Socioeconomic aspects and characteristics of small-scale fishery in eastern Mediterranean Sea

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Abstract

Small-scale fishery represents an important part of Mediterranean fishery. In order to improve the knowledge on this sector primary research was carried out in the Dodecanese fishery aiming to identify the fishery and socioeconomic characteristics, fishing activities, and to identify the small-scale fisheries métiers. Specifically, data were collected over the time period 2013-2014 by interviews aiming to characterize fleets, fishing gear used, fishing activity and socioeconomic elements and interviews during unloading aimed at catch data. The highest CPUE values were reported for *Boops boops* (2.38±2.93 kg/1500 m net*day) caught by gillnet in the winter season, *Xiphias gladius* (101.03±86.06 kg/800 hooks*day) by drifting longline in the spring season. The catch is traded in both the wholesale and the retail market. The most important métiers with fishing gear and target species: gillnet, *B. boops*, trammel net, *Scorpaen porcus* and *Mullus surmuletus*, set longline, *Pagellus erythrinus, Pagrus pagrus, Diplodus sargus*, drifting longlines, *X.gladius* and handlines, *Octopus vulgaris*. The Dodecanese fishery need management measures to protect fishery resources and maintain small-scale fishery.

Keywords: Small-scale fishery; fleet; métier; socioeconomics; Eastern Mediterranean.

JEL Codes: Q22, Q20, Q29.

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1. Introduction

Small-scale fishery is characterized by the use of several and diversified fishing gears (Farrugio *et al.,* 1993), small-scale vessels with low tonnage and targeting a very large variety of species. Small-scale fishery presents great variations from one area to another, due to social, economic and historical contexts in which fishermen live and not the different biological and environmental conditions (Farrugio *et al.,* 1993). Furthermore, small-scale fishery makes up a significant source of food to people, economic development on coastal areas and to sustainable development (FAO, 2014).

For many years researchers study demersal stocks subjected to trawling (Whitmarsh et al., 2003; Katsanevakis et al., 2010; Deport et al., 2012; Castro et al., 2012; Samy-Kamal et al., 2014). Due to large heterogeneity of small-scale activities, information on small-scale fishery is limited with the existing indicating differences in fishing trips, time and places of landings as well as different destinations of products (retail, wholesale markets, etc.) representing an additional difficulty in collecting information.

Mediterranean coastal areas present different features, there are studies on several aspects of coastal areas (Halkos & Matsiori, 2012, 2017a, 2017b; Halkos et al., 2017). From an area to other great variations in ecosystems and diversity of species can be detected. For appropriate fishery resources management, an important objective is the detailed knowledge of all Mediterranean coastal fishing activities.

The definition of fishing practices of each fleet segment, in a fishing as diverse as the small-scale summarizes the main characteristics which are fishing gear, target species, area and season (Ulrich and Aderson, 2004; Tzanatos et al., 2006). This group has been referred to métiers, directed fisheries, fishery management units, fishery

strategies and fishing tactics (Palletier and Ferraris, 2000). The term métiers is used here. The identification of métiers is based on analysis of the species composition of large datasets of catch data which are available from logbooks or from collecting landing data (He et al., 1997; Maynou et al., 2003; Ulrich and Aderson, 2004).

In the Mediterranean Sea, studies on several aspects of small-scale fishery were carried out in Spanish waters (Garcia-Rodriguez et al., 2006; Battaglia et al., 2010; Martin et al., 2012), French waters (Marchal et al., 2008; Leleu et al., 2014), in the south Tyrrhenian Sea (Colloca et al., 2004) and Greece (Tzanatos et al., 2005; Tzanatos et al., 2006; Katsanevakis et al., 2009; Stergiou et al., 2006; Moutopoulos et al., 2014, Roditi et al., 2018a, Roditi et al., 2018b).

The aim of our study is to define the basic characteristics of small-scale fishery in eastern Mediterranean Sea examining five of the Dodecanese islands (Kalymnos, Kos, Leros, Patmos, Symi) in Greece, with their inhabitants[1] relying above all on tourism and fishing activities. In order to provide baseline data to develop appropriate management measures, we studied the fleet structure, fishing gear, catch composition and some socio-economic aspects. Moreover, the main small-scale fisheries métiers practiced were identified and the main characteristics of the identified métiers are described.

[1] The inhabitants of each island in the 2011 census were for Kalymnos 16.179, for Kos 33.388, for Leros 7.917, for Patmos 3.040 and for Symi 2.590.

2. Materials and methods

2.1. Data collection

Investigating fishery in the Dodecanese Islands of Kalymnos, Kos, Leros, Patmos and Symi (Figure 1) started with a preliminary survey from September to December 2013 in order to define the fleet range in this area and to know the fishing gear used. For this purpose, data on fishing boat characteristics were obtained from Common Fishery Policy (fleet register) (European Commission, 2013): number of boats, boat name and code, overall length (LOA), gross tonnage (GT), engine power (HP) and gear in fishing license.

Likewise, from February 2013 to May 2014, a monthly survey (3 days per month) by interviews during unloading was performed collecting data by 99 active boats from fishing operations in the 5 landing places of Kalymnos, Kos, Leros, Patmos, Symi. Simple random sampling determined the number of vessels of the 5 islands into consideration.

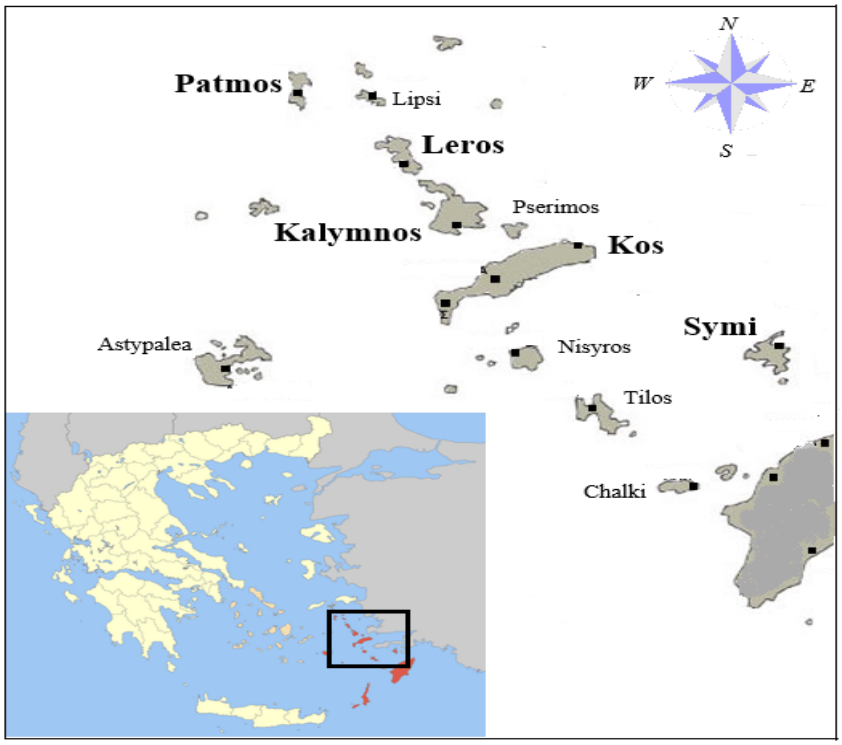

Figure 1: Dodecanese Island, the five islands (Kalymnos, Kos, Leros, Patmos, Symi) are shown emboldened.

2.2. Catch and effort

Start and end times of haul, gear type and its main characteristics (mesh size for nets and hooks for longlines, length of nets and number of hooks), number of crew members, catch weight (kg) and market price (€/kg) per specie for every trip were recorded. Over the study period 1920 fishing operations were recorded. A total of 10 different fishing methods were sampled (gillnet, trammel net, combined net gillnet-trammel net, set longline, drifting longline, trolling lines, squid hand-jig line, handline, pots and beach seines). Data collection at unloading of fishing operations fishing vessels with the main gear drifting longline was difficult for this reason data collection recording realized from fishing logbooks for each fishing vessels.

Fishing effort and catch per unit of effort (CPUE) were calculated for the most utilized gear (gillnet, trammel net, set longline, drifting longline, squid hand-jig line, handline). The meters of net (2000 m)*days for gillnet, the meters of net (5000 m)*days for trammel net, number of hooks (1000)*days for set logline, number of hooks (800)*days of drifting loglines (GFCM, 2007, Battaglia et al., 2010, Battaglia et al., 2017) and number of fishing days for squid hand-jig lines and handlines were used as unit effort. The methodology used for the identification of significant difference among seasonal CPUE and difference among seasonal income (€/kg) per unit effort were the analysis of variance (ANOVA) when the parametric prerequisites of the variables were met. If this was not achieved the non-parametric Kruskal-Wallis test was employed instead (Zar, 1999).

2.3. Métier identification

The data set was thus transformed into two matrices with denoting species x fishing days (rows x columns). The contents of the matrix were caught in kg. The clusters were transformed into a similarity matrix by applying a Bray-Curtis

coefficient and were subjected to the groups-average linking method. Then, Hierarchical clustering analysis was used to classify the groups from the resulting of the species (Moutopoulos et al., 2014; Garcia-Rodrigues et al., 2006). The 50% level ensured that most important species were actually included in the description of each métier (Silva et al., 2002).

Each métier identified groups (cluster) with different strategies with respect to species, season(s), fishing ground (depth), number and size of hooks. Excluded from the analysis were species targeted in only one or two operations and operations with zero species. In all fishing operations of a specific gear type persistent targeting of the same species a priori was considered as forming a distinct métier (Tzanatos et al., 2006). This was the case for drifting longline, squid hand-jig line, handline, trolling line and pots.

2.4. Socio-economic data

Socio-economic data were collected by an interview process consisting from face-to-face interviews to skippers (in most of the cases, with a skipper being owner-operator of the vessel) on a random sample of 99 active fishing vessels in the ports of Kalymnos, Kos, Leros, Patmos and Symi from June 2014 to October 2014. The fishing interviewees were the skippers of the 99 boats randomly sampled.

The questionnaire was consisted of two different parts: "fishery" and "socio-economic". Data on fishing boat characteristics were obtained: boat name and code, overall length (LOA), gross tonnage (GT), engine power (HP). Number and income of crew, sale value of boat, various economic information (like fixed and variable costs) and fishermen opinion about fishing tourism were also asked. The socioeconomic data provided information on age, education level, marital status, number of children, years of fishing and monthly income.

3. Results

3.1. Fishery

Aw mentioned a total of 99 boats were recorded during the survey in the five Dodecanese Islands (Kalymnos, Kos, Leros, Patmos, Symi). They are generally small size, ranging from 5.35 to 23.22 m (with a mean overall length of 10.01±3.41 S.D), and with engine power 2.05 to 450 HP (with a mean engine power of 58.66±70.21 S.D), gross tonnage 0.75 to 81.00 GT (with a mean gross tonnage of 8.40±10.85 S.D). Overall, 80 boats (80.8 %) were measured less than 12 m LOA and 19 (19.2 %) were larger than 12 m. Artisanal fishery was usual characterized by vessels <12 m LOA carrying out trip shorter than 24 h. In this case vessels >12 m LOA can be also considered as artisanal fisheries in relation to the typology of gear used and the fishing tactics adopted. The mean boat age was 18.31±12.05 years (1 to 55 years).

The most important fishery in the areas is in Kalymnos Island, with a number of 67 boats. Table 1 presents the mean characteristics of the fleet.

Table 1: Number of boats and mean characteristics of fleet (LOA=overall length, GT=gross tonnage, HP=engine power).

Island	No. of boats=99			
	No. boats	LOA	GT	HP
Kalymno	67	10.43±3.99	10.27±12.71	65.37±82.03
Ko	12	12.40±8.42	4.67±2.66	40.83±28.74
Lero	10	8.78±1.33	4.34±1.50	50.20±35.34
Patmo	7	7.97±1.80	3.38±1.60	32.57±17.06
Symi	3	13.65±10.88	9.53±7.67	69.00±46.93

The seasonal fishing activity for every gear (relative frequency in %) from February 2013 to May 2014 is illustrated in Figure 2. The analysis of this graph shows that gillnets, trammel nets and set longlines are widely used in all seasonal.

3.2. Métier identification

A total of 41 métiers were identified in the Dodecanese Island fishery for 10 different fishing gears, for each métier the main species, season and gears characteristics (Table 2).

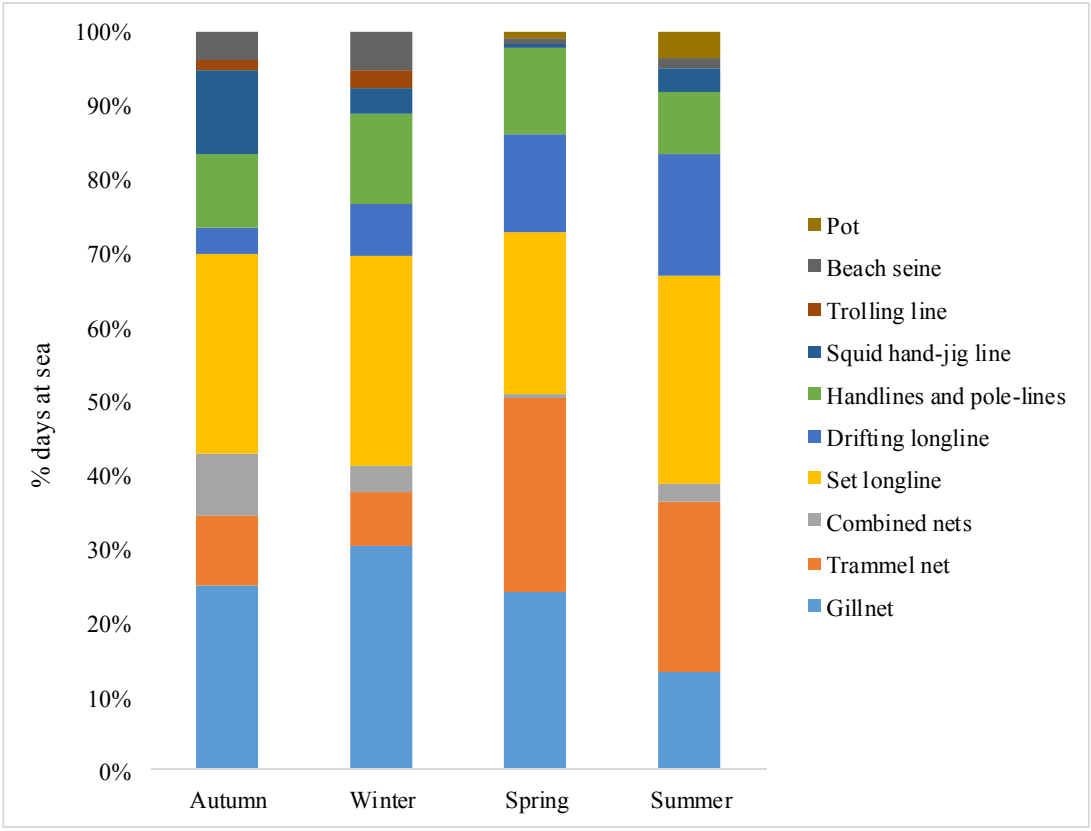

Figure 2: Seasonal activity of boats in 2013-2014 in terms of percentage (%) of days at sea per fishing gear.

Gillnets are the most utilized gear in coastal areas. A total of 8 métiers were identified. The métier GILL9 appeared with a large number of operations (233) carried out winter and spring with main target species *B.boops*. Métier GILL7 is practiced in spring with main target species *M.surmuletus* and métier GILL8 is carried out in late summer, autumn and early winter with main species *M.barbatus*. Trammel nets identified 9 métiers too. More than 50% of sampled operations belonged to one métier (TR9) with the main species of these métier being *S.porcus* and *M.surmuletus*.

Set longlines fishery of the Dodecanese Islands identified 12 métiers. Métiers LLS8 (*P.pagrus*), LLS10 (*P.erythrinus*) and LLS12 (*D.sargus*) are carried out at same times during the year. Métier LLD (*X.gladius*), SLHP (*L.vulgaris*), LHP (*O.vulgaris*) and LTL (*S.sarda*) are well defined by one single main species.

3.3. Catch and effort

On a total of 1873 fishing trips collected during landings, 60 species were recorded: 54 fish species, 3 cephalopods and 3 crustaceans. On all five islands, fishery is rather diversified in fishing methods. Five of these gear (gillnet, trammel net, set longline, drifting lingline, handline) have the largest percentage of fishing trips (88.7 %) and for each one, the duration of fishing by gear, a description of equipment and the characteristics of boats by gear were identified (Table 3).

Table 4 shows the average daily CPUE values per season calculated for commercial species caught by gillnet, trammel net, set longlines, drifting longlines, and handline and income per fishing day on the bases of landings from February 2013 to May 2014. Fishing operations using gillnet were able to capture a high number of species (n=33) but only 20 appeared quite regularly during the year. A high seasonality in CPUE is apparent with peak values of 2.95 kg/1500 m of net per day in winter 2013, 2.25 kg/1500 m of net per day in winter 2014 and 2.14 kg/1500 m of net per day in spring 2013. This proves that CPUE differs significantly with regard to season (Kruskall-Wallis, H=126.58, p<0.001). *B.boops* reported the highest CPUE values in the year of catch-effort survey.

Handlines is the most selective gear, as catch was made exclusively for 1 species: *O.vulgaris*. As reported in Table 4 (CPUE) spring 2014 is characterized by a higher CPUE value significantly different with regard to season (Kruskall-Wallis,

H=60.03, $p<0.001$). The target species *X.gladius* fished by drifting longline were recorded in spring 2014 (101.03 kg/800 hooks per day). *X.gladius* was the main commercial catch species. However, the mean CPUE for *X.gladius* always exceeds 3.15 kg per day in every season reaching the highest mean values in spring 2014 (101.03 kg per day). Mean CPUE recorded in summer 2013 and spring 2014 were significantly higher than those obtained in the other seasons. Contrarily, in the autumn was lower than in the other seasons, which has proven that CPUE differed significantly with regard to season (Kruskall-Wallis, *H*=41.81, $p<0.001$).

Fishing operations using trammel net were able to capture a high number of species (n=28) but only 16 appeared quite regularly during the year. High seasonality in CPUE was not present with only peak values of 0.59 kg/1500 m of net per day in spring 2013, having proven that CPUE differs significantly with regardw to season (Kruskall-Wallis, *H*=98.98, $p<0.001$). There were no species reporting the highest CPUE values in the year of catch-effort survey.

Moreover, fishing operations using set longlines were able to capture a high number of species (n=30) but only 13 appeared quite regularly during the year. A high seasonality in CPUE is apparent, with peak values of 1.62 kg /1000 hooks per day in summer, CPUE differs significantly with regard to season (Kruskall-Wallis, *H*=60.03, $p<0.001$). *S.aurata*, *P.pagrus* and *P.erythrinus* reported the highest CPUE values in the year of catch-effort survey. *S.aurata* catches are represented by few large-sized specimens.

Furthermore, during the survey cetacean (dolphin and seal) and silver-cheeked toadfish (*Lagocephalus sceleratus*) interactions were reported from fishermen for more frequent in association with specific fishing gear. In particular, these events were very frequent in gillnet and trammel net fishing, affecting negatively on yields

(predation), on gear functionality (damages) and then on income of fishers. According to fishermen, cetacean and silver-cheeked toadfish growth has been strong in recent years. In the study area common dolphin (*Delphinus delphis*) appeared, at a depth of 200 m and near the coastal area (Frantzie et al., 2003), in the same depth, in particular fishing gear was operating.

There is no fish market and catches are traded mainly in the wholesale sector (82.8 %) and less retail sector (22.2 %) in the local market and exported in some cases, such as swordfish (*X.gladius*) abroad, mainly in Italy.

In spite of the tourist presences in the 5 islands that required the license to practice fishing tourism, tourism related activities involved none boats and fishermen were not even recognized of the activities of fishing tourism. The fishing boats could operate with fishing tourism activities above all in summer. In this case, tourists attend to fishing operations conducted by nets, longlines, trolling lines and pots.

The analysis of fishing activity management cost for the 99 active boats that participated in the survey and the monthly average income per fisherman is summarized in Table 6.

Table 2. Métiers identified in the five Islands in the Dodecanese (Kalymnos, Kos, Leros, Patmos, Symi) and their main characteristics (season, no shading, with use, light grey shading, least use, dark grey shading, moderate use, black shading, intensive, fishing gear)(FAO code, 1980).

					Fishing period (month)												Depth (m)		Mesh size (mm) or hook size (number)	
No	Metier and gear (FAO code)	Number of Operations	Main species	Other species	J	F	M	A	M	J	J	A	S	O	N	D	Range	Mean	Range	Peak
	Gillnets (07.9.1)																			
1	GILL1	14	*O.melanura*	*D.dentex* *B.belone*													5-73	26.13±24.84	30,32, 34	32
1	GILL2	2	*P.erythrinus*	-													36.6-101	76.2±34.65	24,36	24,36
3	GILL3	16	*P.bogaraveo*	*M.mustelus* *M.surmuletus* *S.porcus*													9-366	181.94±128.56	21-22, 36,38,40	36
4	GILL4	4	*S.aurita* *S.ocellatus*	*P.erythrinus* *S.cretense* *S.aurata*													55-128	103.67±42.14	34,36,40	40
5	GILL5	16	*S.cretense* *D.puntazzo* *E.fasciatus*	*N.norvegicus* *S.aurata* *M.surmuletus*													50-110	80.32±21.65	20,24,34,36, 50	36
6	GILL6	60	*M.surmuletus*	*S.cantharus*													4.5-366	47.58±46.01	18,21,22,24	21-22
7	GILL7	48	*M.barbatus*	*S.aurita* *M.surmuletus*													27-84	59.62±12.40	18-22	18
8	GILL8	230	*B.boops*	*M.surmuletus* *M.barbatus* *S.cretense*													4-187	60.99±32.18	18-26	26
	Trammel nets (07.5.0)																			
9	TR1	14	*S.sarda* *B.boops*														15-55	51.07±11.12	21,26,28	28
10	TR2	4	*D.sargus* *D.dentex* *P.pagrus*														18-110	64±41.14	40	40
11	TR3	18	*P,bogaraveo*														15-220	55.22±45.08	21,24,26	24
12	TR4	6	*P.erythrinus* *S.porcus*	*M.mustelus*													24-220	82.17±71.98	24,40,50	24

Table 2 continued

No	Metier and gear (FAO code)	Number of Operations	Main species	Other species	Fishing period (month)												Depth (m)		Mesh size (mm) or hook size (number)	
					J	F	M	A	M	J	J	A	S	O	N	D	Range	Mean	Range	Peak
13	TR5	4	*S.cretense* *S.porcus* *D.dentex* *S.rivulatus*	*M.surmuletus*													29-64	42.75±15.98	23,24,26,28,30, 32	23
14	TR6	7	*D.dentex*	*N.norvegicus* *S.porcus*													50-82	68±11.31	24,36,40	36
15	TR7	22	*S.colias* *M.surmuletus* *M.barbatus*	*S.porcus* *D.dentex*													37-187	86.68±51.98	20-24,40	20
16	TR8	11	*M.cephalus*	*M.surmuletus* *O.vulgaris* *D.dentex*													18-73	41.13±14.10	20,22,26,50	22,26
17	TR9	233	*S.porcus* *M.surmuletus*	*S.officinalis* *S.cretense*													3.5-366	45.27±41.13	22-24,26,32,36	26,36
	Combined gillnets-trammel nets (07.6.0)																			
18	COMB1	2	*S.porcus*														150	150	36	36
19	COMB2	21	*M.barbatus* *S.cretense*	*M.surmuletus* *S.aurita*													33-99	62.70±27.19	18,19,24,26	18,24
20	COMB3	33	*B.boops* *M.surmuletus*	*S.officinalis* *O.vulgaris* *P.erythrinus* *S.porcus*													5.4-91.5	45.26±26.27	18-24,26,45	24,26
	Set longlines (09.3.0)																			
21	LLS1	13	*K.pelamis*	-													29-46	36.62±4.25	7,10-13	7,10-11,13
22	LLS2	35	*D.dentex*	*P.pagrus*													13-155	53.31±34.10	8-11,13	10
23	LLS3	6	*E.fasciatus*														65-72	69.50±2.34	4,8	4
24	LLS4	5	*M.mustelus*	*E.fasciatus*													27-549	147.81±197.51	3,10	10

Table 2 continued

No	Metier and gear (FAO code)	Number of Operations	Main species	Other species	Fishing period (month)												Depth (m)		Mesh size (mm) or hook size (number)	
					J	F	M	A	M	J	J	A	S	O	N	D	Range	Mean	Range	Peak
25	LLS5	4	*O.vulgaris*	-													9-366	140.67±175.69	10,13,14	10
26	LLS6	23	*P.bogaraveo*	*Z.faber* *P.erythrinus*													50-600	178.58±175.23	10,11,14	14
27	LLS7	8	*O.melanura* *S.aurata*														9-64	31.08±15.18	13,14	13
28	LLS8	98	*P.pagrus*	*S.cantharus*													18-165	93.60±32.10	9-14	13,14
29	LLS9	67	*S.aurata*	*P.erythrinus* *D.vulgaris*													9-119	58.02±24.13	9-14	14
30	LLS10	116	*P.erythrinus*	*O.vulgaris* *D.vulgaris*													18-128	63.10±18.98	9-14	14
31	LLS11	15	*D.vulgaris*	*P.pagrus*													18-329	46.67±80.27	13,14	14
32	LLS12	87	*D.sargus*	*D.vulgaris* *S.aurata* *P.pagrus*													5-119	30.52±22.95	13,14	14
	Drifting longlines (09.4.0)																			
33	LLD	202	*X.gladius*														18-3660	447.91±707.13	2-4,6	2
	Trolling lines (09.6.0)																			
34	LTL	17	*S.sarda*														2.5-110	72.21±42.23	-	-

Table 2 continued

No	Metier and gear (FAO code)	Number of Operations	Main species	Other species	Fishing period (month) J	F	M	A	M	J	J	A	S	O	N	D	Depth (m) Range	Mean	Mesh size (mm) or hook size (number) Range	Peak
	Squid jig hooks (09.1.0)																			
35	SLHP	69	*L.vulgaris*														18-73	60.93±14.24	-	-
	Handlines (09.1.0)																			
36	LHP	204	*O.vulgaris*														2-73	29.33±18.56	-	-
	Pots (08.2.0)																			
37	FPO	20	*P.narval*														5-183	106.30±75.35	-	-
	Beach seines (02.01.0)																			
38	SB1	6	*B.belone*														2-50	25.45±24.06	9,12	9,12
39	SB2	16	*B.boops* *S.colias* *S.smaris*														40-95	57.50±15.43	18,20	20
40	SB3	27	*L.vulgaris*	*S.colias* *S.smaris*													30-95	63.97±22.71	20,40,50	20,40

Table 3: Duration of fishing by gear (gillnet, trammel net, set longline, drifting longline, handline), with information on characteristics of boats (LOA= overall length), gear description (meters of net/number of hooks), number of crew (member).

Gear	Gillnet	Trammel net	Set longline	Drifting longline	Handlines
Durations of fishing per fishing trips (hours/days)	1-20 (6.90±3.75) hours	1-24 (6.90±10.07) hours	1-24 (8.21±6.30) hours	1-28 (8.08±6.61) days	1.3-13 (7.45±2.69) hours
Crew size (member)	1-4 (1.98±0.84)	1-4 (1.74±0.75)	1-4 (1.73±0.81)	1-5 (3.71±0.88)	1-2 (1.03±0.18)
Boat length (m)	2.50-14.85 (9.25±2.49)	5.35-9.08 (9.08±1.80)	5.35-16.90 (8..68±1.94)	5.90-23.22 (16.12±4.47)	5.75-11.95 (7.79±1.26)
Gear description (meters of net/number of hooks)	1.500-4.000 (2.200±1.041)	1.500-5.000 (4.730±934)	40-5000 (1.110±685.32)	200-2800 (805.88±348.82)	-

Table 4: Season commercial specie CPUE values and income per fishing trips for gear (GILL=gillne, kg/1500 m net*day, TR=trammel net, kg/1500 m net*day, LLS=set longline, kg/1000 hooks*day, LLD=drifting longline, kg/800 hooks*day, LHP=handline, kg/day) based on landings for the five Islands in the Dodecanese in 2013-2014 season.

Species	Gear	Winter 2013		Spring 2013		Summer 2013		Autumn 2013		Winter 2014		Spring 2014	
		CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)
Boops boops	GILL	2.38±2.93	5.22±5.81	0.94±2.11	2.74±5.09	0.07±0.06	0.30±0.28	0.13±0.09	0.53±0.47	1.65±1.67	3.20±2.73	0.60±1.72	0.53±1.45
Dentex dentex	GILL	0.01±0.01	0.20±0.08	0.03±0.02	0.67±0.48	0.01±0.00	0.14±0.09	-	-	-	-	0.01±0.01	0.36±0.28
Diplodus sargus	GILL	0.01±0.01	0.12±0.10	-	-	-	-	-	-	0.01±0.00	0.17±0.11	-	-
Mugil cephalus	GILL	0.07±0.06	0.38±0.33	-	-	-	-	-	-	-	-	-	-
Mullus barbatus	GILL	0.08±0.09	1.05±1.13	0.05±0.02	0.48±0.32	0.07±0.03	0.66±0.28	0.07±0.05	0.67±0.51	0.08±0.05	0.72±0.47	0.01±0.01	0.21±0.17
Mullus surmuletus	GILL	0.05±0.04	1.02±0.66	0.07±0.05	1.49±0.98	0.04±0.02	0.80±0.54	0.30±0.01	0.40±0.24	0.07±0.07	1.32±1.51	0.05±0.04	1.00±0.74
Oblada melanura	GILL	-	-	0.08±0.02	0.45±0.10	0.01±0.01	0.06±0.06	-	-	-	-	0.01±0.01	0.11±0.03
Octapus vulgaris	GILL	0.03±0.01	0.19±0.10	0.07±0.07	0.46±0.50	-	-	-	-	0.01±0.01	0.03±0.02	-	-
Pagellus bogaraveo	GILL	0.04±0.01	0.20±0.09	0.07±0.07	0.37±0.43	0.11±0.01	0.01±0.01	-	-	-	-	0.08±0.10	0.48±0.53
Palinurus elephas	GILL	-	-	0.03±0.01	0.77±0.47	-	-	-	-	-	-	0.01±0.01	0.31±0.18
Pagellus erythrinus	GILL	-	-	0.02±0.01	0.32±0.18	-	-	-	-	-	-	-	-
Pagrus pagrus	GILL	-	-	0.01±0.01	0.52±0.79	-	-	-	-	-	-	-	-
Sardinella aurita	GILL	-	-		-	0.01±0.01	0.02±0.01	0.01±0.01	0.05±0.03		-	-	-
Scomber colias	GILL	0.03±0.02	0.14±0.11	0.12±0.07	0.65±0.38	0.04±0.03	0.28±0.20	0.01±0.01	0.07±0.05	-	-	0.01±0.01	0.12±0.07
Sparisoma cretense	GILL	0.01±0.00	0.09±0.03	0.04±0.02	0.36±0.19	0.07±0.04	0.68±0.41	0.01±0.01	0.05±0.05	-	-	-	-
Siganus luridus	GILL	-	-	0.01±0.01	0.11±0.09		-	-	-	0.01±0.01	0.08±0.04	-	-
Scorpaena porcus	GILL	0.01±0.01	0.14±0.09	0.09±0.10	0.84±0.91	0.01±0.01	0.08±0.06	-	-	0.01±0.01	0.14±0.09	0.02±0.02	0.22±0.27
Sepia officinalis	GILL	-	-	0.04±0.04	0.24±0.22	-	-	-	-	0.02±0.02	0.12±0.12	0.02±0.03	0.13±0.15
Sarda sarda	GILL	0.13±0.17	0.34±0.43	0.12±0.09	0.54±0.27	-	-	0.13±0.05	0.20±0.06	0.12±0.06	0.36±0.19	0.20±0.16	0.61±0.44
Trachinus draco	GILL	-	-	0.01±0.00	0.06±0.03	-	-	-	-	-	-	-	-
Z.faber	GILL	-	-	0.01±0.00	0.10±0.01	-	-	-	-	-	-	0.01±0.02	0.07±0.01
Other species	GILL	0.11±0.09	0.62±0.72	0.40±0.92	1.41±1.77	0.04±0.03	0.21±0.34	0.05±0.05	0.27±0.43	0.09±0.10	0.79±1.34	0.12±0.23	0.52±0.81
Seasonal mean	**GILL**	**2.96±3.45**	**9.71±9.62**	**2.21±3.61**	**12.31±13.21**	**0.48±0.25**	**3.24±2.28**	**0.71±0.28**	**2.24±1.84**	**2.00±1.96**	**6.76±6.51**	**1.17±2.39**	**4.8±5.19**
Dentex dentex	TR	-	-	0.02±0.01	0.53±0.40	-	-	-	-	-	-	0.01±0.01	0.28±0.33
Diplodus sargus	TR	-	-	0.01±0.01	0.08±0.07	0.01±0.00	0.06±0.02	-	-	-	-	0.01±0.00	0.10±0.04
Mugil cephalus	TR	-	-	0.02±0.01	0.07±0.05	-	-	-	-	-	-	-	-
Mullus barbatus	TR	0.01±0.00	0.05±0.02	0.01±0.00	0.07±0.04	-	-	-	-	-	-	-	-
Mullus surmuletus	TR	0.01±0.01	0.32±0.29	0.04±0.03	0.73±0.57	0.02±0.01	0.42±0.38	0.01±0.00	0.13±0.11	-	-	0.03±0.06	0.57±0.72
Oblada melanura	TR	-	-	0.01±0.01	0.03±0.02	0.01±0.00	0.08±0.03	-	-	-	-	-	-
Octopus vulgaris	TR	0.02±0.03	0.13±0.16	0.03±0.04	0.22±0.24	-	-	-	-	-	-	0.01±0.01	0.05±0.09
Pagellus bogaraveo	TR	-	-	0.03±0.03	0.19±0.32	0.01±0.01	0.03±0.02	-	-	-	-	-	-
Palinurus elephas	TR	-	-	0.04±0.06	1.01±1.52	-	-	-	-	-	-	0.01±0.01	0.27±0.19
Pagellus erythrinus	TR	-	-	0.01±0.01	0.50±0.41	-	-	-	-	-	-	-	-
Scomber colias	TR	0.01±0.01	0.09±0.06	0.01±0.01	0.06±0.03	0.01±0.01	0.07±0.05	-	-	-	-	-	-
Sparisoma cretense	TR	-	-	0.01±0.01	0.10±0.08	0.08±0.06	0.63±0.67	0.03±0.04	0.28±0.35	-	-	0.01±0.01	0.01±0.01
Siganus luridus	TR		-	0.01±0.01	0.38±0.33	0.03±0.02	0.38±0.33	0.01±0.01	0.38±0.33		-		-
Sepia officinalis	TR	0.01±0.01	0.05±0.05	0.04±0.06	0.23±0.31	0.01±0.01	0.09±0.03	-	-	0.01±0.00	0.03±0.01	0.06±0.08	0.38±0.41
Scorpaena porcus	TR	0.01±0.00	0.06±0.03	0.08±0.09	0.80±0.86	0.04±0.02	0.45±0.32	0.01±0.01	0.05±0.04	0.01±0.01	0.04±0.02	0.05±0.05	0.50±0.50
Sarda sarda	TR	-	-	0.14±0.24	0.42±0.74	-	-	-	-	-	-	0.06±0.03	0.20±0.10
Other species	TR	0.04±0.04	0.32±0.65	0.11±0.12	0.63±0.79	0.02±0.05	0.44±1.01	0.01±0.00	0.10±0.09	-	-	0.01±0.01	0.36±0.33
Seasonal mean	**TR**	**0.1±0.09**	**1.02±1.26**	**0.59±0.71**	**6.05±6.78**	**0.22±0.14**	**2.65±21.86**	**0.07±0.07**	**0.94±0.92**	**0.02±0.01**	**0.07±0.03**	**0.25±0.26**	**2.72±2.72**

Table 4 continued

Species	Gear	Winter 2013		Spring 2013		Summer 2013		Autumn 2013		Winter 2014		Spring 2014	
		CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)	CPUE	Income per fishing trips(€)
Conger conger	LLS	-	-	0.01±0.00	0.02±0.01	-	-	0.01±0.01	0.04±0.02	-	-	-	-
Dentex dentex	LLS	0.10±0.05	2.01±1.03	0.13±0.10	3.91±3.13	0.14±0.11	3.06±2.55	0.07±0.04	1.50±0.91	-	-	0.10±0.07	2.16±1.45
Diplodus sargus	LLS	0.03±0.01	1.12±1.47	0.04±0.07	0.81±1.44	0.09±0.07	1.53±0.93	0.09±0.07	1.59±1.27	0.07±0.04	0.93±0.59	0.07±0.05	0.95±1.12
Diplodus vulgaris	LLS	0.02±0.01	0.31±0.31	0.05±0.03	0.60±0.38	0.11±0.08	21.47±107.43	0.12±0.06	0.98±0.52	0.02±0.01	0.25±0.13	0.06±0.02	0.54±0.37
Epinephelus fasciatus	LLS	-	-	-	-	0.08±0.06	1.42±1.17	0.01±0.01	0.27±0.17	-	-	-	-
Katsuwonus pelamis	LLS	0.11±0.07	0.93±0.58		-	-	-	0.09±0.04	0.45±0.15	0.05±0.01	0.50±0.10	0.75±0.00	7.5±0.00
Muraena helena	LLS	-	-	0.02±0.03	0.07±0.09	-	-	0.02±0.01	0.06±0.03	-	-	-	-
Mustelus mustelus	LLS	-	-		-	0.23±0.19	1.52±1.26		-		-	-	-
Oblada melanura	LLS	-	-	-		0.08±0.10	0.67±0.82	-	-	-		-	-
Octopus vulgaris	LLS	0.03±0.02	0.18±0.13	0.08±0.07	0.55±0.46	0.05±0.03	0.27±0.16	0.01±0.01	0.16±0.17	-	-	-	-
Pagellus bogaraveo	LLS	-	-	-	-	0.16±0.06	0.80±0.33	0.05±0.03	0.06±0.04	-	-	0.02±0.00	0.24±0.06
Pagellus erythrinus	LLS	0.13±0.08	1.57±1.16	0.05±0.03	0.79±0.65	0.11±0.08	1.35±1.15	0.25±0.17	0.41±0.29	0.20±0.21	2.51±3.26	0.07±0.04	0.68±00.42
Pagrus pagrus	LLS	0.11±0.79	2.40±1.69	0.31±0.22	6.59±4.67	0.13±0.09	2.49±1.88	0.19±0.13	3.79±4.67	0.17±0.10	3.53±2.64	0.30±0.25	5.61±5.02
Sparus aurata	LLS	0.31±0.15	4.69±2.80	0.31±0.22	0.43±0.79	0.13±0.09	0.87±0.60	0.19±0.13	4.05±3.22	0.17±0.10	3.15±1.99	0.30±0.25	0.63±0.85
Spondyliosoma cantharus	LLS	-	-	0.05±0.06	0.96±0.82	0.02±0.01	0.62±0.35	-	-	-	-	0.01±0.01	0.16±0.12
Other species	LLS	0.19±0.17	0.58±0.67	0.22±0.24	1.22±2.74	0.49±1.01	2.13±4.15	0.07±0.06	0.55±1.13	0.12±0.08	0.74±0.79	0.34±0.64	1.03±1.97
Seasonal mean	**LLS**	**1.03±1.35**	**13.79±9.84**	**1.27±1.07**	**15.95±15.18**	**1.86±1.98**	**38.2±122.78**	**1.19±0.79**	**13.91±12.59**	**0.81±0.55**	**11.61±9.5**	**2.14±1.33**	**19.5±11.38**
X.gladius	LLD	18.40±14.39	128.75±7116.30	28.70±27.45	272.15±215.93	81.97±210.29	577.96±1.486	3.15±3.6	15.36±13.97	25.80±19.61	296.58±425.77	101.03±86.06	912.78±1.451
Seasonal mean	**LLD**	**18.40±14.39**	**128.75±7116.30**	**28.70±27.45**	**272.15±215.93**	**81.97±210.29**	**577.96±1.486**	**3.15±3.6**	**15.36±13.97**	**25.80±19.61**	**296.58±425.77**	**101.03±86.06**	**912.78±1.451**
O.vulgaris	LHP	0.35±0.19	1.96±1.13	0.22±0.15	1.19±0.84	0.26±0.14	1.34±0.73	0.38±0.18	2.04±0.91	0.44±0.24	2.55±1.39	0.60±0.25	3.37±2.40
Seasonal mean	**LHP**	**0.35±0.19**	**1.96±1.13**	**0.22±0.15**	**1.19±0.84**	**0.26±0.14**	**1.34±0.73**	**0.38±0.18**	**2.04±0.91**	**0.44±0.24**	**2.55±1.39**	**0.60±0.25**	**3.37±2.40**

3.4. Socio-economic data

The social profile of the 99 fishermen is reported in Table 5.

Table 5: Social profile of the 99 fishermen form 5 islands in the Dodecanese.

Number of fishermen	**99**
Mean age of fishermen (years)	48.57±12.16
Mean years of work in fishing sector	35.0.±13.62
School level	
Illiterate	12.1
Primary school	59.6
Junior high school	20.2
High school	5.1
Technical education graduates	2.0
Graduate of higher education	1.0
From fishermen family	
Yes	91.9
No	8.1
Marital Status	
Married	86.9
Single	12.1
Divorced	1.0
Number of children	1-5 (2.62±1.01)
Main employed	
Yes	92.9
No	7.1
Knowledge of fishing tourism	
Yes	29.3
No	70.7

Table 6: Costs and revenue (mean values and standard deviations) for the 99 active boats in the five islands, Dodecanese (Kalymnos, Kos, Leros, Patmos, Symi).

Number of boat	**99**
Boat age (years)	18.31±12.05
Fixed costs (per year)	
boat maintenance €	2.014±2.472
Variable costs	
Crew wage (per day) €	33.94±10.23
Production costs (per year)	
fuel consumption €	11.050±15.530
lubricants €	1.793±2.290
Net income of the owner-operator (per month) €	1.188±779
Annual day of activity (days)	229±54.57

The survey on wholesale and retail prices showed that there was no difference and in some cases the price was the same in both wholesale and retail respectively (Figure 3). Target species *B.boops* of gillnet (GILL7, Table 2) show that low wholesale and retail price (less than 5 €/kg) with valuable mullidae such as *M.surmuletus* (more than 15 €/kg) and *M.barbatus* (more than 10 €/kg). Target species *S.porcus* and *M.surmuletus* of trammel net (TR9, Table 2) show that valuable with *M.surmuletus* wholesale more than 15 €/kg and retail sale more than 20 €/kg and *S.porcus* more than 5 €/kg wholesale and retail sale respectively. The significant commercial value of X.gladius (more than 5 €/kg) (Fig.3) assures a good income by drifting longline ranging from 15.36±13.97 to 912.78±1.451 € (Table 4). Total daily income (€) per fishing trip calculated per unit effort (kg/1000 hooks*day) range from 11.6±9.5 to 38.2±122.7 € for set longline winter and summer seasons respectively. The best income for this gear is given by P.*pagrus, P.erythrinus* and *S.aurata* (Table 4).

Despite the higher income, ranging from 15.36±13.97 to 912.78±1.451 € (Table 4) coming from catch *X.gladius* drifting longline has considerable costs associated largely with costs per fishing trips (4.912±4.767 €) due to durations of fishing (8.08±6.61 days) (Table 3). Moreover, this is mainly determined by low wholesale and retail prices of target species (*X.gladius*) (Figure 3). A nearly opposite situation was recorded for the handline, which had a low CPUE but also lower cost per fishing trips (19.02±16.19 €) (Table 3).

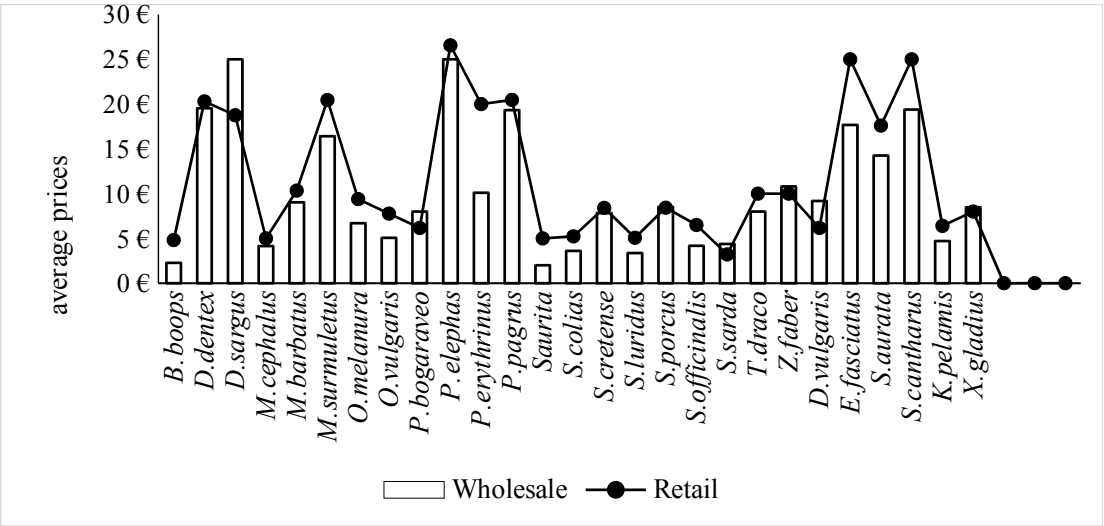

Figure 3: Average wholesale prices of main target species per fishing gear, compared with retail ones.

4. Discussion

The Dodecanese fishery is mainly small-scale fishery. In spite of the development of other fishing activities (bottom trawls and purse seines), the Dodecanese fishery (Kalymnos, Kos, Leros, Patmos, Symi) small-scale sector is strongly traditional and contributes significantly to the local economy. Small-scale fisheries constitute an important part of the fishing sector in the Mediterranean Sea (Farrugio et al., 1993). As in other Mediterranean coastal fisheries the fishing fleet was largely diverse with a great variability in equipment (Farrugio et al., 1993, Colloca et al., 2004, Tzanatos et al., 2005).

Gillnet, trammel net and set longline are the most representative small-scale gear in the Mediterranean area (Colloca et al., 2004; Tzanatos et al., 2005; Garcia-Rodriguez et al., 2006). In the Mediterranean areas, gillnet fishery identified métiers with target species *M.merluccius, M.surmuletus, S.aurata, P.erythrinus* us and *S.sarda* (Tzanatos et al., 2006; Maynou et al., 2011; Martin et al., 2012; Leleu et al., 2014) where both of these métiers coincide with the findings of our survey (GILL2 and

GILL6, Table 2). On the other hand, métier GILL8 (Table 2) where the main target species *B.boops* does not seem to find a comparison in the other Mediterranean area.

Trammel net fishery identified same métier targeting *M.surmuletus, S.porcus* and *D.dentex* in the other Mediterranean areas (Tzanatos et al., 2006; Maynou et al., 2011; Martin et al., 2012; Palmer et al., 2017) as opposed to target species *S.officinalis* that do not appear in the study area. In fact, the use of set longline in the Greek Sea is frequent (Stergiou et al., 2002; Tzanatos et al., 2006; Katsanevakis et al., 2009) and Mediterranean areas (Colloca et al., 2004; Garcia-Rodriguez et al., 2006; Castro et al., 2011; Maynou et al., 2011; Martin et al., 2012; Palmer et al., 2017) targeting mainly *M.merluccius* while this métier is not fount in the study area where P.*erythrinus, P.pagrus, D.sargus* and *S.aurata* mainly appeared as target species.

In the study area a métier (LLD) was identified targeting pelagic species (*X.gladius*) with gear drifting longline. According to the European Regulation (EC no. 7479/2013 and 6514/2014) catch of this species is nor allowed for the months October, November and March in the five Island fleets because of the lack of TAC (Total Available Catch) in this fishery.

Availability of different species characterizes the fishing activity to exploit the periodicity of resources depending on season. Seasonal rotation of fishing gear appears in the Mediterranean fisheries (Colloca et al., 2004; Tzanatos et al., 2005; Battaglia et al., 2010; Maynou et al., 2011). Seasonal rotation of métier is an important feature of small-scale fishery, fishermen adapts to dynamic environmental conditions and to different presence of resources in order to optimize yields.

Tourist flows towards the five islands are high for almost six months per year, but fishermen fail to exploit alternative resources like fishing tourism. Although, there is a law on fishing tourism (Ministerial Decree no. 414/2354/2015) no fishermen uses

it. This constitutes to the promotion of small-scale coastal fishing organizing tours around islands, carrying out fishing performances or demonstrations of cultural traditions linked to fishery. Moreover, the abundance of cetaceans in this area could be an additional tourist attraction. Finally, the development of fishing tourism may contribute to the conservation of fish stocks as a result of the closure of fisheries as long as fishermen are involved in the fishing tourism.

According to Tsikliras et al. (2013) SE (Dodecanese islands) Aegean is one of the areas where there was heavy exploitation of fish stocks. It is possible that intense fishing of the species *B.boops* which occurs mainly during the winter months is due to the reduction of some other fishing resources. *B.boops* is an easy target for fishermen in this period because it is abundant and close to the coast.

To protect fishery resources and maintain small coastal fisheries, it is important to take comprehensive management measures such as the continuous monitoring of fish stocks, the implementation of alternative sources of income for fishermen such as fishing tourism and the assessment of the economic value of small-scale coastal fishing.

References

Battaglia, P., Romeo, T., Consoli, P., Scotti, G., Andaloro, F., 2010. Characterization of the artisanal fishery and its socio-economic aspects in the central Mediterranean Sea (Aeolian Islands, Italy). Fish. Res. 102, 87–97.

Castro, J., Marín, M., Pérez, N., Pierce, G. J., Punzón, A., 2012. Identification of métiers based on economic and biological data: The Spanish bottom otter trawl fleet operating in non-Iberian European waters. Fish. Res. 125–126, 77–86.

Colloca, F., Crespi, V., Cerasi, S., Coppola, S. R., 2004. Structure and evolution of the artisanal fishery in a southern Italian coastal area. Fish. Res. 69, 359–369.

Deporte, N., Ulrich, C., Mahevas, S., Demaneche, S., Bastardie, F., 2012. Regional *métiers* definition: a comparative investigation of statistical methods using a workflow applied to international otter trawl fiheries in the North Sea. ICES J. of Mar. Sci. 69, 331–342.

European Commission, 2013. Fisheries and Maritime Affairs, Fleet Register. http://ec.europa.eu/fisheries/fleet/index.cfm?method=Search.SearchSimple&country=GRC.

FAO, 2014. The State of World Fisheries and Aquaculture. Opportunities and challenges. Food and Aqriculture Organization of the United Nations. Rome.

Farrugio, H., Oliver, P., Biagi., 1993. An overview of the history, knowledge, recent and future research trends in Meditterranean fisheries. Sci. Mar. 57, 105-119.

Frantzis, A., Alexiadou, P., 2003. Cetaceans of the Greek Seas. HCMR Monographs on Marine Science, Athens.

Garcia-Rodriguez, M., Fernandez M. A., Esteban A., 2006. Characterisation, analysis and catch rates of the small-scale fisheries of the Alicante Gulf (SE Spain) over a 10 years time series. Fish. Res. 77, 226-238.

Halkos G., Matsiori S., 2012. Assessing the economic value of protecting artificial lakes. MPRA Paper 39557, University Library of Munich, Germany.

Halkos, G., Matsiori, S., 2017a. Estimating recreational values of coastal zones, MPRA Paper 80911, University Library of Munich, Germany.

Halkos, G., Matsiori, S., 2017b. Environmental attitude, motivations and values for marine biodiversity protection, Journal of Behavioral and Experimental Economics (formerly The Journal of Socio-Economics), Elsevier, vol. 69 (C), pages 61-70.

Halkos, G., Matsiori, S., Dritsas, S., 2017. Exploring social values for marine protected areas: The case of Mediterranean monk seal, MPRA Paper 82490, University Library of Munich, Germany.

He, X., Bigelow, K.A., Boggs, C.H., 1997. Cluster analysis of longline sets and fishing strategies within the Hawaii-based fishery. Fish. Res. 31. 147-158.

Katsanevakis, S., Maravelias, C.D., Kell, L.T., 2009. Landings profiles and potential métiers in Greek set longlines. ICES J. of Mar. Sci. doi:10.1093/icesjms/fsp279.

Katsanevakis, S., Maravelias, C. D., Vassilopoulou, V., 2010b. Otter trawls in Greece: Landing profiles and potential métiers. Mediterranean Mar. Sci. 11, 43–59.

Leleu, K., Pelletier, D., Charbonnel E., Letourneur, Y., Frédéric, B., Boudouresque, F. C., 2014. Métiers, effort and catches of a Mediterranean small-scale coastal fishery: The case of the Côte Bleue Marine Park. Fish. Res. 154, 93-101.

Marchal, P., 2008. A comparative analysis of métiers and catch profiles for some French demersal and pelagic fleets. ICES J. Mar. Sci. 65, 674-686.

Martín, P., Maynou, F., Stelzenmüller, V., Sacanell, M., 2012. A small-scale fishery near a rocky littoral marine reserve in the northwestern Mediterranean (Medes Islands) after two decades of fishing prohibition. Sci. Mar.76, 607–618.

Maynou, F., Demertre, M., Sanchez, P., 2003. Analysis of catch per unit effort by multivariate analysis and generalised linear models for deep-water crustacean fisheries off Barcelona (NW Mediterranean). Fish. Res. 65, 257-269.

Moutopoulos, K. D., Ramfos A., Moukas, C., Katselis, G., 2014. Description of a daily fishing activity from a small-scale fisherman in Central Greece (Korinthiakos Gulf). Aquat. Living Resour. 6, 67.

Zar, J.H., 1999. Biostatistical Analysis, Fourth Edition, 663p and Apprendixes, Prentice Hall, New Jersey.

Palmer, M., Tolosa, B., Grau, M,A., Mar Gil, M., Obregon,C., Morales-Nin, B. Combining sale records of landings and fisheries knowledge for presenting metiers in a small-scale, multi-gear, multispecies fishery. Fisheries Research. 195, 59-70.

Pelletier, D., Ferraris, J., 2000. A multivariate approach for defining fishing tactics from commercial catch and effort data. Can. J. Fish. Aquat. Sci. 57, 51-65.

Roditi, K., Halkos, G., Matsiori, S., Vafidis, D., 2018a. Small-scale fishery of the Eastern Mediterranean Sea: A case study in the Kalymnos Island, Greece, MPRA Paper 84506, University Library of Munich, Germany.

Roditi, K., Halkos, G., Matsiori, S., Vafidis, D., 2018b. Sustainable management of fish stock: An assessment of small-scale fishing in Greece. MPRA Paper 84730, University Library of Munich, Germany.

Samy-Kamal, M., Forcada, A., Sánchez-Lizaso, J. L., 2014. Trawling fishery of the western Mediterranean Sea: Métiers identification, effort characteristics, landings and income profiles. Ocean and Coastal Management. 102, 269–284.

Stergiou, I.K., Moutopoulos, D. K., Erzini, K., 2002. Gill net and longlines fisheries in Cyclades waters (Aegean Sea): Species composition and gear competition. Fish. Res. 57, 25–37.

Stergiou, I.K., Moutopoulos, K. D., Soriguer, C. M., Puente, E., Lino, G. P., Zabala, Cristina., Monteiro, Pedro., Errazkin, A. L., Erzini, K., 2006. Trammel net catch species composition, ctach rates and métiers in southern European waters: A multivariate approach. Fish. Res. 79, 170-182.

Tsikliras, C. A., Antonopoulou, E., Stergiou, I.K., 2010. Spawning period of Mediterranean marine fishes. Rev. Fish. Biol. Fisheries. 20, 499-538.

Tzanatos, E., Dimitriou, E., Katselis, G., Georgiadis, M., Koutsikopoulos, C., 2005. Composition, temporal dynamics and regional characteristics of small-scale fisheries in Greece. Fish. Res. 73, 147–158.

Tzanatos, E., Somarakis, S., Tserpes, G., Koutsikopoulos, C., 2006. Identifying and classifying small-scale fisheries métiers in the Mediterranean: A case study in the Patraikos Gulf, Greece. Fish. Res. 81, 158–168.

Ulrich, C., & Andersen, B. S., 2004. Dynamics of fisheries, and the flexibility of vessel activity in Denmark between 1989 and 2001. ICES J. of Mar. Sci. 61, 308–322

Whitmarsh, D., Pipitone, C., Badalamenti, F., D'Anna, G., 2003. The economic sustainability of artisanal fisheries: the case of the trawl ban in the Gulf of Castellammare, NW Sicily. Marrine Policy 27, 489-49.