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Landing Obligation - Part 6 (Fisheries targeting demersal species in the Mediterranean Sea) (STECF-15-19)

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Abstract

This report presents the responses of the Scientific, Technical and Economic Committee for Fisheries to requests from the European Commission for advice on the implementation of the EU Common Fisheries Policy. Advice is given in relation to the following: Landing Obligation (Fisheries targeting demersal species in the Mediterranean Sea).

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

Landing Obligation - Part 6

(Fisheries targeting demersal species in the Mediterranean Sea) (STECF-15-xx)

THIS REPORT WAS REVIEWED DURING THE WINTER PLENARY MEETING HELD FROM 9 TO 13 NOVEMBER 2015 IN BRUSSELS

BACKGROUND

The landing obligation included under Article 15 of Regulation (EU) No 1380/2013 on the Common Fisheries Policy (CFP)[1] stipulates the progressive elimination of discards of species subject to catch limits and, in the Mediterranean Sea, also catches of species subject to minimum sizes as defined in Annex III of Regulation (EC) No 1967/2006 (MEDREG)[2].

In the Mediterranean Sea, the landing obligation took effect for fisheries targeting (small and large) pelagic species as from 1 January 2015. In October 2014 and based on joint recommendations developed by the Member States concerned, a Commission Delegated Regulation establishing a discard plan for certain small pelagic fisheries was adopted[3]. This regulation identifies the species and fisheries to which concrete measures would apply and it fixes the level of de minimis exemptions. Even though bluefin tuna is a large pelagic species subject to catch limits in the Mediterranean Sea, there is a legal obligation to discard it under the International Commission for the Conservation of Atlantic Tunas (ICCAT). This international decision implies an exception of the landing obligation set in Article 15(2)[4].

[1] REGULATION (EU) No 1380/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC (OJ L 354, 28.12.2013, p. 354).

[2] COUNCIL REGULATION (EC) No 1967/2006 of 21 December 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 1626/94 (OJ L 409, 30.12.2006, p. 11).

[3] COMMISSION DELEGATED REGULATION (EU) No 1392/2014 of 20 October 2014 establishing a discard plan for certain small pelagic fisheries in the Mediterranean Sea (OJ L 370, 30.12.204, p. 21).

[4] COMMISSION DELEGATED REGULATION (EU) 2015/98 of 18 November 2014 on the implementation of the Union's international obligations, as referred to in Article 15(2) of Regulation (EU) No 1380/2013 of the European Parliament and of the Council, under the International Convention for the Conservation of Atlantic Tunas and the Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries (OJ L 16, 23.01.2015, p. 23).

REQUEST TO THE STECF

STECF is requested to review the report of the STECF Expert Working Group meeting, evaluate the findings and make any appropriate comments and recommendations. In making their evaluation STECF is asked to take into account any additional supporting information they may be supplied by the Member States Regional Groups.

Observations of the STECF

STECF observes and acknowledges the work undertaken by the EWG chair and experts to produce the report of EWG 15-14, Landing Obligation Part 6. STECF observes that, due to difficulties arising from inaccurate and incomplete data relating to Mediterranean fisheries, TOR1, identifying and describing the main demersal fisheries, took most of the time available to the EWG. This difficulty prevented the full completion of other TORs.
STECF observes that a list describing the main demersal fisheries with species subject to minimum landing sizes is provided; defining the fishery through area, gear used and target species. TOR1 is fully addressed in section 2 of the EWG report.

Phasing in, at 2017 and 2019, of species to be subject to the landing obligation is to be done according to whether they are the species that define the fisheries or not. This implementation could mean that in the same marine region, and possibly using the same gear, two vessels could be considered to be engaged in different fisheries, depending on their target species. Then, between 2017 and 2019, one crew will be obliged to retain their target species and the other crew could discard the same species, if it is not defined as their target species. STECF observes that it may be much more simple and achievable to phase species into the landing obligation in 2017 according only to marine geographical area or species, rather than by fisheries, however defined.

STECF observes that TOR2 was not addressed by the EWG 15-14 because it could find no information on approaches used by MS to identify species that define fisheries in the Mediterranean Sea.

STECF observes that TOR3 is addressed in section 3 of the EWG 15-14 report which includes a review of available survival information. However, there is little or no literature or evidence available on survivability after discarding in the Mediterranean. Survival rates from studies in other sea areas cannot be directly applied to Mediterranean fisheries as gear characteristics, fishing techniques, sorting on the deck, and environmental conditions are not comparable between sea areas.

STECF observes that, in response to TOR4, the EWG 15-14 report contains a review of technical measures and their effectiveness in improving selectivity in Mediterranean fisheries.
STECF considers that the best option to improve selectivity in the area is a combination of various technical measures used together with dynamic spatial and seasonal restrictions on fishing, as well as permanent restrictions on fishing in nursery areas. The ideal combination of measures depends on area, species, catch composition and “other factors”.

STECF observes that, due to time restrictions, EWG 15-11 did not provide a specified list of the most effective measures for various species, areas or circumstances, and that such a list might be helpful for policy makers.

STECF observes that TOR5 was not fully addressed because fisheries were identified only at the end of the meeting. There is some discussion of the issue that although the legal requirement to discard fish will be removed once the landing obligation is implemented, the economic incentive to discard would remain, unless the vessel operators perceive a high likelihood of having to pay a fine that would exceed their losses or costs incurred from observing the landing obligation arising from retaining and landing unwanted fish.

STECF observes that since TOR1 has been fully addressed, it would now be possible to more fully address TOR5, namely, to identify discard issues that cannot be addressed through improved selectivity or which would create disproportionate costs of sorting unwanted catches on board. However, as mentioned in a previous STECF report (STECF 13-23, https://stecf.jrc.ec.europa.eu/reports/discards), STECF can only advise likely broad levels of costs of handling as a proportion of the sales value of the fish. There is no scientific definition of "disproportionate" in this context and therefore it would be the role of policy makers to decide at which level such a threshold should be set. In this context, STECF agrees it is necessary to identify potential indicators to evaluate the landing obligation and to assess the performance of individual regional discard plans. This is an important issue that should be considered within regional discard plans and work should progress on this aspect.

Conclusions of the STECF

STECF concludes that the EWG 15-14 report represents an important step in identifying and assessing some of the key issues associated with the landing obligations in the Mediterranean Sea.

STECF concludes that, in order to utilise the exemption relating to high survivability of discarded fish, it will be necessary to conduct research and develop appropriate evidence on post-discard survival rates.

STECF concludes that it would be simpler and more realistic to implement the phased approach to bringing species under the landing obligation according to marine geographical area or species rather than according to the species that define the fisheries.

The landing obligation stipulates the progressive elimination of discards of species subject to catch limits and, in the Mediterranean Sea, catches of species subject to minimum sizes as defined in Annex III of Regulation (EC) No 1967/2006 (MEDREG). STECF concludes that, in order to monitor the development of the discards ban, the data collection (landings and discards) for all species included in the MEDREG, should be added to the MS National Programmes.

STECF concludes that further exploration as to the utility of different technical measures in the context of achieving the objectives of the CFP in Mediterranean fisheries is warranted, for example through a dedicated EWG. Specifically, this should aim to evaluate the biological and economic impact of changing selectivity through adjustments in technical regulations and to identify what can be achieved by TCMs regarding the broader objectives of the CFP including the achievement of MSY objectives and the landing obligation.

Expert Working Group EWG-15-14 report

REPORT TO THE STECF

EXPERT WORKING GROUP ON
Landing Obligation - Part 6
(Fisheries targeting demersal species in the Mediterranean Sea)
(STECF-15-14)

Ancona, Italy, 12-16 October 2015

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

EXECUTIVE SUMMARY

Main European Demersal Fisheries

A critical analysis of DCF data on value and volume of landings, as well as on fishing effort, allowed identifying the main European demersal fisheries in Mediterranean. Efforts to ensure that Member States submit complete datasets in response to the DCF economic data call for the EU fishing fleet should be stepped up. Such data should be made available to a future EWG. Taking into account a 75 % threshold of the cumulative value and volume of landings, on the basis of the data of the last two years, it was possible, for each fishery, to identify the most important target species. An exploratory analysis of the landings volume data by Member State and year was carried out. EWG15-14 decided to restrict the analysis to the years 2013 and 2014 in order to identify the most important species driving the fisheries and that will be subject to landing obligation in 2017 because landings data for all Mediterranean MS was available for these years. The dataset did not provide any data for the following taxa with MLS: *Epinephelus* spp, *Lithognathus mormyrus, Polyprion americanus, Homarus gammarus,* Palinuridae, *Pecten jacobeus* and *Venerupis* spp.

Bottom otter trawl for demersal species (DEMSP_OTB). This is undoubtedly the most important fisheries, widespread in all the Mediterranean GSAs, by the majority of the trawl vessels. It is particularly relevant in GSAs 6, 7, 9, 16, 18, 17, 20 and 22. The fisheries target a variety of species; the most important ones are European hake and red mullets. Other species play an important role in specific GSAs: deep water pink shrimp (e.g. in GSAs 16 and 9), horned and musky octopuses (in GSAs 7 and 18), Norway lobster (in GSA17, Croatia). Mantis shrimp (in GSA7), common octopus (in GSA6), and picarels (in GSAs 5 and 23).

Bottom otter trawl for mixed deep water species (MDDWSP_OTB). A minor fraction of bottom otter trawlers is involved in fisheries performed mostly on the continental shelf break (from 200 to 400 m). The most important target species include Norway lobster and deep water pink shrimp.

Bottom otter trawl for deep water species (DWSP_OTB). This fishery specialises mainly on the exploitation of red shrimps on the continental slope. The value and the volume of the landings are almost entirely constituted by red and blue shrimp as well as by giant red shrimps, with differences according to the areas. These fisheries are present in particular in GSAs 5, 6, 7, 10, 15, 16 and 19.

Trammel net fisheries for demersal species (DEMSP_GTR). These fisheries are widespread in Mediterranean and are practiced by a large fraction of the small scale vessels. It is carried out in the coastal zones and employs different kinds of trammel nets, alternated along all the year according to the availability of resources. In general, the most important target species are the red and the striped red mullets and the common cuttlefish. However, there are other target species, which can vary according to the areas and seasons, e.g. the common sole in GSA17 (Italian side) or the Caramote prawn in GSA22.

Set gillnet fisheries for demersal species (DEMSP_GNS). These fisheries are practiced by a large part of the small scale vessels. A wide group of target species is present, with differences from one GSA to another. They vary from European hake (in GSAs 20, 9 and 7), Common sole (GSA17, Italian coast, and GSA10), Red mullets (GSAs 16 and 11), European seabass (GSAs 6 and 7), Pandoras (GSAs 1 and 7), Bogue (GSA25), and Round sardinella (GSA23).

Set longline for demersal fish (DEMF_LLS). A small fraction of the artisanal vessels employs longlines (mostly bottom longlines). The most important target species are the European hake (in GSAs 6, 7, 10, 16, 18 and 19), and Sparids (in GSAs 5, 11, 15, 17, coasts of Croatia and Slovenia, GSAs 23 and 25).

Pots and traps for demersal species (DEMSP_FPO). These are other specialised fisheries, carried out in many areas. The most important target species is common octopus, or cuttlefish, as in GSA17.

Boat dredge for molluscs (MOL_DRB). They are fisheries present in the GSAs 1, 6, 10, 17 and 18. They exclusively target clams (*Chamelea gallina*).

Survival information

Limited information on survivability is available for the species listed in Annex III of Regulation (EC) No. 1967/2006. Indeed, from studies carried out in the Mediterranean there is practically no information available for most of the concerned species. Therefore, studies which estimate discard survival in the Mediterranean Sea are urgently required in case exemptions to the landing obligation regulation are requested. Survivability would be better informed if dedicated survival studies were undertaken specifically in the Mediterranean fisheries concerned, since survival rates estimated in areas other than the Mediterranean cannot be directly applied to the Mediterranean fisheries. This is due to the fact that, among others, gear characteristics (e.g. mesh sizes are usually larger in the North Atlantic) and fishing techniques as well as environmental conditions (e.g., temperature) are not directly comparable to the Mediterranean.

Mitigation measures to improve the demersal trawl selectivity

The wide range of developments in fishing gear technology continues to have a significant impact on bycatch, and consequently on discarding. Much of this bycatch consists of juvenile and low-value fish that are often discarded, usually dead. To minimize the biological impacts on bycatch and to promote ecologically sustainable fisheries in the Mediterranean, fishing gears should be modified to address both the size and species selectivity issues. Improved selectivity can be achieved by modifying gear design and/or operation, and by using alternative fishing gears. The changes usually involve modifying the size, shape and twine thickness of the codend meshes, changing the number of meshes around to codend circumference or inserting square mesh windows, sorting grids, fish eye, separator panel, etc either in the codend or in the aft part of the extension piece. However, most of *Bycatch Reduction Devices* (BRDs) tested around the world are difficult to implement in the Mediterranean. A review of selectivity studies has been carried out, and the main factors that can influence bottom trawl selectivity were identified.

Mesh size. Mesh size is considered the main factor affecting codend selectivity; this is why minimum mesh size for the codend has been fixed by legislation in the Mediterranean.

Mesh opening angle. The same mesh size can have variable selectivity depending on the opening angle of the mesh. Mesh opening angle mostly depends on the weight of the catch in the codend, and it can be manipulated by changing the number of meshes in the codend circumference. Owing to the generally low catch in the Mediterranean trawl, the effect of codend circumference is not always clear, even if simulations confirm that the opening angle strongly affects the selective properties of a codend.

Mesh geometry. Mesh geometry is an important technical factor that is known to affect demersal trawl selectivity. Diamond-mesh codends are traditionally used in Mediterranean, while square-mesh codends have only recently been introduced with the EC Reg. No. 1967/2006. Recent studies performed in the Mediterranean that compared the selectivity of diamond and square-mesh codend of the same mesh size, showed that square-mesh codends more effectively release juveniles of target fish. Article 9 of the EC Reg. No. 1967/2006 established the mandatory use of 40 mm square-meshed netting at the codend of towing nets or, at the duly justified request of the ship-owner, by a diamond-meshed net of 50 mm. However, the available studies highlight that some species benefit from DM50 codends, while for some others changing from SM40 to DM50 did not have any significant effect. Therefore, the use of a 50 mm diamond-meshed codend should be justified only when the size selectivity is demonstrated to be equivalent to or higher than that of 40 mm square-mesh codend. The EC Reg. No. 1967/2006 clearly explains that in case of towing nets the smallest meshes shall be at the codend. Thus, the correct interpretation of this Regulation is: in the case of 40 mm square-mesh codend the rest of the net should have a mesh opening larger than 40 mm; in the case of 50 mm diamond-mesh codend the rest of the net shall have a mesh opening more than 50 mm. However, a weakness still remains in the Regulation, given that there is no requirement to report the length of the codend. In fact, the actual risk is that fishermen may decide to adopt 40 mm square-mesh codend; in this case they can use short square-mesh codends (less than a meter for example) by leaving the rest of the net with 40 mm diamond-mesh netting, rendering these technical measures practically inefficient. In this regard the review of demersal trawl net designs carried out in the *MyGears* project can be a useful tool to identify codend properties. The improvement in selectivity when using the square-mesh was not evident for flatfish, most likely due to their specific cross sectional shape. Therefore, 50 mm diamond-mesh codend should be mandatory in cases where flatfish define trawl fisheries, such as in the Rapido trawling. Moreover, studies on the effect of a 60 mm diamond-mesh codend on selectivity should be implemented.

Square-mesh panels. The use of square-mesh panels in studies carried out in the Mediterranean did not show any clear positive effects on the selectivity when compared with traditional trawl gear. Thus, the results obtained did not encourage proceeding with these tests. In fact, the full square-mesh codend showed, on average, a better selective performance than a square-mesh panel.

New net designs. Novel designs for bottom trawl nets have been tested in recent projects (BENTHIS, KBBE-CALL 6-312088) with promising results. The selector device consists of two separator panels, which carry the fish near the side panels of trawl net where escapement windows are placed to guarantee the escapement of juveniles and other unwanted catches. Separator panels can represent another solution. A separator panel is a selective device based on the behaviour differences between species. The basic design consists of a single panel inserted horizontally by splitting the trawl totally or partially, in two levels. The selectivity process is completed by the use of meshes large enough to allow the escape of juveniles on the upper part of the trawl. The use of these new devices should be tested more in depth.

Sorting grids. Sorting grids are generally rigid panels of spaced bars made of aluminium, steel or plastic fitted to the extension of the trawl, immediately in front of the codend. Sorting grids are used to physically block the passage of bycatch into the codend and guide it toward an escape opening. The use of sorting grids seems to show promising results for species selection, even if there is not a clear positive effect on selectivity when compared to traditional trawl gear. In particular, sorting grids showed good results in sorting shrimps and Norway lobsters from other species.

Thus, the use of sorting grids should be studied more in depth in fisheries targeting shrimps (*Aristaemorpha folicaea* and *Aristeus antennatus*) and Norway lobsters (*Nephrops norvegicus*). The access to certain fishing grounds and areas, for instance, could be allowed only if bottom trawlers will be equipped with sorting grids. However, new technical measures can be effective only if they can be proven to be simple, workable and enforceable. Therefore, it is essential to identify standard properties of the grids that should be included in a clear provision (i.e. setting a clear dimension for grid bars and space between bars).

Footrope. In the basic design the front part of a bottom trawl is framed with a headline on the top, equipped with a series of floats and a groundrope on the bottom. The groundrope is equipped with leads and/or chain, which is designed to provide a good contact with the bottom and increase catch efficiency. The groundrope of a trawl net has an effect on the amount or proportion of flatfish and shellfish that may be caught. The Council Regulation (EC) No 1967/2006 stated: "*Technical specifications limiting the maximum dimension of floatline, groundrope, circumference or perimeter of trawl nets […] shall be adopted, by October 2007, in accordance with the procedure laid down in Article 30 of this Regulation*". The dimensions of groundrope and headrope mainly affect fishing effort, catch efficiency and, indirectly, the amount of discard. Therefore, it is advisable to set a maximum length for the headrope and groundrope, according with the data collected during *MyGears* project (Sala et al., 2013).

Alternative gears. The use of passive gears (passive nets and pots) as a possible alternative solution to mitigate the trawling impact and reduce discards should be investigated more in depth, mainly taking into account the economic consequences of this change. Technical solution to improve pot catch efficiency should be tested as well. Potential consequences include some short- and long-terms possible effects on the socio economic characteristics of the target stocks exploitation, market prices, gear and maintenance costs, and acceptability by the fisheries sector.

Dredges. The selectivity of dredges is usually the sum of two selective processes: the selectivity of the main gear (the dredge or cage) and the selectivity of the sieve. Many factors are known to affect dredge selectivity. According to the landing obligation, once the species, covered by the obligation are on deck they cannot be discarded, with the exception for the species for which scientific evidence demonstrates high survival rates. This is assumed for the clam *Chamelea gallina* in the Adriatic clam fisheries. However studies on the survivability of this species do not exist and must be carried out. Sala et al. (2014) confirm that it is technically rather unfeasible to select only individuals with a size not smaller than the Minimum Conservation Reference Size (MCRS). Therefore, as already permitted for Anchovy and Sardine, for which Member States may convert the minimum size into 110 specimens per kg and 55 specimens per kg respectively, a similar approach (number of clams per kg) should also be allowed for *C. gallina*.

Passive nets. The review of selectivity studies confirm that passive nets are quite selective and mesh opening is the most important parameter to take into consideration for selectivity issue. According to the review carried out in the Archimedes project the mesh size provisions included in the Article 9 of Council Regulation 1967/2006 ("Bottom-set gillnets shall not have a mesh size opening smaller than 16 mm) seems to be unbalanced with the actual situation, since most of nets have a mesh opening greater than 20 mm. Moreover, the Council Regulation 1967/2006 only refers to mesh opening of bottom-set gillnets, without mentioning trammel nets and combined nets, which are widely used in the entire Mediterranean Sea. Thus, the definition of a minimum mesh size also for trammel nets and combined nets should be suggested.

Economic impacts of the Landing Obligation

There are legal and economic reasons to discard. The landing obligation will remove the legal constraints (e.g. minimum landing size), but economic reasons may prevail. The economic reasons to discard are small size or poor quality of the individuals (e.g., damaged or not so fresh), highgrading, low market price, or catch of non-commercial species because of low demand that do not compensate sorting and handling costs. In order to avoid discards, once the legal constrains are eliminated (landing obligation), there is the need that incentives to land the catch are higher than the incentives to discard it (i.e., handling and sorting costs).

On the other hand, the landing incentives could be, for example, a compensation (payment) for the landed fish that would be otherwise discarded (i.e., undersized) by weight landed. However, it is also not easy to set a proper value. A compensation lower than the sorting costs may not be an incentive sufficient for fishermen to avoid discarding; while, a payment higher than the costs could have the opposite effect, and be an incentive for fishermen to voluntary target undersized fish. This implies that, at theoretical level, the compensation for landing unwanted fish should be delineated, at least, by fleet segment and fisheries. The extent of the discards will also depend on the selectivity of the gear and the fishing strategy (e.g., the ability and willingness of the skipper to avoid nursery areas), which will affect the expected revenues and costs.

Fishers' compliance with the landing obligation will largely depend on the expected changes (i.e., decrease) in profitability (coming from changes in revenues, costs or both) compared to the expected level of fines to pay if detected not complying with the landing obligation regulation. Under the landing obligation, if there are no economic incentives to land the undersized fish caught, there is the need of high levels of surveillance to ensure that they are not discarded. However, typically fisheries control and enforcement is quite costly. So, a high level of surveillance to ensure the full implementation of an EU discard ban could be very costly considering the size of the EU fleet. Further considerations that should be considered when implementing the LO are the in land costs and investments in infrastructures to guarantee that the undersized fish landed is utilized and not wasted; the need to define the incentives to land the catch; the control and enforcement costs necessary to establish and implement the landing obligation.

1. INTRODUCTION

1.1. Background

The landing obligation included under Article 15 of Regulation (EU) No 1380/2013 on the Common Fisheries Policy (CFP)[5] stipulates the progressive elimination of discards of species subject to catch limits and, in the Mediterranean Sea, also catches of species subject to minimum sizes as defined in Annex III of Regulation (EC) No 1967/2006 (MEDREG)[6]. In the Mediterranean Sea, the landing obligation took effect for fisheries targeting (small and large) pelagic species as from 1 January 2015. In October 2014 and based on joint recommendations developed by the Member States concerned, a Commission Delegated Regulation establishing a discard plan for certain small pelagic fisheries was adopted[7]. This regulation identifies the species and fisheries to which concrete measures would apply and it fixes the level of *de minimis* exemptions. Even though Bluefin tuna is a large pelagic species subject to catch limits in the Mediterranean Sea, there is a legal obligation to discard it under the International Commission for the Conservation of Atlantic Tunas (ICCAT). This international decision implies an exemption from the landing obligation set in Article 15(2)[8].

1.2. Existing information

Since late 2013, five STECF Expert Working Groups[9] have been organised with the purpose of providing advice and guidance for the Commission, Member States and the stakeholders in the implementation of the landing obligation. A number of scientific and technical issues have been examined, such as the identification of fisheries with specific discard problems, and reviewing scientific knowledge on the survival of species. STECF has also carried out evaluations of joint recommendations for discard plans put forward by regional groups of Member States. In parallel, the European Commission granted in 2014 a pilot project on catch and discard composition including solutions and possible elimination of unwanted by-catches in trawl net fisheries in the Mediterranean Sea (the so-called, *DISCATCH* project). The main objectives of the project are to: (1) provide an overall assessment of the fishing fleet discarding behaviour and to identify the main reasons for discarding; and (2) identify measures to mitigate or eliminate by-catches of unwanted species.

[5] REGULATION (EU) No 1380/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC (OJ L 354, 28.12.2013, p. 354).

[6] COUNCIL REGULATION (EC) No 1967/2006 of 21 December 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 1626/94 (OJ L 409, 30.12.2006, 11).

[7] COMMISSION DELEGATED REGULATION (EU) No 1392/2014 of 20 October 2014 establishing a discard plan for certain small pelagic fisheries in the Mediterranean Sea (OJ L 370, 30.12.204, p. 21).

[8] COMMISSION DELEGATED REGULATION (EU) 2015/98 of 18 November 2014 on the implementation of the Union's international obligations, as referred to in Article 15(2) of Regulation (EU) No 1380/2013 of the European Parliament and of the Council, under the International Convention for the Conservation of Atlantic Tunas and the Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries (OJ L 16, 23.01.2015, p. 23).

[9] Reports STECF-13-23, STECF-14-01, STECF-14-06, STECF-14-19, and STECF-15-05 are available at following address: http://stecf.jrc.ec.europa.eu/reports/discards.

The outcome of a comprehensive review and analysis of the scientific papers and technical reports within this project are considered to be of relevance for the EWG15-14[10]. Furthermore, two Horizon 2020 projects are currently underway: *DiscardLess* "Strategies for the gradual elimination of discards in European fisheries" and *MINOUW* "Science, technology and society initiative to minimize unwanted catches in European fisheries". The ongoing work of these projects, particularly for the cases studies in the Mediterranean Sea, should also be taken into consideration.

1.3. Next steps

The landing obligation will apply to demersal species subject to minimum sizes as defined in Annex III of the MEDREG. This includes fisheries for finfish species (e.g. *Merluccius merluccius, Mullus* spp, *and Solea vulgaris*), crustaceans (e.g. *Nephrops norvegicus, Homarus gammarus,* and *Parapenaeus longirostris*) as well as mollusc bivalves (e.g. *Chamelea* spp). The time-frame for implementation of the landing obligation has been set on a phased basis: (i) as from 1 January 2017 for species which define the fisheries; and (ii) as from 1 January 2019 for other all species subject to minimum sizes. To assist Member States and the Mediterranean Advisory Council (MEDAC) in formulating joint recommendations that will form the basis of regional discard plans for fisheries targeting these species it is proposed to convene a further STECF-EWG specifically addressed to the Mediterranean and Black Seas.

1.4. Terms of Reference for the EWG-15-14

The EWG15-14 is requested to address the following Terms of Reference:

TOR 1. Identify and describe the main demersal fisheries where the species caught are subject to minimum sizes. The fisheries shall be described in terms of species, catch composition, fishing gear and fleets.

TOR 2. Review and provide comments on the approach used by the Member States to identify the species that define the fisheries in the Mediterranean Sea.

TOR 3. Review available survival information and assess whether the findings can be applicable to the stocks that may fall under the landing obligation (e.g., *Nephrops norvegicus* or *Chamelea* spp).

TOR 4. Review existing mitigation measures to improve the selectivity of the fishing gears targeting demersal stocks and identify, on the basis of satisfactory evidences, the most effective measures that could be implemented in a short term for the different fisheries.

TOR 5. Identify potential discard issues associated with the fisheries previously identified that cannot be addressed through improvements in selectivity or would lead to disproportionate costs of sorting unwanted catches on board.

[10] The Interim Report and the deliverables of the DISCATCH project are available for the STECF EWG15-14. However note that the project has not finalised yet and that any document should therefore not been widely distributed.

2. Main European Demersal Fisheries in terms of species, catch composition, fishing gear and fleets

2.1. Data source

When discussing the best approach to describe 'main demersal fisheries' EWG15-14 discussed the fact that fisheries are driven by economic factors. As such data on landings values as well as weight should ideally be considered. Moreover experts agreed that in order to describe fisheries in terms of species and catch composition, data on all species caught is required.

Two data sources were available to experts during EWG15-14:

- DCF Mediterranean data call [11]
- DCF economic data call for the EU fishing fleet [12]

Both data sources have inherent limitations. Whilst the DCF Mediterranean data call contains information on fisheries at metier level, it does not contain data on all species fished by EU Member States, and instead is restricted to the 62 species / species groups included in the data call (see Appendix 1.7 of the data call for a list of the species included). The Mediterranean data call also does not include data on value or landings. EWG15-14 thus decided to look into the possibility of using the DCF economic data call in order to address TOR1.

The 2015 fleet economic data call requested transversal and economic data covering years 2008 to 2014. Capacity data (GT, kW, no. of vessels) was requested up to and including 2014, while employment and economic parameters were requested up to and including 2013. Most effort and all landings data were requested up to and including 2014, as well as, income from landings (non-mandatory). Landings and effort data for fleet segments operating in the Mediterranean & Black Sea region (i.e. Area 37) were requested at the GCFM-GSA level for the first time by the 2015 economic data call. An exploratory analysis revealed several problems with the data submitted by Member States in response to this data call:

- Landings data was not available for Greece;
- Spanish landings data were only available for 2011-2013;
- French landings data were only available for 2012 and 2013;
- For the Mediterranean and Black Sea (FAO Major Fishing Area 37) landings data at geographic stratification level 4, i.e. at the level of GFCM Geographic Sub-Areas were only available for the Italian and Croatian fleets. For the Spanish and Cypriot fleets only part of the data was available at level 4. For all other countries fishing in Area 37 all or part of the data was only available at geographic stratification level 3, i.e. at the level of FAO divisions (see Table 9 in the *§Annex 3. Information on the Landing and Economic DCF databases*);

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[11] Ref. Ares (2015)1710784 - 22/04/2015; Official call for data on landings, discards, length and age compositions, fishing effort, biological parameters, trawl and hydro acoustic surveys in the Mediterranean and in the Black Sea.

[12] Ref. Ares (2015)421690 - 03/02/2015; Call for fleet economic scientific data concerning 2008-2014.

- Data on landings values were not available for all records for which data on landings weights were available (see Table 9);
- Data on fishing gear type was not always available. The use of data on dominant fishing techniques was not considered to be a viable alternative when characterising the 'main demersal fisheries' as required by TOR 1, since the concept of fishing techniques refers to the dominant fishing gear used, and may thus mask the use of several additional fishing gears (see Table 9 in the *§Annex 3. Information on the Landing and Economic DCF databases*). Moreover, the definition of fishing techniques also regroups several fishing methods, for instance the fishing technique DTS includes both demersal trawlers and/or demersal seiners. This issue was particularly problematic for Spain, where no information on fishing gear was available.

EWG15-14 considers that the use of economic information as well as the use of landings data which contains information on all species targeted by a fisheries would have been required to identify and describe the main demersal fisheries operating in the Mediterranean, and thus to fully address TOR1. In order to achieve this, a complete dataset which contains in particular (i) information on fishing gear for all Member States, and (ii) data at the DCF geographic stratification level 4, i.e. the level of GFCM Geographic Sub-Areas is required. Efforts to ensure that Member States submit complete datasets in response to the DCF economic data call for the EU fishing fleet should be stepped up. Such data should be made available to a future EWG.

EWG15-14 further considers that the DCF Mediterranean data call should be revised: (i) catch (landings and discards) information for all species included in Annex III of EC 1967/2006, and (ii) landings data for all species at metier level for the different GSAs and Member States should be requested. Having a more complete dataset available would greatly facilitate the work of a future EWG. Nevertheless an exploratory analysis of the landings volume data by MS and year was carried out (Figure 1). EWG15-14 decided to restrict the analysis to the years 2013 and 2014 in order to identify the most important species driving the fisheries and that will be subject to landing obligation in 2017 because landings data for all Mediterranean MS was available for these years. The dataset considered is constituted by 522 records, where each record represents the combination of country (only EU Mediterranean countries), GSA, year (2013-2014), fisheries and gear. In this dataset the information available for demersal fisheries (MDPSP, FINF, MOL, CEP, DWSP, MDDWSP, DEMF, DEMSP) were 412. Figure 2 illustrates the contribution of typologies of demersal fisheries in each gear reported in the landing data and the relative number of records. The gear OTB is employed in four typologies of demersal fisheries. OTB is the most important gear in terms of number of records reported in the landings of the official biological data call and is mainly represented by DEMSP and DWSP fisheries. A group of passive gears (GTR, LLS, GNS, FPO and LHP) is also important in terms of number of records and is mainly represented by DEMSP fisheries with the exception of LHP represented by FINF and CEP fisheries. The remaining gears are constituted by less than 10 records represented mainly by MOL and CEP fisheries of the available dataset on landings of demersal fisheries contained in 2015 official Mediterranean and Black Sea Data Call provides information for a total of 66 species. However, the EWG 15-14 decided to group some species at genus level due to the unique MLS present in the Annex 3 of 1967/2006 (e.g. *Mullus* spp). Of the resulting 52 taxa the dataset provides information for 13 taxa with MLS according with the Annex 3 of 1967/2006. The dataset did not provide any data for the following taxa with MLS: *Epinephelus* spp, *Lithognathus mormyrus, Polyprion americanus, Homarus gammarus,* Palinuridae, *Pecten jacobeus* and *Venerupis* spp. In Figure 3 are showed the contribution of taxa with MLS in each gear reported in the landing dataset and the relative number of records. The same information is reported by country in Figure 4.

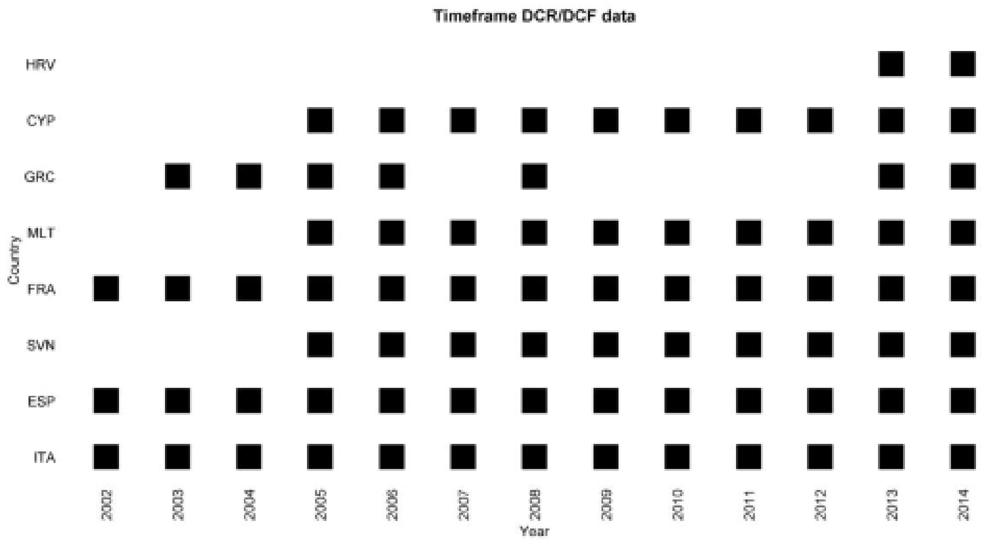


Figure 1. Time frame coverage by country (only Mediterranean) of landing dataset from 2015 official Mediterranean and Black Sea Data call.

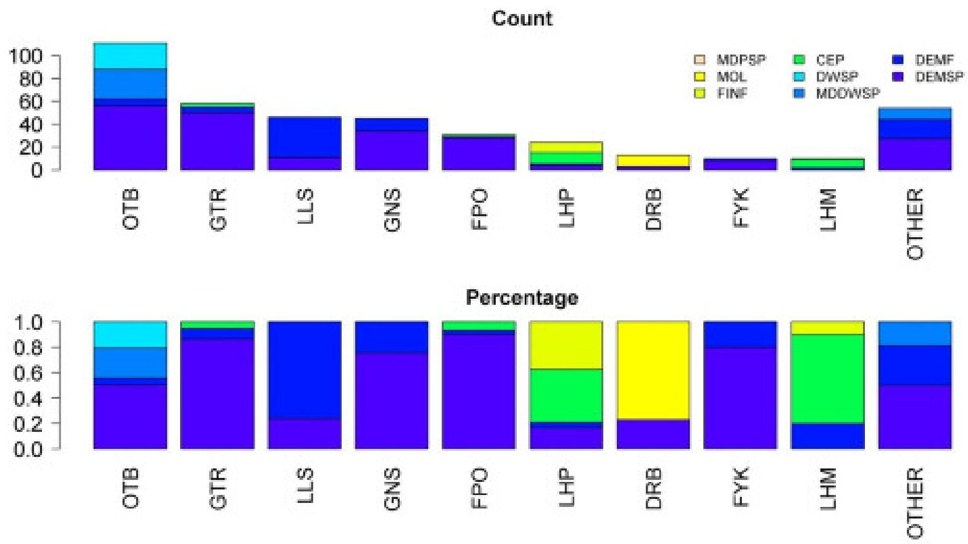


Figure 2. Count and relative percentage of fisheries record distributions by gear.

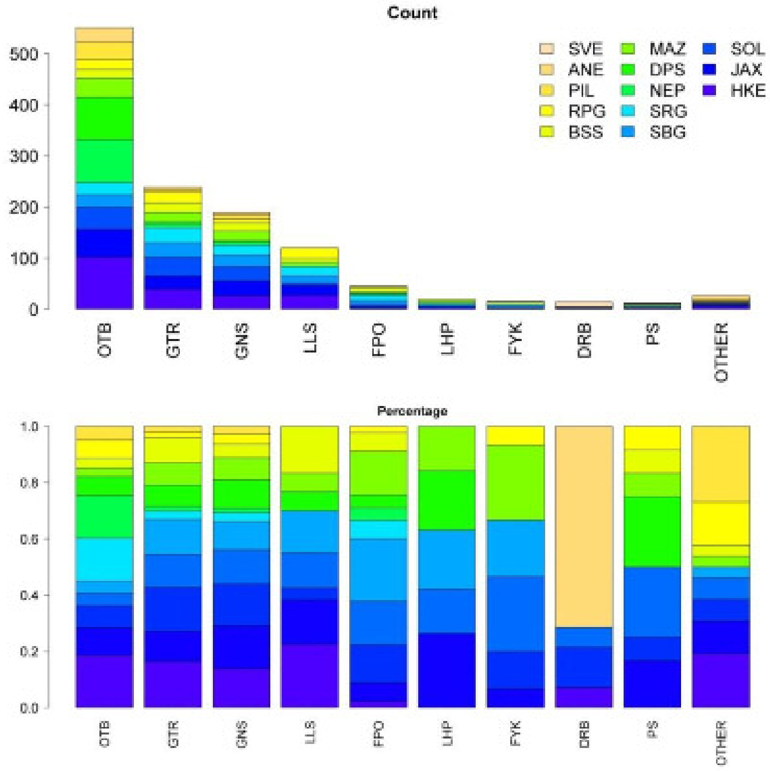


Figure 3. Count and relative percentage of species record distributions by gear.

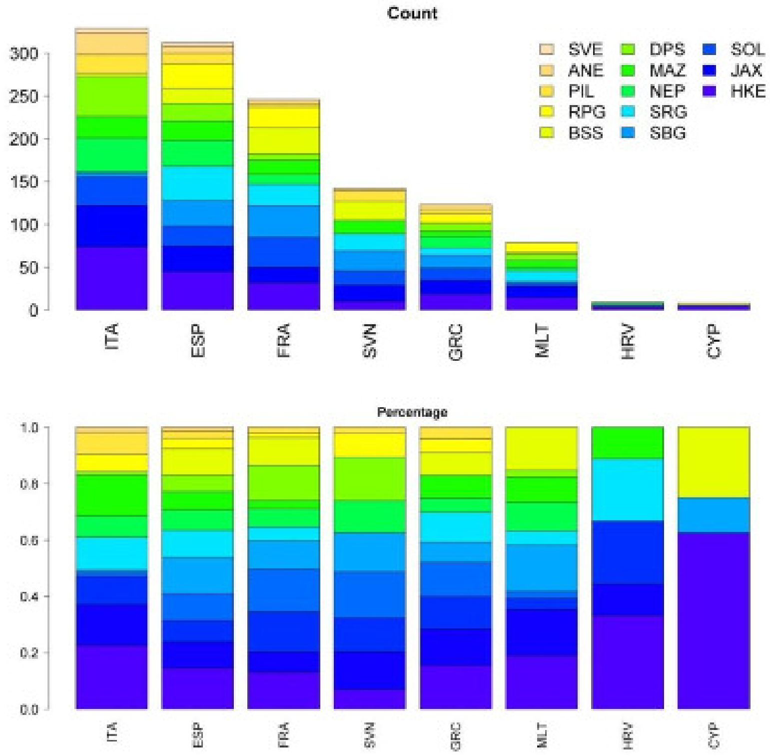


Figure 4. Count and relative percentage of species record distributions by country.

2.2. Group definition

2.2.1. Northern Alboran Sea (GSA 1)

2.2.1.1. Set gillnets targeting demersal species (DEMSP_GNS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Pagellus* spp (PAX), *Octopus vulgaris* (OCC), *Diplodus* spp (SRG) and *Merluccius merluccius* (HKE) (Figure 5a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Pagellus* spp (PAX), *Sardinella aurita* (SAA), *Octopus vulgaris* (OCC), *Diplodus* spp (SRG) and *Merluccius merluccius* (HKE) (Figure 5b). With the exception of *Octopus vulgaris* (OCC) and *Sardinella aurita* (SAA), all other species are included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 120 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL0612 (85%), VL2440 (10%) and VL1218 (9%). In the period 2012-2014, this fleet performed, on average, 7,427 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 5c. The most important fleet segment in terms of fishing effort is VL0612.

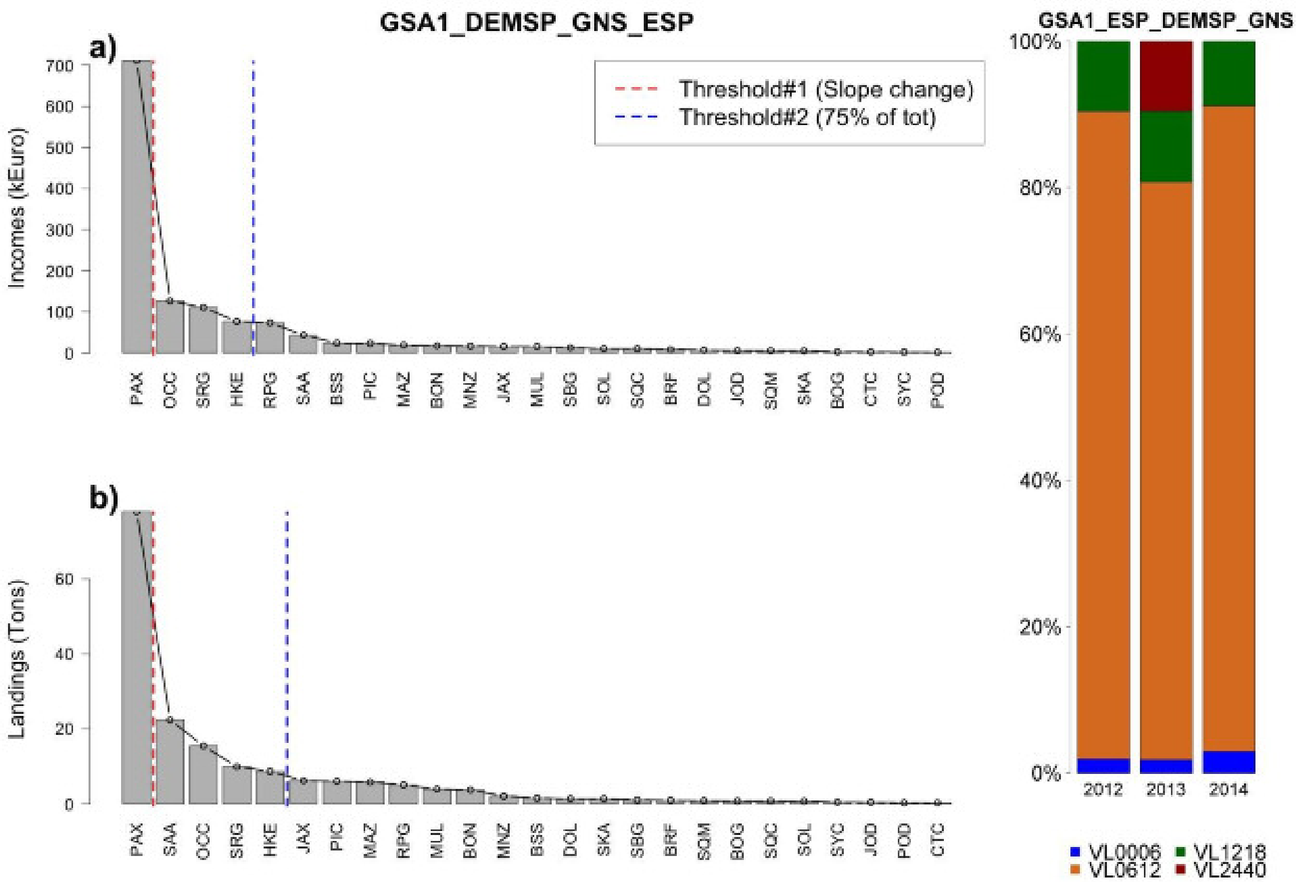


Figure 5. Cumulative percentage for the GSA01_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.1.2. Trammel nets targeting demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Mullus* spp (MUX), *Sepia officinalis* (CTC), *Pagellus* spp (PAX), *Octopus vulgaris* (OCC) and *Merluccius merluccius* (HKE) (Figure 6a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Mullus* spp (MUX), *Sepia officinalis* (CTC), *Pagellus* spp (PAX), *Octopus vulgaris* (OCC), *Trachurus* spp (JAX) and *Merluccius merluccius* (HKE) (Figure 6b). With the exception of *Octopus vulgaris* (OCC) and *Sepia officinalis* (CTC), all other species are included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 261 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL0612 (81 %) and VL1218 (16 %). In the period 2012-2014, this fleet performed, on average, 35,988 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 6c. The most important fleet segment in terms of fishing effort is VL0612.

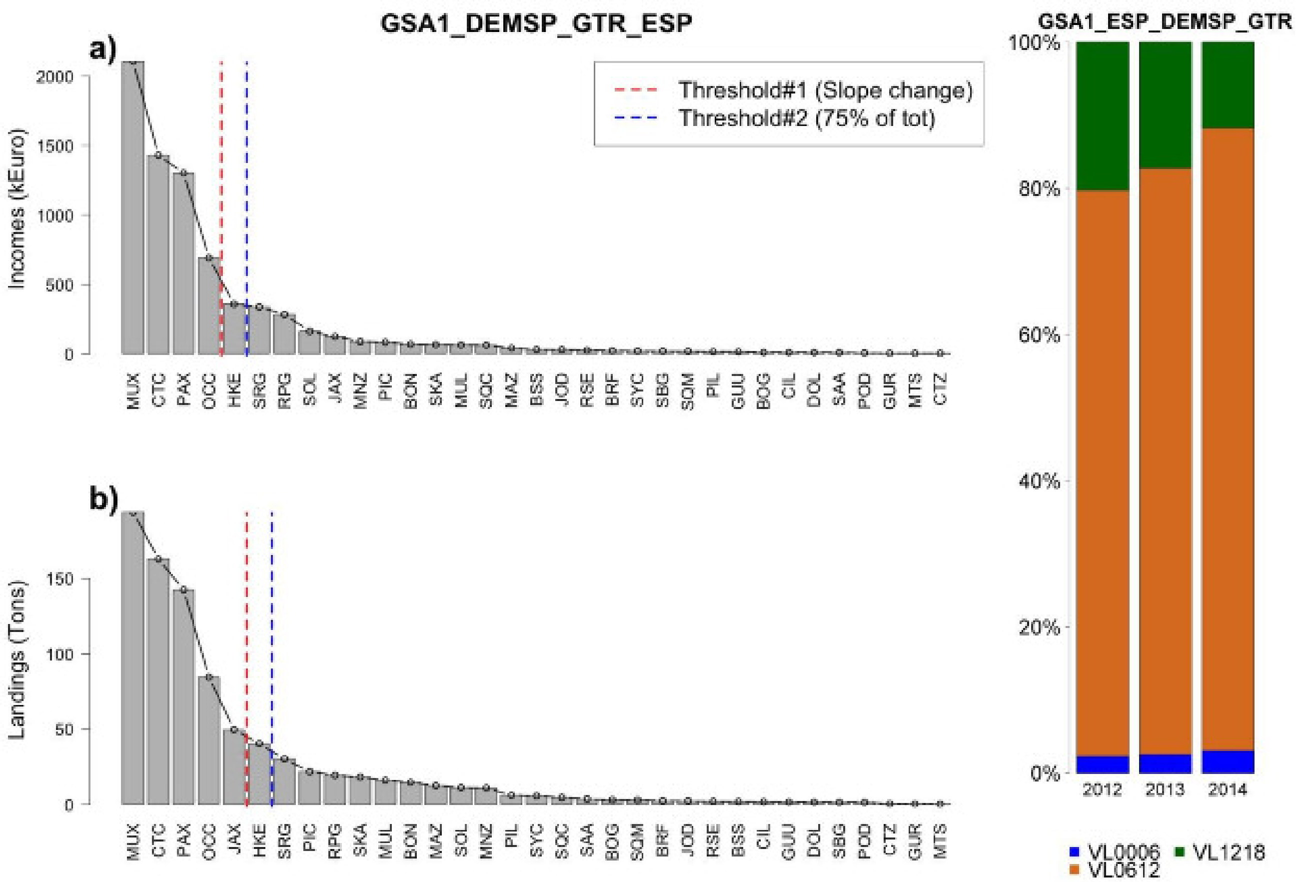


Figure 6. Cumulative percentage for the GSA01_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.1.3. Pole lines targeting demersal species (DEMSP_LHP)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Mullus* spp (MUX) and *Diplodus* spp (SRG) (Figure 7a). These two species also account for the 75 % of the cumulative percentage in terms of biomass of landings (Figure 7b). Both species are included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 10 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL0612 (82%) and VL1218 (17 %). In the period 2012-2014, this fleet performed, on average, 131 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 7c. The most important fleet segment in terms of fishing effort is VL0612.

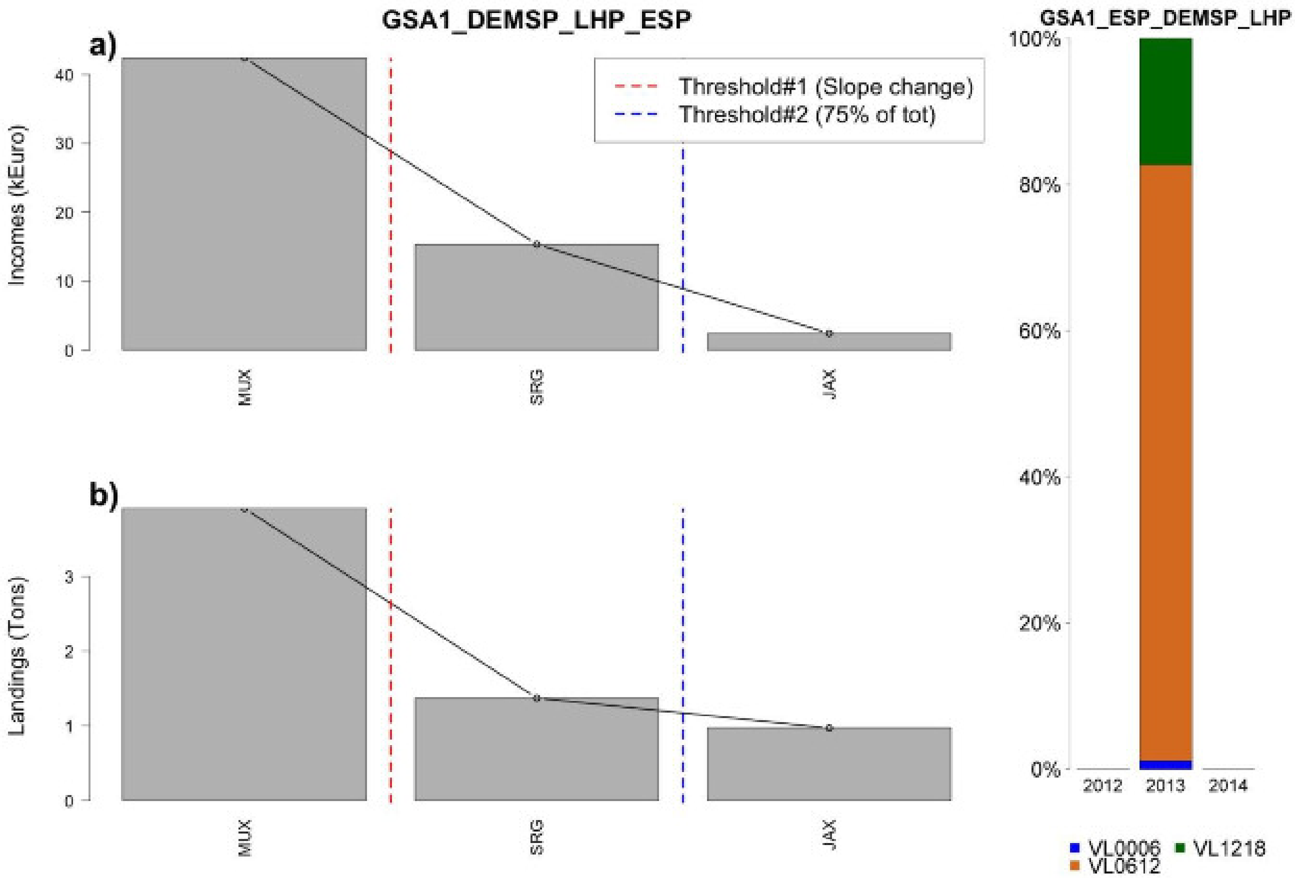


Figure 7. Cumulative percentage for the GSA01_DEMSP_LHP, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.1.4. Set longlines targeting demersal fish (DEMF_LLS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Pagellus* spp (PAX), *Merluccius merluccius* (HKE) and *Sparus pagrus* (RPG) (Figure 8a). These three species also account for the 75 % of the cumulative percentage in terms of biomass of landings (Figure 8b). All three species are included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 47 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL0612 (54 %), VL1218 (30 %), VL1824 (14%) and VL2440 (7 %). In the period 2012-2014, this fleet performed, on average, 6,884 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 8c. The most important fleet segment in terms of fishing effort is VL0612.

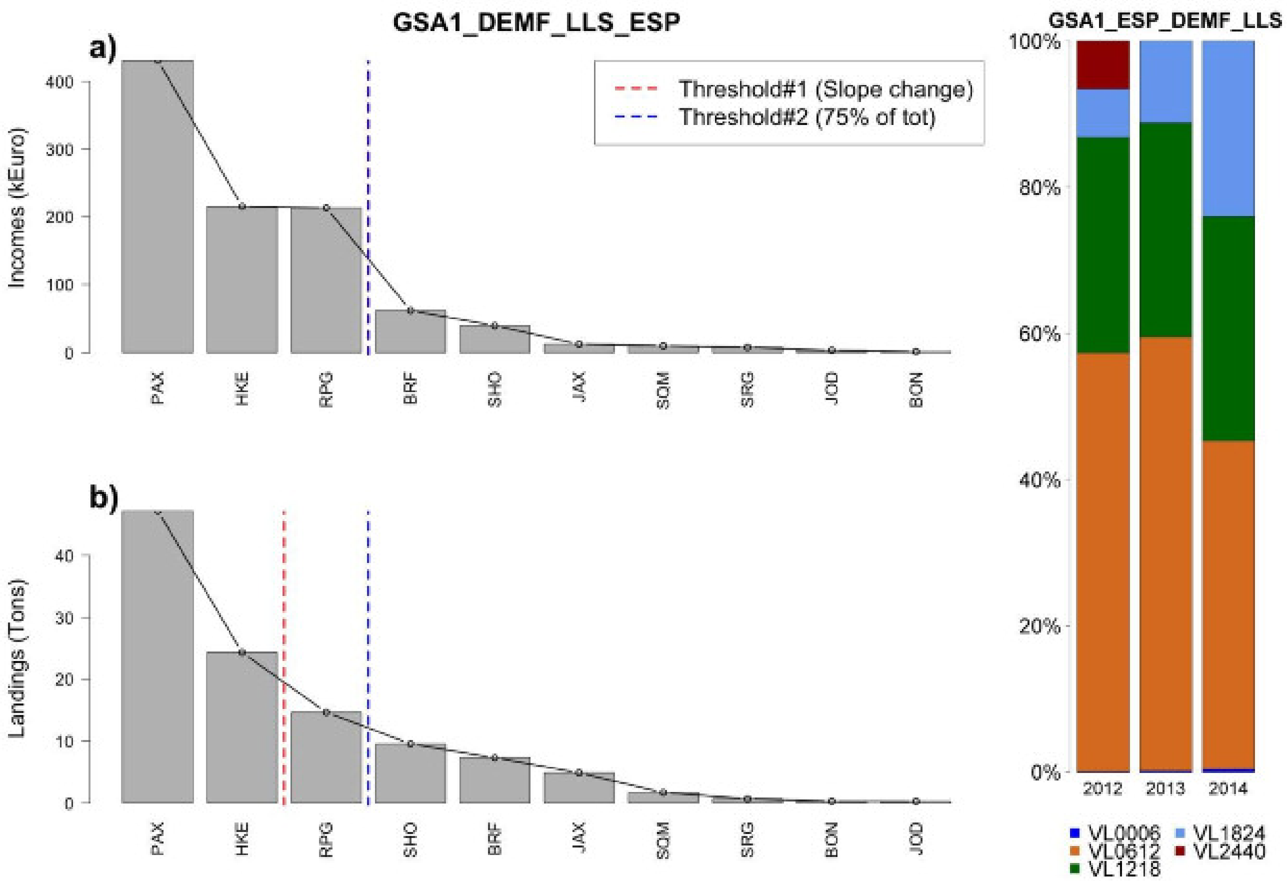


Figure 8. Cumulative percentage for the GSA01_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.1.5. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Octopus vulgaris* (OCC), *Trachurus* spp (JAX), *Merluccius merluccius* (HKE), *Mullus* spp (MUX), *Pagellus* spp (PAX), *Lophius* spp (MNZ), *Parapenaeus longirostris* (DPS) and *Micromesistius poutassou* (WHB) (Figure 9a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Trachurus* spp (JAX), *Octopus vulgaris* (OCC), *Micromesistius poutassou* (WHB), *Merluccius merluccius* (HKE), *Pagellus* spp (PAX), *Mullus* spp (MUX) and *Lophius* spp (MNZ) (Figure 9b). The species *Merluccius merluccius* (HKE), *Trachurus* spp (JAX), *Mullus* spp (MUX), *Pagellus* spp (PAX) and *Parapenaeus longirostris* (DPS) are included in the Annex III of the EU Reg. 1967/2006. These fisheries are performed in GSA 1 by the bottom trawl fleets operating on the muddy bottoms of continental shelf and upper slope. According to the most recent DCF data, in the period 2012-2014, 122 vessels, on average, were involved in these fisheries. This fleet was mostly represented by the segments VL1824 (64%), VL1218 (21%) and VL2440 (15%). In the period 2012-2014, this fleet performed, on average, 949,141 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 9c. The most important fleet segment in terms of fishing effort is VL1824.

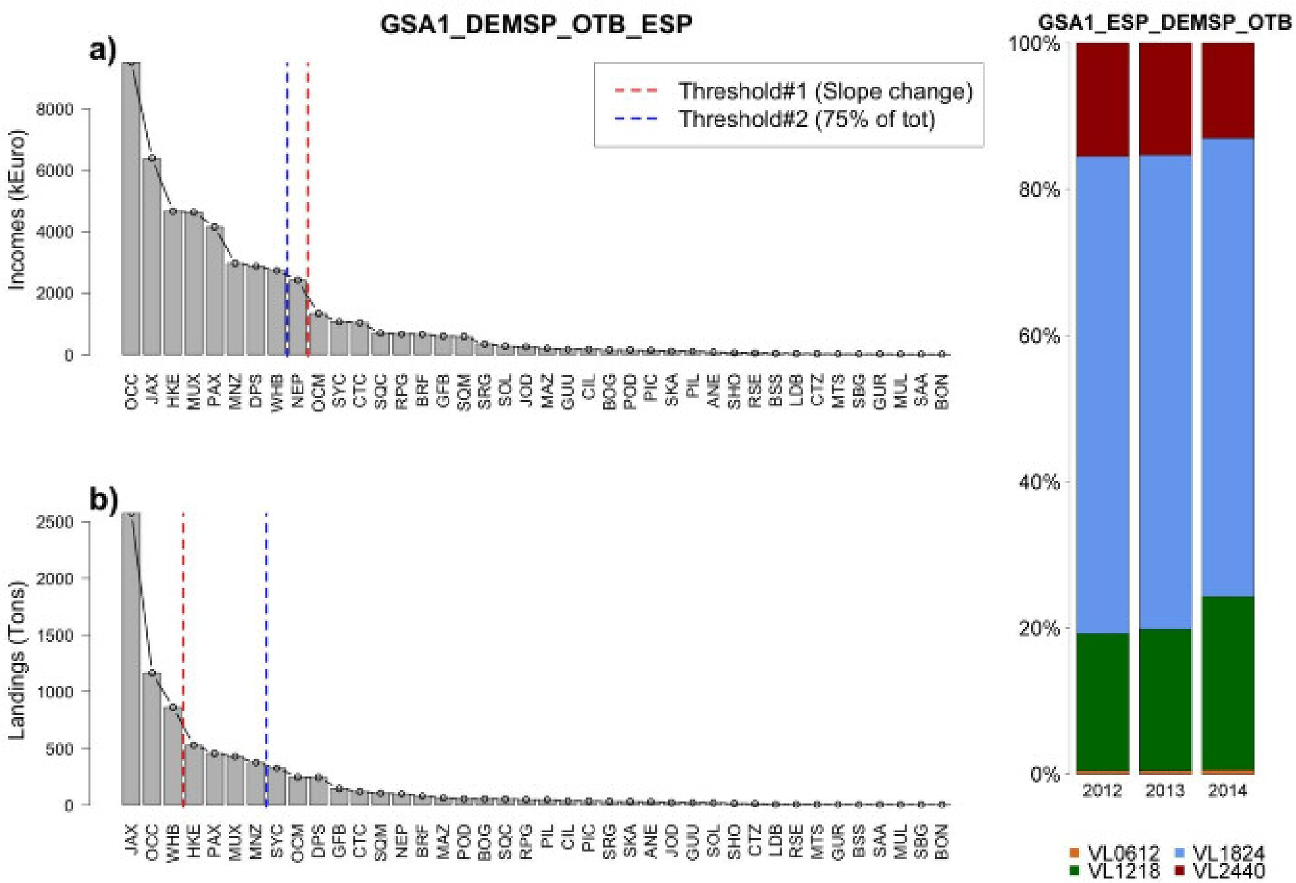


Figure 9. Cumulative percentage for the GSA01_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.1.6. Bottom otter trawl targeting deep water species (DWSP_OTB)

The red shrimp *Aristeus antennatus* (ARA) is the most important target species in terms of incomes (Figure 10a). In terms of landings, *Aristeus antennatus* (ARA) and *Phycis blennoides* (GFB) account for the 75 % of cumulative percentage of landings (Figure 10b). None of these two species is included in the Annex III of the EU Reg. 1967/2006. These fisheries are performed in GSA 1 by the bottom trawl fleets operating on the muddy bathyal bottoms, from 500 to 800 m depth.

According to the most recent DCF data, in the period 2012-2014, 41 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL1824 (58%) and VL2440 (36%). In the period 2012-2014, this fleet performed, on average, 284,477 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 10c. The most important fleet segment in terms of fishing effort is VL1824.

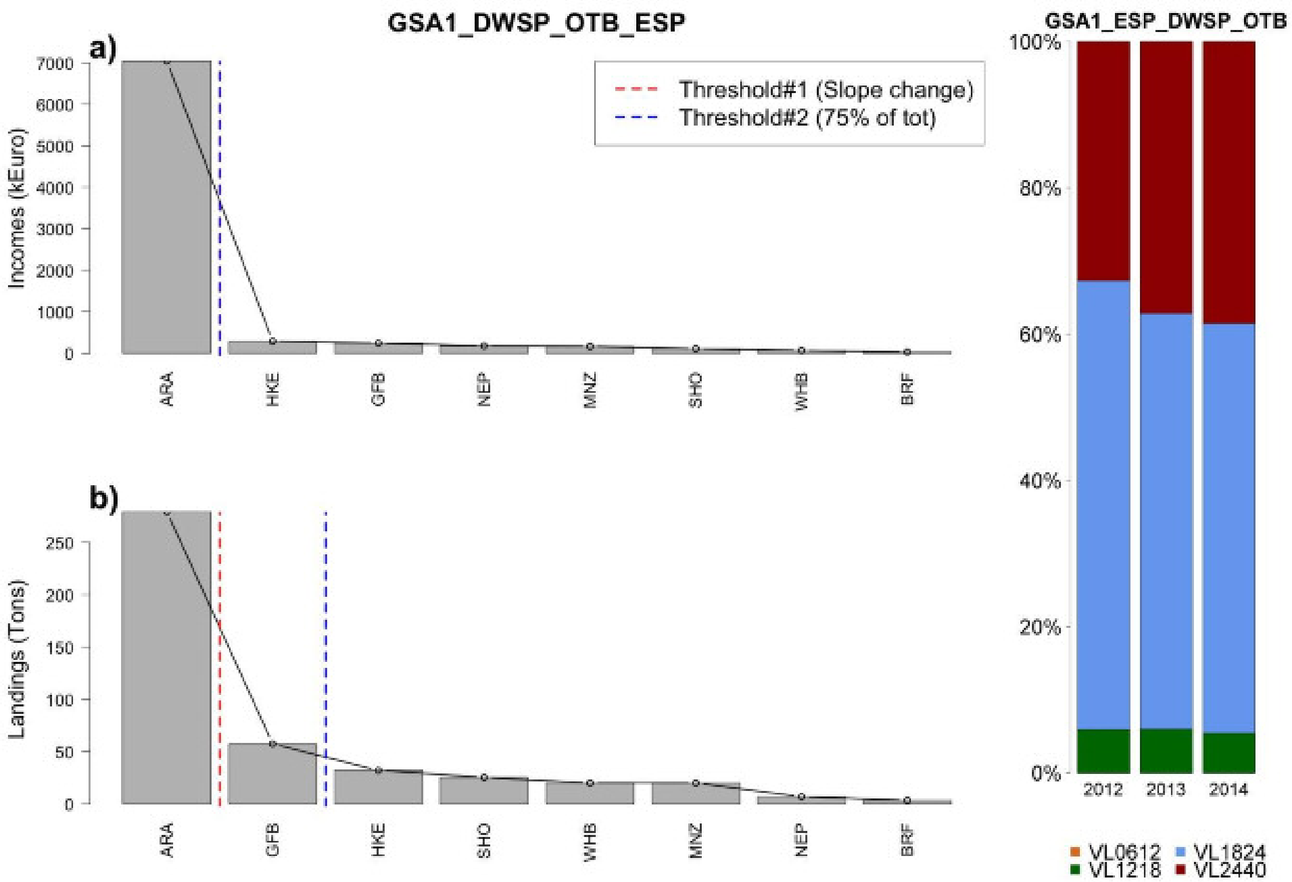


Figure 10. Cumulative percentage for the GSA01_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.1.7. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Merluccius merluccius* (HKE), *Lophius* spp (MNZ), *Parapenaeus longirostris* (DPS), *Nephrops norvegicus* (NEP), *Phycis blennoides* (GFB), *Mullus* spp (MUX) and *Helicolenus dactylopterus* (BRF) (Figure 11a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Aristeus antennatus*, (ARA), *Micromesistius poutassou* (WHB), *Merluccius merluccius* (HKE), *Lophius* spp (MNZ), *Phycis blennoides* (GFB), *Trachurus* spp (JAX), *Octopus vulgaris* (OCC), *Helicolenus dactylopterus* (BRF) and *Parapenaeus longirostris* (DPS) (Figure 11b). The species *Merluccius merluccius* (HKE), *Trachurus* spp (JAX), *Mullus* spp (MUX), *Nephrops norvegicus* (NEP) and *Parapenaeus longirostris* (DPS) are included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 34 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1824 (61%), VL2440 (35%) and VL1218 (5%). In the period 2012-2014, this fleet performed, on average, 49,705 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 11c. The most important fleet segment in terms of fishing effort is VL1824.

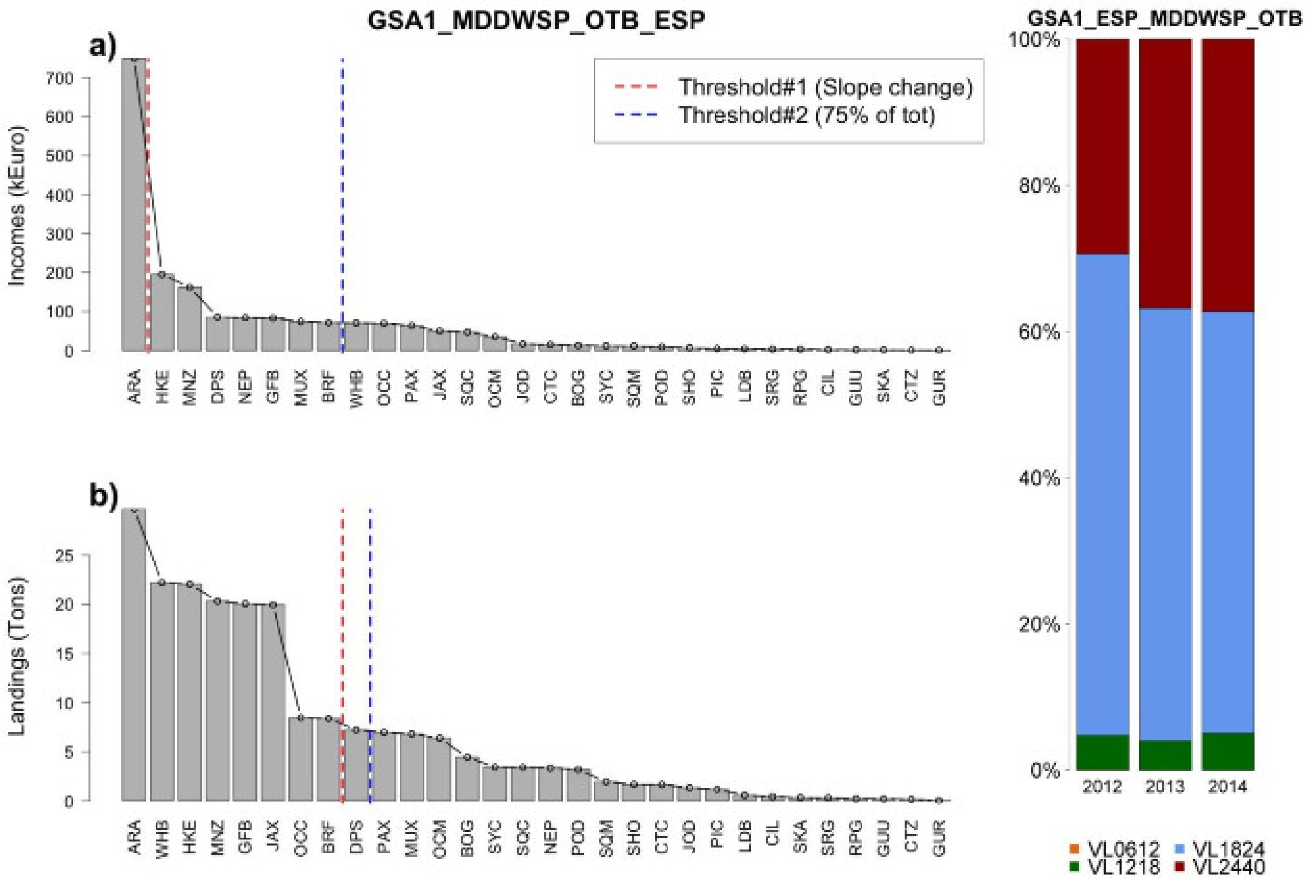


Figure 11. Cumulative percentage for the GSA01_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.2. *Alboran Sea (GSA 2)*

2.2.2.1. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Loligo* spp (SQC), *Lophius* spp (MNZ), *Nephrops norvegicus* (NEP) and *Helicolenus dactylopterus* (BRF) (Figure 12a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Loligo* spp (SQC), *Lophius* spp (MNZ), *Phycis blennoides* (GFB), *Helicolenus dactylopterus* (BRF) and *Merluccius merluccius* (HKE) (Figure 12b). The species *Nephrops norvegicus* (NEP) and *Merluccius merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006.

These fisheries are performed in GSA 2 by the bottom trawl fleets operating on the muddy bottoms of continental shelf and upper slope. According to the most recent DCF data, in the period 2012-2014, 3 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1824 (81 %), VL2440 (27 %) and VL1218 (2 %). In the period 2012-2014, this fleet performed, on average, 5,868 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 12c. The most important fleet segment in terms of fishing effort is VL1824.

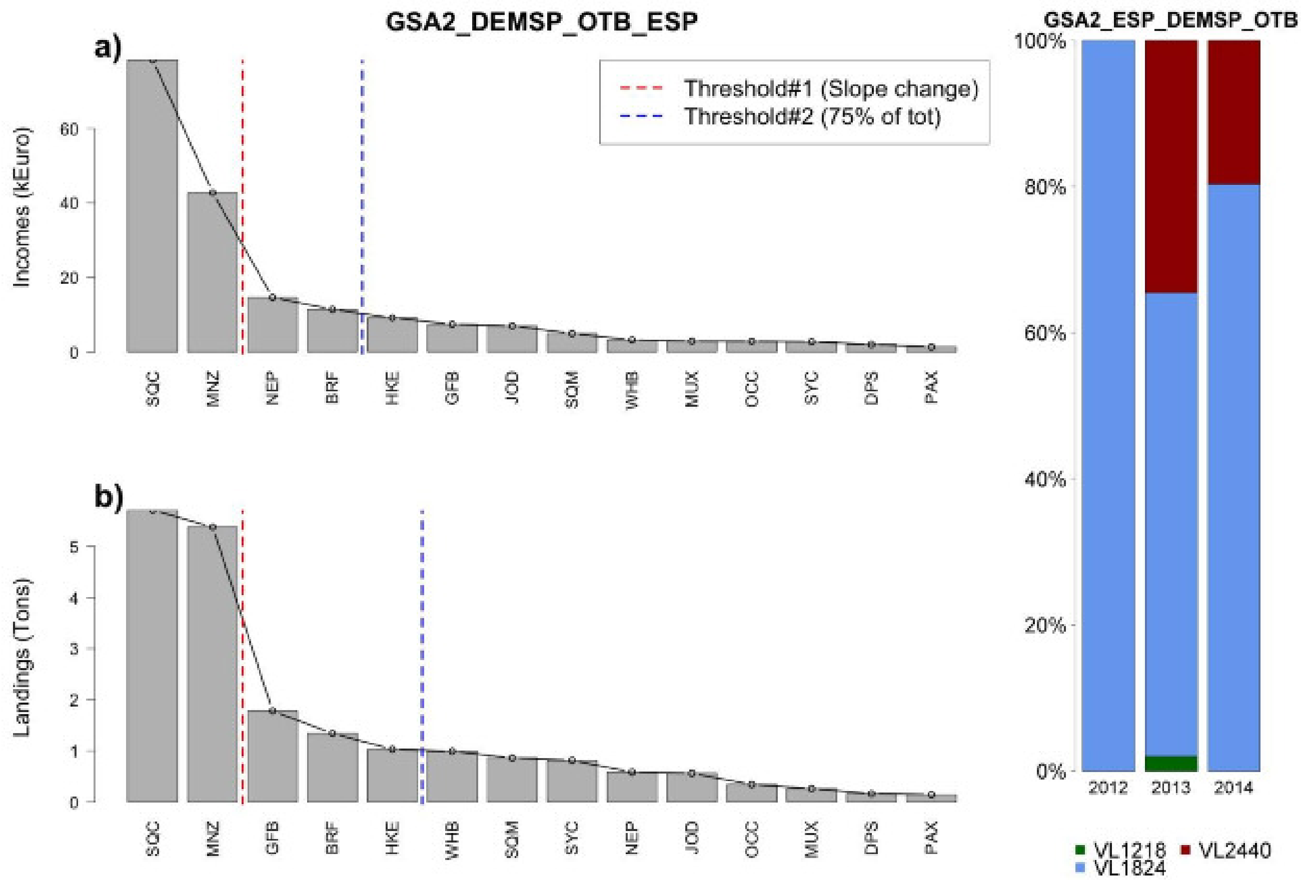


Figure 12. Cumulative percentage for the GSA02_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.2.2. Bottom otter trawl targeting deep water species (DWSP_OTB)

The red shrimp *Aristeus antennatus* (ARA) is the most important target species in terms of incomes (Figure 13a) and landings (Figure 13b). None of these two species is included in the Annex III of the EU Reg. 1967/2006. These fisheries are performed in GSA2 by the bottom trawl fleets operating on the muddy bathyal bottoms, from 500 to 800 m depth.

According to the most recent DCF data, in the period 2012-2014, 9 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL1824 (83 %) and VL2440 (17 %). In the period 2012-2014, this fleet performed, on average, 61,831 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 13c. The most important fleet segment in terms of fishing effort is VL1824.

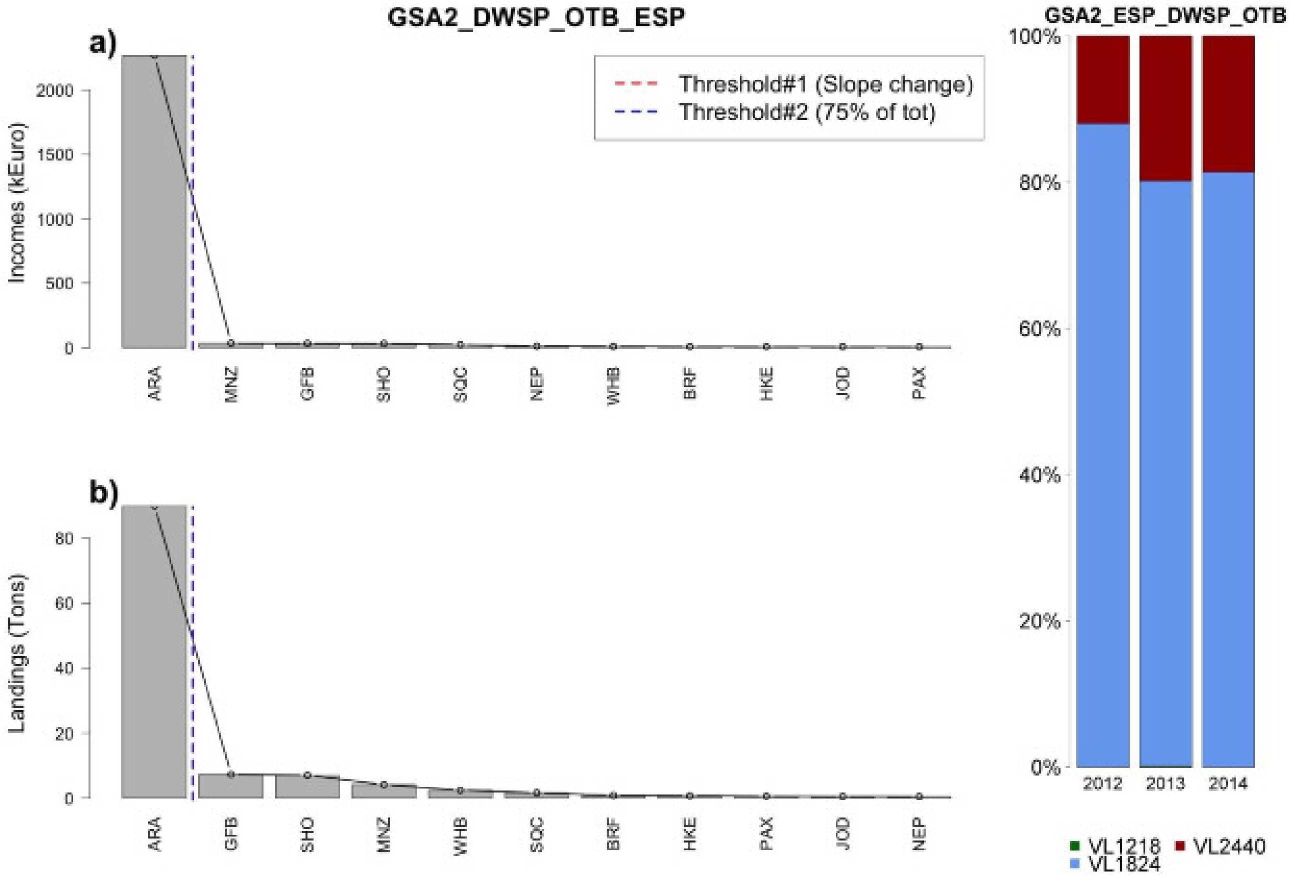


Figure 13. Cumulative percentage for the GSA02_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.2.3. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Loligo* spp (SQC) and *Lophius* spp (MNZ) (Figure 14a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Loligo* spp (SQC), *Lophius* spp (MNZ), *Scyliorhinus canicula* (SYC), *Micromesistius poutassou* (WHB) and *Phycis blennoides* (GFB) (Figure 14b). None of these species is included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 6 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1824 (96 %) and VL2440 (4 %). In the period 2012-2014, this fleet performed, on average, 24,910 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 14c. The most important fleet segment in terms of fishing effort is VL1824.

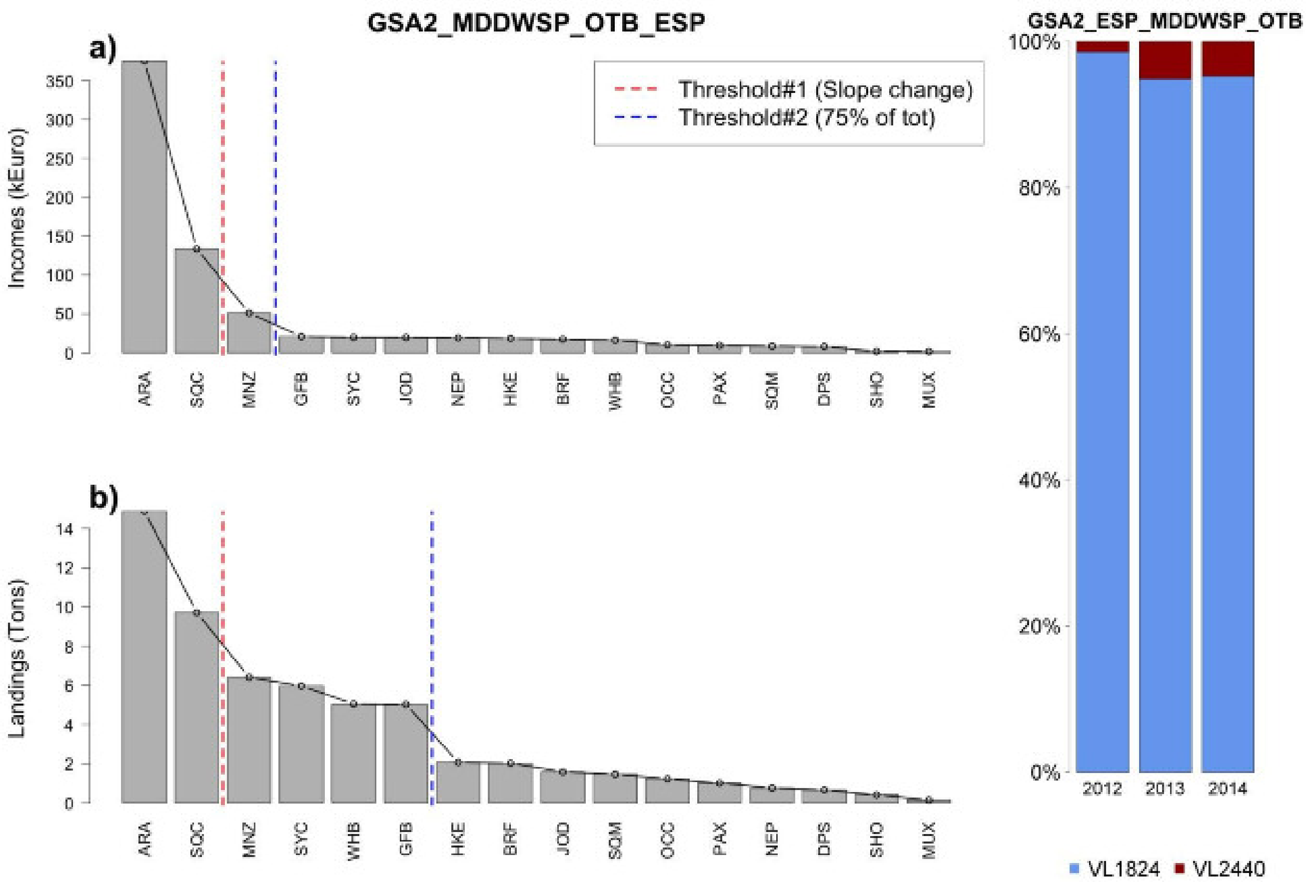


Figure 14. Cumulative percentage for the GSA02_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.3. *Balearic Islands (GSA 5)*

2.2.3.1. Set gillnets targeting demersal species (DEMSP_GNS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Scorpaena scrofa* (RSE), *Sparus pagrus* (RPG) and *Raja* spp (SKA) (Figure 15a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Raja* spp (SKA), *Scorpaena scrofa* (RSE), *Sparus pagrus* (RPG) and *Scyliorhinus canicula* (SYC) (Figure 15b). The species *Sparus pagrus* (RPG) is included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 150 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL0612 (92 %) and VL1218 (7 %). In the period 2012-2014, this fleet performed, on average, 13,194 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 15c. The most important fleet segment in terms of fishing effort is VL0612.

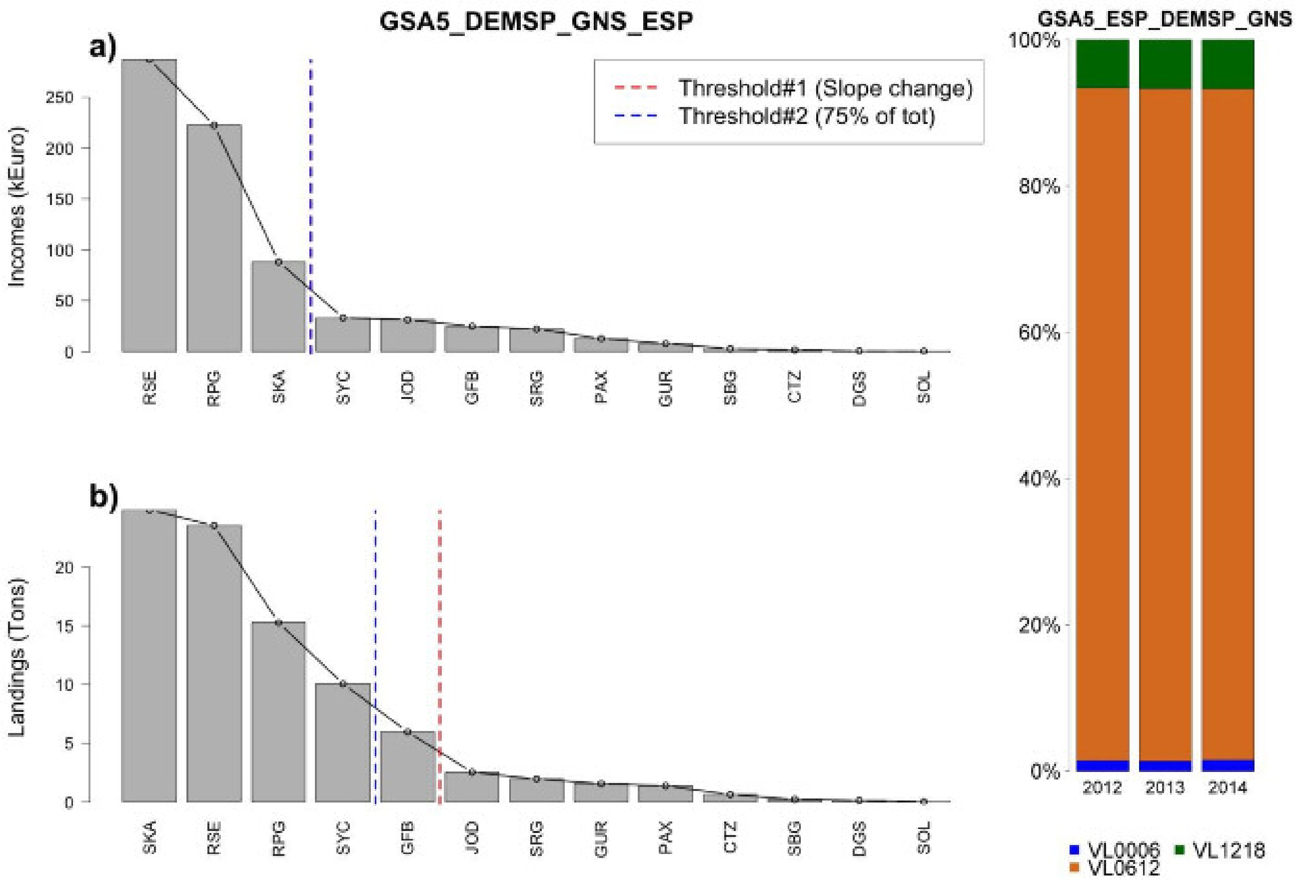


Figure 15. Cumulative percentage for the GSA05_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.3.2. Trammel nets targeting demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Sepia officinalis* (CTC), *Scorpaena scrofa* (RSE) and *Mullus* spp (MUX) (Figure 16a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Sepia officinalis* (CTC), *Scorpaena scrofa* (RSE), *Mullus* spp (MUX) and *Raja* spp (SKA) (Figure 16b).The species *Mullus* spp (MUX) is included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 161 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL0612 (98%). In the period 2012-2014, this fleet performed, on average, 31,238 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 16c. The most important fleet segment in terms of fishing effort is VL0612.

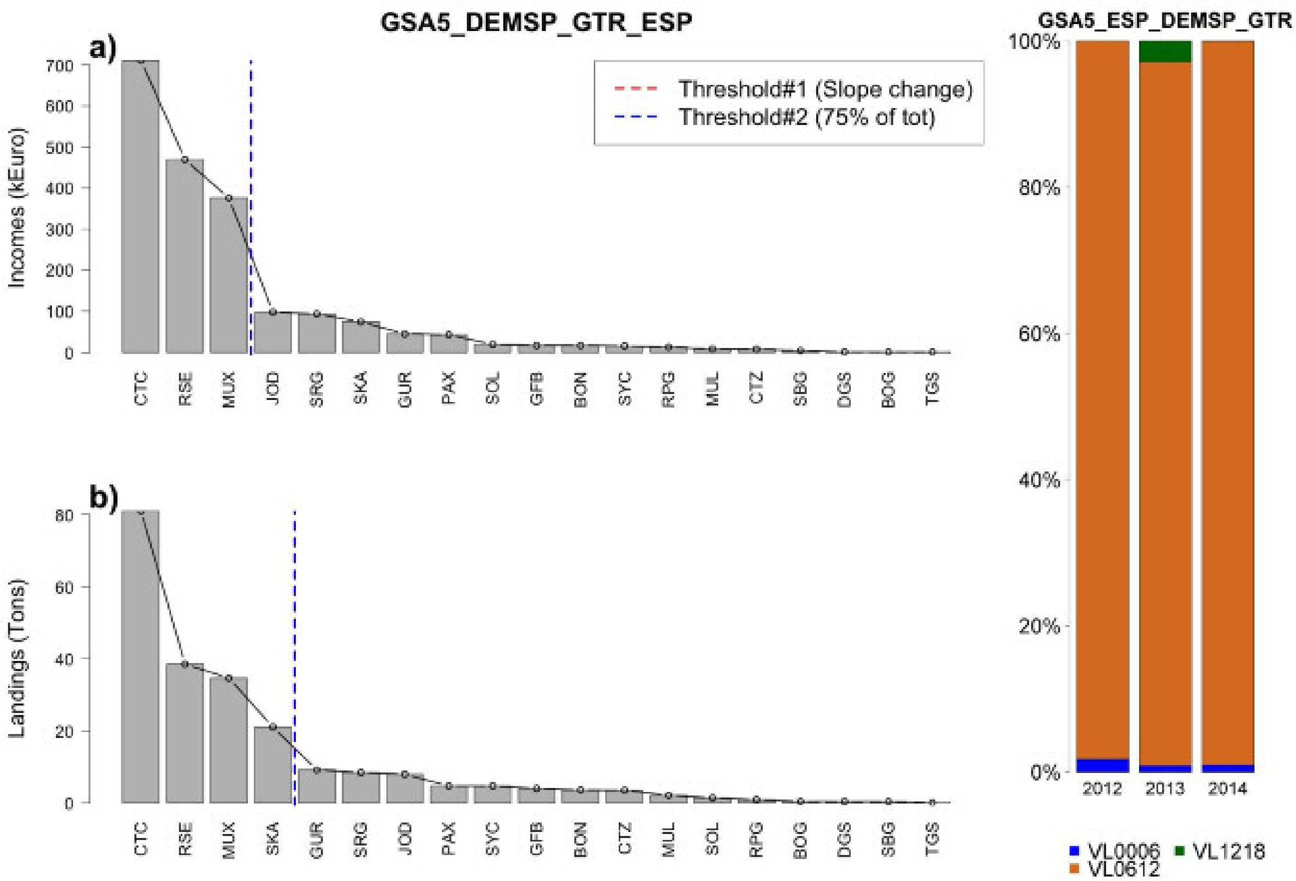


Figure 16. Cumulative percentage for the GSA05_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.3.3. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Loligo* spp (SQC), *Merluccius merluccius* (HKE), *Mullus* spp (MUX), *Octopus vulgaris* (OCC), *Spicara* spp (PIC), *Zeus faber* (JOD), *Nephrops norvegicus* (NEP), *Illex coindetii* (SQM) and *Lophius* spp (MNZ) (Figure 17a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Spicara* spp (PIC), *Merluccius merluccius* (HKE), *Loligo* spp (SQC), *Octopus vulgaris* (OCC), *Trachurus* spp (JAX), *Mullus* spp (MUX), *Scyliorhinus canicula* (SYC), *Micromesistius poutassou* (WHB), *Raja* spp (SKA) and *Illex coindetii* (SQM) (Figure 17b). From these species, *Trachurus* spp (JAX), *Merluccius merluccius* (HKE) and *Nephrops norvegicus* (NEP) are included in the Annex III of the EU Reg. 1967/2006.

These fisheries are performed in GSA5 by the bottom trawl fleets operating on the muddy bottoms of continental shelf and upper slope. According to the most recent DCF data, in the period 2012-2014, 60 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1824 (67 %), VL2440 (17 %) and VL1218 (15 %). In the period 2012-2014, this fleet performed, on average, 302,470 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 17c. The most important fleet segment in terms of fishing effort is VL1824.

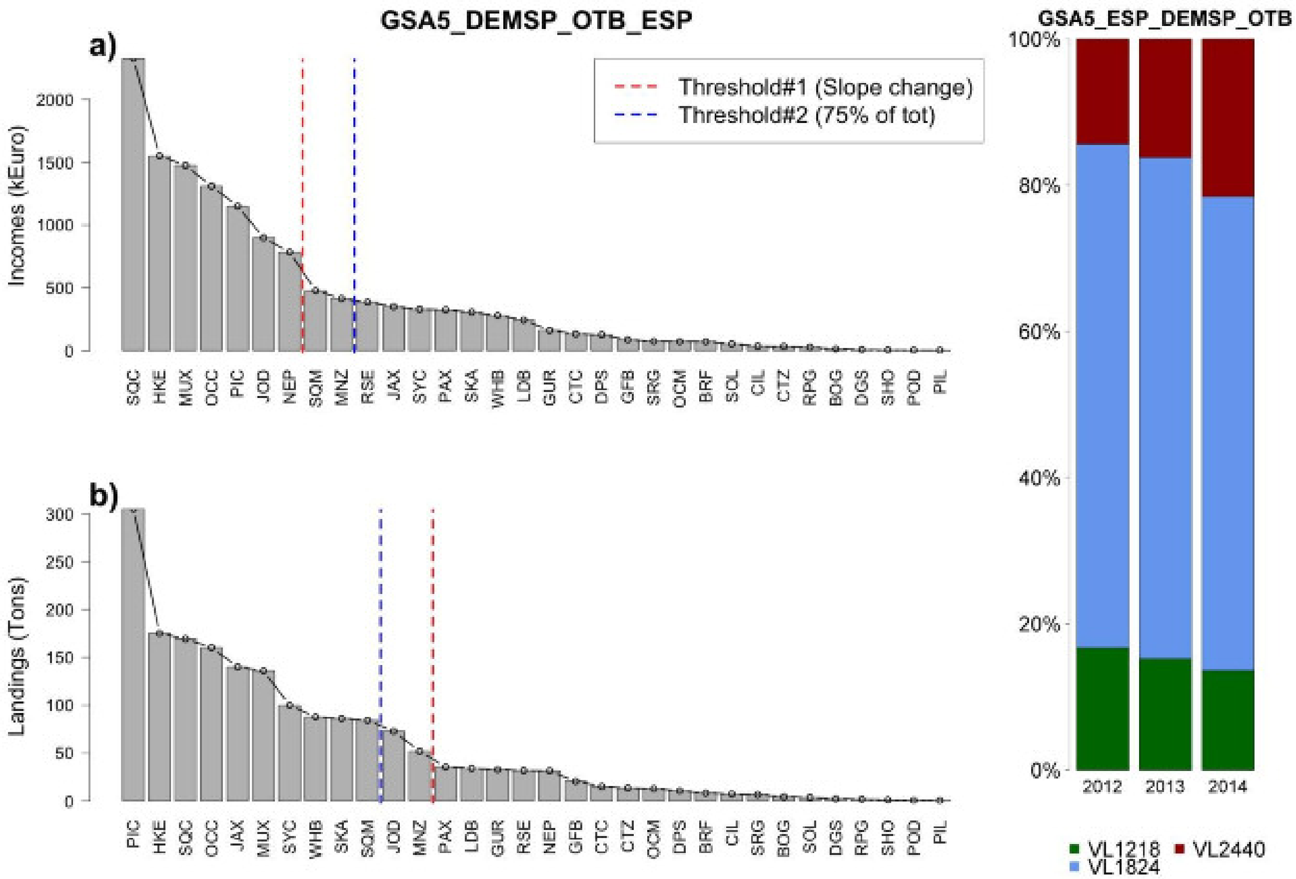


Figure 17. Cumulative percentage for the GSA05_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.3.4. Bottom otter trawl targeting deep water species (DWSP_OTB)

The red shrimp *Aristeus antennatus* (ARA) is the most important target species in terms of incomes (Figure 18a). In terms of landings, *Aristeus antennatus* (ARA), *Phycis blennoides* (GFB), *Lophius* spp (MNZ) and *Merluccius merluccius* (HKE) account for the 75 % of cumulative percentage of landings (Figure 18b). The species *Merluccius merluccius* (HKE) is included in the Annex III of the EU Reg. 1967/2006.

These fisheries are performed in GSA5 by the bottom trawl fleets operating on the muddy bathyal bottoms, from 500 to 800 m depth. According to the most recent DCF data, in the period 2012-2014, 41 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL1824 (67 %) and VL2440 (32 %). In the period 2012-2014, this fleet performed, on average, 207,382 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 18c. The most important fleet segment in terms of fishing effort is VL1824.

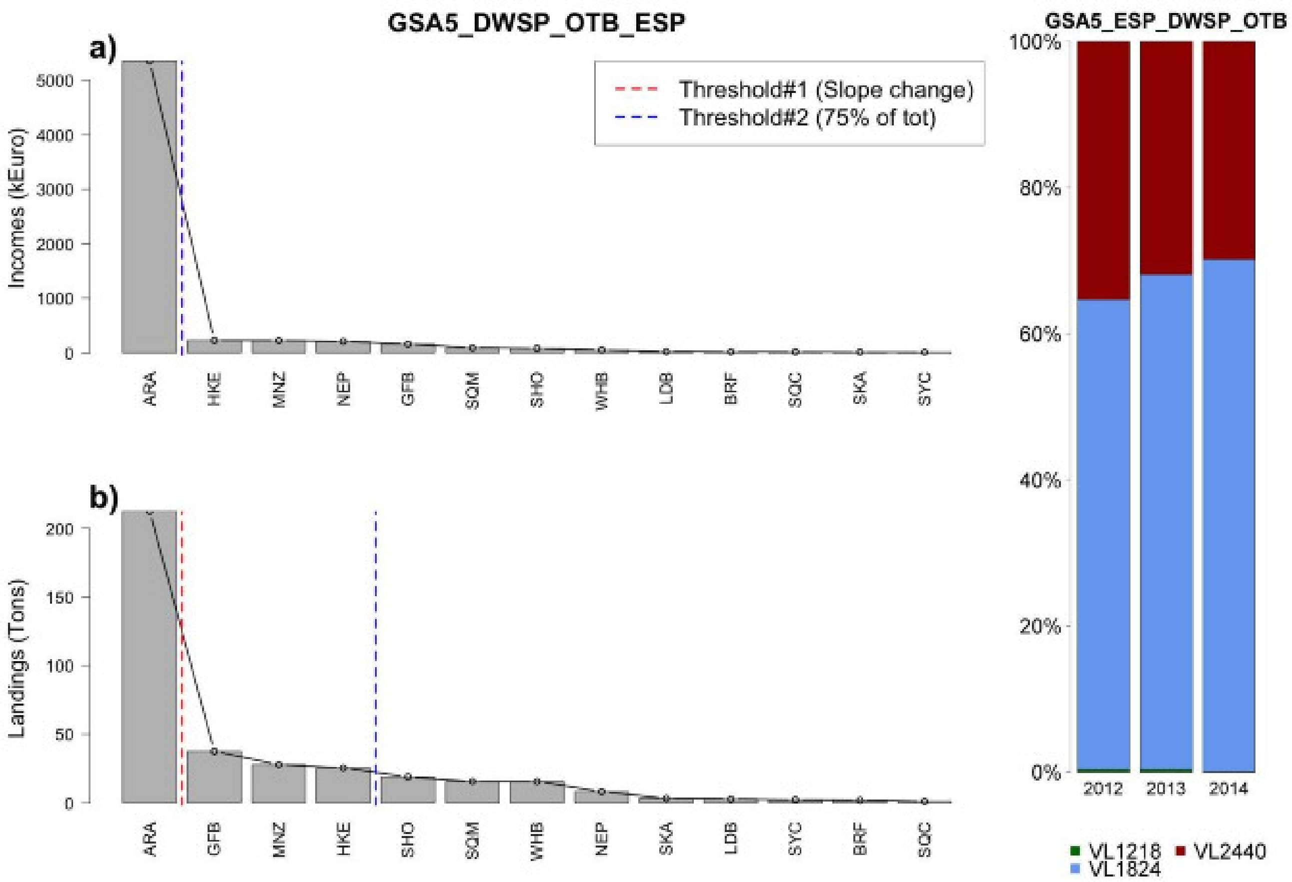


Figure 18. Cumulative percentage for the GSA05_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.3.5. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Loligo* spp (SQC), *Spicara* spp (PIC), *Mullus* spp (MUX), *Nephrops norvegicus* (NEP) and *Octopus vulgaris* (OCC) (Figure 19a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Spicara* spp (PIC), *Loligo* spp (SQC), *Trachurus* spp (JAX), *Octopus vulgaris* (OCC), *Mullus* spp (MUX), *Merluccius merluccius* (HKE), *Micromesistius poutassou* (WHB), *Scyliorhinus canicula* (SYC) and *Illex coindetii* (SQM) (Figure 19b). The species *Mullus* spp (MUX), *Nephrops norvegicus* (NEP) and *Merluccius merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 35 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1824 (76 %) and VL2440 (23 %). In the period 2012-2014, this fleet performed, on average, 137,529 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 19c. The most important fleet segment in terms of fishing effort is VL1824.

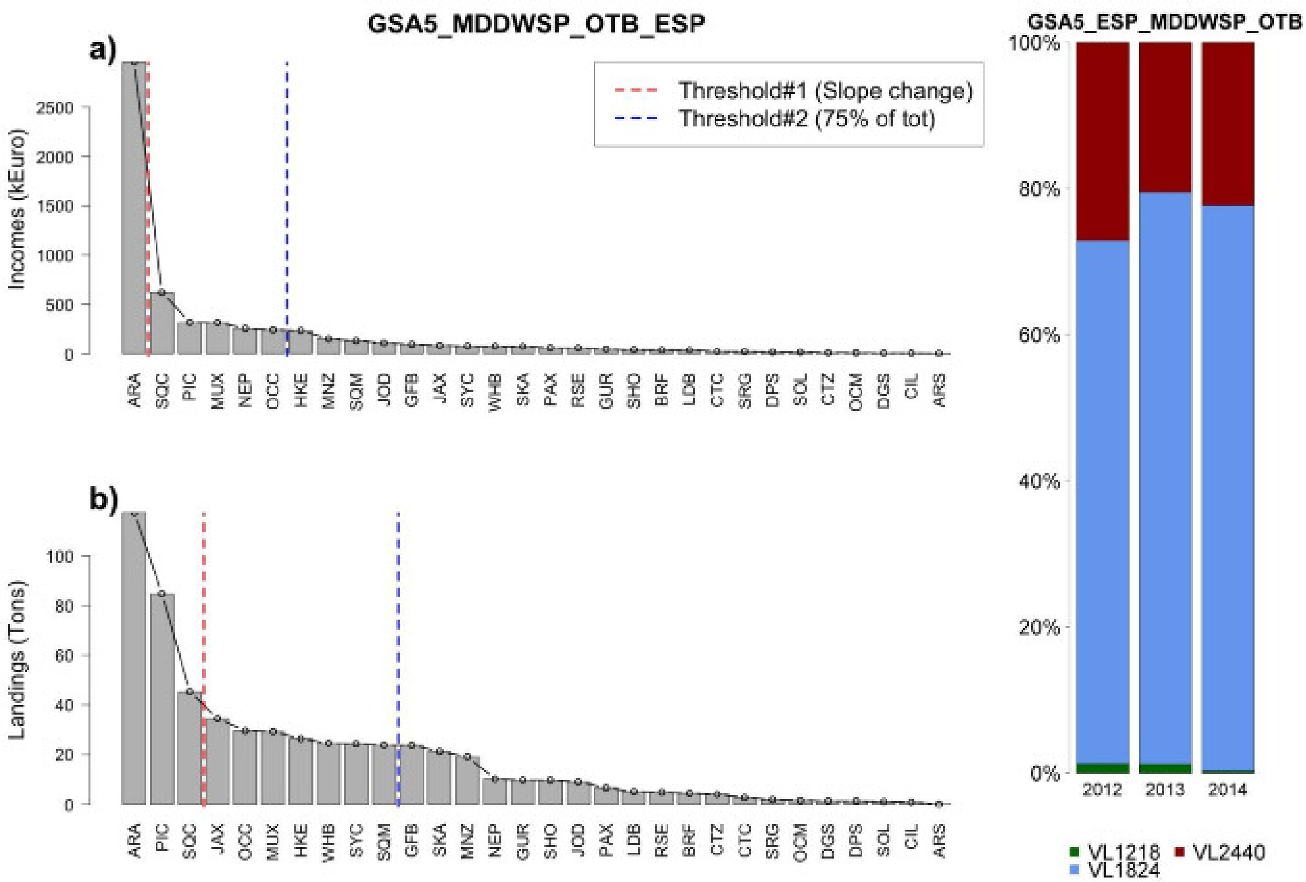


Figure 19. Cumulative percentage for the GSA05_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.4. Northern Spain (GSA 6)

2.2.4.1. Set longlines targeting demersal fish (DEMF_LLS)

By far, the dominant species in landings expressed in weight is *Merluccius merluccius* (HKE).The species which cumulative percentage in terms of value of landings accounts for 75 % are *Merluccius merluccius* (HKE), *Pagellus* spp (PAX) and *Diplodus* spp (SRG) (Figure 20a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Merluccius merluccius* (HKE), *Pagellus* spp (PAX), *Diplodus* spp and *Trachurus* spp (Figure 20b). These species are included in Annex III of the EU Reg. 1967/2006. According to the most recent DCF data, in the period 2012-2014, around 340 vessels were involved in these fisheries, most of them, around 250, of fleet segment VL0612. In the period 2012-2014, this fleet performed, on average, 56,161 GT*days at sea. Figure 20c shows the subdivision of this fishing effort according to year and fleet segments.

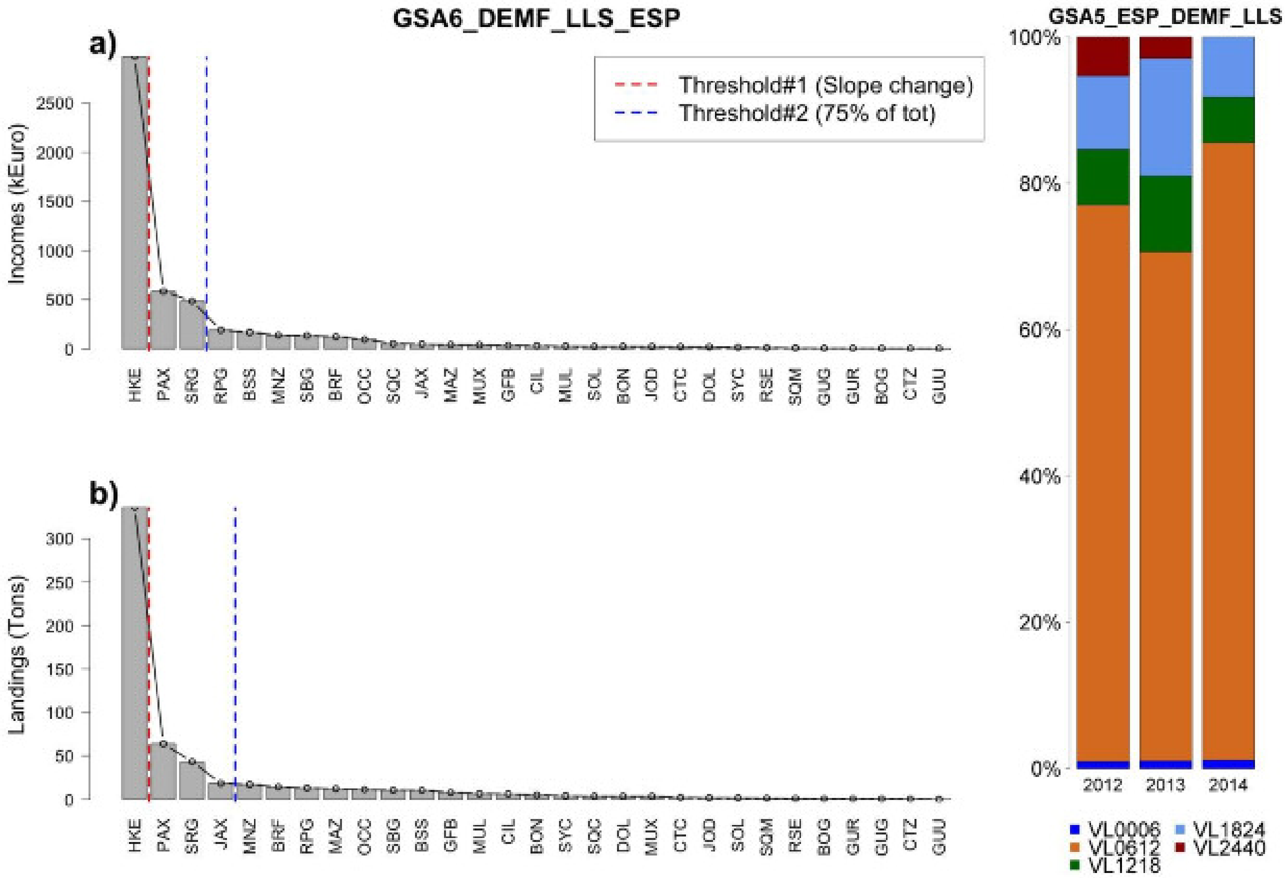


Figure 20. Cumulative percentage for GSA06_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.4.2. Pots and traps targeting demersal species (DEMSP_FPO)

These are very specialized small- scale fisheries, targeting common octopus (*Octopus vulgaris*). Income and catches come from this species (Figure 21a and b, respectively), not included in Annex III of the EU Reg. 1967/2006. These seasonal fisheries are performed in GSA 6 by small-scale vessels, in rocky shallow bottoms where the species inhabits, inaccessible to trawlers. According to the most recent DCF data, in 2014 around 200 vessels were involved in these fisheries, most of them of VL0612 and VL1218 segments. In the period 2012-2014, this fleet performed, on average, 117,769 GT*days at sea. Figure 21c shows the subdivision of this fishing effort, according to year and fleet segments.

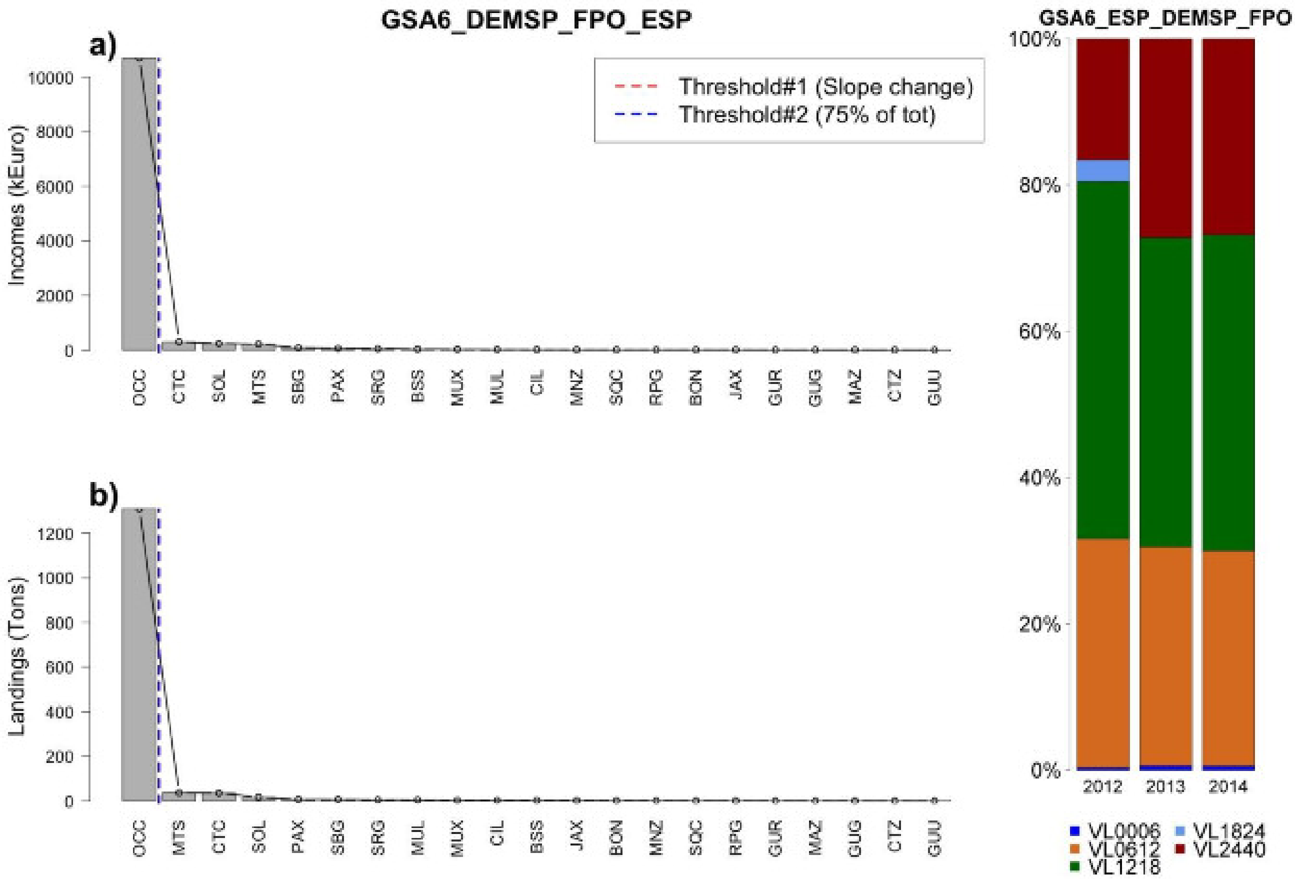


Figure 21. Cumulative percentage for GSA06_DEMSP_FPO, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.4.3. Set gillnet targeting deep water species (DEMSP_GNS)

The dominant species of these fisheries, both in terms of landings weight and income is *Sparus aurata* (Figure 22). The species which cumulative percentage in terms of landings expressed in weight accounts for 75 % are *Sparus aurata* (SBG), *Pagellus* spp (PAX), *Diplodus* spp (SRG), *Merluccius merluccius* (HKE) and *Dicentrarchus labrax* (BSS), all of them included in Annex III of the EU Reg. 1967/2006. The target species changes along the year. In terms of value of landings, the species which cumulative percentage accounts for 75 % are *Sparus aurata* (SBG), *Pagellus* spp (PAX), *Diplodus* spp (SRG) and *Dicentrarchus labrax* (BSS). According to the most recent DCF data, in the period 2012-2014, around 400 vessels were involved in these fisheries, most of them, around 300, of fleet segment VL0612. In the period 2012-2014, this fleet performed, on average, 85,373 GT*days at sea. Figure 22c shows the subdivision of this fishing effort according to year and fleet segments.

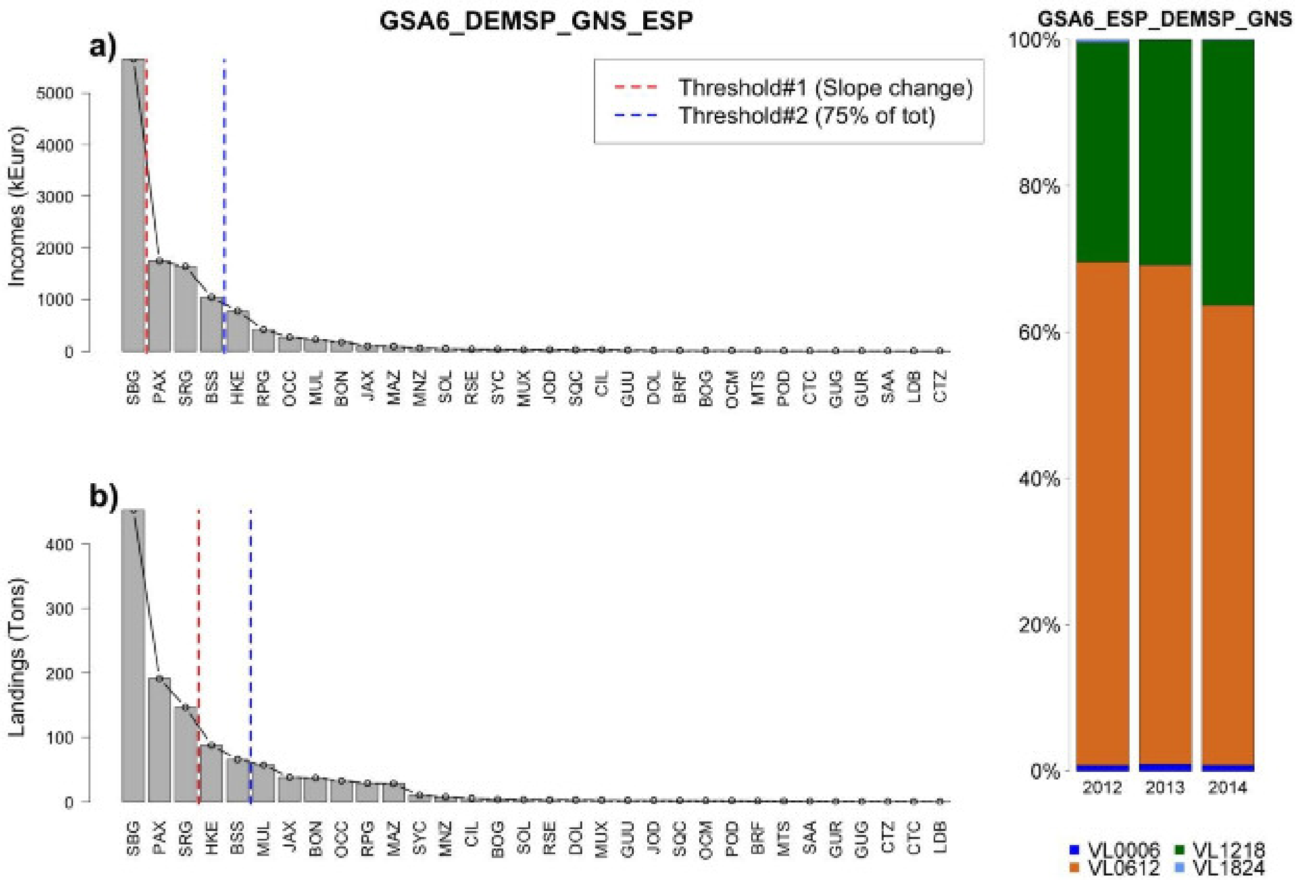


Figure 22. Cumulative percentage for GSA06_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.4.4. Trammel net targeting demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Mullus* spp (MUX), *Sepia officinalis* (CTC), *Sparus aurata* (SBG), *Pagellus* spp (PAX), *Solea Solea* (SOL), *Octopus vulgaris* (OCC) and *Diplodus* spp (SRG) (Figure 23a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Sepia officinalis* (CTC), *Mullus* spp (MUX), *Pagellus* spp (PAX), *Sparus aurata* (SBG), *Octopus vulgaris* (OCC) and *Solea Solea* (SOL) (Figure 23b). With the exception of cephalopods, *Sepia officinalis* (CTC) and *Octopus vulgaris* (OCC), the other species are included in Annex III of the EU Reg. 1967/2006. According to the most recent DCF data, in the period 2012-2014, around 480 vessels were involved in these fisheries, most of them, more than 350, of fleet segment VL0612. In the period 2012-2014, this fleet performed, on average, 216,526 GT*days at sea. Figure 23c shows the subdivision of this fishing effort according to year and fleet segments.

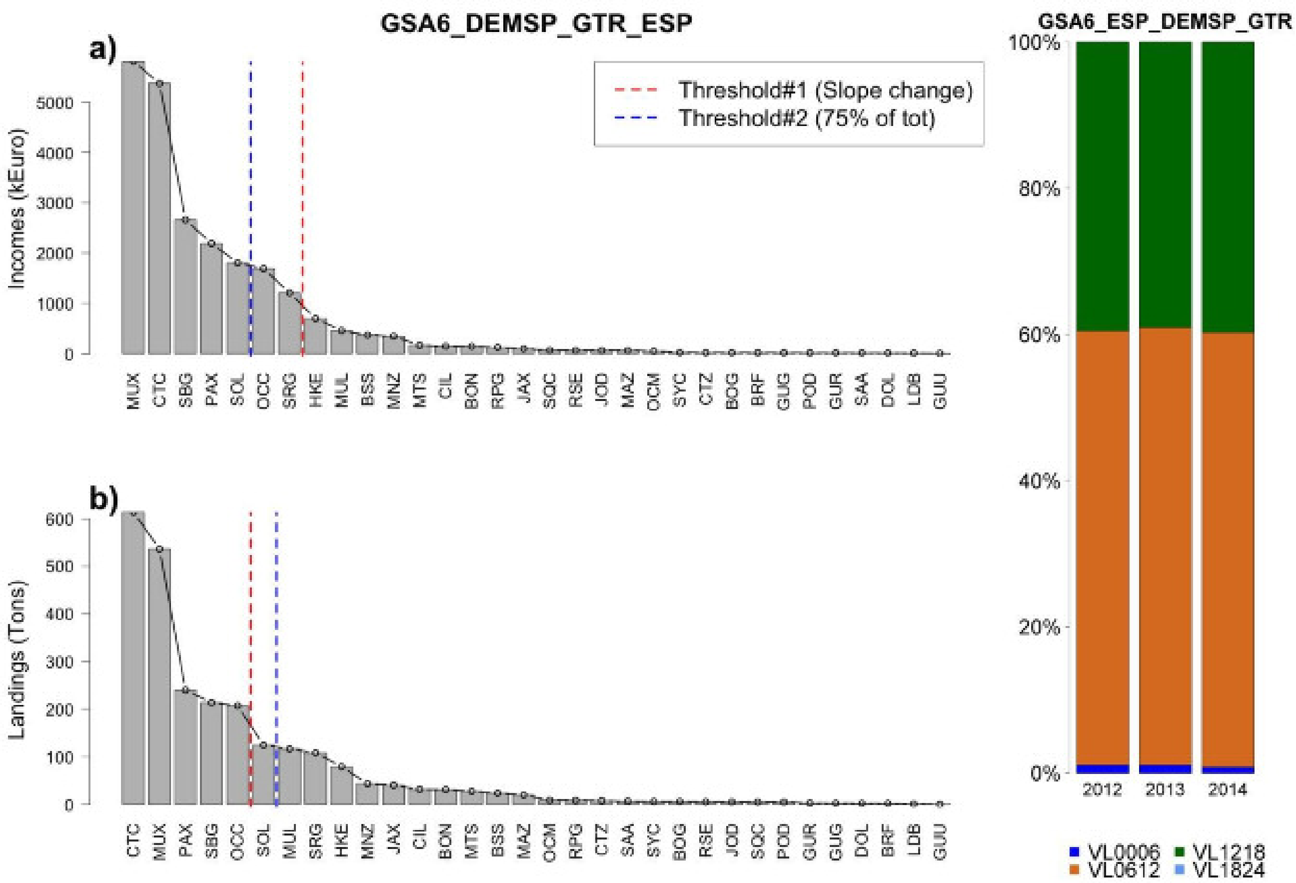


Figure 23. Cumulative percentage for GSA06_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.4.5. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Merluccius merluccius* (HKE), *Mullus* spp (MUX), *Nephrops norvegicus* (NEP), *Eledone* spp (OCM), *Pagellus* spp (PAX), *Lophius* spp (MNZ), *Octopus vulgaris* (OCC), *Illex coindetii* (SQM), *Sparus aurata* (SBG) and *Squilla mantis* (MTS) (Figure 24a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Merluccius merluccius* (HKE), *Eledone* spp (OCM), *Trachurus* spp (JAX), *Mullus* spp (MUX), *Lophius* spp (MNZ), *Illex coindetii* (SQM), *Pagellus* spp (PAX), *Trisopterus minutus* (POD), *Octopus vulgaris* (OCC), *Micromesistius poutassou* (WHB) and *Squilla mantis* (MTS) (Figure 24b). Of these species, HKE, MUX, NEP, PAX, SBG, JAX are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, ca. 440 vessels were involved in these fisheries (around 220 of fleet segment VL1824; 110 of VL1218; and 100 of VL2440). In the period 2012-2014, this fleet performed, on average, 3,756,741 GT*days at sea. Figure 24c shows the subdivision of this fishing effort according to year and fleet segments.

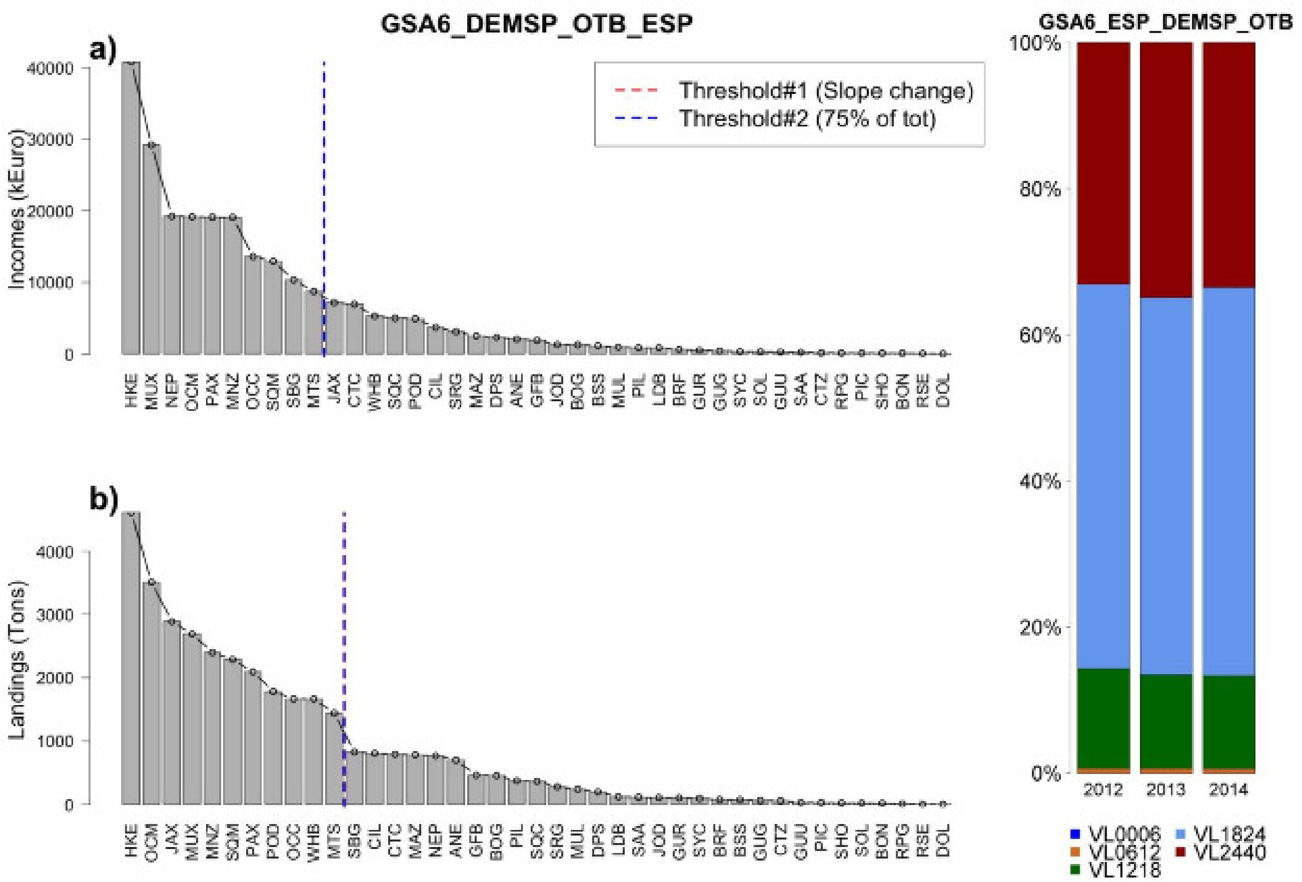


Figure 24. Cumulative percentage for GSA06_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.4.6. Bottom otter trawl targeting demersal deep water species (DWSP_OTB)

Aristeus antennatus (ARA) is the dominant species of these fisheries, both in income and biomass. These fisheries are performed at depths of between 400 and 800, in the submarine canyons, the habitat for blue and red shrimp. This species represents more than 75 % of the landings value to the vessels involved in these fisheries (Figure 25a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Phycis blennoides* (GFB) and *Merluccius merluccius* (HKE) (Figure 25b). Of these species, HKE is included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 136 vessels, on average, were involved in these fisheries (ca. 77 of fleet segment VL1824 and 57 of VL2440). In the period 2012-2014, this fleet performed, on average, 976,979 GT*days at sea. Figure 25c shows the subdivision of this fishing effort according to year and fleet segments.

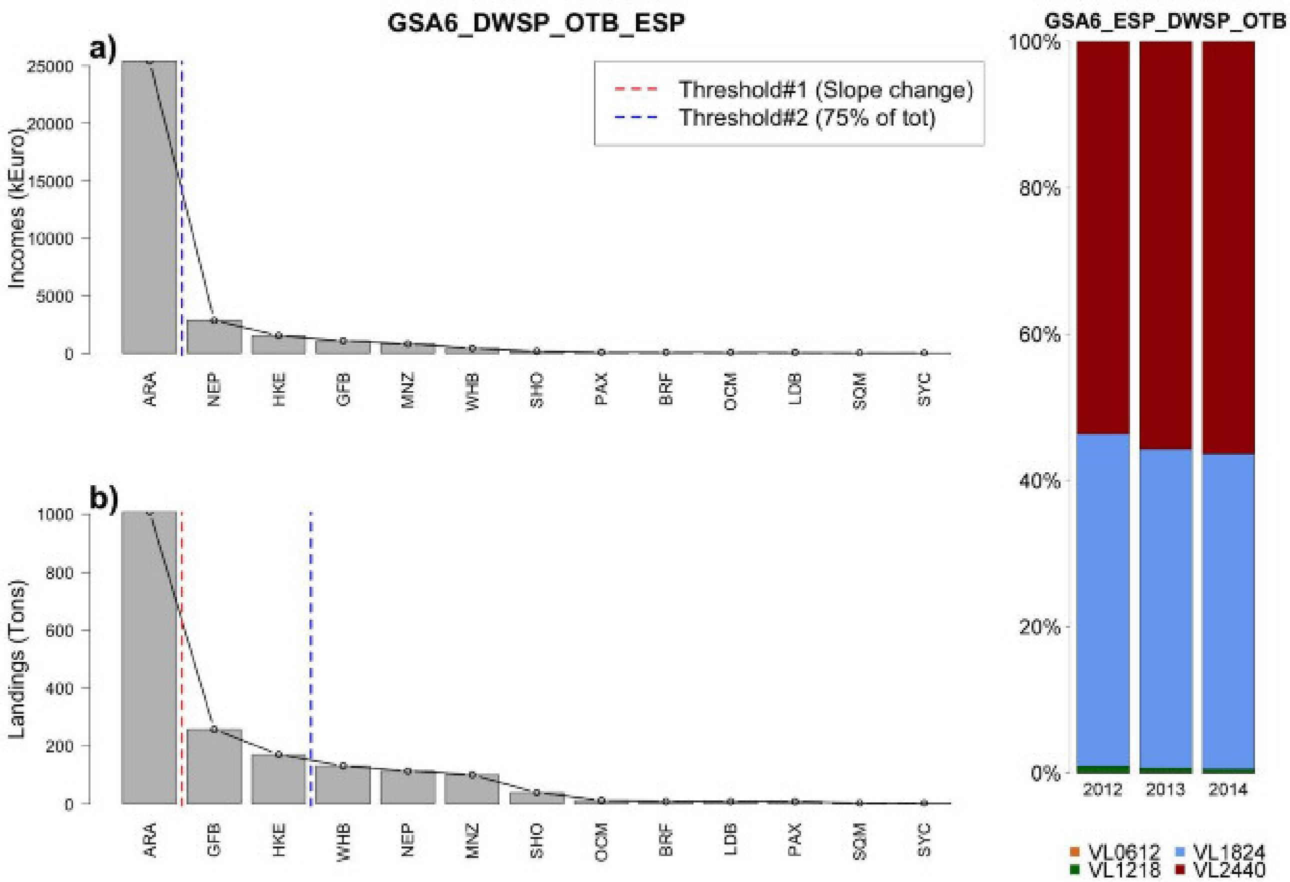


Figure 25. Cumulative percentage for GSA06_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.4.7. Bottom otter trawl targeting mixed dermersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Nephrops norvegicus* (NEP), *Merluccius merluccius* (HKE), *Lophius* spp (MNZ), and *Micromesistius poutassou* (WHB) (Figure 26a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Aristeus antennatus* (ARA), *Merluccius merluccius* (HKE), *Micromesistius poutassou* (WHB), *Nephrops norvegicus* (NEP), *Phycis blennoides* (GFB), *Lophius* spp (MNZ), *Eledone* spp (OCM) and *Trachurus* spp (JAX) (Figure 26b). Of these species, NEP, HKE and JAX are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 115 vessels, on average, were involved in these fisheries (ca. 60 of fleet segment VL1824 and 46 of VL2440). In the period 2012-2014, this fleet performed, on average, 382,240 GT*days at sea. Figure 26c shows the subdivision of this fishing effort according to year and fleet segments.

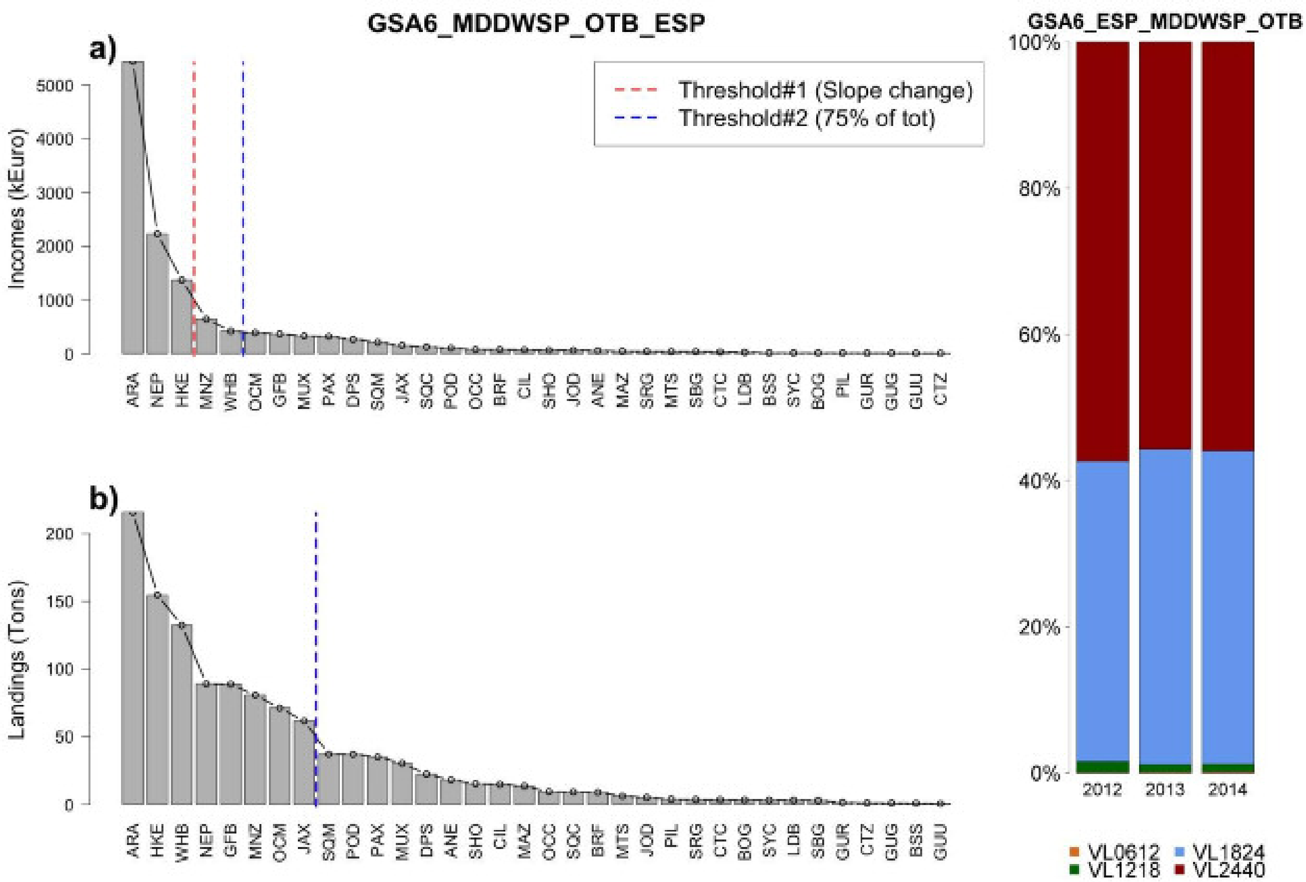


Figure 26. Cumulative percentage for GSA06_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5. *Gulf of Lion (GSA 7, France)*

2.2.5.1. Boat dredge (DEMSP_DRB)

This is a small-scale fisheries, targeting common sole (*Solea Solea*; SOL) and common octopus (*Octopus vulgaris*; OCC). Common sole is included in Annex III of the EU Reg. 1967/2006. (Figure 27). These two species account for 75 % of landings expressed in terms of value of landings and weight.

According to the most recent DCF data, in 2012, 34 vessels of fleet segment VL0012 were involved in these fisheries, and only one in 2013 and 2014 (11,762 GT*days at sea in 2012 and around 260 GT*days at sea in 2013 and 2014). Figure 27c shows the subdivision of this fishing effort, according to year and fleet segments.

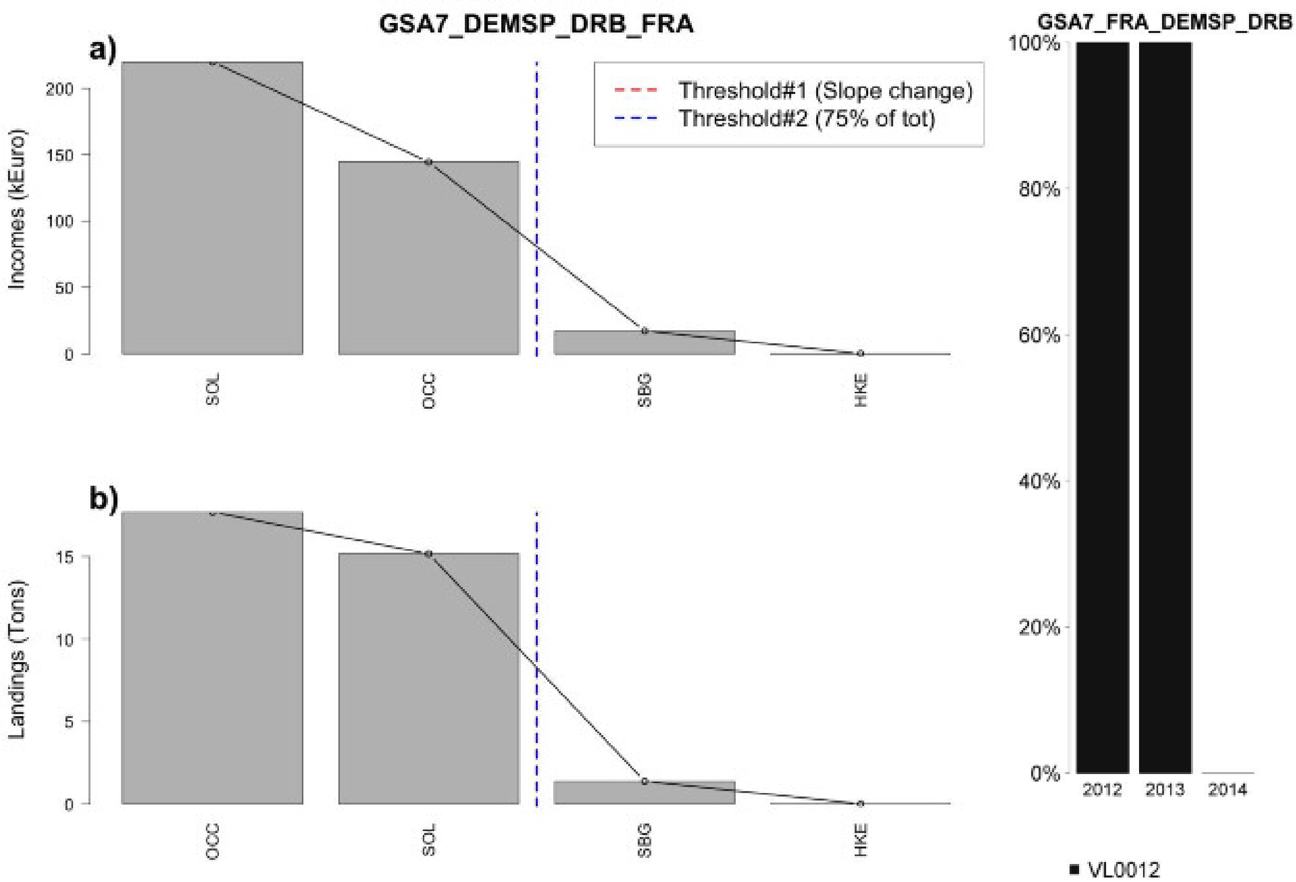


Figure 27. Cumulative percentage for GSA07_DEMSP_DRB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.2. Pots and traps targeting demersal species (DEMSP_FPO)

These are very specialized small-scale fisheries, targeting common octopus (*Octopus vulgaris; OCC*). Income and catches come from this species, not included in Annex III of the EU Reg. 1967/2006, which accounts for more than 75 % of the total (Figure 28).

According to the most recent DCF data, in 2012, 87 vessels of fleet segment VL0012 were involved in these fisheries, and only two in 2013 of fleet segment VL1218 (30,000 GT*days at sea in 2012 and 622 GT*days at sea in 2013). Figure 28c shows the subdivision of this fishing effort, according to year and fleet segments.

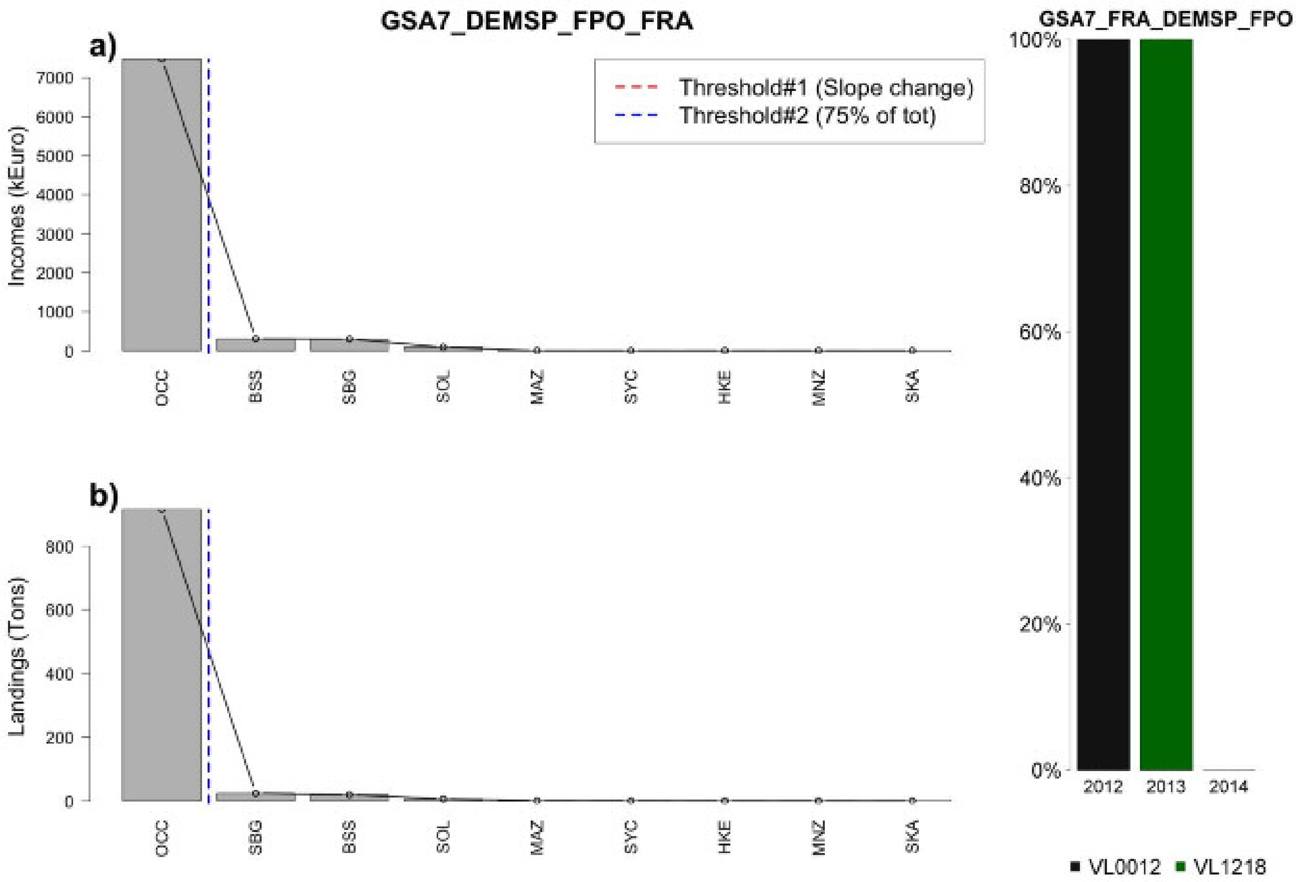


Figure 28. Cumulative percentage for GSA07_DEMSP_FPO, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.3. Fyke nets (DEMSP_FYK)

These are very specialized small-scale fisheries, targeting *Sparus aurata* (SBG). Income and catches come from this species (Figure 29), included in Annex III of the EU Reg. 1967/2006, that accounts for more than 75 % of the total. According to the most recent DCF data, in the period 2012-2014, 211 vessels of fleet segment VL0612 were involved in these fisheries in 2012 (21,966 GT*days at sea; Figure 29c).

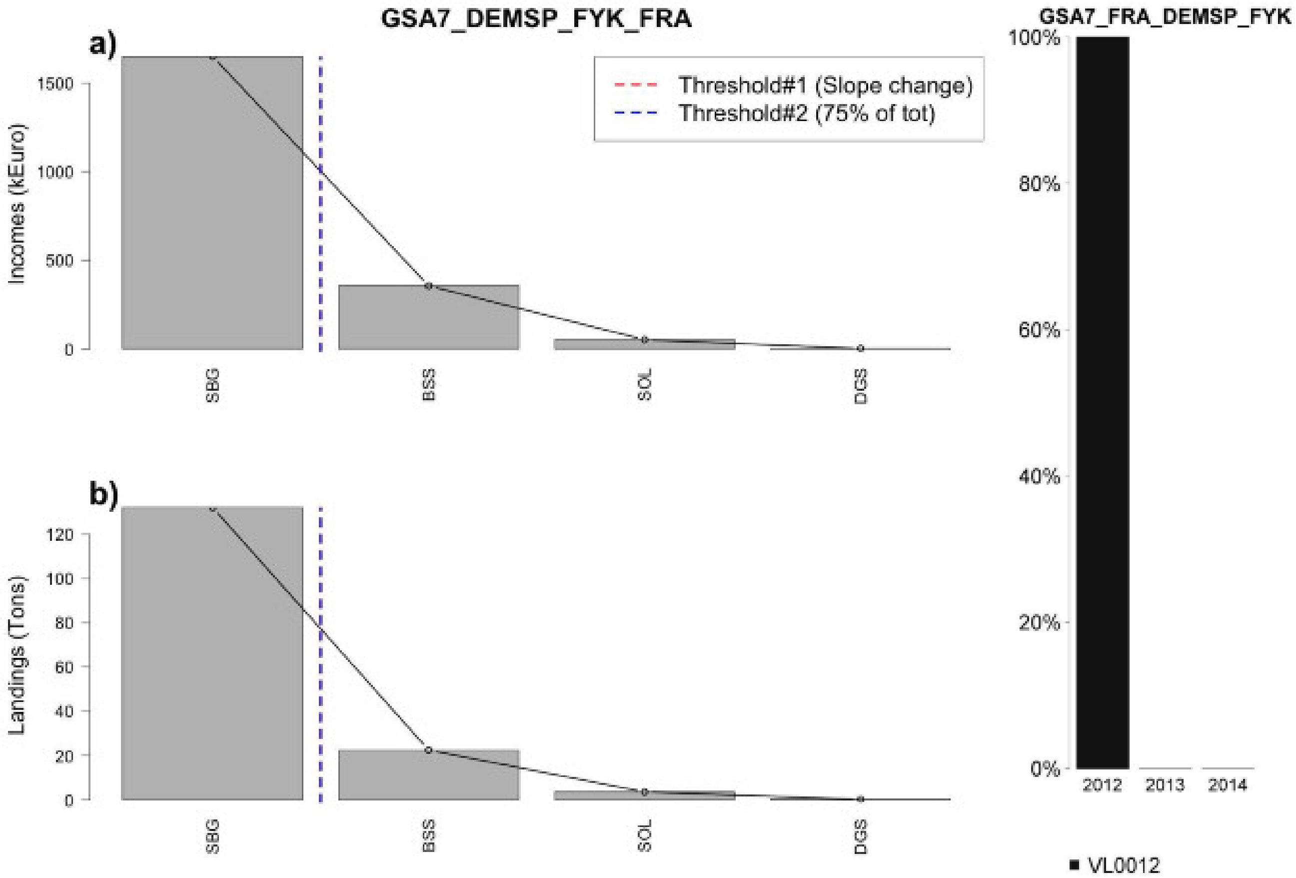


Figure 29. Cumulative percentage for GSA07_DEMSP_FYK, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.4. Set gillnet targeting demersal species (DEMSP_GNS)

Two species are dominant in the landings expressed in weight, *Sparus aurata* (SBG) and *Merluccius merluccius* (HKE). Income from SBG is much higher than that from HKE. These two species account for 75 % of total income and biomass (Figure 30). SBG and HKE are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 478 vessels were involved in these fisheries in 2012 (fleet segment VL0012), and 7 in 2013 (VL1218). In the period 2012-2014, this fleet performed 135,974 GT*days at sea in 2012 and 4,809 GT*days at sea in 2013. Figure 30c shows the subdivision of this fishing effort according to year and fleet segments.

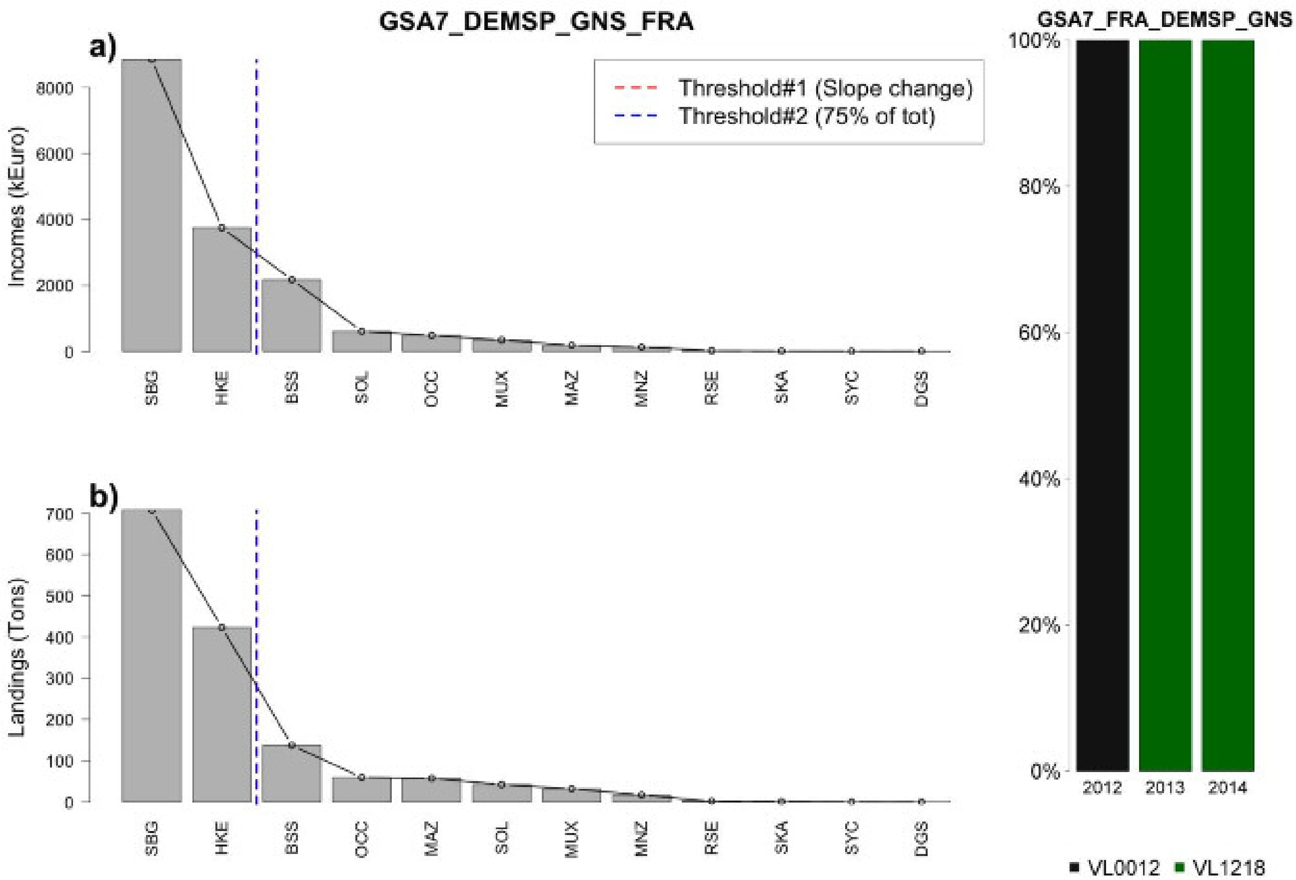


Figure 30. Cumulative percentage for GSA07_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.5. Trammel net targeting demersal species (DEMSP_GTR)

Two species are dominant in the landings expressed in value, *Solea Solea* (SOL) and *Sparus aurata* (SBG), which along with *Octopus vulgaris* (OCC) account for 75 % of the total. The species which cumulative percentage in terms of biomass of landings accounts for 75 % are SBG, SOL, OCC and *Lophius* spp (MNZ, Figure 31). Of these target species, SOL and SBG are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 461 vessels were involved in these fisheries in 2012 (VL0012), and 7-8 (VL1218) in 2013-2014. In the period 2012-2014, this fleet performed 124,726 GT*days at sea in 2012; and 5,224 and 53, respectively, in 2013 and 2014. Figure 31c shows the subdivision of this fishing effort according to year and fleet segments.

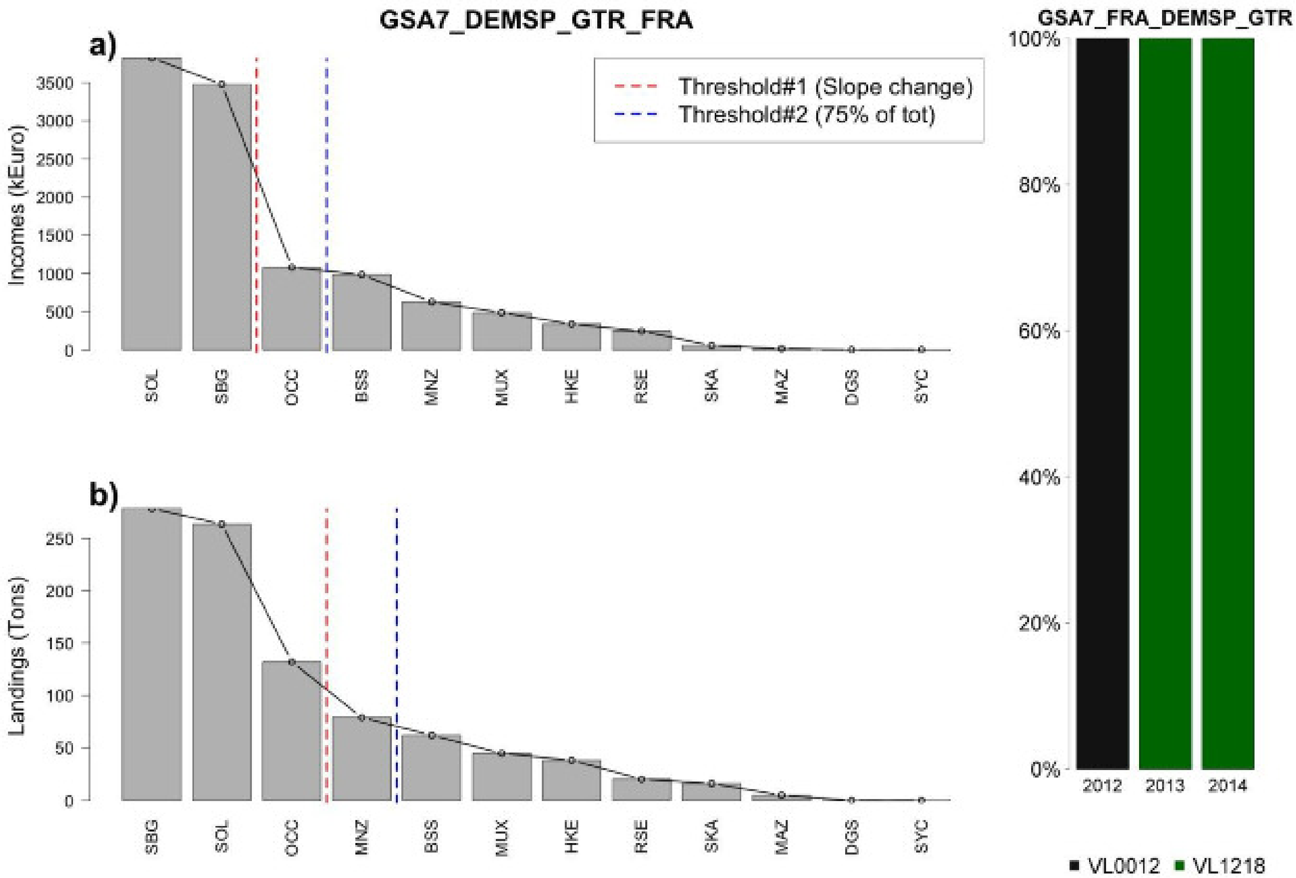


Figure 31. Cumulative percentage for GSA07_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.6. Pole lines targeting demersal species (DEMSP_LHP)

Landings of these fisheries are very low. Sea bass, *Dicentrarchus labrax* (BSS) is the dominant species in landings expressed as income. This species, along with *Octopus vulgaris* (OCC), account for 75 % of the total income and biomass of landings. (Figure 32). BSS is included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 69 vessels of fleet segment VL0012 were involved in these fisheries in 2012. This fleet performed 5,879 GT*days at sea in 2012. Figure 32c shows the subdivision of this fishing effort according to year and fleet segments.

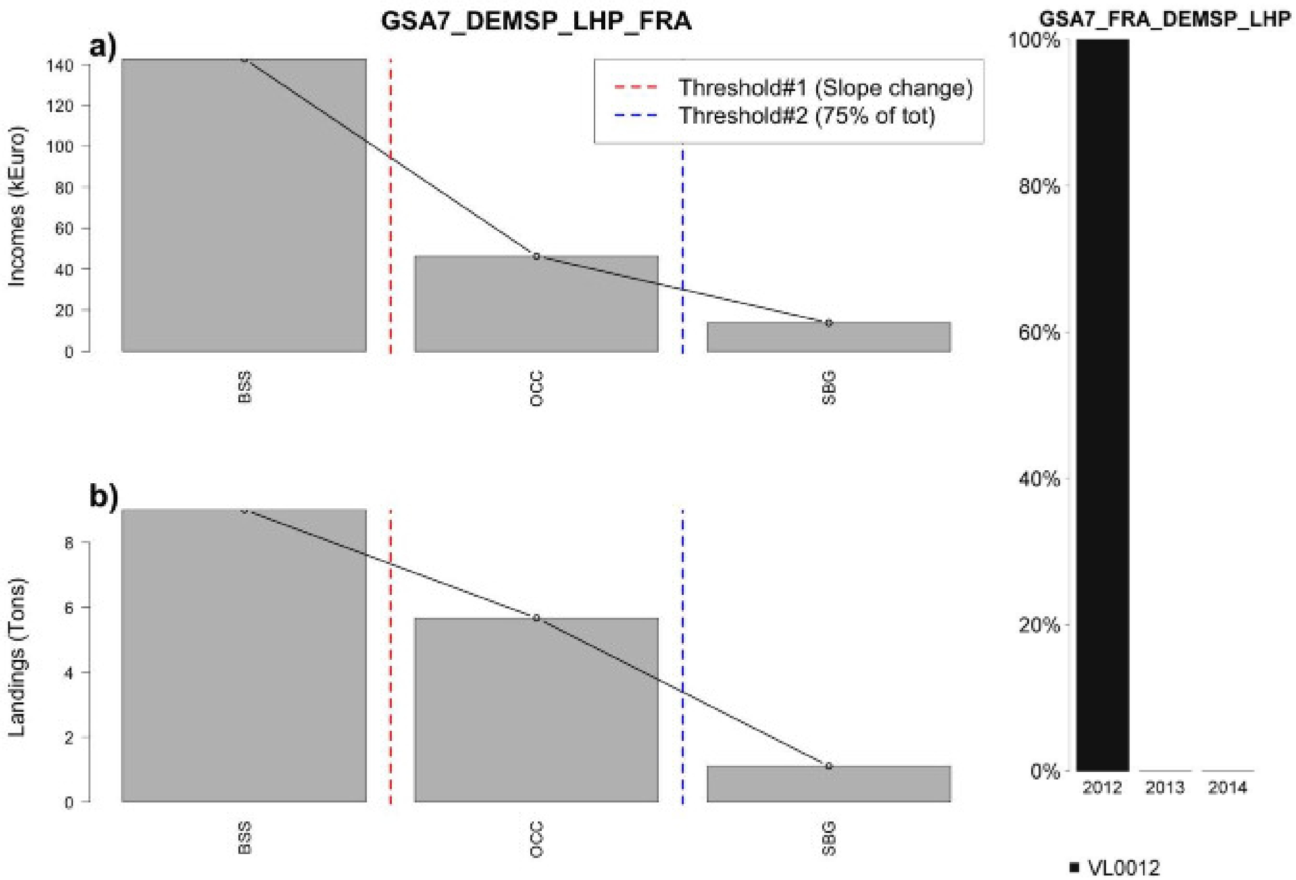


Figure 32. Cumulative percentage for GSA07_DEMSP_LHP, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.7. Set longlines targeting demersal species (DEMSP_LLS)

The target species of these fisheries are *Dicentrarchus labrax* (BSS) and *Sparus aurata* (SBG). These two species account for 75 % of the landings income and biomass (Figure 33). BSS and SBG are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, 163 vessels were involved in these fisheries in 2012 (VL0012), and 2 (VL1218) in 2013. In the period 2012-2014, this fleet performed 22,621 GT*days at sea in 2012 and 664 in 2013. Figure 33c shows the subdivision of this fishing effort according to year and fleet segments.

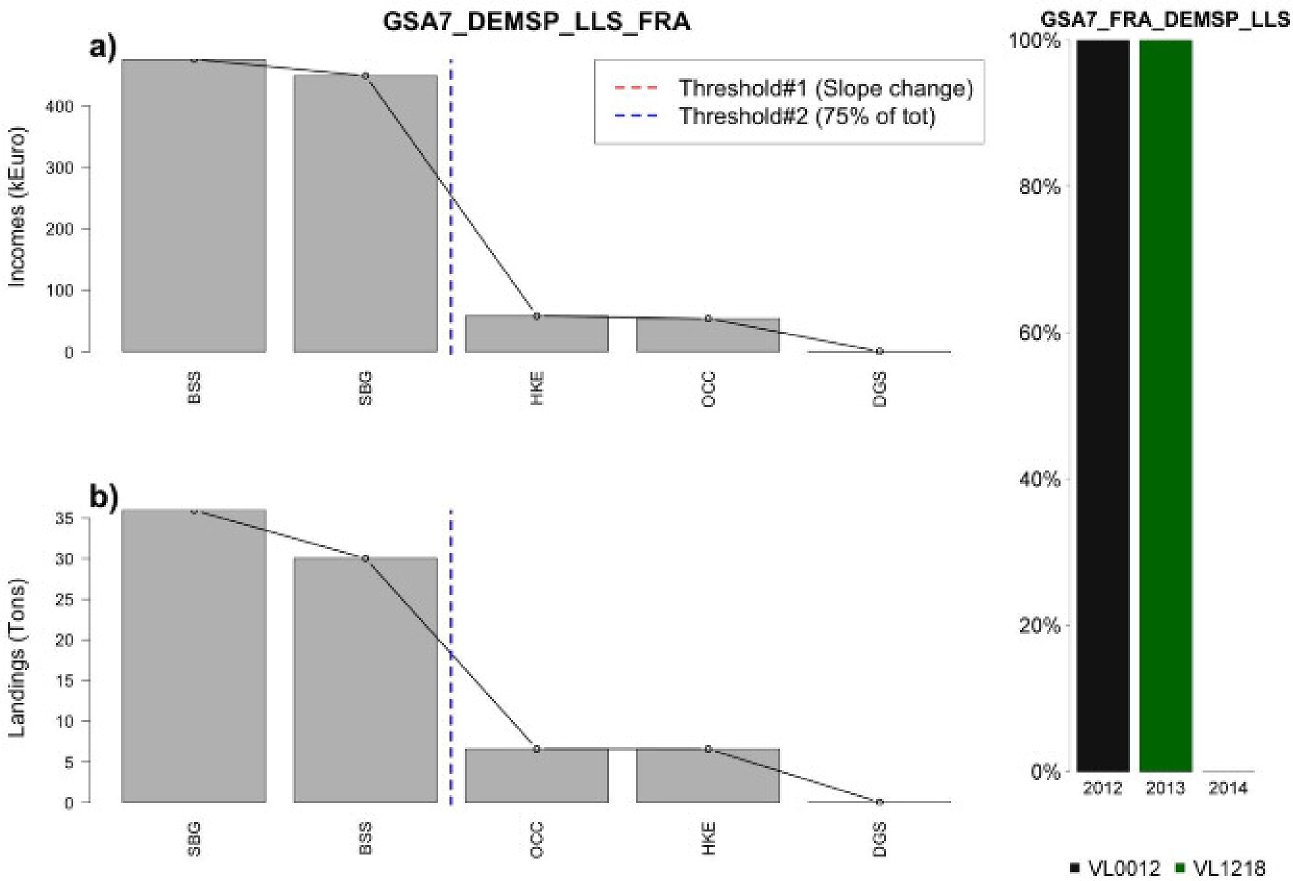


Figure 33. Cumulative percentage for GSA07_DEMSP_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.8. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Merluccius merluccius (HKE) is the target species of these fisheries. The species which cumulative percentage in terms of value of landings account for 75 % are *Merluccius merluccius* (HKE), *Lophius* spp (MNZ) and *Octopus vulgaris* (OCC). It is worth noting that *Mullus* spp (MUX) income is similar to that of MNZ and OCC. The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Merluccius merluccius* (HKE), *Lophius* spp (MNZ) and *Octopus vulgaris* (OCC). (Figure 34). Of these species, HKE and MUX are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2013-2014, 59 vessels were involved in these fisheries in 2013 (no fleet segment detailed) and in 2014, 1 vessel of fleet segment VL2240. This fleet performed 929,623 GT*days at sea in 2013 and 450 GT*days at sea in 2014. Figure 34c shows the subdivision of this fishing effort according to year and fleet segments.

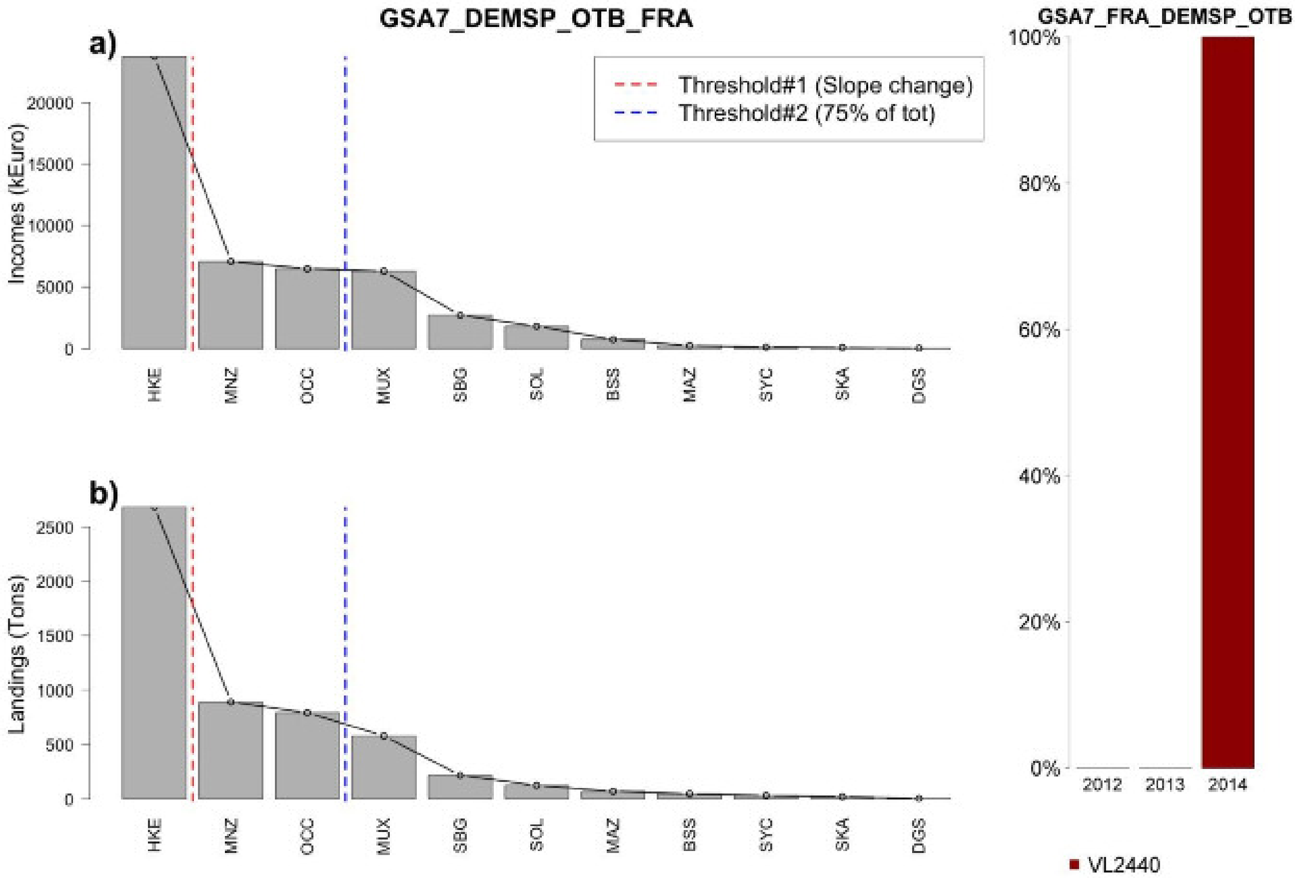


Figure 34. Cumulative percentage for GSA07_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.9. Purse seine targeting demersal species (DEMSP_PS)

The target species of these fisheries is *Sparus aurata* (SGB), which accounts for practically the total income and landings (Figure 35). SGB is included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in 2012, 24 vessels of fleet segment VL0012 were involved in these fisheries, and 2 in 2013 (VL1218). In 2012 this fleet performed 30,000 GT*days at sea and 249 in 2013. Figure 35c shows the subdivision of this fishing effort according to year and fleet segments.

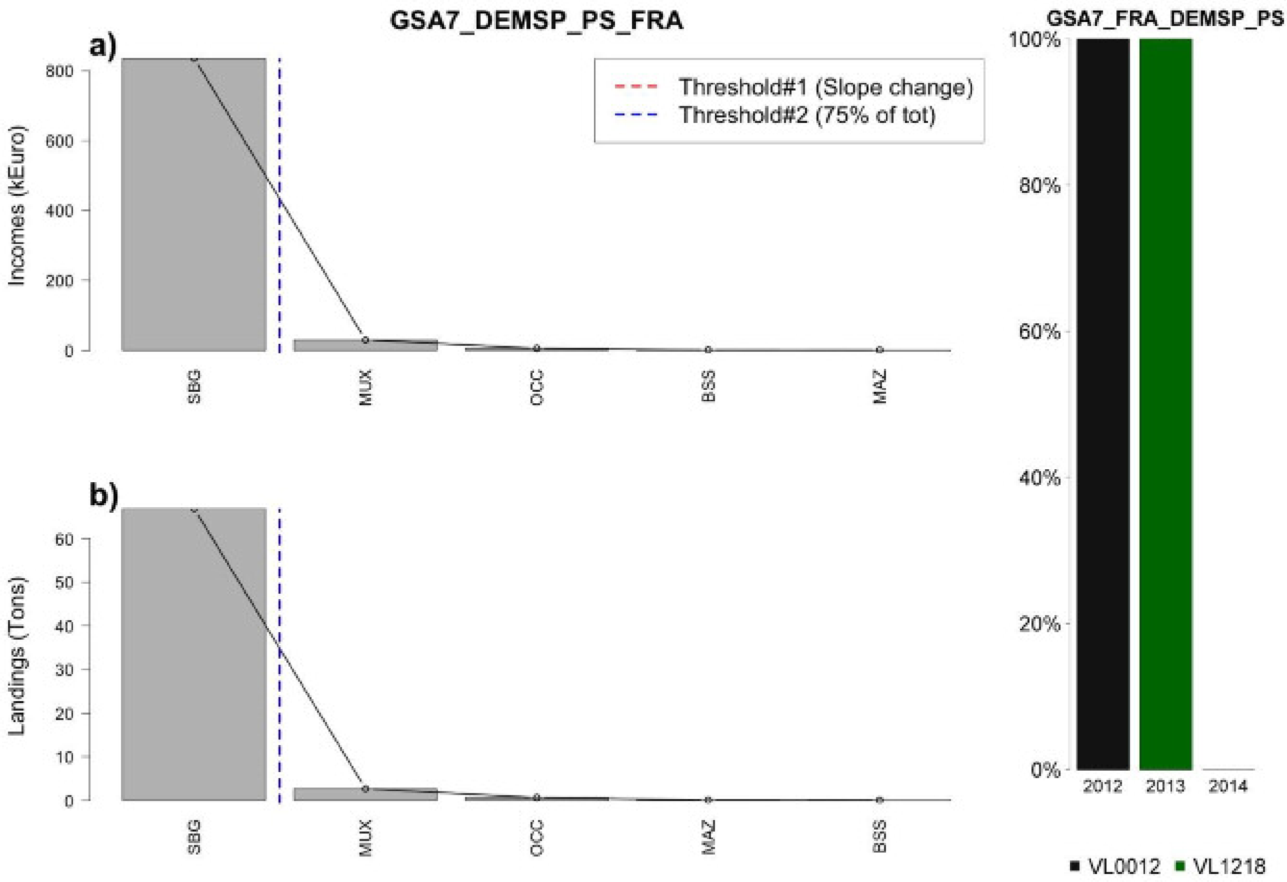


Figure 35. Cumulative percentage for GSA07_DEMSP_PS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.10. Beach seine targeting demersal species (DEMSP_SB)

Landings of these fisheries are very low. The target species are *Dicentrarchus labrax* (BSS) and *Sparus aurata* (SBG) that account for 75 % of landings value and biomass (Figure 36). BSS and SBG are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in 2012, 16 vessels of fleet segment VL0012 were involved in these fisheries. In 2012 this fleet performed 750 GT*days at sea. Figure 36c shows the subdivision of this fishing effort according to year and fleet segments.

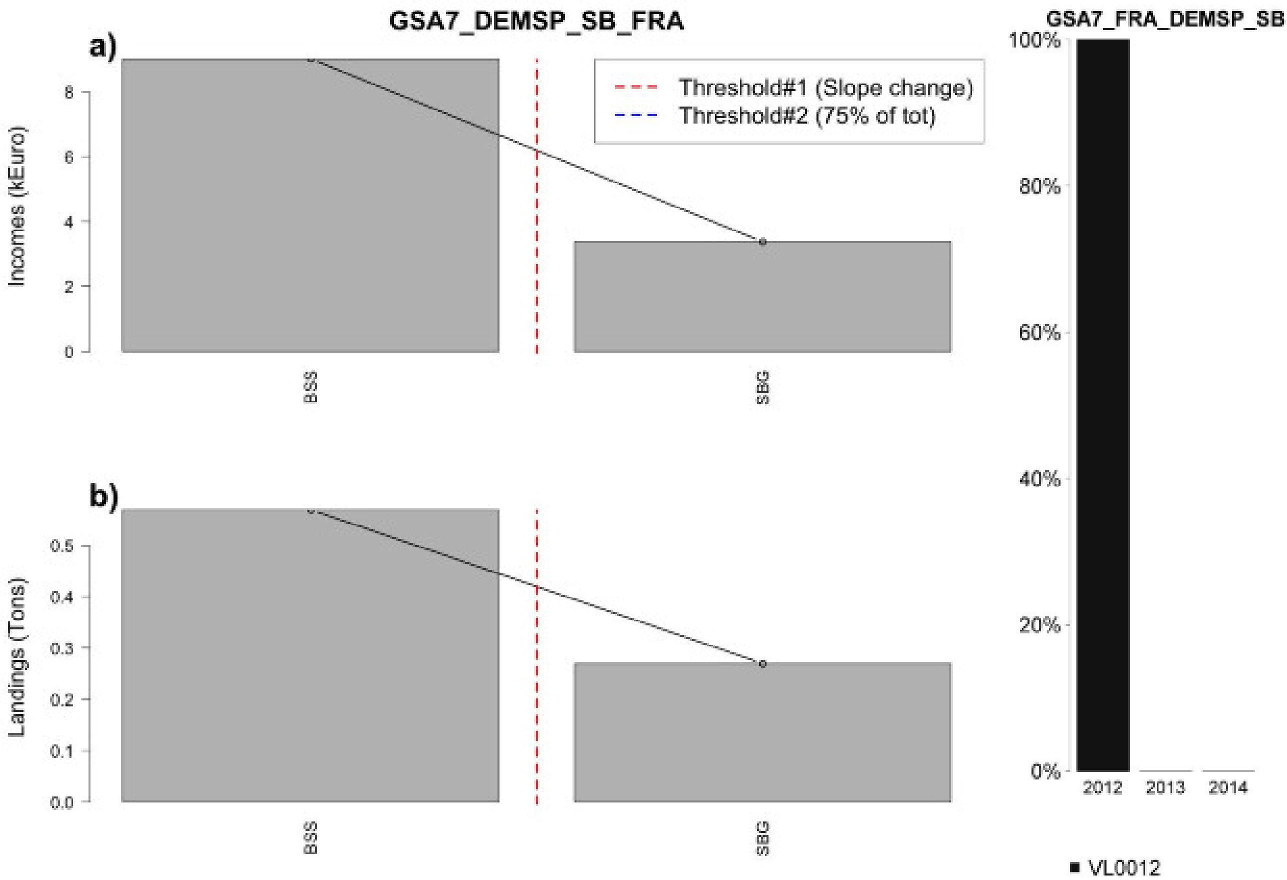


Figure 36. Cumulative percentage for GSA07_DEMSP_SB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.5.11. Beam trawl targeting demersal species (DEMSP_TBB)

Landings of these fisheries are very low. The target species are *Octopus vulgaris* (OCC) and *Mullus* spp (MUX) (Figure 37). MUX is included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in 2012, 22 vessels of fleet segment VL0012 were involved in these fisheries. In 2012 this fleet performed 3750 GT*days at sea. Figure 37c shows the subdivision of this fishing effort according to year and fleet segments.

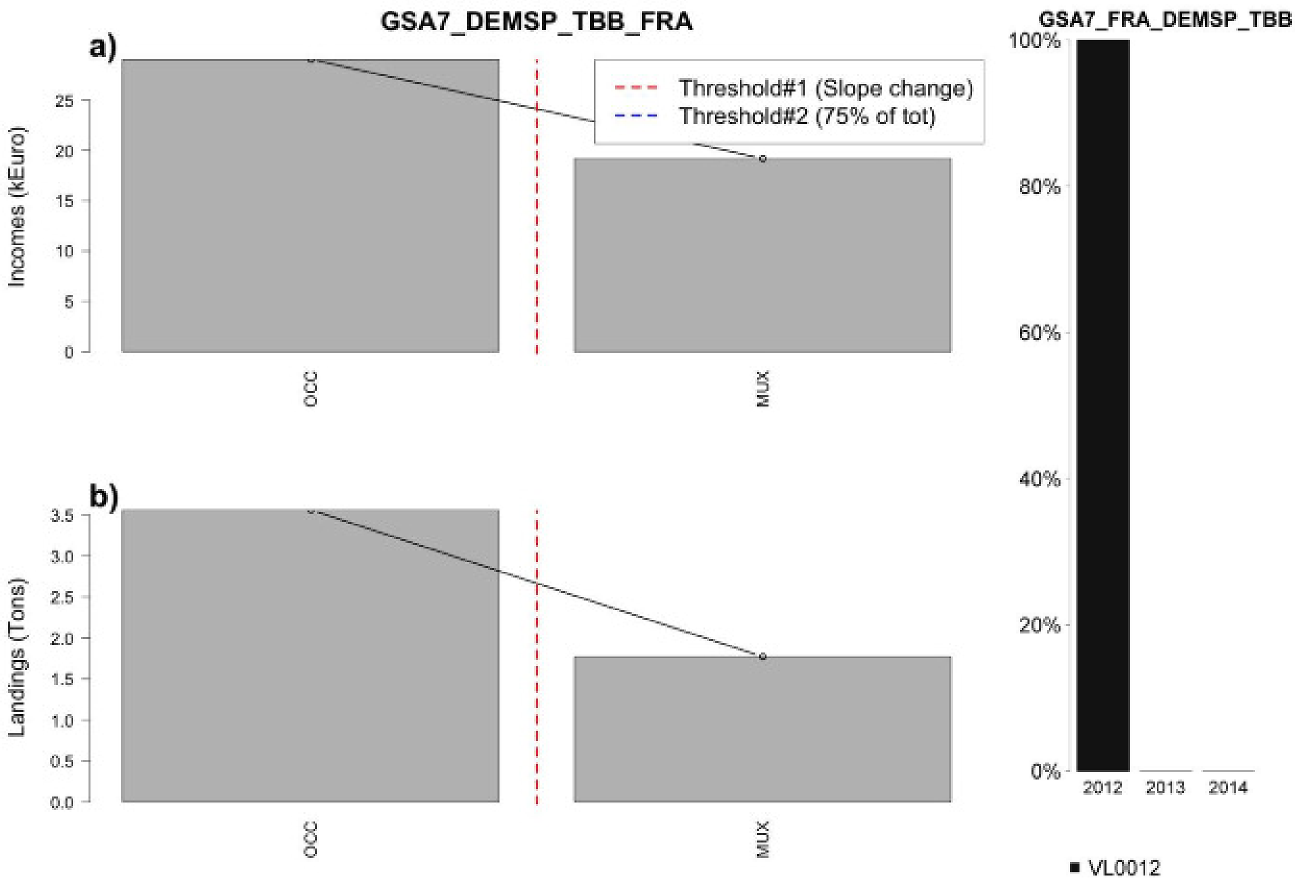


Figure 37. Cumulative percentage for GSA07_DEMSP_TBB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.6. *Gulf of Lion (GSA 7, Spain)*

2.2.6.1. Set longlines targeting demersal species (DEMF_LLS)

Merluccius merluccius (HKE) is the main target species of these fisheries. At present landings are very low. This species, along with *Pagellus* spp (PAX) *Helicolenus dactylopterus* (BRF), account for 75 % of the total income and biomass of landings. (Figure 38). HKE and PAX are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, on average, 11 vessels were involved in this fishey (4 of fleet segment VL0612 and 7 of VL1218). This fleet performed in the period 2012-2014, on average 12100 GT*days at sea. Figure 38c shows the subdivision of this fishing effort according to year and fleet segments.

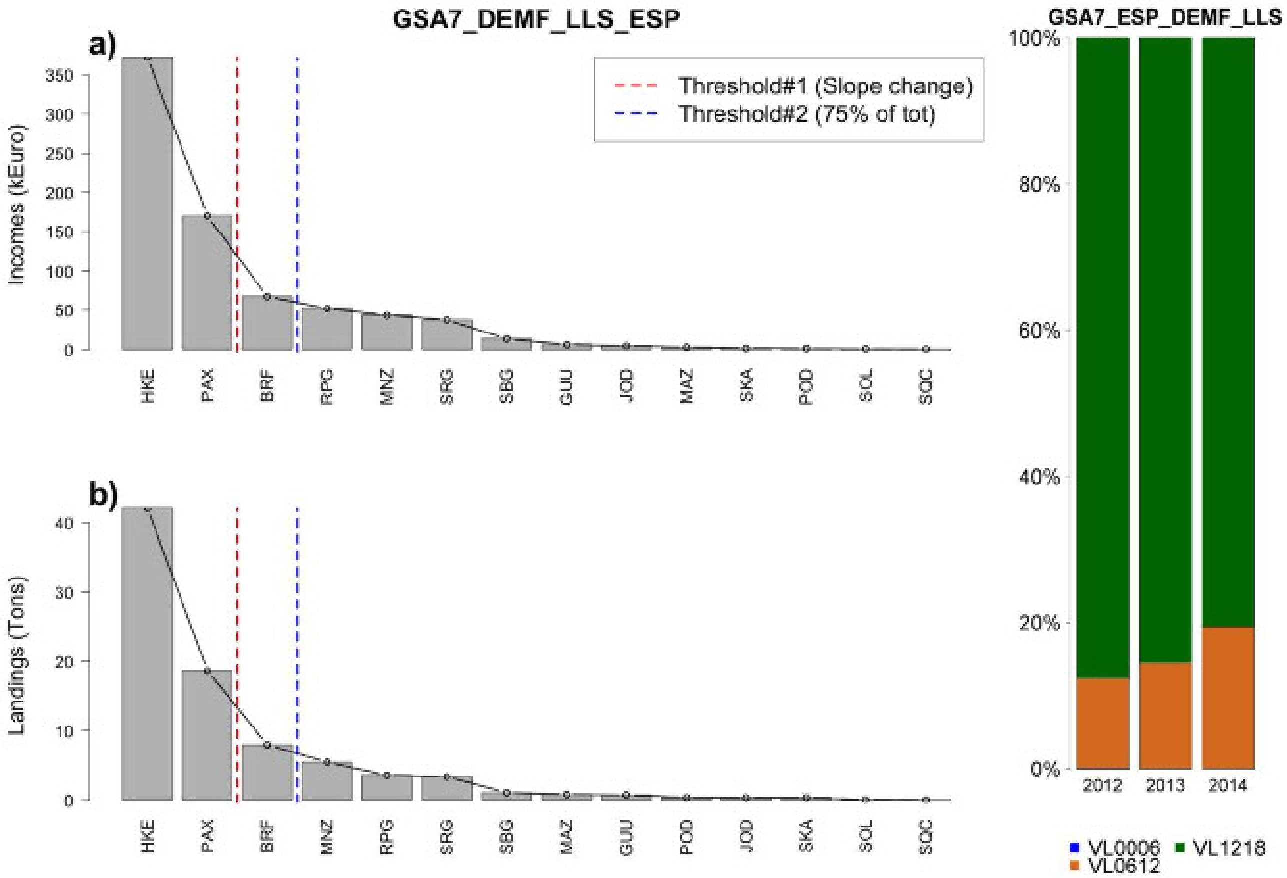


Figure 38. Cumulative percentage for GSA07_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.6.2. Set gillnet targeting demersal species (DEMSP_GNS)

The dominant species in landings expressed in income and in weight are *Pagellus* spp (PAX). The species which cumulative percentage both in terms of value of landings and biomass account for 75 % are PAX, *Sparus aurata* (SBG) and *Diplodus* spp (SRG) (Figure 39). These species are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, the number of vessels involved in these fisheries was 2-3 of fleet segment VL0006; 5 of segment VL0612; and 1 of segment VL1218. In the period 2012-2014, this fleet performed, on average, 600 GT*days at sea. Figure 39c shows the subdivision of this fishing effort according to year and fleet segments.

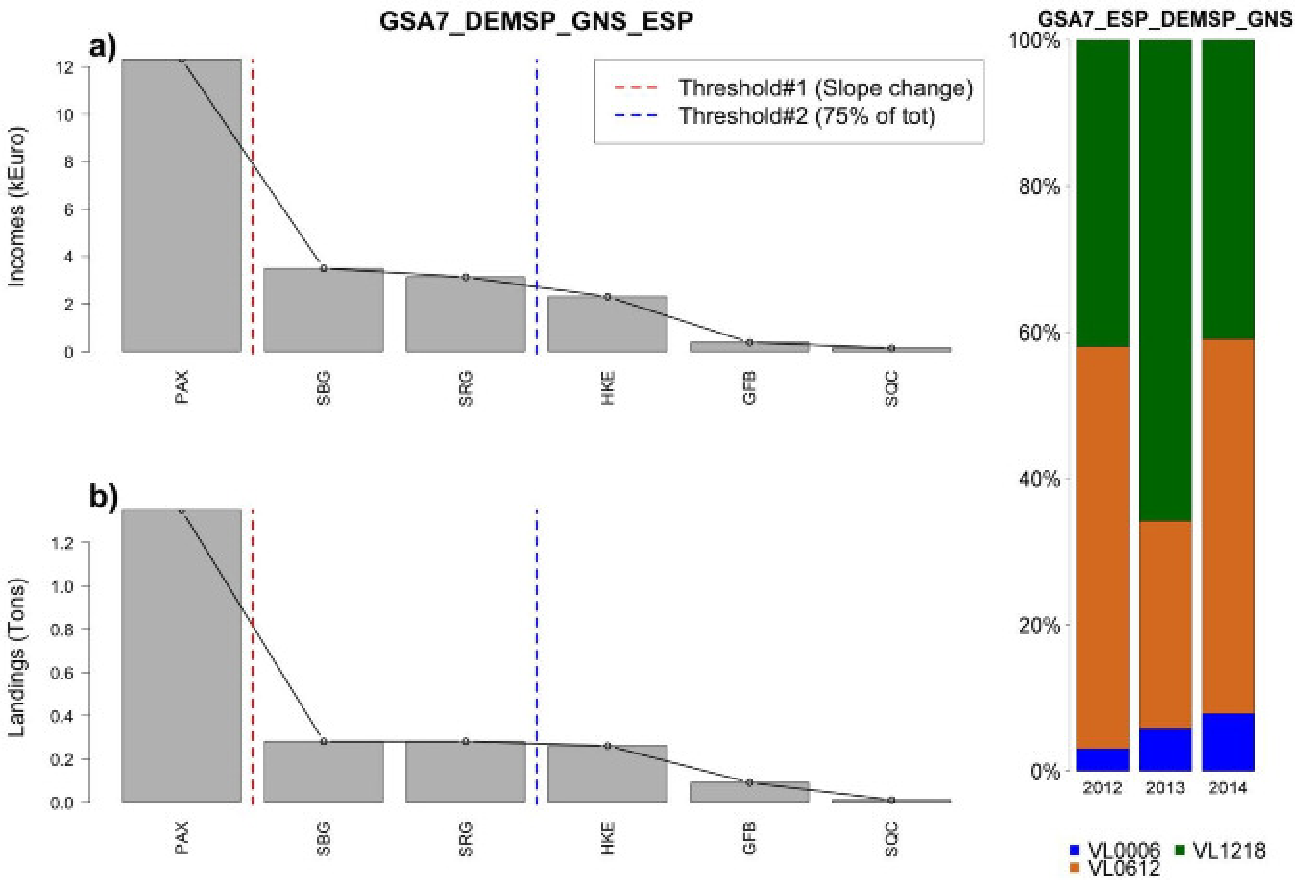


Figure 39. Cumulative percentage for GSA07_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.6.3. Trammel net targeting demersal species (DEMSP_GTR)

Landings of these fisheries are very low. The species which cumulative percentage both in terms of value of landings and biomass account for 75 % are *Pagellus* spp (PAX), *Sparus aurata* (SBG) and *Solea Solea* (SOL) (Figure 40). These species are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, a limited number of vessels were involved these fisheries (on average, 1 of fleet segment VL0006 and 3 of VL0612; plus 1 of VL1218 in 2012). In the period 2012-2014, this fleet performed, on average, 223 GT*days at sea. Figure 40c shows the subdivision of this fishing effort according to year and fleet segments.

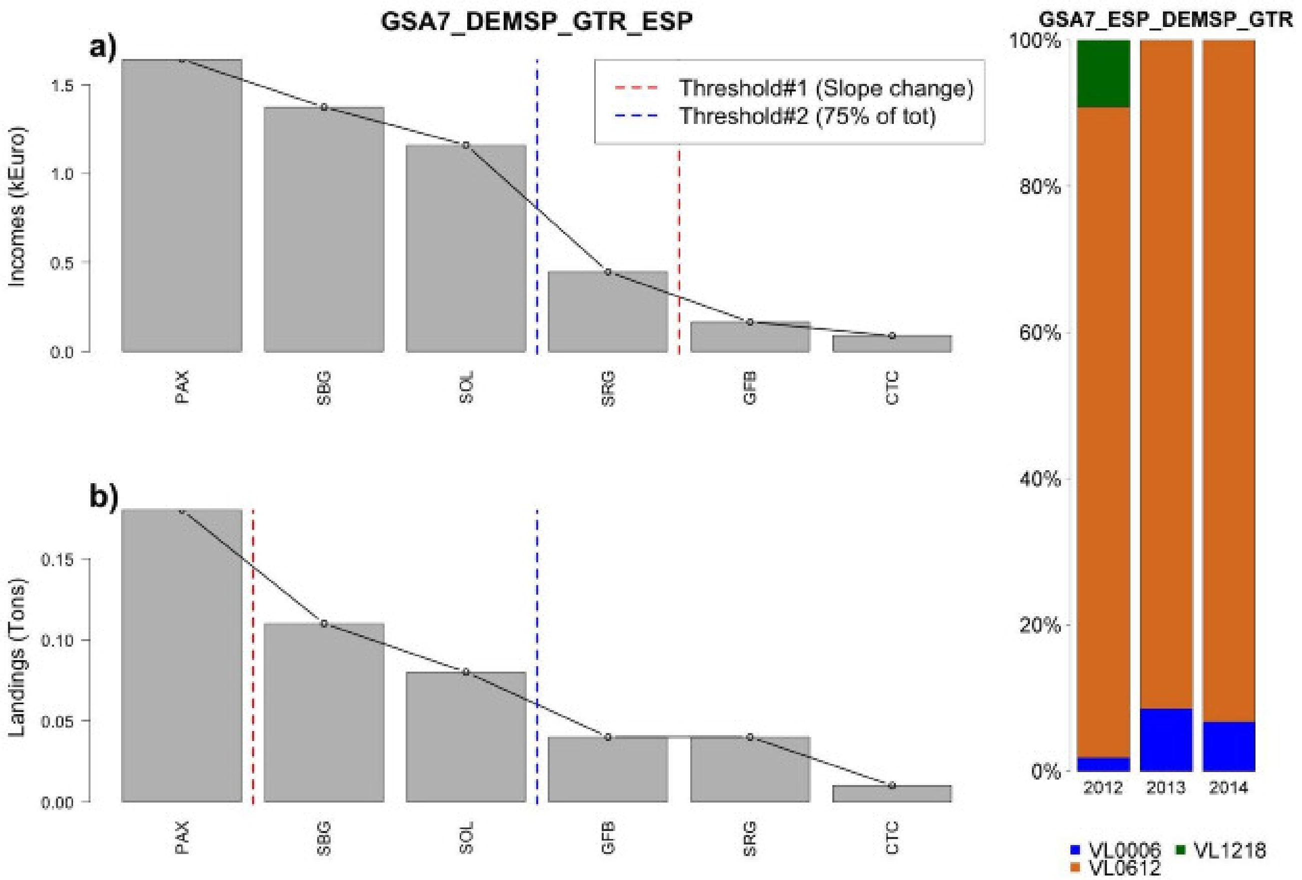


Figure 40. Cumulative percentage for GSA07_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.6.4. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Merluccius merluccius (HKE) is the target species of these fisheries. The species which cumulative percentage in terms of value of landings accounts for 75 % are *Merluccius merluccius* (HKE), *Mullus* spp (MUX), *Nephrops norvegicus* (NEP), *Lophius* spp (MNZ), *Eledone* spp (OCM), *Micromesistius poutassou* (WHB), *Illex coindetii* (SQM) and *Loligo* spp (SQC). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Merluccius merluccius* (HKE), *Micromesistius poutassou* (WHB), *Eledone* spp (OCM), *Trisopterus minutus* (POD), *Trachurus* spp (JAX), *Lophius* spp (MNZ), *Mullus* spp (MUX) and *Scomber* spp (MAZ) (Figure 41). Of these species, HKE, MUX, NEP, JAX and MAZ are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, ca. 20 vessels were involved in these fisheries (1 of fleet segment VL0612; 1 of VL1218; 7-8 of VL1824; 8-12 of VL2440). In the period 2012-2014, this fleet performed, on average, 478,506 GT*days at sea. Figure 41c shows the subdivision of this fishing effort according to year and fleet segments.

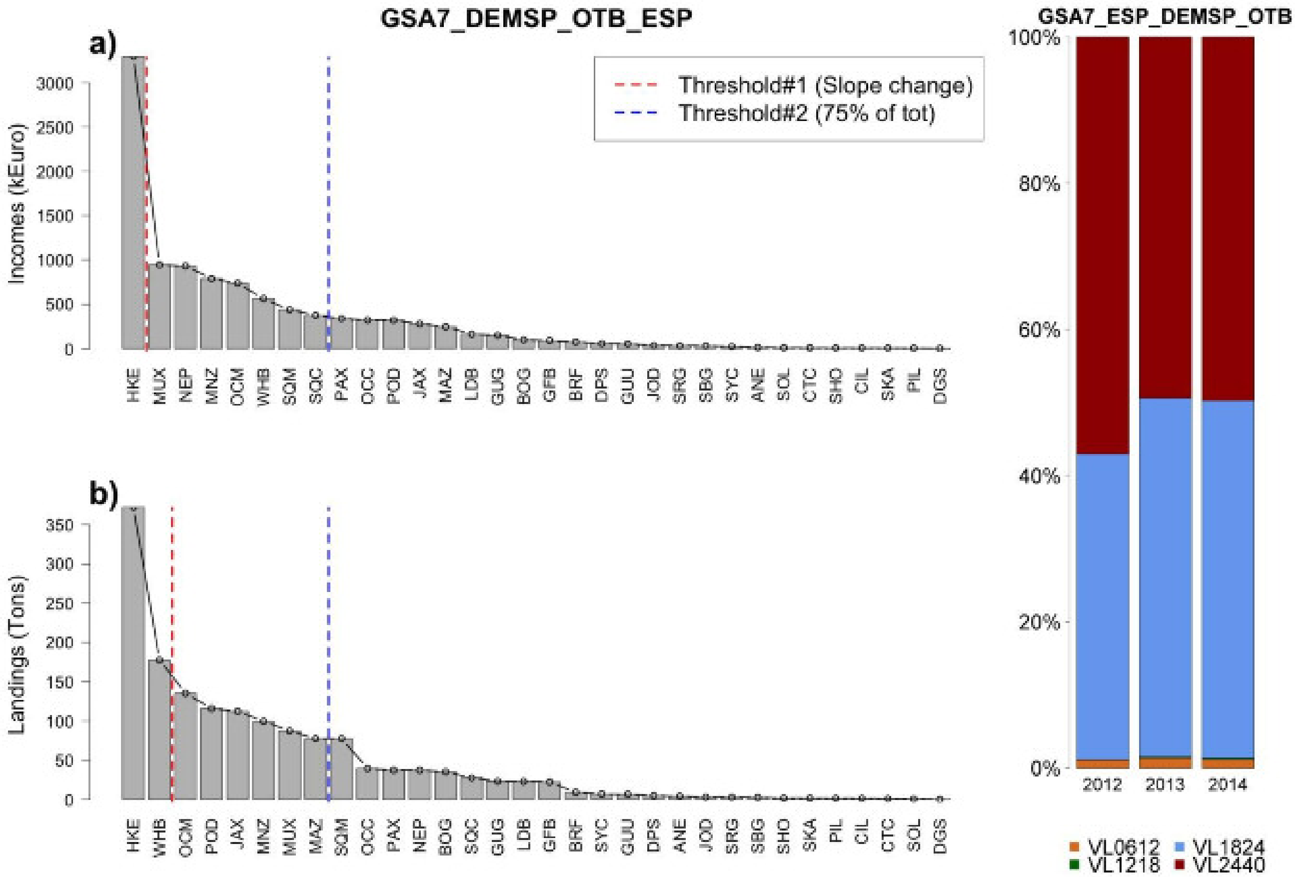


Figure 41. Cumulative percentage for GSA07_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.6.5. Bottom otter trawl targeting deep water species (DWSP_OTB)

Aristeus antennautus (ARA) is the target species of these fisheries, which accounts for more than 75 % of income. The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Aristeus antennautus* (ARA), *Phycis blennoides* (GFB) and *Merluccius merluccius* (HKE) (Figure 42). Of these species, HKE and MUX are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, on average, 12 vessels were involved in these fisheries (9 of fleet segment VL2440 and 3 of VL1824). In 2012-2014, this fleet performed, on average, 72,290 GT*days at sea. Figure 42c shows the subdivision of this fishing effort according to year and fleet segments.

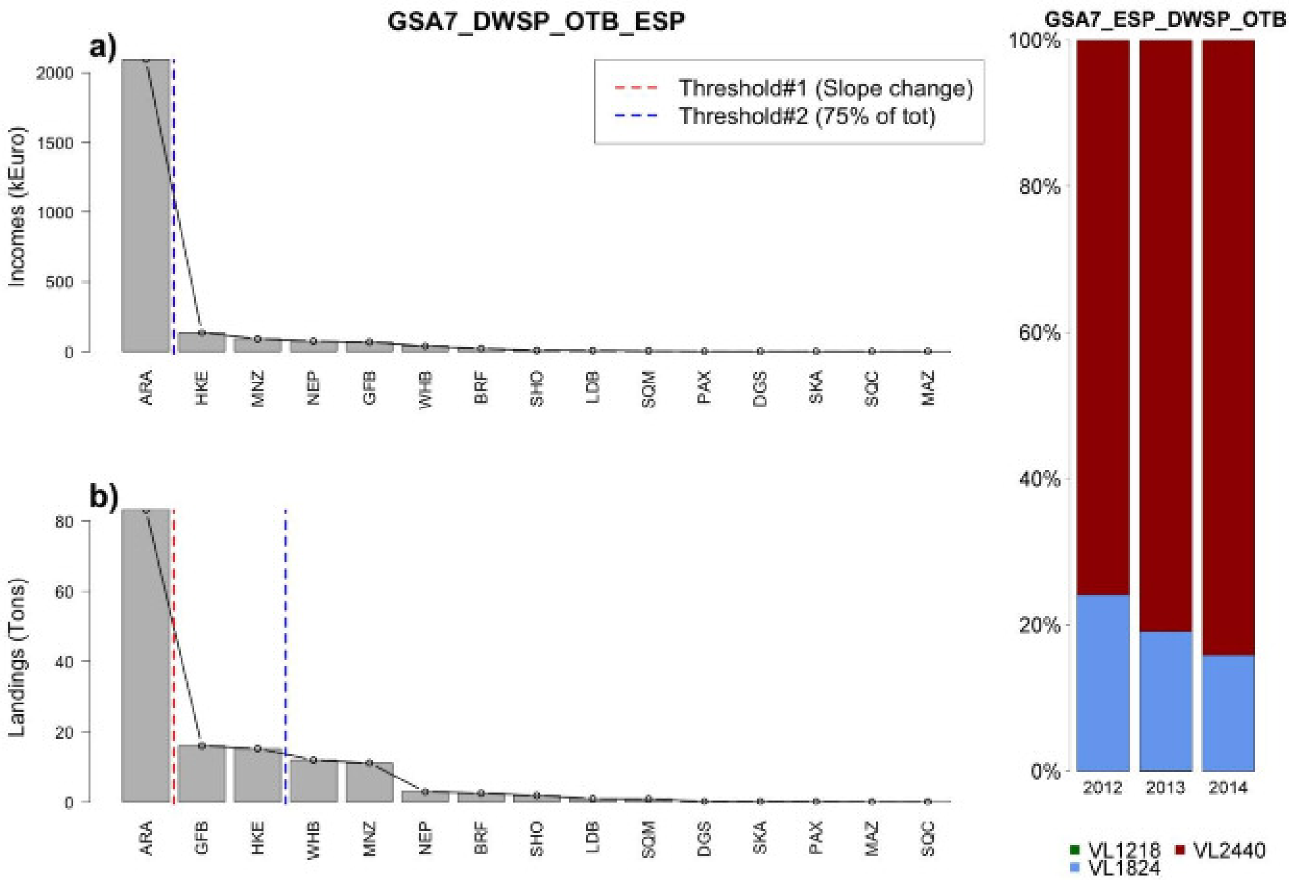


Figure 42. Cumulative percentage for GSA07_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.6.6. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in terms of value of landings account for 75 % are *Aristeus antennatus* (ARA), *Nephrops norvegicus* (NEP), *Merluccius merluccius* (HKE) and *Lophius* spp (MNZ). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Micromesistius poutassou* (WHB), *Aristeus antennatus* (ARA), *Merluccius merluccius* (HKE), *Lophius* spp (MNZ), *Phycis pblennoides* (GFB) and *Nephrops norvegius* (NEP) (Figure 43). Of these species, NEP and HKE are included in Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, on average, 13 vessels were involved in these fisheries (9 of fleet segment VL2440 and 4 of VL1824). In 2012-2014, this fleet performed, on average, 17,370 GT*days at sea. Figure 43c shows the subdivision of this fishing effort according to year and fleet segments.

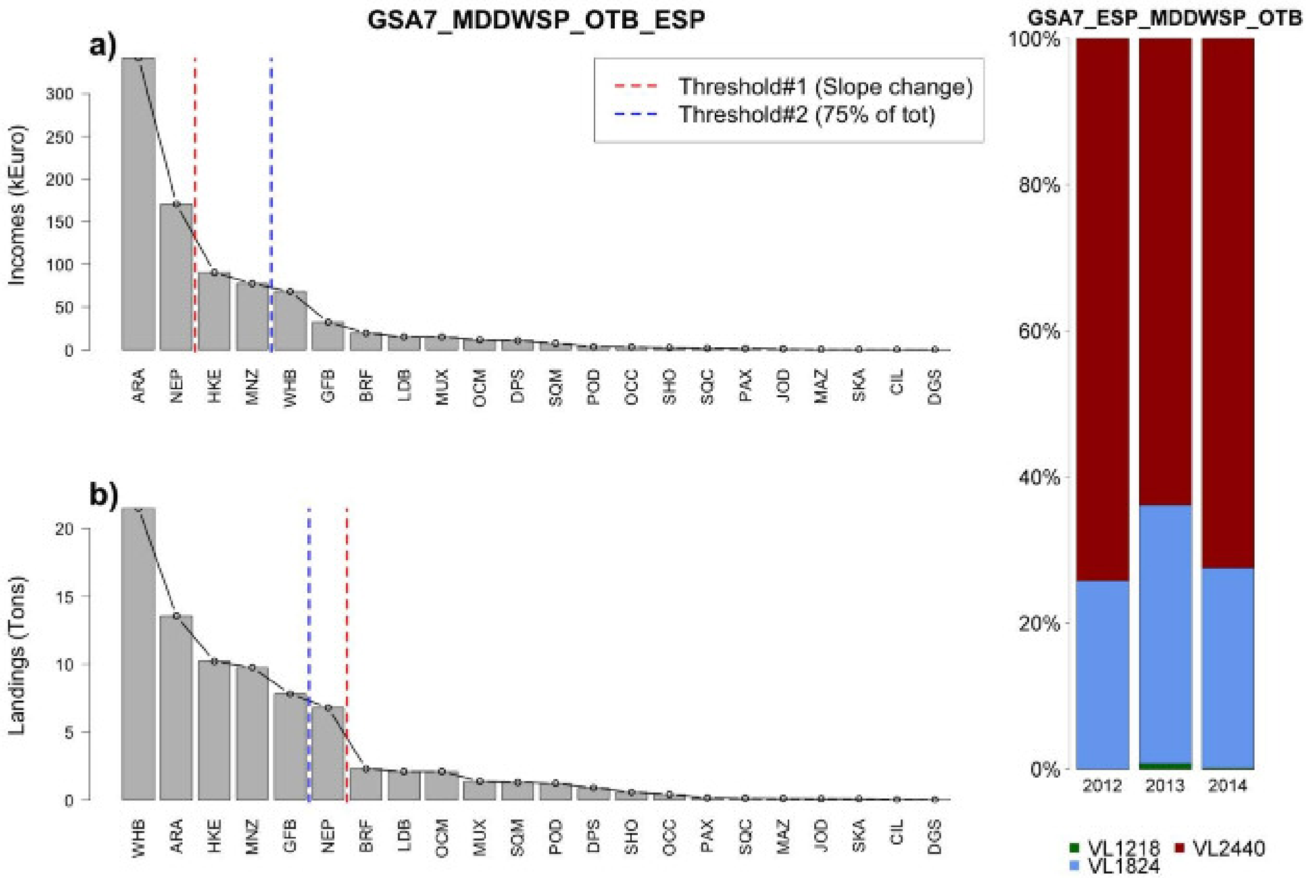


Figure 43. Cumulative percentage for GSA07_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.7. *Corsica Island (GSA 8)*

2.2.7.1. Pots and traps for cephalopods (CEP_FPO)

The target species is the common octopus, *Octopus vulgaris* (CTC), accounting for almost the total landings, both in terms of value and volume. *O. vulgaris* is not included in the Annex III of the EU Reg. 1967/2006 (Figure 44). In the period 2012-2014, 3 vessels of the segment VL0012, on average, were involved in these fisheries (DCF data). Data on fishing effort are scattered and therefore not reported.

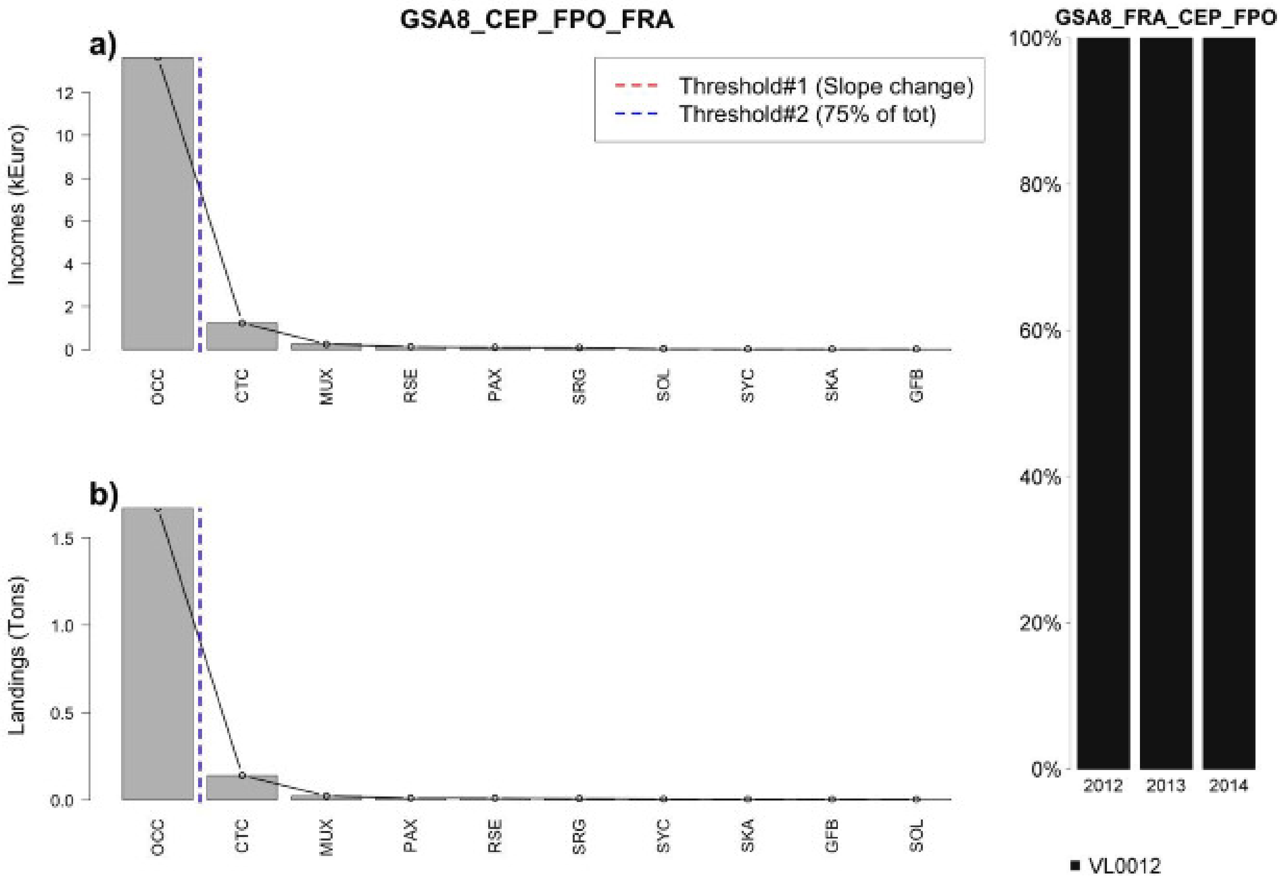


Figure 44. Cumulative percentage for GSA08_CEP_FPO, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.7.2. Trammel net for cephalopods (CEP_GTR)

Sepia officinalis (CTC) is by far the most important species of these fisheries, both in terms of value and volume of landings (Figure 45). It is followed in importance by *Scorpaena scrofa* (RSE) and *Mullus* spp (MUX). *S. offcinalis* is not included in the Annex III of the EU Reg. 1967/2006.

According to the DCF data for the period 2012-2014, four vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL0012. The subdivision of this fishing effort, according to years and fleet segments, is shown in Figure 45c.

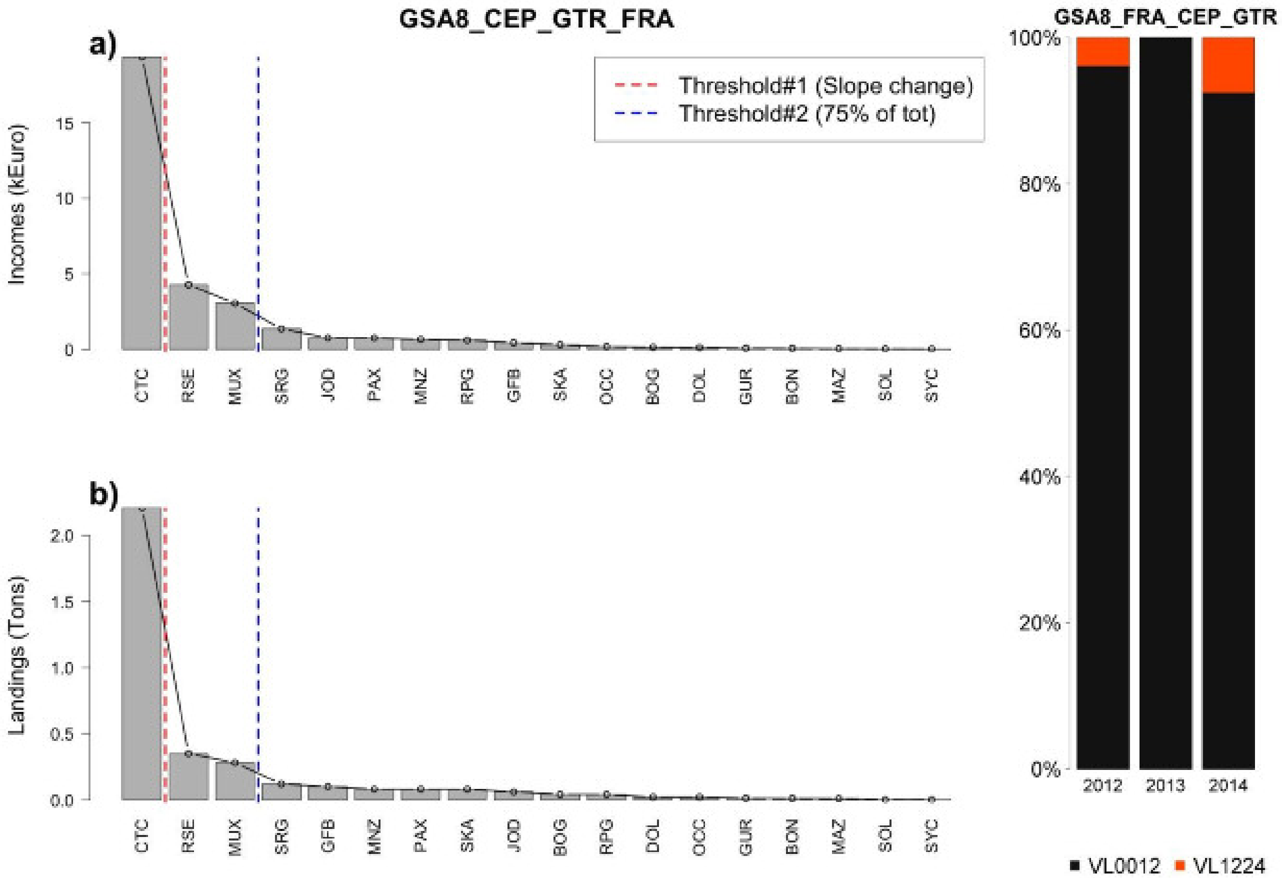


Figure 45. Cumulative percentage for GSA08_CEP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.7.3. Trammel net for demersal fish (DEMF_GTR)

The species which cumulative percentage in value of landings accounts for 75 % (Figure 46a) are the red scorpionfish, *Scorpaena scrofa* (RSE), *Mullus* spp (MUX), the sargo breams, *Diplodus* spp (SRG), the cuttlefish, *Sepia officinalis* (CTC), the common sole, *Solea Solea* (SOL). *Mullus* spp, *Diplodus* spp and *S. Solea* are included in the Annex III of the EU Reg. 1967/2006. In volume of landings there is less dominance of species: other important species are the greater forkbeard, *Phycis blennoides* (GFB) and the skates, Rajidae (SKA) (Figure 46b).

According to the most recent DCF data, in the period 2012-2014, 84 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL0012. The subdivision of this fishing effort, according to years and fleet segments, is shown in Figure 46c.

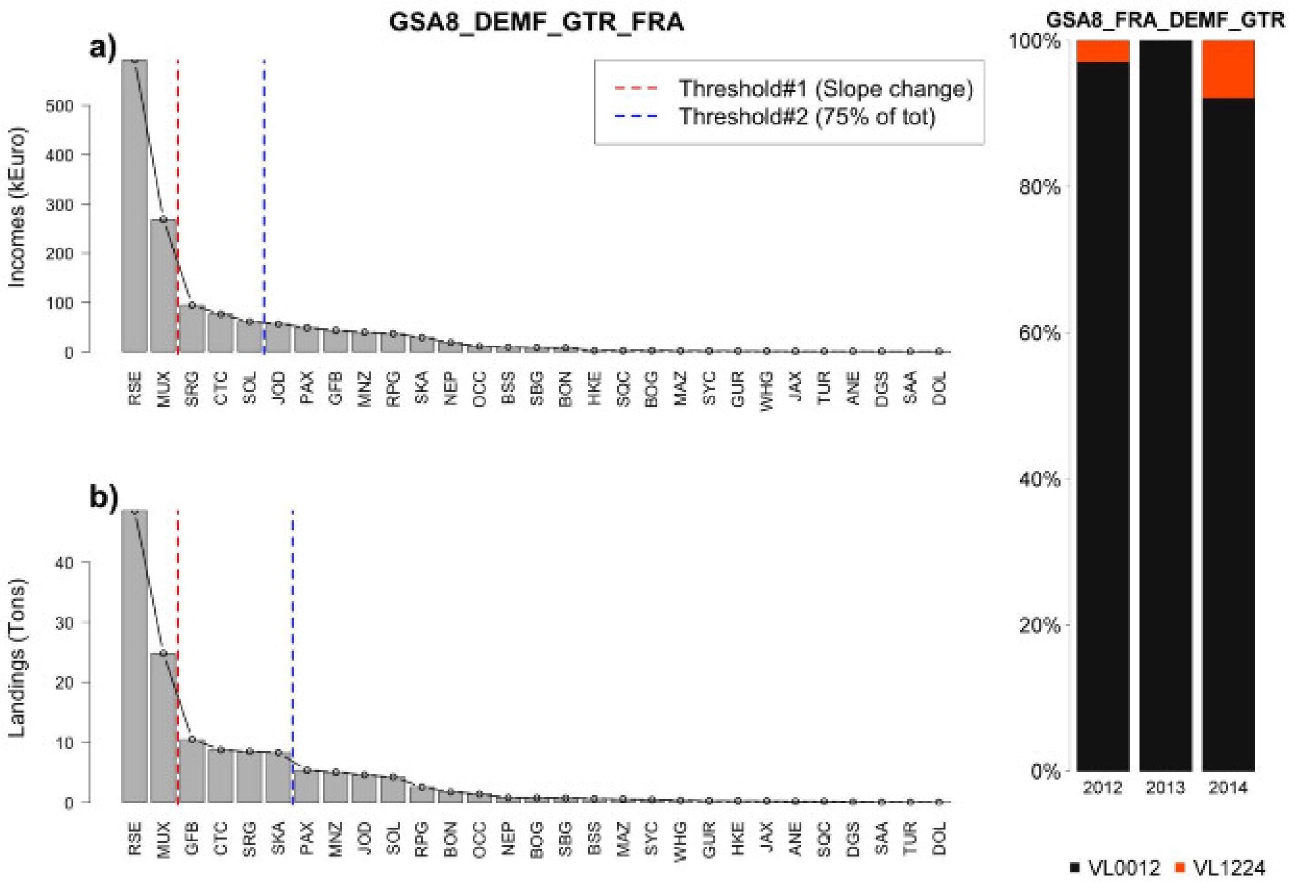


Figure 46. Cumulative percentage for GSA08_DEMF_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.7.4. Set longline for demersal fish (DEMF_LLS)

The most important species of these fisheries, both in terms of value and volume of landings, are *Scorpaena scrofa* (RSE), the red porgy, *Pagrus pagrus* (RPG), the Pandoras, *Pagellus* spp (PAX) and *Diplodus* spp (SRG) (Figure 47a and b, respectively). *Pagellus* spp and *Diplodus* spp are included in the Annex III of the EU Reg. 1967/2006. On the basis of DCF data, in the period 2012-2014, 28 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL0012. The subdivision of this fishing effort, according to years and fleet segments, is shown in Figure 47c.

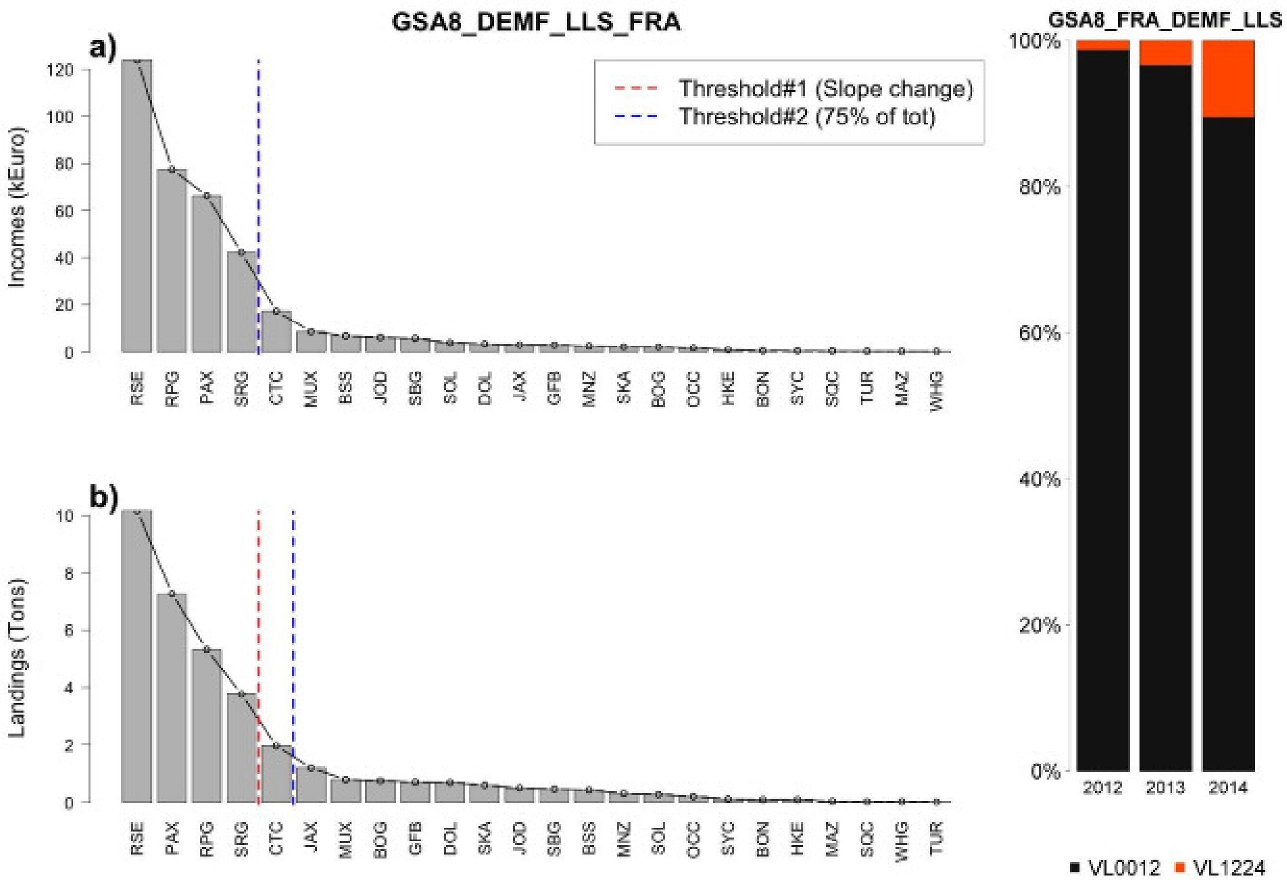


Figure 47. Cumulative percentage for GSA08_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.7.5. Bottom otter trawl for demersal fish (DEMF_OTB)

These fisheries are characterized by a variety of species, even with different ecological characteristics. The most important of them, both in terms of value and volume of landings are *Mullus* spp (MUX), the Ommastrephid squids (SQC), *N. norvegicus* (NEP), the John dory, *Zeus faber* (JOD), the Pandoras *Pagellus* spp (PAX), the bogue, *Boops Boops* (BOG) (Figure 48). *Mullus* spp and *N. norvegicus* are included in the Annex III of the EU Reg. 1967/2006.

According to the DCF data, in the period 2012-2014, three vessels, on average, were involved in these fisheries. Data on fishing effort are rather scattered.

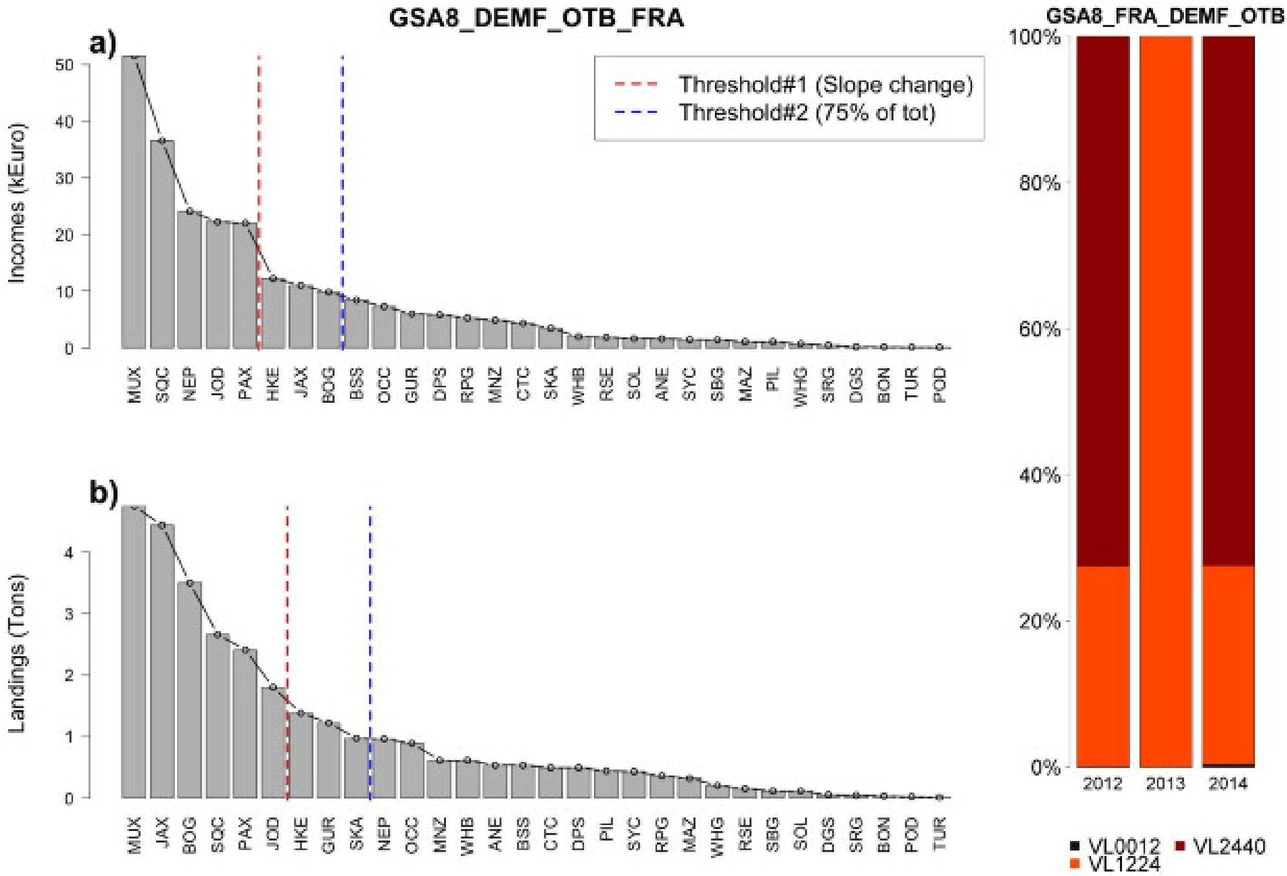


Figure 48. Cumulative percentage for GSA08_DEMF_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014).

2.2.7.6. Set gillnet for demersal species (DEMSP_GNS)

The species which cumulative percentage in value of landings accounts for 75 % are *Zeus faber* (JOD), *Scorpaena scrofa* (RSE), *Diplodus* spp (SRG), *Mullus* spp (MUX), and the European sea bass, *Dicentrarchus labrax* (BSS) (Figure 49a). All these species, except *Z. faber* and *S. scrofa,* are included in the Annex III of the EU Reg. 1967/2006. In volume of landings there is less dominance: other important species are the Rajidae (SKA) and *Sepia officinalis* (CTC) (Figure 49b).

In the period 2012-2014, 37 vessels, on average, were involved in these fisheries (DCF data). This fleet was mostly composed by the segment VL0012. The subdivision of this fishing effort, according to years and fleet segments, is shown in Figure 49c.

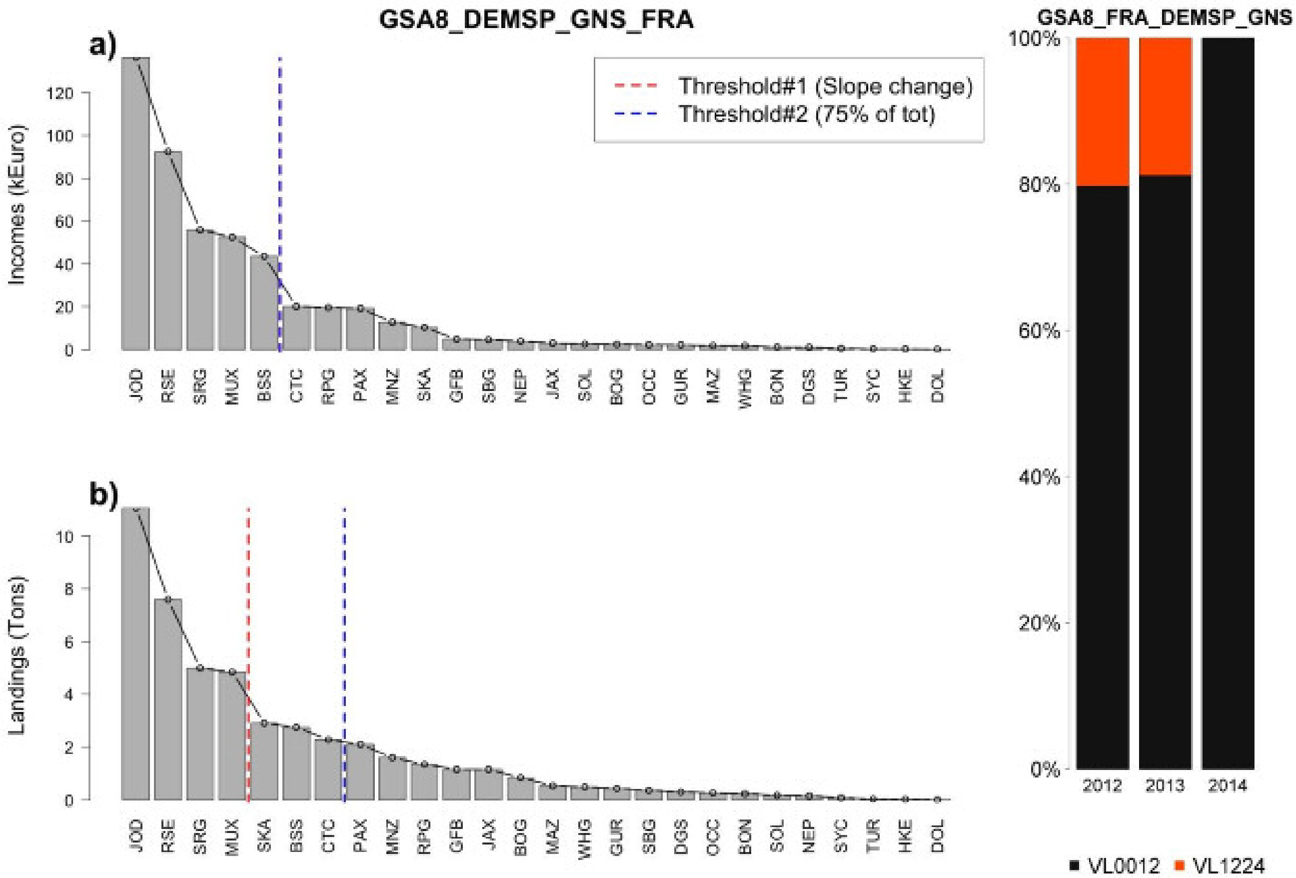


Figure 49. Cumulative percentage for GSA08_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.7.7. Trammel net for demersal species (DEMSP_GTR)

The species which cumulative percentage in value of landings accounts for 75 % are *Scorpaena scrofa* (RSE), the monkfishes, *Lophius* spp (MNZ), *Zeus faber* (JOD), *Mullus* spp (MUX). Important species in terms of volume of landings are also Rajidae (SKA) and *Phycis blennoides* (GFB) (Figure 50b). Of these species, only *Mullus* spp (MUX) is included in the Annex III of the EU Reg. 1967/2006. On the basis of the last DCF data, in the period 2012-2014, 67 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segment VL0012. The subdivision of this fishing effort, according to years and fleet segments, is shown in Figure 50c.

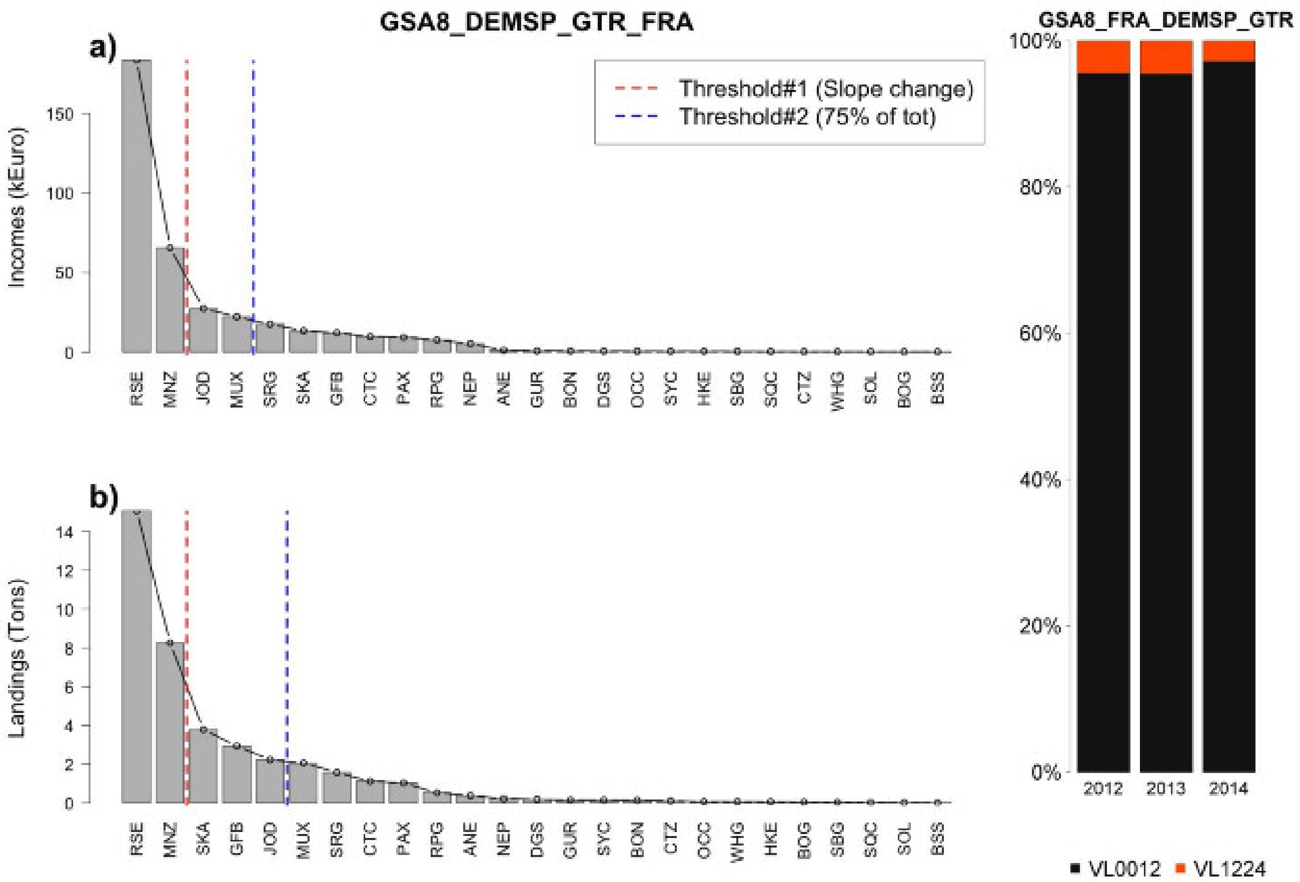


Figure 50. Cumulative percentage for GSA08_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.7.8. Bottom otter trawl for demersal species (DEMSP_OTB)

Among the species which cumulative percentage in value and in volume of landings accounts for 75 %, the Norway lobster, *Nephrops norvegicus* (NEP) clearly predominates (Figure 51). This species is followed by the Ommastrephid squids (SQC), the European hake, *Merluccius merluccius* (HKE) and the red mullets, *Mullus* spp (MUX) (Figure 51). All these species, except the squids, are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, there is less dominance: other species accounting for 75 % of cumulative percentage are the blue withing, *Micromesistius poutassou* (WHB), the Horse and Mediterranean mackerels, *Trachurus* spp (JAX), the Pandoras, *Pagellus* spp (PAX), the bogue*, Boops Boops* (BOG), the deep water pink shrimp, *Parapenaeus longirostri*s (DPS) (Figure 51b).

According to the DCF data, in the period 2012-2014, 3 vessels, on average, were involved in these fisheries. In Figure 51c, the subdivision of this fishing effort, according to years and fleet segments, is shown. The most important fleet segment in terms of fishing effort is VL2440.

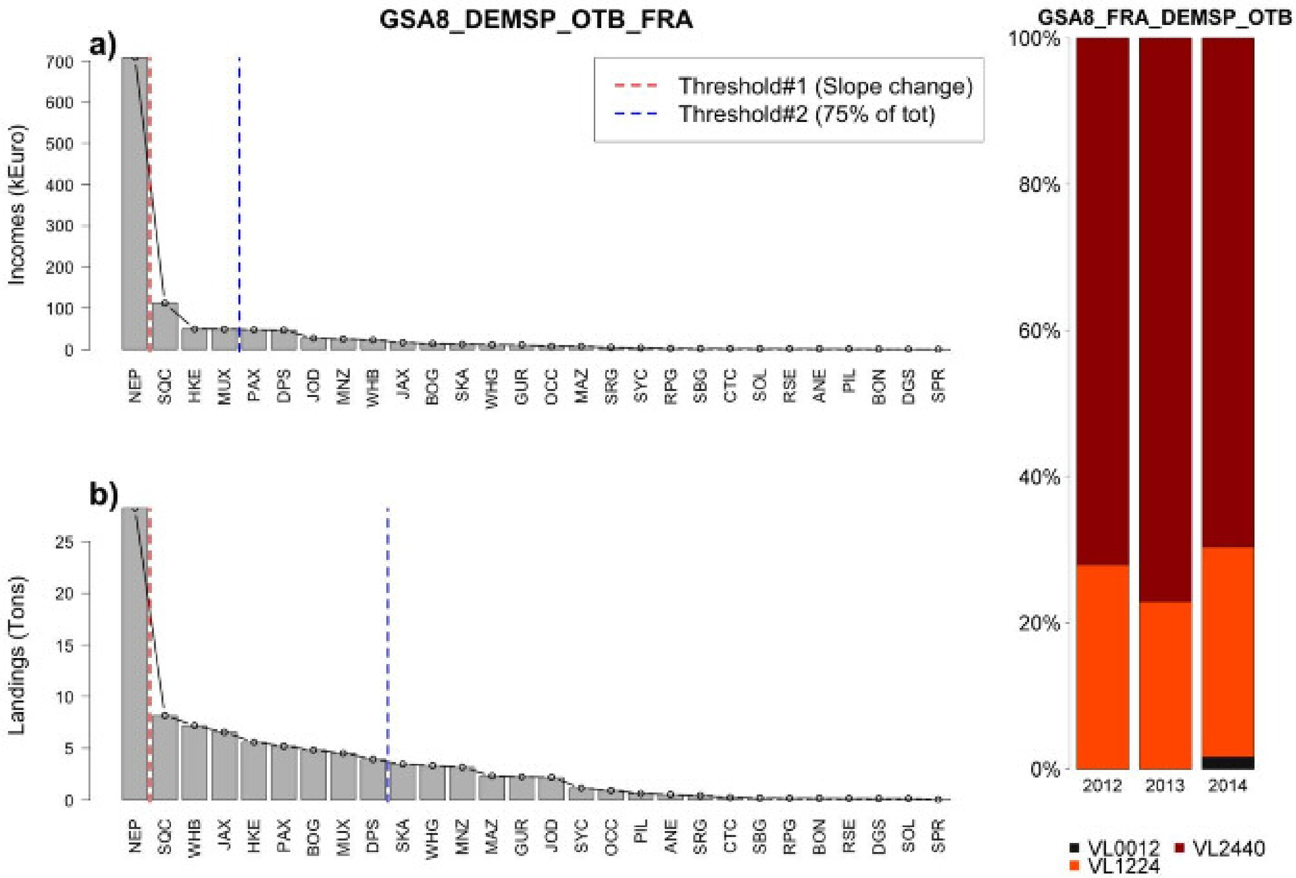


Figure 51. Cumulative percentage for GSA08_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.8. *Ligurian and North Tyrrhenian Sea (GSA 9)*

2.2.8.1. Set gillnets targeting demersal species (DEMSP_GNS)

The European hake, *M. merluccius* (HKE) is by far the most important species of these fisheries, both in terms of value and volume of landings (Figure 52). As regards the value of landings, other species accounting for the 75 % cumulative percentage are *Mullus* spp (MUX) and *S. officinalis* (CTC) (Figure 52a); as concerns the volume of landings, the other species contributing to the 75 % cumulative percentage are Mugilidae (MUL), *Mullus* spp (MUX), and the Horse and Mediterranean mackerels, *Trachurus* spp (JAX) (Figure 52b). Among these species, *M. merluccius, Mullus* spp and *Trachurus* spp are included in the Annex III of the EU Reg. 1967/2006.

These fisheries, in the period 2012-2014, were performed by 348 vessels, on average, according to the DCF data. This fleet was mostly composed by the segment VL0612 (70 %). In the period 2012-2014, this fleet accounted, on average, for 106,271 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments, is shown in Figure 52c. The most important fleet segment in terms of fishing effort is VL0612. *M. merluccius* and *Trachurus* spp are caught by gillnet used on the bottoms of continental shelf and upper slope, from 80 to 250 m depth, while the other species are caught mostly along the coastal zone.

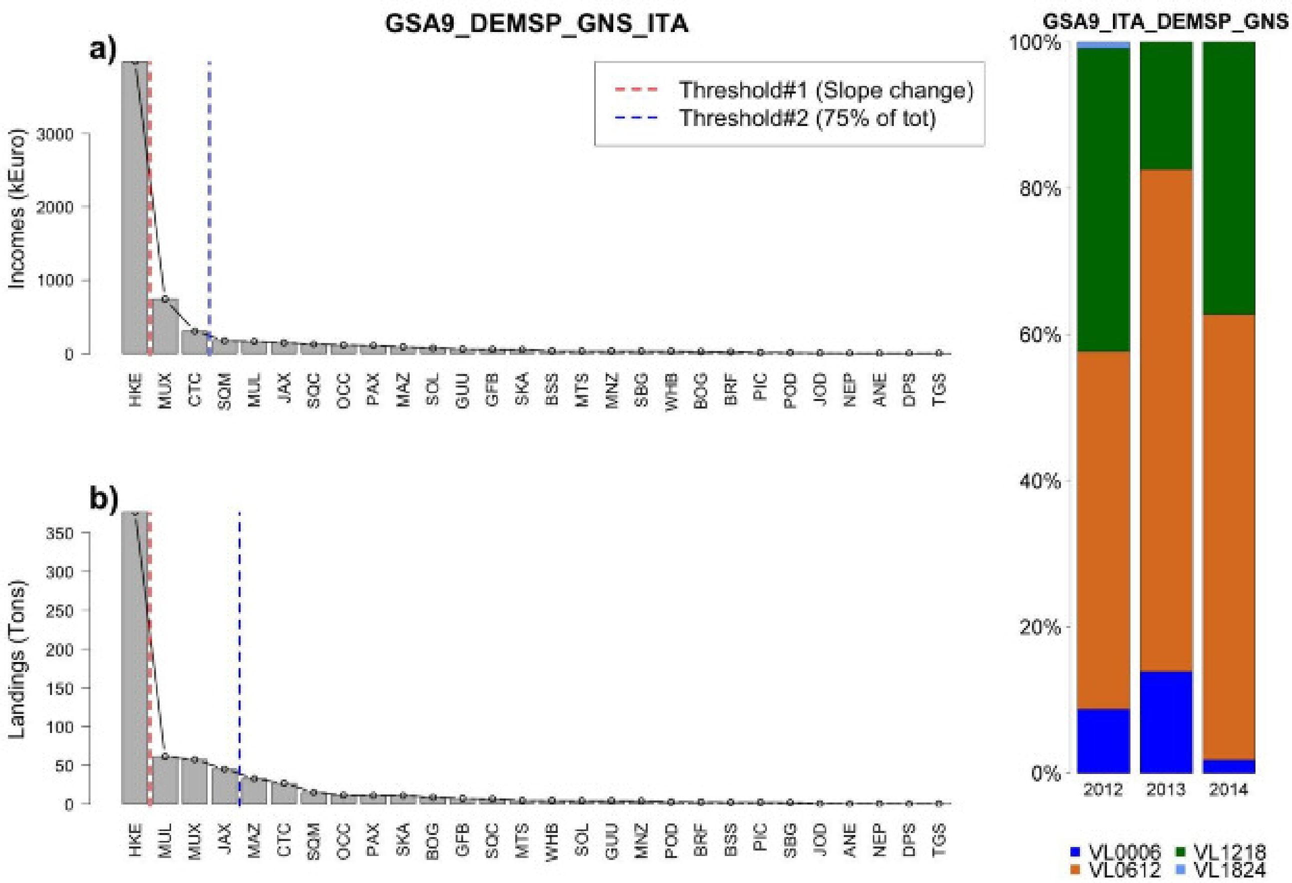


Figure 52. Cumulative percentage for the GSA09_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.8.2. Trammel nets for demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Mullus* spp (MUX), *S. officinalis* (CTC), the common octopus, *Octopus vulgaris* (OCC), *M. merluccius* (HKE) and the common sole, *Solea Solea* (SOL) (Figure 53a). With the exception of the two cephalopods, all the other species are included in the Annex III of the EU Reg. 1967/2006. The species with 75 % cumulative percentage in terms of volume of landings are *Mullus* spp (MUX), *S. officinalis* (CTC), *O. vulgaris* (OCC), and the grey mullets, Mugilidae (MUL) (Figure 53b). All these species are exploited by the small scale fleets of GSA 9, in different zones of the coastal areas and in different seasons of the year. This fleet is mostly composed by the segment VL0612 (80 %). In the period 2012-2014, this fleet performed, on average, 207,108 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 53c. The most important fleet segment in terms of fishing effort is VL0612.

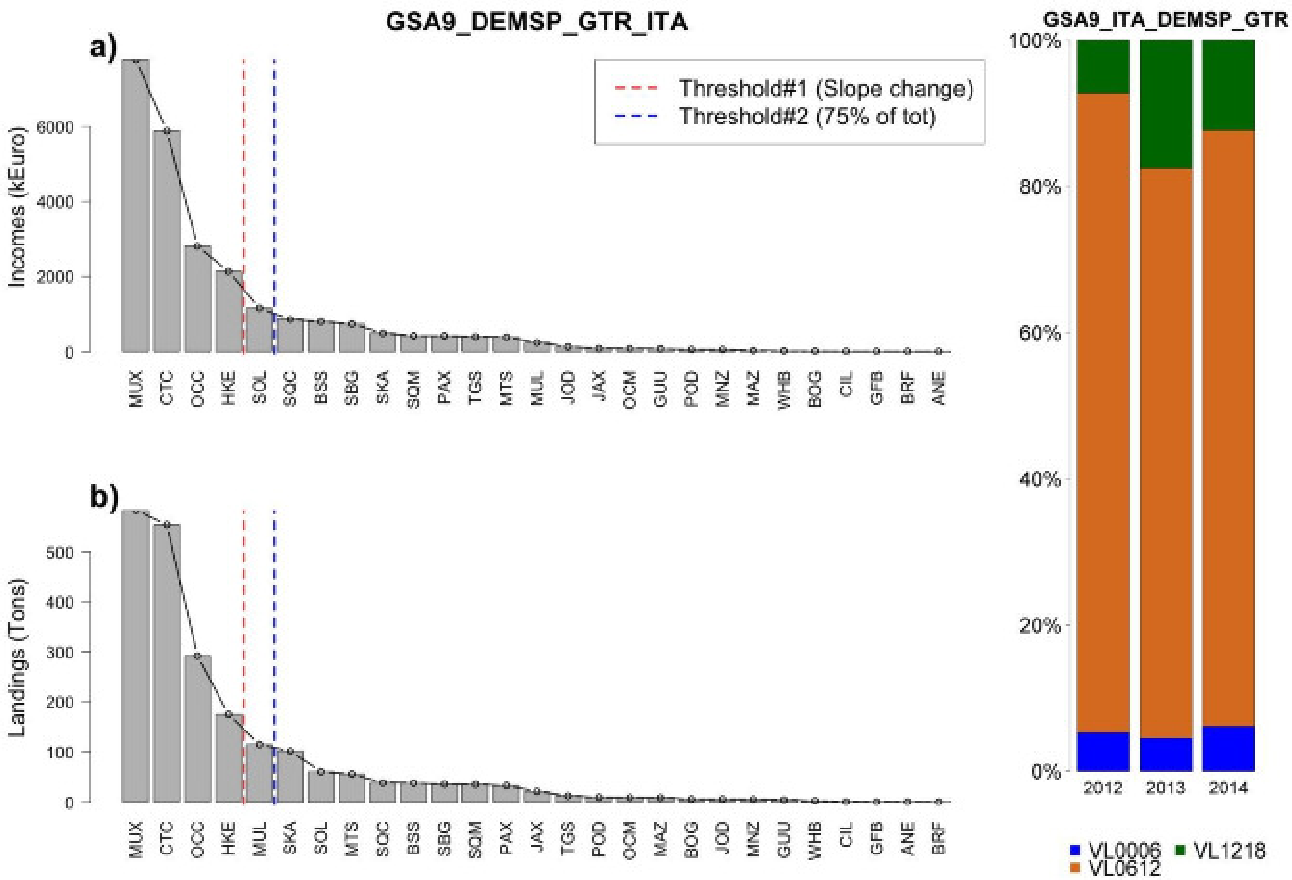


Figure 53. Cumulative percentage for the GSA09_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.8.3. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Figure 54 shows that the 75 % cumulative percentage of the total value and volume of landings of these fisheries are shared among several species. The most important of them, both in terms of value and volume of landings are, in order of importance: the European hake, *Merluccius merluccius* (HKE), the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the deep water pink shrimp, *Parapenaeus longirostris* (DPS), the musky and horned Octopuses, *Eledone cirrhosa* and *E. moschata* (OCM), the Ommastrephid squids *Illex coindetii* and *Todaropis eblanae* (SQC), the common cuttlefish, *Sepia officinalis* (CTC) (Figure 54). These species, except the cephalopods, are included in the Annex III of the EU Reg. 1967/2006. Another important species, in terms of value of landings, is the Norway lobster, *Nephrops norvegicus* (NEP), while in terms of volume of landings are the European anchovy, *Engraulis encrasicolus*, (ANE) and the mantis shrimp, *Squilla mantis* (MTS) (Figure 54). These fisheries are performed in GSA 9 by the bottom trawl fleets operating on the muddy bottoms of continental shelf and upper slope. According to the most recent DCF data, in the period 2012-2014, 176 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1218 (46 %) and VL1824 (41 %). In the period 2012-2014, this fleet performed, on average, 1,368,752 GT*days at sea. In Figure 54c, the subdivision of this fishing effort, according to the years and the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL1824.

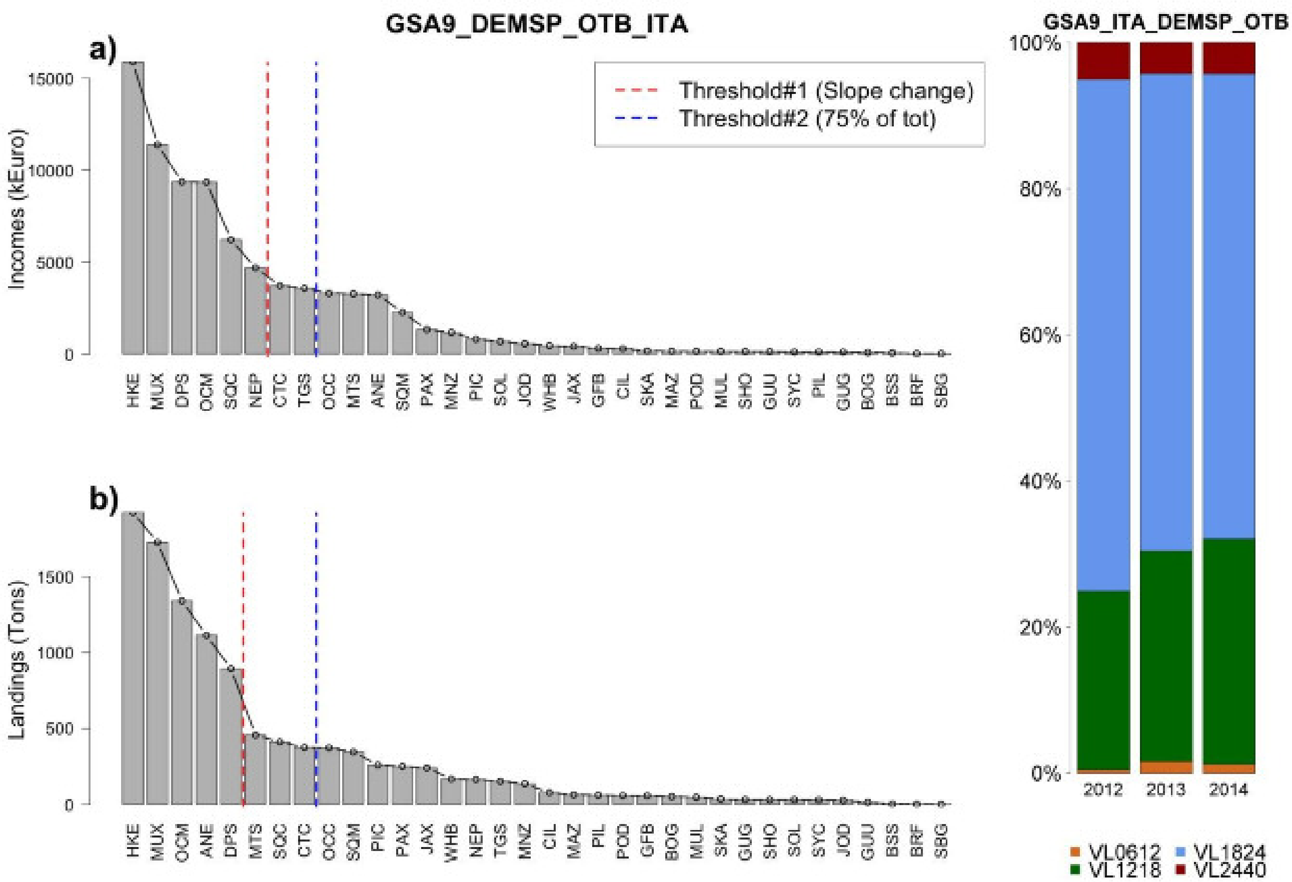


Figure 54. Cumulative percentage for the GSA09_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.8.4. Bottom otter trawl targeting deep water species (DWSP_OTB)

The blue and red giant shrimp, *Aristeus antennatus* (ARA), is clearly the only target species of these fisheries, accounting for about 90 % both in terms of the total value and landings (Figure 55a and b, respectively). This species is not included in the Annex III of the EU Reg. 1967/2006. These fisheries are performed in GSA 9 by the bottom trawl fleets operating on the muddy bathyal bottoms, from 500 to 800 m depth.

According to the most recent DCF data, in the period 2012-2014, 27 vessels, on average, were involved in these fisheries. This fleet is mostly composed by the segment VL1218 (61 %). In the period 2012-2014, this fleet performed, on average, 178,517 GT*days at sea. In Figure 55c, the subdivision of this fishing effort, according to the years and the fleet segments, is shown. In terms of fishing effort, also the fleet segment VL1824 is important.

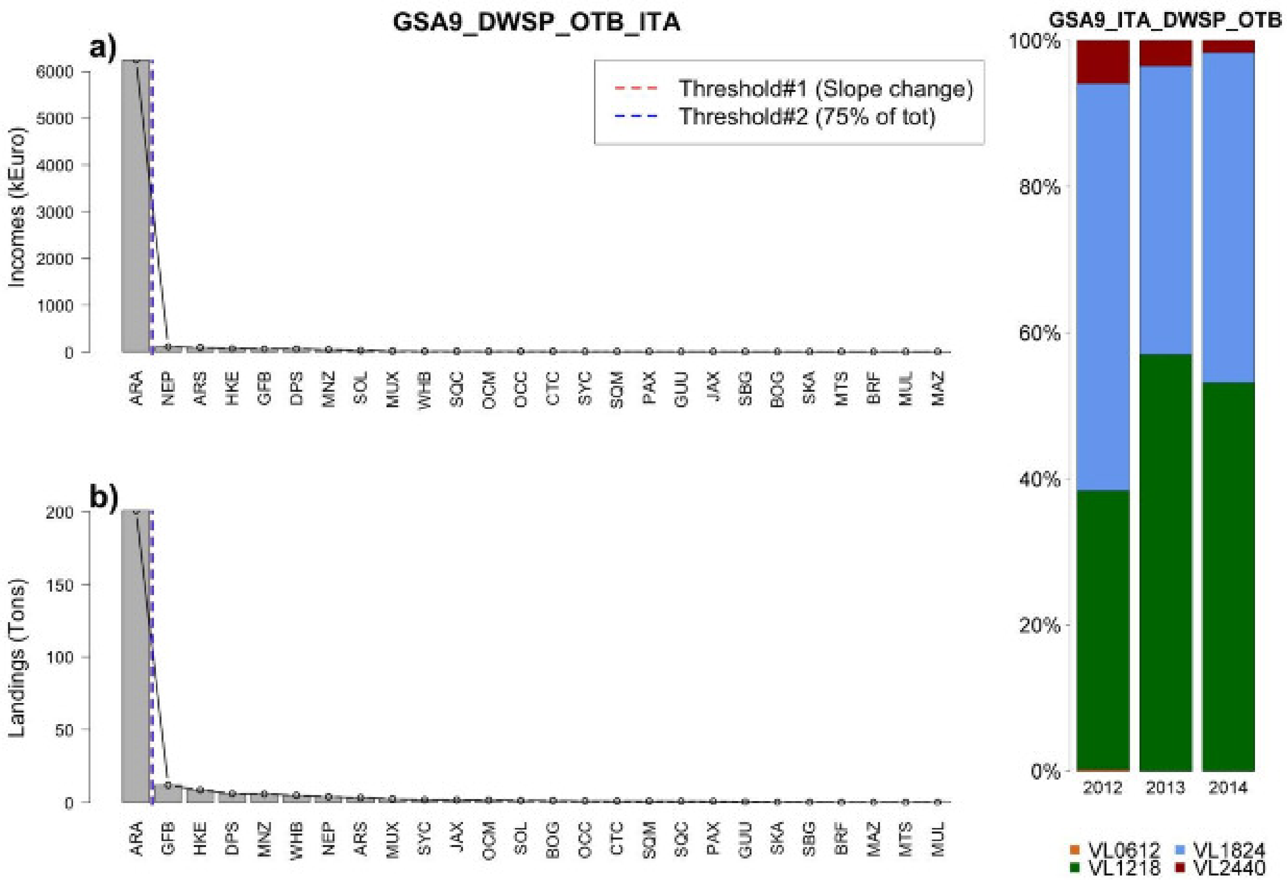


Figure 55. Cumulative percentage for the GSA09_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.8.5. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in value of landings accounts for 75 % are *N. norvegicus* (NEP), *P. longirostris* (DPS), *A. antennatus* (ARA), the giant red shrimp, *Aristaeomorpha foliacea* (ARS), *M. merluccius* (HKE), *Eledone* spp (OCM) (Figure 56a). *N. norvegicus* (NEP), *P. longirostris* (DPS), and *M. merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006. In volume of landings there is less dominance: other important species are *Mullus* spp (MUX), blue withing, *Micromesistius poutassou (*WHB), greater forkbeard, *Phycis blennoides* (GFB), broadtail squid, *Illex coindetii* (SQM) (Figure 56b).

According to the most recent DCF data, in the period 2012-2014, 49 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1218 (47 %) and VL1824 (45 %). In the period 2012-2014, this fleet performed, on average, 350,925 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 56c. The most important fleet segment in terms of fishing effort is VL1824.

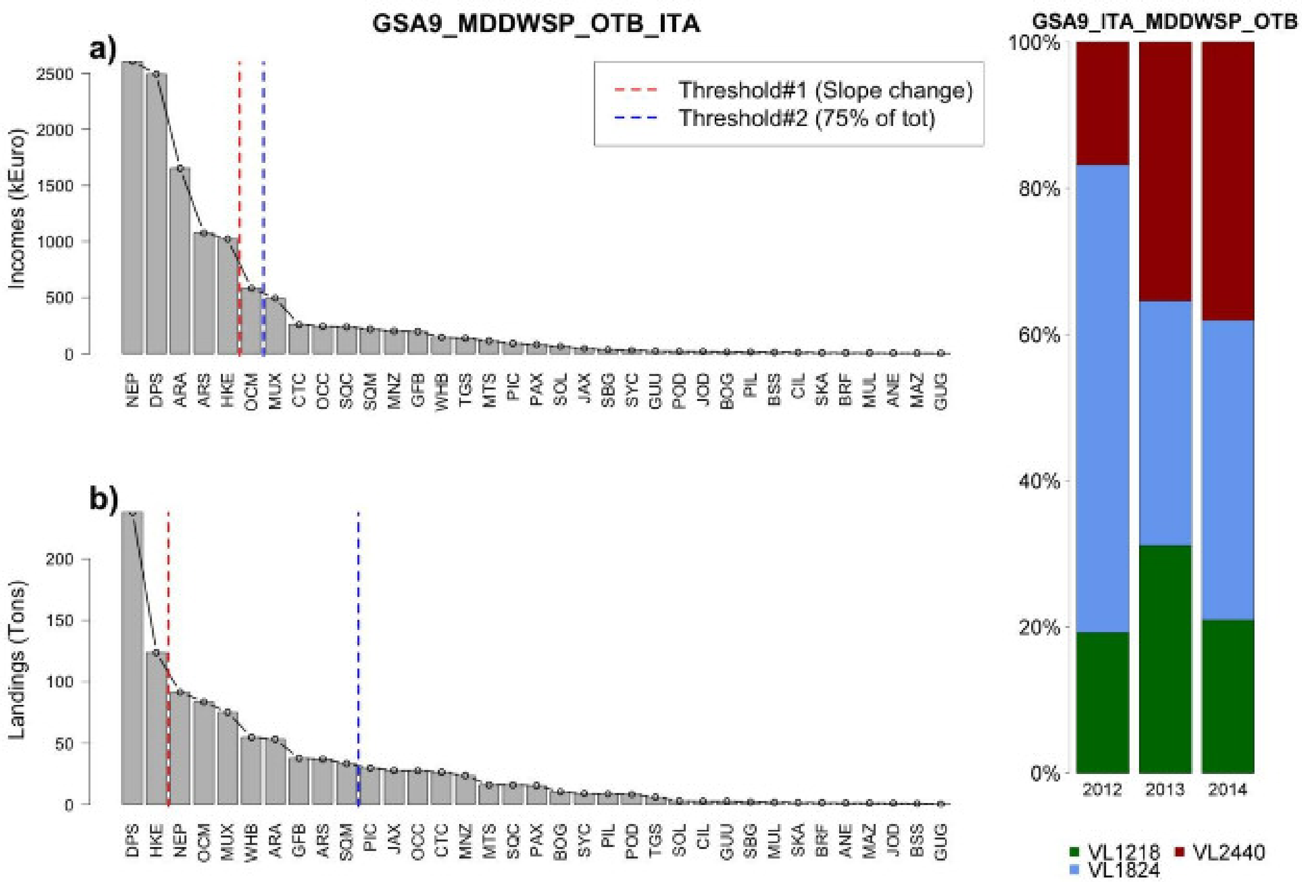


Figure 56. Cumulative percentage for the GSA09_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.9. South Tyrrhenian Sea (GSA 10)

2.2.9.1. Set longlines targeting demersal fish (DEMF_LLS)

The species which percentage in terms of landing value accounts for 75 % of cumulative distributions is *Merluccius merluccius* (HKE), while in terms of landing volume the species are *Merluccius merluccius* (HKE) and *Trachurus* spp (JAX), both included in the Annex III of the EU Reg. 1967/2006 (Figure 57). For this fisheries, given the high level of specialization the landing value criterion seems more suitable for fisheries identification.

According to the most recent DCF data, in the period 2012-2014, this fleet was mostly composed by the segments VL0612 (28 %) and VL1218 (68 %), operating on the continental shelf and upper slope. In the period 2012-2014, this fleet performed, on average, 11,608 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 57c.

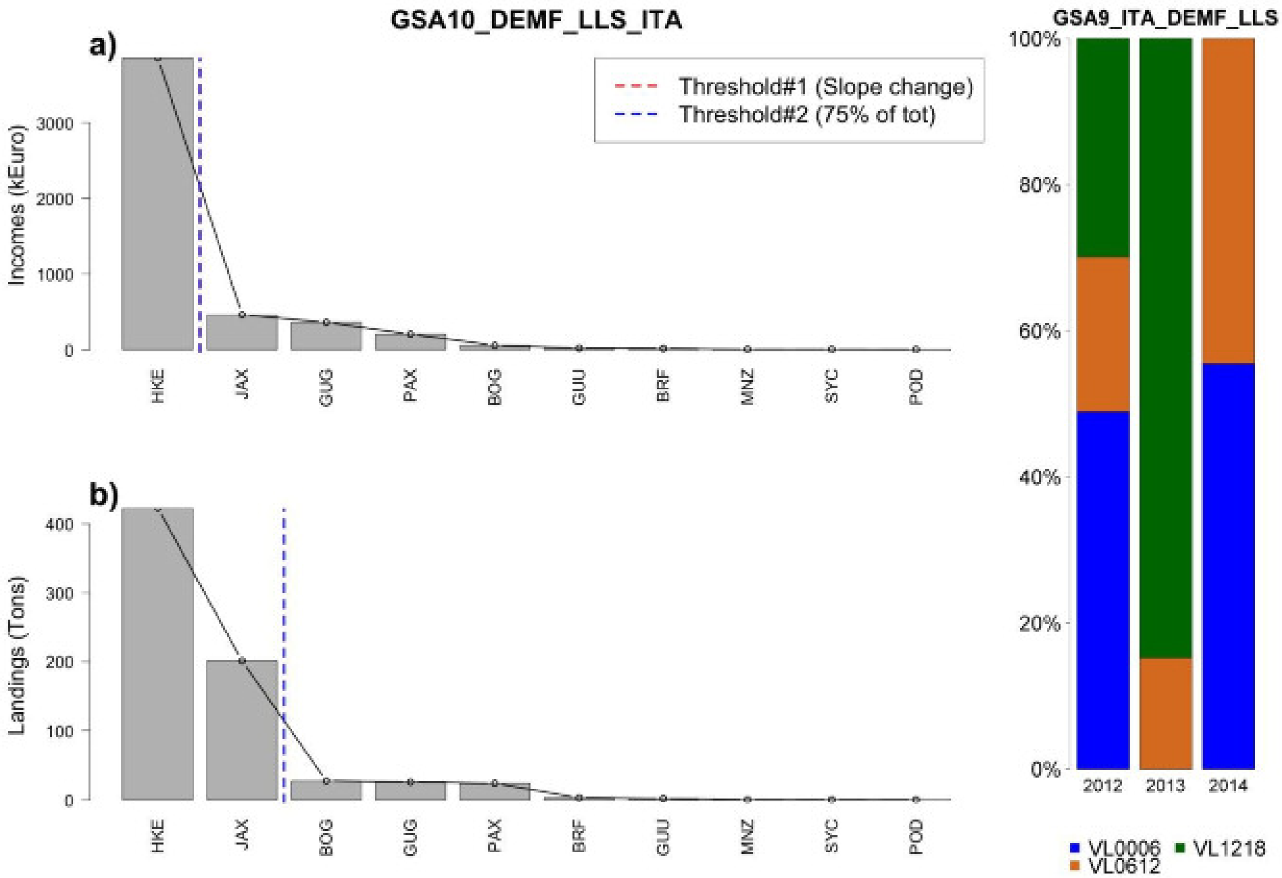


Figure 57. Cumulative percentage for the GSA10_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.9.2. Set gillnets targeting demersal species (DEMSP_GNS)

The species which landing value and landing volume in percentage are accounting for the part of the cumulative distributions left to the slope change is: *Merluccius merluccius* (HKE) (Figure 58) that is included in the Annex III of the EU Reg. 1967/2006. In GSA 10, these fisheries are performed by fleets operating on the continental shelf and upper slope.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL0006 (11 %) and VL0612 (83 %). In the same period, this fleet performed, on average, 14,344 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 58c.

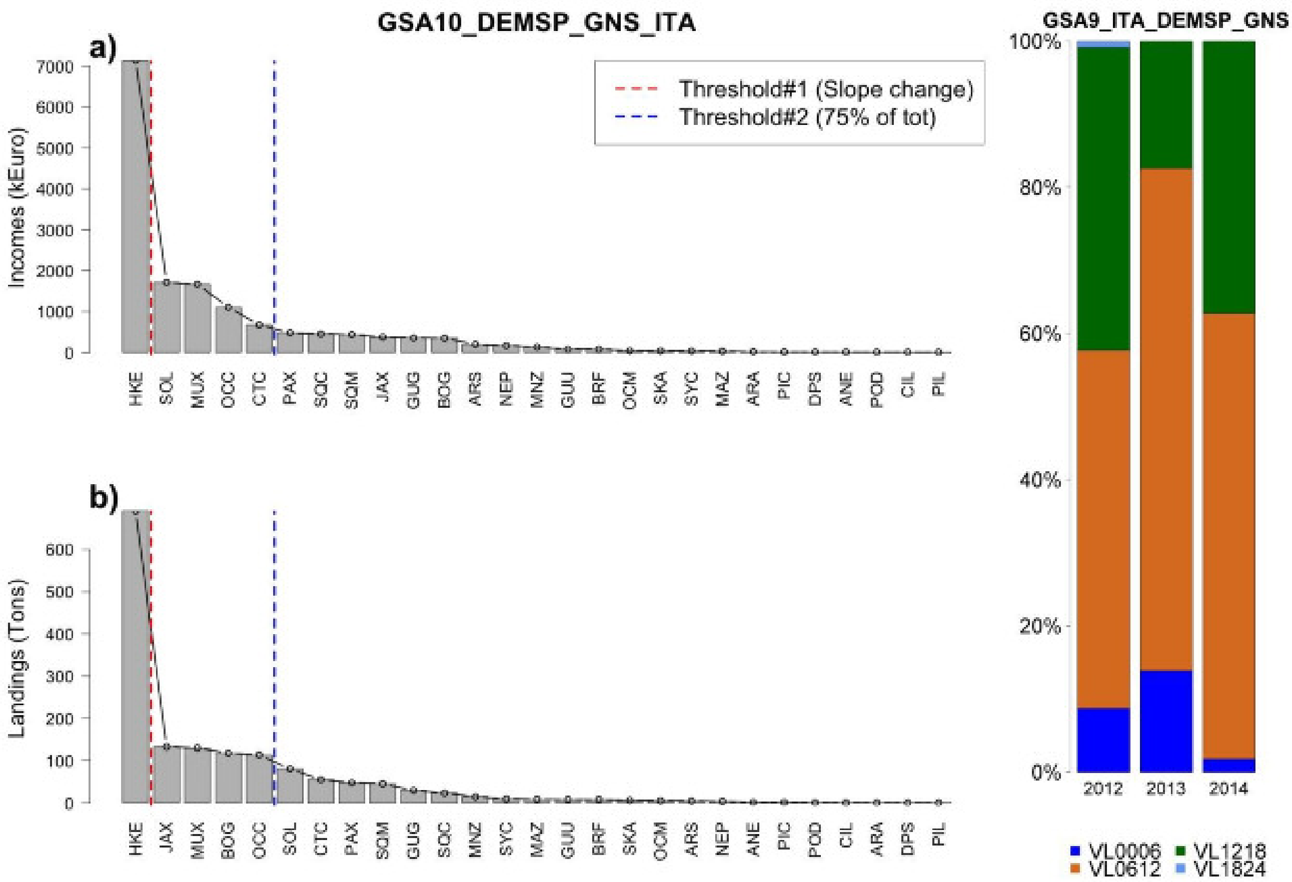


Figure 58. Cumulative percentage for the GSA10_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.9.3. Trammel nets targeting demersal species (DEMSP_GTR)

The species which percentage in terms of value of landings account for 75 % of the cumulative distribution are *Merluccius merluccius* (HKE), *Sepia officinalis* (CTC), *Mullus* spp (MUX) and *Solea Solea* (SOL) (Figure 59). The species which percentage in terms of volume of landings accounts for 75 % of the cumulative distributions are *Merluccius merluccius* (HKE), *Sepia officinalis* (CTC), *Mullus* spp (MUX) and *Boops Boops* (BOG). Among these species those included in the Annex III of the EU Reg. 1967/2006 are: *Merluccius merluccius* (HKE), *Mullus* spp (MUX) and *Solea Solea* (SOL).

According to the most recent DCF data, in the period 2012-2014, this fleet was mostly composed by the segments VL0006 (14 %) and VL0612 (81 %), operating on the continental shelf. In the period 2012-2014, this fleet performed, on average, 15,275 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 59c.

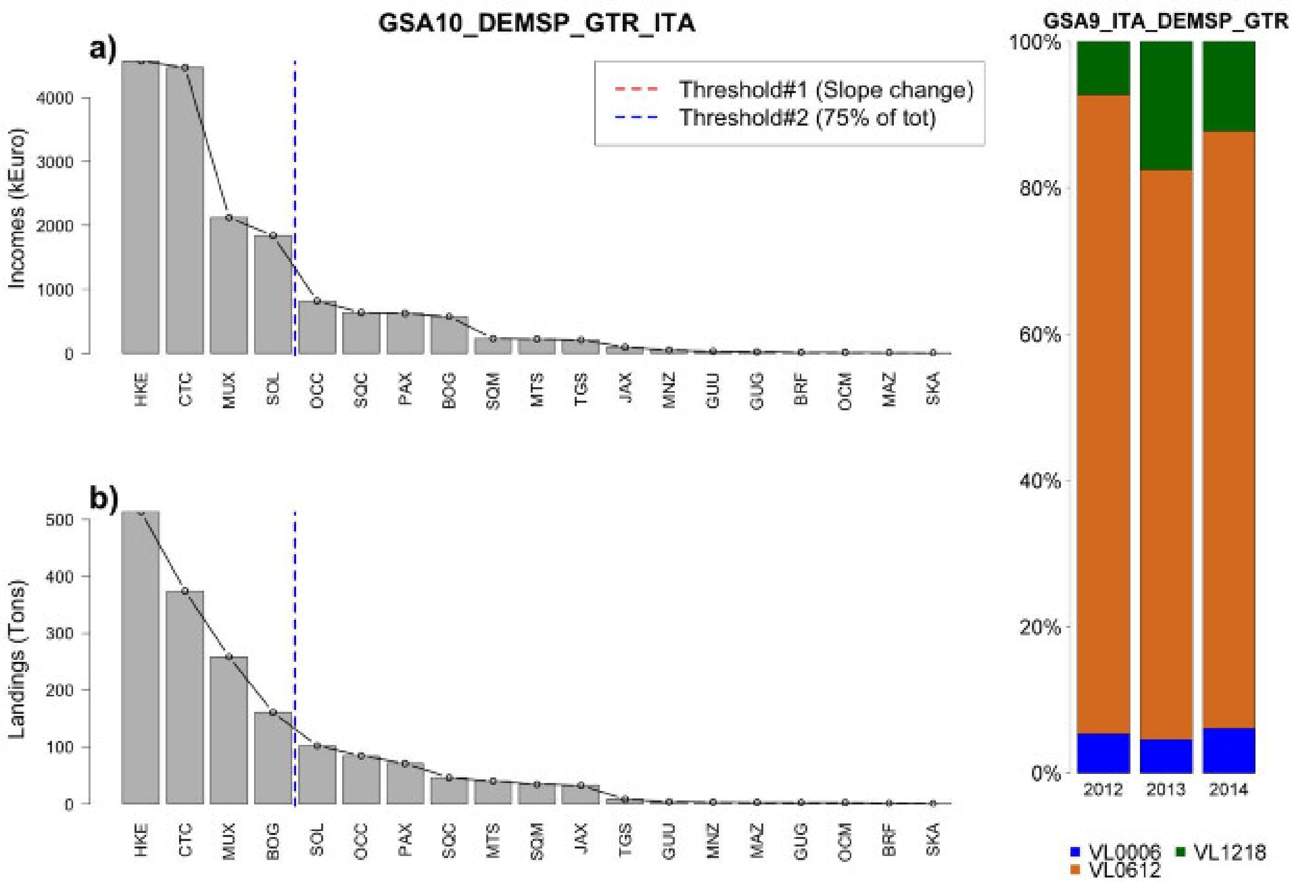


Figure 59. Cumulative percentage for the GSA10_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.9.4. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Species which landing value in percentage is accounting for 75 % of cumulative distribution are: *Mullus* spp (MUX), *Penaeus keraturus* (TGS), *Parapenaeus longirostris* (DPS), *Merluccius merluccius* (HKE), and *Squilla mantis* (MTS) (Figure 60). Among these species, *Mullus* spp (MUX), *Parapenaeus longirostris* (DPS) and *Merluccius merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006. Species which landing volume in percentage is accounting for 75 % of cumulative distribution are: *Mullus* spp (MUX), *Squilla mantis* (MTS), *Engraulis encrasicolus* (ANE), *Parapenaeus longirostris* (DPS) and *Merluccius merluccius* (HKE). Among these species, *Mullus* spp (MUX), *Engraulis encrasicolus* (ANE), *Parapenaeus longirostris* (DPS) and *Merluccius merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006. In GSA 10 these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of continental shelf and upper slope. According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL1218 (37 %) and VL1824 (62 %). In the same period, this fleet performed, on average, 54,579 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 60c.

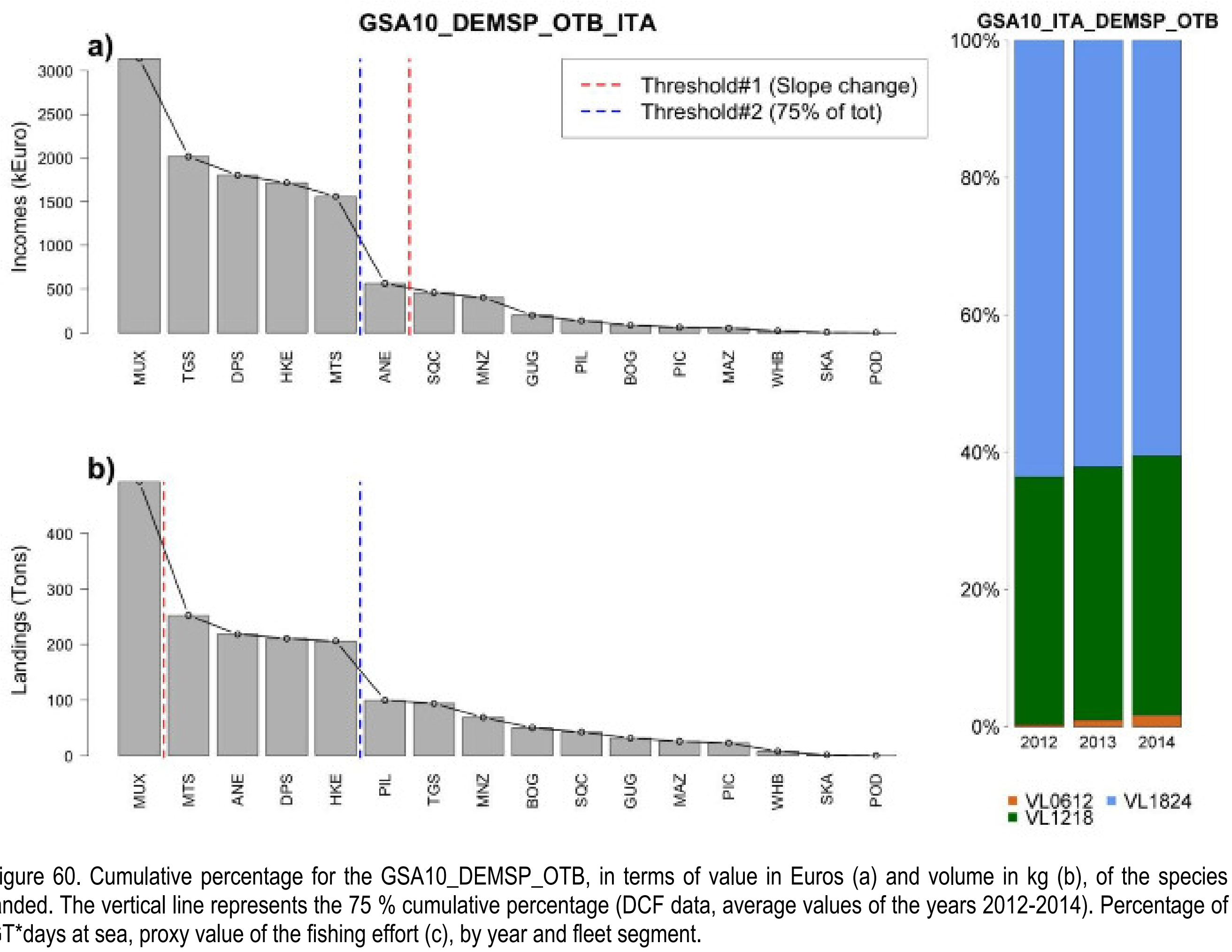


Figure 60. Cumulative percentage for the GSA10_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.9.5. Bottom otter trawl targeting deep water species (DWSP_OTB)

Species which cumulative landing value in percentage is accounting for 75 % is *Aristaeomorpha foliacea* (ARS) (Figure 61a), that is not included in the Annex III of the EU Reg. 1967/2006. Species which cumulative landing volume in percentage is accounting for 75 % are; *Aristaeomorpha foliacea* (ARS) and *Parapenaeus longirostris* (DPS), the latter is included in the Annex III of the EU Reg. 1967/2006. In these fisheries the criterion of landing value should prevail. In GSA 10 these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of slope and bathyal bottoms.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL1218 (58 %) and VL1824 (41 %). In the same period, this fleet performed, on average, 18,217 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 61c.

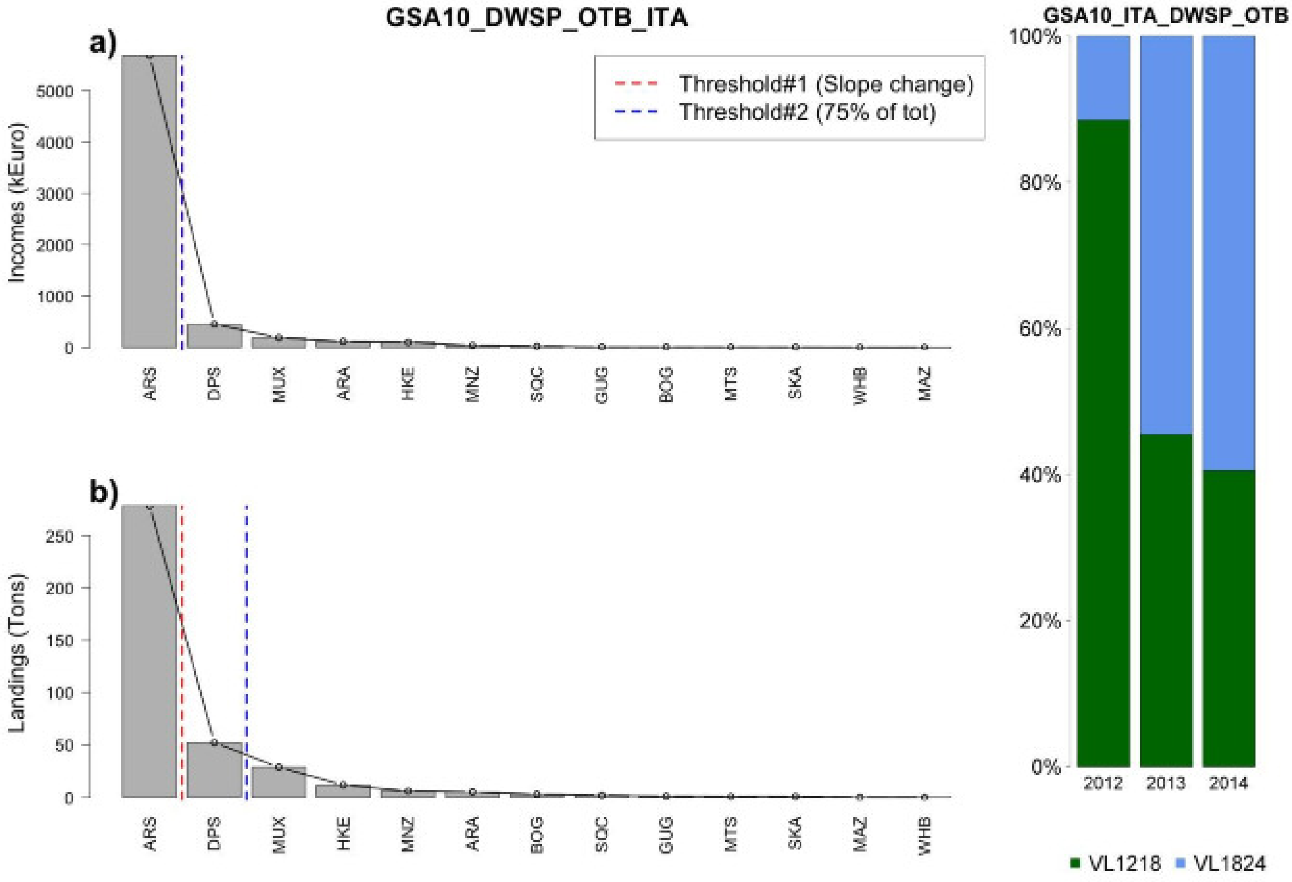


Figure 61. Cumulative percentage for the GSA10_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.9.6. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

Species which landing value in percentage is accounting for the part of the cumulative distribution left to the slope change are: *Aristaeomorpha foliacea* (ARS), *Parapenaeus longirostris* (DPS), *Mullus* spp (MUX) and *Merluccius merluccius* (HKE) (Figure 62). Among these species *Parapenaeus longirostris* (DPS), *Mullus* spp (MUX) and *Merluccius merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006. Species which landing volume in percentage is accounting for 75 % of the cumulative distribution, a threshold that is overlapping with the part of the cumulative distribution left to the slope change are: *Parapenaeus longirostris* (DPS), *Mullus* spp (MUX), *Aristaeomorpha foliacea* (ARS), *Merluccius merluccius* (HKE) and *Lophius* spp (MNZ). Among these species *Parapenaeus longirostris* (DPS), *Mullus* spp (MUX) *and Merluccius merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006.

In GSA 10, these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of the continental shelf and slope. According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL1218 (25 %) and VL1824 (74 %). In the same period, this fleet performed, on average, 63,596 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 62c.

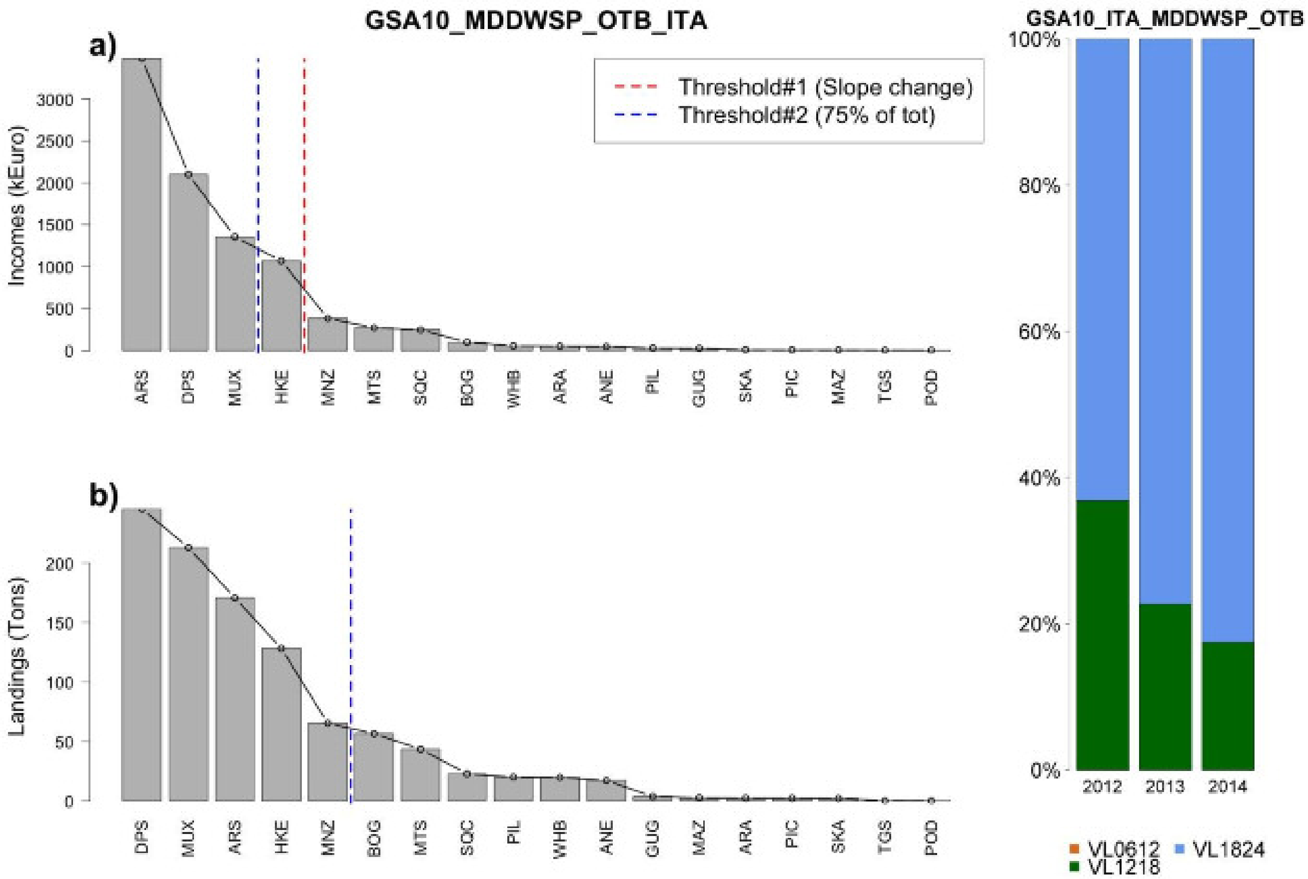


Figure 62. Cumulative percentage for the GSA10_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.10. *Sardinia Island (GSA 11)*

2.2.10.1. Trammel net (UNK_GTR)

The most important species, both in terms of value and volume of landings, are the red mullets, *Mullus* spp (MUX), followed by the common cuttlefish, *Sepia offcinalis* (CTC) (Figure 63). *Mullus* spp are included in the Annex III of the EU Reg. 1967/2006. In Figure 63c, the subdivision of this fishing effort, according to the years and the fleet segments, is shown. The most important fleet segment in terms of fishing effort is VL0612.

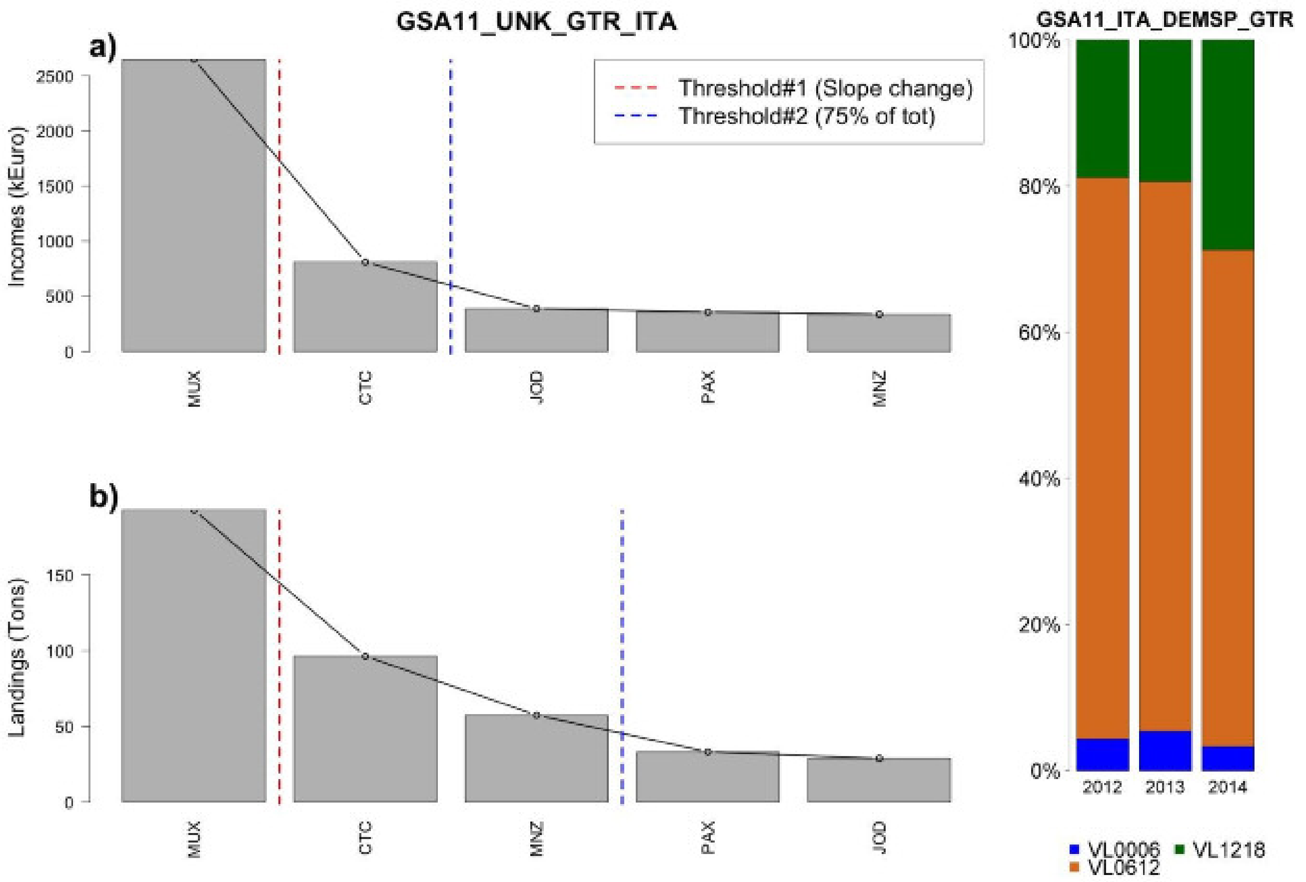


Figure 63. Cumulative percentage for the GSA11_UNK_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.10.2. Bottom otter trawl (UNK_OTB)

The most important species, both in terms of value and volume of landings, are the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), followed by the Ommastrephid squids *Illex coindetii* and *Todaropis eblanae* (SQC), the giant red shrimp, *Aristaeomorpha foliacea* (ARS), the European hake, *Merluccius merluccius* (HKE), the red and blue giant shrimp, *Aristeus antennatus* (ARA), the musky and horned Octopuses, *Eledone cirrhosa* and *E. moschata* (OCM) (Figure 64). Of these species, the red mullets and the European hake are included in the Annex III of the EU Reg. 1967/2006. In Figure 64c, the subdivision of this fishing effort, according to the years and the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL2440 followed by VL1824.

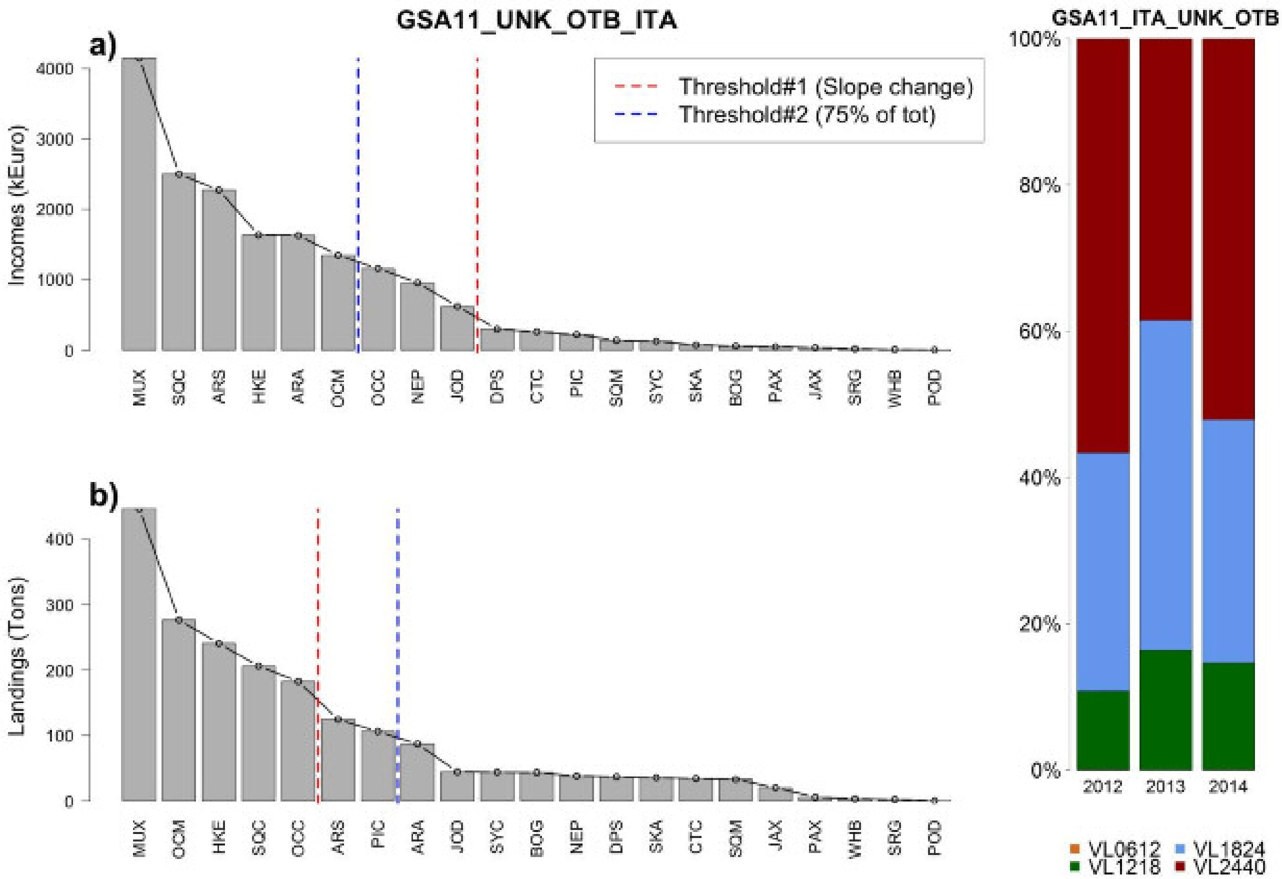


Figure 64. Cumulative percentage for the GSA11_UNK_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11. *Malta Island (GSA 15)*

2.2.11.1. Hand lines targeting cephalopods (CEP_LHM)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Loligo* spp (SQC) (Figure 65a). The same species account for the 75 % of the cumulative percentage in terms of biomass of landings (Figure 65b). No cephalopods are included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was composed of the segments VL0612 (53 %) and VL0006 (47 %). In the period 2012-2014, this fleet performed, on average, 1,656 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 65c. The most important fleet segment in terms of fishing effort is VL0612.

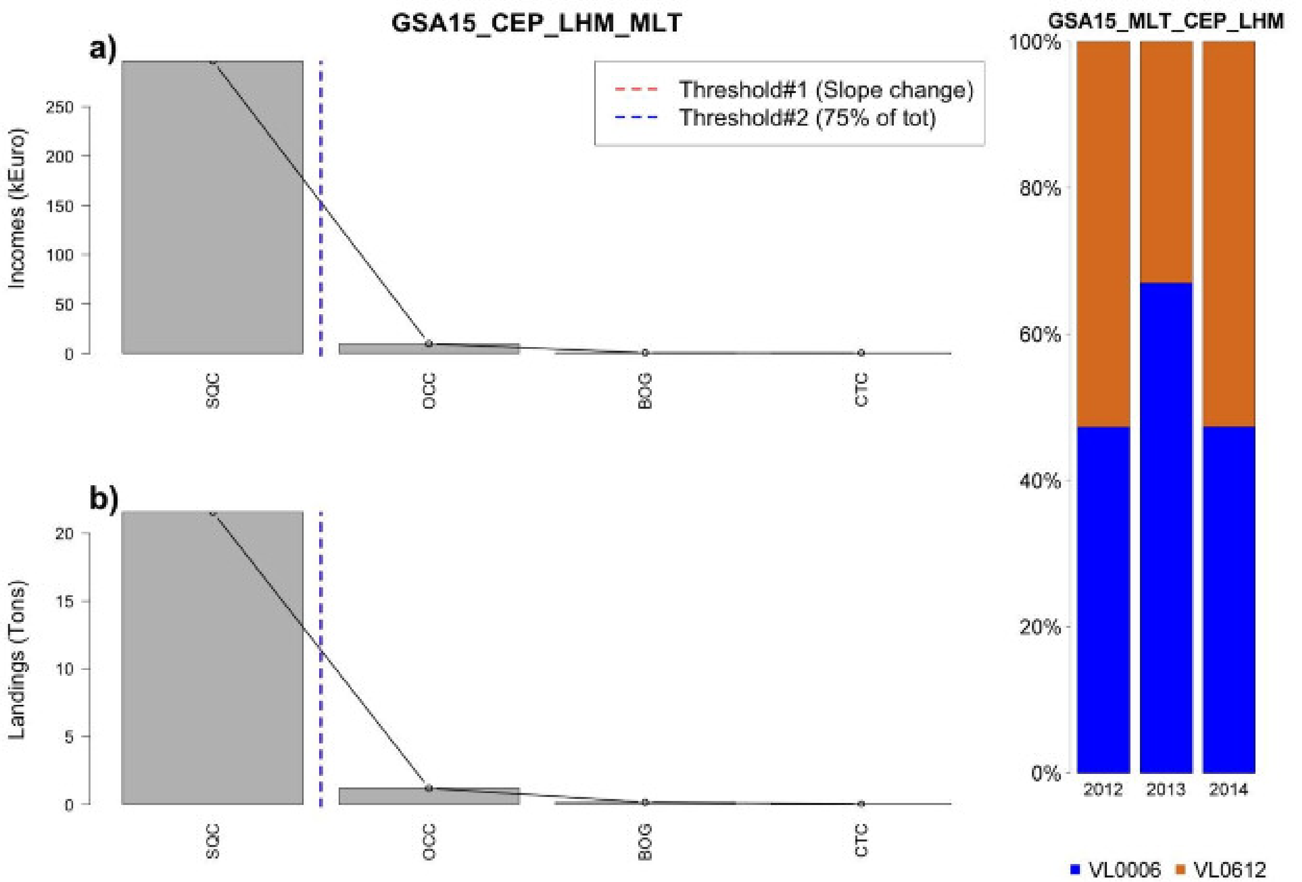


Figure 65. Cumulative percentage for the GSA15_CEP_LHM, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.2. Set longlines targeting demersal fish (DEMF_LLS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Diplodus* spp (SRG) and *Pagellus* spp (PAX) (Figure 66a). *Diplodus* spp (SRG) and *Raja* spp (SKA) account for the 75 % of the cumulative percentage in terms of biomass of landings (Figure 66b). *Diplodus annularis, Diplodus puntazzo, Diplodus sargu*, *Diplodus vulgaris*, *Pagellus acarne, Pagellus bogaraveo,* and *Pagellus erythrinus* are included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was mostly composed of the segments VL0612 (40 %), VL1824 (34 %), VL1218 (14 %) and VL0006 (12 %). In the period 2012-2014, this fleet performed, on average, 6,031 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 66c. The most important fleet segment in terms of fishing effort is VL0612.

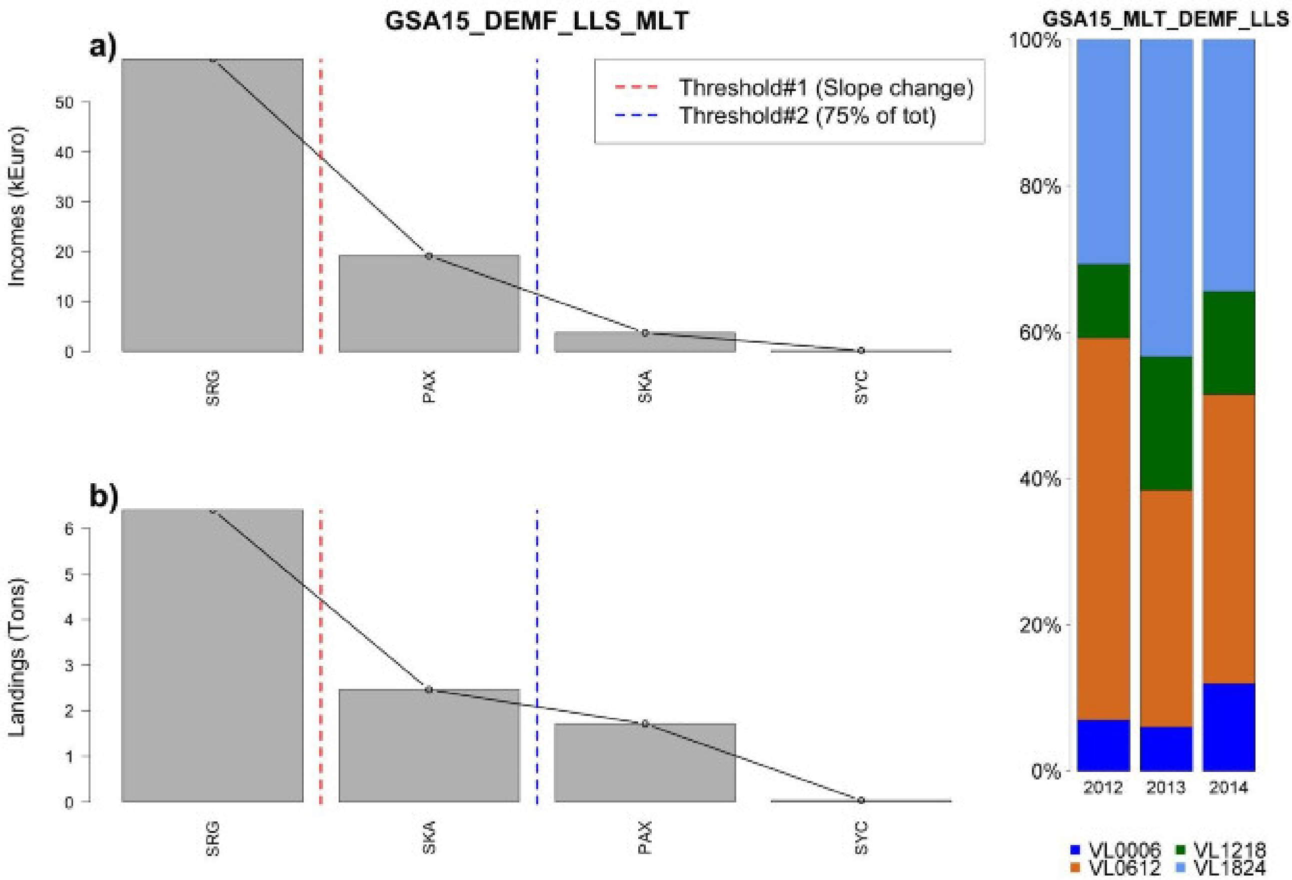


Figure 66. Cumulative percentage for the GSA15_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.3. Pots and traps targeting demersal species (DEMSP_FPO)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Octopus vulgaris* (OCC) and *Boops Boops* (BOG) (Figure 67a). The same species account for the 75 % of the cumulative percentage in terms of biomass of landings (Figure 67b). Neither of these species are included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data (2014), this fleet was composed of the segments VL0612 (75 %) and VL0006 (25 %). In the period 2012-2014, this fleet performed, on average, 19,723 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 67c. The most important fleet segment in terms of fishing effort is VL0612.

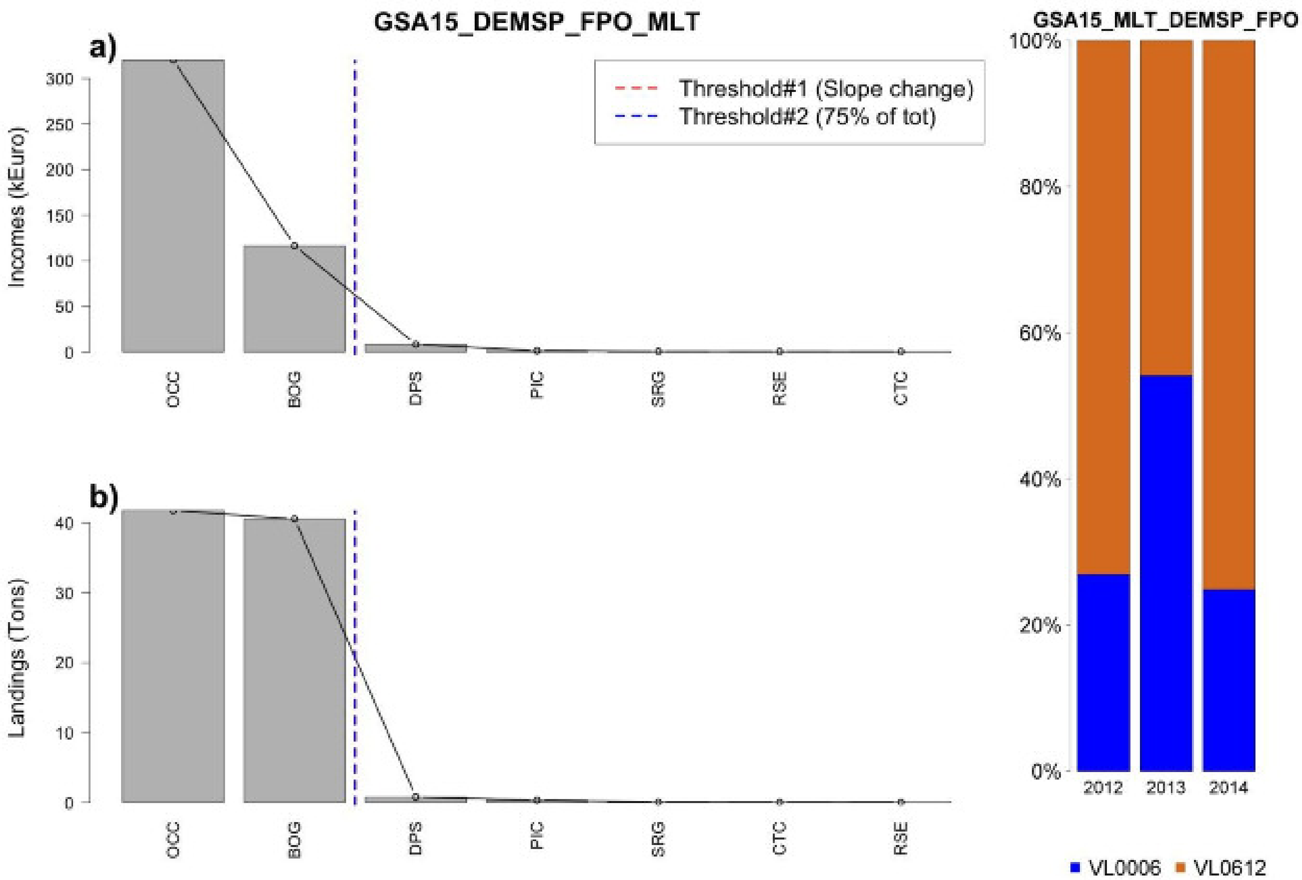


Figure 67. Cumulative percentage for the GSA15_DEMSP_FPO, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.4. Set gillnets targeting demersal species (DEMSP_GNS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Boops Boops* (BOG), *Scomber* spp (MAZ), and *Trachurus* spp (JAX) (Figure 68a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Boops Boops* (BOG), and *Scomber* spp (MAZ) (Figure 68b). *Scomber* spp (MAZ) and *Trachurus* spp (JAX) are included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was mostly composed of the segments VL0612 (94%), and VL0006 (6%). In the period 2012-2014, this fleet performed, on average, 1,162 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 68c. The most important fleet segment in terms of fishing effort is VL0612.

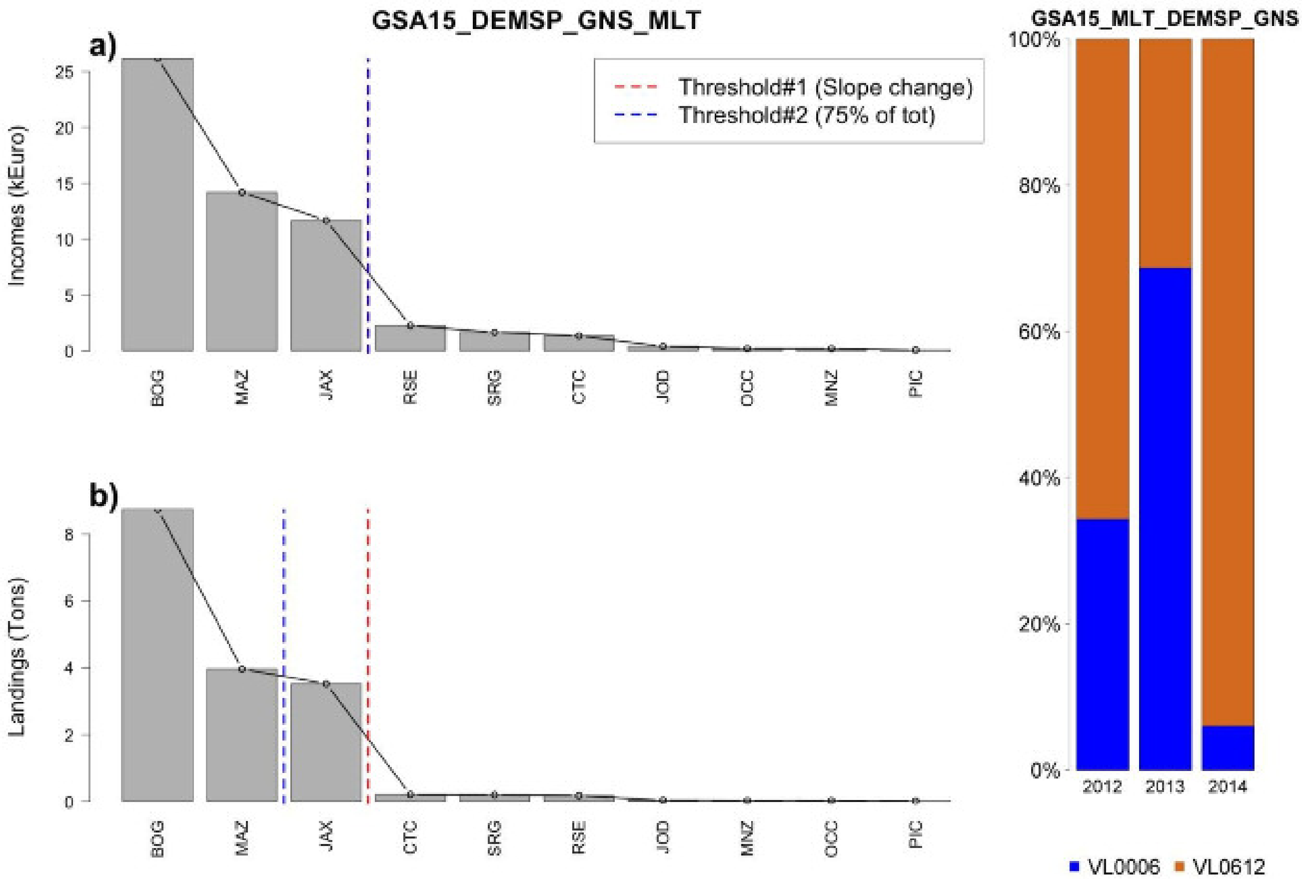


Figure 68. Cumulative percentage for the GSA15_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.5. Trammel nets targeting demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Mullus* spp (MUX), *Sepia officinalis* (CTC), and *Scorpaena scrofa* (RSE) (Figure 69a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Mullus* spp (MUX), *Sepia officinalis* (CTC), *Scorpaena scrofa* (RSE), and *Diplodus* spp (SRG) (Figure 69b). *Mullus* spp (MUX) as well as *Diplodus annularis, Diplodus puntazzo, Diplodus sargu*, and *Diplodus vulgaris* are included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was mostly composed of the segments VL0612 (73 %) and VL0006 (27 %). In the period 2012-2014, this fleet performed, on average, 6,613 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 69c. The most important fleet segment in terms of fishing effort is VL0612.

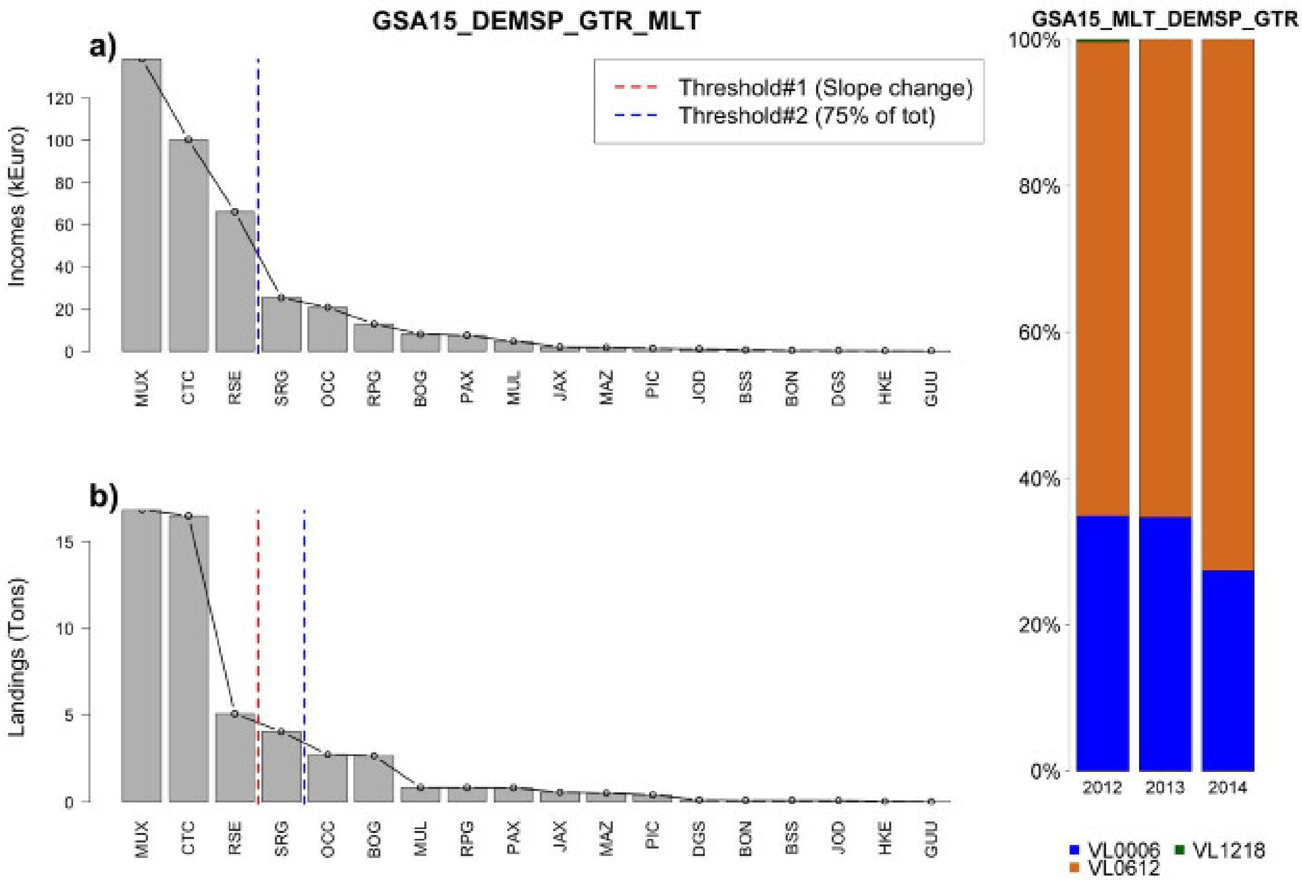


Figure 69. Cumulative percentage for the GSA15_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.6. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Mullus* spp (MUX) (Figure 70a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Mullus* spp (MUX) and *Raja* spp (SKA) (Figure 70b). From these species, only *Mullus* spp (MUX) are included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was mostly composed of the segments VL1824 (60 %), and VL2440 (40 %). In the period 2012-2014, the Maltese fleet operating in GSA 15 performed, on average, 30,367 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 70c. The most important fleet segment in terms of fishing effort is VL1824.

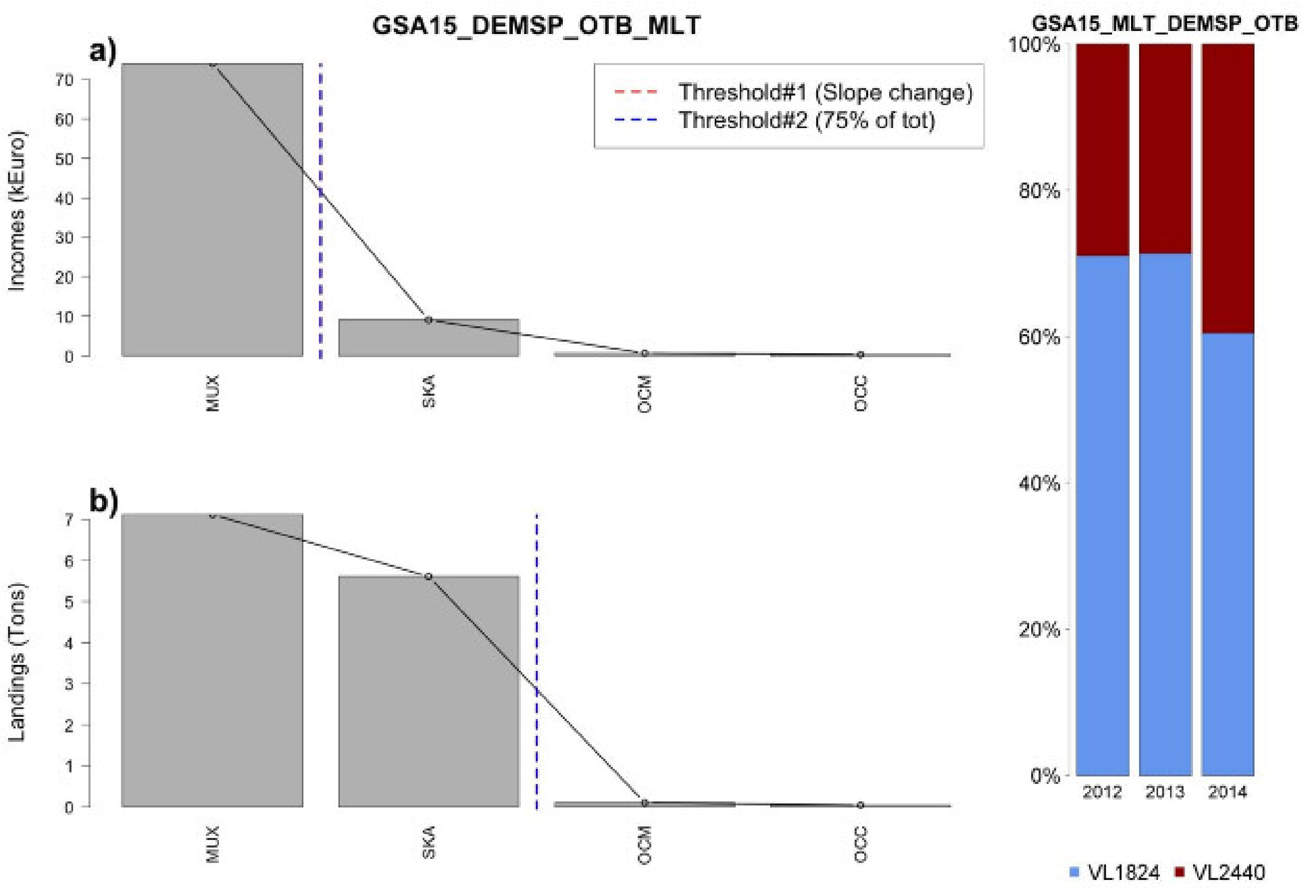


Figure 70. Cumulative percentage for the GSA15_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.7. Bottom otter trawl targeting deep water species (DWSP_OTB)

The giant red shrimp *Aristaeomorpha foliacea* (ARS) is the most important target species in terms of incomes (Figure 71a). In terms of landings, *Aristaeomorpha foliacea* (ARS) and *Parapenaeus longirostris (DPS)* account for the 75 % of cumulative percentage of landings (Figure 71b). *Parapenaeus longirostris* is included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was exclusively composed of the segment VL1824 in 2013 and 2014. In the period 2012-2014, this fleet performed, on average, 25,585 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 71c. The most important fleet segment in terms of fishing effort is VL1824.

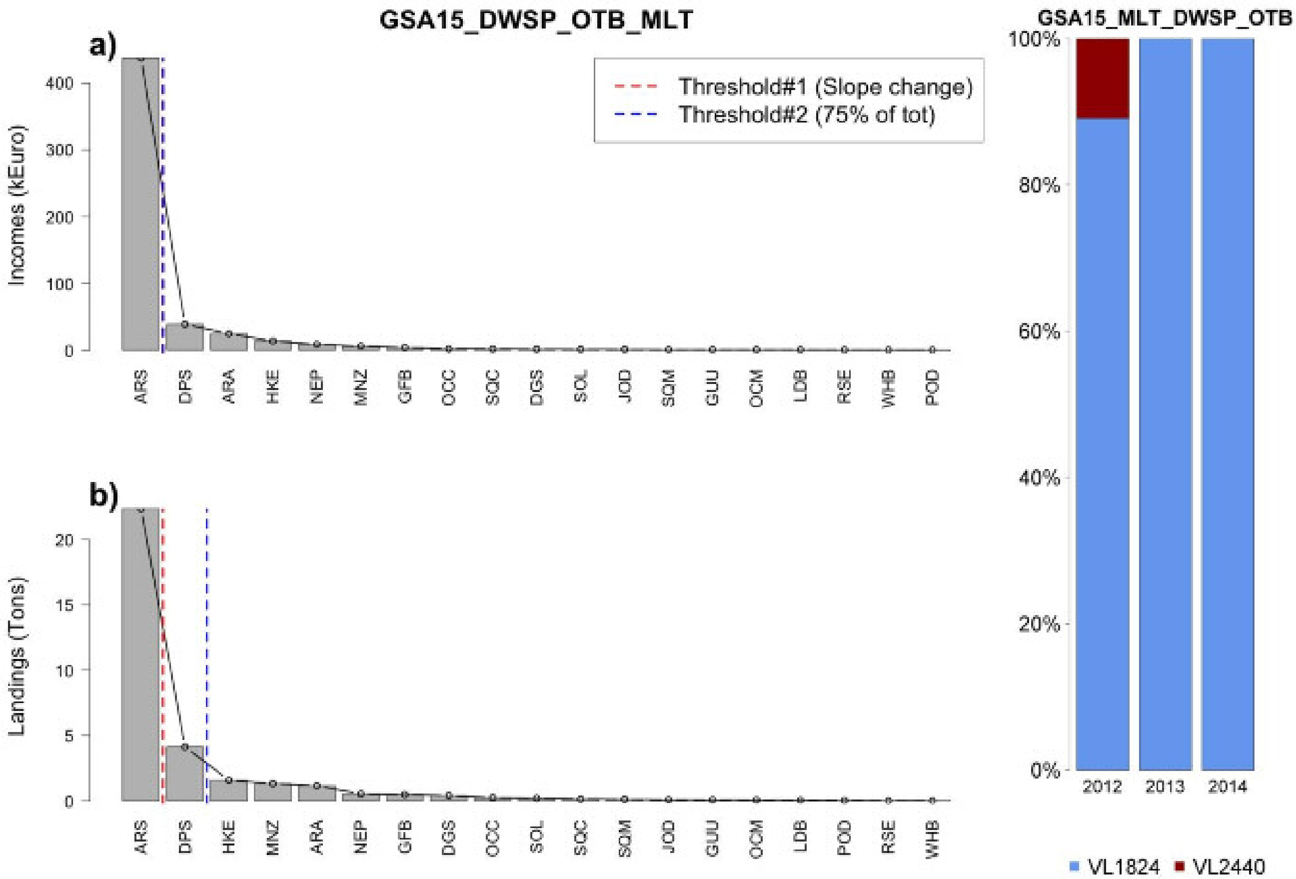


Figure 71. Cumulative percentage for the GSA15_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.8. Pole lines targeting finfish (FINF_LHP)

The species which cumulative percentage in terms of value of landings accounts for 75 % is *Pagellus* spp (PAX) (Figure 72a). This species also account for the 75 % of the cumulative percentage in terms of biomass of landings (Figure 72b). *Pagellus acarne, Pagellus bogaraveo,* and *Pagellus erythrinus* are included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was mostly composed of the segments VL0006 (22%) and VL0612 (48%). In the period 2013-2014, this fleet performed, on average, 269 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 72c. The most important fleet segment in terms of fishing effort is VL0006.

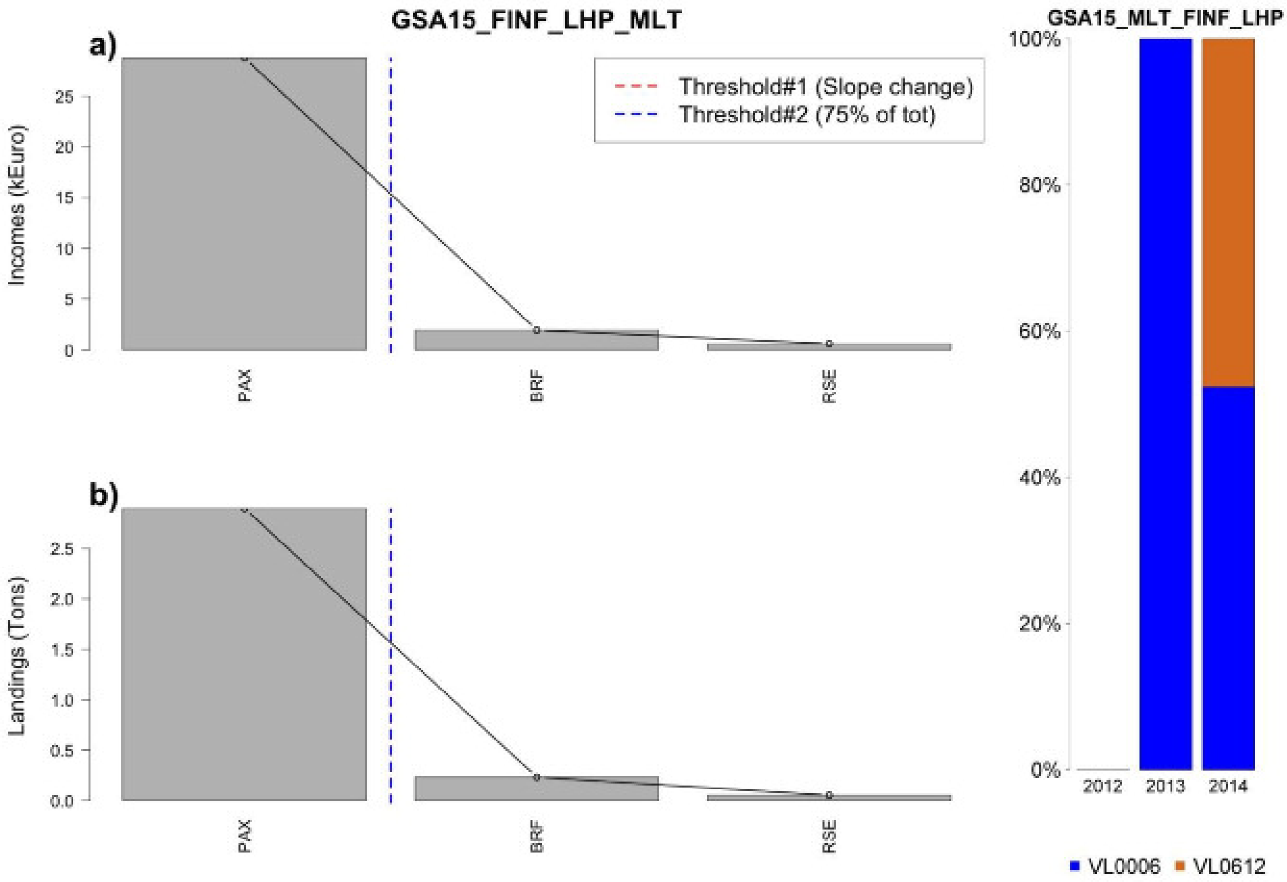


Figure 72. Cumulative percentage for the GSA15_FINF_LHP, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.11.9. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are *Mullus* spp (MUX), *Aristaeomorpha foliacea* (ARS), *Parapenaeus longirostris* (DPS), and *Merluccius merluccius* (HKE) (Figure 73a). The species which cumulative percentage in terms of biomass of landings accounts for 75 % are *Mullus* spp (MUX), *Parapenaeus longirostris* (DPS), *Merluccius merluccius* (HKE), *Aristaeomorpha foliacea* (ARS) and *Pagellus* spp (PAX) (Figure 73b). With the exception of *Aristaeomorpha foliacea* (ARS), all other species are included in the Annex III of the EU Reg. 1967/2006. According to the most recent DCF data (2014), this fleet was mostly composed of the segments VL1824 (56 %), and VL2440 (44 %). In the period 2012-2014, this fleet performed, on average, 6,918 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 73c. The most important fleet segment in terms of fishing effort is VL1824.

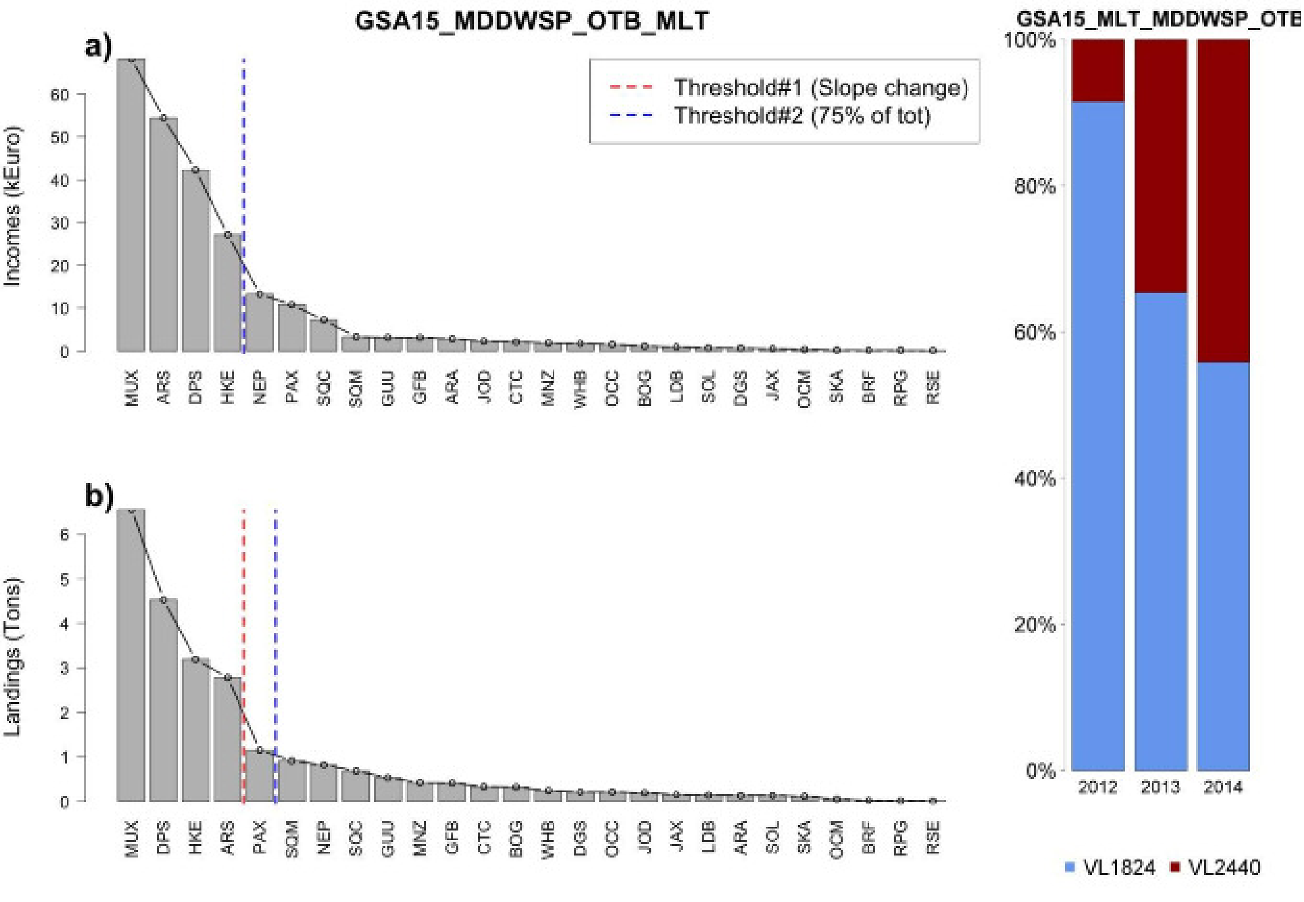


Figure 73. Cumulative percentage for the GSA15_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.12. South of Sicily (GSA 16)

2.2.12.1. Set longlines targeted to demersal fish (DEMF_LLS)

European Hake, *Merluccius merluccius* (HKE, 52 %) and Pandoras, *Pagellus erythrinus and P. bogaraveo,* (PAX, 23 %) are the main target of longlines fisheries in GSA 16, accounting for about 75 % both in terms of the total value of landings (Figure 74a). Similar percentage is also found for landing in tons (Figure 74b). These taxa are included in the Annex III of the EU Reg. 1967/2006. These fisheries operate mainly in coastal bottoms of GSA 16, although few larger vessels can also fish in offshore banks. According to the most recent DCF data, in the period 2012-2014, 70 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL1218 (48 %) and VL0612 (41 %). In the period 2012-2014, this fleet performed, on average, 25,730 GT*days at sea. In Figure 74c, the subdivision of this fishing effort according to the years and the fleet segments is shown.

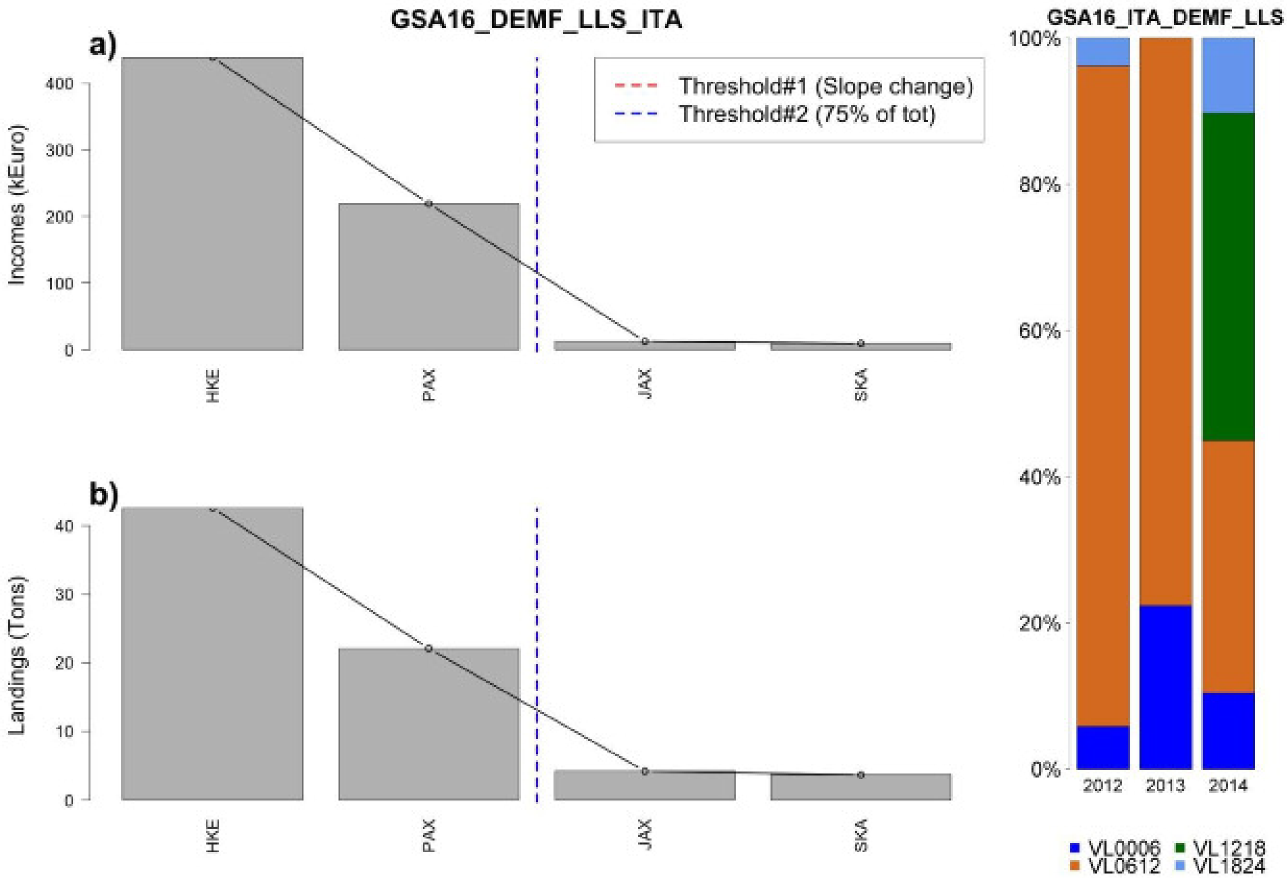


Figure 74. Cumulative percentage for the GSA16_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.12.2. Trammel nets targeted to demersal species (DEMSP_GTR)

The striped red mullet, *Mullus surmuletus,* and the red mullet, *Mullus barbatus,* (MUX, 59 %) together with the cuttlefish, Sepia officinalis, (CTC, 17%) are the species which contribute to about 75 % both in terms of the total value of landings of trammel net fisheries in GSA 16 (Figure 75a). Similar percentage is found considering the landings in tons (Figure 75b). *Mullus* spp are included in the Annex III of the EU Reg. 1967/2006, whereas no minimum legal size is enforced for Sepia officinalis. These fisheries operate mainly in coastal bottoms of GSA 16, although few larger vessels also fish in offshore banks. According to the most recent DCF data, in the period 2012-2014, 435 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL0612 (66 %) and VL1218 (23 %). In the period 2012-2014, this fleet performed, on average, 159,117 GT*days at sea. In Figure 75c, the subdivision of this fishing effort according to the years and the fleet segments is shown. The fishing effort exerted by the smaller vessels (VL06) amounts to about 10 % in mean.

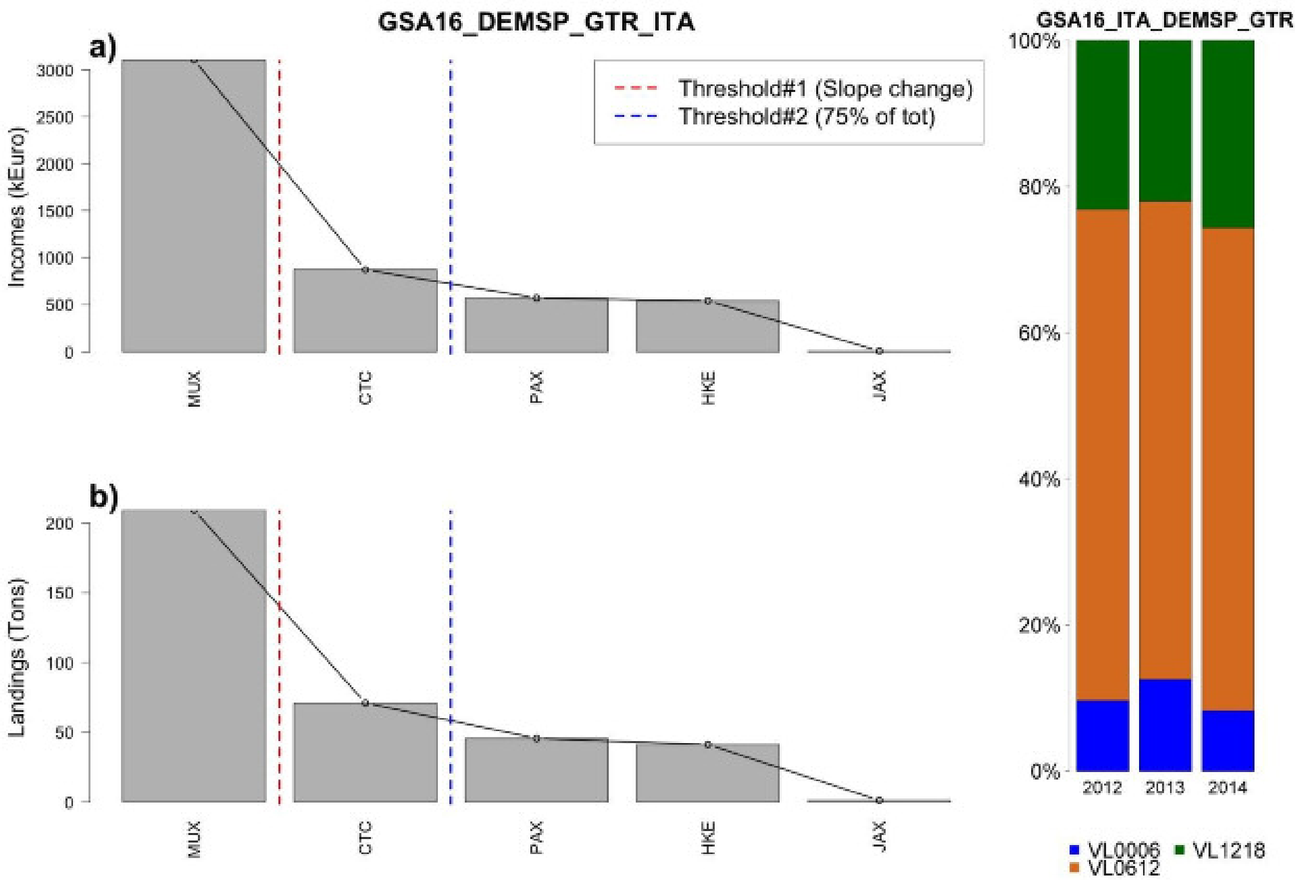


Figure 75. Cumulative percentage for the GSA16_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.12.3. Bottom otter trawl targeting to demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the deep water pink shrimp, *Parapenaeus longirostris* (DPS, 60 %) and the European hake, *Merluccius merluccius* (HKE, 15 %) (Figure 77a). The two species are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landing, the same species mentioned above account for higher fraction of the landed biomass (Figure 77b). These fisheries are performed by trawlers based on GSA 16 but operating the muddy bottoms of continental outer shelf and upper slope of the GSA 12, 13, 14 and 15. According to the most recent DCF data, in the period 2012-2014, 147 vessels, on average, were involved in these fisheries. This fleet was mostly composed by the segments VL2440 (44 %) and VL1824 (39 %). In the period 2012-2014, this fleet performed, on average, 2,347,237 GT*days at sea per year. In Figure 77c the subdivision of this fishing effort, according to the years and the fleet segments is shown. The fleet segment VL0612 is negligible.

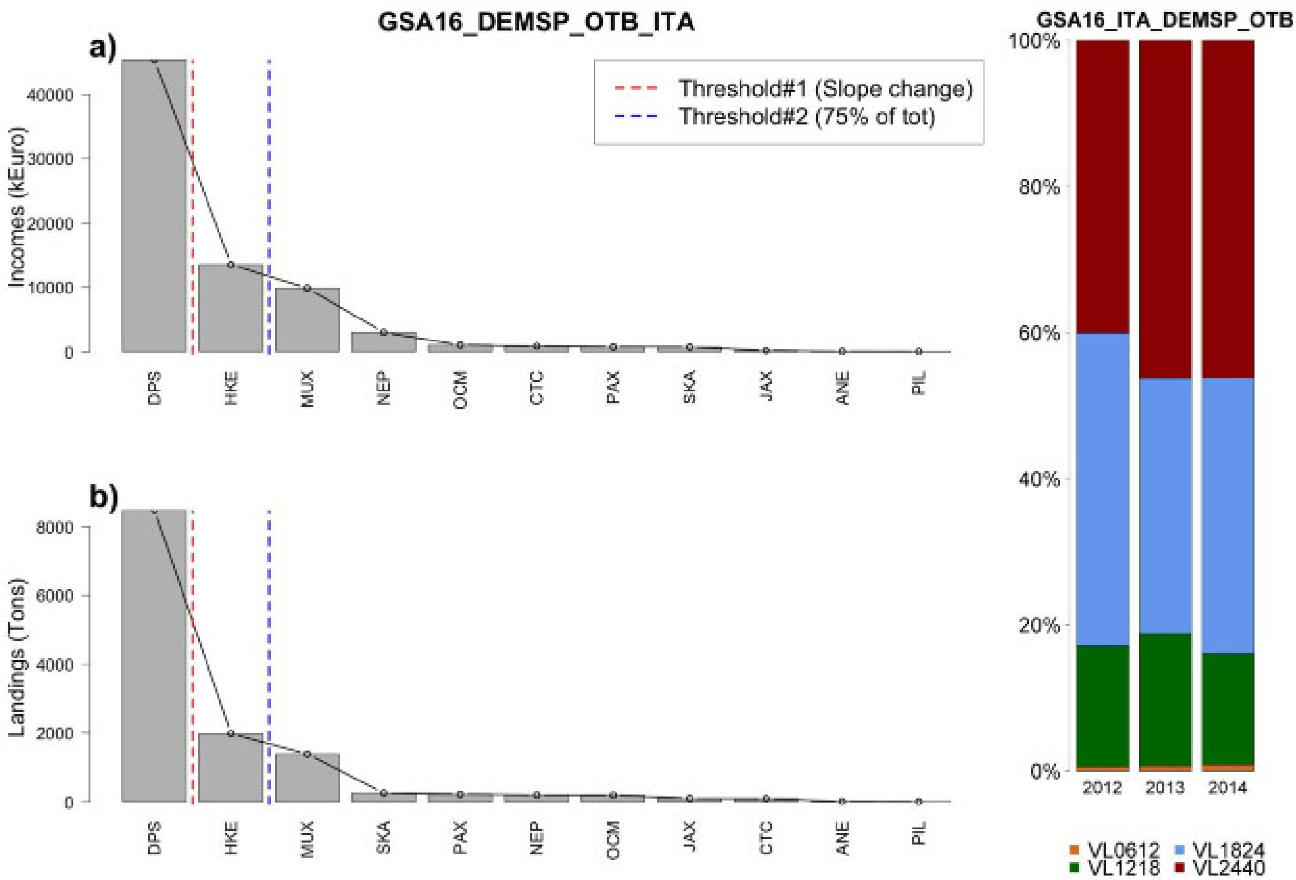


Figure 76. Cumulative percentage for the GSA16_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.12.4. Bottom otter trawl targeting to deep water species (DWSP_OTB)

The red giant shrimp, *Aristaeomorpha foliacea* (ARS), is clearly the only target species of these fisheries, accounting for about 75 % both in terms of the total value and landings (Figure 77a Figure 77b, respectively). This species is not included in the Annex III of the EU Reg. 1967/2006. These fisheries are performed on the muddy bathyal bottoms, from 300 to 800 m depth. Traditionally the Sicilian bottom trawlers fishing on deep water shrimps operate mainly in GSA 12, 13, 14, 15, 16, and 21. Some trawlers targeted to Red shrimps, registered in *Mazara del Vallo* harbour, exploit also fishing grounds in GSAs 22, 23 and 24. According to the most recent DCF data, in the period 2012-2014, 49 vessels, on average, were involved in these fisheries. This fleet was mainly composed by the segment VL2440 (74 %), followed by VL 1824 (18 %). In the period 2012-2014, this fleet performed, on average, 1,860,114 GT*days at sea. In Figure 77c, the subdivision of this fishing effort according to the years and the fleet segments is shown. During 2013 some trawlers of fleet segment VL1218 and VL1824 shifted from MDDWSP to DWSP in terms of fishing effort.

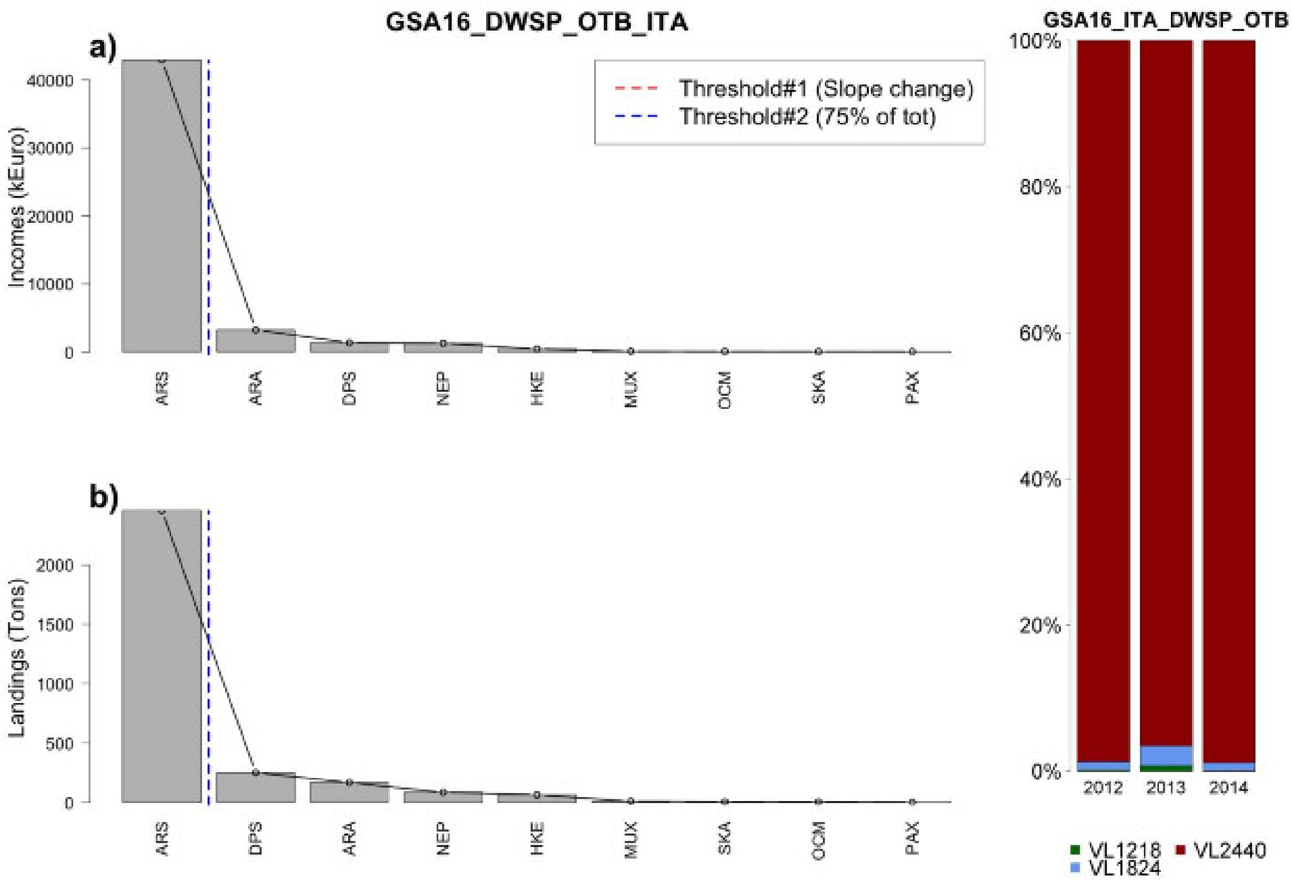


Figure 77. Cumulative percentage for the GSA16_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.12.5. Bottom otter trawl targeting to mixed demersal and deep water species (MDDWSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the deep water pink shrimp, *Parapenaeus longirostris* (DPS, 32 %), the red giant shrimp, *Aristaeomorpha foliacea* (ARS, 29 %), and the European hake, *Merluccius merluccius* (HKE, 14 %) (Figure 78a). The two species are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landing, the same species mentioned above account for higher fraction of the landed biomass, although Hake landings in tons are higher than the giant red shrimp ones (Figure 78b). These fisheries are performed by trawlers based on GSA 16 but operating the muddy bottoms of continental outer shelf and upper slope of the GSA 12, 13, 14, 15 and 16. According to the most recent DCF data, in the period 2012-2014, 60 vessels, on average, were involved in these fisheries. The fleet was mostly composed by the segments VL2440 (72 %) and, in lesser extension, VL1824 (23 %). In the period 2012-2014, this fleet performed, on average, 1,200,003 GT*days at sea per year. In Figure 78c the subdivision of this fishing effort, according to the years and the fleet segments is shown.

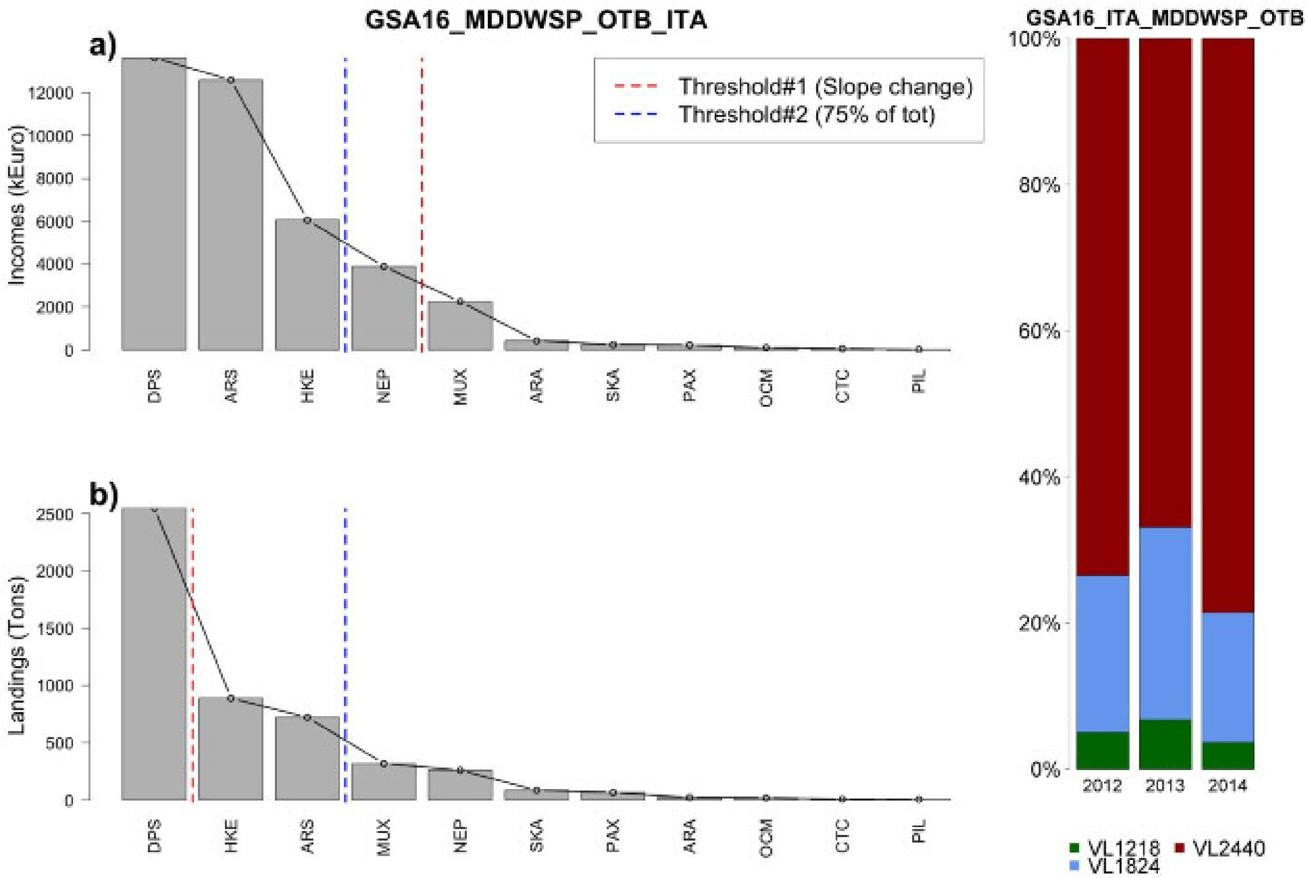


Figure 78. Cumulative percentage for the GSA16_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.13. Northern Adriatic Sea (GSA 17, Italy)

2.2.13.1. Pots and traps targeting demersal species (DEMSP_FPO)

Sepia officinalis is the most important target species of pots and traps fleet operating in GSA 17 in coastal areas. This species is not included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 51,220 GT*fishing day. The biggest percentage of total effort (77 %) was exerted by vessels from 6-12 m LOA, followed by 0-6 m (22 %) and 12-18 m (1 %) vessels (Figure 79).

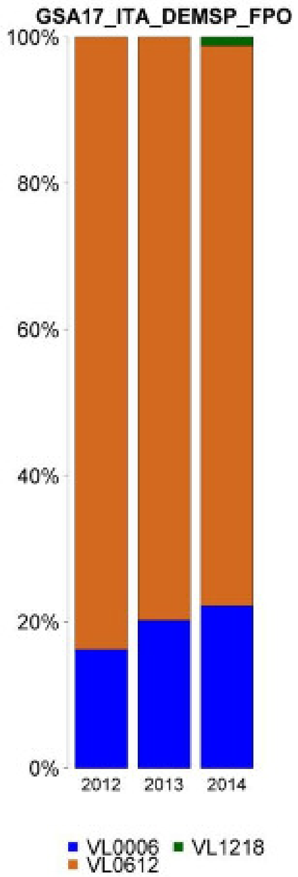


Figure 79. Percentage of GT*days at sea in the GSA17_ITA_DEMSP_FPO fisheries, proxy value of the fishing effort, by year and fleet segment.

2.2.13.2. Set gillnet targeting demersal species (DEMSP_GNS)

Solea Solea and *Squilla mantis* are the most important target species of the set gillnet fleet operating in GSA 17 in coastal areas both in terms of landing in values and landing in weights (Figure 80a and Figure 80b). Only the first species is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 233,376 GT*fishing day. The biggest percentage of total effort (55 %) was exerted by vessels from 06-12 m LOA, followed by 0-6 m (46 %), 24-40 m (18 %) and 12-18 m (3 %) vessels (Figure 80c).

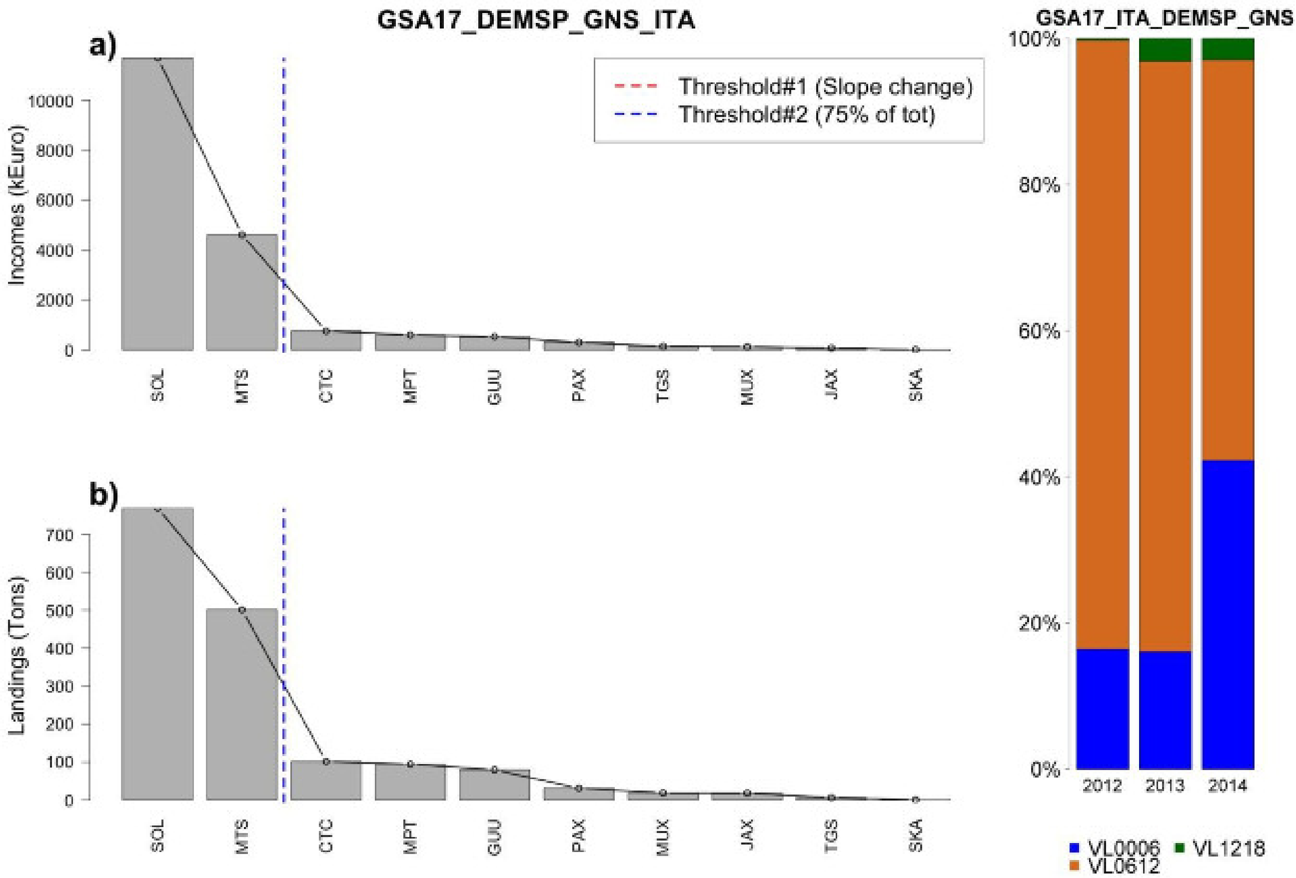


Figure 80. Cumulative percentage for the GSA17_ITA_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.13.3. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Merluccius merluccius, *Mullus barbatus*, *Nephrops norvegicus*, *Squilla mantis*, *Sepia officinalis* and *Penaeus kerathurus* are the most important target species in terms of landing values of the bottom trawl fleet operating in GSA 17 on the muddy bottoms of continental shelf (Figure 81a). In terms of landing in weight *Eledone* spp is also important (Figure 81b). However, only *M. merluccius*, *M. barbatus* and *N. norvegicus* are included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this metier in 2014 was equal to 2,711,270 GT*fishing day. The biggest percentage of total effort (52 %) was exerted by vessels from 18-24 m LOA, followed by 12-18 m (28 %), 24-40 m (18 %) and 6-12 m (2 %) vessels (Figure 81c).

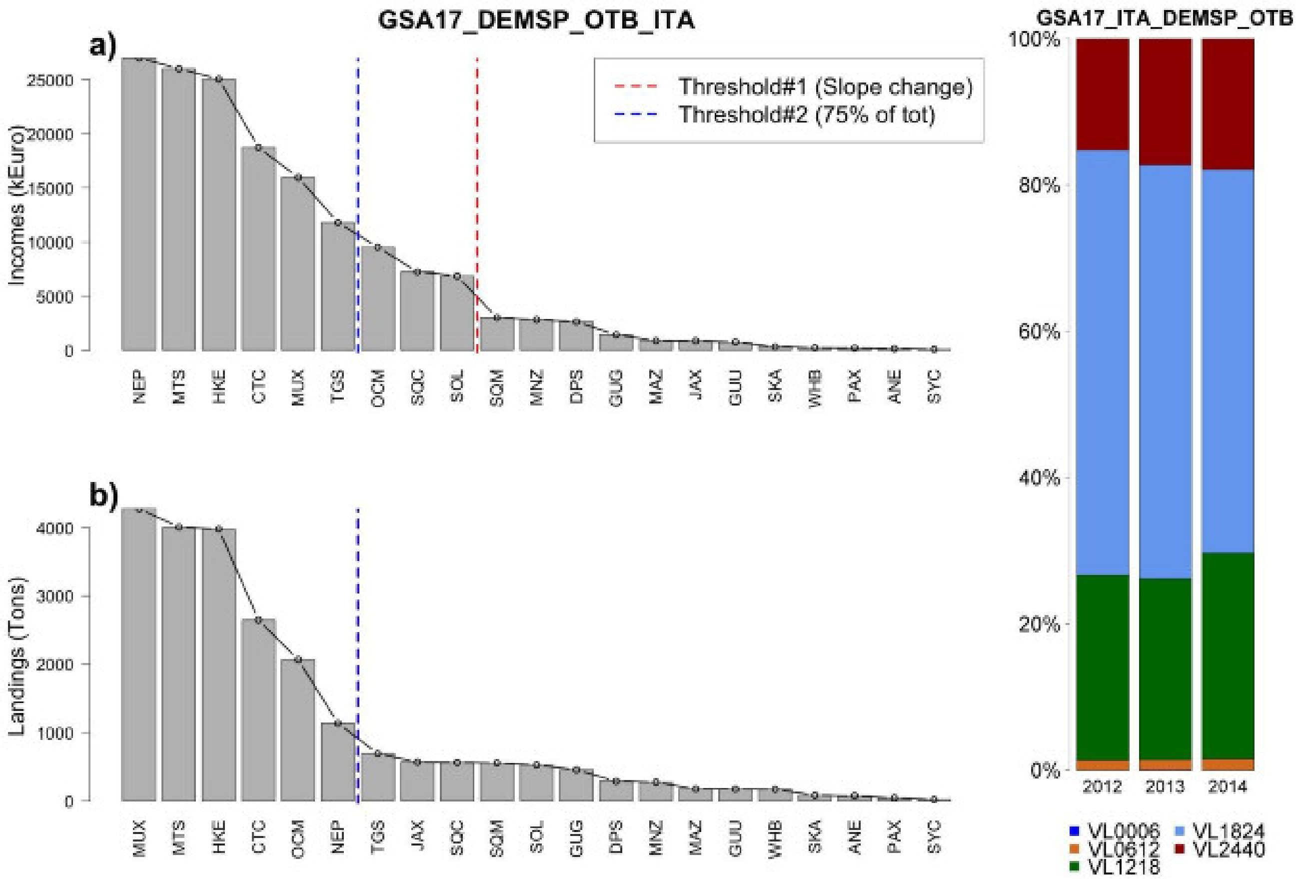


Figure 81. Cumulative percentage for the GSA17_ITA_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.13.4. Dredges targeting molluscs (MOL_DRB)

Chamelea gallina is the most important target species of the dredge fleet operating in GSA 17 in coastal areas. This species is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 589,654 GT*day at sea. This fleet is constituted only by vessels from 12-18 m LOA (Figure 82).

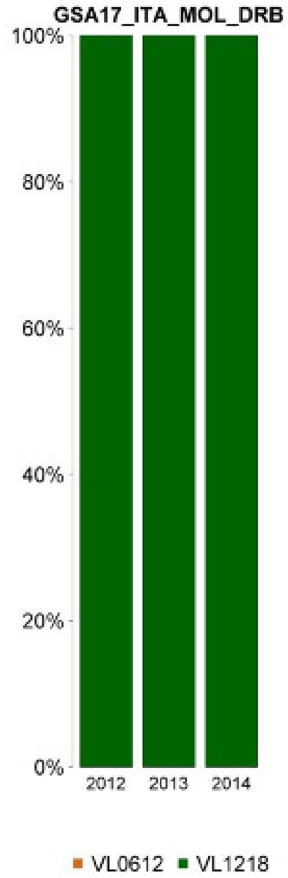


Figure 82. Percentage of GT*days at sea in the GSA17_ITA_MOL_DRB fisheries, proxy value of the fishing effort, by year and fleet segment.

2.2.14. Northern Adriatic Sea (GSA 17, Slovenia)

2.2.14.1. Pole lines targeting cephalopods (CEP_LHP)

Loligo spp is the most important target taxa of the pole lines fleet operating in GSA 17 in Slovenia waters both in terms of landing in values and landing in weights (Figure 83a and Figure 83b). This species is not included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 219.67 GT*fishing day. The biggest percentage of total effort (88 %) was exerted by vessels from 6-12 m LOA, followed by 0-6 m LOA (12 %) vessels (Figure 83c).

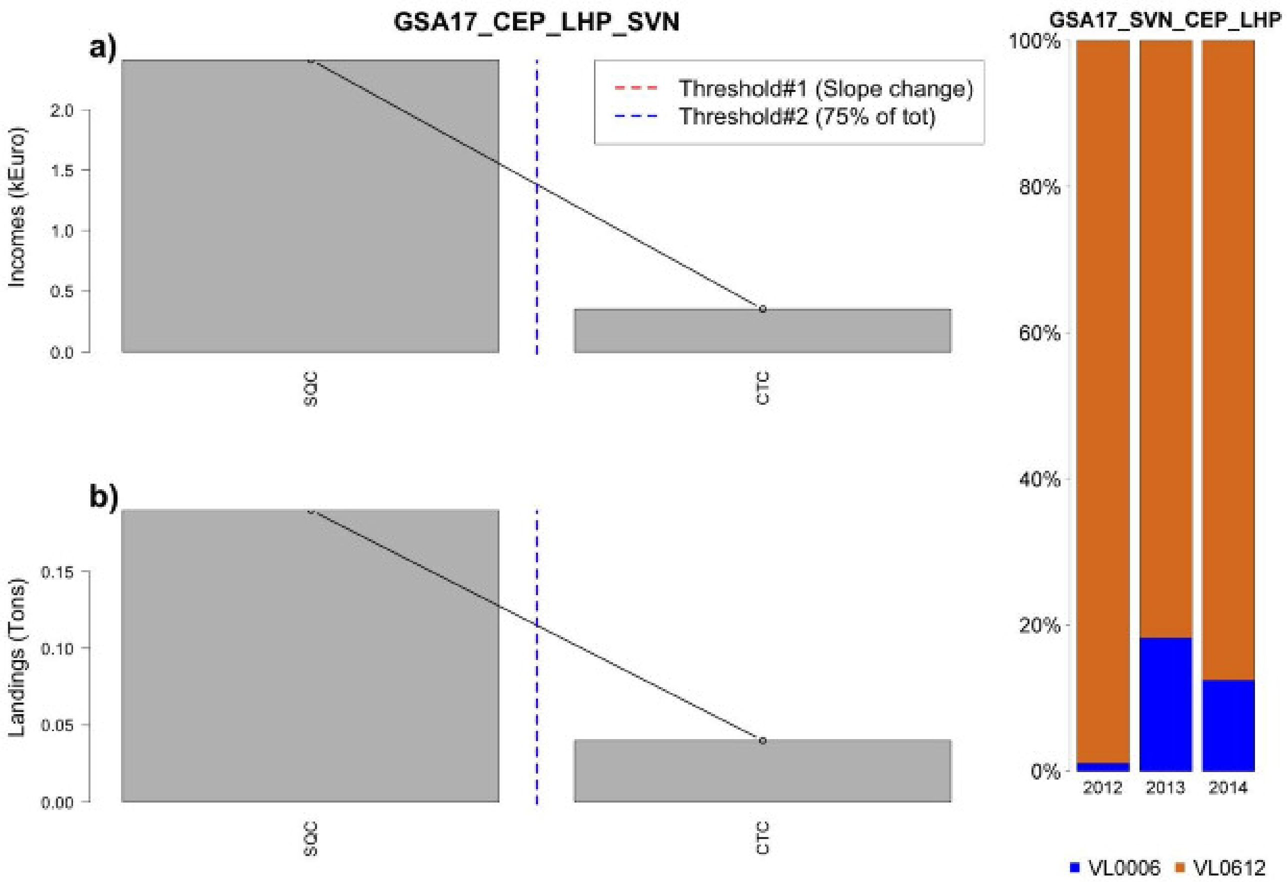


Figure 83. Cumulative percentage for the GSA17_SVN_CEP_LHP, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.14.2. Pots and traps targeting demersal species (DEMSP_FPO)

Sepia officinalis and *Squilla mantis* are the most important target species of pots and traps fleet operating in GSA 17 in Slovenia waters both in terms of landing in values and landing in weights (Figure 84a and Figure 84b). Both species are not included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 51,220 GT*fishing day. The biggest percentage of total effort (98 %) was exerted by vessels from 0-6 m LOA, followed by 6-12 m LOA (2 %) vessels (Figure 84c).

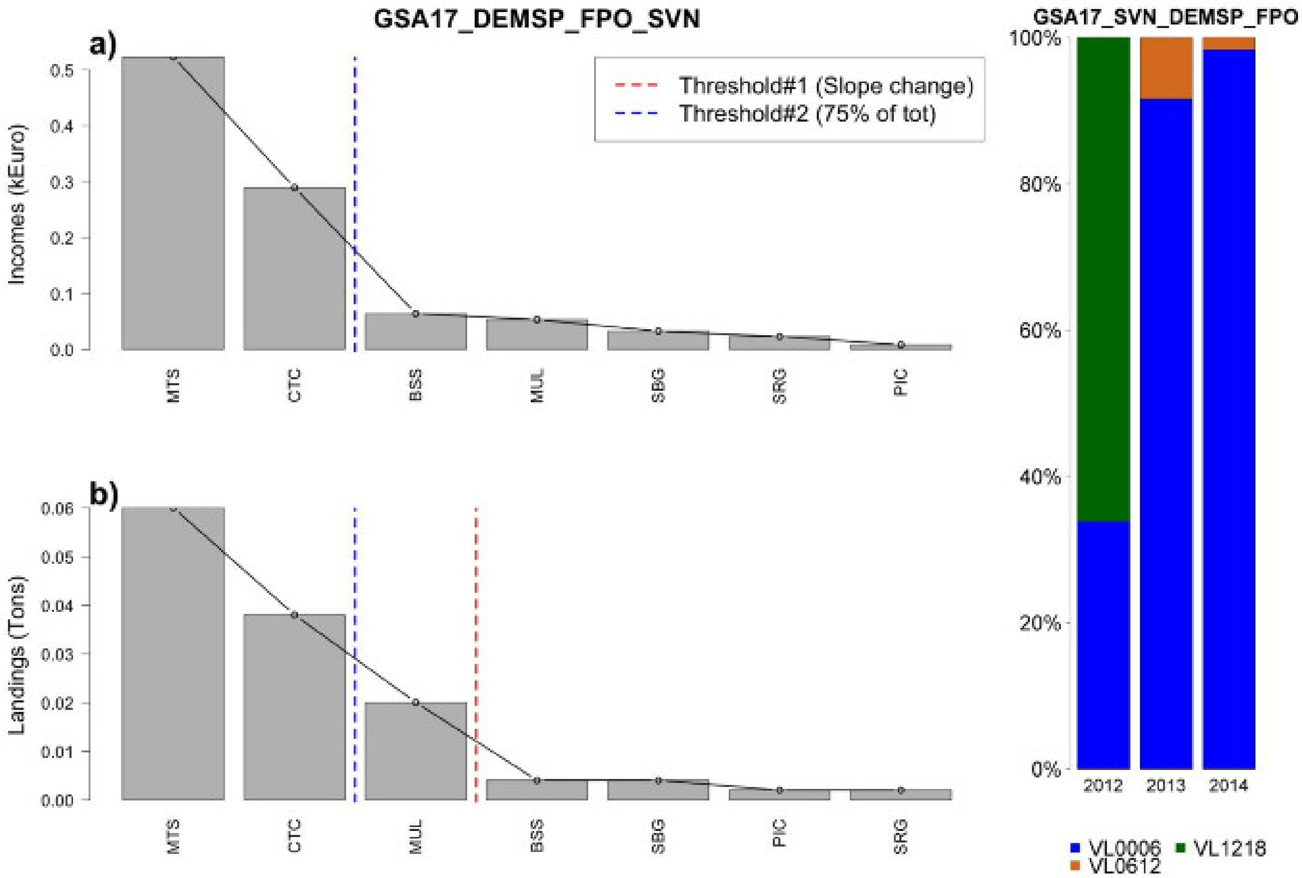


Figure 84. Cumulative percentage for the GSA17_SVN_DEMSP_FPO, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.14.3. Fyke nets targeting demersal species (DEMSP_FYK)

Diplodus spp, *Pagellus spp*, *Loligo spp* and *Mugilidae* are the most important target taxa of the fyke nets fleet operating in GSA 17 in Slovenia waters both in terms of landing in values and landing in weights (Figure 85a and Figure 85b). Only the first two taxa are not included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 268 GT*fishing day. The biggest percentage of total effort (52 %) was exerted by vessels from 6-12 m LOA, followed by 0-6 m LOA (48 %) vessels (Figure 85c).

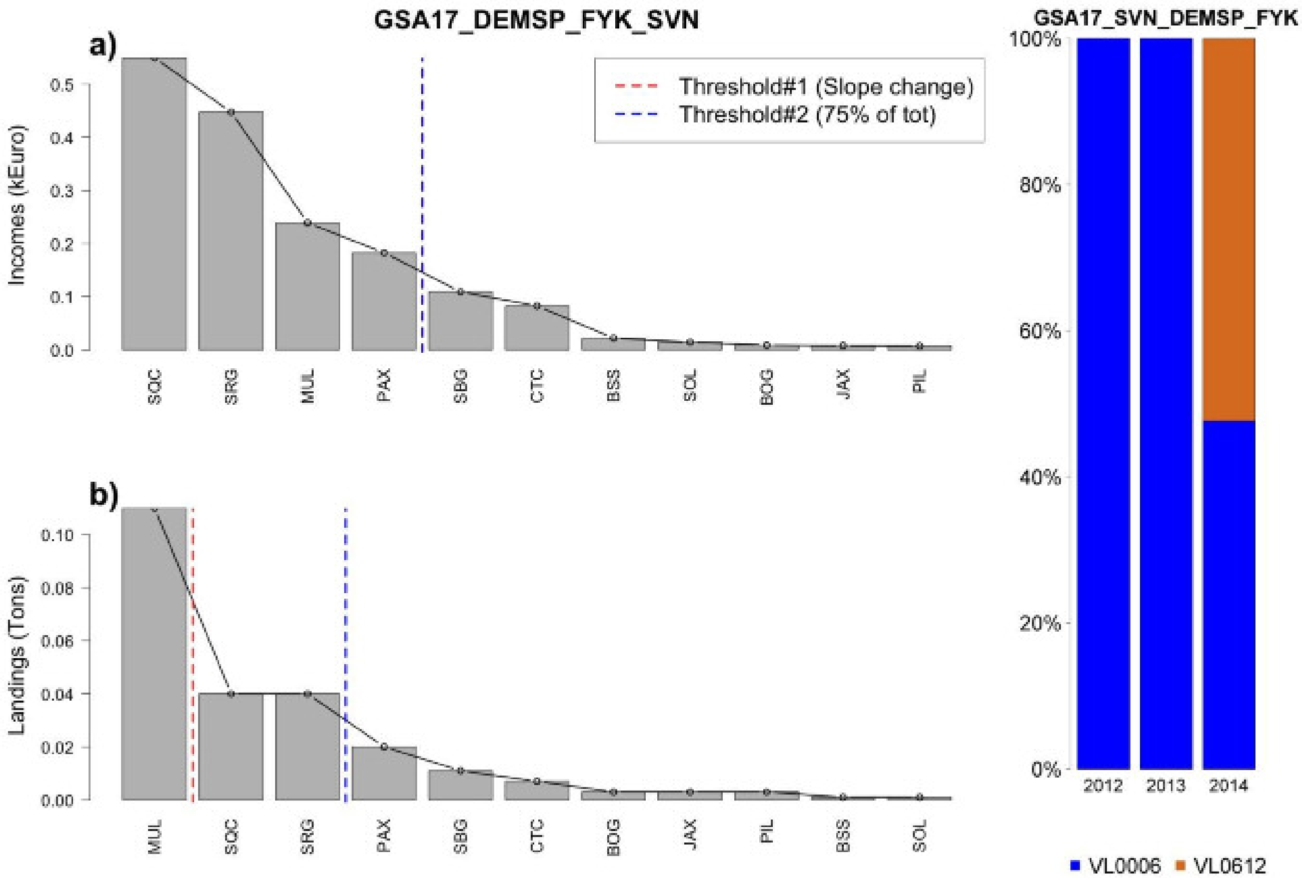


Figure 85. Cumulative percentage for the GSA17_SVN_DEMSP_FYK, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.14.4. Set gillnet targeting demersal species (DEMSP_GNS)

Sparus aurata, *Solea Solea*, *Pagellus* spp and *Dicentrarchus labrax* are the most important target taxa of the set gillnet fleet operating in GSA 17 in Slovenia waters both in terms of landing in values and landing in weights, in particular also the category Mugilidae is important in landing in weights (Figure 86a and Figure 86b). All the species important in terms of landing values are included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 6,066 GT*fishing day. The biggest percentage of total effort (75 %) was exerted by vessels from 6-12 m LOA, followed by 0-6 m LOA (20 %) and 12-18 LOA vessels (5%; Figure 86c).

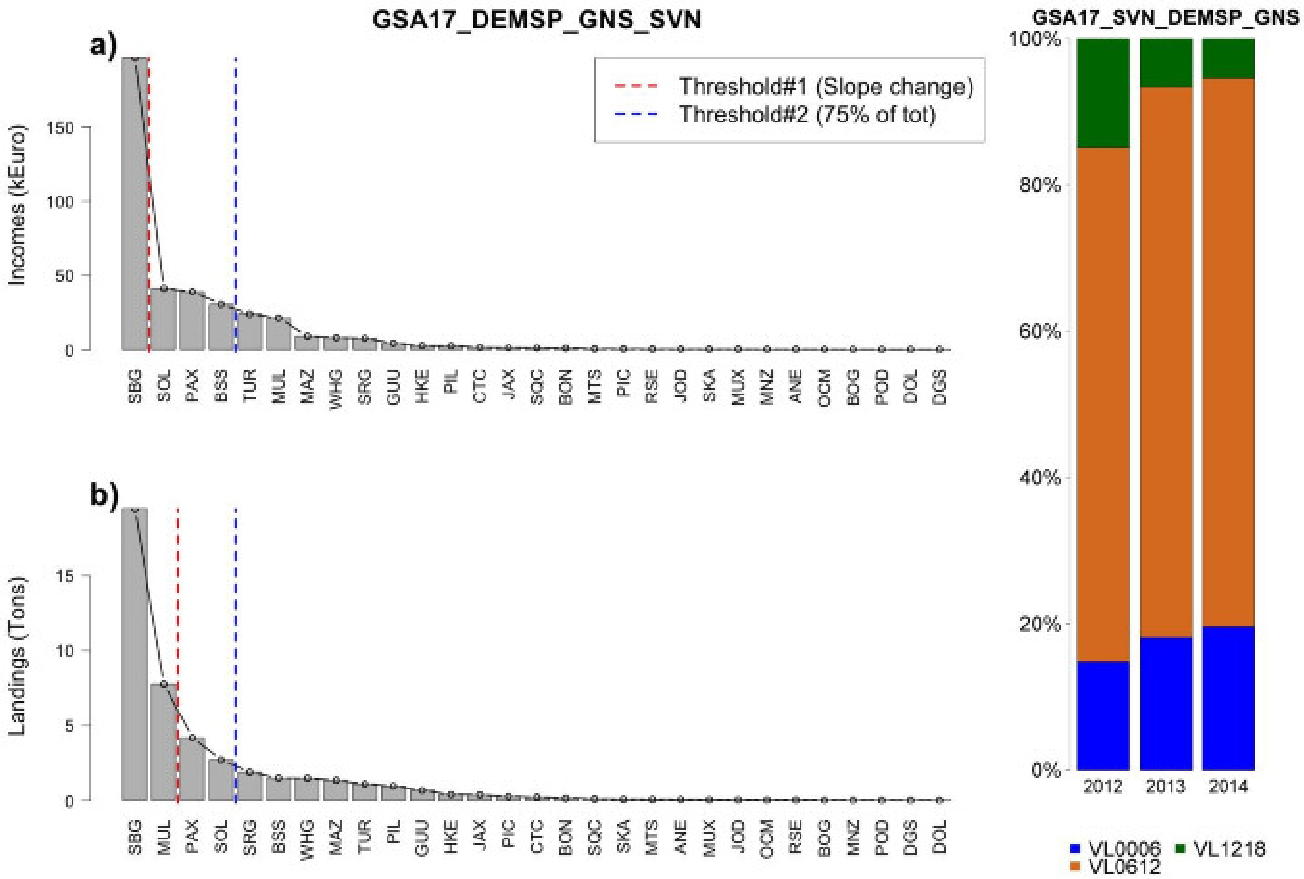


Figure 86. Cumulative percentage for the GSA17_SVN_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.14.5. Trammel net targeting demersal species (DEMSP_GTR)

Solea Solea and *Sparus aurata* are the most important target species of the trammel net fleet operating in GSA 17 Slovenia waters both in terms of landing in values and landing in weights, in particular also the category Mugilidae is important in landing in weights (Figure 87a and Figure 87b). *S. Solea* and *S. aurata* are included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 10,542 GT*fishing day. The biggest percentage of total effort (80 %) was exerted by vessels from 6-12 m LOA, followed by 0-6 m LOA (16 %)and 12-18 LOA vessels (4%; Figure 87c).

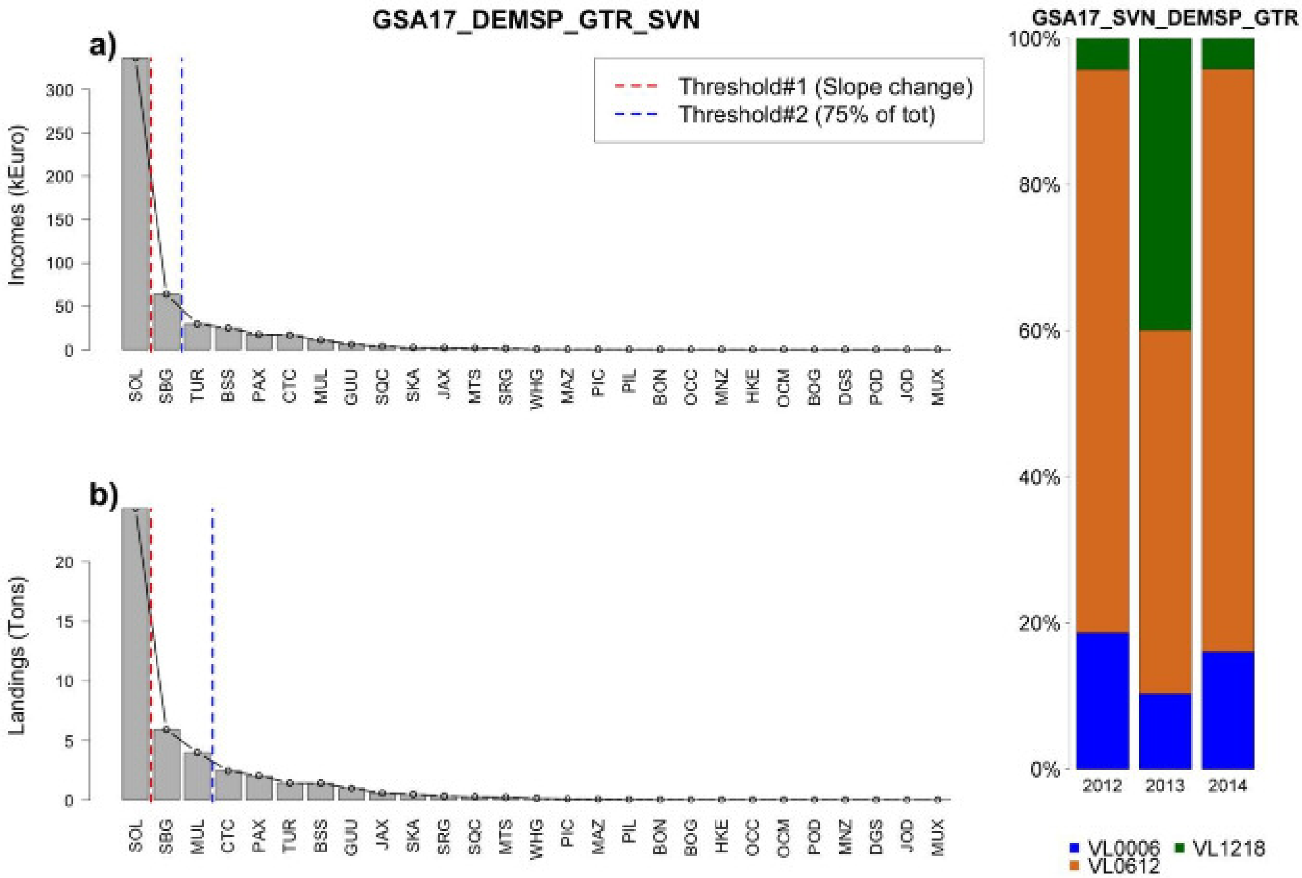


Figure 87. Cumulative percentage for the GSA17_SVN_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.14.6. Set longline targeting demersal fish (DEMF_LLS)

Sparus aurata is the most important target species of the set longline fleet operating in GSA 17 in Slovenia waters both in terms of landing in values and landing in weights (Figure 88a and Figure 88b). This species is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 83.99 GT*fishing day. The biggest percentage of total effort (67 %) was exerted by vessels from 0-6 m LOA, followed by 6-12 m LOA vessels (33 %; Figure 88c).

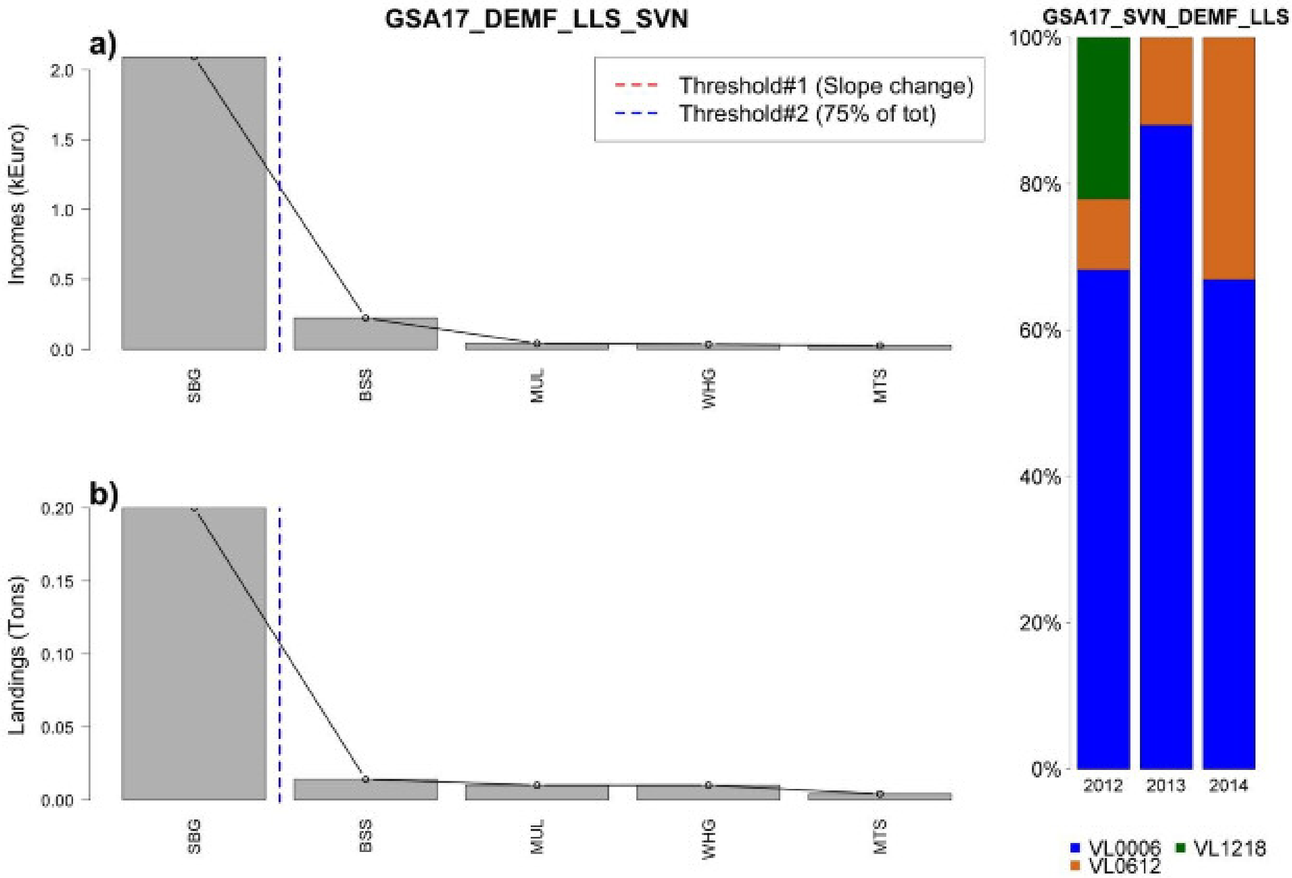


Figure 88. Cumulative percentage for the GSA17_SVN_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.14.7. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Eledone spp, *Loligo* spp and *Merlangius merlangus* are the most important target taxa of the bottom trawl fleet operating in GSA 17 in Slovenia waters both in terms of landing in values and landing in weights, in particular also the category Mugilidae is important in landing in weights (Figure 89a and Figure 89b). However all the taxa mentioned are not included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 9,372 GT*fishing day. The biggest percentage of total effort (87 %) was exerted by vessels from 12-18 m LOA, followed by 6-12 m LOA vessels (13 %; Figure 89c).

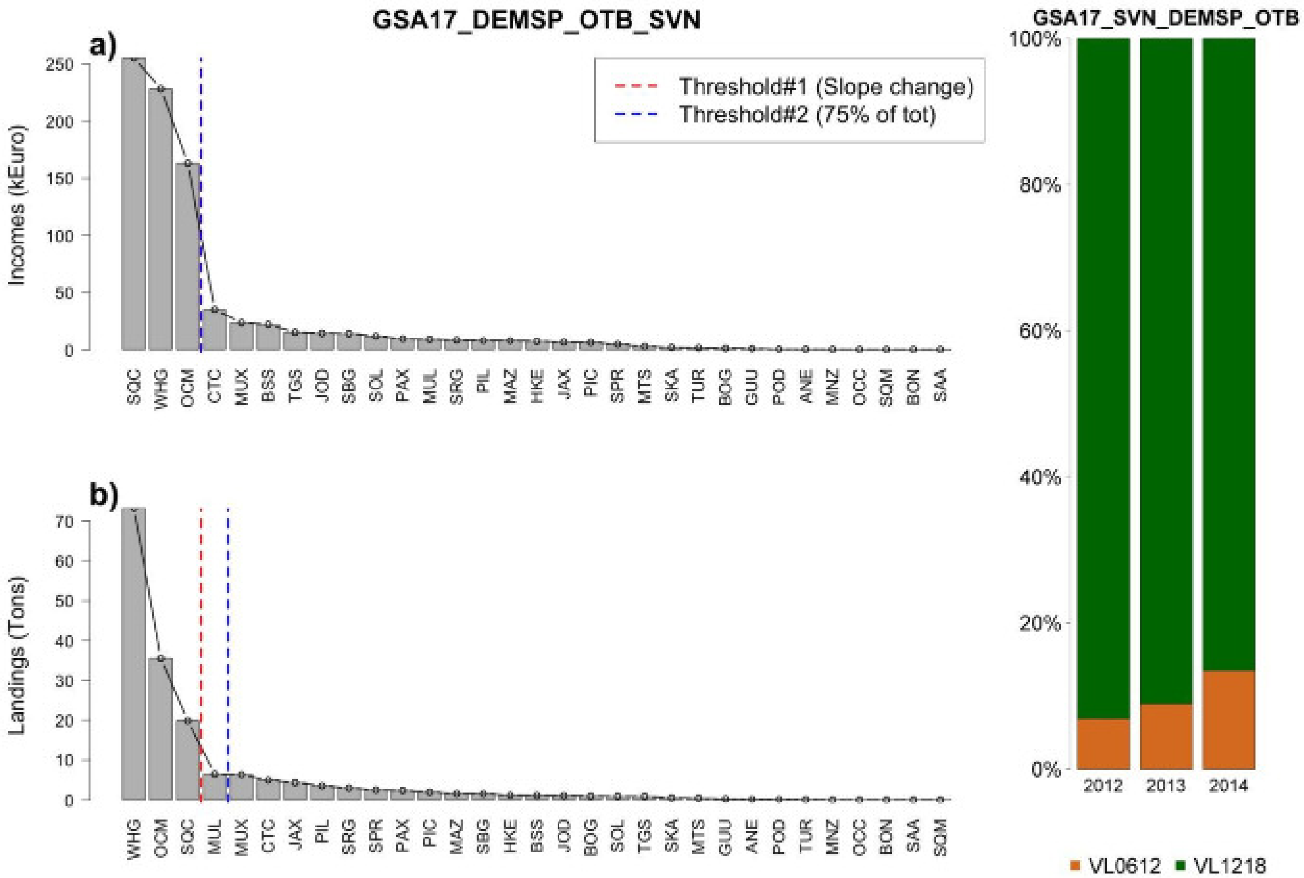


Figure 89. Cumulative percentage for the GSA17_SVN_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.14.8. Pole lines targeting finfish (FINF_LHP)

Dicentrarchus labrax and *Merlangius merlangus* are the most important target species of the pole lines fleet operating in GSA 17 in Slovenia waters both in terms of landing in values and landing in weights, in particular also the *Spicara smaris* is important in landing in weights (Figure 90a and Figure 90b). Only *D. labrax* is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 547.62 GT*fishing day. The biggest percentage of total effort (90 %) was exerted by vessels from 6-12 m LOA, followed by 12-18 m (8 %) and 0-6 m (2 %) vessels (Figure 90c).

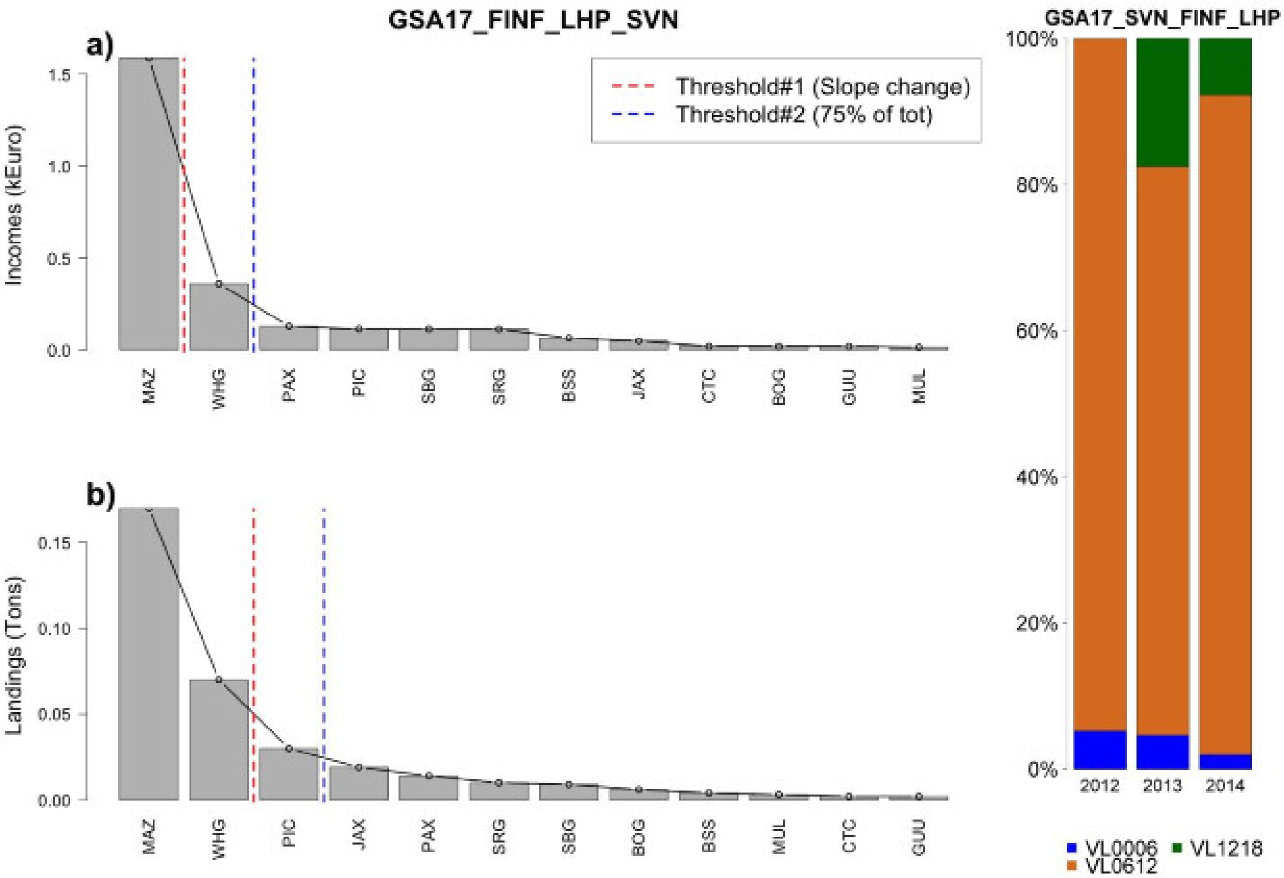


Figure 90. Cumulative percentage for the GSA17_SVN_FINF_LHP, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.15. *Northern Adriatic Sea (GSA 17, Croatia)*

2.2.15.1. Trammel nets targeting demersal species (DEMF_GTR)

Solea Solea is the most important target species of the trammel net fleet operating in GSA 17 in Croatian waters and it is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier equals to 65,099.52 GT*fishing day. The biggest percentage of total effort (83.24 %) was exerted by vessels belonging to the segment 6-12 m LOA. The rest of the effort was exerted by vessels belonging to 12-18 m LOA (13.31 %) and 0-6 m LOA (3.45 %) segment of the fleet (Figure 91).

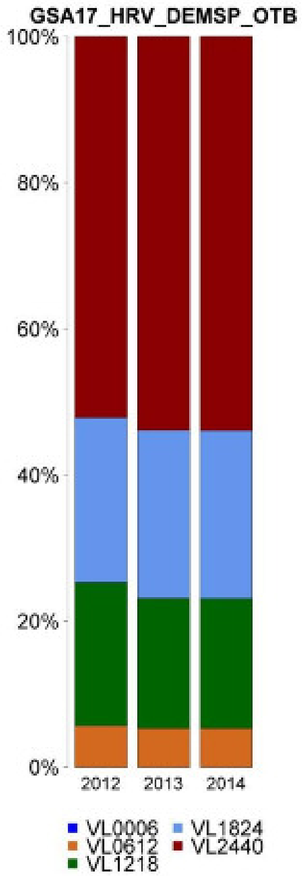


Figure 91. Percentage of GT*days at sea in the GSA1_DEMSP_OTB fisheries, proxy value of the fishing effort, by year and fleet segment.

2.2.15.2. Bottom trawling targeting demersal fish (DEMF_OTB)

The primary target species of this metier are *Mullus barbatus* and *Merluccius merluccius* (Figure 92). Both species are included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier equals to 675,103.4 GT*fishing day. The biggest percentage of total effort (33.78 %) was exerted by vessels from 24-40 m LOA, followed by 12-18 m (30.25 %), 18-24 m (25.91 %) and 6-12 m (10.06 %) vessels (Figure 92c).

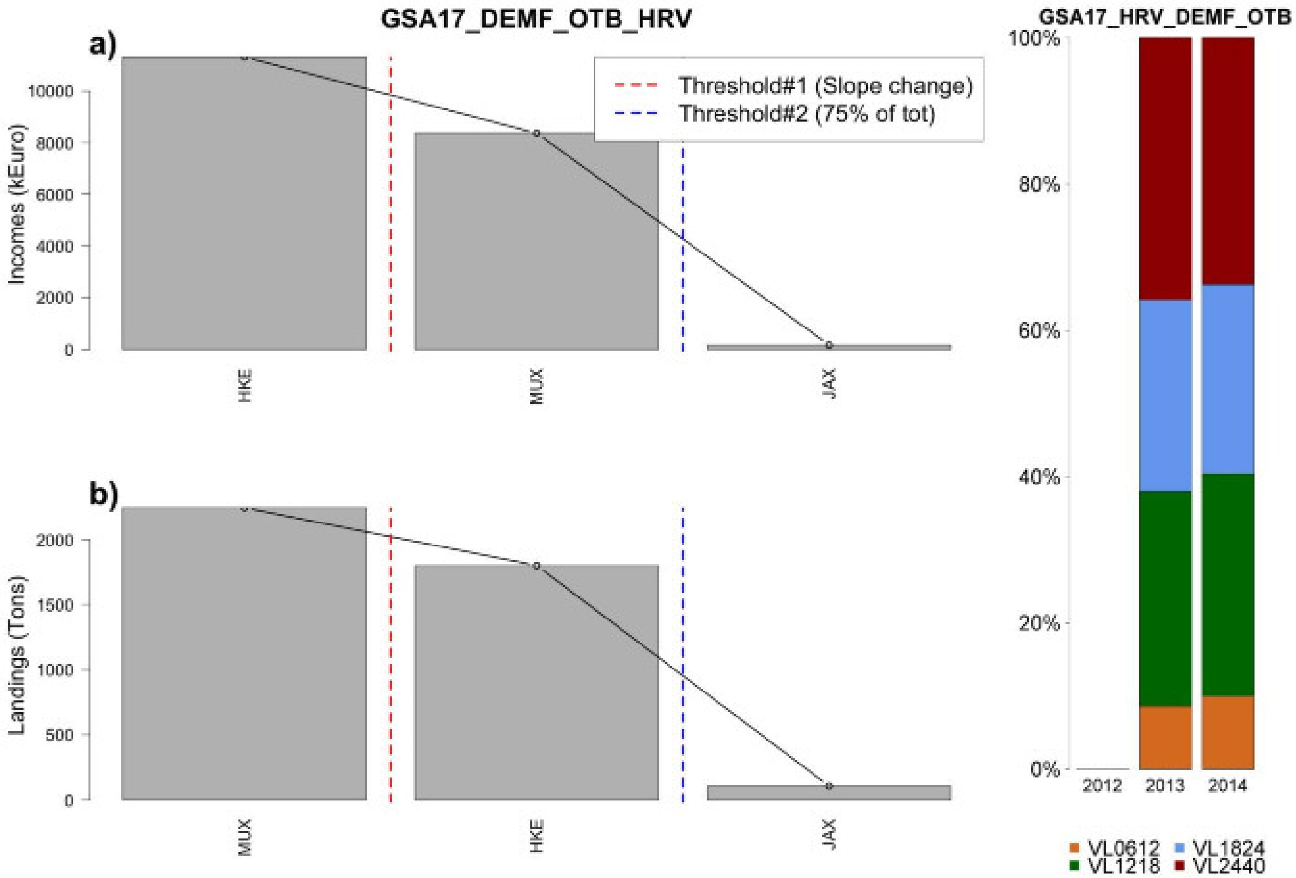


Figure 92. Cumulative percentage for the GSA17_HRV_DEMF_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.15.3. Bottom trawling targeting demersal species (DEMSP_OTB)

M. merluccius, P. longirostris, N. norvegicus, M. barbatus and, *Eledone* spp are the most important target taxa of the bottom trawl fleet operating in GSA 17 in Croatian waters (Figure 93). First four species are included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier equals to 3,922,134.7 GT*fishing day. The biggest percentage of total effort (53.94 %) was exerted by vessels belonging to the segment 24-40m LOA (Figure 93c). The rest of the effort was exerted by vessels belonging to 18-24 LOA (23 %), 12-18 LOA (17.75 %), 6-12 LOA (5.31%) and 0-6 LOA (less than 0.001%).

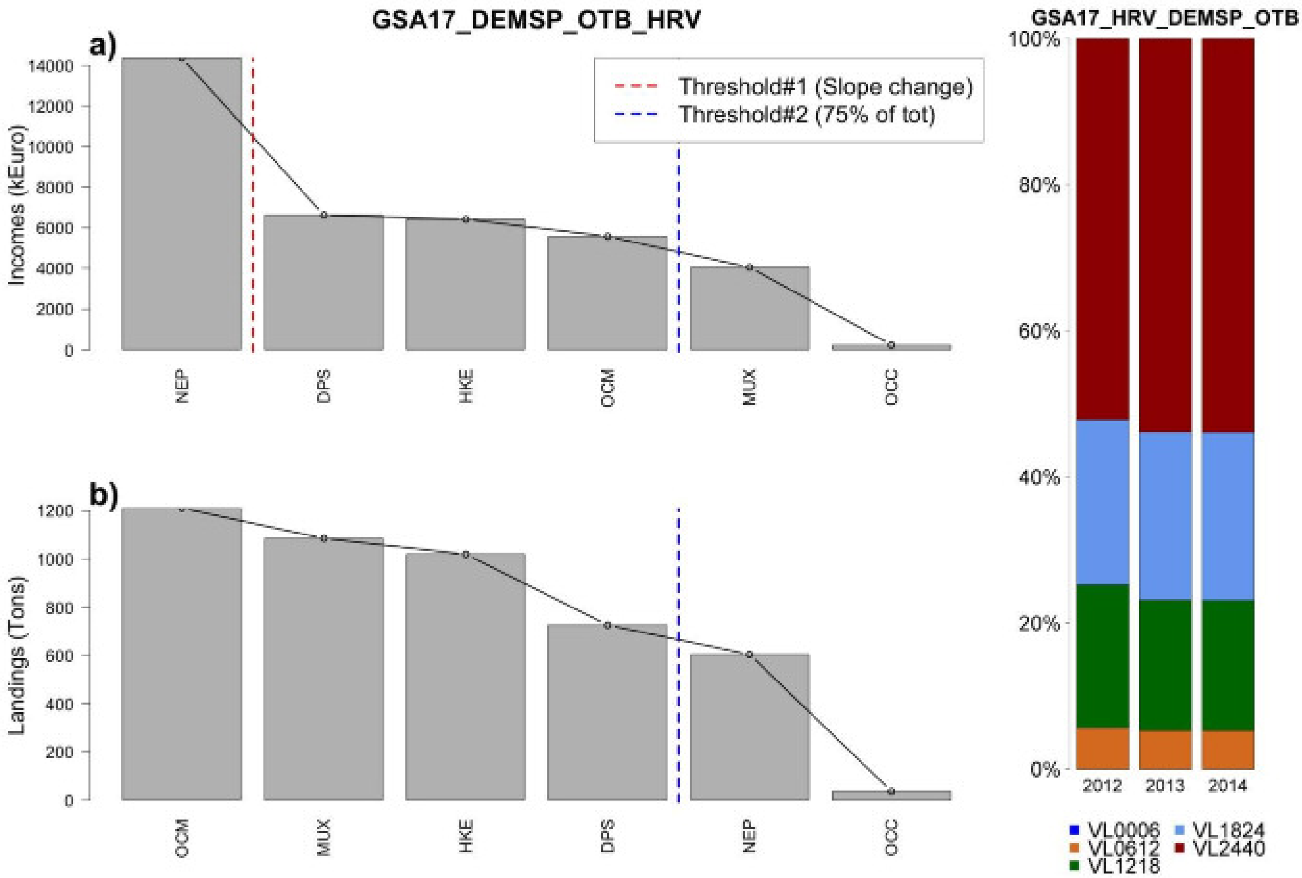


Figure 93. Cumulative percentage for the GSA17_HRV_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.16. South Adriatic Sea (GSA 18)

2.2.16.1. Set longlines targeting demersal fish (DEMF_LLS)

In this fisheries the species which landing volume in percentage is accounting for the part of the cumulative distribution left to the slope change is *Merluccius merluccius* (HKE), while in terms of landing value the species accounting for 75 % of the cumulative distribution (in this case the threshold of 75 % and that of the slope change in the cumulative distribution are overlapping) are *Merluccius merluccius* (HKE) and *Eutrigla gurnardus* (GUG) (Figure 94). Among these species *Merluccius merluccius* (HKE) is included in the Annex III of the EU Reg. 1967/2006. For these fisheries, given the high level of specialization targeting *Merluccius merluccius* the landing volume criterion seems more suitable for fisheries identification.

According to the most recent DCF data, in the period 2012-2014, this fleet was mostly composed by the segments VL0612 (23 %) and VL1218 (81 %), operating on the continental shelf and upper slope. In the period 2012-2014, this fleet performed, on average, 6,303 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 94c.

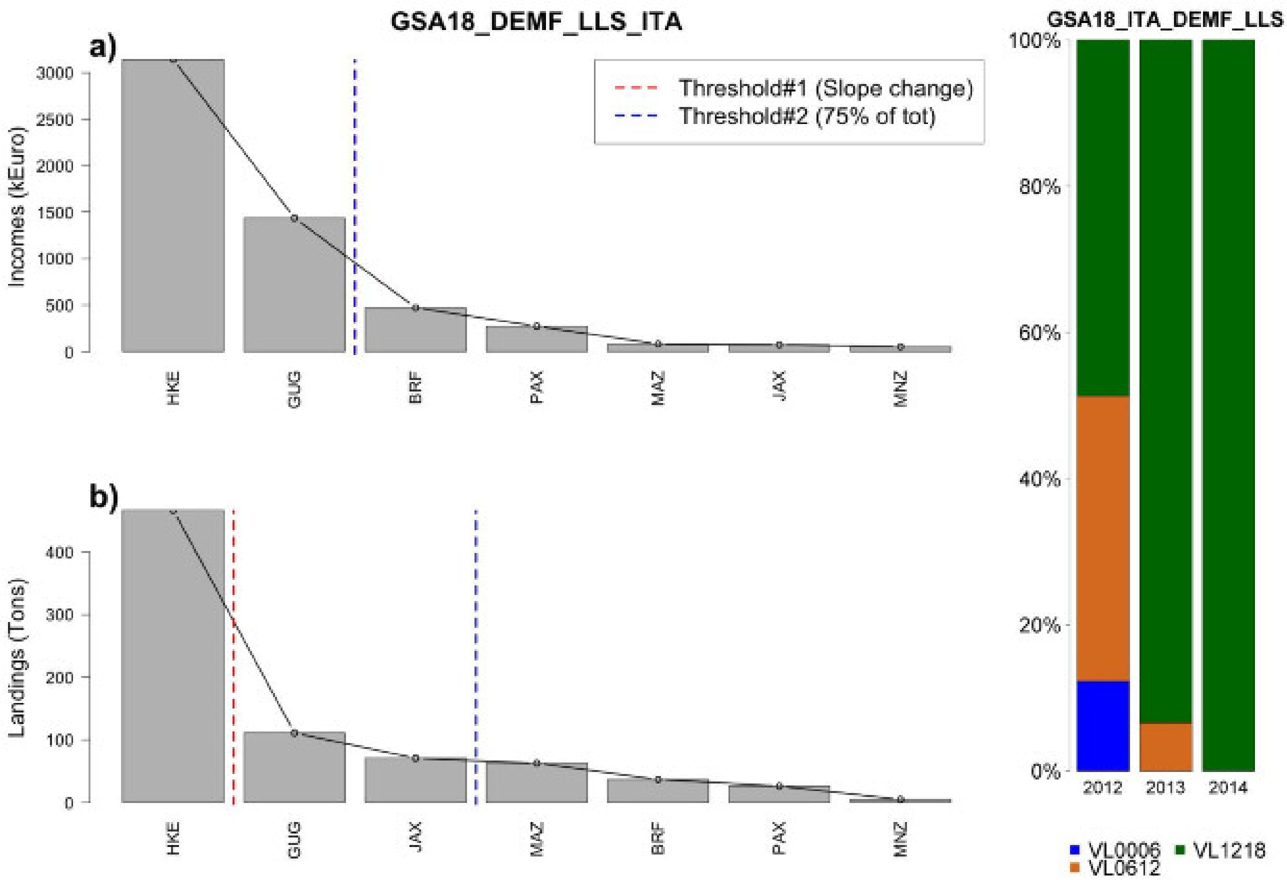


Figure 94. Cumulative percentage for the GSA18_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.16.2. Set gillnets targeting demersal species (DEMSP_GNS)

The species which landing value and landing volume is accounting 75 % of the cumulative distributions are: *Sepia officinalis* (CTC), *Mullus* spp (MUX) and *Octopus vulgaris* (OCC) (Figure 95). Among these species only *Mullus* spp (MUX) is included in the Annex III of the EU Reg. 1967/2006. In GSA 18, these fisheries are performed by fleets operating on the upper continental shelf. According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL0006 (37 %) and VL0612 (63 %). In the same period, this fleet performed, on average, 5,784 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 95c.

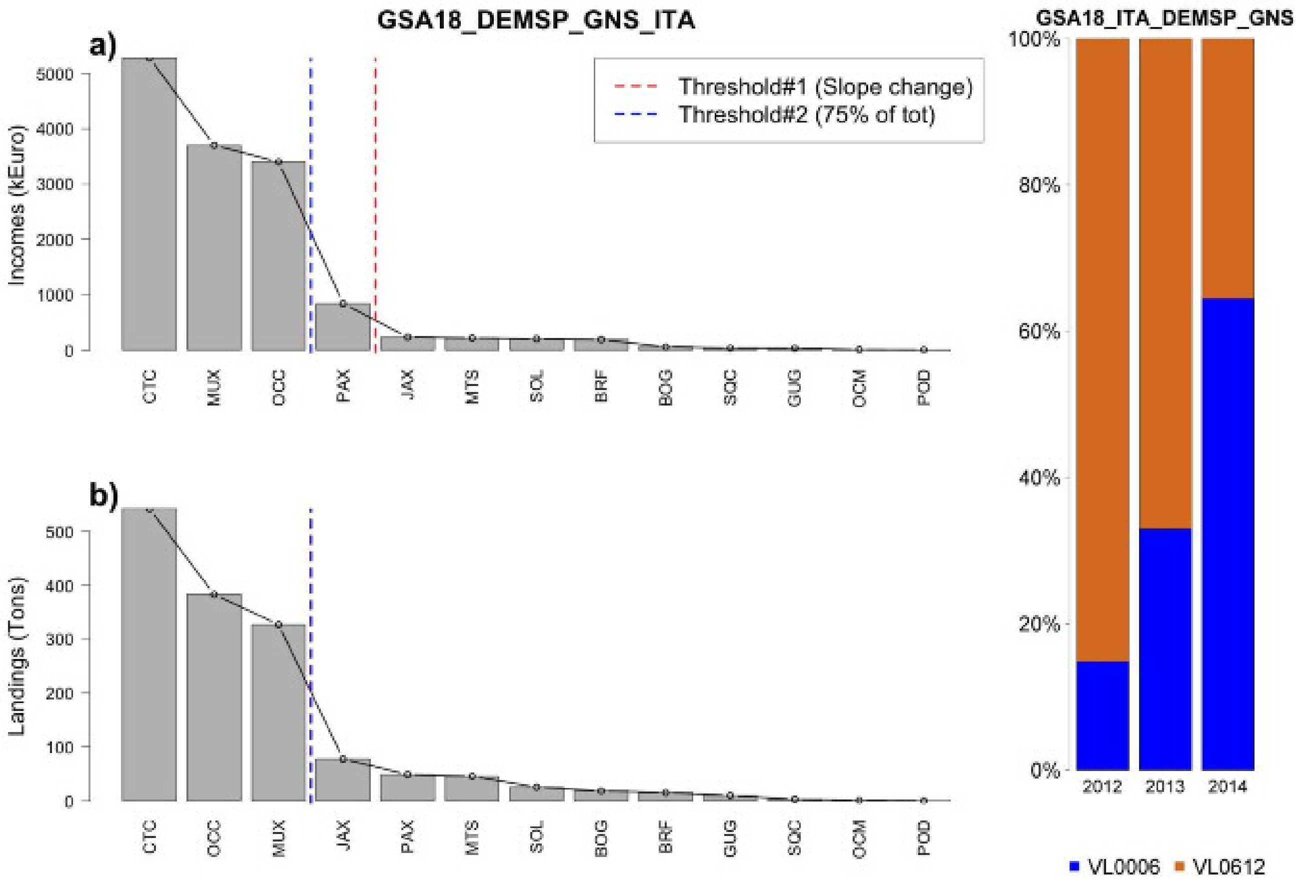


Figure 95. Cumulative percentage for the GSA18_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.16.3. Trammel nets targeting demersal species (DEMSP_GTR)

The species which percentage in terms of value and volume of landings account for 75 % of the cumulative distributions are: *Sepia officinalis* (CTC), *Octopus vulgaris* (OCC) and *Mullus* spp (MUX) (Figure 96). Among these species only *Mullus* spp (MUX) is included in the Annex III of the EU Reg. 1967/2006.

According to the most recent DCF data, in the period 2012-2014, this fleet was mostly composed by the segments VL0006 (19 %) and VL0612 (87 %), operating on the upper continental shelf. In the period 2012-2014, this fleet performed, on average, 6,656 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 96c.

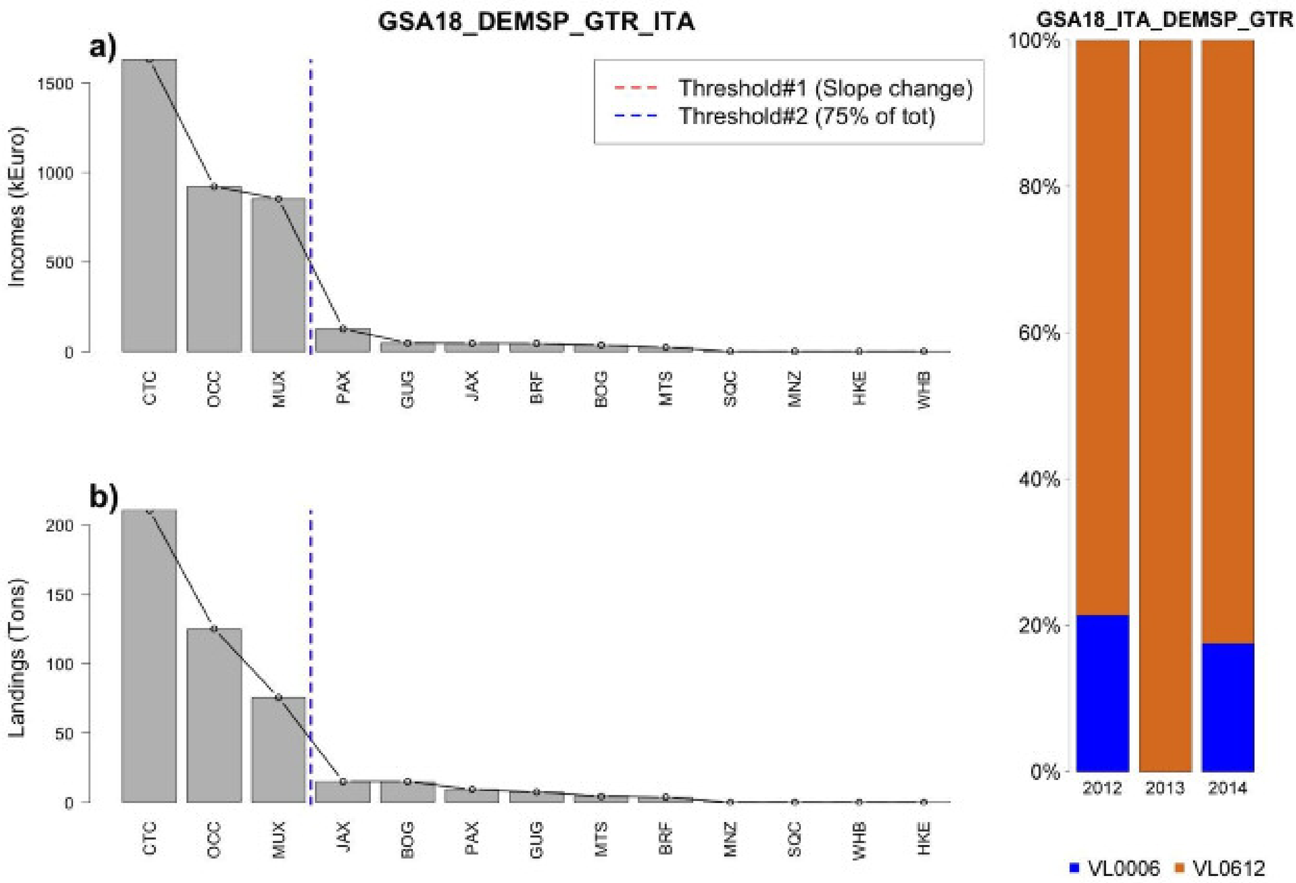


Figure 96. Cumulative percentage for the GSA18_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.16.4. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Species which landing value is accounting for 75 % of the cumulative distribution are: *Merluccius merluccius* (HKE), *Nephrops norvegicus* (NEP), *Mullus* spp (MUX), *Eledone* sp (OCM) and *Parapenaeus longirostris* (DPS) (Figure 97); among these only *Eledone* spp (OCM) is not included in the Annex III of the EU Reg. 1967/2006. Species which landing volume in percentage is accounting for 75 % of the cumulative distribution are: *Merluccius merluccius* (HKE), *Nephrops norvegicus* (NEP), *Mullus* spp (MUX), *Eledone* spp (OCM), *Parapenaeus longirostris* (DPS) and *Squilla mantis* (MTS) (); *Merluccius merluccius* (HKE), *Nephrops norvegicus* (NEP), *Mullus* spp (MUX) and *Parapenaeus longirostris* (DPS) are included in the Annex III of the EU Reg. 1967/2006. In these fisheries the criterion of landing volume should prevail. In GSA 18 these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of continental shelf.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL1218 (56 %) and VL1824 (36 %). In the same period, this fleet performed, on average, 100,411 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 97c.

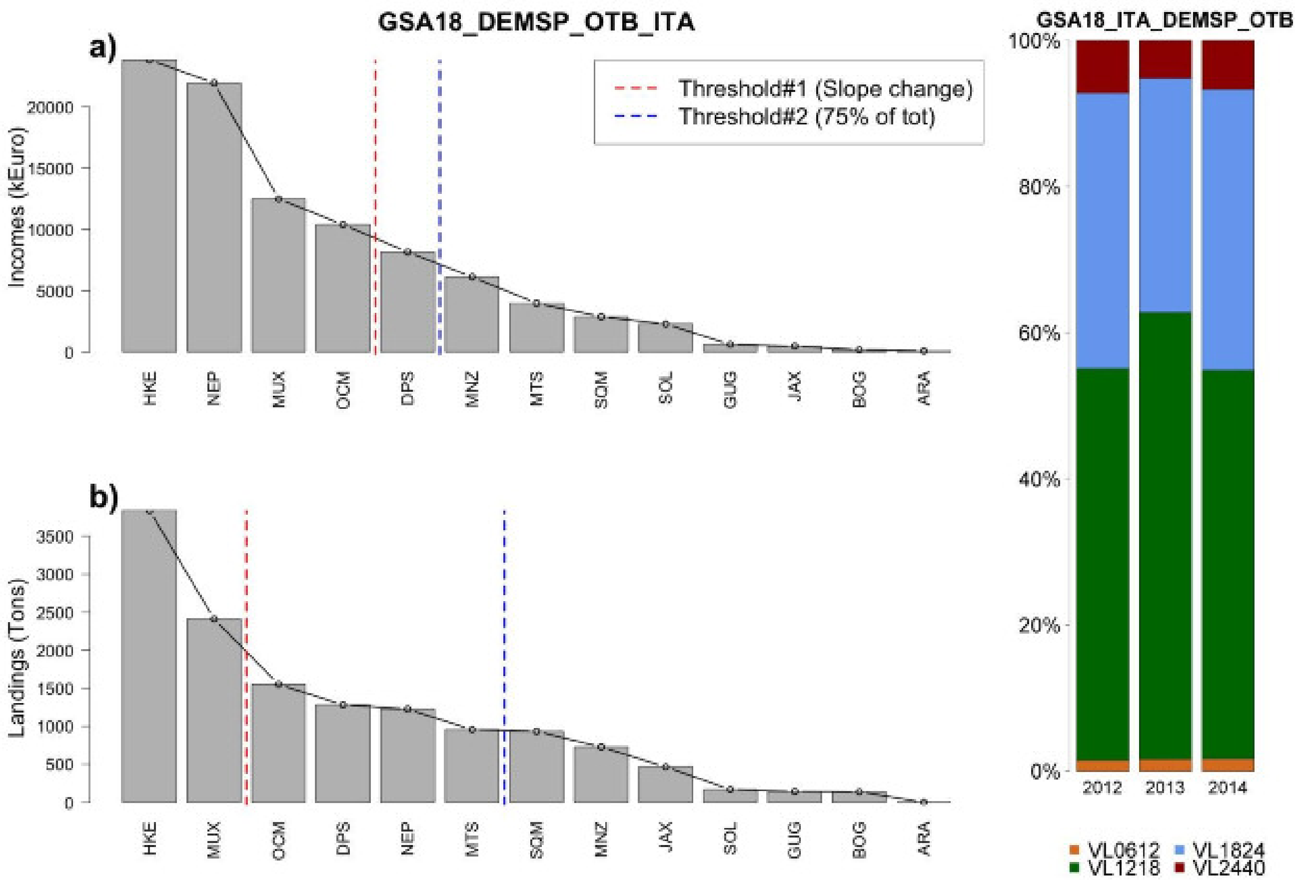


Figure 97. Cumulative percentage for the GSA18_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.16.5. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

Species which landing value is accounting for 75 % of the cumulative distribution are: *Nephrops norvegicus* (NEP), *Merluccius merluccius* (HKE), *Parapenaeus longirostris* (DPS), *Aristaeomorpha foliacea* (ARS), *Lophius* spp (MNZ) (Figure 98); the species *Nephrops norvegicus* (NEP), *Merluccius merluccius* (HKE) and *Parapenaeus longirostris* (DPS) are included in the Annex III of the EU Reg. 1967/2006. Species which landing volume in percentage is accounting for 75 % of the cumulative distribution are: *Merluccius merluccius* (HKE), *Parapenaeus longirostris* (DPS), *Lophius* sp. (MNZ), *Nephrops norvegicus* (NEP), *Eutrigla gurnardus* (GUG), *Eledone* spp (OCM) and *Squilla mantis* (MTS) (); the species *Merluccius merluccius* (HKE), *Parapenaeus longirostris* (DPS) and *Nephrops norvegicus* (NEP) are included in the Annex III of the EU Reg. 1967/2006. In these fisheries the criterion of landing volume should prevail. In GSA 18, these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of continental shelf and slope.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL1824 (48 %) and VL2440 (45 %). In the same period, this fleet performed, on average, 10,982 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 98c.

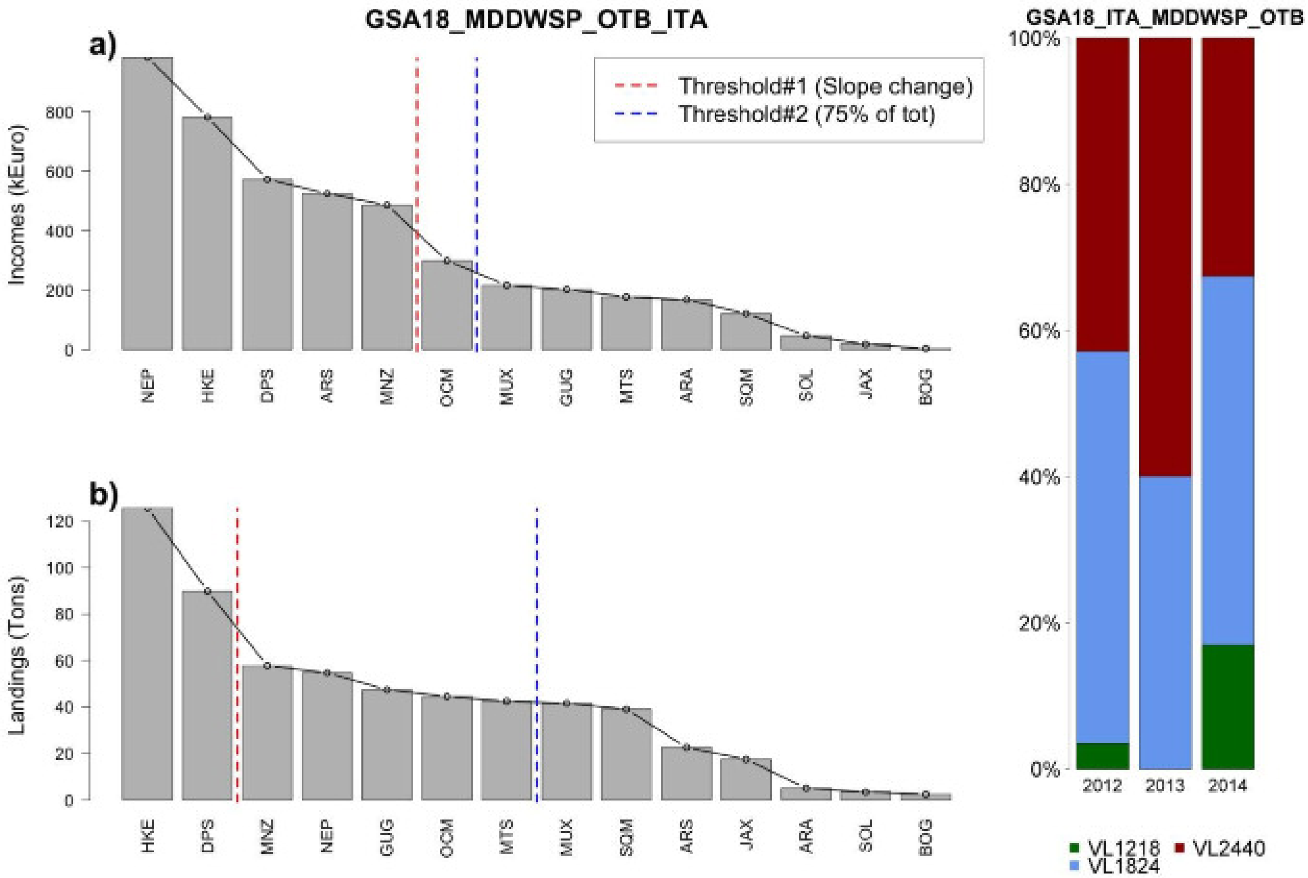


Figure 98. Cumulative percentage for the GSA18_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.17. *Western Ionian Sea (GSA 19)*

2.2.17.1. Set longlines targeting demersal fish (DEMF_LLS)

The species which landing value and volume is accounting in percentage for the part of the cumulative distributions left to the slope change is: *Merluccius merluccius* (HKE), which is included in the Annex III of the EU Reg. 1967/2006 (Figure 99). These fisheries have a high degree of specialization.

According to the most recent DCF data, in the period 2012-2014, this fleet was mostly composed by the segments VL0612 (35 %) and VL1218 (63 %), operating on the continental shelf and upper slope. In the period 2012-2014, this fleet performed, on average, 17,920 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 99c.

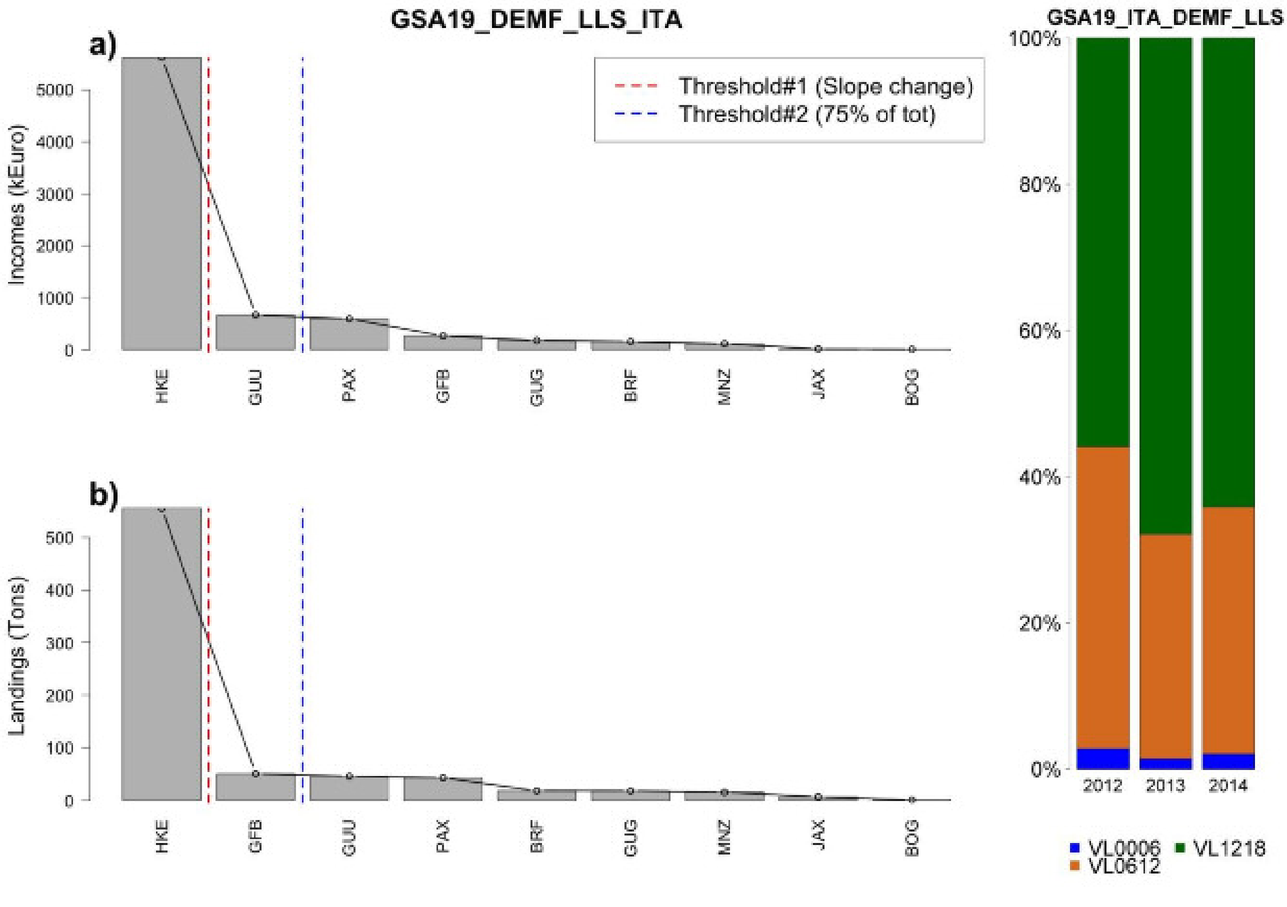


Figure 99. Cumulative percentage for the GSA19_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.17.2. Set gillnets targeting demersal species (DEMSP_GNS)

The species which landing value and landing volume in percentage are accounting for the part of the cumulative distributions left to the slope change are: *Mullus* spp (MUX) and *Merluccius merluccius* (HKE) (Figure 100), both included in the Annex III of the EU Reg. 1967/2006. For these fisheries the criterion based on the slope change seems more suitable as it takes into account the species which characterize the fisheries. In GSA 19, these fisheries are performed by fleets operating on the continental shelf and upper slope.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL0006 (22 %) and VL0612 (75 %). In the same period, this fleet performed, on average, 31,733 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 100c.

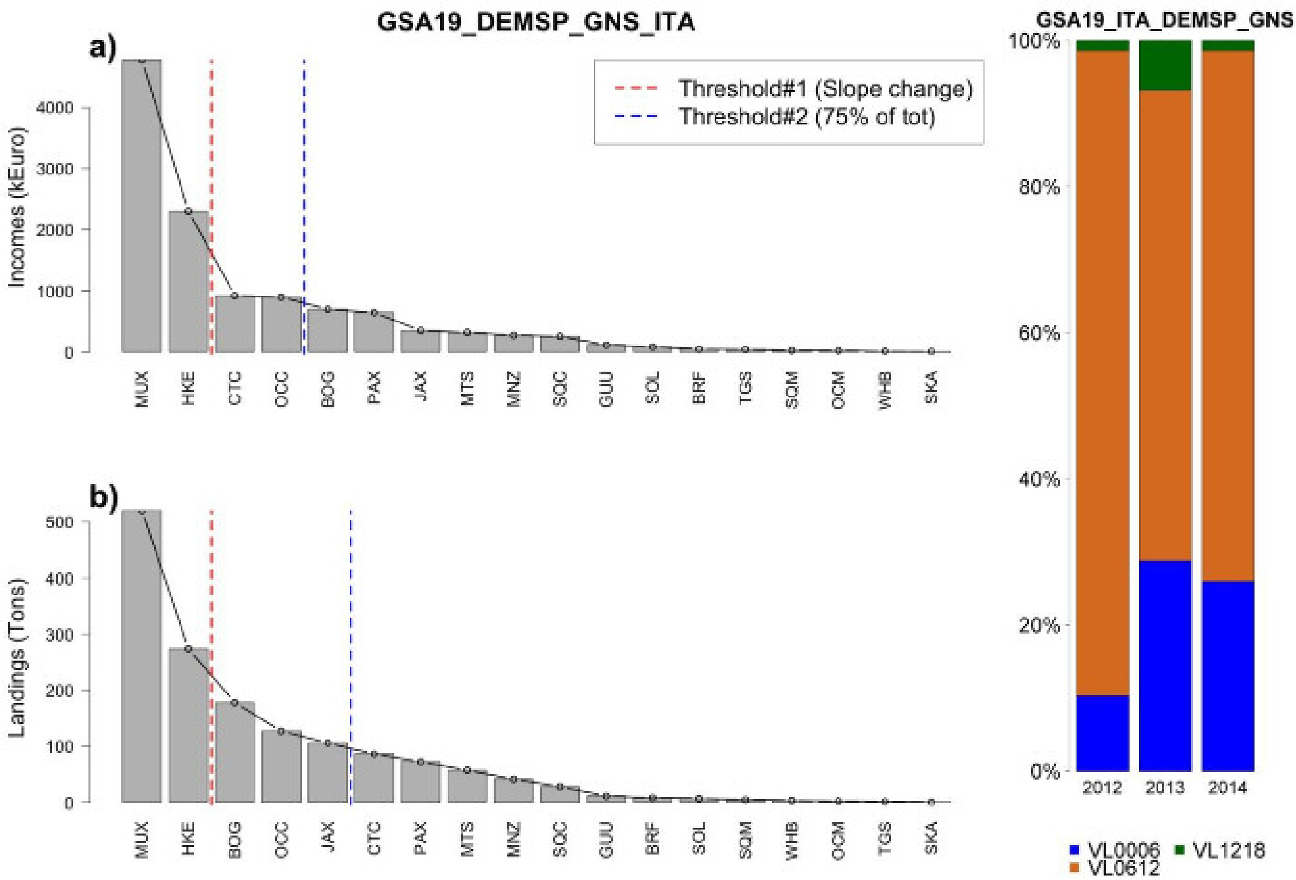


Figure 100. Cumulative percentage for the GSA19_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.17.3. Trammel nets targeting demersal species (DEMSP_GTR)

The species which landing value in percentage is accounting for the part of the cumulative distributions left to the slope change are: *Sepia officinalis* (CTC), *Merluccius merluccius* (HKE), *Octopus vulgaris* (OCC), *Mullus* spp (MUX) and *Pagellus* spp (PAX) (Figure 101). The same species account for 75 % of the cumulative distributions in terms of volume of landings. Among these species those included in the Annex III of the EU Reg. 1967/2006 are: *Merluccius merluccius* (HKE), *Mullus* spp (MUX) and *Pagellus* spp (PAX).

According to the most recent DCF data, in the period 2012-2014, this fleet was composed by the segments VL0006 (15 %), VL0612 (70 %) and VL1218 (15 %), operating on the continental shelf. In the period 2012-2014, this fleet performed, on average, 13,136 GT*days at sea. The subdivision of this fishing effort according to the years and the fleet segments is shown in Figure 101c.

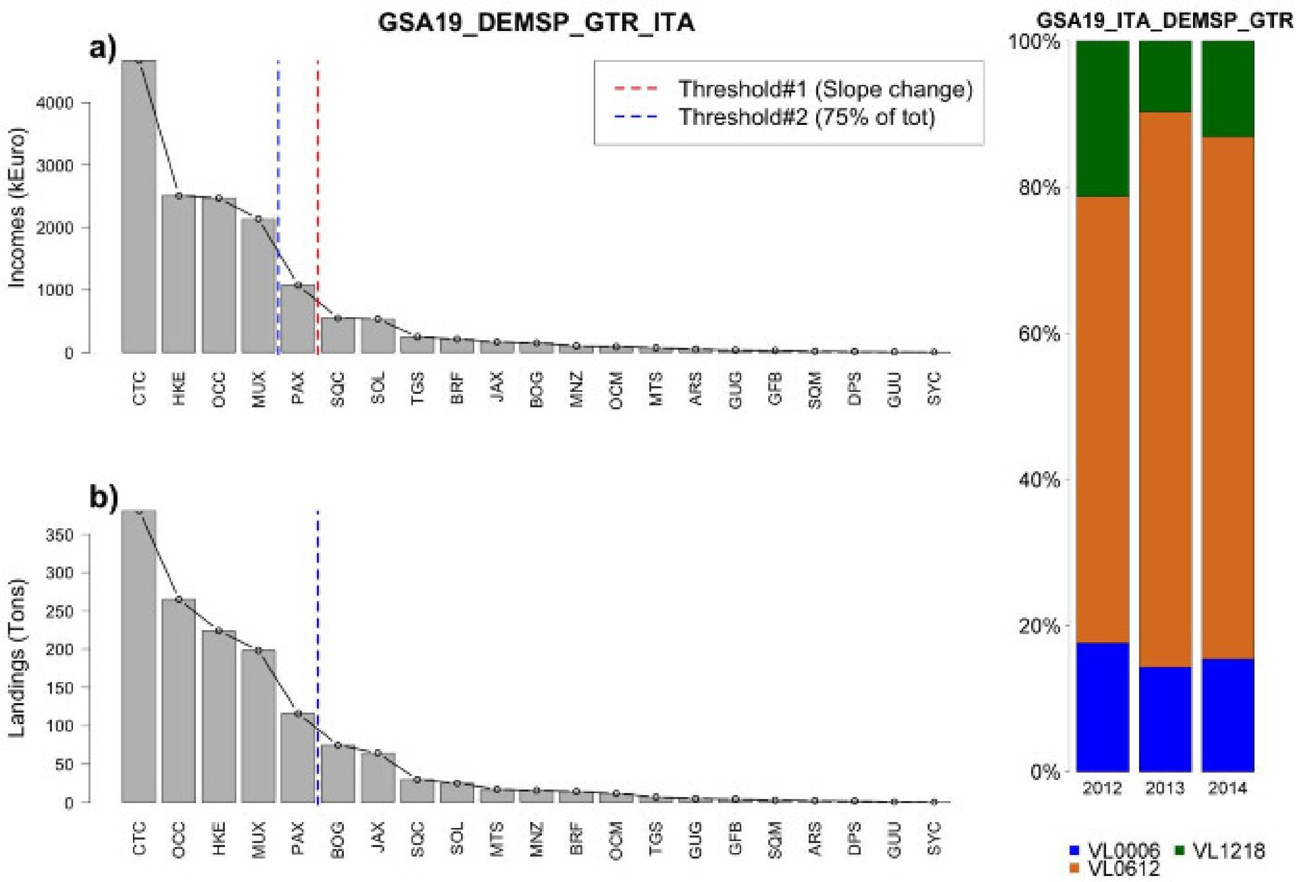


Figure 101. Cumulative percentage for the GSA19_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.17.4. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Species which both landing value and volume in percentage are accounting for 75 % of cumulative distribution are: *Parapenaeus longirostris* (DPS) and *Mullus* spp (MUX) (Figure 102), both included in the Annex III of the EU Reg. 1967/2006. In GSA 19, these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of continental shelf and upper slope.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL1218 (58 %) and VL1824 (40 %). In the same period, this fleet performed, on average, 10,432 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 102c.

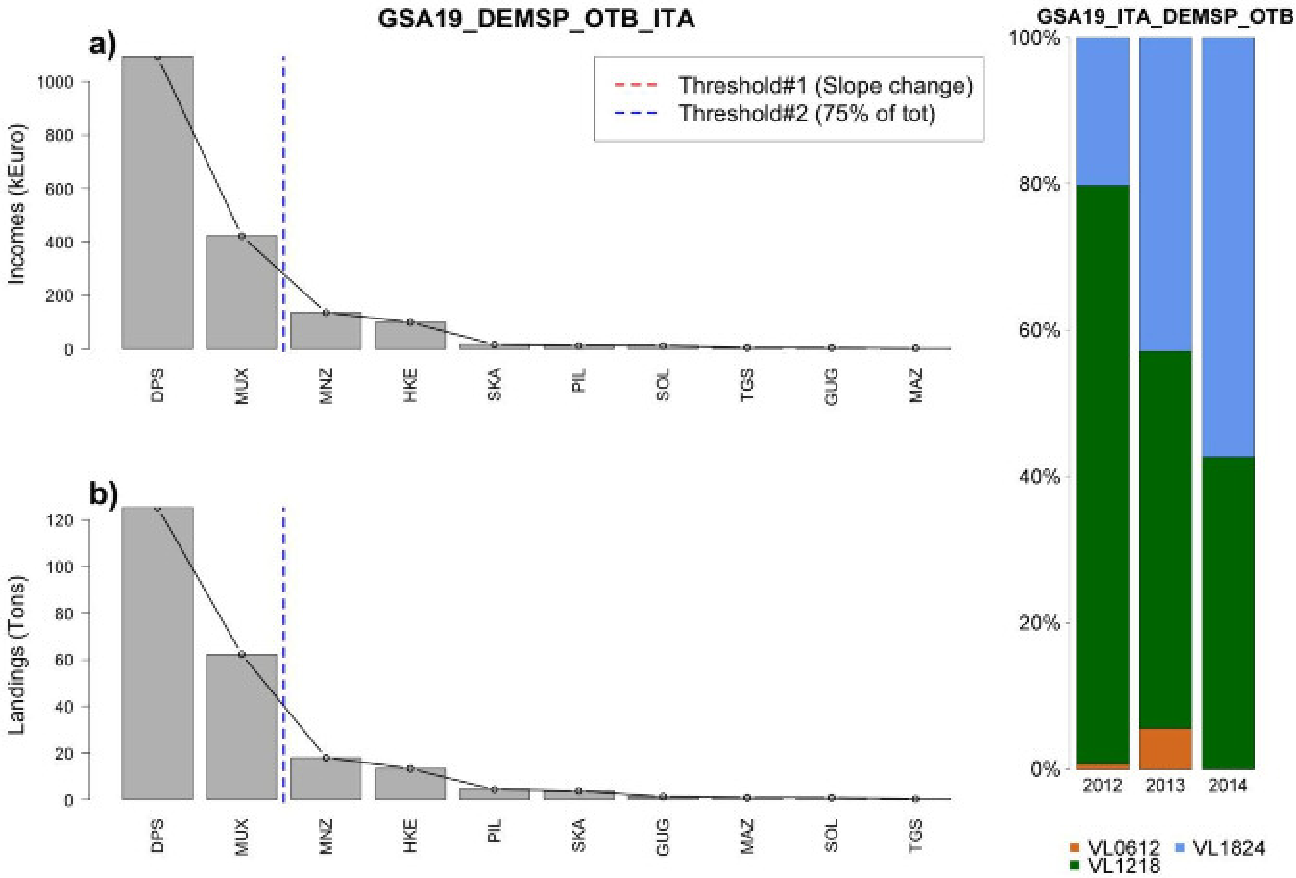


Figure 102. Cumulative percentage for the GSA19_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.17.5. Bottom otter trawl targeting deep water species (DWSP_OTB)

Species which cumulative landing value and volume in percentage are accounting for 75 % are *Aristaeomorpha foliacea* (ARS) and *Aristeus antennatus* (ARA) (Figure 103), which are not included in the Annex III of the EU Reg. 1967/2006. In GSA 19, these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of slope and bathyal bottoms.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segment VL1218 (95 %). In the same period, this fleet performed, on average, 37,142 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 103c.

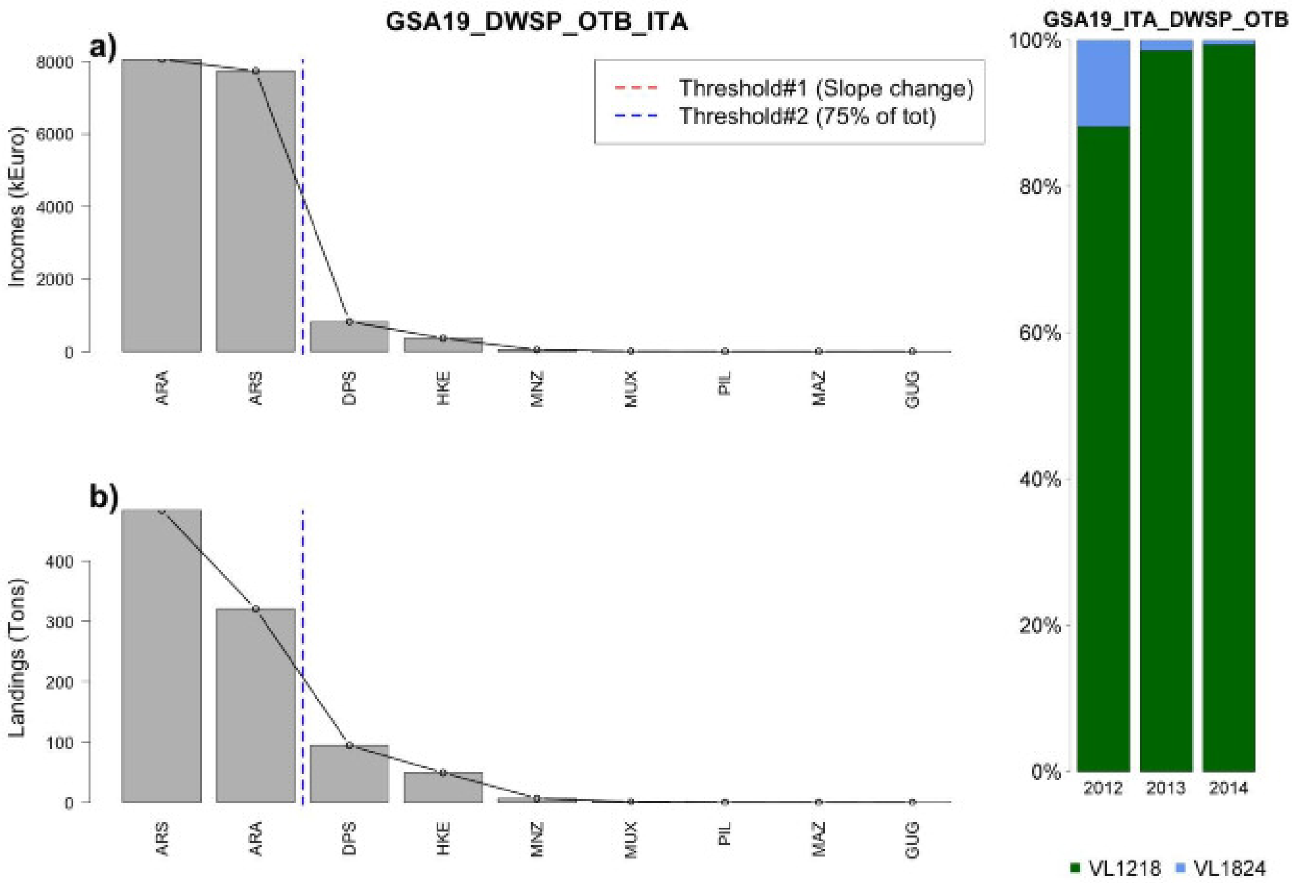


Figure 103. Cumulative percentage for the GSA19_DWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.17.6. Bottom otter trawl targeting mixed demersal and deep water species (MDDWSP_OTB)

Species which landing value in percentage is accounting for the part of the cumulative distribution left to the slope change are: *Aristeus antennatus* (ARA), *Parapenaeus longirostris* (DPS) and *Aristaeomorpha foliacea* (ARS) (Figure 104). Among these species only *Parapenaeus longirostris* (DPS) is included in the Annex III of the EU Reg. 1967/2006. Species which landing volume in percentage is accounting for 75 % of the cumulative distribution are: *Parapenaeus longirostris* (DPS), *Aristaeomorpha foliacea* (ARS), *Aristeus antennatus* (ARA) and *Merluccius merluccius* (HKE). Among these species *Parapenaeus longirostris* (DPS) and *Merluccius merluccius* (HKE) are included in the Annex III of the EU Reg. 1967/2006. For these fisheries the criterion based on landing volume is more suitable, as allows to take into account the species *Merluccius merluccius* that is important in the fisheries assemblage. In GSA 19, these fisheries are performed by the bottom trawl fleets operating on the muddy bottoms of the continental shelf and slope.

According to the most recent DCF data, in the period 2012-2014 this fleet was mostly composed by the segments VL1218 (70 %) and VL1824 (30 %). In the same period, this fleet performed, on average, 50,800 GT*days at sea. The subdivision of this fishing effort, according to the years and the fleet segments is shown in Figure 104c.

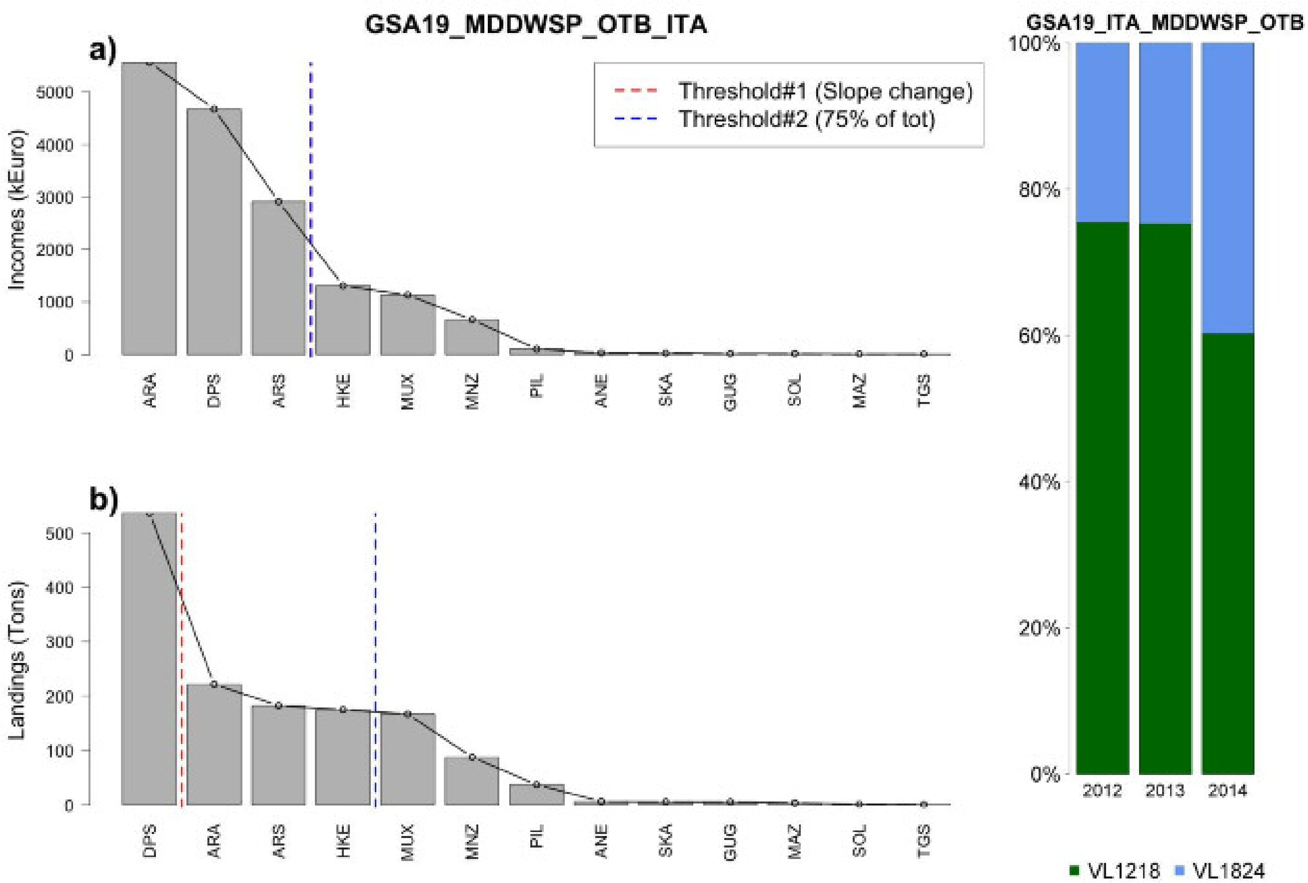


Figure 104. Cumulative percentage for the GSA19_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.18. *Eastern Ionian Sea (GSA 20)*

For year 2013 Greece provided data only for the last quarter, thus we only based catch composition analysis (landings and economic) on 2014 values. While effort data are reported for the two years 2013 and 2014.

2.2.18.1. Set gillnets targeting demersal species (DEMSP_GNS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the European hake, *Merluccius merluccius* (HKE) and the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX) (Figure 105a). All these species are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above and the Jack and horse mackerels, *Trachurus* spp (JAX), account for 75 % of the landed biomass (Figure 105b). These fisheries are performed in GSA 20 by artisanal vessels operating mainly on the continental shelf. In Figure 105c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612 which accounts, on average, for 93 % of the effort.

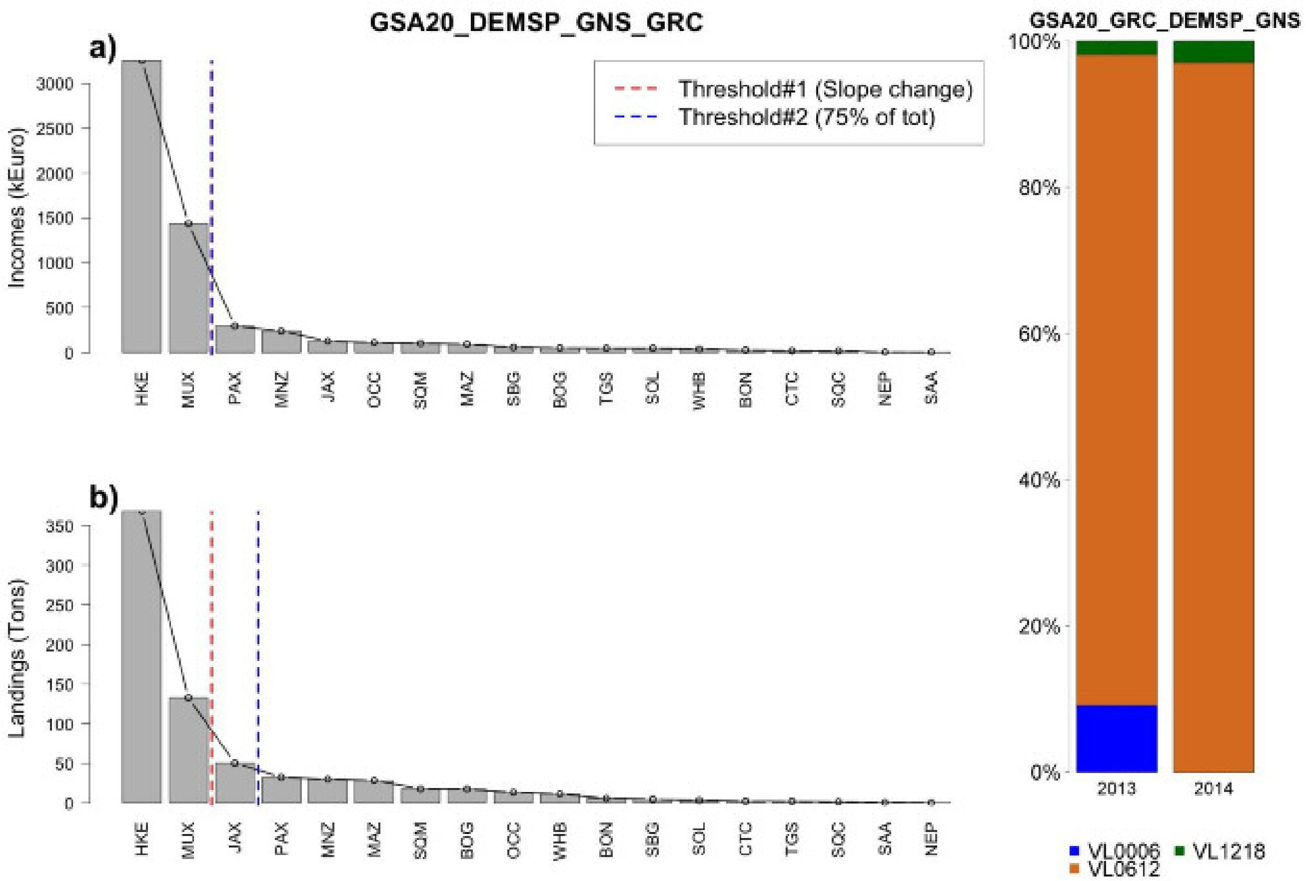


Figure 105. Cumulative percentage for the GSA20_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.18.2. Trammel nets targeting demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the Gilthead seabream, *Sparus aurata* (SBG), the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the Common cuttlefish, *Sepia officinalis* (CTC), the Common octopus, *Octopus vulgaris* (OCC), the Caramote prawn, *Penaeus kerathurus* (TGS) and the Common sole, *Solea Solea* (SOL), (Figure 106a). *Sparus aurata*, *Mullus barbatus, M. surmuletus* and *Solea Solea* are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above except the Caramote prawn but additionally including the European hake and the Pandoras, *Pagellus* spp (PAX) account for 75 % of the landed biomass (Figure 106b). These fisheries are performed in GSA 20 by artisanal vessels operating mainly on the continental shelf. In Figure 106c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612 which accounts, on average, for 84 % of the effort.

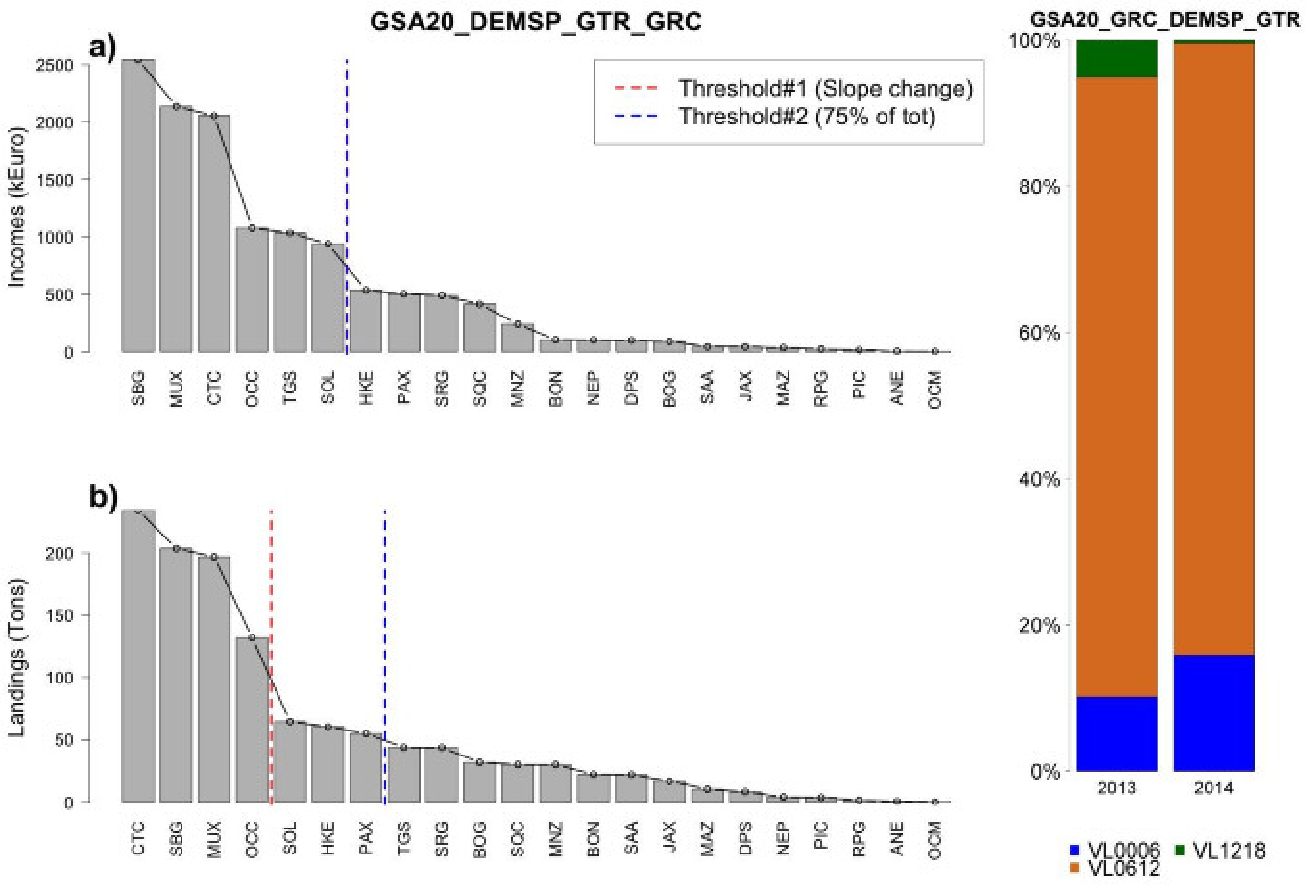


Figure 106. Cumulative percentage for the GSA20_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.18.3. Set longlines targeting demersal species (DEMSP_LLS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the Gilthead seabream, *Sparus aurata* (SBG), the European hake, *Merluccius merluccius* (HKE) and the Jack and horse mackerels, *Trachurus* spp (JAX) (Figure 107a). These species are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above account for 75 % of the landed biomass (Figure 107b). These fisheries are performed in GSA 20 by artisanal vessels operating mainly on the continental shelf. In Figure 107c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612 which accounts, on average, for 85 % of the effort.

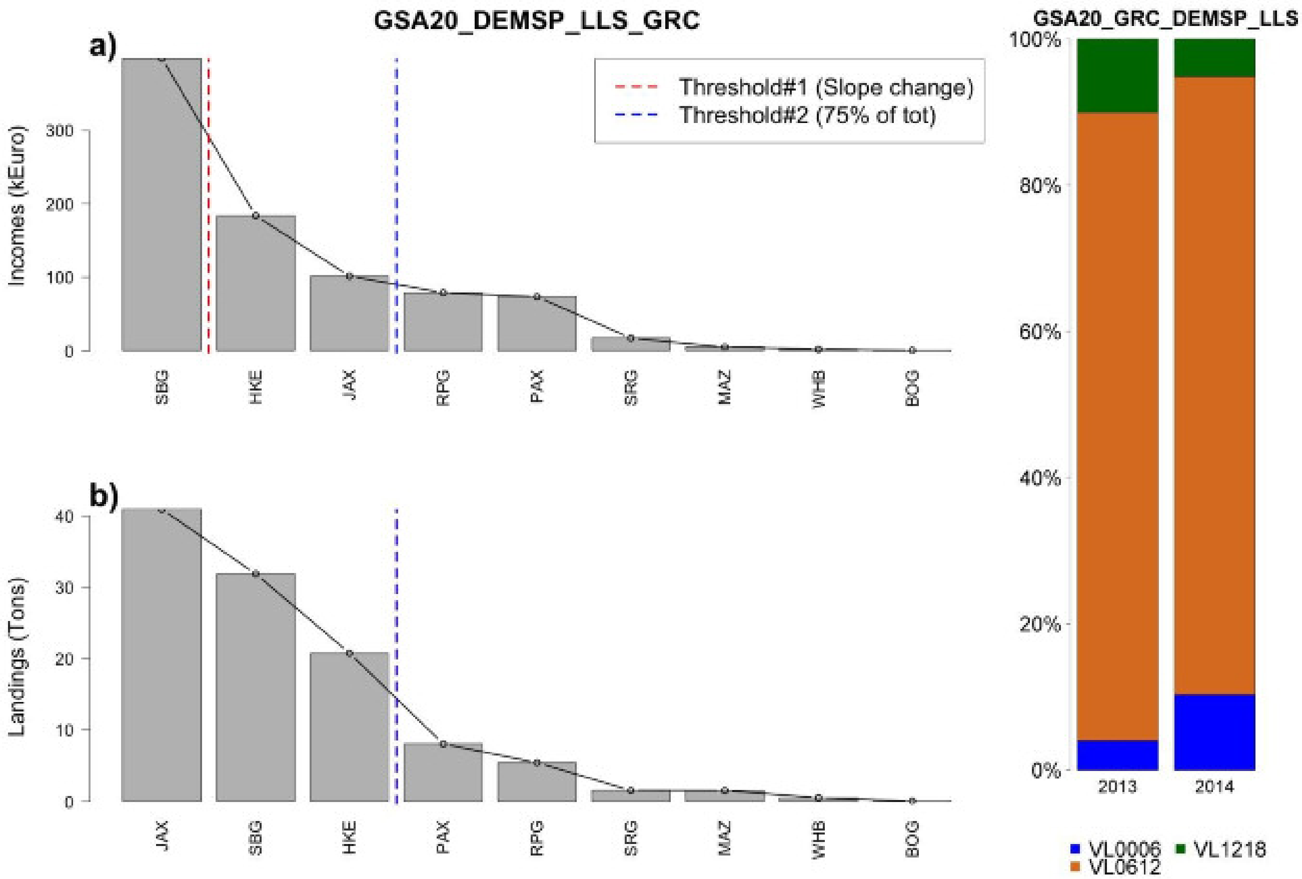


Figure 107. Cumulative percentage for the GSA20_DEMSP_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.18.4. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the Caramote prawn, *Penaeus kerathurus* (TGS), the European hake, *Merluccius merluccius* (HKE), the Common squids, *Loligo* spp (SQC), the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX) and the Gilthead seabream, *Sparus aurata* (SBG) (Figure 108a). These species, except *Penaeus kerathurus* and *Loligo* spp are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above and additionally the Common cuttlefish, *Sepia officinalis* (CTC) and the Pandoras, *Pagellus* spp (PAX) account for 75 % of the landed biomass (Figure 108b). These fisheries are performed in GSA 20 by the bottom trawl fleets operating on the muddy bottoms of continental shelf and slope. In 2014, this fleet performed 572,591 GT*days at sea. In Figure 108c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL2440 which accounts, on average, for 63 % of the effort.

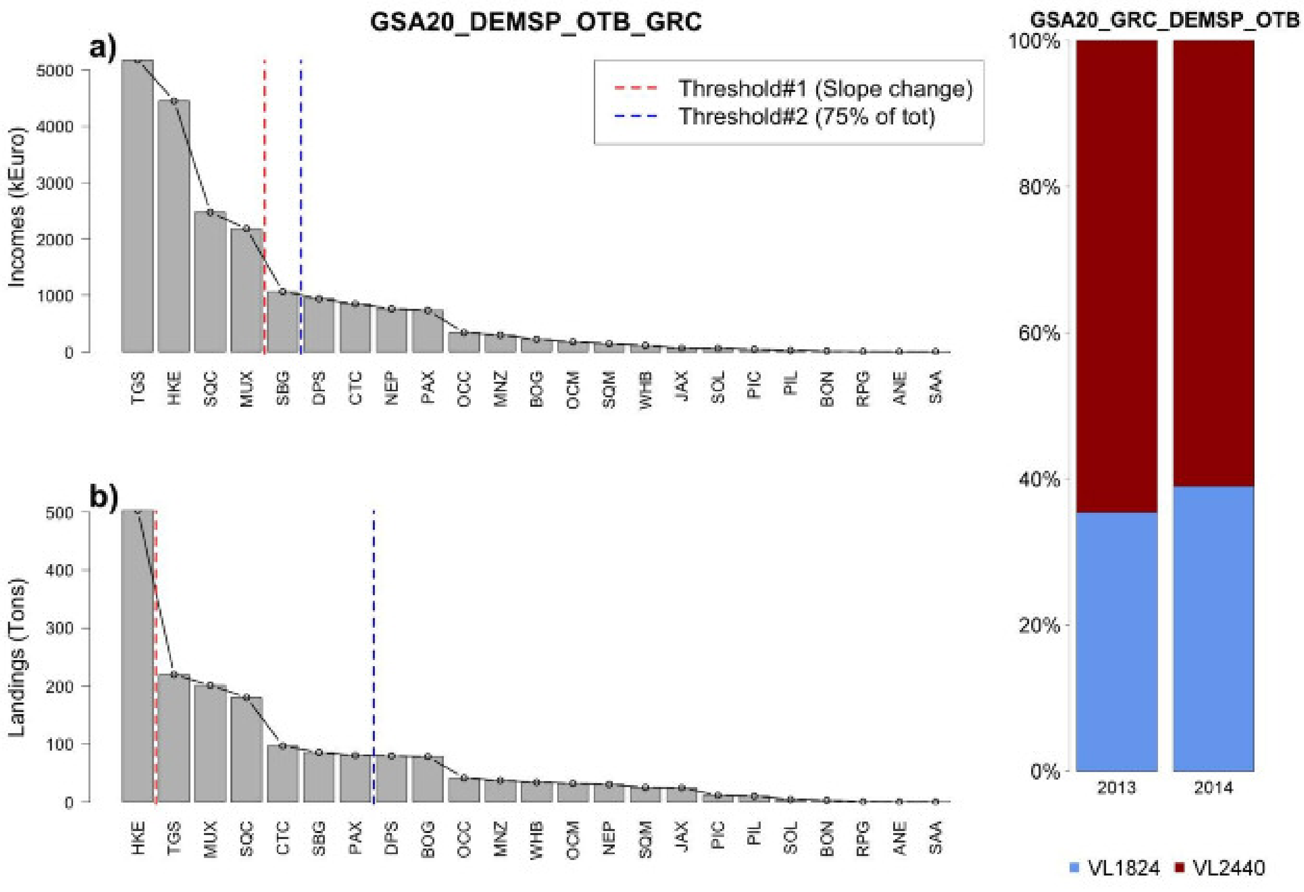


Figure 108. Cumulative percentage for the GSA20_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.19. *Aegean Sea (GSA 22)*

2.2.19.1. Pots and traps targeting demersal species (DEMSP_FPO)

Only one species, the Common octopus, *Octopus vulgaris* (OCC) accounts for more than 75 % in terms of value of landings (Figure 109a) and landed biomass (Figure 109b). This species is not included in the Annex III of the EU Reg. 1967/2006. These fisheries are performed in GSA 22 by artisanal vessels operating mainly on the continental shelf. In Figure 109c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612 which accounts, on average, for 95 % of the effort.

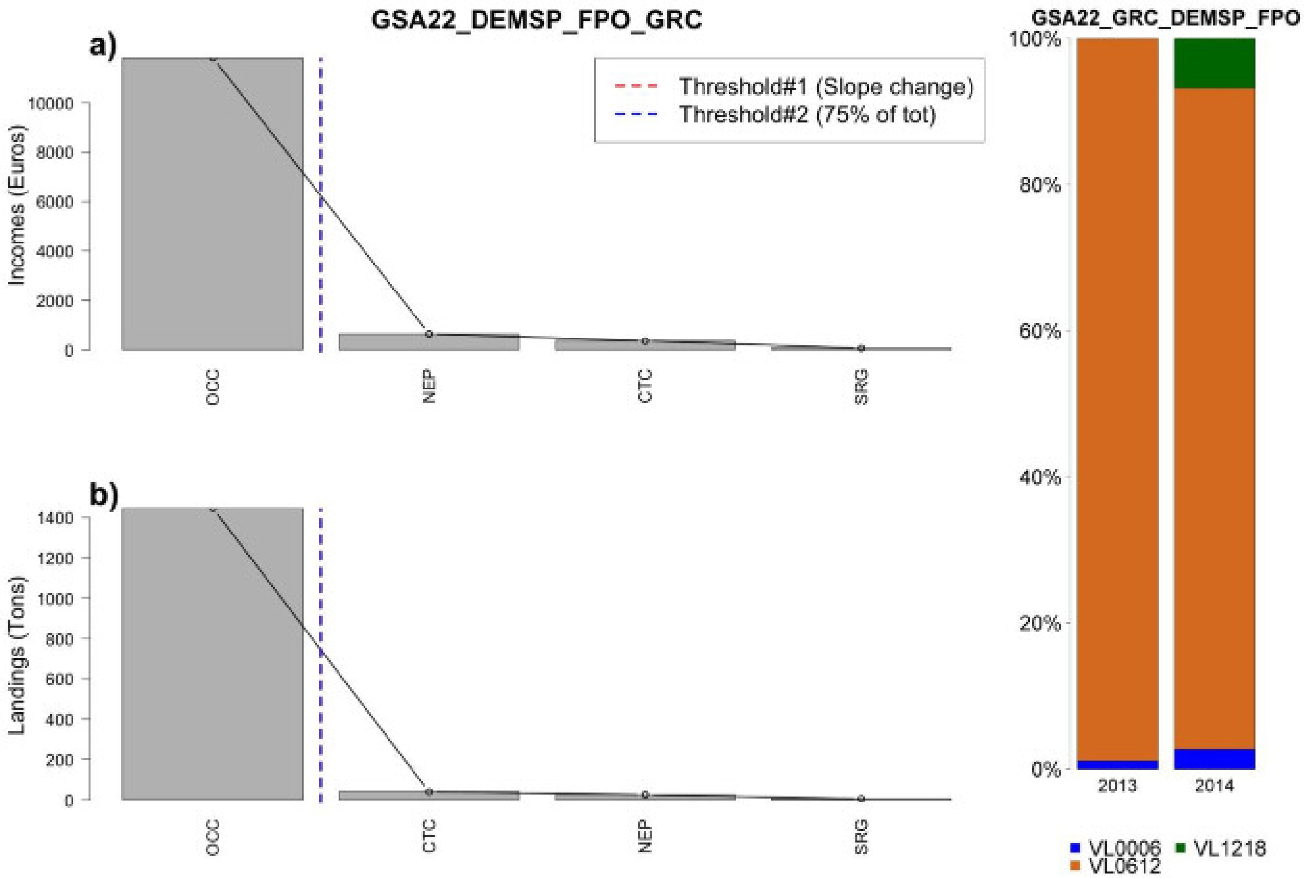


Figure 109. Cumulative percentage for the GSA22_DEMSP_FPO, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.19.2. Set gillnets targeting demersal species (DEMSP_GNS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the European hake, *Merluccius merluccius* (HKE), the Norway lobster, *Nephrops norvegicus* (NEP), the Sardine, *Sardina pilchardus* (PIL), the Mackerels, *Scomber* spp (MAZ) and the Monkfishes, *Lophius* spp (MNZ) (Figure 110a). These species, except *Lophius* spp, are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above with the exception of the Norway lobster, Monkfishes and Bogue, *Boops Boops* (BOG) and the Jack and horse mackerels, *Trachurus* spp (JAX) account for higher fraction of the landed biomass (Figure 110b). These fisheries are performed in GSA 22 by artisanal vessels operating mainly on the continental shelf. In Figure 110c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612 which accounts, on average, for 89 % of the effort.

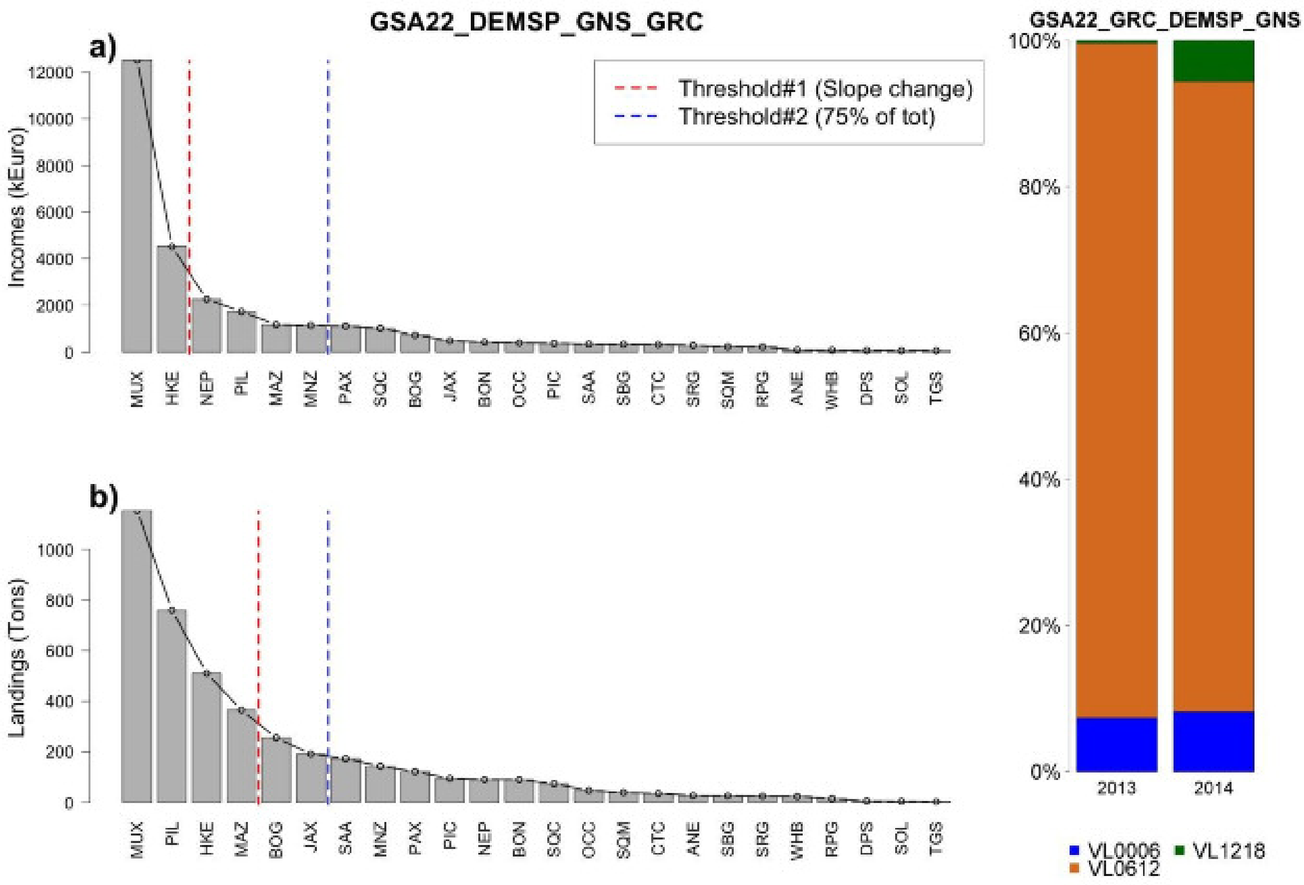


Figure 110. Cumulative percentage for the GSA22_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.19.3. Trammel nets targeting demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the Common cuttlefish, *Sepia officinalis* (CTC), the Caramote prawn*, Penaeus kerathurus* (TGS), the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the Common sole, *Solea Solea* (SOL), the Pandoras, *Pagellus* spp (PAX) and the Gilthead seabream, *Sparus aurata* (SBG) (Figure 111a). These species, except *Sepia officinalis, Penaeus kerathurus* and *Octopus vulgaris* are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above additionally including the Common octopus, *Octopus vulgaris* (OCC) account for 75 % of the landed biomass (Figure 111b). These fisheries are performed in GSA 22 by artisanal vessels operating mainly on the continental shelf. In Figure 111c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612 which accounts, on average, for 87 % of the effort.

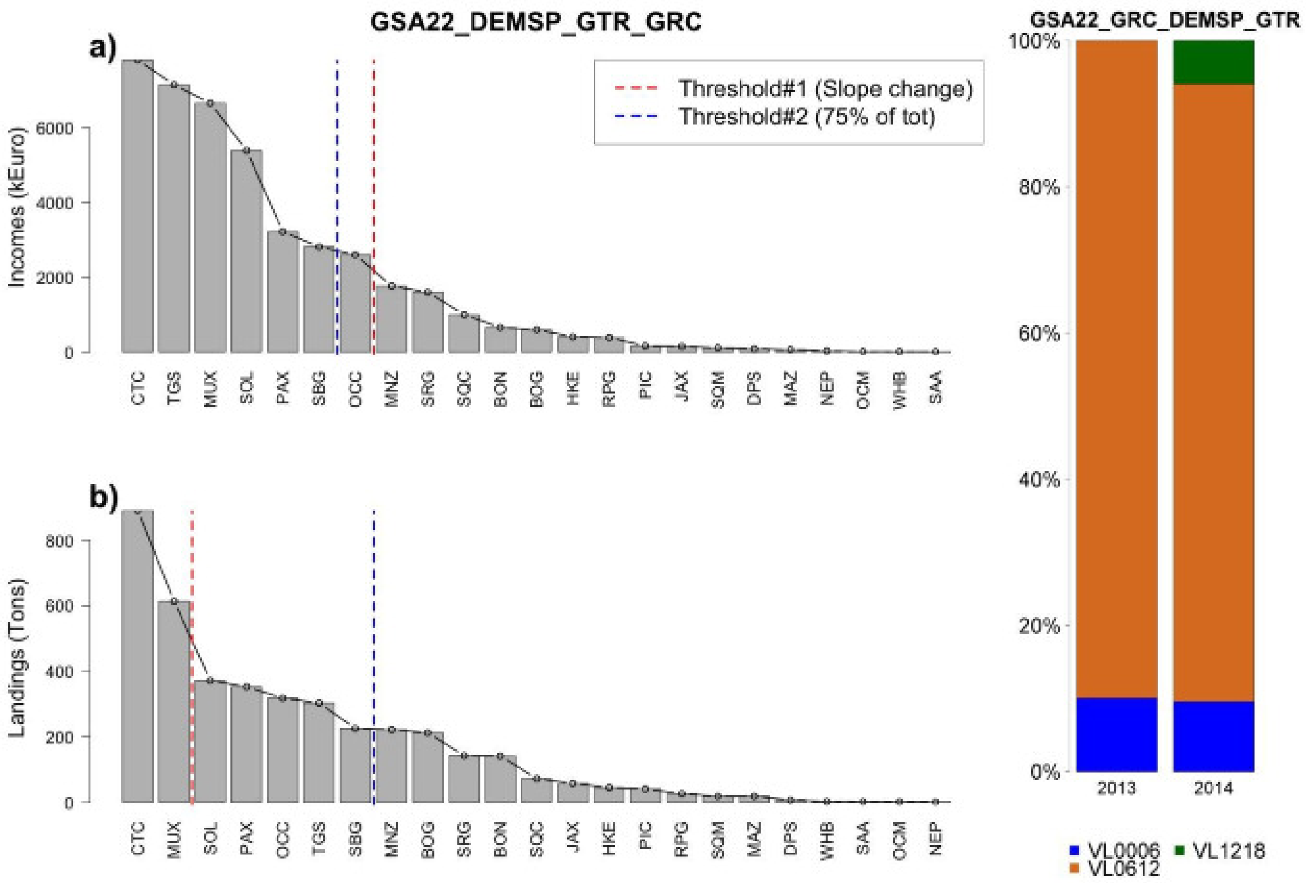


Figure 111. Cumulative percentage for the GSA22_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.19.4. Set longlines targeting demersal species (DEMSP_LLS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the Gilthead seabream, *Sparus aurata* (SBG), the Red porgy, *Pagrus pagrus* (RPG), the Sargo breams, *Diplodus* spp (SRG) and the Pandoras, *Pagellus* spp (PAX) (Figure 112a). All these species are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above and Hake, *Merluccius merluccius* (HKE) account for 75 % of the landed biomass (Figure 112b). These fisheries are performed in GSA 22 by artisanal vessels operating mainly on the continental shelf. In Figure 112c the subdivision of this fishing effort, according the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612 which accounts, on average, for 71 % of the effort.

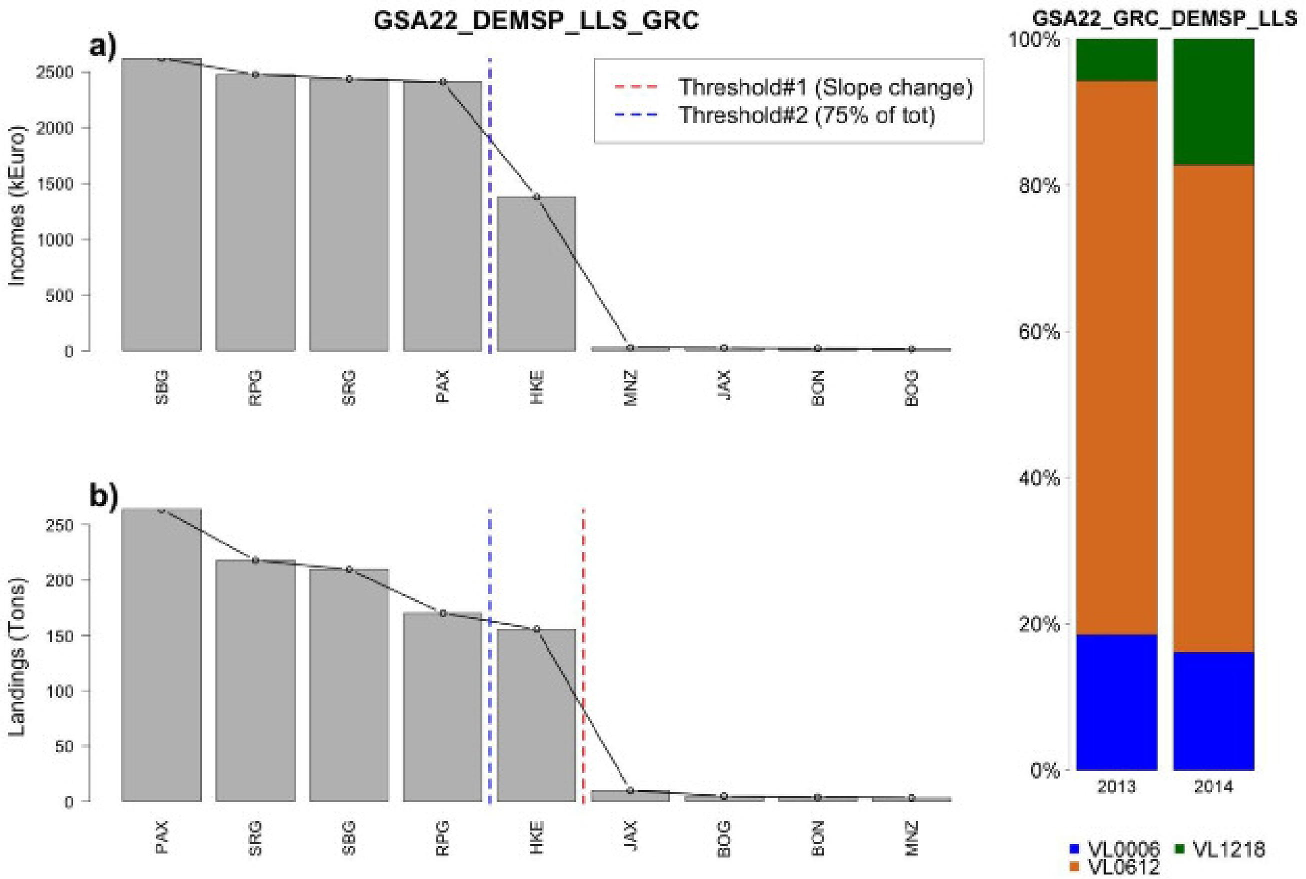


Figure 112. Cumulative percentage for the GSA22_DEMSP_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.19.5. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the Deep water rose shrimp, *Parapenaeus longirostris* (DPS), the European hake, *Merluccius merluccius* (HKE), the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the Caramote prawn, *Penaeus kerathurus* (TGS) and the Common octopus, *Octopus vulgaris* (OCC) (Figure 113a). These species, except *Penaeus kerathurus* and *Octopus vulgaris*, are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above excluding *Penaeus kerathurus* but additionally including the Broadtail squid, *Illex coindetii* (SQM) and Anchovy, *Engraulis encrasicolus* (ANE), account for 75 % of the landed biomass (Figure 113b). These fisheries are performed in GSA 22 by the bottom trawl fleets operating on the muddy bottoms of continental shelf and slope. In 2014, this fleet performed 4,200,152 GT*days at sea. In Figure 113c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL2440 which accounts, on average, for 84 % of the effort.

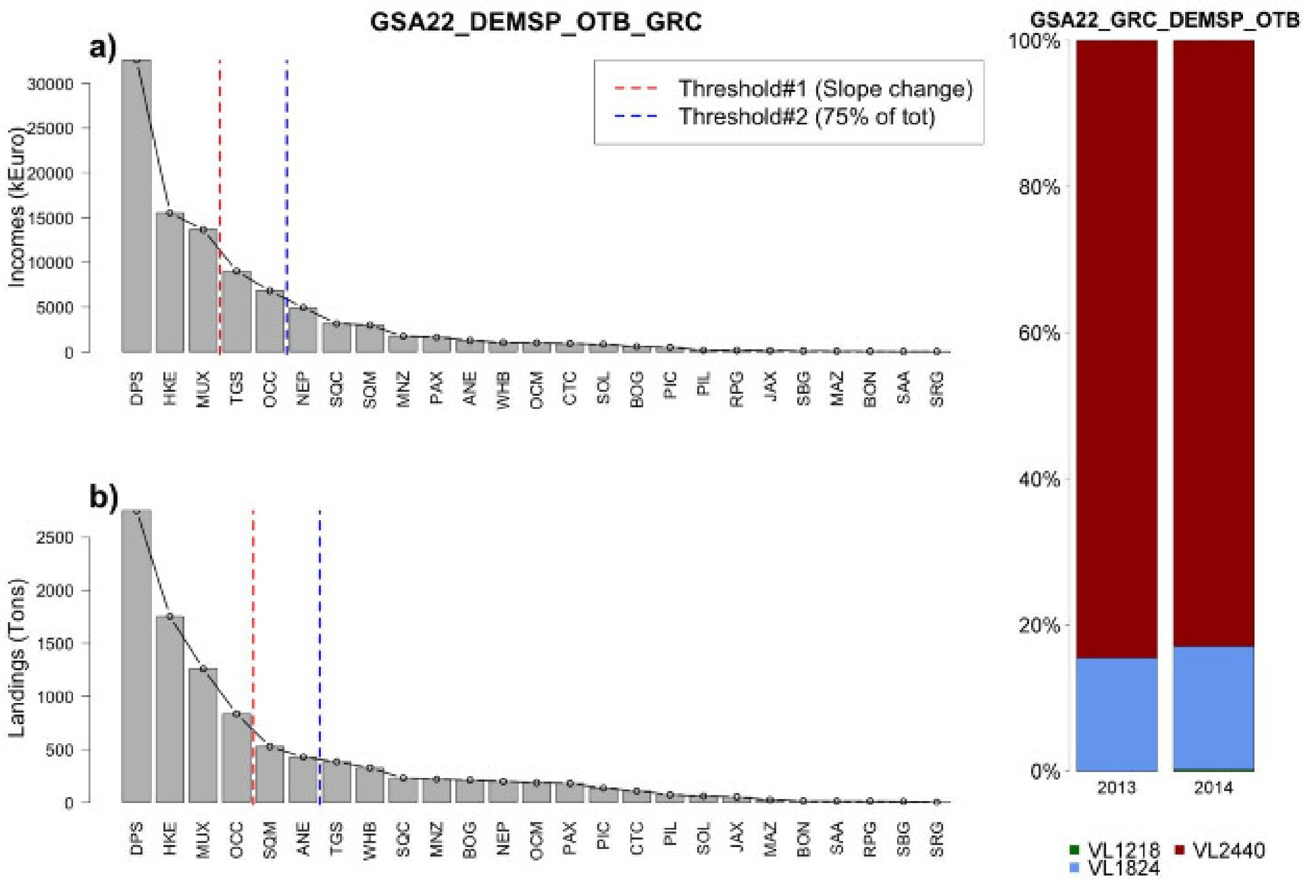


Figure 113. Cumulative percentage for the GSA22_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.20. Crete Island (GSA 23)

2.2.20.1. Set gillnets targeting demersal species (DEMSP_GNS)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the Pandoras, *Pagellus* spp (PAX) and the Round sardinella, *Sardinella aurita* (SAA) (Figure 114a). These species, except *Sardinella aurita*, are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, only the Round sardinella and the Pandoras account for more than 75 % of the landed biomass (Figure 114b). These fisheries are performed in GSA 23 by artisanal vessels operating mainly on the continental shelf. In Figure 114c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment, in terms of fishing effort is VL0612, which accounts, on average, for 75 % of the effort.

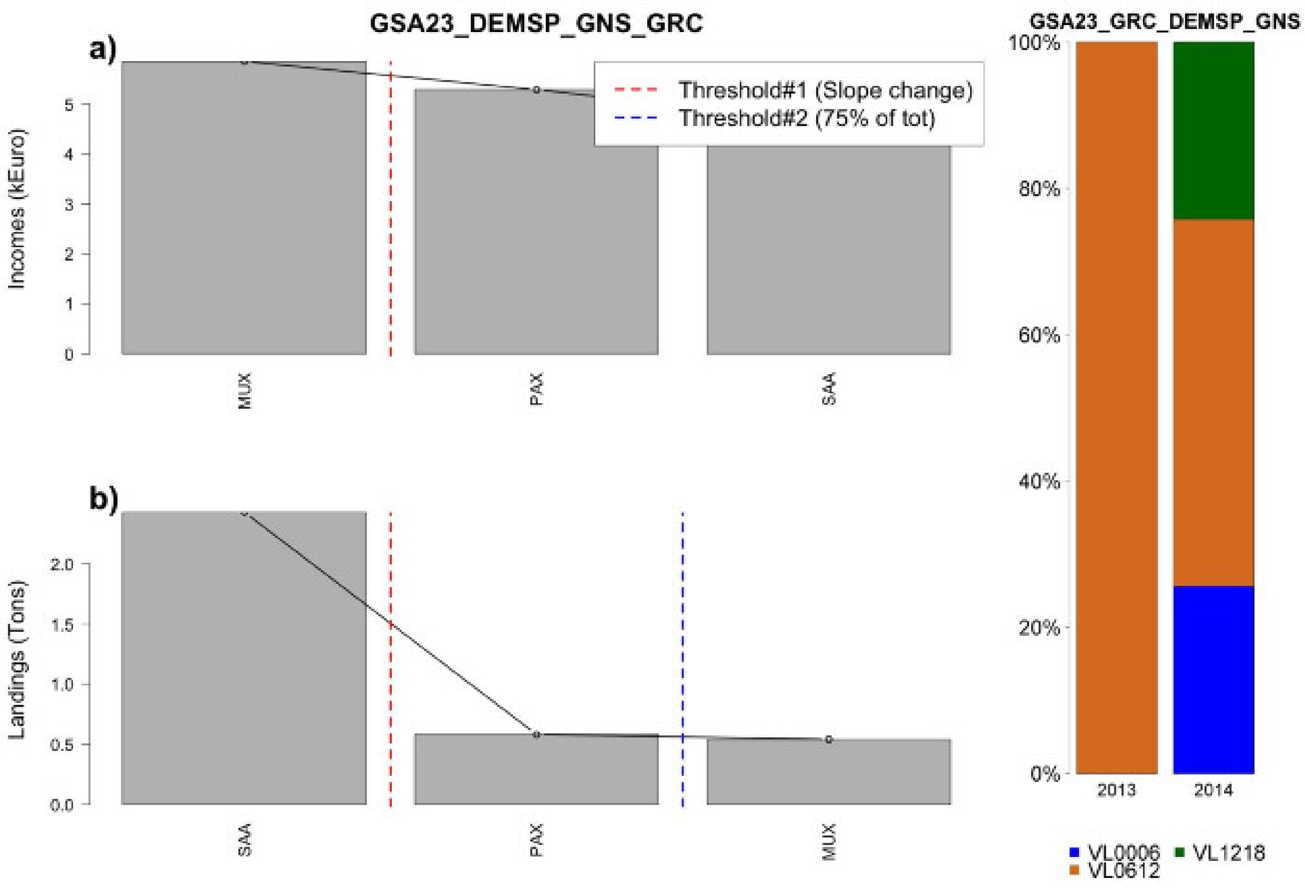


Figure 114. Cumulative percentage for the GSA23_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.20.2. Trammel nets targeting demersal species (DEMSP_GTR)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the Common cuttlefish, *Sepia officinalis* (CTC), the Pandoras, *Pagellus* spp (PAX) and the Bogue, *Boops Boops* (BOG) (Figure 115a). The red mullets and the Pandoras are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above account 75 % of the landed biomass (Figure 115b). These fisheries are performed in GSA 23 by artisanal vessels operating mainly on the continental shelf. In Figure 115c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612, which accounts, on average, for 90 % of the effort.

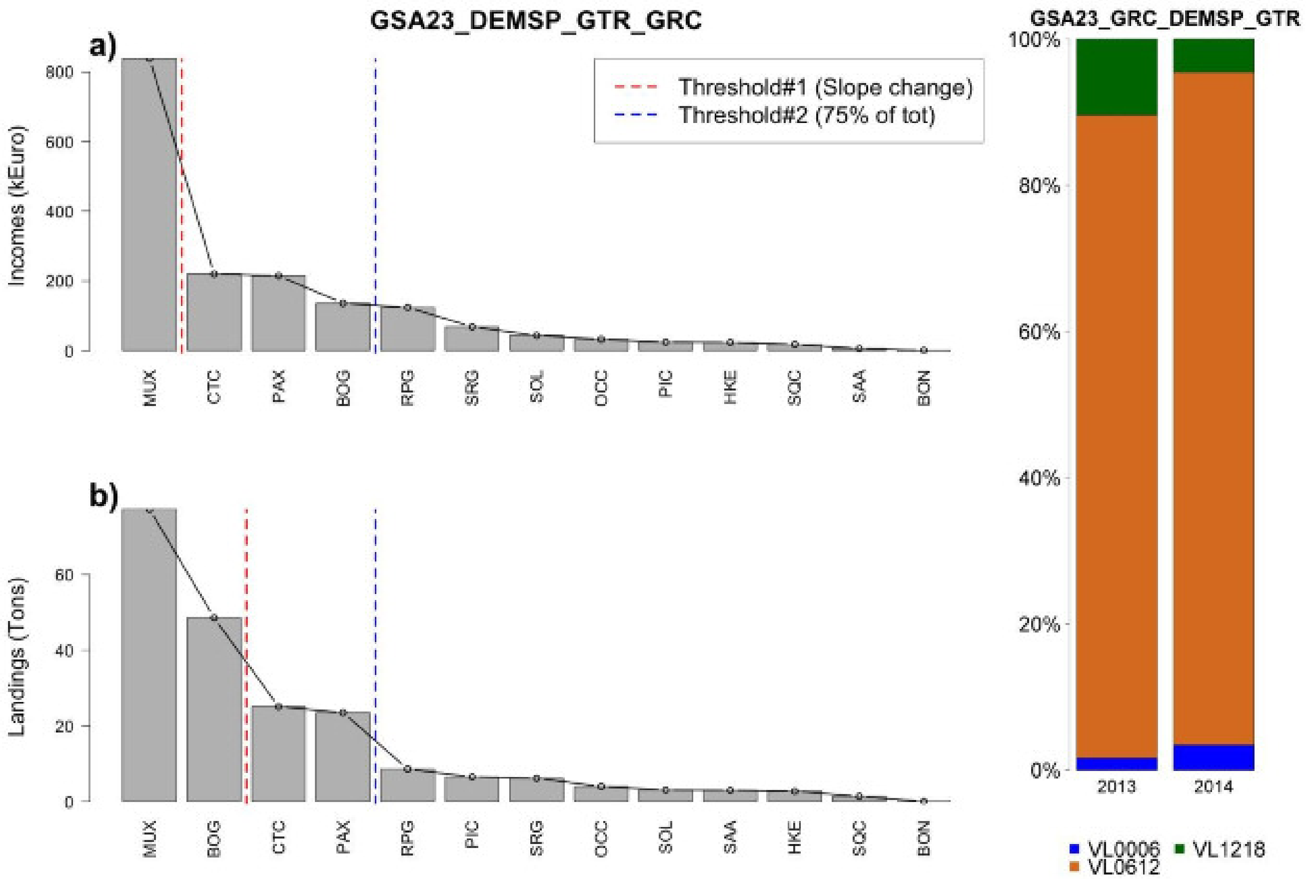


Figure 115. Cumulative percentage for the GSA23_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.20.3. Set longlines targeting demersal species (DEMSP_LLS)

The Red porgy, *Pagrus pagrus* (RPG) alone accounts for 75 % in terms of value of landings (Figure 116a) and is included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the Red porgy and the Sargo breams, *Diplodus* spp (SRG) account for more than 75 % of the landed biomass (Figure 116b). These fisheries are performed in GSA 23 by artisanal vessels operating mainly on the continental shelf. In Figure 116c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL0612, which accounts, on average, for 76 % of the effort.

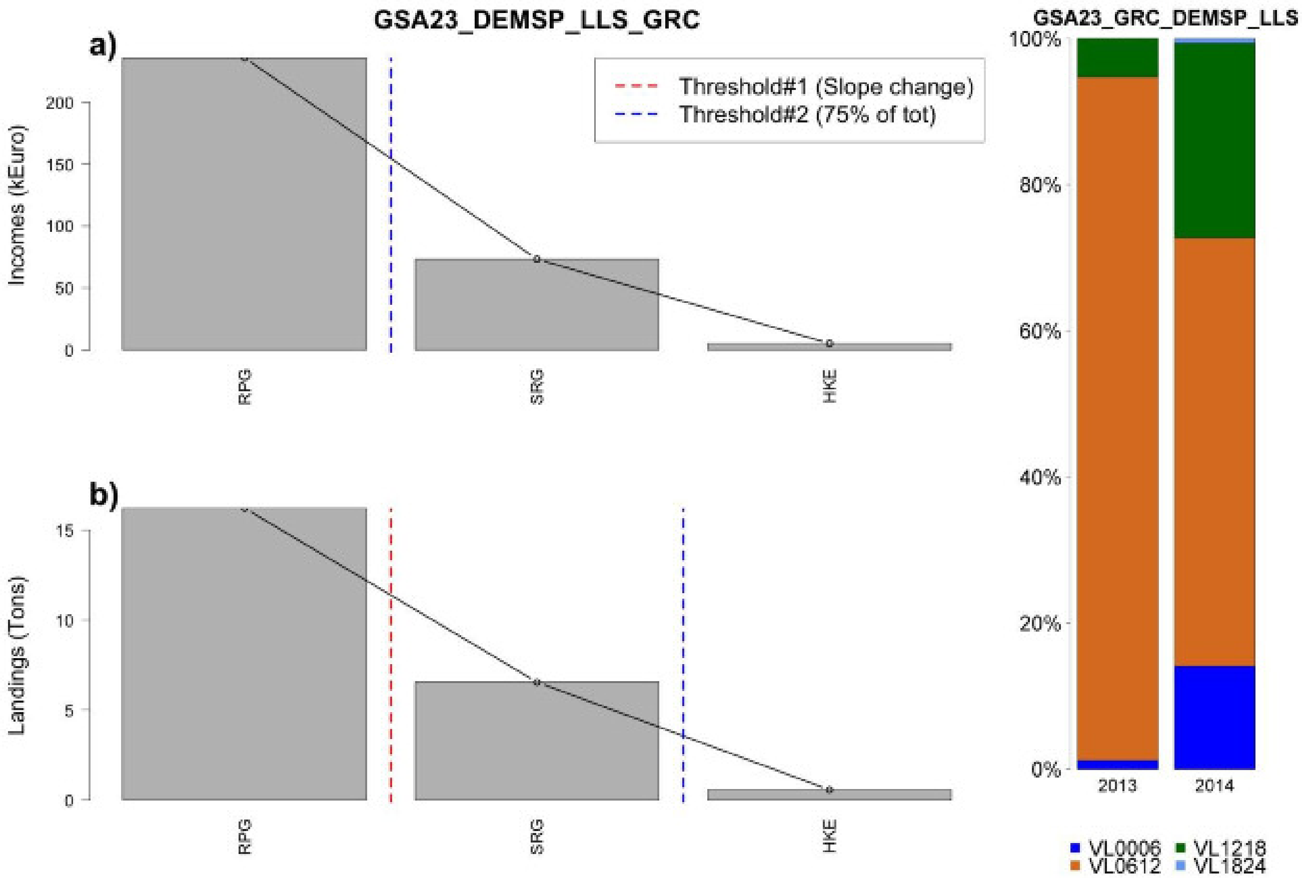


Figure 116. Cumulative percentage for the GSA23_DEMSP_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.20.4. Bottom otter trawl targeting demersal species (DEMSP_OTB)

The species which cumulative percentage in terms of value of landings accounts for 75 % are the red mullets, *Mullus barbatus* and *M. surmuletus* (MUX), the European hake, *Merluccius merluccius* (HKE), the deep water pink shrimp, *Parapenaeus longirostris* (DPS), the Picarels, *Spicara* spp (PIC) and the Common squids, *Loligo* spp (SQC) (Figure 117a). *Mullus barbatus, M. surmuletus*, *Merluccius merluccius* and *Parapenaeus longirostris* are included in the Annex III of the EU Reg. 1967/2006. In terms of volume of landings, the same species mentioned above but with the Bogue, *Boops Boops* (BOG), instead of *Loligo* spp account for 75 % of the landed biomass (Figure 117b). These fisheries are performed in GSA 23 by the bottom trawl fleets operating on the muddy bottoms of continental shelf and slope. In 2014, this fleet performed 177,264 GT*days at sea. In Figure 117c the subdivision of this fishing effort, according to the fleet segments is shown. The most important fleet segment in terms of fishing effort is VL2440, which accounts, on average, for 90 % of the effort.

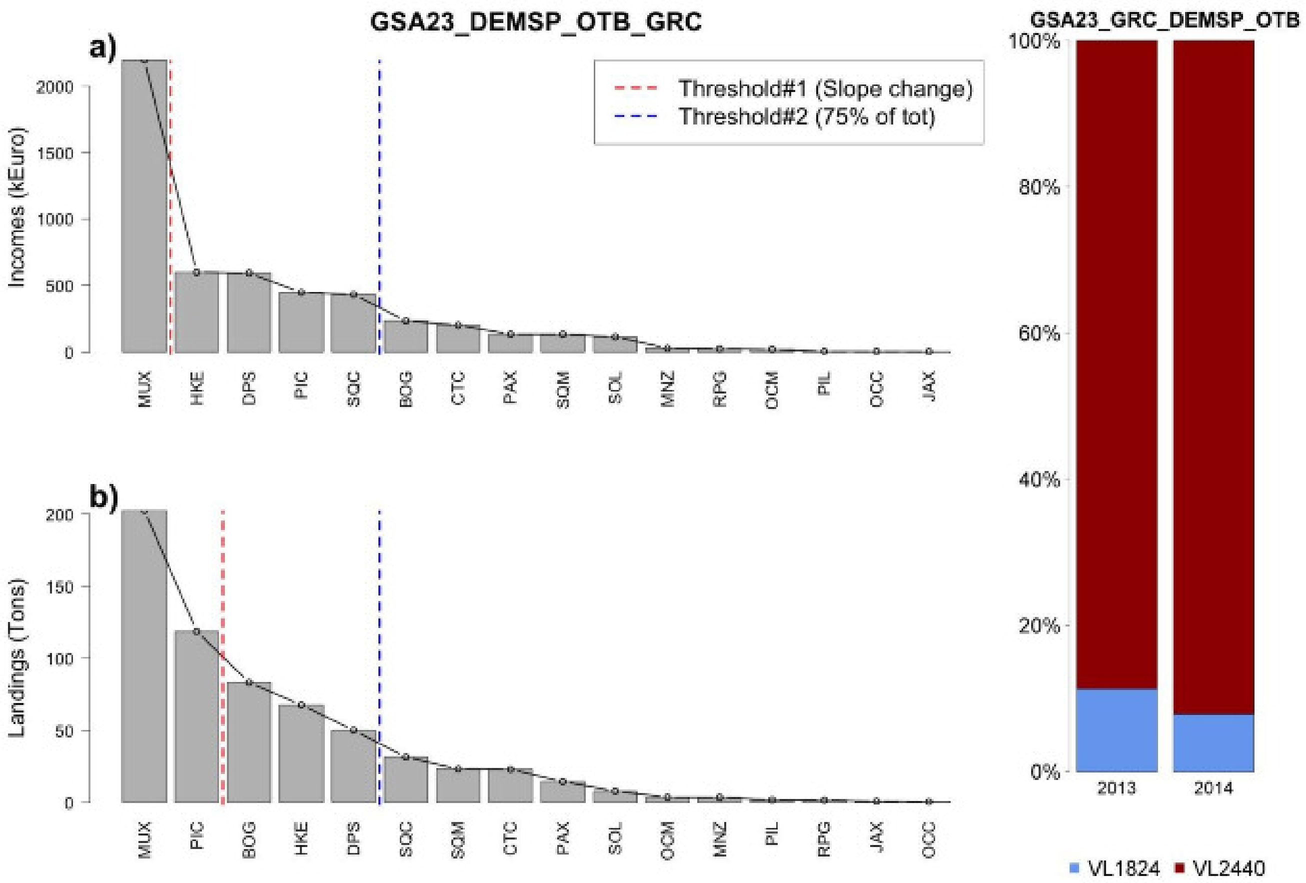


Figure 117. Cumulative percentage for the GSA23_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the year 2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.21. Cyprus Island (GSA 25)

2.2.21.1. Set longline targeting demersal species (DEMF_LLS)

Pagrus pagrus is the most important target species of the set longline fleet operating in GSA 25 in coastal areas both in terms of landing values and landing in weight (Figure 118a and Figure 118b). The species is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 11,301 GT*fishing day. The 100 % of the effort was exerted by 0-12 m LOA vessels (Figure 118c).

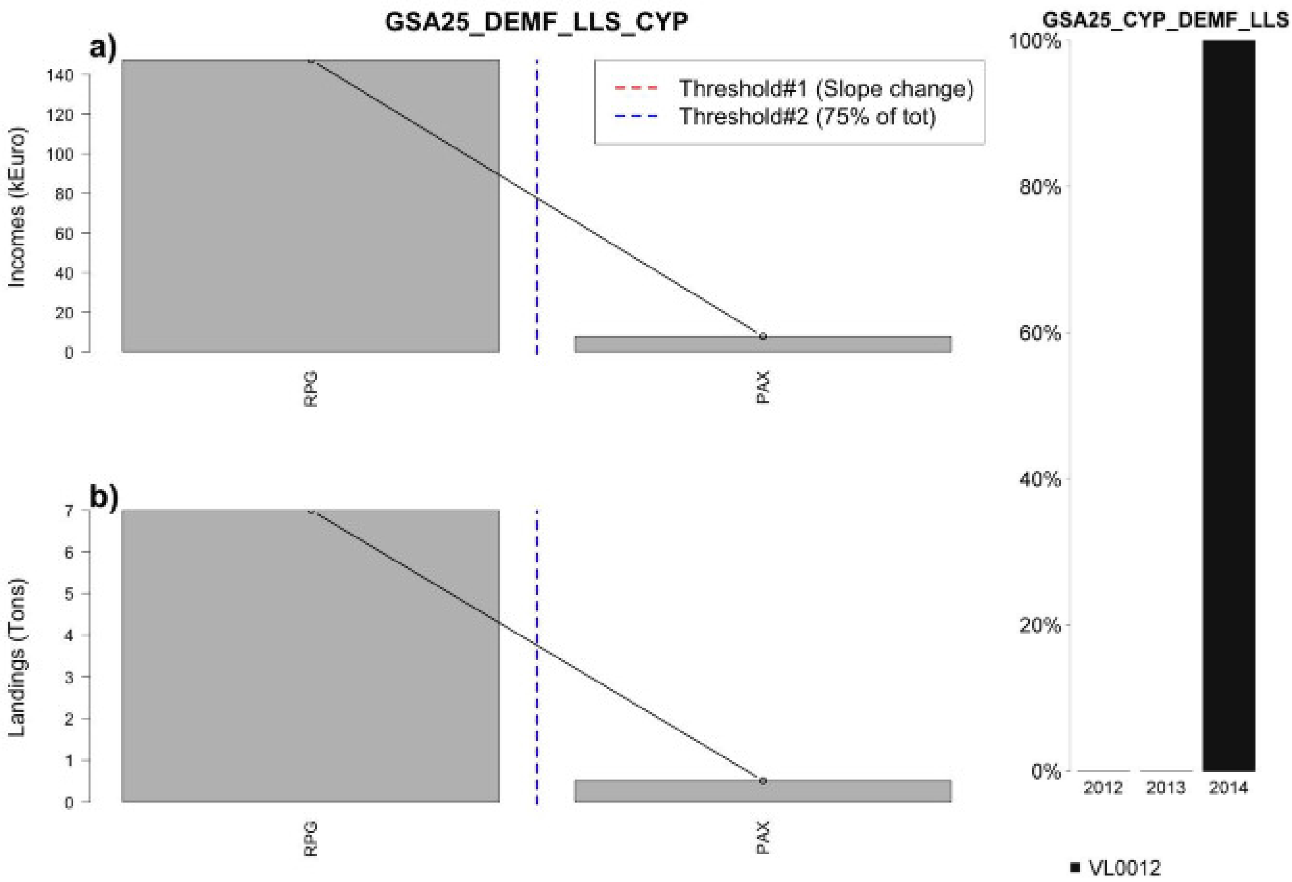


Figure 118. Cumulative percentage for the GSA25_DEMF_LLS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.21.2. Set gillnet targeting demersal species (DEMSP_GNS)

Boops Boops is the most important target species of the set gillnet fleet operating in GSA 25 in coastal areas both in terms of landing values and landing in weight (Figure 119a and Figure 119b). The species is included in not the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 59,613 GT*fishing day. The 100 % of the effort was exerted by 0-12 m LOA vessels (Figure 119c).

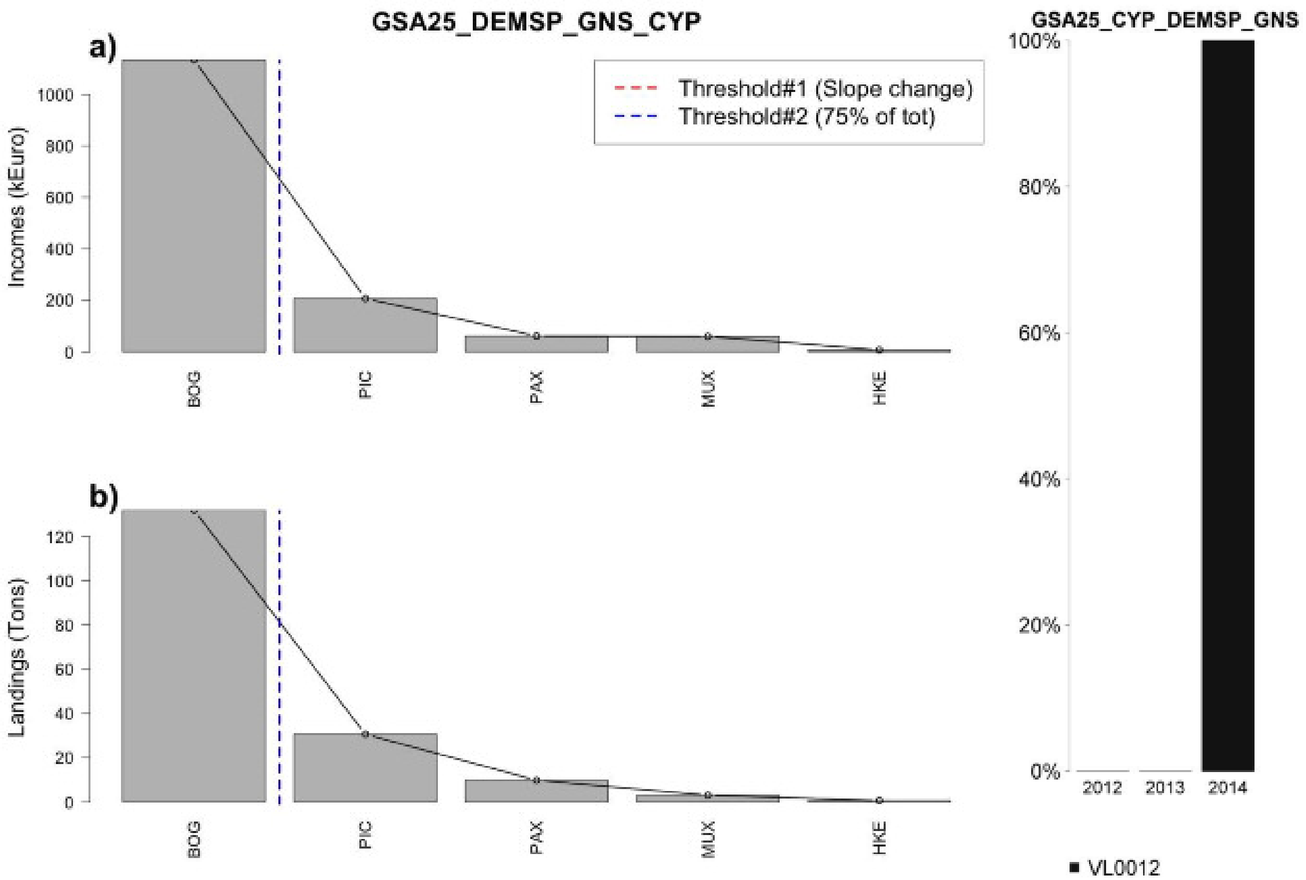


Figure 119. Cumulative percentage for the GSA25_DEMSP_GNS, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.21.3. Trammel net targeting demersal species (DEMSP_GTR)

Mullus barbatus and *Boops Boops* are the most important target species of the trammel net fleet operating in GSA 25 in coastal areas waters, both in terms of landing in values and landing in weights, in particular also *Spicara smaris* is important in landing in weights (Figure 120a and Figure 120b). Only red mullet is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 131,027 GT*fishing day. The 100 % of the effort was exerted by 0-12 m LOA vessels (Figure 120c).

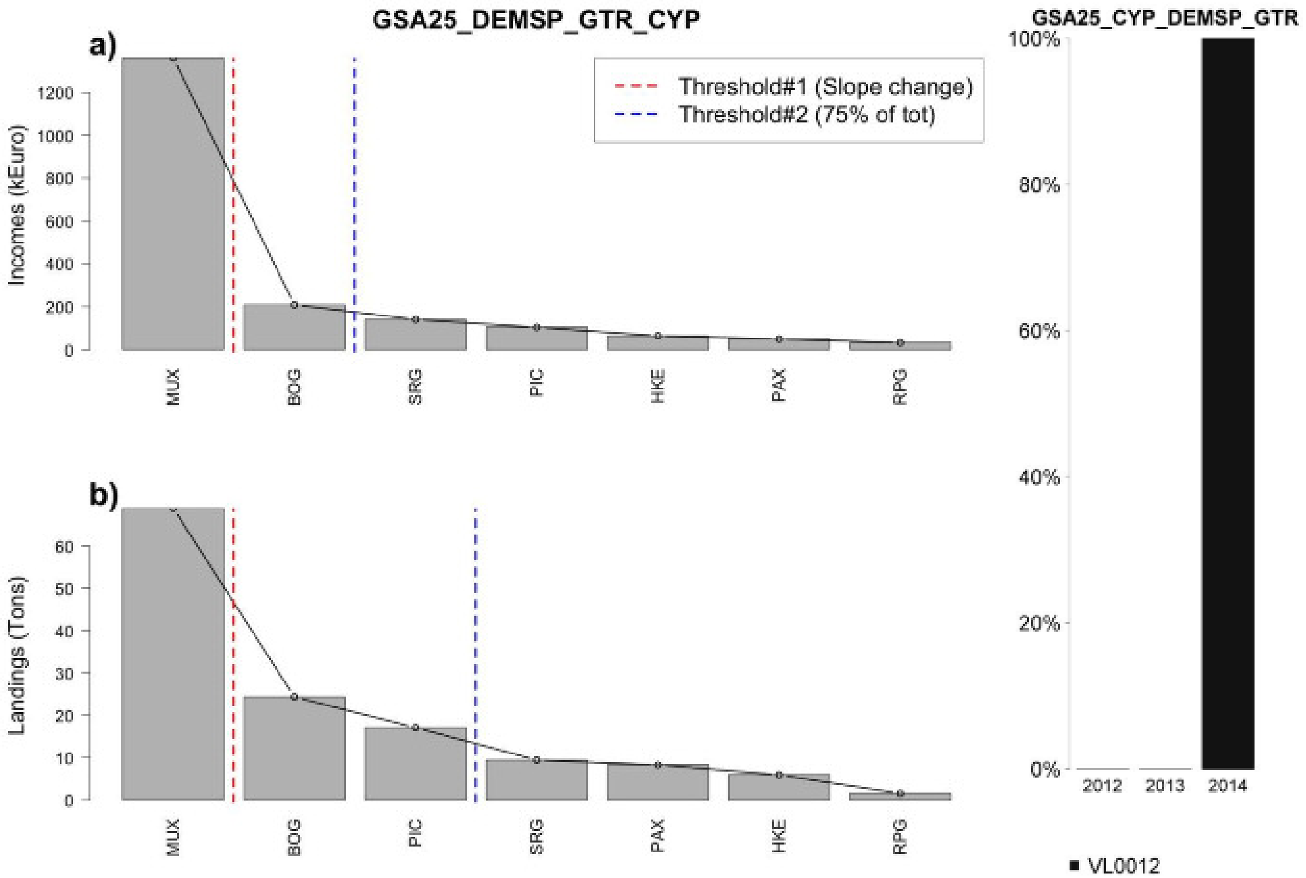


Figure 120. Cumulative percentage for the GSA25_DEMSP_GTR, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.2.21.4. Bottom otter trawl targeting demersal species (DEMSP_OTB)

Mullus barbatus and *Spicara smaris* are the most important target species of the bottom trawl fleet operating in GSA 25 on the muddy bottoms of continental shelf and upper slope both in terms of landing values and landing in weight (Figure 121a and Figure 121b). Only red mullet is included in the Annex III of the EU Reg. 1967/2006. According to the most recent data, a total effort exerted by this métier in 2014 was equal to 33,560 GT*fishing day. The 100 % of the effort was exerted by 24-40 m LOA vessels (Figure 121c).

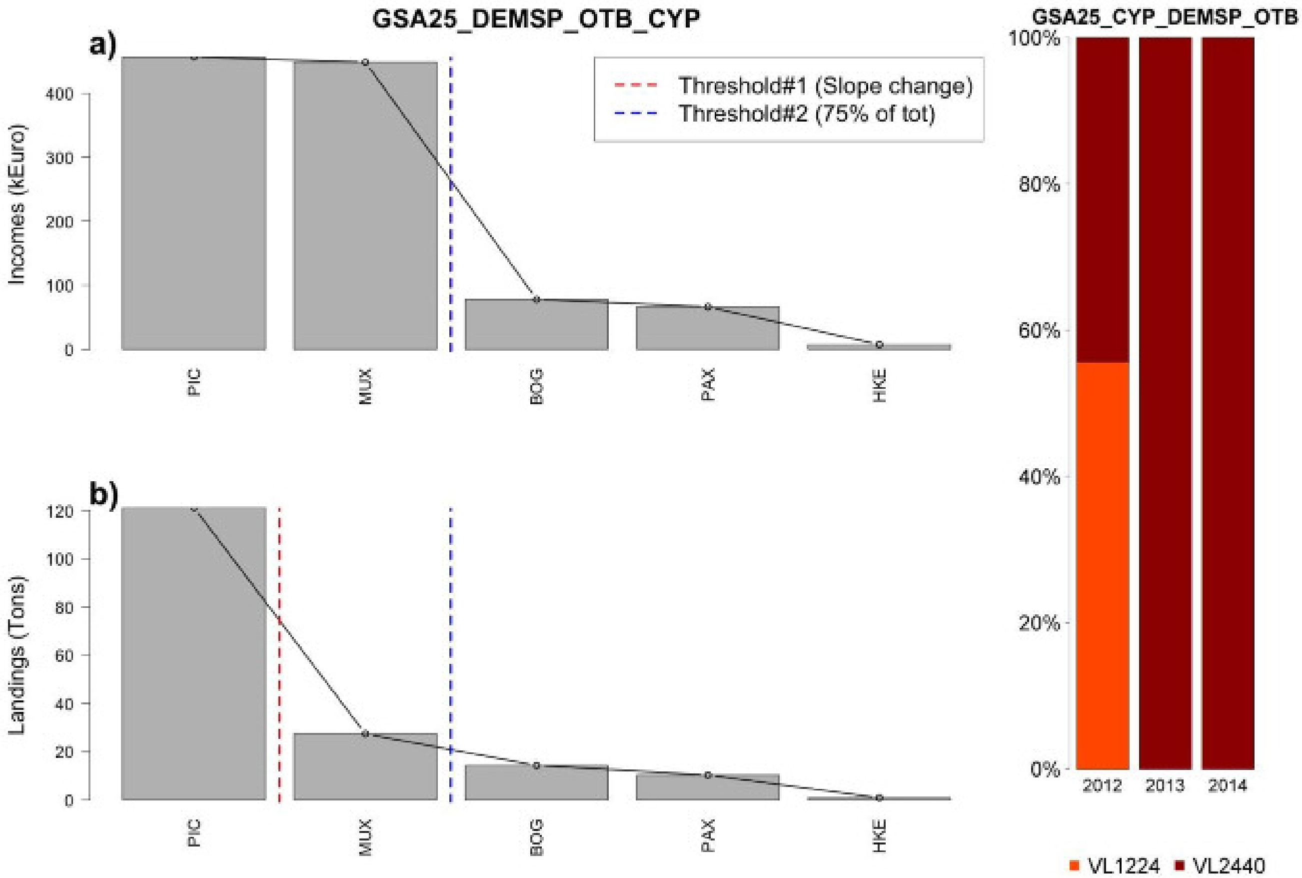


Figure 121. Cumulative percentage for the GSA25_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014). Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.

2.3. Species defining the main Mediterranean demersal fisheries

2.3.1. Boat dredges (DRB)

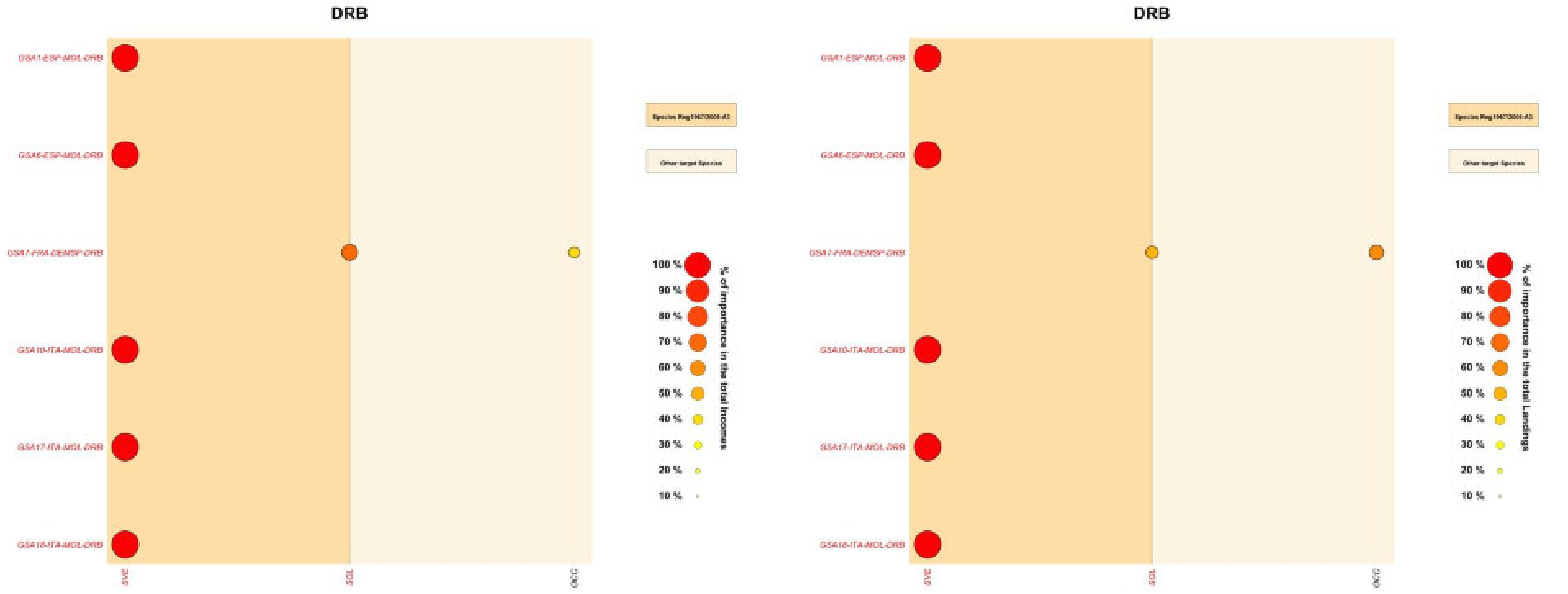
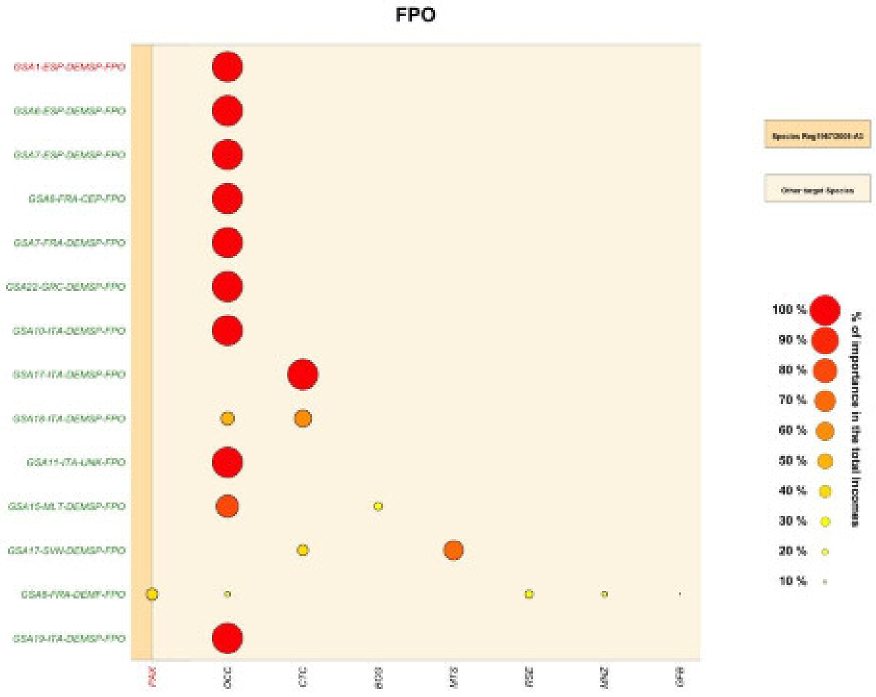


Figure 122. Main selected species defining the Mediterranean demersal with boat dredge gears (DRB). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes (left) or landings (right). Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.2. *Pots and traps (FPO)*



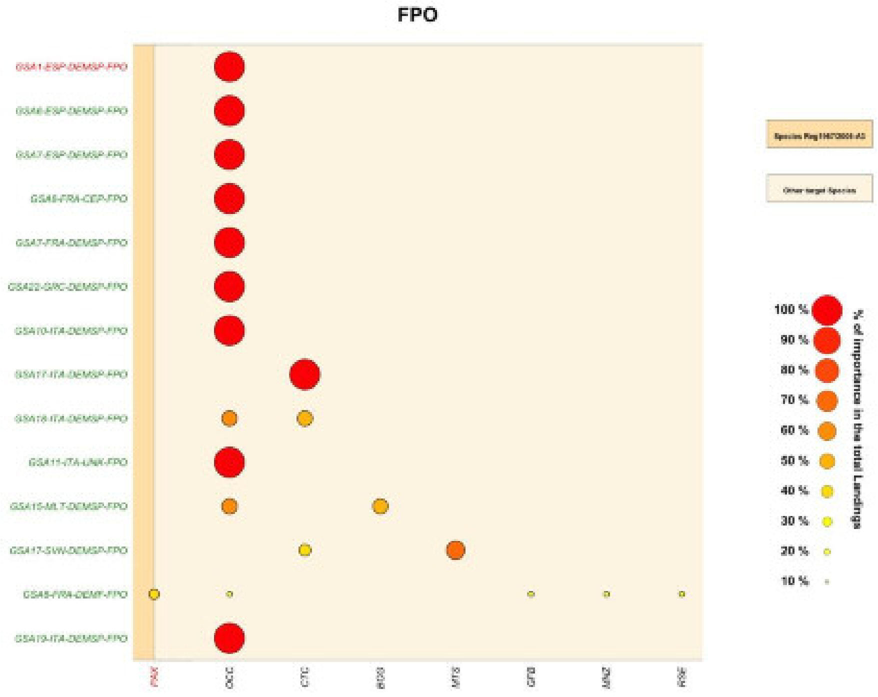


Figure 123. Main selected species defining the Mediterranean demersal with pots and traps (FPO). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.3. *Fyke nets (FYK)*

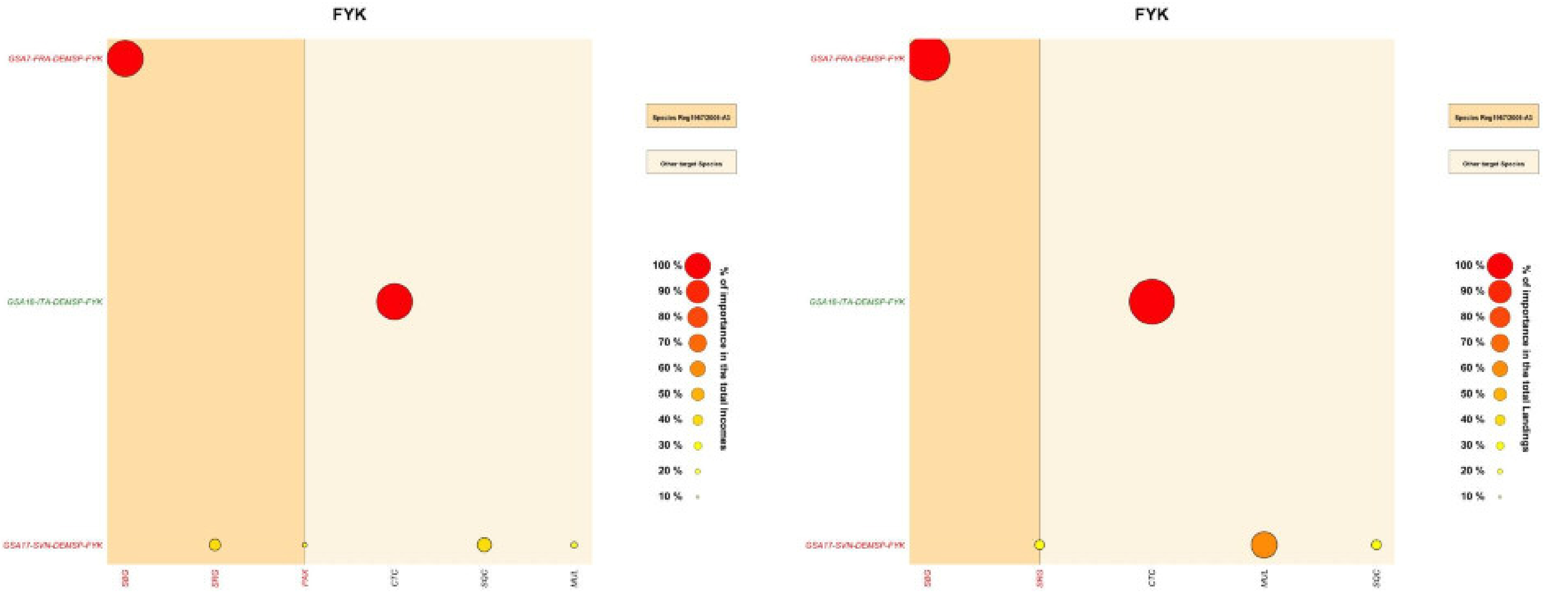


Figure 124. Main selected species defining the Mediterranean demersal with *Fyke* net gears (FYK). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.4. Set gillnets (GNS)

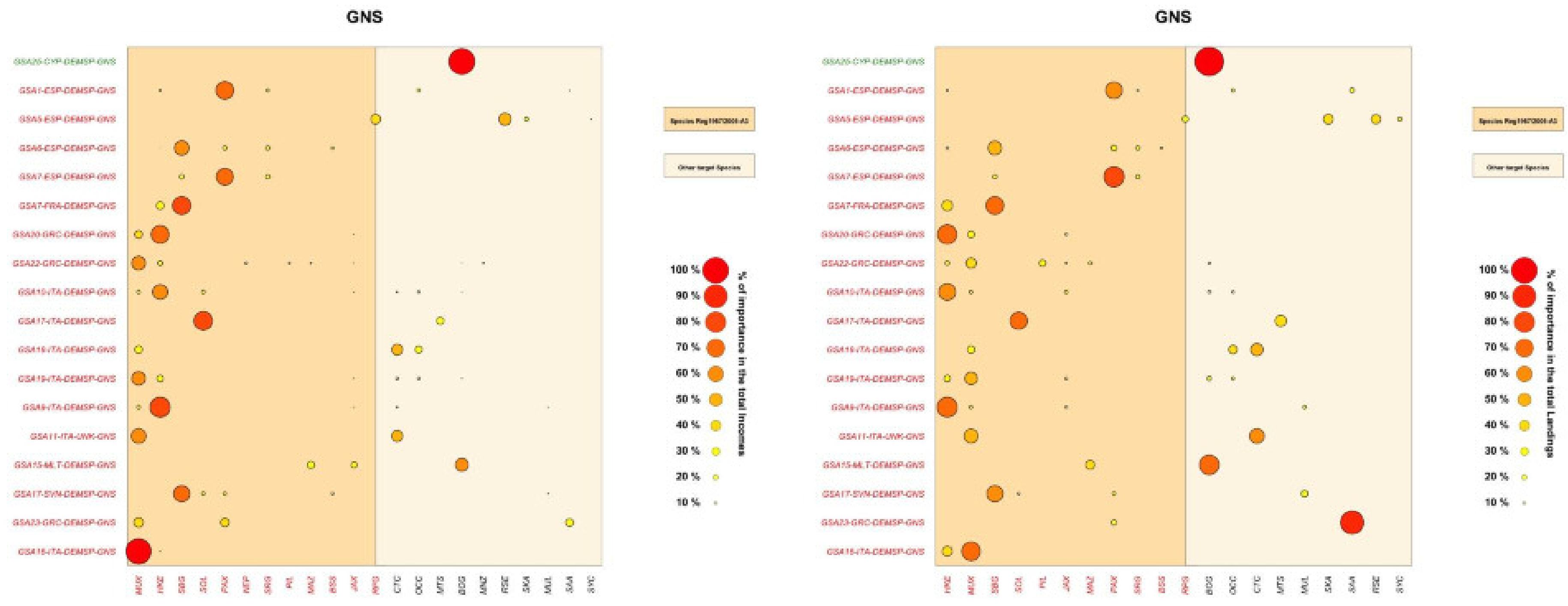


Figure 125. Main selected species defining the Mediterranean demersal with set gillnets (GNS). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.5. *Trammel nets (GTR)*

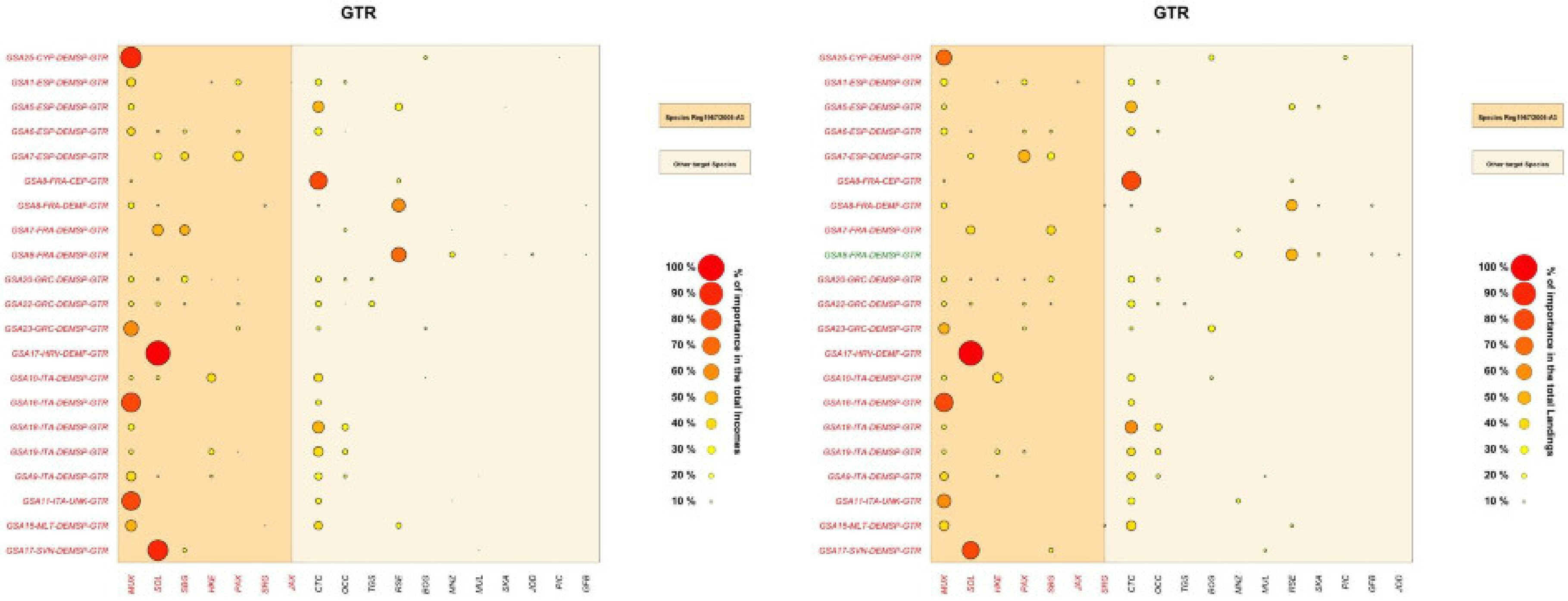


Figure 126. Main selected species defining the Mediterranean demersal with trammel nets (GTR). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.6. *Hand lines (LHM)*

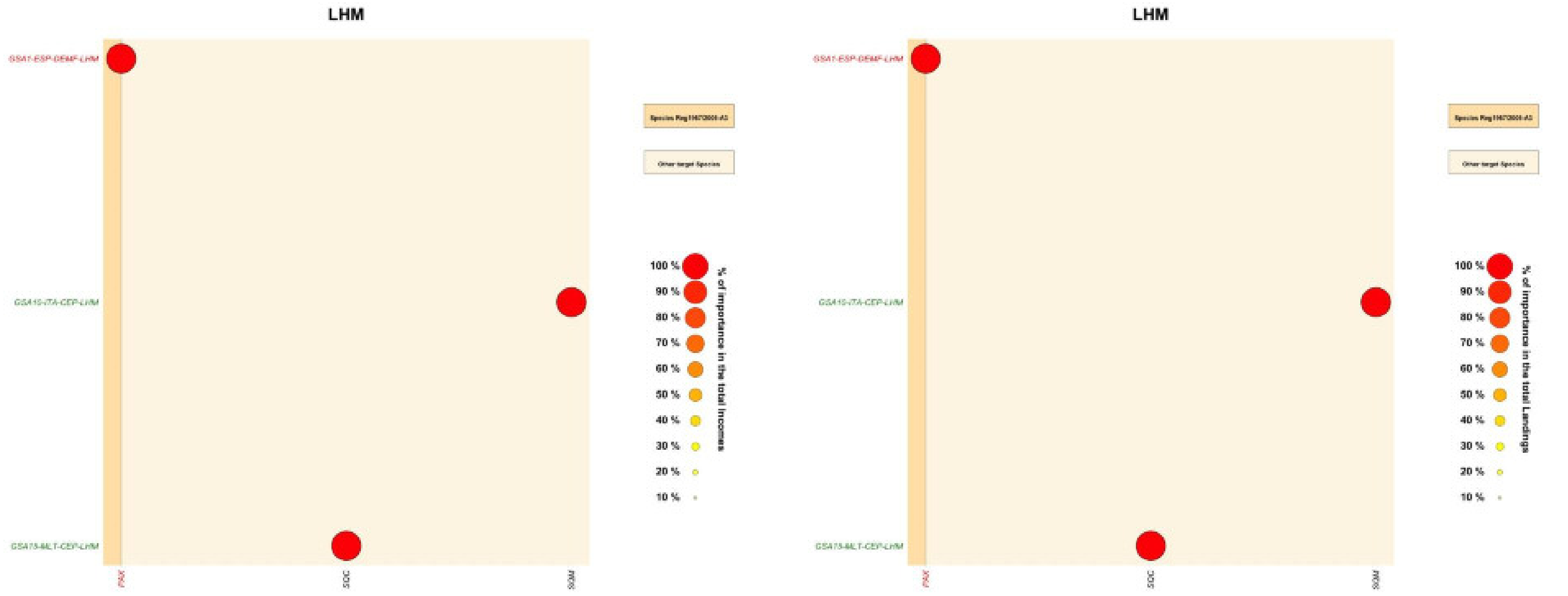


Figure 127. Main selected species defining the Mediterranean demersal with hand line gears (LHM). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.7. *Pole lines (LHP)*

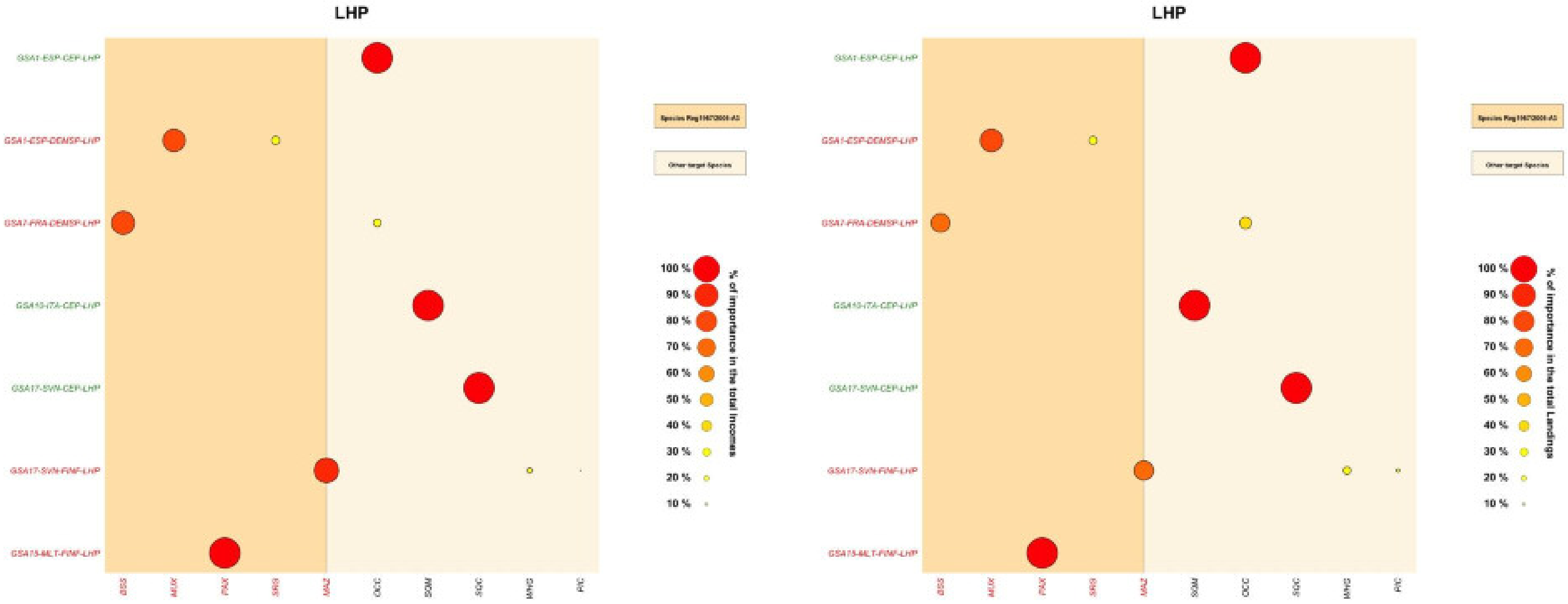


Figure 128. Main selected species defining the Mediterranean demersal with pole line gears (LHP). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.8. *Set longlines (LLS)*

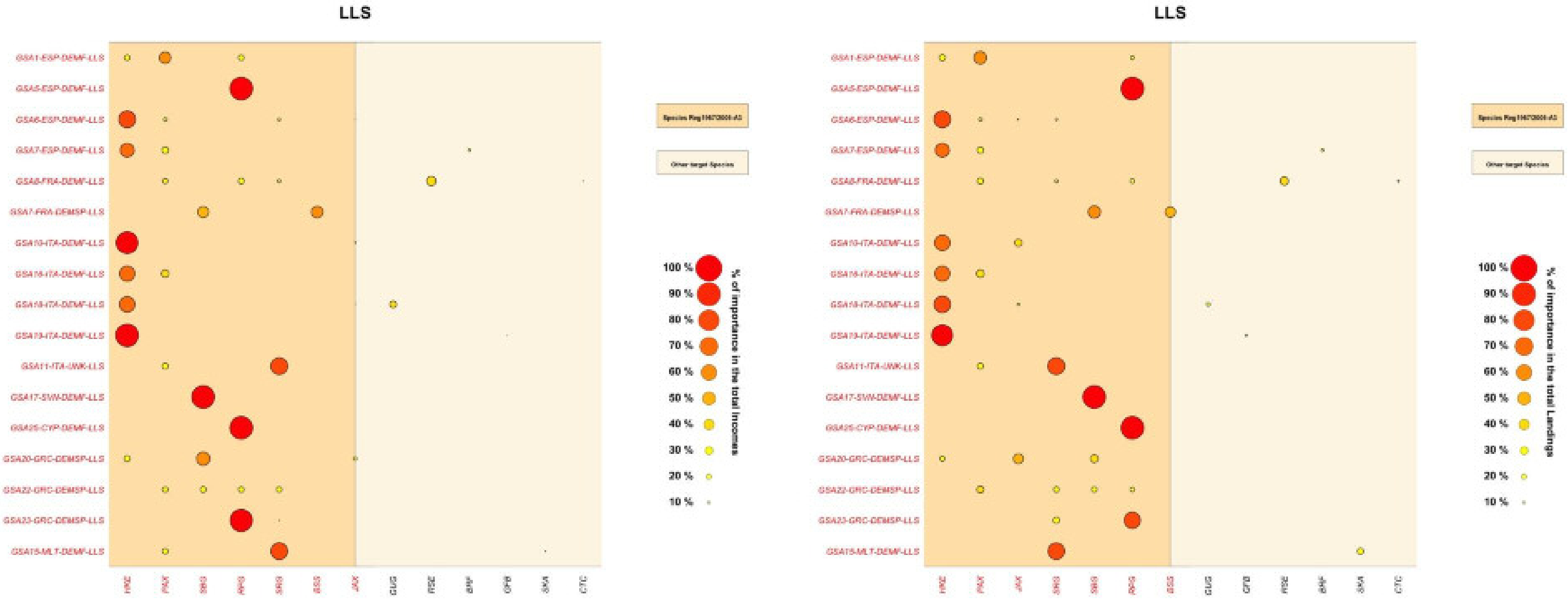


Figure 129. Main selected species defining the Mediterranean demersal with set longlines (LLS). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.3.9. Bottom otter trawls (OTB)

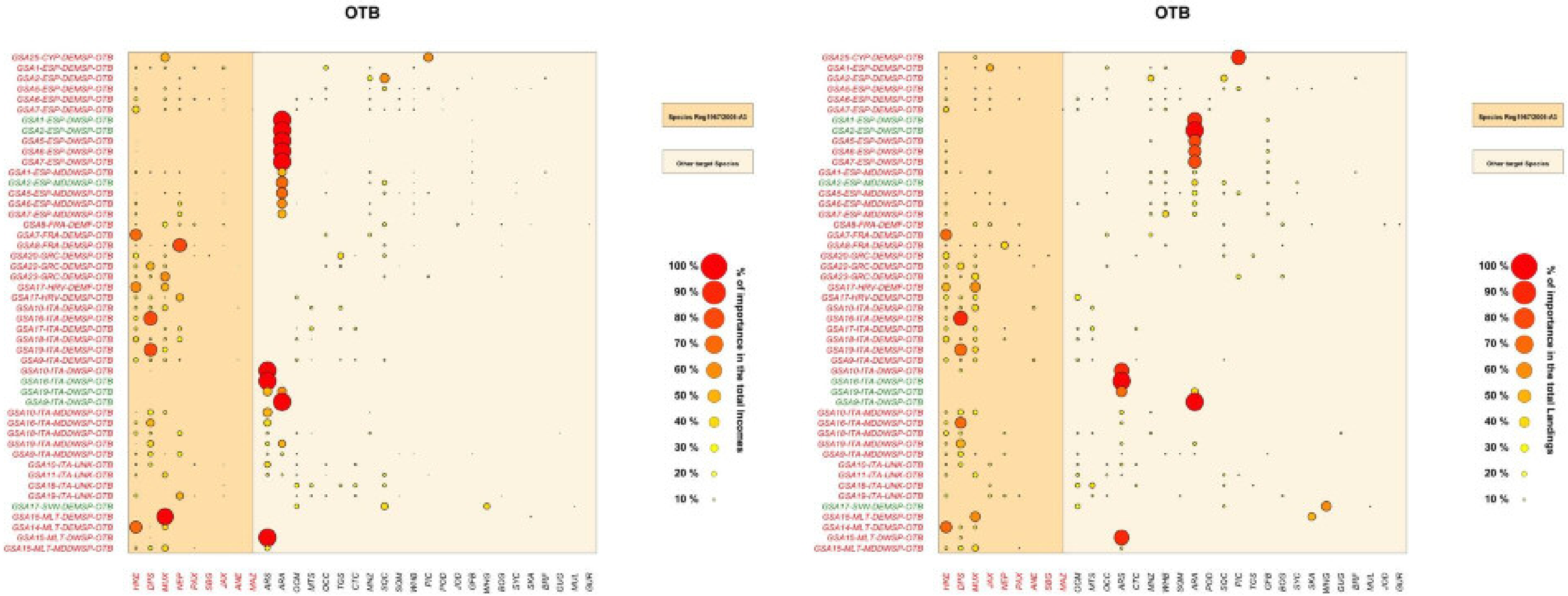
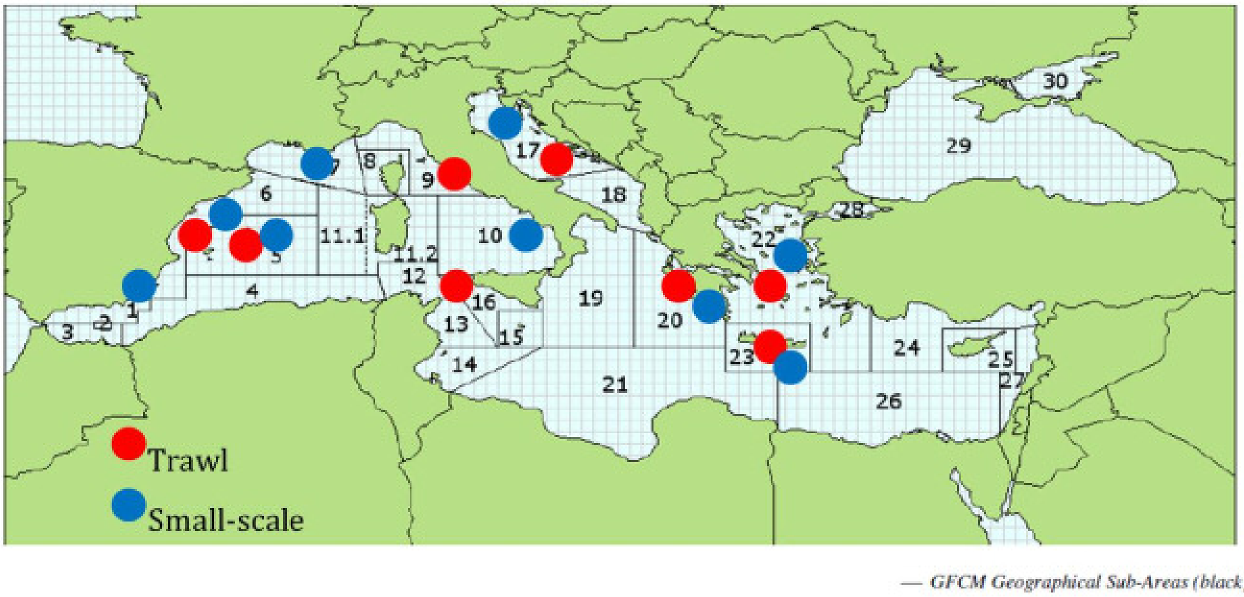


Figure 130. Main selected species defining the Mediterranean demersal with a bottom otter trawl gears (OTB). The species selected are landed at least by one fishery and have been selected if in each fishery they fall within the 75 % cumulative percentage of the incomes. Species in red are demersal species subject to minimum sizes as defined in Annex III of the MEDREG. Fisheries in green do not have any Annex III's species in their landings. The bubble size represents the percentage of the incomes (value in Euros, left) or landings (right) of each species on the total incomes, which is given by the sum of the incomes considering only these main selected species.

2.4. Catch profile of the main EU Mediterranean fisheries based on literature review

An extensive bibliographic survey of the recent scientific literature (i.e. since end of ‘90s) reporting quantitative information on catch composition/landing profiles of EU Mediterranean fisheries was carried out during EWG 15-14. Searches included scientific works available in the Web Of Science (WOS; http://wokinfo.com/) and grey literature from the web (Google Scholar; https://scholar.google.com/). The examined studies included data on fishing gears, target species and catch/landings composition. A total of 30 studies, published from 1998 to 2013, were found (Annex 4). These studies cover 10 different GSAs (1, 5, 6, 7, 9, 10, 17, 20, 22, 23) from both the western and eastern basin (Figure 131). Important data gaps for relevant fisheries and fishing areas were found, such as trawl in Adriatic and Gulf of Lions, which would need to be filled. Results are summarized in Annex 5 and Table 1 where the main target and by-catch species are indicated for each fisheries/metier.

A quite wide range of methods were applied to characterize fisheries and identify fishing metiers, including the catch composition of vessels using specific gears and the use of multivariate analyses. These last are aimed at defining the fishing practices of each fleet segment using a given gear (i.e. trammel nets) by reducing the description of the variety of fishing trips/daily landings to a single categorical variable, the métier, that summarizes its main characteristics, i.e. the gear used, the fishing ground, and the target species (Pelletier and Ferraris, 2000). As well described in these papers, Mediterranean fisheries are generally highly multi-specific, with several target species and by-catch species identified in landings in some areas. Either trawl or small-scale fisheries can perform different métier during the year and even during a single fishing trip depending by several factors such as the level of catches obtained at that moment and the price of target species in the market.



01 - Northern Alboran Sea	07 - Gulf of Lions	13 - Gulf of Hammamet	19 - Western Ionian Sea	25 - Cyprus Island
02 - Alboran Island	08 - Corsica Island	14 - Gulf of Gabes	20 - Eastern Ionian Sea	26 - South Levant
03 - Southern Alboran Sea	09 - Ligurian and North Tyrrhenian Sea	15 - Malta Island	21 - Southern Ionian Sea	27 - Levant
04 - Algeria	10 - South and Central Tyrrhenian Sea	16 - South of Sicily	22 - Aegean Sea	28 - Marmara Sea
05 - Balearic Island	11.1 - Sardinia (west) 11.2 - Sardinia (east)	17 - Northern Adriatic	23 - Crete Island	29 - Black Sea
06 - Northern Spain	12 - Northern Tunisia	18 - Southern Adriatic Sea	24 - North Levant	30 - Azov Sea

Figure 131. Spatial distribution of the available studies dealing with the characterization of Mediterranean demersal fisheries (trawl and small-scale) found in the literature search by GFCM Geographical Sub-Areas (GSAs)

2.4.1. *Western Mediterranean*

In the western Mediterranean, bottom trawlers operate along a wide bathymetric range, from the shallow shelf (deeper than 50 m depth) to the middle slope (down to 800-1000 m). In this basin, information was only available for trawlers from GSAs 5, 6 and 9 and small-scale fleets from GSAs 1, 5, 6, 7 and 10.

2.4.1.1. Trawl fleet

In the Spanish areas (GSA 5 and 6), commercial trawlers employ up to four different fishing tactics (Merella et al., 1998; Moranta et al., 2000; Alemany and Alvarez, 2003; García-Rodríguez, 2003; Maynou et al., 2003; Ordines et al., 2006; Palmer et al., 2009; Samy-Kamal et al., 2014), which are associated with the shallow and deep continental shelf (SS and DS, respectively), and the upper and middle continental slope (US and MS, respectively). Vessels mainly target striped red mullets (*Mullus* spp) and European hake (*M. merluccius*) on the SS and DS respectively, which are caught along with a large variety of fish and cephalopod species.

On the SS, the main by-catch species are *S. smaris, O. vulgaris* and *Trachurus* spp, whereas on the DS predominate *T. mediterraneus, C. cirrhus, Lophius* spp and a mixed fish commercial category known as "morralla". The Norway lobster (*N. norvegicus*) and the red shrimp (*A. antennatus*) are the main target species on the US and MS respectively. The Norway lobster is caught at the same time as a large number of other fish and crustacean species, mainly *M. poutassou, M. merluccius, P. blennoides* and *P. longirostris.* Although the red shrimp fishery might be considered the only monospecific Mediterranean fishery, a large by-catch is also taken comprising *G. melastomus*, *M. poutassou, P. blennoides* and *G. longipes.*

In Ligurian and North Tyrrhenian Sea (GSA9), Sbrana et al. (2003) identified three different fishing tactics corresponding to the shelf (50-200 m), upper slope (200-400 m) and middle slope (400-600 m). Hake was the target species in the two first strata, but the by-catch differed because it included *E. cirrhosa* and *T. minutus* on the shelf but *M. poutasou, Trachurus* spp and *P. longirostris* on the upper slope. Norway lobster was the target species on the deepest grounds, where the by-catch included was dominated by *E. cirrhosa, M. poutassou* and shrimps of the Aresteidae family.

Altogether, the fishing tactics identified in the western basin are included in three different DFC codes: OTB-DEMSP, OTB-DWSP and OTB-MDDWSP. The OTB-DEMSP includes the fishing tactics targeting shelf (*Mullus* spp, *M. merluccius*) and upper slope (*N. norvegicus*) species, whereas OTB-DWSP includes exclusively the fishing tactic targeting the red shrimp (*A. antennatus*). The OTB-MDDWSP refers to landings including fishing tactics from both the shelf and slope.

2.4.1.2. Small-scale fleet

According to the literature review, the most important gears in the Spanish areas (GSAs 1, 5 and 6) are trammel nets (GTR), gillnets (GNS) and longlines (LLS), which are used to take a large variety of demersal species including fish, cephalopods and crustaceans (García-Rodríguez et al., 2006; Forcada et al., 2010; Maynou et al., 2011; Martin et al., 2012; Quetglas et al., *unpublished*). The most common métiers using trammel nets include as target species the fishes striped red mullet (*M. surmuletus*) and sole (*Solea* spp), the cephalopods cuttlefish (*S. officinalis*) and octopus (*O. vulgaris*) and the crustacean spiny lobster (*P. elephas*) and prawn (*P. kerathurus*). The most common gillnet fishery targets hake (*M. merluccius*) but there are also many other types focusing on other fish species (e.g. Sparidae, *S. sarda*).

Longlines are used to take a large variety of fish species such as many different species of the Sparidae family in coastal waters and large-sized hake individuals (*M. merluccius*) in deeper depths. Along the Spanish coast, there are also important fisheries of handlines (LHM) targeting squid (*L. vulgaris*) and pots or traps fisheries (FPO) targeting octopus (*O. vulgaris*). Finally, there are some localized, but very important fisheries, such as the fishery for dolphinfish (*C. hippurus*) and transparent goby (*A. minuta*) using purse seines (PS) in the Balearic Islands.

In the Gulf of Lions (GSA7), the most important gears are gillnets (GNS), trammel nets (GTR) and longlines (LLS) (Gómez et al., 2006; Leleu et al., 2014). Target species of gillnets include fish (*M. surmuletus, M. merluccius*, Sparidae), whereas those of trammel nets include both fish (*Solea* spp) and crustaceans (*P. elephas*); longlines are used to fish many different species of the Sparidae family (e.g. *D. sargus, D. labrax, S. aurata*). There are also important pot (FPO) fisheries targeting octopus (*O. vulgaris*).

In the South and Central Tyrrhenian Sea (GSA10), the most important gears are trammel nets (GTR), gillnets (GNS) and longlines (LLS) (Colloca et al., 2004; Battaglia et al., 2010). Trammel nets target a large variety of fish (*M. merluccius*, *Mullus* spp, *Scorpaena* spp) and some cephalopod (*S. officinalis*) and crustacean (*P. elephas*) species. Gillnets are used to take different target fish species (e.g. *M. merluccius, S. dumerilii, Spicara* spp); in some métiers, the cephalopod *I. coindetii* represents an important by-catch. Longlines target fishes such as *M. merluccius* and *P. bogaraveo*. There are also boat seine (SV) fisheries focused on *Spicara* spp and *B. Boops* and trap fisheries targeting prawns (*P. edwardsii, P. narval*).

2.4.2. Central-Eastern Mediterranean

2.4.2.1. Trawl fleet and dredges

In Greek waters (GSAs 20, 22, 23), commercial trawlers mostly exploit fishing grounds on the continental shelf and the shallower part of the upper slope (Katsanevakis et al., 2010a; Stergiou et al., 2003). The main identified target species are *M. kerathurus, M. barbatus, M. merluccius, P. longirostris, S. smaris, B. Boops, L. vulgaris, O. vulgaris* and *Eledone spp.* In the Strait of Sicily, off-shore trawl fleet (OTB-DWS) exploiting deep-water shrimps (*A. foliacea, A. antennatus*) and deep-water rose shrimp (*P. longirostris*) have hake (*M. merluccius*), *C. agassizi* and *H. dactylopterus* as main commercial by-catch species (Castriota et al., 2001). Available data for beam-trawl in the Adriatic (GSA 17) shows that sole (*S. Solea*) and other high-prize flat fishes are the main target species of this fishery, which also lands a mix of demersal fish and shell-fish, such as *S. mantis, M. kerathurus, B. brandaris, S. officinalis, C. lucerna* (Scarcella et al., 2007). Regarding hydraulic-dredges for striped venus (*C. gallina*) in Adriatic, this fishery discards benthic invertebrates with a high component (about 30%) of undersized specimens of *C. gallina* (Morello et al., 2001).

2.4.2.2. Small-scale fleet

Up to 17 different fishing gear to target 62 commercial species have been identified in Greek Seas (Tzanatos et al., 2005, 2007, 2013; Miliou, 2010). In the Patraikos Gulf, Tzanatos et al. (2006, 2007) identified 11 main métiers, including 6 different trammel nets to catch 6 groups of target species (*S. Solea, D. dentex, M. barbatus, M. kerathurus, S. officinalis,* sparids). Gillnets and combined nets are used to catch hake and seabass respectively. Also longlines are widely used to target *S. dumerilii, D. dentex, M. merluccius* and pots for cephalopods (*O. vulgaris, S. officinalis*). A study on longline fishery based on landings profiles showed that in all, 13 métiers were conducted in the Aegean Sea and 7 in the Ionian Sea.

The most important métiers identified were those targeting white sea bream (*D. sargus*), hake, common sea bream (*P. pagrus*), and common pandora (*P. erythrinus*). In general, sparids and groupers are the main targets and by-catch species of this fishery (Katsanevakis et al., 2010b). In the Eastern Adriatic Sea (Croatia) 13 different fishing métiers were identified (Tzanatos et al., 2013). They include several types of trammel nets to target a mix of fish (i.e. red mullets, scorpionfish, flatfish) and shellfish (i.e. spiny lobster, octopus, cuttlefish). Gillnets are used to catch bogue (*B. Boops*), bonito (*S. sarda*) and other medium pelagic fish. A specific gillnet is used to target elasmobranchs (i.e. smooth-hounds). Hake is caught mainly using longlines. Finally boat seines target mainly picarel (*S. smaris*). On the Italian side of the GSA17, two main trammel nets have been identified to target *L. mormyrus* and *S. officinalis* respectively and 2 gillnet types for sole and a mix of coastal species on sandy bottoms. Traps are commonly used to catch *S. officinalis* and the gastropods *N. mutabilis* (Fabi and Grati, 2001).

Table 1. Summary of the target species and main by-catch species by GSA and fishery (trawl, small-scale) obtained from the literature research; DCF codes are also provided.

<table>
<tr><th>GSA</th><th>Fishery</th><th>DCF code</th><th>Target Species</th><th>By-catch Species</th></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Trawl</td><td>OTB-DEMSP</td><td>M. surmuletus, M. merluccius, N. norvegicus</td><td>S. smaris, mixed fish, O. vulgaris, M. poutassou, L. vulgaris, T. mediterraneus, Raja spp, Z. faber, C. cirrhus, P. blennoides</td></tr>
<tr><td>OTB-DWSP</td><td>A. antennatus</td><td>M. merluccius, M. poutassou, G. melastomus, P. blennoides, H. dactylopterus, Lepidorhombus spp, Mullus spp</td></tr>
<tr><td>OTB-MDDWSP</td><td>A. antennatus, N. norvegicus, M. merluccius</td><td>M. poutassou, G. melastomus, P. blennoides, H. dactylopterus,</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Trawl</td><td>OTB-DEMSP</td><td>Mullus spp, M. merluccius, N. norvegicus</td><td>M. poutassou, P. blennoides, Morralla*, O. vulgaris, E. cirrhosa, Lophius spp, Tachurus spp, S. officinalis, M. poutassou, Scomber spp</td></tr>
<tr><td>OTB-DWSP</td><td>A. antennatus</td><td>M. poutassou, P. blennoides, G. longipes</td></tr>
<tr><td>OTB-MDDWSP</td><td>A. antennatus, N. norvegicus, M. merluccius</td><td>M. poutassou, P. blennoides, G. longipes</td></tr>
<tr><td>9</td><td>Trawl</td><td>OTB-DEMSP</td><td>M.merluccius, N. norvegicus</td><td>E. cirrhosa, T.minutus, M. poutassou, Trachurus spp, P. longirostris</td></tr>
<tr><td>20</td><td>Trawl</td><td>OTB-DEMSP</td><td>M. kerathurus, M. barbatus, M. merluccius, P. longirostris, S. smaris, B. Boops, L. vulgaris, O. vulgaris</td><td>M. merluccius, P. longirostris</td></tr>
<tr><td>22-23</td><td>Trawl</td><td>OTB-DEMSP</td><td>M. kerathurus, M. barbatus, M. merluccius, P. longirostris, B. Boops, O. vulgaris, Lophius spp, Eledone spp</td><td>M. merluccius, M. kerathurus, P. longirostris, Trachurus spp, I. coindetii, M. barbatus, M. poutassous</td></tr>
<tr><td>17</td><td>Trawl</td><td>TBB-DEMSP</td><td>Solea spp, P. maxima, S. rhombus</td><td>S. mantis, M. kerathurus, B. brandaris, S. officinalis, C. lucerna</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Small-scale</td><td>GTR-DEMSP</td><td>S. officinalis, Mullus spp, Sparidae, S. Solea, P. elephas, M. kerathurus</td><td></td></tr>
<tr><td>GNS-DEMF</td><td>M. merluccius, S. sarda, A rochei, S. dumerilii, Sparidae, E. alletteratus</td><td></td></tr>
<tr><td>LLS-DEMF</td><td>Sparidae, S. dumerilii</td><td>Serranidae, C. conger, M. helena, D. dentex, E. marginatus</td></tr>
<tr><td>LHM-DEMSP</td><td>L. vulgaris, S. dumerilii,</td><td></td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Small-scale</td><td>FPO-DEMSP</td><td>O. vulgaris</td><td>Solea spp</td></tr>
<tr><td>GNS-DEMF</td><td>M. merluccius, P. erythrinus, M. surmuletus, S. Solea</td><td>D. labrax, P. phycis, Scorpaena spp, P. bogaraveo, S. sarda, S. aurata, C. linguatula, L. mormyrus, S. dumerilii, mixed fishes, U. scaber, L. piscatorius, D. dentex</td></tr>
<tr><td>GTR-DEMSP</td><td>O. vulgaris, Solea spp, S. officinalis, M. surmuletus, P. elephas, P. bogaraveo</td><td>B. brandaris, L. mormyrus, O. vulgaris, Mixed fish, S. scrofa</td></tr>
<tr><td>LLS-DEMF</td><td>C. conger, Sparidae, M. merluccius, S. aurata,D. labrax, P. erythrinus, P. pagrus</td><td></td></tr>
</table>

GSA	Fishery	DCF code	Target Species	By-catch Species
7	Small-scale	GNS-DEMF	Sparidae, *S. aurata, M. surmuletus, M. merluccius, Scorpaena* spp, *Pagellus* spp, *L. amia*	*M. barbatus*, sparidae
		GTR-DEMSP	*P. elephas, Scorpaena* spp, *O. vulgaris, S. Solea*	*S. rhombus, D. labrax*, Labridae
10	Small-scale	FPO-DEMSP	*Plesionika edwardsii, P. narval*	
		GNS-DEMF	*M. merluccius, B. Boops, Spicara spp, L. mormyrus, S. dumerilii*	*S. sarda, D. sargus, Liza spp*
		GNS-DEMSP	*M. merluccius, Trachurus spp, I. coindetii, S. japonicus, P. bogaraveo*	*O. vulgaris, U. scaber*
		GTR-DEMSP	*Scorpaena spp, M. surmuletus, M. barbatus, P. elephas, S. officinalis*	
		LLS-DEMF	*M. merluccius, P. bogaraveo*	
		SV-DEMSP	*Spicara spp, B. Boops*	*mixed demersals*
17	Small-scale	GNS-DEMF	*S. Solea, L. mormyrus, D. labrax, S. umbra, U. cirrosa,* Mugilidae	
		GTR-DEMF	*L. mormyrus*	
		GTR-DEMSP	*S. officinalis*	
		FPO-CEP	*S. officinalis*	
		FPO-MOL	*N. mutabilis*	
20	Small-scale	LLS-DEMF	*D. sargus, O. melanura, E. costae, D. dentex,* Rays, *S. dumerili, P. erythrinus, E. aeneus, E. marginatus, D. dentex, P. pagrus, M. merluccius, Phycis spp, C. conger, S. dumerilii, E. marginatus*	
		GTR-DEMF	*D. labrax, S. aurata, D. sargus, M. merluccius, D. dentex, S. aurata, Mugilidae, M. barbatus, M. kerathurus*	
		GTR-CEP	*S. officinalis*	
		FPO-CEP	*O. vulgaris, S. vulgaris*	
22	Small-scale	LLS-DEMF	*E. marginatus, D. dentex, D. labrax, D. macrophthalmus, O. melanura, P. pagrus, D. sargus, E. costae*	
		GTR-DEMF	*M. surmuletus, S. scrofa, P. elephas, P. pagrus, D. dentex*	*S. japonicus, C. hippurus*
		SV-MDPSP	*B. Boops, A. boyeri*	
		LLS-DEMF	*P. pagrus, S. cantharus,*	*D. vulgaris, D. dentex*

3. LITERATURE REVIEW OF THE SURVIVAL INFORMATION

Article 15 of Regulation (EC) 1380/2013 states that in the Mediterranean all species which are subject to minimum sizes as defined in the Annex III of EC Reg. No. 1967/2006 (hereafter referred as MEDREG) shall be brought and retained on board the fishing vessels, recorded, and landed in accordance with the timeframes outlined in EC Reg No. 1380/2013. It is further specified that the landing obligation shall not apply to species for which scientific evidence demonstrates high survival rates, taking into account the characteristics of the gear, of the fishing practices and of the ecosystem. Moreover the landing obligation does not apply to endangered species for which fishing is legally prohibited.

EWG15-14 reviewed information on survivability for species listed in Annex III of the MEDREG available from the Mediterranean. Because of the limited information concerning the Mediterranean fisheries EWG15-14 also performed a literature review aiming to spot survival of species included in the MEDREG but estimated in fisheries outside the Mediterranean. The findings of this review are summarized in Table 2 and Table 3.

In order to determine whether 'high survival' rates are possible for stocks which fall under the landing obligation in the Mediterranean Sea, it is first necessary to consider what the precise definition of 'high' survivability is. STECF 13-23 proposed a threshold of true survival >50 %, i.e. a greater proportion of fish surviving than dying, as a cut-off point. However it is important to note since the definition of 'high' survivability is subjective and species- as well as fisheries-specific, the choice of a suitable threshold should also take into account the potential benefits for other stocks and the broader ecosystem.

A minor proportion of survival can be also an acceptable reason for allowing discards whenever stocks are in extremely bad exploitation conditions. The precise survival threshold to be applied should ideally be considered on a case by case basis. It is however evident that estimates of survivability vary considerably both within (in extreme cases from 0 % to 100 %) and between different studies. Several factors influence the level of stress and the extent of injuries of discarded by-catch species, and thus affect mortality rates. These parameters may relate to:

(i) The manner in which the fishing operation is carried out. Survivability will be affected by factors such as fishing gear type, the duration of the fishing operation, the movement of fishing gear during capture, hauling speed, catch composition and crowding density, how gear is hauled on-board, the manner by which catches are handled, sorted and treated, the design of the fishing vessel and the training / experience of crew, the manner by which discards are returned to the sea;

(ii) Environmental factors. Survivability will be affected by depth / water or air temperature / salinity / light changes due to the fishing operation, season, weather and sea-states;

(iii) Biological factors. Survivability varies significantly between species, with size, the condition or health-status of an individual before capture, the presence of a swim bladder in the captured species and depth, season (e.g. whether captured pre- or post-spawning season), the types and quantities of predators present in the ecosystem where discarding is taking place.

A detailed overview of these factors and how they affect survivability is provided in STECF report 13-23, and not repeated here. Additional information on factors causing mortality of trawl-caught and discarded fish is given in Suuronen (2005).

It is evident that the numerous possible causes of mortality and related mechanisms need to be considered on a case by case basis when determining whether high survival rates may be possible for stocks which fall under the landing obligation in the Mediterranean Sea.

Moreover, the likely uncertainty associated with estimated mortality rates should be taken into account (see Table 2 and Table 3 for differences in estimated discards survival rates). Studies on survival of discards are almost absent from the Mediterranean. Giomi *et al*. (2008) studied the survival of discarded *Liocarcinus depurator* in the Northern Adriatic Sea Rapido trawl fisheries and found seasonal effects which were mainly attributed to air temperature. However, *Liocarcinus depurator* is not included in Annex III of the MEDREG and is not within the scope of the EWG15-14. Figuerola *et al*. (2001) used a commercial otter bottom trawl to experimentally study the survival of some crustaceans and bony fish off the Catalan Coast and found relatively high (71.4 %) survival of sole after 3 days (Table 2). Tsagarakis *et al.*, (2015) conducted a pilot experiment to estimate survival of species/sizes discarded in the Ionian Sea trawl fisheries. Most species included in their study are not subject to MLS, however five of the species considered (*Diplodus annularis, Merluccius merluccius, Pagellus erythrinus, Trachurus* spp*, Parapenaeus longirostris*) are included in the MEDREG.

Survival of *Merluccius merluccius, Pagellus erythrinus* and *Trachurus* spp was negligible while seasonal effects were identified for *Diplodus annularis* and *Parapenaeus longirostris* with evidence for increased survival during spring in contrast to early autumn when survival was almost zero (Tsagarakis *et al.*, 2015) (Table 2). Still, the results of this study are considered preliminary because of the low sampling intensity and because only a limited number of factors that can potentially affect discards survival was taken into account, thus robust conclusions cannot be inferred.

As for *Chamelea gallina*, the fishing target in the Adriatic hydraulic dredge fisheries, more than 30 % of commercially fished clams showed shell damage (Moschino *et al.,* 2003) and only a small fraction of damaged discarded clams may be able to recover.

Still, a high percentage of undamaged individuals remains, which implies that survival can be substantial in that fisheries. However, this does not mean that all undamaged individuals survive the mechanical stress from fishing. Physiological responses of clams were affected by the fishing method, air exposure, air temperature and season (Moschino *et al.,* 2008), while decreased capability of clams to cope with mechanical stress during or immediately after spawning was found.

3.1. Conclusions

The information on survivability of the species listed in Annex III of Regulation (EC) No. 1967/2006 is very limited. Information and data needs that constitute robust scientific evidence of high survival are in general substantial and require dedicated scientific experiments, which are capable of demonstrating survival in the short, medium and long term. Thus, studies which estimate discards survival in the Mediterranean are urgently required in case exemptions to the landing obligation regulation are requested. The EWG proposes the studies to be performed in the fisheries concerned, so that the results reproduce as far as possible the conditions faced by the discarded species.

Table 2. Survival information for species listed in Annex III of Regulation (EC) No 1967/2006 estimated in the Mediterranean (Exp: experimental).

Scientific name	Common name	Survival	Fishing method	Location	Duration	Reference
Fish						
Dicentrarchus labrax	Sea-bass	-				
Diplodus annularis	Annular sea-bream	Spring: 35.7% Autumn: 0%	Bottom trawl (exp.)	Ionian Sea	72 hr	Tsagarakis et al. (2015)
Diplodus puntazzo	Sharpsnout sea-bream	-				
Diplodus sargus	White sea-bream	-				
Diplodus vulgaris	Two-banded sea-bream	-				
Engraulis encrasicolus	European anchovy	-				
Epinephelus spp	*Groupers*	-				
Lithognathus mormyrus	*Stripped sea-bream*	-				
Merluccius merluccius	Hake	0%	Bottom trawl (exp.)	Ionian Sea	72 hr	Tsagarakis et al. (2015)
Mullus spp	Red mullets	-				
Pagellus acarne	Spanish sea-bream	-				
Pagellus bogaraveo	Red sea-bream	-				
Pagellus erythrinus	Common pandora	Spring: 3.9% Autumn: 0%	Bottom trawl (exp.)	Ionian Sea	72 hr	Tsagarakis et al. (2015)
Pagrus pagrus	Common sea-bream	-				
Polyprion americanus	Wreckfish	-				
Sardina pilchardus	European sardine	-				
Scomber spp	Mackerel	-				
Solea vulgaris	Common sole	71.4%	Bottom trawl (exp.)	Catalan Sea	3 days	Figuerola et al. (2001)
Sparus aurata	Gilt-head sea-bream	-				
Trachurus spp	Horse mackerel, Scad	0%	Bottom trawl (exp.)	Ionian Sea	72 hr	Tsagarakis et al. (2015)
Crustaceans						
Homarus gammarus	Lobster	-				
Nephrops norvegicus	Norway lobster	-				
Palinuridae	Crawfish	-				
Parapenaeus longirostris		Spring: 45.5% Autumn: NA	Bottom trawl (exp.)	Ionian Sea	72 h	Tsagarakis et al. (2015)
Molluscs						
Pecten jacobeus	Scallop	-				
Venerupis spp	Carpet-clams	-				
Chamelea spp	Venus-shells	*	Hydraulic dredge			Moschino et al. (2003, 2008)

* Survival of *Chamelea gallina* has not been explicitly estimated but studies on damage caused by the fishing gear and on physiological responses to mechanical stress exist and are mentioned in the text.

Table 3. Survival information for species listed in Annex III of Regulation (EC) No 1967/2006 estimated in geographic areas other than the Mediterranean.

Scientific name	Common name	Survival	Fishing method	Location	Duration	Reference
Fish						
Pagrus pagrus	Common sea-bream	80%	Hook and line	USA	Immediate	Revil (2012)
		18%	Hook and line	USA	Immediate	Revil (2012)
Solea vulgaris	Common sole	71-100%	Shrimp beam trawl	North Sea	5 days	Revil (2012)
		33-59%	Shrimp trawl	Germany	7 days	Revil (2012)
		4-37%	Fish trawl and beam trawl	Netherlands	3.5 days	Revil (2012)
		14%	Beam trawl	southern North Sea	91 hr	Depestele et al. (2014)
Crustaceans						
Nephrops norvegicus	Norway lobster	58-75 %	Crustacean trawl	Sweden	5 days	Revil (2012)
		21-85%	Crustacean trawl	USA	4 hr	Revil (2012)
		44-88%	Crustacean trawl	Irish Sea	1 hr	Revil (2012)
		12-60%	Crustacean trawl	Portugal	5-9 days	Revil (2012)

Overall the information in Table 2 and Table 3 shows that only very limited information on survivability is available for species listed in Annex III of the MEDREG; when only information from studies carried out in the Mediterranean is considered there is practically no information available for most of the concerned species. It is thus evident that studies which estimate discard survival in the Mediterranean Sea are urgently required in case exemptions to the landing obligation regulation are requested. Survivability would be better informed if dedicated survival studies were taken in the fisheries. Several experimental approaches have been used in the past to estimate discard survival in the field and in the laboratory. The most widely used approaches to studying survivability are:

(i) Keeping subjects in captivity to determine mortality rates after capture;

(ii) Tagging discarded specimens and monitoring physiological status / behaviour or estimating survival rates from the number of returned tags;

(iii) Assessing the health or vitality of specimens to be discarded (e.g. injuries, activity rates etc.), and estimating the likelihood of survival.

A detailed review of the principles behind each of these methods, the associated benefits and limitations, as well as a summary of the potential sources of error and bias is available in STECF report 13-23 and in ICES WKMEDS reports (ICES, 2014a; 2014b; 2015).

These reports define a framework for undertaking survival studies which consider the advantages and disadvantages of the various possible methods, which should be followed in order to produce reliable and usable discard survival estimates in an efficient manner. Based on the available information shown in Table 2, only sole would display survival rates above the 50% survival threshold mentioned above, in the bottom and beam trawl fisheries. According to experiments outside the Mediterranean (Table 3), other species with high survival would be Norway lobster in crustacean trawl fisheries and common sea-bream in hook and line fisheries. It should be noted however that these survival rates from areas other than Mediterranean cannot be directly applied to the Mediterranean fisheries as, among others, gear characteristics (e.g. mesh sizes are usually larger in the North Atlantic) and fishing techniques as well as environmental conditions (e.g., temperature) are not directly comparable to the Mediterranean.

4. Literature Review of the Mitigation Measures to improve the selectivity of the fishing gears targeting demersal stocks

4.1. Background

The capture of undesirable species is a recognized problem with all fishing methods. Bycatch can include species that may be targeted in other fisheries, undersized fish in the target fishery as well as accidentally caught endangered or protected species. In all cases, these fish and shellfish are part of a species population and an ecosystem. The wide range of developments in fishing gear technology continues to have a significant impact on bycatch, and consequently on discarding. Much of this bycatch consists of juvenile and low-value fish that are often discarded, usually dead. Therefore, removing them affects the food chain and ultimately the economic and social aspects of the fishery in many ways. For example, good results are achieved when fishermen release bycatch, retain it for consumption or sale, or when weakened or dead bycatch becomes food for scavengers in the food chain. Bad results occur when an endangered or protected species is removed from its already small population.

Fishermen primarily aim to catch species of high commercial value, and consequently bottom trawl fishing operations are usually characterized by frequent and quick changes of fishing ground that cause substantial differences in species composition of catches. In such highly efficient gear, the amount of bycatch caught is sometimes so large that it causes serious problems in the management of fisheries and resources. The main problem with the bottom trawl bycatch is that most of this portion of the catch might not survive because it is damaged in the net, brought up from depths too quickly, or thrown back too late. The problem of bycatch is particularly important in multispecies fisheries like the Mediterranean where different species of animals are found together in the same time and place. The management of a multispecies fishery is difficult since most of fishes and invertebrates caught attain different sizes when fully grown, have different shapes and behaviours, and finally have different Minimum Landing Sizes (MLSs) making it hard to target only one of them in their shared habitat. At present, the management of fishing stocks in Mediterranean is mainly based on defining closed areas and seasons, minimum landing sizes, minimum mesh sizes, and limiting fishing effort. In the meantime, it is very difficult to define a minimum codend mesh size for towed nets in a multispecies fishery where several species are caught simultaneously, because a mesh size appropriate for one species could be unsuitable for many others (Stewart, 2002). In recent years, there have been many initiatives to improve selectivity of fishing nets or more correctly to reduce the capture and discard of non-target fish, but it has also become clear that the natural behaviour patterns of many species prevent effective selection. For a trawl gear to be truly selective, fish entering the net should be tested to insure that those that are small enough to pass through the meshes escape and those that are above the minimum landing size are retained (Glass and Wardle, 1995).

In the last twenty years, several studies showed that technical modification of traditional fishing gears might improve the release of undersized fish and unwanted bycatch (Kennelly, 1995; Wileman et al., 1996; Broadhurst, 2000; Valdemarsen and Suuronen, 2003). Improved selectivity can be achieved by modifying gear design and/or operation, and by using alternative fishing gears.

The changes usually involve modifying the size, shape and twine thickness of the codend meshes or inserting square-mesh windows, sorting grids, fish eye, separator panel, etc. either in the codend or in the aft part of the extension piece (for the successful separation of targets and non-targets species.

In general, these devices aim at reducing the catch of juveniles as well the incidental catch of unwanted species (bycatch). In the latter case, they are known as Bycatch Reduction Devices (BRDs). BRDs are commonly used in trawl fisheries allowing fish that are not targeted by the fishers to escape from the net before it is hauled back into the boat. However, most of BRDs experimented around the world are difficult to implement in the Mediterranean. To minimize the biological impacts on bycatch and to promote ecologically sustainable fisheries in the Mediterranean, fishing gears should be modified to address both the size and species selectivity issues.

The commercial mesh size codend traditionally used in the Mediterranean is shown to be too small to allow the escape of immature fish. The economic consequences of introducing gear modifications are possibly the single most important constraint. In many cases, bycatch costs fishers time and money. This further emphasizes the need for a close partnership with industry in the introduction of BRDs and more selective gears in a gradual and adaptive manner. Therefore, fishermen must be a part of the research process for the rapid development of effective BRDs and to successfully reduce bycatch. This will result in a higher compliance with the rules and regulations.

By avoiding the catch of rocks and debris, BRDs might also improve trawl performance and procedures on board through: *i)* reduced damage to the codend; *ii)* less time spent in shooting and hauling because of smaller catches and longer tow duration; *iii)* reduced time spent for sorting of catch on board; *iv)* improved catch quality, and; *v)* reduced injuries to crew from dangerous animals.

On the other hand, experimental trials are essential in order to find out the right setup and to reduce short-term economic loss. In fact, the risk of losing the large specimens is really high especially in mixed fisheries. Windows, grids etc. are often designed to take advantage of the general upwards escape behaviour of fish and are, therefore, normally positioned in the upper half of the codend or extension piece. Some BRDs are described below.

4.2. Trawl nets

4.2.1. Mesh size

Mesh size is considered as the main factor affecting codend selectivity and this is why all the Mediterranean legislations have set a fixed minimum mesh size for the codend. Mesh size of the net can be defined by three different technical parameters: 1) bar length, which is the longest distance between two opposite knots or joints in the same mesh when fully extended (it is equal to the sum of two bars; Figure 132a); 2) Mesh opening, which is the distance between the centres of two opposite knots or joints in the same mesh when fully extended in the N direction (Figure 132b); and 3) Mesh side or bar length, which is the distance between two sequential knots measured from centre to centre when the yarn between those points is fully extended (Figure 132c). The bar length measure is often used by commercial fishermen and by net manufacturers.Basically, the increase of mesh size usually means an increase in the 50% retention length. The use of greater mesh opening implies an increase in the mean size of fish caught.

Beverton (1963) showed that most of the organisms escape from the trawl through the codend meshes, what is probably the main reason why the majority of selectivity studies in Mediterranean were focused on increasing the codend mesh size in order to improve bottom trawls selectivity (Stewart, 2002). Figures (Figure 133-Figure 139) are showing the main relationship between selectivity parameters 'Retention length at 50 %' (L50) and Selection Range (SR) and mesh size for main target species in the Mediterranean.

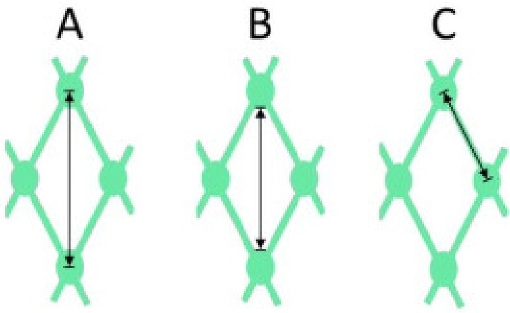


Figure 132. Technical parameters defining mesh size of net: A) Mesh Length; B) Mesh Opening; C) Mesh Bar or Mesh Side. *Courtesy of Sala et al. (2013).*

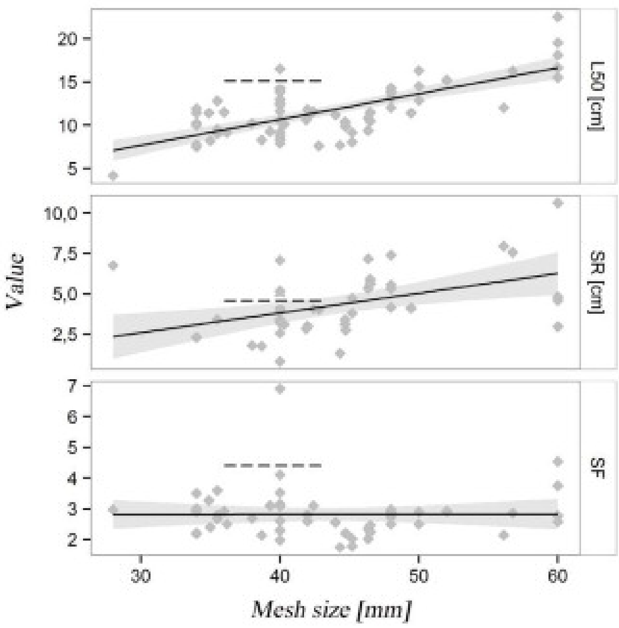


Figure 133. Relationship between selectivity parameters (L50% and SR) and mesh size for *M. merluccius*. Solid line represents diamond-mesh (DM) codends. Dashed line represents average value for square-mesh (SM) codends (because of the lack of available data).

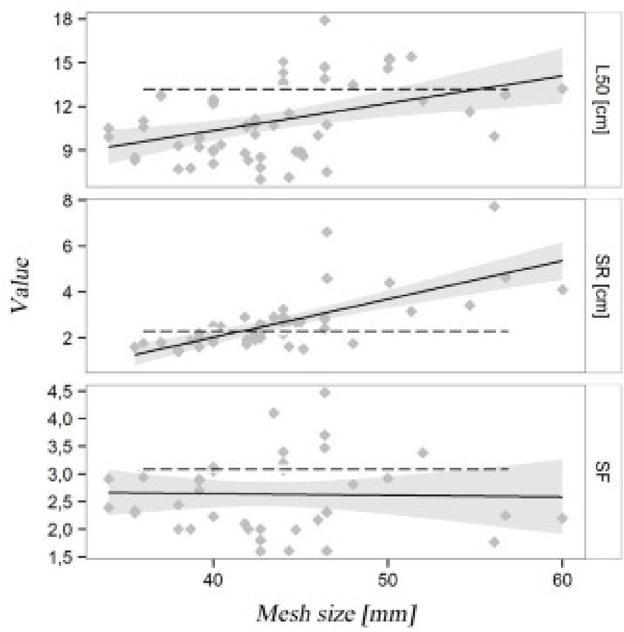


Figure 134. Relationship between selectivity parameters (L50% and SR) and mesh size for *M. barbatus*. Solid line represents diamond-mesh (DM) codends. Dashed line represents average value for square-mesh (SM) codends (because of the lack of available data).

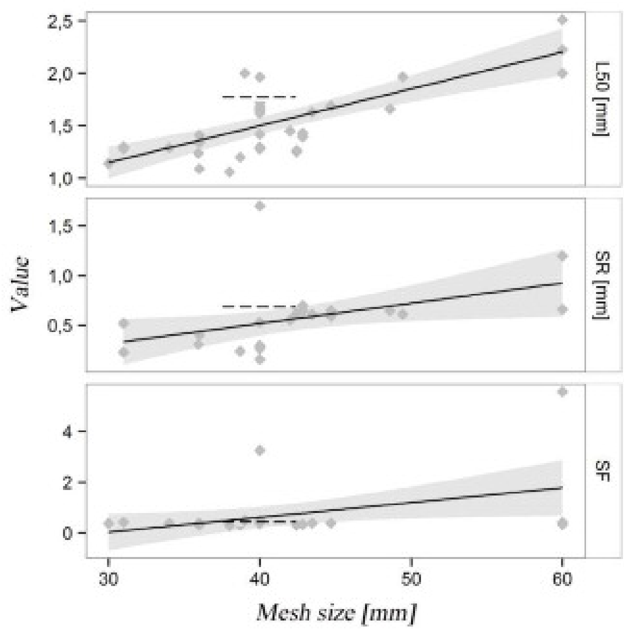


Figure 135. Relationship between selectivity parameters (L50% and SR) and mesh size for *P. longirostris*. Solid line represents diamond-mesh (DM) codends. Dashed line represents average value for square-mesh (SM) codends (because of the lack of available data).

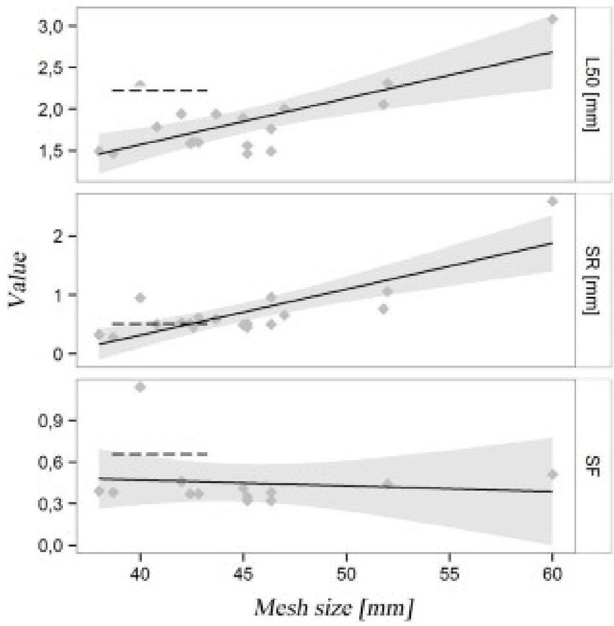


Figure 136. Relationship between selectivity parameters (L50% and SR) and mesh size for *N. norvegicus*. Solid line represents diamond-mesh (DM) codends. Dashed line represents average value for square-mesh (SM) codends (because of the lack of available data).

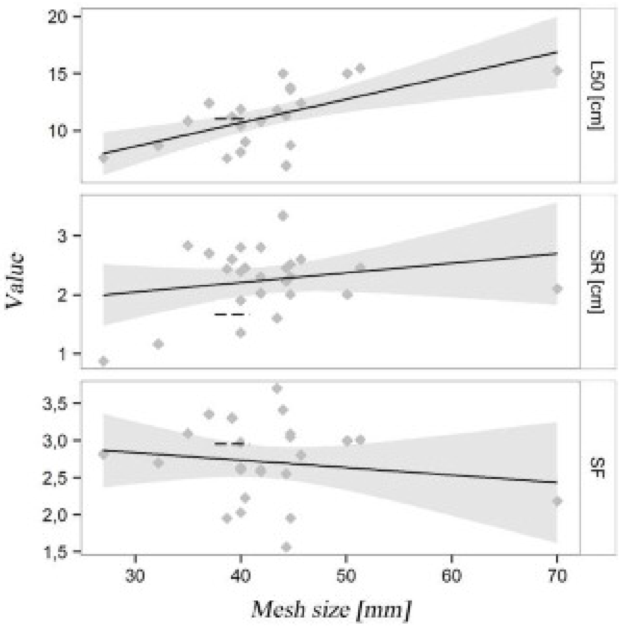


Figure 137. Relationship between selectivity parameters (L50% and SR) and mesh size for *P. erythrinus*. Solid line represents diamond-mesh (DM) codends. Dashed line represents average value for square-mesh (SM) codends (because of the lack of available data).

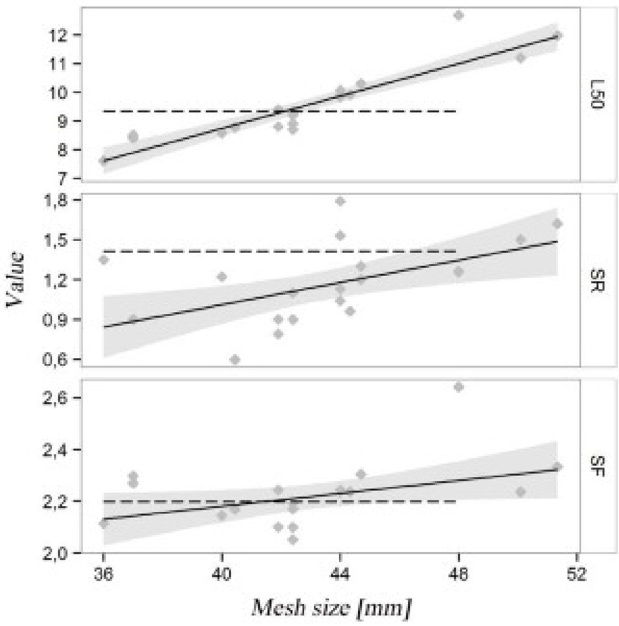


Figure 138. Relationship between selectivity parameters (L50% and SR) and mesh size for *D. annularis*. Solid line represents diamond-mesh (DM) codends. Dashed line represents average value for square-mesh (SM) codends (because of the lack of available data).

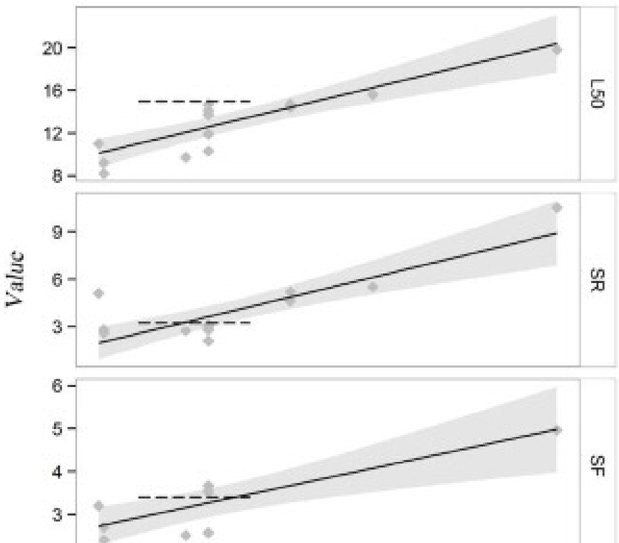


Figure 139. Relationship between selectivity parameters (L50% and SR) and mesh size for *Trachurus* spp. Solid line represents diamond-mesh (DM) codends. Dashed line represents average value for square-mesh (SM) codends (because of the lack of available data).

4.2.2. Mesh geometry

Mesh geometry is an important technical factor that is known to affect bottom trawl selectivity. Diamond-mesh codends are historically most commonly used in Mediterranean bottom trawl fisheries, while square-mesh codends have only recently been introduced with the EC Regulation 1967/2006 (Figure 140). Few years before this regulation came into power the number of studies studying square-mesh codend selectivity increased in number (Figure 141). Majority of the studies demonstrated better juvenile release efficiency when square-mesh codend was used compared to the diamond-mesh codend of the same mesh size. However, the inevitable short term economic losses usually discourage fishermen from using it. For example, Bahamon et al. (2006) estimated 12-33 % short term economic losses for 40 mm square-mesh codends in shallow shelf fishing grounds in the Mediterranean due to the escape of a high number of small species with relatively high commercial value. Furthermore, the improvement in selectivity when using the square-mesh was not evident for flatfishes most likely due to their specific cross sectional shape.

Many recent studies performed in the Mediterranean that compared the selectivity of diamond and square-mesh codend of the same mesh size, showed that square-mesh codends are much better in releasing juveniles of target fish. This is mostly because diamond-meshes close under the weight of the catch, reducing the juvenile release efficiency, while meshes in square-mesh codend showed to be much more stable during the tow.

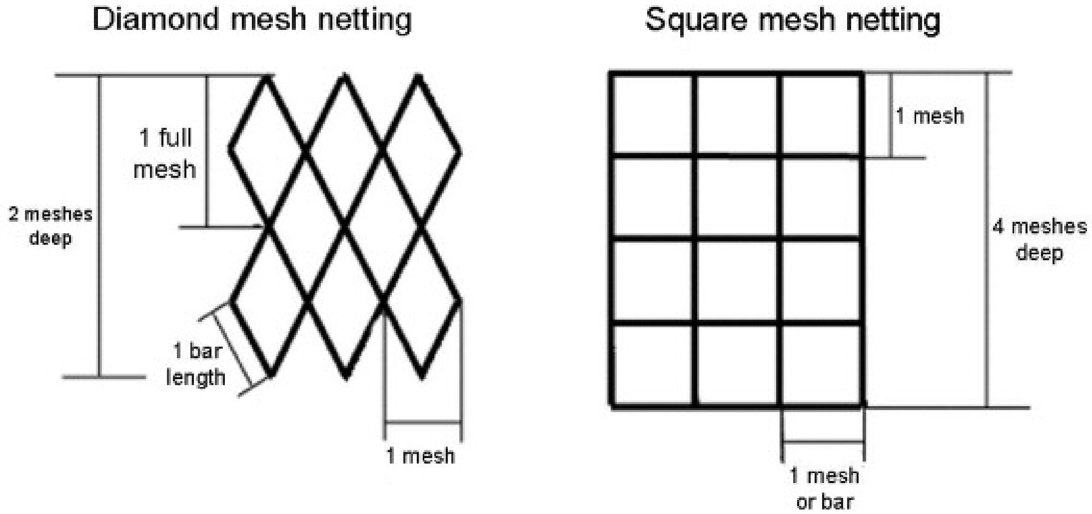


Figure 140. Diamond- and square-mesh netting. *Courtesy of Sala et al. (2013).*

Several studies have demonstrated that a different configuration (square or T90, Figure 140) can greatly improve the selective performance of the trawl (Ordines et al., 2006; Lucchetti, 2008; Sala et al., 2008; Tosunoğlu et al., 2009; Sala et al., 2014). In this regard, the GFCM Recommendation 33/2009/2 on the minimum mesh size in the codend of demersal trawl nets state that: “The Members and Cooperating entities of GFCM shall adopt and implement, at latest by 31 January 2012, a minimum 40 mm square-mesh codend or a diamond-mesh size of at least 50 mm, of acknowledged equivalent or higher size selectivity, for all trawling activities exploiting demersal stocks when operating in the GFCM Area”.

Article 9 of the Council Regulation (EC) No 1967/2006 established the mandatory use of 40 mm square-meshed netting at the codend of towing nets or, at the duly justified request of the ship-owner, by a diamond-meshed net of 50 mm. In multispecies fisheries such as demersal trawl fisheries in the Mediterranean, it is difficult to choose a single codend mesh that would be appropriate for all the species in the catch, due to differences in body shape and size at first maturity. From the graphs in Figure 142 and Figure 143 we can see that some of the investigated species benefit from DM50 codends while for some species change from SM40 to DM50 did not have any significant effect (see for the literature review Table 8 in the *Annex 2. . Mediterranean selectivity* studies). This is probably related to the cross sectional shape of the fish.

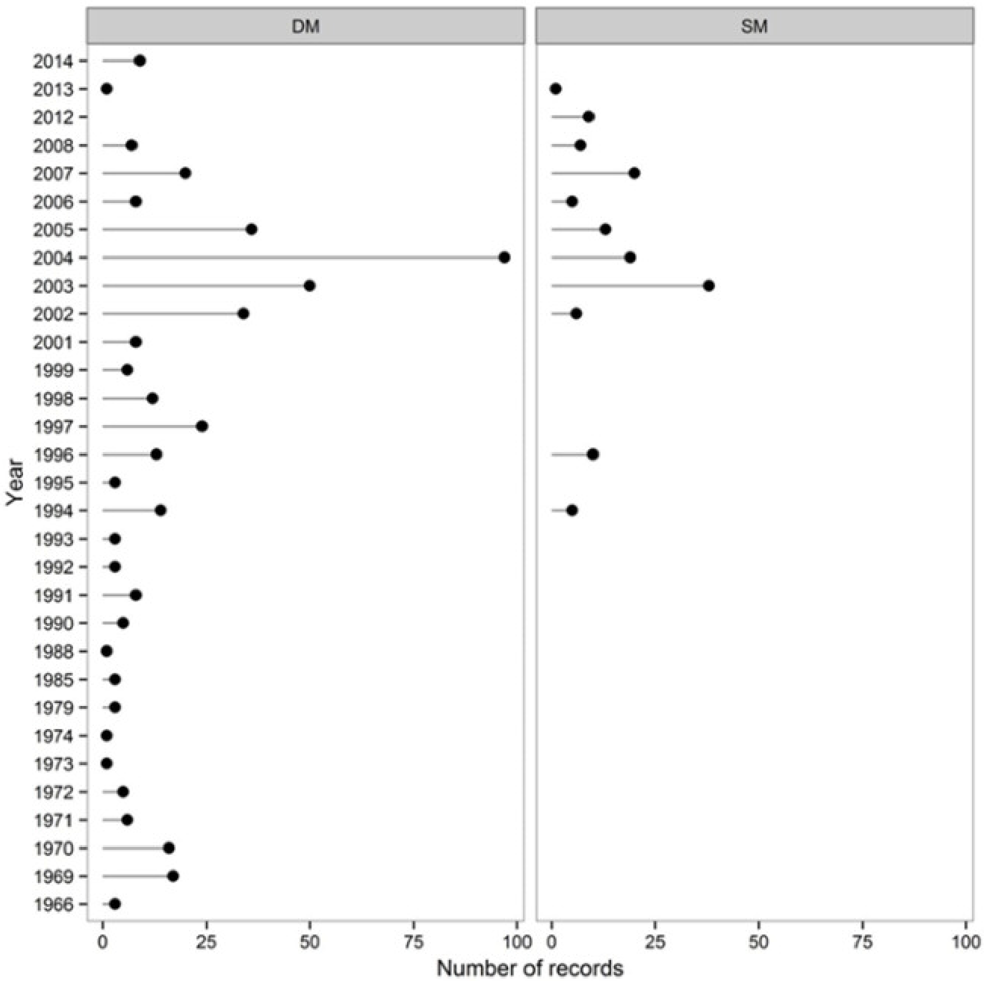


Figure 141. Number of records per year collected from the literature (DM: diamond-mesh; SM: square-mesh).

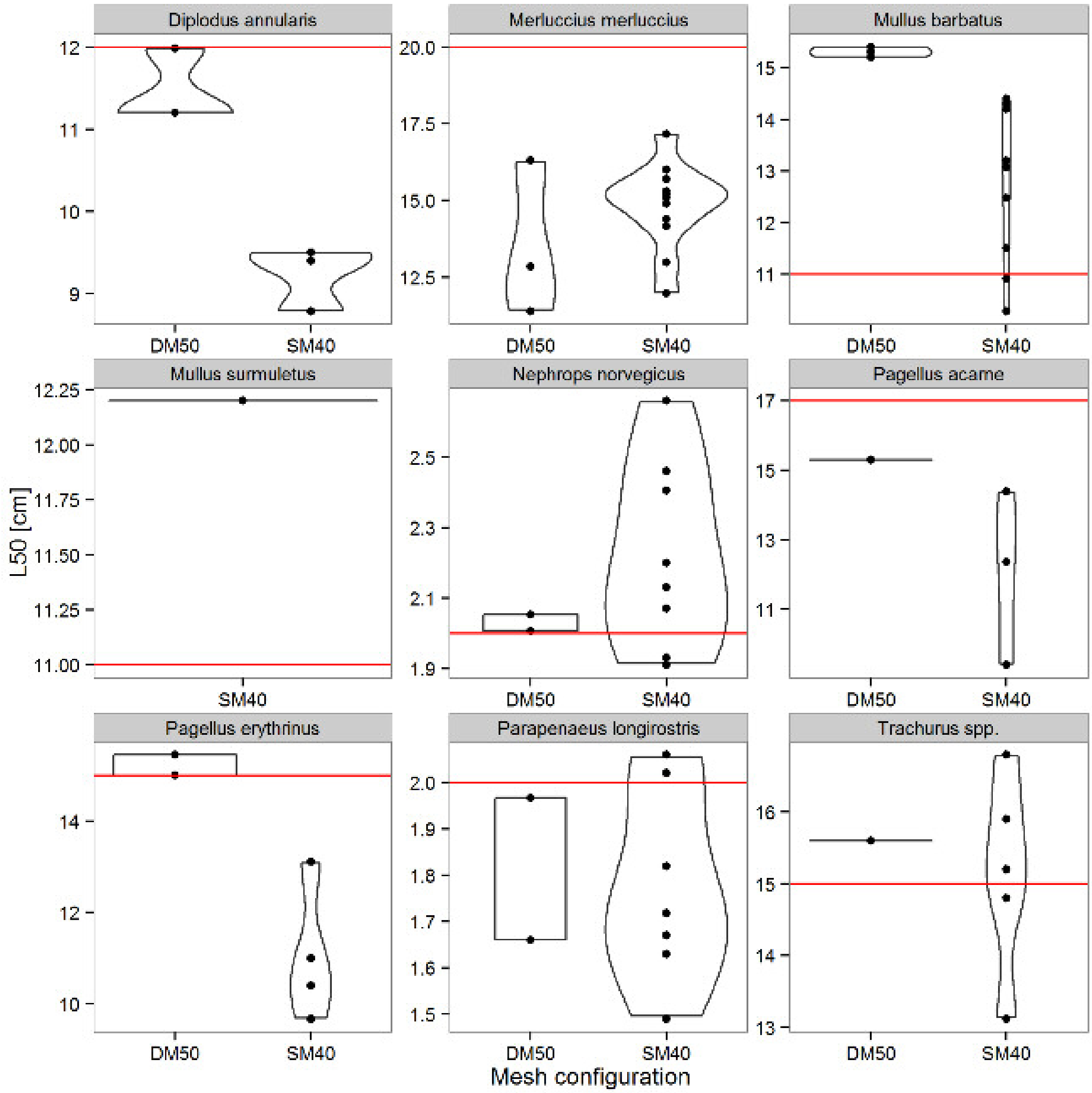


Figure 142. The range of selectivity parameter L50 (length of fish that has a 50% probability of being retained or escaping after entering the codend) obtained from the literature for 40 mm square-mesh (SM40) and 50 mm diamond-mesh (DM50) codends in relation with species specific MLS (red line) defined in the EC Regulation 1967/2006. See Table 8 in the *Annex 2. . Mediterranean selectivity* studies.

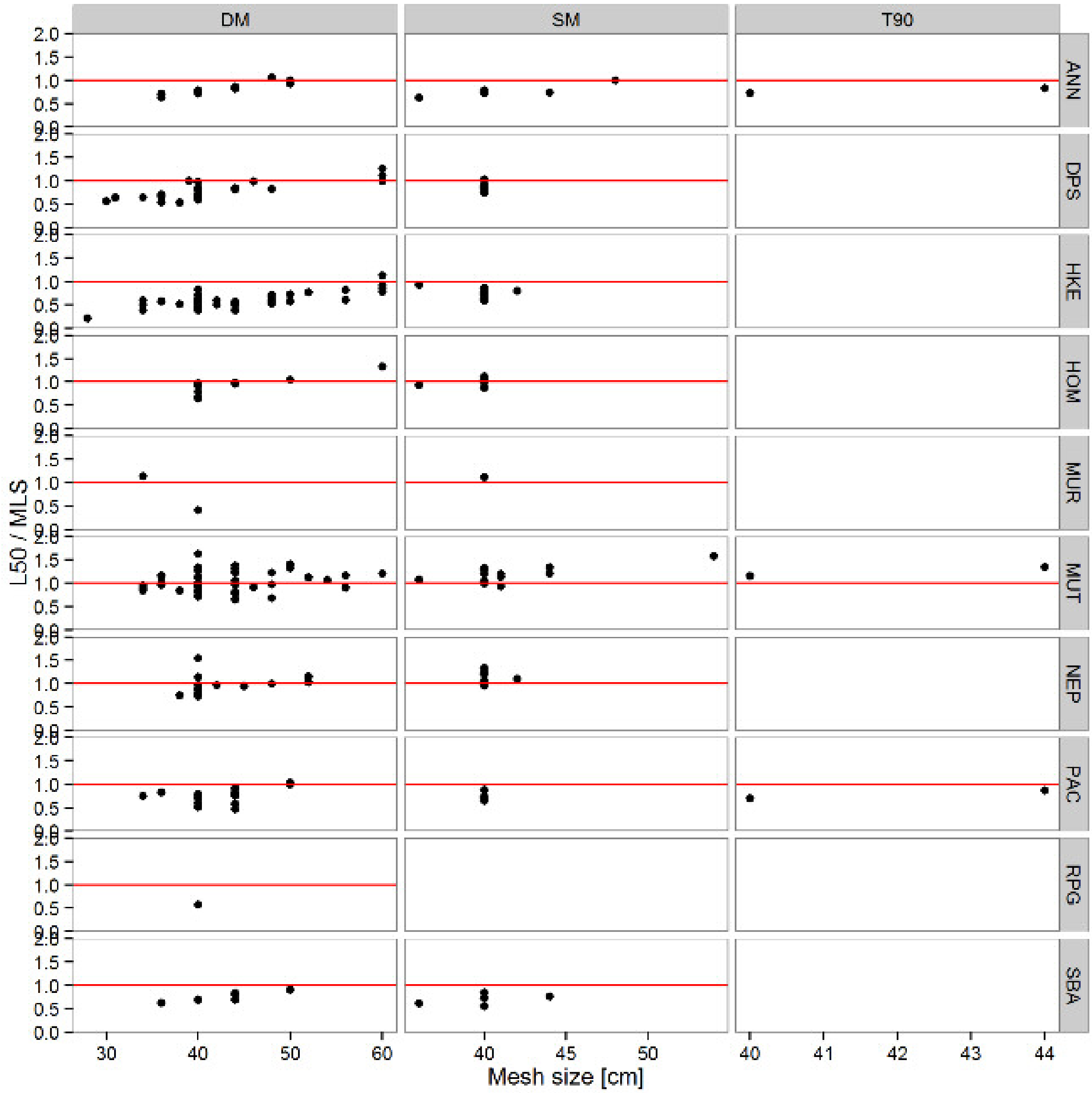


Figure 143. Relationship between the ratio of L50 and MLS versus mesh size for species having MLS in the EU Regulation 1967/2006, collected from literature analysis (see Table 8 in the *Annex 2. . Mediterranean selectivity* studies).

4.2.2.1. T90 codend

This is the name given to diamond-mesh turned by 90 degrees. Traditionally, the orientation of diamond-mesh netting is determined by the orientation of the knots used in the netting manufacturing. By turning the netting 90 degrees, the meshes do not close as tightly under load and small fish and other animals can escape. The T90 codend has the advantage that it is easier to mount on a net than a square-mesh and there is no loss of net in the construction of T90 panels. However, it is evident that the square-mesh stays more open and selectivity is also affected by this (Figure 144). Only Tokaç et al. (2014) tested T90 in Mediterranean and compared it to conventional diamond-mesh codend. The results showed significant improvement in size selectivity for red mullet and common pandora but not for annular sea bream. According to the authors, this was attributed to the because of different morphologies.

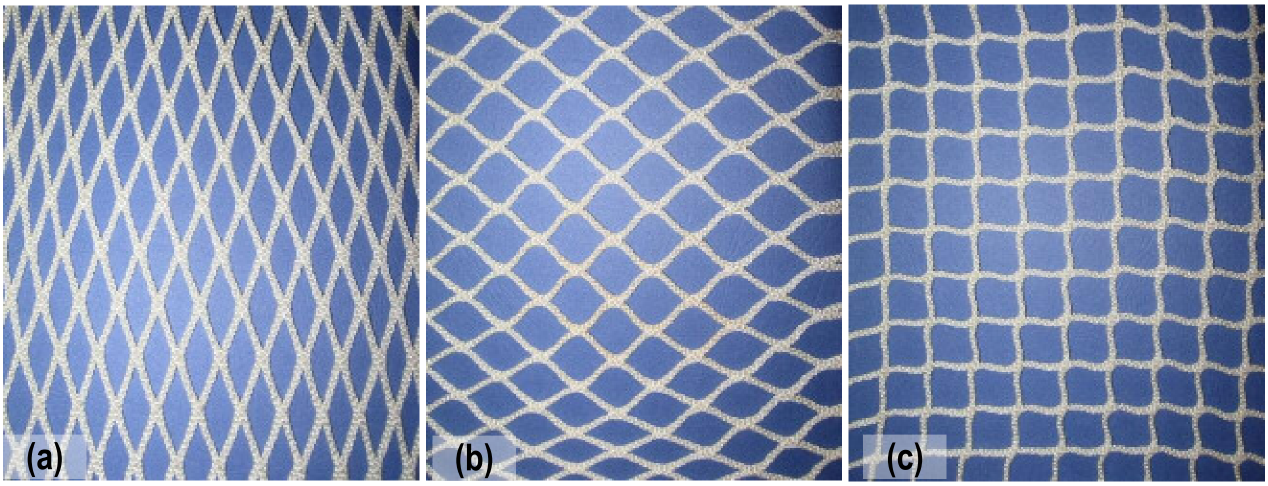


Figure 144. Mesh configuration tested in the Mediterranean Sea: a) diamond-; b) T90, and; c) square-mesh netting. *Courtesy of A. Lucchetti (CNR, Italy).*

Tokac A., Herrmann B., Aydın C., Kaykac A., Ünlülera A., Gökce G., 2014. Predictive models and comparison of the selectivity of standard (T0) and turned mesh (T90) codends for three species in the Eastern Mediterranean. Fisheries Research, 150: 76-88.

The main objective of this study was to compare and predict the size selective properties of 90◦turnedmesh codends (T90) with those of similar standard diamond-mesh codends (T0) without other design changes. In particular, we wanted to investigate whether a T90 codend can be a simple way to improve size selectivity in the multi-species Mediterranean demersal trawl fisheries. Data were collected and analysed for three species, while considering the codend design parameters mesh size (m) and netting direction (T0 or T90) as potential fixed effects for size selection parameters 50% retention length (L50) and selection range (SR). A special model was constructed and model choice was performed separately for red mullet (*Mullus barbatus*), common pandora (*Pagellus erythrinus*) and annular sea bream (*Diplodus annularis*) based on the AIC value (Akaike, 1974) while considering every possible simpler sub-model following the procedure described in Wienbeck et al. (2011). L50 and SR predictions were made based on this model for T0 and T90 codends with mesh sizes from 38 mm to 52 mm for each species separately. The findings revealed that T90 codends significantly improve size selectivity of red mullet and common pandora compared to conventional T0 codends of the same mesh size. However, L50 and SR values for T0 and T90 codends were found to be similar for annular sea bream. This difference in codend size selectivity between species with regard to turning codend netting orientation by 90◦may be related to the difference in body shape. Red mullet and common pandora have rounded shapes while annular sea bream has a laterally compressed body shape. Increase in mesh size was found to increase L50 for all three species for both codend types.

4.2.2.2. Square-mesh panel

As showed above, the most obvious and widely used technique to change the selectivity of a trawl gear is to increase the codend mesh size. Alternatively, it's possible to replace the traditional diamond-meshes with a square-mesh codend. The advantage of square-mesh is that it remains open under load unlike diamond-meshes which close, thus hampering the escape of small animals. The effect of square-mesh codend has been already described. In some countries, the use of square-mesh windows has been widely investigated and they have been included in the legislation. The size of square-mesh used in the panel directly determines the size of fish that are allowed to escape. Square-mesh netting panels can be simply constructed from diamond-mesh material by turning the netting panel 45 degrees. However, these panels may suffer from the knots slippage if made from knotted net material. As a result, square-mesh codends are usually constructed from knotless material. Repairing damaged square-mesh netting is a more difficult task, but they have been demonstrated to substantially reduce bycatch in some fisheries. This device can be used in shrimp and fish trawl fisheries.

The use of square-mesh windows has been extensively studied in a variety of locations in the upper panel of the trawl, including the codend extension piece and near the bosom of the headrope (Figure 145). They have been shown to be particularly effective in fisheries where particular species exhibit distinctive upward escape reactions.

A particular type of square-mesh window is the Bacoma panel. The Bacoma-selectivity window is a relatively recent development, emanating from the Baltic Sea area. The BACOMA codend is a codend with the upper panel consisting mainly of one large square-mesh window that allows juvenile fish to escape, an idea dating back to the mid-1990s (Madsen et al., 1999). Square-mesh panels inserted in the top of the net have been shown to allow smaller fish to escape, where otherwise they would have been trapped in the codend. However, square-mesh panels have several problems: they are harder to insert and repair for fishermen and their effectiveness depends on their position in the net, visibility and ambient light levels. The BACOMA escape window became part of technical regulations in the IBCFC (International Baltic Sea Fisheries Commission) in 2001. Some prototypes of Square-mesh panel tested in the Mediterranean Sea have been reported in Figure 145. Nevertheless, studies on the effect of square-mesh windows in the Mediterranean are scarce (Table 4).

Figure 145. Square-mesh panel tested in the Mediterranean Sea. *Courtesy of A. Lucchetti (CNR, Italy).*

Metin, C., Özbilgin, H., Tosunoğlu, Z., Gökçe, G., Aydin, C., Metin, G., Ulaş, A., Kaykaç, H., Lök, A., Düzbastilar, F.O., Tokaç, A., 2005. Effect of square-mesh escape window on codend selectivity for three fish species in the Aegean Sea. Turk. J. Vet. Anim. Sci., 29: 461-468.

Poor selectivity of conventional trawl codends has recently been a serious concern in Turkish fisheries. Modification of the codends to reduce the capture of juvenile fish has been one of the management tools for sustainable fisheries. This study investigates effect of square-mesh escape window installation on selectivity of bottom trawl codends for red mullet (*Mullus barbatus*), annular sea bream (*Diplodus annularis*) and common pandora (*Pagellus erythrinus*) in the Aegean Sea. Codend mesh selectivity experiments were carried out using 40 mm nominal diamond-mesh PE codend with a square-mesh escape window inserted in the forward part of the top panel. The experiments were carried out in Üzmir Bay in the eastern Aegean Sea between 24th June and 31st July 2002 on board R/V "Eges". A total of 9 valid hauls were made by using hooped covered codend method. Selectivity parameters were obtained by using logistic equation with the maximum likelihood method. Mean L50 s and selection ranges of the window installed codend were found as 12.55 (se 0.18) and 2.27 (se 0.06) cm for red mullet, 9.49 (se. 0.27) and 1.26 (se. 0.05) cm for annular sea bream and 12.18 (se 0.31) and 2.00 (se 0.07) cm for common pandora, respectively. Comparison of the results with those obtained in other studies carried out in the same area by using conventional codends show that the use of square-mesh escape window in the forward part of the top panel increases the escape of juvenile red mullet, annular sea bream and common pandora.

Brčić, J., Herrmann, B., Sala, A., 2015. Can a square-mesh panel inserted in front of the codend improve size and species selectivity in trawl fisheries? (ICES WGFTFB 2015, Lisbon, Portugal, May 2015, Conference paper).

A 50 mm square-mesh panel was inserted in front of the codend in a typical Mediterranean bottom trawl net to improve the selectivity for *Trachurus Trachurus* (Atlantic horse mackerel), *Merluccius merluccius* (European hake), *Mullus barbatus* (red mullet), *Trisopterus minutus* (poor cod), *Illex coindetti* (broadtail shortfin squid), and *Parapaeneus longirostris* (deep-water rose shrimp). Escapement through the square-mesh panel was low, and differences in selectivity between the system with and without the panel were not significant. The low release efficiency of the square-mesh panel was caused by the lack of fish making contact with the panel during their drift toward the codend. Contact with the selection device was thus found to be the main factor influencing the size selectivity of trawl net equipped with the square-mesh panel positioned in front of the codend.

Tokaç, A., Ozbilgin, H., Kaykac, H., 2010. Selectivity of conventional and alternative codend design for five fish species in the Aegean Sea. J. Appl. Ichthyol., 26: 403-409.

Currently, traditional Mediterranean trawls are generally made with non-selective netting and the fishing boats are involved in multi-species fisheries. As a result, most near-shore stocks are over-exploited. Weather permitting; the demersal trawl fleet tends to fish in relatively deeper, international waters of the Aegean Sea, where the catch is usually higher. Therefore, the need for evaluation of the codends used in these fisheries and the potential improvements to their selectivity is of prime importance. In the present study, selectivity data were collected for hake (*Merluccius merluccius*), blue whiting (*Micromesistius poutassou*), greater forkbeard (Phycis blennoides), blackbelly rosefish (*Helicolenus dactylopterus dactylopterus*) and fourspotted megrim (*Lepidorhombus boscii*) in commercial (300 MC) and square-mesh top panel (SMTPC) codends. Trawling was carried out at depths of 274-426 m onboard a commercial vessel chartered for a 15-day sea trial in August 2004. Selection parameters were obtained by fitting a logistic equation using a maximum likelihood method. Results of the selectivity analysis indicated that the commercially used 40 mm nominal mesh size PE codend was rather unselective for the species investigated in this study. In general, the square-mesh top panel codend has relatively higher L50 values than the commercial codend. However, except for blue whiting, even this codend is rather unselective when 50% maturity lengths (LM50) are considered.

Tokaç, A., Özbilgin, H., Kaykaç, H., 2009. Alternative codend designs to improve size selectivity for Norway lobster (Nephrops norvegicus) and rose shrimp (Parapenaeus longirostris) in the Aegean Sea. Crustaceana, 82: 689-702.

Rose shrimp (*Parapenaeus longirostris*) and Norway lobster (*Nephrops norvegicus*) are the two main target crustaceans for the demersal trawl fleet in the international waters of the Aegean Sea. In the present study, selectivity data were obtained for these two species in commercial codends (300 MC is 40 mm polyethylene codend with 300 meshes on its circumference) and two newly designed types, known as a narrow codend (200 MC is 40 mm polyethylene codend with 200 meshes on its circumference - 33% reduced) and square-mesh top panel codend (SMTPC is constructed as 150 diamond-meshes on the lower and 75 square-meshes on the top panel), respectively. These three types of codends were tested using the covered codend method. Trawling was carried out at depths ranging from 269 to 426 m onboard a commercial vessel in August 2004. Selection parameters were obtained by fitting a logistic equation using the maximum likelihood method. The rose shrimp, in terms of weight, was the most abundant marketable species, with catch per hour values of 19.1, 16.0, and 15.0 kg in 300 MC, 200 MC, and SMTPC, respectively. Results of the selectivity analysis indicate that the commercially used 40 mm nominal mesh size PE codend is rather unselective for these species. In general, narrow and square-mesh top panel codends have relatively higher L50values than the commercial codend. However, the differences are significant only for rose shrimp, but not for Norway lobster. It is concluded that despite the improvements in selectivity, the codend modifications ‘narrow’ and ‘square-mesh top panel’ were not sufficient to release immature specimens of either species, at least not when using the 40 mm PE standard netting.

Özbilgin, H., Tosunoglu, Z., Aydin, C., Kaykac, H., Tokac, A., 2005. Selectivity of standard, narrow and square-mesh panel trawl codends for hake (Merluccius merluccius) and poor cod (Trisopterus minutus capelanus). Turk. J. Vet. Anim. Sci., 29: 967-973.

The selectivity of 3 trawl codends, (1) a commercially used standard codend, (2) a narrow codend (100 meshes on its circumference instead of 200) and (3) a square-mesh top panel codend, was tested for hake (*Merluccius merluccius*) and poor cod (*Trisopterus minutus capelanus*) between 8 and 24 October 2003, in the Aegean Sea. Data were collected using the covered codend technique, and analysed by means of a logistic equation with the maximum likelihood method. The results show that the commercially used standard codend (40 mm mesh size PE codends, 200 meshes on its circumference) retains all the hake that enter and releases only a few specimens of poor cod. The narrow codend has better selectivity than the standard codend (L 50 = 14.28 cm for hake and 14.11 cm for poor cod). The selectivity of the square-mesh top panel codend was higher than that of the narrow codend for hake (L50 = 15.25 cm), while it was similar for poor cod (L50 = 14.25 cm).

Kaykac, H., 2010. Size selectivity of commercial (300 MC) and larger square-mesh top panel (LSMTPC) trawl codends for blue whiting (Micromesistius poutassou Risso, 1826) in the Aegean Sea. Afr. J. Biotechnol., 9: 9037-9041.

In the present study, size selectivity of a commercial (300 MC) and a larger square mesh top panel (LSMTPC) codend for blue whiting (*Micromesistius poutassou*) were tested on a commercial trawl net in the international waters between Turkey and Greece. Trawling, performed during daylight was carried out at depths ranging from 124 to 230 m, and towing speed changed between 2.2 and 2.3 knots for a 13-day sea trial in August 2005. Selectivity data were obtained by using the covered codend technique. Selection parameters were estimated by fitting a logistic equation using the maximum likelihood method. The results show that mean L50 values of 16.98 (s.e. 0.22) and 22.84 (s.e. 0.51) cm were estimated for 300 MC and LSMTPC, respectively. These values show that the LSMTPC codend has higher L 50 values than the 300 MC codend. In view of the length value of blue whiting at first maturity (15 to 18 cm), mean L50 value of LSMTPC codend is remarkably higher than 300 MC codend.

Table 4. Selectivity parameters for *panel+codend* trawl systems from literature review. Year: time when the experiment was conducted; Area: geographical area; GSA: GFCM Geographical Sub-Areas; MLS: minimum landing size as defined by Council Regulation (EC) No. 1967/2006; System: codend (C) or grid+codend (GC); MC: mesh configuration (DM, diamond; SM, square-mesh); NMS: nominal mesh size in the codend; MMS: measured mesh size in the codend; L50: length of fish that has a 50% probability of being retained or escaping after entering the codend; SR: difference in length between the fish that has a 75 and 25 % probability of retention;

ID	Year	Area	GSA	Species	MLS	System	C_MC	C_NMS	C_MMS	SMP_MC	SMP_NMS	SMP_MMS	L50	SR	Reference
1	2004	East Aegean Sea	22	HKE	20	C	DM	40	42.42	NA	NA	NA	11.59	4.07	Tokaç et al., 2009a
1	2004	East Aegean Sea	22	WHB	NA	C	DM	40	42.42	NA	NA	NA	18.75	4.43	Tokaç et al., 2009a
1	2004	East Aegean Sea	22	GFB	NA	C	DM	40	42.42	NA	NA	NA	12.53	3.77	Tokaç et al., 2009a
1	2004	East Aegean Sea	22	BRF	NA	C	DM	40	42.42	NA	NA	NA	7.7	1.43	Tokaç et al., 2009a
1	2004	East Aegean Sea	22	HKE	20	SMP&C	DM	40	41.43	SM	40	41.65	15.2	5.89	Tokaç et al., 2009a
1	2004	East Aegean Sea	22	WHB	NA	SMP&C	DM	40	41.43	SM	40	41.65	19.42	2.8	Tokaç et al., 2009a
1	2004	East Aegean Sea	22	GFB	NA	SMP&C	DM	40	41.43	SM	40	41.65	20.88	10.27	Tokaç et al., 2009a
1	2004	East Aegean Sea	22	BRF	NA	SMP&C	DM	40	41.43	SM	40	41.65	10.36	1.93	Tokaç et al., 2009a
2	2003	East Aegean Sea	22	HKE	20	C	DM	40	NA	NA	NA	NA	14.28	3.42	Özbilgin et al., 2005
2	2003	East Aegean Sea	22	HKE	20	SMP&C	DM	40	NA	SM	40	NA	15.25	2.87	Özbilgin et al., 2005
2	2003	East Aegean Sea	22	POD	NA	C	DM	40	NA	NA	NA	NA	14.11	1.69	Özbilgin et al., 2005
2	2003	East Aegean Sea	22	POD	NA	SMP&C	DM	40	NA	SM	40	NA	14.25	1.61	Özbilgin et al., 2005
3	2004	East Aegean Sea	22	NEP	2	C	DM	40	42.42	NA	NA	NA	15.86	5.18	Tokaç et al., 2009b
3	2004	East Aegean Sea	22	NEP	2	C	DM	40	42.83	NA	NA	NA	15.98	6.15	Tokaç et al., 2009b
3	2004	East Aegean Sea	22	NEP	2	SMP&C	DM	40	41.43	SM	40	41.66	17.01	7.86	Tokaç et al., 2009b
3	2004	East Aegean Sea	22	DPS	2	C	DM	40	42.42	NA	NA	NA	12.66	6.21	Tokaç et al., 2009b
3	2004	East Aegean Sea	22	DPS	2	C	DM	40	42.83	NA	NA	NA	14.29	6.43	Tokaç et al., 2009b
3	2004	East Aegean Sea	22	DPS	2	SMP&C	DM	40	41.43	SM	40	41.66	14.3	7.08	Tokaç et al., 2009b
4	2002	East Aegean Sea	22	MUT	11	SMP&C	DM	40	NA	SM	40	NA	12.55	2.2	Metin et al., 2005
4	2002	East Aegean Sea	22	ANN	12	SMP&C	DM	40	NA	SM	40	NA	9.3	0.9	Metin et al., 2005
4	2002	East Aegean Sea	22	PAC	15	SMP&C	DM	40	NA	SM	40	NA	11.3	2.3	Metin et al., 2005
5	2005	East Aegean Sea	22	WHB	NA	C	DM	40	NA	NA	NA	NA	16.98	3.47	Kaykac, 2010
5	2005	East Aegean Sea	22	WHB	NA	SMP&C	DM	40	NA	SM	NA	NA	22.84	7.32	Kaykac, 2010
6	2012	Tyrrhenian Sea	9	HOM	15	SMP&C	DM	50	51.9	SM	50	51.6	15.17	4.72	Brčić et al. (unpublished data)
6	2012	Tyrrhenian Sea	9	HKE	20	SMP&C	DM	50	51.9	SM	50	51.6	13.71	3.37	Brčić et al. (unpublished data)
6	2012	Tyrrhenian Sea	9	MUT	11	SMP&C	DM	50	51.9	SM	50	51.6	10.35	9.11	Brčić et al. (unpublished data)
6	2012	Tyrrhenian Sea	9	POD	NA	SMP&C	DM	50	51.9	SM	50	51.6	11.08	3.04	Brčić et al. (unpublished data)
6	2012	Tyrrhenian Sea	9	SQM	NA	SMP&C	DM	50	51.9	SM	50	51.6	6.29	2.52	Brčić et al. (unpublished data)
6	2012	Tyrrhenian Sea	9	DPS	2	SMP&C	DM	50	51.9	SM	50	51.6	16.7	4.88	Brčić et al. (unpublished data)

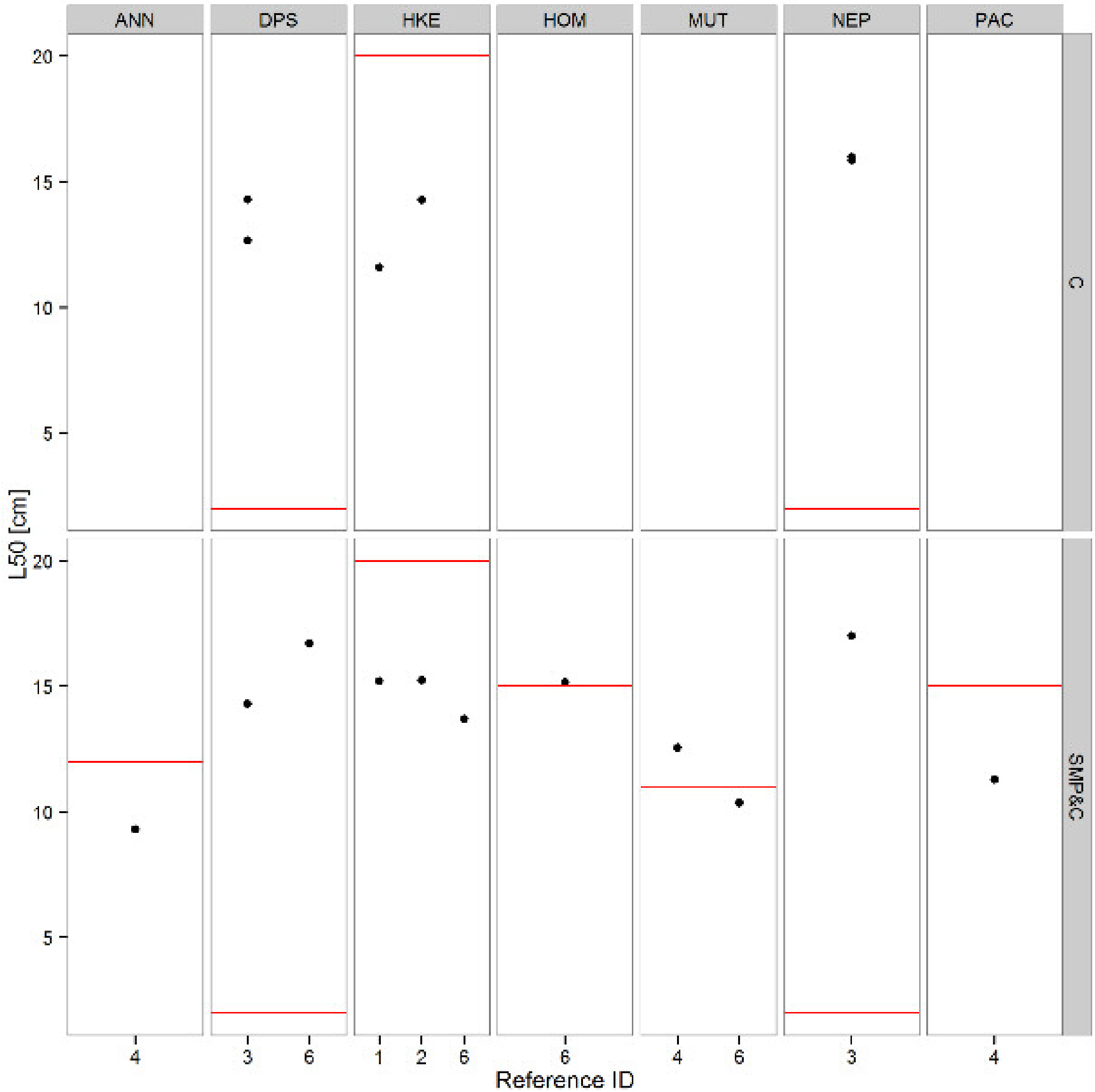


Figure 146. The range of selectivity parameter L50 (length of fish that has a 50% probability of being retained or escaping after entering the codend) reported by studies which used square-mesh panel in order to improve the selectivity of bottom trawls in Mediterranean. Red line represents MLS for every species as defined in the EC Regulation 1967/2006.

4.2.3. Mesh opening angle

As mentioned above, mesh size is the most studied factors that affect codend selectivity. However, the same mesh size can have variable selectivity depending on the opening angle of the mesh. Mesh opening angle mostly depends on the weight of the catch in the codend and it can be manipulated by changing the number of meshes in the codend circumference. The effect of changing the number of meshes in the codend circumference on the selectivity of bottom trawls was first studied in the North Sea in the early nineties (Reeves et al., 1992). The study performed by Sala and Lucchetti (2010) was the first of this kind in the Mediterranean, whose results did not show any effect of increased circumference on the codend selectivity probably because of small catch sizes. However, the second study performed by Sala and Lucchetti (2011), where codend catches were larger, showed a relevant effect of codend circumference on selectivity. Figures below (from Figure 147 to Figure 151) demonstrate relationship between opening angles and mesh size for diamond- (DM) and square-mesh (SM) codends for various species.

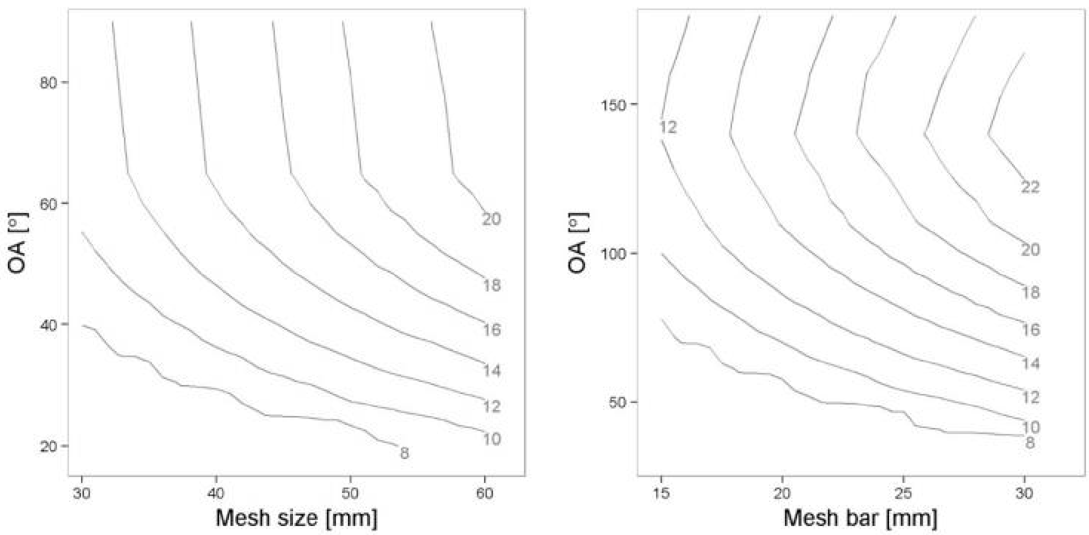


Figure 147. Relationship between Opening Angle (OA), mesh size and selectivity parameter L50 (isolines) for diamond (left) and square-mesh (modeled as hexagonal mesh) for *Merluccius merluccius*.

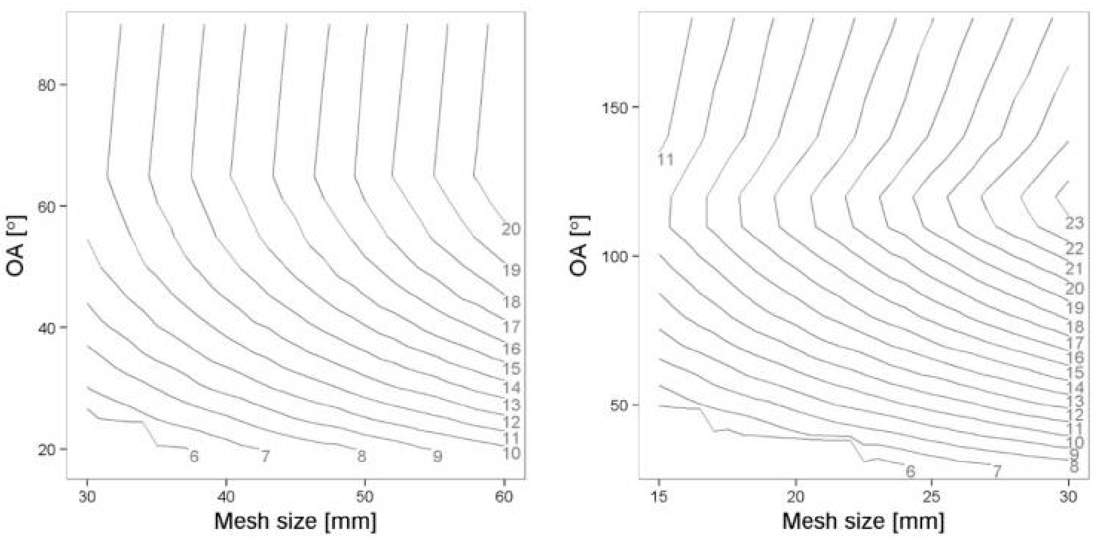


Figure 148. Relationship between Opening Angle (OA), Mesh size and selectivity parameter L50 (isolines) for diamond (left) and square-mesh (modeled as hexagonal mesh) for *Trachurus mediterraneus*.

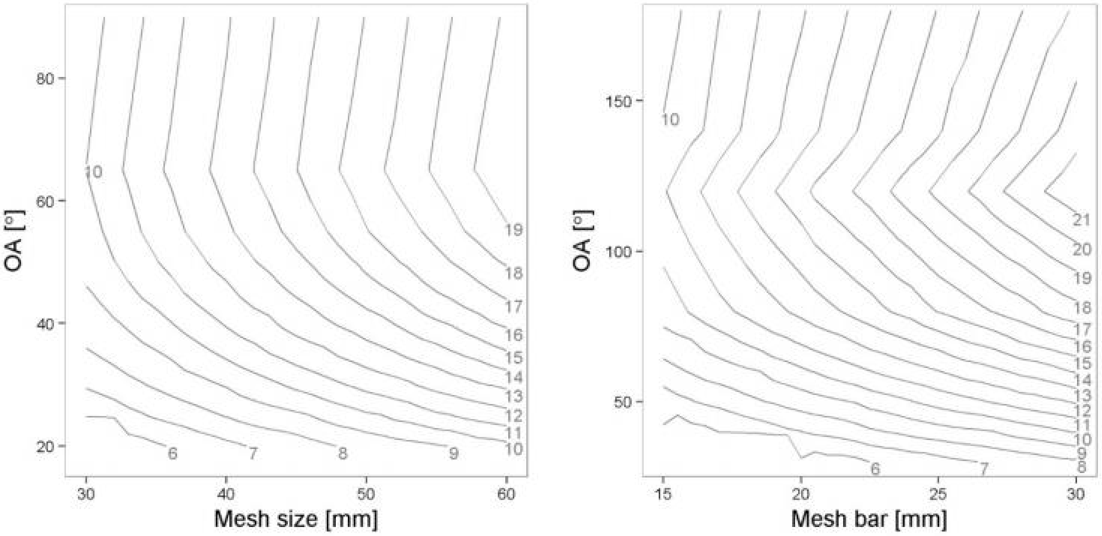


Figure 149. Relationship between Opening Angle (OA), Mesh size and selectivity parameter L50 (isolines) for diamond (left) and square-mesh (modeled as hexagonal mesh) for *Trachurus Trachurus*.

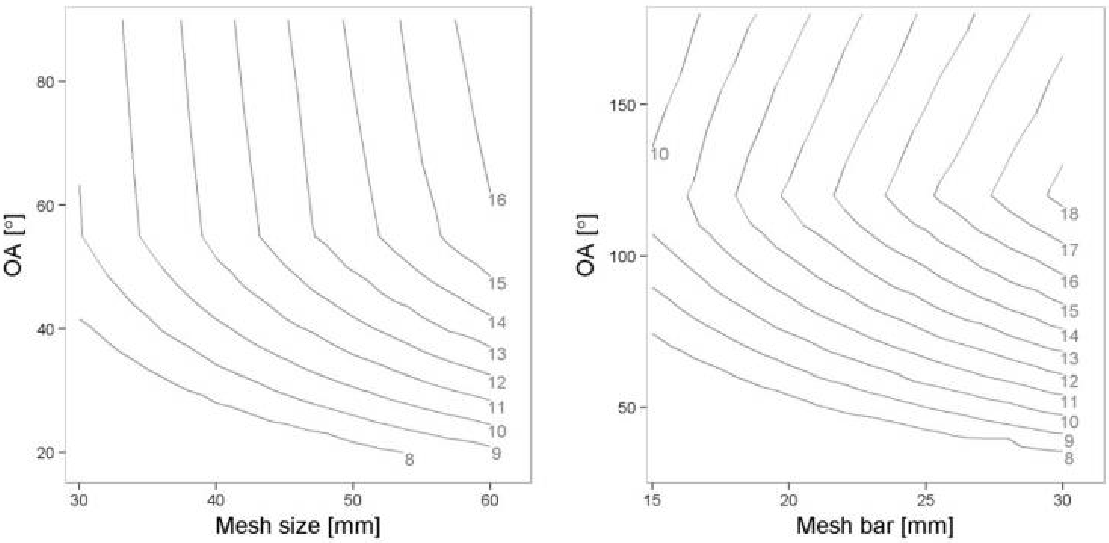


Figure 150. Relationship between Opening Angle (OA), Mesh size and selectivity parameter L50 (isolines) for diamond (left) and square-mesh (modeled as hexagonal mesh) for *Mullus barbatus*.

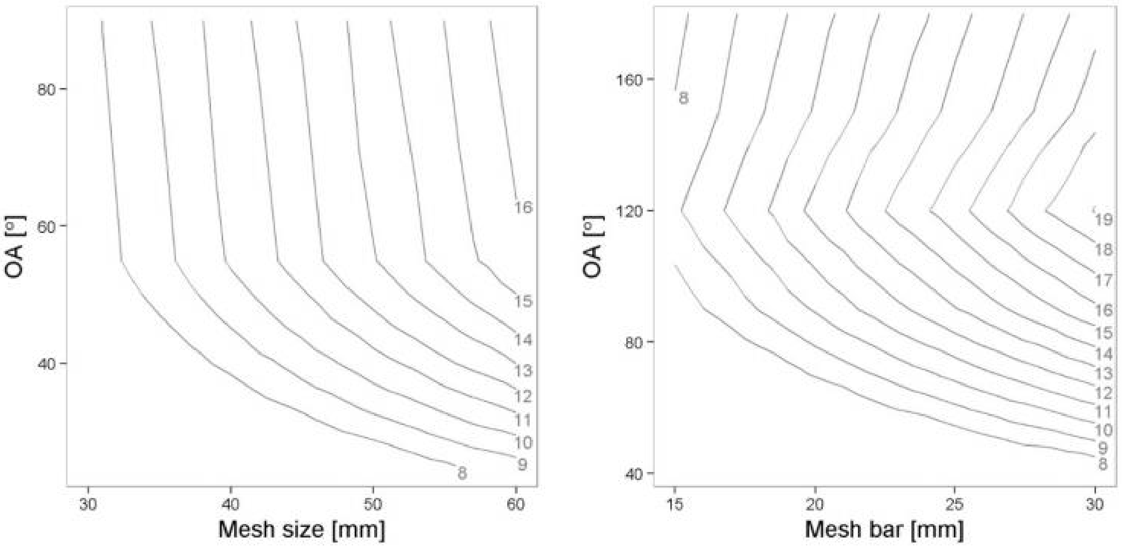


Figure 151. Relationship between Opening Angle (OA), Mesh size and selectivity parameter L50 (isolines) for diamond (left) and square-mesh (modeled as hexagonal mesh) for *Mullus surmuletus*.

4.2.4. Sorting Grids

Sorting grids are generally rigid panels of spaced bars made of aluminium, steel or plastic fitted to the extension of the trawl, immediately in front of the codend. Sorting grids are used to physically block the passage of bycatch into the codend and guide it toward an escape opening while small animals (including shrimp) pass through the bars of the grid and enter the codend. As animals pass through the net, they are eventually deflected by the grid and guided towards the escape opening. The grid can be oriented to guide animals through an escape in the upper or lower panel of the codend. Sometimes, a non-rigid inclined panel of netting is used to drive bycatch towards the escape opening at the top of the trawl. Thus, depending on material used to construct the inclined grid or netting panel, it is possible to identify either "hard" or "soft" grids. The escape opening is a sort of hole-cut in the codend and is usually covered with a netting to prevent the escape of marketable catch, shrimp included. The cover must be constructed with a mesh size small enough so that large animals do not become entangled as they are trying to escape. The cover must also act as a trapdoor, allowing unhindered escape of these animals and quickly returning to close the escape opening. The grid is sewn into the net at an angle normally between 40 and 60 degrees and immediately behind an escape opening cut into the netting. Depending on the positioning and bar spacing of the grid, these devices can be tailored to reduce the capture of either large or small unwanted animals (Eayrs, 2007). Sorting grids are mandatory in certain fisheries, and are widespread in others. In most fisheries where the grids have been introduced, fishermen have initially complained that they are unwieldy, unpractical and cause the loss of commercial species. However, the use of the grids has subsequently become a marked success in reducing bycatch, although the loss of marketable catch remains a problem. There is little evidence that organisms are injured as they are deflected off the grid. Different types of grid devices are available for the reduction of unwanted bycatch. One of the most commonly used grids in the Southeast Asia (Thailand, Brunei Darussalam, Vietnam, Indonesia and Malaysia) is the *Juvenile and Trash Excluder Device* (JTED) that aims at excluding juvenile- and trash-fish (small, undersized fish and other animals that were traditionally discarded overboard because they had no economic value in bottom trawl shrimp fisheries).

In recent years, this part of the catch (juvenile- and trash-fish) has become an important source of income for many small-scale fishermen given that this part of catch can be sold as fish meal or food for cultured fish or shrimp. Shrimp trawling is generally regarded as one of the least selective fishing methods because the bycatch may consist of over several hundred teleost species. Thus, the development of technical solutions designed to exclude small fish from the trawl and maintain the catch of shrimp and large fish is essential. The JTED is a device composed by three sections hinged together. The first two sections are metal grids and the third section is a metal frame supporting a panel of fine-mesh netting. Small fish swim between the bars of the grids and escape. The netting panel in the third section helps maintaining the orientation of the device and hampering shrimp returning forward in the codend and escaping, and prevents small fish from re-entering the codend. For instance, *Juvenile and Trash Excluder Devices* (JTEDs) typically having a very small bar spacing of 50 or 55 mm is used in Norwegian waters and Barents Sea to exclude non-target fish species and juveniles, while JTEDs in southeast Asia have been tested with spacing ranging from 12-25 mm. A similar solution called Nordmore grid is also applied in other regions (Norway, North Atlantic etc.). Nordmore grid is an aluminium grid mainly designed to exclude large animals from shrimp trawls. In this type of grid, the space between bars is typically 100 mm. A funnel of netting guides all animals to the bottom of the grid. Large animals are guided by the grid towards the escape opening in the top of the codend, while shrimps and other small animals pass through the grid and enter the codend. The setting of the grid angle is essential to avoid the loss of shrimp. The grids can also be used to target large specimens while avoiding the catch of juveniles. In this case, the escape opening is usually positioned in the lower section of the net. Figure 152 summarizes selectivity parameters L50 (length of fish that has a 50% probability of being retained or escaping after entering the codend) reported by studies (mentioned above) which used sorting grids to improve the selectivity of bottom trawls in Mediterranean.

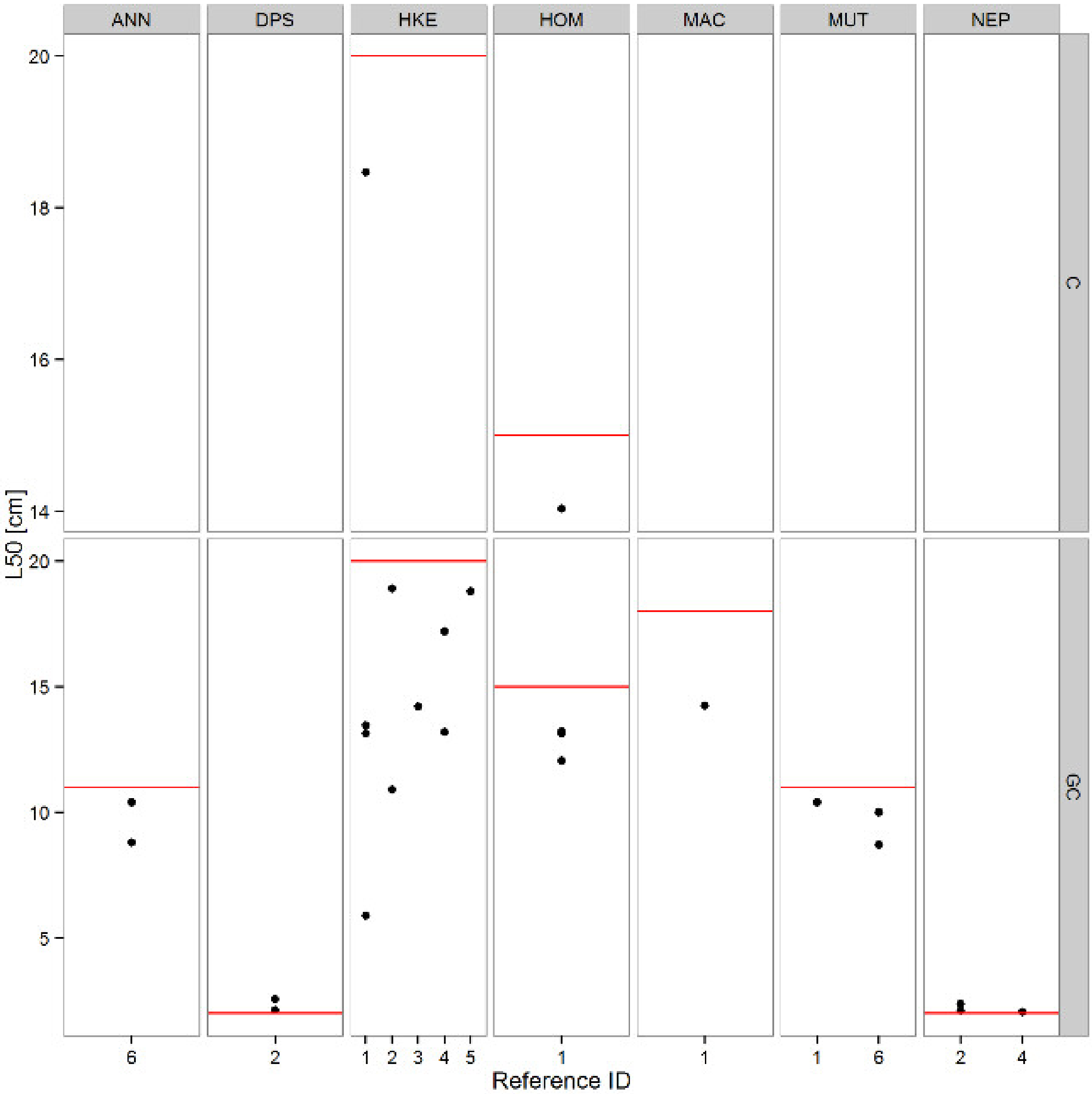


Figure 152. The range of selectivity parameter L50 (length of fish that has a 50 % probability of being retained or escaping after entering the codend) reported by studies which used sorting grids in order to improve the selectivity of bottom trawls in Mediterranean. Red line represents MLS for every species as defined in the EC Regulation 1967/2006. System: codend (C) or *grid+codend* (GC).

Table 5. Selectivity parameters for *grid+codend* trawl systems. Year: time when the experiment was conducted; Area: geographical area where the experiment was conducted; GSA: GFCM Geographical Sub-Areas (GSA) where experiment was conducted; Species: Species on which the selectivity experiment was conducted; MLS: minimum landing size as defined by Council Regulation (EC) No. 1967/2006; System: codend (C) or *grid+codend* (GC); MC: mesh configuration (DM, diamond; SM, square-mesh); NMS: nominal mesh size in the codend; MMS: measured mesh size in the codend; L50: length of fish that has a 50% probability of being retained or escaping after entering the codend; SR: difference in length between the fish that has a 75 % probability of retention and that with a 25% probability of retention.

Year	Area	GSA	Species	MLS	System	MC	NMS	Grid material	BS	L50	SR	Reference
2003	NW Mediterranean	6	HKE	20	C	SM	36	NA	NA	18.47	5.07	Sardà et al. (2006)
2003	NW Mediterranean	6	HKE	20	GC	DM	40	Rigid plastic	20	13.14	3.13	Sardà et al. (2006)
2003	NW Mediterranean	6	HKE	20	GC	DM	40	Rigid plastic	20	13.45	2.36	Sardà et al. (2006)
2003	NW Mediterranean	6	HKE	20	GC	DM	40	Rigid plastic	15	5.88	3.48	Sardà et al. (2006)
2003	NW Mediterranean	6	HOM	15	C	SM	36	NA	NA	14.03	2.48	Sardà et al. (2006)
2003	NW Mediterranean	6	HOM	15	GC	DM	40	Rigid plastic	20	13.22	4.55	Sardà et al. (2006)
2003	NW Mediterranean	6	HOM	15	GC	DM	40	Rigid plastic	20	13.13	3.33	Sardà et al. (2006)
2003	NW Mediterranean	6	HOM	15	GC	DM	40	Rigid plastic	15	12.05	4.24	Sardà et al. (2006)
2003	NW Mediterranean	6	MUT	11	GC	DM	40	Rigid plastic	20	10.4	3.9	Sardà et al. (2006)
2003	NW Mediterranean	6	MAC	18	GC	DM	40	Rigid plastic	20	14.25	4.25	Sardà et al. (2006)
2005	Balearic Islands	5	HKE	20	GC	DM	40	Flexible plastic	15	10.9	5.1	Massutí et al. (2009)
2005	Balearic Islands	5	HKE	20	GC	DM	40	Flexible plastic	20	18.9	3.4	Massutí et al. (2009)
2005	Balearic Islands	5	NEP	2	GC	DM	40	Flexible plastic	15	2.12	0.67	Massutí et al. (2009)
2005	Balearic Islands	5	NEP	2	GC	DM	40	Flexible plastic	20	2.38	0.86	Massutí et al. (2009)
2005	Balearic Islands	5	DPS	2	GC	DM	40	Flexible plastic	15	2.14	1.32	Massutí et al. (2009)
2005	Balearic Islands	5	DPS	2	GC	DM	40	Flexible plastic	20	2.57	1.14	Massutí et al. (2009)
2003	NW Mediterranean	6	HKE	20	GC	DM	40	two-sections	20	14.2	7.26	Sardà et al. (2005)
2005	NW Mediterranean	6	HKE	20	GC	DM	42	Flexible plastic with funnel	20	17.2	6.2	Bahamon et al. (2007)
2005	NW Mediterranean	6	HKE	20	GC	DM	42	Flexible plastic no funnel	20	13.2	3.6	Bahamon et al. (2007)
2005	NW Mediterranean	6	NEP	2	GC	DM	42	Flexible plastic no funnel	20	2.05	9.3	Bahamon et al. (2007)
2002	NW Mediterranean	6	HKE	20	GC	DM	40	rigid	20	18.8	2.1	Sardà et al. (2004)
2003	East Aegean Sea	NA	MUT	11	GC	DM	NA	rigid	12	8.7	1.7	Aydin et al. (2008)
2003	East Aegean Sea	NA	MUT	11	GC	DM	NA	rigid	14	10	2.9	Aydin et al. (2008)
2003	East Aegean Sea	NA	ANN	11	GC	DM	NA	rigid	12	8.8	1.6	Aydin et al. (2008)
2003	East Aegean Sea	NA	ANN	11	GC	DM	NA	rigid	14	10.4	2.5	Aydin et al. (2008)

Sala A., Lucchetti A., Affronte M., 2011. Effects of Turtle Excluder Devices on bycatch and discard reduction in the demersal fisheries of Mediterranean Sea. Aquat. Living Resour., 24: 183–192.

The Central Mediterranean provides important neritic habitats for loggerhead turtles (*Caretta caretta*), but Mediterranean bottom trawlers catch an estimated 30 000 turtles a year, with 25% mortality. Mortality by trawling is mainly due to enforced apnoea during towing activity. In order to reduce the submergence time and consequent turtle mortality, a specific technical modification was developed in the early 1980s: the Turtle Excluder Device (TED). In this paper, we field-tested a typical Supershooter TED and three new types of low-cost TED, built with different designs and materials, incorporating aspects of US and Australian TEDs, as well as design features to improve handling and catch rates. The performance of the TEDs was investigated under commercial fishing conditions in diverse trawling grounds in the Adriatic Sea (Mediterranean). All TEDs were easy to operate and did not require changes to normal fishing operations. Due to lack of entry of turtles it was not possible to evaluate the ability of the different TEDs to release turtles, but one large loggerhead turtle (*C. caretta*) was captured during the experimental tows and was successfully excluded by the Supershooter. The TEDs reduced anthropogenic debris and, consequently, sorting operations on board. Among the four TEDs tested, both the semi-rigid TED and the Supershooter performed in accordance with the design objectives: total discards were reduced but total commercial catches were not significantly reduced. With the Supershooter, all European hake (*Merluccius merluccius*) individuals equal to or above 16 cm were found in the codend and 10–15% of those between 5.0 and 15.5 cm were released. In general, the total discard rate of the TED-equipped nets was reduced to around 20–60%. Since the Council Regulation (EC) No. 1967/2006 called for a discard reduction policy in waters under the jurisdiction of the European Union, TEDs may have some broader value in this context.

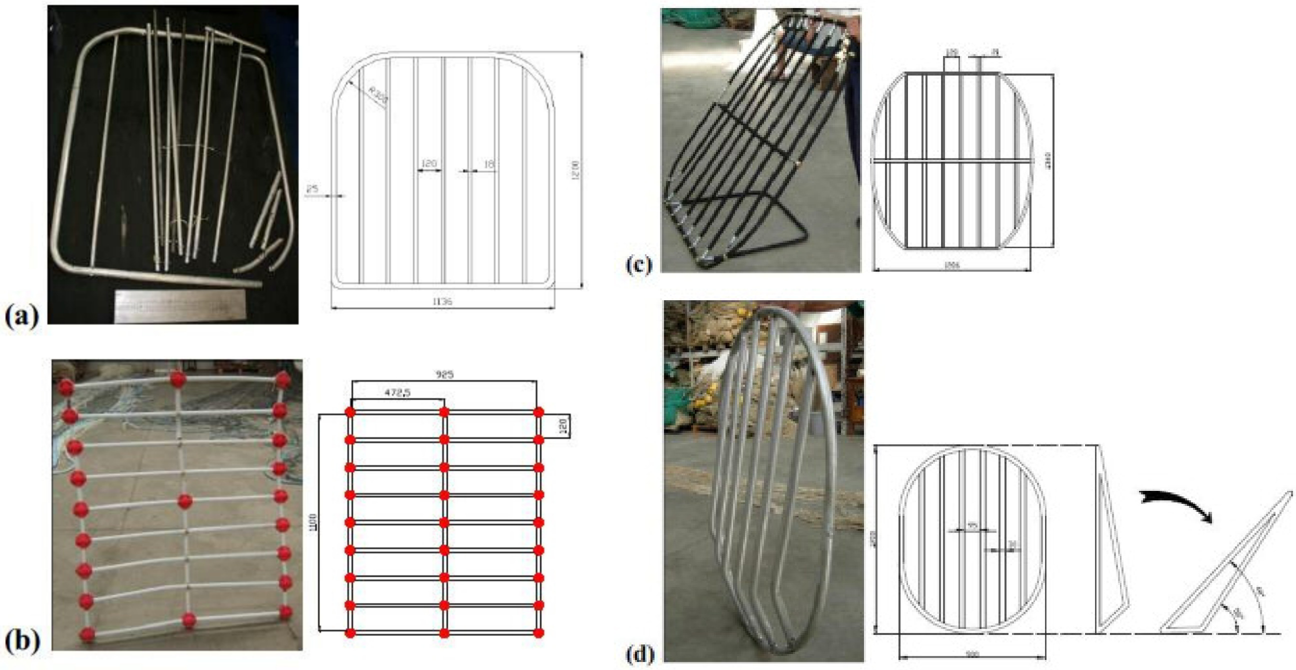


Figure 153. Dimensions (mm) of the Turtle Excluder Devices (TED) used in Sala et al. (2011). TED1 (a), made of aluminium broke down because of the large quantity of debris. (b) TED2, made of a flexible grid of mixed cable (steel inside and polyethylene outside). TED2 was installed with the aim of making the TED position capable of adjusting according to net movements during tow. (c) TED3, made of a semi-rigid and resistant grid of steel and rubber, with the aim of combining the flexibility of rubber and the resistance of steel. (d) TED4, the Supershooter grid made of classic aluminium. TED4 is commonly used in prawn fisheries in several countries. To take into account the complex fishing composition (crustaceans, molluscs and fishes together), we kept the space between reflector bars larger than in the standard models.

Brčić J., Herrmann B., De Carlo F., Sala A., 2015. Selective characteristics of a shark-excluding grid device in a Mediterranean trawl. Fisheries Research, 172: 352-360.

Galeus melastomus (blackmouth catshark) is often caught as bycatch in demersal trawls in the Mediterranean. In order to reduce bycatches of shark we tested an excluder grid with 90 mm bar spacing during experimental fishing in the Tyrrhenian Sea (Western Mediterranean). Data collected made it possible to simultaneously evaluate catch losses of two commercial species: Nephrops norvegicus (Norway lobster) and *Phycis blennoides* (greater forkbeard). The escape outlet ahead of the grid and the codend were both mounted with a cover in order to collect escaped fish ahead of the grid and through the codend meshes. We used a structural model to estimate the contribution of the individual selective processes consisting of the excluder grid and the size selective codend. The 90 mm excluder grid did not prove to be efficient in excluding *G. melastomus*, while it excuded more of *P. blennoides*. Catches of N. norvegicus were also affected by the presence of the grid, but not as much as the catches of other two species. The results obtained for the experimental grid + codend setup were then compared with the estimated selectivity for the "codend alone" setup. Furthermore, by way of explorative simulation with other grid bar spacing, we concluded that reducing the grid bar spacing to 70 mm would provide better compromise between the reduction of *G. melastomus* as bycatch and the catch rate of *P. blennoides* and *N. norvegicus*.

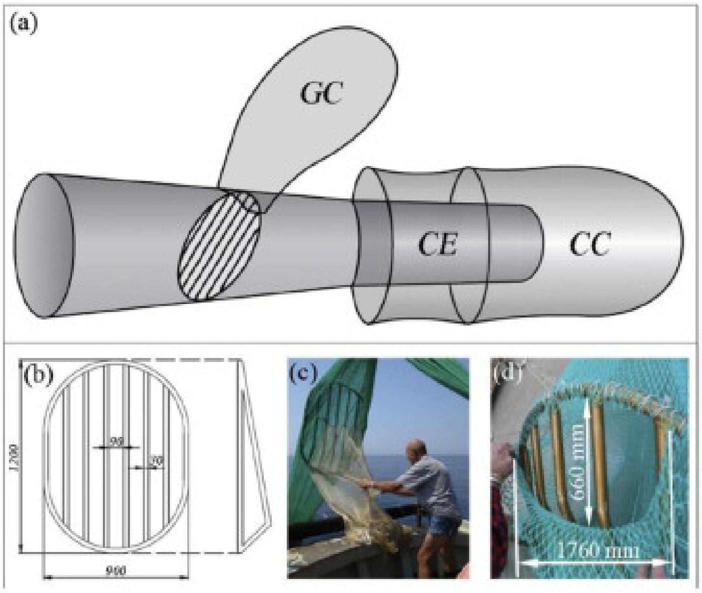


Figure 154. Selectivity experimental design of shark-excluding grid device (a) and Superhooter technical characteristics (b) used in Brčić et al. (2015).

Massutì E., Ordines F., Guijarro B., 2009. Efficiency of flexible sorting grids to improve size selectivity of the bottom trawl in the Balearic Islands (Eestern Mediterranean), with comparison to a change in mesh codend geometry. J. Appl. Ichthyol., 25: 153–161.

In recent years several studies have been developed to improve the selectivity of the Mediterranean bottom trawl fisheries, which exert high fishing pressure on young individuals. The focus has been mainly on increasing the mesh size in the codend or changing its mesh geometry; few studies have assessed the efficiency of the sorting grid systems. Analysis of 21 trawl hauls carried out at depths of 117–697 m off the Balearic Islands (western Mediterranean) in October–November 2005, studied size selectivity of the trawl using flexible sorting grids with 15 (SG15) and 20 (SG20) mm bar spacing. A divided polyamide bottom trawl designed for commercial purposes demonstrated high efficiency for the simultaneous use of both sorting grid sizes at different depth intervals (DS: deep shelf; US: upper slope; MS: middle slope). The results were also compared with those from the authors previous studies in the area where 40 mm diamond (DM) and square (SM) mesh codends were used. A saturation effect was detected on the DS for both sorting grids, due to the large amount of biomass captured at this depth interval. Size selectivity of 11 species was modelled, which showed an increase in length at first capture (L50) from SG15 to SG20. Values of L50 estimated for the main target species were: 10.9 cm total length (TL) with SG15, and 18.9 cm TL with SG20 for *Merluccius merluccius*; 21.1 mm carapace length (CL) with SG15, and 23.8 mm CL with SG20 for *Nephrops norvegicus*; and 15.9 mm CL with SG15, and 19.6 mm CL with SG20 for *Aristeus antennatus*. Comparison of size selectivity parameters between the sorting grids and cod-ends of different geometry showed clear differences. For most species, the highest value of L50 was obtained with SM (e.g. 26.6 mm CL for N. norvegicus and 22.1 mm CL for *A. antennatus*). Exceptions were the round-fish *M. merluccius*, the flatfish *Lepidorhombus boscii*, and the crustacean *Parapenaeus longirostris*, with values of SG20 (18.9 cm TL, 12.1 cm TL, and 25.7 mm CL, respectively) higher than with SM (15.2 cm TL, 10.2 cm TL, and 20.2 mm CL, respectively). Sorting grid selection ranges were broader than those estimated for DM and SM. Experience shows that the exchange of the DM for the SM and/or the introduction of SG20 can improve selectivity in the Mediterranean trawl, SM being more efficient than SG20 in the Balearic Islands.

Aydın C., Tosunoglu Z., Tokac A. (2008). Sorting grid trials to improve size selectivity of red mullet (Mullus barbatus) and annular sea bream (Diplodus annularis) in Turkish bottom trawl fishery. J. Appl. Ichthyol. , 24: 306–310

Sorting grids with two different bar spacings (12 mm and 14 mm) were tested to improve size selectivity of the commercially important fish species, red mullet (*Mullus barbatus*) and annular sea bream (*Diplodus annularis*), in Turkish bottom trawl fishery. Fishing trials were carried out between April and May 2003 in Izmir Bay, Aegean Sea, using a traditional bottom trawl. Selectivity data were collected by the top cover method and analysed by means of a logistic equation with the maximum likelihood method. Mean selectivity was also estimated and compared using the EC Model software that takes between-haul variations into account. The codend catch size as an additional explanatory variable was used in the comparison. The Kolmogorov–Smirnov (K–S) test was also applied to detect differences between length-frequency distributions in the upper and lower bags of the 12 and 14 mm bar spacings for red mullet and annular sea bream. The mean L50 values of red mullet were 8.7 and 10.0 cm with the 12 and 14 mm grids, respectively. The L50 value of 14 mm was comparable with the L50 value of the codend mesh size; however, the 12 mm value was rather low. The mean L50 values of 12 and 14 mm bar spacings were 8.8 and 10.4 cm for annular sea bream, respectively; the value of 14 mm bar spacing was very close to 50% size at sexual maturity of the species (10.5 cm). The K–S test indicated length distributions of red mullet and annular sea bream in the 12 and 14 mm upper and lower bags as significantly different ($P < 0.05$). These results show that improving the size selectivity in a multi-species fishery using a single selective device is rather difficult.

Aydın C., Tosunoglu Z., 2012. Evaluation of sorting grids for deepwater rose shrimp (Parapenaeus longirostris) in the Eastern Mediterranean demersal trawl fishery. J. Appl. Ichthyol., 28: 102–106.

The study aimed to evaluate sorting grids of 10 and 15 mm bar spacing specifically for separation of deep water rose shrimp, but including other species, in a Mediterranean multispecies demersal trawl fishery. Data were collected 15–25 October 2008 in Sıgˇacık Bay, Eastern Aegean Sea with the commercial trawler, 'Hapuloglu', using a modified bottom trawl net. A total of 22 valid hauls (12 with 10 mm, ten with 15 mm grids) were obtained. The separation rate of anglerfish was highest, with 100% for weight and number in both codends among all species. Grid elimination of broadtail short-fin squid showed differences between 95.3 and 80.3% in terms of weight, and 89.7 and 66.2% in terms of number for 10 and 15 mm, respectively. Separation ratios for hake, silver scabbard fish, and horse mackerel were between 96.3 and 100% in terms of weight, and 92.2 and 100% in terms of number in both codends. Shrimp separation was in total calculated as 60.8 and 37.0% by number, and 70.7 and 44.4% by weight in 10 and 15 mm bar spacing trawl grids, respectively, demonstrating that substantial improvement in species selectivity (deep water rose shrimp from others) is possible to achieve by adding sorting grids in the Mediterranean demersal trawl fishery. To optimize the overall selection performance in such fisheries, a variety of grid systems, bar spacings and materials as well as the economic consequences need to be evaluated.

Aydın C., Tokac A., Aydın I., Erdogan U., Maktay B., 2011. Species selectivity in the Eastern Mediterranean demersal trawl fishery using grids to reduce non-target species. J. Appl. Ichthyol., 27: 61–66.

The aim of the present study was to analyze the value of sorting grids with 20 mm bar spacing for species separation, in a demersal trawl fishery mainly targeting deep water rose shrimp (*Parapenaeus longirostris*) in the Eastern Mediterranean. Fishing trials were carried out 17–24 August 2008 onboard the commercial trawler 'Hapuloglu', using a modified bottom trawl net. The separation rate for silver scabbard fish (*Lepidopus caudatus*) was highest among all species with 98% by weight and 97% by number in 44 mm diamond (44D) and 40 mm square-mesh (40S) codends, respectively. The exclusion of European hake (*Merluccius merluccius*) by the grid shows differences between 85 and 93%, in weight and 64 and 83% in number for codends of 44D and 40S, respectively. Excluding the ratio for greater forkbeard (*Phycis blennoides*), the angler fish (*Lophius piscatorius*) and broadtail short fin squid (*Illex coindetii*) varied between 93 and 97% in weight and 81 and 86% in number in both codends. Losses of legal sized rose shrimp were determined as 23 and 25% in 44D and 40S, respectively.

Bahamon N., Sardà F., Suuronen P. (2007). Selectivity of flexible size-sorting grid in Mediterranean multispecies trawl fishery. Fisheries Science, 73: 1231–1240.

The selectivity of a flexible sorting grid with 20-mm bar spacing (BS20) installed in front the conventional trawl cod end was investigated. The standard covered cod end method was used. Data was adequate for analysing the selectivity of European hake *Merluccius merluccius*, poor cod *Trisopterus minutus capelanus*, greater forkbeard *Phycis blennoides* and Norway lobster Nephrops norvegicus. The selectivity of the 20-mm sorting grid was compared with the performance of 40-mm diamond (DM40) and square-mesh (SM40) cod ends. The effect of a guiding funnel on the performance of the grid (BS20-f) was also explored. Finally, the potential changes in yield per recruit (Y/R) and biomass per recruit (B/R) after implementing a sorting grid were explored. An overall improvement in the 50% selection length (L50) with all four species was substantial when comparing the BS20 to the DM40. Higher improvement in L50s was achieved when the grid was equipped with the guiding funnel. When comparing the performance of the BS20-f to the SM40, there was no marked difference in L50s. The Y/R and B/R, however, are substantially higher with BS20-f for poor cod and about the same for European hake. BS20 compared to SM40 achieved lower Y/R and B/R for all four species; the smallest difference was observed for Norway lobster.

Sardà F., Molí B., Palomera I., 2004. Preservation of juvenile hake (Merluccius merluccius, L.) in the western Mediterranean demersal trawl fishery by using sorting grids. Sci. Mar., 68 (3): 435-444.

The Mediterranean fishery has experienced a decline in catches over the past 20 years due to an excessive increase in effort caused by both increased trawler engine power and rapid technological advances in fishing technology and fish location. This has led to overexploitation, in which immature individuals support an increasing portion of the catches. The present study was undertaken to test a sorting grid and square-mesh-panel as juvenile exclusion systems. Our experience was a pilot study of such a system in the western Mediterranean. The purpose of these exclusion systems was to help juvenile hake escape from the net. The results demonstrate that the use of sorting grids for small fish in trawl gears in the Mediterranean is an efficient and practical means of avoiding the capture and discarding of unwanted individuals, with escape rates of over 50% (ranging between 50 and 90%). The grids were efficient and useful for excluding hake (*Merluccius merluccius*) on bottoms located at depths between 50 and 300 m, where hake are found all year round. A bar spacing of 20 mm yielded escape rates of L50 at 18.8 cm TL (L25 = 16.8 cm and L75 = 20.9 cm). Panels made of square-meshes achieved poorer results than the grids. The grid system was effective for most of the species caught in the study area.

Sardà F., Bahamón N., Sardà-Palomera F., Molí B., 2005. Commercial testing of a sorting grid to reduce catches of juvenile hake (Merluccius merluccius) in the western Mediterranean demersal trawl fishery. Aquat. Living Resour., 18: 87–91.

Mediterranean demersal fisheries have experienced an ongoing decline in catches over the past 20 years as a result of excessive increases in effort caused both by growth in trawler engine power and by rapid technological advances in fish finding and fishing technology. This has led to an overexploitation of these resources. An increasing share of the catches consists of immature individuals. This study was undertaken to test a sorting grid with a bar spacing of 20 mm as a means of excluding juveniles in the commercial hake (*Merluccius merluccius*) fishery in the Catalan Sea, western Mediterranean. The grid was placed in the extension section of the gear 5 m in front of a cod-end. Divided cod-end design was used to collect the escapees and target species. The mean selection length (*L*50) of the ten hauls was 14.2±0.7 cm, with a selection range of 7.3±0.4 cm. The biomass of hake under *L*50 that escaped through the grid represented 50.1±6.7 % of the total hake biomass. These promising results indicate that sorting grids can be used in excluding small hakes in the Mediterranean Sea. Further trials are required to improve the sorting efficiency of the grid.

Sardà F., Bahamon N., Molí B., Sardà-Palomera F., 2006. The use of a square-mesh codend and sorting grids to reduce catches of young fish and improve sustainability in a multispecies bottom trawl fishery in the Mediterranean. Scientia Marina, 70 (3): 347-353.

In order to improve the capacity of bottom trawl fishing gears to reduce catches of young fish and discards in a highly exploited demersal trawl fisheries in the Mediterranean, the size-selection performance of a 36-mm square-mesh codend and two sorting grids with 20 and 15 mm bar spacing was assessed. Alternate hauls were used to assess the selectivity of 36-mm square-mesh codend. Selectivity of sorting grids was assessed using a double codend in which fish that escaped through the grid were captured in the lower codend while other fish were guided into the upper codend. The mean selection length (L50) for European hake was 18.5 cm and that for the Atlantic horse mackerel was 14.0 cm with the 36-mm square-mesh codend. These values are close to their current minimum landing sizes (20 cm for hake and 12 cm for horse mackerel). The sorting grid with 20-mm bar spacing showed L50 value of 13.3 cm for hake, suggesting that a larger grid-spacing would be needed to obtain sufficient sorting performance. Similarly, for Atlantic mackerel the estimated L50 of 14.3 cm indicates that larger grid spacing is required to attain an L50 that would be close to the current MLS (18 cm). For Atlantic horse mackerel and red mullet, the L50 obtained with the sorting grid with 20-mm bar spacing was close to the MLS of these species (the MLS of red mullet is 11 cm). The selectivity of the sorting grid with 15-mm bar spacing was generally very poor.

4.2.5. Separator Panels

Separator panel is a selective device based on the behaviour differences between species. The basic design consists of a single panel inserted horizontally by splitting the trawl totally or partially, in two levels. The selectivity process is completed by the use on the upper part of the trawl of meshes large enough to allow the escape of juveniles (Figure 155). The rigging and position of this panel is nevertheless critical to the efficiency of this system. In this case, the codend where the unwanted catch is retained should be kept open, in order to allow the release off unwanted catch.

The general aim of separating panels as a selectivity tool is to take advantage of behavioural differences between fish and other animals to separate the catch into species groups (theoretically target and non-target species). The segregation of different species in the two compartments can be caused by morphological differences (size and/or shape), or by different reactions to fishing gears. Fisheries that have benefited from the separator principle are shrimp fisheries (for Panaeid, Pandalid and Crangonid species), prawn fisheries (for *Nephrops* spp) which sometimes have high levels of finfish bycatches associated with them.

The careful selection of mesh size in each codend; e.g., square-mesh codend could allow the size selection of fish to be optimized. In the Mediterranean where several species caught together are marketable, the separator panel also allows rocks, shell, crabs and other bottom-dwelling animals to be kept separated from the commercial part of the catch (Figure 155). This usually increases the quality of fish that are driven in the upper codend. The main goal of a separator panel is to split catch on the basis of inter-species variations in natural behaviour and/or the reactions to fishing gear. For example, flatfish species and crustaceans generally live very close to the seabed and, hence, they enter the trawl gear at a low level. On the other hand, species like hakes, sparids, red mullets tend to rise upwards in the mouth of the trawl and consequently enter the net at a higher level.

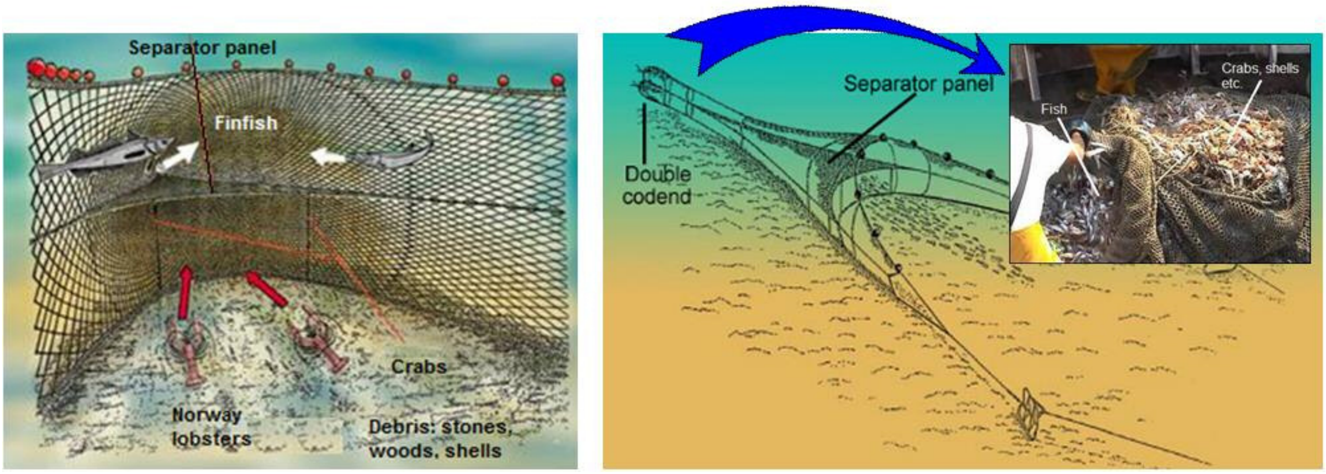


Figure 155. Separator panel that divides the trawl catch in two compartments. *Courtesy of A. Lucchetti (CNR, Italy).*

4.2.6. New net designs

Novel designs for a bottom trawl net have been tested in recent projects (BENTHIS, KBBE-CALL 6-312088) with promising results. The experiment focused on two different tasks. One task was related to a possible modification of the net design, and the other is related to the net material. A selector device has been implemented in one net of a twin trawl, while the other net acted as a referenced net. Furthermore, two sets of selectors have been prepared, with same design: one realized in standard material, the other using Dyneema, in order to evaluate possible influence of the material in selectivity and drag resistance of the net.

One of the twin trawls (A) represents the reference in terms of catches and geometrical and mechanical characteristics such as net openings and drag resistance. The other twin trawl will be used for the implementation of the selector device (B). The selector device consists of two separator panels, which carry the fish near the side panels of trawl net. The side panels along the separator panels will be provided of an escapement window (C) proper mesh size and configuration to guarantee the escapement of juveniles and other unwanted catches. At the end of the separator panels, through two passages (D) fishes will proceed along the net until the codend. Comparing catches and discards (i.e. discard is the fraction of the total catch which was considered as non-commercial), the selector decreased the fraction of discard, in both the net configuration (standard material and Dyneema). While the catch is almost the same, it seemed that the lateral panels evacuated most of the potential discard.

4.2.7. *Fisheye*

Fisheye is a small opening held by a rigid frame that is attached to the top or sides of the codend through which fish can escape. Fisheye is designed to allow fish to voluntarily swim through an escape opening in the codend (Crespi and Prado, 2008). In its simple design, fisheye is a triangular or rectangular shaped-cut made in the netting. An aluminium or steel frame is more commonly used to provide an elliptical or "eye shaped" rigid escape opening. Fisheyes are generally used in shrimp trawling and allow for the escape of swimming species (fish). In shrimp trawl fisheries, the poor swimming ability of prawns and the location of the fisheye at the top of the codend reduce their chances of escape. To escape through the hole, fish must swim towards the mouth of the net and out of the escape opening in the fisheye. Generally, the fisheye should be located as close as possible to the codend drawstrings to enable small fish to escape but care is required to ensure that prawns cannot escape also. Studies on trawl selectivity effects of fisheye are not available in the Mediterranean.

4.2.8. *Footrope modifications*

In the basic design the front part of a bottom trawl is framed with a headline on the top, equipped with a series of floats and a groundrope on the bottom, equipped with leads and/or chain, which is designed to provide a good contact with the bottom and increase catch efficiency. The ground rope of a trawl net has an effect on the amount or proportion of flatfish and shellfish that may be caught. Fishermen, especially over hard seabed, are used to rig their nets with footropes having a diameter more than 40 mm, with heavy chains not strictly joined to the footrope, bobbins, rubber discs or other instruments which allow them to fish over this kind of surfaces, avoiding ground damage form the contact with the stones whilst maintaining ground contact. Moreover, in order to enhance the gear efficiency, bottom trawls are rigged with heavier tickler chains which imply a higher physical impact on the bottom. Tickler chains are usually shorter than the footrope and during towing operations they determine a considerable physical impact on the seabed. Obviously, the use of these types of groundrope leads to a great amount of discard. To reduce the bottom impact of heavy ground gears, several configurations of wheels, or rolling gears were tested starting with pairs of rubber disks mounted on an axle and attached to the fishing line at a fixed angle. Using larger rubber bobbins will increase the height of the groundrope above the seabed and reduce the amount of bottom-dwelling animals and debris caught. In recent studies, raised footrope trawls have been proven to eliminate unwanted catch. Raised-footrope was designed to provide vessels with means of continued fishing without catching groundfish and benthic organisms. In this type of trawl, the footrope is about 0.45 to 0.6 m above the bottom (Carr and Milliken, 1998). The raised footrope and net allows complete flatfish escape and has much less contact with the seafloor than does the traditional ground gear. This can be achieved by replacing the groundgear with several weights, each attached to the footrope at a pre-determined position. As only a few weights are used (five or six) and replace the entire groundgear, animals on the seabed have a good opportunity of avoiding contact with the trawl and subsequent capture. Damage to seabed animals is also reduced dramatically. Different types of beam trawl are also used in Mediterranean. They are generally used in shallow waters by small units within some small-scale fisheries. Provençal “gangui” (from the Southeast of France) and Catalan (NW Spain) “ganguils”, Greek “kankava” for sponges, Italian “gangamo” for prawns and sea urchins (used in Sicily) are the most common examples. In the Provençal French fishery using “gangui”, the target species are scorpaenidae, red mullets and other high value species used in traditional dishes.

In Italy, large bottom trawlers of the Adriatic coast can use a kind of beam trawl, the so-called “Rapido trawl”, to catch scallops (*Pecten jacobeus*) and queen scallops (*Aequipecten opercularis*) on sandy on detritic bottoms (“maerl”) at 40-50 m depth at some distance from the coast, and common sole (*Solea Solea*) in muddy inshore areas. The gear consists of a box dredge 3-4 m wide and about 170 kg weight rigged with 5-7 cm long teeth and a lower leading edge, and net bag to collect the catch (Giovanardi et al., 1998).

Beam trawling causes physical disruption of the seabed through contact of the gear components with the sediment and the resuspension of sediment into the water column in the turbulent wake of the gear. High fuel consumption, seabed disturbance and high discard rates are well-known disadvantages of this fishing technique. These shortcomings are increasingly gaining scientific and political attention, especially with the upcoming discard ban in Europe. The most promising alternative fishing technique meeting both the fisherman’s aspirations, and the need for ecological progress is pulse fishing with electro-trawls (Soetaert et al., 2015). Although a significant amount of research has been done on electro-trawls and their impact on marine organisms, most data were published in very diverse sources ranging from local non-peer reviewed reports with a limited distribution to highly consulted international peer reviewed journals. A comparative fishing experiment with conventional beam trawls was carried out in the North Sea. The results revealed that pulse trawls had fewer fish discards (57 %, $p<0.0001$), including 62 % undersized plaice (*Pleuronectes platessa*) ($p<0.0001$), and 80% discarded weight of benthic invertebrates ($p=0.0198$) per hectare. The pulse fishing technique also resulted in lower fuel consumption (37-49 %), and consequently in spite of lower landings net revenues were higher (van Marlen et al., 2014). Other studies confirmed pulse trawling as a valid alternative gears to traditional beam trawlers targeting sole and plaice. When it concerns discards, in the pulse trawl, the catch rates of undersized (discard) sole were significantly lower than in the conventional beam trawl, and also catch rates of benthic fauna were significantly lower. At the same time, the economic performance of the pulse trawl can compete with comparable beam trawl, thanks to in oil consumption (45-50 %), which is a high cost for beam trawlers. Moreover, the use of a pulse trawl generates less emission of CO_2 than the use of a beam trawl (Taal and Hoefnagel, 2010).

4.2.9. Alternative Gears

The bottom impact exerted by bottom trawling as well as the overexploitation of demersal resources in addition to poor selectivity all encourage fishing technologist to propose and develop alternative gears as possible mitigating solutions. However, it has to be kept in mind that any local fishery is developed through “*trial and error*” for generations to find the most efficient way of fishing. So, it is not an easy task to introduce alternative solutions in a fishery. Moreover, what’s an effective and responsible fishing method in one area does not necessarily work well in another one since several factors can affect the efficiency of a fishing method such as species behaviour, bottom conditions, temperature, fishing season etc.

One of the possible alternatives for exploitation of near bottom organisms is to increase the use of stationary fishing gears that have much less impact on bottom habitats. However, the shift from trawl fishing to another technique with less impact must take into account the risk of profitability loss due to lower fishing efficiency or the lack of know-how at least during the first years of exploitation. For some target species, bottom set gillnets and longlines might be both practical and economically viable alternatives to bottom trawling but other species like shrimp and small non-shoaling fish species cannot be caught economically with such gears. Some marine organisms targeted with demersal gear have diurnal and/or seasonal vertical migrations.

For these targets, an off-bottom harvesting fishing technique might be a bottom-friendly alternative. The use of pots is usually considered as a valid alternative to high impacting gears mainly because pots can be used on all types of bottom. To accommodate more pots in the limited space available on deck of a vessel, certain models of pots have to be either collapsible or designed so that they can be piled one upon each other (Figure 156).

An advantage of using traps is that catches are usually still alive and uninjured when the gear is retrieved so that unwanted bycatch organisms can be released with a good chance of survival in most cases. However, factors such as on deck injury and exposure, traumas due to pressure shock, or thermal shock may affect the survival of released organisms. Therefore, the use of traps offers the possibility of low bycatch mortality in comparison with many other fishing activities in general. The bycatch obtained in traps can also be further minimized by modifying pot design including choosing the correct size, shape and material; right pot entrance and escape openings etc.; mesh sizes; and the right location, season and time settings. The use of certain types of bait also has the potential attracting the target species and/or repelling unwanted species.

The main concern with traps is the catch efficiency that is obviously really low if compared with trawling. In this regard, recent studies have investigated the effect of light attraction (ICES-WGFTFB, 2013). There is considerable potential for artificial light to be used constructively in the development of more efficient and responsible fishing methods. It has been known for a long time that a light attracts fish, shrimp and insects at night. The problem is to identify the best colour for a light attractor.

Figure 156. Collapsible fish pots as a possible solutions for the reduction of trawl impact. *Courtesy of A. Lucchetti (CNR, Italy).*

Some studies have revealed that the more efficient light is blue or green. Light attractor should have high intensity, emit its light in a colour similar to the fishes space (blue or green), be powered by a portable electrical supply and be submersible. The most significant technological advance in light fisheries in recent years is the adoption of LED lights in favour of incandescent, halogen, and metal halide illumination. This technology is similarly effective compared to many of the older sources of illumination with the added benefit of requiring considerably less energy (ICES-WGFTFB, 2013). Therefore, technical solutions to improve catch efficiency should be investigated more in depth.

One of the main concern with traps as with other passive gears is the loss of gear at sea during fishing operations with trap continuing to catch fish or other organisms (ghost fishing). The use of biodegradable materials, and various escape vents have successfully been implemented in traps to reduce their ghost-fishing capacity. However, the loss of pots in seabeds with low natural structure or complexity such as sandy or muddy habitats may sometimes diversify the monotonous sea bottom by adding habitat complexity that offers refuges and shelters for various species and so acting in the same manner as artificial reefs.

4.3. Passive nets

Gillnets, trammel nets and combined nets are currently among the most important passive nets largely used along the Mediterranean coasts for the catch of a great number of demersal, benthic and pelagic species. Fish can be caught because gilled, entangled or enmeshed in the netting. Gilling and entangling are two different principles of catching:

- Gilling is where the mesh surrounds the fish just behind the gill cover;
- Wedging or enmeshing is where the mesh surrounds the body as far as the dorsal fin;
- Entangling is where the fish is held in the net by teeth, maxillaries, fins or other projections without necessarily penetrating the mesh; and
- Entrapping is where the fish is entrapped in bags or pockets of netting. This is the typical catching method of a trammel net.

The catching method strongly depends on the gear properties. Fixed nets can be designed to catch both demersal and pelagic species. They are, especially gillnets, fishing gears with a high degree of selectivity that’s regulated by the mesh size. Gillnets are highly selective gears and the mesh size is usually decided on the basis of the target species. Therefore, it is possible to say that gillnet are species-specific gear. Trammel net catching process implies that the fish entangle themselves in a pocket of small mesh webbing between the two layers and large meshed walls. This type of capture is exclusive of the trammel net. Fish can be caught also because gilled, entangled or enmeshed in the netting. Therefore the trammel net is considered to be less selective than the gillnet. Combined nets are not that frequently used; they combine the catching methods of trammel net with those of gillnet. The catching process in passive nets depends on intercepting fish as they move, therefore these gears are considered as more selective than active gears such as a bottom trawl. Size-selectivity is generally good with gillnets, but the trammel nets are generally less selective since both small and large specimens can be caught. In general, the species-selectivity is often poor in passive gears since most of the species can be caught. Moreover, it should be considered that the direct mortality is really high since most fish die during the capture so there is little potential benefit from releasing bycatch. Selectivity of the species studied in the Mediterranean are reported in Figure 157 Figure 158.

Table 6. Summary of selectivity studies performed on gillnets and trammel nets in Mediterranean. Area: geographical area where the experiment was conducted; GSA: GFCM Geographical Sub-Areas (GSA) where experiment was conducted; Species: Species on which the selectivity experiment was conducted; MLS: minimum landing size as defined by Council Regulation (EC) No. 1967/2006; MS: reported mesh size; ML: modal length ; SV: Spreading value.

Gear	*Reference*	GSA	Area	*Species*	MLS	MS	ML	SV
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	36	10.11	0.89
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	40	10.64	0.82
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	44	10.09	0.83
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	36	11.24	0.99
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	40	11.18	0.91
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	44	11.21	0.92
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	36	12.36	1.09
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	40	12.30	1.00
Gillnet	*Ayaz et al. (2010)*	22	North Aegean Sea	*Diplodus annularis*	12	44	12.33	1.01
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	32	8.86	0.49
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	36	9.97	0.56
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	40	11.08	0.62
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	44	12.19	0.68
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	32	13.68	1.00
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	36	15.39	1.13
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	40	17.1	1.25
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	44	18.81	1.38
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	32	12.19	0.50
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	36	13.71	0.57
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	40	15.23	0.63
Gillnet	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	44	16.76	0.69
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	32	8.82	0.53
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	36	9.93	0.60
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	40	11.03	0.66
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Diplodus annularis*	12	44	12.13	0.73
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	32	14.7	1.47
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	36	16.54	1.65
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	40	18.38	1.84
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Mullus surmuletus*	11	44	20.22	2.02
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	32	14.16	2.21
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	36	15.94	2.21
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	40	17.71	2.21
Trammel net	*Karakulak and Erk, (2008)*	22	North Aegean Sea	*Pagellus acarne*	17	44	19.48	2.21
Gillnet	*Sbrana et al. (2007)*	9	North Thyrrenian Sea	*Merluccius merluccius*	20	53	33.00	3.90
Gillnet	*Sbrana et al. (2007)*	9	North Thyrrenian Sea	*Merluccius merluccius*	20	62.5	38.92	4.61
Gillnet	*Sbrana et al. (2007)*	9	North Thyrrenian Sea	*Merluccius merluccius*	20	70	43.59	5.16
Gillnet	*Sbrana et al. (2007)*	9	North Thyrrenian Sea	*Merluccius merluccius*	20	82	51.06	6.04
Gillnet	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Lithognathus mormyrus*	20	45	16.50	NA
Gillnet	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Lithognathus mormyrus*	20	70	26.30	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Lithognathus mormyrus*	20	45	16.50	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Lithognathus mormyrus*	20	70	26.30	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Lithognathus mormyrus*	20	45	16.50	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Lithognathus mormyrus*	20	70	26.30	NA
Gillnet	*Fabi et al. (2002)*	9	Ligurian Sea	*Lithognathus mormyrus*	20	45	16.50	NA

Gear	*Reference*	GSA	Area	*Species*	MLS	MS	ML	SV
Gillnet	*Fabi et al. (2002)*	9	Ligurian Sea	*Lithognathus mormyrus*	20	70	26.30	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Lithognathus mormyrus*	20	45	16.50	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Lithognathus mormyrus*	20	70	26.30	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Lithognathus mormyrus*	20	45	16.50	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Lithognathus mormyrus*	20	70	26.30	NA
Gillnet	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Diplodus annularis*	12	45	12.10	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Diplodus annularis*	12	45	12.10	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Diplodus annularis*	12	45	12.10	NA
Gillnet	*Fabi et al. (2002)*	9	Ligurian Sea	*Diplodus annularis*	12	45	12.10	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Diplodus annularis*	12	45	12.10	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Diplodus annularis*	12	45	12.10	NA
Gillnet	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Mullus barbatus*	11	45	16.70	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Mullus barbatus*	11	45	16.70	NA
Trammel net	*Fabi et al. (2002)*	17	Central Adriatiac Sea	*Mullus barbatus*	11	45	16.70	NA
Gillnet	*Fabi et al. (2002)*	9	Ligurian Sea	*Mullus barbatus*	11	45	16.70	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Mullus barbatus*	11	45	16.70	NA
Trammel net	*Fabi et al. (2002)*	9	Ligurian Sea	*Mullus barbatus*	11	45	16.70	NA
Gillnet	*Fabi and Grati, (2008)*	17	Central Adriatiac Sea	*Solea Solea*	20	64.2	21.20	NA
Gillnet	*Fabi and Grati, (2008)*	17	Central Adriatiac Sea	*Solea Solea*	20	65.2	21.60	NA
Gillnet	*Fabi and Grati, (2008)*	17	Central Adriatiac Sea	*Solea Solea*	20	67.8	22.40	NA
Gillnet	*Fabi and Grati, (2008)*	17	Central Adriatiac Sea	*Solea Solea*	20	70.2	23.20	NA
Gillnet	*Fabi and Grati, (2008)*	17	Central Adriatiac Sea	*Solea Solea*	20	71.8	23.80	NA
Gillnet	*Ozekinci et al. (2005)*	22	Aegean sea	*Diplodus annularis*	12	52	12.50	NA
Gillnet	*Ozekinci et al. (2005)*	22	Aegean sea	*Diplodus annularis*	12	54	13.50	NA
Gillnet	*Ozekinci et al. (2005)*	22	Aegean sea	*Diplodus annularis*	12	56	14.00	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Diplodus annularis*	12	34	8.80	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Diplodus annularis*	12	38	9.80	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Diplodus annularis*	12	42	10.90	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Diplodus annularis*	12	46	11.90	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Mullus surmuletus*	11	34	12.20	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Mullus surmuletus*	11	38	13.60	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Mullus surmuletus*	11	42	15.00	NA
Gillnet	*Petrakis and Stergiou, (1995)*	22	Aegean sea	*Mullus surmuletus*	11	46	16.50	NA
Gillnet	*Metin et al. (1998)*	22	Izmir Bay	*Diplodus annularis*	12	36	10.08	NA
Gillnet	*Metin et al. (1998)*	22	Izmir Bay	*Diplodus annularis*	12	40	11.20	NA
Gillnet	*Metin et al. (1998)*	22	Izmir Bay	*Diplodus annularis*	12	44	12.32	NA
Gillnet	*Francesconi et al. (2005)*	9	Ligurian Sea	*Solea Solea*	20	76	26.50	NA
Gillnet	*Francesconi et al. (2005)*	9	Ligurian Sea	*Solea Solea*	20	80	28.50	NA
Gillnet	*Francesconi et al. (2005)*	9	Ligurian Sea	*Solea Solea*	20	84	29.60	NA
Trammel net	*Olguner and Deval, 2013*	24	Antalya Bay	*Mullus barbatus*	11	40	17.00	1.14
Trammel net	*Olguner and Deval, 2013*	24	Antalya Bay	*Mullus barbatus*	11	44	18.70	1.25
Trammel net	*Olguner and Deval, 2013*	24	Antalya Bay	*Pagellus erythrinus*	15	40	13.90	0.71
Trammel net	*Olguner and Deval, 2013*	24	Antalya Bay	*Pagellus erythrinus*	15	44	15.30	0.78
Trammel net	*Olguner and Deval, 2013*	24	Antalya Bay	*Pagellus acarne*	17	40	15.70	0.86
Trammel net	*Olguner and Deval, 2013*	24	Antalya Bay	*Pagellus acarne*	17	44	17.50	0.94
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus erythrinus*	15	34	10.66	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus erythrinus*	15	38	11.92	NA

Gear	*Reference*	GSA	Area	*Species*	MLS	MS	ML	SV
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus erythrinus*	15	42	13.17	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus erythrinus*	15	46	14.42	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus acarne*	17	34	11.04	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus acarne*	17	38	12.34	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus acarne*	17	42	13.64	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Pagellus acarne*	17	46	14.94	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Mullus barbatus*	11	34	13.26	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Mullus barbatus*	11	38	14.82	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Mullus barbatus*	11	42	16.38	NA
Gillnet	*Petrakis and Stergiou, (1996)*	22	South Euboikos Gulf	*Mullus barbatus*	11	46	17.94	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Diplodus vulgaris*	18	41.6	11.14	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Diplodus vulgaris*	18	50	13.27	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Diplodus vulgaris*	18	62.5	16.58	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Diplodus annularis*	12	41.6	14.01	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Diplodus annularis*	12	50	16.69	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Mullus surmuletus*	11	41.6	16.29	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Mullus surmuletus*	11	50	19.39	NA
Gillnet	*Follesa et al., (2002)*	11	Western Sardinian Sea	*Mullus surmuletus*	11	62.5	24.24	NA

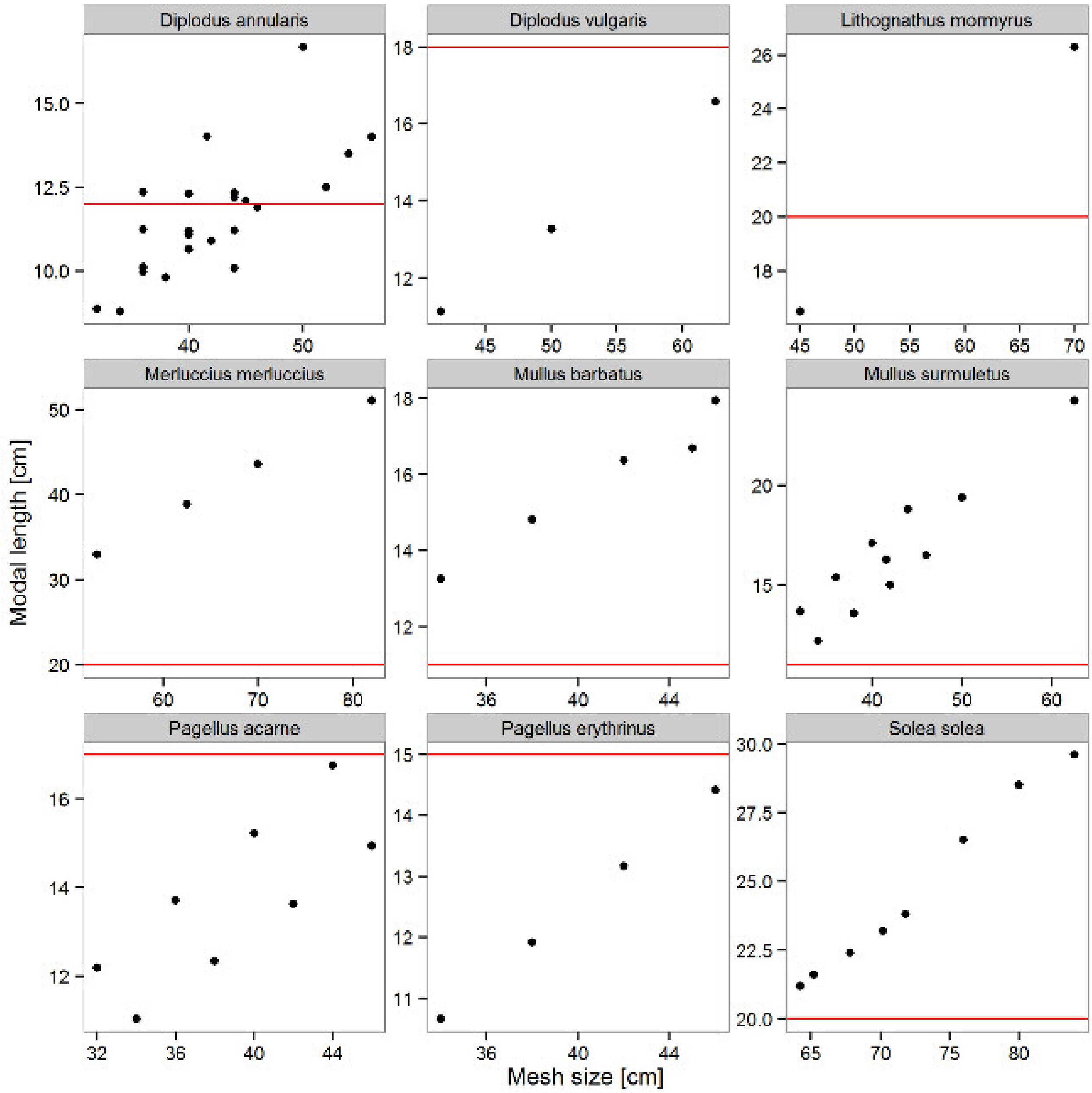


Figure 157. Passive gears selectivity studies carried out in the Mediterranean Sea: relationship between Modal length and mesh size obtained from the literature (Table 6) for Mediterranean gillnet.

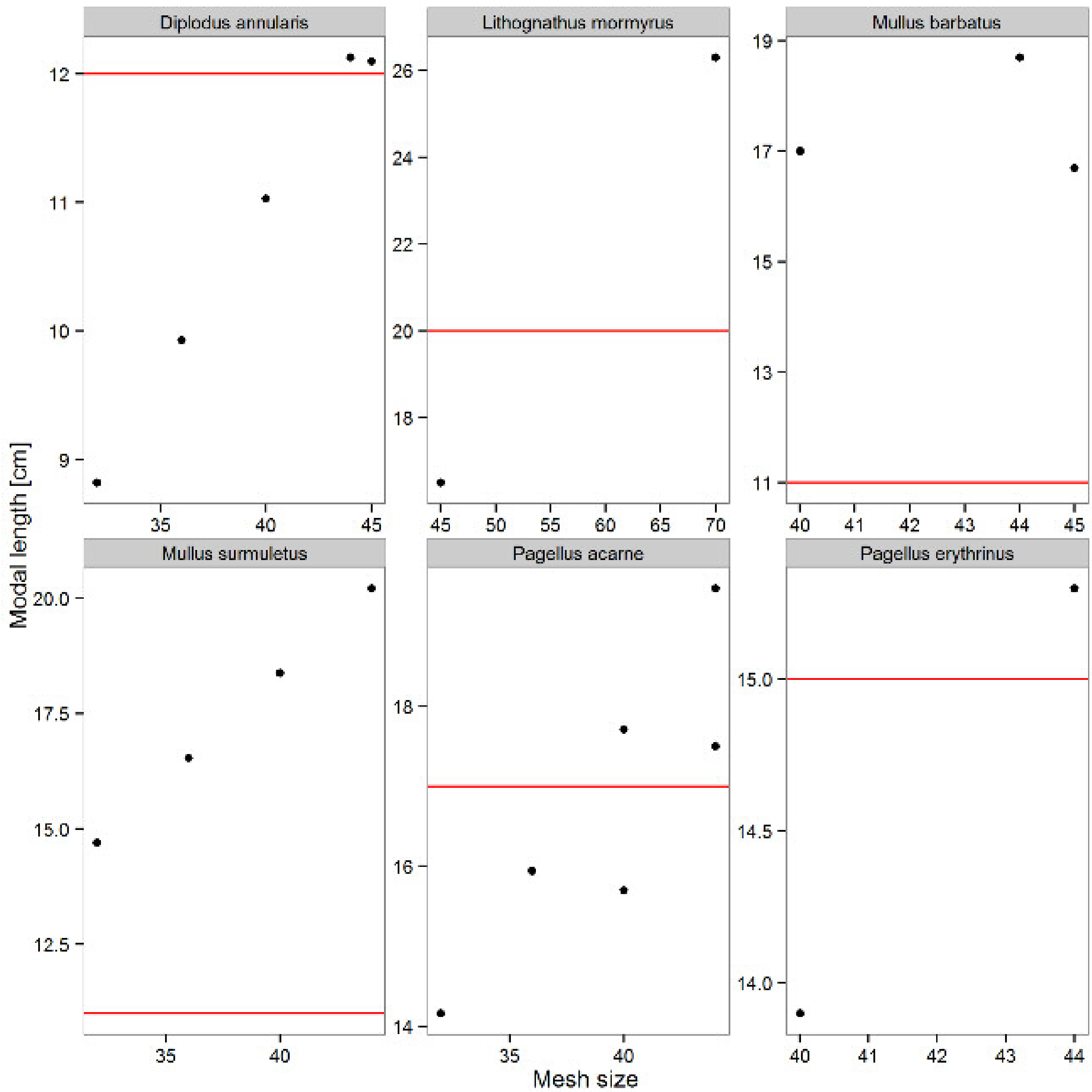


Figure 158. Passive gears selectivity studies carried out in the Mediterranean Sea: relationship between Modal length and mesh size obtained from the literature (Table 6) for Mediterranean trammel net.

4.4. Hydraulic dredges

The dredges, mainly the hydraulic ones, are considered as highly impacting fishing gears. The impact of dredging can be summarized as follows: a) Catch of undersized clams; b) physical effects; c) suspension of sediment, increased turbidity; d) disruption of the sediment surface; e) creation of dredge tracks (10-20 cm deep); f) mortality and damage in benthic organisms: shell damage to bivalves caused by dredging; g) effects of suspended sediment on marine organisms; h) reduction in benthic organisms; i) temporary decline in commercially-sized shellfish; j) indirect effects of dredging related to habitat disruption; k) effects of dredging on biodiversity; l) alterations of the Biochemistry and Physiology of Shellfish after Dredging; m) evidence of reduced shellfish recruitment. A whole series of management measures are usually applied including: a) output control measures limiting the catches (daily catch quantities) of the fleets belonging to each harbour or region, by departure at sea and unit of time. One of the principal management measures traditionally implemented in some countries in the Mediterranean is the suspension of fishing activities for short or long periods to allow greater protection of the resources and the marine environment; b) closed areas; c) input control measures addressing production factors, through restrictions on the number of boats licensed to fish and the time (daily fishing hours) available for fishing; d) input control measures limiting the size and the engine power of the fishing vessels; e) technical measures regulating the relationship between input and output, governing the size of catches, the temporary or seasonal suspension of exploitation activity and the closure of fishing areas; f) technical measures on the characteristics and dimensions of the fishing gear and sieves.

The selectivity of dredges is usually the sum of two selective processes: the selectivity of the main gear (the dredge or cage) and the selectivity of the sieve. Therefore the selective process in the hydraulic dredge fisheries has two stages: the first stage takes place at sea while fishing, the second occur on board the vessel. Many factors are known to affect dredge selectivity. These include the technical properties of the dredge, such as dredge setup and design (teeth length and angle, blade length and angle, space between rods, dredge weight) and operational factors (towing speed, tow duration) and environmental conditions (sea state, type of sediment etc.). Selectivity studies have been carried out in the Mediterranean Sea (Sala et al., 2015) to investigate the selectivity performance of striped hydraulic dredgers targeting venus clam (*Chamelea gallina*). Due to the fact that the cage of the dredge becomes clogged with sediment during the tow, mechanical sorting by the vibrating sieve can be considered as the main catch selection process. The effect of the grid hole diameter and sorting speed of the vibrating sieve of a hydraulic dredger was investigated in a field study to determine its clam selection properties and to formulate proposals aimed at improving fishery management.

Data analysis demonstrates that it is technically impossible to select only individuals with a size not smaller than the Minimum Conservation Reference Size (MCRS). However, combined sorting using a grid sequence would provide both an overall increase of Retention Length 50% (L50) and a reduced Selection Range (SR), while ensuring less than 5% retention of undersize individuals and a catch efficiency of commercial sizes of about 80%. The results show that the L50 obtained for three consecutive grids of the sorting system (hole diameter 21.5 mm, 21.1 mm, 20.5 mm respectively) ranged from 24.91 mm, to 25.3 mm and 22.87 mm respectively. Froglia and Gramitto (1981) reported that the 25% and 75 % percentiles of the retained *C. gallina* were at 21.5 mm and 24.5 mm when the grid parallel bars were slightly less than 11 mm apart, and the same limits changed to 19.5 mm and 33.0 mm once the space between consecutive bars had been increased by one mm.

4.5. Measures that could be implemented in the short term

Measure	Fishery	Importance *
40 mm square-mesh codends can be substituted by a 50 mm diamond-meshed codends at the duly justified request of the ship-owner only if an acknowledged size selectivity of species subjected to landing obligation is equivalent to or higher than that of 40 mm square-mesh codend	Mixed Demersal Bottom Trawl fishery	++
Definition of minimum codend length, according with MyGears project results	Mixed Demersal Bottom Trawl fishery	+++
Definition of headrope and groundrope maximum length according with MyGears project results	Mixed Demersal Bottom Trawl fishery	+++
50 mm diamond-mesh codend mandatory, in case where flatfish defines the trawl fishery	e.g. Rapido trawling (TBB) targeting common sole	+++
Allowing the conversion of the MCRS into number of clams per kg	Hydraulic Dredge Fisheries	+++
Reviewing the minimum mesh opening of gillnets included in the Council Regulation (EC) No 1967/2006 on the light of review carried out in Archimedes project	Small Scale Fisheries	++
Defining a minimum mesh size also for trammel nets and combined nets	Small Scale Fisheries	++

* +++ High; ++ Medium; + Low

4.6. Studies that could be implemented in the short term

Measure	Fishery	Importance *
Studies on raised footrope trawl	Mixed Demersal Bottom Trawl fishery	++
Studies on 60 mm diamond-mesh codend	TBB targeting flatfish	+++
Square-mesh panels	Mixed Demersal Bottom Trawl fishery	+
Modified trawl (i.e. separator panels)	Mixed Demersal Bottom Trawl fishery	++
Identification of a standard sorting grid (i.e. identify optimum bar spacing)	Deepwater Shrimp fishery (DWS) and Norway lobster fishery: i.e. Pomo Pit closed area.	+++
Studies on the clam survivability	Hydraulic clam dredge fishery	+++
Studies on alternative gears such as pots and light attraction	-	++

* +++ High; ++ Medium; + Low

4.7. Conclusions

According to the Council Regulation (EC) No 1967/2006 all EU trawlers in the Mediterranean are obligated to use either 40 mm square-mesh codend, or if dully justified by the ship-owner, 50 mm diamond-mesh codend. The exact explanation of the "dully justified request" does not exist in the regulation allwoing member states to interpret the meaning of that statement subjectively. In the Recommendation GFCM/33/2009/2 on the minimum mesh size in the codend of demersal trawl nets as well as in the article 15 of the recent amendment to the Council Regulation (EC) No 1967/2006 in form of Regulation (EU) No 1343/2011, which defines minimum trawl codend mesh size used in the Black sea fisheries, it is stated that old 40 mm mesh codends shall be replaced with 40 mm square-mesh codends or, at the duly justified request of the ship-owner, by a 50 mm diamond-meshed codends with an acknowledged size selectivity equivalent to or higher than that of 40 mm square-mesh codend, which is much more clearly defined than in the Council Regulation (EC) No 1967/2006. The Council Regulation (EC) No 1967/2006 clearly explained that in case of towing nets the smallest meshes shall be at the codend. Thus, the correct interpretation of this Regulation is:

- in case of 40 mm square-mesh codend, the rest of the net should have a mesh opening more than 40 mm;
- in case of 50 mm diamond-mesh codend, the rest of the net shall have a mesh opening more than 50 mm.

However, a weakness still remains in the Regulation, given that the length of the codend is not reported. In fact, the actual risk is that fishermen may decide to adopt 40 mm square-mesh codend; in these cases they can use short square-mesh codends (less than a meter for example) by leaving the rest of the net with 40 mm diamond-mesh netting, by making practically inefficient these technical measures. In this regards the review of demersal trawl net designs carried out in the MyGears project can be a useful tool to identify codend properties. The square-mesh codends had proven to be highly efficient with round fish, by increasing the selectivity of demersal trawl. On the other hand diamond-mesh codends are more selective than square-mesh for flat fish; thus even if data for flat fish subjected to a minimum landing size (common sole *Solea Solea*) are not available, the results show that for fishing gears targeting flatfish the use of diamond-mesh codend should be advisable.The use of sorting grids seems to show promising results for the species selection, even if there is not a clear positive effect on the selectivity, compared to the traditional trawl. In more detail, sorting grids showed good results in sorting shrimps and Norway lobsters from the other species. Thus, the use of sorting grids should be implemented in fisheries targeting shrimps (*Aristaemorpha folicaea* and *Aristeus antennatus*) and Norway lobsters. The access to certain fishing ground and areas, for instance, could be allowed only if bottom trawlers will be equipped with sorting grids. However, new technical measures can be effective only if they are simple, workable and enforceable. Therefore, it is essential to identify standard properties of the grids that should be included in a clear provision (i.e. setting a clear dimension for the grid's bar and space between bars).

The use of square-mesh panels <u>did not show any clear positive effects on the selectivity</u> if compared with the traditional trawl. Thus, the results obtained did not encourage proceeding with these tests. In fact, the full square-mesh codend showed, on average, a better selective performance than a square-mesh panel. The Council Regulation (EC) No 1967/2006 stated: "T*echnical specifications limiting the maximum dimension of floatline, groundrope, circumference or perimeter of trawl nets […] shall be adopted, by October 2007, in accordance with the procedure laid down in Article 30 of this Regulation*".

The dimensions of groundrope and headrope mainly affect fishing effort, catch efficiency and, indirectly, the amount of discard. Therefore, it is advisable to set a maximum length for the headrope and groundrope, according with the data collected during MyGears project (Sala et al., 2013). The use of passive gears (passive nets and pots) as a possible alternative solution to mitigate the trawling impact and reduce discards should be investigated more in depth, mainly taking into account the economic consequences of this change. Technical solution to improve pot catch efficiency should be tested as well. Some potential consequences give some short- and long-terms possible effects on the socio economic characteristics of the target stocks exploitation, market prices, gear and maintenance costs, and acceptability by the fishery sector.

The review of selectivity studies confirm that passive nets are quite selective and mesh opening is the most important parameter to take into consideration for selectivity issue. According to the review carried out in the Archimedes project the mesh size provisions included in the Article 9 of Council Regulation 1967/2006 ("Bottom-set gillnets shall not have a mesh size opening smaller than 16 mm) seems to be unbalanced with the actual situation, since most of nets have a mesh opening greater than 20 mm. Moreover, the Council Regulation 1967/2006 only refers to mesh opening of bottom-set gillnets, without mentioning trammel nets and combined nets, that are widely used in the entire Mediterranean Sea.

Sala et al. (unpublished data) investigated the selectivity of sorting grid devices which fishermen use to sort out their catches on-board the clam fishing vessels. According to the landing obligation, once the species, covered by the obligation are on deck they cannot be discarded, with the exception for the species for which scientific evidence demonstrates high survival rates. This is possibly the case of the clam *Chamelea gallina* in the Adriatic clam fisheries; however studies on the survivability of this species must be carried out. The study from Sala et al. (unpublished data) can prove to be very beneficial to these fisheries. Recalling that the MLS for this species is 25 mm the results confirm that it is technically rather unfeasible to select only individuals with a size larger than the Minimum Conservation Reference Size (MCRS). Therefore, as already permitted for Anchovy and Sardine, for which Member States may convert the minimum size into 110 specimens per kg and 55 specimens per kg respectively, we suggest that a similar approach should be allowed also for *Chamelea gallina*.

4.8. Complementary measures to gear selectivity improvement to delay size at first capture and reduce potential discards

There are at least two possible ways to deal with the undesired catch of small-sized individuals. One is to modify gear characteristics so as to allow smaller fish to escape (e.g. increase mesh size). In mixed fisheries such as these occurring in the Mediterranean, where the catch is composed by many species and many of them are small-sized even when they are adult, the increase of mesh size aimed at a better exploitation pattern and reduction of discards of undersized individuals of certain species may result in considerable escapement of individuals of other species with consequent important economic losses. Gear modifications other than increasing mesh size can be done (e.g. Escapement windows), but effectiveness may be variable and species-specific as it mainly depends on the behaviour of each species. The utilization of gears characterized by different selection ability at different depths, different grounds or when targeting different stocks can be effective, but such measures work better when a single species dominates the catch. However, that is not a common case in Mediterranean fisheries, especially in fisheries operating over the continental shelf.

Alternative ways to avoid the capture of undersized individuals could be to restrict operations in specific grounds where nurseries occur (e.g. at certain depths, areas and/or over specific types of substrate) or to restrict fishing in certain periods of the year that coincide with the recruitment of exploited species. However, this strategy may not be equally efficient for all exploited species as different species may exhibit different recruitment time schedules and juveniles may exhibit different levels of aggregation. In any case, many demersal species are known to recruit at the littoral zone, especially in early summer. In some countries, seasonal fishing bans have been enforced in coincidence with this process. A prohibition to operate in the 3 nm stripe or under 50 m of depth is already enforced for trawlers (EU Reg. 1967/2006) but further measures can be enforced for those species that recruit in deeper waters, such as hake.

It is difficult to provide quantitative estimates of the potential impacts associated with improvements in the selectivity of fishing gears. The same difficulties apply for the evaluation of the likely consequences of the enforcement of any alternative technical measure (when and where to fish). While short-term losses can be expected, at a medium- and long-term a better exploitation pattern should have positive consequences on the age structure of the stock at sea and in productivity (Maravelias et al., 2014).

4.8.1. Findings from the DISCATCH project

In the framework of DISCATCH project (deliverable D2.2; I. Bitetto, K. Tsagarakis, et al., 2015) GAM multivariate analysis has been used to identify drivers of discards and bycatch in two selected Mediterranean European fisheries, namely trawlers in GSA 18 and GSA 22, for 3 commercially important species: European hake (*Merluccius merluccius*), deep water pink shrimp (*Parapenaeus longirostris*) and horse mackerel (*Trachurus Trachurus*). The analyses were based on data collected on board commercial bottom trawl vessels from 2010 to 2013 in the Southern Adriatic (GSA 18) and from 1996 to 2008 in the Aegean Sea (GSA 22). The available data allowed to evaluate the effects on fisheries discards due to several factors such as inter-annual variability, seasonal variations, technical duration of fishing operations, total catch, and spatial localization. In both case studies, a significant positive relationship was detected between discards and total catch, as also found by Feekings et al. (2012).

According to the results obtained in GSA 18, the discard process is closely linked to the recruitment, both in a seasonal and in a spatial dimension: indeed, for all the final models for which the month factor was found to be significant, an increased effect on discards was detected during the recruitment period. By contrast, for GSA 22 no seasonal effect was found for any species except from the deep-water rose shrimp, because its recruitment period spans throughout the year (Sobrino et al., 2005) and no direct association with periods of high discarding is possible. A link between discard and recruitment was also found by Feeking et al. (2012) for the Danish demersal fleet in Kattegat.

In GSA 22, areas of higher discarding appear to coincide partially with the presence of nursery grounds of hake and horse mackerel and to a lesser extend of deep water rose shrimp, although this observation is based on the limited information available on the nursery areas of these species in GSA 22 (currently only available for June). Depth-related patterns were previously reported for Mediterranean trawl fisheries, however they vary regionally, depending also on the species composition (Tsagarakis et al., 2014). For hake in GSA 18, the mean depth had a significant effect on discards, suggesting that the discards decrease at increasing depth, which is consistent with the tendency of larger individuals to inhabit deeper grounds. This is also the case for the deep-water rose shrimp in GSA 22 where juveniles are associated with shallower waters (Sobrino et al., 2005), but no depth-related effects were found for the other studied species. However, it should be noted that depth is linked to the geographic location and its effect is lost when latitude and longitude are included in the model.

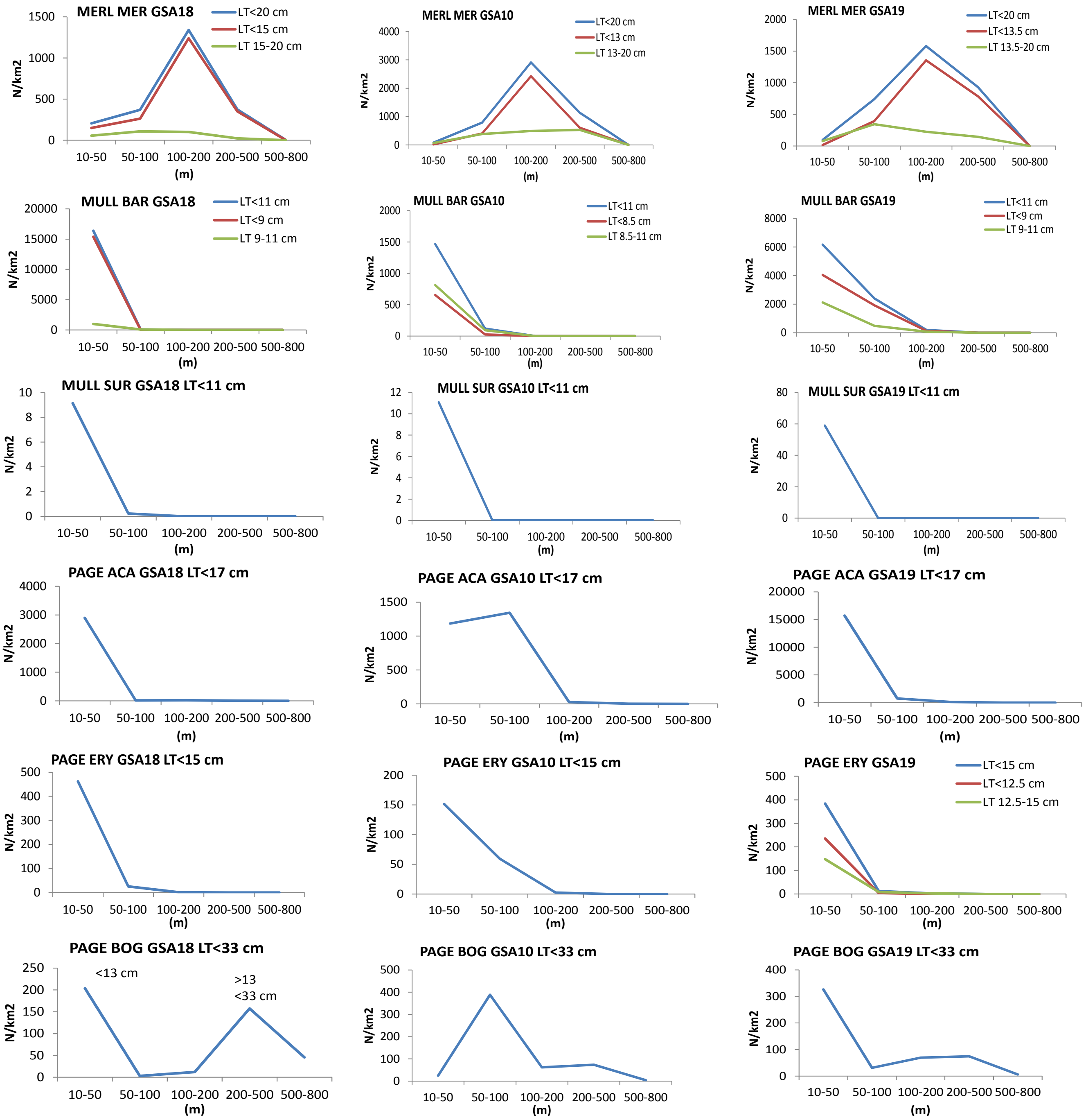
The findings of this study were in agreement with previous studies that showed spatial and temporal variability in discards, while the comparison with the recent results obtained within MEDISEH project (Colloca et al., 2013; 2015) on the location of nurseries of several demersal species implies that discarding is linked, among other factors, to the geographical localization of fishing operations, as this often matches areas where juveniles concentrate.

4.8.2. Insights from MEDITS data

MEDITS time-series can provide some useful information to estimate local abundance indices of the population fraction below the MLS for those species appearing both in the list of the Annex III of the EU Reg. 1967/2006 and in the MEDITS reference list. This can be achieved by analyzing the distribution of such indices in different MEDITS depth strata and geographical sub-areas. This information can help to give insight on the potential availability of such population fraction to the towed gears and possibly identify depth strata/areas where risk of catching population fractions below the MCRS of some important demersal species is higher. In this exercise, GSAs 10, 18 and 19 were used as case study. MLSs as well as the thresholds based on recruitment size as used in MEDISEH project were taken into account. Abundance indices by year and depth stratum were computed according to the MEDITS protocol (Figure 159). Indices were also computed by hauls and bubble plots of the positive hauls (to each species and size) were estimated (Figure 160). For both the approaches more recent data, i.e. those related to the last 5 years were used.

MEDITS data indicate that the distribution of juveniles of some coastal species is rather inshore, but goes beyond the limit of 50 m depth, which is the currently defining the area already protected by the EU Reg. 1967/2006. The distribution of juveniles extends to approximately 70 m depth, at least during the period in which the survey is carried out, which matches the recruitment time of some important coastal species.

These species are mainly the target of the OTB fisheries (principally demersal and mid-water fisheries). Thus a short term complementary measure to mitigate the impact on the juvenile fraction of the population might be the temporal limitation of OTB also in the area between 50 m and approximately 70-80 m depth. For the investigated species, the best timing for such limitations would be late spring and early summer. Regarding species whose recruitment is mainly occurring offshore, like European hake and deep-water pink shrimp, the protection of juveniles can rely more on the protection of nursery areas, given the occurrence of juveniles in deeper waters. In some cases, as for hake, the areas with higher concentration of recruits do not overlap with those where the fraction of the population between the recruit threshold size and MLS is located. However, in general, the fraction of the population considered as recruits is greater than the fraction of the population between the recruit threshold size and MLS, and it is concentrated, thus more vulnerable to fishing.



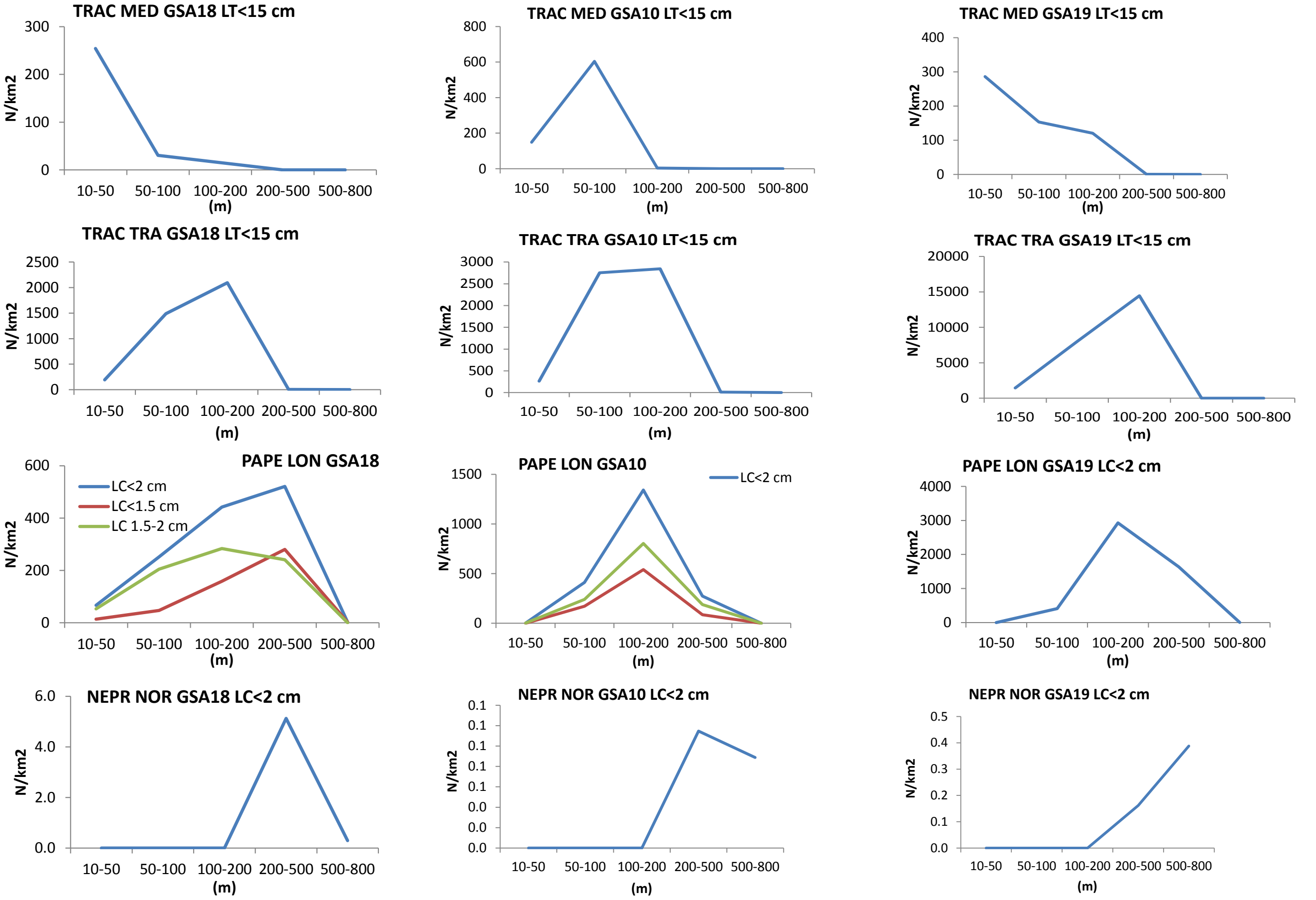


Figure 159. Depth distribution of demersal species from the MEDITS survey (average of last 5 years). The fraction of the population below the MLS is shown (blue line). When available, the threshold used in MEDISEH to identify recruits is also shown (brown line), and also the fraction of the population between that size and the MLS (green line).

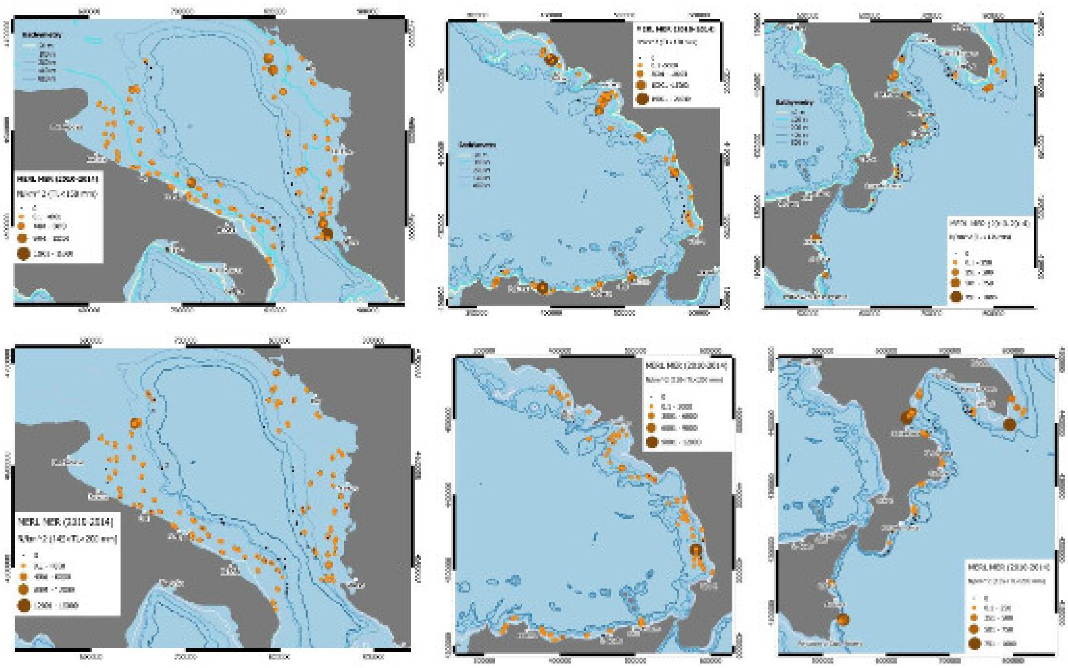


Figure 160. Bubble plots of the locations with higher presence of hake in the three case study areas. In the upper panels, the fraction of the population below the recruitment size used in MEDISEH is represented. In the lower panels, the fraction of the population between the threshold used in MEDISEH and the MLS is used (last 5 years of MEDITS data are used).

4.8.3. *Information on nurseries of Annex III species in the Mediterranean*

Available information on the nursery areas in the Mediterranean of all 24 finfish and crustacean species or groups of species included in Annex III was also reviewed here. The aim was to synthesize current knowledge and to investigate the potential of spatiotemporal restrictions in fishing operations to reduce unwanted catches. For ten Annex III species or group of species, nursery areas have been recently investigated throughout the Mediterranean in the framework of the MEDISEH project (Table 1). For six of them (*Engraulis encrasicolus*, *Sardina pilchardus*, *Scomber* spp, *Trachurus* spp, *Merluccius merluccius*, *Parapenaeus longirostris*) there was good overlap of the timing of the survey and recruitment, and sufficient representation in the catch of the survey so as to infer a good depiction of nursery areas throughout the Mediterranean EU waters (Figure 161) (Colloca et al., 2013).

For four more species (*Mullus barbatus*, *Pagellus erythrinus*, *Solea vulgaris*, *Nephrops norvegicus*) identification of nurseries within MEDISEH was possible only in a few GSAs, due to the general lack of sufficient overlap between the survey and recruitment time schedules, and/or because of low survey catches in most GSAs (Table 1). This review of the MEDISEH species or groups of species that appear also in Annex III suggests there is readily available information for all or at least for some GSAs, which could inform management regarding the usefulness of spatiotemporal restrictions on fishing to protect juveniles. Of the remaining 14 Annex III species or groups of species that were not examined in MEDISEH, 12 exhibit nurseries at the littoral zone and/or estuaries (*Dicentrarchus labrax*, *Diplodus annularis*, *Diplodus puntazzo*, *Diplodus sargus*, *Diplodus vulgaris*, *Epinephelus* spp, *Lithognathus mormyrus*, *Pagelus acarne*, *Pagellus bogaraveo*, *Pagrus pagrus*, *Sparus aurata*, Palinuridae).

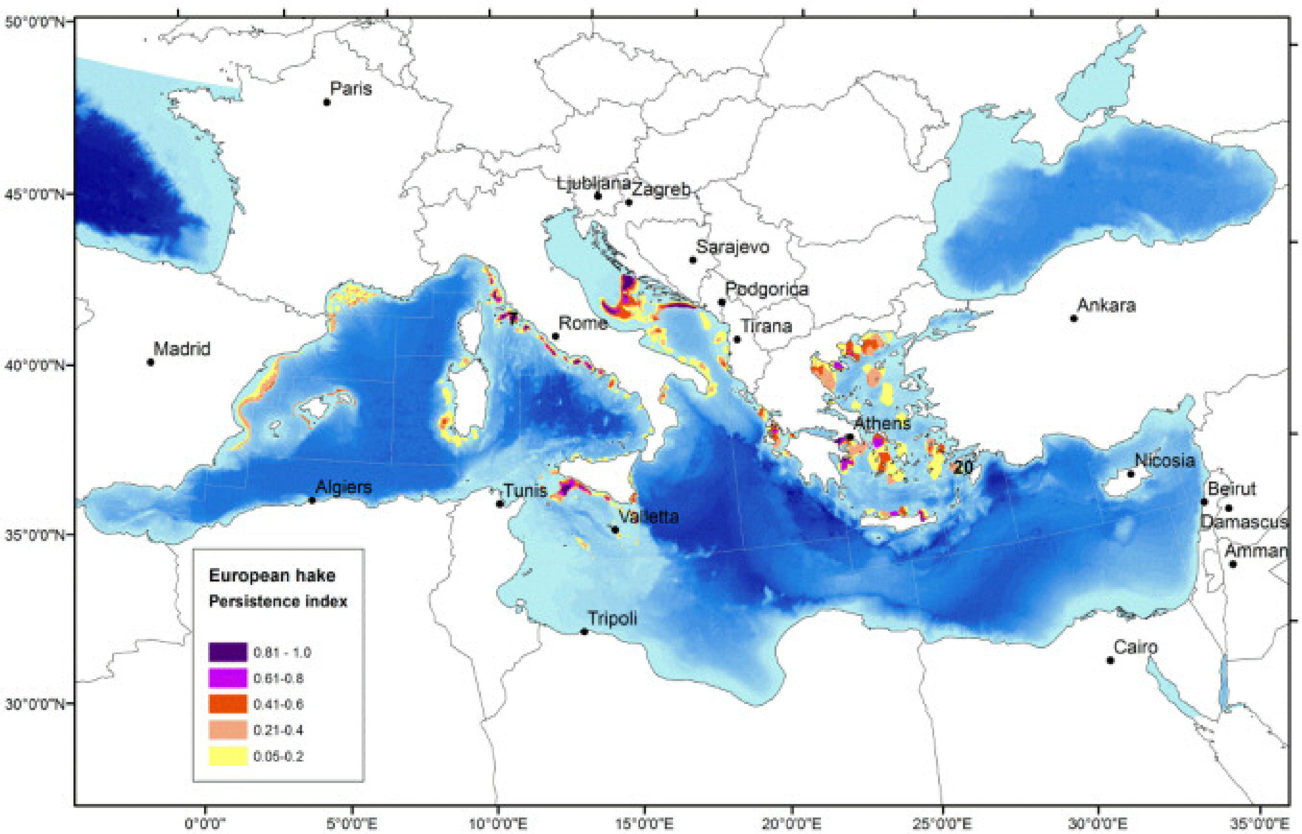


Figure 161. Map of hake (*Merluccius merluccius*) nurseries in the Mediterranean as estimated within the MEDISEH project (Colloca et al., 2013).

The current literature review suggested that available information on the exact position and extent of these nurseries exists only at local scale (Table 9). It should be noted that these nurseries at the littoral zone are already largely inaccessible to trawling due to the current EU legislation (Council Regulation 1967/2006); however, they are still vulnerable to other gears (e.g. boat seines, set nets) and to recreational fishing. There are also two Annex III species where no nursery areas could be defined: Juveniles of *Polyprion americanus* are pelagic and do not form aggregations (Deudero et al., 1999), while nursery areas for *Homarus gammaru*s remain unknown in Europe (Mercer et al., 2002). There is a need for further large-scale studies that would allow the identification of nurseries of these Annex III species that were not covered or were only partially covered by MEDISEH. This way, improvement of selectivity on the basis of avoidance of nurseries could be better organised.

Table 7. A summary of the information available on the nursery areas of all fish and crustacean species of Annex **III** in the Mediterranean. Bold font indicates information coming from the MEDISEH project.

Species	**Info available on nursery areas in the Mediterranean**	**Geographical scale**	**Comments**	**Reference**
Dicentrarchus labrax	Y	Local scale	Nurseries mostly in estuaries	Local studies (e.g. Dufour et al., 2007)
Diplodus annularis	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Guidetti, 2000)
Diplodus puntazzo	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Vigliola et al., 1988)
Diplodus sargus	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Vigliola et al., 1988)
Diplodus vulgaris	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Vigliola et al., 1988)
Engraulis encrasicolus	**Y**	**All Med**	**Habitat suitability model**	**Giannoulaki et al. (2013)**
Epinephelus spp	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. La Mesa et al., 2002)
Lithognathus mormyrus	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Mariani, 2006)
Merluccius merluccius	**Y**	**All Med**	**Hotspot identification model**	**Colloca et al. (2015)**
***Mullus* spp**	**Y (*Mullus barbatus*)**	**Adriatic**	**Hotspot identification model**	**Colloca et al. (2015)**
	Y (*Mullus surmuletus*)	Local scale	Nurseries in littoral zone	Local studies (e.g. Tserpes et al., 2002)
Pagellus acarne	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Kalogirou et al., 2010)
Pagellus bogaraveo	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Spedicato et al. 2002)
Pagellus erythrinus	**Y**	**Italian GSAs**	**Hotspot identification model**	**Colloca et al. (2015)**
Pagrus pagrus	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Kalogirou et al., 2010)

Species	Info available on nursery areas in the Mediterranean	Geographical scale	Comments	Reference
Polyprion americanus	N	-	Pelagic juveniles	Deudero et al. (1999)
Sardina pilchardus	**Y**	**All Med**	**Habitat suitability model**	**Giannoulaki et al. (2013)**
***Scomber* spp**	**Y (for both *S. scombrus* and *S. colias*)**	**All Med**	**Habitat suitability model**	**Giannoulaki et al. (2013)**
Solea vulgaris	**Y**	**Adriatic**	**Hotspot identification model**	**Colloca et al. (2015)**
Sparus aurata	Y	Local scale	Nurseries mostly in estuaries	Local studies (e.g. Dimitriou et al., 2007)
***Trachurus* spp**	**Y (for both *T. Trachurus* and *T. mediterraneus*)**	**All Med**	**Habitat suitability model**	**Giannoulaki et al. (2013)**
Homarus gammarus	N	-	-	Mercer et al. (2002)
Nephrops norvegicus	**Y**	**Italian GSAs**	**Hotspot identification model**	**Colloca et al. (2015)**
Palinuridae	Y	Local scale	Nurseries in littoral zone	Local studies (e.g. Diaz et al., 2001)
Parapenaeus longirostris	**Y**	**All Med**	**Hotspot identification model**	**Colloca et al. (2015)**

4.8.4. Removing fishing pressure on nurseries: A case study

An example of a shift in effort allocation from inside to outside of a hake nursery ground with positive changes in exploitation pattern is presented here. In this case, the shift was not a consequence of the establishment of a protected area but resulted from an enhanced control of minimum landing size in the Viareggio port (Southern Ligurian Sea, GSA9) which was enforced in the 1990s (Abella et al., 2005) . Very important nursery areas for hake are positioned off this port, mainly concentrated within the depth range 100 - 200 m. These areas (Figure 162) were traditionally exploited by the Viareggio fleet and huge quantities of small-sized hake were removed and landed every year, as they had high commercial value.

Following the enhancement of the mentioned controls, considering that the landing and commercialization of small hakes was no longer possible and the low presence of other high valued species in the catches within the nursery grounds, fishing on these areas did not longer guarantee good enough revenues. As a consequence, fishing operations inside the depth range 100 - 200 m in the nursery area were progressively abandoned. Figure 5 shows the changes that occurred in the allocation of the commercial fleet's effort in the nursery area off the Viareggio port. In Figure 163, the overall distribution of effort by depth of the whole trawlers' fleet along the years is shown. It is quite evident the gradual decrease of the activities between the depth range 100-200 m. The size composition of hake caught by trawlers has shown a clear shift away from the small-sized individuals between 4 and 12 cm (Figure 165).

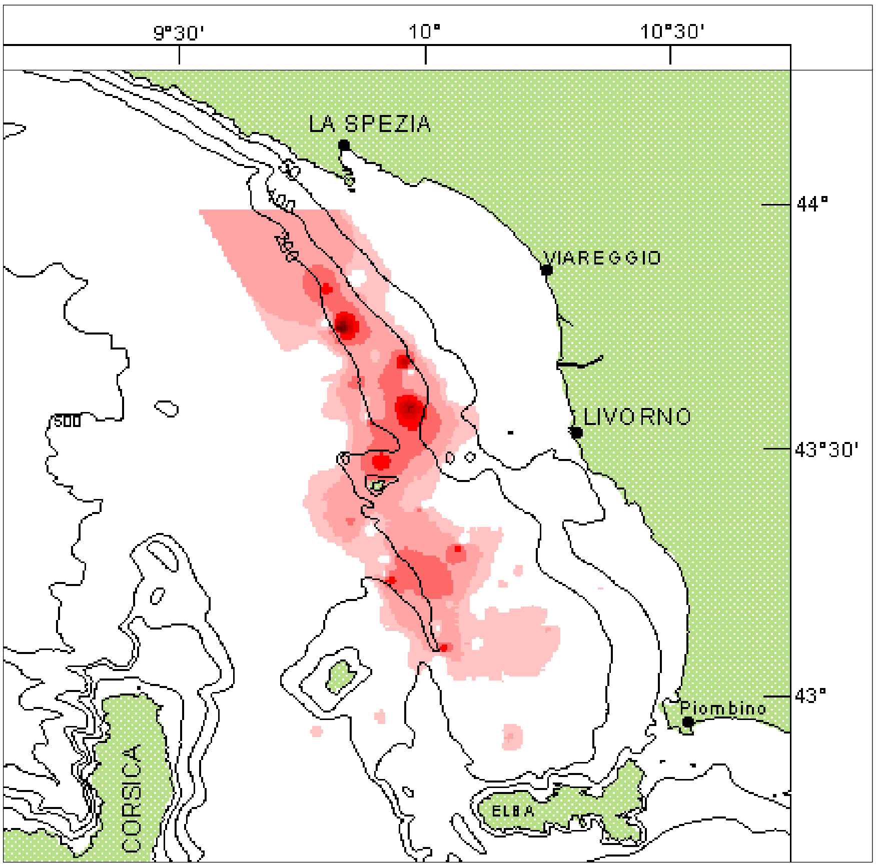


Figure 162. Distribution of the nursery area off the Viareggio port (Southern Ligurian Sea, Italy).

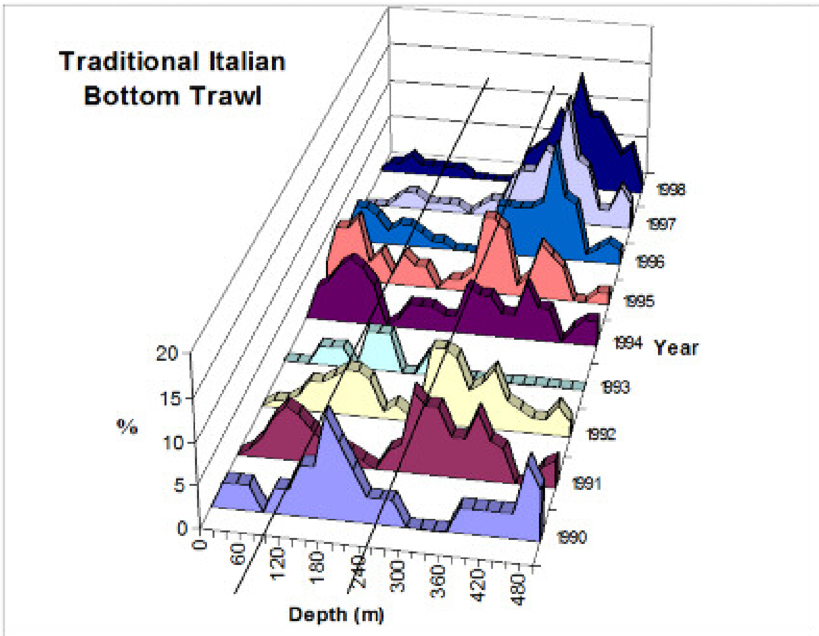


Figure 163. Distribution of yearly effort of bottom trawlers by depth by year showing a progressive abandon of the operations in the depth range 100-200m, where hake juveniles are densely concentrated.

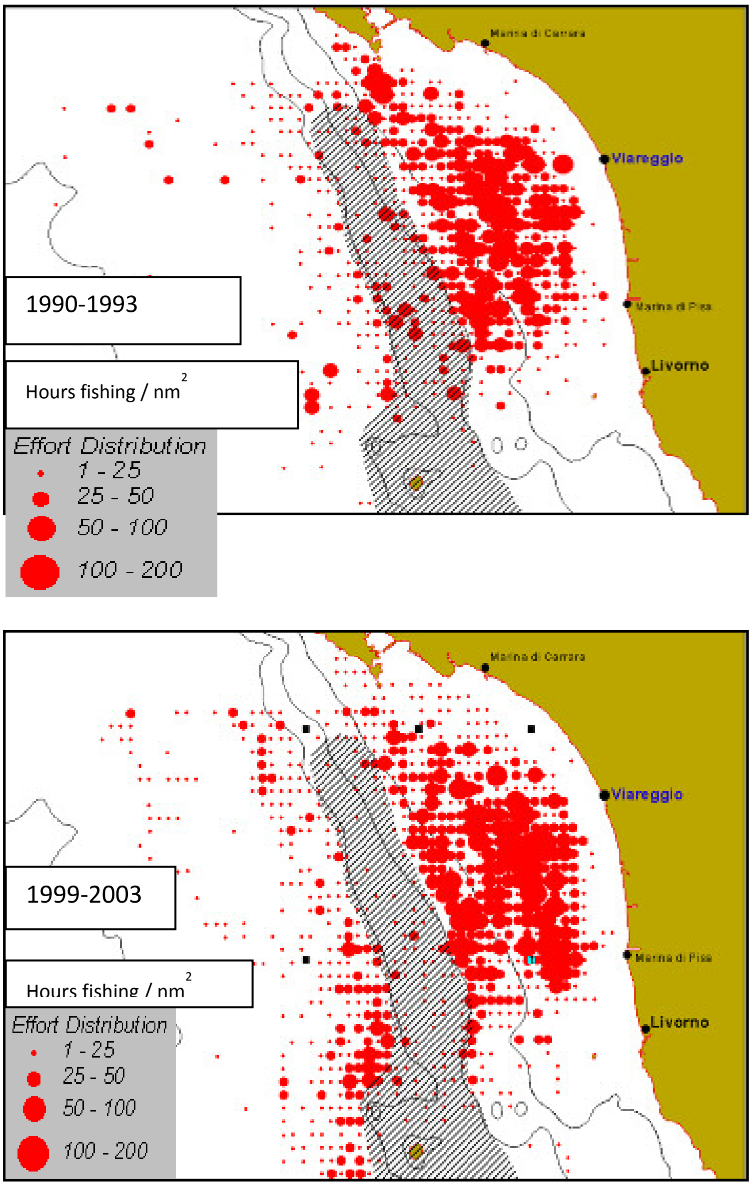


Figure 164. Spatial distribution of the commercial fleet's effort in the Southern Ligurian Sea (Viareggio fleet) in successive periods after the control of minimum landing size of hake was progressively enhanced.

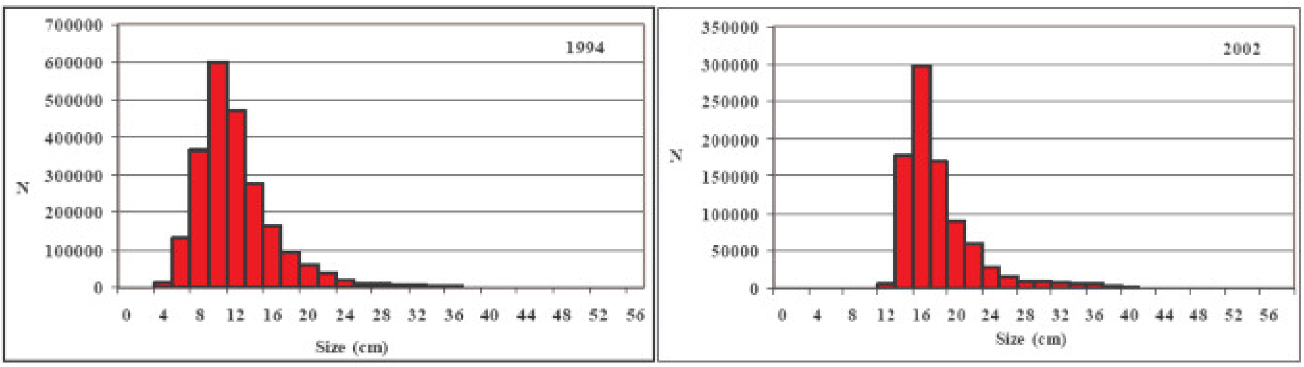


Figure 165. Size distribution of catches in 1994 (left) and 2002 (right).

4.8.5. Conclusions

Changes in gear selectivity alone, through changes in mesh size/shape or changes in gear architecture, might result in insufficient improvement of the exploitation pattern of some demersal fish stocks. Therefore other measures, such as temporal and spatial fisheries limitations, can be complementary and useful for this purpose. An increase of the codend mesh size compatible with the Minimum Landing Size (MLS) of e.g. hake would also impact the catch of the other species that could be selected sustainably using a smaller mesh than that needed for hake. In addition, survival rates of many demersal species escaping through the codend can be low and this can jeopardize the effectiveness of improved gear selectivity.

Gear modifications (e.g. changes in mesh size/shape) should be complemented by adaptive spatial/temporal fishing limitations, in order to restrict fishing in nursery areas during recruitment periods (Lutchman, 2014). The implementation of mitigation measures is a general strategy to protect juveniles and reduce discards and it should rely upon a mix of options to support fisheries management, all based on a delay of the age/size at first capture.

5. IDENTIFICATION OF POTENTIAL DISCARD ISSUES

5.1. Background

The Common Fisheries Policy (CFP)[13] aims at the progressive elimination of unwanted catches, in particular of discards of species subject to catch limits and, in the Mediterranean Sea, also catches of species subject to minimum sizes[14]. Discards occur because of legal and economic reasons. Regulations often define the catch that can be legally targeted or landed. Fishes that exceed the quota, are below the minimum landing size (MLS) or do not meet catch composition regulations cannot be retained on board and must be discarded (e.g. European Commission, 2002). For economic reasons, catch of target species could also be discarded if it is of small size or poor quality (e.g., damaged or not so fresh) because of high grading (especially when quota or storage room is limited) or low market value that do not compensate sorting costs; or catch of non-commercial species because of low demand resulting in low market value (Pascoe, 1997; Catchpole et al., 2005). Discards are highly variable depending on fisheries and fishing gears (Rochet and Trenkel, 2005); so are sorting costs. Thus, discards take place because fishermen expect to obtain more profits with this practice or are obliged due to legal issues.

The impact of discards in a fishery depends on the survival rate that is linked to the species and the fishing gear (Davis, 2002). The survival rate of discards is generally low for fishes and can reach 0 % of the discards for some of them (Hill and Wassenberg, 1990; Davis, 2002; STECF, 2013; see also paragraph *§Literature Review of the Survival information*). Improving selectivity, in particular reducing the catches of the smallest individuals that would be otherwise discarded (e.g. below the minimum legal size), results in medium to long term higher yields per unit of fishing effort and in greater catch values (Broadhurst et al., 1996; Fonseca et al., 2005a; 2005b; Raveau et al., 2012). If a landing obligation / discard ban removes the legal obstacles, discards may still occur because of economic reasons.

A discard ban will be beneficial (at least from a biological perspective) if total removals are reduced (Condie et al., 2014) or if at the same amount of removals, these are obtained from fishing pattern closer to the optimal exploitation pattern. Such a reduction of removals can take place without reducing landings, by avoiding undersized fish. Experience shows that discard bans in order to have a positive effect require of additional management measures to improve selectivity and consequently to reduce fishing mortality (Bellido et al., 2011; Condie et al., 2014).

There are cases where catches of undersized individuals can be avoided through improvements in selectivity, but there are some cases where it is not possible (see paragraph *§Literature Review of the Mitigation Measures to improve the selectivity of the fishing gears targeting demersal stocks*). In the cases where selectivity improvements cannot avoid the catch of undersized fish, the success and outcomes of a landing obligation will largely depend on the extent fishers will avoid undersized fish that otherwise would be discarded (Guillen et al., 2014). Hence, in these cases in order to avoid the catch of undersized fish it is necessary to establish economic incentives.

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[13] Regulation (EU) No 1380/2013.
[14] As defined in Annex III of Regulation (EC) No 1967/2006.

Under the landing obligation, if there are no economic incentives to land the undersized fish caught, there is the need of high level of surveillance to ensure that they are not discarded (Condie et al., 2014). Here is where the concept of (disproportionate) costs of control and enforcement is introduced. Typically fisheries control and enforcement is quite costly (Arnason et al., 2008). So a high level of surveillance to ensure the full implementation of an EU discard ban could be very costly (disproportionate also) considering the size of the EU fleet (Condie et al., 2014)[15].

In conclusion, incentives to land the catch need to be higher than the incentives to discard it. Even if legal obstacles are removed, incentives to discard even target species may remain. These incentives to discard part of the catch are mainly related to the limited physical storage on board and high sorting costs compared to expected revenues. Moreover, the extent of the discards will also depend on the selectivity of the gear and the fishing strategy (e.g., the ability and willingness of the skipper to avoid nursery areas), which will depend on the expected revenues and costs. The landing obligation may lead mainly to changes in catch profiles, changes in fish prices and/or changes in operational costs.

Changes in catch profiles:

- Quicker filling of storage rooms implying shorter and more numerous trips: may lead to lower landings.
- Changes in selectivity and the fishing strategy/behaviour (e.g., the ability and willingness of the skipper to avoid nursery areas): missing catches, even if would have not been previously discarded.
- Decrease of scavenger species (e.g., shrimps, *Nephrops*, octopuses). Extracting biomass from the sea can represent an ecological cost. The landing of discards could increase the extraction of energy from the ecosystem and reduce its secondary production with no direct benefit for fishermen (Coll et al., 2008; Libralato et al., 2008; Sardá et al., 2015). Due to the decrease in food availability for meso-pelagic scavengers or benthic fish and invertebrates (Catchpole et al., 2006), although these processes are less well understood (ICES, 2014). A direct consequence of banning discards is the creation of a food shortage for scavenging species, but the effect of this shortage will depend on their ability to switch to other preys, potentially causing cascading effects on other species through increased predation or competition. Bioenergetic and ecosystem models have shown that discards may have strong direct and indirect impacts across the whole food-web, which may have positive or negative impacts on populations, or even alteration or simplification of trophic webs (Fulton et al., 2005; Catchpole et al., 2006; Kaiser and Hiddink, 2007; Heath et al., 2014).
- Potential increase in the abundance of small sized fish through changes in fishing strategies, with potential effects on the whole food-web and so on species biomass.
- Future recovery of stocks: it is expected that in the future fish stocks will recover, if the discards ban helps reduce fishing mortality, and consequently catches will increase, in part thanks to the landing obligation regulation.

[15] EWG 13-17 considers that regarding high risk fisheries, full monitoring (CCTV and/or observers) are the only control methods which seem to offer the only effective approach to ensure all catches are documented and counted against quota. Likewise, these control methods seem to be adequate to monitor that undersized fish is not discarded.

Changes in fish prices:

- Quicker filling of storage rooms implying shorter and more numerous trips: prices may increase as products are fresher. There might be changes in product forms and new products.
- Average size of landings may increase in the long term, if the discards ban helps reduce fishing mortality, leading to higher prices. Guillen et al. (2014) show that if discards could be reduced or avoided (e.g. with selectivity improvements), then landings above MLS would increase together with the average weight of landings and the biomass at sea.

Changes in operational costs:

- Quicker filling of storage rooms implying shorter and more numerous trips may lead to fuel cost increases. Moreover, some fishers may invest in newer vessels with larger storage room or even some processing onboard.
- Changes in selectivity and the fishing strategy/behaviour (e.g., the ability and willingness of the skipper to avoid nursery areas): this can lead to changes in the gears used (increasing costs) and potential fuel costs changes.
- Future recovery of stocks: higher biomass at sea should lead to a higher Catch per Unit of Effort (CPUE), and consequently fishing costs may partly decrease.
- More handling/sorting on-board: This could lead to labour cost increases. The need of more work to be done on-board, and even the potential need to hire more crew, may lead to labour cost increases (or not) depending on the (shared) remuneration system and the fixity of the share rate (Guillen et al., 2015).

Other impacts

- Changes in fisheries control and monitoring: need to increase fisheries control and enforcement to guarantee compliance may easily lead to higher control and enforcement costs.
- Changes in inland structures: the establishment of the landing obligation may require providing some infrastructures to the fishing ports in order to utilize the unwanted catches that are landed.
- Decrease of seabird populations: a great portion of discards are consumed by seabirds, potentially leading to either negative or positive effects on seabirds' populations (Bicknell et al., 2013; Votier et al., 2013).

5.2. Economic impacts of the landing obligation

STECF EWG15-14 has been convened to assist Member States and the Mediterranean Advisory Council (MEDAC) in formulating joint recommendations that will form the basis of regional discard plans for fisheries targeting demersal species in the Mediterranean and Black Seas.

According to the basic principles of the CFP, before measures are included in discard plans, account shall be taken of their likely economic and social impact. One important element that should therefore be considered is the identification of potential indicators for evaluations of the landing obligation and for the assessment of the performance of individual regional discard plans. STECF EWG13-17 was already requested to consider this issue, but it was not addressed because of insufficient time available.

EWG15-14 noticed that this is an important aspect that should be considered within regional discard plans and work should progress on this aspect. Even if no specific TOR is reported on this issue, EWG15-14 considered useful to deliver some preliminary thoughts on the basis of the scientific work already available. The assessment of the impacts of the landing obligations is implemented using different approaches, in particular through bio-economic models and/or effectiveness evaluation (Malvarosa et. al, 2015). The main socio-economic criteria to evaluate the impact of the landing obligation regulation are:

- Changes in the economic performance of the fleets/vessels involved. These changes can come mainly due to a reduction in the landings value and/or an increase in the costs. In addition, it could also be considered changes in the economic performance of fish processing plants, other activities in land (e.g., fishing guilds, marketing), and of the public administrations (especially if further control and enforcement needs to be put in place).
- Changes in employment: number of fishers, average wage, average working hours. In addition, it should also be considered employment in land (e.g., fish processing plants).
- Changes in production: quantity (and value) of landings by species, available fish for the processing industry (human and non-human production).

The common (minimum) parameters required to be collected by vessel (or fleet segment) in order to evaluate the economic impacts of the landing obligation regulation are in line with the parameters collected under the EU's Data Collection Framework. These parameters to be collected are:

- Quantity and value of fish by species (if possible by age, weight or length) landed and caught. This will provide information on the fleet's revenues and importance of each species caught. Before the landings obligation takes place, quantities caught and landed may be different to the existence of discards. Information on discards it is of great importance as it will provide insights of the fishers' capacity to avoid undesired fish. Other sources of income (e.g. subsidies, selling fishing rights) should be also collected if they represent a significant share in the totals income.
- The number of vessels, average (or total) kW, and average (or total) GT will provide information of the evolution of the fishing fleet overtime, and if the landings obligation has impacted it.
- Days at sea and/or fishing days show the effort devoted in a fisheries, and consequently will show how the landings obligation has impacted effort. Together with the quantities caught may provide an estimate of the evolution of the catch per unit of effort (CPUE). Similarly, information on the number of fishing trips and average time per fishing trip will reflect changes in the fishing patterns.
- Number of fishers and working hours, which allows estimating the full time equivalent - FTE, will show the evolution of employment (and employment per vessel) due to the landing obligation. Information of unpaid labour should be provided if it exists.
- Average wage and how fishers are remunerated (e.g., fixed or shared remuneration systems) will help to estimate labour costs, and how they change over time.
- Fuel costs and fuel consumption (e.g., in litres), repair and maintenance costs, other variable costs (e.g., oil, ice, bait, commercialization costs), other non-variable costs (e.g., mooring costs, insurance, permits).

- Value of assets (includes vessel, gears, and quotas attached to the vessel) to estimate capital and depreciation costs. Also value of investments done, which should especially include changes/adaptations of new gears, and storage rooms.

In addition to these economic parameters, bio-economic models will also require some biological parameters in order to evaluate discard mitigation strategies. Required biological parameters to model the fisheries will depend on the bio-economic model used. Most commonly required biological parameters are: biomass at sea (by age-class), fishing mortality, selectivity, growth parameters, maturity, etc.

5.3. Theoretical approach

Profitability is commonly defined as the difference between revenues and costs:

Profits = Revenues - Variable costs - Fixed costs

It is commonly assumed that fishermen take their decisions aiming at maximizing their profits. Because fishermen take their decisions before revenues and most of the costs are fully known, they base their decisions on expected revenues and costs:

Expected (Profits) = Expected (Revenues) - Expected (Costs)

Following Becker (1968) approach in crime economics theory[16], fishermen will comply with a regulation based on their expected profits. In other words, fishermen will probably not comply with the landing obligation regulation if profits are expected to be higher by not complying.

Compliance: *Expected (Profits complying) >or = Expected (Profits not complying)*

No compliance: *Expected (Profits complying) < Expected (Profits not complying)*

In this case, the possibility of apprehension when committing an infringement (discarding in our case) and the potential fines in the profitability estimation should be considered. The expected profits when complying with the regulation remain the same:

Expected (Profits complying) = Expected (Revenues) - Expected (Costs)

However, the expected profits when not complying with the regulation are:

Expected (Profits not complying) = Expected (Revenues) - Expected (Costs) – Expected (Fines)

Where the expected fines are determined by the probability of detecting the infraction (i.e., discarding) multiplied by the potential fines.

*Expected (Fines) = Probability detection * Fine*

Therefore, fishermen’s compliance with the landing obligation (when not complying with the regulation can lead to higher profits) will largely depend on the level of control and enforcement that determines the probability of detection and the value of the fines[17].

[16] Assuming risk neutral fishermen.

[17] Moreover, there is a direct relation between control and enforcement level and the control and enforcement costs for the administration.

We could disaggregate costs between fixed and variable costs. Where variable and fixed costs could be further disaggregated in:

Variable costs =Crew costs + Unpaid labour + Energy costs + Repair and Maintenance costs + other variable costs

Fixed costs = Non variable costs + depreciation + opportunity cost of capital

Because fixed costs refer to costs not related to the fishing activity, they will remain the same whether fishermen comply or not with the landing obligation.

Expected (Profits complying) = Expected (Revenues c) - Expected (Variable costs c) - Fixed costs

Expected (Profits not complying) = Expected (Revenues nc) - Expected (Variable costs nc) - Fixed costs - Expected (Fines nc)

Thus, comparing changes (higher, equal or lower : > = <) in the expected profits of complying (c) with the landing obligation with the ones from not complying (*nc*) is a function of the revenues and the variable costs.

Expected (Profits complying) > = < Expected (Profits not complying)

Expected (Revenues c) - Expected (Variable costs c) > = < Expected (Revenues nc) - Expected (Variable costs nc) - Expected (Fines nc)

This could be rewritten as:

Expected (Revenues c – Revenues nc) - Expected (Variable costs c – Variable costs nc) > = < Expected (Fines nc)

Hence, fishermen’s compliance with the landing obligation will largely depend on the expected changes (i.e., decrease) in profitability (coming from changes in revenues, costs or both) compared to the expected level of fines to pay if detected when not complying with the landing obligation regulation.

5.4. Disproportionate costs

Since the CFP (Regulation (EU) No 1380/2013) does not intend to generate excessive burden on fishermen, in those cases where disproportionate costs of handling unwanted catches may arise, *de minimis* exemptions may be established. However, no clear definition of disproportionate costs is provided on the regulation. Previous STECF working groups have examined the issue of disproportionate costs in other areas, but STECF working groups have not defined disproportionate costs.

EWG13-16 simply assumed that disproportionate costs are already occurring and that the key aspects of the regulation are: *(i)* how to define when the unwanted catch is “below a certain percentage of the total catch of that gear”, *(ii)* how to set the “the percentage unwanted”, and *(iii)* how this should be implemented in a discard plan. EWG14-01 stated that *"The disproportionate cost is assumed and the issue is to arrive at some discard percentage which will be permitted for a particular gear in a specific fishery". However EWG 14-01 concluded that "the process of arriving at an acceptable discard percentage for different gears under an assumption of disproportionate cost is complex and depends on the specificities of each fisheries – EWG considered that defining specific values would have been unhelpful"*.

On the way the landing obligation it is drafted, the concept of disproportionate costs is a key issue. Selecting the value of “disproportionate costs” is very challenging because it could easily lead to an over or under utilization of *de minimis* exemption and consequently it may allow too less or too much discarding to occur.

In fact, "disproportionate costs" criterion is not defined in the economic theory[18], but it seems that ultimately will be a political decision. So, the threshold value for disproportionality may depend on the fleet segment, the fleet segment's profitability, economic cycle, time of year, region, political willingness, etc. Consequently, there is the need to developed objective criteria to ensure a transparent decision making process.

5.5. Indicators to evaluate the landing obligation and to assess disproportionate costs

There is the need to monitor overtime the fleet's economic performance to properly evaluate the impact of the landing obligation. Impact estimates done before the landing obligation are in place (e.g. with current data) and would most likely overestimate the impact (i.e., the costs) of the regulation. This is because it is very complex to properly assess changes in fishermen behaviour, so it is commonly assumed that the behaviour of fishermen does not change and so will continue to fish with the same exploitation pattern (e.g. obtaining the same level of discards). With this assumption, landing revenues would remain the same as the previous period while costs would increase with the landing obligation due to the increase in sorting costs. However, because of the cost increase, fishermen may decide to change their behaviour (i.e., fishing strategy or exploitation pattern), and so revenues and cost would change from the previous period. If fishermen decide to change their behaviour it will be because they are expecting to obtain more profits than the ones they would obtain if they would not change (Tsitsika and Maravelias, 2008; Maravelias et al., 2014). So, in order to evaluate the impact of the landing obligation it is necessary to continue to monitor the fleet's economic performance once the landing obligation is in place. Several scientific projects are currently ongoing aspiring to obtain data and evaluate the economic impacts of the landings obligation at vessel and fleet levels. Hence, the two H2020 (*MINOUW* and *DiscardLess*) research projects should bring some more elements or discussion on these subjects in the following years. EWG 13-16 analysed the use of the "current revenue to break even revenue ratio"[19] as an appropriate indicator to use evaluate the landing obligation regulation, concluding that the use of the indicator has a great potential but requires further analysis and refinement before it can be considered an appropriate evaluation tool. However, we consider that instead of estimating the ratio between the fleets' current revenue and break-even revenue, it would be better to simply monitor the profitability evolution. Because:

- Profitability offers a more clear and easy message to managers and stakeholders,
- Determining thresholds for the "disproportionate costs" value from profits may be easier,
- In a Cost-Benefit Analysis (CBA) context it may be relevant to compare, for example, with the funding required for different in land infrastructures for processing discards or the control and enforcement costs.
- It is a common output in many bio-economic models used for impact assessments.

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[18] The only analogous use of the "disproportionate cost" concept takes place in the Water Framework Directive, but they also suffer from the lack of a definition and it seems that no consensus on its definition has been reached (Görlach and Pielen, 2007; Brouwer, 2008).

[19] The breakeven revenue (BER) is the revenue required to cover both fixed and variable costs so that no losses are incurred and no profits are generated. The current revenue (CR) is the total operating income of the fleet segment, which consists of income from landings and non-fishing income. The ratio between the fleets' current revenue and break-even revenue indicators shows how close the current revenue of a fleet is to the revenue required for the fleet to break-even from an economic point of view).

When estimating and monitoring profits, we believe that it would be better to use "operating economic profits". We chose "operating economic profits" to monitor fleet's economic performance because it focuses in the fishing activity (income from other activities is not included), accounts for indirect costs and opportunity costs of capital, but no taxes nor financial costs[20].

Operating economic profits = Revenues - Crew costs - Unpaid labour - Energy costs - Repair and Maintenance costs - other variable costs - Non variable costs - depreciation - opportunity cost of capital

Changes in profits (e.g. over time) can be reported as a function of a base year (e.g. considering the first year of the series as base 100) or of a base case (e.g. considering the base case scenario as base 100) in order to provide a more intuitive figure. Likewise, in order to compare fisheries or fleets, profits could be presented as a function of the total value of assets, consequently obtaining the Return on Fixed Tangible Assets (ROFTA).

ROFTA measures profits in relation to capital invested, i.e. indicates how profitable a sector is relative to its total assets. The higher the return, the more efficient the sector is in utilising its asset base. As data on intangible assets (e.g. fishing rights, natural resource) are not always available in fisheries, the Return on Fixed Tangible Assets (ROFTA) is used as an approximation of ROI. In addition, the profit indicator could be accompanied with the Gross Value Added, given the nature of the workforce and shared salaries in Mediterranean fisheries (Guillen et al., 2015), as well as potential difficulties on the capital estimation (total value of assets to estimate the opportunity cost of capital):

Gross Value Added = Revenues - Energy costs - Repair and Maintenance costs - other variable costs - Non variable costs

5.6. Estimation of different potential short-term scenarios of LO implementation

The current lack of proper estimates on changes in catch profiles, costs and prices overtime, in part due to the current lack of bio-economic models addressing this issue considering the Mediterranean specificities, makes impossible to provide at this stage any estimates of the potential impact of the LO implementation in the EU Mediterranean fleets. However, because we have been asked to provide some estimates of the impact of the LO implementation in Mediterranean fisheries, we provide some potential short-term scenarios that EU fleets could face, just for illustrative purposes. In order to do so, ROFTA has been calculated for some selected fleet segments and 3 different scenarios have been assumed:

- Scenario 1: *status quo*;
- Scenario 2: a 20 % revenue decrease from selectivity changes is assumed;
- Scenario 3: increased crew costs (+20 %) due to increased work on board (that may come from higher salaries of the current crew to remunerate the work increase of the need to hire more crew) for sorting and handling are assumed.

[20] On a simplified way, we may have the following profit categories: a) Gross profit = turnover – direct (variable) costs; b) Operating profit = gross profits – indirect costs (e.g. fix costs, depreciation); c) EBIT = operating profit + non-operating income; d) Net profit = EBIT – taxes – financial costs. We differentiate economic profits (also called extraordinary profits) from (normal) profits because in the former the opportunity cost of capital is deduced to the profits (in addition, the opportunity cost of labor is included as wages + imputed value of unpaid labor).

The assumptions considered to estimate the different scenarios are:

- No consideration has been given to any potential increases in income that you would expect with uplift in long-term catches, consequently, focusing more in the short term. No changes in fishermen behaviour have been considered. Therefore the analysis presents a static view of possible changes in profit margin but based on historic (by necessity) revenue information and therefore considered the impact on the profit margin of a % decrease in revenue that you expect from increases in selectivity[21]. Therefore, this could be viewed as a worst case scenario as it does not consider any possible increases that would occur with any future uplift in stocks or changes in fishermen behaviour.
- There are a number of other unforeseen factors that can affect the profit margin such as fluctuations in fuel and market prices that we assume constant overtime in the estimation.
- Economic information is already compiled as part of the DCF process and is already available in the STECF Annual Economic Report. However, these data are quite highly aggregated and may not be suitable for all required analysis, but it is likely that within Member States those institutions responsible for providing economic information could aggregate (disaggregate) data at an appropriate level in the formulation of discard plans.

Results are presented in Figure 166. However, it should be kept in mind that they are presented only for **illustrative purposes** to understand in what direction short-term changes in profitability could move to, because:

- Values presented are not real changes in revenue from increased selectivity. A more detailed analysis of the likely impact of the change in selectivity by fleet and fisheries is needed;
- The increase in costs may be due to different reasons (e.g. as a result of on board sorting and handling, for safety reasons relating to storage capacity on board and also related to damaged fish caused by depredation by marine mammals or other predators). Here as well, a more detailed analysis of the costs by fleet and fisheries is required;
- The increase in crew costs should be assessed considering the labour needs (increase in salaries or crew number), as well as the type of remuneration (as fixed salary or as share of the revenues). Once again, a more detailed analysis of the extra labour required and its costs by fleet and fisheries is required.

5.7. Further considerations

The **in land costs and investments** in infrastructures should be considered to guarantee that the undersized fish landed is utilized and not wasted. These infrastructures may consist on handling of the catches, refrigerator plants, and transportation. From the "Joint Recommendations" for Discard Plans that the Mediterranean EU countries submitted[22], only the French component contained an example of the estimated costs that will be generated by handling onsite catches. The example is based on the costs generated by handling catches onsite in the harbour of Sète (France), provided by the SATHOAN producer organization.

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[21] Improving selectivity, in particular reducing the catches of the smallest individuals that would be otherwise discarded (e.g., below the minimum legal size), results in medium to long term higher yields per unit of fishing effort and in greater catch values (Broadhurst et al., 1996; Fonseca et al., 2005a; Fonseca et al., 2005b; Raveau et al., 2012).

[22] Discards Management Plan for Western Mediterranean Sea (GSAs 1-12 except for GSAs 3 and 4).

- Handling and disposal of the products onsite = 75€ / ton;
- Conservation of the products onsite = 100 € / ton;
- Transport of the products = 30 € / ton;
- Indirect cost (business expenses) = 20 € / ton.

So, a total cost of 225 € per ton (0.255 € per kg) of fish is estimated, generated from handling unwanted catches onsite from Sète vessels, the closest harbour to Bézier. This cost does not take into account the cost of handling onboard (e.g., sorting), as well as the potential loss of income generated by their storage, at the expense of commercial catches usually landed. Hence, the need to build infrastructures (e.g. further refrigerator space) in some ports may arise.

In order to avoid discards, once the legal constrains are eliminated (landing obligation), there is the need that incentives to land the catch are higher than the incentives to discard it (i.e., **sorting costs**). So, there is the need to define the incentives to land the catch. These incentives could be, for example, a compensation (payment) for the landed fish that would be otherwise discarded (i.e., undersized) by weight landed. However, it is also not easy to set a proper value.

A compensation lower than the sorting costs may not be a strong incentive for fishermen to avoid discarding; while, a payment higher than the costs could have the opposite effect, and be an incentive for fishermen to voluntary target undersized fish. This implies that, at theoretical level, the compensation for landing unwanted fish should be delineated, at least, by fleet segment and fisheries. In this case, a disproportionate cost could be defined as a required compensation to cover the sorting costs that the administration considers too high to pay. It should be considered that the landing obligation could lead to improvements in the medium and long-term economic performances of fisheries; however, if any landing incentives (compensations) are removed (e.g. once the economic improvements appear), individual fishing vessels would have incentives to discard, which could lead to the initial situation (i.e., without the landing obligation).

Under the landing obligation, if there are no economic incentives (or are lower than the costs) to land the undersized fish caught, there is the need of high level of surveillance to ensure that they are not discarded. Hence, the **control and enforcement costs** necessary to establish and run the landing obligation should be considered. In order to ensure the full implementation and compliance with the landing obligation a high level of surveillance may be required, which could be very costly (Condie et al., 2014). The level of surveillance determines the probability to detect an infringement, but is directly related to costs. In other words, if surveillance from a control tool (e.g., observers, CCTV) increases, the control and enforcement costs will also increase. The existence of a certain control and enforcement level will produce a deterrence effect on fishermen that would follow, at least in part, the landing obligation regulation. The degree that determines how the landing obligation is followed would be determined by the expected costs that will have the fishermen if they comply with the landing obligation and the expected fines[23] if they do not comply with the landing obligation. Moreover, part of the control and enforcement cost could be recovered from the fines.

23 Where the expected fines are determined by the probability of detecting the infraction (discarding) multiplied by the potential fines. Hence the total deterrence effect in a fishery would be equal to the sum of the expected fines for all vessels participating in the fishery. So, increases in the value of the fines can easily increase deterrence effect with no direct costs for the administration.

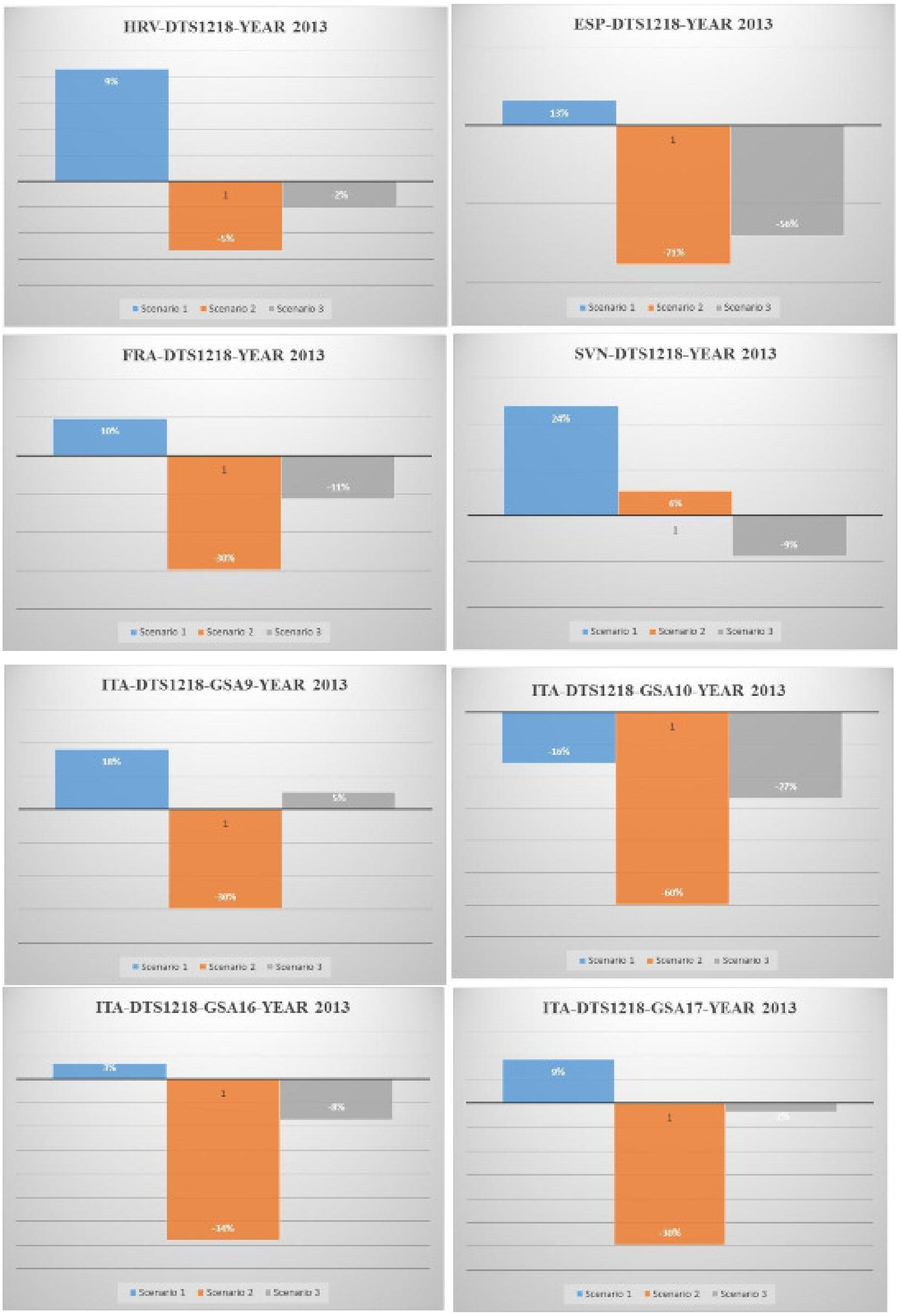

Figure 166. ROFTA for selected fleet segments. Scenario 1: status quo; Scenario 2: 20% revenue decrease from selectivity change assumed; Scenario 3: 20% labour costs increase due to increased work on board for sorting and handling. *Source: DCF data. Results are presented only for illustrative purposes.*

6. FINAL CONCLUSIONS

Main European Demersal fisheries in Mediterranean

- The two data sources available to experts during EWG15-14 were the **DCF Mediterranean data call** and the **DCF economic data** call for the EU fishing fleet. Since the DCF economic data call includes information on all species landed and data on value of landings, EWG15-14 looked into the possibility of using the DCF economic data call in order to address TOR1. A number of problems were identified with the use of the DCF economic data call, which would need to be resolved in order to use the this data source to identify and describe main demersal fisheries in future:
  a) landings data was not available for all countries and years;
  b) landings data was not available at level 4 (i.e. GSA level) for all countries;
  c) landings values were not available for all records on landings weights;
  d) data on fishing gear was not always available (data on fishing technique was not considered a viable alternative for the purpose of TOR1).
- EWG15-14 concluded that given these problems the DCF Mediterranean data call was the more appropriate source of data to use. However, experts consider that the Mediterranean data call should also be revised by asking Member States to submit data on (i) catch (landings and discards) information for all species included in Annex III of EC 1967/2006, and (ii) landings data for all species at metier level for the different GSAs and Member States in future. Such data is required in order to accurately identify and describe the main demersal fisheries where the species caught are subject to minimum sizes, as was requested by TOR1;
- However, in order to define *'species driving'* the fisheries, landings in value (Euro) have been used in the analysis to define the main species. Values of each species (Income in Euro) have been calculated by multiplying the volume of landings (tons) from the DCF Mediterranean data call by the Cost rate (Euro/kg) obtained from the DCF economic data call;
- According to the FAO, a fishery (and "fisheries") is typically defined in terms of the "people involved, species or type of fish, area of water or seabed, method of fishing, class of boats, purpose of the activities or a combination of the foregoing features". The definition often includes a combination of fish and fishers in a region, the latter fishing for similar species with similar gear types. Consideration should be given to what groups or combinations of vessels, species, areas and gears are being included. Where possible the term or concept must be defined more precisely, such as fleet segment or vessels, or activity by vessels fishing mainly for species in area. Accordingly to the Annex 1 of the DCF Mediterranean data call, EWG15-14 used an aggregation based on combination of **area** (GSA and Country); **fisheries or metier** (species complex, gear and vessel characteristics); and **gear**. For the sake of simplicity, in this report each combination was called "*Fisheries*";
- the main species, based on value of landings (Euro), have been therefore found for each so called *Fisheries*. Phasing-in based on fisheries will lead to situations where certain species will be either

included or excluded from the Landing Obligation depending on the fishery in which they are caught. This could in turn present significant control issues and may incentivise switching between fishing gear and/or fisheries. Therefore, consideration should be given to phasing-in by species per area, as this negates the need to define fisheries (fleet/metier combination) which is problematic particularly in complex multi-species/multi-gear fisheries, which tend to lack obvious boundaries.

- The list of fisheries presented by in this report is based on EWG15-14 experts' review of potential fisheries definitions and on current knowledge of technical fishing gear options. The fishery definitions presented may not match those currently being considered by other regional groups and therefore may not be of specific relevance.

Survival

- Information and data needs that constitute robust scientific evidence of high survival are in general substantial and require dedicated scientific experiments, which are capable of demonstrating survival in the short, medium and long term;
- it is evident that estimates of survivability vary considerably both within and between different studies and are influenced by numerous factors (e.g., gear, fishing practise, depth, season, environmental characteristics);
- the literature review of the survival information showed that there is practically no information available from Mediterranean fisheries for most of the concerned species;
- survival rates from areas other than Mediterranean exist for only few of the concerned species but cannot be directly applied to the Mediterranean fisheries as, among others, gear characteristics and fishing techniques as well as environmental conditions (e.g., temperature) are not directly comparable to the Mediterranean;
- it is thus evident that studies which estimate discard survival in the Mediterranean Sea are urgently required in case exemptions to the landing obligation regulation are requested. Survivability would be better informed if dedicated survival studies were taken in the fisheries;
- the choice of a suitable threshold for defining 'high survival' rates should ideally be considered on a case by case basis, taking into account the potential benefits for stocks and the broader ecosystem.

Selectivity and complementary measures

- Square mesh coded is more efficient in releasing juveniles then diamond mesh codend of the equivalent mesh size; therefore the use of 50 mm diamond mesh codend should only be allowed with an acknowledged size selectivity equivalent to or higher than that of 40 mm square mesh codend. On the other hand, the improvement in selectivity when using the square mesh is not evident for flatfishes most likely due to their specific cross sectional shape. Therefore, 50 mm diamond mesh codend should be mandatory, in case where flatfish defines the trawl fishery;
- a weakness still remains in the Regulation 1967/2006 that hampers the efficacy of square mesh codends; the length of the codend is not reported. The actual risk, in case fishermen decide to adopt 40 mm square

mesh codend, is that they use short codends (less than a meter for example) by leaving the rest of the net with 40 mm diamond mesh netting. This will make practically inefficient these technical measures; therefore it is of paramount importance to fix a minimum codend length;

- the use of square mesh panels in the Mediterranean studies did not show any clear positive effects on the selectivity, while alternative trawl designs (separator panels) as well as sorting grids seems to be promising, and should be tested in certain fisheries (*Aristaemorpha folicaea, Aristeus antennatus, Nephrops norvegicus*);
- groundropes of bottom trawl, equipped with leads and/or chains strongly affect catch efficiency and, indirectly, the amount of discard, therefore technical properties of groundropes (maximum length, diameter etc.) should be set;
- in hydraulic dredging clam fisheries, recent studies confirm that it is technically rather unfeasible to select only individuals with a size not smaller than the Minimum Conservation Reference Size (MCRS). Therefore, as already permitted for Anchovy and Sardine, for which Member States may convert the minimum size into 110 specimens per kg and 55 specimens per kg respectively, a similar approach (number of clams per kg) should be allowed also for Chamelea gallina. Discarding of juvenile clams after on-board sieving process should only feasible if studies show high survivability of the discarded clams;
- the review of selectivity studies confirm that passive nets are quite selective and mesh opening is the most important parameter to take into consideration for selectivity issue; in this regards the definition of a minimum mesh size also for trammel nets and combined nets is suggested;
- protection of nursery areas would improve fisheries selectivity and reduce discards;
- further bathymetric, spatial and temporal restrictions of fishing operations could be employed for the protection of concentrations of undersized fish or of individuals in other critical life stages;
- there is adequate information available for some key species (e.g. hake) to guide decisions on spatio-temporal fishing restrictions aimed at protecting undersized fish.

Potential discard issues

- The landing obligation will remove the legal constraints (e.g. minimum landing size), but economic reasons to discard may prevail;
- so, in order to avoid discards there is the need that incentives to land the catch are higher than the incentives to discard it (i.e., handling and sorting costs). Ideally the compensation (incentive) for landing unwanted fish should be defined, at least, by fleet segment and fishery. A compensation lower than the sorting and handling costs may not be enough incentive for fishers to avoid discarding; while, a compensation higher than the costs could have the opposite effect, and be an incentive for fishers to voluntary target undersized fish;
- if there are no economic incentives to land the undersized fish caught, there is the need of high levels of surveillance to ensure the full implementation of an EU discard ban that are often quite costly, considering the size of the EU fleet.

ANNEX 1. THE OMNIBUS REGULATION (EU) 2015/812

The *Omnibus* Regulation (EU) 2015/812 of the European Parliament and of the Council of 20 May 2015 introduced extensive amendments to existing regulations. For the Mediterranean Sea, Regulations (EC) No 1967/2006 and (EU) No 1380/2013 of the European Parliament and of the Council, as regards the landing obligation were amended as follows:

Changes to Regulation 1967/2006 (MEDREG) introduced by the *Omnibus* Regulation		
Article	**Amendment text**	**Effects**
2	Definitions	Definition of 'unintended catches'.
14	New legal insert	Delegated act powers to COM, particularly in the areas of reducing or eliminating unwanted catches and measures which may derogate away from Regulation 1967/2006.
15	MCRS	Update in light of new CFP regulation and the provision for MCRS to be altered by delegated acts. Catches subject to the LO below MCRS must be landed and counted against quotas. Member States to have in place storage, handling and market infrastructures for such catches and provide support. Those fish caught below MCRS NOT under the LO to be discarded.
15a	New insert – delegated acts	COM powers *vis-à-vis* delegated acts to protect juvenile marine organisms. May derogate from MCRS established in Annex III of Regulation 1967/2006.
16	Direct fishing for fish below MCRS	Can be done for restocking or transplantation WITH permission and under authority of the MS where the activity occurs.
29a	Insert – delegated acts	Legal text.
Annex III	MCRS	References to 'minimum size' changes to MCRS.

Changes to Regulation 1380/2013 (CFP) introduced by the *Omnibus* Regulation		
Article	**Amendment text**	**Effects**
AM 1 **Art. 15.4 d)** ***(new)***	In Article 15, paragraph 4, a new point (d) is added: "(d) fish which shows damage caused by predators".	Fish damaged by predators is exempt of the landing obligation, together with: - Prohibited species - *De minimis* - High survivability
AM 2 **Art. 15.5 a)**	In Article 15, paragraph 5, point (a) is replaced by the following: "(a) specific provisions regarding fisheries or species covered by the landing obligation referred to in paragraph 1, such as the technical measures referred to in points (a) to (e) of Article 7(2), aimed at increasing gear selectivity or reducing and as far as possible eliminating unwanted catches".	Technical measures may be included in the discard plans/multiannual plans.
AM 3 **Art 15.13 a)** ***(new)***	In Article 15, paragraph 13a is added as follows: "(13a) By 31 May 2016, and by 31 May of each subsequent year up to and including 2020, the Commission shall submit to the Parliament and to the Council an annual report on the implementation of the landing obligation, based on information transmitted by the Member States, the Advisory Councils and other relevant sources to the Commission. Annual reports shall include: – steps taken by Member States and producer organisations to comply with the landing obligation; – steps taken by Member States regarding the control of compliance with the landing obligation; – information on the socio-economic impact of the landing obligation; – information on the effect of the landing obligation on safety on board fishing vessels;	The Commission will report annually on the implementation of the landing obligation.

	– information on the use and outlets of catches below the minimum conservation reference size of a species subject to the landing obligation; – information on port infrastructures and of vessels' fitting with regard to landing obligation; – for each fisheries concerned, information on the difficulties encountered in the implementation of the landing obligation and recommendations to address them.	

ANNEX 2. MEDITERRANEAN SELECTIVITY STUDIES

Table 8. Selectivity parameters obtained from literature for diamond-, T90 and square-mesh codends. Year: time when the experiment was conducted; Area: geographical area where the experiment was conducted; GSA: GFCM Geographical Sub-Area (GSA) where experiment was conducted; Species: Species on which the selectivity experiment was conducted; MLS: minimum landing size as defined by Council Regulation (EC) No. 1967/2006: MC: mesh configuration (DM, diamond; SM, square-mesh); NMS: nominal mesh size in the codend; MMS: measured mesh size in the codend; L50: length of fish that has a 50% probability of being retained or escaping after entering the codend; SR: difference in length between the fish that has a 75 % probability of retention and that with a 25% probability of retention.

Year	Area	GSA	Species	MLS	MC	NMS	MMS	L50	SR	References
2003	Aegean Sea	22	Mullus barbatus	11	DM	40	42.40	10.06	2.05	Özbilgin et al 2011
2003	Aegean Sea	22	Mullus barbatus	11	DM	40	42.40	11.14	2.14	Özbilgin et al 2011
2003	Aegean Sea	22	Mullus barbatus	11	DM	40	42.40	10.76	2.27	Özbilgin et al 2011
2003	Aegean Sea	22	Mullus barbatus	11	DM	40	42.40	10.95	1.91	Özbilgin et al 2011
1988	North Tyrrenian Sea	9	Merluccius merluccius	20	DM	38	NA	10.20	1.80	Abella and Serena, 1998
1990	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	34.00	11.40	NA	Aldelbert e Carriers 1990
1990	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	40.00	13.00	NA	Aldelbert e Carriers 1990
1990	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	50.00	16.30	NA	Aldelbert e Carriers 1990
1990	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	60.00	19.50	NA	Aldelbert e Carriers 1990
1990	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	40.00	12.40	NA	Aldelbert e Carriers 1990
2007	North Levant	24	Mullus barbatus	11	DM	44	43.46	10.70	2.90	Ates et al 2011
2007	North Levant	24	Pagellus acarne	17	DM	44	43.46	11.80	2.40	Ates et al 2011
2007	North Levant	24	Pagellus erythrinus	15	DM	44	43.46	11.80	1.60	Ates et al 2011
2007	North Levant	24	Mullus barbatus	11	SM	40	37.55	14.20	3.10	Ates et al 2011
2007	North Levant	24	Pagellus erythrinus	15	SM	40	37.55	11.00	2.60	Ates et al 2011
2007	Aegean Sea	22	Parapenaeus longirostris	2	SM	40	42.40	1.67	0.65	Aydin and Tosunoglu 2009
2007	Aegean Sea	22	Merluccius merluccius	20	DM	44	44.70	10.40	3.10	Aydin and Tosunoglu 2010
2007	Aegean Sea	22	Merluccius merluccius	20	DM	44	44.70	10.30	3.40	Aydin and Tosunoglu 2010
2007	Aegean Sea	22	Trachurus spp.	15	DM	44	44.70	14.70	4.60	Aydin and Tosunoglu 2010
2007	Aegean Sea	22	Trachurus spp.	15	DM	44	44.70	14.40	5.20	Aydin and Tosunoglu 2010
2007	Aegean Sea	22	Merluccius merluccius	20	SM	40	42.40	14.40	4.80	Aydin and Tosunoglu 2010
2007	Aegean Sea	22	Merluccius merluccius	20	SM	40	42.40	14.90	5.90	Aydin and Tosunoglu 2010
2007	Aegean Sea	22	Trachurus spp.	15	SM	40	42.40	15.90	5.60	Aydin and Tosunoglu 2010
2007	Aegean Sea	22	Trachurus spp.	15	SM	40	42.40	16.80	4.80	Aydin and Tosunoglu 2010
2007	Eastern Aegean	22	Parapenaeus longirostris	2	DM	44	44.70	1.69	0.59	Aydin et al 2009
2007	Eastern Aegean	22	Parapenaeus longirostris	2	DM	44	44.70	1.69	0.65	Aydin et al 2009
2008	Eastern Aegean	22	Diplodus annularis	12	DM	50	50.10	11.20	1.50	Aydin et al 2011
2008	Eastern Aegean	22	Diplodus annularis	12	DM	50	50.10	11.20	1.50	Aydin et al 2011
2008	Eastern Aegean	22	Mullus barbatus	11	DM	50	50.10	15.20	4.40	Aydin et al 2011
2008	Eastern Aegean	22	Mullus barbatus	11	DM	50	50.10	15.30	4.40	Aydin et al 2011
2008	Eastern Aegean	22	Pagellus acarne	17	DM	50	50.10	15.30	2.40	Aydin et al 2011
2008	Eastern Aegean	22	Pagellus erythrinus	15	DM	50	50.10	15.00	2.00	Aydin et al 2011
2008	Eastern Aegean	22	Diplodus annularis	12	SM	40	40.80	9.50	0.80	Aydin et al 2011
2008	Eastern Aegean	22	Diplodus annularis	12	SM	40	40.80	9.40	0.80	Aydin et al 2011
2008	Eastern Aegean	22	Mullus barbatus	11	SM	40	40.80	14.40	2.50	Aydin et al 2011
2008	Eastern Aegean	22	Mullus barbatus	11	SM	40	40.80	14.30	2.30	Aydin et al 2011
2008	Eastern Aegean	22	Pagellus acarne	17	SM	40	40.80	14.40	4.00	Aydin et al 2011
2008	Eastern Aegean	22	Pagellus erythrinus	15	SM	40	40.80	13.10	0.70	Aydin et al 2011
2005	Catalan Sea	6	Merluccius merluccius	20	DM	42	40.30	10.10	3.10	Bahamon et al 2006
2005	Catalan Sea	6	Merluccius merluccius	20	SM	42	40.30	16.00	4.80	Bahamon et al 2006
2005	Catalan Sea	6	Nephrops norvegicus	2	SM	42	40.30	2.20	0.65	Bahamon et al 2006
1997	Central Tyrrenian Sea	9	Merluccius merluccius	20	DM	40	NA	8.31	3.20	Baino, 1998
1997	Central Tyrrenian Sea	9	Mullus barbatus	11	DM	40	NA	9.02	1.98	Baino, 1998
1997	Central Tyrrenian Sea	9	Pagellus erythrinus	15	DM	40	NA	8.11	1.90	Baino, 1998
1997	Central Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	40	NA	1.28	0.16	Baino, 1998
2004	Northern Alboran Sea	1	Merluccius merluccius	20	DM	40	NA	8.67	3.90	Baro et al. 2007
2004	Northern Alboran Sea	1	Mullus barbatus	11	DM	40	NA	8.07	2.21	Baro et al. 2007
2004	Northern Alboran Sea	1	Octopus vulgaris	11	DM	40	NA	3.03	3.99	Baro et al. 2007
2004	Northern Alboran Sea	1	Parapenaeus longirostris	2	DM	40	NA	1.62	0.27	Baro et al. 2007
2004	Northern Alboran Sea	1	Sepia elegans	11	DM	40	NA	1.61	2.46	Baro et al. 2007
2004	Northern Alboran Sea	1	Sepia elegans	11	DM	40	NA	2.79	1.34	Baro et al. 2007
2004	Northern Alboran Sea	1	Trachurus spp.	15	DM	40	NA	11.90	2.80	Baro et al. 2007
2004	Northern Alboran Sea	1	Merluccius merluccius	20	SM	40	NA	15.21	3.12	Baro et al. 2007
2004	Northern Alboran Sea	1	Merluccius merluccius	20	SM	40	NA	17.16	2.38	Baro et al. 2007

Year	Area	GSA	Species	MLS	MC	NMS	MMS	L50	SR	References
2004	Northern Alboran Sea	1	Mullus barbatus	11	SM	40	NA	11.50	1.79	Baro et al. 2007
2004	Northern Alboran Sea	1	Nephrops norvegicus	2	SM	40	NA	2.13	0.62	Baro et al. 2007
2004	Northern Alboran Sea	1	Octopus vulgaris	11	SM	40	NA	3.83	4.80	Baro et al. 2007
2004	Northern Alboran Sea	1	Parapenaeus longirostris	2	SM	40	NA	1.72	0.60	Baro et al. 2007
2004	Northern Alboran Sea	1	Sepia elegans	11	SM	40	NA	4.30	1.24	Baro et al. 2007
2004	Northern Alboran Sea	1	Sepia elegans	11	SM	40	NA	4.47	1.52	Baro et al. 2007
2004	Northern Alboran Sea	1	Trachurus spp.	15	SM	40	NA	14.80	1.10	Baro et al. 2007
2004	North Tyrrenian Sea	9	Merluccius merluccius	20	DM	40	NA	9.17	2.56	Belcari et al 2007
2004	North Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	40	NA	1.30	0.53	Belcari et al 2007
2004	North Tyrrenian Sea	9	Trachurus spp.	15	DM	40	NA	10.28	3.04	Belcari et al 2007
2004	North Tyrrenian Sea	9	Merluccius merluccius	20	DM	60	NA	18.10	10.62	Belcari et al 2007
2004	North Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	60	NA	2.23	1.20	Belcari et al 2007
2004	North Tyrrenian Sea	9	Trachurus spp.	15	DM	60	NA	19.83	10.52	Belcari et al 2007
2007	North Levant	24	Parapenaeus longirostris	2	DM	44	43.46	1.63	0.61	Deval et al. 2009
2007	North Levant	24	Parapenaeus longirostris	2	SM	40	37.55	1.82	0.55	Deval et al. 2009
1979	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	35.50	12.80	NA	Dremiere 1979
1979	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	34.00	10.20	NA	Dremiere 1979
1979	Gulf of Lyon	7	Merluccius merluccius	20	DM	NA	34.90	11.40	NA	Dremiere 1979
1970	Adriatic Sea	17	Merluccius merluccius	20	DM	NA	35.50	9.00	3.40	Ferretti and Froglia, 1975
1973	Adriatic Sea	17	Merluccius merluccius	20	DM	NA	42.00	11.00	3.00	Ferretti and Froglia, 1975
1969	Adriatic Sea	17	Mullus barbatus	11	DM	NA	38.00	7.70	1.40	Ferretti and Froglia, 1975
1970	Adriatic Sea	17	Mullus barbatus	11	DM	NA	35.50	8.50	1.60	Ferretti and Froglia, 1975
1970	Adriatic Sea	17	Mullus barbatus	11	DM	NA	42.00	8.30	1.90	Ferretti and Froglia, 1975
1972	Adriatic Sea	17	Mullus barbatus	11	DM	NA	42.70	7.80	2.60	Ferretti and Froglia, 1975
1972	Adriatic Sea	17	Mullus barbatus	11	DM	NA	42.70	8.50	2.00	Ferretti and Froglia, 1975
1972	Adriatic Sea	17	Mullus barbatus	11	DM	NA	42.70	7.00	2.20	Ferretti and Froglia, 1975
1974	Adriatic Sea	17	Mullus barbatus	11	DM	NA	41.80	8.80	2.90	Ferretti and Froglia, 1975
1970	Adriatic Sea	17	Trachurus spp.	15	DM	NA	34.00	8.20	2.60	Ferretti and Froglia, 1975
1972	Adriatic Sea	17	Trachurus spp.	15	DM	NA	34.00	9.20	2.80	Ferretti and Froglia, 1975
1972	Adriatic Sea	17	Trachurus spp.	15	DM	NA	33.70	11.00	5.10	Ferretti and Froglia, 1975
1991	Spain	6	Merluccius merluccius	20	DM	NA	39.30	9.26	NA	Gil De Sola Simarro 1991
1991	Spain	6	Merluccius merluccius	20	DM	NA	36.20	9.10	NA	Gil De Sola Simarro 1991
1994	Spain	6	Merluccius merluccius	20	DM	NA	35.00	8.21	NA	Gil De Sola Simarro 1994
1994	Spain	6	Merluccius merluccius	20	DM	NA	40.00	9.11	NA	Gil De Sola Simarro 1994
1994	Spain	6	Merluccius merluccius	20	DM	NA	50.00	12.85	NA	Gil De Sola Simarro 1994
1985	Morocco	3	Parapenaeus longirostris	2	DM	39	NA	2.00	NA	Gon˜i, R, 1985.
1985	Morocco	3	Parapenaeus longirostris	2	DM	60	NA	2.51	NA	Gon˜i, R, 1985.
1999	Central Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	30	NA	1.14	NA	GRUND, 1999
1999	South Ligurian Sea	9	Parapenaeus longirostris	2	DM	34	NA	1.29	NA	GRUND, 1999
1999	South Tyrrenian Sea	10	Parapenaeus longirostris	2	DM	36	NA	1.09	NA	GRUND, 1999
1999	Ionian Sea	19	Parapenaeus longirostris	2	DM	36	NA	1.34	NA	GRUND, 1999
1999	North Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	38	NA	1.06	NA	GRUND, 1999
2003	Balearic Islands	5	Merluccius merluccius	20	DM	40	NA	11.60	0.80	Guijaro and Massuti 2006
2003	Balearic Islands	5	Parapenaeus longirostris	2	DM	40	NA	1.72	1.70	Guijaro and Massuti 2006
2003	Balearic Islands	5	Parapenaeus longirostris	2	DM	40	NA	1.66	0.30	Guijaro and Massuti 2006
2003	Balearic Islands	5	Merluccius merluccius	20	SM	40	NA	15.30	2.20	Guijaro and Massuti 2006
2003	Balearic Islands	5	Nephrops norvegicus	2	SM	40	NA	2.66	0.34	Guijaro and Massuti 2006
2003	Balearic Islands	5	Nephrops norvegicus	2	SM	40	NA	2.46	0.15	Guijaro and Massuti 2006
2003	Balearic Islands	5	Parapenaeus longirostris	2	SM	40	NA	2.06	2.10	Guijaro and Massuti 2006
2003	Balearic Islands	5	Parapenaeus longirostris	2	SM	40	NA	2.02	0.23	Guijaro and Massuti 2006
2004	Adriatic Sea	18	Pagellus erythrinus	15	DM	NA	27.00	7.60	0.87	Joksimović et al 2009
2004	Adriatic Sea	18	Pagellus erythrinus	15	DM	NA	32.20	8.68	1.16	Joksimović et al 2009
2004	Adriatic Sea	18	Pagellus erythrinus	15	DM	NA	35.00	10.82	2.83	Joksimović et al 2009
2004	Adriatic Sea	18	Pagellus erythrinus	15	DM	NA	44.00	15.00	3.34	Joksimović et al 2009
2004	Adriatic Sea	18	Pagellus erythrinus	15	DM	NA	70.00	15.26	2.10	Joksimović et al 2009
2005	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	42.00	1.45	0.56	Kaycac et al. 2009
2005	Aegean Sea	22	Parapenaeus longirostris	2	DM	48	48.60	1.66	0.65	Kaycac et al. 2009
2005	Aegean Sea	22	Parapenaeus longirostris	2	SM	40	40.20	1.63	0.43	Kaycac et al. 2009
2005	Eastern Aegean	22	Nephrops norvegicus	2	DM	40	42.58	1.60	0.45	Kaykac et al 2009
2005	Eastern Aegean	22	Nephrops norvegicus	2	DM	40	43.68	1.94	0.59	Kaykac et al 2009
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	34	NA	11.90	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Mullus barbatus	11	DM	34	NA	9.90	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Mullus barbatus	11	DM	34	NA	10.50	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	36	NA	11.50	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Mullus barbatus	11	DM	36	NA	10.60	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	40	NA	14.10	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Mullus barbatus	11	DM	40	NA	12.50	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	42	NA	11.80	NA	Larraneta et al 1969

Year	Area	GSA	Species	MLS	MC	NMS	MMS	L50	SR	References
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	44	NA	11.20	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Mullus barbatus	11	DM	46	NA	10.00	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	48	NA	13.10	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	50	NA	14.50	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Mullus barbatus	11	DM	50	NA	14.60	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	52	NA	15.20	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Mullus barbatus	11	DM	52	NA	12.40	NA	Larraneta et al 1969
1969	Golfo di Valencia	6	Merluccius merluccius	20	DM	NA	35.50	9.50	NA	Larraneta et al 1969
2001	Central Tyrrenian Sea	9	Merluccius merluccius	20	DM	40	NA	7.90	4.10	Lembo et al., 2002
2001	Central Tyrrenian Sea	10	Mullus barbatus	11	DM	40	NA	8.90	1.80	Lembo et al., 2002
2001	Central Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	40	NA	1.42	0.29	Lembo et al., 2002
2001	Central Tyrrenian Sea	9	Merluccius merluccius	20	DM	60	NA	15.50	4.80	Lembo et al., 2002
2001	Central Tyrrenian Sea	10	Mullus barbatus	11	DM	60	NA	13.20	4.10	Lembo et al., 2002
2001	Central Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	60	NA	2.00	0.66	Lembo et al., 2002
1971	Adriatic Sea	17	Merluccius merluccius	20	DM	NA	35.50	9.50	NA	Levi et al 1971
1971	Adriatic Sea	17	Mullus barbatus	11	DM	NA	35.50	8.30	NA	Levi et al 1971
1970	Cyprus	23	Mullus barbatus	11	DM	34	39.19	9.20	1.60	Livadas 1988
1970	Cyprus	23	Mullus barbatus	11	DM	34	39.19	9.90	2.20	Livadas 1988
1970	Cyprus	23	Mullus barbatus	11	DM	34	39.19	9.80	2.00	Livadas 1988
1970	Cyprus	23	Mullus surmuletus	11	DM	34	39.19	12.50	2.90	Livadas 1988
1970	Cyprus	23	Pagellus erythrinus	15	DM	34	39.19	11.20	2.60	Livadas 1988
1970	Cyprus	23	Mullus barbatus	11	DM	40	46.38	14.70	2.90	Livadas 1988
1970	Cyprus	23	Mullus barbatus	11	DM	40	46.38	13.90	2.80	Livadas 1988
1970	Cyprus	23	Mullus barbatus	11	DM	40	46.38	17.90	2.40	Livadas 1988
1997	Aegean Sea	22	Diplodus annularis	12	DM	44	NA	9.88	1.04	Lök et al 1997
1997	Aegean Sea	22	Diplodus annularis	12	DM	44	NA	9.84	1.53	Lök et al 1997
1997	Aegean Sea	22	Diplodus annularis	12	DM	44	NA	10.07	1.79	Lök et al 1997
1997	Aegean Sea	22	Mullus barbatus	11	DM	44	NA	13.68	2.92	Lök et al 1997
1997	Aegean Sea	22	Mullus barbatus	11	DM	44	NA	15.06	3.24	Lök et al 1997
1997	Aegean Sea	22	Mullus barbatus	11	DM	44	NA	14.32	2.14	Lök et al 1997
2006	Northern Adriatic	17	Merluccius merluccius	20	DM	40	42.80	7.60	4.01	Luccheti 2008
2006	Northern Adriatic	17	Merluccius merluccius	20	SM	40	42.80	12.98	3.65	Luccheti 2008
1995	West Aegean Sea	22	Nephrops norvegicus	2	DM	40	40.80	1.78	0.50	Mytilineou et al 1998
1995	West Aegean Sea	22	Nephrops norvegicus	2	DM	48	47.00	2.01	0.66	Mytilineou et al 1998
1995	West Aegean Sea	22	Nephrops norvegicus	2	DM	52	51.80	2.05	0.76	Mytilineou et al 1998
1985	Algeria	4	Parapenaeus longirostris	2	DM	40	NA	1.68	NA	Nouar, 1985
2003	Balearic Islands	5	Merluccius merluccius	20	DM	40	NA	10.60	3.30	Ordines et al. 2006
2003	Balearic Islands	5	Mullus surmuletus	11	DM	40	NA	4.50	5.80	Ordines et al. 2006
2003	Balearic Islands	5	Trachurus spp.	15	DM	40	NA	13.70	2.10	Ordines et al. 2006
2003	Balearic Islands	5	Merluccius merluccius	20	SM	40	NA	15.20	3.30	Ordines et al. 2006
2003	Balearic Islands	5	Mullus surmuletus	11	SM	40	NA	12.20	2.10	Ordines et al. 2006
2003	Balearic Islands	5	Pagellus acarne	17	SM	40	NA	9.40	4.20	Ordines et al. 2006
2003	Balearic Islands	5	Pagellus erythrinus	15	SM	40	NA	10.40	2.00	Ordines et al. 2006
2003	Balearic Islands	5	Trachurus spp.	15	SM	40	NA	15.20	3.00	Ordines et al. 2006
2002	Eastern Aegean	22	Pagellus erythrinus	15	DM	40	NA	10.50	2.80	Özbilgin et al 2003
2003	Eastern Aegean	22	Diplodus annularis	12	DM	40	42.40	8.70	1.10	Ozbilgin et al 2005
2003	Eastern Aegean	22	Diplodus annularis	12	DM	40	42.40	9.30	0.90	Ozbilgin et al 2005
2003	Eastern Aegean	22	Diplodus annularis	12	DM	40	42.40	9.20	0.90	Ozbilgin et al 2005
2003	Eastern Aegean	22	Diplodus annularis	12	DM	40	42.40	8.90	1.10	Ozbilgin et al 2005
2003	Eastern Aegean	22	Merluccius merluccius	20	DM	40	NA	14.28	3.42	Ozbilgin et al 2005
1994	West Aegean Sea	22	Merluccius merluccius	20	DM	28	NA	4.16	6.75	Petrakis et al 1997
1994	West Aegean Sea	22	Merluccius merluccius	20	DM	40	NA	13.79	7.06	Petrakis et al 1997
1994	West Aegean Sea	22	Merluccius merluccius	20	SM	40	NA	15.10	5.68	Petrakis et al 1997
2004	Aegean Sea	22	Merluccius merluccius	20	DM	40	NA	12.60	5.16	Petrakis et al. 2004
2004	Aegean Sea	22	Merluccius merluccius	20	DM	40	NA	12.32	4.87	Petrakis et al. 2004
2004	Aegean Sea	22	Merluccius merluccius	20	DM	40	NA	10.44	4.87	Petrakis et al. 2004
2004	Aegean Sea	22	Mullus barbatus	11	DM	40	NA	12.37	2.52	Petrakis et al. 2004
2004	Aegean Sea	22	Pagellus erythrinus	15	DM	40	NA	11.88	1.35	Petrakis et al. 2004
2004	Aegean Sea	22	Pagellus erythrinus	15	DM	40	NA	10.41	2.39	Petrakis et al. 2004
2004	Aegean Sea	22	Pagrus pagrus	18	DM	40	NA	10.28	0.71	Petrakis et al. 2004
2004	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	NA	1.96	0.53	Petrakis et al. 2004
2004	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	NA	1.96	0.53	Petrakis et al. 2004
2004	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	NA	1.65	0.53	Petrakis et al. 2004
2004	Aegean Sea	22	Trachurus spp.	15	DM	40	NA	14.11	3.10	Petrakis et al. 2004
2004	Aegean Sea	22	Trachurus spp.	15	DM	40	NA	14.66	3.11	Petrakis et al. 2004
2004	Aegean Sea	22	Trachurus spp.	15	DM	40	NA	14.66	3.11	Petrakis et al. 2004
2004	Aegean Sea	22	Trachurus spp.	15	DM	40	NA	14.11	3.10	Petrakis et al. 2004
1997	Strait of Sicily	16	Parapenaeus longirostris	2	DM	31	NA	1.30	0.52	Ragonese and Bianchini 2006

Year	Area	GSA	Species	MLS	MC	NMS	MMS	L50	SR	References
1998	North Tyrrenian Sea	10	Parapenaeus longirostris	2	DM	31	NA	1.28	0.23	Ragonese and Bianchini 2006
1997	South Tyrrenian Sea	10	Parapenaeus longirostris	2	DM	36	NA	1.41	0.40	Rinelli et al 2005
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	40	45.20	8.03	3.80	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	40	45.20	9.12	4.72	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	40	46.35	10.84	7.15	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	40	46.35	9.37	5.33	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Nephrops norvegicus	2	DM	40	45.20	1.46	0.51	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Nephrops norvegicus	2	DM	40	45.20	1.56	0.45	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Nephrops norvegicus	2	DM	40	46.35	1.76	0.96	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Nephrops norvegicus	2	DM	40	46.35	1.49	0.50	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Merluccius merluccius	20	SM	40	43.25	11.97	6.11	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Merluccius merluccius	20	SM	40	43.25	15.70	8.68	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Nephrops norvegicus	2	SM	40	43.25	1.93	0.75	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Nephrops norvegicus	2	SM	40	43.25	2.07	0.62	Sala and Luchetti 2010
2005	Central Adriatic Sea	17	Alloteuthis media	11	DM	48	46.50	4.47	1.18	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Alloteuthis media	11	DM	48	46.50	3.68	1.37	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	48	46.50	11.45	5.62	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	48	46.50	10.43	5.87	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Mullus barbatus	11	DM	48	46.50	10.74	4.59	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Mullus barbatus	11	DM	48	46.50	7.50	6.61	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Alloteuthis media	11	DM	56	56.75	5.17	2.49	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Alloteuthis media	11	DM	56	56.10	4.50	1.84	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	56	56.75	16.25	7.56	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Merluccius merluccius	20	DM	56	56.10	11.99	7.94	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Mullus barbatus	11	DM	56	56.75	12.78	4.63	Sala and Luchetti 2011
2005	Central Adriatic Sea	17	Mullus barbatus	11	DM	56	56.10	9.95	7.72	Sala and Luchetti 2011
2004	Adriatic Sea	17	Merluccius merluccius	20	DM	44	44.73	9.85	2.75	Sala et al 2007
2004	Adriatic Sea	17	Merluccius merluccius	20	DM	44	44.33	7.70	1.30	Sala et al 2007
2004	Adriatic Sea	17	Mullus barbatus	11	DM	44	44.73	8.90	2.68	Sala et al 2007
2004	Adriatic Sea	17	Mullus barbatus	11	DM	44	44.33	7.12	1.61	Sala et al 2007
2004	Adriatic Sea	17	Pagellus erythrinus	15	DM	44	44.73	8.71	2.52	Sala et al 2007
2004	Adriatic Sea	17	Pagellus erythrinus	15	DM	44	44.33	6.92	2.23	Sala et al 2007
2004	Adriatic Sea	17	Merluccius merluccius	20	DM	40	38.70	8.26	1.74	Sala et al 2008
2004	Adriatic Sea	17	Mullus barbatus	11	DM	40	38.70	7.76	1.86	Sala et al 2008
2004	Adriatic Sea	17	Nephrops norvegicus	2	DM	40	38.70	1.46	0.28	Sala et al 2008
2004	Adriatic Sea	17	Pagellus erythrinus	15	DM	40	38.70	7.56	2.43	Sala et al 2008
2004	Adriatic Sea	17	Parapenaeus longirostris	2	DM	40	38.70	1.20	0.24	Sala et al 2008
2004	Adriatic Sea	17	Trachurus spp.	15	DM	40	38.70	9.71	2.75	Sala et al 2008
2004	Adriatic Sea	17	Merluccius merluccius	20	SM	40	38.65	14.17	3.64	Sala et al 2008
2004	Adriatic Sea	17	Mullus barbatus	11	SM	40	38.65	10.91	1.43	Sala et al 2008
2004	Adriatic Sea	17	Nephrops norvegicus	2	SM	40	38.65	1.91	0.37	Sala et al 2008
2004	Adriatic Sea	17	Pagellus erythrinus	15	SM	40	38.65	9.67	1.36	Sala et al 2008
2004	Adriatic Sea	17	Parapenaeus longirostris	2	SM	40	38.65	1.49	0.26	Sala et al 2008
2004	Adriatic Sea	17	Trachurus spp.	15	SM	40	38.65	13.12	2.43	Sala et al 2008
2012	Adriatic sea	17	Mullus barbatus	11	SM	41	41.05	13.07	2.34	Sala et al. 2014 (unpublished)
2012	Adriatic sea	17	Mullus barbatus	11	SM	41	41.05	12.48	2.40	Sala et al. 2014 (unpublished)
2012	Adriatic sea	17	Mullus barbatus	11	SM	41	41.50	10.29	1.43	Sala et al. 2014 (unpublished)
2006	South Tyrrenian Sea	10	Mullus barbatus	11	DM	44	45.15	8.58	1.51	Sala et al. 2015
2006	South Tyrrenian Sea	10	Mullus barbatus	11	DM	54	54.70	11.63	3.41	Sala et al. 2015
2006	South Tyrrenian Sea	10	Mullus barbatus	11	SM	44	45.95	13.20	1.73	Sala et al. 2015
2006	South Tyrrenian Sea	10	Mullus barbatus	11	SM	54	56.90	17.28	4.30	Sala et al. 2015
2004	Adriatic Sea	17	Mullus barbatus	11	DM	44	45.00	8.90	2.68	Sala et al., 2006
1991	West Mediterranean	6	Nephrops norvegicus	2	DM	38	NA	1.49	0.33	Sardà et al 1993
1991	West Mediterranean	6	Nephrops norvegicus	2	DM	40	NA	3.08	2.59	Sardà et al 1993
1991	West Mediterranean	6	Nephrops norvegicus	2	DM	42	NA	1.94	0.53	Sardà et al 1993
1991	West Mediterranean	6	Nephrops norvegicus	2	DM	45	NA	1.89	0.49	Sardà et al 1993
1991	West Mediterranean	6	Nephrops norvegicus	2	DM	52	NA	2.31	1.06	Sardà et al 1993
2003	NW Mediterranean	6	Merluccius merluccius	20	SM	36	NA	18.47	5.07	Sardà et al 2006
2003	NW Mediterranean	6	Trachurus spp.	15	SM	36	NA	14.03	2.48	Sardà et al 2006
1992	North Tyrrenian Sea	9	Merluccius merluccius	20	DM	34	NA	7.74	2.29	Sbrana and Reale, 1994
1999	North Tyrrenian Sea	9	Parapenaeus longirostris	2	DM	40	35.93	1.24	0.31	Sbrana et al 2006
1992	North Tyrrenian Sea	9	Merluccius merluccius	20	DM	NA	34.00	7.47	2.29	Sbrana et al. 1998
2003	Adriatic Sea	17	Merluccius merluccius	20	DM	48	NA	14.28	4.15	Soldo 2004
2003	Adriatic Sea	17	Merluccius merluccius	20	DM	48	NA	13.94	5.31	Soldo 2004
2003	Adriatic Sea	17	Merluccius merluccius	20	DM	48	NA	13.70	5.55	Soldo 2004
2003	Adriatic Sea	17	Merluccius merluccius	20	DM	48	NA	11.99	7.38	Soldo 2004
2003	Adriatic Sea	17	Mullus barbatus	11	DM	48	NA	13.49	1.74	Soldo 2004
2003	Adriatic Sea	17	Nephrops norvegicus	2	DM	48	NA	7.24	3.01	Soldo 2004

Year	Area	GSA	Species	MLS	MC	NMS	MMS	L50	SR	References
2003	Adriatic Sea	17	Merluccius merluccius	20	DM	60	NA	16.64	2.96	Soldo 2004
2003	Adriatic Sea	17	Merluccius merluccius	20	DM	60	NA	16.62	4.59	Soldo 2004
1994	West Aegean Sea	22	Nephrops norvegicus	2	DM	40	NA	2.28	0.95	Stergiou et al 1997
1994	West Aegean Sea	22	Nephrops norvegicus	2	SM	40	NA	2.41	0.59	Stergiou et al 1997
2004	Eastern Aegean	22	Merluccius merluccius	20	DM	40	42.42	11.59	4.07	Tokaç et al 2010
1996	Eastern Aegean	22	Diplodus annularis	12	DM	36	NA	7.61	1.35	Tokaç et al. 1998
1996	Eastern Aegean	22	Mullus barbatus	11	DM	36	NA	11.02	1.76	Tokaç et al. 1998
1996	Eastern Aegean	22	Pagellus acarne	17	DM	36	NA	10.61	2.21	Tokaç et al. 1998
1996	Eastern Aegean	22	Diplodus annularis	12	DM	40	NA	8.58	1.22	Tokaç et al. 1998
1996	Eastern Aegean	22	Mullus barbatus	11	DM	40	NA	12.19	2.15	Tokaç et al. 1998
1996	Eastern Aegean	22	Pagellus acarne	17	DM	40	NA	11.80	1.61	Tokaç et al. 1998
1996	Eastern Aegean	22	Diplodus annularis	12	DM	44	NA	9.87	1.13	Tokaç et al. 1998
1996	Eastern Aegean	22	Mullus barbatus	11	DM	44	NA	13.50	2.65	Tokaç et al. 1998
1996	Eastern Aegean	22	Pagellus acarne	17	DM	44	NA	14.16	1.38	Tokaç et al. 1998
1996	Eastern Aegean	22	Diplodus annularis	12	DM	48	NA	12.68	1.26	Tokaç et al. 1998
1996	Eastern Aegean	22	Diplodus annularis	12	SM	36	NA	7.47	2.06	Tokaç et al. 1998
1996	Eastern Aegean	22	Mullus barbatus	11	SM	36	NA	11.82	1.58	Tokaç et al. 1998
1996	Eastern Aegean	22	Pagellus acarne	17	SM	36	NA	10.38	2.27	Tokaç et al. 1998
1996	Eastern Aegean	22	Diplodus annularis	12	SM	40	NA	8.79	1.51	Tokaç et al. 1998
1996	Eastern Aegean	22	Mullus barbatus	11	SM	40	NA	13.20	1.85	Tokaç et al. 1998
1996	Eastern Aegean	22	Pagellus acarne	17	SM	40	NA	12.36	1.77	Tokaç et al. 1998
1996	Eastern Aegean	22	Diplodus annularis	12	SM	44	NA	8.82	1.10	Tokaç et al. 1998
1996	Eastern Aegean	22	Mullus barbatus	11	SM	44	NA	14.67	2.89	Tokaç et al. 1998
1996	Eastern Aegean	22	Pagellus acarne	17	SM	44	NA	13.03	1.99	Tokaç et al. 1998
1996	Eastern Aegean	22	Diplodus annularis	12	SM	48	NA	12.03	2.22	Tokaç et al. 1998
2002	Eastern Aegean	22	Diplodus annularis	12	DM	36	37.00	8.50	0.90	Tokaç et al. 2004
2002	Eastern Aegean	22	Diplodus annularis	12	DM	36	37.00	8.40	0.90	Tokaç et al. 2004
2002	Eastern Aegean	22	Mullus barbatus	11	DM	36	37.00	12.70	1.80	Tokaç et al. 2004
2002	Eastern Aegean	22	Mullus barbatus	11	DM	36	37.00	12.80	1.80	Tokaç et al. 2004
2002	Eastern Aegean	22	Pagellus erythrinus	15	DM	36	37.00	12.40	2.70	Tokaç et al. 2004
2002	Eastern Aegean	22	Diplodus annularis	12	DM	40	41.90	8.80	0.90	Tokaç et al. 2004
2002	Eastern Aegean	22	Diplodus annularis	12	DM	40	41.90	8.80	0.90	Tokaç et al. 2004
2002	Eastern Aegean	22	Mullus barbatus	11	DM	40	41.90	10.70	1.90	Tokaç et al. 2004
2002	Eastern Aegean	22	Mullus barbatus	11	DM	40	41.90	10.70	1.90	Tokaç et al. 2004
2002	Eastern Aegean	22	Pagellus erythrinus	15	DM	40	41.90	10.90	2.80	Tokaç et al. 2004
2002	Eastern Aegean	22	Pagellus erythrinus	15	DM	40	41.90	10.80	2.30	Tokaç et al. 2004
2002	Eastern Aegean	22	Diplodus annularis	12	DM	44	44.70	10.30	1.30	Tokaç et al. 2004
2002	Eastern Aegean	22	Diplodus annularis	12	DM	44	44.70	10.30	1.20	Tokaç et al. 2004
2002	Eastern Aegean	22	Pagellus erythrinus	15	DM	44	44.70	13.60	2.00	Tokaç et al. 2004
2002	Eastern Aegean	22	Pagellus erythrinus	15	DM	44	44.70	13.80	2.30	Tokaç et al. 2004
2004	Aegean Sea	22	Nephrops norvegicus	2	DM	40	42.42	1.59	0.52	Tokaç et al. 2009
2004	Aegean Sea	22	Nephrops norvegicus	2	DM	40	42.83	1.60	0.62	Tokaç et al. 2009
2004	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	42.42	1.27	0.62	Tokaç et al. 2009
2004	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	42.83	1.43	0.64	Tokaç et al. 2009
2004	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	42.42	1.25	0.61	Tokaç et al. 2009
2004	Aegean Sea	22	Parapenaeus longirostris	2	DM	40	42.83	1.39	0.70	Tokaç et al. 2009
2014	Aegean Sea	22	Diplodus annularis	12	DM	40	40.44	8.77	0.60	Tokaç et al. 2014
2014	Aegean Sea	22	Mullus barbatus	11	DM	40	40.44	9.38	2.48	Tokaç et al. 2014
2014	Aegean Sea	22	Pagellus erythrinus	15	DM	40	40.44	8.99	2.45	Tokaç et al. 2014
2014	Aegean Sea	22	Diplodus annularis	12	DM	44	44.33	9.92	0.96	Tokaç et al. 2014
2014	Aegean Sea	22	Mullus barbatus	11	DM	44	44.33	11.53	2.72	Tokaç et al. 2014
2014	Aegean Sea	22	Pagellus erythrinus	15	DM	44	44.33	11.30	2.45	Tokaç et al. 2014
2014	Aegean Sea	22	Diplodus annularis	12	DM	50	51.34	11.98	1.62	Tokaç et al. 2014
2014	Aegean Sea	22	Mullus barbatus	11	DM	50	51.34	15.40	3.15	Tokaç et al. 2014
2014	Aegean Sea	22	Pagellus erythrinus	15	DM	50	51.34	15.45	2.45	Tokaç et al. 2014
2014	Aegean Sea	22	Diplodus annularis	12	T90	40	40.44	8.77	0.60	Tokaç et al. 2014
2014	Aegean Sea	22	Mullus barbatus	11	T90	40	40.44	12.65	1.48	Tokaç et al. 2014
2014	Aegean Sea	22	Pagellus erythrinus	15	T90	40	40.44	10.52	1.38	Tokaç et al. 2014
2014	Aegean Sea	22	Diplodus annularis	12	T90	44	44.33	9.92	0.96	Tokaç et al. 2014
2014	Aegean Sea	22	Mullus barbatus	11	T90	44	44.33	14.80	1.62	Tokaç et al. 2014
2014	Aegean Sea	22	Pagellus erythrinus	15	T90	44	44.33	12.97	1.28	Tokaç et al. 2014
2006	Aegean Sea	22	Parapenaeus longirostris	2	DM	46	49.44	1.97	0.61	Tosunoglou et al. 2007
2006	Aegean Sea	22	Merluccius merluccius	20	DM	50	49.44	11.40	4.10	Tosunoglou et al. 2008
2006	Aegean Sea	22	Trachurus spp.	15	DM	50	49.44	15.60	5.50	Tosunoglou et al. 2008
1997	Eastern Aegean	22	Pagellus acarne	17	DM	44	45.70	13.60	1.90	Tosunoğlu 2007
1997	Eastern Aegean	22	Pagellus erythrinus	15	DM	44	45.70	12.40	2.60	Tosunoğlu 2007
2002	Eastern Aegean	22	Diplodus annularis	12	DM	40	41.90	9.40	0.79	Tosunoğlu et al 2003
2002	Eastern Aegean	22	Merluccius merluccius	20	DM	40	41.90	10.60	2.84	Tosunoğlu et al 2003

Year	Area	GSA	Species	MLS	MC	NMS	MMS	L50	SR	References
2002	Eastern Aegean	22	Mullus barbatus	11	DM	40	41.90	10.60	1.71	Tosunoğlu et al 2003
2002	Eastern Aegean	22	Pagellus acarne	17	DM	40	41.90	11.60	2.08	Tosunoğlu et al 2003
2002	Eastern Aegean	22	Pagellus erythrinus	15	DM	40	41.90	10.80	2.02	Tosunoğlu et al 2003
1966	NA	NA	Merluccius merluccius	20	DM	34	NA	10.00	NA	Vives et al 1966
1966	NA	NA	Merluccius merluccius	20	DM	40	NA	16.50	NA	Vives et al 1966
1966	NA	NA	Merluccius merluccius	20	DM	60	NA	22.50	NA	Vives et al 1966
1991	Tyrrhenian sea	9	Mullus barbatus	11	DM	38	NA	9.30	1.50	Voliani and Abella 1998

ANNEX 3. INFORMATION ON THE LANDING AND ECONOMIC DCF DATABASES

Table 9. Number of records refers to the records in the database. Level of detail on the fishing region available for each Member State. CYP: Cyprus; ESP: Spain; FRA: France; HRV: Croatia; ITA: Italy; MLT: Malta; SVN: Slovenia

Fishing Sub-Region	Country	Landings Value	Landings Weight
37.2.2	CYP	61	63
GSA13	CYP	10	10
GSA14	CYP	56	56
GSA15	CYP	43	43
GSA21	CYP	23	39
GSA22	CYP	8	8
GSA24	CYP	70	70
GSA25	CYP	886	888
GSA26	CYP	29	29
GSA27	CYP	6	6
37.1.3	ESP	130	130
37.2.1	ESP	2	2
37.2.2	ESP	33	33
37.3.1	ESP	4	4
37.3.2	ESP	8	8
GSA1	ESP	6883	6883
GSA5	ESP	2790	2790
GSA6	ESP	8915	8915
GSA7	ESP	542	542
37.1.1	FRA	8	8
37.1.2	FRA	9073	9073
37.1.3	FRA	1991	1991
37.2.2	FRA	3	3
37.3.2	FRA	1	1
GSA17	FRA	1	1
NA	FRA	334	336
GSA17	HRV		15813
GSA10	ITA	4964	4964
GSA11	ITA	3386	3386
GSA16	ITA	3042	3042
GSA17	ITA	6314	6314
GSA18	ITA	2149	2149
GSA19	ITA	3312	3312
GSA9	ITA	4309	4309
37.2.2	MLT	6791	6791
GSA17	SVN	3554	3554

Table 10. Number of records refers to the records in the economic database. Overview of information on dominant fishing techniques, and the actual gears used by fishing vessels available in the database.

Fishing Technique[1]	Fishing Gear[2]	Landings Value	Landings Weight
DFN	DRB	8	40
DFN	DRH	2	2
DFN	FPN	26	26
DFN	FPO	405	698
DFN	FYK	262	289
DFN	GNC	221	221
DFN	GND	38	38
DFN	GNS	1594	2279
DFN	GTN	542	947
DFN	GTR	1812	2419
DFN	HAR	8	8
DFN	LA	4	4
DFN	LHM	22	22
DFN	LHP	164	447
DFN	LLD	95	112
DFN	LLS	264	621
DFN	LNS	17	17
DFN	LTL	29	121
DFN	NK	2708	2971
DFN	NO	31	31
DFN	OTB	150	381
DFN	OTM	3	7
DFN	PS	142	191
DFN	SB	16	272
DFN	TBB		14
DRB	DRB	160	450
DRB	FPO	28	28
DRB	FYK	6	6
DRB	GNS	61	86
DRB	GTN	12	12
DRB	GTR	24	93
DRB	LHP		2
DRB	LLS	1	1
DRB	LTL		2
DRB	NK	465	466
DRB	OTB	51	304
DTS	DRB		159
DTS	FPO	15	76

Fishing Technique[1]	Fishing Gear[2]	Landings Value	Landings Weight
DTS	FYK	32	34
DTS	GND	4	4
DTS	GNS	217	573
DTS	GTN		32
DTS	GTR	328	592
DTS	LHP		111
DTS	LLD	49	57
DTS	LLS	26	99
DTS	LTL		8
DTS	NK	7985	8190
DTS	NO	9	9
DTS	OTB	11413	12367
DTS	OTM	459	572
DTS	OTT	167	167
DTS	PS	11	130
DTS	PTB	42	42
DTS	PTM	98	98
DTS	SB	35	438
DTS	TBB	530	530
FPO	DRB	31	33
FPO	FPN	4	4
FPO	FPO	229	450
FPO	FYK	234	240
FPO	GNC	79	79
FPO	GND	2	2
FPO	GNS	174	417
FPO	GTN	43	78
FPO	GTR	225	392
FPO	LHM	5	5
FPO	LHP	7	107
FPO	LLD	12	13
FPO	LLS	125	291
FPO	LTL	8	32
FPO	NK	677	737
FPO	NO	25	25
FPO	OTB	5	33
FPO	OTM	18	18
FPO	PS	6	9
FPO	SB	1	20
FPO	TBB		1

Fishing Technique[1]	Fishing Gear[2]	Landings Value	Landings Weight
HOK	FPN	2	2
HOK	FPO	68	210
HOK	FYK	16	41
HOK	GNC	10	10
HOK	GND	2	2
HOK	GNS	173	526
HOK	GTN	29	89
HOK	GTR	294	522
HOK	LA	68	68
HOK	LHM	2	2
HOK	LHP	42	426
HOK	LLD	642	705
HOK	LLS	1361	1746
HOK	LTL	69	203
HOK	NK	2061	2246
HOK	NO	66	66
HOK	OTB	59	77
HOK	PS	39	46
HOK	SB	3	40
HOK	TBB		2
MGO	DRB		1
MGO	FPO	8	57
MGO	FYK		4
MGO	GNS	24	271
MGO	GTN	41	143
MGO	GTR	77	263
MGO	LA	58	58
MGO	LHP	4	104
MGO	LLD	79	79
MGO	LLS	228	343
MGO	LTL	4	57
MGO	NK	37	388
MGO	NO	1	1
MGO	OTB		40
MGO	OTM		2
MGO	PS	48	61
MGO	SB	14	196
MGO	TBB	45	45
PG	FPO		1
PG	GNS	50	50

Fishing Technique[1]	Fishing Gear[2]	Landings Value	Landings Weight
PG	GTR	344	344
PG	LLS	17	17
PG	LTL	3	3
PGO	DRB	10	10
PGO	DRH	11	11
PGO	FPO	26	26
PGO	FYK	16	16
PGO	GNC	27	27
PGO	GNS	76	76
PGO	GTN	8	8
PGO	GTR	10	10
PGO	LHM	2	2
PGO	LLS	1	1
PGO	LTL	1	1
PGO	NK	41	41
PGO	NO	58	58
PGO	SB	67	67
PGP	DRB	61	61
PGP	DRH	6	6
PGP	FPO	804	926
PGP	FYK	458	465
PGP	GNC	129	129
PGP	GND	189	189
PGP	GNS	4418	4639
PGP	GTN	262	288
PGP	GTR	5293	5443
PGP	LA	12	12
PGP	LHM	78	78
PGP	LHP	155	243
PGP	LLD	886	887
PGP	LLS	2253	2421
PGP	LNB	12	12
PGP	LTL	131	131
PGP	NK	3688	3723
PGP	NO	565	565
PGP	OTB	546	560
PGP	OTM	7	7
PGP	PS	420	420
PGP	PTM	4	4
PGP	SB	303	310

Fishing Technique[1]	Fishing Gear[2]	Landings Value	Landings Weight
PMP	DRB	77	112
PMP	FPO	184	333
PMP	FYK	44	52
PMP	GNC	13	13
PMP	GND	24	24
PMP	GNS	298	666
PMP	GTN	74	199
PMP	GTR	703	976
PMP	LA	37	37
PMP	LHM	4	4
PMP	LHP	42	176
PMP	LLD	186	188
PMP	LLS	511	712
PMP	LTL	73	163
PMP	NK	922	1178
PMP	NO	36	36
PMP	OTB	62	190
PMP	OTM		2
PMP	PS	226	324
PMP	SB	36	340
PMP	SSC	18	18
PMP	TBB		8
PS	DRB		7
PS	FPO	8	8
PS	GNC	4	4
PS	GND	1	1
PS	GNS	161	308
PS	GTN	10	21
PS	GTR	171	269
PS	LA	7	7
PS	LHP	1	37
PS	LLD	48	49
PS	LLS	19	41
PS	LTL	1	1
PS	NK	1987	2011
PS	NO	3	3
PS	OTB	41	188
PS	PS	1747	2285
PS	PTM	42	42
PS	SB	4	117

Fishing Technique[1]	Fishing Gear[2]	Landings Value	Landings Weight
PS	SSC	1	1
PS	TBB		1
TBB	OTB	245	245
TBB	TBB	852	852
TM	GNS	12	12
TM	GTN	2	2
TM	LLD	1	1
TM	NK	1	1
TM	OTB	175	175
TM	OTM	85	85
TM	OTT	60	60
TM	PS	3	3
TM	PTM	642	642
TM	TBB	4	4

1 Fishing techniques: DFN: Drift and/or fixed netters; DRB: Dredgers; DTS: Demersal trawlers and/or demersal seiners; FPO: Vessels using pots and/or traps; HOK: Vessels using hooks; MGO: Vessel using other active gears; MGP: Vessels using polyvalent active gears only; PG: Vessels using passive gears only for vessels < 12 m; PGO: Vessels using other passive gears; PGP- Vessels using polyvalent passive gears only; PMP: Vessels using active and passive gears; PS: Purse seiners; TM: Pelagic trawlers; TBB: Beam trawlers.

2 Fishing gear: DRB: Boat dredge; DRH: Hand dredges; FPN: Stationary uncovered pound nets; FPO: Pots and traps; FYK: Fyke nets; GNC: Encircling gillnets; GND: Driftnet; GNS: Set gillnet; GTN: Combined gill and trammel nets; GTR: Trammel net; HAR: Harpoons; LA: Lampara nets; LHM: Hand lines; LHP: Pole lines; LLD: Drifting longlines; LLS: Set longlines; LNB: Boat-operated lift nets; LNS: Shore operated stationary lift nets; LTL: Trolling lines; NK: Not known / confidential; NO: No gear; OTB: Bottom otter trawl; OTM: Midwater otter trawl; OTT: Multi-rig otter trawl; PS: Purse seine; PTB: Bottom pair trawls; PTM: Pelagic/Midwater pair trawl; SB: Beach and boat seine; SSC: Fly shooting seine; TBB: Beam trawl.

ANNEX 4. CATCH PROFILE IN THE MAIN EU MEDITERRANEAN FISHERIES BASED ON LITERATURE REVIEW: REFERENCE LIST

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species (24)	DCF code (métier)	Methodology	Observations (25)	Source
1	Western	5	Palma de Mallorca	1983-1991	Trawl	Shelf trawl	***Mullus spp, Spicara*** spp, ***O. vulgaris, E. moschata,*** mixed fish *("moralla")*	OTB-DEMSP	Clustering based on daily landings	-	Alemany and Alvarez 2003
						Shelf-slope trawl	***A. antennatus, N. norvegicus, M. poutassou, M. merluccius***	OTB-MDDWSP			
						Slope trawl	***A. antennatus,*** *M. merluccius, M. poutassou, Mullus* spp	OTB-DWSP			
2	Western	10	Aeolian Islands	2006-2007	Small-scale	Set gillnets	***B. Boops, Spicara*** **spp,** ***L. mormyrus***	GNS-DEMF	LPUEs artisanal vessels	-	Battaglia et al 2010
						Trammel net	***Scorpaena*** **spp,** ***M. surmuletus, P. elephas, S. officinalis***	GTR-DEMSP			
						Trammel net	***M. merluccius***	GRT-DEMF	-	-	-
						Bottom seine	***Spicara spp, B. Boops***, mixed demersals	SV-DEMSP	-	-	-
						Bottom traps	***P. edwardsii, P. narval***	FPO-DEMSP			
						Bottom longlines	***M. merluccius***	LLS-DEMF			
						Bottom longlines	***P. bogaraveo***	LLS-DEMF			
3	Western	10	Cilento (Campania)	1995-96; 2001	Small-scale	Set gillnets	***M. merluccius***, *Trachurus* spp, *I. coindetii, S. japonicus, P. bogaraveo*	GNS-DEMSP	Clustering of LPUEs artisanal vessels	-	Colloca et al 2004
						Set gillnets	***S. dumerilii***, *S. sarda, D. sargus, Liza* spp	GNS-DEMF			
						Trammel nets and combined nets	***S. officinalis***, *O. vulgaris, Mullus spp, U. scaber, D. annularis*	GTR-DEMSP			
						Trammel nets and combined nets	***M. barbatus***, *S. officinalis, M. surmuletus, O. vulgaris, U. scaber*	GTR-DEMSP			

(24) Italics bold: target species, italics: main by-catch species.

(25) Note that tables and figure refer to the correspondent Source reported in the table.

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species (24)	DCF code (métier)	Methodology	Observations (25)	Source
4	Western	1	Santa Pola- Alicante	2003-2005	Small-scale	Trammel nets (6 different métier)	***S. officinalis, Mullus* spp, Sparidae, *S. Solea, P. elephas, M. kerathurus***	GTR-DEMSP	Interview and on-board sampling	See Tab. 1 and Fig. 7 for details on gear characteristics and by-catch.	Forcada et al 2010
						Set gillnets	***M. merluccius***	GNS-DEMF			
						Set gillnets	***S. sarda***, *A rochei, S. dumerilii*	GNS-DEMF			
						Set gillnets	**Sparidae**, *S. dumerilii. E. alletteratus*	GNS-DEMF			
						Combined nets	***S. sarda***, *A rochei, S. dumerilii,* Sparidae				
						Bottom longlines	**Sparidae**, *Serranidae, C. conger, M. helena*	LLS-DEMF			
						Troll lines	***S. dumerilii***, *D. dentex, E. marginatus*	LTL-DEMF			
						Handlines	***L. vulgaris***, ***S. dumerilii***,	LHM-DEMSP			
5	Western	6	Alicante Gulf	1992-1999	Trawl	Slope trawl	***A. antennatus***, *G. longipes, M. poutassou, P. blennoides, M. merluccius, N. norvegicus*	OTB-MDDWSP	Clustering of monthly landings data	Two main clusters	García-Rodríguez 2003
						Shelf-slope trawl	*M. merluccius, M. poutassou, O. vulgaris, Scomber* spp	OTB-DEMSP			
6	Western	6	Alicante Gulf	1994-2003	Small-scale	Trammel nets	*S. officinalis*	GTR-DEMSP	Clustering and PCA of daily landings	-	García-Rodríguez et al 2006
						Trammel nets	***O. vulgaris***, *S. officinalis, Mullus* spp	GTR-DEMSP			
						Trammel nets	***S. Solea***, Mixed fish, *O. vulgaris*	GTR-DEMSP			
						Long lines	***C. conger***, Sparidae	LLS-DEMF			
						Long lines	***Sparidae***, *C. conger*	LLS-DEMF			
						Set gillnets	***M. merluccius***	GNS-DEMF			

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species (24)	DCF code (métier)	Methodology	Observations (25)	Source
7	Eastern	22	North Aegean Sea	2002-2006	Trawl	Shelf trawl	**Octopodidae, *M. barbatus,*** *M. merluccius, M. kerathurus*	OTB-DEMSP	Multivariate analysis of landings data	The limitations of using landing profiles to identify métiers	Katsanevakis et al 2010a
		22-23	Aegean, Crete			Shelf trawl	***B. Boops, M. merluccius***, *P. longirostris*	OTB-DEMSP			
		22	Argosaronikos, North Aegean			Shelf-slope trawl	***M. merluccius***, ***P. longirostris***, ***Lophius* spp**, *Trachurus* spp, *I. coindetii, M. barbatus* (mixed)	OTB-MDDWSP			
		22	Evvoikos, North Aegean			Shelf trawl	***M. kerathurus***, *M. merluccius*	OTB-DEMSP			
		22	Evvoikos			Slope trawl	***N. norvegicus,*** *M. poutassous, M. barbatus*	OTB-MDDWSP			
		20	C.S. Ionian Sea			Shelf trawl	***M. kerathurus***, *M. merluccius*	OTB-DEMSP			
		20	Ionian Sea			Shelf-slope trawl	***M. barbatus, M. merluccius***, *P. longirostris*	OTB-DEMSP			
		20	C.S. Ionian Sea			Shelf-slope trawl	***M. merluccius, P. longirostris***	OTB-MDDWSP			
		20	Ionian Sea			Shelf-slope trawl	***M. merluccius***, ***M. barbatus, B. Boops, L. vulgaris, O. vulgaris*** *(mixed)*	OTB-MDDWSP			
		20	C.S. Ionian Sea			Shelf- trawl	***S. smaris, M. merluccius, M. barbatus***	OTB-DEMSP			
8	Eastern	22	Aegean Sea	2002-06	Longlines	Bottom longlines (14 métiers)	***E. marginatus, D. dentex, D. labrax, D. macrophthalmus, O. melanura, P. pagrus, D. sargus, E. costae, E. marginatus***	LLS-DEMF	Landings profile based on landing composition of fish trips	See Table 5 for further details	Katsanevakis et al 2010b
		20	Ionian Sea			Bottom longlines (7 métiers)	***D. sargus, O. melanura, E. costae, D. dentex,* Rays, *S. dumerilii, P. erythrinus, E. aeneus, E. marginatus, D. dentex, P. pagrus, M. merluccius, Phycis* spp, *C. conger***				

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species (24)	DCF code (métier)	Methodology	Observations (25)	Source
9	Western	7	Provence (Cote Bleu MPA)	2009-10	Small-scale	Set gillnets	**Sparidae, *S. aurata***	GNS-DEMF	Interviews, multivariate analyses	-	Leleu et al 2014
						Combined nets	***D. labrax, S. aurata**, Diplodus* spp				
						Set gillnets	***M. surmuletus,** M. barbatus*	GNS-DEMF			
						Set gillnets	***M. merluccius,** Pagellus* spp	GNS-DEMF			
						Set gillnets	***Scorpaena* spp,** *M. surmuletus*	GNS-DEMF			
						Trammel nets	***P. elephas, Scorpaena* spp**, Labridae	GTR-DEMSP			
						Trammel nets	***S. Solea,** S. rhombus, D. labrax*	GTR-DEMF			
10	Western	7	Cape Creus	2003	Small-scale	Traps	***O. vulgaris***	FPO-DEMSP	Maritime socio-anthropology	-	Gómez et al 2006
						Longlines, gillnets	***D. sargus, D. labrax, D. dentex, S. aurata, E. marginatus***	LLS-DEMF/GNS-DEMF			
						Longlines, trammel nets	***Scorpaena* spp**	LLS-DEMF/GTR-DEMF			
						Gillnet	***L. amia***	GNS-DEMF			
11	Eastern	20, 22, 23	Greek Seas	2002	Small-scale	17 métier identified	***B. Boops, Mullus* spp, *Scorpaena* spp, *P. erythrinus, Diplodus* spp, *P. pagrus, D. dentex, M. kerathurus, Solea* spp, *P. elephas, S. cretensis, M. merluccius, Trachurus* spp, *S. officinalis, E. marginatus, L. mormyrus, D. labrax, S. smaris, O. vulgaris***	-	Interviews	-	Tzanatos et al 2005
12	Central-Eastern	20	Patraikos Gulf	Different sources. See Table 2	Small-scale	11 different metiers	*See Table 3*	-	-	Provides a Métier Sustainability Index" (MSI25).	Tzanatos et al 2013
		17	Adriatic Sea			13 different metiers					
	Western	6	Tabarca Marine			17 different metiers					

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species (24)	DCF code (métier)	Methodology	Observations (25)	Source
13	Eastern	20	Patraikos Gulf	2004-2005	Small-scale	Uses metiers defined by Tzanatos et al 2006	-	-	-	Analyse discarding practices	Tzanatos et al 2007
14	Eastern	20	Patraikos Gulf	2004-2005	Small-scale	Combined net: gillnet-trammel net	***D. labrax, S. aurata, D. sargus***	GTR-DEMF	Hierarchical cluster analysis (Ward's method).	Provides detailed information on fishing characteristics (Table 1) and main by-catch species (Fig. 4)	Tzanatos et al 2006
						Gillnet	***M. merluccius***	GNS-DEMF			
						Longline	***S. dumerilii***	LLS-DEMF			
						Longline	***M. merluccius, C. rhonchus***	LLS-DEMF			
						Longline	***D. dentex, E. guaza***	LLS-DEMF			
						Pots	***O. vulgaris, S. vulgaris***	FPO-CEP			
						Trammel net	***M. merluccius***	GTR-DEMF			
						Trammel net	***D. dentex, S. aurata,* Mugilidae**	GTR-DEMF			
						Trammel net	***M. barbatus***	GTR-DEMF			
						Trammel net	***M. kerathurus, M. barbatus***	GTR-DEMSP			
						Trammel net	***S. officinalis***	GTR-DEMSP			
						Trammel net	***D. dentex, S. aurata, D. sargus, P. pagrus, L. mormyrus, P. erythrinus***	GTR-DEMF			
15	Eastern	22	Aegean Sea	1996-2001	Trawl	Trawl	*M. merluccius, M. barbatus, O. vulgaris Eledone* spp, *L. budegassa P. longirostris, P. kerathurus*	-	Cluster analysis	Considers the trawl as a whole, not differentiates metiers.	Stergiou et al 2003
16	Western	9	Tyrrhenian Sea	1991–1999	Trawl	Metier 1 (50-200 m)	*M. merluccius, E. cirrhosa, T. minutus*	OTB-DEMSP	Hierarchical clustering (AHC)	Detailed information on species composition in Fig. 4.	Sbrana et al 2003
						Metier 2 (200-400)	*M. merluccius, M. poutassou, Trachurus* spp, *P. longirostris, N. norvegicus*	OTB-DEMSP			
						Metier 3 (400-600)	*N. norvegicus, E. cirrhosa,* Aristeidae	OTB-DWSP			

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species (24)	DCF code (métier)	Methodology	Observations (25)	Source
17	Western	6	Alicante Gulf (SE Spain)	2002-2011	Trawl	Red mullet	***Mullus* spp,** *O. vulgaris, Tachurus* spp, *M. merluccius, S. officinalis*	OTB-DEMSP	Cluster analysis	Main species composition by metiera n port are in Fig. 11	Samy-Kamal et al 2014
						European hake	***M. merluccius,*** Morralla*, *O. vulgaris, Lophius* spp	OTB-DEMSP			
						Norway lobster	***N. norvegicus,*** *M. poutassou, P. blennoides, M. merluccius*	OTB-DEMSP			
						Red shrimp	***A. antennatus,*** *M. poutassou, P. blennoides, G. longipes*	OTB-DWSP			
18	Western	5	Balearic Islands	2002-2003	Trawl	Shallow shelf (50-78)	***M. surmuletus***, *S. smaris,* mixed fish, *L. vulgaris, T. mediterraneus*	OTB-DEMSP	Species composition	Detailed species composition by métier in Table 1	Ordines et al 2006
						Deep shelf (147–189 m)	Mixed fish, *Raja* spp, *Z. faber, M. surmuletus*	OTB-DEMSP			
19	Western	5	Balearic Islands	1996-1997	Trawl	Group A (300 m)	***N. norvegicus***, *C. cirrus, Raja* spp	OTB-DEMSP	Hierarchical classification	Detailed species composition by group are in Table 3 and Fig. 6	Moranta et at 2000
						Group B (489 m)	***A. antennatus***, *M. poutassou, H. dactylopterus, Lepidorhombus* spp	OTB-DWSP			
						Group C (616 m)	***A. antennatus***, *G. melastomus, P. blennoides, M. poutassou*	OTB-DWSP			
20	Western	5	Balearic Islands	2001-2006	Trawl	Shallow shelf	*S. smaris,* ***M. surmuletus***, *O. vulgaris*	OTB-DEMSP	Cluster analysis (Bray-Curtis)	Detailed species composition by métier is in Table 2	Palmer et al 2009
						Deep shelf	***M. merluccius***, *T. mediterraneus, C. cirrhus*	OTB-DEMSP			
						Upper Slope	*M. poutassou, M. merluccius,* ***N. norvegicus***	OTB-DEMSP			
						Middle slope	***A. antennatus***, *P. blennoides, M. poutassou*	OTB-DWSP			
21	Eastern	22	Aegean Sea	2009	Small-scale	Trammel net, 30-36 mm	*S. scrofa, P. elephas, P. pagrus, D. dentex*	GTR-DEMSP	Species composition		Miliou et al 2010
						Trammel net, 22-24 mm	*M. surmuletus, S. japonicus, C. hippurus*	GTR-DEMF			
						Long Lines, hook No 9–14	*S. pagrus, S. cantharus, D. vulgaris, D. dentex.*	LLS-DEMF			

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species [24]	DCF code (métier)	Methodology	Observations [25]	Source
22	Western	5	Balearic Islands	1996-1997	Trawl	Upper slope (350-600)	***N. norvegicus,*** *M. merluccius, M. poutassou, P. blennoides, G. melastomus*	OTB-DEMSP	Species composition		Merella et al 1998
23	Western	6	Catalonia	2000-2009	Small-scale	Trammel net – sole	***Solea K.,*** *L. mormyrus, O. vulgaris, S. officinalis*	GTR-DEMSP	Cluster analysis	Percentages of landings per métier in Table 3.	Maynou et al 2011
						Pots– octopus	***O. vulgaris,*** *Solea* spp	FPO-DEMSP			
						Gillnet− varied	*L. mormyrus, S. dumerilii,* mixed fishes	GNS-DEMF			
						Trammel net− cuttlefish	***S. officinalis,*** *B. brandaris, Solea* spp	GTR-DEMSP			
						Longline– hake	***M. merluccius***	LLS-DEMF			
						Trammel net – red mullet	***M. surmuletus,*** *Scorpaena* spp	GTR-DEMF			
						Gillnet – hake	***M. merluccius***	GNS-DEMF			
24	Western	6	Catalonia	1992-1998	Trawl	Fishing tactic 1 Upper slope	*M. poutassou, M. merluccius, P. blenoides,* ***A. antennatus, N. norvegicus***	OTB-MDDWSP	Cluster analysis	-	Maynou et al 2003
						Fishing tactic 2 Continental shelf	*L. depurator,* ***O. vulgaris, E. cirrhosa***	OTB-DEMSP			
						Fishing tactic 3 Continental shelf	***M. surmuletus,*** Sparidae, *Trachurus* spp	OTB-DEMSP			
						Fishing tactic 4 Middle slope	***A. antennatus,*** *P. blennoides, M. poutassou*	OTB-DWSP			

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species [24]	DCF code (métier)	Methodology	Observations [25]	Source
25	Western	6	Catalonia	2003-2005	Small-scale	Trammel net 1	***S. officinalis,*** *P. elephas, S. scrofa, S. Solea*	GTR-DEMSP	-	-	Martin et al 2012
						Trammel net 2	***M. surmuletus,*** *P. elephas, P. bogaraveo, S. Solea*	GTR-DEMSP			
						Trammel net 3	***S. Solea,*** *D. labrax, P. phycis*	GTR-DEMF			
						Trammel net 4	*S. porcus, P. phycis, L. mormyrus*	GTR-DEMF			
						Longline 1	***S. aurata,*** *C. conger*	LLS-DEMF			
						Longline 2	***D. labrax,*** *C. conger, P. erythrinus*	LLS-DEMF			
						Longline 3	***P. erythrinus,*** *D. labrax, C. conger, P. pagrus*	LLS-DEMF			
						Gillnet 1	***M. merluccius,*** *S. aurata, C. linguatula, P. bogaraveo*	GNS-DEMF			
						Gillnet 2	***P. erythrinus,*** *P. bogaraveo, S. sarda*	GNS-DEMF			
						Gillnet 3	*S. sarda, L. mormyrus, U. scaber, P. phycis*	GNS-DEMF			
						Gillnet 4	*S. aurata, S. sarda, M. merluccius*	GNS-DEMF			
						Gillnet 5	*S. sarda, S. scrofa, P. phycis, L. piscatorius, P. bogaraveo, D. dentex*	GNS-DEMF			
26	Western	5	Balearic Islands	2000-2014	Small-scale	Trammel net-Cuttlefish	***S. officinalis***, *O. vulgaris, Scorpaena* spp, *Raja* spp, *M. surmuletus*	GTR-DEMSP	Cluster analysis	-	Quetglas et al unpublished
						Trammel net-Lobster	***P. elephas,*** *S. scrofa, Raja* spp, *Lophius* spp, *Z. faber*	GTR-DEMSP			
						Longline-deep	***S. scrofa,*** *Raja* spp, *S. pagrus, C. conger, D. dentex, S. cantharus*	LLS-DEMF			
						Purse seine	***C. hippurus,*** *N. ductor*	PS-DEMF			
						Purse seine	***A. minuta***	PS-DEMF			
						Trammel net-Mullet	***M. surmuletus***, *S. officinalis, S. scrofa, O. vulgaris*	GTR-DEMSP			
						Longline-shore	***D. dentex***, *S. scrofa, S. cantharus, S. pagrus, E. marginatus*	LLS-DEMF			
						Handlines-Squid	***L. vulgaris***	LHM-DEMSP			

N	Basin	GSA	Area	Year	Fishery	Fishig gear	Target Species [24]	DCF code (métier)	Methodology	Observations [25]	Source
27	Central	17	Ancona	2000-2002	Beam-trawl	Beam-trawl	***Solea* spp, *P. maxima, S. rhombus,*** *S. mantis, M. kerathurus*, *B. brandaris, S. officinalis, C. lucerna*	TBB-DEMSP	Catch composition of daily catches	-	Scarcella et al., 2007
28	Central	17	Ancona - Fano	1999-2000	Small-scale	Gillnet	***S. Solea***	GNS-DEMF	Catch composition of daily catches	-	Fabi and Grati, 2003
						Gillnet	***L. mormyrus, D. labrax, S. umbra, U. cirrosa,* mugilids**	GNS-DEMF			
						Trammel net	***L. mormyrus***	GTR-DEMF			
						Trammel net	***S. officinalis***	GTR-DEMSP			
						Pots and traps	***S. officinalis***	FPO-CEP			
						Pots and traps		FPO-MOL			
29	Central	12-16	Strait of Sicily, Mazara del Vallo fleet	1993	Trawl	Trawl	***A. foliacea, A. antennatus, P. longirostris,*** *M. merluccius, C. agassizi, H. dactylopterus*	OTB-DWSP	Catch composition of daily catches	-	Castriota et al., 2001
30	Central	17	S. Benedetto - Senigallia	2000-2001	Hydraulic dredges	Hydraulic dredges	***C. gallina***	DRB-MOL	Catch composition of daily catches	30% of discards made by C. gallina undersized specimens	Morello et al., 2005

ANNEX 5. CATCH PROFILE IN THE MAIN EU MEDITERRANEAN FISHERIES BASED ON LITERATURE REVIEW: LITERATURE REFERENCES

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8. CONTACT DETAILS OF STECF MEMBERS AND EWG-15-14 LIST OF PARTICIPANTS

Information on STECF members and invited experts' affiliations is displayed for information only. In some instances the details given below for STECF members may differ from that provided in Commission Decision of 27 October 2010 on the appointment of members of the STECF (2010/C 292/04) as some members' employment details may have changed or have been subject to organisational changes in their main place of employment. In any case, as outlined in Article 13 of the Commission Decision (2005/629/EU and 2010/74/EU) on STECF, Members of the STECF, invited experts, and JRC experts shall act independently of Member States or stakeholders. In the context of the STECF work, the committee members and other experts do not represent the institutions/bodies they are affiliated to in their daily jobs. STECF members and invited experts make declarations of commitment (yearly for STECF members) to act independently in the public interest of the European Union. STECF members and experts also declare at each meeting of the STECF and of its Expert Working Groups any specific interest which might be considered prejudicial to their independence in relation to specific items on the agenda. These declarations are displayed on the public meeting's website if experts explicitly authorized the JRC to do so in accordance with EU legislation on the protection of personnel data. For more information: http://stecf.jrc.ec.europa.eu/adm-declarations

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9. LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on: https://stecf.jrc.ec.europa.eu/ewg1514

1. EWG-15-14 – Doc 1 - Declarations of invited and JRC experts (see also section 7 of this report – List of participants)

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