Small-scale fishery of the Eastern Mediterranean Sea: A case study in the Kalymnos Island, Greece

Halkos, George and Roditi, Kyriakoula and Matsiori, Steriani and Vafidis, Dimitrios

Department of Economics, University of Thessaly, Department of Ichthyology Aquatic Environment, University of Thessaly

11 February 2018

Small-scale fishery of the Eastern Mediterranean Sea: A case study in the Kalymnos Island, Greece

Kyriakoula Roditi[1], George Halkos[2], Steriani Matsiori[1], Dimitrios Vafidis[1]

[1] Oceanography Laboratory, Department of Ichthyology & Aquatic Environment, University of Thessaly

[2] Laboratory of Operations Research, Department of Economics, University of Thessaly

Abstract

This study analyzes the small-scale fishery in Kalymnos Island (located in Eastern Mediterranean Sea) to evaluate fishing practices in this fishery. The métiers of this fishery are defined with a multivariate analysis approach for assessing the main fishery resources and fishing gear employed. The empirical findings show that longlines in this fishery practice 10 types of métiers. Some of these métiers, in terms of target species, gear and seasonality are also used in other small-scale Mediterranean fisheries. The main 6 type of métiers with fishing gear: set longlines, drifting longlines, handlines and squid jig-lines with target species *P.pagrus, D.vulgaris, P.erythrinus, S.aurata, X.gladius, O.vulgaris,* and *L.vulgaris*. The seasonal rotation of métiers is determined by the availability of different fish species rather than market price. Identified the métiers provides information for developing monitoring and management strategies for the small-scale fishery. The small-scale fishery constitutes an important social component of local coastal communities.

Keywords: Landing; Small-scale fishery; Multivariate analysis; Métier; Longline.

JEL Codes: Q22, Q20, Q29.

Cite as:

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

1. Introduction

A small-scale fishery is characterized as any small capital investment fishery, operating in small boats, exploiting areas close to the coast and using a large number of gears and practices, targeting a high diversity of species and usually manned by one or two professional fishers (Colloca et al., 2004). Common Fishery Policy (CFP) aims to manage fisheries resources. An important step to protect fishing stocks is to identify characteristics in each fishing practice (Palletier and Ferraris, 2000).

The skipper must choose target species, fishing location, fishing gear before each fishing trip and has to decide according to season of the year, weather and market prices (Salas and Gaertner, 2004). In the literature, these combinations are referred in fishing tactics (Pelletier and Ferraris 2000), métiers (Biseau and Condeaux 1988) or fishing strategies (He et al. 1997). The term métier is used.

Studies carried out in the Mediterranean Sea identified the main métiers and their characteristics for small-scale fishery (Ulrich et al. 2004, Forcada et al., 2010, Martin et al. 2012, Quetglas et al. 2016). Several studies were carried out with aiming to identifying métiers with main gears trammel nets and gillnets (Stergiou et al. 2006, Maynou et al. 2010, Leteu et al. 2014), trawl (Castro et al. 2012, Samy-Kamal et al. 2014) and set longlines (Castro et al. 2011). Tzanatos et al. (2005) identified the most important métiers in Greece and Tzanatos et al. (2006) the main small-scale métiers of the Patraikos Gulf by the five different fishing gear. Characterization of fishing activity was based on daily data from a small-scale fisherman of the Korinthiakos Gulf (gillnets, trammel nets and longlines) (Moutopoulos et al. 2014). Landing profiles and potential métiers with the main gear set longlines, boat seines and otter trawls (Katsanevakis et al. 2009, 2010a, 2010b). For management of small-scale fisheries, it is important to know the fishing tactics and strategies and their impact on fish stocks (Salas et al. 2004).

The aim of this paper is to identify the main longlines fisheries métiers and the economic information practiced in Kalymnos island, one of the most important fisheries

grounds in the Aegean Sea with a very active small-scale coastal fleet of the Eastern Mediterranean Sea.

2. Materials and Methods

2.1. Data collection

The catch was obtained every 15 days of the small-scale fleet (43 boats) for the period from February 2013 to May 2014 (16 complete months) for the port of Kalymnos Island (Figure 1) by interviews during unloading (Leleu et al. 2014, Battaglia et al. 2010, Battaglia et al. 2017). With the exception of 11 boats, recording of fishing operations of fishing logbooks was complicated due to data collection at unloading (Cadiou et al. 2009, Marchal et al. 2008, Deport et al. 2012). Kalymnos Island was chosen because it is a representative port with a large active small-scale coastal fleet. In 2014 this small-scale coastal landing 350 t of fish, crustaceans and cephalopods and 650 t *X.gladius* and 20 t *T.thynnus*. Figure 1 presents the fishing harbour of Kalymnos island in Dodecanese, of Eastern Greece.

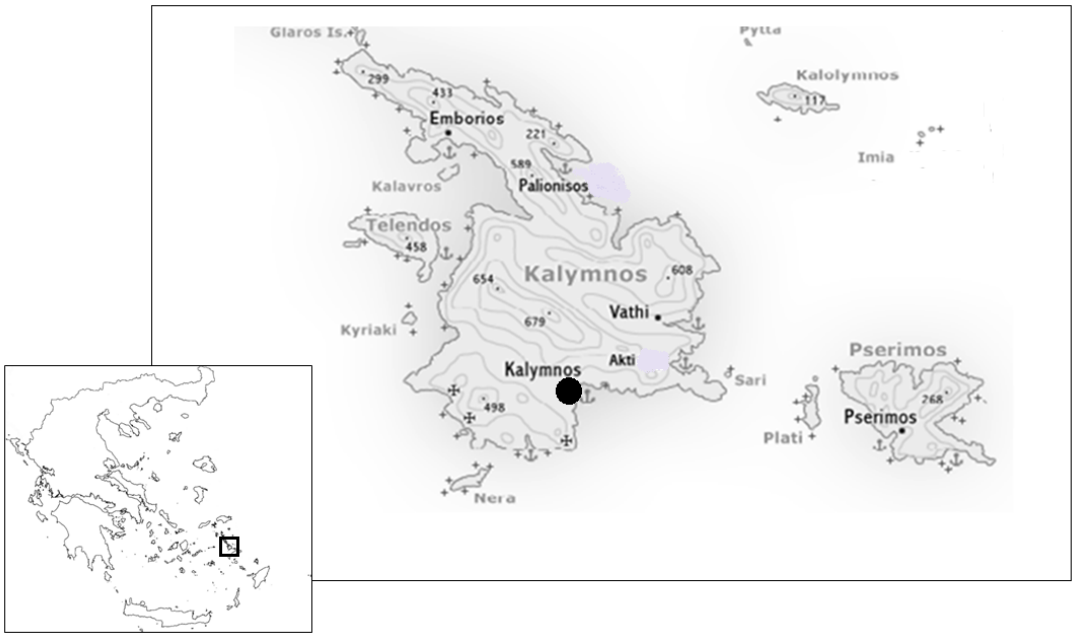

Figure 1: Map of fishing harbor (Kalymnos Island, Dodecanese, Greece, Eastern Mediterranean Sea).

As in other Mediterranean fisheries, the boats in this fleet carry out daily fishing trips of 1 to 22 h and come back to their homeport to sell their catch. The boats with length greater than 12 m undertake fishing trips between 1 and 28 days. Total catches are sold wholesale in the local or abroad markets. Data collection included catch weight (kg), market price (€/kg) by species, type of gear and its technical characteristics (number and size of hooks), characteristics of fishing ground (depth) and number of crew members.

Four types of fishing gears existed in 2013 for vessels in small-scale fleet segment in Kalymnos island: nets (trammel nets, gillnets, combined trammel and gillnets), longlines (set longline, drifting longline, trolling line, handlines and pole-lines and squid hand-jig line), traps (pots) and beach seines. Our paper focuses on the second group (longlines). A total of 781 fishing trips and 812 fishing operations using longlines (with 747 fishing operations used in the final statistical analysis) were collected.

During 2014 we interviewed the skippers of vessels that use longlines. The interview survey consisted of contacting the owner-operator (who in this case was 74.4 % skipper and 25.6 % father or son of the skipper). This face-to-face interview required one to two hours for each fisherman. The aim of the interviews was to complete information on the characteristics of the fishing gear (length-LOA, gross tonnage-GRT, engine power-HP) and the economic parameters of the activity.

2.2. Multivariate analysis

The Principal Component Analysis (PCA) was applied and followed by a Hierarchical Cluster Analysis (HCA) using Euclidean distance and Ward's aggregation method (Palletier and Ferraris, 2000) to classify the catch profiles, identifying groups (cluster) with different strategies with respect to species, season(s), fishing ground (depth), number and size of hooks. From the analysis species targeted in only one or two operations and operations with zero species were excluded. In all fishing operation of a specific gear type the persistent targeting of the same species was a priori considered as forming a distinct métier (Tzanatos et al., 2006). This was the case for drifting longlines, trolling lines, handlines and squid hand-jig line (LLD, LTL, LHP, SLHP).

Groups (clusters) with a small proportion of fishing activities were removed for the fishing gear set longlines. The data set was thus transformed into two matrices with rows fishing days and columns denoting species. 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 and the resulting of the species (Moutopoulos et al., 2014, Garcia-Rodrigues et al., 2006). A 50% level ensured that most important species were actually included in the description of each métier (Silva et al., 2002). We chose a dissimilarity level of 20 % as the cut of value.

In order to identify the main species characterizing each métiers, based on both production and market price value, the similarity percentage analysis (SIMPER) was used to the triangular matrices of the Bray-Curtis similarity index (Stergiou et al., 2003). Hierarchical cluster analysis (Ward's criterion) was applied to categorize métiers with similarity characteristics with grouping based on total number of recorded operation, total catch of these operations, the respective total income and number of months the métiers was active (Tzanatos et al., 2006).

3. Results

Table 1 presents the technical characteristics of small-scale fishing fleets using fishing gears: set longlines, drifting longlines, handlines, squid jig lines and trolling lines in Kalymnos island for the time period February 2013 to May 2014.

Table 1: Technical characteristics of the fleet.

	Number of boats	Mean LOA	Mean HP	Mean GRT
Longlines	43	10.22±4.06 (5.75-23.22)	60.21±92.13 (2.05-450)	10.45±14.64 (0.88-81)

For the fishing trips with main gear set longlines, 11 principal components were retained accounted for 67% of the total variation in the original data. The hierarchical cluster analysis of fishing trips was based on these 11 principal components led to the identification

of 18 clusters (Table 2). Overall, 25 species accounted for the landings with the fishing gear set longlines.

Multivariate analysis showed that for the set longlines fishing of Kalymnos island six metiers appeared (Fig. 2): LLS1, LLS2, LLS3, LLS4, LLS5 and LLS6. In the case of fishing gear, drifting longlines, trolling lines, handlines and squid jig lines due to the president targeting was the same species considered as forming a distinct métiers.

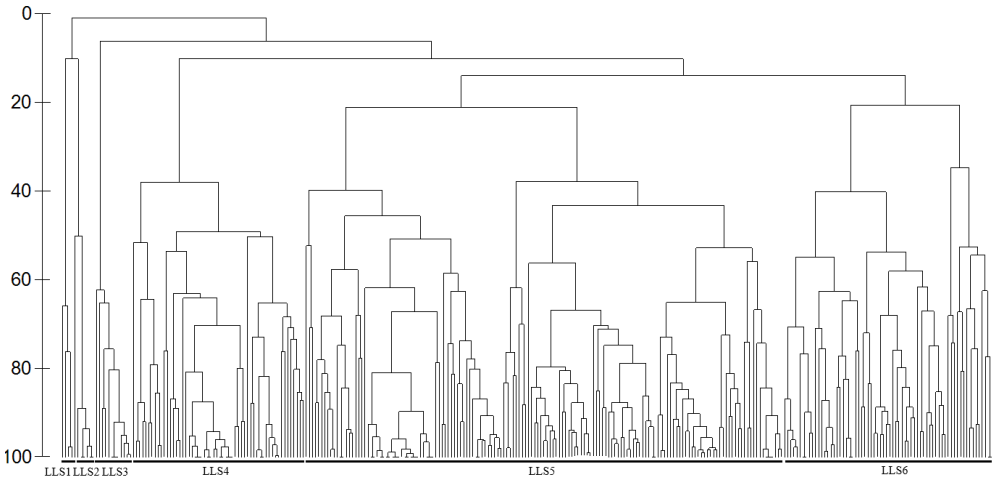

Figure 2: All 6 métiers (LLS1, LLS2, LLS3, LLS4, LLS5, and LLS6) identified

A total of 10 main métier were identified. The métier LLS4 and LLS5 are mainly carried out in spring and in late summer. In early winter, métier LLS6 becomes more important while métiers LLS1 and LLS3 are practiced mainly in the summer. In spring and summer, métier LLS2 appeared as intense fishing activity. Métier LLD is practiced in spring and early summer. In early autumn métier SLHP becomes more important while métier LHP is practiced in late winter and spring. Métier LTL is mainly carried out in late autumn and winter. Métiers LLS3, LL6 and LLD are practiced also by large vessels (>12 m), while the other métiers are practiced only by small vessels (<12 m) (Table 3).

Métiers LLD (*X.gladius*), SLHP (*L.vulgaris*), LHP (*O.vulgaris*), LTL (*S.sarda*) as well defined one single target species. Métier LLS4 target *P.pagrus* and métier LLS5 target *D.vulgaris* were deployed at the same times during the year. Métier LLS6 appeared in two main target species: *P.erythrinus* and *S.aurata* and was carried out with set longlines of different hook sizes (mainly 14). Métier LLS3 catches mainly *P.bogaraveo* using set

longlines. Finally, métier LLS1 target *E.fasciatus* and LLS2 target *D.dentex* using set longlines.

The annual production of each métier and average market price (€/kg) are presented in Figure 3. Average métier income (Figure 4) shows that targeting *X. gladius* with drifting longlines during April-June (LLD), *P. pagrus* during March-May, August (LLS4), *D. vulgaris* and *D. sargus* during May-June, August (LLS5), *P. erythrinus* and *S. aurata* on December (LLS6) with set longlines and *O. vulgaris* during February-May with handlines were high income. L. vulgaris (LHPS) during September-December with squid hand-jig line were large high income. In summer, *E. fasciatus* (LLS1) and *P.bogaraveo* (LLS3) with set longlines were low income-high uncertainty métiers, *D. dentex* (LLS2) during April-July were low income-high uncertainty métier and *S. sarda* during November-January was high income.

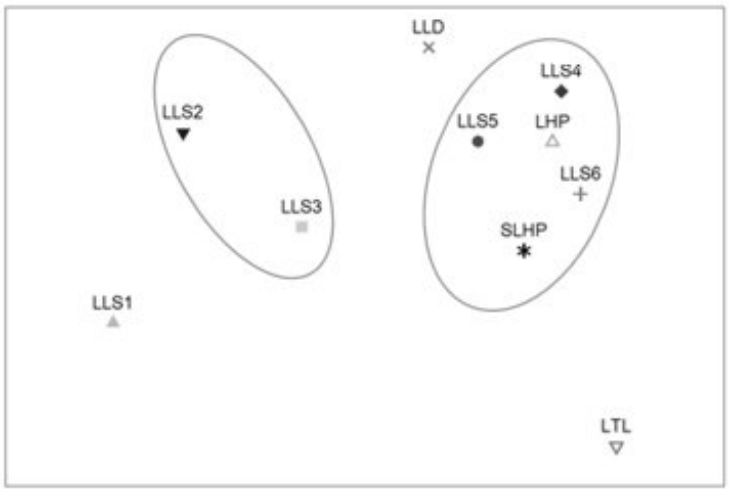

Figure 4: Average value of income (€) per fishing day for the identified métiers.

A lower distance (about 9, Figure 5), two groups (Group 1 and Group 2) and three outlying métiers (LLD, LLS1 and LTL) were identified. Group 1 (LLS4, LLS5, LLS6, LHP, SLHP) comprised métiers with intense fishing activity and high catch and income. Group 2 (LLS2 and LLS3) comprised low catch but high income. The métier LLS1 presented low catch and income while métier LLD comprises very high catch and income and LTL comprised lower catch but high income.

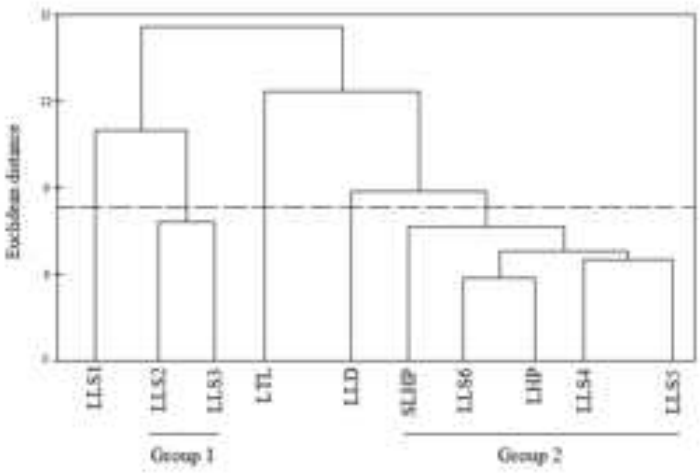

Figure 5: Dentrogram from hierarchical cluster analysis of métiers using catch, income and active months.

The analysis of fishermen's responses to economic questions in the interviews (43 boats) allowed us to understand the economic situation of longlines (Table 4). All vessels carried 1 to 5 people, and the owner-operator was in 74.4% skipper and in 25.6% father or son of the skipper. The crew wage was fount at 58.70±33.22 €/day. Longline income of owner-operator was 1.338±920 €/month. Concerning the variable cost involved, fuel cost was 12.054±17.323 €/year, oil cost 1.427±2.144 €/year and vessel maintenance cost 2.169±2.877 €/year.

Table 4: Economic information of fishers (n=43 respondents) in Kalymnos island with vessels of small-scale using fishing gear (set longlines, drifting longlines, handlines, sqiuid jig-lines, trolling lines).

	Mean per vessel	Range
Capital (boat value, €)	51329±64220	2500-250.000
Crew size	2.7±1.3	1-5
Average number of days at sea	234±50.87	140-340
Fuel cost (€)	12054±17323	900-79920
Lubricant cost (€)	1427±2144	200-13500
Variable cost (€)	7154±4757	300-20000
Vessel maintenance cost (€)	2169±2877	500-15000
Crew wage (per day)	58.70±33.22	20-130
Owner-operator wage (per month)	1338±920	500-5000

4. Discussion

The small-scale fishing fleet in Kalymnos island showed similar characteristics to other small-scale fisheries in the Mediterranean, in terms of technical characteristics (Table 1). For example, Forcada et al. (2010), Battaglia et al. (2010) and Maynou et al. (2011) indicate very similar values of overall length, gross registered tonnage and engine power in the Gulf of Alicante (Spain), Aeolian Island (Italy) and in the port of Vilanova (Spain).

The results of our study show that small-scale coastal longlines fishery in Kalymnos island practiced 10 clearly defined métiers in the period February 2013-May 2014. The métiers mainly match to different types of set longlines (in terms of number and size of hook only) with the use of drifting longlines, trolling lines, handlines and squid hand-jig lines for specific target species (*X.gladius* in the case of drifting longlines, *S.sarda* in the case of trolling lines, *O.vulgaris* in the case of handlines and *L.vulgaris* in the case of squid hand-jig lines).

Most métiers presented intense fishing activity at specific times of the year, with a seasonal rotation dictated by availability of target species. For instance, *P.pagrus* and *D.vulgaris* in spring and in late summer, *P.erythrinus* and *S.aurata* in winter, *X.gladius* in spring, *L.vulgaris* in autumn and *O.vulgaris* in late winter and spring. Small-scale coastal fishing vessels operated near the harbour and vessels less than 12 m, although the drifting longlines métier, which is practiced further from the harbour tented to be carried out by larger vessels (>12 m).

Tzanatos et al. (2006) reported that one important métier was present in the Gulf of Patraikos (Greece, one targeting *Merluccius merluccius*) and it has been identified in several areas of the Spanish cost (Maynou et al. 2011, Castro et al. 2011) but this was not identified in our present study. In fact, 9 of our 10 metiers (LLS1, LLS2, LLS3, LLS4, LLS5, LLS6, LLD, LHP) are well represented in other Mediterranean small-scale fisheries in terms of target species and in some cases seasonality, although the rigging of fishing gear may differ slightly (in case in the métier LHP with target species octopus). For instance, the métier

SLHP with same species and seasonality as in our study are present in other Mediterranean areas like in the Alicante Gulf small-scale fishery (Forcada et al., 2010).

Likewise, our métier LLD using drifting longlines to fish for *X.gladius* is similar to métier in Italy (Colloca et al., 2004, Russo et al., 2016), our métier LLS2 using longlines to fish for D.dentex is similar to métier in the Gulf of Patraikos in Greece (Tzanatos et al., 2006) and our métier LLS3, LLS4, LLS5, LLS6 using Sparidae set longlines were also documented in several areas of Spanish and Italian coasts (Colloca et al. 2003, Garcia-Rodriguez et al. 2006, Forcada et al. 2010). Metier LHP with same species but different fishing gear are present in other Mediterranean areas (Tzanatos et al. 2006, Forcada et al. 2010, Maynou et al. 2011).

Fishers are targeting throughout the year at various stages in life histories of commercial species such as spawning (Stergiou et al. 2006, Tzanatos et al. 2006, Forcada et al. 2010). Some of the identified métiers of our study coincide annually with important period of life history of target species such as the spawning period. Specifically this is the case for species such as *X.gladius, S.aurata, P.pagrus* and *D.dentex*. It is possible that increased fishing pressure as these species during this period might have a negative impact on the stocks. For example, target species *X.gladius* are exploited and this is the reason that Common Fisheries Policy has taken some protective measures.

Our study shows that seasonal rotation of métiers is determined by the availability of different fish species rather than market prices as previously described by Maynou et al. (2010). Fisheries targeted species with a higher market price such as *P.pagrus, S.aurata, P.erythrinus, D.vulgaris, X.gladius* were targeted at the same intensity with species with a lower market price like the target species *O.vulgaris* with a high income from this activity as well. In the three métiers (LLS3, LLS4, LLS6) there was a large amount (kg) of the species *S.cabrilla* which was not a type of target species and has not a commercial value, however, it was available on the local market and contributed to the total income of fisheries.

The empirical findings of our study showed multi-specific nature of small-scale fishery due to the variety of gear involved and seasonality. The findings from similar studies demonstrated the importance of the management of small-scale coastal fishery. These fisheries have historically been a major source of high quality food, employment and economic benefits for the coastal areas (Llorent and Font, 2013).

It is necessary to maintain small-scale coastal fishery, where it is reduced in several areas (Colloca et al. 2004, Maynou et al. 2011, Lloret et al. 2013), as well as taking management measures to protect fish stocks. According to Tsiklira et al. (2013) in the Greek Seas catches of each stock in 2007 led to declines/collapses. Specially, one of the most heavily exploited sub-areas was SE Aegean (in the Dodecanese islands). Guyader et al. (2007) concluded that large-scale and recreational fisheries constituted the main threat to small-scale coastal fisheries, resources and space in Europe. Continuous recording of fish stocks in coastal areas such as the study area is important for maintaining small-scale coastal fishing and protecting fish stock.

Acknowledgements

The authors would like to thank the fishermen of the vessels in Kalymnos for their co-operation and valuable assistance.

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.

Battaglia P., Andaloro F., Consoli P., Peda C., Raicevich S., Spagnolo M., Romeo T. 2017. Baseline data to characterize and mange the small-scale fishery (SSF) of an oncoming Marine Protected Area (Cape Milazzo, Italy) in the western Mediterranean Sea. *Ocean & Coastal Management*. 148:231-244.

Biseau A., Gondeaux E. 1988. Apport des methods d'ordination en typologie des flottilles. J. Cons. Int. Explor. Mer 44:286-296.

Cadiou G., Boudouresque C.F., Bonhomme P., Le Direach, L. 2009. The management of artisanal fishing within the Marine Protected Area (MPA) of the Port-Cros National Park (northwest Mediterranean Sea): a success story? *ICES J. of Mar. Sci*. 66:41-49.

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.

Castro J., Marín M., Pierce G. J., Punzón A. 2011. Identification of metiers of the Spanish set-longline fleet operating in non-Spanish European waters. *Fish. Res*. 107:100–111.

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.

Forcada A., Valle C., Sanchez-Lizaso J. L., Bayle-Sempere J. T., Corsi F. 2010. Structure and spatio-temporal dynamics of artisanal fisheries around a Mediterranean marine protected area. *ICES J. of Mar. Sci.* 67:191–203.

FAO 1980. International Standard Statistical Classification of Fishing Gear (ISSCFG). Coordinating Working Party (CWP)-Report of the 10th Season, Madrid, 22-29 July 1980. FAO Fisheries Report. R242. 65 pp.

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.

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., Vassilopoulou V., Haralabous J. 2010a. Boat seines in Greece: Landings profiles and identification of potential métiers. *ICES J. of Mar. Sci.* 74:65–76.

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

Katsanevakis S., Maravelias C.D., Kell L.T. 2009. Landings profiles and potential

métiers in Greek set longlines. *ICES J. of Mar. Sci*. 67:000-000 doi:10.1093/icesjms/fsp279.

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.

Lloret J., Font, T. 2013. A comparative analysis between recreational and artisanal fisheries in a Mediterranean coastal area. *Fisheries Management and Ecology*. 20:148-160.

Marchal P. 2008. A comparative analysis of métiers and catch profiles for some French demersal and pelagic fleets. *ICES J. Mar. Sci*. 2008; 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., Recasens L., Lombarte A. 2011. Fishing tactics dynamics of a Mediterranean small-scale coastal fishery. *Aquat. Living Resour*. 24:149–159.

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.

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

Quetglas A., Merino G., Ordines F., Guijarro B., Garau A., Antoni M.G., Oliver P., Massutí, E. 2016. Assessment and management of western Mediterranean small-scale fisheries. *Ocean and Coastal Management*. 133:95-104.

Russo T., Carpentieri P., Fiorentino F., Arneri E., Scardi M., Cioffi A., Cataudella S. 2016. Modeling landings profiles of fishing vessels: An application of Self-Organizing Maps to VMS and logbook data. *Fish. Res*. 181:34-47.

Salas S., Gaertner D. 2004. The behavioural dynamics of fishers: management implications. *Fish and Fisheries*. 5:153-167.

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.

Silva L., Gil J., Sobrino I. 2002. Definition of fleet components in the Spanish artisanal fishery of the Gulf of Cadiz(SW Spain ICES division IXa). *Fish. Res*. 59:117–128.

Stergiou I.K., Machias, A., Somarakis S., Kapantagakis A. 2003. Can we define target species in Mediterranean trawl fisheries? *Fish. Res*. 9:431-435.

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., Tsiros Z.V., Stergiou I.K. Assessing the state of Greek marine fisheries resources. *Fish. Manag. And Eco*. 20:34-41.

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.

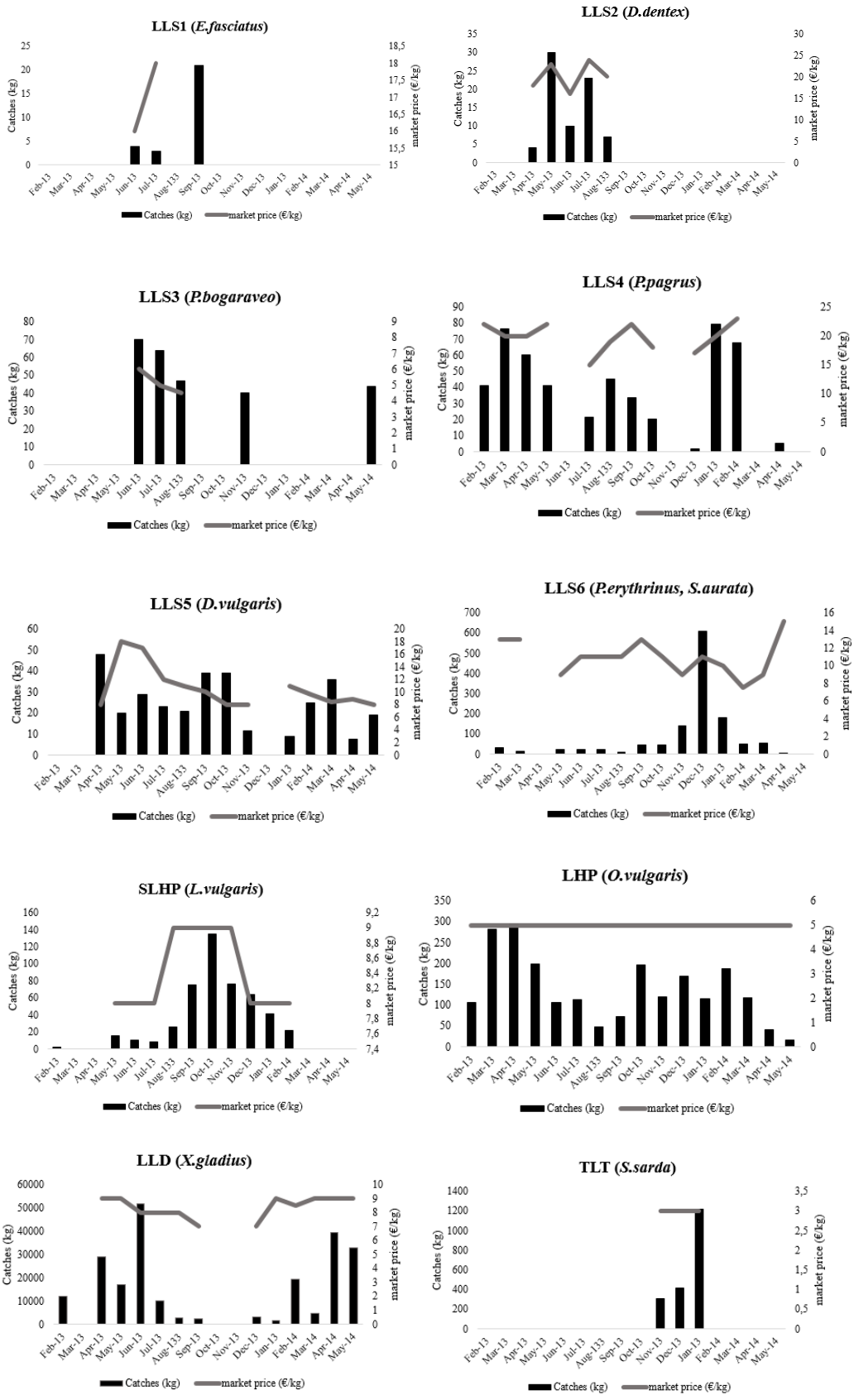

Figure 3: Bars represent the total annual catch (kg) for each target species of each metier and lines represent the average market price (€/kg) of the target species for each metier.

Table 2: Average landing profiles of the 18 clusters identified in fishing trips with set longlines, given as proportion (%) of landings of each species to the total landings of each cluster

	Landings profile																		
Taxon	A	B	C	**D**	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Total
P. erythrinus	**96.3**	**24.4**	**58.3**	**23.1**	0.0	**47.4**	**97.7**	0.0	0.0	**32.5**	7.5	**25.0**	0.0	**25.0**	57.1	**37.5**	**25.0**	0.0	39.7
D. sargus	**100**	**97.6**	**33.3**	**61.5**	**66.7**	0.0	4.5	**30.8**	**85.7**	**25.0**	9.4	0.0	**100**	0.0	28.6	0.0	0.0	0.0	35.4
P.pagrus	3.7	**26.8**	8.3	**46.2**	**33.3**	**31.6**	0.0	**92.3**	0.0	8.8	**84.9**	**37.5**	**50.0**	**25.0**	28.6	**50.0**	**25.0**	**100**	30.3
D.vulgaris	**100**	**97.6**	**41.7**	**92.3**	**66.7**	0.0	0.0	**30.8**	**28.6**	2.5	5.7	0.0	**25.0**	0.0	57.1	0.0	0.0	0.0	29.1
S.aurata	3.7	**56.1**	**33.3**	**23.1**	**33.3**	5.3	**15.9**	0.0	**71.4**	**62.5**	1.9	**12.5**	**25.0**	0.0	28.6	0.0	**25.0**	0.0	28.9
S.cabrilla	**33.3**	0.0	**25.0**	**7.7**	**33.3**	**21.1**	**97.7**	**23.1**	**14.3**	6.3	**26.4**	**12.5**	**50.0**	0.0	57.1	**87.5**	0.0	0.0	28.3
O.vulgaris	**11.1**	0.0	**16.7**	**0.0**	0.0	5.3	**47.7**	0.0	0.0	2.5	7.5	0.0	0.0	0.0	28.6	**37.5**	0.0	0.0	10.9
D.macrophthalmus	0.0	0.0	0.0	**0.0**	0.0	**100**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**75.0**	0.0	6.3
D.dentex	0.0	0.0	8.3	**0.0**	**33.3**	0.0	0.0	0.0	0.0	0.0	**26.4**	**12.5**	0.0	0.0	14.3	0.0	0.0	**100**	6.0
C.conger	0.0	0.0	**16.7**	**100**	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	**25.0**	0.0	14.3	0.0	0.0	0.0	5.1
S.cantharus	0.0	0.0	0.0	**7.7**	0.0	0.0	0.0	**100**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**25.0**	0.0	0.0	4.6
E.fasciatus	0.0	0.0	**100**	**0.0**	**33.3**	0.0	0.0	0.0	0.0	0.0	0.0	**25.0**	0.0	0.0	0.0	0.0	0.0	0.0	4.3
M.helena	0.0	0.0	0.0	**30.8**	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	**25.0**	**25.0**	0.0	0.0	0.0	**66.7**	3.7
M.aquila	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	2.0
O.melanura	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**100**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
S.porcus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**62.5**	**50.0**	0.0	2.0
Z.faber	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**37.5**	**100**	0.0	2.0
M.mustelus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**75.0**	0.0	0.0	0.0	0.0	0.0	0.0	1.7
P.elephas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	**100**	1.1
S.scriba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**100**	0.0	0.0	0.0	0.0	0.0	1.1
K.pelamis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**100**	0.0	0.0	0.0	0.0	1.1
S.maximus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.9	0.0	0.0	0.0	0.9
E.maginatus	0.0	0.0	0.0	0.0	**100**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
S.scrofa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**100**	0.9
E.aeneus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**37.5**	0.0	0.0	0.0	0.0	0.0	0.0	0.9

The most important species of each profile (with a proportion in landings>10 %) are shown emboldened.

Table 3: Métiers identified in the island of Kalymnos and their main characteristics.

				Fishing period (month)													Depth (m)		Percentage of operations by vessel size		Hook size (number)		Number of hooks	
Cluster /Metier	**Number of Operations**	**Main species**	**Other species**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Fishing gear (FAO code)**	**Range**	**Mean**	**<12 m**	**>12 m**	**Range**	**Peak**	**Range**	**Mean**
LLS1	5	*E.fasciatus*	*D.dentex*													Set longlines (09.3.0) (LLS)	65-72	69.40±2.6	100	-	4 8-9	4	600	600
LLS2	7	*D.dentex*	*M.helena*													Set longlines (09.3.0) (LLS)	17-120	60.85±39.03	100	-	8 10	10	300-600	471±125
LLS3	12	*P.bogaraveo*	*P.erythrinus* *S.cabrilla*													Set longlines (09.3.0) (LLS)	90	90	91.7	8.3	14	14	1000-4500	1591±937
LLS4	70	*P.pagrus*	*D.vulgaris* *S.aurata* *P.erythrinus* *S.cantharus* *S.cabrilla*													Set longlines (09.3.0) (LLS)	10-128	81.62±34.98	100	-	9 14	13 14	300-2000	1090±437
LLS5	**108**	***D.vulgaris***	***D.sargus*** ***P.eryhtrinus*** ***S.aurata*** ***P.pagrus*** ***C.conger***													Set longlines (09.3.0) (LLS)	5.5-85	38.09±20.84	100	-	11 13-14	14	250-2500	1286±590
LLS6	**100**	***P.erythrinus*** ***S.aurata***	***P.pagrus*** ***O.vulgaris*** ***S.cabrilla***													Set longlines (09.3.0) (LLS)	9-320	67.09±33.20	90	10	7-8 11 13-14	14	350-5000	1499±869
LLD	**187**	***X.gladius***														Drifting longline (09.4.0) (LLD)	18-2000	473±765	13.7	86.3	2-4 6-7	2 3	400-2800	883±302
SLHP	61	*L.vulgaris*														Squid jig hook (09.1.0) (LHP)	18-79	64.32±11.89	100	-	-	-	-	-
LHP	181	*O.vulgaris*														Handlines (09.1.0) (LHP)	2-73	30.29±17.92	100	-	-	-	-	-
LTL	16	*S.sarda*														Trolling line (09.6.0) (LTL)	2.5-128	65.32±49.19	100	-	-	-	-	-

The season (no shading, without use, light grey shading, least use, dark grey shading, moderate use, black shading, intensive use), fishing gear (FAO code, 1980).