Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 27(6): 597 – 620 (2023)
www.ejabf.journals.ekb.eg

Fish Assemblages of the Bottom Trawl Fishery off Mostaganem, the Gulf of Arzew, Algeria, SW Mediterranean Sea

Sid Ali Belaid[1*], Sidi Mohammed Ghomari[1], José M. Bellido[2], Rym Bachetarzi[3], Bilel Bensari[3], Lamia Bahbah[3]

[1]Protection, Valorization of Coastal Marine Resources and Molecular Systematics Laboratory, Department of Marine Science and Aquaculture, Faculty of Science of Nature and Life, University of Mostaganem Abdelhamid Ibn Badis, P.O. Box 227, P.C. 27000, Mostaganem, Algeria

[2]Spanish Institute of Oceanography, Spanish National Research Council (IEO, CSIC), Oceanographic Center of Murcia, Varadero Street 1, 30740 San Pedro del Pinatar, Murcia, Spain

[3]Biological Oceanography and Marine Environment Laboratory (LOBEM), Faculty of Biological Science, University of Science and Technology, Houari Boumediene. P.O. Box 32 El Alia, P.C. 16111 Bab Ezzouar, Algiers, Algeria

[*]**Corresponding Author: sidali.belaid@univ-mosta.dz**

ARTICLE INFO

Article History:
Received: Sept. 30, 2023
Accepted: Oct. 25, 2023
Online: Dec. 7, 2023

Keywords:
Mediterranean,
Algerian fisheries,
Trawling,
Landings,
Discards

ABSTRACT

Several Mediterranean fisheries are experiencing flaws in the application of the management system based on input control, including Algeria, where the state of fisheries and stocks remain unclear. This paper focused on the characterization of the catches from bottom trawling by professional fishing vessels in the Mostaganem fishery (West of Algeria). Catch data were collected on board between 2017 and 2020 in two different fishing areas between isobaths 30 and 100 meters in depth. Out of a total of 87 species caught, discards represented a greater variety of species (74) than landings (57). Quantitatively, the landing weights were estimated at 7.8 tons, while the discard weights were lower, accounting for 1.8 tons. Between the two fishing areas, a significant difference was detected in the composition of discards and landings, while for the weights, the two areas were similar. Generally, the Mostaganem fishery is similar to other bottom trawl Mediterranean fisheries both for target and discard species. Otherwise, this research highlighted the existence of an uncontrolled black market, which sustains the practice of illegal, unregulated and unreported fishing, and potentially increases the rate of overexploitation.

INTRODUCTION

Fishery resources in the Mediterranean are of great socioeconomic importance for the surrounding countries **(Damalas *et al*., 2015)**. Fishing has always been a key economic activity providing livelihoods to hundreds of thousands of people, as well as shaping the traditions and cultural heritage of coastal communities in the region **(Coll *et al*., 2010; Libralato *et al*., 2018)**.

It has been widely reported that the current level of fishing pressure on the Mediterranean basin, exerted by a wide variety of fishing vessels and fishing gears, has affected the productivity of commercial stocks. This fact has sharply increased the risk of species decline and has contributed to disrupting the productivity and functioning of the ecosystem **(Colloca *et al*., 2017)**. This pressure is still intense, and several stocks and ecosystems are showing signals of critical conditions **(Colloca *et al*., 2017; Libralato *et al*., 2018)**. In this respect, some economic indicators show important business difficulties in the sector **(Sabatella *et al*., 2017; Libralato *et al.*, 2018)**. Although a decrease was recorded in the fishing vessels in recent decades ranging from 30 to 64% **(Maynou, 2020)**, aligned with another decrease in the percentage of overexploited stock from 88% to 73% from 2014 to 2020 **(FAO, 2022)**. Yet, there are still critical issues that compromise the potential recovery of Mediterranean and Black Sea fish stocks **(Libralato *et al*., 2018)**.

The Mediterranean fishing management focuses mainly on input controls **(Vassilakopoulos *et al*., 2014; Bellido *et al*., 2020)**, which are defined as mechanisms regulating the fishing effort entering the fishery, viz. capacity, areas, seasons and the time of fishing **(Bellido *et al*., 2020)**. This management strategy seems to be the most appropriate, with few exceptions **(Damalas *et al*., 2018)** and seems to be more suitable to the specificities of fishing in the Mediterranean basin, but it also requires significant, technical and regulatory resources **(Bellido *et al*., 2020)**. However, in developing countries, such as Algeria, the state of fisheries and stocks is still unclear **(Colloca *et al*., 2017)**. Several fisheries in the Mediterranean Sea show a weakness in the control, enforcement and the application of regulations, in particular for the adoption of new fishing gear **(Damalas & Vassilopoulou, 2013; Bellido *et al*., 2020)**.

On the other hand, the management objectives are usually expressed in terms of fishing indicators, such as fishing mortality. Stock assessments for major commercial stocks are based on catch estimates **(Rihan *et al*., 2019)**, while initial catches only included landings. It is only in the last decades that other several sources of fishing mortality, such as discards, have been reported and investigated, while becoming a major subject. An important change for the entire Mediterranean Sea was the adoption of the EU Common Fisheries Policy, which focused on what is caught rather than what is landed **(European Parliament Plenary, 2013; Vilela & Bellido, 2015)**. This approach has allowed an inclusion of discards to estimate fishing mortality, reducing the uncertainty in these estimates **(Moutopoulos *et al*., 2018)**, as well as providing more reliable estimates of maximum sustainable yield and other biological reference points **(Adão *et al*., 2018)**.

Thus, the acquisition of reliable data, in particular coming from observers onboard, has become crucial in the Mediterranean Sea, mainly due to the existence of discrepancies and misreporting in the official data on landings, which could cause bias on the estimates of fishing mortality **(Moutopoulos *et al*., 2018)**.

Fishing activities are highly significant in the southern Mediterranean shore **(Bellido *et al.*, 2014)** although rates vary among countries. Algeria, located in Geographical Sub Area Four (GSA 4) of the General Fisheries Commission for the Mediterranean (GFCM) and ranking as the third-largest producer country in the Mediterranean Sea, considers this activity essential. While, a significant drop in the total number of jobs on board has been observed, decreasing from 37,797 jobs **(FAO, 2020)** to 10,315 jobs **(FAO, 2022)**.

Several studies in this region have focused on the mono-specific aspect of fish stocks, in particular by studying the economy, growth or reproduction of high economic and ecologically important species. For instance, **Maouel *et al.* (2014)** applied an integrated fisheries management tool based on a bio-economic model to the small pelagic fishery (particularly sardine fishery). On the other hand, some studies were interested in fisheries management and governance, for example, **Babouri *et al.* (2014)** reported an analysis of the impact of fishing at the level of Algerian fisheries through trophic indicators. Furthermore, **Boubekri *et al.* (2018)** studied the small-scale fishing, identifying its governance and management systems. Nevertheless, studies concerning trawling activity are still scarce, and concerning discards, they are practically non-existent.

Hence, this paper addressed the fish assemblages, both in term of landings and discards, on board professional bottom trawlers at the national level (GSA 4), where trawlers represent 9.4% of the total fishing fleet **(FAO, 2022)** dominated by small-scale vessels (66.2%). In this regions, trawlers focused on three types of fishing through benthic and pelagic trawlers. Regarding the benefits of catches at the economic level, the industrial fisheries strongly dominate the small-scale fisheries, where they represent 94% of the total annual revenue **(FAO, 2022)**.

Thus, the objectives of this work were to characterize the catches in this fishery, spanning isobaths from 30 meters up to 100 meters of depth, and highlight the existing management problems in this fishery.

MATERIALS AND METHODS

1. Study area

The large production of the fishing activity in Algeria is spread over 14 main ports, and the region of Mostaganem represents one of the most important areas in terms of fishery resources. It is extended on a coastal line of 124km with three fishing ports (Port of Salamander, Main Port of Mostaganem and Port of Sidi Lakhdar), which are the based-ports off a fleet of more than 50 trawlers (Source: Direction of Fisheries and Marine Resources of Mostaganem, 2021). The Mostaganem fishery is located in the Gulf of Arzew (North-West of Algeria) (Fig. 1). This area is part of GSA 4 of the GFCM.

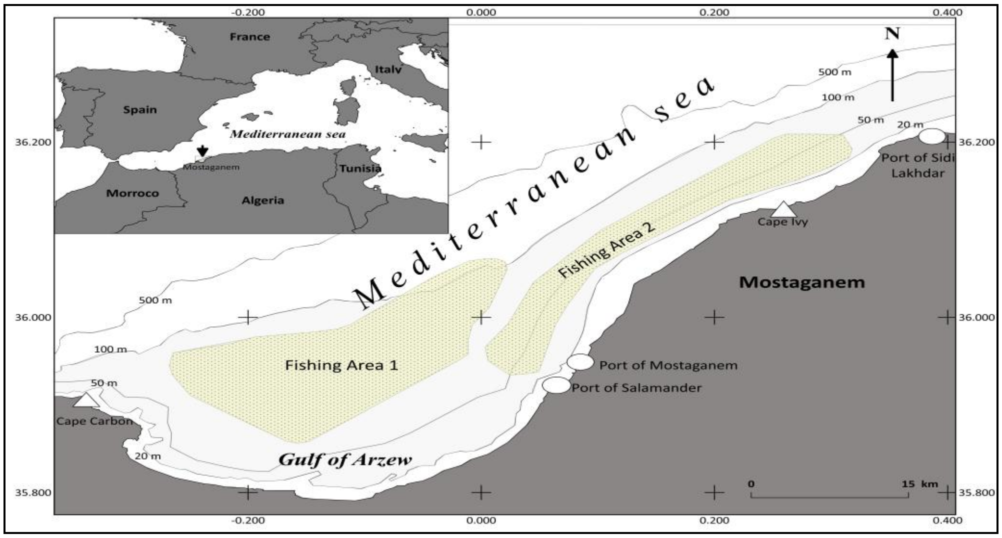

Fig. 1. Study area and fishing ports off the Gulf of Arzew (SW Algeria)

The Gulf of Arzew extends from Cape Ivi in the East (36°37'N, 0°13'W) to Cape Carbon in the West (35°54'N, 0°20'W). The western Gulf area comprises a continental shelf which is characterized by some rocky spots and a steep slope near Cape Carbon, which limits trawl fishing in this area. On the contrary, the eastern part of the Gulf is characterized by flat bottoms **(Kies *et al*., 2012)**, favoring the practice of trawl fishing over a large area. The eastern area shows a slight slope, particularly from 50m to 100m isobaths, where depth decreased with a very gentle slope, making the area quite suitable for trawl fishing **(Caulet *et al*., 1979; Amar *et al*., 2007)**. These differences between the two areas are the main reasons that produce different fishing strategies according to the target species. Furthermore, these two areas are identified as the two main fishing grounds according to local knowledge from the fishermen (Fig. 1).

2. Data collection

Data collection of catches including discards and landings has been carried out by a single observer on board of two professional trawlers based at the main port of Mostaganem. The two vessels are similar in terms of tonnage, means of navigation and fishing gear, and they are considered representative of the trawling fleet operating in the area. Both vessels are equipped with a bottom otter trawl with stretched cod-end mesh size of 20mm. We have to note that the number of sampled vessels was limited for various reasons outside the control of the researcher, including accessibility and authorization issues. Additionally, the fact that deployment of observers is essential for the monitoring and estimation of discards **(Kelleher, 2005; Bellido *et al*., 2011)**, this method is also effective for the observation of landings in cases with no formal (or poor) standardized records of fishery statistics of catch and effort, which in some cases can end in illegal, unreported or unregulated fishing practices (IUU).

The identification of the catches was made in two stages. Formerly, the discards were identified and directly weighed on board, during the sorting operation of the catch, which was carried out by the fishermen on the vessel's deck. Latterly, landings were identified and then weighed by the fishermen during the storage or marketing operation. In addition, samples were taken to the laboratory when more precise identification of a particular specimen was needed.

In total, 71 trawl stations (hauls) over 38 trips were observed from May to December 2017 and from June 2019 to February 2020. Area (1) was sampled by 29 observed hauls, while area (2) was sampled by 42 observed hauls. The largest sampling effort was in the fall season, with 28 trawl hauls. Winter accounted for 10 sampled hauls; spring was the lowest sampling effort with 15 hauls, and summer accounted for 18 sampled hauls.

The duration of the fishing operation is on an average of 14 hours per day, with usually two trawl hauls carried out per day. Trawling depths were variable on each haul, ranging from 30 to 100m in depth.

3. Data analysis

Several analyses on the data collected were performed using an open-source software "R". Non-parametric Kruskall-Wallis homogeneity tests, adequate for large samples, were used for comparison purposes between the two fishing areas. Those tests were used after non- normal distribution of data resulted with Kolmogorov-smirnov and Lilliefors fit tests.

A qualitative study was carried out to compare the composition of species in the two fishing areas. Through the similarity analysis (ANOSIM), the similarity between the species discarded and landed was verified on a presence/ absence matrix. It was performed with the Sorensen-Dice distance calculator, which is adequate for the binary matrix, and allowed us to calculate the dissimilarity index between the two areas. Simper similarity analysis on the same matrix, with the Bray-Curtis distance calculator which is used in benthic ecology, allowed us to identify the species that contribute the most to the dissimilarity **(Clarke & Warwick, 2001)** in the two fishing areas.

Subsequently, a quantitative study was carried out for each area in order to highlight the most discarded and landed species. A multiple factor analysis (MFA) was carried out to better visualize the correlations between the species and every trawl haul in the two areas. An ascending hierarchical classification (AHC) completed the MFA analysis to group the species according to their criteria of resemblance. The aggregation criterion of the first Ward method was preferred to the second Ward method of squares of distances in order to minimize the separation of groups due to the large difference in weight between species. The function ''Tanglegram'' of the package ''Dendextend'' allowed us to compare the classification of discards and landings between the two areas.

RESULTS

1. Catch composition and productivity

A total of 87 species were caught, comprising 74 fish species (85%), 7 molluscs species (8.1%) and 6 arthropods species (6.9%). These species can be also gathered into 24 orders, with Eupercaria *incertae sedis* (22.9%), Perciformes (17.6%), Pleuronectiformes (6.7%) and Clupeiformes (6.7%), representing the prominent groups. Molluscs are mainly represented by the order Octopoda (48.8%) and Sepiida (28.6%). Moreover, Arthropods are represented by the order Decapoda (83.3%) and Stomatopoda (16.7%). A full list of species is reported in ST. (1).

The total number of species caught indicates a slight difference between the two areas, where area (1) is represented by fewer species than area (2), with correspondingly 65 species against 71 species. However, area (1) seems to be more diverse into every sampling haul since we found 29 species by haul in area (1) and 25 species per haul in area (2).

Regarding total catches for the two areas, total landings for the 71 hauls were 7.8 tons, with an average of 110.1kg per haul. While, the two areas achieved a different sampling intensity (results were similar for both areas), with average landing of 108.8kg per haul in area (1) (29 observed hauls) and 110.9kg per haul in area (2) (42 observed hauls). The comparison between the two areas with the non-parametric homogeneity test of Kruskal-Wallis shows that there is no significant difference between landings of the two areas ($P < 0.19$); therefore, the two areas are balanced in terms of landed weights.

Similar results were found for the discards. The total discards on the 71 observed hauls were 1.8 tons, with an average of 25.7kg per haul. The two areas correspondingly discarded an average of 22kg per haul in area (1) and 27kg per haul in area (2). Kruskal-Wallis shows no significant difference between the discards of the two areas ($P < 0.1218$).

2. Landing and discards patterns

Regarding landings (ST. 1), 51 species of fish (89.5%) and 6 species of molluscs (10.5%) were landed. Area (1) is characterized by fewer commercial species (31) compared to area (2) (49). Discards comprised up to 74 species (ST.1), with 61 fish species (82.4%), 7 molluscs species (9.5%) and 6 arthropods species (8.1%).

Upon analyzing both Cross catches and discards data, it was found that11 species were never discarded. Additionally, 27 species were never landed. Similarly, common species between the two areas represent 47 species (63.5% of total) for discards and 23 species (40.3% of total) for landings.

While, total numbers in the two areas are similar in the discards composition (59 species for area (1) and 60 species for area (2)), while area (1) shows more discard species by haul (26 species/ haul for area (1) versus 18 species/ haul in area (2)). This is also consistent with the bigger species diversity by haul in the area (1) above mentioned.

Regarding the most significant species on landings, several species were oftenly landed on the two areas (≥ 75% of the observed hauls); these species are *Trachurus mediterraneus*, *Mullus barbatus*, *Eledone moschata*, *Octopus vulgaris* and *Pagellus acarne* among others. Other species such as *Scyliorhinus canicula*, *Trachurus trachurus* and *Citharus linguatula* were more frequently landed (≥ 50%) in one of the two areas and rarely (< 25%) in the other. On the other hand, several species were landed only in a single area with a significant frequency (≥ 25%), such as *Gobius niger* or *Solea solea*. The percentages of landings for each species for both areas is reported in ST.(1).

Similar to landings, discards show a great variability between the two areas (ST. 1). Some species, such as *Trachurus mediterraneus*, *P.acarne*, *Squilla mantis*, *C.linguatula*, show a similar discargding behavior in the two areas (≥ 75% of the observed hauls show discards). Other species such as *M.merluccius*, *Trygla lyra*, *Chelidonichthys cuculus* were more discarded (≥ 50%) in one of the two areas and rarely (< 25%) in the other. Finally, some species such as *G.niger*, *Sardinella aurita*, *Cepola macrophtalma* only appeared in the discards of a single area but with a significant frequency (≥ 25%),.

It should be noted that an accidental/ opportunistic catch (bycatch) of the species *Mola mola* was observed on different sampled hauls.

2.1. Analysis of similarity (ANOSIM)

ANOSIM analysis for landings indicate that there is a dissimilarity between the two areas, with a significant difference in landing pattern between the areas (R= 0.33, *P*> 0.0001). These characteristic species of each area were identified by a Simper similarity analysis (ST. 2). The result shows that 11 species account for 50% of the total dissimilarity contribution between the two areas. These species include *Spicara maena* (7%), *Pagellus erythrinus* (6.4%), *Boops boops* (5.5%), *C.linguatula* (5.5%), *Loligo vulgaris* (4.8%), *S.canicula* (4.6%), *T.trachurus* (4.5%), *Merluccius merluccius* (4.1%), *Sepia officinalis* (3.9%), *Raja sp* (3.3%) and *Zeus faber* (3.2%).

Same result was found upon analyzing discarding pattern by ANOSIM. A significant dissimilarity in discarding behavior between the two fishing areas is apparent (R= 0.665, *P*> 0.0001). SIMPER similarity analysis (ST.3) shows that 18 species contribute to 50% of the total dissimilarity in the discarding pattern between the two areas. The primary driving species for this dissimilarity include *S.maena, Chelidonichthys cuculus, Gobius niger, T.trachurus, M.merluccius, C.macrophtalma, Parapenaeus longirostris, Ophidion barbatum*.

2.2. Multiple factor analysis (MFA)

Regarding landings, MFA reveals two haul groups clearly distinguishing area (1) and area (2) (Fig. 2a**)**. Most of the trawl hauls of the two areas are well correlated with axis *dim1* and indicate that the hauls of the two areas have practically similar weights. The axis *dim2* divides the hauls of the two areas, highlighting a significant difference between them. This disparity in composition is clearly demonstrated. The projection of species (Fig. 2b) shows that axis *dim1* seems to divide the most landed species in the two areas; these are the species: *O.vulgaris*, *M.barbatus*, *P.erythrinus*, *M.surmuletus*, *P.acarne, T.mediterraneus, S.officinalis, L.vulgaris, C.linguatula, Trachinus draco, B.boops, S.canicula, E.moschata.* This projection correspondingly shows a significant contribution to the landings for *O.vulgaris* and *M.barbatus* in the two areas. The driving species in the landings of each area are separated by axis *dim2*. Specifically, species such as *M.barbatus, P.erythrinus, M.sumuletus, P.acarne* characterize the landings in area (1), whereas *O.vulgaris, T.mediterraneus, C.linguatula, S.officinalis, L.vulgaris* characterize the landings in area (2).

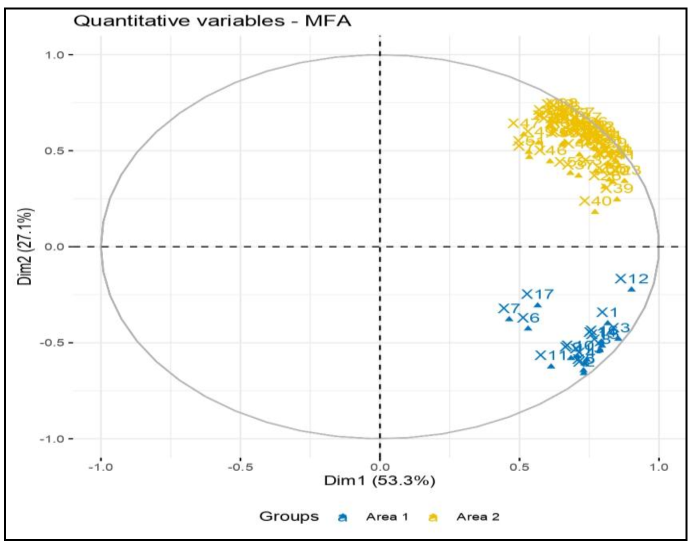

Fig. 2a. Representation of landings trawl hauls on the MFA projection axis

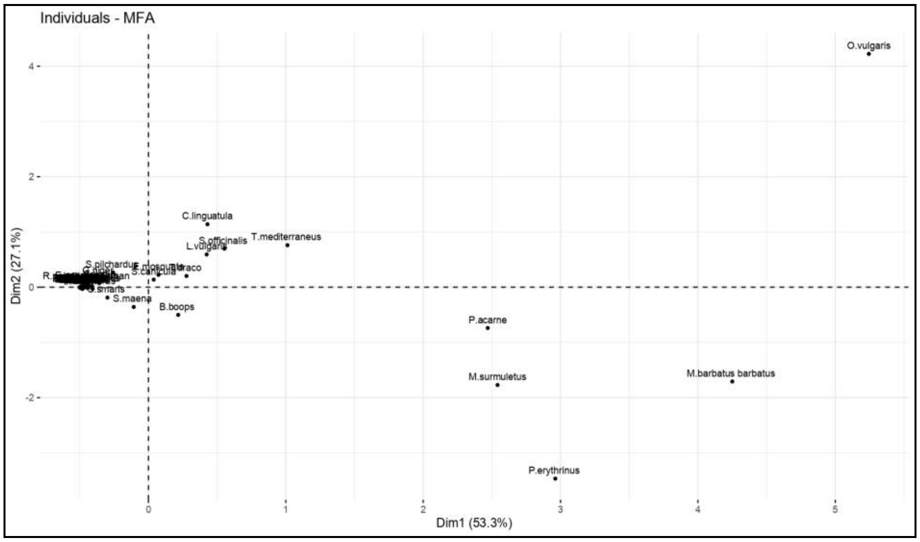

Fig. 2b. Representation of landed species on the MFA projection axis

However, when analyzing discards, three distinct haul groups were identified. The first group exclusively consisted of area hauls, with a significant contribution from axis dim1 and a low contribution from axis dim2. The second group, mainly comprising area (2) hauls, had a high contribution from axis dim2 and a low, positive contribution from axis dim1. Lastly, the third group, entirely composed of area (1) hauls, showed a high contribution from axis dim2 and a low, negative contribution from axis dim1 (Fig. 3a). This could be explained by their difference in the composition of the discards but also on the contributions of certain species more important in one of the two areas. The species projection (Fig. 3b) shows that axis *dim1* divide the most discarded species, including *T.mediterraneus, S.maena, Sardina pilchardus, S.mantis, P.acarne, Conger conger, Serranus hepatus.* The main results are marked by the dominance of species *T.mediterraneus* in the two areas. This species still shows a stronger correlation with the trawl hauls of area (1), taking into account axis *dim2* and which could be explained by a strong influence of these weights in the total weights of discards in this area. Fuerthermore, *S.maena* species has important discard weights in area (1), whereas in area (2), the discard weights are low given the very strong correlation with the trawl hauls of area (1) on axis dim2. Finally, particularly for hauls 66 to 71 (first group aforementioned), the species *S.mantis, P.acarne, S.hepatus,* and *C.linguatula* show very high discards given the strong correlations on axis *dim2* with these trawl hauls.

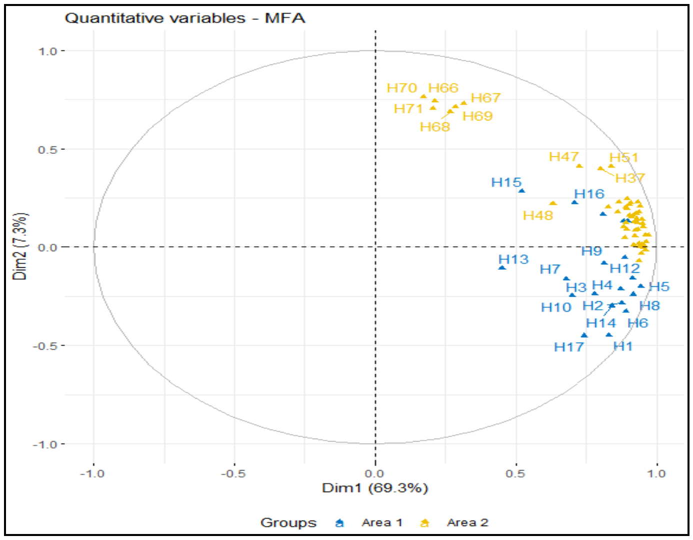

Fig. 3a. Representation of discards trawl hauls on the MFA projection axis

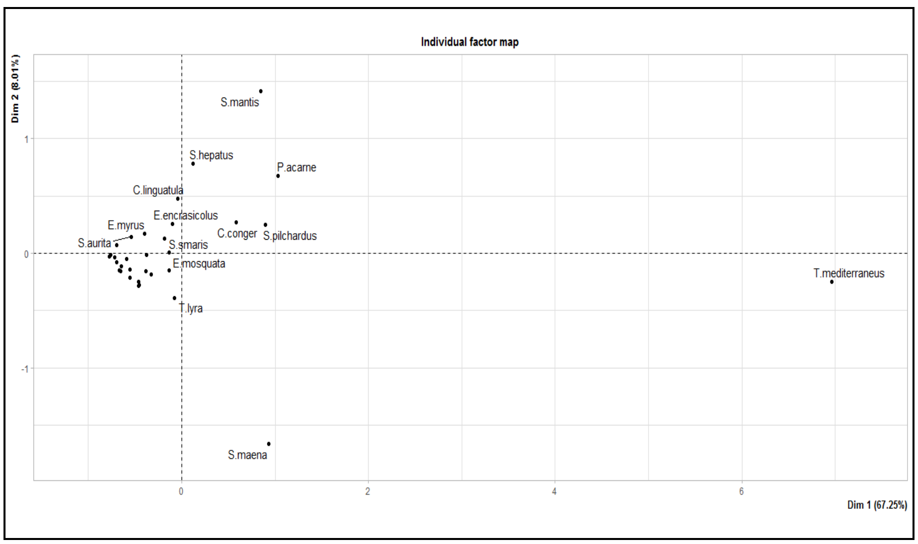

Fig. 3b. Representation of discarded species on the MFA projection axis

2.3. Ascending hierarchical classification (AHC)

The dendrogram results of area (1) (Fig. 4) show a division into 2 major groups of species in the landings on the cut-off level 40.

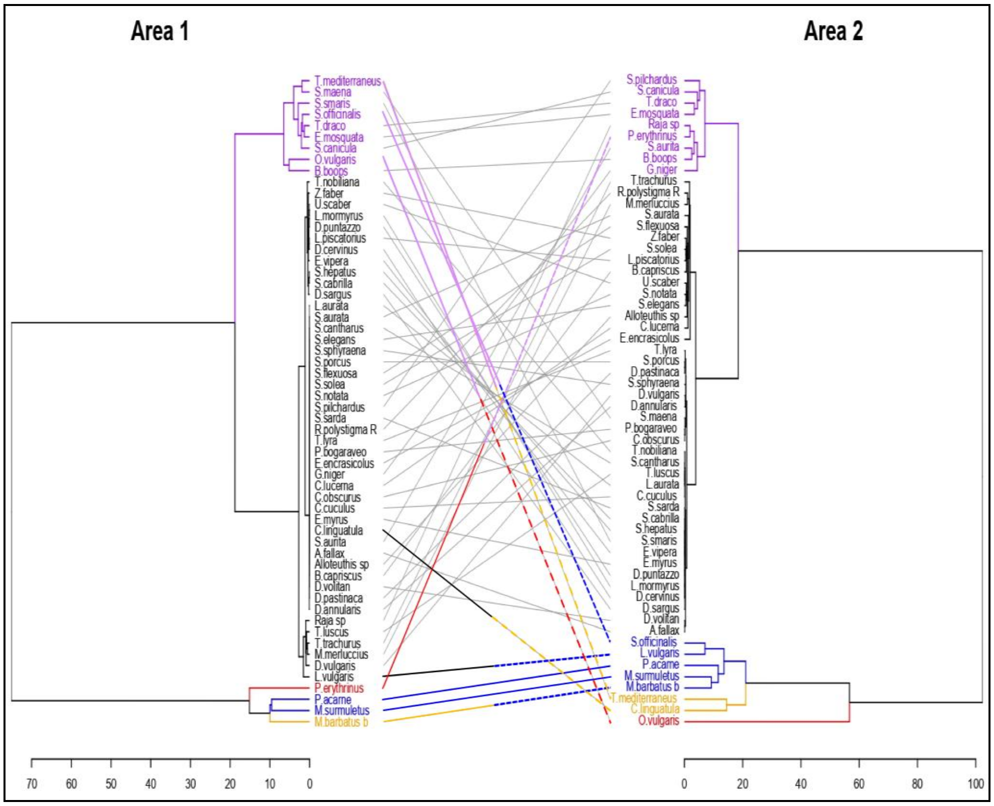

Fig. 4. AHC Dendrograms of area (1) and area (2) of landed species made by Ward's first method

Group 1 represents the most landed species where species *P.erythrinus* is dominant, whereas group 2 represents species less landed (Purple line color) such as: *O.vulgaris*, and low-frequency or rare species (Black line color). The dendrogram results of area (2) (Fig. 4) show division into 2 major groups of species on the cut-off level 80. Group 1 of the most landed species is dominated by *O.vulgaris* species, while group 2 is represented by less landed species, with constant species (Purple line color) and species with low-frequency or rare (Black line color). The crossing between the two dendrograms highlights the difference between the composition of the main landed species between the two areas. The number of species in the first and main group in area (2) is greater than that of area (1); however, these two areas have common characteristic species. While, for the groups of species with lower landings, there is little change observed in the composition of the subgroups for the two areas. The species characteristic of the landings in area (1), *P.erythrinus*, appears in the group which represents the least landed species in area (2). This is also the case in area (2) for species *O.vulgaris, T.mediterraneus* and *S.officinalis*.

Regarding discards, the dendrogram results of area (1) (Fig. 5) shows a division into two major groups of species on the cut-off level 50. Group 1 represents the most discarded species in area (1) and is characterized by a dominance of the species *T.mediterraneus.*

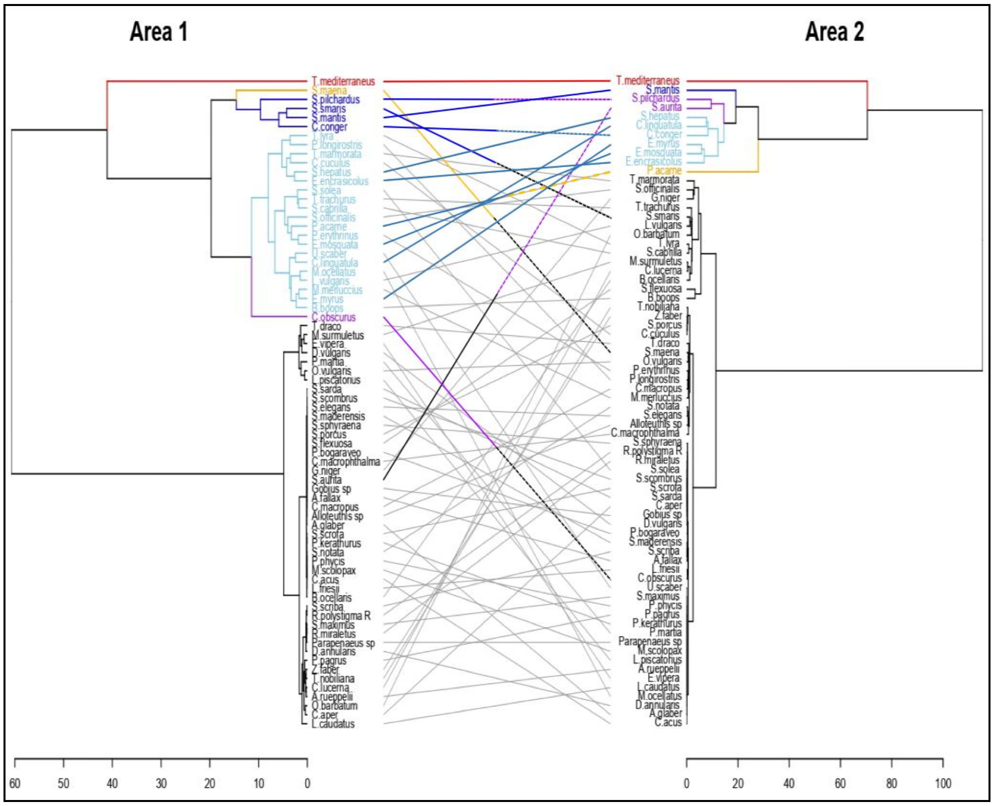

Fig. 5. AHC dendrograms of area (1) and area (2) of discarded species made by Ward's first method

The rest of the group consists of species, such as *S.maena*, *S.pilchardus*, *Chelidonichthys obscurus*, *S.mantis* & *C.conger*. While group 2 represents the leasts discarded species and contains a large number of them. The dendrogram results of area (2) shows division on the cut-off level 80 between a group of the most discarded species and a group of less discarded species. The species *T.mediterraneus* is the most discarded species and is distinguished from the other species of the first group. Other important species of the first group form a second subgroup, such as the species *P.acarne*, *S.mantis*, *S.pilchardus* & *S.aurita*. The second group, which represents the least discarded species, is formed by the majority of discarded species. The crossing between the two dendrograms highlights an imbalance between the two areas, where area (1) is more varied and is characterized by a greater number in the main group of important species in the discards than area (2). However, the majority of the most discarded species of area (2) belongs to the group of the most discarded species of area (1), except the species *S.aurita*. It should be noted that several species of the first and main group of species discarded from area (1), such as the species *S.maena*, *T.lyra*, are part of the group of species least discarded in area (2).

DISCUSSION

The present study reported the main fish assemblages comprising the Mostaganem fishery as well as the characterization of the landings and discards of professional bottom trawling.

We found that the Mostaganem fishery is similar to other Mediterranean fisheries. The most discarded species were *T.mediterraneus, S.maena, S.pilchardus, S.mantis, P.acarne, C.conger* & *S.hepatus,* with a notable dominance of species *T.mediterraneus* in the two areas. Similar results were found by **Carbonell *et al.* (2018)** for the dominance in the discards for *Trachurus* spp.

The most landed species were *O.vulgaris, M.barbatus, M.surmuletus, P.erythrinus, P.acarne, T.mediterraneus, S.officinalis, L.vulgaris, C.linguatula, T.draco, B.boops, S.canicula* & *Eledone* spp. This similarity with other Mediterranean fisheries is due to the fact that these species are common to the whole Mediterranean shore, with also a similar commercial value. Furthermore, a common cultural heritage as well as culinary preferences are shared among the communities from these regions.

Despite that our sampling is limited to an area between 30 to 100 meters in depth, the specific composition of discards is still important (74 species). Our results coincide with those observed in the Ionian Sea, where the total number of discarded species is near to a hundred, whereas totally or partially discarded **(Tsagarakis *et al*., 2008)**. In addition, this diversity could be greater at these shallow depths, considering the results observed in the Gulf of Cadiz that show that the highest number of species are found in the shallowest trawl hauls (< 100m) **(Gamaza-Márquez *et al*., 2020)**. Regarding the disclusion of the deep waters in our study, discards diversity could be potentially higher as several authors have reported spatial variations in the composition of discards related to the depth **(Pennino *et al*., 2017, Despoti *et al*., 2020)**.

Additionally, an important difference was recorded in the pattern of discards and landing species, where greater diversity was observed for the discarded species. The same was observed in Hellenic waters **(Vassilopoulou *et al*., 2007)** and can be explained by the fact that the discards include non-marketable species as well as the fraction of commercial species.

Numerous and different local or regional features could define landings and discards, influencing the different discarding pattern **(Maynou *et al*., 2018)**. These two components of the total catch are closely related. Fishing management should be realistic and deal efficient both for landings and discards. Indeed, there is a large number of discarded species which do not appear in the landings, and this could be explained by the low market values of several species, such as *Blennius ocellaris, Ophidion barbatum,*and *Torpedo marmorata*. In addition, it should be noted that the ports lack all the valuation market chain that could make them marketable for all these species.

On the other hand, a small number of landed species do not appear in the discards. This could be explained by regulatory and economic factors. National regulation on mimimun landing sizes is absent or poorly implemented, thus all size fractions can be landed, being fully available to the market. This is particularly important for valuable species such as *M.barbatus, M.surmuletus* and *L.vulgaris*, which are even more valuable in the market when the specimens are small (smaller than the legal market size); sometimes small sizes get even higher market prices than large specimens.

The large size of the specimens could be another important element to take into account for certain species which are not discarded, such as *Dactylopterus volitans, S.canicula* & *Balistes capricus*. In addition, the low availability of some of these species in the fishing area is the most likely reason, leading to their very low catches.

Similarly, difference between the average numbers of species discarded and landed highlight clear fishing strategies, and demonstrate a complexity of the commercial demand for the potential species that can be landed. Indeed, the low variety of species landed, being concentrated mostly on high value species, would increase the number of non-commercial species potentially discarded. This may cause cumulative strong pressure on commercial species.

On the other hand, although there are no apparent quantitative differences in the total production between the two areas, the areas notably differ qualitatively. Several reasons could explain this difference. The former is the different seabed substrat of the two areas, which would cause variations both in distribution and abundance for certain species in an area, and then with an effect on their catchability. Season and oceanographic features are also an important driving factors in spatial movements, particularly for those species which show a greater variability in their occurrence pattern in both areas, for instance those ones only present occasionally in one area. Finally, every fishing strategy will adapt to all these various factors, and also integrating weather conditions and market demand. In general, habitat could limit the presence of certain species in a given area, while season could cause variability in the distribution and abundance pattern, affecting their availability to fishing.

From a quantitative point of view, catches seem generally low; however, the catch level is not really a good indicator in this type of coastal fishery. Catches are daily landed and storage does not represent a problem **(Viðarsson *et al*., 2019)**. This is even an opportunity since there is still room to store and land a fraction of the catch now discarded. Valorization initiatives of the discard fraction of the fishery are needed.

Only two species (*T.mediterraneus* and *P.acarne*) show a continous and stable discards and landing pattern. These species are easy available in the fishing area with very variable size ranges. They have a significant market value and are either discarded or landed based on the fisher's quick decision during sorting, leading to their frequent presence in both fractions.

Moreover, it is important to note that catch estimates are, at least for some fisheries, higher than those reported due to unreported landings and discards **(Zeller *et al*., 2018; Uhlmann *et al*., 2019)**. Though illegal, unreported and unregulated (IUU) fishing is a complex, multidimensional and dynamic problem **(Belova, 2015)**, it is a major problem in underdeveloped and developing countries **(Ulaş *et al*., 2018)** where the surveillance of fisheries, as well as control of landing points are difficult to manage. The creation of clandestine trades or black markets for certain highly prized species in other countries would increase the number of undeclared species and possibly, in some cases, increase the fishing pressure on the species concerned.

Our observations on board reported a noticeable change in the fishing strategies of the vessels, as well as the increasing importance of the capture of cephalopod species in the region. In recent years, certain species of cephalopods, particularly *O.vulgaris* and *Eledone* spp., have reached increasingly higher prices in the market, even with no official landing at the points of first sale, and in these cases they were not declared. This sharp price increase was mainly due to a new clandestine market for the exportation of these cephalopod catches.

In addition to this unreported fishing, this has led to the creation of unregulated or even illegal fishing, where a new phenomenon has been observed. It consists of the capture of *Octopus* species through unauthorized fishing gear such as cement blocks (based on personal observations). This very low-cost pseudo-gear, used as a construction material, is used by small-scale fishers as a passive fishing gear resembling a shelter for these species.

Some similar practices in a small-scale fishery have been reported in Taza National Park on the Algerian East Coast, where the practice of illegal, unprofessional fishing was at the origin of many conflicts in this region due to the existence of illegal markets **(Boubekri *et al*., 2018)**.

On the other hand, priority should be directed toward improving selectivity in order to reduce discards and decrease unwanted fishing mortality on fish stocks, which should benefit the health of marine ecosystems **(Bellido *et al*., 2011)**. A stricter implmentation of the regulations, particularly with more severe monitoring should be adopted for the sustainability of stocks and the ecosystem. Most times in these fisheries, the minimum landing sizes were set at wrong lengths, ecologically inadequate and do not respect the life cycle of species **(Stergiou *et al*., 2009; Lucchetti *et al*., 2021)**.

We urge for an improvement in selectivity as the most crucial action to be taken for the protection and preservation of both the resource and the environment. This would avoid the capture of immature individuals, as well as allowing indirectly to promote more efficient and more advanced means for fishing at greater depths. Development of adequate fishing nets or the respect of the regulations on the sizes of the cod-end mesh is clearly urgent to carry out. We discoraged the use of the authorized cod-end mesh size, which corresponds to the narrow mesh size of 40mm. This should not be used, according to the mesh sizes used by the trawlers in similar fisheries.

Technical measures are by nature restrictive, and their implementation and enforcement procedures often encounters delays and numerous difficulties **(Bellido *et al*., 2020)**. This fishery shows alarmant signals of overexploitation in view of the observed low catches. However, when landings and benefits are low, fishermen could aspire to changes in the management system **(Christou *et al*., 2018)**, which would promote the collaboration of all stakeholders.

The diversification of landings should be a mean of reducing discards by sensitizing consumers to varying their consumption with new products, which should have an impact on market and consumer preferences **(Stithou *et al*., 2019)**, as well as generating reduced fishing pressure on target species **(Hall *et al*., 2005)**.

In addition, the existence of an uncontrolled black market has given way to the practice of IUU fishing, and has potentially increased the rate of overexploitation of fish stocks, and particularly cephalopod stocks in the Mostaganem fishery.

Finally, this study reports a first characterization of the fishery in the western region of the Algerian basin. We are really aware this study presents certain limitations, for instances the low number of fishing vessels taking part in the sampling scheme for the areas and the different seasons studied. However, the results provide important and necessary information on the fishery, as well as revealing certain gaps and challenges. Therefore, this study could be useful to implement fishery monitoring, surveillance and development plans for this fishing sector, which is radical for the region. Routinary monitoring would bring more consistent estimates of discards and landings, which would allow a better understanding of the fishery.

ACKNOWLEDGMENTS

All our thanks and our gratitude to the vessels' owners of Mostaganem fishery with whom we had the chance to collaborate and who allowed us to work on board of their vessels, as well as to the skippers and fishermen for their patience and their great sympathy in sharing their experiences and knowledge.

DECLARATION OF INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

FUNDING INFORMATION

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

Adão, A.C.; Breen, M.; Eichert, M. and Borges, T.C. (2018). By-catch species susceptibilities and potential for survival in Algarve (southern Portugal) deep-water crustacean trawl fishery. Sci. Mar. 82(S1): 14 –149.https://doi.org/10.3989/ scimar.04740.02A

Amar, Y.; Kandouci, A.; Lebid, S.; Djahed, B.; Zahzeh, T. and Anani, M. (2007). Description of the macrobenthic population in the Gulf of Arzew in northwestern Algeria. Pak. J. Bio. Sci. 10: 2676-2681.https://doi.org/10.3923/pjbs.2007.2676.2681

Babouri, K.; Pennino, M.G. and Bellido, J.M. (2014). A trophic indicators toolbox for implementing an ecosystem approach in data-poor fisheries: The Algerian and Bou-Ismail Bay examples. Sci. Mar. 78 (S1): 37-51.

Bellido, J.M.; Santos, M.B.; Pennino, M.G.; Valeiras, X. and Pierce, G.J. (2011). Fishery discards and bycatch: solutions for an ecosystem approach to fisheries management? Hydrobiologia, 670 (1): 317–333.

Bellido, J.M.; Carbonell, A.; Garcia-Rodriguez, M.; Garcia, T. and Gonzalez, M. (2014). The obligation to land allcatches-consequences for the Mediterranean. In: DepthAnalysis. Directorate-General for Internal Policies, European Parliament, 52 pp.

Bellido, J.M.; Sumaila, U.R.; Sanchez-Lizaso, J.L.; Palomares, M.L. and Pauly, D. (2020). Input versus output controls as instruments for fisheries management with a focus on Mediterranean fisheries. Mar. Policy 118: e103786. https://doi.org/10.1016/j.marpol. 2019.103786

Belova, G. (2015). Illegal Unreported And Unregulated Fishing In The Black Sea. International conference KNOWLEDGE-BASED ORGANIZATION. 21. https://doi.org/10.1515/kbo-2015-0069

Boubekri, I.; Caveen, A.J.; Djebar, A.B.; Amara, R.; Mazurek, H. (2018). Structure and spatio-temporal dynamics of the artisanal small-scale fisheries at the future MPA of "Taza" (Algerian coast, SW Mediterranean). Mediterr. Mar. Sci. 19 (3): 555–571. https://doi.org/10.12681/mms.16192

Caulet, J. (1972). The organogenesis sediments of the Algerian precontinent (translated from French). Mémoire Museum National d'Histoire Naturelle., Paris. Série C., 25: 1-289.

Carbonell, A.; García, T.; González, M.; Álvarez-Berastegui, D.; Mallol, S.; De la Serna, J.M.; *et al.* (2018). Modelling trawling discards of the Alboran fisheries in the Mediterranean Sea, Reg. Stud. Mar. Sci. 23: 73-86,:https://doi.org/10.1016/j. rsma. 2017.11.010

Christou, M.; Haralabous, J.; Stergiou, K.I.; Damalas, D. and Maravelias, C.D. (2017). An evaluation of socioeconomic factors that influence fishers' discard behaviour in the Greek bottom trawl fishery. Fish. Res. 195: 105–115. https://doi.org/10.1016/j.fishres.2017.07.003

Clarke, K.R. and Warwick, R.M. (2001). Change in Marine Communities: An Approach to statistical analysis and Interpretation. 2nd Ed. Plymouth Marine Laboratory, Plymouth. 176pp.

Coll, M.; Piroddi, M.; Steenbeek, J.; Kaschner, K.; Ben Rais Lasram; F., Aguzzi, J.; *et al*. (2010). The biodiversity of the Mediterranean Sea: estimates, patterns, and threats. PLoS ONE 5(8): e11842. https://doi.org/10.1371/journal.pone.0011842

Colloca, F.; Scarcella, G.; Libralato, S. (2017). Recent Trends and Impacts of Fisheries Exploitation on Mediterranean Stocks and Ecosystems. Front. Mar. Sci. 4: 244. https://doi.org/10.3389/fmars.2017.00244

Damalas, D. and Vassilopoulou, V. (2013). Slack regulation compliance in the Mediterranean fisheries: a paradigm from the Greek Aegean Sea demersal fishery, modelling discard ogives. Fish. Manag. Ecol. 20: 21–33.

Damalas, D.; Maravelias, C.D.; Osio, G.C.; Maynou, F.; Sbrana, M. and Sartor, P. (2015). "Once upon a Time in the Mediterranean" Long Term Trends of Mediterranean Fisheries Resources Based on Fishers' Traditional Ecological Knowledge. PLoS ONE 10(3): e0119330. https://doi.org/10.1371/journal. pone.0119330

Damalas, D.; Ligas, A.; Tsagarakis, K.; Vassilopoulou, V.; Stergiou, K.; Kallianiotis, A.; Sbrana, M. and Maynou, F. (2018). The "discard problem" in Mediterranean fisheries, in the face of the European Union landing obligation: the case of bottom trawl fishery and implications for management. Mediterr. Mar. Sci. *19*(3): 459-476. http://doi.org/10.12681/mms.14195

Despoti, S.; Milisenda, G.; Ligas, A.; Bentes, L.; Maynou, F.; Vitale, S.; *et al*. (2020). Marine spatial closures as a supplementary tool to reduce discards in bottom trawl fisheries : examples from southern European waters. Fish. Res. 232: 105714. https://doi.org/10.1016/j.fishres.2020.105714

European Parliament Plenary. (2013). European Parliament legislative resolution of 6 February 2013 on the proposal for a regulation of the European Parliament and of the Council on the Common Fisheries Policy (COM(2011)0425 – C7-0198/2011 – 2011/0195(COD)) [online]. Available from : https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011PC0425&from=EN

FAO (Food and Agriculture Organization). (2020). The State of Mediterranean and

Black Sea Fisheries 2020. General Fisheries Commission for the Mediterranean. Rome. https://doi.org/10.4060/cb2429en

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

Gamaza-Márquez, M.A.; Pennino, M.G.; Torres, M.A.; Acosta, J.J.; Erzini, K.; and Sobrino, I. (2020). Discard practices in the gulf of Cadiz multispecies trawl fishery. Implications for the EU 'landing obligation'. Mar. Policy, 118: 104008.

Hall, S.J. and Mainprize, B.M. (2005). Managing by-catch and discards: how much progress are we making and how can we do better? Fish Fish. 6: 134–155.

Kelleher, K. (2005). Discards in the world's marine fisheries: an update. FAO Fisheries Technical Paper 470. Rome, FAO. 2005. 131pp.

Kies, F.; Mezali, K.; Soualili, D.L. (2012). Modeling with R of theMostaganem fishery and the nutrient flows (N, P, Si) of the OuedChéliff (Algeria) (Translated from French). Editions Universitaires Européennes-EUE. 132 pp, ISBN: 978-3-8381-8346-6.

Libralato, S.; Colloca, F.; Gücü, A.C.; Maravelias, C.D.; Solidoro, C.; Villasante, S. and Cardinale, M. (2018). Editorial: Challenges and Opportunities for the EU Common Fisheries Policy Application in the Mediterranean and Black Sea. Front. Mar. Sci. 5: 299. https://doi.org/10.3389/fmars.2018.00299

Lucchetti, A.; Virgili, M.; Vasapollo, C.; Petetta, A.; Bargione, G.; Li veli, D.; *et al*. (2021). An overview of bottom trawl selectivity in the Mediterranean Sea. Mediterr. Mar. Sci. 22(3): 566-585. https://doi.org/10.12681/mms.26969

Maouel, D.; Maynou, F.; Bédrani, S. (2014). Bioeconomic Analysis of Small Pelagic Fishery in Central Algeria. Turkish J. Fish. Aquat. Sci. 14: 897-904.

Maynou, F. (2020). Evolution of fishing capacity in a Mediterranean fishery in the first two decades of the 21st c. Ocean Coast Manag, Volume 192.

Maynou, F.; Gil, M.D.M.; Vitale, S.; Giusto, G.B.; Foutsi, A.; Rangel, M.; *et al*. (2018). Fishers' perceptions of the European Union discards ban : perspective from south European fisheries. Mar. Policy. 89: 147-153.

Moutopoulos, D.K.; Tsagarakis, K.; Machias, A. (2018). Assessing ecological and fisheries implications of the EU landing obligation in Eastern Mediterranean. J. Sea Res. 141: 99–111. https://doi.org/10.1016/j.seares.2018.08.006

Paradinas, I.; Marín, M.; Pennino, M.G.; López-Quílez, A.; Conesa, D.; Barreda, D.; Gonzalez, M.; Bellido, J.M. (2016). Identifying the best fishing-suitable areas under the new European discard ban. ICES J. Mar. Sci. 73 (10): 2479–2487.

Pennino, M.G.; Vilela, R.; Valeiras, J.; Bellido, J.M. (2017). Discard management: a spatial multi-criteria approach. Mar. Policy. 77: 144–151.

Pérez-Roda, M.A (ed.).; Gilman, E.; Huntington, T.; Kennelly, S.J.; Suuronen, P.; Chaloupka, M. Medley, P. (2019). A third assessment of global marine fisheries discards. FAO Fisheries and Aquaculture Technical Paper No. 633. Rome, FAO. 78 pp.

Rihan, D.; Uhlmann, S.S.; Ulrich, C.; Breen, M.; Catchpole, T. (2019). Requirements for Documentation, Data Collection and Scientific Evaluations. In: S. Uhlmann, C. Ulrich, S. Kennelly. (eds) The European Landing Obligation. Springer, Cham. https://doi.org/10.1007/978-3-030-03308-8_3

Sabatella, E.C.; Colloca, F.; Coppola, G.; Fiorentino, F.; Gambino, M.; Malvarosa, L. and Sabatella, R. (2017). Key Economic Characteristics of Italian Trawl Fisheries and Management Challenges. Front. Mar. Sci. 4: 371. https://doi.org/10.3389/fmars. 2017.00371

Stergiou, K.I.; Moutopoulos, D.K.; Armenis, G. (2009). Perish legally and ecologically: the ineffectiveness of the minimum landing sizes in the Mediterranean Sea. Fish. Manag. Ecol. 16: 368-375.

Stithou, M.; Vassilopoulou, V.; Tsagarakis, K.; Edridge, A.; Machias, A.; Maniopoulou, M.; *et al*. (2019). Discarding in Mediterranean trawl fisheries—a review of potential measures and stakeholder insights. Marit. Stud. 18: 225–238. https://doi.org/10.1007/s40152-018-00131-0

Tsagarakis, K.; Machias, A.; Giannoulaki, M.; Somarakis, S. and Karakassis, I. (2008). Seasonal and temporal trends in metrics of fish community for otter-trawl discards in a Mediterranean ecosystem. ICES J. Mar. Sci. 65: 539–550. https://doi.org/10.1093/icesjms/fsn023

Uhlmann, S.S.; Ulrich, C.; Kennelly, S. (2019). The European Landing Obligation Reducing Discards in Complex, Multi-Species and Multi-Jurisdictional Fisheries. Springer, Cham. https://doi.org/10.1007/978-3-030-03308-8

Ulaş, A.; Essaih, M.; İlker, A.; Tomris, D. and Didem, G. (2018). A focus on illegal, unreported and unregulated fishing in the Aegean Sea, in: G. Özcan, A.S. Tarkan, and T. Özcan (Eds.). Proceeding Book, International Marine and Freshwater Sciences Symposium, 18-21 October 2018, Kemer-Antalya / Turkey, pp. 75-79. https://doi:10.13140/RG.2.2.23353.42086

Vassilopoulou, V.; Machias, A. and Tsagarakis, K. (2007). By-catch and discards in multi-species fisheries and their Impact in the Hellenic waters, in: C. Papaconstantinou, A. Zenetos, V. Vassilopoulou, and G. Tserpes (Eds.), State of Hellenic Fisheries. (Athens: Hellenic Centre for Marine Research), pp. 251–260.

Vilela, R. and Bellido, J.M. (2015). Fishing suitability maps: helping fishermen reduce discards. Can. J. Fish. Aquat. Sci. 72 (8): 1191-1201. https://doi.org/10.1139/cjfas-2013-0522

Viðarsson, J.R.; Einarsson, M.I.; Larsen, E.P.; Valeiras, J. and Ragnarsson, S.Ö. (2019). Onboard and Vessel Layout Modifications. In: Uhlmann S., Ulrich C., Kennelly S. (eds) The European Landing Obligation. Springer, Cham. https://doi.org/10.1007/978-3-030-03308-8_16

Zeller, D.; Cashion, T.; Palomares, M. and Pauly, D. (2018). Global marine fisheries discards: A synthesis of reconstructed data. Fish Fish. 19(1): 30–39. https://doi.org/10.1111/faf.12233

SUPPLEMENTARY TABLES

Supplementary table 1: Table of weights and frequencies of occurence of catched species.

		Area 1				Area 2			
	Species	Landing Weights (kg)	Landing Frequences (%)	Discard Weights (kg)	Discard Frequences (%)	Landing Weights (kg)	Landing Frequences (%)	Discard Weights (kg)	Discard Frequences (%)
Acanthuriformes	*C.aper*	-	-	1,19	82,4	-	-	0,233	40,7
Anguilliformes	*C.conger*	-	-	19,189	82,4	-	-	72,03	81,5
	E.myrus	-	-	4,086	64,7	-	-	23,1	33,3
Blenniformes	*B.ocellaris*	-	-	0,025	5,9	-	-	5,37	51,9
Carangaria incertae sedis	*S.sphyraena*	-	-	-	-	2,5	5,6	0,25	3,7
Carangiformes	*T.mediterraneus*	40,2	94,1	92,794	100,0	490	92,6	544,4	98,1
	T.trachurus	8,3	52,9	6,7	76,5	15	5,6	2,1	3,7
Carcharhiniformes	*S.canicula*	26	35,3	-	-	111	55,6	-	-
Clupeiformes	*A.fallax*	-	-	-	-	0,9	3,7	0,05	1,9
	E.encrasicolus	-	-	10,132	64,7	11,8	13,0	36,58	51,9
	S.aurita	-	-	-	-	21,2	13,0	28,7	42,6
	S.maderensis	-	-	-	-	-	-	0,28	3,7
	S.pilchardus	-	-	19,855	82,4	105,1	31,5	107,62	94,4
Dactylopteriformes	*D.volitan*	-	-	-	-	0,8	1,9	-	-
Eupercaria incertae sedis	*B.boops*	58,8	82,4	7,341	76,5	62,4	37,0	15,34	46,3
	C.macrophthalma	-	-	-	-	-	-	3,401	66,7
	D.annularis	1	5,9	0,14	5,9	-	-	-	-
	D.cervinus	1,4	11,8	-	-	-	-	-	-
	D.puntazzo	0,6	5,9	-	-	-	-	-	-
	D.sargus	0,4	5,9	-	-	1,2	1,9	-	-
	D.vulgaris	1,8	11,8	0,9	11,8	4,95	18,5	0,07	1,9
	L.mormyrus	0,5	5,9	-	-	-	-	-	-
	P.acarne	532	94,1	11,02	88,2	28,5	25,6	197,4	83,3
	P.bogaraveo	-	-	-	-	1	1,9	0,29	1,9
	P.erythrinus	273	88,2	5,45	64,7	533,2	83,3	1,72	16,7
	P.pagrus	-	-	0,484	17,6	-	-	-	-
	S.aurata	-	-	-	-	6	1,9	-	-
	S.cantharus	-	-	-	-	0,71	7,4	-	-
	S.flexuosa	-	-	-	-	2,1	3,7	9,675	22,2
	S.maena	49,7	82,4	41,641	100,0	3,1	7,4	1,9	16,7
	S.smaris	13	41,2	9,42	47,1	-	-	2,4	13,0
Gadiformes	*M.merluccius*	4,8	35,3	4,59	100,0	20	38,9	2,04	33,3
	P.phycis	-	-	0,01	5,9	-	-	-	-
	T.luscus	4	5,9	-	-	0,72	5,6	-	-
Gobiiformes	*G.niger*	-	-	-	-	58	35,2	13,916	81,5
	Gobius sp	-	-	-	-	-	-	0,34	3,7
	L.friesii	-	-	0,052	23,5	-	-	1,08	37,0
Lophiiformes	*L.piscatorius*	1,2	11,8	1,03	11,8	7,5	13,0	0	0,0
Mugiliformes	*C.auratus*	-	-	-	-	0,4	1,9	-	-
Mulliformes	*M.barbatus barbatus*	397	88,2	2,205	52,9	610	100,0	6,27	64,8
	M.surmuletus	238	82,4	1,32	35,3	275	72,2	1,57	14,8
Myliobatiformes	*D.pastinaca*	-	-	-	-	1,6	1,9	-	-
Ophidiiformes	*C.acus*	-	-	0,03	5,9	-	-	0,02	3,7
	O.barbatum	-	-	0,558	76,5	-	-	2,804	22,2
Perciformes	*C.cuculus*	-	-	8,795	88,2	0,84	7,4	0,38	11,1
	C.lucerna	-	-	0,15	5,9	8,9	9,3	0,6	1,9
	C.obscurus	-	-	7	5,9	1,6	1,9	0,19	3,7
	E.vipera	3,5	11,8	1,275	29,4	-	-	-	-
	S.cabrilla	0,5	5,9	6,163	52,9	-	-	2,43	13,0
	S.hepatus	0,3	5,9	7,232	58,8	-	-	85,36	98,1
	S.notata	-	-	0,02	5,9	9,96	33,3	1,574	31,5
	S.porcus	-	-	-	-	2,95	11,1	0,21	7,4
	S.scriba	-	-	0,17	17,6	-	-	0,12	3,7
	S.scrofa	-	-	0,065	17,6	-	-	0,154	11,1
	T.draco	28	70,6	1,823	52,9	182	94,4	1,69	13,0
	T.lyra	-	-	15,532	100,0	2,67	9,3	3,74	48,1
	U.scaber	0,5	5,9	1,3	11,8	11,8	24,1	0	0,0
Pleuronectiformes	*A.rueppelii*	-	-	0,15	5,9	-	-	-	-
	C.linguatula	-	-	4,558	88,2	362,9	61,1	68,3	96,3
	M.ocellatus	-	-	2,276	47,1	-	-	-	-
	S.maximus	-	-	0,025	5,9	-	-	-	-
	S.solea	-	-	2,244	58,8	8,8	25,9	0,12	3,7
Rajiformes	*R.miraletus*	-	-	0,1008	17,6	-	-	0,3	1,9
	R.polystigma Regan	-	-	0,245	17,6	15,2	16,7	0,53	5,6
	Raja sp	10	11,8	-	-	44,7	37,0	-	-
Scombriformes	*L.caudatus*	-	-	0,4	5,9	-	-	-	-
	S.sarda	-	-	0,01	5,9	0,2	1,9	0,112	3,7
	S.scombrus	-	-	-	-	-	-	0,1	1,9
Syngnathiformes	*M.scolopax*	-	-	0,03	11,8	-	-	-	-
Tetraodontiformes	*B.capriscus*	-	-	-	-	8,5	9,3	-	-
	*M.Mola**	-	-	-	5,9	-	-	-	5,5
Torpediniformes	*T.nobiliana*	1	5,9	0,336	17,6	0,7	1,9	0,6	3,7
	T.marmorata	-	-	7,919	58,8	-	-	17,6	48,1
Zeiformes	*Z.faber*	3,95	23,5	0,508	41,2	7,7	27,8	0,73	13,0
Decapoda	*P.longirostris*	-	-	7,573	76,5	-	-	1,53	22,2
	A.glaber	-	-	-	-	-	-	0,02	1,9
	Plesionika sp	-	-	0,15	23,5	-	-	-	-
	P.kerathurus	-	-	0,03	5,9	-	-	-	-
	P.martia	-	-	3,177	52,9	-	-	-	-
Stomatopoda	*S.mantis*	-	-	12,405	94,1	-	-	131,8	98,1
Octopoda	*E.moschata*	15,4	94,1	9,409	64,7	149,3	98,1	38,68	66,7
	C.macropus	-	-	-	-	-	-	0,9	5,6
	O.vulgaris	80,4	94,1	1,4	35,3	2034	100,0	1,9	9,3
Sepiida	*S.elegans*	-	-	-	-	2	1,9	1,1	3,7
	S.officinalis	27,5	64,7	11,77	76,5	403,6	81,5	13,116	63,0
Myopsida	*Alloteuthis sp*	-	-	1,8	5,6	6	5,6	-	-
	L.vulgaris	17	47,1	3,765	52,9	339,1	79,6	7,76	90,7

*** Bycatch species**

Source of species taxonomie :

World Register Of Marine Species (WORMS), 2021. www.marinespecies.org. Consulted on December 2021.

Supplementary table 2: SIMPER similarity analysis table of landed species.

Species	Av. dissim	Contrib. %	Cumulative %	Mean Area 1	Mean Area 2
S.maena	2,992	7,011	7,011	0,824	0,0741
P.erythrinus	2,751	6,445	13,46	0,941	0,259
B.boops	2,339	5,48	18,94	0,824	0,37
C.linguatula	2,166	5,075	24,01	0	0,611
L.vulgaris	2,061	4,828	28,84	0,471	0,796
S.canicula	1,965	4,604	33,44	0,353	0,556
T.trachurus	1,937	4,539	37,98	0,529	0,0556
M.merluccius	1,779	4,168	42,15	0,353	0,389
S.officinalis	1,693	3,967	46,12	0,647	0,815
Raja sp	1,409	3,302	49,42	0,118	0,37
Z.faber	1,376	3,223	52,64	0,235	0,278
M.surmuletus	1,356	3,178	55,82	0,824	0,722
T.draco	1,309	3,067	58,89	0,706	0,944
G.niger	1,198	2,806	61,69	0	0,352
S.notata	1,113	2,608	64,3	0	0,333
S.pilchardus	1,078	2,525	66,83	0	0,315
P.acarne	0,9676	2,267	69,09	0,882	0,833
D.sargus	0,9458	2,216	71,31	0,118	0,185
U.scaber	0,9284	2,175	73,48	0,0588	0,241
S.solea	0,9078	2,127	75,61	0	0,259
S.smaris	0,8979	2,104	77,71	0,235	0
L.piscatorius	0,7419	1,738	79,45	0,118	0,13
R.polystigma Regan	0,6174	1,447	80,9	0	0,167
T.mediterraneus	0,5303	1,243	82,14	0,941	0,926
S.aurita	0,5084	1,191	83,33	0	0,13
E.encrasicolus	0,4397	1,03	84,36	0	0,13
E.vipera	0,43	1,007	85,37	0,118	0
M.barbatus barbatus	0,4267	0,9996	86,37	0,882	1
D.cervinus	0,3854	0,903	87,27	0,118	0
T.luscus	0,378	0,8856	88,16	0,0588	0,0556
S.porcus	0,3743	0,877	89,04	0	0,111
E.moschata	0,3586	0,8402	89,88	0,941	0,981
C.lucerna	0,326	0,7638	90,64	0	0,0926
T.nobiliana	0,3181	0,7452	91,39	0,0588	0,0185
O.vulgaris	0,3031	0,7102	92,1	0,941	1
T.lyra	0,2998	0,7024	92,8	0	0,0926
D.vulgaris	0,2917	0,6835	93,48	0,0588	0,0185
S.cantharus	0,2567	0,6015	94,08	0	0,0741
C.cuculus	0,2374	0,5562	94,64	0	0,0741
S.cabrilla	0,2055	0,4814	95,12	0,0588	0
S.hepatus	0,2055	0,4814	95,6	0,0588	0
D.annularis	0,2055	0,4814	96,08	0,0588	0
S.sphyraena	0,1879	0,4402	96,52	0	0,0556
L.mormyrus	0,1799	0,4216	96,94	0,0588	0
D.puntazzo	0,1799	0,4216	97,37	0,0588	0
Alloteuthis spp	0,1682	0,3942	97,76	0	0,0556
S.flexuosa	0,1576	0,3693	98,13	0	0,037
A.fallax	0,1406	0,3294	98,46	0	0,037
B.capriscus	0,1335	0,3127	98,77	0	0,037
S.aurita	0,08324	0,195	98,97	0	0,0185
D.volitan	0,07959	0,1865	99,15	0	0,0185
L.aurata	0,06777	0,1588	99,31	0	0,0185
S.elegans	0,061	0,1429	99,46	0	0,0185
P.bogaraveo	0,05903	0,1383	99,59	0	0,0185
C.obscurus	0,05903	0,1383	99,73	0	0,0185
D.pastinaca	0,05719	0,134	99,87	0	0,0185
S.sarda	0,05719	0,134	100	0	0,0185

Overall average dissimilarity : 42,68

Supplementary table 3: SIMPER similarity analysis table of discarded species.

Species	Av. dissim	Contrib. %	Cumulative %	Mean Area 1	Mean Area 2
S.maena	1,942	3,82	3,82	1	0,167
C.cuculus	1,869	3,675	7,495	0,882	0,111
G.niger	1,845	3,628	11,12	0	0,815
T.trachurus	1,677	3,297	14,42	0,765	0,037
M.merluccius	1,588	3,122	17,54	1	0,333
C.macrophthalma	1,479	2,909	20,45	0	0,667
P.longirostris	1,475	2,9	23,35	0,765	0,222
O.barbatum	1,453	2,858	26,21	0,765	0,222
P.erythrinus	1,342	2,639	28,85	0,647	0,167
S.solea	1,307	2,57	31,42	0,588	0,037
C.aper	1,293	2,543	33,96	0,824	0,407
E.myrus	1,293	2,543	36,5	0,647	0,333
T.lyra	1,228	2,414	38,92	1	0,481
B.boops	1,197	2,354	41,27	0,765	0,463
T.draco	1,189	2,338	43,61	0,529	0,13
T.marmorata	1,168	2,298	45,91	0,588	0,481
P.martia	1,163	2,287	48,2	0,529	0
S.cabrilla	1,16	2,281	50,48	0,529	0,13
E.encrasicolus	1,159	2,278	52,75	0,647	0,519
B.ocellaris	1,143	2,248	55	0,0588	0,519
M.barbatus barbatus	1,142	2,245	57,25	0,529	0,648
L.vulgaris	1,105	2,172	59,42	0,529	0,907
E.moschata	1,07	2,104	61,52	0,647	0,667
S.smaris	1,048	2,06	63,58	0,471	0,13
M.ocellatus	1,023	2,013	65,6	0,471	0
S.officinalis	1,02	2,005	67,6	0,765	0,63
S.aurita	1,002	1,97	69,57	0	0,426
Z.faber	0,984	1,935	71,51	0,412	0,13
L.friesii	0,9742	1,916	73,42	0,235	0,37
S.hepatus	0,9139	1,797	75,22	0,588	0,981
M.surmuletus	0,8646	1,7	76,92	0,353	0,148
O.vulgaris	0,837	1,646	78,57	0,353	0,0926
S.notata	0,7555	1,486	80,05	0,0588	0,315
C.conger	0,7183	1,412	81,46	0,824	0,815
E.vipera	0,6327	1,244	82,71	0,294	0
P.acarne	0,5554	1,092	83,8	0,882	0,833
S.scrofa	0,5363	1,055	84,85	0,176	0,111
S.flexuosa	0,502	0,987	85,84	0	0,222
Plesionika sp	0,4956	0,9745	86,82	0,235	0
S.pilchardus	0,4845	0,9526	87,77	0,824	0,944
T.nobiliana	0,455	0,8947	88,66	0,176	0,037
R.polystigma Regan	0,4304	0,8463	89,51	0,176	0,0556
P.pagrus	0,4085	0,8034	90,31	0,176	0
S.scriba	0,3963	0,7793	91,09	0,176	0,037
R.miraletus	0,3727	0,7328	91,82	0,176	0,0185
C.linguatula	0,3564	0,7007	92,53	0,882	0,963
M.scolopax	0,3029	0,5957	93,12	0,118	0
U.scaber	0,2658	0,5226	93,64	0,118	0
L.piscatorius	0,2652	0,5216	94,17	0,118	0
D.vulgaris	0,2624	0,516	94,68	0,118	0,0185
S.sarda	0,2308	0,4538	95,14	0,0588	0,037
C.acus	0,2099	0,4127	95,55	0,0588	0,037
S.mantis	0,1964	0,3862	95,93	0,941	0,981
C.obscurus	0,196	0,3855	96,32	0,0588	0,037
S.porcus	0,1774	0,3488	96,67	0	0,0741
C.lucerna	0,1648	0,3241	96,99	0,0588	0,0185
P.kerathurus	0,1371	0,2697	97,26	0,0588	0
A.rueppelii	0,134	0,2635	97,53	0,0588	0
L.caudatus	0,1281	0,2519	97,78	0,0588	0
P.phycis	0,1281	0,2519	98,03	0,0588	0
Alloteuthis sp	0,1214	0,2387	98,27	0	0,0556
D.annularis	0,1178	0,2316	98,5	0,0588	0
S.maximus	0,1132	0,2226	98,72	0,0588	0
C.macropus	0,1102	0,2167	98,94	0	0,0556
S.sphyraena	0,09944	0,1955	99,13	0	0,037
S.elegans	0,08332	0,1638	99,3	0	0,037
Gobius sp	0,08332	0,1638	99,46	0	0,037
S.maderensis	0,07426	0,146	99,61	0	0,037
T.mediterraneus	0,04263	0,08383	99,69	1	0,981
S.scombrus	0,04073	0,0801	99,77	0	0,0185
A.glaber	0,04073	0,0801	99,85	0	0,0185
A.fallax	0,039	0,07669	99,93	0	0,0185
P.bogaraveo	0,03595	0,07068	100	0	0,0185

Overall average dissimilarity : 50,85