WORKSHOP ON MIXED FISHERIES FLEETS (WKMIXFLEET)

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ICES International Council for the Exploration of the Sea
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Contents

i Executive summary

The ICES Workshop on Mixed Fisheries Fleets (WKMIXFLEET) brought together the expertise of mixed fisheries scientists and economists to address concerns raised by stakeholders, and issues identified by the ICES Working Group on Mixed Fisheries Advice, on the fleet definitions used to produce mixed fisheries advice.

The work undertaken by WKMIXFLEET included defining a new framework for fleet segmentation, applying this to new sources of mixed fisheries data (Regional Database and Estimation System - RDBES), identifying differences compared with the current approach and considering future data sources or changes to current data calls which may aid the implementation of the new framework.

The new framework builds fleets as groups of vessels of the same fleet segment (defined by main Fishing Technique and Vessel Length Category), on an ecoregion basis, and makes use of spatial information as well as data on gear choice, target species assemblages and catch compositions. By defining the initial segments at the Fishing Technique*Length Category level, the new framework increases the compatibility of mixed fisheries fleet segmentation with the Annual Economic Report segmentation. It thus offers the opportunity to extend the current advice to more integrated advice products that account for socio-economic issues related to technical interactions in some segments. Additionally, this approach defines fleets based on more homogeneous aggregates of vessels which, in turn, improves the characterization of fleet behaviour. Using clear and transparent definitions to build fleets that are easier to understand and communicate is expected to raise the salience of mixed fisheries advice products to stakeholders and advice requestors. Additionally, the new data fields and level of disaggregation provided through the RDBES data, highlight scope for developing new mixed fisheries analyses and advice. Though the RDBES data will be an adequate data source for implementing the new framework, several future datasets and knowledge, such as future RDBES data products and data on social aspects, were identified which would bring additional value to mixed fisheries advice if incorporated with the new framework.

Unfortunately, some data quality issues in this new RDBES dataset, discovered during the workshop, prevent this framework from being implemented immediately. These issues also prevented a fully documented methodology from being developed. A necessary ecoregion appropriation of the fleet definition was also underlined. Therefore, this work will be progressed by the ICES Working Group on Mixed Fisheries Methodology in coordination with the ICES Working Group on Economics.

ii Expert group information

Expert group name	Workshop on mixed fisheries fleets (WKMIXFLEET)
Expert group cycle	Annual
Year cycle started	2023
Reporting year in cycle	1/1
Chairs	Harriet Cole (UK)
	Claire Macher (France)
Meeting venue and dates	12–13 March 2024, Copenhagen, Denmark (25 participants)

1 Introduction

Currently, the fleet designations used to produce mixed fisheries considerations are not true fleets but rather aggregations of fishing activities (i.e. métier). As such, the fleets used do not represent unique groups of vessels which has implications for accurately characterizing fleet fishing behaviour and assessing choking effects. Furthermore, a key outcome from the recent series of scoping workshops with stakeholders on mixed fisheries advice (WKMIXFISH, WKMIXFISH2) were concerns about the methodology used to define the fleets operating in the mixed fisheries models (ICES, 2020; ICES, 2023). These concerns mostly centre on the lack of transparency on the definitions used and that the current fleet designations do not resonate with what stakeholder groups identify as a fleet.

It is important to separate what is meant by a fleet from the métier as this workshop focused on fleet definitions. Broadly, a fleet is a physical group of vessels that share similar characteristics in terms of technical features and/or major activity, such as vessel length class and predominant fishing gear. Whereas, a métier is a group of fishing operations targeting a similar (assemblage of) species, using similar gear, during the same period of the year and/or within the same area and which are characterized by a similar exploitation pattern. The allocation of the fishing effort per métier along the year defines the vessel strategy.

Additionally, stakeholders have expressed interest in seeing more information on the economic impacts of the mixed fisheries considerations. However, the current designations are not easily combined with fleet-based, economic datasets such as the Annual Economic Report database (STECF 23-07; Prellezo *et al*., 2023) which relies on the EU Multiannual Union Programme (EU, 2017; EU Regulation 1004/2017 EU-MAP) segmentation inherited from the former Data Collection Framework (EU, 2008; Council Regulation (EC) No 199/2008, DCF, 2008). Alternative fleet definitions are required to facilitate collaborations with the Working Group on Economics to advance the integration of advice on the socio-economic viability of mixed fisheries scenarios.

This report details the work undertaken by mixed fisheries scientists and fisheries economists to develop a new approach to fleet segmentation for mixed fisheries models using the RDBES commercial effort and landings tables at the primary data source by answering the following ToRs:

a) Develop and document a new methodology for defining fleets using the combined expertise of mixed fisheries scientists and economists;
b) Apply this new methodology to mixed fisheries data, taking into consideration future data sources and availability;
c) Compare the new and existing fleet definitions and, where possible, evaluate the potential effects this may have on fleet dynamics and mixed fisheries scenario results;
d) Identify any new datasets or changes to current data calls needed to implement the new methodology.

2 ToR A: Define a new methodology for defining fleets using the combined expertise of mixed fisheries scientists and economists

2.1 Summary of issues

Many of the issues with the current fleet designations used by WGMIXFISH are rooted in the current data provision. Currently, effort and landings data are provided by national institutes through an annual data call (see data call for 2024; ICES, 2024a). These data are used directly within WGMIXFISH to define fleets and métiers on an ecoregion-by-ecoregion basis. The current approach of designating fleets as aggregations of fishing activity rather than as groups of vessels is used because the data do not provide information on individual vessels. Furthermore, the level of spatial aggregation in the data (ICES division level) means that changes in the spatial dynamics of choking behaviour cannot be adequately captured. Finally, the methodologies used to derive the data (e.g. calculation of fishing effort) are not standardized which means direct comparisons cannot be made between countries and the provision of data can sometimes be incomplete. However, the Regional DataBase and Estimation System (RDBES) offers an alternative data source which will resolve some of these issues (see Table 1.1). The RDBES provides a fully documented methodology for deriving commercial effort and landings data at the statistical rectangle level, with information on individual vessels (provided through encrypted vessel IDs) and information on EU fleet segmentation of each vessel (Fishing technique and Length Category). As such, these data source is used here to explore alternative fleet designations.

Several presentations were given to demonstrate and explore the existing issues and potential alternative approaches. These are summarized below.

Claire Macher – economic and bioeconomic issues related to fleet segmentation and example of an *ad hoc* fleet segmentation in the Bay of Biscay

The talk presented introduced the issues related to the segmentation of vessels into appropriated fleet segments of similar strategy/cost structure/behaviours/constraints. Segmentation is shown to be key from an economic and bioeconomic point of view to avoid diluting impacts by forming heterogeneous groups of vessels which may hide the issues and potential chokes. Additionally, this may affect the stakeholder's perspective in terms of salience and the legitimacy of the assessments provided.
EU and alternative segmentation approaches were then presented: While the EU Multiannual Union Programme is based on a consensual fleet segmentation, the results from a workshop held in 2022 proposed an alternative segmentation derived from EU segmentation but accounting for Ecoregion, polyvalent or exclusiveness of vessels in terms of gears and structuring group of species targeted (Demanèche *et al*., 2022). This approach was the basis of an *ad hoc* segmentation developed with stakeholders in the Bay of Biscay for the Multiannual Management Plan impact assessment where main emblematic fleets of interest to stakeholders were identified.

Bernhard Kühn – experiences matching NS mixfish fleets to AER data

The talk outlined a procedure on how to add economic data to the WGMIXFISH FLBEIA model of the North Sea and summarized the challenges and opportunities given that fleet and métier definitions between the model and the economic data from the Annual Economic Report (AER) fundamentally differ. The focus was to shed light on the mismatch of current

fleet definitions with other data products outside WGMIXFISH that likely become more important in the context of EBFM.

Youen Vermard – Explorations of RDBES data at WKFO2

The talk outlined the use of RDBES and the information contained in the field "fishingTechnique" to improve fleet definition in the mixed fisheries model used in WGMIXFISH. In fact, only one fishing technique is allocated to each vessel per year corresponding to the main gear used during the year. Even if not perfect to define a fleet, this information would be a great improvement allowing, for example, the creation polyvalent fleets, which is not possible at the time being.
First analyses made during WKFO2 and WKMIXFLEET showed that it is in theory possible to use RDBES and fishing technique to define fleets in WGMIXFISH. However, these analyses also show that this information is missing for some countries and a minimum of 3 years of data in the RDBES would be needed before using it (usual procedures in WGMIXFISH use 3 years to compute catchabilities).

Harriet Cole – Exploration of RDBES Scottish data

This talk presented an exploration of the Scottish RDBES data and explored the potential use of this new data source. A key data limitation found was that a row of data sometimes represented effort or landings aggregated over several vessels. Therefore, a workaround would be needed to partition the effort and landings between the aggregated vessels to allow these aggregated vessels to be allocated to different fleets. An exploration of clustering vessels based on the proportion of shared statistical rectangles fished was shown which demonstrated that the spatial information provided by RDBES could be used in fleet definitions.

Arina Motoval – WKTRADE as an example of spatial economic disaggregation approach- linking FDI-VMS – AER

This talk presented the main approach and results from the WKTRADE workshops that are dedicated to the operationalization of the link between available VMS, STECF FDI and AER economic data to estimate landings and economic performance indicators of each fishery. It highlighted methodological issues related to allocating economic costs and benefits at a fine spatial scale using available data.

The UK approach to fleet segmentation operated by SeaFish was also presented. The national segmentation takes into account vessel activities around the UK coast and further differentiates demersal trawlers by region and main target species. This segmentation should be useful and appropriate to mixed fisheries regional advice. Estimation of economic indicators per individual vessel within SeaFish fleet segments allows reporting of data for different aggregation levels (e.g. DCF and SeaFish fleet segments). The online Fleet Enquiry Tool was also presented (Moran-Quintana *et al*., 2020).

Table 2.1. Summary of data characteristics in the current WGMIXFISH effort and landings data compared to the RDBES effort and landings data and the impact this has on mixed fisheries analyses.

Item	Current WGMIXFISH effort and landings data	RDBES effort and landings data	Impact on mixed fisheries analyses
Lowest level of spatial aggregation	ICES division	Statistical rectangle	Fleets can be segmented using spatial information at rectangle level. This means we are more able to adequately capture spatial impacts on choking behaviour.
Standardization of methodology	None. National data submitters follow their own procedures and are not comparable.	Fully documented methodology described through data model.	Standardized methodologies and definitions allow direct comparisons between countries.
Vessel activity	No information provided on vessels. Data are provided at métier level aggregated across many vessels.	Encrypted vessel IDs provided.	The current data provision means that the activity of 1 vessel may end up being inadvertently split over many "fleets". Encrypted vessel IDs and clarification of fleet definition ensure individual vessels are assigned to only 1 fleet.
Species provided	Main target species are requested in the data call but provision is not complete.	Extensive list	An extensive list of species allows additional mixed fisheries analyses to be conducted which includes species/stocks not included in the MF models. Especially important for assessing revenue from non-modelled species

2.2 Framework for fleet segmentation

All experts agreed that the vessel is the base unit for forming fleets and being able to assess bioeconomic impacts of alternative mixed fisheries scenarios. While an individual vessel can practice several métier, it should be allocated to only one fleet. The DCF fleet definition of country*fishing technique*vessel length was agreed as the starting point for fleet segmentation as each vessel falls into just one category of country, fishing technique and vessel length each year (see Tables 2.2 and 2.3 for definitions). The fishing technique is defined as the predominant fishing gear used by a vessel throughout the year (>50% of fishing time). These three characteristics represent common data fields found in a variety of fleet-based databases, including the RDBES and the AER. Thus, they can be used as a key to link together fleet-based outputs from WGMIXFISH to economic data.

However, the optimal fleet segmentation for mixed fisheries models will need to be more disaggregated than that provided by the DCF fleet definition. As a result, the DCF fleet definition should be tracked throughout the fleet formation process so that the outputs from the mixed fisheries scenarios can be merged with AER data more easily.

An example of a hierarchy of fleet definitions:

- Super-fleet (matching unclustered DCF definition – country*fishing technique*vessel length)
- MIXFISH fleet (e.g. using spatial information/ecoregion, assemblage of species targeted, stakeholder input, etc)

Table 2.2. Fishing technique codes and descriptions as defined under the DCF (Fleet Segment DCF / EU-MAP - European Commission (europa.eu).

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

Table 2.3.Vessel length class codes and descriptions as defined under the DCF (Fleet Segment DCF / EU-MAP - European Commission (europa.eu).

Vessel length class	Description
VL0006	Vessel less than 6 meters in length. For Supra region 2 only.
VL0008	Vessel less than 8 meters in length. For Baltic Sea only.
VL0010	Vessel between 0 meters and 10 meters in length. For Supra region 1 and 3 only.
VL0612	Vessel between 6 meters and 12 meters in length. For Supra region 2 only.
VL0812	Vessel between 8 meters and 12 meters in length. For Baltic Sea only.
VL1012	Vessel between 10 meters and 12 meters in length. For Supra region 1 and 3 only.
VL1218	Vessel between 12 meters and 18 meters in length. All regions.
VL1824	Vessel between 18 meters and 24 meters in length. All regions.

Vessel length class	Description
VL2440	Vessel between 24 meters and 40 meters in length. All regions.
VL40XX	Vessel greater than 40 meters in length. All regions.

Beyond the DCF fleet definition, a variety of characteristics are available in the RDBES data to group vessels exhibiting similar behaviour. Several of these were explored in the presentations given and include statistical rectangle, exclusivity of gear choice, dominant target assemblage and catch or value compositions. Currently, mixed fisheries fleets are not spatially disaggregated which means that technical interactions can appear to be stronger than they are in reality given the spatial separation of catches. Thus, spatial patterns in fishing should be an important component of the fleet segmentation process. Initial explorations of the RDBES data indicate that the statistical rectangle information will be able to substantially improve this issue. Previous modelling work to evaluate management plans in the Bay of Biscay highlighted the importance of the other characteristics. This was used to inform an initial framework proposal for fleet segmentation for mixed fisheries based on the RBDES database (see Figure 2.1).

This framework proposes:

- an initial segmentation of the vessels into fleets based on the EU segmentation (Fishing Technique*Length Category) – this allows the connection to cost structures of the AER defined at this aggregation level;
- the identification within these supra-segments of subgroups of vessels fishing in the Bay of Biscay to focus specifically on vessels operating in the Ecoregion Bay of Biscay and be able to properly account for the interactions between species and vessels found in the ecoregion of interest. This emphasized the need for criteria to decide which vessels of various fleets are actually operating in the ecoregion (e.g. based on effort proportion) which is especially crucial when some of the fleets may operate over the boundary between different ecoregions considered by WGMIXFISH. Expert and stakeholder knowledge are key to defining criteria based on data analyses and knowledge of fleet behaviour;
- a specific selection among each fleet*ecoregion of mixed fisheries vessels based on a selection of vessels fishing for stocks of interest to WGMIXFISH with the possibility at this stage to refine segmentation by including the species or the assemblages of species targeted by a subset of vessels of the fleet*ecoregion*stock selection (e.g. Nephrops trawlers, Sole netters…).

Once the allocation of vessels by sub-fleet is made, effort and landings (in quantity and value) data by métier by sub-fleet can be extracted and economic data calculated using appropriated methods to disaggregate economic data by EU fleet into sub-fleet (based on cost structures).

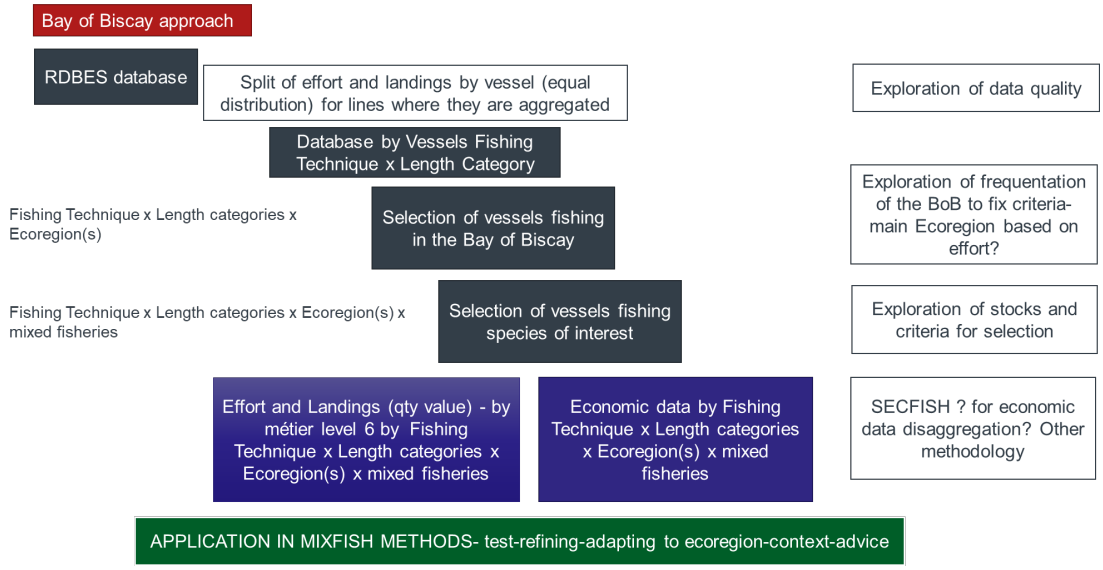

Figure 2.1. Proposed approach to fleet segmentation in the Bay of Biscay.

However, it is important to note that the exact definition of fleets (and métiers) used in a model are likely to be question-specific so that they are in line with the overall aims of the model. For example, the WGMIXFISH models aim to highlight incompatibilities in the single-stock advice given the technical interactions in the demersal fleets. This might not require the exact same approach to the Bay of Biscay ad-hoc model described in section 2.1.1 which was built to evaluate management plans. Furthermore, the finer level of fleet segmentation for mixed fisheries models opens up new areas of interest. For example, small-scale fleets contribute little to overall catches but could be disproportionately affected by changes in stock level catch advice (in particular to their dependence on some species in terms of gross value of landings) and the ability to identify and consider the behaviour of polyvalent vessels. While these two examples may not be influential enough to consider changing the current mixed fisheries model assumptions and scenarios, they do give insights into new types of mixed fisheries analyses and advice products which could be developed.

Although finer levels of fleet segmentation allow fleet behaviour to be better captured, this approach is likely to result in large numbers of fleets comprising a small number of vessels which will increase model complexity and computation requirements. As such, it is important to identify where caution is needed when making decisions about combining fleets.

One such example is vessel length categories. In the current mixed fisheries fleets several length categories are aggregated together into one fleet. However, vessel length categories are highly correlated with cost structures or fishing area (coast/large) so there is a benefit to keeping fleets separated over vessel length categories when it comes to providing accurate assessments of the bioeconomic impacts of mixed fisheries scenarios. Therefore, it was recommended that differences in cost structures be considered alongside catchabilities when aggregating fleets.

It is also worth underlining that approaches considering individual vessels, with the ability to aggregate indicators according to needs, tend to be allowed by better computational abilities and detailed data. Their operationalization for complex modelling to support advice is nevertheless not fully achieved.

WGMIXFISH has made great efforts to define and document “best practices” in data processing and model conditioning to raise confidence among stakeholders in the methodologies used. Therefore, clear definitions of aggregations and thresholds which are reproducible year-to-year are a key objective for WGMIXFISH.

2.3 Summary of key points

- The vessel will form the base unit for forming fleets.
- Data fields that are common to RDBES and the AER database will be tracked/traced through the fleet formation process.
- The DCF "un-clustered" fleet definition – country*fishing technique*vessel length category – will be used as the starting point for fleet segmentation.
- Fleet definitions will further consider combinations of statistical rectangle, exclusivity of gear choice, dominant target assemblage and catch or value compositions as required.
- An ecoregion viewpoint is key to determining which fleet segments are important by defining which vessels are operating in the area and which species are relevant to characterizing fishing activities.
- The overall purpose of the mixed fisheries models should be used to inform on fleet segmentation decisions.
- Parsimony in the number of fleets should be balanced against the impact that combining fleets may have on the accuracy of bioeconomic assessments through linking to socioeconomic datasets.
- Clear definitions for fleet segmentation that are traceable and reproducible are needed to maintain and raise confidence in the mixed fisheries considerations among stakeholders.

3 ToR B: Apply new methodology to mixed fisheries data, taking into consideration future data sources and availability

3.1 Initial data exploration

Having defined a framework for fleet segmentation, the next step was to explore the RDBES commercial effort (CE) and landings (CL) tables concerning the key data fields identified in the framework. However, this exploration revealed several data quality issues which prevented a full exploration of fleet segmentation approaches. These data quality issues included missing data fields (e.g. "NULL" listed in fishing technique) and incorrect métiers (e.g. only dredge métiers were listed for England-UK). Additionally, some countries expressed concerns about these data being used for advice products when it is a very new product and, as yet, fairly untested. As a result, WGMIXFISH will engage with the WGRDBESGOV group to provide feedback on the RDBES data products.

The first step taken was to examine the DCF fleet segment definition of fishing technique and vessel length category. Figures 3.1-3.3 show how these fleet segments interact with the gear categories métier used within each segment in the Bay of Biscay, Celtic Sea and North Sea. In the Bay of Biscay (Figure 3.1) there is a large mix of fishing techniques seen across the vessel length categories whereas certain fishing techniques seem to be more highly associated with specific vessel length categories in the Celtic Sea (Figure 3.2). The importance of polyvalence in the Bay of Biscay can also be seen in the large number of entries under these fishing techniques (PGP, PMP, MGP). This also raised questions on how stable the allocation of fishing technique may be year-to-year as this could substantially influence the size of certain fleets over time. Alternative segmentations could use different criteria to define a "predominant" gear while retaining the DCF fishing technique allocation for merging with other datasets.

In the Celtic Sea, small vessels often report a MIS gear category no matter the reported fishing technique. Additionally, a large number of entries report dredges as the gear category which is related to the previously identified issue in the data from England-UK. This can be seen in the North Sea too (Figure 3.3). In all three ecoregions, the DTS fishing technique is often associated with more of a mix of gear categories compared to the DFN fishing technique which is dominated by nets. In the North Sea, a large number of entries with NULL as the reported fishing technique can be seen which makes a detailed analysis of fleet segments in this ecoregion difficult.

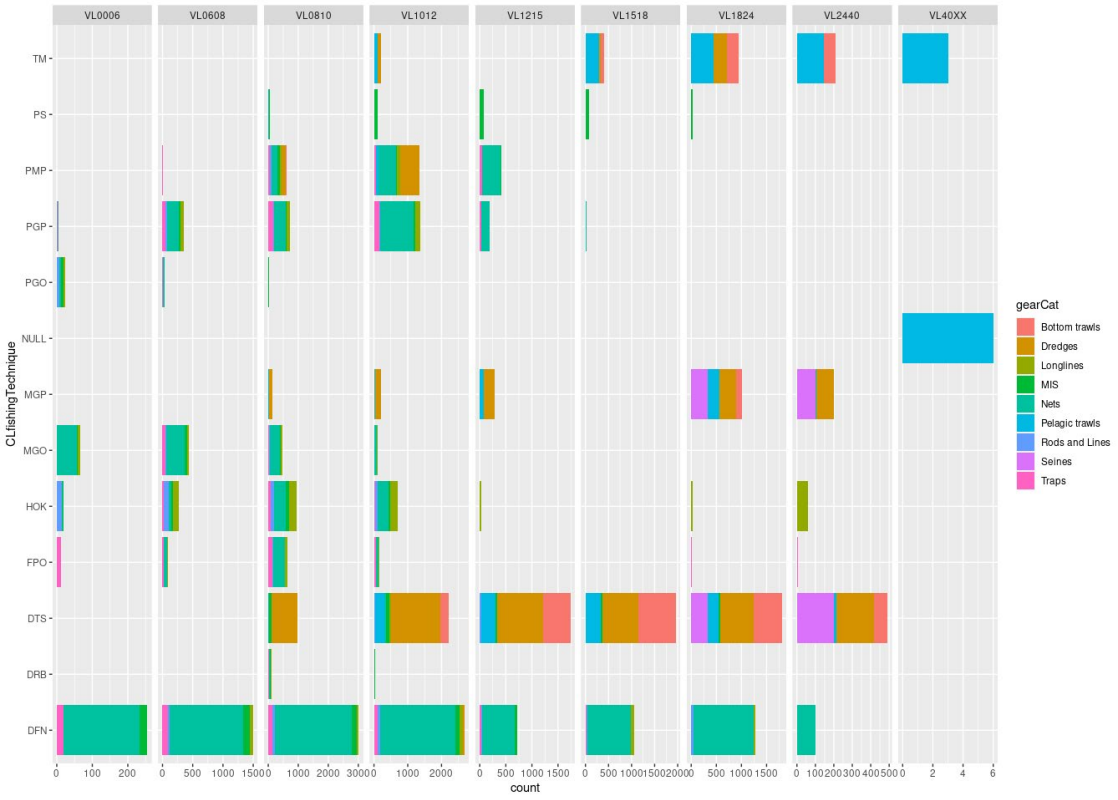

Figure 3.1. Number of data entries by gear category and fishing techniques and vessel size in the Bay of Biscay (27.8.a and 27.8.b)

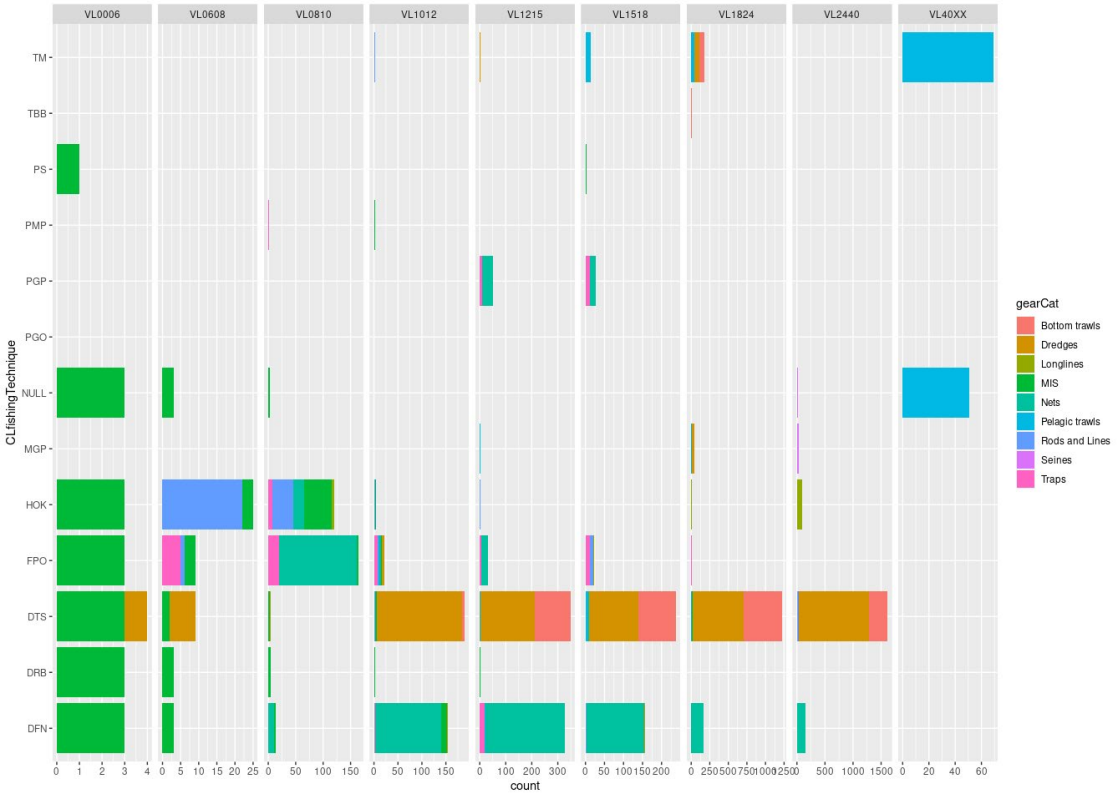

Figure 3.2. Number of entries by gear category and fishing techniques and vessel size in the Celtic Sea (27.7.b, 27.7.c, 27.7.f, 27.7.g, 27.7.h, 27.7.j, 27.7.k)

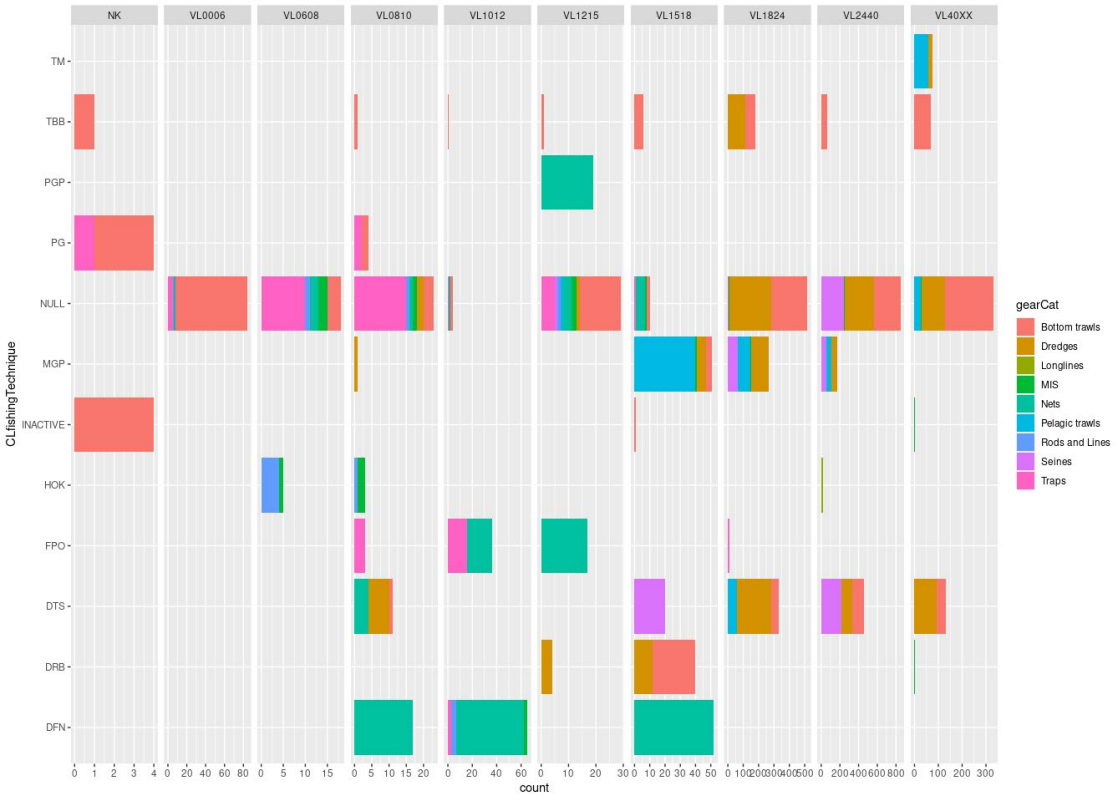

Figure 3.3. Number of entries by gear category and fishing techniques and vessel size in the North Sea (27.4.a, 27.4.b and 27.4.c)

3.2 Vessels as the base unit

Exploring the RDBES CE and CL tables revealed that data can be aggregated over more than 1 vessel. This is a major barrier to using vessels as the base unit for fleets as data on individual vessels cannot be directly examined. Two ways to deal with this were demonstrated at the workshop.

The first was to take the groups of aggregated vessels into account when defining fleets so that vessels that are aggregated together in the data are allocated to the same fleet. This would be expected to work fairly well as vessels need to have similar characteristics (country, fishing technique, rectangle, vessel length category, métier, species) to be aggregated together in the data. However, we then cannot easily partition effort, landings data between the aggregated vessels. This makes fleet definitions involving gear choice exclusivity or catch/value compositions impossible and risks diluting fleet behaviour by forcing aggregation of vessels which ideally should be allocated to separate fleets. It also means that the importance of individual statistical rectangles to each vessel, in terms of effort, cannot be assessed. This has major implications for incorporating spatial information into the fleet definitions which is a key aim of this work.

The other method explored was to decompose the CE and CL tables to vessel-level data by assuming an equal split of effort and landings. The key advantage here is that we can use vessels as the base unit. However, this would be at the cost of introducing some uncertainty in the effort and landings per rectangle and vessel. Analysis showed that the proportion of data rows that were already at the vessel level for the CE and CL tables was 76% and 79%, respectively. Therefore, as the majority of the data are already provided at the vessel level, the sensitivity of the fleet segmentation to the introduced uncertainty should not be substantial. Further analysis is needed

to assess the proportion of vessel-level data rows across countries, ecoregions and other data categories to provide an informed view of how this may affect each ecoregion model.

Although the encrypted vessel IDs allow us to track the allocation of individual vessels to fleets within a year of data there were questions raised over the tracking of individual vessels between years. The encrypted vessel IDs are allocated by national data submitters and it is unknown if the same vessel is given the same encrypted ID year-to-year. However, it will be possible to track the total number of vessels in each fleet year-to-year and so this may be adequate for time-series analysis of fleet changes.

3.3 Defining ecoregion activity – Bay of Biscay example

In this example, we assessed vessel activity, in terms of landings, concerning the Bay of Biscay ("27.8.a", "27.8.b", "27.8.d"). Specifically, we looked at the number of vessels operating in the ecoregion, the proportion of their activity occurring in the ecoregion and the proportion of the main species caught by vessels spending most of their activity in the Bay of Biscay.

This analysis was done using a "vessel-based" RDBES and CL table, i.e. dividing landings by the number of vessels defined by the unique encrypted vessel IDs. Vessels operating in the Bay of Biscay were defined as those landing at least 1 kg of fish in ICES divisions 27.8.a, 27.8.b or 27.8.d. Then, the percentage of activity spent in the Bay of Biscay was calculated as the proportion of a vessel's landings taken in the Bay of Biscay. The number of vessels per country operating in the Bay of Biscay, either exclusively or not, is shown in Table 3.1 and Figure 3.4. From this, it can be seen that Spain and France account for the majority of the vessels operating in the ecoregion. Most of the French vessels fishing in the Bay of Biscay spend all their activity in the Bay of Biscay whereas, a substantial number of Spanish vessels fishing in the Bay of Biscay also operate outside the ecoregion.

Focusing on the vessels that are exclusively operating in the ecoregion, Figure 3.5 shows the contribution of these vessels towards the total landings by species for the 30 top species ranked by landings weight. This shows that all landings of blue whiting (WHB) and two-thirds of hake (HKE) landings are taken by vessels that also operate in areas outside the Bay of Biscay. Whereas species such as sea bass (BSS), megrim (MEG), Norway lobster (NEP), pollack (POL), sole (SOL) and whiting (WHG), which are all included in the mixed fisheries considerations, are mostly caught by vessels operating exclusively within the Bay of Biscay.

This shows that taking an ecoregion viewpoint is an important consideration for defining fleets operating in an ecoregion due to the interaction between the split of in/out-of-area vessel activity and their overall contribution to the landings of the main species caught in the ecoregion. Both of these will need to be considered in the methodology for fleet segmentation. This also highlights the need for taking similar approaches across ecoregions to ensure comparable treatment of fleets with vessels operating across ecoregions.

Table 3.1. Number of unique vessels per country in RDBES CL table for all areas and for the Bay of Biscay (27.8.abd) where at least 1kg of fish is caught.

Vessel Flag Country	Number of vessels in RDBES CL table (all areas)	Number of vessels catching >=1kg in Bay of Biscay	Number of vessels with 100% of activity in the Bay of Biscay
BE	61	6	-
DE	1	1	-
DK	1901	1	-
EE	1224	-	-
ES	7054	584	38
FI	1301	-	-
FR	2615	1412	1120
GB-ENG	2165	4	-
GB-NIR	217	2	-
GB-SCT	1701	6	1
GB-WLS	234	-	-
IE	1345	5	-
LT	73	-	-
LV	208	-	-
NL	349	6	-
PL	809	-	-
PT	352	-	-
SE	834	-	-

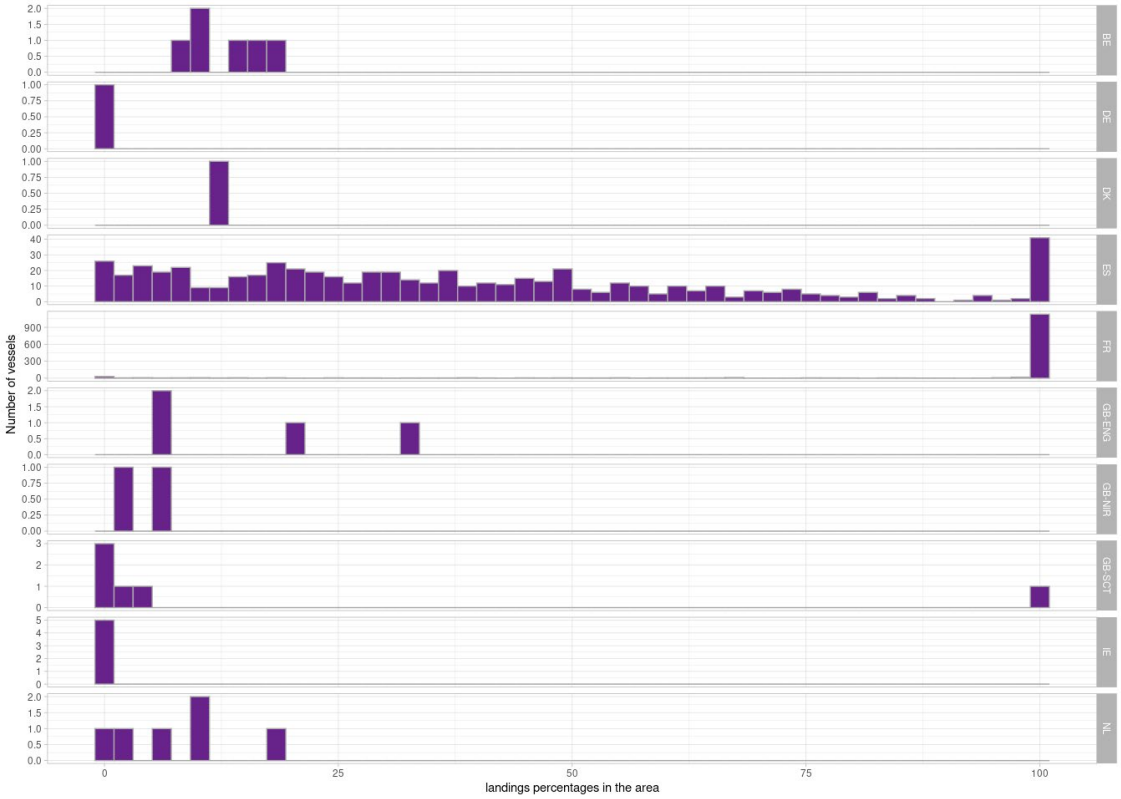

Figure 3.4. Number of vessels by percentage of landings taken within the Bay of Biscay per country.

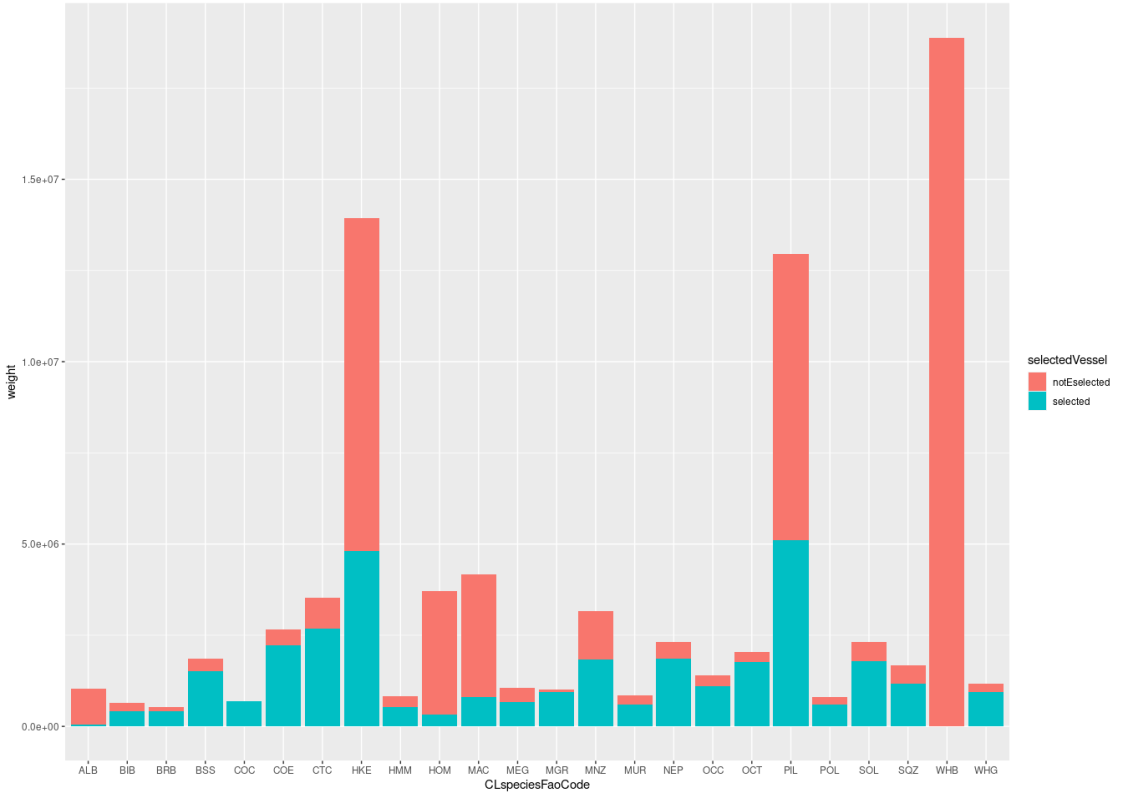

Figure 3.5. Percentage of the top 30 species from the Bay of Biscay caught by vessels operating exclusively ("selected") or non-exclusively ("notEselected") in the Bay of Biscay.

3.4 Future data sources and availability

Incorporating new data sources into the fleet definitions will be facilitated by the inclusion of data fields in the RDBES CE and CL tables which are common across many fisheries databases. Future data sources which may be likely to be used for mixed fisheries assessments would include Vessel Management System (VMS) data which could be merged with the CE and CL tables to provide information on fishing activity at finer spatial scales. The mixed fisheries "min" scenario has been seen to be more sensitive to the share of quota between fleets (ICES, 2024b,c) compared to other model input parameters. Therefore, future use of databases on quota allocation, trading and exchanges would complement the fishing activity information used by WGMIXFISH.

Steps have been taken at the workshop to increase the compatibility of the WGMIXFISH fleets with economic fisheries data so similar approaches could be used to provide compatibility with social-economic datasets. This would provide additional information on social impacts of advice changes such as effects on downstream employment and on communities that are especially reliant on the fishing industry. Such information could be used to produce new advice products to complement the current mixed fisheries considerations. Connection to the work conducted in the Ecosystem Overviews and in the WGSOCIAL are of great interest to further account for these socio-economic dimensions.

Finally, additional RDBES data products are expected to become available in near future which will ultimately replace the InterCatch database as a data source for single-stock assessments and advice. The current WGMIXFISH fleet data are routinely combined with outputs from InterCatch to allocate discard rates and age distributions to the individual fleets. Therefore, using the RDBES CE and CL tables as a data source for fleet formation builds in compatibility with the future RDBES data products that will contain information on discards and age distributions.

4 ToR C: Compare the new and existing fleet definitions and, where possible, evaluate the potential effects this may have on fleet dynamics and mixed fisheries scenario results

Due to the data quality issues encountered an explicit comparison of new and existing fleet definitions was not possible in terms of total effort and landings. However, the likely differences seen can be inferred from the framework described under ToR a (section 2). First, the technical interactions associated with a fleet will be captured more accurately due to the improvements allowed by using the RDBES as a data source. These include preventing the activity of individual vessels from being split across fleets and using spatial information to segment the fleets. This means that choking behaviour at the fleet level should be more realistic.

Additionally, we have more data to draw on such as the number of vessels and value landed as well as better linkages with databases providing further economic information. Such information may be used at an ecoregion level to identify the fleets most important for demonstrating the incompatibilities in the single-stock advice in the context of a mixed fishery. The additional data also gives us greater flexibility and scope for making future changes to fleet definitions to answer new types of advice requests or address concerns raised by stakeholders.

An example from the Bay of Biscay attempted to form WGMIXFISH-type fleets from the CL table for France and Spain. Figures 4.1 and 4.2 demonstrate how the fishing technique maps to the WGMIXFISH-type fleets. In most cases, there seems to be a direct relationship between the fishing technique (predominant fishing gear) and the WGMIXFISH-type fleet allocation. For example, French gillnetters between 10 and 24 metres (FR_G_10<24m) consist entirely of vessels with a DFN fishing technique (drifting or fixed nets). However, it can also be seen that some vessels with fishing techniques of pots, hooks and line and polyvalent vessels have some of their activity allocated to the gillnet WGMIXFISH fleets. The new approach to fleet segmentation will prevent mixing of vessel activity across fleet groupings and create new fleets consisting of vessels displaying mixed gear choices.

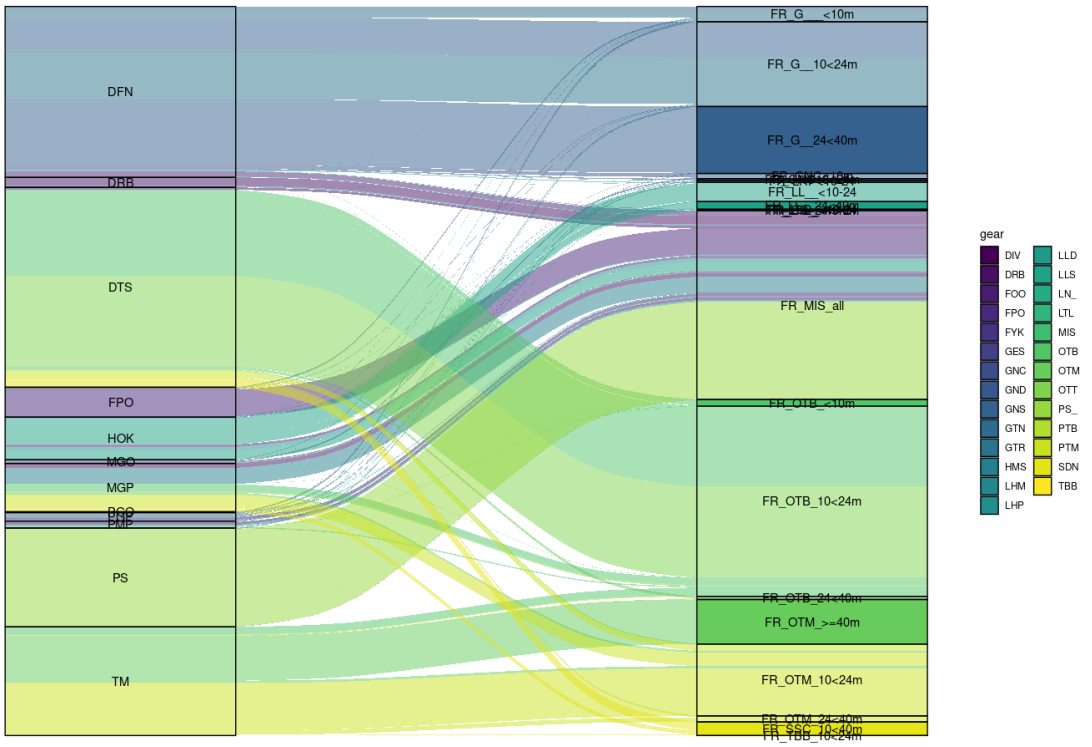

Figure 4.1. Bay of Biscay. Comparing fishing technique designation to WGMIXFISH fleet allocations for French vessels.

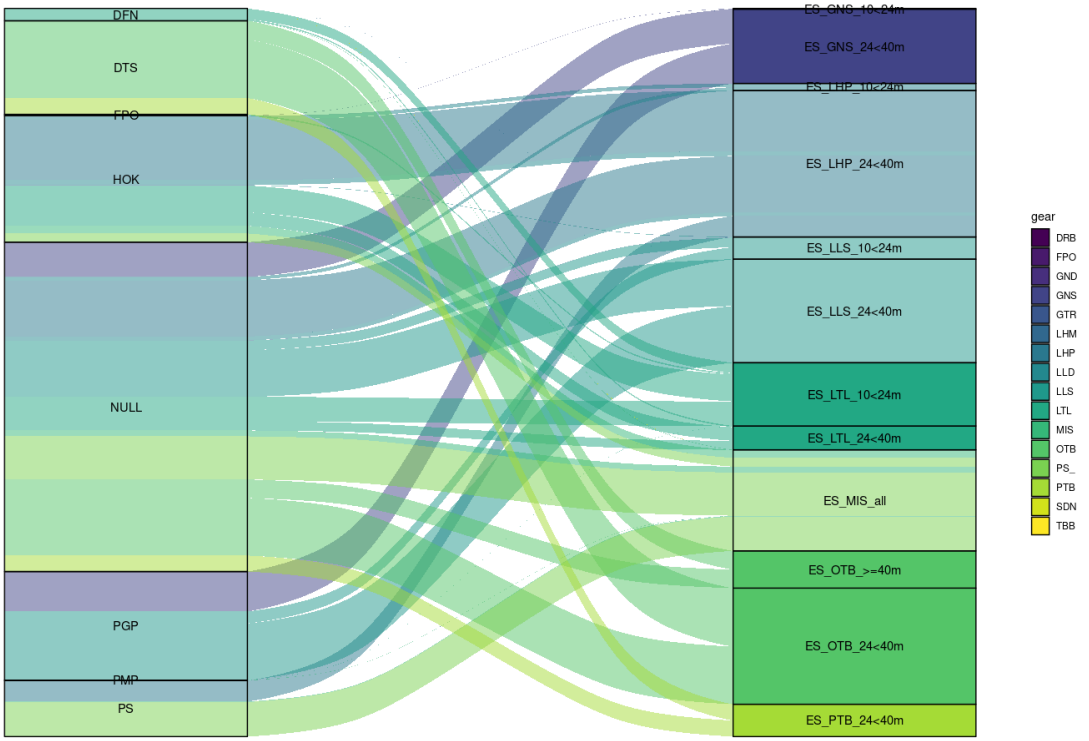

Figure 4.2. Bay of Biscay. Comparing fishing technique designation to WGMIXFISH fleet allocations for Spanish vessels.

The potential effects of the new fleet segmentation process are difficult to predict. However, the new definitions will result in a larger number of fleets overall (accounting in particular for more vessel length classes) though most of these will be smaller in terms of total landings, effort and/or number of vessels. Nevertheless, this means that the behaviour and catchability of the major fleets will be more accurately captured as there will be less noise introduced from inadvertently including the partial fishing activity of other vessels with heterogeneous behaviours.

This finest segmentation will also better highlight the specific challenges for some fleet segments that were aggregated and diluted before. It will for example highlight the high dependencies of some segments to stocks caught in highly mixed harvesting processes and to better account for some choke effects and potential behaviour assumptions at the finest levels.

A recent analysis of the sensitivity of the mixed fisheries scenarios to different fleet and métier structures did not show much of an effect on the total catches (ICES, 2024b; ICES, 2024c). Disaggregating fleets further (in this specific case, by vessel length category) did not change the overall level of catch as the gains and losses in terms of choking were ultimately balanced out across the fleets. However, it should be noted that that analysis did not benefit from the new information available in the RDBES tables which may give rise to changes in choking behaviour which are not possible to obtain with the current WGMIXFISH data. The use of this database and the finest and most coherent definition of the fleets with the economic data thus offer new opportunities in highlighting choke effects and potential socio-economic challenges. It also opens up a new basis for enriching the approach with alternative assumptions of behaviours according to fleets or accounting for stakeholders' knowledge.

The changes in fleet definitions described here will therefore ease the communication and understanding of the mixed fisheries considerations among stakeholder groups and advice requesters. More accurate, traceable and salient fleet definitions will raise confidence in the methods used for mixed fisheries analyses and the useability and uptake of the outputs of WGMIXFISH which should not be undervalued as a benefit.

5 ToR D: Identify any new datasets or changes to current data calls needed to implement the new methodology

The current data calls of consideration are the RDBES data call and WGMIXFISH data call for effort and landings data. One potential improvement to the current RDBES data call would be to explicitly request data at the level of individual vessels. A small proportion of the lines in the database, aggregate effort and landings of several vessels that have the same fishing technique, length category and country when they fish in a given month in the same ICES division/rectangle with the same métier. Providing effort and landings by individual vessels for those lines would address the key data concerns found during exploration of the data. This would also be key for spatial analyses. However, the majority of the RDBES effort and landings data are already at the individual vessel level (76% and 79% respectively). Additionally, the RDBES data model has had many revisions and there is little appetite for making additional changes through the initial phase of instigating the RDBES. Therefore, further investigation of the sensitivity of fleet segmentation to the aggregation of vessels should be completed before making such a request to change the RDBES data call.

As a result of the quality issues found in the RDBES tables, it would seem that it may be some time before these data are ready for use as a data source for ICES advice products. In the meantime, we can consider making changes to the current WGMIXFISH data call to request the DCF un-clustered fishing technique as an additional data field. While this would still not give access to data on individual vessels or finer spatial scales for fleet allocation, it would give certainty on ensuring vessel behaviour is not split across WGMIXFISH fleets and, allow links to be made between mixed-fisheries scenario results and economic databases. Therefore, a change to the WGMIXFISH data call will be considered for 2025.

No new datasets are needed to implement the fleet segmentation framework as detailed in Section 2 of this report. The RDBES CE and CL tables offer an important opportunity to improve the quality of the mixed fisheries advice products. However, several other data sources to consider are listed in Section 3 that could be used in future to refine fleet definitions (e.g. integrating VMS data) or to provide more accurate fleet information in a more compatible form than currently used (e.g. other RDBES data products, quota share and trading data). Additionally, the framework for fleet definitions as described in Section 2 demonstrates how increasing the compatibility of WGMIXFISH fleets with economic data impacts on the fleet segmentation decisions. Therefore, future work around increasing compatibility with socio-economic datasets may be expected to have similar implications for refining fleet definitions.

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Annex 2: Resolutions

WKMIXFLEET – Workshop on mixed fisheries fleets

2023/WK/FRSG34 The **Workshop on mixed fisheries fleets** (WKMIXFLEET), chaired by Harriet Cole, UK, and Claire Macher, France, will be established and meet in Copenhagen, Denmark 12–13 March 2024 to:

a) Develop and document a new methodology for defining fleets using the combined expertise of mixed fisheries scientists and economists;
b) Apply this new methodology to mixed fisheries data, taking into consideration future data sources and availability;
c) Compare the new and existing fleet definitions and, where possible, evaluate the potential effects this may have on fleet dynamics and mixed fisheries scenario results;
d) Identify any new datasets or changes to current data calls needed to implement the new methodology.

WKMIXFLEET will report by 12 April 2024 for the attention of ACOM.

Supporting information

Priority	The work is essential to ICES to progress in the development of its capacity to provide advice on multispecies fisheries. Such advice is necessary to fulfil the requirements stipulated in the MoUs between ICES and its client commissions.
Scientific justification	Currently, the fleet designations used to produce mixed fisheries considerations are not true fleets but rather aggregations of fishing activities. As such, the fleets used do not represent unique groups of vessels and therefore have implications for accurately characterizing fleet fishing behaviour and assessing choking effects. Additionally, alternative fleet definitions would facilitate collaborations with WGECON to advance the integration of advice on the socio-economic viability of mixed fisheries scenarios. Demand for such information has been expressed by stakeholders, most pertinently through WKMIXFISH.
Resource requirements	Some support will be required from the ICES Secretariat.
Participants	The workshop is normally attended by some 15–20 members and guests.
Secretariat facilities	SharePoint site provision and Atlantic room.
Financial	No financial implications.
Linkages to advisory and science committees	ACOM.
Linkages to other groups	WGMIXFISH-METHODS, WGMIXFISH-ADVICE, WKMIXFISH3, and WGECON.
Linkages to other organizations	STECF – Fisheries Dependent Information expert group.