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PORTRAYING TRAWL FISHERY IN ALBANIAN WATERS: CASE STUDY FROM THE SARANDË AREA (SOUTHERN ALBANIA)

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ABSTRACT

The current study provides valuable insight into the trawl fishery operating in southern Albanian waters via an integrated approach based on high-frequency onboard monitoring trawl vessels and on-site interviews with local fishers. Multivariate analyses of the composition of species landings or economic revenue revealed groups that, depending on the group, were distinguished by improved fisheries landings and economic efficiency. The majority of the catch consisted of a variety of demersal and small- and medium-sized pelagic species, confirming the Adriatic Sea's multispecies nature. Target species identified in terms of catches and revenue imply a systematic tactic over a long period of time, and incidental catches are equally important in terms of overall group similarity. The identification of target species groups may be useful in assessing the current sampling stratification schemes.

How to Cite

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INTRODUCTION

The FAO Code of Conduct for Responsible Fisheries promotes biodiversity maintenance, safeguarding, and conservation by minimizing the impact of fisheries on both target and non-target species, as well as the ecosystem as a whole (FAO, 2019). Fisheries landings statistics serve as the starting point for the recording of the impact of fishing on ecosystems because fisheries status concerns are currently the most prominent ones (for reviews, Froese et al., 2012; Pauly and Froese, 2012). The validity of each country's fisheries landings data has a significant impact on the accuracy and potential differences of fisheries statistics (Garibaldi, 2012), which can lead to incorrect conclusions about the health of fishery ecosystems (de Mutsert et al., 2008). This is especially important in the Mediterranean, because its fisheries are characterized by multi-species nature, which is increasing the complexity of fishing effects on ecosystems and the *bias* in the reporting of reliable fisheries data from official authorities (Moutopoulos and Koutsikopoulos, 2014).

Albanian fisheries are mainly marine, contributing about 2/3 of total catches (Spaho et al., 1997) within its Exclusive Economic Zone, where there is an extensive easy-to-trawl shelf in the north and deep waters with a rocky seabed in the south. The fishing fleet consists mainly of bottom trawlers, which contribute approximately 23.0% (110 out of 480 fishing vessels) (FAO, 2022) and 94.6% of the total Albanian fishing fleet and landings (Institute of Statistics, INSTAT, 2019: http://www.instat.gov.al/) (Bakiu and Gurma, 2018), whereas the remaining part is covered by other forms of large-scale and small-scale fishery, respectively (Bakiu et al., 2018, 2022a). Although the information on trawl fisheries has so far been carried out in North and Central Adriatic waters (Carpi et al., 2017; FAO, 2018), this is not the case for Albanian waters. Likewise, even though passive fishing gear has been extensively studied in Albanian waters (lagoon fishery: Peja et al., 2006; small-scale fishery: Bakiu et al., 2018, 20022a,b), this is not the case for dynamic fisheries such as the trawl fishery. A regional fisheries management program known as FAO-AdriaMed has been carried out in Albanian waters for two years, including the monitoring of commercial species catch, with trawl vessel owners reporting landed catches to the fishery inspectorate on a regular and obligatory basis. However, the *bias* of reporting data in quantity and species specificity remains high. Concerning by-catch, since 2018 GFCM has been implementing a discards monitoring program through the Albanian Ministry of Agriculture and Rural Development. In 2021, the monitoring programme was carried out in the four largest ports (Durrs, Vlora, Shngjin, and Saranda) in accordance with the GFCM methodology, both onboard bottom trawler vessels and at landing sites, for a total of 75 observations (SRC-AS, 2022). Thus, there is a need to narrow the gap of knowledge regarding the diversification of multi-gear in data-poor fisheries areas such as the Albanian trawl fisheries.

The aim of the present study is to make a contribution to the knowledge of the state and dynamics of the Albanian trawl fishery, using catch and fishing effort data collected *via* monitoring onboard trawl fishing vessels operating in the Sarandë region from January 2016 to March 2017. In parallel, the knowledge of local fishers was supplementary used through on-the-spot interviews of all trawl fishers hosted in the Sarandë region in order to provide insights into the corresponding fishery. Target and incidental species caught by trawl fishery in Albanian waters were estimated based on the application of multivariate analysis of species landings and economic data. In multi-species fisheries, such as the studied ones, multivariate analysis has been successfully used to identify commercial fisheries assemblages, fishing *métiers* and fishing strategies, using both experimental and commercial catches, of industrial fisheries in various areas of the world's oceans (e.g. Celtic Sea: Moore et al., 2019; North Sea: Deponte et al., 2012; West Mediterranean Sea: Maynou et al., 2011; East Mediterranean Sea: Stergiou et al., 2003). Clusters identified by multivariate analyses consisted of groups with similar operational and fisheries characteristics and thus these groups can be seen as part of fishing tactics. This is because fishers generally target either the most abundant species at a fishing ground or the most commercially important species (trawl fisheries: Stergiou et al., 2003; small-scale fisheries: Moutopoulos et al., 2014).

MATERIALS AND METHODS

Data sampling

The Sarandë region (Fig. 1) covers a coastline approximately 20 km long and 5 km wide, and hosts 13 trawl fishing vessels (thereafter OTB), representing 8.3% of OTB numbers in Albanian waters and 22% in southern Albania in 2016 (Bakiu and Gurma, 2018). Monthly in-situ samplings were conducted on 5 of 13 OTB vessels hosted in the port of Saranda (weather conditions permitting) from January 2016 till March 2017. The technical characteristics of each trawl vessel used for the samplings and the number of in-situ surveys are presented in Table 1. All OTB vessels hosted in the study area had similar technical features to those of the surveyed vessels (local fishery inspectorate, pers. comm.).

All fishing operations were performed close to the Bay of Saranda (Manastir, Kakome, Qefal, Lukov, Borsh) at depths of up to 300 m (Fig. 1). The fishing grounds were selected by the fishers in traditional areas in order to ensure the highest possible catches, and that fishing was as similar as possible to the traditional fishing activities employed in each site. One to three scientists accompanied the professional fishers in order to separate the catches and record the required information. After hauling, the catch was sorted by commercial category and taxonomic level, and the number of specimens and total weight per species were recorded. Fish market prices were also obtained

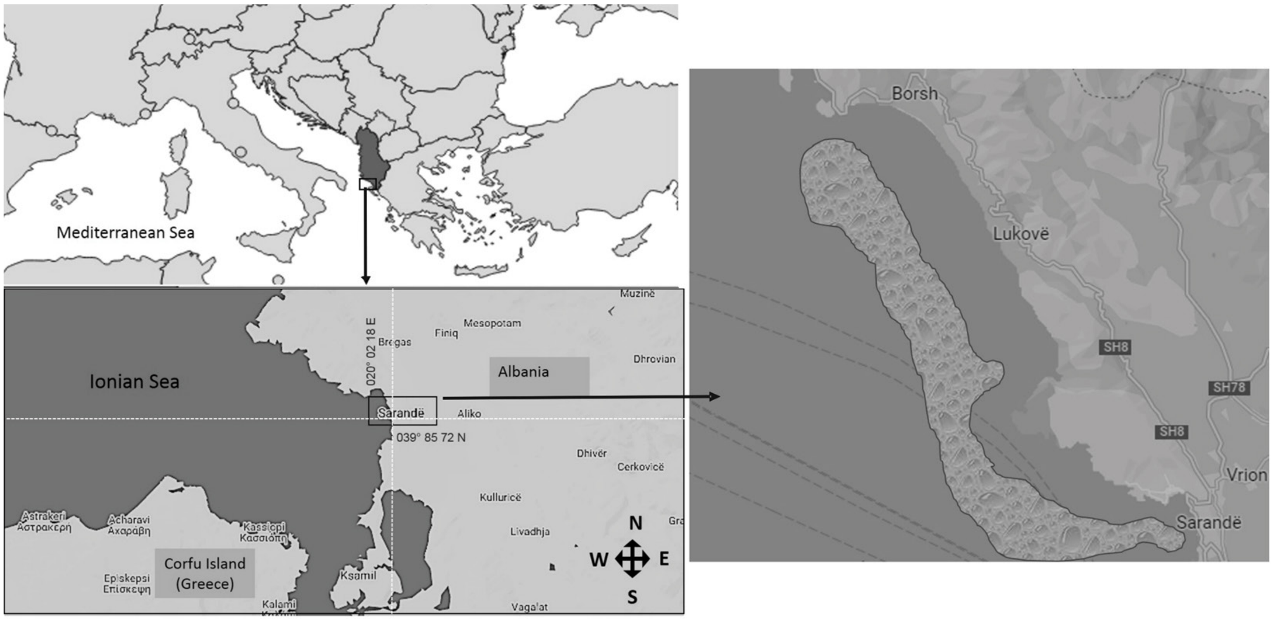


Fig 1. The location of Saranda in Albania; on the right side, trawl vessels fishing in fishing areas between Sarande and Himare, similarly to the description provided by Bakiu et al. (2022)

Table 1. Vessel characteristics, gear specifications and operational information of the trawl fishery conducted for the samplings in southern Albanian waters during 2016-2017

Vessel name	Trawler net length (m)	Trawler net height (m) (m) (m)	Boat lenght (m)	Engine power (HP)	Fishing depth (m)	Total fishing time (hours)
AKUARIO	60	1800	21.5	270	70-300	6
ALQIVJADHI	50	1400	16.0	375	50-300	4-8
BORESI	50	1500	16.0	415	65-350	6-8
MARIO	60	2000	23.0	260	70-300	6-8
PIERO AMATO	50	1800	16.0	240	50-300	6-8

from local wholesalers and prices were expressed as average annual prices for each species.

On-the-spot interviews were conducted with all trawl fishers (n=13) hosted in the Sarandë region from April to mid-May 2019. Before the interviews, informative talks were given to entice the trawl fishers to cooperate. Interviews were conducted in private, one-on-one, to avoid being influenced by the presence or interference of other colleagues. To stimulate fishers' perceptions and minimize any potential *bias*, all interviews were conducted by the same person, ensuring that questions were presented in the same way and answered freely without prompting or influence. The questionnaire consisted of three different parts facilitating the quantification of the results and the investigation of the relations between different factors and the attitude: (a) fisher's profile, (b) dependence on fisheries (fishing intensity and frequency) and (c) personal views on fisheries management and problems encountered.

Data analyses

Overall 68 onboard samplings, that were relative to a fishing trip, were described by 12 variables in a matrix of 426 lines, and 12 columns were constructed. The variables were vessel name, date, trawl net length and height, mesh size of the net, vessel length and engine power (in horsepower), fishing depth, time, species caught per kg and economic value. Values per kg for all species caught were taken from Sarandë fish stores. Taking into account that vessel characteristics (i.e. vessel length and engine power) and gear specifications (i.e. trawl net length and height, and mesh size used) are constant for each fishing vessel, therefore, fishing tactics were determined by the combination of fishing vessel and date. Each element of such a set corresponds to a tactic given to a multi-species composition. Following a similar method proposed by Stergiou et al. (2003), the target and incidental catch of species by the trawl fishery can be defined for most of a cluster similarity within a group of fishing operations estimated by the species composition of both catches and fish values per fishing trial. This is because fishers, in order to attain economic gains, generally operate in hot spots of target species and thus high catch rates of these species were expected in the majority of different fishing operations. Thus, fishers target either the most abundant species or the species providing a satisfactory combination of landings per market value. The advantage of this method, when compared with other methods (Principal Component Analysis, Principal Coordination Analysis), is that it is based on subjective criteria (Bisaeu, 1998; Deponte et al., 2012).

A cluster analysis was used on two matrices (rows X columns): species landings X sampling trial and species landings ∗ price/kg X sampling trials. Prior to the multivariate analyses, the species contributing 95% to the total catch and value per fishing trials were used in the analyses, and thus the reduction in the dataset to only these key species was performed (Deponte et al., 2012). Species catch and value composition matrices were both square-root transformed in order to reduce the weighting of abundant or valuable species (Field et al., 1982) by retaining as many species as possible to maintain the multi-species features of the Mediterranean trawl fishery. Then, the matrices were both converted into triangular matrices of similarities using the Bray-Curtis coefficient (Bray and Curtis, 1957) and were subjected to a group-average linking method. Differences between the identified groups formed by the cluster analysis and those based on centroid distances between groups were tested with the non-parametric PERMANOVA test (Anderson et al., 2008). Pair-wise comparisons were computed when significant differences ($P < 0.05$) among factor levels were detected. SIMPROF was also used to test whether each cluster is unique or not from its surrounding clusters (Anderson et al., 2008). The contribution of each species to the average Bray-Curtis similarity within the aforementioned groups was also identified using SIMPER analysis (Clarke and Gorley, 2006). All the above-mentioned multivariate analyses were performed using PRIMER ver 1.0.6 & PERMANOVA+ (Anderson et al., 2008). The average proportion of species in each fishing tactic (cluster) was computed. With respect to the interview data, descriptive statistics (i.e. estimation of means and standard deviations) and frequency of occurrence (%) were applied to all statements.

RESULTS

Overall landings and species caught

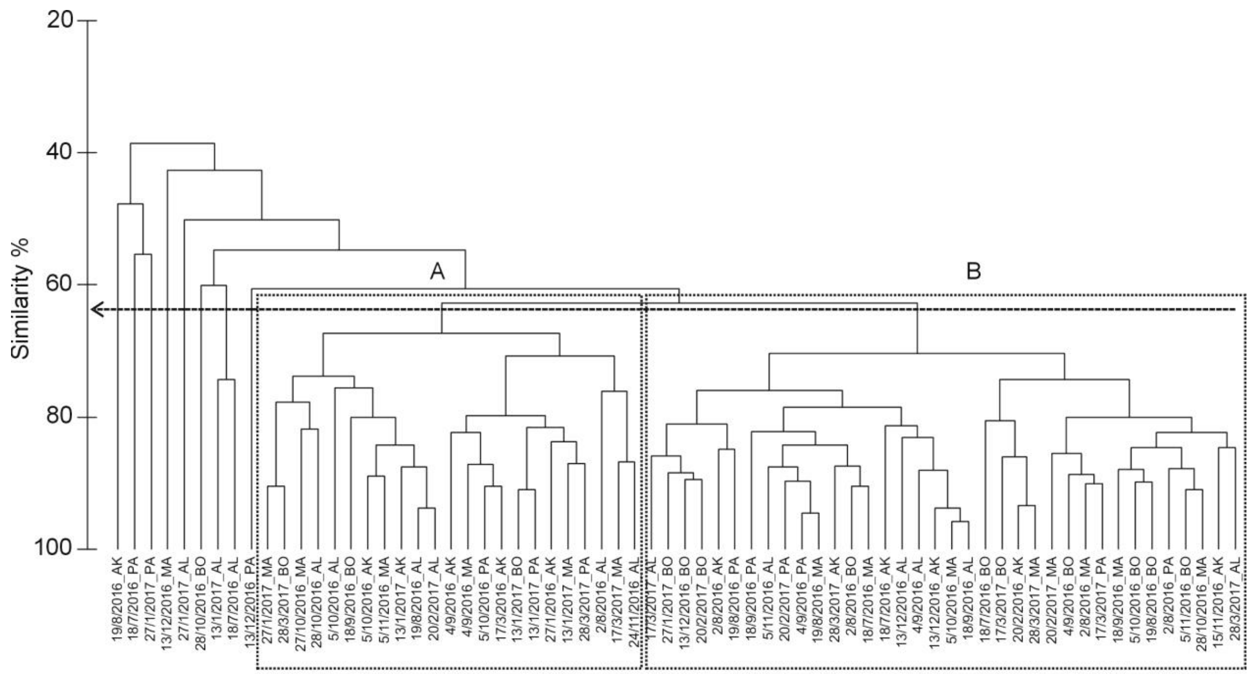
From five trawlers, overall 3417 kg of specimens were recorded, belonging to 20 species (15 fish species, 2 crustacean species and 3 cephalopod species) (Table 2). Fishes accounted for the major part of the catch and catch revenue, contributing to half of the total trawl catches (50.0%) and revenue (56.4%), followed by crustaceans (31.2% and 23.1%, respectively) and cephalopods (18.8% and 20.5%, respectively). Twenty species were recorded with the number of species caught per trial ranging from 3 to 14 (Table 2). The daily number of species, which accounted for up to 80% of the corresponding catches, ranged between one (in one case) and four (in 9 cases) species. Six species accounted for ¾ of the total recorded catch (75.4%) (Table 2). *Parapenaeus longirostris* (31.0%) and, to a lesser extent, *Merluccius merluccius* (14.9%) and *Loligo vulgaris* (11.5%) highly contributed to the above-estimated catches, followed by *Mullus surmuletus*, *Octopus vulgaris* and *Sardina pilchardus* that cumulatively contributed 18% of the total catch. Similarly, six species contributed almost a similar percentage of the catch landings to the total catch revenue with *P. longirostris* (21.5%), *Loligo vulgaris* (14.3%) and *M. merluccius* (13.8%) contributing highly to total revenue, whereas *M. surmuletus* (7.9%) and *Zeus faber* (6.7%) followed to a lesser extent (Table 2).

Table 2. Total catch (C, in kg), mean annual values (V, in lek), mean annual catch and value composition (C% and V%, respectively) of the species caught by trawls in southern Albanian waters during 2016-2017

Species catch%	C	C%	V	V%
Dentex dentex	94	3.0	10.8	5.8
Dicentrarchus labrax	3.5	0.1	10.5	0.2
Diplodus puntazzo	4	0.1	8.3	0.2
Epinephelus nei	52.5	1.7	10.8	3.3
Homarus gammarus	7	0.2	45.7	1.9
Loligo vulgaris	393	12.4	7.3	16.4
Merluccius merluccius	510.5	16.4	5.4	15.9
Mullus surmuletus	202	6.4	7.8	9.1
Octopus vulgaris	199	6.3	5.1	5.9
Parapenaeus longirostris	1060	33.6	4.0	24.6
Sardina pilchardus	213	6.8	0.8	1.0
Scomber scombrus	68	2.2	0.8	0.3
Scorpaena scrofa	9	0.3	2.4	0.1
Sepia officinalis	36	1.1	6.0	1.3
Solea solea	21	0.7	4.8	0.6
Sparus aurata	22	0.7	10.5	1.3
Trigla lyra	101.5	3.2	7.3	4.3
Zeus faber	151	4.8	8.9	7.8
Total	**3417**		**19891.9**	

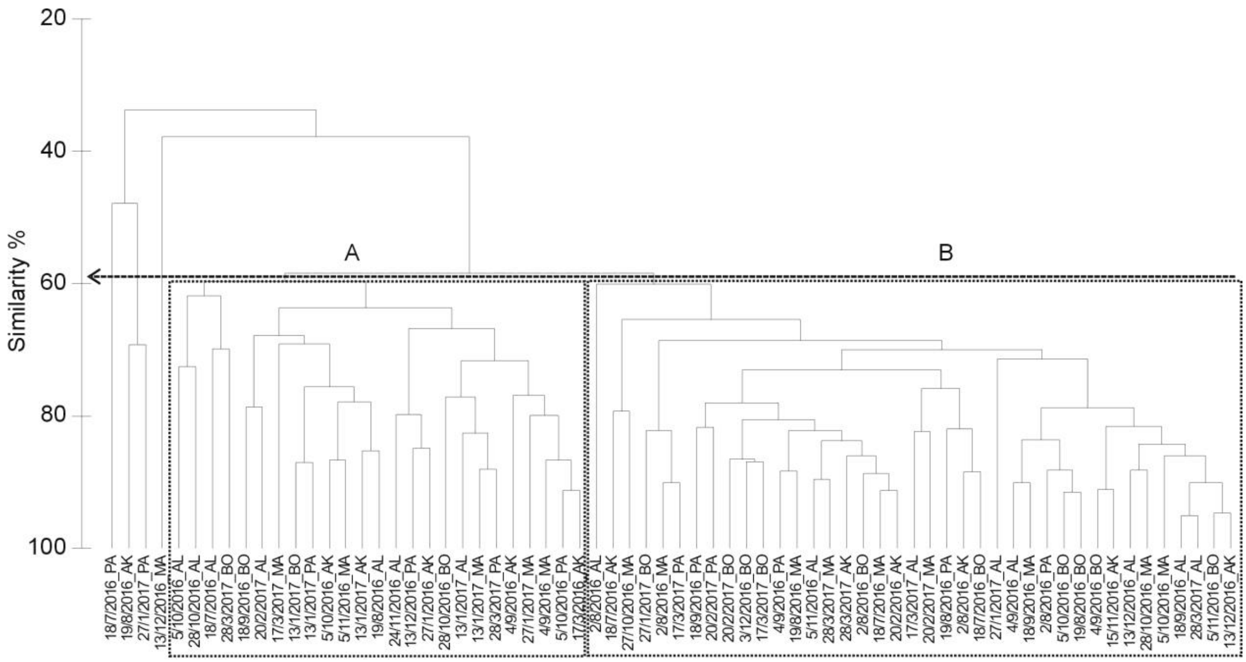
Target species identification

The classification of the matrices applied to the species and value compositions per fishing trials indicated that, at the 62.8% and 58.5% similarity levels, respectively, sampling trials (PERMANOVA test: pseudo F-ratio > 54.3; $P < 0.05$) grouped into two large groups of trials (Figs. 2 and 3, respectively). SIMPROF test revealed that the corresponding groups were significantly unique from their surrounding clusters. In the analyses, the species contributing 95.0% to the total catch and value per fishing trial were used. Group A consisted of 25 and 24 fishing trials, group B consisted of 35 and 40 fishing trials, and the outliers consisted of eight and four, respectively. The outliers were represented by one fishing trial per fishing vessel and thus indicated a unique case. Both groups A and B had significantly lower catches and economic revenue when compared to the corresponding groups which came from outlier fishing trials (see Figs. 2 and 3). The composition of catches and values, as well as the species contributing to the Bray-Curtis similarity within the identified groups, are shown in Figures 2 and 3. The species that contributed most to the Bray-Curtis similarity within groups A and B, in terms of both catch and value ratios, were listed in decreasing order of importance, *P. longirostris*, *M. merluccius* and *M. surmuletus*.



Species	A (70.78%)			B (74.76%)			Outliers (37.90%)		
	Av. Ab.	Comp%	Contr%	Av. Ab.	Comp%	Cum%	Av. Ab.	Comp%	Cum%
Dentex dentex	1.37	4.30	3.47	1.00	2.71	1.68	1.12	0.93	2.00
Loligo vulgaris	0.29	1.94	0.06	4.37	**19.89**	**22.34**	1.31	3.98	3.00
Merluccius merluccius	4.62	**22.00**	**26.19**	3.86	**14.50**	**19.72**	3.41	7.24	**32.17**
Mullus surmuletus	2.85	8.71	**16.64**	2.46	**5.85**	**11.94**	2.16	2.59	20.03
Octopus vulgaris	2.25	9.58	6.27	1.26	4.61	2.10	1.96	3.98	9.50
Parapenaeus longirostris	6.13	**37.76**	**36.05**	5.95	**35.80**	**31.74**	3.10	11.69	**21.51**
Sardina pilchardus		1.61		1.83	**8.94**	**4.08**	2.02	5.71	7.69
Scomber scombrus				0.33	0.92	0.18	0.94	6.91	0.91
Trigla lyra	1.57	4.68	4.44	1.17	3.23	2.52		0.27	0.00
Zeus faber		0.11					1.74	19.92	2.29
Other species	2.17	9.31	6.88	1.42	3.55	3.70	0.56	36.79	0.89
Mean catch per trial	**6.45**			**7.61**			**16.37**		
SD catch per trial		**5.45**			**6.38**			**26.94**	

Fig 2. Dendrogram for group-average clustering based on Bray-Curtis similarities between catch ratios (in kg) per sampling trials (square root transformation) for all species caught by trawls during 2016-2017. The table indicates the contribution of each species to the average Bray-Curtis similarity (Av. Ab.) within groups (shown with capital letters), the composition of catches to total within this group (Comp%) and the percentage contribution to the Bray-Curtis similarity of groups (Contr%). Values in bold indicate the most important species in each case.



Species	A (70.78%)			B (74.76%)			Outliers (37.90%)		
	Av. Ab.	Comp%	Contr%	Av. Ab.	Comp%	Cum%	Av. Ab.	Comp%	Cum%
Dentex dentex	2.18	8.15	6.16		4.94	0.00			
Epinephelus nei	1.15	5.09	1.98	0.75	2.37	0.79		1.00	
Homarus gammarus	0.62	2.60	0.34	0.38	1.79	0.16			
Loligo vulgaris				4.80	**27.22**	**25.62**	1.15	4.09	3.72
Merluccius merluccius	4.61	**20.84**	**28.33**	3.87	**14.71**	**21.36**	1.93	**5.51**	**22.82**
Mullus surmuletus	3.30	**11.97**	**20.39**	3.06	**8.61**	**16.60**	1.30	2.86	**17.08**
Octopus vulgaris	2.32	**8.61**	**7.32**	1.25	4.44	2.35	1.22	2.88	10.39
Parapenaeus longirostris	5.09	**26.81**	**29.52**	4.98	**27.22**	**27.98**	2.30	**6.67**	**27.84**
Trigla lyra	1.62	5.98	4.28		4.42	0.00		0.27	
Zeus faber		0.17				0.00	3.80	**25.00**	**12.99**
Other species	1.18	9.79	1.68	1.73	4.28	5.15	0.87	51.72	5.16
Mean value per trial	**33.37**			**41.24**			**178.30**		
SD value per trial		**20.26**			**29.76**			**309.40**	

Fig 3. Dendrogram for group-average clustering based on Bray-Curtis similarities between catch value ratios (in euro/kg) per sampling trials (square root transformation) for all species caught by trawls during 2016-2017. The table indicates the contribution of each species to the average Bray-Curtis similarity (Av. Ab.) within groups (shown with capital letters), the composition of catch values to total revenue within this group (Comp%) and the percentage contribution to the Bray-Curtis similarity of groups (Contr%). Values in bold indicate the most important species in each case.

These three species accounted for more than 55% of the total catches and values in almost 90% of the trawl fishing trials (fishing trials in groups A and B) in southern Albanian waters.

Apart from those target species, other important species for group A in terms of catches and values were *O. vulgaris* and *D. dentex*, respectively. For group B, in terms of catches, *L. vulgaris* was the target species, whereas in terms of values *O. vulgaris* and *D. dentex* were the most commercially important species. For the outliers, *O. vulgaris* and *S. pilchardus* were the most important species in terms of catches, whereas *Z. faber* and *O. vulgaris* were the most commercially important species. More than 64% of the fishing trials for both groups A and B were conducted in deeper fishing grounds, when compared with the corresponding trials of the outliers (64% vs, 27%), whereas the inverse was true for shallow waters where fishing trials for the outliers were mostly conducted (73% vs. 36%, respectively). All identified groups exhibited a clear seasonality of the total catch and value composition (Fig. 4): (a) group A indicated higher catches and economic revenue during August-November and January-March, (b)

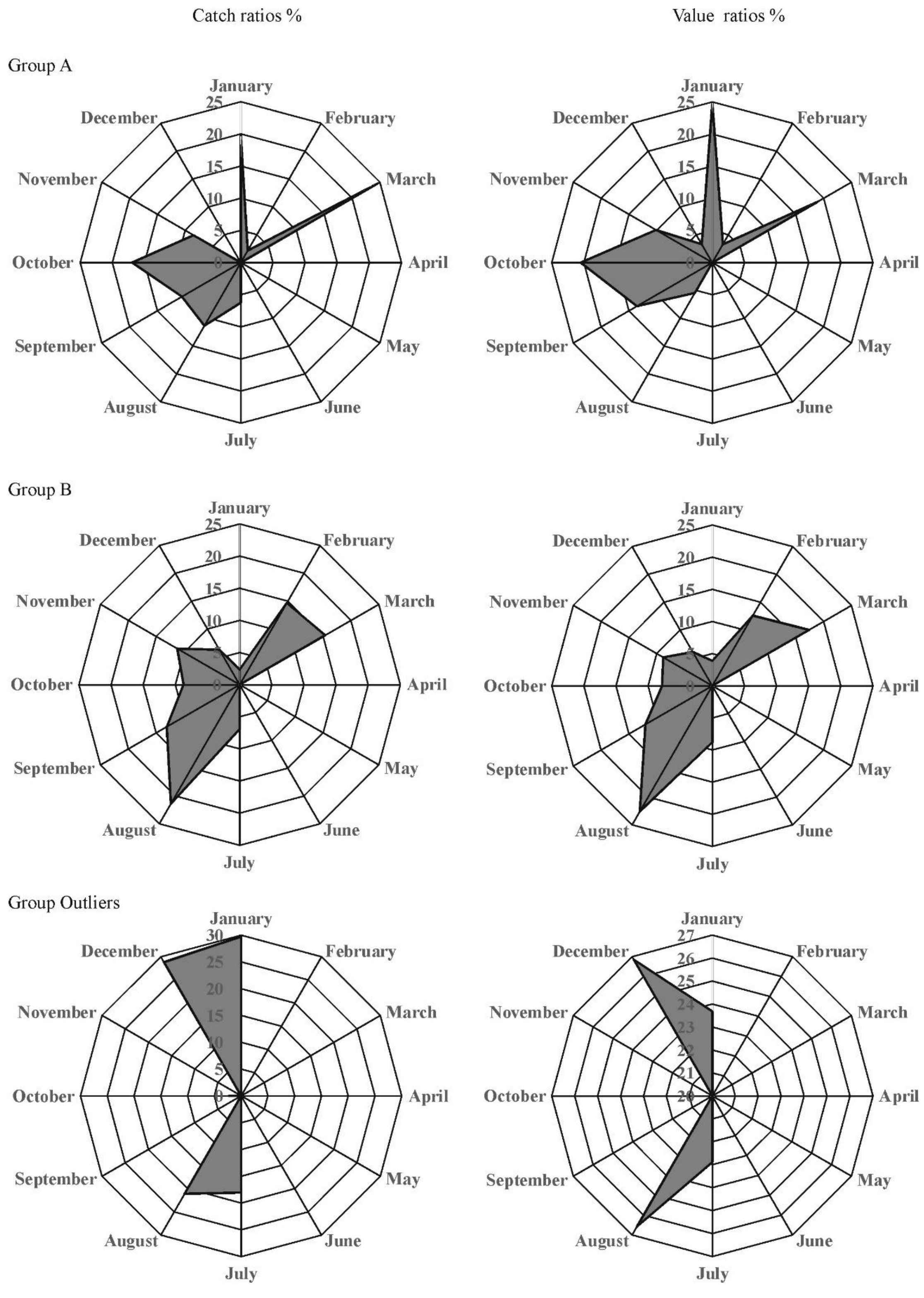


Fig 4. Monthly catch (in kg) and value (in euro/kg) distribution for all species caught by trawls during 2016-2017.

group B showed higher corresponding estimates during August-November and February-March, and (c) outlier fishing trials during July-August and December-January.

Interviews

Almost half of the trawl fishers in the Sarandë region (46.2%) stated that they had another profession besides fishing, whereas a great number had an elementary education (84.6%). Trawl fishery is characterized by the absence of seasonality in the fishing activity, averaging from 15.4 (November) to 17.5 (June) days at sea per month (Fig. 5a), and between 180 and 240 fishing days annually, depending on each fisher. Regarding the economic cost of fishing, the vast majority of fishers (93.3%) stated that they have a daily wage, with personnel costs depending on profits (100%).

Fishers considered, at a higher percentage, illegal fishing with unauthorized gear as the most critical issue (first choice: 38.5%), followed by the revision of the fisheries legislation (first choice: 23.1%) and the Regulation on fisheries landings (first choice: 23.1%) (Fig. 5b). Although the problem of illegal fishing was more pronounced among the fishers, half of them (53.9%) considered the intensification of patrolling as an important solution to illegal fishing. The majority of the trawl fishers (> 83.3%) stated that in the next years they did not plan to retire, modernize or sell their vessel and stop fishing, whereas a great number of fishers (83.3%) intended more likely to replace their vessels and continue fishing (Fig. 5c). All the fishers interviewed considered that there was strong competition with other fishery compartments for space, fishery resources and economic value.

DISCUSSION

In the present study, an integrated approach was carried out in southern Albanian waters based on sampling onboard trawl vessels and on-site interviews with the corresponding fishers. Multivariate analyses based on the combination of two types of fishery-related data, such as species catch and value ratios, revealed that in multispecies trawl fishery, such as in the present study (14 species contributed up to 98% of the total catch and value data), the target species can be defined as the species belonging to a large part of cluster groups (groups A and B each comprised more than 94% of the total fishing trials) of both catches and values (Bisaeu, 1998; Stergiou et al., 2003). The differentiation in species composition *per* fishing trial might be attributed to the combined effect of the following factors: (a) seasonal variability, (b) spatiotemporal prohibitions of the fishing activities and (c) market effect. The major part of the catch was represented by a variety of demersal and small- and medium-sized pelagic species that are in agreement with the corresponding species catch composition reported by FAO (Moutopoulos et al., 2015). *P. longirostris*, *M. merluccius* and *M. surmuletus* make up the main part of the trawl catch. *P. longirostris* and *M. merluccius* were also the main trawl *métiers* found in the Greek Ionian Sea, while *L. vulgaris* and *O. vulgaris* were found only in corresponding métiers in the northern Greek Ionian Sea (Katsanevakis et al., 2010). Considering that fishing operations were conducted by fishers following traditional practices in traditional fishing grounds, we considered groupings as indications of fishing strategies, i.e. combinations of depths and seasons, adopted by fishers in order to take advantage of seasonal migrations and availability of the most important target species in each area. It also seemed that the vessel size was independent of the fishing strategy, mostly due to the small size of the fleet (16-23 m). Hence, the identified *métier* was identified by the combination of month, species value and catch.

A fisher can switch between alternative tactics during short-term periods while seeking to maximize profit based on prior experience in order to take advantage of the availability of the target species in accordance with market demands (Salas et al., 2004). For instance, trawl fishers from the fishing port of Shengjin or Durres fish in the Seman Delta or close to the peninsula of Karaburun (all areas well-known for their richness in fish biodiversity and abundance among fishers). The outlier fishing trials (Figs 2 and 3), which exhibited the highest catch and economic revenue of the trawl fishery, when compared with its most common fishing tactics (groups A and B), implied an opportunistic tactic during a short-term period. A similar tactic has been also observed in Greek (Tzanatos et al., 2006; Korinthiakos Gulf: Moutopoulos et al., 2014) and in Albanian (Bakiu et al., 2022) small-scale fishery. This is because fishers adopt a "higher income-higher risk" approach by targeting species of high commercial value (Table in Fig. 2: *Zeus faber* and *Dentex dentex*), which are 20% higher in average fish prices, during a period when demand for that fish species is high due to tourism (Fig. 4: August and December). Such tactics proved to be quite efficient in terms of daily income and might imply net economic gains for fishers, but at the same time seemed to increase the risk, as indicated by the higher variability in both catch and economic revenue (SD estimates in the tables of Figs. 2 and 3). In contrast, groups A and B ensured low but persistent production and income over the long term (Salas et al., 2004), which is likely beneficial for fishers to balance their daily expenses.

Incidental catch of species contributed 31% and 37% to the total catch and value of the trawl fisheries. In southern Albanian waters, similarly to other areas in the Eastern Mediterranean, incidental catch in trawl fisheries is of equal importance in terms of overall group similarity and catch per sampling trials, and so in catch values (Stergiou et al., 2003; Katsanevakis et al., 2010). Incidental, non-targeted species are represented by pelagic fish species, which further contributed to the catches (incidentally caught species), especially in the outlier fishing trials since some that were occasionally caught (i.e. *S. pilchardus*, *Solea solea*, *Trigla lyra*, *Scomber scombrus*) ensured

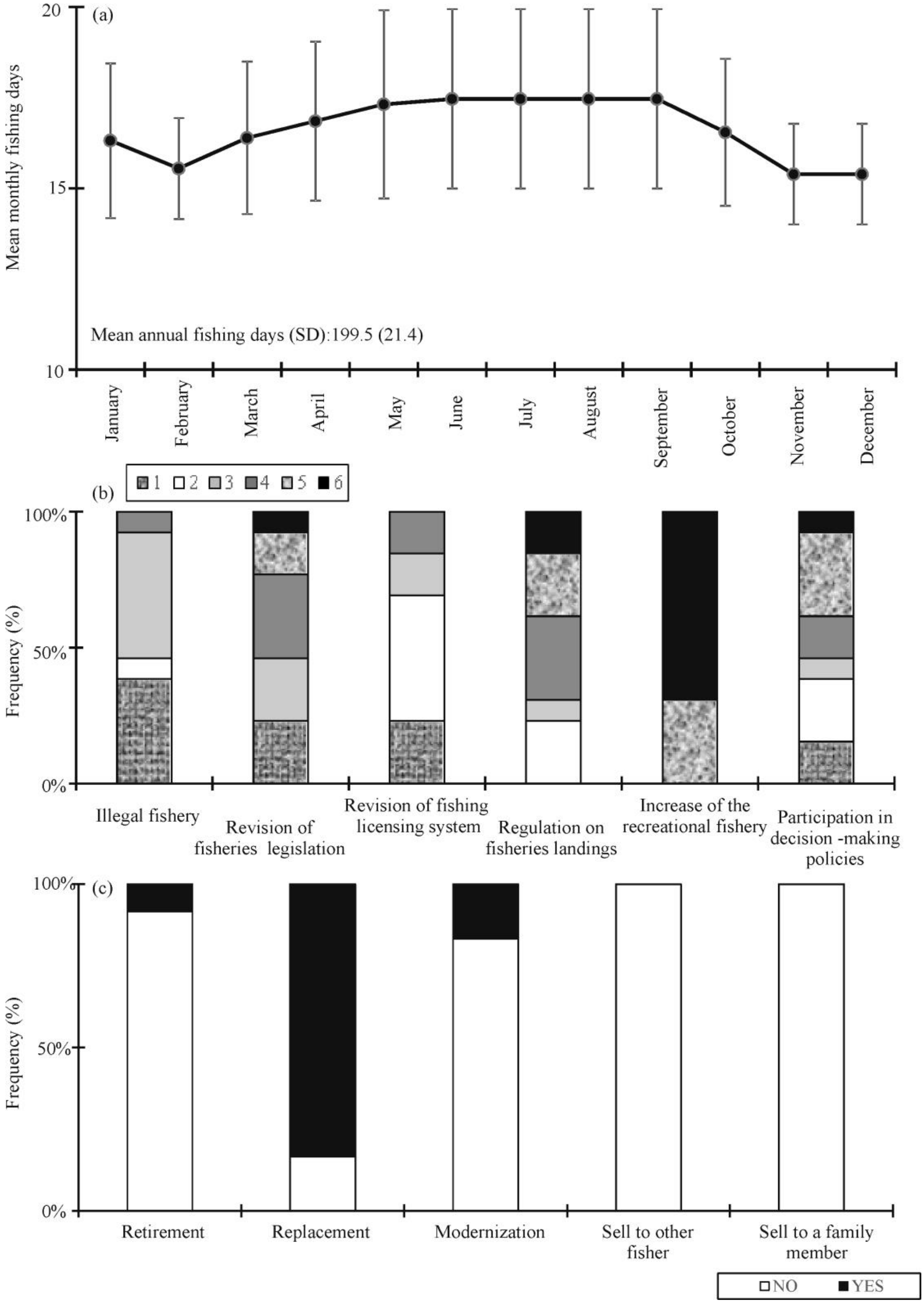


Fig 5. Interview results on the: (a) mean annual and monthly fishing days per area of the trawl fisheries in south Albanian waters, (b) frequency perception (%) on the most common problems encountered by the fishers (1 being the first choice), and (c) frequency perception (%) of the future intentions of the fishers in the next years.

additional income to the fishers apart from the targeted species.

The majority of the fishing trials (more than 60%) were conducted at depths greater than 100 m, which are inhabited by most of the species. Trawlers are not allowed to fish within three nautical miles off the coast, and at depths greater than 1,000 meters. The results from the interviews reveal that trawl fishers operate at sea for at least half of each month (mean days at sea on a monthly basis: 16.6 days (SD: 2.2)), indicating that fishing grounds are subjected to fishing all year round, thus allowing no spatial and/or temporal refuge for the different stocks analysed. This is in accordance with the fishing operations in the Adriatic Sea where most fishing grounds can be reached within a few hours from the home harbor (Bastardie et al., 2017). The problem gets aggravated when taking into account that several species are constantly present in the fishing grounds, albeit in lower abundance than the target species, resulting in an increased diversity of landings. Taking into account that the species exploited in the study area have different life history characteristics and range in size from a few cm (e.g. *S. pilchardus*) to over 1 m (e.g. *Epinephelus* spp.), any technical measure implemented may be optimal for some species but completely ineffective for others (e.g. Stergiou et al., 2009).

Fisheries management must shift toward other ecosystem-based approaches, such as marine protected areas, which provide refuge in space rather than in numbers and mitigate the various effects of overfishing, growth, and recruitment (Jennings et al., 2001). A critical problem encountered by trawl fishers, according to their statements, is the intensive illegal fishery conducted both by professional and unlicensed fishers, which was mostly attributed to insufficient patrolling. Control systems could be refined through the ecosystem services provided by professional fishers who could be prompted to establish an auto-control (Agnew et al., 2009) by contributing their professional knowledge and experience to effective management measures (Zaucha et al., 2016). The fact that all trawl fishers have declared their intention to continue fishing by replacing their fishing vessel highlights the need for a long-term strategy for the trawl fisheries sector to ensure the sustainability of Albanian fisheries resources.

CONCLUSION

The identification of different *metiers* in the Albanian trawl fishery could reduce the complexity of the Mediterranean fishery compartmentalization. This would enhance scientific results and weaken management decisions. Quantifying fishing pressure based on fishing activities could be a useful application for data-poor and multi-gear fisheries areas in order to implement an efficient control system for better management plan implementation and sustainability (Moutopoulos et al., 2020). The present study aims to improve and simplify the monitoring of fisheries data through an updated data collection methodology. In fact, fisheries monitoring based on identifiable fishing strategies (Tserpes et al., 2006), as well as the use of complementary relative measures, such as the use of proportions of each species in the landings *per* fishing gear instead of absolute landings and the estimation of the discarded quantities, could reduce data uncertainty. In addition, the collaboration among the independent organisations responsible for collecting fisheries data could lead to further improvements by complying with the standards issued under the Data Collection Framework.

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PRIKAZ RIBOLOVA KOČOM U ALBANSKIM VODAMA: STUDIJA SLUČAJA IZ PODRUČJA SARANDË (JUŽNA ALBANIJA)

SAŽETAK

Ova studija pruža vrijedan uvid u ribolov kočama koji se odvija u vodama južne Albanije putem integriranog pristupa koji se temelji na visokofrekventnom nadzoru kočarskog broda i intervjuima s lokalnim ribarima. Multivarijantne analize sastava iskrcajnih vrsta ili ekonomskog prihoda skupina utvrdile su da su se grupe razlikovale ovisno o poboljšanom iskrcaju u ribolovu i gospodarskoj učinkovitosti. Većinu ulova činile su razne pridnene te male i srednje velike pelagične vrste, što potvrđuje multispecijsku prirodu Jadranskog mora. Ciljne vrste identificirane u smislu ulova i prihoda podrazumijevaju sustavnu taktiku tijekom dugog vremenskog razdoblja, a slučajni ulovi jednako su važni u smislu ukupne sličnosti skupine. Identifikacija ciljnih skupina vrsta može biti korisna u procjeni trenutnih shema stratifikacije uzorkovanja.

Ključne riječi: ciljne vrste, ribolov više vrsta, slučajni ulov, ekonomske vrijednosti

REFERENCES

Anderson, M. J., Gorley, R. N., Clarke, K. R. (2008): PERMANOVA+ for PRIMER: Guide to Software and Statistical Methods. PRIMER-E: Plymouth, UK.

Bakiu, R., Cakalli, M., Korro, K., Di Franco, A. and Guidetti, P. (2018): Small-Scale Fisheries at an Albanian Marine Protected Area: A Collaborative Attitude is Associated with Higher Catches. Mar Coast Fish, 10: 527-535. https://doi.org/10.1002/mcf2.10036

Peja, N., Vaso, A., Miho, A., Rakaj, N., Crivelli, A.J. (1996): Characteristics of Albanian lagoons and their fisheries,
Fisheries Research, Volume 27, Issue 4, (1996): Pages 215-225, ISSN 0165-7836, https://doi.org/10.1016/0165-7836(95)00467-X.

Bakiu, R., Beqiri, K., Konomi, A., Ziou, A., Moutopoulos, D. K. (2022b):Fisheries assessment of the Albanian lagoon fisheries. Fisheries & Aquatic Life, 30(2), 74-84. https://doi.org/10.2478/aopf-2022-0007

Bakiu, R., Cakalli, M., Korro, K., Di Franco, A., Guidetti, P. (2018): Small-Scale Fisheries at an Albanian Marine Protected Area: A Collaborative Attitude is Associated with Higher Catches. Marine and Coastal Fisheries, 10, 527-535. https://doi.org/10.1002/mcf2.10036

Bakiu, R., Gurma, M. (2018): Characterization of small-scale and large-scale fisheries in Saranda (South Albania, Ionian Sea). J. Black Sea/Mediterranean Environment, 24(3), 212-223.

Bakiu, R., Moutopoulos, D. K., Gurma, M., Çakalli, M. (2022a): Typology of the Albanian small-scale fisheries. Croatian Journal of Fisheries 80(1), 26-37. https://doi.org/10.2478/cjf-2022-0004

Bisaeu, A. (1998): Definition of a directed fishing effort in a mixed-species trawl fishery, and its impact on stock assessment. Aquatic Living Resources, 11(3), 119-136. https://doi.org/10.1016/S0990-7440(98)80109-5

Bastardie, F., Angelini, S., Bolognini, L., Fuga, F., Manfredi, M. (2017): Spatial planning for fisheries in the Northern Adriatic: working towards viable and sustainable fishing. Ecosphere, 8(2), e01696. https://doi.org/10.1002/ecs2.1696

Bray, J. R., Curtis, J. T. (1957): An ordination of the upland forest communities of southern Wisconsin. Ecological Monography, 27, 325-349.

Carpi, P., Scarcella, G., Cardinale, M. (2017): The Saga of the Management of Fisheries in the Adriatic Sea: History, Flaws, Difficulties, and Successes toward the Application of the Common Fisheries Policy in the Mediterranean. Frontiers in Marince Science, 22. https://doi.org/10.3389/fmars.2017.00423

Clarke, K., Gorley, R. N. (2006): Primer v6: User Manual/ Tutorial.

de Mutsert, K., Cowan, J. H. Jr, Essington, T. E., Hilborn, R. (2008): Reanalyses of Gulf of Mexico fisheries data: landings can be misleading in assessments of fisheries and fisheries ecosystems. Proceedings of the National Academy of Sciences of the United States of America, 105(7), 2740-2744. https://doi.org/10.1073/pnas.0704354105

Deponte, N., Urlich, C., Mahévas, S., Demanénce, S., Bastardie, F. (2012): Regional me ´tier definition: a comparative investigation of statistical methods using a workflow applied to international otter trawl fisheries in the North Sea. ICES Journal of Marine Science, 69(2), 331-342. https://doi.org/10.1093/icesjms/fsr197

FAO. (2022): The State of Mediterranean and Black Sea Fisheries (2022): General Fisheries Commission for the Mediterranean. Rome. https://doi.org/10.4060/cc3370en

FAO. (2021): Report of the 5th meeting of the Subregional Committee for the Adriatic Sea (SRC-AS):of the GFCM Scientific Advisory Committee on Fisheries. Online, 17 – 20 May 2022 - DRAFT REPORT https://gfcm.sharepoint.com/EG/Report%20v2/Forms/AllItems.aspx?id=%2FEG%2FReport%20v2%2F2021%2FSRC%2DAS%2FGFC2FGFCM%5FSRC%2DAS%5F2021%55FReport%2Epdf&parent=%2FEG%2FReport%20v2%2F2021%2FSRC%2DAS&p=true&ga=1

FAO. (2019): Monitoring the incidental catch of vulnerable species in Mediterranean and Black Sea fisheries: Methodology for data collection. FAO Fisheries and Aquaculture Technical Paper No. 640. Rome, FAO. ISBN 978-92-5-131548-4

FAO. (2018): The State of Mediterranean and Black Sea Fisheries. General Fisheries Commission for the Mediterranean. Rome. 172 pp. Licence: CC BY-NC-SA 3.0 IGO. https://medblueconomyplatform.org/wp-content/uploads/2020/08/file-library-bfdf6a4ee58db4935e2a.pdf

Field, J. G., Clark, K. R., Warwick, R. M. (1982): A practical strategy for analysing multispecies distribution patterns. Marine Ecology Progress Series, 8, 37-52.

Froese, R., Zeller, D., Kleisner, K., Pauly, D. (2012):What catch data can tell us about the status of global fisheries. Marine Biology, 159(6), 1283-1292. https://doi.org/10.1007/s00227-012-1909-6

Garibaldi, L. (2012): The FAO global capture production database: a six-decade effort to catch the trend. Marine Policy, 36, 760-768. https://doi.org/10.1016/j.marpol.2011.10.024

Jennings, S., Kaiser, M. J., Reynolds, J. D. (2001): Marine Fisheries Ecology. Blackwell Science, London, UK., 432 pp.

Katsanevakis, S., Maravelias, C. D., Vassilopoulou, V. (2010): Otter trawls in Greece: Landing profiles and potential *métiers*. Mediterranean Marine Science, 11(1), 43-59. https://doi.org/10.12681/mms.90

Maynou, F., Recasens, L., Lombarte, A. (2011): Fishing tactics dynamics of a Mediterranean small-scale coastal fishery. Aquatic Living Resources, 24, 149. https://doi.org/10.1051/alr/2011131

Moore, C., Davie, S., Robert, M., Pawlowski, L., Dolder, P., Lordan, C. (2019): Defining *métier* for the Celtic Sea mixed fisheries: A multiannual international study of typology. Fisheries Research, 219, 105310. https://doi.org/10.1016/j.fishres.2019.105310

Moutopoulos D. K., Brady, B., Pauly, D. (2015): Reconstruction of Albanian fishery catches by fishing gear, 1950 to 2010. Fisheries Centre Working Paper #2015-12, University of British Columbia, Vancouver, 12 p. http://www.seaaroundus.org/doc/publications/wp/2015/Moutopoulos-et-al-Albania.pdf

Moutopoulos D. K., Koutsikopoulos, C. (2014): Fishing strange data in national fisheries statistics of Greece. Marine Policy, 48, 114-122. https://doi.org/10.1016/j.marpol.2014.03.017

Moutopoulos, D. K., Prodromitis, G., Katselis, G., Koutsikopoulos, C. (2020): Mapping fisheries hot-spot and high-violated fishing areas in professional and recreational small-scale fisheries. Aquaculture and Fisheries, 5(5), 265-272. https://doi.org/10.1016/j.aaf.2019.10.003

Moutopoulos, D. K., Ramfos, A., Moukas, C., Katselis, G. (2014): High frequency on board monitoring from a fully dependent small-scale fisherman in Central Greece (Korinthiakos Gulf). International Aquatic Research, 6, 67. https://doi.org/10.1007/s40071-014-0067-5

Pauly, D., Froese, R. (2012): Comments on FAO's state of fisheries and aquaculture, or 'SOFIA2010'. Marine Policy, 36, 746-752. https://doi.org/10.1016/j.marpol.2017.01.006

Peja, N., Vaso, A., Miho, A., Rakaj, N., Crivelli, A. J. (1996):Characteristics of Albanian lagoons and their fisheries, Fisheries Research, 27(4), 215-225. https://doi.org/10.1016/0165-7836(95)00467-X.

Salas, S., Sumaila, U. R., Pitcher, T. J. (2004): Short-term decisions of small-scale fishers selecting alternative target species: a choice model. Canadian Journal of Fisheries and Aquatic Sciences, 61, 374-383. https://doi.org/10.1139/F04-007

Spaho, V., Flloko, A., Selfo, S. (1997): Albanie, une agriculture en transition Options Méditerranéenes, Séries, B(15), 143-154.

Stergiou, K. I., Machias, A., Somarakis, S., Kapantagakis, A. (2003): Can we define target species in Mediterranean trawl fisheries? Fisheries Research, 59, 431-435. https://doi.org/10.1016/S0165-7836(02)00016-4

Stergiou, K. I., Moutopoulos, D. K., Armenis, G. (2009): Perish legally and ecologically: the ineffectiveness of the minimum landing sizes in the Mediterranean Sea. Fisheries Management and Ecology, 16, 368-375. https://doi.org/10.1111/j.1365-2400.2009.00672.x

Tserpes, G., Moutopoulos, D. K., Peristeraki, P., Katselis, G., Koutsikopoulos, C. (2006): Study of swordfish fishing dynamics in the eastern Mediterranean by means of machine learning approaches. Fisheries Research, 78(2-3), 196-202. https://doi.org/10.1007/s10750-008-9499-5

Tzanatos, E., Somarakis, S., Tserpes, G., Koutsikopoulos, C. (2006): Identifying and classifying small-scale fisheries m´ etiers in the Mediterranean: A case study in the Patraikos Gulf, Greece. Fisheries Research, 81, 158-168. https://doi.org/10.1016/j.fishres.2006.07.007

Urlich, C., Wilson, D. C. K., Nielsen, J. R., Bastardie, F., Reeves, S. A., Andersen, B. S., Eigaard, O. R. (2012): Challenges and opportunities for fleet- and *métier*-based approaches for fisheries management under the European Common Fishery Policy. Ocean and Coastal Management, 70, 38-47. https://doi.org/10.1016/j.ocecoaman.2012.06.002