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Scientific, Technical and Economic Committee for Fisheries (STECF)

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Support of the Action plan to conserve fisheries resources and protect marine ecosystems (STECF-OWP-22-01)

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Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines.

This report was supported by ad hoc contract work reviews by STECF by written procedure. The work was done in support to the Action plan to conserve fisheries resources and protect marine ecosystems.

**SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) -
Support of the Action plan to conserve fisheries resources and protect marine
ecosystems (STECF-OWP-22-01)**

Background provided by the Commission

The European Commission is working on an Action plan that will recommend actions for the Member States and the Commission to better explore the contribution of the common fisheries policy to the objectives of the environmental legislation, notably the Birds, Habitats and Marine Strategy Framework Directives.

One of the most important elements of this Action plan will be the activity and performance of mobile bottom-contact fishing gears in EU waters. In that context, ICES has provided advice in 2021 on several management options, including spatial closures. However, this advice has several limitations: it does not cover all EU waters, notably the Mediterranean and Black Seas (MED&BS), it does not present the information by MS, and that no analysis has been performed on the mobile bottom-contact fishing activity in relation to marine protected areas. Hence, to increase the knowledge, as an ad hoc solution to meet the short-term needs of the Commission, the GIS analysis of EU spatial fishing effort and landings data on c-square level from the EU Data Collection Framework as compiled in the STECF Fisheries Dependent Information database in combination with shape-files of the EU marine protected areas, is requested. The purpose of the analysis is to quantify fishing activity with mobile bottom-contacting fishing gears that is deployed within marine protected areas, with respect to effort, catches and the first-sale value of the catches.

The request pertained to the fishing zones defined in Article 5 of Regulation (EU) 2019/1241. The analysis should contain the EU vessels active in EU marine waters. The demersal gear requested to be included in the analysis are the OTB, OTT, PTB, SSC, SDN, SB, SV, DRB, HMD, TBB, SPR. Data should have been analyzed and compiled for the most recent years held in the FDI database, since 2017. Considering that reporting of spatial data is mandatory since 2017, at least the most recent three years since then should have been analyzed, taking note of the potential current incompleteness of 2020 data. The analysis must contain figures both per year and as an average of the analyzed time-series, to ensure the figures are representative.

Request to the STECF

The STECF is asked to review the ad hoc work report, evaluate the findings and make any appropriate comments and recommendations.

Summary of the information provided to STECF

STECF ad hoc contracts 2188 & 2189 "GIS analysis in support of the Action plan to conserve fisheries resource and protect marine ecosystems"

STECF was provided with the ad hoc report (hereafter referred as "*GIS report*") requested by DG MARE to carry out a geographical analysis on data of fishing effort and landings weight and value provided by the EU Member States under the remit of the EU Data Collection Framework (DCF). The study focused on the demersal fisheries in the EU waters, the MSFD regions and subregions, and EU Marine Protected Areas (MPAs) defined in the EU-27 waters (see Page 3 of the GIS report). The analysis is based on the 2017-2019 Fisheries Dependent Information (FDI) data from which spatial data is available at the country level. The report mentioned some major issues in the data provided for 2020, mainly in the Mediterranean Sea, which justified not accounting for this year in the analysis. The country-level of aggregation was required by the DG MARE for conducting the analysis. A report with supporting tables, datasets and maps detailing the aggregation of effort and landings estimates per EU Member State resulting from the analysis were delivered to DG MARE in electronic format and made available to STECF, with one Annex per ToR, for the 5 ToRs. The TORs were:

ToR 1: Deliver estimates of the fishing effort in all marine protected areas for all above 12m mobile bottom contacting gears, per MS, gear type, EU totals, MSFD region and subdivision.

ToR 2: Deliver estimates splitting the overall into the core fishing areas and the peripheral fishing areas.

ToR 3: same as ToR 2, but splitting the estimates for vessels activities lying inside or outside the EU MPAs.

ToR 4: Same as ToR 1, 2 and 3 but for vessels <12m

ToR 5: Provide an accessible version of the code used for the above analyses, to allow extracting values for any MPA.

STECF comments

STECF notes that the GIS report provides quantitative information for 2017-2019 on the fishing activities using all types of mobile bottom-contacting gears in the EU Waters and per subarea with geographical relevance, including the MSFD regions and subdivisions. The information is derived from the analysis of EU DCF data extracted from the FDI data sets collated by STECF. STECF acknowledges that the contractors have addressed all ToRs. However, STECF has the following comments:

Data sources and spatial resolution

STECF notes that the analyses are based on data that could be made readily available without needing a dedicated data-call. This includes a set of various pre-existing shape-files for mapping the MPAs in the EU-27 waters, and the FDI data annually submitted by the Member States to STECF. STECF observes that the GIS report has identified that the quality of the outcomes depends not only on the quality of these two data sources individually, but also on the assumptions made when overlapping them with each other. This is important since these two sources of spatial data mis-align in terms of geographical resolution, the FDI 0.5x0.5 c-square resolution being coarser than the MPA polygons.

STECF observes that to compute the effort and landings occurring in MPAs, the GIS report thus estimated the part of the declared effort, landings weight and landings value lying within the MPA in each c-square grid cell. The GIS report states that this was based on the proportion of the protected surface areas in the c-square assuming that the fishing activity has a uniform distribution in the c-square area. STECF considers that this assumption is likely to be a major approximation since fishing is known to usually aggregate on a scale smaller than 0.5x0.5 degrees (Eigaard et al. 2017, Amoroso et al. 2018). STECF underlines that this misalignment of data spatial resolution thus induces inherent uncertainty, impairing the objective of providing accurate estimates of effort and landing weight and value made in the MPAs of the EU-27 Waters.

STECF notes that the choice to use readily available data instead of a slower track via a data call for more detailed spatial data comes with important trade-offs in terms of uncertainty and robustness of the analyses. STECF notes that to refine the analysis further, these coarse FDI data need to be supplemented by finer scale VMS or AIS data before the overlay with MPAs is made (see, for example, the workflow developed for HELCOM in Bastardie et al. 2017). STECF understands though that doing so would require the systematic collection and use of nationally owned VMS data (see, for example, a workflow in Eigaard et al. 2017), or the use of less reliable but publicly available AIS data (Natale et al. 2015), as used for example, in a recent study similarly focused on measuring the footprint of "high-risk fishing" in the existing European MPAs (Perry et al. 2022). It could be envisaged that such data are collected, for example, by extending the current ICES data call (the one required by the ICES WGSFD) to cover the Mediterranean and Black Sea countries.

MPA shapefiles

STECF observes that the contractors used spatial data layers available from the European Environmental Agency (EEA). These spatial data outlining the boundaries of sites submitted by each EU MS are validated by the EEA as described at <https://www.eea.europa.eu/data-and-maps/data/natura-13>. However, the EEA notes that it cannot guarantee that all inconsistencies detected in national datasets are removed in the European dataset. STECF observes that, for example, there may be national plans for closures in EU Waters which build on previously existing local fisheries temporal closures or permanent bans (such as e.g., the 6 nm territorial zone in the Aegean Sea or the Adriatic Sea, and a 12 nm territorial zone in part of the Ionian Sea), making the estimates of the GIS report uncertain, depending on whether these areas have been excluded from the analysis or not.

STECF notes that the contractors used two different spatial layers (Natura 2000 and the European inventory of nationally designated areas (CDDA)), which means that they had to create a dedicated GIS geographic framework to carry out the overlapping analysis of the two sources,

with the removals of duplicates and the merging areas when overlapping MPAs were detected. Two different GIS layers were thus merged in the GIS report (see GIS report page 3). STECF considers that while the work done by the contractors in combining the different MPAs shapefiles is adequate, it would be more useful to collate (if it does not exist already) and maintain a single unified MPA layer at the EU level, including all the MPAs of international and national relevance. STECF suggests that the most appropriate procedure would thus be that the combined shapefiles be prepared and provided by the EU Commission services or agencies rather than by the contractors.

Furthermore, STECF notes that the GIS report is unclear as to which MPAs are included or not. STECF understands that the MPAs to analyse should include Special Areas for Conservation (SACs) defined by the EU MSFD, Special Protected Areas (SPAs) defined by the Habitat Directive, and nationally protected areas; Nevertheless, some examples of MPAs known to STECF members seem to be omitted from the analysis (e.g. some Mediterranean Fishery Restricted Areas FRAs), and it remains unclear to STECF whether all the existing protected areas in EU waters where trawling is allowed have been included in the spatial analysis.

STECF notes that the aggregated estimates and findings of the report are sensitive to which MPAs are included or not. Including areas already restricting bottom contacting gears, will underestimate the effect (in percentages) of implementing restrictions on other areas not yet regulated. Similarly, not including areas only partially restricted to bottom contacting gears will underestimate the impact of implementing a full restriction on them within MPAs.

Some areas are currently not or only partially restrictive because the management plans are not in place ("paper parks") or are still not fully implemented. The process from the area designation to the enforcement of restrictions is stepwise (see e.g., Grorud-Colvert et al. 2021). Hence, one uncertainty in the GIS analysis is that the current degree of implementation of monitoring plans associated with each of these areas is unknown, including if there are existing restrictions on the use of bottom contacting gears. This calls for an exhaustive inventory collecting such information, also including any possible available information on the level of enforcement and compliance within restricted areas, knowing that some studies have already identified some lack of compliance with existing restrictions on bottom contact fishing gears (e.g., Tasseti et al 2019). These two factors - low implementation and/or low compliance - have not been accounted for in the GIS report.

Core areas

STECF observes that the method to identify the core areas from the peripheral areas (ToR3) needs to be better described. This is especially the case in confirming whether, and how, a ranking of the c-square grid cells has been applied before computing the percentiles of fishing effort and identifying the core fishing areas. This is because there are different possible ways to identify core fishing grounds for a given percentage of fishing effort deployed at sea, (e.g., ranking the grid cells from the highest to the lowest effort or using a linear programming optimization procedure to pool different groups of cells constituting the searched percentage as developed in ICES WKTRADE3 to identify core grounds, based on Ban and Vincent 2009). Additionally, STECF has some reservations about how the spatial data are displayed in the report and shapefiles to visualize the outcomes. Hence, it would be beneficial to supplement this data visualization with a curve plot showing the cumulated fishing effort versus the spatial footprint to

illustrate that fishing is usually an aggregative activity (i.e., most of the fishing effort is deployed in a small area, the remaining effort is deployed in an extensive area). In Figure 5 of the GIS report, the estimation shows for example that only 5% of the effort is deployed in what could be called the “peripheral-to-the-fishing-ground cells”, which represents an extensive surface area.

STECF also notes that persistent core fishing areas will only be fully captured if the grid cell resolution is at the scale at which fishing is carried out.

MPA types

STECF notes that different MPAs have a different basis for requiring protection, and that bottom contact fishing gears will impact them differently. For example, for marine mammal sanctuaries, bottom contacting gears will impact food availability or disturb migratory corridors used by the species. In contrast, for other MPAs the impact will directly affect the species/habitats, causing degradation or fatalities. Nevertheless, the GIS report does not distinguish results by MPA type.

STECF observes that other layers derived from the European Marine Observation and Data Network (EMODnet) could be retrieved and may have been helpful in this regard. However, these were not requested to be used in the GIS report. For example, mapping the fishing pressure per seabed habitat type retrieved from EUSeaMap 2019 <https://www.emod-net-seabedhabitats.eu/about/euseamap-broad-scale-maps/> would be valuable given the importance of the seabed type has on the fishing effort spatial allocation and marine species distribution. The distinction of these elements would offer the possibility to evaluate the effectiveness of regulation on bottom contacting gears at a finer scale as well as a clearer vision of the consequences for the fleet segments. Therefore, STECF considers that performing the GIS analysis by MPA category may produce meaningful results in addition to the aggregated view mixing up different types of protection. These considerations further support the suggestion that one single quality-checked and unified layer including all the MPAs of international and national relevance (and including thus their basis for protection) would be best provided by EU Commission ahead of any future exercise of this sort.

Bottom impact per vessel size and gear type

STECF notes that many tables in the GIS report (Tables 16-20) provided the estimates of all vessel categories pooled together. STECF cautions against using those findings at such a level of data aggregation. It is acknowledged that different vessel sizes have very different fishing power, impacting seafloor areas differently when using bottom contacting gears of various sizes (Eigaard et al. 2016). It is also acknowledged that different bottom contacting fishing gears have different impact on the seafloor, and that, for example, bottom trawling is very different from seining (Eigaard et al 2016). In this regard, a more detailed evaluation should be performed on the appropriateness of describing the fishing pressure solely with the "sum of fishing days" metric, as it poorly related to fishing power due to differences in gear size (e.g., STECF EWG 18-09). Hence, it appears of primary importance to refine the analysis to account for the vessel size effect and the gear type in use. STECF understands that the contractors have later conducted a similar analysis at the request of DG MARE to account for the vessel size effect. However, STECF notes that the results of this extra analysis are not presented in the GIS report and cannot, therefore, be commented upon.

Additional considerations

STECF notes that the MPAs in the Mediterranean show a gradual shift from a few extended surface MPAs in the western Mediterranean toward numerous small-surface MPAs in the Adriatic Sea and Eastern Mediterranean. STECF observes that many small MPAs, combined with the Eastern Mediterranean's diverse topography and the multi-gear/multi-species nature of its fisheries, are potentially more complex to implement, enforce and monitor.

STECF suggests that a basic economic assessment would be a helpful addition to compute, for example income from landings value minus variable costs, using costs data collated in the FDI. Such an analysis was carried out in ICES (2020) from the outcomes of ICES WKTRADE2 and WKTRADE3 to disaggregate variable costs from the STECF Annual Economic Report (AER) via the STECF FDI data to obtain the contribution margin in c-square (described in ICES WKTRADE3, section 3).

Finally, STECF recalls that conducting static analyses based on snapshots of the historical deployment of fishing activities at sea ignores by nature the dynamics of fleets and stocks. Hence, effort displacement effects and long-term dynamics are highly likely to arise along with stock and habitat recovery. Examples of effects previously discussed by STECF include:

- the seasonal closures of bottom trawlers on the part of the fished GSA 7 area that would displace effort (STECF PLEN 19-03, ToR 6.4),
- the adoption of trawl closures in GSAs 9, 10, and 11 leading to an increase in fishing pressure on hake sub-adults and adults (STECF 20-01, ToR 3.5),
- the displacement of the gillnet fishery in the Kattegat where there is an increasing incidence of sensitive species bycatch (STECF PLEN 21-01, ToR 6.6),
- displacement in West Med closed areas toward other gears, species and habitats (STECF PLEN 21-02, ToR 6.2), and
- the decrease of the catch rates for the targeted species outside the Celtic Sea Protection Zone (STECF PLEN 21-03, ToR 5.8).

Possible future work could examine trade-offs in management scenarios with the purpose of including the effects of fleet displacement in the evaluation (e.g., Bastardie et al. 2020). As the approach presented in the GIS report did not evaluate displacement, the analysis is therefore likely to underestimate the ecological and economic benefits of the future closed areas scenarios. This is on the assumption that all the impacted fishing landings weight and value will be lost if a ban on fishing within MPAs was enforced, or overestimate these benefits if the pressure from the fishing fleets is increased on surrounding areas in an attempt to compensate for the economic losses. STECF reiterates that fleets are expected to adapt to closed areas and to move to other fishing areas to compensate for the loss. When evaluating the effect of closed areas regarding achieving CFP objectives, it is thus of utmost importance to consider these effects from a longer-term perspective.

STECF conclusions

STECF concludes that the main objective of the exercise for the ad hoc contractors was to assess the overlap between fishing activities with bottom towed gears and MPAs, as a step towards quantifying the effects on fisheries of the enforcement of protection measures. However, while STECF acknowledges that the contractors have adequately responded to their Terms of Reference

based on the readily available FDI data, STECF concludes that the FDI spatial data resolution is too coarse and does not allow a full assessment of the overlap between fishing activities and MPAs.

STECF concludes that performing the analysis by MPA category may produce meaningful results in addition to the aggregated effects pooling all MPAs together since different objectives of protection (migratory corridors, vulnerable benthic habitats, sensitive species, sensitive life stages of exploited stocks, etc.) may call for different types of fisheries restrictions.

STECF concludes that unclarities remain about which MPAs are included or not in the GIS report. STECF concludes that a single quality-checked unified MPA shapefile would be best computed and maintained by EU Commission services or agencies, including all the MPAs of international and national relevance. Such a layer (shapefile) should also include in the .dbf file the type of protection for each polygon of the MPAs (e.g., cetaceans, Natura 2000, etc.), for analysing the potential impact of fishing activity by typology of protection.

STECF concludes that aggregating fishing days across all vessel length categories and gear types is not an accurate descriptor of the actual bottom impact of the bottom contacting gears. STECF concludes that the analysis should, at a minimum, be performed and displayed by vessel length group and gear type to account for differences in impact strength and catching power per fishing day.

References

- Amoroso, R., et al. (2018) Bottom fishing footprints on the 'world's continental shelves. *Proceedings of the National Academy of Sciences*, 115, E10275-E10282.
- Bastardie, F., Danto, J., Rufener, M-C., van Denderen, P. D., Eigaard, O. R., Dinesen, G. E., & Nielsen, J. R. (2020). Reducing fisheries impacts on the seafloor: a bio-economic evaluation of policy strategies for improving sustainability in the Baltic Sea. *Fisheries Research*, 230, [105681]. <https://doi.org/10.1016/j.fishres.2020.105681>
- Bastardie, F., Eigaard, O. R., Nielsen, J. R., Egekvist, J., Hintzen, N. T., van Denderen, P. D., & Rijnsdorp, A. (2017). Fisheries Impact Evaluation Tool (FIT) with Application to Assess the Bottom Fishing Footprint in Western Baltic Sea (ICES Subdivisions 22-24). *International Council for the Exploration of the Sea (ICES)*. <https://doi.org/10.5281/zenodo.883054>
- Ban NC, Vincent ACJ (2009) Beyond Marine Reserves: Exploring the Approach of Selecting Areas where Fishing Is Permitted, Rather than Prohibited. *PLoS ONE* 4(7): e6258. <https://doi.org/10.1371/journal.pone.0006258>
- EC, 2020. Report from the commission to the European parliament and the council on the implementation of the Marine Strategy Framework Directive (Directive 2008/56/EC) {SWD(2020) 60 final}.
- EEA 2018, European Environment Agency, Marine protected areas conserve life, 2018. 767. <https://doi.org/10.2800/405185>.

- Eigaard O.R., Bastardie F., Breen M.I., Dinesen G.E., Lafargue P., Nielsen J.R., Nilson H., O'Neil F., Polet H., Reid D., Sala A., Sköld M., Smith C., Sørensen T.K., Tully O., Zengin M., Hintzen N.T., Rijnsdorp A.D. (2016). Estimating seafloor pressure from trawls and dredges based on gear design and dimensions. *ICES J. Mar. Sci.* 73(1): 27-43
- Eigaard, O. R., Bastardie, F., Hinzen, N. T., Buhl-Mortensen, L., Mortensen, P. B., Catarino, R., Dinesen, G. E., Egekvist, J., Fock, H., Geitner, K., Gerritsen, H., González, M. M., Jonsson, P., Kavadas, S., Laffargue, P., Lundy, M., Gonzalez-Mirelis, G., Nielsen, J. R., Papadopoulou, N., ... Rijnsdorp, A. D. (2017). The footprint of bottom trawling in European waters: distribution, intensity, and seabed integrity. *ICES Journal of Marine Science*, 74(3), 847-865. <https://doi.org/10.1093/icesjms/fsw194>
- Grorud-Colvert et al. 2021. The MPA Guide: A framework to achieve global goals for the ocean. *Science* 373, 1215
- ICES 2020. EU request on indicators of the pressure and impact of bottom-contacting fishing gear on the seabed, and of trade-offs in the catch and the value of landings. *ICES Special Request Advice*,
- ICES. 2021. A series of two Workshops to develop a suite of management options to reduce the impacts of bottom fishing on seabed habitats and undertake analysis of the trade-offs between overall benefit to seabed habitats and loss of fisheries revenue/contribution margin for these options (WKTRADE3). *ICES Scientific Reports*. 3:61. 100 pp. <http://doi.org/10.17895/ices.pub.8206>
- Natale F, Gibin M, Alessandrini A, Vespe M, Paulrud A (2015) Mapping Fishing Effort through AIS Data. *PLoS ONE* 10(6): e0130746. <https://doi.org/10.1371/journal.pone.0130746>
- Perry AL, Blanco J, García S and Fournier N (2022) Extensive Use of Habitat-Damaging Fishing Gears Inside Habitat-Protecting Marine Protected Areas. *Front. Mar. Sci.* 9:811926.doi: 10.3389/fmars.2022.811926
- Scientific, Technical and Economic Committee for Fisheries (STECF) – Review of technical measures (part 1) (STECF-20-02). EUR 28359 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-27161-1, doi:10.2760/734593, JRC123092.
- Tassetti, A.N., Ferrà, C., Fabi., G. 2019. Rating the effectiveness of fishery-regulated areas with AIS data, *Ocean & Coastal Management*, 175, 90-97

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ANNEX - STECF AD HOC CONTRACTS 2188 & 2189

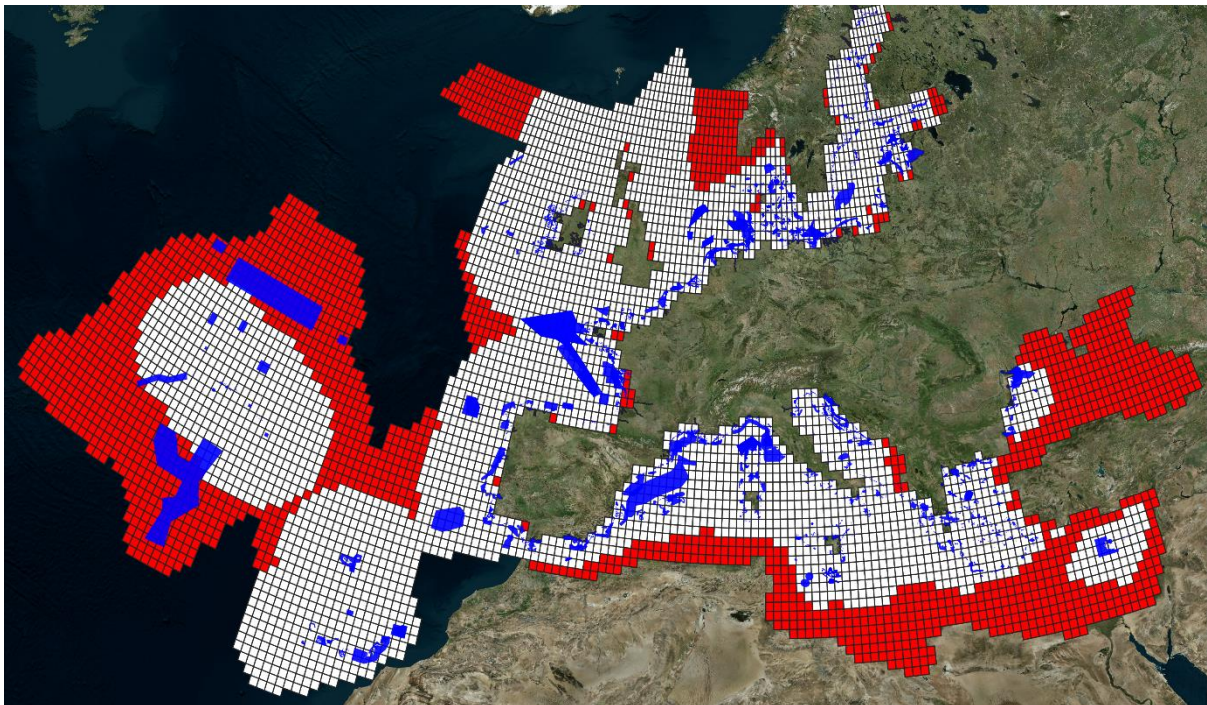
This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area.

STECF ad hoc contracts 2188 & 2189

GIS analysis in support of the Action plan to conserve fisheries resources and protect marine ecosystems

Maurizio Gibin and Antonella Zanzi

This document is one of the deliverables related to the STECF contracts 2188 and 2189. The purpose of the work was to carry out a geographical analysis on data of fishing effort and landings, weight and value, provided by EU Member States under the remit of the EU Data Collection Framework (DCF). The analysis focused on the fishing activity carried out by the demersal fisheries, as recorded in the DCF Fisheries Dependent Information database, in the EU marine waters, in the MSFD regions/subregions and subdivisions, and in the EU marine protected areas defined in the EU-27 waters. Datasets and maps resulting from the analysis were delivered to DG MARE in electronic format.



The above map shows in red the extension of the MSFD marine regions, in white the extension of the EU marine waters (for years 2017-2019) and in blue the marine protected areas. The present study considered only the marine protected areas belonging to the EU-27 waters.

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Scope of work

As requested by the Terms of Reference of the contracts, we carried out a spatial analysis of the fisheries effort and landings data extracted from the EU Data Collection Framework (DCF) Fisheries Dependent Information (FDI) database.

The analysis focused on the fishing activity carried out in the EU marine waters by the demersal fisheries as recorded in the DCF FDI database. The study considered the FDI data provided by EU Member States for 2017, 2018 and 2019 and the vessel length categories *above-12m*, *below-12m* and all the vessel categories together.

Objective of the study was to spatially analyse this subset of data from the FDI database in combination with the EU marine protected areas (MAPs) defined in the EU-27 waters and with the MSFD marine regions/subregions and subdivisions.

Terms of Reference for the work, as defined in the contracts, are listed in Annex 1. In addition to what requested in the contracts, we were requested by DG MARE to perform an additional analysis considering each of the vessel length categories defined in the FDI database; this additional request is not covered by the present document.

Geographical datasets

C-square dataset

The management of spatial data in the FDI database exploits the Concise Spatial Query and Representation System (c-square) [1] 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 EWG on Fisheries Dependent Information. It is available at:

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

Marine protected areas and MSFD regions

The following data sources were used to determine the geographical distribution and extension of the EU marine protected areas and of the MSFD marine regions/subregions and subdivisions:

1. The Natura 2000 dataset available at https://sdi.eea.europa.eu/data/b1777027-6c85-4d19-bdf2-5840184d6e13?path=%2FNatura2000_end2020_shp
2. The European inventory of nationally designated areas (CDDA) available at <https://www.eea.europa.eu/data-and-maps/data/nationally-designated-areas-national-cdda-16>
3. The dataset of the MSFD marine regions/subregions available at <https://www.eea.europa.eu/data-and-maps/data/europe-seas-1>
4. The dataset with MSFD subdivisions for the Atlantic provided by DG MARE (file MSFDsubdivisionsICES_2021.zip)
5. Information on MSFD subdivisions for the Mediterranean and Black Sea provided by DG MARE (file MSFDsubdivisions_MedBlack_20211212.zip)

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 [2], 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 carry out until 2020.

Spatial data

The spatial FDI dataset contains: a) fishing effort data defined as fishing days, b) landings weight (tonnes) and c) landings value (euro) by c-square at the resolution of 0.5×0.5 degree.

Spatial information are collected by Member States through logbooks, VMS data, sales notes and sample surveys. When the information on the fishing site is not available, an approximation is applied; the most common approximation method is based on the port of landings (i.e. the catch is allocated by c-squares or rectangles based on the landing port). 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 reports of the FDI EWG (STECF-21-11 [3], STECF-20-10 [4], STECF-19-11 [5]).

In the context of the FDI data call, Member States can provide spatial data 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 on the format of the data requested by the call itself is available on the following website

<https://datacollection.jrc.ec.europa.eu/dc/fdi>

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 is currently limited to 7 years (2014-2020). In addition for the Mediterranean and Black Sea the reporting of spatial data is mandatory only since 2017.

For the current analysis, three years of data were selected from the available data: 2017, 2018 and 2019. The rationale for this choice was: a) the availability of spatial data for the Mediterranean and Black Sea only since 2017 and b) some major issues in the data provided for the year 2020, mainly in the Mediterranean Sea, that suggested to exclude the last year of available data.

Geographical coverage

The FDI database covers all the oceans and seas where the fishing fleet of the European Union operates. For the purpose of the current work, we selected from the FDI database the subset for the following FAO fishing areas: 27 (Northeast Atlantic), 37 (Mediterranean and Black Sea) and 34 (Eastern Central Atlantic). In the geographical framework built for

the analysis, the subset extracted from the FDI database was then further limited to the EU marine waters.

Gear types

The analysis focused on the bottom-contacting fishing vessels. The demersal gear types 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
Bottom otter trawl	OTB
Otter twin trawl	OTT
Bottom pair trawl	PTB
Beach seines	SB
Danish seines (Anchored seine)	SDN
Pair seines	SPR
Scottish seines (Fly shooting seine)	SSC
Boat seines	SV
Beam trawl	TBB

Data quality

Data collected during the FDI data calls were checked by the STECF expert working group on Fisheries Dependent Information (STECF-21-11 [3], STECF-20-10 [4], STECF-19-11 [5]).

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-10m in the FAO fishing area 27 (Northeast Atlantic) and for the vessel length categories above-12m in the Mediterranean and Black Sea.

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 considered to be lower than the quality of data for the other vessel categories.

Comparison between catch and spatial landings data

In the FDI database, landings data (weight and values) are available in 2 tables: in the catch table (Table A) and in the spatial landings table (Table H). In the catch table, data are provided by FAO subarea; in the spatial landings table, instead, data are available by c-square at the resolution of 0.5×0.5 degree or by rectangle (as described before).

To verify if in Table H there are missing fleet segments that were provided in Table A, we

compared the subsets extracted from both tables containing the gear types listed in table 1, FAO fishing areas 27, 34 and 37, and years 2017-2019.

The result of the comparison highlighted that some fleet segments, for which there are available information in the catch table, are not present in the spatial landings table. Table 2 shows the data available in the catch table (Table A) for the fleet segments that are not present in the spatial landings table (Table H)¹.

Table 2. Fleet segments absent in the spatial landings table but present in the catch table, by country and year

Country	2017		2018		2019	
	vessel length	gear type	vessel length	gear type	vessel length	gear type
DEU	VL1218	DRB				
DEU	VL2440	DRB	VL2440	DRB	VL2440	DRB
DEU	VL40XX	DRB	VL40XX	DRB	VL40XX	DRB
ESP			VL40XX	OTT	VL40XX	OTT
EST	VL40XX	OTB	VL40XX	OTB	VL40XX	OTB
FIN					VL0010	SSC
ITA			VL0006	DRB	VL0006	DRB
ITA			VL0006	OTB		
ITA	VL0006	SV	VL0006	SV	VL0006	SV
ITA	VL0612	DRB	VL0612	DRB	VL0612	DRB
ITA	VL0612	OTB	VL0612	OTB	VL0612	OTB
ITA	VL0612	SV	VL0612	SV	VL0612	SV
ITA	VL0612	TBB	VL0612	TBB	VL0612	TBB
ITA	VL1218	SV	VL1218	SV	VL1218	SV
ITA			VL40XX	OTB	VL40XX	OTB
MLT	VL1824	OTB				
ROU	VL0612	SB	VL0612	SB	VL0612	SB
ROU	VL0612	TBB	VL0612	TBB	VL0612	TBB

Data cleaning

Preliminary checks were performed on the FDI spatial data to verify if the coordinates lying on land and the compatibility of the coordinates with the corresponding declared rectangle type. Based on the results of these checks, some data were excluded from the dataset initially prepared for the analysis.

From the effort dataset we excluded 297 rows, for a total of 4939 fishing days (1167 fishing days in 2017, 1969 fishing days in 2018 and 1803 fishing days in 2019), corresponding to 0.17% of fishing days present in the dataset originally selected for the analysis.

¹ In the table and later in the document countries are identified by their three-letter country code defined in ISO 3166-1

From the landings dataset we excluded 2870 rows, for a total of 11931.4 tonnes of landings (2804 tonnes in 2017, 5112 tonnes in 2018 and 4015 tonnes in 2019), corresponding to 0.3% of landings in the dataset originally selected for the analysis.

In the following table the fishing days and the landings weight and value excluded from the dataset are detailed by country.

Table 3. Landings and effort data excluded from the dataset

Country	Effort fishing days			Landings weight tonnes			Landings value euro		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
ESP	3	14.38	4.76	0.66	200	33.7	4361.65	746121	221034
FRA	16.13	20.19	9.57	0.56	0.72	0.5	4655.8	5178.4	3299.3
HRV	2.9	1.55	0.02	0.1	0.12		114.8	189.38	
ITA			3.48	0.6	2.93	13.4	*	*	*
MLT	573	527	536	40.47	32.33	51.59	266959.76	236958.27	425463.4
PRT	8	2	4	3.5	0.23	1.32	3644.4	2605.56	4155.35
ROU	564	1404	1245	2758.27	4875.84	3914.37	1104143	2096609.6	2806411.98

* Landings value data are not available for Italy

Data confidentiality

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 [6] aggregated at EU fleet 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 and in the analysis both confidential and non-confidential data were used.

Spatial analysis

The geographical framework used in the analysis was build based on the EEZ of the EU waters and on the datasets listed in the paragraph *Geographical datasets*.

Duplicated and overlapping MPAs

The datasets Natura 2000 and CDDA were the sources used to define the MPAs in the geographical framework. When merging these two geographical datasets, some MPAs were present more than once with different codes because the two datasets use different codification to catalogue the MPAs.

A cleaning step was performed to identify those duplicates: the name and the spatial extension of the area was used as criteria to identify the duplicated MPAs. The identified duplicates were eliminated from the final geographical framework used for the analysis.

There are also cases of MPAs spatially overlapping that are not duplications. These MPAs are maintained in the framework and treated as distinct MPAs. The values computed per MPA are not affected by the presence of overlapping MPAs; however, the resulting dataset with the fishing activity by MPA is useful only to analyse the information for each MPA and

these values cannot be further aggregated because of the risk of overestimate the fishing activity.

To overcome this limitation, a dataset of c-squares without overlapping areas was produced: this second dataset does not contain the information on single MPAs (MPA codes and names); it contains instead the list of distinct c-squares and for each of them the proportion belonging to at least one MPA. Using this proportion, it is possible to compute the correct aggregated values by country, gear type, MSFD region/subregion and subdivision. An example is shown in the following figure: Figure 1.a shows the part of a c-square that falls inside on MPA; Figure 1.b shows another part of the *same c-square* that falls inside an overlapping MPA, Figure 1.c shows the final deduplicated dataset at c-square level, containing all the surface of the same c-square that is covered by *at least one* MPA.

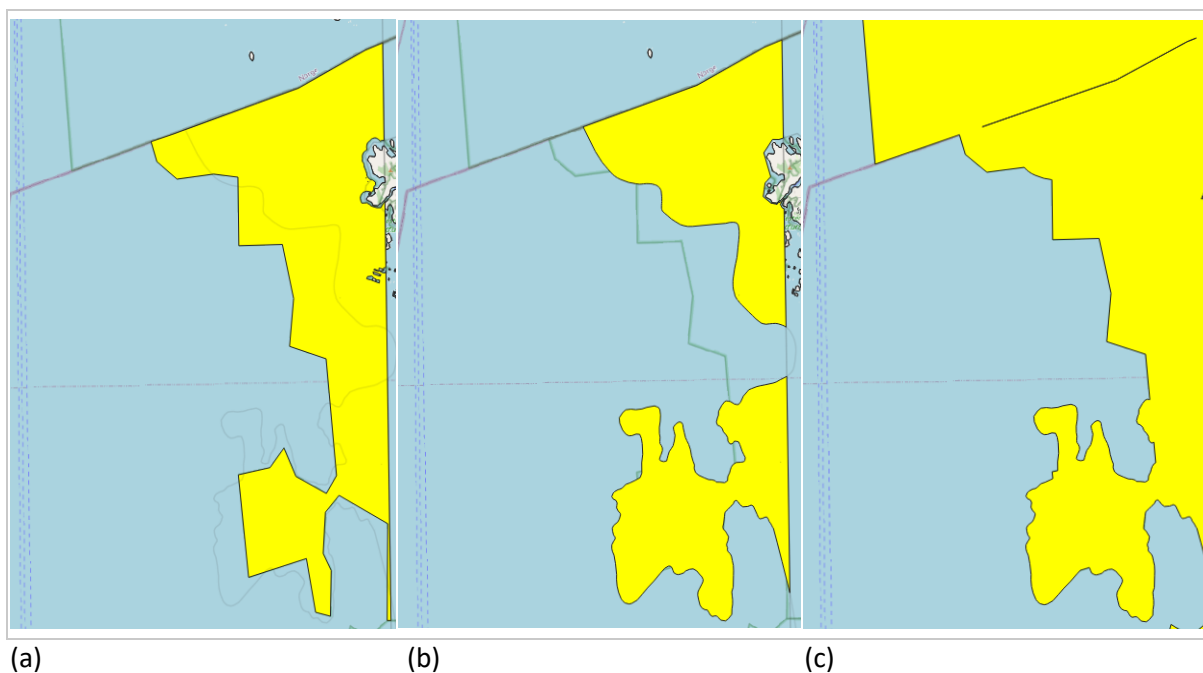


Figure 1. The c-square dataset without overlapping areas: (a) the part of a c-square that falls inside on MPA (b) another part of the same c-square that falls inside an overlapping MPA (c) the final deduplicated dataset at c-square level containing all the surface of the same c-square that is covered by at least one MPA

C-squares partially in and outside MPAs

The analysis of the FDI spatial data versus the MPAs was carried out identifying the c-square belonging to each MPA and then computing the total values for the fishing effort (fishing days) and landings (weight and value) in each MPA.

For marine protected areas with irregular borders having therefore c-squares that are partially inside and outside the MPA, the estimation of the fishing activity inside the MPA has been based on the proportion of the areas assuming that the fishing activity has a uniform distribution in the c-square area. The same approach has been used for the MPAs smaller than a single c-square. An example is shown in Figure 2.



Figure 2. Examples of c-squares that are partially inside and outside the MPAs

MSFD subdivisions

MSFD subdivisions were defined by ICES for FAO fishing area 27 and a file with their definitions was provided to us by DG MARE. For Mediterranean and Black Sea, subdivisions have not yet been formally established; for this work, we used a preliminary version of subdivisions for Mediterranean and Black Sea that was provided by DG MARE.

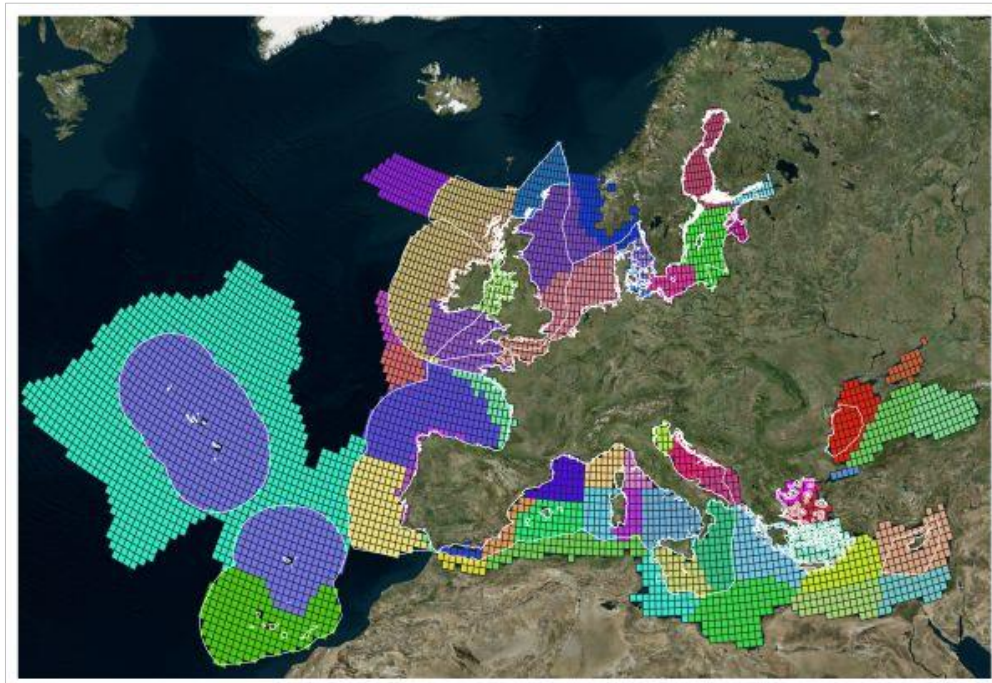


Figure 3. MSFD subdivisions with the new defined subdivisions: Macaronesia-23 around the Azores and Madeira, and Macaronesia-24 around the Canary Islands

As agreed with DG MARE and DG ENV during a meeting on 11 February 2022, in the MSFD subregion called Macaronesia we defined two new MSFD subdivisions in connection with

the EEZs of the Azores, Madeira and the Canary Islands. The new subdivisions, called Macaronesia-23 and Macaronesia-24, were added to the geographical framework used for the analysis. In Figure 3, Macaronesia-23 is plotted in blue violet around the Azores and Madeira, while Macaronesia-24 is visualized in green around the Canary Islands.

In addition, there was the need to extend the ICES subdivision *Bay of Biscay and the Iberian Coast-5*, whose construction was based upon the ICES rectangles dataset having the southern boundary at latitude 36° N. To cover the southernmost part of the *Bay of Biscay and the Iberian Coast* MSFD subregion, we defined a new small subdivision called *Bay of Biscay and the Iberian Coast-51* that was then added to the geographical framework used for the analysis as part of the *Bay of Biscay and the Iberian Coast-5*.

Core and peripheral fishing areas

Core and peripheral areas were determined computing, for each year and for vessel categories above-12m and below-12m, the distribution of the fishing activity for the following three dimensions: marine subdivision of MSFD regions, gear type and EU marine waters.

Core areas were calculated as the 95%, 90%, 80% and 70% quantiles of the distribution of fishing effort, landings weight and landings value. Each c-square was then classified on the basis of the corresponding percentile.

The calculation of core areas, with the identification of the 95%, 90%, 80% and 70% percentiles of the distribution of the fishing activity, is affected by the resolution of the dataset. Core areas are identified as groups of c-squares with the same percentile because the size of a single c-square, 0.5 decimal degrees (approximately 50 Km), is too wide to identify smoothed core area polygons.

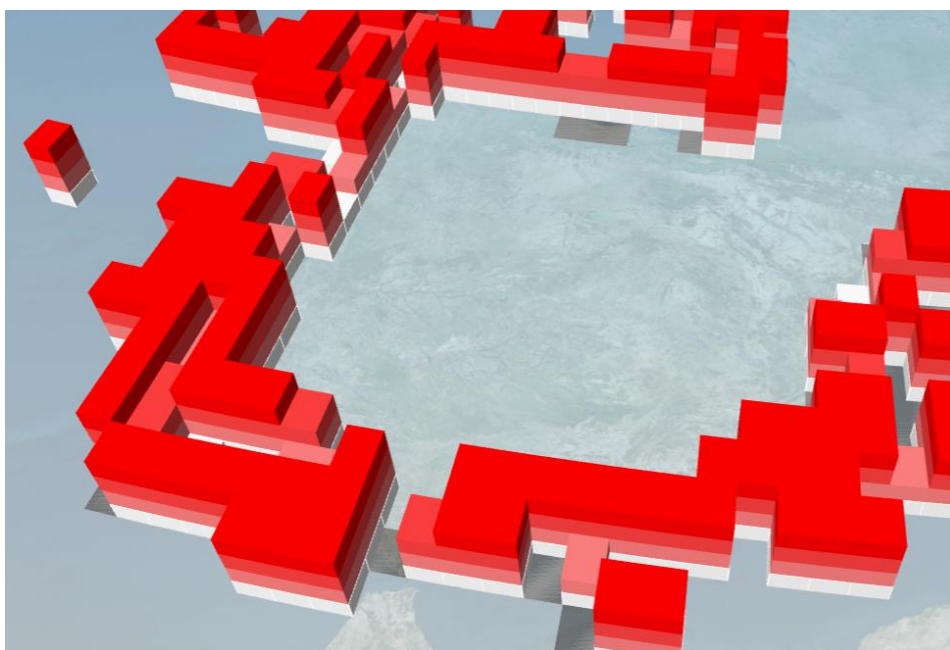


Figure 4. Example of the tri-dimensional projection of core areas

The image in Figure 4 provides a clear example of the different core areas identified by the 95%, 90%, 80% and 70% percentile of the distribution of effort for the totals in every MSFD subdivisions in the Bay of Biscay region. The core areas as groups of c-squares can

be easily detected using an isometric tri-dimensional projection. Features have been artificially extruded to show the different percentiles coloured in ascending order from the 95% (white) to the 70% (dark red).

The following figure shows the same geographical region and the same core areas as in the 3D model above using a 2D choropleth map.

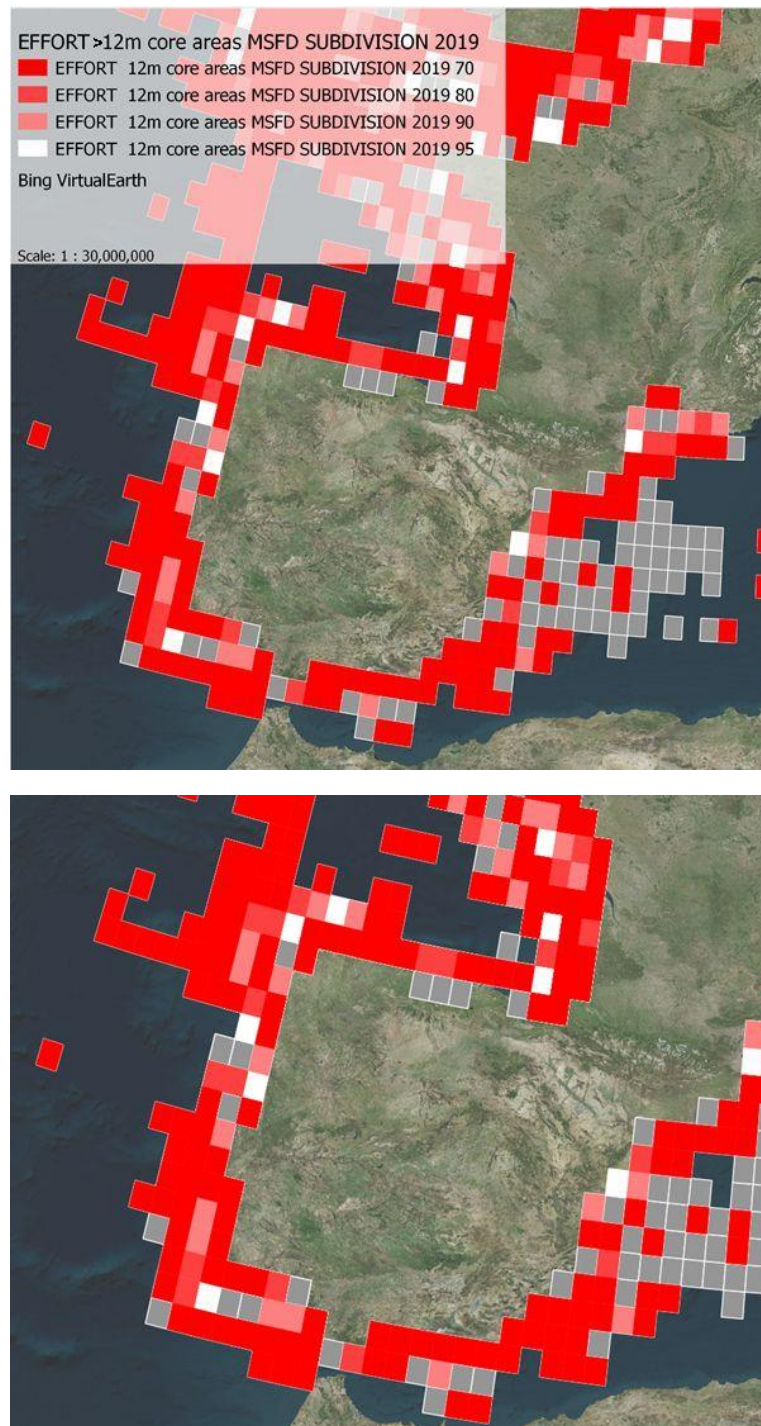


Figure 5. 2D choropleth map of the same region showed in the previous figure

Considerations on the quality of the analysis results

The quality of the results of the analysis depends: a) on the quality of the source FDI dataset, b) on the quality of the datasets used to define the geographical framework, and c) on the assumption that was necessary to adopt in order to spatially assign the fishing activity available by c-square to the MPAs.

Constraints and limitations that need to be considered when looking at the results of this analysis are summarized in the following.

Coverage and completeness of the FDI dataset

Even if the coverage of the FDI database for the vessel length categories above-10m in the FAO fishing area 27 (Northeast Atlantic) and for the vessel length categories above-12m in the Mediterranean and Black Sea is considered good, the real degree of completeness of the FDI dataset is not reported in the STECF reports.

More importantly, it is generally acknowledged that there are issues in the collection of data for the small scale fisheries (vessel length categories below-10m in the Northeast Atlantic and vessel length categories below-12m in the Mediterranean and Black Sea) and for this reason the FDI dataset for the vessel length category below-12m has a lower coverage and quality.

It is also interesting to note that for some of the MPAs defined in the geographical framework used for the analysis no fishing activity are recorded in the FDI dataset for the demersal gear types selected for the analysis. This absence of fishing activity can be related to fishing restriction existing in the MPAs and not necessarily depending on lack of data provided by Member States.

C-squares partially in and outside MPAs

The assumption that the fishing activity (effort, landings weight and value) is uniformly distributed in the c-square area was needed to deal with the c-squares that are partially inside and outside the MPAs. However, this assumption does not reflect the real distribution of the fishing activity in a c-square.

Overlapping MPAs

The geographic framework contains overlapping MPAs. For this reason, the resulting values per individual MPA cannot be aggregated to compute total values by country, gear type, MSFD region/subregion and subdivision. To overcome this limitation, a dataset of c-squares without overlapping areas was produced. This dataset contains the list of distinct c-squares and, for each of them, the proportion belonging to at least one MPA; using this proportion, it is possible to compute the correct aggregated values by country, gear type, MSFD region/subregion and subdivision.

Core areas

The calculation of core areas is affected by the resolution of the dataset. The size of a single c-square, 0.5 decimal degrees (approximately 50 Km), is too wide to identify smoothed core area polygons; for this reason core areas are instead identified as groups of c-squares with the same percentile.

Summary results

For the vessel category above-12m, vessel category below-12m and all vessel categories together, we estimated the values of fishing effort, landings weight and landings value within MPAs defined in the EU-27 waters.

A summary of the results for the analysed time-series is shown in Tables 4 and 5, respectively excluding and including the United Kingdom fishing activity, giving average values of EU fishing fleet activity in EU marine waters with average values and proportion of EU fishing fleet activity in MPAs.

Table 4. Average results for 2017-2019, excluding UK data

Vessel category	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
above-12m	538.4	114.5	21.3	834.8	117.5	14.1	1641591.5	316048.7	19.3
below-12m	217.5	49.0	22.5	97.1	30.3	31.2	143115.2	40634.2	28.4
all vessel categories	756.2	163.6	21.6	933.5	148.1	15.9	1787519.3	357222.3	20.0

Table 5. Average results for 2017-2019, including UK data

Vessel category	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
above-12m	634.6	115.9	18.3	1045.9	121	11.6	2139301.8	324774.9	15.2
below-12m	250.6	49.0	19.6	110.2	30.4	27.5	180453.6	40711.3	22.6
all vessel categories	885.5	165.0	18.6	1157.7	151.7	13.1	2322568.1	366025.5	15.8

In the FDI database there is a small amount of data with unreported vessel length (vessel length recorded as *not known*, NK). For this reason, the dataset for all vessel categories contains also data not included in the datasets for the vessel categories above-12m and below-12m.

Term of Reference 1

For the vessel category above-12m, we estimated the values of the fishing activity, in terms of fishing effort, landings weight and landings value, within MPAs defined in the EU-27 waters.

Tables 6 and 7 show a summary of the results for the vessel category above-12m, respectively excluding and including the United Kingdom fishing activity, giving values of EU fishing fleet activity in EU marine waters with values and proportion of EU fishing fleet activity in MPAs.

Table 6. Summary results for the vessel category above-12m, excluding UK data

Year	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
2017	707.3	147.1	20.8	1028.1	125.5	12.2	1730082.7	331256.9	19.1
2018	492.9	106.3	21.6	791.5	119.7	15.1	1697154.6	348045.2	20.5
2019	415.0	90.1	21.7	684.7	107.2	15.7	1497537.1	268844.1	18

Table 7. Summary results for the vessel category above-12m, including UK data

Year	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
2017	805.1	148.5	18.4	1244.7	129.5	10.4	2231337.1	340623.0	15.3
2018	588.7	107.6	18.3	1001.4	122.9	12.3	2187837.9	356409.3	16.3
2019	509.9	91.5	17.9	891.7	110.6	12.4	1998730.5	277292.4	13.9

The following tables show the results by country and year, with the percentages computed against the total fishing activity per country in the EU marine waters. In the tables and later in the document countries are identified by their three-letter country code defined in ISO 3166-1.

Table 8. Fishing activity in MPAs by country, vessel length above-12m, year 2017

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	14517	2488	17.14	23989	2074	8.65	85374754	8504153	9.96
BGR	1136	192	16.90	1740	290	16.67	958820	160088	16.70

CYP	1442	0	0.00	171	0	0.00	1406247	295	0.02
DEU	31692	15821	49.92	26435	7372	27.89	88742300	36485900	41.11
DNK	36359	7646	21.03	461673	34959	7.57	209295228	28131854	13.44
ESP	107338	34243	31.90	83363	17613	21.13	210714461	46331243	21.99
EST									
FIN	57	2	3.51	150	6	4.00	175	7	4.00
FRA	98684	29950	30.35	144219	28233	19.58	451409969	106983987	23.70
GBR	97792	1316	1.35	216514	4059	1.87	501254347	9366110	1.87
GRC	47773	7189	15.05	15551	2214	14.24	107106451	14737030	13.76
HRV	27386	4762	17.39	3690	532	14.42	12818521	1789699	13.96
IRL	28929	829	2.87	37030	786	2.12	128412156	3504153	2.73
ITA	217412	23643	10.87	8514	997	11.71			
LTU	886	48	5.42	1705	80	4.69	1523109	61537	4.04
LVA	1111	43	3.87	3175	178	5.61	3256676	128850	3.96
MLT	296	15	5.07	80	21	26.25	786475	192668	24.50
NLD	44382	11132	25.08	76673	14072	18.35	321593832	65347428	20.32
POL	5994	1072	17.88	13675	1699	12.42	10781440	1342117	12.45
PRT	26835	6727	25.07	32595	9851	30.22	49655533	13697751	27.59
ROU	884	172	19.46	4038	785	19.44	1616194	314122	19.44
SVN	4312	288	6.68	32246	2157	6.69	199586	13348	6.69
SWE	9924	877	8.84	57436	1543	2.69	44430799	3530650	7.95

Table 9. Fishing activity in MPAs by country, vessel length above-12m, year 2018

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	14158	2453	17.33	21981	1799	8.18	81086977	7361191	9.08
BGR	1180	217	18.39	1595	286	17.93	931430	168046	18.04
CYP	498	0	0.00	137	0	0.00	1082811	0	0.00
DEU	30445	15129	49.69	36531	12582	34.44	93277155	39809823	42.68
DNK	35911	7788	21.69	268258	22881	8.53	186537446	27069593	14.51
ESP	11613	2117	18.23	73164	16898	23.10	217201948	54444543	25.07
EST									
FIN									
FRA	98608	31243	31.68	143856	30647	21.30	427980044	108667567	25.39
GBR	95788	1292	1.35	209776	3197	1.52	490683258	8364118	1.70

GRC	47428	6945	14.64	15487	2238	14.45	97223541	13720827	14.11
HRV	25642	4391	17.12	3523	481	13.65	13136345	1717361	13.07
IRL	27183	616	2.27	32654	625	1.91	131417485	3670514	2.79
ITA	105527	13594	12.88	474	47	9.92			
LTU	630	43	6.83	865	59	6.82	648682	38006	5.86
LVA	930	39	4.19	2092	72	3.44	2148418	56367	2.62
MLT	213	11	5.16	99	33	33.33	1142507	392710	34.37
NLD	44978	11850	26.35	82295	17385	21.13	342721258	71299674	20.80
POL	6430	1516	23.58	13157	2149	16.33	10094544	1824803	18.08
PRT	27209	7151	26.28	26065	7543	28.94	56476136	14724824	26.07
ROU	14	3	21.43	44	9	20.45	18904	3674	19.44
SVN	4080	273	6.69	41582	2781	6.69	312988	20932	6.69
SWE	10260	965	9.41	27781	1222	4.40	33715978	3054743	9.06

Table 10. Fishing activity in MPAs by country, vessel length above-12m, year 2019

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	13425	2137	15.92	20726	1664	8.03	78721077	6307476	8.01
BGR	1681	326	19.39	2387	438	18.35	1147802	214063	18.65
CYP	617	0	0.00	136	0	0.00	1217094	0	0.00
DEU	26630	12389	46.52	22503	6454	28.68	53877173	16515943	30.65
DNK	34590	7182	20.76	211388	23178	10.96	169360385	24483949	14.46
ESP	17029	3692	21.68	69563	16276	23.40	200377631	47898812	23.90
EST									
FIN									
FRA	95756	29856	31.18	135401	28927	21.36	411982250	101588530	24.66
GBR	94968	1403	1.48	207000	3403	1.64	501193479	8448259	1.69
GRC	46140	6772	14.68	14608	2223	15.22	95671802	14097340	14.74
HRV	23654	4249	17.96	3365	496	14.74	13069260	1851613	14.17
IRL	28076	605	2.15	34456	651	1.89	144436737	3338809	2.31
ITA	40260	5109	12.69	4027	395	9.81			
LTU	123	3	2.44	113	2	1.77	96503	1570	1.63
LVA	240	14	5.83	832	49	5.89	463103	15023	3.24
MLT	562	36	6.41	114	20	17.54	1506841	272066	18.06
NLD	40058	7725	19.28	68167	11895	17.45	227783398	32289956	14.18

POL	5314	1584	29.81	11370	1842	16.20	8404146	1547983	18.42
PRT	25681	7099	27.64	25419	8818	34.69	53794988	15031129	27.94
ROU	169	33	19.53	598	116	19.40	304453	59173	19.44
SVN	5231	350	6.69	38886	2601	6.69	355860	23799	6.69
SWE	9734	920	9.45	20607	1158	5.62	34966565	3306898	9.46

The results for Term of Reference were delivered to DG MARE as CSV files and shapefiles plus an Excel file containing summary data results by country, year, gear type, MSFD region/subregion and subdivision.

Term of Reference 2

Core fishing areas of above-12m vessels were calculated, with core areas defined as the c-squares with highest 95%, 90%, 80% and 70% of total fishing effort, landings weight and landings value per MSFD subdivisions, gear type and EU waters. The resulting data and maps for Term of Reference 2 were delivered to DG MARE in electronic format.

As an example, the following figures show the maps with the core areas computed using 2019 data for the three variables fishing effort, landings weight and landing value and the three dimensions MSFD subdivisions and gear type and EU waters. The core areas are ranked by the percentiles, where 95% contains the most of the c-squares. In the following maps the percentiles are displayed as overlapped layers; however, using the shapefiles delivered, it is possible to explore each layer individually.

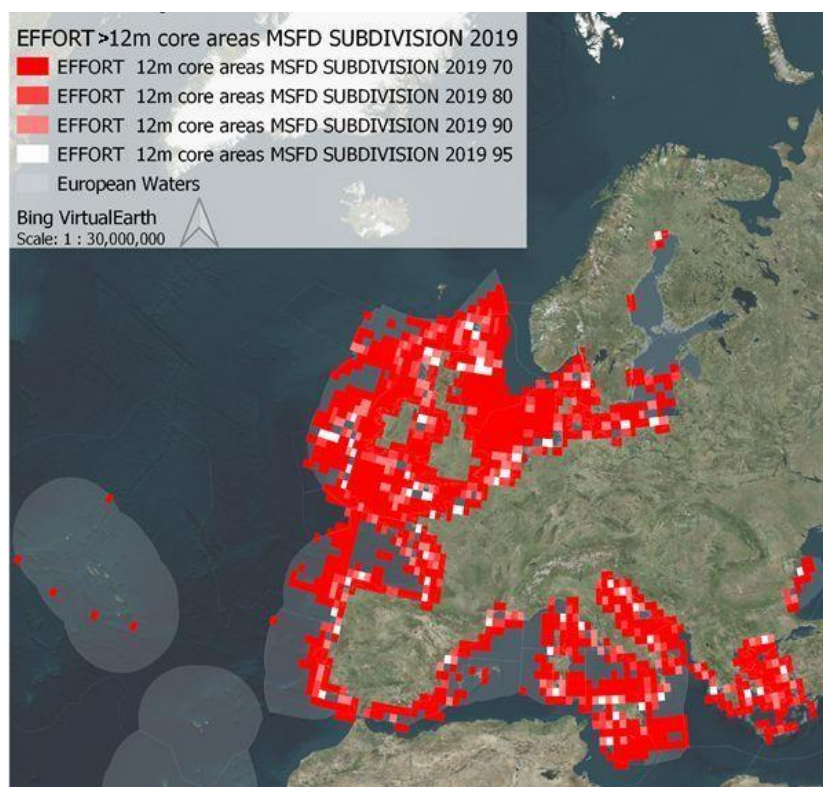


Figure 6. Core areas map of fishing effort per MSFD subdivision

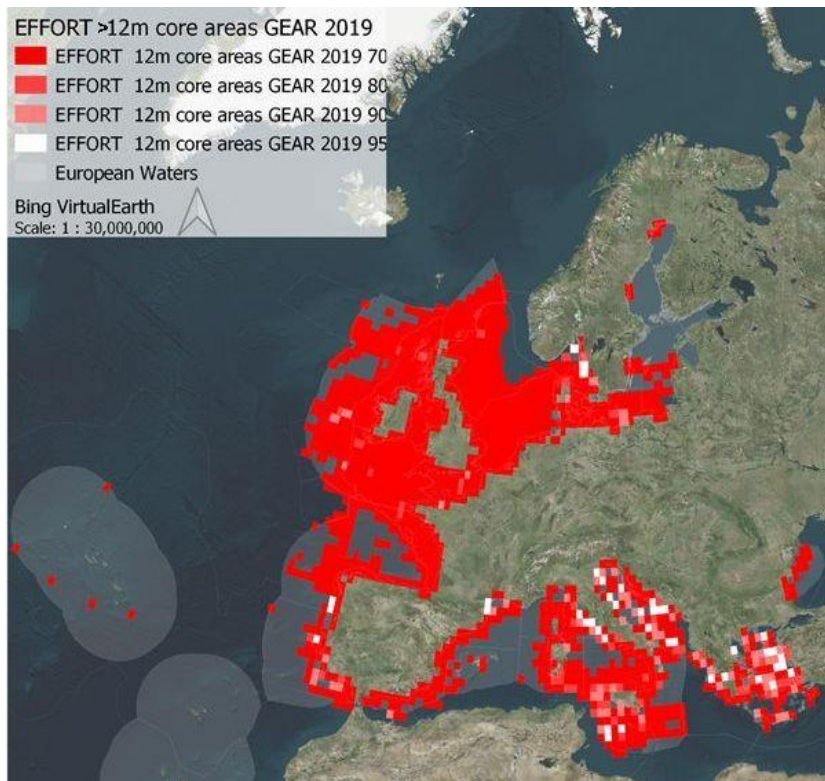


Figure 7. Core areas map of fishing effort per gear type

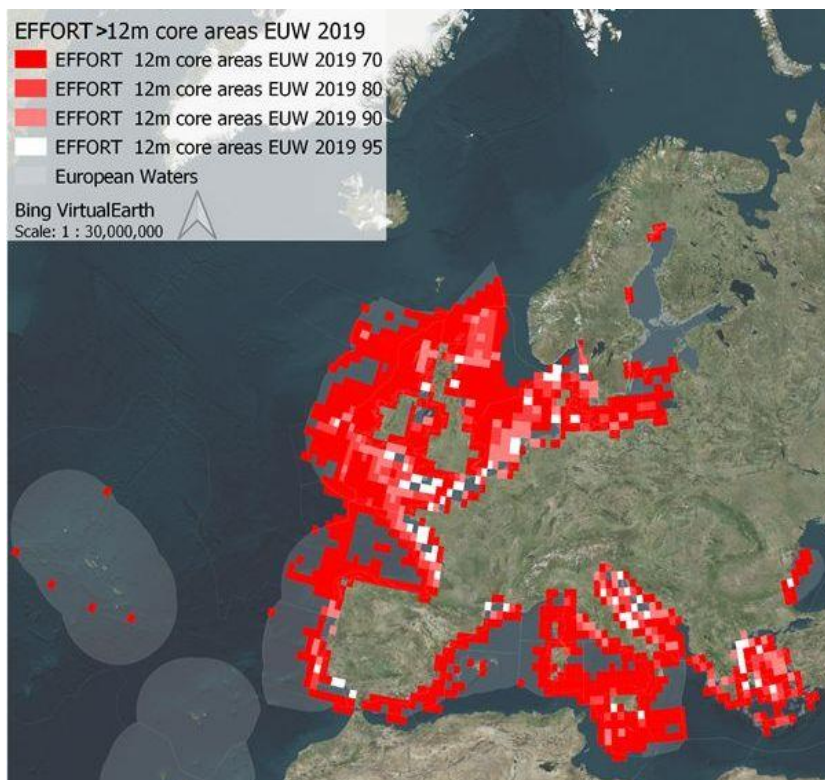


Figure 8. Core areas map of fishing effort per EU waters

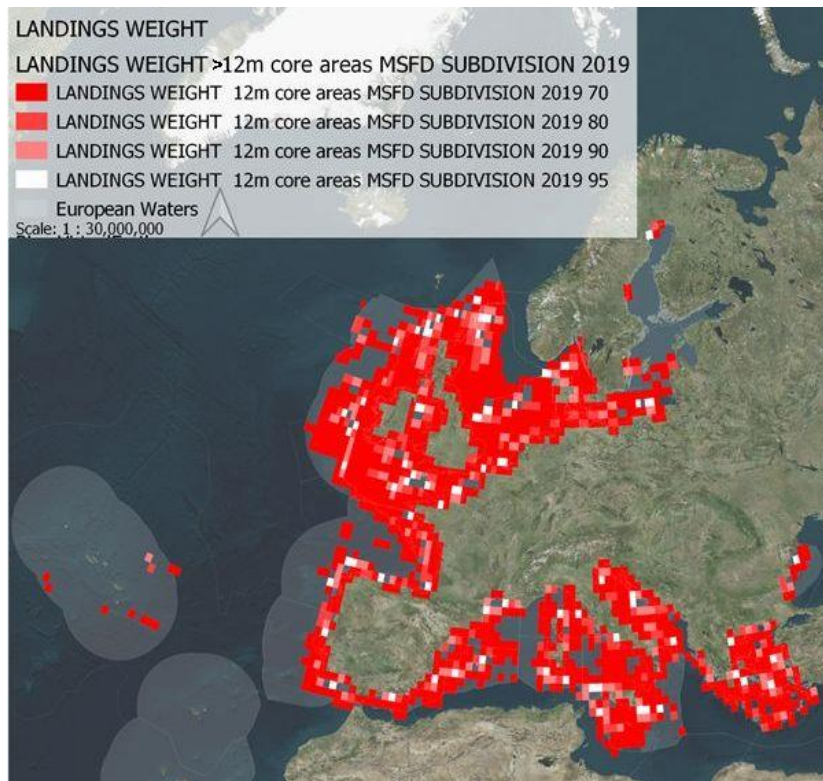


Figure 9. Core areas map of landings weight per MSFD subdivision

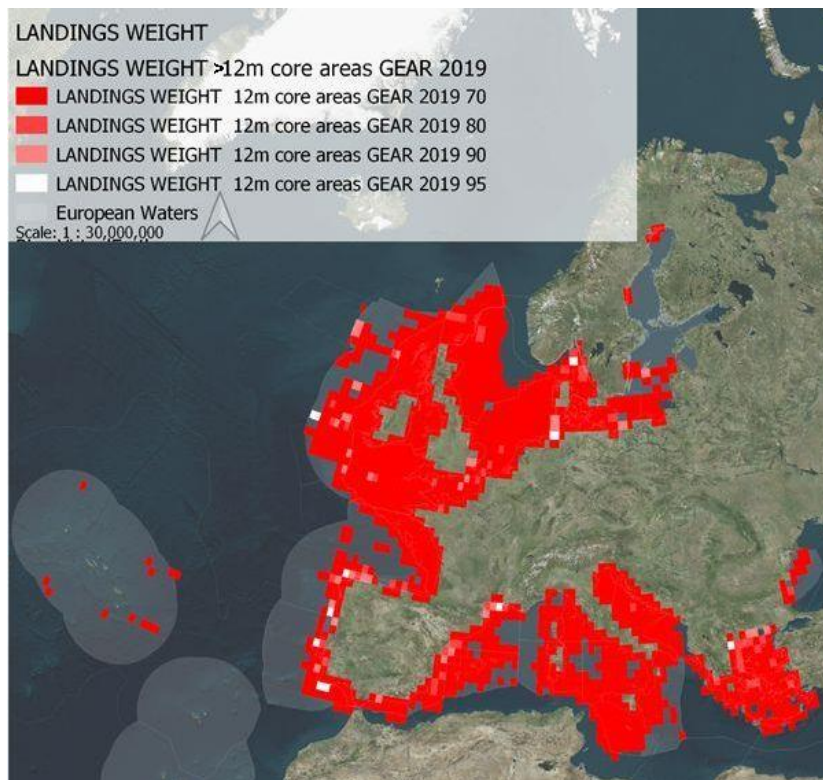


Figure 10. Core areas map of landings weight per gear type

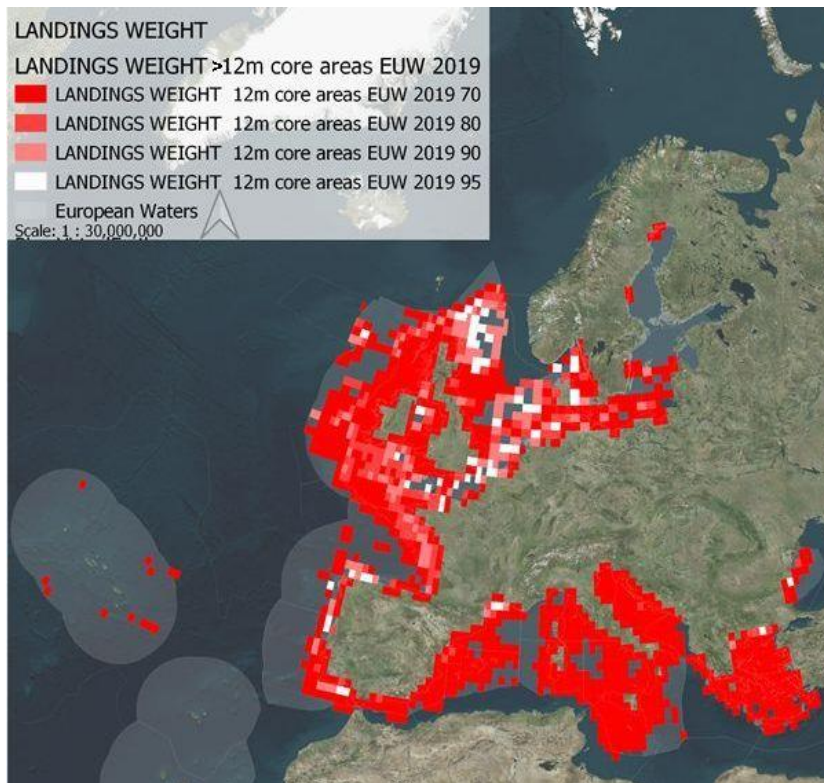


Figure 11. Core areas map of landings weight per EU waters

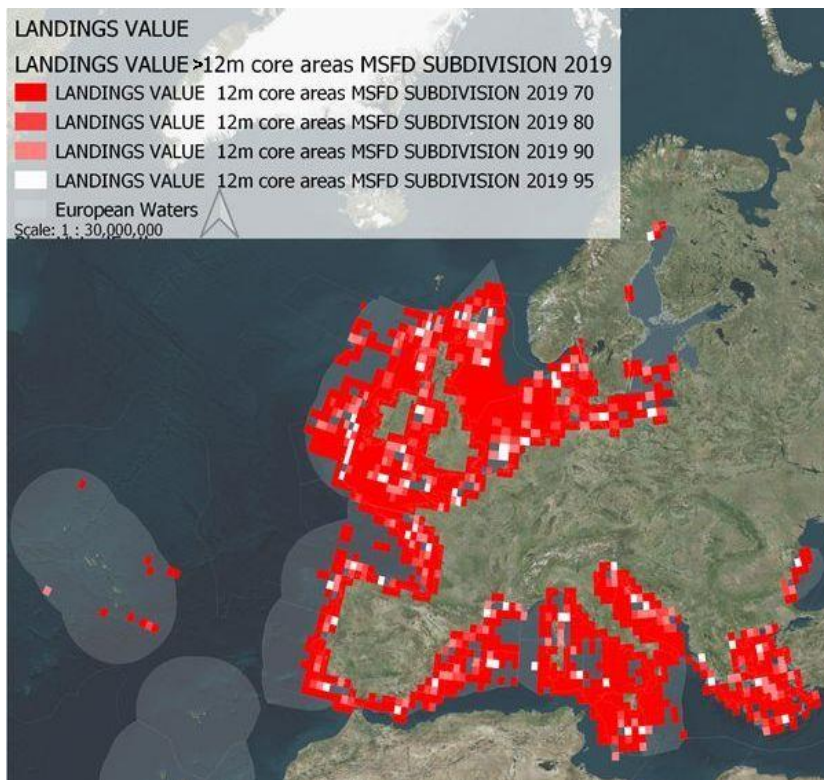


Figure 12. Core areas map of landings value per MSFD subdivision

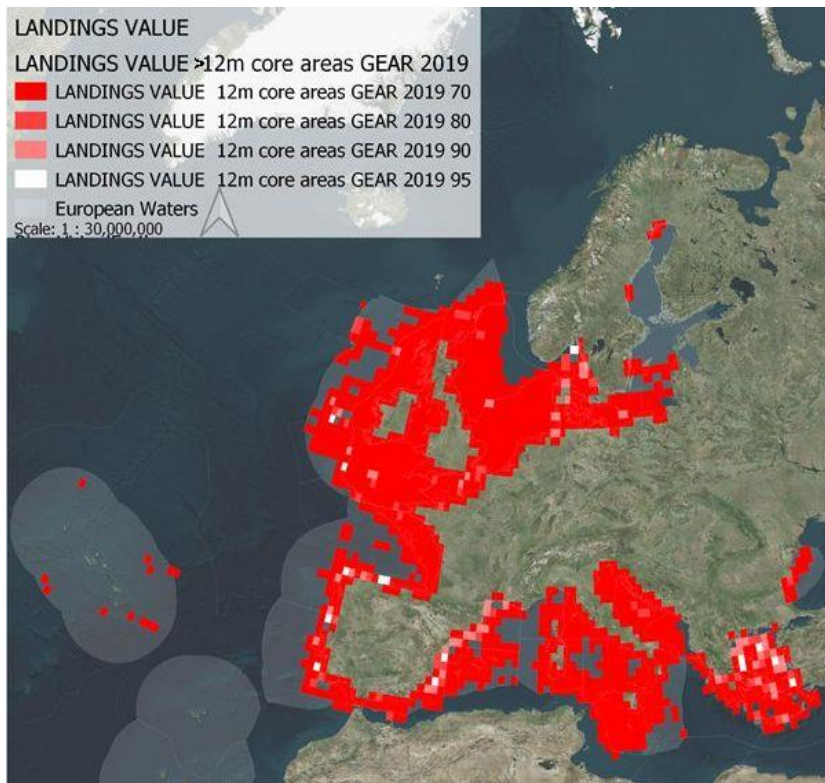


Figure 13. Core areas map of landings value per gear type

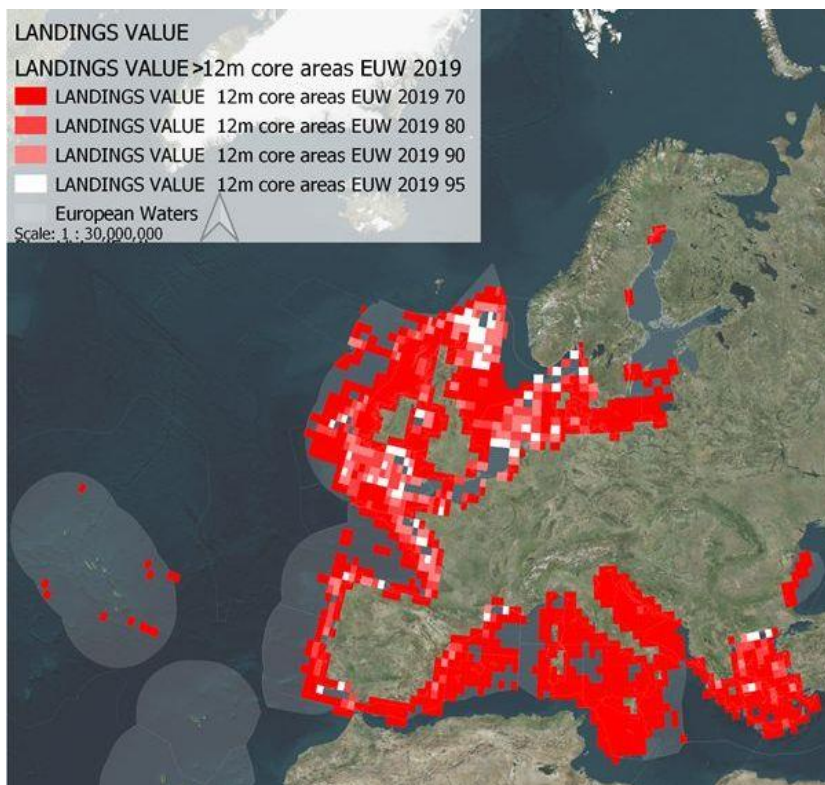


Figure 14. Core areas map of landings value per EU waters

Term of Reference 3

For vessel category above-12m, estimates of fishing effort, landings weight and landings value within MPAs were computed, separated by core and peripheral areas. The resulting data and maps for Term of Reference 3 were delivered to DG MARE in electronic format.

Term of Reference 4

Vessel length below-12m

For the vessel category below-12m, we estimated the values of fishing effort, landings weight and landings value within the MPAs defined in the EU-27 waters.

Tables 11 and 12 show a summary of the results for the vessel category below-12m, respectively excluding and including the United Kingdom fishing activity, giving values of EU fishing fleet activity in EU marine waters with values and proportion of EU fishing fleet activity in MPAs.

Table 11. Summary results for the vessel category below-12m, excluding UK data

Year	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
2017	248.7	54.6	21.9	100.3	32.9	32.8	159918.8	43895.8	27.4
2018	170.8	43.7	25.6	104.4	30.6	29.3	138384.4	40773.6	29.5
2019	232.9	48.7	20.9	86.7	27.5	31.8	131042.5	37233.3	28.4

Table 12. Summary results for the vessel category below-12m, including UK data

Year	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
2017	283.9	54.6	19.2	114.2	32.9	28.8	200757	43960.7	21.9
2018	202.7	43.8	21.6	116.6	30.6	26.2	172711.3	40849.5	23.7
2019	265.1	48.7	18.4	99.9	27.6	27.6	167892.6	37323.6	22.2

The following tables show the results by country and year, with the percentages computed against the total fishing activity per country in the EU marine waters.

Table 13. Fishing activity in MPAs by country, vessel length below-12m, year 2017

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	3	2	66.67	1	0	0.00	5540	3067	55.36
BGR	412	55	13.35	110	18	16.36	64651	10195	15.77
CYP									
DEU	1730	1079	62.37	629	215	34.18	1084887	558268	51.46
DNK	7015	1526	21.75	8754	1500	17.14	10015848	2248706	22.45
ESP	124964	17529	14.03	3456	524	15.16	25045566	3635795	14.52
EST	76	17	22.37	24	4	16.67	22705	4467	19.67
FIN									
FRA	65960	24465	37.09	68074	27876	40.95	92998194	31645692	34.03
GBR	35216	57	0.16	13851	26	0.19	40838227	64855	0.16
GRC	5404	1105	20.45	467	114	24.41	2092212	496927	23.75
HRV	18152	4833	26.63	1044	240	22.99	3379671	778878	23.05
IRL	3680	397	10.79	1263	159	12.59	5743778	719114	12.52
ITA									
LTU									
LVA	406	252	62.07	377	236	62.60	64750	40228	62.13
MLT	0	0		1	1	100.00	2148	1176	54.75
NLD	1159	345	29.77	1233	230	18.65	5100457	1450089	28.43
POL	82	73	89.02	13	11	84.62	18350	16234	88.47
PRT	13819	2443	17.68	6531	1225	18.76	8141652	1818188	22.33
ROU									
SVN	1644	110	6.69	6288	421	6.70	99812	6675	6.69
SWE	4208	343	8.15	2061	103	5.00	6038562	462122	7.65

Table 14. Fishing activity in MPAs by country, vessel length below-12m, year 2018

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL									
BGR	436	60	13.76	81	14	17.28	51970	8640	16.62
CYP									
DEU	2247	1291	57.45	764	301	39.40	1371327	639987	46.67

DNK	7156	1611	22.51	4741	832	17.55	8925963	2005363	22.47
ESP	46692	7122	15.25	470	113	24.04	2638098	681852	25.85
EST	43	12	27.91	6	1	16.67	7804	1700	21.78
FIN									
FRA	66353	24153	36.40	67826	25921	38.22	94110806	31790755	33.78
GBR	31939	57	0.18	12169	31	0.25	34326898	75881	0.22
GRC	9778	1954	19.98	770	170	22.08	3128349	662866	21.19
HRV	15402	3964	25.74	915	208	22.73	3162540	722686	22.85
IRL	2784	333	11.96	944	118	12.50	4676492	505614	10.81
ITA									
LTU									
LVA	103	63	61.17	189	110	58.20	57599	24626	42.75
MLT	0	0		2	1	50.00	4860	2660	54.73
NLD	1018	327	32.12	1641	342	20.84	5994424	1496411	24.96
POL	305	132	43.28	405	112	27.65	278050	88169	31.71
PRT	12955	2271	17.53	6418	1059	16.50	8347191	1717522	20.58
ROU									
SVN	1510	101	6.69	17459	1168	6.69	147389	9857	6.69
SWE	3998	337	8.43	1809	101	5.58	5481567	414915	7.57

Table 15. Fishing activity in MPAs by country, vessel length below-12m, year 2019

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	1	0	0.00	1	0	0.00	2820	193	6.84
BGR	346	49	14.16	85	13	15.29	42692	6659	15.60
CYP									
DEU	1423	477	33.52	561	147	26.20	827178	232971	28.16
DNK	6214	1475	23.74	4194	765	18.24	7534752	1740776	23.10
ESP	116887	14887	12.74	1234	282	22.85	6832088	1607222	23.52
EST	31	9	29.03	2	1	50.00	4820	963	19.98
FIN									
FRA	63141	22681	35.92	61233	23831	38.92	87373046	28716182	32.87
GBR	32257	77	0.24	13185	34	0.21	36850119	90324	0.25
GRC	9241	1808	19.56	689	135	19.59	2816326	527743	18.74
HRV	13991	3766	26.92	858	204	23.78	3037289	700331	23.06

IRL	2401	293	12.20	1097	142	12.94	4539205	541240	11.92
ITA									
LTU									
LVA	106	65	61.32	87	54	62.07	17376	10807	62.19
MLT	0	0		1	0	0.00	2597	1421	54.72
NLD	957	214	22.36	1456	272	18.68	3658555	632072	17.28
POL	120	106	88.33	17	15	88.24	21522	18967	88.13
PRT	12961	2404	18.55	5660	1048	18.52	8928512	2067570	23.16
ROU									
SVN	1541	103	6.68	8452	565	6.68	130738	8743	6.69
SWE	3508	320	9.12	1059	73	6.89	5272951	419448	7.95

The results for the vessel length below-12m were delivered to DG MARE as CSV files and shapefiles plus an Excel file containing summary data results by country, year, gear type, MSFD region/subregion and subdivision.

Core fishing areas of below-12m vessels were calculated, with core areas defined as the c-squares with highest 95%, 90%, 80% and 70% of total fishing effort, landings weight and landings value per MSFD subdivisions, gear type and EU waters. The resulting data and maps were delivered to DG MARE in electronic format.

Aggregated values for all vessel categories

For all vessel categories aggregated values, we estimated the values of fishing effort, landings weight and landings value within the MPAs defined in the EU-27 waters.

Tables 16 and 17 show a summary of the results, respectively excluding and including the United Kingdom fishing activity, giving values of EU fishing fleet activity in EU marine waters with values and proportion of EU fishing fleet activity in MPAs.

Table 16. Summary results for all vessel categories, excluding UK data

Year	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
2017	956.2	201.8	21.1	1128.6	158.4	14.0	1890710.3	375400.1	19.9
2018	663.8	150.1	22.6	897.3	150.5	16.8	1837833.1	389311.7	21.2
2019	648.5	138.9	21.4	774.7	135.3	17.5	1634014.4	306955.2	18.8

Table 17. Summary results for all vessel categories, including UK data

Year	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	1000 fishing days	1000 fishing days		1000 tonnes	1000 tonnes		1000 euro	1000 euro	
2017	1089.2	203.1	18.7	1358.9	162.5	12.0	2432802.9	384831.1	15.8
2018	791.6	151.5	19.1	1119.3	153.8	13.7	2362843.3	397751.7	16.8
2019	775.7	140.4	18.1	994.9	138.7	13.9	2172058	315493.8	14.5

The disparity between the totals for all the vessel categories compared to the sum of the values for above-12m and below-12m is due to the presence of unreported vessel length (vessel length recorded as *not known*, NK) in the FDI database.

The following tables show the results by country and year, with percentages computed against the total fishing activity per country in the EU marine waters.

Table 18. Fishing activity in MPAs by country, all vessel categories, year 2017

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	14520	2490	17.15	23990	2074	8.65	85380294	8507220	9.96
BGR	1548	246	15.89	1850	308	16.65	1023471	170283	16.64
CYP	1442	0	0.00	171	0	0.00	1406247	295	0.02
DEU	33421	16900	50.57	27064	7587	28.03	89827186	37044168	41.24
DNK	43374	9173	21.15	470428	36460	7.75	219311076	30380560	13.85
ESP	232302	51772	22.29	86819	18136	20.89	235760026	49967039	21.19
EST	76	17	22.37	24	4	16.67	22705	4467	19.67
FIN	57	2	3.51	150	6	4.00	175	7	4.00
FRA	164645	54415	33.05	212293	56109	26.43	544408163	138629679	25.46
GBR	133009	1373	1.03	230365	4085	1.77	542092575	9430964	1.74
GRC	53177	8294	15.60	16017	2328	14.53	109198664	15233956	13.95
HRV	45537	9595	21.07	4735	772	16.30	16198193	2568577	15.86
IRL	32609	1226	3.76	38293	944	2.47	134155934	4223267	3.15
ITA	217412	23643	10.87	8514	997	11.71			
LTU	886	48	5.42	1705	80	4.69	1523109	61537	4.04
LVA	1517	295	19.45	3552	414	11.66	3321426	169078	5.09
MLT	296	15	5.07	81	22	27.16	788624	193843	24.58
NLD	45672	11530	25.25	78010	14336	18.38	327403066	67044923	20.48
POL	6076	1145	18.84	13687	1711	12.50	10799790	1358351	12.58

PRT	40654	9170	22.56	39126	11075	28.31	57797185	15515939	26.85
ROU	884	172	19.46	4038	785	19.44	1616194	314122	19.44
SVN	5956	398	6.68	38535	2577	6.69	299398	20023	6.69
SWE	14133	1220	8.63	59498	1646	2.77	50469360	3992772	7.91

Table 19. Fishing activity in MPAs by country, all vessel categories, year 2018

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	14158	2453	17.33	21981	1799	8.18	81086977	7361191	9.08
BGR	1616	277	17.14	1676	300	17.90	983401	176686	17.97
CYP	498	0	0.00	137	0	0.00	1082811	0	0.00
DEU	32692	16420	50.23	37295	12883	34.54	94648482	40449809	42.74
DNK	43067	9400	21.83	272999	23713	8.69	195463409	29074956	14.87
ESP	58306	9239	15.85	73634	17011	23.10	219840046	55126395	25.08
EST	43	12	27.91	6	1	16.67	7804	1700	21.78
FIN	0	0		0	0		0	0	
FRA	164961	55396	33.58	211682	56568	26.72	522090850	140458322	26.90
GBR	127726	1349	1.06	221943	3228	1.45	525010157	8439999	1.61
GRC	57206	8899	15.56	16257	2408	14.81	100351890	14383693	14.33
HRV	41043	8355	20.36	4438	689	15.53	16298885	2440047	14.97
IRL	29966	950	3.17	33597	744	2.21	136093977	4176128	3.07
ITA	105527	13594	12.88	474	47	9.92			
LTU	630	43	6.83	865	59	6.82	648682	38006	5.86
LVA	1033	102	9.87	2281	182	7.98	2206017	80993	3.67
MLT	213	11	5.16	101	34	33.66	1147368	395369	34.46
NLD	46109	12205	26.47	85190	17957	21.08	351009792	73288956	20.88
POL	6735	1647	24.45	13562	2261	16.67	10372594	1912972	18.44
PRT	40164	9423	23.46	32483	8602	26.48	64823327	16442346	25.36
ROU	14	3	21.43	44	9	20.45	18904	3674	19.44
SVN	5590	374	6.69	59040	3948	6.69	460378	30789	6.69
SWE	14258	1303	9.14	29590	1324	4.47	39197545	3469658	8.85

Table 20. Fishing activity in MPAs by country, all vessel categories, year 2019

Country	Effort EU waters	Effort MPA	%	Landing weight EU waters	Landing weight MPA	%	Landing value EU waters	Landing value MPA	%
	fishing days	fishing days		tonnes	tonnes		euro	euro	
BEL	13426	2137	15.92	20727	1664	8.03	78723897	6307669	8.01

BGR	2027	376	18.55	2472	451	18.24	1190494	220722	18.54
CYP	617	0	0.00	136	0	0.00	1217094	0	0.00
DEU	28054	12866	45.86	23064	6601	28.62	54704351	16748914	30.62
DNK	40803	8657	21.22	215582	23943	11.11	176895137	26224725	14.83
ESP	133916	18579	13.87	70797	16558	23.39	207209718	49506034	23.89
EST	31	9	29.03	2	1	50.00	4820	963	19.98
FIN	4	0	0.00	5	0	0.00	2	0	0.00
FRA	158897	52537	33.06	196634	52758	26.83	499355295	130304712	26.09
GBR	127224	1480	1.16	220184	3437	1.56	538043597	8538584	1.59
GRC	55381	8580	15.49	15296	2357	15.41	98488128	14625084	14.85
HRV	37645	8016	21.29	4223	701	16.60	16106549	2551945	15.84
IRL	30477	898	2.95	35553	792	2.23	148975942	3880049	2.60
ITA	40260	5109	12.69	4027	395	9.81	0	0	
LTU	123	3	2.44	113	2	1.77	96503	1570	1.63
LVA	346	79	22.83	919	103	11.21	480479	25830	5.38
MLT	562	36	6.41	115	21	18.26	1509439	273487	18.12
NLD	41639	8090	19.43	72990	12719	17.43	236876780	33799791	14.27
POL	5434	1690	31.10	11387	1857	16.31	8425668	1566950	18.60
PRT	38642	9503	24.59	31079	9866	31.74	62723500	17098699	27.26
ROU	169	33	19.53	598	116	19.40	304453	59173	19.44
SVN	6772	453	6.69	47338	3166	6.69	486597	32542	6.69
SWE	13243	1240	9.36	21666	1231	5.68	40239516	3726345	9.26

The results for all vessel categories were delivered to DG MARE as CSV files and shapefiles plus an Excel file containing summary data results by country, year, gear type, MSFD region/subregion and subdivision.

Term of Reference 5

The datasets resulting from the analysis were delivered to DG MARE in Excel and CSV files, while the maps were delivered as shapefiles (i.e. a geospatial vector data format) that can be visualized using a GIS software application.

The scripts implemented and used to carry out the analysis, with the input datasets, were also delivered to DG MARE. The whole analysis can be reproduced using these scripts and datasets.

In addition:

- two Tableau dashboards were prepared and delivered to allow an easier way to interact with the spatial data produced by the analysis, and
- a 3D model was provided to illustrate the different percentiles used to define the core areas.

Additional request

In addition to what requested in the Terms of Reference and following a request received by DG MARE in January 2022 after the signature of the contracts, the analysis by marine protected areas (MPAs) was performed also for each of the vessel length categories defined in the FDI database (VL0006, VL0010, VL0612, VL1012, VL1218, VL1824, VL2440 and VL40XX). For this additional analysis, it was requested and agreed (during a meeting on 11 February 2022) to use a different FDI subset of data: a dataset not limited to EU marine waters but covering the FAO fishing areas considered in the study (areas 27, 34 and 37). The results of this extra analysis were delivered in electronic format to DG MARE on 19 February 2022 and are not presented in this document.

References

- [1] Tony Rees (2003). C-Squares, a New Spatial Indexing System and its Applicability to the Description of Oceanographic Datasets. *Oceanography* 16(1):11-19
- [2] 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
- [3] Scientific, Technical and Economic Committee for Fisheries (STECF) – Fisheries Dependent Information – FDI (STECF-19-11). Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-14096-2, doi:10.2760/230618, JRC119066
- [4] 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
- [5] 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
- [6] Gibin Maurizio and Zanzi Antonella (2020): Fisheries landings & effort: data by c-square (2015-2019). European Commission, Joint Research Centre Data Catalogue [Dataset] PID: <http://data.europa.eu/89h/79745491-f847-450a-a26d-fd4a8e4a14f4>

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Annex 1: Terms of Reference

Background

The European Commission is working on an Action plan² which will recommend actions for the Member States and the Commission to better link the implementation of the common fisheries policy with environmental legislation, notably the Birds, Habitats and Marine Strategy Framework Directives. A key topic in the Action plan is on the regulation of mobile bottom-contact fishing gears in EU waters. In that context, ICES has provided³ advice in 2021 on several management options, including spatial closures. Limitations of this advice in the short term are that the advice does not cover all EU waters, notably the Mediterranean and Black Seas, and that no analysis has been performed on the mobile bottom-contact fishing activity in relation to marine protected areas. Although new initiatives exist to extend the analysis, the Commission has an urgent short-term need for data analysis on the spatial fishing activity of bottom-contact fishing gears for all EU waters, before the launch of the Action plan in March 2022. As an ad hoc solution to meet the short-term needs of the Commission, the GIS analysis of EU spatial fishing effort and landings data on c-square level⁴ from the EU Data Collection Framework as compiled in the STECF Fisheries Dependent Information database in combination with shape-files of the EU marine protected areas, is requested.

Scope of the analysis

The request pertains to the fishing zones defined in Article 5 of Regulation (EU) 2019/1241. The analysis should contain the EU vessels active in EU marine waters. The demersal gear types to be included in the analysis are the OTB, OTT, PTB, SSC, SDN, SB, SV, DRB, HMD, TBB, SPR. Data should be analysed and compiled for the most recent years held in the FDI database, since 2017. Considering that reporting of spatial data is mandatory since 2017, at least the most recent three years since then should be analysed, taking note of the potential current incompleteness of 2020 data. The analysis must contain figures both per year and as an average of the analysed time-series, to ensure the figures are representative.

For the purposes of this analysis, the following should be included within the meaning of marine protected area:

- a. Special areas of conservation (SAC) established under Council Directive 92/43/EEC;
- b. Special protection areas (SPA) established under Directive 2009/147/EC;
- c. Nationally protected areas (including those designated in accordance with obligations under regional sea conventions);

The marine protected areas with known restricting measures on bottom trawling are excluded from the analysis to prevent false attribution of fishing effort and landing to those areas. DG MARE will specify which areas that are to the contractors.

² Road map for the Action plan to conserve fisheries resources and protect marine ecosystems (europa.eu)

³ ICES (2021). *Special Request Advice* EU ecoregions. EU request on how management scenarios to reduce mobile bottom fishing disturbance on seafloor habitats affect fisheries landing and value. eu.2021.08.pdf (ices.dk)

⁴ A c-square is 0.5 degrees of latitude x 0.5 degrees of longitude. This is about 30 x 24.2 nautical miles (56 x 44.8 km) at the latitude of Gibraltar and 30 x 14.9 nautical miles (56 x 27.6 km) at the latitude of Helsinki

Outcome of the request required by the client

The contractor is requested to deliver the following:

1. Estimates of the fishing activity in terms of fishing effort in all marine protected areas for all above-12m mobile bottom contacting fishing vessels, per Member State, gear type, EU totals and MSFD region and subdivision. This must be delivered in the form of a shape file and summary tables indicating the estimated values per MS, subdivision and gear type and EU totals. Where possible, the contractor should remain site codes and site type features in the output, to facilitate ex-post analysis.
Additionally the contractor must provide:
 - a. The relative shares of fishing effort in all marine protected areas, per Member State, subdivision and gear type relative to their respective (EU) totals.
 - b. As 1. and 1.a, but for landings weight and landings value.
2. GIS shape file maps of the core and peripheral fishing areas of above-12m vessels, with core areas defined as the c-squares with highest 90% of total bottom fishing effort per marine subdivision of MSFD regions⁵, gear type and overall (all EU marine waters). This must be delivered in the form of layered maps (shapefiles) and summary tables (Excel).
 - a. As above, but for definitions of core area, based on landings weight and landings value.
 - b. As above, but for each type of gear type;
 - c. As 2(a and b), but for a definition of core fishing area as 95%, 80% and 70% of fishing effort, landings weight and value.
3. Estimates of the fishing effort of above-12m vessels within marine protected areas, separated by core and peripheral areas using the different definitions under 2(c). This must be delivered in the form of a table indicating the estimated values per MS.
Additionally the contractor must provide:
 - a. A table of relative shares of fishing activity in marine protected areas in core and peripheral areas, per Member State and gear type.
 - b. As above, but for landings weight and landings value.
4. To the extent possible, having regard to the coverage, completeness and quality of available information, complete similar analyses as under points 1, 2 and 3 for (a) under-12m vessels, and (b) aggregated values for all vessels, notably for the sub-12m vessels of countries with complete data coverage of this fleet segment and EU totals for all bottom-trawling. And, alongside provide a short evaluation of the coverage, completeness and quality of available information.
5. Provide an accessible version of the code or script used for the above analyses, allowing a relatively inexperienced user to extract values of effort, landings weight and landings value by gear type, Member State and vessel length for any MPA (or group of MPAs), making appropriate (and documented) interpolations and imputations from values in adjacent and enclosed c-squares.

⁵ To be provided by DG ENV

The contractor is requested to deliver full documentation on the methodology used and modelling choices, notably explaining the approach taken on:

- a. The estimation of fishing activity in marine protected areas that are small and/or have irregular borders and therefore have c-squares that are partially in and outside the MPA.
- b. A short discussion on the overall quality of the estimates in the outputs.
- c. The approach in attributing values of overlapping MPAs, or MPAs presented under different frameworks, and the influence on the calculation of totals and subtotals.
- d. The detection and processing of anomalies in the data and the handling thereof. The contractor should flag data quality issues to the Commission, if encountered.
- e. The assurance of confidentiality by discreet handling of data and the discreet communication of results to the Commission.

Annex 2: FDI dataset

The dataset used as input for the analysis was prepared selecting from the FDI database the data of interest for the analysis as described in the paragraph *FDI dataset*. The following tables show the summary of this FDI subset by country, year and vessel category *above-12m*, *below-12m* and all vessel categories together.

Table 21. FDI data by country in EU waters, year 2017, vessel categories above-12m and below-12m

Country	Vessel length>12m			Vessel length<12m		
	Effort	Landings weight	Landings value	Effort	Landings weight	Landings value
	fishing days	tonnes	euro	fishing days	tonnes	euro
BEL	14517	23989	85374754	3	1	5540
BGR	1136	1740	958820	412	110	64651
CYP	1442	171	1406247			
DEU	31692	26435	88742300	1730	629	1084887
DNK	36359	461673	209295228	7015	8754	10015848
ESP	107338	83363	210714461	124964	3456	25045566
EST				76	24	22705
FIN	57	150	175			
FRA	98684	144219	451409969	65960	68074	92998194
GBR	97792	216514	501254347	35216	13851	40838227
GRC	47773	15551	107106451	5404	467	2092212
HRV	27386	3690	12818521	18152	1044	3379671
IRL	28929	37030	128412156	3680	1263	5743778
ITA	217412	8514				
LTU	886	1705	1523109			
LVA	1111	3175	3256676	406	377	64750
MLT	296	80	786475	0	1	2148
NLD	44382	76673	321593832	1159	1233	5100457
POL	5994	13675	10781440	82	13	18350
PRT	26835	32595	49655533	13819	6531	8141652
ROU	884	4038	1616194			
SVN	4312	32246	199586	1644	6288	99812
SWE	9924	57436	44430799	4208	2061	6038562

Table 22. FDI data by country in EU waters, year 2018, vessel categories above-12m and below-12m

Country	Vessel length>12m			Vessel length<12m		
	Effort	Landings weight	Landings value	Effort	Landings weight	Landings value
	fishing days	tonnes	euro	fishing days	tonnes	euro
BEL	14158	21981	81086977			
BGR	1180	1595	931430	436	81	51970
CYP	498	137	1082811			
DEU	30445	36531	93277155	2247	764	1371327
DNK	35911	268258	186537446	7156	4741	8925963
ESP	11613	73164	217201948	46692	470	2638098
EST				43	6	7804
FIN						
FRA	98608	143856	427980044	66353	67826	94110806
GBR	95788	209776	490683258	31939	12169	34326898
GRC	47428	15487	97223541	9778	770	3128349
HRV	25642	3523	13136345	15402	915	3162540
IRL	27183	32654	131417485	2784	944	4676492
ITA	105527	474				
LTU	630	865	648682			
LVA	930	2092	2148418	103	189	57599
MLT	213	99	1142507	0	2	4860
NLD	44978	82295	342721258	1018	1641	5994424
POL	6430	13157	10094544	305	405	278050
PRT	27209	26065	56476136	12955	6418	8347191
ROU	14	44	18904			
SVN	4080	41582	312988	1510	17459	147389
SWE	10260	27781	33715978	3998	1809	5481567

Table 23. FDI data by country in EU waters, year 2019, vessel categories above-12m and below-12m

Country	Vessel length>12m			Vessel length<12m		
	Effort	Landings weight	Landings value	Effort	Landings weight	Landings value
	fishing days	tonnes	euro	fishing days	tonnes	euro
BEL	13425	20726	78721077	1	1	2820
BGR	1681	2387	1147802	346	85	42692
CYP	617	136	1217094			
DEU	26630	22503	53877173	1423	561	827178
DNK	34590	211388	169360385	6214	4194	7534752
ESP	17029	69563	200377631	116887	1234	6832088
EST				31	2	4820
FIN						
FRA	95756	135401	411982250	63141	61233	87373046
GBR	94968	207000	501193479	32257	13185	36850119
GRC	46140	14608	95671802	9241	689	2816326
HRV	23654	3365	13069260	13991	858	3037289
IRL	28076	34456	144436737	2401	1097	4539205
ITA	40260	4027				
LTU	123	113	96503			
LVA	240	832	463103	106	87	17376
MLT	562	114	1506841	0	1	2597
NLD	40058	68167	227783398	957	1456	3658555
POL	5314	11370	8404146	120	17	21522
PRT	25681	25419	53794988	12961	5660	8928512
ROU	169	598	304453			
SVN	5231	38886	355860	1541	8452	130738
SWE	9734	20607	34966565	3508	1059	5272951

Table 24. FDI data by country in EU waters, all vessel categories together

Country	2017			2018			2019		
	Effort	Landings weight	Landings value	Effort	Landings weight	Landings value	Effort	Landings weight	Landings value
	fishing days	tonnes	euro	fishing days	tonnes	euro	fishing days	tonnes	euro
BEL	14520	23990	85380294	14158	21981	81086977	13426	20727	78723897
BGR	1548	1850	1023471	1616	1676	983401	2027	2472	1190494
CYP	1442	171	1406247	498	137	1082811	617	136	1217094
DEU	33421	27064	89827186	32692	37295	94648482	28054	23064	54704351
DNK	43374	470428	219311076	43067	272999	195463409	40803	215582	176895137
ESP	232302	86819	235760026	58306	73634	219840046	133916	70797	207209718
EST	76	24	22705	43	6	7804	31	2	4820
FIN	57	150	175				4	5	2
FRA	164645	212293	544408163	164961	211682	522090850	158897	196634	499355295
GBR	133009	230365	542092575	127726	221943	525010157	127224	220184	538043597
GRC	53177	16017	109198664	57206	16257	100351890	55381	15296	98488128
HRV	45537	4735	16198193	41043	4438	16298885	37645	4223	16106549
IRL	32609	38293	134155934	29966	33597	136093977	30477	35553	148975942
ITA	217412	8514		105527	474		40260	4027	
LTU	886	1705	1523109	630	865	648682	123	113	96503
LVA	1517	3552	3321426	1033	2281	2206017	346	919	480479
MLT	296	81	788624	213	101	1147368	562	115	1509439
NLD	45672	78010	327403066	46109	85190	351009792	41639	72990	236876780
POL	6076	13687	10799790	6735	13562	10372594	5434	11387	8425668
PRT	40654	39126	57797185	40164	32483	64823327	38642	31079	62723500
ROU	884	4038	1616194	14	44	18904	169	598	304453
SVN	5956	38535	299398	5590	59040	460378	6772	47338	486597
SWE	14133	59498	50469360	14258	29590	39197545	13243	21666	40239516

A note about the totals of fishing activity by all vessel categories for Finland (in 2019) and Netherlands (in 2017, 2018 and 2019): due to the presence of unreported vessel length (vessel length recorded as *not known*, NK) in the FDI database, the totals by all vessel categories for these 2 countries differ from the sum of the values for the above-12m and under-12m categories.

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