

# SCOPING WORKSHOP 3 ON NEXT GENERATION OF MIXED FISHERIES ADVICE (WKMIXFISH3)

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## International Council for the Exploration of the Sea Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46  
DK-1553 Copenhagen V  
Denmark  
Telephone (+45) 33 38 67 00  
Telefax (+45) 33 93 42 15  
[www.ices.dk](http://www.ices.dk)  
[info@ices.dk](mailto:info@ices.dk)

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## SCOPING WORKSHOP 3 ON NEXT GENERATION OF MIXED FISHERIES ADVICE (WKMIXFISH3)

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### Editors

Paul Dolder • Marc Taylor

### Authors

Michael Andersen • Elizabeth Bourke • Harriet Cole • Robert Cook • Rufus Danby • Paul Dolder  
Marta Ferraro • Dorleta Garcia • Phil Green • Jenni Grossmann • Ruth Kelly • Luca Lameni  
Neil Maginnis • Claire Marcher • Claire Moore • Angela Muench • Virginia Polonio • Dale Rodmell  
Chloe Rogers • Jane Sandell • Mogens Schou • Sonia Seixas • Erik Sulanke • Klaas Sys • Marc Taylor  
Christian Tsangarides • Youen Vermard



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# Contents

i	Executive summary .....	ii
ii	Expert group information .....	iii
1	Introduction.....	1
1.1	Opening remarks.....	1
2	ToR A–C: Review and discussion of recent methodological developments to support mixed fisheries science.....	2
2.1	Short-term goals (1–2 years) .....	2
2.1.1	Methodological Framework.....	2
2.1.2	Develop a feedback mechanism and communications guidelines to engage with stakeholders.....	3
2.1.3	Develop ways of presenting the trade-offs for over/undershoot of quotas at the fleet level which are currently not clear .....	4
2.1.4	Include descriptive information on strength of technical interactions among stocks .....	5
2.1.5	Provide clear, consistent wording on assumptions in the advice sheet .....	8
2.1.6	Review of scenarios for each ecoregion .....	8
2.1.7	Continued development of methods for validation of models, hindcasting methods and uncertainty/sensitivity analysis .....	9
2.1.7.1	Impact of fleet and métier definitions.....	9
2.1.7.2	Analyses of uncertainty and sensitivity to assumptions in mixed fisheries forecasts.....	9
2.1.8	More descriptive information on fleet and métier activity .....	10
2.1.9	Development of approaches that can identify long-term trade-offs and consider rebuilding of depleted stocks from a mixed fisheries perspective .....	12
2.2	Ongoing strategy for improvements to fleet and métier definitions considering future data sources and availability.....	12
3	Update of progress and priority list.....	14
	Short-term goals:.....	14
	Short/medium-term goals:.....	14
	Medium/long-term goals: .....	15
4	Future needs and priorities .....	16
5	References.....	17
Annex 1:	List of participants.....	18
Annex 2:	Resolutions .....	20

## i Executive summary

WKMIXFISH are a series of workshops bringing together scientists, advice recipients, and stakeholders to identify future research and advisory priorities for mixed fisheries science. The third scoping workshop on the next generation of mixed fisheries advice (WKMIXFISH3) met to review changes to mixed fisheries considerations and progress on method development since the last workshop in March 2023.

The workshop focused on three areas of development. First, it reviewed changes and clarifications to mixed fisheries considerations that were incorporated to improve communication around the purpose of and assumptions in the advice. Second, it reviewed the substantial methodological development that has been undertaken by WGMIXFISH-METHODS and EU and UK research projects. The focus of this work was to address an EU/UK joint request to ICES on mixed fisheries science. Third, it discussed the outcome of a workshop on fleet and métier definitions (WKMIXFLEET) that took place the preceding two days.

Methodological developments included evaluation of uncertainty in mixed fisheries models, analyses of sensitivity to model assumptions, including fleet and métier structure, and creating new ways to explore mixed fisheries data. It was noted that these, in combination with new tools, guidance, and visualizations, helped to provide greater understanding of the models and advice. While these endeavours are ongoing, there was general support for continued development; in particular, the deployment of a mixed fisheries online app to provide end-users and stakeholders with the ability to interact with the multifaceted outputs from mixed fisheries models. Support for, and engagement with, developments on using the Regional Database Estimation System (RDBES) data to make improvements to fleet and métier definitions was also highlighted.

Next steps identified were for WGMIXFISH-ADVICE and WGMIXFISH-METHODS to use the valuable feedback obtained to continue to develop the tools, and implement and receive feedback on them as part of an iterative process. It was noted that further research and dedicated time for scientists was necessary to support the ongoing improvements to mixed fisheries advice and data products, and that this should be a priority.

## ii Expert group information

<b>Expert group name</b>	Scoping workshop 3 on next generation of mixed fisheries advice (WKMIXFISH3)
<b>Expert group cycle</b>	Annual
<b>Year cycle started</b>	2023
<b>Reporting year in cycle</b>	1/1
<b>Chairs</b>	Marc Taylor (Germany) Paul Dolder (UK)
<b>Meeting venue and date</b>	14 March 2024, Copenhagen, Denmark (27 participants)

# 1 Introduction

The third scoping workshop on the next generation of mixed fisheries advice (WKMIXFISH3) chaired by Marc Taylor (Germany) and Paul Dolder (UK), met at ICES HQ in Copenhagen and online on 14 March 2024.

The WKMIXFISH series of workshops are designed to promote dialogue between scientists, advice requesters, and other stakeholders to identify ways to improve understanding of mixed fisheries science and advice and ensure that it meets management needs. The purpose of this one-day workshop (WKMIXFISH3) was to update participants on the many initiatives and developments that have been undertaken since WKMIXFISH2 the previous year (ICES, 2023a), and to further discuss future avenues for improvements to advice products.

Since WKMIXFISH2, the regular working groups (WGMIXFISH-ADVICE, WGMIXFISH-METHODS) have sought to make changes to the advice sheets and associated reports to better communicate the purpose and assumptions behind mixed fisheries considerations. Further, there has been a substantive set of analyses as part of research projects to address a question to ICES from the EU and UK on mixed fisheries science. These initiatives, alongside the ICES workshop on mixed fisheries fleets (WKMIXFLEET) which took place in the preceding two days, were the basis of much of the discussion.

The workshop was attended by 27 participants (six industry, two advice recipients/managers, two NGOs, two fisheries consultants, and 15 scientists working in research organizations). This report presents the chairs' summary of proceedings and the views expressed.

This report is structured around the discussion at the workshops Terms of Reference (Annex 2) and gives a summary of the views expressed and suggestions for further development.

## 1.1 Opening remarks

A brief introductory discussion highlighted the following views expressed by stakeholders:

- There was generally widespread support for mixed fisheries science and improved accounting of the realities of fisheries in management advice. However, industry representatives were less in favour of specific mixed fisheries advice on TACs, due to a perception that this did not consider adaptation to quotas that occurs in many ways (changing fishing patterns, quota swaps, etc.);
- Mixed fisheries considerations currently apply to a limited number of regions and species, and there was support for more fisheries to be considered in order to help identify discarding issues and unavoidable bycatch;
- A particular focus of mixed fisheries science could be on rebuilding stocks where there was zero catch advice. A desire for more scenarios and approaches that identified ways to rebuild stocks given mixed fishery catches was expressed by some participants;
- Some scepticism of catch projections in fisheries under *status quo* fishing behaviour was expressed. While acknowledging the difficulties in predicting behavioural responses to changes in TACs, a more dynamic use of fisheries models and science was something that participants expressed as something that should be explored in future.

## 2 ToR A–C: Review and discussion of recent methodological developments to support mixed fisheries science.

Much of the workshop centred on presentations from the chairs and open discussion on progress that has been made since WKMIXFISH2 on the development of methods and improved communication around mixed fisheries science. This covered all the Terms of Reference for the meeting (A–C, Annex 2), and incorporated a discussion of the work undertaken at WKFLEET the previous two days.

A list of priority areas and a workplan split into short-, medium- and long-term were identified as part of WKMIXFISH2 (ICES, 2023a). These priorities partially overlapped with areas of research being undertaken to address the *EU/UK joint request regarding mixed fisheries science* (ICES, 2024a; ICES, 2024b), and these outputs were reviewed together and updated as necessary. Progress towards the goals is summarized in Tables 2.1–2.3, with the main discussion points given below.

### 2.1 Short-term goals (1–2 years)

#### 2.1.1 Methodological Framework

Increased transparency and consistency of methodology implemented in mixed fisheries advice has been introduced through the development of WGMIXFISH best practices document. It provides recommendations for the implementation of models for mixed fisheries considerations and aids in standardizing approaches. It is also useful as a guide for new case studies (most recently, Irish Sea and Baltic). More information is now also presented in the accompanying WGMIXFISH-ADVICE report in terms of the structure and assumptions in mixed fisheries models (Figure 2.1).



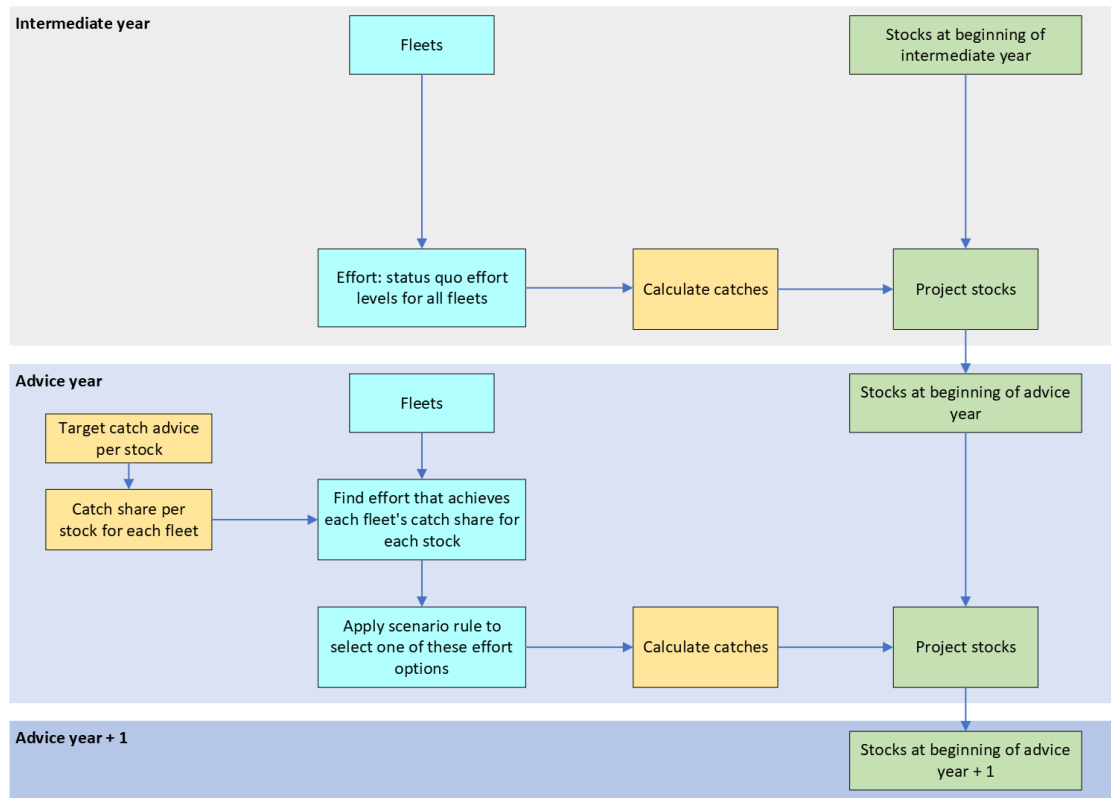


Figure 2.1. Diagrammatic representation of the model structure in providing mixed fisheries considerations.

### 2.1.2 Develop a feedback mechanism and communications guidelines to engage with stakeholders

Further information has been provided in the WGMIXFISH-ADVICE report to allow for greater transparency on the final fleet and métier definitions used. The procedure for the aggregation of input data on catches and effort (Intercatch métier and accessions) into mixed fisheries fleet and métier definitions is now provided in the report for some case studies (ICES, 2023b, Appendix 6), allowing for review and feedback by stakeholders for consistency.

There was general appreciation for the opportunity to provide feedback on fleet definitions and noted that these should not be too rigid and should be suitable for the mixed fisheries considerations. The key focus should be ensuring that any aggregation of data needs to be suitable for purpose and tested to ensure that it does not result in ‘false’ technical interactions (further discussion of this in section 2.2).

Visualizations of the flow of data to fleets and métier are also another option, and an example of this was presented (Figure 2.2). Generally, such a visualization was considered more helpful in understanding the information going into the models than text, but would be more accessible in an interactive form, which would allow queries by end-users to subset data of interest (e.g. fleets). Development of an online advice app for WGMIXFISH is underway, similar to *adviceXplorer* (<https://ices-taf.shinyapps.io/adviceexplorer/>) for single-stock advice. Progress on the MIXFISH app was presented, and feedback gathered for future development on the types of features that would be useful.

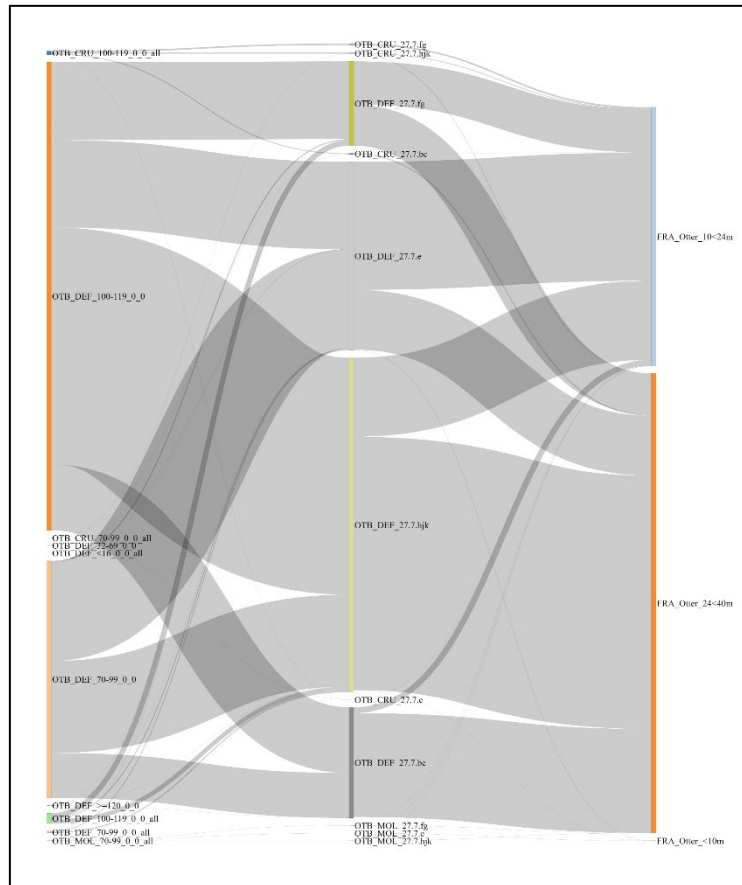


Figure 2.2. An example of how intercatch métier data are aggregated into supra-métier and fleets for French Otter trawl vessels.

### 2.1.3 Develop ways of presenting the trade-offs for over/undershoot of quotas at the fleet level which are currently not clear

One direct piece of feedback from WKMIXFISH2 was the desire for more information on changes in catches at the fleet-level that are implied under mixed fisheries scenarios, and different examples were presented (e.g. Figure 2.3). Presentation of catches was seen as more directly interpretable and relevant than the change in effort figure that is currently featured in the advice. The perspective also highlights the trade-offs at the fleet level implied by different mixed fisheries scenarios. Future reports could include these figures as supplementary information, and code for producing the figures is now incorporated in the *mixfishtools* R package (<https://github.com/ices-tools-dev/mixfishtools>).

It was emphasized that these visualizations should indicate both landings and discards, as the landing obligation results in an incentive to discard in mixed fisheries and it's important to see where this incentive results from targeting different fisheries. It was also highlighted that the over/under landing figure brings another aspect around socio-economic impacts and fairness: with some fleets disproportionately affected by choke stocks that are a minor component of their fishery, and these negatively impacting on uptake in their target fishery (so-called "weak interactions"), and the additional figure allows this message to be understood more clearly.

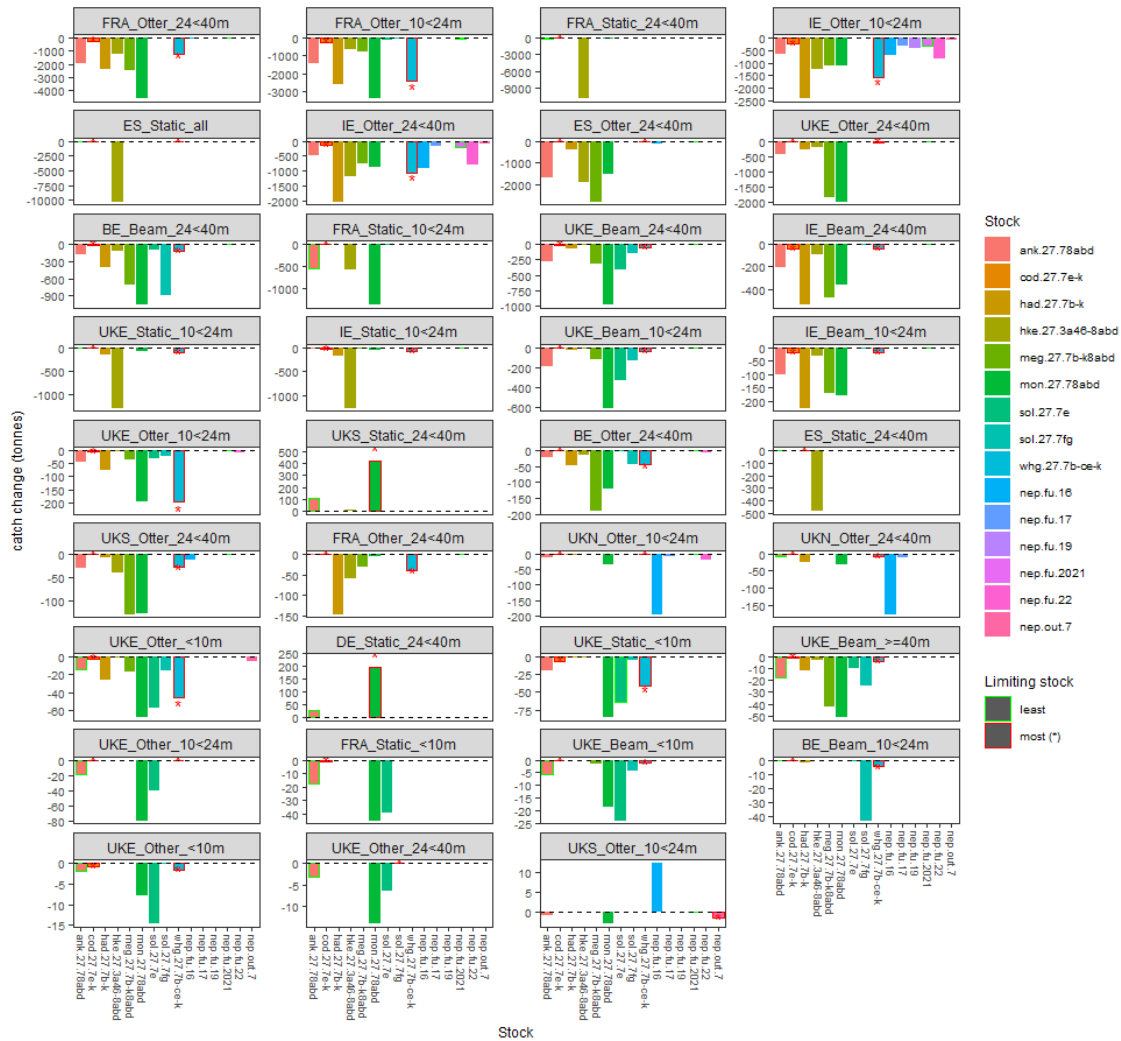


Figure 2.3. Example figure showing a change in implied catches under the ‘min’ scenario (over/under current catches) for fleets in the Celtic Sea model.

### 2.1.4 Include descriptive information on strength of technical interactions among stocks

Various initiatives created within the *EU/UK joint request regarding mixed fisheries science* (ICES, 2024a; ICES, 24b) led to new visualizations, both static and interactive. The approaches varied from presenting data on interactions based on the most disaggregated data possible (e.g. at the trip level considering spatial, temporal, and gear information; see Figure 2.4), to presenting information that attempts to summarize the data to highlight the key interactions among métier and stocks (Figure 2.5) or between stocks (Figure 2.6).

There was interest in both types of presentation. The trip level information was considered interesting, and potentially quite informative of the variation between trips. Again, the ability to filter down to stocks, métier or components of interest was highlighted as a useful feature – implying that many of these figures were best placed in an interactive web application rather than as pages of PDFs. It was also highlighted that anonymity of vessels needed to be maintained when using very disaggregated data.

The technical interactions matrix figure (Figure 2.6) is already presented in the Greater North Sea Ecoregion Fisheries Overview (ICES, 2022), and there has been work done to refine the

methods for use in all ecoregions. There was a discussion on the emphasis of the figure; currently, it highlights significant interactions between pairs of species where a significant interaction is defined with a “fishery focus”, where the species landings is greater than 5% of a stratum (e.g. Belgian Beam trawlers of a given mesh size) total landings. This can create a slightly incongruous situation when a species declining in abundance or available quota results in the strata having a low interaction with the species, even where that stratum might still be responsible for a significant share of the fishing mortality. It was suggested that the emphasis should change to one where the impact of the fishery on the species of concern is highlighted, so a significant interaction would be defined based not on the strata’s total landings, but rather by the impact of the strata on the total catches of the species of concern. This alternate approach would better account for the differences in stock sizes (i.e. “stock focus”).

Discussion highlighted the merits of both approaches. On the one hand, “what else is filling up my hold” could be of interest to industry stakeholders, while “what target fisheries are impacting the status of other species” is of primary interest to managers. A further suggestion was that the figure could be filterable, so that the data going in was representative to smaller areas than the stock level and therefore could inform on measures needing to be taken at a smaller spatial scale.

Developments in visualization and information on the strength of technical interactions are likely to feed into Fisheries Overview reports soon.

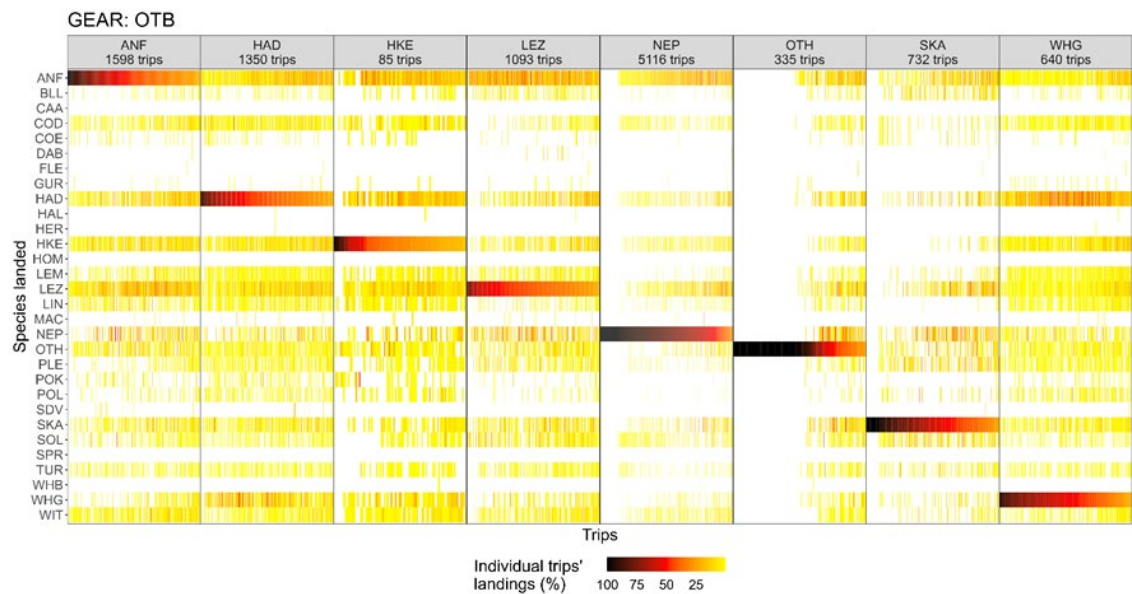


Figure 2.4. Trip level information from Irish otter trawl trips organized into the nominal target species for the trip (panels) and the proportion of each species in the trip landings, coloured from black to white.

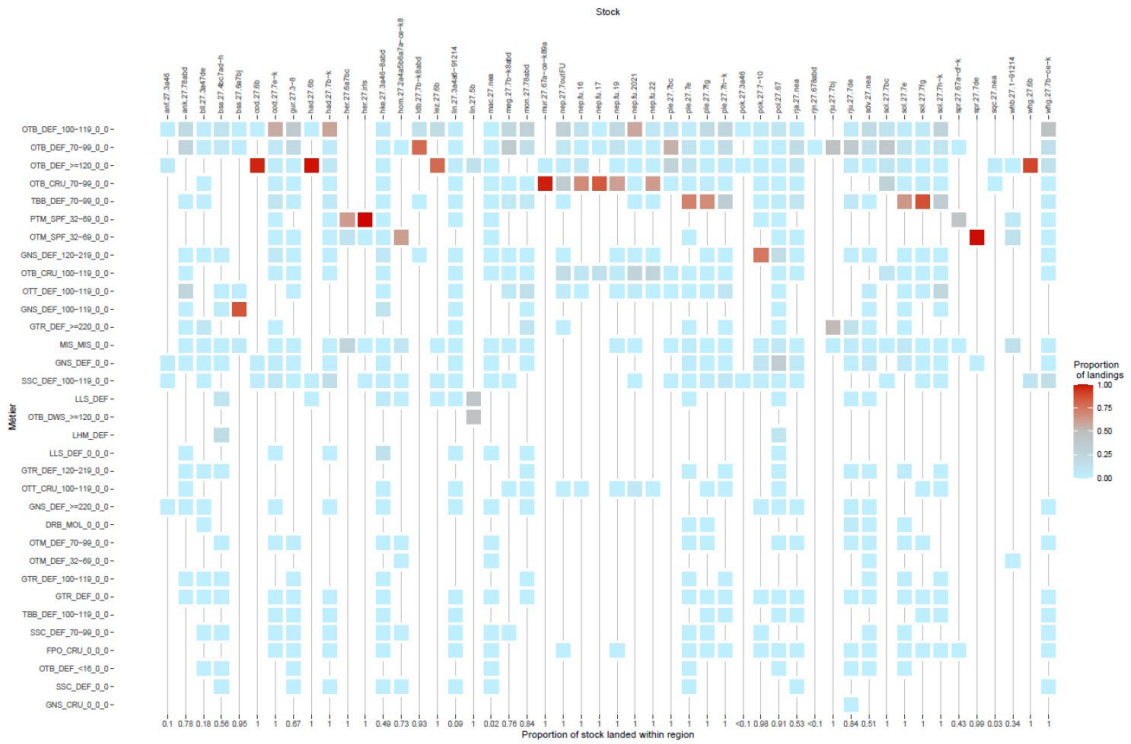


Figure 2.5. Matrix plot of the proportion of landings of stocks (in the x-axis) from each of the disaggregated métier (y-axis). Colour shading represents the share of the landings of the species for that métier.

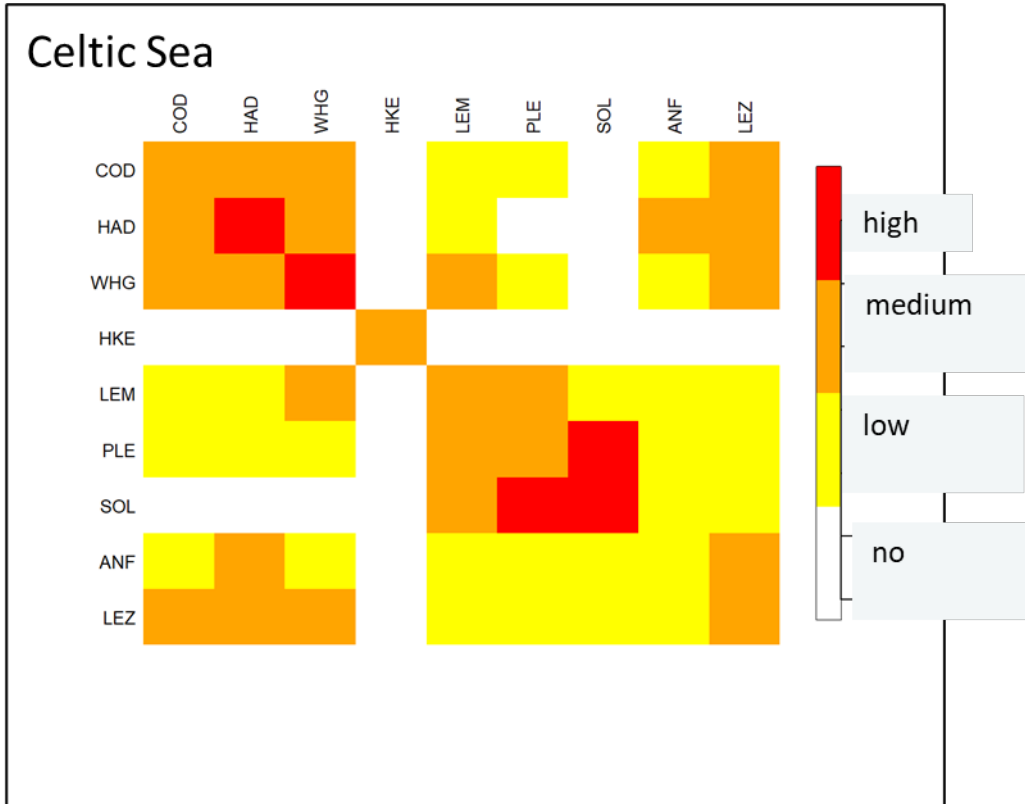


Figure 2.6. Example of interaction plot between pairs of species. In the rows are the species considered the target for the fishery, and the columns indicate the associated species caught, with the colour indicating the strength of technical interaction between the target fishery and associated species.

### 2.1.5 Provide clear, consistent wording on assumptions in the advice sheet

Last year's advice sheets improved clarity in presentation of model assumptions within the headline paragraphs, with a common format implemented across all mixed fisheries considerations advice sheets. The Methodological Framework document (to be published following WGMIXFISH-METHODS 2024) now outlines best practices for stock inclusion, considering such aspects as commercial importance (i.e. target stocks, managed by TAC) and degree of mixed fishery interactions, but also allowing for bycatch or non-target stocks when of interest in a mixed fisheries context.

Two further clarifications were sought for the advice sheets or report:

- Additional information on quota share assumptions should be added and made explicit (either in text or Table 2).
- The colours used in headline plots needs clarification in legend, as their meaning was currently not clear.

### 2.1.6 Review of scenarios for each ecoregion

While some flexibility is given to WGMIXFISH case studies to define scenarios according to their unique situation, further standardization of more common scenarios has been developed since the last scoping meeting. New standard scenarios have been added; e.g. a revised "min\_range" scenario that allows for the exploration of advice levels associated with FMSYupper for stocks in good status, and a "min\_exzero" scenario that removes effort restrictions caused by zero-catch advice stocks to evaluate the degree of overshoot of zero-TAC advice stocks associated with other target stock advice.

Depending on region-specific management challenges, the group discussed further considerations for additional scenarios:

Other scenarios should be informed by single-stock catch options tables. These scenarios may be included in the considerations or report documents, but are also possible through technical services documents (such as currently used for the zero-catch advice stocks).

Rebuilding scenarios (i.e. to achieve some increase in SSB) would be of interest, but it was noted that these should originate in the single-stock advice catch table (once defined by WKREBUILD; ICES, 2023c).

Alternative scenarios where choking effects were not implemented for 'weak' technical interactions were also possible. However, this would need defining (e.g. what defines a 'weak interaction', less than 1%, 2%, 5%, etc. of a given stocks catch) and further the consequences of this would need to be fully considered. For example, would the resultant catch projections, which would result in different quota catch shares for fleets compared to the recent past, mean they could only be presented at the fleet-level?

## **2.1.7 Continued development of methods for validation of models, hindcasting methods and uncertainty/sensitivity analysis**

There were two substantive sets of analyses undertaken to address the EU/UK special request on mixed fisheries (ICES, 2024a; ICES 2024b) related to uncertainty and sensitivity of mixed fisheries models. The first related to the formulation of fleets and métier in mixed fisheries models and how that affects catch projections through possible artefacts of data aggregation; the second related to uncertainty and sensitivity of the models to assumptions made in conditioning the forecasts. These analyses are further elaborated in the following subsections.

### **2.1.7.1 Impact of fleet and métier definitions**

Presentations on work undertaken using the North Sea and Celtic Sea case studies demonstrated the relative insensitivity of the mixed fisheries models to fleet and métier structure. The way mixed fisheries models are currently used, based on an assumption of fixed effort share among métiers (as an average of the recent past), means that further disaggregation of métiers does not impact overall catch projections as the interactions between fleets and stocks are being forecast at the fleet level. Disaggregation of super-fleets into smaller sub-fleets has some limited impact on catch projections, but these were most evident where sub-fleets showed marked differences in their choking stocks as compared to the original super-fleet. At the aggregated level of overall stock catches the impact of more disaggregated fleets was small under the mixed fisheries scenarios. This highlighted that even where a technical interaction might be considered ‘weak’ for some vessels (i.e. catching only a small proportion of a non-target stock relative to the target stocks), and where this can be identified in the data and separated by alternative fleet definitions, it still results in a similar choking effect at the overall stock level as currently presented.

Alternative assumptions of fleet behaviour were also tested, where effort share among métier was optimized to maximize the effort for each fleet, and this had a more substantial impact on the total effort each fleet was able to expend. However, it was noted that such an optimization was not necessarily realistic, but a demonstration of the impact of alternative assumptions. Such alternative assumptions regarding effort allocation could be explored in future, but a major challenge in trying to predict behavioural changes in response to quotas was highlighted by both scientists and industry representatives. There was not a strong appetite for changing the current approach of ‘*status quo*’ behaviour in mixed fisheries considerations.

### **2.1.7.2 Analyses of uncertainty and sensitivity to assumptions in mixed fisheries forecasts**

The key assumptions made in projecting catches under technical interactions are future catchability (the abundance-standardized catch per unit effort for each fleet-métier-stock combination), selectivity (relative catch per age), fleet quota shares, and effort shares for each métier of a fleet.

Methods and routines to account for these factors and estimate uncertainty in catch projections were developed in the Celtic Sea and Bay of Biscay case studies. The analyses demonstrated that most uncertainty derives from catchability assumptions. Ways to display uncertainty were also presented; for example, in terms of catch uptake or choking probability by fleets and stock combinations.

Comparisons of uncertainty across different parameters revealed the importance of assumed values for catchability and quota share assumptions, in particular for non-target stocks, and the impact these can have in choking of target stocks for some fleets. The ICES WGMIXFISH-METHODS working group plan to explore these results further and use them to improve conditioning of the models, where possible.

The group discussed whether uncertainty in catch projections should be included in mixed fisheries considerations, and it was generally thought that focus would likely remain on the median or average results. Nevertheless, presentation of some probabilities could be useful, such as the likelihood of a stock choking a given fleet. This information could supplement the current approach mentioned by fishing industry representatives whereby they compare annual uptakes against the proposed changes in catch limitations and assess choke risk on that basis.

### 2.1.8 More descriptive information on fleet and métier activity

At WKMIXFISH2 stakeholders and advice requesters had identified the need for additional information on fleet and métiers. Understanding the key métier that impact stocks (such as in the figures in section 2.1.4), their spatial patterns and spatial catch composition is considered useful when looking to identify ways to decouple technical interactions between stocks. A challenge in this regard is the development of tools that can display data products at a suitably aggregated level to be meaningful but stay within general data protection regulation (GDPR) requirements.

WGMIXFISH resolved to work with ICES WGSFD to make available supplemental data on catch composition at high spatial resolution, but this was likely to be a longer-term process. A preceding workshop (WKMIXFLEET) had been evaluating the use of the Regional Database for Estimation (RDBES) for fleet definition. As the data are spatially resolved (at the scale of ICES statistical rectangle), it could also serve to more effectively evaluate stock interactions through the previously mentioned visualizations and supplemental online tools.

An example of a data product at a higher spatial resolution is spatially-resolved catch composition. An interactive tool which allowing filtering of STECF FDI data (Gibin *et al.*, 2022) by gear and species demonstrated how clear spatial separation can be seen in North Sea landings data, and support identification of groups of species with similar spatial landings distributions (Figure 2.7).

A presentation was also made on progress made in developing a mixed fisheries component of the ICES *adviceExplorer* (<https://ices-taf.shinyapps.io/adviceexplorer/>). The tool largely replicates the outputs of the PDF-based mixed fisheries considerations, but there is scope for it to provide additional information and visualizations. It was noted that in general PDFs were not a good format for communicating the complexity of mixed fisheries scenarios and outputs. More use of online tools would support better understanding of the models, assumptions, and outputs and allow stakeholders to focus on elements and scales most relevant to them. Some specific feedback included:

- More information from the mixed fisheries scenarios beyond what's in the PDF; e.g. biomass trajectories of the stocks under different scenarios,
- Make use of a feedback mechanism within the online tool as a way for stakeholders to communicate what does / doesn't work in the app,
- A need to ensure anonymity of data when defining fleets and displaying disaggregated data.



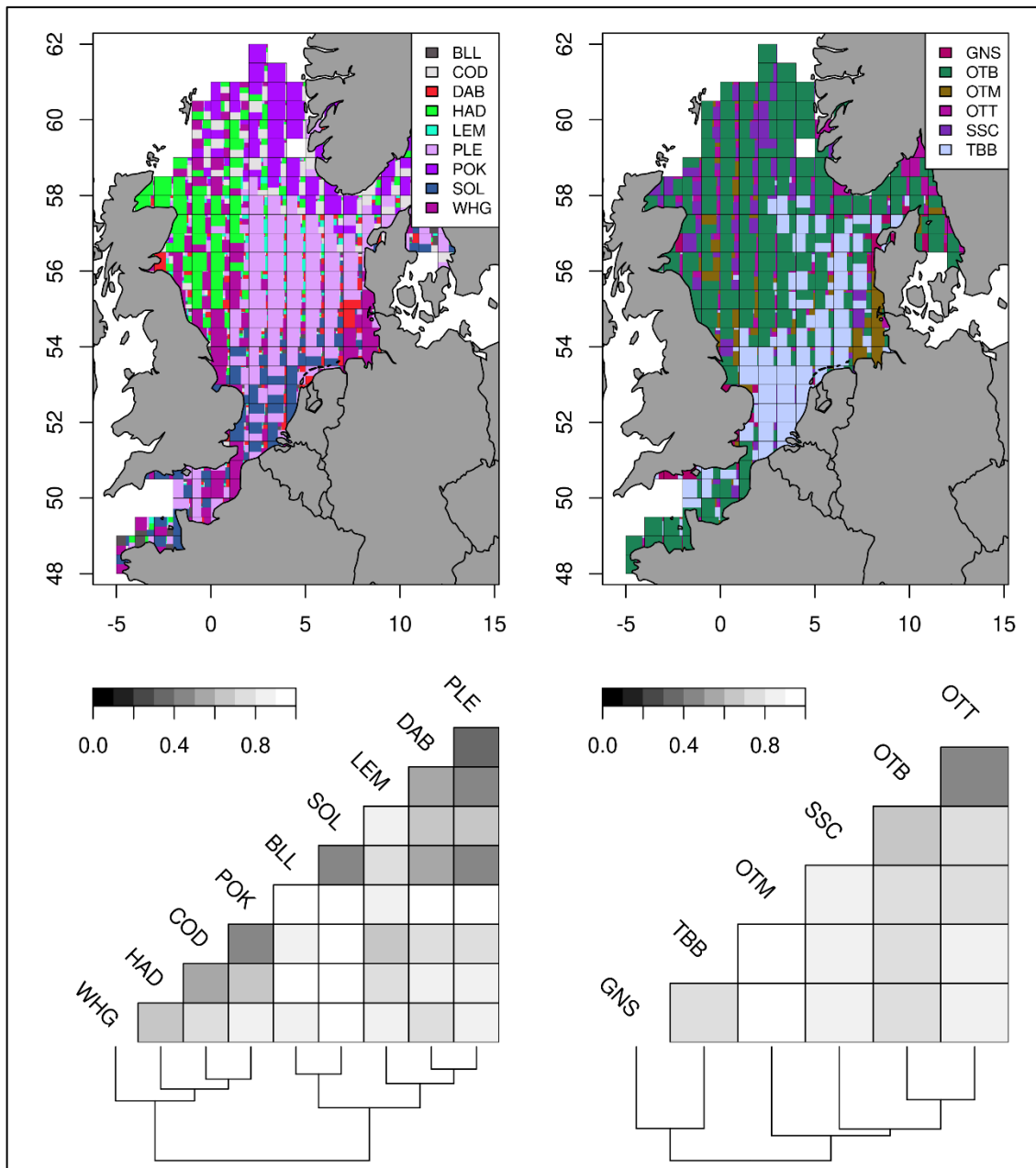


Figure 2.7. An example of the scaled landings (proportion in each ICES rectangle) using STECF FDI data. Data are aggregated by a selected subset of species (left top panel) and gear types (right top panel). Lower panels show the degree of dissimilarity (Bray–Curtis) in landings patterns among species (left lower panel) and gear types (right lower panel). Strongest overlapping groups are indicated by lower dissimilarity (darker colours) and are arranged closer to each other in the dendrograms (see [https://github.com/marchtaylor/fdi\\_spatial\\_landings](https://github.com/marchtaylor/fdi_spatial_landings) for further details).

### **2.1.9 Development of approaches that can identify long-term trade-offs and consider rebuilding of depleted stocks from a mixed fisheries perspective**

Mixed Fisheries Considerations focuses on the consequences of implementation of short-term tactical advice (i.e. catch advice) taking account of technical interactions. Some stakeholders expressed an interest in understanding longer term trade-offs between stock rebuilding and yield, when considering mixed fisheries interactions. This is not something that WGMIXFISH have actively developed, as assumptions around fleet behaviour, trade-offs among fleets, changes in the environment and wider economic considerations because more important over longer time frames. However, many spin-off projects have been done in parallel that do consider longer term dynamics, basing their mixed fishery models on those developed in WGMIXFISH. Examples include: ProByFish (EASME 2021), PANDORA (e.g. Kühn et al 2023), SEAwisE (seawiseproject.org), MixME (Pace *et al.*, in review), SANoBA (European Commission *et al.*; 2021; Bastardie *et al.*; 2022), among others.

First, an application of the North Sea model which incorporating correlations between environmental variables and recruitment dynamics and projected these forwards under climate change scenarios demonstrated the variable impact on different fleets. Second, a simulation of single-stock MSY management accounting for technical interactions demonstrated the challenge in achieving single-stock management objectives simultaneously for three gadoid stocks in the Celtic Sea.

Some scepticism of long-term projections was expressed by some participants, both in a mixed fisheries context and more generally in fisheries. While any long-term forecasting is challenging, the tools demonstrated the ability to distinguish *relative* trade-offs between different management approaches (as opposed to absolute outcomes), and thus may be useful to develop further to inform on the impact of different approaches in the longer term.

In the short term, the workshop on guidelines and methods for the design and evaluation of rebuilding plans for category 1–2 stocks (WKREBUILD2; ICES, 2024c) are in the process of developing guidelines for rebuilding advice for currently zero-catch advice stocks. There was interest in incorporating rebuilding scenarios into mixed fisheries considerations scenarios, which should be straightforward if such a scenario is provided in the single-stock advice catch-option tables. This may help progress away from zero-catch advice, which is unlikely to be implemented in stocks where clear mixed-fisheries interactions exist and where technical interactions with other fisheries are the primary source of fishing mortality.

## **2.2 Ongoing strategy for improvements to fleet and métier definitions considering future data sources and availability**

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 defined for use in mixed fisheries models may not represent unique groups of vessels which has implications for accurately characterizing fleet fishing behaviour and assessing choking effects. These concerns were raised by stakeholders at previously held WKMIXFISH scoping workshops (ICES, 2021; ICES, 2023a), leading to several ongoing efforts to better refine the WGMIXFISH methodology. The topic remains a top priority for the working group, and was addressed in detail during a separate workshop (WKMIXFLEET) held in parallel with this meeting.

Recent methodological development has centred on three main areas: fleet/métier definition procedures, fleet behaviour (i.e. effort allocation among métiers), and data sources. Fleet/métier definitions have continually improved over time, benefitting from more consistency among case studies and increased transparency on data aggregations, allowing for interrogated by stakeholders (see Section 2.1.2). Fleet behaviour currently used in mixed fishery considerations assumes static effort distribution by métier, consistent with recent historical distributions. This assumption is now more clearly communicated, and there is a general consensus that, although fleets are likely to adjust their effort allocation in response to current single-stock advice and shifts in choking stocks, its simplicity is likely preferable to more sophisticated attempts to predict fishing behaviour. Nevertheless, recent work explored options for deviating from this assumption, e.g. via métier effort share optimization, in order to provide more realistic forecasts (ICES, 2024a ICES, 2024b).

Despite these advances there is still the perception that the current method hides the polyvalency of individual vessels. WKMIXFLEET explored the potential benefits offered by the next generation of data (Regional Database & Estimation System, RDBES), which is gradually being made available to working groups within ICES. The new format is less spatially-aggregated, which should allow for further fleet segmentation based on their areas of activity, helping to remove some false and better identify weak technical interactions in particular fleet-métier-stock combinations. Furthermore, the data includes additional métier information that allows matching to other economic datasets such as the Annual Economic Report database (STECF 23-07; Prellezo *et al.*, 2023) and facilitating collaborations with the Working Group on Economics (WGECON). Finally, (anonymised) vessel identification codes are seen as important additional information for capturing the polyvalent nature of fishing activities and avoiding the erroneous splitting of a vessel's effort across multiple fleets. This vessel-based approach will also help to create additional realism in terms of linkages to socio-economic variables.

### 3 Update of progress and priority list

Below are several tables summarizing the short-, medium-, and long-term goals for methodological developments, as defined during WKMIXFISH2 (ICES, 2023a). Progress over the past year is noted when applicable.

#### Short-term goals:

Objective	Time frame	Progress since WKMIXFISH2
Develop a feedback mechanism and communications guidelines to engage with stakeholders on an annual basis.	< 1 year	Development of methodological framework clarifies modelling decisions and validation approaches. Improved transparency in fleet and métier definitions now provided (ICES, 2023d; ICES, 2024a; ICES, 2024b).
Develop ways of presenting the trade-offs for over/undershoot of quotas at the fleet level which are currently not clear.	< 1 year	Concept ideas and visualizations were developed and presented to the workshop (ICES, 2023d).
Include more descriptive information on strength of technical interactions among stocks.	1–2 years	Methods developed for presentation in Fisheries Overview (ICES, 2024a; ICES, 2024b).
Provide clear, consistent wording on assumptions in the advice sheet including rationale for the assumptions, including on why certain stocks are/aren't included.	< 1 year	Implemented new descriptions since WGMIXFISH-ADVICE 2024.
Review of scenarios for each ecoregion including identification of any additional scenarios that could be helpful (and understanding this didn't need to be each year, as many of the challenges were the same each year).	< 1 year	New standard scenarios implemented in 2024. Rebuilding scenarios can be incorporated when available (WKREBUILD2).
Continued development of validation of models, hindcasting methods and uncertainty/sensitivity analysis (as currently planned by the group which will also help address the UK/EU Specialised committee on Fisheries questions).	1–2 years	Various methods developed (ICES, 2024a; ICES 2024b).

#### Short/medium-term goals:

Objective	Time frame	Progress since WKMIXFISH2
More descriptive information including working with ICES WGSFD to make available supplemental data on catch composition at high spatial resolution	2–3 years	Working with new RDBES data to develop online data products as part of the upcoming Mixed Fisheries Explorer app.
More information on fleets and métier contributing most to fishing mortality of the stocks, and their spatial patterns	1–2 years	Ongoing exploration of new RDBES data, continuing work started at WKMIXFLEET.

Objective	Time frame	Progress since WKMIXFISH2
Reviewing the fleet and métier structure for each ecoregion to ensure credibility to stakeholders (and considering what role stakeholder could have in this process).	1–2 years	Initial implementation of transparent fleet/métier aggregation information in current advice for some case studies.
Communication of uncertainty.	2–3 years	Methods for quantifying uncertainty presented (ICES, 2023d; 2024a; ICES, 2024b).
Provide tools to present the data (at a suitably aggregated level) so its accessible to stakeholders, e.g. through an app.	2–3 years	Under development, with initial launch planned for 2024.
Continued links with WGECON to improve economic considerations.	2–3 years	Initial work started on linking fleet definitions between WGMIXFISH and WGECON during WKMIXFLEET. Common strategy developed to make use of consistent fleet codes between STECF and RDBES data.

\* RDBES = Regional Database & Estimation System

\*\* STECF = Scientific, Technical and Economic Committee for Fisheries

## Medium/long-term goals:

Objective	Time frame	Progress since WKMIXFISH2
Development of approaches that can identify long-term trade-offs and consider rebuilding of depleted stocks from a mixed fisheries perspective.	3–5 years	Progress on testing tools and methods for long-term scenarios within a Management Strategy Evaluation (MSE) presented with various spin-off projects utilizing these approaches. Work to continue within WGMIXFISH-METHODS.

## 4 Future needs and priorities

Many of the short-term methodological priorities identified during WKMIXFISH2 were addressed over the past year, although key points remain work in progress. Of these, fleet definitions and the robustness of mixed fisheries considerations to false technical interactions remain top priorities. As evidence of this, the recent WKMIXFLEET workshop was used to concretely define a strategy for future work, with emphasis on utilizing new data sources (e.g. RDBES) that both allow for finer disaggregation of fishing activities (e.g. spatial) for the definition of fleets as well as provide a common framework for integrating work across working groups in ICES (e.g. WGECON). Furthermore, the higher spatial resolution will also improve summaries of technical interactions in Fisheries Overviews.

WGMIXFISH has expanded in recent years to cover five case study regions, with another (Baltic) potentially on the horizon. As part of the long-term strategy for increase transparency of methodology, the working group continues to develop the documentation of methodologies and the best practices thereof to facilitate and unify work across current and future case study applications. The group however recognizes the need to “ground-truth” the model assumptions and definitions, and, as such, will continue to develop mechanisms to allow for direct feedback from stakeholders. Given the complexity of the multistock and multifleet model frameworks, future online applications are seen as crucial interfaces to allow stakeholders to explore and filter model components in order to provide focused examination and feedback (e.g. to fleet definitions). In addition, an online application could also allow for the presentation of more case study-specific scenarios, such as a wider range of catch options related to stock rebuilding.

Given the valuable feedback that this series of scoping workshops has generated, both in terms of how mixed fisheries considerations are used as well as the suggestions for improvement, it is the intension of WGMIXFISH to maintain this dialogue going forward. A date for a future WKMIXFISH4 will be defined once the larger changes to conditioning data and online applications have been implemented, in order evaluate their impacts.

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## Annex 1: List of participants

Name	Institute	Country of institute	E-mail
Angela Muench	Cefas	UK	angela.muench@cefass.gov.uk
Chloe Rogers (observer)	UK Fisheries	UK	chloe.rogers@ukfisheries.net
Christian Tsangarides (observer)	Low Impact Fishers of Europe	EU	bans@lifeplatform.eu
Claire Marcher	Ifremer	France	claire.macher@ifremer.fr
Claire Moore	Marine Institute	Ireland	claire.moore@Marine.ie
Dale Rodmell (observer)	Eastern England Fish Producers Organisation Ltd	UK	dale@eefpo.org.uk
Dorleta Garcia	ICES	Denmark	dorleta.garcia@ices.dk
Elizabeth Bourke (observer)	The National Federation of Fishermen's Organisations	UK	ebourke@nffo.org.uk
Erik Sulanke	Thünen Institute	Germany	erik.sulanke@thuenen.de
Harriet Cole	Marine Scotland Science	UK	harriet.cole@gov.scot
Jane Sandell	UK Fisheries Ltd	UK	jane@ukfisheries.net
Jenni Grossmann	ClientEarth	UK	grossmann@clientearth.org
Klaas Sys	ILVO	Belgium	klaas.sys@ilvo.vlaanderen.be
Luca Lamoni	ICES	Denmark	luca.lamoni@ices.dk
Marc Taylor	Thünen Institute of Sea Fisheries	Germany	marc.taylor@thuenen.de
Marta Ferraro	Marine Institute	Ireland	marta.ferraro@marine.ie
Michael Andersen (observer)	Danish Fishers	Denmark	ma@dkfisk.dk
Mogens Schou (observer)	Aquamind	Denmark	mogens.schou@aquamind.dk
Neil Maginnis	ICES	Denmark	neil.maginnis@ices.dk
Paul Dolder	Cefas	UK	paul.dolder@cefass.gov.uk
Phil Green	Defra	UK	philip.green@defra.gov.uk
Robert Cook	Defra	UK	rob.cook@defra.gov.uk
Rufus Danby (observer)	Scottish White Fish Producers Association	UK	rufus@swfpa.com
Ruth Kelly	AFBI	UK	ruth.kelly@afbini.gov.uk
Sonia Seixas	Universidade Aberta	Portugal	sonia.seixas@uab.pt



<b>Name</b>	<b>Institute</b>	<b>Country of institute</b>	<b>E-mail</b>
Virginia Poloni	Independent Consultant	Ireland	vpovedano@gmail.com
Youen Vermard	Ifremer	France	youen.vermard@ifremer.fr

## Annex 2: Resolutions

2023/WK/FRSG35 The third **Scoping workshop on next generation of mixed fisheries advice** (WKMIXFISH3), chaired by Paul Dolder, UK, and Marc Taylor, Germany, will be established and meet in Copenhagen, Denmark 14 March 2024 to:

- a) Update and review methodological developments since the previous scoping meeting, including work at WGMIXFISH-METHODS 2023 and in response to the Joint UK-EU request to ICES for advice regarding mixed fisheries science;
- b) Review and make recommendations for potential changes to mixed fishery considerations utilizing feedback from the previous scoping meeting;
- c) Review ongoing strategy for improvements to fleet and métier definitions considering future data sources and availability.

WKMIXFISH3 will report by 12 April 2024 for the attention of ACOM.

WKMIXFISH3 is the second of a two-part workshop (with the previous WKMIXFISH2) to take place in March 2024 to update stakeholders regarding recent changes to WGMIXFISH-ADVICE initiated since the last meeting. The meeting will also be informed by WKMIXFLEET, which is scheduled to take place immediately before WKMIXFISH3, aiming to review methodologies used for defining fleets with the goal of improved mixed fishery and economic considerations.

### Supporting information

Priority	Mixed fisheries considerations are requested by several ICES clients. While they were first delivered in 2009 for the North Sea, there are still basic gaps on how mixed fisheries considerations are used, what is needed that is not yet provided, validity of assumptions made, and how to communicate them. The activity of this working group will enable ICES to close the existing knowledge gaps and to reshape the advice to fulfil client needs and make it more informative. Consequently, these activities are considered to have a high priority.
Scientific justification	ToR [a] Modelling assumptions and methodologies employed by mixed fishery models and forecasts will have consequences for results and subsequent advice. It is therefore important to accurately understand the implications of these assumptions. Methodological evaluations conducted within WGMIXFISH-METHODS and in a separate special request will be reviewed to assess potential applications to mixed fishery considerations. ToR [b] Several changes to mixed fishery considerations have been implemented since the previous scoping meeting; including presentation of current model assumptions, selection of mixed fishery scenarios, and visualization of results. These changes will be reviewed in terms of their ability to facilitate communication of results to clients. ToR [c] Changes in future data sources are likely to improve the ability to define fleets that accurately represent fishing activities and assess choking effects. Additionally, alternative fleet definitions would facilitate the integration of advice on the socio-economic viability of mixed fisheries scenarios and allow further collaboration among working groups, such as WGECON.
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.

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Linkages to advisory and science committees ACOM.

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Linkages to other groups WGMIXFISH-METHODS, WGMIXFISH-ADVICE, and WKMIXFLEET.

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Linkages to other organizations STECF – Fisheries Dependent Information expert group.

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