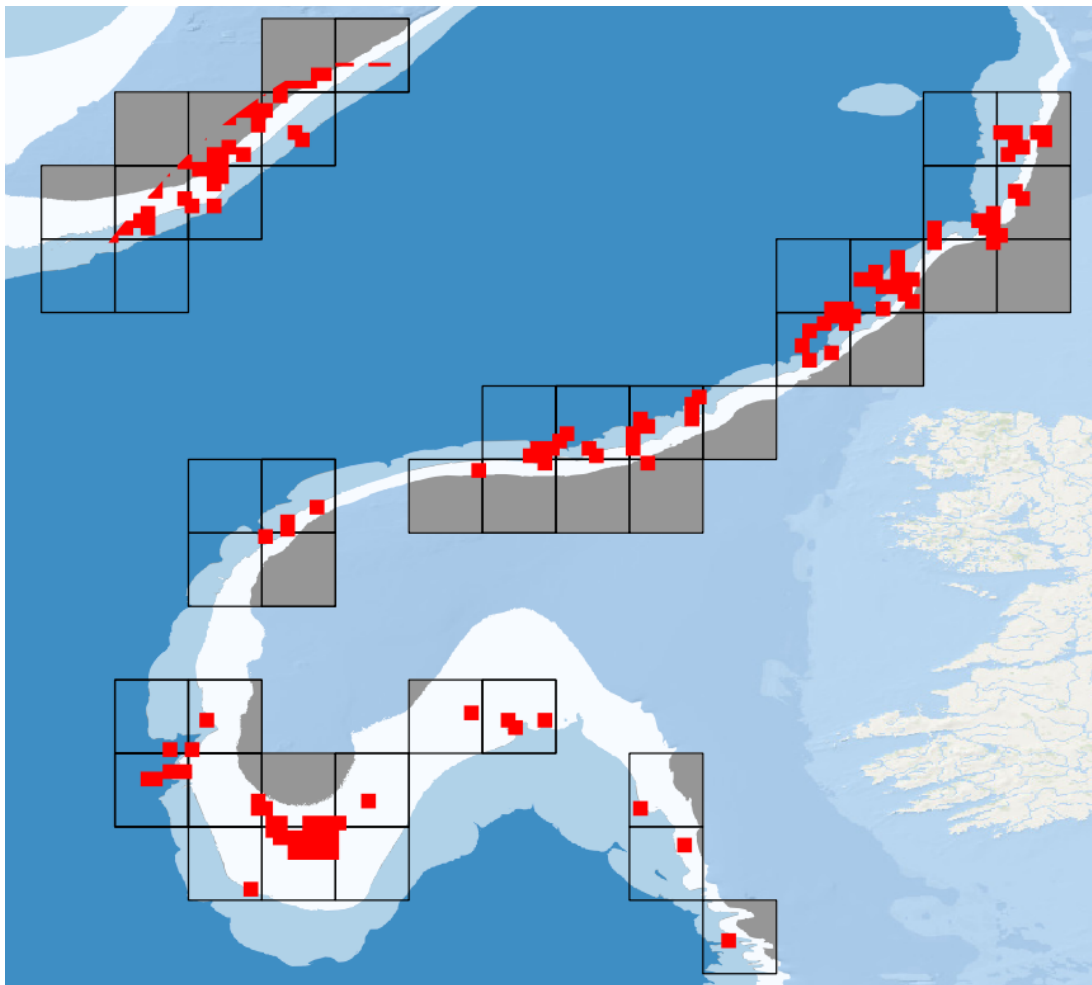


VULNERABLE MARINE ECOSYSTEMS IN EU WATERS: GIS ANALYSIS

Deliverable for the STECF ad hoc contracts 2314 & 2315

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In the context of the annual review of the Vulnerable Marine Ecosystem areas listed in the Implementing Act (EU) 2022/1614 adopted by the European Commission on September 2022, we carried out a geographical analysis on spatial data of fishing effort and landings at c-square level from the EU Data Collection Framework as compiled in the Fisheries Dependent Information database in combination with shapefiles of three different lists of Vulnerable Marine Ecosystem areas provided by DG Mare after ICES advice. The approach used to carry out the analysis and a summary of the results are presented in this document while the full datasets resulting from the analysis are provided as an electronic annex. In addition to the main analysis, in Appendix 2 are reported the results of the analysis carried out for Spanish data from the ICES VMS/logbook dataset.



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Summary

The Deep-sea Access Regulation [1] is governing the access to deep-sea fishing and setting conditions for protecting VME areas in EU and international waters. On 15 September 2022, the European Commission adopted the Implementing Act (EU) 2022/1614 [2] determining the existing deep-sea fishing areas and establishing a list of areas in the Northeast Atlantic where VMEs are known to occur or are likely to occur. These areas where VMEs are known to occur or are likely to occur were closed to bottom fishing below 400m.

As per article 9(6) of the Deep-sea Access Regulation [1], the European Commission shall review annually the list of VME areas on the basis of advice received from the Scientific, Technical and Economic Committee for Fisheries (STECF) and, where appropriate, amend the list by means of implementing acts.

In this context, we were requested to carry out a spatial analysis of the fisheries effort and landings data extracted from the Fisheries Dependent Information (FDI) database. The analysis focused on the fishing activity carried out by EU vessels equipped with bottom-contacting gears active in EU waters of the Northeast Atlantic as recorded in the FDI database. The temporal coverage of the time-series in the FDI database extends from 2013 to 2021.

The geographical frameworks used to perform the spatial analysis contain the definitions of areas where VMEs are known to occur or are likely to occur provided in the ICES advice; in particular the analysis focused on the scenario used to establish the list of VMEs in the Implementing Act (EU) 2022/1614 [2] and on two of the five scenarios presented in the most recent ICES advice [5].

The management of spatial data in the FDI database exploits the Concise Spatial Query and Representation System (c-square) [12] at the resolution of 0.5×0.5 degree. This scale is too coarse to provide reliable estimations of fishing effort and landings in the VME areas. To limit the uncertainties derived from the size of the c-squares used in the FDI dataset compared to the size of the VMEs, for the current analysis we considered only data relating to deep fishing trips as defined in the FDI data call specifications.

To test the reliability of the data provided following the deep fishing trips definition used in the FDI data, we plotted the selected FDI c-squares on the bathymetry map of the Northeast Atlantic built using the bathymetric dataset provided by GEBCO [13]. The resulting map shows the overlap of the FDI c-squares with the waters between the 400m-800m depth and supports the hypothesis that deep fishing trips from the FDI dataset are a good proxy of fishing activity within the depth range 400m-800m.

A comparison of the results of spatial analysis carried out for the three scenarios considered are introduced in the paragraph "Main findings", while the complete results of the spatial analysis are released in electronic format as CSV data files and GIS shapefiles. In addition to the main analysis, in Appendix 2 are reported the results of the analysis carried out for Spanish data from the ICES VMS/logbook dataset. The ICES VMS/logbook dataset contains fishing effort and landings data aggregated at 0.05 c-square. This resolution is one order of magnitude bigger than the one used in the FDI dataset allowing a more precise detection of where the fishing activity occurred.

Introduction

Fishing for deep-sea species with gears that can scrape the bottom of the seabed has an important impact on the deep-sea fauna which compose the so-called Vulnerable Marine Ecosystems (VMEs).

The Deep-sea Access Regulation [1] is governing the access to deep-sea fishing and setting conditions for protecting VMEs in EU and international waters. The Deep-sea Access Regulation aims at establishing a sustainable exploitation of deep-sea stocks while reducing the environmental impact of these fisheries and preventing significant adverse impacts on VMEs.

On 15 September 2022, the European Commission adopted the Implementing Act (EU) 2022/1614 [2] determining the existing deep-sea fishing areas and establishing a list of areas in the Northeast Atlantic where VMEs are known to occur or are likely to occur. The areas in the second list (i.e. areas with VMEs) were closed to bottom fishing below 400m. The areas where VMEs are known to occur or are likely to occur listed in the Implementing Act were identified following the ICES advice provided to the European Commission in 2021 [3] and 2022 [4]. The advice provided by ICES involved two data streams: VMS/logbook data to quantify the fishing footprint and data on where VMEs are known to occur or are likely to occur. Data on VMEs and fishing activity were aggregated at the scale of 0.05 degrees latitude $\times$ 0.05 degrees longitude c-square cells, where they are assumed to be uniformly distributed. ICES used VMS data to determine the presence or absence of mobile bottom-contacting gear fishing within a c-square. The assessment area comprises c-squares that overlap the 400–800 m depth zone in EU waters where fishing operations using bottom-contacting gear can occur, while fishing with static gear is not included in the assessment scenarios.

As per article 9(6) of the Deep-sea Access Regulation [1], the European Commission shall review annually the list of VME areas on the basis of advice received from the Scientific, Technical and Economic Committee for Fisheries (STECF) and, where appropriate, amend the list by means of implementing acts.

In this context we were requested to carry out a spatial analysis of the fisheries landings and effort data extracted from the Fisheries Dependent Information (FDI) database. The analysis focuses on the fishing activity carried out by EU vessels equipped with bottom-contacting gears active in EU waters as recorded in the FDI database for the years 2013 to 2021.

The goal of this spatial analysis is to inform a subsequent socio-economic analysis for VMEs in EU waters that could allow STECF to deliver an opinion on the consequences of changes in the list of VME areas as proposed by the ICES advice of April 2023 [5]. The FDI dataset has been chosen for the spatial analysis also for the possibility to link by fleet segment the FDI landings and effort data with data provided by Member States to the DCF fleet socio-economic data call.

The geographical frameworks used to perform the spatial analysis contain the definitions of areas where VMEs are known to occur or are likely to occur provided in the ICES advice; in particular the analysis focused on the scenario used to establish the list of VME areas in the Implementing Act (EU) 2022/1614 and on two of the five scenarios presented in the most recent ICES advice [5].

A comparison of the results of spatial analysis carried out for the three scenarios considered are introduced in the paragraph “Main findings”, while the complete results of the spatial analysis are released in electronic format as CSV data files and GIS shapefiles. Constraints and limitations to consider when looking at the results of this analysis are mentioned in the text when we describe data and methods used and are also summarized in the paragraph “Limitations and caveats”.

FDI dataset

The EU Member States collect fisheries data to support the Common Fisheries Policy (CFP) through scientific advice. Fisheries data from the EU fishing fleet are collected under the remit of the EU Data Collection Framework (DCF). As per Article 17 of Regulation (EU) 2017/1004 [6], Member States are requested to supply data as specified in the different DCF data calls.

Spatial effort and landings data are provided by Member States in the context of the Fisheries Dependent Information (FDI) data call and are currently available in the DCF FDI database.

To be noted that the DCF data calls are addressed to EU Member States only and that the United Kingdom provided data to the FDI data call for fishing activity carried out until 2020.

Spatial data

Spatial information is collected by Member States through logbooks, VMS data, sales notes and sample surveys. In the context of the FDI data call, spatial data can be provided or by c-square at the resolution of 0.5×0.5 degree or by rectangle providing, in the second case, the type of rectangle used and the latitude and longitude of the centre of the rectangle itself. The FDI data call defines four types of rectangles having respectively the following grid cell resolution: 0.5×0.5 degree (e.g. GFCM squares), 0.5×1 degree (e.g. ICES rectangles), 1×1 degree (e.g. IOTC), 5×5 degree (e.g. ICCAT).

Detailed information on the FDI data call and the format of the data requested by the call are available on the JRC website <https://datacollection.jrc.ec.europa.eu/>

Geographical coverage

The FDI dataset covers all the oceans and seas where the fishing fleet of the European Union operates. For the purpose of the current work, we used data from the Northeast Atlantic (FAO area 27).

Temporal coverage

Being the FDI a recent data call (the first call was launched in 2018), the temporal coverage of the data in the FDI database for area 27 is currently limited to 9 years (2013-2021). For the current analysis, data for all the available years were considered.

Deep fishing trips

Landings and effort information are provided to the FDI data call by fleet segment and are characterised by a set of variables. One of these variables is called DEEP and it is used to identify deep fishing trips.

In the FDI dataset, deep fishing trips are reported in all the divisions of FAO area 27 (Northeast Atlantic) except in the Baltic (division 27.3.d), in the Sound and Belt Sea (division 27.3.b,c) and in the Kattegat strait (subdivision 27.3.a.21).

A fishing trip is marked as a deep fishing trip when the catch of deep-sea species retained exceeds 100 kg. The deep species to be considered are described in the following EU regulations: for data up to and including 2016 the deep-sea species to be considered are listed in the Annex I of the regulation (EC) 2347/2002 [7], while for data from 2017 the deep-sea species to be considered are listed in the Annex I of the regulation (EU) 2016/2336 [1]. However, catches during fishing trip marked as deep are not limited to those species and the whole catch contains also other species that are not listed in the mentioned EU regulations. As an example, the Appendix 1 shows the list of species that in the FDI dataset are related to deep fishing trips in FAO area 27 for the year 2021.

To limit the uncertainties derived from the size of the c-squares used in the FDI dataset compared to the size of the VME areas, for the current analysis we considered only data

relating to deep fishing trips.

Gear types

The analysis focused on the bottom-contacting fishing vessels. The gear type codes included in the analysis are listed in Table 1.

Table 1. Gear types of interest for the analysis

Gear type	Gear code
Boat dredges	DRB
Mechanised dredges including suction dredges	HMD
Set gillnets (anchored)	GNS
Drifting longlines	LLD
Set longlines	LLS
Danish seines (Anchored seine)	SDN
Pair seines	SPR
Scottish seines (Fly shooting seine)	SSC
Beach seines	SB
Boat seines	SV
Pots and Traps	FPO
Bottom otter trawl	OTB
Otter twin trawl	OTT
Bottom pair trawl	PTB
Beam trawl	TBB

The dataset used for this work is a subset extracted from the FDI database for FAO area 27 with data for all the available years and for the gear types listed in Table 1.

Confidential data

Some of the data in the FDI database were marked as confidential data by the Member States providing the data. To preserve the confidentiality of the data, the FDI spatial dataset is publicly disseminated [8] aggregated at EU level. For the purpose of the present work, this level of aggregation was not useful and it was necessary to access the original FDI data disaggregated at country level. So in the analysis both confidential and non-confidential data were used.

Data quality

Data collected during the FDI data calls were checked by the STECF expert working group on Fisheries Dependent Information.

The FDI dataset was also compared with other public data sources: with the data published by Eurostat (<https://ec.europa.eu/eurostat/data/database>) and with the data collected by the DCF Fleet Socio-Economic data call as disseminated on the STECF web site (<https://stecf.jrc.ec.europa.eu/data-dissemination>).

On the basis of the results of these comparisons and the opinion of the experts attending the working group, the FDI dataset is considered to have a good coverage for the vessel length categories above-12m in the Mediterranean and Black Sea and for the vessel length

categories above-10m in the other FAO fishing areas.

For the limitations existing in the collection of spatial data for small-scale fisheries, in the FDI dataset the quality of data for the vessel category below-12m in the Mediterranean and Black Sea and below-10m for the other waters is lower than the quality of data for the other vessel categories.

The majority of countries submitting data to the FDI data call include small scale fleet data in their spatial data submissions. The fishing location requested in FDI spatial tables is primarily obtained from official declarative forms which are mandatory in many Member States. In countries where declarative forms do not include information on fishing location on the desired resolution or where such declarative forms are not available, an approximation of spatial information or on-site sampling is applied. The most common approximation method is based on the port of landings (i.e. the catch is allocated by rectangles based on the landing port).

For small scale fisheries it is difficult to estimate the number of fishing days when logbooks data are not available. An approach used by some countries is to estimate the fishing days from the sales notes, assuming that one sale note corresponds to one fishing day.

About the quality of the information provided for deep fishing trips, in the FDI EWG reports it is not mentioned a detailed assessment relating to the DEEP variable. However, these data were checked with all the rest of the dataset. Only in the report STECF-21-12 [10] in the national chapter for Portugal it was mentioned that "for the year 2020, not all trips were classified for the DEEP indicator, whereby this indicator should be used with reservations by the end user".

More information on the methods used by Member States to collect and approximate the data requested in the context of the FDI data call can be found in the STECF report of the FDI EWG (STECF-20-10 [9], STECF-21-11 [10], STECF-22-10 [11]).

Geographical datasets

Deep-Sea Vulnerable Marine Ecosystems

The following datasets were used to define the geography of the areas in Northeast Atlantic where VMEs are known to occur or are likely to occur:

1. The geographical dataset provided by DG MARE with the definitions of 87 VME areas selected among the VME areas in the *Scenario 2 option 1* produced by ICES advice in 2022 [3].

This scenario was used in the Implementing Act (EU) 2022/1614. It includes a) c-squares between 400–800m depth with VME habitats as well as c-squares with high and medium VME indices, regardless of fishing activity, b) c-squares with a low VME index only if adjacent to c-squares with medium to high VME indices, and c) low VME index c-squares if bottom-contacting gear fishing intensity (SAR) is also low (SAR < 0.43).

2. Geographical datasets with the definitions of VME areas for *Scenario C* and *Scenario D* produced by ICES advice in 2023 [4].

In the ICES advice, VMEs protection polygons were determined for the scenarios A and B on evidence of VMEs occurrence only; while for scenarios C, D and E they were determined on evidence of both VMEs occurrence and mobile bottom-contacting gear fishing intensity. In particular, scenario C includes a) c-squares with VME habitats and c-squares with high and medium VME index, b) c-squares with low VME index if SAR < 0.43, and c) c-squares with low VME index and SAR ≥ 0.43, but only if adjacent to c-squares with low VME index with SAR < 0.43, or c-squares with VME habitat, high or medium VME index; while scenario D includes c-squares with VME habitats and c-squares with high, medium and low VME index, only if SAR < 0.43.

The c-square dataset

The management of spatial data in the FDI database exploits the Concise Spatial Query and Representation System (c-square) [12] at the resolution of 0.5×0.5 degree. For the current analysis, we used the c-square dataset that was prepared for the STECF FDI EWG. It is available at:

<https://github.com/maurizioqibin/EWG-FDI-MAPPING/tree/master/csquares>

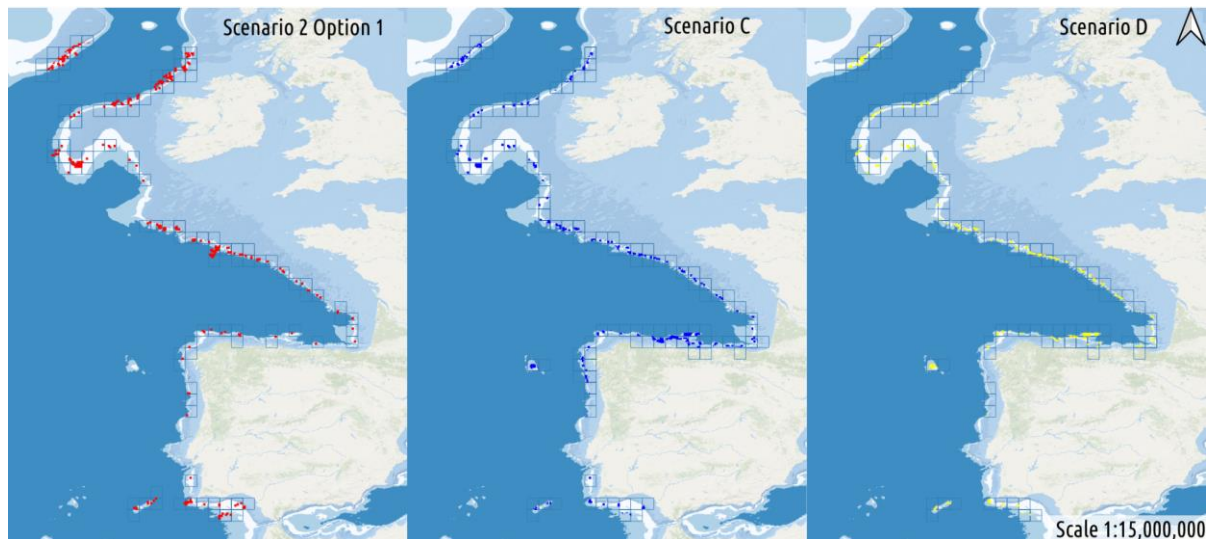


Figure 1. The maps show the c-squares of the FDI data (0.5×0.5 resolution) that contain the three different scenarios produced by ICES and selected by DG MARE, that have been used in the analysis. Waters between the 400m-800m depth (used in the identification of the VMEs) are reported in white.

Spatial analysis

Three geographical frameworks were built based on the VMEs spatial information mentioned in the paragraph *Geographical datasets*, one for each of the scenarios considered in the analysis.

Preliminary checks have been performed on the FDI spatial data to verify if the coordinates lying on lands and the compatibility of the coordinates with the declared rectangle type. On the basis of the results of these checks, some data were excluded from the original dataset.

The dataset was then limited to data in FAO area 27, with gear codes listed in Table 1, and marked as deep fishing trips. Having applied the aforementioned criteria, for each scenario we proceeded to identify and select the c-squares within the FDI dataset that contain VMEs (see Figure 1).

For each scenario, the results of the analysis are the estimation of the fishing activity in the VME areas, in terms of fishing days, landings weight (tonnes) and landings value (euro). These estimated values are provided at the following level of aggregation: country, year, supra-region, fishing technique, vessel length, geographical indicator, gear type, sub-region and the number identifying the VME (vme_id). In addition, average values for the whole time-series (2013-2021) are computed.

The rationale behind considering only landings and effort data from the deep fishing trips is to limit the uncertainty derived from the size of the c-squares used in the FDI dataset compared to the size of the VME areas (see Figure 2 for a comparison of the size of c-squares and VMEs in *Scenario 2 option 1*). The VME areas have been produced by including the depth range of 400m to 800m. The FDI data *do not* report the depth where the fishing activity occurred. In contrast, the variable DEEP in the FDI data requires Member States

to indicate those trips where the amount of deep-sea species catches is above 100Kg. If the FDI data are filtered out of all non-DEEP and non-bottom contacting gear, the final dataset will report all fishing activity for bottom contacting gears effectively occurring at the range 400m-800m.

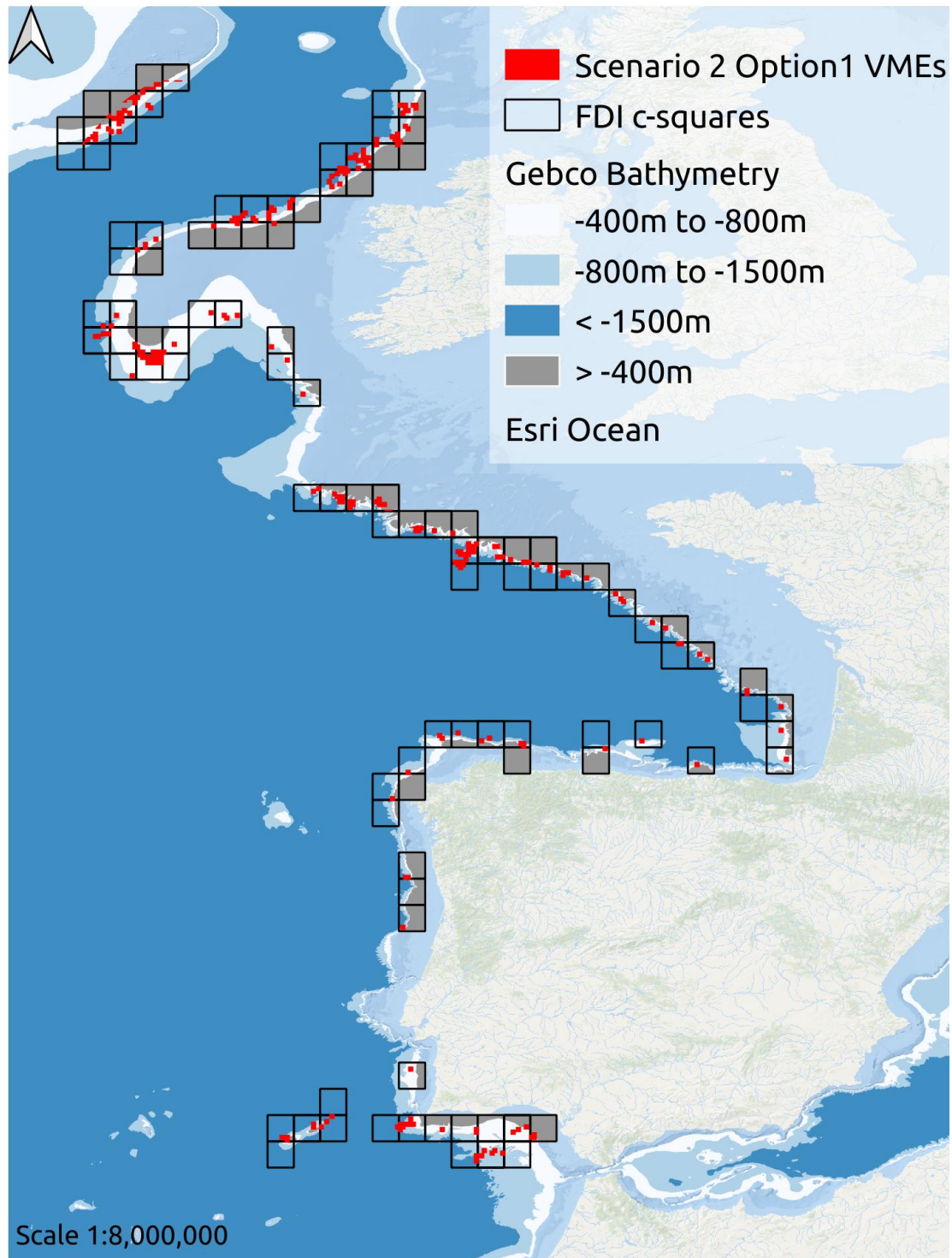


Figure 2. The map shows the c-squares of the FDI data (0.5x0.5 resolution) that contain the 87 VME polygons of Scenario 2 option 1 selected for the Implementing Act (EU) 2022/1614. Waters between the 400m-800m depth (used in the identification of the VMEs) are reported in white.

To test the reliability of the deep fishing trips definition used in the FDI data, for the three scenarios we plotted the selected FDI c-squares on the bathymetry map of the Northeast Atlantic built using the bathymetric dataset provided by GEBCO [13]. The result for the *Scenario 2 option 1* (the scenario used in the Implementing Act (EU) 2022/1614) is presented in Figure 2, where it is possible to observe the overlapping of the FDI c-squares with the waters between the 400m-800m depth.

Despite the size of the FDI c-squares, the area where the fishing activity occurs is very limited as most of the c-square area is covered by depth ranges where fishing activity is not very likely to occur (deep-sea species are caught in depths of up to 1,500 metres, beyond the main fishing grounds of the continental shelves). Some DEEP records in the FDI might include catches of non-deep-sea species made above the range 400m-800m, but the biology of the species and selecting bottom contacting gears within DEEP records supports the hypothesis that deep fishing trips from the FDI dataset are a good proxy of fishing activity within the depth range 400m-800m.

Main findings

The results of the analysis for all the considered scenarios contain information for the following countries: Germany, Spain, Ireland, France and Portugal.

The dataset used as input for the analysis contained the 15 gear types listed in Table 1. However, the results dataset contains 9 gear types for *Scenario 2 option1* and *Scenario C*, and 8 gear types for *Scenario D*. The lists of gear types present in the results for the 3 scenarios are shown in Table 2.

Table 2. Gear types present in the results of the analysis

Gear type	Gear code	<i>scenario 2 option 1</i>	<i>scenario C</i>	<i>scenario D</i>
Boat dredges	DRB	✓	✓	
Mechanised dredges including suction dredges	HMD			
Set gillnets (anchored)	GNS	✓	✓	✓
Drifting longlines	LLD	✓	✓	✓
Set longlines	LLS	✓	✓	✓
Danish seines (Anchored seine)	SDN	✓	✓	✓
Pair seines	SPR			
Scottish seines (Fly shooting seine)	SSC			
Beach seines	SB			
Boat seines	SV			
Pots and Traps	FPO	✓	✓	✓
Bottom otter trawl	OTB	✓	✓	✓
Otter twin trawl	OTT	✓	✓	✓
Bottom pair trawl	PTB	✓	✓	✓
Beam trawl	TBB			

The number of VME areas differs in the three considered scenarios: 87 in *Scenario 2 option 1*, 122 in *Scenario C* and 107 in *Scenario D*. Table 3 shows the average number of VME areas where the analysis estimated some fishing activity for the whole time-series (2013-2021).

Table 3. Average number of VME areas where the analysis estimated some fishing activity for the time-series (2013-2021)

country code	scenario 2 option 1	scenario C	scenario D
DEU	13	20	19
ESP	63	83	73
FRA	53	66	60
IRL	20	24	19
PRT	18	25	21

In the following we show the averages of the estimated totals for the whole analysed time-series (2013-2021), but also for the period 2018-2021.

Tables 4, 5 and 6 show the averages of the estimated totals for the analysed time-series (2013-2021) respectively for *Scenario 2 option1*, *Scenario C* and *Scenario D*; while Figures 3, 4 and 5 show a graphical comparison of these average values by scenario.

Table 4. Scenario 2 option 1: average of the estimated totals for the time-series (2013-2021)

country code	fishing days (number)	landings weight (tonnes)	landings value (euro)
DEU	52.4	45.44	254963.2
ESP	4628.82	6578.94	24078352.37
FRA	1708.89	3868.81	13420332.04
IRL	224.62	359.04	999222.30
PRT	622.67	657.09	1604893.34

Table 5. Scenario C: average of the estimated totals for the time-series (2013-2021)

country code	fishing days (number)	landings weight (tonnes)	landings value (euro)
DEU	49.3	41.64	221203
ESP	6501.72	8388.02	30231880.57
FRA	2134.65	4691.30	16557696.34
IRL	176.71	291.67	821982.27
PRT	646.33	747.9	1678171.34

Table 6. Scenario D: average of the estimated totals for the time-series (2013-2021)

country code	fishing days (number)	landings weight (tonnes)	landings value (euro)
DEU	49.2	41.6	221007
ESP	5256.5	7524.49	27870289.96
FRA	1833.25	3608.19	13256320.46
IRL	147.43	198.21	601209.09
PRT	594.22	705.46	1592507.24

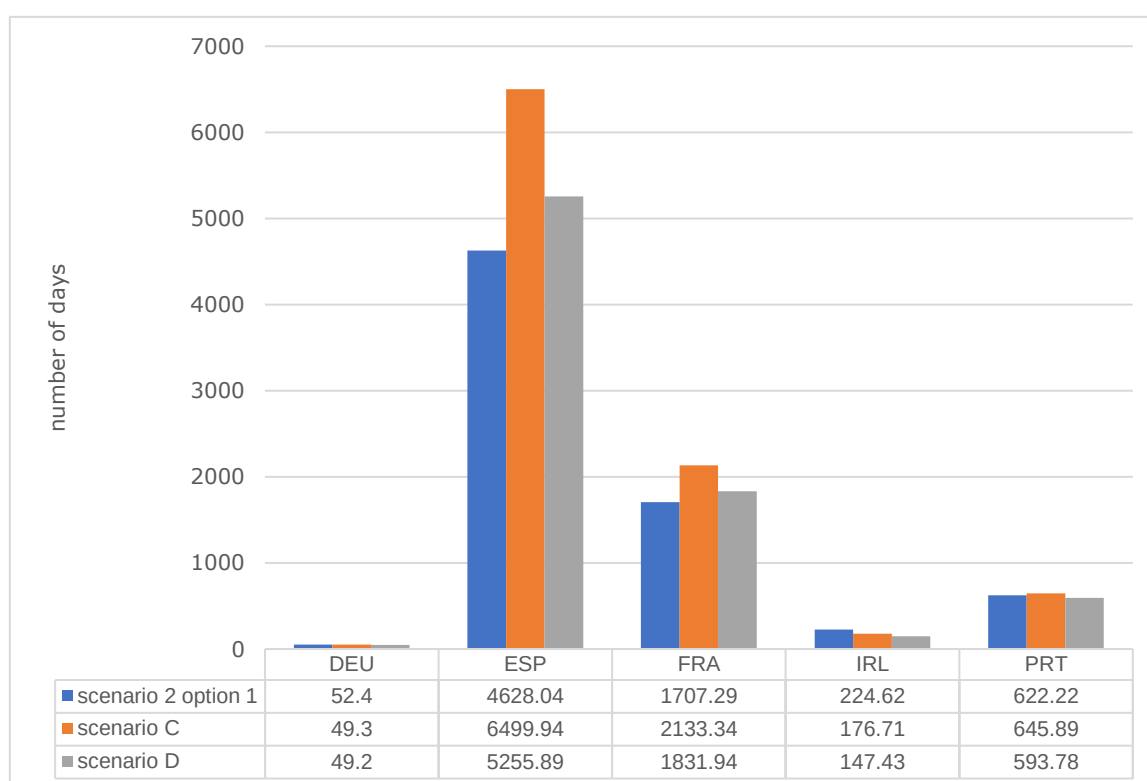


Figure 3. Estimated fishing effort average for the time-series (2013-2021) by scenario

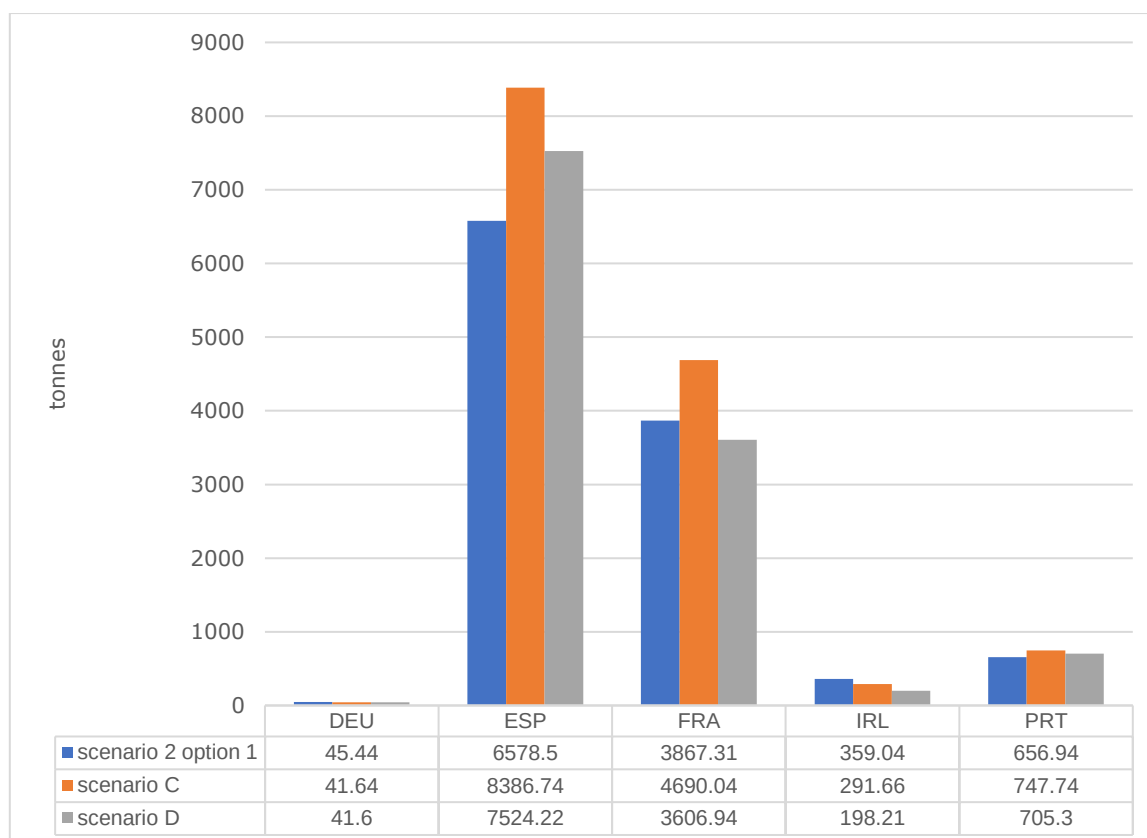


Figure 4. Estimated landings weight average for the time-series (2013-2021) by scenario

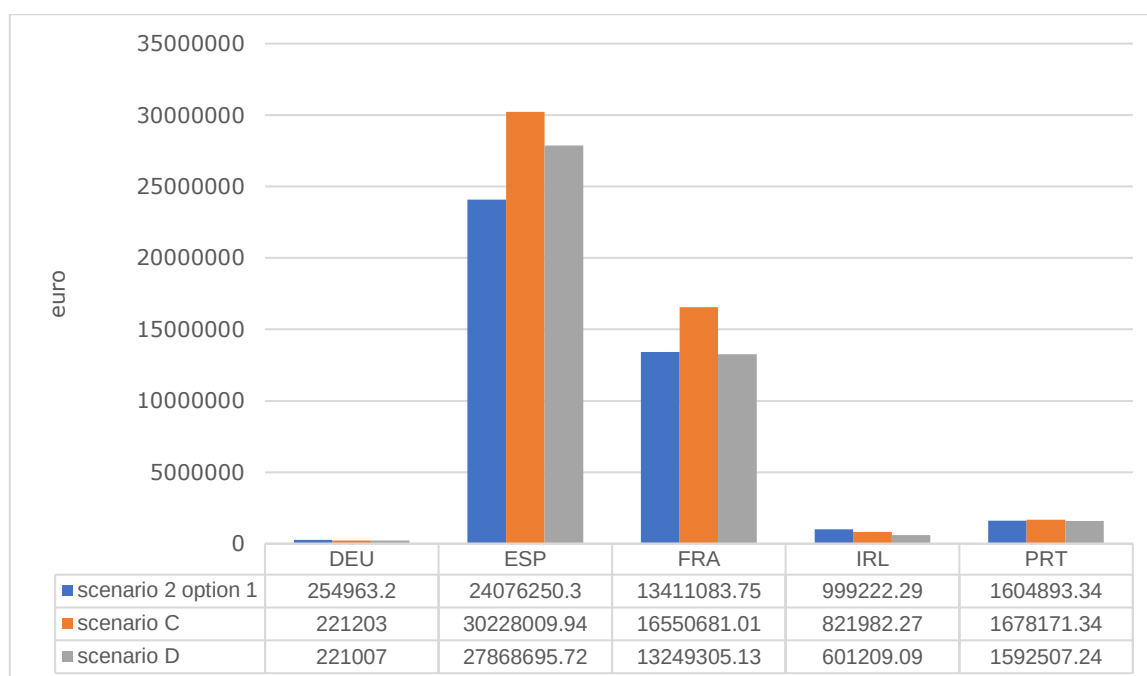


Figure 5. Estimated landings value average for the time-series (2013-2021) by scenario

Tables 7, 8 and 9 show the averages of the estimated totals for the period 2018-2021 respectively for *Scenario 2 option1*, *Scenario C* and *Scenario D*; in addition Figures 6, 7 and 8 show a graphical comparison of these average values by scenario.

Table 7. Scenario 2 option 1: average of the estimated totals for the period 2018-2021

country code	fishing days (number)	landings weight (tonnes)	landings value (euro)
DEU	58.83	52.75	306652.7
ESP	122.97	118.04	586058.91
FRA	2153.88	4299.03	16145077.55
IRL	172.83	298.91	869974.49
PRT	775	741.85	1726246.54

Table 8. Scenario C: average of the estimated totals for the period 2018-2021

country code	fishing days (number)	landings weight (tonnes)	landings value (euro)
DEU	77	43.47	236399.8
ESP	140.12	128.12	643383.25
FRA	2709.12	5297.85	19945364.29
IRL	136.03	241.5	713125.07
PRT	767.5	757.81	1726665.42

Table 9. Scenario D: average of the estimated totals for the period 2018-2021

country code	fishing days (number)	landings weight (tonnes)	landings value (euro)
DEU	77	43.47	236399.8
ESP	139	127.31	641185.66
FRA	2395.07	4353.83	16664894.21
IRL	93.42	123.98	403862.43
PRT	706.75	687.3	1597681.52

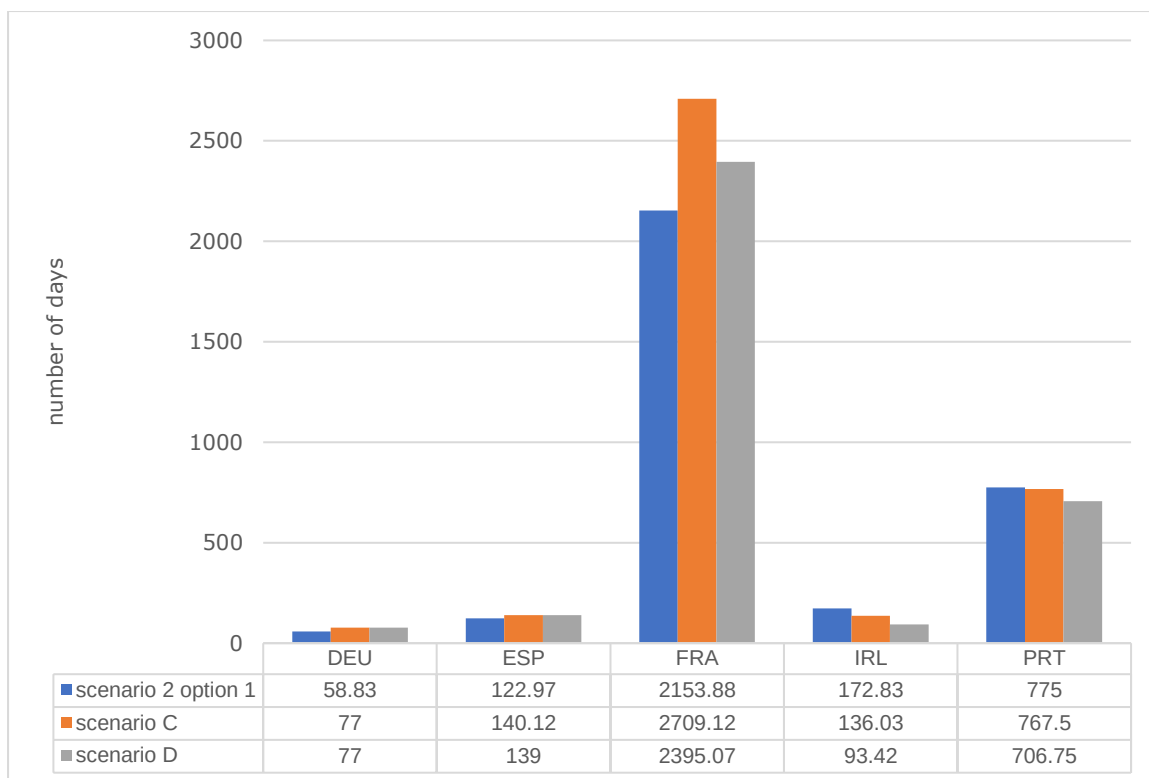


Figure 6. Estimated fishing effort average for the period 2018-2021 by scenario

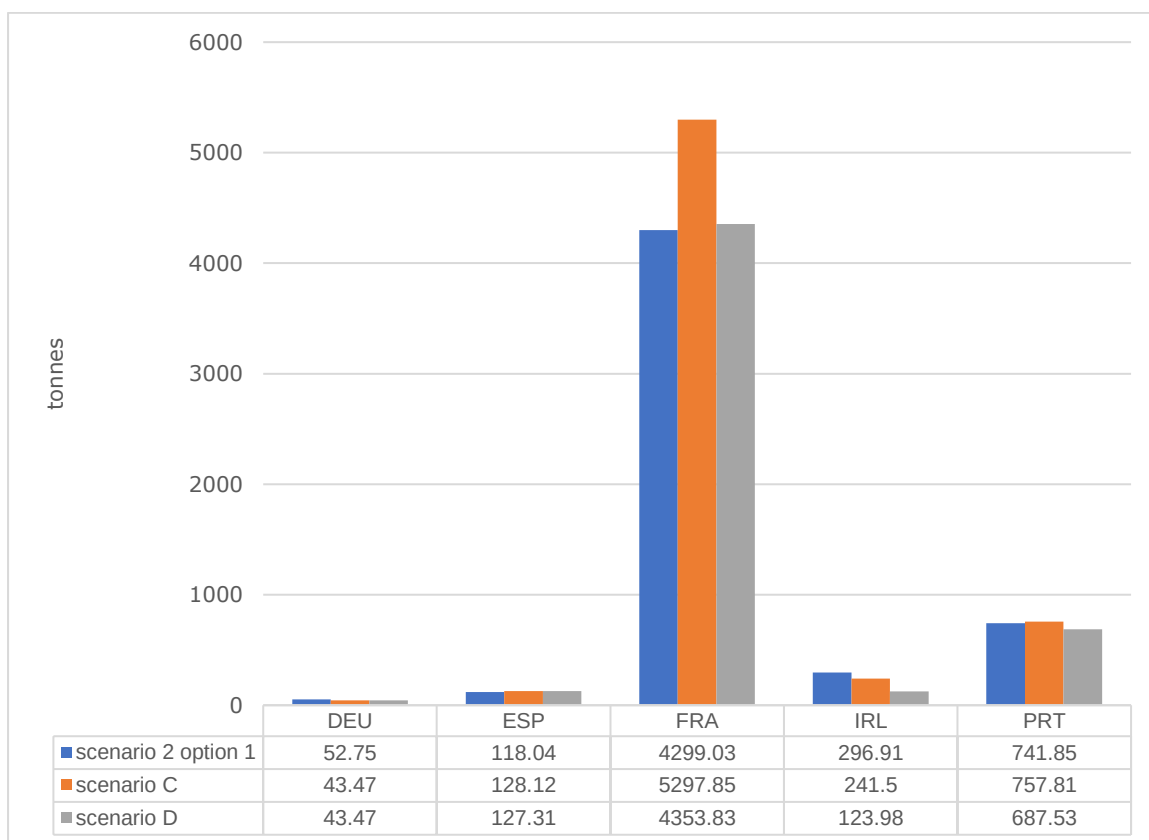


Figure 7. Estimated landings weight average for the period 2018-2021 by scenario

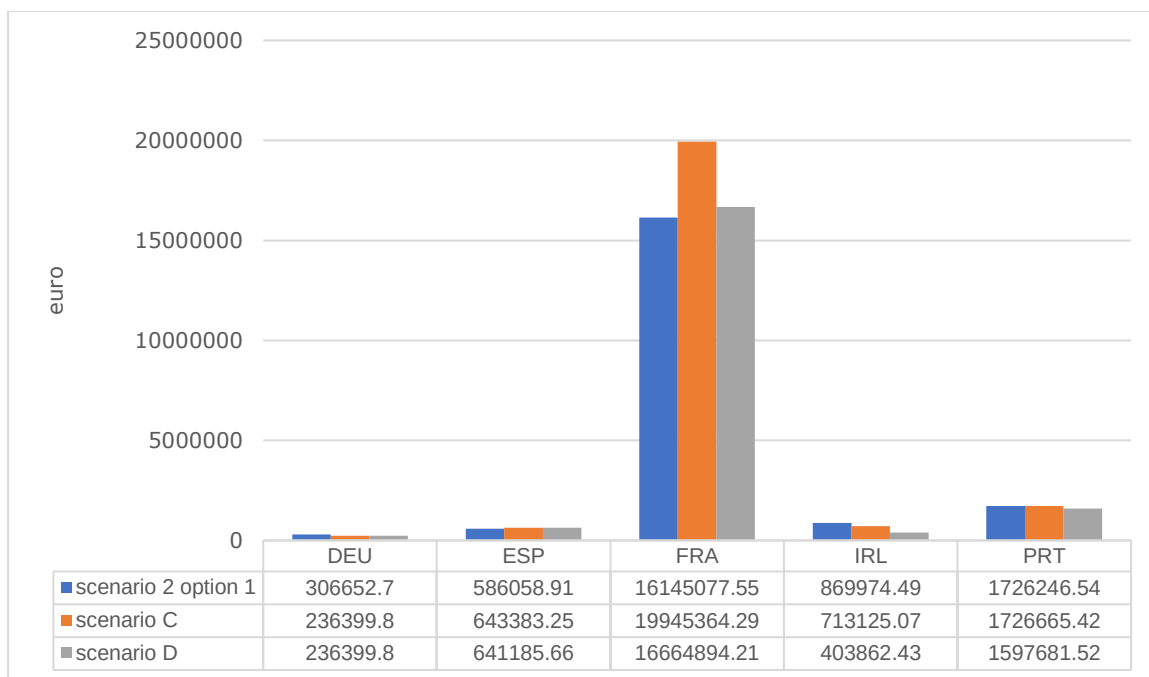


Figure 8. Estimated landings value average for the period 2018-2021 by scenario

In the following, for each country it is shown a comparison of the estimated totals by scenario and year.

Germany

Germany provided information about deep fishing trips only for 5 of the 9 years in the FDI time-series. For the years where data are available, the result of the analysis show almost no differences between the 2 scenarios from the new ICES advice (*Scenario C* and *Scenario D*). Compared with *Scenario 2 option 1*, the estimated fishing activity in the VME areas for this scenario is higher for some years but lower for others.

Table 10. Germany: gear types present in the results by year for all the scenarios

gear code	2013	2014	2015	2016	2017	2018	2019	2020	2021
FPO	✓	✓					✓	✓	✓
GNS	✓						✓	✓	✓

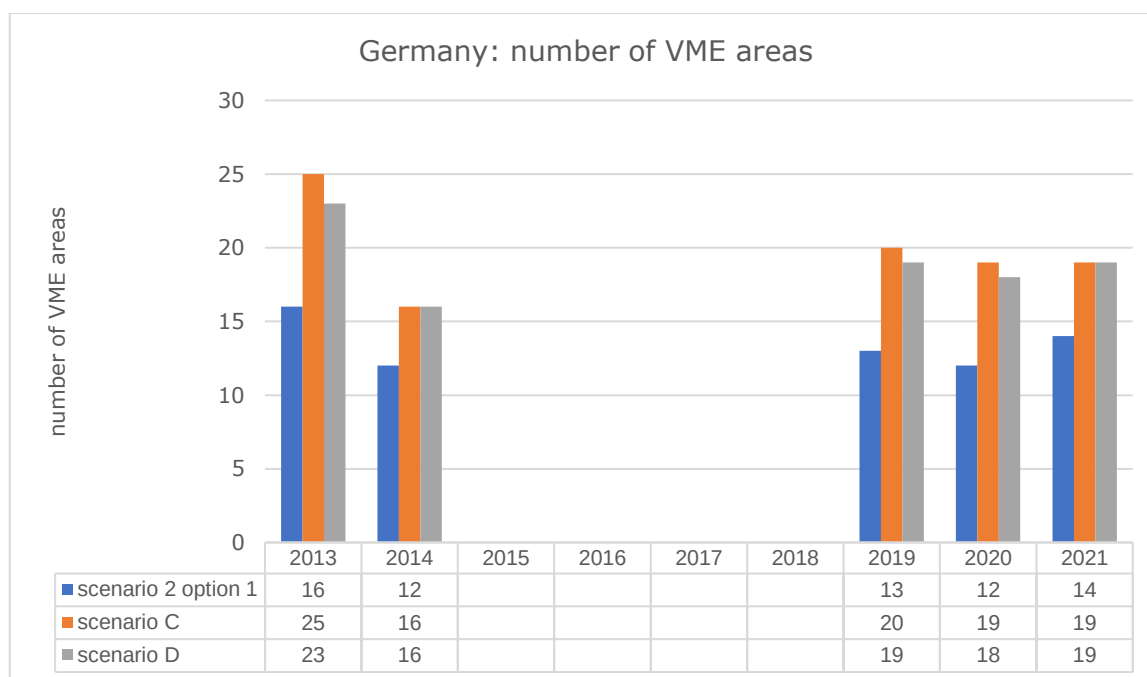


Figure 9. Germany: number of VME areas where fishing activity has been estimated by scenario and year

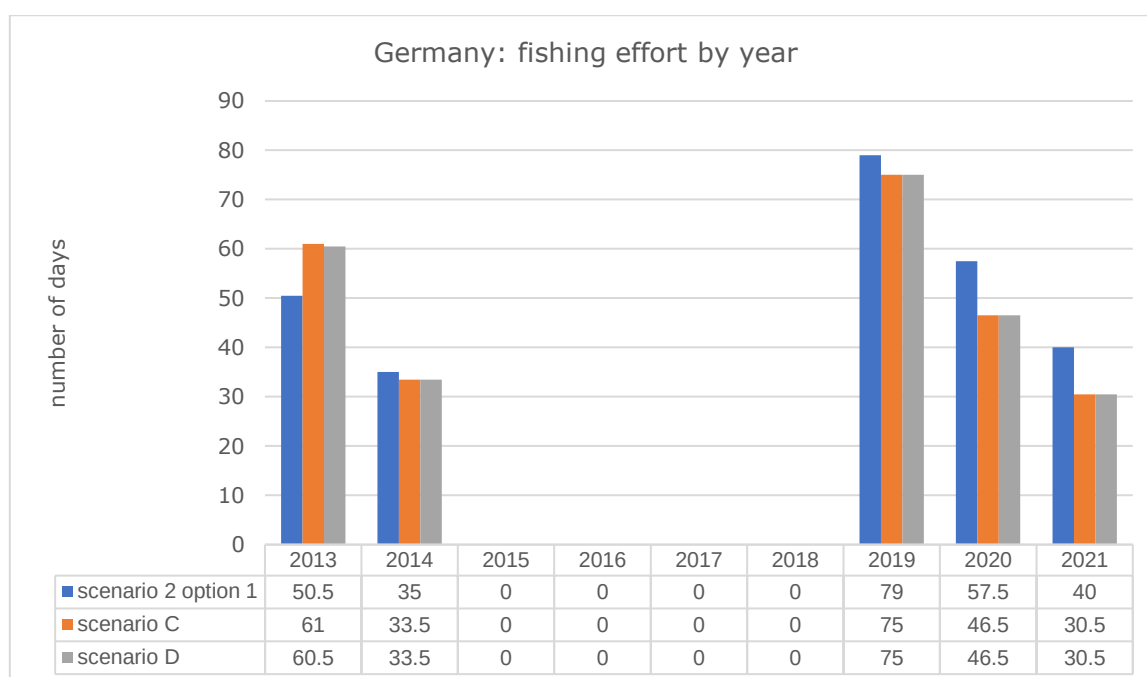


Figure 10. Germany: estimated fishing effort (number of fishing days) by scenario and year

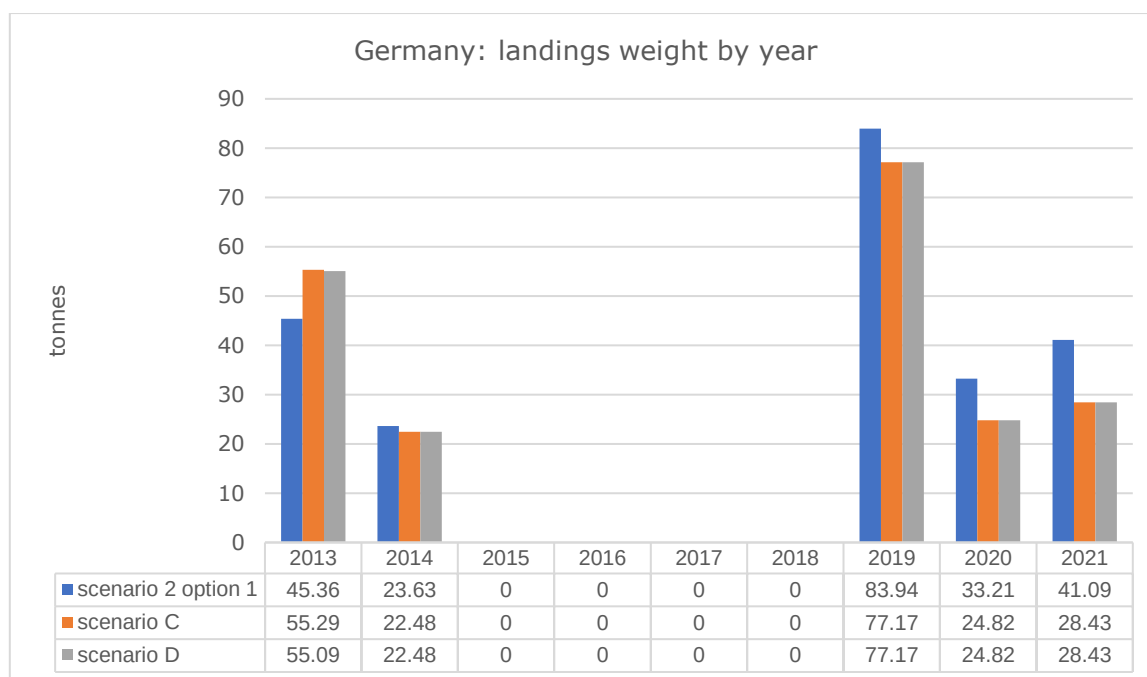


Figure 11. Germany: estimated landings weight (tonnes) by scenario and year

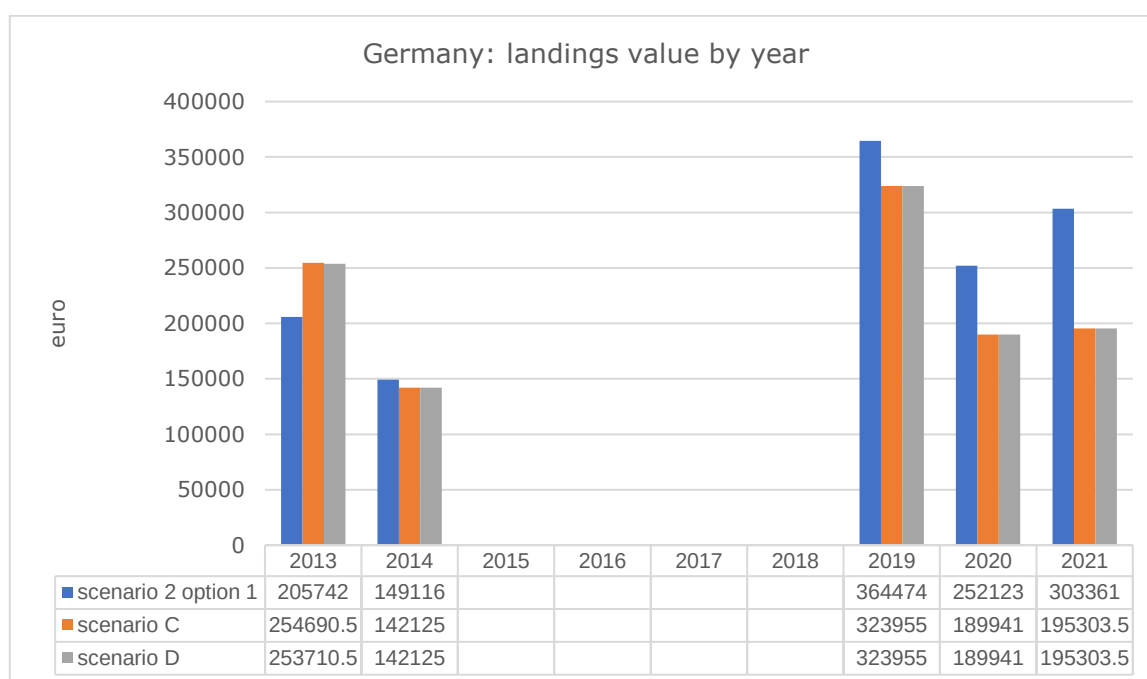


Figure 12. Germany: estimated landings value (euro) by scenario and year

Spain

In the information reported by Spain to the FDI data calls, there is a big discrepancy in the amount of data reported about deep fishing trips before and from 2018 onwards.¹ We noticed also that, in the deep fishing trips from 2018 onwards, Spain reported only

¹ In the opinion of a Spanish expert attending the STECF EWG on FDI, this discrepancy in the data could be caused by a change occurred in 2018 in the method used to determine deep fishing trips.

data for 3 gear types (that is GNS, LLS and OTB), while before 2018 data for more gear types were reported.

Table 11. Spain: gear types present in the results by year for *Scenario 2 option 1*

gear code	2013	2014	2015	2016	2017	2018	2019	2020	2021
DRB	✓	✓	✓	✓	✓				
FPO	✓	✓	✓	✓	✓				
GNS	✓	✓	✓	✓	✓	✓	✓	✓	✓
LLD	✓	✓							
LLS	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTB	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTT	✓	✓							
PTB	✓	✓	✓	✓	✓				

Table 12. Spain: gear types present in the results by year for *Scenario C*

gear code	2013	2014	2015	2016	2017	2018	2019	2020	2021
DRB	✓	✓	✓	✓	✓				
FPO	✓	✓	✓	✓	✓				
GNS	✓	✓	✓	✓	✓	✓	✓	✓	✓
LLD	✓	✓			✓				
LLS	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTB	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTT	✓	✓							
PTB	✓	✓	✓	✓	✓				

Table 13. Spain: gear types present in the results by year for *Scenario D*

gear code	2013	2014	2015	2016	2017	2018	2019	2020	2021
FPO	✓	✓	✓	✓	✓				
GNS	✓	✓	✓	✓	✓	✓	✓	✓	✓
LLD	✓				✓				
LLS	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTB	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTT	✓	✓							
PTB	✓	✓	✓	✓	✓				

As a consequence of this discrepancy in the Spanish data, the number of VME areas where the fishing activity has been estimated by the analysis is lower from 2018 onwards.

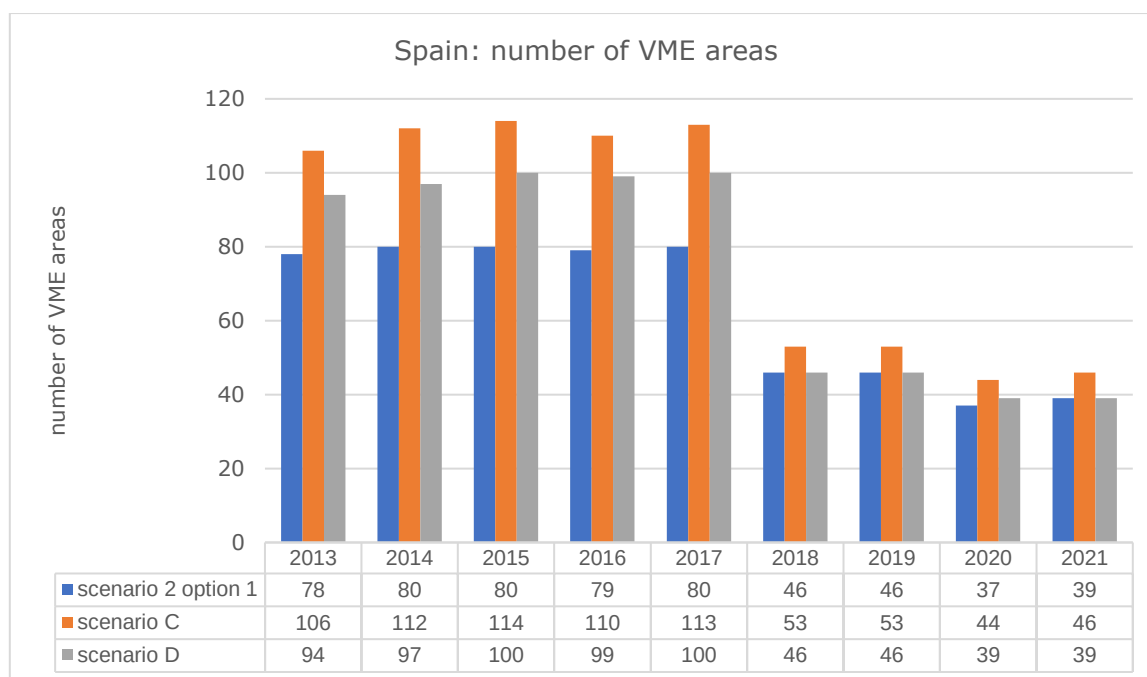


Figure 13. Spain: number of VME areas where fishing activity has been estimated by scenario and year

Among the three scenarios, the lowest fishing activity in the VME areas has been estimated for *Scenario 2 option 1*. Comparing *Scenario C* and *Scenario D*, for the years before 2018 the estimated fishing activity is lower in the second scenario; while for years from 2018 the analysis generates a similar result for both scenarios C and D.

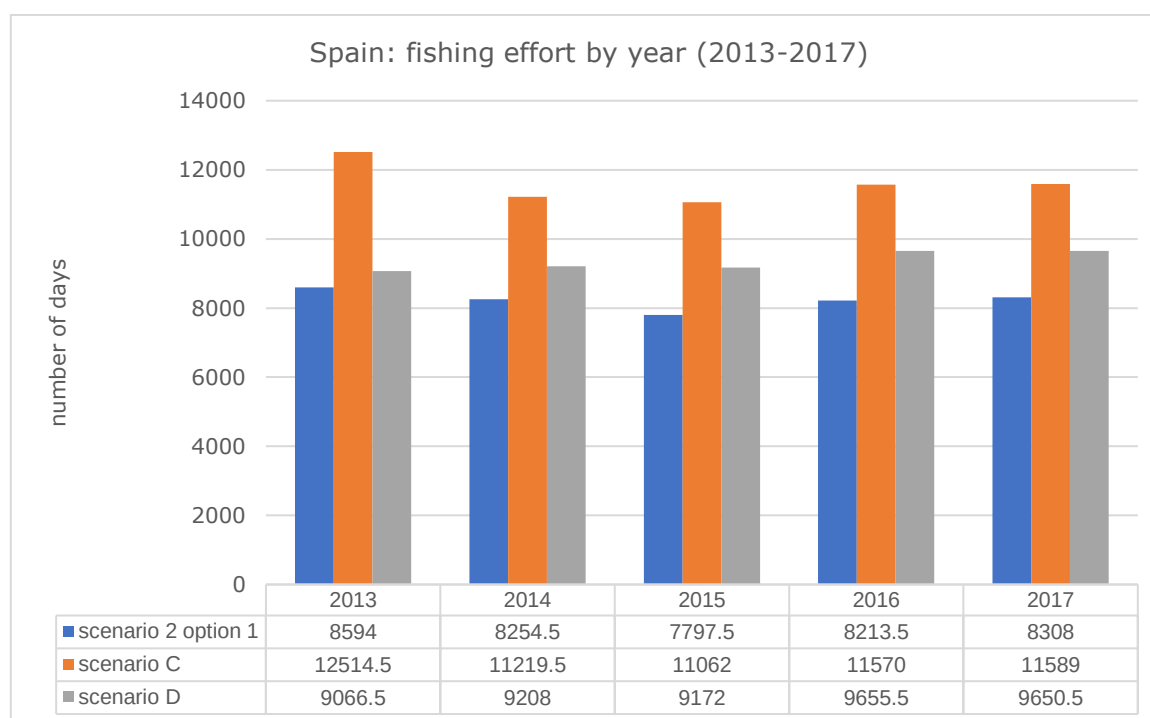


Figure 14. Spain: estimated fishing effort (number of fishing days) by scenario and year (2013-2017)

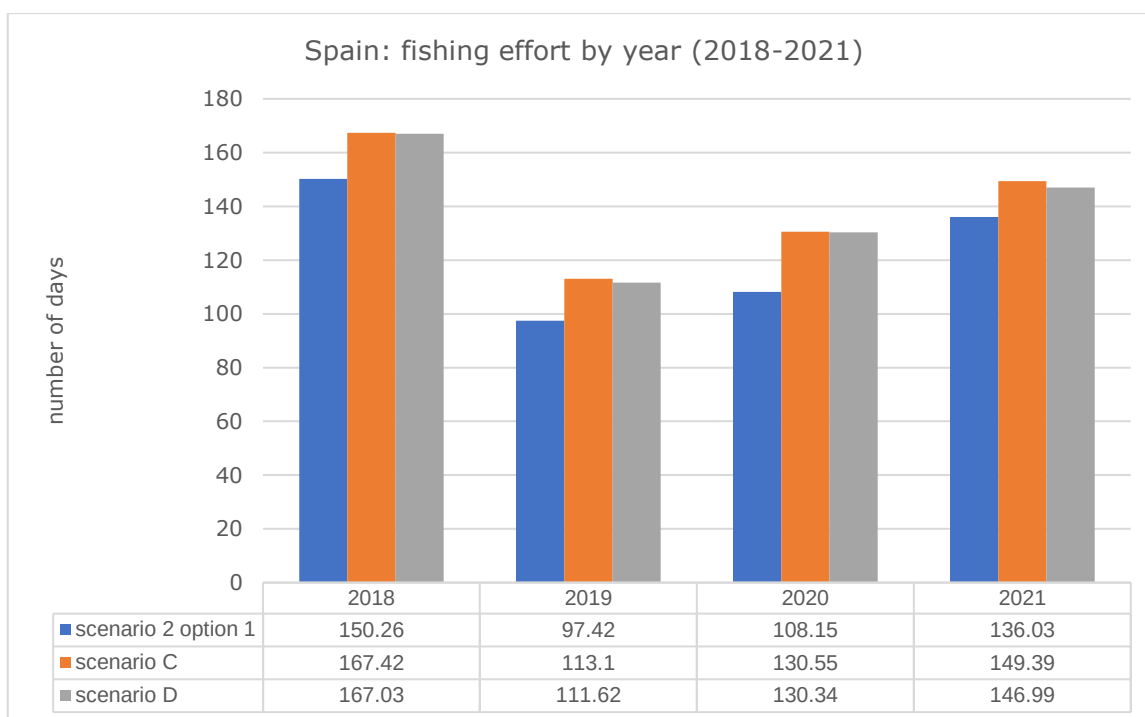


Figure 15. Spain: estimated fishing effort (number of fishing days) by scenario and year (2018-2021)

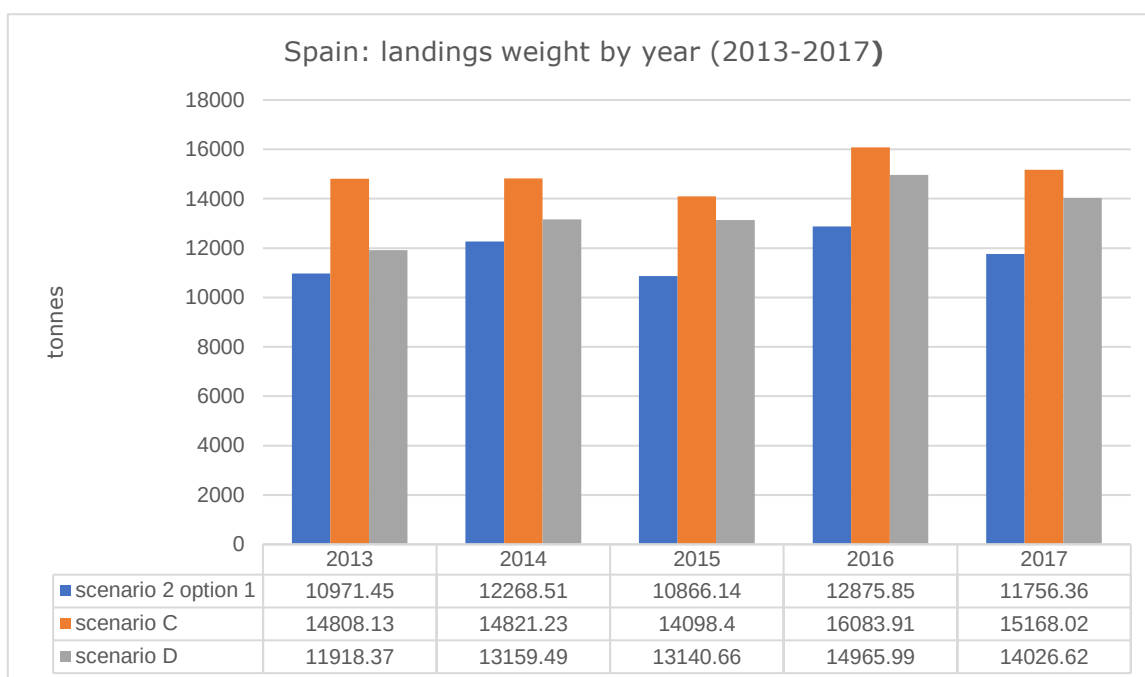


Figure 16. Spain: estimated landings weight (tonnes) by scenario and year (2013-2017)

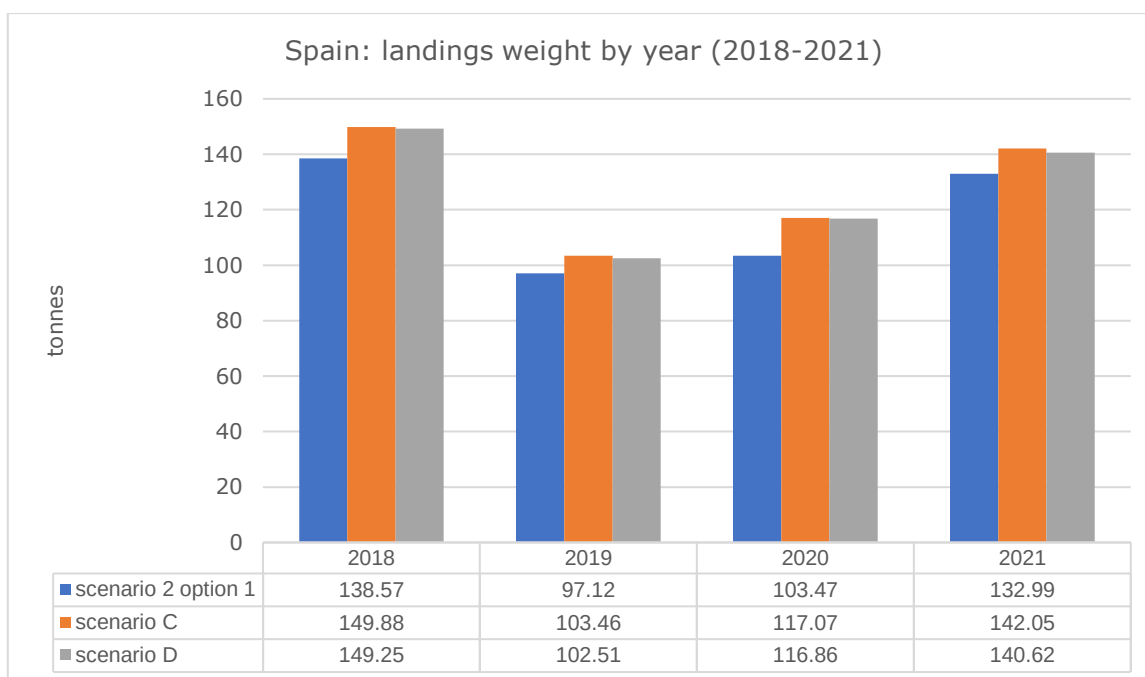


Figure 17. Spain: estimated landings weight (tonnes) by scenario and year (2018-2021)

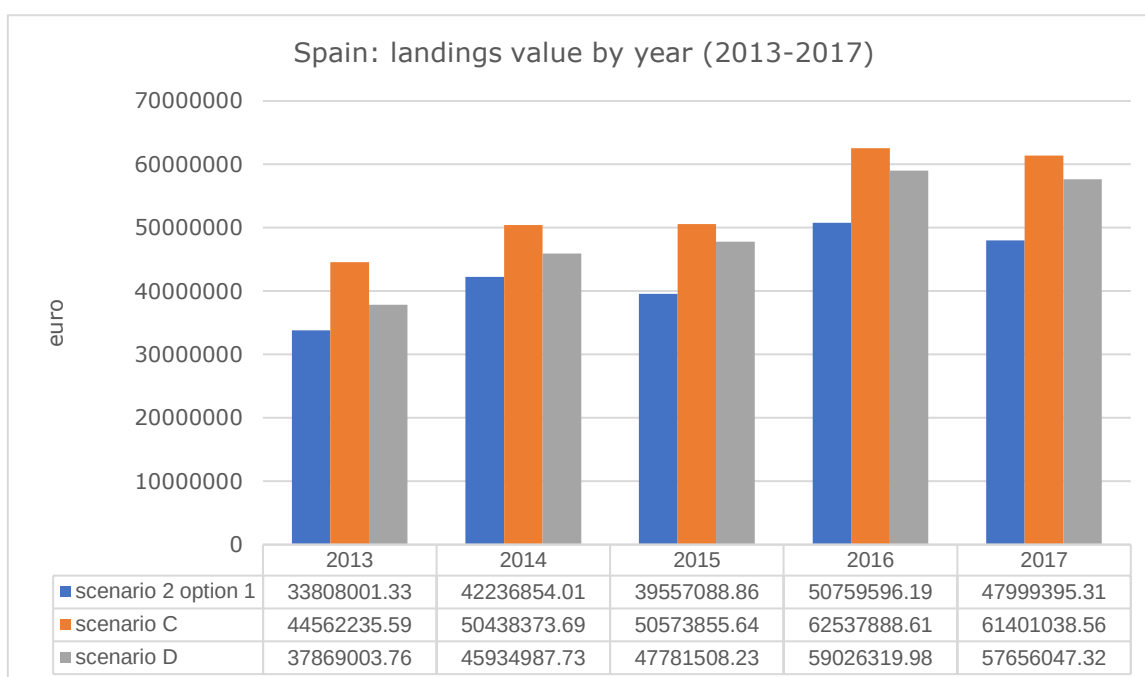


Figure 18. Spain: estimated landings value (euro) by scenario and year (2013-2017)

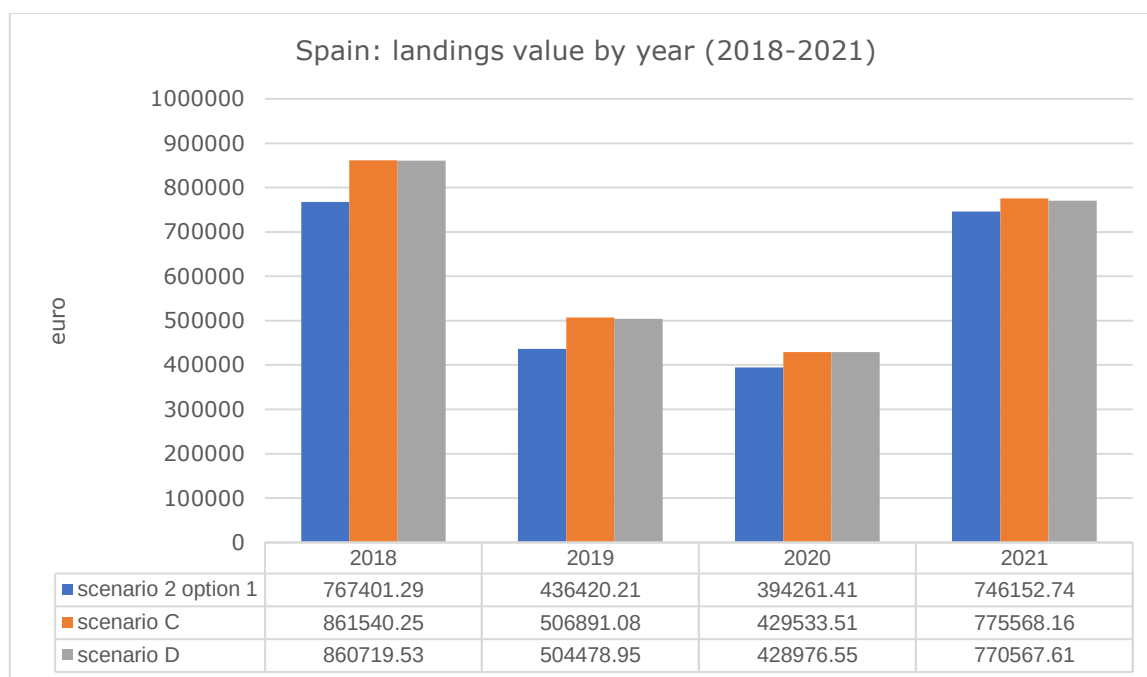


Figure 19. Spain: estimated landings value (euro) by scenario and year (2018-2021)

France

For France, among the three scenarios, the highest fishing activity in the VME areas has been estimated for *Scenario C*. Comparing the other two scenarios, estimated values for *Scenario D* in some years are higher than the estimated values for *Scenario 2 option 1*, but are lower in other years.

Table 14. France: gear types present in the results by year for all the scenarios

gear code	2013	2014	2015	2016	2017	2018	2019	2020	2021
FPO	✓								
GNS	✓	✓	✓	✓	✓	✓	✓	✓	✓
LLD	✓	✓	✓						
LLS	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTB	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTT	✓	✓	✓	✓	✓	✓	✓	✓	✓
SDN	✓	✓	✓	✓		✓			✓

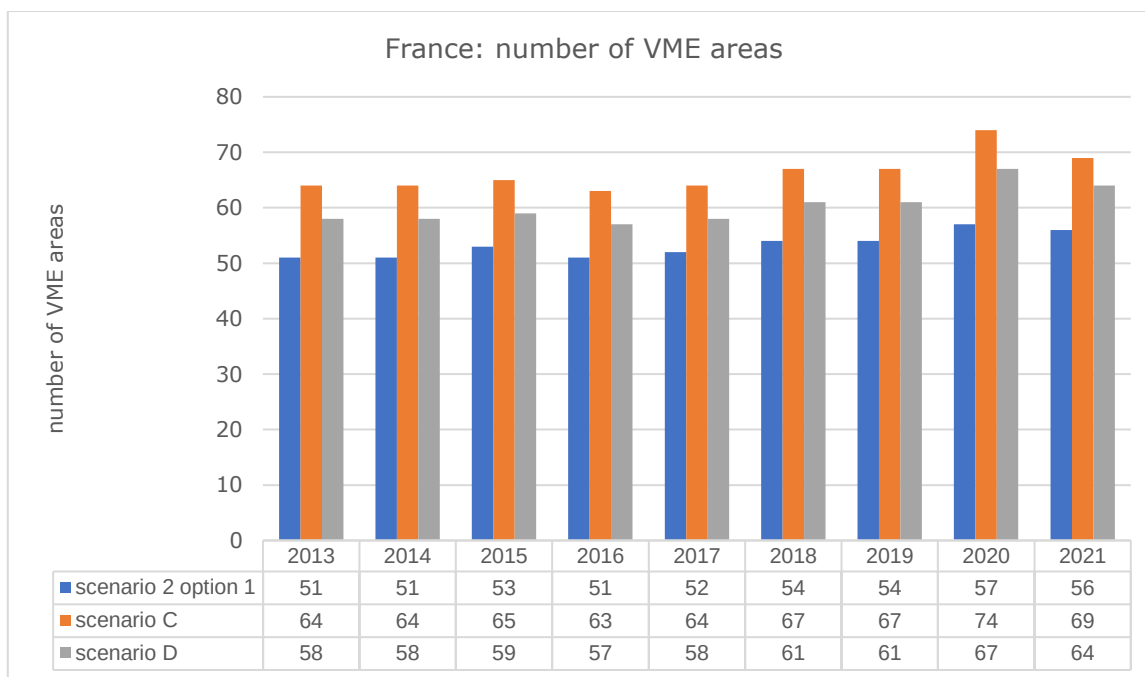


Figure 20. France: number of VME areas where fishing activity has been estimated by scenario and year

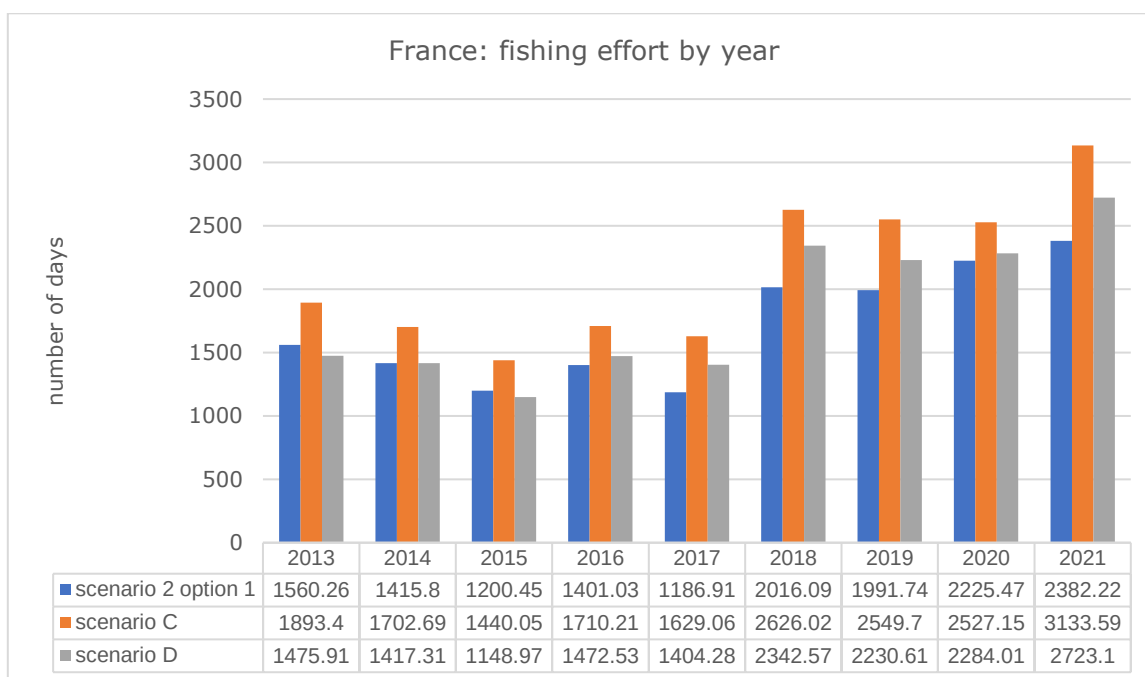


Figure 21. France: estimated fishing effort (number of fishing days) by scenario and year

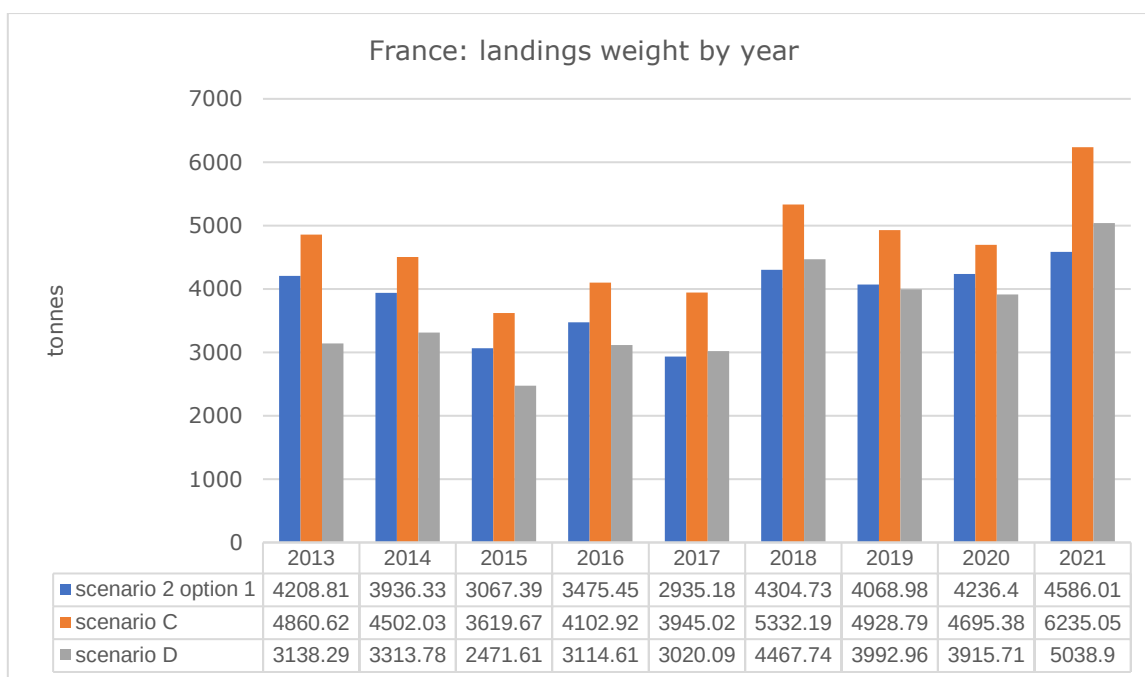


Figure 22. France: estimated landings weight (tonnes) by scenario and year

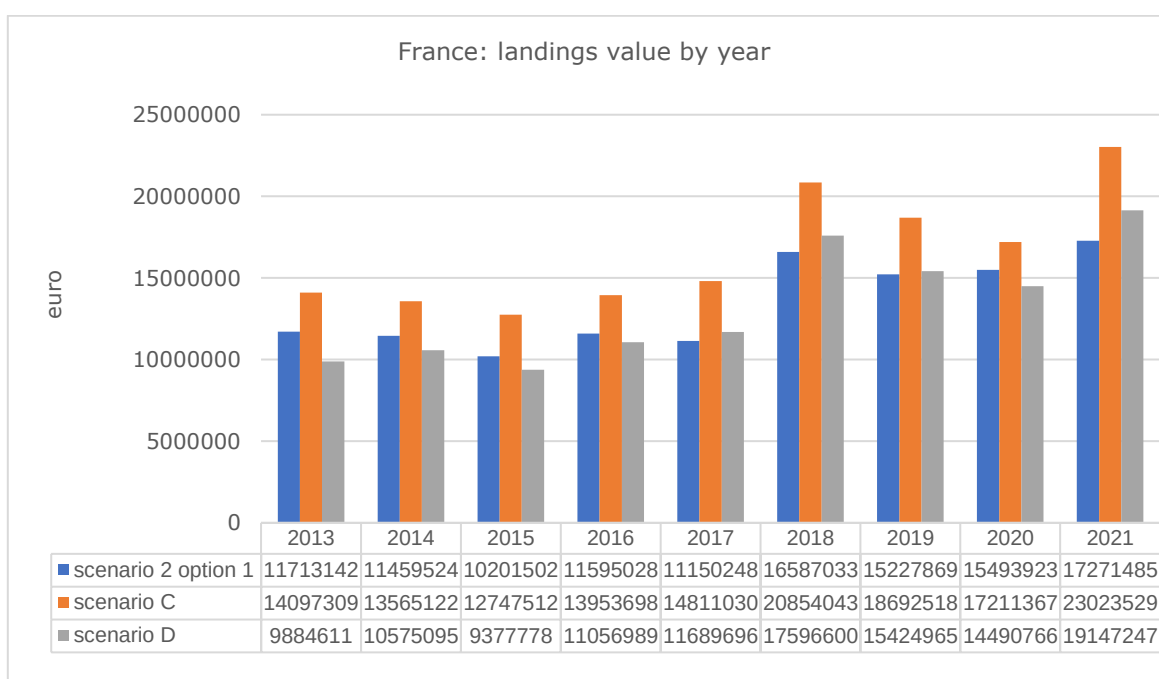


Figure 23. France: estimated landings value (euro) by scenario and year

Ireland

For Ireland, both the scenarios from the new ICES advice show a decrease in the estimated fishing activity in the VME areas compared to *Scenario 2 option 1*. In addition, between *Scenario C* and *Scenario D*, the estimated fishing activity in the VME areas is lower in the second.

Table 15. Ireland: gear types present in the results by year for all the scenarios

gear code	2013	2014	2015	2016	2017	2018	2019	2020	2021
OTB	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTT	✓	✓	✓	✓		✓	✓	✓	✓

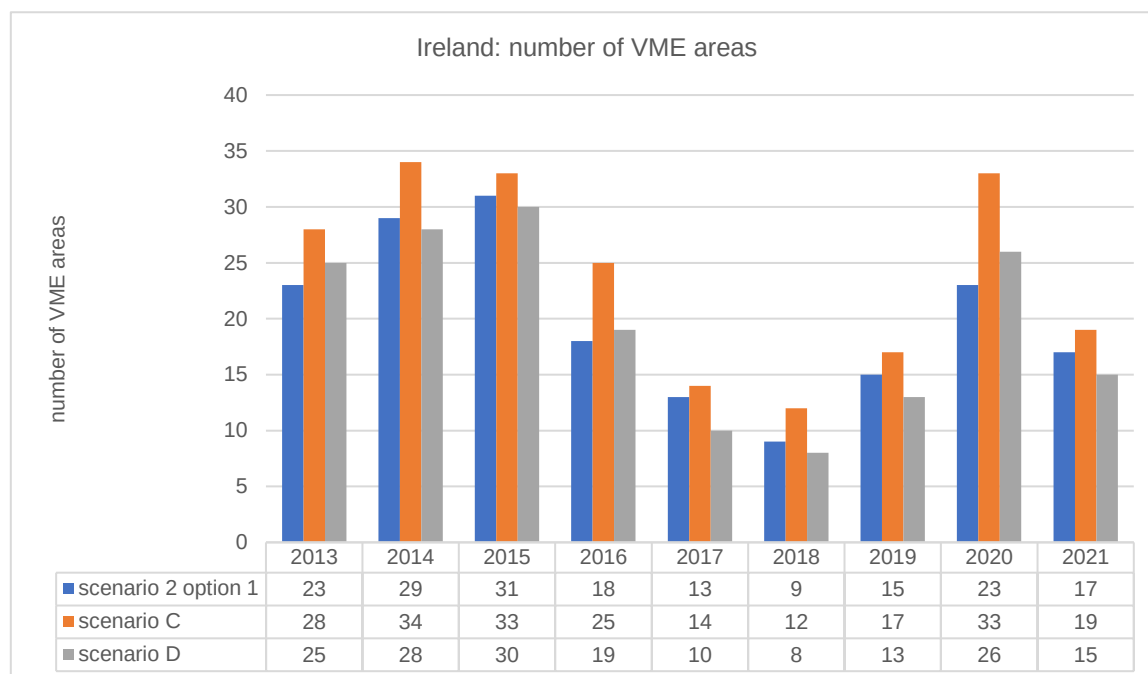


Figure 24. Ireland: number of VME areas where fishing activity has been estimated by scenario and year

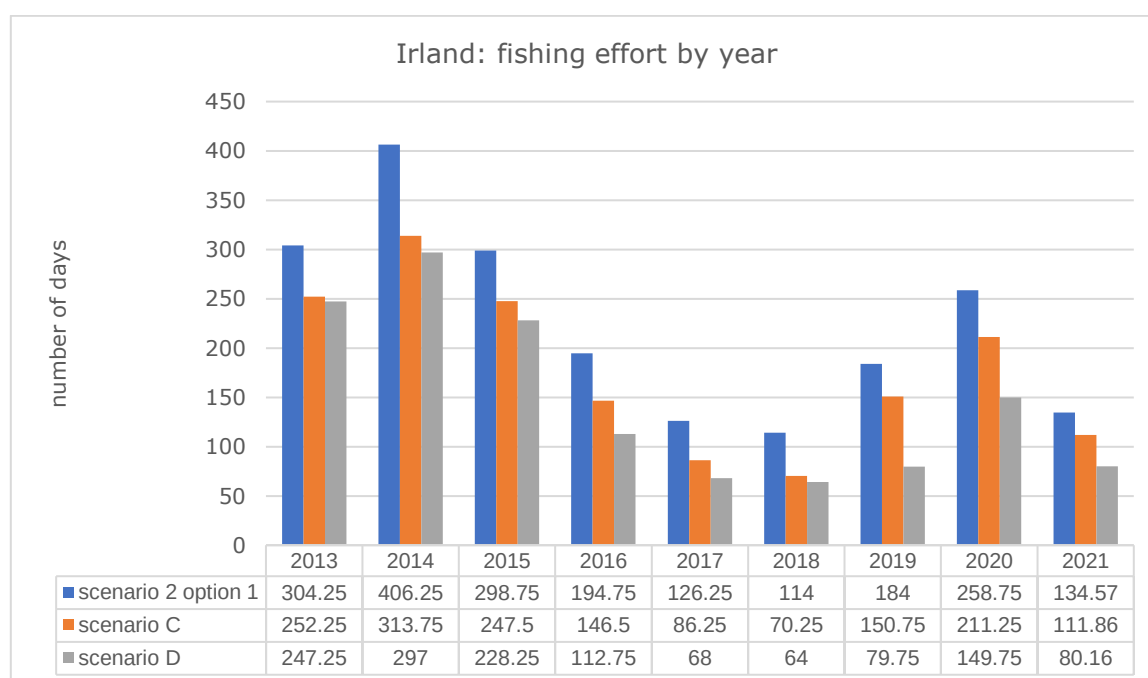


Figure 25. Ireland: estimated fishing effort (number of fishing days) by scenario and year

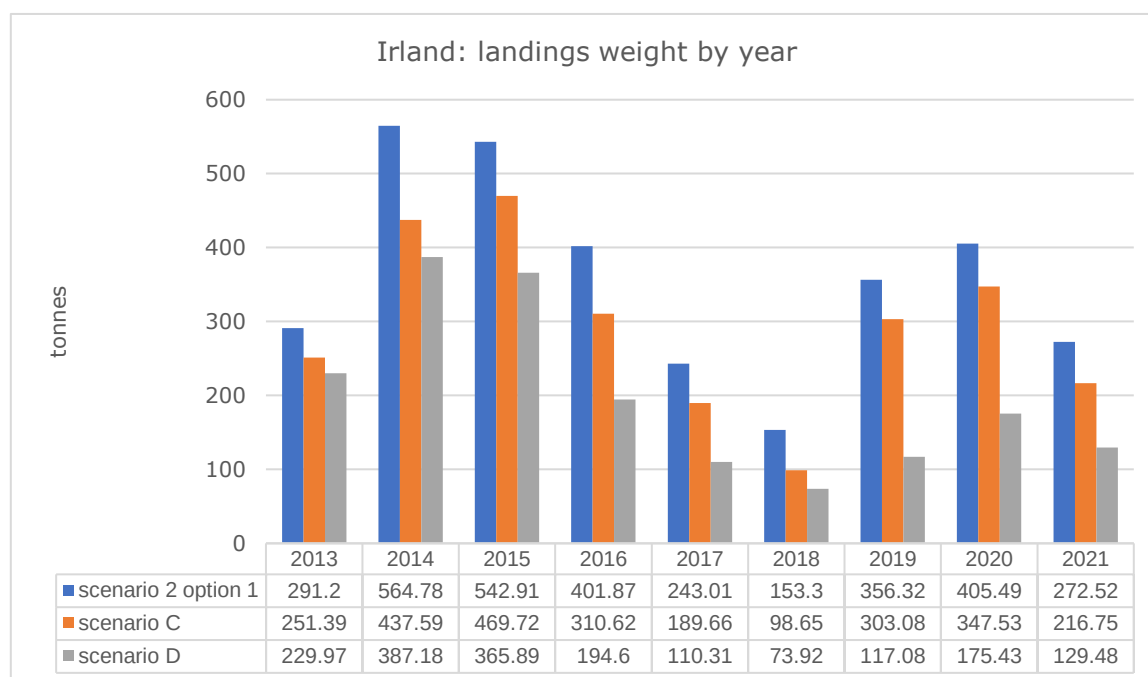


Figure 26. Ireland: estimated landings weight (tonnes) by scenario and year

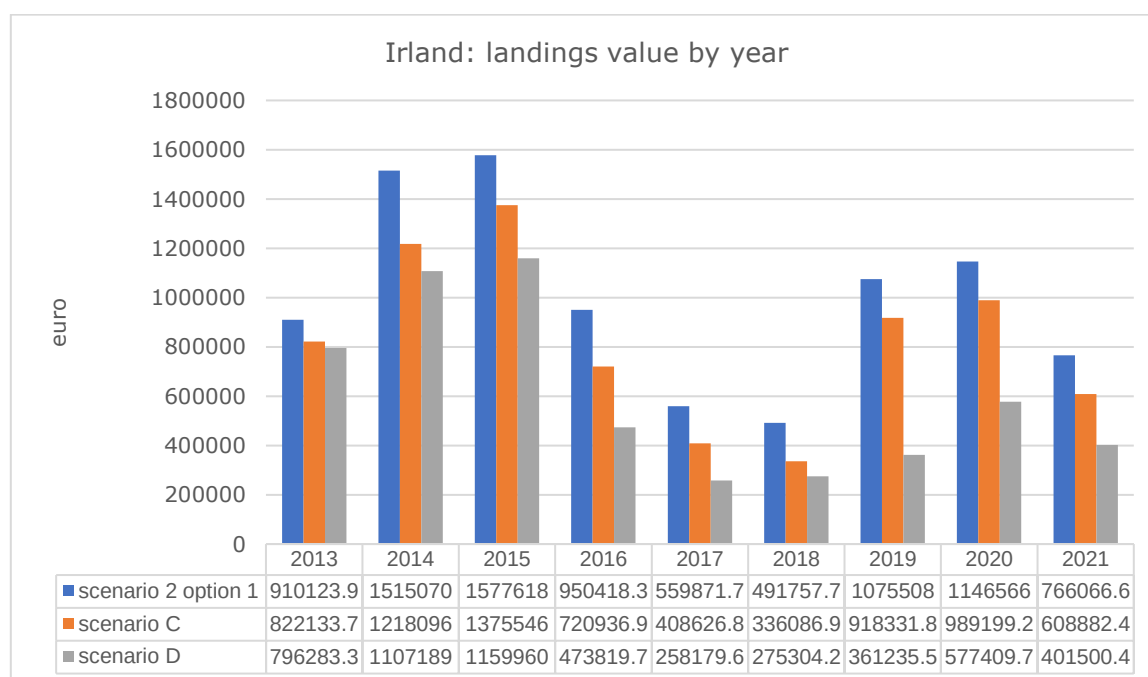


Figure 27. Ireland: estimated landings value (euro) by scenario and year

Portugal

For Portugal too, between the 2 considered scenarios from the new ICES advice, the estimated fishing activity in the VME areas is lower in *Scenario D*. Compared with *Scenario 2 option 1*, the estimated values for this scenario are higher for some years but lower for others.

Table 16. Portugal: gear types present in the results by year for all the scenarios

gear code	2013	2014	2015	2016	2017	2018	2019	2020	2021
FPO					✓	✓	✓		
GNS			✓	✓	✓	✓	✓	✓	✓
LLD		✓				✓	✓		✓
LLS	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTB	✓	✓	✓	✓	✓	✓	✓	✓	✓

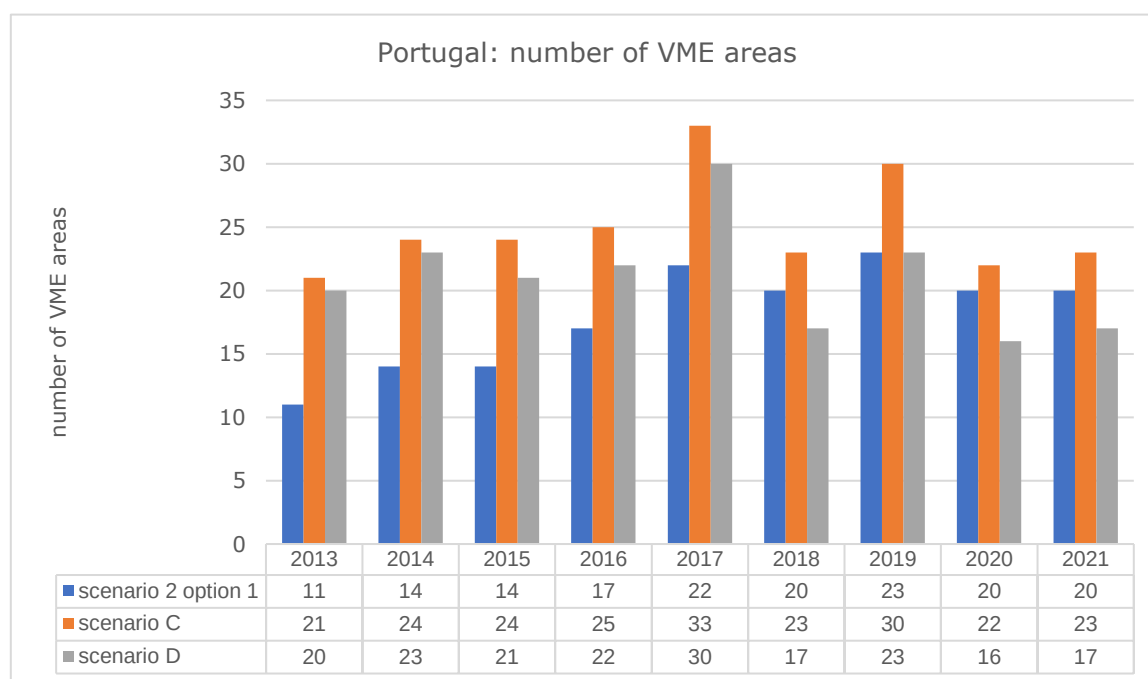


Figure 28. Portugal: number of VME areas where fishing activity has been estimated by scenario and year

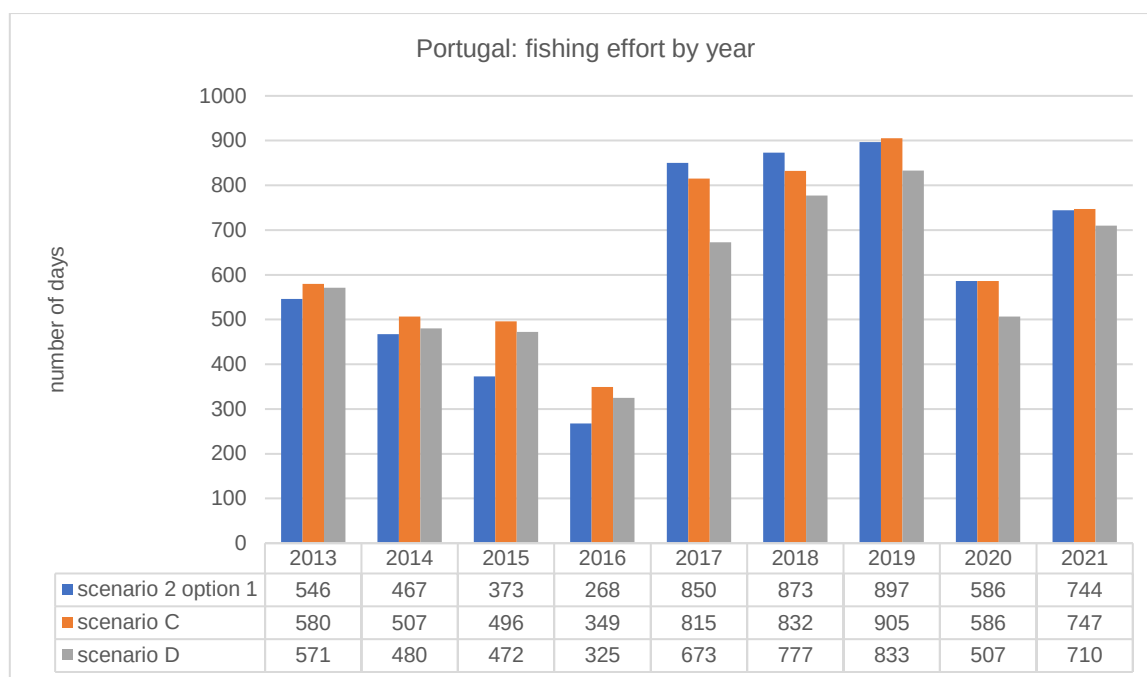


Figure 29. Portugal: estimated fishing effort (number of fishing days) by scenario and year

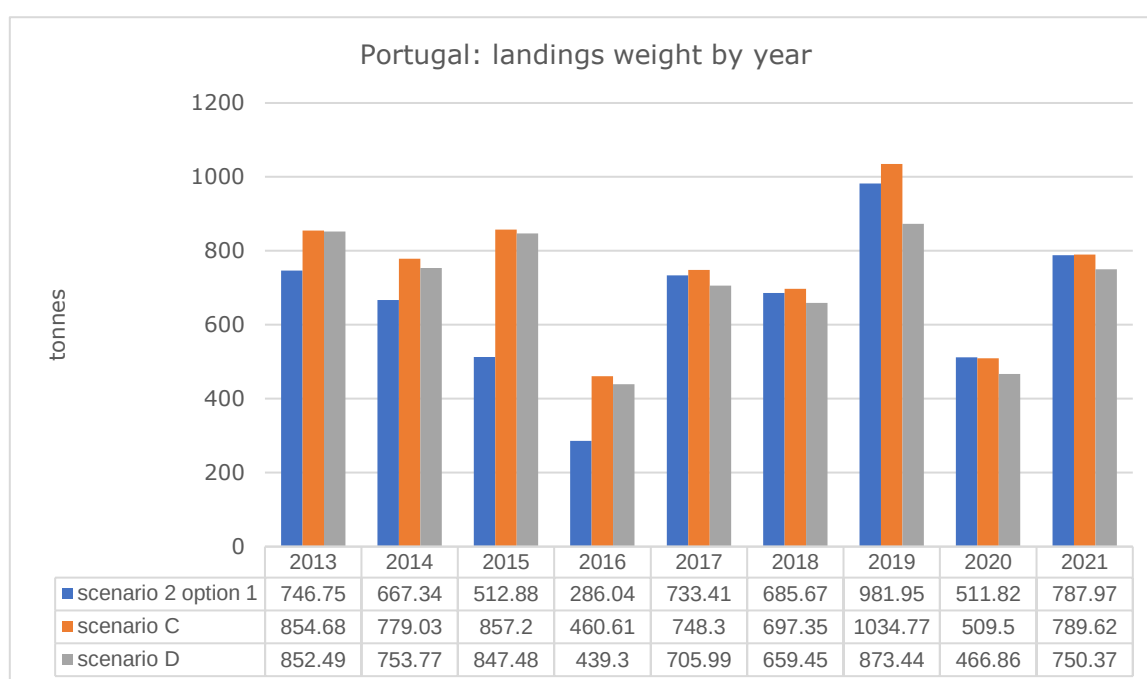


Figure 30. Portugal: estimated landings weight (tonnes) by scenario and year

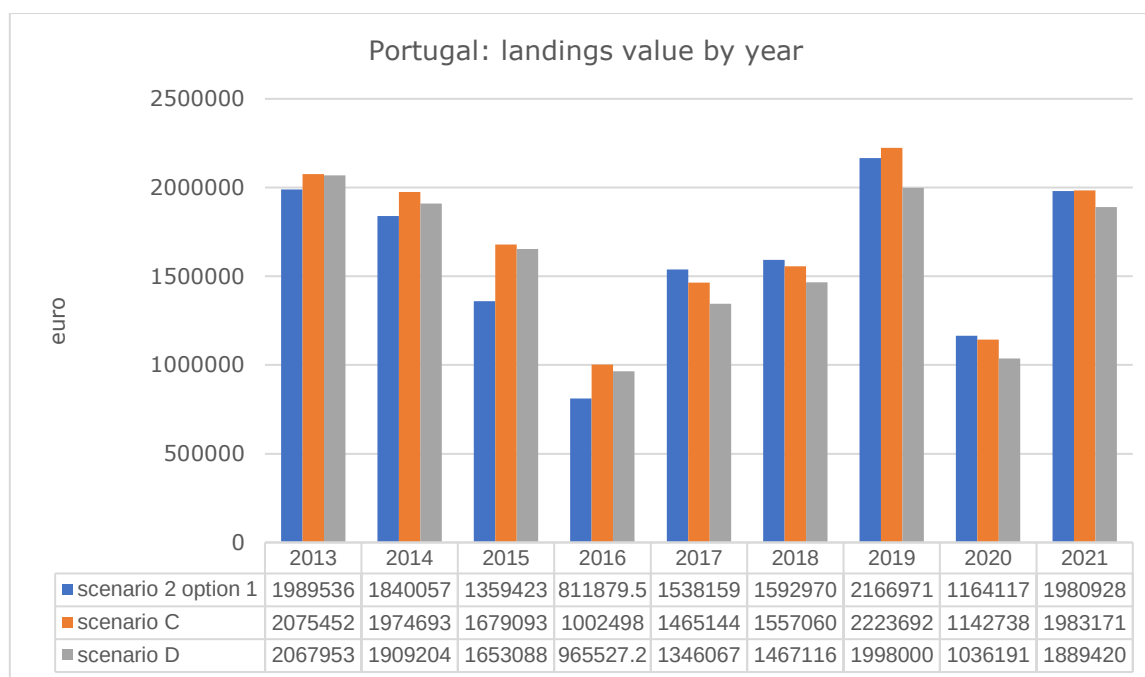


Figure 31. Portugal: estimated landings value (euro) by scenario and year

It is to be noted that in the report STECF-21-12 [10] in the national chapter for Portugal it was mentioned that “for the year 2020, not all trips were classified for the DEEP indicator, whereby this indicator should be used with reservations by the end user”.

Limitations and caveats

There are some limitations and caveats, listed below, that should be taken into account when considering the results of this work.

Scale

The scale of the FDI is too coarse to provide reliable estimations of fishing effort and landings. Fisheries data at high resolution are not available because they are considered sensitive by Member States. The Fisheries Dependent Information is the data call among the EU DCF with the highest spatial resolution: c-squares of 0.5 x 0.5 degrees, which corresponds to squares of varying dimensions and surfaces (approx 55 km sq). Projected data provide better estimations when using the proportional apportionment method. At this scale it is very problematic to apply the proportional apportionment method because the assumptions on which the method is relying upon might not hold. The most important of such assumptions is considering the fishing effort or the landings measure constant throughout the entire surface of the c-square, it is spatially extensive. Spatially extensive attributes are proportionally apportioned by allocating a variable of interest that is measured over a larger geographic area to a smaller spatial unit based on the relative size or proportion of the area covered by the smaller unit.

Ecological fallacy

Ecological fallacy is a formal fallacy in the interpretation of statistical data that occurs when inferences about the nature of individuals are deduced from inferences about the group to which those individuals belong. In the context of this analysis, assuming that fishing effort and landings are constant throughout a c-square of approximately 55 square kilometres might be unrealistic, considering the size of a fishing vessel and the gear used. The fisheries footprints produced by the ICES advice in 2022 are based on VMS plus logbook data and then aggregated at c-squares with 0.05 degree resolution. The fisheries

footprint resolution is one order of magnitude more precise than the FDI data. Overlapping the fisheries footprint with the FDI data can help but the issue is still present when using proportional apportionment method. In practical terms, we could estimate fishing effort and landings for VMEs without knowing if a Member State effectively fished there.

C-squares partially in and outside VME areas

For the purpose of the current analysis, we decided not to use proportional apportionment because the resolution of the FDI c-squares is too coarse (see Figure 2). We instead considered any c-square that partially or totally contained a VME area and then filtered the effort and landings by selecting only FDI data reported as deep fishing trips.

When a c-square contained more than one VME area, effort and landings reported as deep fishing trips for that c-square were apportioned among the VME areas falling within it.

Data source coverage and completeness

On the basis of the quality checks carried out and the opinion of the experts attending the STECF FDI EWG, the FDI dataset is considered to have a good coverage for the vessel length categories above-10m in the Northeast Atlantic (FAO fishing area 27). On the contrary, for the limitations existing in the collection of spatial data for small-scale fisheries, the coverage for the vessel category below-10m in the FDI dataset is low.

Definition of deep fishing trips in the FDI dataset

In the regulation (EU) 2016/2336 [1] the number of deep-sea species listed in Annex 1 increased compared to the list of species present in the same Annex in the regulation (EC) 2347/2002 [7]. These lists of species were used to define if a fishing trip has to be considered as a deep fishing trip in the FDI data call. The new list was used in the FDI data call for data from 2017 onwards.

References

- [1] Regulation (EU) 2016/2336 of the European Parliament and of the Council of 14 December 2016 establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic and provisions for fishing in international waters of the north-east Atlantic and repealing Council Regulation (EC) No 2347/2002.
- [2] Commission implementing regulation (EU) 2022/1614 of 15 September 2022 determining the existing deep-sea fishing areas and establishing a list of areas where vulnerable marine ecosystems are known to occur or are likely to occur.
- [3] ICES 2021. EU Request to advise on the list of areas where VMEs are known to occur or are likely to occur and on the existing deep-sea fishing areas (ref. (EU)2016/2336.). In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, sr.2021.01. <https://doi.org/10.17895/ices.advice.7507>
- [4] ICES 2022. EU request for a Technical Service to provide data output of the ICES 2021 advice on the deep-sea access regulation (ref. (EU)2016/2336) as coordinates for EU waters area only. In Report of the ICES Advisory Committee, 2022. ICES Advice 2022. sr. 2022.02. <https://doi.org/10.17895/ices.advice.10039>
- [5] ICES 2023. Advice on areas where Vulnerable Marine Ecosystems (VMEs) are known to occur or are likely to occur in EU waters. In Report of the ICES Advisory Committee, 2023. ICES Advice 2023, vme.eu <https://doi.org/10.17895/ices.advice.22643356>
- [6] Regulation (EU) 2017/1004 of the European Parliament and of the Council of 17 May 2017 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy and repealing Council Regulation (EC) No 199/2008.
- [7] Regulation (EU) 2347/2002 of the European Parliament and of the Council of 16 December 2002 establishing specific access requirements and associated conditions applicable to fishing for deep-sea stocks.

- [8] Gibin, Maurizio; Kovšars, Maksims; Adamowicz, Maciej; Zanzi, Antonella; Hekim, Zeynep (2022): Fisheries landings & effort: data by c-square. European Commission, Joint Research Centre (JRC) [Dataset] PID: <http://data.europa.eu/89h/00ae6659-ddde-4314-a9da-717bb2e82582>
- [9] Scientific, Technical and Economic Committee for Fisheries (STECF) – Fisheries Dependent Information – FDI (STECF-20-10). EUR 28359 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-27166-6, doi:10.2760/61855, JRC122995.
- [10] Scientific, Technical and Economic Committee for Fisheries (STECF) – Fisheries Dependent Information – FDI (STECF-21-12). EUR 28359 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-45887-6, doi:10.2760/3742, JRC127727.
- [11] Scientific, Technical and Economic Committee for Fisheries (STECF) – Fisheries Dependent Information – FDI (STECF-22-10). EUR 28359 EN, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-76-60494-5, doi:10.2760/154294, JRC132080.
- [12] Tony Rees (2003). C-Squares, a New Spatial Indexing System and its Applicability to the Description of Oceanographic Datasets. *Oceanography* 16(1):11-19.
- [13] GEBCO Compilation Group (2023) GEBCO 2023 Grid, doi:10.5285/f98b053b-0cbc-6c23-e053-6c86abc0af7b

Appendix 1

In the FDI data call, the definition used to determine a deep fishing trip is based on the species listed in the regulations 2016/2336 [1] and 2347/2002 [7]. However, the catches during deep trips are not limited to those species and the whole catch of a fishing trip marked as deep contains also other species not listed in the mentioned EU regulations. As an example, the following table shows the list of species that in the FDI dataset are related to deep fishing trips in FAO area 27 for the year 2021.

Table 17. FDI dataset: species present in deep fishing trips (year 2021, FAO area 27)

AKL	ALB	ALF	ALH	ANF	ANG	ANK	ARA	ARG	ARU
ARY	ASD	ATB	ATP	BAS	BIB	BLB	BLI	BLL	BLT
BOG	BON	BOP	BRB	BRF	BSF	BSH	BSS	BUX	BXD
BYS	CAA	CAB	CAS	CAT	CBS	CEP	CET	CFB	CLX
CMO	COD	COE	CRE	CRG	CRW	CTB	CTC	DAB	DEC
DGS	DGX	DPS	DPY	ELP	ENX	EOI	EPI	FLE	FLX
FOR	FOX	FPI	GAD	GAG	GBR	GDG	GFB	GHL	GPD
GUG	GUN	GUR	GUU	GUX	HAD	HAL	HAU	HDK	HER
HKE	HKW	HMM	HMY	HOM	HPR	HYD	IAR	ILL	ITO
JAA	JAI	JAX	JOD	JOS	KCT	KEF	LBE	LDB	LDV
LEF	LEM	LEP	LEZ	LHT	LIN	LUM	LXX	MAC	MAS
MEG	MGC	MGR	MKG	MMH	MNZ	MON	MSF	MUE	MUI
MUR	MUT	MUX	MYG	MZZ	NEP	NOP	OCC	OCM	OCT
OFJ	OIL	OTH	OUL	OUM	OXY	PAC	PLA	PLE	POA
POD	POI	POK	POL	PRA	PSL	PSS	RAJ	REB	RED
REG	RHG	RIB	RJC	RJE	RJF	RJG	RJH	RJI	RJK
RJM	RJN	RJO	RJR	RNG	ROL	RPG	RSE	SAN	SAO
SBA	SBG	SBR	SBS	SCL	SCR	SCS	SDV	SFS	SGZ
SHD	SHO	SIP	SKA	SKJ	SLI	SLO	SMA	SMD	SOL
SOO	SOS	SPR	SPU	SQC	SQE	SQI	SQM	SQR	SQU

SQZ	SRA	SRG	SRQ	SRX	SSH	SWA	SWO	SYC	SYT
THS	TJX	TOD	TOE	TRG	TRI	TSD	TTO	TUR	UCA
USB	USK	VLO	WEG	WHB	WHE	WHG	WIT	WRA	WRF
YTC									

Appendix 2

After the delivery of the result of the analysis carried out with the FDI dataset, we received the request from DG MARE to analyse Spanish data from a VMS/logbook dataset provided by ICES.

The ICES VMS/logbook dataset we were allowed to use contains fishing effort and landings (weight and value) aggregated at 0.05 c-square cells segmented by the following gear types: DRB, OTB, OTT, PTB, SDN, SSC and TBB, by metier DCF level 6 and by vessel length. The dataset contains data for the following countries: Belgium, Ireland, France, Netherlands, Portugal and Spain, and the temporal coverage is the period 2018-2021.

For Spanish data, the only gear types reported are DRB, OTB and PTB with the following vessel length categories: VL1518, VL1824, VL2440, VL40XX. In addition, for Spanish data only the landings weight is present, while the landings value was not reported.

Comparison of VMS/logbook and FDI datasets

In the first part of the analysis we aggregated the VMS/logbook dataset at different levels and merged it with the FDI dataset in an effort to compare fishing activity data in the 2 datasets and to assess whether VMS/logbook and FDI have similar distributions and totals.

In the VMS/logbook dataset, the unit of measures used are *hours* for the fishing effort and *kilogrammes* for the weight of landings, while in the FDI dataset the unit of measures used are respectively *number of days* and *tonnes*. To compare the 2 datasets, the value from the VMS/logbook dataset for the fishing effort were converted into number of days (dividing by 24 hours) and the weight of landings into tonnes.

The comparison of the 2 dataset was limited by the gear types and the vessel length categories present in the VMS/logbook dataset and by the time period covered. Doing this exercise we noticed that the amount of data available for Spain in the FDI dataset is higher compared to the data present in the VMS/logbook dataset.

Table 18. Comparison of Spanish data from the 2 datasets by year, vessel length and gear type

country	year	vessel length	gear type	fishing days VMS	fishing days FDI	landings weight (tonnes) VMS	landings weight (tonnes) FDI
ESP	2018	VL1824	OTB	3299.12	6630.45	3935.93	3122.76
ESP	2018	VL1824	PTB	92.66	162.50	358.28	450.91
ESP	2018	VL2440	OTB	8199.68	12919.49	12224.74	33843.92
ESP	2018	VL2440	PTB	2666.47	5102.51	17222.79	24643.62
ESP	2018	VL40XX	OTB	449.52	1231.39	176.95	16691.77
ESP	2019	VL1824	OTB	3057.35	6720.47	3636.41	3894.50
ESP	2019	VL1824	PTB	59.12	172.47	399.17	551.27
ESP	2019	VL2440	OTB	8184.22	12037.83	11743.73	30494.72
ESP	2019	VL2440	PTB	2190.34	4723.29	17086.45	23315.71
ESP	2019	VL40XX	OTB	409.29	1165.89	356.68	17536.23

ESP	2020	VL1824	OTB	3415.30	6220.80	4886.59	3820.04
ESP	2020	VL1824	PTB	66.44	181.47	684.18	859.06
ESP	2020	VL2440	OTB	8307.35	11435.75	16191.04	34698.64
ESP	2020	VL2440	PTB	2358.04	4176.00	17750.13	24047.12
ESP	2020	VL40XX	OTB	373.54	1046.23	444.92	14183.48
ESP	2021	VL1824	OTB	3543.62	6361.46	4530.15	4768.36
ESP	2021	VL1824	PTB	73.22	184.98	483.79	681.26
ESP	2021	VL2440	OTB	8047.49	11533.51	15353.03	35597.93
ESP	2021	VL2440	PTB	2227.78	4323.94	19723.86	26078.38
ESP	2021	VL40XX	OTB	334.54	975.49	282.99	13564.81

Table 19. Comparison of Spanish data from the 2 datasets by year, vessel length, gear type and metier

country	year	vessel length	gear type	metier	fishing days VMS	fishing days FDI	landings weight (tonnes) VMS	landings weight (tonnes) FDI
ESP	2018	VL1824	OTB	OTB_DEF_>=55_0_0	221.10	64.44	325.93	55.53
ESP	2018	VL1824	OTB	OTB_MCD_>=55_0_0	2980.04	6411.89	3156.41	2538.13
ESP	2018	VL1824	OTB	OTB_MPD_>=55_0_0	90.70	130.12	445.82	522.07
ESP	2018	VL2440	OTB	OTB_DEF_100-119_0_0	469.61	884.75	215.22	2976.20
ESP	2018	VL2440	OTB	OTB_DEF_70-99_0_0	2265.54	3149.64	833.77	8708.78
ESP	2018	VL2440	OTB	OTB_DEF_>=55_0_0	2956.92	4610.68	3399.82	5683.78
ESP	2018	VL2440	OTB	OTB_DEF_>=70_0_0	704.81	1753.60	188.01	3382.61
ESP	2018	VL2440	OTB	OTB_MCD_>=55_0_0	219.87	356.93	339.38	323.38
ESP	2018	VL2440	OTB	OTB_MCF_>=70_0_0	693.81	10.98	305.60	21.49
ESP	2018	VL2440	OTB	OTB_MPD_>=55_0_0	868.70	2104.52	6624.88	12641.27
ESP	2018	VL2440	OTB	OTB_SPF_>=70_0_0	19.65	7.00	313.94	25.17
ESP	2018	VL2440	PTB	PTB_DEF_>=70_0_0	366.28	495.54	1150.84	2538.27
ESP	2018	VL40XX	OTB	OTB_MCF_>=70_0_0	134.59	8.91	80.26	24.08
ESP	2019	VL1824	OTB	OTB_DEF_>=55_0_0	198.68	142.79	415.32	81.73
ESP	2019	VL1824	OTB	OTB_MCD_>=55_0_0	2829.04	6424.34	2899.77	3154.63
ESP	2019	VL1824	OTB	OTB_MPD_>=55_0_0	27.67	114.92	317.71	649.30
ESP	2019	VL2440	OTB	OTB_DEF_100-119_0_0	397.10	953.25	185.84	3274.06
ESP	2019	VL2440	OTB	OTB_DEF_70-99_0_0	2315.82	2980.18	778.59	7613.92
ESP	2019	VL2440	OTB	OTB_DEF_>=55_0_0	3322.51	4330.94	3810.54	5343.21
ESP	2019	VL2440	OTB	OTB_DEF_>=70_0_0	1098.84	1724.44	419.09	3648.24
ESP	2019	VL2440	OTB	OTB_MCD_>=55_0_0	248.20	368.08	299.53	338.26
ESP	2019	VL2440	OTB	OTB_MCF_>=70_0_0	192.61	44.92	172.94	127.34
ESP	2019	VL2440	OTB	OTB_MPD_>=55_0_0	594.82	1546.41	6017.95	9563.34
ESP	2019	VL2440	PTB	PTB_DEF_>=70_0_0	268.56	448.20	977.99	2271.88
ESP	2019	VL40XX	OTB	OTB_DEF_>=70_0_0	114.89	473.57	72.81	1356.78
ESP	2019	VL40XX	OTB	OTB_MCF_>=70_0_0	36.65	11.00	40.44	35.34
ESP	2020	VL1824	OTB	OTB_DEF_>=55_0_0	291.41	98.87	712.93	140.13
ESP	2020	VL1824	OTB	OTB_MCD_>=55_0_0	3016.99	5929.35	3450.00	2675.71
ESP	2020	VL1824	OTB	OTB_MPD_>=55_0_0	87.89	149.58	716.26	986.43
ESP	2020	VL2440	OTB	OTB_DEF_100-119_0_0	477.51	808.22	204.53	2658.04

ESP	2020	VL2440	OTB	OTB_DEF_70-99_0_0	2278.44	2985.72	764.92	8323.33
ESP	2020	VL2440	OTB	OTB_DEF_>=55_0_0	3132.75	4007.19	4878.64	6380.94
ESP	2020	VL2440	OTB	OTB_DEF_>=70_0_0	803.67	1877.94	265.68	3913.08
ESP	2020	VL2440	OTB	OTB_MCD_>=55_0_0	214.36	341.40	281.69	260.16
ESP	2020	VL2440	OTB	OTB_MPD_>=55_0_0	657.08	1358.21	8752.25	12232.91
ESP	2020	VL2440	PTB	PTB_DEF_>=70_0_0	322.24	417.62	673.09	1695.69
ESP	2020	VL40XX	OTB	OTB_DEF_>=70_0_0	7.42	488.73	1.91	1237.66
ESP	2021	VL1824	OTB	OTB_DEF_>=55_0_0	201.81	80.25	623.52	418.69
ESP	2021	VL1824	OTB	OTB_MCD_>=55_0_0	3214.40	6189.84	3418.15	3861.28
ESP	2021	VL1824	OTB	OTB_MPD_>=55_0_0	112.69	74.21	482.88	462.76
ESP	2021	VL2440	OTB	OTB_DEF_100-119_0_0	164.87	1204.26	104.75	3464.74
ESP	2021	VL2440	OTB	OTB_DEF_70-99_0_0	2570.69	2891.07	831.81	7915.98
ESP	2021	VL2440	OTB	OTB_DEF_>=55_0_0	3092.73	4143.58	6697.83	10086.83
ESP	2021	VL2440	OTB	OTB_DEF_>=70_0_0	1424.47	1804.72	622.05	3900.70
ESP	2021	VL2440	OTB	OTB_MCD_>=55_0_0	182.63	309.30	174.40	204.92
ESP	2021	VL2440	OTB	OTB_MPD_>=55_0_0	587.22	1144.54	6434.78	9793.60
ESP	2021	VL2440	PTB	PTB_DEF_>=70_0_0	300.62	380.84	492.52	1319.47
ESP	2021	VL40XX	OTB	OTB_DEF_>=70_0_0	181.53	485.21	117.51	1346.22

VMS/logbook dataset and VME areas analysis

Unlike the main analysis, with this dataset we used the proportional apportionment to analyse the VMS/logbook data against the VME areas for the 3 scenarios already used before: the VME polygons were overlayed on the c-squares at 0.05 resolution and then calculate the proportion of c-square within a specific VME polygon. Fishing activity data for the c-squares that falls completely within a VME polygon will be attributed a proportion of 1. Fishing activity data for c-square that partially cover the VME polygon will be multiplied by the proportion of the c-square area within the VME polygon.

The VMS/logbook dataset includes only a limited number of gears, therefore it was not possible to estimate the impact of the different scenarios for all mobile bottom contacting gears.

The following tables and figures show the results of the analysis by scenario. Also in the results the values estimated using VMS/logbook data for the fishing effort were converted into number of days (dividing by 24 hours) and the values estimated for the weight of landings into tonnes.

Table 20. *Scenario 2 option 1: estimated fishing effort and landings by year and gear type*

country	year	gear type	number of fishing days	landings weight (tonnes)
ESP	2018	OTB	258.68	298.60
ESP	2018	PTB	32.60	349.79
ESP	2019	OTB	236.93	330.35
ESP	2019	PTB	40.98	553.51
ESP	2020	OTB	241.73	297.22
ESP	2020	PTB	23.95	396.47
ESP	2021	OTB	266.15	337.66
ESP	2021	PTB	23.14	332.59

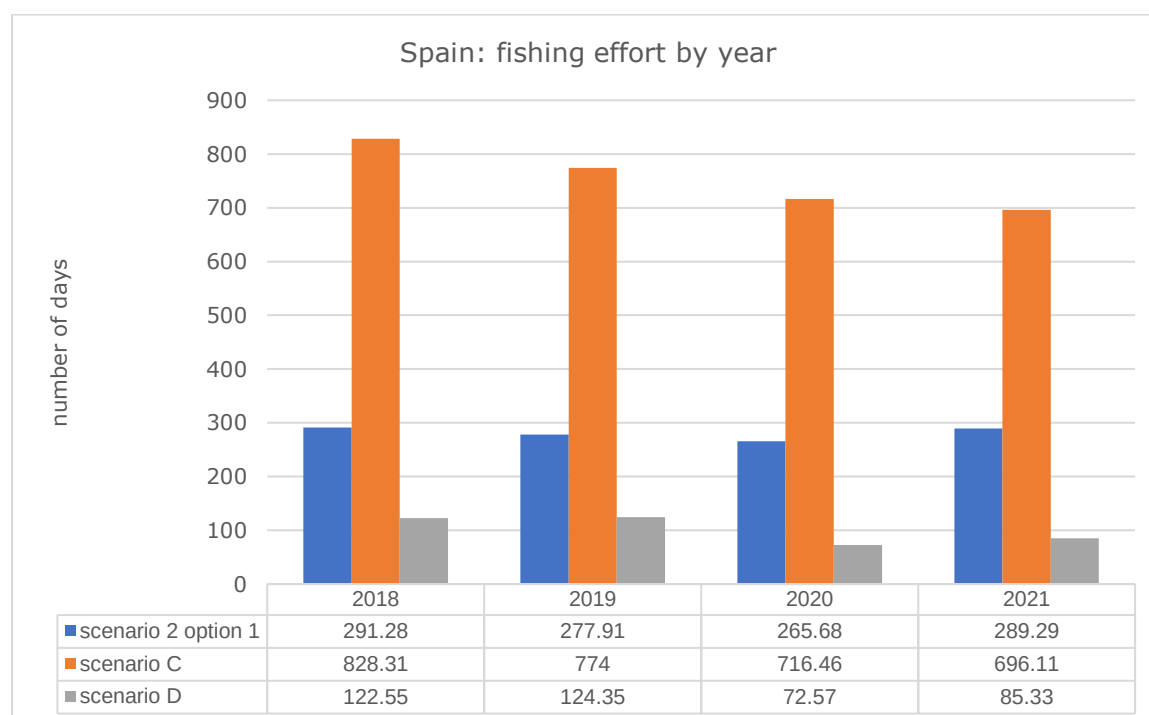
Table 21. *Scenario C:* estimated fishing effort and landings by year and gear type

country	year	gear type	number of fishing days	landings weight (tonnes)
ESP	2018	OTB	452.02	937.10
ESP	2018	PTB	376.29	4,062.43
ESP	2019	OTB	415.17	943.35
ESP	2019	PTB	358.83	4155.00
ESP	2020	OTB	356.00	931.96
ESP	2020	PTB	360.46	3769.26
ESP	2021	OTB	386.50	1524.80
ESP	2021	PTB	309.61	3618.37

Table 22. *Scenario D:* estimated fishing effort and landings by year and gear type

country	year	gear type	number of fishing days	landings weight (tonnes)
ESP	2018	OTB	74.65	103.67
ESP	2018	PTB	47.90	543.95
ESP	2019	OTB	71.79	124.82
ESP	2019	PTB	52.56	631.44
ESP	2020	OTB	49.60	101.78
ESP	2020	PTB	22.97	216.48
ESP	2021	OTB	57.91	159.68
ESP	2021	PTB	27.42	351.98

From the output of this analysis, among the three scenarios, the lowest fishing activity in the VME areas has been estimated for *Scenario D* and the highest for *Scenario C*.

**Figure 32.** Spain: estimated fishing effort (number of fishing days) by scenario and year

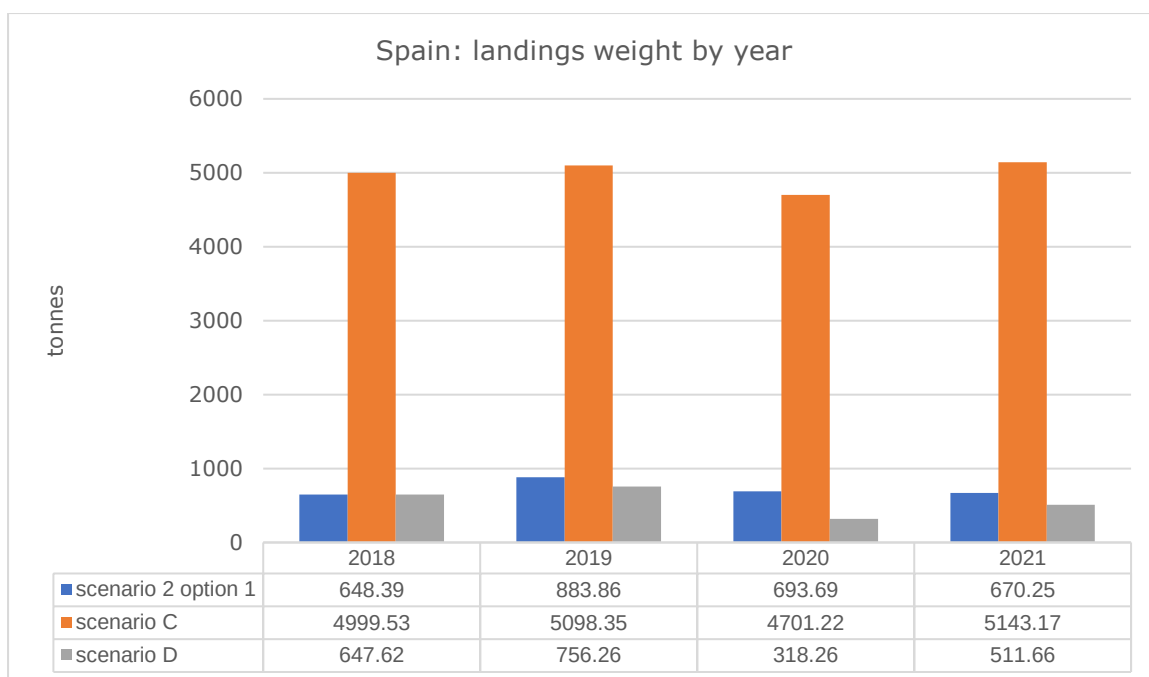


Figure 33. Spain: estimated landings weight (tonnes) by scenario and year

Comparison of the results

The following tables show, for the 3 scenarios considered, the comparison of the results from this analysis with the results from the analysis carried out using the FDI dataset.

This comparison is limited by the time period covered by the VMS/logbook and by the gear types and vessel length categories available for Spain in both datasets.

Table 23. *Scenario 2 option 1:* comparison between the results from the 2 analyses by year, vessel length, gear type and VME

country	year	vessel length	gear type	VME id	fishing days VMS	fishing days FDI-DEEP	landings weight (tonnes) VMS	landings weight (tonnes) FDI-DEEP
ESP	2018	VL1824	OTB	1	0.04	0.08	0.01	0.07
ESP	2018	VL1824	OTB	4	45.84	0.05	46.20	0.15
ESP	2018	VL1824	OTB	5	28.99	0.05	23.31	0.15
ESP	2018	VL1824	OTB	6	102.15	0.05	80.29	0.15
ESP	2018	VL1824	OTB	7	0.05	0.16	0.00	0.46
ESP	2018	VL2440	OTB	14	0.58	0.10	0.17	0.27
ESP	2018	VL2440	OTB	15	1.13	2.85	0.53	9.76
ESP	2018	VL2440	OTB	53	0.53	0.17	0.44	0.22
ESP	2018	VL2440	OTB	54	1.58	0.14	0.65	0.78
ESP	2018	VL2440	OTB	66	0.60	0.32	0.11	0.62
ESP	2019	VL1824	OTB	4	35.08	0.05	41.55	0.06
ESP	2019	VL1824	OTB	5	26.59	0.05	24.33	0.06
ESP	2019	VL1824	OTB	6	100.59	0.05	118.29	0.06
ESP	2019	VL1824	OTB	7	0.02	0.16	0.00	0.19
ESP	2019	VL2440	OTB	14	0.51	0.24	0.19	0.65
ESP	2019	VL2440	OTB	15	1.15	2.55	0.48	7.00

ESP	2019	VL2440	OTB	53	0.73	0.03	0.51	0.06
ESP	2019	VL2440	OTB	55	0.04	0.07	0.00	0.06
ESP	2019	VL2440	OTB	66	0.12	0.04	0.02	0.19
ESP	2020	VL1824	OTB	4	39.15	0.07	43.07	0.07
ESP	2020	VL1824	OTB	5	26.54	0.07	20.34	0.07
ESP	2020	VL1824	OTB	6	100.13	0.07	94.88	0.07
ESP	2020	VL1824	OTB	7	0.00	0.21	0.00	0.22
ESP	2020	VL2440	OTB	15	1.00	1.59	0.38	4.39
ESP	2020	VL2440	OTB	54	0.50	0.03	0.72	0.47
ESP	2021	VL1824	OTB	4	40.44	0.03	48.21	0.04
ESP	2021	VL1824	OTB	5	32.40	0.03	22.12	0.04
ESP	2021	VL1824	OTB	6	101.14	0.03	119.32	0.04
ESP	2021	VL1824	OTB	7	0.29	0.29	0.07	0.60
ESP	2021	VL2440	OTB	4	3.23	0.02	3.46	0.04
ESP	2021	VL2440	OTB	5	7.53	0.02	5.43	0.04
ESP	2021	VL2440	OTB	6	9.24	0.02	11.06	0.04
ESP	2021	VL2440	OTB	7	0.06	0.12	0.00	0.44
ESP	2021	VL2440	OTB	14	1.16	0.59	0.93	0.89
ESP	2021	VL2440	OTB	15	0.95	2.17	0.61	3.69

Table 24. *Scenario C:* comparison between the results from the 2 analyses by year, gear type, vessel length and VME

country	year	vessel length	gear type	VME id	fishing days VMS	fishing days FDI-DEEP	landings weight (tonnes) VMS	landings weight (tonnes) FDI-DEEP
ESP	2018	VL1824	OTB	16	0.04	0.06	0.01	0.05
ESP	2018	VL1824	OTB	20	30.17	0.16	29.69	0.46
ESP	2018	VL1824	OTB	21	0.05	0.16	0.00	0.46
ESP	2018	VL2440	OTB	25	0.58	0.10	0.17	0.27
ESP	2018	VL2440	OTB	26	1.13	2.14	0.53	7.14
ESP	2018	VL2440	OTB	27	32.64	0.71	96.38	2.61
ESP	2018	VL2440	OTB	80	0.72	0.04	0.35	0.04
ESP	2018	VL2440	OTB	81	0.04	0.04	0.02	0.04
ESP	2018	VL2440	OTB	83	9.24	0.36	3.64	0.49
ESP	2018	VL2440	OTB	84	0.50	0.17	0.43	0.22
ESP	2018	VL2440	OTB	85	1.92	0.38	0.80	1.16
ESP	2018	VL2440	OTB	99	0.00	0.32	0.00	0.62
ESP	2019	VL1824	OTB	20	19.03	0.16	23.00	0.19
ESP	2019	VL1824	OTB	21	0.02	0.16	0.00	0.19
ESP	2019	VL2440	OTB	25	0.39	0.24	0.16	0.65
ESP	2019	VL2440	OTB	26	1.15	1.75	0.48	4.83
ESP	2019	VL2440	OTB	27	34.99	0.79	92.35	2.17
ESP	2019	VL2440	OTB	80	0.44	0.04	0.19	0.06
ESP	2019	VL2440	OTB	81	0.07	0.04	0.08	0.06
ESP	2019	VL2440	OTB	82	0.83	0.40	0.14	0.42
ESP	2019	VL2440	OTB	83	5.27	0.50	2.92	0.43
ESP	2019	VL2440	OTB	84	0.71	0.03	0.50	0.06

ESP	2019	VL2440	OTB	85	2.84	0.04	1.30	0.03
ESP	2019	VL2440	OTB	86	0.04	0.04	0.00	0.03
ESP	2020	VL1824	OTB	20	21.04	0.21	22.83	0.22
ESP	2020	VL1824	OTB	21	0.00	0.21	0.00	0.22
ESP	2020	VL2440	OTB	26	1.00	1.10	0.38	3.13
ESP	2020	VL2440	OTB	27	27.35	0.49	103.46	1.26
ESP	2020	VL2440	OTB	80	0.44	0.37	0.10	0.36
ESP	2020	VL2440	OTB	81	0.05	0.37	0.08	0.36
ESP	2020	VL2440	OTB	82	0.17	0.82	0.09	0.62
ESP	2020	VL2440	OTB	83	6.98	0.27	2.54	0.21
ESP	2020	VL2440	OTB	85	0.86	0.03	1.23	0.47
ESP	2021	VL1824	OTB	20	19.72	0.08	23.13	0.11
ESP	2021	VL1824	OTB	21	0.29	0.29	0.07	0.60
ESP	2021	VL2440	OTB	20	2.66	0.07	2.86	0.11
ESP	2021	VL2440	OTB	21	0.06	0.12	0.00	0.44
ESP	2021	VL2440	OTB	25	1.16	0.59	0.93	0.89
ESP	2021	VL2440	OTB	26	0.95	1.49	0.61	2.43
ESP	2021	VL2440	OTB	27	30.88	0.68	319.81	1.26

Table 25. *Scenario D:* comparison between the results from the 2 analyses by year, gear type, vessel length and VME

country	year	vessel length	gear type	VME id	fishing days VMS	fishing days FDI-DEEP	landings weight (tonnes) VMS	landings weight (tonnes) FDI-DEEP
ESP	2018	VL1824	OTB	15	0.04	0.06	0.01	0.05
ESP	2018	VL1824	OTB	19	0.02	0.16	0.00	0.46
ESP	2018	VL2440	OTB	22	0.58	0.10	0.17	0.27
ESP	2018	VL2440	OTB	23	1.13	2.85	0.53	9.76
ESP	2018	VL2440	OTB	71	0.04	0.07	0.02	0.08
ESP	2018	VL2440	OTB	73	0.50	0.17	0.43	0.22
ESP	2018	VL2440	OTB	74	1.07	0.38	0.47	1.16
ESP	2018	VL2440	OTB	88	0.00	0.32	0.00	0.62
ESP	2019	VL2440	OTB	22	0.39	0.24	0.16	0.65
ESP	2019	VL2440	OTB	23	1.15	2.55	0.48	7.00
ESP	2019	VL2440	OTB	71	0.07	0.04	0.08	0.06
ESP	2019	VL2440	OTB	72	0.83	0.53	0.14	0.56
ESP	2019	VL2440	OTB	73	0.71	0.03	0.50	0.06
ESP	2019	VL2440	OTB	74	1.63	0.04	0.73	0.03
ESP	2019	VL2440	OTB	75	0.04	0.04	0.00	0.03
ESP	2020	VL2440	OTB	23	1.00	1.59	0.38	4.39
ESP	2020	VL2440	OTB	71	0.05	0.75	0.08	0.72
ESP	2020	VL2440	OTB	72	0.17	1.09	0.09	0.83
ESP	2020	VL2440	OTB	74	0.63	0.03	0.87	0.47
ESP	2021	VL1824	OTB	19	0.04	0.29	0.01	0.60
ESP	2021	VL2440	OTB	19	0.02	0.12	0.00	0.44
ESP	2021	VL2440	OTB	22	1.16	0.59	0.93	0.89

ESP	2021	VL2440	OTB	23	0.95	2.17	0.61	3.69
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Conclusions

The resolution (0.05×0.05) of the c-square is one order of magnitude bigger than the one used in the FDI dataset (0.5×0.5) and shows where fishing activity data are missing (Figure 34). The use of the ICES VMS/logbook dataset improved the analysis because it allowed us to detect where the fishing activity occurred with more precision.

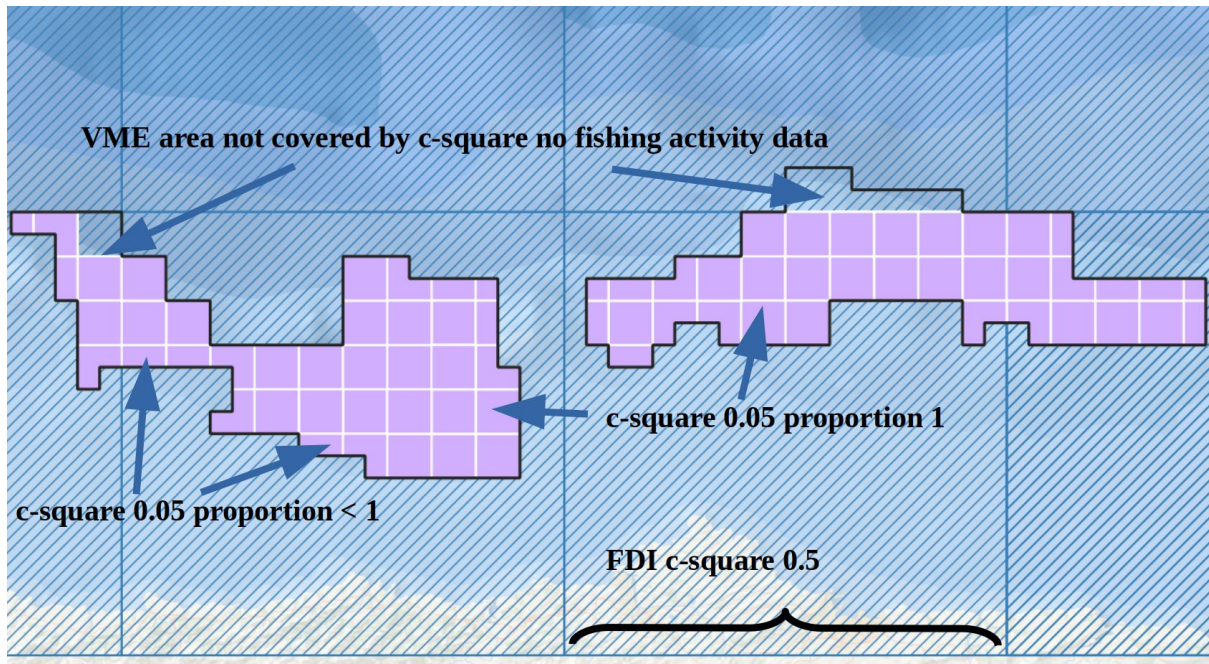


Figure 34. Scenario C: VME ID 42 and 43 and the corresponding c-squares at 0.05×0.05 resolution from the VMS/logbook dataset. In hashed blue pattern the FDI c-squares at 0.5×0.5 .

A constraint for this analysis is represented by the limited amount of data available for Spain in the VMS/logbook dataset. Despite this limitation, the analysis of the VMS dataset confirmed that the FDI dataset resolution is unsuitable for the scale of analysis of the VME scenarios and it should not be used for any analysis at similar scale. In addition, the VMS analysis confirmed that the DEEP variable is not a good indicator of fishing activities in the VME areas for the data provided by Spain to the FDI data call for the deep fishing trips.

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