual Other Cost €	2403.8	4482.6	0	0	450	2500	36500	667.2	2500	1.9	3.0	0.1	11	634	100
Annual Total Expense €	4627.9	6429.8	0	600	1650	6000	41975	2149.8	5375	1.4	2.2	0.1	5	634	100
Daily Bait Cost €	10.5	8.4	0	5	10	15	75	7.4	10	0.8	2.4	0.1	12.2	634	100
Daily Transport Cost €	4.5	6.7	0	0	4	5	60	5.9	5	1.5	3.7	0.1	20.6	634	100
Other Cost €	17.2	27.2	0	0	5	20	150	7.4	20	1.6	2.7	0.1	8.5	634	100
Daily RF hours	4.9	2.2	1.5	3.5	4	6	15	1.5	2.5	0.5	1.5	0.1	3	621	97.9
Annual RF days	113.0	94.7	0	40	100	150	365	89	110	0.8	0.9	0.1	0.2	634	100
Annual RF hours	575.9	619.0	0	140	420	750	4562.5	430	610	1.1	2.2	0.1	7	625	98.6
WTP RF Licence €	24.4	32	0	10	20	20	500	14.8	10	1.3	8.7	0.1	111.6	451	71.1
RF Licence Ownership (Y/N)	0.6	0.5	0	0	1	1	1	0	1	0.8	-0.4	0.1	-1.8	627	98.9
B. Boops	1.2	4.1	0	0	0	0	50	0	0	3.5	6.2	0.1	51.5	634	100
D. annularis	0.6	3.3	0	0	0	0	50	0	0	5.7	11.3	0.1	154.6	634	100
D. labrax	1.8	6.3	0	0	0	0	75	0	0	3.6	7.2	0.1	67.3	634	100
D. vulgaris	0.3	1.5	0	0	0	0	20	0	0	5.2	9.1	0.1	102.4	634	100
L.vulgaris	1.5	9	0	0	0	0	120	0	0	6.0	9.5	0.1	100.8	634	100
Mugil. spp.	2.8	19.0	0	0	0	0	400	0	0	6.7	15.8	0.1	307.5	634	100
P. eriytrinus	0.3	1.2	0	0	0	0	10	0	0	3.7	4.9	0.1	29.7	634	100
S. auratus	21.4	49.9	0	1	10	20	800	14.8	19	2.3	8.9	0.1	112.2	634	100
S. japonicus	0.0	0.1	0	0	0	0	2	0	0	17.8	17.7	0.1	311	634	100
S. officinalis	3.4	27.6	0	0	0	0	500	0	0	8.2	14.3	0.1	230.2	634	100
Serranus spp.	0.0	0.2	0	0	0	0	5	0	0	21.4	23.8	0.1	580.4	634	100
T. trachurus	1.3	10.4	0	0	0	0	200	0	0	7.7	14.2	0.1	237.3	634	100
Annual Catch (kg)	34.6	66.5	0	4	18	40	800	22.2	36	1.9	5.7	0.1	44.9	634	100

Table S 2. Results of ANOVA for species catch amounts by survey locations

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
T_trachurus	Between Groups	1060.723	7	151.532	1.417	.195
	Within Groups	66938.142	626	106.930		
	Total	67998.865	633			
S_japonicus	Between Groups	.151	7	.022	1.721	.101
	Within Groups	7.824	626	.012		
	Total	7.975	633			
B_boops	Between Groups	421.763	7	60.252	3.620	.001
	Within Groups	10420.377	626	16.646		
	Total	10842.140	633			
P_eriytrinus	Between Groups	87.275	7	12.468	10.083	.000
	Within Groups	774.047	626	1.236		
	Total	861.321	633			
S_auratus	Between Groups	33618.546	7	4802.649	1.953	.059
	Within Groups	1539732.017	626	2459.636		
	Total	1573350.563	633			
D_labrax	Between Groups	478.310	7	68.330	1.737	.098
	Within Groups	24626.157	626	39.339		
	Total	25104.467	633			
D_annularis	Between Groups	103.167	7	14.738	1.337	.230
	Within Groups	6898.472	626	11.020		
	Total	7001.639	633			
D_vulgaris	Between Groups	36.163	7	5.166	2.250	.029
	Within Groups	1437.269	626	2.296		
	Total	1473.432	633			
Mugil_spp	Between Groups	3782.693	7	540.385	1.513	.160
	Within Groups	223545.298	626	357.101		
	Total	227327.991	633			
L._vulgaris	Between Groups	572.964	7	81.852	1.007	.425
	Within Groups	50892.096	626	81.297		
	Total	51465.060	633			
Serranus_spp	Between Groups	.230	7	.033	.801	.586
	Within Groups	25.713	626	.041		
	Total	25.943	633			
S._officinalis	Between Groups	6167.562	7	881.080	1.155	.327
	Within Groups	477683.273	626	763.072		
	Total	483850.834	633			

Table S 3. Results of ANOVA for socio-demographic, economic and fisheries varaibles by survey locations

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Annual_Bait_Cost €	Between Groups	114495383.4	7	16356483.345	6.296	.000
	Within Groups	1626306131.0	626	2597933.117		
	Total	1740801514.4	633			
Annual_ Transportation_Cost €	Between Groups	33806495.0	7	4829499.299	5.369	.000
	Within Groups	563142605.7	626	899588.827		
	Total	596949100.8	633			
Annual_Other_Cost €	Between Groups	2467114976.9	7	352444996.711	21.52	.000
	Within Groups	10252252336.9	626	16377399.899		
	Total	12719367313.9	633			
Annual_Gear_Cost €	Between Groups	56786417.9	7	8112345.417	9.158	.000
	Within Groups	554547223.4	626	885858.184		
	Total	611333641.3	633			
Daily_RF_hours	Between Groups	36.2	7	5.173	1.032	.407
	Within Groups	3073.9	613	5.015		
	Total	3110.1	620			
Annual_RF_hours	Between Groups	6772976.6	7	967568.093	2.569	.013
	Within Groups	232354299.4	617	376587.195		
	Total	239127276.1	624			
RF_Experience (Years)	Between Groups	3706.4	7	529.493	1.747	.095
	Within Groups	187593.8	619	303.059		
	Total	191300.2	626			
Age	Between Groups	7910.4	7	1130.059	5.826	.000
	Within Groups	121423.5	626	193.967		
	Total	129334.0	633			
Education	Between Groups	29.6	7	4.231	3.314	.002
	Within Groups	795.2	623	1.277		
	Total	824.8	630			
Income €	Between Groups	30298621.7	7	4328374.541	5.787	.000
	Within Groups	418829418.1	560	747909.675		
	Total	449128039.9	567			
RF_Licence_ Ownership (Y/N)	Between Groups	4.4	7	.633	2.687	.010
	Within Groups	145.8	619	.236		
	Total	150.3	626			
WTP_RF_Licence €	Between Groups	13913.4	7	1987.641	1.974	.057
	Within Groups	446125.1	443	1007.055		
	Total	460038.6	450			

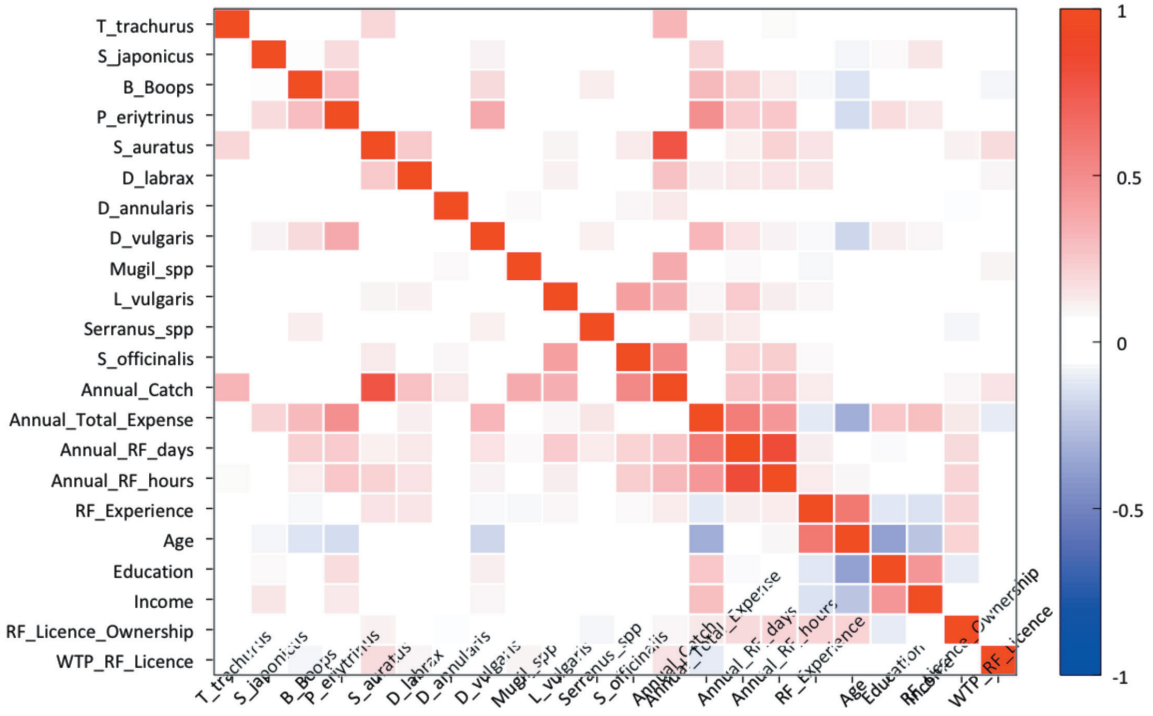

Figure S 1. Heatmap of correlation among certain socio-demographic, economic and fisheries variables. "Species names" indicates annual catch amounts (kg); "RF licence ownership" is as dummy variable (1:Yes/2:No); "WTP RF Licence" indicates fishers' stated annual willingness to pay amount for a RF licence

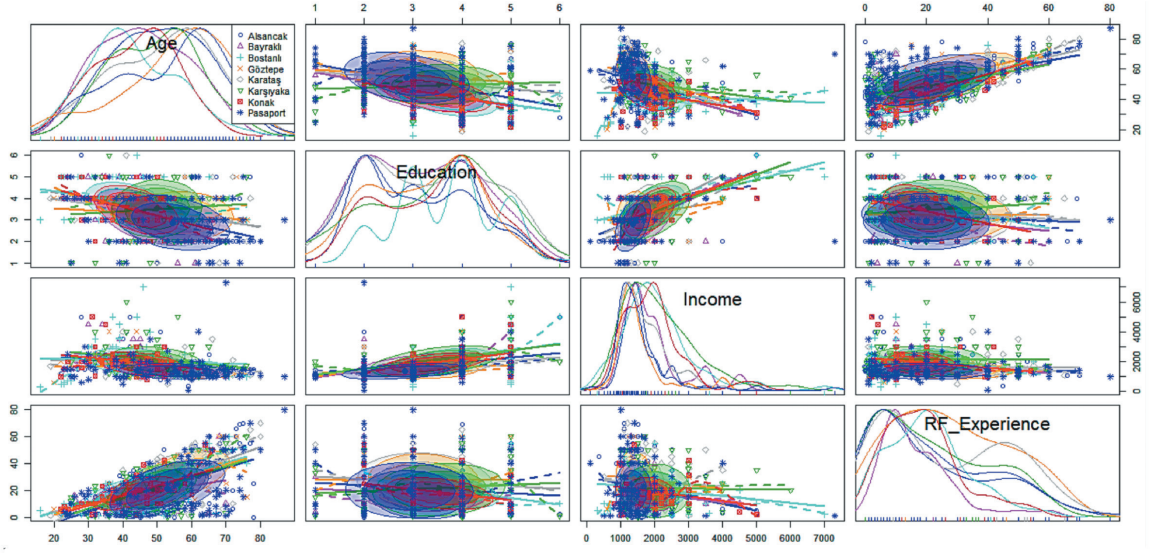

Figure S 2. Density plots shown in a scatterplot matrix of age, education and income variables by survey locations with least square and smooth lines supported by plot concentration ellipses

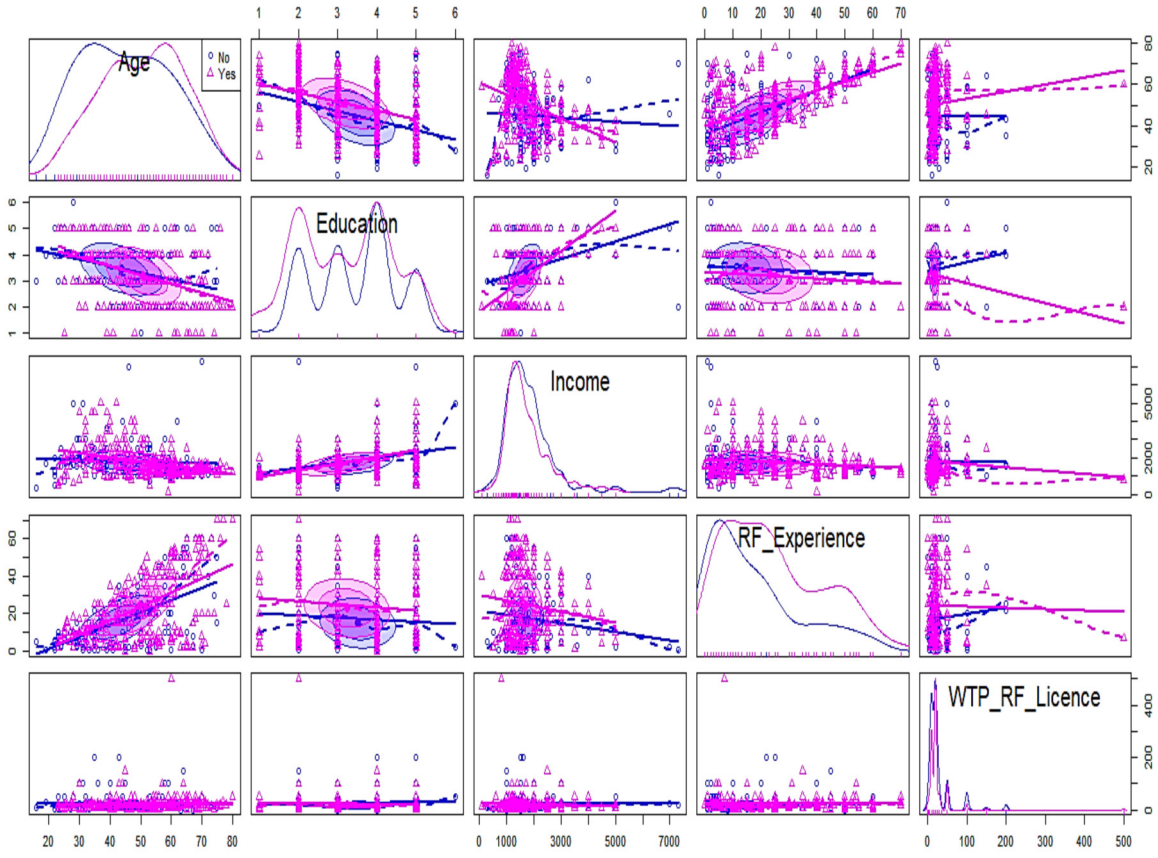

Figure S 3. Density plots shown in a scatterplot matrix of age, education, income and RF experience (in years) variables by RF licence ownership (Yes/No) with least square and smooth lines supported by plot concentration ellipses

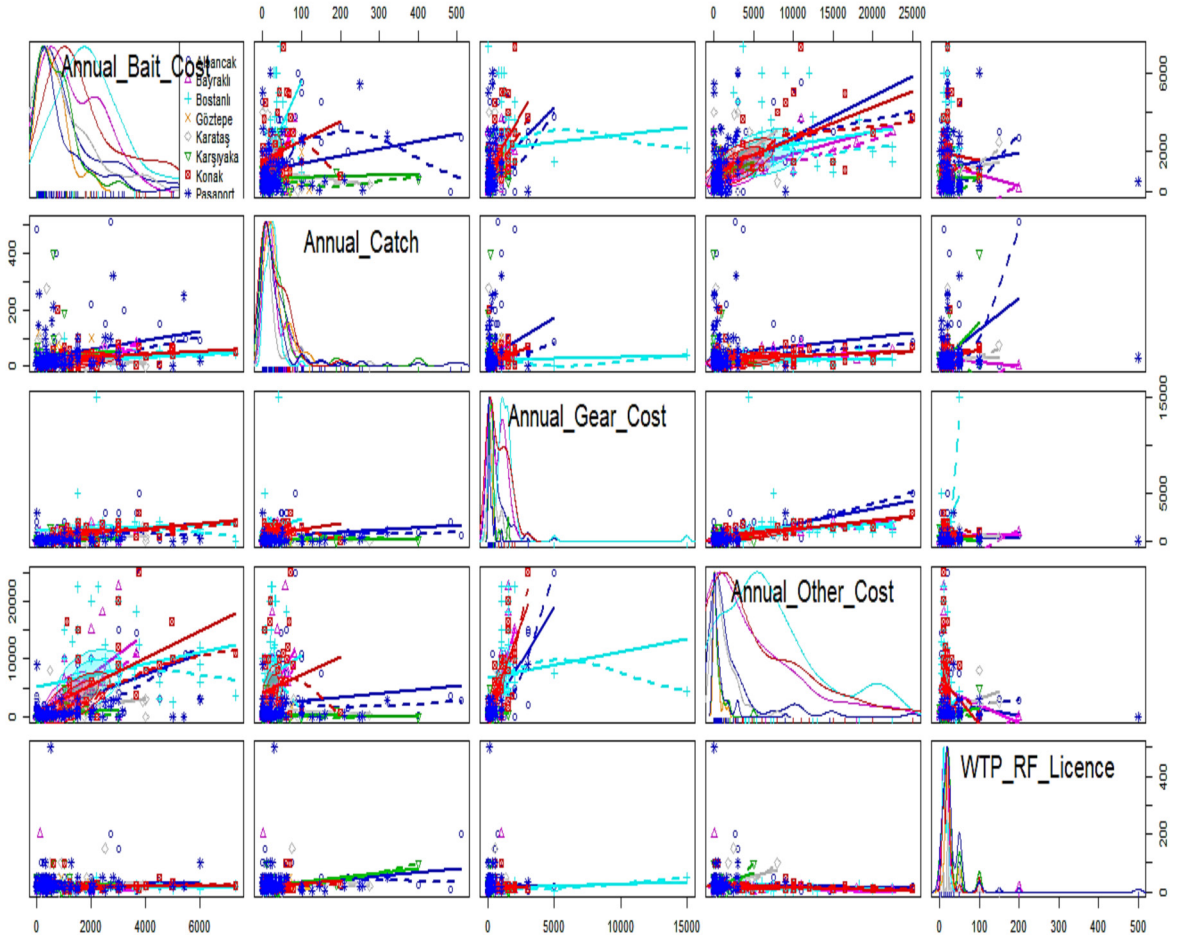

Figure S 4. Density plots shown in a scatterplot matrix of cost items and WTP for RF licence by survey locations with least square and smooth lines

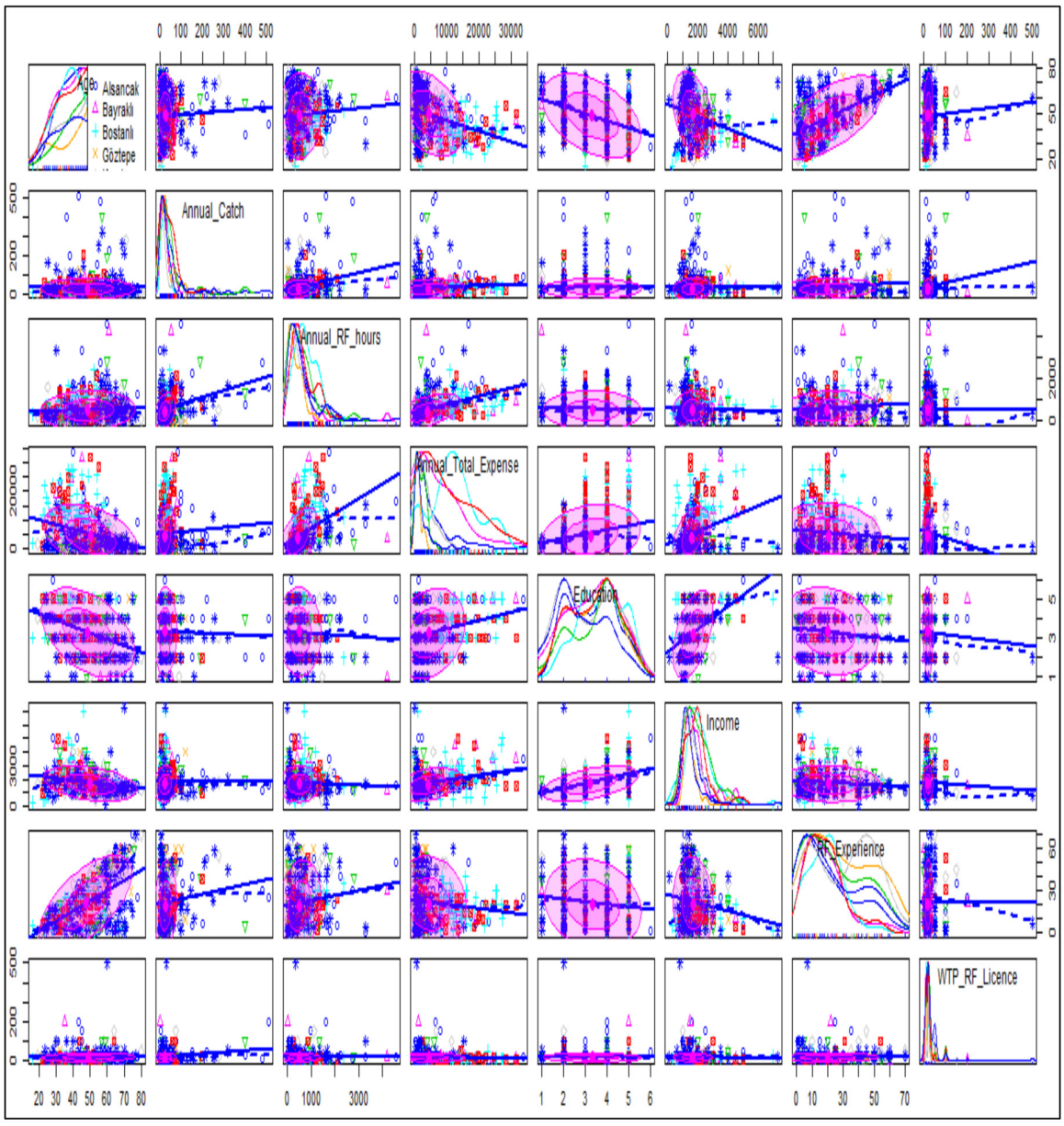

Figure S 5. Density plots shown in a scatterplot matrix of major socio-demographic, economic and fisheries variables by survey locations with least square and smooth lines supported by plot concentration ellipses

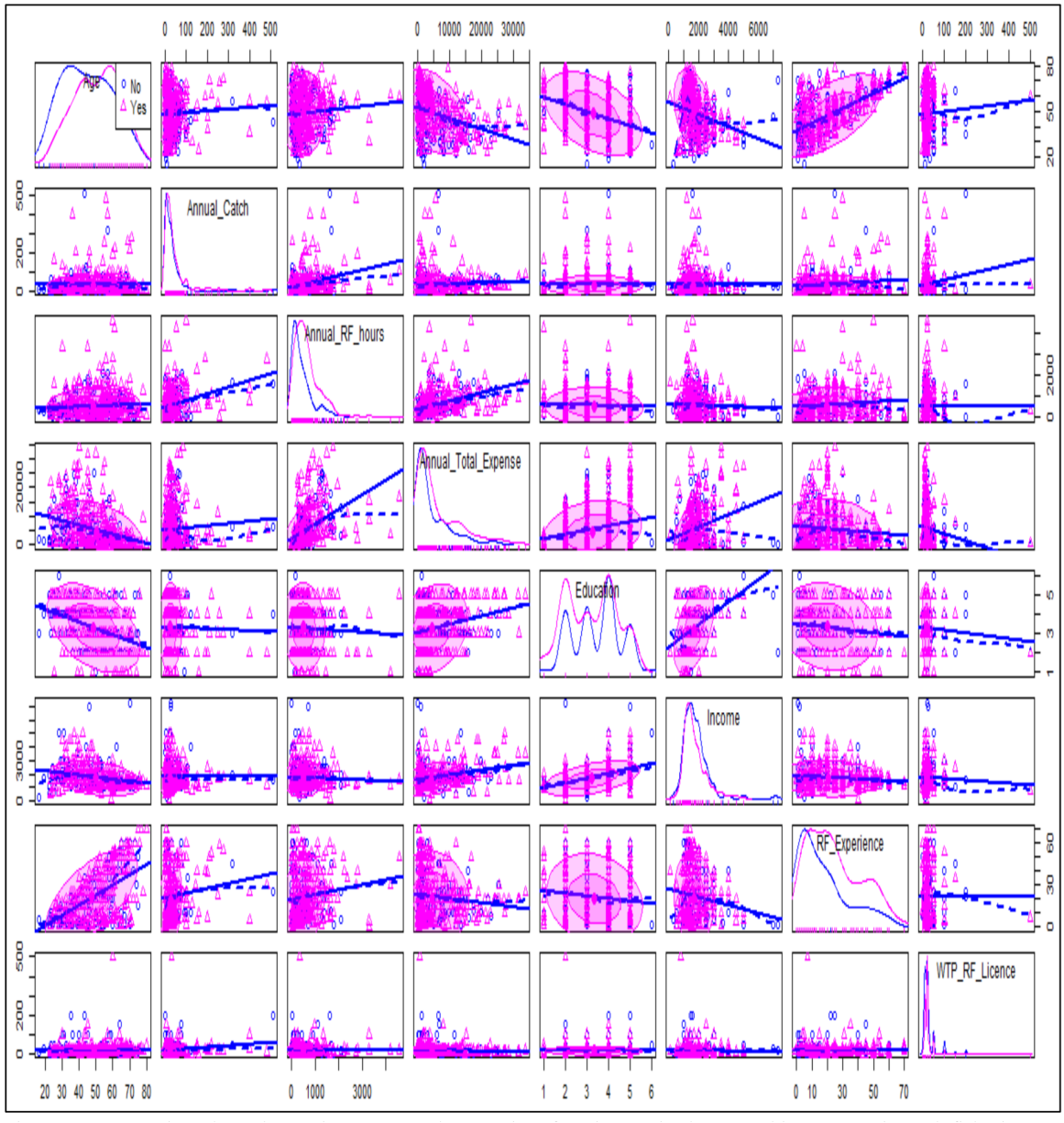

Figure S 6. Density plots shown in a scatterplot matrix of major socio-demographic, economic and fisheries variables by RF licence ownership with least square and smooth lines supported by plot concentration ellipses

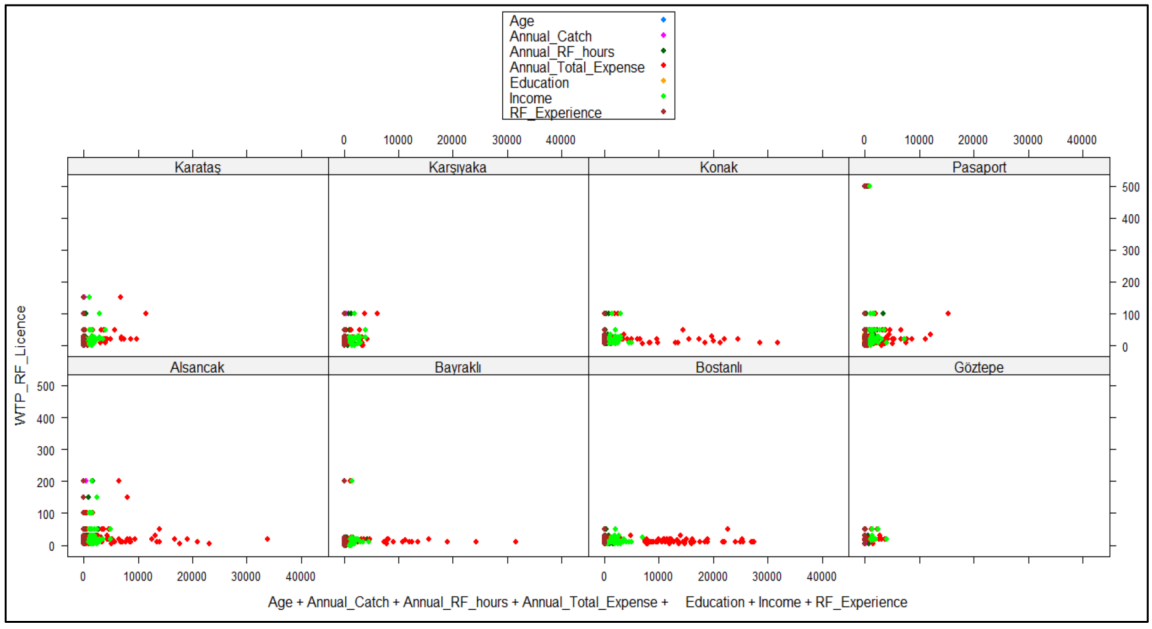

Figure S 7. Comperative plots presenting relations between certain socio-demographic, economic, fisheries variables and WTP for RF licence by each location

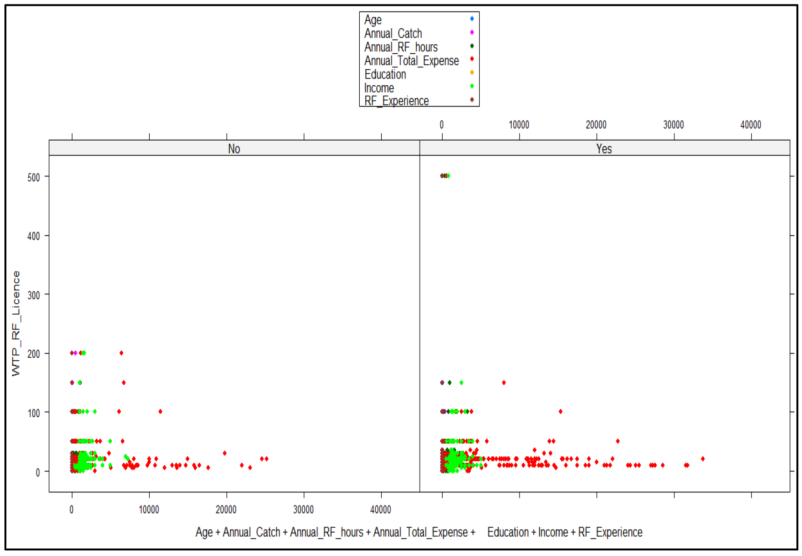

Figure S 8. Comperative plots presenting relations between certain socio-demographic, economic, fisheries variables and WTP for RF licence by RF ownership

igure S 9. Comperative plots presenting relations between certain socio-demographic, economic, fisheries variables and WTP for RF licence by transportation vehicle

Figure S 10. Comperative plots presenting relations between cost items and WTP for RF licence by each survey location and RF licence ownership

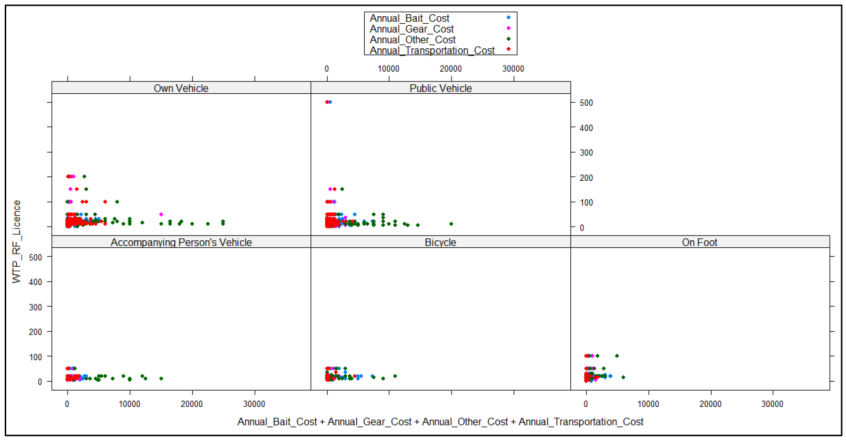

Figure S 11. Comperative plots presenting relations between cost items and WTP for RF licence by transportation vehicle

Rekreacijski ribolov na obalnim kritičnim točkama Izmirskog unutarnjeg zaljeva (Egejsko more, Turska): socioekonomske i menadžerske implikacije

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SAŽETAK

U ovom istraživanju analizirali smo društvene i ekonomske dimenzije obalnog rekreacijskog ribolova (RF) duž Izmirskog unutarnjeg zaljeva u metropolitanskoj provinciji İzmir u Turskoj. Ispitano je 634 rekreativnih ribolovaca na obali, dok je anketiranje obavljeno izravnim intervjuima na licu mjesta tijekom ribolovnih aktivnosti od siječnja do prosinca 2016. godine. Pristup tržišnoj vrijednosti korišten je za izračunavanje neto ekonomskih vrijednosti i troškova rekreativnih ribolovaca u osam obalnih okruga, Göztepe, Karataş, Konak, Pasaport, Alsancak, Bayraklı, Karşıyaka i Bostanlı uz obalu unutarnje uvale. Godišnji ribolovni napori pokazali su značajne razlike među okruzima. Na primjer: ribari u okrugu Bostanli koji imaju visoku razinu obrazovanja s višim primanjima trošili su više vremena za rekreativni ribolov, a u konačnici takav stav ribara u Bostanli okrugu rezultirao je niskim razinama CPUE-a. S obzirom na iskustvo rekreativnih ribolovaca u Bostanli okrugu, oni ili nisu vjerojatno ili će moći ciljati ili uloviti veću ili kvantitativno više riba. Suprotno tome, ribolovci Göztepe-a čine se mnogo profesionalnijima u usporedbi s ribarima tako što imaju najviši ulov u najkraćem vremenu u odnosu na ostale četvrti.

Najveći prosječni CPUE zabilježen je čak i kod ribara iz Göztepe, Karataş-a i Konaka, ipak ti iznosi CPUE bili su znatno ispod onih utvrđenih u prethodnim studijama u Turskoj. S obzirom na sastav ulova ribara, *S. auratus* je bio najčešći ulov za sve ribolovce. Također, većinu ulova su činile vrste *D. labrax* i Mugilide. U svim okrugima primijećeni su visoki izdaci vezani za ribolov, a tada su vrijednosti žetve dostigle prilično visoke razine s obzirom na prethodna istraživanja.

Zaključno, rekreativni ribolov u turskom zaljevu Izmir, velika je društvena i ekonomska aktivnost koja stvara povećanja rashoda, radnih mjesta i neizravne gospodarske aktivnosti u sektoru usluga u rekreativnom ribolovu. Rezultati ove studije pružaju ažurirane informacije o profilima ribolovnih rekreativaca kako bi se regulirao rekreativni ribolov.

Ključne riječi: rekreacijski ribolov, obala, Izmirski unutarnji zaljev