WORKING GROUP ON MIXED FISHERIES ADVICE (WGMIXFISH-ADVICE; outputs from 2024 meeting)

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

Contents

i Executive summary

The ICES Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE) produces mixed fisheries forecasts for the Bay of Biscay, Celtic Seas, Iberian Waters, Irish Sea, and North Sea. These forecasts highlight the potential implications of single-stock (total allowable catch and effort) management on the catches of multiple stocks caught together in mixed fisheries. Mixed fisheries models consider past fishing patterns and catchability of the different fleets, and the catch advice produced by the single-stock advice groups, to provide quantitative forecasts of over- and underexploitation of the different stocks given mixed fishery interactions. The mixed fisheries forecasts were produced using the "FCube" (Fleet and Fishery Forecasts) methodology for the Celtic Sea and Irish Sea, and the "FLBEIA" (Bio-Economic Impact Assessment using FLR) methodology for the Bay of Biscay, Iberian Waters, and North Sea.

The Bay of Biscay mixed fisheries projections consider the single-species advice of 13 stocks (ank.27.78abd, bss.27.8ab, hke.27.3a46-8abd, hom.27.2a3a4a5b6a7a-ce-k8, mac.27.nea, meg.27.7b-k8abd, mon.27.78abd, nep.fu.2324, pol.27.89a, sdv.27.nea, sol.27.8ab, whb.27.1-91214, and whg.27.89a). Given the single-stock catch advice for 2025, the most limiting stock for demersal fisheries in the Bay of Biscay is pollack, whose stock share is first reached for eight of 21 defined fleets. The least limiting stock is black-bellied anglerfish (seven of 21 fleets).

The Celtic Sea mixed fisheries projections consider the single-species advice for 15 stocks (cod.27.7e-k, had.27.7b-k, whg.27.7b-ce-k, nep.fu.16, 17, 19, 20–21, 22, and outside FUs, sol.27.7e, sol.27.7fg, mon.27.78abd, ank.27.78abd, meg.27.7b-k8abd, and hke.27.3a46-8abd). Given the single-stock catch advice for 2025, the most limiting stocks for demersal fisheries in the Celtic Sea are cod and whiting, with 30 of 33 defined fleets choked by these two stocks due to the zero-catch advice, and the fact that almost all fisheries operating with demersal gears catch them. The least limiting stock is black-bellied anglerfish (16 fleets), followed by hake (nine fleets), Norway lobster in FU 20–21 (seven fleets) and white anglerfish (one fleet).

The Iberian waters mixed fisheries projections consider the single-species advice for 5 stocks (ank.27.8c9a, hke.27.8c9a, lbd.27.8c9a, meg.27.8c9a and mon.27.8c9a). Given the single-stock catch advice for 2025, the most limiting stock for demersal fisheries in the Iberian Waters is hake, with all 11 defined fleets reaching their hake quota with a lower effort than for the other stocks. The least limiting stock is black-bellied anglerfish (10 of 11 fleets).

The Irish Sea mixed fisheries projections consider the single-species advice for 7 stocks (cod.27.7a, had.27.7a, ple.27.7a, sol.27.7a, whg.27.7a, nep.fu.14, and 15). Given the single-stock catch advice for 2025, the most limiting stocks for demersal fisheries in the Irish Sea are whiting and cod, with all 12 defined fleets choked by these two stocks due to the zero-catch advice, and the fact that 11 of 12 fleets catch them both. The least limiting stock is haddock (nine of 12 fleets).

The North Sea mixed fisheries projections consider the single-species advice for 20 stocks (bll.27.3a47de, cod.27.47d20, had.27.46a20, ple.27.420, ple.27.7d, pok.27.3a46, sol.27.7d, tur 27.4, whg.27.47d, wit.27.3a47d, nep.fu.5, 6, 7, 8, 9, 10, 32, 33, 34, and 4 outFU). Given the single-stock catch advice for 2025, the most limiting stock for demersal fisheries in the North Sea is cod, whose stock share is first reached for 23 of 37 defined fleets. The least limiting stock is whiting (35 of 37 fleets).

Additional work included contributions to four technical requests.

ii Expert group information

Expert group name	Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE)
Expert group cycle	Annual
Year cycle started	2023
Reporting year in cycle	1/1
Chairs	Harriet Cole, UK
	Marc Taylor, Germany
Meeting venue and dates	30 September–4 October 2024, Copenhagen, Denmark and online (19 participants)
	14–15 October 2024, online meeting

1 Introduction

Working Group on Mixed Fisheries Advice 2024 report

This report documents WGMIXFISH-ADVICE 2024 meeting outputs. The ICES Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE) chaired by Marc Taylor, Germany and Harriet Cole, UK, met on 30 September–4 October 2024 and online on 14–15 October 2024 to apply mixed fisheries forecasts to the 2024 single-species advice for the Bay of Biscay, Celtic Sea, Iberian waters, Irish Sea, and North Sea. This working group also contributed to the fisheries overviews for a number of regions and three technical services.

Within Europe, most fisheries management is undertaken on a stock-by-stock basis, using tools such as total allowable catch (TAC). This form of management does not reflect the reality of most mixed fisheries where multiple species are caught together. Particularly in the case of demersal fisheries where fishers have limited flexibility to discriminate between species caught during fishing operations. This mismatch between the multispecies outcomes of fishing operations and the single-species catch advice can produce a number of challenges for management, including discarding, the emergence of choke species, and missed fishing opportunities.

Within a European context, the need for mixed fisheries advice arose in 2002, when the conflicting states of the various demersal stocks in the North Sea made the limitations of the traditional, single-species approach to advice particularly apparent. These circumstances led to the introduction of management measures, such as effort restrictions and single-species multiannual management plans. The 2014 revision of the CFP-Common Fisheries Policy (EU, 2013) further highlighted the limitation of the single-species advice structure, with the introduction of two additional management measures: the landings obligation and the regional multiannual management plans for mixed fisheries. The introduction of these management measures fundamentally changed how fisheries were managed. Therefore, since 2016 the ICES advice on fishing opportunities has been provided in the context of catch rather than landings. As mixed fisheries objectives are still under development, they cannot be incorporated into the mixed fisheries forecasts, which must build on the existing legal and management system.

ICES Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE) produces management advice and options that take into account the consequences of technical interactions in multistock, multi-gear fisheries. This advice is produced using two different models, depending on the advice region, FCube and FLBEIA. Mixed-fisheries advice is based on the Common Fisheries Policy (CFP) TAC regime and is consistent with relative stability.

1.1 Definitions

Two key descriptive terms form the foundation of mixed fisheries advice, the fleet (or fleet segment), and the métier. Their definition has evolved over time, but the most recent official definitions are provided by the CEC's Data Collection Framework (DCF, Reg. (EC) No 949/2008 and Commission Decision 2010/93/UE), and are adopted here:

- A fleet segment is a group of vessels with the same length class and predominant fishing gear during the year. Vessels may have different fishing activities during the reference period, but might be classified in only one fleet segment.
- 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 characterized by a similar exploitation pattern.

Since 2012, WGMIXFISH has requested catch and effort data from countries data according to aggregations based on the definitions of the EU Data Collection Framework (DCF). The data call allowed merging across DCF métiers and as such national data entries were sometimes not by métier in the strict sense. Merging of métiers to reduce to a manageable number going forward in the forecasts further leads to the formation of combined or 'supra-métiers'.

1.2 Terms of reference

The **Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE)**, chaired by Marc Taylor, Germany, and Harriet Cole, UK, will meet in Copenhagen, Denmark, 30 September–4 October 2024 and online on 14–15 October 2024 to:

a) Carry out mixed fisheries projections for the Bay of Biscay taking into account the single species advice and the management measures in place for 2024 for anglerfish, megrim, sea bass, hake, sole, Norway lobster, whiting, pollack, mackerel, horse mackerel, blue whiting and smooth hound produced by WGBIE, WGWIDE and WGEF in 2024;
b) Carry out mixed demersal fisheries projections for the Celtic Sea taking into account the single species advice and the management measures in place for 2024 for cod, haddock, whiting, hake, megrim, monkfish, sole and Norway lobster that is produced by WGCSE and WGBIE in 2024;
c) Carry out mixed fisheries projections for Iberian waters taking into account the single species advice and the management measures in place for 2024 for hake, four-spot megrim, megrim and anglerfish that is produced by WGBIE in 2024;
d) Carry out mixed demersal fisheries projections for the Irish Sea taking into account the single species advice and the management measures in place for 2024 for cod, haddock, whiting, plaice, sole, and Norway lobster that is produced by WGCSE in 2024;
e) Carry out mixed demersal fisheries projections for the North Sea taking into account the single species advice and the management measures in place for 2023 for cod, haddock, whiting, saithe, plaice, sole, turbot, brill, Norway lobster, and witch that is produced by WGNSSK in 2024;
f) Produce draft mixed-fisheries sections for the ICES advisory report 2024 that includes dissemination of the fleet and fisheries data and forecasts for the North Sea, Celtic Sea, Irish Sea, Bay of Biscay, and Iberian waters.

WGMIXFISH-Advice will report by 8 November 2024 for the attention of ACOM.

Supporting information

Priority	The work is essential to the provision of ICES advice on multispecies fisheries. Such advice is necessary to fulfil the requirements stipulated in the MoUs between ICES and its client commissions.
Scientific justification and relation to action plan	The issue of providing advice for mixed fisheries remains an important one for ICES. The Aframe project, which started on 1 April 2007 and finished on 31 March 2009 developed further methodologies for mixed fisheries forecasts. The work under this project included the development and testing of the FCube approach to modelling and forecasts. In 2008, SGMIXMAN produced an outline of a possible advisory format that included mixed fisheries forecasts. Subsequently, WKMIXFISH was tasked with investigating the application of this to North Sea advice for 2010. AGMIXNS further developed the approach when it met in November 2009 and produced a draft template for mixed fisheries advice. WGMIXFISH has continued this work since 2010.
Resource requirements	Information Governance is indirectly linked to ACOM, SCICOM, DIG, and SIPG.

Participants	Scientific organizations in ICES Member Countries; cooperating organizations.
Secretariat facilities	Meeting facilities, production of report.
Financial	None.
Linkages to advisory committee	ACOM.
Linkages to other committees or groups	SCICOM through the WGMG. Strong link to STECF.
Linkages to other organizations	This work serves as a mechanism in fulfilment of the MoU with EC and fisheries commissions. It is also linked with STECF work on mixed fisheries.

2 Bay of Biscay

2.1 Background

2.1.1 The fisheries

The Bay of Biscay covers ICES divisions 8.a–b and 8.d. These fisheries target a large range of species with different gears and in many cases are highly mixed. The trawl fisheries use otter, beam and pelagic trawls. Otter trawl is the main gear used in demersal fisheries in this ecoregion. The species caught depends on the area and the range of depths fished, as well as on the codend mesh size. The main species caught in these fisheries are hake, anglerfish, megrim, Norway lobster, sole, horse mackerel, mackerel, blue whiting, sea bass, pollack, red mullet, and cephalopods (cuttlefish and squid). Set-net fisheries target sole, hake, pollack, sea bass, anglerfish, and crustacean species while the longline fishery targets hake with bycatch of other deep-water species. The fisheries are mainly carried out by French and Spanish vessels with the addition of some vessels from Ireland, UK and Belgium.

Hake caught in ICES Division 3.a and subareas 4, 6, and 7, megrim and anglerfish in Subarea 7, pollack in 8.c and 9.a and mackerel, horse mackerel and blue whiting outside Bay of Biscay are also included in the current analysis to account for all fishing mortality on these stocks.

2.1.2 Management measures

In the context of the new Common Fisheries Policy (CFP), the EU has developed a multiannual management plan (MAP) for the management of the Western Waters demersal mixed fisheries, which has been in force since 2019 (EU, 2019), replacing the former single-stock long-term management plans with an unique framework defining objectives and constraints for both target and bycatch demersal species. Among the stocks with analytical assessments included in the Bay of Biscay mixed fisheries analysis, several are either shared between the EU and non-EU member states (which are not involved in the EU-MAP) or not included in the EU-MAP. In those cases, ICES gives advice based on the ICES MSY approach or the precautionary approach (PA).

The EU landing obligation was introduced in 2016 (EU, 2015). This regulation prohibits the discarding of certain species on a fishery-by-fishery approach. From 1 January 2019, catches of all quota species in the Bay of Biscay are subject to the EU landing obligation rule, except if an exemption is in place.

2.2 FLBEIA

2.2.1 Software

The analysis was conducted using the FLR framework (Kell *et al*., 2007); www.flr-pro-ject.org; FLCore 2.6; FLAssess 2.6.3; FLash 2.5.11) and was run with R version 4 (R Core Team, 2022). All forecasts were projected using the FLBEIA package (version 1.16.1, García *et al.,* 2017). FLBEIA is an FLR package that facilitates the bioeconomic evaluation of management strategies in a multistock and multifleet framework. A total of 13 stocks were considered in the present analysis. 10 stocks are assessed as an ICES category 1 (with one Norway lobster stock assessed based on UWTV survey) and the 3 remaining stocks are assessed as ICES category 3.

The list of species considered and the software used in the single-species assessments and forecasts are summarized in Table 2.1

Table 2.1. Summary of stocks incorporated in the mixed fisheries analysis for the Bay of Biscay, the assessment model and forecast used to produce the single species advice.

Stocks	Assessment	Forecast
BLACK-BELLIED ANGLERFISH - 7, 8.a-b and 8.d	Length-based age-structured (Stock Synthesis)	Stock Synthesis
SEA BASS - 8.a-b	Age- and length-based analytical (Stock Synthesis)	*Ad hoc* code
HAKE - 3.a, 4, 6, 7 and 8.a-b and 8.d	Length-based and sex-disaggregated (Stock Synthesis)	Stock Synthesis
HORSE MACKEREL - Northeast Atlantic	Length- and age-based analytical (Stock Synthesis)	Stock Synthesis
MACKEREL - Northeast Atlantic and adjacent waters	Age-based analytical assessment (SAM)	FLR STF
MEGRIM - 7.b-k and 8.a-b and 8.d	Statistical catch-at-age (a4a)	FLR STF
WHITE ANGLERFISH - 7, 8.a-b and 8.d	Length-based age-structured (Stock Synthesis)	Stock Synthesis
NORWAY LOBSTER - FU 2324	Underwater television (UWTV) survey	*Ad hoc* (excel sheet)
POLLACK - 8 and 9.a	Trends from biomass index from commercial LPUE index from French gill-net and length-based indicators (LBIs)	No
SMOOTH-HOUND - Northeast Atlantic and adjacent waters	Trends from combined biomass index and length-based indicator	*Ad hoc* (excel sheet)
SOLE - 8.a-b	Age-based analytical assessment (SAM) using catches	FLR STF
BLUE WHITING - Northeast Atlantic and adjacent waters	Age-based analytical assessment (SAM)	SAM forecast (deterministic version)
WHITING - 8 and 9.a	Trends from biomass index from commercial LPUE (French bottom trawl) and Length Based Indicators (LBIs)	No

2.2.2 Scenarios

The basis of the model is to estimate the potential future levels of fleet fishing effort corresponding to the fishing opportunities (TACs by stock and/or effort allocations by fleet) available to that fleet, based on fleet effort distribution and catchability by métier. This level of effort was used to estimate landings and catches by fleet and stock, using standard forecasting procedures.

The advice basis for stocks with analytical single species assessments was given in terms of the EU multiannual plan (MAP) for Western Waters when it is applicable, or alternatively, according to MSY approach (for the stocks shared with non-EU members for instance). For the stocks with no analytical assessments (category 3), the advice was based on the precautionary approach. A total of 17 scenarios were produced:

Table 2.2. Summary of scenarios produced for the mixed fisheries analysis of the Bay of Biscay.

Scenario	Mixed Fisheries effort assumption	Basis for catch limit in 2025
Minimum (min)	For each fleet, fishing in 2025 stops when the catch for any one of the stocks meets the fleet's stock share*. This option is the most precautionary option and can highlight some potential 'choke species' issues.	ICES catch advice
Maximum (max)	For each fleet, fishing in 2025 continues until the catches of all stocks meet the fleet's stock share*. This option illustrates the degree of overshoot of the single-stock advice if fishing is not restricted by the fleet stock shares*.	
Status quo effort (sq_E)	The effort of each fleet in 2025 is set equal to the average effort in the most recent three years (2021–2023) for which landings and discard data are available. However, for the pelagic fleets that catch the remaining quota for mackerel, horse mackerel and blue whiting it is assumed that they catch all their available stock share independently of the effort needed.	Not applicable
Minimum including ranges (min_range)	Same as min scenario.	Catches corresponding to $F_{MSY\ upper}$ for stocks in good status (SSB ≥ MSY $B_{trigger}$) and scaled F_{MSY} advice levels (F_{MSY} × SSB/MSY $B_{trigger}$) for the other stocks (including zero catch advice stocks). Applies only to stocks with ranges defined and where corresponding catch scenarios are provided in the single-stock advice.
Stock-specific MSY or PA approach (ank/bss/hke/hom/mac/meg/mon/nep/pol/sdv/sol/whb/whg)	All fleets set their effort in 2025 corresponding to their stock-specific quota share, regardless of other catches. This option causes overshoot of some stocks, except in the case of horse mackerel (hom), which causes underutilization of some stocks.	ICES catch advice

*** Throughout this analysis, the term 'fleet's stock share' or 'stock share' is used to describe the share of the fishing opportunities for each particular fleet, which has been calculated based on the single-stock advice for 2025 and the historical proportion of the stock catch taken by the fleet (2021–2023).**

2.3 Stock input data and recent trends

2.3.1 Stocks

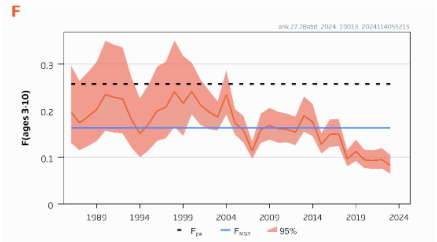
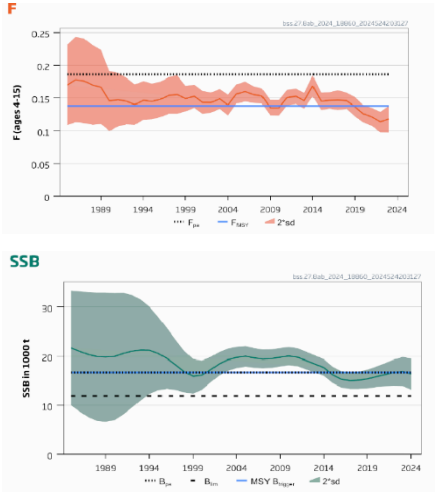
2.3.1.1 Data

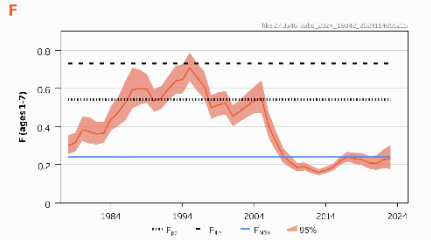
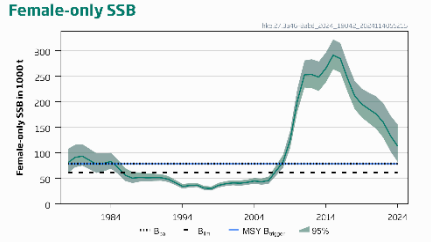
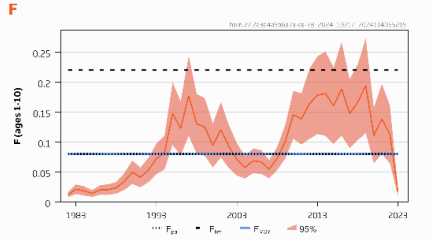
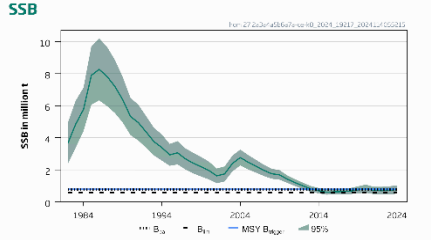
The single species assessment data for the different stocks were provided by the ICES Working Group for the Bay of Biscay and the Iberian Coast Ecoregion (WGBIE; ICES, 2024a), ICES Working Group on Elasmobranch Fishes (WGEF; ICES, 2024b) and ICES Working Group on Widely Distributed Stocks (WGWIDE; ICES, 2024c). A number of the stocks considered within this mixed-fisheries analysis are being assessed using stochastic assessments. Stock Synthesis (Methot and Wetzel, 2013), length-based age-structured is used for the Northern hake stock (also sex-disaggregated), the anglerfish stocks in the southern Celtic Seas and the Bay of Biscay, the Northeast Atlantic horse mackerel and northern and central Bay of Biscay sea bass. SAM (Nielsen and Berg, 2014) is used for the Northeast Atlantic mackerel and blue whiting and the Bay of Biscay sole stocks. A Bayesian statistical catch-at-age model, a4a (Jardim *et al.*, 2015), is used for the stock of megrim in the west and southwest of Ireland and the Bay of Biscay. Some of those assessments are length based and/or seasonal and for some of these stocks the advice is based on stochastic projections (Table 2.1). All this cannot currently be fully replicated in the deterministic FLBEIA software. However, the projections carried out with FLBEIA are routinely compared to those carried out in the single-species assessment working group to assess the potential impact of using different approaches and results are reasonably similar (see Section 2.5.1.1 below); as such, WGMIXFISH does not consider that the difference impacts significantly on the mixed fisheries advice and the projections.

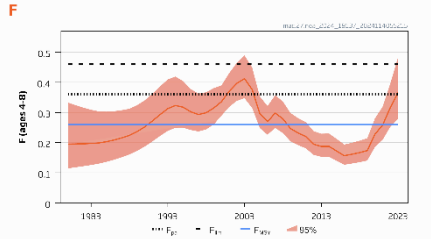
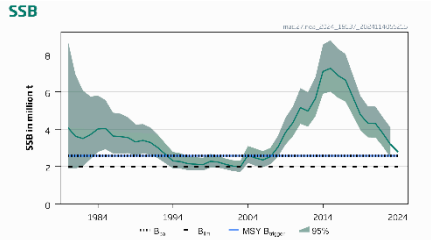
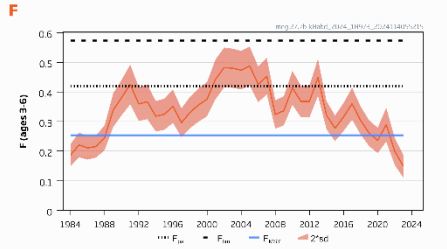
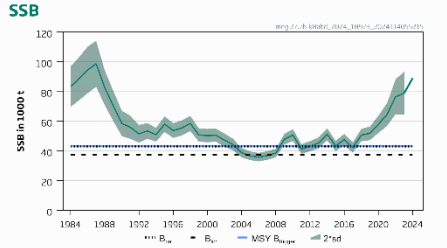
2.3.1.2 Trends and advice

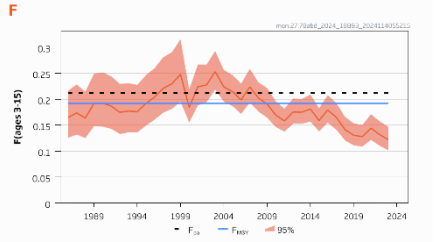
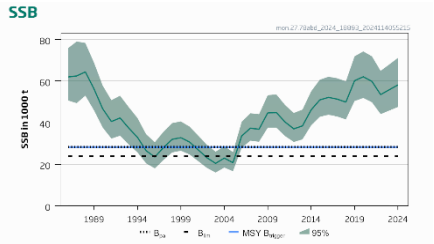
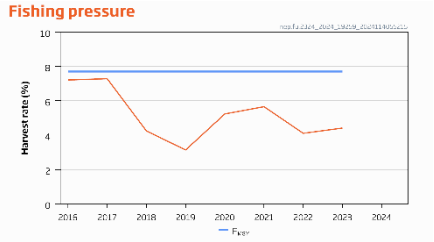
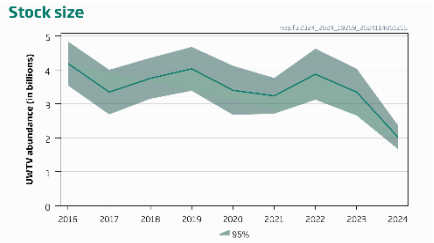
The advice for these stocks was drafted by the ICES WGBIE (ICES, 2024a), WGEF (ICES, 2024b) and WGWIDE (ICES, 2024c) under consideration by ACOM. In order to give a global overview of all Bay of Biscay demersal stocks of interest to this analysis, this information is summarized in the Table 2.3 based on the single species advice.

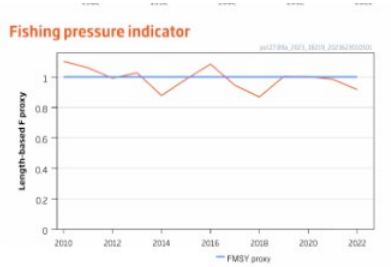
Table 2.3. Summary of stock status and ICES advice for the stocks included in the mixed fishery analysis.

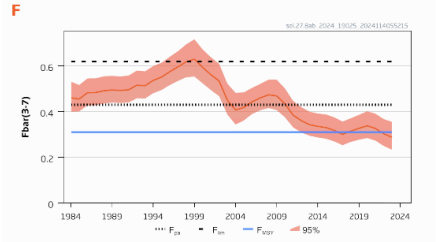
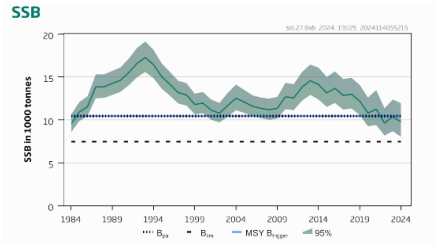
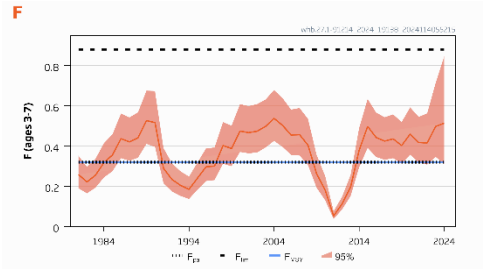
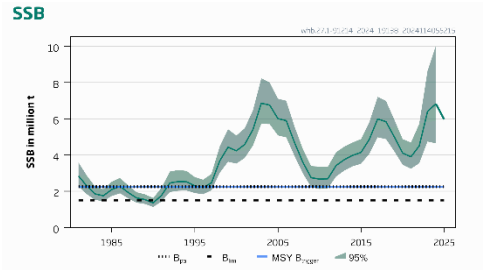
Species	Area	Stock status	Advice 2025
ank.27.78abd (Black-bellied anglerfish)	7, 8.a–b and 8.d		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 25 317 tonnes. ICES notes the existence of a precautionary management plan developed and adopted by one of the relevant management authorities for this stock. The use of combined species TACs for the two anglerfish species, black-bellied anglerfish (Lophius budegassa) and white anglerfish (Lophius piscatorius), prevents effective control of the single-species exploitation rates and could lead to the overexploitation of either species.
bss.27.8ab (Sea bass)	8.a–b		ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, total removals in 2025 that correspond to the F ranges in the plan are between 2 631 tonnes (corresponding to F_{MSY} × SSB_{2025}/MSY $B_{trigger}$) and 2 241 tonnes (corresponding to F_{MSY} lower × SSB_{2025} / MSY $B_{trigger}$). This applies to the sum of the commercial and recreational catches.

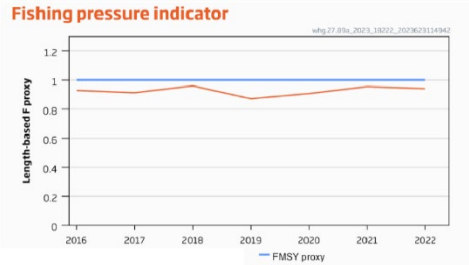
Species	Area	Stock status	Advice 2025
hke.27.3a46-8abd (Hake)	3.a, 4, 6, 7 and 8.a-b and 8.d	F  Female-only SSB  	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 52 466 tonnes. ICES notes the existence of a precautionary management plan developed and adopted by one of the relevant management authorities for this stock.
hom.27.2a3a4a5b6a7a-ce-k8 (Horse mackerel)	Northeast Atlantic	F  SSB  	ICES advises that when the maximum sustainable yield (MSY) approach is applied, catches in 2025 should be no more than 75 545 tonnes. North Sea horse mackerel is caught in a mixed fishery with western horse mackerel in Division 7.e, and ICES advises that there should be zero catch of North Sea horse mackerel in 2025. Catches of North Sea horse mackerel in the fishery for Western horse mackerel in Division 7.e should be minimized to support the recovery of the North Sea stock.

Species	Area	Stock status	Advice 2025
mac.27.nea (Mackerel)	Northeast Atlantic and adjacent waters	F  SSB  	ICES advises that when the maximum sustainable yield (MSY) approach is applied, catches in 2025 should be no more than 576 958 tonnes.
meg.27.7b-k8abd (Megrim)	7.b-k and 8.a-b and 8.d	F  SSB  	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 21 144 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. The use of combined species TAC for the two megrim species, megrim (*Lepidorhombus whiffiagonis*) and four-spot megrim (*Lepidorhombus boscii*), prevents effective control of the single-species exploitation rates and could lead to the overexploitation of either species.

Species	Area	Stock status	Advice 2025
mon.27.78abd (White anglerfish)	7, 8.a–b and 8.d	 	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 34 983 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. The use of combined species TAC for the two anglerfish species, black-bellied anglerfish (*Lophius budegassa*) and white anglerfish (*Lophius piscatorius*), prevents effective control of the single-species exploitation rates and could lead to the overexploitation of either species.
nep.fu.2324 (Norway lobster)	FU 2324	 	ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 3 502 tonnes.

Species	Area	Stock status	Advice 2025
pol.27.89a (Pollack)	8 and 9.a		ICES advises that when MSY approach is applied, commercial catches should be no more than 872 tonnes in each of the years 2024 and 2025. All commercial catches are assumed to be landed. ICES cannot quantify the corresponding total catches because the recreational catches cannot be quantified.
sdv.27.nea (Smooth-hound)	Northeast Atlantic and adjacent waters		ICES advises that when the MSY approach is applied, landings should be no more than 5 329 tonnes in each of the years 2024 and 2025. ICES cannot quantify the corresponding catches.

Species	Area	Stock status	Advice 2025
sol.27.8ab (Sole)	8.a-b	 	ICES advises that when the EU multiannual plan (MAP) for the Western waters and adjacent waters is applied, catches in 2025 that correspond to the F ranges in the plan are between 1 716 (corresponding to $F_{MSY\ lower} \times SSB_{2025}$ / MSY $B_{trigger}$) and 2 510 tonnes (corresponding to $F_{MSY} \times SSB_{2025}$ / MSY $B_{trigger}$).
whb.27.1-91214 (Blue whiting)	Northeast Atlantic and adjacent waters	 	ICES advises that when the long-term management strategy agreed by Norway, the European Union, the Faroe Islands, Iceland, and the UK is applied, catches in 2025 should be no more than 1 447 054 tonnes.

Species	Area	Stock status	Advice 2025
whg.27.89a (Whiting)	8 and 9.a	 	ICES advises that when MSY approach is applied, catches should be no more than 1 347 tonnes in each of the years 2024 and 2025.

2.4 Fleets and métiers

2.4.1 Catch and effort data

The WGMIXFISH data call requests landings and effort data consistent with the definition of DCF métiers and with data submitted to InterCatch (though with additional vessel length disaggregation), disaggregated into vessel length categories. Discard data were not requested by vessel length categories, as national observer sampling programs do not distinguish between vessel lengths. Instead, discard ratios for the various métiers aggregated across all vessel lengths were extracted from InterCatch and applied to the landings of the corresponding métiers in the vessel length specific data.

Age distribution is assumed equal to the one used in the assessment for all métiers. However, the information by métier and area is now available in InterCatch and could be integrated in the MIXFISH data in future assessments. The relative size of catches of the stocks incorporated in the mixed fisheries projections is shown in Figure 2.1.

The final dataset extracted from InterCatch includes discards estimates (either imported or raised) for all stocks and métiers. These InterCatch estimates have been used to estimate a discard ratio by métier, which allows allocating discards for all WGMIXFISH fleets and métiers with matching names, such that:

$$d^* = \frac{Dl}{L}$$

Where d* is the discard value for the métier used by FLBEIA, l is the weight of landings for the métier used by FLBEIA and L and D are the weight of landings and discards entered for the (vessel length aggregated) métier in InterCatch.

The fleet segments used in the mixed-fisheries analysis are defined by combining the country and the fishing gear group (Figure 2.2).

The suspected mislabelling of rays species by a number of member states is still unresolved and consequently it was not possible to include rays in this mixed fisheries analysis. These stocks are thornback ray (rjc.27.8abd), cuckoo ray (rjn.27.678abd), and undulate ray (rju.27.8ab).

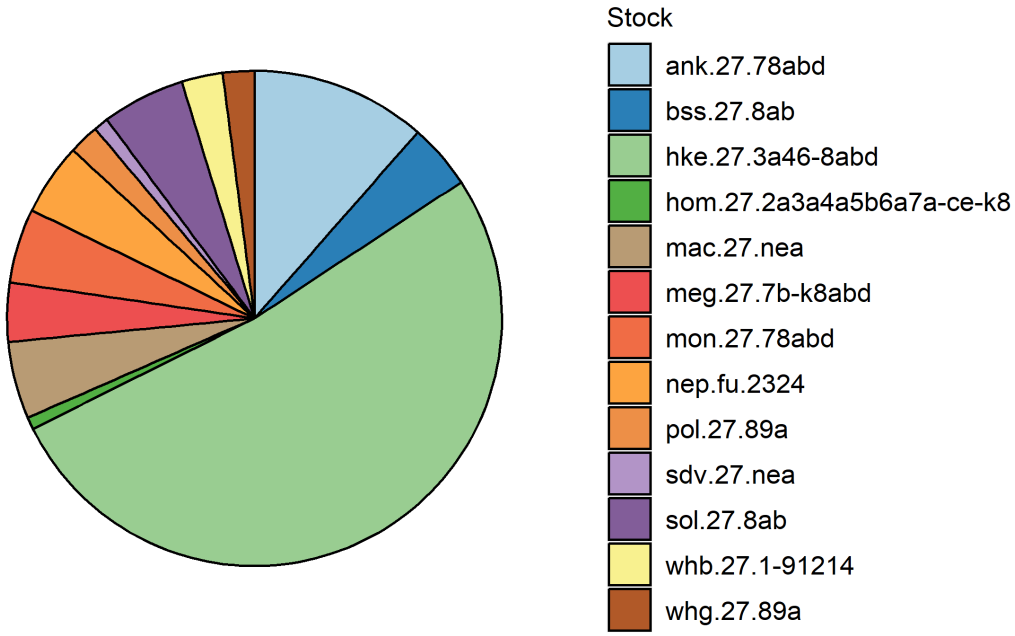


Figure 2.1. Bay of Biscay: Distribution of landings of the stocks included in the mixed fisheries projections (average 2021–2023).

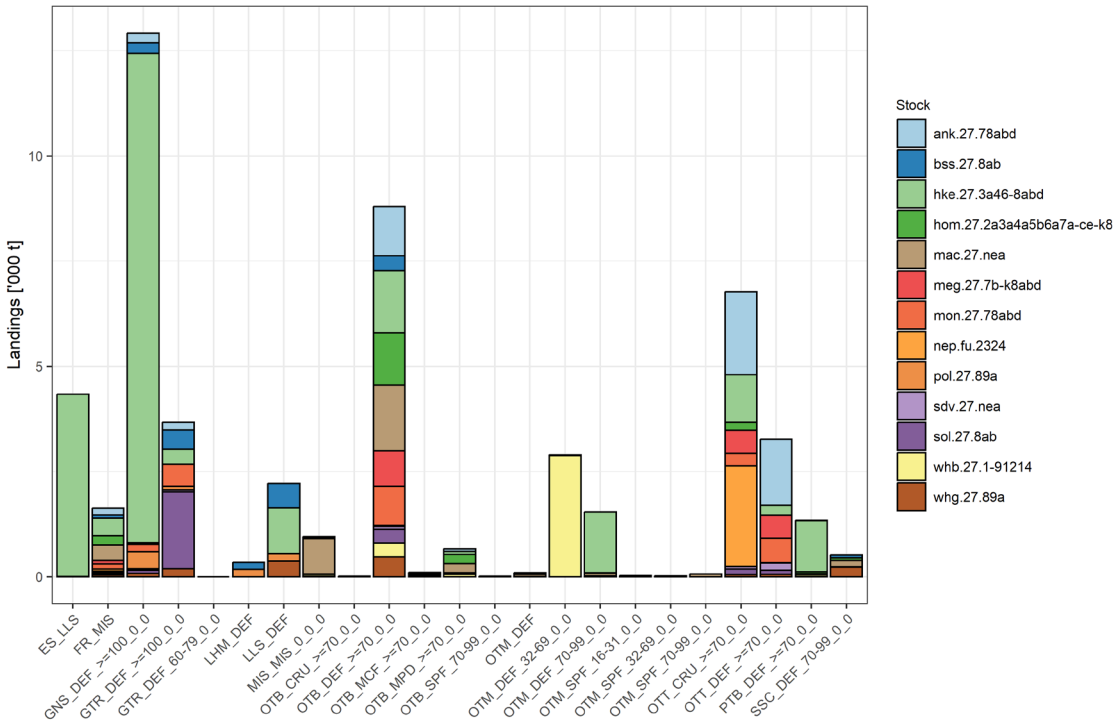


Figure 2.2. Bay of Biscay: Landings distribution of species by métier (average 2021–2023). The métiers used are described in Table 2.4. Each fleet engages in one or several different métiers, among a total of 24 métiers, according to the group of target species and the technical characteristics of the fishing gear. Catches of métier OTH_* (outside 8.a-b and 8.d) have not been included.

2.4.2 Definition of fleets and métiers

The procedure to define the fleets and métier in the model was the following:

1. Fleets were defined by aggregating landing and effort across country, gear group and vessel length (where applicable).
2. Pelagic fleets with null bycatch of demersal species (these are Spanish purse-seiners, hand and pole lines, see Figure 2.3) were removed from the analysis.
3. Fleets landing a small amount (less than 1% in last 3-year mean) of any of the stocks included in the analysis were binned into a country specific "MIS" fleet (these are "FR_MIS" and "ES_MIS").
4. Within a fleet, métiers were defined as a combination of gear, target species (e.g. demersal fish, DEF, or crustaceans, CRU) and country.
5. Métiers landing less than 2% of each stock (last 3-year mean) are aggregated under "MIS" métier category.
6. Stock catches lower than 1 t (in all the last 3 data years) are removed.
7. Effort and landing files were matched to ensure consistency. Métiers without catch of any of the modelled stocks in the last 3 data years are not retained.
8. Out of Bay of Biscay (area 8.a-b and 8.d) catches of each of the stocks are aggregated into an "OTH" fleet by stock (named as "OTH_[stock]") together with the catches of the pelagic fleets in Bay of Biscay, to reduce the dimensions of the model.

Figure 2.3. Bay of Biscay: Landings distribution by fleet and species type (average 2021–2023).

The final data used contained 21 fleets, covering landing and effort inside the Bay of Biscay (8.a-b and 8.d) for the years 2021 to 2023. These fleets engage in one or several different métiers, among a total of 24 métiers (Table 2.4). Several fleets still represent a small amount of catch and could be combined in order to reduce the total number of fleets. Additionally, eight extra fleets were included to cover the landings of some stocks outside the Bay of Biscay (see Section 2.1.1).

The distribution of landings by stock and métier is presented in Figure 2.1 and Figure 2.2, respectively.

Table 2.4. Métier categories used in the Bay of Biscay mixed fisheries analysis.

Métier category	Gear and target	Mesh size
ES_LLS	Spanish longline	-
FR_MIS	Other gear types (Spanish and French, respectively)	-
GNS_DEF_>=100_0_0	Set gillnet targeting demersal fish	≥ 100 mm
GTR_DEF_>=100_0_0	Trammelnet targeting demersal fish	>=100 mm
GTR_DEF_60-79_0_0	Trammelnet targeting demersal fish	60-79 mm
LHM_DEF	Handline targeting demersal fish	-
LLS_DEF	Set longline targeting demersal fish	-
MIS_MIS_0_0_0	Other gear types	-
OTB_CRU_>=70_0_0	Norway lobster bottom otter trawl	≥ 70 mm
OTB_DEF_>=70_0_0	Bottom otter trawl directed to demersal fish	≥ 70 mm
OTB_MCF_>=70_0_0	Bottom otter trawl directed to mixed cephalopods and demersal fish	≥ 70 mm
OTB_MPD_>=70_0_0	Bottom otter trawl directed to mixed pelagic and demersal fish	≥ 70 mm
OTB_SPF_70-99_0_0	Bottom otter trawl directed to pelagic fish	70-99 mm
OTM_DEF	Medium water otter trawl directed to demersal fish	-
OTM_DEF_32-69_0_0	Medium water otter trawl directed to demersal fish	32-69 mm
OTM_DEF_70-99_0_0	Medium water otter trawl directed to demersal fish	70-99 mm
OTM_SPF_16-31_0_0	Medium water otter trawl directed to pelagic fish	16-31 mm
OTM_SPF_32-69_0_0	Medium water otter trawl directed to pelagic fish	32-69 mm
OTM_SPF_70-99_0_0	Medium water otter trawl directed to pelagic fish	70-99 mm
OTT_CRU_>=70_0_0	Twin otter trawl directed to crustaceans	≥ 70 mm
OTT_DEF_>=70_0_0	Twin otter trawl directed to demersal fish	≥ 70 mm
PTB_DEF_>=70_0_0	Pairtrawlers directed to demersal fish	≥ 70 mm
SSC_DEF_70-99_0_0	Fly shooting seine	70-99 mm
MIS	All pelagic gears and all other gears outside 8.a-b and 8.d	-

2.4.4 Trends

Analyses of trends by fleet were carried out on 2021–2023 data. A number of exploratory graphs were produced to aid quality checking of the data once compiled into the final fleets object for catches, effort and catchability. Catchability plots by stock, fleet and métier are presented in Figure 2.4 to Figure 2.26.

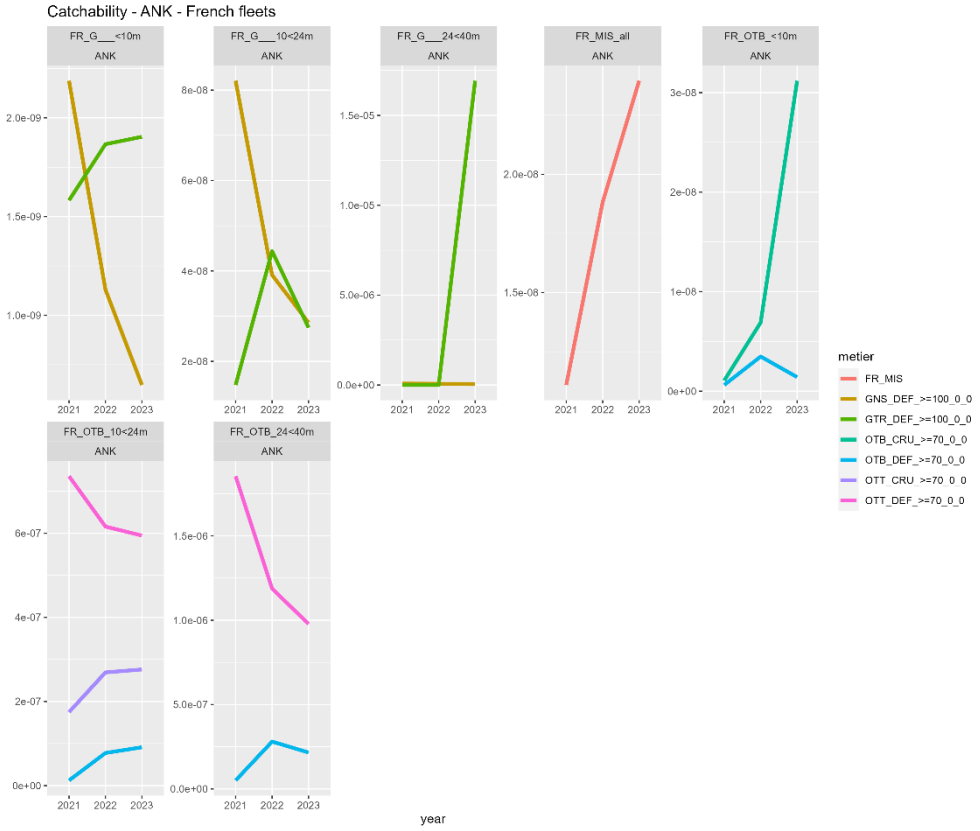


Figure 2.4. Bay of Biscay: trends of French catchability for black-bellied anglerfish (ank) by fleet and métier.

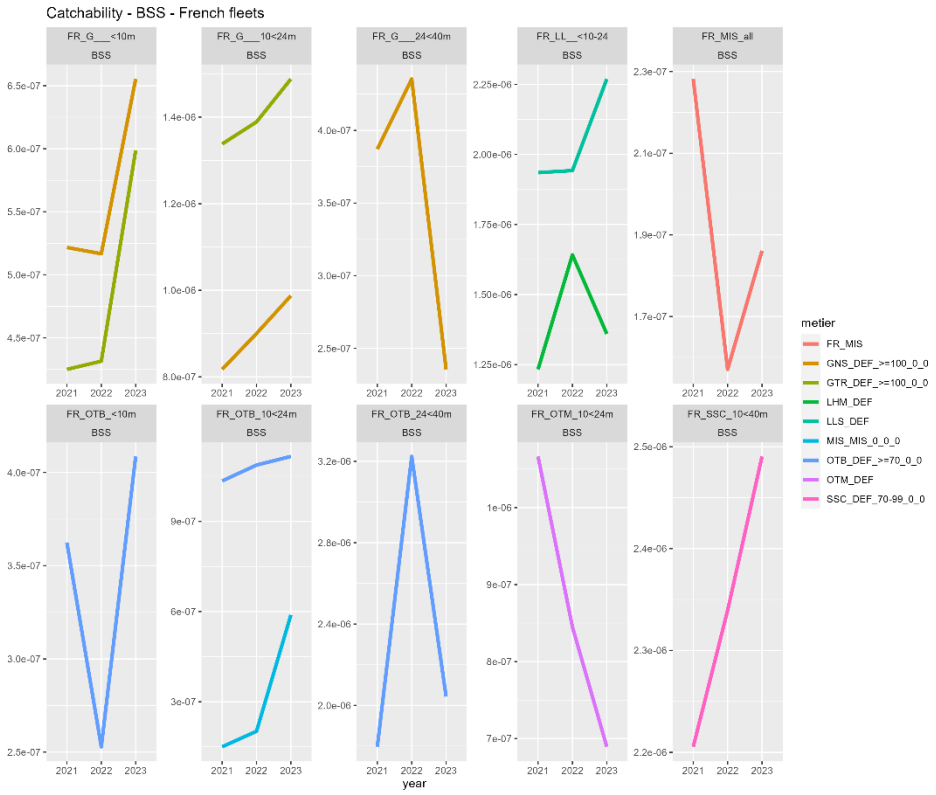


Figure 2.5. Bay of Biscay: trends of French catchability for sea bass (bss) by fleet and métier.

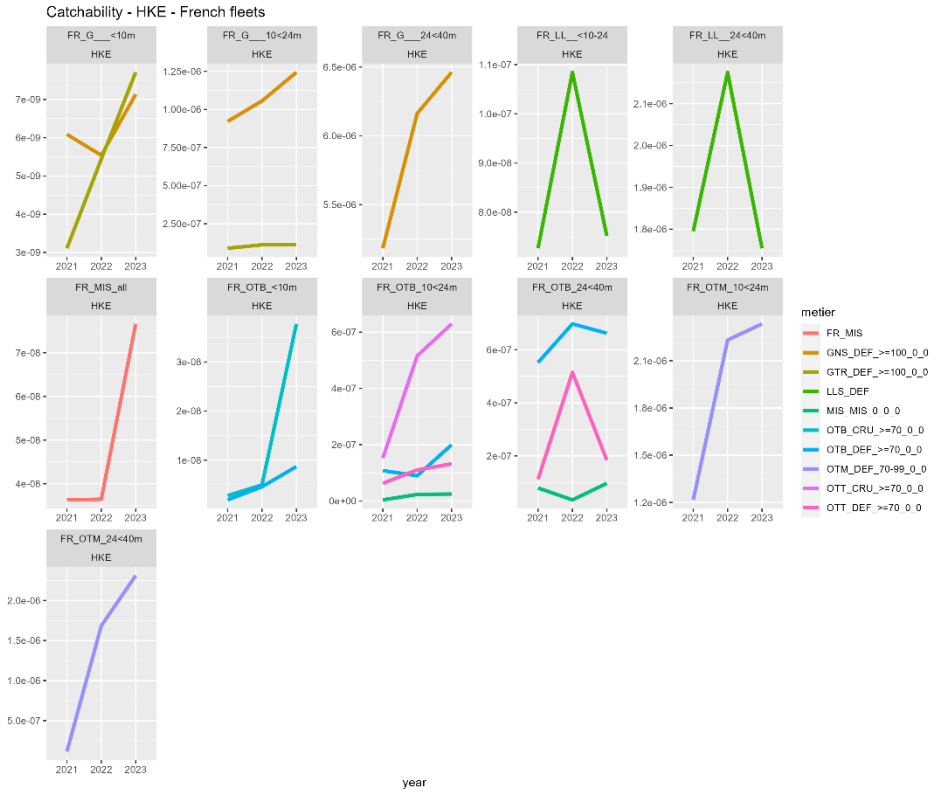


Figure 2.6. Bay of Biscay: trends of French catchability for hake (hke) by fleet and métier.

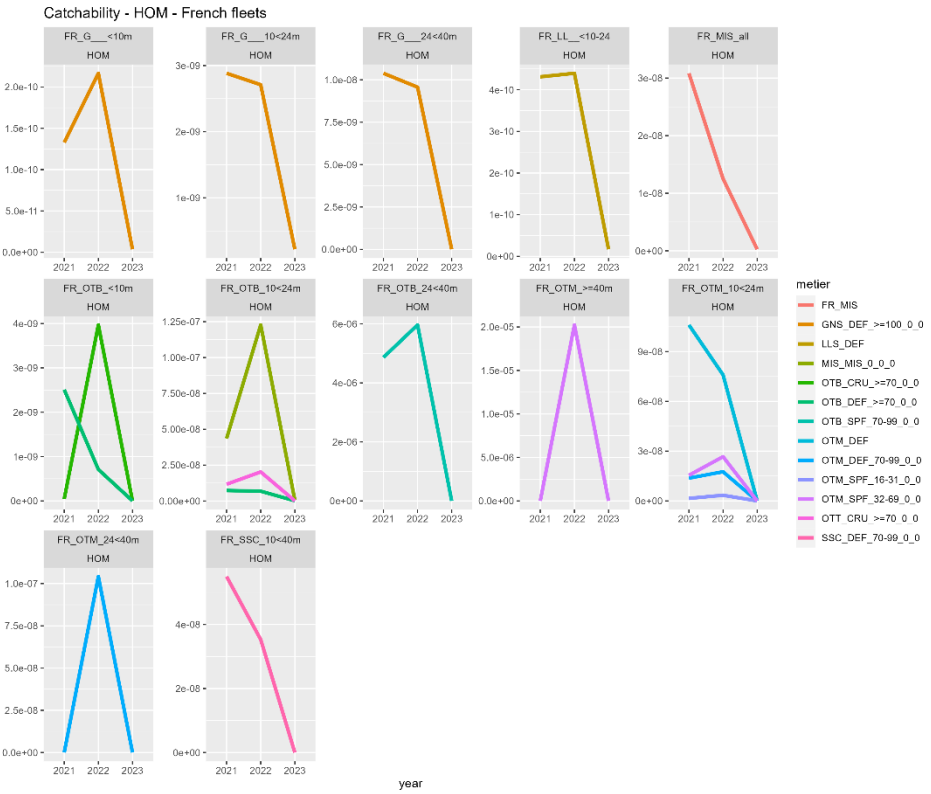


Figure 2.7. Bay of Biscay: trends of French catchability for horse mackerel (hom) by fleet and métier.

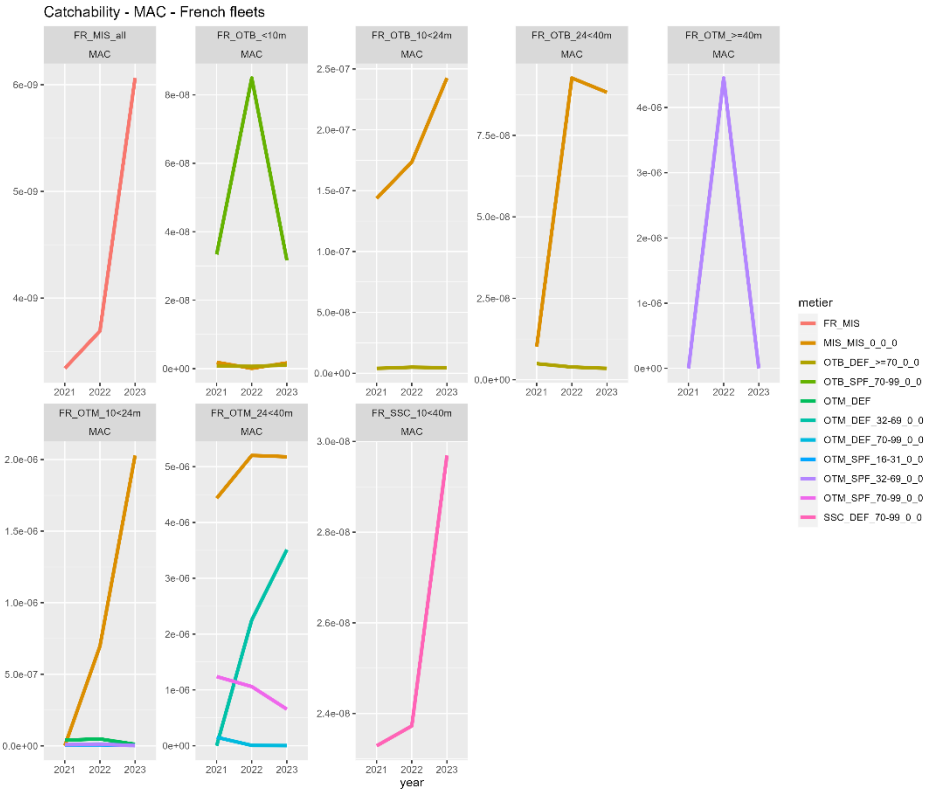


Figure 2.8. Bay of Biscay: trends of French catchability for mackerel (mac) by fleet and métier.

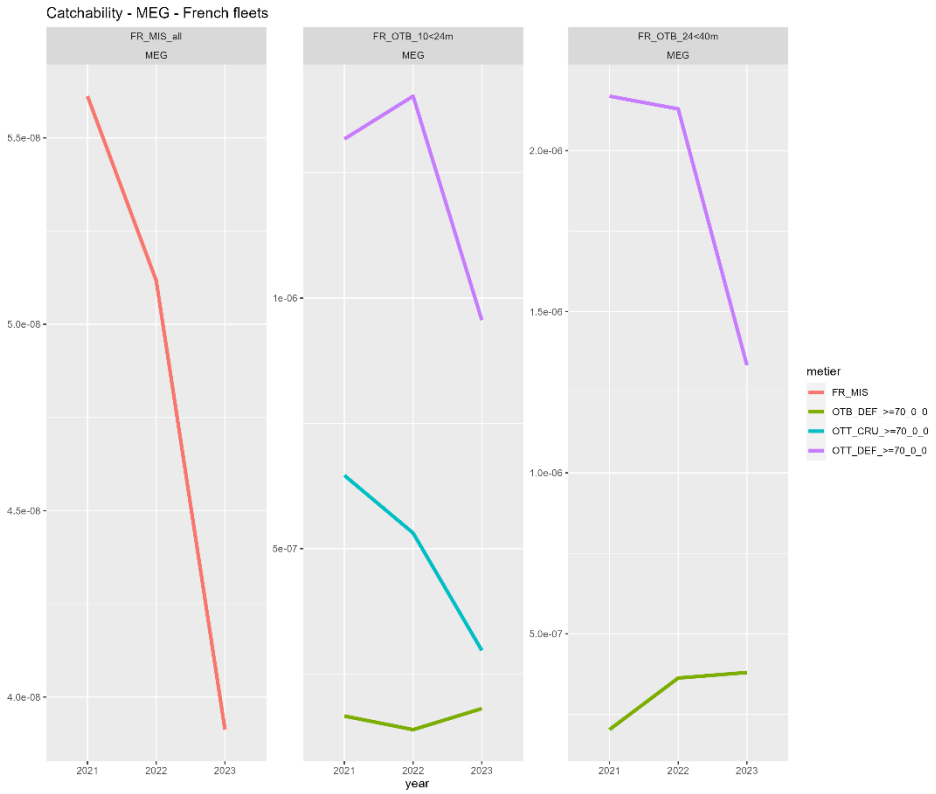


Figure 2.9. Bay of Biscay: trends of French catchability for megrim (meg) by fleet and métier.

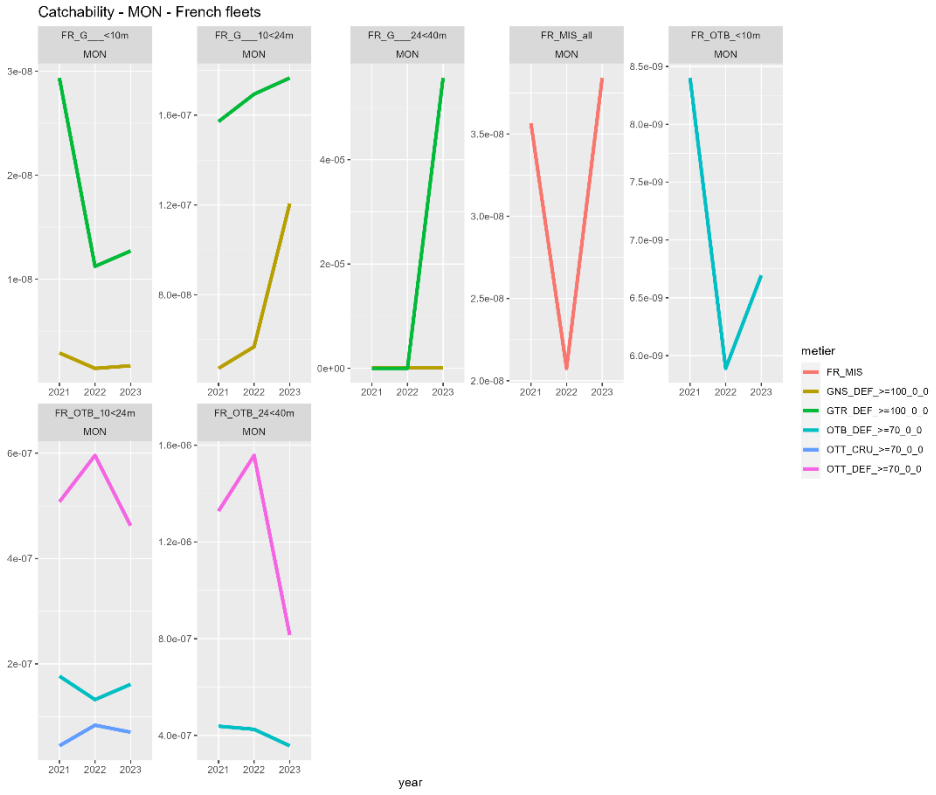


Figure 2.10. Bay of Biscay: trends of French catchability for white anglerfish (mon) by fleet and métier.

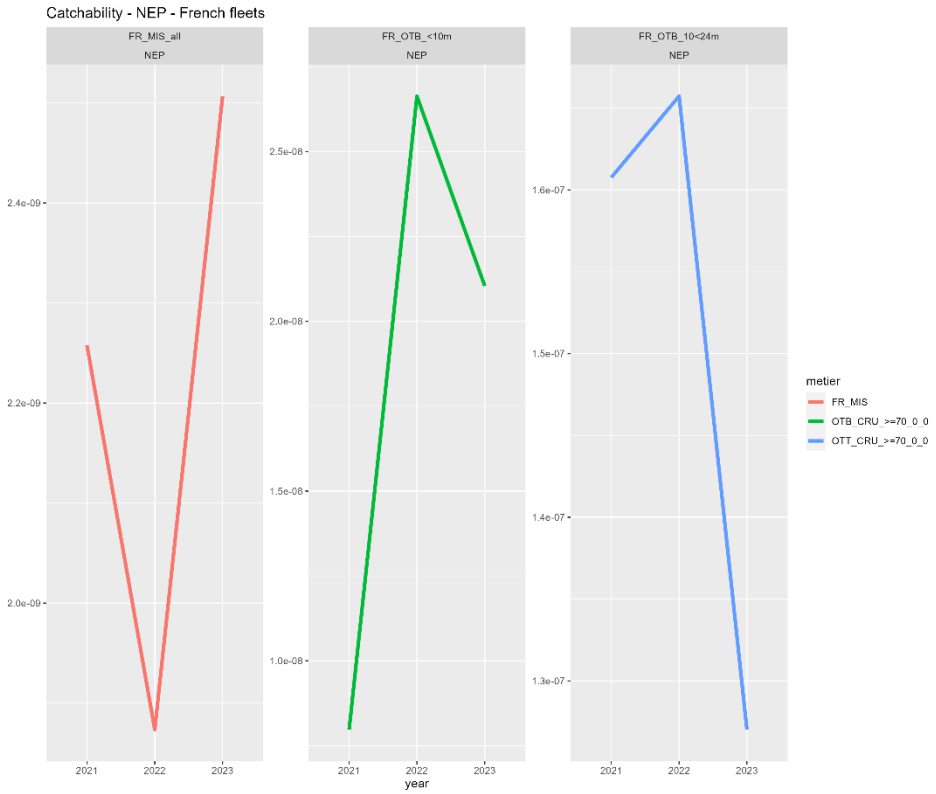


Figure 2.11. Bay of Biscay: trends of French catchability for Norway lobster (nep) by fleet and métier.

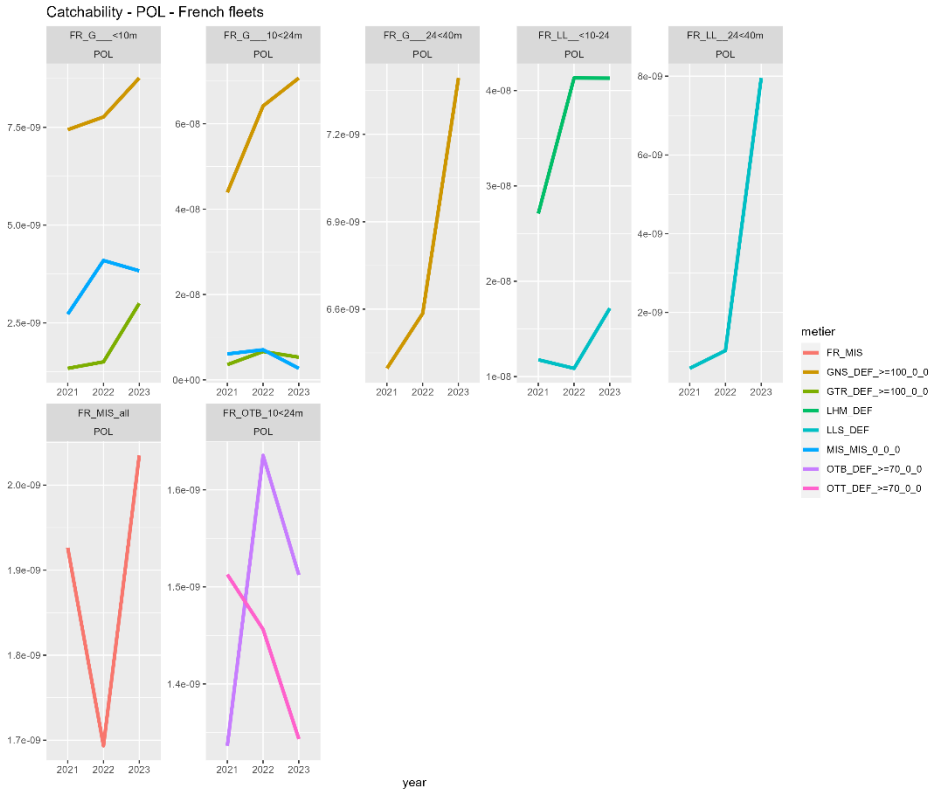


Figure 2.12. Bay of Biscay: trends of French catchability for pollack (pol) by fleet and métier.

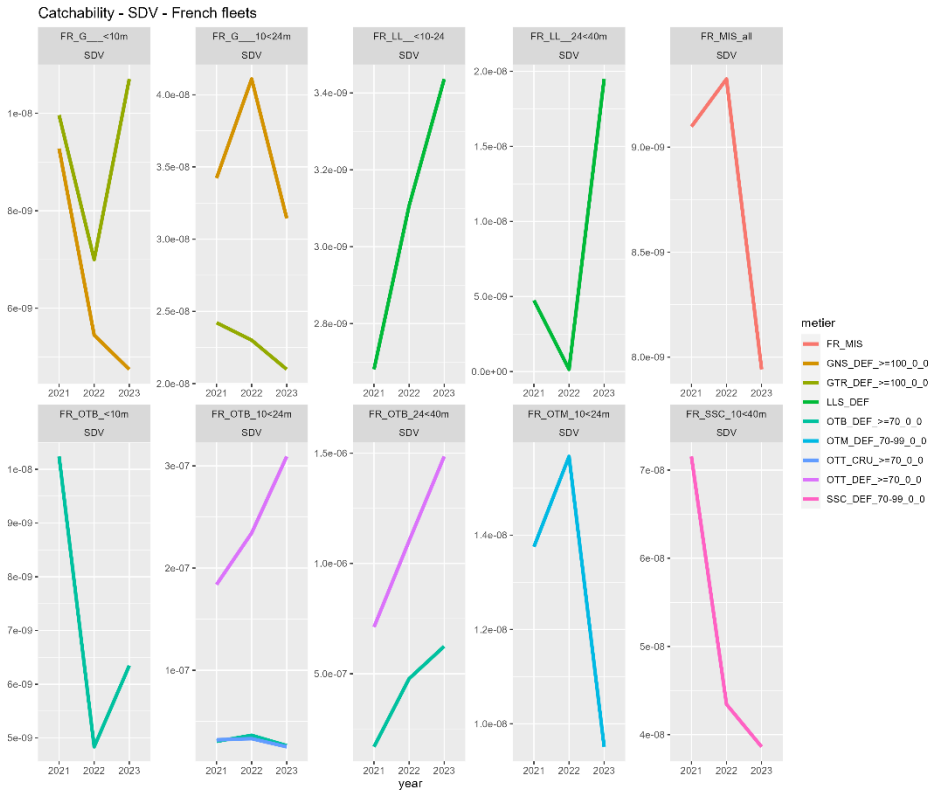


Figure 2.13. Bay of Biscay: trends of French catchability for smooth-hound (sdv) by fleet and métier.

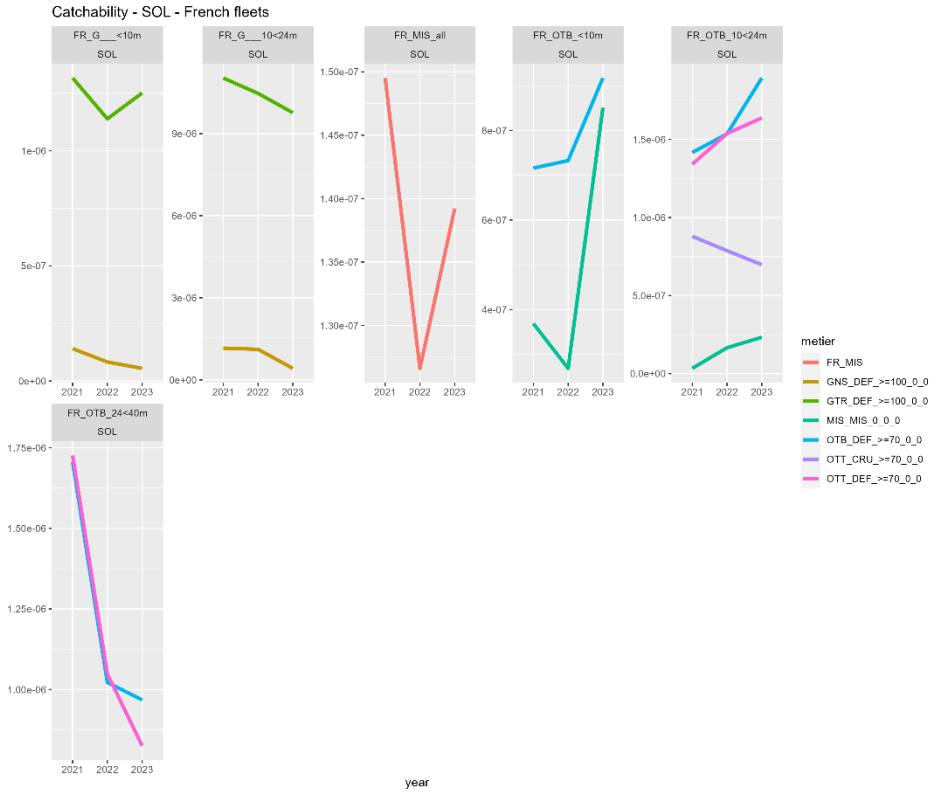


Figure 2.14. Bay of Biscay: trends of French catchability for sole (sol) by fleet and métier.

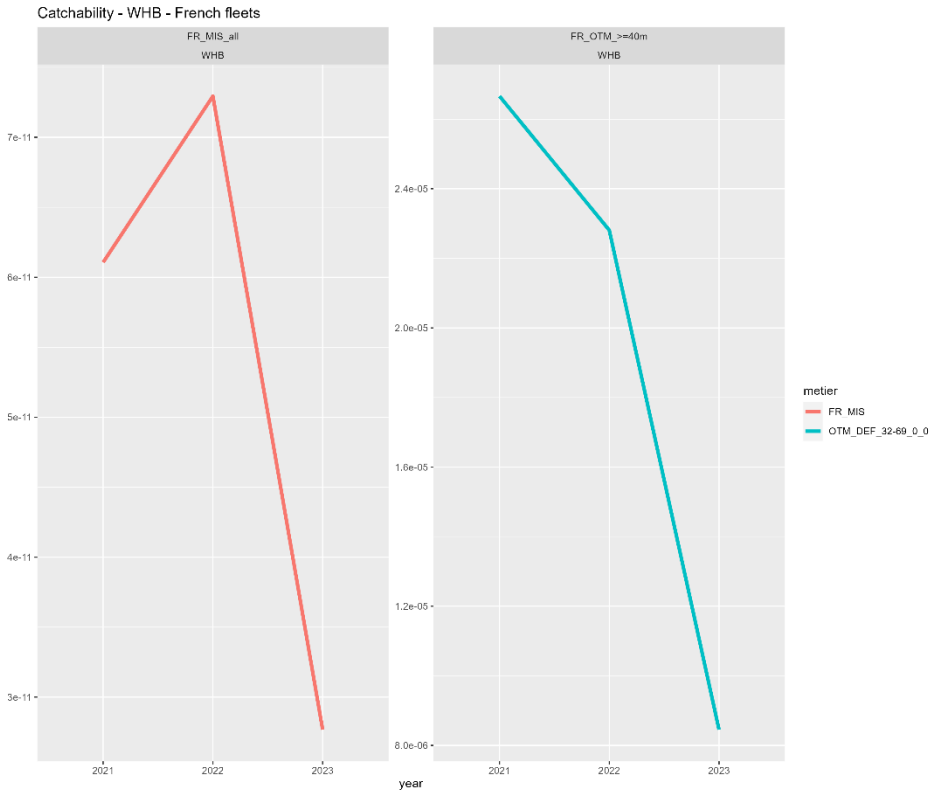


Figure 2.15. Bay of Biscay: trends of French catchability for blue whiting (whb) by fleet and métier.

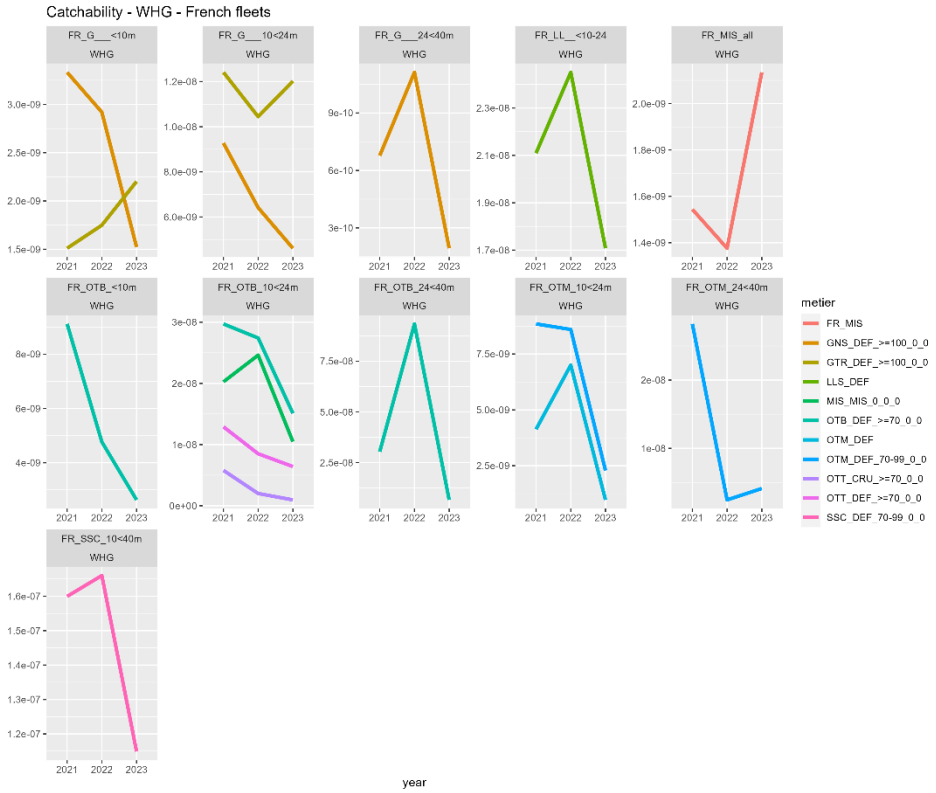


Figure 2.16. Bay of Biscay: trends of French catchability for whiting (whg) by fleet and métier.

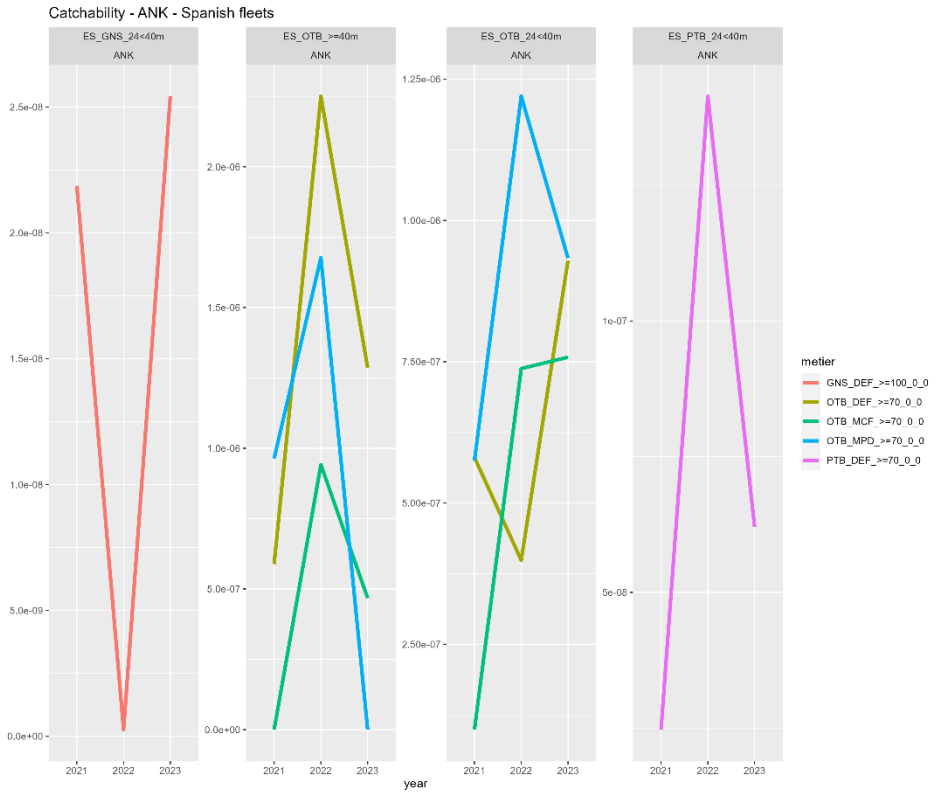


Figure 2.17. Bay of Biscay: trends of Spanish catchability for black-bellied anglerfish (ank) by fleet and métier.

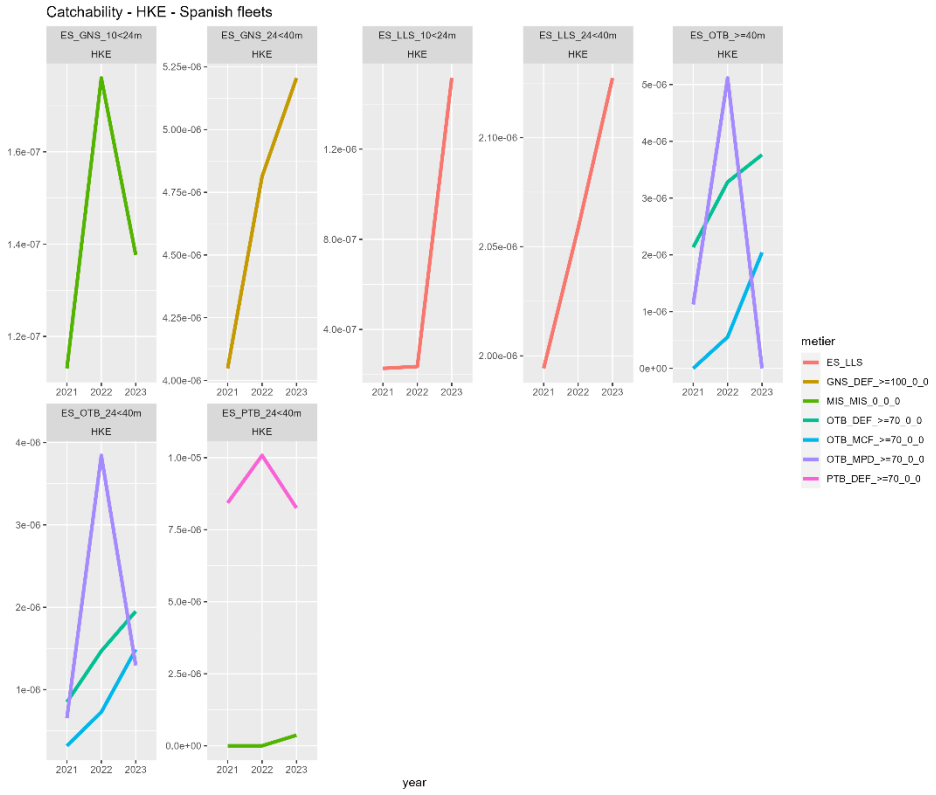


Figure 2.18. Bay of Biscay: trends of Spanish catchability for hake (hke) by fleet and métier.

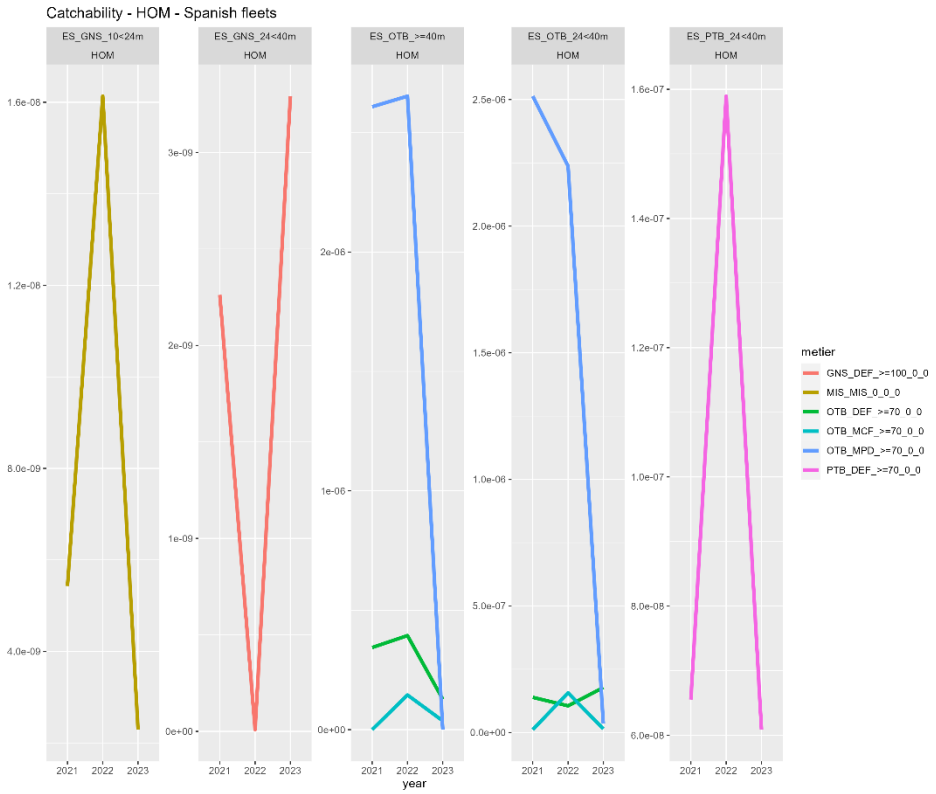


Figure 2.19. Bay of Biscay: trends of Spanish catchability for horse mackerel (hom) by fleet and métier.

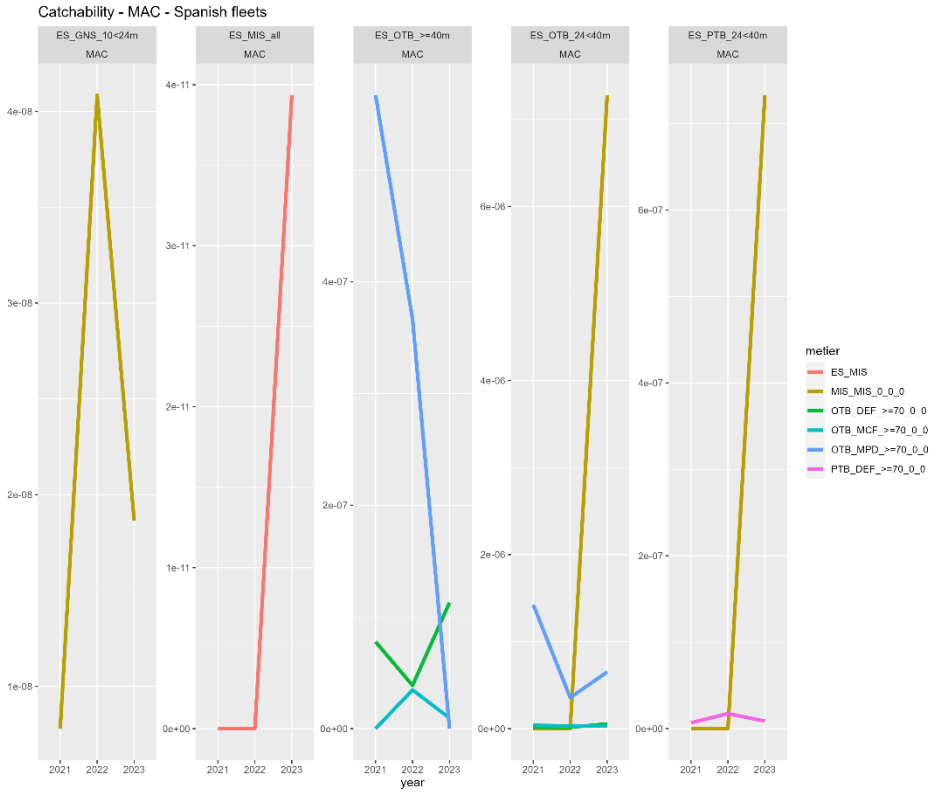


Figure 2.20. Bay of Biscay: trends of Spanish catchability for mackerel (mac) by fleet and métier.

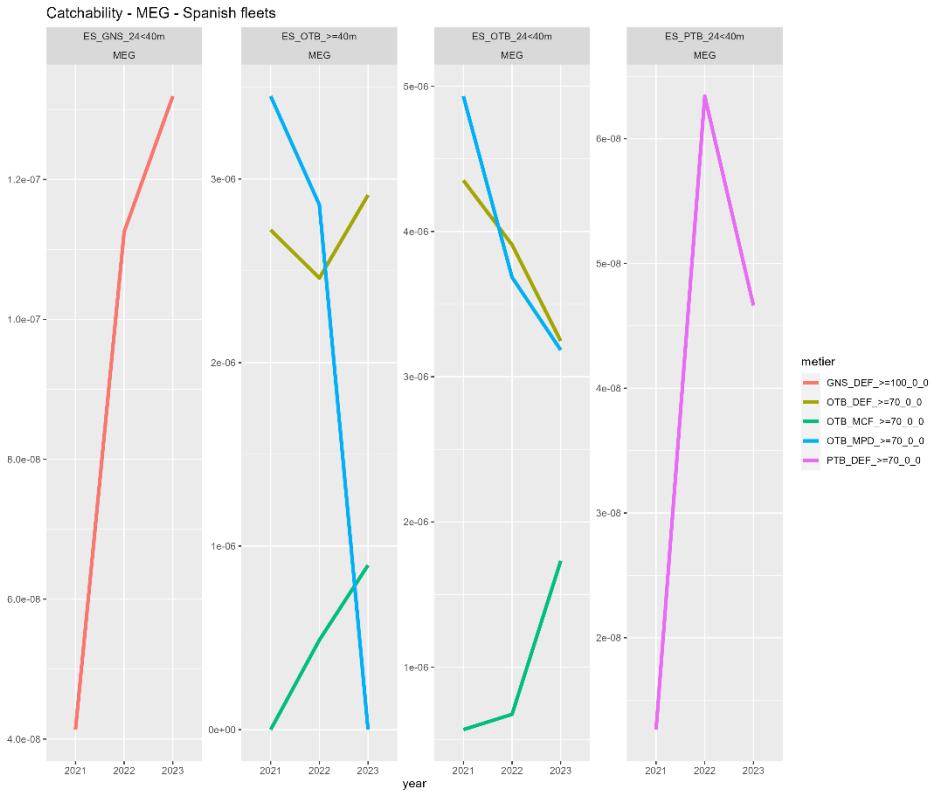


Figure 2.21. Bay of Biscay: trends of Spanish catchability for megrim (meg) by fleet and métier.

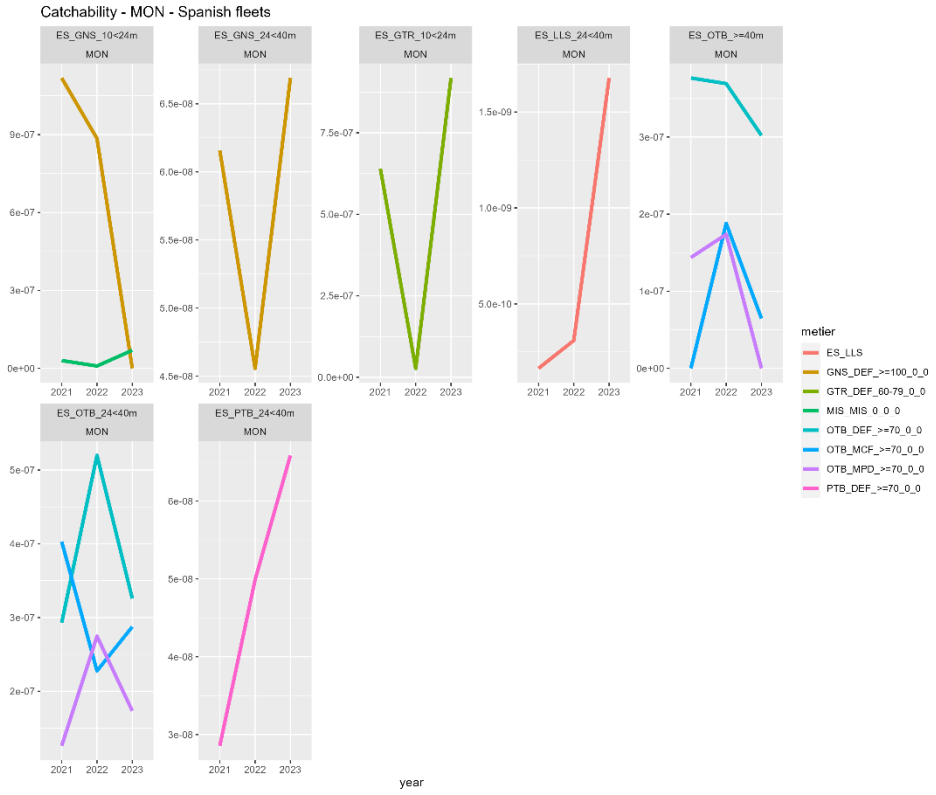


Figure 2.22. Bay of Biscay: trends of Spanish catchability for white anglerfish (mon) by fleet and métier.

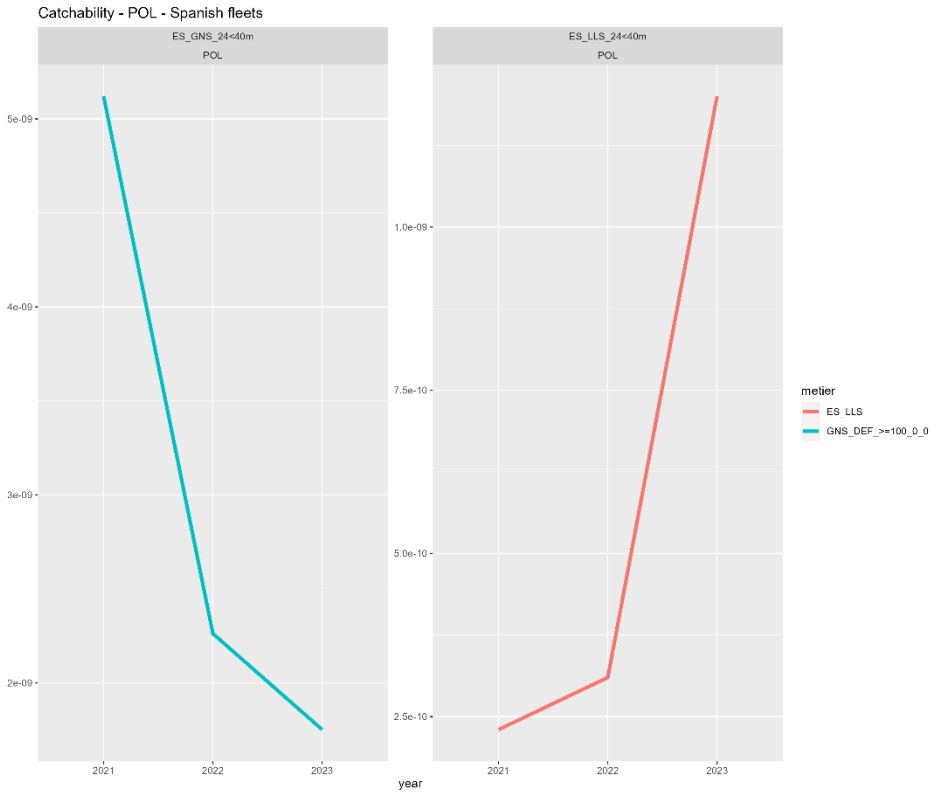


Figure 2.23. Bay of Biscay: trends of Spanish catchability for pollack (pol) by fleet and métier.

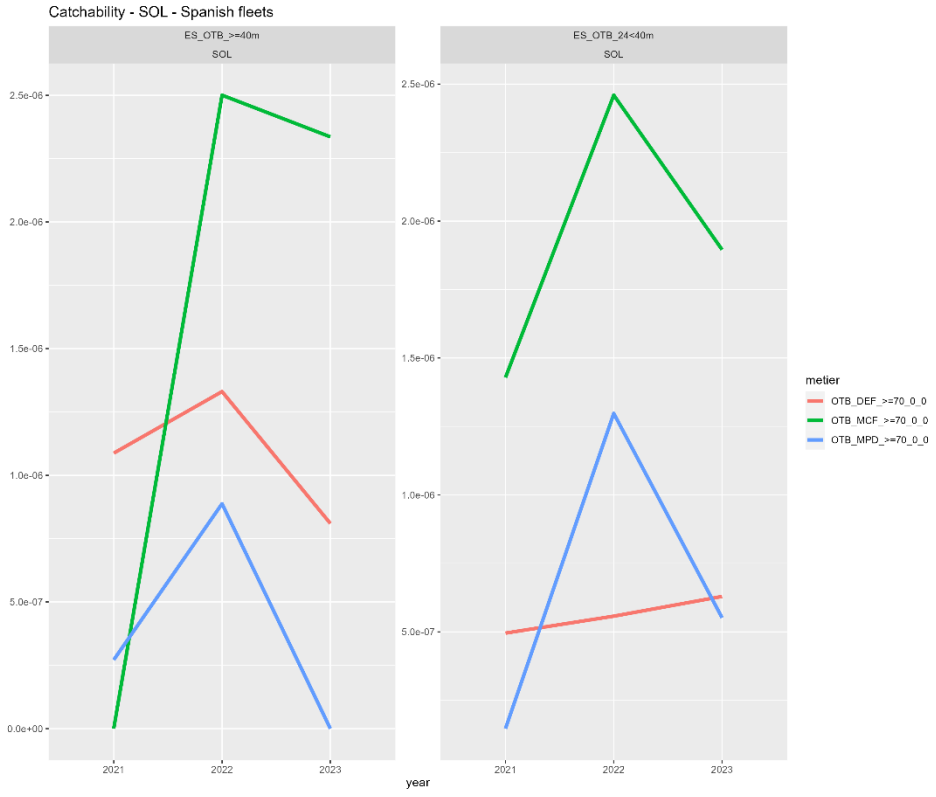


Figure 2.24. Bay of Biscay: trends of Spanish catchability for sole (sol) by fleet and métier.

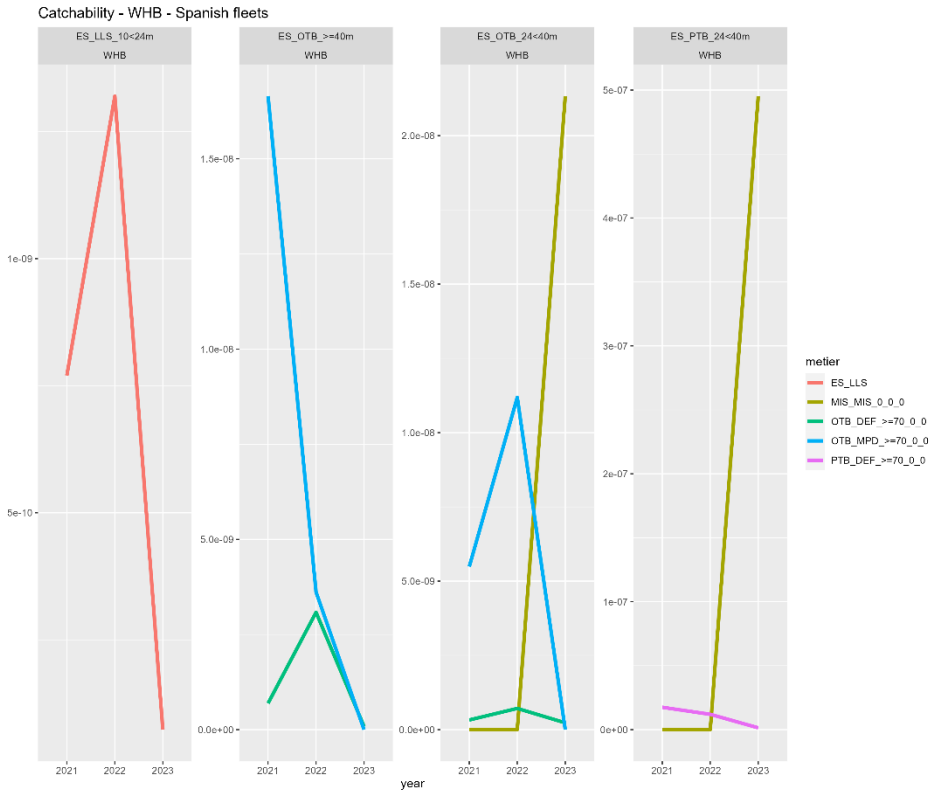


Figure 2.25. Bay of Biscay: trends of Spanish catchability for blue whiting (whb) by fleet and métier.

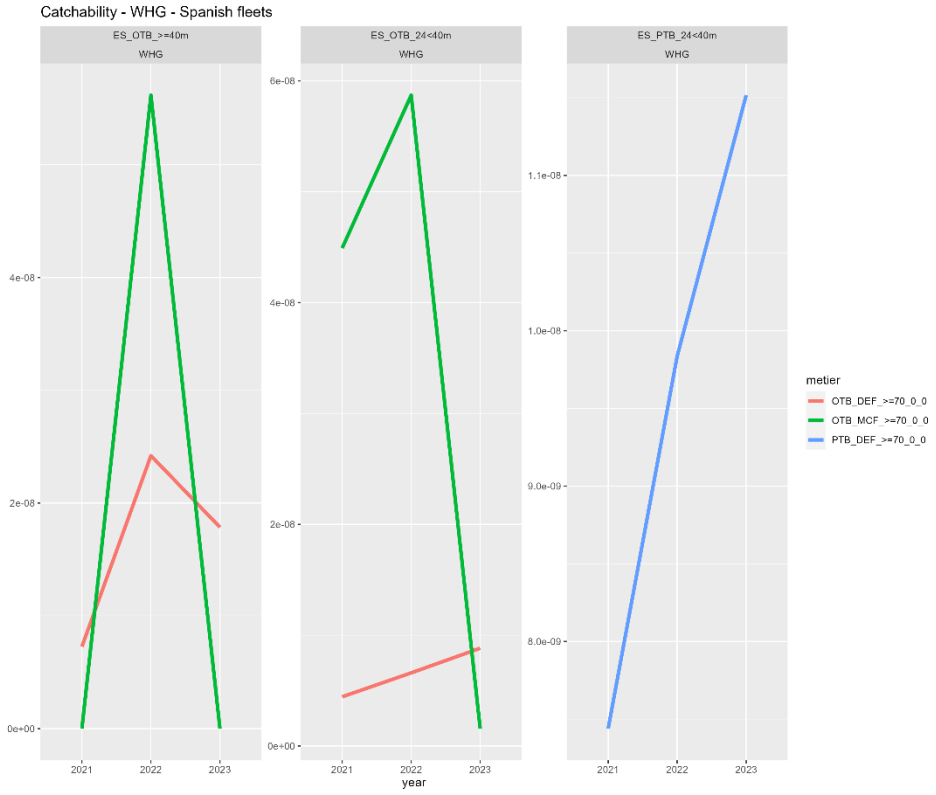


Figure 2.26. Bay of Biscay: trends of Spanish catchability for whiting (whg) by fleet and métier.

2.5 Mixed fisheries forecasts

2.5.1 Description of scenarios

2.5.1.1 Baseline runs

The objectives of the single-species stock baseline runs were to:

- reproduce as closely as possible the single-species advice produced by ACOM, and
- act as the reference scenario for subsequent mixed fisheries analyses.

The various single-stock forecasts presented by WGBIE and WGWIDE are performed using different software and setups (see Section 2.2.1, above). However, for the purposes of the mixed fisheries analyses, it is necessary to gather all forecasts into a single unified framework, which builds on the *FLBEIA* library (García *et al.* 2017). The same forecast settings as in the assessment working group (WGBIE or WGWIDE) are used for each stock regarding weight-at-age, selectivity and recruitment, as well as assumptions made for the intermediate year (2024) and basis for advice (MSY approach). Using these settings, and not introducing any mixed fisheries interactions, short-term forecasts are carried out at WGMIXFISH. This baseline run is then compared to the estimates provided in the ICES advice sheets (Table 2.5).

2.5.1.2 Mixed fisheries runs

Mixed-fisheries analyses considers the implications of mixed fisheries operating under single-stock catch advice regimes based on the fishing patterns of the various fleets (i.e. catchability by stock and métier and effort share by métier) in recent years (2021–2023).

The mixed fishery analysis uses a *status quo* effort assumption for the intermediate year (2024) for all the fleets, except for the other fleets taking up the remaining catches for a single pelagic stock ("OTH_HOM", "OTH_MAC" and "OTH_WHB"), which assume effort required for full quota uptake in the intermediate year. The *status quo* effort assumption for the intermediate year is considered a plausible assumption because it is in line with the standard single-stock short-term forecasting approach.

For the TAC year (2025), the FLBEIA scenarios are used for catches in the Bay of Biscay, whereas the catches outside the Bay of Biscay are associated with a single additional fleet per stock ("OTH_*"), assuming that they catch their full quota share.

The projections were run assuming a full and perfect implementation of a discard ban (i.e. all quota species caught must be landed, with no exemptions, de *minimis* or interspecies flexibilities).

In summary, the FLBEIA runs followed the scheme below:

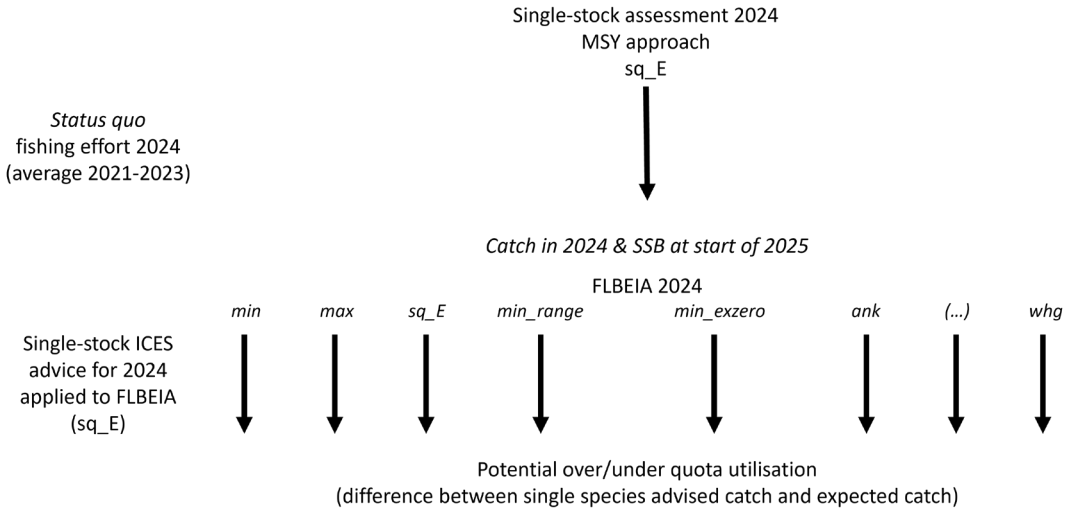


Table 2.5. Bay of Biscay: Summary of the 2025 catch advice and target Fs, resulting from the Advice Approaches considered by ICES.

Stock	Advice rational	Total catch advice 2025	F 2025	SSB 2026
Black-bellied anglerfish 7, 8.a-b and 8.d	MSY	25 317	0.163	67 235
Sea bass 8.a-b	MAP	2 504	0.128	14 525
Hake 3.a, 4, 6, 7 and 8.a-b and 8.d	MSY	52 466	0.24	98 340
Horse mackerel Northeast Atlantic and adjacent waters	MSY	75 545	0.080	887 444
Mackerel Northeast Atlantic and adjacent waters	MSY	576 958	0.26	2 718 914
Megrim 7.b-k and 8.a-b and 8.d	MSY	21 144	0.25	73 492
White anglerfish 7, 8.a-b and 8.d	MSY	34 983	0.192	56 926
Sole 8.a-b	MAP	2 510	0.29	9 527
Blue whiting Northeast Atlantic and adjacent waters	MSY	1 447 054	0.32	5 761 173

2.5.2 Results of FLBEIA runs

2.5.2.1 Baseline runs

As for some stocks, the population dynamics model used for the assessment differs from the one used in FLBEIA, some discrepancies were found between the FLBEIA baseline runs and the single-stock forecasts (Table 2.7, Table 2.8, and Table 2.9). The replicated forecast for the majority of stocks were very similar to the single-stock advice for total catches, F and SSB (differences lower than 9%). Discrepancies were largest for horse mackerel and blue whiting (with maximum differences of 9% each).

Difference in the horse mackerel short-term forecast assumption on mean weight compared to its Stock Annex were identified and discussed. To reproduce the single-stock forecast mean weight were set to the 2023 value and not averaged over 2021-2023. This should be changed next year.

Discrepancies in fishing mortality (F) were expected for hake because the length-based, seasonal models used in the stock assessments were approximated with age-based, annual models in the mixed fisheries analysis. Differences in F for the stocks assessed using SAM (Nielsen and Berg, 2014), mackerel and blue whiting, are explained by differences in the F estimation methodology. On the one hand, FLBEIA estimates F by approximating values from the Baranov equation, whereas in SAM it is calculated based on the changes in numbers-at-age from one year to the following and the natural mortality. Discrepancies in estimated discards were large for some stocks, specifically for hake and megrim. The discrepancies observed are probably related to the stock assessment used (Stock Synthesis), but WGMIXFISH has not been able to properly explain what is the specific factor that causes it. Nevertheless, these differences are not expected to affect the outcomes of the mixed-fisheries simulations as the TAC is assumed to constrain the total catches and these are satisfactorily reproduced.

In general, the differences observed this year were small (≤ 9%) for all stocks. Consequently, the WGMIXFISH deterministic forecast was considered close enough to the single-stock advice to be used as a basis for the mixed-fisheries projections.

2.5.2.2 Mixed fisheries analysis

The full overview of the FLBEIA projections to 2026 is presented in Table 2.9 and Figure 2.27–Figure 2.30. The results for 2025 can be compared to each other as in a single-species option table. For ease of comparison, the landings relative to the single-stock advice are also presented (Table 2.9 and Figure 2.27). The resulting catch by scenario in the advice year (2025) is provided in Table 2.7, along with the single-stock advice for reference (Baseline). The resulting spawning-stock biomass (SSB) at the beginning of 2026 and the fishing mortality (F) value for 2025 are shown in Table 2.8.

Mixed-fisheries analyses considers the implications of mixed fisheries operating under single-stock catch limits, taking into account the fishing pattern and catchability of the various fleets in recent years (2021-2023). The scenarios, therefore, do not assume any amount of quota balancing through adaptation of fishing behaviour. Mixed-fisheries catch scenario results show that it is not possible to achieve all advised single-stock catches simultaneously under the current fishing patterns. For instance, if decreasing fishing mortality for pollack is the major objective and fleets stop fishing after exhaustion of their pollack catch advice, this would mean that the catch advice for other species in the mixed fisheries may not be fully utilized. As a consequence, scenarios that result in under- or overutilization are useful in identifying the main mismatches between the fishing opportunities for the various stocks, where limiting catch advice can create potential "choke species" effects at fleet level. Such scenarios indicate the direction in which fleets may

have to adapt to more fully utilize these catch opportunities without increasing the risk of unwanted catch.

The "min" scenario is based on the assumption that fishing stops for a fleet once one of the stock quotas is exhausted, representing a full implementation of the EU's landings obligation. For 2025, the results of the "min" scenario, indicate that pollack is the most limiting stock in the Bay of Biscay mixed-fisheries constraining eight out of 21 fleet segments (Figure 2.27). The catch advice for this pollack stock has shown a 20% reduction in 2022–2023 relative to 2021 and an additional 36% reduction in 2024-2025. Of the remaining fleets, five are constrained by blue whiting, four by mackerel, and three by horse mackerel.

The "max" scenario is included to demonstrate the upper bound of potential fleet effort and stock catches, because it assumes all fleets continue fishing until all their stock shares are exhausted, irrespective of economic viability, legality, or fleet capacity. For 2025, the results in none of the single-stock scenarios are similar to the "max" scenario, indicating that the least limiting stock varies from fleet to fleet. Black-bellied anglerfish would be the least limiting stock for seven out of 21 fleets, smooth-hound for four fleets, white anglerfish and horse mackerel for three fleets each, hake for two fleets and mackerel for one fleet (Figure 2.27). Under this scenario, an overshoot of the advised catch is seen for the other considered stocks.

The *status quo* effort "sq_E" scenario sets the effort of each fleet in 2025 equal to the average of the effort in the most recently recorded three years for which data are available (2021-2023). For the pelagic fleets that catch the remaining quota for mackerel, horse mackerel and blue whiting, we assume that they catch all their available quotas. This scenario investigates the mixed-fisheries outcomes if the situation remains the same in terms of total effort and effort allocation among métiers. This situation presents a potential 2025 catch advice overshoot for sole, pollack and whiting.

The "min_range" scenario explores how the higher catch advice associated with the $F_{MSY\ upper}$ reference point may reduce choking behaviour in mixed fisheries and increase overall quota uptake. However, catches per stock in 2025 are slightly increased for megrim, anglerfish and hake due to the increase in catch opportunities provided by the $F_{MSY\ upper}$ option for the stocks above MSY $B_{trigger}$ (Figure 2.27). In this scenario, the choke species per fleet are the same as for the "min" scenario and any increase in catch come from the fleets accounting for catches taken outside the model area.

ICES single-stock catch advice for demersal stocks in 2025 is based on either existing management plans or ICES MSY approach. Scenario results show that it is not possible to achieve all advised single-stock catches simultaneously under current fishing patterns. However, the "min" scenario does deliver the management objectives of the single-stock advice for SSB and/or F simultaneously for all stocks. This scenario demonstrates the 'choke species' effect that may result from a strictly implemented landing obligation without adaptation of the fleets. Although there is no scenario which can achieve SSB above B_{pa} for sea bass in 2026, all the scenarios do result in SSB above B_{lim} in 2026. For sole, the "max" scenario results in SSB below B_{lim} in 2026 while the "sq_E" scenario results in SSB between B_{lim} and B_{pa} and both the "min" and "min_range" scenarios result in SSB above B_{pa} in 2026.

Horse mackerel, mackerel, and blue whiting are included in these analyses as they are potential choke species for some demersal fleets. Catches taken by these fleets represent very small proportions of the overall catches from these stocks, so the impact of these fleets on the dynamics of the stocks of mackerel, blue whiting, and horse mackerel is negligible although they are economically important for these fleets.

Table 2.6. Bay of Biscay: Baseline run outputs from the FLBEIA package.

	ANK	BSS	HKE	HOM	MAC	MEG	MON	SOL	WHB
2024_Fbar	0.090	0.117	0.22	0.0148	0.41	0.21	0.133	0.29	0.51
2024_Fmult	1	1	1	1	1	1	1	1	1
2024_Landings	11 605	2 441	46 647	12 891	95 3882	15 611	21 414	2 481	1 880 881
2024_SSB	500 18	16 435	133 082	724 637	3 372 345	78 940	55 830	10 369	6 401 983
2025_Fbar	0.163	0.128	0.24	0.080	0.26	0.25	0.192	0.29	0.32
2025_Fmult	2	1	1	5	1	1	1	1	1
2025_Landings	20 823	2 631	46 348	75 545	576 958	17 905	30 573	2 477	144 7054
2025_SSB	65 144	15 197	104 136	792 446	2 818 528	83 021	62 729	9 779	6 337 789
2026_SSB	56 588	16 027	113 092	729 177	3 065 086	87 644	58 112	10 224	6 973 605

Table 2.7. Bay of Biscay: Comparison between baseline run and ICES advice. Figures for 2024 compare results from the baseline run (that use the same assumptions for F in the intermediate year as the forecasts leading to ICES advice) to the ICES intermediate year results.

	ANK	BSS	HKE	HOM	MAC	MEG	MON	SOL	WHB
2024_Catch Baseline	14 824	2 489	52 074	13 818	953 966	18 705	24 382	2 743	1 880 888
2024_Catch ICES	14 755	2 441	52 301	12 891	954 112	19 256	24 814	2 513	1 881 072
2024_% diff catch	1	1.02	1	1.07	1	0.97	0.98	1.09	1
2025_Catch Baseline	25 317	2 631	52 466	7 5545	576 958	21 144	34 983	2 510	1 447 054
2025_Catch ICES	25 317	2 631	52 466	7 5545	576 958	21 144	34 983	2 510	1 447 054
2025_% diff catch	1	1	1	1	1	1	1	1	1

	ANK	BSS	HKE	HOM	MAC	MEG	MON	SOL	WHB
2024_Landings Baseline	11 605	2 441	46 647	12 891	953 882	15 611	21 414	2 481	1 880 881
2024_Landings ICES	12 058	2 441	48 761			16 316	21 688	2 480	1 881 072
2024_% diff land	0.96	1	0.96			0.96	0.99	1	1
2025_Landings Baseline	20 823	2 631	46 348	7 5545	576 958	17 905	30 573	2 477	1 447 054
2025_Landings ICES	21 173	2 504	48 036	7 5545	576 958	18 132	30 634	2 476	1 447 054
2025_% diff land	0.98	1.05	0.96	1	1	0.99	1	1	1
2024_Discards Baseline	3 220	48	5 426	927	84	3 094	2 968	262	7
2024_Discards ICES	2 697	0	3 540	0	0	2 940	3 126	33	0
2024_% diff disc	1.19	0	1.53	0	0	1.05	0.95	7.9	0
2025_Discards Baseline	4 494	0	6 118	0	0	3 239	4 410	33	0
2025_Discards ICES	4 144	0	4 430	0	0	3 012	4 348	34	0
2025_% diff disc	1.08		1.38			1.08	1.01	0.97	

Table 2.8. Bay of Biscay: FLBEIA baseline run outputs for SSB and F relative to ICES advice.

	SSB_2024	SSB_2025	SSB_2026	F_2023	F_2024	F_2025
ANK	1.00	1.00	1.00	0.99	1.00	1.00
BSS	0.98	0.99	1.00	1.00	0.99	1.00
HKE	1.00	1.00	1.01	1.01	1.04	1.04
HOM	1.01	1.01	1.00	1.00	1.09	1.09
MAC	1.00	1.01	1.01	0.99	0.99	0.96
MEG	0.98	0.98	0.98	1.00	1.04	1.03
MON	1.00	0.99	0.99	1.00	1.02	1.02
SOL	1.00	1.01	1.02	0.95	0.95	0.95
WHB	1.02	1.07	1.03	0.98	1.09	0.93

Table 2.9. Results of running FLBEIA scenarios on the TAC year (2025). Comparison of the single-stock ICES advice and potential catch in the various FLBEIA scenarios.

Stock	Single stock catch advice 2025	max	sq_E	min_ range	min_ exzero	ank	bss	hke	hom	mac	meg	mon	nep	pol	sdv	sol	whb	whg
ANK	25 317	1	0.58	1.22	0.87	1	0.90	0.88	0.89	0.87	0.91	0.94	0.92	0.87	0.93	0.89	0.89	0.88
BSS	2 631	1.50	0.92	0.63	0.51	1.34	1	0.95	0.75	0.87	0.96	1.15	1	0.64	1.28	0.89	0.91	0.84
HKE	52 466	1.28	0.92	1.13	0.81	1.16	1	1	1.07	0.96	1.02	1.11	1	0.89	1.03	0.98	0.97	0.96
HOM	75 545	1.01	1	0.99	0	1.01	1	1	1	0.99	1	1	1	0.99	1	1	0.99	1
MAC	576 958	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MEG	21 144	1.13	0.85	1.38	0.91	1.11	0.98	0.96	1	0.94	1	1.03	1.01	0.95	1.01	0.97	0.96	0.97
MON	34 983	1.05	0.70	1.01	0.92	1.05	0.97	0.95	0.95	0.95	0.97	1	0.98	0.93	0.99	0.96	0.96	0.95
NEP	3 502	1.61	0.72	0.50	0.30	1.61	0.79	0.62	0.56	0.56	0.87	1.05	1	0.50	1.01	0.69	0.72	0.64
POL	872	2.2	1.48	1	0.99	1.94	1.54	1.51	1.23	1.40	1.44	1.77	1.46	1	1.94	1.39	1.41	1.33
SDV	5 329	1.44	0.72	0.49	0.41	1.42	0.78	0.66	0.57	0.59	0.82	1.02	0.91	0.51	1	0.68	0.70	0.64
SOL	2 510	1.76	1.05	0.74	0.50	1.76	1.13	1.05	0.92	0.99	1.09	1.47	1.13	0.75	1.43	1	1.04	0.97
WHB	1 447 054	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WHG	1 347	1.95	1.10	0.77	0.76	1.76	1.20	1.08	0.91	0.96	1.19	1.40	1.27	0.82	1.54	1.07	1.09	1

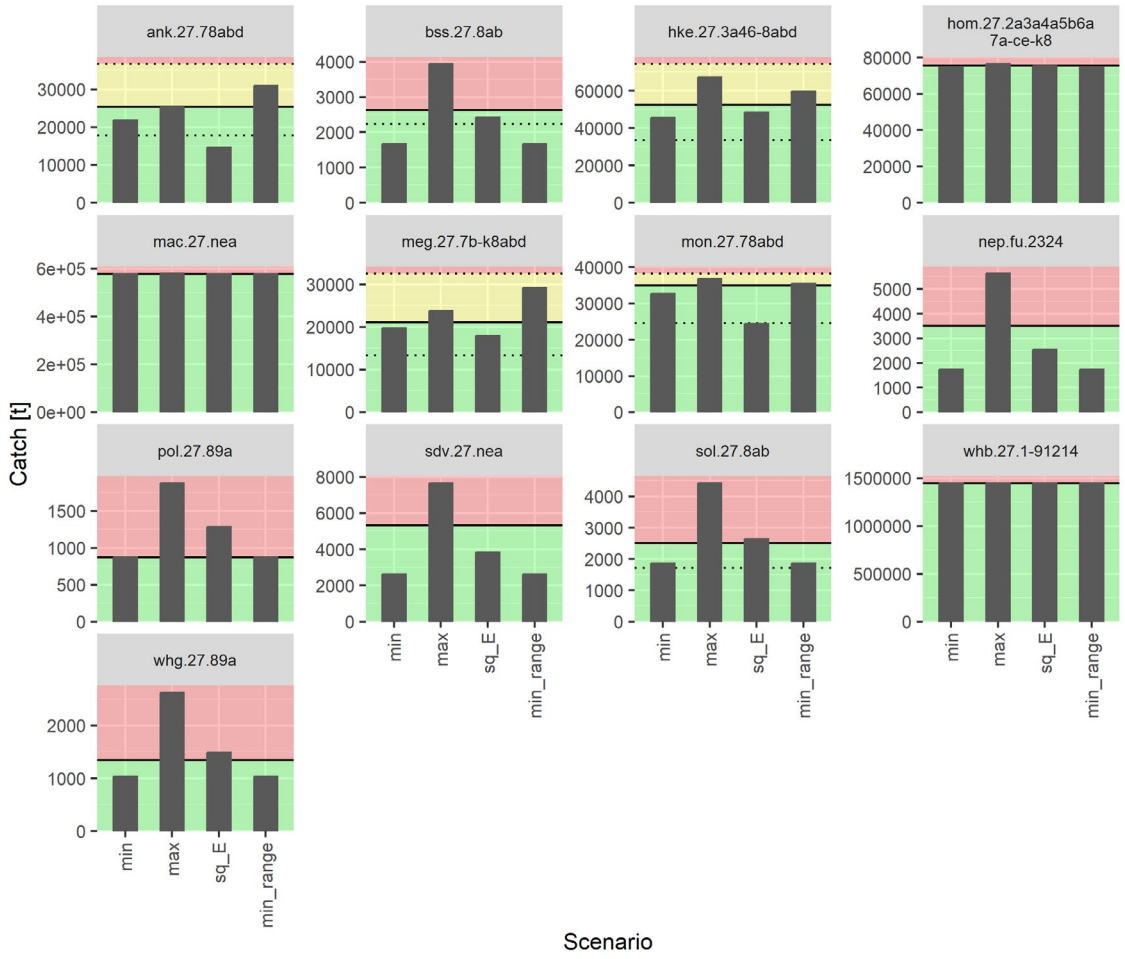


Figure 2.27. Bay of Biscay mixed fisheries forecast: Estimates of 2025 catches (in tonnes) by stock and scenario (Table 2.2). The horizontal dashed lines correspond to the single-stock catch advice, with areas above and below the line representing potential over and undershoot, respectively.

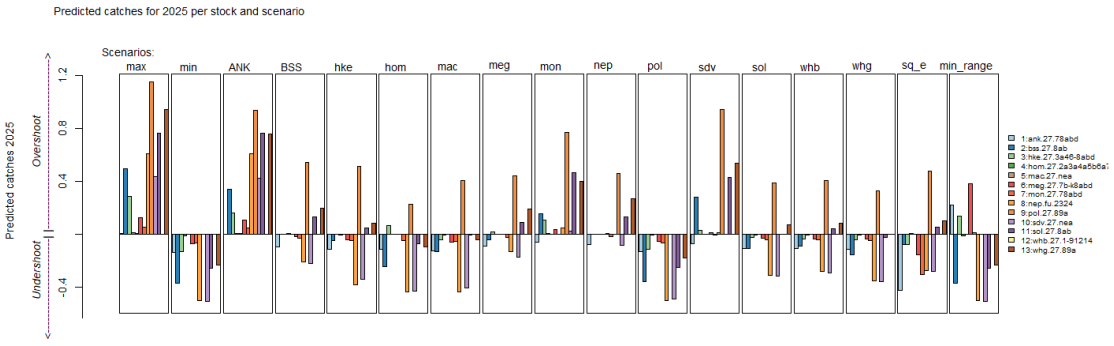


Figure 2.28. Bay of Biscay mixed fisheries forecasts: TAC year results (2025). FLBEIA estimates of potential percentage of catches change by stock (relative to the TAC advice) and scenario (Table 2.2). Horizontal line corresponds to the single-stock advice for 2025. Bars below the value of zero show the percentage of undershoot (compared to the single species catch advice) in cases where catches are predicted to be lower when applying the scenario.

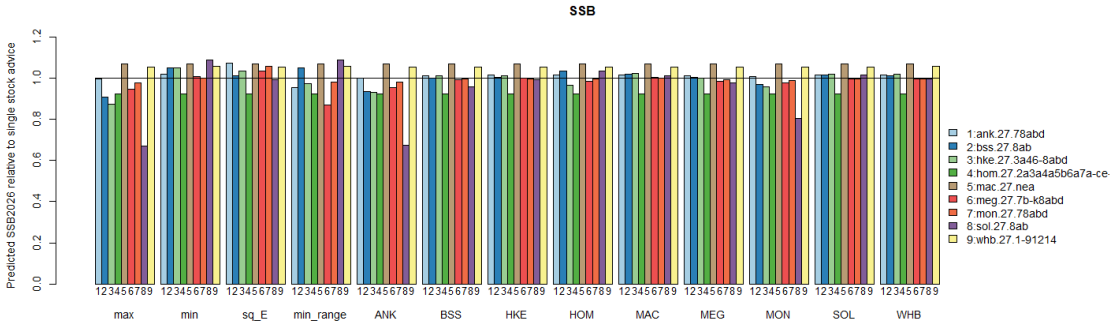


Figure 2.29. Bay of Biscay mixed fisheries forecasts: Estimates of potential SSB at the start of 2026 by stock and scenario (Table 2.2), expressed as a ratio to the single-species advice forecast (Table 2.4). Horizontal line corresponds to the SSB resulting from the single-stock advice (at the start of 2026).

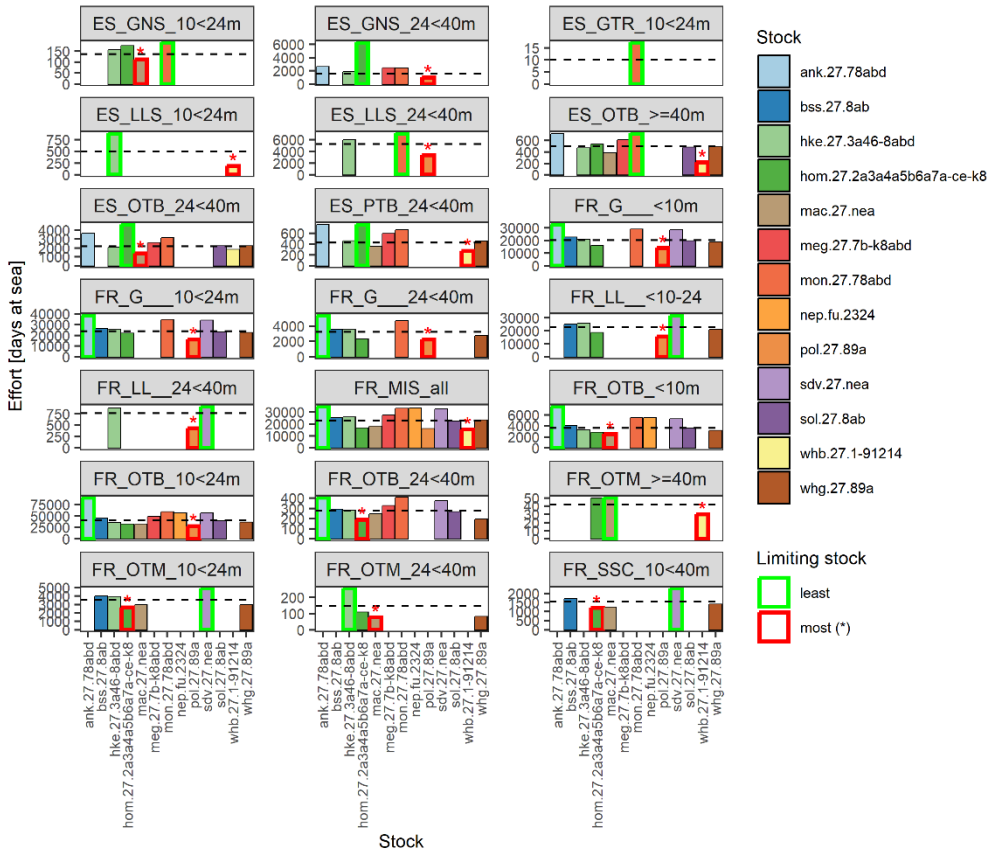


Figure 2.30. Bay of Biscay mixed fisheries forecast: Estimates of effort by fleet needed to reach the advice for the single stocks. Stocks are coded by colour, with the most limiting stock ("choke species") for each fleet in 2025 highlighted with a red border and the least limiting species highlighted with a green border. Fleet names are given by country (FR = France, ES = Spain) and by combinations of main gear and vessel size differing across countries and based on homogeneous average fishing patterns. Vessels in the various fleet segments can engage in several fisheries (métiers) over the year. The *status quo* effort for each fleet (average 2021-2023) is shown as a dashed line for reference.

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3 Celtic seas

3.1 Background

Fisheries in the Celtic Sea are highly mixed, targeting a range of species with different gears. Otter trawl fisheries target mixed gadoids (cod, haddock, and whiting), N*ephrops*, hake, anglerfish, megrims, rays as well as cephalopods (cuttlefish and squid). Beam trawl fisheries target flatfish (plaice, sole, turbot), anglerfish, megrim, and cephalopods (cuttlefish and squid), while set-net fisheries target flatfish, hake, pollack, cod, anglerfish, as well as some crustacean species. Beam trawling occurs for flatfish (in 7.e and 7.fg) and rays (7.f). The fisheries are mainly prosecuted by French, Irish, and English vessels with additional Belgian beam trawl fisheries (7.efg) and Spanish trawl and net fisheries along the shelf edge (7.hjk).

The mixed gadoid fishery predominately takes place in ICES areas 7.f and 7.g with these areas responsible for >75% of the landings of each cod, haddock and whiting. Landings are predominately by French and Irish vessels, though UK vessels also take significant landings of these species.

3.1.1 Management measures

In 2024, the ICES advice for all stocks considered in this model was given in terms of the ICES MSY approach, except *Nephrops* out of Functional Units which was given under the precautionary approach. A multiannual management plan (MAP) for Western and adjacent waters has been adopted by the EU for stocks covered by this advice (Council Regulation (EC) 2019/472) which ICES considers to be precautionary. However, there is no agreed shared management plan with the UK for these stocks. There are two species-specific management plans for the region; a hake recovery plan (Council Regulation (EC) No 811/2004) which implements a Total Allowable Catch (TAC) annually based on a defined Harvest Control Rule (HCR) and a management plan with both a HCR and effort management elements for sole in the Western channel (7.e; Council Regulation (EC) No 509/2007). There are also effort, technical and area closure measures in place, which are summarized below. The EU western waters regulation (Council Regulation (EC) No 1954/2003) implements an effort ceiling for ≥ 15 m vessels fishing for demersal species in Subarea 7 with additional effort ceiling specifications for an area to the South and West of Ireland known as the 'Biologically Sensitive Area' for vessels ≥ 10 m. A series of technical measures are in place for demersal trawl gears operating in various parts of the Celtic Sea. This includes maximum number of meshes in circumference, incorporation of a square mesh panel (SMP), and minimum mesh size in the codend dependent on the target composition and/or area. Technical measures for the recovery of hake stock, which includes Subarea 7. Commission regulation (EC) No 1162/2001, commission regulation (EC) No 2062/2001, and commission regulation (EC) No 494/2002. The most recent of which relates to incorporation of the SMP detailed in commission implementing regulation (EU) No 737/2012 of 14 August 2012. A summary of current measures is published by BIM of Ireland[1].

Since 2005, three ICES rectangles (30E4, 31E4, and 32E3) have been closed during the first quarter (Council Regulations 27/2005, 51/2006, and 41/2007, 40/2008 and 43/2009) known as the Trevose closure, with the objective of reducing fishing mortality on cod. Another area closure was in place for EU fisheries in FU16 (the Porcupine bank) between 1 May - 31 July 2010-2012; however,

[1]https://bim.ie/fisheries/advisory-services/fisheries-management-chart

the period of the EU regulatory closure was reduced to only May between 2013 and 2019 (Council Regulation 2019/124) and has not been in force since 2020 (Council Regulation 2020/123).

As of the 1 January 2016 a European demersal species landings obligation was introduced (Commission Delegated Regulation (EU) 2015/2438). This regulation prevents the discarding of certain species on a fishery by fishery approach. Since 1 January 2019, catches of all quota species in the Celtic Seas have been subject to the EU landings obligation rule, except an ex-emption is in place. An overview of the exemptions of the landings obligation can be found below:

Exemptions to the landing obligation in 2021

Species	Exemption type	Area	Gear	Maximum de minimis exemption (% of total annual catch)
Albacore tuna	De minimis	7	Midwater pair trawls	5
Whiting	De minimis	7b -7k	Bottom trawls and seines ≥ 80 mm, Pelagic and beam trawls 80-119 mm	5
Sole	De minimis	7a, 7d -7h	Beam trawl 80-119 mm with Flemish Panel	3
Sole	De minimis	7d,e,f & g	Trammel nets and gillnets	3
Haddock	De minimis	7b,c & 7e-k	Bottom trawls and seines ≥ 100 mm, catches comprising ≤30% Nephrops	5
Haddock	De minimis	7b,c & 7e-k	Vessels using ≥ 80 mm, with catches comprising more than 30% Nephrops	5
Haddock	De minimis	7b,c & 7e-k	Beam trawls ≥ 80 mm with Flemish Panel	5
Haddock [1]	De minimis	6a	Nephrops bottom trawls using <119mm with HSG	3
Megrim [2]	De minimis	7	Beam Trawls 80-119mm & Bottom trawls	4
Horse mackerel	De minimis	6 & 7b-k	Bottom trawls, seines & beam trawls	3
Mackerel	De minimis	6 & 7b-k	Bottom trawls, seines & beam trawls	3
Boarfish	De minimis	7b,7c,7f-7k	Bottom trawls	0.5
Argentine	De minimis	EU 5b & 6	Bottom trawls ≥ 100 mm	0.6
Species	**Exemption Type**	**Area**	**Gear**	**Discard Release Notes**
Nephrops	Survivability	6 & 7	Pots, creels or traps	immediately & where caught
Nephrops	Survivability	7	Bottom trawls 70-99mm with HSG* or ≥100mm	immediately & where caught
Nephrops	Survivability	6a (<12nm)	Bottom trawls 80-110 mm	immediately & where caught
Skates & rays	Survivability	6 & 7	All gears	Released immediately
Plaice	Survivability	7d -7g	Trammel nets and otter trawls	Released immediately
Plaice	Survivability	7d -7g	Beam Trawls with flip up rope or benthic release panel (vessels > 221kW)	Released immediately
Plaice	Survivability	7a-7g	BT2 (vessels ≤221 kW or ≤24 m) inside 12 nm, tows ≤ 1:30 hour	Released immediately
All Species	Survivability	EU 5b; 6 & 7	Pots, creels and traps	Released immediately

[1] Applies ony to haddock <MCRS (30cm), [2] Applies ony to megrim <MCRS (20cm)
* See list of highly specific gears for Nephrops. ** Bottom trawls:70 to 99mm in 7f,7g, 7h North of 49.5°N & 7j East of 11°W - catches must comprise 55% whiting or anglerfish, hake & megrim combined; ≥100mm in the rest of 7

Reference: Commission Delegated Regulation (EU) 2020/2015

3.2 Model

3.2.1 Software

All analyses were conducted using the FLR framework (Kell *et al.*, 2007; FLCore 2.6.19, FLFleet 2.6.1, FLAssess 2.6.3, Flash 2.5.11) running with R4.2.2 (R Development Core Team, 2020). All forecasts were projected using the same fwd() function in the Flash Package, except where a SAM forecast procedure is used for the single-stock advice (see table below) and the stockassessment 0.12 library (Nielsen and Berg, 2014) is used instead. The FCube method was developed as a stand-alone script using FLR objects as inputs and outputs, but has been adapted to more accurately implement single-stock forecast procedures. Software used in the single-species assessments and forecasts was as outlined in the table below:

Stock	Assessment	Forecast
cod.27.7e–k	Age-based stochastic analytical assessment (SAM)	SAM
had.27.7bc,e–k	Age-based stochastic analytical assessment (SAM)	SAM
whg.27.7bc,e–k	Age-based stochastic analytical assessment (SAM)	SAM

Stock	Assessment	Forecast
meg.27.7b-k8abd	Statistical catch-at-age model (A4A)	FLR STF
mon.27.78abd	Statistical catch-at-age model (SS3)	FLR STF
ank.27.7-8abd	Length-based age-structured Stock Synthesis model (SS3)	FLR STF
sol.27.e	Age-based analytical assessment (XSA)	FLR STF
sol.27.7fg	Age-based stochastic analytical assessment (SAM)	SAM
hke.27.3a46-8abd	Length-based and sex-disaggregated model (SS3)	FLR STF
nep.fu.16	Underwater TV survey	NA
nep.fu.17	Underwater TV survey	NA
nep.fu.19	Underwater TV survey	NA
nep.fu.2021	Underwater TV survey	NA
nep.fu.22	Underwater TV survey	NA
nep.27.7outFU	Precautionary approach	NA

3.2.2 Scenarios

FCube (Ulrich *et al.* 2008; 2011) was used to forecast several mixed fisheries scenarios. The basis of the model is to estimate the potential future levels of effort by a fleet corresponding to the fishing opportunities (catches by stock and/or effort allocations by fleet) available to that fleet, based on fleet effort distribution and catchability by métier. This level of effort was used to estimate landings and catches by fleet and stock, using standard forecasting procedures. The basis for each single-stock advice was retained in the current mixed fisheries framework except for the "min-range" scenario as detailed below.

The following six options (or scenarios) were included in the advice:

Scenario code	Mixed fisheries effort assumption	Basis for catch limit 2025
Minimum (*min*)	For each fleet, fishing in 2025 stops when the first stock share* of that fleet has been caught. This scenario is the most precautionary option and can highlight some potential "choke species" issues.	ICES catch advice
Maximum *(max)*	For each fleet, fishing in 2025 continues until all stock shares* of that fleet have been caught. This option illustrates the degree of overshooting of the single-stock advice if fishing is not restricted by the fleet stock shares*.	
Status quo effort (*sq_E*)	The effort of each fleet in 2025 is set equal to the average effort in the most recent three years (2021-2023).	Not applicable
Minimum including ranges	Same as min scenario.	Catches corresponding to $F_{MSY\ upper}$ for stocks in good status (SSB ≥ MSY

Scenario code	Mixed fisheries effort assumption	Basis for catch limit 2025
(*min_range*)		$B_{trigger}$) and scaled F_{MSY} advice levels (F_{MSY} × SSB/MSY $B_{trigger}$) for the other stocks (including zero catch advice stocks).
Minimum excluding zero advice stocks (*min_exzero*)	For each fleet, fishing in 2025 stops when the catch for any one of the stocks meets the fleet's stock share* ignoring cod and whiting where there is zero catch advice. This scenario illustrates the effect of fishing to the next nearest non-zero advice stock.	ICES catch advice
Haddock single-stock advice (*had-cs*)	For each fleet, fishing in 2025 stops when the catch of haddock meets the fleet's stock share* for haddock, regardless of other catches. Fleets which do not catch haddock follow a *status quo* effort assumption (as described for the sq_E scenario).	

***Note that throughout this document, the term "fleet's stock share" or "stock share" is used to describe the share of the fishing opportunities for each particular fleet. These fishing opportunities are calculated based on the single-stock advice for 2024 and the historical proportion of the stock landings taken by the fleet (2021-2023), and the TAC split between the Celtic Sea region and other areas.**

A replacement scenario to the previously provided "range" scenario explores how the higher catch advice associated with the $F_{MSY\ upper}$ or scaled F_{MSY} reference points may reduce choking behaviour in mixed fisheries and increase overall uptake stock shares.

Additionally, a "min_exzero" scenario is provided. The scenario is consistent with a full implementation of a landing obligation given the individual single-stock advice for all stocks except cod and whiting. This aims to illustrate the potential bycatch of stocks where there is zero catch advice and if the next nearest choke becomes limiting irrespective of the catch advice for cod and whiting.

Some additional scenarios are presented here but were not presented in the mixed fisheries considerations advice sheet:

Scenario code	Mixed fisheries effort assumption	Basis for catch target 2025
cod_FARzero	For each fleet, fishing in 2025 stops when the catch of cod meets the fleet's stock share* for cod, regardless of other catches. Fleets which do not catch cod follow a *status quo* effort assumption (as described for the sq_E scenario).	For cod and whiting, catches corresponding to the scaled F_{MSY} advice levels (F_{MSY} x SSB/MSY $B_{trigger}$). ICES headline catch advice is used for other stocks.
whg_FARzero	For each fleet, fishing in 2025 stops when the catch of whiting meets the fleet's stock share* for whiting, regardless of other catches. Fleets which do not catch whiting follow a *status quo* effort assumption (as described for the sq_E scenario).	For cod and whiting, catches corresponding to the scaled F_{MSY} advice levels (F_{MSY} x SSB/MSY $B_{trigger}$). ICES headline catch advice is used for other stocks.
cod_FARcod	For each fleet, fishing in 2025 stops when the catch of cod meets the fleet's stock share* for cod, regardless of other catches. Fleets which do not catch cod follow a *status quo* effort assumption (as described for the sq_E scenario).	For cod only, catches corresponding to the scaled F_{MSY} advice levels (F_{MSY} x SSB/MSY $B_{trigger}$). ICES headline catch advice is used for other stocks.
cod-cs	For each fleet, fishing in 2025 stops when the catch of cod meets the fleet's stock share* for cod, regardless of other catches. Fleets which do not catch cod follow a	ICES catch advice

Scenario code	Mixed fisheries effort assumption	Basis for catch target 2025
	status quo effort assumption (as described for the sq_E scenario).	
whg-cs	For each fleet, fishing in 2025 stops when the catch of whiting meets the fleet's stock share* for whiting, regardless of other catches. Fleets which do not catch whiting follow a *status quo* effort assumption (as described for the sq_E scenario).	

***Note that throughout this document, the term "fleet's stock share" or "stock share" is used to describe the share of the fishing opportunities for each particular fleet. These fishing opportunities are calculated based on the single-stock advice for 2024 and the historical proportion of the stock landings taken by the fleet (2021-2023), and the TAC split between the Celtic Sea region and other areas.**

3.3 Data compilation

Following IBPMIXFISH 2021 (ICES, 2021), the data compilation R scripts were significantly revised to improve workflow, readability, and reproducibility. These revisions have been thoroughly detailed in the IBP report and annex. The input data source to these scripts remains the same.

Data used to produce the mixed fisheries forecasts comes from three sources:

1. Stock data: Stock abundance, age-structure, reference points, catch advice, and trends. These data are supplied by the single species assessment working groups, the data are also retrieved from the ICES Standard Assessment Graph (SAG) server on a stock by stock basis and used to validate data submissions to WGMIXFISH.
2. Fisheries dependent data: fleet and métier trends in landings and effort. These data are sourced from the WGMIXFISH data call ("accessions data").
3. Discard rates: InterCatch.

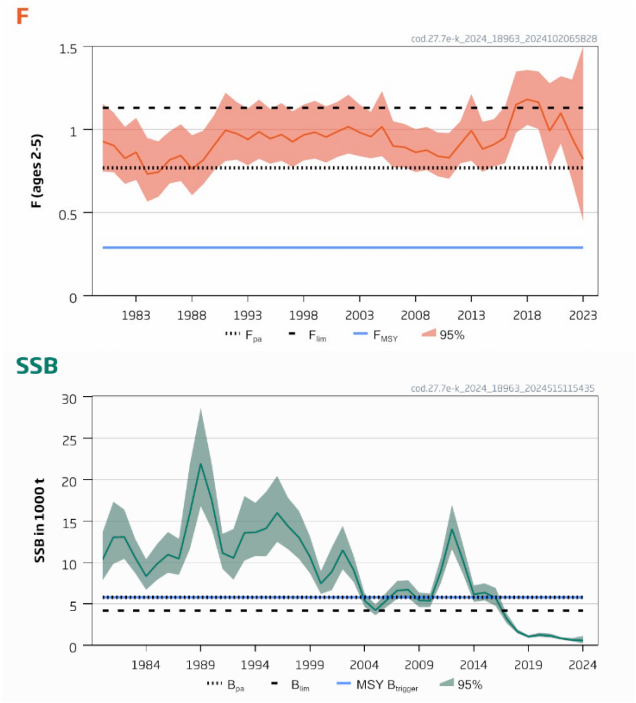
Details on the collection, structure and implementation of these data sources can be found in the stock annex (ICES, 2022). Below specific details of the data sources in 2024 have been described.

3.3.1 Stock data

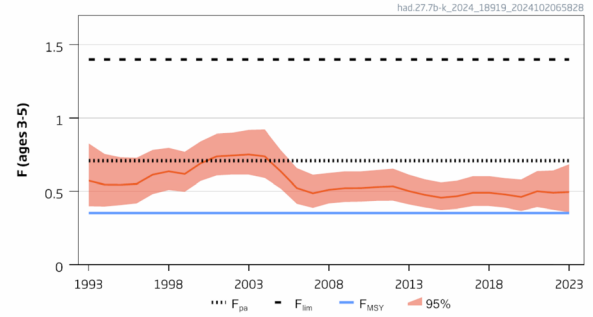
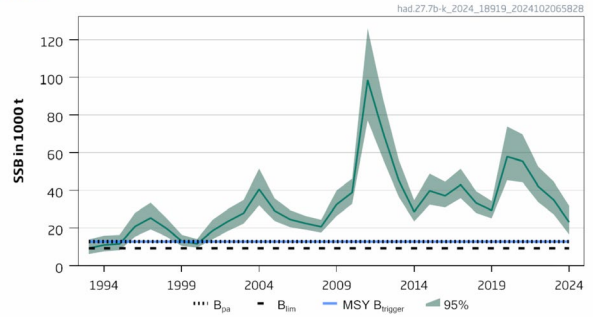
Single species stock assessment outputs including abundance, fishing mortality, biological parameters (maturity, natural mortality) and age-structure was supplied by WGCSE (ICES, 2024b) and WGBIE (ICES 2024c) in the form of FLR stock objects. Details of reference points, advice for 2025, TAC and trends in stock status were taken from the advice sheets. The consistent support and cooperation from the chairs and single species stock assessors has greatly eased the workload of WGMIXFISH in 2024. An overview of the trends and advice for demersal stocks included in Celtic Sea mixed fisheries analysis from the single species advice for these stocks is described below (ICES, 2024b, 2024c; Tables 3.1-3.2).

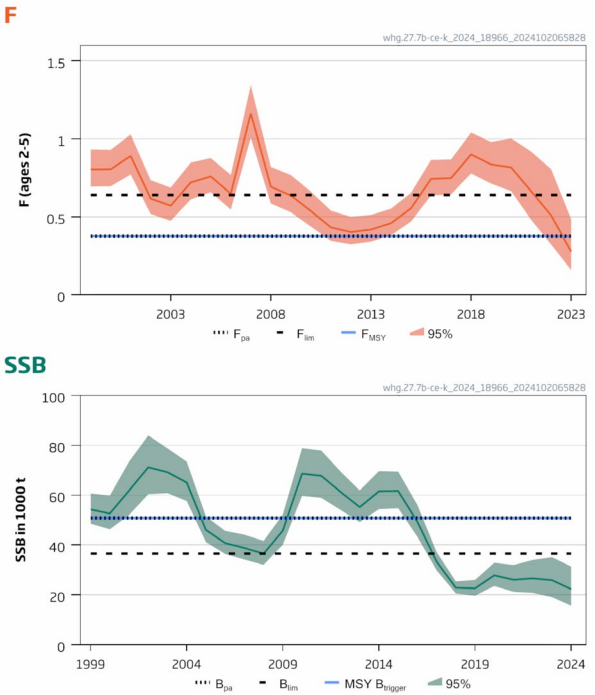
Table 3.1. Summary of advice and stock trends for the stocks included in the Celtic Sea mixed fisheries model (ICES 2024b, 2024c)

Analytical stocks

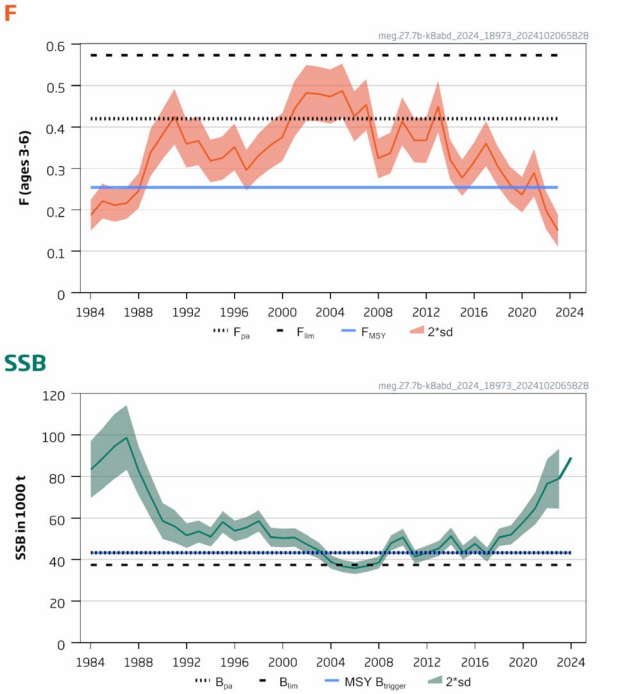
Species	Area	Stock status	Advice 2024
cod.27.7e-k (Cod)	Divisions 7.e–k (western English Channel and southern Celtic Seas)		ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2025. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

Summary: Fishing pressure on the stock is above F_{MSY} and between F_{pa}, and F_{lim}, and spawning-stock size is below MSY $B_{trigger}$, B_{pa}, and B_{lim}.

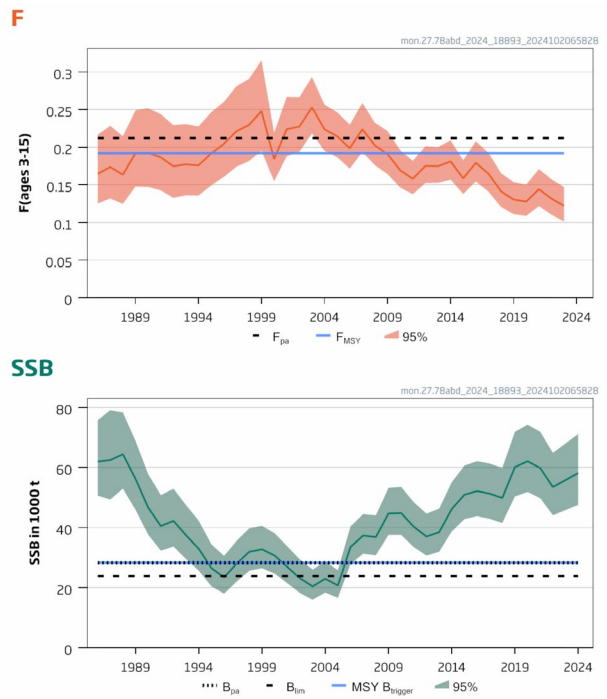
Species	Area	Stock status	Advice 2024
had 27.b-k (Haddock)	Divisions 7.b–k (southern Celtic Seas and English Channel)	**F**  **SSB**  **Summary:** Fishing pressure on the stock is above F_{MSY} but below F_{pa} and F_{lim}, and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 4 644 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

Species	Area	Stock status	Advice 2024
whg.27.b–c,e–k (Whiting)	Divisions 7.b–c and 7.e–k (southern Celtic Seas and western English Channel)		ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2025. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

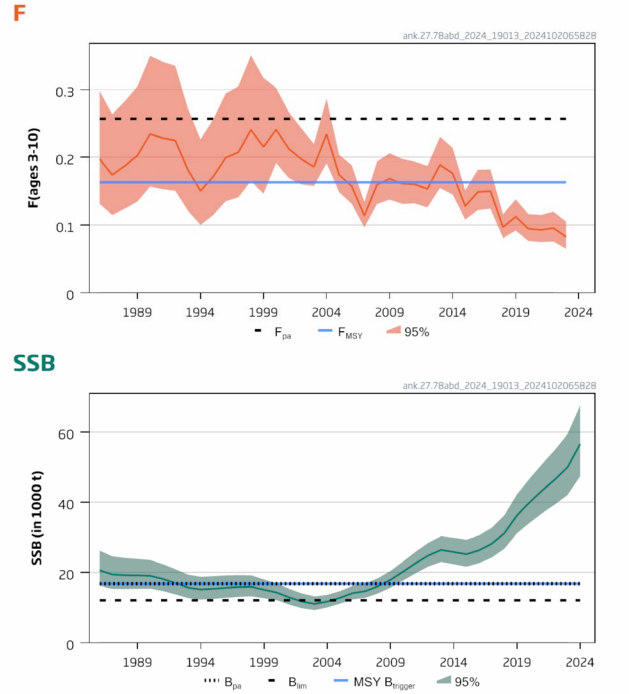
Summary: Fishing pressure on the stock is below F_{MSY}, and spawning-stock sizeis below MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Species	Area	Stock status	Advice 2024
meg.27.7b-k8abd (Megrim)	Divisions 7.b–k, 8.a–b, and 8.d (west and southwest of Ireland, Bay of Biscay)		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 21 144 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. The use of combined species TAC for the two megrim species, megrim (Lepidorhombus whiffiagonis) and four-spot megrim (Lepidorhombus boscii), prevents effective control of the single-species exploitation rates and could lead to the overexploitation of either species. ICES has not identified any conservation aspects other than those related to the commercial fisheries.

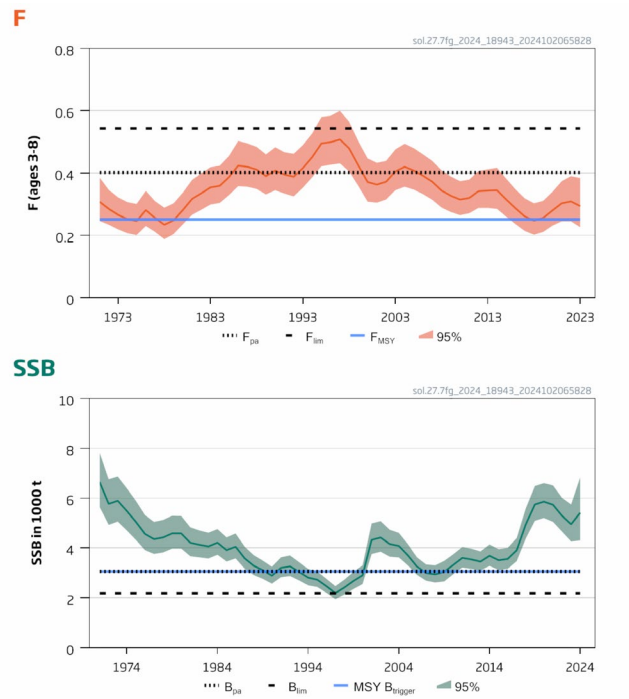
Summary: Fishing pressure on the stock is below F_{MSY}, and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Species	Area	Stock status	Advice 2024
mon.27.78abd (White anglerfish)	Subarea 7 and in divisions 8.a–b and 8.d (southern Celtic Seas, Bay of Biscay)		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 34 983 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. The use of combined species TAC for the two anglerfish species, black-bellied anglerfish (Lophius budegassa) and white anglerfish (Lophius piscatorius), prevents effective control of the single-species exploitation rates and could lead to the overexploitation of either species. ICES has not identified any conservation aspects other than those related to the commercial fisheries.

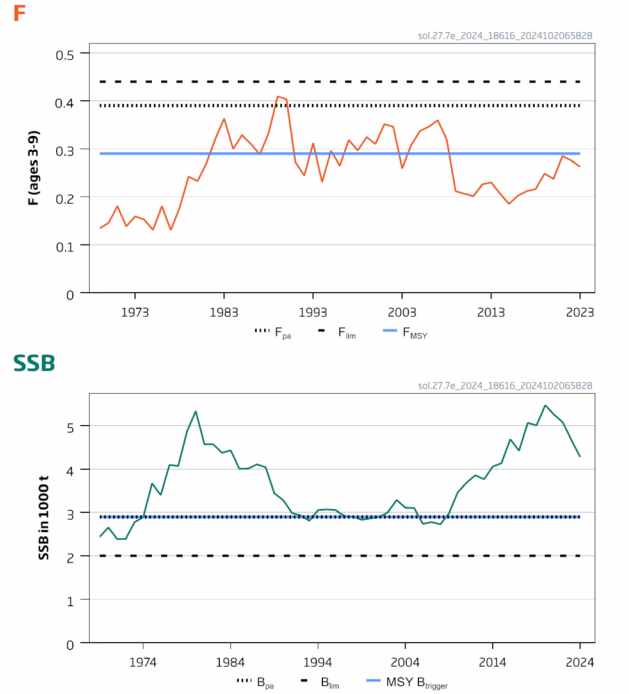
Summary: Fishing pressure on the stock is below F_{MSY}; spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Species	Area	Stock status	Advice 2024
ank.27.7-8abd (Black-bellied anglerfish)	Subarea 7 and divisions 8.a–b and 8.d (Celtic Seas, Bay of Biscay)		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 25 317 tonnes. ICES notes the existence of a precautionary management plan developed and adopted by one of the relevant management authorities for this stock. The use of combined species TACs for the two anglerfish species, black-bellied anglerfish (Lophius budegassa) and white anglerfish (Lophius piscatorius), prevents effective control of the single-species exploitation rates and could lead to the overexploitation of either species. ICES has not identified any conservation aspects other than those related to commercial fisheries.

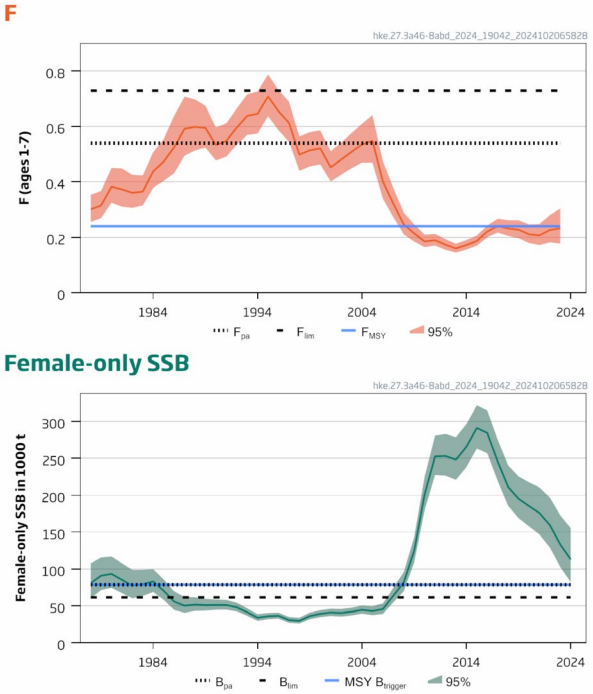
Summary: Fishing pressure on the stock is below F_{MSY}, and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Species	Area	Stock status	Advice 2024
sol.27.7fg (Sole)	Divisions 7.f and 7.g (Bristol Channel, Celtic Sea)		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 1 149 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

Summary: Fishing pressure on the stock is above F_{MSY} but below Fpa and Flim;spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.

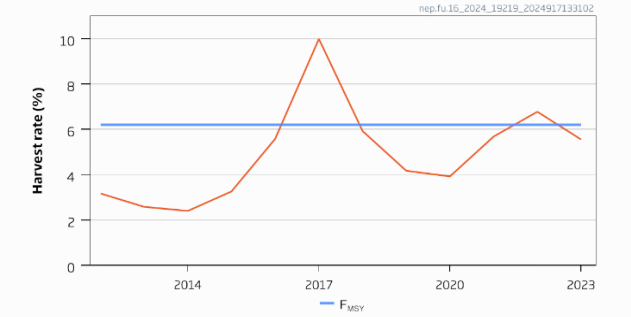
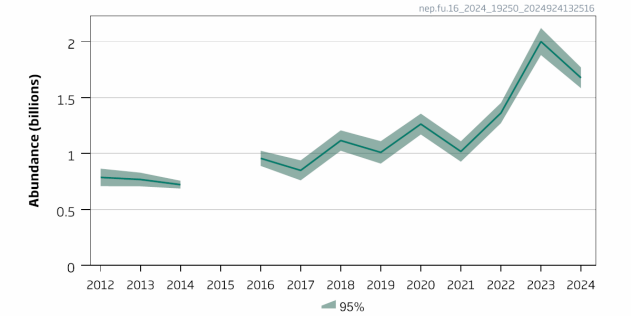
Species	Area	Stock status	Advice 2024
sol.27.e (Sole)	Divisions 7.e (western English Channel)		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 1 151 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

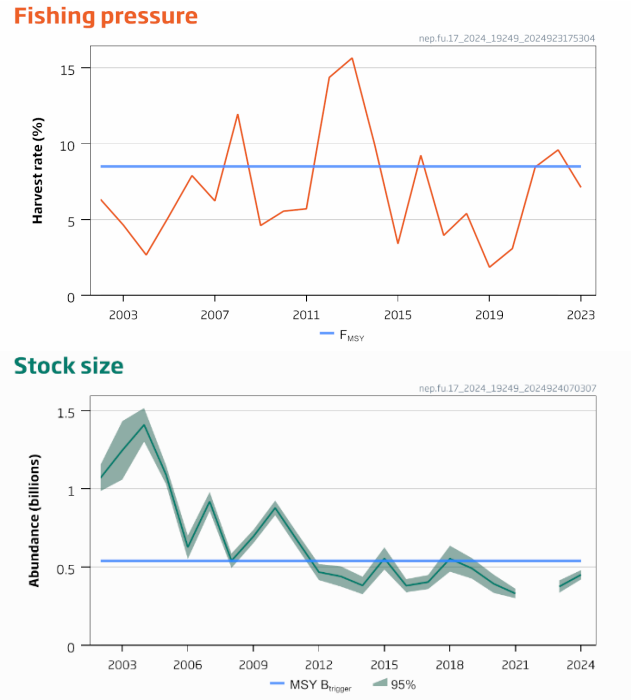
Summary: Fishing pressure on the stock is below F_{MSY}, and spawning-stock sizeis above MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Species	Area	Stock status	Advice 2024
hke.27.3a46-8abd (Hake)	Subareas 4, 6, and 7, and in divisions 3.a, 8.a–b, and 8.d, Northern stock (Greater North Sea, Celtic Seas, and the northern Bay of Biscay)		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 52 466 tonnes. ICES notes the existence of a precautionary management plan developed and adopted by one of the relevant management authorities for this stock. ICES has not identified any conservation aspects other than those related to the commercial fisheries.

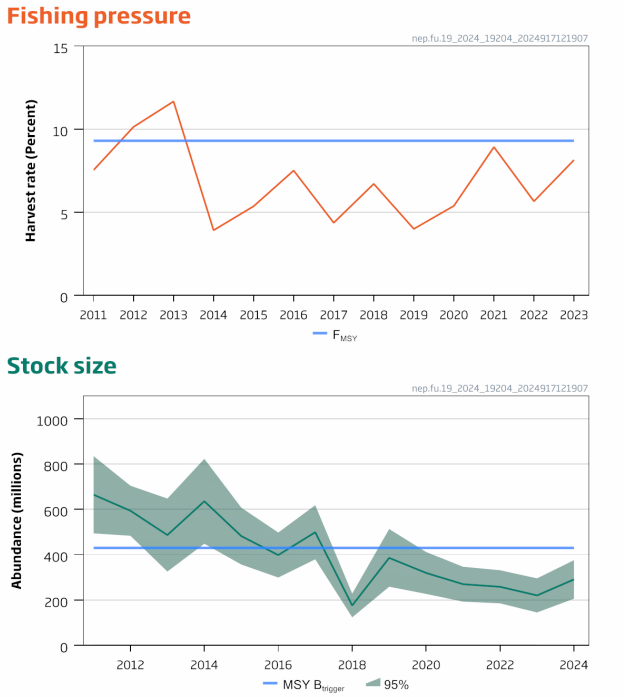
Summary: Fishing pressure on the stock is below F_{MSY}, and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Nephrops stocks

Species	Area	Stock status	Advice 2024
nep.fu.16 (Nephrops)	Divisions 7.b–c and 7.j–k, Functional Unit 16 (west and southwest of Ireland, Porcupine Bank)	**Fishing pressure**  **Stock size**  **Summary:** Fishing pressure on the stock is below F_{MSY}, and no reference points for stock size have been defined for this stock.	ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, and assuming zero discards, catches in 2025 that correspond to the F ranges in the MAP are between 2 813 and 3 488 tonnes. The entire range is considered precautionary when applying ICES advice rule. To ensure that the stock in Functional Unit (FU) 16 is exploited sustainably, management should be continued at the FU level. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

Species	Area	Stock status	Advice 2024
nep.fu.17 (Nephrops)	Division 7.b, Functional Unit 17 (west of Ireland, Aran grounds)		ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 that correspond to the F ranges in the MAP are between 565 and 649 tonnes. To ensure that the stock in Functional Unit (FU) 17 is exploited sustainably, management should be implemented at the FU level. A transfer of advised catch from other FUs to FU 17 could lead to overexploitation. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

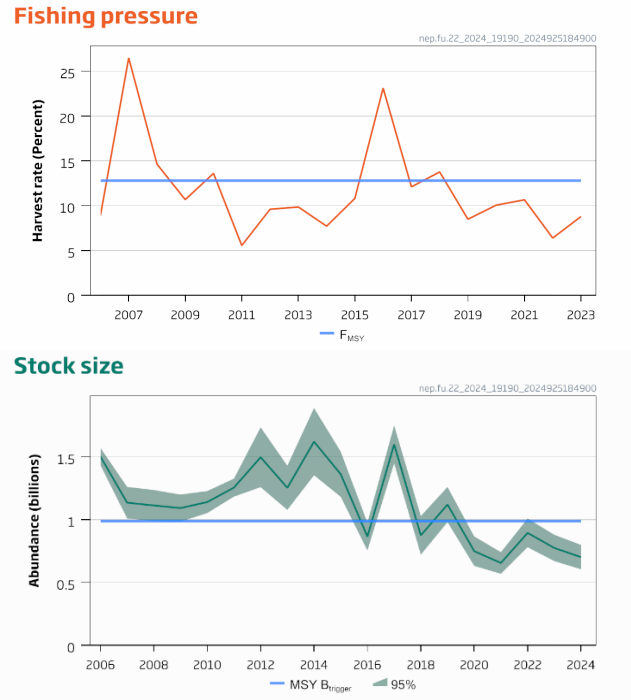
Summary: Fishing pressure on the stock is below F_{MSY}, and stock size is below MSY $B_{trigger}$.

Species	Area	Stock status	Advice 2024
nep.fu.19 (Nephrops)	Divisions 7.a, 7.g, and 7.j, Functional Unit 19 (Irish Sea, Celtic Sea, eastern part of southwest of Ireland)		ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 that correspond to the F ranges in the MAP are between 385 and 433 tonnes. To ensure that the stock in Functional Unit (FU) 19 is exploited sustainably, management should be implemented at the FU level. A transfer of advised catch from other FUs to FU 19 could lead to overexploitation. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

Summary: Fishing pressure on the stock is below F_{MSY}, and stock size is below MSY $B_{trigger}$.

Species	Area	Stock status	Advice 2024
nep.fu.2021 (Nephrops)	Divisions 7.b–c and 7.j–k, Divisions 7.g and 7.h, functional units 20–21 (Celtic Sea)		ICES advises that when the MSY approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 2 153 tonnes. To ensure that the stock in functional units (FUs) 20–21 is exploited sustainably, management should be implemented at the level of the combined FUs 20–21.ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 7. ICES considers this plan to be precautionary when implemented at the FU level. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

Summary: Fishing pressure on the stock is below F_{MSY}, and stock size is above MSY $B_{trigger}$.

Species	Area	Stock status	Advice 2024
nep.fu.22 (Nephrops)	Divisions 7.g and 7.f, Functional Unit 22 (Celtic Sea, Bristol Channel)		ICES advises that when the MSY approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 1 541 tonnes. To ensure that the stock in Functional Unit (FU) 22 is exploited sustainably, management should be implemented at the FU level. ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 7. ICES considers this plan to be precautionary when implemented at the FU level. Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

Summary: Fishing pressure on the stock is below F_{MSY}, and stock size is below MSY $B_{trigger}$.

Species	Area	Stock status	Advice 2024
nep.27.7out.FU* (Nephrops)	Subarea 7, outside the functional units (southern Celtic Seas, southwest of Ireland)		ICES advises that when the precautionary approach is applied, landings should be no more than 120 tonnes in each of the years 2024, 2025, and 2026. ICES cannot quantify the corresponding total catches. ICES has not identified any conservation aspects.

*** Format of nep.27.7outFU differs from other stocks because the advice was published in 2023.**

3.3.2 Fisheries dependent data

Information on fisheries is supplied according to the WGMXIFSH data call in the form of "accessions" data, which provides disaggregated fleet data at the level of a métier which are consistent with the definitions outlined in the DCF. This includes landings (in tonnes) for defined species and fishing effort (in kW days). In 2019, there was a new data call for WGMIXFISH, which changed the format in which the data were requested.

Data on disaggregated landings for the anglerfish (white-bellied anglerfish and black-bellied anglerfish) and megrims (megrim and four-spot megrim) are provided to accessions using several different species codes, including multiple species or aggregate anglerfish codes (ANF, MON, MNZ, ANK) and multiple species or aggregate megrim codes (LBD, LEZ, MEG). Due to inconsistencies in report at the species level it is not possible to use these data directly, and landings must be reallocated to species based on an external information.

In previous years the split for anglerfish has been based on an output provided by WGBIE which details year and country specific proportions of each species for subarea 27.7. The split for megrim has been based on information from the Irish anglerfish and megrim survey, also year specific, but not area disaggregated. This led to some inconsistencies between the derived accessions disaggregated landings, and the species landings splits as estimated by WGBIE.

This year a change was implemented to the data processing so that the InterCatch files were directly used to calculate subarea (including 27.8) and year-country specific species splits for the anglerfish and megrim stocks. This provided greater consistency for species-level accessions landings with the total stock-level landings in the stock objects, and thus the quality of data input to the mixed fisheries model.

3.3.3 Discard data

Discard ratios were calculated from InterCatch discard estimates (either raw country submission or raised) and applied to the landings data supplied by member states in the WGMIXFISH data call. All discard estimates were retrieved from InterCatch and assigned to the same métier within the WGMIXFISH accessions files. However, this method relies on being able to match métier definitions between the two datasets. The conformity of métiers in MIXFISH and InterCatch was generally high (Figure 3.9) and improving year after year, but it was still not possible to match a few métiers. It would be desirable for countries to keep improving the consistency between data uploaded to InterCatch and data submitted to WGMIXFISH.

3.3.4 Defining fleets and métiers

The data sources described above are then combined to produce the "fleet object" which is used as an input into FCube. Within this object the fleets were defined by aggregating catch and effort across country, gear group, and vessel length (where applicable). Any fleet catching < 1% of each of the stocks included the analysis was binned into a "miscellaneous" ("MIS_MIS") fleet to reduce the dimensions of the model. Effort and catch files were matched to ensure consistency and métiers with effort and no catch were aggregated to the MIS fleet.

Within a fleet, a métier was defined as a combination of gear, target species (e.g. demersal fish, DEF, or crustaceans, CRU) and ICES Subarea (e.g. 7b). A similar aggregating procedure as for the fleets was performed, where any métier catching < 10% of a given fleet catch of each stock was aggregated into a "MIS" métier. This results in a large number of fleets and métiers due to the diversity of activity in the Celtic Sea. The data are therefore aggregated to ICES area-level groupings for the Celtics Sea (7bc; 7e; 7fg; 7hjk), this has a useful benefit of reducing run time,

but also reveals the net contribution of "smaller" fleets in a manner that is more comparable for end-users. Additionally, single-stock out-of-area fleets ("OOA") account for the catches of stocks that occur outside the Celtic Sea region (i.e. the Bay of Biscay and Eastern Channel for megrim, Bay of Biscay, Irish sea and Eastern Channel for anglerfish and monkfish and Bay of Biscay, Irish Sea, Eastern Channel, West of Scotland and the North Sea and Kattegat for hake. Separate OOA fleets were defined from accessions data for each out-of-area region and stock, yielding thirteen single-stock OOA fleets. The final retained fleets accounted for most of the fishing mortality of each stock ("detailed fleets", Figure 3.1) while the small fleets ("MIS_MIS") contributed little overall (Figure 3.1). Out-of-area fleets contributed an important share of fishing mortality for hake and anglerfish.

The final data used contained **33** detailed fleets (country * gear grouping * vessel length category), a "MIS_fleet" (MIS_MIS), and **13** single-stock "OOA" fleets. Each detailed fleet engages in several of the 35 different métier each catching the stocks incorporated into this model (Table 3.3, Figures 3.2-3.7). The combination of stocks landed by each métier varies greatly (Figures 3.2-3.3).

3.3.5 Quality control

As a quality control procedure, the total landings and discards across all fleets were compared to the values estimated from the single-species stock assessments (Table 3.4). Some stock landings may not be accounted for in the fleets defined above due to issues such as landings from countries or areas not included in the Celtic Sea mode or national landings with missing logbook information that cannot be allocated to a specific fleet. The landings coverage for all fish stocks is very high (above 95% of landings of each fish stock for each of the years 2021-2023 could be allocated to one of the fleets).

Remaining small inconsistencies between fleet data used by WGMIXFISH and stock data were addressed by scaling the total catch-by-weight across fleets to match stock assessment catch estimates. A multiplicative scaling factor was calculated for each stock and data year and applied to métier-level landings and discards, ensuring that the proportional distribution of both catches and landings across fleets remain consistent with accessions data, but allowing the overall landings-discards ratio to differ from stock assessment estimates.

3.4 Mixed fisheries forecasts

3.4.1 Description of scenarios

3.4.1.1 Baseline runs

The objectives of the single-species stock baseline runs were to: 1) Reproduce as closely as possible the single-species advice produced by ICES, 2) And act as the reference scenario for subsequent mixed-fisheries analyses.

The various single-stock forecasts produced by the single species working groups are performed using different software and setups (see Section 3.2.1 above). The FCube model has been coded as a method in R 64bits (R Development Core Team, 2008), as part of the FLR framework (Kell *et al.*, 2007, http://www.flr-project.org). Input data are in the form of FLFleets and FLStocks objects from the FLCore package, and two forecast methods were used, *stf()* from the FLAssess and *fwd()* from the Flash packages. Stock objects were processed using Fla4a (version 1.8.2), FLXSA (version 2.6.4), stockassessment (version 0.12.0). As such, the input parameterization as well as the stock projections are made externally using existing methods and packages, while only 3 steps are internalised in the method, thus keeping full transparency and flexibility in the use of the model. In the mixed-fisheries runs, all forecasts were done with either the FLR forecast method

or the stockassessment *forecast()* method for SAM stocks. This ensured greater coherence between the single-stock and mixed fishery forecasts.

The same forecast settings as the single species assessment are used for each stock regarding weight-at-age, selectivity, and recruitment, as well as assumptions on the F in the intermediate year and basis for advice (MSY approach and precautionary approach). Some differences can occur in the forecast calculations, because of the diversity of single-stock assessment methods used, and the WG always investigates in depth the reasons for potential discrepancies. Adjustments to the Fcube forecasts are made if necessary to minimize discrepancies to the largest extent possible.

The baseline runs therefore act as a quality control procedure to ensure that the projections are set up correctly within the FCube script. The baseline run has the additional benefit of acting as a quality control check on the projections produced by the single species stock assessors.

3.4.1.2 Mixed fisheries runs

For the mixed fisheries runs, the following assumptions/settings are used.

First, an effort based intermediate year assumption (average effort 2021-2023) is used instead of the single-stock advice assumption. This is considered more consistent with a mixed-fishery fleet-based hypothesis for catch than using the divergent single-stock approaches and provides the same functional link between fishing effort and fishing mortality across all stocks.

Second, for the stock targets in the FCube scenarios a fishing mortality consistent with the catch advice in the TAC year is used to drive the mixed fisheries scenarios rather than using the target F from the single-stock catch advice. Using the advised fishing mortality as the target in the scenarios means that under a stock limiting scenario, it is possible to not achieve the single-stock catch advice for that stock. This is because the stock size at the beginning of the TAC year can be different from the single-stock forecast as a different intermediate year assumption is used in the mixed fisheries scenarios. Hence, a different catch in the TAC results from the advised F. Using an F consistent with the advised catch as the target in the scenario ensures that the catch advice is always achieved but it may result in a different fishing mortality to the single-stock advice. This was considered more in line with a "implementation error" type approach, given the single-stock catch advice is fixed and intermediate year uncertain and impacting the TAC year.

Finally, the proportional allocation of ICES catch advice for anglerfish, monkfish, megrim and hake between detailed and OOA fleets is assumed to follow the 2024 TAC splits. The allocation of catch advice for each stock for the Celtic Sea region across detailed and MIS fleets was assumed to follow the average proportional share of stock landings by these fleets over the years 2021-2023.

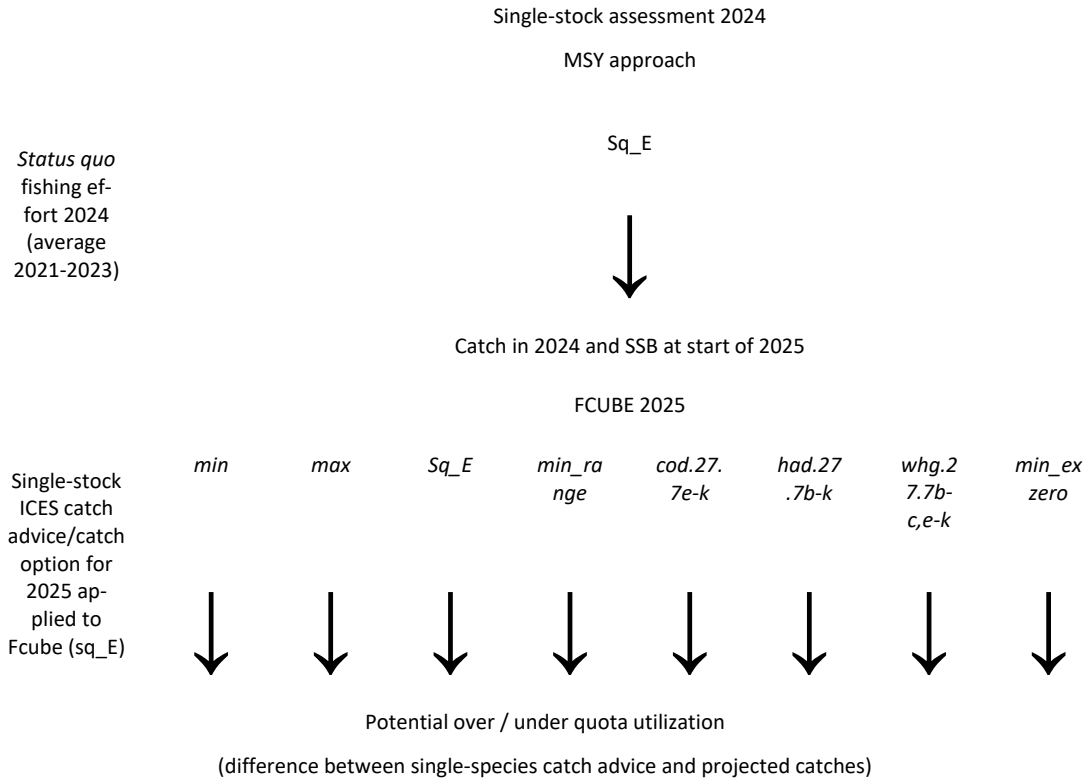
FCube analyses of the intermediate year (2024)

For the mixed fisheries advice, the intermediate year assumption used was *status quo* fishing effort (average (2021-2023), with Fcube scenarios applied in the TAC year.

FCube analyses of the TAC year (2025)

Six scenarios were run, as outlined in Section 3.2.2 above.

In summary, the FCube runs followed the scheme below:



3.4.2 Results of FCube runs

3.4.2.1 Baseline run

Table 3.5 summaries the result of the baseline runs for each of the stocks included in the model. Figure 3.8 shows the required change in fishing mortality for each stock. This trend shows that cod requires the biggest reduction in F, indicating that the zero-catch advice would lead to a choke for all the fisheries that catch cod. Whiting also requires a reduction in F to zero, but from a lower *status quo* F than cod. No issues were encountered in replicating the single-species advice. The results from these baseline runs are compared with the results from the corresponding single-stock advice in Table 3.5 and summarized in Figure 3.6. The replicated forecast for all stocks were almost identical with the single-stock advice with a maximum deviation of 1.6% for hake SSB in 2025. This results from the difficulty in replicating the length-based forecast procedure in the age-based Fcube framework. The SSB deviation under the same assumed F as the single-stock advice resulted in a 3.7% deviation, which was considered reasonable given software constraints. The second highest deviation (excluding rounding errors for reported precision on fishing mortality) was haddock SSB in 2026 which was a -0.6% difference.

3.4.2.2 Mixed fisheries analyses

Intermediate year

The full overview of the FCube projections to 2025 is presented in Tables 3.6-3.10, Figures 3.9-3.11. The results for 2025 can be compared to each other as in a single-species option Table 3.2. For all baseline scenarios, WGMIXFISH assumed *status quo* effort in 2024.

TAC year FCube runs

The outcomes of the *minimum* and *maximum* scenarios are driven by which of the stocks will be most and least limiting for each individual fleet (Tables 3.6-3.7, Figure 3.11).

The *"min"* scenario is consistent with a full implementation of a landing obligation (without any exemptions) given the individual single-stock advice. In 2025, the "min" scenario shows that cod limits 29 of the 33 fleets; 26 of these fleets will also choke on whiting, and one fleet chokes on whiting but not on cod. This is due to the zero-catch advice for cod and whiting and that almost all fleets catch cod and whiting to a greater or lesser extent. The four remaining fleets had no cod or whiting landings and so were limited by white anglerfish (two fleets) and haddock (one fleet).

The *"max"* scenario shows the upper bound of potential fleet effort and stock catches in that it assumes all fleets continue fishing until all their stock shares for all stocks are exhausted irrespective of economic viability, legality, or fleet capacity. In 2025, the "max" scenario indicated that fleets have different least limiting stocks, which results in over-quota catches of all stocks (Figure 2). Black-bellied anglerfish (16 fleets), hake (nine fleets), Norway lobster FU 20-21 (seven fleets), and white-bellied anglerfish (one fleet) are the least limiting stocks.

The *status quo* effort *"sq_E"* scenario sets the effort of each fleet in the forecast years equal to the average of the effort in the most recent three years for which data are available (2021–2023). This scenario investigates the mixed-fisheries outcomes if the situation remains the same in terms of total effort and effort allocation among métier. For 2025, this scenario results in catch overshoots above the single-stock advice of cod and whiting (zero catch advice), overshoots of haddock and Celtic Sea sole, undershoots of white and black-bellied anglerfish, hake, megrim, Western Channel sole and Norway lobster.

The *"min_range"* scenario explores how the higher catch options associated with the $F_{MSY\ upper}$ or scaled F_{MSY} reference points (for stocks where ranges are defined) may reduce choking behaviour in mixed fisheries and increase overall quota uptake. In this scenario, the choke species per fleet are the same as for the "min" scenario. Catches for all stocks in 2025 are slightly increased above the "min" scenario as a result of the increase in catch opportunity provided by the scaled F_{MSY} advice rule.

The *"min_exzero"* scenario is consistent with a full implementation of a landing obligation given the individual single-stock advice for all stocks except cod and whiting. In this scenario cod and whiting were not included as effort-restricting stocks. In 2025, haddock becomes the most limiting stock constraining 12 out of 33 fleet segments for this scenario. The remaining fleets are constrained by Norway lobster (nine fleets across three functional units), Celtic Sea sole (eight fleets), western English Channel sole (two fleets) and white anglerfish (two fleets).

In addition, a *"had-cs"* scenario is presented because of the strong technical interaction between haddock and the two zero-catch advice cod and whiting stocks. This scenario assumes that effort is set according to the single-stock catch advice for haddock for all fleets (based on ICES MSY approach) and presents catches for other stocks in a mixed-fisheries context. Under this scenario, the haddock catch advice is fully utilized, while the cod and whiting catch advice are exceeded. All other stock catch advice is underutilized.

ICES single-stock advice for demersal stocks considered here is based on its MSY approach, except for Norway lobster outside FUs, which is based on ICES precautionary approach. ICES provides zero-catch advice for cod and whiting in 2025, based on the MSY approach with precautionary considerations. Scenario results show that it is not possible to achieve all advised single-stock catches simultaneously under current fishing patterns. Additionally, there is no scenario which can achieve SSB above B_{lim} for cod or whiting in 2026

Mixed-fisheries catch scenarios can take specific management priorities into account, and these results indicate that it is not possible to achieve all single-species management objectives simultaneously. ICES single-stock advice for demersal stocks is based on ICES maximum sustainable yield (MSY) approach. Any catch of cod or whiting in 2025 is not considered precautionary as both stocks are estimated to be at and remain below B_{lim} in 2026 (Table 3.9).
Scenarios that result in under- or overutilization are useful in identifying imbalance between the fishing opportunities of the various stocks. They indicate the direction in which fleets may have to adapt to fully utilize their catch opportunities without collectively exceeding single-stock fishing opportunities. Under the scenarios presented here, the *max* scenario suggests that if all fleets' stock shares are to be fully utilized, catches of all other stocks would be considerably higher than advised in the single-stock advice. As all fleets catch cod and whiting to a greater or lesser extent, any fishing effort in fisheries that occur where these stocks are present is likely to result in catches of cod and/or whiting above the single-stock advice (zero catch), which is considered not precautionary. Of the presented scenarios, the *min* scenario meets the objective of all stocks being fished at or below F_{MSY}. In contrast to single-stock advice there is no single recommendation from this advice, instead a range of scenarios are presented. The ICES single-stock advice provides catch opportunities consistent with the ICES MSY approach. To be consistent with these objectives a scenario is necessary that delivers the SSB and/or F objectives of the single-stock advice for all stocks considered simultaneously. This is not possible in 2025 due to the SSB for cod and whiting stocks being below B_{lim} in 2026, even with a zero catch in 2025 and most fisheries are likely to result in some catches of cod and/or whiting.

The *min* scenario assumes that fishing stops when the catch for any one of the stocks meets the fleet's stock share. This is similar to the full implementation of a landing obligation. Supporting measures aimed at minimizing the misalignment between activity and stock shares for the fleets, such as changes in gear selectivity, spatio-temporal management measures, or reallocation of stock shares, may be required if fishing opportunities are to be fully taken under a fully implemented landing obligation.

Fleet level catch change

A request from stakeholders during the recent WKMIXFISH2 process (ICES, 2023) was for a figure that showed the loss and gain in catches at the fleet level under the scenarios. One such figure was developed during the meeting, which demonstrates how for some fleets only a small share of a choke quota can result in large reductions in catches of target species (e.g. French, and Spanish static fleets (longlines and nets), Figure 3.14). The intention is to refine the figure and present it as an option that could be included in future advice sheets following feedback from stakeholders and clients.

Relative stability

Relative stability as such is not directly included as an input to the model. Instead, an assumption that the relative landings share of the fleets are constant is used as a proxy, and in the scenarios above, once the assumed share for out-of-area catches are removed for the relevant stocks based on the TAC allocations, this input is calculated as the average (2021-2023) landing share by fleet and stock. As a crosscheck, the landings by national fleets were summed over nation for each scenario, and the share by country was compared with this initial input (Figure 3.15). The results show some deviations across all scenarios which arise because (under the assumption of a full discard ban), fleets with a small share of a stock but high discard rate have their fishing activity limited by that stock, resulting in underutilization of their target stock(s). This can translate to underutilization at the national level, as seen by the change in landings share of the stocks by EU Member States in the mixed fisheries forecasts.

3.4.2.3 EU Technical request for zero catch advice stocks

In addition to the standard mixed fisheries scenarios ICES are asked to provide advice on potential catches of zero catch advice stocks given fishing opportunities for target stocks. For Celtic Sea cod, three additional scenarios were provided using the Celtic Sea mixed fishery model including catches:

1. Based on haddock fished at F_{MSY}.
2. Based on haddock fished at $F_{MSY\ lower}$.
3. Based on haddock fished at an intermediate level between F_{MSY} and $F_{MSY\ lower}$.

The level of catches (2025), fishing mortality (2025) and spawning-stock biomass (2026) under each of these scenarios are provided in Tables 3.11-3.13.

Table 3.2. Celtic Sea. Summary of the ICES single-species advice for 2025. Where a stock/Functional Unit does not have a management plan the landings follow ICES advice.

Species	Agreed TAC (summed TACs) 2024	Total catch advice for 2025	Projected landings advice for 2025	Ftotal/Harvest ratio for 2025	Fwanted/Harvest ratio for 2025	SSB 2025	SSB 2026	Rationale
cod.27.7e-k (Cod)	644*	0	n/a	0	0	733	2265	MSY
had.27.7b-k (haddock)	8252**	8252	6772	0.353	0.353	27 904	30 295	MAP
whg.27.b–c,e–k (Whiting)	23709***	0	0	0	0	26 361	33 995	MSY
meg.27.7b-k8abd (Megrim)	24170^	23303	19670	0.23	n/a	95 693	89 889	MSY
mon.27.78abd (White anglerfish)	61081^++	35502	31090	0.192	0.192	64 207	64 669	MSY
ank.27.7-8abd (Black-bellied anglerfish)	61081^++	25579	21175	0.163	0.163	56 821	60 186	MSY
sol.27.7fg (Sole)	1267	1267	1198	0.251	0.251	5850	5659	MAP
sol.27.e (Sole)	1184	1057	1052	n/a	0.29	3705	3500	MSY
hke.27.3a46-8abd (Hake)	40599	72839	67637	0.24	0.24	147 052	129 326	MAP
nep.fu.16 (Nephrops)	4560^^	4560	4560	6.2^	n/a	2002		MAP
nep.fu.17 (Nephrops)	18903^^^	454	375	5.9^	n/a	375		MAP
nep.fu.17 (Nephrops)	18903^^^	248	170	4.8^	n/a	220		MAP
nep.fu.2021 (Nephrops)	18903^^^	1865	1728	6^	n/a	1026		MSY

Species	Agreed TAC (summed TACs) 2024	Total catch advice for 2025	Projected landings advice for 2025	Ftotal/Harvest ratio for 2025	Fwanted/Harvest ratio for 2025	SSB 2025	SSB 2026	Rationale
nep.fu.22 (Nephrops)	18903^^^	1912	1695	10^	n/a	776		MSY
nep.27.7out.FU+ (Nephrops)	18903^^^	120	120					n/a

*** TAC applies to divisions 7.b–c and 7.e–k, subareas 8–10, and EU waters of CECAF 34.1.1.**

**** TAC applies to divisions 7.b–k and subareas 8–10.**

***** TAC applies to Subarea 7 (except Division 7.a).**

****** TAC Includes L. boscii and divisions 7.a and 8.e.**

******* 'of which limit' from the total Subarea 7 TAC.**

******** TAC applies to whole of Subarea 7.**

^ Harvest ratio for Projected landings + Projected dead discards.

^^ applies to both Lophius species combined

Table 3.3. Celtic Sea. Métiers consistent with DCF métier level 5 and additional métiers in the model.

Mixed-fisheries métier	Gear	Target species
LLS_DEF	Longline trawls	Demersal fish
LLS_FIF	Longline trawls	Finfish
OTB_DEF	Otter trawls	Demersal fish
OTT_DEF	Twin otter trawls	Demersal fish
OTB_CRU	Otter trawls	Crustaceans
OTT_CRU	Twin otter trawls	Crustaceans
GNS_DEF	Gillnets	Demersal fish
GTR_DEF	Trammelnets	Demersal fish
SSC_DEF	Scottish seines	Demersal fish
SDN_DEF	Danish seines	Demersal fish
TBB_DEF	Beam trawls	Demersal fish
FPO_CRU	Static pots	Crustaceans
OTH / MIS_MIS	Other miscellaneous gears	Any
Outside (of 7bc,e-k)	All gears	Any

Table 3.4. Celtic Sea. Proportion of the stocks total landings and discards (from WGCSE, WGBIE) covered by the MIXFISH fleets. A ratio >1 means that the catch information collated by MIXFISH is higher than the information used by WGCSE, WGBIE.

Year	Stock	Working Group Landings (WGCSE, WGBIE)	Working Group Discards (WGCSE, WGBIE)	Ratio of Landings	Ratio of Discards	WGMIXFISH Landings	WGMIXFISH Discards
2021	ank.27.78abd	8239	5919	0.724	2.134	11384	2774
2022	ank.27.78abd	9635	5487	0.79	1.871	12189	2933
2023	ank.27.78abd	10814	2572	0.876	2.464	12339	1044
2021	cod.27.7e-k	547	582	0.906	1.107	604	526
2022	cod.27.7e-k	617	96	0.966	1.278	638	75
2023	cod.27.7e-k	495	15	1.001	1.005	494	15
2021	hke.27.3a46-8abd	68061	6738	1.003	0.969	67845	6953
2022	hke.27.3a46-8abd	67433	3241	1.005	0.909	67110	3564
2023	hke.27.3a46-8abd	59380	2990	1.004	0.931	59158	3213
2021	meg.27.7b-k8abd	14941	3893	0.946	1.225	15795	3177
2022	meg.27.7b-k8abd	12739	2858	0.972	1.078	13106	2652
2023	meg.27.7b-k8abd	10375	1926	0.987	1.028	10517	1875
2021	mon.27.78abd	22620	3946	0.918	2.062	24637	1913
2022	mon.27.78abd	21171	2695	0.948	1.767	22340	1525
2023	mon.27.78abd	19810	2826	0.932	2.06	21252	1372
2021	sol.27.7fg	1433	82	0.989	1.249	1449	66
2022	sol.27.7fg	1335	70	1.001	0.983	1334	72
2023	sol.27.7fg	1165	75	1.041	0.62	1119	120
2021	whg.27.7b-ce-k	6062	1172	1.004	0.98	6037	1197
2022	whg.27.7b-ce-k	4898	1935	1.048	0.896	4675	2158
2023	whg.27.7b-ce-k	4468	414	0.999	1.009	4472	411
2021	had.27.7b-k	12177	3156	1.001	0.997	12164	3167
2022	had.27.7b-k	10269	3598	0.983	1.052	10446	3421
2023	had.27.7b-k	7501	2031	1.028	0.91	7300	2233
2021	sol.27.7e	1391	0	1	NA	1391	0
2022	sol.27.7e	1409	0	1	NA	1409	0

Year	Stock	Working Group Landings (WGCSE, WGBIE)	Working Group Discards (WGCSE, WGBIE)	Ratio of Landings	Ratio of Discards	WGMIXFISH Landings	WGMIXFISH Discards
2023	sol.27.7e	1237	0	1	NA	1237	0
2021	nep.out.7	346	0	1	NA	346	0
2022	nep.out.7	440	0	1	NA	440	0
2023	nep.out.7	457	0	1	NA	457	0
2021	nep.fu.22	1616	149	1	1	1616	149
2022	nep.fu.22	1271	141	1	1	1271	141
2023	nep.fu.22	1242	312	1	1	1242	312
2021	nep.fu.2021	697	47	1	1	697	47
2022	nep.fu.2021	795	70	1	1	795	70
2023	nep.fu.2021	1442	129	1	1	1442	129
2021	nep.fu.19	415	173	1	1	415	173
2022	nep.fu.19	247	107	1	1	247	107
2023	nep.fu.19	260	141	1	1	260	141
2021	nep.fu.16	2476	0	1	NA	2476	0
2022	nep.fu.16	2846	0	1	NA	2846	0
2023	nep.fu.16	3011	0	1	NA	3011	0
2021	nep.fu.17	498	88	1	1	498	88
2022	nep.fu.17	452	122	1	1	452	122
2023	nep.fu.17	411	170	1	1	411	170

Table 3.5. Celtic Sea. Comparison between the outputs from the reproduction of the advice and ICES advice. Values for 2024 compare results from the baseline run to the ICES intermediate year results. The baseline run uses the same assumptions for F in the intermediate year as the forecasts leading to ICES advice.

Year	Stock	Value	FCube.baseline	Single.Spp.Advice	% difference
2024	ank.27.78abd	catch	14759	14755	0
2024	ank.27.78abd	discards	0	2697	-100
2024	ank.27.78abd	Fbar	0.09	0.09	-0.2
2024	ank.27.78abd	landings	14759	12058	22.4
2024	ank.27.78abd	Recruitment	149976	149976	0
2024	ank.27.78abd	ssb	56620	56618	0
2024	cod.27.7e-k	catch	538	539	-0.2
2024	cod.27.7e-k	discards	0	-	-
2024	cod.27.7e-k	Fbar	0.82	0.82	0
2024	cod.27.7e-k	landings	538	-	-
2024	cod.27.7e-k	Recruitment	1067	1067	0
2024	cod.27.7e-k	ssb	585	585	0
2024	had.27.7b-k	catch	7718	7698	0.3
2024	had.27.7b-k	discards	0	824	-100
2024	had.27.7b-k	Fbar	0.5	0.5	-0.8
2024	had.27.7b-k	landings	7718	6874	12.3
2024	had.27.7b-k	Recruitment	234566	234566	0
2024	had.27.7b-k	ssb	23043	23051	0
2024	hke.27.3a46-8abd	catch	52466	52301	0.3
2024	hke.27.3a46-8abd	discards	0	3540	-100
2024	hke.27.3a46-8abd	Fbar	0.22	0.22	0.5
2024	hke.27.3a46-8abd	landings	52466	48761	7.6
2024	hke.27.3a46-8abd	Recruitment	803627	803627	0
2024	hke.27.3a46-8abd	ssb	113800	112699	1
2024	meg.27.7b-k8abd	catch	19323	19256	0.3
2024	meg.27.7b-k8abd	discards	0	2940	-100
2024	meg.27.7b-k8abd	Fbar	0.21	0.21	1.4
2024	meg.27.7b-k8abd	landings	19323	16316	18.4

Year	Stock	Value	FCube.baseline	Single.Spp.Advice	% difference
2024	meg.27.7b-k8abd	Recruitment	216722	216722	0
2024	meg.27.7b-k8abd	ssb	89073	89073	0
2024	mon.27.78abd	catch	24727	24814	-0.4
2024	mon.27.78abd	discards	0	3126	-100
2024	mon.27.78abd	Fbar	0.13	0.13	0
2024	mon.27.78abd	landings	24727	21688	14
2024	mon.27.78abd	Recruitment	110549	110549	0
2024	mon.27.78abd	ssb	58200	58152	0.1
2024	sol.27.7e	catch	1184	1184	0
2024	sol.27.7e	discards	0	5	-100
2024	sol.27.7e	Fbar	0.27	0.27	1.1
2024	sol.27.7e	landings	1184	1179	0.4
2024	sol.27.7e	Recruitment	4083	4083	0
2024	sol.27.7e	ssb	4274	4274	0
2024	sol.27.7fg	catch	1347	1347	0
2024	sol.27.7fg	discards	0	95	-100
2024	sol.27.7fg	Fbar	0.3	0.3	1
2024	sol.27.7fg	landings	1347	1252	7.6
2024	sol.27.7fg	Recruitment	5177	5177	0
2024	sol.27.7fg	ssb	5412	5415	-0.1
2024	whg.27.7b-ce-k	catch	4718	-	-
2024	whg.27.7b-ce-k	discards	0	455	-100
2024	whg.27.7b-ce-k	Fbar	0.27	0.27	0
2024	whg.27.7b-ce-k	landings	4718	4263	10.7
2024	whg.27.7b-ce-k	Recruitment	350153	350153	0
2024	whg.27.7b-ce-k	ssb	22335	22290	0.2
2025	ank.27.78abd	catch	25322	25317	0
2025	ank.27.78abd	discards	0	4144	-100
2025	ank.27.78abd	Fbar	0.16	0.16	0

Year	Stock	Value	FCube.baseline	Single.Spp.Advice	% difference
2025	ank.27.78abd	landings	25322	21173	19.6
2025	ank.27.78abd	Recruitment	150676	150676	0
2025	ank.27.78abd	ssb	65236	65236	0
2025	cod.27.7e-k	catch	0	0	-
2025	cod.27.7e-k	discards	0	-	-
2025	cod.27.7e-k	Fbar	0	0	-
2025	cod.27.7e-k	landings	0	-	-
2025	cod.27.7e-k	Recruitment	1067	1067	0
2025	cod.27.7e-k	ssb	678	676	0.3
2025	had.27.7b-k	catch	4658	4644	0.3
2025	had.27.7b-k	discards	0	1269	-100
2025	had.27.7b-k	Fbar	0.35	0.35	0
2025	had.27.7b-k	landings	4658	3375	38
2025	had.27.7b-k	Recruitment	234566	234566	0
2025	had.27.7b-k	ssb	13308	13307	0
2025	hke.27.3a46-8abd	catch	52927	52466	0.9
2025	hke.27.3a46-8abd	discards	0	4430	-100
2025	hke.27.3a46-8abd	Fbar	0.24	0.24	0
2025	hke.27.3a46-8abd	landings	52927	48036	10.2
2025	hke.27.3a46-8abd	Recruitment	797846	797846	0
2025	hke.27.3a46-8abd	ssb	105667	103963	1.6
2025	meg.27.7b-k8abd	catch	21505	21144	1.7
2025	meg.27.7b-k8abd	discards	0	3012	-100
2025	meg.27.7b-k8abd	Fbar	0.25	0.25	1.6
2025	meg.27.7b-k8abd	landings	21505	18132	18.6
2025	meg.27.7b-k8abd	Recruitment	216722	216722	0
2025	meg.27.7b-k8abd	ssb	83883	83883	0
2025	mon.27.78abd	catch	34860	34983	-0.4
2025	mon.27.78abd	discards	0	4348	-100

Year	Stock	Value	FCube.baseline	Single.Spp.Advice	% difference
2025	mon.27.78abd	Fbar	0.19	0.19	0
2025	mon.27.78abd	landings	34860	30634	13.8
2025	mon.27.78abd	Recruitment	111151	111151	0
2025	mon.27.78abd	ssb	62924	62907	0
2025	nep.fu.16	catch	3488	3488	0
2025	nep.fu.16	discards	0	0	-
2025	nep.fu.16	discards.dead	0	0	-
2025	nep.fu.16	discards.surviving	0	0	-
2025	nep.fu.16	Fbar	0.06	0.06	0
2025	nep.fu.16	landings	3488	3488	0
2025	nep.fu.16	Recruitment	-	-	-
2025	nep.fu.16	ssb	-	1677	-
2025	nep.fu.17	catch	649	649	0
2025	nep.fu.17	discards	139	139	0
2025	nep.fu.17	discards.dead	104	104	0
2025	nep.fu.17	discards.surviving	35	35	0
2025	nep.fu.17	Fbar	0.07	0.07	0
2025	nep.fu.17	landings	510	510	0
2025	nep.fu.17	Recruitment	-	-	-
2025	nep.fu.17	ssb	-	451	-
2025	nep.fu.19	catch	433	433	0
2025	nep.fu.19	discards	136	136	0
2025	nep.fu.19	discards.dead	102	102	0
2025	nep.fu.19	discards.surviving	34	34	0
2025	nep.fu.19	Fbar	0.06	0.06	0
2025	nep.fu.19	landings	297	296	0.3
2025	nep.fu.19	Recruitment	-	-	-
2025	nep.fu.19	ssb	-	291	-
2025	nep.fu.2021	catch	2153	2153	0

Year	Stock	Value	FCube.baseline	Single.Spp.Advice	% difference
2025	nep.fu.2021	discards	163	163	0
2025	nep.fu.2021	discards.dead	122	122	0
2025	nep.fu.2021	discards.surviving	41	41	0
2025	nep.fu.2021	Fbar	0.06	0.06	0
2025	nep.fu.2021	landings	1990	1990	0
2025	nep.fu.2021	Recruitment	-	-	-
2025	nep.fu.2021	ssb	-	1152	-
2025	nep.fu.22	catch	1541	1541	0
2025	nep.fu.22	discards	193	193	0
2025	nep.fu.22	discards.dead	145	145	0
2025	nep.fu.22	discards.surviving	48	48	0
2025	nep.fu.22	Fbar	0.09	0.09	0
2025	nep.fu.22	landings	1348	1348	0
2025	nep.fu.22	Recruitment	-	-	-
2025	nep.fu.22	ssb	-	703	-
2025	nep.out.7	catch	120	120	0
2025	nep.out.7	discards	0	-	-
2025	nep.out.7	discards.dead	-	-	-
2025	nep.out.7	discards.surviving	-	-	-
2025	nep.out.7	Fbar	NA	NA	-
2025	nep.out.7	landings	120	120	0
2025	nep.out.7	Recruitment	-	-	-
2025	nep.out.7	ssb	-	-	-
2025	sol.27.7e	catch	1151	1151	0
2025	sol.27.7e	discards	0	5	-100
2025	sol.27.7e	Fbar	0.29	0.29	0
2025	sol.27.7e	landings	1151	1146	0.4
2025	sol.27.7e	Recruitment	4083	4083	0
2025	sol.27.7e	ssb	3983	3984	0

Year	Stock	Value	FCube.baseline	Single.Spp.Advice	% difference
2025	sol.27.7fg	catch	1151	1149	0.2
2025	sol.27.7fg	discards	0	69	-100
2025	sol.27.7fg	Fbar	0.25	0.25	0
2025	sol.27.7fg	landings	1151	1080	6.6
2025	sol.27.7fg	Recruitment	5177	5177	0
2025	sol.27.7fg	ssb	5273	5275	0
2025	whg.27.7b-ce-k	catch	0	0	-
2025	whg.27.7b-ce-k	discards	0	0	-
2025	whg.27.7b-ce-k	Fbar	0	0	-
2025	whg.27.7b-ce-k	landings	0	0	-
2025	whg.27.7b-ce-k	Recruitment	350153	350153	0
2025	whg.27.7b-ce-k	ssb	21228	21210	0.1
2026	ank.27.78abd	ssb	67236	67235	0
2026	cod.27.7e-k	ssb	2038	2040	-0.1
2026	had.27.7b-k	ssb	19501	19379	0.6
2026	hke.27.3a46-8abd	ssb	101944	98340	3.7
2026	meg.27.7b-k8abd	ssb	73191	73492	-0.4
2026	mon.27.78abd	ssb	56944	56926	0
2026	sol.27.7e	ssb	3706	3706	0
2026	sol.27.7fg	Ssb	5222	5226	-0.1
2026	whg.27.7b-ce-k	Ssb	26686	26691	0

Table 3.6. Celtic Sea. The "most" limiting stocks, "least" limiting stocks and stocks that are neither most or last limiting ("intermediate") under the single-stocks advice. Note that totals can sum to greater than number of fleets where two stocks are equally limiting (in this case, cod and whiting which both have zero catch advice).

stock	intermediate	least	most
ank.27.78abd	17	16	0
cod.27.7e-k	4	0	29
had.27.7b-k	32	0	1
hke.27.3a46-8abd	24	9	0
meg.27.7b-k8abd	33	0	0
mon.27.78abd	30	1	2
sol.27.7e	33	0	0
sol.27.7fg	33	0	0
whg.27.7b-ce-k	6	0	27
nep.fu.16	33	0	0
nep.fu.17	33	0	0
nep.fu.19	33	0	0
nep.fu.2021	26	7	0
nep.fu.22	33	0	0
nep.out.7	33	0	0

Table 3.7. Celtic Sea. The "most" limiting stocks, "least" limiting stocks and stocks that are neither most or last limiting ("intermediate") under the single-stocks advice excluding cod and whiting.

stock	intermediate	least	most
ank.27.78abd	17	16	0
had.27.7b-k	21	0	12
hke.27.3a46-8abd	24	9	0
meg.27.7b-k8abd	33	0	0
mon.27.78abd	30	1	2
sol.27.7e	31	0	2
sol.27.7fg	25	0	8
nep.fu.16	33	0	0
nep.fu.17	33	0	0
nep.fu.19	27	0	6
nep.fu.2021	26	7	0
nep.fu.22	31	0	2
nep.out.7	32	0	1

Table 3.8. Celtic Sea. Mixed-fisheries advice in the Celtic Sea. Catch (in tonnes) per mixed-fisheries scenario 2025, in absolute values.

Stock	Single-stock catch advice (2025)^	MIN	MAX	sqE	Min_Range	HAD	min_wo_ cod_whg	COD _cod_whg_ FMSY_Red	WHG _cod_whg_ FMSY_Red	cod_ FMSY_Red	COD	WHG
ank.27.78abd	25317	6032	26267	14098	6412	13037	12013	6371	9707	6371	5999	6761
cod.27.7e-k	0	0	1135	774	43	629	532	43	372	43	0	3
had.27.7b-k	4644	0	10034	6156	291	4641	3803	291	2698	291	0	16
hke.27.3a46-8abd	52466	23273	55893	48102	23910	29255	30859	21423	29628	21423	20778	27786
meg.27.7b-k8abd	21144	2154	30062	18241	2757	12008	9878	2757	7135	2757	2155	2164
mon.27.78abd	34983	9454	49715	24100	10241	23837	21456	10030	17392	10030	9278	10873
sol.27.7e	1151	0	1975	1094	65	934	849	75	472	75	22	60
sol.27.7fg	1149	0	2240	1363	61	649	592	61	436	61	0	0
whg.27.7b-ce-k	0	0	9507	5811	288	4878	3987	288	2753	288	0	0
nep.fu.16	3488	42	6005	3235	160	2527	1788	252	1484	252	134	134
nep.fu.17	649	0	1156	640	27	523	393	27	307	27	0	0
nep.fu.19	433	0	780	420	19	349	260	19	199	19	0	0
nep.fu.2021	2153	0	2012	1076	46	865	655	46	495	46	0	0
nep.fu.22	1541	0	2456	1350	58	1101	840	58	643	58	0	0
nep.27.7outFU	120	1	195	106	5	84	62	6	49	6	2	2

^ Advised catches of no more than the indicated value.

Table 3.9. Celtic Sea. Mixed-fisheries advice in the Celtic Sea. Fishing mortality per mixed-fisheries scenario 2024, in absolute values.

Stock	Single-stock catch advice (2026)^	MIN	MAX	sqE	Min_Range	HAD	min_wo_ cod_whg	COD _cod_whg_ FMSY_Red	WHG_ cod_whg_ FMSY_Red	cod_ FMSY_Red	COD	WHG
ank.27.78abd	0.16	0.04	0.17	0.09	0.04	0.08	0.07	0.04	0.06	0.04	0.04	0.04
cod.27.7e-k	0.00	0.00	1.98	0.99	0.04	0.73	0.58	0.04	0.37	0.04	0.00	0.00
had.27.7b-k	0.35	0.00	0.98	0.50	0.02	0.35	0.28	0.02	0.19	0.02	0.00	0.00
hke.27.3a46-8abd	0.24	0.10	0.25	0.21	0.10	0.12	0.13	0.09	0.13	0.09	0.09	0.12
meg.27.7b-k8abd	0.25	0.02	0.38	0.21	0.03	0.13	0.11	0.03	0.08	0.03	0.02	0.02
mon.27.78abd	0.19	0.05	0.29	0.13	0.05	0.13	0.11	0.05	0.09	0.05	0.05	0.06
sol.27.7e	0.29	0.00	0.56	0.27	0.01	0.23	0.21	0.02	0.11	0.02	0.00	0.01
sol.27.7fg	0.25	0.00	0.56	0.31	0.01	0.13	0.12	0.01	0.09	0.01	0.00	0.00
whg.27.7b-ce-k	0.00	0.00	0.98	0.48	0.02	0.38	0.30	0.02	0.19	0.02	0.00	0.00
nep.fu.16	0.06	0.00	0.11	0.06	0.00	0.04	0.03	0.00	0.03	0.00	0.00	0.00
nep.fu.17	0.07	0.00	0.18	0.10	0.00	0.08	0.06	0.00	0.05	0.00	0.00	0.00
nep.fu.19	0.06	0.00	0.19	0.10	0.00	0.08	0.06	0.00	0.05	0.00	0.00	0.00
nep.fu.2021	0.06	0.00	0.06	0.03	0.00	0.03	0.02	0.00	0.02	0.00	0.00	0.00
nep.fu.22	0.09	0.00	0.17	0.10	0.00	0.08	0.06	0.00	0.05	0.00	0.00	0.00

Legend:	Fish stocks	Norway lobster FUs
	$F_{2025} \leq F_{MSY}$	$F_{2025} \leq F_{MSY}$
	$F_{MSY} < F_{2025} \leq F_{pa}$	-
	$F_{pa} < F_{2025} \leq F_{lim}$	-
	$F_{pa} < F_{2025}$, no F_{lim} defined	-
	$F_{2025} > F_{lim}$	$F_{2025} > F_{MSY}$

Notes:

*** ank.27.78abd and mon.27.78abd have no F_{lim}.**

**** Norway lobster stocks have no F_{pa} or F_{lim} limits, and so colours relate to above (black) or below (white) F_{MSY} harvest rates.**

Table 3.10. Celtic Sea. Mixed-fisheries advice in the Celtic Sea. Spawning-stock biomass per mixed-fisheries scenario 2026, in absolute values.

Stock	Single-stock catch advice SSB(2026)^	MIN	MAX	sqE	Min_Range	HAD	min_wo_ cod_whg	COD_ cod_whg_ FMSY_Red	WHG_ cod_whg_ FMSY_Red	cod_ FMSY_Red	COD	WHG
ank.27.78abd	67235	76512	67012	72715	76332	73213	73695	76351	74780	76351	76527	76168
cod.27.7e-k	2040	1889	343	782	1825	977	1112	1825	1342	1825	1889	1883
had.27.7b-k	19379	24127	14301	18008	23836	19500	20315	23836	21418	23836	24127	24111
hke.27.3a46-8abd	98340	118521	101203	105310	118180	115322	114466	119513	115123	119513	119858	116107
meg.27.7b-k8abd	73492	93401	64696	76777	92775	83197	85396	92775	88235	92775	93401	93392
mon.27.78abd	56926	66428	51962	61166	66145	61260	62115	66221	63576	66221	66491	65918
sol.27.7e	3706	4816	2914	3757	4753	3912	3994	4743	4358	4743	4795	4758
sol.27.7fg	5226	6393	4090	4990	6331	5721	5779	6331	5936	6331	6393	6393
whg.27.7b-ce-k	26691	24787	16852	19804	24531	20578	21331	24531	22382	24531	24787	24787

Legend

- $SSB_{2026} \geq B_{pa}$ or MSY $B_{trigger}$
- $SSB_{2026} \geq B_{lim}$; no B_{pa} defined
- $B_{lim} \leq SSB_{2026} < B_{pa}$
- $SSB_{2026} < B_{lim}$

*Female SSB

Table 3.11. Mixed-fisheries advice in the Celtic Sea (Technical request). Catch (in tonnes) per mixed-fisheries scenario 2025, in absolute values.

Stock	Single-stock catch advice (2025)	Haddock F_{msy}	Haddock F_{msy_int}	Haddock F_{msy_lower}	Haddock F_{msy_upper}
ank.27.78abd	25317	13037	11860	10728	15918
cod.27.7e-k	0	629	538	440	817
had.27.7b-k	4644	4641	3875	3096	6350
hke.27.3a46-8abd	52466	29255	27714	26232	33023
meg.27.7b-k8abd	21144	12008	10225	8482	16250
mon.27.78abd	34983	23837	21450	19139	29608
nep.27.7outFU	120	84	68	53	124
nep.fu.16	3488	2527	2046	1587	3719
nep.fu.17	649	593	481	373	873
nep.fu.19	433	349	282	219	513
nep.fu.2021	2153	1022	827	641	1503
nep.fu.22	1541	1101	892	691	1621
sol.27.7e	1151	934	785	637	1280
sol.27.7fg	1149	649	532	417	927
whg.27.7b-ce-k	0	4878	4109	3313	6551

Table 3.12. Mixed-fisheries advice in the Celtic Sea (Technical request). TAC year (2025) fishing mortality per mixed-fisheries scenario 2025, in absolute values.

Stock	Single-stock F advice (2025)	Haddock F_{msy}	Haddock F_{msy_int}	Haddock F_{msy_lower}	Haddock F_{msy_upper}
ank.27.78abd	0.16	0.08	0.07	0.07	0.1
cod.27.7e-k	0	0.73	0.59	0.46	1.07
had.27.7b-k	0.35	0.35	0.29	0.22	0.52
hke.27.3a46-8abd	0.24	0.12	0.12	0.11	0.14
meg.27.7b-k8abd	0.25	0.13	0.11	0.09	0.18
mon.27.78abd	0.19	0.13	0.11	0.1	0.16
nep.27.7outFU	NA	NA	NA	NA	NA
nep.fu.16	0.06	0.05	0.04	0.03	0.07
nep.fu.17	0.07	0.08	0.06	0.05	0.12
nep.fu.19	0.06	0.08	0.07	0.05	0.12
nep.fu.2021	0.06	0.03	0.02	0.02	0.04
nep.fu.22	0.09	0.08	0.06	0.05	0.12
sol.27.7e	0.29	0.23	0.19	0.15	0.33
sol.27.7fg	0.25	0.13	0.11	0.08	0.2
whg.27.7b-ce-k	0	0.38	0.31	0.24	0.56

Table 3.13. Mixed-fisheries advice in the Celtic Sea (Technical request). TAC year + 1 (2026) SSB per mixed-fisheries scenario 2025, in absolute values.

Stock	Single-stock SSB advice (2026)	Haddock F_{msy}	Haddock F_{msy_int}	Haddock F_{msy_lower}	Haddock F_{msy_upper}
ank.27.78abd	67235	73213	73767	74300	71860
cod.27.7e-k	2040	977	1104	1244	726
had.27.7b-k	19379	19500	20242	20996	17824
hke.27.3a46-8abd	98340	115322	116145	116938	113312
meg.27.7b-k8abd	73492	83197	85039	86841	78824
mon.27.78abd	56926	61260	62118	62948	59186
sol.27.7e	3706	3912	4056	4199	3578
sol.27.7fg	5226	5721	5839	5956	5432
whg.27.7b-ce-k	26691	20578	21227	21901	19195

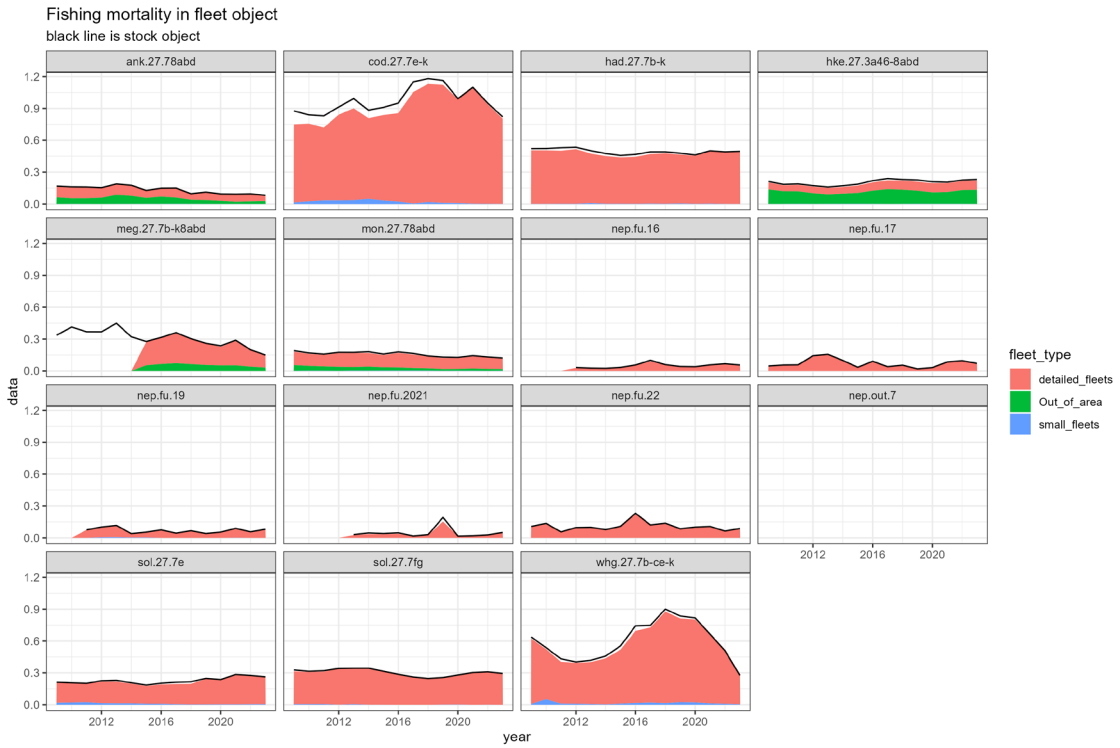


Figure 3.1. Celtic sea. Time-series of partial fishing mortality accounted for by those fleets explicitly represented in the model ("detailed fleets"), the fleets that were aggregated together due to having only a small share of any stock catches ("small fleets") and fleets accounting for catches outside the model domain ("out-of-area").

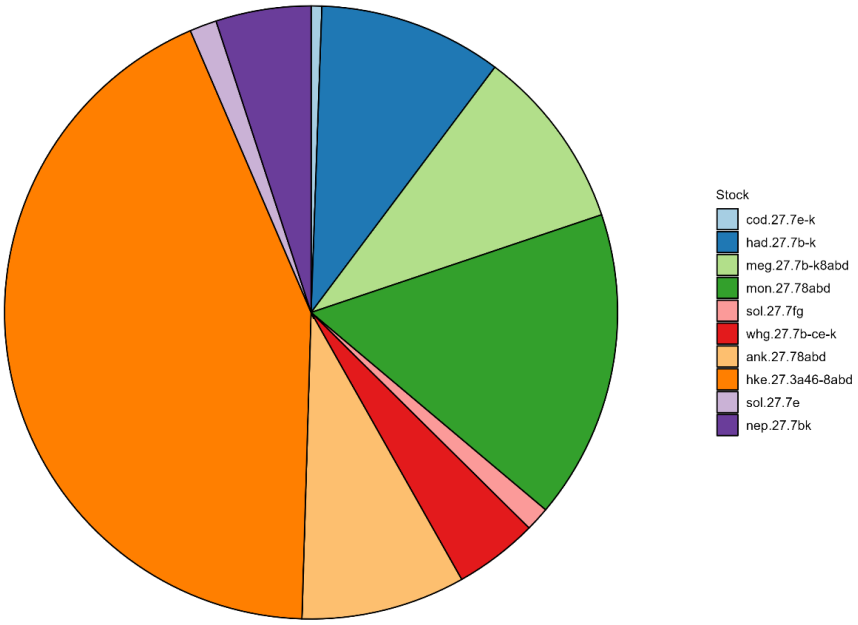


Figure 3.2. Celtic Sea. Distribution of landings of those stocks included in the mixed fisheries projections.

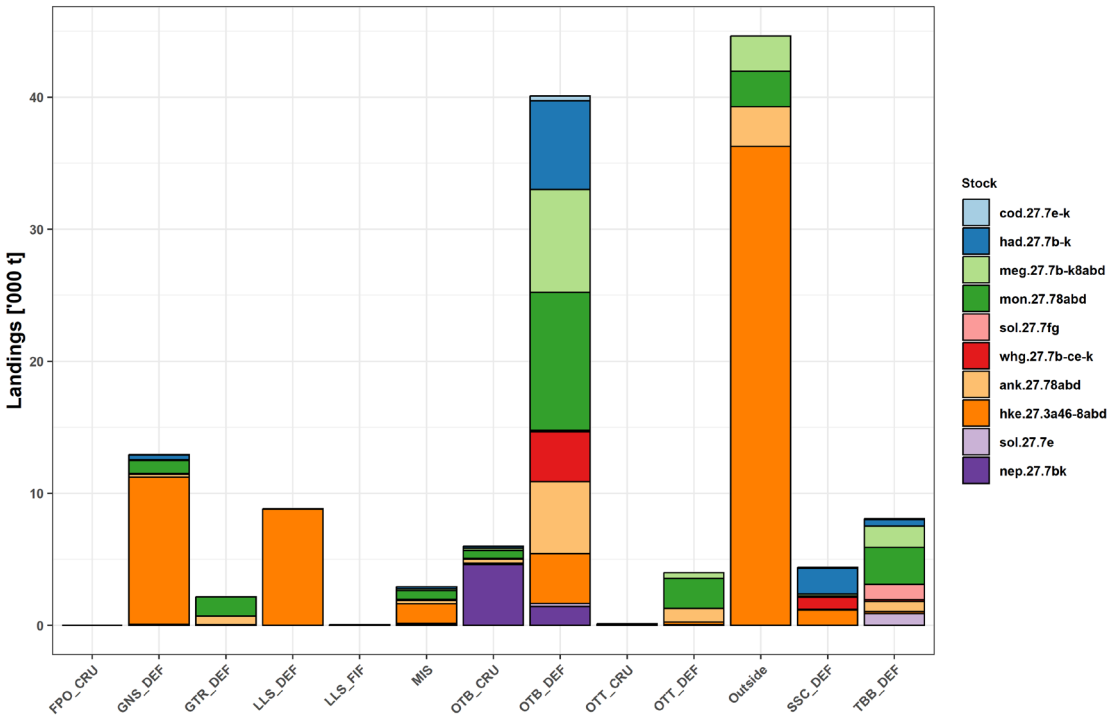


Figure 3.3. Celtic Sea. Landings distribution of species by métier with landings consisting of more than 1% of any of the stocks (1-7; average from 2021-2023) Note. The "miscellaneous" (MIS) category displayed here is a mixed category consisting of (i) landings without corresponding effort and (ii) landings of métiers within a fleet with landings of less than 10% of each of the stocks; average from 2021-2023). The "outside" category contains catches outside the Celtic Sea region.

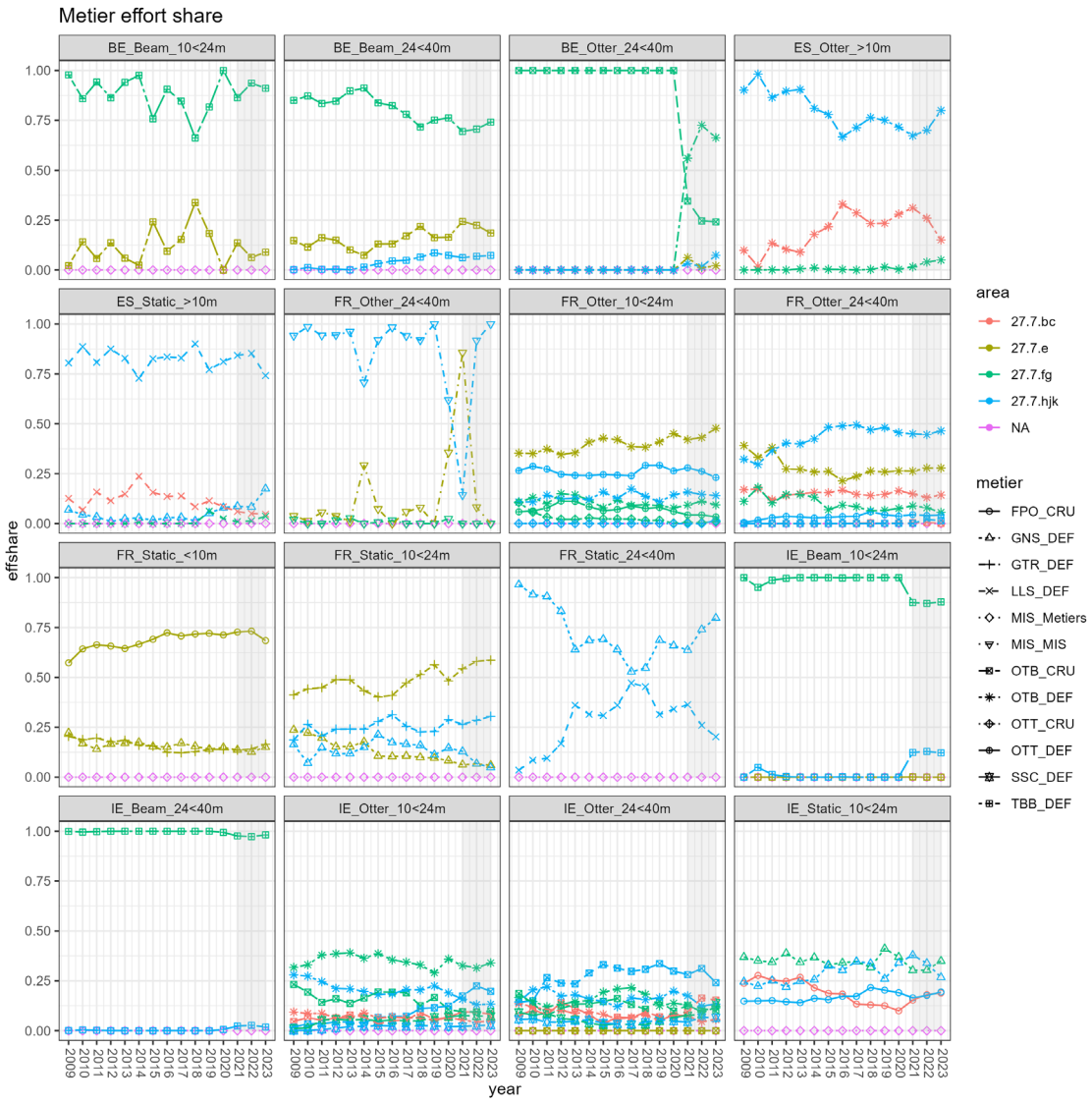


Figure 3.4. Celtic Sea. Effort share (in proportion) by métier and by year for each fleet (part 1). The average years used for forecasting the effort share in the scenarios are shaded in grey.

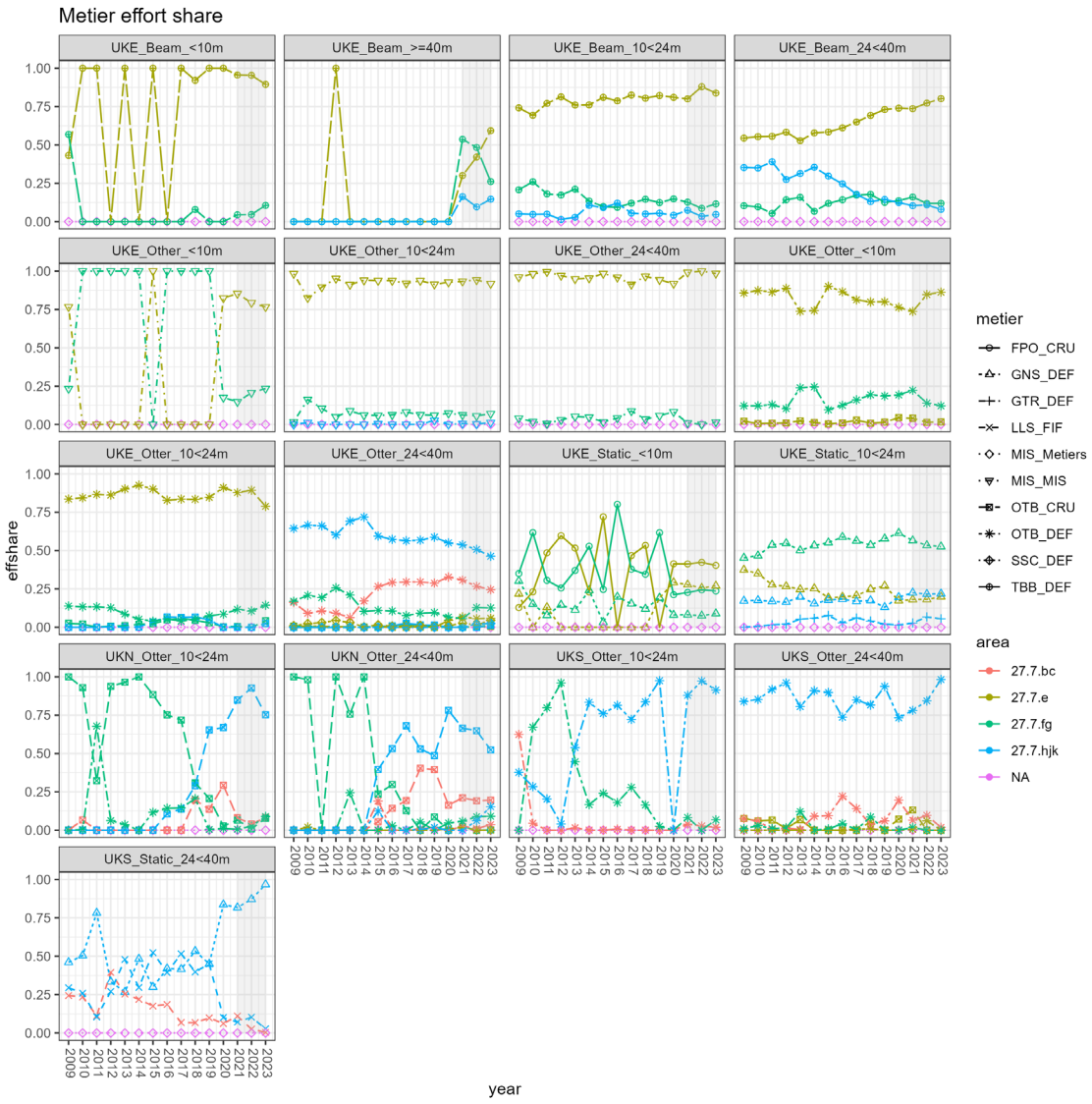


Figure 3.5. Celtic Sea. Effort share (in proportion) by métier and by year for each fleet (part 2). The average years used for forecasting the effort share in the scenarios are shaded in grey.

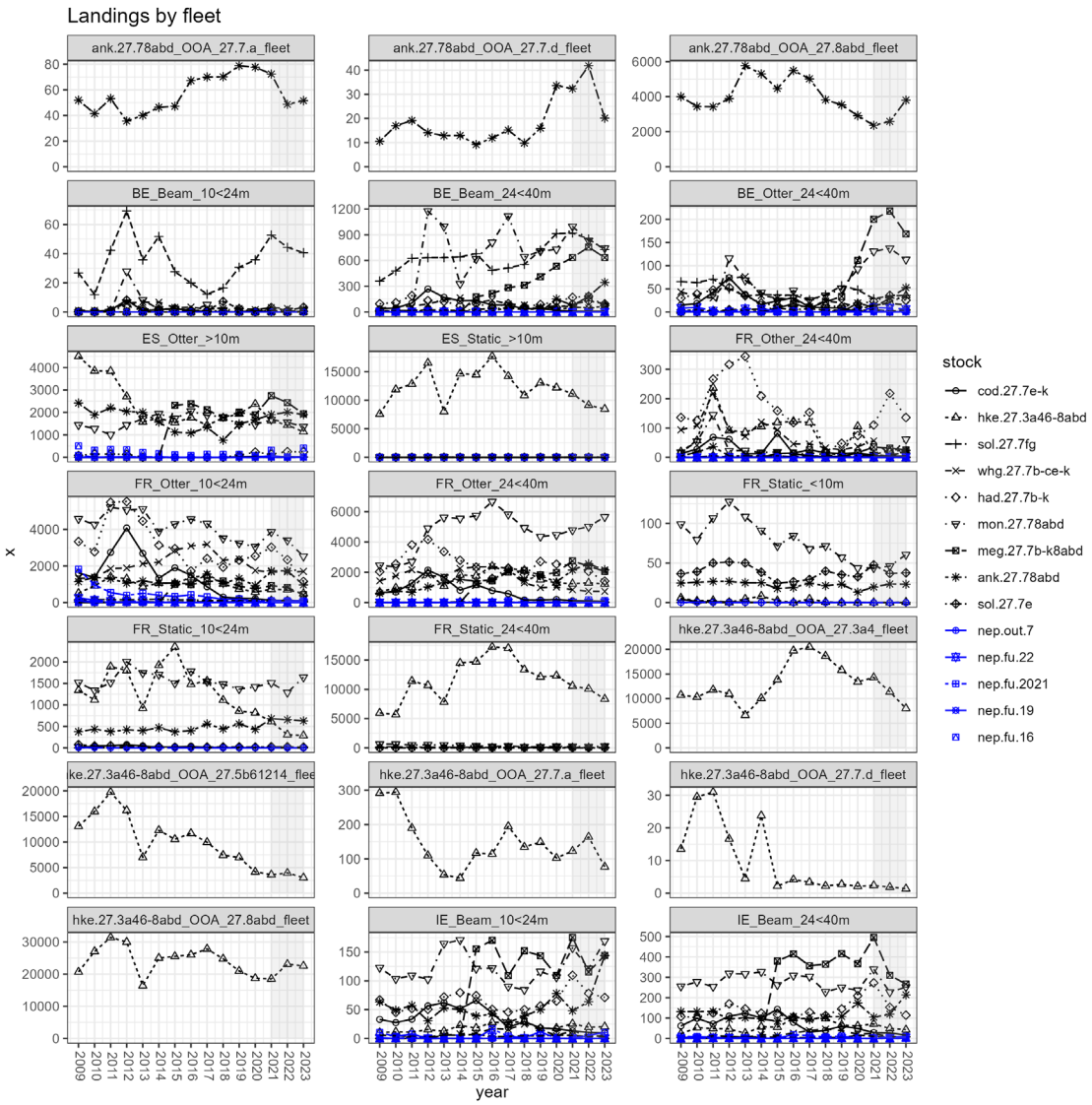


Figure 3.6. Celtic Sea. Landings by fleet, stock and year (part 1). Note. different scales on the y-axis.

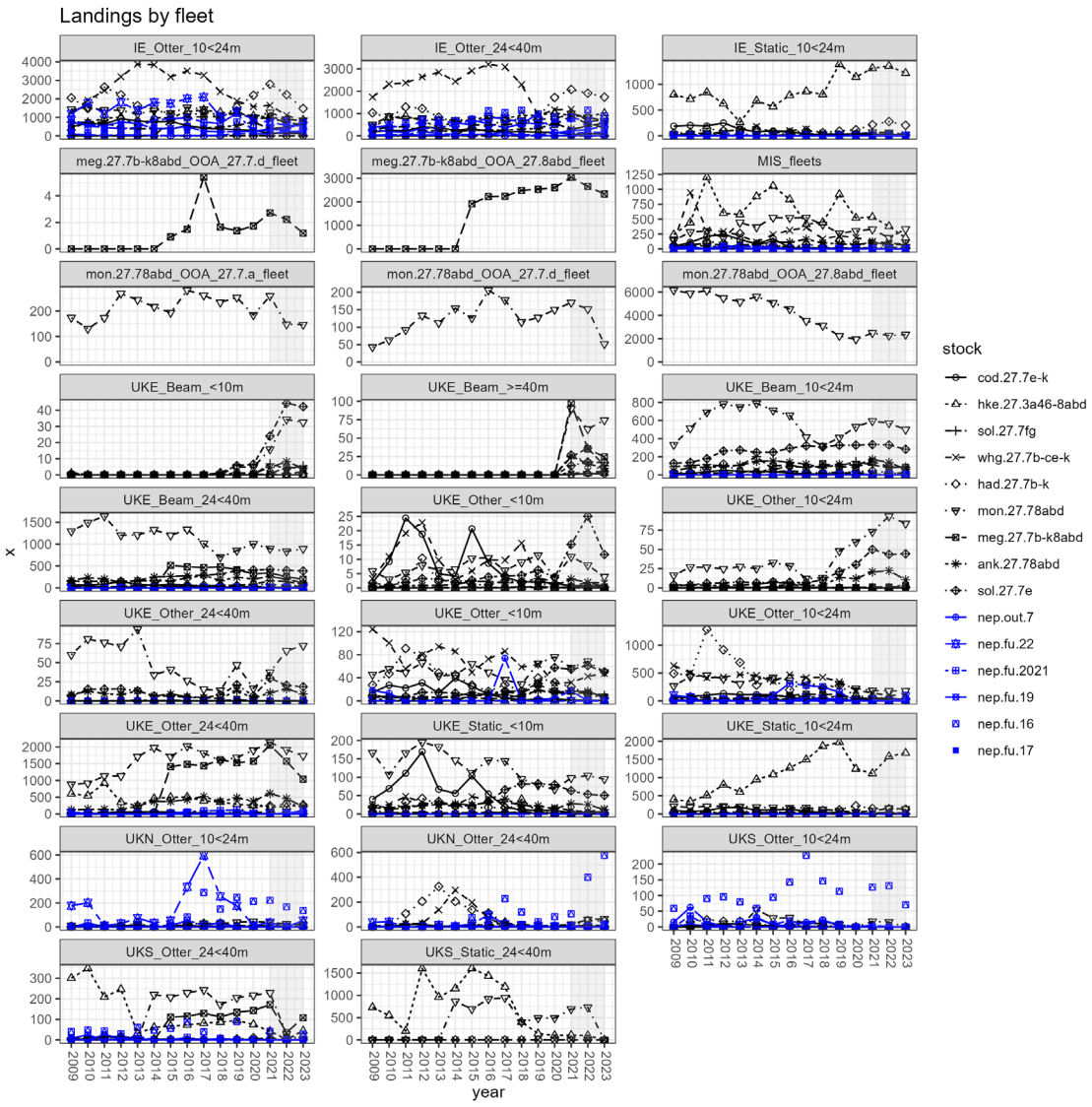


Figure 3.7. Celtic Sea. Landings by fleet, stock and year (part 2). Note: different scales on the y-axis.

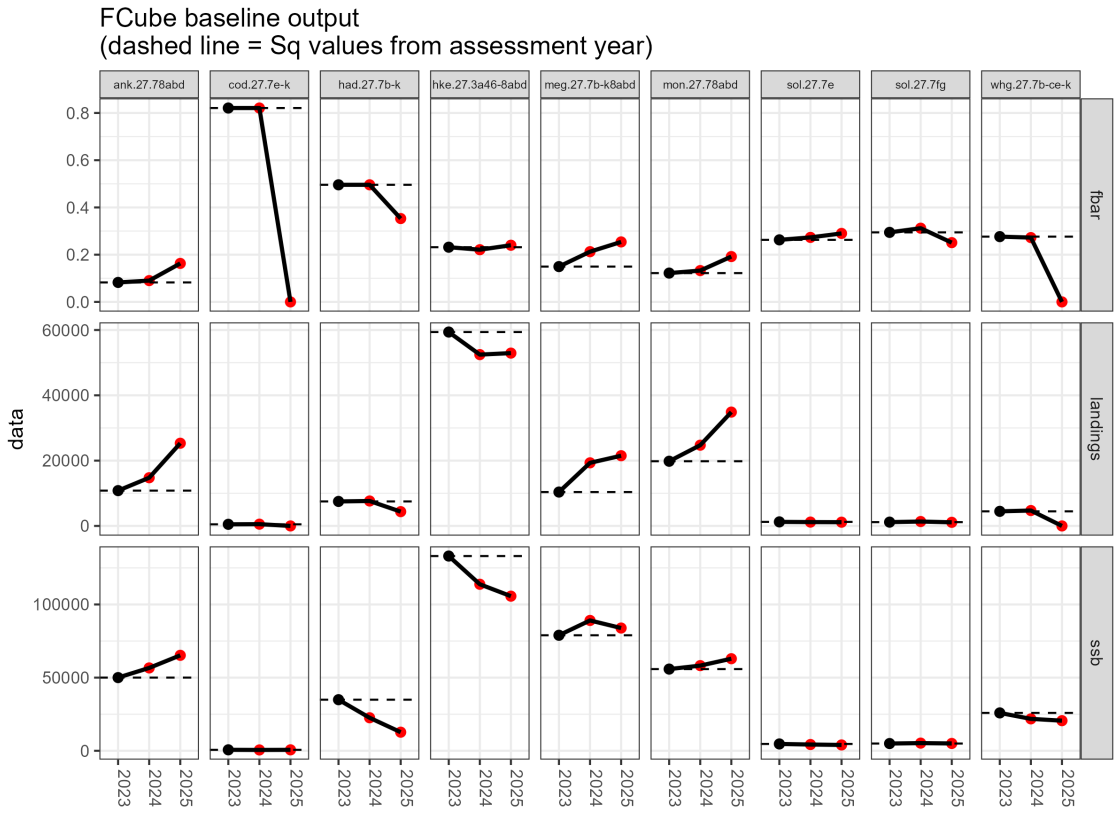


Figure 3.8. Celtic Sea. Change in fishing mortality (Fbar), landings (tonnes) and SSB (tonnes) assumed in the intermediate year (2024) and required for the TAC year (2025) under the single-stock forecast assumptions consistent with the MSY approach.

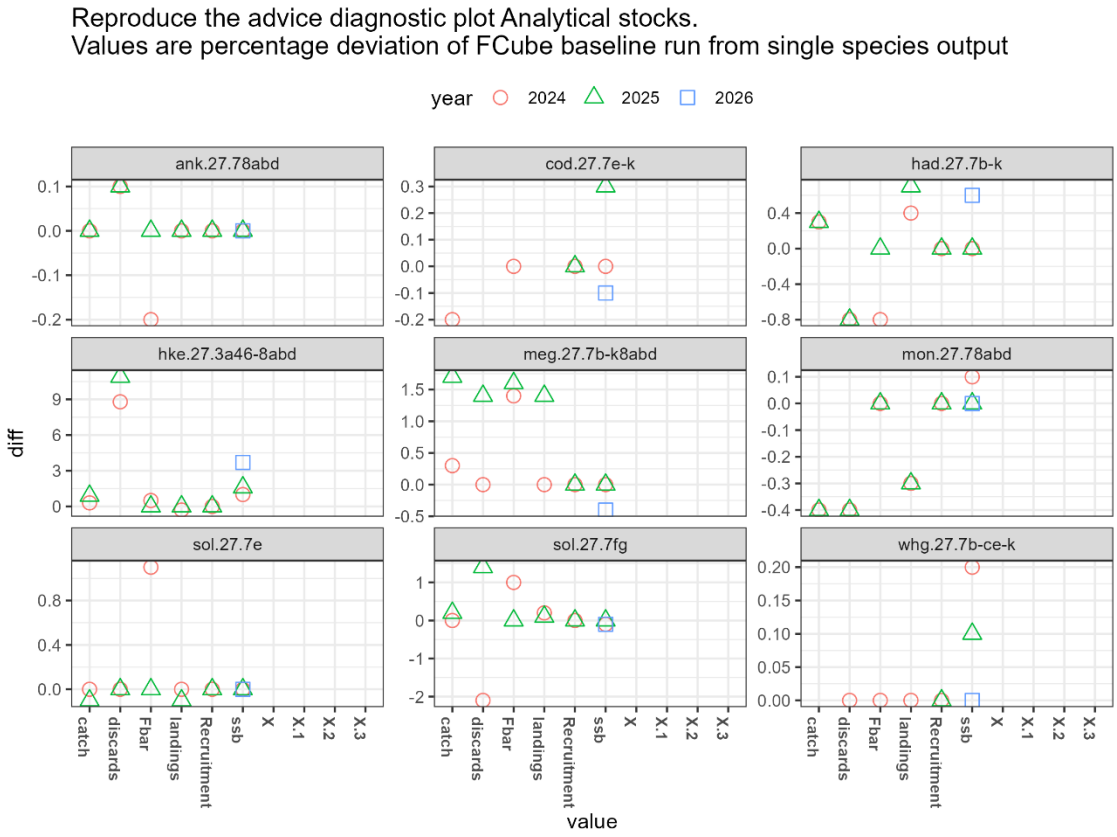


Figure 3.9. Celtic Sea. Percentage difference between FCube baseline run and single-species advice for finfish stocks, showing Fbar (2024–2025), catch, discards and landings (2024–2025) and SSB (2023–2026).

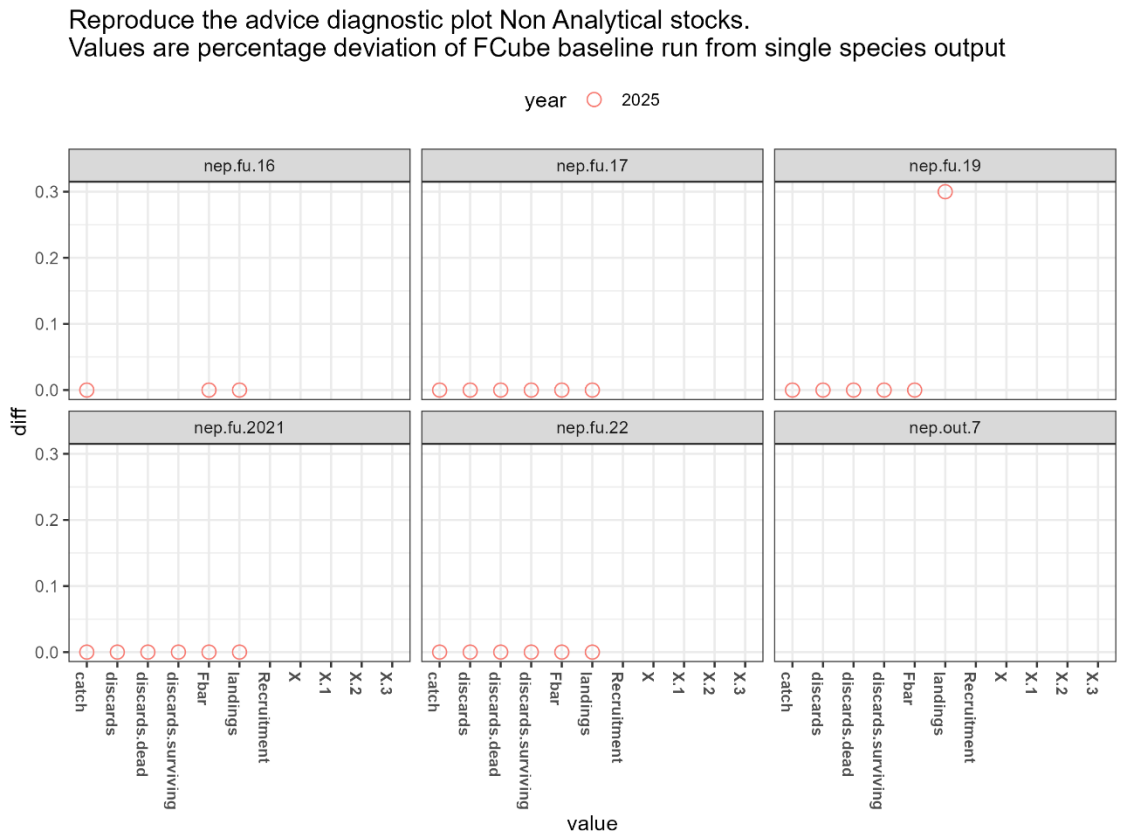


Figure 3.10. Celtic Sea. Percentage difference between FCube baseline run and single-species advice for Nephrops stocks, showing harvest ratio, catch, discards and landings (2025).

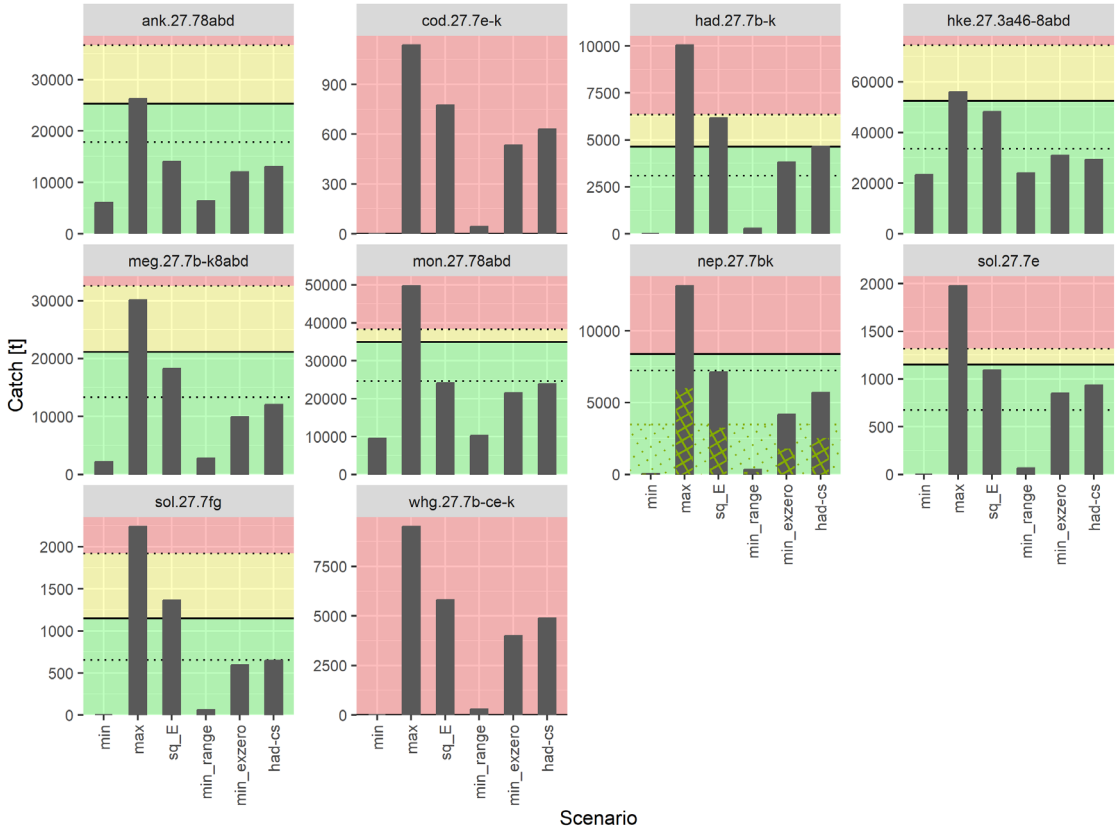


Figure 3.11. Celtic Sea. Estimates of potential 2025 catches (in tonnes) by stock and scenario. The horizontal solid line corresponds to the single-stock catch advice. For those stocks with fishing mortality ranges defined, the lower dotted lines illustrate the catches corresponding to $F_{MSY\ lower}$ or reduced $F_{MSY\ lower}$ for stocks with SSB < MSY $B_{trigger}$. The upper dotted lines illustrate the catches corresponding to FMSY upper for stocks with defined ranges and with SSB ≥ MSY $B_{trigger}$. The hashed bars in nep.27.7bk indicate the proportion of catches of Norway lobster caught in FU 16, and the dotted area indicates the catch limit which applies in this FU.

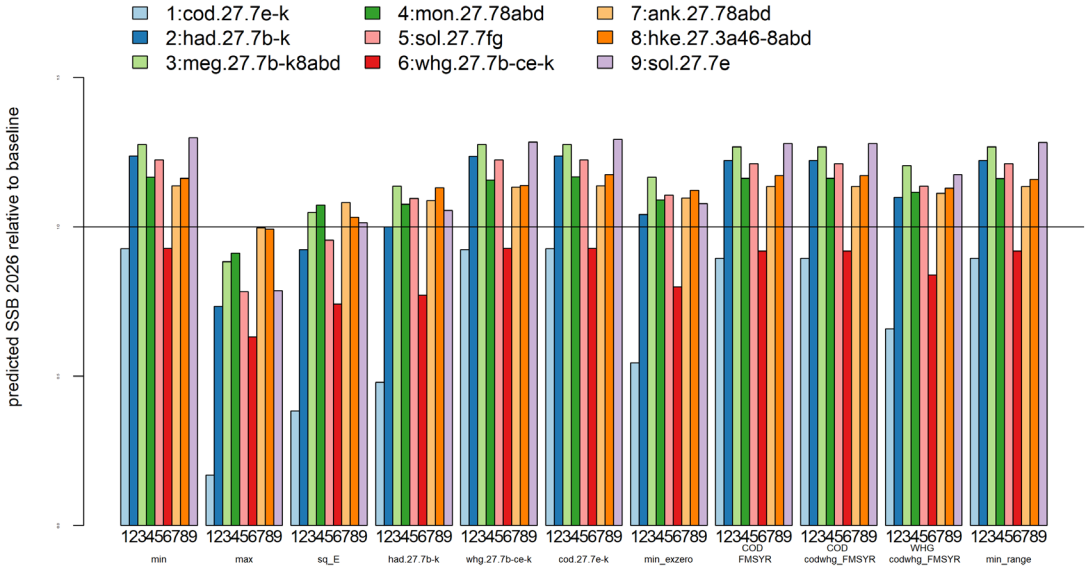


Figure 3.12. Celtic Sea. Mixed fisheries advice for divisions 7.b–c and 7.e–k. Estimates of potential SSB at the start of 2026 by stock after applying the mixed fisheries scenarios, relative to SSB resulting from the single-stock advice forecast (the horizontal line). Note: scenario names in this plot are slightly different from those named in section 3.2.2 but are as follows: had.27.7b-k = "had-cs", whg.27.7b-ce-k = "whg-cs", cod.27.7e-k = "cod-cs", COD FMSYR = "cod_FARcod", COD codwhg_FMSYR = "cod_FARzero", WHG codwhg_FMSYR = "whg_FARzero".

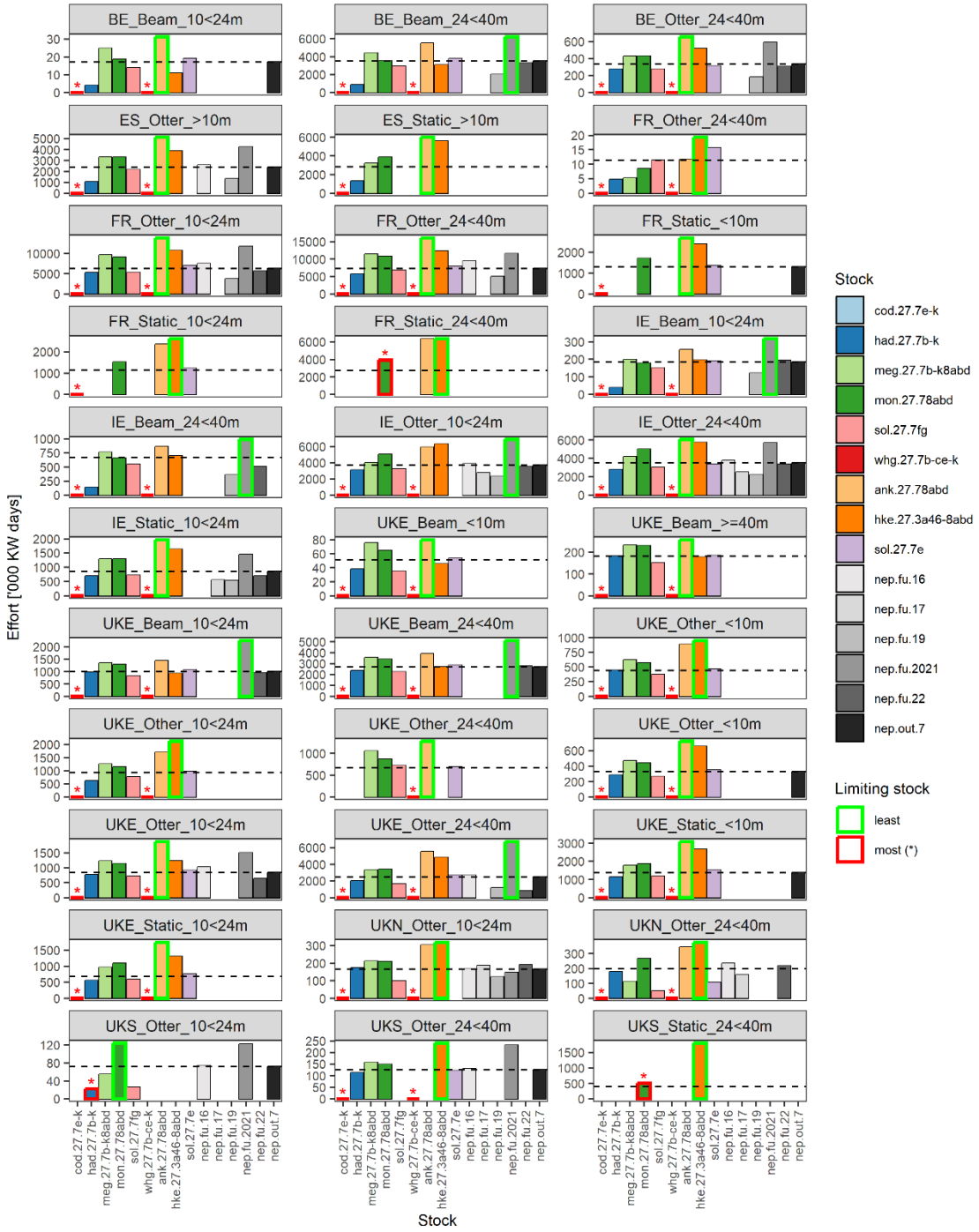


Figure 3.13. Mixed fisheries for the Celtic Sea. Estimates of effort by fleet needed to reach each single-stock advice. The stocks are coded by colour, with the bar for the most limiting stock ("choke species") for each fleet in 2025 highlighted with a red border and the bar for the least limiting species highlighted with a green border. Fleet names are given by country, main gear, and vessel length (m). The *status quo* effort for each fleet (average 2021-2023) is shown as a dashed line for reference.

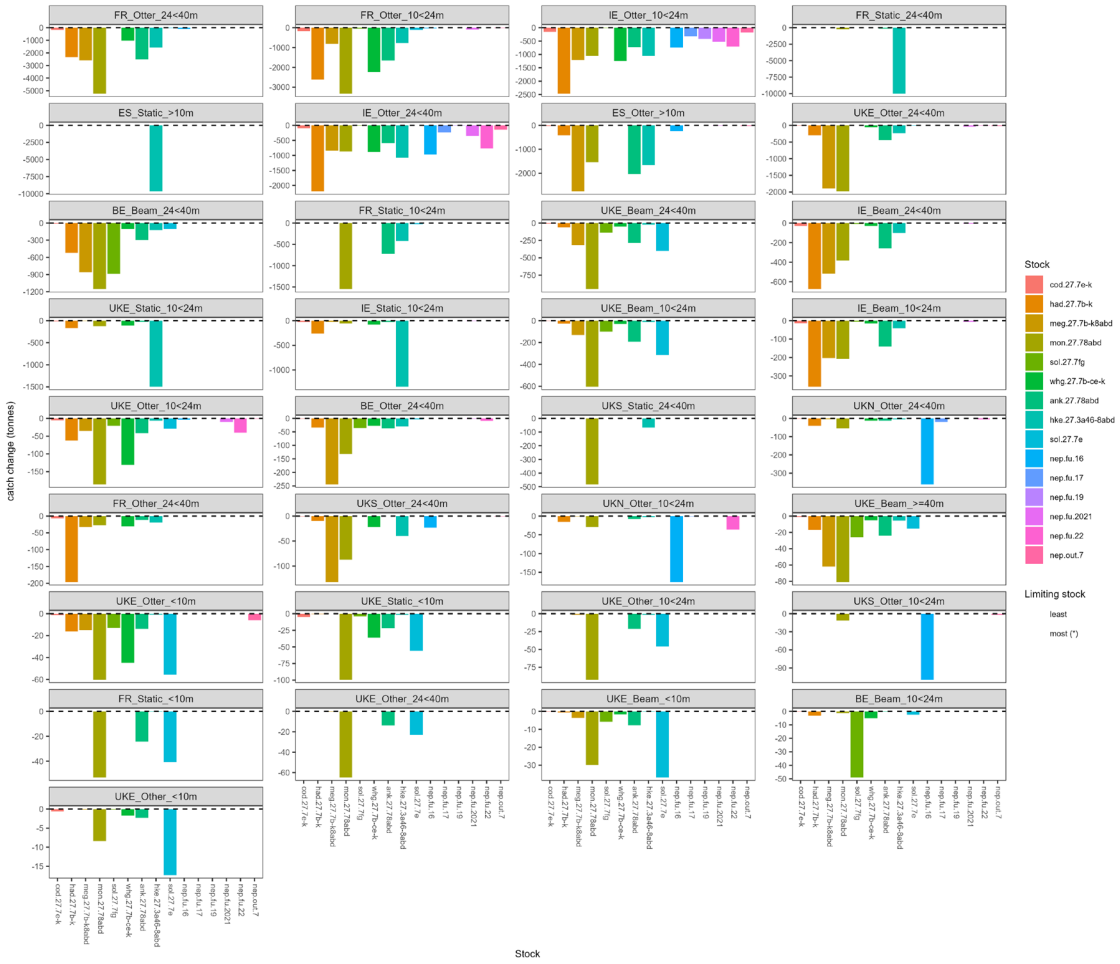
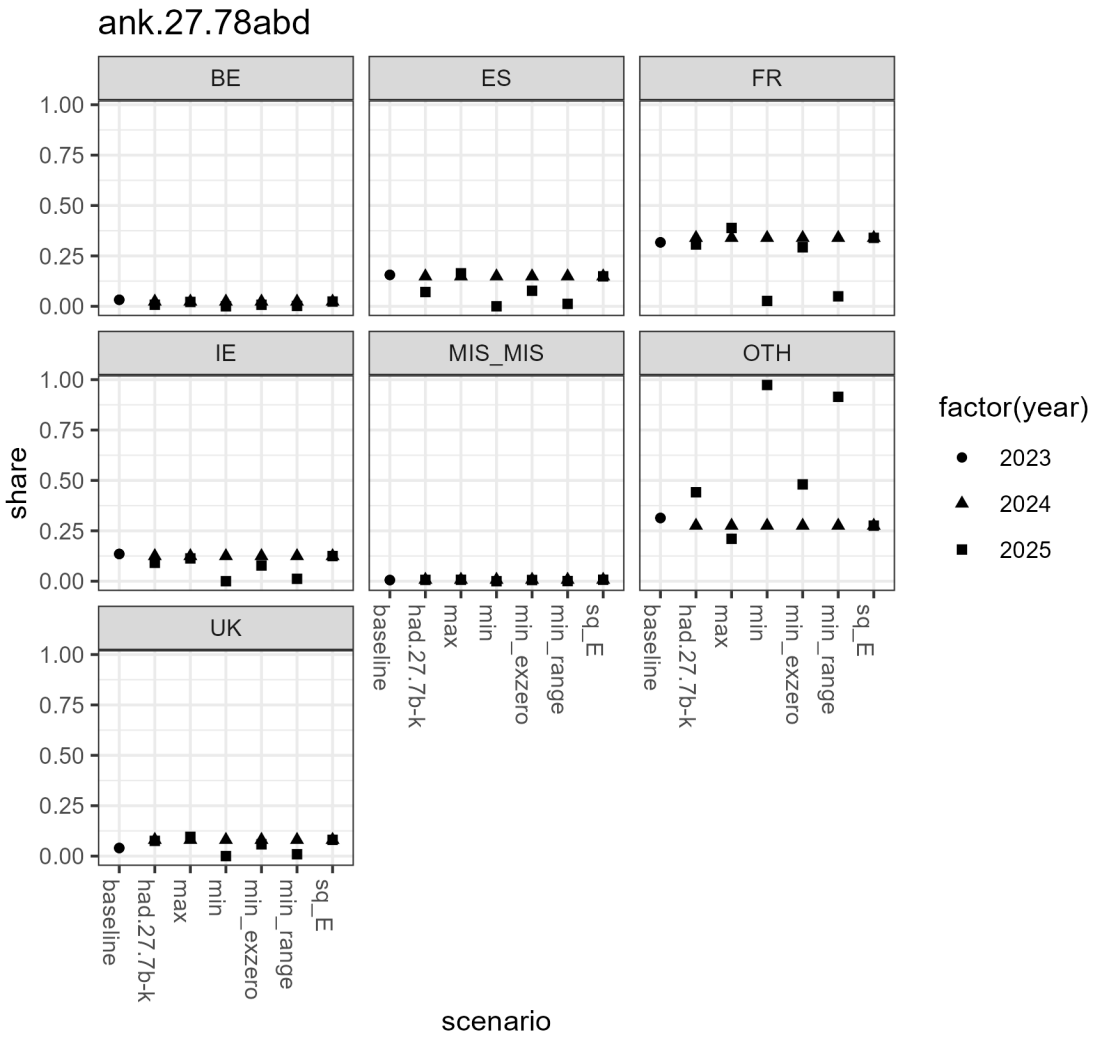


Figure 3.14. Mixed fisheries for the Celtic Sea. Estimates of change in catch by fleet under the "min" scenario. The stocks are coded by colour, with the bar for the most limiting stock ("choke species") for each fleet in 2025 highlighted with a red border and the bar for the least limiting species highlighted with a green border. Fleet names are given by country, main gear, and vessel length (m). Fleets are ordered by those with the largest catches to the smallest.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UK
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scenario
factor(year)
2023
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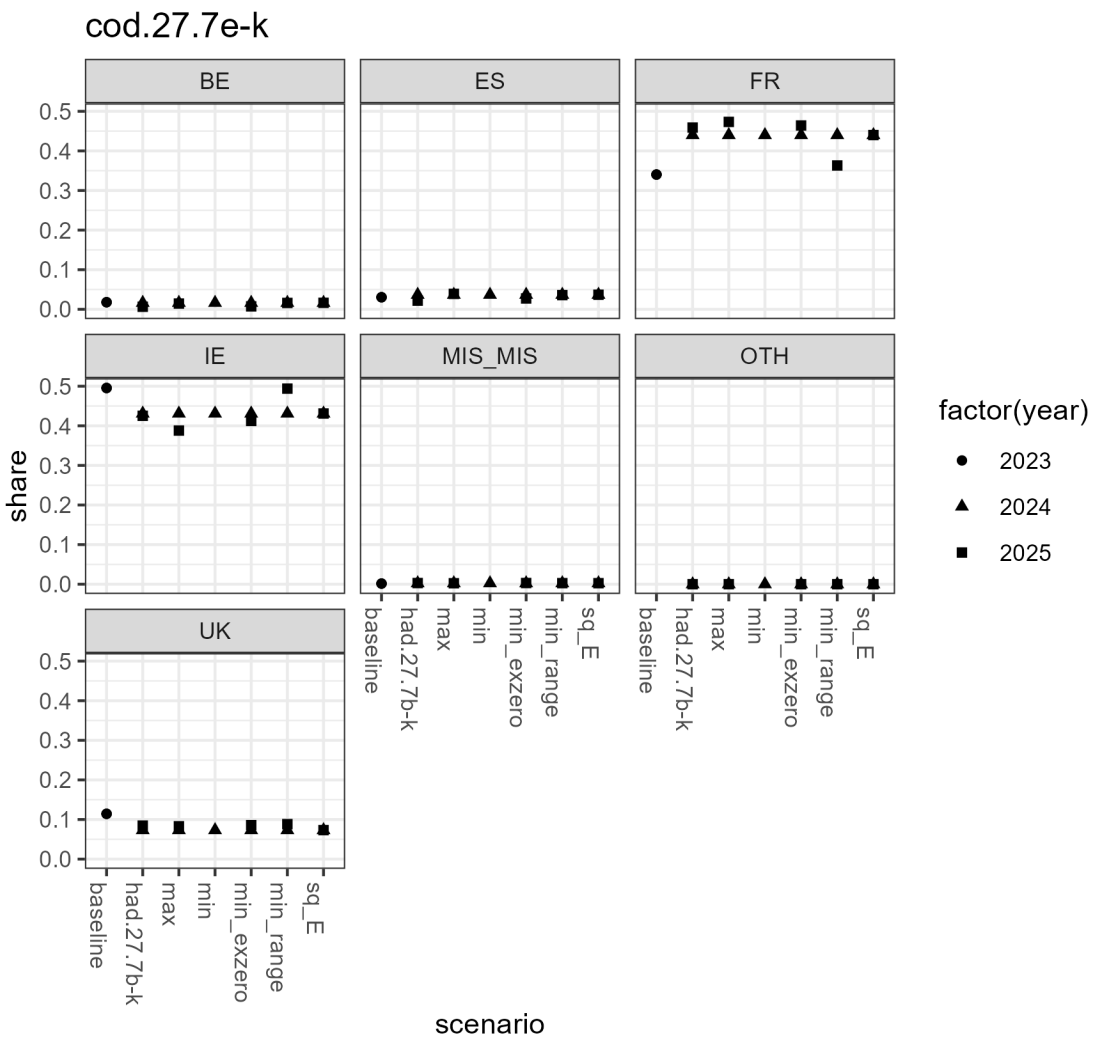
2025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scenario
factor(year)
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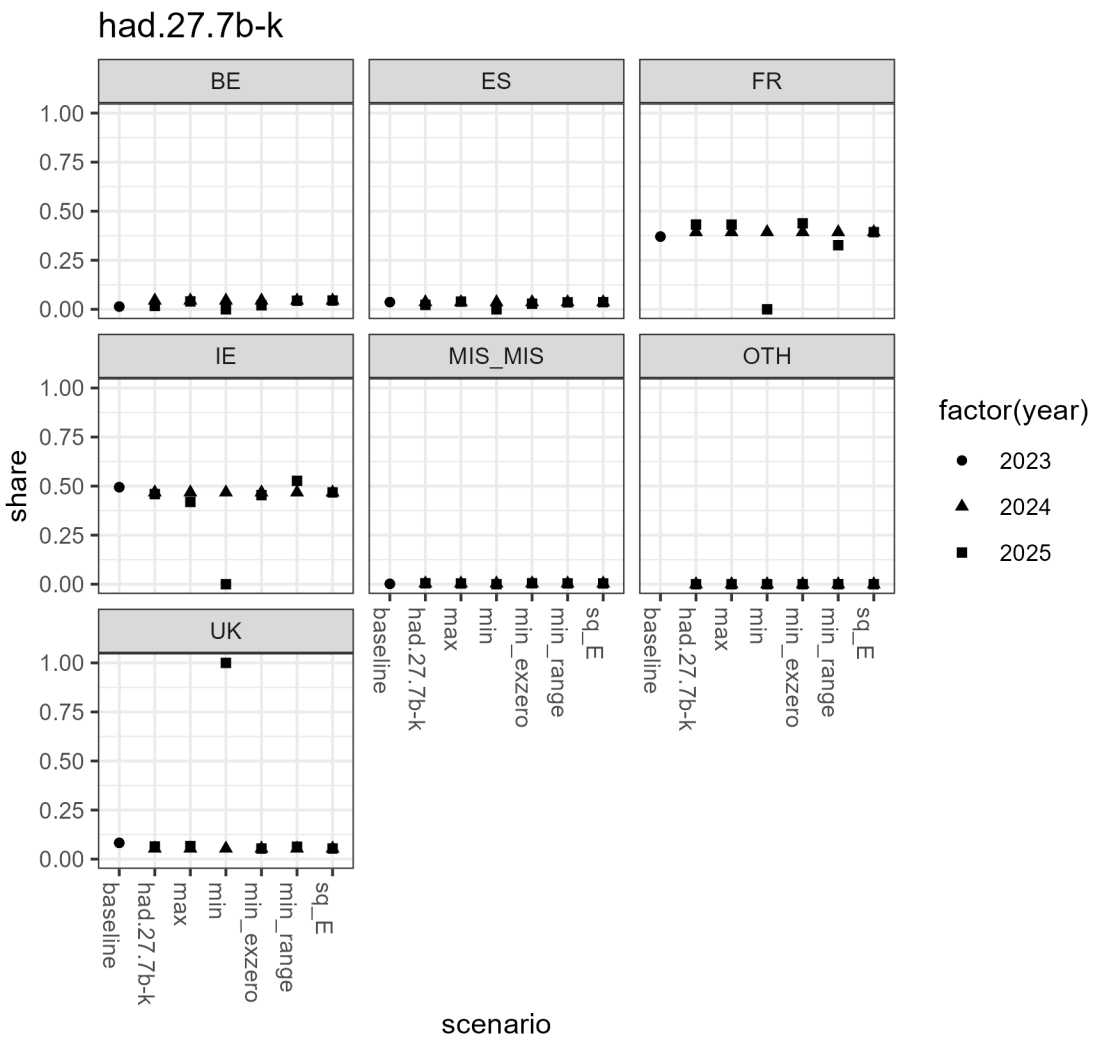
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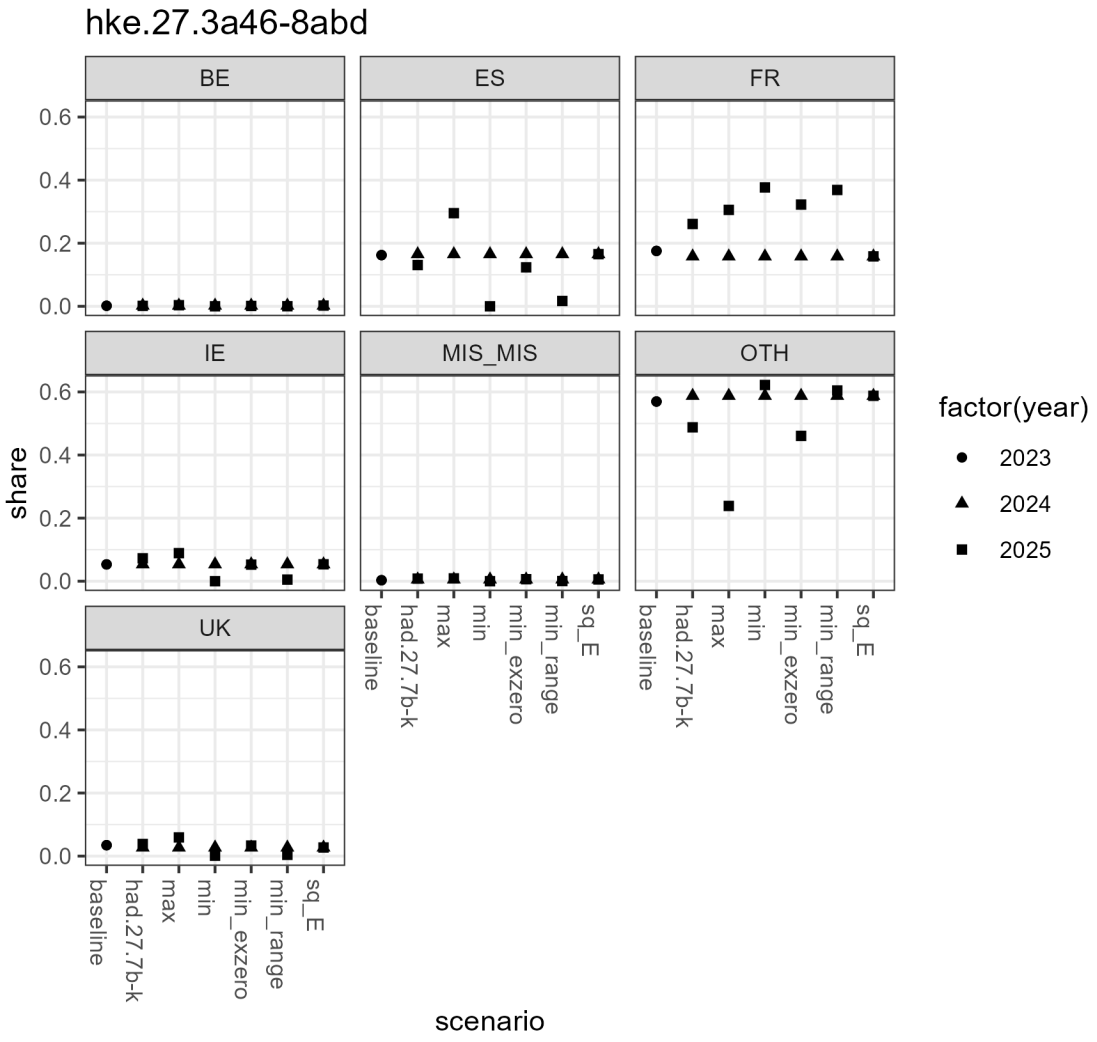
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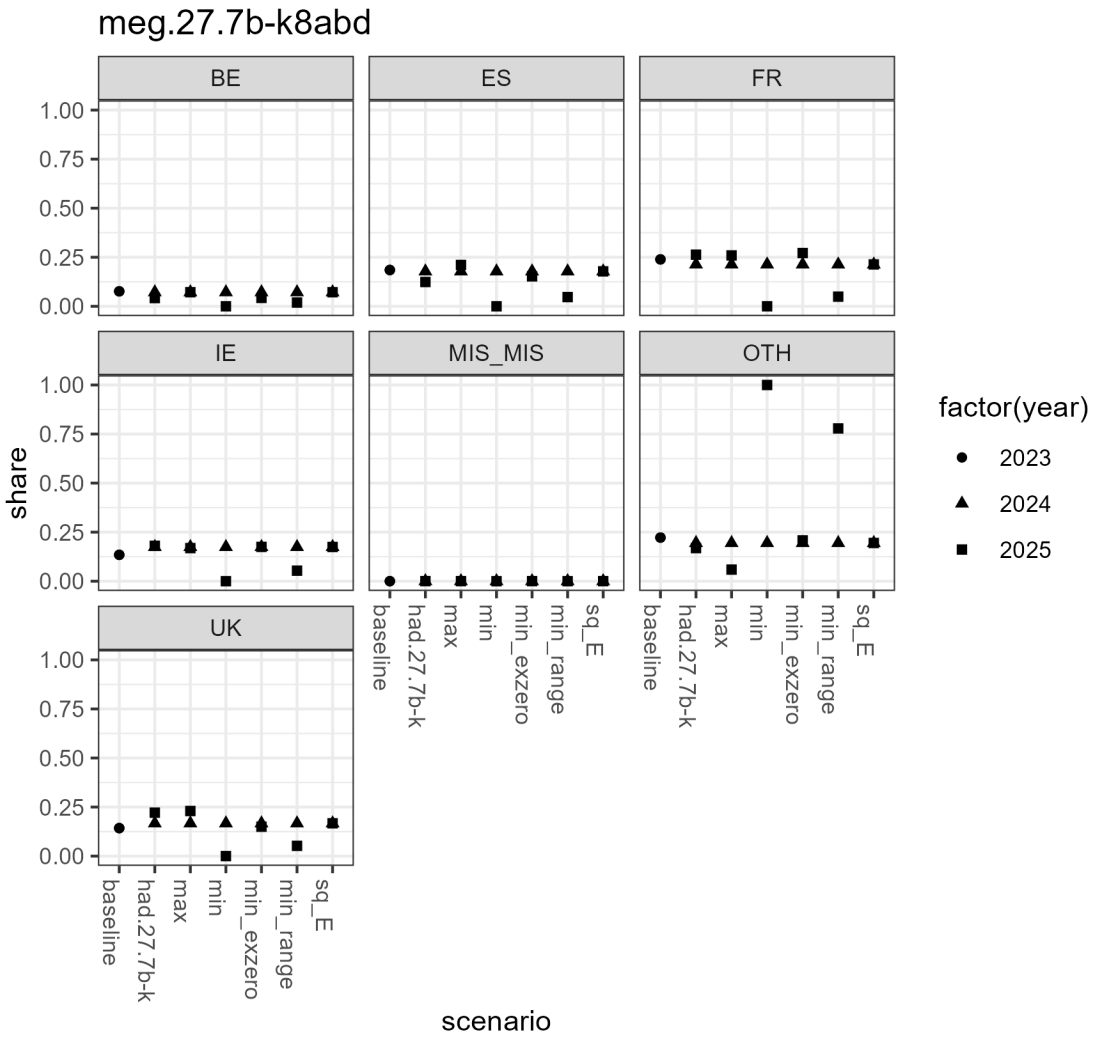
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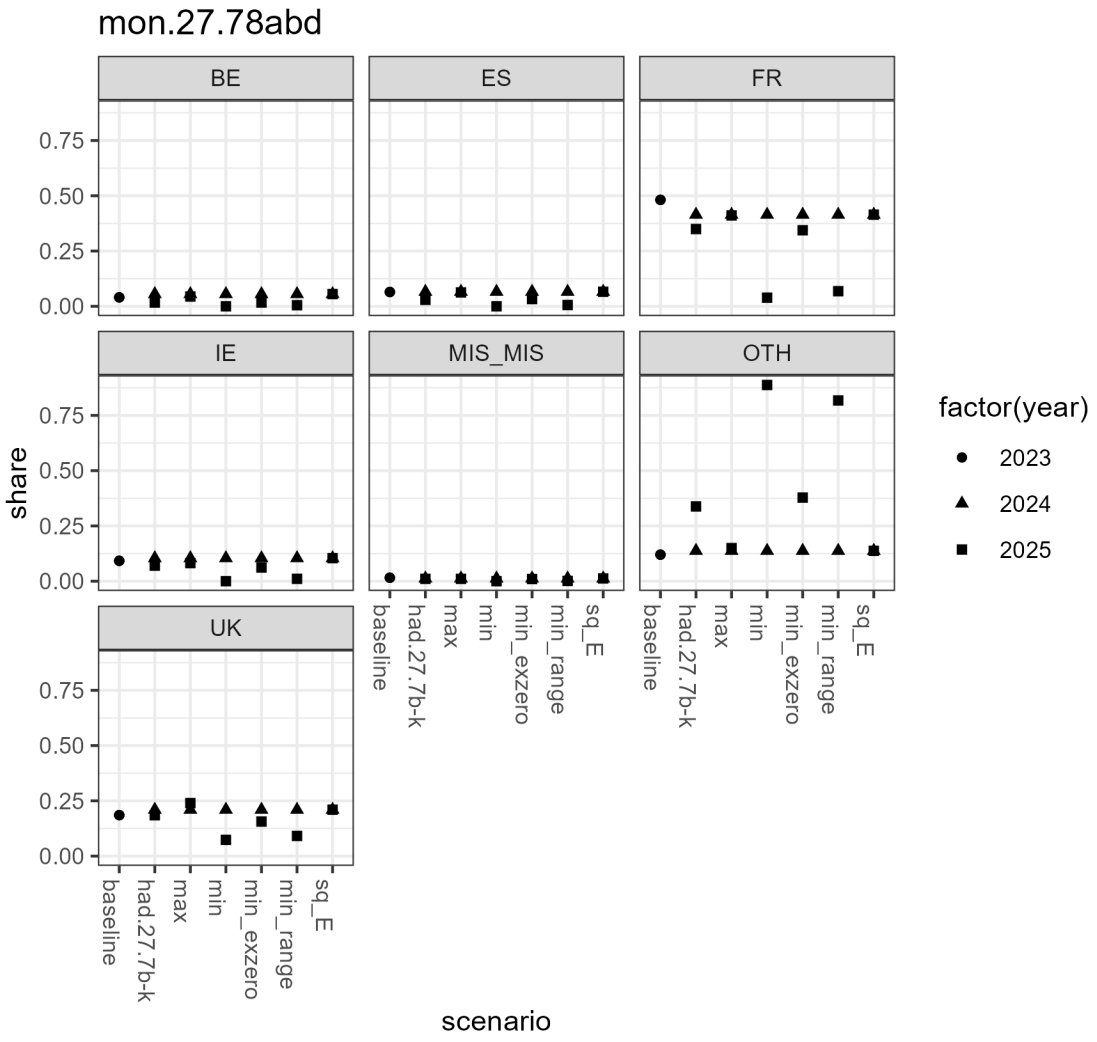
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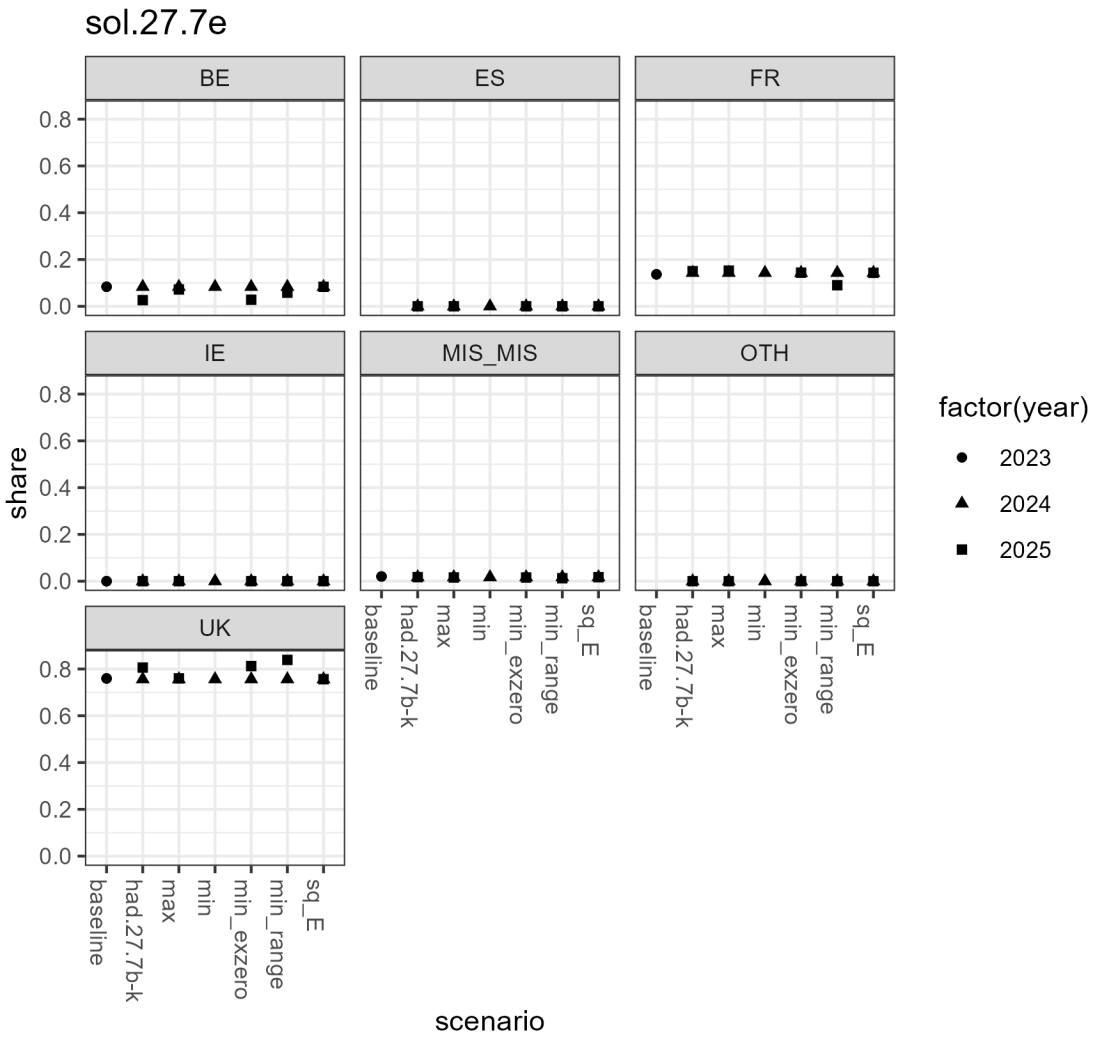
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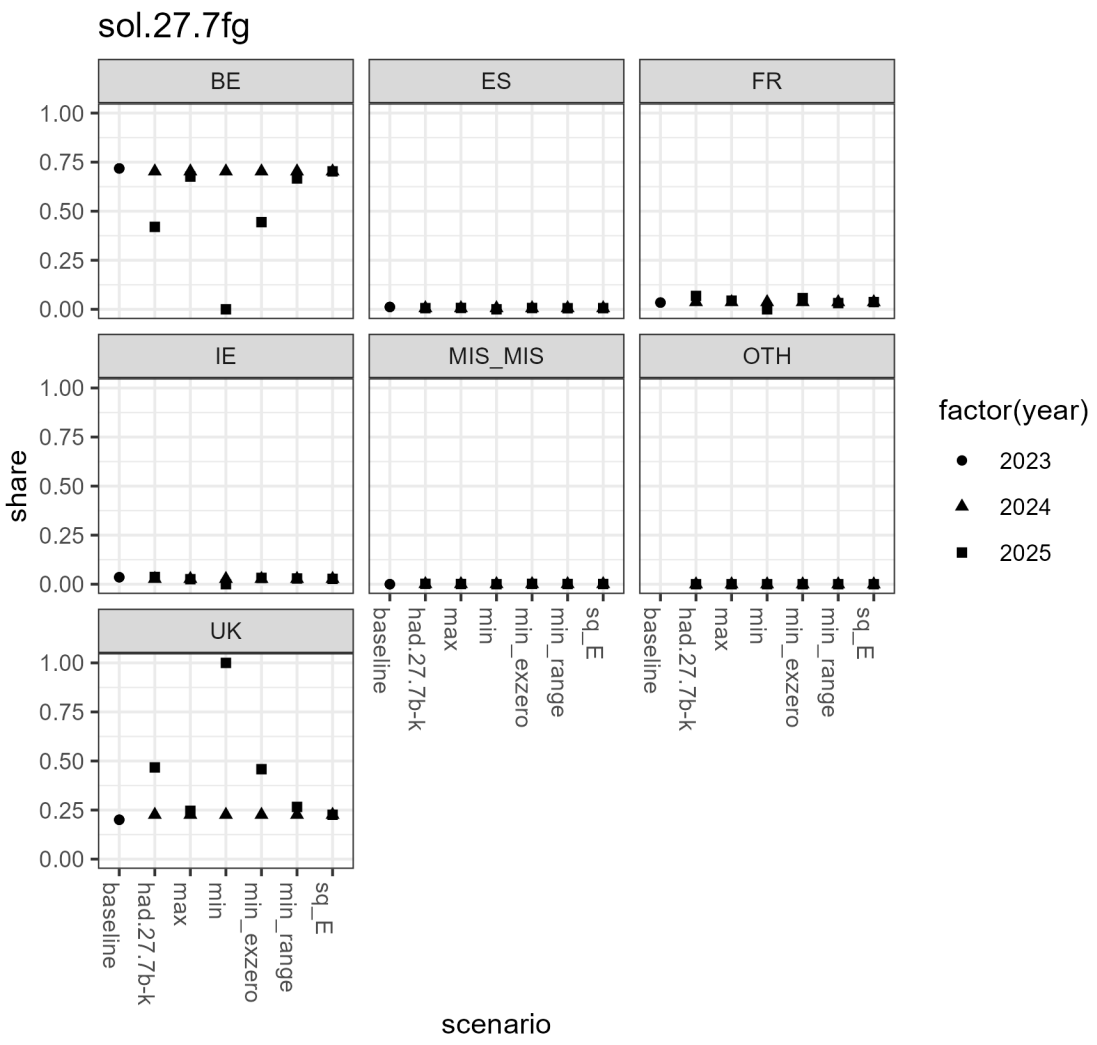
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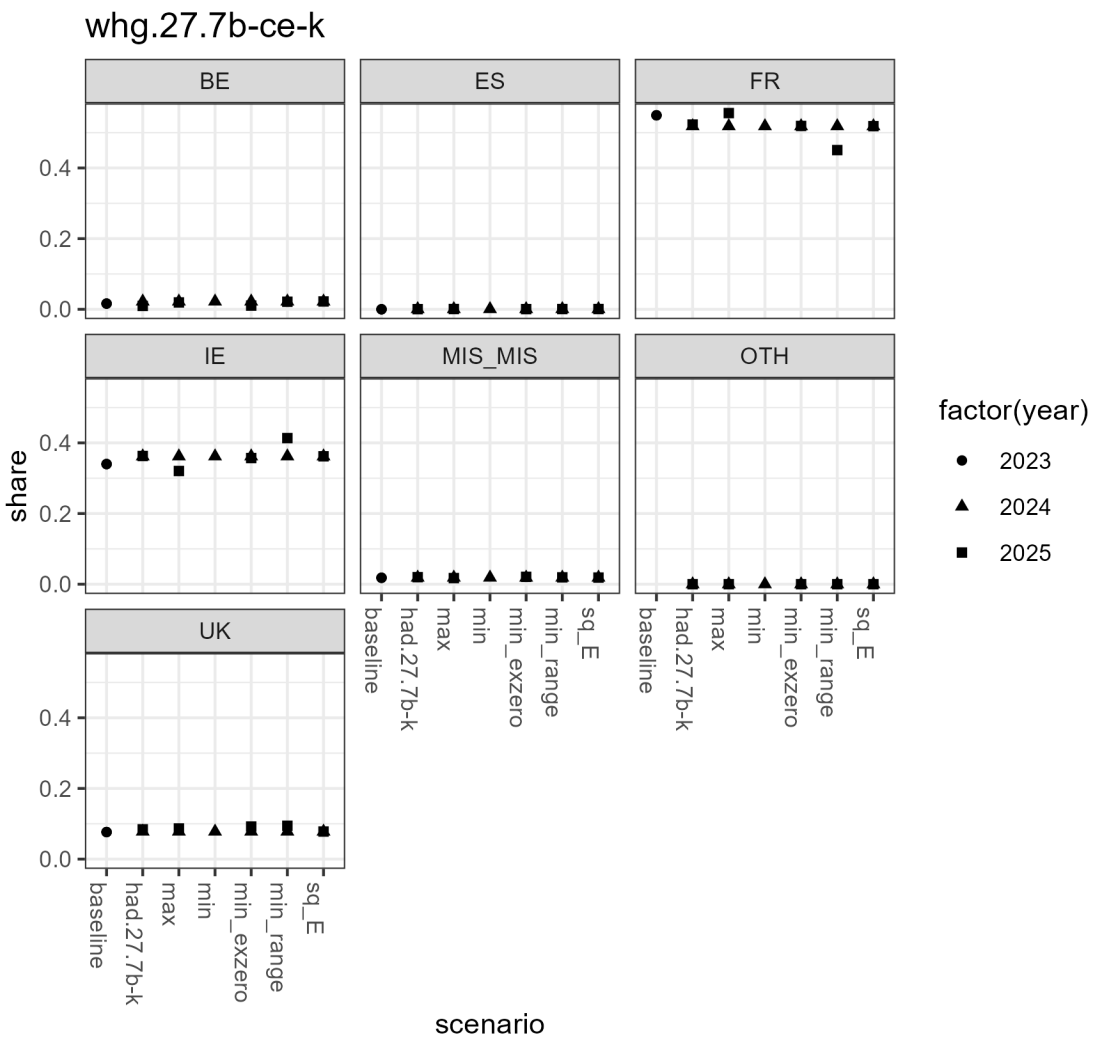

Figure 3.15. Test for relative stability. Changes of relative share of species' landings by country in 2024 and 2025 compared to the 2023 share, for the 'baseline' and 7 FCube scenarios.

3.5 References

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4 Iberian waters

4.1 Background

Fisheries operating within the Atlantic Iberian Coast Ecoregion capture a diverse range of species, including demersal, pelagic, wide-ranging, and deep-sea species. Various elasmobranch species are also caught. The fisheries are predominantly conducted by Portuguese and Spanish vessels, with limited participation from French vessels.

Portuguese and Spanish demersal fisheries are typically mixed, harvesting a wide variety of species that reflect the biological diversity of the areas they exploit. These fisheries employ several gear types. Trawl fisheries (using otter or pair trawls) land species such as *Nephrops*, hake, anglerfish, megrims, blue whiting, mackerel, horse mackerel, and cephalopods (e.g. cuttlefish and squid). Gillnet fisheries target species such as sole, hake, pollack, and anglerfish, while longline fisheries primarily target hake.

Analyses of the Spanish demersal fleets in divisions 8.c and 9.a show that the main target species are blue whiting, mackerel, hake, horse mackerel, anglerfish, and megrims. Three pelagic/semi-pelagic species—blue whiting, mackerel, and horse mackerel—constituted 58% of the total landings in these demersal métiers between 2021 and 2023.

In the Portuguese demersal métier, the most important species caught by demersal fish trawlers are horse mackerel, mackerel, hake, and blue whiting. The three pelagic/semi-pelagic species (blue whiting, mackerel, and horse mackerel) constituted 37% of the total landings between 2021 and 2023. Portuguese crustacean trawlers primarily target Norway lobster and rose shrimp—which, despite lower landed volumes, hold significant economic value—as well as blue whiting. Hake, anglerfish, sole, and rays are also present in trawl catches, though they are additionally targeted by the artisanal fleet using gillnets and trammelnets

There is a large small-scale multi-gear fleet operating in the area, using a variety of gear types that allow the exploitation of ecological communities across different habitats, depths, and substrata. The composition of landings depends largely on the fishing gear used and the ecological community of the fishing grounds visited, which may vary seasonally. Segmenting this large small-scale fleet presents a challenge in the area.

This mixed fisheries analysis will focus on finfish species within ICES divisions 8.c (Bay of Biscay – South) and 9.a (Portuguese waters – East). The species considered are part of the demersal mixed fisheries in Atlantic Iberian waters, including hake (hke.27.8c9a), four-spot megrim (ldb.27.8c9a), megrim (meg.27.8c9a), black-bellied anglerfish (ank.27.8c9a), and white anglerfish (mon.27.8c9a). Other stocks in the area may be relevant to describe the effort allocation and technical interactions. The inclusion of additional species in mixed fisheries models is ongoing and will broaden the scope and enhance the understanding of mixed fisheries in the area.

4.1.1 Management measures

The Total Allowable Catch (TAC) is the primary fishery management tool in this region. TACs (and quotas) were introduced for most stocks in the 1980s, though they were generally not restrictive until the early 1990s. The 2013 reform of the Common Fisheries Policy (CFP) aimed to eliminate discarding through the introduction of the EU Landing Obligation (LO). The LO was implemented for pelagic species in 2015 and has been gradually phased in for demersal TAC species since 2016. From 2019, the LO applies to all TAC species, although some exemptions

remain. Delegated Regulation (EU) 2019/2237 includes a *de minimis* exemption for the southern hake caught with trawls and seines, megrims caught with gillnets, trawls and seines, and anglerfish caught with gillnets, trawls and seines in ICES Subareas 8 and 9.

A wide range of technical measures are also in place, including those aimed at improving the selectivity of towed gears (partly to reduce bycatch) and gear restrictions (ICES, 2024). Spatial management is also applied, both for fisheries management and ecosystem protection. Closed areas and seasons are used to protect spawning and juvenile fish, for example. Protected areas have been designated for habitats and species listed under the EU Nature Directives. Fishery regulations are in place to limit certain fisheries that may impact vulnerable habitats.

Regulation (EU) 2019/472 of the European Parliament and Council, published on 19 March 2019, established a multiannual plan for stocks fished in the Western Waters and adjacent areas and for the fisheries exploiting those stocks. This regulation repealed the Southern Hake and Norway Lobster Recovery Plan (EC No. 2166/2005), which had set effort reduction measures. Fishing opportunities in the area are outlined annually by EU regulations, primarily based on the ICES scientific advice.

The multiannual management plan (MAP, EU Regulation 2019/472) includes 36 demersal and deep-sea stocks, along with several Norway lobster Functional Units (FUs) in Western Waters. Five regionally important stocks are currently considered in the mixed fisheries analysis of Iberian Waters—hake (hke.27.8c9a), megrim (meg.27.8c9a), four-spot megrim (ldb.27.8c9a), black-bellied anglerfish (ank.27.8c9a), and white anglerfish (mon.27.8c9a)—all of which are also included in the multiannual management plan

4.2 FLBEIA

4.2.1 Software

All analyses were conducted using the FLR framework (Kell *et al.,* 2007); www.flr-pro-ject.org; FLCore 2.6.15; FLAssess 2.6.3;) running with R 4.0.1 (R Development Core Team, 2020). All forecasts were projected using the FLBEIA Package (v1.15.5; García *et al.,* 2017). FLBEIA is an FLR package that facilitates the bioeconomic evaluation of management strategies in a multistock and multifleet framework. It can be used to produce both short and long-term simulations. The application of the framework, with detailed results, data diagnostics and model outputs, is available in the Transparent Assessment Framework (TAF) repository at https://github.com/ices-taf/2024_IW_MixedFisheriesAdvice.

Table 4.1 summarizes the assessment models and forecast methods used for each of the species included in the mixed fisheries framework.

Table 4.1. Software used in the single-species assessments and forecasts

Stocks	Assessment	Forecast
BLACK-BELLIED ANGLERFISH **ank.27.8c9a**	Surplus Production model (SpiCT)	NA
HAKE **hke.27.8c9a**	Length-based age-structured Stock Synthesis model (SS3)	SS3
FOUR-SPOT MEGRIM **ldb.27.8c9a**	Statistical catch-at-age model (a4a)	FLR STF

Stocks	Assessment	Forecast
MEGRIM **meg.27.8c9a**	Statistical catch-at-age model (a4a)	FLR STF
WHITE ANGLERFISH **mon.27.8c9a**	Length-based age-structured Stock Synthesis model (SS3)	SS3 (*ad hoc* R code)

4.2.2 Scenarios

The basis of the model is to estimate the potential future levels of effort by a fleet corresponding to the fishing opportunities (TACs by stock and/or effort allocations by fleet) available to that fleet, based on fleet effort distribution and catchability by métier. This level of effort was used to estimate landings and catches by fleet and stock, using standard forecasting procedures.

In 2024, ICES provided single-stock catch advice in accordance with the EU MAP for the Western Waters and adjacent areas at the MSY level (including catch levels at F_{MSY} ranges) for hake, megrims, and white anglerfish, while applying the MSY approach for black-bellied anglerfish.

The current mixed fisheries framework for the area includes a *status quo* scenario (business as usual) and individual stock scenarios, as well as *maximum/minimum* scenarios that permit the evaluation of contrasting levels of fishing effort. It also includes a *min-range* scenario that allows catches to reach the upper range of the F_{MSY} level for stocks in good condition, simulating a less restrictive catch level that reduces the impact of choke species within a mixed fishery context. A detailed description of each scenario is available in Table 4.2.

Table 4.2. Mixed fisheries for the Iberian waters. Mixed-fisheries scenarios.

Scenario code	Scenarios
max	**"Maximum":** For each fleet, fishing stops when all stocks have been caught up to the fleet stock shares*. This option causes overshooting of the single-stock advice possibilities of all other stocks.
min	**"Minimum":** For each fleet, fishing stops when the catch for any one of the stocks meets the fleet stock shares*. This option is the most precautionary option, causing underutilization of the single-stock advice possibilities of other stocks.
sq_E	***"Status quo* effort":** The effort of each fleet in the catch advice year (2025) is set equal to the average effort in the most recent three years (2019–2021) for which catch and effort data are available.
min_range	Same as min scenarios but with catches corresponding to $F_{MSY\ upper}$ for stocks in good status (SSB ≥ MSY $B_{trigger}$) and scaled F_{MSY} advice levels (F_{MSY} × SSB/MSY $B_{trigger}$) for the other stocks (including zero catch advice).
ank	**"Black-bellied anglerfish":** All fleets set their effort corresponding to that required to catch their black-bellied anglerfish stock share*, regardless of other catches.
hke	**"Hake":** All fleets set their effort corresponding to that required to catch their hake stock share*, regardless of other catches.
ldb	**"Four-spot megrim":** All fleets set their effort corresponding to that required to catch their four-spot megrim stock share*, regardless of other catches.
meg	**"Megrim":** All fleets set their effort corresponding to that required to catch their megrim stock share*, regardless of other catches.

Scenario code	Scenarios
mon	**"White anglerfish":** All fleets set their effort corresponding to that required to catch their white anglerfish stock share*, regardless of other catches.

*** Throughout this section, the term "fleet stock share" or "stock share" is used to describe the share of the fishing opportunities for each particular fleet. These are calculated based on the single-stock advice for 2025 and the historical proportion of the stock landed by the fleet (2021–2023).**

4.3 Stock input data and recent trends

4.3.1 Stock data

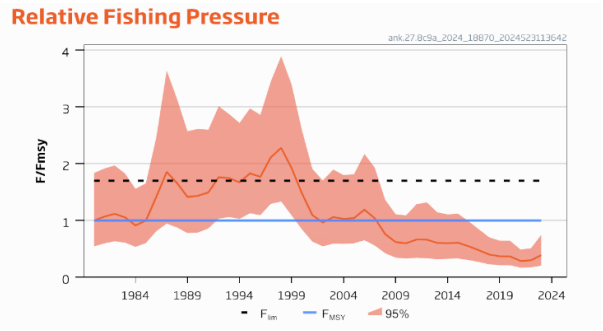
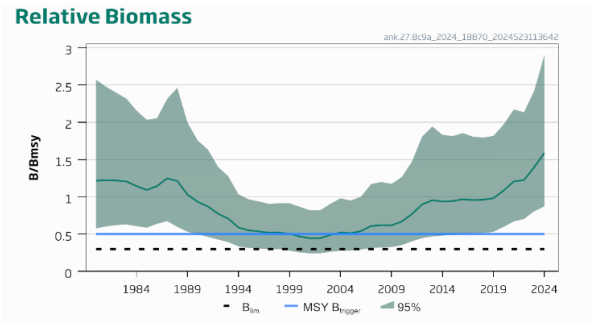
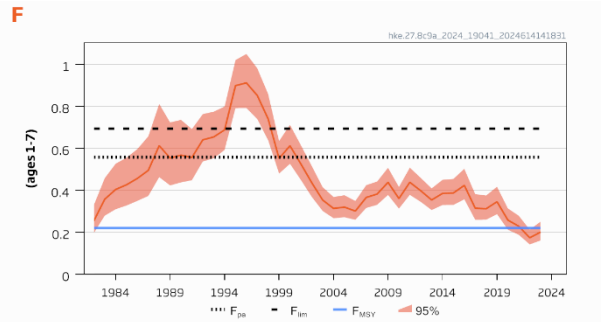
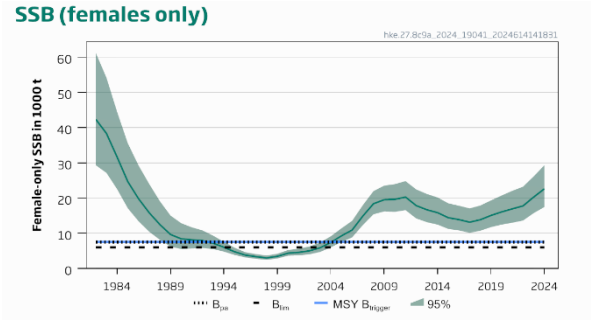
The assessment data for the different stocks are collected annually from the ICES Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE, ICES, 2024). For hake and both megrims, total catches (landings and discards) are included in the single-stock assessment. In contrast, the assessments of white anglerfish and black-bellied anglerfish include only landings, as discards are nearly negligible for these species.

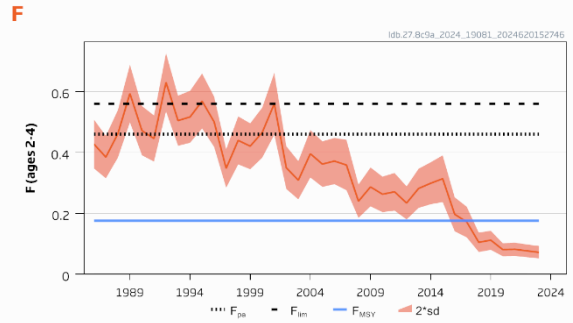
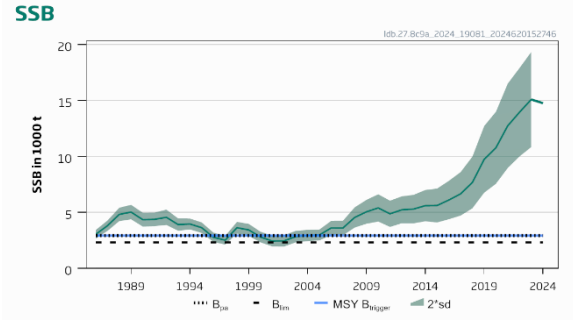
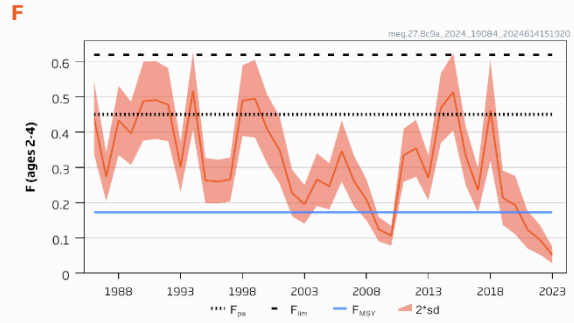
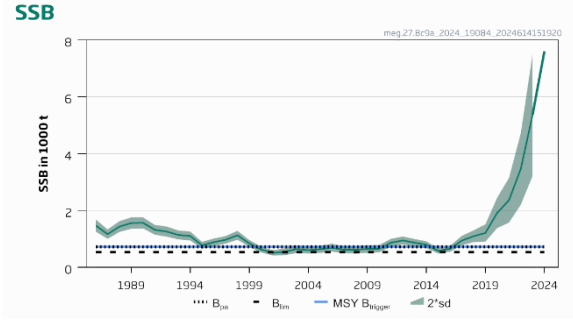
The assessment data for stocks with analytical assessments were directly provided by the respective stock coordinators as FLStock objects. White anglerfish and hake are assessed using a Stock Synthesis length-based and seasonal-based statistical assessment. However, the implementation of FLBEIA requires age-based dynamics, and the assumptions made in the assessment model for these two species cannot be fully replicated. This discrepancy may lead to differences in projections generated by both approaches, primarily due to the distinction between the length-based model used for these stocks and the age-based model applied in the mixed-fisheries analysis. Projections produced with FLBEIA are routinely compared to those generated in the single-species assessment working group to evaluate the potential impact of employing different approaches. The black-bellied anglerfish stock is assessed using a surplus production model (SPiCT). Single-stock advice for black-bellied anglerfish is provided following ICES guidelines for category 2 stocks. The updated single-species assessment and forecast methods are outlined in Section 4.5.1.1.

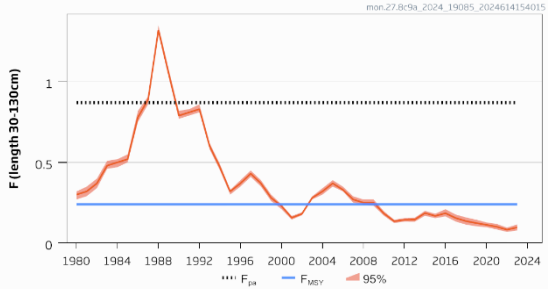
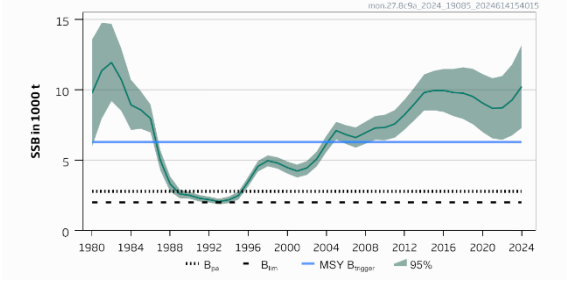
4.3.2 Stock trends and advice

Recent trends in spawning-stock biomass (SSB), fishing mortality (F), and recruitment are detailed by stock in ICES (2024), with the latest advice for 2024 available on the published ICES advice sheets. To provide a comprehensive overview of the Iberian demersal stocks included in this analysis, the information is summarized in Table 4.3, which presents trends in F and SSB and corresponding advice, SSB, and target F values.

Table 4.3 Summary of stocks included in the mixed-fisheries advice

Species	Area	Stock status		Advice 2025
ank.27.8c-9a (black-bellied anglerfish)	Divisions 8.c and 9.a (Cantabrian Sea, Atlantic Iberian waters)			Summary: Fishing pressure on the stock is below F_{MSY}, and biomass is above MSY $B_{trigger}$ and B_{lim}. Advice: ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 2486 tonnes.
hke.27.8c-9a (Hake)	Divisions 8.c and 9.a (Cantabrian Sea, Atlantic Iberian waters)			Summary: Fishing pressure on the stock is below FMSY, and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim} Advice: ICES advises that when the EU multiannual plan (MAP) for the Western Waters and adjacent waters is applied, catches in 2025 that correspond to the F ranges in the plan are between 10 659 and 20 404 tonnes. Catches higher than those corresponding to F_{MSY} (15 105 tonnes) can only be taken under conditions specified in the MAP, while the entire range is considered precautionary when applying ICES advice rule

Species	Area	Stock status	Advice 2025
ldb.27.8c-9a. (Four-spot Megrim)	Divisions 8.c and 9.a (Cantabrian Sea, Atlantic Iberian waters)	F  SSB 	Summary: The fishing pressure on the stock is below FMSY; spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}. Advice: ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, catches in 2025 that correspond to the F ranges in the plan are between 1 903 and 4 098 tonnes. According to the MAP, catches higher than those corresponding to F_{MSY} (2 727 tonnes) can only be taken under conditions specified in the MAP, while the entire range is considered precautionary when applying the ICES advice rule.
meg.27.8c-9a (Megrim)	Divisions 8.c and 9.a (Cantabrian Sea, Atlantic Iberian waters)	F  SSB 	Summary: Fishing pressure on the stock is below F_{MSY}; spawning stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}. Advice: ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, catches in 2025 that correspond to the F ranges in the plan are between 1 161 and 2 595 tonnes. According to the MAP, catches higher than those corresponding to FMSY (1 721 tonnes) can only be taken under conditions specified in the MAP, while the entire range is considered precautionary when applying the ICES advice rule.

Species	Area	Stock status	Advice 2025
mon.27.8c-9a (white anglerfish)	Divisions 8.c and 9.a (Cantabrian Sea, Atlantic Iberian waters)	F  SSB  	Summary: Fishing pressure on the stock is below F_{MSY}, and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}. Advice: ICES advises that when the EU multiannual plan (MAP) for Western waters and adjacent waters is applied, catches in 2025 that correspond to the F ranges in the plan are between 2 098 tonnes and 3 863 tonnes. According to the MAP, catches higher than those corresponding to FMSY (2 946 tonnes) can only be taken under conditions specified in the MAP, while the entire range is considered precautionary when applying the ICES advice rule.

There are differences between stock areas, management areas, and management rules (MSY approach or MAP) for the stocks considered here. ICES advice area and management areas for the main stocks are summarized below:

Species	ICES single-stock advice area	Management area
Black-bellied anglerfish	ICES divisions 8.c and 9.a. (Iberian waters). Category 2 stock.	Combined TAC for anglerfish stocks EU waters of Division 8.c; subareas 9 and 10; EU waters of CECAF 34.1.1
Hake	ICES divisions 8.c and 9.a. (Iberian waters). Category 1 stock.	EU waters of Division 8.c; subareas 9 and 10; EU waters of CECAF 34.1.1
Four-spot megrim	ICES divisions 8.c and 9.a. (Iberian waters). Category 1 stock.	Combined TAC for megrim stocks. EU waters of Division 8.c; subareas 9 and 10; EU waters of CECAF 34.1.1
Megrim	ICES divisions 8.c and 9.a. (Iberian waters). Category 1 stock.	Combined for megrim stocks. EU waters of Division 8.c; subareas 9 and 10; EU waters of CECAF 34.1.1
White anglerfish	ICES divisions 8.c and 9.a. (Iberian waters). Category 1 stock.	Combined TAC for anglerfish stocks. EU waters of Division 8.c; subareas 9 and 10; EU waters of CECAF 34.1.1

4.4 Fleets and métiers

4.4.1 Catch and effort data

The mixed-fisheries assessment is based on landings, discards and effort data provided by the National laboratories and administrations to the annual ICES data calls (InterCatch database: discards and landings by stock, area and métier, consistent with the DCF definition of métiers), and data collected by STECF for the evaluation of the effort regime (Accessions data, that contains information on landings and fishing effort by area, quarter and métier). These fishery data, structured by DCF fleet segments and métiers, are used as inputs together with ICES single-stock data and advice, in the integrated FLBEIA framework.

The final dataset extracted from InterCatch for use by WGBIE includes discards estimates for all stocks and some métiers, which are used to estimate the discard ratio for the mixed-fisheries fleets in the assessment of hake and both megrims (anglerfish stocks discards are considered negligible). InterCatch files also provided non-reported landings (WGBIE estimates) besides the official landings. The fleet information specifically required by the WGMIXFISH, needed to split landings by fleet segment and métier, were provided by Spain and Portugal with official landings and economic value. France provides landings by métier accounting for less than 1% of the total catch of the stocks considered in MIXFISH. Discards and non-reported landings are added from the relevant InterCatch files. This year the information by métier and area is now available in InterCatch and could be integrated in the MIXFISH data for future assessments.

Landings and effort data requested by WGMIXFISH were provided by Spain, Portugal, and France, covering the fleets operating in Atlantic Iberian waters. Portugal provides a series of effort and landings for the period 2015-2023, using an updated algorithm for métier classification since 2019. Some outdated métiers that had no catches in the last three years were removed in the new series. The two megrims are not usually landed separately for the majority of the

commercial categories, being recorded together. In the case of anglerfish species, despite recent improvements, there are still some degree of misidentification in landings (ICES, 2024). Therefore, estimates of species-specific landings for these species are derived from their relative proportions in market samples and applied to correct Portuguese landings at the species level. For the period 2009-2016, Spain provided effort and official landings as a single series, while data for 2017-2022 were supplied independently by two laboratories, IEO and AZTI. In 2023, Spain dataset was again provided as a single series. Landings for anglerfish and megrims were not species-specific for 2009-2016. Time-series of landings and discards are cross-checked between single-stock assessments and the data compiled by WGMIXFISH from ICES Data Accessions and InterCatch.

The proportion of landings between 2021-2023 for stocks considered in the mixed-fisheries projections is shown in Figure 4.1. Hake (hke.27.8c9a) was the dominant species, comprising 77% of the total landings, followed by black-bellied anglerfish (ank.27.8c9a, 7%), white anglerfish (mon.27.8c9a, 6%), four-spot megrim (ldb.27.8c9a, 6%) and megrim (meg.27.8c9a, 3%). The southern hake stock accounts for the highest catches in almost all fisheries operating in the area using demersal gears. Megrims are predominantly caught by bottom otter trawls targeting demersal fish, while anglerfish are captured using both bottom otter trawls and gillnets. Average total landings (2021–2023) of all species and fleets considered in the mixed-fisheries considerations were 12 082 tonnes, with: 46% landed by trawls gears; 37% by gill- and trammelnets; 14% by longlines and 3% by a group of miscellaneous gears dominated by small-scale vessels (Figure 4.2).

4.4.2 Definition of fleets and métiers

Fleet and métier categories used in the mixed-fisheries analysis are based on the EU Data Collection Framework (DCF) level 6 categories provided by Spain and Portugal.

In 2023, 71 métiers were reported through the ICES Data Accessions. InterCatch data included 25 fleet categories with catches on the species considered in the mixed fisheries analysis. 14 fleet segments are aggregated based on their relevance for the Portuguese and Spanish fisheries, gear group and on the species catchability considered in mixed fisheries advice (Table 4.5). The classification of fleet segments did not include vessel size for Spanish trawlers as the disaggregation by métier already captures this information. In the case of Portugal, the contribution of the small vessels was minor, and their catch profile was similar to the largest vessels profile, hence a single fleet is used for the three trawl size categories. National fleets with minor landings in the mixed-fisheries stocks are aggregated to a miscellaneous fleet. Mixed-fisheries multigear fleets use a diversity of gears that allow exploitation of different fish assemblages in different habitats and depths.

Within the fleet segments, mixed-fisheries métiers are defined by the combination of fishing gear, target species, mesh size and country. The 'MIS' métier represents the artisanal multi-gear fleet operating in the area. This 'MIS' miscellaneous métier encompasses both Portuguese and Spanish miscellaneous fleets. The effort reported by the Spanish miscellaneous fleet (SP_MIS) has increased substantially this year, not due to an actual increase in fishing effort, but as a result of changes to the effort calculation algorithm implemented by the Spanish fisheries directorate. The catches from the SP_MIS fleet for the case study species are minor (Figure 4.2), with no significant impact detected on the mixed-fisheries analysis. There was some changes in the resolution and classification of certain gears, but the overall effort for the remaining métier has remained consistent with that of previous years. The 'FR-MIS' fleet represents a mixed category, consisting of landings the French fleets, which account for less than 1% of total catches (average 2021-2023). Table 4.6 provides details on the main fishing gear, country, mesh size, and target assemblage of the final métier categories used in the mixed-fisheries analysis. These mixed-fisheries multigear

fleets use a diversity of gears that allow exploitation of different fish assemblages in different habitats and depths.

The procedure for defining and aggregating fleets and métiers was partially revised in 2024. Further analysis is required on the method for matching and aggregating the fleet and métier used in mixed-fisheries analysis to account for the different technical characteristics in both active and passive gears of the Portuguese and Spanish fleets.

4.4.3 Trends

Trend analyses by fleet are carried out using data from 2021–2023. Several exploratory graphs are produced to assist in the quality control of the data once it was compiled into the final fleet object for catches, effort, and catchability (available in the TAF repository). The catchability plots by stock, fleet, and métier for the Spanish and Portuguese fleet segments are presented in Figures 4.3 and 4.4, respectively. A significant decrease in the catchability of the SP-MIS was observed, primarily due to the artificially inflated effort resulting from changes to the effort calculation algorithm implemented by the Spanish fisheries directorate.

The key assumption in the projections is that catchability by stock and métier and effort distribution (share) for the intermediate year (2024) and forecast year (2025) is the average of the last three years (2021–2023). Although slight changes in fishing patterns may occur over time, the scenarios presented do not assume any adaptation of fishing behaviour.

4.5 Mixed fisheries forecasts

4.5.1 Description of scenarios

4.5.1.1 Baseline runs

The objectives of the single-species stock baseline runs were to:

1. reproduce as closely as possible the single-species advice produced by ACOM, and
2. act as the reference scenario for subsequent mixed fisheries analyses.

The various single-stock forecasts presented by WGBIE are performed using different software and setups. For the purposes of the mixed fisheries analyses, it is necessary to gather all forecasts into a single unified framework, which builds on the "FLBEIA" library (García *et al*., 2017). Some of the assessments are length based and this cannot be fully replicated in the deterministic FLBEIA software. The same forecast settings as in the stock annex for each Category 1 stock regarding maturity, weight-at-age, selectivity and recruitment, as well as assumptions on the F in the intermediate year and basis for advice (MSY approach). For Category 2 black-bellied anglerfish, assessed with surplus production model (SPiCT), the catch estimates in the ICES advice sheet under *status quo* F/F_{MSY} was used. The F *status quo* estimates provided in the ICES advice sheets were used for the stocks with analytical assessment. The forecast settings as in the stock annex for each category 1 stock is outlined in Table 4.4.

Table 4.4. Mixed fisheries for the Iberian waters. FLBEIA forecast settings for stocks with dynamics.

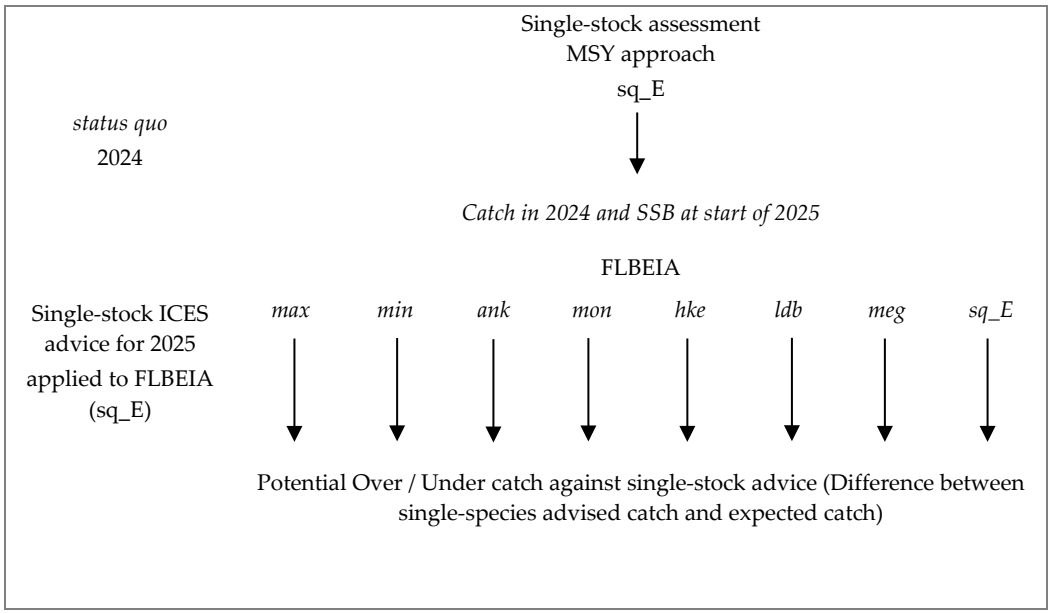
Stocks	Assessment model	Single-stock forecast	Fbar	Fsq	Weight-at-age and maturity	Recruitment	discards proportion
hke.27.8c-9a	(SS3)	SS3	age1-age7	Average F (2021–2023)	Average (2019–2023)	= Estimated by BevHolt in SS3	Average (2021–2023)

Stocks	Assessment model	Single-stock fore-cast	Fbar	Fsq	Weight-at-age and maturity	Recruitment	discards proportion
ldb.27.8c-9a	(a4a)	FLR	age2-age4	Average F (2021–2023)	Average (2019–2023)	GeoMean (1990–2021)	Average (2019–2023)
meg.27.8c-9a	(a4a)	FLR	age2-age4	Average F (2021–2023)	Average (2019–2023)	GeoMean (1998–2021)	Average (2019–2023)
mon.27.8c-9a	(SS3)	SS3	Age1-age8	Average F (2021–2023)	Average (2019–2023)	GeoMean (2003–2023)	Discards negligible

4.5.1.2 Mixed fisheries runs

The mixed fishery analysis used a *status quo* effort assumption for the intermediate year (2024), with the FLBEIA scenarios used for the advice year (2025). The *status quo* effort assumption for the intermediate year is considered a plausible assumption because it is in line with the standard single-stock short-term forecasting approach. The projections were run assuming a full and perfect implementation of a discard ban (i.e. all quota species caught must be landed, with no exemptions, *de minimis* or interspecies flexibilities).

In summary, the FLBEIA runs followed the scheme below:



4.5.2 Results of FLBEIA runs

4.5.2.1 Baseline runs

The rationale behind the single-species baseline runs is given in the previous section 4.5.1.1. The ICES single-stock advice for category 2 black-bellied anglerfish is based on the MSY approach and for hake, megrims and white anglerfish is based on the F_{MSY} ranges in accordance with the EU multiannual plan (MAP) for demersal stocks in the western waters (EU, 2019). The results from the baseline runs for fishing mortality (F), landings, and spawning-stock biomass (SSB; Table 4.7) are compared with the results from the corresponding ICES single-stock runs in Table

4.8 (catch differences expressed as ratios) and Table 4.9 (SSB and F differences expressed as ratios)

Due to methodological differences between the forecasts conducted in single-species assessments and the deterministic forecast done within WGMIXFISH (section 4.5.1.1), some discrepancies are to be expected between the baseline run reproducing the assessments. Despite these methodological differences, the differences observed this year were less than 11%. The WGMIXFISH deterministic forecast was considered close enough to the single-stock advice to be used as a basis for the mixed-fisheries projections. The issues and problems encountered in replicating the single-species advice for each species are identified below:

mon.27.8c-9a: Assessment with length-based SS3 model. The F_{sq} (30-130 cm) use in the assessment forecast was defined in FLBEIA as F_{sq} (age1-age8) based on age–length analysis. Discrepancies of 1% were observed in the final assessment year and in the SSB for the end of the advice year 2025. Differences in fishing mortality were also 1% for both the interim and advice years.

hke.27.8c-9a: Assessment with a seasonal, sex separated, length-based SS3 model. Discrepancies in spawning-stock biomass and fishing mortality for the interim year were 2% and 5%, respectively. In the forecast year, differences for both SSB and F were less than 6%.

ldb.27.8c-9a: Assessment with a4a. Discrepancies in SSB were the highest with 11% at the end of the interim year and a 2% difference in the forecast year. A 4% difference was observed in F during both the interim and forecast years when comparing the FLBEIA run with the single-stock advice forecasts.

meg.27.8c-9a: Assessment with a4a. Differences of 3% and 6% were observed for SSB and 5% and 3% for F, in the interim year and forecast year, respectively.

ank.27.8c-9a: Category 2 stock, assessment with surplus production model. F and biomass projections are relative to F_{MSY} and B_{MSY}. No discrepancies in catch/landings.

The outputs of the scenarios at the start of the advice year were consistent with the single-stock forecasts with only minor differences arising from the adjusted methods used in the FLBEIA framework and each single-species stock methodology. These differences were considered acceptable for modelling the technical interactions between stocks and fleets in the mixed-fisheries scenarios.

4.5.2.2 Mixed fisheries analyses

The full overview of the outputs of the FLBEIA scenarios for catch, spawning-stock biomass (SSB), and fishing mortality (F) projections is presented in Tables 4.10, 4.11, and 4.12, respectively. Figure 4.5 illustrates the trade-offs in catches and the potential for quota overshoot and undershoot in 2025, highlighting the most restrictive stock (hke.27.8c-9a) and the least restrictive stock (ank.27.8c-9a). For ease of comparison, the horizontal dashed line represents the advised catch from the single-stock assessment. Figure 4.6 provides a similar overview, showing the estimated potential catches for 2025 by stock and scenario. The horizontal line corresponds to the single-stock catch advice, while the lower and upper dotted lines indicate the catches corresponding to $F_{MSY\ lower}$ and $F_{MSY\ upper}$. Coloured areas above and below these lines represent potential over- and undershoots.

Figure 4.7 illustrates the estimates of SSB by stock at the end of the advice year in the mixed-fisheries scenarios, expressed as a ratio when compared to the estimated SSB from the single-stock advice. The horizontal line indicates the point at which the SSB estimates are equal between the single-stock and mixed-fisheries estimates.

All mixed fisheries scenarios are based on the *status-quo* effort assumption for the interim year and assuming a full implementation of the discard ban. Since all considered stock limits fall within the case study area, no catches are made outside this region. Scenario assumptions for the intermediate year (2024) and forecast year (2025) are listed below:

Variable	Technical Basis
Effort per fleet (2024)	Days-at-sea: average (2021–2023)
Fishing patterns (2024–2025)	Catchability by stock and métier: average (2021–2023) Effort-share by métier: average (2021–2023)
Fleet stock share allocations (2025)	Catch share by fleet: average (2021–2023)

A total of nine scenarios were explored corresponding to different effort constraints for 2025. The results and main points of each scenario are outlined below:

The forecasted scenarios are presented in terms of catch and the potential for catch advice over- and undershoot, which is driven by the most and the least restrictive single-stock advice (Figure 4.5-4.6)

The '**min**' scenario assumes that fishing for a fleet ceases when any stock quota is exhausted. For 2025, the results of the 'min' scenario are very similar to those of the 'hke' and 'sq_E' scenarios, indicating that hke.27.8c-9a is the most limiting stock for all fleets and is nearly fully exploited in the area. This scenario highlights the potential loss of fishing opportunities for ank.27.8c-9a and mon.27.8c-9a, and to a lesser extent, for the two megrim stocks**,** meg.27.8c-9a and ldb.27.8c-9a.

The '**max**' scenario demonstrates the upper bound of potential fleet effort and stock catches, assuming that all fleets continue fishing until all stock shares are exhausted, regardless of economic viability and fisheries behaviour. In 2025, the scenario results in over-quota catches for hke.27.8c-9a, meg.27.8c-9a, ldb.27.8c-9a, and mon.27.8c-9a. This scenario also shows that the ank.27.8c-9a stock is the least limiting. In this case, the fishing mortality estimates for 2025 exceed F_{MSY} levels for hke.27.8c-9a, meg.27.8c-9a, ldb.27.8c-9a, and mon.27.8c-9a (Table 4.12).

The 'sq_E' *status quo* scenario sets the fleet effort in the advice year equal to the average effort from the most recent three years with available data (2021-2023). This scenario examines the mixed-fisheries outcomes assuming that the total effort and its allocation among métiers remain unchanged. For 2025, the scenario shows an undershoot of the advised catches for all stocks, except for hake, where the catch is very close to the advised level. These results align with the recent pattern of TAC undershooting for these stocks and the full uptake of hake catch limit.

In the '**min_range**' scenario, the choke species remains the same as in the 'min' scenario (hke.27.8c-9a). However, catches for all remaining stocks in 2025 are increased, although they still do not reach the TAC levels. This increase in catch opportunities is due to the application of the $F_{MSY\ upper}$ option for stocks above MSY $B_{trigger}$.

In addition, scenarios based on individual stocks are presented to further explore the consequences of individual stock catch advice on the catches of other stocks. The results for the '**ank**' scenario are similar to those of the 'max' and to a lesser extent the '**mon**' scenario. The reduction in SSB is greater for the hke.27.8c-9a stock, driven by increased effort in these scenarios and the technical interactions between this species and all fleets. The '**mon**' scenario estimates effort levels slightly lower than those in the '**ank**' and 'max' scenarios.

The '**hke**' scenario produces the same outcome as the 'min' scenario, identifying hake as the choke species across all fleets in the mixed-fisheries analysis.

The '**ldb**' and '**meg**' scenarios provide a different perspective, offering increased fishing opportunities for both stocks compared to the 'hke' scenario. The 'meg' scenario, by definition, aligns with the observed average catch-to-TAC ratio for this species, which has been close to 1 in recent years. This scenario also predicts an undershoot for the ldb.27.8c-9a, ank.27.8c-9a, and mon.27.8c-9a stocks, similar to the undershoots observed in recent years. This pattern may be due to the four-spot megrim and anglerfish being caught by the same bottom otter trawl gears.

The above scenarios that result in under- or overshoot are useful in identifying the main mismatches between the fishing opportunities of the various stocks, where limiting catch advice can create potential "choke species" effects at fleet level. They indicate the direction in which fleets may have to adapt their fishing behaviour to fully utilize their catch opportunities without collectively exceeding single-stock fishing opportunities. The estimates of effort by fleet needed to reach each single-stock catch advice is presented in Figure 4.8. Stocks are coded by colour, with the bars for the most limiting stock ("choke species") for each fleet in 2025 highlighted with a red border and asterisk and the bars for the least limiting species highlighted with a green border. The *status quo* effort for each fleet (average 2021-2023) is shown as a dashed line for reference.

4.6 Summary of mixed fisheries considerations

Mixed fisheries projections were conducted for nine scenarios corresponding to different assumptions on the future effort deployment by the fleets. The trade-offs in catches and any potential for overshoot and undershoot of the single-stock advice associated with each scenario were explored. Mixed-fisheries considerations were described for black-bellied anglerfish (ank.27.8c9a), hake (hke.27.8c9a), four-spot megrim (lbd.27.8c9a), megrim (meg.27.8c9a), and white anglerfish (mon.27.8c9a) in the Iberian Waters. Given the single-stock catch advice for 2025, the most limiting stock for demersal fisheries in the Iberian Waters is hake, with all 11 defined fleets reaching their hake quota with a lower effort than for the other stocks. The least limiting stock is black-bellied anglerfish (10 of 11 fleets). It was assumed that fleet fishing patterns in the forecast years are the same as observed in the recent past.

4.7 References

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Table 4.5. Detailed description of the fleet categories with relevant catches in the species considered in the Iberian waters mixed fisheries analysis and final mixed fisheries métier group. Fleets with minor landings in the mixed-fisheries stocks are aggregated to a miscellaneous fleet

Acronym	DCF definition	Description	Mixed fisheries métier
GNS_DEF_>=100_0_0	Set gillnet targeting demersal fish with mesh sizes larger than 100 mm	Spanish set gillnet ("*rasco*") targeting white anglerfish in ICES Division 8c with mesh size of 280 mm	GNS_*rasco*
GNS_DEF_0_0_0	Set gillnet targeting demersal fish	Portuguese fleet using set gillnets targeting a variety of mixed demersal species	GTN _DEF_PT
GNS_DEF_60-79_0_0	Set gillnet targeting demersal fish with mesh sizes within the range 60–79 mm	Spanish small set gillnet ("*beta*") targeting a variety of demersal fish in northwestern Spanish waters	GTN_DEF_SP
GNS_DEF_80-99_0_0	Set gillnet targeting demersal fish with mesh sizes within the range 80–99 mm	Spanish set gillnet ("*volanta*") targeting hake with nets of 90 mm mesh size in northwestern Spanish waters	GNS_*volanta*
GTR_DEF_0_0_0	Trammelnet targeting demersal fish	Portuguese fleet using trammelnets targeting a variety of mixed demersal species	GTN _DEF_PT
GTR_DEF_50-79_0_0	Trammelnet targeting demersal fish with mesh sizes within the range 60–79 mm	Spanish trammelnet targeting a variety of demersal species in northwestern Spanish waters	GTN_DEF_SP
LLS_DEF_0_0_0	Set longline targeting demersal fish	Spanish set longline targeting a variety of demersal fish in Spanish Iberian waters	LLS_DEF
MIS_MIS_0_0_0_HC	Miscellaneous	Portuguese and Spanish artisanal fleet not covered by other métier	MIS
OTB_CRU_>=55_0_0	Bottom otter trawl targeting crustaceans using mesh sizes larger than 55 mm	Portuguese bottom otter trawl targeting *Nephrops* and rose shrimp	OTB_CRU
OTB_DEF_>=55_0_0	Bottom otter trawl targeting demersal fish using mesh sizes larger than 55 mm	Spanish bottom otter trawl targeting hake, anglerfish, and megrim using "*baca*" nets of 70 mm mesh size in Divisions 8c and 9a	OTB_DEF
OTB_DEF_>=65_0_0	Bottom otter trawl targeting demersal fish using mesh sizes larger than 65 mm	Portuguese bottom otter trawl targeting demersal fish in Division 9a	OTB_DEF
OTB_ MCD_>=55_0_0	Bottom otter trawl targeting mixed crustaceans and demersal fish using mesh sizes larger than 55 mm	Spanish bottom otter trawl targeting a variety of fish and crustaceans using nets of 55 mm mesh size in southwestern Iberian waters (Gulf of Cadiz and Southern Portuguese waters)	OTB_MCD
OTB_MPD_>=55_0_0	Bottom otter trawl targeting mixed pelagic and demersal fish using mesh sizes larger than 55 mm	Spanish bottom otter trawl targeting pelagic (horse mackerel, mackerel…) and demersal fish (hake) by using "*jurelera*" nets of	OTB_PTB_MPD

Acronym	DCF definition	Description	Mixed fisheries métier
		55 mm mesh size in northwestern Spanish waters	
PTB_ MPD _>=55_0_0	Bottom pair trawl targeting mixed pelagic and demersal fish using mesh sizes larger than 55 mm	Bottom pair trawl targeting pelagic (blue whiting, mackerel…) and demersal fish (hake) by using nets of 55 and 70 mm mesh size in northwestern Spanish waters	OTB_PTB_MPD

Table 4.6. Métier categories description used in mixed-fisheries analysis (PT- Portugal; SP-Spain; FR-France)

Acronym	Gear / country	Mesh size / main target assemblage
GNS_rasco	Gillnets / SP	≥ 100 mm / anglerfish
GNS_*volanta*	Gillnets / SP	≥ 80 mm and < 99 mm / hake
GTN_DEF_SP	Gillnets, trammelnets / SP	≥ 50 mm and < 79 mm / demersal
GTN_DEF_PT	Gillnets, trammelnets / PT	Any / demersal
LLS_DEF	Longlines / PT; SP	Any / demersal
OTB_CRU	Otter trawls / PT	≥ 55 mm / crustaceans
OTB_DEF	Otter trawls / PT ; SP	≥ 65 mm / demersal
OTB_MCD	Otter trawls / SP	≥ 55 mm / crustacean; demersal
OTB_PTB_MPD	Otter and pair trawls / SP	≥ 55 mm / pelagic; demersal
MIS	Artisanal miscellaneous / PT ; SP	Any / mixed
FR_MIS	Miscellaneous / FR	Any / mixed

Table 4.7. Baseline run outputs from the FLBEIA package.

	ANK*	HKE	LDB	MEG	MON
2024_Fbar	-	0.2	0.077	0.09	0.094
2024_Landings	997	9594	1122	306	867
2024_SSB	-	23093	14593	7175	10334
2025_Fbar	-	0.22	0.176	0.173	0.24
2025_Landings	2486	13274	2434	1629	2946
2025_SSB	-	26831	14515	8269	11735
2026_SSB	-	30522	12857	7516	11768

***Category 2 stock set with fixed dynamics in FLBEIA.**

Table 4.8. Comparison between baseline run and ICES estimated catches for intermediate and advice years. Figures for 2024 compare results from the baseline run - that use the same forecast assumptions in the intermediate year as the forecasts leading to ICES advice

	ANK*	HKE	LDB	MEG	MON
2024_catches Baseline	940	11987	1272	809	1034
2024_ catches ICES	1118	11987	1272	809	1034
2024_ratio FLBEIA/ICES	0.84	1	1	1	1
2025_ catches Baseline	2486	15105	2727	1721	2946
2025_ catches ICES	2486	15105	2727	1721	2946
2025_ ratio FLBEIA/ICES	1	1	1	1	1
2024_landings Baseline	1118	10379	1141	717	1034
2024_ landings ICES	1118	11115	1140.776	717.4578	1034
2024_ratio FLBEIA/ICES	1	0.93	1	1	1
2025_ landings Baseline	2486	13274	2434	1629	2946
2025_ landings ICES	2486	14017	2486	1667	2946
2025_ ratio FLBEIA/ICES	1	0.95	0.98	0.98	1
2024_discards Baseline	0	1608	131	92	0
2024_ discards ICES	0	1012	103	55	0
2024_ratio FLBEIA/ICES	-	1.59	1.27	1.67	-
2025_ discards Baseline	0	1831	293	92	0
2025_ discards ICES	0	1088	241	54	0
2025_ ratio FLBEIA/ICES	-	1.68	1.22	1.7	-

*Category 2 stock set with fixed dynamics in FLBEIA.

Table 4.9. Comparison of SSB and F forecasts between FLBEIA baseline run outputs and single-stock assessment (ratio FLBEIA / ICES).

	SSB_2024	SSB_2025	SSB_2026	F_2024	F_2025
ank.27.8c9a*	-	-	-	-	-
ldb.27.8c9a	0.99	1.11	0.98	1.04	1.04
meg.27.8c9a	0.94	1.06	0.97	1.05	1.03
mon.27.8c9a	1.01	1	1.01	1.01	1.01
hke.27.8c9a	1.02	1	0.96	1.05	1.06

*Category 2 stock set with fixed dynamics in FLBEIA.

Table 4.10. Results of running FLBEIA scenarios on the advice year (2025). Comparison of the single-stock ICES advice and potential catches in the various FLBEIA scenarios.

	Single-stock Catch (2025)	min	max	sq_E	min-range	ANK	HKE	LDB	MEG	MON
ank.27.8c9a	2486	1002	2487	939	1354	2486	1004	1669	1290	1908
hke.27.8c9a	15105	14915	27981	15056	20147	27977	15105	24224	19971	26108
ldb.27.8c9a	2727	1616	3778	1295	2183	3778	1616	2727	2387	2956
meg.27.8c9a	1721	1151	2658	912	1554	2658	1151	1939	1721	2086
mon.27.8c9a	2946	1576	3723	1361	2129	3722	1580	2633	2141	2946

Table 4.11. Results of running FLBEIA scenarios on the advice year. Comparison of the Spawning-stock biomass (SSB) results in 2026 (end 2025) from single-stock advice. Weights are in tonnes.

	Single-stock SSB (2026)	min	max	sq_E	min-range	ANK	HKE	LDB	MEG	MON
ank.27.8c9a*	-	-	-	-	-	-	-	-	-	-
hke.27.8c9a	31680	25475	5947	22504	22890	5952	25384	11506	17880	8651
ldb.27.8c9a	13098	13981	10446	14314	13363	10446	13981	12770	13138	12261
meg.27.8c9a	7788	8248	5557	8534	7760	5557	8248	7091	7557	6778
mon.27.8c9a	11639	13010	10835	13227	12450	10835	13006	11939	12437	11622

*Category 2 stock set with fixed dynamics in FLBEIA.

Table 4.12. Results of running FLBEIA scenarios on the advice year. Comparison of the Fishing mortality levels in 2025 from single-stock advice.

	Single-stock F (2025)	min	max	sq_E	min-range	ANK	HKE	LDB	MEG	MON
ank.27.8c9a*	-	-	-	-	-	-	-	-	-	-
hke.27.8c9a	0.22	0.22	0.41	0.22	0.29	0.41	0.22	0.35	0.29	0.38
ldb.27.8c9a	0.18	0.1	0.24	0.08	0.14	0.24	0.1	0.18	0.15	0.19
meg.27.8c9a	0.17	0.12	0.27	0.09	0.16	0.27	0.12	0.19	0.17	0.21
mon.27.8c9a	0.24	0.13	0.3	0.11	0.17	0.3	0.13	0.21	0.17	0.24

*Category 2 stock set with fixed dynamics in FLBEIA.

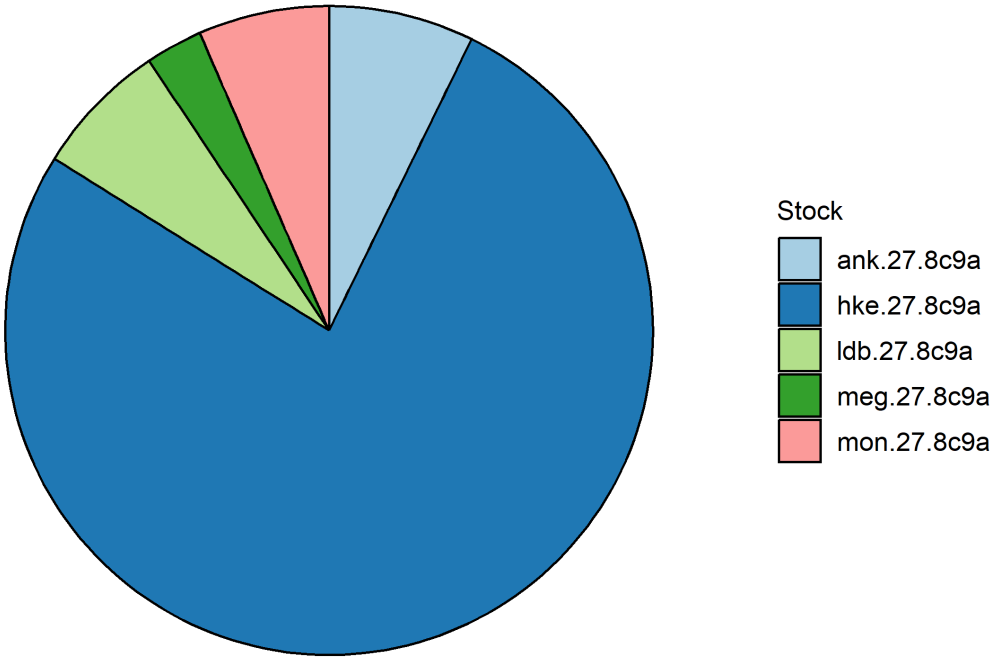


Figure 4.1. Landings distribution by stock (average 2021–2023): Hake (77%), black-bellied anglerfish (7%), white anglerfish (6%), four spot megrim (6%) and megrim (3%).

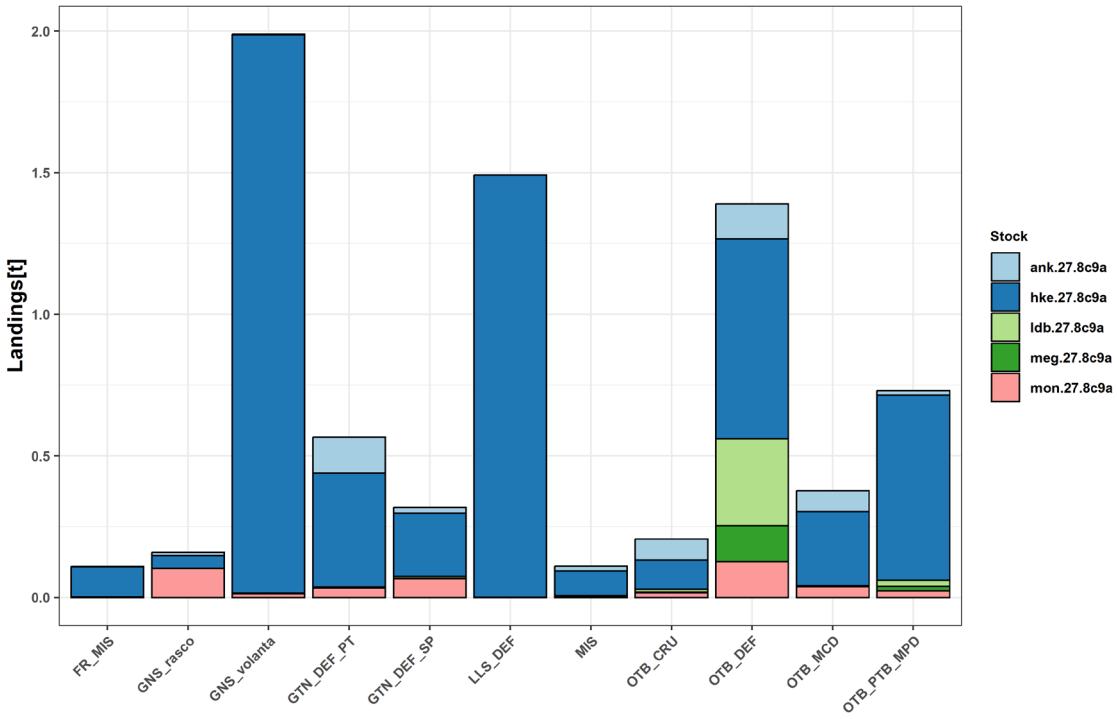


Figure 4.2. Distribution of stocks landed by métier 2021-2023. A list of métier definitions is available in Table 4.6.

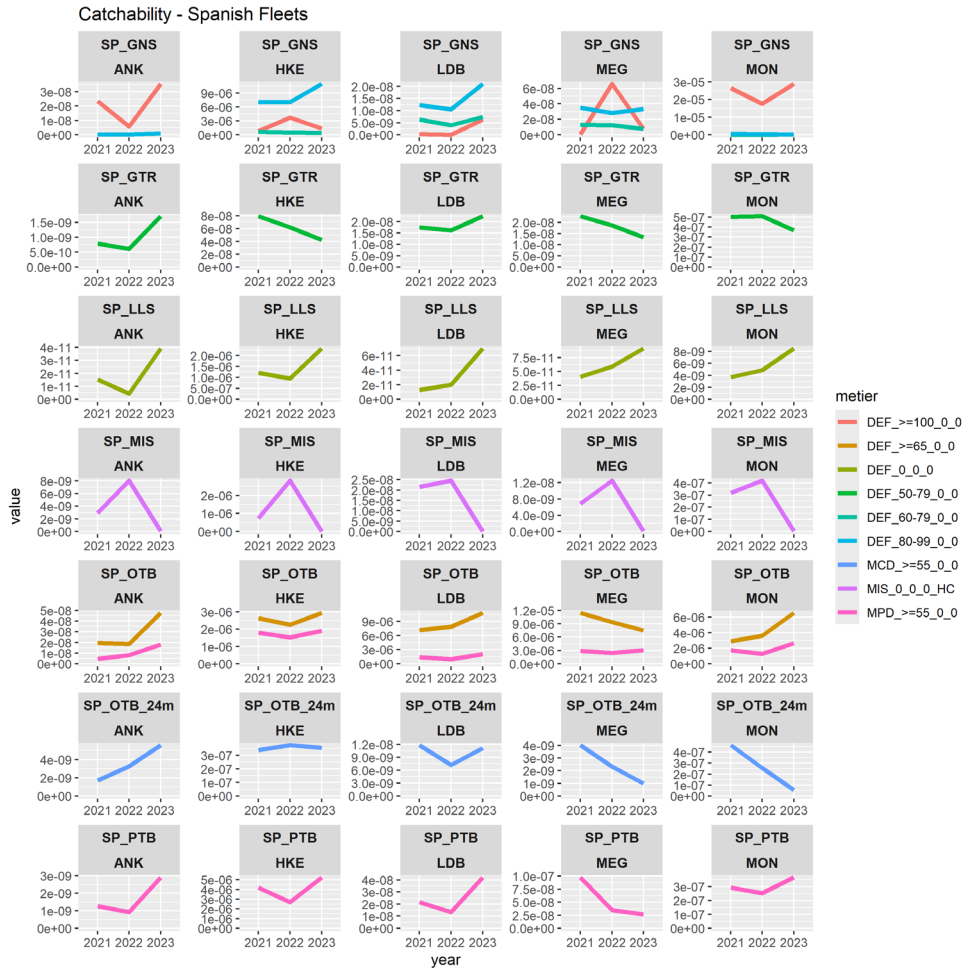


Figure 4.3. Trends of Spanish catchability by stock, fleet and métier from 2021-2023.

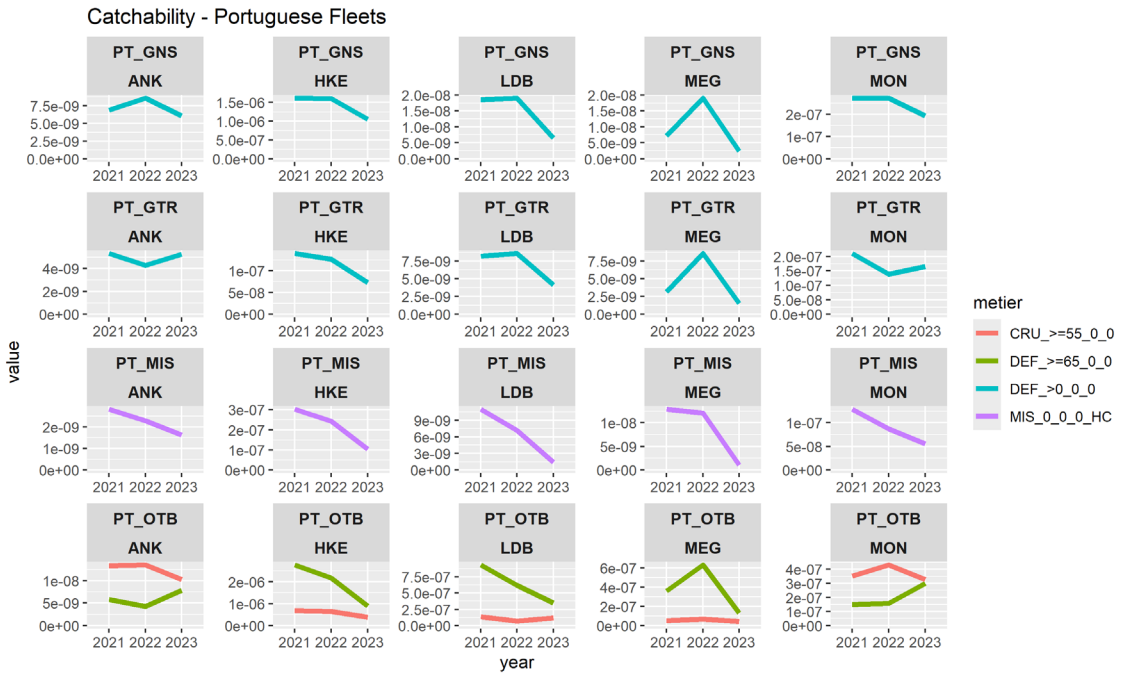


Figure 4.4. Trends of Portuguese catchability by stock, fleet and métier from 2021-2023.

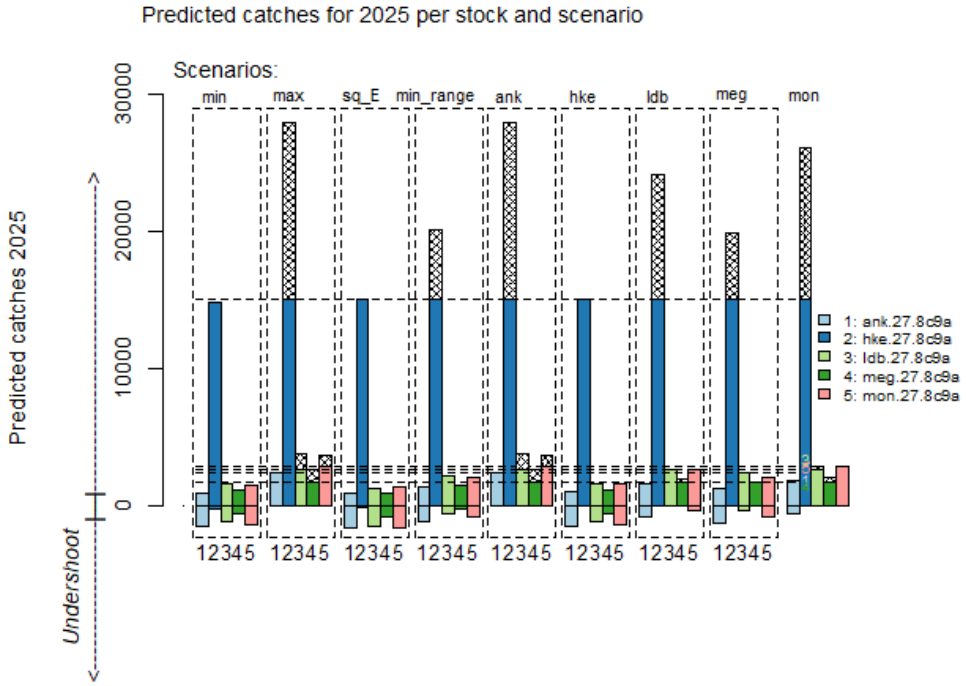


Figure 4.5. Mixed fisheries forecasts for catches in 2025. FLBEIA estimates of potential catches by stock after applying the status-quo effort scenario to all stocks in the intermediate year. Horizontal lines correspond to the catch set by the single-stock advice. Bars below the value of zero show the scale of undershoot (compared to the single-species catch advice) in cases where catches are predicted to be lower when applying the scenario.

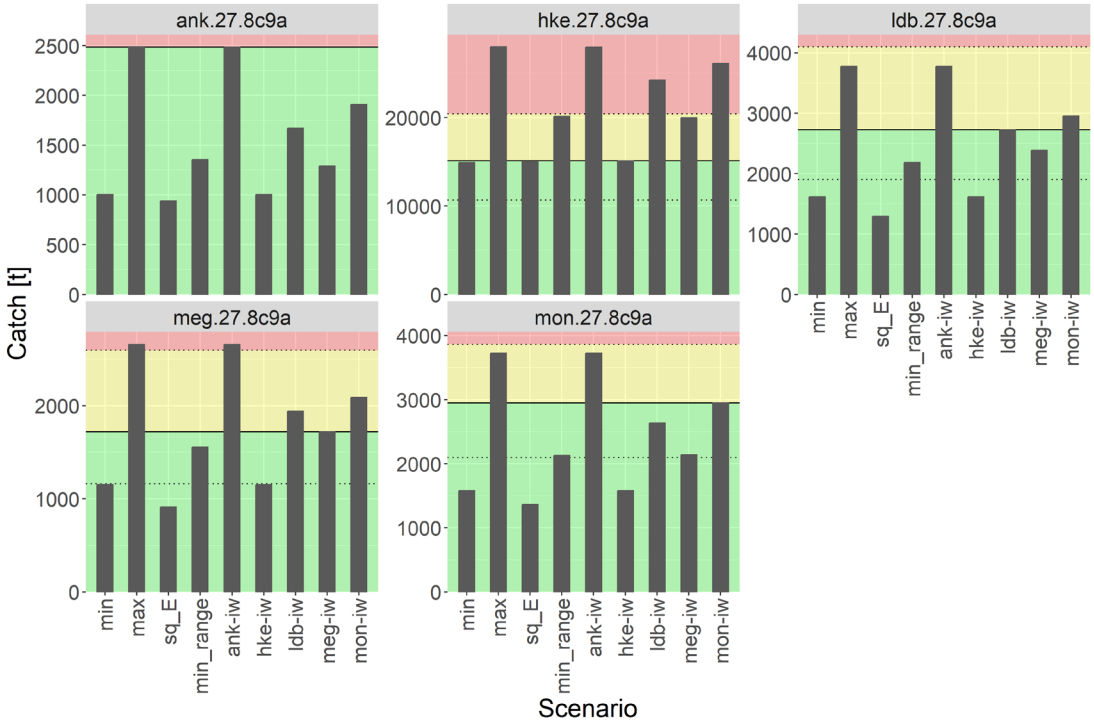


Figure 4.6. Estimates of potential 2025 catches (in tonnes) by stock and scenario. Solid lines correspond to the single-stock catch advice. Lower dotted lines illustrate the catches corresponding to $F_{MSY\ lower}$ or reduced $F_{MSY\ lower}$ for stocks with SSB < MSY $B_{trigger}$. Upper dotted lines illustrate the catches corresponding to $F_{MSY\ upper}$ and only appears for stocks with SSB ≥ MSY $B_{trigger}$.

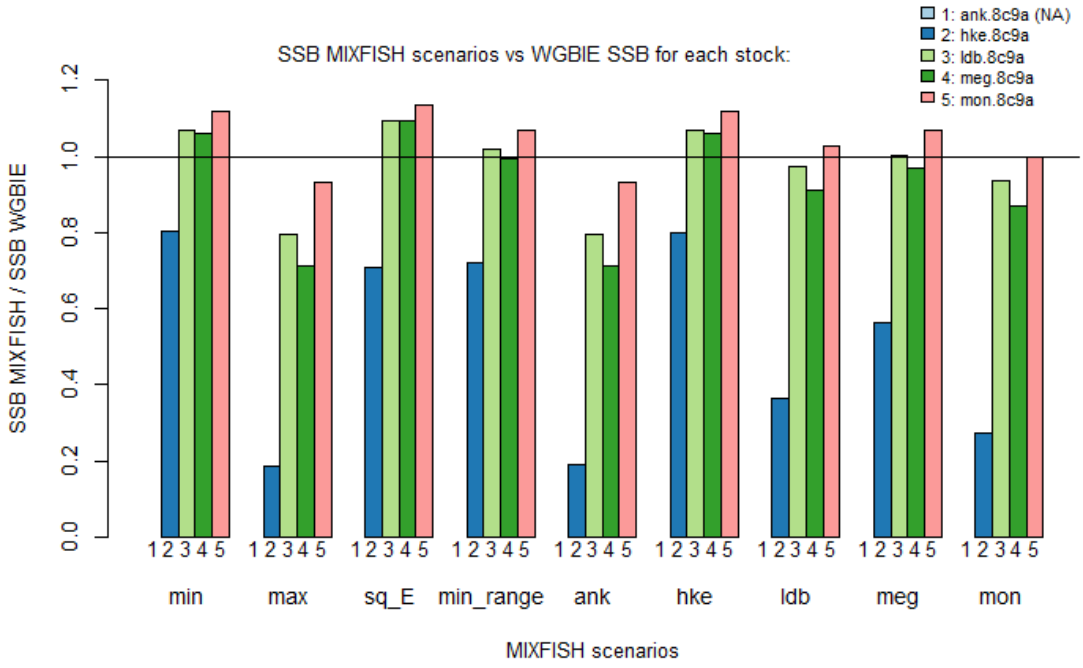


Figure 4.7. Mixed fisheries forecasts for estimates of potential SSB at the start of 2026 by stock after applying the mixed fisheries scenarios, expressed as a ratio to the single-species advice forecast. Horizontal line corresponds to the SSB resulting from the single-stock advice (at the start of 2026).

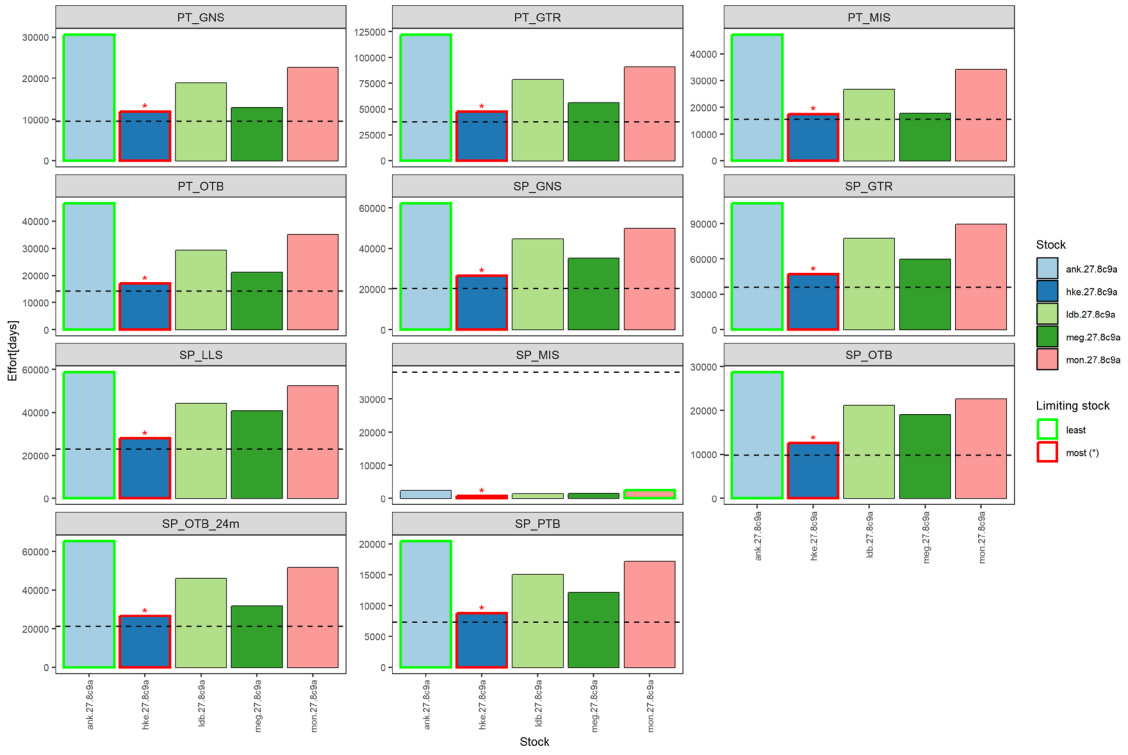


Figure 4.8. Estimates of effort by fleet needed to reach the single-stock advice catches. The bar for the most limiting stock ('choke species') for each fleet in 2025 highlighted with a red border and the bar for the least limiting species highlighted with a green border. The *status quo* effort for each fleet (average 2021-2023) are shown as a dashed line for reference.

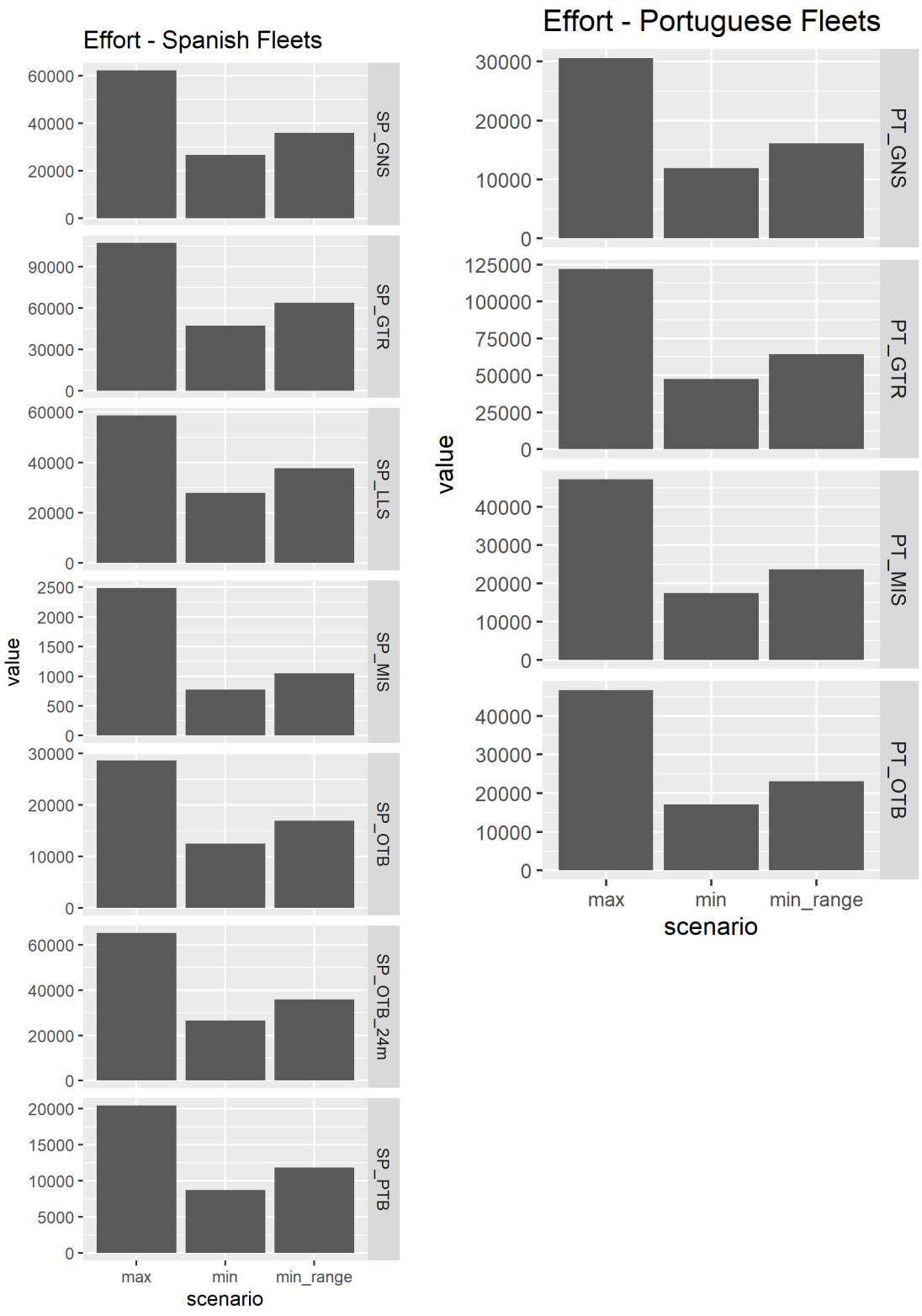


Figure 4.9. FLBEIA estimates of effort by the Spanish and Portuguese fleet corresponding to the individual "quota share" (or partial target F) by stock in 2025 for contrasting MIXFISH scenarios *min, max and min_range*.

5 Irish Sea

5.1 Background

The Irish Sea, ICES Division 7.a, is a relatively enclosed sea basin situated between Ireland/Northern Ireland and Great Britain. It is connected to the Celtic Sea (7.g) in the south by St George's Channel, and in the north, it is linked to the West of Scotland (6.a) by the Northern Channel. Within the Irish Sea there are distinct habitat patches formed from a combination of bathymetry, topographical features and hydrography. The area contains a deeper channel in the west with a maximum depth exceeding 275 m, and eastern bays have depths less than 50 m. A large, well-defined, deep-water mud basin is located in the northwestern region close to the Northern Irish and Irish coastline. There is another distinct mud habitat in the east of the division. These two mud habitats are identified as two separate *Nephrops* functional units (FU14 and FU15; Figure 5.1).

Norway lobster (*Nephrops*) is the main demersal species landed by Irish Sea fisheries. *Nephrops* is mainly targeted using otter trawls (OTB) with mesh size in the range 70–99 mm. This fishery is primarily focused in the northwest of the Irish Sea, with > 95% of landings in 2023 caught in FU 15. Of demersal species haddock accounts for the second highest landings and is mainly caught in otter trawls (OTB) and midwater otter trawls (OTM). Sole accounts for the third highest landings in the Irish Sea, and is mainly targeted by beam trawls (TBB).

In addition to demersal fisheries, a seasonal pelagic herring fishery operates in late summer to early autumn in the pre- and post-spawning period. Dredge fisheries target king and queen scallops, with king scallops in coastal areas and the queen scallop fishery operating in the central area south of the Isle of Man. To a lesser extent queen scallops are also targeted using trawlnets during the late summer when swimming activity is most pronounced.

Four nations carry out most of fishing activity in the Irish Sea, namely: Northern Ireland, Republic of Ireland, England and Belgium. There is variation in the landings profiles of each country reflecting different fishing patterns, practices, and quota shares (Figure 5.2 and 5.3).

5.1.1 Management measures

Fishing opportunities Irish Sea (ICES division 7.a) are managed by TACs for six demersal species: cod, haddock, plaice, sole, whiting, and *Nephrops.* Single species advice for these stocks is issued annually by the ICES Working Group for the Celtic Seas Ecoregion (WGCSE). Category 1 analytical assessments are conducted for all fish stocks. *Nephrops* stocks are assessed using UWTV based stock assessment models at the FU level.

A multiannual management plan (MAP) for Western and adjacent waters has been adopted by the EU for cod, haddock and whiting in the Irish Sea, and *Nephrops* in FU's 14 and 15 (Council Regulation (EC) 2019/472) which ICES considers to be precautionary. Plaice in the Irish Sea is taken into account under the EU multiannual plan (MAP) as a bycatch species. However, there is no agreed shared management plan with UK for these stocks. ICES is not aware of any agreed precautionary management plan for sole in this area. A single *Nephrops* TAC is issued for Subarea 7 (with an 'of which' provision for FU16). ICES notes that to ensure that each stock is exploited sustainably, management should be implemented at the FU level.

Cod and whiting are managed as bycatch only in the Irish Sea, with no directed fishery of either species permitted in the area. As such they are likely to have considerable mixed fisheries

implications, and catches may be impacted by adjusting the fishing opportunities permitted for other species in addition to technical measures such as area closures and technical devices such as highly selective gears. For a summary of current technical measures in the region see: (https://bim.ie/fisheries/advisory-services/fisheries-management-chart). Catches of whiting are primarily observed in *Nephrops* directed otter trawl fisheries, with a smaller proportion from finfish directed otter trawls and other gears. Catches of cod are primarily observed in demersal fish directed otter trawl fisheries (both OTB and OTM), with significant proportions from *Nephrops* directed otter trawls and beam trawls. Council Regulation (EC) No. 304/2000 and Regulation (EC) No. 2549/2000 introduced area closures on the cod spawning grounds for ten weeks from mid-February till the end of April. These area closures now occur annually, although there are some derogations in place for gears not targeting cod.

As of the 1 January 2016 a European demersal species landings obligation was introduced (Commission Delegated Regulation (EU) 2015/2438). This regulation prevents the discarding at sea of certain species on a fishery-by-fishery approach. This regulation prevents the discarding of certain species on a fishery-by-fishery approach. Since 1 January 2019, catches of all quota species in the Celtic Seas have been subject to the EU landings obligation rule, except where an exemption is in place, and a UK landings obligation remains in place following the exit of the UK from the EU. An overview of the exemptions of the EU landings obligation can be found below:

Exemptions to the landing obligation in 2024

Species	Exemption type	Area	Gear	Maximum de minimis exemption (% of total annual catch)
Albacore tuna	De minimis	7	Midwater pair trawls	5
Whiting	De minimis	7d -7e	Bottom trawls and seines ≥ 80 mm, Pelagic trawls and beam trawls 80-119 mm	3
Sole	De minimis	7a, 7h - 7k	Beam trawl 80-119 mm with Flemish Panel	3
Sole	De minimis	7d,e,f & g	Trammel nets and gill nets	3
Haddock	De minimis	7b,c & 7e-k	Bottom trawls and seines ≥ 100 mm with catches comprising ≤30% Nephrops	5
Haddock	De minimis	7b,c & 7e-k	Vessels using ≥ 80 mm, with catches comprising more than 30% Nephrops	5
Haddock	De minimis	7b,c & 7e-k	Beam trawls ≥ 80 mm with Flemish Panel	5
Megrim [1]	De minimis	7	Beam Trawls 80-119mm & Bottom trawls**	4
Horse mackerel	De minimis	6 & 7b-k	DMF [2] using bottom trawls, seines & beam trawls	3
Mackerel	De minimis	6 & 7b-k	DMF [2] using bottom trawls, seines & beam trawls	3
Boarfish	De minimis	7b,7c,7f-7k	Bottom trawls	0.5
Argentine	De minimis	EU 5b & 6	Bottom trawls ≥ 100 mm	0.6
Species	**Exemption**	**Area**	**Gear**	**Discard Release Notes**
Nephrops	Survivability	6 & 7	Pots, creels or traps	immediately whole & where caught
Nephrops	Survivability	7	Bottom trawls 70-99mm with HSG* or ≥100mm	immediately whole & where caught
Nephrops	Survivability	6a (<12nm)	Bottom trawls 80-110 mm	immediately whole & where caught
Skates & rays	Survivability	6 & 7	All gears	Released immediately
Plaice	Survivability	7d -7k	Seines (SSC)	Released immediately
Plaice	Survivability	7d -7g	Trammel nets and otter trawls	Released immediately
Plaice	Survivability	7a -7g	Beam Trawls with flip up rope or benthic release panel (vessels > 221kW)	Released immediately
Plaice	Survivability	7a-7g	BT2 (vessels ≤221 kW or ≤24 m) inside 12 nm, tows ≤ 1:30 hour	Released immediately
Pot Caught Sp.	Survivability	EU 5b; 6 & 7	Pots, creels and traps	Released immediately

[1] Applies ony to megrim <MCRS (20cm), [2] Demersal Mixed Fisheries
* See list of area-specific highly selective gears for Nephrops in table
** Bottom trawls: 70 to 99mm in 7f, 7g, 7h North of 49.5°N & 7j East of 11°W - catches must comprise > 55% whiting or anglerfish, hake & megrim combined; ≥100mm in the rest of 7

Reference: Commission Delegated Regulations (EU) 2023/2623

5.2 Model

5.2.1 Software

The FCube model has been coded as a method in R 64bits (R Development Core Team, 2008), using the FLR framework (Kell *et al.*, 2007, www.flr-project.org). Input data are in the form of FLFleets and FLStocks objects from the FLCore 2.6.19 and FLFleet 2.6.1 packages. Stock objects were created using outputs from single-stock assessment for each fish stock: FLa4a (version 1.8.2)

and FLXSA (version 2.6.1). Forecasts for fish stocks with analytical assessments were projected using the fwd() function in the Flash package (version 2.5.11). *Nephrops* catch forecasts were calculated based on a combined FU14 and FU15 stock, with the same R approach used for individual FU's in the single-stock advice. As such, the input parameterization as well as the stock projections are made externally using existing methods and packages, while only the FCube specific steps are internalised in the method, thus keeping full transparency and flexibility in the use of the model.

All code and data are stored at: https://github.com/ices-taf/2024_IrS_MixedFisheriesAdvice

Table 5.1. Software used by WGCSE in the single-species assessments and forecasts

Stock	Assessment	Forecast
cod.27.7a	Stock synthesis (SS3)	FLR STF
had.27.7a	ASAP (Age-Structured Assessment Programme; NOAA)	FLR STF
nep.fu.14	Underwater TV survey	NA
nep.fu.15	Underwater TV survey	NA
ple.27.7a	Age-based stochastic analytical assessment (SAM)	SAM
sol.27.7a	Age-based stochastic analytical assessment (SAM)	SAM
whg.27.7a	ASAP (Age-Structured Assessment Programme; NOAA)	FLR STF

5.2.2 Scenarios

FCube (Ulrich *et al.* 2008; 2011) was used to forecast seven mixed-fisheries scenarios (Table 5.2). The basis of the model is to estimate the future levels of effort for each fleet corresponding to the fishing opportunities available to that fleet, based on recent fleet effort distribution and catchability by stock and métier. This level of effort is then used to estimate the corresponding summed *F* of all fleets per stock, and catches are then forecast using the standard forecast procedures from the single-species assessment (with the exception of plaice and sole which are forecast using FLR rather than SAM). The basis for each single-stock advice is retained in the current mixed fisheries framework.

The mixed fisheries model includes cod, haddock, plaice, sole, whiting and *Nephrops* FU14 and FU15. For fish stocks the stock objects used in the model were received directly from the single-stock coordinators and match those used in the single-stock advice (ICES, 2024a). *Nephrops* stocks in FU14 and FU15 were merged in the mixed fisheries model (see section 5.3.1 below for technical details), and a single scenario representing the sum of the advice for both FU14 and FU15 was used to represent the Irish Sea *Nephrops* fishing advice. Following model testing this was selected as the best approach, because the landings and discards data in MIXFISH accessions and InterCatch for fish stocks is at the level of ICES division (7.a). Therefore, it is not currently possible to allocate catch compositions of fish stocks at the individual FU level. Furthermore, *Nephrops* targeting fleets move between FU's using the same métiers depending on fishing opportunities and conditions. Therefore, while *Nephrops* stocks are best assessed as separate FU's the behaviour and catch compositions of the fishery within the mixed fishery model (given the available data) are best captured by merging FU14 and FU15 stocks and advice within the model. Out of FU and FU19 catches are excluded from the model, as these are unlikely to reflect the main target areas of the Irish Sea *Nephrops* fishery and represent <1% of the landings.

A retrospective analysis highlighted difficulties in predicting catches of sole based on Norway lobster and gadoid catches under previous model assumptions (ICES, 2023). This is due to differences in the fleet behaviour of fleets predominantly targeting sole (beam trawl fleets and Belgian otter trawls), which are largely unrelated to other fisheries in the region. Therefore, this year, the stock-specific scenarios (Table 5.2) additionally restrict the effort of fleets targeting sole in the region, based on the advice for sole for 2025. This affects the interpretation of these single-stock scenarios other than "sol-is".

A new scenario has been added last year, the "min_range" scenario (see Table 5.2). The "min_range" scenario explores how the higher catch options associated with the $F_{MSY\ upper}$ or scaled F_{MSY} reference points (for stocks where ranges are defined) may reduce choking behaviour in mixed fisheries and increase overall quota uptake. Under this scenario scaled F_{MSY} catch options are applied in the case of stocks with headline zero-catch advice based on precautionary principles in the single-stock advice. As such the "min_range" scenario cannot be considered precautionary for these stocks. The "min_range" scenario makes use of the multiannual plan (MAP) F_{MSY} ranges defined for demersal stocks under the EU MAP for the western waters (EU, 2019). There is no agreement between the EU and the UK regarding this plan, and it is not used as the basis of the advice for these shared stocks.

The following scenarios are included in the mixed fisheries considerations:

Table 5.2. Mixed fisheries scenarios considered for the Irish Sea

Scenario code	Mixed fisheries effort assumption	Basis for catch target 2024
Minimum (*min*)	For each fleet, fishing in 2024 stops when the first stock share* of that fleet has been caught. This scenario is the most precautionary option and can highlight some potential "choke species" issues.	ICES catch advice
Maximum (*max*)	For each fleet, fishing in 2024 continues until all stock shares* of that fleet have been caught. This option illustrates the degree of overfishing of the single-stock advice if fishing is not restricted by the fleet stock shares*.	
Status quo effort (*sq_E*)	The effort of each fleet in 2024 is set equal to the average effort in the most recent three years (2020-2022) for which landings and discard data are available.	Not applicable
Minimum including ranges (*min_range*)	Same as min scenario.	Catches corresponding to $F_{MSY\ upper}$ for stocks in good status (SSB ≥ MSY $B_{trigger}$) and scaled F_{MSY} advice levels (F_{MSY} × SSB/MSY $B_{trigger}$) for the other stocks (including zero catch advice stocks).
Single-stock advice for cod (*cod-is*), haddock (*had-is*), Norway lobster (*nep-is*), sole (*sol-is*), and whiting (*whg-is*)	For each fleet, fishing in 2024 stops when the catch of the focus stock meets the fleet's stock share*. Fleets which do not catch the focus stock follow a *status quo* effort assumption (as described for the sq_E scenario). In all of these single-stock advice scenarios, fleets that target sole (all beam trawls and Belgium otter trawls) are limited by their stock share of sole rather than by the scenario focus stock.	ICES catch advice

*** Throughout this document, the term "stock share" is used to describe the share of the fishing opportunities for each fleet, calculated based on the single-stock advice for 2025 and the historical proportion of the catches of that stock taken by the fleet (average 2021-2023).**

5.3 Data compilation

Data used to produce the mixed fisheries forecasts comes from three sources:

1. Stock data: stock abundance, structure, reference points and advice (ICES, 2024a).
2. Fisheries dependent data: fleet and métier trends in landings and effort (2021-2023), are from the WGMIXFISH data call.
3. Discard data: from the ICES InterCatch database, and WGCSE stock coordinators.

5.3.1 Stock data

Single species stock assessment outputs including biomass, fishing mortality, biological parameters (maturity, natural mortality) and age-structure for demersal fish stocks were supplied by WGCSE stock co-ordinators in the form of FLR stock objects (with the exception of plaice which was supplied as a SAM object). FLR stock objects for *Nephrops* FU14 and FU 15 were created based on landings, discard and stock numbers, mean weights and harvest rates in the WGCSE advice meeting report (ICES, 2024a). *Nephrops* stock objects were merged by summing their respective stock objects using the R package FLCore, to create a single Irish Sea *Nephrops* stock object within the mixed fisheries model (see section 5.2.2 above). This results in the annual landings, discards, catches and stock (tonnes and number) being the sum of those in the individual stocks. The individual weights in landings, discards, stock and catches, are calculated as the mean individual weight per year weighted by the numbers of each FU14 and FU15 in each year. The annual harvest rates of the merged stock object were calculated as the catch numbers divided by the stock numbers per year. The forecast harvest rate based on *Nephrops* advice was calculated based on the sum of the advice for both FU's. Specifically, the advised harvest rate for catch in the advice year is calculated as:

$$Adviced\ catch\ numbers = \frac{Advised\ catch\ FU14\ (t) + Advised\ catch\ FU15\ (t)}{Mean\ catch\ weight\ (g)}$$

$$Harvest\ rate = \frac{Advised\ catch\ numbers}{Stock\ numbers}$$

Reference points, advice for 2025, TAC in 2024 and trends in stock status were from WGCSE advice sheets. The consistent support and cooperation from the chairs and single species stock assessors has greatly eased the workload of WGMIXFISH. An overview of the trends and advice for stocks included in Irish Sea mixed fisheries analysis from the single species advice sheets for these stocks is described below (ICES 2024a; Table 5.3).

5.3.2 Fisheries dependent data

Information on fisheries is supplied according to the WGMIXFISH data call in the form of "accessions" data, this provides disaggregated fleet data at the level of métier which are consistent with the definitions outlined in the DCF. This includes landings (in tonnes) for defined species and fishing effort (in KW days). Landings and effort métiers for the model stocks were checked for consistency within countries and years, and effort data were available for all of the métiers for which landings were reported. For comparison of accessions data and other data sources see section 5.3.5 Quality Control.

5.3.3 Discard data

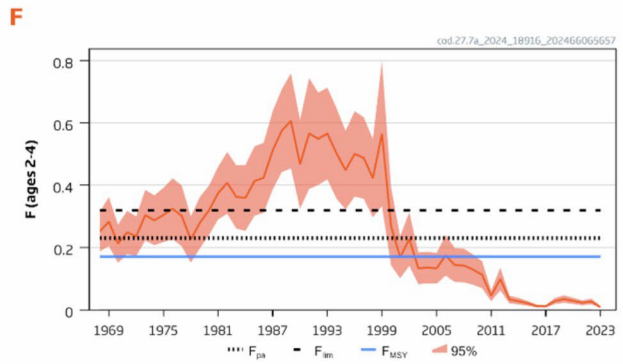
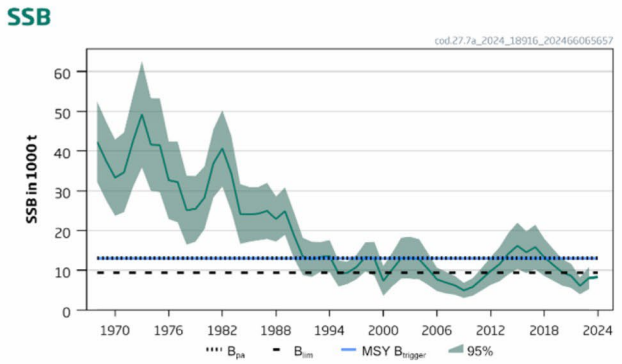
Discard ratios were calculated per stock, country, year and métier (DCF level 6 where possible e.g. OTB_CRU_70-99_0_0_all) from InterCatch data used in single-stock assessments. These ratios were applied to the landings data supplied in the WGMIXFISH accessions data call to calculate corresponding discard weights for the submitted landings.

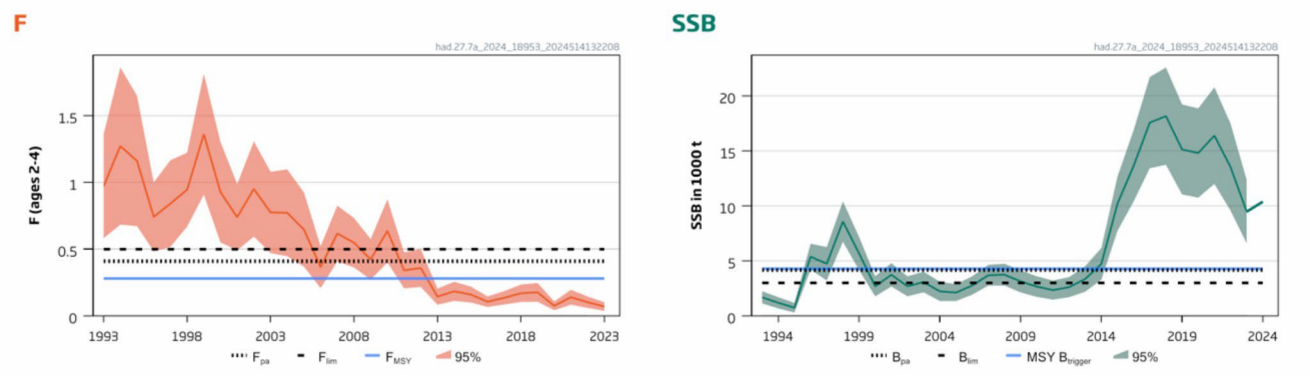
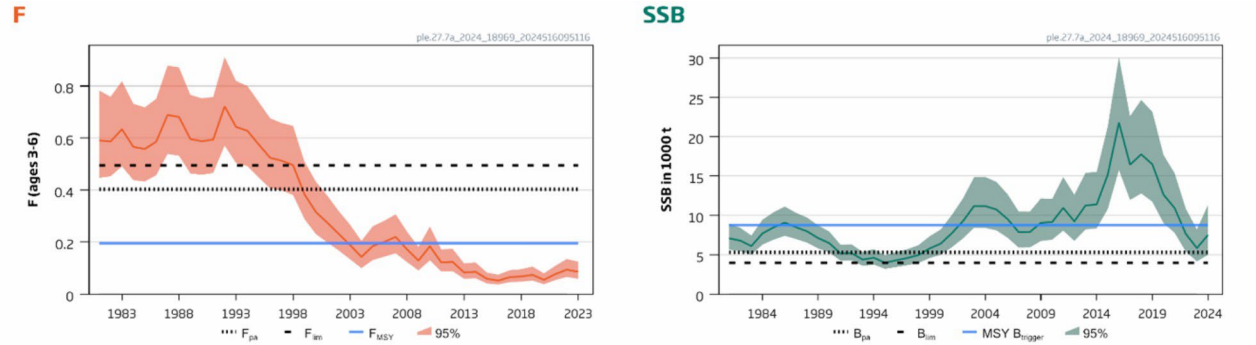
For some stocks in Division 27.7.a discard data are estimated by WGCSE single-stock assessors outside the ICES InterCatch system prior to the single-stock assessment, and in these cases discard data in InterCatch formats were sourced directly from the stock coordinators of these stocks. In the case of whg.27.7a this related to changes in data processing to accommodate incorporation of other sampling sources following disruptions to sampling programmes. In *Nephrops* FU14 there was no discard data available in 2020 due to the Covid-19 pandemic. Therefore, discard rates were estimated as the mean value of the three preceding years (per country and métier), as per the WGCSE single-stock assessment for this stock. An adjustment was made to the discard estimate of ple.27.7a for the English OTB_CRU_70_99_0_0_all in 2021 to match the single-stock assessment as the discard raising for this fleet was conducted outside InterCatch for that year. Haddock discards for 2022 from some Irish fleets were also estimated separately due to low sampling and were therefore received directly from the WGCSE stock assessor.

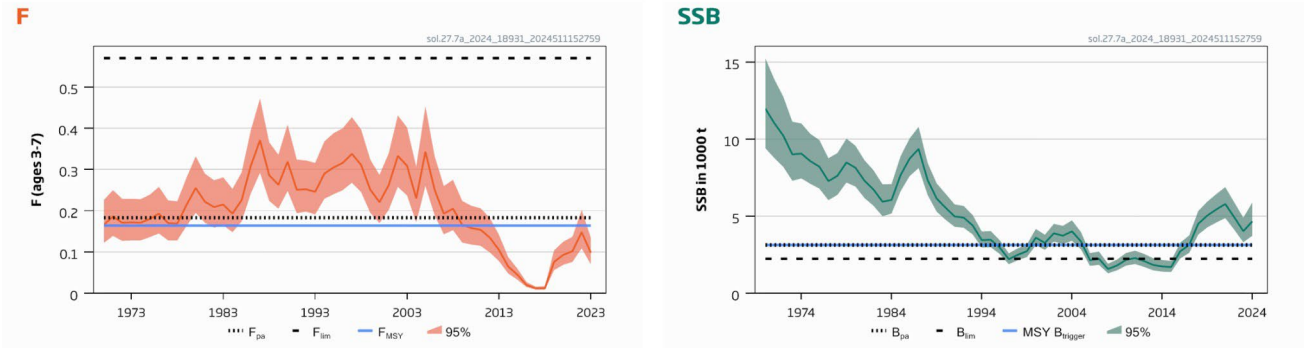
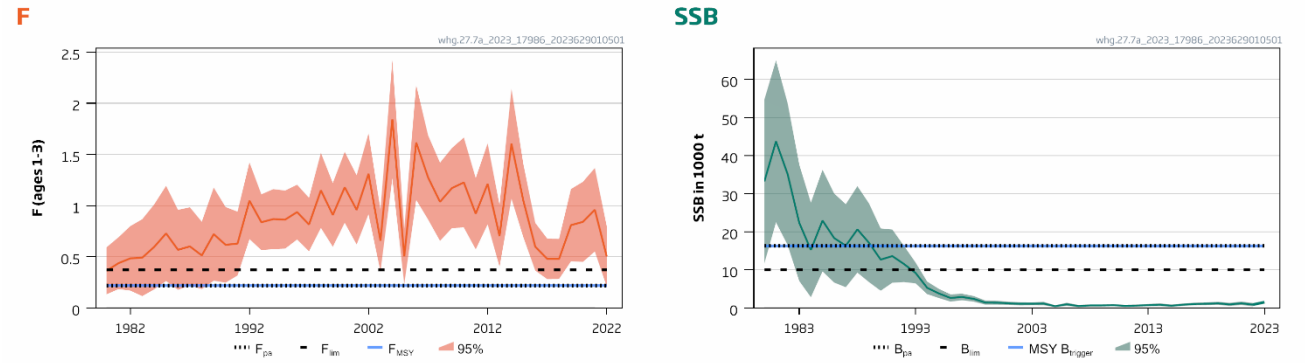
Overall, the conformity of métiers in MIXFISH and InterCatch was high, however, it would be desirable for countries to continue improving the consistency between data uploaded to InterCatch and data submitted to WGMIXFISH (for details see 5.3.7 Quality Control).

Table 5.3. Summary of advice, fishing pressure/harvest rate and stock trends for the stocks included in the Irish Sea mixed fisheries model (ICES 2024a)

Fish stocks

Species	Area	Stock status	Advice
cod.27.7.a	Irish Sea – Division 7a (excluding rectangles 33E2 and 33E3)	  **Summary:** Fishing pressure on the stock is below F_{MSY}, and spawning-stock size is below MSY $B_{trigger}$, B_{pa}, and B_{lim}.	ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2025. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock.

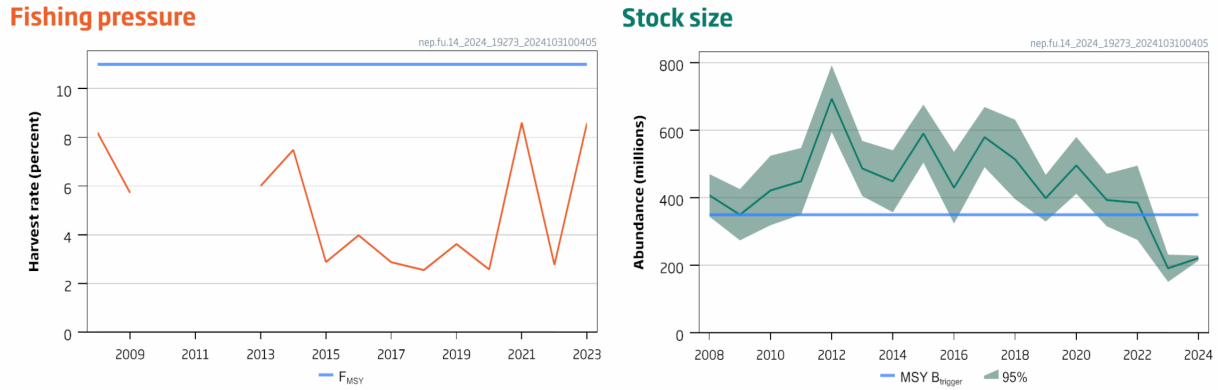
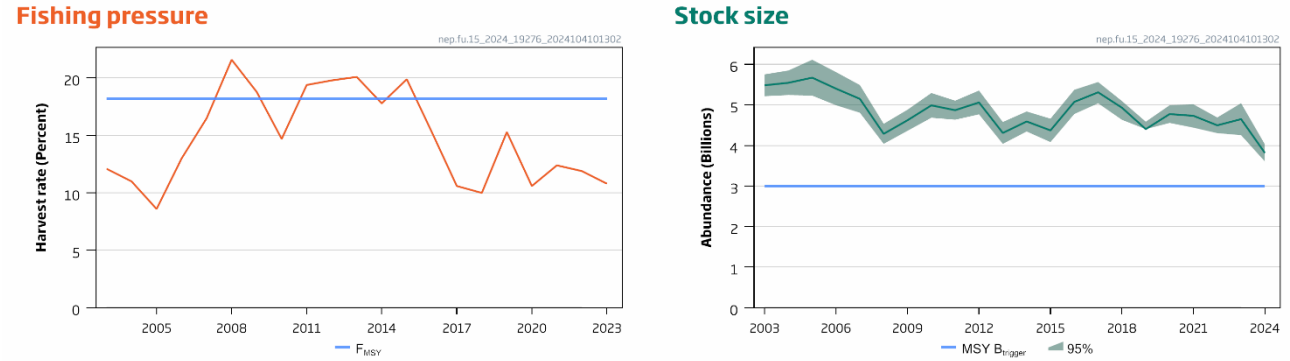
Species	Area	Stock status	Advice
had.27.7a (Haddock)	Irish Sea – Division 7a (excluding rectangles 33E2 and 33E3)		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 1 893 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock.
		Summary: Fishing pressure on the stock is below F_{MSY}, and spawning–stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.	
ple.27.7a (Plaice)	Irish Sea – Division 7a		ICES advises that when the MSY approach is applied catches in 2025 should be no more than 1 504 tonnes.
		Summary: Fishing pressure on the stock is below F_{MSY}; spawning-stock size is below MSY $B_{trigger}$ but above B_{pa} and B_{lim}.	

Species	Area	Stock status	Advice
sol.27.7a (Sole)	Irish Sea – Division 7a		ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 609 tonnes.
Whg.27.7a	Irish Sea – Division 7a (excluding rectangles 33E2 and 33E3)		ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catches in 2024 and 2025.

Summary: Fishing pressure on the stock is below F_{MSY}; spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Summary: Fishing pressure on the stock is above F_{MSY}, F_{pa}, and F_{lim}; spawning-stock size is below MSY $B_{trigger}$, B_{pa}, and B_{lim}.

Nephrops stocks

Species	Area	Stock status	Advice
nep.fu.14 (*Nephrops*)	Divisions 7.a, Functional Unit 14 (Irish Sea, West)	 **Summary:** Fishing pressure on the stock is below F_{MSY}, and stock size is below MSY $B_{trigger}$.	ICES advises that when the MSY approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2016–2023, catches in 2025 should be no more than 297 tonnes.
nep.fu.15 (*Nephrops*)	Divisions 7.a, Functional Unit 15 (Irish Sea, West)	 **Summary:** Fishing pressure on the stock is below F_{MSY}, and stock size is above MSY $B_{trigger}$.	ICES advises that when the MSY approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 10 062 tonnes. To ensure that the stock in Functional Unit (FU) 15 is exploited sustainably, management should be implemented at the FU level.

5.3.4 Building the fleet

The above data sources are then combined to produce the "fleet object" which is used as an input for the FCube model. Fleet objects were created using the FLCore 2.6.19 and FLFleet 2.6.1 packages, fleets were defined by their country and predominant fishing gear and target fishery based on mesh-size. Vessel lengths have not been used in the categorization of fleets, due to the relatively small size of the fishery operating in the Irish Sea. Fleet categories are not necessarily exclusive, and individual boats may contribute to the effort of multiple fleets if they change their fishing gear (i.e. boats may be polyvalent). Within countries fleets were split based on the following categories:

- Beam trawls (all sizes)
- Otter trawls crustaceans (mesh-size 70-99mm)
- Otter trawls demersal fish (mesh-size ≥ 100mm)
- Pelagic gears (32-69mm)
- Seines

Any fleets which did not land > 1% of any stock in the model were then grouped into an 'MIS_MIS' fleet to reduce model complexity.

Métiers were based on the Technical Regulation (TR) classes methodology outlined in the long-term plan for cod stocks, with an added category to describe gears targeting pelagic fish (OTM/PTM mesh-size 32-69mm). Midwater otter trawls with a mesh-size >100mm were included in the TR1 category. Specifically:

Gear groupings and assigned métiers in the FCube fleets:

a) Bottom trawls and seines (OTB, OTT, PTB, SDN, SSC, SPR, OTM) of mesh:
   1. TR1 equal to or larger than 100 mm,
   2. TR2 equal to or larger than 70 mm and less than 100 mm,
   3. TR3 equal to or larger than 16 mm and less than 32 mm;

b) Beam trawls (TBB) of mesh:
   1. BT1 equal to or larger than 120 mm
   2. BT2 equal to or larger than 80 mm and less than 120 mm;

c) Gillnets, entangling nets (GN);

d) Trammelnets (GT);

e) Longlines (LL)

f) Pelagic – Otter or pelagic trawls with mesh sizes 32-69mm

Métiers accounting for < 1% of landings of any stock within a fleet were grouped as 'MIS'. This process resulted in 12 fleets, with 1 métier per fleet for all fleets except pelagic fleets which include 2 métiers (Figure 5.4). Six separate métier classes were included in the final fleet objects: TR1, TR2, BT2, PTM_SPF, OTM_SPF and MIS. Métiers are described according their DCF level 5 métiers in the advice sheet for consistency with DCF, WGMIXFISH accessions and Celtic Seas Ecoregion terminology.

Table 5.4 Fleets and métiers used in the Irish Sea mixed-fisheries model.

FCube Fleet name	Country	FCube métier name	DCF métier	Gear	Target species
Beam_all_BE	Belgium	BT2	TBB_DEF	Beam trawls	Demersal fish
Beam_all_EN	England (UK)	BT2	TBB_DEF	Beam trawls	Demersal fish
Beam_IE	Ireland	BT2	TBB_DEF	Beam trawls	Demersal fish
DSeine_IE	Ireland	TR1	SSC_DEF	Scottish seines	Demersal fish
Otter_CRU_EN	England (UK)	TR2	OTB_CRU	Otter trawls	Crustaceans
Otter_CRU_IE	Ireland	TR2	OTB_CRU	Otter trawls	Crustaceans
Otter_CRU_NI	Northern Ireland (UK)	TR2	OTB_CRU	Otter trawls	Crustaceans
Otter_DEF_BE	Belguim	TR1	OTB/OTM_DEF	Otter trawls	Demersal fish
Otter_DEF_IE	Ireland	TR1	OTB/OTM_DEF	Otter trawls	Demersal fish
Otter_DEF_EN	England (UK)	TR1	OTB/OTM_DEF	Otter trawls	Demersal fish
Otter_DEF_NI	Northern Ireland (UK)	TR1	OTB/OTM_DEF	Otter trawls	Demersal fish
Pelagic_NI	Northern Ireland (UK)	Pelagic	OTM/PTM_SPF	Pelagic/midwater trawls	Pelagic fish
*MIS_MIS	Any	MIS	OTHER	Other gears, including dredges, pots, gillnets, trammelnets, longline trawls and gears reported as miscellaneous	Any

*** Fleets and métiers with landings < 1% of any of the stocks in the model (average 2021 to 2023). The "MIS_MIS" fleet is not included in Figure 5.11 or in the count of fleets most or least restricted by a stock.**

Alternative configurations for fleets in the Irish Sea model were discussed at the WGMIXFISH 2022 Irish Sea Mixed Fisheries Model Review meeting, and at the WGMIXFISH-Methods meeting 2022 (see ICES 2022, pp 63-65 for details). Both of these meetings upheld the view that the separation of fleets into separate groupings relating to *Nephrops* (CRU) and demersal (DEF) fisheries produced more realistic model behaviour than previous model versions which grouped these métiers within national 'otter trawl fleets'. Specifically, disaggregating these métiers allows the model to simulate the behaviour where boats may continue fishing with a different métier (e.g. OTB_CRU instead of OTB_DEF), even after the one of these métiers has reached its limit for a particular stock. For example, under the current configuration, if a nation has reached its landings quota (stock share) of cod for its OTB_DEF fleet, that nation would be able continue fishing with its OTB_CRU fleet, if either a) there was still landings quota for cod available to the OTB_CRU fleet, or b) if the OTB_CRU fleet for that nation did not catch any cod in the model.

5.3.5 Quality control

5.3.5.1 Métier coding – WGMIXFISH vs. InterCatch

Where possible discard estimates were retrieved from InterCatch and assigned to the same métiers within the WGMIXFISH accessions files. This method relies on being able to match métier definitions between the two datasets. Where an exact match was not possible, expert knowledge was used to apply discard rates from similar InterCatch métiers (see Table 5.5). These métier year combinations accounted for < 1% of the total accessions landings for the stocks in the model.

5.3.5.2 Matching Accessions, InterCatch and ICES landings

The initial match between the accessions landings, InterCatch landings and official landings was good (Figure 5.6). However, some small discrepancies remained between the WGMIXFISH accessions landings for gadoid stocks (cod, haddock and whiting) for some fleets. Therefore, WGMIXFISH accession landings data were rescaled per country, métier and gadoid stock to exactly match those used in the single-stock assessment prior to further analyses. Following the matching of landings data described above, discard rates from InterCatch were applied to the WGMIXFISH accessions landings to estimate discards. There was a good match between the accessions calculated discards, InterCatch discards and ICES advice discards for all stocks.

In ple.27.7a discards are treated differently in the single-stock assessment stock objects. For plaice, discards are adjusted by an estimated 40% dead discard rate in the assessment to represent survivability of discarded catch (i.e. total discards x 0.6 = dead discards; ICES, 2024a). Therefore, the dead discard rate was applied to plaice discards on the country, year, métier level within the mixed fishery fleet objects. After the FCube mixed-fisheries forecast, the dead discards of plaice onto the forecast catch estimates as per the single-stock assessment process. These procedures are intended to maximize consistency between the single-stock assessment and mixed fisheries model.

5.4 Mixed fisheries forecasts

5.4.1 Description of scenarios

5.4.1.1 Baseline runs

The objectives of the single-species stock baseline runs were to:

1. reproduce as closely as possible the single-species advice,
2. act as the reference scenario for subsequent mixed fisheries analyses.

The various single-stock forecasts produced by the single species assessment Working Groups are performed using different software and setups (Table **Error! Reference source not found.**). The FCube model has been coded as a method in R 64bit (R Development Core Team, 2008), as part of the FLR framework (Kell *et al.*, 2007, www.flr-project.org). Input data are in the form of FLFleets and FLStocks objects from the FLCore 2.6.16 package, and two forecast methods were used, stf() from the FLAssess (version 2.6.3) and fwd() from the Flash (version 2.5.11) packages. Stock objects were processed using FLa4a (version 1.8.2), FLXSA (version 2.6.5). As such, the input parameterization as well as the stock projections are made externally using existing methods and packages, while only 3 steps are internalised in the method, thus keeping full transparency and flexibility in the use of the model (see stock annex for details). In the mixed-fisheries baseline run, all forecasts for analytical fish stocks were calculated using the FLR forecast method.

Nephrops in the Irish Sea mixed fishery model represent the sum of FU14 and FU15 *Nephrops* stocks (see sections 5.2.2 and 5.3.1 for details). Therefore, in the baseline run forecasts for this stock are compared to the sum of the advice for FU14 + FU15. Only catches and landings can be compared with the single-stock advice, as there is no comparable harvest rate for the combined stocks calculated in the single-stock advice. Future catches and landings of *Nephrops* are estimated following the single-stock procedures.

The same forecast settings as the single species assessment are used for each stock regarding weight-at-age, selectivity, and recruitment, as well as assumptions on the F in the intermediate year and basis for advice as the single-stock forecasts for the baseline run. This ensured greater coherence between the single-stock and mixed fishery forecasts. Some differences can occur in the forecast calculations, (because of the diversity of single-stock assessment methods used) and WGMIXFISH always investigates in depth the reasons for potential discrepancies. Adjustments to the FCube forecast methods are made if necessary to minimize discrepancies.

The baseline run acts as a quality control procedure to ensure that the stock objects and projection methods closely match those used in the single-stock assessment. The baseline run has the additional benefit of acting as a quality control check on the projections produced by the single-stock assessments.

5.4.1.2 Mixed fisheries runs

FCube intermediate and forecast year assumptions

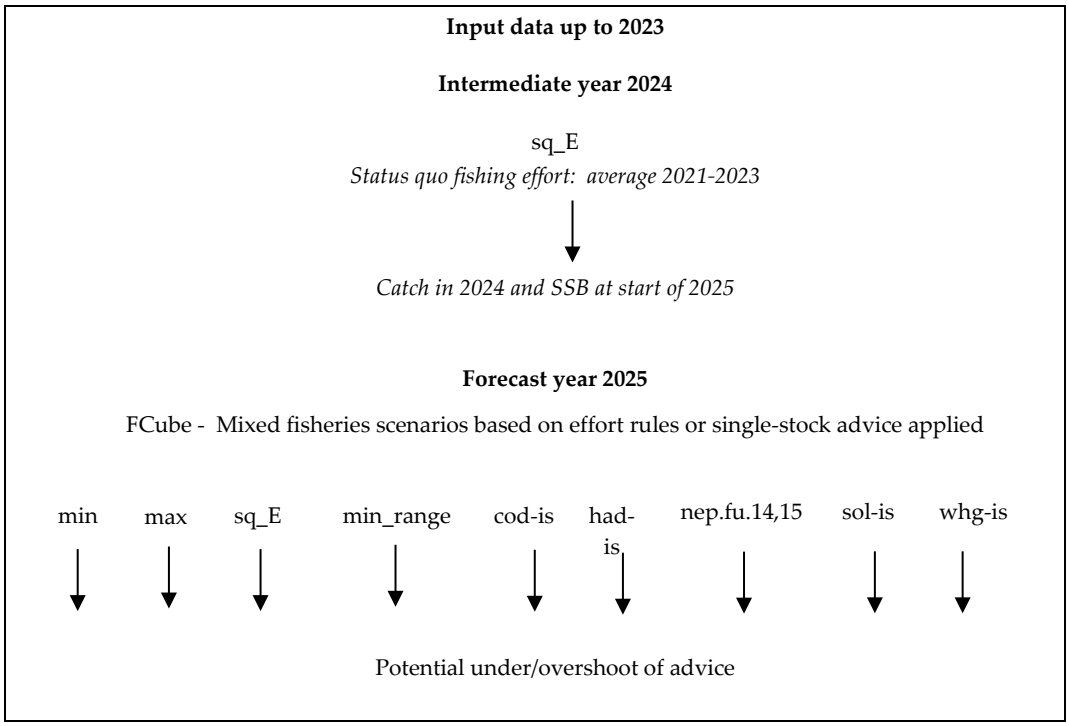
In all FCube scenarios, the effort of fleets and métiers in the intermediate year was the average of the three preceding data years (2021-2023). This is similar to an intermediate year assumption of mean *F* of the preceding three years commonly used in single-stock assessments, but individual single-stock assessments may differ in their intermediate year assumptions. These differences in assumptions may produce small differences in intermediate year forecasts between mixed fisheries and single-stock assessments. FCube catchabilities are the mean of last three data years per métier. Stock shares of fleets and métiers are calculated as the average proportion of catches reported by each fleet and métier in the preceding three data years.

No landings to discards split is presented for forecast years in the mixed fisheries model projections. Internally, the model assumes all catch of cod, haddock and sole in the intermediate and forecast years to be landed, concordant with a full application of a landings obligation in future years. Plaice discards are treated within the stock objects in the same manner in the single-stock assessment, and discards are added to the forecast values projected by FCube as per the single-stock advice process.

FCube analyses for the TAC year (2024)

Nine mixed fisheries scenarios were run as outlined in Section 5.2.2 above. A 'min', 'max', *status quo,* and 'min_range' scenario, and stock-specific scenarios with a fishing mortality consistent with the *F* in the single-stock headline advice for cod, haddock, *Nephrops*, sole and whiting. A scenario for plaice was not run as plaice is primarily a bycatch stock of other fisheries in the region, and the current ICES catch advice for plaice in 7.a. is unlikely to be limiting in 2025 based on recent observed catches. A retrospective analysis highlighted difficulties in predicting catches of sole based on Norway lobster and gadoid catches under previous model assumptions (ICES, 2023). This is due to differences in the fleet behaviour of fleets predominantly targeting sole (beam trawl fleets and Belgian otter trawls), which are largely unrelated to other fisheries in the region. Therefore, this year, the stock-specific scenarios (Table 5.2.2) additionally restrict the effort of fleets targeting sole in the region, based on the zero-catch advice for sole in 2025.

In summary, the FCube runs followed the scheme below:



5.4.2 Results of FCube runs

5.4.2.1 Baseline run – reproducing the single-stock advice

Overall consistency of results between single species stock assessments and FCube baseline runs was achieved, based on comparisons of predicted catches, landings, SSB and Fbar in 2024 and 2025 for analytical stocks (Table 5.7, Figures 5.7 and 5.8), and landings and catch in 2025 for *Nephrops* stocks (Table 5.7). For demersal fish stocks the differences between the baseline runs ('reproduce the advice') forecasts and those of WGCSE were small (≤ 3.9% in all cases). The largest deviations were seen for plaice and sole and likely result from the difference in the forecast method used (i.e. FLR in the mixed fisheries forecast rather than SAM which is used in the single-stock assessment). However, these differences were low for both for both plaice and sole, and therefore FLR was considered to be an appropriate method for reproducing this stock forecast in the Irish Sea FCube model this year. *Nephrops,* comparisons between the forecast in 2024, and the sum of the advice targets for NEP14 and NEP15 from the WGCSE showed very small differences (≤ 1%). Hence, the process of merging the stocks in the mixed fisheries model is considered an adequate match for the advice forecasts conducted at the functional unit level by WGCSE. For all model stocks, the deviation from the in single-stock advice was well below the acceptable deviation threshold of 10%, applied in other advice regions.

Figure 5.9 shows the required change in fishing mortality for each fish stock if the intermediate year assumptions (2024) and advice targets (2025) of the single-stock advice are to be met. A large reduction in Fbar would be required to meet the advice target of zero catch for whiting in 2023, with a small reductions in the Fbar of cod also required. Meanwhile, an increase in Fbar would be required to catch up to the advice of haddock and plaice. *Nephrops* catches in recent years are also considerably below current single-stock advice.

5.4.2.2 Mixed fisheries analyses

The overview of the FCube catch projections for each scenario is shown in Tables 5.8-5.10 and Figures 5.10-5.11. In contrast to single-stock advice there is no single advised catch level based

on the mixed fishery approach, instead a range of scenarios are presented. Scenarios that result in under- or overshoot of single-stock advice are useful in identifying imbalances between the fishing advice for the various stocks. They indicate the direction in which fleets may have to adapt to fully utilize their catch opportunities without collectively exceeding single-stock fishing opportunities. ICES single-stock advice for the stocks considered here are based on a combination of the MSY approach and precautionary considerations. The MSY approach is used for haddock, sole and *Nephrops*. Scenarios for cod, and whiting are based on ICES zero-catch advice, based on precautionary considerations. In mixed fisheries scenarios, it is assumed that fleet fishing patterns in the forecast years are the same as observed in the recent past.

The "min" scenario is consistent with a full implementation of a landing obligation given the individual single-stock advice (Table 5.8, Figure 5.10; i.e. all fleets stop fishing when their stock-share of any individual stock is reached). For 2025, the "min" scenario shows that whiting limits all 12 fleets. This is due to the zero-catch advice for whiting and because all fleets catch whiting. Secondarily, cod is also limiting due to the zero-catch advice, and is caught by 11 of the 12 fleets (Figure 5.11).

The "max" scenario shows the upper bound of potential fleet effort and stock catches (Table 5.8, Figure 5.10), in that it assumes all fleets continue fishing until all their stock shares for all stocks are exhausted irrespective of economic viability, legality, or fleet capacity. For 2025, the "max" scenario, shows that haddock would be the least limiting stock for nine out of 12 fleets, and plaice for two fleets (Figure 5.11).

The *status quo* effort "sq_E" scenario sets the effort of each fleet in the forecast years equal to the average of the effort in the most recent three years for which data are available (2021-2023). This scenario investigates the mixed-fisheries outcomes if the situation remains the same in terms of total effort and effort allocation among métier. For 2025, this scenario results in catch overshoots above the single-stock advice of cod and whiting (zero catch advice), and undershoots of haddock, plaice, Norway lobster and sole (Table 5.8, Figure 5.10).

The "min_range" scenario explores how the higher catch options associated with the FMSY upper or scaled F_{MSY} reference points (for stocks where ranges are defined, including zero-advice stocks) may reduce choking behaviour in mixed fisheries and increase overall quota uptake. Catches for all stocks in 2025 are marginally increased above the "min" scenario, primarily because of the increase in catch opportunity provided by the scaled F_{MSY} advice rule used in place of the zero catch advice for cod and whiting in this scenario (Table 5.8, Figure 5.10).

In addition, several stock-specific scenarios are presented to further explore the consequences of individual stock catch advice on the catches of other stocks. In all stock-specific scenarios, fleets which target sole (all beam trawls and Belgian otter trawls) are assumed to also be restricted by the catch advice for sole in 2025 in addition to the scenario-specified stock.

The "nep-is" scenario results in an overshoot for cod and whiting and an undershoot for haddock, plaice and sole. The "had-is" scenario would result in an overshoot of the catch advice for other stocks, except plaice. Catches in both the "nep-is" and "had-is" advice scenarios are considerably above those of the "sq_E" scenario, indicating that the fishing effort required to achieve the 2025 catch advice for Norway lobster and haddock is higher than that observed in recent years (Table 5.8, Figure 5.10).

The "cod-is" and "whg-is" scenarios are presented to explore the consequences of the zero-catch advice for these stocks. The "whg-is" scenario implies that catches of the other Irish Sea stocks would also be zero (equal to the "min" scenario). The "cod-is" scenario suggests that there would be some small catches of whiting by a single fleet which is not restricted by the zero-catch advice for cod (Figure 5.11).

Taken together these results indicate that it is unlikely to be possible to achieve all single-species management objectives simultaneously. ICES single-stock advice for demersal stocks is based on ICES maximum sustainable yield (MSY) approach. However, only the 'min' scenario can be considered in keeping with the precautionary principle, due to zero catch advice for cod and whiting in the region. Here, cod and whiting SSB is projected to remain below B_{lim} in 2026 under all scenarios. Plaice SSB in 2026 is projected to be above B_{lim} but below B_{pa} in the 'max','sq_E', 'had-is', 'nep-is' and 'sole-is' advice scenarios, but above all biomass reference points in the 'min', 'min-range', 'cod-is' and whg-is' scenarios. SSB of haddock and sole is projected to remain above all biomass reference points in all scenarios (Table 5.10)

The current mixed-fisheries scenarios illustrate the implications of the single-species advice for cod, haddock, Norway lobster, plaice, sole and whiting stocks. Additional scenarios for whiting in Division 7.a. are provided in ICES (2024b).

5.5 References

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Table 5.5 Mismatch between accessions and InterCatch métiers. Table shows the accessions métiers (WGMIXFISH) for which no matching métier was available from that country and year. InterCatch métiers from corresponding countries and years were used to apply discard rates to these accessions métiers. Total landings, indicates total landings for that country, year and métier in the accessions data.

Country	Accessions métier	Year	Tonnes in accession	InterCatch métier
EN	OTB_DEF_100-119_0_0_all	2020	2.328	OTB_DEF_>=120_0_0_all
EN	TBB_CRU_16-31_0_0_all	2021	0.002	OTB_CRU_16-31_0_0_all
EN	FPO_CRU_0_0_0_all	2022	0.255	MIS_MIS_0_0_0_all
EN	TBB_CRU_16-31_0_0_all	2022	0.082	OTB_CRU_16-31_0_0_all
IE	OTB_DEF_>=120_0_0_all	2020	140.692	OTB_DEF_100-119_0_0_all
IE	OTB_DEF_70-99_0_0_all	2020	12.200	OTB_CRU_70-99_0_0_all
IE	TBB_DEF_100-119_0_0_all	2020	0.86	TBB_DEF_70_99_0_0_all
IE	OTB_DEF_70-99_0_0_all	2021	12.79	OTB_CRU_70_99_0_0_all
IE	DRB_MOL_0_0_0_all	2022	0.310	MIS_MIS_0_0_0
IE	OTB_DEF_70-99_0_0_all	2022	25	TBB_DEF_70-99_0_0_all
NI	TBB_CRU_16-31_0_0_all	2020	5.093	OTB_CRU_70-99_0_0_all
NI	TBB_CRU_16-31_0_0_all	2021	1.152	OTB_CRU_70-99_0_0_all

Table 5.6 Irish Sea. Summary of the ICES single-species advice for 2025. Target Fs are left justified; harvest ratios are right justified.

Species	Agreed TAC 2024	Total Catch-advice for 2025	Projected landings-advice for 2025	Ftotal /Harvest ratio for 2025	F projected landings 2025	SSB 2026
cod.27.7a	165	0	0	0	0	6311
had.27.7a	2663	1893	1243	0.28	0.127	6264
nep.FU.14	18903*	297	279	7%**	n/a	n/a
nep.FU.15	18903*	9229	7951	18.2%**	n/a	n/a
ple.27.7a	1902	1504	485	0.182	0.048	8237
sol.27.7a	625	609	529	0.164	0.131	4502
whg.27.7a	721	0	0	0	0	1223^

*** TAC applies to all FU's of Subarea 7, of which no more than 4560 t may be caught in FU16.**

**** Harvest ratio for projected landings + projected dead discards**

***** Single-stock advice for whg.27.7a was last issued in 2023. SSB values for 2026 are from the 2024 WGCSE update assessment (ICES, 2024a)**

Table 5.7 Comparison between the outputs from the baseline run (reproduction of advice) and ICES advice. Figures for 2023 compare results from the baseline run (FLR forecasts) to the ICES single-stock intermediate year results. In the case of zero-catch advice stocks (cod.27.7.a and whg.27.7a) reproduction of the advice is tested against the F_{MSY} catch option from the single-stock advice. As whg.27.7a single-stock advice is issued on a two-year cycle, there is no landings or catch for the intermediate year from the single-stock advice shown. The baseline run uses the same assumptions for F in the intermediate year as the forecasts leading to ICES advice.

year	stock	value	FCube.baseline	Single.Spp.Advice	Difference
2024	cod.27.7a	catch	103	103	0.00
2024	cod.27.7a	Fbar	0.020	0.020	0.00
2024	cod.27.7a	landings	94	94	0.00
2024	cod.27.7a	ssb	8266	8266	0.00
2025	cod.27.7a	catch	727	727	0.00
2025	cod.27.7a	Fbar	0.171	0.171	0.00
2025	cod.27.7a	landings	641	641	0.00
2025	cod.27.7a	ssb	6399	6399	0.00
2026	cod.27.7a	ssb	5598	5598	0.00
2024	had.27.7a	catch	897	906	-1.00
2024	had.27.7a	Fbar	0.104	0.104	0.00
2024	had.27.7a	landings	646	646	0.00
2024	had.27.7a	ssb	10382	10382	0.00
2025	had.27.7a	catch	1868	1893	-1.30
2025	had.27.7a	Fbar	0.28	0.28	0.00
2025	had.27.7a	landings	1243	1243	0.00
2025	had.27.7a	ssb	7917	7917	0.00
2026	had.27.7a	ssb	6264	6264	0.00
2025	nep.7a	catch	10419	10359	0.60
2025	nep.7a	Fbar	0.176	NA	NA
2025	nep.7a	landings	9018	8937	0.90
2024	ple.27.7a	catch	664	674	-1.50
2024	ple.27.7a	Fbar	0.086	0.086	0.00
2024	ple.27.7a	landings	214	217	-1.40
2024	ple.27.7a	ssb	7439	7526	-1.20
2025	ple.27.7a	catch	1457	1504	-3.1

year	stock	value	FCube.baseline	Single.Spp.Advice	Difference
2025	ple.27.7a	Fbar	0.182	0.182	0.00
2025	ple.27.7a	landings	470	485	-3.2
2025	ple.27.7a	ssb	7928	8134	-2.5
2026	ple.27.7a	ssb	7919	8237	-3.9
2024	sol.27.7a	catch	428	436	-1.80
2024	sol.27.7a	Fbar	0.116	0.116	0.00
2024	sol.27.7a	landings	377	382	-1.30
2024	sol.27.7a	ssb	4573	4665	-2.0
2025	sol.27.7a	catch	594	609	-2.5
2025	sol.27.7a	Fbar	0.164	0.164	0.00
2025	sol.27.7a	landings	517	529	-2.3
2025	sol.27.7a	ssb	4566	4647	-1.70
2026	sol.27.7a	ssb	4455	4502	-1.00
2024	whg.27.7a	catch	1401	NA	NA
2024	whg.27.7a	Fbar	0.71	0.71	0.00
2024	whg.27.7a	landings	199	NA	NA
2024	whg.27.7a	ssb	1073	1074	-0.100
2025	whg.27.7a	catch	482	489	-1.40
2025	whg.27.7a	Fbar	0.22	0.22	0.00
2025	whg.27.7a	landings	67	67	0.00
2025	whg.27.7a	ssb	1210	1211	-0.100
2026	whg.27.7a	ssb	1756	1758	-0.100

Table 5.8 Mixed fisheries for the Irish Sea. Catches in 2025 (tonnes) resulting from single-stock advice and under different mixed fisheries scenarios.

Stock	Single-stock advice	Catch (2025) resulting from mixed-fisheries scenarios								
	Catch (2025)*	min	max	sq_E	min_range	cod-is	had-is	nep-is	sol-is	whg-is
cod.27.7a	0	0	229	87	2	0	213	103	113	0
had.27.7a	1893	0	1864	765	17	0	1851	896	981	0
nep.fu.14, nep.fu.15	10359	0	18161	6821	157	0	18154	10358	10102	0
ple.27.7a	1504	0	1705	705	16	0	1229	965	987	0
sol.27.7a	609	0	1008	430	10	0	652	578	594	0
whg.27.7a	0	0	2419	1302	39	27	2390	1738	1714	0

Table 5.9 Mixed fisheries for the Irish Sea. Fishing mortality (F) in 2025 resulting from single-stock advice and under different mixed-fisheries scenarios for demersal fish species. Results are not presented for Norway lobster. The colour gradients of the legend show the forecast fishing mortality under each scenario in relation to reference points detailed in legend.

Stock	Single-stock advice	F (2025) resulting from mixed-fisheries scenarios								
	F (2025)	min	max	sq_E	min_range	cod-is	had-is	nep-is	sol-is	whg-is
cod.27.7a	0	0	0.052	0.0195	0.0004	0	0.048	0.023	0.025	0
had.27.7a	0.28	0	0.28	0.107	0.0023	0	0.28	0.126	0.139	0
ple.27.7a	0.182	0	0.22	0.085	0.00192	0	0.152	0.118	0.120	0
sol.27.7a	0.164	0	0.29	0.116	0.0026	0	0.181	0.159	0.164	0
whg.27.7a	0	0	1.84	0.70	0.0163	0.0113	1.80	1.05	1.03	0

Legend:

$F_{2025} \leq F_{MSY}$

$F_{MSY} < F_{2025} \leq F_{pa}$

$F_{pa} < F_{2025} \leq F_{lim}$

$F_{2025} > F_{lim}$

Table 5.10 Mixed fisheries for the Irish Sea. Spawning-stock biomass (SSB) in 2026 results from single-stock advice and under different mixed-fisheries scenarios. Results are not presented for Norway lobster. All weights are in tonnes. The colour gradients of the legend show the forecast SSB under each scenario in relation to reference points detailed in legend.

Stock	Single-stock advice	SSB (2026) resulting from mixed-fisheries scenarios								
	SSB (2026)	min	max	sq_E	min_range	cod-is	had-is	nep-is	sol-is	whg-is
cod.27.7a	6311	6312	6086	6226	6310	6312	6102	6210	6200	6312
had.27.7a	6264	8042	6250	7300	8025	8042	6262	7175	7093	8042
ple.27.7a	8237	8952	7749	8454	8940	8952	8085	8270	8254	8952
sol.27.7a	4502	4986	4086	4601	4977	4986	4403	4468	4454	4986
whg.27.7a	2175	2188	371	1106	2153	2164	386	790	806	2188

Legend:

$SSB_{2026} \geq B_{pa}$ or MSY $B_{trigger}$

$SSB_{2026} \geq B_{lim}$, no B_{pa} defined

$B_{lim} \leq SSB_{2026} < B_{pa}$

$SSB_{2026} < B_{lim}$

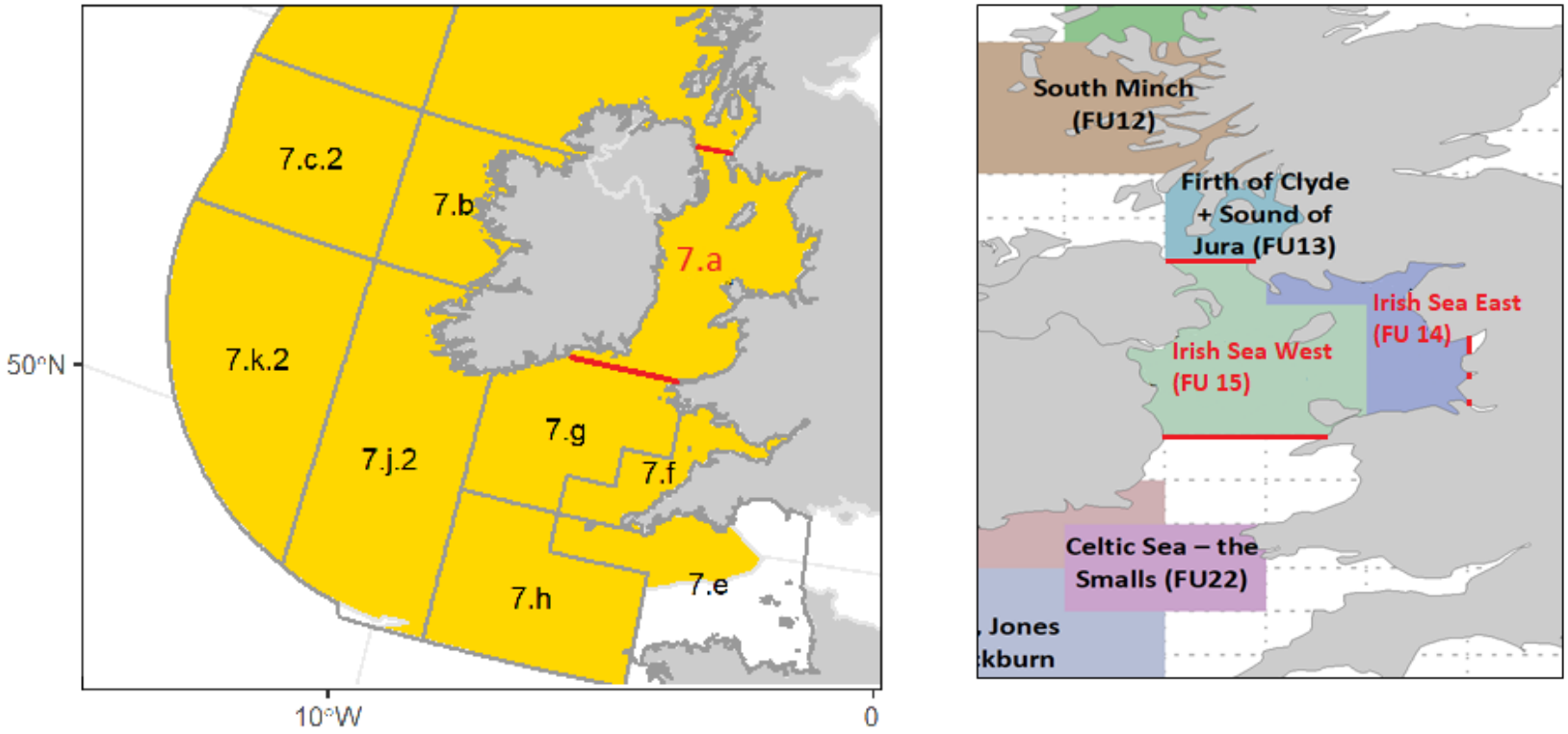


Figure 5.1. ICES Area description for fish (7a) and *Nephrops* Functional Units (FU) in the Irish Sea region.

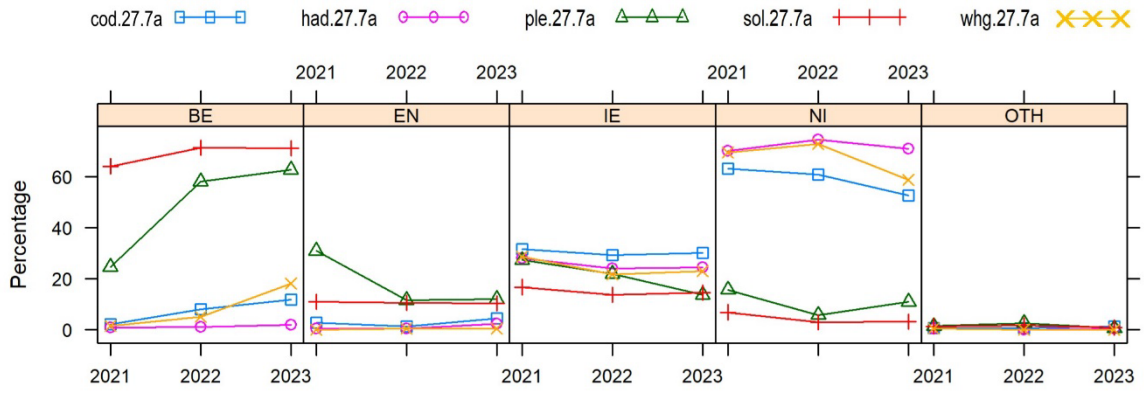


Figure 5.2. Percentage of total catches by country per fish stock 2021-2023. BE = Belgium, EN = England (UK), IE = Ireland, NI = Northern Ireland (UK). OTH = fleets of any nationality landing < 1% of any stocks.

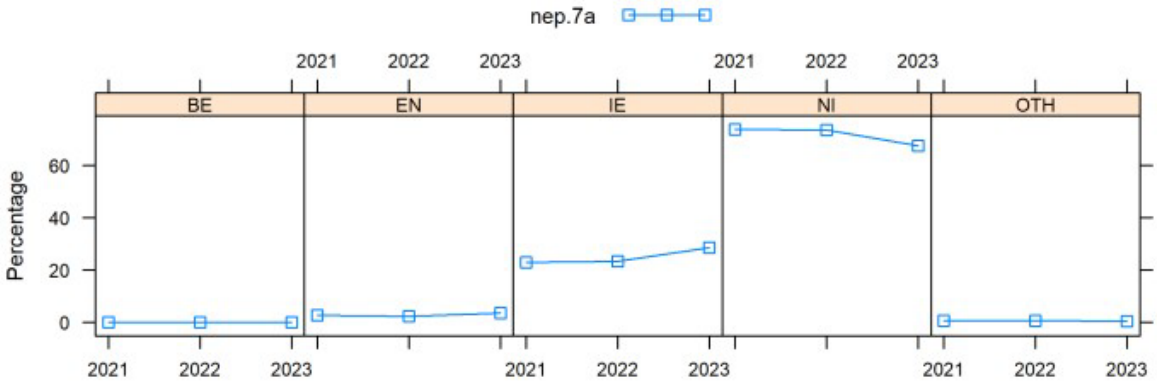


Figure 5.3. Percentage of total catches of *Nephrops* by country 2021-2023, BE = Belgium, EN = England (UK), IE = Ireland, NI = Northern Ireland (UK). OTH = fleets of any nationality landing < 1% of any stocks.

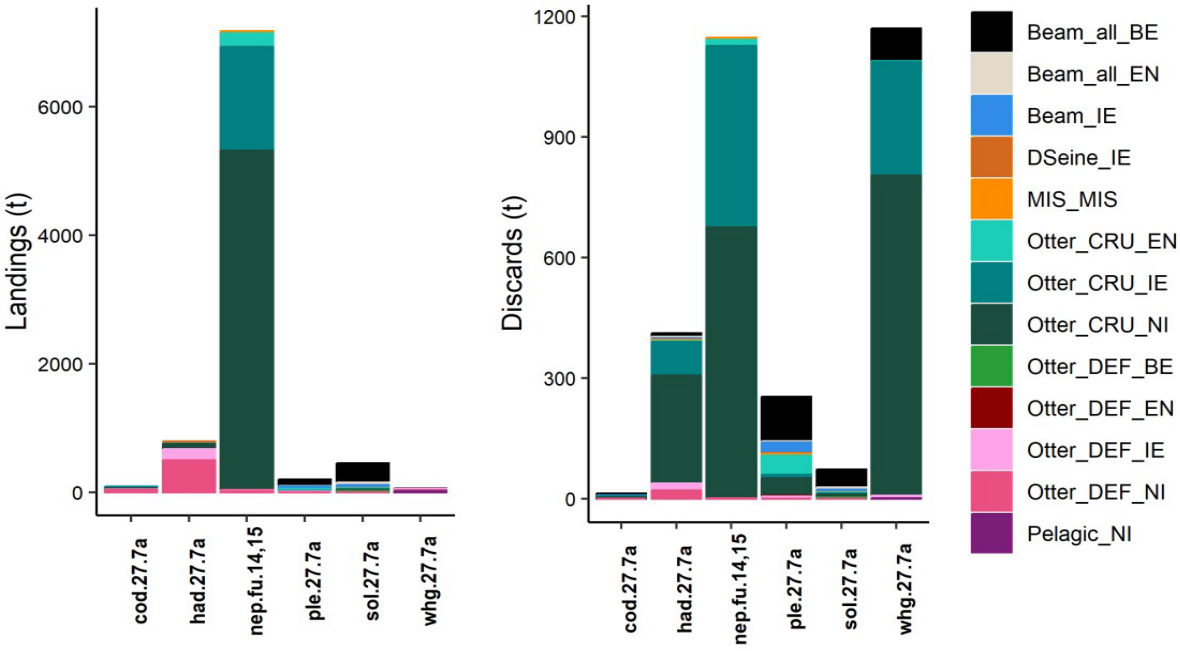


Figure 5.4. Landings and discards of stocks included in the FCube model by fleet (average 2021-2023). *Y*-axis scale differs between landings and discards plots. Colours indicate fleets used in the FCube model. Plaice discards are 'dead discards' only, calculated at the 40% survival rate as per the single species assessment.

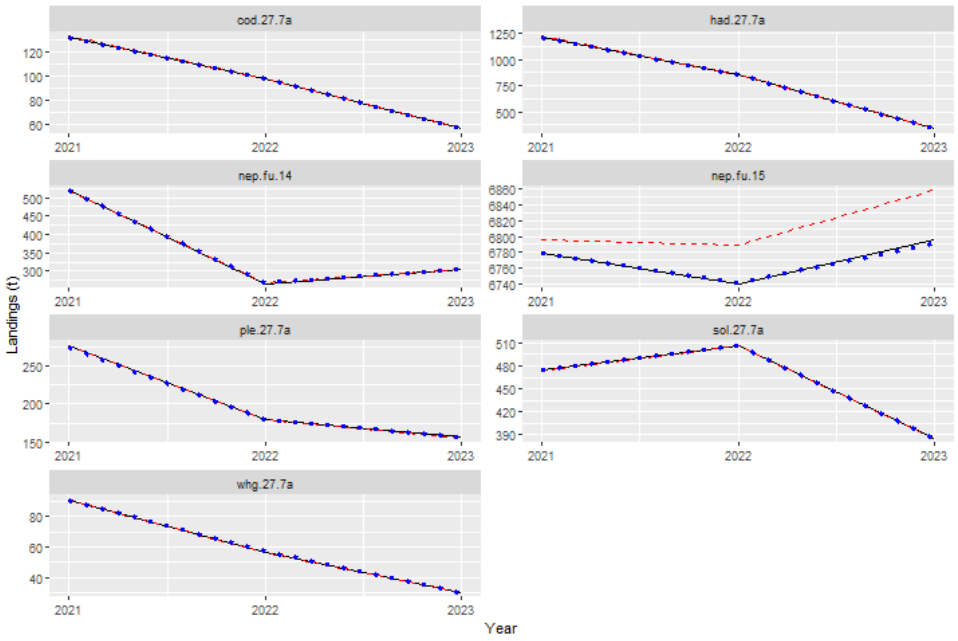


Figure 5.5. Quality control comparison of different sources of landings data. Blue dotted lines show ICES landings from WGCSE advice sheets, dashed red line shows WGMIXFISH accessions landings data and solid black lines show landings reported in InterCatch data. Note differing scales on y-axes per stock.

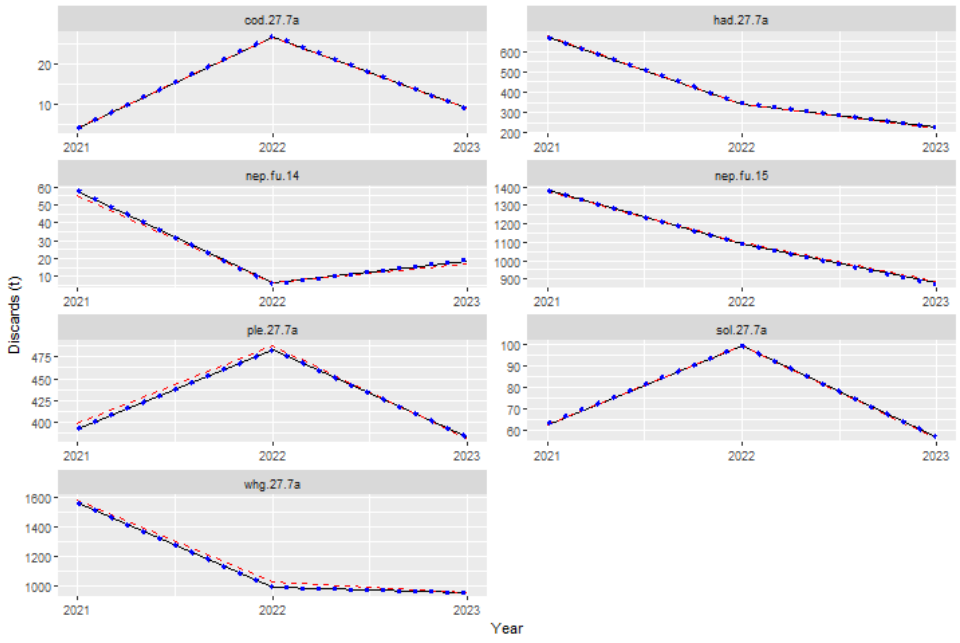


Figure 5.6. Quality control comparison of different sources of discards data. Blue dotted lines show ICES assessment discards from WGCSE advice sheets, dashed red line shows WGMIXFISH discards by applying the discards rate from InterCatch per métier, country and year to accessions landings. Solid black lines show discards reported in InterCatch data. Note differing scales on y-axes per stock.

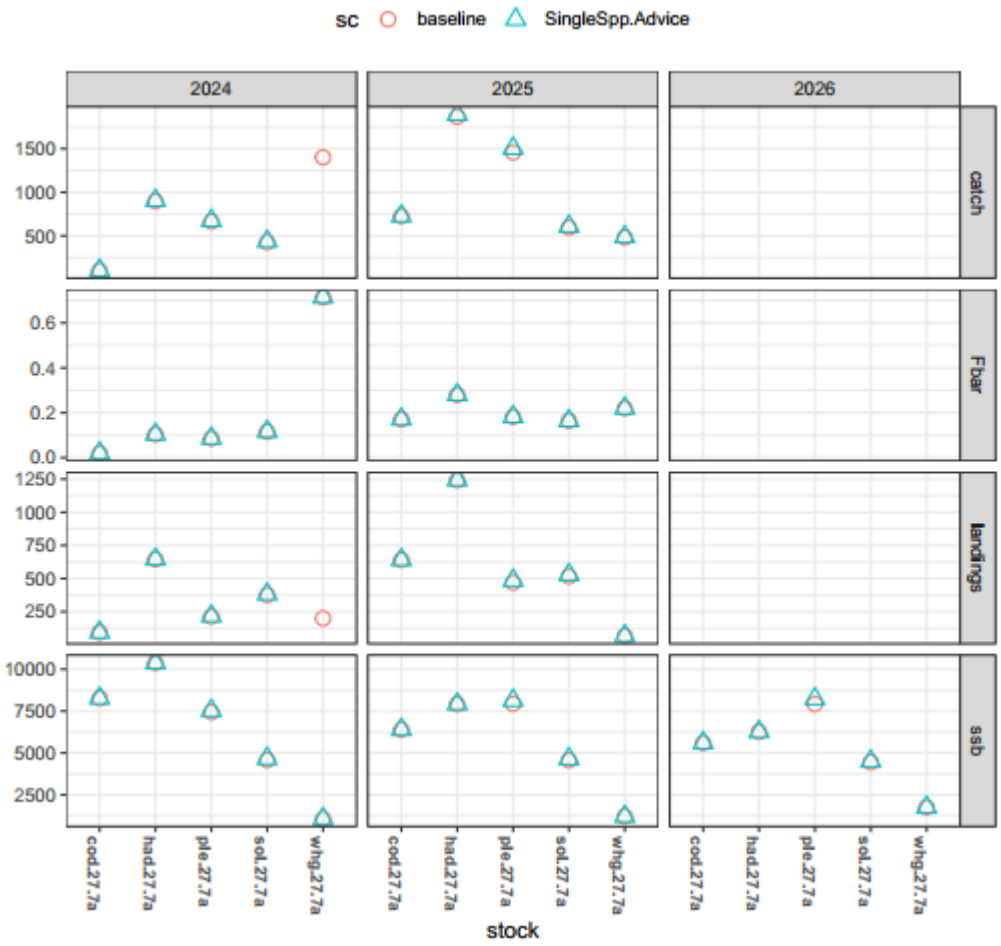


Figure 5.7. Irish Sea. Difference in absolute values between mixed fisheries baseline run (reproduction of advice) and single-stock advice for demersal fish stocks, showing catch, Fbar and landings (2024–2025) and SSB (2025–2026). In the case of zero-catch advice stocks (cod.27.7.a and whg.27.7a) reproduction of the advice is tested against the F_{MSY} catch option from the single-stock advice. As whg.27.7a single-stock advice is issued on a two-year cycle, there is no landings or catch for the intermediate year from the single-stock advice shown above.

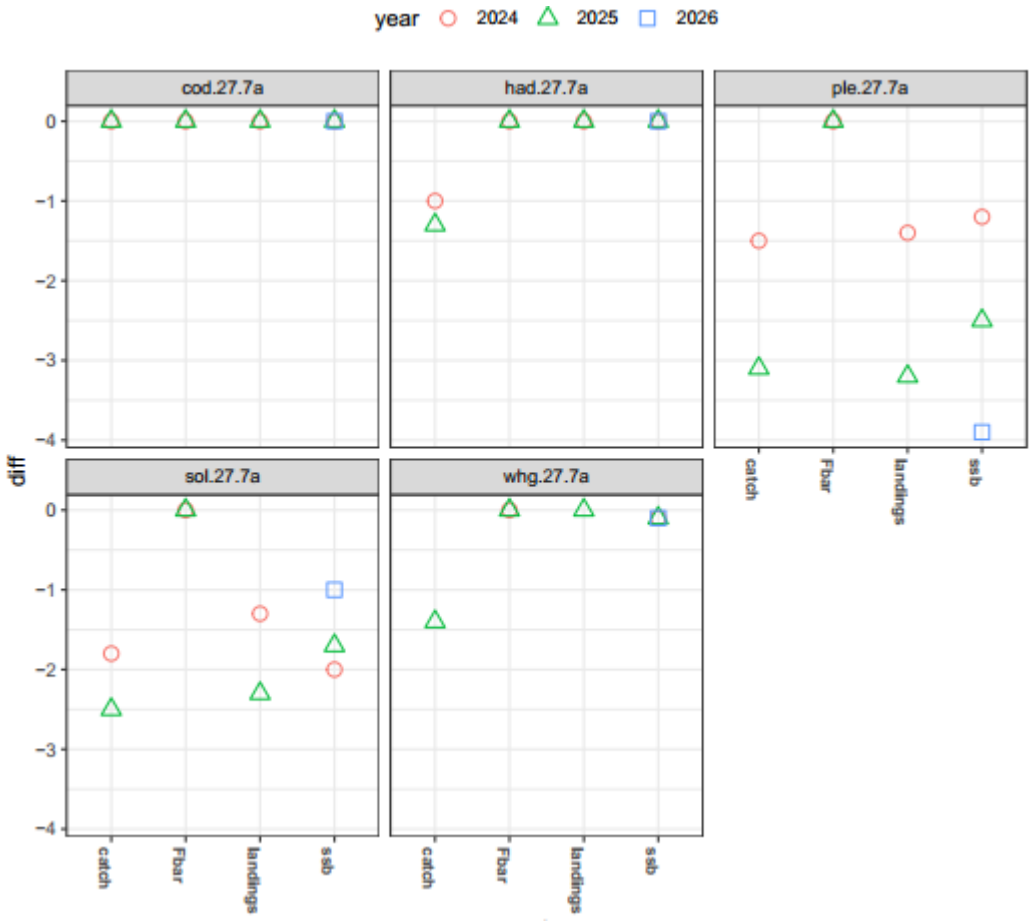


Figure 5.8. Irish Sea. Proportional difference between mixed fisheries baseline run (reproduction of advice) and single-species advice for finfish stocks, showing catch (tonnes), Fbar and landings (tonnes; 2024–2025) and SSB (tonnes; 2025–2026). In the case of zero-catch advice stocks (cod.27.7.a and whg.27.7a) reproduction of the advice is tested against the F_{MSY} catch option from the single-stock advice. As whg.27.7a single-stock advice is issued on a two-year cycle, there is no landings or catch for the intermediate year from the single-stock advice shown above.

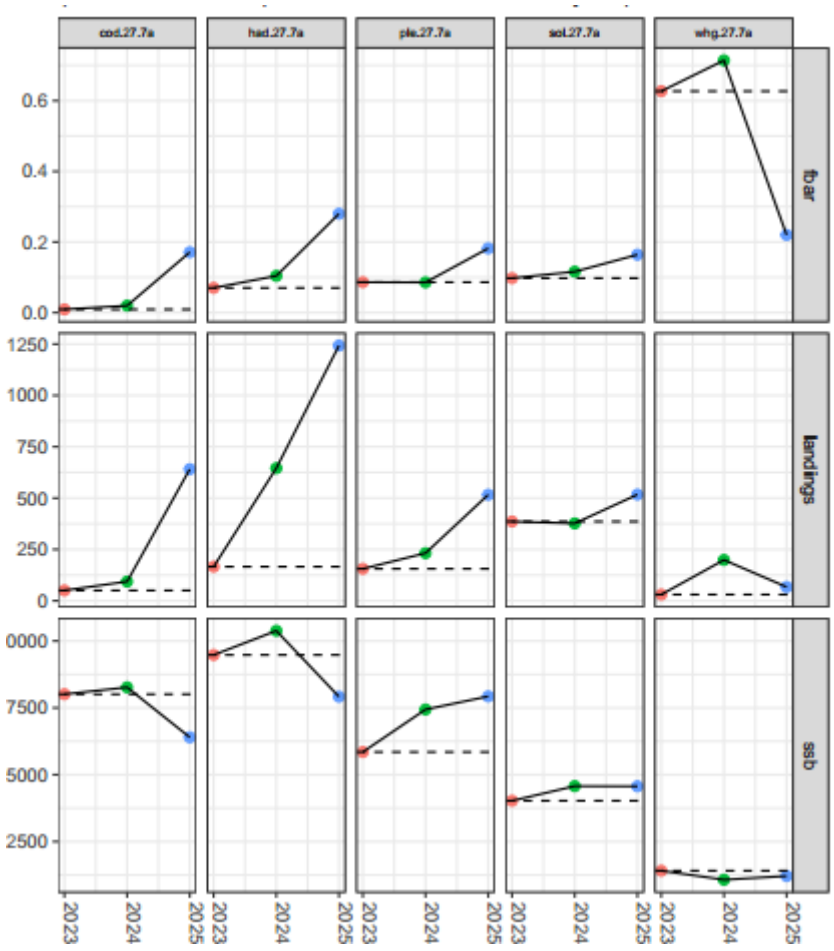


Figure 5.9. Change in fishing mortality (Fbar), landings (tonnes) and SSB (tonnes) assumed in the intermediate year (2024) and required for the advice year (2025) under the single-stock forecast assumptions. Dashed line represents value in the most recent data year (2023).

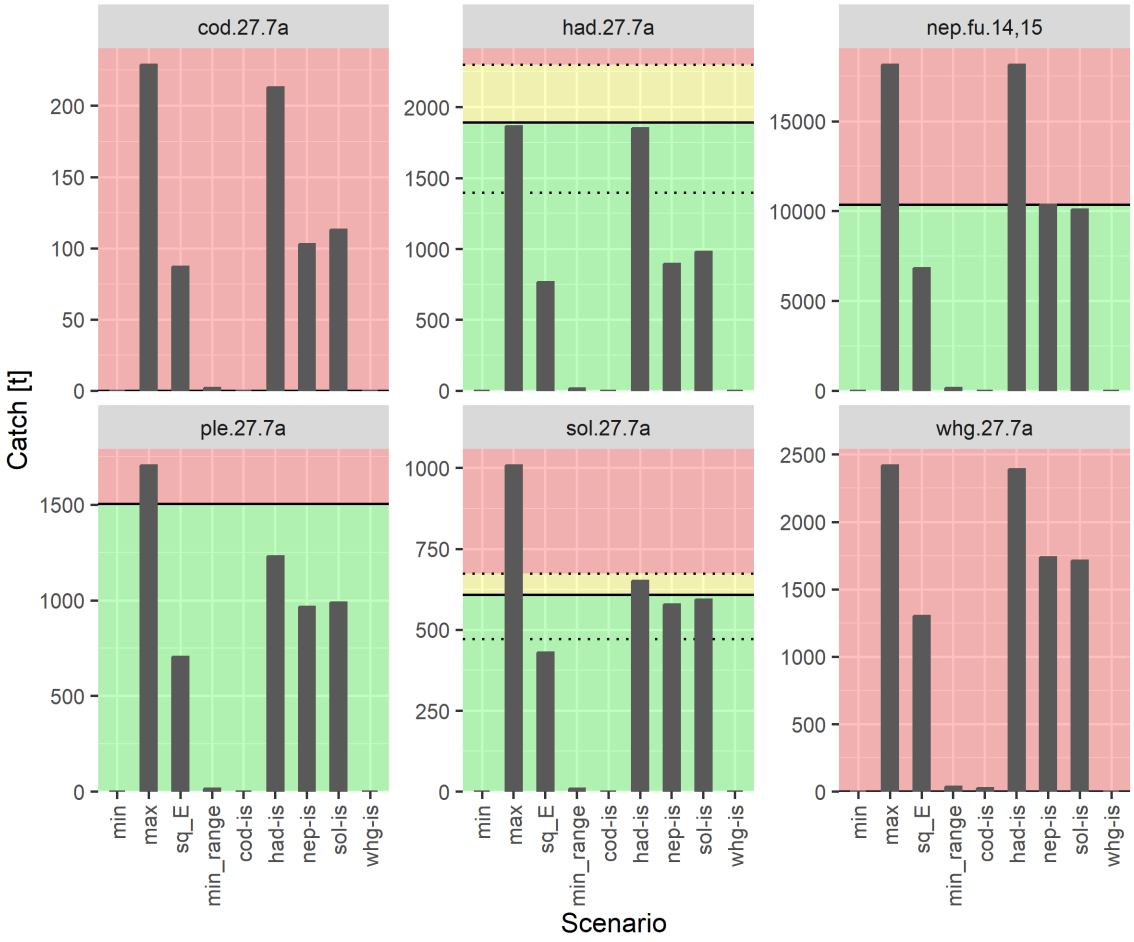


Figure 5.10. Mixed fisheries for the Irish Sea. Mixed-fisheries projections of potential 2025 catches (in tonnes) by stock and scenario. The horizontal solid line corresponds to the single-stock catch advice. For those stocks with fishing mortality ranges defined, lower dotted lines illustrate the catches corresponding to $F_{MSY\ lower}$ or reduced $F_{MSY\ lower}$ or reduced $F_{MSY\ lower}$ for stocks with SSB < MSY $B_{trigger}$. The upper dotted lines illustrate the catches corresponding to $F_{MSY\ upper}$ for stocks with defined ranges and with SSB ≥ MSY $B_{trigger}$.

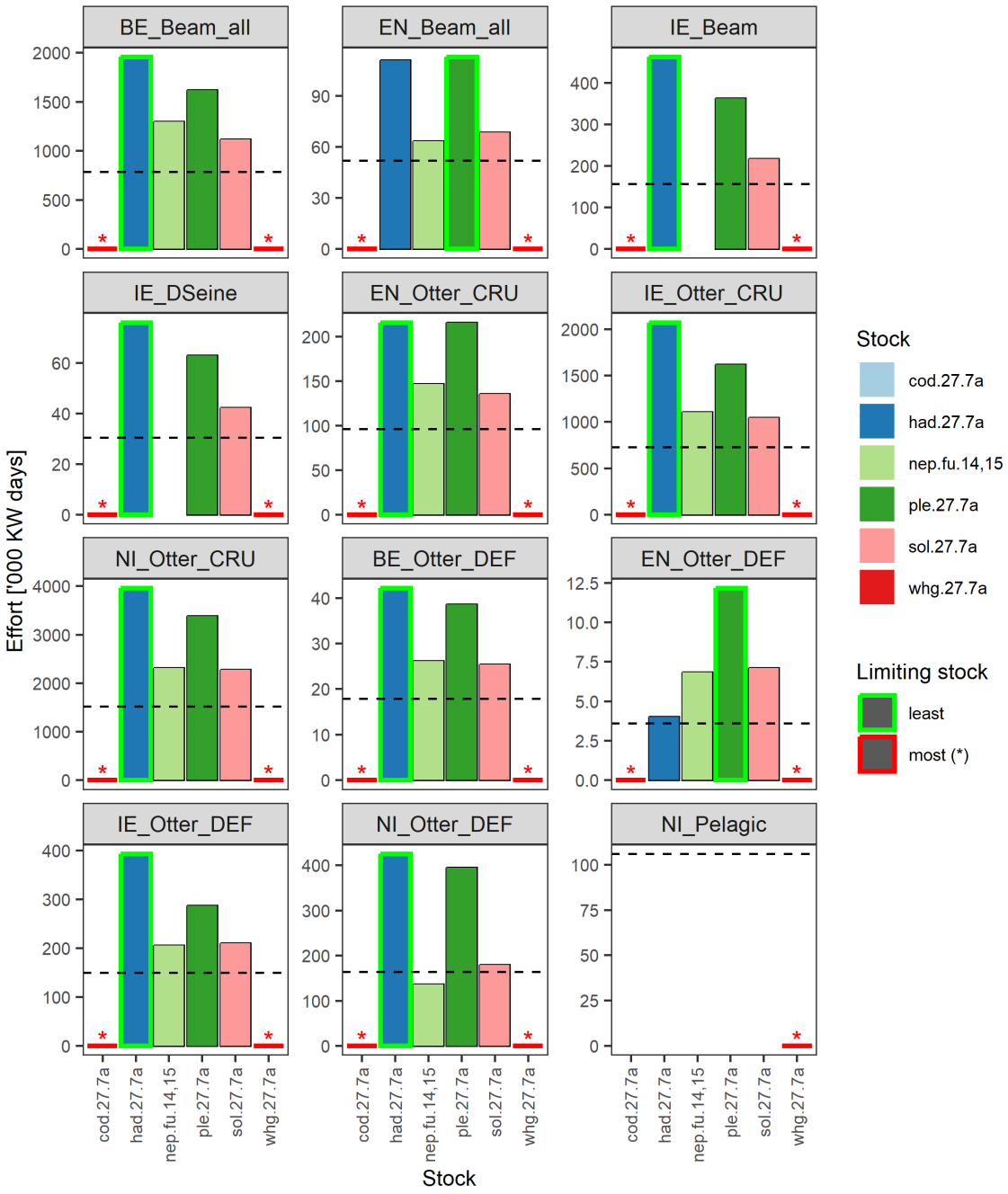


Figure 5.11. Mixed fisheries for the Irish Sea. Estimates of effort by fleet needed to reach each single-stock catch advice. Stocks are coded by colour, with the most limiting stock ("choke species") for each fleet in 2025 highlighted with a red border with an asterisk and the bar for the least limiting species highlighted with a green border. Fleet names are given by country, main gear and target species assemblage. The *status quo* effort for each fleet (average 2021–2023) is shown as a dashed line for reference.

6 North Sea

6.1 Background

Please refer to the North Sea Mixed Fisheries stock annex for a full description of the geographical area and the fishery.

6.1.1 Effort limitations

In previous years, WGMIXFISH advice has considered restrictions to effort in line with legislation related to the cod recovery plan (Council Regulation (EC) 1342/2008). Since 2018, in preparation with the full implementation of the landing obligation for all stocks in 2019, new legislation was issued that removed these restrictions (Council Regulation (EU 2019 amending EU 2018/973). Some limitations now exist in terms of fleet capacity rather than effort, but these are not considered in the current WGMIXFISH scenarios.

6.1.2 Stock-based management plans

In the context of the new CFP, the EU has developed a Multiannual management plan (MAP) for the management of the North Sea demersal mixed fisheries, which has been in force since 2018 (EU, 2018), and replacing the former single-stock long-term management plans with a unique framework defining objectives and constraints for both target and bycatch demersal species. The majority of the stocks included in the North Sea demersal mixed fisheries analysis are shared between the EU, UK and Norway. As there is no agreement with Norway and the UK regarding the EU MAP, ICES gives advice based on the ICES MSY approach. Some of the stocks included in the mixed fisheries analysis are considered as bycatch under the MAP (North Sea turbot and witch). However, these stocks have now Category 1 assessments, and since they are stocks shared with UK and Norway, ICES also gives advice for the stocks on the basis of the ICES MSY framework (while according to the MAP, they should be managed according to the precautionary approach).

In the mixed fisheries simulations, it is assumed that TACs for 2024 will be based on the ICES advice and may therefore not correspond for all stocks to the application of the EU MAP. In practice, the TACs for shared stocks are agreed during EU/UK/Norway negotiations, and may deviate from the ICES advice.

6.2 FLBEIA

6.2.1 Software

All analyses were conducted using the FLBEIA model (version 1.16.1.16; García *et al.*, 2017), coded as a method in R (R Core Team, 2022), as part of the FLR framework (Kell *et al.*, 2007; www.flr-project.org). Input data are in the form of FLFleetsExt and FLBiols objects inherited from the FLCore 2.6.20.9200 package objects, and two forecast methods were used, stf() from the FLAssess (version 2.6.3) and fwd() from the Flash (version 2.5.11) packages. Both input parameterization as well as the stock projections are made using FLBEIA functions and methods (version 1.16.1.16), that are flexible enough to allow covering different alternatives. FLBEIA source code is available at GitHub (https://github.com/flr/FLBEIA). The code, software and versions are

part of the ICES Transparent Assessment Framework (TAF) and can be fully reproduced from this repository (see https://github.com/ices-taf/2024_NrS_MixedFisheriesAdvice).

The baseline run is performed with the objective of reproducing as closely as possible the single-species advice produced by ACOM, and act as the reference scenario for subsequent mixed fisheries analyses. Models used for single-species assessments and forecasts are listed in Table 6.1) The single-stock forecast is performed using the 'fwd()' method in FLR (FLash R add-on package). The same forecast settings as in WGNSSK are used for each stock regarding weight-at-age, selectivity and recruitment, as well as assumptions on the F in the intermediate year and basis for advice. Some stock assessments (e.g. cod 4, 6a, 7d and 20; haddock 4, 6a and 20; whiting 4 and 7d) use data from the current year (intermediate year) and therefore produce stock abundance estimates for this year, which are used as the starting numbers for the short-term forecasts. The FLash fwd() function is not designed to use stock abundances provided in the first year of the projections and overwrites any existing values with the outcome of the survival equation, using numbers and mortality rates from the previous year. Therefore the FLash fwd() function was modified so that, if stock abundances-at-age are provided for the first year in the short-term forecast, they are effectively used as starting values and not replaced.

Table 6.1. Software and models used in the single-species assessments and forecasts. For the *Nephrops* stocks not in the table, the assessment methods are simpler and conducted on excel spreadsheets.

Species	Assessment	Forecast
BRILL 4, 3.a and 7.de	SPiCT	SPiCT
COD 4, 3.a, 6.a and 7.d	Multistock SAM	Multistock SAM
HADDOCK 4, 3.a and 7.d	SAM	SAM
NEPHROPS FU32	SPiCT	SPiCT
PLAICE 4	SAM	SAM
SAITHE 4, 3.a and 6	SAM	SAM
SOLE 4	SS3	FLR
WHITING 4 and 7.d	SAM	MFDP
PLAICE 7.d	AAP	FLR
SOLE 7.d	SAM	SAM
TURBOT 4	SAM	FLR
WITCH 4, 3.a and 7.d	SAM	SAM

6.2.2 Scenarios

Single-species ICES advice for North Sea stocks of interest is given according to specific single-species options, existing management plan, ICES maximum sustainable yield (MSY) approach, or precautionary approach (PA). The basis for each single-stock advice is retained in the current mixed fisheries framework. Given fishing opportunities available for each fleet (e.g. TACs by stock or effort allocation by fleet), FLBEIA estimates the potential future levels of effort for each fleet, based on fleet effort distribution and catchability by métier. Based on this effort level,

landings and discards (i.e. catches) by fleet are estimated using standard forecasting procedures. For the catch advice year FLBEIA is used to run the scenarios (Table 6.2).

Table 6.2. Mixed fisheries for the Greater North Sea. Mixed-fisheries scenarios.

Scenario	Mixed Fisheries effort assumption	Basis for catch targets in 2025
Minimum (min)	For each fleet, fishing in 2025 stops when the catch for any one of the stocks meets the fleet's stock share*. This scenario is the most precautionary option and can highlight some potential "choke species" issues.	ICES catch advice
Maximum (max)	For each fleet, fishing in 2025 continues until the catches of all stocks meet the fleet stock share*. This option illustrates the degree of overshoot of the single-stock advice if fishing is not restricted by the fleet stock shares*.	
Status quo effort (sq_E)	The effort of each fleet in 2025 is set equal to the effort in the most recent year (2023).	Not applicable
Minimum including ranges (min_range)	Same as min scenario.	Catches corresponding to $F_{MSY\ upper}$ for stocks in good status (SSB ≥ MSY $B_{trigger}$) and scaled F_{MSY} advice levels (F_{MSY} × SSB/MSY $B_{trigger}$) for the other stocks (including zero catch advice). Applies only to stocks with ranges defined.
Cod single-stock advice (cod-ns)	For each fleet, fishing in 2025 stops when the catch of cod meets the fleet's stock share* for cod, regardless of other catches. Fleets which do not catch cod follow a *status quo* effort assumption (as described for the "sq_E" scenario).	ICES catch advice

*** Throughout this document, the term "fleet stock share" is used to describe the share of the fishing opportunities for each particular fleet. These fishing opportunities are calculated based on the single-stock advice for 2025 and the historical proportion of the stock catches taken by the fleet (2023).**

Incorporating *Nephrops* into the mixed fisheries advice produces a number of complicating factors: for example, *Nephrops* are fished in distinct geographic areas or functional units (FU), only some of which receive an abundance estimate (necessary to calculate a catchability). This WG followed the approach adopted by ICES (2009) which is to perform the normal FLBEIA prediction for those FUs with absolute abundance estimates, then to calculate a ratio of change from the current yields to the ICES advice for the same FUs. For those FUs without absolute abundance estimates, landings resulting from the FLBEIA run were simply taken to be the most recently recorded landings multiplied by the same ratio R. To do this, landings for each métier had to be apportioned across the FUs. This was facilitated by the supply of effort and catch data by FU.

6.3 Stock input data and recent trends

6.3.1 Stock input data

The assessment data for the different stocks were supplied by ICES WGNSSK (ICES, 2024b). Similar to last year, all stock inputs formatted as FLR stock objects were directly provided to WGMIXFISH by the respective stock coordinators, and this eased greatly the quality of the process of collecting stock data.

In 2024, during WGMIXFISH-ADVICE an error was found with the North Sea sole assessment in the way discards were modelled. This meant corrections to the assessment and forecast were needed before the catch advice for 2025 could be reissued. However, the time-scale for this process mean the updated North Sea sole assessment and advice were not available to WGMIXFISH at the time of publication. Therefore, North Sea sole has been omitted from the mixed-fisheries scenarios this year.

An increasing number of WGNSSK stocks are being assessed using stochastic assessments (multistock SAM model for Northern Shelf cod, SAM model for haddock, plaice in the North Sea, saithe, sole in the Eastern English channel, turbot, whiting and witch). An AAP assessment was used for the plaice stock in the English Channel and a SPiCT assessment for brill and Norway lobster in FU 32. Therefore, for some of these stocks the advice is based on stochastic forecasts, which cannot be fully replicated in the deterministic FCube or FLBEIA software. Therefore, output from both FLBEIA and FCube projections were compared to the median projections of the single-species stochastic forecasts on which single-stock advice is based and results are very similar (see Section 6.5); as such, WGMIXFISH does not consider the difference in models to have a significant impact on the mixed fisheries considerations.

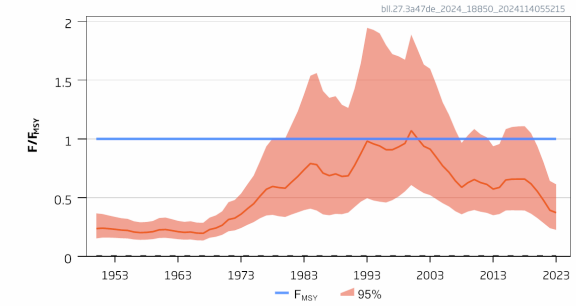
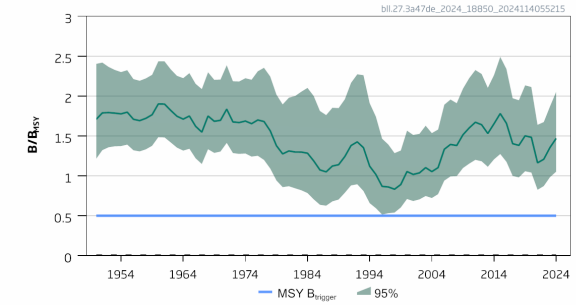
Following the benchmark that took place in 2023, the former North Sea and West of Scotland cod stocks were combined into a single Northern Shelf stock-complex. Northern Shelf cod is composed of three substocks, assessed as separate entities in a multistock assessment model. The distribution of the three substocks overlap to a large extent for 3 quarters of the year, and there is currently no method to separate the substocks in the catch samples. Therefore, the data available to WGMIXFISH on catches by fleet and métier is provided at the combined stocks level, which makes it impossible to model the individual substocks for the mixed-fisheries projections. Therefore, in the mixed-fisheries model, the three substocks are combined in a single FLStock object, and are modelled as if there were a single population.

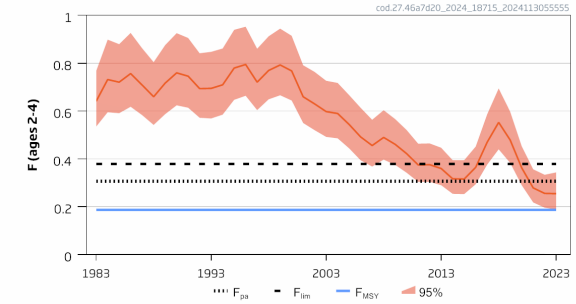
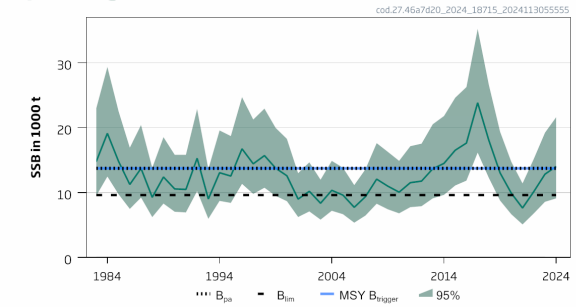
Nephrops stocks were incorporated in the evaluation by functional unit (although they are managed under a single TAC). The functional units with stock indices from underwater surveys and harvest rates (FU6, FU7, FU8 and FU9) have an advice based on the F_{MSY} approach. FU 32 gives an advice based on the F_{MSY} approach on SPiCT model. These FUs are explicitly modelled in the projections, and they can act as most or least limited stocks. For the five other functional units (FUs 5, 10, 33 and 34 and Nephrops outside FUs) no quantification of stock size is available, and the advice is based on the precautionary approach. The future dynamics of these FUs is not modelled in the projections (cannot be choke stocks) but catch projections can be made based on the effort resulting from the different scenarios, and assuming constant CPUEs for these FUs.

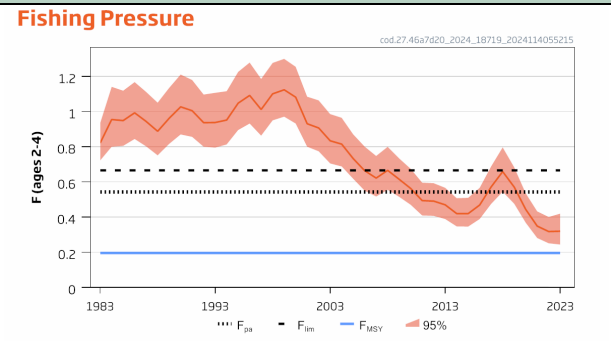
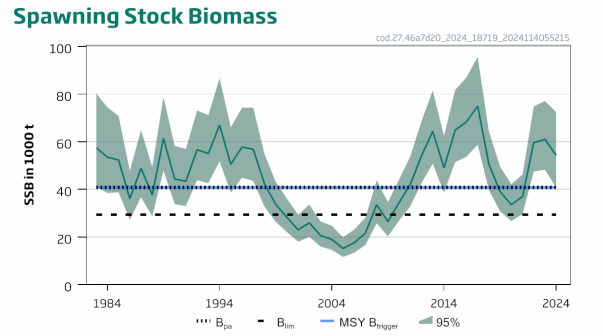
6.3.2 Recent trends and advice

The advice for these stocks is drafted by the WGNSSK (ICES 2024) under considerations by ACOM. Recent trends are described on a stock-by-stock basis, and latest advice by stock is available on the ICES website. An overview of mixed fisheries North Sea demersal stocks advice and trends are summarized below (Table 6.3). It should be noted that although there is only one advice, additional management considerations are also listed in each single-species advice document.

Table 6.3 Summary of stocks included in the mixed-fisheries advice.

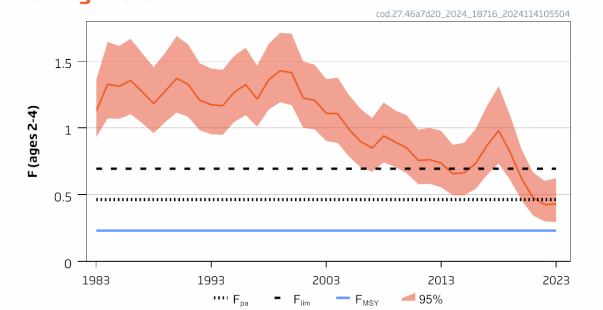
Species	Area	Stock status	Advice for 2025
bll.27.3a47de (brill)	Subarea 4 and divisions 3.a and 7.d–e (North Sea, Skagerrak and Kattegat, English Channel)	**Relative fishing pressure**  **Relative exploitable biomass**  Summary: Fishing pressure on the stock is below F_{MSY}, and the stock size is above MSY $B_{trigger}$.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 2 970 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock.

Species	Area	Stock status	Advice for 2025
cod.27.46a7d20 (cod)	Subarea 4, division 6.a and 7.d, and Subdivision 20 (North Sea, West of Scotland, eastern English Channel, Skagerrak)	**Fishing Pressure**  **Spawning Stock Biomass**  Summary: Fishing pressure on the Viking substock is above F_{MSY}, but below F_{pa} and F_{lim}; spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim} for the Viking substock.	Northern shelf cod comprises three substocks (Northwestern, Southern and Viking) which mix and are caught together. ICES advises that when the MSY approach is applied for the Southern substock and precautionary considerations to protect the Southern substock are applied for the Northwestern and Viking substocks, catches in 2025 should be no more than 15 511 tonnes, which corresponds to 9 920 tonnes from the Northwestern substock, 3 343 tonnes from the Viking substock, and 2 248 tonnes from the Southern substock. These catches by substock should not be taken as area-specific advice.

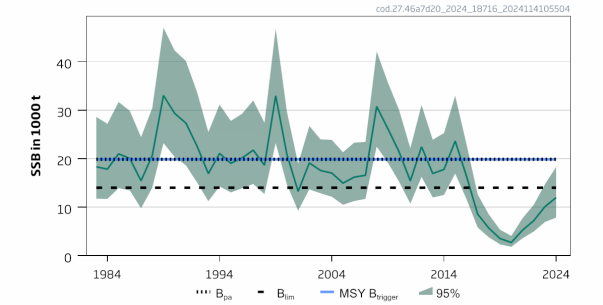
Species	Area	Stock status	Advice for 2025
		  Summary: Fishing pressure on the Northwestern substock is above F_{MSY}, but below F_{pa} and F_{lim}; spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim} for the Northwestern substock.	

Species	Area	Stock status	Advice for 2025

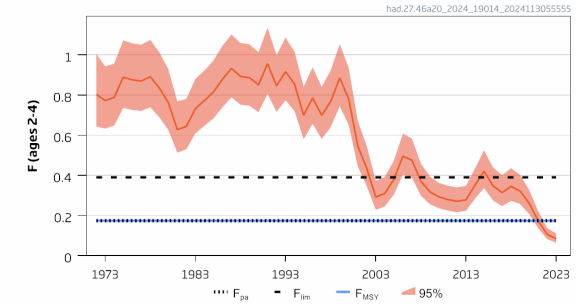
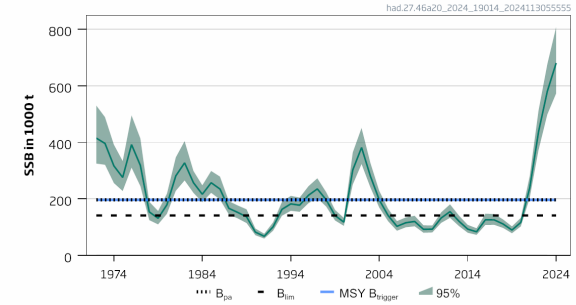
Fishing Pressure

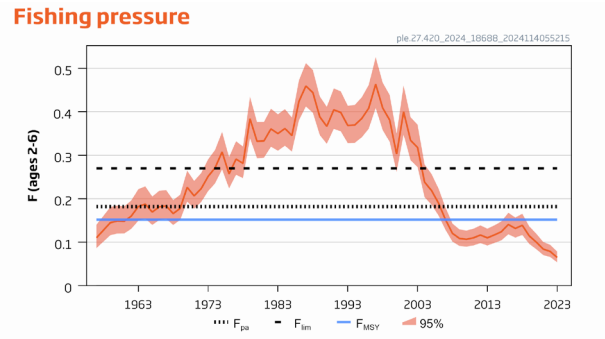
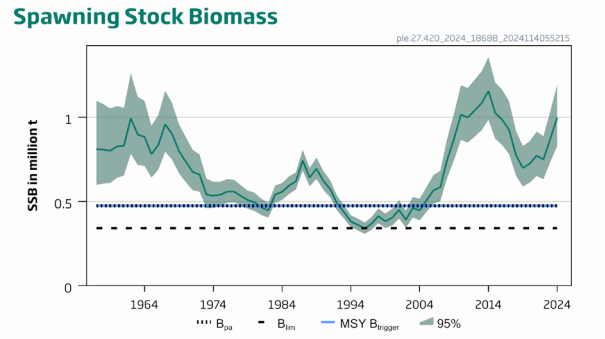


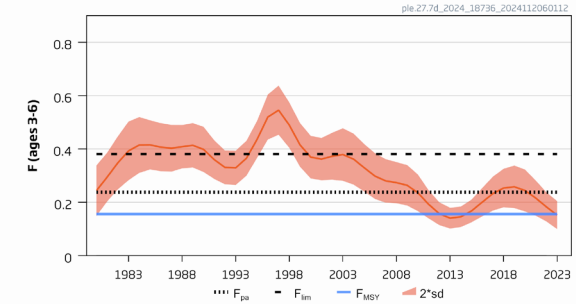
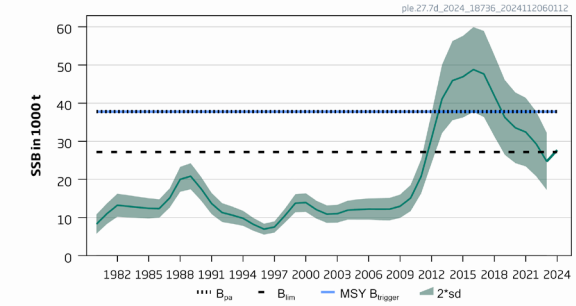
Spawning Stock Biomass

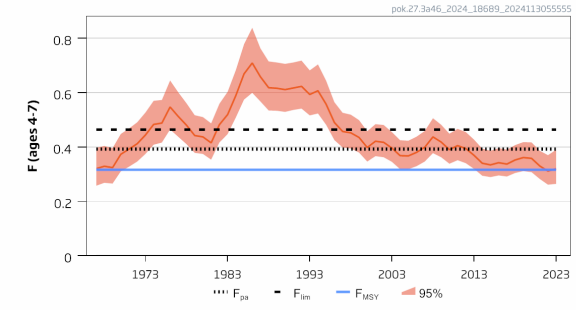
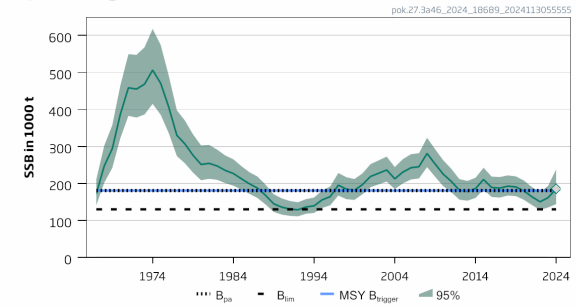


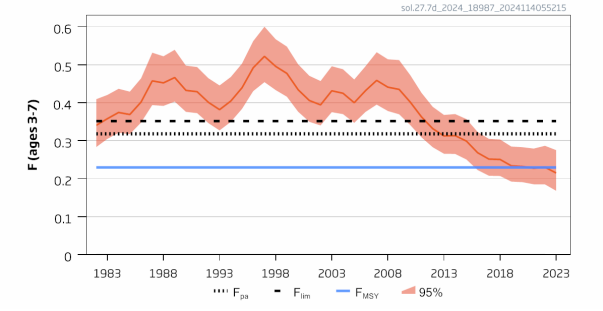
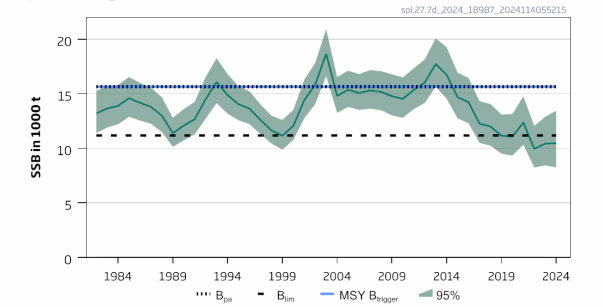
Summary: Fishing pressure on the Southern substock is above $F_{MSY,}$ but below F_{pa} and F_{lim}; spawning-stock size is below MSY $B_{trigger}$, B_{pa}, and B_{lim} on the Southern substock.

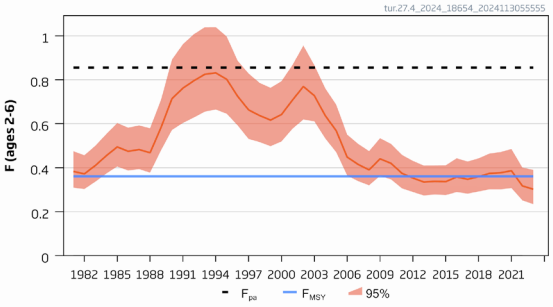
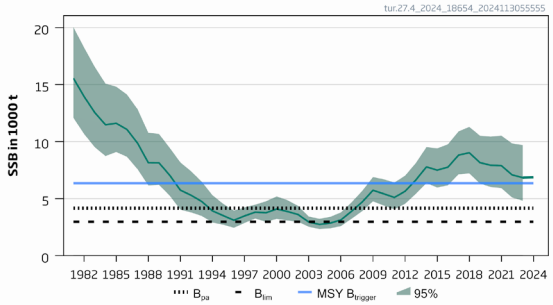
Species	Area	Stock status	Advice for 2025
had.27.46a20 (haddock)	Subarea 4, Division 6.a, and Subdivision 20 (North Sea, West of Scotland, Skagerrak)	**Fishing pressure**  **Spawning Stock Biomass**  Summary: Fishing pressure on the stock is below F_{MSY}, and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.	ICES advises that when the MSY approach is applied, total catches in 2025 should be no more than 112 435 tonnes.

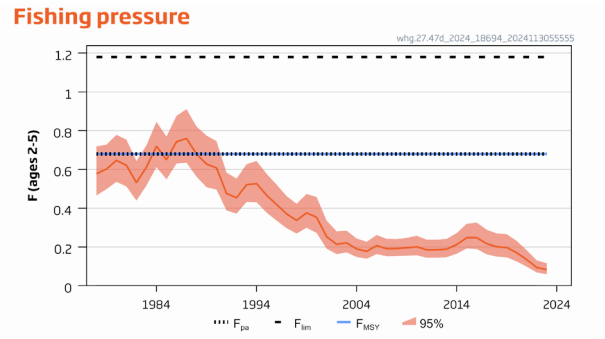
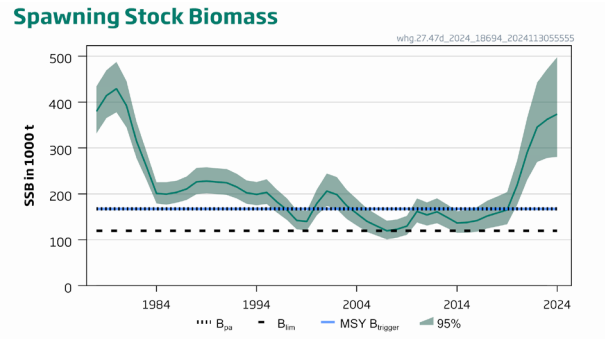
Species	Area	Stock status	Advice for 2025
ple.27.420 (Plaice)	Subarea 4 (North Sea) and Subdivision 20 (Skagerrak)	  Summary: Fishing pressure on the stock is below F_{MSY} and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and, B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 176 988 tonnes.

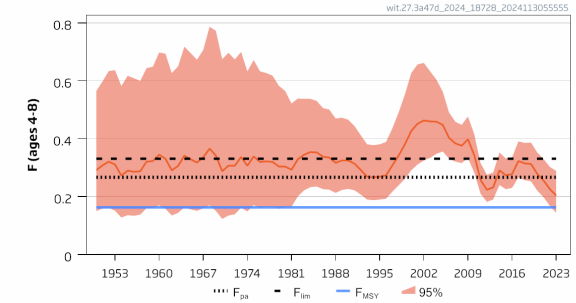
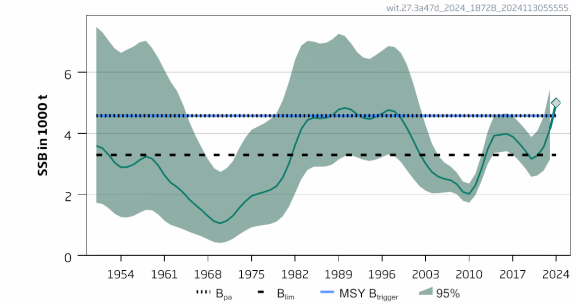
Species	Area	Stock status	Advice for 2025
ple.27.7d (plaice)	Division 7.d (eastern English Channel)	**Fishing pressure**  **Spawing Stock Biomass**  Summary: Fishing pressure on the stock is below F_{MSY} but below F_{pa} and F_{lim} and spawning-stock size is below MSY $B_{trigger}$ and between B_{pa} and B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 2 600 tonnes. The use of a combined TAC for plaice in divisions 7.d and 7.e prevents effective control of stock exploitation rates and could lead to the overexploitation of either stock. ICES advises that management should be implemented at the stock area level.

Species	Area	Stock status	Advice for 2025
pok.27.3a46 (saithe)	Subareas 4 and 6, and in Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)	**Fishing pressure**  **Spawning Stock Biomass**  Summary: Fishing pressure on the stock is above F_{MSY}; spawning-stock size is above MSY $B_{trigger}$, B_{pa} and B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 79 071 tonnes.

Species	Area	Stock status	Advice for 2025
sol.27.7d (sole)	Division 7.d (eastern English Channel)	**Fishing pressure**  **Spawning Stock Biomass**  Summary: Fishing pressure on the stock is below F_{MSY} but below F_{pa} and F_{lim}; spawning-stock size is below MSY $B_{trigger}$, B_{pa} and B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 1 209 tonnes.

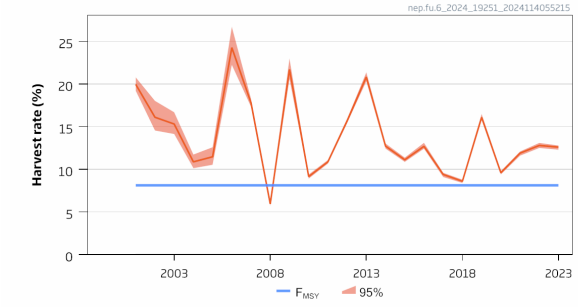
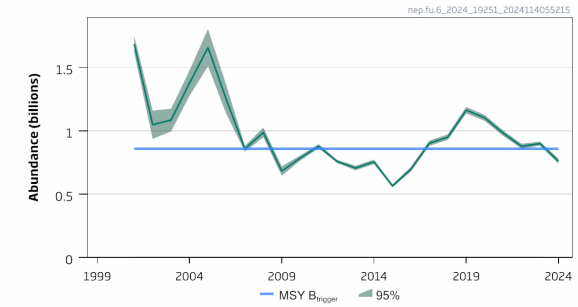
Species	Area	Stock status	Advice for 2025
tur.27.4 (turbot)	Subarea 4 (North Sea)	**Fishing pressure**  **Spawning Stock Biomass**  Summary: Fishing pressure on the stock is below F_{MSY}; spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 2 426 tonnes.

Species	Area	Stock status	Advice for 2025
whg.27.47d (whiting)	Subarea 4 (North Sea) and Division 7.d (Eastern Channel)	  Summary: Fishing pressure on the stock is below F_{MSY} and spawning-stock size is above MSY $B_{trigger}$, B_{pa}, and B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 188 148 tonnes.

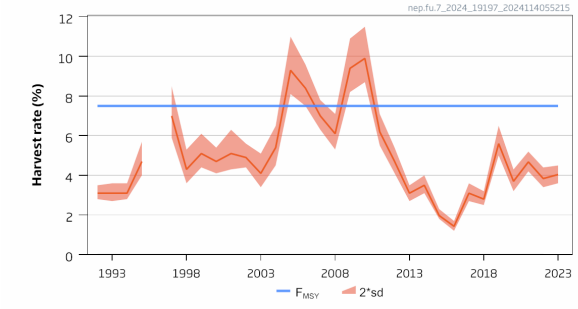
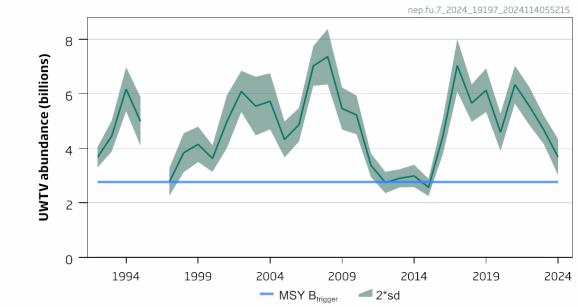
Species	Area	Stock status	Advice for 2025
wit.27.3a47d (witch)	(North Sea, Skagerrak and Kattegat, eastern English Channel	**Fishing pressure**  **Spawning Stock Biomass**  Summary: Fishing pressure on the stock is above F_{MSY} but below F_{pa} and F_{lim}; spawning-stock size is predicted to be above MSY $B_{trigger}$, B_{pa}, and B_{lim}.	ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 1 969 tonnes.

Nephrops stocks

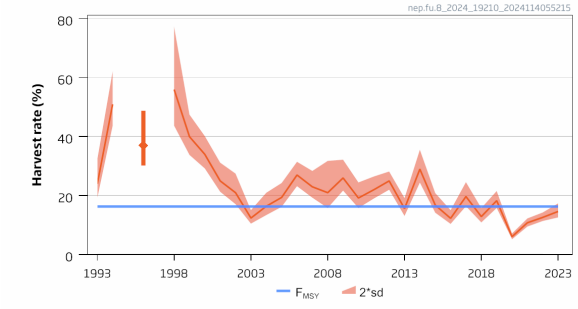
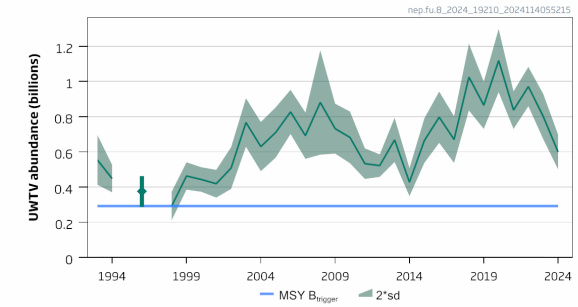
Species	Area	Stock status	Advice for 2025
Nephrops nep.27.4outFU	Subarea 4, outside the functional units (North Sea)	ICES cannot assess the stock and exploitation status relative to maximum sustainable yield (MSY) and precautionary approach (PA) reference points because the reference points are undefined.	ICES advises that when the precautionary approach is applied, landings should be no more than 241 tonnes in each of the years 2025 and 2026. ICES cannot quantify the corresponding total catches.
Nephrops nep.fu.5	Botney Gut-Silver Pit (FU 5)	ICES cannot assess the stock and exploitation status relative to maximum sustainable yield (MSY) and precautionary approach (PA) reference points because the reference points are undefined.	ICES advises that when the precautionary approach is applied, and assuming that discard rates do not change from the average of the years 2021–2023, catches should be no more than 1 256 tonnes in each of the years 2025 and 2026. To ensure that the stock in this Functional Unit (FU) 5 is exploited sustainably, management should be implemented at the FU level. Transfer of advised catch from other FUs to FU 5 could lead to overexploitation.

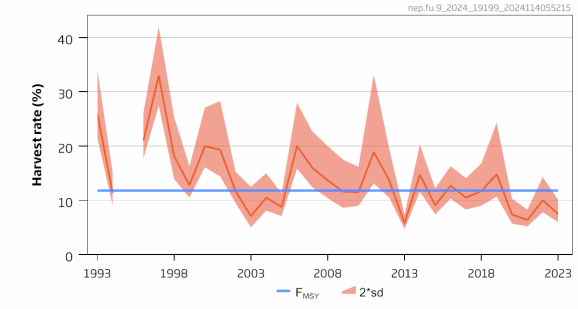
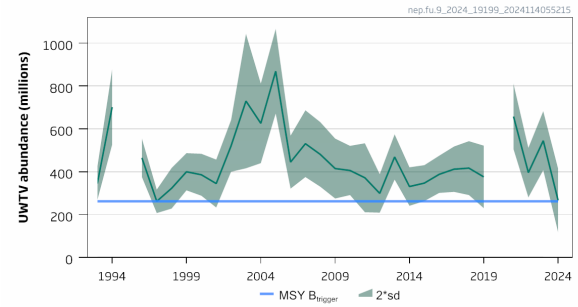
Species	Area	Stock status	Advice for 2025
Nephrops nep.fu.6	Farn Deeps (FU 6)	**Fishing pressure**  **Stock size** 	ICES advises that when the maximum sustainable yield (MSY) approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 1 230 tonnes. To ensure that the stock in Functional Unit (FU) 6 is exploited sustainably, management should be implemented at the FU level. Transfer of advised catch from other FUs to FU 6 could lead to overexploitation.

Summary: Fishing pressure on the stock is above F_{MSY}, and the stock size is below MSY $B_{trigger}$.

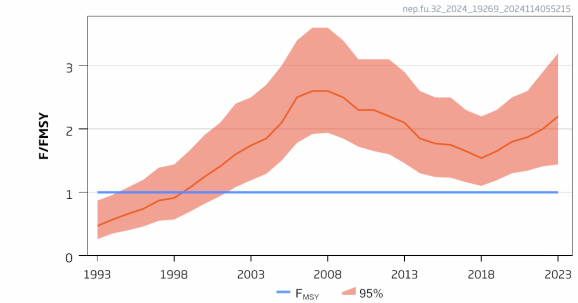
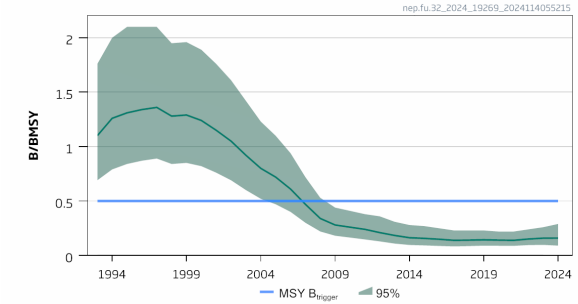
Species	Area	Stock status	Advice for 2025
Nephrops nep.fu.7	Fladen Ground (FU 7)	**Fishing pressure**  **Stock size** 	ICES advises that when the maximum sustainable yield (MSY) approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 9 149 tonnes. To ensure that the stock in Functional Unit (FU) 7 is exploited sustainably, management should be implemented at the FU level. The catch in FU 7 has been lower than advised in recent years, and if the difference is transferred to other FUs, this could result in non-precautionary exploitation of those FUs

Summary: Fishing pressure on the stock is below F_{MSY} and stock size is above MSY $B_{trigger}$.

Species	Area	Stock status	Advice for 2025
Nephrops nep.fu.8	Firth of Forth (FU 8)	**Fishing pressure**  **Stock size**  **Summary**: Fishing pressure on the stock is below F_{MSY}, and stock size is above MSY $B_{trigger}$.	ICES advises that when the maximum sustainable yield (MSY) approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 2 079 tonnes. To ensure that the stock in Functional Unit (FU) 8 is exploited sustainably, management should be implemented at the FU level. Transfer of advised catch from other FUs to FU 8 could lead to overexploitation.

Species	Area	Stock status	Advice for 2025
Nephrops nep.fu.9	Moray Firth (FU 9)	**Fishing pressure**  **Stock size**  **Summary**: Fishing pressure on the stock is below F_{MSY}, and stock size is above MSY $B_{trigger}$.	ICES advises that when the maximum sustainable yield (MSY) approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 884 tonnes. To ensure that the stock in Functional Unit (FU) 9 is exploited sustainably, management should be implemented at the FU level. Transfer of advised catch from other FUs to FU 9 could lead to overexploitation.

Species	Area	Stock status	Advice for 2025
Nephrops nep.fu.10	Noup (FU 10)	ICES cannot assess the stock and exploitation status relative to maximum sustainable yield (MSY) and precautionary approach (PA) reference points because the reference points are undefined.	ICES advises that when the precautionary approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in each of the years 2025 and 2026 should be no more than 24 tonnes. To ensure the stock in Functional Unit (FU) 10 is exploited sustainably, management should be implemented at the FU level. Transfer of advised catch from other FUs to FU 10 could lead to overexploitation

Species	Area	Stock status	Advice for 2025
Nephrops nep.fu.32	Norwegian Deep (FU 32)	**Relative fishing pressure**  **Relative exploitable biomass**  **Summary**: Fishing pressure on the stock is above F_{MSY}, and stock size is below MSY $B_{trigger}$.	ICES advises that when the maximum sustainable yield (MSY) is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2021–2023, catches in 2025 should be no more than 38 tonnes. To ensure the stock in Functional Unit (FU) 32 is exploited sustainably, management should be implemented at the FU level.
Nephrops nep.fu.33	Horns Reef (FU 33)	ICES cannot assess the stock and exploitation status relative to MSY and PA reference points, because the reference points are undefined	ICES advises that when the precautionary approach is applied, landings in each of the years 2025 and 2026 should be no more than

Species	Area	Stock status	Advice for 2025
			972 tonnes. ICES cannot quantify the corresponding total catches. To ensure that the stock in Functional Unit (FU) 33 is exploited sustainably, management should be implemented at the FU level. Transfer of advised catch from other FUs to FU 33 could lead to overexploitation
Nephrops nep.fu.34	Devils Hole (FU 34)	ICES cannot assess the stock and exploitation status relative to maximum sustainable yield (MSY) and precautionary approach (PA) reference points because the reference points are undefined.	ICES advises that when the precautionary approach is applied catches in each of the years 2025 and 2026 should be no more than 599 tonnes. To ensure the stock in this functional unit (FU) 34 is exploited sustainably, management should be implemented at the FU level. Transfer of advised catch from other FUs to FU 34 could lead to overexploitation

6.4 Fleets and métiers

6.4.1 Catch and effort data

Prior to 2012, catch (landings and discards) and effort data were submitted to WGMIXFISH as comma separated files structured around the distinction of gear, mesh size and vessel length categories (based to a large extent on the format used by the STECF for the evaluation of effort management). From 2012 to 2014 a joint WGNSSK/WGMIXFISH data call has been issued, with age and discards data by métier (consistent with the DCF definition of métiers) to be submitted to InterCatch, and landings and effort data by métier and vessel length class to be submitted as .csv files. Since 2015, ICES generalized the data call to most stocks and regions. The process and the quality of data have thus continuously improved over time.

Noticeably, although the data collation process has become smoother, it remains a very tedious and time-demanding task. The processes developed to automate the various steps of merging different datasets from different countries and different data sources together have increased the number of checks and graphical visualization of the data. Starting from 2019, data submissions have been evaluated with the aid of newly developed quality control routines, which are summarized in a report. This process has aided both data submitters and participants of WGMIXFISH in terms of identifying problematics entries and has greatly eased the model conditioning process.

Norway began to submit data to WGMIXFISH in 2022 covering the period from 2015 onwards. However, due to data quality issues, Norway are only able to provide effort and landings data for vessels over 15m. The provision of data on vessels under 15m are expected within a few years. Previously, these missing Norwegian catches were implicitly included in the OTH-OTH fleet which includes any difference in total catches between the fleet data and the single-stock assessments. However, this year the catches associated with Norwegian vessels under 15m were estimated through comparisons with the catches reported to InterCatch and accounted for in an additional fleet called "NO_<15".

A significant proportion of catches of brill are taken outside the North Sea model area in division 7.e and subdivision 3.a.21. Similar to catches from Norwegian vessels < 15m, these out-of-area catches are encapsulated in an addition fleet, "BLL_OTH", to account for all sources of removals in the North Sea model for brill. In total, these additional fleets, NO_<15 and BLL_OTH account for approximately 3% of all landings in the North Sea model.

Previously, any remaining missing catches (<1% of total landings) were included in the OTH-OTH fleet and were derived from the difference in total catches between the fleet data and the single-stock assessments. However, this year a new procedure was incorporated to account for these differences following work undertaken to address the EU/UK joint request regarding mixed fisheries science (ICES, 2024a). A rescaling procedure was implemented so that the total catch in the fleets used for the mixed fisheries consideration matched the total estimated catch from the respective single-stock assessments. This procedure improved consistency of the projections with single-stock advice and management implementation.

The final dataset extracted from InterCatch for use by WGNSSK includes discards estimates (either imported or raised) for all stocks and métiers. These InterCatch estimates have been used to estimate a discard ratio for each country/métier/stock combination, which allows allocating discards for all WGMIXFISH métiers with matching names, such that:

$$d^* = \left(\frac{D}{L}\right) l$$

Where d* is the discard value for the métier used by FLBEIA, l is the weight of landings for the métier used by FLBEIA and L and D are the weight of landings and discards entered for the (vessel length aggregated by métier in InterCatch). For age-based stocks, discard rates are estimated for each age class. Similarly, proportions at age in the landing and discards from InterCatch are used to allocate age distributions to all WGMIXFISH métiers with matching names for age based stocks. This matching process became automated in 2023 and begins with allocations made where exact matches for stock, year, area and métier (gear, target assemblage, mesh size) exist between the datasets. Where no exact match exists, the variables are dropped in turn (mesh size > target assemblage > gear > area) and allocations of the mean value from matching data records are made. Any remaining unmatched WGMIXFISH fleet data records are then allocated stock level values as reported in the stock assessment

The relative size of landings of the stocks incorporated in the mixed fisheries projections is shown in Figure 6.1 .

6.4.2 Definitions of fleets and métiers

Minor revisions were made in 2023 to the procedure for defining fleets and métiers, however, the majority of the process has been the same since 2012. Nevertheless, as the procedure is applied to the last data year, the number of fleets and métiers can vary slightly from one WGMIXFISH report to the next.

In summary, the procedure follows a number of steps:

- Initial fleet allocations are made using country, gear type and, when necessary, vessel length group. Initial métier category allocations are made using the definitions used in the cod long-term management plan.
- Within a fleet, small métiers are defined as those that fail to catch at least 5% of the fleets total landings of at least one stock. These métiers are aggregated to a "MIS" métier category.
- Small fleets are defined as fleets that fail to catch at least 1% of the total landings of at least one stock. These fleets are aggregated to a "MIS_MIS" fleet.
- Métiers without catch of any of the modelled stocks in the last data year are not retained.

A full list of the métiers reported to WGMIXFISH and the final fleet and métier category allocation following these processing steps can be found in Annex 6.

Despite the data now being available according to DCF categorization, WGMIXFISH is of the opinion to continue using the categorization following the EU Cod management plan as used in previous years, both in order to maintain the consistency of the MIXFISH time-series and in order to continue addressing management-oriented scenarios and issues. WGMIXFISH métiers are thus defined as combinations of gear, mesh size and area (North Sea (Subarea 4), Skagerrak (Subdivision 3.a.20), West of Scotland (Division 6.a) or Eastern Channel (Division 7.d), see Table 6.4 and Figure 6.2.

The consistency between DCF and EU Cod plan categories had been investigated by WGMIXFISH 2011 and during the pilot data call performed in autumn 2011. It was determined that most DCF métiers as sampled by individual nations could automatically be allocated to a corresponding EU Cod plan métier, with two exceptions: the TBB_DEF_70-99_0_0 métier in the North Sea (as the corresponding BT2 métier is only defined for the mesh sizes 80–99) and the OTB_DEF (or CRU)_90-119_0_0 métier in the Skagerrak, which straddles over the TR1 (>=100 mm) and TR2 (70–99 mm) categories. As in previous years, the TBB_DEF_70-99_0_0 métier was assumed equivalent to BT2, and the Skagerrak 90-119_0_0 was assumed as TR2, to maintain consistency with previous data. Since 2012 the Swedish *Nephrops* fishery with an escapement grid,

OTB_CRU_70-89_2_35 has been kept distinct from the other DCF métiers. Since 2020, fleets are conditioned as age-disaggregated fleets, this means that catchability at age is considered for each métier rather than having catchability at the fleet level (see Stock Annex).

In 2023, the final data used contained 39 national fleets (including the NO_<15 and BLL_OTH fleets). These fleets engage in 1 to 13 different métiers each, resulting in 174 combinations of country*fleet*métier*area catching fish and *Nephrops* stocks considered this year (Table 6.4). The balance of landings of the stocks across gear categories is shown in Figure 6.2.

Diagnostics were produced to check the fleet conditioning in FLBEIA. The fishing mortality-at-age and averaged as well as age-disaggregated and total catch, landings and discards across all fleets was compared to the values estimated from the single-species stock assessments (Figure 6.3 to Figure 6.6 and Table 6.5 to Table 6.8). Some discrepancies exist although most are minor. These discrepancies are due to the fact that weight at age and age distributions for each stock is now given at the fleet level rather than the stock which induces some differences between the InterCatch data and the ones used in the single species assessment.

6.4.3 Trends

A number of overview graphs (using the Lattice and ggplot package in R) were produced to aid quality checking of the data once compiled into the final fleets object. Some are useful to show the relative importance of the fleets chosen and trends in their effort and catches. Effort by fleet in absolute levels (Figure 6.7) and relative trends (Figure 6.8.), and landings by fleet and stock (9) are included in this report.

6.5 Mixed fisheries forecasts

6.5.1 Description of scenarios

6.5.1.1 Baseline run

The various single-stock forecasts presented by WGNSSK are performed using different software and setups (see Section 6.2.1). For the purpose of the mixed fisheries analyses, it is necessary to gather all stock assessment output and forecasts settings into a single unified framework in FLR, which builds on the "FLBEIA" package (García *et al*., 2017). The same forecast settings as in WGNSSK are used for each stock regarding weight-at-age, selectivity and recruitment, as well as the assumptions made for the intermediate year (2024) and the basis for advice (ICES MSY advice rule). Using these settings, and not introducing any mixed-fisheries interactions, short-term forecasts are carried out at WGMIXFISH. This baseline run is then compared to the estimates provided in the ICES advice sheets.

For most stocks, reproducing the setting use for the single-stock forecasts can be done by applying the same assumptions as in WGNSSK. For instance, a common assumption for future biological parameters such as fish weight, natural mortality or proportion of mature fish at age is that they are equal to the mean of the values of the last 3 years. For some stocks, this required copying the actual values used in the single-stock forecast. This was the case for the COD-NS (natural mortality, stock weights, and proportion mature at age simulated for the single-stock forecast using gaussian Markov random fields) and HAD (future weights based on a cohort-based growth model).

For a number of stocks (COD-NS, HAD, WHG-NS) the stock assessment produces abundances-at-age estimates until the current year (while for the other stocks, the assessment goes until one year before the current year). For these stocks, the forecasts conducted at WGMIXFISH use these

abundances-at-age estimates as starting numbers-at-age for 2024. For the other stocks, starting number for 2024 are calculated as the survivors from 2023, given the abundances and fishing mortality-at-age for 2023.

In the case of the HAD stock, the WGNSSK forecast starts one year earlier than for the other stocks (i.e. first forecast year is 2023 whereas it is 2024 for most stocks). Instead of reproducing this in the WGMIXFISH framework, which would have required too many modifications of the existing code, the SAM estimates of the numbers-at-age for 2024 were replaced in the FLStock object by the median of the abundances-at-age from the SAM forecast for 2024.

This year, two stocks assessed using a surplus production model (SPICT) were included in the WGMIXFISH model : BLL and NEP32. The FLR framework used to produce this baseline run cannot accommodate stocks using a biomass dynamics model. For this reason, BLL and NEP32 were not included in the baseline run.

For a number of stocks, it is not expected that the single-stock advice can be exactly reproduced within the FLR environment. There are data and model related differences between the framework used at WGMIXFISH and the different single-stock forecasts conducted at WGNSSK:

- For a number of stocks assessed using SAM (cod, haddock, saithe, sole 7d and witch), the single-stock advice is based on stochastic forecasts (in which the forecast result is the median of a number of iterations, carried out with different starting conditions and process variance realization), which cannot be reproduced using FLR.
- In the case of cod, the single-stock advice is based on stochastic forecasts conducted separately using SAM for each of the three substocks. At WGMIXFISH, the FLR forecast is conducted on the sum of the three substocks, applying the same assumption for the intermediate years (status quo F) and using the same rate of change in fishing mortality between 2024 and 2025 as applied for the single-stock advice (Fbar2025 = 0.35 Fbar2024, same rate applied for all substocks).
- For whiting, the single-stock forecast uses the Multi Fleet Deterministic Projection (MFDP) forecast software, which models separately fleets fishing for human consumption and the industrial fishery, which is a different fleet specification that in FLBEIA and can also not be reproduced with the FLR function used to project the stocks.

In addition to that, the FLBEIA framework has some specificities of its own which depart from the way most stock assessment and forecast methods operate:

- Although assumption used for conditioning the forecast are the same, in FLBEIA, future assumptions regarding biology and exploitation pattern are derived from fleet-disaggregated data, while at WGNSSK they are derived from stock-level assessment input and output
- The catch process is modelled using a different equation (Baranov equation for single-stock advice and for Cobb Douglas equation in FLBEIA)

In order to assess the impact of the change in modelling framework on the quantities produced in short-term projections for the various stocks considered, two different baseline runs are produced using the WGMIXFISH FLR environment:

- WGMIXFISH FLR baseline: a simple FLR deterministic forecast using the fwd() function that uses exactly the same input (starting abundances, future biology and fisheries selectivity) and the same production function (Baranov) as the forecast methods used in the WGNSSK. This run is used as a quality check that is mainly aimed at checking that all stock data and future assumptions are transferred correctly into the FLR/FLBEIA environment. Discrepancies with the WGNSSK forecast should be minimal, and only results

from method used in WGNSSK not being fully reproducible in FLR (e.g. SAM stochastic forecasts).

- WGMIXFISH-FLBEIA baseline: a FLBEIA baseline run in which stocks are projected forward independently from each other (no mixed fisheries interactions). In addition to the discrepancies observed for the simple FLR run, this WGMIXFISH-FLBEIA baseline run may deviate further from the WGNSSK single-stock advice as they are carried out with mean weight, discard rate and selectivity at age based on the mixed-fisheries data, and using the Cobb Douglas production function. The aim of this baseline run is to assess the impact of changing from a modelling framework not considering fleets, to a fleet-explicit one.

These two baseline runs are compared with the single-stock advice forecast from WGNSSK.

6.5.1.2 Mixed fisheries runs

Prior to 2013, projections were run applying the mixed fisheries scenarios two years in a row, i.e. both for the intermediate year and the TAC year. This allowed WGMIXFISH to analyse why management plans often did not deliver their expected results and why some short-term forecasts had been over-optimistic in the past (Kraak *et al*., 2013), by evaluating the impact of the assumptions in the intermediate year.

However, since 2013, the working group adopted a forecast approach for the intermediate year on the basis of s*tatus quo* effort (Table 6.9). The *status quo* effort assumption is considered a plausible assumption and is more in line with the standard single-stock short-term forecasting approach (which apply a *status quo* F, unless a TAC constraint is used).

An important change to the projections was implemented in 2015, to account for the landing obligation. Historically, the mixed fisheries projections have been presented in terms of landings and overshoots or undershoots of the retained portion of the catch, assuming fishing fleets would discard as observed in past years and that only the landings counted against the fleets' stock shares.

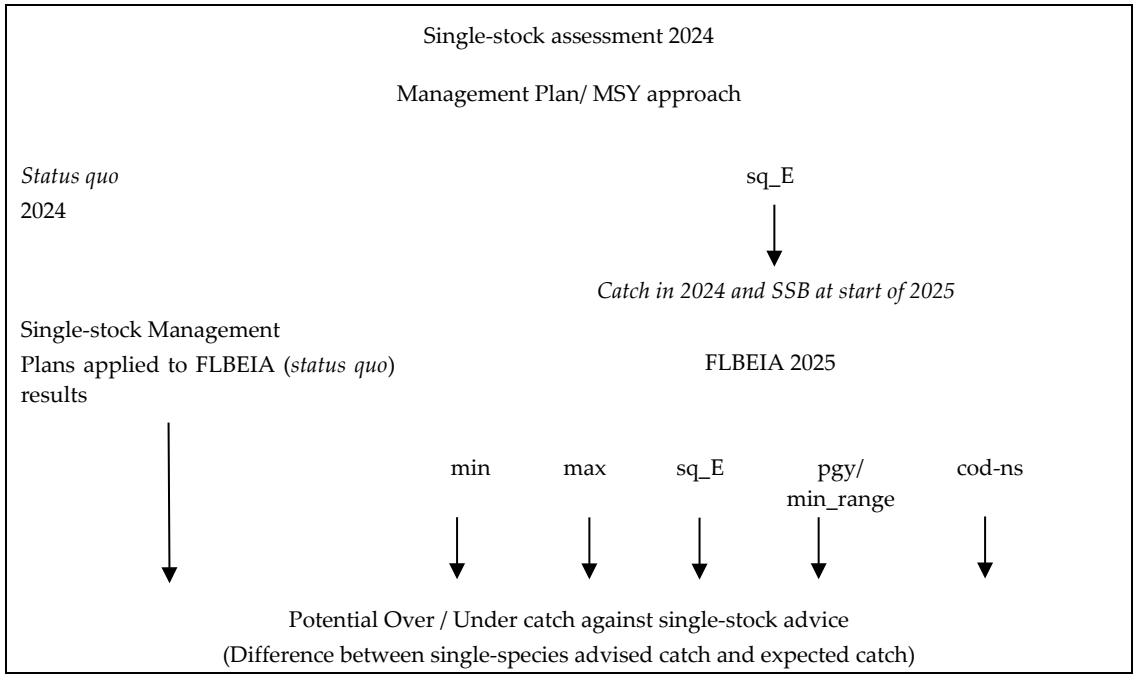
The projections were run assuming a full and perfect implementation of the discard ban (i.e. all quota species caught must be landed, with no exemptions, *de minimis* or interspecies flexibilities) for species under landing obligation, i.e. all catches are assumed to be landed and to count against the quota.

Since 2021, projections are performed with age-disaggregated data at the métier level. This change does not affect the total catch that can be taken in the advice year of the alternative scenarios. However, for some stocks it affects the age-composition of the catch and associated Fbar values, and may provide additional insights into discard and landing quantities at the métier, fleet and stock level.

To increase the similarity between the mixed fisheries and single species projections, the population dynamics in the intermediate year have been changed to fixed population dynamics since 2022. This forces the mixed fisheries projection models to use the same stock numbers as single species forecasts at the start of the projection.

Since 2023, the "min_range" scenario is presented. This scenario is an alternative "min" scenario in which F_{MSY} target values in the advice year are replaced by target fishing mortalities corresponding to $F_{MSY\ upper}$ for stocsk where SSB > MSY $B_{trigger}$ or scaled F_{MSY} advice levels (F_{MSY} × SSB/MSY $B_{trigger}$) for the other stocks. This scenario supercedes the previous "range" scenario which presented a "min" scenario using fishing mortality values that minimized the difference between catches realized under a "min" and "max" scenario by exploring F values between the lower and upper F_{MSY} ranges for each stock where applicable.

In summary, the FLBEIA runs followed the scheme below:



6.5.2 Results

6.5.2.1 Baseline run

WGMIXFISH-FLR baseline run

The Figure 6.10 summarizes the trends in single-stocks advice between the last data year (2023) and the two forecast years (2024 and 2025). The advised catch for 2025 for COD-NS corresponds to a 65% decrease in F_{bar} compared to 2024. This decrease corresponds to the implementation of the MSY advice rule for the Southern substock, and the implementation of a decrease of the same proportion for the other two substocks, as a precautionary measure. Such a decrease in F_{bar} implies that the effort corresponding to this advice for all fleets catching this stock would be much lower than the current effort. Other stocks also have a catch advice for 2025 that imply an substantial decrease in F_{bar} compared to 2024 (approximately -24% for PLE-EC , -28% for SOL-EC, -19% for WIT and -87% for NEP FU32). On the other hand, the advice catch for whiting (WHG-NS), haddock (HAD) and North Sea plaice (PLE-NS) correspond to a strong increase in F_{bar} compared to 2024 (by 719%, 107% and 134%, respectively). Meanwhile, more modest increases in F_{bar} are seen for saithe (POK) and turbot (TUR) compared to 2024 (by 1.3% and 20%, respectively). Among the stocks with no (analytical) assessment, there were also large changes in advice from 2024 to 2025 (-50% for NEP FU9).

The comparison between the WGMIXFISH-FLR baseline run and the ICES single-stock advice is summarized in Table 6.10 for the *Nephrops* stocks and in Figure 6.11 for the fish stocks. The issues encountered in replicating the single-species advice in FLR are detailed below.

Cod: The Northern Shelf cod forecast is a stochastic projection, conducted separately for the three substocks. For each substock, the forecast produces internally in SAM generated a large number of replicates of the stock, representative of the confidence interval of the F-at-age and N-at-age. The forecast also propagates the stochastic SAM processes (random walks on F and process errors on N) into the projection period. Finally, for COD-NS, the forecast simulates for each replicates the future natural mortality, stock weight and proportion fish mature at age for the future years from Gaussian Markov random fields.. The short-term forecast conducted at WGMIXFISH

does not use SAM, but a simple deterministic forecast conducted on the combined stock (sum of the three substock). Despite these noticeable differences in the projection methodology, only small differences were observed (-4.0% for the catch in 2025 and 3.9% for SSB in 2025) between the FLR forecast and the single-stock advice.

Haddock: The haddock assessment and forecast are also conducted using SAM. The SAM forecast is run with 2023 as a starting year. This was not reproduced in the FLR forecast, which started in 2024, using the median of the stock abundances from the SAM forecast as starting numbers for 2024. The single-stock forecast also uses weight-at-age in the forecasted period produced by a growth model instead of the commonly used assumption of constant weights equal to the average over the recent years. Those specific values could not be reproduced in the forecasting procedure of FLR and were therefore entered manually.

Some small discrepancies were also observed for this stock. The -1.4% difference in SSB for 2024 is explained by the fact that the HAD advice sheet reports the stock assessment estimate (SAM) for this year, which is different from the value obtained by the SAM forecast. Differences for the advice year, 2025, are smaller (maximum -2.7% for the catches and -2.5% for the SSB). The difference for the SSB in the year following the advice, 2026, is -6.1%.. The FLR forecast was considered sufficiently close for use in the mixed fisheries projection.

Whiting: Although whiting is assessed using SAM, the WGNSSK forecast is deterministic, conducted using MFDP. The WGNSSK forecast treats the industrial bycatch separately from the landings for human consumption, with specific future weights-at-age and selectivity and assumes a *status quo* F value for this fishery, independent from the value of target F for the human consumption fishery. The FLR forecast used at WGMIXFISH does not allow for multiple fleets and therefore the industrial bycatch is included in the discards component, which means that its F is scaled to the overall F. The future landings selectivity and weights-at-age were recalculated as the weighted means of the values in the landings for human consumption and industrial bycatch.

The FLR forecast reproduces well the single-stock forecast for the intermediate year (2024). For the advice year, 2025, there is a -7.6% difference in the landings (while the difference is much smaller for the catches) which come from the fact that part of the industrial bycatch is ascribed to landings in the WGNSSK forecast, while industrial bycatch were all ascribed to the discards in the FLR forecast. Given the strong increase in F_{bar} between the current year and the advice year (by a factor 8), the difference in the treatment of the industrial fishery bycatch (status quo and modelled separately in MFDP vs. incorporated in discards and therefore scaled to the overall F). This is considered close enough for use in the mixed fisheries projection, since the mixed-fisheries projection are considering catches rather than landings.

Saithe: As for cod and haddock, the 2024 saithe assessment and forecast were carried out using the SAM assessment model. The difference in forecast procedure compared to WGMIXFISH resulted in differences in the output of -2.2% in the 2024 SSB and -4.4% in the 2025 catches and –3.5% in 2026 for SSB. The FLR forecast was considered sufficiently close for use in the mixed fisheries projection.

North Sea Plaice: the assessment and forecast are also conducted using SAM, which explain the small differences with the FLR deterministic forecast (maximum -1.9% on the 2025 catch).

English Channel Plaice: Significant migrations of plaice occur between the North Sea, Eastern Channel and Western Channel. As a result, only a proportion of the plaice TAC defined in Subdivision 7.d corresponds to the Eastern Channel plaice. The forecast takes account of the expected quantity of plaice caught in the eastern channel adjusting for these migrations.

The single-stock advice is based on a deterministic forecast run in FLR, which was reproduced almost identically by WGMIXFISH.

English Channel Sole: The 2024 English Channel Sole assessment and forecast were carried out using the SAM assessment model. As for the other stocks with a SAM stochastic forecast, some small differences were observed between the single-stock and the FLR forecasts (-3.2 % and - 4.6% for the 2024 and 2025 SSB values).

Turbot: The turbot assessment is conducted with SAM, but the WGNSSK forecast procedure is deterministic using the FLR package. These results were reproduced identically at WGMIXFISH.

The turbot assessment does not include discard information (for lack of accurate discard-at-age data), and therefore the landings (in the assessment and in the short-term projections) are equal to the catches. WGNSSK applies a correction of the projected landings to take into account the discard rate in weight (5.9% in 2024). This has not been reproduced in the WGMIXFISH baseline run and explains the difference in the 2024 and 2025 catch between the single-stock advice and the WGMIXFISH baseline run.

Witch: As for other stock where SAM is used to run a stochastic forecast, small differences with the single species advice were encountered, of less than 2.5% for all forecasted quantities.

***Nephrops*:** The forecasts applied the recommended harvest rates to the most recent abundance estimates available for the FUs considered at category 1 stocks (FU 6, 7, 8 and 9). The ICES advice for 2024 is given assuming that the landing obligation is applied in 2024 for all FUs, with an exemption of high survival for catches with pots (FPO), and for catches with bottom trawls (OTB, TBN) with a mesh size of at least 80 mm equipped with a netgrid selectivity device. The WGNSSK procedure was reproduced as closely as possible in FLR and the differences in the forecasted 2025 landings were in all cases under 4%.

WGMIXFISH-FLBEIA baseline run

The forecast conducted using FLBEIA without mixed-fisheries interactions is compared to the WGMIXFISH-FLR baseline run and the single-stock advice on Figure 6.12.. In FLBEIA, the stocks are projected forward based on catches. In order to configure the FLBEIA runs, the catches in 2024 and 2025 from the single-stock advice were used as constraints. This differs from the method applied for the single-stock advice and the WGMIXFISH-FLR baseline run, for which the constraint in the intermediate year can be either a F_{bar} or a catch constraint (depending on the stocks) and the calculation in the advice year is based on a F_{bar} value. As a result, the forecasted catches for 2024 and 2025 in the WGMIXFISH-FLBEIA baseline run are the same as the single-stock advice (blue curve on the black line on Figure 6.12), while small differences can be observed for the WGMIXFISH-FLR baseline (as detailed above). The only exception is for TUR, for which the assessment (and the FLR objects used a WGMIXFISH) do not contain discards while in the single-stock advice, discards are added as an assumed proportion of the landings.

Differences are observed for the catches for 2023, the last data year. The 2023 catches in FLBEIA are the sum across métiers of the landings and discards-at-age multiplied by the corresponding weight-at-age which are obtained by WGMIXFISH from the InterCatch data combined with the accession data. These sums of catches are generally close to the ICES estimates provided on the single-stock advice. The stock assessment output provided by WGNSSK, however, contain catches estimated by the stock assessment model (which differ from the observed catches) for part of the stock. This explains the differences for 2023 catch for several stocks on Figure 6.12.

In general, the WGMIXFISH-FLBEIA forecast reproduced the single-stock forecasts well for the SSB (differences with single-stock advice generally under 5%) although larger discrepancies are often observed for the 3rd projection year (2026). The large discrepancies found for WIT are due to the fact that FLBEIA is not able to compute accurately the SSB for stocks not spawning at the start of the year, which is the case for WIT. Computing manually the SSB using the output of FLBEIA gave values close to the single-stock advice. For most stocks, the FLBEIA forecast leads

to similar differences as obtained with the FLR forecast, indicating that the main cause for the difference is the impossibility to reproduce in a deterministic FLR forecast some of the specificities of the forecast done in WGNSSK (e.g. stochasticity).

Large discrepancies were observed for the landings and discards for most stocks, with higher discards and lower landings in the WGMIXFISH-FLBEIA projections. The most extreme example is for PLE-EC, for which the landings in the WGMIXFISH-FLBEIA baseline are less than 60% of those from the single-stock advice (while the discards are higher). The cause of these discrepancies could not be fully understood at WGMIXFISH. A potential reason could be that the proportions of discards vs. landings in the stock objects provided by WGNSSK may be different from those resulting of the use of fleet and métier disaggregated data that is used in FLBEIA. Further investigations are required to ascertain that this is indeed the cause.

Large differences are also observed for the F_{bar} values calculated by FLBEIA (projections done based on catches and fishing mortality calculated a posteriori).

In conclusion, using the mixed-fisheries model for the projections leads to some differences in forecasted quantities, which are related both to the difference in methodologies (projections based on F or catches, using the Baranov equation vs. projection based on catch only, using the Cobb-Douglas equation), and to the underlying data (stock-aggregated selectivity, weights and discard ratios, vs. fleet specific values).

The WGMIXFISH-FLBEIA baseline produces similar population dynamics as the WGMIXFISH-FLR baseline since forecasted SSB values (and therefore underlying population numbers-at-age) are broadly similar, and catches are, by default, equal to single-stock (since that is the constraint used for the projection). This indicates that, when the mixed-fisheries interactions are introduced in the model, the model should represent population dynamics and catches (resulting from the choice of a most or least limiting effort) in an appropriate manner. These quantities are the main quantities relevant to the mixed fisheries advice. There could be some concern with the landings vs. discards values produced, as well as with the F_{bar} values, but these quantities are not relevant to the mixed fisheries advice.

Mixed fisheries analyses

The full overview of the FLBEIA projections are presented in Table 6.11 and in Figure 6.13 to Figure 6.16 . Figure 6.13 displays the catch by scenario for each of the species. Potential overshoot/undershoot on this figure are calculated by comparing the single-species catch advice for 2025 with the mixed fisheries catch estimates. The anticipated SSBs in 2026 of the mixed fisheries scenarios compared to the baseline are shown in Figure 6.14 , and Figure 6.15 shows the effort needed to reach the single-stock advice and highlights the most and least limiting stock per fleet. Figure 6.16 shows the relative quota uptake by fleet in case of the "min" scenario. A summary of catches by scenario, including the single-stock advice values for reference, is presented in Table 6.12. Finally, Figure 6.17 summarizes all the mixed fisheries projections and compares them to the single-species advice projections.

The outcomes of the "min" and "max" scenarios are driven by the stocks that will be most and least limiting for each individual fleet. Cod was estimated to be the most limiting stock in the "min" scenario. The "min" scenario assumes that fleets would stop fishing when their first quota share is exhausted, regardless of the actual importance of this quota share, thus leading to a distorted perception of plausible fleet behaviour. While this can be considered an unlikely scenario as long as discarding is allowed, this scenario reflects the constraints that result from a strictly implemented discard ban. Assuming a strictly implemented landings obligation (i.e. a discard ban where all catches of quota species must be counted against quota, with no flexibilities such as exemptions, *de minimis* allowed discards or interspecies flexibility, as the "min" scenario represents), cod would be the most limiting stock, constraining 23 of the 37 fleet segments (not

considering the BLL_OTH and MIS_MIS fleets; Figure 6.15 and Figure 6.16). Norway lobster constrains 14 fleets (13 constrained by nep.fu.32, and one by nep.fu.6). This would result in undershooting the advised catches for 2025 provided by the single species advice for all stocks (Figure 6.13).

Conversely, in the "max" scenario, North Sea whiting would be the least limiting stock for 35 out of 37 fleets. This is similar to the results of last year. Saithe and turbot are the other stocks identified as least limiting for one fleet each (Figure 6.15 and Figure 6.16). Under the "max" scenario all stocks exceed the respective catch advice except for whiting (Figure 6.13).

The "cod_ns" scenario reflects the fishing mortality corresponding to the single-species advice for cod.27.47d20 (based on the ICES MSY approach with precautionary considerations), and the results present fishing opportunities for other stocks in a mixed fisheries context. It is similar to the "min" scenario as most fleets are choked by cod in the "min" scenario. The main difference is found for the Norwegian fleets, which can increase effort in the "cod-ns" scenario compared to the "min" scenario due to the removal of Norway lobster as a choking stock in this scenario. Similar scenarios based on the single-stock advice for the other finfish stocks could be provided by ICES, but the "cod-ns" scenario is considered here because it was requested by managers in the past.

Mixed fisheries results for Norway lobster are displayed after combining functional units 6-9 and 32 (FUs 6-9, 32) in one plot, but stock status and fishing opportunities differ widely across FUs. In particular, FU32 (Fladen Ground) is exploited well above the MSY target, and acts as a most limiting stock for 13 fleets. In order to ensure Norway lobster stocks are exploited sustainably in the different FUs, management should therefore be implemented at the FU level. Potential overshoot of catch opportunities for FU32 should not be transferred to other FUs.

The "min_range" scenario is identical with the "min" scenario. The fleets choked by cod cannot increase effort since $F_{MSY\ upper}$ cannot be considered for stocks with SSB < $B_{trigger}$. In addition, F_{MSY} ranges are not defined for Norway lobster Functional Units.

6.6 References

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Table 6.4. Final fleet and métier categories used in the mixed fishery analysis. 4, 3AN and 7D refer to ICES area. Effort is in kWdays and catch is in tonnes, and both figures are for the year 2023.

Fleet	Métier	Effort	Catch	Fleet	Métier	Effort	Catch
BE_Beam>=24	BT1.4	914	1800	FR_Otter10-40	MIS	133	26
BE_Beam>=24	BT2.4	285	592	FR_Otter10-40	TR1.4	936	3714
BE_Beam>=24	BT2.7D	1695	1221	FR_Otter10-40	TR1.6A	264	119
BE_Beam10-24	beam_oth.4	553	620	FR_Otter10-40	TR1.7D	113	11
BE_Beam10-24	BT2.4	70	88	FR_Otter10-40	TR2.4	358	355
BE_Beam10-24	BT2.7D	185	830	FR_Otter10-40	TR2.7D	3898	1724
BE_Otter	OTB32-69.4	236	118	GE_Beam>=24	BT1.4	78	112
BE_Otter	OTB32-69.7D	27	3	GE_Beam>=24	BT2.4	1981	2961
BE_Otter	TR1.4	434	907	GE_Otter10-24	OTB32-69.4	3	5
BE_Otter	TR2.4	335	1840	GE_Otter10-24	TR1.3AN	69	148
BE_Otter	TR2.7D	12	6	GE_Otter10-24	TR1.4	89	148
BLL_OTH	OTH	1000	432	GE_Otter10-24	TR2.4	363	1698
DK_OTH	OTH.3AN	217	193	GE_Otter24-40	MIS	4	2
DK_OTH	OTH.4	7083	4734	GE_Otter24-40	TR1.3AN	225	356
DK_Otter>=24	OTB32-69.3AN	1276	303	GE_Otter24-40	TR1.4	3769	6964
DK_Otter>=24	OTB32-69.4	107	13	GE_Otter24-40	TR2.4	365	997
DK_Otter>=24	TR1.3AN	170	409	GE_Otter24-40	TR2.7D	57	8
DK_Otter>=24	TR1.4	1913	4632	MIS_MIS	MIS	38906	4576
DK_Otter>=24	TR2.3AN	879	1382	NL_Beam<24	beam_oth.4	2768	1446

Fleet	Métier	Effort	Catch	Fleet	Métier	Effort	Catch
DK_Ot-ter>=24	TR2.4	195	723	NL_Beam<24	BT1.3AN	0	3
DK_Otter10-24	OTB32-69.3AN	155	47	NL_Beam<24	BT1.4	0	141
DK_Otter10-24	OTB32-69.4	17	2	NL_Beam<24	BT2.4	161	2354
DK_Otter10-24	TR1.3AN	159	466	NL_Beam>=40	BT1.3AN	72	279
DK_Otter10-24	TR1.4	391	1012	NL_Beam>=40	BT1.4	483	1375
DK_Otter10-24	TR2.3AN	2770	4666	NL_Beam>=40	BT2.4	10334	43896
DK_Otter10-24	TR2.4	8	68	NL_Beam24-40	BT1.3AN	40	280
DK_Seine	TR1.3AN	502	3843	NL_Beam24-40	BT1.4	158	824
DK_Seine	TR1.4	808	2103	NL_Beam24-40	BT2.4	829	3834
DK_Static	GN1.3AN	417	885	NL_Beam24-40	MIS	471	80
DK_Static	GN1.4	844	2408	NL_Otter	OTB32-69.4	314	315
DK_Static	LL1.3AN	7	58	NL_Otter	otter_oth.4	115	206
DK_Static	LL1.4	13	136	NL_Otter	ot-ter_oth.7D	76	76
EN_<10	GN1.4	99	20	NL_Otter	TR1.3AN	4	9
EN_<10	GN1.7D	270	177	NL_Otter	TR1.4	658	2629
EN_<10	GT1.4	23	6	NL_Otter	TR1.7D	20	2
EN_<10	GT1.7D	96	60	NL_Otter	TR2.4	1338	8556
EN_<10	LL1.4	47	10	NL_Otter	TR2.7D	727	578
EN_<10	LL1.7D	83	0	NO_<15	OTH	1000	5127
EN_<10	MIS	317	10	NO_DSeine24-40	MIS	7	52
EN_<10	pots.4	1192	11	NO_DSeine24-40	TR1.3AN	45	278
EN_<10	pots.7D	584	2	NO_DSeine24-40	TR1.4	562	3161
EN_<10	TR1.4	29	84	NO_OTH	OTH.3AN	2	0

Fleet	Métier	Effort	Catch	Fleet	Métier	Effort	Catch
EN_<10	TR1.7D	1	1	NO_OTH	OTH.4	810	5263
EN_<10	TR2.4	293	597	NO_Ot-ter>=40	OTB32-69.3AN	24	2
EN_<10	TR2.7D	92	97	NO_Ot-ter>=40	OTB32-69.4	1698	514
EN_Beam>10	beam_oth.4	155	1	NO_Ot-ter>=40	otter_oth.4	550	108
EN_Beam>10	beam_oth.7D	1	7	NO_Ot-ter>=40	TR1.4	4785	11063
EN_Beam>10	BT1.4	373	1174	NO_Ot-ter>=40	TR3.4	10349	2624
EN_Beam>10	BT2.4	878	2349	NO_Ot-ter10-24	OTB32-69.3AN	1087	60
EN_Beam>10	BT2.7D	67	342	NO_Ot-ter10-24	OTB32-69.4	597	50
EN_Ot-ter>=40	OTB32-69.4	68	35	NO_Ot-ter10-24	ot-ter_oth.3AN	71	1
EN_Ot-ter>=40	TR1.4	165	300	NO_Ot-ter10-24	otter_oth.4	38	1
EN_Ot-ter>=40	TR2.4	54	76	NO_Ot-ter10-24	TR1.3AN	66	8
EN_Ot-ter>=40	TR2.7D	4	0	NO_Ot-ter10-24	TR1.4	451	184
EN_Otter10-24	MIS	48	34	NO_Ot-ter10-24	TR3.3AN	307	32
EN_Otter10-24	TR1.4	277	611	NO_Ot-ter10-24	TR3.4	6	0
EN_Otter10-24	TR1.7D	0	0	NO_Ot-ter24-40	OTB32-69.3AN	926	60
EN_Otter10-24	TR2.4	859	2091	NO_Ot-ter24-40	OTB32-69.4	1777	165
EN_Otter10-24	TR2.7D	112	65	NO_Ot-ter24-40	ot-ter_oth.3AN	142	13
EN_Otter24-40	MIS	123	37	NO_Ot-ter24-40	otter_oth.4	401	48
EN_Otter24-40	otter_oth.4	965	521	NO_Ot-ter24-40	TR1.3AN	99	12
EN_Otter24-40	ot-ter_oth.7D	522	116	NO_Ot-ter24-40	TR1.4	3683	2318

Fleet	Métier	Effort	Catch	Fleet	Métier	Effort	Catch
EN_Otter24-40	TR1.4	582	2417	NO_Otter24-40	TR3.3AN	42	3
EN_Otter24-40	TR1.6A	12	13	NO_Otter24-40	TR3.4	1288	550
EN_Otter24-40	TR1.7D	7	0	NO_Pelagic	pelagic.4	4104	1244
FR_<10	GN1.7D	53	1	NO_Static	GN1.3AN	36	8
FR_<10	GT1.4	6	1	NO_Static	GN1.4	2375	2816
FR_<10	GT1.7D	169	32	NO_Static	LL1.4	1946	1090
FR_<10	MIS	6	1	NO_Static	LL1.6A	715	3
FR_<10	OTH.7D	123	19	NO_Static	pots.3AN	12	0
FR_<10	TR1.7D	1	0	NO_Static	pots.4	152	17
FR_<10	TR2.4	2	0	SC_Otter<10	TR1.4	27	84
FR_<10	TR2.7D	23	12	SC_Otter<10	TR2.4	276	712
FR_Nets>10	GN1.7D	12	1	SC_Otter>=24	TR1.4	8707	66129
FR_Nets>10	GT1.4	10	4	SC_Otter>=24	TR1.6A	1377	4610
FR_Nets>10	GT1.7D	369	301	SC_Otter>=24	TR2.4	424	1364
FR_OTH	MIS	25	19	SC_Otter>=24	TR2.7D	88	127
FR_OTH	OTH.4	23	225	SC_Otter10-24	MIS	14	626
FR_OTH	OTH.6A	0	82	SC_Otter10-24	TR1.4	5601	20491
FR_OTH	OTH.7D	5358	234	SC_Otter10-24	TR1.6A	891	835
FR_OTH	pelagic.4	1126	74	SC_Otter10-24	TR2.4	1280	8407
FR_OTH	pelagic.6A	415	0	SC_Otter10-24	TR2.6A	2264	918
FR_OTH	pelagic.7D	783	40	SW_Otter	OTB32-69.3AN	841	88
FR_OTH	TR2.4	63	56	SW_Otter	OTB32-69.4	112	32
FR_OTH	TR2.7D	572	583	SW_Otter	TR1.4	245	1554

Fleet	Métier	Effort	Catch	Fleet	Métier	Effort	Catch
FR_Otter>=40	TR1.4	1936	8336	SW_Otter	TR2.3AN	872	1171
FR_Otter>=40	TR1.6A	866	580	SW_Otter	TR2_grid.3AN	914	319

Table 6.5. Average fishing mortality (Fbar) in 2023 between the single-stock assessment (SSA) and FLBEIA.

	FLBEIA	SSA	Diff_FLBEIA/SSA
BLL	0.144	0.137	0.05
COD-NS	0.293	0.297	-0.01
HAD	0.089	0.084	0.06
PLE-EC	0.205	0.152	0.35
PLE-NS	0.061	0.065	-0.06
POK	0.299	0.320	-0.07
SOL-EC	0.201	0.215	-0.06
TUR	0.290	0.302	-0.04
WHG-NS	0.084	0.083	0.01
WIT	0.227	0.204	0.11

Table 6.6. Total catch in 2023 between the single-stock assessment (SSA) and FLBEIA.

	FLBEIA	SSA	Diff_FLBEIA/SSA
BLL	1074.653	1074.653	0.000
COD-NS	36738.320	37422.935	-0.018
HAD	67552.316	60979.108	0.108
PLE-EC	4215.660	3480.220	0.211
PLE-NS	71843.388	61451.738	0.169
POK	70502.947	65865.035	0.070
SOL-EC	1663.183	1631.789	0.019
TUR	1745.463	1711.968	0.020
WHG-NS	28722.878	28910.717	-0.006
WIT	1688.338	1641.266	0.029

Table 6.7. Total landings in 2023 between the single-stock assessment (SSA) and FLBEIA.

	FLBEIA	SSA	Diff_FLBEIA/SSA
BLL	1074.653	1074.653	0.000
COD-NS	28862.639	28483.663	-0.013
HAD	37702.348	44268.209	0.174
PLE-EC	810.579	899.477	0.110
PLE-NS	24553.343	26077.187	0.062
POK	62691.369	68065.676	0.086
SOL-EC	1419.060	1451.839	0.023
TUR	1711.968	1745.463	0.020
WHG-NS	18644.448	18598.149	-0.002
WIT	1514.135	1533.716	0.013

Table 6.8. Total discards in 2023 between the single-stock assessment (SSA) and FLBEIA.

	SSA	FLBEIA	Diff_FLBEIA/SSA
BLL	0.000	0.000	-
COD-NS	8559.868	8254.658	-0.036
HAD	23230.991	23284.107	0.002
PLE-EC	2669.640	3316.183	0.242
PLE-NS	36740.662	45766.202	0.246
POK	3173.728	2437.271	-0.232
SOL-EC	212.729	211.345	-0.007
TUR	0.000	0.000	-
WHG-NS	10268.816	10124.730	-0.014
WIT	151.253	154.622	0.022

Table 6.9. Intermediate year assumption in the baseline and mixed fisheries projections.

	Fbar in 2024	Landings in 2024	Discards in 2024	Catches in 2024	SSB in 2025
bll.27.3a47de	0.114	952	0	952	9405
cod.27.46a7d20	0.305	30059	8369	38428	79135
had.27.46a20	0.090	46299	19593	65891	522103
ple.27.7d	0.217	596	2675	3271	27036

	Fbar in 2024	Landings in 2024	Discards in 2024	Catches in 2024	SSB in 2025
ple.27.420	0.064	23104	42698	65802	1137915
pok.27.3a46	0.295	65325	2608	67933	191919
sol.27.7d	0.228	1171	383	1554	10225
tur.27.4	0.288	1849	8	1857	7346
whg.27.47d	0.084	20660	9171	29832	363296
wit.27.3a47d	0.246	1436	463	1898	5597
nep.fu.5	0.005	703	107	810	8138
nep.fu.6	0.007	1601	537	2137	17083
nep.fu.7	0.001	3933	107	4039	112770
nep.fu.8	0.008	1471	182	1653	11805
nep.fu.9	0.003	511	51	562	7489
nep.fu.10	0.004	19	2	21	213
nep.fu.32	0.320	191	0	191	640
nep.fu.33	0.004	832	828	1660	15307
nep.fu.34	0.004	722	107	829	8277
nep.27.4outFU	0.002	717	181	898	8978

Table 6.10. Comparison between WGMIXFISH-FLR baseline run and ICES advice for *Nephrops in the TAC year (2025). The values for *Nephrops* FUs that do not receive an absolute ICES abundance estimate are set according to the ICES approach for data-limited *Nephrops* stocks. No 'ICES advice' values are given for *Nephrops* in the intermediate year because the baseline run uses values based on recorded landings in the previous year which can vary significantly from the advice for each FU.**

year	value	scenario	NEP5	NEP6	NEP7	NEP8	NEP9	NEP10	NEP32	NEP33	NEP34	NEPOTH-NS
2025	landings	ICES_advice	1038	1056.0	9125.0	2051.0	881.0	24		972	567	241
2025	landings	MIXFISH_baseline	1038	1074.0	9055.0	1971.0	879.0	24			567	241
2025	landings	difference (%)	0	1.7	-0.8	-3.9	-0.2	0			0	0

***These numbers are landings values; ICES advice does not provide total catch.**

Table 6.11. Results of Final FLBEIA runs.

scenario	year	indica-tor	BLL	COD-NS	HAD	PLE-EC	PLE-NS	POK	SOL-EC	TUR	WHG-NS	WIT	NEP10	NEP32	NEP33	NEP34	NEP5	NEP6	NEP7	NEP8	NEP9	NEP OTH-NS
baseline	2024	landings	0.114	32998	52658	1105	31680	73292	1273	1860	20465	1498	31		1315	1195	1150	3354	7763	3160	1694	1094
baseline	2025	landings	0.175	13087	91533	945	83976	72647	997	2284	121067	1876	24			567	1038	1074	9055	1971	879	241
baseline	2024	catch	0.163	39348	65416	3348	74072	76362	1504	1860	30998	1579										
baseline	2025	catch	8321	14884	109356	2603	173566	75611	1195	2284	185770	1958	24			599	1256	1241	9150	2082	888	241
baseline	2024	Fbar	9405	0.297	0.084	0.152	0.065	0.32	0.211	0.302	0.083	0.153	0.147		0.096	0.153	0.193	0.244	0.065	0.269	0.232	0.145
baseline	2025	Fbar	9461	0.104	0.174	0.116	0.152	0.316	0.159	0.361	0.68	0.163			0.075			0.072	0.075	0.163	0.118	
baseline	2024	ssb	952	80271	598127	27682	989431	181577	10130	6881	372493	4937										
baseline	2025	ssb	1648	80392	522141	28064	1135365	188991	10307	7223	363344	5422										
baseline	2026	ssb	1539	100092	394467	27861	1086547	187489	11022	7151	236350	5710										
min	2024	Fbar	952	0.305	0.09	0.217	0.064	0.295	0.228	0.288	0.084	0.246	0.004	0.32	0.004	0.004	0.005	0.007	0.001	0.008	0.003	0.002
min	2025	Fbar	1648	0.064	0.02	0.118	0.034	0.061	0.11	0.136	0.027	0.048	0.002	0.059	0.001	0.001	0.002	0.004	0	0.003	0.001	0.001
min	2026	Fbar	1539	0.049	0.015	0.092	0.024	0.045	0.087	0.096	0.02	0.037	0.001	0.045	0.001	0.001	0.001	0.003	0	0.003	0.001	0.001
min	2024	ssb	0	80271	598127	27682	989431	181577	10130	6881	372493	5352	213	597	15307	8277	8138	17083	112770	11805	7489	8978
min	2025	ssb	0	79135	522103	27036	1137915	191919	10225	7346	363296	5597	213	640	15307	8277	8138	17083	112770	11805	7489	8978
min	2026	ssb	0	105372	472942	27445	1203263	238573	11311	8659	369352	6751	213	851	15307	8277	8138	17083	112770	11805	7489	8978
min	2024	catch	0.114	38428	65891	3271	65802	67933	1554	1857	29832	1898	21	191	1660	829	810	2137	4039	1653	562	898
min	2025	catch	0.69	8312	13646	1574	34328	15029	802	1018	9297	469	9	38	539	299	328	1146	1414	726	229	344

scenario	year	indicator	BLL	COD-NS	HAD	PLE-EC	PLE-NS	POK	SOL-EC	TUR	WHG-NS	WIT	NEP10	NEP32	NEP33	NEP34	NEP5	NEP6	NEP7	NEP8	NEP9	NEP OTH-NS
min	2026	catch	1.316	8260	9761	1244	25257	13373	707	876	7015	460	7	38	401	234	246	894	1108	570	180	261
min	2024	landings	8321	30059	46299	596	23104	65325	1171	1849	20660	1436	19	191	832	722	703	1601	3933	1471	511	717
min	2025	landings	9405	6779	9912	301	11552	14598	619	1018	5616	425	8	38	484	260	287	858	1377	646	208	270
min	2026	landings	4619	6926	8230	235	9739	13019	545	876	4581	426	6	38	362	204	216	669	1079	507	163	207
min	2024	discards	952	8369	19593	2675	42698	2608	383	8	9171	463	2	0	828	107	107	537	107	182	51	181
min	2025	discards	6489	1534	3734	1273	22776	431	183	0	3680	45	1	0	55	39	42	288	37	80	21	73
min	2026	discards	6078	1334	1531	1009	15518	355	162	0	2434	34	1	0	39	30	30	225	29	63	17	53
max	2024	Fbar	952	0.305	0.09	0.217	0.064	0.295	0.228	0.288	0.084	0.246	0.004	0.32	0.004	0.004	0.005	0.007	0.001	0.008	0.003	0.002
max	2025	Fbar	2823	1.743	0.95	1.975	0.725	1.965	2.161	1.966	0.802	1.804	0.05	1.251	0.034	0.046	0.057	0.066	0.014	0.073	0.039	0.017
max	2026	Fbar	2730	1.745	1.417	1.975	1.593	1.965	2.161	2.044	1.327	2.044	0.076	1.277	0.038	0.07	0.075	0.079	0.033	0.077	0.079	0.023
max	2024	ssb	0	80271	598127	27682	989431	181577	10130	6881	372493	5352	213	597	15307	8277	8138	17083	112770	11805	7489	8978
max	2025	ssb	3666	79135	522103	27036	1137915	191919	10225	7346	363296	5597	213	640	15307	8277	8138	17083	112770	11805	7489	8978
max	2026	ssb	3348	15748	181886	3868	676884	40914	1750	3155	226586	1240	213	89	15307	8277	8138	17083	112770	11805	7489	8978
max	2024	catch	0.114	38428	65891	3271	65802	67933	1554	1857	29832	1898	21	191	1660	829	810	2137	4039	1653	562	898
max	2025	catch	0.135	75234	351929	17416	497962	213949	5388	6530	188148	7524	127	800	12193	5043	5847	13177	24553	10392	3648	6229
max	2026	catch	0.132	36022	165346	8576	465888	104260	2092	2950	155880	2692	187	114	13776	7449	7324	15374	51397	10624	6740	8080
max	2024	landings	8321	30059	46299	596	23104	65325	1171	1849	20660	1436	19	191	832	722	703	1601	3933	1471	511	717
max	2025	landings	9405	3968	84003	373	66656	43585	488	1037	125824	1075	22	19	832	522	1091	921	8907	1850	803	717

scenario	year	indicator	BLL	COD-NS	HAD	PLE-EC	PLE-NS	POK	SOL-EC	TUR	WHG-NS	WIT	NEP10	NEP32	NEP33	NEP34	NEP5	NEP6	NEP7	NEP8	NEP9	NEP OTH-NS
max	2026	landings	9838	1765	54539	156	63924	35353	364	980	94335	599	22	13	615	370	894	597	8907	1235	734	548
max	2024	discards	952	8369	19593	2675	42698	2608	383	8	9171	463	2	0	828	107	107	537	107	182	51	181
max	2025	discards	1271	71266	267926	17044	431307	170365	4899	5493	62324	6449	106	782	11361	4522	4756	12255	15646	8542	2845	5512
max	2026	discards	1301	34257	110807	8420	401964	68907	1728	1970	61545	2093	165	101	13161	7080	6430	14777	42490	9390	6006	7532
sq_E	2024	Fbar	952	0.305	0.09	0.217	0.064	0.295	0.228	0.288	0.084	0.246	0.004	0.32	0.004	0.004	0.005	0.007	0.001	0.008	0.003	0.002
sq_E	2025	Fbar	1271	0.388	0.09	0.221	0.064	0.295	0.273	0.288	0.084	0.231	0.004	0.445	0.004	0.005	0.005	0.009	0.001	0.008	0.003	0.002
sq_E	2026	Fbar	1301	0.375	0.09	0.22	0.064	0.295	0.27	0.288	0.084	0.238	0.004	0.446	0.004	0.005	0.005	0.009	0.001	0.008	0.003	0.002
sq_E	2024	ssb	0	80271	598127	27682	989431	181577	10130	6881	372493	5352	213	597	15307	8277	8138	17083	112770	11805	7489	8978
sq_E	2025	ssb	0	79135	522103	27036	1137915	191919	10225	7346	363296	5597	213	640	15307	8277	8138	17083	112770	11805	7489	8978
sq_E	2026	ssb	0	64614	439373	25258	1172578	194222	10077	7724	353814	5723	213	605	15307	8277	8138	17083	112770	11805	7489	8978
sq_E	2024	catch	0.114	38428	65891	3271	65802	67933	1554	1857	29832	1898	21	191	1660	829	810	2137	4039	1653	562	898
sq_E	2025	catch	0.177	36274	59500	3093	68919	65533	1583	1983	28970	2034	21	285	1660	829	810	2137	4039	1653	562	898
sq_E	2026	catch	0.166	30037	53052	2927	67424	64533	1563	2058	27486	2171	21	269	1660	829	810	2137	4039	1653	562	898
sq_E	2024	landings	8321	30059	46299	596	23104	65325	1171	1849	20660	1436	19	191	832	722	703	1601	3933	1471	511	717
sq_E	2025	landings	9405	12823	46266	518	28228	63214	931	1983	20158	1813	19	38	832	522	703	921	3933	1471	511	717
sq_E	2026	landings	9444	12230	46252	495	29911	62104	924	2058	19833	1838	19	38	832	522	703	921	3933	1471	511	717
sq_E	2024	discards	952	8369	19593	2675	42698	2608	383	8	9171	463	2	0	828	107	107	537	107	182	51	181
sq_E	2025	discards	1665	23451	13234	2575	40691	2320	652	0	8812	221	2	247	828	307	107	1216	107	182	51	181

scenario	year	indicator	BLL	COD-NS	HAD	PLE-EC	PLE-NS	POK	SOL-EC	TUR	WHG-NS	WIT	NEP10	NEP32	NEP33	NEP34	NEP5	NEP6	NEP7	NEP8	NEP9	NEP OTH-NS
sq_E	2026	discards	1567	17806	6800	2432	37513	2430	639	0	7652	333	2	231	828	307	107	1216	107	182	51	181
cod-ns	2024	Fbar	952	0.305	0.09	0.217	0.064	0.295	0.228	0.288	0.084	0.246	0.004	0.32	0.004	0.004	0.005	0.007	0.001	0.008	0.003	0.002
cod-ns	2025	Fbar	1665	0.123	0.037	0.119	0.038	0.112	0.11	0.15	0.037	0.094	0.002	0.195	0.001	0.002	0.002	0.004	0.001	0.003	0.001	0.001
cod-ns	2026	Fbar	1567	0.102	0.031	0.097	0.028	0.086	0.092	0.114	0.03	0.079	0.001	0.153	0.001	0.001	0.002	0.003	0	0.003	0.001	0.001
cod-ns	2024	ssb	0	80271	598127	27682	989431	181577	10130	6881	372493	5352	213	597	15307	8277	8138	17083	112770	11805	7489	8978
cod-ns	2025	ssb	0	79135	522103	27036	1137915	191919	10225	7346	363296	5597	213	640	15307	8277	8138	17083	112770	11805	7489	8978
cod-ns	2026	ssb	0	97264	464787	27424	1199404	227927	11305	8564	366474	6468	213	764	15307	8277	8138	17083	112770	11805	7489	8978
cod-ns	2024	catch	0.114	38428	65891	3271	65802	67933	1554	1857	29832	1898	21	191	1660	829	810	2137	4039	1653	562	898
cod-ns	2025	catch	0.175	15511	25129	1593	39433	27133	807	1113	13003	935	9	125	683	357	356	1171	1727	726	240	386
cod-ns	2026	catch	0.163	15511	19673	1329	30559	24075	751	1010	10516	956	8	117	562	301	288	949	1456	612	203	316
cod-ns	2024	landings	8321	30059	46299	596	23104	65325	1171	1849	20660	1436	19	191	832	722	703	1601	3933	1471	511	717
cod-ns	2025	landings	9405	12823	19461	305	14788	26171	623	1113	8665	867	8	38	628	311	314	869	1682	646	218	313
cod-ns	2026	landings	9461	13012	17157	252	12988	23226	579	1010	7478	900	7	38	519	262	255	711	1418	544	185	259
cod-ns	2024	discards	952	8369	19593	2675	42698	2608	383	8	9171	463	2	0	828	107	107	537	107	182	51	181
cod-ns	2025	discards	1648	2688	5668	1289	24645	961	184	0	4338	68	1	87	55	46	42	303	46	80	22	73
cod-ns	2026	discards	1539	2499	2515	1077	17570	849	172	0	3038	56	1	79	43	39	33	239	38	67	19	57
min_range	2024	Fbar	952	0.305	0.09	0.217	0.064	0.295	0.228	0.288	0.084	0.246	0.004	0.32	0.004	0.004	0.005	0.007	0.001	0.008	0.003	0.002
min_range	2025	Fbar	1648	0.064	0.02	0.118	0.034	0.061	0.11	0.136	0.027	0.048	0.002	0.059	0.001	0.001	0.002	0.004	0	0.003	0.001	0.001

scenario	year	indica-tor	BLL	COD-NS	HAD	PLE-EC	PLE-NS	POK	SOL-EC	TUR	WHG-NS	WIT	NEP10	NEP32	NEP33	NEP34	NEP5	NEP6	NEP7	NEP8	NEP9	NEP OTH-NS
min_range	2026	Fbar	1539	0.049	0.015	0.092	0.024	0.045	0.087	0.096	0.02	0.037	0.001	0.045	0.001	0.001	0.001	0.003	0	0.003	0.001	0.001
min_range	2024	ssb	0	80271	598127	27682	989431	181577	10130	6881	372493	5352	213	597	15307	8277	8138	17083	112770	11805	7489	8978
min_range	2025	ssb	0	79135	522103	27036	1137915	191919	10225	7346	363296	5597	213	640	15307	8277	8138	17083	112770	11805	7489	8978
min_range	2026	ssb	0	105372	472942	27445	1203263	238573	11311	8659	369352	6751	213	851	15307	8277	8138	17083	112770	11805	7489	8978
min_range	2024	catch		38428	65891	3271	65802	67933	1554	1857	29832	1898	21	191	1660	829	810	2137	4039	1653	562	898
min_range	2025	catch		8312	13646	1574	34328	15029	802	1018	9297	469	9	38	539	299	328	1146	1414	726	229	344
min_range	2026	catch		8260	9761	1244	25257	13373	707	876	7015	460	7	38	401	234	246	894	1108	570	180	261
min_range	2024	landings		30059	46299	596	23104	65325	1171	1849	20660	1436	19	191	832	722	703	1601	3933	1471	511	717
min_range	2025	landings		6779	9912	301	11552	14598	619	1018	5616	425	8	38	484	260	287	858	1377	646	208	270
min_range	2026	landings		6926	8230	235	9739	13019	545	876	4581	426	6	38	362	204	216	669	1079	507	163	207
min_range	2024	discards		8369	19593	2675	42698	2608	383	8	9171	463	2	0	828	107	107	537	107	182	51	181
min_range	2025	discards		1534	3734	1273	22776	431	183	0	3680	45	1	0	55	39	42	288	37	80	21	73
min_range	2026	discards		1334	1531	1009	15518	355	162	0	2434	34	1	0	39	30	30	225	29	63	17	53

Table 6.12. Mixed fisheries for the North Sea. Catch per mixed-fisheries scenario 2025, in absolute values.

Stock	Single.stock.advice	max	min	sq_E	min_range	cod.ns
bll.27.3a47de	2823	1648	6489	1271	1648	1665
cod.27.46a7d20	15511	8312	75234	36274	8312	15511
had.27.46a20	112435	13646	351929	59500	13646	25129
ple.27.7d	2600	1574	17416	3093	1574	1593
ple.27.420	176988	34328	497962	68919	34328	39433
pok.27.3a46	79071	15029	213949	65533	15029	27133
sol.27.7d	1209	802	5388	1583	802	807
tur.27.4	2426	1018	6530	1983	1018	1113
whg.27.47d	188148	9297	188148	28970	9297	13003
wit.27.3a47d	1969	469	7524	2034	469	935
nep.fu.5	1256	328	5847	810	328	356
nep.fu.6	1230	1146	13177	2137	1146	1171
nep.fu.7	9149	1414	24553	4039	1414	1727
nep.fu.8	2079	726	10392	1653	726	726
nep.fu.9	884	229	3648	562	229	240
nep.fu.10	24	9	127	21	9	9
nep.fu.32	38	38	800	285	38	125
nep.fu.33	972	539	12193	1660	539	683
nep.fu.34	599	299	5043	829	299	357
nep.27.4outFU	241	344	6229	898	344	386

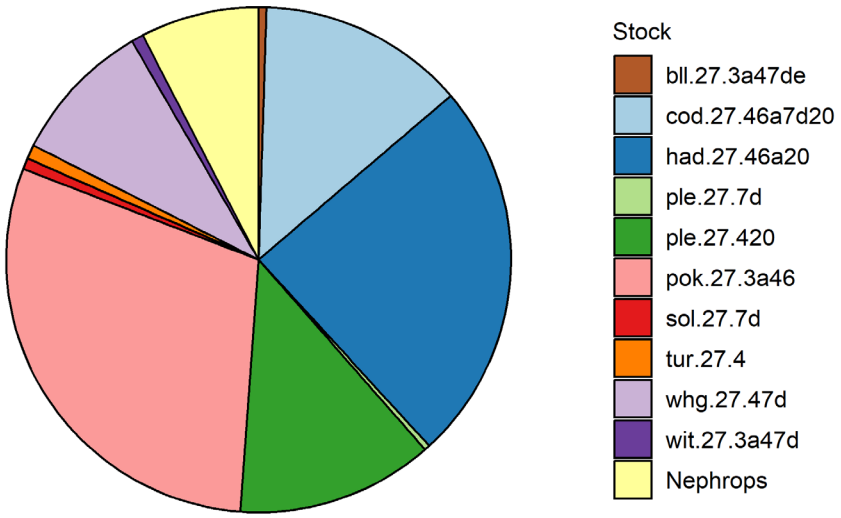

Figure 6.1. Distribution of 2023 landings weight of those stocks included in the mixed fisheries projections.

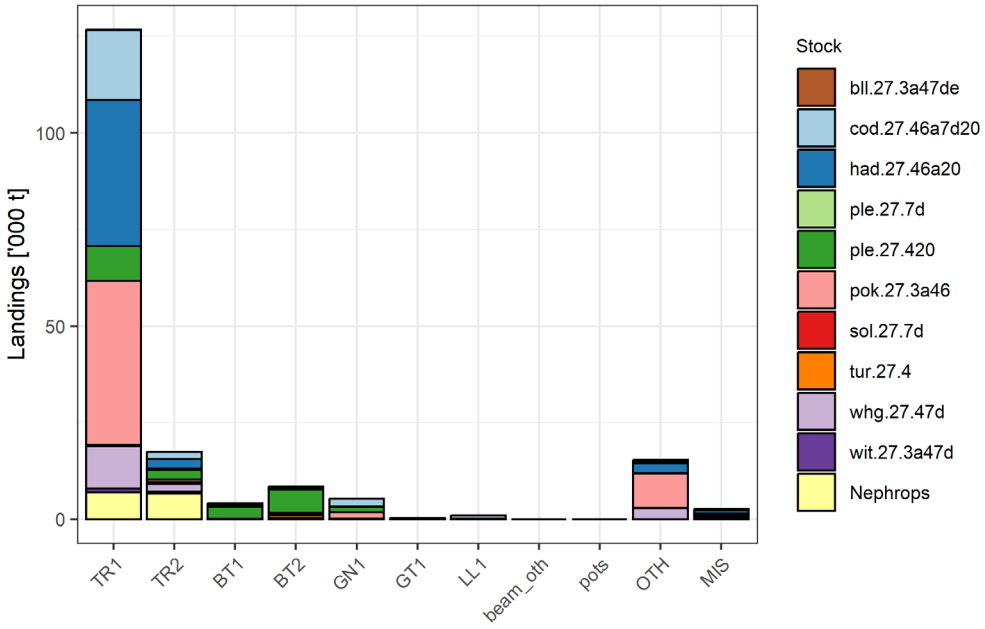

Figure 6.2. 2023 landings distribution of species by métier category. Note: "MIS" contains landings of "small" métiers that, within a fleet, fail to catch at least 5% of the fleet's total landings of at least one stock. The "OTH" displayed here is a mixed category consisting of (i) landings without corresponding effort contained in the BLL_OTH and NO_<15 fleets and (ii) landings of uncommon métiers.

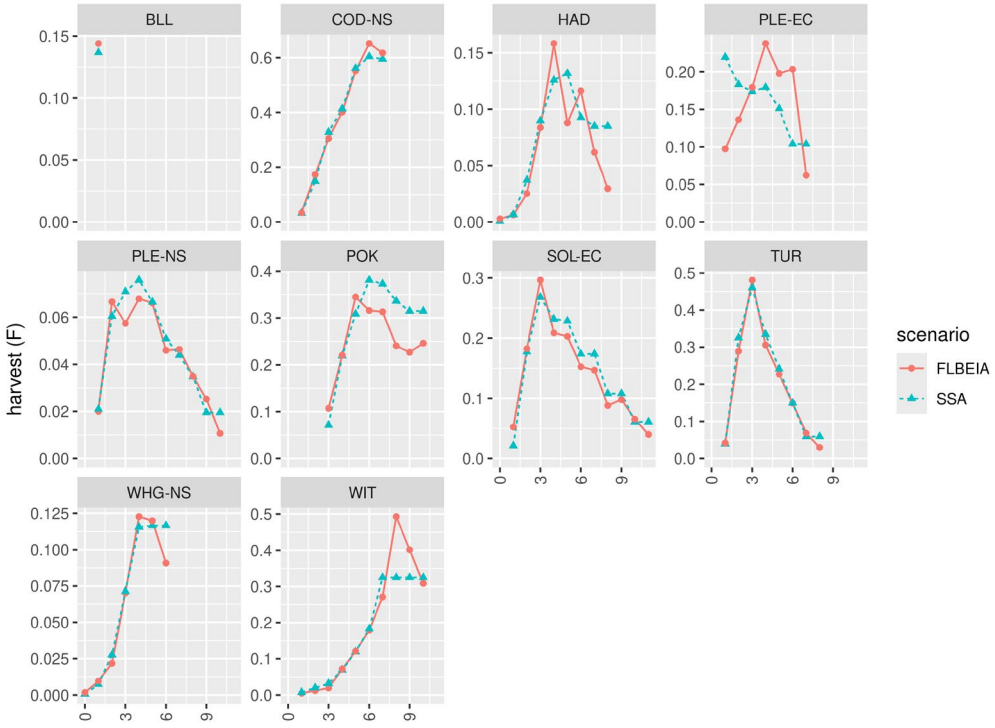

Figure 6.3. Fishing mortality-at-age in the last assessment year (2023).

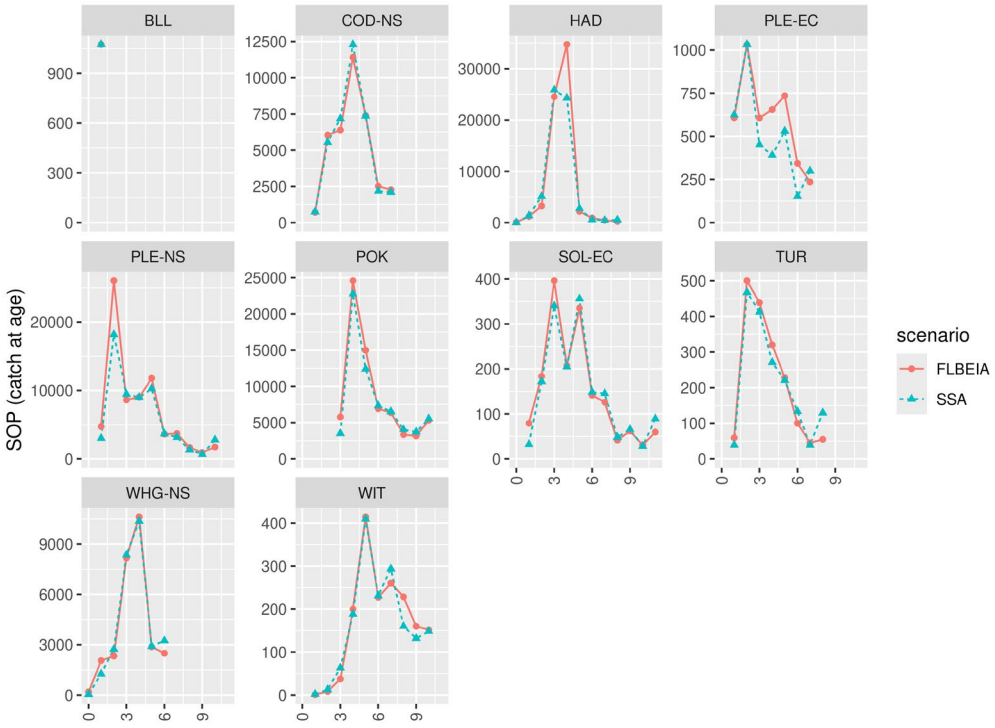

Figure 6.4. Sum of product (numbers*weight) catches in the last assessment year (2023).

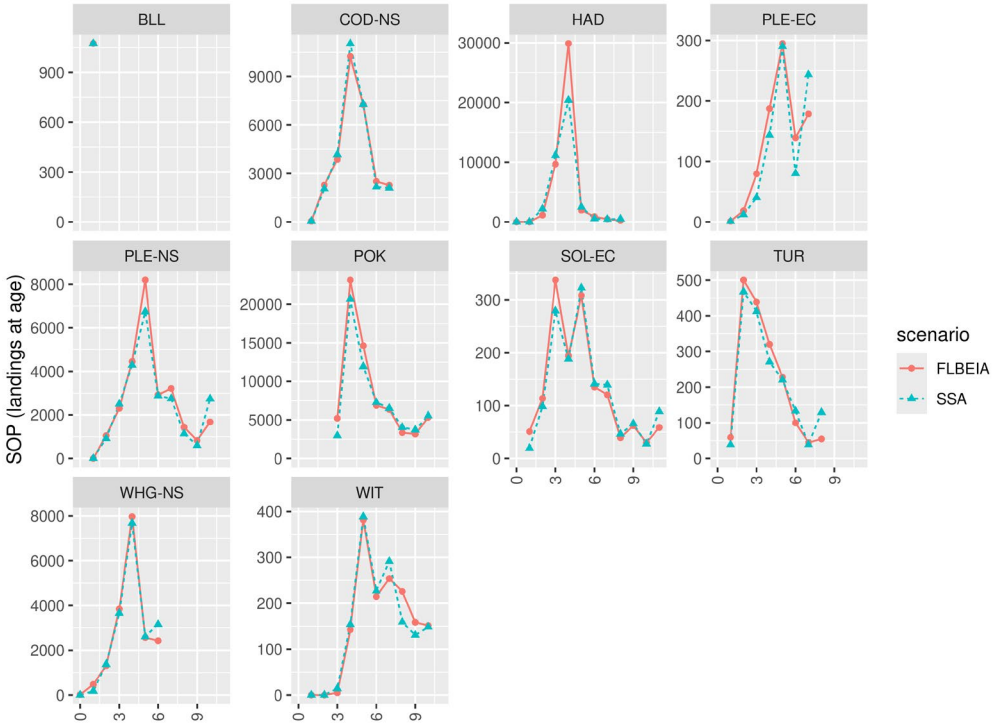

Figure 6.5. Sum of product (numbers*weight) landings in the last assessment year (2023).

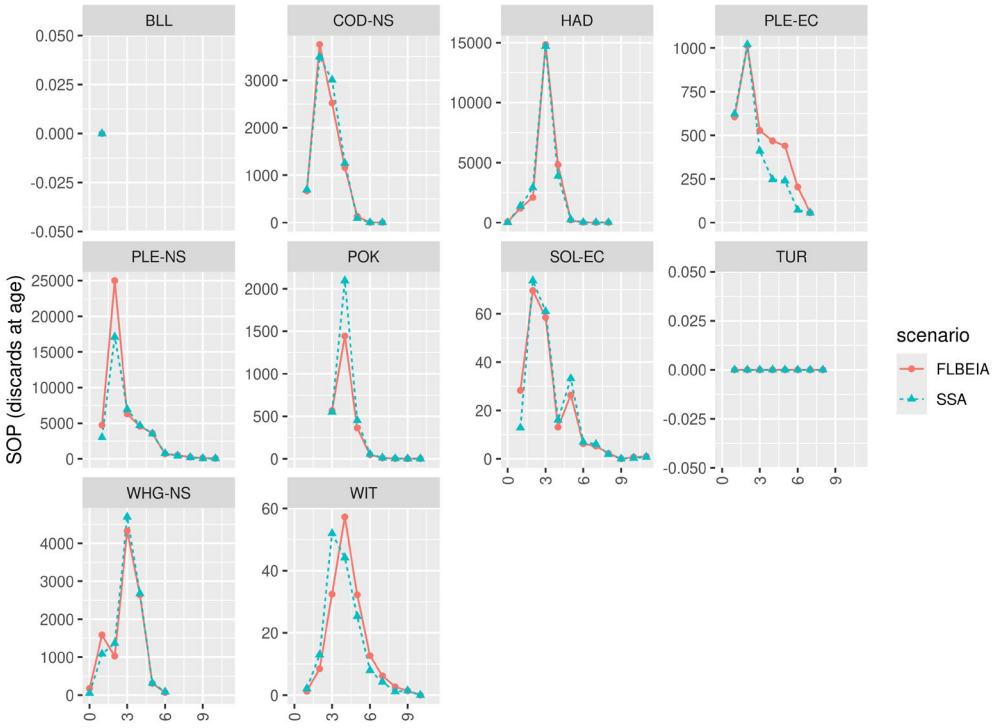

Figure 6.6. Sum of product (numbers*weight) discards in the last assessment year (2023).

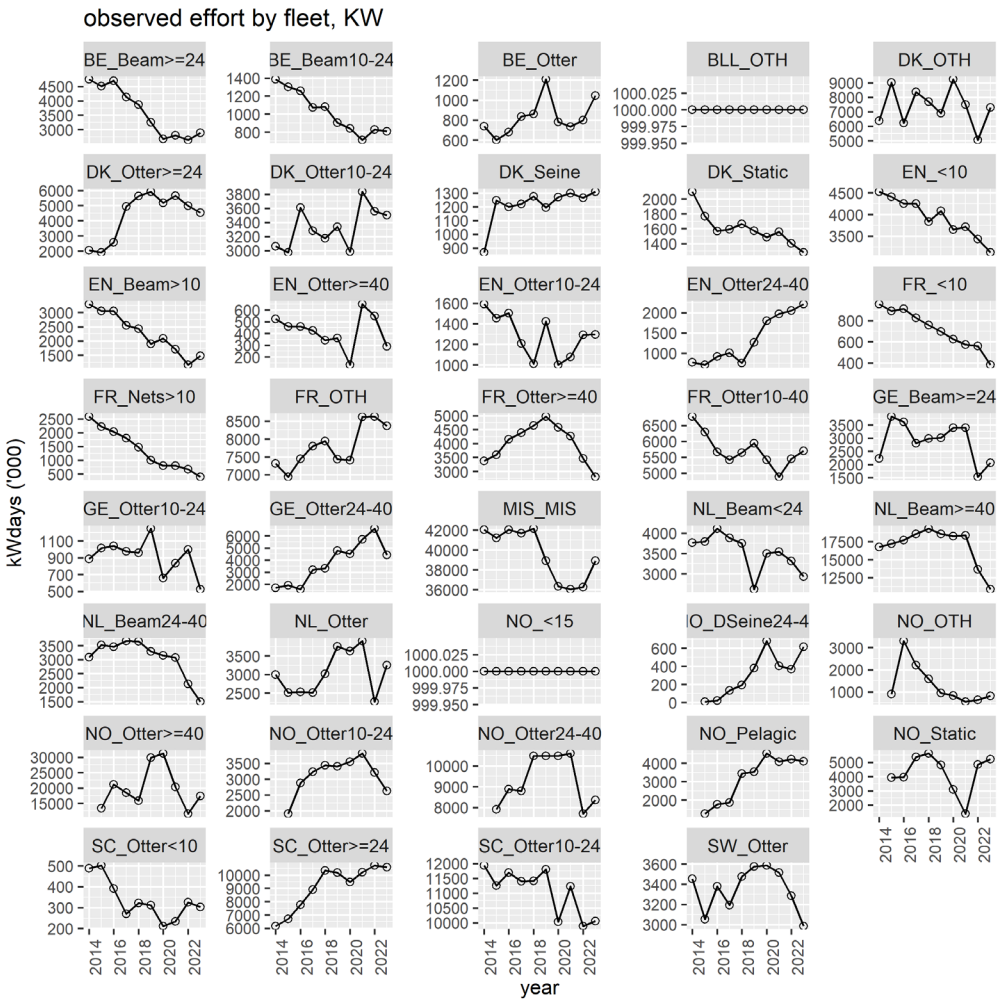

Figure 6.7. Effort by fleet and year for the North Sea demersal fleets, in '000 kWdays.

Figure 6.8. Relative trends (compared to the 2023 value) in effort (KW Days) by fleet and year for the North Sea demersal fleets.

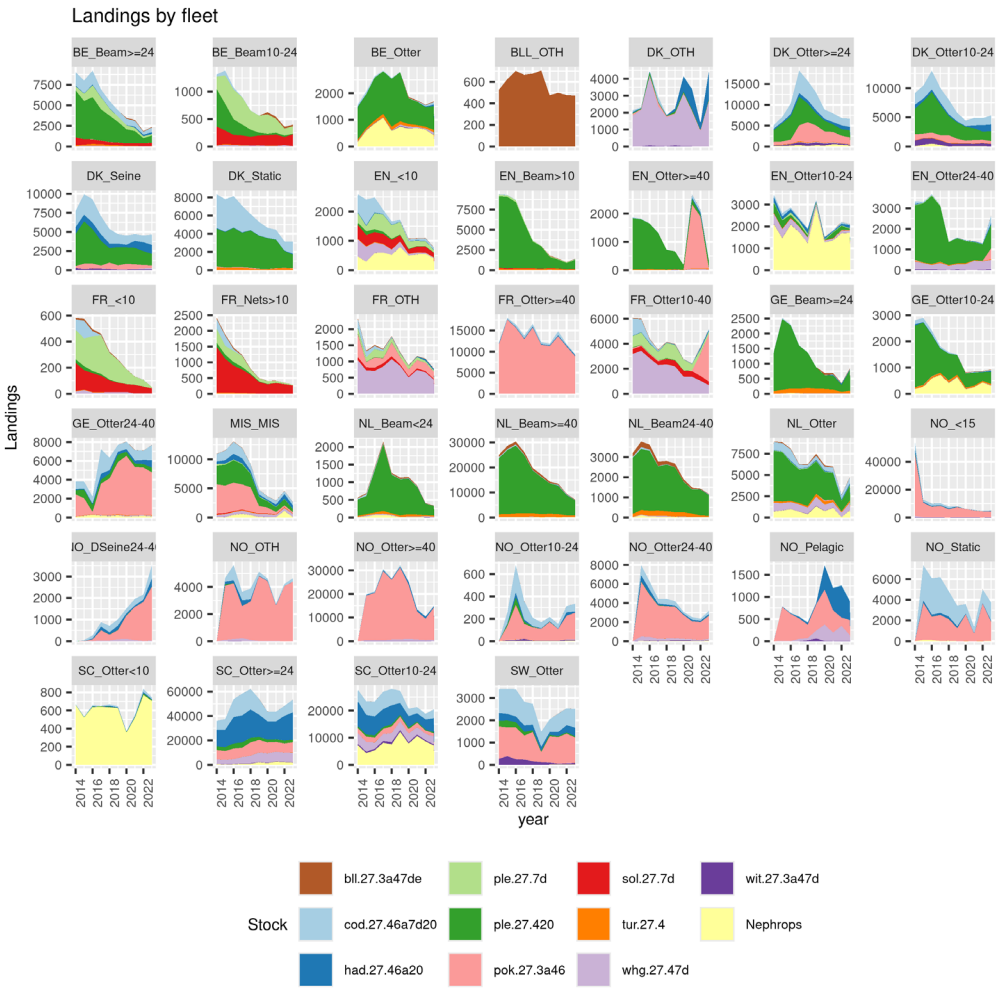

Figure 6.1. Landings by fleet, stock and year.

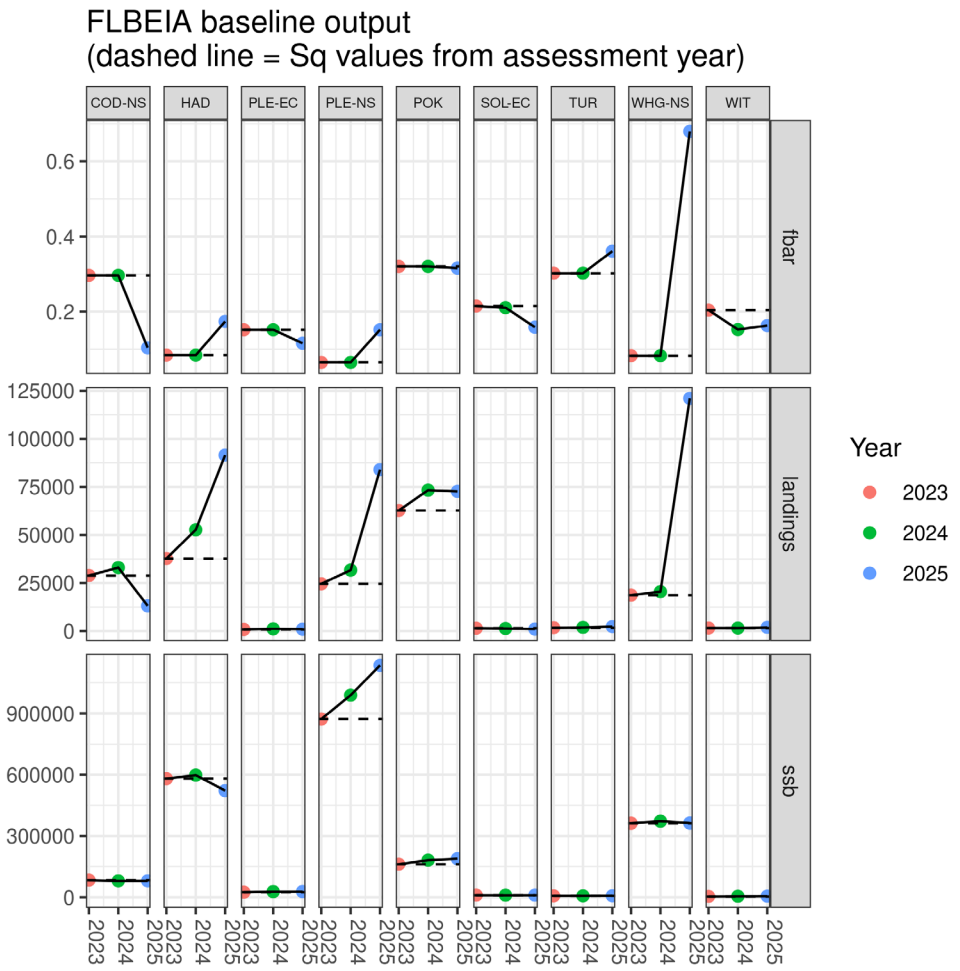

Figure 6.10. Summary of the relative changes in the single-stock advice for 2024 and 2025 compared to the situation in 2023.

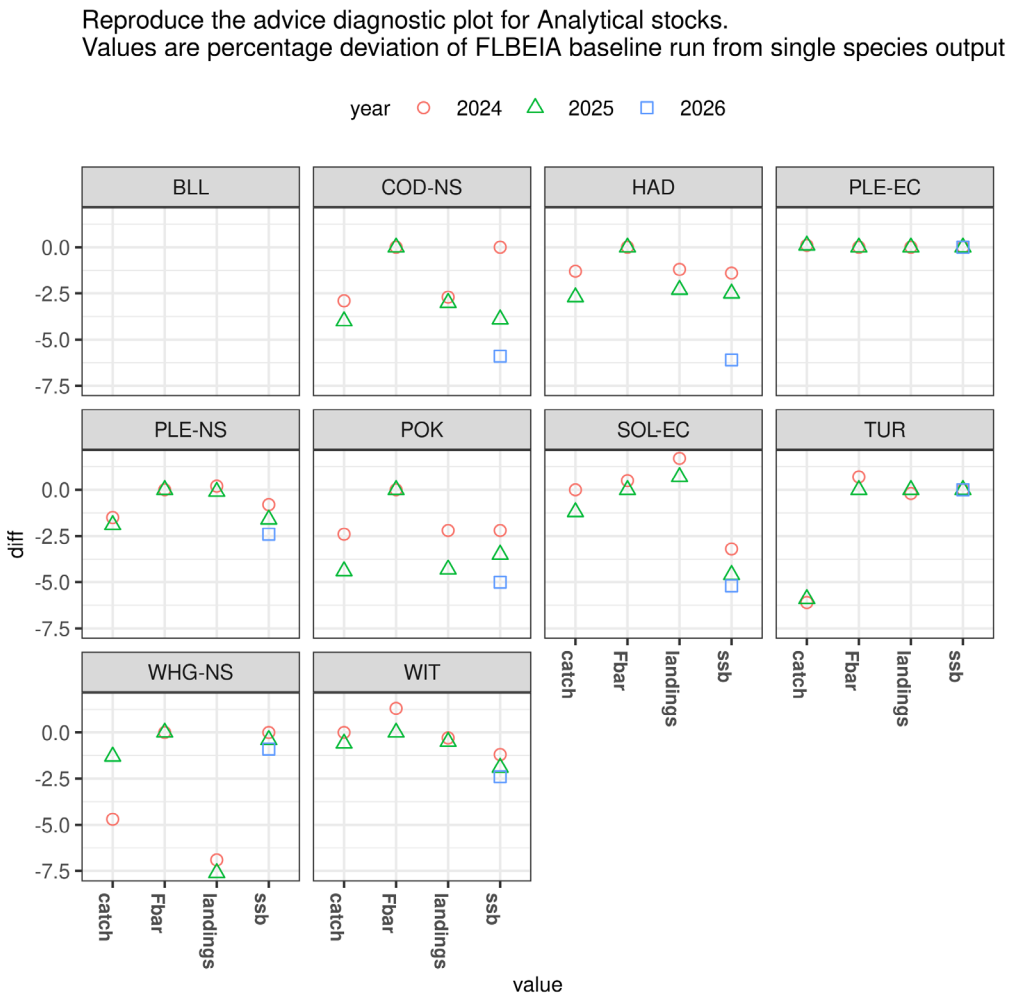

Figure 6.11. Difference (in percent) between WGMIXFISH-FLR baseline run and Single-stock advice for finfish stocks, showing Fbar, catch, landings (2024—2025), and SSB (2024—2026).

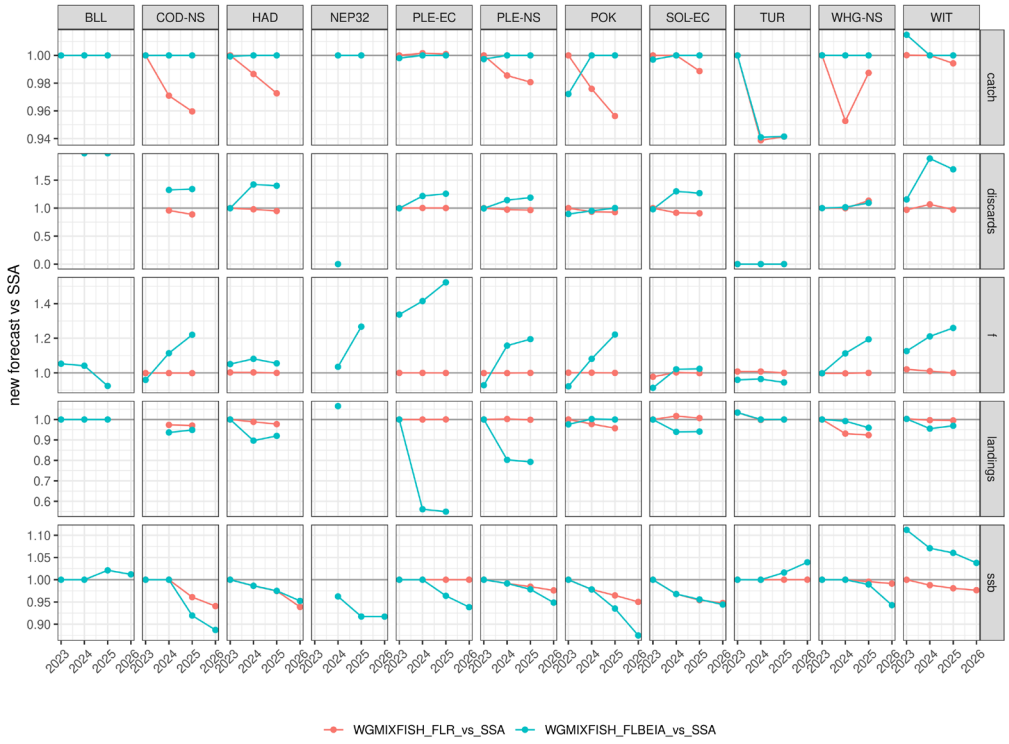

Figure 6.12. Comparison of the WGMIXFISH baseline runs and the WGNSSK single-stock advice. Displayed are the ratios of the WGMIXFISH baseline runs values (FLR in blue and FLBEIA in red) over those of the single-stock advice

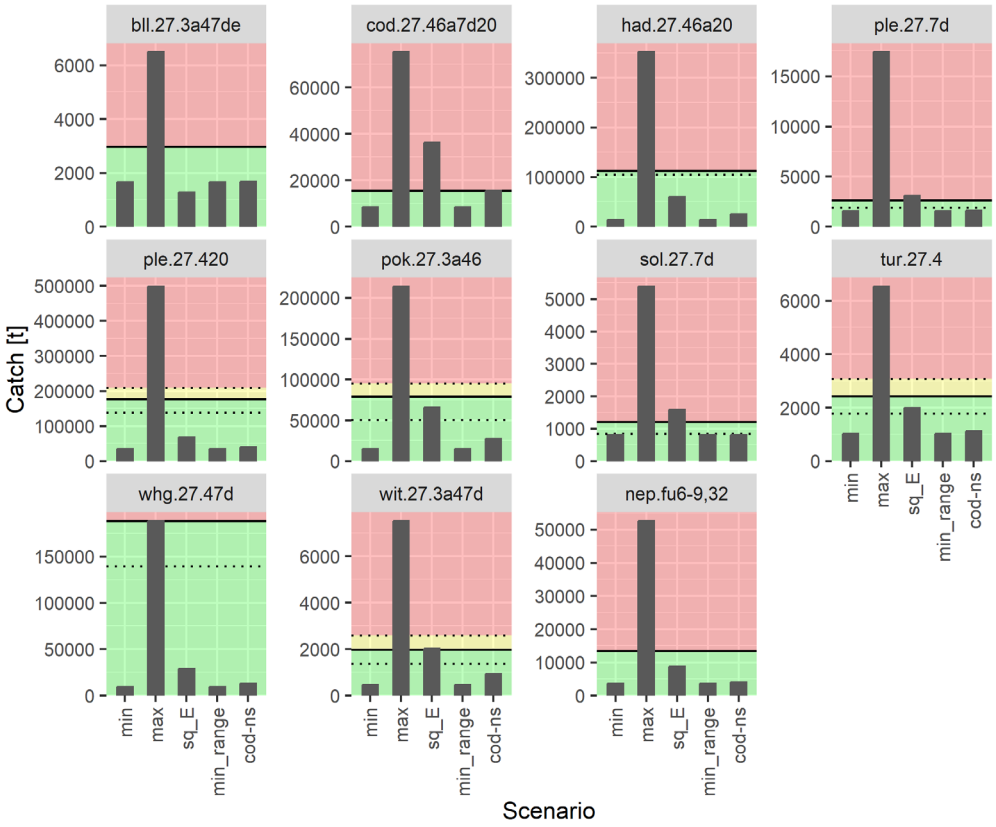

Figure 6.13. Mixed-fisheries projections of potential 2025 catches (in tonnes) by stock and scenario (Table 1). Solid lines correspond to the single-stock catch advice. For those stocks with fishing mortality ranges defined, the lower dotted lines illustrate the catches corresponding to $F_{MSY\ lower}$ or reduced $F_{MSY\ lower}$ for stocks with SSB < MSY $B_{trigger}$. The upper dotted lines illustrate the catches corresponding to $F_{MSY\ upper}$ for stocks with defined ranges and with SSB ≥ MSY $B_{trigger}$. Only Category 1 and 2 stocks are shown. Norway lobster FUs 6-9 and 32 are aggregated for simplicity although all ten FUs are included in the analysis.

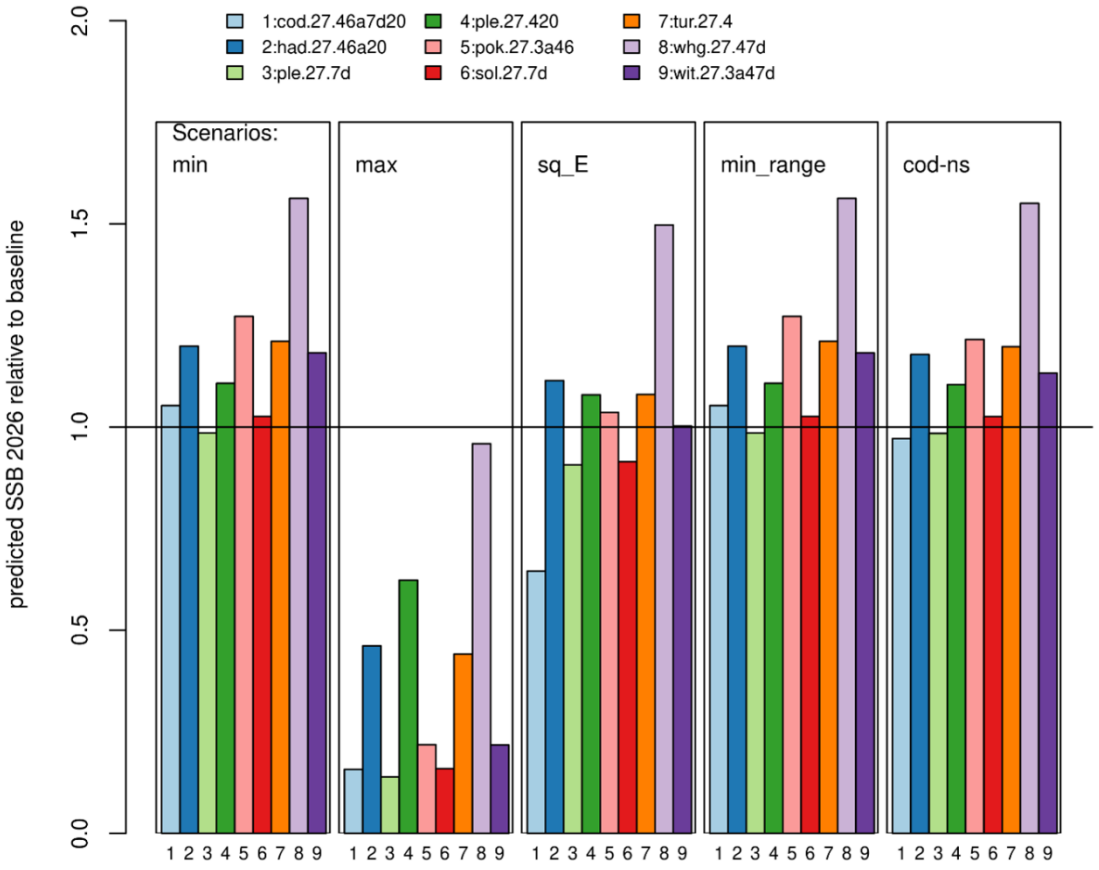

Figure 6.14. Mixed fisheries for the North Sea. Estimated SSB at the start of 2026 by stock after applying the mixed-fisheries scenarios, expressed as a ratio to the single-stock advice forecast. The horizontal line corresponds to the SSB resulting from the single-stock advice. Norway lobster are not included as the abundance was not forecasted in the mixed-fisheries model.

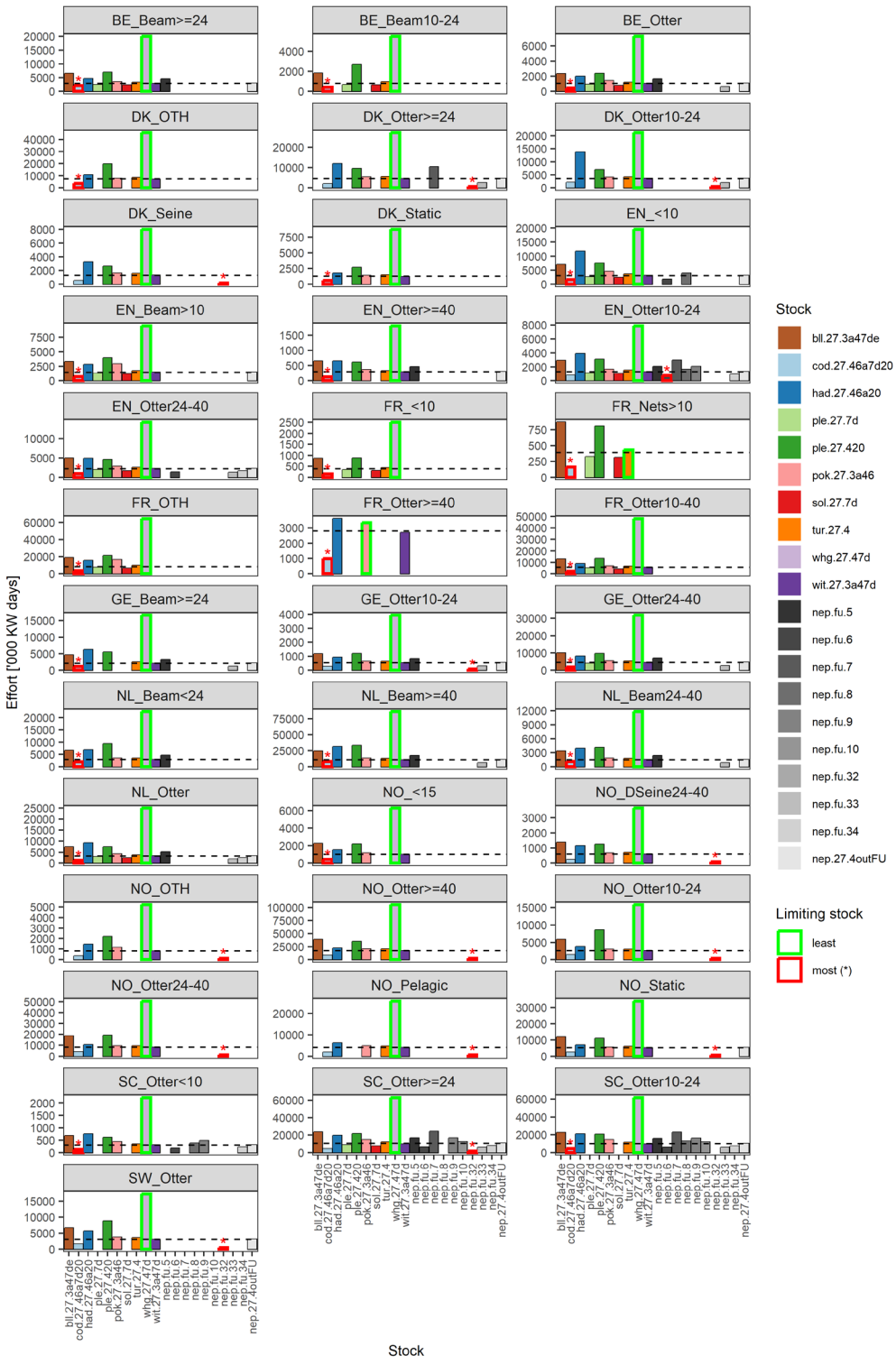

Figure 6.15. Mixed fisheries for the North Sea. Estimates of effort by fleet needed to reach each single-stock advice. Red triangles highlight the most limiting species for that fleet in 2025 ("choke species"), whereas the green triangles highlight the least limiting species. Fleet names are given by country (BE = Belgium, DK = Denmark, EN = England, FR = France, GE = Germany, NL = the Netherlands, NO = Norway, SC = Scotland, SW = Sweden) and by meaningful combinations of main gear and vessel size differing across countries and based on homogeneous average fishing patterns. Vessels in the various fleet segments can engage in several fisheries (métiers) over the year.

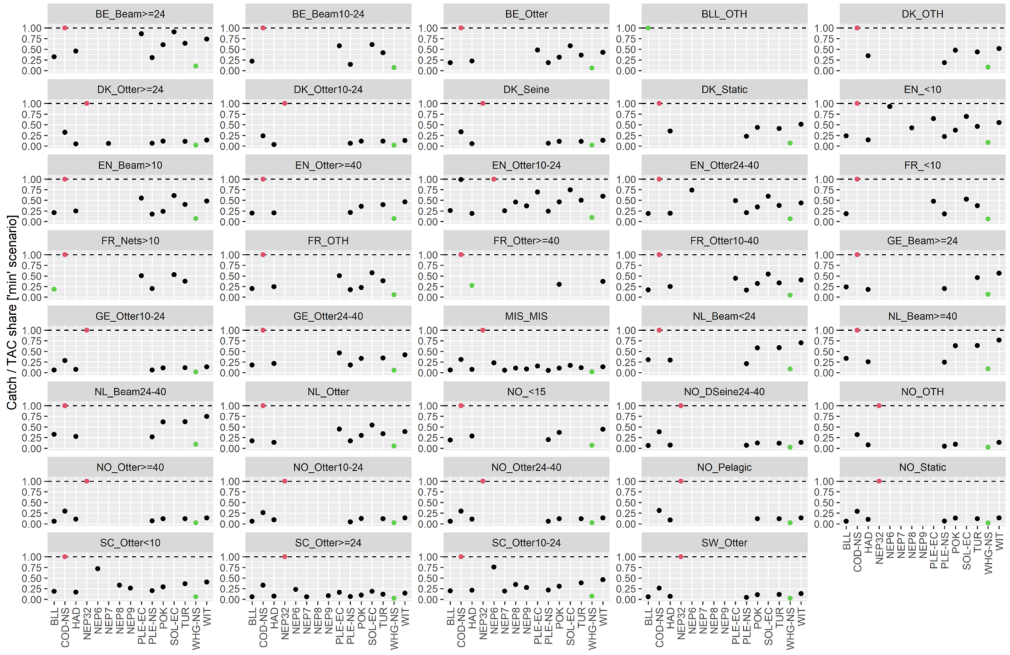

Figure 6.16. Quota uptake in 2025 in the min scenario. Red dots highlight the most limiting species for that fleet ("choke species"), whereas the green dots highlight the least limiting species.

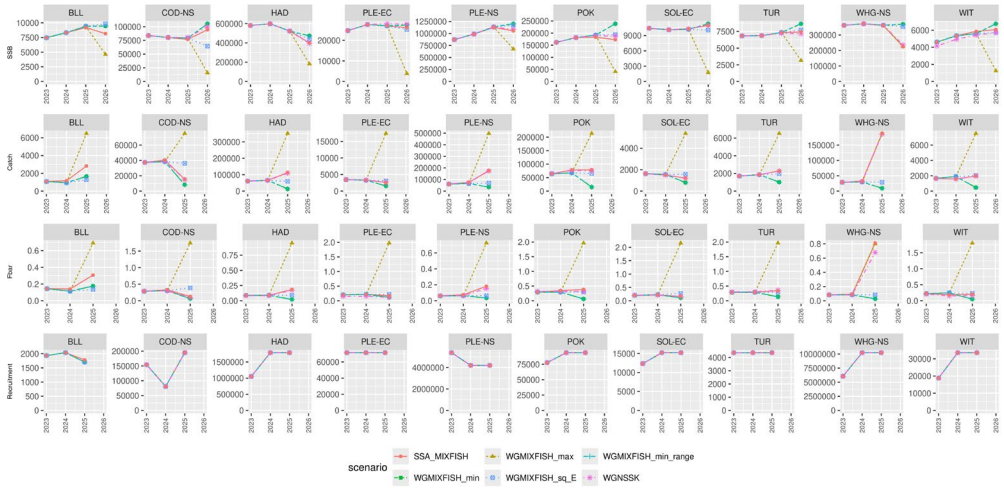

Figure 6.17. Comparison of the mixed fisheries projections in all the scenarios (WGMIXFISH) with the single-species advice projections (WGNSSK).

7 Baltic Sea

7.1 Background

Due to a lack of experts on the Baltic Sea fisheries being available for the WGMIXFISH-ADVICE meeting, an update to the Baltic Sea was not provided this year.

8 WGMIXFISH-METHODS 2025 planning

8.1 General methodological developments

The following method developments have been identified as being relevant to all ecoregions:

- Investigate discrepancy in discard estimates/change in discard mean weights in FLBEIA.
- Develop a structured quality control procedure to assess quality of RDBES CL and CE data for use as WGMIXFISH data source.
- Perform a hindcast simulation using actual catches observed in 2024 to assess the prediction skill of the mixed fisheries models.
- Review treatment of *Nephrops* FUs in the models and presentation of results

8.2 Baltic (on hold)

- Continue work on the comparison of RDBES data to the InterCatch data to be certain that the data matches.
- RDBES landings data does not include information about stock. The landings data were allocated to stock based on subdivision border only, however some stocks are also caught outside the specified stock area. Work on correcting the allocation of landings to stock is needed.
- Current usage of RDBES landings data has the drawback that information on discards is not included in the analysis which would be important especially for the demersal fishery. Investigate how to get discard estimates from the RDBES data.
- Set up code in TAF for producing catch composition plots.
- Further analyses on mixed-fisheries fleets to best reflect the technical interactions in the region.

8.3 Bay of Biscay

There are several issues in the modelling process to provide mixed fisheries advice for Bay of Biscay that need to be addressed in future meetings.

- Continued implementation of the code, tables and figures in the ICES-taf repository (https://github.com/ices-taf) and automate the preparation of the different reports. Standardize main plots to present (using mixfishtools package) and include missing ones (e.g. Sankey plot or catch composition).
- Investigate the differences obtained in the short-term forecast between that carried out for mixed fisheries advice and that of the assessment working groups, specifically for hake, horse mackerel, white anglerfish and blue whiting.
- Improve fleet structure based on this year's fleet configuration, if considered necessary. Revise the assumptions for out of area catches for harmonization with other case studies. Documentation and justification of the procedure.
- Analyse reported data for rays and decide on how to make assignments to the different species, given official catch data and information from surveys. Documentation and justification of the assumptions made.
- Analyse the option of including fleet-dependent age structure in the conditioning of the model for some stocks.

- Analyse the relevance of existing scenarios and identify new relevant ones. For example, include sensitivity runs to the impact of combined TACs for anglerfish (*Lophius spp.*) and rays (in case they are included next year).
- Consider defining maximum fleet effort as an upper limit in scenarios.

8.4 Celtic Sea

The following topics have been identified for future work in the Celtic Sea case study:

- Continue work on the implementation of an age-based model.
- Consider handling of the 'out of area' catches; the fleet should have explicit quota shares based on TAC splits (as indicated by the sensitivity analysis, this fleet quota share assumption can have a large influence on overall projections for these stocks),
- Consider outcomes of fleet and métier sensitivity analyses, and uncertainty and sensitivity analyses and any changes that should be implemented to the model as a result,
- Investigate raising procedure and "top-up" fleets: currently operating on landings and discards independently, but need to consider total catch,
- Consider whether to split the Static fleet into separate Longline and gillnet fleets to better represent differences,
- Streamline code, repository and results tables and figures in TAF: much improvement was made this year in automating the report. – need to implement automated table and figure numbering. The report script still needs a few development to move redundant hard coded infos into a separate 'reference' file. Another thing that was problematic was the generation of the single advice / plot big table as the Nephrops SAG plots were not available publicly through the *icesSAG* library while available on the draft advice sheets and therefore their automated inclusion was complicated. One way forward would be a Rmd script specific to generate a word document in landscape mode just for that table, and to detect and pick the advice figures where they are available. In the end, it would be only a matter of inserting properly this file into the report section. Another thing to develop is to automatically in the text the various numbers in the description of the fleets that change from year-to-year.
- Evaluate alternative effort scenarios based on changes implemented to allow fleet specific vectors of choking stocks,
- Develop methods for longer term projections based on rebuilding of depleted stocks,

8.5 Iberian Waters

The following issues have been identified for future work in the Iberian waters case study:

- Improve mixed-fisheries fleets to best reflect the technical interactions in the region. Further address the new métier classification and resolution of effort data.
- Improvement of code structure in TAF. Continued implementation of report results, tables and figures in in R markdown.
- Inclusion of other stocks: The wide distributed stocks Scomber scombrus (mac.27.nea) and Micromesistius poutassou (whb.27.1-91214) are to be tested in the mixed fisheries model. These species have their southernmost distribution in the area and only have some sea-sonal, minor catches (when compared to the rest of the wide stock) but are relevant to some demersal métiers operating in the area.

- Consider other stocks in the area that are not included in the mixed fisheries methodology which are relevant to the effort allocation and technical interactions in mixed fisheries demersal métiers.

8.6 Irish Sea

The following areas would be useful to address in order to improve the mixed fisheries assessment methods in the Irish Sea

- Investigate of further scenarios based on alternative advice options for zero-catch stocks (e.g. cod and whiting).
- Implement historic model validation techniques in annual workflow.
- Further streamlining code, repository and results tables and figures.
- Investigate the potential for implementation of an age-based model (e.g. FLBEIA/ age-based FCube model) and compare with current FCube approach.
- Investigate differences in catch compositions of fish-stocks between Nephrops FU's if data sources allow.

8.7 North Sea

The following topics have been identified for future work in the North Sea case study:

- TAF, improvements of the scripts:
  - Modify model_01 to read the BRPs (reference points) csv automatically.
  - Better handle dataPrep scripts so they are run before running data.R.
  - Check if the projection is needed in output.R script or if the results from model_04 can be used instead.
- Data
  - Consider adding new stocks: e.g. *Nephrops* in FU 3-4, Northern Shelf anglerfish.
  - Speed up data scripts.
  - Review the current diagnostic plots produced and consider removing some or adding new ones.
- Methodology
  - Use the results of the STARMixFish report to update the methodology if relevant.
- Report and Stock Annex
  - Further maintenance if relevant.
  - Improvement of the RMarkdown report script, i.e. delete all old range code, add the Nephrops stocks to Table 4 and 5 of advice sheet, add ICES rounding rule to the outputs (notably advice sheet tables) using icesAdvice::icesRound(), add shading to Tables 4 and 5.

Annex 1: List of participants

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Annex 2: Audit reports

Audit of the Mixed-fisheries advice for the Bay of Biscay

Date: [21/10/2024]

Auditor: Chun Chen

Summary of the advice

Assessment type: FLBEIA mixed fisheries assessment
Single-stock Assessments used as basis (stock/assessment model/EG forecast method)

Species	ICES code	Assessment	Forecast
WHITE ANGLERFISH 7, 8.a–b and 8.d	mon.27.78abd	Length-based age-structured SS3	SS3
HAKE 3.a, 4, 6, 7 and 8.a,b,d	hke.27.3a46-8abd	Length-based and sex-disaggregated SS3	SS3
SOLE 8.a-b	sol.27.8ab	Age-based analytical SAM using catches	SAM forecast (deterministic)
MEGRIM 7.b-k and 8.a-b,d	meg.27.7b-k8abd	Statistical catch-at-age (a4a)	FLR-STF
NORWAY LOBSTER 8.a-b	nep.fu.2324	UWTV survey	Ad-hoc (excel sheet)
HORSE MACKEREL in the Northeast Atlantic	hom.27.2a4a5b6a7a-ce-k8	Length- and age-based analytical SS3	SS3
MACKEREL in the Northeast Atlantic and adjacent waters	mac.27.nea	Age-based analytical SAM	FLR-STF
BLACK-BELLIED ANGLERFISH 7, 8.a-b,d	ank.27.78abd	Length-based age-structured SS3	SS3
POLLACK 8 and 9.a	pol.27.89a	Trends from biomass index from commercial LPUE index from French gillnet and length-based indicators (LBIs; Category 3)	no
SEA BASS 8a,b	bss.27.8ab	Length-based age-structured SS3	*ad hoc* R code
SMOOTH-HOUND in the Northeast Atlantic and adjacent waters	sdv.27.nea	Trends from combined biomass index and length-based indicator (Category 3)	Ad-hoc (excel sheet)
BLUE WHITING in the Northeast Atlantic and adjacent waters	whb.27.1-91214	Age-based analytical SAM	SAM (deterministic)

WHITING 8 and 9.a	whg.27.89a	Trends from biomass index from commercial LPUE (French bottom trawl) and Length Based Indicators (LBIs; Category 3)	no

Framework used for mixed fisheries forecasts:
The FLBEIA model coded in R, using the FLR framework (www.flr-project.org).

Data issues:
Catch and effort data were compiled mostly on the basis of the data collected in annual ICES data calls and data collected by STECF. The assessment data for the different stocks is taken from the WGBIE, WGEF and WGWIDE.

The suspected mislabelling of rays species by a number of member states is still unresolved and consequently it was not possible to include rays in this mixed fisheries analysis. These stocks are thornback ray (rjc.27.8abd), cuckoo ray (rjn.27.678abd), and undulate ray (rju.27.8ab).

The replicated forecast for the majority of stocks were almost identical with the single-stock advice (differences lower than 10%). Discrepancies were larger for sea bass, horse mackerel and blue whiting, hake and white anglefish (with maximum differences of 9%, 9%, 5% and 4%, respectively). Issues with horse mackerel mean weight, and is expected to be changed next year.

Consistency:

no changes compared to last year

Mixed fisheries situation:
Given the single-stock catch advice for 2025, the most limiting stock for demersal fisheries in the Bay of Biscay is pollack, whose quota is first reached for eight of 21 defined fleets. The least limiting stock is black-bellied anglerfish (seven of 21 fleets). It is assumed that fleet fishing patterns in the forecast years are the same as observed in the recent past.
Management Plan:
A multi-annual plan exists and covers some stocks in Western Waters and adjacent waters however, for some of these stocks, this MAP is currently not recognized by Norway or the UK. In those cases, ICES advice is given on the ICES MSY approach.

General comments

Technical comments
All technical comments for documents have been added to the documents as a tracked change or comment balloon.

Advice sheet:

Figure 2: FR_G__10<24m, there seems to be 2 _, is that by definition?

In figure 3, it is mentioned in footnote that catches of métier OTH have not been included. But it is the first time we see this OTH métier definition, and it is in the Table 6. I guess in table 6 OTH métier (outside 8a-b and 8d) is classified as MIS?

Report section:

Some editing done to table 2.3

Some minor editing was done to make report and advice consistent

Section 1.4.2: it is said a total of 21 fleets, but there are 24 fleets in Table 2.4.

I am also bit confused how the métier category defined in report Table 2.4 is linked to the 21 fleets in figure 2 in advice sheet.

Is it possible to add the definition of catchability in Section 1.4.3? it is big vague for me. Is it the estimated catch (allocated by landing proportions per fleet) per unit of effort (per fleet)?

Section 1.4.3, can you also help me to understand what shall I check in the exploration catchability plots? E.g. if there are multiple métiers defined as one fleet-stock, then do we expect these métiers show similar trend as well as magnitude of catchability? Do we expect the catchability of one fleet-stock to change dramatically over the 3 years? Does the absolute number of catchability matter?

Table 2.8 : the title says it is landing, but in advice sheet Table 3 it is catch

Stock annex:

Appendix D, model table, not sure if Smooth-hound assessment model is correctly described, in report and presentation, it is described as “Trends from combined biomass index and length-based indicator”

Table 2.4. i chanaged the F2025 value of white anglerfish, please check if it is correct. I am also not sure about sea bass and sole, please check them. Also seems we are missing pollack as well as several other stock as compared to Table 2.8.

Incosisnet description about sol.27.8ab forecast method in SA appendix D table, as compared to report table 2.1 and presentation

Conclusions
The assessment has been carried out appropriately and is fully reproducible. MIXFISH forecast are conducted correctly.

Audit of the Mixed-fisheries advice for the Celtic Sea

Date: [18/10/2024]

Auditor: Klaas Sys

Summary of the advice

1. **Assessment type: FCube mixed fisheries assessment**
2. **Single-stock Assessments used as basis** (stock/assessment model/EG forecast method)

Species	Assessment	Forecast
cod.27.7e–k	Age-based stochastic analytical assessment (SAM)	SAM
had.27.7bc,e–k	Age-based stochastic analytical assessment (SAM)	SAM
whg.27.7bc,e–k	Age-based stochastic analytical assessment (SAM)	SAM
meg.27.7b-k8abd	Statistical catch-at-age model (A4A)	FLR STF
mon.27.78abd	Statistical catch-at-age model (SS3)	FLR STF
ank.27.7-8abd	Length-based age-structured Stock Synthesis model (SS3)	FLR STF
sol.27.e	Age-based analytical assessment (XSA)	FLR STF
sol.27.7fg	Age-based stochastic analytical assessment (SAM)	SAM
hke.27.3a46-8abd	Length-based and sex-disaggregated model (SS3)	FLR STF
nep.fu.16	Underwater TV survey	NA
nep.fu.17	Underwater TV survey	NA
nep.fu.19	Underwater TV survey	NA
nep.fu.2021	Underwater TV survey	NA

4. **Framework used for mixed fisheries forecasts:**

The FCube model coded in R, using the FLR framework (www.flr-project.org).

5. **Data issues:**

Minor discrepancies between the single-stock advice and the Baseline run to reproduce the advice were found, all discrepancies were <2%. The largest deviation was found for hake which is likely related to the conversion of a size-structured model to an age-structured model.

6. Consistency:
The model remains unchanged from last year.

The same mixed-fisheries scenarios were explored as last year: "min", "max", "sq_E", "min_range", "min_exzero", and "had-cs".

This year two new procedures were incorporated. First, explicit out-of-area fleets for hake (3a4, 5b61214, 7a, 7d and 8abd), megrim (7d, 8abd) and white- and black-bellied anglerfish (7a, 7d, 8abd) were incorporated based on the landings, effort and discards data for these areas and stocks. These fleets were then assigned an explicit stock share based on existing TAC allocations, which was assumed to be fully taken except in the *status quo* effort scenario. However, these catches should only be considered representative in the context of the Celtic Sea and may not correspond to the predicted catches given by the Bay of Biscay model. Second, a "rescaling" procedure was implemented so that the total catch in the fleets used for the mixed fisheries consideration matched the total estimated catch from the respective single-stock assessments. These procedures improved consistency of the projections with single-stock advice and management implementation.

Fleets landing less than 1% of each stock were grouped in a MIS_MIS fleet. Note that the OOA and MIS_MIS fleets are not considered in the count of the fleets most of least restricted by a stock.

7. Mixed fisheries situation:

Cod (cod.27.7e-k) and whiting (whg.27.7b-ce-k) are the most limiting stocks (26 out of 33 fleets choke on both cod and whiting, 3 only on cod, and one only on whiting). This is due to the 0 catch advice for this stock and that nearly all fleets in the model catch cod and whiting. The most common least limiting stock are black-bellied anglerfish (ank.27.78bd, 16 fleets), hake (hke.27.3a46-8abd, 9 fleets) and *nephrops* FU20-21 (nep.fu.20-21, 7 fleets).

8. Management Plan:

A multi-annual plan exists for Western Waters and adjacent waters however, this MAP is currently not agreed with the UK. For affected stocks, ICES advice is given on the ICES MSY approach, except for Norway lobster outside FUs, which is based on ICES precautionary approach.

There are two species-specific management plans in this region; a recovery plan for hake (Council Regulation (EC) No 811/2004) which implements a Total Allowable Catch (TAC) annually based on a defined Harvest Control Rule (HCR) and a management plan with both a HCR and effort management element for sole in the Western channel (7.e; Council Regulation (EC) No 509/2007). There are also a number of effort, technical and area closure measures in place.

Catches of all quota species within the Celtic Sea are subject to the landings obligation (with some de minimis and survivability exemptions).

9. General comments

Advice sheet: Well written and adheres to the generic format agreed for all mixed fisheries advice sheets. Data issues and limitations, and model assumptions affecting the advice were explained within the text.

TAF: Generally well documented and easy to follow. Results were fully reproducible. There were no issues to get the code running after manual installing of some R packages.

Report section: Well written, includes detailed information on the stocks included in the WGMIXFISH projections, provides additional information on the scenarios and results, and alternative scenarios.

Stock annex: Comprehensive document that includes background information on the stocks and fisheries in the Ecoregion.

10. Technical comments

All technical comments for documents have been added to the documents as a tracked change or comment balloon.

Advice sheet: Changed a small inconsistency in terms of number of fleets choking on cod and whiting in the min scenario.

TAF: The repository includes all necessary files to run the taf.bootstrap() procedure, and includes data_xx, model_xx and report_xx scripts, but no output scripts. The scripts cannot be called from an "overarching" data.R, model.R, output.R and report.R script. Nevertheless, results can be reproduced by manually running through the scripts.

Report section: Well written, but noted some inconsistencies (or sections that required additional updates) compared to the advice sheet. Some references to the figures and tables also need to be checked.

Stock annex: no changes compared to last year

11. Conclusions

The assessment has been carried out appropriately and is fully reproducible. There are some deviations from previous years related to data procedures. Some restructuring to the TAF repository would be beneficial.

Audit of the Mixed-fisheries advice for Iberian waters

Date: [22/10/2024]

Auditor: Matthew Pace

Summary of the advice

1. **Assessment type:** FLBEIA mixed fisheries assessment
2. **Single-stock Assessments used as basis** (stock/assessment model/EG forecast method)

Species	Assessment	Forecast
BLACK-BELLIED ANGLERFISH **ank.27.8c9a**	Surplus Production model (SpiCT)	NA
HAKE **hke.27.8c9a**	Length-based age-structured Stock Synthesis model (SS3)	SS3
FOUR-SPOT MEGRIM **ldb.27.8c9a**	Statistical catch-at-age model (a4a)	FLR STF
MEGRIM **meg.27.8c9a**	Statistical catch-at-age model (a4a)	FLR STF
WHITE ANGLERFISH **mon.27.8c9a**	Length-based age-structured Stock Synthesis model (SS3)	SS3 (*ad hoc* R code)

3. **Framework used for mixed fisheries forecasts:**

The FLBEIA model coded in R, using the FLR framework (www.flr-project.org).

4. **Data issues:**

Large increase in SP_MIS effort in 2023 compared to preceding years owing to changes in how Spanish effort is reported. This impacts projected catchability and results in larger intermediate year catches for this fleet compared to historical years. However, this does not appear to have a large impact on overall intermediate year catches for any stock.

Small discrepancies between the single-stock advice and the baseline run to reproduce the advice were found. However, all discrepancies were <10%. Discrepancies are due to methodological differences in forecasting methods (e.g. the difficulty in replicating the length-based and seasonal dynamics in the Stock Synthesis assessment for white anglerfish and hake).

5. **Consistency:**

Mixed fisheries simulations are presented for the same five stocks (ank.27.8c9a, hke.27.8c9a, ldb.27.8c9a, meg.27.8c9a and mon.27.8c9a) and using the same fleet and métier definitions as 2023.

The same mixed-fisheries scenarios as 2023 are presented: “min”, “max”, “sq_E”, “min_range”, and individual stock scenarios (“ank”, “hke”, “ldb”, “meg” and “mon”). Black-bellied anglerfish (ank.27.8c9a) is assessed using a surplus production model and was therefore not modelled dynamically in FLBEIA.

6. Mixed fisheries situation:

Hake (hke.27.8c-9a) is most limiting stock for all fleets and restricts fishing opportunities for anglerfish (ank.27.8c-9a and mon.27.8c-9a). Hake catch limits are almost fully consumed under the status quo effort scenario. The least limiting stock is black-bellied anglerfish (ank.27.8c-9a; 10 of 11 fleets).

7. Management Plan:

A multi-annual plan exists and covers the five regionally important stocks considered in the mixed fisheries analysis of Iberian Waters. Fishing opportunities are primarily based on ICES advice and outlined annual by EU regulations.

8. General comments

Advice sheet: No advice sheet is requested of Iberian Waters this year.

TAF: Generally well-structured repository with adequately documented and formatted code. Several scripts and output objects appear to be redundant and could be removed from the repository to avoid future confusion. Results were fully reproducible. One instance where FLBEIA had to be loaded manually to run the script.

Report section: Report is well-written and formatted. Data issues, model conditioning and forecast assumptions, development of mixed-fisheries scenarios, and analysis of results are all suitably reported. Several of the presented figures were generated using older code and should be generated using the latest version of the *mixfishtools* R package for consistency with other ecoregions.

Stock annex: Not updated this year.

9. Technical comments

All technical comments for documents have been added to the documents as a tracked change or comment balloon.

Advice sheet: N/A

TAF: The repository includes all necessary files to reproduce the analysis, but some reorganization would improve clarity.

Report section: some very minor typos and suggestions for updated figures.

Stock annex: N/A

10. Conclusions

The assessment has been carried out appropriately and is fully reproducible. Suggest restructuring the TAF repository to remove redundant code and outputs.

Audit of the Mixed-fisheries advice for Irish Sea

Date: [22/10/2024]

Auditor: Marta Ferraro

Summary of the advice

1. **Assessment type:** FLBEIA mixed fisheries assessment
2. **Single-stock Assessments used as basis**

Species	Assessment	Forecast
cod.27.7.a (Cod)	Stock Synthesis (SS3)	FLR-STF
had.27.7.a (Haddock)	ASAP (Age-Structured Assessment Programme; NOAA)	FLR STF
nep.FU14 (Norway lobster)	Underwater TV Survey	FLR STF
nep.FU15 (Norway lobster)	Underwater TV Survey	NA
ple.27.7.a (Plaice)	Age-based stochastic analytical assessment (SAM)	NA
sol.27.7.a (Sole)	Age-based stochastic analytical assessment (SAM)	SAM
whg.27.7.a (Whiting	ASAP (Age-Structured Assessment Programme; NOAA)	FLR-STF

3. **Framework used for mixed fisheries forecasts:**

The FCube model coded in R, using the FLR framework (www.flr-project.org).

4. **Data issues:**

Some discrepancies between the single-stock advice and the Baseline run to reproduce the advice were found, as are to be expected between the single-stock forecasts and the reproduction of the advice in the mixed-fisheries forecast. Despite the methodological differences between single-stock forecasts and mixed-fisheries forecasts, the differences observed this year were small (< 4%) for all stocks, and the mixed-fisheries forecast was considered close enough to the single-stock advice to be used as a basis for the mixed-fisheries scenarios. The quality of the individual forecasts of the single-stocks will affect the quality of the mixed-fisheries scenarios.

A retrospective analysis highlighted difficulties in predicting catches of sole based on Norway lobster and gadoid catches under previous model assumptions (ICES, 2023a). This is due to differences in the fleet behaviour of fleets predominantly targeting sole (beam trawl fleets and Belgian otter trawls), which are largely unrelated to other fisheries in the region. Therefore, since 2023, the stock-specific scenarios (Table 1) additionally restrict the effort of fleets targeting sole in the region, based on the catch advice for sole in 2025. Sole stock is then considered to be limiting. Henc, two model run were carried out.

In this context, MIS fleets, including mostly small Scottish vessels, were left out of the model runs.

5. **Consistency:**

FCube (Ulrich *et al.* 2008; 2011) was used to forecast seven mixed-fisheries scenarios (Table 5.2). The basis of the model is to estimate the future levels of effort for each fleet corresponding to the fishing opportunities available to that fleet, based on recent fleet effort distribution and catchability by stock and métier. This level of effort is then used to estimate the corresponding summed *F* of all fleets per stock, and catches are then forecast using the standard forecast procedures from the single-species assessment (with the exception of plaice and sole which are forecast using FLR rather than SAM). The basis for each single-stock advice is retained in the current mixed fisheries framework.

For fish stocks the stock objects used in the model were received directly from the single-stock coordinators and match those used in the single-stock advice (ICES, 2024a). *Nephrops* stocks in FU14 and FU15 were merged in the mixed fisheries model (see section 5.3.1 of the report for technical details), and a single scenario representing the sum of the advice for both FU14 and FU15 was used to represent the Irish Sea *Nephrops* fishing advice. Following model testing this was selected as the best approach, because the landings and discards data in MIXFISH accessions and InterCatch for fish stocks is at the level of ICES division (7.a). Therefore, it is not currently possible to allocate catch compositions of fish stocks at the individual FU level. Furthermore, *Nephrops* targeting fleets move between FU's using the same métiers depending on fishing opportunities and conditions. Therefore, whereas *Nephrops* stocks are best assessed as separate FU's the behaviour and catch compositions of the fishery within the mixed fishery model (given the available data) are best captured by merging FU14 and FU15 stocks and advice within the model. Out of FU and FU19 catches are excluded from the model, as these are unlikely to reflect the main target areas of the Irish Sea *Nephrops* fishery and represent <1% of the landings.

A retrospective analysis highlighted difficulties in predicting catches of sole based on Norway lobster and gadoid catches under previous model assumptions (ICES, 2023a. This is due to differences in the fleet behaviour of fleets predominantly targeting sole (beam trawl fleets and Belgian otter trawls), which are largely unrelated to other fisheries in the region. Therefore, this year, the stock-specific scenarios (Table 5.2) additionally restrict the effort of fleets targeting sole in the region, based on the advice for sole for 2025. This affects the interpretation of these single-stock scenarios other than "sol-is".

The above data sources are then combined to produce the "fleet object" which is used as an input for the FCube model. Fleet objects were created using the FLCore 2.6.19 and FLFleet 2.6.1 packages, fleets were defined by their country and predominant fishing gear and target fishery based on mesh-size. Vessel lengths have not been used in the categorization of fleets, due to the relatively small size of the fishery operating in the Irish Sea. Fleet categories are not necessarily exclusive, and individual boats may contribute to the effort of multiple fleets if they change their fishing gear (i.e. boats may be polyvalent). Within countries fleets were split based on the following categories:

- Beam trawls (all sizes)
- Otter trawls crustaceans (mesh-size 70-99mm)
- Otter trawls demersal fish (mesh-size ≥ 100mm)
- Pelagic gears (32-69mm)
- Seines

Any fleets which did not land > 1% of any stock in the model were then grouped into an 'MIS_MIS' fleet to reduce model complexity, including mostly small scottish vessels.

Discards are depicted in the figures as discard rates.

6. **Mixed fisheries situation:**

There is no single-stock that is least limiting, as limiting stocks differ for each fleet. Haddock, appear to be the main driver for gadoid species, as a link with cod and whiting was observed. Given the single-stock catch advice for 2025, the most limiting stocks for demersal fisheries in the Irish Sea are whiting and cod, with all 12 defined fleets reaching their whiting or cod catch advice with a lower effort than for the other stocks. This is due to the zero-catch advice for cod and whiting and the fact that almost all fisheries operating with demersal gears catch these stocks. The least limiting stock is haddock (nine of 12 fleets). It is assumed that fleet fishing patterns in the forecast years are the same as observed in the recent past.

Keeping flatfish in the Irish Sea model was debated by WGMIXFISH-ADVICE in 202

- Keeping in plaice and Sole
    - Consistent with other regions
    - Gives a broader picture of the mixed fishery catches
- Leaving out plaice and sole
- Recent 'historic validations' showed that catches of gadoid and *Nephrops* in the Irish Sea, would have been a poor predictor of sole catches in the recent past

Decision was to alter the stock specific scenarios, such that:
"In all these single-stock advice scenarios, fleets that target sole (all beam trawls and Belgian otter trawls) are also restricted by their stock share of sole in addition to the scenario-specified stock."

2 model runs

- with and without the application of the sole limit on fleets predominantly targeting sole (beam trawl fleets and Belgian otter trawls)
- Advice sheet, as per last year's decision to limit these fleets by sole advice
  All stock based scenarios, min, max, status quo effort and min range

7. Management Plan:

A multiannual management plan (MAP) for Western and adjacent waters has been adopted by the EU for cod, haddock and whiting in the Irish Sea, and *Nephrops* in FU's 14 and 15 (Council Regulation (EC) 2019/472) which ICES considers to be precautionary. Plaice in the Irish Sea is taken into account under the EU multiannual plan (MAP) as a bycatch species. However, there is no agreed shared management plan with UK for these stocks. ICES is not aware of any agreed precautionary management plan for sole in this area. A single *Nephrops* TAC is issued for Subarea 7 (with an 'of which' provision for FU16). ICES notes that to ensure that each stock is exploited sustainably, management should be implemented at the FU level.

Cod and whiting are managed as bycatch only in the Irish Sea, with no directed fishery of either species permitted in the area. As such they are likely to have considerable mixed fisheries implications, and catches may be impacted by adjusting the fishing opportunities permitted for other species in addition to technical measures such as area closures and technical devices such as highly selective gears. For a summary of current technical measures in the region see: (https://bim.ie/fisheries/advisory-services/fisheries-management-chart). Catches of whiting are primarily observed in *Nephrops* directed otter trawl fisheries, with a smaller proportion from finfish directed otter trawls and other gears. Catches of cod are primarily observed in demersal fish directed otter trawl fisheries (both OTB and OTM), with significant proportions from *Nephrops* directed otter trawls and beam trawls. Council Regulation (EC) No. 304/2000 and Regulation (EC) No. 2549/2000 introduced area closures on the cod spawning grounds for ten weeks

from mid-February till the end of April. These area closures now occur annually, although there are some derogations in place for gears not targeting cod.

A new scenario has been added last year, the "min_range" scenario (see Table 5.2). The "min_range" scenario explores how the higher catch options associated with the $F_{MSY\ upper}$ or scaled F_{MSY} reference points (for stocks where ranges are defined) may reduce choking behaviour in mixed fisheries and increase overall quota uptake. Under this scenario scaled F_{MSY} catch options are applied in the case of stocks with headline zero-catch advice based on precautionary principles in the single-stock advice. As such the "min_range" scenario cannot be considered precautionary for these stocks. The "min_range" scenario makes use of the multiannual plan (MAP) F_{MSY} ranges defined for demersal stocks under the EU MAP for the western waters (EU, 2019). There is no agreement between the EU and the UK regarding this plan, and it is not used as the basis of the advice for these shared stocks.

8. General comments

Advice sheet: Well written and adheres to the generic format agreed for all mixed fisheries advice sheets. Data issues affecting the advice were explained within the text.

TAF: Generally well documented and easy to follow. Results were fully reproducible. There were no issues to get the code running.

Report section: Wel written, includes detailed information on the stocks included in the WGMIXFISH projections and how the data were dealt with, provides additional information on the scenarios and results.

Stock annex: Comprehensive document that includes background information on the stocks and fisheries in the Ecoregion.

9. Technical comments

All technical comments for documents have been added to the documents as a tracked change or comment balloon.

Advice sheet: /

TAF: The repository includes all necessary files to run the taf.bootstrap() procedure.

Report section: spotted and corrected some typos

Stock annex: spotted and corrected some typos

10. Conclusions

The assessment has been carried out appropriately and is fully reproducible. Logic behind each step is clear and well explained in the appropriate documents.

Audit of the Mixed-fisheries advice for the Greater North Sea Ecoregion

Date: [05/11/2024]

Auditor: Paul Dolder

Summary of the advice

1. **Assessment type:** FLBEIA mixed fisheries assessment
2. **Single-stock Assessments used as basis** (stock/assessment model/EG forecast method)

Species	Assessment	Forecast
Brill Subarea 4 and divisions 3.a and 7.d–e (North Sea, Skagerrak and Kattegat, English Channel)	SPiCT	SPiCT
Cod Subarea 4, Divisons 6.a and 7.d and Subdivision 3.a.20 (North Sea, West of Scotland, eastern English Channel, and Skagerrak)	Multistock SAM	Multistock SAM
Haddock Subarea 4 , Division 6.a and Subdivision 3.a.20 (North Sea, West of Scotland and Skagerrak)	SAM	SAM
Whiting Subarea 4 and Division 7.d (North Sea and eastern English Channel)	SAM	MDFP
Saithe Subarea 4, 6 and Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)	SAM	SAM
Plaice Subarea 4 and Subdivision 3.a.20 (North Sea and Skagerrak)	SAM	SAM
Sole Division 7.d (eastern English Channel)	SAM	SAM
Plaice Division 7.d (eastern English Channel)	AAP	FLR
Turbot Subarea 4 (North Sea)	SAM	FLR
Witch Subarea 4, Divisions 3.a and 7.d (North Sea, Skagerrak and Kattegat, eastern English Channel)	SAM	SAM
Nephrops FU32	SPiCT	SPiCT

3. **Framework used for mixed fisheries forecasts:**

The FLBEIA model coded in R, using the FLR framework (www.flr-project.org).

4. **Data issues:**

Generally small (<5%) discrepancies in the reproduce the advice FLR baseline run. Slightly larger discrepancies (up to 7%) for landings, catch or SSB for the SAM assessed/forecast stocks but within the accepted tolerance (10%) for all, and expected due to methodological differences. More significant differences in landings projections for North Sea sole due to known issue with discards projections in the single species assessment forecast – expectation this would not be included in the mixed fisheries considerations this year, subject to ADG decision.

The reproduce the advice FLBEIA baseline run has near perfect match for catch (except turbot and witch) but slightly larger discrepancies in fishing mortality (up to +50% for plaice in the eastern channel). There also appears a pattern of FLBEIA baseline runs having higher discards and lower landings than the single-stock advice (which may be linked to the discard mean weights issue identified below). As the mixed fisheries considerations projections are based on catch (not landings and discards separately) this is acceptable but should be investigated in future. Generally, the SSB projections are within 10% tolerance of the single-stock forecast.

There are some differences in selection pattern for some stocks in the single-stock advice and the fleet-aggregated values obtained from FLBEIA following the intermediate year projection, which is done using FLBEIA. Most notably for plaice in the eastern channel, saithe and sole in the North Sea. This is despite the good match between the SOP of catch-at-age and the single-stock catch-at-age. This mainly comes from the discards, and there is a poor match between mean weight-at-age in discards for several stocks. The overall effect of this difference on identified choke stocks is considered small, but as the cause is not fully understood it should be investigated further at WGMIXFISH-METHODS.

5. Consistency:

The same scenarios are presented as last year ('min', 'max', 'sq_E', 'min_range' and 'cod-ns'). The 'min' and 'min-range' scenarios are identical, due to the lack of flexibility in the MSY ranges to reduce mixed fisheries tensions.

North Sea sole was excluded from mixed-fisheries projections this year due to revisions to the single-stock advice not having been finalized by the end of the mixed-fisheries ADG. There is limited impact due to the stock being neither a most or least limiting stock, and the discrepancies in the June and update advice expected to be too significant to include the stock based on the June advice.

6. **Mixed fisheries situation:**

The most limiting stock was cod for 23 of 37 fleets (MIS fleets were not included in the count) and the least limiting stock whiting for 35 of 37 fleets. There is a very large inconsistency between the effort required to take the whiting quota and the cod quota, based on current fishing patterns.

7. Management Plan:

A multi-annual plan exists and covers some stocks in Greater North Sea and adjacent waters however, for some of these stocks, this MAP is currently not recognized by Norway or the UK. In those cases, ICES advice is given on the ICES MSY approach.

8. General comments

Advice sheet:

Generally, well structured, clearly written and follows the overall format used for mixed fisheries considerations.

Comments in detail below, though these were written ahead of – and may have been superseded by - ADG review.

TAF:

Generally easy to follow, logical and well-structured. I was mostly able to run the code, and could up until the final report (which may have been a software version issue, but I lacked time to investigate).

There are quite a lot of ad-hoc fixes to data in script data_01. This is not unexpected, but the process could benefit from a change log, i.e. when, what and why these were introduced. The code failed to run for me in a couple of places, which are detailed below (and could have been down to package versions).

Report section:

Unable to be reviewed as it was not finalized at point of audit, owing to the corrections required following revision to the single-stock advice.

Stock annex:

Generally good, though some small issues are identified below.

9. Technical comments

Advice sheet:

- First paragraph: Inconsistency in how sole 7.d is also described as “eastern English Channel” in the parentheses, where all other stocks are just the stock name.
- Second paragraph: “whose” is an odd choice, as cod isn’t a person! “where the” would be better.
- Total landings percentages are >100%, but this is down to a small rounding (technically 100% + <1%),

TAF:

- Could not run line 122 of data.R due to error in plotting (dev.off() cannot shutdown device). Not clear at what point the script being sourced doesn’t run, but I can run the individual script independently to produce the outputs.
- Could not run Report.Rmd, tb.aggL$header$content$data[1,]$Métier$txt <- "Métier" came back with ‘incorrect number of subscripts on matrix’. It could just be a versioning issue, but I did not have trime to investigate.

Report section:

Unable to be reviewed as it was not finalized at point of audit, owing to the corrections required following revision to the single-stock advice.

Stock annex:

- It may be the text need to change on Nephrops to reflect that FU32 is not assessed by UWTV survey but a SPiCT model fitted to the survey and catch data.
- Table 1 is missing Sole 7d (and may have to delete Sole 4, depending on ADG decision).
- Model used table is missing Brill, needs to remove sole 4.

10. Conclusions

The assessment has been carried out appropriately and I am confident it is fully reproduceable. There are some data and model issues that warrant further exploration, and I recommend this takes place ahead of the next advice meeting.

Annex 3: Stock Annexes

Stock ID	Stock name	Last updated	Link
mix.bob	Bay of Biscay Mixed Fisheries Annex	October 2024	https://doi.org/10.17895/ices.pub.21517905
mix.cs	Celtic Sea Mixed Fisheries Annex	October 2023	https://doi.org/10.17895/ices.pub.21517986
mix.iw	Iberian waters Mixed Fisheries Annex	October 2022	https://doi.org/10.17895/ices.pub.21518010
mix.is	Irish Sea Mixed Fisheries Annex	October 2022	https://doi.org/10.17895/ices.pub.21518034
mix.ns	North Sea Mixed Fisheries Annex	October 2023	https://doi.org/10.17895/ices.pub.21518037

Annex 4: Resolutions for next meeting (draft)

202X/AT/FRSGXX The **Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE)**, chaired by Klaas Sys* (Belgium) and Matthew Pace* (UK), will hold a hybrid meeting in Copenhagen, on 29 September - 3 October 2025 and online on 13-14 October 2025 to:

a) Carry out mixed fisheries projections for the Bay of Biscay taking into account the single species advice and the management measures in place for 2026 for anglerfish, megrim, sea bass, hake, sole, Norway lobster, whiting, pollack, mackerel, horse mackerel, blue whiting and smooth hound produced by WGBIE, WGWIDE and WGEF in 2025.

b) Carry out mixed demersal fisheries projections for the Celtic Sea taking into account the single species advice and the management measures in place for 2026 for cod, haddock, whiting, hake, megrim, monkfish, sole and Norway lobster that is produced by WGCSE and WGBIE in 2026.

c) Carry out mixed fisheries projections for Iberian waters taking into account the single species advice and the management measures in place for 2026 for hake, four-spot megrim, megrim and anglerfish that is produced by WGBIE in 2025.

d) Carry out mixed demersal fisheries projections for the Irish Sea taking into account the single species advice and the management measures in place for 2026 for cod, haddock, whiting, plaice, sole, and Norway lobster that is produced by WGCSE in 2025.

e) Carry out mixed demersal fisheries projections for the North Sea taking into account the single species advice and the management measures in place for 2026 for cod, haddock, whiting, saithe, plaice, sole, turbot, brill, Norway lobster, and witch that is produced by WGNSSK in 2025;

f) Produce draft mixed-fisheries sections for the ICES advisory report 2025 that includes a dissemination of the fleet and fisheries data and forecasts for the North Sea, Celtic Sea, Irish Sea, Bay of Biscay, and Iberian waters.

WGMIXFISH-Advice will report by XX November 2025 for the attention of ACOM.

Annex 5: WGMIXFISH data to fleet and métier category tables

Figure A5.1. North Sea. Sankey plot for Belgium showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

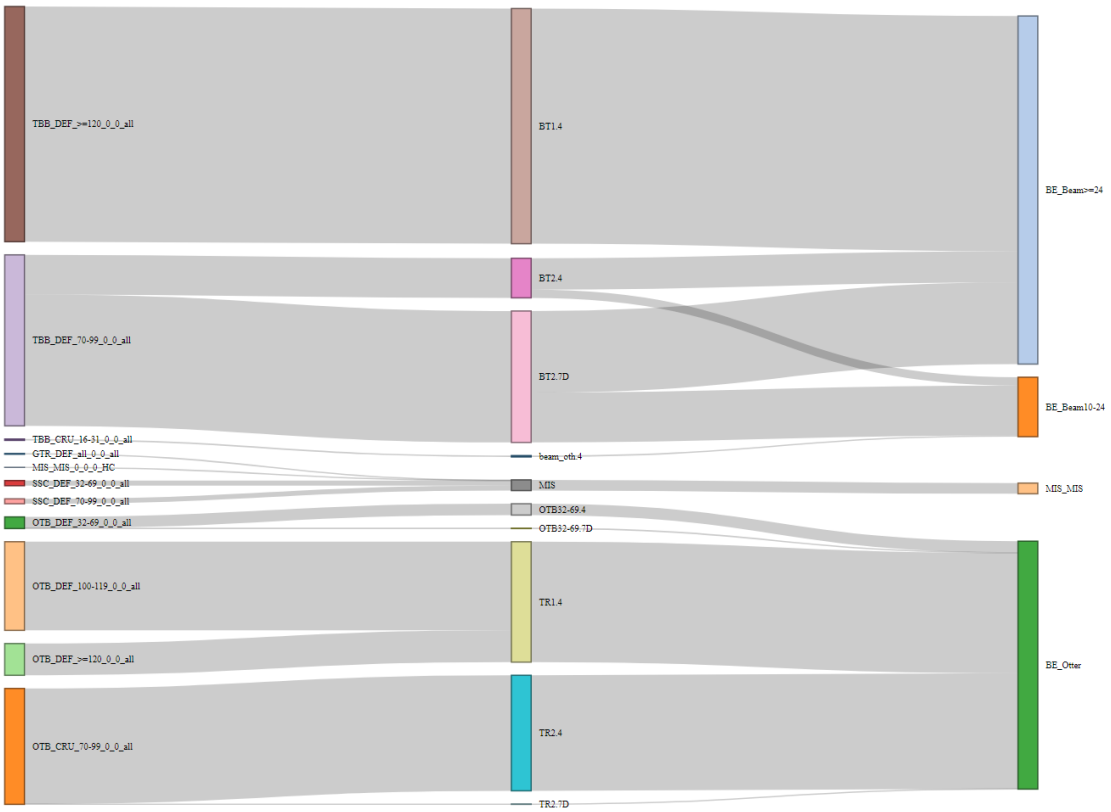

Figure A5.2. North Sea. Sankey plot for Denmark showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

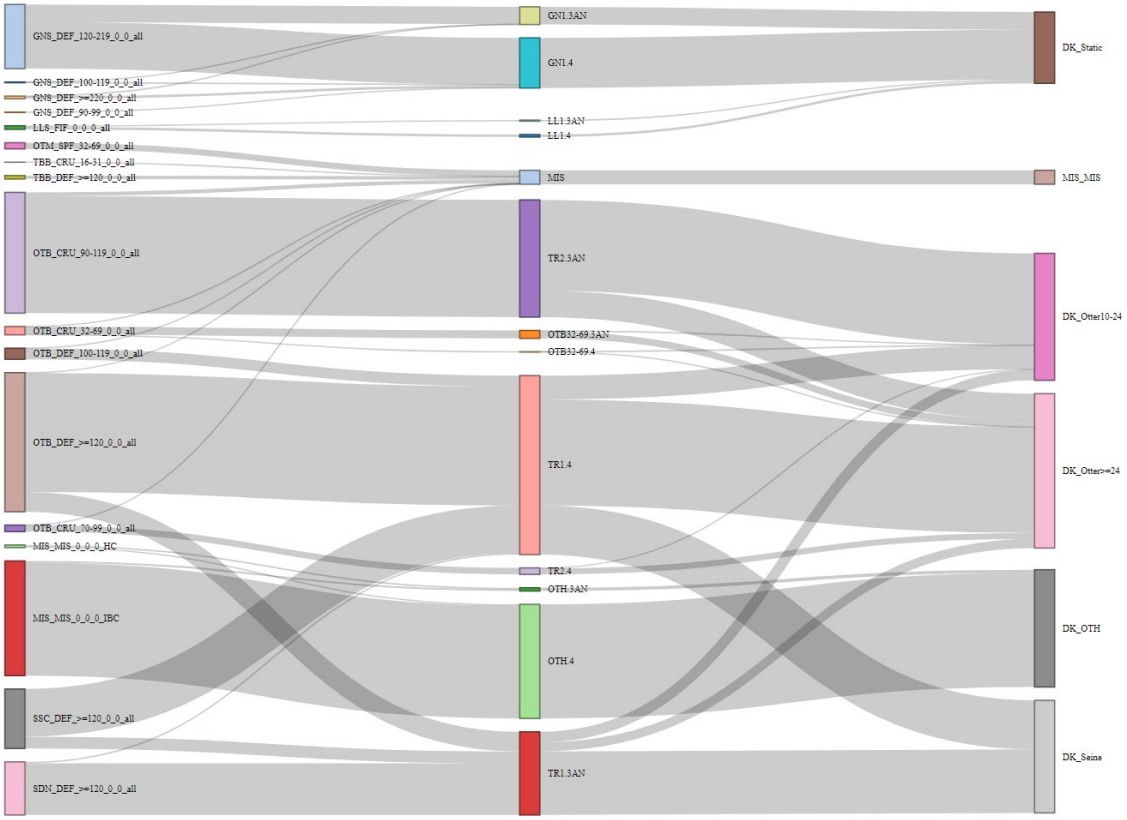

Figure A5.3. North Sea. Sankey plot for UK-England showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

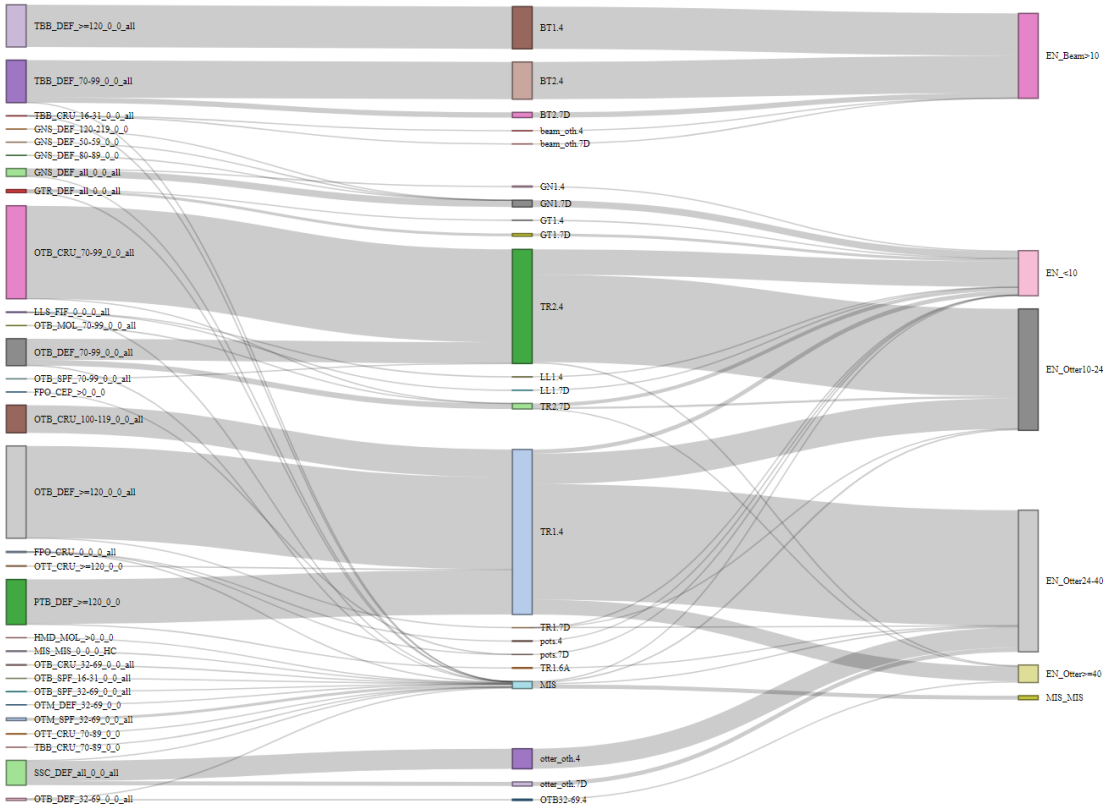

Figure A5.4. North Sea. Sankey plot for Germany showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

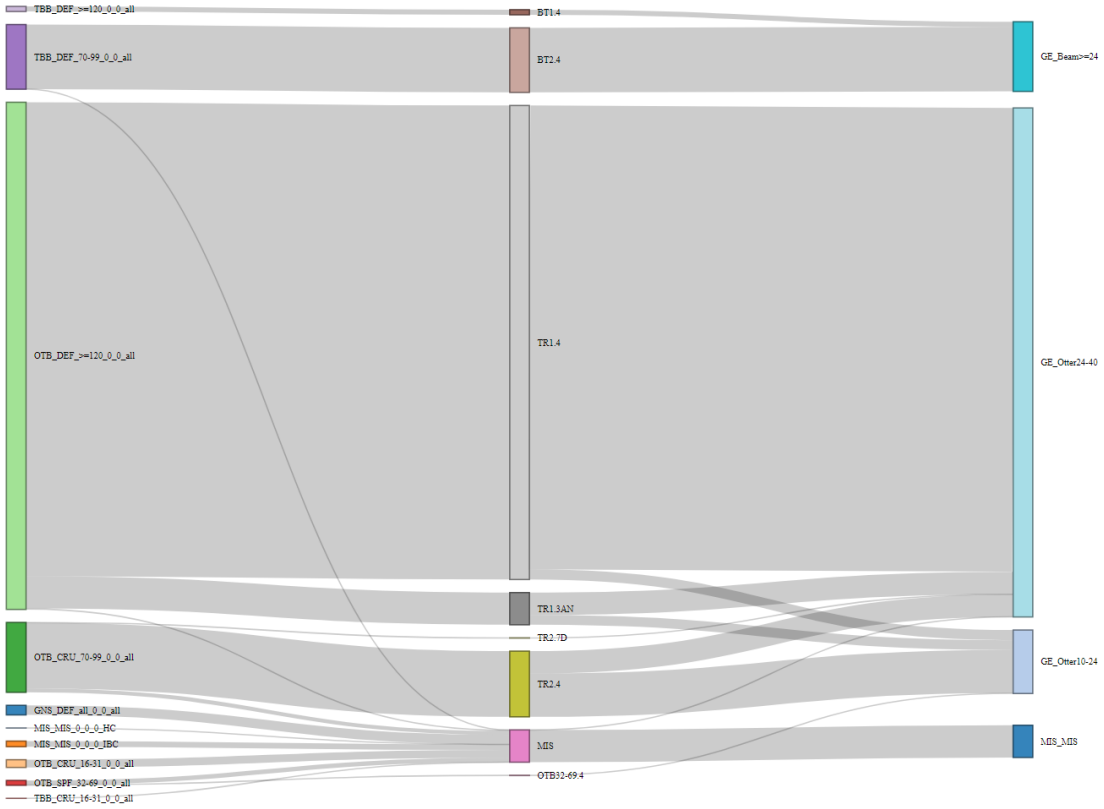

Figure A5.5. North Sea. Sankey plot for France showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

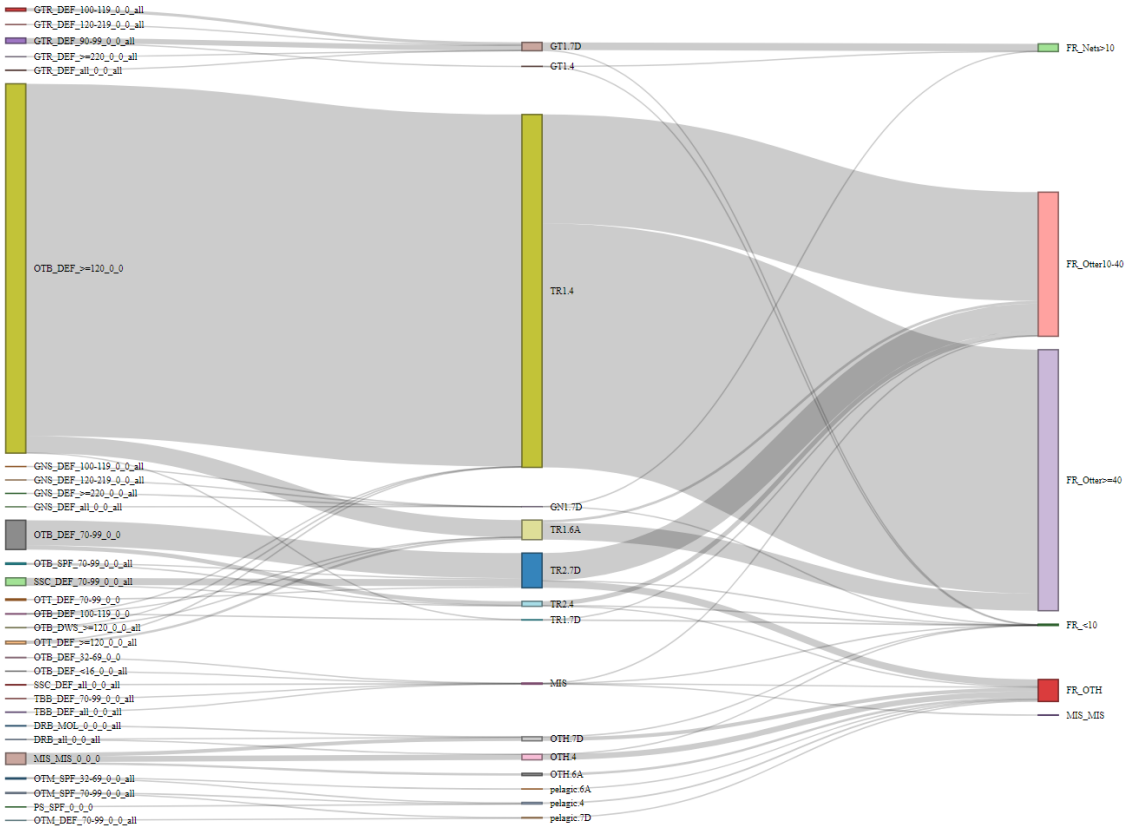

Figure A5.6. North Sea. Sankey plot for Netherlands showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

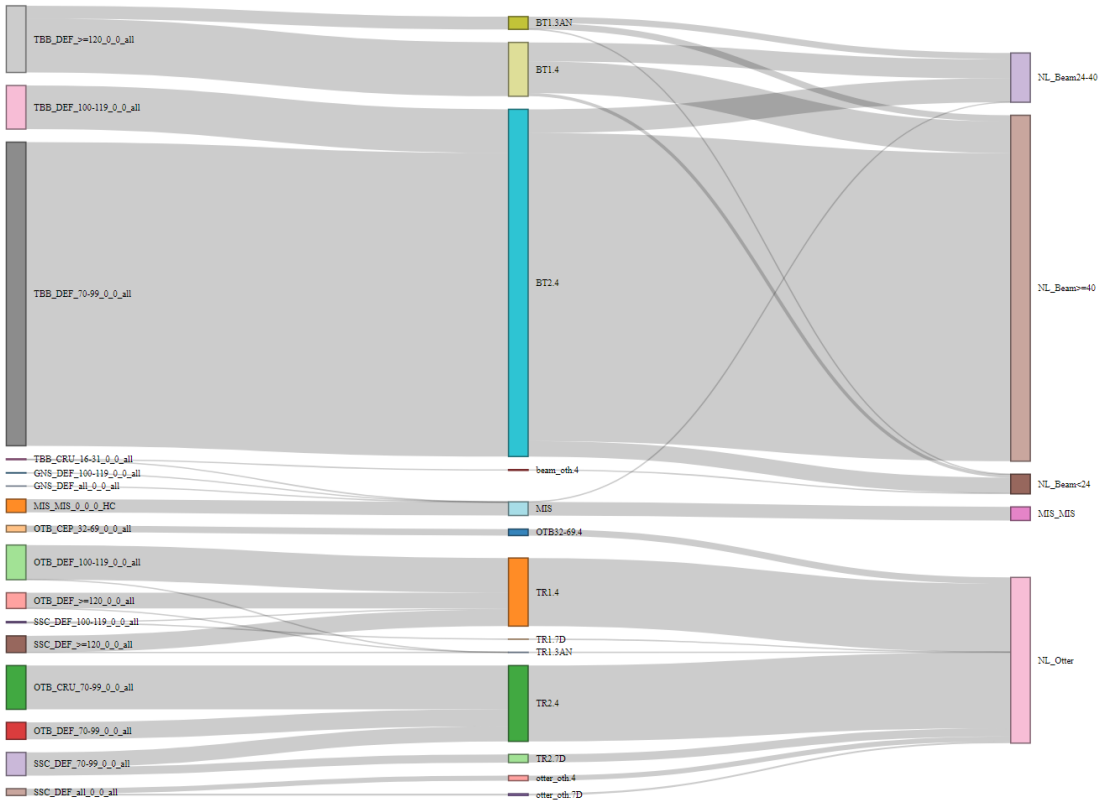

Figure A5.7. North Sea. Sankey plot for Norway showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

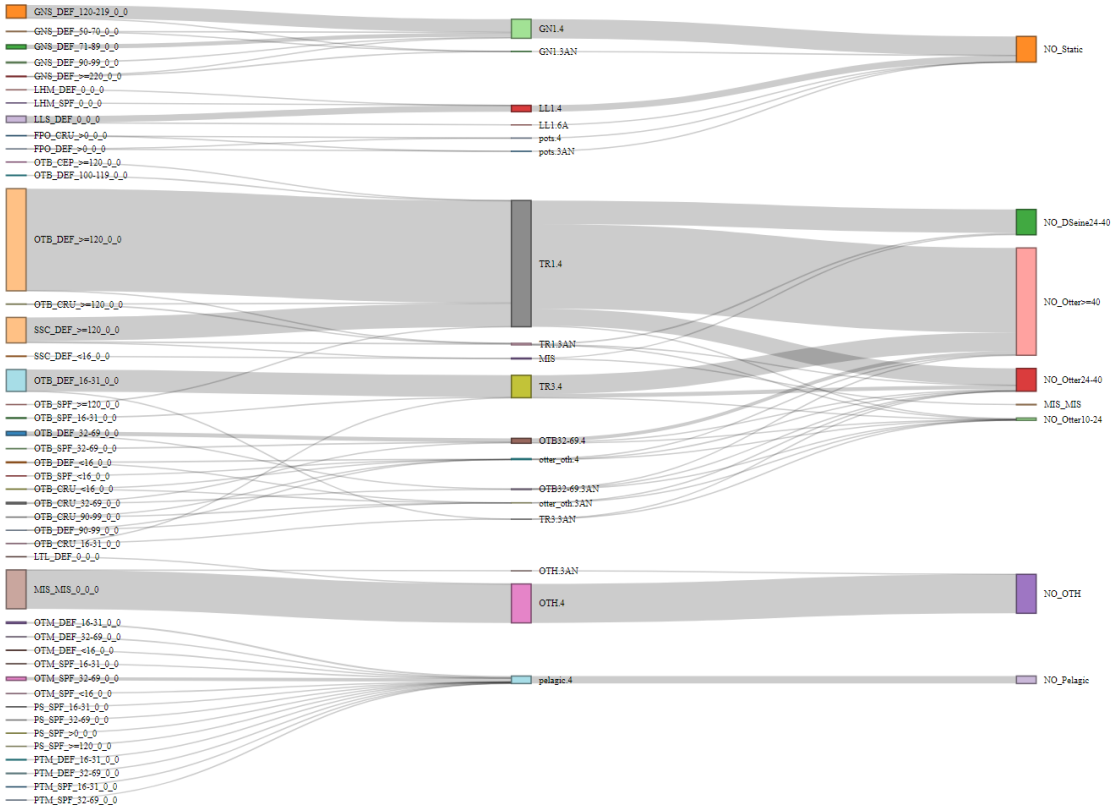

Figure A5.8. North Sea. Sankey plot for UK-Scotland showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.

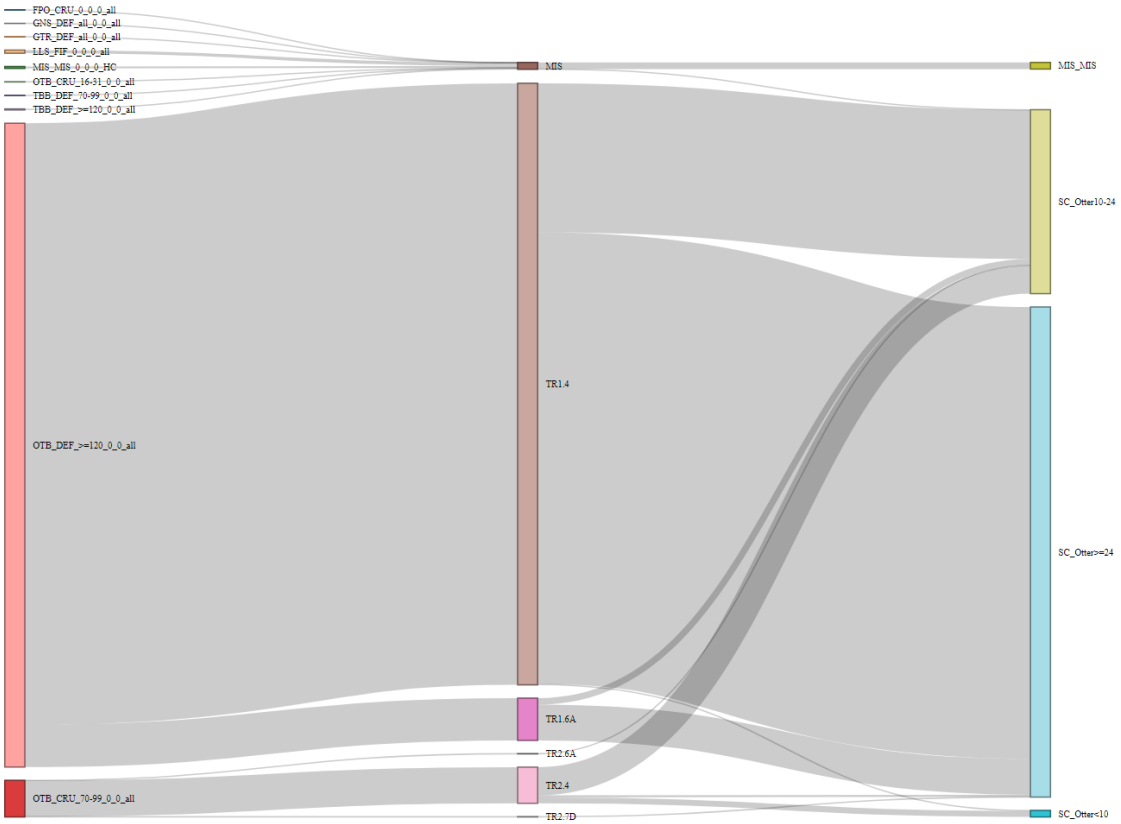

Figure A5.9. North Sea. Sankey plot for Sweden showing the métiers reported to WGMIXFISH through the annual data call for each fleet and métier category used in the mixed fisheries model.