Sustainable management of fish stock: An assessment of small-scale fishing in Greece

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Abstract

The aim of this study was to identify the main métiers practiced by gillnet, trammel net and combined net fishery in the Kalymnos Island. The catch was obtained every 15 days of the small-scale fleet for the period from February 2013 to May 2014 by interviews during unloading. A total 315 fishing operations were recorded. Multivariate analysis applied to either species landings composition or economic revenue. The most important métiers identified were those *B. boops* with gillnet, intense fishing activity during December-February and mesh size 26 mm, métier which targeting *S. porcus* and *S. officinalis* with fishing gear trammel net, intense fishing activity during April-May and mesh size 26 mm. Both of these métiers appeared high produce and income. The results of this study confirm the multi-species natural of small-scale fishing and fishing activity in the area of Kalymnos specific difference from the other area in Greece.

Keywords: Small-scale fisheries; sustainable management; multivariate analysis; fish stock; Kalymnos Island; Mediterranean Sea.

JEL Codes: Q22; Q20; Q29; Q57; Q59.

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1. Introduction

Great variations presented small-scale fishery from one area to another that are not only due to biological and environmental conditions, but also on the social, economic and historical contexts in which fishermen live. For fisheries in the Mediterranean, a significant share represents small-scale fishery (Farrugio *et al.,* 1993). Moreover, it is widely recognized that in several areas of the world, small-scale fishery contributes significantly to poverty reduction and to sustainable development, as well as provide an important source of food to people (FAO 2005). The design of an impartial and accurate monitoring scheme for the small-scale fishery complicate by reason of it presents a large number of fishing vessels and activities along with an extended coastline and usual practice of directly supplying the landings to local markets (Battaglia *et al.,* 2010; Guyader *et al.,* 2013).

The definition of the fishing practices of each fleet segment, in a fishing as diverse as the small-scale summarizing the main characteristics which are fishing gear, target-species, area and season (Ulrich and Anderson, 2004; Tzanatos *et al.,* 2006). This group has been referred to métiers, directed fisheries, fishery management units, fishery strategies and fishing tactics (Pelletier 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 available from logbooks or from collecting landing data (He *et al.,* 1997; Maynou *et al.,* 2003; Ulrich and Anderson, 2004).

In the Mediterranean Sea, study on several aspects of small-scale fishery was carried out in Spain where identified and described the characteristics of the small-scale fisheries based on logbooks and analysis a simple from trips with fishing gear: trammel net, gillnet and longline (Garia-Rodriguez *et al.,* 2006; Martin *et al.,* 2012; Castro *et al.,* 2011; Maynou *et al.,* 2011). A description of the characteristics of the artisanal fisheries and identify their activity in space and time taking place around the Tabarca Marine Reserve (Forcada *et al.,* 2010)

Trawling fishery, effort characteristics, landings profile and métiers identification (Silvia *et al.,* 2002; Maynou *et al.,* 2003; Castro *et al.,* 2012, Samy-Kamal *et al.,* 2014; Quetglas *et al.,* 2016). Description the activity and fishing effort of small-scale fishery located in a French Mediterranean Marine Protected Areas (MPA) (Leleu *et al.,* 2014). Marchal *et al.,* (2008) identified métiers and catch profiles from seven major pelagic and demersal French fleets. The characteristics of fishing effort, fleet and identification métiers in the southern Tyrrhenian Sea (Colloca *et al.,* 2004) in the Danish waters (Ulrich and Andersen, 2004) and in the English Channel (Ulrich *et al.,* 2001).

In the Greek small-scale fishery, the first attempt to identifying the most important métiers, activity and to describe their characteristics based on questionnaires was carried out by Tzanatos *et al.* (2005). Furthermore, identified the main small-scale métiers based on 116 daily trips from five ports of the Patraikos Gulf by five different fishing gear (trammel nets, gillnets, combined nets, longlines and traps) (Tzanatos *et al.*, 2006). Landing profiles and potential métiers in Greek set longlines, boat seines and otter trawls by Katsanevakis et al. (2009); Katsanevakis *et al.* (2010a); Katsanevakis *et al*. (2010b) and drifting longlines fishery in the island of Kalymnos (Roditi *et al.,* 2015) and trammel net fishery in southern European waters (Stergiou *et al.,* 2006). Moutopoulos *et al.* (2014) characterized fishing activity based on daily data from a small-scale fisherman of the Korinthiakos Gulf by three fishing gear.

The aim of this study was to group landing profiles, to identify métiers for the fishing gear gillnets, trammel nets and combined nets base on a sample of landings in the Kalymnos Island (Dodecanese, SE Aegean, Greece). Métiers provide a synthetic description of fishing activities which is useful for understanding the spatial- temporal patterns of effort which improve the response of fishers to management and to improve the design of stratified data collection to achieve better performance in the estimates of species-specific production.

2. Materials and methods

2.1. The data

The catch was obtained every 15 days of the small-scale fleet (32 boats) for the period from February 2013 to May 2014 (16 complete months) for the port of Kalymnos Island (Fig.1) by interviews during unloading (Battaglia *et al.,* 2010, Leleu *et al.,* 2014, Battaglia *et al.,* 2017). Kalymnos Island was chosen because it is a representative port with a large active small-scale coastal fleet. Tsikliras *et al*. (2013) reported that one of the most heavily exploited subareas was SE (Dodecanese islands) Aegean. For this reasons it was considered necessary to study this area.

Over the study period, 315 fishing operations recorded. Fishing vessels operating in the surrounding area of Kalymnos. For each fishing operation, the data collection include the type of the gear and its technical characteristics (mesh size for nets), the characteristics of the fishing ground (depth), catch weight (kg) and market price (€/kg) by species (Tzanatos et al., 2006).

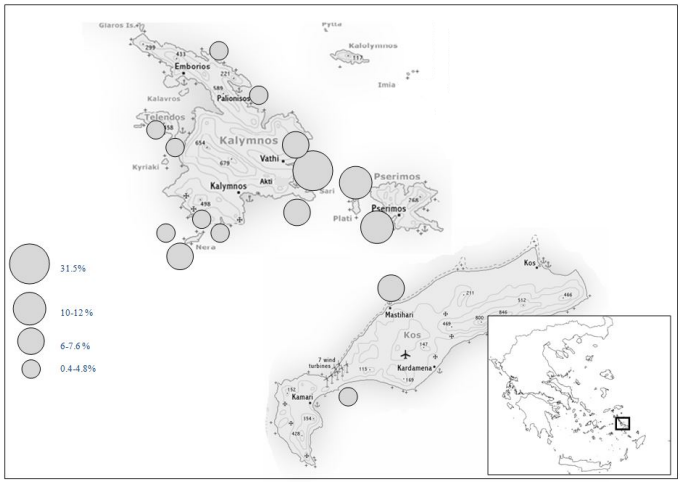

Figure 1: Map of Kalymnos and the surrounding area where carried out fishing activity. (The size of the circle gave the frequency of fishing operations).

2.2. Identification of métiers

A principal components analysis (PCA) was conducted in order to produce a convenient lower dimensional summary of the original variables. The value of i was the number of components selected which corresponding to where large eigenvalues cease and small eigenvalues begin (Everitt, 2005). A hierarchical Cluster Analysis (HCA) based on Ward's criterion was carried out using the retained principal components. The choice of the number of clusters was based on several trials with the different choice of dissimilarity threshold in the resulting dendrogram (Palletier and Ferraris, 200, Deport *et al.,* 2012).

The final characterization of clusters with three different gear: gillnet, trammel nets and combined nets, was based on the month of year the operations were carried out and the species declared as caught in more than 10 % of operations categorized in the specific group (Katsanevakis *et al.,* 2009; Katsanevakis *et al.,* 2010a; Katsanevakis *et al.,* 2010b; Marchal *et al.*, 2008; Martine *et al*., 2012). The level 10 % ensured the most important species (Katsanevakis *et al.,* 2009) whereas from analysis excluded species which targeted in only one or two operations and fishing operations with zero landings. The analysis was performed on 294 fishing operations.

The resulting groups (clusters) were then categorized individual fishing sets. On two matrix with species landings composition x fishing days was applied cluster analysis. Using the double square root transformation matrices were transformed. 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 and from the resulting dendrogram the groups are obtained according to the different abundance patterns of the composition of the species (Garcia-Rodriguez *et al.,* 2006; Moutopoulos *et al.,* 2014). The level 50 % ensured that most important species were actually included in the description of each métiers (Silva *et al.,* 2002). Each cluster was

considered to represent a potential métier (Katsanevakis *et al.,* 2009, Maynou *et al.,* 2011, Leleu *et al.,* 2014). The analysis was performed on 260 fishing operations.

Similarity percentage analysis (SIMPER) was implemented to the triangular matrices of the Bray-Curtis similarity index, in order to identify the main species characterizing each métiers based on both production and market value (Stergiou *et al.,* 2003). Finally, using hierarchical cluster analysis (Ward's method) in order to identify métiers with similarity characteristics were grouped based on the total number of recorded operation, total catch of these operations, the respective total income and the number of months the métiers was active (Tzanatos *et al.,* 2006).

3. Results

3.1. The fleet

Active boat (32) length ranged from 2.5 to 14.8 m (average 9.4±2.5 m), with engine power ranging from 8.8 to 160 HP (average 45.12±37.57 HP) and gross registered tonnage (GRT) ranging from 0.8 to 31.39 GRT (average 6.7±5.8 GRT).

Overall qualitative results of the sampling are presented in Table 1. A total of 44 species were recorded in the catches of trammel net, gillnet and combined net (gillnet-trammel net) (39 fish species, 2 crustaceans and 3 cephalopods). The average weight of the catch per fishing operation was 49.2±70.7 kg. The average weight of the catch per fishing operation was obtained by gillnet (61.05±87.25 kg), followed by trammel net 34.50±38.31 kg and combined net 34.05±32.82 kg.

3.2. Identification of métiers

Eight clusters (A-H) were identified in gillnet, nine (A-I) in trammel net and five (A-E) in combined net. The scree diagrams for the log-transformed landing profile matrix for gillnet, trammel net and combined and the species with highest relative contribution to the variance of the clusters within each fishing gear are presented in Figure 2 and Tables 2-4.

For the fishing trips with the main gear gillnets, 8 principal components retained based on the screen diagram and on the contribution of each component to the total variance (Fig. 2a). These 8 components accounted for 72 % of the total variation in the original data. For the fishing trips with the main gear trammel nets, 10 principal components retained based on scree diagram and on the contribution of each component to the total variance (Fig. 2b). These 10 components accounted for 68 % of the total variation in the original data. Also for the fishing trips with the combined nets (gillnets-trammel nets) 4 principal components retained based on scree diagram and on the contribution of each component to the total variance (Fig. 2c). These 4 components accounted for 62 % of the total variation in the original data. Figure 3 shows the clusters identified through cluster analysis by the gillnet, trammel net and combined net.

The HAC analysis for the fishing gear gillnets based on the 4 clusters (A, B, E, H) led to the identification of 5 métiers (Gill1, Gill2, Gill3, Gill4, Gill5), representing different average landing profiles (Fig. 4a). The analysis was performed on 148 (91.1 %) fishing operations. The clusters (C, D, F, G) consisted of 15 fishing operations were excluded from the analysis because they consisted of a small percentage. The target species of métier Gill1 was red mullet (*M.barbatus*), of the métier of 100 %. Metier Gill2 was one target species bogue (*B.boops*), with a relative contribution to the variance of the métier of 98.9 %. This métier included winter, with intense fishing activity at 50-64 m depth. Striped red mullet (*M.surmuletus*) was the target species of métier Gill3 of 100 %. This métier included autumn and winter, with intense fishing activity at 42-49 m depth. The species characteristics of métier Gill4 were atlantic bonito (*S.sarda*), of the métier of 100 %, seabream (*P.pagrus*) and comber (*S.cabrilla*), with a relative contribution to the variance of these two species of around 50 %, with fishing activity at 18-64 m. Métier Gill5 presented one target species saddled seabream (*O.melanura*).

Table 1: Species recorded during the sampling on board (2013-2014), with indication of the fishing gear that caught the species and market price (G: gillnet, T: trammel net, C: combined net).

	Gear				Gear		
PISCES Chondrichthyes				*Sardinella aurita*	G		C
Myliobatis aquila		T		*Scomber colias*	G		C
				Scorpaena elongata		T	
PISCES Ostheichthyes				*Scorpaena porcus*	G	T	C
Belone belone		T		*Serranus cabrilla*	G	T	C
Boops boops	G		C	*Serranus scriba*		T	C
Dentex dentex	G	T		*Siganus luridus*	G	T	
Diplodus annularis			C	*Siganus rivulatus*		T	
Diplodus puntazzo	G	T		*Sparus aurata*	G	T	
Diplodus sargus	G	T		*Sparisoma cretense*	G	T	C
Diplodus vulgaris	G	T		*Spicara maena*	G	T	C
Engraulis encrasicolus	G			*Sphyraena sphyraena*	G		
Epinephelus aeneus		T		*Spondyliosoma catharus*	G	T	
Epinephelus fasciatus		T		*Symphodus ocellatus*		T	
Katsuwonus pelamis		T		*Trachinus draco*	G		
Merluccius merluccius		T		*Uranoscopus scaber*		T	
Mugil cephalus		T					
Mullus barbatus	G	T	C	**CRUSTACEA**			
Mullus surmuletus	G	T	C	*Palinurus elephas*	G	T	
Myliobatis Aquila		T		*Nephrops norvegicus*		T	
Oblada melanura	G	T					
Pagellus acarne	G			**MOLLUSCA Cephalopoda**			
Pagellus erythrinus	G	T	C	*Loligo vulgaris*	G		
Pagrus pagrus	G	T	C	*Octopus vulgaris*	G	T	C
Phycis blennoidae		T		*Sepia officinalis*	G	T	C
Sarda sarda	G						

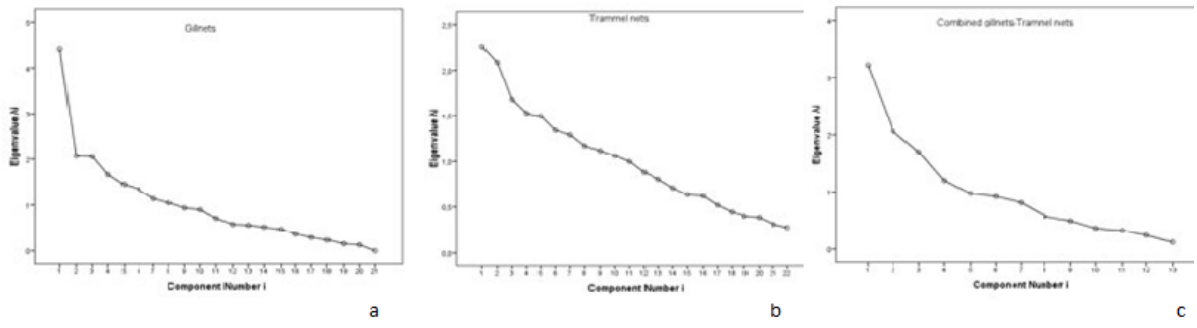

Figure 2: Screen diagrams for the landings profiles data matrices for (a) gillnets, (b) trammel nets, (c) combined gillnets-trammel nets fishing trips.

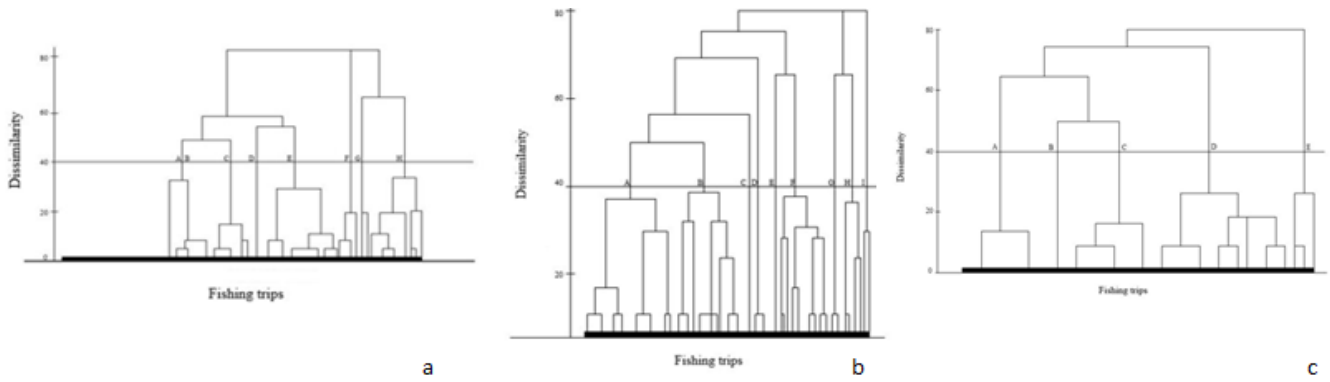

Figure 3: Dendrogram (a) of gillnets fishing trips, 8 clusters (A-H) were intensified (b) of trammel nets fishing trips, 9 clusters (A-I) were intensified and (c) of combined gillnets and trammel nets fishing trips, 5 clusters (A-E) were intensified.

Trammel nets based on the 5 clusters (A, B, D, F, H) led to the identification of 4 métiers (Tr1, Tr2, Tr3, Tr4), representing different average landing profiles (Fig. 4b). The analysis was performed on 81 (87.1 %) fishing operations. The clusters (C, E, G, I) consisted of 12 fishing operations were excluded from the analysis because they consisted of a small percentage. The species characteristics of métier Tr1 were *S.luridis* (100 %) and *S,cretense*, *S.porcus*, *D.dentex*, with a relative contribution to the variance of these three species of 50 %. This métier presented intense fishing effort in the summer at 27-55 m depth. *Sepia officinalis* was the target species of métier Tr2 (100 %), with intense fishing effort in the spring at 18-36.6 m depth. Métier Tr3 with *M.surmuletus* (100 %) intense fishing effort at a depth of 70 m from spring, summer and autumn. Métier Tr4 included two target species *S.porcus* and *S.officinalis*, with a relative contribution to the variance of these two species of around 60 %. This métier presented intense fishing effort in the spring at a depth of 36.6 m.

Table 2: Average landing profiles of the identified clusters within gillnet, with a proportion in landings >10 % (in brackets, the contribution of each cluster, in %, to total data variance within each fishing gear).

Gillnet			
Species	**Cluster**	**Species**	**Cluster**
	A (38.7 %)		F (2.5 %)
B.boops	100	*S.cretense*	100
		S.cabrilla	100
	B (13.5 %)	*B.boops*	50
M.surmuletus	100	*S.porcus*	50
B.boops	50	*M.surmuletus*	50
S.cabrilla	40.9	*M.barbatus*	25
M.barbatus	13.6	*S.officinalis*	25
		O.vulgaris	25
	C (4.3 %)	*D.dentex*	25
O.vulgaris	85.7	*S.luridus*	25
M.surmuletus	85.7		
B.boops	71.4		G (1.2 %)
S.cabrilla	42.9	*S.porcus*	100
S.porcus	28.6	*M.surmuletus*	100
D.vulgaris	28.6	*P.elephas*	100
M.barbatus	14.3	*T.draco*	100
S.aurita	14.3	*S.sphyraena*	100
S.colias	14.3	*S.cabrilla*	50
S.porcus	28.6	*P.erythrinus*	50
		S.officinalis	50
	D (1.2 %)	*D.dentex*	50
S.porcus	100	*S.luridus*	50
S.officunalis	100		
S.luridus	100		H (6.7 %)
D.sargus	100	*O.melanura*	54.5
		S.sarda	45.5
	E (31.9 %)	*B.boops*	27.3
M.barbatus	98.1	*S.porcus*	27.3
S.cabrilla	40.4	*P.pagrus*	27.3
B.boops	34.6	*S.cabrilla*	18.2
S.aurita	15.4	*O.vulgaris*	18.2
P.erythrinus	11.5	*M.surmuletus*	18.2
		D.dentex	18.2

Table 3: Average landing profiles of identified clusters within trammel net, with a proportion in landings >10 % (in brackets, the contribution of each cluster, in %, to total data variance within each fishing gear).

Trammel net			
Species	**Cluster**	**Species**	**Cluster**
	A (33.3 %)		F (15.1 %)
M.surmuletus	67.7	*M.surmuletus*	78.6
S.cabrilla	64.5	*S.cabrilla*	57.1
S.porcus	54.8	*P.erythrinus*	50.0
O.vulgaris	32.3	*S.porcus*	35.7
S.officinalis	29.0	*M.barbatus*	28.6
S,cretense	25.8	*M.merluccius*	28.6
S.luridus	12.9	*Z.faber*	21.4
		S.offricinalis	21.4
	B (25.8 %)	*S.cretense*	14.3
S.porcus	91.7	*O.vulgaris*	14.3
S.officinalis	70.8	*S.scriba*	14.3
S.cabrilla	58.3		
D.dentex	54.2		G (3.2 %)
M.surmuletus	33.3	*M.surmuletus*	100
P.elephas	37.5	*D.vulgaris*	100
S.cretense	20.8	*S.officinalis*	100
P.pagrus	29.2	*S.cabrilla*	100
O.vulgaris	12.5	*D.sargus*	66.7
S.scriba	12.5	*O.vulgaris*	33.3
	C (3.2 %)		H (6.5 %)
M.cephalus	100	*O.melanura*	83.3
S.cabrilla	33.3	*S.porcus*	66.7
S.officinalis	33.3	*S.cretense*	50.0
S.cretense	33.3	*M.surmuletus*	33.3
		O.vulgaris	33.3
	D (6.5 %)	*D.sargus*	33.3
S.rivulatus	100	*Z.faber*	16.7
S.cretense	66.7		
S.porcus	50.0		I (3.2 %)
M.surmuletus	33.3	*S.ocellatus*	100
S.officinalis	33.3	*S.porcus*	66.7
D.dentex	33.3	*S.officinalis*	66.7
		S.scriba	66.7
	E (3.2 %)	*D.dentex*	33.3
N.norvegicus	100	*P.elephas*	33.3
S.porcus	66.7	*P.pagrus*	33.3
M.surmuletus	66.7		
S.officinalis	66.7		
S.cretense	66.7		
D.dentex	33.3		
P.erythrinus	33.3		

Table 4: Average landing profiles of the identified clusters within combined net, with a proportion in landings >10 % (in brackets, the contribution of each cluster, in %, to total data variance within each fishing gear).

Combined net (gillnet-trammel net)			
Species	**Cluster**	**Species**	**Cluster**
	A (22.2 %)		D (41.7 %)
S.officinalis	100	*M.barbatus*	86.7
B.boops	87.5	*S.cabrilla*	80.0
M.surmuletus	50.0	*S.cretense*	80.0
S.cabrilla	37.5	*M.surmuletus*	40.0
O.vulgaris	25.0	*S.aurita*	40.0
S.porcus	25.5	*O.vulgaris*	26.7
M.barbatus	12.5	*B.boops*	20.0
		S.officinalis	13.3
	B (5.6 %)	*S.porcus*	13.3
M.surmuletus	100		
B.boops	100		E (8.3 %)
M.barbatus	100	*M.surmuletus*	100
S.officinalis	100	*S.colias*	100
O.vulgaris	100	*S.cabrilla*	66.7
P.erythrinus	100	*O.vulgaris*	66.7
S.porcus	100	*S.porcus*	66.7
P.pagrus	100	*M.barbatus*	33.3
S.colias	100	*S.cretense*	33.3
S.cabrilla	50.0	*S.officinalis*	33.3
		P.pagrus	33.3
	C (22.2 %)	*S,scriba*	33.3
M.surmuletus	100		
B.boops	100		
M.barbatus	100		
S.officinalis	100		
O.vulgaris	100		
P.erythrinus	100		
S.porcus	100		
P.pagrus	100		
S.cabarilla	50.0		

Combined nets based on the 3 clusters (A, C, D) led to the identification of 2 potential métiers (Comb1, Comb2), representing different average landing profiles (Fig.4c). The analysis was performed on 31 (86.1 %) fishing operations. The clusters (B, E) consisted of 5 fishing operations were excluded from the analysis because they consisted of a small percentage. In this gear, the target species of each métier were identified: red mullet (Mullus

barbatus, métier Comb1), bogue and striped red mullet (Boops boops and Mullus surmuletus). Metier Comb1 presented fishing effort in the autumn and métier Comb2 from autumn and winter.

The main characteristics of the potential métiers are summarized in Table 5.

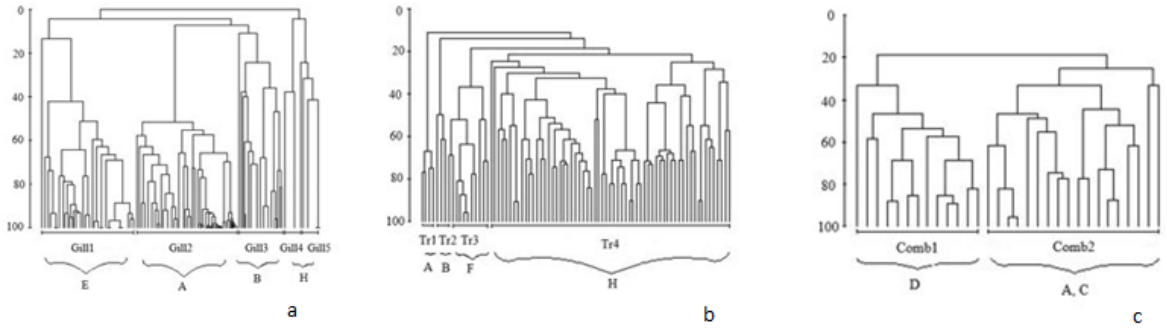

Figure 4: In all, (a) 5 potential métiers (Gill1, Gill2, Gill3, Gill4, Gill5), (b) 4 potential métiers (Tr1, Tr2, Tr3 and Tr4), (c) 2 potential métiers (Comb1, Comb2) were identified representing different landings profiles.

Average métier income (Fig. 5) showed that targeting *B. boops* with gillnets during December-February (Gill2) and *S. porcus* and *S. officinalis* with trammel nets during April-May (Tr4) were high income. *S. sarda* (Gill4) and *O. melanura* (Gill5) with gillnets during October-December and May-June respectively were low-income-high uncertainty métiers. In summer *S. luridus* (Tr1) and *S. officinalis* (Tr2) with trammel nets were low income-high uncertainty métiers. Gillnet métiers (Gill1 and Gill3) were low-income uncertainty métiers. All combined gillnet-trammel net métiers were high income.

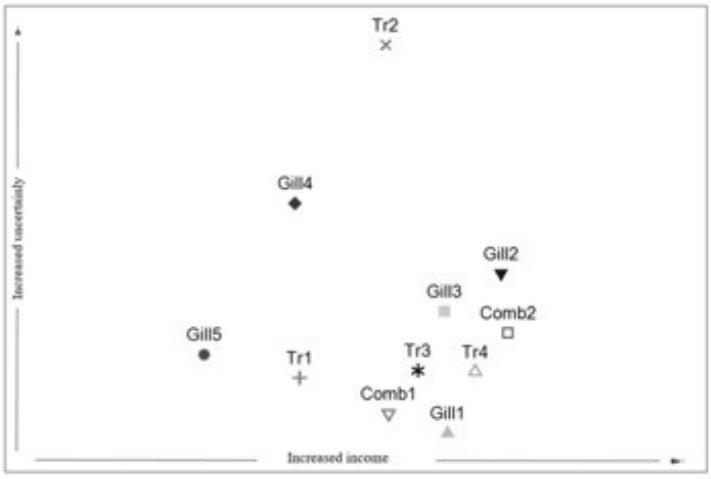

Figure 5. Average value of income (€) per fishing day for the identified métiers.

A lower distance (about 5, Fig. 6) one group (Group 1) and two outlying métiers (Gill2 and Tr4) were identified. Group 1 (Gill1, Gill3, Gill5, Tr1, Tr2, Tr3, Comb1, Comb2) comprised métiers with annual activity and high catch most of them (Comb1, Com2, Gill1, Gill3, Tr3) but relatively low income some of them (Gill1, Gill2, Gill5, Tr1, Tr2). Finally, the métier Gill2 presented high activity in winter and highest income and the métier Tr4 had intense fishing activity in spring and highest income.

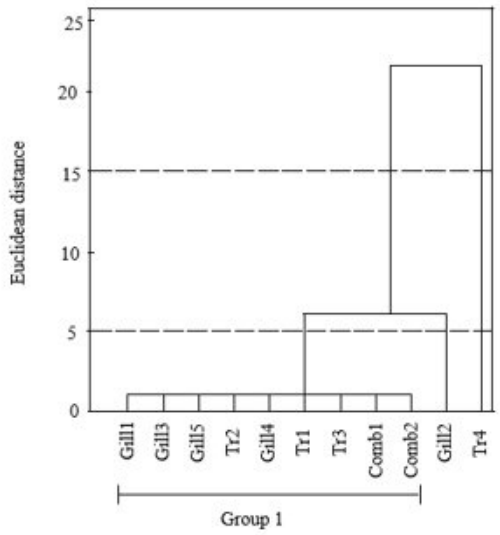

Figure 6. Dendrogram from hierarchical cluster analysis of métiers using catch, income and active months.

Table 5: Potential métiers identified in the island of Kalymnos and their main characteristics (the most important species of each profile are shown emboldened).

Métiers	Number of operations	Mean Species	Percentage of operations by vessel size		Month	Depth		Mesh size (mm)
			<12 m	>12 m	Peak	Range	Peak	Peak
Gill1	35	***M.barbatus (100 %)***	94.3	5.7	July-December	27-84	54-65	18
Gill2	87	***B.boops (98.9 %)***	85.1	14.9	December-February	1.83-91	50-64	26
Gill3	19	***M.surmuletus (100 %)***,	78.9	21.1	October-December	36-91	42-49	18-19
Gill4	2	***S.sarda (100 %)***, *P. pagrus (50 %), S.cabrilla (50 %)*	100	0	February	18-64	18-64	34,36,45
Gill5	5	***O.melanura (100 %)***	100	0	May-June	5-73	5-73	32, 34
Tr1	4	***S. luridus (100 %),*** *S. cretense (50 %), S. porcus (50 %), D. dentex (50 %)*	75	25	August	4-110	27-55	23,24,26
Tr2	3	***S.officinalis (100 %)***	66.7	33.3	April	18-64	18-36.6	24,26,28
Tr3	11	***M. surmuletus (100 %)***	72.7	27.3	April, August-September	18-200	70	24,26
Tr4	63	***S. porcus (69. 8 %)*** ***S. officinalis (66.7 %)***	87.3	12.7	April- May	9-165	36.6	26
Comb1	13	***M. barbatus (100 %)*** *S. cretense (84.6 %)*	100	0	September	15-73	54-66	18,19,24,26,28
Com2	18	***B. boops (88.9 %)*** ***M. surmuletus (72.2 %)***	77.8	22.2	September, January-February	15-91	60-64	24,26

4. Discussion

The small-scale fishery of the Kalymnos Island appeared similar technical characteristics to the other small-scale fisheries in the Mediterranean (Colloca et al., 2004, Tzanatos eta al., 2006, Battaglia et al., 2010, Forcada et al., 2010., Maynou et al., 2011, Leleu et al., 2014, Battaglia et al., 2017). The boats mean size (<10 m), engine power (<45 HP) and tonnage (<10 GRT). In the Kalymnos Island, the fishery identified 11 main métiers using gillnets, trammel nets and and to a lesser extent combined nets. Fishing takes place in multiple fishing grounds close to coast (Colloca et al., 2004, Forcada et al., 2010, Leleu et al., 2014). Metiers are seasonal and catch per fishing trip remains relatively small (less than 50 kg per fishing operation in average with the exception fishing of the species *B.boops*).

Our results show that the small-scale coastal net fishery in the Kalymnos Island practiced 11 clearly métiers in the period February 2013-May 2014. The fishing tactics correspond to gillnets, trammel nets and combined nets. Most métiers are used at species times of the year, with a seasonal rotation dictated by the availability of the target species. The vessels in the fleet comprise the small-scale fisheries generally practice all of the various métier that are traditional in the area, although the some fleet from métiers, which is practiced longer from the harbour, tented to be carried out by larger vessels. The striped red mullet (*Mullus surmuletus*) métier Gill3 practically realized during the same period, as métier Gill2 with target species bogue (*Boops boops*). Regarding our results fisheries choose métier Gill2 that métier Gill3. Métier Gill2 carried out near the harbor while métier Gill3 carried out longer than harbor. However, striped red mullet has low income than bogue. This practice may prove different fishing strategies and fisher preferred the métier which present lower risk (Herrero, 2004). Métier Gill2 uses gillnet, present high-income, although *B.boops* has low market price, fisher targeted in great amount because they want to accept desired profit. This métier (Gill2) coincides with the spawning period of the species (Tsikliras et al., 2010) and combined with the increase fishing pressure, it is possible that has negative consequences in the fish stock.

Maynou et al., (2011) reported that one important métier present in the port of Vilanova (Spain) one targeting *Sepia officinalis* in spring and summer were also present study métier Tr2 with the same gear and period (trammel net, spring) and raised the question of whether these métier is present throughout the Mediterranean. The answer is that the *Sepia officinalis* métier has been identified in several areas in the Mediterranean Sea. For example, *Sepia officinalis* métier present in the Gulf of Patraikos, Greece (Tzanatos et al., 2006) and in several areas of the Spanish coast (Forcada et al., 2010, Martin et al., 2012, Palmer et al., 2017) with the trammel net in winter, spring and summer.

In fact 6 of our 11 métier (Tr3, Tr4, Comb1, Gill1, Gill3, Gil4) are presented in other Mediterranean small-scale fisheries in terms of target species, seasonality and fishing gear. For instance, the métier Tr3 with similar species, seasonality and trammel net fishery as in our study are present in numerous other Mediterranean areas: in the Cilento (South, Italy) artisanal fishery (Colloca et al., 2003), in the Majorca Island trammel net fishery (Merino et al., 2008), in the Alicante Gulf small-scale fishery (Forcada et al., 2010), in the port of Vilanova (Spain) (Maynou et al., 2011), in the Cote Bleue Marine Park (north-western, France) (Leleu et al., 2014) and in the Mallorca (Spain) (Palmer et al., 2017). Likewise, our métier Tr4, which uses trammel net to fish *Scorpaena porcus* is similar to métier in the Majorca Island (Marino et al., 2008), although seasonality may differ slightly, our métier Comb1, which uses combined net (trammel net-gillnet) to fish *Mullus barbatus* was also documented by Colloca et al. (2003) in the Cilento (Italy). Also, our métiers Gill1 and Gill3, which use gillnet to fish *M.barbatus* and *M.surmuletus*, respectively was also documented by Colloca et al. (2003) and our metier Gill4, which uses gillnet with target species *Sarda sarda* has been identified in two areas of the Spanish (Forcada et al., 2010, Martin et al., 2012). Metier Gill2, which uses gillnet, with only target species *B.boops* has not been identified in the other areas in the Mediterranean Sea. This prove that several métiers are extremely localized being present in only a few ports or a single one (Silva et al., 2002). However, other métiers, which target *M.merluccius* is present throughout the Mediterranean (Colloca et al., 2004, Forcada et al., 2010, Tzanatos et al., 2006, Maynou et al., 2011, Martin et al., 2012, Moutopoulos et al., 2014) but not present study.

Métier concurrently reflect the decision of the fisher depend on target species, gear and location at specific tome of the year as a result the catch composition. An important step for understanding the dynamics of small-scale fishery is identification of métiers it provides a synthetic representation of the fishing operations. It is necessary to identify common métiers in Mediterranean small-scale fisheries of different countries facilities monitoring and managing them. From the literature (Garcia –Rodriguez et al., 2006, Maynou et al., 2011) point out that there are some métiers with a clear target species that comprises most of the catch of the fishing trips, such as our métier Gill2, for which 98.9 % of the catch was constituted by the main species (*B.boops*) and métiers Gill1, Gill3, Gill5, Tr2 and Tr3 presented a clear target species (*M.barbatus, M.surmuletus, O.melanura, S.officinalis*).

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