WORKING GROUP FOR THE CELTIC SEAS ECOREGION (WGCSE)

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i Executive summary

The Working Group for the Celtic Seas Ecoregion (WGCSE) performs stock assessments on demersal stocks in Rockall, West of Scotland, Irish Sea, West of Ireland, Western English Channel, Bristol Channel, Celtic Sea and Southwest of Ireland. In 2024, the Working Group provided updated fisheries data, reviews and advice for 10 *Nephrops* functional units and 21 fish stocks. These fish stocks include, three sole, four plaice, three haddock, three whiting, two cod, two megrim, one sea bass, one anglerfish, one pollack stock and one norway pout stock. For most of the stocks, advice was drafted in May and issued in June. Advice for *Nephrops* and Rockall megrim were issued in autumn so that they could take account of the in-year survey information. Cod in division 6a (cod.27.6a) which was previously assessed by WGCSE is addressed by WGNNSK as part of the North Sea Ecoregion, due to its close linkage with other North Sea cod stocks and fisheries (ICES, 2023a).

This year, analytical assessments using age-structured models were conducted for 14 fish stocks. For three stocks advice is based on the 'rfb' advice rule. Advice based on the application of the precautionary buffer was issued for two data-deficient stocks. Surplus-production models, without age or length structure, were used to assess lez.27.4a6a and lez.27.6b. Assessment and advice for pol.27-67 was conducted using a SPiCT assessment. In addition, one whiting stock (whg.27.7.a) for which advice is issued on a biennial basis, was presented and included in the report, although no new advice in issued in 2024.

Three stocks have gone through a benchmark procedure in the past year; anf.27.3a46 and sol.27.7a (ICES, 2024a), and had.27.6b (ICES, 2024b). The benchmark of anf.27.3a46 introduced a change from a category 3 to a category 1 assessment model (SS3), and incorporated new and revised survey indices and updated biological parameters. The benchmark of sol.27.7.a, also incorporated revised indices, catch estimates and a new commercial biomass index. Following benchmark, the 2023 advice for 2024 catch of sol.27.7.a was reassessed by the working group, and reissued in June 2024. The benchmark of had.27.6b introduced a change of the assessment method from a category 3 to category 1 (age-based assessment, SAM), incorporating revised survey data and updated biological parameters. Reference points were also revised.

Of the 19 fish stocks for which status could be assessed relative to MSY (or MSY proxy) reference points; eight were fished below F_{MSY} and were above MSY $B_{trigger}$, three were fished above F_{MSY} and were below MSY $B_{trigger}$, three stocks were fished above F_{MSY} and were above MSY $B_{trigger}$ and five stocks were fished below F_{MSY} and were below MSY $B_{trigger}$. For two fish stocks for which advice was issued in 2024 reference points were unknown.

Underwater TV (UWTV) survey-based assessments were conducted for ten *Nephrops* functional units. Of the *Nephrops* stocks with UWTV assessments, all ten were fished below F_{MSY}. Five were above MSY $B_{trigger}$, and four were below MSY $B_{trigger}$. For *Nephrops* FU-16, $B_{trigger}$ is not yet defined.

ii Expert group information

Expert group name	Working Group for the Celtic Seas Ecoregion (WGCSE)
Expert group cycle	Annual
Year cycle started	2024
Reporting year in cycle	1/1
Chair(s)	Jonathan White, Ireland
	Ruth Kelly, Northern Ireland, United Kingdom
Meeting venue(s) and dates	8-17 May 2024, Copenhagen, Denmark, 29 participants
	24-27 September 2024, Online, 17 participants

1 Introduction

1.1 Terms of reference

1.1.1 Generic ToRs for Regional and Species Working Groups

The following ToRs for 2024 apply to: AFWG, HAWG, NWWG, NIPAG, WGWIDE, WGBAST, WGBFAS, WGNSSK, WGCSE, WGDEEP, WGBIE, WGEEL, WGEF, WGHANSA and WGNAS.

The working group should focus on:

a) Conduct an assessment on the stock(s) to be addressed in 2024 using the method (assessment, forecast or trends indicators) as described in the stock annex and documented in TAF; - complete and document an audit of the calculations and results; and produce a **brief** report of the work carried out regarding the stock, providing summaries of the following where relevant:

Quality control and quality assurance of input data. In the event of late, missing or inconsistent data document issues and deviations from the stock annex.

i) Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information;

ii) For relevant stocks (i.e., all stocks for NEAFC request advice), estimate the percentage of the total catch that has been taken in the NEAFC Regulatory Area in the most recent years.

iii) For category 2 and 3 stocks requiring new advice in 2024, implement the methods in guidance for harvest control rules and stock assessments for stocks in categories 2 and 3 . Replace the former 2 over 3 advice rule (2 over 5 for elasmobranchs) which is no longer considered precautionary.

iv) Evaluate spawning stock biomass, total stock biomass, fishing mortality, catches (projected landings and discards) using the method described in the stock annex;

1) for category 1 and 2 stocks, in addition to the other relevant model diagnostics, the recommendations and decision tree formulated by WKFORBIAS (see Annex 2 of https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/Fisheries%20Resources%20Steering%20Group/2020/WKFORBIAS_2019.pdf) should be considered as guidance to determine whether an assessment remains sufficiently robust for providing advice.

2) If the assessment is deemed no longer suitable as basis for advice, provide advice using an appropriate Category 2-5 approach as described in ICES technical guidance for harvest control rules and stock assessments for stocks in categories 2 and 3 or in Advice on fishing opportunities (for Cat 5 & 6).

3) If the assessment has been moved to a Category 2-5 approach in the past year, consider what is necessary to move back to a Category 1 and develop proposal for the appropriate benchmark process.

v) Provide all requested catch scenarios for the year(s) beyond the terminal year of the data (These are listed in ICES Guidance for completing single-stock advice)

vi) Historical and analytical performance of the assessment and catch options with a succinct description of associated quality issues. For the analytical performance of category 1 and 2 age-structured assessments, report the mean Mohn's rho (assessment retrospective bias analysis) values for time series of recruitment, spawning stock biomass, and fishing mortality rate. The WG report should include a plot of this retrospective analysis. The values should be calculated in accordance with the "Guidance for completing ToR viii) of the Generic ToRs for Regional and Species Working Groups - Retrospective bias in assessment" and reported using the ICES application for this purpose.

b) Produce and quality assure a first draft of the advice for each stock according to ACOM guidelines.

c) Include non-fisheries conservation considerations in accordance with the "ICES Guidelines on Non-Fisheries Conservation Considerations".

d) Review progress on benchmark issues and processes of relevance to the Expert Group.

   i) update the benchmark issues lists for the individual stocks in SID;

   ii) review progress on benchmark issues and identify potential benchmarks to be initiated in 2025 for conclusion in 2026;

   iii) determine the prioritization score for benchmarks proposed for 2025–2026;

   iv) as necessary, document generic issues to be addressed by the Benchmark Oversight Group (BOG)

e) Prepare the data calls for the next year's update assessment and for planned data evaluation workshops;

f) Identify research needs of relevance to the work of the Expert Group.

g) Review and update information regarding operational issues and research priorities on the Fisheries Resources Steering Group SharePoint site.

h) Update TAF, SAG, ASD (Advice and Scenarios database) and SID with final assessment input and output and advice information.

i) Consider and comment on Ecosystem and Fisheries Overviews with a focus on:

   i) identifying and correcting mistakes and errors (both in the text, tables and figures), and

   ii) proposing concrete evidence-based input that is considered essential for the advice but is currently under-developed or missing (with references and Data Profiling Tool entries, as appropriate).

Information of the stocks to be considered by each Expert Group is available here.

1.1.2 Specific ToRs

The Working Group for the Celtic Seas Ecoregion (WGCSE), chaired by Jonathan White*, Ireland and Ruth Kelly, UK meet 8-17 May 2024 in Copenhagen, Denmark and in September 2024 online to:

a) Address generic ToRs for Regional and Species Working Groups;

b) to ensure the assessments will be carried out on the basis of the stock annex. The assessments must be available for audit on the first day of the meeting.

Material and data relevant for the meeting must be available to the group on the dates specified in the 2024 ICES data call.

WGCSE will report by 31st of May 2023 for the attention of ACOM, and by 4th October 2024 for *Nephrops* stocks, anglerfish and megrim in Rockall.

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group.

1.2 Participation

Participation at the WGCSE meetings was hybrid at the May meeting and online only in September. There were 29 participants from 8 organisations. Countries with experts participating in the meeting were Belgium, Denmark, France, Republic of Ireland, and the UK (England, Scotland and Northern Ireland).

1.3 Methods

The type of final assessments presented at the WG are summarised as follows:

Category 1 age-based assessments and forecasts were conducted for and.27.3a46, bss.27.4bc7ad–h, cod 27.7.a; cod.27.7.e–k, had.27.6b, had.27.7.a, had.27.7.b–k, ple.27.7.a, sol.27.7.a, sol.27.7.e, sol.27.7.fg, whg.27.6.a and whg.27.7.b–ce–k.

For these stocks for which a full analytical assessment was possible, the WG used either Extended Survivor's Analysis (XSA), Age-Structured Assessment Program (ASAP), Stock Synthesis (SS3) or state–space assessment model (SAM). These approaches and procedures for using them are discussed in further detail in the relevant stock annexes.

Category 1 Bayesian surplus production model for lez.27.4.a6.a;

Category 1: UWTV survey based assessments and advice were used for nep.fu.11, nep.fu.12, nep.fu.13, nep.fu.14, nep.fu.15, nep.fu.16, nep.fu.17, nep.fu.19, nep.fu.2021 and nep.fu.22.

Category 2: A SPICT assessment was to determine stock status and a short-term catch forecast for Lez.27.6b and pol.27.6-7;

Category 3: Several stocks were now assessed as Data-Limited following the guidelines of WKLIFEIX and X, (ICES, 2019; 2020) following the "rfb" approach, implementing trends from combined biomass index and length-based indicators as the basis for advice. These include: ple.27.7.e; ple.27.7fg; ple.27.7h–k. For these stocks, advice issued in 2024 is for the years 2025 and 2026, following ICES guidelines (ICES, 2019; 2020).

Category 5: No category 5 assessments were carried out by WGCSE in 2024.

Category 6 whg.27.6b and nop.27.6a category 6 data-limited approaches for stocks for which there are negligible landings and stocks caught in minor amounts as bycatch were applied (ICES, 2023b).

1.4 Data issues

Data were generally submitted in a timely fashion through the InterCatch database for landings and discards data, and through the accessions database for other sources of data. Data limitations specific to any individual stocks and/or surveys are described in stock specific chapters.

1.5 Transparent Assessment Framework (TAF)

TAF is a new framework, currently in development, to organize all ICES stock assessments. Using a standard sequence of R scripts, it makes the data, analysis, and results available online, and documents how the data were pre-processed. Among the key benefits of this structured and open approach are improved quality assurance and peer review of ICES stock assessments. Furthermore, a fully scripted TAF assessment is easy to update and rerun later, with a new year of data. A number of assessments are being scripted in standard TAF scripts. See http://taf.ices.dk for more information and https://github.com/ices-taf/ for details. Where TAF is used for individual stocks, this detailed in the report. In cases, where TAF repositories can be made public the web address for these is also included on the relevant advice sheet.

1.6 Internal auditing and external reviews

As in previous years the WG carried out its own internal audit process using the standard ICES template. Given the workload of many of the scientists at WGCSE (sometimes with one scientist responsible for two or more stocks), these reports were finalized after the WG meeting. Audits were therefore typically carried out by correspondence after the WG and not completed for some stocks. All stocks for which advice was provided in June and October 2024 were audited by the WG and audit reports were produced for most of these. Issues discovered during the audit process were corrected in the WG report and advice products.

1.7 Generic ToR e: WGCSE recommendations for stocks to be benchmarked

Stocks recommended for next round(s) of benchmarks:

Listed for 2024–2025 Benchmark	Proposed for 2025–2026 Benchmark
lez.27.4a6a (postponed)	Cod.27.6b
pol.27.6-7	
whg.27.7a	

1.8 Reference list

ICES 2019, Ninth Workshop on the Development of Quantitative Assessment Methodologies based on LIFE-history traits, exploitation characteristics, and other relevant parameters for data-limited stocks (WKLIFE IX). ICES Scientific Reports. 1:77. 131 pp. http://doi.org/10.17895/ices.pub.5550

ICES. 2020. Tenth Workshop on the Development of Quantitative Assessment Methodologies based on LIFE-history traits, exploitation characteristics, and other relevant parameters for data-limited stocks (WKLIFE X). ICES Scientific Reports. 2:98. 72 pp. http://doi.org/10.17895/ices.pub.5985

ICES. 2023a. Benchmark workshop on Northern Shelf cod stocks (WKBCOD). ICES Scientific Reports. 5:37. 425 pp. https://doi.org/10.17895/ices.pub.22591423

ICES. 2023b. Advice on fishing opportunities. In Report of the ICES Advisory Committee, 2023. ICES Advice 2023, section 1.1.1. https://doi.org/10.17895/ices.advice.22240624

ICES. 2024a. Benchmark workshop on selected flatfish stocks (WKBFLATFISH). ICES Scientific Reports. 6:30. 729pp. https://doi.org/10.17895/ices.pub.25471987

ICES. 2024b. Benchmark workshop on selected haddock and saithe stocks (WKBGAD). ICES Scientific Reports. 6:7. 393 pp. https://doi.org/10.17895/ices.pub.25002470

Contents

2 Anglerfish (*Lophius budegassa, Lophius piscatorius*) in subareas 4 and 6 and in Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)

2.1 Introduction

In 2022, based on the recommendations of the WKLIFE workshop, ICES decided that advice should be provided following the *rfb* rule (ICES, 2021). Biennial advice was provided for this stock in 2022 on the basis of the *rfb* category 3 data limited rule utilising a survey index and mean catch length indicator. This resulted in a 30% reduction in advice for 2023 and 2024 (9 881 tonnes) compared to advice for 2022.

This stock was benchmarked in February 2024 (WKBFLAT; ICES, 2024) and a category 1 SS3 assessment was agreed. The assessment and advice this year follow the methods described in the Stock Annex (see annex 2).

ICES advice for 2023 and 2024

ICES advises that when the MSY approach is applied, catches should be no more than 9 881 tonnes in each of the years 2023 and 2024.

2.2 General

2.2.1 Stock description and management units

The anglerfish stock on the Northern Shelf is considered to occur in Division 3.a (Skagerrak and Kattegat), Subarea 4 (the North Sea) and Subarea 6 (West of Scotland plus Rockall). Anglerfish in the North Sea and Skagerrak/Kattegat were considered by this Working Group for the first time in 1999. In 2004 the WGNSDS considered the stock structure of anglerfish on a wider European scale, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division 2.a. In 2013, Division 2.a was removed from WGCSE ToR.

Management of Northern Shelf anglerfish is based on separate TACs for the North Sea Subarea 4 and West of Scotland Subarea 6, and international waters of 5b, 12 and 14. The TACs are set for the UK, EU and international waters of 4, 6 and 5b, and international waters of 12 and 14 but is applicable to EU/UK vessels only and there is no agreed shared TAC for other nations fishing in these areas. There is no TAC for Skagerrak and Kattegat Division 3.a. Table 2.1 summarises the ICES advice and actual management applicable for Northern Shelf anglerfish for 2003 onwards.

Although there is no minimum landing size for this species, there is an EU minimum weight of 500 g for marketing purposes (EC Regulation 2406/96).

Management applicable to 2023 and 2024

COUNCIL REGULATION (EU) 2023/194 of 30 January 2023 fixing for 2023 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, as well as fixing for 2023 and 2024 such fishing opportunities for certain deep-sea fish stocks

Species:	Anglerfishes *Lophiidae*			Zone:	United Kingdom and Union waters of 4; United Kingdom waters of 2a (ANF/2AC4-C)
Belgium		166	(1)(2)	Precautionary TAC	
Denmark		366	(1)(2)		
Germany		178	(1)(2)		
France		34	(1)(2)		
Netherlands		125	(1)(2)		
Sweden		4	(1)(2)		
Union		873	(1)(2)		
United Kingdom		6 338	(1)(2)		
TAC		7 211			

(1) Special condition: of which up to 30% may be fished in United Kingdom, Union and international waters of 6a north of 58°30'N (ANF/*6AN58).

(2) Special condition: of which up to 10 % may be fished in United Kingdom waters of 6a south of 58°30'N; United Kingdom and international waters of 5b; International waters of 12 and 14 (ANF/*56-14).

Species:	Anglerfishes *Lophiidae*			Zone:	6; United Kingdom and international waters of 5b; international waters of 12 and 14 (ANF/56-14)
Belgium		123	(1)	Precautionary TAC	
Germany		141	(1)		
Spain		132	(1)		
France		1 520	(1)		
Ireland		343	(1)		
Netherlands		119	(1)		
Union		2 378	(1)		
United Kingdom		1 704	(1)		
TAC		4 082			

(1) Special condition: of which up to 20 % may be fished in United Kingdom and Union waters of 2a and 4 (ANF/*2AC4C).

COUNCIL REGULATION (EU) 2023/730 of 31 March 2023 amending Regulation (EU) 2023/194 fixing for 2023 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, as well as fixing for 2023 and 2024 such fishing opportunities for certain deep-sea fish stocks, and Regulation (EU) 2022/109

Species:	Anglerfishes *Lophiidae*	Zone: Norwegian waters of 4 (ANF/04-N.)
Belgium	33	Precautionary TAC Article 3 of Regulation (EC) No 847/96 shall not apply. Article 4 of Regulation (EC) No 847/96 shall not apply.
Denmark	842	
Germany	13	
Netherlands	12	
Union	900	
TAC	Not relevant	

COUNCIL REGULATION (EU) 2024/257 of 10 January 2024 fixing for 2024, 2025 and 2026 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, and amending Regulation (EU) 2023/194

Table 34

Species:	Anglerfishes *Lophiidae*		Zone: United Kingdom and Union waters of 4; United Kingdom waters of 2a (ANF/2AC4-C)
Belgium	152	(1)(2)	Precautionary TAC
Denmark	337	(1)(2)	
Germany	164	(1)(2)	
France	31	(1)(2)	
Netherlands	115	(1)(2)	
Sweden	4	(1)(2)	
Union	803	(1)(2)	
United Kingdom	6 408	(1)(2)	
TAC	7 211		

(1) Special condition: of which up to 30 % may be fished in United Kingdom, Union and international waters of 6a north of 58°30'N (ANF/*6AN58).

(2) Special condition: of which up to 10 % may be fished in United Kingdom waters of 6a south of 58°30'N; United Kingdom and international waters of 5b; international waters of 12 and 14 (ANF/*56-14).

Table 35

Species:	Anglerfishes *Lophiidae*	Zone: Norwegian waters of 4 (ANF/04-N.)
Belgium	33	Precautionary TAC
Denmark	842	Article 3 of Regulation (EC) No 847/96 shall not apply
Germany	13	
Netherlands	12	
Union	900	
TAC	Not relevant	

		Table 36		
Species:	Anglerfishes *Lophiidae*		Zone:	6; United Kingdom and international waters of 5b; international waters of 12 and 14 (ANF/56-14)
Belgium		120 [(1)]	Precautionary TAC	
Germany		137 [(1)]		
Spain		128 [(1)]		
France		1 475 [(1)]		
Ireland		334 [(1)]		
Netherlands		116 [(1)]		
Union		2 310 [(1)]		
United Kingdom		1 772 [(1)]		
TAC		4 082		

[(1)] Special condition: of which up to 20 % may be fished in United Kingdom and Union waters of 2a and 4 (ANF/*2AC4C).

2.2.2 Fishery description

A more detailed description of the fisheries can be found in the Stock Annex (see annex 2). The official national landings as reported to ICES are given in Table 2.2 and the breakdown by country in Tables 4.3–4.5. Total officially reported landings of anglerfish from the Northern Shelf are shown in Figure 2.1.

The fishery in 2023

Official landings in 2023 for division 3a, subareas 4 and 6 combined were 16 603 t (1 165 t, 11 199 t and 3 669 t respectively), giving a 47% overshoot of the combined TAC of 11 293 t (55% and 90% TAC uptake respectively). This overshoot is largely caused by landings from division 3a and Norwegian waters of subarea 4. Over quota landings by individual states are most likely due to countries obtaining additional quota from other EU member states, or carrying forward unutilised quota from 2019 and using a flexibility allowance whereby 10% of Subarea 4 TAC can be utilised to reattribute landings from Subarea 6.

Uptake of EC quota in 2023, based on the preliminary officially reported landings, was as follows:

	TAC 6	Landings 6	Uptake (%)	Quota 4 (Norwegian)	TAC 2.a & 4	TAC 2.a & 4(total)	Landings 4	Uptake (%)
Belgium	123	-	0%	33	166	199	217	109%
Denmark	-	1	-	842	366	1208	1098	91%
France	1520	570	38%	-	34	34	109	320%
Germany	141	84	60%	13	178	191	110	58%
Ireland	343	575	168%	-	-	-	-	-
Netherlands	119	-.	0%	12	125	137	119	87%
Norway	-	6	-	-	-	-	1266	-
Russia	-	-	-	-	-	-	-	-
Spain	132	160	121%	-	-	-	-	-
Sweden	-	-	-	-	4	4	350	8750%
UK (total)	1704	2274	133%	1075	6338	7413	7930	107%
Total	4082	3669	90%	1975*	7211		11199	155%

*Quota not included in TAC.

Based on data submitted to ICES, the fishery was principally prosecuted by vessels using demersal trawls (Table 2.6), targeting either white fish (69% of total landings by weight) or *Nephrops* (6%). Alongside these fleets there was also a significant gillnet fishery (13%), as well as an assortment of other gears in which small quantities of anglerfish are caught as bycatch. The latter have been grouped here as miscellaneous gears (10%).

UK vessels accounted for the majority of reported anglerfish landings from the combined Northern Shelf area, taking approximately 61% of the landings overall. Scottish, Danish and Norwegian vessels took 71%, 10% and 11%, respectively, of the North Sea (Divisions 4.a–4.c) landings. Scottish, French and Irish vessels took 61%, 16% and 16%, respectively, of the West Coast (Subarea 6) landings. Landings in Division 3.a are not regulated: Table 2.5 shows the official landings which fluctuated between 400–500 t from 2005–2015, but have more than doubled since then. Danish, Norwegian and Swedish vessels account for 74%, 15% and 9%, respectively, of the landings in Division 3a.

2.3 Data

Landings

National landings data as reported to ICES and Working Group estimates of total landings are given in Table 2.2. The working group procedures used to determine the total international landings numbers and weights-at-length are documented in the stock annex. It is acknowledged that throughout the landings time-series, there have consistently been differences between the total official landings and the landings as estimated by the WG. This is due to differences in the data provided to the WG by national scientists and administrators.

Due to restrictive TACs, the likelihood of misreporting and underreporting of anglerfish landings in the past is considered to have been high, particularly during the period 2003–2005. During the benchmark at WKROUND (ICES, 2013), it was agreed that recent landings are likely to be more accurate from 2006 due to, i) less restrictive TACs, ii) the introduction of buyers and sellers legislation in the UK and Ireland and iii) the offshore gillnet fishery for anglerfish historically conducted by Spanish flagged vessels and thought to under-report landings, being much reduced. Anecdotal reports from fisheries offices and catch sampling staff suggest that towards the end of 2016 and into 2017 the high abundance of anglerfish on the grounds, and the restrictive quota were leading to an increase in suspected misreporting, discarding and black landings. There was no new information in 2021 to suggest that these suspected practices continued into 2018, 2019 or 2020, and the lower quota uptake during these years may indicate that the incentives for this behaviour are no longer prevalent. During the period 2005–2010, landings data were not provided to the Working Group by some of the major nations exploiting the fishery; however the recent data call for the WKAngler benchmark (2018) has meant that WG estimates of subarea 6 and 4 landings have now been calculated for this period.

BMS landings

Minor amounts of below Minimum Size (BMS) landings are reported. These are included in the official landings statistics and are also uploaded to Intercatch for some countries, whilst for other nations, these are accounted for in total discard estimates submitted to Intercatch. The assessment/forecast includes BMS landings within total discards as these landings are typically unsampled and are allocated an age compositions from sampled discards in InterCatch.

Discards

Prior to the WKAngler benchmark (2018) discard estimates have only been available within InterCatch since 2012. Following the WKAngler data call discard information are now available for some fleets since 2002; however, discard information from UK (Scotland) is not available before 2008. The discard estimates that are available from other nations for the 2002–2007 period are substantially higher than the later UK (Scottish) rates. Given that these (non-Scottish) fleets represent proportionally less of the landings, the discards pre-2008 are considered to be non-representative of the overall fishery (WKAngler, 2018).

Landings and discards over time are shown in Figure 2.13. Discard data indicate that discarding in this fishery is relatively low due to high market value and no minimum conservation reference size (MCRS). Overall discarding was 1.4% of total catch in 2023.

Figures 4.3 (a–c) show the percentage of landed weight by fleet, country and area. Length–frequency samples for catch in 2021 were submitted by Belgium, Denmark, France, Germany, Ireland, Norway, UK (England & Wales) and the UK (Scotland). There was good coverage of both the demersal TR1 and TR2 fleets in Subarea 4 and Division 6.a. There were no samples from gillnet vessels which accounted for approximately 13% of all landings (Figure 2.3a).

Length compositions

There is a time-series of commercial catch-at-length data for 2002–2021 (Figure 2.4). The spread of lengths in the landings distributions are wider during the period 2012–2014 after which the distributions are steeper and unimodal. In 2015 the strong 2013 cohort entered the fishery producing a markedly different catch composition of lengths with the bulk of landings being between 30 and 50 cm in length with steep tails either side. Discard rates are lower from 2015 onwards however the landings of <30 cm fish were also lower, suggesting this reduction could be a combination of catch composition and the increase in quota availability.

Biological

An anglerfish ageing exchange was held in 2011 to investigate the possibility of the collation of an international landings-at-age dataset of hard structure age readings, however little agreement was found between methods or readers. This was acknowledged in the findings of the WKROUND report on current assessment and issues with data and assessment of this stock (ICES, 2013). Further to this, discussions at WKAngler established that few countries are actively reading anglerfish hard structures, although they continue to be collected, processed and stored.

2.3.1 Research vessel surveys

Scottish Irish Anglerfish Megrim Industry Science Survey (SIAMISS)

The SIAMISS (Scottish Irish Anglerfish Megrim Industry Science Survey) is a dedicated anglerfish survey. It covers much of the known distribution of the northern shelf anglerfish (ICES divisions 4a, 6a and 6b), with the exception of the central and southern parts of Subarea 4 and the Skagerrak and Kattegat (Division 3a). The survey area has been stratified based on knowledge from fishermen with sampling effort within each stratum allocated roughly according to its expected biomass. Given the large spatial coverage of the survey, it is typically carried out by multiple vessels including commercial fishing vessels and both Irish and Scottish research vessels using a standard gear. Abundance and biomass estimates are worked up on the basis of swept-area and account for herding by the trawl doors and sweeps, ii) escapes under the footrope and iii) anglerfish abundance and biomass in the southern part of Division 6a were not covered in 2005, 2008 and 2010. Further details regarding the survey design and work up can be found in the stock annex.

The survey began in 2005 and is carried out on an annual basis (usually in spring, but sometimes in November). In 2020, however, the Scottish component of the SIAMISS survey (covering the northern North Sea, the north of divisions 6a and 6b) was cancelled due to the COVID-19 pandemic. While the Irish part of the survey did go-ahead (covering the southern part of Division 6a), historical densities and stock trends suggest that extrapolation of this component of the survey to the wider stock area would be inappropriate. Therefore, there is no abundance/biomass estimate from SIAMISS for 2020. In 2022 the anglerfish multi-vessel survey took place from the 12th to 27th of April and involved two vessels: FRV Scotia – surveying Division 4a and Division 6a North of 58°N, and the Irish Marine Institute research vessel FRV Celtic Explorer, surveying Division 6a South of 58°N. One haul with the duration of 60 minutes was made at each sampling station (n=138). Due to a mechanical fault with FRV Scotia the SIAMISS survey did not include Division 6b (Rockall) in 2022.

Figures 4.7 and 4.8 show the 2017-2023 survey haul locations and mean numbers and weight per km^2 caught at these locations. Larger numbers of anglerfish were caught along the shelf-edge below 58°N, with large weights of fish being caught at the same locations and also at Rockall, indicating that the fish at Rockall are larger than those caught on the shelf-edge.

A time-series of total biomass is given in Table 2.6 and Figure 2.9. The total biomass estimate for the Northern Shelf in 2023 was 49 884 t, an decrease of 10% compared to 2022.

The breakdown of total numbers and biomass by division (Table 2.7 and Figure 2.10) shows that Division 6.b has lower estimated population numbers with less variability over time than in either division 6.a or 4.a. Division 4.a consistently has the highest total biomass of the three areas and shows similar temporal trends to Division 6.a. Divisions 6.a and 6.b currently have similar biomass, with 6.b having fewer, but larger, fish.

Estimated total population numbers and biomass at length by area from the survey in 2023 are shown in Figure 2.11 which show a much higher proportion of large fish in division 4.a than in division 6.a. In terms of numbers, area 4.a has by far the highest value, when compared with areas 6.a. Comparison of numbers-at-length and weight-at-length over time for all areas combined show a slight decrease in numbers and biomass compared to 2022. (Figure 2.12).

Estimates of the ratio of survey biomass between subareas 4 and 6 have fluctuated around 1:1, (time-series average of 47.5% in Subarea 4, Table 2.6, Figure 2.13), whereas the management of the stock splits the TAC across 4 to 6 in the proportion 64:36.

The proportion of *Lophius budegassa* in the stock remains at around 10% by weight (Figure 14).

IBTS survey indices

Survey indices for Q1 and Q3 & Q4 combined were derived using GAM-based delta-lognormal models (Berg *et al*., 2014) of numbers per haul in five size-classes, fitted separately to each size-class, with haul duration as an offset, using combined surveys as described in the stock annex and Figure 2.15. The size-classes are (0, 15], (15, 46], (46, 66] and (66, 140], (all in cm), chosen using k-means clustering, and "all". The model consists of two parts: one that describes the probability for a non-zero catch (binomial response) and another that describes the distribution of a catch given that it is non-zero (positive continuous). Explanatory variables included a spatio-temporal smooth, a smooth of depth and categorical time of year, year, gear, day/night and ship effects.

The indices were derived from model predictions on a grid covering the survey area, and are shown for Q1 in Figure 2.16 and Q3 & Q4 in Figure 2.17. Both abundance indices varied considerably over time, with the indices for the last decade being generally above the average in the time-series across multiple size classes. Confidence intervals were moderately wide for Q1 and narrower for Q3 & Q4. The indices for Q1 and Q3 & Q4 by size class are shown in Table 2.8.

Model predictions of anglerfish spatial distributions averaged of averaged across years on the Northern Shelf how that small anglerfish (≤15 cm) are fairly widely distributed at Rockall (in Q3&Q4), on the West Coast and on the north-western edge of the North Sea. Small to medium-sized fish ((15, 46]) are found in roughly the same areas as small fish, but in Q1 they are also found in the Norwegian Trench (Figures 4.18 and 4.19). Medium-sized to large fish ((46, 66]) are distributed at Rockall, along the West Coast shelf edge and to a greater extent (than smaller fish) in the Norwegian Trench (with higher densities there in Q1 than in Q3&Q4). Large fish (> 66 cm) are mainly found at Rockall, at the northern edge of the North Sea and in the Norwegian Trench with their densities on the West Coast extremely low. High densities of anglerfish (of all size classes) are found at Rockall. However, smaller fish are mainly found in the central part of the bank, at rather small depths, while larger fish tend to be found at greater depths.

Mean-standardised indices for Q1 and Q3&Q4 are compared in Figures 4.20. The Q3&Q4 index tends to show higher estimates compared to the Q1 index. It includes Rockall, where relatively high anglerfish densities (compared to the other areas) are observed. The trends were fairly consistent for the two indices, with distinct peaks and valleys present in both.

Index diagnostics

A residual analysis of the model for the two indices, for Q1 and Q3+Q4, showed no serious deficiencies. The residual vs. fitted plots did not reveal any non-linearity, unequal error variances or outliers. The residuals vs. year plot did not reveal any undesired time trend. Spatial residuals by year were also considered. No blocks of positive or negative residuals were found in the spatial distribution. For all years, positives/negatives seem to be reasonably distributed across the area.

The retrospective analysis showed a fairly stable pattern for Q1 (Figures 4.21). The estimates for a given year were very close to the estimates for that year made in the following year. The Mohn's rho statistics were negative for all the size classes. They were above the ICES acceptable threshold of -0.15 (ICES, 2020b). The retrospective analysis for Q3&Q4 conducted for the most recent years showed some variation in the estimates for some size classes (Figure 2.22). The calculated Mohn's rho statistics were both negative and positive. For the largest fish, they were negative and below the threshold.

2.4 Stock assessment

This assessment is an age-based analytical assessment utilising SS3 (xxx, xxxx) as outlined in the stock annex.

2.4.1 Final assessment

A summary of the SS3 input data and parameters is given in Table 2.9 and the SS3 configuration model is given in Table 2.10.

Model diagnostics

Convergence

The model was run with the latest SS version available 3.30.22.1 (Released in January of 2024). There are no parameters estimated at or near the bounds or with unusual large variance. The final gradient on the likelihood is 0.000372461. The Hessian is positive definite. All jitter runs converged and most with the same or similar log-likelihood as the base run. Only 4 runs had a significantly larger total log-likelihood (Figures xx). The assessment is stable with acceptable retrospectives.

Goodness of fit

Indices

Fit to total survey indices are presented in Figures 4.23-4.25. The fits are reasonable for each survey. For IBTS Q1, in the early 1980's the model overestimates index. In this early period, prior to 1991, the IBTS Q1 survey is the only available data besides total landings. SS3 tends to fit landings data quite closely. All indices confirm an increase in recent stock size.

Residual diagnostics

Pearson residuals for show some positive residuals at small and large size for discards (below approximately 40 cm, and above 60cm) (Figure 2.26 top) and at intermediate size (40-60cm) for landings (Figure 2.26 middle). For SIAMISS survey residuals at length are more mixed in value (Figure 2.26 bottom). Residuals at length for the IBTS surveys are shown in Figures 4.27 and 4.28.

To evaluate the overall model fit of the relative abundance indices and composition data, the joint-index residual boxplot was done to the residuals from the fits to indices or mean length for multiple time series, simultaneously. The boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available. The fit to mean lengths shows that SIAMISS has several negative residuals, and the loess smoother is not centred around 0 showing a good fit for catch fleet and SIAMISS length distributions (Figure 2.29). There is increased variability in the residuals of model fit to survey indices (Figure 2.30) Generally, residuals are below 1 for both mean length and indices (except for IBTS Q1 in the first years). Relatively lower variability in index residuals is observed in recent periods, when all three indices are available

(Figure 2.30). The joint residuals look acceptable with small boxes and RMSE with 5.2% for mean length, but RMSE is slightly higher for survey indices with 33.3% (above the limit of 30%).

The Runs tests is used to evaluate whether residuals are normally distributed or show trends. For mean length (Figure 2.31), the runs test passed for SIAMISS length but not for catch lengths, which reflects the more tailored fit to length distributions of this survey using cubic spline selectivity function as compared to the double-normal assumption for catch selectivity.

The runs test for the indices again passed for the SIAMISS survey but not for the IBTS surveys (Figure 2.32). This indicates some conflict between the surveys and better performance for the survey with the shortest time series and detailed length frequency distributions.

Model consistency

R0 profile

The estimated value of SR_LN(R0) is 12.6308 from an initial value of 13. The R0 profile shows a minimum value in the log-likelihood change for the estimated value (Figure 2.33). The length data (SIAMISS, catches) have a major impact on the total log-likelihood change.

Retrospective analysis

Retrospectives were produced running the assessment model leaving out the most recent year of data, sequentially for the past 5 years. Mohn's rho for SSB and F is low (0.09 and -0.14, respectively) and within acceptable limits (between -0.15 and 0.2; Hurtado-Ferro, 2015). All peels are within the confidence intervals for SSB and F retros, while recruitment is more variable with a few peels are outside the confidence intervals (Figures 4.34-4.36). Overall, the retrospectives show that the assessment is relatively stable. In Figure 2.37, parameters that contribute to retros are listed, showing the estimated parameter values are very stable.

Hindcasting

Hindcasting provides a retrospective forecast and allows comparison of forecasted values with actual observations that were not included in the model run. MASE values quantify the predictive power of input data, with values above 1 not contributing to the prediction skill of the model. Plots and values for mean lengths and indices are shown in Figures 4.38 and 4.39. For the survey indices and SIAMISS mean lengths, all values are above 1 and do not have prediction skill. The catch mean lengths have good predictive power (MASE<1).

Jitter runs

50 jitter runs were analysed, all of which converged (Table 2.11). The majority of runs has the same or similar log-likelihood as the final fit (Figure 2.40). Only four jitter runs had a significantly higher log-likelihood. In Figure 2.41, parameters contributing to differences in jitter runs shown, with parameter estimates being relatively stable. Only for a few runs, values are different, affecting selectivity parameters for catch fleet and IBTS Q3&Q4 index.

Stock recruit relationship

A Beverton Holt recruitment relationship is assumed in the model (Figure 2.42). Bias adjustment was carried out within SS3 following the suggested parameter values from SS3 outputs (Figure 2.42; Methot & Taylor, 2011)

Stock status

The stock summary plot including reference points (and intermediate year estimates) is shown in Figure 2.45, and the full summary output is given in Table 2.12. The stock recovered during

2005-2015 following a sharp decline from around 1990-2000. Recruitment is quite variable, with a high estimated recruitment in 2023. However there is some evidence of bias in estimating recruitment.

2.5 Short term forecasts

The forecast for anglerfish was done using stock synthesis (SS3). The intermediate year (2024) assumption for fishing mortality defined $F_{status\ quo}$ as F in the most recent year (2023) at 0.0885 with a catch of 18228 t. This was chosen rather than an average F of recent years as the stock currently presents a trend of declining F. Recruitment in 2024 and 2025 was predicted from the stock-recruitment relationship to be 219263 and 209046 (1,000s) respectively.

A summary of the forecast assumptions is given in Table 2.13.

Given these forecast assumptions for the intermediate year, the SSB at the start of 2025 is estimated as 57665 tonnes and remains well above MSY $B_{trigger}$. The forecast under different catch scenarios for 2025 is shown in Table 2.14.

The forecast stock trajectory under the proposed advice (MSY approach) for 2025 results in a 4% increase in SSB in 2026 compared to 2025. The catch advice for 2025 is 30726 tonnes under the MSY approach. The change in advice is 211% (compared to the advice for 2023 and 2024) and is due to the change in assessment method/advice basis following the benchmark.

Although the contribution to the stock of age 0s and 1s is high in number, as weights-at-age for age 0s and 1s are very low, their contribution to stock biomass is low (Figure 2.44). Fish are considered 50% mature at age 10 and so the contribution to the SSB from recent years is low. In addition, fish are not really recruited into the catch until age 2 (Figure 2.45). So although recruitment is high in 2023, and the model may have a tendency to over-estimate recruitment in recent years, the effect on the forecast in terms of both SSB and catch for 2025 and 2026 is very low.

2.6 Biological reference points

Both MSY and precautionary reference points were re-estimated at WKBFLATFISH (ICES, 2024) and are given below.

Reference points, relative values, and their technical basis.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	38604	5th percentile of equilibrium SSB when fishing at F_{MSY}; in tonnes
	F_{MSY}	0.137	Stochastic simulations (EqSim) with Beverton–Holt stock-recruitment relationship
Precautionary approach	B_{lim}	25686	SSB_{2004}; lowest observed SSB historically; in tonnes.
	B_{pa}	35692	$B_{lim} \times \exp(\sigma \times 1.645)$, where $\sigma = 0.2$; in tonnes.
	F_{lim}	Undefined	Inconsistent with F_{pa}
	F_{pa}	0.215	F_{P05} with advice rule (AR): the F that provides a 95% probability for SSB to be above B_{lim}.
Management plan	MAP MSY $B_{trigger}$	38604	MSY $B_{trigger}$; in tonnes
	MAP B_{lim}	25686	B_{lim}; in tonnes
	MAP F_{MSY}	0.137	F_{MSY}
	MAP range $F_{MSYlower}$	0.105	Consistent with ranges resulting in no more than 5% reduction in long term yield compared with F_{MSY}.
	MAP range $F_{MSYupper}$	0.174	Consistent with ranges resulting in no more than 5% reduction in long term yield compared with F_{MSY}.

2.7 Management plans

ICES is aware of the multiannual management plan (MAP) which has been adopted by the EU for this stock (EU, 2019) and which ICES considers to be precautionary. There is no agreed shared management plan with the UK for this stock, and ICES provides advice according to ICES precautionary approach.

2.8 Uncertainties and bias in assessment and forecast

Commercial data

For a number of years the WG has expressed concerns over the quality of the commercial catch-at-length data because of:

- Accuracy of landings statistics due to species and area misreporting (historically an issue between 1998–2005 and anecdotally again in 2016).
- Lack of information on total catch and catch composition of gillnetters operating on the continental slope to the northwest of the British Isles (See the stock annex for further details of this fishery).

Survey data

There are still several factors which make the survey estimates likely to be underestimates or minimum estimates. Firstly, although experiments have been carried out to estimate escapes from under the footrope, and a model applied to account for this component of catchability, the estimates of smaller anglerfish still look to be underestimated (Figure 2.7). This could be due to either a net selectivity issue, or an availability [to the trawl] issue, as it is known that younger fish occur in shallower water (Hislop *et al*., 2001), or both. Secondly, the area considered is not complete, as the survey does not cover some of Division 4.a and none of 4.b or 4.c. However, numbers are thought to be low in these areas.

Biological information

Knowledge of the biology of anglerfish has improved, with some basic biological parameters suitable for use in future assessments, such as mean weight-at-length in the stock, now available from the industry–science survey data. Difficulties still remain in finding mature females. A further discussion of the biology can be found in the stock annex.

Life-history parameters of the anglerfish species *Lophius piscatorius* and *Lophius Budegassa* in the Northeast Atlantic were reviewed at the WKAngler benchmark (2018) with appropriate ranges of natural mortality (M) discussed and new approaches to estimating age from mixture modelling of length distributions presented (see WKAngler 2018 report for further details).

Stock structure

Currently, anglerfish on the Northern Shelf are split into Subarea 6 (including 5.b (EC), 7 and 14) and the North Sea (and 2.a (EC)) for management purposes. However, genetic studies have found no evidence of separate stocks over these two regions (including Rockall) and particle-tracking studies have indicated interchange of larvae between the two areas (Hislop *et al*., 2001). So, at previous WGs, assessments have been made for the whole Northern Shelf area combined. In fact, both microsatellite DNA analysis (O'Sullivan *et al*., 2005) and particle tracking studies carried out as part of EC 98/096 (Anon, 2001) also suggested that anglerfish from further south (Subarea 7) could also be part of the same stock.

At present, the stock is assessed for the two anglerfish species *L. piscatorius* and *L. budegassa* combined despite differing life-history characteristics and overlap in spatial distribution. This has been the case due to the black anglerfish (*L. Budegassa*) proportionally representing only around 10% of the estimated stock biomass from the SIAMISS-Q2 survey and that the Scottish fleet land the two species for sale combined as "monkfish". Given that the proportion of black anglerfish has been as high as 28% in Division 6.a and that the Scottish market sampling programme records to species level, a splitting out of black anglerfish in this stock may be a consideration for a future benchmark.

2.9 Recommendations for next Benchmark

This stock was last benchmarked in February 2024 at WKBFLATFISH (ICES, 2024). The following suggestions for further work or improvements were made.

- More information on the biology of the stock will be valuable for future improvements to the model. This includes: the definition of the stock area (tagging, genetics); availability of anglerfish of various sizes to the commercial fleet and survey; maturation patterns, including further histological analysis, and possible increased mortality associated with high investment in reproduction (high GSI).
- There is scope to further explore size selection patterns combined with growth parameters to improve the fit of the model.

- The inclusion of two species in the same assessment as well as two sexes with different growth and maturity is not ideal and future assessments may be improved by splitting the species and including sex-specific biology in the model.
- Given the seasonal migration patterns relating to the spawning season, the assumption of a single catchability for both IBTS surveys may be violated for older ages. Moving to a seasonally-resolved model may help resolve this discrepancy.
- The SIAMISS survey data could be improved by providing length distributions in 2005-2006 and apply selectivity correction for all the data years (as suggested in the respective working document). A check of the catch estimations for historical years that haven't been raised in Intercatch to ensure estimation process is consistent through time.

2.10 Management considerations

The two TACs in this area do not match the stock unit. One TAC area covers Subarea 4 and Division 2.a (EC); the second covers Division 5.b (EC) and subareas 6, 12, and 14. There is no TAC for Division 3.a and landings from this area have increased significantly in recent years. As a result of this mismatch, there is a potential for catches to exceed advice. There is no TAC for the Norwegian fishery in Subarea 4.

The TACs in subareas 4 (including Norwegian waters) and 6 until 2010 were split 67:33%, since 2011 they have been split 64:36%. In 2018, 10% of the TAC for 4 and 2.a could be taken from Division 5.b, or subareas 6, 7 and 9. Over the survey time-series, the stock has been fairly evenly distributed between 4:6, the split has fluctuated around 50:50 (47% on average). Note that the North Sea is only partially surveyed: however, the area covered does encompass most of the distribution of anglerfish.

2.11 References

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2.12 Tables

Table 2.1. ICES advice and actual management applicable for Northern Shelf anglerfish for 2003 onwards.

YEAR	Catch corresponding to advice	BASIS	WEST OF SCOTLAND (Sub-area 6)		NORTH SEA (Subarea 4)	
			TAC[4)]	WGCSE landings	TAC[5)]	WGCSE landings
2003	<6700[1)^]	Reduce F below F_{pa}	3180	3068	7000	8714
2004	<8800[2)^]	Reduce F below F_{pa} [2)]	3180	3130	7000	8532
2005	-	No effort increase[2)]	4686	3747	10314	9696
2006	-	No effort increase[2)]	4686	3491	10314	9564
2007	-	No effort increase[2)]	5155	4476	11345	9823
2008	-	No effort increase[3)]	5155	4847	11345	10732
2009	-	No effort increase[3)]	5567	5192	11345	9781
2010	-	No effort increase[3)]	5567	3912	11345	7900
2011	-	Decrease effort	5456	4693	9643	7920
2012	-	Reduce catches	5183	4372	9161	6412
2013	-	Decrease catches by 20%[2)]	4924	4727	8703	6306
2014	10231	Decrease catches by 20%[2)]	4432	5880	7833	8165
2015	14702	Increase landings by 20%[2)]	5313	5008[(7)]	9390	10243
2016	≤ 18435	Increase recent advised catch by no more than 20%[2)]	6375	5966	11267	12854
2017	≤ 22007	Precautionary approach	7650	6460	13521	14508
2018	≤ 26408	Precautionary approach	9180	6356	16225	14280
2019	≤ 31690	Precautionary approach	11453	7912	20237	12674
2020	≤ 22056	Precautionary approach	7971	6601	14085	11582
2021	≤ 17645	Precautionary approach	6377	6032	11972	13168
2022	≤ 14116	Precautionary approach	5102	5091	9014	11521
2023	≤ 9881	MSY approach	4082	3620	7211	11340
2024	≤ 9881	MSY approach	4082		7211	

All values raised to nearest tonne.

^ Landings advice

[1)] Advice for Division 3.a, Subarea 4 and Subarea 6.a combined.

[2)] Advice for Division 3.a, Subarea 4 and Subarea 6 combined.

[3)] Advice for Division 2.a, Division 3.a, Subarea 4 and Subarea 6 combined.

[4)] pplies to 5.b(EC), 6, 7 and 14.

[5)] TAC applies to 2.a & 4 (EC).

[(7)]Landings including raised discards.

Table 2.2. Anglerfish on the Northern Shelf (3.a, 4 & 6). Total official landings by area (tonnes).

	3.a	4.a	4.b	4.c	6.a	6.b	4	6	Total (3a, 4, and 6)	Landings from NEAFC area**	ICES Land-ings***	ICES Discards
1973	140	2085	575	41	9221	127	2701	9348	12189		-	-
1974	202	2737	1171	39	3217	435	3947	3652	7801		-	-
1975	291	2887	1864	59	3122	76	4810	3198	8299		-	-
1976	641	3624	1252	49	3383	72	4925	3455	9021		-	-
1977	643	3264	1278	54	3457	78	4596	3535	8774		-	-
1978	509	3111	1260	72	3117	103	4443	3220	8172		-	-
1979	687	2972	1578	112	2745	29	4662	2774	8123		-	-
1980	652	3450	1374	175	2634	200	4999	2834	8485		-	-
1981	549	2472	752	132	1387	331	3356	1718	5623		-	-
1982	529	2214	654	99	3154	454	2967	3608	7104		-	-
1983	506	2465	1540	181	3417	433	4186	3850	8542		-	-
1984	568	3874	1803	188	3935	707	5865	4642	11075		-	-
1985	578	4569	1798	77	4043	1013	6444	5056	12078		-	-
1986	524	5594	1762	47	3090	1326	7403	4416	12343		-	-
1987	589	7705	1768	66	3955	1294	9539	5249	15377		-	-
1988	347	7737	2061	95	6003	1730	9893	7733	17973		-	-
1989	334	7868	2121	86	5729	313	10075	6042	16451		-	-
1990	570	8387	2177	34	5615	822	10598	6437	17605		-	-
1991	595	9235	2522	26	5061	923	11790	5984	18369		17441	-
1992	938	10209	3053	39	5479	1089	13301	6568	20807		21872	-
1993	843	12309	3143	66	5553	681	15519	6234	22596		23971	-
1994	811	14505	3445	210	5273	909	18162	6182	25155		25057	-
1995	823	17891	2627	402	6354	958	20920	7312	29055		28913	-

	3.a	4.a	4.b	4.c	6.a	6.b	4	6	Total (3a, 4, and 6)	Landings from NEAFC area**	ICES Land-ings***	ICES Discards
1996	702	25176	1847	304	6408	602	27327	7010	35039		35100	-
1997	776	23425	2172	160	5330	990	25757	6320	32853		32728	-
1998	626	16859	2088	78	4506	1313	19026	5819	25471		25293	-
1999	660	13344	1517	24	4284	1401	14885	5685	21230		21854	-
2000	602	12338	1617	31	3311	1074	13986	4385	18973		19682	-
2001	621	12861	1832	21	2660	1309	14714	3969	19304		19157	-
2002	667	11048	1244	21	2280	718	12313	2998	15978		15067	-
2003	478	8523	847	20	2493	643	9390	3136	13004		12008	-
2004	519	8987	851	15	2453	671	9853	3124	13496		11976	-
2005	458	8424	688	5	3019	958	9117	3982	13557		13728	-
2006	426	10340	683	3	2785	915	11026	3700	15152		13292	-
2007	433	10632	749	4	3353	1261	11384	4613	16430		14564	490
2008	486	11038	769	5	3373	1246	11813	4619	16918		15878	903
2009	478	10067	651	8	2984	1820	10726	4804	16008		15372	38
2010	433	8190	615	11	3040	1606	8815	4645	13895		12136	69
2011	405	7760	764	8	2871	1871	8532	4742	13679		12902	95
2012	423	6459	714	4	2835	1831	7177	4666	12266		11143	590
2013	407	6393	546	5	2667	2123	6944	4790	12141		11375	687
2014	440	7633	820	27	2610	1754	8481	4365	13286		14406	448
2015	478	9690	985	16	3290	1723	10691	5013	16182		15663	395
2016	586	11680	1196	11	4638	1423	12887	6060	19533		19412	981
2017	742	13620	1107	7	5024	1504	14733	6528	22023		21719	756
2018	914	13438	823	11	4369	1932	14274	6303	21487		21572	326
2019	1029	11155	1303	28	5030	2647	12486	7677	21192		21-	513
2020	886	10674	1066	24	4749	1685	11763	6434	19064		19 072	316
2021	912	11959	1184	19	4455	1537	13162	5992	20066		20143	249
2022*	1259	10237	1256	10	3545	1458	11503	5003	17765	164	17916	323
2023*	1165	9917	1275	7	2569	1100	11199	3669	16033	95	16157	234

*Preliminary.

**Calculated using both official landings and ICES estimates.

*** Revised values to include Division 3.a official landings when ICES estimates are not available (ICES, 2022b).

Table 2.3. Anglerfish in Subarea 6 (West of Scotland and Rockall). Nominal landings (t) as officially reported to ICES.

Year	Belgium	Denmark	Faroe Is.	France	Germany	Ireland	Netherlands	Norway	Portugal	Russia	Spain	UK (E,W,&NI)	UK (Scotland)	UK (total)	Total	Unallocated	ICES landings
1991	3	1	-	1910	1	522	-	24	-	-	340	369	2 814		5 984	296	6 280
1992	2	3	2	2308	2	820	-	24	-	-	274	524	2 609		6 568	2 638	9 206
1993	9	4	-	2496	163	524	-	25	-	-	186	299	2 528		6 234	3 816	10 050
1994	6	5	-	2382	140	438	-	30	132	-	215	420	2 414		6 182	2 634	8 816
1995	5	10	-	2648	160	853	-	18	128	-	333	425	2 732		7 312	4 984	12 296
1996	-	4	15	2899	113	807	-	15	-	-	229	345	2 583		7 010	11 148	18 158
1997	5	1	4	2059	249	764	27	5	91	-	234	403	2 478		6 320	7 415	13 735
1998	2	2	2	1635	269	879	1	9	413	-	338	307	1 962		5 819	4 821	10 640
1999	-	1	2	1814	194	692	-	6	429	-	344	171	2 032		5 685	3 790	9 475
2000	-	<1	-	1180	158	596	-	14	20	-	231	316	1 870		4 385	3 131	7 516
2001	<1	<1	1	1135	78	609	-	7	18	1	397	237	1 486		3 969	1 890	5 859
2002	<1	-	-	782	38	355	-	4	8	-	229	165	1 417		2 998	−22	2 976
2003	-	<1	-	1403	91	348	-	6	4	-	255	164	865		3 136	−68	3 068
2004	<1	<1	2	1366	105	232	-	5	19	2	153	84	1 156		3 124	6	3 130
2005	-	-	2	1689	116	391	-	5	63	4	117	113	1 482		3 982	−235	3 747
2006	-	-	3	1537	73	445	-	7	-	1	112	70	1 451		3 700	−209	3 491
2007	-	-	2	2090	222	540	-	8	-	1	15	188	1 546		4 613	−137	4 476
2008	-	-	2	2073	146	371	-	7	-	35	259	6	1 720		4 619	228	4 847
2009	-	-	6	1852	211	419	-	9	-	-	242	60	2 005		4 804	388	5 192
2010	-	-	12	1374	166	617	-	14	-	-	229	-	-	2234	4 645	−733	3 912
2011	-	-	1	1676	149	596	-	7	-	-	167	-	-	2145	4 742	−49	4 693
2012	-	-	5	1622	142	581	-	6	-	-	105	132	2 073	2205	4 666	−294	4 372
2013	-	-	-	1777	136	572	-	10	-	-	123	401	1 770	2171	4 790	−63	4 727
2014	-	-	1	1246	151	572	-	4	-	1	81			2310	4 365	1 515	5 880
2015	-	-	<1	1326	201	602	-	8	-	2	149			2724	5 013	−5	5 008
2016	-	-	1	1734	258	741	-	12	-	-	234			3080	6 060	−94	5 966
2017	-	-	<1	1882	246	793	-	5		2	290			3310	6 528	−68	6 460
2018	-	-	-	1287	394	878	-	4	-	-	261			3387	6 211	145	6 356
2019	-	-	-	1293	434	1262	-	2	-	1	358			4322	7 652	160	7 812
2020	-	-	-	1304	229	900	-	1	-	3	264			3731	6 432	169	6 601
2021	-	1	-	1326	157	684	-	-	-	-	282			3539	5 992	40	6 032
2022*	-		3	1011	146	576	-	-	-	-	114			3153	5003	88	5091
2023*			1	570	84	575		6			160			2274	3669	-49	3620

***Preliminary.**

Table 2.4. Nominal landings (t) of Anglerfish in the North Sea, as officially reported to ICES.

Year	Belgium	Denmark	Faroes	France	Germany	Ireland	Netherlands	Norway	Sweden	UK (E,W,&NI)	UK (Scotland)	UK (Total)	Total	Unallocated	ICES landings
1991	372	1 599	1	124	75	-	313	604	14	804	7 884	-	11 790	−1 224	10 566

1992	559	1 686	-	152	70	-	410	639	7	1 158	8 620	-	13 301	−1 573	11 728
1993	595	1 293	12	69	113	-	559	1 227	7	1 463	10 181	-	15 519	−2 441	13 078
1994	753	1 509	18	30	99	-	568	1 329	10	1 582	12 264	-	18 162	−2 732	15 430
1995	607	1 027	20	18	623	-	363	672	4	1 456	16 130	-	20 920	−5 126	15 794
1996	323	1 464	-	7	301	-	201	850	2	1 357	22 822	-	27 327	−11 087	16 240
1997	357	1 489	15	7	619	-	260	678	5	2 969	19 358	-	25 757	−7 540	18 217
1998	389	1 456	10	13	892	-	238	967	11	1 307	13 743	-	19 026	−4 999	14 027
1999	286	1 496	6	18	463	-	166	1 236	12	1 148	10 054	-	14 885	−3 166	11 719
2000	476	1 347	-	8	196	-	168	1 191	81	642	9 877	-	13 986	−2 422	11 564
2001	594	1 540	2	9	104	-	132	1 227	46	658	10 402	-	14 714	−2 037	12 677
2002	459	1 563	10	8	112	-	75	938	65	334	8 749	-	12 313	−600	11 713
2003	190	1 714	3	8	76	1	52	781	10	281	6 274	-	9 390	−676	8 714
2004	265	1 812	11	8	31	-	63	1 021	7	206	6 429	-	9 853	−1 330	8 523
2005	211	1 616	22	4	93	-	45	896	9	130	6 091	-	9 117	579	9 696
2006	141	1 587	2	7	187	-	47	1 018	10	207	7 820	-	11 026	−1 462	9 564
2007	181	1 134	-	14	198	-	76	855	26	425	8 476	-	11 384	−1 561	9 823
2008	185	1 308	-	13	367	-	71	875	76	118	8 800	-	11 813	−1 081	10 732
2009	140	1 382	4	23	233	-	41	881	-	406	7 617	-	10 726	−945	9 781
2010	131	1 337	-	30	145	-	56	802	-	460	5 855	-	8 815	−915	7 900
2011	116	1 127	-	24	63	-	59	505	-	-	-	6 638	8 532	−612	7 920
2012	133	1 122	-	15	275	-	67	496	-	333	4 736	5 069	7 177	−765	6 412
2013	137	1 046	-	15	284	-	42	572	-	621	4 226	4 847	6 944	−638	6 306
2014	217	1 135	-	30	339	-	108	533	-	-	-	6 120	8 481	−316	8 165
2015	200	1 331	-	26	309	-	98	415	10	-	-	8 303	10 691	−448	10 243
2016	253	2 090	-	36	226	-	148	626	11	-	-	9 498	12 887	−33	12 854
2017	169	2 567	-	91	537	-	199	881	18	-	-	10 270	14 733	−225	14 508
2018	156	2 201	-	142	536	-	187	1 267	25	-	-	9 711	14 225	55	14 280
2019	249	2 202	-	186	574	-	405	1 289	36	-	-	7 545	12 486	176	12 662
2020	243	1 398	-	127	361	-	285	997	72	-	-	8 282	11 765	−181	11 582
2021	290	1462	-	108	228	-	376	982	112	-	-	9 604	13 162	6	13 168
2022*	225	1178	<1	73	252	2	283	858	173	-	-	8457	11503	18	11521
2023*	217	1098		109	110		119	1266	350	-	-	7930	11199	141	11340

*Preliminary.

Table 2.5. Nominal landings (t) of Anglerfish in Division 3.a, as officially reported to ICES.

Year	Belgium	Denmark	France	Germany	Netherlands	Norway	Sweden	UK (Total)	Total	Unallocated	ICES landings
1991	15	493	-	-	-	64	23	-	595	-	-
1992	48	658	-	-	-	170	62	-	938	-	-
1993	34	565	-	1	-	154	89	-	843	-	-
1994	21	459	-	<1	-	263	68	-	811	-	-
1995	35	312	-	-	-	440	36	-	823	-	-
1996	-	367	-	1	-	309	25	-	702	-	-
1997	-	550	-	1	-	186	39	-	776	-	-
1998	-	415	-	1	-	177	33	-	626	-	-
1999	-	362	-	2	-	260	36	-	660	-	-
2000	-	377	-	1	-	197	27	-	602	-	-
2001	-	375	-	-	-	200	46	-	621	-	-
2002	-	369	-	1	-	242	55	-	667	288	379
2003	-	215	-	-	3	189	71	-	478	252	226
2004	-	311	-	1	4	130	73	-	519	197	322
2005	-	274	-	1	4	100	79	-	458	174	284
2006	-	227	-	2	3	139	54	-	426	189	237
2007	-	255	-	1	1	132	44	-	433	168	265

2008	-	287	-	1	3	144	51	-	486	187	299
2009	-	344	-	1	-	134	-	-	478	79	399
2010	-	270	-	1	5	158	-	-	433	109	324
2011	-	251	-	2	-	153	-	-	405	116	289
2012	-	307	<1	1	-	115	-	-	423	63	360
2013	-	298	<1	1	-	108	-	-	407	65	342
2014	-	309	-	-	4	127	-	-	440	78	362
2015	-	336	-	1	9	90	42	-	478	66	412
2016	-	389	<1	2	17	124	53	<1	586	−5	591
2017	-	526	1	1	16	118	81	-	742	−9	751
2018	-	597	-	2	16	204	95	-	914	−22	936
2019	-	692	-	1	46	189	100	-	1028	−35	1 063
2020	-	600	-	1	66	129	71	0	866	−22	888
2021	-	678	-	1	46	116	71	-	912	−30	942
2022*		953	-	<1	58	157	90	-	1259	44	1303
2023*	-	857	<1	2	17	179	109	-	1165	32	1197

*Preliminary.

Table 2.6. Total biomass estimates with confidence intervals and relative standard errors from the 2005–2021 SIAMISS-Q2 surveys.

Year	Number of hauls	Number meas-ured	Biomass (t)	Confidence Interval		RSE	Percentage Biomass in subarea 4
2005			38.617	23.479	53.755	20.0	48.27%
2006			40.985	34.478	47.492	8.1	53.49%
2007	156	1569	50.392	43.676	57.108	6.8	56.62%
2008	167	2219	53.546	42.421	64.671	10.6	55.51%
2009	206	1643	38.060	32.987	43.133	6.8	44.82%
2010	168	1280	42.279	30.429	54.129	14.3	51.90%
2011	153	1037	33.254	24.846	41.662	12.9	44.96%
2012	169	1461	36.325	29.704	42.946	9.3	41.59%
2013	93	984	38.395	31.020	45.770	9.8	37.04%
2014	106	1568	52.884	42.769	62.999	5.2	40.25%
2015	117	2198	67.915	58.782	77.047	6.9	43.66%
2016	108	2025	77.946	66.831	89.060	7.275	56.39%
2017	153	3265	87.896	74.222	101.569	7.937	53.47%
2018	142	2714	77.661	66.258	89.064	7.491	37.80%
2019	128	1860	58.575	46.189	70.962	10.789	40.49%
2021	137	1524	48.355	37.233	59.476	11.734	46.71%
2022	65	687	55.423	40.068	70.779	14.136	54.58%
2023	168	2131	49.884	41.639	58.128	8.432	47.08%

Table 2.8. Abundance and biomass estimates from the 2005–2021 SIAMISS-Q2 surveys by ICES subareas and divisions.

Year	Month	Numbers (millions)	Biomass (kt)

		IVa	VIa	VIb	VI	Total	IVa	VIa	VIb	VI	Total
2005	November	11.168	10.866	1.800	12.666	23.834	18.642	14.096	5.879	19.975	38.617
200	Novem-	12.84	10.45	3.174	13.633	26.477	21.92	12.17	6.889	19.064	40.985
200	Novem-	15.30	7.956	4.000	11.956	27.26	28.53	11.07	10.786	21.858	50.392
200	April	12.61	7.718	3.952	11.67	24.283	29.72	14.38	9.442	23.825	53.546
200	April	8.279	5.144	3.688	8.832	17.111	17.05	8.150	12.852	21.002	38.060
201	April	7.366	5.161	3.131	8.292	15.658	21.94	11.59	8.745	20.335	42.279
201	April	5.150	6.057	3.669	9.726	14.876	14.94	9.330	8.974	18.304	33.253
201	Abril	5.432	4.961	5.135	10.096	15.528	15.10	9.213	12.005	21.218	36.325
201	October	8.470	8.461	4.885	13.346	21.816	14.36	10.80	13.626	24.427	38.796
201	April	17.55	16.09	6.488	22.584	40.136	21.28	16.63	14.967	31.60	52.884
201	April	18.26	28.60	5.496	34.100	52.366	29.65	24.04	14.215	38.262	67.915
201	April	21.64	14.38	4.538	18.922	40.569	43.95	18.27	15.717	33.99	77.946
201	April	23.69	16.33	4.360	20.683	44.374	46.99	29.29	11.604	40.901	87.896
201	April	11.81	13.52	6.240	19.768	31.586	29.35	22.35	25.958	48.308	77.661
201	April/May	14.60	21.03	3.592	24.624	39.231	23.71	18.86	15.992	34.856	58.575
202	April	17.37	8.608	3.048	11.656	29.027	22.58	12.74	13.027	25.767	48.355
202	April	13.25	10.28	*3.04	**13.33	**26.59	30.25	12.14	*13.02	**25.17	**55.42
202	April/May	9.917	9.960	3.205	13.165	23.082	23.48	12.83	13.566	26.400	49.884

***Value carried over from 2021 due to missing survey data in division 6b in 2022**

****Total includes value carried over from 2021 due to missing survey data in division 6b in 2022**

Table 2.8. IBTS abundance indices in Q1 and Q3 & Q4. The numbers are standardised to catch-rate per hour.

Year	Effort	NS-WC-IBTS-Q1					NS-WC-IBTS-Q3Q4				
	(hours)	Size class					Size class				
		(0, 15]	(15, 46]	(46, 66]	(66, 140]	All sizes	(0, 15]	(15, 46]	(46, 66]	(66, 140]	All sizes
1983	1	0.0122	0.323	0.3471	0.1036	0.7237	0.2786	0.5315	0.5692	0.1304	1.5413
1984	1	0.03	0.3637	0.2937	0.0851	0.7623	0.6364	1.0456	0.7618	0.1794	2.508
1985	1	0.0166	0.3256	0.4606	0.0943	0.8879	0.1838	1.0666	0.7405	0.1645	2.2806
1986	1	0.0172	0.2416	0.3784	0.1395	0.7009	0.4017	1.1055	1.0423	0.1086	2.435
1987	1	0.0115	0.2484	0.3651	0.1303	0.7109	0.1964	0.8133	0.8118	0.0685	1.8293
1988	1	0.0286	0.4042	0.3647	0.1024	0.8463	0.3201	0.6926	0.8148	0.0927	1.8247
1989	1	0.0149	0.598	0.5247	0.1498	1.2684	0.1844	0.6884	0.7114	0.1079	1.6636
1990	1	0.0145	0.634	0.6767	0.1923	1.3982	0.1818	0.7318	0.7161	0.1534	1.7827
1991	1	0.0195	0.5894	0.4645	0.084	1.0885	0.1456	0.9814	0.5643	0.0842	1.7618

1992	1	0.0539	0.8534	0.5568	0.0988	1.5461	0.2194	0.8224	0.5541	0.1171	1.6381
1993	1	0.0724	1.2888	0.7841	0.1634	2.1285	0.214	1.0218	0.6461	0.0959	1.9762
1994	1	0.0849	0.9643	0.5592	0.0333	1.5236	0.871	1.3106	0.6626	0.1637	2.8128
1995	1	0.0228	1.1706	0.5921	0.1418	1.7526	0.2636	1.7842	0.707	0.1151	2.8473
1996	1	0.0766	1.0144	0.6258	0.1166	1.6176	0.3048	1.266	1.121	0.1285	2.6967
1997	1	0.1375	0.7448	0.7342	0.0834	1.5252	0.1205	0.8573	0.7624	0.0748	1.8067
1998	1	0.0417	0.5796	0.4609	0.1386	1.1369	0.0427	1.1537	0.9628	0.1048	2.2653
1999	1	0.1186	0.8213	0.4997	0.1415	1.4072	0.0756	1.023	0.7383	0.146	1.8975
2000	1	0.0517	1.2869	0.3703	0.0961	1.7557	0.1284	0.6853	0.8345	0.1403	1.7314
2001	1	0.1225	0.8537	0.4099	0.0804	1.333	0.0808	0.4525	0.6266	0.199	1.2838
2002	1	0.2189	0.9439	0.6635	0.0474	1.6687	0.0403	0.8429	0.7508	0.1231	1.8138
2003	1	0.1427	1.2573	0.3982	0.0986	1.8584	0.0751	0.7151	0.7736	0.1657	1.8316
2004	1	0.025	1.0699	0.6601	0.0863	1.739	0.2593	0.9415	0.7392	0.3613	2.1924
2005	1	0.1876	0.563	0.568	0.0417	1.1761	0.4642	1.0737	0.6025	0.2127	2.0137
2006	1	0.1252	0.6743	0.4333	0.0935	1.1755	0.5787	1.8143	0.7357	0.2498	3.0708
2007	1	0.0631	0.7125	0.4598	0.0882	1.2592	0.1684	2.1808	1.176	0.2345	3.4596
2008	1	0.0856	0.7243	0.4854	0.1409	1.3758	0.4059	2.0049	1.6277	0.3048	4.0082
2009	1	0.0484	0.4316	0.501	0.1021	1.0985	0.484	1.6823	1.2756	0.3417	3.492
2010	1	0.0278	0.4566	0.4003	0.1504	1.0887	0.5359	1.3676	0.8804	0.3939	2.9262
2011	1	0.1241	0.4412	0.3832	0.1265	1.0985	0.2943	1.9407	0.6718	0.2872	3.0076
2012	1	0.1782	0.6959	0.4202	0.143	1.3936	0.4376	2.0401	0.785	0.2566	3.1651
2013	1	0.2483	0.5187	0.3006	0.1202	1.1139	0.5675	1.8635	0.9383	0.1803	3.0368
2014	1	0.5202	1.177	0.4624	0.2097	2.1355	0.6479	1.9103	1.0047	0.2718	3.342
2015	1	0.1705	1.6432	0.5458	0.1376	2.3288	0.6997	1.4172	0.9874	0.3332	2.9619
2016	1	0.4074	1.272	0.7809	0.1489	2.2938	0.2786	0.5315	0.5692	0.1304	1.5413
2017	1	0.0165	1.4057	0.9603	0.2206	2.5856	0.6364	1.0456	0.7618	0.1794	2.508
2018	1	0.1366	0.8845	0.653	0.1997	1.8572	0.1838	1.0666	0.7405	0.1645	2.2806
2019	1	0.1979	1.2749	0.5745	0.2249	2.1207	0.4017	1.1055	1.0423	0.1086	2.435
2020	1	0.0939	1.297	0.4744	0.1311	1.8623	0.1964	0.8133	0.8118	0.0685	1.8293
2021	1	0.2048	1.2197	0.5773	0.1162	1.885	0.3201	0.6926	0.8148	0.0927	1.8247
2022	1	0.1814	1.2246	0.7746	0.1377	2.061	0.1844	0.6884	0.7114	0.1079	1.6636
2023	1	0.1233	1.3026	0.6449	0.1923	2.1086	0.1818	0.7318	0.7161	0.1534	1.7827

Table 2.9. A summary of SS3 input data and biological parameters

Input	Data years	description

Landings Discards	1949-2023 2007-2023	Annual, in biomass
Landings LFDs in 2cm bins Discard LFDs in 2cm bins Number of Sampled trips	1993-2023 2007-2023	Annual, in numbers
IBTS Q1, IBTS Q3 + Q4 indices with 4 size classes Number of sampled hauls	1983-2023 1991-2023	Month 2 Month 9, in numbers cm length bins: 0-15, 15-46, 46-66, 66-140cm
SIAMISS index, LFDs, 2 cm bins Number of sampled hauls	2005-2023 (excl 2020) 2007-2023 (excl 2020)	in biomass, Month 11 or 4 (not covered 3.a, 4.b, 4.c)
Natural mortality	Lorenzen/Thorson constant in time	age-specific values
Growth	Linear min age=1 at 11.2 cm von Bertalanffy: Linf=209.8 cm, k=0.06 constant in time	estimated from SIAMISS data (2005-2022 , excl 2016, 2020), combined sexes, both species
Length Weight relationship	Allometric (log estimated) a=0.034 b=2.79 constant in time	estimated from SIAMISS data (2005-2022 combined sexes, both species
Maturity	Length logistic ogive, L50= 94.9695 Slope= -0.0958 constant in time	estimated from SIAMISS data (spring survey 2006-2022), females only, both species, stage 2 set as immature

Table 2.10. Anglerfish in 3a, 4 and 6. SS3 model configuration file summaries.

Starter file

- **SSversion**: 3.30.22.1
- **Use initial parameter values**: 0 in control file
- **Turn off estimation after phase:** 10
- **Final convergence criteria:** 0.0001 (default)
- **Min age for sum biomass**: 0
- **Depletion basis**: 2 (relative to X*SBMSY)
- **Fraction X**: 1 (for depletion denominator above equation)

- **SPR_report_basis**: 2 ((1-SPR)/(1-SPR_MSY)) ; SSB per recruit
- **F_report_units:** 5 (=unweighted mean F for range of ages, ICES default)
- **F_age_range:** 5-10. Age 10 was chosen as older ages are exceedingly rare.
- **F_report_basis**: 0

Data file

- **styr:** 1949 (first year with data)
- **endyr:** 2023
- **nseas:** 1
- **Months/season:** 12. Months in each season (rescaled to 1, months are fraction, see survey timing)
- **Nsubseasons**: 4
- **Spawn_seas**: 1, SSB calculated at the beginning of this season
- **Spawn_month**: 1
- **Ngenders:** 1
- **Nages:** 30
- **N_areas:** 1
- **Nfleets:** 4
    - Catches (only landings prior to 2007), unit biomass, no catch multiplier, error lognormal 0.1 (0.3 prior to 1991) catches before the start of the time-series (1448 t, average 1939-1948)
    - Surveys: SIAMISS (unit biomass), IBTS Q1, IBTS Q3+Q4 (unit numbers), no multiplier, error lognormal
- **Fleets_with_discards**: error is lognormal 0.4, unit in biomass
- **Length bins for the population and data**
    - 2cm bins from 1 to 119, then 121, 122, 125, 195 cm (64 bins, listed lower bounds);
- **Length composition data structure**
    - 2cm bins 5 to 119 cm (58 bins, listed lower bounds)
    - **Compressed bins**: Landings 20, discards 6, SIAMISS 6
    - **Comp_error**: 1 (Dirichlet)
    - **Min sample size**: 0.1
- **N size frequ method**: 1 (generalized length distributions, 4 size groups (lower bounds: 1, 15, 46, 66cm)), IBTS Q1, IBTS Q3+Q4, units in numbers

Control file

- **N_Growth_Pattern:** 1
- **N_Platoon_Within_GrowthPattern**: 1
- **Recr_dist_method**: 4 (none)
- **Number of recruitment settlement events**: 1
- **Growth pattern**: 1, month 1, area 1, age 0
- **Nblock_Patterns:** 0
- **Time-vary parm bound check**: 1
- **Autogen**: 1 1 1 1 1 (read each time-varying parm line)
- **Blocks_per_pattern**: 1
- **natM_type:** 3 (M at age)
- **GrowthModel**: 1 (von Bertalanffy with L1, L2)
- **Growth_Age_for_L1**: 1
- **Growth_Age_for_L2:** 999 (999 to use as Linf)
- **Exponential decay above maxage**: -998 (to not allow growth above maxage)
- **maturity_option:** 1 (length logistic)

- **SD_add_to_LAA**: 0 (recommended)
- **CV_Growth_Pattern**: 0 (CV=f(LAA))
- **Maturity option**: 1 (length logistic)
- **First_Mature_Age:** 1
- **fecundity_option:** 1 (weight dependent, Wt*(a+b*Wt))
- **parameter offset approach**: 1 (none)
- **growth_params:** All biology parameters are based on life-history information compiled
    - L_at_Amin_Fem_GP_1 11.2 (fixed)
    - L_at_Amax_Fem_GP_1 209.8 (fixed)
    - VonBert_K_Fem_GP_1 0.06 (fixed)
    - CV_young_Fem_GP_1 0.2 (fixed)
    - CV_old_Fem_GP_1 0.1 (fixed)
    - Wtlen_1_Fem_GP_1 3.4e-05 (fixed)
    - Wtlen_2_Fem_GP_1 2.79 (fixed)
    - Mat50%_Fem_GP_1 94.9695 (fixed)
    - Mat_slope_Fem_GP_1 -0.0958 (fixed)
    - Eggs/kg_alpha_inter_Fem_GP_1 1 (fixed)
    - Eggs/kg_beta_Fem_GP_1 0 (fixed)
    - Cohort growth dev: 1 (fixed)
    - Frac female: 0.5 (fixed)
- **SR_function:** 3 (std Beverton-holt)
- **Use steepness for initial equ rec**: 1
- **SR_params:** all fixed except R0
    - SR_LN(R0) 13 (estimated in phase 1)
    - SR_BH_steep 0.85 (fixed)
    - SR_sigmaR 0.8 (fixed)
    - SR_regime 0 (fixed)
    - SR_autocorr 0.067 (fixed)
- **do_recdev:** 1 (deviations (R=F(SSB)+dev))
- **MainRdevYrFirst:** 1993 (first year landings LFDs)
- **MainRdevYrLast:** 2023 (last year with data)
- **Recdev_phase:** 3
- **Recdev_early_phase**: 4 (set late phase if not much early data)
- **Recdev_early start**: -12 (choose less than main recdev start, for non equilib distribution)
- **last_early_yr_nobias_adj:** 1948
- **first_yr_fullbias_adj:** 1993
- **last_yr_fullbias_adj:** 2023
- **first_recent_yr_nobias_adj:** 2024
- **max_bias_adj:** 0.9669
- **period of cycles**: 0
- **min rec_dev** -5 (default)
- **max rec_dev** 5 (default)
- **F ball park:** 0.1
- **F ballpark year** : 1950
- **F_Method:** 4
- **Max F**: 3.5
- **N iterations to tune F**: 5
- **Init_F**: 0.02 (estimated in phase 1)
- **Q_options** (set up for CPUE or survey data): link=1, parm_nobiasadj; extra se; float
- **Q_params**: 0.01 (fixed), extra SD 0.15 (fixed)
- **size_selex_types:**

  - **Fleet 1:** Pattern 24 (double normal); discards (with defined retention)
  - **Fleet 2:** Pattern 27 (cubic spline, 4 knots), **Fleet** 3: Pattern 24 (double normal), **Fleet 4:** mirrored (Fleet 3)
- **age_selex_types:** Pattern 0
- **size_selex_para**:
  - SizeSel_P 1 Fleet 1: phase 2, init 10, use_dev 23, min_max 1993-2023
  - SizeSel_P 2 Fleet 1: -15 (fixed)
  - SizeSel_P 3 Fleet 1: phase 4, init 3
  - SizeSel_P 4 Fleet 1: phase 4, init 6.1056700
  - SizeSel_P 5 Fleet 1: phase 4, init -3
  - SizeSel_P 6 Fleet 1: phase 4, init 0

  - Retention_inflection: phase 2, init 30, use_dev 23, min_max 2007-2023
  - Retention_slope: phase 4, init 5
  - Retention_asymptote: 999 (fixed)
  - Retention male offset: 0 (fixed)

  - SizeSel_P_1_SIAMISS(2): 0 (fixed)
  - SizeSel_P_2_SIAMISS(2): 1e30 (fixed)
  - SizeSel_P_3_SIAMISS(2): 1e30 (fixed)
  - SizeSel_P_4_SIAMISS(2): 13.855 (fixed)
  - SizeSel_P_5_SIAMISS(2): 22.1028 (fixed)
  - SizeSel_P_6_SIAMISS(2): 33.8809 (fixed)
  - SizeSel_P_7_SIAMISS(2): 45.3015 (fixed)
  - SizeSel_P_8_SIAMISS(2): 57.3703 (fixed)
  - SizeSel_P_9_SIAMISS(2): 83.9361 (fixed)
  - SizeSel_P1_1_SIAMISS(2): phase 2, init 2.62239
  - SizeSel_P1_2_SIAMISS(2): phase 2, init 5.3307
  - SizeSel_P1_3_SIAMISS(2): -1 (fixed)
  - SizeSel_P1_4_SIAMISS(2): phase 2, init 5.7068
  - SizeSel_P1_5_SIAMISS(2): phase 2, init 6.09623
  - SizeSel_P1_6_SIAMISS(2): phase 2, init 5.29824

  - SizeSel_P_1_IBTSQ1(3): phase 2, init 46.5348
  - SizeSel_P_2_IBTSQ1(3): -15 (fixed)
  - SizeSel_P_3_IBTSQ1(3): phase 4, init 5.1943300
  - SizeSel_P_4_IBTSQ1(3): phase 4, init 6.66304
  - SizeSel_P_5_IBTSQ1(3): phase 4, init -3.14567
  - SizeSel_P_6_IBTSQ1(3): phase 4, init -3.24577

- **Dirichlet parameters**:
  P1: 0.5 (fixed)
  P2: 0.5 (fixed)
  P3: phase 5, init 0.5
  P4: phase 5, init 0.5
  P5: phase 5, init 0.5

- **timevary selex parameters**:
  P1: dev se 4.5 (fixed), rho 0 (fixed)
  P2: dev se 4.5 (fixed), rho 0 (fixed)
- **maxlambdaphase:** 1

- **sd_offset:** 1

Phases

Phase 1: R0, max lambda, initial F

Phase 2: Main selectivity parameters

Phase 3: Main recruitment deviations

Phase 4: Early recruitment deviations, other size selectivity parameters

Phase 5: Dirichlet parameters

Table 2.11. Anglerfish in 3a, 4 and 6. SS3 jitter run results.

Total log-likelihood	Frequency
2282.61	38
2284.92	1
2291.56	3
2332.39	1
2336.73	1
2365.82	1
2414.09	1
3560.62	1
3712.13	1
3916.2	1
3928.34	1

Table 2.12. Summary of the stock assessment. Weights in tonnes. Recruitment in 1000s. Catch is model estimates.

Year	Recruitment			SSB			Landings	Discards	F		
	Low	Mid-point	High	Low SSB	Mid-point	High SSB			Low	Mid-point	High
	thousands			tonnes			tonnes	tonnes			
1949	276624	305455	337291	217117	242054	266991	3158		0.0064	0.0072	0.0081
1950	276587	305419	337256	216534	241431	266328	2800		0.0057	0.0064	0.0072
1951	276555	305387	337225	216033	240872	265711	5094		0.0104	0.0118	0.0132
1952	276470	305303	337143	214625	239427	264229	2736		0.0056	0.0064	0.0071
1953	276430	305262	337101	214009	238725	263441	3767		0.0077	0.0088	0.0098
1954	276368	305198	337036	213007	237652	262297	4426		0.0091	0.0103	0.0116
1955	276292	305121	336958	211767	236349	260931	4485		0.0092	0.0105	0.0118
1956	276214	305042	336879	210525	235045	259565	4929		0.0102	0.0116	0.0130
1957	276130	304956	336791	209165	233632	258099	5065		0.0105	0.0120	0.0134
1958	276046	304870	336704	207820	232236	256652	5076		0.0106	0.0120	0.0135
1959	275966	304788	336621	206552	230920	255288	4613		0.0096	0.0109	0.0123
1960	275903	304723	336553	205562	229878	254194	3672		0.0077	0.0087	0.0098
1961	275870	304687	336514	205052	229314	253576	3381		0.0071	0.0080	0.0090
1962	275855	304669	336493	204820	229038	253256	2700		0.0056	0.0064	0.0071
1963	275868	304679	336499	205012	229196	253380	3521		0.0073	0.0083	0.0093
1964	275872	304683	336502	205076	229253	253430	5270		0.0110	0.0125	0.0139
1965	275842	304654	336475	204604	228803	253002	5749		0.0120	0.0136	0.0153
1966	275800	304614	336438	203956	228177	252398	4117		0.0086	0.0098	0.0110
1967	275795	304608	336432	203862	228077	252292	3410		0.0071	0.0081	0.0091
1968	275805	304617	336439	204024	228224	252424	4012		0.0084	0.0095	0.0107
1969	275803	304615	336437	203985	228181	252377	3529		0.0074	0.0084	0.0094
1970	275813	304624	336445	204138	228326	252514	3470		0.0072	0.0082	0.0092
1971	275826	304637	336457	204347	228531	252715	3623		0.0075	0.0086	0.0096

Year	Recruitment			SSB			Land-ings	Dis-cards	F		
	Low	Mid-point	High	Low SSB	Mid-point	High SSB			Low	Mid-point	High
							tonnes	tonnes			
	thousands			tonnes							
1972	275838	304649	336469	204538	228724	252910	5497		0.0115	0.0130	0.0146
1973	275807	304620	336443	204060	228271	252482	12189		0.026	0.029	0.033
1974	275611	304431	336265	201042	225341	249640	7801		0.0167	0.0189	0.021
1975	275498	304319	336155	199361	223647	247933	8299		0.0178	0.020	0.023
1976	275363	304184	336022	197391	221646	245901	9021		0.0195	0.022	0.025
1977	275206	304026	335864	195113	219325	243537	8774		0.0191	0.022	0.024
1978	275053	303871	335708	192953	217102	241251	8172		0.0178	0.020	0.023
1979	274922	303736	335570	191133	215208	239283	8123		0.0178	0.020	0.023
1980	274805	303616	335447	189537	213545	237553	8485		0.0186	0.021	0.024
1981	51169	116396	264769	188057	212014	235971	5623		0.0123	0.0140	0.0156
1982	58647	121141	250229	187856	211749	235642	7104		0.0155	0.0176	0.0197
1983	56484	114031	230207	187443	211315	235187	8542		0.0189	0.021	0.024
1984	39722	88540	197358	186674	210547	234420	11075		0.026	0.029	0.032
1985	85114	155099	282630	184694	208565	232436	12078		0.032	0.035	0.039
1986	61263	125529	257213	181099	204877	228655	12343		0.037	0.042	0.047
1987	78752	142402	257496	175002	198485	221969	15377		0.054	0.062	0.069
1988	65000	122362	230345	164152	187092	210032	17973		0.072	0.084	0.095
1989	59741	114880	220910	148777	170916	193055	16451		0.072	0.085	0.099
1990	183679	251774	345113	132189	153297	174405	17605		0.082	0.099	0.117
1991	139428	195053	272871	114511	134494	154477	17441		0.088	0.107	0.126
1992	207795	269040	348336	97552	116343	135134	21872		0.120	0.147	0.173
1993	175018	237560	322452	80281	97911	115540	23971		0.127	0.153	0.179
1994	147162	201119	274859	65376	81838	98300	25057		0.128	0.156	0.183
1995	62090	98349	155781	53601	68866	84131	28913		0.133	0.163	0.193

Year	Recruitment			SSB			Landings	Discards	F		
	Low	Mid-point	High	Low SSB	Mid-point	High SSB			Low	Mid-point	High
	thousands			tonnes			tonnes	tonnes			
1996	148174	194246	254643	44246	58429	72613	35100		0.172	0.21	0.25
1997	146210	193912	257178	35880	49160	62440	32728		0.199	0.25	0.30
1998	125669	170505	231338	29072	41557	54041	25293		0.182	0.23	0.28
1999	67241	101600	153515	24293	36081	47868	21854		0.163	0.21	0.26
2000	159247	206827	268624	20844	32028	43212	19682		0.144	0.190	0.24
2001	138555	186230	250309	18448	29099	39750	19157		0.148	0.196	0.24
2002	185322	236476	301751	16423	26592	36762	15067		0.125	0.168	0.21
2003	75013	114619	175138	15288	25086	34885	11916		0.090	0.121	0.152
2004	223559	280716	352486	15251	24811	34372	11906		0.079	0.106	0.132
2005	126778	165578	216252	15896	25335	34773	13618		0.081	0.107	0.132
2006	47495	69292	101092	17046	26504	35963	13163		0.075	0.098	0.121
2007	143683	176656	217196	18994	28696	38398	14565	490	0.079	0.102	0.125
2008	65969	89896	122499	21457	31655	41853	15879	903	0.083	0.107	0.131
2009	63944	86766	117733	24132	35044	45956	15372	38	0.085	0.109	0.133
2010	99266	129411	168710	26779	38564	50349	12136	69	0.068	0.087	0.107
2011	136883	176917	228659	29882	42653	55424	12902	95	0.081	0.103	0.126
2012	231108	283638	348108	31959	45631	59303	11894	870	0.080	0.102	0.123
2013	218465	268642	330344	33362	47732	62103	12064	925	0.085	0.109	0.132
2014	102513	134868	177436	33728	48518	63307	13212	416	0.085	0.110	0.134
2015	145259	183409	231579	33447	48367	63286	16130	422	0.089	0.116	0.142
2016	112237	148090	195397	32705	47509	62314	19446	825	0.099	0.127	0.156
2017	203357	258317	328131	31877	46468	61059	21719	756	0.108	0.138	0.169
2018	200902	262548	343109	31312	45818	60323	21572	326	0.106	0.137	0.169
2019	110454	157123	223511	31270	45981	60692	21552	514	0.110	0.145	0.180

Year	Recruitment			SSB			Land-ings	Dis-cards	F		
	Low	Mid-point	High	Low SSB	Mid-point	High SSB			Low	Mid-point	High
	thousands			tonnes			tonnes	tonnes			
2020	234756	312143	415040	31102	46294	61486	19072	316	0.094	0.126	0.158
2021	179823	253328	356880	31515	47367	63219	20142	250	0.096	0.130	0.164
2022	215867	321252	478086	31813	48448	65083	17916	323	0.075	0.102	0.129
2023	319440	499377	780672	33313	50943	68573	16157	234	0.064	0.089	0.113
2024		219263			53377						
Aver-age	193681	236645	297395	126338	144582	165258	12155	457	0.058	0.073	0.088

* Predicted from stock-recruitment relationship

Table 2.13 Anglerfish in subareas 4 and 6 and in Division 3.a. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{ages\ 5\text{–}10}$ (2024)	0.089	$F_{sq} = F_{(2023)}$
SSB (2025)	57665	Short-term forecast; fishing at F_{sq}, in tonnes
$R_{age\ 0}$ (2024)	219263	Predicted from stock-recruitment relationship; in thousands.
$R_{age\ 0}$ (2025)	209046	Predicted from stock-recruitment relationship; in thousands.
Catch (2024)	18228	Short-term forecast; fishing at F_{sq}; in tonnes
Projected landings (2024)	17955	Short-term forecast assuming average landing pattern (2021–2023); in tonnes
Projected discards (2024)	273	Short-term forecast assuming average discard pattern (2021–2023); in tonnes

Table 2.14 Anglerfish in subareas 4 and 6 and in Division 3.a. Annual catch scenarios. Weights are in tonnes.

Basis	Total catch (2025)	Projected landings* (2025)	Projected discards** (2025)	F_{total} (2025)	SSB (2026)	% SSB change***	% Advice change ^	Probability SSB < B_{lim} in 2026 (%)
ICES advice basis								
MSY approach: F_{MSY}	30726	30265	461	0.137	60272	4.5	211	0
Other scenarios								
EU MAP^^: F_{MSY}	30726	30265	461	0.137	60272	4.5	211	0
EU MAP^^ $F_{MSY\ lower}$	23895	23537	358	0.105	61791	7.2	142	0
EU MAP^^ $F_{MSY\ upper}$	38379	37803	576	0.174	58567	1.56	288	0
F = 0	0	0	0	0	67094	16.4	-100	0
$F = F_{pa}$	46562	45864	698	0.215	56743	-1.6	371	0
$SSB_{2026} = B_{lim}$	184929	182155	2774	1.3	25686	-56	1772	50
$SSB_{2026} = B_{pa}$	140402	138296	2106	0.84	35692	-38	1321	3.2
$SSB_{2026} = SSB_{2025}$	42428	41792	636	0.194	57665	0	211	0
SSB_{2026} = MSY $B_{trigger}$	127467	125555	1912	0.73	38604	-33	1190	0.88
$F = F_{2024}$	20297	19993	304	0.089	62591	8.5	105	0
Catch advice 2025 = TAC_{2024}	11293	11124	169	0.048	64590	12	14.3	0

*** Landings, assuming recent discard rate.**

**** Assuming recent discard rate.**

***** SSB 2026 relative to SSB 2025 (57665 tonnes).**

^ Advice value for 2025 relative to advice value for 2024 (9 881 tonnes)

^^ EU multiannual plan (MAP) for the Western Waters (EU, 2019).

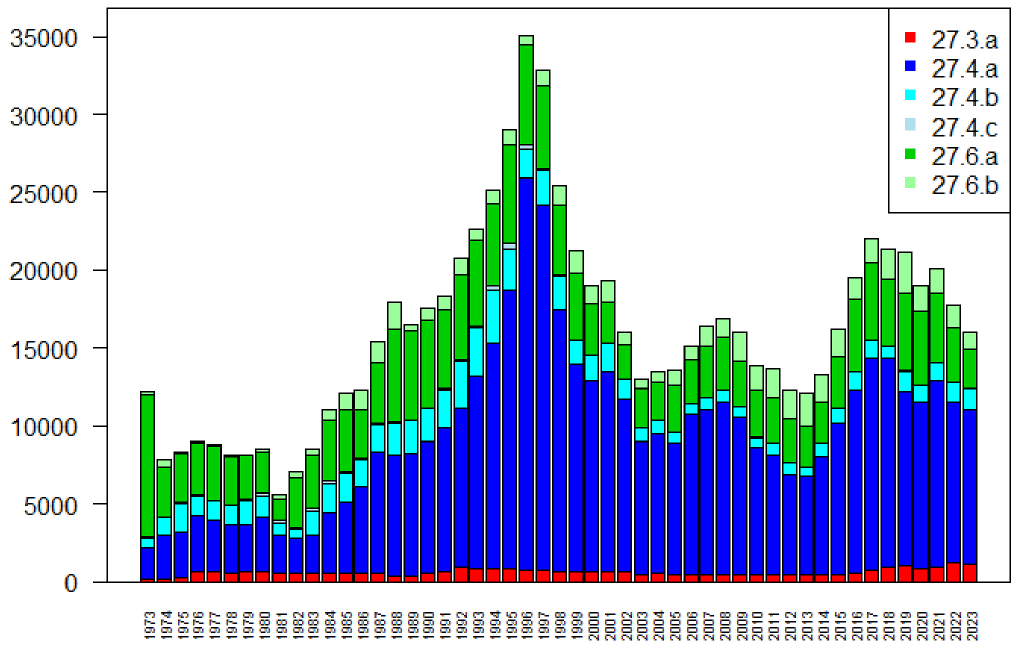


Figure 2.1 and 2.2. Northern Shelf anglerfish. Officially reported landings (thousands of tonnes) by ICES area (1973–2023).

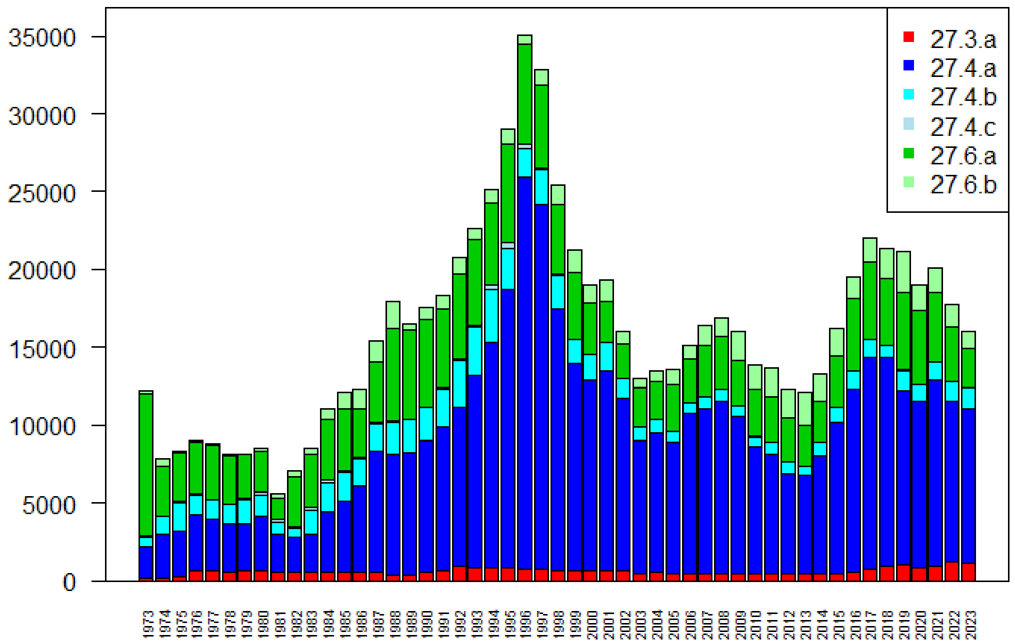


Figure 2.2. Northern Shelf anglerfish. Officially reported landings (thousands of tonnes) by country (2002–2023)

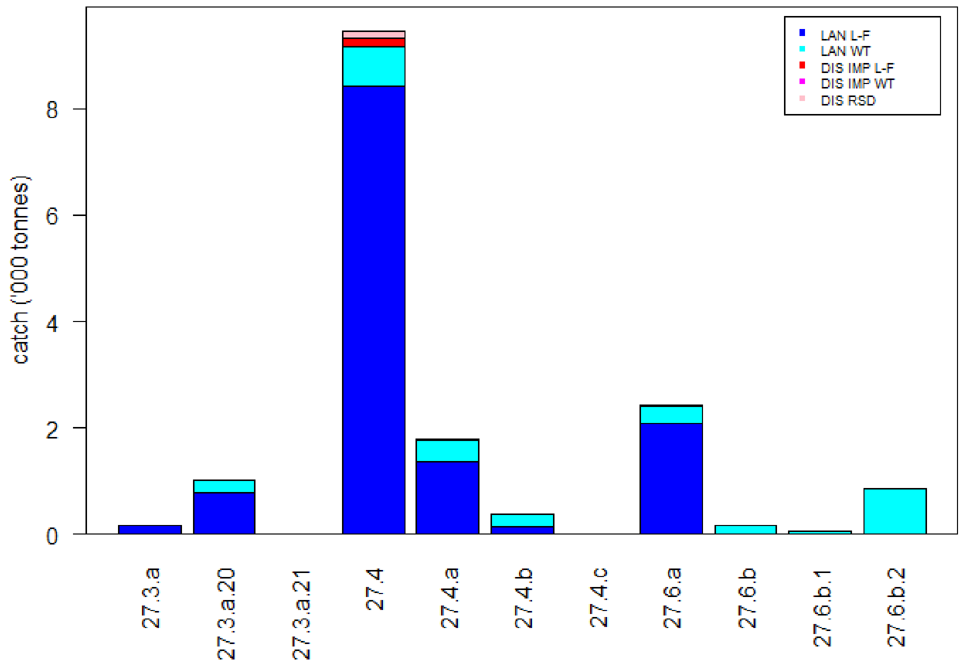


Figure 2.3a. Catch weight by ICES division for 2023. Landings with sampled length frequencies (bright blue), landings for which length frequencies are estimated in InterCatch (cyan), discard weights with sampled

length frequencies (red), discards weight with length frequencies estimated in InterCatch (magenta), discard weights and length frequencies estimated in InterCatch (salmon).

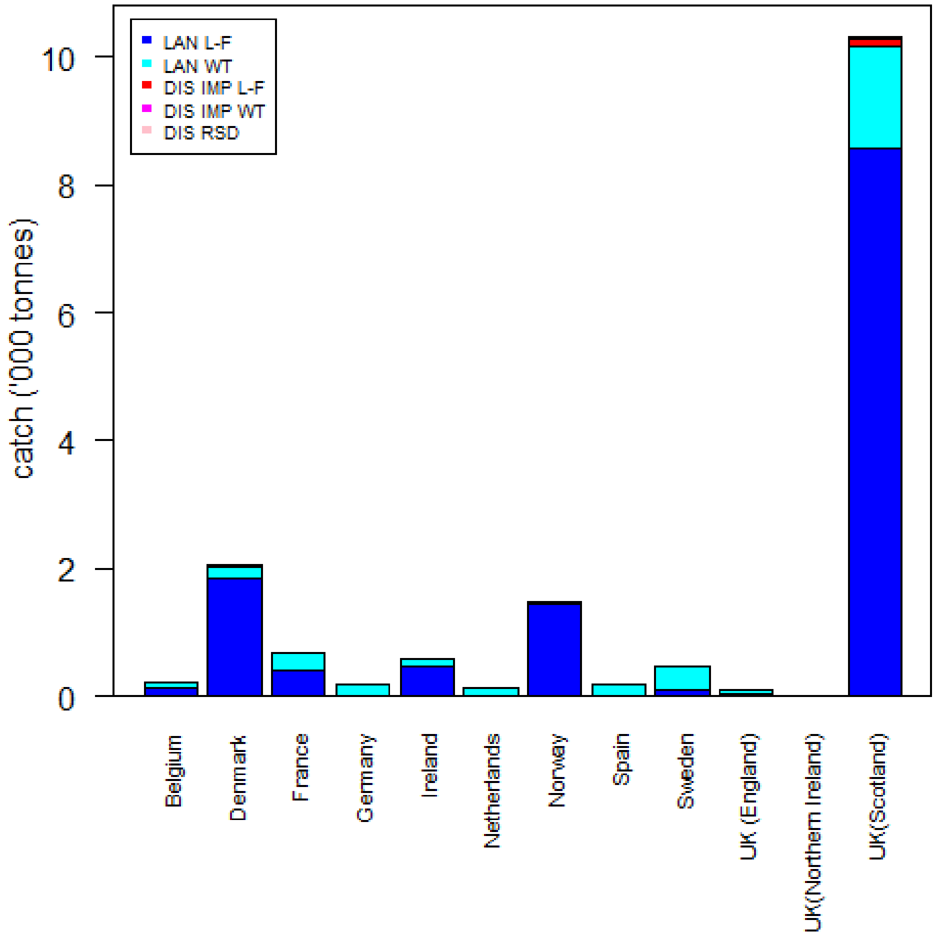


Figure 2.3b. Catch weight by country for 2023. Landings with sampled length frequencies (bright blue), landings for which length frequencies are estimated in InterCatch (cyan), discard weights with sampled length

frequencies (red), discards weight with length frequencies estimated in InterCatch (magenta), discard weights and length frequencies estimated in InterCatch (salmon).

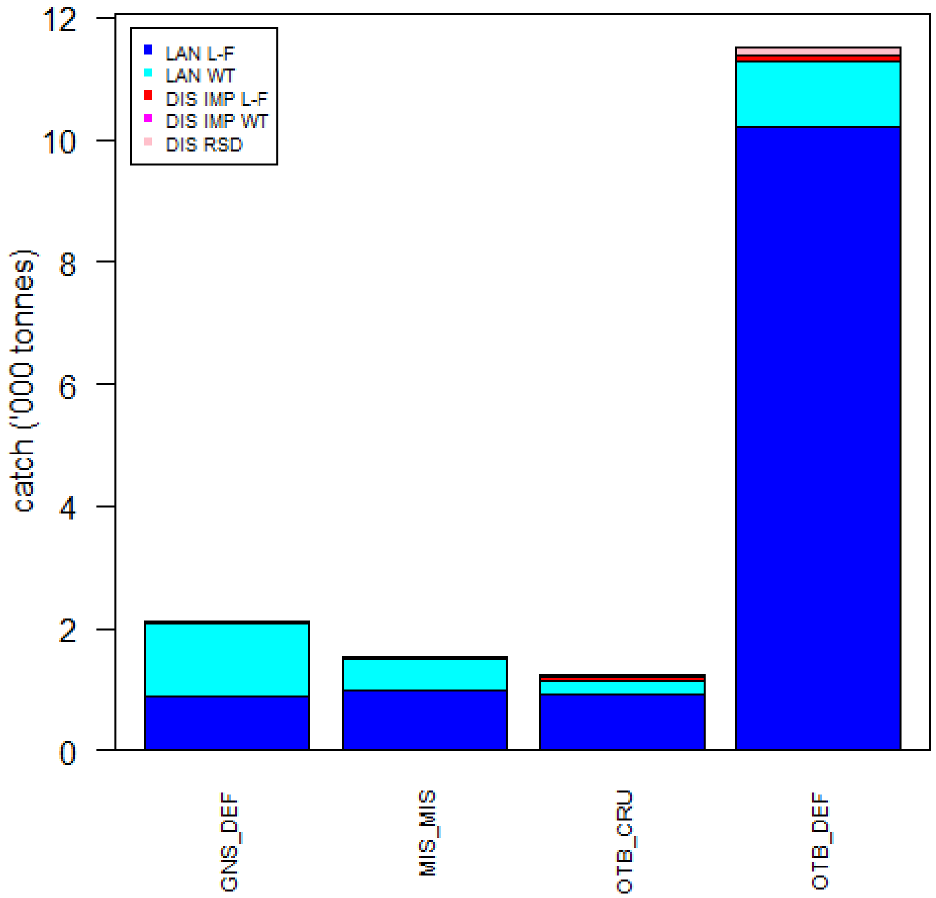


Figure 2.3c. Catch weight by level 5 metier (gear and target species) for 2023. Landings with sampled length frequencies (bright blue), landings for which length frequencies are estimated in InterCatch (cyan), discard weights with sampled length frequencies (red), discards weight with length frequencies estimated in Inter-Catch (magenta), discard weights and length frequencies estimated in InterCatch (salmon).

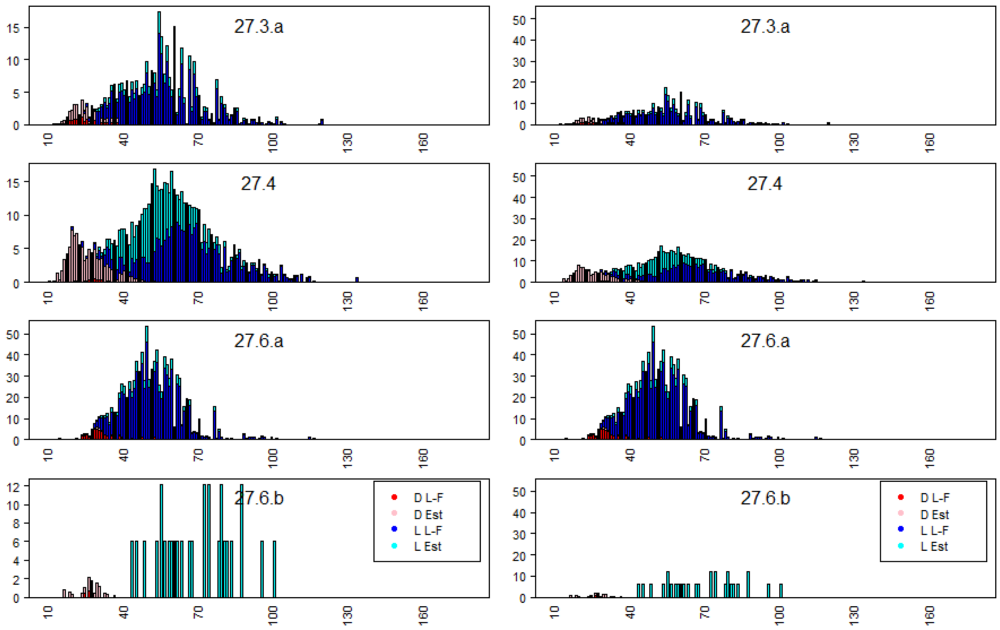


Figure 2.4. Catch length frequencies (thousands - left) and weight-at-length (tonnes - right) for division 3.a (top), 4 (second), 6.a (third) and 6.b (bottom) for 2023. Landings with sampled length frequencies (bright blue), landings for which length frequencies are estimated in InterCatch (cyan), discard weights with sampled length frequencies (red), discards with length frequencies estimated in InterCatch (salmon).

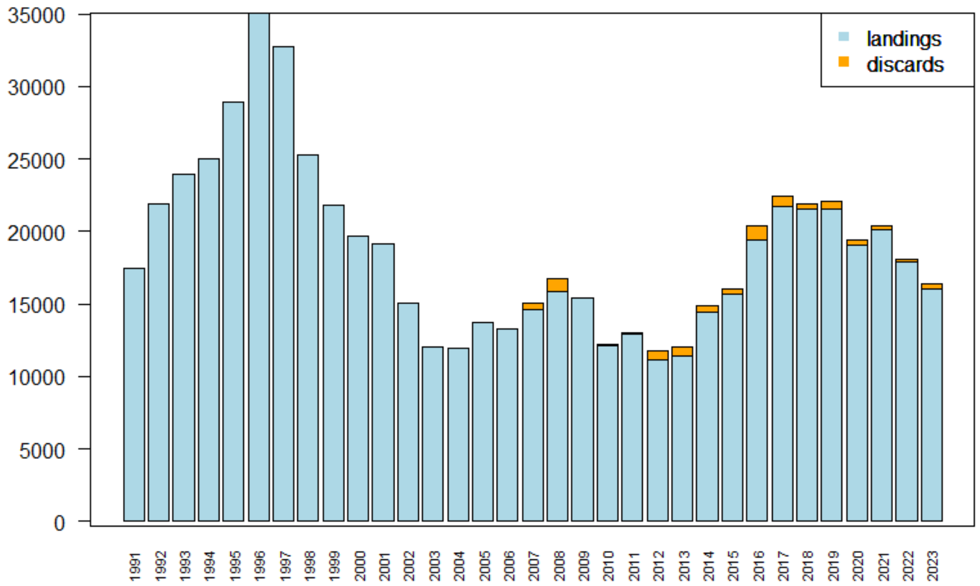


Figure 2.5. ICES landings of anglerfish 1991–2023 (blue) and ICES discards of anglerfish 2007–2023 (orange) in subareas 4 and 6 and in Division 3.a.

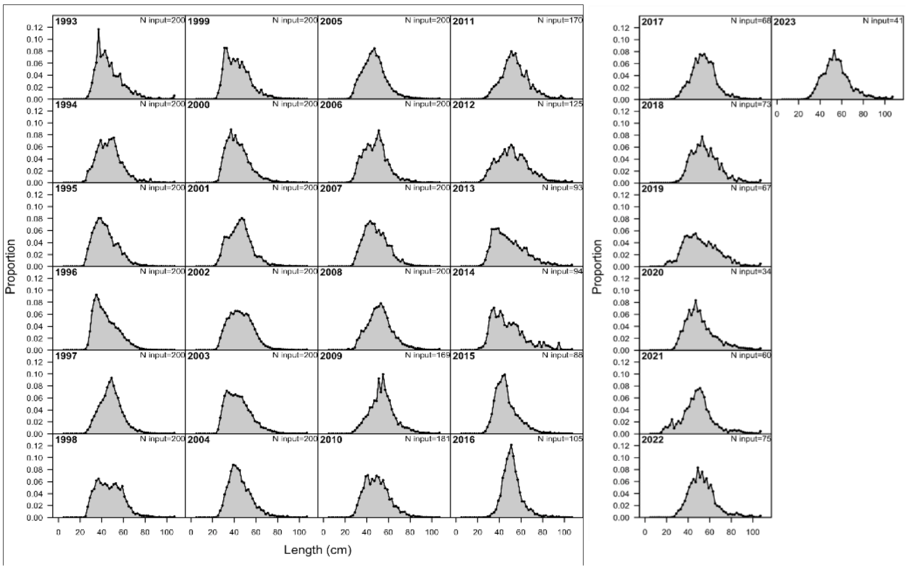


Figure 2.6. WGCSE Landed numbers at-length (cm) density plots 1993–2023.

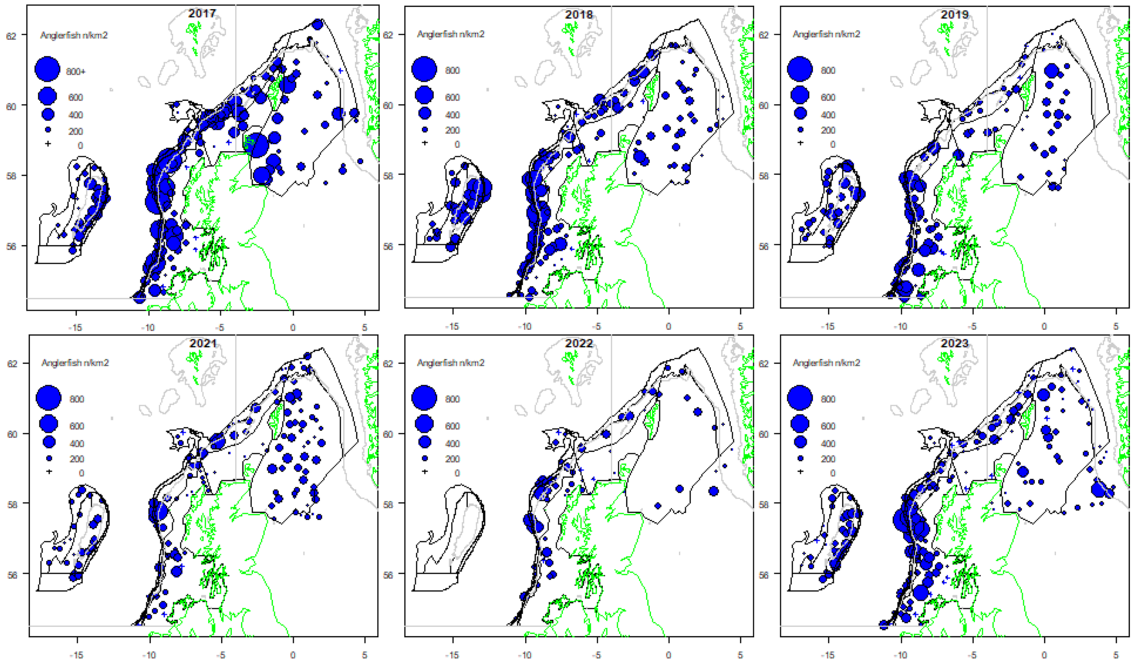


Figure 2.7. Numbers of anglerfish per km² observed by SIAMISS surveys 2016–2022.

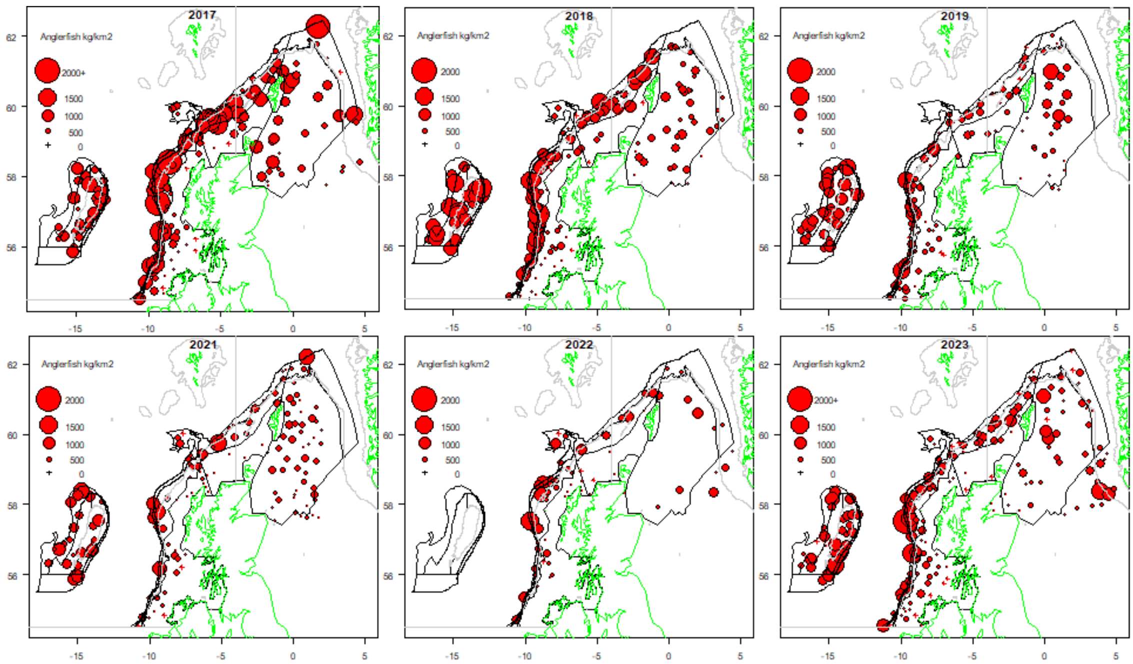


Figure 2.8. Weight of anglerfish(kg) per km² observed by SIAMISS surveys 2016–2022.

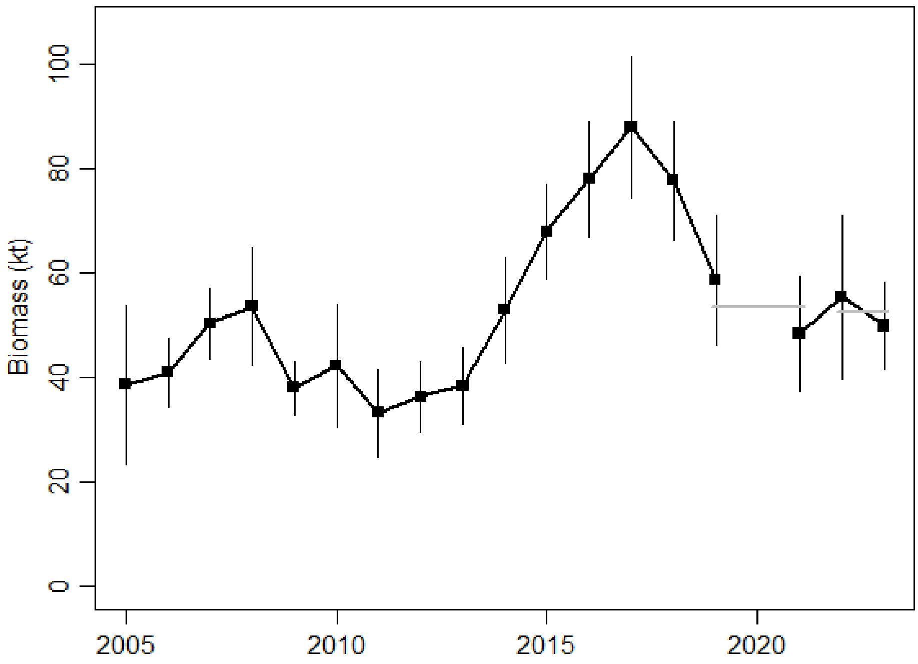


Figure 2.9. SIAMISS estimates of total biomass, with confidence intervals, for subareas 4 and 6 combined, 2005–2023.

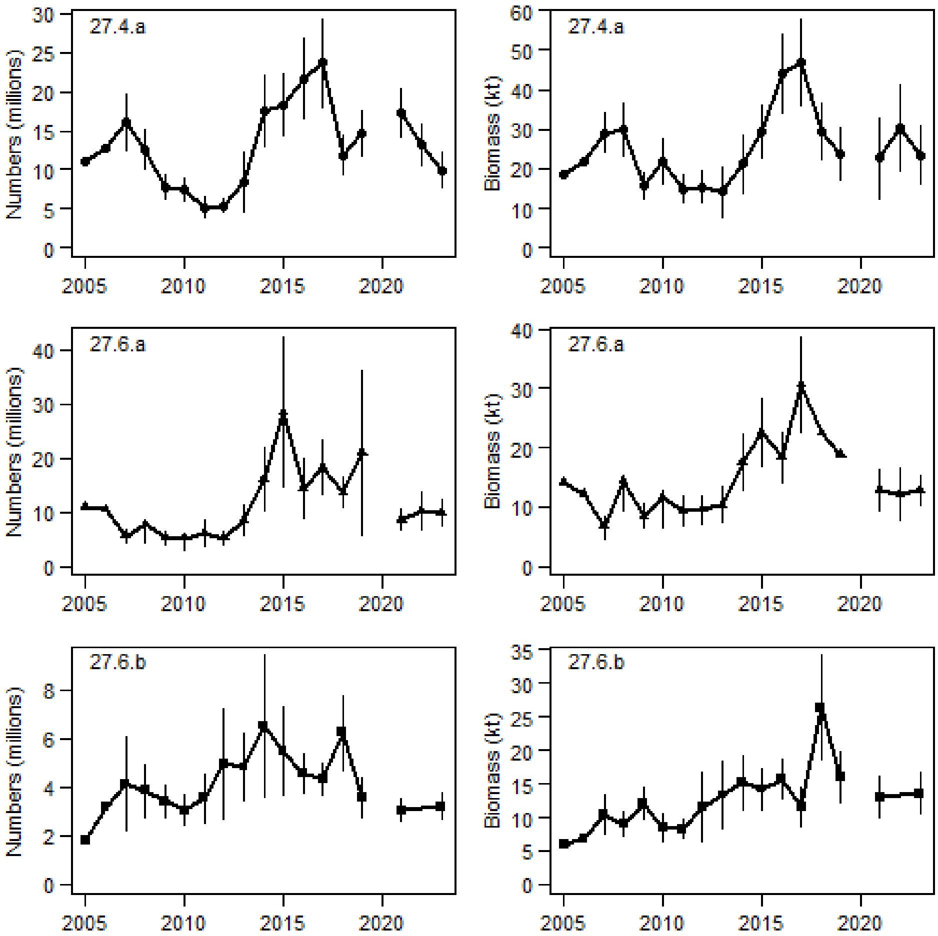


Figure 2.10. SIAMISS-Q2 estimates of total abundance (left) and biomass (right) of anglerfish for the Northern Shelf 2005–2023 provided for ICES Subarea 4a, Division 6.a and Division 6.b.

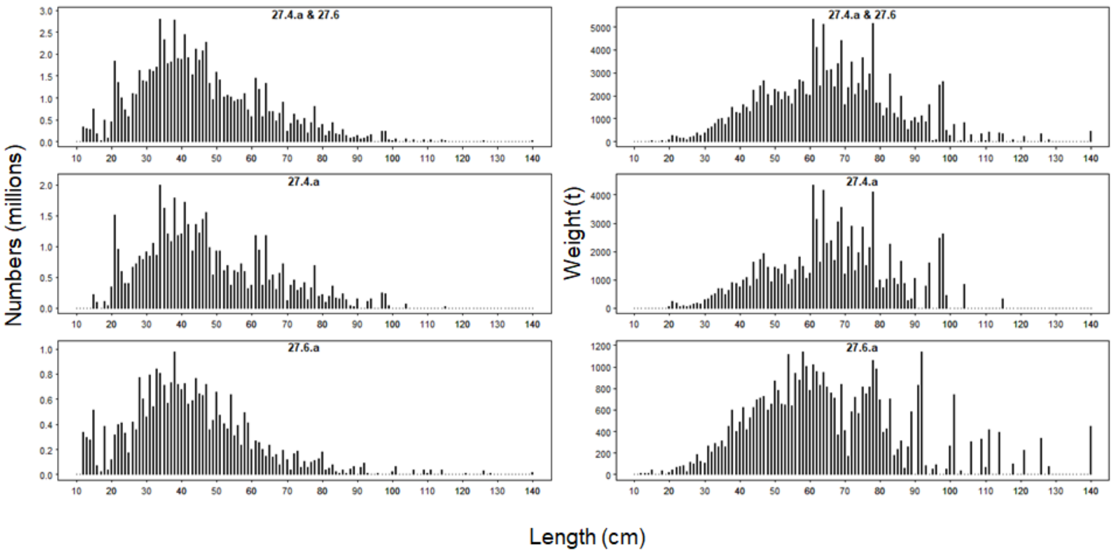


Figure 2.11. SIAMISS-Q2 estimates of total numbers (millions) and weight (t) at-length (cm) for subareas 4.a and 6.a, 2023.

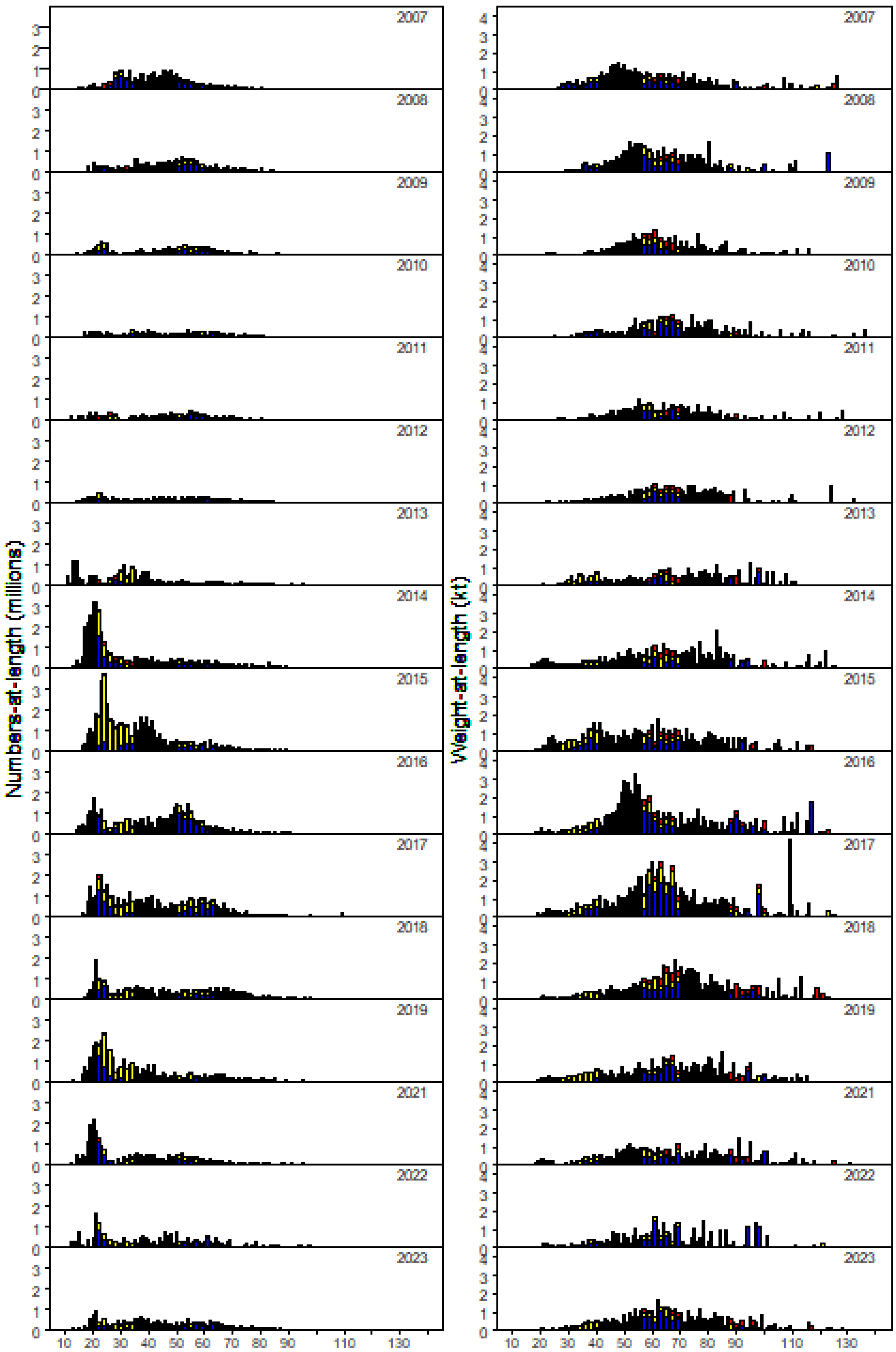


Figure 2.12. SIAMISS-Q2 estimates of total numbers (millions) at-length (cm) (left) and estimates of total biomass (kt) at-length (cm) (right) for subareas 4.a (blue), 6.a (yellow) and 6.b (red) combined, 2007–2022.

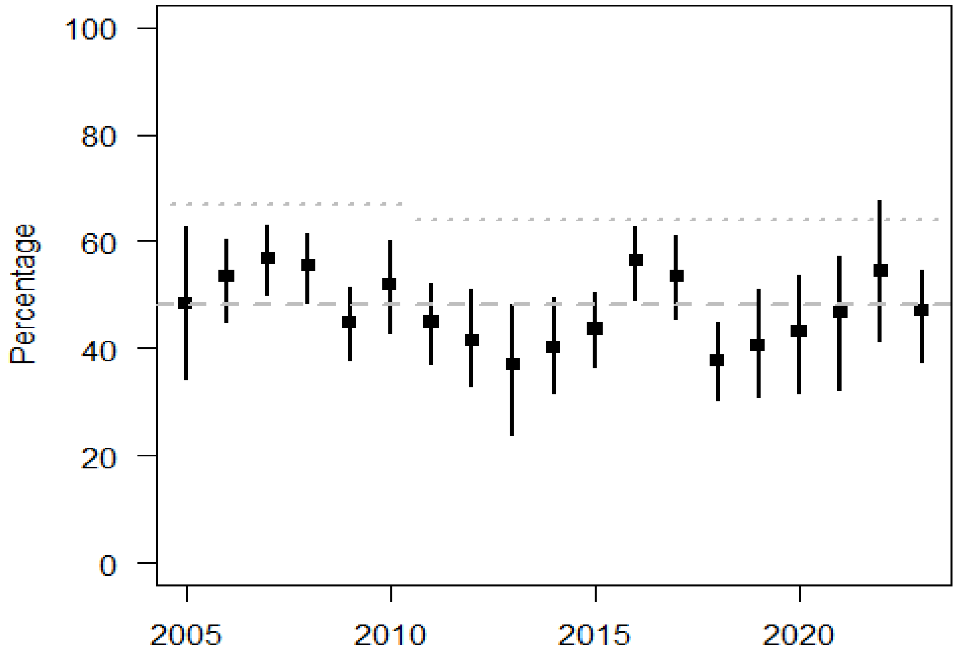


Figure 2.13. Percentage of SIAMISS-Q2 total biomass, with confidence intervals, estimated to be in subareas 4.a–c compared with subareas 4.a–c and 6.a–b combined. The full grey line represents the average of these percentages over the time-series (2005–2022) (48%). The dotted grey lines represent the percentage of TAC allocated for subareas 4.a–c compared to the total of the TAC for subareas 4.a–c and 6.a–b, (67% in 2005–2010, 64% in 2011–2023).

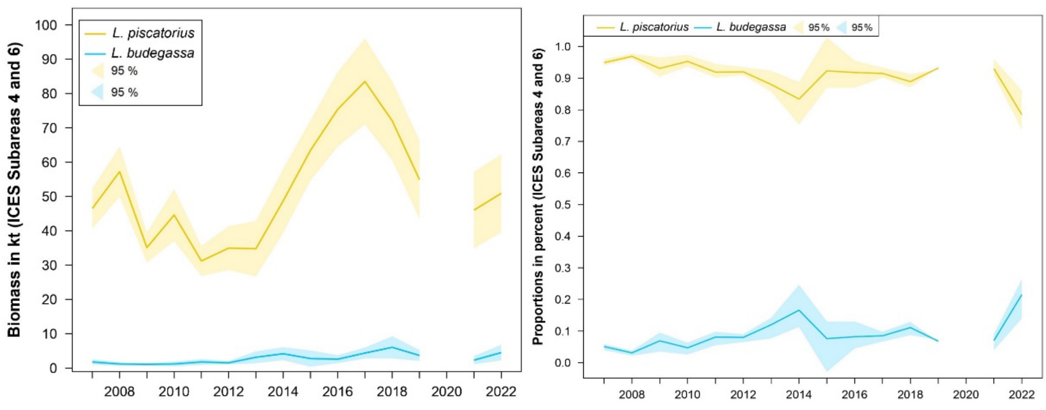
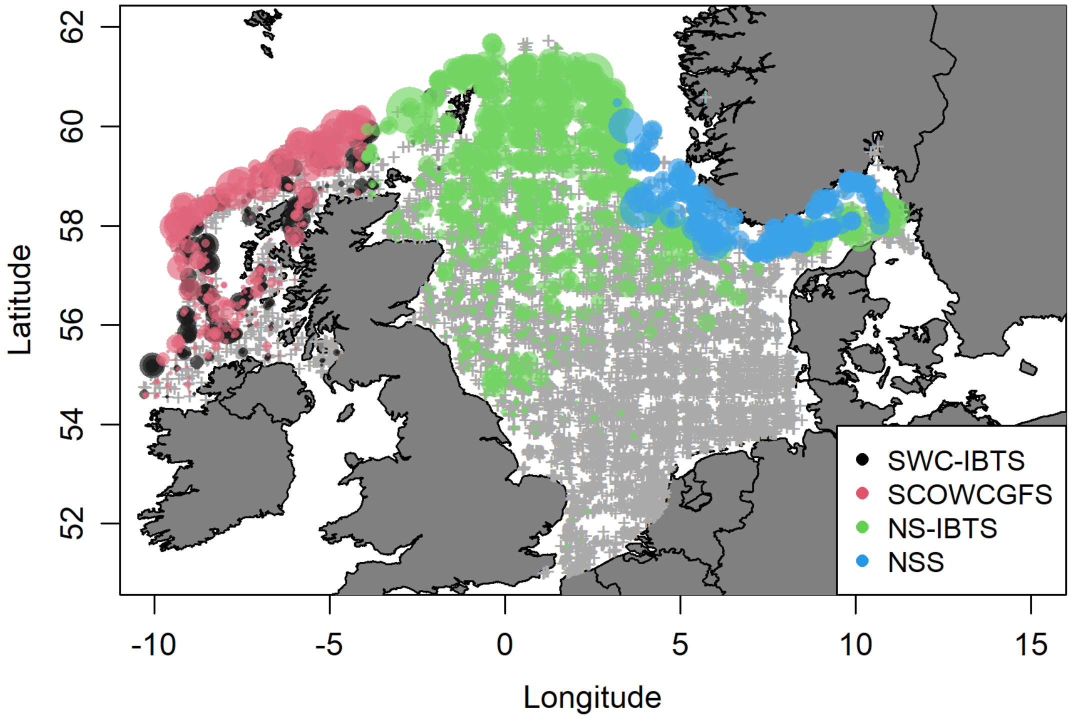


Figure 2.14. SIAMISS-Q2 biomass (kt – left) and percentage biomass (right), of each of the two species *Lophius piscatorius* (orange) and *Lophius budegassa* (cyan) with confidence intervals, estimated to be in subareas 4.a and 6.a–b combined.



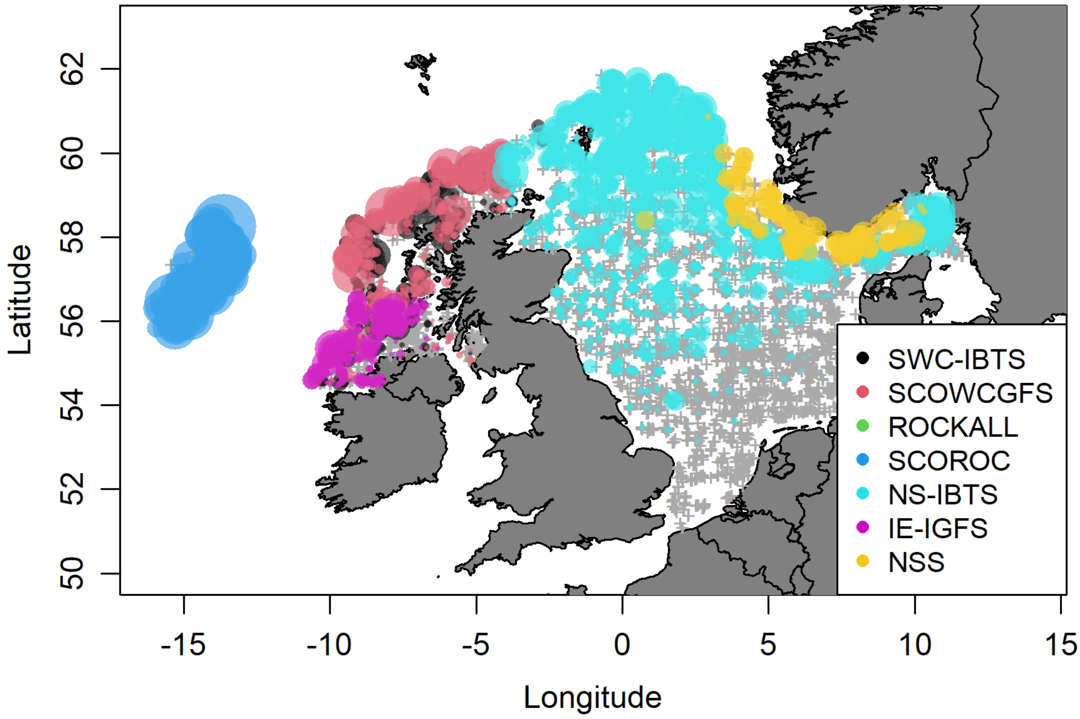


Figure 2.15. Catch weight per haul by survey in Q1 (top panel) and in Q3+Q4 (bottom panel). Non-zero catches are shown as bubbles and zero catches are shown as grey crosses..

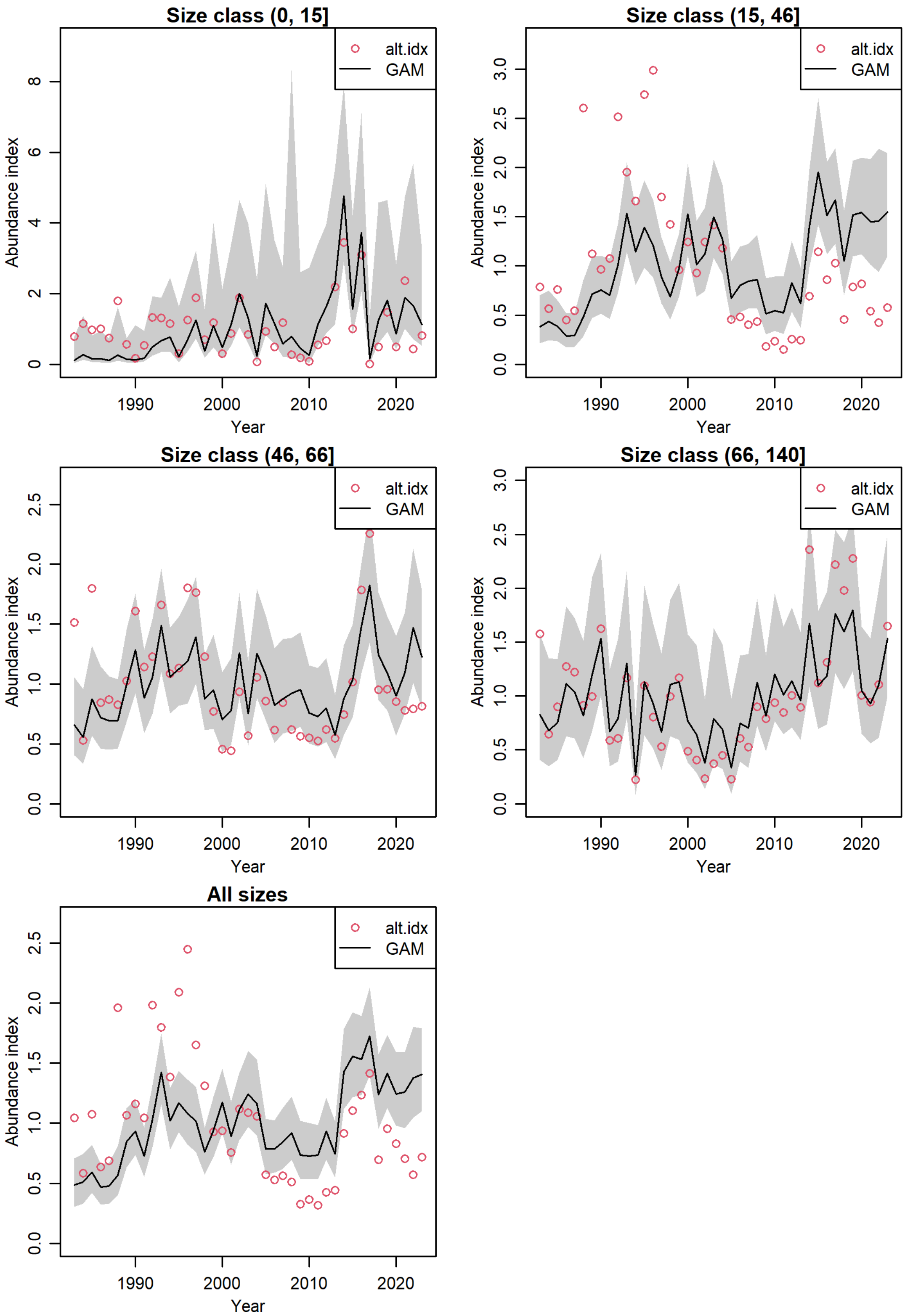


Figure 2.16. Indices derived from a delta-GAM model for abundance and fit to data in Q1 (black line) with 95% confidence limits (in grey). Indices are derived by summing model predictions on a spatial grid. The indices calculated using the stratified mean method for ICES statistical rectangles as strata are shown as red points. The two sorts of indices are mean-standardised.

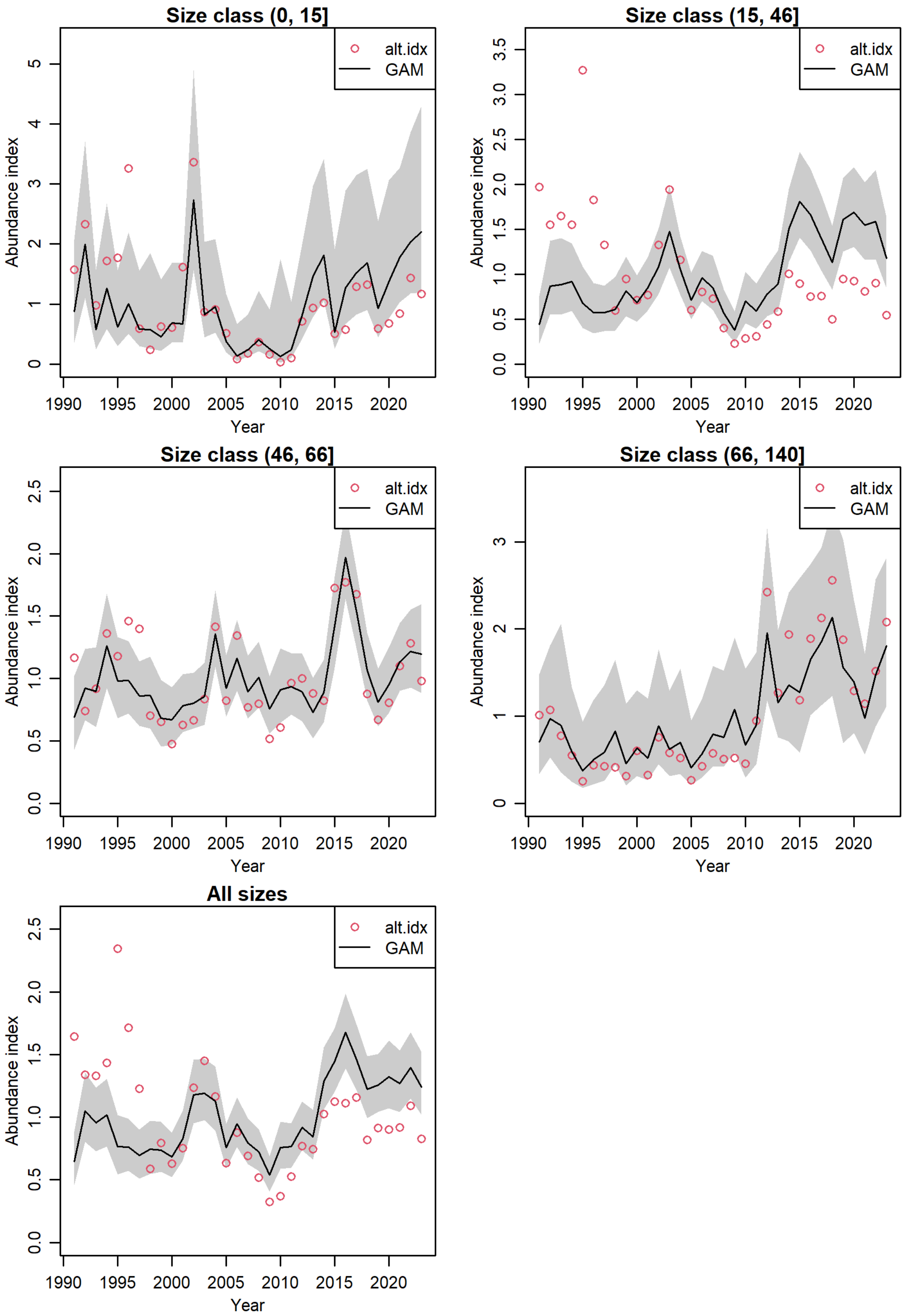


Figure 2.17. Indices derived from a delta-GAM model for abundance and fit to data in Q3+Q4 (black line) with 95% confidence limits (in grey). Indices are derived by summing model predictions on a spatial grid. The indices calculated using the stratified mean method for ICES statistical rectangles as strata are shown as red points. The two sorts of indices are mean-standardised.

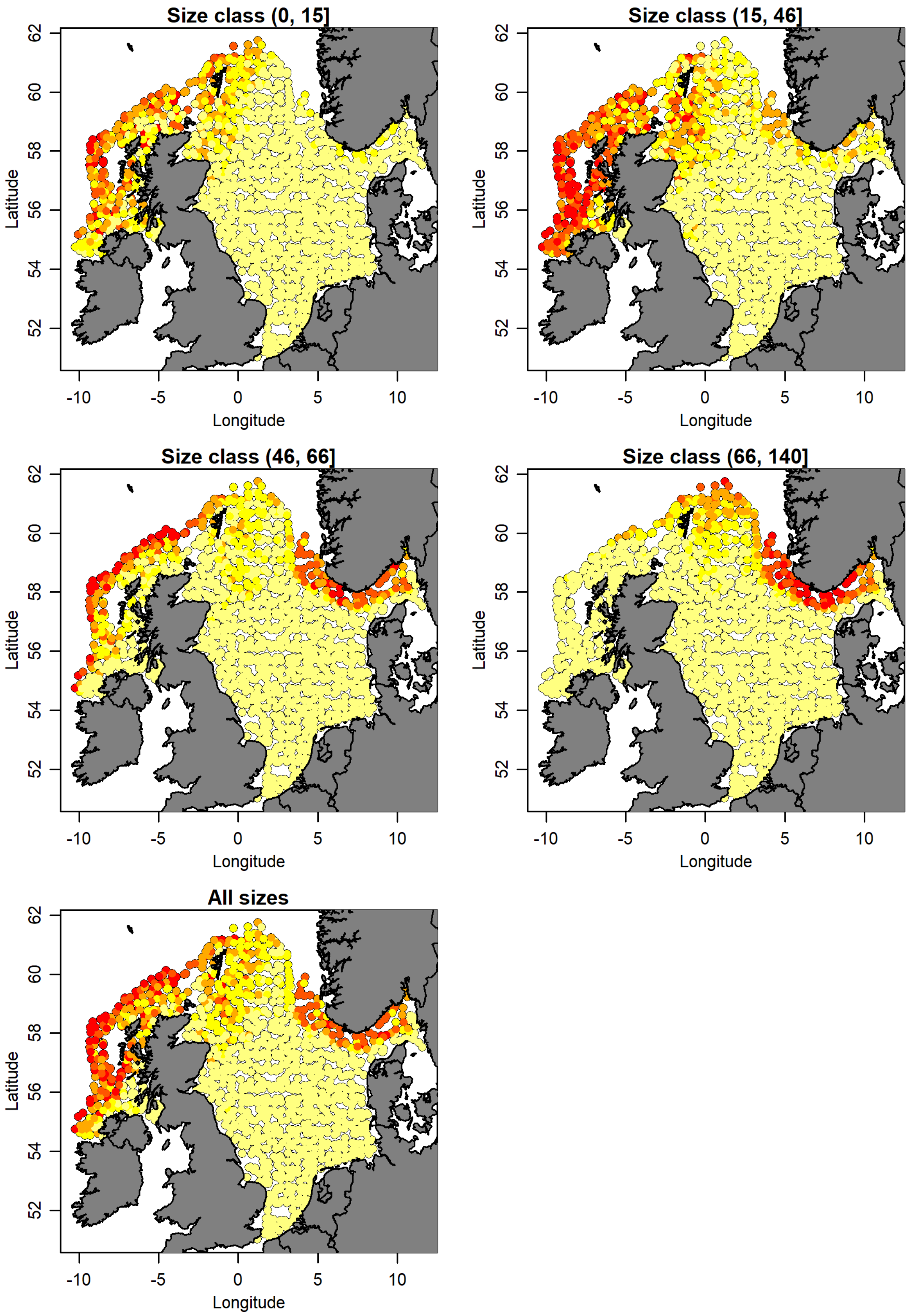


Figure 2.18. Abundance maps by size class in Q1 (all years) obtained by fitting the delta-GAM model.

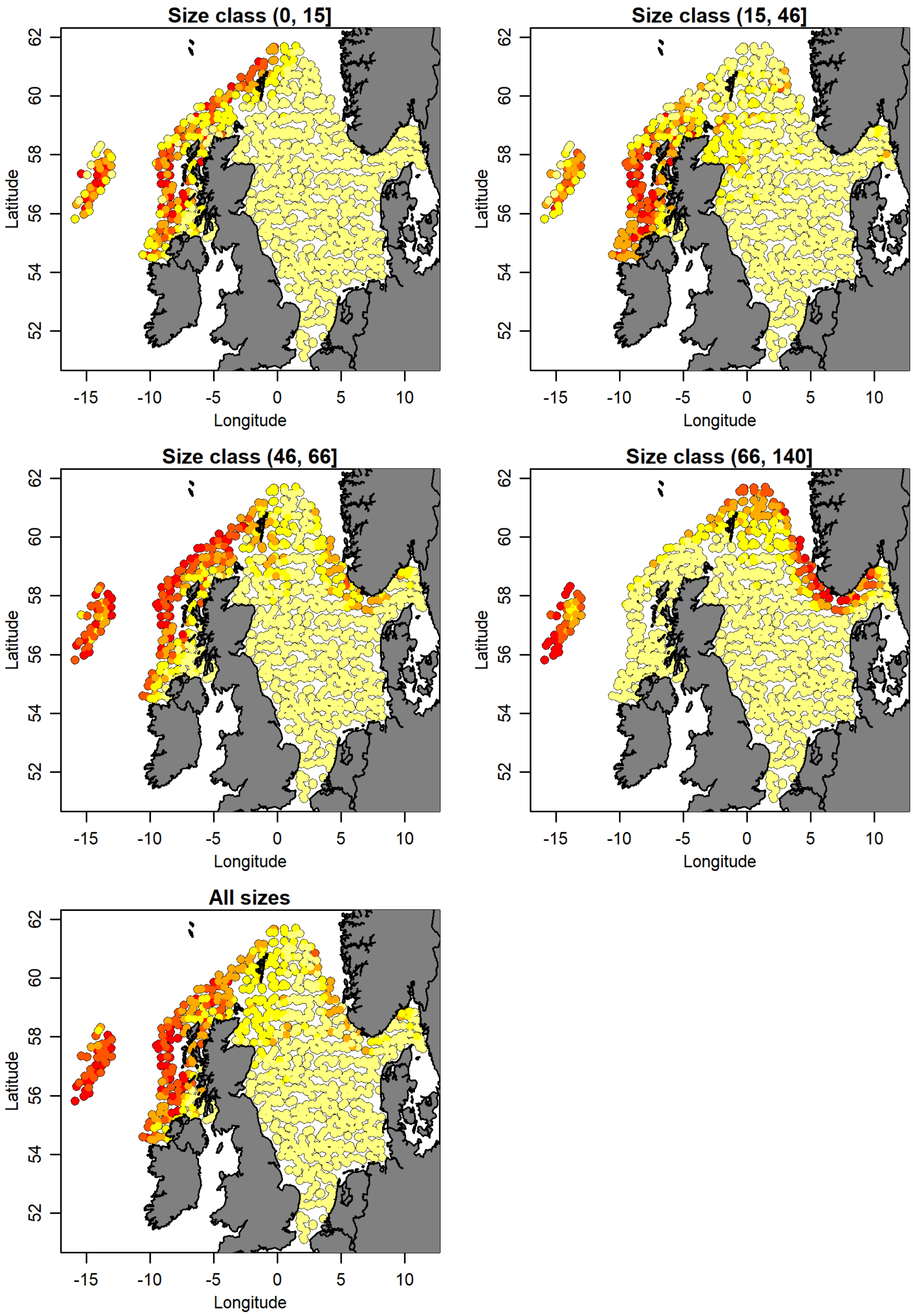


Figure 2.19. Abundance maps by size class in Q3+Q4 (all years) obtained by fitting the delta-GAM model.

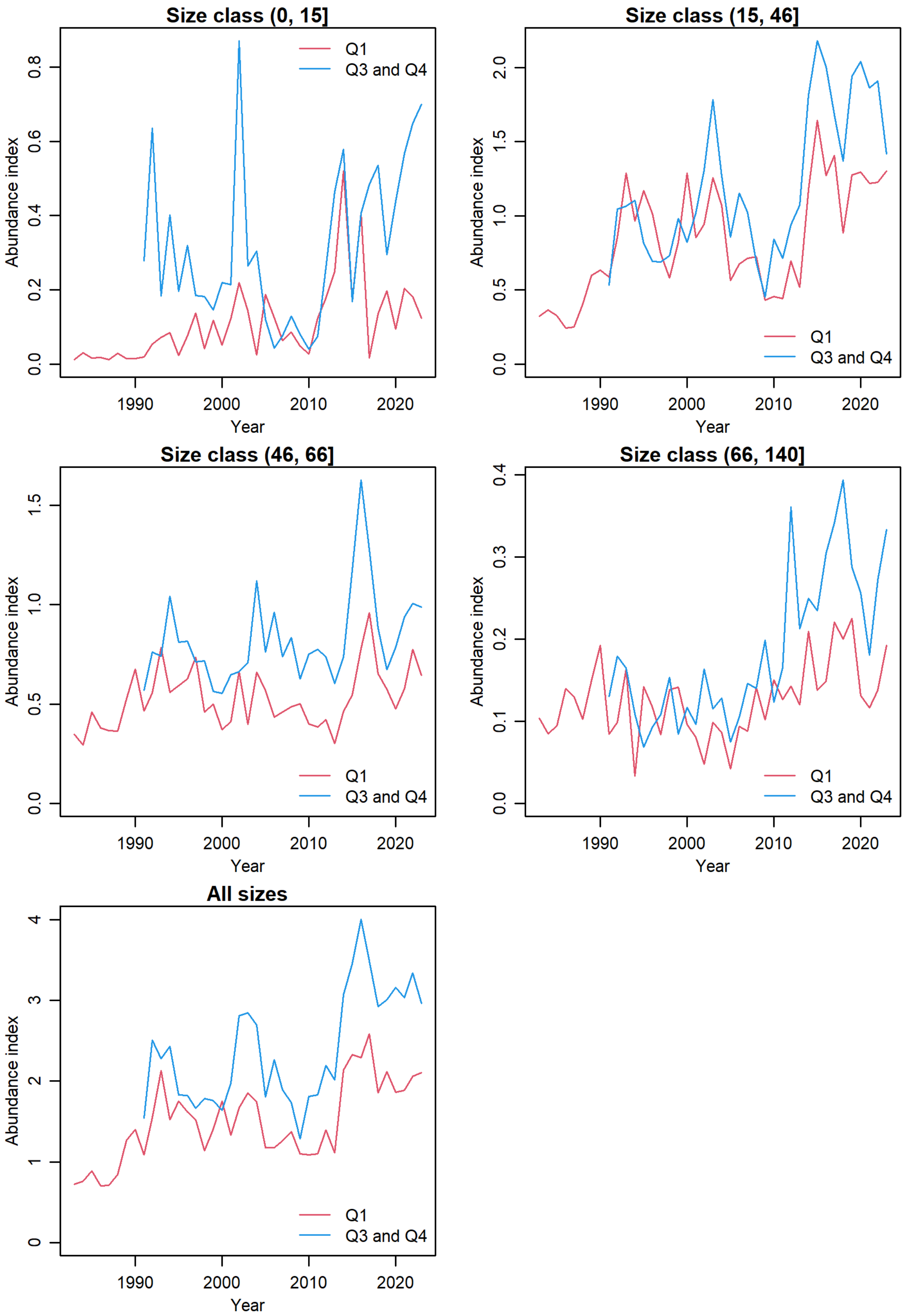


Figure 2.20. Comparison of the two abundance indices, for Q1 and Q3+Q4.

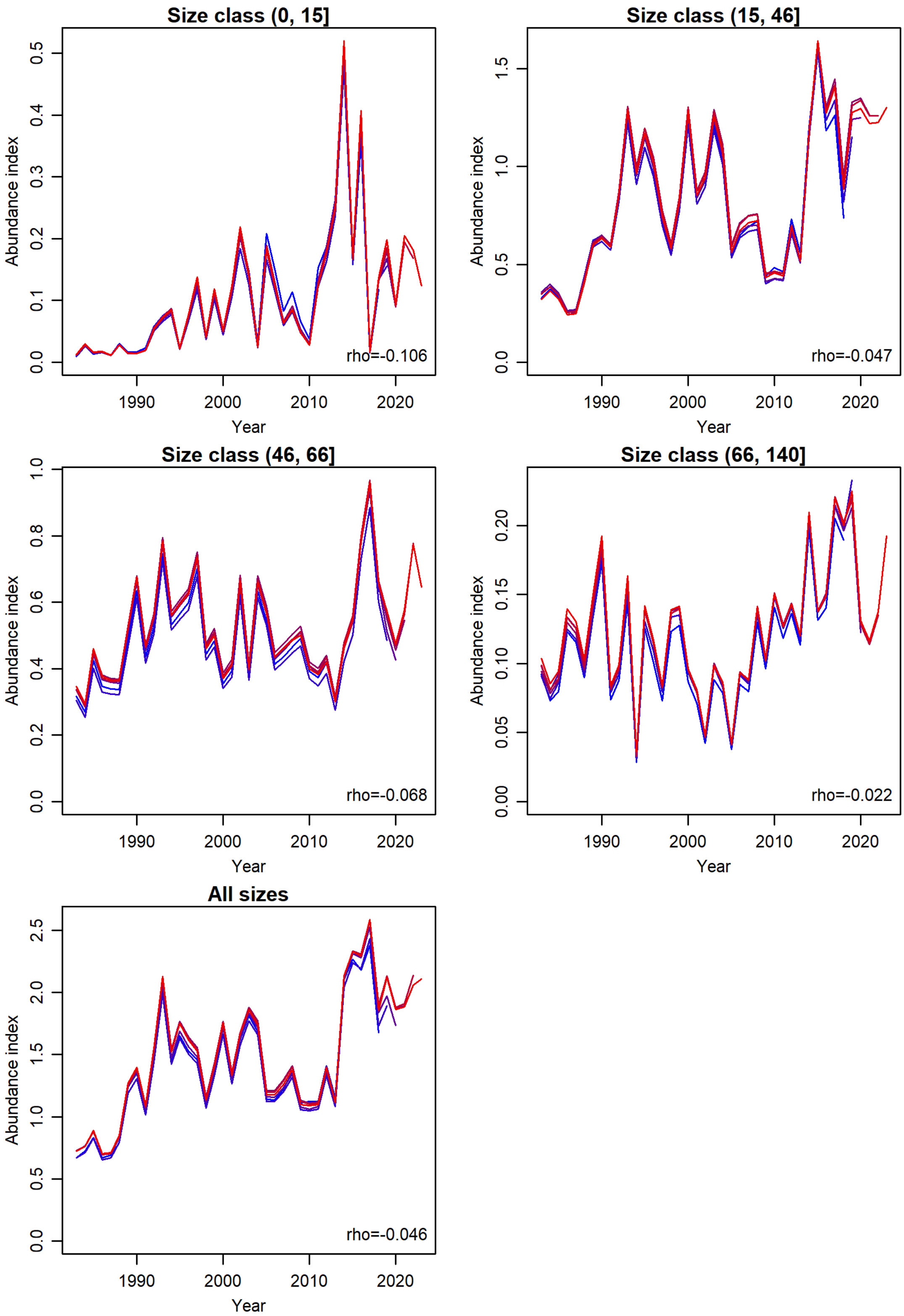


Figure 2.21. Retrospective analysis of the abundance model for Q1 with five peels and the base along with the corresponding Mohn's rho value. The line colour changes accordingly from blue to red.

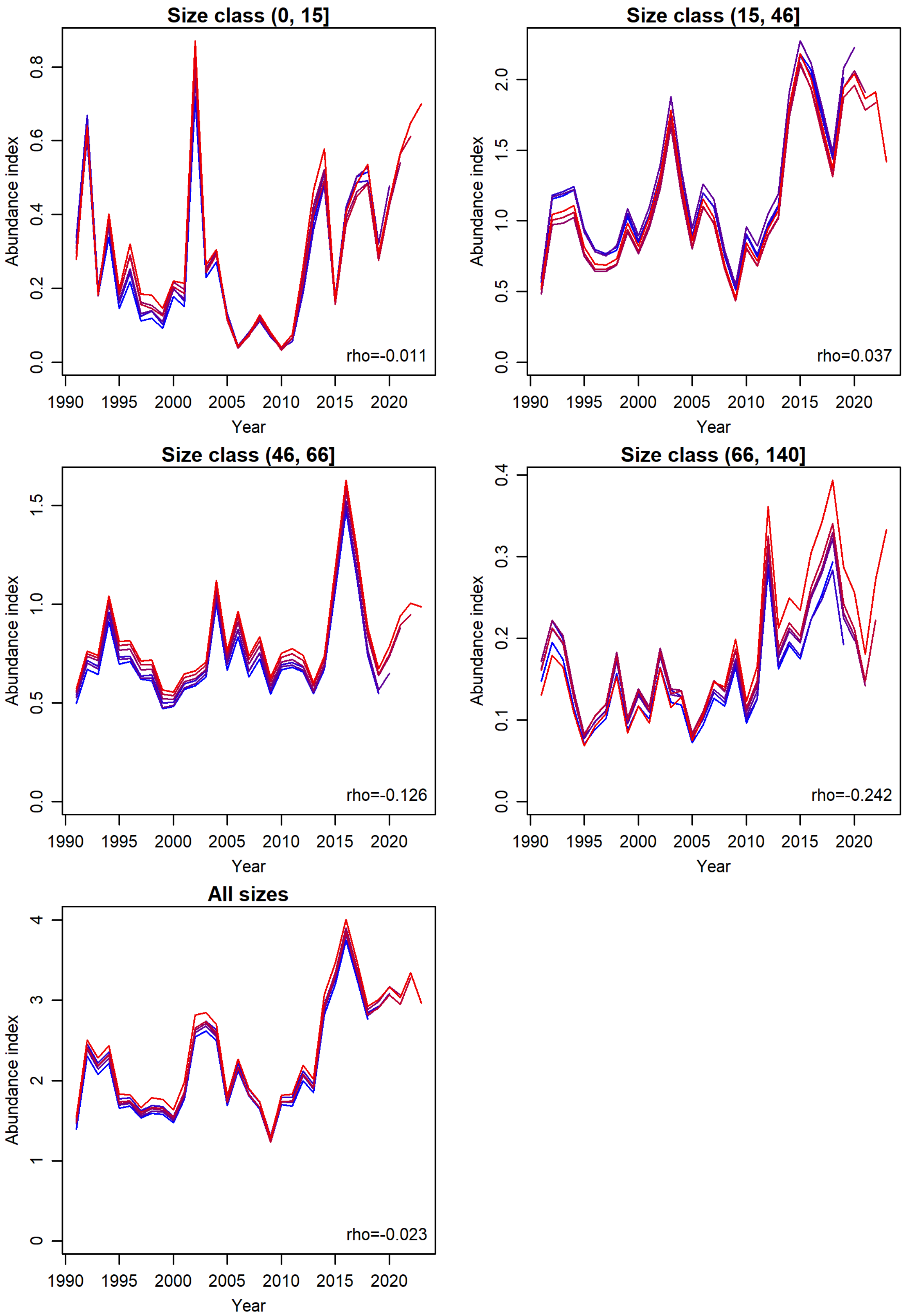


Figure 2.22. Anglerfish in 3a, 4 and 6. etrospective analysis of the abundance model for Q3&Q4 with five peels and the base along with the corresponding Mohn's rho value. The line colour changes accordingly from blue to red.

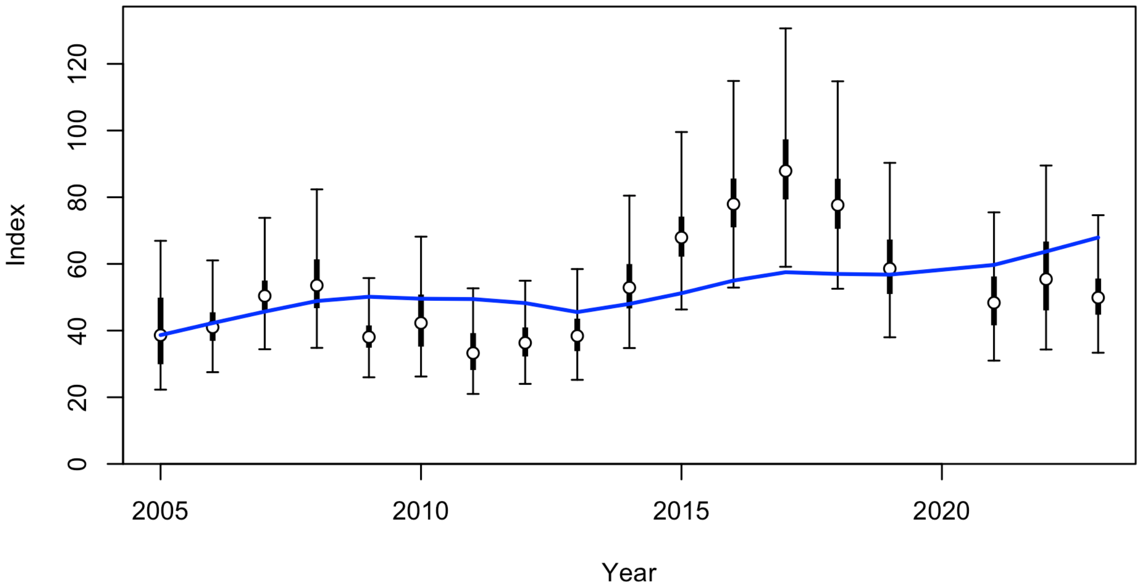


Figure 2.23. Anglerfish in 3.a, 4 and 6. SIAMISS index fit (in blue) to data. Lines indicate 95% uncertainty interval around index values based on the model assumption of lognormal error. Thicker lines indicate input uncertainty before the addition of estimated additional uncertainty parameter.

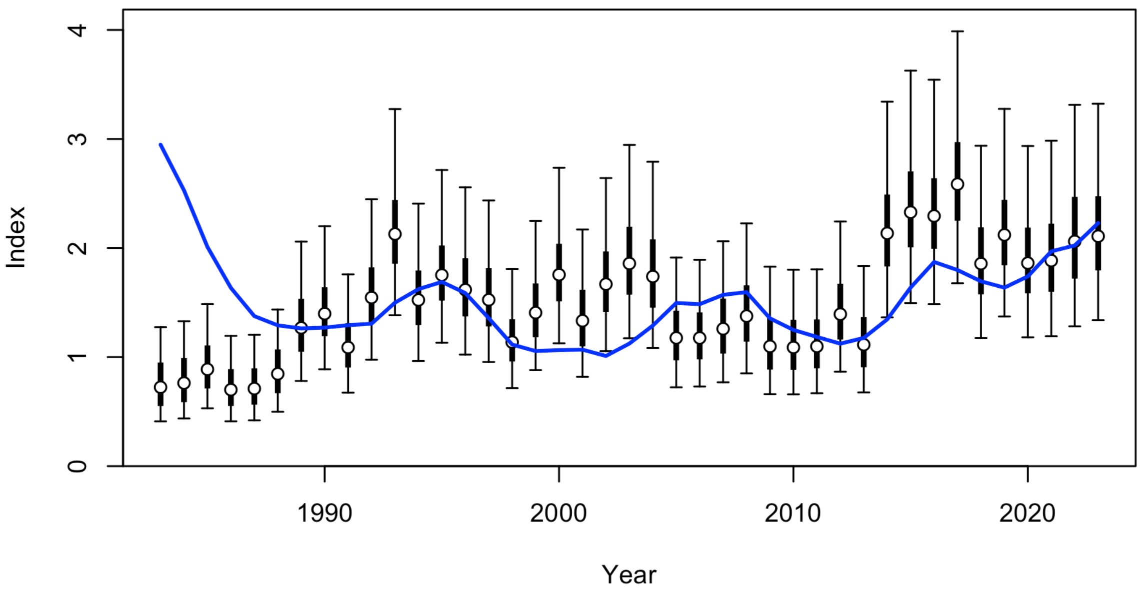
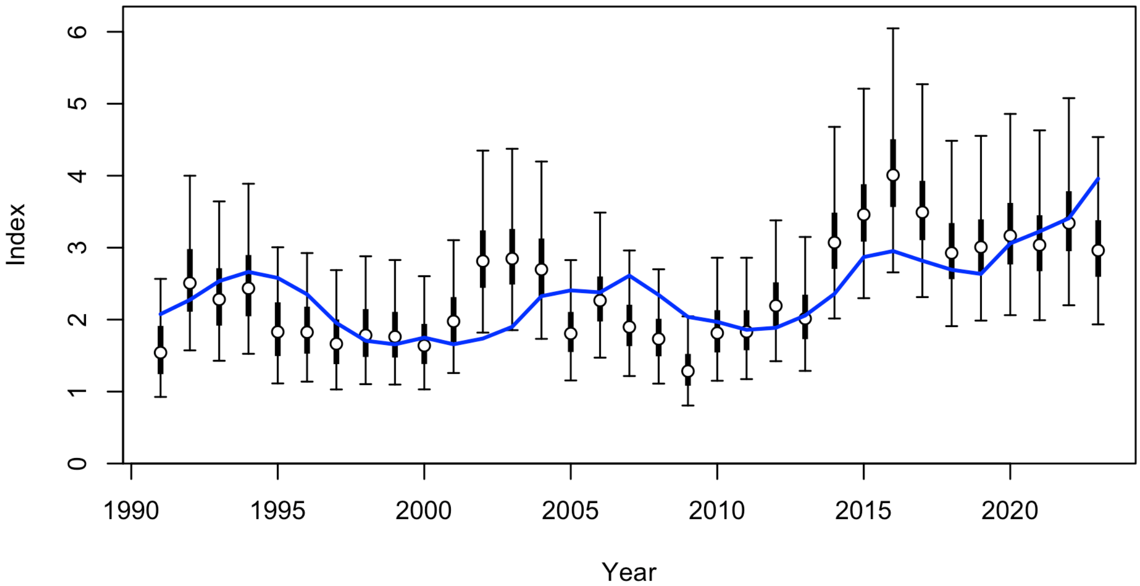


Figure 2.24. Anglerfish in 3.a, 4 and 6. IBTS Q1 index fit (in blue) to data. Lines indicate 95% uncertainty interval around index values based on the model assumption of lognormal error. Thicker lines indicate input uncertainty before the addition of estimated additional uncertainty parameter.



Index
0
1
2
3
4
5
6
1990
1995
2000
2005
2010
2015
2020
Year

Figure 2.25 Anglerfish in 3.a, 4 and 6. IBTS Q3+Q4 index fit (in blue) to data. Lines indicate 95% uncertainty interval around index values based on the model assumption of lognormal error. Thicker lines indicate input uncertainty before the addition of estimated additional uncertainty parameter.

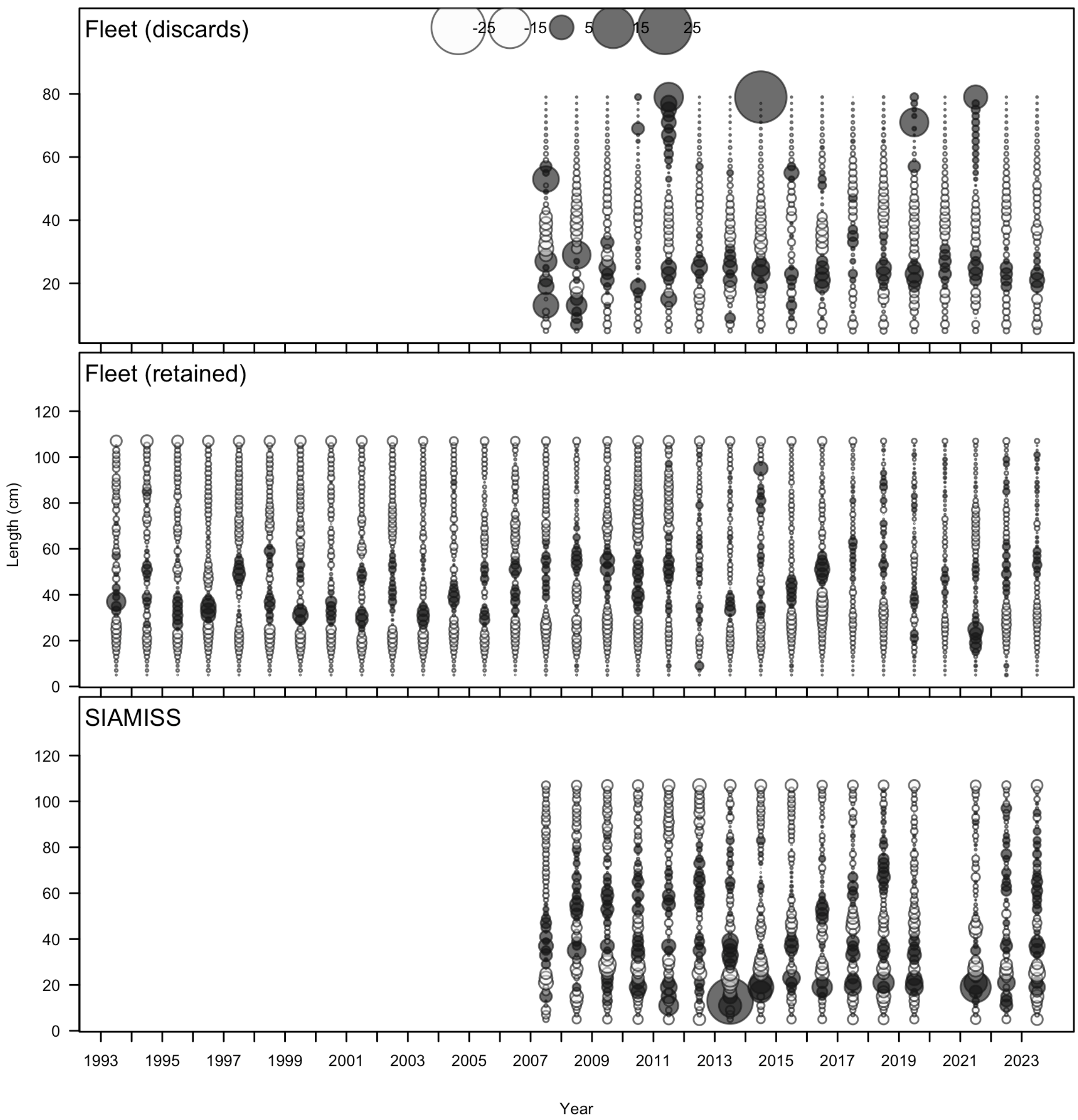


Figure 2.26. Anglerfish in 3.a, 4 and 6. Pearson residuals, comparing across fleets. Dark bubbles are positive residuals (observed > expected) and light bubbles are negative residuals (observed < expected).

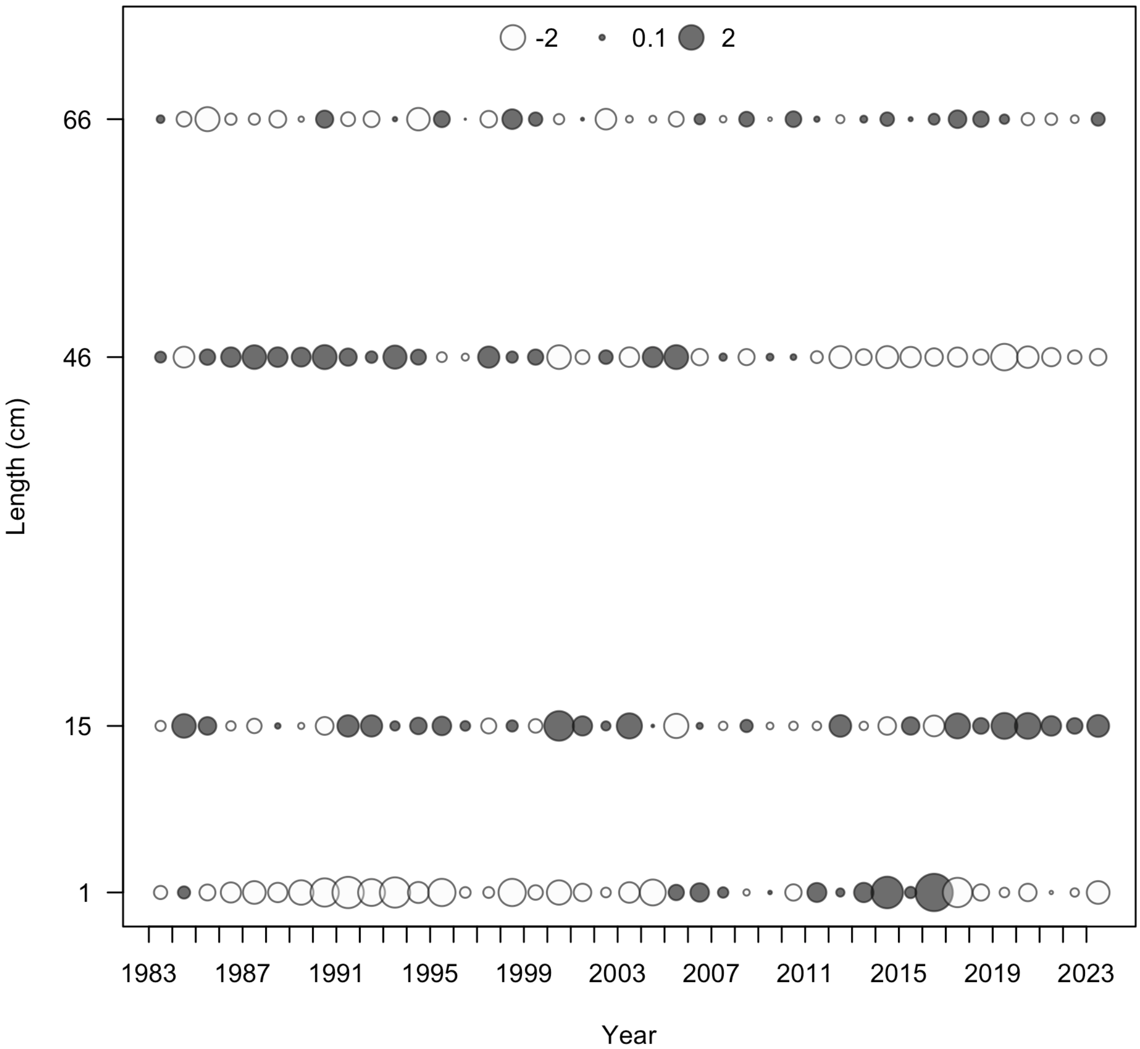


Figure 2.27. Anglerfish in 3.a, 4 and 6. Pearson residuals, IBTS Q1. Dark bubbles are positive residuals (observed > expected) and light bubbles are negative residuals (observed < expected).

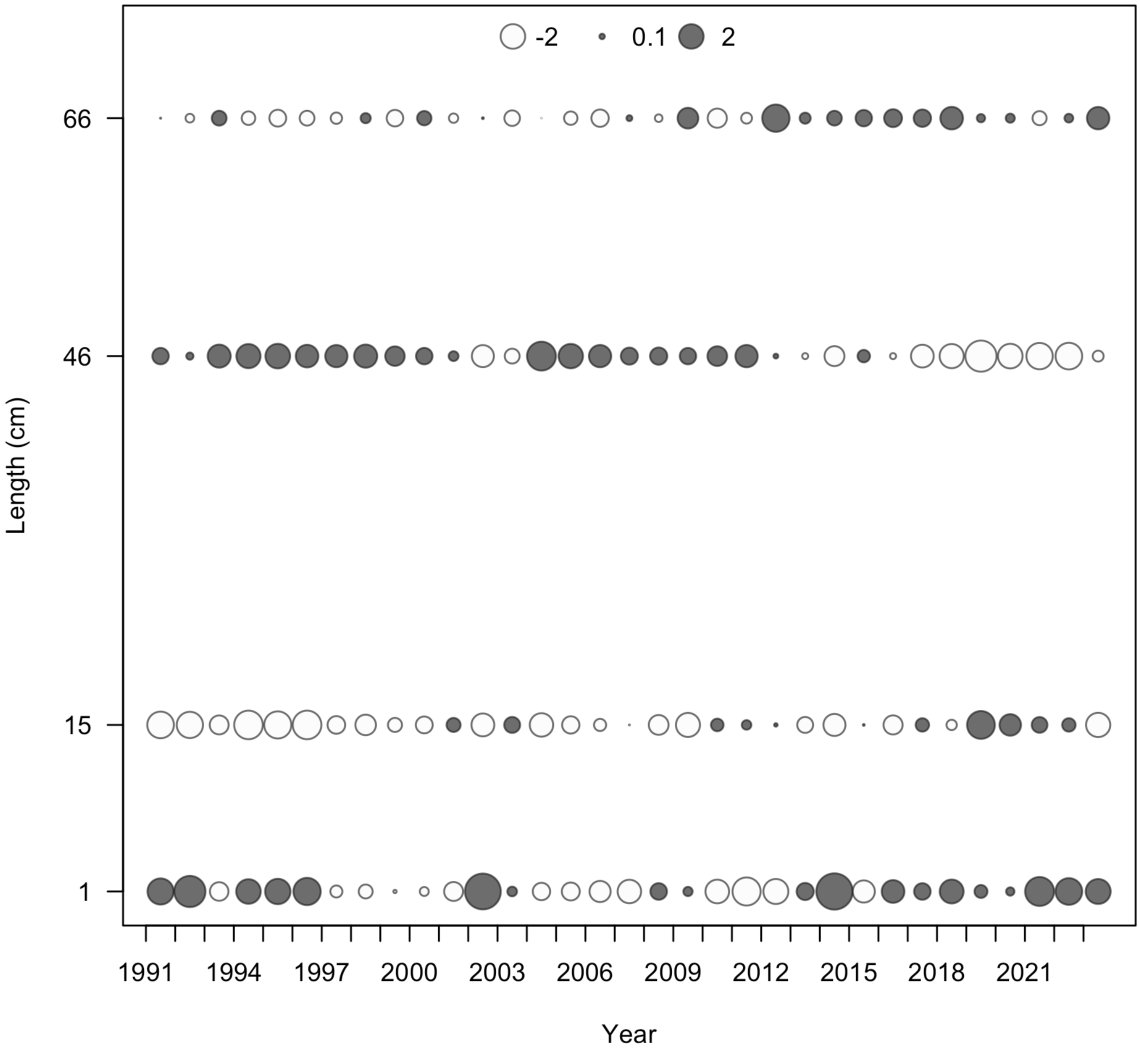


Figure 2.28. Anglerfish in 3.a, 4 and 6. Pearson residuals, IBTS Q3 & Q4. Dark bubbles are positive residuals (observed > expected) and light bubbles are negative residuals (observed < expected).

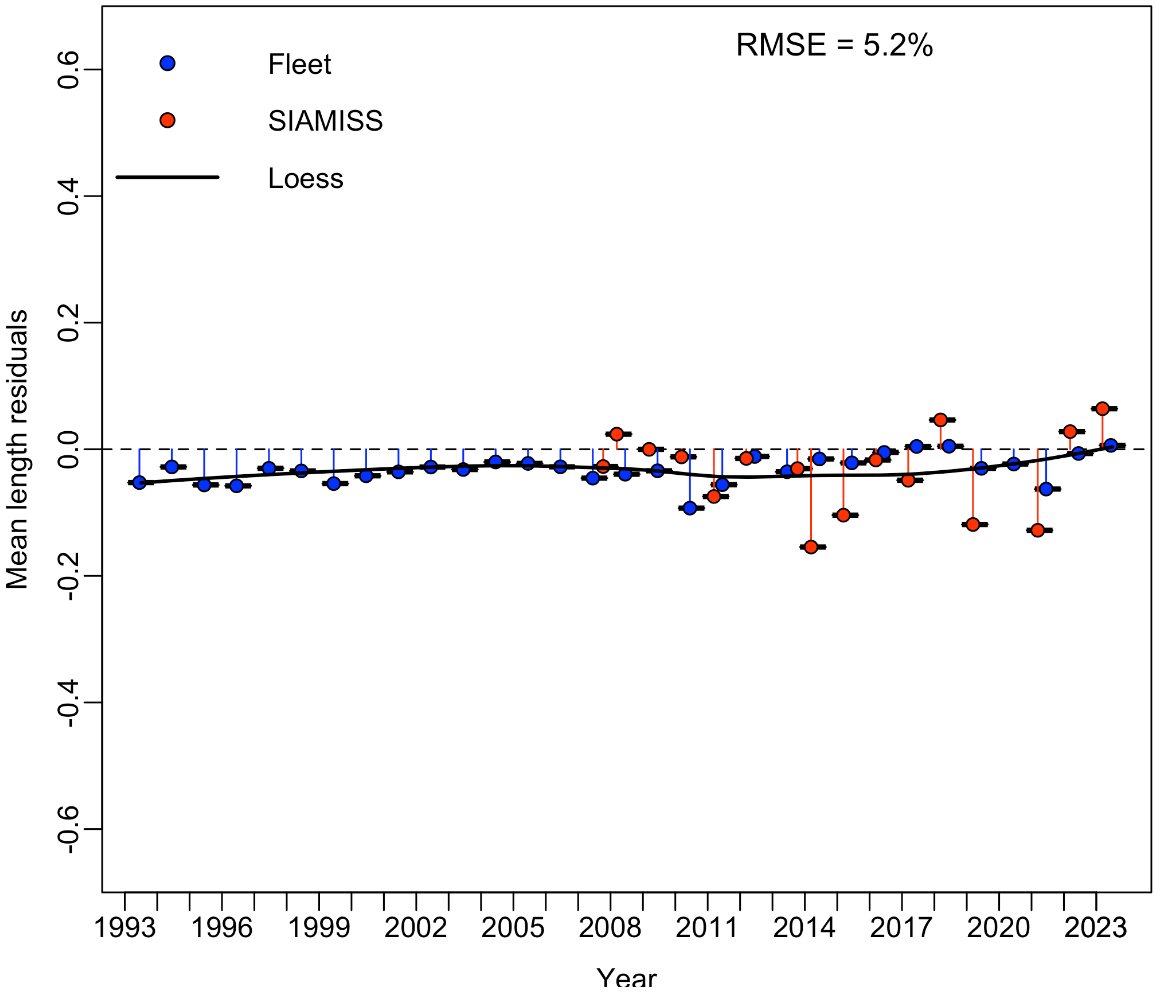


Figure 2.29. Anglerfish in 3.a, 4 and 6. Joint residual plot for to mean lengths. Boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner (value is below 30%).

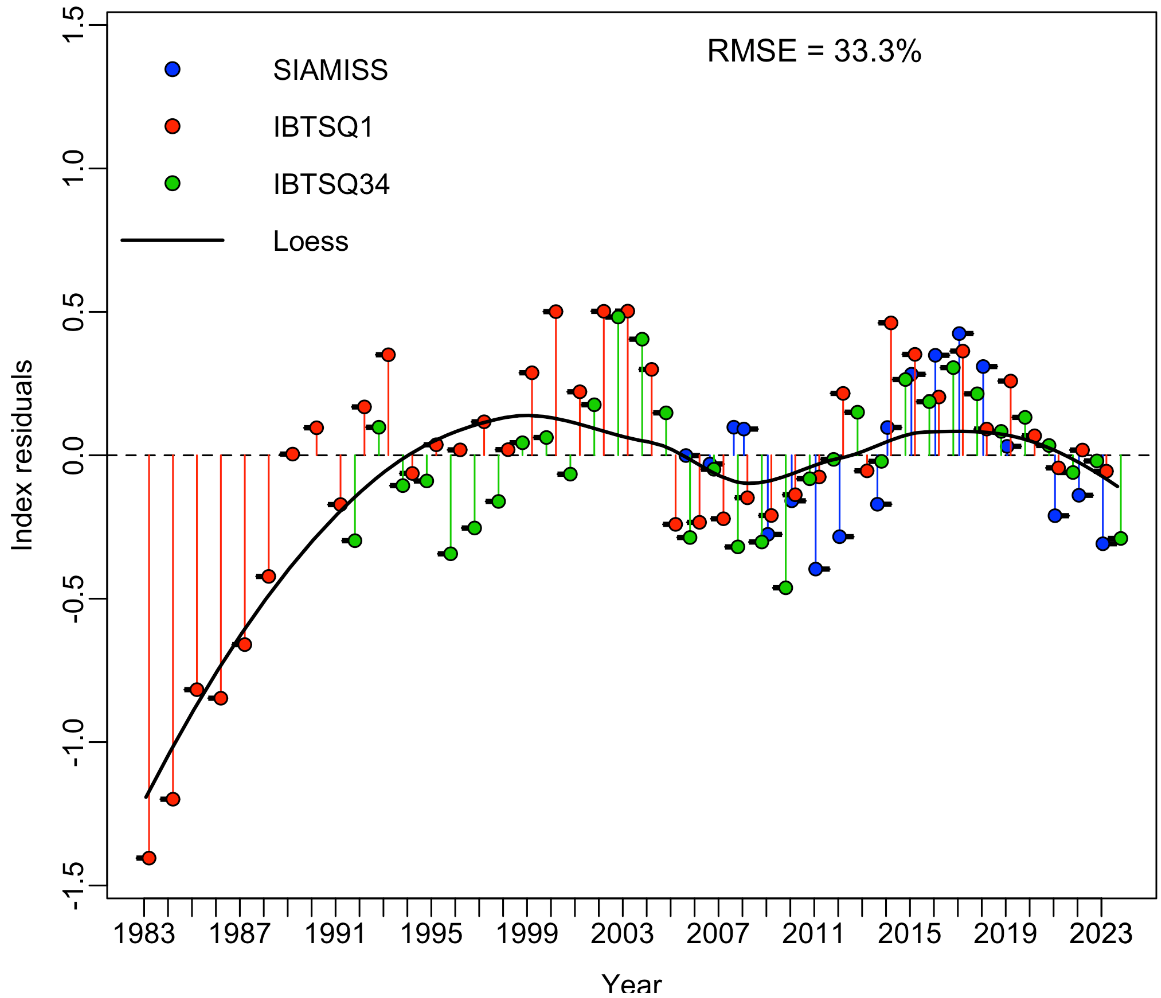


Figure 2.30. Anglerfish in 3.a, 4 and 6. Joint residual plot for to CPUE indices. Boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner of the plot (value is above 30%).

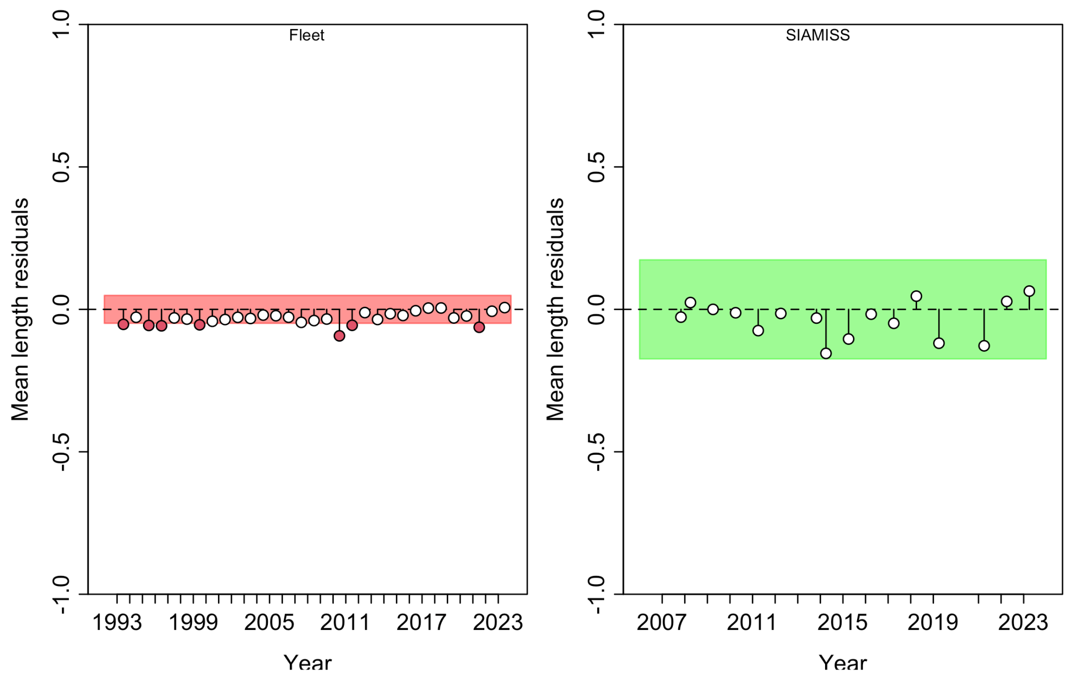


Figure 2.31. Anglerfish in 3.a, 4 and 6. Runs test plot fits to mean lengths. Green shading (p=0.05) no evidence to reject the null hypothesis of randomly distributed time-series of residuals for SIAMISS. The area spans three standard deviations to either side of zero.

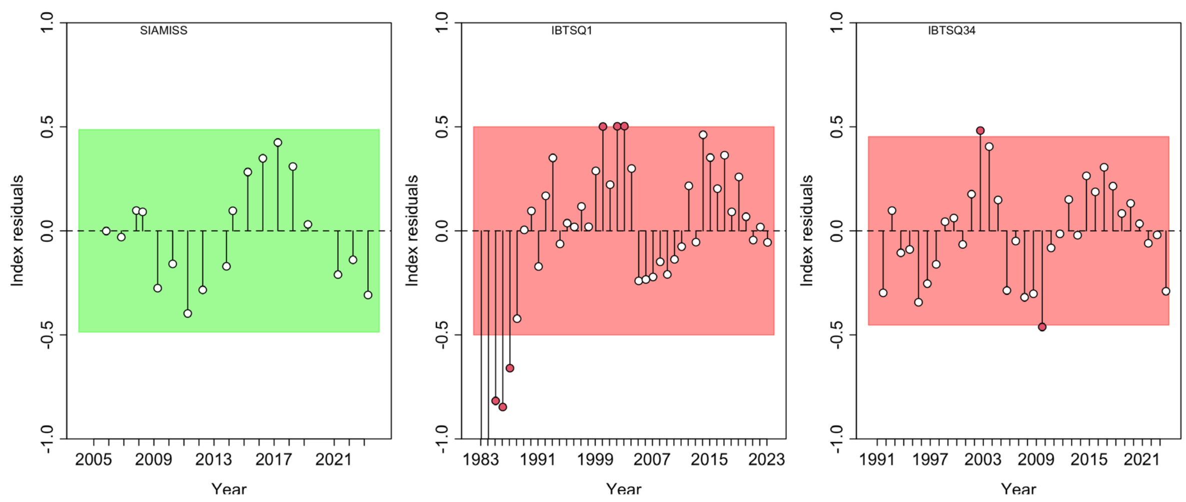


Figure 2.32. Anglerfish in 3.a, 4 and 6. Runs test plot fits to survey indices. Green shading (p=0.05) no evidence to reject the null hypothesis of randomly distributed time-series of residuals for SIAMISS. The area spans three standard deviations to either side of zero.

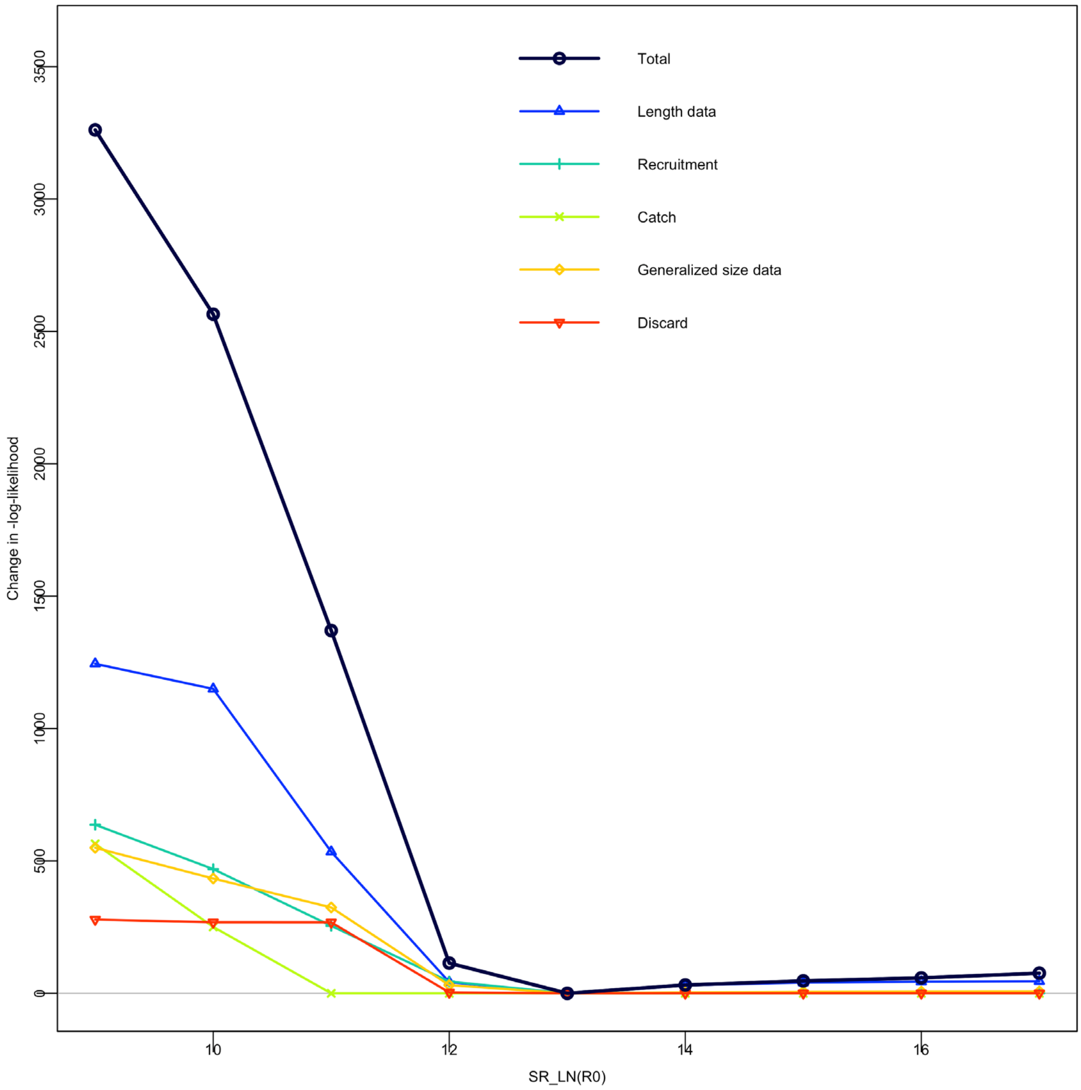


Figure 2.33. Anglerfish in 3.a, 4 and 6. R0 profile.

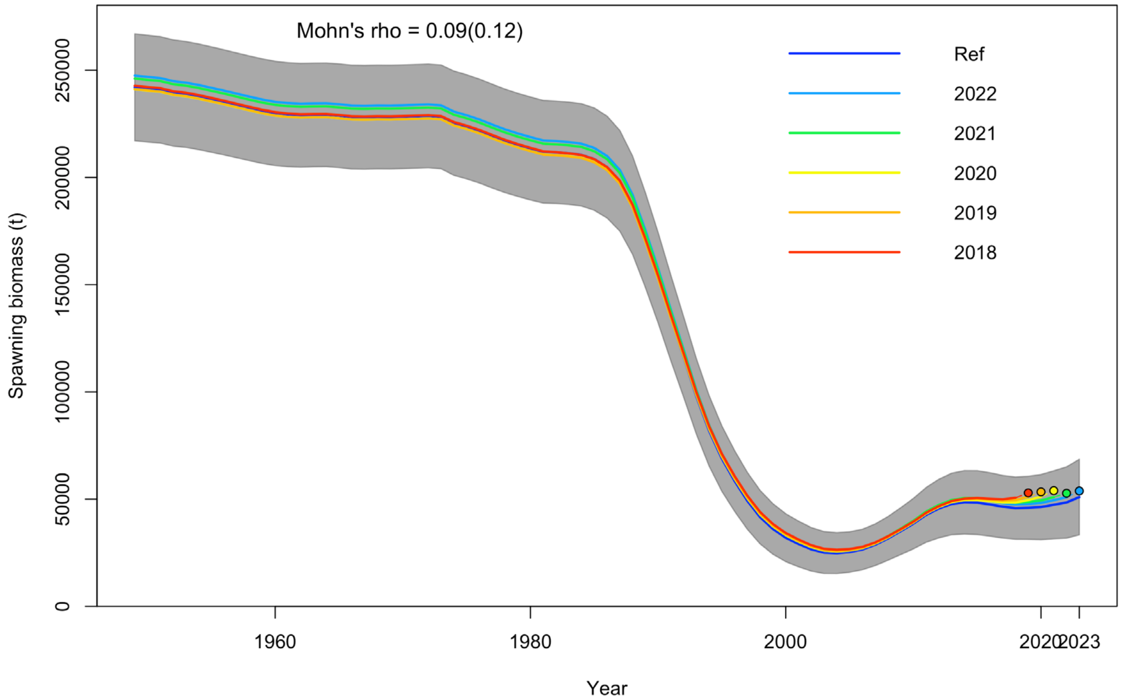


Figure 2.34 Anglerfish in 3.a, 4 and 6. Retrospectives and Mohn's rho value for SSB is 0.09 (Forecast Mohn's rho in brackets).

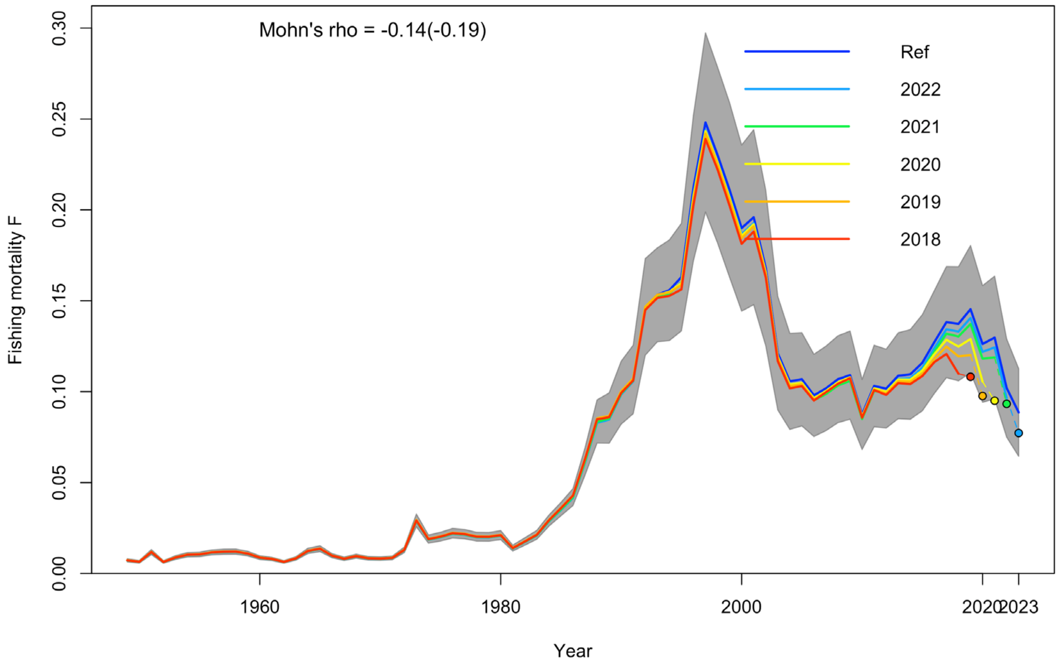


Figure 2.35 Anglerfish in 3.a, 4 and 6. Retrospectives and Mohn's rho value for F is -0.14 (Forecast Mohn's rho in brackets).

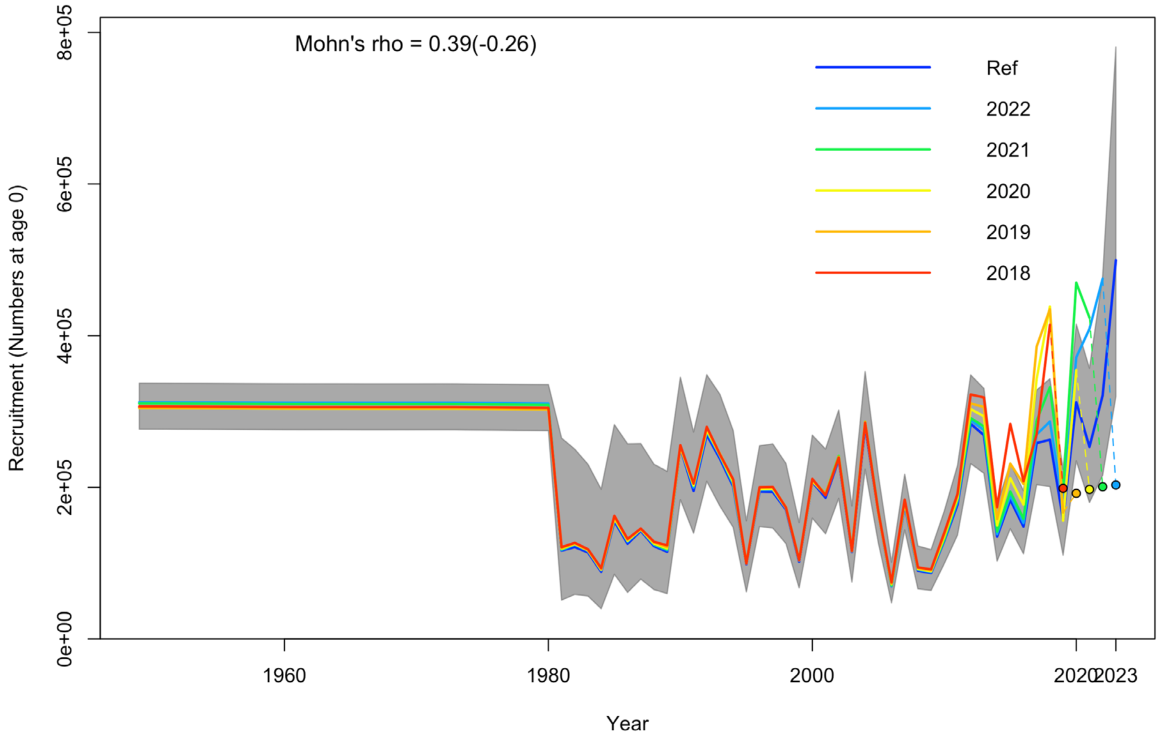


Figure 2.36. Anglerfish in 3.a, 4 and 6. Retrospectives and Mohn's rho value for F is 0.39 (Forecast Mohn's rho in brackets).

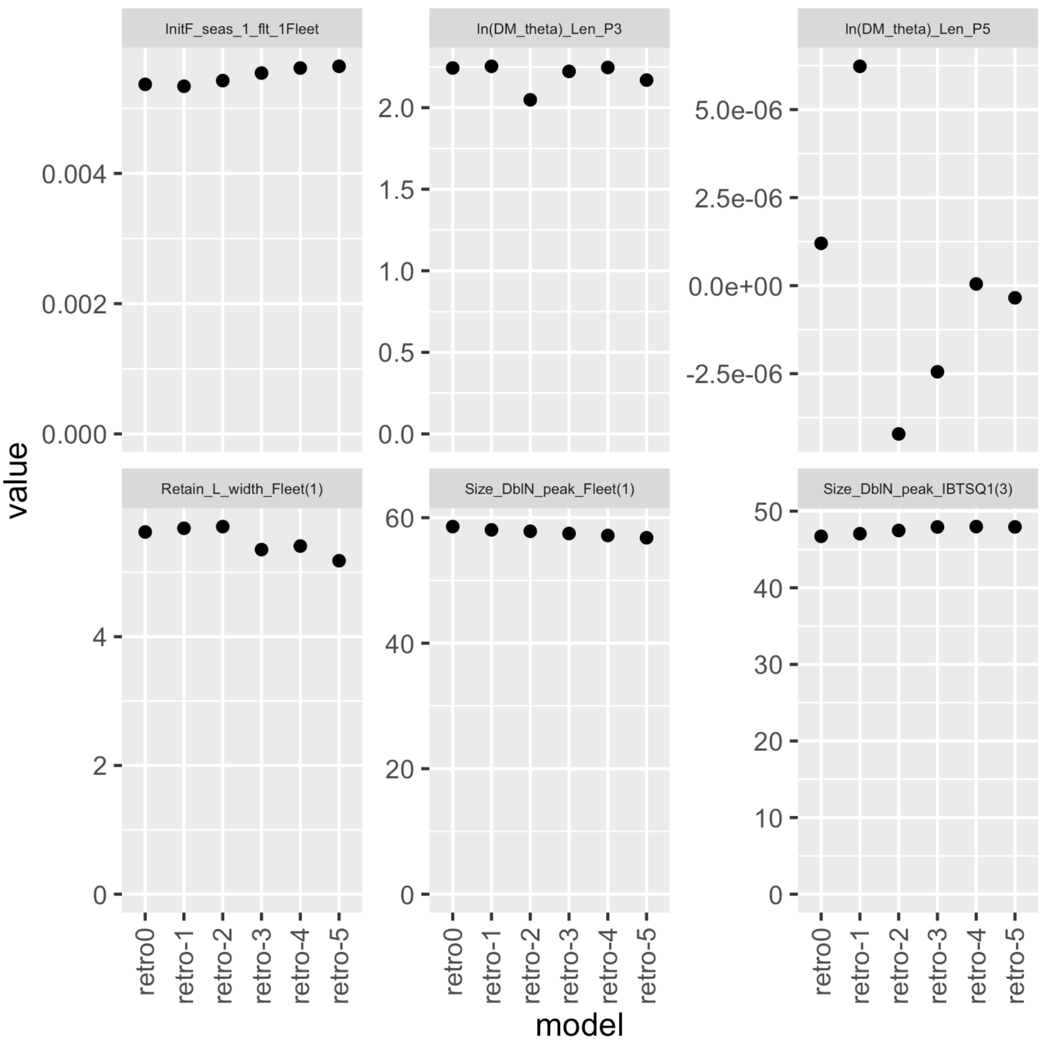


Figure 2.37 Anglerfish in 3.a, 4 and 6. Influence of parameters on retro runs. Value of the parameters which estimated value has a CV higher that 1% in the retro analysis.

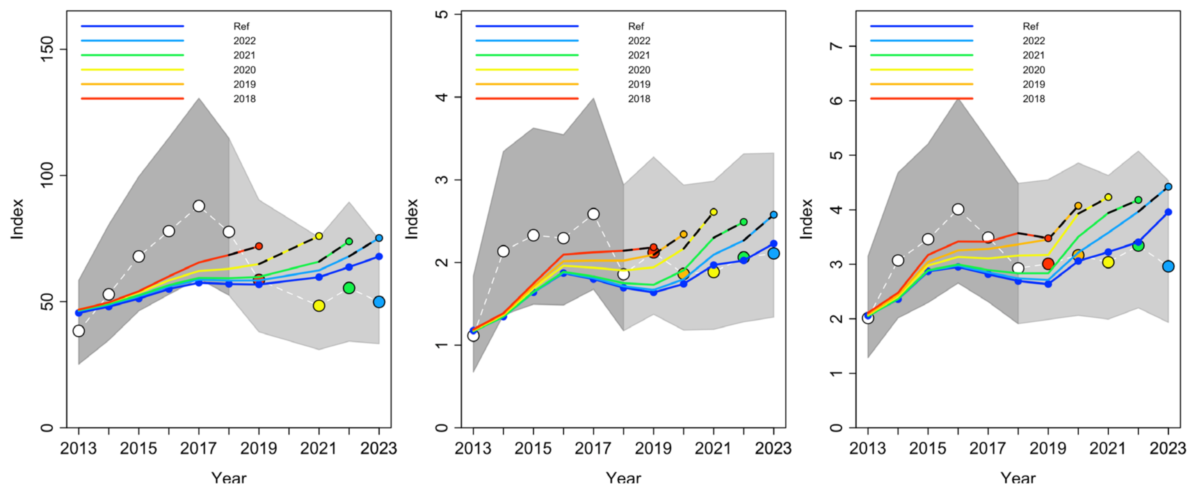


Figure 2.38. Anglerfish in 3.a, 4 and 6. Hindcast cross validation of survey indices (SIAMISS, IBTS Q1, IBTS Q3+Q4).

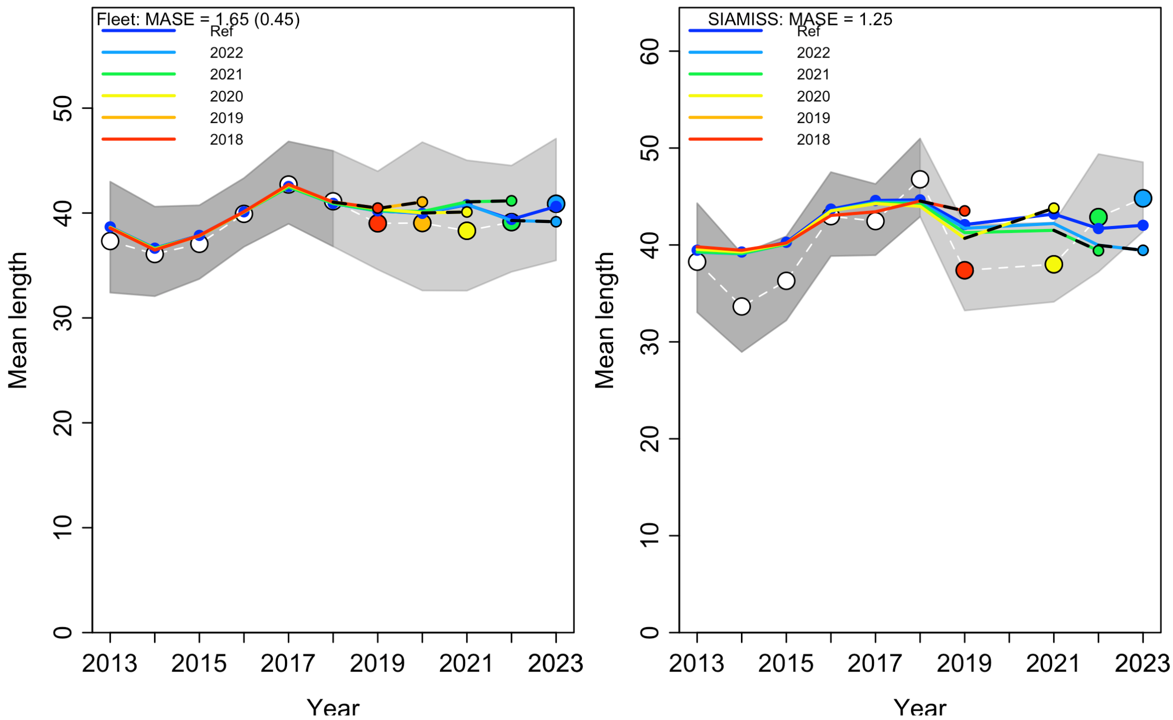


Figure 2.39 Anglerfish in 3.a, 4 and 6. Hindcast cross validation of catch fleet and SIAMISS mean length.

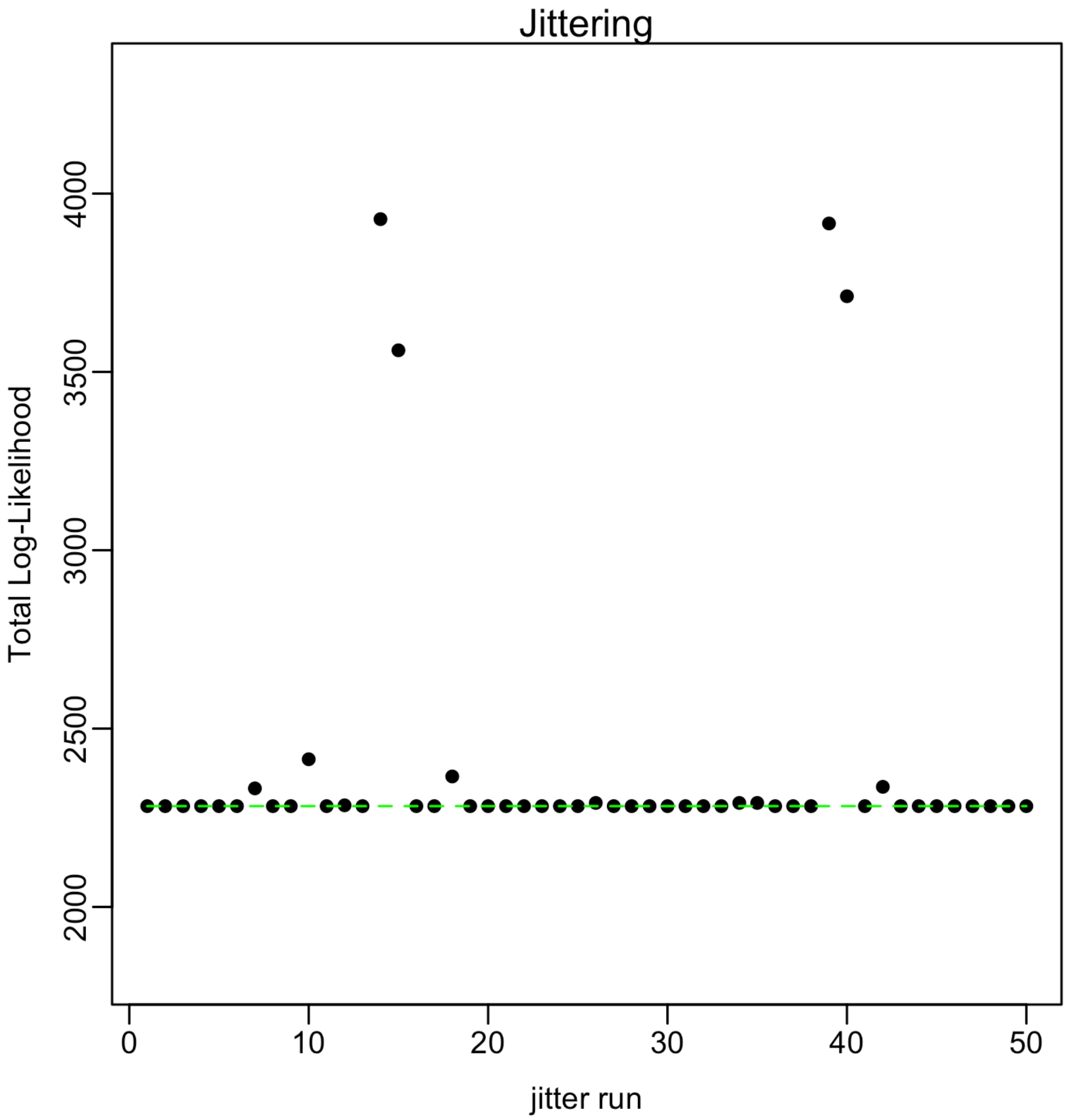


Figure 2.40. Anglerfish in 3.a, 4 and 6. Jitter runs, total log-likelihood of the final fit in dashed green (2282.61).

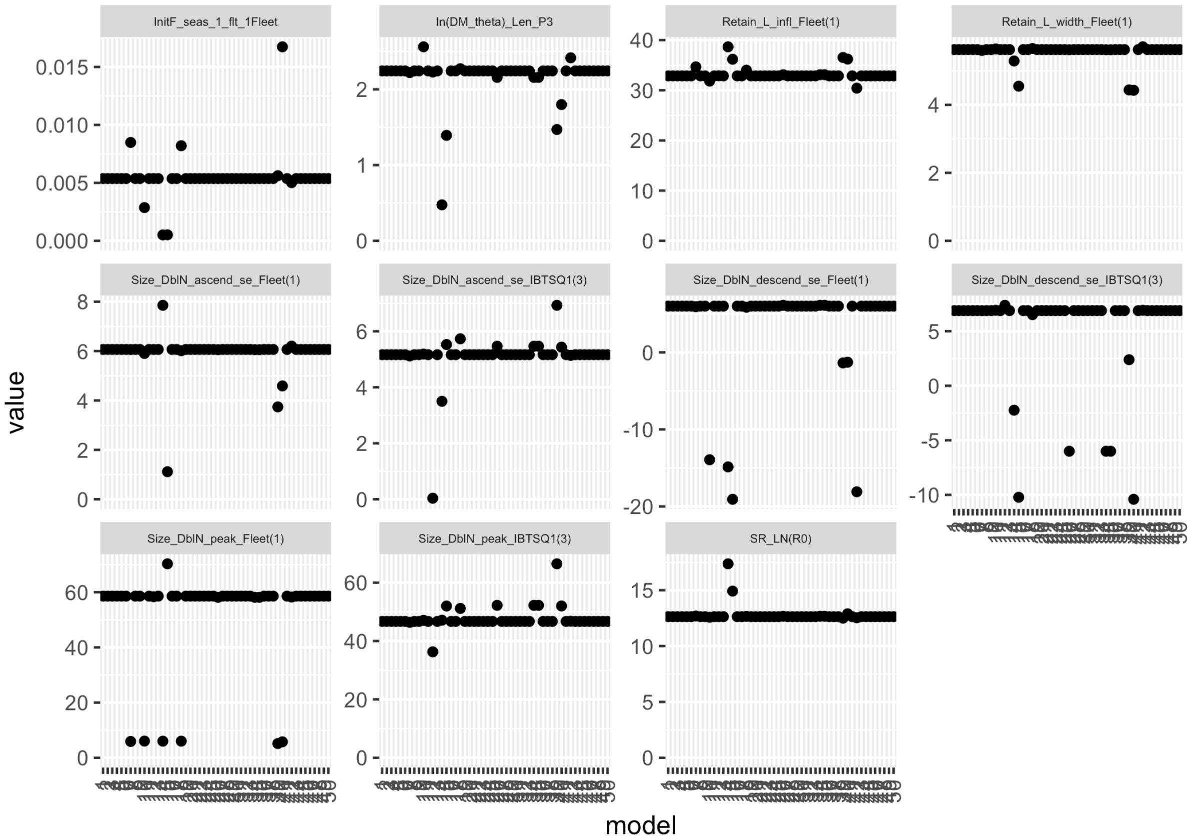


Figure 2.41 Anglerfish in 3a, 4 and 6. Influence of parameters on jitter runs. Value of the parameters which estimated value has a CV higher that 1% in the jitter analysis.

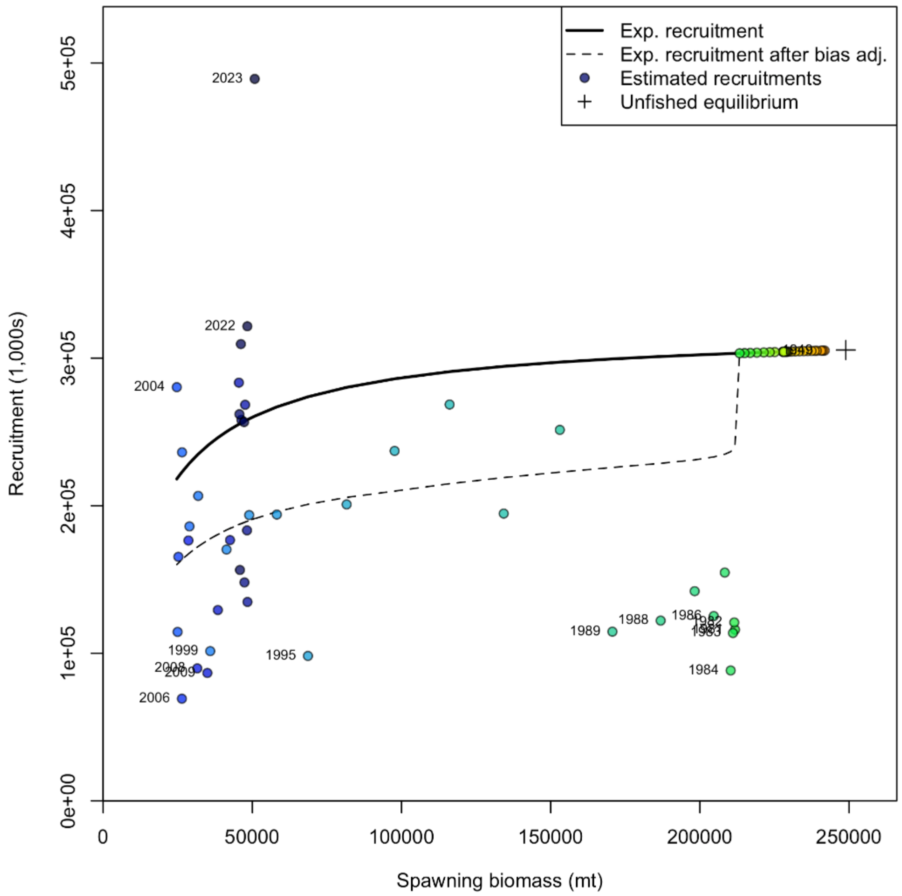


Figure 2.42. Anglerfish in 3.a, 4 and 6. Fitted stock recruit relationship. Year labels on first, last, and years with (log) deviations > 0.5. Point colours indicate year, with warmer colours indicating earlier years and cooler colours in showing later years.

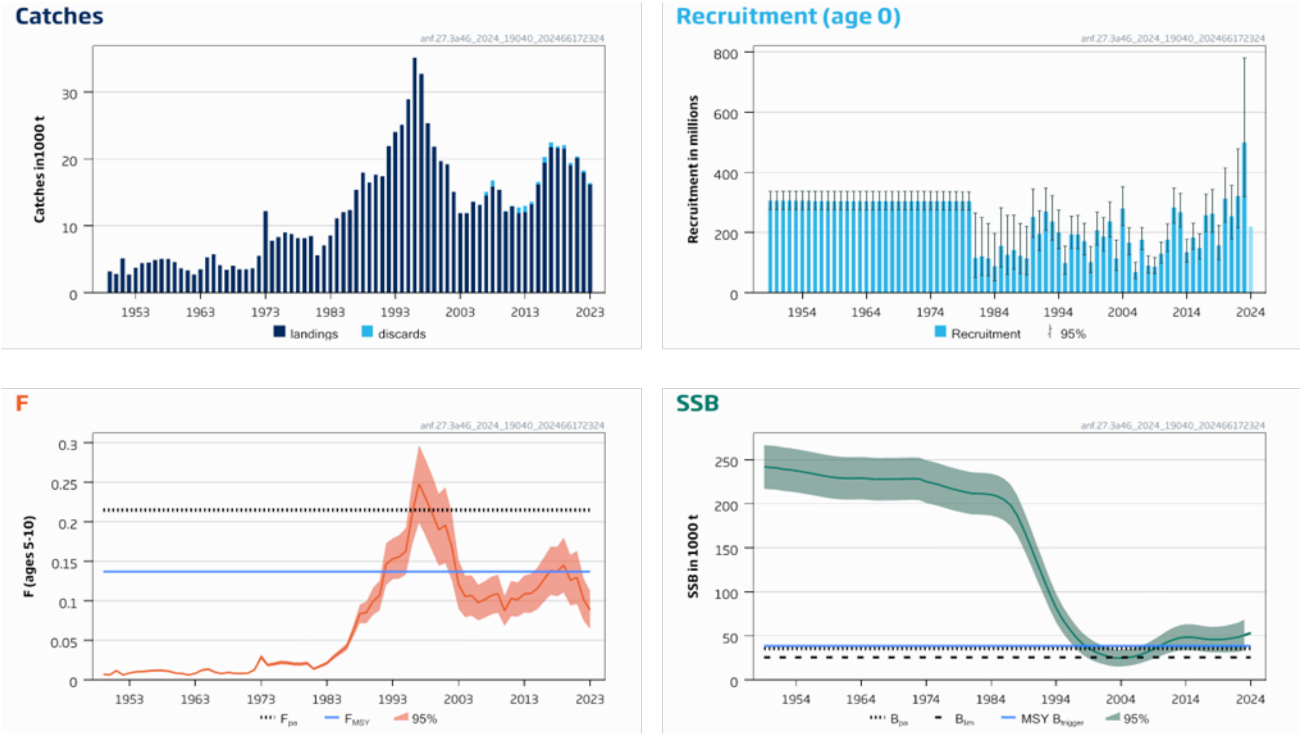


Figure 2.43. Anglerfish in 3.a, 4 and 6. Summary of the stock assessment. The assumed recruitment value for 2024 is shaded in a lighter colour.

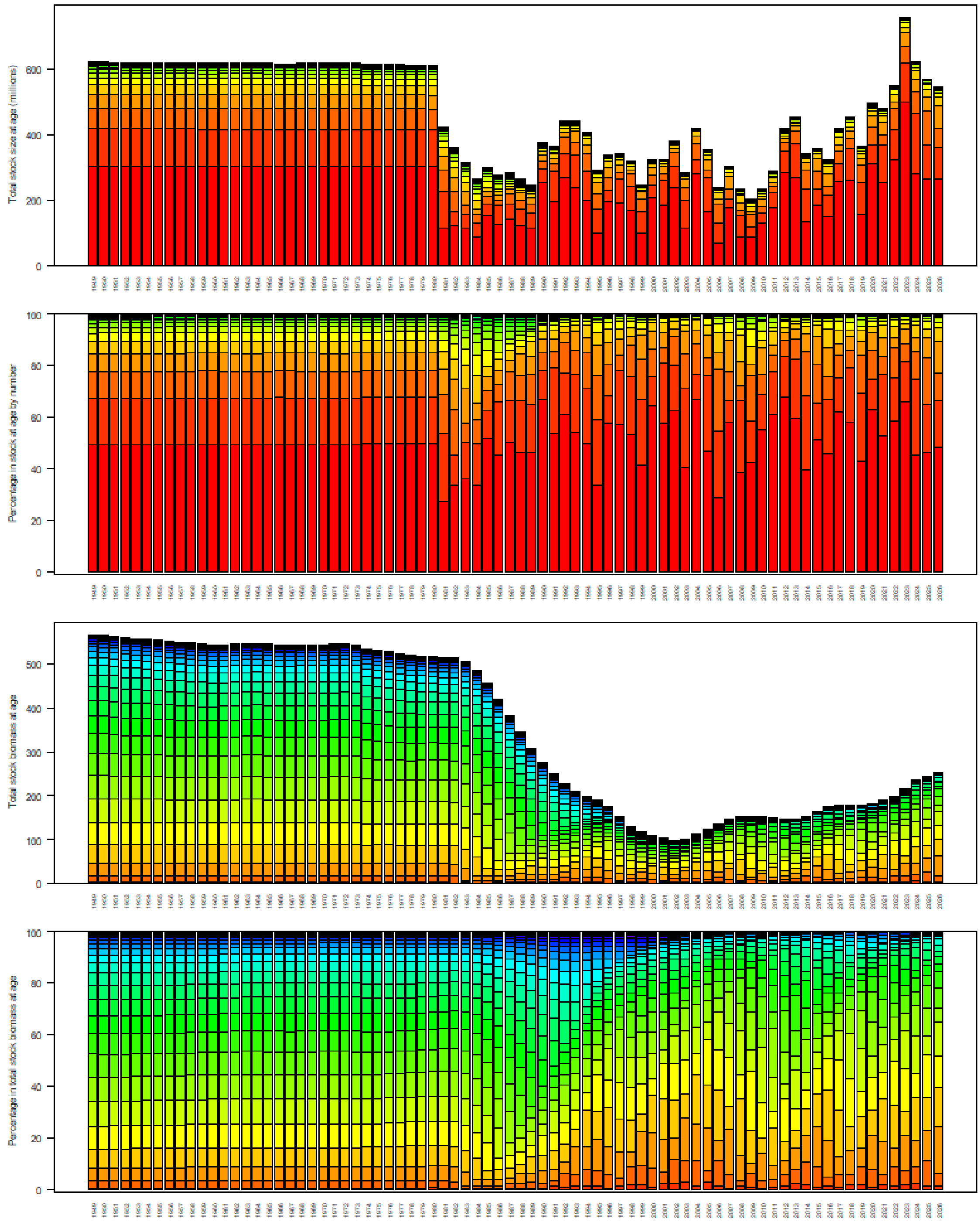


Figure 2.44. Anglerfish in 3.a, 4 and 6. Contribution to the stock by age. Total stock in number (millions) – top plot, percentage of stock in number – second plot, total stock biomass (kt) – third plot, percentage of stock biomass – bottom plot. Warm colours indicate younger ages, cool colours indicate older ages.

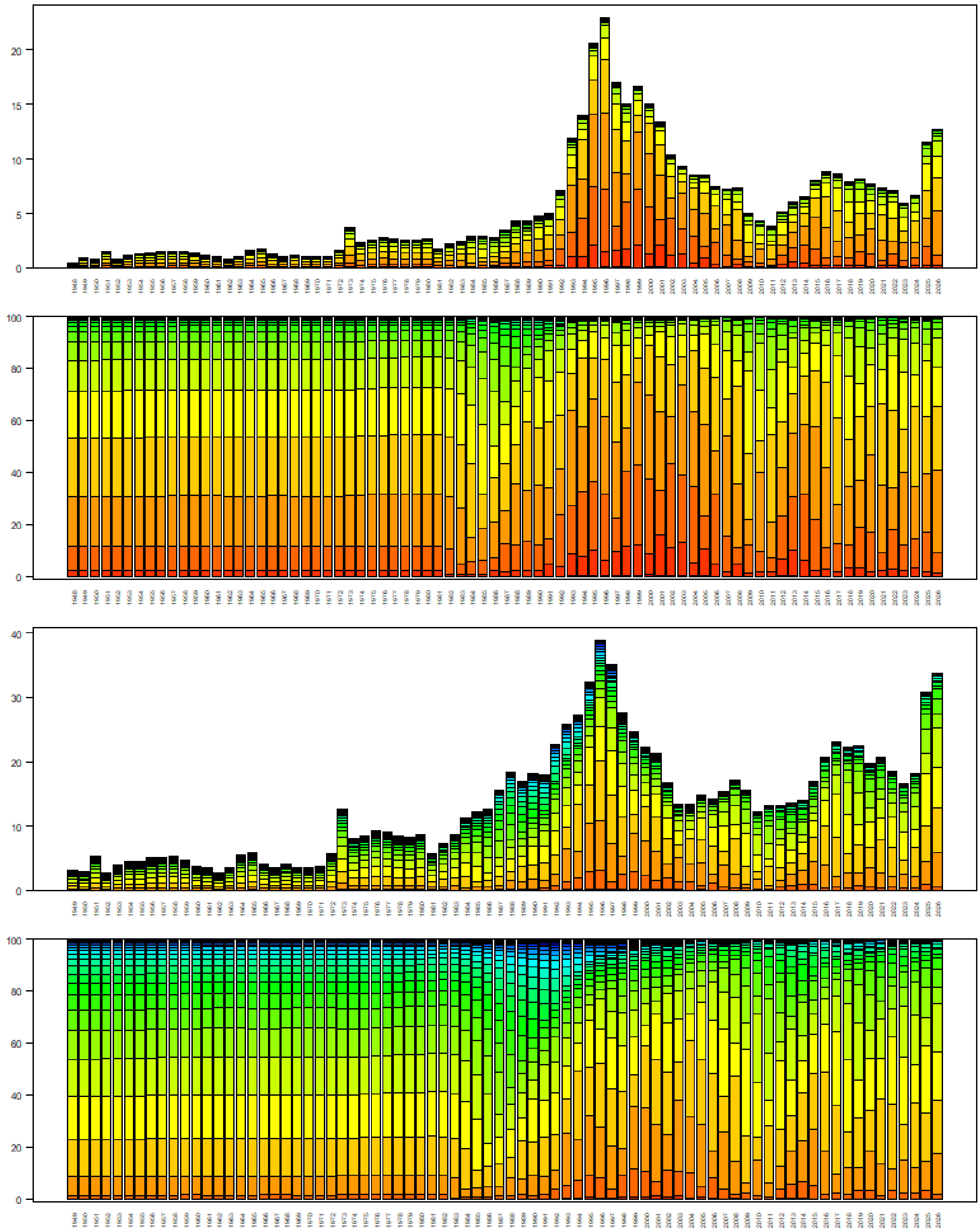


Figure 2.45. Anglerfish in 3.a, 4 and 6. Contribution to the catch by age. Total catch in number (millions) – top plot, percentage of catch in number – second plot, total catch in weight (kt) – third plot, percentage of catch by weight – bottom plot. Warm colours indicate younger ages, cool colours indicate older ages.

Contents

3 Cod (*Gadus morhua*) in Division 6.b (Rockall)

This chapter will not be updated in the report for 2024. This stock has existing multiannual advice that is still relevant for the reporting period.

Contents

4 Cod in 7.a (Irish Sea)

Situated between Ireland and Great Britain the Irish Sea (7.a) is connected by to the Celtic Sea (7.g) at its southern extreme by the St George's Channel and in north is linked to sea region West of Scotland (6.a) by the Northern Channel. The average depth is 50m but the area is contrasted between a deeper channel, in the west, and shallower bays in the east. The channel has a maximum depth exceeding 275m whilst the eastern bays have depths less than 50 m. Distinct habitat patches result from a combination of bathymetry, topographical features and hydrography. The sea bed of the eastern Irish Sea is dominated by fine sediment plains with some small areas of areas of mud habitat, the fine sediments graduate to more coarse material in central areas. A large well defined deep-water mud basin is located in the northwestern region in close to the Northern Irish and Irish coast.

Irish Sea fisheries are predominantly demersal trawling and seining with demersal trawling for *Nephrops* dominating effort with vessels using mesh in the range 70–99 mm. Effort using fishing gear with ≥100 mm mesh sizes is currently at a low level compared to historic activity, a considerable decline in effort was observed between 2003 and 2007 and has continued since. The species composition of catches by vessels in using ≥100 mm mesh consists primarily of haddock, with lower quantities of hake. At present there is no commercial towed gear fishery for cod permitted. Beam trawls are operating within the Irish Sea with mesh sizes in the range 80–119 mm, targeting sole, plaice, and rays. A seasonal pelagic and gillnet herring fishery operates in late summer–early autumn in the pre and post spawning period. Dredge fisheries target king and queen scallops, with king scallops in coastal areas with 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 trawl nets, during the late summer when swimming activity is most pronounced.

There is a recreational fishery which catches cod and with declining commercial rates has become a more important aspect of the total catch. At the last benchmark in February 2022 (ICES, 2023a) the recreational fishery was included in the assessment for the first time, however uncertainties in the data resulted in the exclusion of data from the assessments.

Type of assessment

The stock was benchmarked in February 2022 (ICES, 2023a) and a Stock Synthesis (SS3) fully analytical model is now being used in the cod assessment.

ICES advice applicable to 2023

ICES advised on the basis of precautionary approaches that there should be no directed fisheries, and bycatch and discards should be minimized in 2023. Advice for 2023 was zero catch under the MSY approach.

ICES advice applicable to 2024

ICES advised on the basis of the MSY and precautionary approach that there should be zero catches in 2024 as SSB will be below Blim in 2024 and 2025 (ICES 2023b).

4.1 General

Stock description and management units

The stock and the management unit are both ICES Division 7.a (Irish Sea).

4.1.1 Management applicable to 2023

Table 1: Fishing opportunities (TAC) for 2023 for cod in 27.7.a

	TAC	Landed
Belgium	2	1.3
France	6	0
Ireland	82	18.6
Netherlands	1	0
Union	91	20
United Kingdom	74	36
Total	165	56

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2022.104.01.0001.01.ENG

4.1.2 Fishery in 2023

Landings remained below the set TAC for 2023 of 165 tonnes.

Since 2009, Irish landings of cod reported from ICES rectangles immediately north of the Irish Sea/Celtic Sea boundary (ICES rectangles 33E2 and 33E3) have been reallocated into the Celtic Sea as they represent a combination of inaccurate area reporting and catches of cod considered by ICES to be part of the Celtic Sea stock (ICES, 2009). The amount of Irish landings transferred from 7a to 7e–k by year is shown below. Total official landings for this stock in 2023 were 19 tonnes after this re-allocation and total catches in the area were 75t.

Table 2: Transfers from ICES rectangles 33E2 and 33E3

Year	Tonnes
2004	108
2005	54
2006	103
2007	527
2008	558
2009	193
2010	143
2011	147
2012	130
2013	75
2014	24

Year	Tonnes
2015	39
2016	40
2017	19
2018	20
2019	37
2020	71
2021	52
2022	30
2023	19

The majority of landings in 2023 were taken by the Nephrops fleet, while the demersal fleet only contributed with 33% to the landings. Landings and discards by métier and country can be seen in Table 8. Total uptake of cod TAC was at just 34%.

A Fishery–Science Partnership Survey (FSP) was repeated in the western Irish Sea in spring 2023 in the western Irish Sea using semi-pelagic gear on commercial vessels. This survey attempts to address the lack of sampling opportunities created by the diminishing TAC for cod in the Irish Sea and the resulting significant reduction of a directed whitefish fleet targeting cod.

4.1.3 InterCatch procedure

Since 2013 international landings and discards-at-age are uploaded into InterCatch. Discards are raised for unreported strata and métiers to estimate total discards-at-age.

4.1.4 Landings

The input data on fishery landings and age compositions are split into four periods:

1968–1990. Landings in this period, provided to ICES by stock coordinators from all countries, are assumed to be un-biased and are used directly as the input data to stock assessments.

1991–1999. TAC reductions in this period caused substantial misreporting of cod landings into several major ports in one country, mainly species misreporting. Landings into these ports were estimated based on observations of cod landings by different fleet sectors during regular port visits. For other national landings, the WG figures provided to ICES stock coordinators were used.

2000–2005. Cod recovery measures were considered to have caused significant problems with estimation of landings. The ICES WG landings data provided by stock coordinators for all countries are considered uncertain and estimated within an assessment model. Observations of misreported landings were available for 2000, 2001, 2002 and 2005. However, they have generally not been used to correct the reported landings but have been used to evaluate model estimates in those years.

Since 2006. The introduction of the UK buyers and sellers legislation is considered to have reduced the bias in the landings data but the level to which this has occurred is unknown. Consequently comparisons were made between the fit of the model to recorded landings under an assumption of bias and unbiased information.

2020. The Covid-19 pandemic made the collection of observer data aboard vessels impossible for Q2-Q4, making the estimation of discard data and the establishment of age structure in catches impossible for most of the year. Age structure of the stock is available from Q1 observer data and the 3 surveys, FSP, and Q1 and Q4 groundfish surveys.

2021 The continued COVID-19 situation resulted in reduced sampling; for the quarter 1 2021 the full final tow of the TR1 fleet was landed and sampled by observers ashore. There was very low sampling of cod in the *Nephrops* directed fleet, particularly in quarter 1 due to no observed trips. A raising procedure similar to the previous year was applied, in which the cod sampled in the Northern Ireland fishers self-sampling scheme were applied and raised to the full nephrops *Nephrops* catches. However, no cod were found in the provided self samples.

7) sampling by the Irish Republic did not take place in 2022 and 2023 in the Irish Sea, however there were sufficient samples to account for the missing sample data.

The annual numbers-at-age caught and the mean weights-at-age in landings (applied to the total catch) by age are given in Table 9 and Table 10; numbers of catch-at-age for 2020 are excluded due to limited discard and port sampling during the COVID-19 pandemic.

4.1.5 Discards data

The WKIrish3 (ICES, 2017) benchmark report gives details on historic raising to total national and international discards.

4.1.6 Biological data

Natural mortality

Natural mortality has been revised in WKNSCS (ICES, 2023a). M-at-age was calculated from tagging data following calculated following (Pollock, Hoenig and Jones 1989, Hoenig, Barrowman et al. 1998). Natural mortality is kept constant throughout years.

Maturity

Maturity ogive has been revised in WKIrish2 (ICES, 2016). Each year the smoother is applied to the full time-series of raw data and values are accordingly updated. Updated values after application of the smoother are in Table 12. Please refer to the stock annex for further information.

Survey data used for advice

Please refer to the stock annex (see Annex 2) for a description of the surveys and survey data.

Survey	Ages	Years
FSP survey (B7897)	2-6	2004-2023 (excluding 2014)
NIGFS-WIBTS-Q4 (G7655)	0	1995-2023
NIGFS-WIBTS-Q1 (G7144)	1-4	1995-2023

4.2 Historical stock development

The advice is based on the assessment benchmarked in 2022 (WKNSCS, ICES, 2023a) and revised in 2023 (ICES, 2023b).

4.2.1 Deviations from Stock Annex

The assessment follows the Stock Annex.

4.2.2 Final assessment:

The final assessment has been run in stock Synthesis (SS3). Available data and catch at age, discards at age and numbers at age in surveys can be seen in Figure 1–3, Figure 7 and Tables 9–13, while summary of assessment results can be seen in Table 14.

The fit of the model catch at age data and to the indices is good, showing "all green" runs tests (Figure 12 and Figure 13) as well as the individual residuals. Furthger details on the use of the Runs tests and RMSE can be found in Carvalho *et al.*, 2021. The retrospectives provide a good fit with Mohns rho for SSB and Fbar at -0.03 and -0.05 respectively (Figure 15).

The final results of the assessment can be seen in Figures 4–6.

4.3 Short-term predictions

Short term forecast was carried out in using the FLR forecast environment. Assumptions for the intermediate year can be seen in Table 3. Geometric mean for recruitment is from 2002–2021 (Final year-2), which encompasses the block where recruitment is supposedly reduced.

Table 3: Short term forecast assumptions

Variable	Value	Notes
$F_{ages\ 2–4}$ (2024)	0.02	$F_{sq} = F_{average(2021–2023)}$
SSB (2025)	6399	Short-term forecast fishing at f_{sq}; in tonnes.
$R_{age\ 0}$ (2024 and 2025)	23431	Geometric Mean (2002–2021); in thousands.
Total catch (2024)	103	Fishing at F_{sq}; in tonnes
Projected landings(2024) ((2022)((20(2022(2020)	94	Assuming average landing patterns (2021–2023); in tonnes
Projected discards (2024)	9	Assuming average discard patterns (2021–2023); in tonnes

Table 4 shows the catch scenarios, in particular the zero catch advice and the scaled MSY advices due to SSB being below MSY $B_{trigger}$ and unable to reach B_{lim} even under a no-catch scenario. F_{ECO} is also included in a scaled version. With the Sea Surface temperature Index being being high for the recent years, F_{ECO} is currently set at 0.14, at the lowest value possible.

Table 4: Catch scenarios for 2025; all weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change *	% TAC change ^
MSY approach: F = 0	0	0	0	0	0	0	6311	-1.37	−100
MSY approach: F_{MSY} × SSB (2025)/MSY $B_{trigger}$	368	325	43	0.084	0.073	0.0110	5949	-7.04	123
F = 0	0	0	0	0	0	0	6311	-1.37	-100
EU MAP**: $F_{MSY\ lower}$ × SSB (2025)/MSY $B_{trigger}$	303	268	35	0.069	0.060	0.0090	6012.503	-6.04	84
EU MAP**: $F_{MSY\ lower}$	601	531	70	0.14	0.122	0.0184	5720	-10.6	264
F = F_{MSY}	727	641	86	0.171	0.149	0.0224	5598	-12.52	341
F = F_{pa}	958	844	114	0.23	0.1998	0.030	5372	-16.0	480
F = $F_{MSY\ upper}$	919	810	109	0.22	0.19	0.029	5410	-15.56	457
F = F_{2024}	88	78	10	0.019	0.017	0.0025	6224	-2.73	-47
F = F_{lim}	1294	1138	156	0.32	0.278	0.042	5048	-21	684
F=F_{ECO}	601	531	70	0.14	0.122	0.0184	5720	-10.6	264
F_{ECO} × SSB(2025)/MSY $B_{trigger}$	303	268	35	0.069	0.060	0.0090	6012	-6.04	84
Rollover TAC	165	146	19	0.0370	0.032	0.0049	6148	-3.92	0
SSB (2026) = SSB (2025)***									

* SSB 2026 relative to SSB 2025.

** EU multiannual plan (MAP) for the Western Waters (EU, 2019).

***SSB(2026) = SSB(2025), SSB (2026) = Blim and SSB(2026)= B_{pa} = MSY $B_{trigger}$ options were left blank because none of them can be achieved in 2026, even with zero catches.

^ Total advice in 2025 relative to the TAC in 2024 (165 tonnes).

4.4 Biological reference points

New reference points were defined at WKNSCS (ICES, 2023a) and were adjusted in 2023 (ICES, 2023b). The newly introduced F_{ECO} (ICES, 2023a) has been agreed and reviewed at the benchmark for a stock for the first time. FECO is an opportunity to use environmental data in forecast scenarios (ICES, 2023c). In case of cod in 7a a sea surface temperature (SST) was found to be a reasonable indicator for productivity. The F_{ECO} reference point uses the inverted SST (with a 3-year lag to account for the time from larvae stage to contribution to SSB) rescaled between zero and one which informs the status of the indicator (I_s) in the advicer year compared with previous years. The status of the indicator determines the placement of the F_{ECO} reference point within F_{MSY} ranges (ICES, 2019; 2020); for 2024 F_{ECO} is at 0.14= $F_{MSY\ lower}$, estimated as $F_{MSY\ lower} + ((F_{MSY\ upper} - F_{MSY\ lower}) * I_s)$

Table 5: Biological reference points

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	13012	B_{pa}	ICES, 2023b
	F_{MSY}	0.171	Median point estimates of (F_{MSY}) EqSim with combined SR	ICES, 2023b
	$F_{MSY\ lower}$	0.141	Median lower estimates of (F_{MSY}) EqSim with combined SR	ICES, 2023b
	$F_{MSY\ upper}$	0.22	Median upper point estimates of (F_{MSY}) EqSim with combined SR	ICES, 2023b
	F_{ECO}	0.141	Ecosystem Indicator (I_s); $F_{ECO} = F_{MSY\ lower} + ((F_{MSY\ upper} - F_{MSY\ lower})*I_s)$	ICES, 2023b
Precautionary approach	B_{lim}	9364	Lowest SSB with above-average recruitment	ICES, 2023b
	B_{pa}	13012	B_{lim} combined with the assessment error	ICES, 2023b
	F_{lim}	0.32	F with 50% probability of SSB less than B_{lim}	ICES, 2023b
	F_{pa}	0.23	F_{P05}; the F that leads to SSB > B_{lim} with 95% probability	ICES, 2023b

4.5 Management plans

The Irish Sea cod management plan, as described in Council Regulation (EC) 1342/2008 was evaluated independently by ICES in 2009 using the approach adopted in AGCREMP 2008 and found to be not consistent with the ICES Precautionary Approach (ICES 2009).

4.6 Uncertainties and bias in assessment

4.6.1 Surveys

The Irish Sea has relatively good survey coverage. The quarter 1 groundfish survey and the FSP survey have got good consistent cover of the age contributions. The Q4 groundfish survey only attributes to the recruitment at age 0.

4.6.2 Stock structure and migrations

Stock structure and migrations have been in full discussed in the WKIrish2 report (ICES, 2016), however, there are still uncertainties and discussions.

A tagging study of Irish Sea cod and Celtic Sea cod was conducted from 2016-2019 in part to address these issues. Up to January 2019 4238 cod were caught and tagged aboard chartered commercial fishing vessel using semi-pelagic fishing gear, FSP survey, shore angling competitions and others. Up to January 2019 138 tagged cod were returned. The project relies on collaboration with the fishing industry to provide the data to develop a better understanding of the current behaviour, biology and stock status of Irish Sea cod. Most recent results suggest a stronger migratory behaviour of Irish Sea cod into the Celtic Sea, indicating that up to 18% of mature fish might leave the Irish Sea (Report citation). This will have considerable impacts on the future management and assessment of the stock, but additional research is necessary. Currently a further project using data storage tags and trace element analysis is being conducted to understand stock structure and migratory behaviour as well as mixing.

4.7 Management considerations

A number of emergency and cod recovery plan measures have been introduced since 2000 to conserve Irish Sea cod. These include a spawning closure since 2000 and effort control since 2003. There have also been several vessel decommissioning schemes. As it has not been possible to provide analytical catch forecasts in recent years, the TAC has been reduced by 15–20% annually since 2006 and by 25% since 2009.

An MSY approach was used to set TAC in 2018 and 2019, which was followed by a precautionary advice in 2020 and 2021. Since 2022 the stock has assessed using an MSY approach; however, low SSB and recruitment in recent years result in a zero catch advice.

4.8 Future issues and considerations

Cod in the Irish Sea and the Celtic Sea are in a highly exploited state and show historically a very steep age-profile. Recruitment since 2002 has been impeded.

It is essential to further the understanding of the stock structure to improve future management, which includes the further investigation of migration and natural mortality in the Irish Sea. It might be necessary for a combined approach to manage the stocks in 7A and 7E-G.

Under the current highly exploited status it seems that recruitment rather than fishing pressure is driving stock trends. It is also questionable in how far an MSY approach with reference points as applied in the traditional ICES format is a valid approach for this stock which is recruitment rather than fishery controlled. The working group is awaiting the outcomes of WKREF to further investigate the most appropriate way to manage the stock in the future. This might mean a shift to an MSE approach for management.

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4.10 Tables and figures

Table 6: Official landings of cod in Division 7.a as officially reported to ICES and figures used by ICES from 1996. All weights are in tonnes, minor differences in total value are due to rounding. Countries reported landings are official values.

Year	Belgium	France	Ireland	Netherlands	Spain	UK (England Wales, & NI)	UK (Isle of Man)	UK (Scotland)	Total	Landings in rec-tangles 33E2 & 33E3 ***	ICES Landings	ICES Discards
1996	142	148	2476	25	-	2359	27	126	5303		4964**	
1997	183	268	1492	29	-	2370	19	80	4441		5859**	
1998	316	269	1739	20	-	2517	34	67	4962		5318**	
1999	150	n/a	966	5	-	1665	9	80	2875		4784**	
2000	60	53	455	1	-	799	11	38	1417		1274	
2001	283	74	751	-	-	885	1	32	2026		2252	
2002	318	116	1111	-	-	1134	7	29	2715		2695	
2003	183	151	594	-	14	505	7	23	1477		1285	
2004	104	29	380	-	-	646	5	15	1179	108	1072	
2005	115	35	220	-	-	594	n/a	3	967	54	910	
2006	60	18**	275	-	-	589	n/a	6	948	103	840	
2007	67	17**	608	-	-	423	n/a	2	1117	527	702	148
2008	26	3	618**	-	-	543	22	12	1224	558	661	62
2009	19	12	323**	-	-	387	12	12	765	193	468	60
2010	21	1	289	-	-	282	1	-	594	143	464	377
2011	36	3	275	-	-	169	1	-	485	147	368	43

Year	Belgium	France	Ireland	Netherlands	Spain	UK (England Wales, & NI)	UK (Isle of Man)	UK (Scotland)	Total	Landings in rectangles 33E2 & 33E3 ***	ICES Landings	ICES Discards
2012	23	1	193	-	-	109	< 1	-	326	85	198	658
2013	13	< 1	160			107	< 1	-	281	76	206	118
2014	9	< 1	148	-	-	79	< 1	-	236	24	213	149
2015	12	< 1	137	-	-	50	< 1	-	199	39	161	224
2016	3	< 1	84	-	-	35	< 1	-	122	40	82	60
2017	5	< 1	57	-	-	41	< 1	< 1	103	19	84	59
2018	2	< 1	105	-	-	128	< 1	< 1	235	20	215	42
2019	10	< 1	- c	-	-	195	< 1	< 1	205 c	37	295	7
2020	10	0	77	-	-	97	< 1	< 1	255	71	181	25
2021	3	0	93	-	-	89	<1	<1	185	52	133	4
2022*	3	0	55	-	-	70	<1	<1	128	30	98	27
2023*	1.4	0	19	-	-	36	<1	<1	56		56	9.0

* Preliminary official landings.

** Includes sample-based estimates of landings into ports.

*** Landings in the southern part of Division 7.a (rectangles 33E2 and 33E3) are not included in the assessment and are considered to be part of the cod stock in divisions 7.e–k.

c Incomplete/missing due to part of the data being unavailable under national GDPR clauses.

Table 7 Working Group figures for annual landings and TAC uptake since 2000. a) total, b) by country

a)

Year	Total	TAC	% uptake
2000	1273	2100	61
2001	2251	2100	107
2002	2695	3200	84
2003	1285	1950	66
2004	1072	2150	50
2005	910	2150	42
2006	840	1828	46
2007	702	1462	48
2008	662	1199	55
2009	468	899	52
2010	465	674	69
2011	368	506	73
2012	198	380	52
2013	206	285	72
2014	213	182	117
2015	161	146	110
2016	82	146	56
2017	84	146	57
2018	215	695	31
2019	298	807	37
2020	181	257	70
2021	133	206	65
2022	98	74	132
2023	65	165	34

Table 7b)

2009	UK	Ireland	France	Belgium	Netherlands	Total
Landings	391	55	3	19	0	498
TAC	259	592	33	12	3	899
% uptake	151%	9%	9%	160%	0%	

2010	UK	Ireland	France	Belgium	Netherlands	Total
Landings	292	151	1	21	0	465
TAC	194	444	25	9	2	674
% uptake	150%	34%	4%	233%	0%	

2011	UK	Ireland	France	Belgium	Netherlands	Total
Landings	170	160	3	36	0	369
TAC	146	333	19	7	2	506
% uptake	117%	48%	16%	533%	0%	

2012	UK	Ireland	France	Belgium	Netherlands	Total
Landings	112	63	0	23	0	198
TAC	109	251	14	5	1	380
% uptake	103%	25%	0%	460%	0%	

2013	UK	Ireland	France	Belgium	Netherlands	Total
Landings	107	85	1	13	0	206
TAC	82	188	10	4	1	285
% uptake	130%	45%	10%	325%	0%	

2014	UK	Ireland	France	Belgium	Netherlands	Total
Landings	79	124	0	9	0	213
TAC	52	120	7	2	2	182
% uptake	153%	103%	0%	455%	0%	

2015	UK	Ireland	France	Belgium	Netherlands	Total
Landings	50	99	0	12	0	161
TAC	42	97	5	2	0	146
% uptake	119%	102%	0%	600%	NA	

2016	UK	Ireland	France	Belgium	Netherlands	Total
Landings	35	44	0.4	3	0	82
TAC	42	97	5	2	0	146
% uptake	83%	45%	8%	150%	0%	
2017						
Landings	41	38	0.2	5	0	84
TAC	42	97	5	2	0	146
% uptake	98%	39%	4%	250%	0%	
2018						
Landings	128.5	84.6	0.05	1.9	0	214.9
TAC	200	459	25	9	2	695
% uptake	64%	18%	<1%	<1%	0%	31%

Table 7b) continued

2019	**UK**	**Ireland**	**France**	**Belgium**	**Netherlands**	**Total**
Landings	193.9	90	0.2	10.2	0	294.6
TAC	233	530	30	11	3	807
% uptake	83%	17%	<1%	93%	0%	36.5%
2020						
Landings	95.6	75.9	0	9.5	0	181.1
TAC	74	170	9	3	1	257
% uptake	129%	45%	0%	317%	0%	70%
2021						
Landings	88.7	41.8	0	2.8	0	133.3
TAC	91	104	7	3	1	206
%uptake	97%	40%	0%	93%	0	65%
2022						
Landings	70	25.3	0	2.7	0	98.1
TAC	91	104	7	3	1	206
%uptake	77%	24%	0%	90%	0	48%
2023	**UK**	**Ireland**	**France**	**Belgium**	**Netherlands**	**Total**
Landings	36	19	0	1.4	0	56
TAC	74	82	6	2	1	165

2019	**UK**	**Ireland**	**France**	**Belgium**	**Netherlands**	**Total**
%uptake	49%	23%	0%	70%	0	34%

Table 8: Landings and discard proportions by métier.

Catch (2023)			Landings		
65 tonnes	otter trawls		mid-water trawl	beam trawls	other gear types
	Nephrops directed 55%	demersal fish directed 33%	<1%	9%	1.3%
			56 tonnes		
			Discards		
	otter trawls		mid-water trawl	beam trawls	other gear types
	27% *Nephrops* directed	<1% demersal fish directed	0%	72%	<1%
	9 tonnes				

Table 9 Total catch numbers-at-age (thousands).

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6+**
1968	17	439	1563	1003	456	177	30
1969	20	969	1481	1050	269	186	113
1970	22	1810	1385	352	204	163	71
1971	22	2835	2022	904	144	67	51
1972	26	900	3267	824	250	58	59

Year	0	1	2	3	4	5	6+
1973	27	2377	1091	1783	430	173	81
1974	16	601	3559	557	494	131	74
1975	26	1810	642	1407	294	249	117
1976	27	1247	3007	363	500	61	104
1977	31	946	511	1233	163	218	71
1978	40	855	1092	310	311	39	65
1979	44	1948	1288	608	127	164	71
1980	25	2636	2797	729	243	49	55
1981	38	1457	3635	1448	244	99	47
1982	46	538	2284	1455	557	102	79
1983	47	1011	932	751	499	154	46
1984	37	1733	1195	439	240	161	75
1985	34	1360	2105	703	158	84	77
1986	49	1180	2248	699	203	64	65
1987	47	4522	1793	841	252	75	43
1988	43	2971	4734	702	263	71	38
1989	41	754	2163	1886	231	86	37
1990	38	869	1075	545	372	70	30

Year	0	1	2	3	4	5	6+
1991	47	2169	1408	442	127	98	22
1992	37	1529	1243	664	132	42	49
1993	39	388	2907	403	119	16	13
1994	40	916	569	848	68	20	10
1995	43	678	1283	180	163	7	6
1996	88	447	1113	700	38	39	6
1997	5	651	1149.5	501	213	17	16
1998	0	231	1928	335	80	28	8
1999	141	236	843	871	66	21	7
2000	62	1107	176	107	50	4	1
2001	7	403	841	53	13	9	2
2002	0	238	564	405	7	2	3
2003*	50	121	472	109	36	1	0
2004*	50	161	134	174	22	6	3
2005*	50	118	256	78	34	5	1
2006	50	89	174	128	17	8	3
2007	16	216	210	56	11	1	0
2008	6	77	169	87	9	3	0

Year	0	1	2	3	4	5	6+
2009	329	60	57	66	17	3	0
2010	49	220	188	16	7.5	2	1
2011	10	54	106	36	2	1	1
2012	8	84	135	145	10	0	0
2013	36	37	59	30	9	2	0
2014	1	41	86	26	5	1	0
2015	0	37	80	26	4	1	0
2016	0	11	25	30	2	1	0
2017	0	12	28	16	3	0	0
2018	256	95	27	36	2	2	1
2019	0	60	68	12	9	1	2
2020*	0	108	50	20	4	2	1
2021	0	11.8	22.1	13.1	4.7	0.3	0.7
2022	21.8	118.0	11.8	10.9	3.8	0.8	0.1
2023	0	2.2	35.3	3.7	0.7	0.1	0.01

***Excluded from assessment due to very low sampling**

Table 10. Mean weights-at-age in the landings (used for whole stock and catch). *mean weight at age in landings only available for Q1, hence considerably lower than previous years and not included.

	0	1	2	3	4	5	6+
1996	0.1	0.98	1.63	3.26	5.3	7.72	9.79
1997	0.1	0.85	1.94	3.62	5.29	6.12	9.4
1998	0.1	0.93	1.65	3.73	5.37	7.03	9.35
1999	0.1	0.85	1.62	3.18	5.51	7.52	10.25
2000	0.1	0.85	1.99	3.57	5.14	7.15	8.39
2001	0.1	0.99	1.82	4.15	5.61	7.33	9.51
2002	0.1	0.94	1.84	3.44	5.73	7.71	10.01
2003	0.1	1.21	1.66	3.29	5.43	10.2	11.09
2004	0.1	1.11	2.2	3.63	6.51	7.64	8.61
2005	0.1	0.91	1.94	3.51	5.32	7.74	8.89
2006	0.1	0.83	1.84	3.67	4.71	6.39	7.84
2007	0.1	0.83	1.85	3.78	5.35	7.99	10.04
2008	0.1	0.89	1.59	3.54	6.00	7.57	9.46
2009	0.1	1.1	2.01	3.46	5.31	7.1	6.82
2010	0.1	1.26	2.29	3.93	6.34	7.33	9.64
2011	0.1	0.95	1.88	3.75	5.54	6.75	9.04
2012	0.1	0.93	1.88	3.37	5.34	7.60	8.56
2013	0.1	0.97	2.32	4.06	5.54	7.43	10.79
2014	0.1	0.88	2.26	4.49	7.00	8.75	9.41
2015	0.1	0.83	1.79	3.69	6.49	8.55	9.95
2016	0.1	0.95	1.58	3.1	5.01	10.66	8.136
2017	0.1	0.70	1.82	3.82	5.85	7.62	9.74
2018	0.1	0.43	1.69	3.64	5.56	8.58	8.70
2019	NA	0.44	2.13	4.25	6.14	6.79	9.00
2020 *	0.1	0.523	1.880	3.903	5.85	7.66	9.14
2021	0.1	0.187	1.831	4.164	6.485	8.64	7.25
2022	0.16	0.28	1.71	3.56	5.77	7.66	8.68
2023	NA	1.77	1.29	4.96	8.05	12.5	12.5

Table 10: Estimates of numbers discarded (a) and the discarded proportions (b) from 1968–2023. Data are total numbers ('000 fish) discarded at-age, estimated from numbers per sampled trip raised to total fishing effort by each country supplying data (UK, Ireland and Belgium) Please refer to WKIrish3 (ICES, 2017) documents.

a)

Year	0	1	2	3	4	5	6+
1968	17.81	74.71	0	0	0	0	0
1969	20.85	87.45	0	0	0	0	0
1970	22.13	92.83	0	0	0	0	0
1971	22.94	96.2	0	0	0	0	0
1972	26.51	111.18	0	0	0	0	0
1973	27.17	113.96	0	0	0	0	0
1974	16.94	71.04	0	0	0	0	0
1975	26.38	110.62	0	0	0	0	0
1976	26.77	112.28	0	0	0	0	0
1977	31.05	130.23	0	0	0	0	0
1978	39.96	167.57	0	0	0	0	0
1979	44.35	185.98	0	0	0	0	0
1980	24.6	103.16	0	0	0	0	0
1981	37.67	157.97	0	0	0	0	0
1982	46.04	193.1	0	0	0	0	0
1983	46.98	197.05	0	0	0	0	0

Year	0	1	2	3	4	5	6+
1984	37.3	156.45	0	0	0	0	0
1985	33.89	142.12	0	0	0	0	0
1986	49.15	206.15	0	0	0	0	0
1987	47.38	198.69	0	0	0	0	0
1988	42.59	178.64	0	0	0	0	0
1989	41.03	172.09	0	0	0	0	0
1990	37.85	158.74	0	0	0	0	0
1991	46.64	195.61	0	0	0	0	0
1992	36.74	154.1	0	0	0	0	0
1993	39.4	165.24	0	0	0	0	0
1994	39.92	167.44	0	0	0	0	0
1995	42.97	180.2	0	0	0	0	0
1996	87.95	128.79	0	0	0	0	0
1997	5.28	127.79	0.5	0	0	0	0
1998	0	27.47	2	0	0	0	0
1999	141.42	165.79	0	0	0	0	0
2000	62.36	817.69	0	0	0	0	0
2001	7.22	65.15	0	0	0	0	0

Year	0	1	2	3	4	5	6+
2002	0	42.49	0	0	0	0	0
2003 *	50.43	75.68	32.62	15.83	1.25	0.13	0
2004*	50.43	92.78	32.81	15.83	1.25	0.13	0
2005*	50.43	76.34	32.36	15.83	1.25	0.13	0
2006	50.43	75.08	32	15.83	1.25	0.13	0
2007	16	167	4.60	0	0	0	0
2008	5.50	63.40	3.40	0	0	0	0
2009	329.30	39.80	4.40	0.1	0	0	0
2010	48.70	180	60.30	1.4	0.5	0.1	0
2011	9.70	42.70	0.90	0	0	0	0
2012	7.50	79.90	100.20	112.9	5.9	0.2	0
2013	36.10	31	26.50	11	2	0.5	0
2014	1.09	34.66	41.93	10.3	1.53	0.1	0
2015	0	37.30	45.80	6.8	1.3	0.3	0
2016	0	9.84	14.15	13.45	0.91	0.74	0
2017	0.43	9.85	7.88	8.10	0.57	0.10	0.10
2018	255.50	72.19	8.89	4.88	0.12	0.22	0
2019	0	39.2	0.4	0	0	0	0

Year	0	1	2	3	4	5	6+
2020*	NA						
2021	0	10.6	6.1	0	0	0	0
2022	21.8	107.8	1.0	0	0	0	0
2023	NA	0.28	9.6	0.19	0.01	0	0

*** very low sampling levels**

b)

Year	0	1	2	3	4	5	6+
1968	1	0.17	0	0	0	0	0
1969	1	0.09	0	0	0	0	0
1970	1	0.05	0	0	0	0	0
1971	1	0.03	0	0	0	0	0
1972	1	0.12	0	0	0	0	0
1973	1	0.05	0	0	0	0	0
1974	1	0.12	0	0	0	0	0
1975	1	0.06	0	0	0	0	0
1976	1	0.09	0	0	0	0	0
1977	1	0.14	0	0	0	0	0
1978	1	0.20	0	0	0	0	0

Year	0	1	2	3	4	5	6+
1979	1	0.10	0	0	0	0	0
1980	1	0.04	0	0	0	0	0
1981	1	0.11	0	0	0	0	0
1982	1	0.36	0	0	0	0	0
1983	1	0.19	0	0	0	0	0
1984	1	0.09	0	0	0	0	0
1985	1	0.10	0	0	0	0	0
1986	1	0.17	0	0	0	0	0
1987	1	0.04	0	0	0	0	0
1988	1	0.06	0	0	0	0	0
1989	1	0.23	0	0	0	0	0
1990	1	0.18	0	0	0	0	0
1991	1	0.09	0	0	0	0	0
1992	1	0.10	0	0	0	0	0
1993	1	0.43	0	0	0	0	0
1994	1	0.18	0	0	0	0	0
1995	1	0.27	0	0	0	0	0
1996	1	0.29	0	0	0	0	0

Year	0	1	2	3	4	5	6+
1997	1	0.20	0	0	0	0	0
1998	NA	0.12	0	0	0	0	0
1999	1	0.70	0	0	0	0	0
2000	1	0.74	0	0	0	0	0
2001	1	0.16	0	0	0	0	0
2002	NA	0.18	0	0	0	0	0
2003*	1	0.63	0.07	0.15	0.03	0.12	NA
2004*	1	0.58	0.25	0.09	0.06	0.022	0
2005*	1	0.65	0.13	0.20	0.04	0.03	0
2006	1	0.84	0.18	0.12	0.07	0.02	0
2007	1	0.77	0.02	0	0	0	NA
2008	1	0.82	0.02	0	0	0	NA
2009	1	0.67	0.08	0	0	0	NA
2010	1	0.82	0.32	0.06	0.07	0.05	0
2011	1	0.80	0.01	0	0	0	0
2012	1	0.95	0.74	0.78	0.60	1	NA
2013	1	0.84	0.45	0.37	0.22	0.34	NA
2014	1	0.85	0.49	0.39	0.28	0.09	NA

Year	0	1	2	3	4	5	6+
2015	NA	1	0.57	0.26	0.30	0.23	NA
2016	NA	0.91	0.58	0.45	0.40	0.62	0
2017	1	0.80	0.28	0.51	0.20	0.21	0.49
2018	1	0.76	0.33	0.13	0.05	0.10	0
2019	NA	0.65	<0.01	0	0	0	0
2020*							
2021	1	0.89	0.28	0	0	0	0
2022	1	0.91	0.098	0	0	0	0
2023	NA	0.13	0.27	0.05	0	0	0

NA= not available.

***Data for 2020 is unavailable due to restricted discard sampling**

Table 12. Maturity ogive updated for 2023. Prior to 1995 maturity was considered constant.

Year	1	2	3+
1996	0	0.292	1
1997	0	0.346	1
1998	0	0.399	1
1999	0	0.451	1
2000	0	0.502	1
2001	0	0.553	1
2002	0	0.602	1
2003	0	0.645	1
2004	0	0.666	1
2005	0	0.679	1
2006	0	0.688	1
2007	0	0.696	1
2008	0	0.703	1
2009	0	0.707	1
2010	0	0.706	1
2011	0	0.704	1
2012	0	0.707	1
2013	0	0.711	1
2014	0	0.724	1
2015	0	0.738	1
2016	0	0.754	1
2017	0	0.769	1
2018	0	0.786	1
2019	0	0.802	1
2020	0	0.820	1
2021	0	0.837	1
2022	0	0.855	1
2023	0	0.934	1

Table 13. Survey catch numbers-at-age and c.v. for all three surveys and CPUE for Q1 survey.

Survey catch numbers-at-age and c.v.

Year	c.v.	1	2	3	4
1995	0.68	700.73	386.15	20.03	10.78
1996	0.42	1106.13	329.28	111.67	1.39
1997	0.64	537.30	415.84	66.72	21.39
1998	0.84	169.36	769.23	56.87	11.98
1999	0.86	49.50	253.08	241.87	15.29
2000	0.65	629.60	101.053	34.58	33.01
2001	0.89	406.68	561.44	18.44	5.78
2002	0.64	662.16	253.31	333.54	0
2003	0.54	73.87	1079.20	104.05	32.70
2004	0.75	216.96	171.96	88.62	5.38
2005	0.76	63.53	225.07	29.41	27.96
2006	0.63	169.99	130.75	58.30	2.52
2007	0.95	164.35	124.39	30.60	5.15
2008	0.90	40.66	217.15	13.02	5.17
2009	0.76	144.00	59.00	33.00	9.00
2010	0.82	1022.12	208.96	14.66	2.26
2011	0.49	353.98	414.69	46.01	2.26
2012	0.81	161.90	222.82	99.27	14.25
2013	0.81	276.59	213.68	60.08	1.49
2014	0.63	314.41	222.80	53.29	13.66
2015	0.84	78.96	719.35	69.19	8.56
2016	1.06	349.20	175.00	148.30	10.70
2017	0.77	69.8	445.20	57.80	12.60
2018	1.26	138.1	50.50	62.60	0
2019	0.88	214.9	171.6	27.8	14.7
2020	0.977	78.5	145.4	39.4	0
2021	1.19	86.1	158.9	38.2	0
2022	0.65	625.5	65.6	9.7	2
2023	0.66	0.385	3.63	0.03	0.048

Northern Irish groundfish Quarter 4

year	c.v.	0
1995	0.54	6.66
1996	0.43	12.519
1997	0.72	2.345
1998	0.91	0.047
1999	0.64	6.734
2000	0.79	6.212
2001	0.83	4.863
2002	0.90	0.123
2003	0.71	6.746
2004	0.94	3.663
2005	0.81	8.144
2006	0.87	1.16
2007	1.28	0.067
2008	1.42	0.185
2009	0.94	5.356
2010	1.33	2.779
2011	0.92	0.084
2012	1.26	1.924
2013	0.93	11.208
2014	0.79	0.121
2015	0.87	2.244
2016	1.06	0.149
2017	0.82	4.291
2018	1.42	0.685
2019	1.27	0.072
2020	1.39	0.072
2021	1.61	0.335
2022	1.43	0
2023	1.31	0

UK FSP survey

year	2	3	4	5	6+
2005	0.43	1.41	0.99	0.08	0.03
2006	0.54	2.81	0.43	0.10	0.01
2007	0.61	1.32	0.59	0.06	0.06
2008	0.22	0.82	0.15	0.08	0.02
2009	0.17	1.15	0.38	0.10	0.02
2010	0.74	0.45	0.47	0.13	0.02
2011	0.41	1.68	0.14	0.10	0.04
2012	0.36	2.30	0.80	0.07	0.02
2013	0.84	1.88	1.35	0.37	0.06
2014					
2015	0.60	2.04	1.17	0.26	0.05
2016	1.00	6.39	1.43	0.41	0.03
2017	3.06	2.85	3.84	1.01	0.23
2018	0.43	3.73	0.61	0.63	0.15
2019	1.30	0.75	0.83	0.12	0.19
2020	0.77	2.64	0.13	0.18	0.08
2021	0.24	0.71	0.19	0.01	0.027
2022	0.24	0.54	0.29	0.08	0.047
2023	0.36	0.38	0.14	0.04	0

Q1 groundfish survey CPUE and SD

Year	CPUE	SD
1995	0.955	0.214
1996	1.729	0.313
1997	1.392	0.218
1998	1.436	0.199
1999	1.597	0.256
2000	1.023	0.146
2001	1.491	0.225

Year	CPUE	SD
2002	2.619	0.965
2003	1.697	0.235
2004	0.765	0.139
2005	0.890	0.267
2006	0.508	0.079
2007	0.465	0.105
2008	0.502	0.099
2009	0.494	0.141
2010	0.719	0.130
2011	1.205	0.365
2012	1.018	0.179
2013	1.075	0.206
2014	1.089	0.274
2015	1.785	0.267
2016	1.374	0.247
2017	1.030	0.304
2018	0.632	0.120
2019	0.817	0.222
2020	0.493	0.177
2021	0.476	0.122
2022	0.450	0.116
2023	0.585	0.149

Table 11: Assessment summary

Year	Recruitment age 0			SSB			Land-ings	Dis-cards	Fishing mortality ages 2–4		
	Low	Value	High	Low	Value	High			low	value	High
1968	116685	177502	238319	32158	42277	52397	8541	1285	0.188	0.25	0.32
1969	178222	254838	331454	27564	37478	47392	7991	1898	0.20	0.28	0.36

Year	Recruitment age 0			SSB			Land-ings	Dis-cards	Fishing mortality ages 2–4		
	Low	Value	High	Low	Value	High			low	value	High
1970	295875	395401	494927	23690	33283	42876	6426	708	0.151	0.21	0.27
1971	87071	138580	190089	24612	34635	44658	9246	363	0.179	0.25	0.32
1972	263700	349534	435368	30904	42432	53960	9234	1546	0.173	0.24	0.30
1973	50677	86649	122620	35847	49223	62599	11819	1222	0.22	0.30	0.39
1974	206468	278834	351200	29960	41620	53280	10251	1749	0.21	0.29	0.37
1975	57571	93844	130117	29650	41447	53243	9863	857	0.22	0.30	0.39
1976	100921	149085	197249	22855	32634	42412	10247	381	0.23	0.32	0.42
1977	104280	153144	202008	22042	32172	42302	8054	201	0.20	0.30	0.40
1978	217063	287104	357145	16407	25105	33802	5662	0	0.152	0.23	0.30
1979	247963	320315	392667	17177	25431	33685	7548	0	0.198	0.28	0.36
1980	130294	181298	232302	20364	28248	36133	10599	0	0.24	0.32	0.40
1981	55087	86198	117309	28304	36898	45492	13958	0	0.29	0.38	0.46
1982	84178	121325	158472	31056	40655	50253	13381	313	0.31	0.41	0.51
1983	131445	177592	223739	24823	34319	43815	10015	372	0.26	0.36	0.46
1984	119168	164514	209860	16634	24145	31656	8383	2	0.25	0.36	0.47
1985	85845	125161	164477	17140	24036	30932	10483	61	0.30	0.41	0.52
1986	255606	321610	387614	17516	24212	30909	9852	154	0.31	0.42	0.54
1987	113142	157876	202610	17850	24914	31977	12894	128	0.39	0.51	0.64
1988	45695	75019	104344	17195	22869	28543	14168	109	0.44	0.58	0.71
1989	55083	89636	124188	18896	24872	30847	12751	202	0.45	0.61	0.76
1990	69059	104713	140367	12971	18799	24627	7379	159	0.32	0.47	0.61
1991	118775	160709	202643	8744	13435	18126	7095	163	0.39	0.57	0.74
1992	20155	37464	54772	8300	12728	17156	7735	98	0.40	0.55	0.70
1993	55156	77396	99637	9618	13347	17076	7555	155	0.42	0.57	0.71
1994	57280	76844	96408	9450	13512	17574	5402	142	0.36	0.50	0.65
1995	73179	94732	116285	5879	9127	12374	4587	166	0.32	0.45	0.57
1996	106976	136094	165212	6538	9369	12200	4964	140	0.36	0.50	0.64
1997	23046	34513	45980	7713	10788	13863	5859	120	0.36	0.49	0.62

Year	Recruitment age 0			SSB			Land-ings	Dis-cards	Fishing mortality ages 2–4		
	Low	Value	High	Low	Value	High			low	value	High
1998	6409	11993	17577	9672	13344	17016	5318	29	0.30	0.42	0.55
1999	73643	104841	136039	8605	12869	17132	4784	159	0.33	0.57	0.80
2000	32672	49012	65353	3540	7310	11079	1274	699	0.143	0.27	0.39
2001	44258	62939	81620	5943	10167	14390	2252	64	0.102	0.169	0.24
2002	9348	15274	21199	7872	13028	18184	2695	46	0.141	0.23	0.31
2003	22153	31786	41419	7863	13131	18398	1285	215	0.083	0.134	0.185
2004	9882	14777	19672	7682	12741	17800	1072	254	0.085	0.136	0.187
2005	13506	19555	25603	6309	10293	14278	910	204	0.084	0.134	0.183
2006	18386	26181	33976	4749	7686	10622	840	185	0.110	0.175	0.24
2007	5096	8364	11631	4151	6885	9619	702	145	0.089	0.144	0.198
2008	14410	22044	29677	3817	6188	8558	662	61	0.089	0.143	0.197
2009	35942	54465	72988	3017	4917	6817	466	88	0.081	0.129	0.178
2010	23516	37124	50732	3567	5777	7988	464	386	0.070	0.113	0.156
2011	18727	30820	42912	4908	7730	10552	365	48	0.028	0.045	0.063
2012	25842	42271	58700	6289	9770	13251	198	678	0.063	0.099	0.136
2013	46926	74874	102823	7206	11513	15819	206	152	0.021	0.034	0.046
2014	12949	22632	32315	8956	14171	19385	213	184	0.0177	0.028	0.039
2015	25276	40163	55049	10313	16141	21970	161	147	0.0133	0.021	0.029
2016	5138	9254	13371	9253	14510	19767	82	60	0.0081	0.0125	0.0168
2017	14707	23377	32047	10182	15811	21441	84	59	0.0077	0.0118	0.0159
2018	11962	19130	26298	8556	13255	17954	215	42	0.0187	0.028	11962
2019	7907	12782	17658	7361	11351	15341	295	7	0.023	0.035	7907
2020	4275	7514	10754	6129	9472	12816	181	25	0.0190	0.029	4275
2021	31983	51557	71131	5549	8581	11613	133	4	0.0151	0.023	31983
2022	993	4808	8623	3934	6060	8186	98	27	0.0177	0.027	993
2023	0	896	2337	5248	8010	10772	56	9	0.0058	0.0093	0
2024		23431*			8266						

*Geometric Mean 2002 to 2021

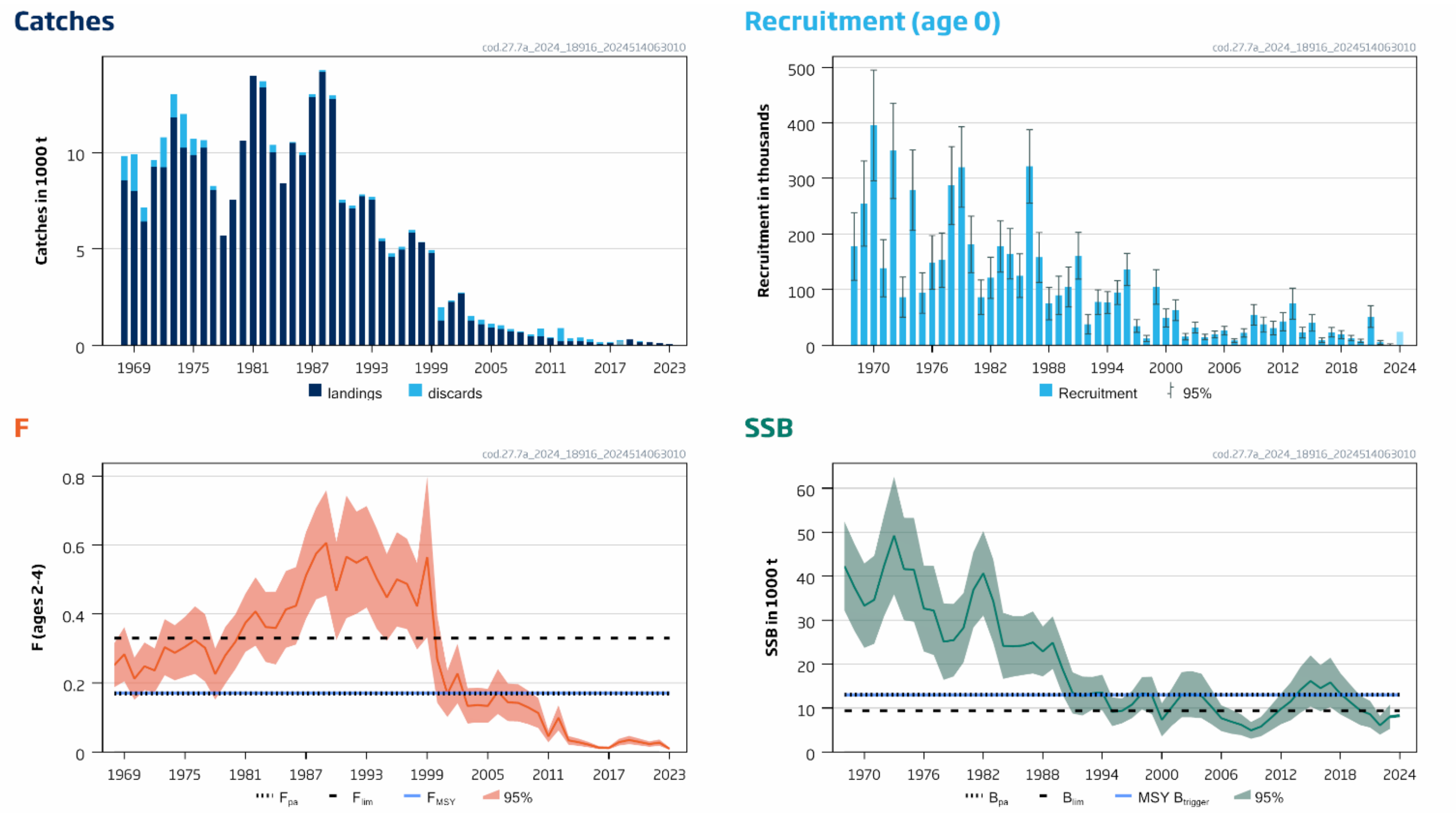


Figure 1: Assessment summary.

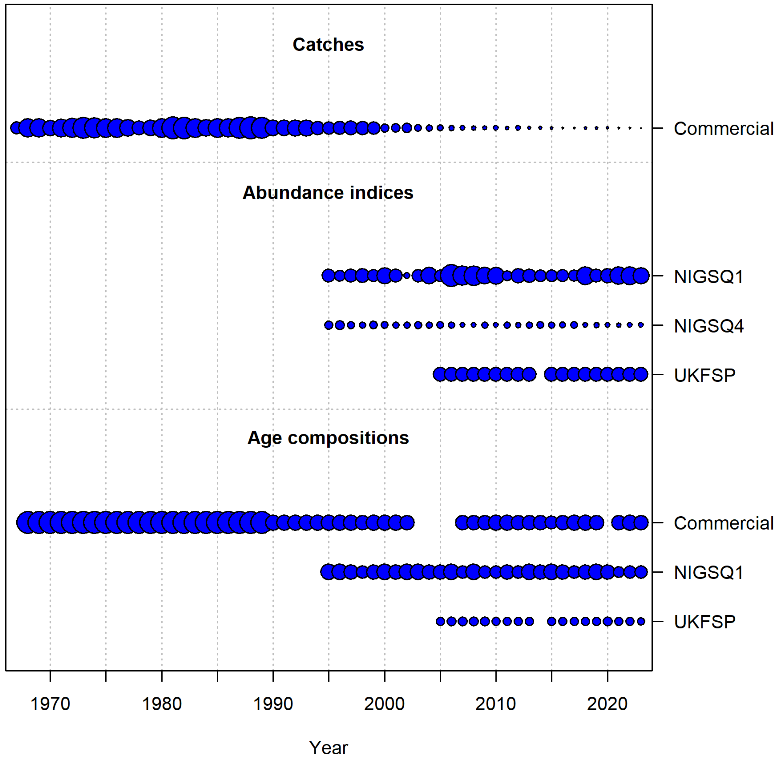


Figure 2 Available data.

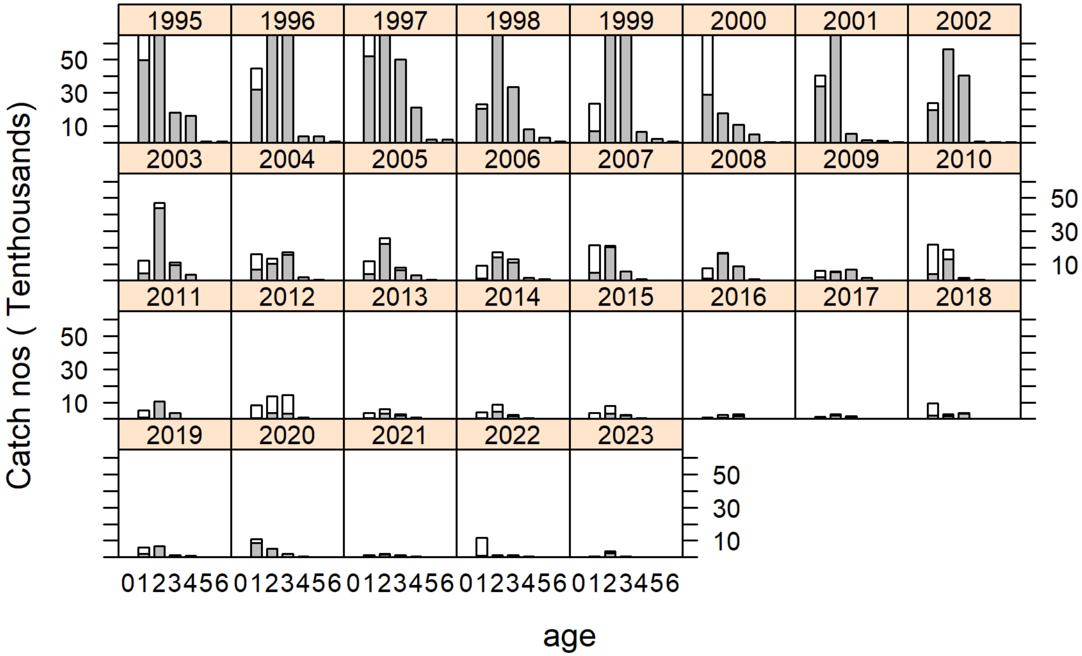


Figure 3: Landings and dicards at age. Landings are shaded in grey, discards in white.

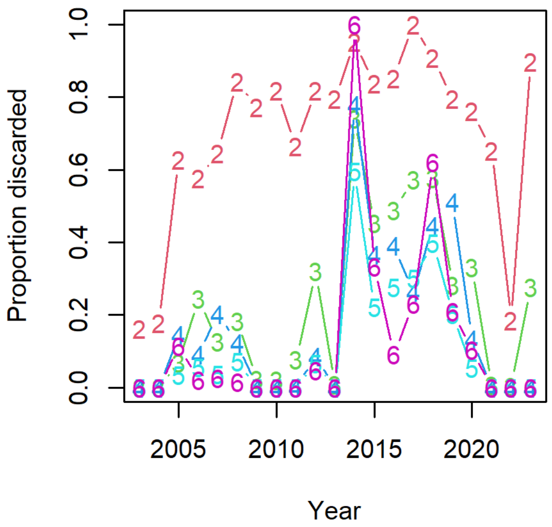


Figure 4:Proportion discarded at age. Ages 1 and 0 not displayed.

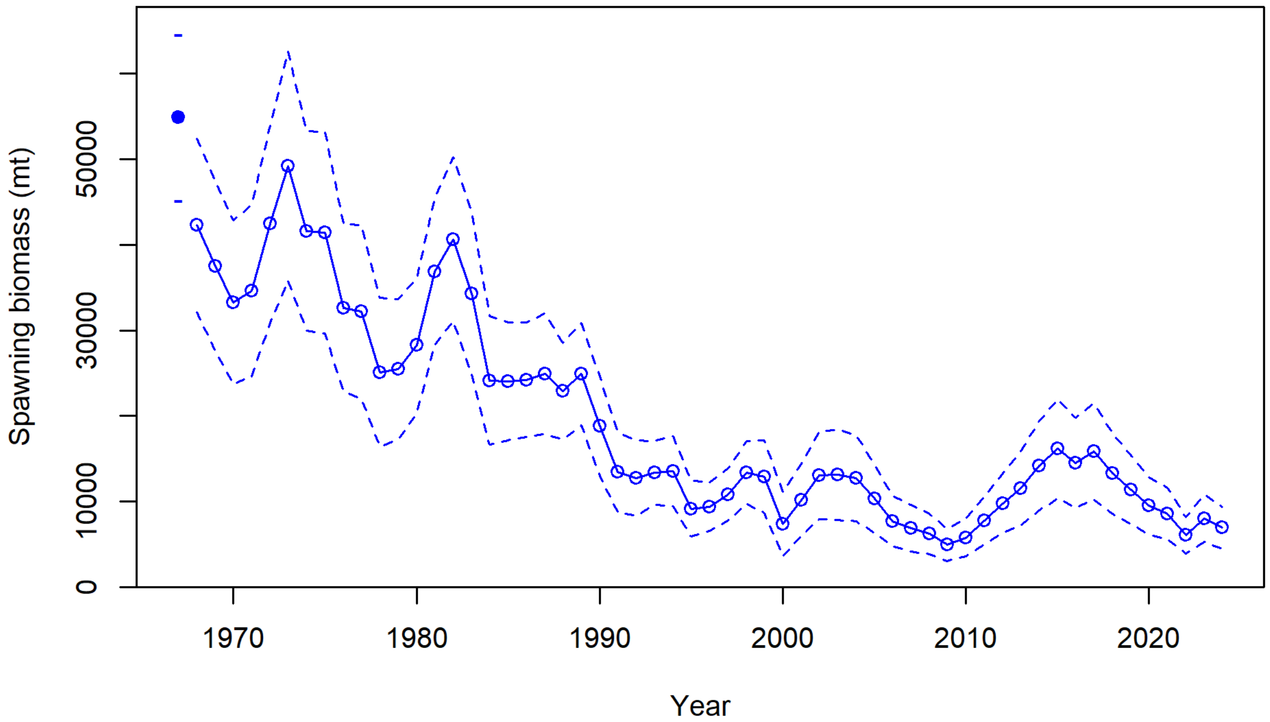


Figure 5: SSB with 95% confidence interval.

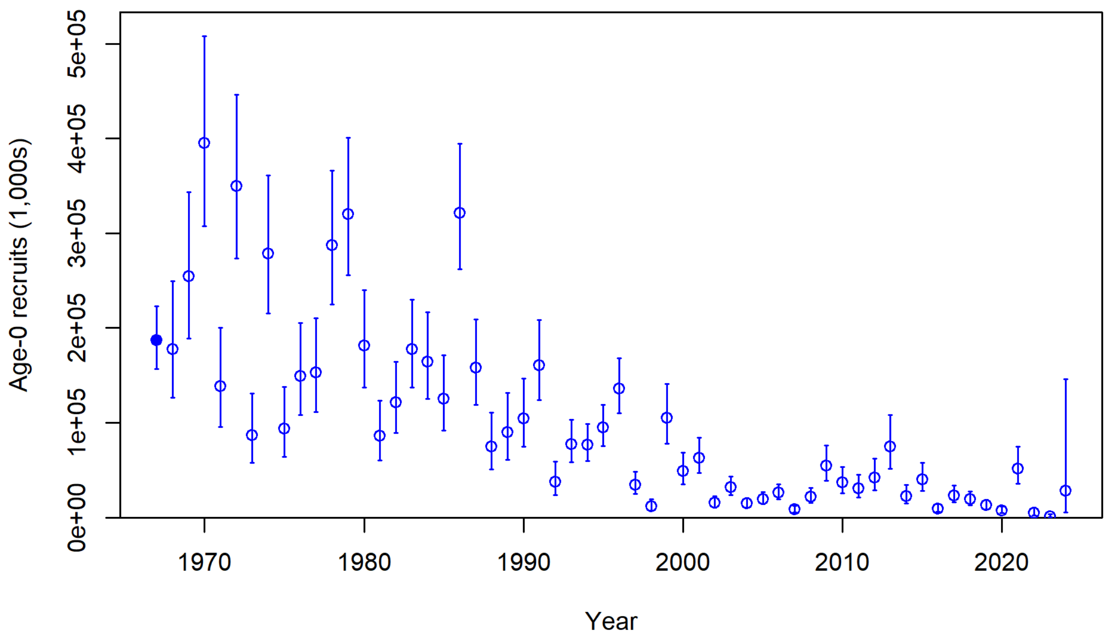


Figure 6: Recruitment with 95% confidence level. Recruitment in the figure for 2023 is model-estimated and not the same as in the forecast.

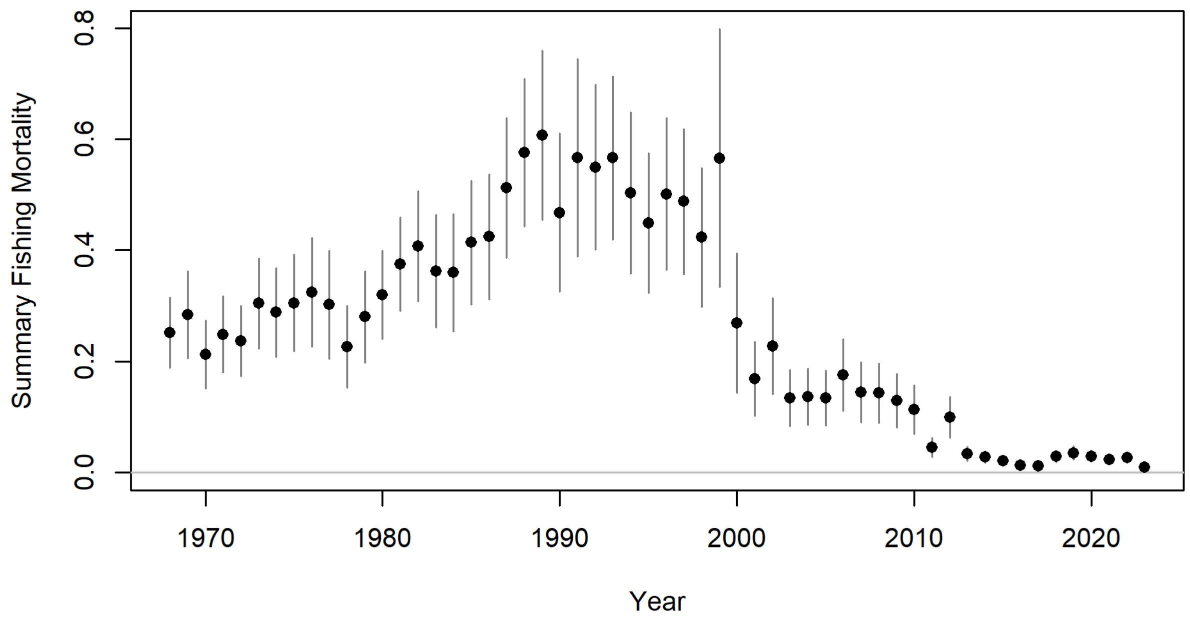


Figure 7 Fbar ages 2-4

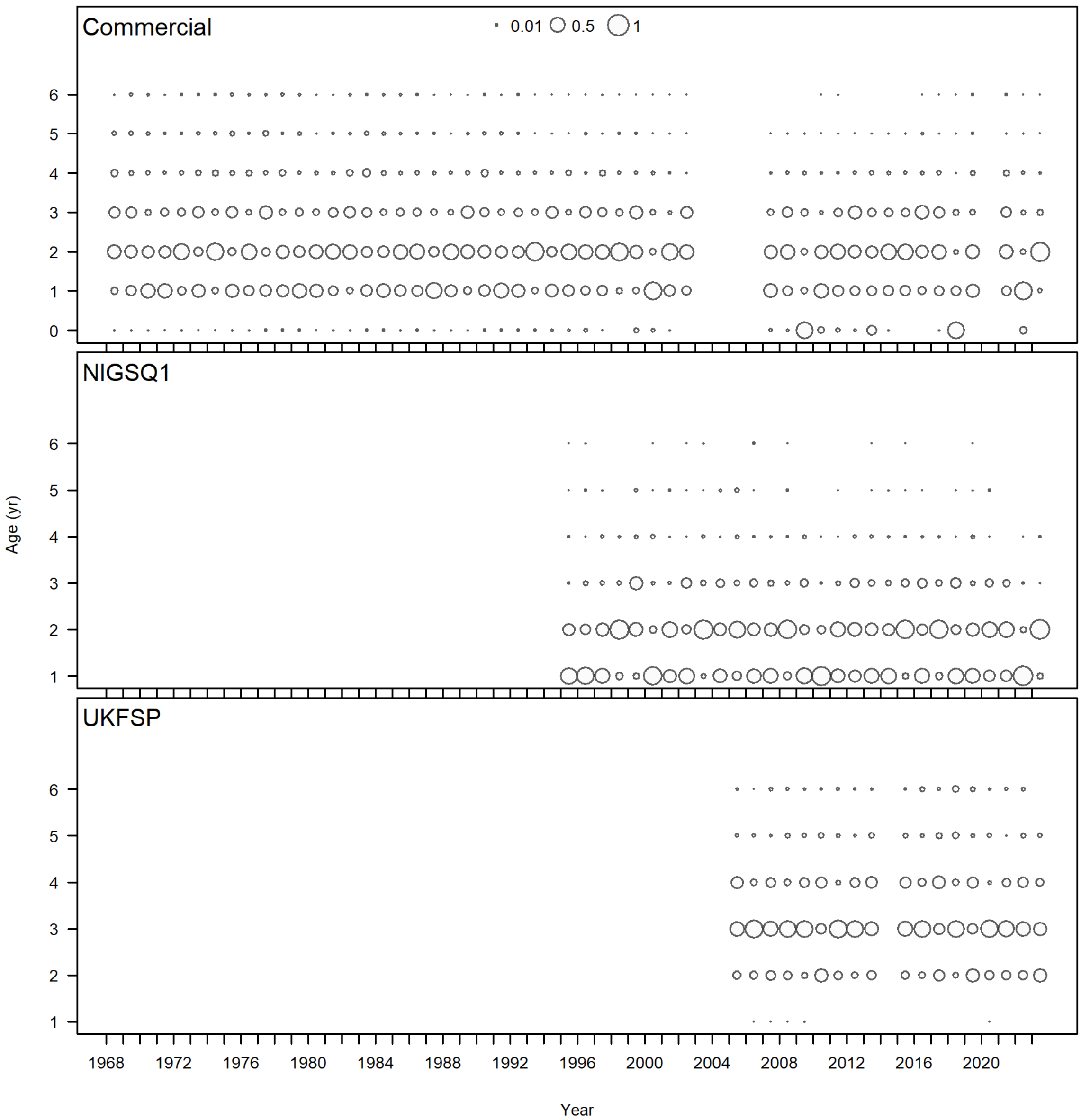


Figure 8: Age compositions for commercial data and surveys.

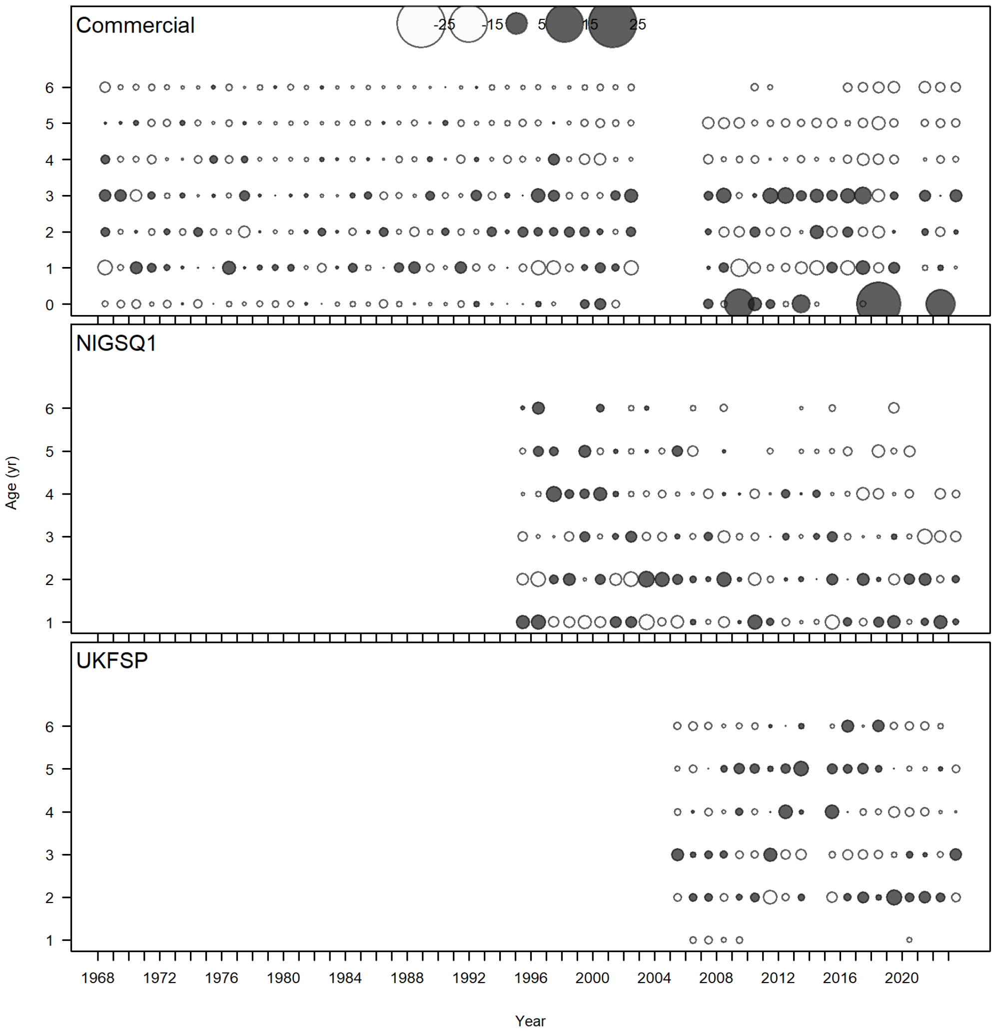


Figure 9. Residuals at age.

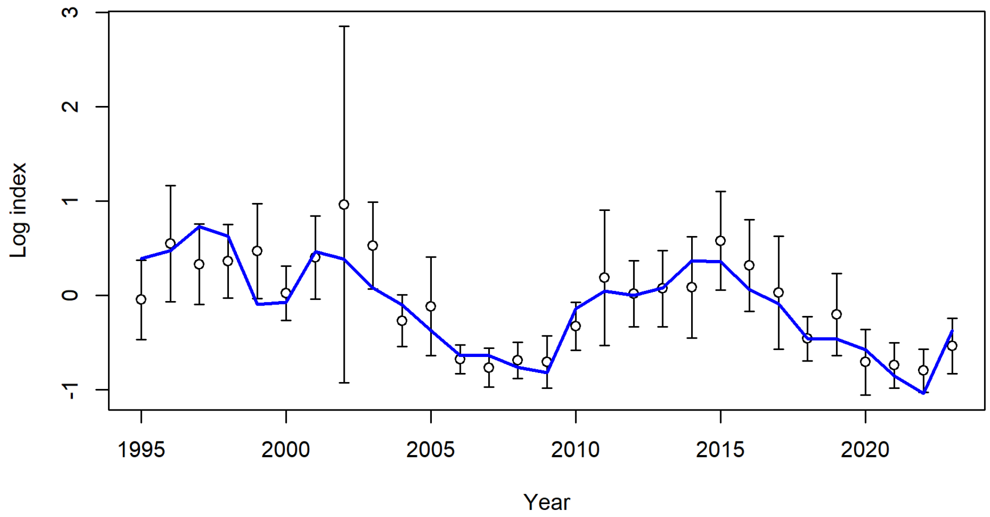


Figure 10. Log CPUE fit NIGFS Q1.

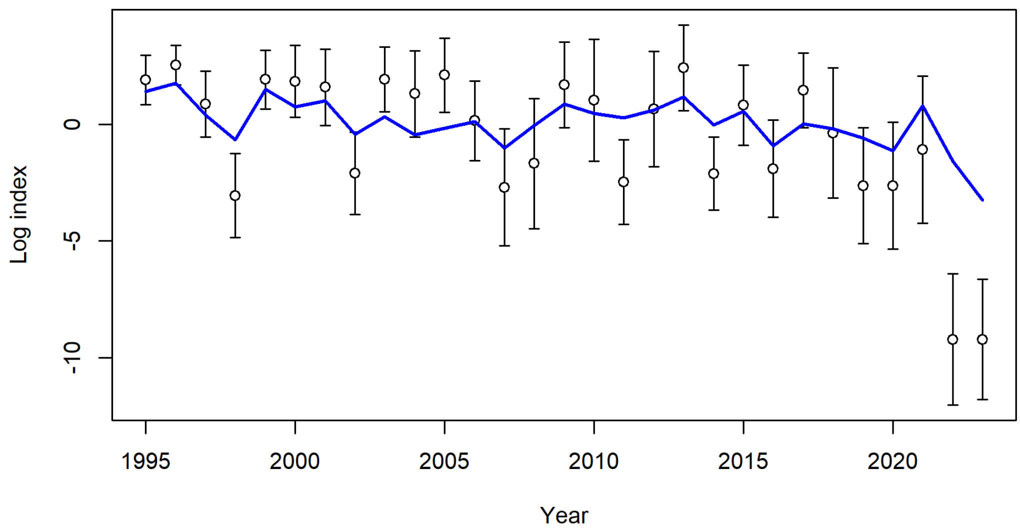


Figure 11. Log index fit NIGFS Q4.

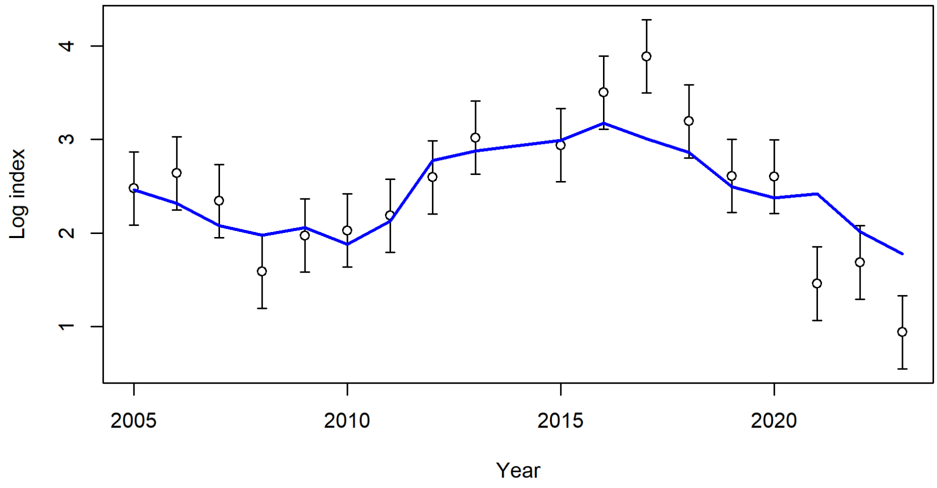


Figure 12. Log index fit UKFSP survey.

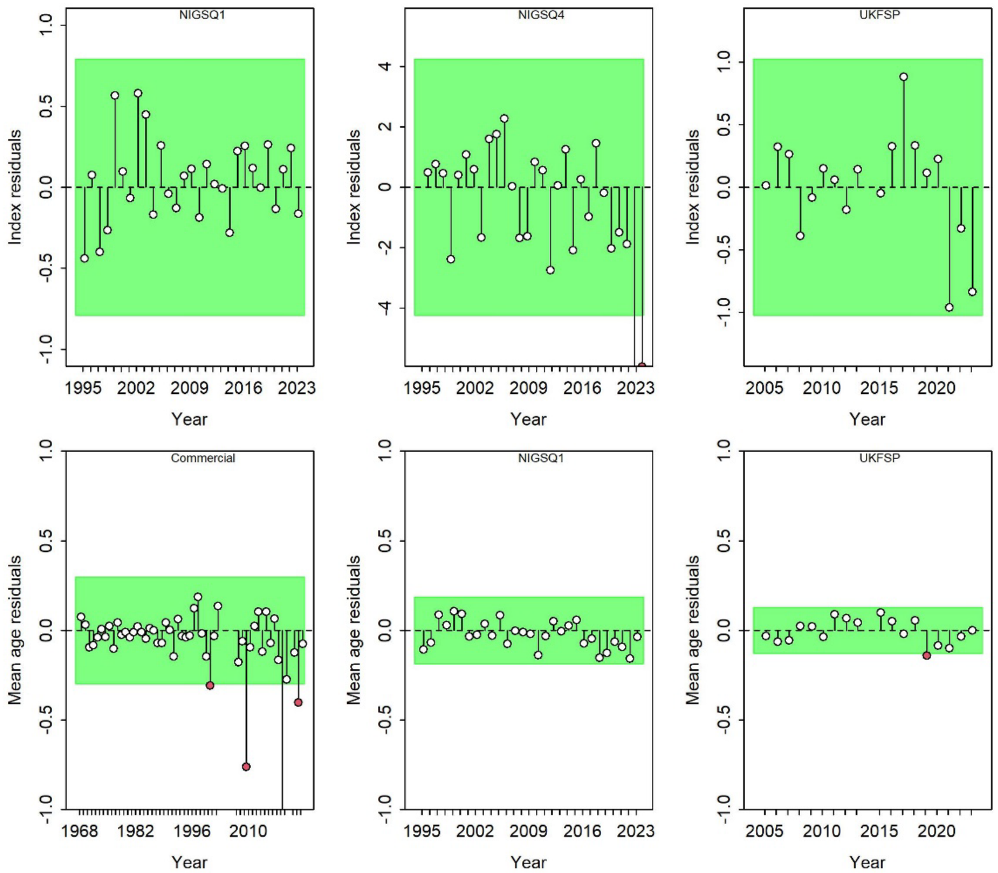


Figure 13. Results for runs tests for the three indices included and and bottom row Mean age residual fits for total catches, NIGFSQ1 and UKFSP surveys.

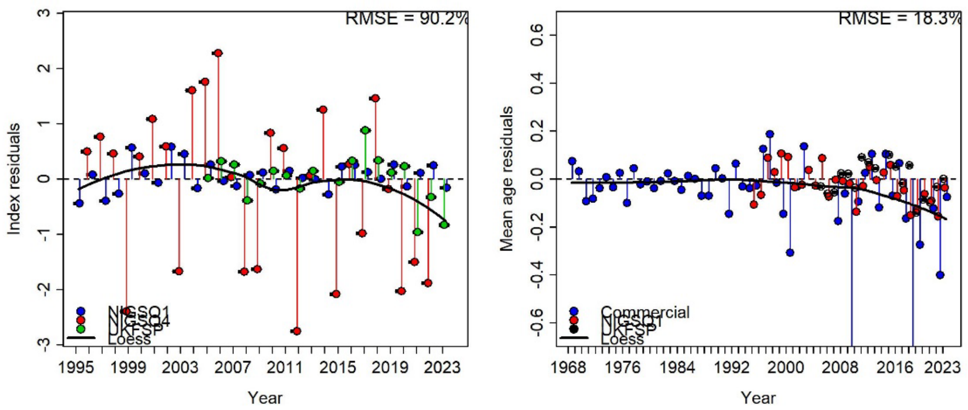


Figure 14. RMSE with fitted LOESS smoother.

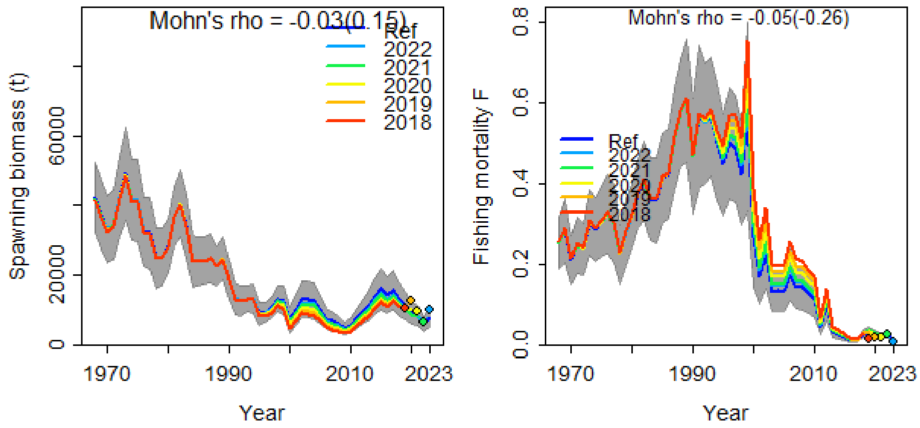


Figure 15. Mohns Rho for SSB and Fbar.

4.10.1.1.1.1

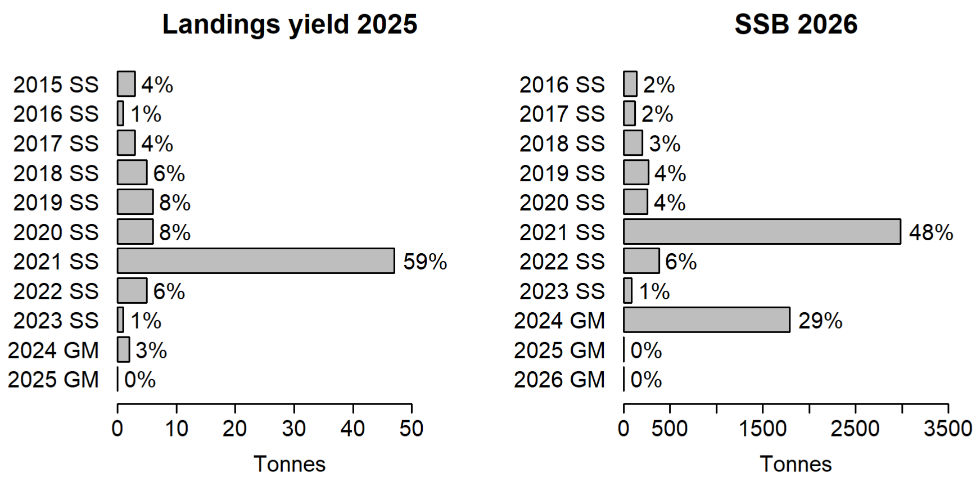


Figure 16. Contribution plot of yearclasses to the Landings in 2025 and the SSB in 2026.

Contents

5 Cod (*Gadius morhua*) in divisions 7.e-k (eastern English Channel and southern Celtic Seas)

Full analytical assessment

This stock has been benchmarked at WKCELTIC 2020. XSA was replace by SAM as the assessment model. Time-series of data were updated since 2004 as well as the tuning series. The first ten years of data (1970–1979) were removed from the assessment time-series of catches, because of inconsistency in cohort tracking information. Data, assessment and forecast procedure are detailed in the stock annex.

Latest ICES advices in 2022 and 2023

2022 – ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2023.

2023 – ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2024.

5.1 Stock description and management units

The TAC is set for ICES Areas 7.b–c, 7.e–k, 8, 10, and CECAF 34.1.1(1), excluding 7.d. This is representative of the stock area as the cod population in 7.d is more relevant to the North Sea population. However, landings from 7.bc are not included in the assessment area.

5.1.1 Management applicable in 2022 and 2023

TAC 2023

Species:	Cod *Gadus morhua*			Zone:	7b, 7c, 7e-k, 8, 9 and 10; Union waters of CECAF 34.1.1 (COD/7XAD34)
Belgium		14	(1)	Analytical TAC Article 8 of this Regulation applies Article 3 of Regulation (EC) No 847/96 shall not apply Article 4 of Regulation (EC) No 847/96 shall not apply	
France		231	(1)		
Ireland		336	(1)		
Netherlands		0	(1)		
Union		581	(1)		
United Kingdom		63	(1)		
TAC		644	(1)		
(1)	Exclusively for by-catches of cod in fisheries for other species. No directed fisheries for cod are permitted under this quota.				

TAC 2024 COUNCIL REGULATION (EU) 2024/257

		Table	27		
Species:	Cod *Gadus morhua*			Zone:	7b, 7c, 7e-k, 8, 9 and 10; Union waters of CECAF 34.1.1 (COD/7XAD34)
Belgium		14	(1)	Analytical TAC	
France		230	(1)	Article 8 of this Regulation applies	
Ireland		335	(1)	Article 3(2) and (3) of Regulation (EC) No 847/96 shall not apply Article 4 of Regulation (EC) No 847/96 shall not apply	
Netherlands		0	(1)		
Union		579	(1)		
United Kingdom		65	(1)		
TAC		644	(1)		
(1)	Exclusively for by-catches of cod in fisheries for other species. No directed fisheries for cod are permitted under this quota.				

Since 2005, 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).

Technical measures applied to this stock are a minimum mesh size (MMS) for beam and otter trawlers in Subarea 7 and a minimum landing size (MLS) of 35 cm.

5.1.2 Fishery

Landings data used by the WG are summarised in Table 6.1 and the Figure 6.1 provides historical landings by countries. In 2023, the catches are 457 t. TAC was not fully taken. Cod is no longer a target species but a bycatch in haddock and whiting dedicated fisheries.

Given the rapid growth of cod in this area, discards are mostly composed of one and two year old fish. Since 2011, quotas were not restrictive and the discard rate has been stable around 10–15%. However, the discards rate in recent years is highly variable. In 2021, the discards rate increased up to 50% as the result of high grading, because of restrictive TACs and delay in total TAC attribution. This delay was mainly due to long discussions around Brexit fisheries negotiations. Discards estimate for 2022 was 75 t which corresponds to a discards rate of 11.5%. In 2023, discard estimate is 13t, which is extremely low. It corresponds to a discard rate of 3 %.

Cod is mainly caught in area 27.7.g, followed by areas 27.7.h, 27.7.e and 27.7.j respectively. No landings are reported in 27.7.k and few in 27.7.j2 (Figure 5.2). France is fishing in all areas but most of its landings are taking in 27.7.h. Ireland is mainly fishing in 27.7.g and Belgium in 27.7.f and UK in 27.7.e. For each country, landings distribution in the Celtic Sea is similar to previous years.

In Celtic Sea, cod is mainly caught by OTB_DEF_100-119_0_0_all metiers, followed by seine SCC_DEF_100–119_0_0_all. Seiners contributions to the catches increased in recent years. Beamers (i.e. TBB_DEF_70–99_0_0_all) also contribute to cod landings (Figure 5.3). Catches of OTB_DEF_70–99_0_0_all are low in recent years.

Discards rate by weight varies among metiers depending on gear, mesh size range and season (Figure 5.4).

5.1.3 Information from the industry

In recent years, yields have been very low and cod is no longer targeted by French vessels and catches represent a very low number of individuals per tow.

The recent regulatory changes in the Celtic Sea since 2019 (Reg UE 2034/2018 which introduces many new selective devices since 01/07/2019 and article 13 Reg UE 123/2020) significantly modifies (1) the size structure of species catches by improving selectivity and the (2) vessel strategy in order to respect different catch composition thresholds.

5.2 Data

5.2.1 InterCatch procedure

Since 2013, international landings and discards data are uploaded in InterCatch. An updated data time series, from 2004 to 2019, was provided as part of the WKCELTIC 2020. Discards are raised for unreported strata to estimate total discards in weight. During WKCELTIC efforts were made to streamline data compilation procedures for fishery-dependent data of the three main gadoids species (cod, haddock and whiting).

Unsampled strata of landings and discards (number-at-age) are filled in using an allocation procedure. Information on national and international assumptions made by data providers and submitters at the national level and allocation grouping used in IC are available on SharePoint (R script).

The impact of the Covid-19 pandemic on the fishery cannot be quantitatively determined but may be assumed to have reduced fishing effort in 2020.

To ensure the consistency of data processing at international level, the same rules are applied each year for the allocation procedure: fill unsampled strata using as much data as possible from the same metier and quarter, regardless of area and country. Unsampled BMS landings and Logbook Registered Discards are filled in using discards data employing as much as possible the same metier and quarter, regardless of area and country.

Low SSB , low recruitment, (selective devise (raised line) and fleet behaviour avoidance strategies (at least non-targeting) lead to low catches resulting in insufficient number of samples, which have reduced the amount of information available to estimate catch.

In 2022, Ireland did not provide information on discard rate and age structure for the main OTB Irish fleet. In 2023, UK discard estimate was zero, while for the same fleet (TBB_DEF) Belgium discard rate was estimated at 25%. The percentage of sampled versus raised data as well as the distribution of sampled data over the quarters were considered low (40 % of landings with missing discard data) but satisfactory (Figure 5.5).

5.2.2 Catches

Age distribution of 2023 catches (i.e. landings and discards) is illustrated in the Figure 5.10 and Table 5.2.

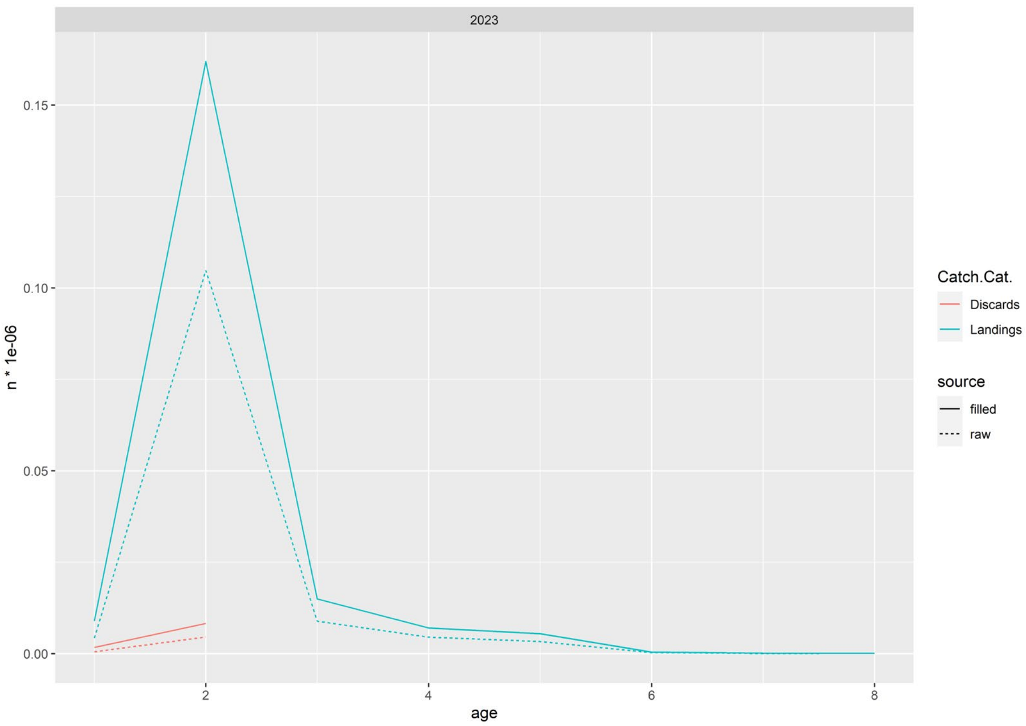
It is noticeable that this stock has always been composed of few age classes, even though Celtic Sea cod can live up to ten years (Table 5.2, Figure 5.10). While the catch are mainly composed of age 2 and 3 since 2000’s , the strong year classes (2009, 2014) has contributed strongly to the catch at older ages in some years:. In 2021, age 1 and age2 represent each 40 % of the catches (in number). In 2022, age 1 and age2 represent each 64 % and 16% of the catches respectively (in number). In 2023, age 1 and age2 represent each 5 % and 86 % of the catches respectively (in number).

5.2.3 Discards

The landings/discards pattern is known to be strongly variable between fleets and years due to metier, recruitment intensity, TACs constraints and mixed fisheries concerns.

Discards are mainly composed of age 1 fish. In recent years, due to quota constraints at vessel level, length distribution of discards for the UK fleet have shown high-grading pattern (cod being a non-target species). However, this fleet has little contribution to both landings and discard quantities and this has not been reported since 2017. In 2021, the French fleet have recorded high-grading patterns for its discards, may be due to restrictive TACs and delay in total TAC allocation. Individual TAC allocations were provided three times and the entire individual TAC was awarded in June. The two preliminary individual TACs, allocated for the period between January and March and between March and July, were reached before the end of their corresponding periods which have led to discard high-grading in Q1 and Q2.

In 2022, discards are mostly composed of 1 year old fish. In 2023, discards are mostly composed of fish of 2 year. (see figure below)



5.2.4 Biological

Catch numbers-at-age, catch weights-at-age and stock weights-at-age are given respectively in Tables 5.2, 5.3 and 5.4.

Temporal trends in stock and catch were scrutinized at WGCSE 2021, to ensure that reduce sampling did not impact catch weight. No important issues were reported.

Biological parameters are described in the stock annex and has been updated at WKCELTIC 2020. Celtic Sea cod are very fast growing and early maturing compared with more northern cod stocks.

Commercial LPUE

Tables 5.5 a–c gather the values of landings, fishing effort and LPUE dataseries for the French (a), Irish (b) and UK fleets (c). Figures 5.6 a-c illustrate the trends of LPUE and effort by country.

The impact of the Covid-19 pandemic on the fishery cannot be quantitatively determined but a slight reduction of fishing effort of the main fleets in 2020 was observed for all country. As, a result in 2020, LPUE of irish otter trawls in VIIg and UK trawls in VIIek are decreasing, while French otter trawl LPUE remain stable.

Catches and effort of the French fleet decrease in 2023, while LPUE remain constant and at a low level. While fishing effort of the Irish fleets remain relatively stable, their LPUE are decreasing in 2023. UK mean fleet is relatively stable in term of effort and LPUE in the recent years.

Remark: The UK English and Welsh effort data are only reliable for vessels over 12 metres registered length, and therefore has always been provided to working groups for vessels greater than 12 metres. The fleet of over 12 meter vessels has been declining gradually over the years, until in 2016 no effort was recorded from this fleet. The zero figures provided for 2016 have been checked and are correct (Figure 5.6c)

5.2.5 Surveys and commercial tuning fleet

Two ongoing surveys, both part of the DCF, IBTS Q4 (EVHOE-WIBTS-Q4; IGFS-WIBTS-Q4) are combined and modelled to produce a single index using VAST modelling (see details in the stock annex and WKCELTIC 2020 report).

In 2017 and 2018, the French EVHOE survey was not conducted due to technical difficulties at the beginning of the survey. The Irish survey covered additional stations normally undertaken by the EVHOE survey. The VAST modelling index shows little retrospective bias and a slight increase in one year old fish in the last quarter of the year 2022.

Commercial tuning index based on French OTB and OTT fleet is provided. The calculation of the commercial tuning series was updated at WKCELIC 2020 to better account for changes in fleet behaviour along the years (see details in the stock annex and WKCELTIC 2020 report). LPUE is decreasing since 2012.

The historical time-series of commercial tuning index (OTDEF French fleet for quarter 2, 3 and 4), and the survey index are shown in Table 5.6.

Data issues

No important issues were reported this year.

As a result of poor information on discard practices in recent years, there is uncertainty around current discarding. In 2021, 2022 and 2023 it was not possible to forecast separate landings and discard estimates.

Catch sampling of the fisheries has been reduced in 2020 due to Covid-19, which may have result in a higher uncertainty associated with discard estimates and age structure of the catch. However, this was considered to have had minimal impact on the perception of the stock status.

Remark: When for a metier/strata landings are uploaded annually, there is no information available in InterCatch to split the annual landings into quarterly landings and therefore the associated age composition and mean weight-at-age. As a result, when extracting quarter 1 versus quarter 2, 3 and 4 data to inform on mean weight of the stock and the catch for the assessment, these data are not used.

5.3 Stock assessment

Model used: SAM (stockassessment.org).

5.3.1 Final update assessment (SAM)

The final assessment was run with the same settings as established by WKCELTIC 2020 and described in the stock annex. Discards are included in the assessment. (sotcokassessment.org, Cod_7ek_WGCSE2020).

Residuals and diagnostics do not highlight any problem regarding the input data and model fit (Figure 5.7 and 5.8). Outputs from the assessment are reported in Tables 5.7–5.10 and in Figures 5. 7–5.11.

There is a tendency for the assessment to overestimate SSB and recruitment. (Figure 5.12a). Mohn's rho analysis (i.e. a measure of the relative difference between an estimate from an assessment with a truncated time-series and an estimate of the same quantity from an assessment using the full time-series) resulted in values of -1% for $F_{bar\,(2\text{-}5)}$, 17% for SSB and 47% for recruitment.

The comparison of runs with and without tuning indices is shown in Figure 5.12b. The information contained in both indices are consistent (survey versus commercial) but lead to distinct final estimates of F.

Remark : the 2018 run of the retrospective analysis is excessively flat, which might indicate that it did not converge.

The retrospective bias in assessment when an additional year of data are incorporated may be due to the variability of cod recruitment over years, the strong dependency of the fishery to recruitment (not well estimated by the survey), the low stock size and the unexpected disappearance of fish of older age.

Despite the high values of the Mohn's rho coefficient for the recruitment and the uncertainties in the estimates of the most recent year, the assessment has been validated, and the output are used to provide the short-term forecast. Despite the uncertainties in the estimates of the most recent years, SSB and F are estimated well below biological references points.

5.3.2 State of the stock

Table 5.7 and 5.8 summarise the estimated fishing mortality-at-age and the stock numbers-at-age, respectively. The stock summary is reported in Table 5.9 and Figure 5.11. Stock_recruitment plots and yield per recruits information are shown in Figure 5.13.

Catches were around 5000 t between 2000 and 2016, with some higher catches following strong recruitments, and decreased around 1300 t since 2019 (Figure 5.11). Reliable discard estimates are available since 2004 and range between 75 and 3749 t depending on the interplay between recruitment dynamics and TAC constraints.

Recruitment has been highly variable over time with occasional very high recruitment followed by period of low recruitments. Since 2012, recruitment has been very weak with the exception of the 2014 year class, which is above average (Table 5.9 and Figure 5.11). The 2023 value is the lowest value of the time series.

Spawning–stock biomass (SSB) has been fluctuating around B_{pa} since 2004, except from 2011 to 2013 (as a consequence of a very good recruitment year) and is below B_{lim} since 2017 (Table 5.9 and Figure 5.11, ICES, 2012).The 2023 value is the lowest value of the time series.

Fishing mortality has been above F_{MSY} for the entire time-series, fluctuating between F_{lim} and F_{pa}. Fishing mortality increased up to above F_{lim} between 2018 and 2019 (Table 5.9 and Figure 5.11). In recent years fishing pressure on the stock is between $F_{pa,}$ and F_{lim}. There is a decreasing trend in F over the last three years.

5.4 Short-term projections

Assumptions made for the short-term projections are described in Table 5.12 and followed the stock annex.

F status quo was used as an assumption of F in 2024 to reflect recent fishing pressure

The recruitment age 1 fish values are 1067 thousands in 2024 and 2025.

SSB is predicted to be 676 t in 2025 which would still be below B_{lim} (4200 t) (Table 5.11).

ICES provides zero-catch advice for this stock in 2025, because the median SSB remains below B_{lim} by 2026 under all catch scenarios (Table 5.12 and Table 5.13).

In the ICES advice framework, this would result in advised catches between 25 tonnes (at $F_{MSY\ lower}$ × SSB_{2024}/MSY $B_{trigger}$) and 60 tonnes (at F_{MSY} × SSB_{2024}/MSY $B_{trigger}$), but the median SSB would remain below B_{lim} by 2026.

The assumed recruitment in 2024 and 2025 used in the forecast constitutes a very significant part (83%) of the projected SSB in 2026 (55 % and 28 %, respectively; Figure 5.14 and Table 5.14).

5.5 Medium-term projection

No medium-term projections were carried out.

5.6 Biological reference points

The reference points has been estimated using the agreed ICES guidelines, see Table 5.11 (ICES, 2016). F_{pa} was set to $F_{p0.5}$; the F that leads to SSB ≥ B_{lim} with 95% probability at the last benchmark in 2020.

5.7 Management plans

The European Parliament and the Council have published a multiannual management plan ICES is aware of the multiannual management plan (MAP) which has been adopted by the EU for this stock (EU, 2019) and which ICES considers to be precautionary. There is no agreed shared management plan between the EU and the UK for this stock, and ICES provides advice according to ICES MSY approach and precautionary considerations. Catch scenarios consistent with the MAP FMSY ranges are provided.

Conservation aspects and associated management measures may exist at a national or regional level but were not reviewed by ICES.

5.8 Uncertainties and bias in assessment and forecast

The stock was benchmarked in 2020. The model was changed to a stochastic state-space assessment model (SAM). Maturity and natural mortality information was updated, discards were included in the assessment, catch (landings and discards) time-series were reviewed and updated from 2004 to 2018, commercial tuning series were reviewed and included as biomass index, and survey indices were updated to a single modelled time-series using a vector-autoregressive spatio-temporal model (VAST). The F-pattern shows less variability across the time-series and higher estimates in most recent years than the previous assessment.

Fishing mortality is observed to be sensitive to the addition of an extra year of data with no systematic trend. However, despite this uncertainty, it is quite clear that the cod stock is well below SBB limits and well above F target. Given that situation and the recommendations of WKBIAS, WGCSE 2024 validated the proposed assessment model and its use for prediction.

5.9 Recommendations for future developments

Despite the work performed to improve the commercial tuning fleet, it is never easy to account for changes in fisheries targeting behaviours. Indeed, in recent years, cod is not targeted anymore by most of the fisheries. Further work and sensitivity analysis on the use or not of commercial indices might also be performed and documented in the future

Even if the survey index combined two surveys, it is based on few fish. Further work and sensitivity analysis on the VAST assumptions might also be performed and documented in the future to ensure that the model will converge for all ages and show low retrospective patterns.

5.10 Management considerations

The retrospective pattern implies that the current F estimates might be uncertain. Forecasts are sensitive to the assumption on recruitment as the landings are usually composed of a high proportion of age 1 and 2 fish (and age 1 for discards).

The recent technical measures introduced in the Celtic Sea, increase in the mesh size of the square mesh panels and raised lines, are expected to reduce catches of Celtic Sea cod and improve the selection pattern. Impact of these measures should be monitored.

Additionally, mixed fisheries issues could be responsible for maintaining F at high level, as other gadoid fishing opportunities are higher. In this context, cod is no longer a target species but can be considered as by catch in the fleet targeting haddock, whiting and *Nephrops*.

Historical information on management consideration can be found in the stock annex.

5.11 References

EU. 2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L 83. 17 pp. http://data.europa.eu/eli/reg/2019/472/oj

ICES. 2012. Report of the Working Group on the Celtic Seas Ecoregion (WGCSE), 9–18 May 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:12.

ICES. 2016. Report of the Workshop to consider FMSY ranges for stocks in ICES categories 1 and 2 in Western Waters (WKMSYREF4), 13–16 October 2015, Brest, France. ICES CM 2015/ACOM:58. 187 pp.

5.12 Tables

Table 5.1. Cod in Divisions 7.e-k. History of commercial landings by country and ICES estimates of discards. Weights in tonnes. (series from 2004 were updated at WKCELTIC 2020). All weights are in tonnes.

Year	Belgium	France	Ireland	UK	Others	Total	Discard estimates	Landings taken or reported in 33E2 and 33E3 *
1971	NA	NA	NA	NA	NA	5782	NA	NA
1972	NA	NA	NA	NA	NA	4737	NA	NA
1973	NA	NA	NA	NA	NA	4015	NA	NA
1974	NA	NA	NA	NA	NA	2898	NA	NA
1975	NA	NA	NA	NA	NA	3993	NA	NA
1976	NA	NA	NA	NA	NA	4818	NA	NA
1977	NA	NA	NA	NA	NA	3059	NA	NA
1978	NA	NA	NA	NA	NA	3647	NA	NA
1979	NA	NA	NA	NA	NA	4650	NA	NA
1980	NA	NA	NA	NA	NA	7243	NA	NA
1981	NA	NA	NA	NA	NA	10597	NA	NA
1982	NA	NA	NA	NA	NA	8766	NA	NA
1983	NA	NA	NA	NA	NA	9641	NA	NA
1984	NA	NA	NA	NA	NA	6631	NA	NA
1985	NA	NA	NA	NA	NA	8317	NA	NA
1986	NA	NA	NA	NA	NA	10475	NA	NA
1987	NA	NA	NA	NA	NA	10228	NA	NA
1988	554	13863	1480	1292	2	17191	NA	NA
1989	910	15801	1860	1223	15	19809	NA	NA
1990	621	9383	1241	1346	158	12749	NA	NA
1991	303	6260	1659	1094	20	9336	NA	NA
1992	195	7120	1212	1207	13	9747	NA	NA
1993	391	8317	766	945	6	10425	NA	NA
1994	398	7692	1616	906	8	10620	NA	NA
1995	400	8321	1946	1034	8	11709	NA	NA
1996	552	8981	1982	1166	0	12681	NA	NA

Year	Belgium	France	Ireland	UK	Others	Total	Discard estimates	Landings taken or reported in 33E2 and 33E3 *
1997	694	8662	1513	1166	0	12035	NA	NA
1998	528	8096	1718	1089	0	11431	NA	NA
1999	326	5488	1883	897	0	8594	NA	NA
2000	208	4281	1302	744	0	6535	NA	NA
2001	347	6033	1091	838	0	8309	NA	NA
2002	555	7368	694	618	0	9235	NA	NA
2003	136	5222	517	346	0	6221	NA	NA
2004	153	2934	657	281	1	4027	543	108
2005	186	2127	855	309	1	3478	1426	54
2006	101	2431	995	371	3	3902	2118	103
2007	107	3113	1208	411	3	4842	1248	527
2008	65	2994	1222	295	1	4577	306	558
2009	48	3020	847	267	5	4187	1229	193
2010	52	2449	1030	296	3	3831	3040	143
2011	123	4808	1010	427	7	6376	3749	147
2012	290	6900	1539	706	8	9443	2341	85
2013	202	5051	1470	548	3	7273	562	76
2014	141	2715	1189	466	0	4512	1569	24
2015	121	3373	1109	422	3	5028	483	39
2016	97	2579	881	365	1	3924	525	40
2017	82	1578	623	188	0	2471	134	19
2018	49	611	706	130	0	1496	316	20
2019	43	369	554	84	NA	1050	300	37
2020	18	371	487	44	2	922	231	71
2021	11	261	309	46	0	627	733	52
2022	9	204	309	51	0	573	75	30
2023	8	155	229	52	0	444	13	19

*Included in Ireland landings estimates. Landings in the south of Division 7.a (33E2 and 33E3) are included in the assessment and are considered to be part of the stock.

Table 5.2. Cod in Divisions 7e-k. Catch number-at-age (in thousands). Number at age 1 and 2 before 2004 are estimated by the assessment model

Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+	Year
NA	NA	285	175	52	55	14	1980
NA	NA	811	153	41	20	12	1981
NA	NA	888	169	36	19	5	1982
NA	NA	540	424	77	21	11	1983
NA	NA	134	97	94	22	5	1984
NA	NA	465	61	40	47	15	1985
NA	NA	673	254	30	31	17	1986
NA	NA	448	250	62	20	15	1987
NA	NA	320	133	46	21	8	1988
NA	NA	2483	149	77	18	11	1989
NA	NA	1006	663	79	21	16	1990
NA	NA	229	330	203	48	14	1991
NA	NA	329	64	70	53	17	1992
NA	NA	928	79	24	19	16	1993
NA	NA	1199	258	27	10	17	1994
NA	NA	310	284	73	13	5	1995
NA	NA	1199	134	95	43	4	1996
NA	NA	951	297	48	22	6	1997
NA	NA	641	254	99	36	8	1998
NA	NA	756	158	59	36	14	1999
NA	NA	419	169	44	17	14	2000
NA	NA	136	98	70	19	19	2001
NA	NA	883	64	33	12	11	2002
NA	NA	827	217	15	9	7	2003
873	1077	229	189	65	5	6	2004
2875	2080	182	93	47	19	8	2005
7477	1052	295	17	25	13	9	2006
3556	1302	355	79	10	8	11	2007

Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+	Year
467	885	403	122	27	4	6	2008
2212	421	424	120	47	11	4	2009
9794	618	151	107	46	14	5	2010
2325	4905	423	49	34	13	4	2011
746	1860	1757	117	18	14	11	2012
388	383	581	516	55	16	7	2013
4708	415	83	132	149	8	2	2014
242	2272	137	26	47	37	7	2015
624	195	707	33	7	17	16	2016
159	561	57	166	24	5	15	2017
902	172	137	14	38	5	2	2018
944	247	29	26	4	11	2	2019
342	548	36	3	2	2	2	2020
329	321	140	16	4	2	1	2021
225	58	37	29	3	1	0	2022
11	170	15	7	5	0	0	2023

Table 5.3. Cod in Divisions 7e-k. Catch weight (in kg) at age

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+
1980	0.457	1.756	4.217	7.147	9.454	11.179	12.73800
1981	0.457	1.756	4.217	7.147	9.454	11.179	12.82433
1982	0.457	1.756	4.217	7.147	9.454	11.179	12.84160
1983	0.457	1.756	4.217	7.147	9.454	11.179	13.04373
1984	0.457	1.756	4.217	7.147	9.454	11.179	12.94520
1985	0.457	1.756	4.217	7.147	9.454	11.179	12.85860
1986	0.457	1.756	4.217	7.147	9.454	11.179	12.73800
1987	0.457	1.756	4.217	7.147	9.454	11.179	12.87613
1988	0.457	1.756	4.217	7.147	9.454	11.179	13.06075
1989	0.457	1.756	4.217	7.147	9.454	11.179	12.90245
1990	0.457	1.756	4.217	7.147	9.454	11.179	13.02887
1991	0.457	1.756	4.217	7.147	9.454	11.179	12.84900
1992	0.457	1.756	4.217	7.147	9.454	11.179	12.76847
1993	0.457	1.756	4.217	7.147	9.454	11.179	12.80275
1994	0.457	1.756	4.217	7.147	9.454	11.179	12.92082
1995	0.457	1.756	4.217	7.147	9.454	11.179	13.04880
1996	0.457	1.756	4.217	7.147	9.454	11.179	12.86750
1997	0.457	1.756	4.217	7.147	9.454	11.179	12.73800
1998	0.457	1.756	4.217	7.147	9.454	11.179	12.86750
1999	0.457	1.756	4.217	7.147	9.454	11.179	12.92300
2000	0.457	1.756	4.217	7.147	9.454	11.179	12.81200
2001	0.457	1.756	4.217	7.147	9.454	11.179	12.94226
2002	0.457	1.756	4.217	7.147	9.454	11.179	12.99664
2003	0.457	1.756	4.217	7.147	9.454	11.179	12.81200
2004	0.585	0.939	4.268	6.849	9.207	12.192	11.86933
2005	0.388	0.899	3.412	6.107	9.138	11.017	11.43300
2006	0.285	1.780	4.758	6.971	9.341	11.119	12.42300
2007	0.362	1.738	4.412	7.943	9.953	12.043	13.20200
2008	0.541	1.925	4.105	7.337	9.483	11.220	12.64783

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+
2009	0.510	2.457	4.324	6.740	9.252	10.707	12.93800
2010	0.330	2.078	5.223	7.863	10.056	12.290	13.78180
2011	0.358	1.381	3.740	7.774	10.314	11.531	13.02500
2012	0.488	1.532	4.108	7.276	10.386	12.096	13.87391
2013	0.655	2.471	4.019	6.976	8.088	9.991	12.55800
2014	0.448	2.281	4.988	7.353	10.180	11.432	14.80600
2015	0.367	1.608	4.230	7.952	10.087	11.147	12.53600
2016	0.706	1.787	4.175	7.386	9.619	11.556	12.35400
2017	0.393	1.532	3.414	6.517	7.630	9.563	11.09620
2018	0.444	1.927	4.076	6.160	9.081	9.780	13.23200
2019	0.465	1.774	4.203	7.223	9.815	10.576	11.95100
2020	0.455	1.369	4.233	8.058	9.731	12.757	13.13100
2021	0.450	1.477	3.946	6.784	9.264	11.004	12.53500
2022	0.580	1.797	4.462	7.188	9.387	10.841	12.65200
2023	0.873	1.661	4.166	6.714	8.855	10.108	14.43100

Table 5.4. Cod in Divisions 7e-k. Stock weight at age =1st quarter values

year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+
1980	0.370	1.421	3.936	6.901	9.324	11.107	13.574000
1981	0.370	1.421	3.936	6.901	9.324	11.107	13.578000
1982	0.370	1.421	3.936	6.901	9.324	11.107	13.578800
1983	0.370	1.421	3.936	6.901	9.324	11.107	13.626820
1984	0.370	1.421	3.936	6.901	9.324	11.107	13.583600
1985	0.370	1.421	3.936	6.901	9.324	11.107	13.607930
1986	0.370	1.421	3.936	6.901	9.324	11.107	13.574000
1987	0.370	1.421	3.936	6.901	9.324	11.107	13.580400
1988	0.370	1.421	3.936	6.901	9.324	11.107	13.695250
1989	0.370	1.421	3.936	6.901	9.324	11.107	13.620270
1990	0.370	1.421	3.936	6.901	9.324	11.107	13.640620
1991	0.370	1.421	3.936	6.901	9.324	11.107	13.579140
1992	0.370	1.421	3.936	6.901	9.324	11.107	13.575410
1993	0.370	1.421	3.936	6.901	9.324	11.107	13.577000
1994	0.370	1.421	3.936	6.901	9.324	11.107	13.582470
1995	0.370	1.421	3.936	6.901	9.324	11.107	13.588400
1996	0.370	1.421	3.936	6.901	9.324	11.107	13.580000
1997	0.370	1.421	3.936	6.901	9.324	11.107	13.574000
1998	0.370	1.421	3.936	6.901	9.324	11.107	13.580000
1999	0.370	1.421	3.936	6.901	9.324	11.107	13.582570
2000	0.370	1.421	3.936	6.901	9.324	11.107	13.577430
2001	0.370	1.421	3.936	6.901	9.324	11.107	13.605840
2002	0.370	1.421	3.936	6.901	9.324	11.107	13.624640
2003	0.370	1.421	3.936	6.901	9.324	11.107	13.577430
2004	0.356	0.830	4.035	6.101	9.324	13.784	9.952167
2005	0.320	0.830	4.035	6.101	9.324	11.135	15.169000
2006	0.267	1.516	4.370	6.325	9.350	11.081	12.688000
2007	0.290	1.453	3.916	8.101	10.658	11.413	15.827000
2008	0.344	1.623	4.027	7.200	8.941	10.916	12.550670

year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+
2009	0.399	1.914	3.880	6.404	8.898	10.507	13.964000
2010	0.286	1.597	4.874	7.466	9.852	11.254	13.545200
2011	0.324	1.030	3.478	8.051	10.251	11.355	15.493000
2012	0.410	1.289	3.641	6.979	9.704	12.111	15.844000
2013	0.440	1.774	3.746	6.854	7.334	9.330	12.844000
2014	0.363	1.762	4.109	6.762	10.082	11.634	15.360000
2015	0.428	1.202	4.326	8.210	10.337	11.508	14.311000
2016	0.618	1.542	3.622	7.110	10.048	11.707	13.416000
2017	0.335	1.337	3.313	6.189	7.249	9.651	10.962330
2018	0.376	1.617	3.675	5.655	8.508	9.223	12.240000
2019	0.366	1.509	3.821	7.254	9.725	10.795	11.486000
2020	0.420	1.200	3.705	8.174	10.286	13.407	13.634000
2021	0.401	1.154	3.272	6.038	8.786	11.148	15.225000
2022	0.499	1.840	4.282	6.808	8.605	10.583	12.434000
2023	0.613	1.288	4.180	6.593	9.199	10.440	14.280000

Table 5.5a. Cod in Divisions 7e-k. LPUE for French OT-DEF fleets. Units: landings in tonnes, effort in 000s hours fished and LPUE in kg/hour fished. This serie is used to tuned the assessment model.

Effort	Landings	Year
264146	3692073	2002
240535	1978251	2003
214247	918840	2004
156961	714850	2005
125245	712566	2006
150288	1193033	2007
138626	814340	2008
143812	647808	2009
143730	705691	2010
258383	2332986	2011
252110	3393990	2012
190886	1696287	2013
151518	1113363	2014
185791	1374691	2015
178399	1122665	2016
137849	483571	2017
102586	163178	2018
114838	136473	2019
96907	149412	2020
97502	102964	2021
84073	60638	2022
48147	37951	2023

Table 5.5b. Cod in Divisions 7e-k. Time series of standardized effort and LPUE for the Irish fleets.

Year	Beam trawlers VIIgj	Scottish seiners VIIgj	Gillnet VIIgj	Otter trawlers VIIj	Otter trawlers VIIg
1995	1.0739155	2.3116338	0.7932263	2.0288004	1.5339901
1996	1.2412737	2.3593171	4.5769556	2.8900057	2.9387727
1997	1.4134435	1.4464493	0.6444256	2.5637842	1.2200505
1998	1.4620132	2.5786260	0.3210033	1.4378701	1.2474022
1999	1.4003316	0.3797466	1.1817480	0.5360746	1.0421730
2000	1.4720509	0.8306928	0.6477115	0.1956183	0.4043004
2001	-0.0854600	0.1827759	0.4723628	0.8005017	0.6927718
2002	-0.7204613	-0.7312301	-0.3738248	0.3368635	-0.5597386
2003	-1.2732699	-1.0930361	-0.5706379	-0.4941315	-0.9910314
2004	-1.1002628	-0.9149536	-0.3119428	-0.7303839	-0.9748648
2005	-0.2855047	-0.5435256	-0.0992071	-0.6266335	-0.7734416
2006	-0.5006298	-0.2339412	-0.1125479	-0.5551541	-0.3223498
2007	-0.7523866	-0.6548663	-0.1237645	-0.6884788	-0.7790546
2008	-0.3506504	-0.4273760	-0.1712674	-0.6554859	-0.5635929
2009	-0.6317310	-0.5964348	-0.2775201	-0.7681634	-0.4542485
2010	-0.3198261	-0.2859472	-0.2784590	-0.5569284	-0.0555065
2011	-0.3165482	-0.4538145	-0.0930641	-0.2950371	-0.0995984
2012	0.9871003	0.2310355	0.1665032	-0.2625095	1.1847930
2013	1.8283100	0.2360443	-0.1496997	-0.1586878	1.1786137
2014	0.7899234	0.4575828	-0.4293544	-0.2625401	0.4559488
2015	1.1817187	0.0913562	-0.4472010	0.0774278	0.0684850
2016	-0.0378088	-0.3428830	-0.5160935	-0.2624196	-0.5263045
2017	-1.1217131	-0.4522025	-0.6766706	-0.4548445	-0.6123161
2018	-0.6310259	-0.1707916	-0.7167977	-0.3863243	-0.1315745
2019	-0.4984040	-0.7356416	-0.6915011	-0.5932309	-0.7681347
2020	-0.6730987	-0.6417493	-0.6476859	-0.5624436	-0.9269366
2021	-1.0441169	-1.0257469	-0.7028098	-0.8049481	-1.3202406
2022	-0.9968448	-0.8564834	-0.6435164	-0.8356647	-0.8883049
2023	-1.5103380	-0.9446365	-0.7703708	-0.9129365	-1.2200624

Year	Beam trawlers VIIgj	Scottish seiners VIIgj	Gillnet VIIgj	Otter trawlers VIIj	Otter trawlers VIIg
1995	20.9	11.7	27.7	93.2	63.3
1996	28.1	17.9	11.4	70.2	60.0
1997	29.7	26.8	10.2	82.7	65.0
1998	40.4	21.5	19.5	89.1	72.3
1999	48.3	9.4	17.1	40.5	51.5
2000	43.8	13.4	17.1	63.9	60.6
2001	42.5	20.7	15.3	67.4	69.4
2002	34.6	29.7	14.5	90.4	77.2
2003	58.2	28.0	22.3	107.4	86.8
2004	57.0	26.5	19.6	88.3	97.1
2005	51.9	20.5	17.0	71.3	124.7
2006	62.0	20.1	15.1	64.5	118.0
2007	58.2	19.3	19.9	78.3	135.4
2008	38.3	14.5	22.0	66.7	125.4
2009	40.8	11.5	24.7	73.0	137.1
2010	41.3	14.0	23.4	85.7	140.8
2011	36.0	15.6	19.4	62.8	120.3
2012	40.6	19.5	23.7	65.6	127.7
2013	39.0	19.8	24.3	61.3	118.2
2014	38.5	19.9	26.3	53.9	127.3
2015	37.9	14.6	26.7	46.9	132.7
2016	39.7	15.7	30.7	50.7	148.2
2017	35.2	15.1	32.8	56.4	136.1
2018	37.5	16.1	30.8	52.1	108.2
2019	34.2	21.6	30.5	53.4	103.9
2020	29.2	19.1	28.5	44.1	89.9
2021	31.9	20.1	37.3	40.3	83.9
2022	22.5	22.1	17.5	32.1	64.4
2023	28.9	22.8	23.7	33.8	66.4

Table 5.5c. Cod in Divisions 7e-k. Time series of landings, effort and LPUE for the UK fleets. Units: landings in tonnes, effort in days fished and LPUE in kg/day

	Beam_trawl_27.7ek		Trawl_27.7ek		Trawl_27.7e	
YEAR	Lands..t.	Effort..Days.	Lands..t..1	Effort..Days..1	Lands..t..2	Effort..Days..2
1983	25.55	2853	40.93	2573	20.60	1871
1984	128.75	8427	235.68	8092	76.42	5618
1985	145.39	7706	250.67	7186	63.97	5411
1986	165.76	6651	232.19	6174	78.31	4425
1987	248.91	8060	210.36	5446	88.49	3701
1988	249.21	9487	262.68	5645	151.35	4265
1989	231.24	10071	177.12	5997	96.00	4607
1990	309.07	10477	305.78	6661	119.41	4423
1991	256.19	9017	242.33	5938	83.60	4004
1992	256.33	8183	231.85	6494	80.76	4108
1993	221.79	9511	183.05	5055	42.88	3761
1994	179.13	13925	78.23	4426	41.25	3423
1995	241.35	15076	115.05	4405	55.09	3294
1996	304.22	15748	120.46	4476	59.21	2589
1997	303.67	16373	150.01	5088	79.81	3011
1998	266.15	15574	119.56	4729	62.50	2699
1999	257.43	15614	90.68	6638	46.81	2486
2000	188.07	16456	110.79	7054	52.59	2681
2001	257.24	17335	109.75	5875	59.05	2732
2002	132.13	16503	82.70	5657	34.11	2448
2003	108.77	18285	58.80	5120	24.48	2273
2004	96.93	18250	44.06	5273	15.05	2334
2005	103.60	17157	41.13	5047	17.38	1762
2006	91.88	15412	55.43	5314	13.54	1699
2007	111.28	15085	49.65	5679	21.61	1917
2008	71.38	13734	49.34	4686	24.26	1750
2009	67.27	12170	27.56	4928	12.56	1847
2010	65.62	12150	31.13	5185	15.27	2213

	Beam_trawl_27.7ek		Trawl_27.7ek		Trawl_27.7e	
2011	99.03	13205	47.73	4354	26.00	1931
2012	165.63	13411	79.03	4312	30.95	2068
2013	114.49	12950	37.30	2014	22.94	1587
2014	87.55	12807	17.07	1606	14.06	1440
2015	89.39	12769	16.68	1061	14.40	978
2016	73.81	13913	0.00	0	0.00	0
2017	35.49	14283	19.37	3718	9.33	2398
2018	24.41	13065	17.51	3233	5.34	1987
2019	18.03	12649	11.76	2660	3.64	1548
2020	10.21	12332	2.55	1464	1.74	1076
2021	14.99	12600	2.54	1911	1.27	1374
2022	11.44	13620	3.93	1615	2.85	1252
2023	12.79	13600	3.04	1792	1.77	1346

Table 5.6. Cod in Divisions 7e-k. Time series of survey indices scrutinized at WGCSE and used in the assessment

Cod in Divisions 7e-k, tuning fleets, WGCSE20			
102			
FR-OTDEF Q2+3+4 trawlers in 7e-k			
2002	2023		
1	1	0.25	1
-1	-1		

Year	Effort	Landings
2002	264146	3692073
2003	240535	1978251
2004	214247	918840
2005	156961	714850
2006	125245	712566
2007	150288	1193033
2008	138626	814340
2009	143812	647808
2010	143730	705691
2011	258383	2332986
2012	252110	3393990
2013	190886	1696287
2014	151518	1113363
2015	185791	1374691
2016	178399	1122665
2017	137849	483571
2018	102586	163178
2019	114838	136473
2020	96907	149412
2021	97502	102964
2022	84073	60638
2023	48147	37951

IR-GFS FR-EVHOE Q4 combined indices - VAST Modelling

2003	2023	NA	NA
1	1	0.79	0.92
1	4	NA	NA

Year	Effort	Age 1	Age 2	Age 3	Age 4
2003	1	23.508	39.435	44.306	15.163
2004	1	35.001	33.533	14.273	16.800
2005	1	125.410	33.582	11.310	0.000
2006	1	81.561	44.073	7.683	0.000
2007	1	93.485	70.089	29.747	9.740
2008	1	28.195	80.015	28.245	9.558
2009	1	61.179	20.918	27.486	9.596
2010	1	510.603	73.796	4.868	6.560
2011	1	237.884	377.377	24.540	3.898
2012	1	22.085	129.768	118.265	25.834
2013	1	23.292	7.761	21.659	27.981
2014	1	291.579	28.234	13.425	18.659
2015	1	13.513	152.798	8.794	0.000
2016	1	125.391	22.630	98.755	17.726
2017	1	23.543	72.419	23.992	28.737
2018	1	35.801	10.993	11.749	4.253
2019	1	156.906	36.018	2.792	4.379
2020	1	55.177	121.167	1.559	0.000
2021	1	21.683	30.417	36.752	1.283
2022	1	79.785	11.359	15.282	7.556
2023	1	3.724	23.840	6.431	0.000

Table 5.7. Cod in Divisions 7e-k. Final SAM fishing mortality at age

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+	Fbar(mean 2-5)
1980	0.493	0.983	0.917	0.918	0.899	1.168	1.168	0.929
1981	0.484	0.962	0.897	0.891	0.868	1.122	1.122	0.904
1982	0.447	0.886	0.822	0.810	0.786	1.009	1.009	0.826
1983	0.467	0.927	0.861	0.846	0.818	1.044	1.044	0.863
1984	0.401	0.793	0.733	0.715	0.690	0.876	0.876	0.733
1985	0.408	0.807	0.747	0.725	0.698	0.881	0.881	0.744
1986	0.447	0.887	0.823	0.797	0.762	0.952	0.952	0.817
1987	0.460	0.914	0.850	0.822	0.786	0.971	0.971	0.843
1988	0.421	0.833	0.773	0.741	0.709	0.868	0.868	0.764
1989	0.450	0.893	0.830	0.787	0.751	0.908	0.908	0.815
1990	0.500	0.995	0.927	0.877	0.833	1.000	1.000	0.908
1991	0.543	1.085	1.016	0.961	0.917	1.094	1.094	0.995
1992	0.533	1.065	0.998	0.939	0.899	1.072	1.072	0.975
1993	0.517	1.031	0.965	0.902	0.863	1.025	1.025	0.940
1994	0.541	1.081	1.014	0.944	0.904	1.073	1.073	0.986
1995	0.520	1.037	0.972	0.902	0.865	1.023	1.023	0.944
1996	0.536	1.070	1.003	0.922	0.881	1.032	1.032	0.969
1997	0.519	1.034	0.968	0.878	0.828	0.956	0.956	0.927
1998	0.542	1.082	1.015	0.915	0.856	0.973	0.973	0.967
1999	0.553	1.104	1.036	0.927	0.864	0.970	0.970	0.983
2000	0.539	1.076	1.010	0.898	0.834	0.925	0.925	0.955
2001	0.556	1.110	1.044	0.928	0.864	0.953	0.953	0.987
2002	0.575	1.150	1.083	0.953	0.882	0.965	0.965	1.017
2003	0.558	1.114	1.050	0.917	0.847	0.922	0.922	0.982
2004	0.544	1.085	1.023	0.891	0.825	0.899	0.899	0.956
2005	0.576	1.148	1.091	0.947	0.882	0.968	0.968	1.017
2006	0.511	1.009	0.964	0.840	0.792	0.879	0.879	0.901
2007	0.501	0.989	0.953	0.836	0.797	0.896	0.896	0.894
2008	0.476	0.941	0.917	0.812	0.784	0.892	0.892	0.864

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+	Fbar(mean 2-5)
2009	0.476	0.944	0.927	0.827	0.808	0.932	0.932	0.877
2010	0.451	0.897	0.885	0.793	0.782	0.915	0.915	0.839
2011	0.446	0.890	0.876	0.781	0.773	0.912	0.912	0.830
2012	0.486	0.978	0.963	0.859	0.853	1.021	1.021	0.913
2013	0.522	1.060	1.044	0.934	0.932	1.125	1.125	0.993
2014	0.469	0.953	0.931	0.827	0.822	0.997	0.997	0.883
2015	0.484	0.987	0.961	0.849	0.843	1.034	1.034	0.910
2016	0.506	1.038	1.006	0.883	0.874	1.085	1.085	0.950
2017	0.608	1.259	1.218	1.069	1.056	1.320	1.320	1.151
2018	0.632	1.311	1.258	1.090	1.066	1.339	1.339	1.181
2019	0.626	1.303	1.242	1.070	1.040	1.319	1.319	1.164
2020	0.543	1.125	1.061	0.904	0.878	1.125	1.125	0.992
2021	0.600	1.249	1.176	1.003	0.970	1.240	1.240	1.099
2022	0.518	1.077	1.013	0.867	0.841	1.083	1.083	0.950
2023	0.450	0.934	0.875	0.748	0.727	0.941	0.941	0.821

Table 5.8. Cod in Divisions 7e-k. Final SAM stock number-at-age

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+
1980	17716	4939	690	302	90	72	21
1981	7859	6679	1328	230	94	29	22
1982	3721	2932	1869	399	76	33	12
1983	8095	1392	867	653	142	29	14
1984	8966	3125	382	266	215	50	12
1985	7885	3656	1032	148	104	85	22
1986	8806	3158	1179	387	62	45	35
1987	27792	3331	930	384	130	26	25
1988	13893	11093	937	309	120	46	15
1989	4774	5574	3618	360	122	45	21
1990	6671	1785	1655	1151	148	45	23
1991	17437	2418	459	490	351	59	21
1992	19312	6264	579	129	137	104	23
1993	10442	6981	1584	161	42	42	33
1994	21288	3657	1819	465	53	15	23
1995	16879	7675	865	494	144	18	10
1996	12199	6093	1999	279	152	50	8
1997	12977	4286	1506	566	102	46	15
1998	8111	4739	1086	424	188	43	18
1999	4338	2869	1170	297	126	65	20
2000	16869	1444	686	312	92	42	27
2001	15280	6165	338	189	98	33	24
2002	5633	5424	1511	98	59	30	18
2003	3466	1897	1187	377	30	19	15
2004	5158	1244	444	301	116	11	12
2005	7830	2037	275	137	94	40	9
2006	8018	2610	485	60	44	31	16
2007	5923	2757	712	149	20	16	17
2008	2177	2111	707	212	52	8	11
2009	5266	832	610	220	74	19	6
2010	23178	1953	250	187	79	25	8
2011	9123	9152	628	90	66	29	10

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7+
2012	1778	3568	2729	210	36	24	14
2013	2295	645	962	803	72	14	11
2014	11368	828	165	267	257	22	6
2015	1096	4505	244	50	92	85	9
2016	2327	403	1176	76	16	31	27
2017	732	851	109	295	28	6	16
2018	1381	244	171	26	70	8	4
2019	3343	425	47	34	7	18	3
2020	1067	1142	75	11	8	2	4
2021	437	371	235	21	4	3	2
2022	886	131	72	50	6	1	1
2023	97	325	34	19	15	2	1

Table 5.9. Cod in Divisions 7e-k. Final SAM summary table

Year	R(age 1)	Low	High	SSB	Low	High	Fbar(2-5)	Low	High	TSB	Low	High
1980	17716	7831	40076	10318	7820	13614	0.929	0.747	1.155	20291	13216	31153
1981	7859	3624	17042	13063	9837	17347	0.904	0.743	1.101	20702	14397	29769
1982	3721	1731	8002	13081	10434	16401	0.826	0.672	1.016	16890	13150	21692
1983	8095	3888	16855	10587	8706	12874	0.863	0.696	1.071	14731	11624	18667
1984	8966	4378	18362	8347	6699	10399	0.733	0.566	0.948	13812	10102	18884
1985	7885	3823	16262	9830	7895	12238	0.744	0.596	0.930	15421	11504	20671
1986	8806	4186	18527	10957	8771	13689	0.817	0.675	0.989	16604	12538	21990
1987	27792	13584	56860	10456	8502	12860	0.843	0.689	1.032	23173	15721	34157
1988	13893	6783	28458	15919	11592	21861	0.764	0.605	0.965	28569	19460	41943
1989	4774	2272	10035	21934	16788	28656	0.815	0.669	0.993	28340	21450	37444
1990	6671	3081	14445	17572	14041	21990	0.908	0.756	1.090	21663	17146	27369
1991	17437	8123	37432	11136	9210	13464	0.995	0.809	1.223	19294	13792	26992
1992	19312	9209	40495	10555	7923	14061	0.975	0.817	1.165	21954	14558	33108
1993	10442	4877	22358	13579	10224	18035	0.940	0.784	1.127	22442	15781	31915
1994	21288	10285	44064	13634	10798	17213	0.986	0.823	1.180	24402	17420	34183
1995	16879	8206	34720	14134	10761	18564	0.944	0.793	1.124	25635	17885	36742
1996	12199	5993	24831	15989	12490	20468	0.969	0.810	1.159	25036	18400	34065
1997	12977	6360	26475	14370	11590	17816	0.927	0.775	1.109	22388	16836	29770
1998	8111	3967	16586	13007	10424	16230	0.967	0.813	1.150	19405	14528	25919
1999	4338	2146	8770	10700	8691	13173	0.983	0.824	1.173	14502	11315	18588
2000	16869	8729	32602	7460	6201	8974	0.954	0.800	1.139	14834	10685	20594
2001	15280	7955	29350	8886	6664	11849	0.987	0.834	1.166	18663	13131	26527
2002	5633	3052	10394	11500	9165	14431	1.017	0.855	1.210	17546	13409	22960
2003	3466	2091	5747	9096	7638	10832	0.982	0.839	1.150	11946	9930	14371
2004	5158	3146	8455	5404	4630	6306	0.956	0.826	1.106	7840	6582	9339
2005	7830	5247	11686	4241	3639	4943	1.017	0.839	1.232	7602	6343	9112
2006	8018	5266	12207	5435	4613	6403	0.901	0.773	1.050	9545	7968	11433
2007	5923	3951	8879	6632	5639	7799	0.894	0.773	1.034	10387	8750	12330

Year	R(age 1)	Low	High	SSB	Low	High	Fbar(2-5)	Low	High	TSB	Low	High
2008	2177	1454	3259	6708	5723	7863	0.863	0.744	1.002	9232	7854	10853
2009	5266	3512	7897	5416	4605	6369	0.876	0.756	1.016	8415	7155	9898
2010	23178	15940	33703	5383	4626	6266	0.839	0.718	0.981	13532	10941	16738
2011	9123	6184	13458	9009	7578	10709	0.830	0.704	0.979	16453	13688	19778
2012	1778	1195	2647	14045	11602	17003	0.913	0.795	1.049	17585	14698	21040
2013	2295	1527	3449	10270	8623	12231	0.993	0.811	1.215	12059	10300	14117
2014	11368	7644	16906	6159	5234	7247	0.883	0.745	1.047	11004	9117	13280
2015	1096	726	1655	6370	5413	7496	0.910	0.779	1.063	9404	7788	11354
2016	2327	1551	3492	5735	4744	6934	0.951	0.795	1.137	7758	6523	9226
2017	732	478	1119	3215	2666	3877	1.150	0.980	1.350	4009	3348	4800
2018	1381	908	2098	1665	1429	1939	1.181	1.027	1.359	2409	2067	2808
2019	3343	2245	4979	1058	908	1233	1.164	1.003	1.350	2590	2081	3222
2020	1067	708	1608	1253	1027	1528	0.992	0.769	1.278	2351	1910	2893
2021	437	284	673	1164	947	1432	1.099	0.915	1.321	1590	1308	1933
2022	886	554	1415	835	696	1002	0.950	0.693	1.301	1409	1164	1707
2023	97	39	241	655	484	887	0.821	0.449	1.501	917	665	1264

Table 5.10a. Cod in Divisions 7e-k. Table of model parameters.

Parameter name	par	sd(par)	exp(par)	Low	High
logFpar_0	-6.901	0.050	0.001	0.001	0.001
logFpar_1	-2.972	0.179	0.051	0.036	0.073
logFpar_2	-2.046	0.177	0.129	0.091	0.184
logFpar_3	-1.851	0.177	0.157	0.110	0.224
logSdLogFsta_0	-2.126	0.554	0.119	0.039	0.362
logSdLogN_0	-0.019	0.128	0.981	0.759	1.267
logSdLogN_1	-1.901	0.343	0.149	0.075	0.297
logSdLogObs_0	-0.551	0.207	0.577	0.381	0.872
logSdLogObs_1	-1.217	0.276	0.296	0.171	0.514
logSdLogObs_2	-1.308	0.161	0.270	0.196	0.373
logSdLogObs_3	-1.842	0.204	0.159	0.105	0.239
logSdLogObs_4	-0.267	0.135	0.765	0.584	1.003
transfIRARdist_0	-0.783	0.410	0.457	0.202	1.037
itrans_rho_0	1.976	0.655	7.213	1.948	26.708

Table 5.10b. Cod in Divisions 7e-k. Model fitting.

Model	log(L)	#par	AIC
Current	-249.86	14	527.72
base	-249.86	14	527.72

Table 5.11. Cod in Divisions 7e-k. Reference points

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	5800	B_{pa}; in tonnes	ICES (2020)
	F_{MSY}	0.29	Segmented regression with B_{lim} (EqSim).	ICES (2020)
Precautionary approach	B_{lim}	4200	B_{loss}, lowest observed SSB from which there has been some recovery (2005).	ICES (2020)
	B_{pa}	5800	B_{lim} × 1.4; in tonnes	ICES (2020)
	F_{lim}	1.13	Segmented regression with B_{lim} (EqSim)	ICES (2020)
	F_{pa}	0.77	F_{P05}; the F that leads to SSB ≥ B_{lim} with 95% probability	ICES (2020)
Management plan (MAP)*	MAP MSY $B_{trigger}$	5800	MSY $B_{trigger}$; in tonnes	EU (2019), ICES (2020)
	MAP B_{lim}	4200	B_{lim}; in tonnes	EU (2019), ICES (2020)
	MAP F_{MSY}	0.29	F_{MSY}	EU (2019), ICES (2020)
	MAP range F_{lower}	0.17	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU (2019), ICES (2020)
	MAP range F_{upper}	0.41	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU (2019), ICES (2020)

Table 5.12. Cod Division 7ek. Short term forecast assumption

Variable	Value	Notes
$F_{ages\ 3–5}$ (2024)	0.821	$F_{sq}=F_{2023}$
SSB (2025)	676	Short-term forecast; in tonnes
$R_{age\ 1}$ (2024-2025)	1067	Median recruitment, resampled from the years 2015–2023; in thousands
Total catch (2024)	539	Short-term forecast; in tonnes

Table 5.13. Stochastic Short term forecast

Fmsy

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.454	1.487	98	40	237	667	495	898	529	386	718
2024	0.821	0.434	1.550	1067	97	3343	585	237	1144	539	293	1082
2025	0.290	0.147	0.569	1067	97	3343	676	189	1748	324	128	809
2026	0.290	0.141	0.589	1067	97	3343	1556	458	4242	603	228	1434

Basis for the advice F=0

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2023	0.821	0.454	1.487	98	40	237	667	495	898	529	386	718
2024	0.821	0.434	1.550	1067	97	3343	585	237	1144	539	293	1082
2025	0.000	0.000	0.000	1067	97	3343	676	189	1748	0	0	0
2026	0.000	0.000	0.000	1067	97	3343	2040	648	5394	0	0	0

Other scenarios

F status quo then Fmsy HCR

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.454	1.487	98	40	237	667	495	898	529	386	718
2024	0.821	0.434	1.550	1067	97	3343	585	237	1144	539	293	1082
2025	0.034	0.017	0.066	1067	97	3343	676	189	1748	42	17	110
2026	0.290	0.141	0.589	1067	97	3343	1976	623	5235	733	269	1838

F status quo then Fmsy lower HCR

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.452	1.491	97	40	236	666	496	898	529	387	717
2024	0.821	0.435	1.555	1067	97	3343	584	234	1148	538	290	1089
2025	0.020	0.010	0.039	1067	97	3343	677	185	1734	25	10	65
2026	0.290	0.143	0.592	1067	97	3343	1998	635	5258	739	272	1869

F status quo then Fmsy upper HCR

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.457	1.484	97	40	239	667	495	900	529	387	713
2024	0.821	0.436	1.547	1067	97	3343	585	238	1149	538	293	1094
2025	0.048	0.024	0.093	1067	97	3343	676	186	1742	60	23	155
2026	0.290	0.142	0.590	1067	97	3343	1946	615	5136	726	267	1826

Stable SSB

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.455	1.481	97	40	237	667	495	900	528	386	716
2024	0.821	0.434	1.546	1067	97	3343	584	236	1148	538	291	1087
2025	1.221	0.623	2.398	1067	97	3343	675	188	1741	953	379	2215
2026	1.205	0.592	2.460	1067	97	3343	676	131	2224	966	346	2133

F2023

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.454	1.487	98	40	237	667	495	898	529	386	718
2024	0.821	0.434	1.550	1067	97	3343	585	237	1144	539	293	1082
2025	0.821	0.416	1.610	1067	97	3343	676	189	1748	739	295	1761
2026	0.821	0.400	1.668	1067	97	3343	961	229	2897	950	365	2093
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Fpa

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.454	1.487	98	40	237	667	495	898	529	386	718
2024	0.821	0.434	1.550	1067	97	3343	585	237	1144	539	293	1082
2025	0.770	0.390	1.510	1067	97	3343	676	189	1748	707	282	1689
2026	0.770	0.375	1.565	1067	97	3343	1005	244	3002	938	363	2071

Flim

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high
2023	0.821	0.454	1.487	98	40	237	667	495	898	529	386	718
2024	0.821	0.434	1.550	1067	97	3343	585	237	1144	539	293	1082
2025	1.130	0.573	2.216	1067	97	3343	676	189	1748	909	361	2135
2026	1.130	0.550	2.296	1067	97	3343	733	149	2377	972	361	2140

Blim - Not achiveable

Bpa, MsyBtrigger - not achievable

Table 5.14. Catch option table

Basis	Total catch (2025)	F_{total} (2025)	SSB (2026)	% SSB change*	% TAC change **	Probability of SSB (2026) <Blim(%)	% Advice change ^
ICES advice basis							
MSY approach: F = 0	0	0	2040	202	-100	91	
Other scenarios							
$F_{MSY} \times SSB_{2025}$/MSY $B_{trigger}$	42	0.034	1976	192	-93	92	
EU MAP***: $F_{MSY\ lower} \times SSB_{2025}$/MSY $B_{trigger}$	25	0.020	1998	196	-96	92	
EU MAP***: $F_{MSY\ upper} \times SSB_{2025}$/MSY $B_{trigger}$	60	0.048	1946	188	-91	93	
F = F_{MSY}	324	0.290	1556	130	-50	97	
F = $F_{MSY\ lower}$	201	0.170	1740	157	-69	95	
F = $F_{MSY\ upper}$	436	0.410	1393	106	-32	98	
F = F_{lim}	909	1.130	733	8	41	100	
F = F_{pa}	707	0.770	1005	49	10	100	
SSB_{2026} = SSB $_{2025}$	953	1.221	676	0	48	100	
F = F_{2024}	739	0.821	961	42	15	99	
SSB_{2026} = B_{lim}****							
SSB_{2026} = B_{pa} = MSY $B_{trigger}$****							

Table 5.15.Cod in Divisions 7e-k. Forecast (a) yield in 2024 and (b) SSB in 2025.

RECRUITMENT	val	type	Prop	age
2025	2,76E-04	2025 Catch	23,638064	1
2024	6,08E-04	2025 Catch	52,164385	2
2023	3,95E-05	2025 Catch	3,383727	3
2022	1,56E-04	2025 Catch	13,41209	4
2021	2,81E-05	2025 Catch	2,41152	5
2020	2,94E-05	2025 Catch	2,523736	6
2019	2,88E-05	2025 Catch	2,466479	7
2026	0,00E+00	2026 SSB	0	1
2025	5,47E+02	2026 SSB	27,684958	2
2024	1,08E+03	2026 SSB	54,487499	3
2023	5,46E+01	2026 SSB	2,765067	4
2022	2,10E+02	2026 SSB	10,601574	5
2021	3,43E+01	2026 SSB	1,736996	6
2020	5,38E+01	2026 SSB	2,723907	7

5.13 Figures

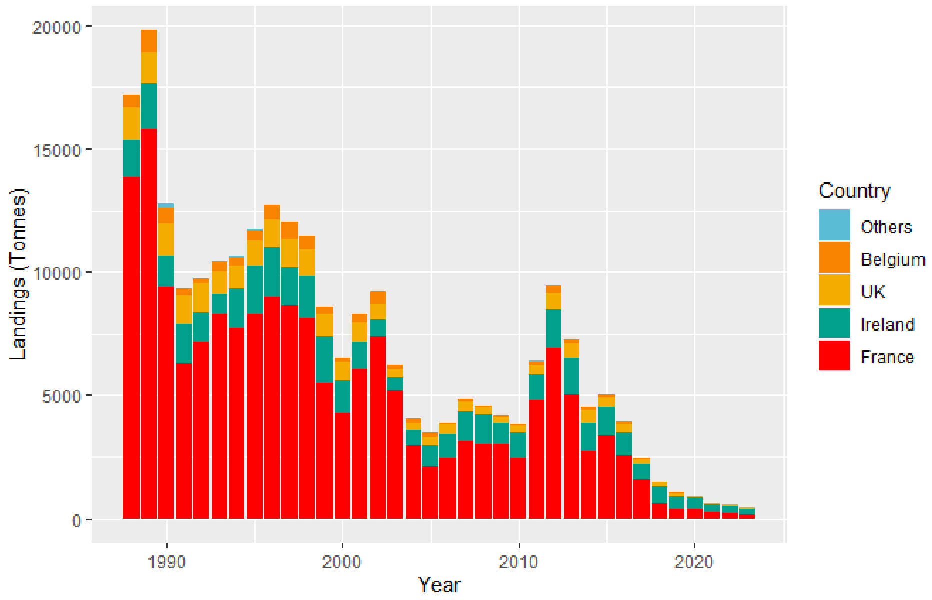


Figure 5.1. Cod in Divisions 7e-k. Historical landings (in Tonnes) by country. Revised at WKCETIC 2020

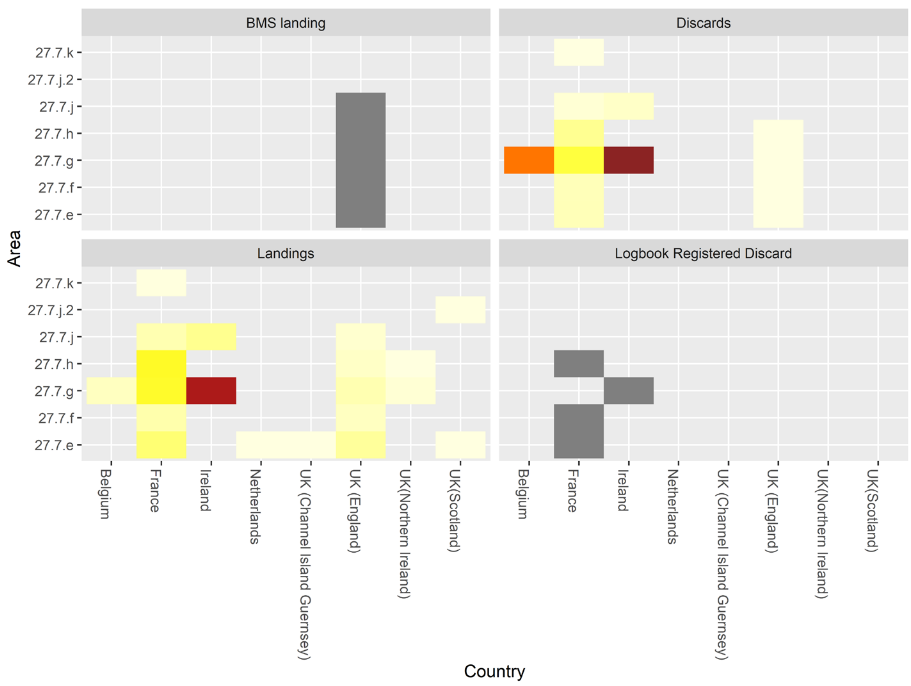


Figure 5.2. Cod in Divisions 7e-k. Catches volume in Tonnes (i.e.landings and discards) by area and country in 2023.

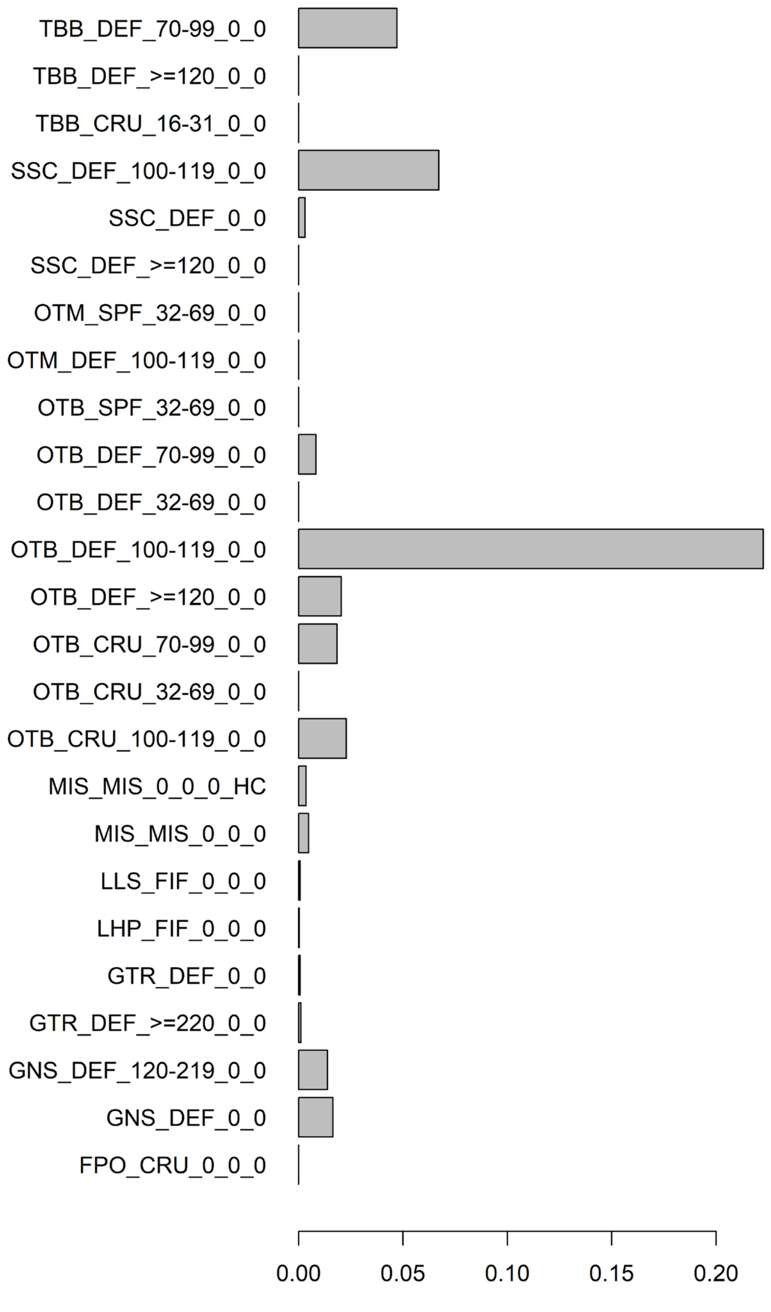


Figure 5.3. Cod in Divisions 7e-k. Proportion of landings per métier (Level 6) in 2023

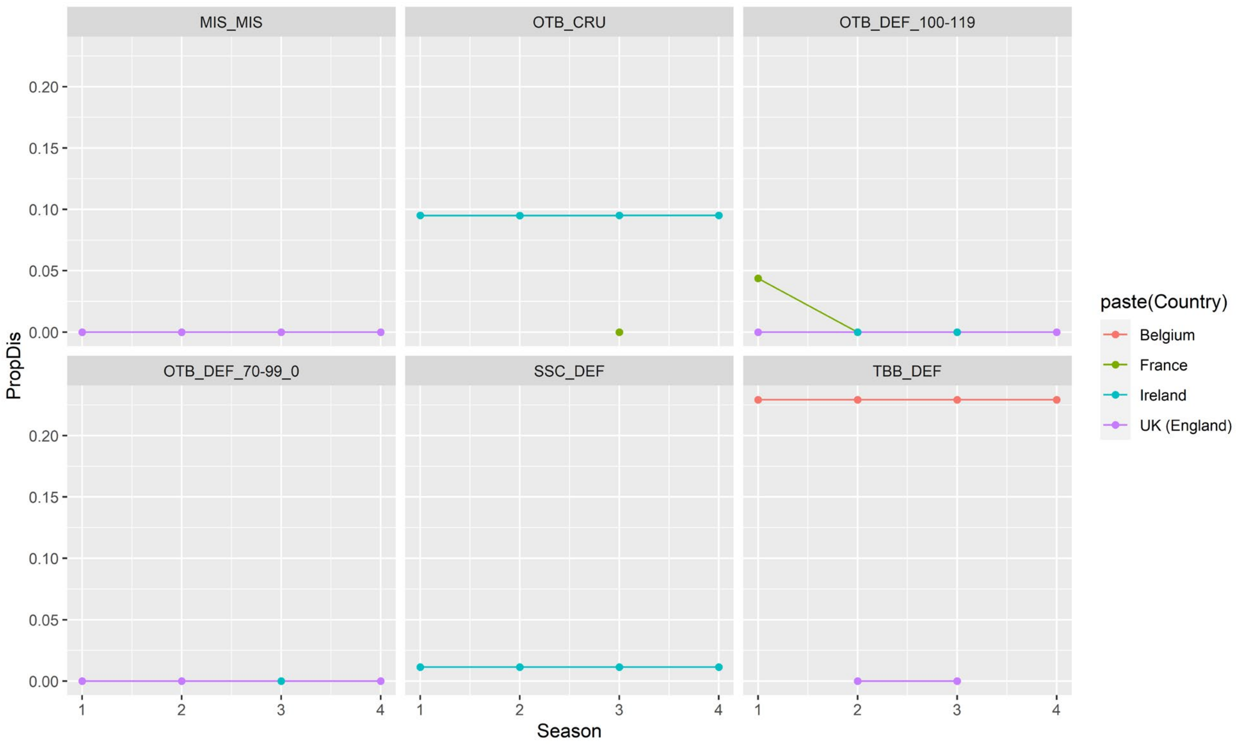


Figure 5.4. Cod in Divisions 7e-k. Discard proportion per fleet and season in 2023.

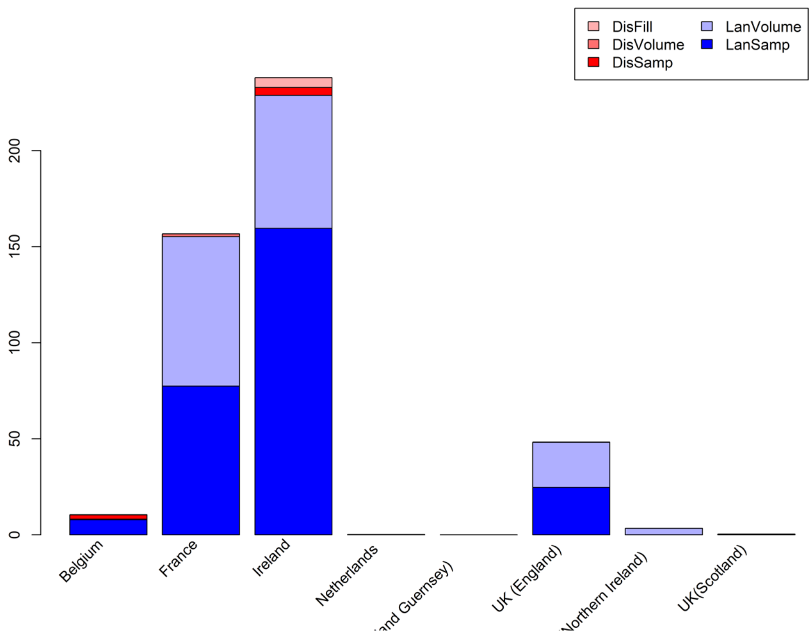


Figure 5.5. Cod in Divisions 7e-k. Allocation procedure in 2023.

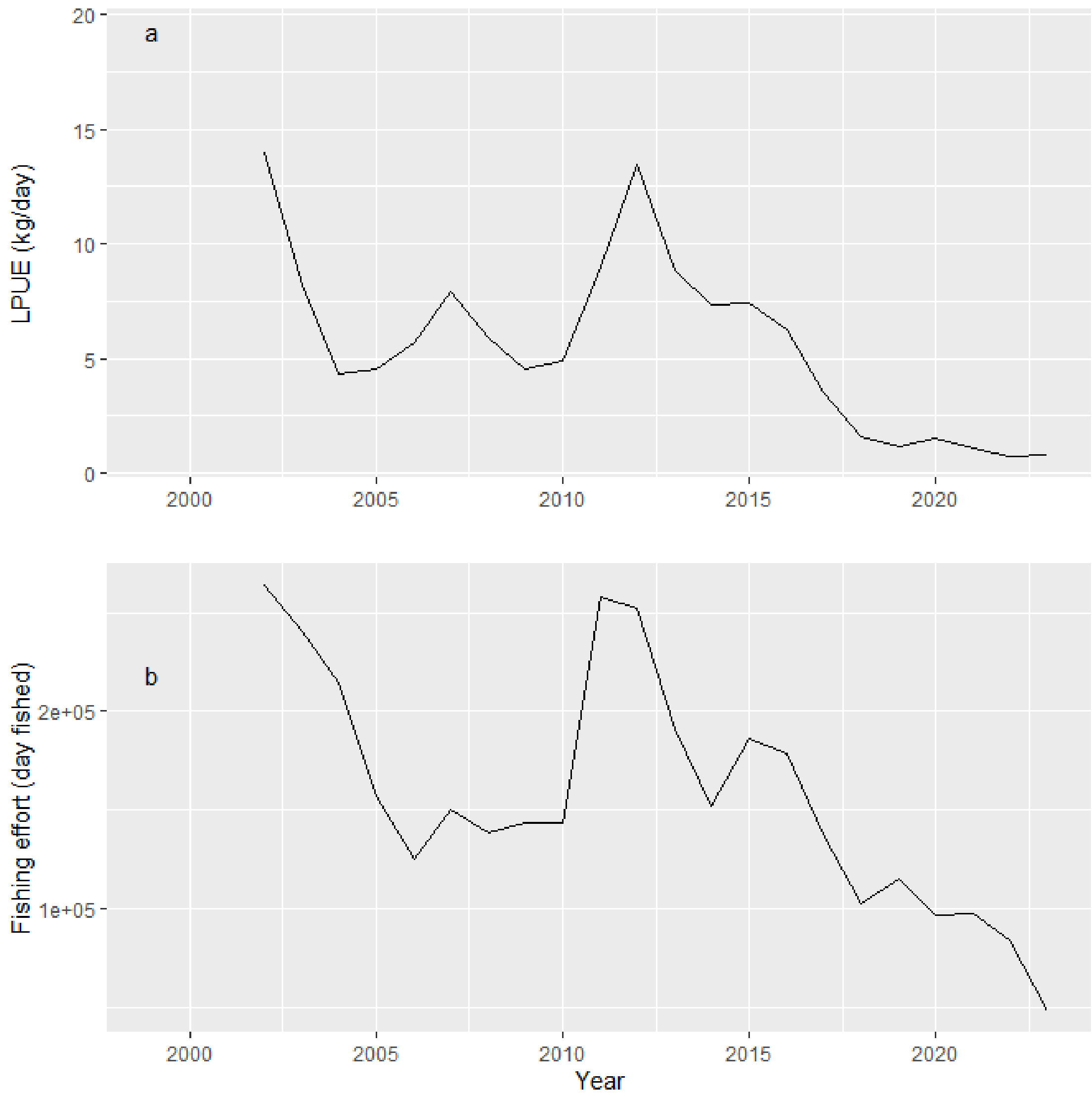


Figure 5.6a. Cod in Divisions 7e-k. Time series of (a) LPUE and (b) fishing effort for the French fleets. Units: LPUE in kg/day and fishing effort in days fished.

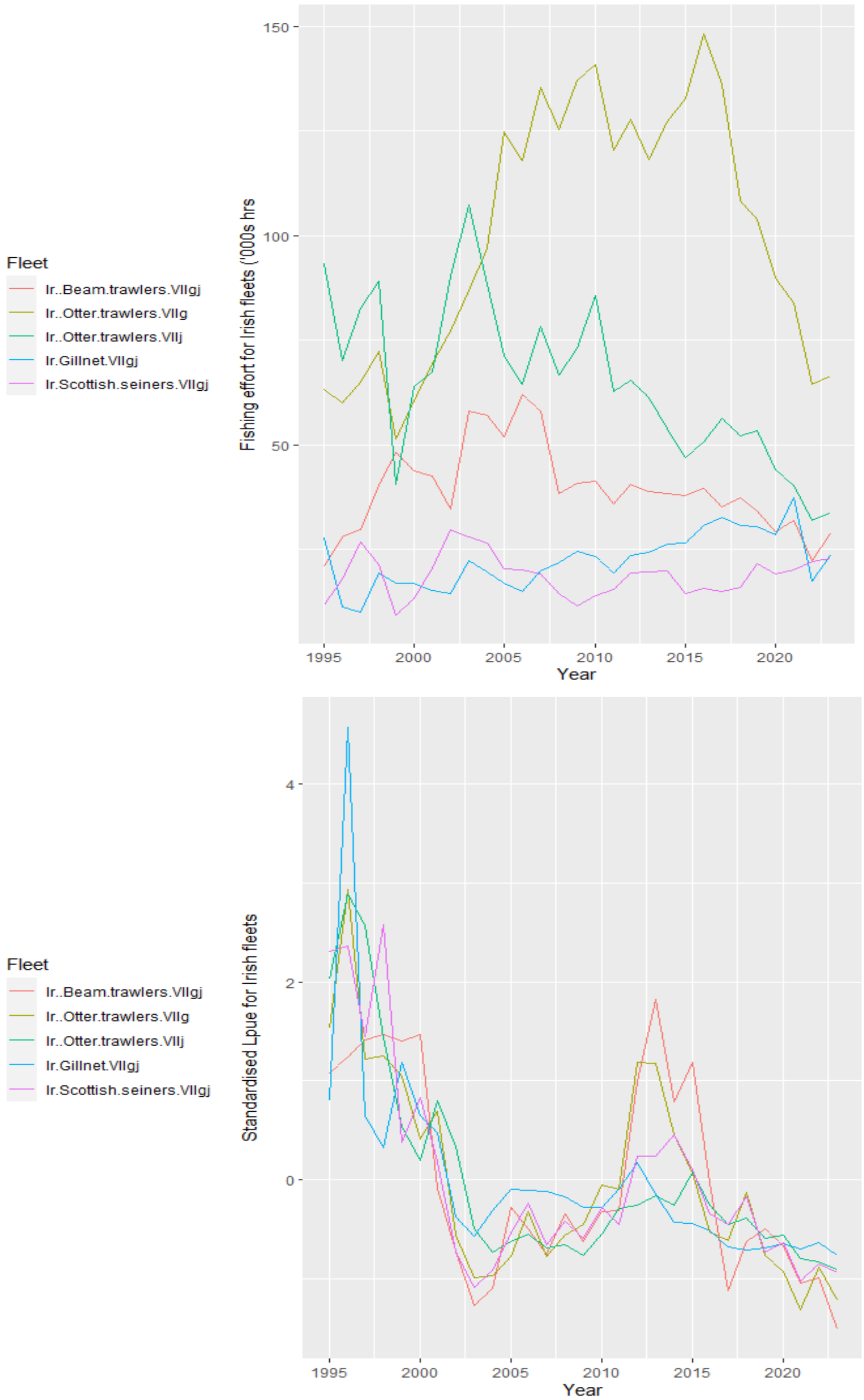


Figure 5.6b. Cod in Divisions 7e-k. Time series of (a) LPUE and (b) fishing effort for the Irish fleets. Units: LPUE in kg/day fished and Effort in 000s hours fished.

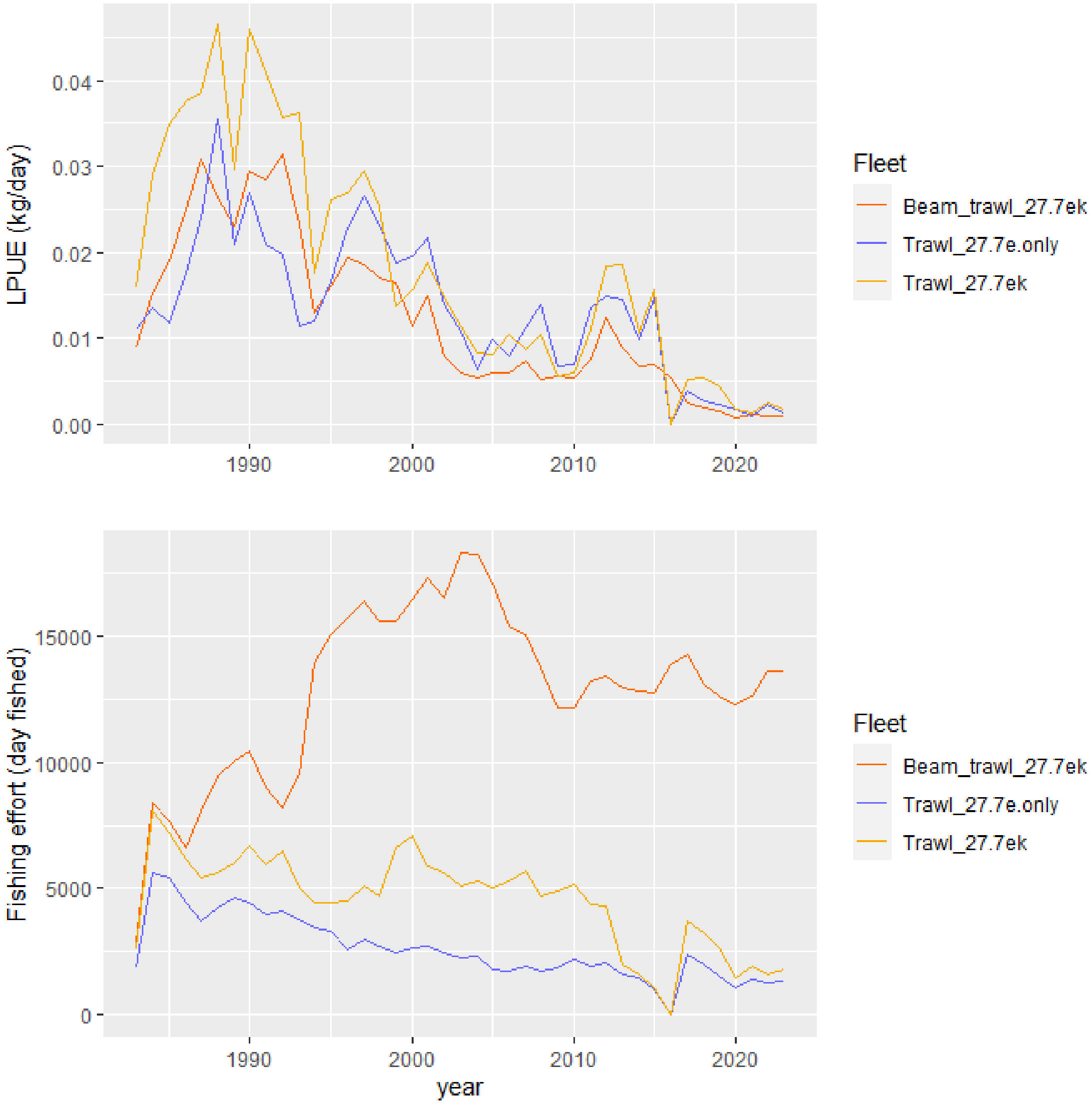


Figure 5.6c. Cod in Divisions 7e-k. Time series of LPUE and fishing effort for the UK fleets. Units: LPUE in kg/day and fishing effort in days fished.

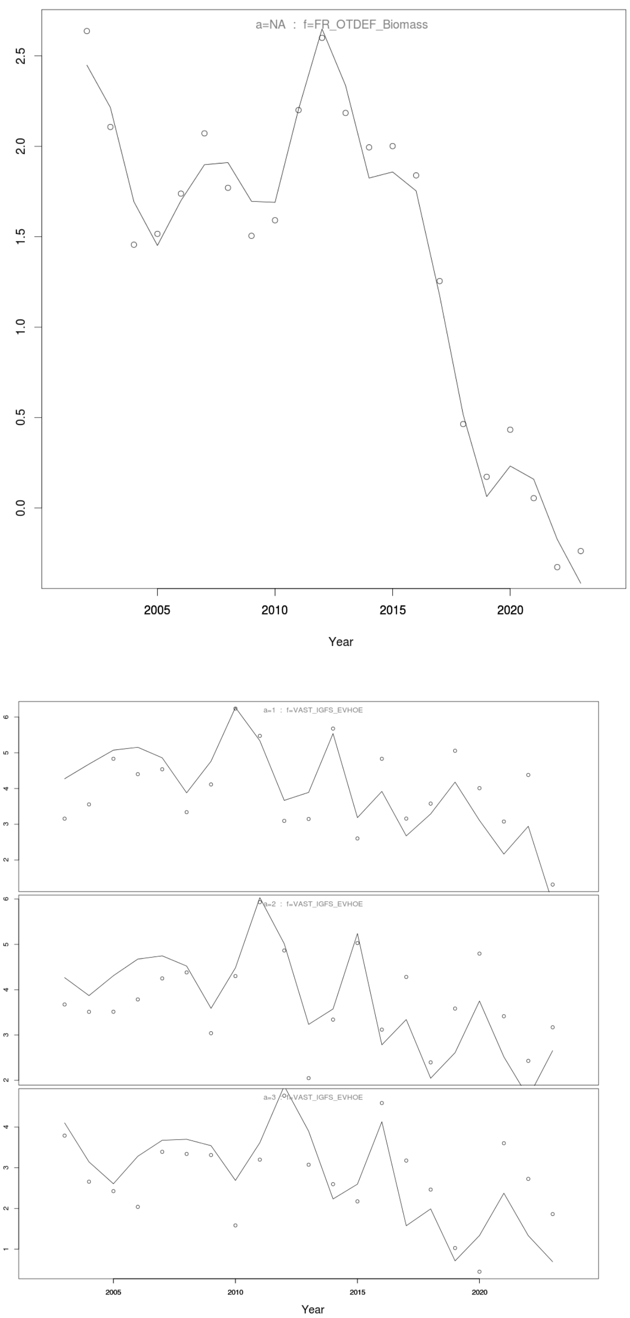


Figure 5.7. Cod in Divisions 7e-k. Fits of the tuning indices used in the assessment. Commercial tuning fleet corresponds to French OTDEF Q2+3+4 as biomass index. The survey index is a combined index based on both French IR-GFS and FR-Evhoe Q4 data where mean number at age are modeled using VAST.

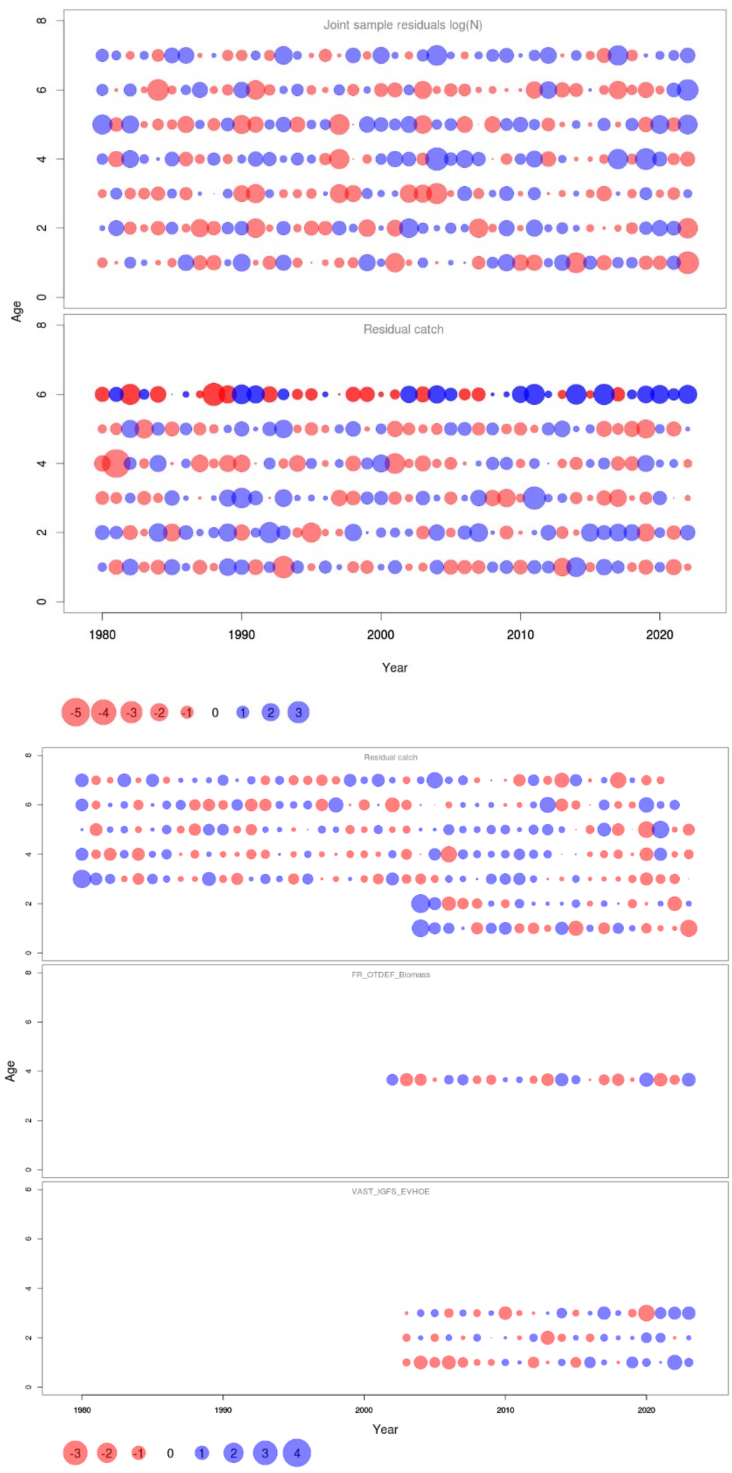


Figure 5.8. Cod in Divisions 7e-k. Final assessment. Residuals

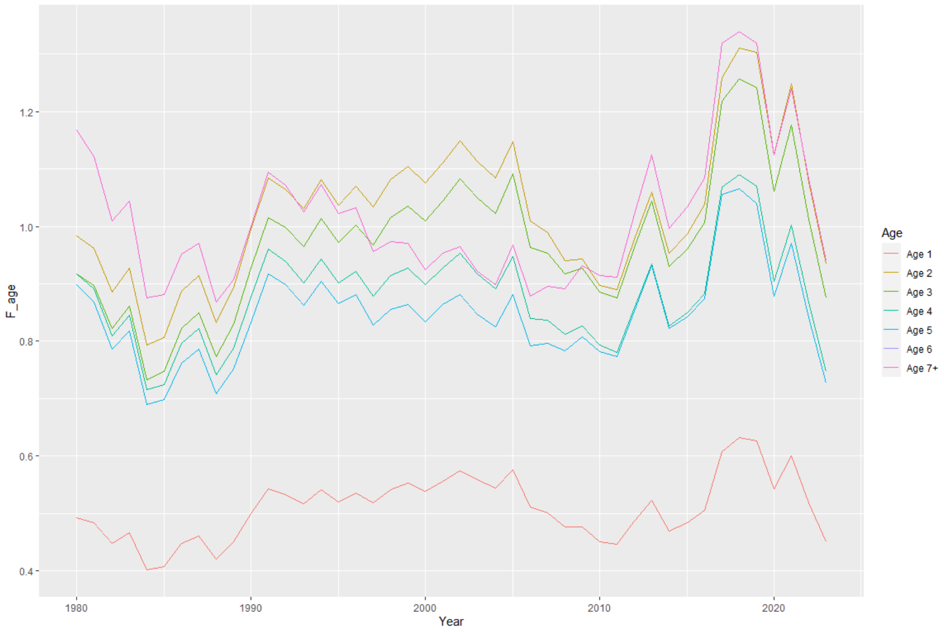


Figure 5.9. Cod in Divisions 7e-k.Fishing mortality at age.

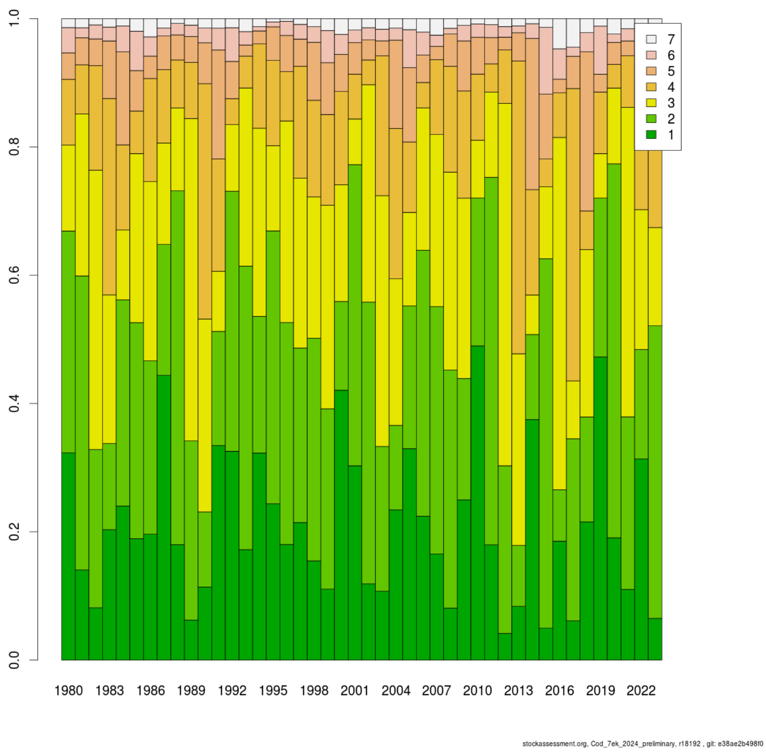


Figure 5.10. Cod in Divisions 7e-k. Final SAM outputs. Catch proportion at age. Age 0 are not included in the assessment.

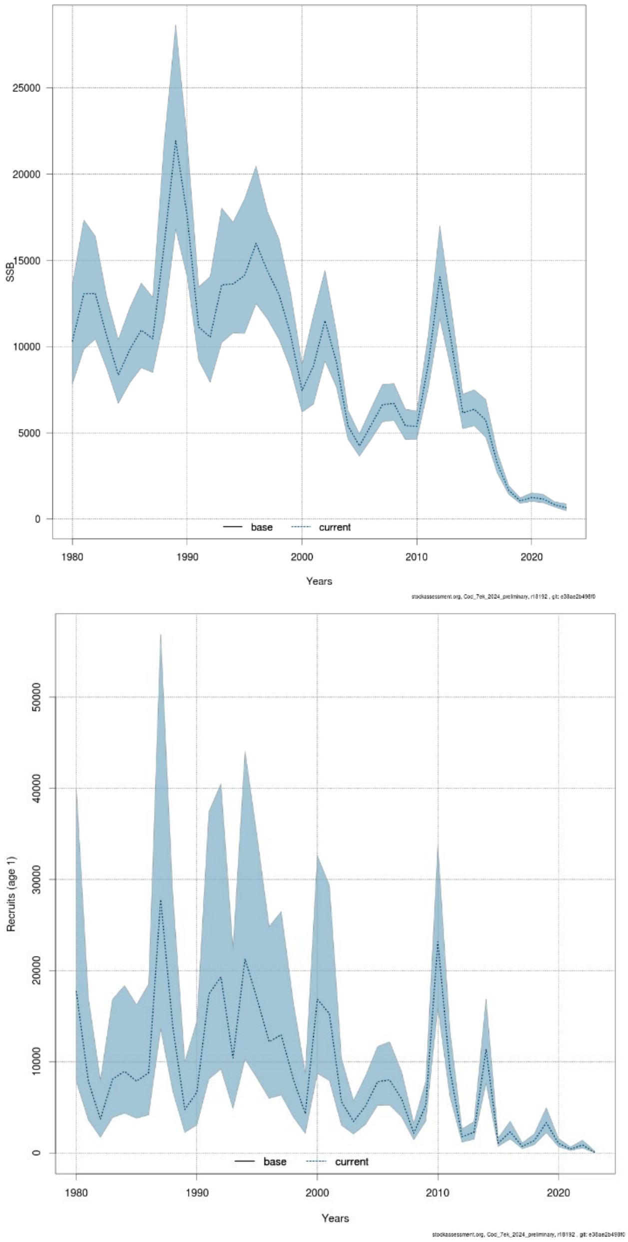


Figure 5.11. Cod in Divisions 7e-k. Final SAM outputs. SSB , R and F estimates.

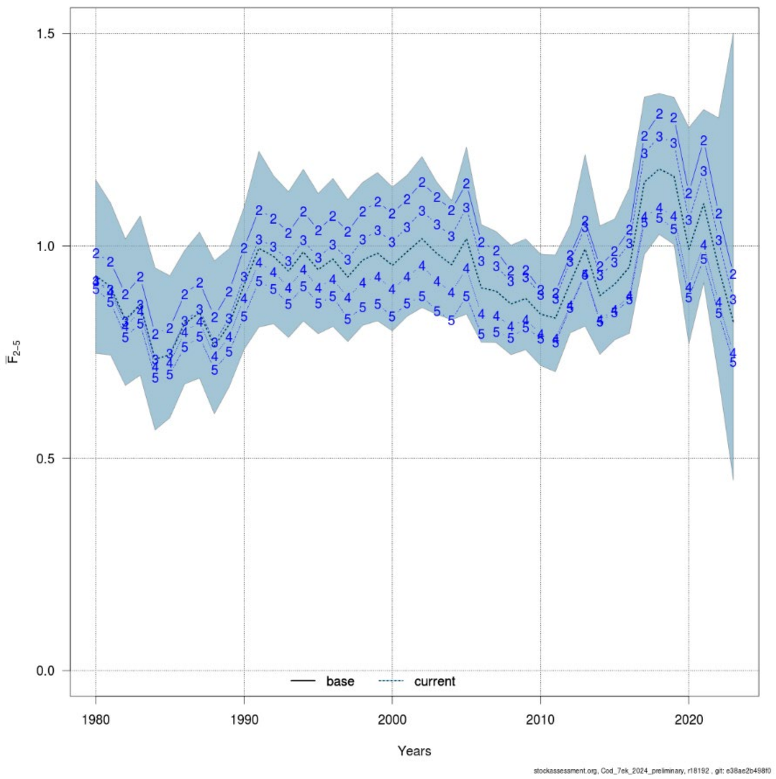
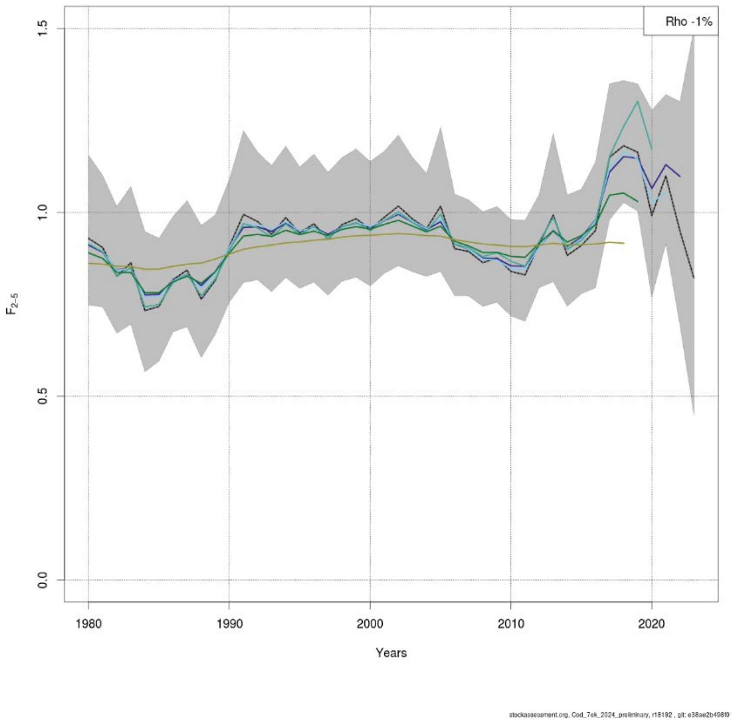


Figure 5.11. continued Cod in Divisions 7e-k. Final SAM outputs. SSB , R and F estimates.



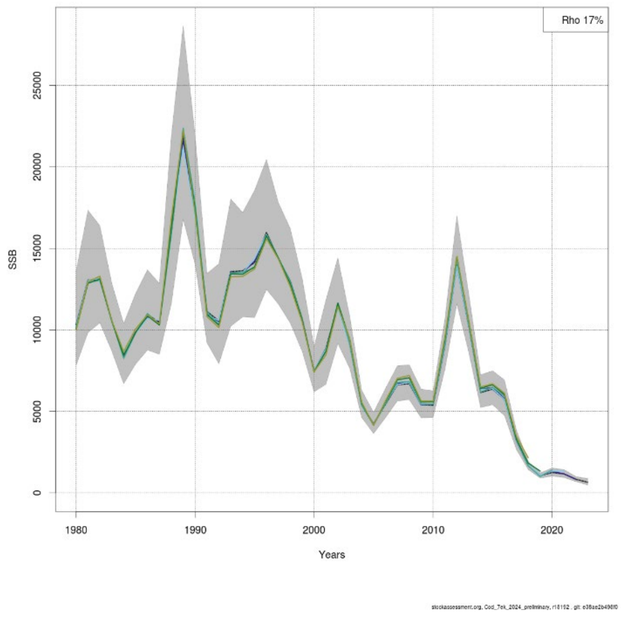


Figure 5.12a. continued. Cod in Divisions 7e-k. Final SAM. Retrospective plots

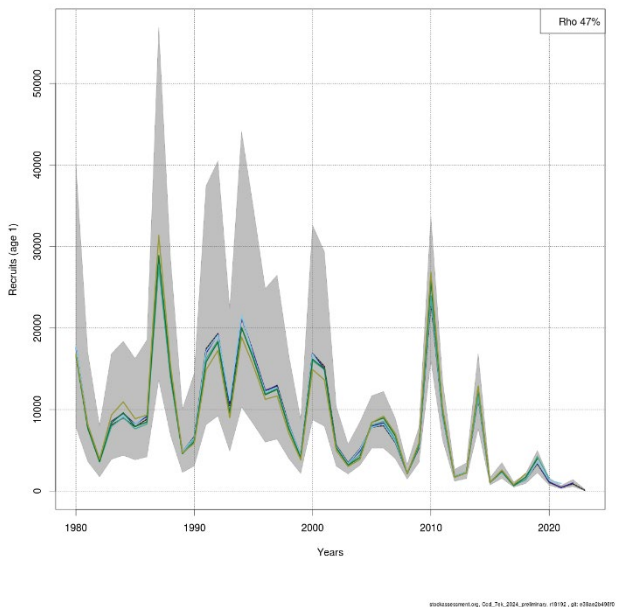
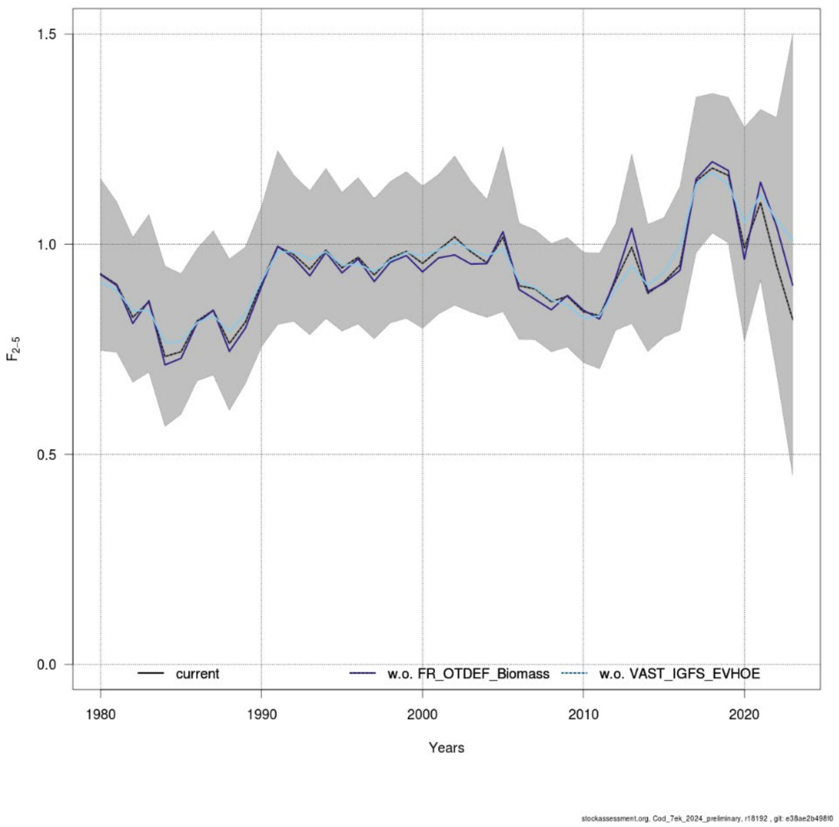


Figure 5.12a. continued. Cod in Divisions 7e-k. Final SAM. Retrospective plots



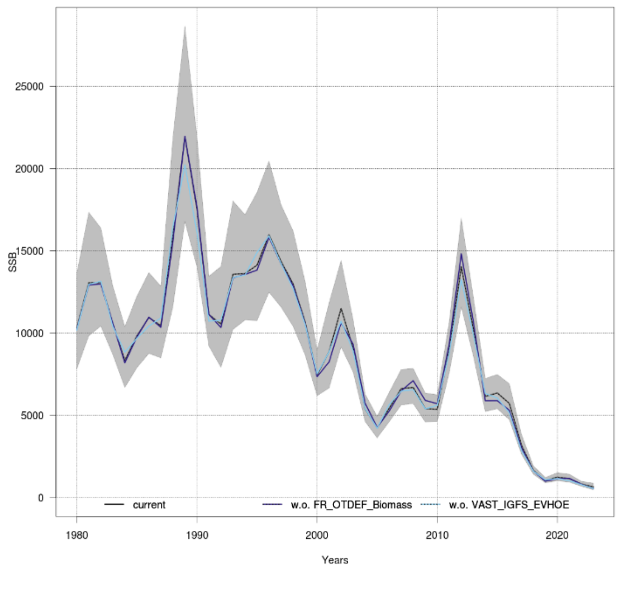


Figure 5.12b. Cod in Divisions 7e-k. Final SAM. Comparison between runs (runs with the two tuning indices, with only the survey index and with only the commercial tuning index)

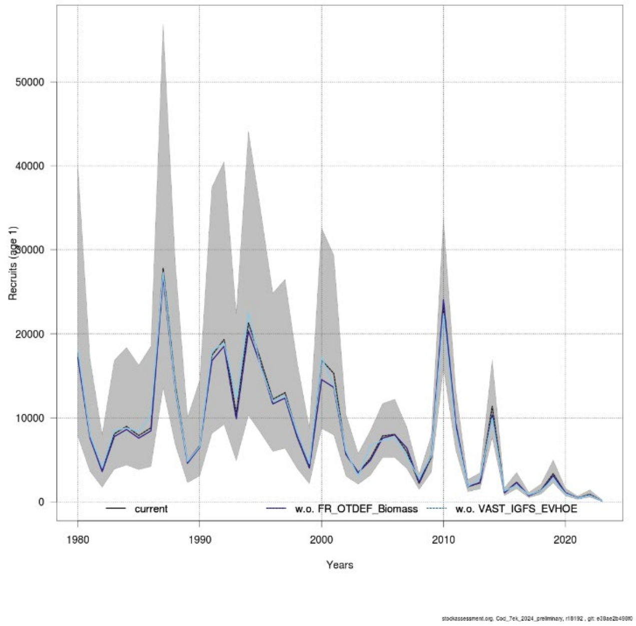


Figure 5.12b. Continued. Cod in Divisions 7e-k. Final SAM. Comparison between runs (runs with the two tuning indices, with only the survey index and with only the commercial tuning index)

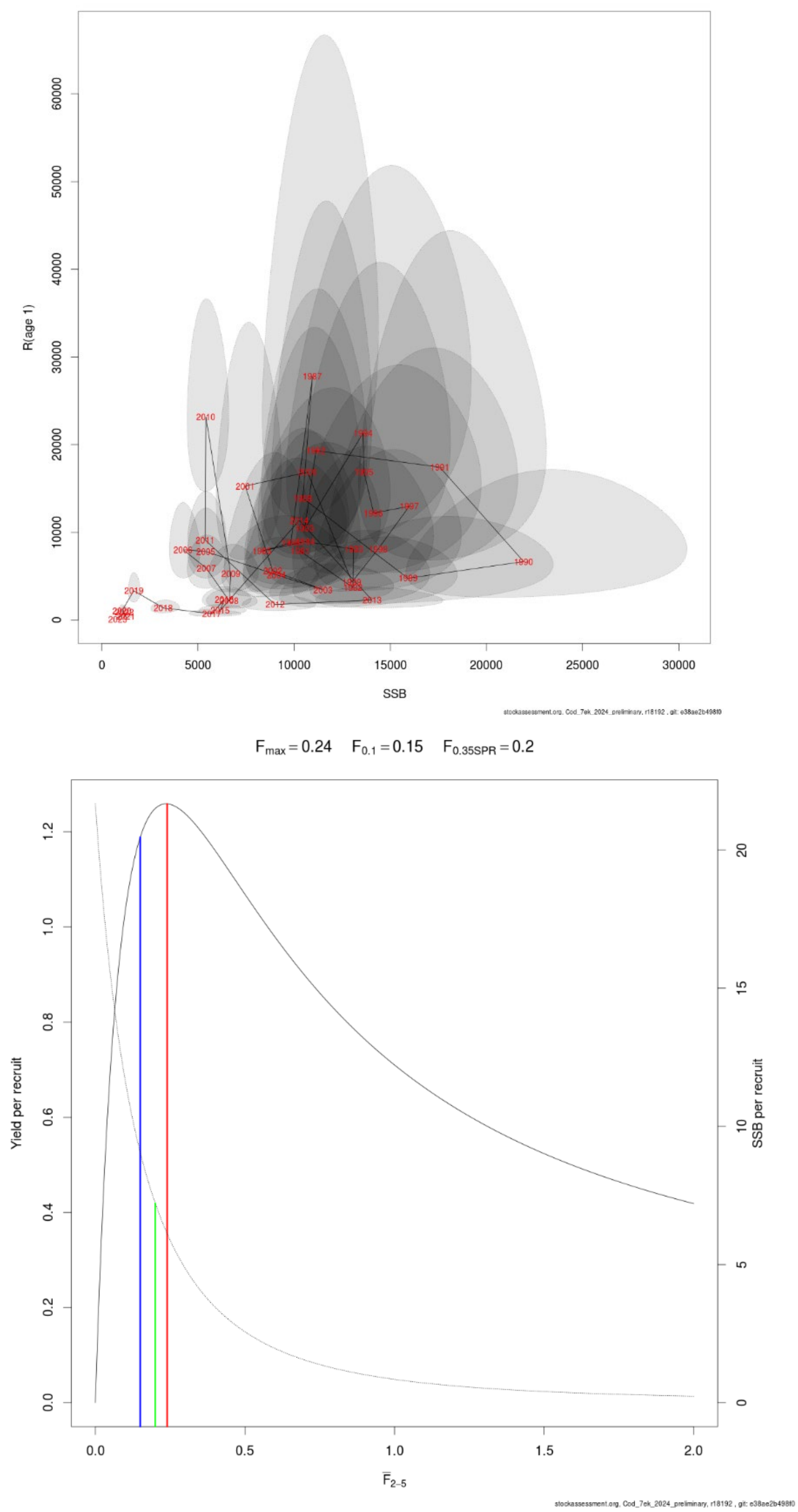


Figure 5.13. Cod in Divisions 7e-k. Stock_recruitment plots and yield per recruits information.

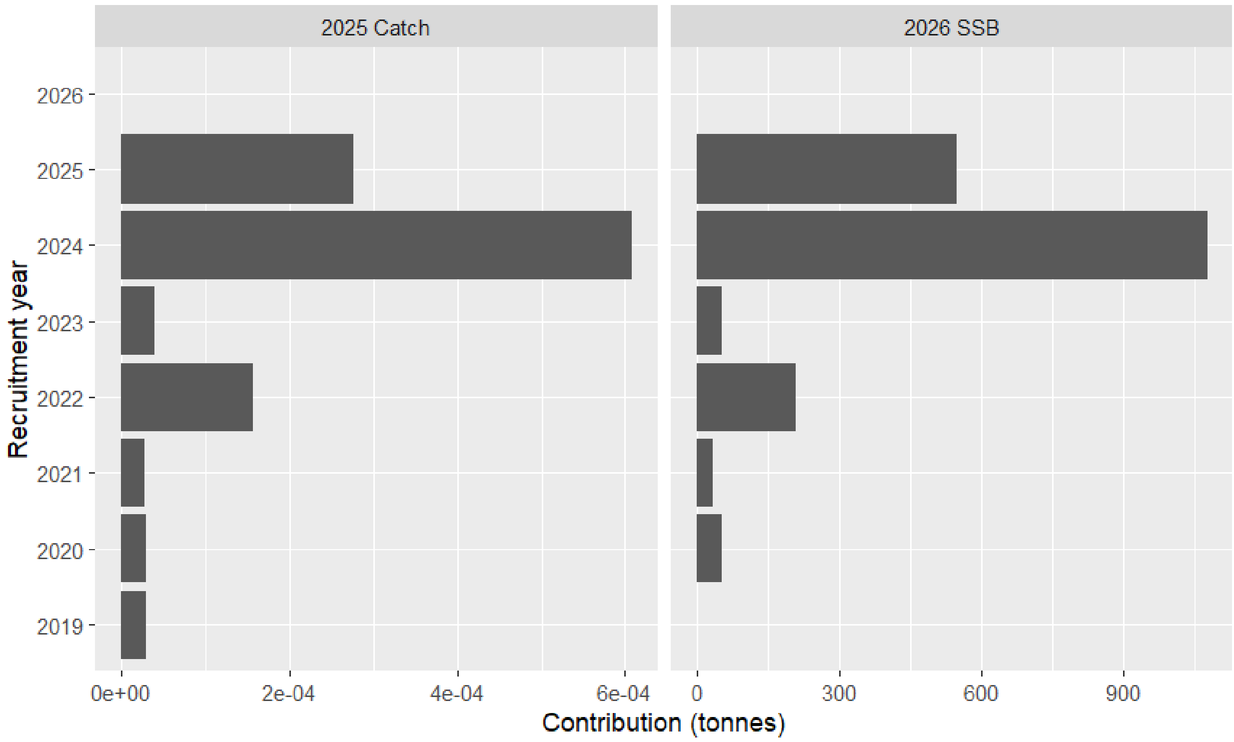


Figure 5.14. Cod in Divisions 7e-k. Forecast (a) catch in 2025 and (b) SSB in 2026.

Contents

6 Haddock in Division 27.6.b (Rockall)

6.1 Introduction

An analytical assessment of this stock has not been carried out since 2021 due to the unavailability of the methods to update the previously utilised survey index. As a result, biennial advice was provided for this stock in 2022 on the basis of the ‘rfb’ category 3 data limited rule utilising a survey index and mean catch length indicator. This resulted in a 30% reduction in advice for 2023 and 2024 (4 078 tonnes) compared to advice for 2022.

In 2024, this stock has been benchmarked (WKBGAD; ICES, 2024) and a category 1 SAM assessment agreed. The assessment and advice this year follow the methods described in the Stock Annex. No estimates of Russian catches are available for 2023, but given that in recent years, these catches have been a very low proportion of the total (See Sections 6.2 and 6.3), this is considered to have minor impact on the assessment and advice.

6.2 General

Advice

ICES advice has been provided on the basis of the MSY approach since 2014. Last year’s advice was for catches of no more than 4 078 tonnes in each of the years 2023 and 2024.

Stock description and management units

The haddock stock at Rockall is considered to be an entirely separate stock from that inhabiting the continental shelf of the British Isles. Since 2004, the EU TAC for haddock in 6.b has been included with divisions 12 and 14. For details of the earlier management units see the Stock Annex (Annex 2).

Management applicable to 2022 to 2024

The TAC is set for the UK, EU and international waters of 6b, and international waters of 12 and 14 but is applicable to EU/UK vessels only and there is no agreed shared TAC for other nations fishing in the NEAFC regualatory area. For 2022 to 2024, the breakdown of the TAC by country is given below. There was no change in TAC between 2023 and 2024, although there were minor changes to the allocation between countries with a greater proportion of the TAC allocated to the UK in 2024.

TAC 2022

Species:	Haddock *Melanogrammus aeglefinus*	Zone:	United Kingdom, Union and international waters of 6b; international waters of 12 and 14 (HAD/6B1214)
Belgium	12	Analytical TAC	
Germany	12	Article 8(2) of this Regulation applies	
France	542		
Ireland	385		
Union	951		
United Kingdom	4 874		
TAC	5 825		

TAC 2023

Species:	Haddock Melanogrammus aeglefinus	Zone:	United Kingdom, Union and international waters of 6b; international waters 12 and 14 (HAD/6B1214)
Belgium	8	Analytical TAC	
Germany	8	Article 7(2) of this Regulation applies	
France	368		
Ireland	264		
Union	648		
United Kingdom	3 430		
TAC	4 078		

TAC 2024

Species:	Haddock *Melanogrammus aeglefinus*	Zone:	United Kingdom, Union and international waters of 6b; international waters 12 and 14 (HAD/6B1214)
Belgium	8	Analytical TAC	
Germany	8	Article 7(2) of this Regulation applies	
France	355		
Ireland	255		
Union	626		
United Kingdom	3 452		
TAC	4 078		

The minimum conservation reference size of haddock taken by EU and UK vessels at Rockall is 30 cm and the stock is fully under the landing obligation. There is no minimum landing size for haddock taken by non-EU/UK vessels within international waters.

In order to protect the pre-recruit stock, the International Waters component of the statistical rectangle 42D5 has been closed for fishing since 2001 and its EU component since 2002 (see the Stock Annex, Annex 2). The protected area (the whole rectangle) is referred to as the Rockall Haddock Box. In 2022, in response to a request for advice from NEAFC on the efficiency of the closure to protect juvenile haddock, ICES concluded the following:

The Rockall Haddock Box does coincide with areas of high juvenile and adult haddock densities, with high densities also observed outside the box to the northeast. For most years since the closure, haddock densities *of age classes 1+ have been higher inside than outside the box. The overall impact of the current closure area on the Rockall haddock stock continues to be difficult to assess.*

In order to protect cold-water corals, three further areas (North West Rockall, Logachev Mounds and West Rockall Mounds) were closed since January 2007 (see the Stock Annex, Annex 2). A new area to protect cold-water corals (Empress of Britain Banks) was established by the NEAFC in 2007 and 2012.

Since 2009 in the NEAFC regulatory area, including international waters of Rockall, a discard ban has been in place. The fishery for haddock within EU/UK waters is under the landing obligation (EU and national legislation).

There is no agreed management plan for haddock in this area. Two management strategies (NEAFC and EU MAP) have been assessed to be precautionary. NEAFC requested ICES to evaluate the harvest control rules (HCRs) that use F_{MSY} as a target. ICES concluded that the NEAFC HCRs in the long-term management strategy for Rockall haddock were consistent with the precautionary approach (ICES, 2019) although this analysis has not been revisited since the recent benchmark.

The multiannual management plan (MAP) which has been adopted by the EU for this stock (EU, 2019) has not been agreed with UK.

Fishery in 2023

Russian fishery

No information was provided on the Russian fishery at Rockall in 2023 and no official landings have been submitted by the Russian Federation since 2021. Landings of 162 tonnes were reported to NEAFC for 2022 (~3% of total estimated catch in that year). Recent fishing activity by Russian vessels at Rockall has been very limited and there is no evidence (either data or anecdotal) to suggest that has changed in 2023.

UK fishery

The UK has the largest demersal trawl fishery operating at Rockall. This consists of a relatively small number of larger Scottish demersal trawlers targeting haddock during periods of good weather. Other important target species included anglerfish (*Lophius* spp.), ling, saithe and megrim. Total reported Scottish haddock landings in 6b have declined by over 40% since 2019 (Table 6.2.1). UK quota uptake was almost 90% in 2023. In 2021 there was a significant increase in the proportion of UK landings taken in international waters (almost 30% in 2021 compared to an average of 15% over 2018–2020), although this has subsequently reduced and was ~16 % in 2023 (Table 6.2.2).

Irish fishery

Reported landings by Irish vessels have also shown a decreasing trend in recent years and in 2023 (314 t) were less than half their 2020 value (679 t) (Table 6.2.1). Irish vessels used single otter trawls with a mesh size ranging from 100 to 120 mm together with a square-mesh panel.

6.3 Data

Landings

Nominal landings as reported to ICES are given in Table 6.2.1 and shown in Figure 6.3.1. Revisions to official catch statistics for previous years are also shown in Table 6.2.1. Some data previously submitted are now no longer or only partially available due to national data confidentiality clauses (Ireland in 2018 and 2019). As has been the case for over ten years, the majority of the reported landings come from the UK (almost 90% in 2023) with smaller amounts reported by Ireland, the Faroe Islands, Norway and Spain.

Data for the NEAFC area only (Subdivision 6b.1) are also shown in Table 6.2.1, and in Table 6.2.2 by nation. Up to 2019, these are taken from the official landings statistics. For 2020 to 2023, the estimates are a mixture of official landings, landings from InterCatch (as landings for the UK are not available split by subdivision in recent years) and landings from NEAFC (for Russia in 2022). In some years, Russian landings are reported as being from 27.6b_NK (i.e. unknown subdivision), however it is assumed that all these landings have been taken in the NEAFC area (i.e. Subdivision 27.6.b.1). The proportion of the total landings coming from international waters is just under 20% in 2023.

Anecdotal evidence suggests that misreporting of haddock from Rockall has occurred historically (particularly on fishing trips where vessels fish in both divisions 6.a and 6.b), but a quantitative estimation of the degree of misreporting is not possible.

Landings data for 2023 submitted to InterCatch are shown in Figure 6.3.2. Note that Scottish landings are submitted by subdivision. Russian Federation landings were not submitted by the national data submitter for 2023, and official landings are also not available for 2022 or 2023 (although landings for 2022 have been reported to NEAFC and are included in ICES estimates) .

Due to the lack of Russian data, total landings (both official and ICES estimates) may be underestimated in 2023. However, given the recent low level of Russian landings this underestimate is considered likely to be minor.

International age composition and mean weight-at-age in the landings were compiled according to the methods described in the Stock Annex. Landings age compositions were allocated to unsampled fleets using a weighted average of all sampled fleets. The weighting algorithm used is 'Mean weight weighted by numbers-at-age or length'. (Note that in recent years, Scottish data have been submitted to InterCatch by subdivision which often results in an 'unsampled' métier/division combination – usually Subdivision 6b.1. Scottish samples are allocated (discard rates and age compositions) to this unsampled métier as they are assumed to be the same métier operating across 6b.2 and 6b.1 with similar fishery characteristics.

BMS landings

Minor amounts of below Minimum Size (BMS) landings are reported. These are included in the official landings statistics and are also uploaded to Intercatch for the UK. For other nations, these are accounted for in total discard estimates submitted to Intercatch. The assessment/forecast includes BMS landings within total discards as these landings are typically unsampled and are allocated an age compositions from sampled discards in InterCatch.

Discards

Haddock at Rockall are reported to have lower size-at-age than haddock from other areas (Blacker, 1971; Khlivnoy, 2006; Filina, Khlivnoy and Vinnichenko, 2009). Historically, the discard rate was high; between 12 and 75% by weight according to the results of discards trips (see the Stock Annex). The methods used to reconstruct the historical time-series of discards when sampling data were insufficient or unavailable are described in the Stock Annex.

Discard rate allocation to unsampled fleets for 2023 followed the procedure outlined in the Stock Annex and consisted of:

- Manually matching annual discards to available quarterly landings by country/fleet (where necessary);

- Using a weighted average discard rate for all unsampled fleets (weighted by CATON) with the exception of the Norwegian longline fleet and the Russian fleet for which discards are both assumed to be zero. In addition, unsampled Scottish OTB_DEF>=120 in Subdivision 6b.1 are allocated samples from the Scottish OTB_DEF>=120 in Subdivision 6b.2.

Discards age compositions were allocated to unsampled fleets in a similar manner to landings age compositions.

Figure 6.3.3 shows estimated landings and discards for 2023 after raising. Scottish landings data are submitted to InterCatch by subdivision with sampling available only for Subdivision 6.b.2 and hence there are raised discards associated with this component of the landings. The final mix of numbers-at-age from sampled and un-sampled landings and sampled and raised (unsampled) discards is given in Figure 7.3.4. The unsampled landings and unsampled raised discards are both largely associated with the Scottish landings from Subdivision 6.b.1.

After raising, the catch distribution by fleet in 2023 is as follows:

Catch	Landings		Discards*	
4492 tonnes	Otter trawl 98%	Other 2%	Otter trawl >99%	Other <1%
	3666 tonnes		826 tonnes	

***Including BMS landings.**

The WG estimates of total landings, discards and BMS landings by weight are given in Table 6.3.1 and shown in Figure 6.3.5. (Values are shown as the sum of products of numbers-at-age and weights-at-age as ICES estimates ('CATON' in Intercatch) are only available for 2012 onwards). In recent years, the total discard proportion by weight (Figure 6.3.6) has shown substantial variability but is typically below 20% (~ 17% in 2023). This is substantially lower than the estimated discard proportion at the start of the time-series when the Scottish fleet was generally utilising a smaller mesh size.

Due to the distant nature of the fishery and the fact that there are relatively few vessels/trips making landings, sampling levels for both landings and discards for this stock are relatively poor. Sampling levels did not significantly worsen during the COVID-19 pandemic and the WG considers that sampling levels are adequate for the estimation of catch-at-age data.

Age- compositions and mean weights-at-age

Raised landings, discards and bms numbers-at-age are given in Tables 6.3.2 – 6.3.4 and and total catch numbers-at-age in Table 6.3.5.

Discard proportions by age are shown in Figure 6.3.7 (landings fractions by age, required for input to the stock assessment are given in Table 6.3.6). There has been a marked change in discarding practices over time. At the start of the time series, a high proportion of older fish were discarded, but in the last ten years, discards are generally limited to age one and two fish. A short time series of the catch-at-age compositions by catch category is shown in Figure 6.3.8.

Annual mean weights-at-age in landings, discards and catch are given in Tables 6.3.7, 6.3.8 and 6.3.9 and shown in Figure 6.3.9 and 6.3.10. Mean weights-at-age in the landings (and catch) were relatively stable historically, but show a significant increase since the mid-2000s, particularly at ages 4 and above, as well as showing increased variability. While the variability may be due to low sampling levels, the reason for the trend is not known, but could potentially be due to cohort dependent growth rates although this has not been fully explored. At older ages in particular, mean weights have begun to decline in more recent years and are levelling off in ages two to four but remain at a higher level than historical values.

Biological

Natural mortality is updated on an annual basis (i.e. between assessment WGs) although is time invariant within the assessment model. Estimates are based on mean weight-at-age (in the catch) and derived on the basis of the Lorenzen (1996) equation:

$$M_a = 3\overline{W}_a^{-0.29}$$

where M_a is the natural mortality at age a and $\overline{W}_a$ is the mean weight-at-age a. Values are then averaged over years (to account for sampling variability) and scaled such that M at the oldest age is equal to 0.2. The resulting values, applied in this year's assessment, are as follows:

Age	1	2	3	4	5	6	7	8+
Natural mortality	0.3539	0.2994	0.2759	0.2580	0.2398	0.2281	0.2120	0.2

Maturity-at-age is based on quarter 3 survey data and is time invariant as follows:

Age	1	2	3	4	5	6	7	8+
Maturity	0.24	0.84	0.99	1.0	1.0	1.0	1.0	1.0

Stock weights-at-age are based on catch weights-at-age (Figure 6.3.10). These weights-at-age are included into the SAM assessment as observations and the 'biopar' feature allows a process model to be fitted with cohort and within year correlations.

Surveys

A Scottish quarter 3 survey at Rockall began in the late 1980s. The current survey is co-ordinated by IBTS and described further in the IBTS reports, the Stock Annex and the 2024 benchmark report (ICES, 2024). The survey has undergone a number of changes in gear and design over the stock assessment period and therefore the index is split into two parts:

- 'Rockall pt1' which is a design based index running from 1991-1997 (unchanged since the 2024 benchmark, Table 6.3.10).
- 'Modelled Q3' which runs from 1999 onwards and is based on a GAM with time varying spatial component

The 'Modelled Q3' index was updated according to the approach agreed at the 2024 benchmark (ICES, 2024) and documented in the Stock Annex. The final model makes use of a Tweedie distribution with log link function, and includes a high resolution smoothly varying spatial effect over time (lat x lon x time); 'depth' and 'timeofYear' as continuous variables; and 'year' as a discrete effect. The resulting survey index is given in Table 6.3.11 (along with CVs which are also used in the assessment. The updated modelled indices show only minor historical revisions when compared to the indices derived at the benchmark (Figure 6.3.11).

6.4 Stock Assessment

This assessment is an age-based analytical assessment utilising SAM (Neilsen and Berg, 2014) as outlined in the stock annex. Exploratory analyses of the input catch and survey data are also carried out.

Exploratory data analysis

Log catch (landings + discards + bms) numbers-at-age over time (Figure 6.4.1) show some tracking of strong and weak cohorts historically. These signals become less apparent and more noisy after 2010, likely due to low sampling levels during a period when the stock was at an extremely low level (2009 to 2013). Catch curves from commercial catch-at-age data are also shown in Figure 6.4.1. Although the data are noisy (particularly latterly), there is some evidence of a flattening off of the catch curves in recent years compared to those of the cohorts spawned at the start of the time series, potentially indicating a decrease in mortality.

Figure 6.4.2 shows the mean standardised catch-at-age by proportion (in number). The figure highlights the strong cohorts and also shows that the very weak recruitments between 2007 and 2011 are consistently seen as well below average in the catch data across their life time. The data appear more noisy in recent years such that the strong cohort recruiting in 2017 does not appear as 'above average' in the catch data until age 2.

Figures 6.4.3 and 6.4.4 show the log mean standardised indices by cohort and log catch curves from the two survey series. The 'Rockall pt1' shows reasonable tracking of year class strength, particularly across ages two to five. The current 'Modelled Q3' survey index shows good internal consistency with relative cohort strength identified consistently across most age classes. In particular, the very high index value at age one in 2022 (~ four times the next highest value) is estimated to be similarly strong at age two the following year (Figure 6.4.4). The survey scatterplots also indicate good correlation between ages (including non-adjacent ages and older ages) (Figure 7.4.5).

Final assessment

The SAM configuration file for the final assessment model run is given in Table 6.4.1. The main features can be summarised as follows:

- Fishing mortality at ages 6 and above are assumed equal (coupled).
- Survey catchabilities are coupled at ages 4 and above with density dependent catchability estimated for the second modelled survey (2 parameters: uncoupled for age 1, coupled age 2 and above).
- Catch observation variance parameters are fixed across ages, but additional uncertainty is estimated for 2011 onwards (consistent with the general change in data processing and apparent increased uncertainty).
- Survey observation variance parameters differ between surveys but are coupled for all age groups within a survey (the second, modelled survey accounts for differences in uncertainty over ages/years by using the externally estimated CVs as relative weighting).
- Recruitment is modelled as a random walk
- Fishing mortality at age is modelled with AR(1) and process variance parameters are coupled across all ages. Process variance in stock numbers-at-age were assumed coupled with the exception of age 1 (the age at recruitment).

The fits of the assessment model to observations (catch and survey indices on a log scale, and weights-at-age) are shown in Figures 6.4.6 to 6.4.8. As expected the fit to the catch data appears better early in the time series and worsens from around 2011 onwards, particularly at older ages. The model appears to follow the survey data well across all ages (particularly for the 'Modelled Q3' indices), although does not quite reach the very low values observed around 2013-2016 at younger ages. The 'biopar' estimates of stock weights-at-age (based on modelling catch weights-at-age) are substantially less variable than the input data – some of the remaining variability (estimated by the model) is explained by year effects and cohort effects.

Standardised one-step ahead residuals and process residuals are shown in Figures 6.4.9 and 6.4.10 respectively. There is a tendency for negative residuals across many age classes in the 'Modelled Q3' index during the period 2018-2021, however this does not appear to have persisted since then. There is also some indication of a block of negative process errors at older ages in the numbers-at-age process. It is not clear what is causing this feature and model settings were explored extensively at the benchmark without resolution. These residual patterns were considered minor issues (largely lying within ±2) and the assessment deemed to be of acceptable quality.

Results of the retrospective analysis are shown in Figure 6.4.11 and indicate that the assessment is robust to the addition of additional years of data. All five peels lie within the confidence bounds of the final assessment, with the main revision in SSB and F related to the peel ending in 2019 when the SSB is at a local maximum (gets revised downwards in subsequent assessments) and the F in that year gets revised upwards. Unusually, recruitment is also well estimated with a Mohn's rho of just over 7%.

Mohn's rho values:

SSB	Mean F (2-5)	Recruitment (age 1)
5.25	-7.17	7.09

The impact of allowing the model to estimate greater observation uncertainty for the catch-at-age observations post-2011 is also apparent in Figure 6.4.11. Confidence intervals on both Fbar and total catch become greater and the model estimates of total catch are less consistent with the observations in this period (underestimate in 2019 and overestimate in 2023).

Final parameter estimates from the SAM assessment are given in Table 6.4.2. Estimates of survey catchability and fishery selectivity are shown in Figures 6.4.12 and 6.4.13. The 'Rockall pt1' survey appears to have higher catchability at lower ages which is in contrast to the 'Modelled Q3' index. This may be more associated with the spatial/depth coverage of the survey series rather than associated with survey gear retention – the earlier survey ('Rockall pt1') is largely confined to the shallower waters of the Rockall bank and therefore the older/larger fish may be less available to the survey if they inhabit the deeper waters of the plateau. The change in estimated fishery selectivity over time (Figure 6.4.13) was explored at the benchmark (ICES, 2024). The gradual change from increasing/flat-topped to dome-shaped coincides with the introduction of the Rockall haddock box closed area (for the protection of juvenile haddock). Analysis of survey data indicates that an increasing proportion of older ages is found within the area closed to fishing than previously and hence is not available to the fishery. The change in selectivity therefore appears to be related to change in availability of the different age classes of the stock to the fishery rather than changes associated with gear selectivity. Table 6.4.3 gives the SAM population numbers-at-age and Table 6.4.4 the estimated F at-age. A full summary output is given in Table 6.4.5.

Stock status

The stock summary plot including reference points (and intermediate year estimates) is shown in Figure 6.4.14. The stock recovered following a period of very low recruitment during 2008 to 2012. The extremely high recruitment in 2022 (almost three times the next highest value) has resulted in a very large increase in SSB such that SSB in 2023 is estimated to be well above reference points and at a historic high (and continues to be so in the intermediate year).

Fishing mortality shows substantial inter-annual variation (particularly historically), but has a general declining trend over the assessment time series. With the exception of 2020 and 2021, estimated F_{bar} has below F_{MSY} since 2011.

6.5 Short-term stock projections

6.5.1 Forecast

Forecasting in SAM takes the form of short-term stochastic projections. Samples are generated from the estimated distribution of survivors (from the assessment). These replicates are then simulated forward according to model and forecast assumptions (see below), using the usual exponential decay equations, but also incorporating the stochastic survival process (using the estimated survival standard deviation) and subject to different catch-options scenarios.

Recruitment in the forecast has been resampled from the full time series of assessment assessments given there appears to be no clear change in productivity over that time (Table 6.5.1). The 0-group survey index generally shows reasonable correlation with assessment estimates of recruitment the following year. However, it was not clear how this information could be incorporated into the SAM forecast and therefore the same recruitment assumption was used for both intermediate and forecast years. Furthermore, the impact of this assumption has extremely limited impact on the forecast results this year, with estimates dominated by the very large 2021 year class. Further consideration to this issue in future.

Ten year average values were taken for the catch mean weights and discard proportions in the forecast. This is to account for the sampling variability (Figure 6.3.7 & Figure 6.3.9) resulting from low levels of catch sampling at Rockall. Stock weights at age are forecast using the GMRF process model from the SAM assessment.

Fishing mortality in the interim year was assumed to be constrained by the TAC. Assuming status quo F (F_{2024}=F_{2023}=0.124) resulted in predicted catches in the intermediate year of almost 15,000 tonnes (TAC_{2024}=4078 tonnes). This was deemed a highly unlikely scenario given that: i) the fishery is a distant targeted haddock fishery and vessels are unlikely to go there without sufficient quota for haddock, particularly when there is a buoyant haddock stock and fishery much closer to home (Northern Shelf haddock), and ii) a relatively low UK TAC uptake was apparent at the time of the assessment WG (35%). A summary of the forecast assumptions is given in Table 7.5.1.

Under the forecast assumption of an intermediate year TAC constraint, landings in 2024 are predicted to be 3937 tonnes and discards 141 tonnes. SSB at the start of 2025 is estimated as 117972 tonnes and remains well above MSY Btrigger. Projected discards in the intermediate year and forecast represent only a very low proportion of total catch (<5%) compared to recent data. This is due to the application of age-based discard proportions which indicate very low discard rates at ages 3 and above. In 2024 and 2025 the majority of the catch is age 3 or 4 (2022 recruitment) and therefore total discards are projected to be low.

The forecast under different catch scenarios for 2025 is shown in Table 6.5.2. Almost all scenarios result in a reduction in SSB in 2026 as the very strong year class passes through the stock (with weaker cohorts following). However, all reasonable scenarios (i.e. F<1.0) results in zero probably of SSB falling below Blim in 2026. The forecast stock trajectory under the proposed advice (MSY approach) for 2025 is shown in Figure 6.5.1 and results in a 14.6% decline in SSB in 2026 (compared to 2025). Both the predicted catch in 2025 and SSB in 2026 are dominated by the year class which recruited in 2022 (Figure 6.5.2). This year class contributes 82% to the catch in 2025 and over 50% to the SSB in 2026.

The catch advice for 2025 is 31 565 tonnes under the MSY approach. The change in advice is 674% (compared to advice given in 2022 for 2023 and 2024) and is due to the increase in stock size following the very high recruitment in 2022 and the change in assessment method/advice basis following the benchmark.

6.5.2 Reference points

Both MSY and precautionary reference points were re-estimated at WKBGAD (ICES, 2024) and are given below.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	12 877	5th percentile of equilibrium SSB when fishing at F_{MSY}; in tonnes	ICES (2024a)
	F_{MSY}	0.28	Stochastic simulations (EqSim) with segmented regression stock recruitment relationship.	ICES (2024a)
Precautionary approach	B_{lim}	8 542	Lowest SSB which results in high recruitment (> 75th percentile) (SSB in 2001); in tonnes	ICES (2024a)
	B_{pa}	11 870	$B_{pa} = B_{lim} \times e^{1.645\sigma}$ where σ=0.2; in tonnes	ICES (2024a)
	F_{lim}	1.10	F giving 50% probability of SSB < B_{lim} in stochastic simulation (EqSim) using segmented regression recruitment with breakpoint = B_{lim}	ICES (2024a)
	F_{pa}	0.42	F_{P05}; the F that leads to SSB ≥ B_{lim} with 95% probability	ICES (2024a)
EU Management plan	MAP MSY $B_{trigger}$	12 877	5th percentile of equilibrium SSB when fishing at F_{MSY}; in tonnes	EU(2019) & ICES(2024a)
	MAP B_{lim}	8 542	Lowest SSB which results in high recruitment (> 75th percentile) (SSB in 2001); in tonnes	EU(2019) & ICES(2024a)
	MAP F_{MSY}	0.28	F_{MSY}	EU(2019) & ICES(2024a)
	MAP range $F_{MSY\ lower}$	0.184	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU(2019) & ICES(2024a)
	MAP range $F_{MSY\ upper}$	0.41	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU(2019) & ICES(2024a)

6.6 Management plans

Haddock at Rockall are included in the EU multiannual management plan (MAP) (EU, 2019). However this is not agreed with the UK or other parties involved in the fishery for this stock and therefore the advice is provided according to the ICES MSY approach.

On a number of occasions previously, ICES has evaluated the harvest control rule components of NEAFC management plan proposals. Further details can be found in ICES (2013) and ICES (2019).

6.7 Quality of the assessment

Figure 6.7.1 shows a comparison between this year's and previous years' assessments. Given the recent benchmark and revisions to reference points, only the assessment results from this year's WG should be compared to the reference points indicated. The results from the latest assessment are relatively consistent with previous analytical assessments (carried out in 2020 and 2021). Differences in estimated recruitment and SSB are likely to be largely due to changes in natural mortality and maturity made at WKBGAD (ICES, 2024). The estimated Fbar from the most recent assessment is much less noisy than that from previous assessments. This is considered likely due to the change in assessment method from XSA, which assumes catch-at-age data to be exact, to SAM, which allows for uncertainty in the catch-at-age observations. Variability in catch-at-age data (due to poor sampling levels) is therefore less likely to be interpreted as a change in fishing mortality by SAM. The retrospective analysis also shows that the new SAM assessment is robust to the addition of extra years of data.

Sampling

While the main fleets in the fishery (UK-Scotland & Ireland) are sampled for both landings and discards, the number of sampling trips is low – typically less than 10 landings sampled per year and less than five discard samples. This is due to the low number of vessels conducting few, but longer, fishing trips to this area. This results in uncertainty in stock assessment input data (catch numbers- and weights-at-age, and discard proportions) and subsequent estimates of fishing mortality. A new industry co-sampling scheme has begun in UK and it is envisaged that this will improve the quality of the catch data in future years.

Surveys

There have been a number of changes to survey design over time. Taking a statistical modelling approach to deriving survey indices can account for some of these changes, and the resulting 'Modelled Q3' indices show high precision and good internal consistency.

6.8 Recommendation for next benchmark

Haddock in Division 6.b. was benchmarked in 2024 (WKBGAD, ICES, 2024). The remaining issues are given below:

Type	Problem/Aim	Work Required	Data Required
Biological parameters	Natural mortality. Currently scaled time invariant Lorenzen. Much lower than other haddock stocks (and most other demersal stocks in general). Given the highly variable stock size and potential for density dependent effects in growth, it seems likely M may also vary over time, and assuming it to be constant may account for some of the residual patterns in the final model.	Explore alternative approaches for deriving natural mortality values – utilising alternative scaling of the Lorenzen estimates, other life-history based approaches or re-evaluating values from N Sea SMS model. Variable M (from Lorenzen) could also be modelled in SAM ('biopar').	Life history parameters.
Assessment method	A number of minor patterns are still apparent in the one-step ahead and process residuals. Further exploration of model configuration settings may improve this.	SAM model configuration exploration	Assessment input data
Input data - discards	The processing of historical catch data (pre-2011) was not revisited at the 2024 benchmark. While most of the historical raw data are unavailable, it may be possible to rework data from around 2005 to place this on a more transparent footing.	Data processing in Intercatch (or using RDBES)	Catch sampling data
Assessment method	Further exploration of the appropriateness of the Fbar age range. The proportion of the catch within the range varies quite considerably over time due to the highly variable recruitment.	Explore the utility of an increased age range or weighted average F over all ages.	Assessment results.
Forecast assumptions	Intermediate year recruitment currently resampled from full time series. Consider how best to make use of information from 0-group survey index not currently included in the assessment.	Consider whether a bespoke SAM forecast function can be utilised to allow separate recruitment assumptions between intermediate & forecast years. Issue could also potentially be addressed by including 0-group index as a forward shifted recruitment (at age 1) index in the assessment (although initial exploration at WKBGAD resulted in substantial retro patterns).	Assessment output

6.9 Management considerations

In 2022 advice for this stock was given following ICES MSY approach for data-limited stocks using the empirical rfb rule (Fischer *et al*., 2021). Following the benchmark, the basis for advice is the MSY approach based on a Category 1 stock assessment.

The year class recruiting in 2022 makes up the majority of the catch in the interim year and forecast (82% in 2025). It is not known how future discarding practices will be affected by this very large year class and therefore there is uncertainty in the projected discards and landings split.

Due to the very high recruitment in 2022 and low fishing mortality, the stock size is at an historic high. This could potentially result in slower individual growth due to density dependent effects which is not accounted for in the calculation of advised catch. A reduction in growth rate of the strong cohort could result in lower advised catch and a higher proportion of discards.

The TAC for haddock in Division 6.b only applies to catches from EU and UK fleets. Part of Division 6.b is in international waters (NEAFC regulatory area) where non-EU/UK vessels are not subject to TAC. This allows for unregulated catches in the Rockall area although in recent years the catches from non-EU/UK fleets have been very low.

6.10 References

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6.11 Tables and Figures

Table 6.2.1. Haddock in Division 6.b. Nominal landings (tonnes) as officially reported to ICES.

Year	Faroe Islands	France	Iceland	Ireland	Norway	Portugal	Russian Federation	Spain	UK (E,W, & NI)	UK (Scot.)	UK (total)	Total^^	Landings from NEAFC area**	ICES landings#
1996	-	-	-	747	24	-	-	1	293	5753		6818		7075
1997	-	-	<0.5	895	24	-	-	22	165	4114		5220		5166
1998	-	-	-	704	40	4	-	21	561	3768		5098		4984
1999	-	-	167	1021	61	-	458	25	288	3970		5990		5358
2000	-	5	-	824	152	-	2154	47	36	2470		5688		5445^
2001	-	2	-	357	70	-	630	51	-	1205		2315		2020^
2002	-	-	-	206	49	-	1630	7	<0.5	1145		3037		3116^
2003	-	-	-	169	60	-	4237	19	56	1607		6148		5967^
2004	-	-	-	19	32	-	5844	-	-	411		6306		6437
2005	-	-	-	105	33	-	4708	-	-	332		5178		5238
2006	2	<0.5	-	41	123	-	2154	5	1	439		2765		2756
2007	2	-	-	338	84	-	1282	+	8	1635		3349		3348
2008	16	-	-	721	36	-	1669	1	-	1779		4222		4221

Year	Faroe Islands	France	Iceland	Ireland	Norway	Portugal	Russian Federation	Spain	UK (E,W, & NI)	UK (Scot.)	UK (total)	Total^^	Landings from NEAFC area**	ICES landings#
2009	10	1	-	352	71	-	55	+	-	2951		3440		3242
2010	42	-	-	169	65	-	198	+	-	2931		3405		3404
2011	2	<0.5	-	123	40	-	-	-	-	1732		1897	376	1861
2012	53	-	-	31	48	-	1	-	-	577		710	33	702
2013	-	-	-	105	121	-	4	-	-	596		826	147	824
2014	24	2	-	94	55	-	388	-	-	1152		1713	423	1690
2015	1	-	-	190	66	-	136	-			2052	2445	241	2442
2016	<0.5	-	-	362	63	-	-	-			2160	2585	565	2504
2017	<0.5	-	-	500	26	-	153	-			3907	4586	715	4431
2018	-	-	-	431[##]	16	-	-	-			3418	3865[##]	782[##]	3850
2019	-	8	-	4[##]	13	-	245	1			6536	6807[##]	809	7782
2020	-	-	-	679	14	-	133	<0.5			4575	5401	745	5510
2021	<0.5	<0.5	-	510	-	-	20	-			3558	4089	1183	4094
2022*	25	-	-	403	-	-	-				3565	3993	1200	4251
2023*	13	-	-	314	71	-	-	1			3494	3894	652	3666

*** Preliminary official landings.**

****Official landings except 2020 - 2023 which include ICES estimates.**

^ Includes the total Russian catch.

^^ Including below minimum size (BMS) landings where available

 # Historical values updated in 2024.

##Incomplete: part of the data being unavailable under data confidentiality clauses. n/a = Not available.

Table 6.2.2. Haddock in Division 6.b. Landings from the NEAFC area (Subdivision 27.6b.1). (Mixture of official landings and ICES estimates – see Section 7.3 for explanation).

Year	Faroe Islands	France	Ireland	Norway	Russian Federation	Spain	UK (total)	Total
2012		0	2.2	4.96	1	0	24.6	32.8
2013		0	4.5	31.4	4	0	107.2	147.1
2014		0	5.85	28.9	388	0	0	422.7
2015		0	6.4	38.6	136	0	59.9	240.9
2016		0	5.2	47.9	-	0	511.8	564.9
2017		0	19.9	7.3	153	0	535.1	715.3
2018		0	**	9.9	-	0	772.6	782.5**
2019		1.4	3.8	7.3	245	0.51	550.4	808.5
2020		0	15.3	11.6	133	0	584.6	744.6
2021	0.2	0.012	140.9		20	0	1021.6	1182.7
2022*	24.709	0	63.2235		162		949.62	1199.6
2023*	12.412		31.7944	59.54		0.0397	547.769	651.6

***Preliminary**

****Incomplete: part of the data being unavailable under data confidentiality clauses.**

Table 6.3.1. Haddock in Division 6.b. ICES estimates of landings, discards and bms calculated as sum of products of numbers and weights (in tonnes).

Year	Landings	Discards	BMS
1991	5655	13228	
1992	5320	11873	
1993	4784	9856	
1994	5733	11027	
1995	5587	9170	
1996	7075	9356	
1997	5166	5893	
1998	4984	10863	
1999	5358	11065	
2000	5445	6611	
2001	2020	1536	
2002	3116	4153	
2003	5967	5521	
2004	6437	883	
2005	5238	505	
2006	2756	386	
2007	3348	2242	
2008	4221	2104	
2009	3242	1556	
2010	3404	907	
2011	1861	152	
2012	702	25	
2013	824	1065	
2014	1690	270	
2015	2442	554	
2016	2504	401	0.4
2017	4431	379	-
2018	3850	788	-

Year	Landings	Discards	BMS
2019	7782	303	4.0
2020	5510	130	1.9
2021	4094	1117	0.7
2022	4251	1095	1.0
2023	3666	764	62.4

Table 6.3.2. Haddock in Division 6.b. International landings numbers (*10³) at-age.

Year	1	2	3	4	5	6	7	8
1991	87	6807	3011	1344	558	32	347	117
1992	86	3642	5623	964	580	364	51	109
1993	28	1919	4740	1157	489	144	178	113
1994	30	1160	5299	3665	1039	66	57	84
1995	1	146	5205	4791	1319	279	14	29
1996	2	5149	1861	4149	2347	473	74	11
1997	0	319	2102	2155	3658	1540	183	9
1998	4	392	1815	1340	1898	2284	897	404
1999	245	2600	2994	1972	1228	1600	1757	534
2000	33	3446	5081	3006	1296	1176	1250	713
2001	402	994	1116	555	991	462	319	230
2002	657	2983	3998	2111	809	217	170	223
2003	920	8103	11010	1848	1189	879	387	206
2004	197	1765	9502	9119	1364	286	262	210
2005	887	2835	6866	7913	725	98	134	48
2006	2344	768	1290	2356	2269	428	94	56
2007	31	1220	2709	1074	1550	1634	531	188
2008	17	749	6191	1164	479	761	684	164
2009	5	11	244	5243	460	261	255	231
2010	0	71	196	352	4078	274	161	133
2011	2	23	71	177	181	2405	100	122
2012	0	0	156	59	0	41	447	31
2013	162	14	2	46	6	46	29	524
2014	198	1528	415	44	121	34	69	528
2015	4	664	3164	104	7	60	10	101
2016	127	612	2137	842	3	2	7	3
2017	7	1336	1783	2179	1207	58	26	33
2018	0	3418	502	2233	598	222	3	10
2019	10	1514	10556	59	484	90	59	1
2020	21	1936	1190	3391	364	518	62	118
2021	132	544	2863	556	1788	53	243	94
2022	60	5806	551	575	203	677	19	58
2023	0	373	2331	606	552	216	97	268

Table 6.3.3. Haddock in 6.b. International discards numbers (*10³) at-age.

Year	1	2	3	4	5	6	7	8
1991	21099	27040	12178	3998	1146	313	51	7
1992	15998	21069	12961	4397	1181	312	40	6
1993	11151	17456	10755	3781	1128	317	60	9
1994	8140	19464	12570	4545	1409	410	79	12
1995	2748	9685	16379	4965	1145	508	34	3
1996	12094	13662	9051	5463	952	278	6	1
1997	9957	10216	3286	1944	1344	218	13	2
1998	14220	19415	8357	3423	1842	483	82	9
1999	17037	19348	9209	3526	2191	1084	413	72
2000	8189	9136	5616	1912	755	322	90	13
2001	7268	1019	583	266	50	15	18	3
2002	12706	8136	539	334	89	43	15	36
2003	5655	15503	3558	217	97	48	7	1
2004	735	2346	781	93	22	10	2	0
2005	174	888	554	210	28	11	9	2
2006	536	707	336	58	22	8	1	0
2007	1458	8609	921	440	678	193	0	0
2008	458	1458	5246	128	28	203	70	12
2009	218	696	993	2803	35	2	15	2
2010	152	463	868	1736	19	2	1	1
2011	2	36	4	6	0	174	27	0
2012	5	6	10	7	2	0	18	0
2013	4733	84	99	40	33	38	0	12
2014	164	1190	0	0	0	0	0	0
2015	71	2153	173	0	0	0	0	0
2016	245	439	502	146	0	0	0	0
2017	1187	334	20	12	0	0	0	0
2018	88	2955	3	40	0	0	0	0
2019	275	471	308	8	76	0	0	0
2020	237	263	0	0	0	0	0	0
2021	2797	1556	339	72	74	0	0	0
2022	1913	2403	150	0	0	0	0	0
2023	4	2462	302	0	0	0	0	0

Table 6.3.4. Haddock in Division 6.b. International bms numbers (*10³) at-age.

Year	1	2	3	4	5	6	7	8
2016	1	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0
2019	2	10	3	0	0	0	0	0
2020	4	3	0	0	0	0	0	0
2021	2	1	0	0	0	0	0	0
2022	2	2	0	0	0	0	0	0
2023	0	201	25	0	0	0	0	0

Table 6.3.5. Haddock in Division 6.b. International catch (landings, discards and bms) numbers- at-age(*10³).

Year	1	2	3	4	5	6	7	8
1991	21186	33847	15189	5341	1704	346	398	124
1992	16084	24711	18584	5361	1761	676	91	115
1993	11178	19375	15494	4938	1617	461	237	122
1994	8170	20623	17868	8209	2449	476	136	97
1995	2749	9831	21585	9756	2464	787	47	32
1996	12096	18811	10911	9612	3299	751	80	12
1997	9957	10535	5388	4098	5002	1758	196	11
1998	14224	19807	10173	4763	3740	2767	979	413
1999	17282	21949	12203	5499	3419	2684	2170	605
2000	8222	12581	10698	4917	2050	1498	1340	726
2001	7669	2013	1699	821	1041	477	338	233
2002	13363	11119	4537	2445	898	260	185	259
2003	6576	23606	14568	2065	1286	927	395	207
2004	932	4112	10282	9212	1386	296	264	210
2005	1061	3723	7420	8124	753	109	143	50
2006	2880	1475	1626	2414	2291	436	95	56
2007	1489	9829	3630	1514	2227	1827	531	189
2008	476	2207	11437	1291	507	964	755	175
2009	223	707	1237	8046	495	263	270	233
2010	152	534	1064	2087	4096	276	162	134
2011	4	59	75	183	181	2579	127	122
2012	5	6	166	67	3	41	465	31
2013	4896	98	101	86	39	84	29	536
2014	362	2718	415	44	121	34	69	528
2015	75	2817	3338	104	7	60	10	101
2016	374	1051	2639	988	3	2	7	3
2017	1194	1670	1802	2191	1207	58	26	33
2018	88	6373	504	2273	598	222	3	10
2019	288	1995	10866	67	560	90	59	1
2020	262	2203	1190	3392	364	518	62	118
2021	2931	2101	3202	628	1862	53	243	94
2022	1975	8211	702	575	203	677	19	58
2023	5	3036	2659	606	552	216	97	268

Table 6.3.6. Haddock in Division 6.b. Landing fraction by age (accounts for total discards including bms).

Year	1	2	3	4	5	6	7	8
1991	0.004	0.201	0.198	0.252	0.327	0.094	0.873	0.941
1992	0.005	0.147	0.303	0.180	0.329	0.538	0.558	0.949
1993	0.002	0.099	0.306	0.234	0.302	0.313	0.748	0.925
1994	0.004	0.056	0.297	0.446	0.424	0.139	0.420	0.873
1995	0.000	0.015	0.241	0.491	0.535	0.354	0.289	0.916
1996	0.000	0.274	0.171	0.432	0.711	0.630	0.923	0.919
1997	0.000	0.030	0.390	0.526	0.731	0.876	0.934	0.811
1998	0.000	0.020	0.178	0.281	0.507	0.825	0.917	0.978
1999	0.014	0.118	0.245	0.359	0.359	0.596	0.810	0.882
2000	0.004	0.274	0.475	0.611	0.632	0.785	0.933	0.981
2001	0.052	0.494	0.657	0.676	0.952	0.969	0.946	0.987
2002	0.049	0.268	0.881	0.863	0.901	0.834	0.918	0.860
2003	0.140	0.343	0.756	0.895	0.925	0.949	0.982	0.995
2004	0.211	0.429	0.924	0.990	0.984	0.966	0.994	0.999
2005	0.836	0.761	0.925	0.974	0.963	0.901	0.935	0.969
2006	0.814	0.521	0.793	0.976	0.990	0.982	0.992	0.998
2007	0.021	0.124	0.746	0.709	0.696	0.894	0.999	1.000
2008	0.036	0.339	0.541	0.901	0.945	0.790	0.907	0.933
2009	0.021	0.016	0.197	0.652	0.928	0.994	0.944	0.989
2010	0.000	0.132	0.184	0.169	0.995	0.993	0.994	0.991
2011	0.576	0.393	0.946	0.966	0.998	0.933	0.789	1.000
2012	0.000	0.000	0.942	0.893	0.064	0.999	0.962	0.999
2013	0.033	0.141	0.016	0.533	0.158	0.550	1.000	0.978
2014	0.548	0.562	1.000	1.000	1.000	1.000	1.000	1.000
2015	0.055	0.236	0.948	1.000	1.000	1.000	1.000	1.000
2016	0.341	0.582	0.810	0.852	0.978	1.000	1.000	1.000
2017	0.006	0.800	0.989	0.995	1.000	1.000	1.000	1.000
2018	0.000	0.536	0.994	0.983	0.999	0.998	1.000	1.000
2019	0.034	0.759	0.971	0.881	0.864	1.000	1.000	1.000
2020	0.080	0.879	1.000	1.000	1.000	1.000	1.000	1.000
2021	0.045	0.259	0.894	0.886	0.960	1.000	1.000	1.000
2022	0.030	0.707	0.785	1.000	1.000	1.000	1.000	1.000
2023	0.000	0.123	0.877	1.000	1.000	1.000	1.000	1.000

Table 6.3.7. Haddock in Division 6.b. International landings mean weights-at-age (kg).

Year	1	2	3	4	5	6	7	8
1991	0.3018	0.4018	0.4439	0.5921	0.7242	0.9630	0.7667	0.5169
1992	0.1364	0.3659	0.4548	0.6582	0.6125	0.7591	0.8127	1.0197
1993	0.3046	0.4021	0.5033	0.7011	0.8305	0.8203	0.8673	1.1368
1994	0.3140	0.3562	0.4522	0.5579	0.6381	1.2244	0.7641	0.9749
1995	0.3767	0.3107	0.4141	0.4789	0.6397	0.6994	1.6996	1.0187
1996	0.3269	0.4364	0.5008	0.4874	0.6272	0.7087	0.7651	0.9060
1997	0.3000	0.3152	0.4008	0.4437	0.5637	0.6614	0.9582	1.2885
1998	0.2561	0.3440	0.4939	0.5166	0.5416	0.5906	0.6753	0.6842
1999	0.0853	0.1768	0.3263	0.4169	0.4954	0.5954	0.6505	0.7015
2000	0.1110	0.2057	0.2421	0.3278	0.4129	0.4835	0.6672	0.8137
2001	0.0936	0.2814	0.3436	0.4967	0.4273	0.5222	0.5553	0.8769
2002	0.1069	0.1956	0.2270	0.3230	0.5209	0.6271	0.7421	0.8504
2003	0.0997	0.1639	0.2461	0.3502	0.3874	0.4229	0.5373	0.7338
2004	0.1418	0.1724	0.2411	0.2932	0.4457	0.6173	0.6802	0.8470
2005	0.1033	0.1841	0.2297	0.3100	0.4613	0.6137	1.0637	1.1813
2006	0.0841	0.1669	0.2225	0.3267	0.4405	0.5981	0.6551	1.0139
2007	0.0959	0.2380	0.2755	0.3216	0.4489	0.5213	0.5616	0.6247
2008	0.1247	0.1972	0.3017	0.4438	0.5833	0.7518	0.9682	1.0522
2009	0.3001	0.3461	0.4198	0.4162	0.6919	0.5118	0.9714	1.0962
2010	0.0518	0.4195	0.5172	0.4566	0.5911	0.9798	1.3463	1.6256
2011	0.2138	0.3285	0.6127	0.4545	0.6943	0.5944	0.6965	0.8486
2012	-	-	0.5550	0.7470	0.8401	1.2405	1.0418	1.7401
2013	0.5069	0.5315	0.6835	0.8879	1.4497	0.8494	1.5170	1.1459
2014	0.1463	0.3517	0.2671	0.4863	1.0387	1.1288	1.2670	1.4003
2015	0.1103	0.3485	0.6158	0.3534	1.1753	0.9483	0.8406	1.4957
2016	0.4090	0.5737	0.6643	0.7667	1.5763	1.8078	2.3443	3.3346
2017	0.1730	0.4600	0.5871	0.6923	0.9442	0.7804	0.9126	1.5459
2018	-	0.3322	0.5641	0.7048	0.9354	1.2347	2.2115	1.8386
2019	0.1895	0.4893	0.5894	0.8246	1.1161	1.4395	1.6628	3.1576
2020	0.2977	0.5311	0.5763	0.8075	0.7486	1.0290	1.5356	1.2720
2021	0.2839	0.3936	0.5116	0.8374	0.8183	1.1379	0.9390	1.6937
2022	0.1738	0.4287	0.7441	0.7928	0.9602	0.9094	0.7988	1.0349
2023	-	0.6131	0.7069	0.9582	0.9595	0.9648	1.6386	1.1609

Table 6.3.8. Haddock in Division 6.b. International discards (and bms) mean weights-at-age (kg).

Year	1	2	3	4	5	6	7	8
1991	0.1418	0.1995	0.2533	0.3059	0.3452	0.3577	0.4931	0.3884
1992	0.1331	0.2169	0.2582	0.2976	0.3301	0.3425	0.4924	0.5411
1993	0.1365	0.2196	0.2601	0.3074	0.3463	0.3593	0.4989	0.5391
1994	0.1528	0.2260	0.2631	0.3080	0.3449	0.3562	0.5027	0.5415
1995	0.1183	0.2204	0.2761	0.3254	0.3406	0.3285	0.4326	0.5048
1996	0.1365	0.2180	0.2756	0.3260	0.3696	0.3476	0.5106	0.5420
1997	0.1364	0.2380	0.2718	0.3123	0.3715	0.4419	0.5070	0.5424
1998	0.1414	0.2482	0.2673	0.2907	0.3266	0.3360	0.4469	0.4866
1999	0.1388	0.2122	0.2548	0.2879	0.3133	0.3178	0.4125	0.4399
2000	0.1891	0.2670	0.2889	0.3110	0.3297	0.3337	0.4796	0.5140
2001	0.1353	0.2467	0.2937	0.3438	0.4122	0.4404	0.5098	0.5313
2002	0.1366	0.2545	0.3082	0.3352	0.3983	0.3377	0.5052	0.3302
2003	0.1614	0.2228	0.2871	0.3421	0.3369	0.4402	0.4807	0.5281
2004	0.1479	0.2177	0.2820	0.3426	0.3239	0.3711	0.4537	0.4112
2005	0.1706	0.2403	0.2981	0.3565	0.3872	0.4728	0.5054	0.5424
2006	0.1319	0.2326	0.3335	0.4201	0.4951	0.4351	0.4259	0.4060
2007	0.1148	0.1791	0.2328	0.2265	0.2425	0.2801	0.4044	0.5145
2008	0.2019	0.2636	0.2785	0.3701	0.3506	0.3581	0.4330	0.5225
2009	0.2465	0.2874	0.3186	0.3434	0.3604	0.6620	0.5018	0.5416
2010	0.1410	0.2205	0.2920	0.3008	0.3225	0.5336	0.4595	0.0725
2011	0.1777	0.2479	0.3002	0.3024	0.7949	0.7274	0.4813	-
2012	0.2630	0.2945	0.4883	0.3193	0.3395	0.7333	0.7966	1.0788
2013	0.2013	0.3370	0.2284	0.3968	0.2473	0.6795	0.0000	0.9802
2014	0.0798	0.2156	-	-	-	-	-	-
2015	0.1040	0.2269	0.3343	-	-	-	-	-
2016	0.2404	0.2757	0.3249	0.3930	0.4090	-	-	-
2017	0.2193	0.3081	0.4820	0.5203	0.7260	-	-	-
2018	0.0879	0.2580	0.3611	0.4222	0.4790	0.5360	-	-
2019	0.1795	0.2586	0.2970	0.3741	0.4862	-	-	-
2020	0.2419	0.2741	-	0.5120	-	-	-	-
2021	0.1817	0.2835	0.3357	0.3438	0.3942	-	-	-
2022	0.1758	0.2929	0.3640	-	-	-	-	-
2023	0.1030	0.2721	0.3090	-	-	-	-	-

Table 6.3.9. Haddock in Division 6.b. International catch (landings and discards) mean weights-at-age (kg).

Year	1	2	3	4	5	6	7	8
1991	0.1425	0.2402	0.2911	0.3779	0.4692	0.4144	0.7319	0.5182
1992	0.1331	0.2388	0.3177	0.3624	0.4231	0.5667	0.6713	0.9954
1993	0.1369	0.2377	0.3345	0.3997	0.4927	0.5035	0.7744	1.0921
1994	0.1534	0.2333	0.3192	0.4196	0.4694	0.4773	0.6124	0.9197
1995	0.1184	0.2218	0.3094	0.4008	0.5007	0.4598	0.7991	0.9756
1996	0.1365	0.2778	0.3140	0.3956	0.5528	0.5751	0.7455	0.8766
1997	0.1364	0.2403	0.3221	0.3814	0.5121	0.6341	0.9285	1.1477
1998	0.1414	0.2501	0.3078	0.3543	0.4357	0.5462	0.6562	0.6798
1999	0.1380	0.2080	0.2723	0.3342	0.3787	0.4833	0.6052	0.6706
2000	0.1888	0.2502	0.2667	0.3212	0.3822	0.4513	0.6547	0.8081
2001	0.1331	0.2638	0.3265	0.4472	0.4266	0.5197	0.5529	0.8723
2002	0.1351	0.2387	0.2366	0.3247	0.5087	0.5792	0.7225	0.7778
2003	0.1527	0.2026	0.2561	0.3493	0.3836	0.4238	0.5363	0.7327
2004	0.1466	0.1982	0.2442	0.2937	0.4438	0.6090	0.6788	0.8465
2005	0.1144	0.1975	0.2348	0.3112	0.4585	0.5997	1.0271	1.1613
2006	0.0930	0.1984	0.2455	0.3289	0.4410	0.5952	0.6533	1.0125
2007	0.1144	0.1864	0.2646	0.2939	0.3861	0.4958	0.5615	0.6246
2008	0.1991	0.2411	0.2911	0.4365	0.5705	0.6689	0.9182	1.0169
2009	0.2477	0.2883	0.3386	0.3908	0.6682	0.5127	0.9453	1.0903
2010	0.1410	0.2468	0.3334	0.3271	0.5899	0.9766	1.3409	1.6121
2011	0.1985	0.2796	0.5958	0.4493	0.6945	0.6033	0.6512	0.8486
2012	0.2630	0.2945	0.5511	0.7011	0.3717	1.2400	1.0325	1.7392
2013	0.2114	0.3645	0.2357	0.6588	0.4373	0.7729	1.5170	1.1423
2014	0.1162	0.2921	0.2671	0.4863	1.0387	1.1288	1.2670	1.4003
2015	0.1043	0.2556	0.6012	0.3534	1.1753	0.9483	0.8406	1.4957
2016	0.2978	0.4491	0.5997	0.7114	1.5504	1.8078	2.3443	3.3346
2017	0.2190	0.4297	0.5859	0.6914	0.9441	0.7804	0.9126	1.5459
2018	0.0879	0.2978	0.5629	0.6999	0.9351	1.2334	2.2115	1.8386
2019	0.1797	0.4335	0.5810	0.7708	1.0302	1.4395	1.6628	3.1576
2020	0.2455	0.5000	0.5763	0.8075	0.7486	1.0290	1.5356	1.2720
2021	0.1863	0.3120	0.4930	0.7810	0.8015	1.1379	0.9390	1.6937
2022	0.1757	0.3889	0.6625	0.7928	0.9602	0.9094	0.7988	1.0349
2023	0.1030	0.3140	0.6580	0.9582	0.9595	0.9648	1.6386	1.1609

Table 6.3.10. Haddock in Division 6.b. Scottish Q3 Rockall haddock survey: 'Rockall pt1' 1991-1997 (ages 1 to 8+ used in the assessment).

	0	1	2	3	4	5	6	7	8+
1991	14458	16398	4431	683	315	228	37	64	3
1992	20336	44912	14631	3150	647	127	200	4	32
1993	15220	37959	15689	3716	1104	183	38	73	21
1994	23474	13287	11399	4314	969	203	30	12	4
1995	16923	16971	6648	5993	1935	483	200	16	-1
1996	33578	19420	5903	1940	1317	325	69	6	1
1997	28897	10693	2384	538	292	281	71	9	1

Table 6.3.11. Haddock in Division 6.b. Scottish Q3 Rockall haddock survey: 'Modelled Q3' index - mean and CV (1999 onwards, ages 1-8+ used in the assessment).

Mean

	0	1	2	3	4	5	6	7	8+
1999	34877.86	85187.17	39974.23	7858.54	3281.63	2780.39	984.82	862.33	268.34
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	239688.63	60357.57	3953.78	3041.45	1402.15	389.02	119.01	103.26	93.06
2002	52256.33	171465.72	30293.22	2266.02	1272.86	936.91	200.06	144.05	208.82
2003	13557.62	78471.92	157756.21	17357.22	2254.44	1380.50	1175.69	295.99	105.86
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	147815.41	33599.26	11729.55	19120.91	29422.88	2898.87	433.86	138.62	85.47
2006	30165.33	170904.08	19479.98	2395.12	12391.23	17019.02	3587.73	118.91	96.56
2007	5764.54	20279.83	57537.76	6899.39	1570.46	3572.91	3745.58	286.98	33.87
2008	964.74	4960.90	7396.23	49316.03	2279.44	546.90	2703.36	3596.01	401.42
2009	944.67	821.78	2375.83	4996.06	25930.36	659.59	161.24	1386.11	208.89
2010	NA	NA	NA	NA	NA	NA	NA	NA	NA
2011	76.32	149.78	1801.51	231.77	401.25	1327.26	6635.27	19.03	113.55
2012	117260.76	29.75	75.64	548.46	88.10	480.91	359.98	4120.28	143.61
2013	49576.73	132145.74	42.28	110.15	86.28	104.30	142.52	227.81	2008.47
2014	36145.32	69968.32	85726.54	55.37	49.03	144.30	72.00	178.48	1020.40
2015	46846.36	30102.37	110689.67	33614.22	36.94	228.32	80.23	33.82	607.91
2016	218062.18	15919.00	22318.29	19978.64	15188.27	47.53	10.32	53.77	287.79
2017	241406.11	315286.76	11172.89	8541.24	14213.82	8604.04	77.46	18.68	135.12
2018	198832.56	35270.97	43752.86	2513.47	1947.47	5141.07	3967.09	0.80	150.22
2019	37695.55	50424.83	11593.99	47985.35	648.16	1180.46	3706.13	948.76	83.44
2020	289881.66	17333.92	12372.73	6531.85	8997.27	478.43	663.18	375.12	392.06
2021	689967.22	113923.00	4944.64	7424.79	2606.78	6991.77	537.41	44.92	793.83
2022	9873.39	1205426.86	26228.72	3261.52	2349.03	1617.13	5875.94	73.15	328.82
2023	40464.87	8664.80	698961.67	23393.63	2012.03	2278.34	1591.47	2742.67	532.47

CV

	0	1	2	3	4	5	6	7	8+
1999	0.3395	0.1104	0.2183	0.3801	0.4874	0.4532	0.3356	0.4112	0.2275
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	0.2936	0.0947	0.1631	0.2914	0.3007	0.3094	0.2581	0.4986	0.1976
2002	0.2564	0.1145	0.1737	0.2955	0.3046	0.3004	0.2906	0.4931	0.2177
2003	0.2913	0.1138	0.1893	0.2361	0.2802	0.2786	0.2401	0.4470	0.2385
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	0.3453	0.1395	0.2127	0.2135	0.2423	0.2963	0.2631	0.4795	0.2266
2006	1.0483	0.1386	0.2017	0.2070	0.2175	0.2054	0.1936	0.3894	0.2514
2007	3.9784	0.1997	0.1710	0.1723	0.2112	0.1766	0.1819	0.3032	0.2956
2008	1.4386	0.2471	0.2209	0.1948	0.2167	0.2375	0.2164	0.3848	0.2796
2009	0.3988	0.2449	0.2565	0.2012	0.1948	0.2387	0.2286	0.4217	0.2490
2010	NA	NA	NA	NA	NA	NA	NA	NA	NA
2011	0.7027	0.2841	0.2477	0.1930	0.3300	0.2134	0.1022	0.4328	0.1886
2012	0.2661	0.3922	0.2683	0.1783	0.2113	0.1547	0.1588	0.0997	0.1692
2013	0.2536	0.0976	0.2969	0.2790	0.2770	0.2444	0.2264	0.2171	0.1201
2014	0.2864	0.0877	0.1607	0.2137	0.2941	0.2268	0.1808	0.3111	0.1066
2015	0.3279	0.1082	0.1748	0.0843	0.3380	0.2464	0.1928	0.3790	0.1210
2016	0.3023	0.1040	0.1378	0.0926	0.1434	0.2410	0.2695	0.2632	0.1375
2017	0.3710	0.0729	0.1210	0.1181	0.0905	0.1029	0.2004	0.3353	0.1805
2018	0.2700	0.0925	0.2520	0.1383	0.3646	0.2535	0.1055	0.7201	0.1737
2019	0.2185	0.0946	0.1931	0.0951	0.2709	0.2019	0.0938	0.2638	0.1881
2020	0.1825	0.1134	0.1494	0.1159	0.1885	0.1741	0.1372	0.1975	0.1344
2021	0.1873	0.0761	0.1358	0.1076	0.1544	0.1209	0.1351	0.2403	0.1150
2022	0.2907	0.0568	0.1655	0.1187	0.2464	0.1920	0.0950	0.3000	0.1391
2023	0.3383	0.1259	0.0739	0.1052	0.1327	0.1124	0.1162	0.0908	0.1302

Table 6.4.1. Haddock in Division 6.b. SAM assessment configuration file.

```
# Configuration saved: Fri May 24 12:27:26 2024
#
# Where a matrix is specified rows corresponds to fleets and columns to ages.
# Same number indicates same parameter used
# Numbers (integers) starts from zero and must be consecutive
# Negative numbers indicate that the parameter is not included in the model
#
$minAge
# The minimium age class in the assessment
 1
$maxAge
# The maximum age class in the assessment
 8
$maxAgePlusGroup
# Is last age group considered a plus group for each fleet (1 yes, or 0 no).
 1 1 1
$keyLogFsta
# Coupling of the fishing mortality states processes for each age (normally only
# the first row (= fleet) is used).
# Sequential numbers indicate that the fishing mortality is estimated individually
# for those ages; if the same number is used for two or more ages, F is bound for
# those ages (assumed to be the same). Binding fully selected ages will result in a
# flat selection pattern for those ages.
   0   1   2   3   4   5   5   5
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$corFlag
# Correlation of fishing mortality across ages (0 independent, 1 compound symmetry,
# 2 AR(1), 3 separable AR(1).
# 0: independent means there is no correlation between F across age
# 1: compound symmetry means that all ages are equally correlated;
# 2: AR(1) first order autoregressive - similar ages are more highly correlated than
# ages that are further apart, so similar ages have similar F patterns over time.
# if the estimated correlation is high, then the F pattern over time for each age
# varies in a similar way. E.g if almost one, then they are parallel (like a
# separable model) and if almost zero then they are independent.
# 3: Separable AR - Included for historic reasons . . .  more later
 2

$keyLogFpar
# Coupling of the survey catchability parameters (nomally first row is
# not used, as that is covered by fishing mortality).
```

```
  -1  -1  -1  -1  -1  -1  -1  -1
   0   1   2   3   3   3   3   3
   4   5   6   7   7   7   7   7

$keyQpow
# Density dependent catchability power parameters (if any).
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1
   0   1   1   1   1   1   1   1

$keyVarF
# Coupling of process variance parameters for log(F)-process (Fishing mortality
# normally applies to the first (fishing) fleet; therefore only first row is used)
   0   0   0   0   0   0   0   0
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$keyVarLogN
# Coupling of the recruitment and survival process variance parameters for the
# log(N)-process at the different ages. It is advisable to have at least the first
age
# class (recruitment) separate, because recruitment is a different process than
# survival.
 0 1 1 1 1 1 1 1

$keyVarLogP
#

$keyVarObs
# Coupling of the variance parameters for the observations.
# First row refers to the coupling of the variance parameters for the catch data
# observations by age
# Second and further rows refers to coupling of the variance parameters for the
# index data observations by age
   0   0   0   0   0   0   0   0
   1   1   1   1   1   1   1   1
   2   2   2   2   2   2   2   2

$obsCorStruct
# Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US" for
unstructured). | Possible values are: "ID" "AR" "US"
 "ID" "ID" "ID"

$keyCorObs
# Coupling of correlation parameters can only be specified if the AR(1) structure
is chosen above.
```

```
# NA's indicate where correlation parameters can be specified (-1 where they cannot).
#1-2 2-3 3-4 4-5 5-6 6-7 7-8
  NA  NA  NA  NA  NA  NA  NA
  NA  NA  NA  NA  NA  NA  NA
  NA  NA  NA  NA  NA  NA  NA

$stockRecruitmentModelCode
# Stock recruitment code (0 for plain random walk, 1 for Ricker, 2 for Beverton-Holt, 3 piece-wise constant, 61 for segmented regression/hockey stick, 62 for AR(1), 63 for bent hyperbola / smooth hockey stick, 64 for power function with degree < 1, 65 for power function with degree > 1, 66 for Shepher, 67 for Deriso, 68 for Saila-Lorda, 69 for sigmoidal Beverton-Holt, 90 for CMP spline, 91 for more flexible spline, and 92 for most flexible spline).
 0

$noScaledYears
# Number of years where catch scaling is applied.
 0

$keyScaledYears
# A vector of the years where catch scaling is applied.

$keyParScaledYA
# A matrix specifying the couplings of scale parameters (nrow = no scaled years, ncols = no ages).

$fbarRange
# lowest and higest age included in Fbar
 2 5

$keyBiomassTreat
# To be defined only if a biomass survey is used (0 SSB index, 1 catch index, 2 FSB index, 3 total catch, 4 total landings, 5 TSB index,  6 TSN index, and 10 Fbar idx).
 -1 -1 -1

$obsLikelihoodFlag
# Option for observational likelihood | Possible values are: "LN" "ALN"
 "LN" "LN" "LN"

$fixVarToWeight
# If weight attribute is supplied for observations this option sets the treatment (0 relative weight, 1 fix variance to weight). Can be specified fleetwise.
 0 0 0

$fracMixF
# The fraction of t(3) distribution used in logF increment distribution
 0
```

```
$fracMixN
# The fraction of t(3) distribution used in logN increment distribution (for each age group)
 0 0 0 0 0 0 0 0

$fracMixObs
# A vector with same length as number of fleets, where each element is the fraction of t(3) distribution used in the distribution of that fleet
 0 0 0

$constRecBreaks
# For stock-recruitment code 3: Vector of break years between which recruitment is at constant level. The break year is included in the left interval. For spline stock-recruitment: Vector of log-ssb knots. (This option is only used in combination with stock-recruitment code 3, 90-92, and 290)

$predVarObsLink
# Coupling of parameters used in a prediction-variance link for observations.
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$stockWeightModel
# Integer code describing the treatment of stock weights in the model (0 use as known, 1 use as observations to inform stock weight process (GMRF with cohort and within year correlations)), 2 to add extra correlation to plusgroup
 1

$keyStockWeightMean
# Coupling of stock-weight process mean parameters (not used if stockWeightModel==0)
 0 1 2 3 4 5 6 7

$keyStockWeightObsVar
# Coupling of stock-weight observation variance parameters (not used if stockWeight-Model==0)
 0 0 0 0 0 0 0 0

$catchWeightModel
# Integer code describing the treatment of catch weights in the model (0 use as known, 1 use as observations to inform catch weight process (GMRF with cohort and within year correlations)), 2 to add extra correlation to plusgroup
 0
$matureModel
# Integer code describing the treatment of proportion mature in the model (0 use as known, 1 use as observations to inform proportion mature process (GMRF with cohort and within year correlations on logit(proportion mature))), 2 to add extra correlation to plusgroup
 0
$mortalityModel
```

```
# Integer code describing the treatment of natural mortality in the model (0 use as
known, 1 use as observations to inform natural mortality process (GMRF with cohort
and within year correlations)), 2 to add extra correlation to plusgroup

 0


$keyXtraSd

# An integer matrix with 4 columns (fleet year age coupling), which allows additional
uncertainty to be estimated for the specified observations

   1 2011   1   0
   1 2012   1   0
   1 2013   1   0
   1 2014   1   0
   1 2015   1   0
   1 2016   1   0
   1 2017   1   0
   1 2018   1   0
   1 2019   1   0
   1 2020   1   0
   1 2021   1   0
   1 2022   1   0
   1 2023   1   0
   1 2011   2   0
   1 2012   2   0
   1 2013   2   0
   1 2014   2   0
   1 2015   2   0
   1 2016   2   0
   1 2017   2   0
   1 2018   2   0
   1 2019   2   0
   1 2020   2   0
….
….
```

Table 6.4.2. Haddock in Division 6.b. Parameter estimates from final SAM assessment.

	par	sd(par)	exp(par)	Low	High
logFpar_0	-1.2460	0.3024	0.2876	0.1571	0.5266
logFpar_1	-1.7503	0.2930	0.1737	0.0967	0.3121
logFpar_2	-2.1725	0.2885	0.1139	0.0640	0.2028
logFpar_3	-2.0891	0.1553	0.1238	0.0907	0.1689
logFpar_4	-4.5613	1.2810	0.0104	0.0008	0.1354
logFpar_5	-3.0829	0.6892	0.0458	0.0115	0.1819
logFpar_6	-3.0163	0.6472	0.0490	0.0134	0.1787
logFpar_7	-2.7736	0.6116	0.0624	0.0184	0.2122
logQpow_0	0.4155	0.0820	1.5151	1.2858	1.7851
logQpow_1	0.3059	0.0508	1.3579	1.2267	1.5031
logSdLogFsta_0	-0.7719	0.1756	0.4621	0.3253	0.6565
logSdLogN_0	0.2947	0.1427	1.3428	1.0094	1.7861
logSdLogN_1	-1.0677	0.1351	0.3438	0.2624	0.4504
logSdLogObs_0	-1.3914	0.1800	0.2487	0.1735	0.3565
logSdLogObs_1	-0.3856	0.1227	0.6800	0.5320	0.8692
logSdLogObs_2	0.7684	0.1066	2.1564	1.7424	2.6686
itrans_rho_0	1.6921	0.2612	5.4307	3.2212	9.1558
logPhiSW_0	5.4723	1.4489	238.0002	13.1232	4316.3362
logPhiSW_1	5.4597	1.3960	235.0366	14.4075	3834.2656
logSdProcLogSW_0	1.3026	0.6658	3.6790	0.9714	13.9336
meanLogSW_0	-1.8846	0.2115	0.1519	0.0995	0.2319
meanLogSW_1	-1.3005	0.2089	0.2724	0.1794	0.4137
meanLogSW_2	-0.9888	0.2074	0.3720	0.2457	0.5632
meanLogSW_3	-0.7332	0.2068	0.4804	0.3177	0.7265
meanLogSW_4	-0.4538	0.2072	0.6352	0.4197	0.9614
meanLogSW_5	-0.2599	0.2086	0.7711	0.5081	1.1703
meanLogSW_6	0.0089	0.2109	1.0089	0.6617	1.5384
meanLogSW_7	0.2361	0.2142	1.2663	0.8251	1.9436
logSdLogSW_0	-1.6779	0.0921	0.1868	0.1553	0.2245
logXtraSd_0	1.4146	0.1952	4.1149	2.7850	6.0798

Table 6.4.3. Haddock in Division 6.b. Estimates of numbers-at-age (in 1000s) from final SAM assessment.

Year	1	2	3	4	5	6	7	8+
1991	144212.43	87770.45	27858.74	9309.99	3499.13	595.05	722.92	179.53
1992	153176.05	87933.31	39091.50	9637.51	2874.91	1295.31	162.39	257.46
1993	137498.17	90313.63	41779.34	12089.11	2847.72	798.86	427.26	186.67
1994	82230.21	90748.41	48752.43	16416.52	4208.98	683.83	200.88	139.96
1995	47811.24	48498.06	57912.30	21687.25	5046.21	1097.22	91.01	51.08
1996	86604.34	46729.32	28185.69	24850.18	7791.52	1504.09	146.19	23.41
1997	84308.11	43250.82	18942.71	12425.52	11703.85	3551.28	528.38	30.51
1998	83680.10	54460.41	24264.66	11683.13	8305.58	6155.73	1860.69	546.54
1999	61523.61	47904.60	23307.41	10117.48	6179.83	4335.24	3012.74	1015.75
2000	25853.47	24954.88	16134.45	7864.49	3367.89	2348.23	1630.54	1079.33
2001	47493.25	9221.30	6569.40	3153.05	2092.63	901.96	669.44	516.31
2002	94119.85	37594.91	8455.51	4701.37	2309.20	851.04	428.61	609.95
2003	50706.67	80942.48	29005.95	4576.51	2501.11	1733.70	662.35	455.25
2004	16950.90	26804.57	36563.90	14791.93	2272.46	852.76	580.85	441.53
2005	24136.76	15425.93	21694.60	22916.27	3960.28	669.26	471.81	269.63
2006	74402.08	15160.41	6732.64	10763.41	11452.17	2612.47	426.09	319.68
2007	20165.60	51228.33	10050.25	3618.79	5959.58	5431.38	1284.12	404.37
2008	7644.93	11540.95	38973.93	3841.56	1494.45	2893.97	2202.80	638.17
2009	3430.08	4487.05	6252.93	23270.91	1603.29	749.39	1000.57	794.00
2010	2719.82	2124.24	2826.53	4231.79	12480.66	743.35	422.20	503.63
2011	622.66	2029.60	815.95	1202.58	1657.41	7067.41	282.87	393.11
2012	522.53	403.47	1180.84	399.61	735.87	808.90	4382.95	392.13
2013	63739.63	369.78	369.10	570.92	297.54	489.04	523.26	2759.82
2014	43780.75	48233.92	306.38	254.83	386.66	217.42	365.89	1714.02
2015	23981.75	42384.55	27563.72	213.48	201.01	257.41	135.22	1067.92
2016	16502.61	18241.16	20022.05	13248.98	161.53	96.70	170.58	586.00
2017	108467.69	11178.51	10472.43	12703.75	7863.44	157.42	81.79	418.91
2018	25988.48	54268.57	4499.70	4477.63	6013.28	4082.59	75.96	330.57
2019	32028.69	14915.63	35713.73	1832.97	2056.56	3627.89	1703.54	227.57

Year	1	2	3	4	5	6	7	8+
2020	16241.85	16406.67	9417.01	14299.13	1151.96	1120.57	1256.97	941.02
2021	57693.35	8295.60	10307.76	4426.33	7722.93	849.69	399.66	1314.09
2022	274022.11	30173.01	5136.43	4508.90	2506.09	5621.38	401.31	819.76
2023	10393.93	243499.78	20838.72	2982.17	2958.95	2114.66	3329.40	986.63

Table 6.4.4. Haddock in Division 6.b. Estimates of fishing mortality-at-age from final SAM assessment.

Year	1	2	3	4	5	6	7	8+
1991	0.1805	0.5230	0.8824	0.9788	0.9721	1.0370	1.0370	1.0370
1992	0.1361	0.3960	0.6987	0.8259	0.8812	0.9096	0.9096	0.9096
1993	0.1065	0.3084	0.5587	0.7216	0.8929	1.0506	1.0506	1.0506
1994	0.1171	0.3371	0.6058	0.8246	1.0993	1.4786	1.4786	1.4786
1995	0.1002	0.2908	0.4967	0.6460	0.8532	1.1909	1.1909	1.1909
1996	0.1621	0.4209	0.5852	0.6400	0.7590	0.9828	0.9828	0.9828
1997	0.1460	0.3416	0.4412	0.4559	0.5194	0.6233	0.6233	0.6233
1998	0.2238	0.4963	0.6224	0.6078	0.6635	0.7908	0.7908	0.7908
1999	0.3486	0.7326	0.9180	0.8756	0.9154	1.0504	1.0504	1.0504
2000	0.4201	0.8739	1.1435	1.0995	1.1550	1.2891	1.2891	1.2891
2001	0.1768	0.3585	0.4940	0.5211	0.5968	0.6809	0.6809	0.6809
2002	0.1703	0.3857	0.5873	0.6146	0.5851	0.5850	0.5850	0.5850
2003	0.1487	0.3835	0.6576	0.7704	0.7420	0.7290	0.7290	0.7290
2004	0.0856	0.2571	0.5074	0.6995	0.6545	0.6182	0.6182	0.6182
2005	0.0644	0.2055	0.3756	0.4343	0.3327	0.3008	0.3008	0.3008
2006	0.0473	0.1471	0.2765	0.3253	0.2580	0.2484	0.2484	0.2484
2007	0.0850	0.2728	0.5097	0.6440	0.5353	0.5561	0.5561	0.5561
2008	0.0729	0.2377	0.4128	0.5295	0.4342	0.4565	0.4565	0.4565
2009	0.0641	0.2173	0.3692	0.4881	0.3903	0.4262	0.4262	0.4262
2010	0.0706	0.2807	0.5091	0.6423	0.4568	0.4940	0.4940	0.4940
2011	0.0295	0.1268	0.2472	0.3079	0.2126	0.2436	0.2436	0.2436
2012	0.0168	0.0766	0.1518	0.1765	0.1108	0.1250	0.1250	0.1250
2013	0.0231	0.1171	0.2392	0.2667	0.1584	0.1676	0.1676	0.1676
2014	0.0205	0.1169	0.2537	0.2785	0.1609	0.1630	0.1630	0.1630
2015	0.0142	0.0872	0.1904	0.2029	0.1102	0.1053	0.1053	0.1053
2016	0.0117	0.0756	0.1609	0.1620	0.0823	0.0715	0.0715	0.0715
2017	0.0169	0.1230	0.2720	0.2795	0.1431	0.1172	0.1172	0.1172
2018	0.0148	0.1158	0.2586	0.2647	0.1326	0.1004	0.1004	0.1004
2019	0.0136	0.1102	0.2433	0.2461	0.1254	0.0914	0.0914	0.0914

Year	1	2	3	4	5	6	7	8+
2020	0.0196	0.1698	0.3873	0.4137	0.2217	0.1673	0.1673	0.1673
2021	0.0185	0.1667	0.3841	0.4146	0.2281	0.1758	0.1758	0.1758
2022	0.0105	0.0976	0.2325	0.2606	0.1481	0.1175	0.1175	0.1175
2023	0.0061	0.0589	0.1504	0.1801	0.1081	0.0887	0.0887	0.0887

Table 6.4.5. Haddock in Division 6.b. Summary of the stock assessment. Weights in tonnes. Recruitment in 1000s. Catch is model estimates.

Year	Recruitment (age 1)			SSB			Fbar (2-5)			Estimated catch		
	Low	Value	High	Low	Value	High	Low	Value	High	Low	Value	High
1991	85777	144212	242457	26753	36269	49169	0.643	0.839	1.094	14067	18040	23134
1992	91126	153176	257477	30098	40562	54662	0.532	0.7	0.923	13277	16734	21092
1993	81138	137498	233006	31573	42699	57746	0.469	0.62	0.82	12240	15395	19362
1994	48465	82230	139521	33696	45168	60544	0.552	0.717	0.931	14140	17799	22405
1995	27855	47811	82065	30495	40689	54291	0.433	0.572	0.755	11402	14424	18246
1996	52690	86604	142348	27616	35649	46018	0.451	0.601	0.801	12698	15651	19291
1997	51272	84308	138630	23037	29955	38952	0.318	0.44	0.607	8862	10757	13058
1998	51598	83680	135710	26545	33561	42431	0.455	0.598	0.785	12710	15468	18825
1999	45286	61524	83583	23451	28708	35143	0.679	0.86	1.09	13066	15861	19252
2000	16342	25853	40901	14358	17724	21881	0.832	1.068	1.371	9556	11589	14053
2001	34884	47493	64660	7032	8772	10943	0.367	0.493	0.661	3059	3697	4468
2002	66548	94120	133114	12754	16333	20916	0.417	0.543	0.708	5261	6586	8246
2003	36264	50707	70901	21038	27973	37194	0.488	0.638	0.835	8279	10532	13397
2004	9938	16951	28912	16155	21677	29088	0.376	0.53	0.746	5775	7293	9208
2005	16477	24137	35357	14086	19127	25973	0.24	0.337	0.473	3940	5020	6396
2006	50827	74402	108913	12888	17078	22630	0.18	0.252	0.352	2692	3304	4056
2007	13204	20166	30798	15766	20415	26437	0.362	0.49	0.665	4748	5806	7100
2008	4773	7645	12245	15279	20634	27867	0.291	0.404	0.56	5048	6401	8117
2009	2060	3430	5711	11519	15807	21691	0.261	0.366	0.514	3794	4971	6512
2010	1472	2720	5026	8540	12322	17778	0.323	0.472	0.691	3237	4220	5501
2011	297	623	1304	5763	8357	12119	0.121	0.224	0.414	773	1409	2569
2012	243	523	1124	4796	7053	10371	0.064	0.129	0.261	414	814	1601
2013	44229	63740	91857	5956	8238	11394	0.107	0.195	0.358	562	988	1738
2014	31201	43781	61433	12485	18277	26757	0.111	0.203	0.369	1024	1954	3729
2015	16504	23982	34848	19730	27742	39007	0.078	0.148	0.28	1769	3546	7105
2016	11315	16503	24070	20148	27368	37176	0.06	0.12	0.242	1777	3552	7098
2017	75647	108468	155529	23875	31698	42086	0.103	0.204	0.407	2632	4969	9379

Year	Recruitment (age 1)			SSB			Fbar (2-5)			Estimated catch		
	Low	Value	High	Low	Value	High	Low	Value	High	Low	Value	High
2018	18271	25988	36967	24363	33855	47045	0.091	0.193	0.411	1959	3834	7504
2019	22481	32029	45632	26734	36234	49109	0.087	0.181	0.376	2743	5772	12142
2020	10897	16242	24208	20274	27442	37143	0.152	0.298	0.586	3443	6940	13990
2021	41453	57693	80297	18216	24080	31832	0.159	0.298	0.558	2586	4632	8297
2022	176743	274022	424844	27239	36332	48460	0.097	0.185	0.352	2075	3636	6371
2023	6446	10394	16761	62889	91843	134125	0.06	0.124	0.26	3228	6805	14349
2024	523	47493*	274022	58349	107879	214925	NA	NA	NA	NA	NA	NA

* Median resampled (1991–2023), as estimated by stochastic projection.

Table 6.5.1. Haddock in Division 6.b. Values in the forecast and interim year.

Variable	Value	Notes
$F_{ages\ 2–5}$ (2024)	0.035	Based on a catch constraint for 2024. Average selection pattern (2021– 2023).
SSB (2025)	117972	Short-term forecast; in tonnes
$R_{age\ 1}$ (2024, 2025, 2026)	47493	Median recruitment, resampled from the years 1991–2023; in thousands
Total catch (2024)	4078	TAC for 2024; in tonnes
Projected landings (2024)	3937	Short-term forecast, assuming average 2014–2023 landing pattern; in tonnes
Projected discards (2024)	141	Short-term forecast, assuming average 2014–2023 discard pattern; in tonnes

Table 6.5.2. Haddock in Division 6.b. Forecast catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change *	% advice change^	Probability of SSB (2026) < Blim (%)
ICES advice basis										
MSY approach: $F = F_{MSY}$	31565	30215	1350	0.28	0.25	0.027	100709	-14.6	674	0
Other scenarios										
EU MAP: F_{MSY}	31565	30215	1350	0.28	0.25	0.027	100709	-14.6	674	0
EU MAP $F_{MSY\ lower}$	22041	21183	858	0.184	0.166	0.0180	111338	-5.6	440	0
EU MAP $F_{MSY\ upper}$	42625	40916	1709	0.41	0.37	0.040	88877	-25	945	0
F = 0	0	0	0	0	0	0	135134	14.5	-100	0
F_{pa}	43399	41662	1737	0.42	0.38	0.041	88080	-25	964	0
F_{lim}	79588	75944	3644	1.1	0.99	0.107	48969	-58	1852	0.44
$F = F_{2024}$	4607	4436	171	0.035	0.031	0.0040	130432	10.5	12.9	0
$SSB_{2026} = B_{lim}$	126876	117999	8877	7.1	6.4	0.69	8542	-93	3011	50
$SSB_{2026} = B_{pa}$	121639	114019	7620	4.7	4.3	0.46	11870	-90	2882	34
SSB_{2026} = MSY $B_{trigger}$	120065	112627	7438	4.3	3.9	0.42	12877	-89	2844	30
$SSB_{2026} = SSB_{2025}$	16257	15633	624	0.131	0.118	0.0130	117972	0	299	0

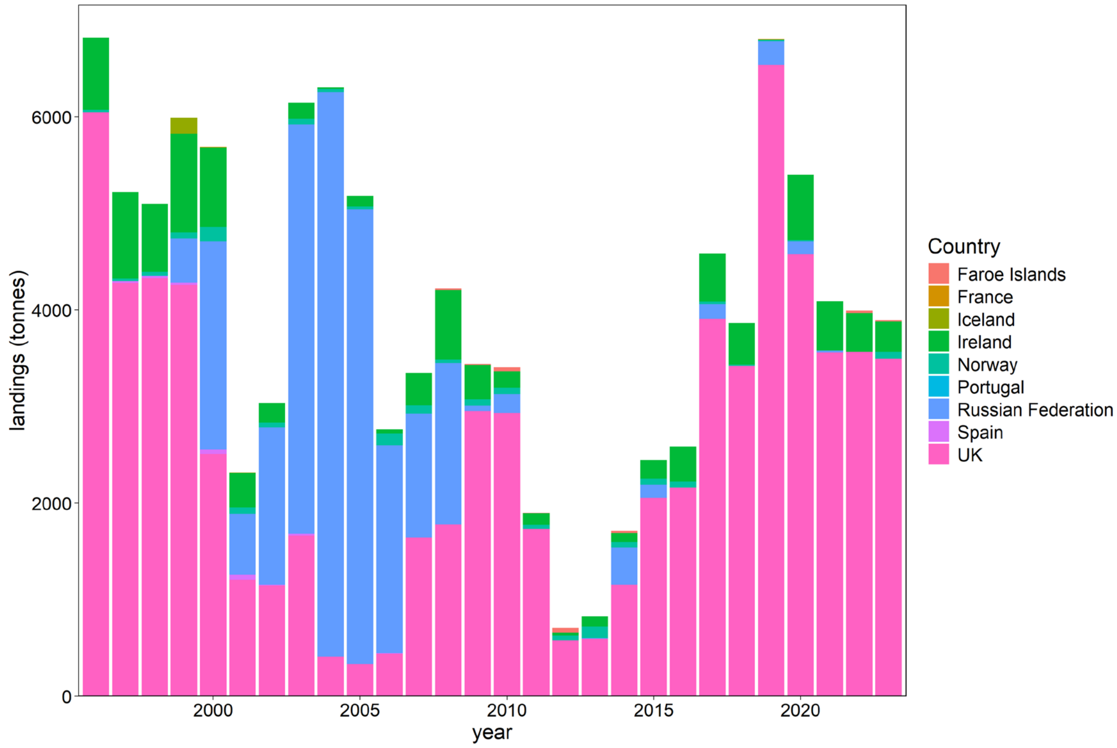


Figure 6.3.1. Haddock in Division 6.b. Official landings by country.

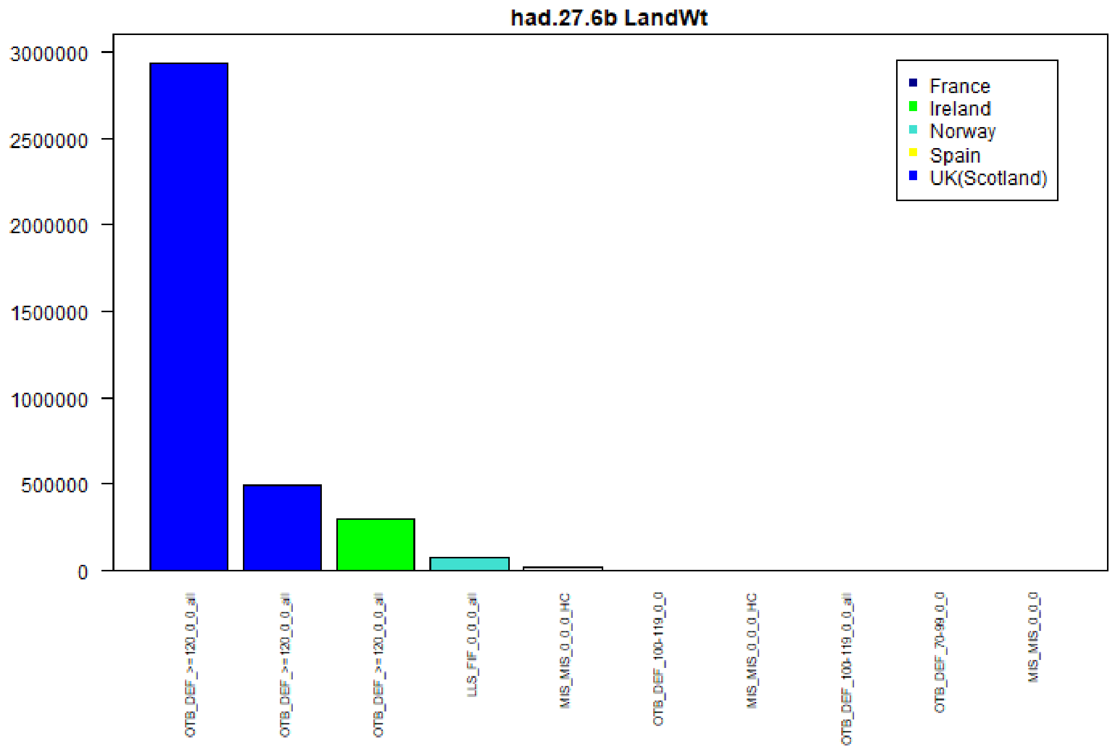


Figure 6.3.2. Haddock in Division 6.b. ICES estimated landings as submitted to Intercatch for 2023. There are two Scottish OTB_DEF>=120 due to landings being submitted by subdivision.

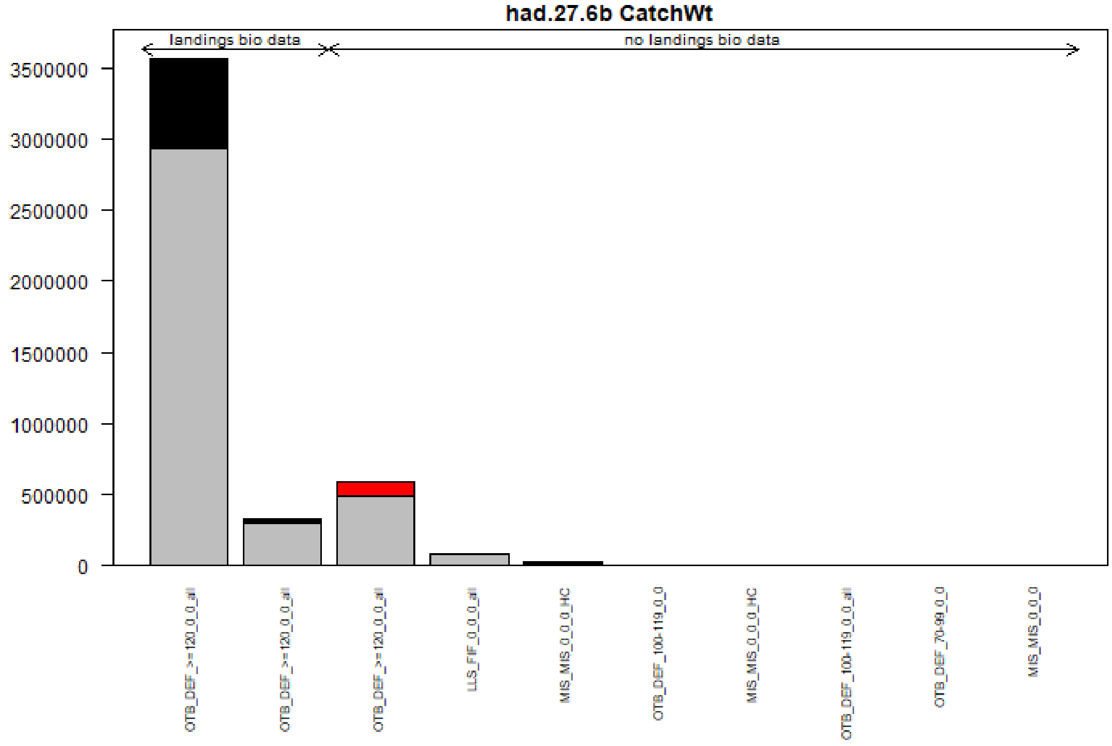


Figure 6.3.3. Haddock in Division 6.b. ICES estimated landings and discards (for 2023) after raising in InterCatch (grey=imported landings; black=imported discards; red=raised discards).

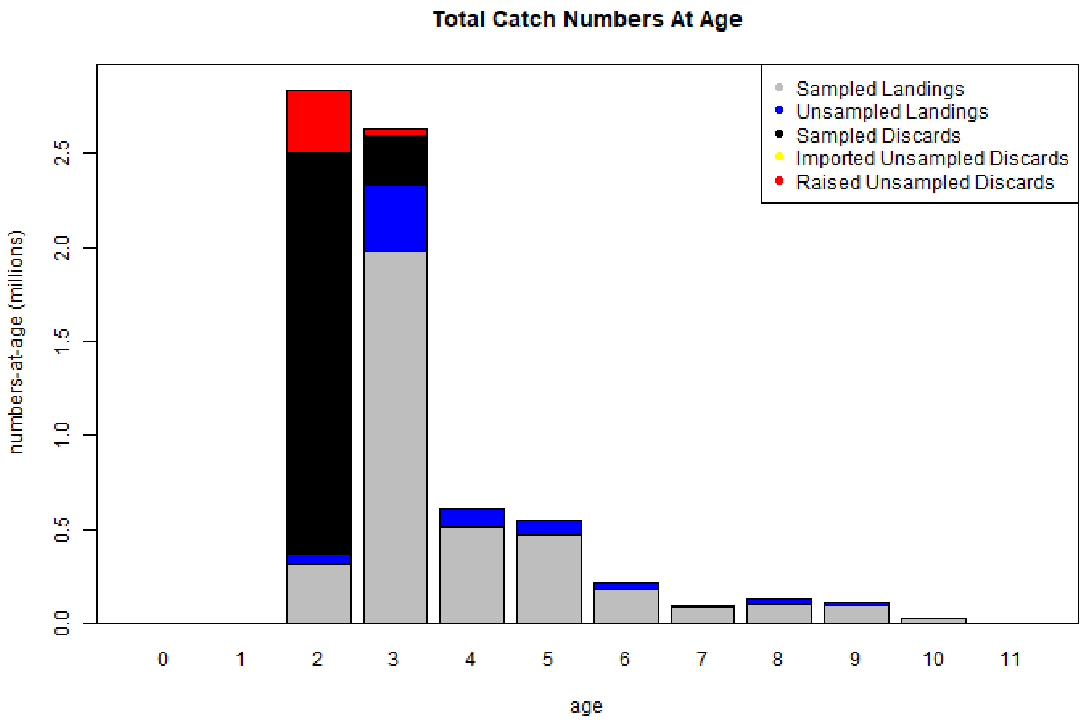


Figure 6.3.4. Haddock in Division 6.b. Catch numbers-at-age by sampled and unsampled landings and sampled and raised (unsampled) discards for 2023, after allocations within InterCatch.

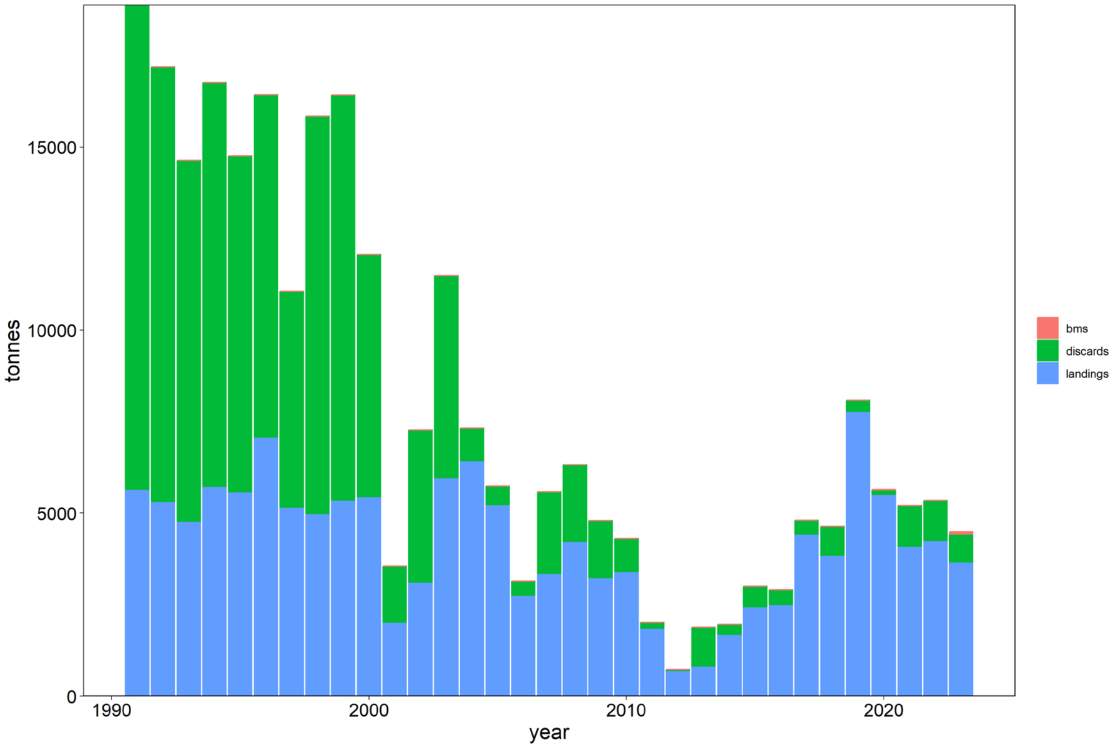


Figure 6.3.5. Haddock in Division 6.b. ICES estimates of total landings and discards.

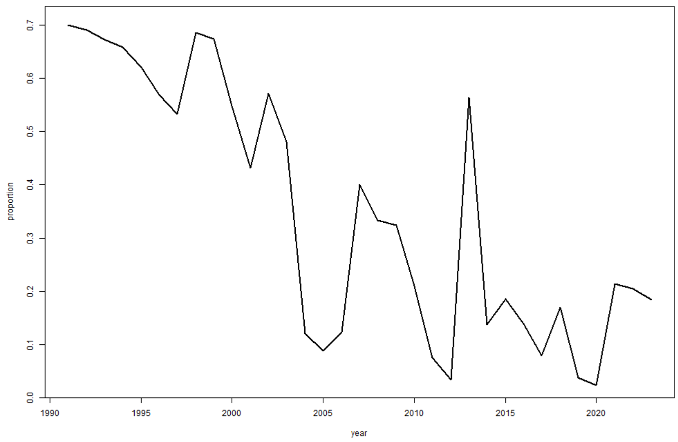


Figure 6.3.6. Haddock in Division 6.b. Discard proportion by weight.

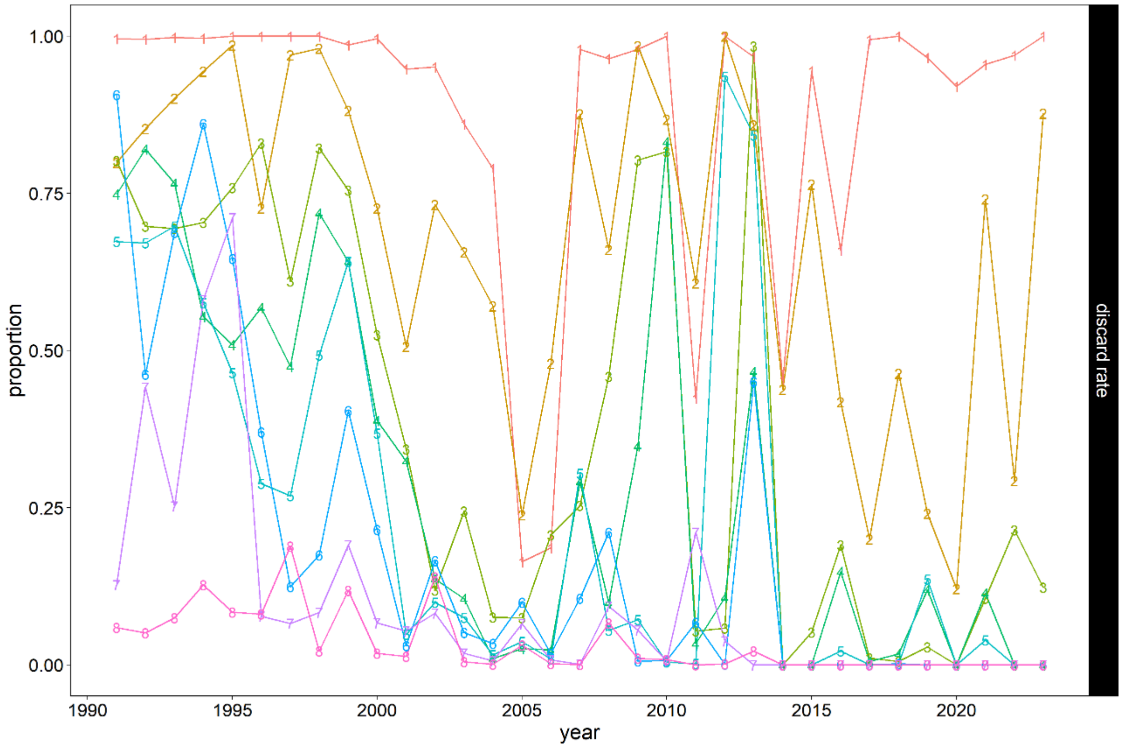


Figure 6.3.7. Haddock in Division 6.b. Discard proportion by age.

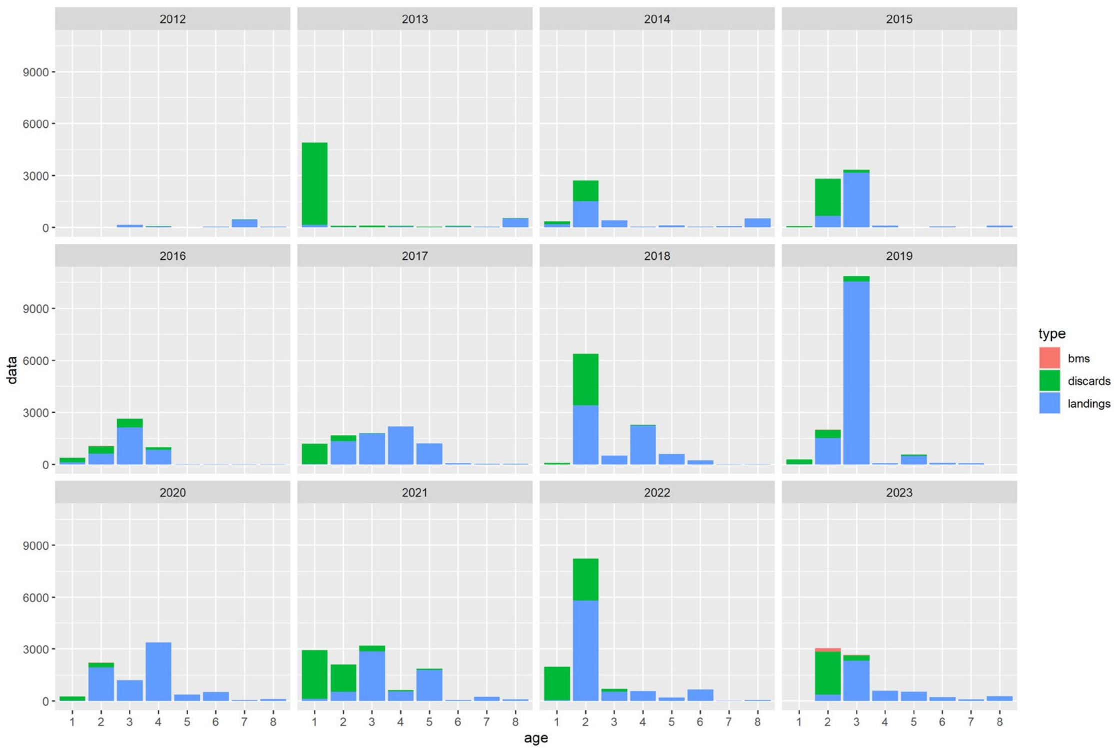


Figure 6.3.8. Haddock in Division 6.b. Catch-at-age in numbers by year. Red: bms, green: discards, blue: landings.

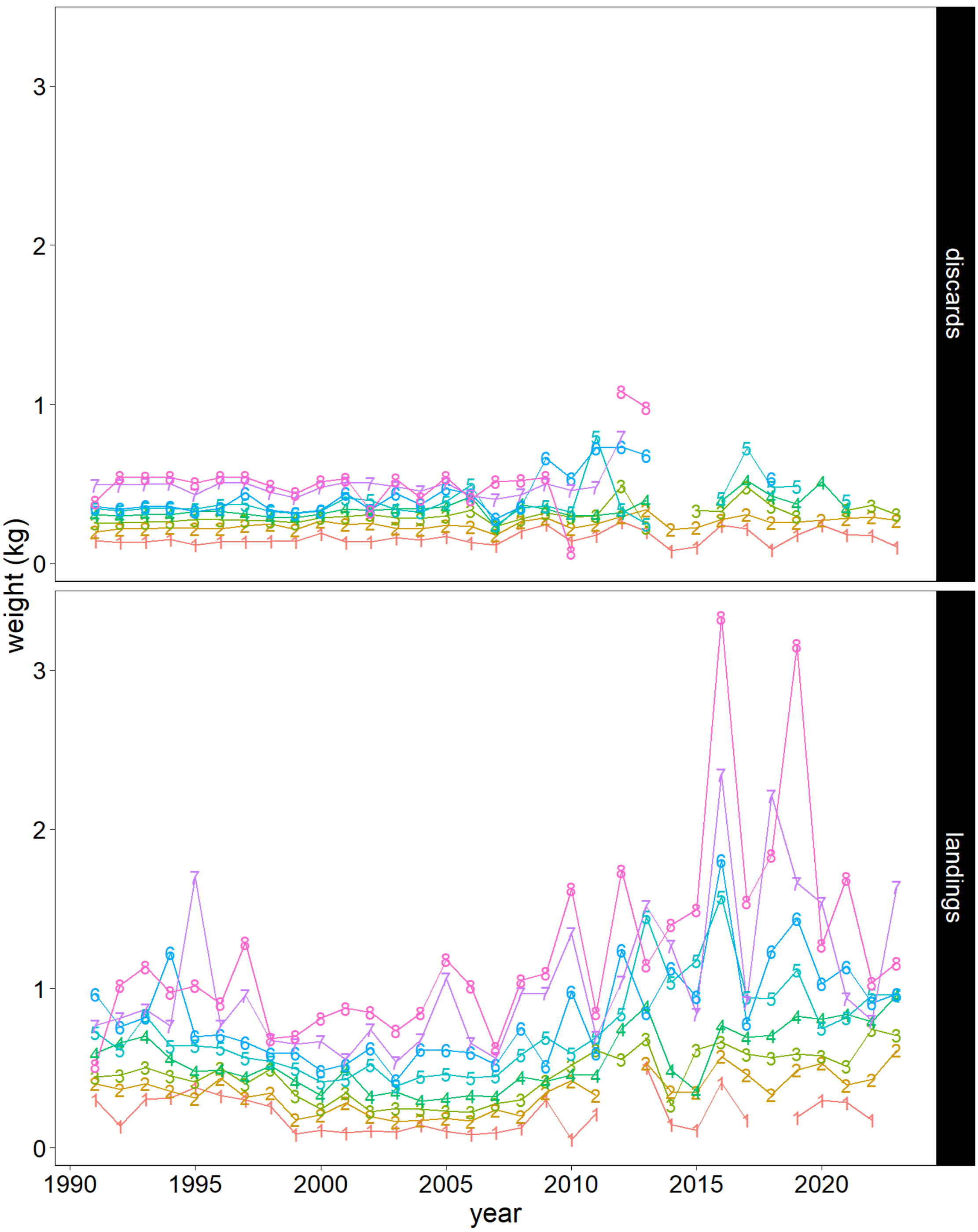


Figure 6.3.9. Haddock in Division 6.b. Mean weight-at-age in discards and landings.

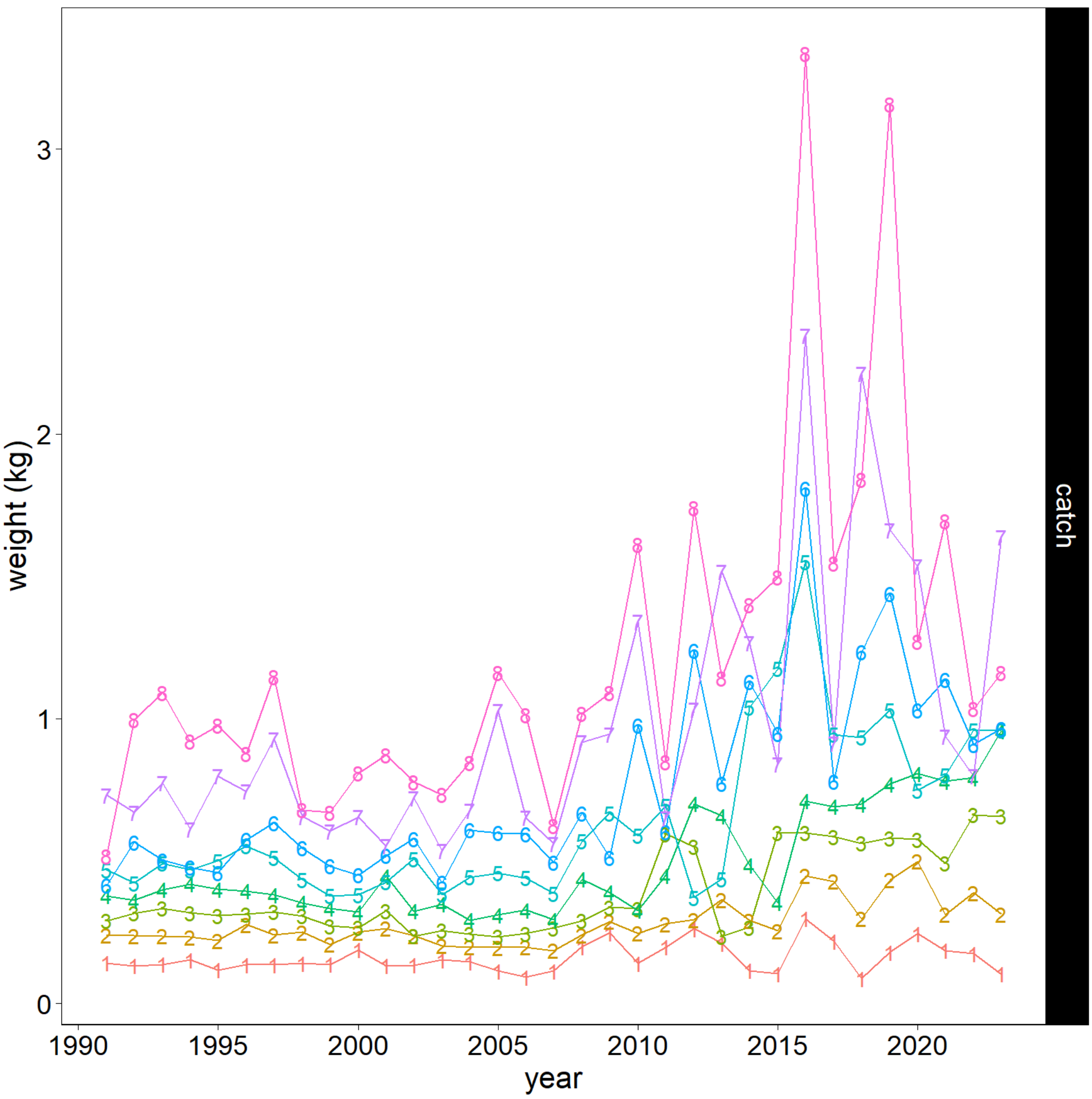


Figure 6.3.10. Haddock in Division 6.b. Mean weight-at-age in catch.

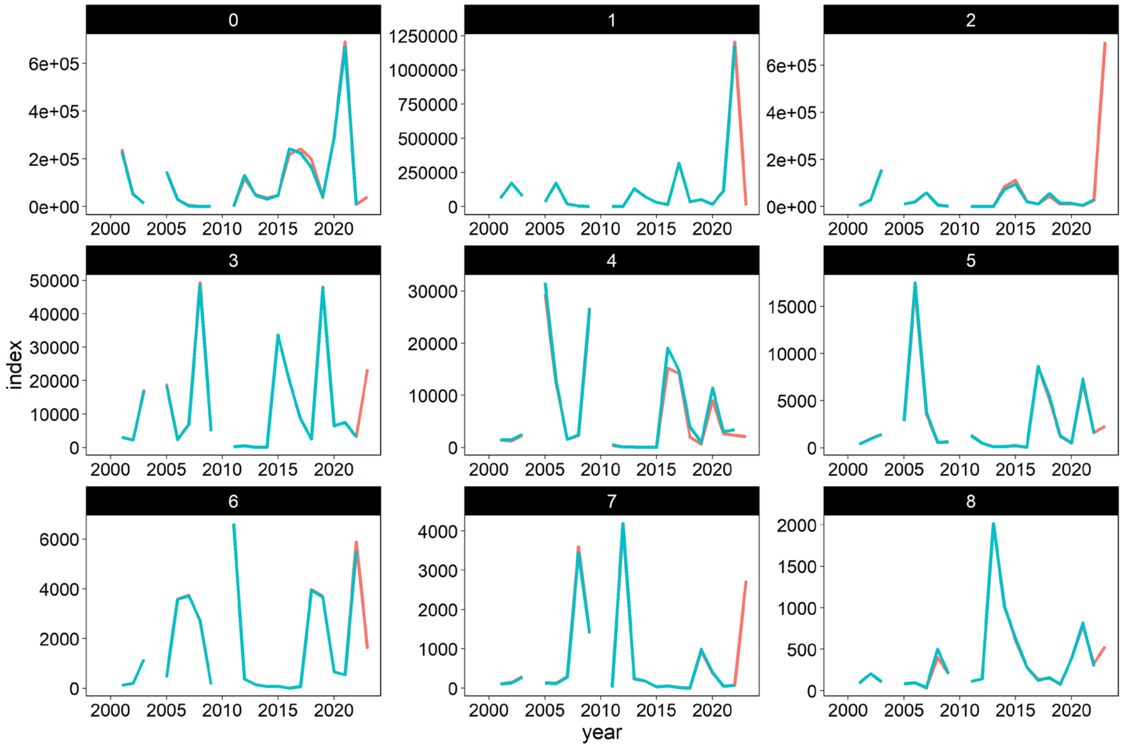
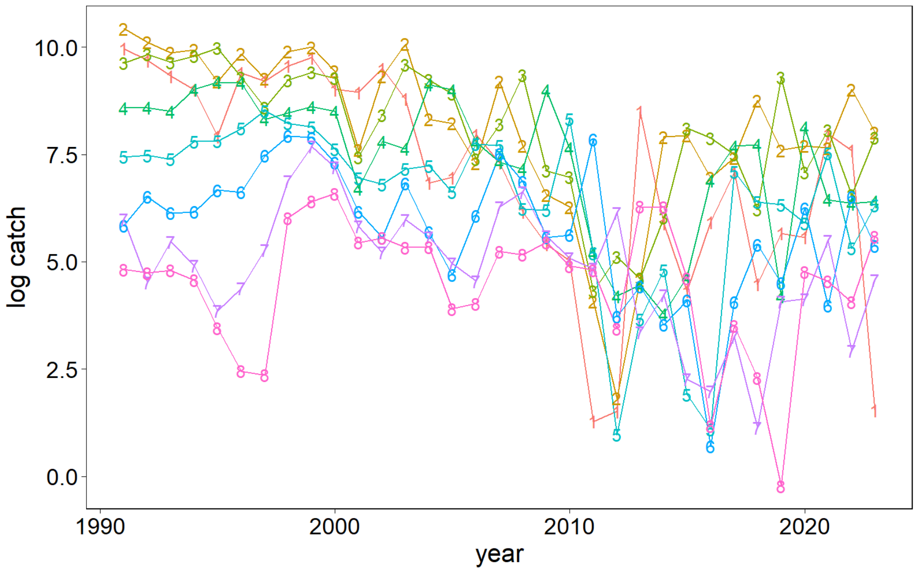


Figure 6.3.11. Haddock in Division 6.b. Comparision of modelled Q3 survey indices between WGCSE 2024 (including data to 2023) and WKBGAD (data <to 2022).



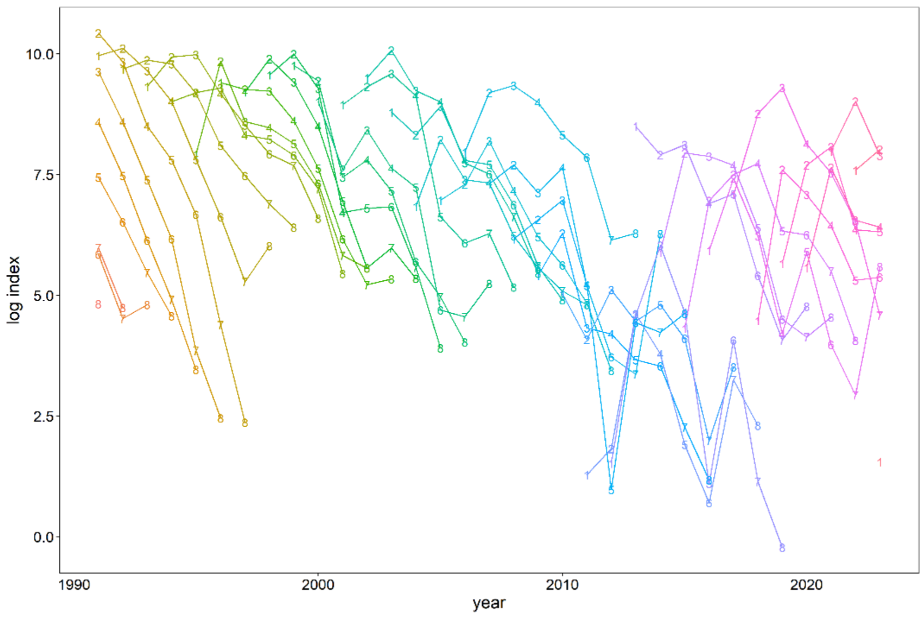


Figure 6.4.1. Haddock in Division 6.b. Log catch numbers-at-age (upper) and catch curves (lower) from commercial catch at age data.

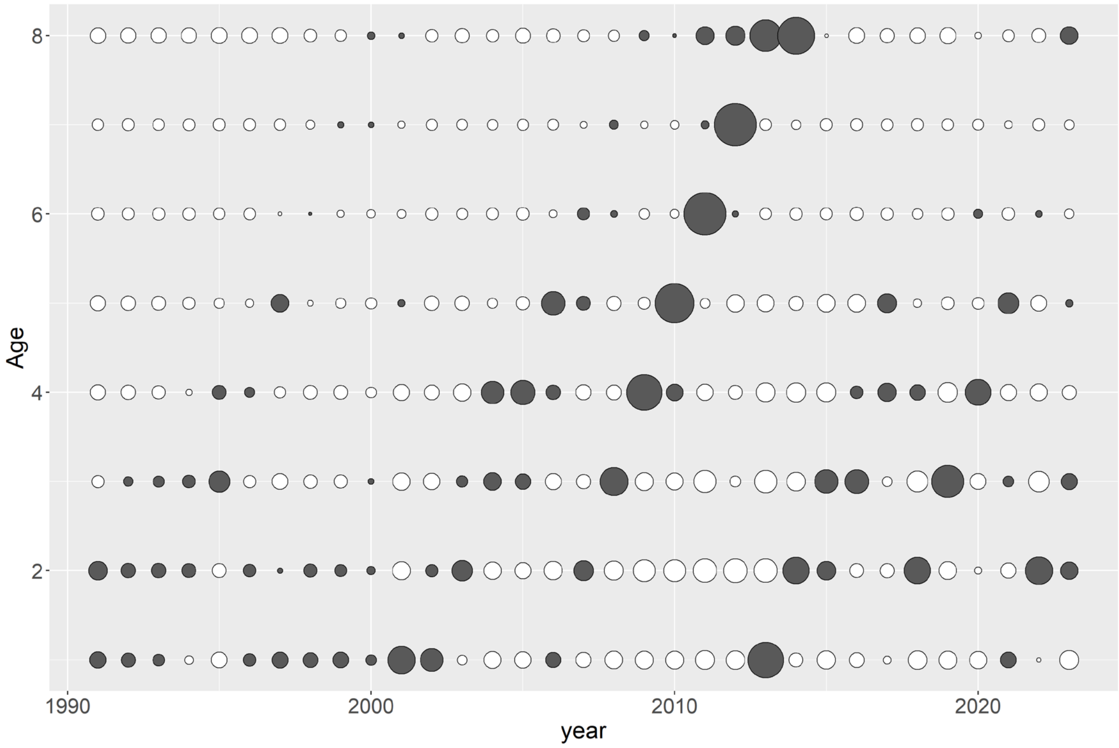
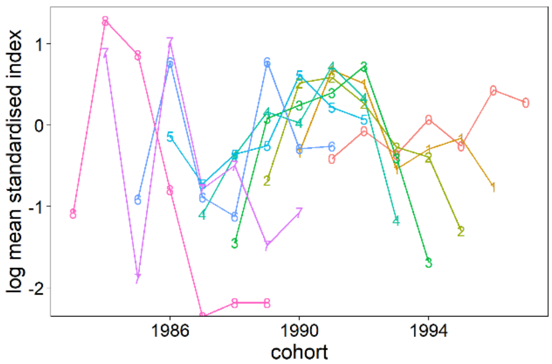


Figure 6.4.2. Haddock in Division 6.b. Mean standardised catch-at-age proportions by number (dark shaded values are above average).



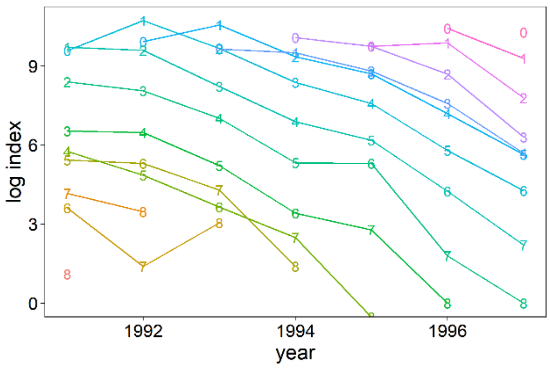


Figure 6.4.3, Haddock in Division 6.b. Rockall pt 1 survey: log mean standardised indices at age by cohort (left) and catch curves (right).

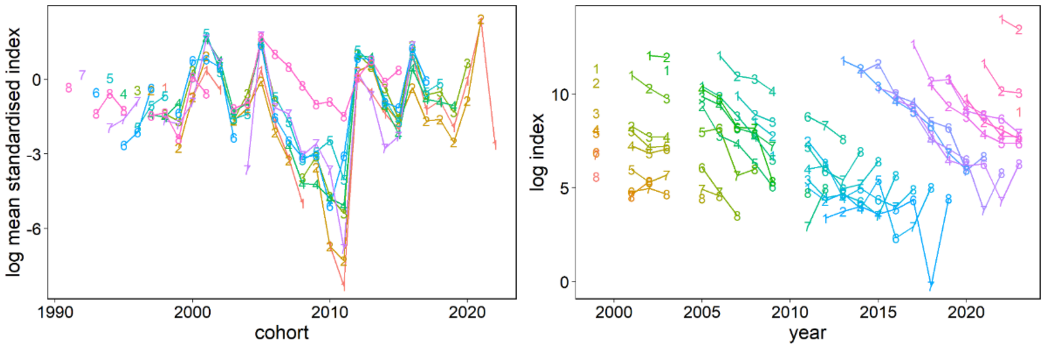


Figure 6.4.4. Haddock in Division 6.b Modelled Q3 survey index: log mean standardised indices by cohort (left) and catch curves (righ).

Figure 6.4.5. Haddock in Division 6.b. Modelled Q3 survey index: scatterplots.

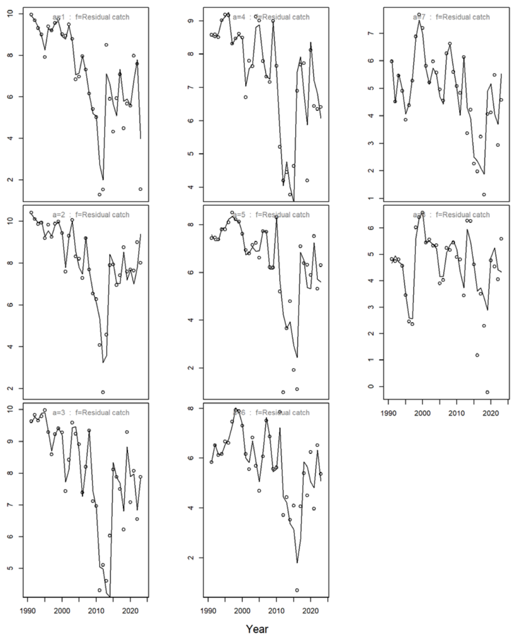


Figure 6.4.6. Haddock in Division 6.b. Comparison of model estimated catch numbers-at-age (log-scale) and input data.

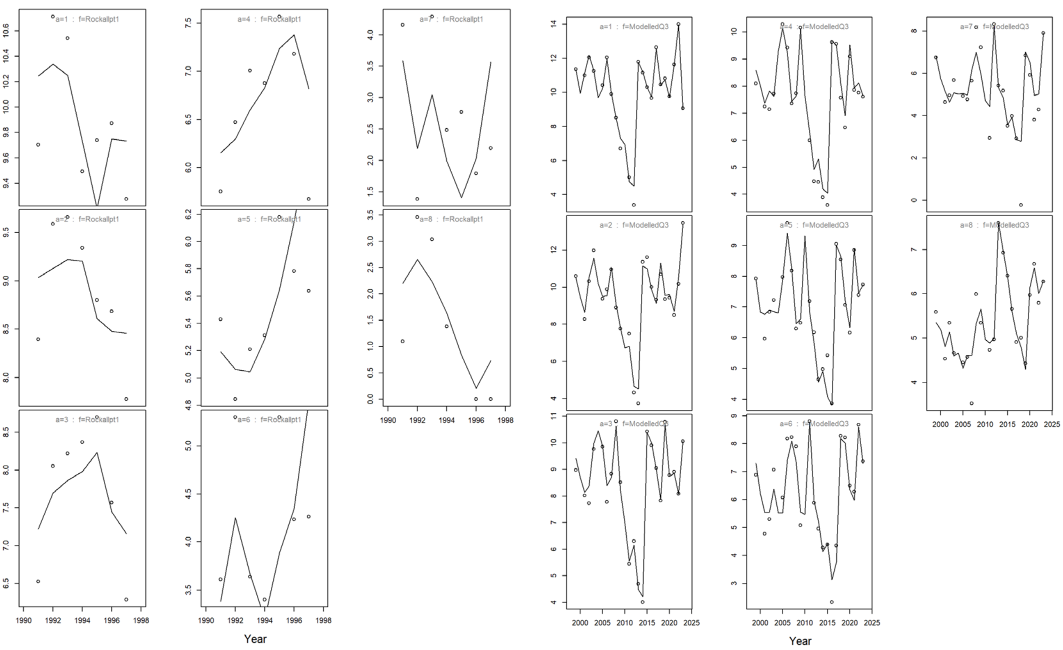


Figure 6.4.7. Haddock in Division 6.b. Comparison of model estimated survey numbers-at-age (log scale) and input data: Rockall pt 1 (left panel of 8 plots) & Modelled Q3 (right panel of 8 plots).

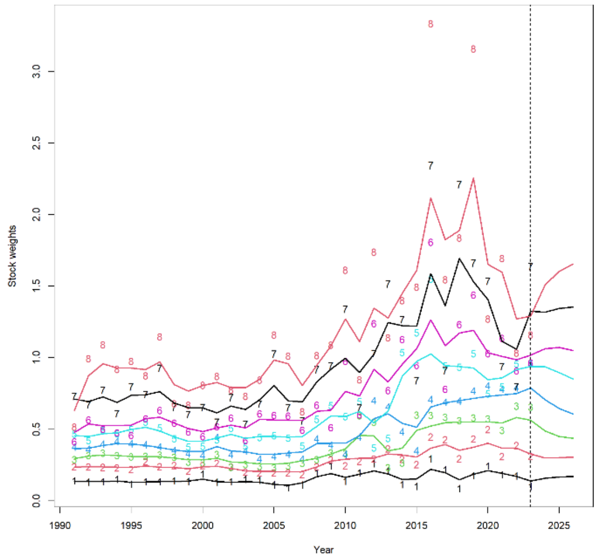


Figure 6.4.8. Haddock in Division 6.b. Comparison of model estimated stock weights-at-age and input data.

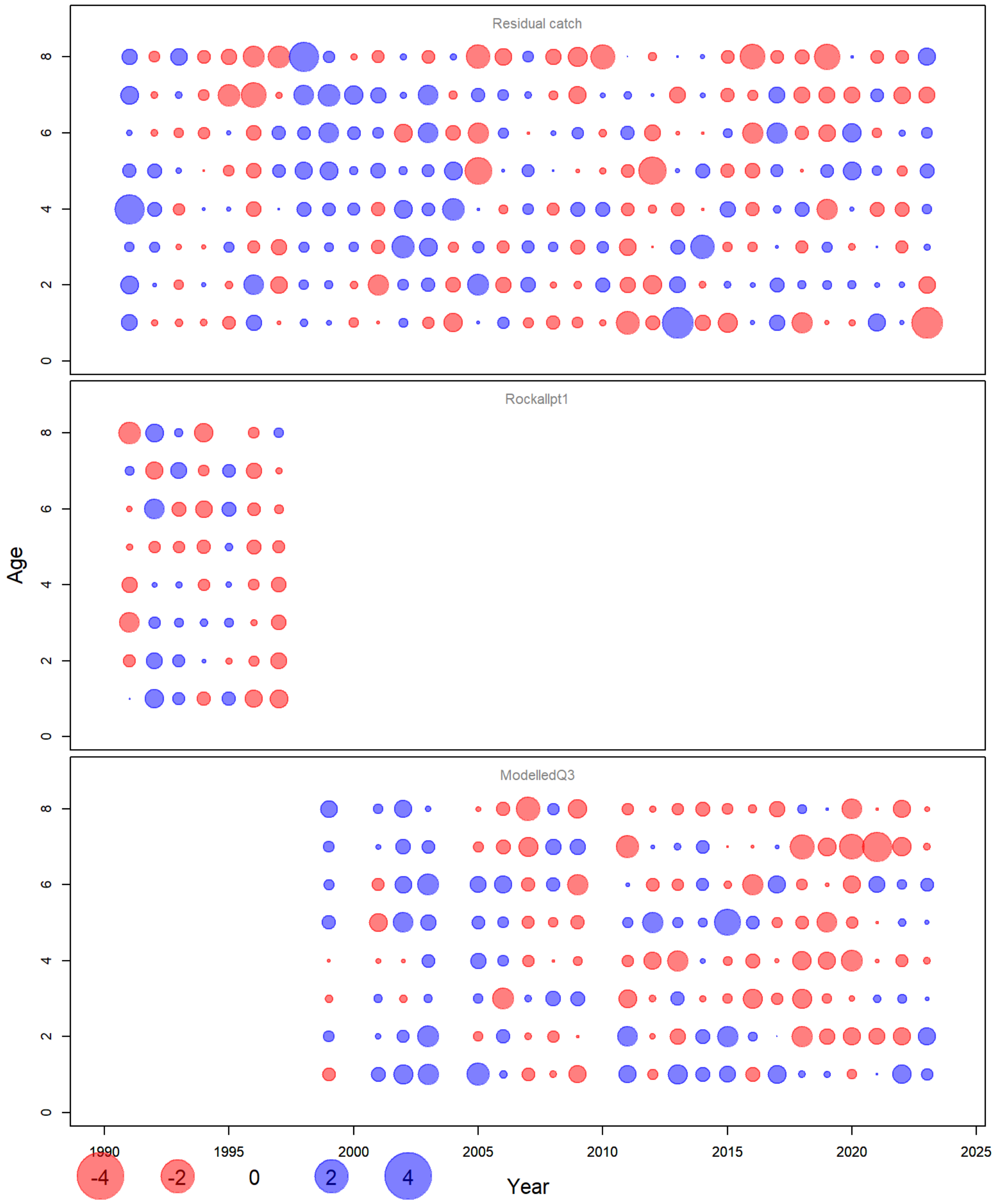


Figure 6.4.9. Haddock in Division 6.b. One-step ahead residuals from final SAM assessment.

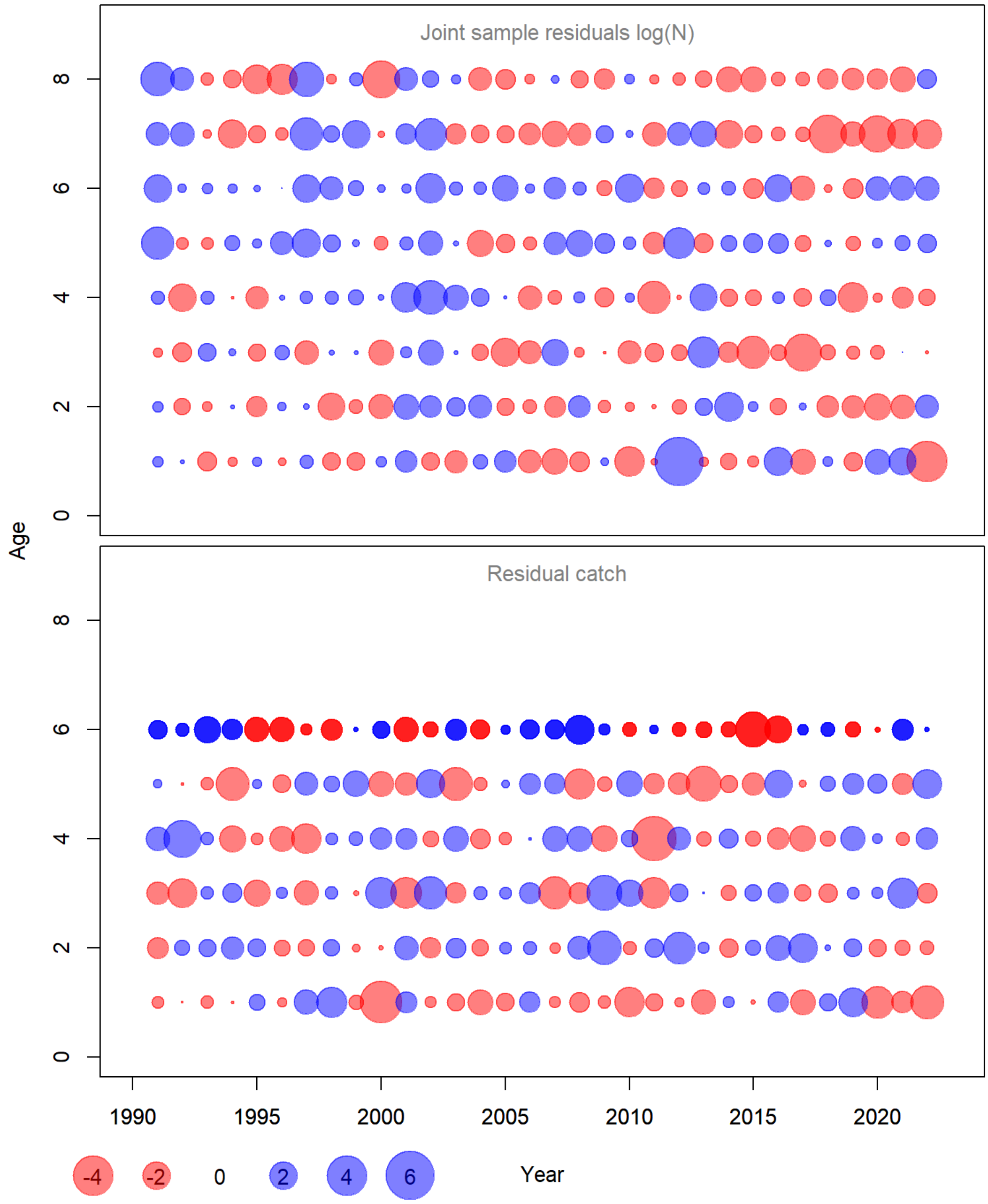


Figure 6.4.10. Haddock in Division 6.b. Process residuals from final SAM assessment.

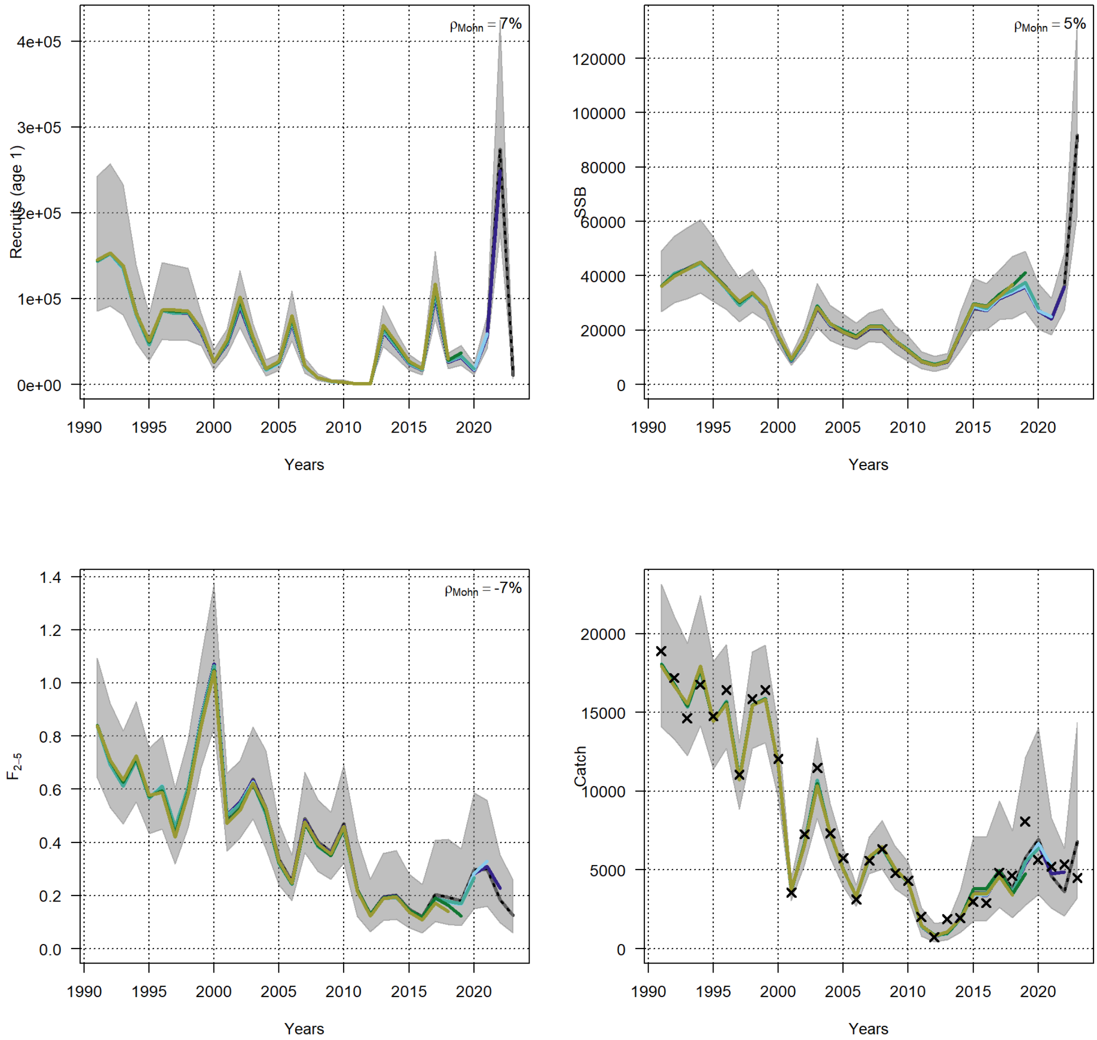


Figure 6.4.11. Haddock in Division 6.b. Final assessment retrospective plots.

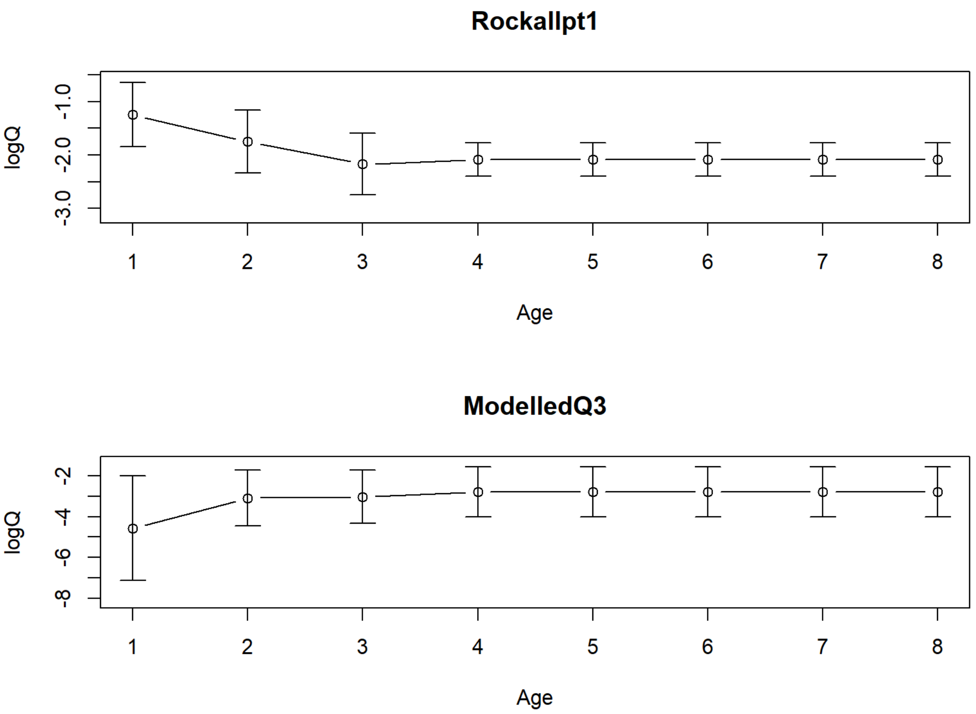


Figure 6.4.12. Haddock in Division 6.b. Final assessment estimates of survey catchabilities.

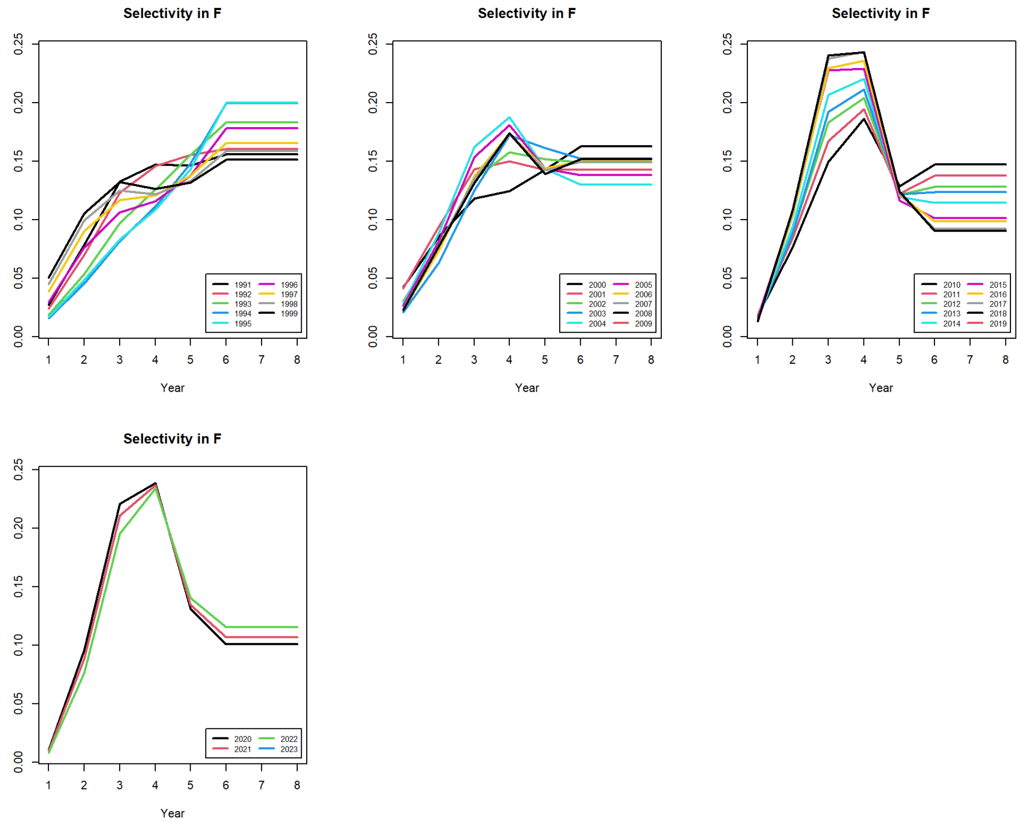


Figure 6.4.13. Haddock in Division 6.b Final assessment estimates of fishery selectivity.

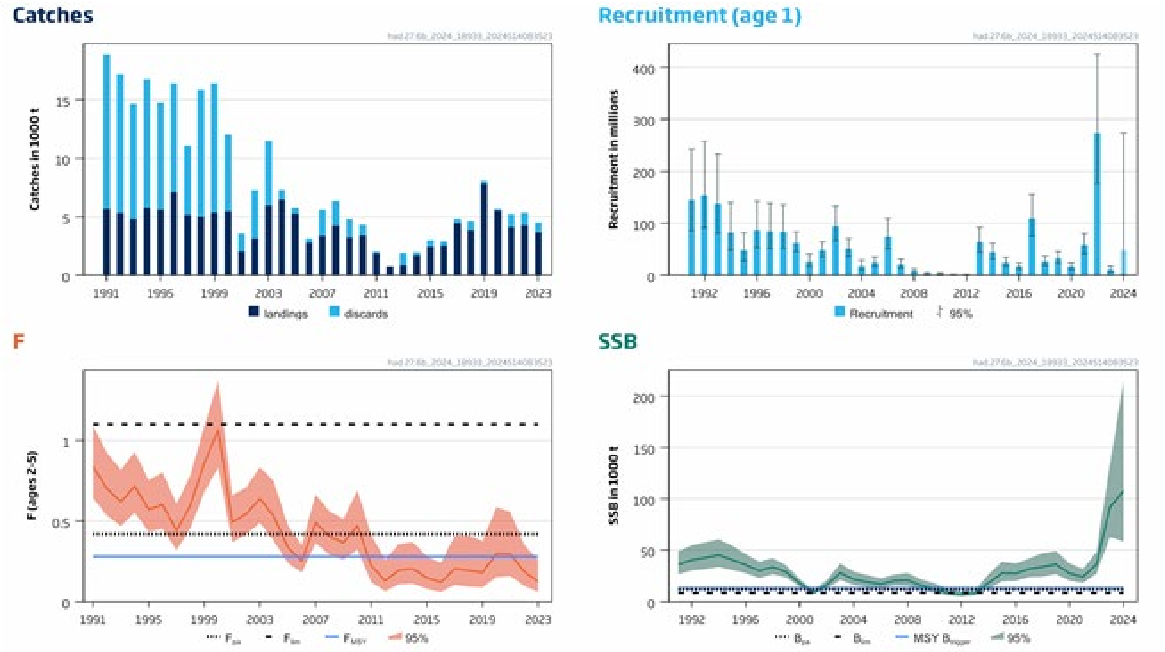


Figure 6.4.14. Haddock in Division 6.b. Summary of the stock assessment. The assumed recruitment value for 2024 is shaded in a lighter colour.

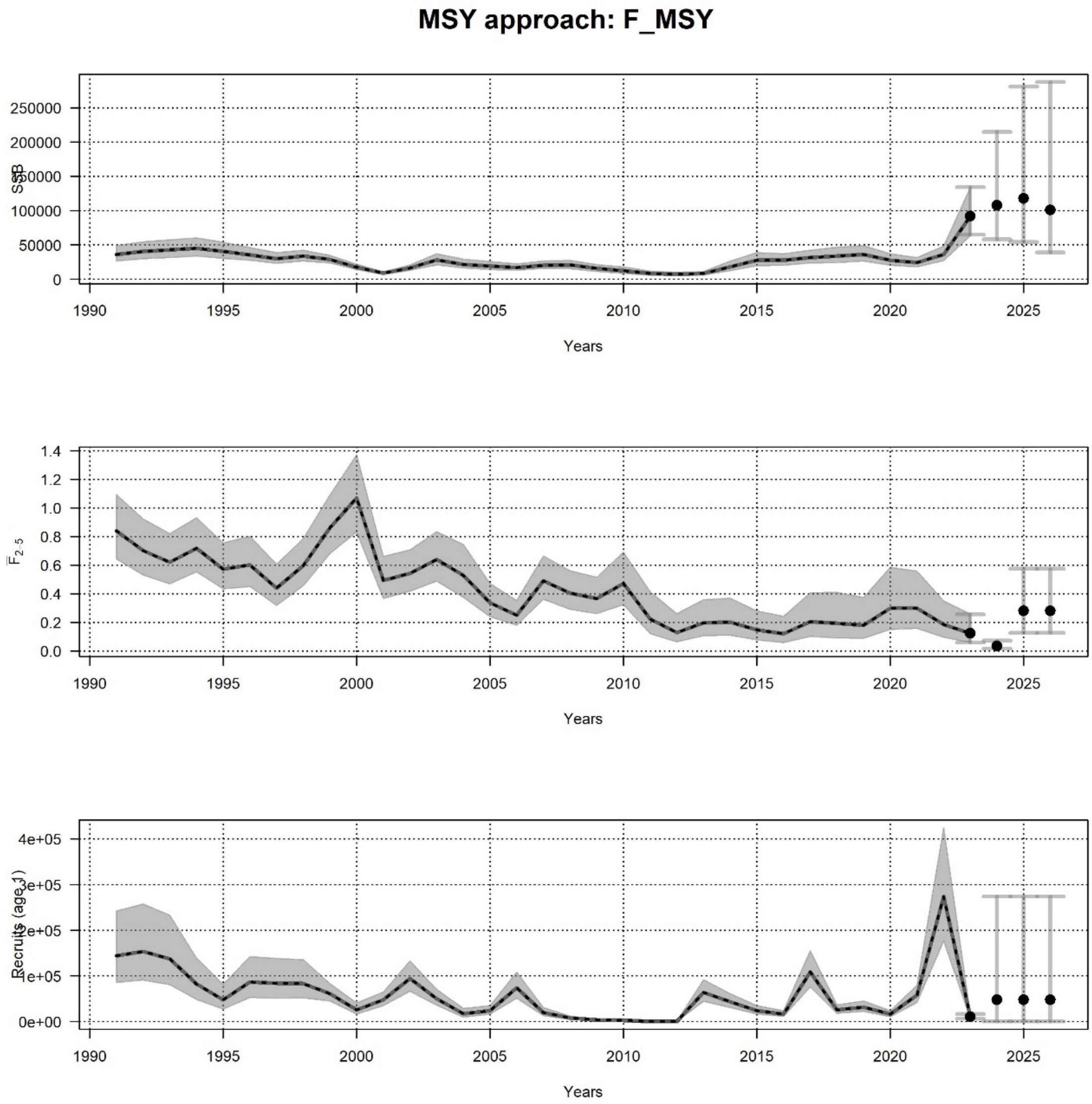


Figure 6.5.1. Haddock in Division 6.b. Forecast at F=F_{MSY} assuming intermediate year TAC constraint and recruitment resampled from the full time series.

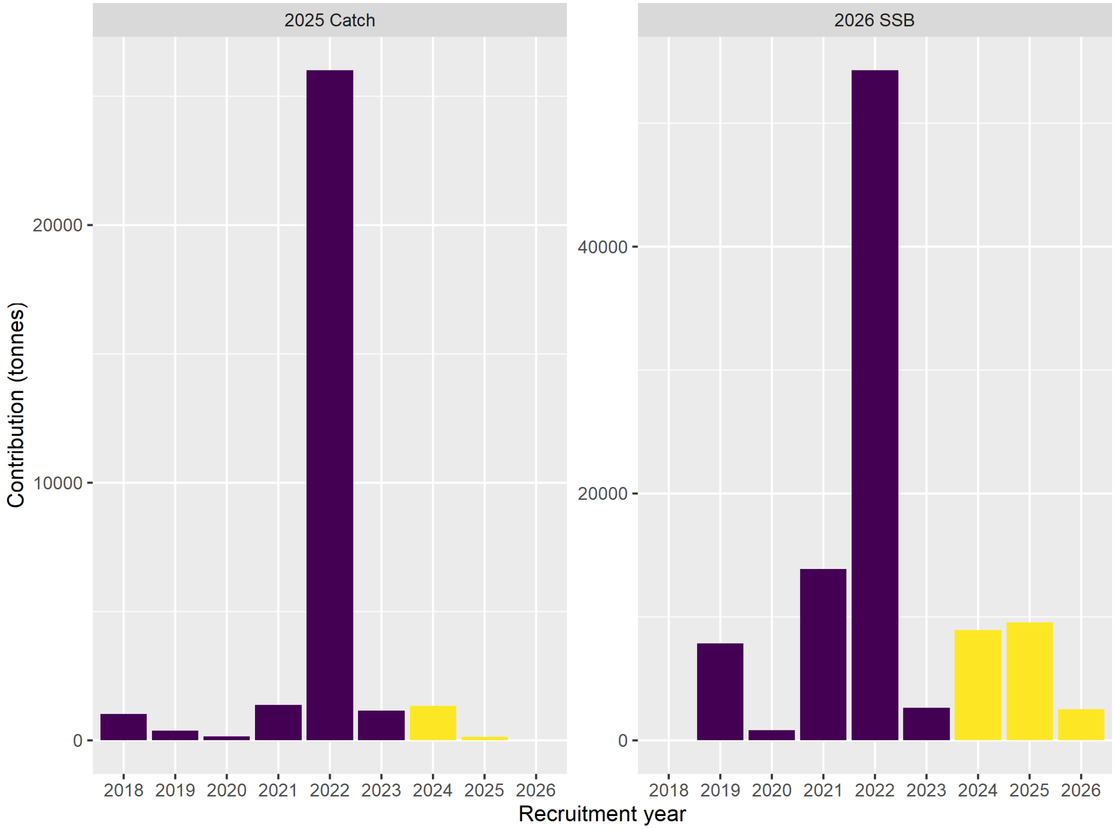


Figure 6.5.2. Haddock in Division 6.b. Contribution to forecast of total catch (2025) and SSB (2026) by recruitment year. Yellow indicates assumed value, blue is an assessment model estimate.

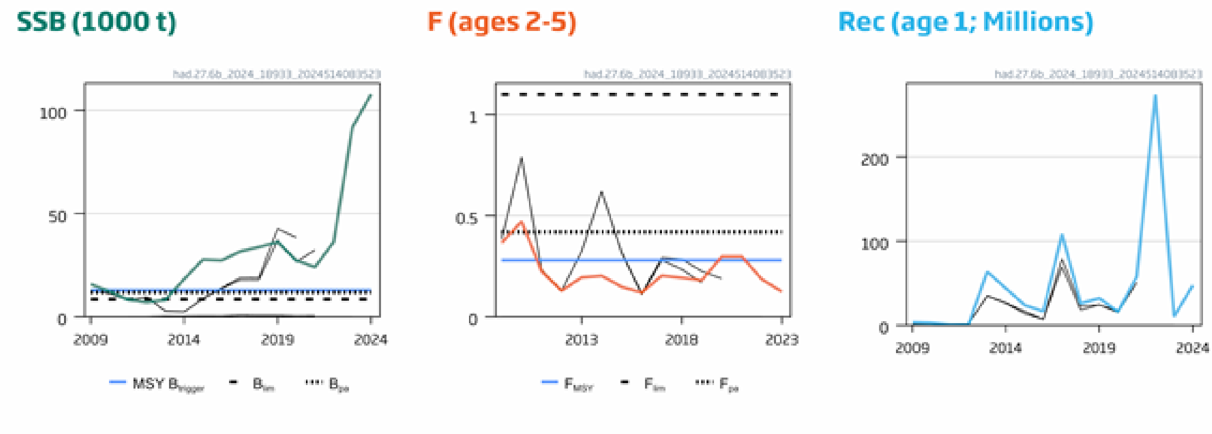


Figure 6.7.1. Haddock in Division 6.b. Historical assessment results (final-year recruitment assumption and SSB estimate included). This stock was benchmarked in 2024 at which point the reference points were revised, and therefore only the last assessment results should be compared to the reference points indicated. Assessments conducted in 2022 and 2023 do not provide estimates of SSB, F and recruitment and therefore are not included.

Contents

7 Haddock (*Melanogrammus aeglefinus*) in Division7.a (Irish Sea)

Type of assessment

Age-structured assessment model using Age Structured Assessment Program (ASAP).

ICES advice applicable to 2023

ICES advises that when the MSY approach is applied, catches in 2023 should be no more than 2648 tonnes.

ICES advice applicable to 2024

ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 2263 tonnes.

ICES advice applicable to 2025

ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 1893 tonnes.

7.1 General

Stock descriptions and management units

The stock and management units are both ICES Division 7.a (Irish Sea). Landings reported by Irish vessels in the southern most rectangles of 7.a have been reassigned to the 7.b–k stock since 2003 because they are believed to be part of the Celtic Sea stock.

Management applicable to 2024 and 2025

Management measures include TAC and effort restrictions as well as technical measures. Due to the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod recovery plan. From 1st January 2019 all fleets catching haddock are subject to the landing obligation. The minimum landing size for haddock in the Irish Sea is 30 cm.

Landings obligation

According to the delegate regulation (EC, 2015) vessels where more than 25% of their landings using trawls and seines in the reference years (2013 & 2014) and area were specified gadoids (cod, haddock, whiting and saithe) are covered by the Landings Obligation. In UK waters All quota species must now be landed, however, these will no longer be taken into account when enforcing catch composition rules (DEFRA, 2023).

7.2 Fishery in 2023

The characteristics of the fishery are described in the stock annex (see Annex 2).

The fishery in 2023 was prosecuted by a similar fleet and gears as in recent years, with directed fishing restricted during the cod closure under special conditions. The targeted whitefish fishery that developed during the 1990 using semi-pelagic trawls was in decline but since 2014 there has been a slight increase in activity due to abundance of the haddock stock and increased fishing opportunity. However, in 2023 this declined further with an increase in fuel cost and low price of haddock making it more profitable for vessels to fish nephrop and herring rather than white-fish. A proportion of the TAC is taken as bycatch in the *Nephrops* fishery in a mixed fishery.

In 2023, the uptake of TAC was 61%. The primary two nations exploiting the stock are the UK and Ireland. ICES catch estimates are adjusted for reallocation of Irish landings from southern rectangles of 7.a to 7.g, as it is believed that these fish do not belong to the 7.a stock. In 2023 this reallocation was greater than the catch from the other rectangles in 7a. Table 7.1 gives nominal landings of haddock from the Irish Sea (Division 7.a) as reported by each country to ICES since 1984.

Data

For a second year there are lower sampling levels for some fleets which commonly discard haddock. In 2023 recent discard rates were used to estimate these unsampled catches, while it was assumed that the discard rates would be lower than the recent average due to low recruitment over the past few years. In 2024 the discards were raised to the landings of similar fleets in another country. Sensitivity analyses indicated that this has minimal impact on the perception of the stock status.

A part of the survey area was not covered by the NIGFS Q4 survey; data were averaged for the missing stations by a 3 year average for those stations. Sensitivity analyses showed that the assessment was robust with respect to this.

Landings

Table 7.2 gives the long-term trend of nominal landings of haddock from the Irish Sea (Division 7.a) as reported to ICES since 1972, together with Working Group estimates. The 1993–2005 WG estimates includes sampled-based re-estimates of landings into the main Irish Sea ports. Sampled based evidence suggests that WG estimates are similar to reported landings since 2006. Following the benchmark (WKROUND 2013) the landings have been revised since 1993, and exclude landings from the southern rectangles in the Irish Sea as they not are believed to be part of this stock.

The methods for estimating quantities and composition of haddock landings from 7.a, used in previous years, are described in the stock annex (see Annex 2). The series of numbers-at-age in the international commercial catch is given in Table 7.4. Sampling levels were not considered adequate to derive catch age compositions in 2003.

Discards

Annual discard data were updated for Northern Ireland. Issues relating to the reliability and confidence in the data were addressed at the benchmark assessment for this stock (WKROUND 2013; WKIrish3 2017). For a second year no discard data were available for the republic of

Ireland. The catches and numbers were raised based on the NI fleets and landings from the Irish fleet.

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the stock annex. The recent estimates of discarding for *Nephrops* fleets observed by previous WG are still evident. A historic time-series of discard numbers-at-age was constructed at the benchmark. Discard rates are very variable between fleets.

Biological data

The derivation of biological parameters and variables is described in the stock annex (see Annex 2). Natural mortality-at-age was calculated using the methods proposed by Lorenzen (1996) at WKIrish2 (2016). The proportions mature-at-age was also recalculated at the benchmark, and based on the mean proportion observed during the NIGFS-WIBTS-Q1 survey with a smoother fitted that is updated annually (Table 7.3).

Surveys

The survey data considered in the assessment for this stock are given in Table 11.5. All survey series data for haddock available to the Working Group are described in the stock annex (see Annex 2). The following age-structured abundance indices were used in the assessment:

- UK (NI) groundfish survey (NIGFS) in March (age classes 1 to 4, years 1992–2023). Acronym NIGFS-WIBTS-Q1.
- UK (NI) groundfish survey (NIGFS) in October (age classes 0 to 3; years 1991 to 2023). Acronym NIGFS-WIBTS-Q4.
- UK (NI) Methot–Isaacs–Kidd (NI-MIK) net survey in June (age 0; years 1994–2023, excluding 2020 and 2022).
- UK Fishery Science Partnership (UKFspW) western Irish Sea roundfish survey (age classes 2 to 5, years 2004–2023, the survey was not conducted in 2014).

In 2022 the UK (NI) Methot-Isaac Kid (NI MIK) net survey was not carried used in the assessment. Experts from the survey deemed that due to survey timing it was unlikely that the survey provided a reliable indication of recruitment.

In 2023 the Q4 NIGFS had reduced coverage, excluding areas in the Republic of Ireland waters. Different options were investigated to deal with the loss of the stations, which is detailed further down.

The relative log standardised indices for cohorts are plotted against time in Figure 7.2. Whilst ages 2 to 4 appear to show strong signal in the UKFspW the ability to detect the year class in age 5 haddock is less clear. The strong 2013 year class could be tracked in all indices, indicating that the different surveys are capturing the prominent year-class signals in this stock (Figure 7.2). Correlation between survey indices by age is positive for all surveys and show high consistency within each survey (Figure 7.3). The indices from the UKFspW survey in the western Irish Sea also show similar year-class signals to the other survey-series, but are noisy with strong year effects (Figure 7.2).

7.3 Assessment

The assessment presented is the single fleet ASAP model.

The following model settings were applied in 2024.

ASAP was used for the assessment and model settings:

Option	Setting
Use likelihood constant	Yes
Mean F (F_{bar}) age range	2–4
Fleet selectivity block 1	Asymptotic (1993-2000)
Fleet selectivity block 2	Age coefficients (age 0–5) (0.2;0.5;0.8;1;0.7;0.5) (2001-2007)
Fleet selectivity block 3	Age coefficients (age 0–5) (0.3;0.6;0.7;0.7;0.4;0.2) (2008-2012)
Fleet selectivity block 4	Age coefficients (age 0–5) (0.1;0.6;0.8;0.9;1.0;1.0) (since 2013)
Discards	Included in catch (not specified separately from landings)
Index units	4 (numbers)
Index month	NIGFS-Q1 (3); NIGFS-Q4 (10); NIMIK (7); UKFSPW(3)
Index selectivity linked to fleet	-1 (not linked)
Index age range	NIGFS-Q1 (1–4); NIGFS-Q4 (0–3); NIMIK (0); UKFSPW(2–5)
Index Selectivity (NIGFS-Q1)	Double logistic
Index Selectivity (NIGFS-Q4)	Asymptotic
Index Selectivity (NIMIK)	
Index Selectivity (UK-FSPW)	Asymptotic
Index CV & ESS (NIGFS-Q1)	Observed strata CV (lower limit 0.1); ESS = 50
Index CV & ESS (NIGFS-Q4)	Observed strata CV (lower limit 0.1); ESS = 50, in 2023 ESS=30
Index CV & ESS (NIMIK)	Observed station CV (lower limit 0.1); ESS = 50; not used for 2020 & 2022
Index CV & ESS (UK-FSPW)	CV = 0.7; ESS = 10
Phase for F-Mult in 1st year	1
Phase for F-Mult deviations	2
Phase for recruitment deviations	3
Phase for N in 1st Year	1
Phase for catchability in 1st Year	3
Phase for catchability deviations	-5 (Assume constant catchability in indices)

Option	Setting
Phase for unexploited stock size	1
Phase for steepness	-5 (Do not fit stock–recruitment curve)
Catch total CV	1993–2000 (0.175); 2003–2006 (0.2); 2007– 2019 (0.15); 2020 (0.175); 2021 -2022 (0.15), 2023 (0.175)
Catch effective sample size	1993–2000 (50); 2003–2006 (1); 2007–2019 (50); 2020 (1); 2021 - 2022 (50), 2023 (45)
Lambda for recruit deviations	0 (freely estimated)
Lambda for total catch	1
Lambda for total discards	NA (discards included in catch)
Lambda for F-Mult in 1st year	0 (freely estimated)
Lambda for F-Mult deviations	0 (freely estimated)
Lambda for index	1 for both indices in the model
Lambda for index catchability	0 for all indices (freely estimated)
Lambda for catchability devs	NA (phase is negative)
Lambda N in 1st year deviations	0 (freely estimated)
Lambda devs initial steepness	0 (freely estimated)
Lambda devs unexpl stock size	0 (freely estimated)

Final update assessment

The final assessment was run with the same settings as established by WKIrish 2017 and described in the stock annex, with the addition of a new selectivity pattern 2013–2023, as applied in 2018 and with a lower starting value for selection of age 0 haddock in the final selectivity block. Additionally there was an increase in the CV on catch due to the reduced sampling of at-sea catch for some fleets in 2022 and 2023. Hence the changes as described in the stock annex were followed. Discards were combined with the landings as catch in the model.

Figure 11.5 shows the predicted and observed catch. The catch information from 2007 to present is regarded as the most confident, during 2003–2006 it is regarded that catch and sampling information is of relatively lower quality due to lack of sampling opportunity. Before 2003, the catch series is regarded as of intermediate confidence. The model has close fit to the current observed catch 2011–present. Before this time, there is consistent over estimation of the catch 2000–2011 following a period of consistent underestimation of catch 1993–2001. Figure 7.6 shows the residuals of the catch proportions-at-age. For all ages there appears to good fit with no consistent pattern, however, there are some large deviations from observed and predicted for age 5 fish since 2015. Figure 7.7 shows that the catch is dominated by fish <4 years, therefore the large residuals for fish of age 5 are likely to result from low sampling and small contribution of 5+ fish to the stock. The fishing pressure (F)-at-age is shown in Table 7.6.

The residuals of the indices are shown in Figure 7.8. A good fit to the NI-MIK index is seen across the series, although some single year events are observed with a strong deviation in the last two years of the index. For the UKFSPW survey a poor fit in years 2017 and 2018 is evident. This suggests an inability of the model to track the large survey index values, this should be investigated further to explore the method of index calculation. There is strong tracking of both NIGFS-WIBTS-Q1 and NIGFS-WIBTS-Q4 index patterns in general, however, a general trend to under estimate the NIGFS-WIBTS-Q1 index by the model early 2000s to 2013, followed by a period of over estimation (during years of high abundance, and with the decline in SSB the model is once again underestimating Q1 survey index.

Figure 7.9 shows the residuals of the survey proportions-at-age. For all indices there is close fit between the observed and model predicted fit for fish up to four years old. The largest deviations occur in five year old fish in the UKFSPW survey, which over-reported five year old fish prior to 2014.

Figure 7.10 shows the retrospective analysis. The predicted catch shows no obvious retrospective pattern, neither does the recruitment estimate or fishing pressure. The results of the assessment are given in Table 7.8.

Comparison with previous assessments

Figure 7.11 shows the comparison of the current assessment with previous ASAP and model. There is close agreement with the stock trends of the current assessment and the previous assessment. Mohn's Rho values were calculated for five retrospective runs 2023: 2018 for F_{bar} (0.03), SSB (-0.08) and recruitment (-.55).

State of the stock

Following a period of sustained decline, since 2008, SSB increased markedly from 2012–2018. A short-term decline was observed in 2014, but was reversed, and since 2014 the SSB has increased markedly. The stock is characterized by highly variable recruitment. The model indicates above average recruitment for the 2009–2012 year class after below average recruitment for the 2007 and 2008 year classes. Recruitment in 2013 is amongst the highest observed in the time-series and has been followed by strong recruitment in 2014 and 2015. Since 2018 SSB has declined from the highest observed level and continued the decline in 2023.

With low recruitment in 2020-2023, the SSB is further projected to decline in 2024, 2025 and 2026.

7.4 Short-term projections

Short-term projections were performed using FLR libraries. Recruitment for 2024–2025 was estimated at (GM 1993–2021; 355689 in thousands). The F used in the forecast for 2024 was derived as Fsq= Faverage (2021-2023) = 0.104.

Catches were split into landings and discards using the proportions of the catch that were discarded over the full the last three years. Input data for the short-term forecast are given in Table 7.7. The management options output is given in Table 7.9.

Estimates of the relative contribution of recent year classes to the 2025 landings and 2026 SSB are shown in Figure 7.12. The contribution to landings in 2025 consists mainly of the 2020 cohort (73%), with the SSB in 2026 largely be dependent on the 2021 cohort, comprising 64% of the SSB and assumed recruitment in 2024 contributing 20%. This is an issue as the SSB will largely consist of the plus group and a GM year.

7.5 Biological references points

MSY evaluations

In response to an EU special request to provide plausible and updated F_{MSY} ranges for Irish Sea haddock the management reference points for the stock were re-estimated (Table 11.10 ICES, 2018). The B_{lim} was set as the lowest SBB at which above recruitment in the upper quartile has been observed (2994 t). The S–R plot for Irish Sea haddock shows no obvious S–R relationship mainly because the recruitment is highly variable. B_{lim} was estimated as 4160 t. MSY B_{pa} is set to 4281 t as the stock has been fished at or below F_{MSY} for more than five years. F_{MSY} median point estimates is 0.28. The upper bound of the F_{MSY} range giving at least 95% of the maximum yield was estimated to 0.35 and the lower bound at 0.20. F_{lim} is estimated to be 0.50 as F with 50% probability of SSB <B_{lim}; F_{pa} as 0.41= $F_{p.05}$ the F that leads to SSB>B_{lim} with 95% probability; F_{lim} x exp(-1.645 x σ); σ = 0.20.

Yield and biomass-per-recruit

Not available for this stock, previous explorations are detailed in the stock annex.

7.6 Management Plans

There is no specific management plan for haddock in the Irish Sea. The regulations affecting Irish Sea haddock remain linked to those implemented under the cod management plan due to potential for bycatch of cod in a fishery targeting haddock (Council Regulation (EC) 1342/2008).

7.7 Uncertainties and bias in assessment and forecast

Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment. However, within the assessment there is relocation of reported landings in rectangles 33E2 and 33E3 which are not considered part of the stock. For the first time in time series used in the assessment the reallocated catch is greater than the catch estimated for the Irish Sea catch. Historic misreporting estimates are considered in the assessment and accounted for. Current misreporting is not considered to be a factor within the fishery.

Discards

Sampling levels of discarding at sea remains high. For Northern Irish vessels targeting haddock 75.0% of trips are observed and 2.4% of the main *Nephrops* targeted fishery trips observed. However, there were very low numbers of trips targeting haddock undertaken. Some fleets which commonly discard haddock were not sampled in 2022 and 2023. In 2023 for these fleets a linear model based on recent discard rates were used to estimate these unsampled catches. Sensitivity analyses indicated that this has minimal impact on the perception of the stock status. However, this was deemed unsuitable for a second year in row, in particular as this part of the fleet, targeting *Nephrops*, largely discards young fish. With the very poor recruitment observed in recent years, application of an average multi-year linear model derived discard rate seemed inappropriate. The landings – to – discard rates of the same metier in another country was therefore applied.

Sensitivity runs of model assuming different levels of confidence in the catch data were conducted to reflect higher uncertainly in catch estimates due to missing sampling data. The results show that the model is robust to increasing the coefficient of variation with neglible change on the estimated numbers at age (Age 0 and Age 1).

Selectivity

A breakpoint in selectivity is applied in 2000, associated with management measures to reduce fishing mortality on cod. The model included three selectivity blocks in fishery-dependent data, reflecting bycatch and targeted fishery until the year 2000 (asymptotic). After 2007, a fleet selectivity pattern without targeted fishing of older fish (dome-shaped) is applied. During 2000–2007 a transition between a fully selected stock to a regime without targeted fishing of older fish is fitted. The use of current specified selectivity blocks may require review at annual at regular intervals. In the current assessment a new selectivity pattern for the fishery was added from 2013 onwards with full selection of fish older than three years. With advice and management for haddock or other species, it is possible that the character of the fishery may change. A retrospective analysis demonstrated a consistent historic downward revision of the perceived SSB trend, however, there is consistent estimation of F. The initial two years of the retrospective plot show significant deviations. This was considered due to the model having a selectivity block, beginning in 2007, with reduced selection for older fish and the introduction of the UKFspW, with an asymptotic selectivity pattern, starting in 2007. The short period to estimate the selectivity parameters for both the fishery and survey index are considered to contribute to the instability of the model during this time.

The high over estimation of older fish in the catch (Figure 7.6) suggest that there might be a change in selectivity. The last selectivity block starts in 2013, ahead of the large recruitment event and a large targeted fishery. Since 2020, with the impact of COVID-19 and subsequent rises in fuel prices, the targeted fishery has been largely decreased due to a combination of factors unrelated to the stock. This would explain the discrepancy between the caught older fish and those estimated by the model.

In 2024 the introduction of a 5th selectivity block was investigated. However, while the fit of the catch-at-age was improved, there was no real over-all improvement of the model. WGCSE decided in the light of the the change in fleet behaviour likely being short-term and the inclusion of an extra selectivity block warranting an external review and no apparent change/improvement in the assessment, to postpone the decision to a future benchmark.

Surveys

The survey indices used in the model have spatial coverage of the assessment area. The combination of a recruitment index (NI-MIK), juvenile fish survey indices (NIGFS-WIBTS-Q1 & NIGFS-WIBTS-Q4) and the UKFspW survey aimed at older fish using commercial fishing gear means that the full age range of the stock is covered by survey information.
In 2023 the Irish part of the NIGFS Q4 could not be conducted, therefore an average of the previous 3 years of the stations missed (abundance by age) was applied. Sensitivity analysis suggest that this approach was feasible to use in the circumstances.

7.8 Recommendations for next benchmark

This stock was benchmarked through the WKIrish (2017) process in 2016–2017. New estimation of the MikNet survey and re-estimation of ages from separate targeting and non-targeting fisheries should be considered. Ecosystem based indicators of productivity should be investigated to allow progress toward Ecosystem Based Fisheries Management. There has been increasing uncertainty of 'older' (age 5 fish), contributing to a 'high' retrospective pattern – with the model predicting more older fish than observed in the fishery data this may in part be due to the post 2020 - change in fleet behaviour with a decline in the directed fishery. The stock definition should be revised to reflect the understanding that the southern rectangles of the Irish Sea are considered part of the Celtic Sea haddock stock

7.9 References

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7.10 Tables and Figures

Table 7.1. Haddock in 7.b,c, e-k. Official landings (quota uptake in brackets).

Year	BEL	ESP	FRA	IRL	UK*	Others	Total	TAC**
1994	123	0	2788	908	240	17	4076	
1995	189 (28%)	19	2964 (74%)	966 (72%)	266 (44%)	64	4468	6000
1996	133 (9%)	48	4527 (49%)	1468 (47%)	439 (31%)	38	6653	14000
1997	246 (16%)	54	6581 (71%)	2789 (90%)	569 (41%)	31	10270	14000
1998	142 (6%)	260	3674 (28%)	2788 (63%)	444 (22%)	52	7360	20000
1999	51 (2%)	88	2725 (19%)	2034 (42%)	278 (13%)	71	5247	22000
2000	90 (5%)	110	3088 (28%)	3066 (83%)	289 (17%)	13	6656	16600
2001	165 (12%)	646	4842 (61%)	3608 (135%)	422 (35%)	19	9702	12000
2002	132 (128%)		4348 (70%)	2188 (106%)	315 (34%)	106	7089	9300
2003	118 (130%)		5781 (106%)	1867 (103%)	393 (48%)	82	8241	8185
2004	136 (127%)		6130 (96%)	1715 (80%)	313 (33%)	159	8453	9600
2005	167 (130%)		4174 (54%)	2037 (80%)	292 (25%)	197	6867	11520
2006	99 (77%)		3191 (42%)	1874 (73%)	274 (24%)	183	5621	11520
2007	119 (93%)		4143 (54%)	1931 (75%)	385 (33%)	50	6628	11520
2008	109 (84%)		3638 (47%)	1800 (70%)	566 (49%)	121	6234	11579
2009	131 (102%)		5430 (70%)	2983 (116%)	716 (62%)	48	9308	11579
2010	170 (132%)		6240 (81%)	2609 (101%)	852 (74%)	128	9999	11579
2011	211 (143%)		8389 (95%)	3323 (112%)	1657 (124%)	129	13709	13316
2012	232 (125%)		11793 (106%)	4129 (112%)	1901 (114%)	166	18221	16645
2013	174 (111%)		8747 (93%)	2699 (86%)	1455 (103%)	23	13098	14148
2014	99 (94%)		6375 (101%)	2092 (99%)	785 (83%)	21	9372	9479
2015	118 (127%)		5679 (102%)	1657 (89%)	769 (92%)	6	8229	8342
2016	88 (109%)		4487 (93%)	1730 (107%)	692 (95%)	27	7024	7258
2017	110 (128%)		4885 (95%)	1677 (97%)	690 (89%)	12	7374	7751
2018	89 (116%)		4470 (97%)	1444 (94%)	583 (84%)	9	6595	6910
2019	90 (97%)		4526 (82%)	1559 (84%)	516 (62%)	170	6861	8329
2020	107 (88%)		3808 (53%)	2628 (109%)	543 (50%)	222	7308	10859
2021	155 (105%)		4249 (48%)	3379 (114%)	515 (21%)	149	8447	15000
2022	190 (130%)		3904 (45%)	3110 (107%)	587 (23%)	234	8025	15000
2023	108 (95%)		2855 (42%)	2987 (131%)	642 (24%)	287	6878	11901

*** UK Includes Channel Islands.**

**** TAC Applied to subareas 7–10 from 1995 to 2008 and to 7b–k, 8, 9 and 10 from 2009 onwards.**

Table 7.2. Haddock in 7.b,c, e-k. ICES estimate of the landings (lan) and discards (dis).

Year	BEL Lan	ESP Lan	FRA Lan	IRL Lan	UK Lan	Others Lan	Total Lan	FRA Dis*	IRL Dis**	Others Dis***	Total Dis****	Total Catch
1993							3348	505	594	109	1208	4556
1994							4131	1116	594	176	1886	6017
1995							4470	730	1221	267	2218	6688
1996							6756	3170	713	426	4309	11065
1997							10827	2129	502	253	2883	13710
1998							7928	680	140	114	934	8862
1999							4970	477	54	55	586	5556
2000							7499	1587	727	189	2503	10002
2001							9278	2234	743	441	3418	12696
2002	134	85	3878	2070	301	20	6488	871	5651	552	7073	13561
2003	116	82	5960	1731	362	41	8292	1835	6941	680	9456	17748
2004	137	143	6336	1785	303	73	8777	1108	5156	486	6750	15527
2005	166	209	4101	2078	285	0	6839	1564	5818	2571	9953	16792
2006	98	194	3131	1899	269	1	5592	1313	2745	1841	5899	11491
2007	117	186	4134	2139	385	1	6961	372	2483	696	3552	10513
2008	108	166	4577	1984	558	0	7392	990	3741	2930	7660	15052
2009	129	49	5503	3270	711	2	9664	905	3320	3098	7322	16986
2010	170	115	6421	2899	821	3	10429	3260	4570	10870	18701	29130
2011	211	78	8381	3702	1551	35	13957	3963	4329	7515	15807	29764
2012	232	79	12293	4596	1929	67	19196	2754	2653	2878	8285	27481
2013	174	51	8738	3097	1458	20	13538	671	1116	2175	3962	17501
2014	99	3	6350	2543	849	2	9846	1732	1171	2715	5619	15464
2015	118	0	5683	2035	766	6	8608	2024	2519	2398	6941	15549
2016	88	0	4573	2271	689	27	7648	5482	2810	3773	12065	19713
2017	111	0	4895	2381	699	11	8099	2633	1928	2130	6691	14789
2018	89	0	4377	1989	578	12	7046	1920	1189	2688	5798	12844
2019	89	89	4548	2412	518	0	7656	1616	1445	542	3603	11259
2020	102	176	3815	3193	546	27	7859	1450	1873	937	4260	12119
2021	149	108	4257	4211	516	19	9260	706	1075	604	2385	11645
2022	189	230	3915	3974	584	4	8895	1219	1049	505	2773	11668
2023	107	280	2855	3819	658	-	7718	246	1296	705	2246	9964

*** For 1993–2007 fixed discard ratios were used to estimate French discards.**

**** For 1993–1994, the mean Irish discards over 1995–1999 were used.**

***** Estimated from the proportion of the landings of `Others' between 1993 and 2012.**

****** Discard estimates are available from 2005; prior to 2005, discard estimates are based on limited sampling.**

Table 7.3. Haddock in 7.b,c, e–k. LPUE (kg/hour fishing) of haddock and effort (hours fishing x 1000) for Irish Otter trawls in 7.bc, 7.fgh and 7.jk, the French demersal fleet in 7.bc–ek and effort only for the UK trawl fleets (excluding beam trawls) in 7.e–k (effort in fishing days).

	FR GAD 7ek effort	FR GAD 7ek lpue	IRL OTB 7bc effort	IRL OTB 7bc lpue	IRL OTB 7fgh effort	IRL OTB 7fgh lpue	IRL OTB 7jk effort	IRL OTB 7jk lpue	UK Trawl 7e–k effort
1983	NA	NA	NA	NA	NA	NA	NA	NA	51.5
1984	NA	NA	NA	NA	NA	NA	NA	NA	161.8
1985	NA	NA	NA	NA	NA	NA	NA	NA	143.7
1986	NA	NA	NA	NA	NA	NA	NA	NA	123.5
1987	NA	NA	NA	NA	NA	NA	NA	NA	108.9
1988	NA	NA	NA	NA	NA	NA	NA	NA	112.9
1989	NA	NA	NA	NA	NA	NA	NA	NA	119.9
1990	NA	NA	NA	NA	NA	NA	NA	NA	133.2
1991	NA	NA	NA	NA	NA	NA	NA	NA	118.8
1992	NA	NA	NA	NA	NA	NA	NA	NA	129.9
1993	NA	NA	NA	NA	NA	NA	NA	NA	101.1
1994	NA	NA	NA	NA	NA	NA	NA	NA	88.5
1995	NA	NA	78	5.77	64	1.48	106	2.20	88.1
1996	NA	NA	47	4.16	60	5.35	73	3.24	89.5
1997	NA	NA	63	4.36	65	5.83	92	8.23	101.8
1998	NA	NA	79	5.71	72	4.09	99	5.88	94.6
1999	NA	NA	77	5.27	51	2.35	52	3.53	132.8
2000	306	6.12	74	4.73	61	10.43	72	4.25	141.1
2001	333	10.57	78	4.30	69	8.69	81	7.41	117.5
2002	289	10.63	63	2.81	79	3.22	108	5.50	113.1
2003	264	15.15	81	2.09	87	3.26	123	3.88	102.4
2004	217	19.39	82	2.51	97	3.49	108	3.35	105.5
2005	175	14.67	69	2.45	127	4.53	93	3.70	100.9
2006	167	10.64	60	2.56	119	4.19	89	3.59	106.3
2007	160	14.97	60	3.31	136	4.01	103	3.66	113.6
2008	148	19.60	48	4.36	127	4.56	84	4.60	93.7
2009	150	22.65	48	5.47	141	9.25	82	7.09	98.6
2010	131	30.83	54	4.36	144	7.33	101	5.15	103.7

	FR GAD 7ek effort	FR GAD 7ek lpue	IRL OTB 7bc effort	IRL OTB 7bc lpue	IRL OTB 7fgh effort	IRL OTB 7fgh lpue	IRL OTB 7jk effort	IRL OTB 7jk lpue	UK Trawl 7e–k effort
2011	216	22.90	40	6.39	129	10.51	84	5.58	87.1
2012	188	45.03	44	4.93	135	13.17	84	6.58	86.2
2013	215	27.40	42	5.38	126	8.69	80	4.92	40.3
2014	203	19.81	46	5.22	142	5.11	77	3.91	32.1
2015	NA	NA	31	4.42	150	4.95	78	2.91	21.2
2016	NA	NA	39	2.41	164	4.94	83	3.09	NA
2017	NA	NA	36	2.25	151	5.10	92	2.43	NA
2018	NA	NA	46	2.19	125	5.33	93	1.70	NA
2019	NA	NA	32	2.42	127	5.86	93	1.73	NA
2020	NA	NA	34	2.80	98	11.2	84	1.86	NA
2021	NA	NA	39	4.23	92	14.68	86	2.70	NA
2022	NA	NA	40	4.66	73	15.50	75	1.96	NA
2023	NA	NA	35	9.40	73	12.36	65	2.37	NA

Table 7.4. Haddock in 7.b,c, e–k. Landings numbers-at-age.

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8 +
1993	0	491	3291	948	810	255	129	129	45
1994	0	1277	5223	674	302	94	24	35	16
1995	0	4275	1622	1327	270	245	46	0	0
1996	0	3693	15998	818	313	93	32	10	9
1997	0	1353	9645	5553	716	354	139	144	110
1998	0	167	3184	7403	1443	307	178	86	61
1999	0	476	654	1464	2425	307	18	19	6
2000	0	2197	2996	784	741	1250	205	35	28
2001	0	4297	8638	1131	303	317	321	54	39
2002	0	879	4274	3400	765	39	89	74	26
2003	0	703	8791	2160	1226	116	43	49	51
2004	0	125	5948	4663	928	589	51	12	20
2005	0	1075	1732	4230	1821	280	75	1	3
2006	0	839	3250	1034	2189	484	42	28	0
2007	0	404	4617	2916	737	1310	161	33	4
2008	0	1692	3268	3736	1046	286	414	91	50
2009	0	338	7111	2760	1890	577	228	234	38
2010	0	1757	5192	6031	1036	580	257	110	123
2011	0	100	12726	3607	3410	661	261	129	132
2012	0	82	1135	19931	2559	1795	323	109	108
2013	0	86	465	1899	10533	861	468	96	44
2014	0	277	854	467	1511	5585	368	219	40
2015	0	41	4881	632	309	928	2030	257	80
2016	0	62	310	5200	216	143	546	682	92
2017	0	58	2019	1071	3930	135	117	246	312
2018	0	70	714	2833	926	1653	42	64	150
2019	0	513	1566	1257	2678	529	762	41	110
2020	0	120	4318	1449	755	1381	260	175	30
2021	0	285	1295	6691	740	569	640	248	169
2022	0	187	1067	2455	4952	317	175	176	82
2023	0	15	2676	1199	2470	3186	104	48	46

Table 7.5. Haddock in 7.b,c, e–k. Discard numbers-at-age.

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8+
1993	0	7617	2816	160	6	0	0	0	0
1994	0	15120	3069	170	5	0	0	0	0
1995	0	32830	1977	91	4	0	0	0	0
1996	0	20734	8976	187	9	0	0	0	0
1997	0	12613	10022	493	5	0	0	0	0
1998	0	3580	2348	445	5	0	0	0	0
1999	0	3742	1562	100	10	0	0	0	0
2000	0	29015	2521	64	3	0	0	0	0
2001	0	25234	6772	219	2	0	0	0	0
2002	0	21624	20729	249	7	0	0	0	0
2003	0	52412	11075	352	8	0	0	0	0
2004	0	11733	21598	1395	61	0	0	0	0
2005	0	30472	25291	6821	97	1	0	0	0
2006	0	20089	4529	11	10	4	1	0	0
2007	0	10748	8498	572	6	6	0	0	0
2008	0	34221	12620	1676	78	0	0	0	0
2009	0	21175	13989	592	64	0	0	0	0
2010	0	95699	19014	2742	34	1	0	0	0
2011	0	5881	58967	1675	262	16	1	0	1
2012	0	2732	5169	18518	153	55	2	0	0
2013	0	4076	2767	1372	4028	58	2	1	1
2014	0	20197	3315	507	631	732	4	1	0
2015	0	3590	18090	704	26	155	162	13	6
2016	0	27587	5222	8406	51	12	56	501	2
2017	0	3208	11913	1602	2121	31	2	4	3
2018	0	5287	5127	5306	491	215	0	2	2
2019	0	12878	2847	773	409	37	17	1	4
2020	0	2722	10938	597	28	25	1	1	0
2021	0	4890	3773	2799	23	12	1	0	0
2022	0	3498	2128	2216	1743	29	18	0	0
2023	0	566	5206	903	900	687	0	0	0

Table 7.6. Haddock in 7.b,c, e–k. VAST survey data.

Year \Age	0	1	2	3	4	5	6	7
2003	34657.1	183901.4	14824.11	1271.209	1077.005	20.317	15.05	8.221
2004	104108	18644.98	23294.92	2331.764	857.426	427.252	855.369	9.569
2005	76847.96	31331.95	4530.519	6780.567	867.029	210.172	50.803	0
2006	30897.08	10023.17	6396.957	1428.127	1299.173	240.659	56.086	32.995
2007	292627.7	15370.73	3664.862	2102.062	678.878	801.197	107.088	14.935
2008	84867.76	52050.11	2551.022	672.422	793.756	288.593	777.782	187.043
2009	895176.1	18738.14	15438	606.974	369.291	275.464	406.445	164.14
2010	36900.74	304741.5	10123.78	4855.938	247.623	213.787	354.202	110.356
2011	22551.86	13340.71	75804.35	2271.317	1240.737	211.431	146.219	51.953
2012	7666.998	6687.683	3972.997	13359.49	748.524	585.504	109.112	51.764
2013	261170.2	2477.077	2832.642	1366.481	5305.446	371.162	418.306	48.924
2014	30548.27	55737.78	1017.904	865.09	931.7	1846.524	347.384	129.816
2015	132153.5	26940.71	16984.26	596.107	374.817	617.137	1228.794	78.781
2016	21883.07	47017.02	12361.18	5441.418	428.786	196.485	933.596	265.76
2017	69643.4	6054.359	15135.19	2681.514	927.991	90.063	17.304	189.139
2018	281978.1	9037.188	1621.882	2571.67	1496.166	678.873	28.096	28.995
2019	104146.9	127131.6	4507.18	964.693	1677.255	481.623	348.946	25.758
2020	32072.81	37079.58	54321.79	944.239	493.966	1061.173	1272.678	358.153
2021	74420.03	14555.64	12443.3	12688.66	277.992	73.44	349.207	162.558
2022	867.503	23531.07	5573.722	4502.198	5772.396	166.346	91.706	130.105
2023	931.74	610.792	11343.55	1614.277	1441.52	2096.595	140.238	11.766

Table 7.7. Haddock in 7.b,c, e–k. Fishing mortality- (F) at-age.

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8
1993	0	0.332	0.724	0.576	0.576	0.568	0.551	0.617	0.617
1994	0	0.324	0.702	0.555	0.547	0.536	0.52	0.582	0.582
1995	0	0.321	0.698	0.555	0.546	0.533	0.518	0.578	0.578
1996	0	0.313	0.691	0.56	0.554	0.539	0.524	0.583	0.583
1997	0	0.322	0.721	0.608	0.62	0.613	0.602	0.665	0.665
1998	0	0.316	0.716	0.614	0.646	0.65	0.644	0.706	0.706
1999	0	0.302	0.69	0.592	0.628	0.636	0.633	0.686	0.686
2000	0	0.324	0.758	0.656	0.704	0.72	0.72	0.763	0.763
2001	0	0.33	0.786	0.689	0.752	0.772	0.777	0.815	0.815
2002	0	0.319	0.777	0.684	0.76	0.789	0.801	0.838	0.838
2003	0	0.307	0.748	0.669	0.754	0.83	0.857	0.896	0.896
2004	0	0.306	0.744	0.662	0.735	0.817	0.842	0.862	0.862
2005	0	0.298	0.709	0.603	0.633	0.672	0.667	0.676	0.676
2006	0	0.263	0.609	0.507	0.518	0.544	0.54	0.574	0.574
2007	0	0.248	0.584	0.49	0.48	0.491	0.484	0.523	0.523
2008	0	0.247	0.598	0.521	0.506	0.507	0.505	0.564	0.564
2009	0	0.23	0.565	0.519	0.519	0.527	0.526	0.595	0.595
2010	0	0.21	0.525	0.504	0.52	0.544	0.555	0.642	0.642
2011	0	0.192	0.485	0.491	0.528	0.572	0.6	0.715	0.715
2012	0	0.181	0.458	0.481	0.531	0.593	0.634	0.774	0.774
2013	0	0.171	0.43	0.449	0.497	0.559	0.605	0.758	0.758
2014	0	0.158	0.403	0.427	0.467	0.532	0.581	0.745	0.745
2015	0	0.145	0.373	0.411	0.449	0.512	0.569	0.744	0.744
2016	0	0.144	0.366	0.416	0.461	0.524	0.579	0.76	0.76
2017	0	0.141	0.365	0.426	0.488	0.558	0.604	0.784	0.784
2018	0	0.135	0.352	0.422	0.487	0.563	0.604	0.784	0.784
2019	0	0.119	0.314	0.395	0.477	0.564	0.614	0.799	0.799
2020	0	0.106	0.277	0.363	0.46	0.563	0.609	0.787	0.787
2021	0	0.109	0.28	0.372	0.496	0.635	0.699	0.897	0.897
2022	0	0.109	0.275	0.362	0.484	0.626	0.697	0.896	0.896
2023	0	0.117	0.289	0.373	0.492	0.623	0.681	0.871	0.871

Table 7.8. Haddock in 7.b,c, e–k. Stock numbers-at-age (start of year) (`1000).

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8
1993	136156	49682	12994	4506	1238	369	300	188	87
1994	400185	45383	17435	3517	1579	443	137	115	100
1995	473824	135535	15666	4841	1255	599	172	55	83
1996	165127	160880	47081	4324	1726	474	237	69	53
1997	58956	55508	58936	12692	1526	649	188	97	48
1998	86301	19599	19236	16754	4033	525	236	70	52
1999	365380	28769	6892	5304	5755	1293	180	83	41
2000	347571	124329	10464	1945	1859	2016	448	65	43
2001	475192	116519	43548	2726	623	609	646	144	35
2002	1009731	159202	40009	11221	828	187	190	196	54
2003	232693	345601	57562	9814	3597	231	59	58	74
2004	347182	80248	119250	15173	3060	1068	64	17	36
2005	242907	115439	29985	31363	4742	896	279	16	15
2006	186495	79864	39443	8138	10134	1558	286	89	11
2007	703465	63896	29716	11961	3156	3917	590	113	36
2008	393393	229802	24496	9339	4479	1313	1590	246	64
2009	2401344	131042	85193	7600	3508	1747	559	652	119
2010	204335	806739	51954	27076	2896	1372	699	230	296
2011	86208	69508	309456	17107	9943	1203	539	272	199
2012	56808	28709	29678	103842	6513	3771	474	200	162
2013	627247	19600	11781	11805	38631	2513	1368	171	113
2014	215795	207471	8323	4278	5385	14804	987	500	91
2015	482405	74731	84798	3207	1713	2464	5740	383	191
2016	98216	163740	33192	32090	1296	708	1063	2178	188
2017	144659	32738	66171	13357	12373	507	280	413	752
2018	920762	45443	14040	24782	5630	4787	187	106	372
2019	308835	311039	18095	5654	9907	2279	1795	70	156
2020	154967	100757	136524	6793	2347	3909	894	647	70
2021	234566	52335	44724	58565	2683	928	1410	337	227
2022	8353	79521	22354	19658	25521	1015	327	448	156
2023	4104	2949	35923	9447	8591	10254	352	107	161

Table 7.9. Haddock in 7.b,c,e–k. Stock Summary: Estimated recruitment, spawning–stock biomass (SSB), and average fishing mortality.

Year	Low	R(age 0)	High	Low	SSB	High	Low	Fbar(3-5)	High
1993	65039	136156	285039	6115	9236	13948	0.40	0.57	0.83
1994	245618	400185	652018	7566	10995	15979	0.40	0.55	0.76
1995	291900	473824	769133	8183	11578	16381	0.41	0.55	0.73
1996	102561	165127	265861	15401	20813	28128	0.42	0.55	0.73
1997	36627	58956	94897	19167	25326	33465	0.48	0.61	0.78
1998	53458	86301	139320	15485	19884	25534	0.51	0.64	0.80
1999	227790	365380	586077	10497	13147	16466	0.50	0.62	0.77
2000	218042	347571	554046	9579	11655	14180	0.57	0.69	0.84
2001	303962	475192	742878	14056	18511	24378	0.61	0.74	0.89
2002	658021	1009731	1549426	18376	23546	30171	0.62	0.74	0.90
2003	157956	232693	342794	22289	27899	34920	0.61	0.75	0.92
2004	237526	347182	507463	31972	40622	51612	0.59	0.74	0.92
2005	165861	242907	355744	23704	29128	35793	0.52	0.64	0.78
2006	125904	186495	276245	20371	24529	29534	0.41	0.52	0.66
2007	479952	703465	1031067	19042	22418	26392	0.39	0.49	0.61
2008	269643	393393	573936	17484	20644	24375	0.42	0.51	0.63
2009	1636595	2401344	3523446	26402	32509	40029	0.43	0.52	0.64
2010	133955	204335	311691	32758	38900	46193	0.43	0.52	0.64
2011	59521	86208	124860	77023	98507	125983	0.44	0.53	0.65
2012	38240	56808	84390	56384	70609	88423	0.44	0.54	0.66
2013	429961	627247	915056	36601	45453	56447	0.41	0.50	0.61
2014	145940	215795	319087	23476	28588	34814	0.39	0.48	0.58
2015	331718	482405	701543	32384	39786	48880	0.37	0.46	0.56
2016	67204	98216	143538	30886	37113	44595	0.38	0.47	0.57
2017	95422	144659	219303	35825	42970	51540	0.40	0.49	0.60
2018	625003	920762	1356477	27966	33265	39568	0.40	0.49	0.60
2019	209689	308835	454858	25080	29349	34345	0.39	0.48	0.59
2020	104372	154967	230086	45339	57873	73873	0.37	0.46	0.58
2021	151342	234566	363555	44201	55479	69635	0.39	0.50	0.64
2022	4759	8353	14660	33702	42137	52684	0.38	0.49	0.64
2023	1827	4104	9217	27276	34916	44696	0.36	0.50	0.69
2024	4104	234566*	2401344	16427	16427	31739			

*** Median resampled (1993–2023), as estimated by stochastic projection.**

Table 7.10. Haddock in divisions 7.b,c,e–k. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{ages\ 3\text{–}5}$ (2024)	0.496	F = $F_{Average\ (2021\text{–}2023)}$, rescaled to F_{2023}
SSB (2025)	13307	Short-term forecast; in tonnes
$R_{age\ 0}$ (2024, 2025)	234566	Median recruitment, resampled from the years 1993–2023; in thousands
Total catch (2024)	7698	Short-term forecast; in tonnes
Projected landings (2024)	6874	Short-term forecast, assuming average 2021–2023 landing pattern; in tonnes
Projected discards (2024)	824	Short-term forecast, assuming average 2021–2023 discard pattern; in tonnes

*** Random resampling of a distribution may lead to different median estimates.**

Table 7.11. Haddock in divisions 7.b,c,e–k. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change*	% advice change^	Probability of SSB (2026) <Blim(%)
ICES advice basis										
MSY approach: F_{MSY}	4644	3375	1269	0.353	0.282	0.071	19379	46	-44	7.5
Other scenarios										
EU MAP ^^: F_{MSY}	4644	3375	1269	0.353	0.282	0.071	19379	46	-44	7.5
EU MAP^^ $F_{MSY\ lower}$	3099	2277	822	0.221	0.177	0.044	20896	57	-62	4.5
EU MAP^^ $F_{MSY\ upper}$	6353	4548	1805	0.521	0.416	0.105	17715	33	-23	11.6
F = 0	0	0	0	0	0	0	24025	81	-100	1.14
F_{pa}	7978	5624	2354	0.71	0.57	0.142	16118	21	-3	16.8
F_{lim}	12384	8239	4145	1.40	1.12	0.28	12013	-9.7	50	34
$SSB_{2026} = B_{lim}$	15544	9778	5766	2.2	1.75	0.44	9227	-31	88	50
$SSB_{2026} = B_{pa}$= MSY $B_{trigger}$	11488	7748	3740	1.23	0.98	0.25	12822	-3.6	39	30
F = F_{2024}	6115	4387	1728	0.50	0.40	0.100	17946	35	-26	11.0
$SSB_{2026} = SSB_{2025}$	10968	7451	3517	1.14	0.91	0.23	13307	0.00	33	28

* SSB_{2026} forecast relative to SSB_{2025}.
^ Advice values for 2025 relative to the MSY value for 2024 (8252 tonnes).
^^ EU multiannual plan (MAP) for the Western Waters (EU, 2019).

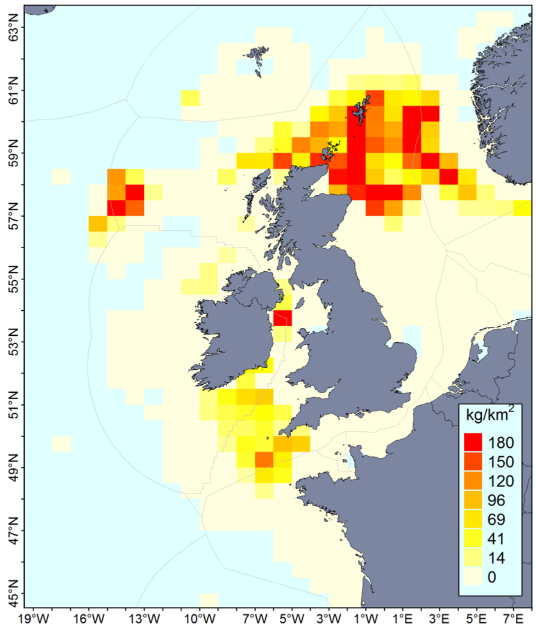


Figure 7.1. International haddock landings by ICES rectangle (all gears; 2016–2020, data from https://stecf.jrc.ec.europa.eu/data-dissemination).

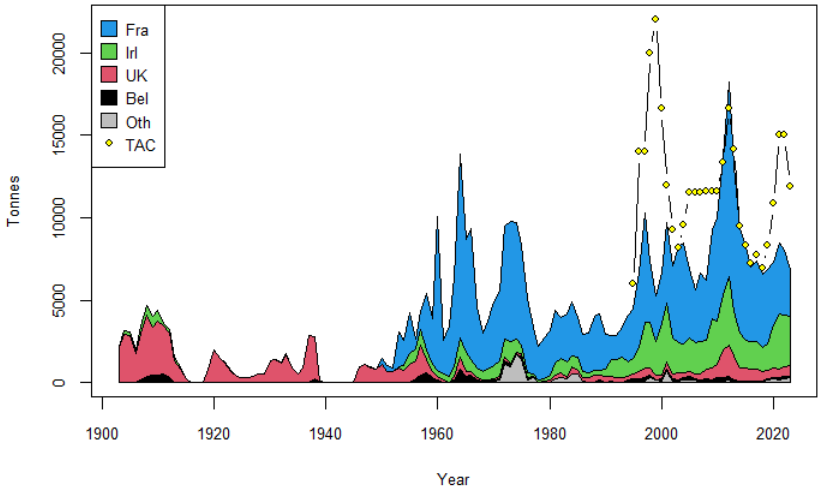


Figure 7.2. Haddock in 7.b,c,e–k. Official ICES landings and TAC of haddock in 7.b–k.

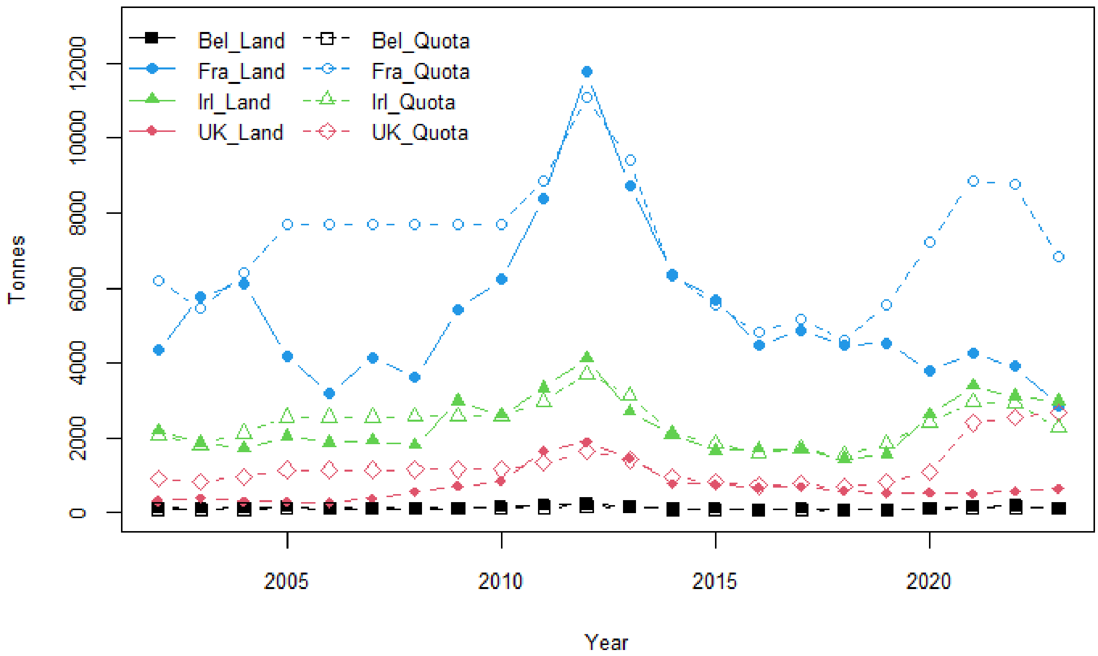


Figure 7.3. Haddock in 7.b,c,e–k. Official ICES landings and quota by country.

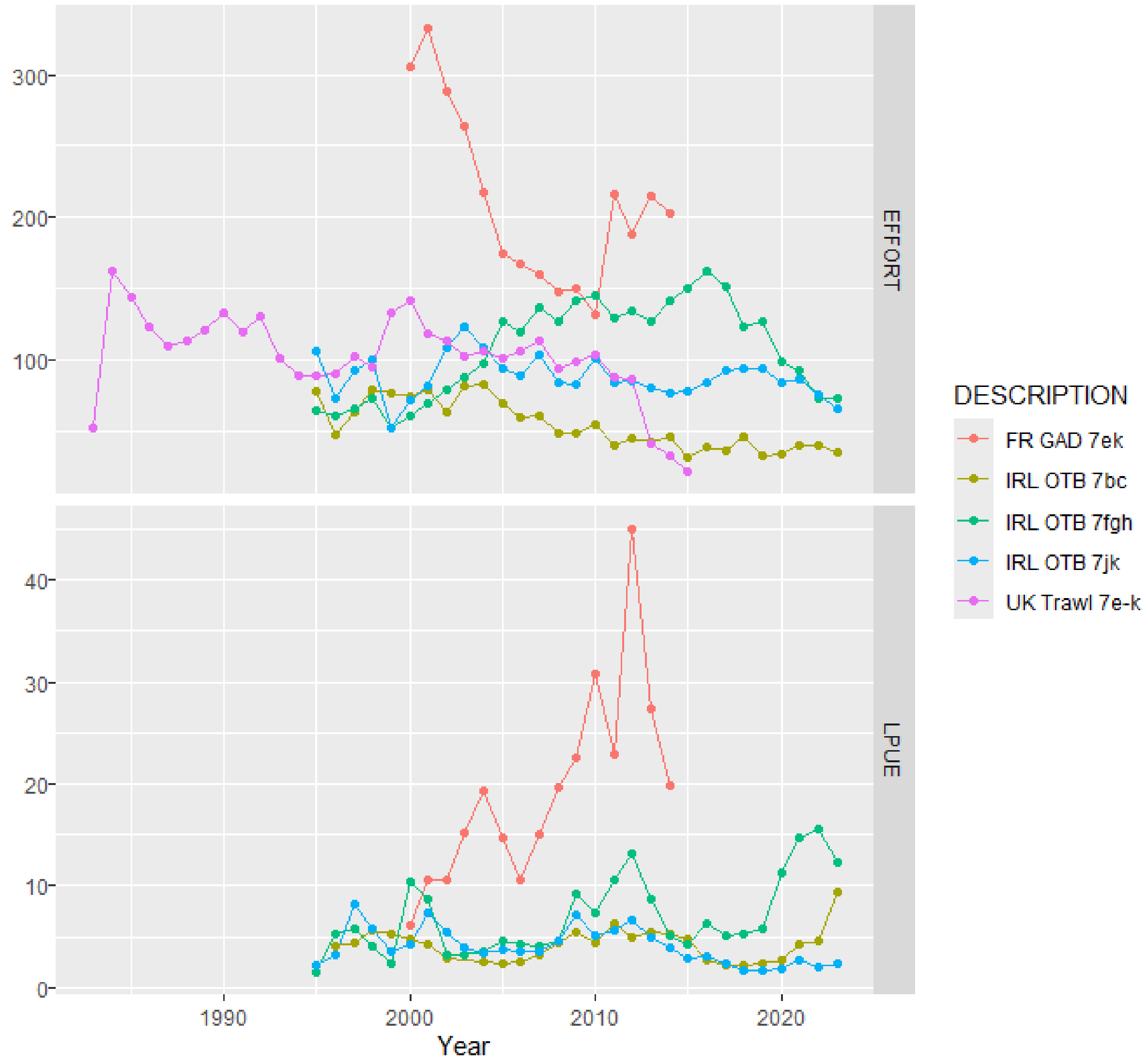


Figure 7.4. Haddock in 7.b,c,e–k. Effort ('1000 h) of the Irish Otter trawl fleets, the French demersal otter trawl fleet and for UK trawl fleet (effort in fishing days, rescaled to other fleets) and LPUE(kg/h) for the Irish and French fleets.

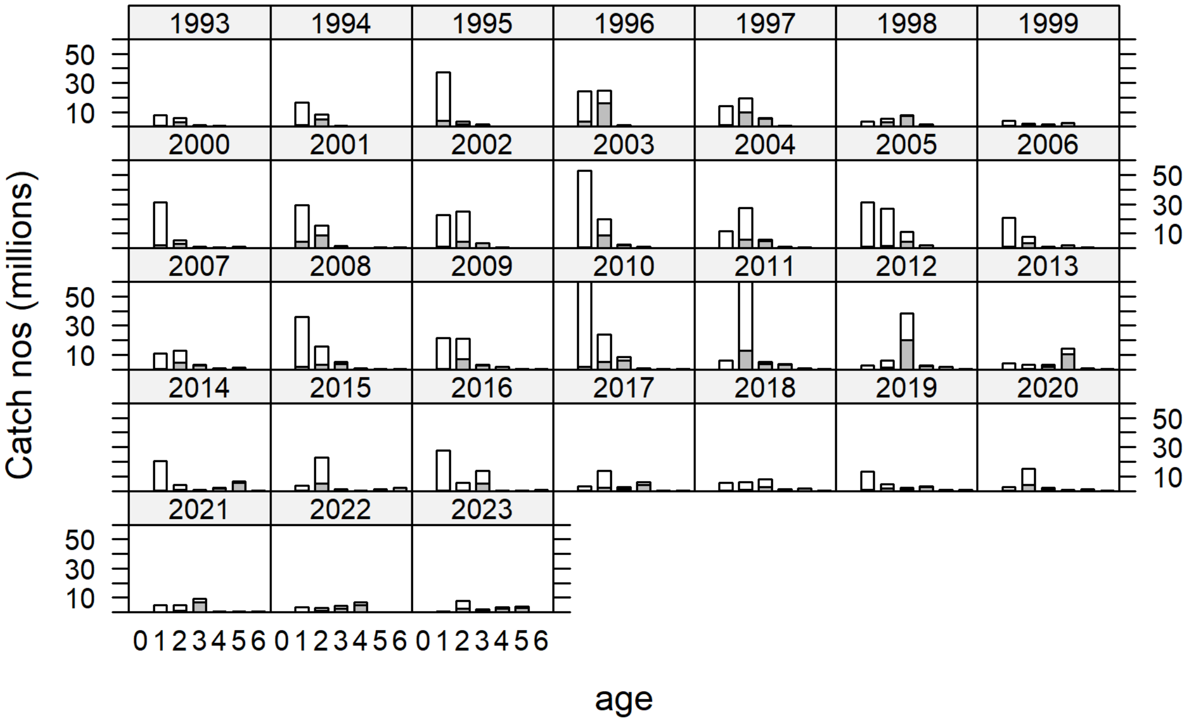


Figure 7.5. Haddock in 7.b,c,e–k. Catch by number by age class (grey = landings, white = discards).

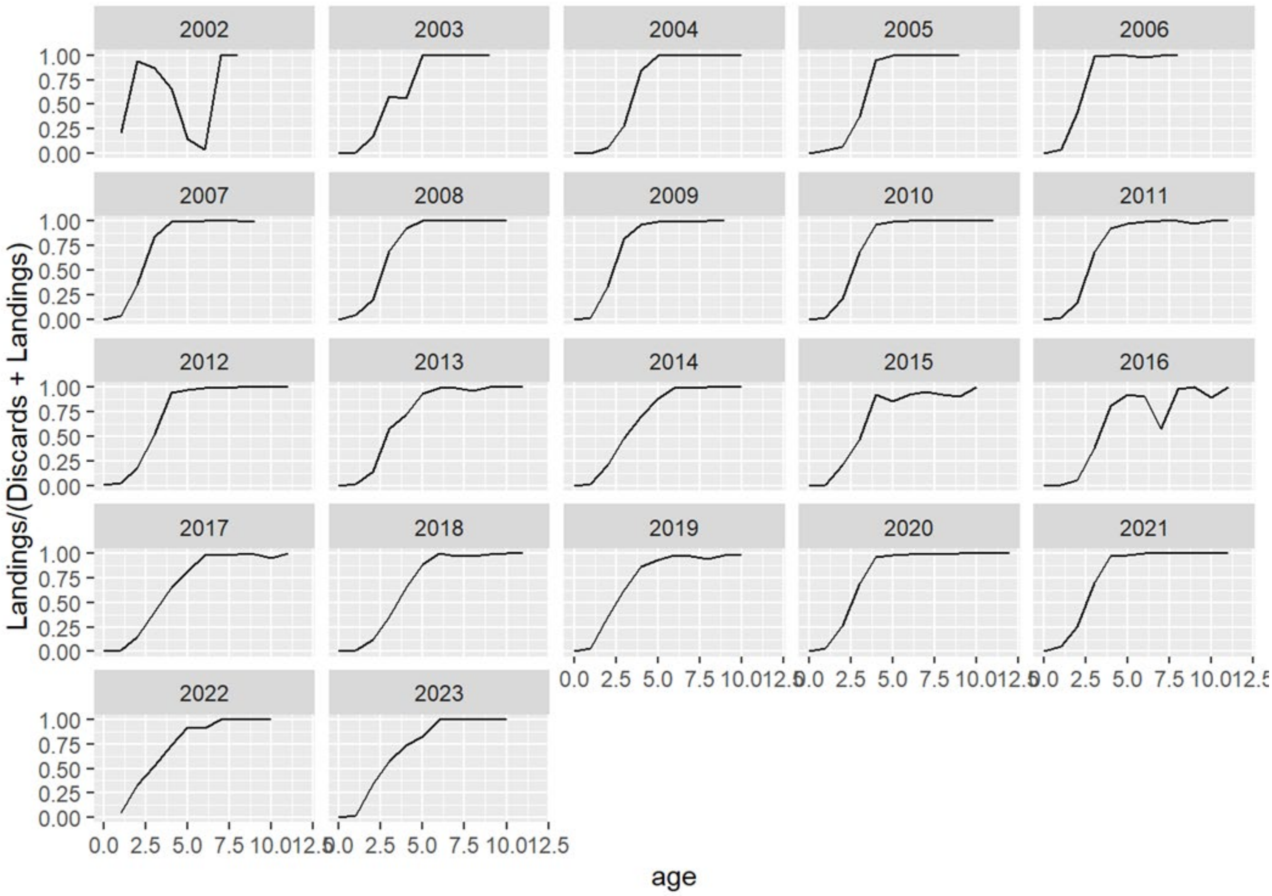


Figure 7.6. Haddock in 7.b,c,e–k. Proportional representation of landings relative to catch (discards + landings) by age.

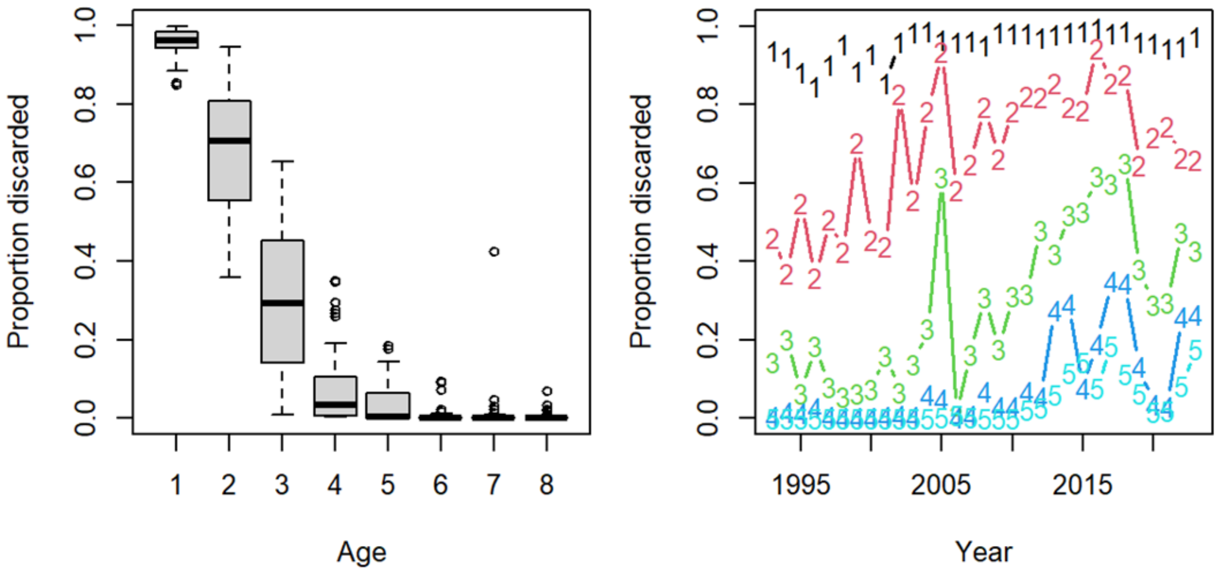


Figure 7.7. Haddock in 7.b,c,e–k. Proportion of discards by age (left) and year (right).

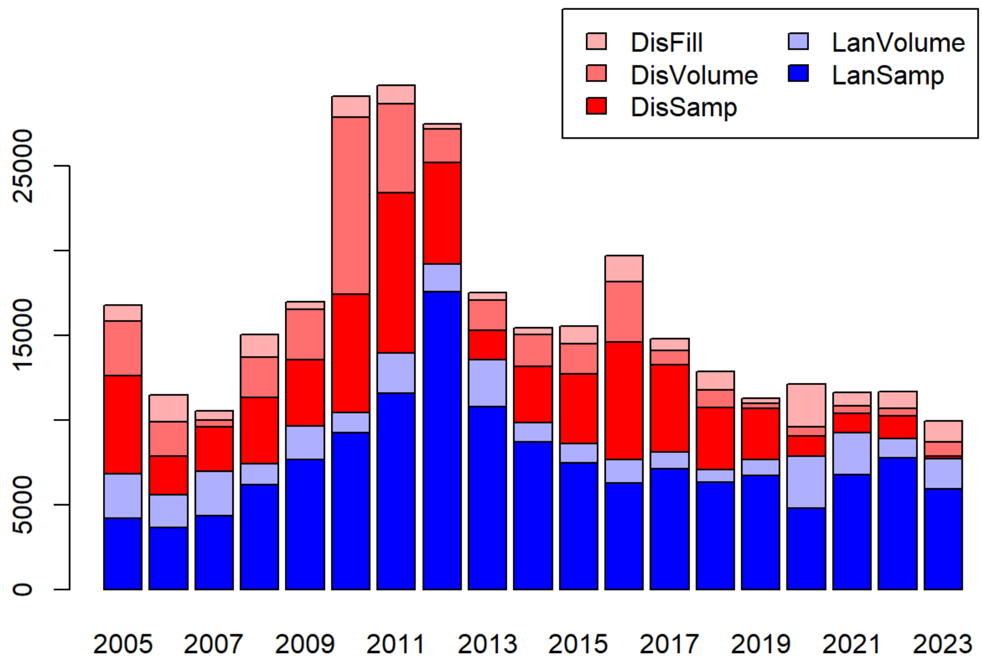


Figure 7.8. Haddock in 7.b,c,e–k. Distribution sampled and unsampled catches by country.

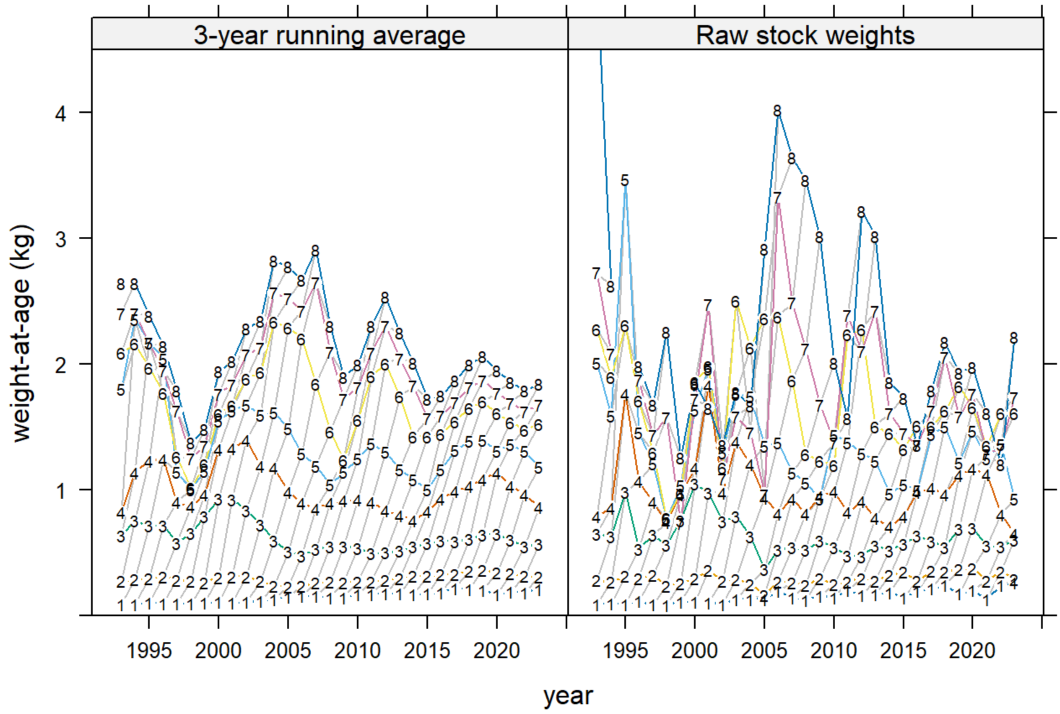


Figure 7.9. Haddock in 7.b,c,e–k. Raw stock weights-at-age (right) and the three-year running average stock weights (left).

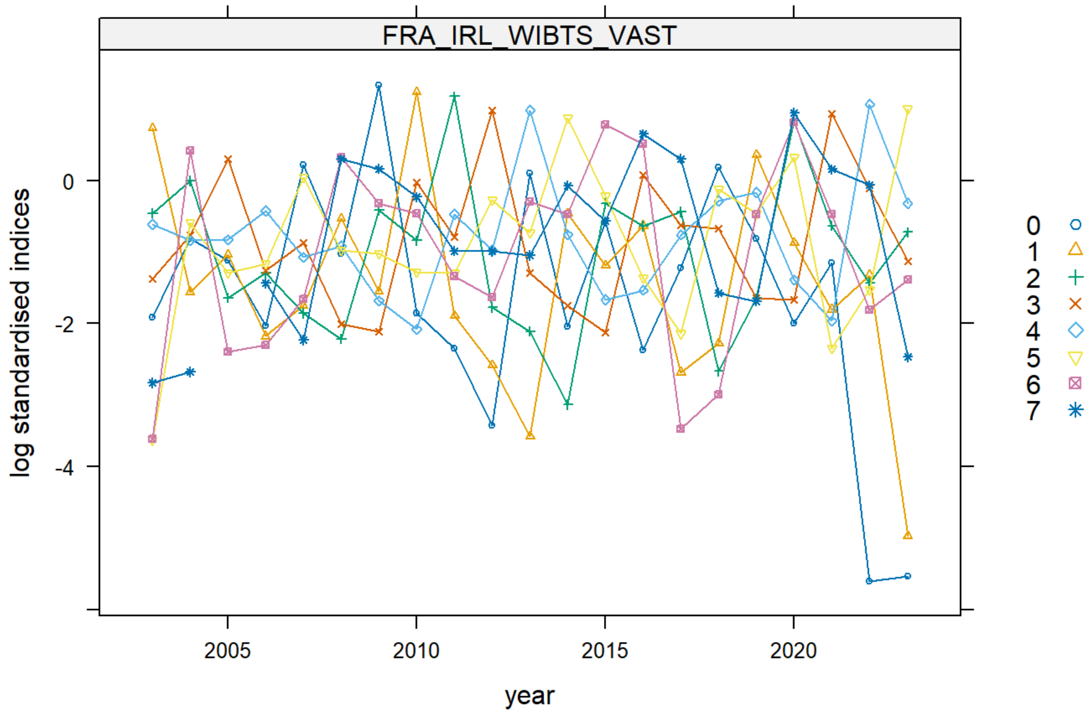


Figure 7.10. Haddock in 7.b,c,e–k. Log VAST standardised tuning fleets by year. The FRA-IRL-IBTS survey is the combined French EVHOE Q4 WIBTS and Irish IGFS Q4 WIBTS survey.

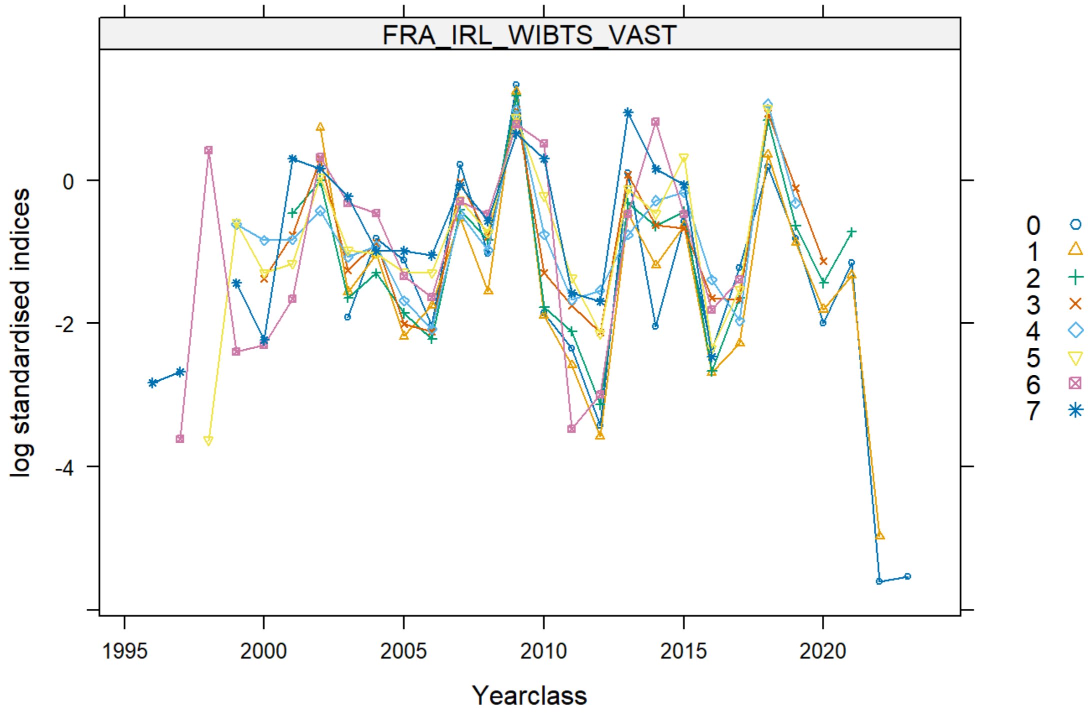


Figure 7.11. Haddock in 7.b,c,e–k. Log VAST standardised tuning fleets by cohort.

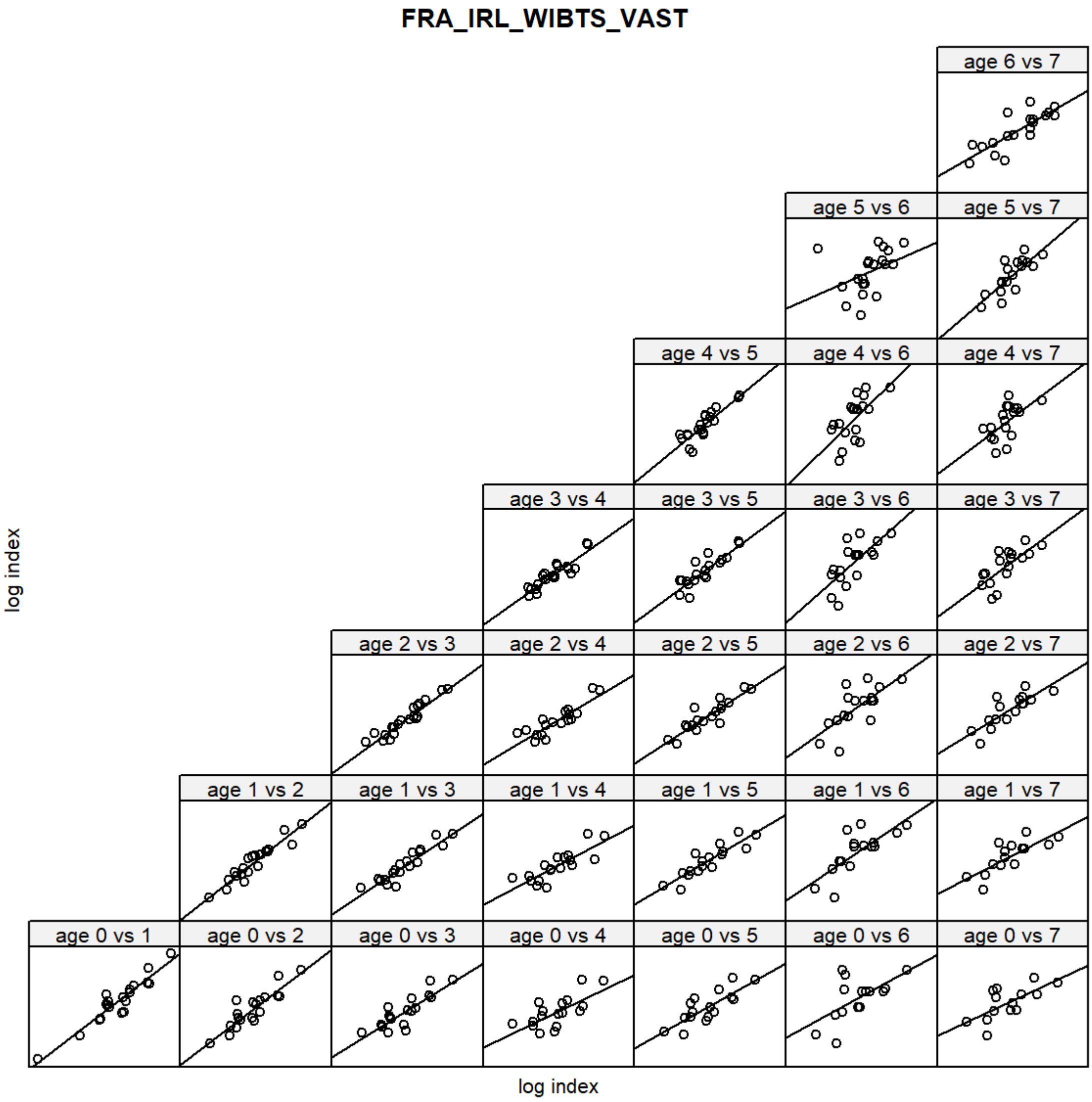


Figure 7.12. Haddock in 7.b,c,e–k. Scatterplot matrix of log indices of cohorts at different ages.

Figure 7.13. Haddock in 7.b,c,e–k. Residuals of the proportions-at-age in catch (upper) and survey (lower).

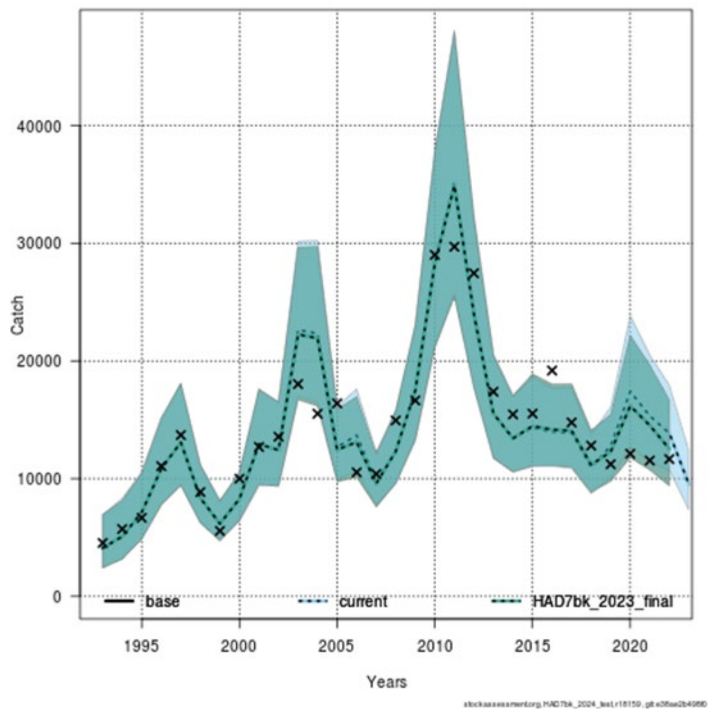


Figure 7.14. Haddock in 7.b,c,e–k. Observed (line) and predicted (x) catches.

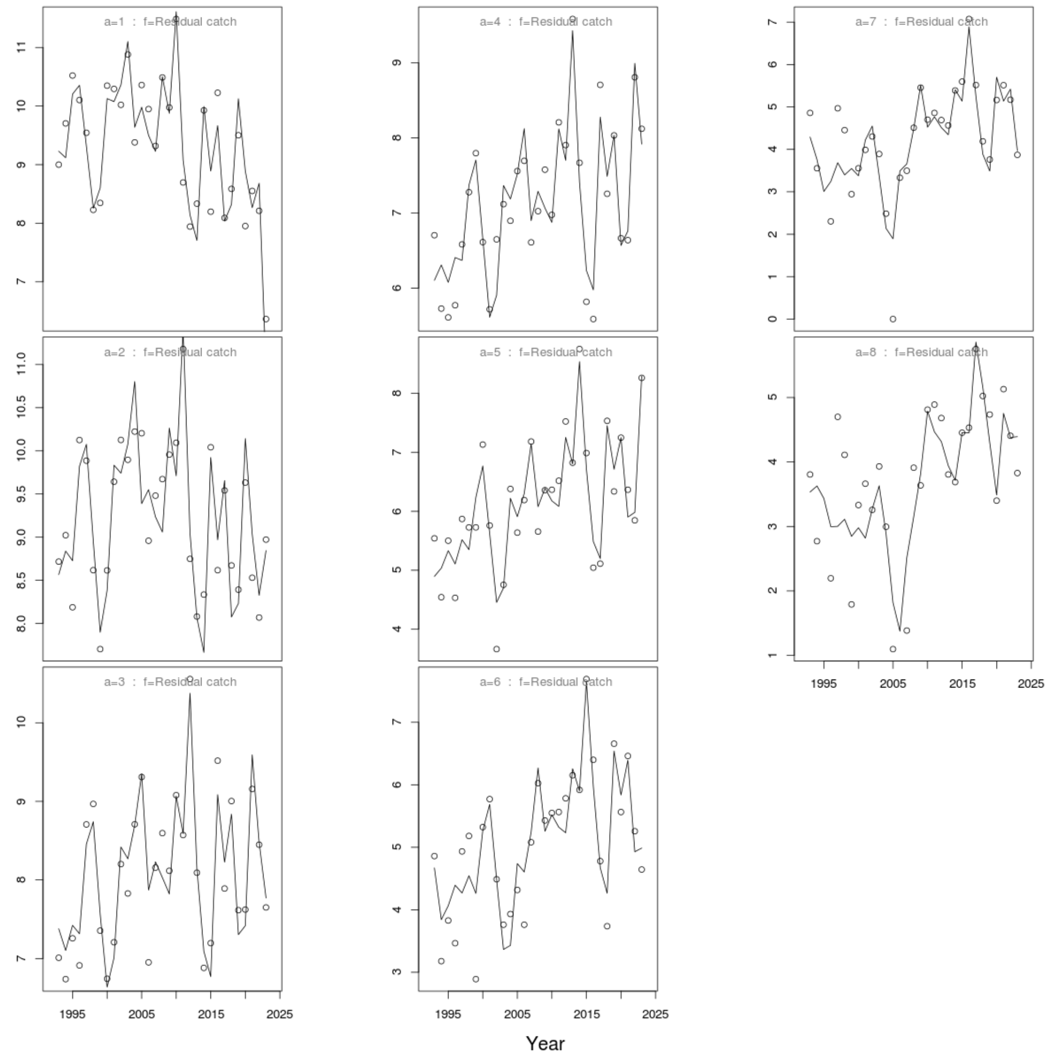


Figure 7.15. Haddock in 7.b,c,e–k. Observed and predicted (circles and line respectively) catch-at-age.

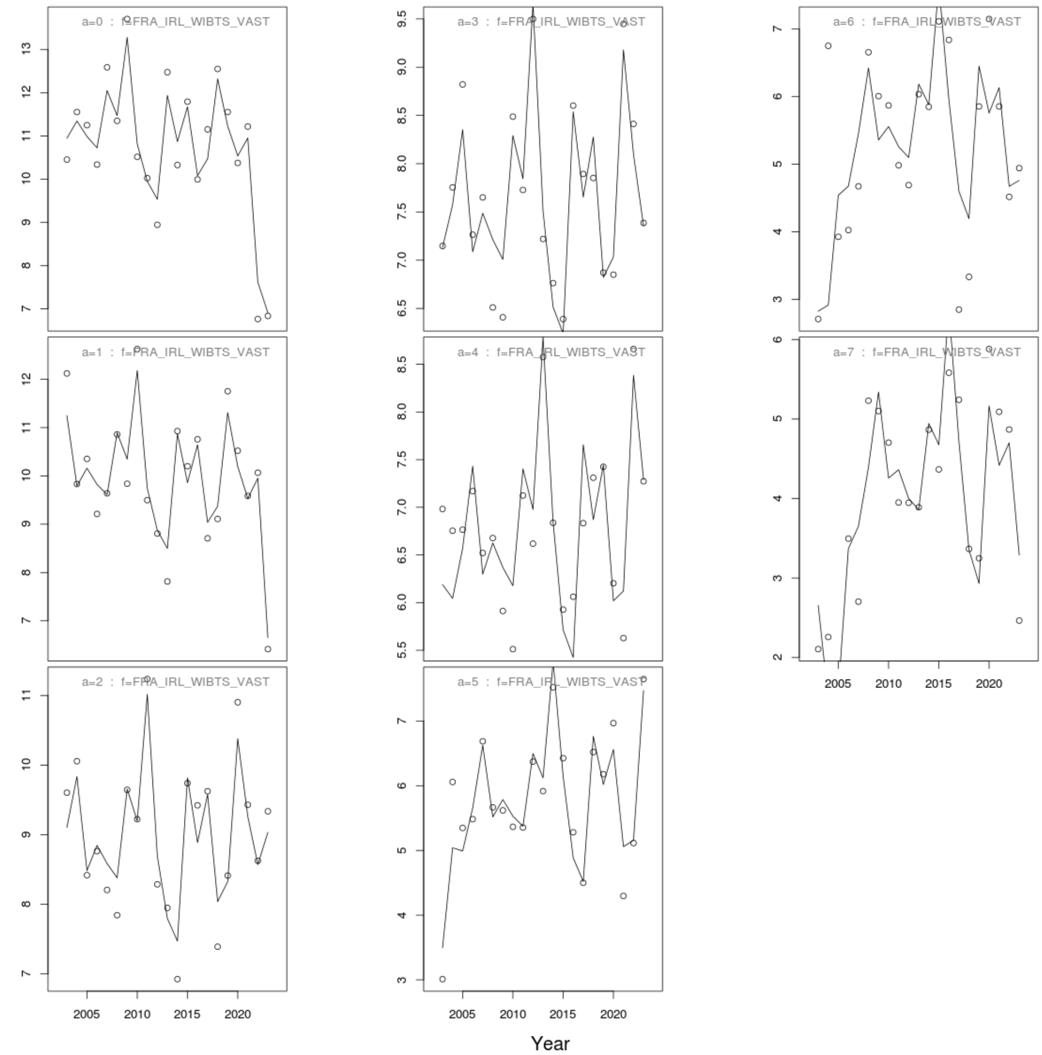


Figure 7.16. Haddock in 7.b,c,e–k. Observed and predicted (circles and line respectively) VAST survey indices.

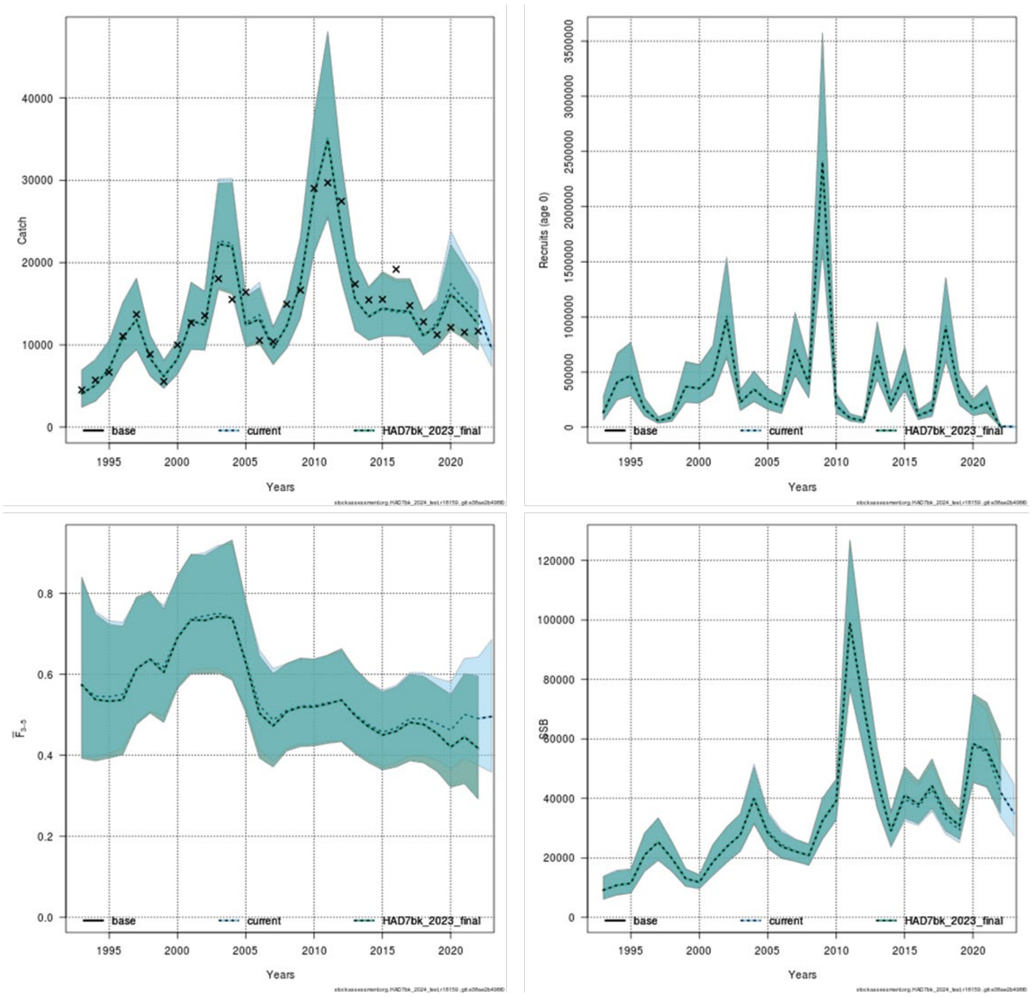


Figure 7.17. Haddock in 7.b,c,e–k. SAM assessment stock summary plots.

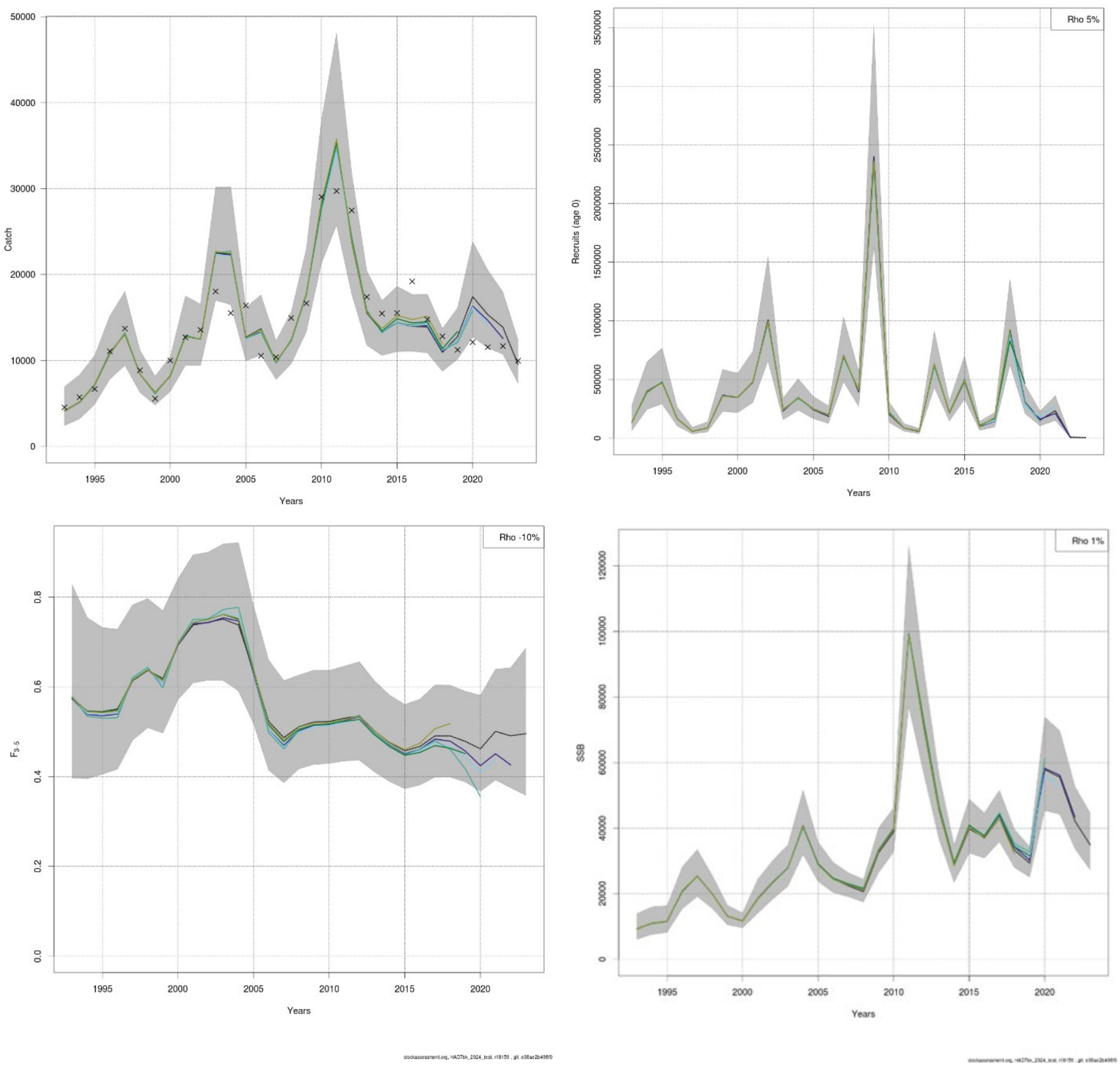


Figure 7.18. Haddock in 7.b,c,e–k. Retrospective analysis of the final SAM assessment run. Catch (top left), recruitment (top right), F (bottom left) and SSB (bottom right).

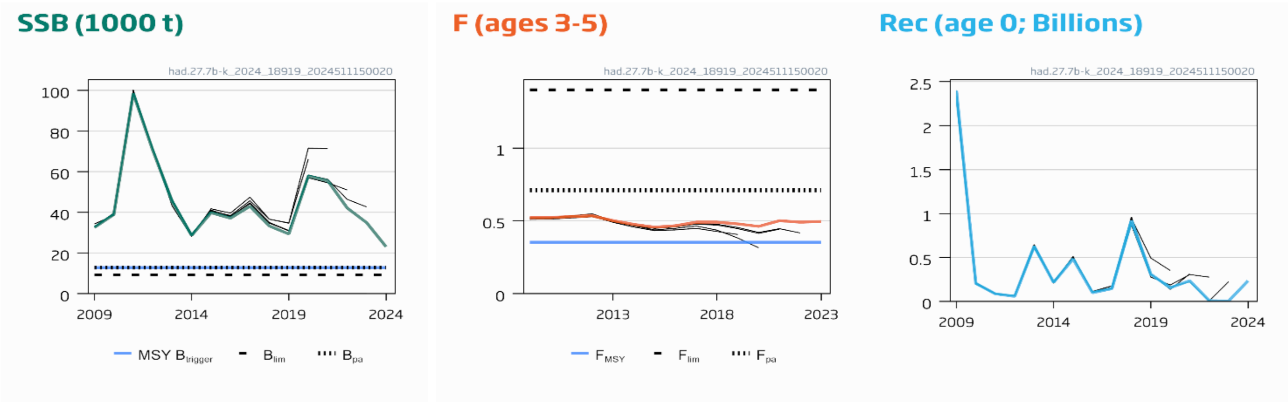


Figure 7.19. Haddock 7.b,c,e–k. Historical assessment results (final-year recruitment and SSB assumptions included).

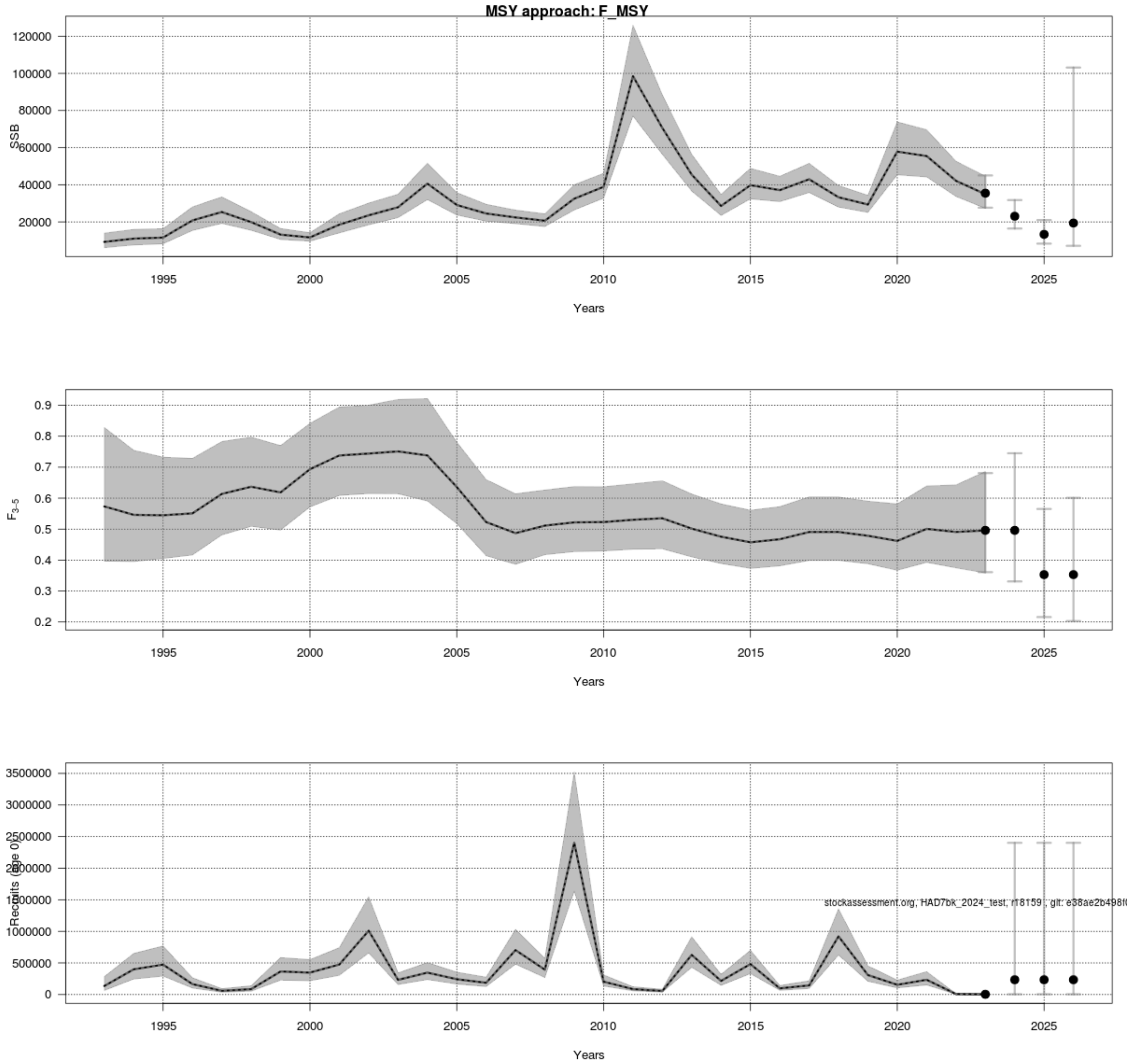


Figure 7.20. Haddock in 7.b,c,e–k. Assessment and forecast of the final SAM run. SSB (top), and F (middle) and recruitment (bottom).

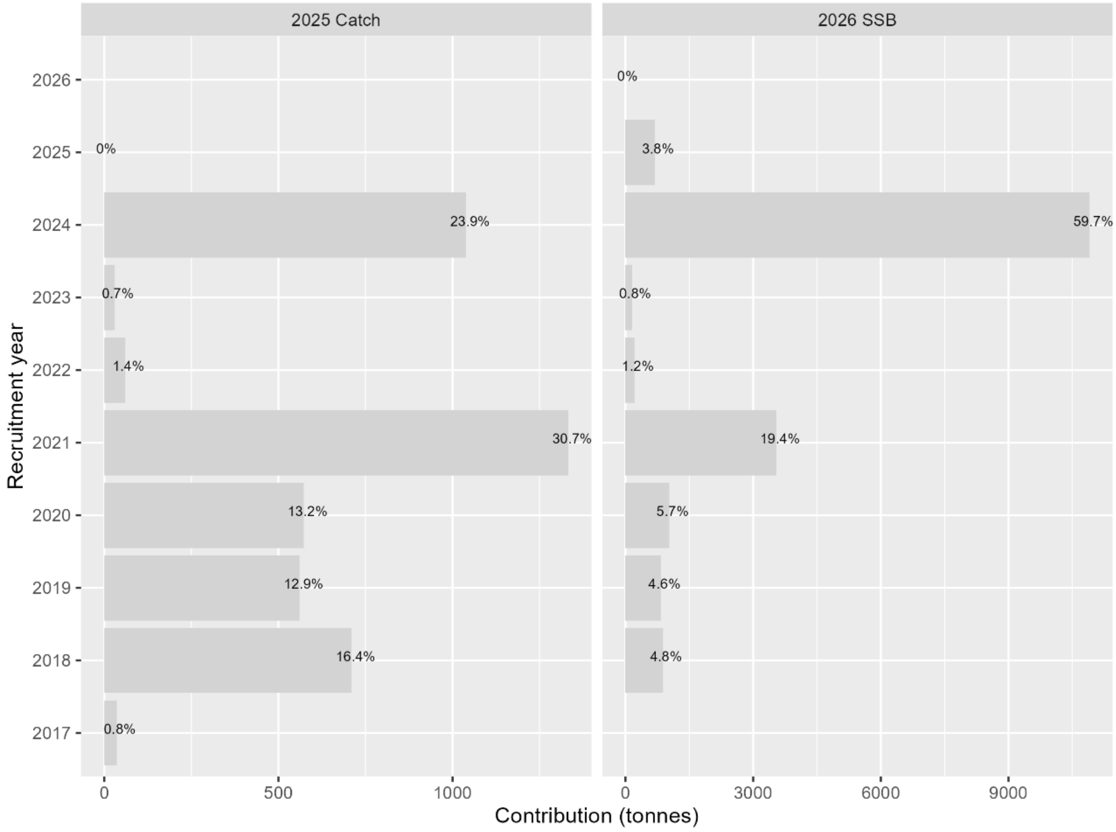


Figure 7.21. Haddock 7.b,c,e–k. Recruitment Contribution of recent year classes used in predictions, and the relative (%) contributions to catch and SSB (by weight) of these year classes.

Contents

8 Haddock in divisions 7.b,c,e-k

Type of assessment in 2024

The Celtic Sea haddock (27.7b,c,e–k) assessment was benchmarked in 2020, with discard and landings data reviewed and updated from 2005 onwards.

The 2024 SAM assessment was undertaken in the web tool: www.stockassessment.org. The procedure detailed in the Stock Annex, performed in the preceding year was followed.

ICES advice applicable to 2024

Last year's full advice is available in the Report of the ICES Advisory Committee, 2023. ICES Advice 2023, had.27.7b–k.

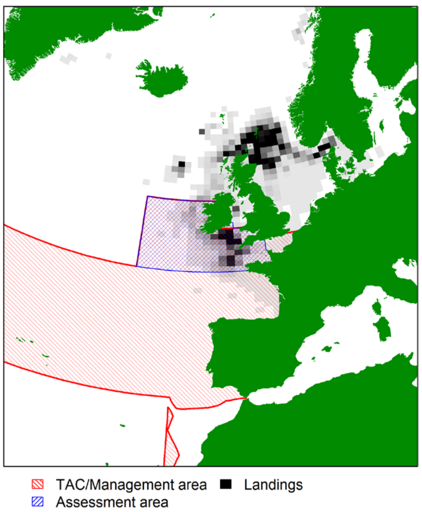
https://doi.org/10.17895/ices.advice.21840807.v1

The headline advice was as follows:

"ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 8 252 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by some of the relevant management authorities for this stock."

8.1 General

Stock description and management units



The basis for the stock assessment area 7.b,c,e–k is described in detail in the stock annex.

Figure 8.1 (see section 8.14) shows the spatial distribution of international haddock landings in the NE Atlantic for 2016. It is clear from the figure that the stock extends into Area 8 and it could be argued that landings from 8 should be included in the stock area. In recent years these landings varied between 20 and 300 t which is up to 4% of the total landings in the stock area.

The TAC for haddock is set for the combined Areas 7.b–k, 8, 10 and 10 and EU waters of CECAF 34.1.1. This does not correspond to the stock assessment area (7.b–k).

2024 management (Council Regulation (EU) 2024/257)

https://eur-lex.europa.eu/eli/reg/2024/257/oj

Species:	Haddock		Zone:	7b-k, 8, 9 and 10; Union waters of CECAF 34.1.1
	Melanogrammus aeglefinus			(HAD/7X7A34)
Belgium		76	Analytical TAC	
France		4 549	Article 7(2) of this Regulation applies	
Ireland		1 516		
Union		6 141		
United Kingdom		1 584		
TAC		8 252		

Since 2009, a separate TAC is set for 7.a haddock; previously a separate allocation for 7.a existed within the TAC for 7, 8, 9 and 10.

The 2020 EU Council Regulation included Article 13, "Remedial measures for cod and whiting in the Celtic Sea" which will impact the Celtic Sea haddock fishery as these three species occupy similar areas. Article 13 implements spatial and fishing gear restrictions in an effort to reduce fishing pressure on cod and whiting.

8.2 The fishery

The official landings reported to ICES are given in Table 8.1. Before 2002, the TAC was well in excess of the landings in the TAC area. The TAC appeared to become restrictive for France in 2003–2004 and Ireland in 2001–2003. During 2005–2008 landings were well below the TAC. In 2009 and 2010 the total landings were still below the TAC, but the quota appeared to become restrictive again for Ireland and Belgium. Since 2011, the TAC has been close to the total landings and can be assumed to be restrictive for all countries. In the last three years uptake by France has reduced to around 45%. The UK quota share has increased substantially due to Brexit (Figure 8.3).

Figure 8.1 shows the distribution of international landings between 2016 and 2020. Most haddock landings were taken from the northern North Sea, Irish sea, Rockall and from the Celtic Sea.

Figure 8.2 shows a longer time-series of official landings and TAC. The time-series is characterized by a number of peaks with rapid increases in the landings, mostly followed by rapid decreases within a few years, suggesting the fishery was taking advantage of sporadic events of very high recruitment. During the 1960s and 1970s, three such peaks in landings occurred: the landings increased from less than 4000 t to 10 000 t or more. During the 1980s and early 1990s, landings were relatively stable around 2000–4000 t. During the mid-1990s the haddock landings increased again to over 10 000 t, mirroring increased landings in the Irish Sea in that period. Since the late 1990s the landings have varied between 7000 and 10 000 t and in 2012, the landings were the highest on record at more than 18 000 t.

Working Group estimates of the landings and discards are given in Table 8.2. The discard estimate for 2010 was the highest on record at 18 701 tonnes, this was mainly a consequence of the 2009 cohort entering the fishery. The overall catch in 2023 has declined to just under 10 000t.

Table 8.3 and Figure 8.4 show that Irish commercial LPUE was relatively low between 2003 and 2007 after which it increased. Effort in the French gadoid fleet has declined considerably since the early 2000s as the result of a decommissioning scheme. The French and Irish 7.fgh fleets both showed an increase in LPUE as the strong 2009 cohort entered the fishery. These data are presented for auxiliary information only; these fleets are not used directly in the assessment.

8.2.1 Information from the industry

No updated information from industry was received.

8.3 Data

8.3.1 Landings and discard numbers-at-age

Sampling levels have varied between countries in 2023. There is a slight decrease in landings and discard samples in 2023 but this is not thought to change the perception of stock status.

Discard and retained catch at age distributions are shown in Figure 8.5. Many of the discarded fish will be above the MLS, which is likely to be the result of restrictive quota. The strong 2018 year class was mainly discarded in 2020 and is mostly retained in 2021 at age 3 and at age 4 in 2022. The catch is dominated by 2 year olds in 2023 and these 2 year olds contribute most to the catch weight.

Landings numbers-at-age are given in Table 8.4 and discard numbers-at-age are given in Table 8.5. Despite some uncertainty about the quality of the discard data, it is possible to track strong year classes in both the discards and the landings-at-age matrices. Figure 8.6 shows proportional representation of landings relative to catch (discards + landings) by age, 2002–2023. Discards account for a large proportion of the catch numbers up to age 3. Figure 8.7 shows the proportions-at-age that are discarded. In 2022 and 2023, it appears that older fish are also being discarded. There is no sign of any strong incoming year class.

Sampled and un-sampled catch (landings and discards) by year are shown in Figure 8.8. There were more discard fill ins made in 2023.

Figure 8.9 shows that the raw stock weights-at-age which are fairly noisy, a 3-year running average was applied to the stock weights used in the assessment. There appear to be cyclical trends in the weights-at-age that follow cohorts (rather than year-effects). There is a decline in stock weight for age 4 and age 5 fish over the last few years.

8.3.2 Biological

The assumptions of natural mortality and maturity are described in the stock annex. The maturity ogive used in the assessment is quite sharp, with 0.39% of 2 year olds and 91% of 3 year olds mature (stock annex).

8.3.3 Surveys and commercial tuning fleets

The available surveys and commercial tuning fleets are described in detail in the stock annex. One survey index is used in the assessment: the FR-IRL-IBTS index, which is a combined index from the French EVHOE Q4 WIBTS and Irish IGFS Q4 WIBTS surveys. This is standardised following the VAST procedure (see Annex 2, stock annexes).

The index data are given Table 8.6. The standardised indices are given by year in Figure 8.10 and by cohort in Figure 8.11. Figure 8.12 shows the scatterplot matrices of the log indices. These plots indicate that the internal consistency of the indices is robust. Notably, there is a considerable reduction in the estimate of age 0 fish in the VAST index for 2022 and 2023. This is indicative of very low recruitment to the stock.

8.4 Historical stock development

Model used: SAM

Software used: Stock Assessment.Org (https://www.stockassessment.org)

Name: HAD7bk_2024_final_1

8.4.1 Data screening

The general approach to data screening and analysis was followed in addition to the data exploration tools available in the FLR package FLEDA. The results of the data screening are fully documented using R markdown and are available in the folder 'Data\ had.27.7.b–k on the ICES SharePoint. https://tinyurl.com/5h9dfxr9

8.4.2 Final update assessment

The final assessment was run with the same settings as established by WKCELTIC 2020 and described in the stock annex. While discards were combined with the landings and not supplied separately to the model, annual discard fractions were incorporated.

Figure 8.13 shows the residuals of that catch proportions-at-age. For age classes where discards dominate, the residuals are relatively large. There are no obvious pattern in the younger ages but the residuals in the middle of the time-series show a mostly positive evolution from the 2006 cohort. The strongest negative residuals occur for the older age classes in 2006. Observed and assessment predicted catches are shown in Figure 8.14. The predicted catches were generally accurate while there was a tendency for under estimation from 2011–2018. The predicted catch in the last 3 years is higher than the observed catch although the 2023 estimate is closer to the modelled estimate. The observed and predicted index catch at age values are shown in Figure 8.15. The assessment generally follows the survey index trends in age classes across the time-series.

In the proportions-at-age residual plots of the survey (FRA-IRL-WIBTS_VAST) there are no consistent patterns (Figure 8.16). The assessment generally follows the survey index trends in age classes across the time-series.

The SAM assessment is shown in Figure 8.17, detailing catch, landings, SSB F and recruits with 95% confidence intervals. As noted, the predicted catch is higher in 2020 and 2021. The 2022 model estimate of catch is closer to the observation although still overestimated somewhat. Fishing mortality and SSB estimates are very close to last year's assessment. The terminal F (0.417) remains above F_{MSY} (0.353). Recruitment is downscaled compared to last year's assessment.

8.4.3 State of the stock

Table 8.7 shows the estimated fishing mortality-at-age and Table 8.8 shows the stock numbers-at-age. The stock summary is given in Table 8.9.

The spawning–stock biomass (SSB) peaked in 2011 as the very strong 2009 year class matured; this cohort was followed by three years of below-average recruitment which led to a rapid decline in SSB after 2011. Recent recruitment has varied around the average, with a notable peak in 2009 and in 2018. In 2022 and 2023, recruitment is estimated to be the lowest in the observed time-series. SSB has declined, while fishing mortality (F) has been above F_{MSY} for the entire time-series but also shows a declining trend. There has also been an upward revision of fishing mortality.

8.5 Short-term projections

Because recruitment of haddock is characterised by sporadic events, the assumed median recruitment for the intermediate years introduces significant uncertainty for the SSB estimate.

Short-term projections were performed in SAM as a stochastic process. Recruitment was estimated at 234 566 in 2024 and 2025 respectively, (median resampled 1993–2023; thousands). For 2022 and 2023, there is very low recruitment to the stock. Despite this WGSCE2024 uses a median recruitment value for age 0 (234 566) in the assumption. In the past the stock has tended to produce above average recruitment following one or two years of low recruitment. Given that this is a haddock stock prone to recruitment pulses, it would not be realistic to assume that recruitment in 2024 will remain also at a low level. Therefore the working group decided to use median recruitment. The short-term predictions are expected to give a reasonably reliable estimate of landings and discards in 2024 (assuming average F 2021–2023 and average discard patterns seen in 2021-2023). Intermediate year assumptions are given in Table 7.10. The management options are given in Table 8.11.

8.6 MSY evaluations and biological reference points

ICES carried out and evaluation of MSY and PA reference points for this stock at WKCELTIC (ICES, 2020). The results are summarized below:

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	12 822	B_{pa}; in tonnes.	ICES (2020a)
	F_{MSY}	0.353	Based on simulation using a segmented regression stock–recruitment relationship (EqSim)	ICES (2020a)
Precautionary approach	B_{lim}	9227	Lowest observed SSB; in tonnes	ICES (2020a)
	B_{pa}	12 822	B_{lim} combined with the assessment error; B_{lim} × exp (1.645 × σ); σ = 0.20 (default setting); in tonnes	ICES (2020a)
	F_{lim}	1.40	F with 50% probability of SSB < B_{lim}	ICES (2020a)
	F_{pa}	0.708	$F_{p0.5}$; the F that leads to SSB ≥ B_{lim} with 95% probability	ICES (2020a)
EU MAP	MAP MSY $B_{trigger}$	12 822	MSY B_{pa}; in tonnes	EU (2019), ICES (2020a)
	MAP B_{lim}	9227	Lowest observed SSB; in tonnes	EU (2019), ICES (2020a)
	MAP F_{MSY}	0.353	F_{MSY}	EU (2019), ICES (2020a)
	MAP range F_{lower}	0.221	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU (2019), ICES (2020a)
	MAP range F_{upper}	0.521	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU (2019), ICES (2020a)

8.7 Management Plans

ICES is aware of the multiannual management plan (MAP) that has been adopted by the EU for this stock (EU, 2019) and that ICES considers to be precautionary. There is no agreed shared management plan between the EU and UK for this stock, and ICES provides advice according to ICES MSY approach. Catch scenarios consistent with the MAP F_{MSY} ranges are provided.

8.8 Uncertainties and bias in assessment and forecast

8.8.1 Landings

Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches, although the assessment is contingent on the accuracy of the landings statistics. Catch sampling in 2023 is lower than in previous years but is considered sufficient to describe the stock.

8.8.2 Discards

Irish discards have been monitored since 1995. The number of trips sampled has varied considerably over time (between three and 62 trips per year). Sample numbers were particularly low in 1995, 1999–2002 and 2006. During the remaining years, the number of sampled trips was considered sufficient to give reliable estimates of discards. In 2022, there was no sampling of the OTB_CRU fleet, however this metier only accounts for ~2% of the overall discard rate internationally.

French discard data exist from 2004 onwards but the data are not considered to be reliable before 2008. The time-series of French discards was reconstructed by assuming that 90% of one-year olds, 50% of two-year olds and 10% of three year olds were discarded throughout the time-series. These proportions were estimated from the available discard and retained catch data provided by France. Discards were estimated for the early part of the time-series at WKROUND (2012) and retained by WKCELTIC up to 2004.

Although recent discard estimates are considered to be more reliable, the problem remains that the number of observer trips is very small compared to the total number of trips (typically <1% of all trips are sampled). The level of uncertainty owing to the small sample sizes is likely to be high but the cost of increasing discard coverage would be considerable.

8.8.3 Assessment bias

Figure 8.18 shows the retrospective of the SAM analysis. The predicted catch shows little retrospective pattern neither does the SSB estimate with the Mohn's Rho for SSB estimated to be low at 1%. Recruitment is well estimated with a Mohn's Rho value of 5%. Fishing mortality has been upscaled in the latest assessment. The Mohn's Rho is estimated to be 10%.

The historical assessment results (Figure 8.19) shows a reduction in estimated stock size for the 2023 assessment as a result of recent low recruitment and older year classes being removed from the stock.

8.9 Forecast

The 2018 cohort is projected to account for 16% the projected catch in 2025. This strong cohort was picked up by both the Irish and French quarter 4 surveys in 2018 but its contribution only accounts for 5% of SSB in 2026.

Figure 8.20 shows the assessment and forecast of the final SAM run for the F_{MSY} catch option leading to an SSB of 13 307 tonnes in 2025 and advised catch of 4644 tonnes. The decrease in catch advice in 2025 is due to a combination of extremely low recruitment in 2022 and 2023 and a decrease in spawning stock size as well as an upward revision of fishing mortality.

There are historic low recruitment observations in 2022 and 2023. The assumed recruitment in 2024 and 2025 contributes 64% to the SSB in 2026, indicating that the forecast stock size is now more uncertain and highly dependent on individual year classes (Figure 8.21).

8.10 Recommendations for next benchmark

8.10.1 Stock audit

The audit of the 2024 report did not raise any concerns.

8.11 Recommendations for future work

Future benchmarks should consider mixed fisheries and multispecies interactions as well as environmental drivers that may be impacting on growth and recruitment of all three species.

Catch data should continue to be monitored for indirect evidence of improved selection patterns due to the augmented TCMs in the Celtic Sea. Direct monitoring of escapement through SMPs would also be useful.

It would be desirable to include discards separately in the assessment model in order to specify greater precision for the discard numbers-at-age than for the landings numbers-at-age. However; WKROUND (2012) concluded that this resulted in undesirable residual patterns. The benchmark workshop did not have sufficient time to fully evaluate this problem.

8.12 Management considerations

The stock size fluctuates strongly over the time. The size of the stock is determined to a large extent by recruitment, which has been erratic and in 2018 is shown to have been large. There is very low recruitment to the stock. There is no discernible relationship between stock size and recruitment, as is the case with most haddock stocks.

Fishing mortality has been consistently above F_{MSY}, but this has not led to a decreasing trend in stock size, which suggests that the stock is robust to overfishing, however F has been increasing since 2015 and at current levels the SSB could quickly fall below $MSYB_{trigger}$ if recruitment were to be low for three or four years. The high recruitment seen in 2018 is moving through the fishery and the older year classes are being removed from the stock.

Discarding of under-size as well as marketable fish is a serious problem for this stock, with approximately two thirds of catch numbers and almost half the catch weight being discarded on average over the past decade. Alternative or complimentary approaches to managing such strong, recruit-driven fluctuations are required, especially with regard to the EU landings obligation.

The minimum landing size of haddock is 30 cm, which is approximately the same as the mean length of two-year old haddock in the Celtic sea. Because gadoids are caught in a mixed fishery, restrictive quota in recent years have led to increased discarding of marketable fish as well as already considerable discarding of undersized fish. Technical measures have been introduced to reduce discards of undersize gadoids (110 mm square-mesh panel in the *Nephrops* fisheries and 100 mm in the gadoid fisheries). It is not clear whether this is sufficient to reduce discard mortality of future cohorts. It is important that technical measures are fully implemented and their effectiveness in reducing discards and impact on commercial catches are monitored and evaluated.

8.13 References

EU. 2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008.

COUNCIL REGULATION (EU) 2020/123 of 27 January 2020, fixing for 2020 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters.

COUNCIL REGULATION (EU) 2021/703 of 26 April 2021, amending Regulations (EU) 2021/91 and (EU) 2021/92 as regards certain fishing opportunities for 2021 in Union and non-Union waters.

ICES. 2016a. Report of the Workshop to consider FMSY ranges for stocks in ICES categories 1 and 2 in Western Waters (WKMSYREF4), 13–16 October 2015, Brest, France. ICES CM 2015/ACOM:58. 187 pp.

ICES. 2016b. EU request to ICES to provide F_{MSY} ranges for selected stocks in ICES subareas 5 to 10. ICES Advice 2016 Book 5, ICES Special Request Advice, Published 5 February 2016.

8.14 Tables and Figures

Table 8.1. Haddock in 7.b,c, e-k. Official landings (quota uptake in brackets).

Year	BEL	ESP	FRA	IRL	UK*	Others	Total	TAC**
1994	123	0	2788	908	240	17	4076	
1995	189 (28%)	19	2964 (74%)	966 (72%)	266 (44%)	64	4468	6000
1996	133 (9%)	48	4527 (49%)	1468 (47%)	439 (31%)	38	6653	14000
1997	246 (16%)	54	6581 (71%)	2789 (90%)	569 (41%)	31	10270	14000
1998	142 (6%)	260	3674 (28%)	2788 (63%)	444 (22%)	52	7360	20000
1999	51 (2%)	88	2725 (19%)	2034 (42%)	278 (13%)	71	5247	22000
2000	90 (5%)	110	3088 (28%)	3066 (83%)	289 (17%)	13	6656	16600
2001	165 (12%)	646	4842 (61%)	3608 (135%)	422 (35%)	19	9702	12000
2002	132 (128%)		4348 (70%)	2188 (106%)	315 (34%)	106	7089	9300
2003	118 (130%)		5781 (106%)	1867 (103%)	393 (48%)	82	8241	8185
2004	136 (127%)		6130 (96%)	1715 (80%)	313 (33%)	159	8453	9600
2005	167 (130%)		4174 (54%)	2037 (80%)	292 (25%)	197	6867	11520
2006	99 (77%)		3191 (42%)	1874 (73%)	274 (24%)	183	5621	11520
2007	119 (93%)		4143 (54%)	1931 (75%)	385 (33%)	50	6628	11520
2008	109 (84%)		3638 (47%)	1800 (70%)	566 (49%)	121	6234	11579
2009	131 (102%)		5430 (70%)	2983 (116%)	716 (62%)	48	9308	11579
2010	170 (132%)		6240 (81%)	2609 (101%)	852 (74%)	128	9999	11579
2011	211 (143%)		8389 (95%)	3323 (112%)	1657 (124%)	129	13709	13316
2012	232 (125%)		11793 (106%)	4129 (112%)	1901 (114%)	166	18221	16645
2013	174 (111%)		8747 (93%)	2699 (86%)	1455 (103%)	23	13098	14148
2014	99 (94%)		6375 (101%)	2092 (99%)	785 (83%)	21	9372	9479
2015	118 (127%)		5679 (102%)	1657 (89%)	769 (92%)	6	8229	8342
2016	88 (109%)		4487 (93%)	1730 (107%)	692 (95%)	27	7024	7258
2017	110 (128%)		4885 (95%)	1677 (97%)	690 (89%)	12	7374	7751
2018	89 (116%)		4470 (97%)	1444 (94%)	583 (84%)	9	6595	6910
2019	90 (97%)		4526 (82%)	1559 (84%)	516 (62%)	170	6861	8329
2020	107 (88%)		3808 (53%)	2628 (109%)	543 (50%)	222	7308	10859
2021	155 (105%)		4249 (48%)	3379 (114%)	515 (21%)	149	8447	15000
2022	190 (130%)		3904 (45%)	3110 (107%)	587 (23%)	234	8025	15000
2023	108 (95%)		2855 (42%)	2987 (131%)	642 (24%)	287	6878	11901

*** UK Includes Channel Islands.**

**** TAC Applied to subareas 7–10 from 1995 to 2008 and to 7b–k, 8, 9 and 10 from 2009 onwards.**

Table 8.2. Haddock in 7.b,c, e-k. ICES estimate of the landings (lan) and discards (dis).

Year	BEL Lan	ESP Lan	FRA Lan	IRL Lan	UK Lan	Others Lan	Total Lan	FRA Dis*	IRL Dis**	Others Dis***	Total Dis****	Total Catch
1993							3348	505	594	109	1208	4556
1994							4131	1116	594	176	1886	6017
1995							4470	730	1221	267	2218	6688
1996							6756	3170	713	426	4309	11065
1997							10827	2129	502	253	2883	13710
1998							7928	680	140	114	934	8862
1999							4970	477	54	55	586	5556
2000							7499	1587	727	189	2503	10002
2001							9278	2234	743	441	3418	12696
2002	134	85	3878	2070	301	20	6488	871	5651	552	7073	13561
2003	116	82	5960	1731	362	41	8292	1835	6941	680	9456	17748
2004	137	143	6336	1785	303	73	8777	1108	5156	486	6750	15527
2005	166	209	4101	2078	285	0	6839	1564	5818	2571	9953	16792
2006	98	194	3131	1899	269	1	5592	1313	2745	1841	5899	11491
2007	117	186	4134	2139	385	1	6961	372	2483	696	3552	10513
2008	108	166	4577	1984	558	0	7392	990	3741	2930	7660	15052
2009	129	49	5503	3270	711	2	9664	905	3320	3098	7322	16986
2010	170	115	6421	2899	821	3	10429	3260	4570	10870	18701	29130
2011	211	78	8381	3702	1551	35	13957	3963	4329	7515	15807	29764
2012	232	79	12293	4596	1929	67	19196	2754	2653	2878	8285	27481
2013	174	51	8738	3097	1458	20	13538	671	1116	2175	3962	17501
2014	99	3	6350	2543	849	2	9846	1732	1171	2715	5619	15464
2015	118	0	5683	2035	766	6	8608	2024	2519	2398	6941	15549
2016	88	0	4573	2271	689	27	7648	5482	2810	3773	12065	19713
2017	111	0	4895	2381	699	11	8099	2633	1928	2130	6691	14789
2018	89	0	4377	1989	578	12	7046	1920	1189	2688	5798	12844
2019	89	89	4548	2412	518	0	7656	1616	1445	542	3603	11259
2020	102	176	3815	3193	546	27	7859	1450	1873	937	4260	12119
2021	149	108	4257	4211	516	19	9260	706	1075	604	2385	11645
2022	189	230	3915	3974	584	4	8895	1219	1049	505	2773	11668
2023	107	280	2855	3819	658	-	7718	246	1296	705	2246	9964

*** For 1993–2007 fixed discard ratios were used to estimate French discards.**

**** For 1993–1994, the mean Irish discards over 1995–1999 were used.**

***** Estimated from the proportion of the landings of `Others' between 1993 and 2012.**

****** Discard estimates are available from 2005; prior to 2005, discard estimates are based on limited sampling.**

Table 8.3. Haddock in 7.b,c, e–k. LPUE (kg/hour fishing) of haddock and effort (hours fishing x 1000) for Irish Otter trawls in 7.bc, 7.fgh and 7.jk, the French demersal fleet in 7.bc–ek and effort only for the UK trawl fleets (excluding beam trawls) in 7.e–k (effort in fishing days).

	FR GAD 7ek effort	FR GAD 7ek lpue	IRL OTB 7bc effort	IRL OTB 7bc lpue	IRL OTB 7fgh effort	IRL OTB 7fgh lpue	IRL OTB 7jk effort	IRL OTB 7jk lpue	UK Trawl 7e–k effort
1983	NA	NA	NA	NA	NA	NA	NA	NA	51.5
1984	NA	NA	NA	NA	NA	NA	NA	NA	161.8
1985	NA	NA	NA	NA	NA	NA	NA	NA	143.7
1986	NA	NA	NA	NA	NA	NA	NA	NA	123.5
1987	NA	NA	NA	NA	NA	NA	NA	NA	108.9
1988	NA	NA	NA	NA	NA	NA	NA	NA	112.9
1989	NA	NA	NA	NA	NA	NA	NA	NA	119.9
1990	NA	NA	NA	NA	NA	NA	NA	NA	133.2
1991	NA	NA	NA	NA	NA	NA	NA	NA	118.8
1992	NA	NA	NA	NA	NA	NA	NA	NA	129.9
1993	NA	NA	NA	NA	NA	NA	NA	NA	101.1
1994	NA	NA	NA	NA	NA	NA	NA	NA	88.5
1995	NA	NA	78	5.77	64	1.48	106	2.20	88.1
1996	NA	NA	47	4.16	60	5.35	73	3.24	89.5
1997	NA	NA	63	4.36	65	5.83	92	8.23	101.8
1998	NA	NA	79	5.71	72	4.09	99	5.88	94.6
1999	NA	NA	77	5.27	51	2.35	52	3.53	132.8
2000	306	6.12	74	4.73	61	10.43	72	4.25	141.1
2001	333	10.57	78	4.30	69	8.69	81	7.41	117.5
2002	289	10.63	63	2.81	79	3.22	108	5.50	113.1
2003	264	15.15	81	2.09	87	3.26	123	3.88	102.4
2004	217	19.39	82	2.51	97	3.49	108	3.35	105.5
2005	175	14.67	69	2.45	127	4.53	93	3.70	100.9
2006	167	10.64	60	2.56	119	4.19	89	3.59	106.3
2007	160	14.97	60	3.31	136	4.01	103	3.66	113.6
2008	148	19.60	48	4.36	127	4.56	84	4.60	93.7
2009	150	22.65	48	5.47	141	9.25	82	7.09	98.6
2010	131	30.83	54	4.36	144	7.33	101	5.15	103.7

	FR GAD 7ek effort	FR GAD 7ek lpue	IRL OTB 7bc effort	IRL OTB 7bc lpue	IRL OTB 7fgh effort	IRL OTB 7fgh lpue	IRL OTB 7jk effort	IRL OTB 7jk lpue	UK Trawl 7e–k effort
2011	216	22.90	40	6.39	129	10.51	84	5.58	87.1
2012	188	45.03	44	4.93	135	13.17	84	6.58	86.2
2013	215	27.40	42	5.38	126	8.69	80	4.92	40.3
2014	203	19.81	46	5.22	142	5.11	77	3.91	32.1
2015	NA	NA	31	4.42	150	4.95	78	2.91	21.2
2016	NA	NA	39	2.41	164	4.94	83	3.09	NA
2017	NA	NA	36	2.25	151	5.10	92	2.43	NA
2018	NA	NA	46	2.19	125	5.33	93	1.70	NA
2019	NA	NA	32	2.42	127	5.86	93	1.73	NA
2020	NA	NA	34	2.80	98	11.2	84	1.86	NA
2021	NA	NA	39	4.23	92	14.68	86	2.70	NA
2022	NA	NA	40	4.66	73	15.50	75	1.96	NA
2023	NA	NA	35	9.40	73	12.36	65	2.37	NA

Table 8.4. Haddock in 7.b,c, e–k. Landings numbers-at-age.

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8 +
1993	0	491	3291	948	810	255	129	129	45
1994	0	1277	5223	674	302	94	24	35	16
1995	0	4275	1622	1327	270	245	46	0	0
1996	0	3693	15998	818	313	93	32	10	9
1997	0	1353	9645	5553	716	354	139	144	110
1998	0	167	3184	7403	1443	307	178	86	61
1999	0	476	654	1464	2425	307	18	19	6
2000	0	2197	2996	784	741	1250	205	35	28
2001	0	4297	8638	1131	303	317	321	54	39
2002	0	879	4274	3400	765	39	89	74	26
2003	0	703	8791	2160	1226	116	43	49	51
2004	0	125	5948	4663	928	589	51	12	20
2005	0	1075	1732	4230	1821	280	75	1	3
2006	0	839	3250	1034	2189	484	42	28	0
2007	0	404	4617	2916	737	1310	161	33	4
2008	0	1692	3268	3736	1046	286	414	91	50
2009	0	338	7111	2760	1890	577	228	234	38
2010	0	1757	5192	6031	1036	580	257	110	123
2011	0	100	12726	3607	3410	661	261	129	132
2012	0	82	1135	19931	2559	1795	323	109	108
2013	0	86	465	1899	10533	861	468	96	44
2014	0	277	854	467	1511	5585	368	219	40
2015	0	41	4881	632	309	928	2030	257	80
2016	0	62	310	5200	216	143	546	682	92
2017	0	58	2019	1071	3930	135	117	246	312
2018	0	70	714	2833	926	1653	42	64	150
2019	0	513	1566	1257	2678	529	762	41	110
2020	0	120	4318	1449	755	1381	260	175	30
2021	0	285	1295	6691	740	569	640	248	169
2022	0	187	1067	2455	4952	317	175	176	82
2023	0	15	2676	1199	2470	3186	104	48	46

Table 8.5. Haddock in 7.b,c, e–k. Discard numbers-at-age.

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8+
1993	0	7617	2816	160	6	0	0	0	0
1994	0	15120	3069	170	5	0	0	0	0
1995	0	32830	1977	91	4	0	0	0	0
1996	0	20734	8976	187	9	0	0	0	0
1997	0	12613	10022	493	5	0	0	0	0
1998	0	3580	2348	445	5	0	0	0	0
1999	0	3742	1562	100	10	0	0	0	0
2000	0	29015	2521	64	3	0	0	0	0
2001	0	25234	6772	219	2	0	0	0	0
2002	0	21624	20729	249	7	0	0	0	0
2003	0	52412	11075	352	8	0	0	0	0
2004	0	11733	21598	1395	61	0	0	0	0
2005	0	30472	25291	6821	97	1	0	0	0
2006	0	20089	4529	11	10	4	1	0	0
2007	0	10748	8498	572	6	6	0	0	0
2008	0	34221	12620	1676	78	0	0	0	0
2009	0	21175	13989	592	64	0	0	0	0
2010	0	95699	19014	2742	34	1	0	0	0
2011	0	5881	58967	1675	262	16	1	0	1
2012	0	2732	5169	18518	153	55	2	0	0
2013	0	4076	2767	1372	4028	58	2	1	1
2014	0	20197	3315	507	631	732	4	1	0
2015	0	3590	18090	704	26	155	162	13	6
2016	0	27587	5222	8406	51	12	56	501	2
2017	0	3208	11913	1602	2121	31	2	4	3
2018	0	5287	5127	5306	491	215	0	2	2
2019	0	12878	2847	773	409	37	17	1	4
2020	0	2722	10938	597	28	25	1	1	0
2021	0	4890	3773	2799	23	12	1	0	0
2022	0	3498	2128	2216	1743	29	18	0	0
2023	0	566	5206	903	900	687	0	0	0

Table 8.6. Haddock in 7.b,c, e–k. VAST survey data.

Year \Age	0	1	2	3	4	5	6	7
2003	34657.1	183901.4	14824.11	1271.209	1077.005	20.317	15.05	8.221
2004	104108	18644.98	23294.92	2331.764	857.426	427.252	855.369	9.569
2005	76847.96	31331.95	4530.519	6780.567	867.029	210.172	50.803	0
2006	30897.08	10023.17	6396.957	1428.127	1299.173	240.659	56.086	32.995
2007	292627.7	15370.73	3664.862	2102.062	678.878	801.197	107.088	14.935
2008	84867.76	52050.11	2551.022	672.422	793.756	288.593	777.782	187.043
2009	895176.1	18738.14	15438	606.974	369.291	275.464	406.445	164.14
2010	36900.74	304741.5	10123.78	4855.938	247.623	213.787	354.202	110.356
2011	22551.86	13340.71	75804.35	2271.317	1240.737	211.431	146.219	51.953
2012	7666.998	6687.683	3972.997	13359.49	748.524	585.504	109.112	51.764
2013	261170.2	2477.077	2832.642	1366.481	5305.446	371.162	418.306	48.924
2014	30548.27	55737.78	1017.904	865.09	931.7	1846.524	347.384	129.816
2015	132153.5	26940.71	16984.26	596.107	374.817	617.137	1228.794	78.781
2016	21883.07	47017.02	12361.18	5441.418	428.786	196.485	933.596	265.76
2017	69643.4	6054.359	15135.19	2681.514	927.991	90.063	17.304	189.139
2018	281978.1	9037.188	1621.882	2571.67	1496.166	678.873	28.096	28.995
2019	104146.9	127131.6	4507.18	964.693	1677.255	481.623	348.946	25.758
2020	32072.81	37079.58	54321.79	944.239	493.966	1061.173	1272.678	358.153
2021	74420.03	14555.64	12443.3	12688.66	277.992	73.44	349.207	162.558
2022	867.503	23531.07	5573.722	4502.198	5772.396	166.346	91.706	130.105
2023	931.74	610.792	11343.55	1614.277	1441.52	2096.595	140.238	11.766

Table 8.7. Haddock in 7.b,c, e–k. Fishing mortality- (F) at-age.

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8
1993	0	0.332	0.724	0.576	0.576	0.568	0.551	0.617	0.617
1994	0	0.324	0.702	0.555	0.547	0.536	0.52	0.582	0.582
1995	0	0.321	0.698	0.555	0.546	0.533	0.518	0.578	0.578
1996	0	0.313	0.691	0.56	0.554	0.539	0.524	0.583	0.583
1997	0	0.322	0.721	0.608	0.62	0.613	0.602	0.665	0.665
1998	0	0.316	0.716	0.614	0.646	0.65	0.644	0.706	0.706
1999	0	0.302	0.69	0.592	0.628	0.636	0.633	0.686	0.686
2000	0	0.324	0.758	0.656	0.704	0.72	0.72	0.763	0.763
2001	0	0.33	0.786	0.689	0.752	0.772	0.777	0.815	0.815
2002	0	0.319	0.777	0.684	0.76	0.789	0.801	0.838	0.838
2003	0	0.307	0.748	0.669	0.754	0.83	0.857	0.896	0.896
2004	0	0.306	0.744	0.662	0.735	0.817	0.842	0.862	0.862
2005	0	0.298	0.709	0.603	0.633	0.672	0.667	0.676	0.676
2006	0	0.263	0.609	0.507	0.518	0.544	0.54	0.574	0.574
2007	0	0.248	0.584	0.49	0.48	0.491	0.484	0.523	0.523
2008	0	0.247	0.598	0.521	0.506	0.507	0.505	0.564	0.564
2009	0	0.23	0.565	0.519	0.519	0.527	0.526	0.595	0.595
2010	0	0.21	0.525	0.504	0.52	0.544	0.555	0.642	0.642
2011	0	0.192	0.485	0.491	0.528	0.572	0.6	0.715	0.715
2012	0	0.181	0.458	0.481	0.531	0.593	0.634	0.774	0.774
2013	0	0.171	0.43	0.449	0.497	0.559	0.605	0.758	0.758
2014	0	0.158	0.403	0.427	0.467	0.532	0.581	0.745	0.745
2015	0	0.145	0.373	0.411	0.449	0.512	0.569	0.744	0.744
2016	0	0.144	0.366	0.416	0.461	0.524	0.579	0.76	0.76
2017	0	0.141	0.365	0.426	0.488	0.558	0.604	0.784	0.784
2018	0	0.135	0.352	0.422	0.487	0.563	0.604	0.784	0.784
2019	0	0.119	0.314	0.395	0.477	0.564	0.614	0.799	0.799
2020	0	0.106	0.277	0.363	0.46	0.563	0.609	0.787	0.787
2021	0	0.109	0.28	0.372	0.496	0.635	0.699	0.897	0.897
2022	0	0.109	0.275	0.362	0.484	0.626	0.697	0.896	0.896
2023	0	0.117	0.289	0.373	0.492	0.623	0.681	0.871	0.871

Table 8.8. Haddock in 7.b,c, e–k. Stock numbers-at-age (start of year) (`1000).

	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8
1993	136156	49682	12994	4506	1238	369	300	188	87
1994	400185	45383	17435	3517	1579	443	137	115	100
1995	473824	135535	15666	4841	1255	599	172	55	83
1996	165127	160880	47081	4324	1726	474	237	69	53
1997	58956	55508	58936	12692	1526	649	188	97	48
1998	86301	19599	19236	16754	4033	525	236	70	52
1999	365380	28769	6892	5304	5755	1293	180	83	41
2000	347571	124329	10464	1945	1859	2016	448	65	43
2001	475192	116519	43548	2726	623	609	646	144	35
2002	1009731	159202	40009	11221	828	187	190	196	54
2003	232693	345601	57562	9814	3597	231	59	58	74
2004	347182	80248	119250	15173	3060	1068	64	17	36
2005	242907	115439	29985	31363	4742	896	279	16	15
2006	186495	79864	39443	8138	10134	1558	286	89	11
2007	703465	63896	29716	11961	3156	3917	590	113	36
2008	393393	229802	24496	9339	4479	1313	1590	246	64
2009	2401344	131042	85193	7600	3508	1747	559	652	119
2010	204335	806739	51954	27076	2896	1372	699	230	296
2011	86208	69508	309456	17107	9943	1203	539	272	199
2012	56808	28709	29678	103842	6513	3771	474	200	162
2013	627247	19600	11781	11805	38631	2513	1368	171	113
2014	215795	207471	8323	4278	5385	14804	987	500	91
2015	482405	74731	84798	3207	1713	2464	5740	383	191
2016	98216	163740	33192	32090	1296	708	1063	2178	188
2017	144659	32738	66171	13357	12373	507	280	413	752
2018	920762	45443	14040	24782	5630	4787	187	106	372
2019	308835	311039	18095	5654	9907	2279	1795	70	156
2020	154967	100757	136524	6793	2347	3909	894	647	70
2021	234566	52335	44724	58565	2683	928	1410	337	227
2022	8353	79521	22354	19658	25521	1015	327	448	156
2023	4104	2949	35923	9447	8591	10254	352	107	161

Table 8.9. Haddock in 7.b,c,e–k. Stock Summary: Estimated recruitment, spawning–stock biomass (SSB), and average fishing mortality.

Year	Low	R(age 0)	High	Low	SSB	High	Low	Fbar(3-5)	High
1993	65039	136156	285039	6115	9236	13948	0.40	0.57	0.83
1994	245618	400185	652018	7566	10995	15979	0.40	0.55	0.76
1995	291900	473824	769133	8183	11578	16381	0.41	0.55	0.73
1996	102561	165127	265861	15401	20813	28128	0.42	0.55	0.73
1997	36627	58956	94897	19167	25326	33465	0.48	0.61	0.78
1998	53458	86301	139320	15485	19884	25534	0.51	0.64	0.80
1999	227790	365380	586077	10497	13147	16466	0.50	0.62	0.77
2000	218042	347571	554046	9579	11655	14180	0.57	0.69	0.84
2001	303962	475192	742878	14056	18511	24378	0.61	0.74	0.89
2002	658021	1009731	1549426	18376	23546	30171	0.62	0.74	0.90
2003	157956	232693	342794	22289	27899	34920	0.61	0.75	0.92
2004	237526	347182	507463	31972	40622	51612	0.59	0.74	0.92
2005	165861	242907	355744	23704	29128	35793	0.52	0.64	0.78
2006	125904	186495	276245	20371	24529	29534	0.41	0.52	0.66
2007	479952	703465	1031067	19042	22418	26392	0.39	0.49	0.61
2008	269643	393393	573936	17484	20644	24375	0.42	0.51	0.63
2009	1636595	2401344	3523446	26402	32509	40029	0.43	0.52	0.64
2010	133955	204335	311691	32758	38900	46193	0.43	0.52	0.64
2011	59521	86208	124860	77023	98507	125983	0.44	0.53	0.65
2012	38240	56808	84390	56384	70609	88423	0.44	0.54	0.66
2013	429961	627247	915056	36601	45453	56447	0.41	0.50	0.61
2014	145940	215795	319087	23476	28588	34814	0.39	0.48	0.58
2015	331718	482405	701543	32384	39786	48880	0.37	0.46	0.56
2016	67204	98216	143538	30886	37113	44595	0.38	0.47	0.57
2017	95422	144659	219303	35825	42970	51540	0.40	0.49	0.60
2018	625003	920762	1356477	27966	33265	39568	0.40	0.49	0.60
2019	209689	308835	454858	25080	29349	34345	0.39	0.48	0.59
2020	104372	154967	230086	45339	57873	73873	0.37	0.46	0.58
2021	151342	234566	363555	44201	55479	69635	0.39	0.50	0.64
2022	4759	8353	14660	33702	42137	52684	0.38	0.49	0.64
2023	1827	4104	9217	27276	34916	44696	0.36	0.50	0.69
2024	4104	234566*	2401344	16427	16427	31739			

*** Median resampled (1993–2023), as estimated by stochastic projection.**

Table 8.10. Haddock in divisions 7.b,c,e–k. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{ages\ 3–5}$ (2024)	0.496	F = $F_{Average\ (2021–2023)}$, rescaled to F_{2023}
SSB (2025)	13307	Short-term forecast; in tonnes
$R_{age\ 0}$ (2024, 2025)	234566	Median recruitment, resampled from the years 1993–2023; in thousands
Total catch (2024)	7698	Short-term forecast; in tonnes
Projected landings (2024)	6874	Short-term forecast, assuming average 2021–2023 landing pattern; in tonnes
Projected discards (2024)	824	Short-term forecast, assuming average 2021–2023 discard pattern; in tonnes

*** Random resampling of a distribution may lead to different median estimates.**

Table 8.11. Haddock in divisions 7.b,c,e–k. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change*	% advice change^	Probability of SSB (2026) <Blim(%)
ICES advice basis										
MSY approach: F_{MSY}	4644	3375	1269	0.353	0.282	0.071	19379	46	-44	7.5
Other scenarios										
EU MAP ^^: F_{MSY}	4644	3375	1269	0.353	0.282	0.071	19379	46	-44	7.5
EU MAP^^ $F_{MSY\ lower}$	3099	2277	822	0.221	0.177	0.044	20896	57	-62	4.5
EU MAP^^ $F_{MSY\ upper}$	6353	4548	1805	0.521	0.416	0.105	17715	33	-23	11.6
F = 0	0	0	0	0	0	0	24025	81	-100	1.14
F_{pa}	7978	5624	2354	0.71	0.57	0.142	16118	21	-3	16.8
F_{lim}	12384	8239	4145	1.40	1.12	0.28	12013	-9.7	50	34
$SSB_{2026} = B_{lim}$	15544	9778	5766	2.2	1.75	0.44	9227	-31	88	50
$SSB_{2026} = B_{pa}$= MSY $B_{trigger}$	11488	7748	3740	1.23	0.98	0.25	12822	-3.6	39	30
$F = F_{2024}$	6115	4387	1728	0.50	0.40	0.100	17946	35	-26	11.0
$SSB_{2026} = SSB_{2025}$	10968	7451	3517	1.14	0.91	0.23	13307	0.00	33	28

* SSB_{2026} forecast relative to SSB_{2025}.
^ Advice values for 2025 relative to the MSY value for 2024 (8252 tonnes).
^^ EU multiannual plan (MAP) for the Western Waters (EU, 2019).

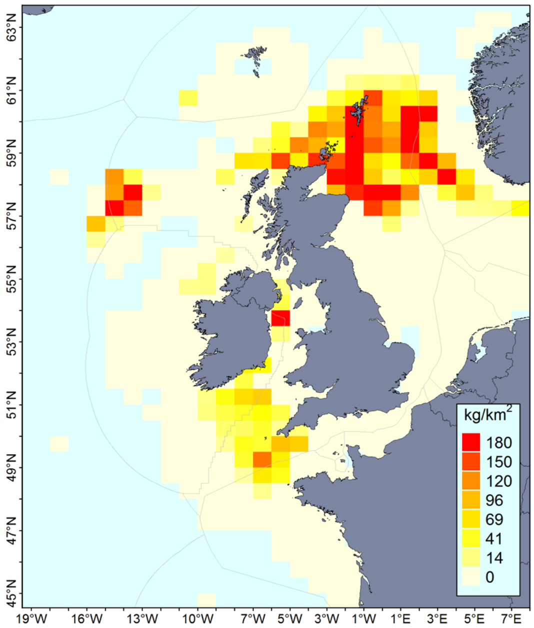


Figure 8.1. International haddock landings by ICES rectangle (all gears; 2016–2020, data from https://stecf.jrc.ec.europa.eu/data-dissemination).

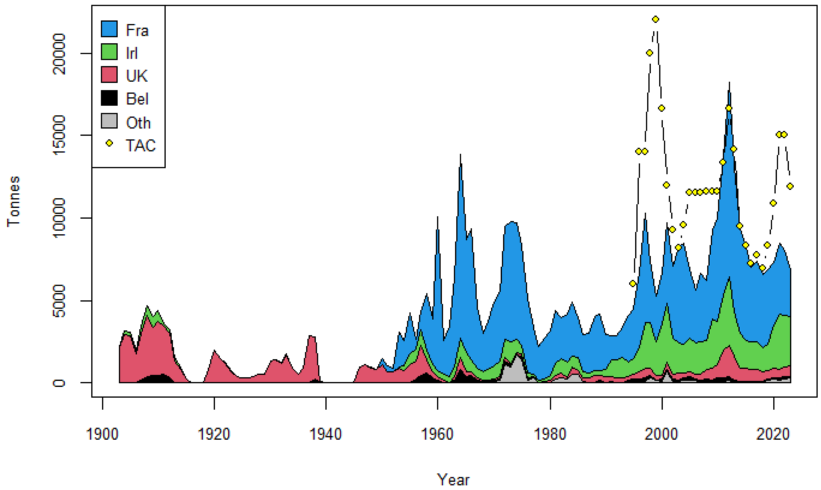


Figure 8.2. Haddock in 7.b,c,e–k. Official ICES landings and TAC of haddock in 7.b–k.

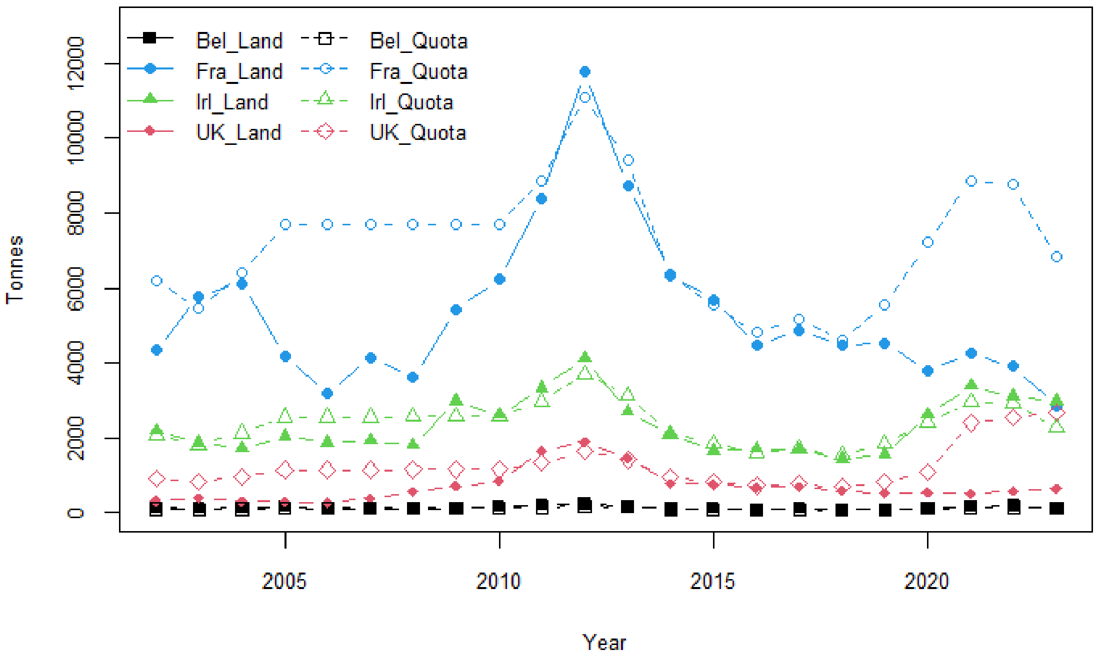


Figure 8.3. Haddock in 7.b,c,e–k. Official ICES landings and quota by country.

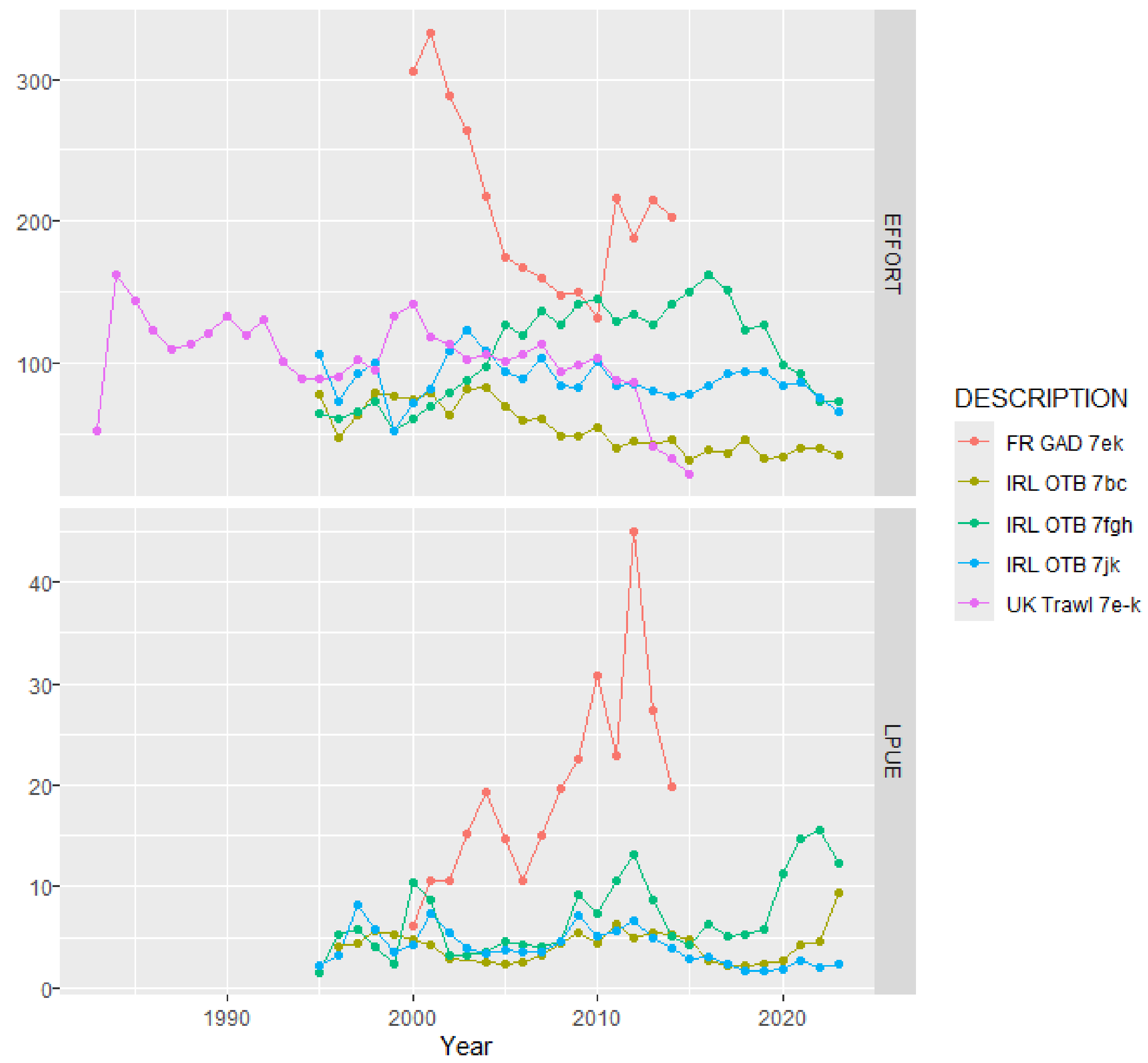


Figure 8.4. Haddock in 7.b,c,e–k. Effort ('1000 h) of the Irish Otter trawl fleets, the French demersal otter trawl fleet and for UK trawl fleet (effort in fishing days, rescaled to other fleets) and LPUE(kg/h) for the Irish and French fleets.

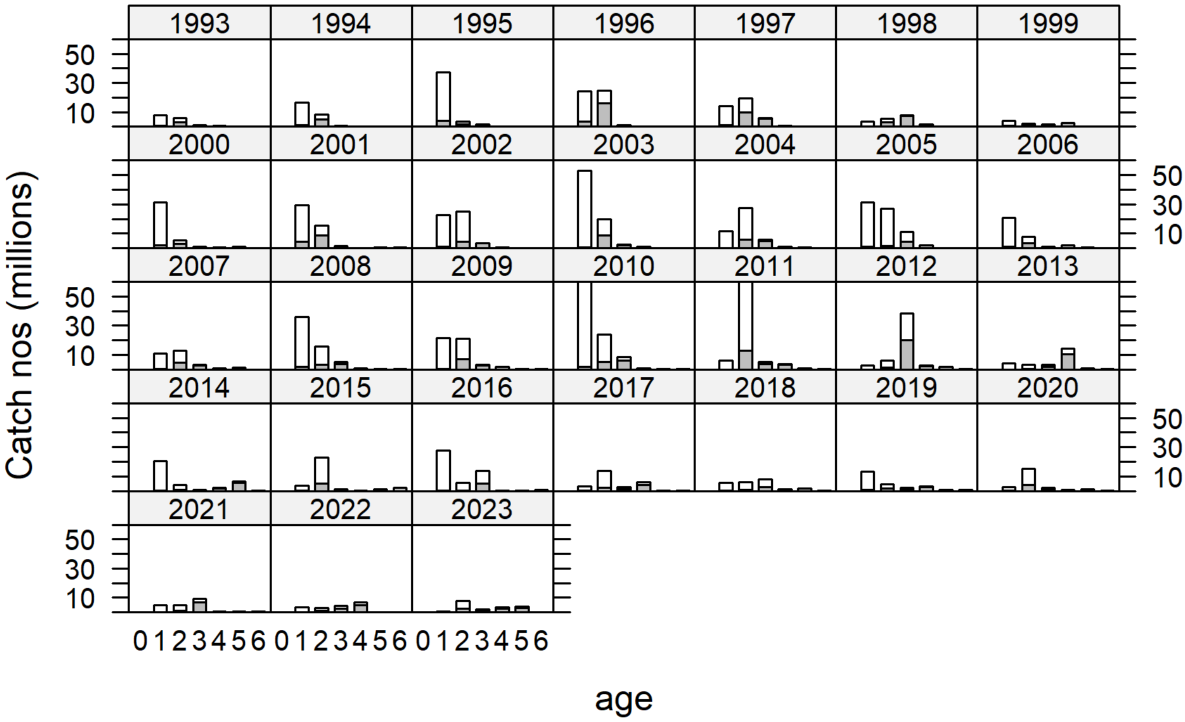


Figure 8.5. Haddock in 7.b,c,e–k. Catch by number by age class (grey = landings, white = discards).

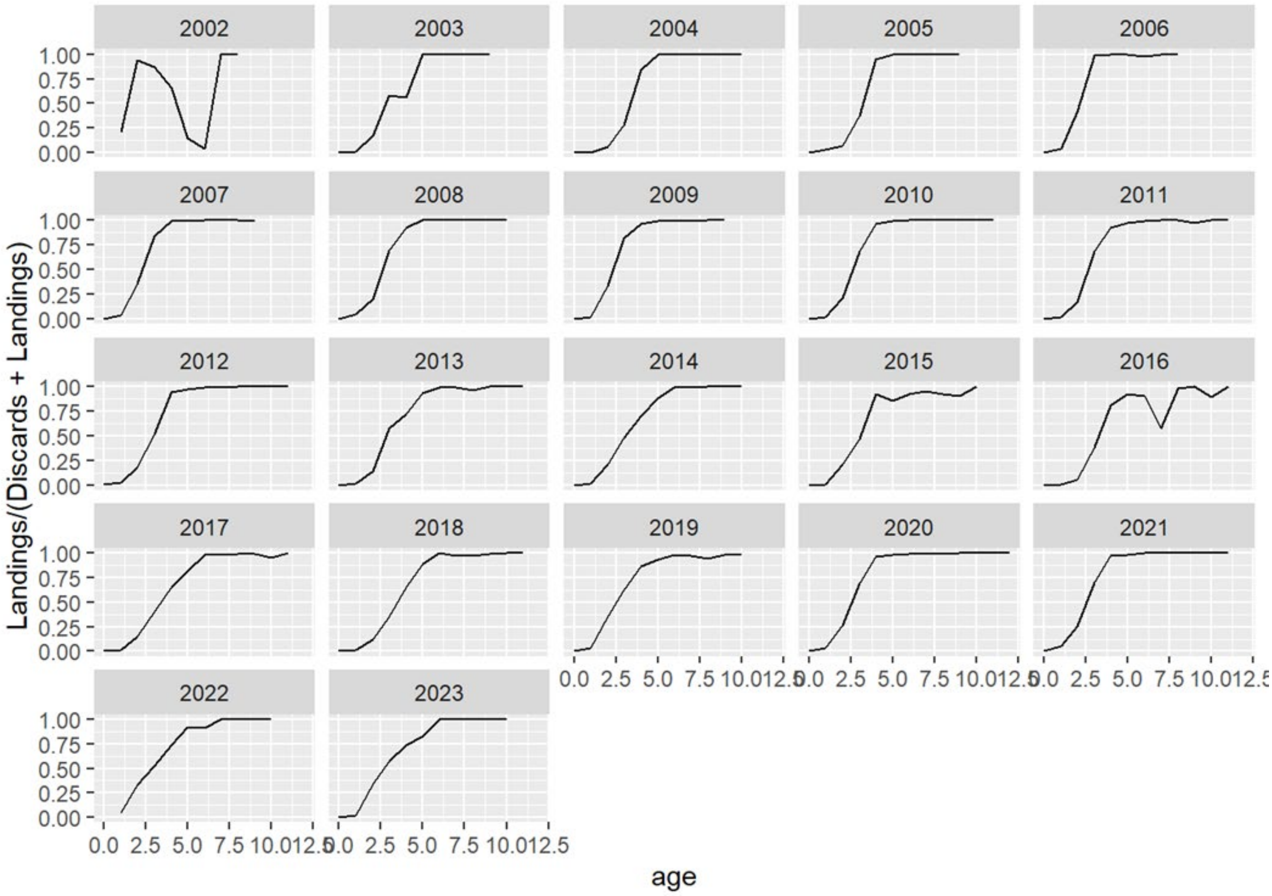


Figure 8.6. Haddock in 7.b,c,e–k. Proportional representation of landings relative to catch (discards + landings) by age.

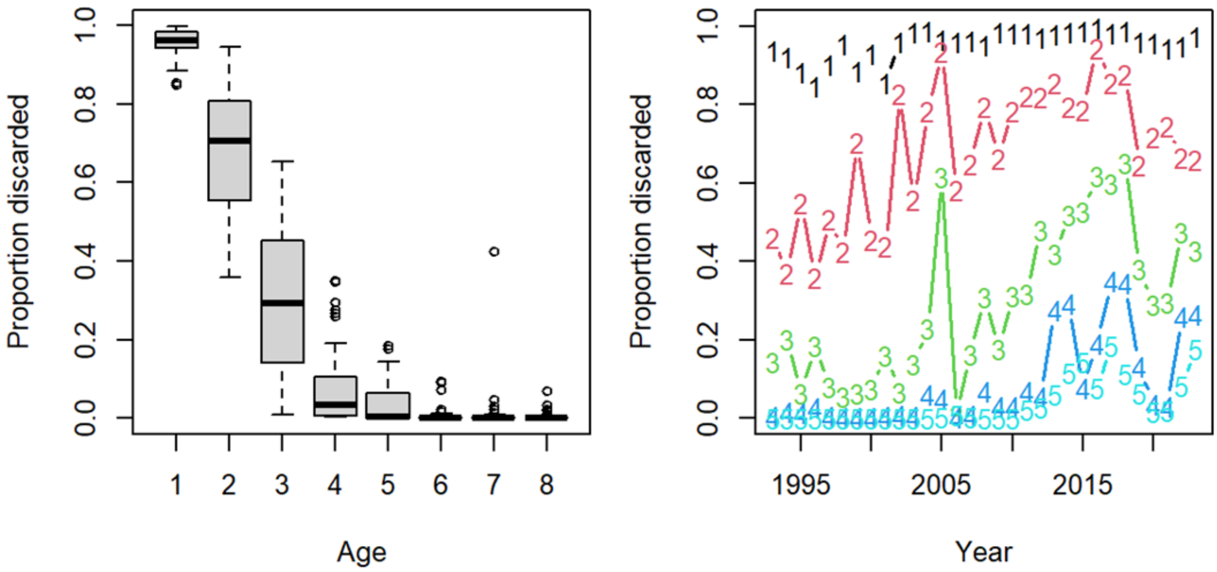


Figure 8.7. Haddock in 7.b,c,e–k. Proportion of discards by age (left) and year (right).

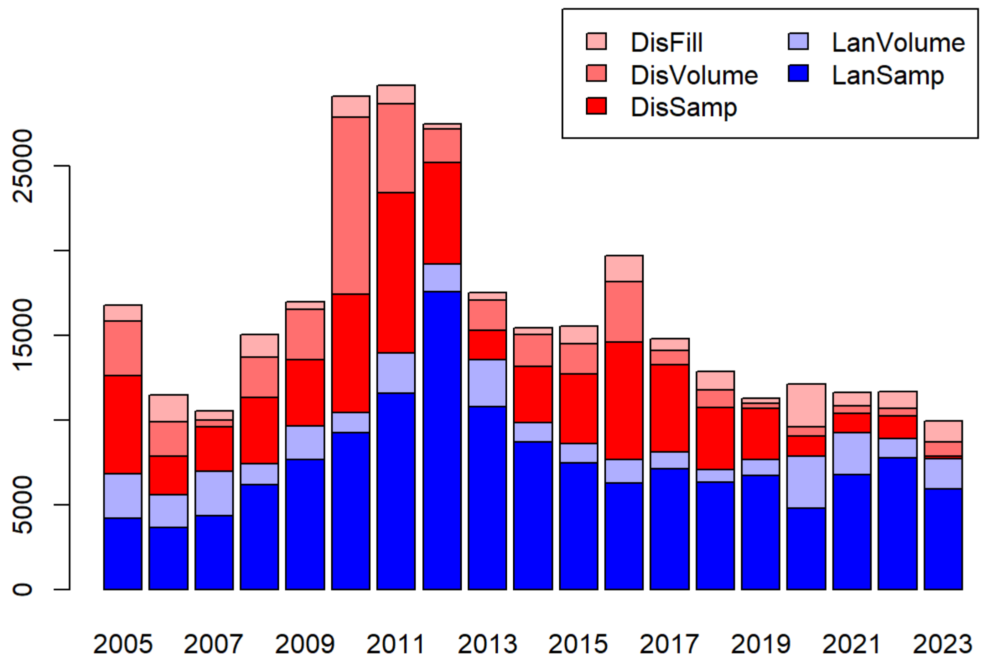


Figure 8.8. Haddock in 7.b,c,e–k. Distribution sampled and unsampled catches by country.

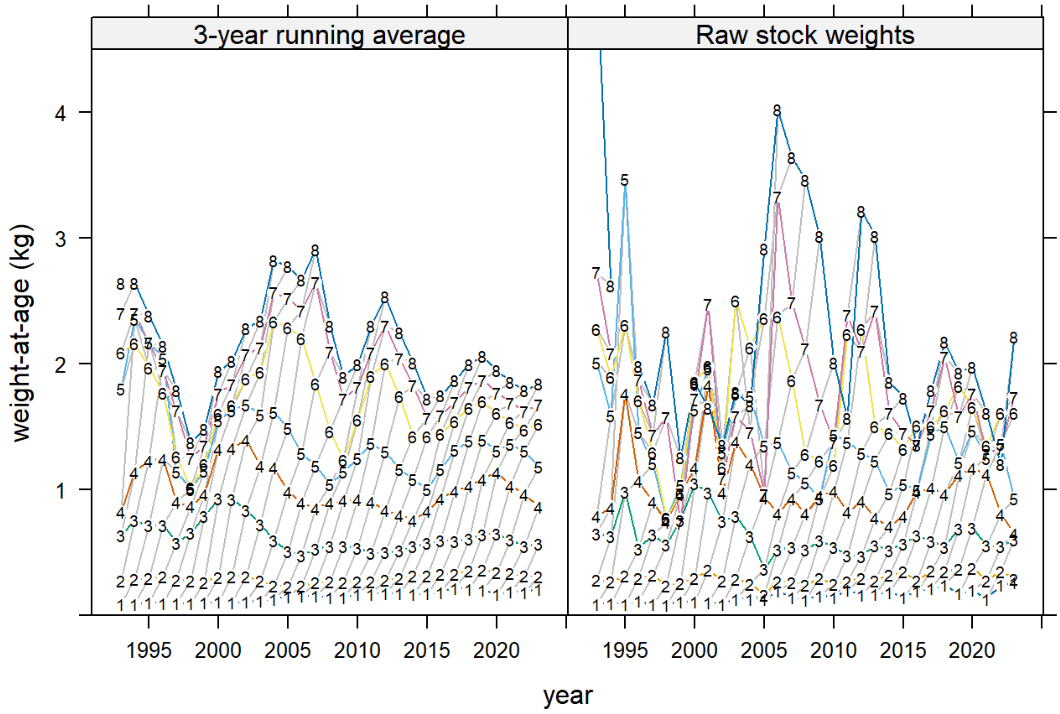


Figure 8.9. Haddock in 7.b,c,e–k. Raw stock weights-at-age (right) and the three-year running average stock weights (left).

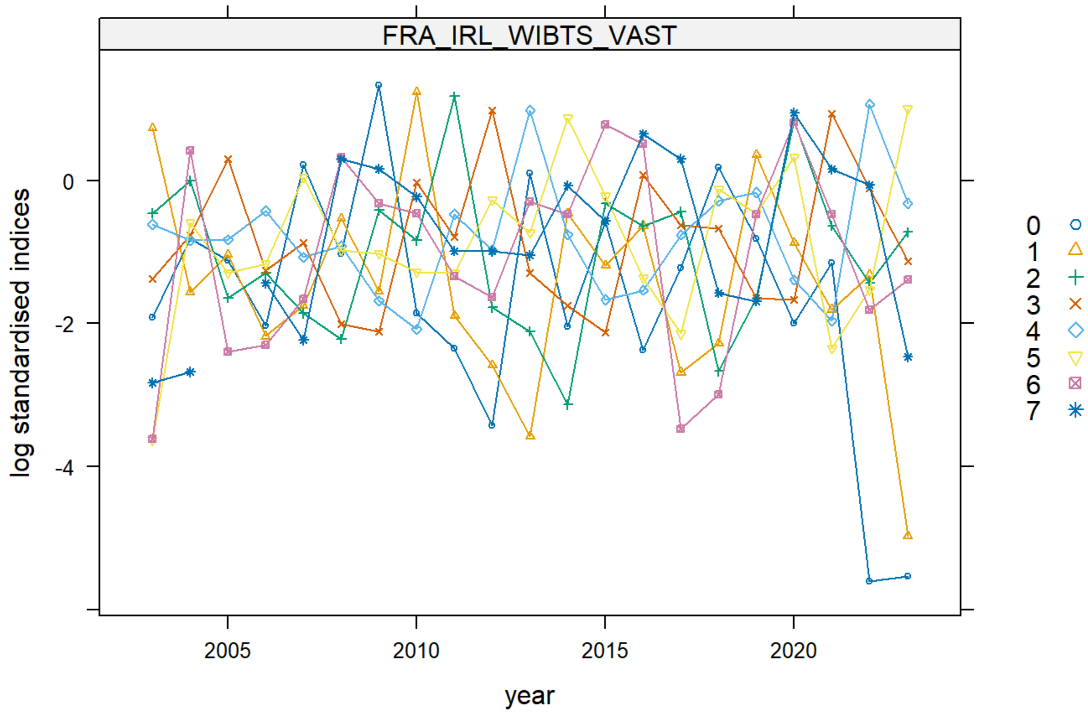


Figure 8.10. Haddock in 7.b,c,e–k. Log VAST standardised tuning fleets by year. The FRA-IRL-IBTS survey is the combined French EVHOE Q4 WIBTS and Irish IGFS Q4 WIBTS survey.

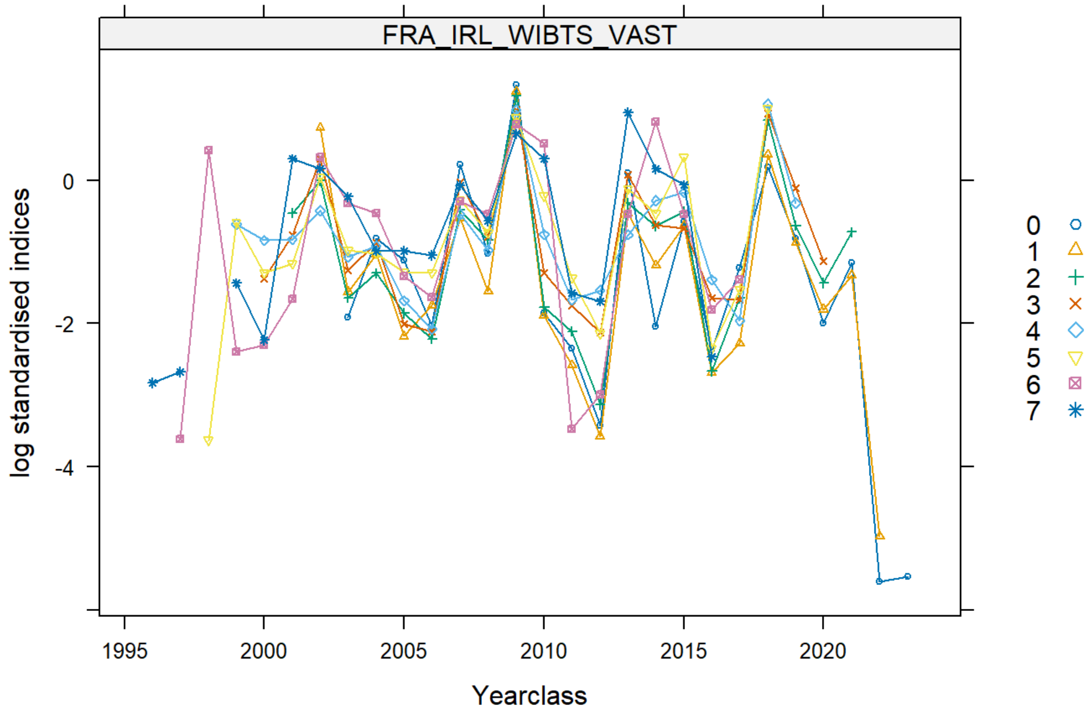


Figure 8.11. Haddock in 7.b,c,e–k. Log VAST standardised tuning fleets by cohort.

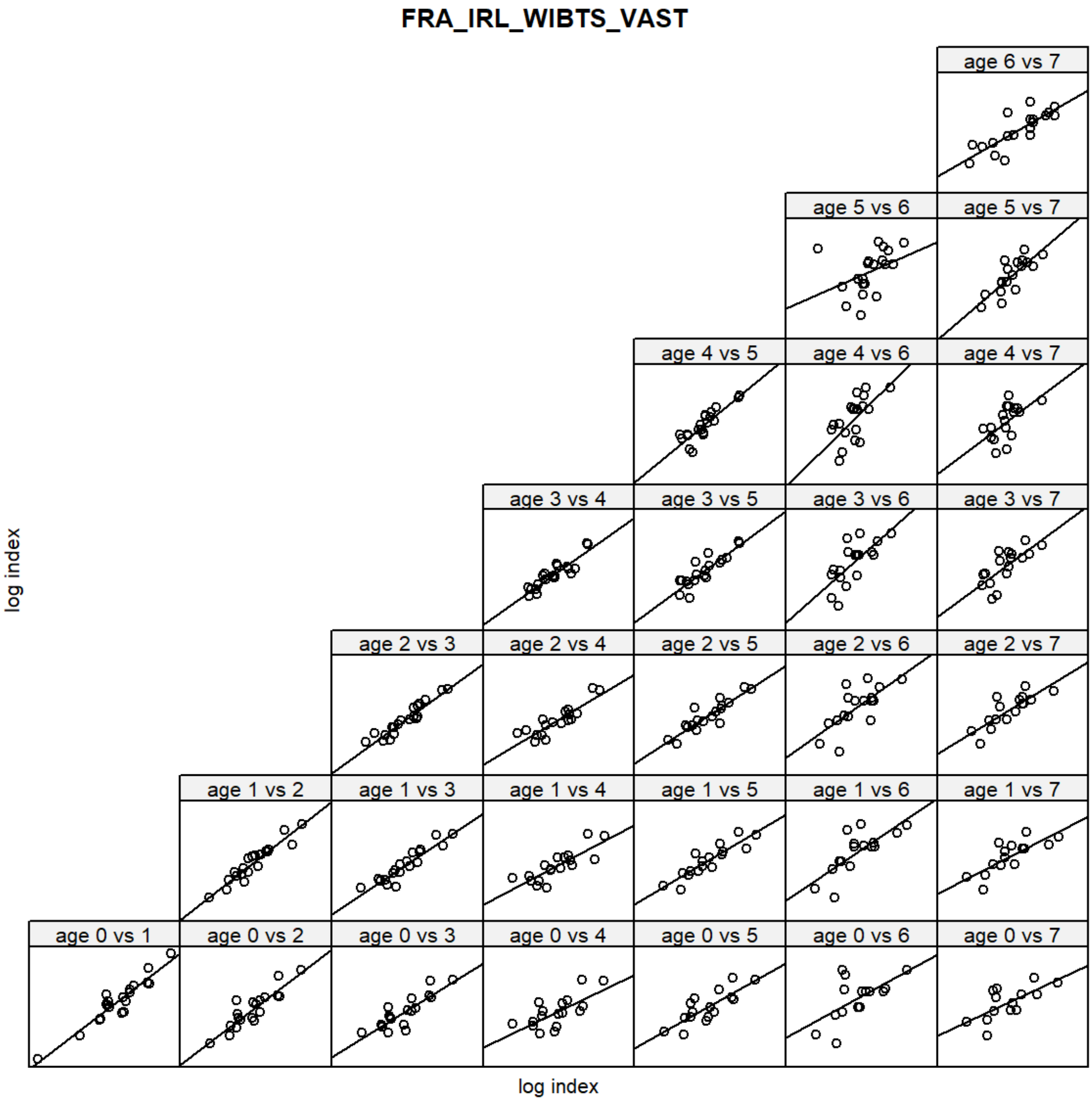


Figure 8.12. Haddock in 7.b,c,e–k. Scatterplot matrix of log indices of cohorts at different ages.

Figure 8.13. Haddock in 7.b,c,e–k. Residuals of the proportions-at-age in catch (upper) and survey (lower).

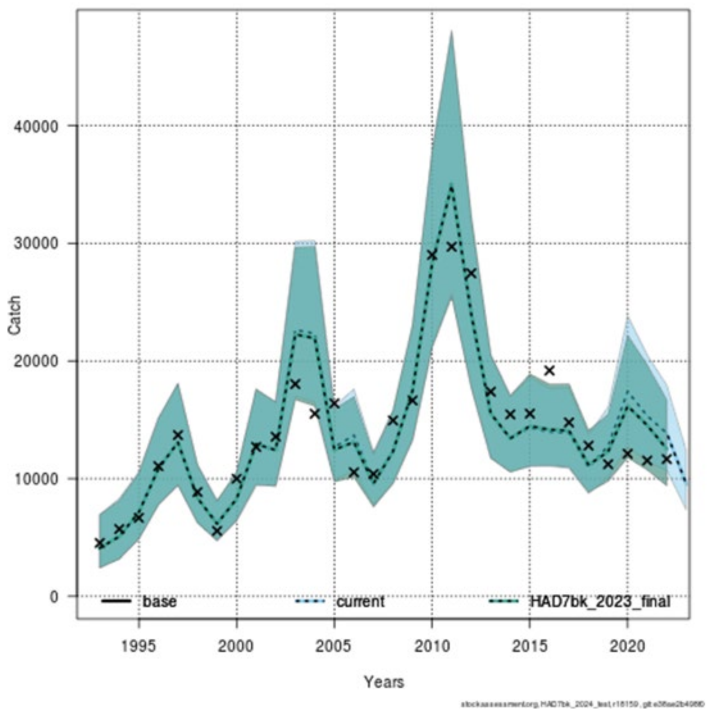


Figure 8.14. Haddock in 7.b,c,e–k. Observed (line) and predicted (x) catches.

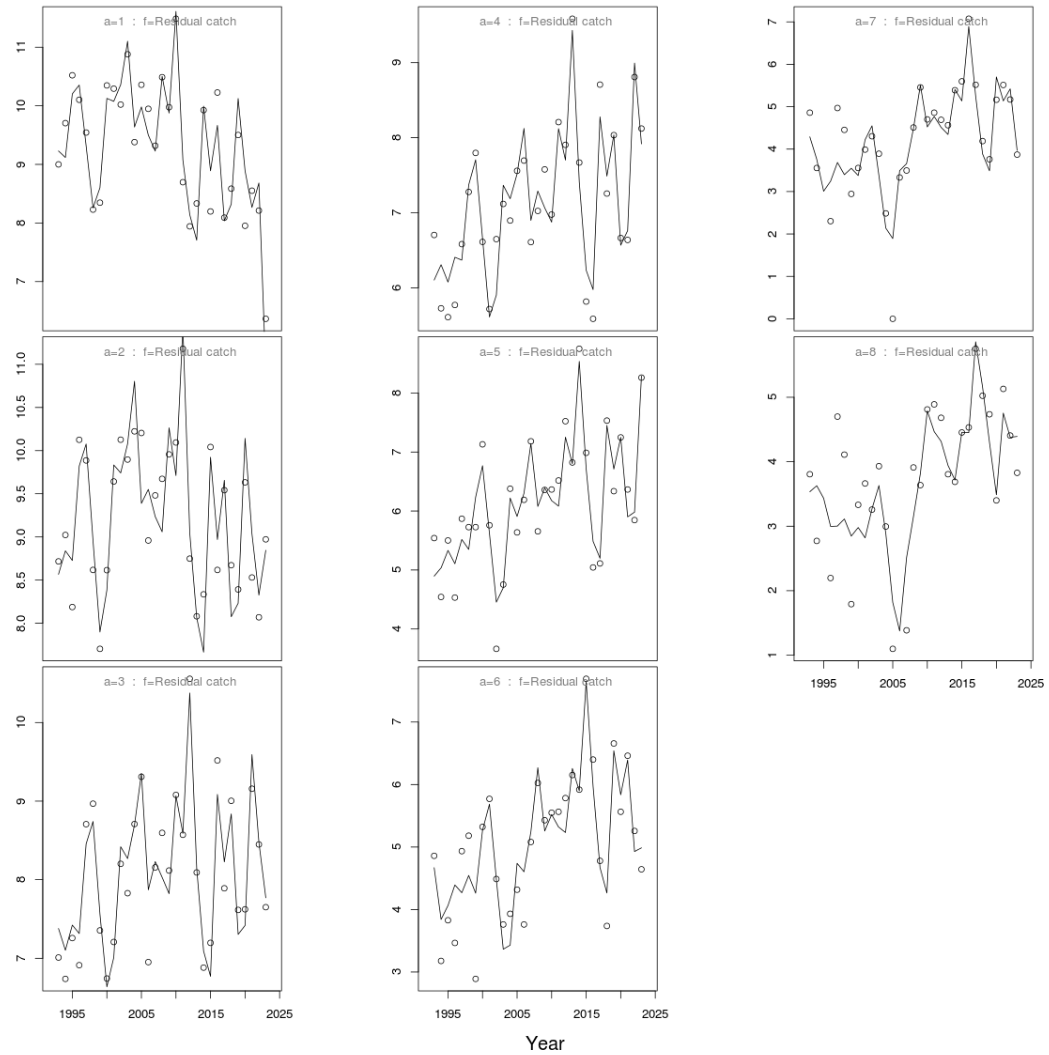


Figure 8.15. Haddock in 7.b,c,e–k. Observed and predicted (circles and line respectively) catch-at-age.

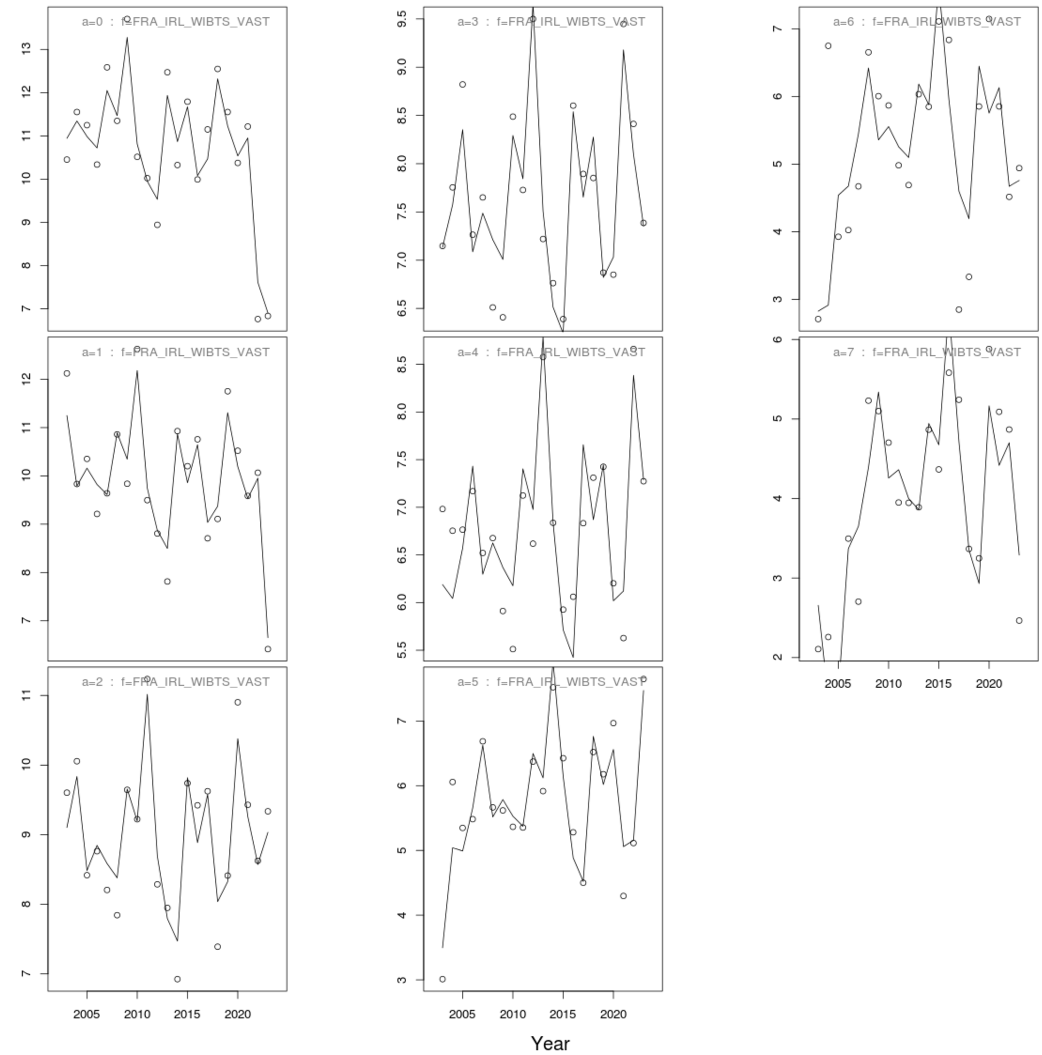


Figure 8.16. Haddock in 7.b,c,e–k. Observed and predicted (circles and line respectively) VAST survey indices.

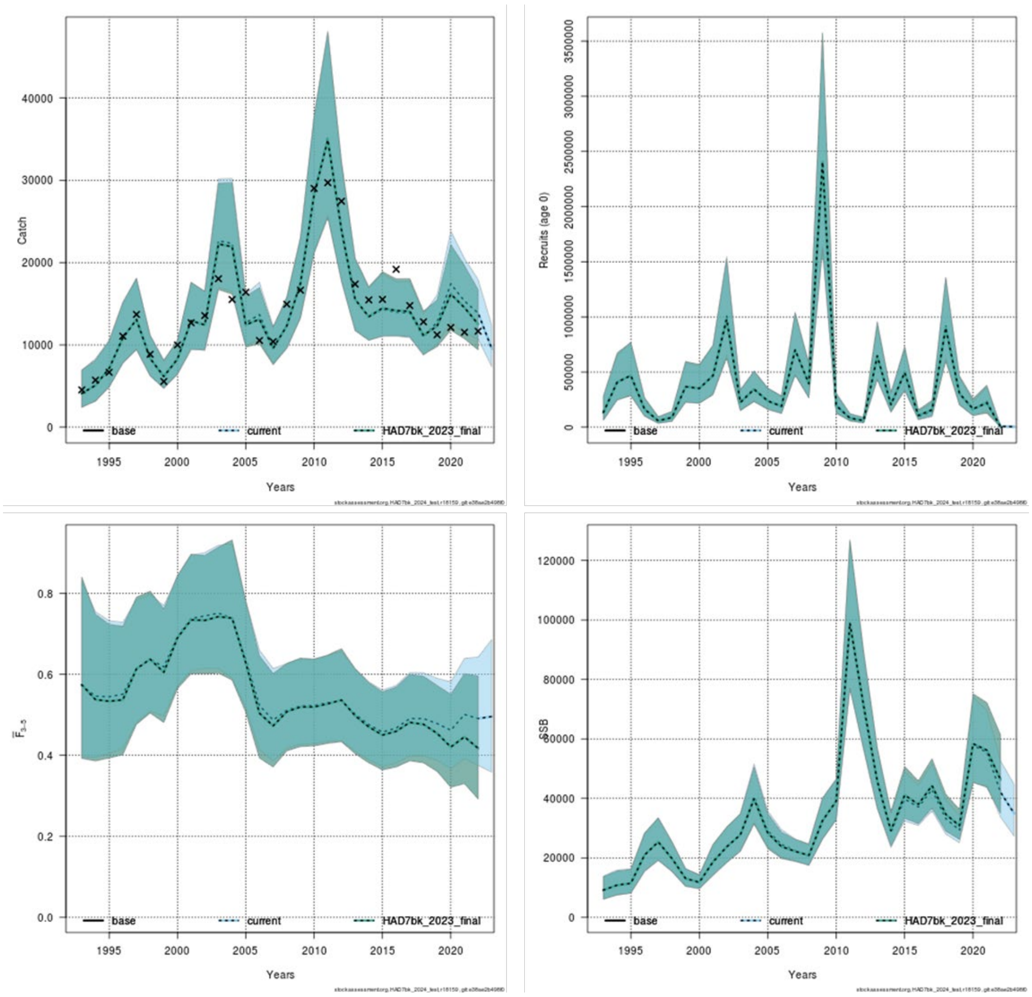


Figure 8.17. Haddock in 7.b,c,e–k. SAM assessment stock summary plots.

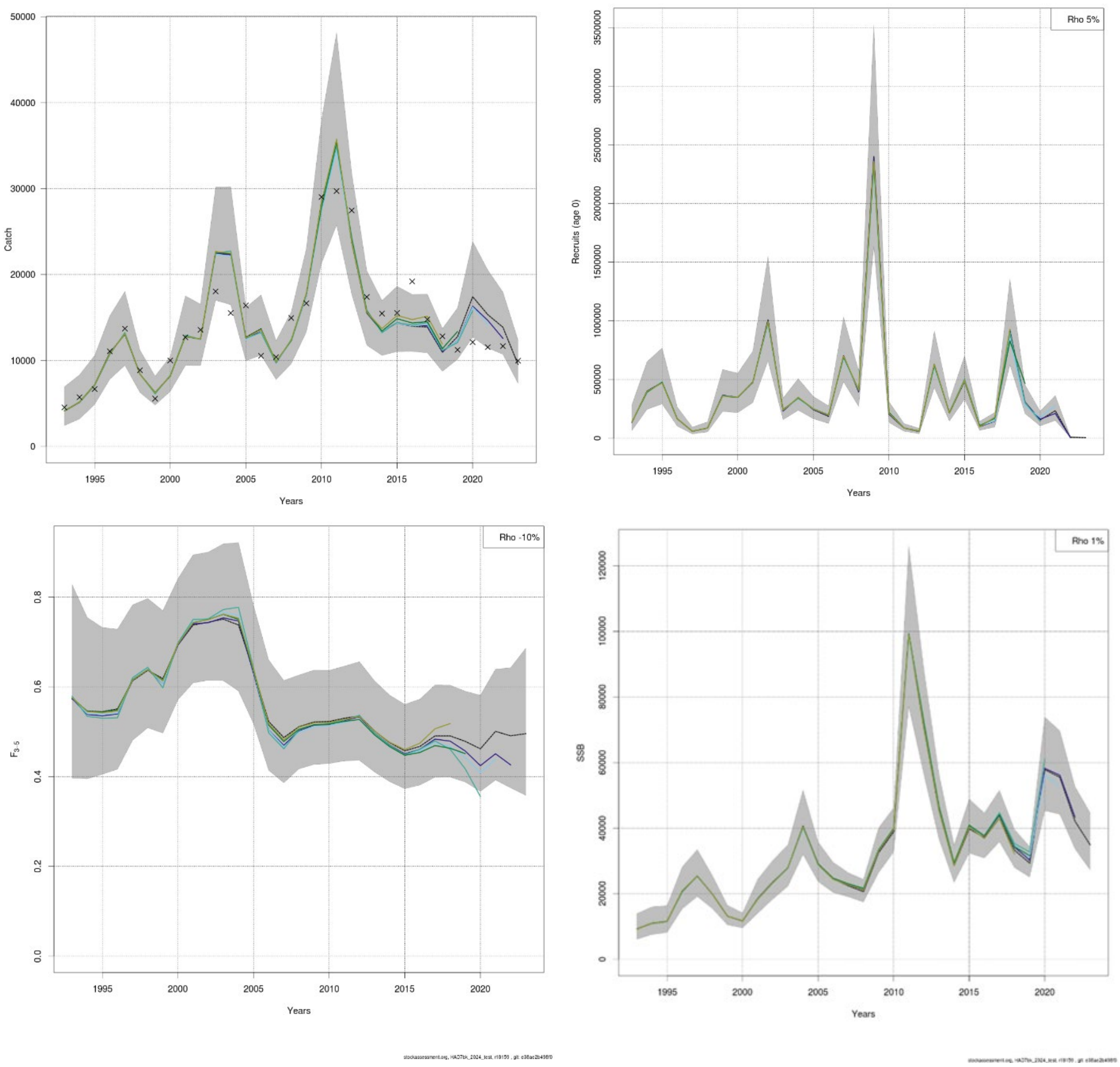


Figure 8.18. Haddock in 7.b,c,e–k. Retrospective analysis of the final SAM assessment run. Catch (top left), recruitment (top right), F (bottom left) and SSB (bottom right).

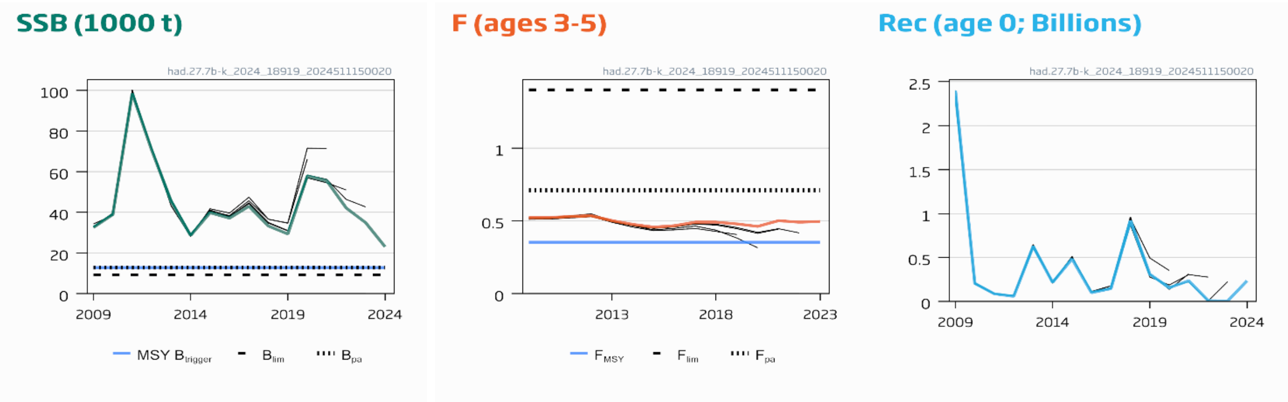


Figure 8.19. Haddock 7.b,c,e–k. Historical assessment results (final-year recruitment and SSB assumptions included).

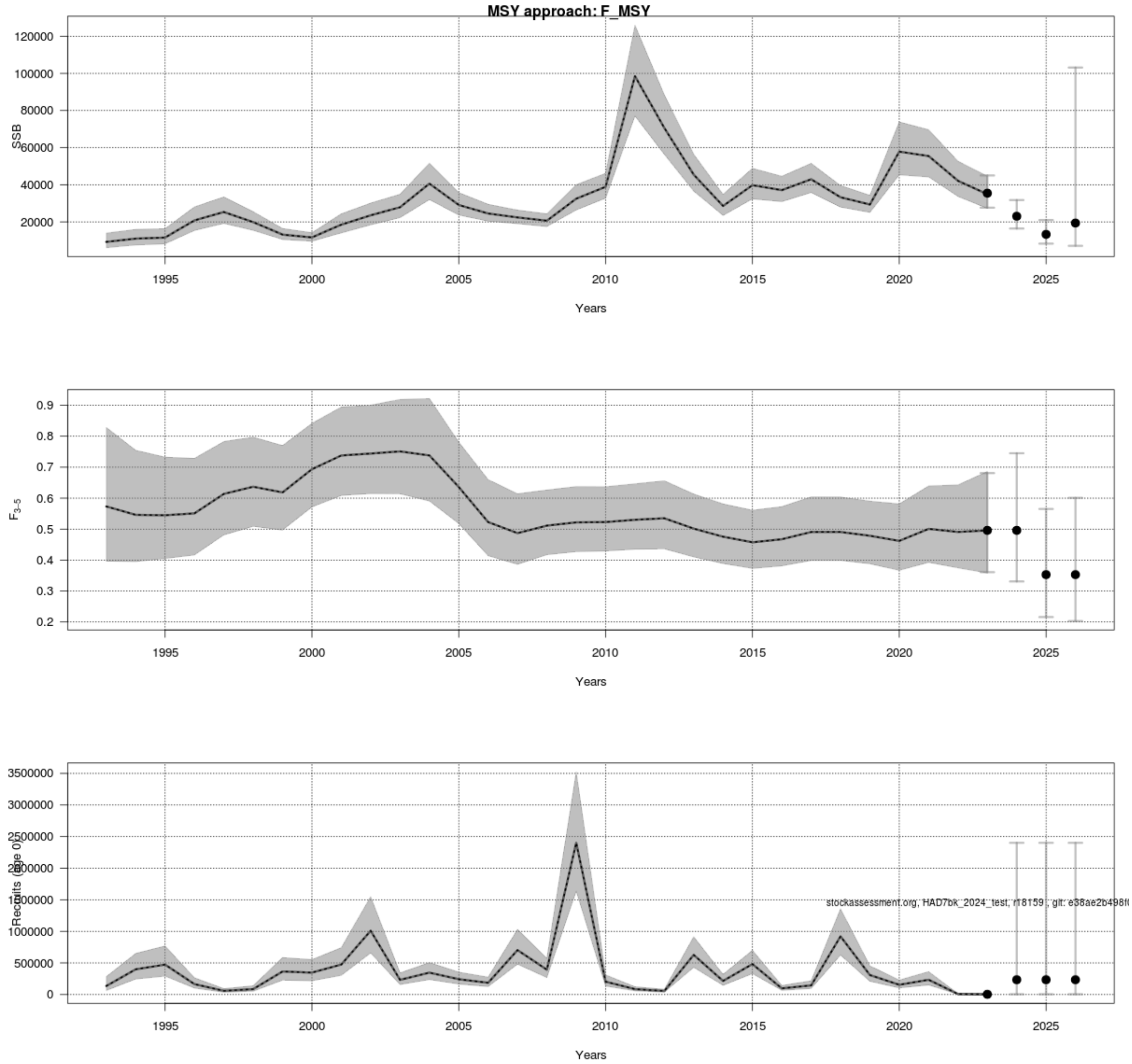


Figure 8.20. Haddock in 7.b,c,e–k. Assessment and forecast of the final SAM run. SSB (top), and F (middle) and recruitment (bottom).

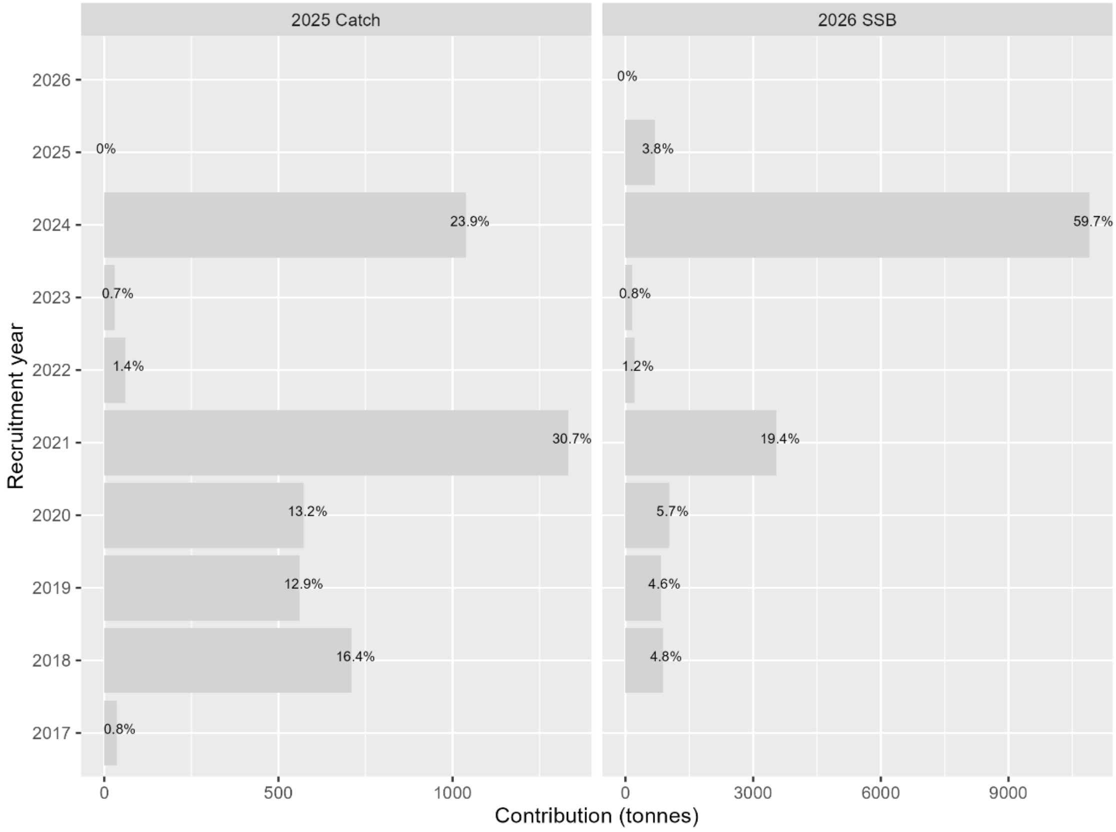


Figure 8.21. Haddock 7.b,c,e–k. Recruitment Contribution of recent year classes used in predictions, and the relative (%) contributions to catch and SSB (by weight) of these year classes.

Contents

9 Megrim (*Lepidorhombus* ssp.) in divisions 4.a and 6.a (northern North Sea, West of Scotland)

Type of assessment in 2024

Update of 2023 assessment with new landings and survey data. The model used to carry out the assessment is the Schaefer Surplus production process model in R and Winbugs.

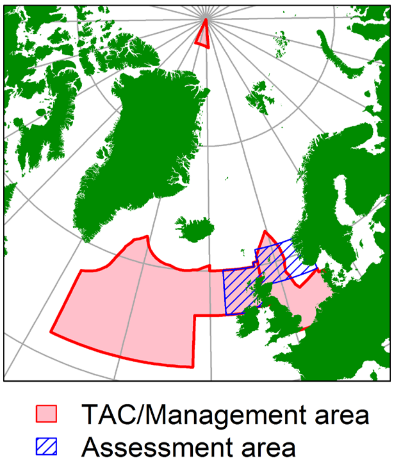
ICES advice applicable to 2025

ICES advises that when the MSY approach is applied, catches in 2025 should be no more than 7550 tonnes.

9.1 General

Stock description and management units

Megrim stock structure is uncertain and historically the Working Group has considered megrim populations in 6.a and 6.b as separate stocks. The review group questioned the basis for this in 2004. Data collected during an EC study contract (98/096) on the 'Distribution and biology of anglerfish and megrim in the waters to the West of Scotland' showed significantly different growth parameters and significant population structure difference between megrim sampled in 6.a and 6.b (Anon, 2001). Spawning fish occur in both areas but whether these populations are reproductively isolated is not clear. As noted by WGNSDS (2008), megrim in 4.a has historically not been considered by ICES. Since 2009 data from 4 and 2.a are included in this report, but international catch and weight-at-age data for 4, prior 2006 were not available to the working group. Given that there is little evidence to suggest that megrim in 6.a and 4.a are separate stocks, based on a visual inspection of the spatial distribution of commercial landings and fishery-independent survey data, WKFLAT (2011) concluded that megrim in 6.a and 4.a should be considered as a single stock. This has subsequently been supported through recent genetic studies (MacDonald and Prieto, 2012) indicating that there is one stock consisting of divisions 4.a (northern North Sea) and 6.a (West of Scotland) and another separate stock in Division 6.b (Rockall).



Management area (red boxes) and assessment area (blue hatched boxes).

Species:	Megrims *Lepidorhombus* spp.		Zone: United Kingdom and Union waters of 4; United Kingdom waters of 2a (LEZ/2AC4-C)
Belgium	9	(1)	Analytical TAC
Denmark	8	(1)	Article 7(2) of this Regulation applies
Germany	8	(1)	
France	48	(1)	
Netherlands	39	(1)	
Union	112	(1)	
United Kingdom	2 874	(1)	
TAC	2 986		
(1)	Special condition: of which up to 20 % may be fished in United Kingdom, Union and international waters of 6a north of 58°30'N (LEZ/*6AN58).		

Species:	Megrims *Lepidorhombus* spp.		Zone: 6; United Kingdom and international waters of 5b; international waters of 12 and 14 (LEZ/56-14)
Spain	566	(1)	Analytical TAC
France	2 207	(1)	Article 7(2) of this Regulation applies
Ireland	645	(1)	
Union	3 418	(1)	
United Kingdom	2 611	(1)	
TAC	6 029		
(1)	Special condition: of which up to 25 % may be fished in: United Kingdom and Union waters of 2a and 4 (LEZ/*2AC4C).		

2024 TAC for 4 and 2.a (upper) and TAC for 6, EC waters of 5.b and International waters of 12 and 14 (lower)

In division 6.a, the uptake of the 2023 TAC for ICES Division 6 and EU waters of 5.b was just 13.7%. The low uptake was mainly due to poor utilisation of quota by France and the UK, managing only 1.6 and 13.6% respectively. In division 4.a, the uptake of the TAC for Area 4 and 2.a was 54%. The majority of available TAC (96%) is allocated to the UK, who utilised 53% of the available quota.

9.2 Fishery in 2023

Landings

Catches of megrim comprise two species, *Lepidorhombus whiffiagonis* and *L. boscii*. Information available to the Working Group indicates that *L. boscii*, are a negligible proportion of the Scottish and Irish megrim catch (Kunzlik *et al*., 1995; Anon, 2001).

Commercial catches are dominated by female megrim, typically 90% of the total catch. The ICES landings estimate for 6.a and 4.a. is 2352 tonnes and are well below the total TAC covering the fished areas of 4.a–6.a.

Official landings data for each country together with Working Group best estimates of landings from 6.a are shown in Table 9.2 and for 4.a in Table 9.3. ICES landings are estimated from InterCatch and, if unavailable, official reported landings are used.

There are often differences between official data and InterCatch, especially for this stock where there has been some historic misreporting of landings by area. Up until 2009 the working group redistributed the landings between 4.a and 6.a in line with what was done for monkfish in this area (ICES 2012). This has not been done since then due to shifting of the observed trends, and reduced relevance of the issue due to the areas being assessed together. Some minor area misreporting is suspected, explaining the occasional differences between official and ICES landings.

Discards

Discard data were made available by Ireland, Scotland and France and total discards were estimated to be 114 tonnes or 4.4% by weight for 2023. This is up slightly from 3.5% in 2022, but over the last 9 years, total discard estimates have been reasonably consistent at around 5-10%, so this slight increase brings discards back towards historical trends.

A linear decline in discards from 30 to 15% over time between 1985 and 2012 is assumed in the stock assessment. From 2013 onwards discard data have taken from ICES estimates, and there are no deviations from the agreed stock annex.

Catch

A breakdown of 2023 catch by main gear type as estimated by ICES is given below:

Catch	Landings			Discards		
2466 tonnes	Finfish trawls	*Nephrops* trawls	Other gears	Finfish trawls	*Nephrops* trawls	Other gears
	99%	< 1%	< 1%	86%	14%	< 1%
	2352 tonnes			114 tonnes		

Surveys

Indices from six fishery-independent surveys are used in the assessment. The surveys are outlined in Table 9.1 below and details can be viewed in the stock annex (see Annex 2).

Table 9.1. Summary indices used for surplus production model.

NUMBER	SURVEY	NATIONALITY	AREA	TIME-SERIES	DEPTH RANGE (M)
1	Sco-IBTS-Q3 (G2829)	Scotland	4.a	1987-present	<400 m
2	Sco-IBTS-Q1 (G1022)	Scotland	4.a	1987-present	<400 m
3	ScoGFS-WIBTS-Q1 (G1179)	Scotland	6.a	1986-2010	40-400
4	ScoGFS-WIBTS-Q4 (G4299)	Scotland	6.a	1986-2010	50-300
5	SIAMISS-Q2 (G3745)	Scotland	6.a/4.a	2005-present	50-1050
6	SIAMISS-Q2 (G1794)	Ireland	6.a	2005-present	50-850

Figures 9.1 to 9.5 present the megrim biomass maps for the SIAMISS and IBTS surveys. The SIAMISS bubble plots (G3745 and G1794) show steady megrim abundance throughout the area over the time-series. Figure 9.2. (Sco-IBTS-Q3 (G2829) 4.a) and figure 9.3 (Sco-IBTS-Q1(G1022) 4.a) show the biomass in the northern North Sea. Biomass in the southern North Sea remains quite low. The Sco-IBTS-Q1 survey in 2022 was shortened and did not extend to the megrim habitat in the north, so the survey was removed from the assessment. The assessment was tested to be robust to this adjustment. The survey was completed as normal in 2023.

Figure 9.4 (ScoGFS-WIBTS-Q1(G1179) 6.a) and figure 9.5 (ScoGFS-WIBTS-Q4(G4299) 6.a) also show a steady biomass over the time-series and are shown until the survey design and ground gear changed in 2010. Data were truncated from the time-series going into the assessment.

9.3 Estimation of survey cpue indices

Cpue trends of survey data

The data from the IBTS surveys exhibit a relatively large proportion of zeros, therefore the delta method of Stefánsson (1996) was used to generate indices. This method (delta-gamma model) comprises fitting two generalized linear models. The first model (binomial GLM) is used to obtain the proportion of non-zero tows, and is fit to the data coded as 1 or 0, if the tow contained a positive or zero cpue, respectively. The second model is fit to the positive only cpue data using a gamma or lognormal GLM.

The biomass trend for the SIAMISS survey is shown in Figure 9.6. The biomass appears relatively stable over time in both areas. The biomass trends for the four IBTS surveys are shown in Figure 9.7.

9.4 Stock assessment

The input data for the stock assessment are given in Table 9.4; this comprises of a time-series from all survey indices, and ICES catch estimates for this stock.

2024 Final run

The Pearson residual diagnostic plots for the final assessment are shown in Figure 9.8. The residuals for the two 6.a surveys and the SIAMISS survey are fairly randomly dispersed around zero. A trend in the residuals is evident for the two 4.a surveys, with increasing positive residuals in the last decade.

The prior and posterior distributions for the parameters in the final model fit, are shown in Figure 9.9. The priors are given in Table 9.5. The posterior distributions are similar to previous year's assessments. The posterior parameter estimates for the final assessment model are given in Table 9.6. These are similar to recent assessments.

Figure 9.10 shows the final model fits to the cpue series and the estimates of total biomass and harvest ratio. The fits to the 6.a and SIAMISS surveys are reasonable. The fits to the 4.a surveys show that the model is not fitting well to those surveys in recent years. This issue needs to be examined further in the next benchmark.

The time-series of B/B_{MSY}, F/F_{MSY}, landings and discards used in the final assessment are given in Table 9.7.

Comparison with previous assessments

Figure 9.11 compares the final assessment with those conducted by WGCSE at previous meetings. The 2024 assessment assesses the biomass estimate to be stable since 2020; prior to being revised down in recent years. Estimates of fishing mortality decreased considerably after several years of an upward trend. There are also some deviations in the historic estimates of F and Biomass around 2000. These are linked to the use of the 6.a surveys to derive the delta-gamma cpues truncated in 2010.

To evaluate evidence of possible bias in the assessment population metrics, a Mohn's Rho analysis resulted in values of -0.0094 for Fbar and 0.0039 for biomass. ICES considers a value greater than 0.20 to be unacceptably high.

State of the stock

The state of the stock has not changed significantly since last year. Fishing mortality has been below F_{MSY} for almost the full time-series and has an overall declining trend since the late 1990s. Biomass has consistently been above MSY $B_{trigger}$ and shows an increasing trend since 2005. The stock in 2024 is estimated to be 1.48 times B_{MSY} and the fishing mortality in 2023 is estimated to have been 34% of F_{MSY}.

9.5 Short-term projections

Short-term projections have been updated according to the method set out in the stock annex. The basis for the catch options is given in Table 9.8.

The management option table is given in Table 9.9. Fishing at F_{MSY} in 2024 is projected to result in total catches of 7550 t (landings of 7214 t and discards of 336 t) and a Biomass of 1.35 times B_{MSY} in 2025.

9.6 Biological reference points

Precautionary approach reference points

F_{MSY}, B_{MSY} and the yield at MSY are all directly estimated in the model. It should be noted that these will vary when new survey and catch information is added. B_{pa} and B_{lim} are defined as 50%B_{MSY} and 30%B_{MSY} respectively. F_{lim} is defined as 1.7 F_{MSY} and is the F that drives the stock to B_{lim} assuming B_{lim}=30%B_{MSY}. The derivation is given below:

$P=rB(1-B/K)$

The surplus productivity associated with B_{lim} *is:*

$P_{lim}=rB_{lim}(1-B_{lim}/K)$

The corresponding F is:

$F_{lim}=rB_{lim}(1-B_{lim}/K)/B_{lim} = r(1-B_{lim}/K)$

$B_{lim}=0.3B_{MSY} = 0.3K/2$

$F_{lim} = r(1-0.3K/(2K)) = r(1-0.3/2) =0.85r$

$F_{MSY}=r/2$, *let x denote the proportionality between* F_{MSY} *and* F_{lim}

$xF_{MSY}=F_{lim}$

$x(r/2)=0.85r$

$x=2*0.85$

$x=1.7$

MSY reference points

In 2015 ICES provided precautionary F_{MSY} ranges that are derived to deliver no more than a 5% reduction in long-term yield compared with MSY. Details of this analysis are given in WKMSYREF3 (ICES, 2015) and the derivations are given below.

	MSY F_{lower} b)	F_{MSY} b)	MSY F_{upper} b) with AR	MSY $B_{trigger}$
Megrim in divisions 4.a and 6.a	0.39 × r d)	r/2 d)	r/2 d)	K d)

The stock has been fished below F_{MSY} for more than ten years, therefore, the WG considered it appropriate to set the MSY $B_{trigger}$ = B_{MSY} according to the ICES guidelines (ICES, 2017).

Uncertainties and bias in assessment and forecast

The model estimates of B and F do have large uncertainty. Despite this, there is a low probability that SSB is below MSY $B_{Trigger}$ and a high probability that F is below F_{MSY}.

The reference points are re-estimated within the assessment. The change between 2024 and 2023 reference points are consistent with previous years and results in a rescaling of relative stock status. However, in absolute terms, stock trends are consistent with those of previous years.

Owing to incomplete discard data, historical discard rates (1985–2012) are assumed to have declined, from 30% at the beginning of the time-series, to an estimate of 15% in 2012. The evaluation of current stock status is robust to this assumption. Estimates since 2013 are based on observed discards.

Recommendation for next benchmark

This stock was subject to an inter-benchmark in 2012 (IBP-MEG, 2012). Due to incomplete age data, particularly for 4.a, a Bayesian state–space surplus production model was chosen as the final assessment model. Subsequent update assessments have highlighted a problem fitting to the 4.a surveys which needs to be examined in a future benchmark.

WGCSE recommends the following explorations:

- The SIAMISS survey should be merged into one continuous index. The length data for the index should also be examined.
- The ScoGFS-WIBTS-Q1/Q4 2011+: the ScoGFS-WIBTS-Q1/Q4 survey time-series should also be examined for re-introduction into the assessment as a new time-series. There may also be scope to integrate the IGFS.
- Available length and age-structured data should be compiled for this stock.
- Length or age-structured assessment models could be explored.

Once sufficient progress has been made on the points above, WGCSE will suggest a benchmark schedule.

Management considerations

Megrim is a bycatch species in the mixed demersal trawl in divisions 6.a and 4.a. Management measures for other species have constrained the fishery and reduced effort and fishing mortality on megrim. The general increase in mesh size in 6 and 4 since 2010 has also benefited the stock.

The TAC in 6 has not been fully utilised. However, the uptake rate is country specific, with some Member States reporting landings above their quota in the North Sea. Partial quota uptake by individual Member States may be linked to reduction in effort rather than reflective of a reduction in biomass. The TAC and assessment area are incompatible. There are two separate TAC areas covering ICES areas 6 and 4, whereas the assessment covers ICES divisions 6.a and 4.a combined. Due consideration of the inconsistency between management and assessment area is required when setting fishing opportunities for this stock and the separate 6.b Rockall stock. ICES (2013) have advised the EC that the TAC areas should be consistent with the assessment area and that ICES has no basis on how to split the catch advice so that it is consistent with the TAC areas.

9.7 References

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9.8 Tables and Figures

Table 9.2 Megrim in Division 6.a. History of commercial landings. All weights are in tonnes.

Year	Belgium	France	Ireland	Netherlands	Spain	UK (E, W, and NI)	UK (Scotland)	UK (Total)	Official total	ICES landings
1990	0	398	317	0	91	25	1093	-	1924	2210
1991	1	455	260	0	48	167	1223	-	2154	2432
1992	0	504	317	0	25	392	887	-	2125	2549
1993	0	517	329	0	7	298	896	-	2047	2721
1994	1	408	304	0	1	327	866	-	1907	2693
1995	0	618	535	0	24	322	952	-	2451	3498
1996	0	462	460	0	22	156	944	-	2044	4054
1997	0	192	438	1	87	123	954	-	1795	3272
1998	0	172	433	0	111	65	841	-	1622	2705
1999	0	0	438	0	83	42	831	-	1394	2648
2000	0	135	417	0	98	20	754	-	1424	2247
2001	0	252	509	0	92	7	770	-	1630	2473
2002	0	79	280	0	89	14	643	-	1105	1828
2003	0	92	344	0	98	13	558	-	1105	1642
2004	0	50	278	0	45	17	469	-	859	1328
2005	0	48	156	0	69	10	269	-	552	561
2006	0	53	221	0	52	7	339	-	672	875
2007	0	104	191	0	5	9	658	-	967	1301
2008	0	92	172	0	149	6	868	-	1287	1545
2009	0	174	188	0	112	13	940	-	1427	1387

Year	Belgium	France	Ireland	Netherlands	Spain	UK (E, W, and NI)	UK (Scotland)	UK (Total)	Official total	ICES landings
2010	0	271	318	0	288	2	820	-	1699	1698
2011	0	153	227	0	217	2	713	-	1312	1308
2012	0	140	214	0	142	4	586	-	1086	1083
2013	0	105	203	0	213	2	468	-	991	949
2014	0	126	246	0	57	29	438	-	894	948
2015	0	140	311	0	140	-	-	520	1110	1110
2016	0	189	408	0	146	-	-	694	1437	1430
2017	0	132	336	0	313	-	-	579	1359	1359
2018	0	117	301	0	273	-	-	680	1370	1380
2019	0	122	271	0	368	-	-	844	1606	1611
2020	0	120	250	0	302	-	-	711	1382	1380
2021	0	124	378	0	335	-	-	633	1469	1464
2022*	0	79	186	0	197	-	-	488	950	958
2023*	0	33	240	0	167	-	-	312	753	775

* Preliminary official landings.

Table 9.3 Megrim in Division 6.a. History of commercial landings. All weights are in tonnes.

Year	Belgium	Denmark	France	Germany	Ireland	Netherlands	Norway	Sweden	UK (E, W, and NI)	UK (Scotland)	UK (Total)	Official total	ICES landings
1990	4	2	0	3	0	24	0	0	17	112	-	1176	837
1991	3	1	0	6	0	28	0	0	9	116	-	1216	878
1992	2	4	36	3	0	27	0	0	47	137	-	1491	1025
1993	7	6	25	4	0	30	0	0	8	173	-	1816	1081
1994	2	1	27	1	0	28	0	0	19	200	-	2078	1207
1995	7	2	24	2	0	26	0	0	44	219	-	2298	1172
1996	5	7	14	1	0	9	0	0	4	322	-	3261	1199
1997	3	5	16	2	0	20	0	0	3	309	-	3140	1584
1998	5	18	14	4	0	30	0	0	5	262	-	2704	1548
1999	4	21	0	1	0	26	0	0	4	212	-	2177	1111
2000	10	29	7	3	0	20	0	0	2	204	-	2115	1247
2001	2	52	5	1	0	11	0	0	2	185	-	1927	1098
2002	5	8	6	0	0	9	0	0	3	167	-	1706	975
2003	3	11	11	2	1	7	< 0.	0	1	123	-	1271	727
2004	0	7	9	2	0	11	< 0.	0	1	113	-	1160	739
2005	0	1	3	4	0	19	< 0.	0	1	958	-	986	966
2006	0	3	4	1	0	6	1	0	6	133	-	1357	1179
2007	0	11	18	4	0	1	1	0	14	142	-	1472	1047
2008	0	31	20	1	0	1	4	0	4	152	-	1581	1349
2009	0	54	9	0	0	0	6	0	29	144	-	1545	1484
2010	0	22	1	0	0	1	2	0	25	141	-	1466	1499
2011	0	23	10	3	0	0	1	0	34	136	-	1431	1430
2012	0	35	5	3	0	0	1	0	19	137	-	1441	1441
2013	0	48	8	3	0	0	17	0	33	165	-	1765	1788
2014	0	35	6	1	0	0	12	0	53	142	-	1530	1551
2015	0	26	7	0	0	0	8	0	-	-	117	1217	1230
2016	0	46	13	2	0	2	21	0	-	-	127	1357	1313
2017	0	60	36	3	0	< 0.	29	0	-	-	119	1327	1235
2018	0	61	67	1	0	1	34	0	-	-	154	1706	1706
2019	0	63	103	4	0	1	46	0	-	-	134	1557	1585
2020	<	40	80	3	0	4	54	<	-	-	176	1951	1935
2021	0	73	73	9	0	1	49	<	-	-	194	2150	2139
2022*	0	49	66	7	0	2	38	<	-	-	131	1472	1463
2023*	<	20	66	4	0	< 0.	38	<	-	-	138	1513	1577

* Preliminary official landings.

Table 9.4 Time-series of megrim survey indices in ICES Area 6.a and Division 4 and ICES estimated catch as used in the surplus production model.

Year	sco.via.q1	sco.via.q4	sco.iva.q1	sco.iva.q3	monk.via	monk.iva	Catch (t)
1985	2.59	NA	NA	NA	NA	NA	6427
1986	1.69	NA	1.25	NA	NA	NA	4051
1987	1.37	NA	1.49	NA	NA	NA	6488
1988	2.01	NA	1.66	NA	NA	NA	7273
1989	1.16	NA	1.33	NA	NA	NA	4778
1990	1.07	1.59	0.76	NA	NA	NA	4187
1991	0.79	1.27	0.50	0.33	NA	NA	4514
1992	0.96	1.89	0.58	0.32	NA	NA	4837
1993	1.01	2.06	1.11	0.31	NA	NA	5107
1994	1.59	3.25	0.26	0.38	NA	NA	5200
1995	1.56	1.86	0.00	0.39	NA	NA	6181
1996	1.94	1.95	0.51	0.62	NA	NA	6902
1997	1.10	1.08	0.43	0.44	NA	NA	6334
1998	1.09	1.89	0.83	0.23	NA	NA	5507
1999	1.32	1.36	1.00	0.26	NA	NA	4833
2000	1.14	1.19	0.85	0.26	NA	NA	4460
2001	1.00	0.97	0.29	0.10	NA	NA	4527
2002	0.76	1.86	1.21	0.37	NA	NA	3528
2003	1.27	1.20	0.56	0.33	NA	NA	2961
2004	1.24	1.06	0.28	0.46	NA	NA	2566
2005	0.69	1.01	0.59	0.82	1660	4753	1883
2006	0.92	1.12	0.78	0.94	2689	3345	2515
2007	0.91	1.20	0.85	1.38	3380	6348	2856
2008	1.25	0.96	1.54	1.24	2467	7754	3496
2009	1.57	1.40	1.93	1.11	3831	5947	3445
2010	1.17	NA	1.74	1.78	3312	5395	3811
2011	NA	NA	1.91	1.66	2502	4684	3264

Year	sco.via.q1	sco.via.q4	sco.iva.q1	sco.iva.q3	monk.via	monk.iva	Catch (t)
2012	NA	NA	2.56	1.56	3451	4839	2973
2013	NA	NA	2.64	1.50	6175	6460	3064
2014	NA	NA	2.18	1.31	3033	11970	2809
2015	NA	NA	3.00	1.39	2563	4987	2499
2016	NA	NA	1.46	1.31	3028	8208	2911
2017	NA	NA	1.83	1.08	6509	10239	2787
2018	NA	NA	1.40	1.15	3364	7154	3342
2019	NA	NA	0.66	1.01	2144	7982	3381
2020	NA	NA	1.36	0.90	NA	NA	3529
2021	NA	NA	1.17	0.76	3268	6898	3803
2022	NA	NA	NA	0.97	3063	8700	2507
2023	NA	NA	1.00	0.71	2215	5874	2466

Table 9.5. *Lepidorhombus whiffiagonis* in ICES areas 6.a and 4.a. Prior distributions on parameters.

Parameter	Symbol	Prior distribution	Notes
Intrinsic rate of population growth	r	$\text{Uniform}(0.001, 2.0)$	
Carrying capacity	K	$\text{Uniform}(\ln(\max(C)), \ln\left(10 \times \sum_{t=1985}^{2010} C_t\right)$	From the maximum catch to ten times the cumulative catch across all years assuming uniform distribution on the logarithmic scale
Catchabilities	$\log(q_j)$	$\text{Uniform}(-11.0, 0.0)$	Uniformly distributed on log-scale. See catchability sensitivity in Section 2.2.3.1
Process error variance	$\frac{1}{\sigma_u^2}$	$\text{Gamma}(\text{shape} = 0.001, \text{rate} = 0.001)$	Gamma distributed on inverse variance (precision) scale
Measurement error variances	$\frac{1}{\sigma_{\varepsilon,j}^2}$	$\text{Gamma}(\text{shape} = 0.001, \text{rate} = 0.001)$	Gamma distributed on inverse variance (precision) scale
Proportion of *K* in 1985	a	$\text{Uniform}(0.01, 2.0)$	

Table 9.6. Parameter estimates for final assessment outputs.

Parameter	Estimates 2015	Estimates 2016	Estimates 2017	Estimates 2018	Estimates 2019	Estimates 2020	Estimates 2021	Estimates 2022	Estimates 2023	Estimates 2024
r.hat	0.51	0.51	0.51	0.47	0.50	0.51	0.52	0.52	0.52	0.53
K.hat	47216	46840	42681	55129	44116	42625	41634	40573	41556	40961
MSY	5612	5362	5072	5362	5123	5101	5020	4978	5030	5028
F_{MSY}	0.26	0.26	0.25	0.23	0.25	0.26	0.26	0.26	0.26	0.26
B_{MSY}	23608	23420	21340	27565	22058	21313	20817	20287	20778	20481
B	42416	42356	37610	38057	37062	32660	32408	31632	32752	30114
F	0.07	0.07	0.07	0.08	0.08	0.1	0.1	0.12	0.08	0.09
B_{lim}	7082	7026	6402	8269	6617	6394	6245	6086	6233	6144
B_{trig}	11804	11710	10670	13782	11029	10656	10408	10143	10389	10240

Table 9.7. Time-series of B/B_{MSY} and F/F_{MSY} estimates and landings and discards in tonnes for the final assessment.

Year		B/B_{MSY}		Landings	Discards*		F/F_{MSY}	
	Low	Value	High			Low	Value	High
1985	1.30	2.39	3.71	4499	1928	0.37	0.65	1.10
1986	1.08	1.64	2.24	2858	1193	0.33	0.52	0.77
1987	1.10	1.55	2.04	4614	1874	0.55	0.92	1.31
1988	1.02	1.42	2.01	5212	2061	0.62	1.14	1.65
1989	0.83	1.16	1.58	3451	1327	0.50	0.86	1.25
1990	0.75	1.06	1.43	3047	1140	0.47	0.81	1.20
1991	0.70	1.00	1.30	3310	1204	0.56	0.93	1.42
1992	0.72	1.05	1.37	3574	1263	0.57	0.96	1.43
1993	0.79	1.12	1.53	3802	1305	0.55	0.96	1.41
1994	0.82	1.21	1.73	3900	1300	0.50	0.91	1.36
1995	0.87	1.24	1.80	4670	1511	0.60	1.09	1.62
1996	0.84	1.20	1.77	5253	1649	0.68	1.28	1.92
1997	0.73	1.02	1.38	4856	1478	0.76	1.36	1.97
1998	0.68	0.96	1.35	4253	1254	0.65	1.23	1.81
1999	0.64	0.93	1.36	3759	1074	0.57	1.11	1.66
2000	0.60	0.87	1.23	3494	966	0.57	1.07	1.61
2001	0.56	0.81	1.12	3571	956	0.64	1.17	1.80
2002	0.57	0.83	1.20	2803	725	0.46	0.86	1.33
2003	0.59	0.87	1.25	2369	592	0.36	0.68	1.04
2004	0.62	0.88	1.22	2067	499	0.33	0.57	0.86
2005	0.66	0.91	1.19	1527	356	0.25	0.40	0.61
2006	0.77	1.03	1.32	2054	461	0.30	0.48	0.73
2007	0.89	1.20	1.54	2348	508	0.29	0.48	0.71
2008	0.97	1.32	1.70	2894	602	0.34	0.54	0.82
2009	1.05	1.43	1.85	2871	574	0.30	0.49	0.73
2010	1.11	1.46	1.90	3197	614	0.33	0.54	0.77
2011	1.10	1.49	1.91	2738	526	0.28	0.45	0.65

Year		B/B_{MSY}		Landings	Discards*		F/F_{MSY}	
	Low	Value	High			Low	Value	High
2012	1.23	1.63	2.13	2524	449	0.24	0.38	0.54
2013	1.37	1.85	2.52	2737	327	0.22	0.35	0.52
2014	1.37	1.85	2.45	2500	309	0.20	0.32	0.46
2015	1.28	1.70	2.17	2340	159	0.20	0.30	0.44
2016	1.39	1.79	2.28	2744	167	0.22	0.34	0.48
2017	1.43	1.93	2.61	2594	193	0.19	0.31	0.45
2018	1.34	1.73	2.21	3087	255	0.26	0.40	0.57
2019	1.19	1.59	2.01	3197	184	0.29	0.44	0.63
2020	1.17	1.59	2.12	3315	214	0.29	0.46	0.67
2021	1.20	1.57	2.00	3603	200	0.32	0.51	0.73
2022	1.12	1.55	2.01	2420	87	0.20	0.33	0.50
2023	1.09	1.47	1.90	2352	114	0.21	0.34	0.51
2024	0.98	1.48	2.03					

*** Discard estimates prior to 2013 are approximated, based on limited sampling information**

Table 9.8. Basis for the catch options.

Variable	Value	Notes
F_{2023}/F_{MSY}	0.32	*Status quo*: F_{sq} = relative F (2022)
B_{2024}/B_{MSY}	1.67	Short-term forecast
Catch (2023)	2349	Short-term forecast; in tonnes
Projected landings (2023)	2233	Assuming average landings ratio (2020–2022); in tonnes
Projected discards (2023)	116	Assuming average discard ratio (2020–2022); in tonnes

Table 9.9. The management option table.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	Fishing mortality F_{2025}/F_{MSY}	Stock size B_{2026}/B_{MSY}	% B change *	% advice change^
ICES advice basis							
MSY approach: *F= F_{MSY}*	*7550*	*7214*	*336*	*1*	*1.35*	*-19.1*	*-4.4*
Other scenarios							
EU MAP^^: F_{MSY}	*7550*	*7214*	*336*	*1*	*1.35*	*-19.1*	*-4.4*
EU MAP^^: $F_{MSY\ lower}$	*5900*	5637	*263*	*0.78*	*1.44*	*-13.6*	*-25*
EU MAP^^: $F_{MSY\ upper}$	*7550*	*7214*	*336*	*1*	*1.35*	*-19.1*	*-4.4*
F = 0	*0*	*0*	*0*	*0*	1.76	*5.3*	*-100*
B_{2026} = B_{lim}	*28550*	*27279*	*1271*	*3.8*	*0.30*	-82	*261*
B_{2026} = B_{pa} = MSY $B_{trigger}$	*23900*	22836	1064	3.1	0.50	-70	203
B_{2026} = B_{2025}	5200	4969	231	0.68	1.48	0	-34
F = F_{2024}	2400	2293	107	0.31	1.63	-2.5	-70

* Biomass 2026 relative to biomass 2025.

^ Advice value for 2025 relative to the advice value for 2024 (7900 tonnes).

^^ EU multiannual plan (MAP) for the Western Waters (EU, 2019).

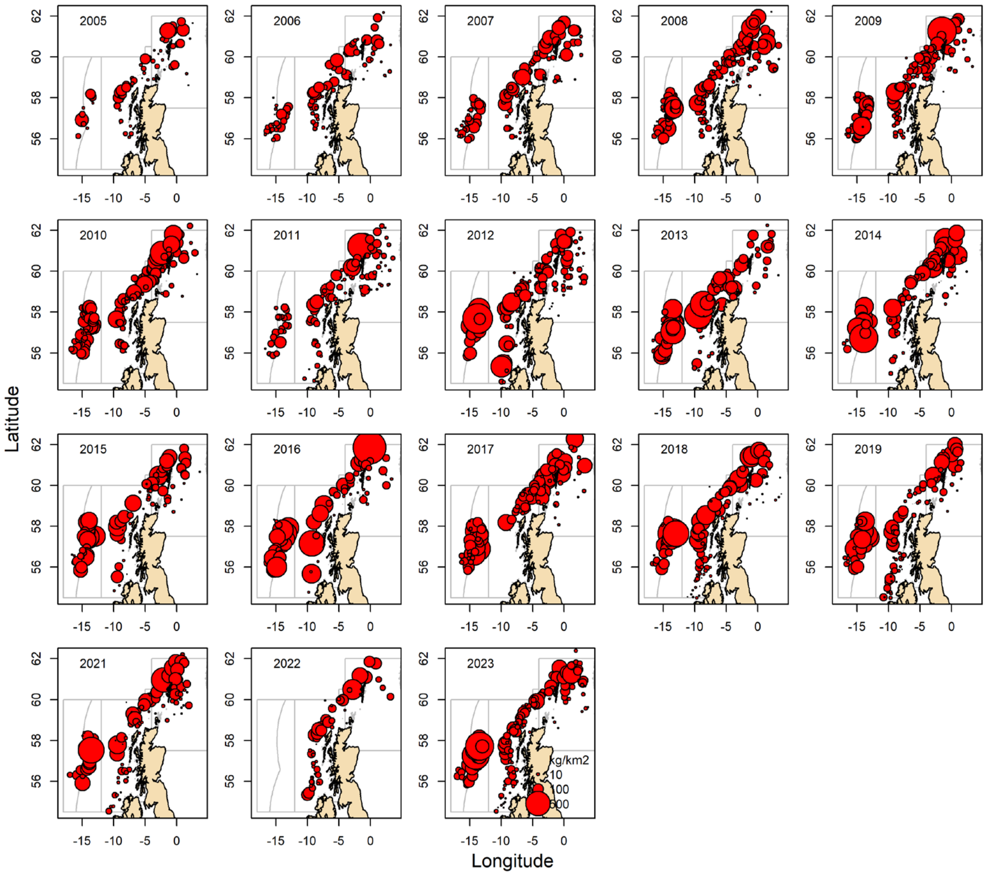


Figure 9.1. Maps of the northern continental shelf around the British Isles showing the biomass of megrim during the Scottish Irish Anglerfish and Megrim Industry Science Survey (SIAMISS) survey 2005–present. There was no survey in 2020 due to COVID.

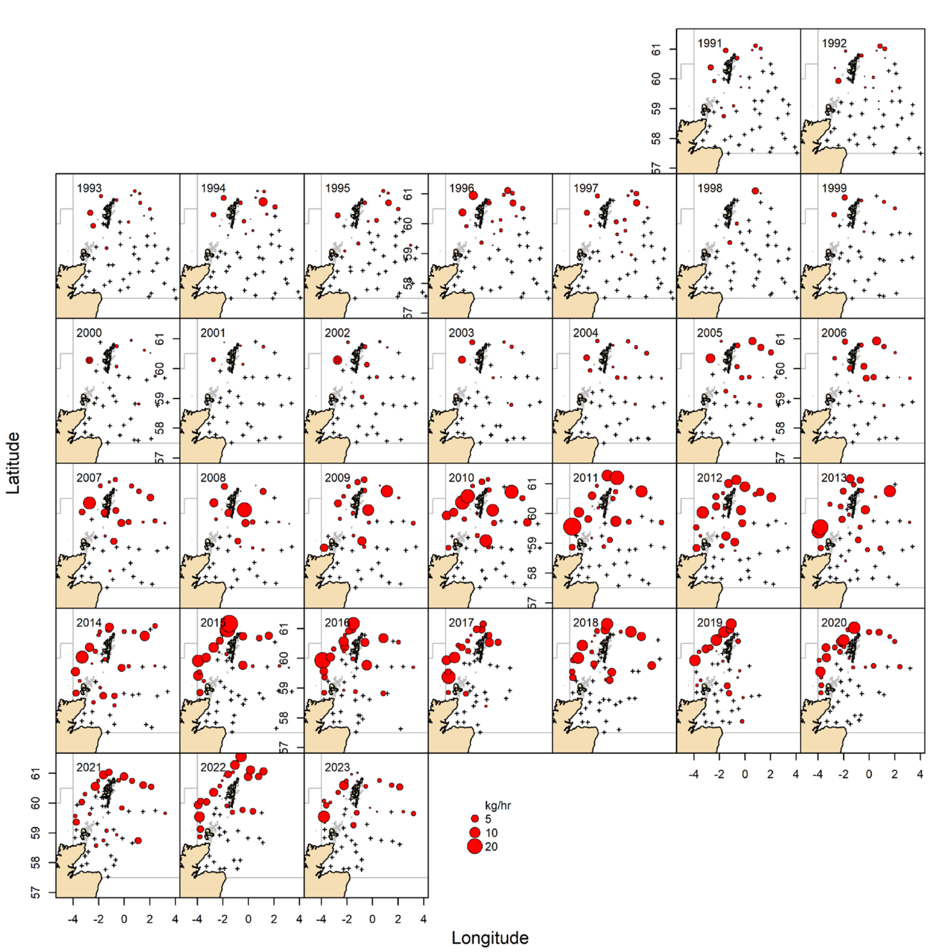


Figure 9.2. Sco-IBTS Q3 4.a 1991–present megrim biomass maps.

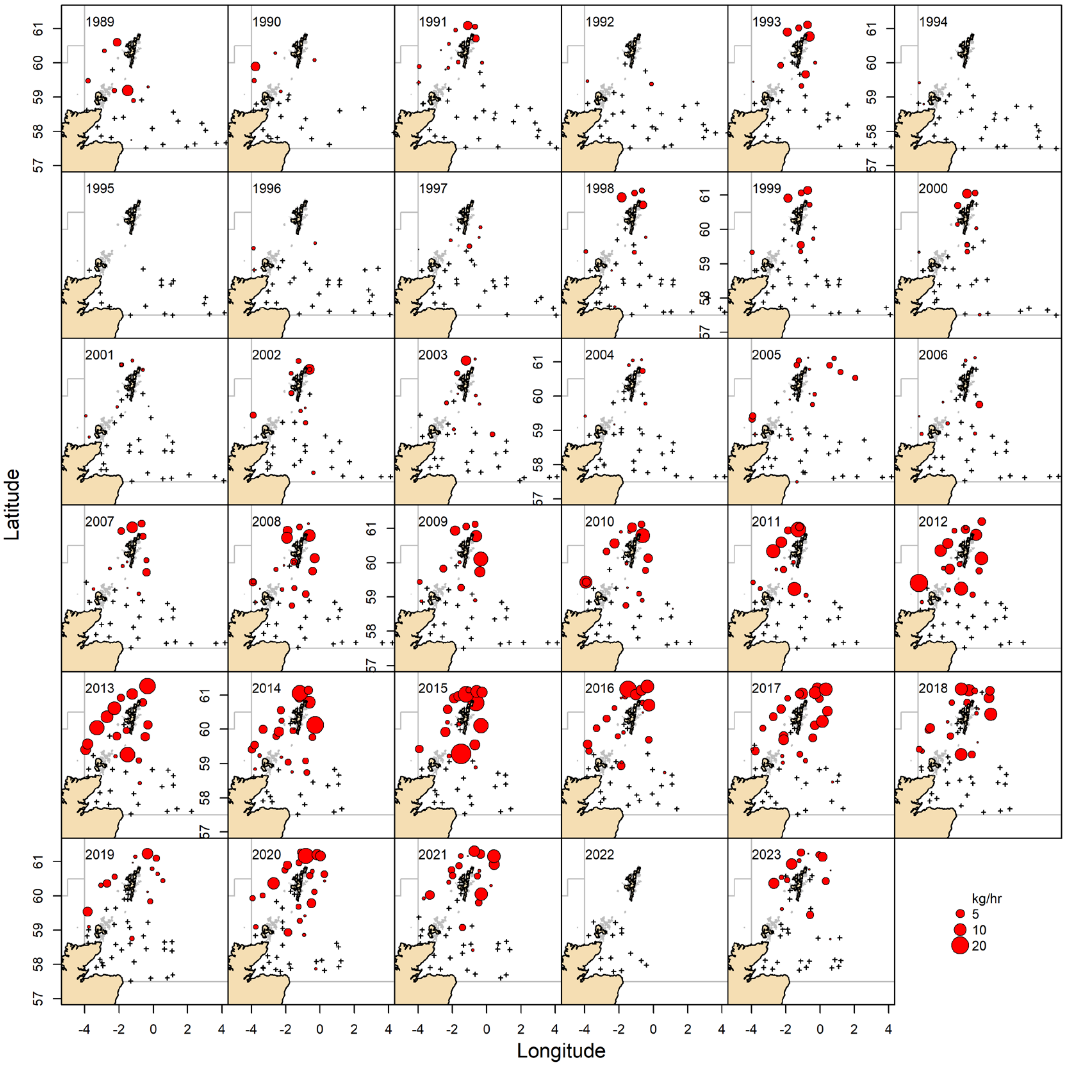


Figure 9.3. ScoIBTS Q1 4.a 1986–present megrim biomass maps.

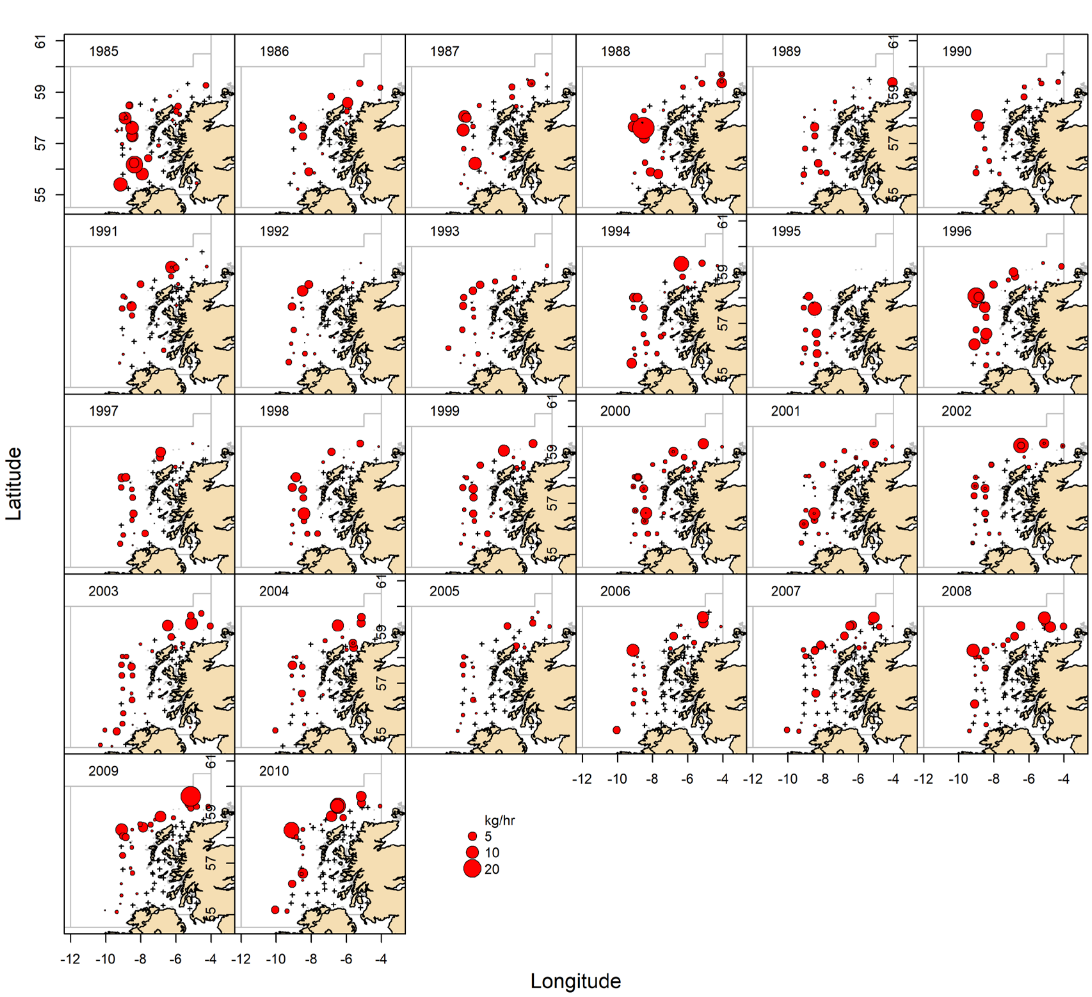


Figure 9.4 ScoGFS-WIBTS Q1 6.a megrim biomass maps.

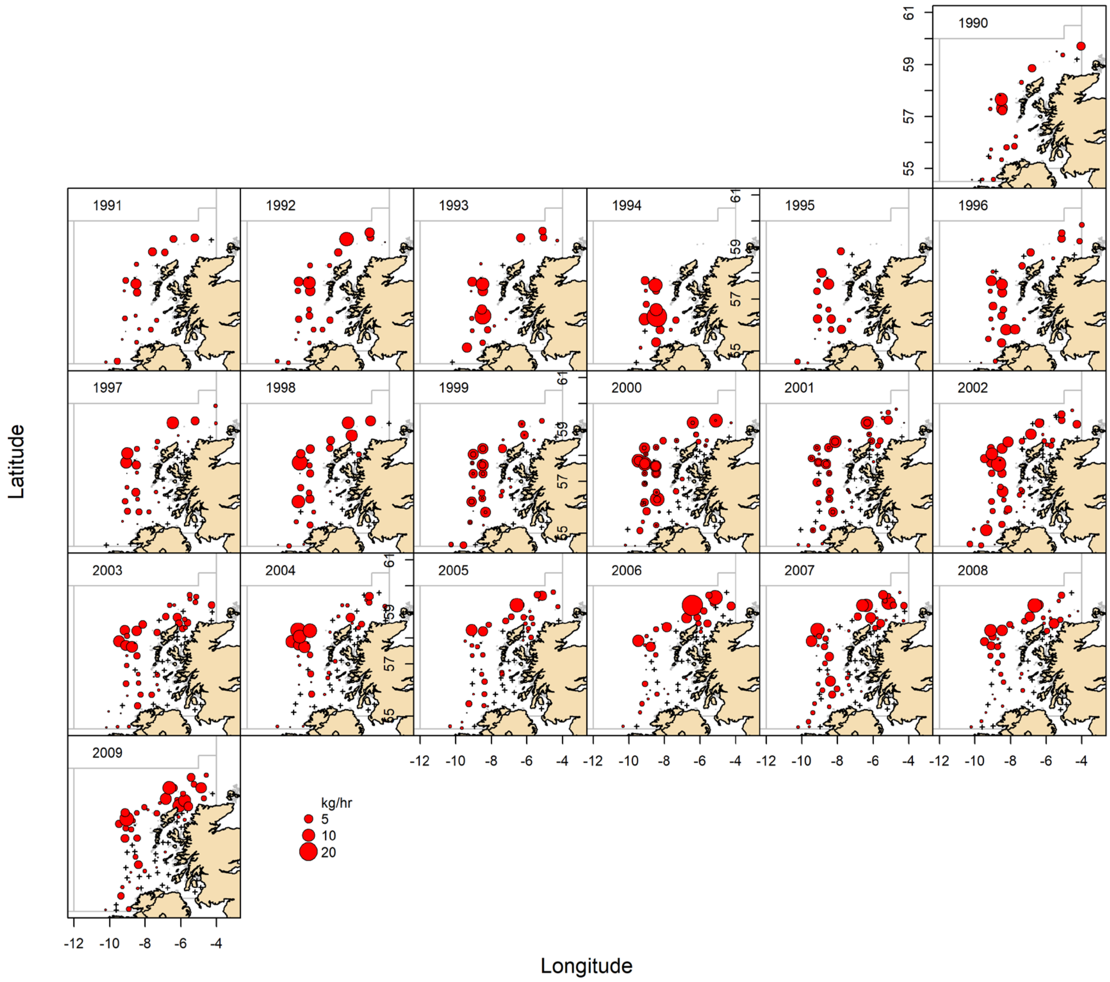


Figure 9.5 ScoGFS-WIBTS Q4 6.a megrim biomass maps.

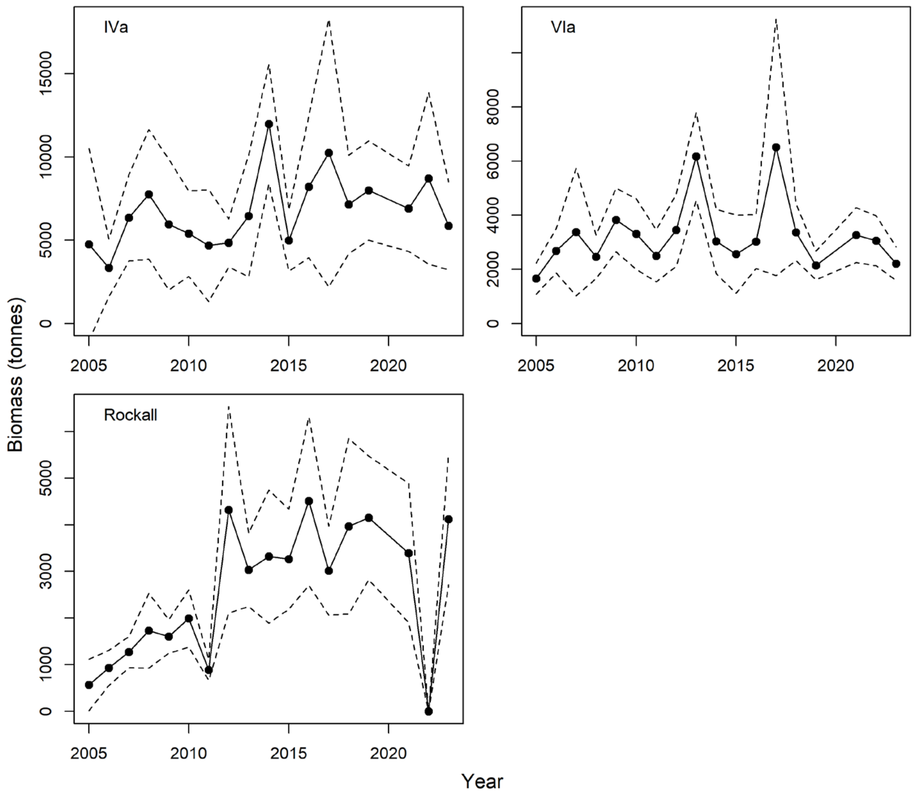


Figure 9.6. Megrim biomass estimates in ICES divisions 4, 6.a and 6.b from Scottish Irish Anglerfish and Megrim Industry Science Survey (SIAMISS) survey with 95%cls.

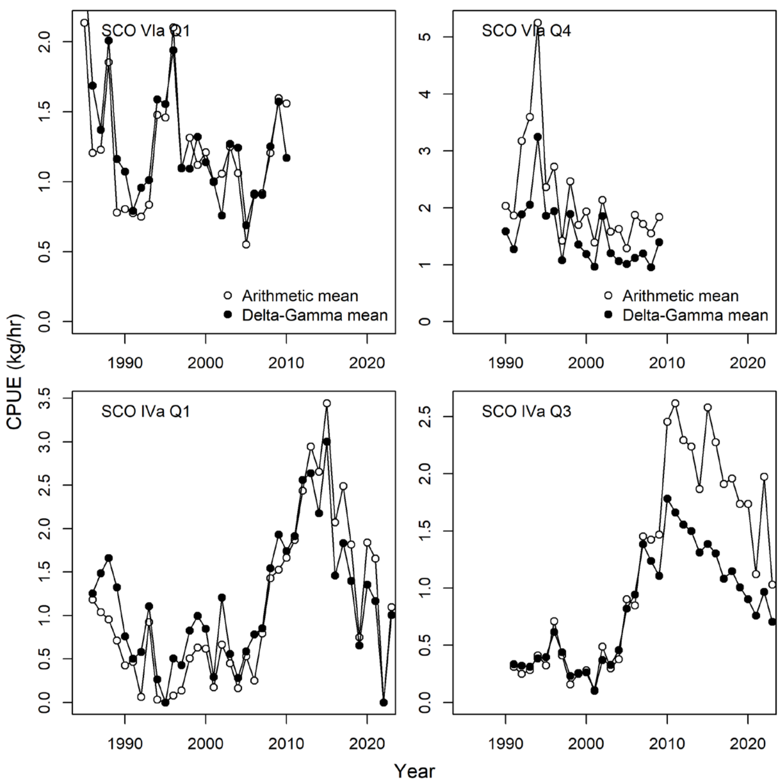


Figure 9.7. Megrim cpue estimates in from the IBTS surveys.

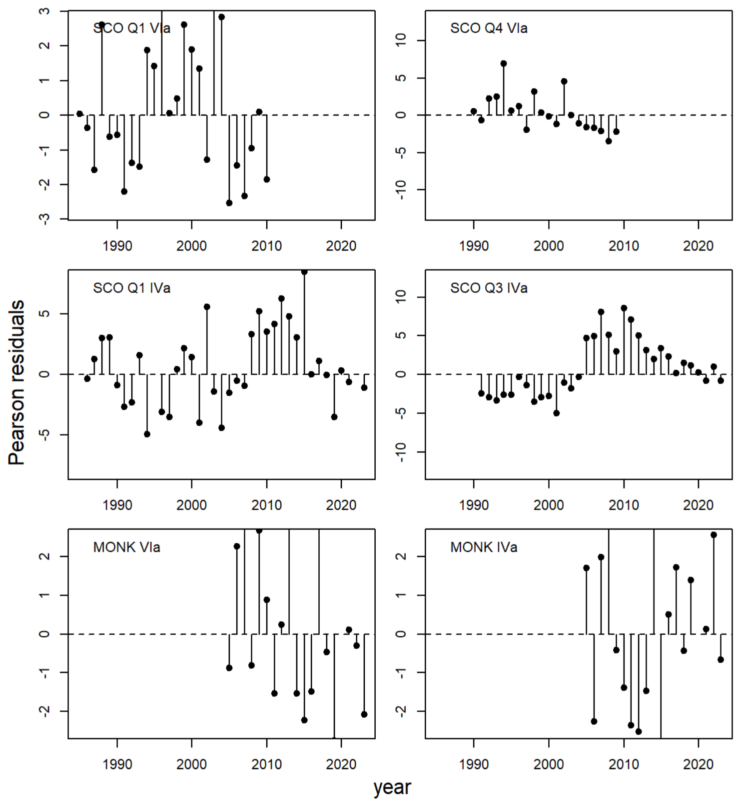


Figure 9.8. Pearson residuals for the six survey indices.

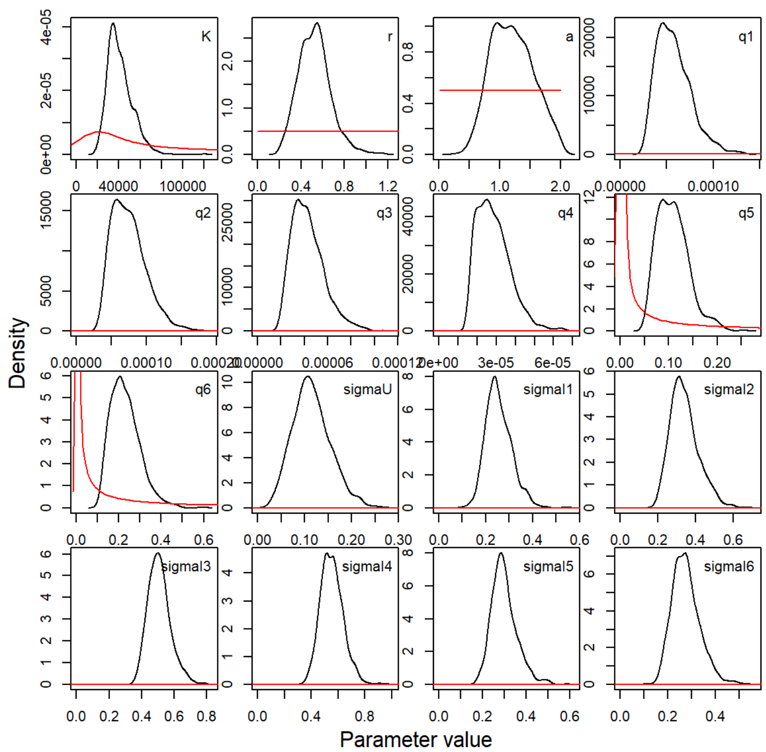


Figure 9.9. Prior (red line) and posterior distributions (black line) for the parameters in the model.

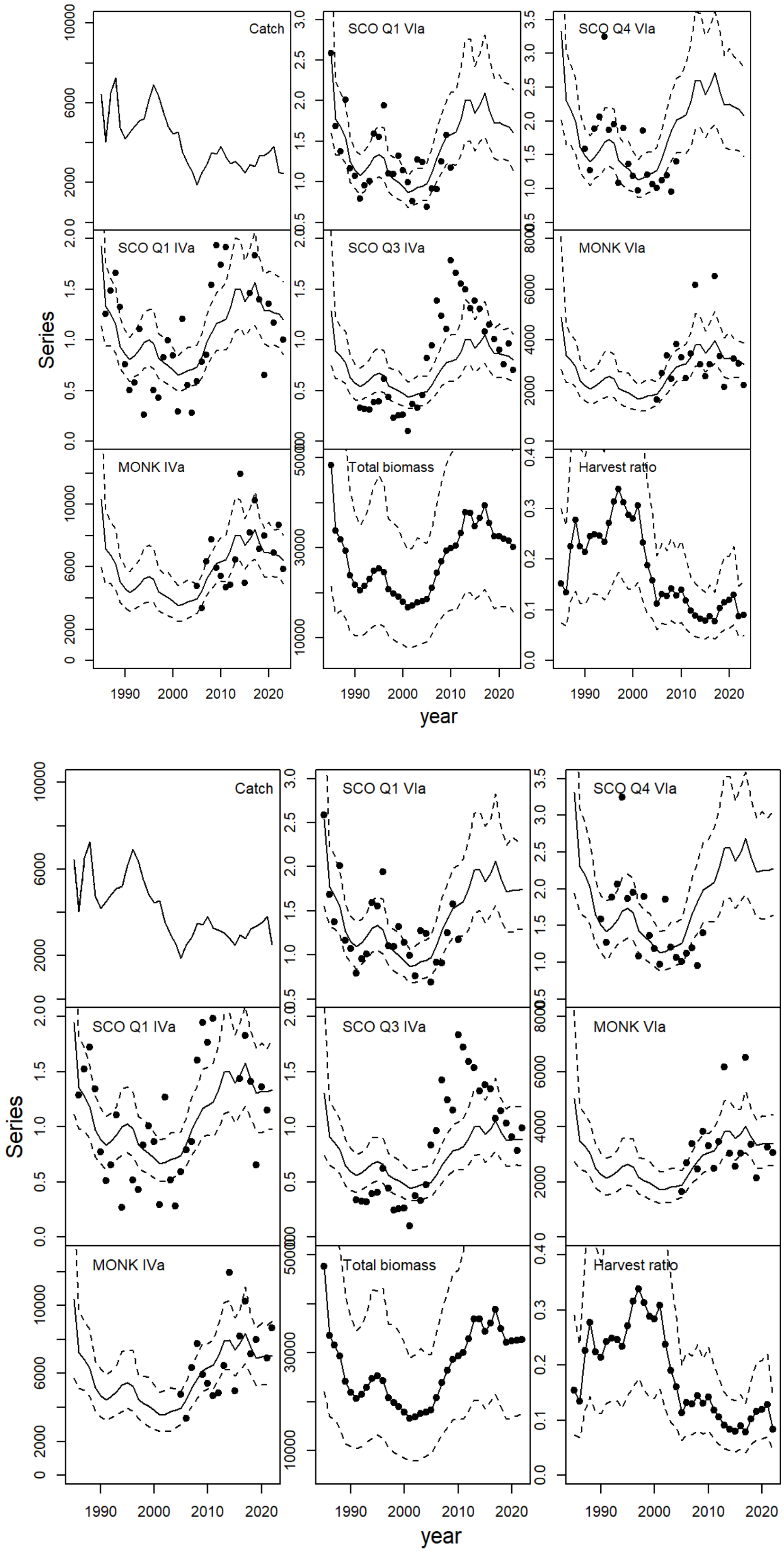


Figure 9.10. Time-series of catch and model estimates of total biomass and exploitation rate (median values are shown as solid lines and 95% confidence intervals shown as broken lines). The model fits to the various cpue series is also shown (observations dots, median fit solid line and 95% confidence intervals shown as broken lines).

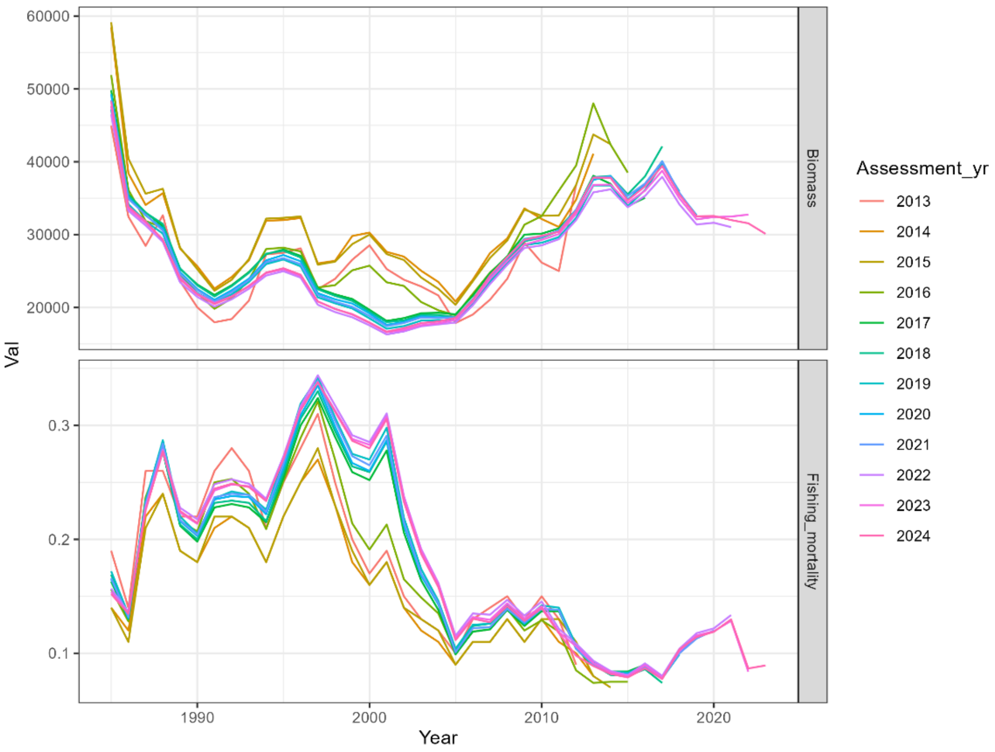


Figure 9.11. Comparison with previous assessments.

Contents

10 Megrim (*Lepidorhombus spp*.) in Division 6b. (Rockall)

10.1 General

Type of assessment in 2024

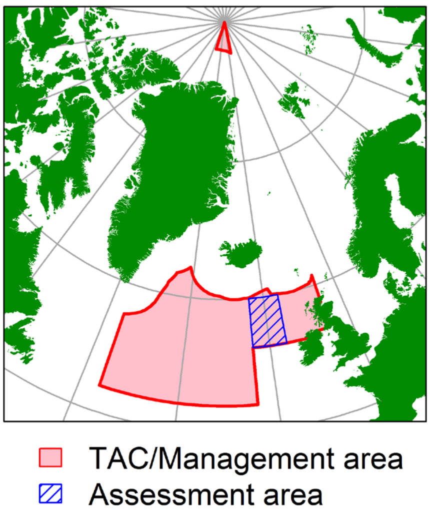
This stock was benchmarked in 2021 (ICES, 2021) and, as a result, the stock was changed from category 3 to category 2. The assessment, which is now based on Surplus Production in Continuous Time (SPiCT, Pedersen and Berg, 2017), includes revised assumptions and model priors. Reference points were also revised. These changes have resulted in a more reliable assessment and the methodology is appropriate to determine stock status and a short-term catch forecast.

ICES advice applicable to 2025

ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, catches in 2025 should be no more than 1192 tonnes.

Stock description and management units

Megrim stock structure is uncertain. Data collected during an EC study contract (98/096) on the 'Distribution and biology of anglerfish and megrim in the waters to the west of Scotland,' showed significantly different growth parameters and significant population structure difference between megrim sampled in 6.a and 6.b (Gordon, 2001). Spawning fish occur in both areas but whether these populations are reproductively isolated is not clear. WKFLAT (2011) concluded that megrim in 6.b should continue to be considered as a separate stock until further information is available.



Management area (red box) and assessment area (blue hatched area).

TAC regulations for 2024 in 6 and 5b are given below:

Species:	Megrims *Lepidorhombus* spp.			Zone:	6; United Kingdom and international waters of 5b; international waters of 12 and 14 (LEZ/56-14)
Spain		566	(1)	Analytical TAC	
France		2 207	(1)	Article 7(2) of this Regulation applies	
Ireland		645	(1)		
Union		3 418	(1)		
United Kingdom		2 611	(1)		
TAC		6 029			
(1)	Special condition: of which up to 25 % may be fished in: United Kingdom and Union waters of 2a and 4 (LEZ/*2AC4C).				

Fishery in 2023

Ireland had the highest catches in 2022 followed by the UK and Spain (Table 10.1). The majority of the landings and catches are from otter trawlers.

Catch	Landings		Discards
451 tonnes	Otter trawls 78%	Other gears 22%	451 tonnes
	439 tonnes		12 tonnes

10.2 Landings

Official landings data for each country together with Working Group best estimates of catches from 6.b are shown in Table 10.1 and Figure 10.1.

Catches of megrim comprise two species, *Lepidorhombus whiffiagonis* and *L. boscii*. Information available to the Working Group indicates that *L. boscii*, are a negligible proportion of the Scottish and Irish megrim catch (Kunzlik *et al*., 1995; Anon, 2001). It is not clear to the WG whether landings of other countries are accurately partitioned by megrim species. Megrim are caught in association with anglerfish by some fleets and are area-misreported along with anglerfish. However, it is unknown whether misreporting from Division 6.b is an issue.

Discards

Discard data for 2023 were available for Ireland, UK and Spain in InterCatch. Total discard estimates were available from 2005–2023. To estimate catches prior to 2005, for the SPiCT analysis; a catch over landing ratio of 1.2 was used (derived from that observed ratio between 2017–2020). In 2023, discards represented approximately 2.7% of catch; decreasing from 18 to 12 tonnes (Table 10.1 and Figure 10.1). Discards are estimated to be the lowest in the time series.

Surveys

In 2005, Scotland initiated a new industry–science partnership survey to provide an absolute abundance estimate for anglerfish. Sixteen years of survey data are available and these cover the main distribution of the anglerfish fishery. The survey is also considered to have greater spatial coverage for megrim, and as such was recommended by WKAGME (2008) as the main source of data of megrim relative biomass, for all megrim stocks in the Northern Shelf.

The survey index for 6.b is shown in Figure 14.2. Due to technical reasons the survey was unable to sample in Division 6.b, so the stock size is unknown for 2022. This value is also absent in 2020 due to the absence of the Scottish and Irish Anglerfish and Megrim Industry Science Survey [G3745] which was cancelled due to Covid. Sensitivity trials showed the assessment to be robust to the missing data and it was decided by the group to use the updated assessment despite the missing input data. In 2023 and 2024 the survey was successfully completed.

The available data shows the stock abundance to have been stable since 2012 prior to which it displayed a largely increasing abundance and biomass trend since 2005. The area-stratified survey provides a minimum estimate of absolute biomass; survey catches are raised based on swept area and weighted by area. The survey assumes that all megrim in the trawl path are retained e.g. q=1. Assuming full retention is overly optimistic, therefore the minimum estimate of stock biomass was provided.

Historical stock development

Prior to the benchmark in 2021, the stock was a category 3 stock that utilised a SPiCT assessment and the ratio of the mean of the last two Scottish and Irish Anglerfish and Megrim Industry Science Survey index values.

10.3 Final Assessment

Following on from the benchmark (ICES, 2021), the final assessment utilised a SPiCT model utilising the recommendations and developed settings. The catch data is shown in Figure 14.1 and combined the landings and discard estimates. The abundance index from the Scottish and Irish Anglerfish and Megrim Industry Science Survey is shown in Figure 14.2. Following on from the sensitivity and robustness testing at the benchmark the following prior settings were applied:

- Surplus production curve fixed (n=2)
- Intrinsic growth rate (r) 0.39 – modelled from FishLife
- An initial biomass depletion prior of 0.5
- Intermediate year catch – average of last 3 years' catch

The output of the model can be seen in Figure 10.3. There is some autocorrelation in the catch time series but generally the residuals are good (Figure 10.4) and the retrospective plots for the assessment show good agreement with all the peels (Figure 10.5). Final parameter estimates from the SPiCT run are given in Table 10.2.

State of the stock

The summary plots can be seen in Figure 10.3 and they show fishing pressure on the stock is below F_{MSY} and biomass is above MSY $B_{trigger}$ and B_{lim}. The summary of the assessment is shown in Table 10.3.

10.4 Short-term projections

Short term projections were conducted using a 2024 catch that was the average of the preceding 3 years, and the assumptions are shown below:

Variable	Value	Notes
F (2024)/F_{MSY}	0.38	F corresponding to *status quo* catch
B (2025)/B_{MSY}	1.52	Short-term forecast (STF) with *status quo* catch
Catch (2024)	501	*Status quo* catch (average 2021–2023) ; in tonnes

Four management scenarios were explored and the catch and relative reference points estimated for 2025. Adopting the MSY approach (using the 35th percentile of predicted catch under $F=F_{MSY}$) gave an estimated catch of 1192 tonnes, a F/F_{MSY} of 0.91 and a B/B_{MSY} of 1.41.

Basis	Total catch (2025)	F_{2025}/F_{MSY}	B_{2026}/B_{MSY}	% B change **	% advice change***
ICES advice basis					
MSY approach (35th percentile of predicted catch distribution under $F = F_{MSY}$)	1192	0.91	1.41	-6.9	6.9
Other scenarios					
F_{MSY}	1305	1.00	1.39	-8.4	17.0
F_{2023}	493	0.36	1.55	2.1	-56
F = 0	0	0	1.65	8.5	-100

* Calculations were done with unrounded inputs, and computed values may not match exactly when calculated using the rounded figures in the table.
** Biomass 2026 relative to biomass 2025.
*** Advice value for 2025 relative to the advice value for 2024 (1115 tonnes).

MSY reference points

The MSY reference points are calculated based on the relative reference points estimated by the SPiCT model, so will change when the assessment is updated. The reference points are calculated as:

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	$0.5 \times B_{MSY}$	Relative value (B/B_{MSY}) from the SPiCT assessment model. B_{MSY} is estimated directly from the SPiCT model and changes when the assessment is updated.
	F_{MSY}	$1 \times F_{MSY}$	Relative value (F/F_{MSY}) from the SPiCT assessment model. F_{MSY} is estimated directly from the SPiCT model and changes when the assessment is updated.
Precautionary approach	B_{lim}	$0.3 \times B_{MSY}$	Relative value (equilibrium yield at this biomass is 50% of MSY).
	F_{lim}	$1.7 \times F_{MSY}$	Relative value (the F that drives the stock to B_{lim}).

Uncertainties and bias in assessment and forecast

Due to the missing 2022 and 2020 survey data sensitivity analyses were conducted last year to determine the impact on the assessment. The survey was successfully completed in 2023 and 2024, and shows a short term increase in biomass and confirms that the stock biomass has been relatively stable for the last decade.

Currently the assessment uses the Scottish and Irish Anglerfish and Megrim Industry Science Survey to estimate biomass. It should be noted that the survey was specifically designed to catch angler fish. While this is not an issue when the biomass index is presented in the relative context, in the case of megrim; the raised biomass calculation is based on full retention of megrim in the haul. The estimates are therefore considered as the minimum.

10.5 Recommendation for next Benchmark

This stock was subject to benchmark in 2021.

10.6 Management considerations

The TAC in 6 has not been fully utilised; the uptake rate is country-specific; partial quota by individual Member States may be an artefact of reduction in effort rather than reflective of a reduction in biomass. The TAC and assessment area are incompatible.

10.7 References

Gordon, J.D. 2001. (co-ordinator) Distribution and biology of anglerfish and megrim in waters to the west of Scotland. Final Report of EC DGXIV Study Contract 98/096 XX.

Kunzlik, P. A., A. W. Newton and A. W. Jermyn. 1995. Exploitation of monks (*Lophius* spp.) and megrims (*Lepidorhombus* spp.) by Scottish fishermen in ICES Division VIa (West of Scotland). Final report EU FAR contract MA-2-520.

ICES. 2011. Report of the Benchmark Workshop on Flatfish (WKFLAT), 1–8 February 2011, Copenhagen, Denmark. ICES CM 2011/ACOM:39. 257 pp.

ICES. 2021. Benchmark Workshop on the development of MSY advice for category 3 stocks using Surplus Production Model in Continuous Time; SPiCT (WKMSYSPiCT). ICES Scientific Reports. 3:20. 316 pp. https://doi.org/10.17895/ices.pub.7919.

Pedersen, M. W. and Berg, C. W. 2017. A stochastic surplus production model in continuous time. Fish Fish, 18: 226–243. doi:10.1111/faf.12174.

10.8 Tables and Figures

Table 10.1 Megrim in Division 6.b. History of catch and landings; official landings presented by country and ICES estimated catch. All weights are in tonnes.

Year	France	Ireland	Spain	Germany	UK (England, Wales, & Northern Ireland)	UK (Scot-land)	UK	Official landings	ICES catch
1990	-	196	363	-	19	226	-	804	-
1991	-	240	587	-	14	204	-	1045	-
1992	-	139	683	-	53	198	-	1073	-
1993	-	128	594	-	56	147	-	925	-
1994	-	176	574	-	38	258	-	1046	-
1995	-	117	520	-	27	152	-	816	-
1996	-	124	515	-	92	112	-	843	-
1997	-	141	628	-	76	164	-	1009	-
1998	-	218	549	-	116	208	-	1091	-
1999	-	127	404	-	57	278	-	866	-
2000	4	167	427	-	57	309	-	964	-
2001	< 0.5	176	370	-	42	236	-	824	-

Year	France	Ireland	Spain	Germany	UK (England, Wales, & Northern Ireland)	UK (Scotland)	UK	Official landings	ICES catch
2002	< 0.5	87	120	-	41	207	-	455	-
2003	-	83	93	-	74	382	-	632	-
2004	-	43	71	-	42	372	-	528	-
2005	-	68	88	-	19	207	-	382	469
2006	-	95	59	-	9	181	-	345	419
2007	-	87	19	-	36	152	-	294	128
2008	-	68	84	-	1	141	-	294	353
2009	-	48	46	-	5	160	-	259	270
2010	-	47	41	-	6	87	-	180	165
2011	-	72	28	-	3	66	-	169	162
2012	-	120	61	-	-	89	-	270	245
2013	-	181	-	-	-	58	-	240	293
2014	-	230	73	-	-	95	-	398	358
2015	-	256	190	-	-	-	130	576	538
2016	-	272	69	-	-	-	116	457	550
2017	-	358	215	-	-	-	180	753	819
2018	-	438	61	-	-	-	263	763	967
2019	25	76 †	94	-	-	-	229	425†	817
2020	41	467	112	-	-	-	246	866	920
2021	1	293	71	-	-	-	212	577	631
2022	-	248	57	<0.5	-	-	98	402	420
2023*	-	152	100	-	-	-	191	444	451

* Landing values are preliminary.
† Incomplete/missing as a result of part of the data being unavailable under data confidentiality clauses.

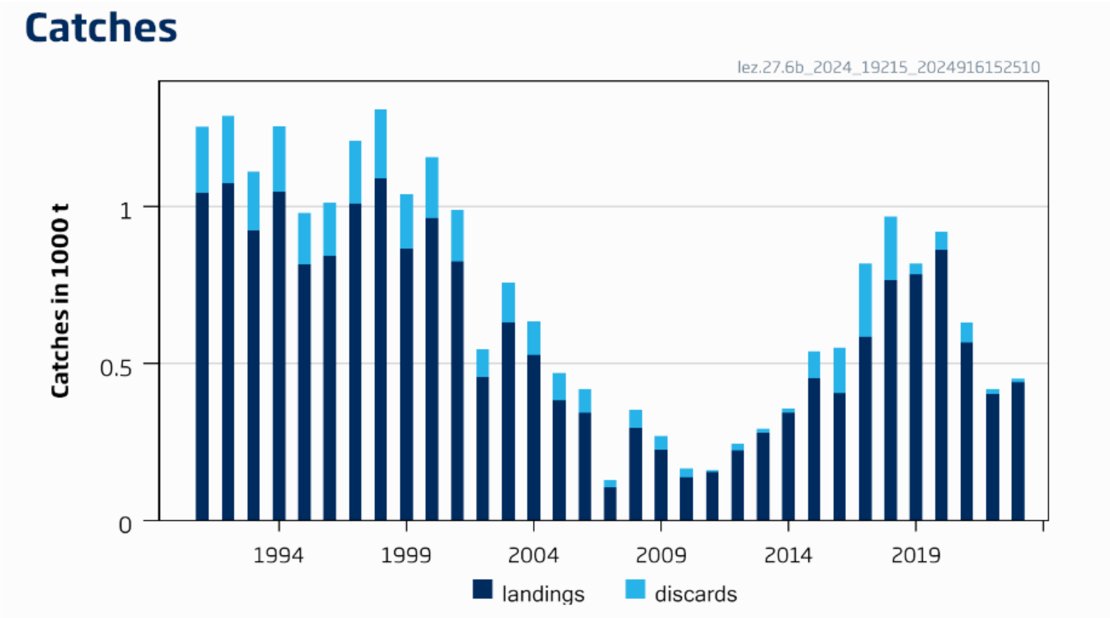


Figure 10.1. Lez.27.6b ICES estimated landings and discards. Discard data are only available since 2005; values prior to that are assumed to be 20% of landings based on the observed ratio from 2017 to 2020.

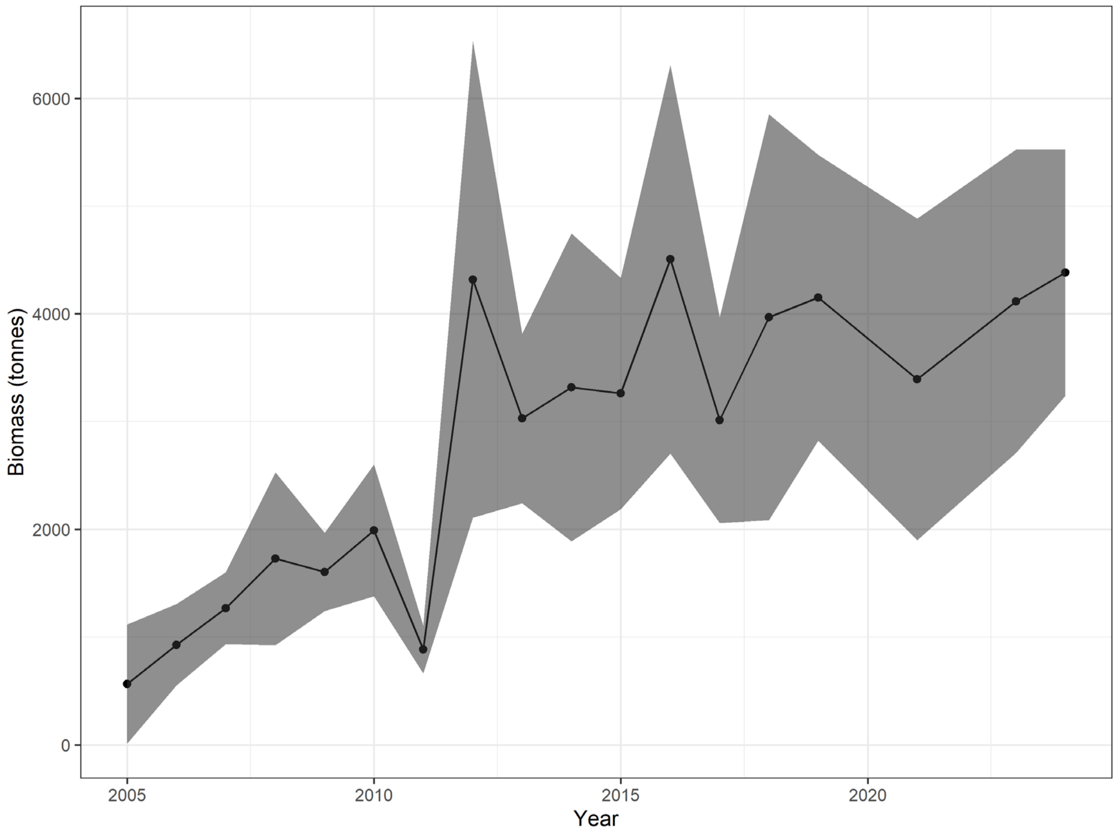


Figure 10.2. Survey data for lez.6b from SIAMISS (Scottish and Irish Anglerfish and Megrim Industry Science Survey[G3745])

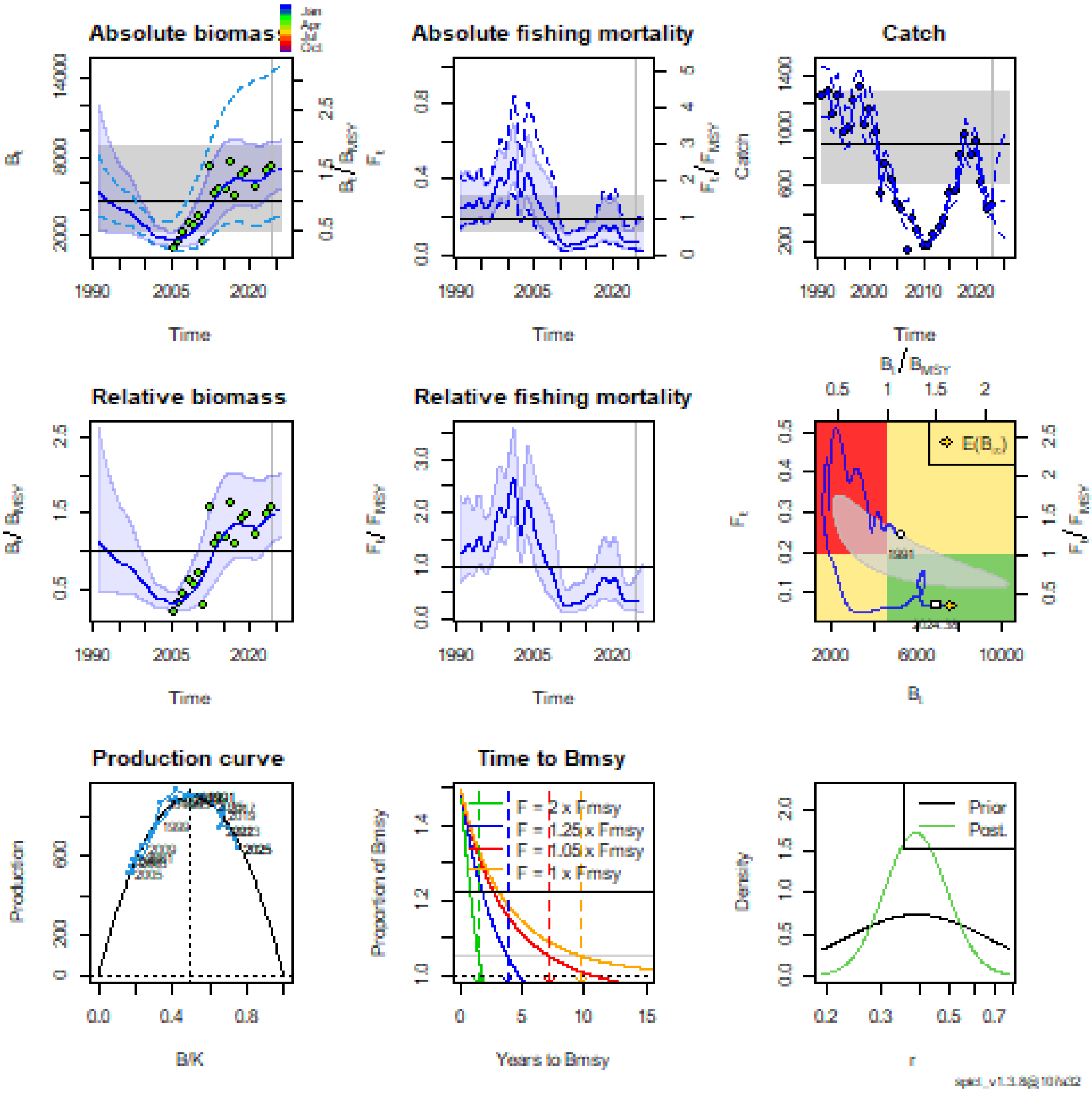


Figure 10.3. SPiCT model output for lez.27.6b. Top right: observed and fitted catch with 95 ci. Centre left: Biomass relative to B_{MSY}. Centre: F relative to F_{MSY}. Corresponding MSY quantities are shown in each plot as horizontal lines (0.5 B_{MSY} in the case of the relative biomass plot). Centre right Kobe plot of stock trajectory.

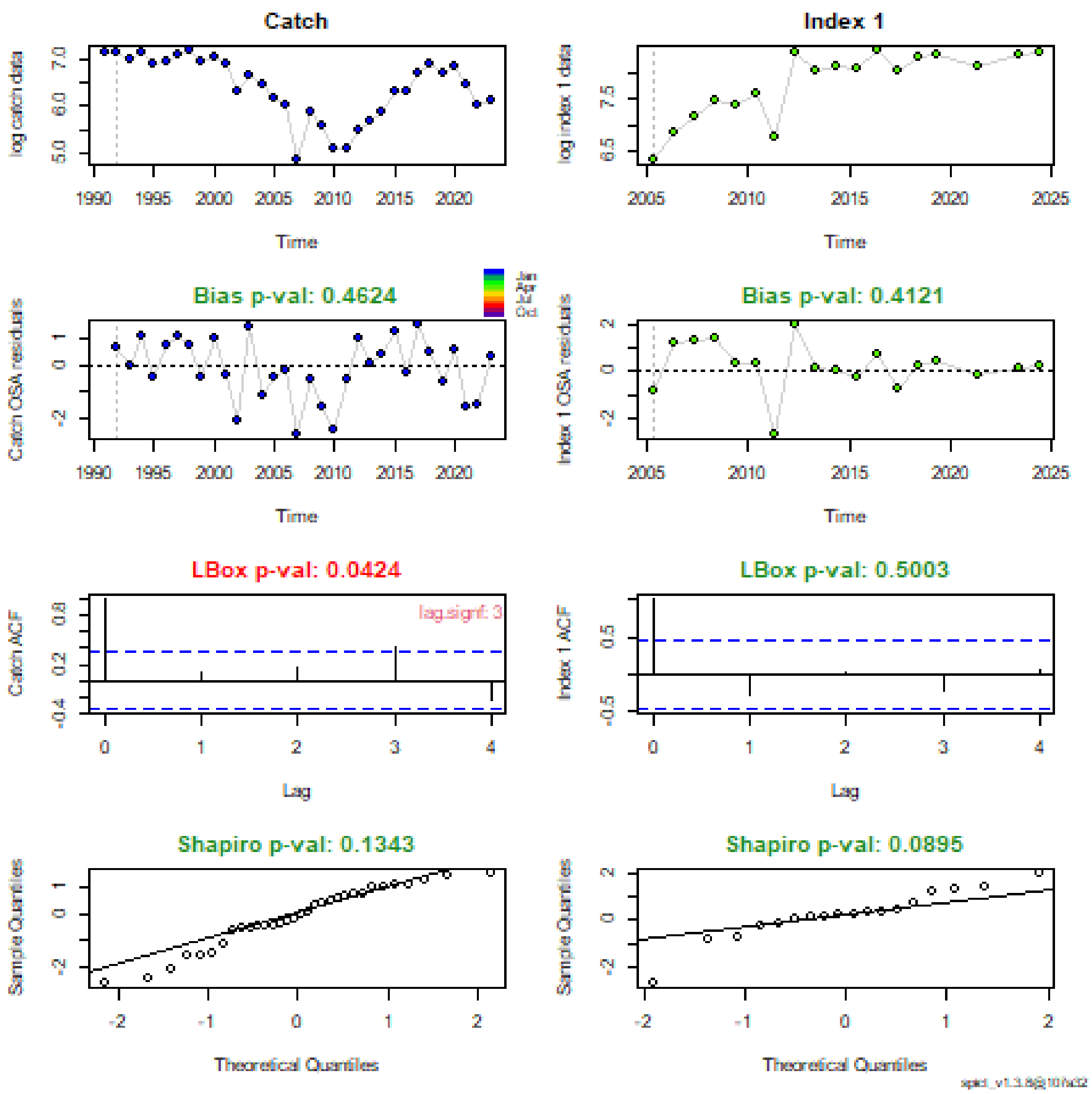


Figure 10.4. SPiCT model residual output for lez.27.6b

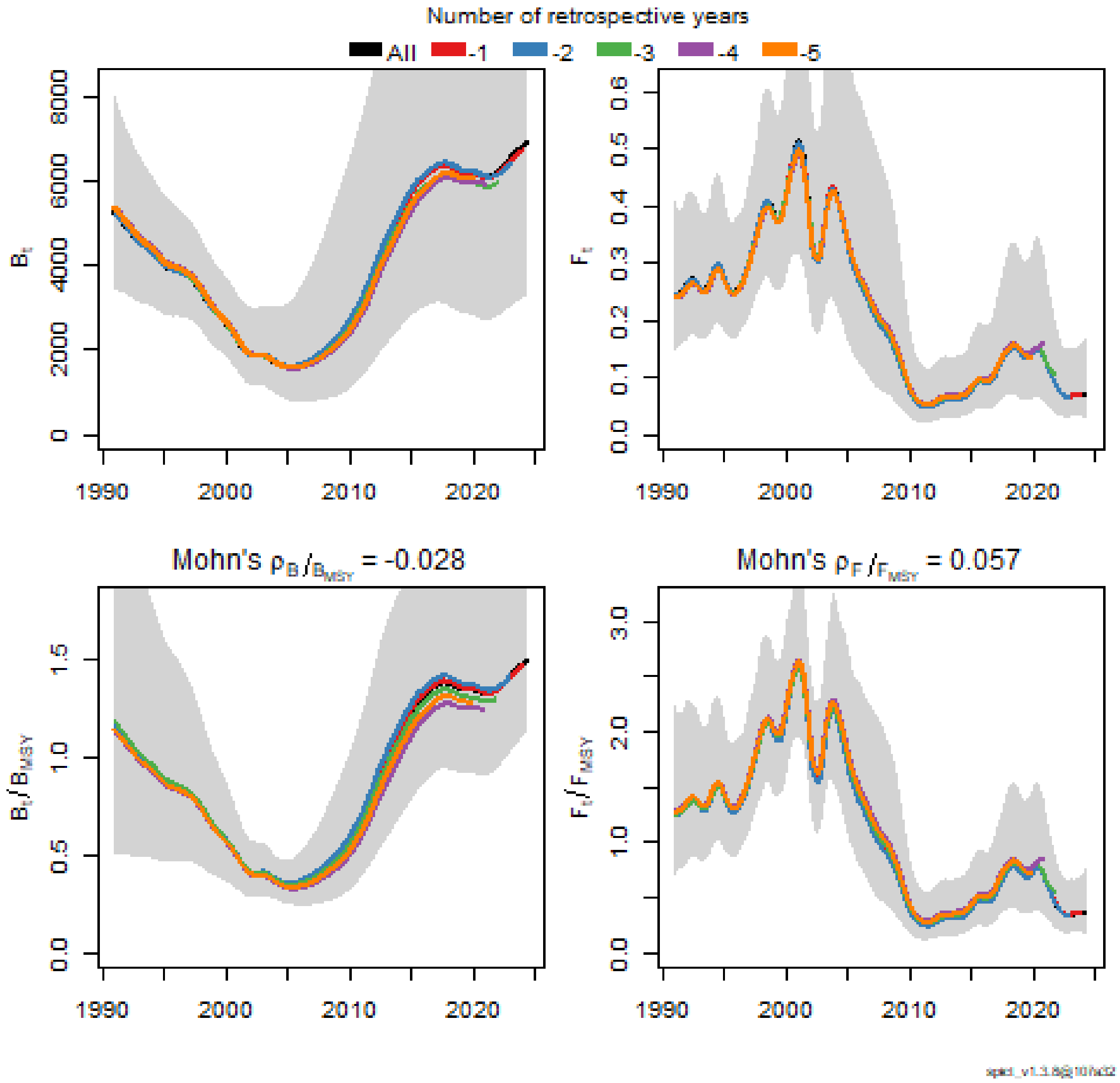


Figure 10.5. SPiCT model retrospectives for lez.27.6b

Table 10.2. SPICT results for Lez.27.6b.

```
Model parameter estimates w 95% CI
            estimate        cilow        ciupp    log.est
 alpha     6.1860230    0.7989385 4.789716e+01  1.8222924
 beta      0.2497627    0.0571731 1.091097e+00 -1.3872441
 r         0.3899077    0.2479786 6.130689e-01 -0.9418454
 rc        0.3899077    0.2479786 6.130689e-01 -0.9418454
 rold      0.3899077    0.2479786 6.130689e-01 -0.9418454
 m       904.7520622  630.2423641 1.298828e+03  6.8076609
 K      9281.7061021 4859.2527669 1.772908e+04  9.1358007
 q         0.5989741    0.2757042 1.301286e+00 -0.5125370
 sdb       0.0496377    0.0065553 3.758645e-01 -3.0030053
 sdf       0.2983366    0.2079381 4.280347e-01 -1.2095331
 sdi       0.3070597    0.2169132 4.346700e-01 -1.1807129
 sdc       0.0745133    0.0212641 2.611081e-01 -2.5967772
 pp        0.9655581    0.7881244 9.952894e-01  3.3334333
 robfac   13.4654341    2.5052024 1.042333e+02  2.5229595

Deterministic reference points (Drp)
           estimate        cilow        ciupp   log.est
 Bmsyd 4640.8530511 2429.6263834 8864.5386749  8.442654
 Fmsyd    0.1949538    0.1239893    0.3065344 -1.634993
 MSYd   904.7520622  630.2423641 1298.8277854  6.807661
Stochastic reference points (Srp)
          estimate        cilow        ciupp   log.est rel.diff.Drp
 Bmsys 4622.851409 2422.4083429 8822.1109426  8.438767 -0.003894056
 Fmsys    0.194345    0.1235908    0.3056052 -1.638120 -0.003132712
 MSYs   898.417272  628.1896504 1284.8884011  6.800635 -0.007051055

States w 95% CI (inp$msytype: s)
                    estimate        cilow        ciupp    log.est
 B_2024.38      6907.2253723 3255.0489547 1.465716e+04  8.8403233
 F_2024.38         0.0681550    0.0270736 1.715728e-01 -2.6859713
 B_2024.38/Bmsy    1.4941483    1.1220553 1.989634e+00  0.4015563
 F_2024.38/Fmsy    0.3506905    0.1594209 7.714412e-01 -1.0478511

Predictions w 95% CI (inp$msytype: s)
                  prediction        cilow        ciupp    log.est
 B_2026.00      7185.5196215 3433.8784555 1.503597e+04  8.8798231
 F_2026.00         0.0681552    0.0208056 2.232633e-01 -2.6859672
 B_2026.00/Bmsy    1.5543480    1.2037917 2.006990e+00  0.4410561
 F_2026.00/Fmsy    0.3506920    0.1185063 1.037792e+00 -1.0478470
 Catch_2025.00   484.3136240  232.9076171 1.007093e+03  6.1827327
 E(B_inf)       7595.3596721           NA           NA  8.9352928
```

Table 10.3 Assessment summary. ICES estimated landings and discards. Discard data are only available since 2005; values prior to that are assumed to be 20% of landings based on the observed ratio from 2017 to 2020. High and low refers to 95% confidence intervals. All weights in tonnes.

Year	Relative Biomass			Landings	Discards	Relative fishing pressure		
	Low	Midpoint	High	tonnes	tonnes	Low	Midpoint	High
1991	0.50	1.14	2.61	1045	209	0.68	1.25	2.3
1992	0.50	1.06	2.27	1073	215	0.80	1.35	2.3
1993	0.48	0.98	2.0	925	185	0.83	1.33	2.1
1994	0.48	0.93	1.81	1046	209	0.92	1.43	2.2
1995	0.46	0.86	1.62	816	163	0.94	1.42	2.1
1996	0.46	0.84	1.51	843	169	0.87	1.29	1.92
1997	0.46	0.81	1.41	1009	202	1.06	1.53	2.2
1998	0.44	0.74	1.24	1091	218	1.39	1.96	2.8
1999	0.39	0.64	1.03	866	173	1.45	2.0	2.8
2000	0.36	0.57	0.89	964	193	1.54	2.1	2.9
2001	0.32	0.48	0.72	824	165	1.93	2.6	3.6
2002	0.28	0.40	0.58	455	91	1.36	1.88	2.6
2003	0.28	0.40	0.56	632	126	1.25	1.77	2.5
2004	0.27	0.37	0.50	528	106	1.50	2.2	3.2
2005	0.25	0.34	0.47	382	87	1.08	1.74	2.8
2006	0.24	0.35	0.51	344	75	0.78	1.39	2.5
2007	0.24	0.38	0.59	106	22	0.58	1.14	2.2
2008	0.25	0.42	0.71	294	59	0.45	0.95	2.0
2009	0.27	0.48	0.85	226	44	0.33	0.73	1.63
2010	0.31	0.56	1.01	139	26	0.173	0.40	0.92
2011	0.38	0.68	1.21	155	7	0.110	0.25	0.58
2012	0.48	0.84	1.45	224	21	0.121	0.27	0.58
2013	0.58	0.99	1.68	278	15	0.145	0.31	0.66
2014	0.68	1.12	1.84	343	15	0.151	0.32	0.67
2015	0.78	1.23	1.96	453	85	0.20	0.41	0.82
2016	0.85	1.31	2.01	405	145	0.23	0.46	0.92
2017	0.92	1.36	2.02	586	233	0.28	0.54	1.07
2018	0.93	1.37	2.02	764	203	0.39	0.75	1.47
2019	0.92	1.34	1.97	783	34	0.36	0.73	1.45
2020	0.91	1.34	1.96	861	59	0.36	0.73	1.48
2021	0.90	1.32	1.93	566	65	0.32	0.65	1.33
2022	0.94	1.34	1.92	402	18	0.199	0.40	0.82
2023	1.02	1.41	1.95	439	12	0.171	0.34	0.66
2024	1.10	1.48	1.98					

Contents

11 Norway lobster (*Nephrops norvegicus*) in Division 6.a, Functional Unit 11 (West of Scotland, North Minch)

11.1 Introduction

Nephrops stocks have previously been identified by WGNEPH on the basis of population distribution, and defined as separate Functional Units. The Functional Units (FU) in ICES Division 6.a (of which there are three) are defined by the groupings of ICES statistical rectangles given in Table 11.1 and illustrated in Figure 11.1. The functional unit is the level at which the WG collates fishery data (quantities landed and discarded, fishing effort and length distributions) and at which it performs assessments.

Type of assessment in 2024

The assessment of North Minch *Nephrops* in 2024 is based on a combination of examining trends in fishery indicators and abundance estimated by underwater TV survey, both of which comprise an extensive data series for this FU. The assessment follows the process defined by the benchmark WG (WKNEPH 2009 and WKNEPH 2013) and is conducted annually according to standards set out by the Manual for the Nephrops Underwater TV Surveys (Dobby H., et al, 2021). Further details on the assessment and catch options are provided in the stock annex.

ICES advice applicable to 2023

'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 2019 – 2021, catches in 2023 should be no more than 3784 tonnes.

To ensure that the stock in Functional Unit 11 is exploited sustainably, management should be implemented at the functional unit level.

ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 6. ICES considers this plan to be precautionary when implemented at the FU level.'

ICES advice applicable to 2024

'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 2020 – 2022, catches in 2024 should be no more than 4218 tonnes.

To ensure that the stock in Functional Unit 11 is exploited sustainably, management should be implemented at the functional unit level.

ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 6. ICES considers this plan to be precautionary when implemented at the FU level.'

11.2 General

Nominal landings as reported to ICES for divisions 6.a and 6.b are presented in Table 11.1.1. Total official landings from Division 6.a were 9938.82 tonnes in 2023, mostly reported by the UK with only 82 tonnes reported from Ireland and 2 tonnes reported by Spain. Table 11.1.2 and Figure 12.1.2 shows WG estimates of landings in Division 6.a broken down by FU. *Nephrops* landings are also made from outside the functional units, from statistical rectangles where small pockets of suitable sediment exist, although these are generally small amounts. In 2023, 294 tonnes of landings were reported from outside the FUs which is higher than the long-term average (Table 11.1.2). The main areas of activity outside FUs are the Stanton Bank (to the west of the South Minch) and areas of suitable sediment along the shelf edge and slope to the west of the Hebrides. There are no functional units in Division 6.b and only very small quantities of *Nephrops* are landed (Table 11.1.1(b)).

Stock description and management units

The North Minch (FU 11) is located at the northern end of the west coast of Scotland (Figure 11.1.1). Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the North Minch functional unit these substrates are distributed according to prevailing hydrographic and bathymetric conditions. The area is characterised by numerous islands of varying size and sea lochs, which occur along the mainland coast. These topographical features create a diverse habitat with complex hydrography and a patchy distribution of soft sediments. Results from work on mapping the spatial extent of *Nephrops* habitat in the North Minch sea lochs indicate that the muddy habitat in these areas is only a very small proportion of the total *Nephrops* grounds in the North Minch (WKNEPH 2013).

Management applicable to 2023 and 2024

The management unit is Subarea 6 and EU and international waters of 5.b. The TAC for this area is 13141 tonnes in 2024, down from 13311 tonnes in 2023.

During 2016–2020, fisheries catching *Nephrops* in Division 6.a have been covered by the EU landing obligation (EU, 2015a). Creel fisheries are exempt from the landing obligation due to high survivability of discards. Demersal trawlers using a codend between 80mm–110mm and within 12 miles of shore are also exempt from the landings obligation. Since 2021, this stock is still under a landing obligation, and there are still exemptions in place.

Ecosystem aspects

Details of the ecosystem aspects for this functional unit are provided in the stock annex if available.

Fishery description

Information on developments in the fishery was provided by Marine Directorate compliance officers.

In 2023, the fishery was generally described as very good, with market remaining stable for most of the year and being above average for trawlers.

In recent years the fishery starts steadily, with a good yield in the summer fishery from May to August. The fishery then tails off in the Autumn. This is said to be a seasonal occurrence rather than being caused by bad weather. The majority of the Western Isles trawl fleet has tended to relocate to the east coast and to the fishing grounds in the Firth of Forth/Eyemouth/Shields for the winter months in recent years. Trawl activity in the winter months is generally at a relatively low level.

Activity in the *Nephrops* trawl sector was up in 2023 owing to an increase in market value and better return than those seen in the South Minch for this fleet.. However, the creel sector remained fairly stable.

The largest part of the North Minch fleet is still based at Stornoway, numbering approximately 215 vessels in 2023. The majority of the Stornoway vessels (175) are below 10 m in length.

The fleet were targeting the same areas of the North Minch in 2023 as in previous years. Vessels based in Stornoway fish the North Minch with the fleet based in Barra moving between the North and South Minch. In 2023, the Bara fleet spent little time in their local area and moved into the North Minch due to the better prices local for both trawl and creel. Only a few of the trawl fleet moved to the East coast from September onward as seen in recent years, before returning for the Christmas market.

Very few vessels came from outside to fish in the area in 2023. Two trawlers were noted from the Clyde area and regularly landed into Stonoway throughout the year. Three additional vessels from the Ullapool fleet made regular landings as Spring/Summer visitors.

Since 2009, vessels have been required to fit 120 mm square meshed panels, in accordance with the west coast emergency measures (Council Reg. (EU) 43/2009). Large SMPs (200 mm) are also widely used in the North Minch and have been mandatory for all TR2 vessels with power >112 kW fishing under the Scottish Conservation Credits scheme.

Further general information on the fishery can be found in the stock annex.

11.3 Data available

InterCatch

Data for 2023 were successfully uploaded into InterCatch prior to the 2024 WG meeting. Uploaded data were worked up in InterCatch to generate 2023 raised international length–frequency distributions. Allocation schemes for any unsampled fleets are described in the stock annex. Data exploration in InterCatch has previously shown that outputs of raised data were very close to those generated by the previous method applied internally with differences being <0.1%. As such, InterCatch length–frequency outputs have been used in the stock assessment since 2012.

Commercial catch

Official catch statistics (landings) reported to ICES are shown in Tables 11.1.1(a) and 11.1.1(b); these relate to the whole of 6.a of which the North Minch is a part. Landings by gear category for FU11 provided by country have been reported since 1981 and are presented in Table 11.2.1. Landings from this fishery are usually only reported from Scotland; between 2012 and 2014 two tonnes of *Nephrops* landings were reported by Ireland and values between one and three tonnes have been reported since 2017. Total reported Scottish landings in 2023 were 2602.4 tonnes, consisting of 1963 tonnes landed by trawlers targeting *Nephrops* (~75%), 391 tonnes landed by creel vessels (~15%) and 248 tonnes by other trawlers (~10%). In 2023, a small amount of *Nephrops* below minimum size (BMS) was also reported (0.4 tonnes).

Effort data

In 2015, WGCSE agreed that effort should be reported in kW days as this is likely to be more informative about changes in the actual fleet effort. Reported effort by Scottish trawlers targeting *Nephrops* (Métiers: OTB_CRU – Bottom Otter Trawls Targeting Crustaceans and OTT_CRU – Multirig Otter Trawls Targeting Crustaceans) has shown a decreasing trend since 2000 (Figure 12.2.1) but in 2012 the effort increased by 20% due to the influx of vessels from the North Sea during the first quarter of the year. Since then, effort has declined although there was a small increase in 2016. The decline in effort observed in recent years continued until 2020. There has been an observed increase in effort since 2021 effort is now similar to levels seen before the COVID-19 pandemic. Note that the year range in effort time-series (2000–2023) does not match the more extensive year range available for landings, due to a lack of confidence in the reliability of older effort data in the Marine Directorate database. The effort is also slightly inconsistent with the landings data because effort is provided for TR2 vessels only, while the '*Nephrops* trawl' landings also includes landings by large mesh trawlers targeting *Nephrops*.

Sampling levels

Length compositions of landings and discards are obtained during market and on-board observer sampling respectively. These sampling levels are shown in Table 12.2.2. Owing to the relaxation of COVID-19 pandemic rules, which disrupted both the fishing industry and government sampling programmes in 2020 and 2021, sampling effort in 2023 was at a similar level seen prepandemic with all quarters now being sampled. In 2022, a co-sampling programme was established whereby fishers submitted catch samples at port for measurement by the Marine Directorate which has aiding in the increased smapling of discards. Length compositions for the creel fishery are available for landings only as the small numbers of discards survive well and are not considered to be removed from the population.

Length compositions

Figure 11.2.2 shows a series of annual length–frequency distributions for the period 2000 to 2023. Catch (removals) length compositions are shown for each sex along with the mean length for both. In both sexes the mean sizes fluctuate over time and has generally remained stable since 2012. This parameter might be expected to reduce in size if overexploitation were taking place. In 2023, the mean size of males decreased as did that of the females when compared to 2022.

Sex ratio

Males consistently make the largest contribution to the landings, although the proportion of males does vary between years (Figure 11.2.3(a)). This is likely due to the varying seasonal pattern in the fishery and associated relative catchability (due to different burrow emergence behaviour) of male and female *Nephrops.* Males are available throughout the year and the fishery is prosecuted in all quarters (although effort is usually reduced during the winter months when the weather is poor). Females are mainly taken in the summer when they emerge after egg hatching. The seasonal change in proportion of males to females is evident in Figure 11.2.3(b). In 2023 the normal temporal trend in sex ratios was observed where males dominate in quarters one and four but the ratio is more even (or often female dominated) in quarters two and three.

Mean weights

The mean weight in the landings (trawls and creels combined) shows substantial interannual variation (Figure 11.2.4 and Table 11.2.3) decreasing between 2010 and 2012, followed by an increase in 2013–2015 and a decrease again in 2016 and stable in 2017 followed by an increasing trend onward before a decrease in 2022. In 2023 a further decrease can be observed. Given the relatively larger size of creel caught *Nephrops* (compared to trawl) the proportion of creel landings has a substantial effect on overall size composition. The increases in mean weight to 2010 and 2020 (and also size, Figure 11.2.2) in particular were due to a higher proportion of creel landings. Figure 11.2.5 shows the mean weight by sample and gear type over the period 2014–2023. In 2023, a larger proportion of trawl landings were reported, thus resulting in a lower mean weight in the total catch. There is no obvious trend in North Minch trawl-caught mean weights for females, however, there is a small increase in the mean weight of trawl caught males over time. The mean weight in creel caught males and females has shown little change over the time period. The mean weight in the landings has a significant impact on the catch forecast. Due to the high interannual variability in mean weights it was considered more appropriate to use a full time-series average, from 1999 (first year with creel and trawl length distributions combined) until 2023 for producing the catch options.

Discarding

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 1990. Discard rates fluctuate in this FU and averaged ~6.0% by number in the last three years (Table 11.2.4). In 2023, the discard rate increased to 7.2% by number (from 6.0% in 2022).

It is likely that some *Nephrops* survive the discarding process. An estimate of 25% (Charuau *et al*., 1982; Sangster *et al*., 1997; Wileman *et al*., 1999) survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard survival rate for creel caught *Nephrops* has been shown to be high (ICES, 2013) and a value of 100% is used. The discard rate (adjusted for survival) which will be used in the provision of landings options for 2025 is 6.5% based on a three-year average of 2021 – 2023.

Abundance indices from UWTV surveys

The Underwater TV surveys are available for this stock since 1994 (missing surveys in 1995 and 1997). The stock area for this FU was updated in 2013 to 2908 km^2 (see stock annex for further details). In 2022, due to the COVID-19 pandemic, the UWTV survey was carried out with a reduced scientific staffing, necessitating a reduced sampling schedule in some areas. UWTV survey in 2022 sampled 72% of the planned stations relative to 2021(100% of planned stations). While unquantified, the 28% reduction in the number of sampled stations is considered to have minimal impact on the quality of the abundance estimate. Since 2023, the UWTV survey has been carried out as planned with 100% of planned stations being sampled.

A total of 48 valid TV stations were used in the final survey analysis for 2024 (Table 11.2.5). Table 11.2.6 shows the basic analysis for the most recent TV survey conducted in FU11. At the 2012 SGNEPS meeting (ICES, 2012) it was decided that a CV (relative standard error) of <20% was an acceptable precision level for UWTV survey estimates of abundance. The CV for the most recent TV survey was 11.9%, lower than the precision level agreed (Table 11.2.6).

Figure 11.2.6 shows the distribution of stations in recent TV surveys (2013–2024), with the size of the symbols reflecting the *Nephrops* burrow density. Table 12.2.5 and Figure 12.2.7 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates.

The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009; ICES, 2013). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative relative to absolute conversion factor estimated for FU11 was 1.33 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 33%.

11.4 Assessment

Comparison with previous assessments

The assessment follows the same procedure as last year and is based on a combination of examining trends in fishery indicators and underwater TV abundance estimates. Landings predictions are derived by applying a harvest rate to the UWTV survey estimate of abundance and assuming a length composition derived from recent fishery data (including data from both trawl and creel fisheries).

State of the stock

The assessment summary is provided in Table 11.2.4. The underwater TV survey is presented as the best available information on the North Minch *Nephrops* stock. The surveys provide a fishery-independent estimate of *Nephrops* abundance. At present, it is not possible to extract any length or age-structure information from the survey and therefore it only provides information on abundance over the area of the survey.

TV survey estimated stock abundance in 2024 was 1489 million individuals, a 12.0% decrease from the 2023 estimate. The stock is still well above the MSY $B_{trigger}$ value of 541 million, or the rounded value of 540 million individuals used in the provision of advice (Figure 11.2.7).

The calculated harvest rate in 2023 (dead removals/TV abundance = 7.7%) is below the F_{MSY} proxy for this stock (the value associated with high long-term yield and low risk depletion) of 10.8%.

11.5 Catch Scenarios

Landings predictions and catch scenarios at various harvest rates (based on principles established at WKNEPH (ICES, 2009)), including a selection of those equivalent to the per-recruit reference points, are made on the basis of the 2024 UWTV survey conducted in June. These were presented in September 2024 for the provision of advice.

The table below shows the agreed inputs to the catch scenarios table.

Variable	Value	Notes
Stock abundance (2025)	1310	UWTV survey 2024; individuals in millions
Mean weight in projected landings (2025)	26.65	Average 1999–2023; in grammes
Mean weight in projected discards (2025)	11.42	Average 1999–2023; in grammes
Projected discard rate (2025)	6.5	Average 2021–2023; percentage by number of the total catch
Discard survival rate (2025)	25	Percentage by number of discard

Due to the high interannual variability in mean weights it was considered more appropriate to use a full time-series average, from 1999 (first year with creel and trawl length distributions combined) until 2023 for producing the catch scenarios.

* Discard survival in the creel fishery is assumed to be 100%, as outlined in the stock annex.

11.6 Reference points

New reference point F_{MSY} were derived for this stock at WKMSYRef4 (ICES, 2016). This was updated on the basis of an average of estimated F_{MSY} proxy harvest rates over a period of years, this corresponds more closely to the methodology for finfish. In cases where there is a clear trend in the values a five-year average was chosen. Similarly, the five-year average of the F at 95% of the YPR obtained at the F_{MSY} proxy reference point was proposed as the F_{MSY} lower bound and the five-year average of the F above F_{MAX} that leads to YPR of 95% of the maximum as the upper bound. Using an average value also has the advantage of reducing the effect of any unusually high or low estimates of the F_{MSY} proxy, which occasionally appear. For this stock, the F_{MSY} proxy has been revised from 10.9% to 10.8%.

WKFMSYRef4 did not update the MSY $B_{trigger}$ except for rounding to tens of millions. MSY $B_{trigger}$ has been defined as the lowest stock size from which the abundance has increased (ICES, 2013) and is calculated as 541 million individuals and rounded to 540 million for use as MSY $B_{trigger}$ in the advice. Full details are contained in the stock annex.

These reference points should remain under review by WGCSE and may be revised, should improved data become available.

Table 11.2.4 and Figure 11.5.1 show the harvest rates for FU11. From 2006–2009 there was a sustained period of high (above F_{MSY} proxy) harvest rates followed by two years of low harvest rates of around 6–7%. A sudden increase was observed in 2012, following this, the harvest rate declined and has remained below the F_{MSY} proxy. Harvest rate historical low of 3.1% was recorded in 2020, with a slight increase to 4.6% and 5.4% in 2021 and 2022 respectivly (still well below F_{MSY} proxy) and is 7.7% in 2023. It is likely that prior to 2006, the estimated harvest rates may not be representative due to underreporting of landings.

11.7 Management strategies

Scotland has recently established a network of regional Inshore Fisheries Groups (rIFGs), non-statutory bodies that aim to improve the management of Scotland's inshore fisheries out to six nautical miles, and to give commercial inshore fishermen a strong voice in wider marine management developments. The rIFGs will contribute to regional policies and initiatives relating to management and conservation of inshore fisheries, including impacts on the marine environment and the maintenance of sustainable fishing communities and measures designed to better conserve and sustainably exploit stocks of shellfish and sea fish (including salmon) in their local waters. Although no IFG proposals specific to the management of *Nephrops* fisheries have yet been adopted, some of the IFG management plans for the Scottish West Coast include spatial management of *Nephrops* fisheries and the introduction of creel limits.

On the 8th of February 2016, phase 1 of the fisheries management measures for inshore MPAs in Scottish waters came into force (SG, 2016). These measures relate to both NCMPA (Marine (Scotland) Act and the UK Marine and Coastal Access Act) and SACs (EC Habitats Directives – Council Directive 92/43/EEC) both of which have the aim of conserving biological diversity in Scottish waters and contribute to Scotland's MPA network (SG, 2017a). Although not specific to the management of the *Nephrops* fishery, they will influence spatial patterns of fishing for *Nephrops* where controls on the two main gear types, demersal trawls and creels are implemented on *Nephrops* habitat. Within the North Minch functional unit, two MPAs are covered by fisheries management measures. Specifically the Wester Ross NCMPA where fishing activity is banned for demersal gears for vessels over 500 kW in power and banned in certain areas for vessels below 500 kW. North of the main *Nephrops* ground is the Loch Laxford SAC where demersal trawling is banned

(SG, 2016). The areas of the SAC and NCMPA relative to the estimated *Nephrops* habitat within the North Minch functional unit are displayed in Figure 11.6.1.

11.8 Quality of assessment and forecast

The length and sex composition of the landings data is considered to be well-sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the fishery adequately. The landings length compositions from 1999 onwards, are derived from both creel and trawl samples. The creel fishery which accounted for 23% of landings in 2021 and 18% of landings in 2022 has further decrease in 2023 to 15%. This part of the fishery exhibits a length distribution composed of larger animals.

There were concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers legislation was introduced and the reliability began to improve. Because of this, the final assessment adopted is independent of historical landings data. Harvest rates since 2006 are also considered more reliable due to more accurate landings data reported under this legislation. Incorporation of creel length compositions (since the 2010 WG) has also improved estimates of harvest rates. Underwater TV surveys have been conducted for this stock since 1994, with a continual annual series available since 1998. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are relatively small for this functional unit. In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise.

The cumulative absolute conversion factor estimates for FU11 are largely based on expert opinion (see stock annex). The precision of these bias corrections cannot yet be characterised. The landings derived in the forecast (catch options table) are sensitive to the input dead discard rate and mean weights in landings, and this introduces uncertainties in the catch forecasts. Precision estimates are needed for these forecast inputs.

The stock area was revised in 2013 (ICES, 2013) using integrated VMS-logbook data to more accurately estimate the spatial extent of *Nephrops* catches. Two other factors however, have the potential to increase the fished area further. Firstly, the inclusion of vessels smaller than 15 m would likely increase the fished area in some of the inshore locations and secondly, it is known that most of the sea lochs have areas of mud substrate and are typically fished by creel boats. In recent years, a number of TV surveys have taken place in the major North Minch sea lochs in an attempt to improve estimates of the ground area and *Nephrops* abundance. Work presented at the WKNEPH 2013 (ICES, 2013) showed that the total area of the sea lochs is 105 km^2, which is considerably smaller than the offshore VMS area estimated to be 2908 km^2. Therefore, it is unlikely that the exclusion of these inshore areas from the survey have an impact in the mean densities and overall abundance of *Nephrops* in the North Minch.

11.9 Recommendation for next benchmark

This stock was last benchmarked in 2013 (ICES, 2013). WGCSE will keep the stock under close review and recommend a future benchmark as required.

11.10 Management considerations

The WG, ACOM and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level and management at the functional unit level could provide the controls to ensure that catch opportunities and effort were compatible and in line with the scale of the resource.

Creel fishing takes place in this area but overall effort by this fleet in terms of creel numbers is not known, and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the North Minch and STECF estimates that discards of whiting and haddock are high in 6.a generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Efforts to reduce discards and unwanted bycatches of cod include the implementation of large square meshed panels (SMPs) of 120 mm under the west coast emergency measures, and SMPs of 200 mm which were introduced under the Scottish Conservation Credits scheme.

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11.12 Tables and Figures

Table 11.1. *Nephrops* functional units and descriptions by statistical rectangle.

Functional Unit	Stock	Division	ICES Rectangles
11	North Minch	6.a	44–46 E3–E4
12	South Minch	6.a	41–43 E2–E4
13	Clyde	6.a	39–40 E4–E5

Table 11.1.1(a). Nominal landings (tonnes) of *Nephrops* in Division 6.a, 1980–2023, as officially reported to ICES.

	France	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK- Scotland	UK	TOTAL
1980	5	1	-	-	7422	-	7428
1981	5	26	-	-	9519	-	9550
1982	1	1	-	1	9000	-	9003
1983	1	1	-	11	10 706	-	10 719
1984	3	6	-	12	11 778	-	11 799
1985	1	1	28	9	12 449	-	12 488
1986	8	20	5	13	11 283	-	11 329
1987	6	128	11	15	11 203	-	11 363
1988	1	11	7	62	12 649	-	12 730
1989	-	9	2	25	10 949	-	10 985
1990	-	10	4	35	10 042	-	10 091
1991	-	1	-	37	10 458	-	10 496
1992	-	10	-	56	10 783	-	10 849
1993	-	7	-	191	11 178	-	11 376
1994	3	6	-	290	11 047	-	11 346
1995	4	9	3	346	12 527	-	12 889
1996	-	8	1	176	10 929	-	11 114
1997	-	5	15	133	11 104	-	11 257
1998	-	25	18	202	10 949	-	11 194
1999	-	136	40	256	11 078	-	11 510
2000	1	130	69	137	10 667	-	11 004
2001	9	115	30	139	10 568	-	10 861
2002	-	117	18	152	10 225	-	10 512
2003	-	145	12	81	10 450	-	10 688
2004	-	150	6	267	9941	-	10 364
2005	-	153	17	153	7616	-	7939
2006	-	133	1	255	13 419	-	13 808

	France	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK- Scotland	UK	TOTAL
2007	-	155	-	2088	14 120	-	16 363
2008	-	56	1	419	14 795	-	15 271
2009	-	53	-	1226	11 462	-	12 741
2010	-	45	1	1962	10 250	-	12 258
2011	-	38	-	2517	10 419	-	12 974
2012	-	28	-	2502	11 807	-	14 337
2013*	-	5	-	-	-	12866	12871
2014	-	51	-	-	-	12760	12811
2015	-	75	-	-	-	11653	11728
2016	-	107	0	-	-	14600	14707
2017	-	114	-	-	-	11442	11557
2018	-	65	0	-	-	8849	8914
2019	-	92	-	-	-	9 018*	9110
2020	-	71	-	538	6334	6872	6943
2021	-	42	-	984	8738.4	9722.4	9764.4
2022	-	71	-	953	7372.4	8325.4	8325.4
2023	-	82	2	-	-	9855*	9939

*** Includes landings reported by Isle of Man.**

Table 11.1.1(b). Nominal landings (tonnes) of *Nephrops* in Division 6.b, 1980–2023 as officially reported to ICES. There are no Functional Units in ICES Division 6.b but occasional small landings are made.

	France	Germany	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK- Scotland	TOTAL
1980	-	-	-	-	-	-	0
1981	-	-	-	-	-	-	0
1982	-	-	-	-	-	-	0
1983	-	-	-	-	-	-	0
1984	-	-	-	-	-	-	0
1985	-	-	-	-	-	-	0
1986	-	-	-	8	-	-	8

	France	Germany	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK- Scotland	TOTAL
1987	-	-	-	18	11	-	29
1988	-	-	-	27	4	-	31
1989	-	-	-	14	-	-	14
1990	-	-	-	10	1	-	11
1991	-	-	-	30	-	-	30
1992	-	-	-	2	4	1	7
1993	-	-	-	2	6	9	17
1994	-	-	-	5	16	5	26
1995	1	-	-	2	26	1	30
1996	-	6	-	5	65	5	81
1997	-	-	1	3	88	23	115
1998	-	-	1	6	46	7	60
1999	-	-	-	5	2	5	12
2000	2	-	8	3	4	4	21
2001	1	-	1	14	2	7	25
2002	1	-	-	7	3	7	18
2003	-	-	1	5	6	18	30
2004	-	-	-	2	7	13	22
2005	3	-	1	1	5	7	17
2006	-	-	-	-	1	3	4
2007	-	-	-	2	3	-	5
2008	-	-	-	-	-	-	0
2009	-	-	-	-	-	-	0
2010	-	-	-	-	-	-	0
2011	-	-	-	-	-	-	0
2012	-	-	-	-	-	-	0
2013	-	-	-	-	-	-	0
2014	-	-	-	-	-	-	0
2015	-	-	-	-	-	-	0

	France	Germany	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK- Scotland	TOTAL
2016	-	-	-	-	-	0	0
2017	-	-	-	-	-	2	2
2018	-	-	-	-	-	0	0
2019	-	-	0	-	-	-	0
2020	-	-	0.5	-	-	-	-
2021	-	-	0.02	-	-	-	0
2022	-	-	-	-	-	0.2	0.2
2023	-	-	-	-	-	0.3	0.3

Table 11.1.2. ***Nephrops*****, Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 1981–2023.**

Year	FU11	FU12	FU13	Other	Total
1981	2861	3652	2968	39	9520
1982	2799	3552	2620	27	8998
1983	3197	3413	4076	34	10720
1984	4143	4300	3310	36	11789
1985	4060	4008	4286	104	12458
1986	3381	3484	4341	89	11295
1987	4084	3892	3009	257	11242
1988	4035	4473	3664	529	12701
1989	3205	4745	2812	212	10974
1990	2546	4430	2909	182	10067
1991	2793	4442	3038	255	10528
1992	3559	4237	2803	248	10847
1993	3193	4458	3343	344	11338
1994	3614	4414	2630	441	11099
1995	3655	4682	3987	460	12784
1996	2872	3995	4057	239	11163
1997	3046	4344	3621	243	11254
1998	2441	3730	4841	157	11169

Year	FU11	FU12	FU13	Other	Total
1999	3257	4052	3752	438	11499
2000	3247	3953	3417	421	11038
2001	3259	3991	3182	420	10852
2002	3440	3305	3384	397	10526
2003	3269	3879	3173	433	10754
2004	3082	3869	2973	403	10327
2005	2949	3848	3395	254	10446
2006	4166	4633	4780	241	13820
2007	3978	5471	6660	420	16529
2008	3799	5356	5923	128	15206
2009	3496	4285	4779	185	12745
2010	2413	3846	5843	569	12671
2011	2697	3702	6432	219	13050
2012	3542	3989	6687	435	14653
2013	3413	3776	5435	234	12858
2014	3257	3179	6207	53	12696
2015	3002	3400	5147	309	11858
2016	3529.4*	4402	6447	236	14614.4
2017	2491	3757	5403	250	11900
2018	1956	2540	4143	160	8796
2019	1979	2220	4683	173	9053
2020	1331	1976	3636	152	7095
2021	2075	2193	5015	237	9520
2022	2205.4*	2560*	3923	239	8927.4
2023	2602.4*	2561	4415	294	9872.4

***Includes below minimum size landed discards.**

Table 11.2.1. ***Nephrops*, North Minch (FU11), Nominal Landings of *Nephrops*, 1981–2023.**

UK Scotland						Other United Kingdom and Ireland	Total
Year	*Nephrops* trawl	other	creel	Below Minimum Size	Subtotal		
1981	2320	171	370	0	2861	0	2861
1982	2323	105	371	0	2799	0	2799
1983	2784	96	317	0	3197	0	3197
1984	3449	160	534	0	4143	0	4143
1985	3235	117	708	0	4060	0	4060
1986	2641	203	537	0	3381	0	3381
1987	3459	143	482	0	4084	0	4084
1988	3450	148	437	0	4035	0	4035
1989	2603	112	490	0	3205	0	3205
1990	1941	134	471	0	2546	0	2546
1991	2229	126	438	0	2793	0	2793
1992	2978	149	432	0	3559	0	3559
1993	2699	86	408	0	3193	0	3193
1994	2916	245	453	0	3614	0	3614
1995	2940	183	532	0	3655	0	3655
1996	2354	148	370	0	2872	0	2872
1997	2553	102	391	0	3046	0	3046
1998	2023	68	350	0	2441	0	2441
1999	2792	56	409	0	3257	0	3257
2000	2695	28	524	0	3247	0	3247
2001	2649	42	568	0	3259	0	3259
2002	2775	79	586	0	3440	0	3440
2003	2606	45	618	0	3269	0	3269
2004	2391	30	661	0	3082	0	3082
2005	2270	23	656	0	2949	0	2949
2006	3446	23	697	0	4166	0	4166

UK Scotland						Other United Kingdom and Ireland	Total
Year	*Nephrops* trawl	other	creel	Below Minimum Size	Subtotal		
2007	3361	26	591	0	3978	0	3978
2008	3229	13	557	0	3799	0	3799
2009	2849	34	613	0	3496	0	3496
2010	1783	9	621	0	2413	0	2413
2011	2109	17	571	0	2697	0	2697
2012	2963	12	565	0	3540	2	3542
2013	2356	480	575	0	3411	2	3413
2014	2752	13	490	0	3255	2	3257
2015	2561	23	418	0	3002	0	3002
2016	3039	15	475	0.4	3529.4*	0	3529.4*
2017	2086	30	374	0	2490	1	2491
2018	1592	30	331	0	1953	3	1956
2019	1521	31	425	0	1977	2	1979
2020	900	17	414	0	1331	0	1331
2021	1549	53	472	1.1*	2075.1	0	2075.1
2022	1646	155	404	0.4*	2205.4	1	2205.4
2023	1963	248	391	0	2602.4	0	2602.4

***Below minimum size landings not rounded to show it was reported.**

Table 11.2.2. *Nephrops* Scottish sampling levels all FUs in 6.a (including N. Irish for Clyde).

		2021		2022		2023	
FU		N trips*	N measured	N trips*	N measured	N trips*	N measured
North Minch	Landings	34	13 368	35	14 653	43	23054
	Discards	9	1 439	10	989	12	1748
South Minch	Landings	33	13 770	28	13 108	29	12413
	Discards	3	306	7	385	9	967
Clyde	Landings	31	14 510	22	9 219	17	7418
	Discards	-	-	-	-	-	-

*** Number of trips expressed as number of hauls for discards.**

Table 11.2.3. *Nephrops* mean weight in the landings (FU11–13).

Year	FU11	FU12	FU13
1990	21.39	19.99	24.27
1991	25.35	21.74	20.65
1992	21.66	24.10	25.16
1993	20.79	21.26	29.44
1994	23.45	24.96	25.28
1995	22.24	21.96	19.24
1996	26.68	23.10	21.68
1997	21.71	23.37	24.21
1998	23.65	22.18	17.98
1999*	22.70	25.14	17.39
2000	24.19	27.30	19.96
2001	25.33	23.79	19.46
2002	25.93	26.83	16.35
2003	26.03	27.86	19.13
2004	25.16	27.37	18.80
2005	27.65	28.11	17.96
2006	24.52	26.24	19.27
2007	23.61	23.95	19.05
2008	23.90	23.91	16.59
2009	25.42	23.87	18.31
2010	29.39	25.86	21.21

Year	FU11	FU12	FU13
2011	27.56	31.10	19.34
2012	23.43	29.17	21.83
2013	27.52	27.48	20.72
2014	27.96	29.91	20.79
2015	28.74	28.15	22.21
2016	25.76	24.76	17.70
2017	25.89	27.76	17.02
2018	27.39	27.27	16.14
2019	26.59	28.54	17.2
2020	31.06	36.58	18.96
2021	34.78	29.96	15.27
2022	31.78	33.50	18.88
2023	24.01	36.55	19.69
Average**	26.65	28.04	17.95

*** From 1999 onwards mean weights are shown for trawl and creels combined.**

** Average for FU11 and FU12 (1999–2023); FU13 (2021–2023).

Table 11.2.4. ***Nephrops*****, North Minch (FU11): Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.**

YEAR	LANDINGS IN NUMBERS (MILLIONS)	DISCARDS IN NUMBERS (MILLIONS)	REMOVALS IN NUMBERS (MILLIONS)**	ADJUSTED SURVEY VMS (MILLIONS)*	HARVEST RATE VMS	LANDINGS (TONNES)	DISCARDS (TONNES)	DISCARD RATE	DEAD DISCARD RATE	MEAN WEIGHT IN LANDINGS (g)	MEAN WEIGHT IN DISCARDS (g)
1999	144	28	165	794	20.7	3257	273	16.4	12.8	22.7	9.69
2000	134	10	142	1166	12.1	3247	100	6.9	5.2	24.19	10.08
2001	129	17	141	1092	13	3259	160	11.7	9.1	25.33	9.32
2002	133	28	154	1337	11.5	3440	277	17.6	13.8	25.93	9.78
2003	126	30	148	1751	8.5	3269	299	19.2	15.2	26.03	10
2004	122	18	136	1751	7.8	3082	202	13	10.1	25.16	11.02
2005	107	50	144	1540	9.4	2949	507	32	26.1	27.65	10.09
2006	170	74	225	1762	12.8	4166	757	30.3	24.6	24.52	10.27
2007	168	12	177	1206	14.7	3978	214	6.5	5	23.61	18.1
2008	159	19	173	1047	16.5	3799	194	10.5	8.1	23.9	10.36
2009	138	35	164	1195	13.7	3496	327	20.3	16	25.42	9.34
2010	82	12	91	1293	7	2413	128	12.4	9.6	29.39	10.98
2011	96	16	108	1726	6.3	2697	154	14.2	11	27.56	9.66
2012	151	21	167	891	18.7	3542	213	12.6	9.3	23.43	10.33
2013	122	24	140	1403	10	3413	364	16.4	12.8	27.52	15.18
2014	115	8	121	1251	9.6	3257	77	6.3	4.8	27.96	9.99
2015	103	15	114	1445	7.9	3002	143	12.6	9.8	28.74	9.66

YEAR	LANDINGS IN NUMBERS (MILLIONS)	DISCARDS IN NUMBERS (MILLIONS)	REMOVALS IN NUMBERS (MILLIONS)**	ADJUSTED SURVEY VMS (MILLIONS)*	HARVEST RATE VMS	LANDINGS (TONNES)	DISCARDS (TONNES)	DISCARD RATE	DEAD DISCARD RATE	MEAN WEIGHT IN LANDINGS (g)	MEAN WEIGHT IN DISCARDS (g)
2016	136	22	152	1422	10.7	3529***	266	14	10.9	25.76	12.05
2017	95	5	99	1050	9.4	2491	65	5.3	4	25.89	12.51
2018	72	5	75	1188	6.4	1956	59	6.6	5.1	27.39	11.46
2019	74	4	78	1232	6.3	1979	51	5.5	4.2	26.59	11.92
2020	43	3	45	1439	3.1	1331	31	5.7	4.3	31.06	11.84
2021	61	4	64	1391	4.6	2075.1	65	6.2	4.7	34.78	16.02
2022	69	4	72	1346	5.4	2206.4	52	6.0	4.6	31.78	11.77
2023	108	8	114	1489	7.7	2602.4	119	7.2	5.5	24.01	14.6
2024				1310							
Average****									5.0	26.65	11.42

*** harvest rates previous to 2006 are unreliable.**

**** Removals numbers take the dead discard rate into account.**

***** Includes below minimum size landings.**

****** Dead discard average: 2021–2023; Mean weight in landings and discards average: 1999–2023.**

Table 11.2.5. *Nephrops*, North Minch (FU11): Results of the 1994–2024 TV surveys (values adjusted for bias).

YEARS	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS/M²)	ABUNDANCE (SEDIMENT; MILLIONS)	95% CONFIDENCE INTERVAL (SEDIMENT; MILLIONS)	ABUNDANCE (VMS; MILLIONS)	95% CONFIDENCE INTERVAL (VMS; MILLIONS)
1994	41	0.29	500	74	820	122
1995				No Survey		
1996	38	0.19	330	47	541	76
1997				No Survey		
1998	38	0.31	547	77	898	127
1999	36	0.27	484	89	794	147
2000	39	0.40	711	82	1166	134
2001	56	0.38	666	81	1092	133
2002	37	0.46	815	91	1337	149
2003	41	0.60	1068	129	1751	211
2004	38	0.60	1068	107	1751	175
2005	41	0.53	939	100	1540	164
2006	30	0.61	1074	101	1762	165
2007	36	0.41	735	92	1206	150
2008	41	0.36	638	95	1047	157
2009	26	0.41	729	138	1195	227
2010	37	0.44	-	-	1293	231
2011	41	0.59	-	-	1726	226
2012	41	0.31	-	-	891	181
2013	41	0.48	-	-	1403	206
2014	44	0.43	-	-	1251	171
2015	41	0.50	-	-	1445	370
2016	39	0.49	-	-	1422	290
2017	42	0.36	-	-	1050	149
2018	44	0.40	-	-	1188	244
2019	47	0.42	-	-	1232	256
2020	33	0.49	-	-	1439	319

YEARS	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS/M²)	ABUNDANCE (SEDIMENT; MILLIONS)	95% CONFIDENCE INTERVAL (SEDIMENT; MILLIONS)	ABUNDANCE (VMS; MILLIONS)	95% CONFIDENCE INTERVAL (VMS; MILLIONS)
2021	50	0.48	-	-	1391	215
2022	36	0.46	-	-	1346	355
2023	47	0.51	-	-	1489	281
2024	48	0.45	-	-	1310	310

Table 12.2.6. *Nephrops*, North Minch (FU11): Results of the 2024 TV survey.

STRATUM	AREA (km²)	NUMBER OF STATIONS	MEAN BURROW DENSITY (no./m²)	OBSERVED VARIANCE	ABUNDANCE (MILLIONS)	STRATUM VARIANCE	PROPORTION OF TOTAL VARIANCE	SURVEY PRECISION LEVEL (CV)
2024 TV survey								
VMS	2908	48	0.450	0.137	1309.9	24084	1	
Total	2908	48			1309.8	24084	1	0.119

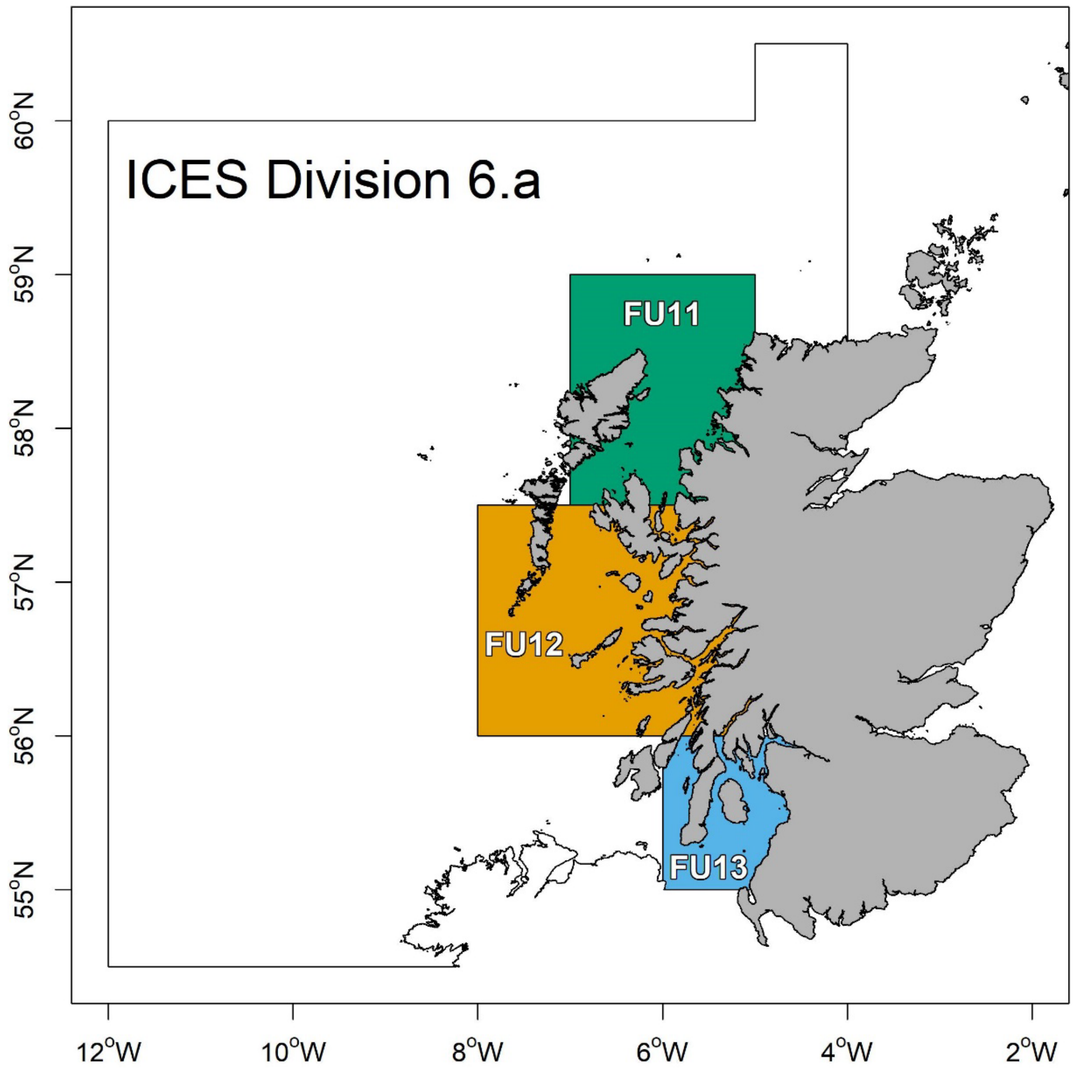

Figure 11.1.1 ***Nephrops*** **Functional Units in 6.a. North Minch (FU11), South Minch (FU12), Clyde (FU13).**

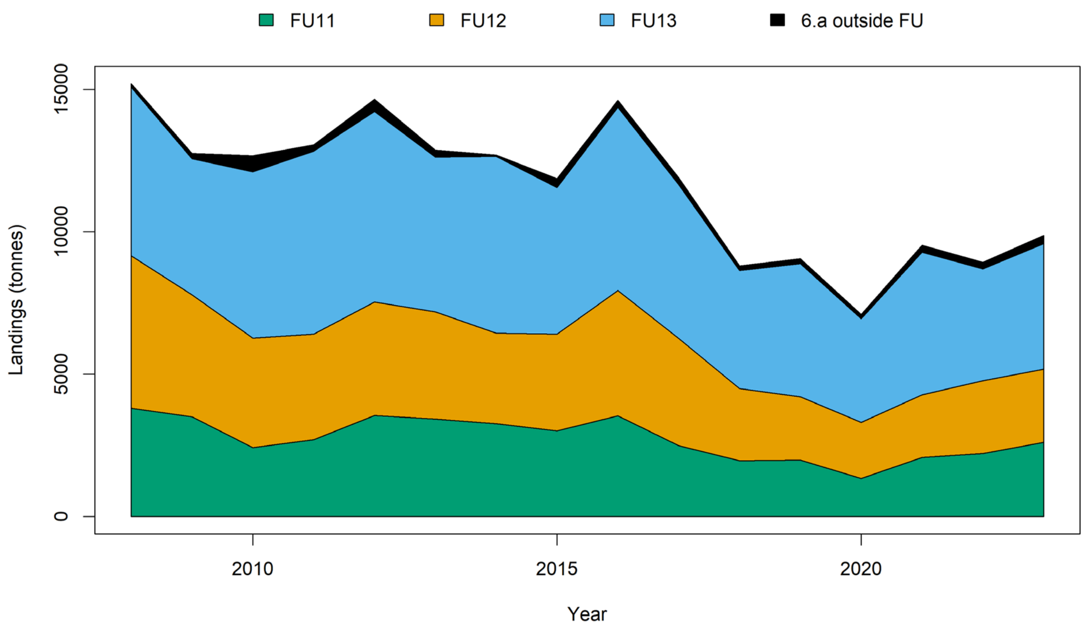

Figure 11.1.2. ***Nephrops*** **in Division 6.a. Landings (tonnes) by functional unit (FU11, 12 &13) and from rectangles outside the functional units (6.a outside FU).**

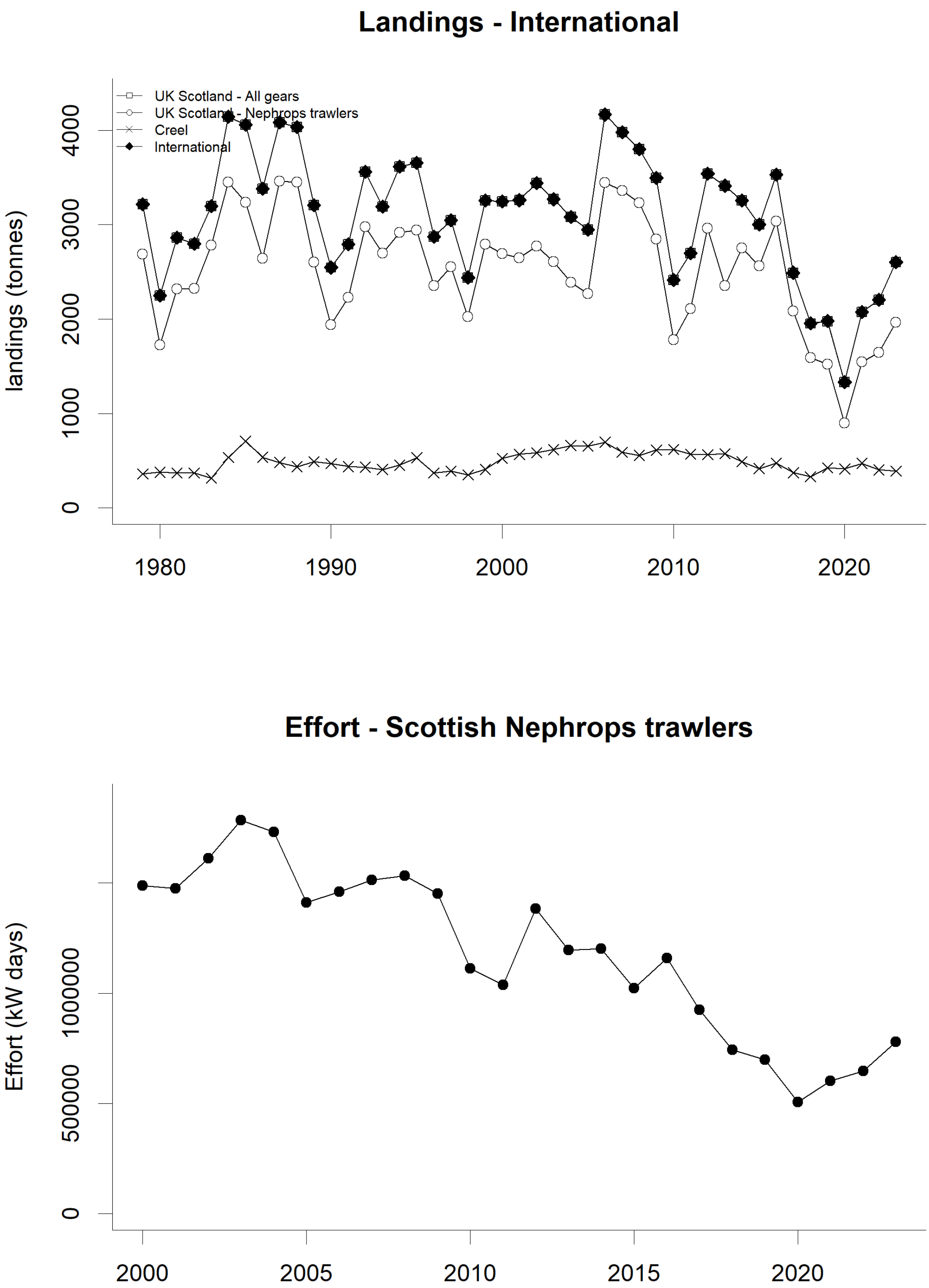

Figure 11.2.1. ***Nephrops*****, North Minch (FU11). Long-term landings and effort.**

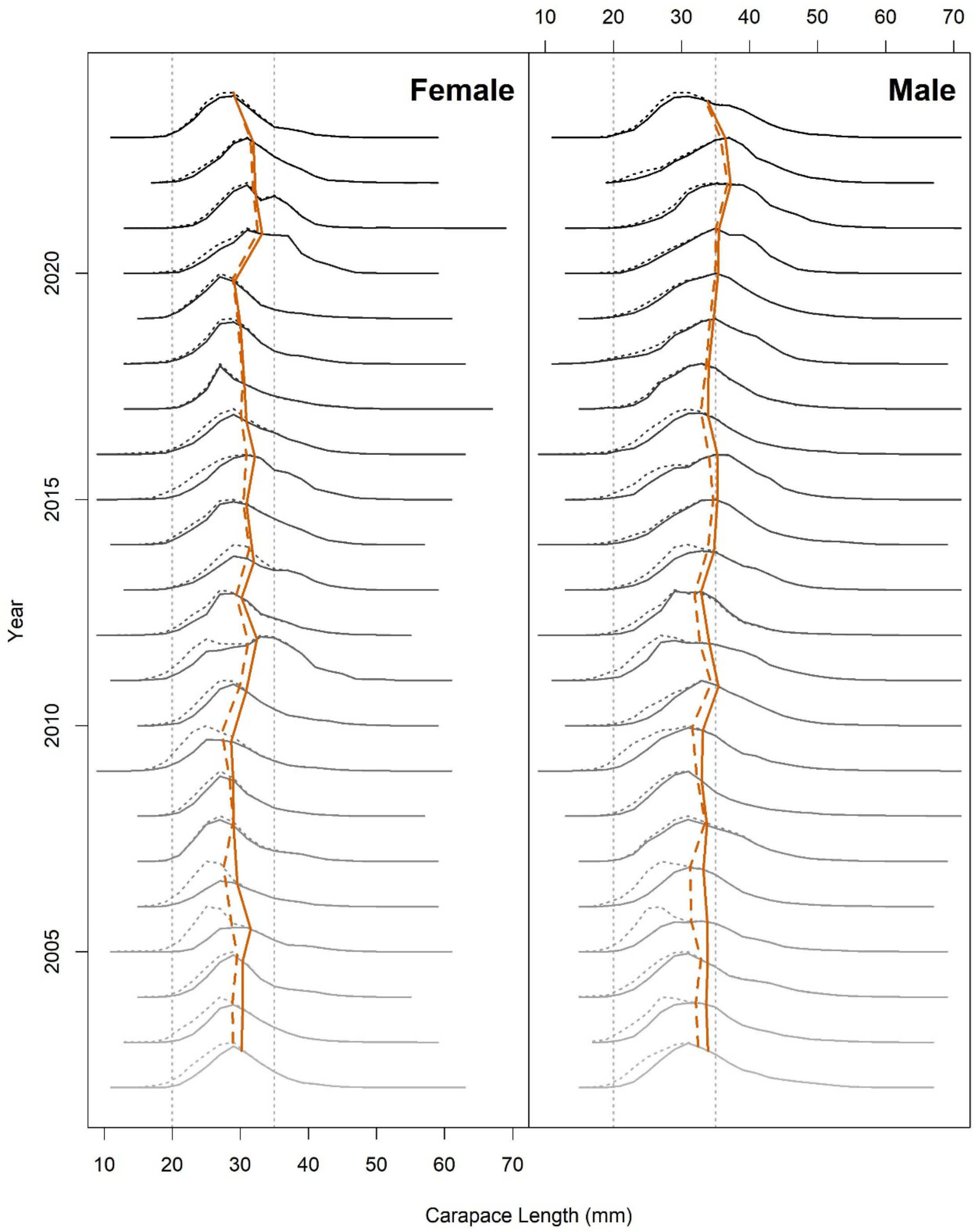

Figure 11.2.2. ***Nephrops*****, North Minch (FU11), Catch length–frequency distribution (dotted) and landings (solid) for Nephrops, 2001 – 2023. Mean size in catches and landings are represented by solid and dashed lines, respectively. Vertical dotted lines are minimum conservation reference size (20 mm) and 35 mm.**

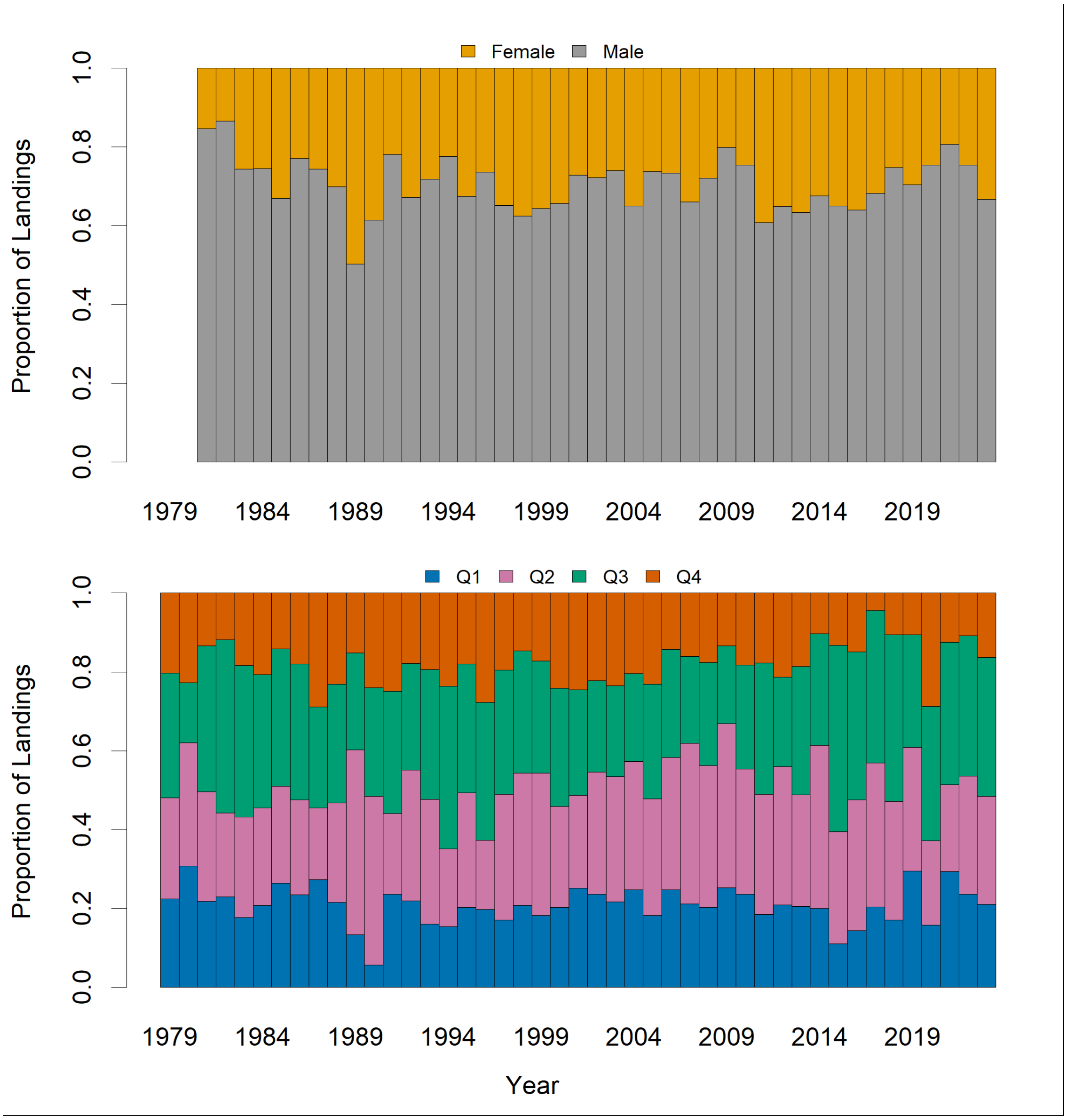

Figure 11.2.3 (a). ***Nephrops,*** **North Minch (FU11), Proportion of landed weight by sex (top), by quarter (bottom) from Scottish trawlers.**

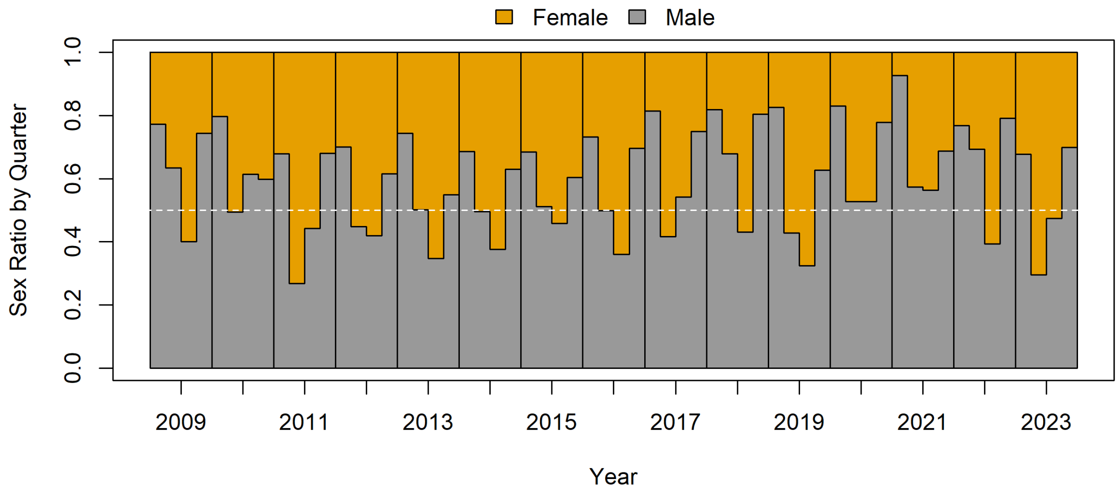

Figure 11.2.3 (b). ***Nephrops,*** **North Minch (FU11), quarterly numeric proportions by sex (2009–2023).**

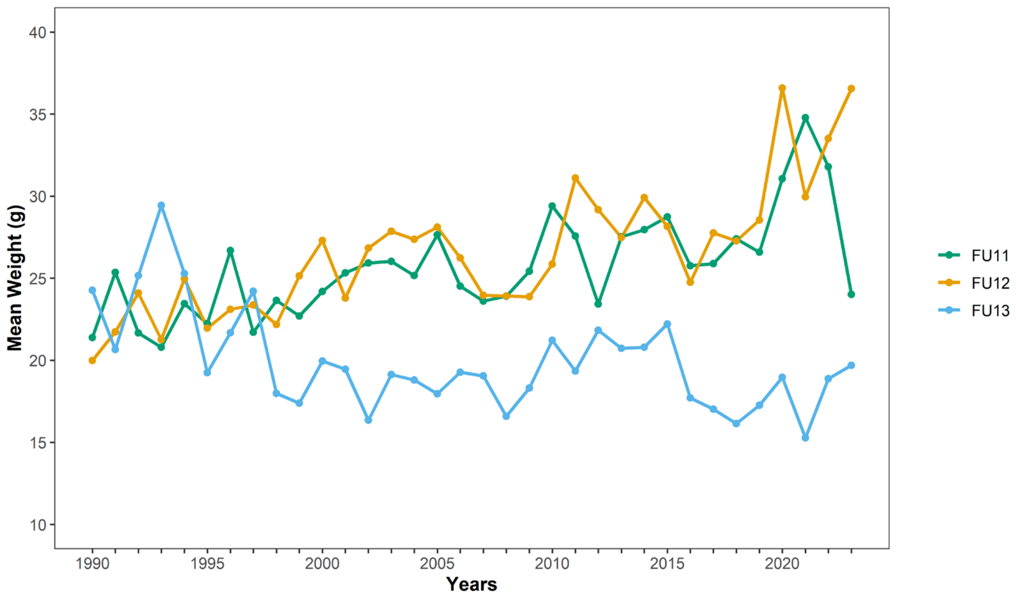

Figure 11.2.4. ***Nephrops*****, (FU11 North Minch, FU12 South Minch and FU13 Clyde), mean weight in the landings from 1990–2023 (from Scottish market sampling data).**

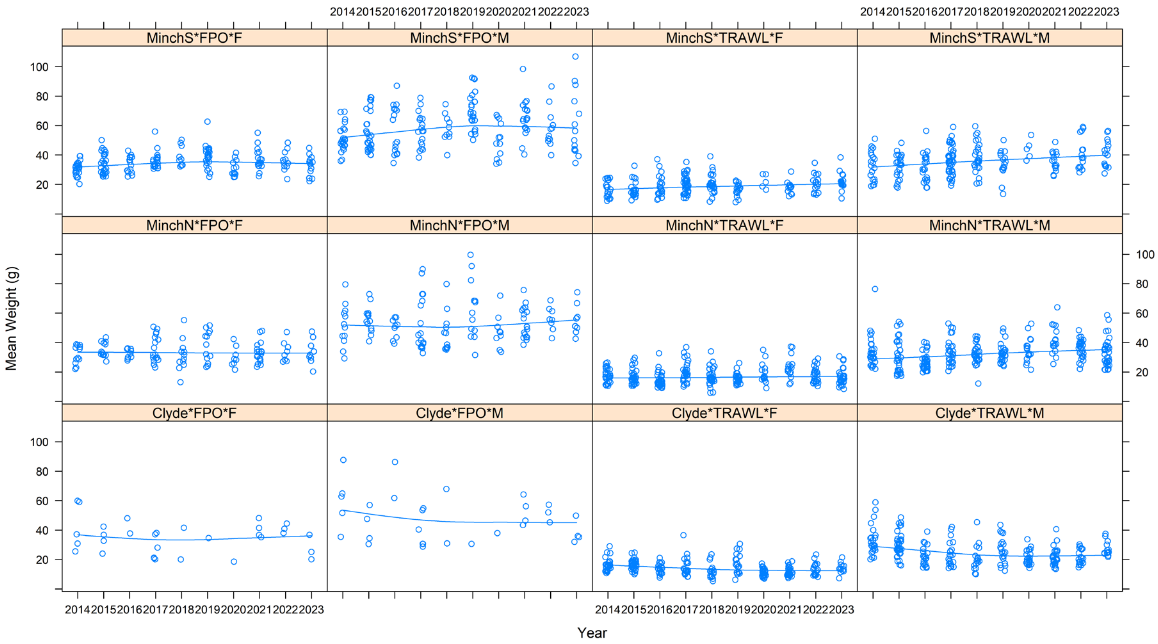

Figure 11.2.5. ***Nephrops*, (FU11 North Minch, FU12 South Minch, FU13 Clyde), mean weight in 2014–2023 by sample date, sex, métier and functional unit.**

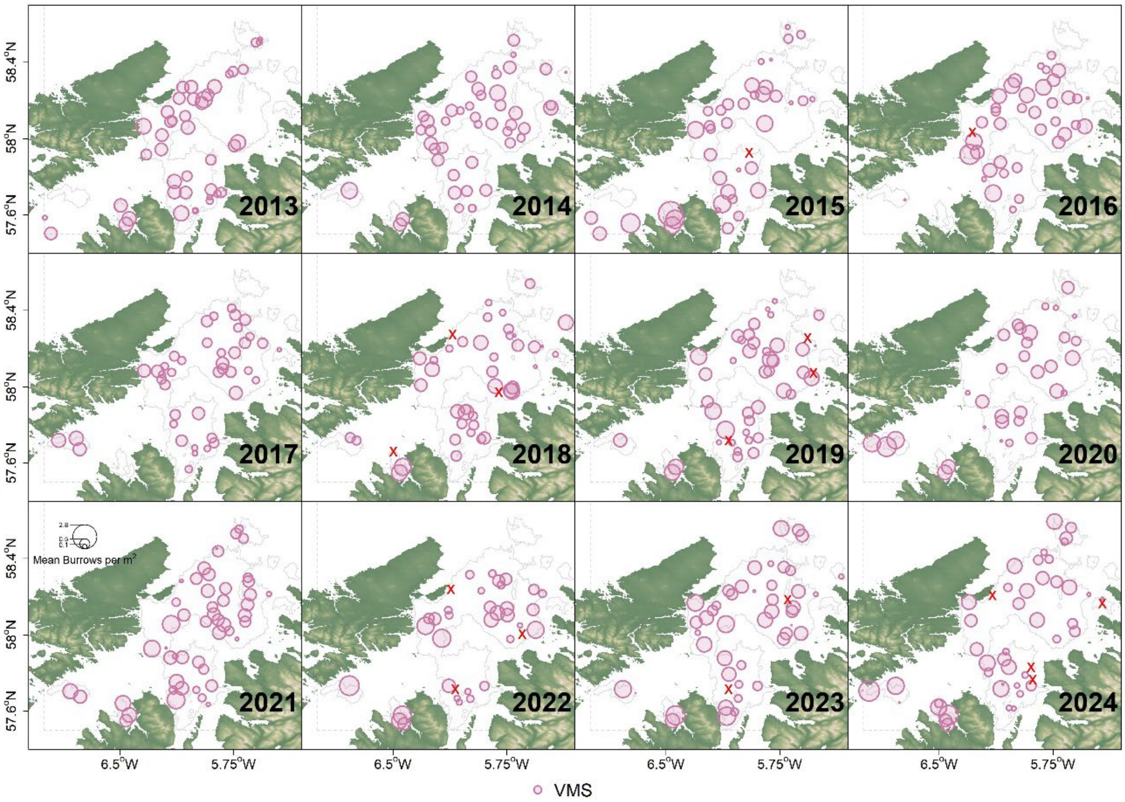

Figure 11.2.6. ***Nephrops*, North Minch (FU11), TV survey station distribution and density (mean burrows/m²), 2013–2024. Bubbles in these figures are all scaled the same. Red crosses represent zero observations.**

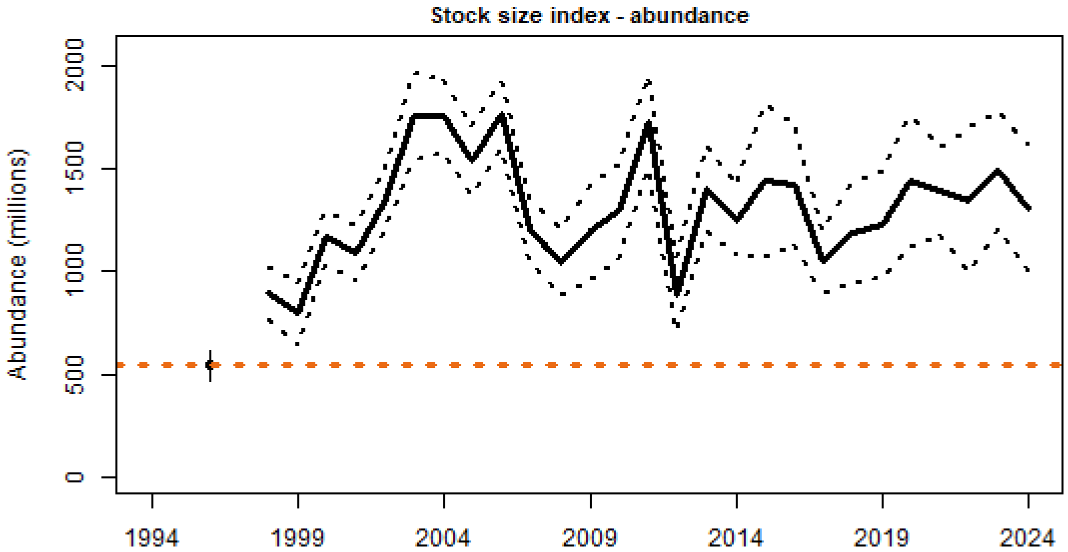

Figure 11.2.7. ***Nephrops*, North Minch (FU11), time-series of revised TV survey abundance estimates (adjusted for bias; solid black line), with 95% confidence intervals (dashed black lines), 1994–2024 (no survey in 1995 and 1997). The dashed red line is the rounded $B_{trigger}$ value of 540 million individuals.**

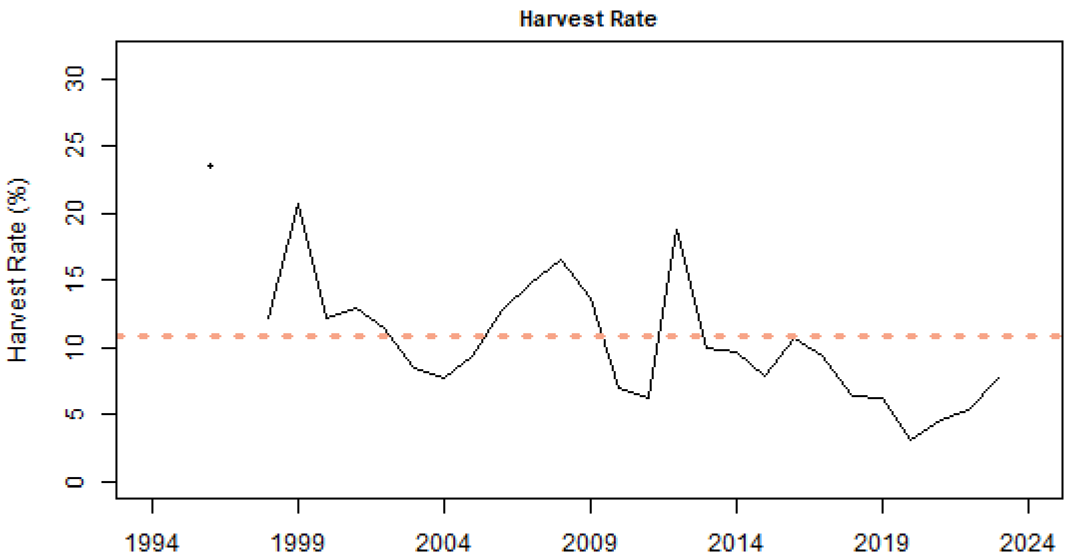

Figure 11.5.1. ***Nephrops*, North Minch (FU11), harvest rate, 1994–2023 (no survey data in 1995 and 1997). The harvest rate is calculated by dead removals/TV abundance. The dashed and solid lines are the F_{MSY} proxy harvest rate (10.8%) and the time-series of estimated harvest rates, respectively. Harvest rates prior to 2006 are considered unreliable.**

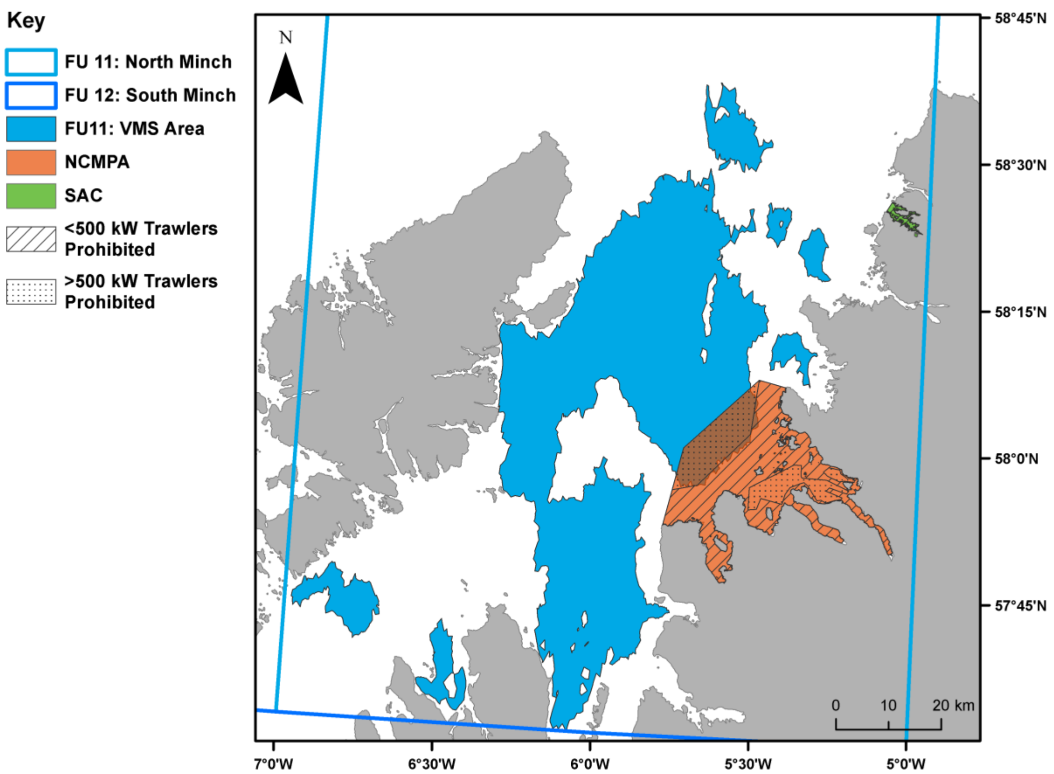

Figure 11.6.1. The area of *Nephrops* habitat (estimated from VMS data) within the North Minch (FU11) relative to the areas of the Nature Conservation MPA (NCMPA) and Special Area of Conservation (SAC) showing areas within these where demersal trawling is banned (hatched) and where it is permitted for vessels below 500 kW (clear; depending on gear type, see SG, 2016). Geographic Coordinate System: OSGB 1936, Datum: OSGB 1936, Projected Coordinate System: British National Grid. Coastline by Wessel and Smith (2016), MPA sites subsetted from NCMPA (SNH, 2015) and SAC (SNH, 2016) layers, management areas by SG (2017b) and functional units generated from merged ICES rectangles (ICES, 2017). Map and modified layers created using ArcGIS (ESRI, 2014).

Contents

12 Norway lobster (*Nephrops norvegicus*) in Division 6.a, Functional Unit 12 (West of Scotland, South Minch)

12.1 Introduction

Type of assessment in 2024

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follow the process defined by the benchmark WG (WKNEPH, 2009; WKNEPH, 2013). Full details are provided in the stock annex.

ICES advice applicable to 2023

'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 2019–2021, catches in 2023 should be no more than 5242 tonnes.

To ensure that the stock in Functional Unit (FU) 12 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 6. ICES considers this plan to be precautionary when implemented at the FU level.'

ICES advice applicable to 2024

'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 2020–2022, catches in 2024 should be no more than 4696 tonnes.

To ensure that the stock in Functional Unit (FU) 12 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 6. ICES considers this plan to be precautionary when implemented at the FU level.'

12.2 General

Stock description

The South Minch (FU12) is located midway down the west coast of Scotland (see. Section 12 FU11 North Minch, Figure 12.1). The area is characterised by numerous islands of varying size, with sea lochs occuring along the mainland coast. These topographical features create a diverse habitat with complex hydrography and a patchy distribution of various soft sediments. Further details are provided in the stock annex.

Management applicable to 2023 and 2024

Management is at the ICES subarea level as described at the beginning of Section 12 FU11 North Minch.

Ecosystem aspects

Details of the ecosystem aspects for this functional unit are provided in the stock annex where available.

Fishery description

Information on developments in the fishery was provided by Marine Directorate compliance officers. In 2023 the fishery was described as remaining generally very poor.

Two distinct fleets operate in the South Minch and the main ports are Oban and Mallaig. In Oban in 2023, there were 41 local vessels (37 < 12m vessels). In Mallaig there are 18 local vessels, 10 of which are creelers. The local fleet in Oban noted that in 2023 it was difficult to find sufficient crew numbers. Malaig reported a poor year in the South minch with many of the fleet opting to move to the North Minch with some months of the year seeing no vessles >12m opterating in the South Minch.

Since 2009, vessels have been required to fit 120 mm square meshed panels, in accordance with the west coast emergency measures (Council Reg. (EU) 43/2009). Large SMPs (200 mm) are also widely used and were made mandatory for all TR2 vessels with power >112 kW fishing as part of the previous Scottish Conservation Credits scheme. Twin rig vessels tend to use a 200 mm square mesh panel with a 100 mm or larger mesh codend. These vessels do not catch bulk quantities and this leads to *Nephrops* of better average size and quality. A comment was noted in 2017 about the use of bungee cords to keep the meshes closed. This was investigated by Compliance officers but was deemed to be legal and was not reported as a problem in subsequent years.

There is very little fish bycatch landed due to the restrictions on cod, haddock and whiting (detailed in ICES, 2016a, ICES, 2016b and ICES, 2016c). Estimates of discard rates of haddock and whiting remain high (ICES, 2016d and ICES, 2017a). Haddock in areas 6a are now covered by the landings obligation in area.

Further general information on the fishery can be found in the stock annex.

12.3 Data available

InterCatch

Data for 2023 were uploaded to InterCatch prior to the 2024 WG meeting. Uploaded data were worked up in InterCatch to generate 2023 raised international length–frequency distributions. Allocation schemes for any unsampled fleets are described in the stock annex. Data exploration in InterCatch has previously shown that outputs of raised data were very close to those generated by the previous method applied internally with differences being <0.1%. As such, InterCatch length–frequency outputs have been used in the stock assessment since 2012.

The COVID-19 pandemic has resulted in reduced sampling of commercial catches for FU12 since 2020. While sampling levels have increased in 2023; discard sample data for FU12 was unavailable for quarter three, and so, the InterCatch estimate of discard rate for quarter three was based on samples collected in quarter two as described in the stock annex.

Commercial catch

Official catch statistics (landings) reported to ICES are shown in Table 11.1.1 (see. Section 11 FU11 North Minch). These relate to the whole of 6.a, of which the South Minch is a part. Landings for FU12 provided through national laboratories are presented in Table 12.2.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, with low levels reported from the rest of the UK and Ireland. Total reported Scottish landings in 2023 were 2561 tonnes (this includes 34 tonnes from other UK vessels, and 35 tonnes from Ireland). This consists of 1715 tonnes (69%) landed by Scottish *Nephrops* trawlers and 746 tonnes (30%) landed by Scottish creel vessels. In 2023 no below minimum size (BMS) landings were reported. The proportion of creel caught landings has generally increased somewhat over the past decade, from 19% in 2012 to as high as 29% in 2020. In 2022 creel caught landings accounted for 18% of Scottish landings; however, in 2023 this has increased to 30%.

Effort data

In 2015, WGCSE agreed that effort should be reported in kW days as this is likely to be more informative about changes in the actual fleet effort. Effort shows an overall decreasing trend since 2003 but there are peaks in 2008 and 2012, which can be attributed to visiting North Sea trawlers (Figure 12.2.1). The decline in effort observed in recent years halted in 2021, with a slight observed increase in effort following the extensive interruptions the fishery experienced in 2020 due to the COVID-19 pandemic. However, Since 2022, effort has decreased once again. Note that the effort time-series range (2000–2023) does not match the more extensive range available for landings due to a lack of confidence in the reliability of older effort data in the Marine Directorate database. The effort is also slightly inconsistent with the landings data because effort is provided for TR2 vessels only, while the '*Nephrops* trawl' landings also includes landings by large mesh trawlers targeting *Nephrops*.

Sampling levels

Length compositions of landings and discards are obtained during market sampling and on-board observer sampling respectively. In 2022, a co-sampling programme was established whereby fishers submitted catch samples at port for measurement by the Marine Directorate. The sampling levels are shown in Table 11.2.2 (see. Section 11 FU11 North Minch). Sampling effort in 2023 was similar to that seen in 2022. Length compositions for the creel fishery are available for landings only as the small numbers of discards from the fishery survive well. Therefore these animals are not considered to be removed from the population, and 100% survival is assumed (ICES, 2013).

Length compositions

Figure 12.2.2 shows a series of annual length–frequency distributions from 2004 onwards which appear fairly stable across the time-series. Catch and landings length compositions, and mean size are shown for each sex. The mean size of both males and females increased in 2023 by ~7mm.

Sex ratio

The sex ratios observed in the South Minch since 2020 have shown some divergence from those observed in years with better sample coverage, although males still made the largest contribution to the annual landings in most quarters. In the years prior to 2020, males were available to the fishery throughout the year while females were mainly caught in the summer when they emerge from their burrows after egg hatching has occurred. This seasonal change could be observed in the quarterly sex ratios, with males dominating the catch in quarters one and four, and a more even sex ratio observed in quarters two and three. However, in 2020 and 2022, all quarterly sex ratios were majority male (Figure 12.2.3) due to the decreased number of samples which were available for the year. In 2023, the quarterly sex ratios were more similar to typical years, although quarter three had a slightly higher male ratio. This metric is used as an indicator, whereby increasing proportions of females in the catch might signal an effect of acute overfishing. In the case of recent years, however, the unusual sex ratios are known to be due to poor sampling, and not a cause for concern to management.

Mean weights

The mean weight in the landings (Figures 11.2.4 and 11.2.5; see. Section 11 FU11 North Minch, Table 11.2.3) have fluctuated around a relatively high level since 2011. Seasonal variability (and occasional outliers) in mean weights are seen in the individual sample estimates. There appears to be a small increase in the mean weight of the males for the trawl caught *Nephrops* and also for both males and females caught by creels (Figure 11.2.5). The annual estimate of mean weight in the landings has an effect on the catch forecast. Over the time-series, there is a general increasing trend in mean weights in the landings, with the highest recorded mean weight seen in 2020, followed by a substantial decrease in 2021. An increase was seen in 2022 and again in 2023 likley due to the increase rato of creel catchs to trawl catches.

Discarding

Discarding of undersized and unwanted *Nephrops* occurs in this fishery. Discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 1990. Discarding rates in this FU have varied considerably over the years, ranging from 3% to over 25%. In 2022, the discarding rate was 7.8%, this represents an increase from 2022 (7.3%). The low levels of discarding in recent years may be explained by poor fishing and a gradually decreasing fleet (Table 12.2.2).

Studies (Charuau *et al.*, 1982; Sangster *et al.*, 1997; Wileman *et al.*, 1999) suggest that some *Nephrops* survive the discarding process, thus, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard survival rate for creel caught *Nephrops* has been shown to be high (ICES, 2013) and a value of 100% is assumed. The discard rate (adjusted to account for survival) which will be used in the forecast was estimated by taking a three-year average (2021–2023), amounting to 7.6%.

Abundance indices from UWTV surveys

An underwater TV survey of the stock is conducted annually according to standards set out by the Manual for the Nephrops Underwater TV Surveys (Dobby *et al.*, 2021). Surveys use a stratified random approach, and have been carried out for this stock since 1995. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows. Since 2021, a sample allocation scheme was implemented in which sample numbers per stratum were as close to proportionate to sediment areal coverage as sample size and logistics would allow in order to improve precision in abundance estimates (see. Annex 3). The numbers of valid stations used in the final analysis in each year are shown in Table 13.2.3. On average, 36 stations have been considered valid each year, and raised to a stock area of 5072 km^2 (derived from BGS sediment data). A total of 40 valid TV stations were completed in 2024 and used in the survey analysis (Table 12.2.4).

TV survey abundance estimates from 1995–2024 are shown in Table 12.2.3 and Figure 12.2.4. Following an interbenchmark at WGCSE 2022, abundance estimates from 2007-2023 were calculated using a krigging method to reduce uncertainty in the estimation (see. Annex 3) and updated abundance estimates are presented in Table 12.2.3 along with a reduced time series relative to the new abundance estimation procedure presented in Figure 12.2.4. Since 2007, the stock has undergone cycles wherein abundance oscillates between high and low values over five to six year periods (Figure 12.2.4), with changes of up to 1211 million individuals between the lowest and highest points of a cycle (between 2012 and 2016). The 2024 abundance represents a 4% decrease in relation to 2023.

Following discussions at WGNEPS 2022, an MSY Btrigger reference point for the new abundance time series was estimated based on the method used for FU 19 and FU 22 (ICES, 2016f; see Annex 3). A normal distribution with mean and standard deviation equal to those of the time-series of kriged abundance estimates was randomly generated, and the 5% quantile of that distribution (960 million) was taken as MSY Btrigger (rounded to the nearest 10 million individuals). The new MSY Btrigger value is 5.9% lower than the former value of 1020 million individuals.

Table 13.2.4 shows a more detailed summary of the results from the three most recent TV surveys conducted in FU12. The table includes estimates of abundance and variability in each of the strata adopted in the stratified random approach. Mean burrow density increased in 2024, in comparison to the 2023 survey, in all strata apart from Sandy Mud. Densities are generally lower in the western parts of the area towards the Outer Hebrides and higher in the inshore areas to the south west of Skye (Figure 12.2.5 and Figure 12.2.6). The CV for the 2024 TV survey (Table 12.2.4) is lower than the 20% precision level agreed by WGNEPS (2019).

The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009; ICES, 2013), WGNEPS (ICES, 2018a), WKNEPS (ICES, 2018b) and (Leocádio *et al*., 2018). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative relative to absolute conversion factor estimated for FU12 was 1.32 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 32%.

12.4 Assessment

Comparison with previous assessments

The assessment follows the same procedure as last year and is based on a combination of examining trends in fishery indicators and underwater TV abundance estimates. The process was defined by the benchmark WG and is described in the stock annex.

State of the stock

The underwater TV survey is presented as the best available information on the South Minch (FU12) *Nephrops* stock. The details of the 2024 survey are shown in Table 12.2.4, and compared with the 2022 and 2023 outcomes. At present, it is not possible to extract any length or age structure information from the survey and therefore it only provides information on abundance over the area of the survey.

TV survey estimated stock abundance in 2024 was 1430 million individuals, above the MSY $B_{trigger}$ value of 960 million and is used for the provision of advice.

The calculated harvest rate in 2022 (dead removals/TV abundance = 4.9%) was below the F_{MSY} proxy for this stock (the value associated with high long-term yield and low risk depletion) of 11.7%.

12.5 Catch scenarios table

Landings predictions and catch options at various harvest rates (based on principles established at WKNEPH (ICES, 2009), are made on the basis of the 2024 UWTV survey conducted in June. These were presented at WGCSE NEPH in September 2024 for the provision of advice.

Catch scenarios table inputs and historical estimates of mean weight in landings and harvest rates are presented in Table 12.2.2 and summarised below. The calculation of catch scenarios for the South Minch follows the procedure outlined in the stock annex.

Given the variability in mean weights it was considered more appropriate to use a full time-series average, from 1999 (first year with creel and trawl length distributions combined) until 2023.

The table below shows the agreed inputs to the catch scenario table.

Input	Data	2024 assessment
Survey abundance (millions)	UWTV 2024	1430
Mean weight in projected landings (g)	2021–2023	33.34
Mean weight in projected discards (g)	2021–2023	12.73
Dead projected discards	2021–2023	7.6%*
Discard survival rate	Proportion by number (assumed)	25%**

*** Based on mean discard rate (2017-2022) allocated to 2022.**

**** Discard survival in the creel fishery is assumed to be 100%, as outlined in the stock annex.**

12.6 Reference points

Reference points were derived for this stock at WKMSYRef4 (ICES, 2016e). These are updated on the basis of an average of estimated F_{MSY} proxy harvest rates over a period of years which corresponds more closely to the methodology for finfish. In cases where there is a clear trend in the values, a five-year average was chosen. Similarly, the five-year average of the F at 95% of the YPR obtained at the F_{MSY} proxy reference point was proposed as the F_{MSY} lower bound and the five-year average of the F above F_{MAX} that leads to YPR of 95% of the maximum as the upper bound. Using an average value also has the advantage of reducing the effect of any unusually high or low estimates of the F_{MSY} proxy, which occasionally appear. For this stock, the F_{MSY} proxy has been revised from 12.3% to 11.7%.

Following review at WGCSE 2022 and WGNEPS 2022, an, MSY $B_{trigger}$ for the new abundance time series has been defined as the fifth percentile of the probability distribution of abundance for the time-series 2007-2022, assuming a normal distribution; individuals in millions and is calculated as 960 million individuals (in 2023). Full details are contained in the stock annex.

These should remain under review by WGCSE and may be revised should improved data become available.

Table 12.2.2 and Figure 12.5.1 show the harvest rates for FU12. Due to the revised TV survey abundance estimates calculated in 2023; havest rates since 2007, have been recalculated and are presented in the tables with a reduced time series presented in Figure 12.5.1. The harvest rate has fluctuated over the time-series and has been below the F_{MSY} proxy since 2013. The increase in 2016, compared to the 2013–2015 harvest rates, was due to relatively increased landings compared to abundance. The harvest rate more than halved in 2018 compared to 2017, and has continued to decrease through 2020 to a new historical low, increasing again in 2021 with a small decline in 2022 (5.1%) and in 2023 (4.9%).

It is likely that prior to 2006, the harvest rates are underestimates due to under-reported landings.

12.7 Management strategies

Scotland has established a network of regional Inshore Fisheries Groups (rIFGs), non-statutory bodies that aim to improve the management of Scotland's inshore fisheries out to six nautical miles, and to give commercial inshore fishermen a strong voice in wider marine management developments. The rIFGs will contribute to regional policies and initiatives relating to management and conservation of inshore fisheries, including impacts on the marine environment and the maintenance of sustainable fishing communities and measures designed to better conserve and sustainably exploit stocks of shellfish and sea fish (including salmon) in their local waters. Although no IFG proposals specific to the management of *Nephrops* fisheries have yet been adopted, some of the IFG management plans for the Scottish West Coast include spatial management of *Nephrops* fisheries and the introduction of creel limits.

On the 8th of February 2016, phase 1 of the fisheries management measures for inshore MPAs in Scottish waters came into force (SG, 2016). These measures relate to both Nature Conservation MPAs (NCMPAs; Marine (Scotland) Act and the UK Marine and Coastal Access Act) and Special Areas of Conservation (SACs; EC Habitats Directives – Council Directive 92/43/EEC) both of which have the aim of conserving biological diversity in Scottish waters and contribute to Scotland's MPA network (SG, 2017a). Although not specific to the management of the *Nephrops* fishery, they will influence spatial patterns of fishing for *Nephrops* where controls on the two main gear types, demersal trawls and creels, are implemented on *Nephrops* habitat. There are seven protected areas within the South Minch functional unit with fisheries management measures. MPAs on the main areas of *Nephrops* habitat include the Loch Sunart to the Sound of Jura NCMPA where demersal trawling is banned in some areas, i.e. zoned, and seasonal closures implemented in others, Loch Sunart NCMPA/SAC, where demersal trawling is banned and creeling is zoned, the East of Mingulay SAC, demersal trawling banned and creeling zoned, and the Trenish Isles SAC, demersal trawling banned. Another area is the Loch Duich, Long and Alsh NCMPA/SAC, covering some patches of muddy sediment, where demersal trawling is banned or temporally closed in other areas that extend beyond the MPA onto muddy sediment. Other areas include the Loch Creran SAC/NCMPA, demersal trawling banned and creeling zoned, and the Firth of Lorn SAC, which has the same management as the Loch Sunart to the Sound of Jura NCMPA. For the Firth of Lorn and Loch Creran, management was in place prior to 2016 (SG, 2016). An additional NCMPA, at Loch Carron, was designated using emergence powers in 2017 (SG, 2017b). The areas of the SACs and NCMPAs relative to the estimated *Nephrops* habitat within the South Minch functional unit are displayed in Figure 12.6.1.

12.8 Quality of assessment and forecast

The length and sex composition of the landings data is considered to be generally adequately sampled, sampling levels have remained relatively consistent over the past two years (see Section 12.2), with the exception of quarter 2 of 2020 where sampling efforts were disrupted by the COVID-19 pandemic. Discard sampling has been conducted for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the trawl fishery adequately. The reduced sampling effort in 2022 meant that discard sample data was not available for Quarter three, and it was agreed at WGCSE that estimates of discard rates and size distributions for 2022 would be adequately approximated for the purpose of forecasting by averaging of discard samples across all available Quarters between 2017 and 2022. In 2023, while sampling efforts increased slightly; there was still no discard sampling in Quarter three. At the May WGCSE meeting it was decided that Quarter 2 sampling was adequate in 2023 to represent Quarter 3 and allocations were thus carried out as described in the stock annex. The landings length compositions from 1999 onwards are derived from both creel and trawl samples. The creel fishery, which accounts for 30% of the landings in 2023 and increasingly operates over similar areas to trawling, exhibits a length composition composed of larger animals.

There are concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers legislation was introduced and the reliability began to improve. Because of this, the final assessment adopted is independent of official statistics. Harvest rates since 2006 are also considered more reliable due to more accurate landings data reported under new legislation. Incorporation of creel length compositions has also improved estimates of harvest rates.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. The survey is targeted at known areas of mud, sandy mud and muddy sand within the South Minch. The variance of density estimates in the South Minch is relatively high, particularly in the sandy mud strata, resulting in large confidence intervals and a greater uncertainty on the abundance estimates than in other FUs. This makes it difficult to determine which population changes are significant. Although the CV's have been smaller in recent years.

There is a need to explore options to implement further stratification for the South Minch survey area. In the provision of catch options based on the absolute survey estimates, additional uncertainties related to mean weight in the landings and the discard rates also arise. A three-year average (i.e. 2021–2023 for the 2024 assessment) of discard rates (adjusted to account for some survival of discarded animals) has been used in the calculation of catch options.

The cumulative relative to absolute conversion factor estimates for FU12 are largely based on expert opinion. The precision of these bias corrections cannot yet be characterised. The landings derived in the forecast (catch options table) are sensitive to the input dead discard rate and mean weights in landings, and this introduces uncertainties in the catch forecasts. Precision estimates are needed for these forecast inputs.

The overall area of the ground is estimated from the available BGS contoured sediment data and at present is considered to be a minimum estimate. Work is underway to improve the area estimation. VMS data linked to landings (from queries of the Scottish FIN database) suggest no major differences between areas fished and the mud sediment maps. Two other factors however, are likely to increase the estimate of ground area available for *Nephrops* and *Nephrops* directed fishing. Firstly, the inclusion of vessels smaller than 15 m would likely increase the fished area in some of the inshore locations and secondly, it is known that most of the sea lochs have areas of mud substrate and are typically fished by creel boats. In recent years, limited TV surveys have taken place in some of the sea lochs and attempts are being made to utilise these data to improve estimates of mud area and *Nephrops* abundance in the South Minch.

12.9 Recommendation for next benchmark

This stock was last benchmarked in 2009. WGCSE will keep the stock under close review and recommend future benchmark as required.

At WGCSE 2022 it was agreed that a benchmark/interbenchmark should be carried out on FU 12 Nephrops, addressing the potential for provision of abundance estimates with reduced uncertainty using alternate estimation methods (ICES, 2022). An interbenchmark was presented at WGCSE 2023 (see. Annex 5) with the alternative abundance estimation process being accepted by WGCSE and used in the provision of advice for 2024.

12.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES division level. Management at the functional unit level could provide controls to ensure effort and catch were in line with resources available.

Creel fishing takes place in this area but overall effort in terms of creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the South Minch and estimated discards of whiting and haddock by the TR2 fleet are high in area 6.a generally. It is important that efforts continue to ensure that unwanted bycatch is kept to a minimum in this fishery.

12.11 References

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12.12 Tables and figures

Table 12.2.1. *Nephrops*, South Minch (FU12), ICES estimates of landings of *Nephrops*, 1981–2023.

UK SCOTLAND						OTHER UK	IRELAND	TOTAL
YEAR	*NEPHROPS* TRAWL	OTHER	CREEL	BELOW MINIMUM SIZE	SUB TOTAL			
1981	2966	254	432	0	3652	0	0	3652
1982	2925	206	421	0	3552	0	0	3552
1983	2595	362	456	0	3413	0	0	3413
1984	3229	477	594	0	4300	0	0	4300
1985	3096	424	488	0	4008	0	0	4008
1986	2694	288	502	0	3484	0	0	3484
1987	2928	418	546	0	3892	0	0	3892
1988	3544	364	555	0	4463	10	0	4473
1989	3846	338	561	0	4745	0	0	4745
1990	3732	263	435	0	4430	0	0	4430
1991	3596	342	503	0	4441	1	0	4442
1992	3478	209	549	0	4236	1	0	4237
1993	3609	194	650	0	4453	5	0	4458
1994	3742	264	405	0	4411	3	0	4414
1995	3443	717	508	0	4668	14	0	4682
1996	3108	417	469	0	3994	1	0	3995
1997	3518	329	493	0	4340	3	1	4344
1998	2851	340	538	0	3729	0	1	3730
1999	3165	359	514	0	4038	0	14	4052
2000	2940	311	700	0	3951	0	2	3953
2001	2823	391	768	0	3982	0	9	3991
2002	2234	314	743	0	3291	0	14	3305
2003	2812	203	858	0	3873	0	6	3879
2004	2864	105	879	0	3848	0	21	3869
2005	2812	46	955	0	3813	1	34	3848

UK SCOTLAND						OTHER UK	IRELAND	TOTAL
YEAR	*NEPHROPS* TRAWL	OTHER	CREEL	BELOW MINIMUM SIZE	SUB TOTAL			
2006	3570	97	922	0	4589	9	35	4633
2007	4437	21	959	0	5417	19	35	5471
2008	4433	12	896	0	5341	2	13	5356
2009	3346	24	900	0	4270	4	11	4285
2010	2836	19	969	0	3824	16	6	3846
2011	2876	11	783	0	3670	23	9	3702
2012	3159	32	773	0	3964	19	6	3989
2013	2490	543	729	0	3762	13	1	3776
2014	2490	3	637	0	3130	32	17	3179
2015	2662	18	665	0	3345	22	33	3400
2016	3450	22	838	0	4310	33	59	4402
2017	2833	60	775	0	3668	23	66	3757
2018	1693	86	682	0	2461	45	34	2540
2019	1493	39	621	0	2153	29	38	2220
2020	1320	25	554	0	1899	8	69	1976
2021	1549	53	472	0.3	2074.3	77	42	2193.3
2022	1743	65	653	3	2464	25	71	2560
2023	1715	31	746	0	2492	34	35	2561

Table 12.2.2. *Nephrops*, South Minch (FU12): Adjusted TV survey abundance, landings, discard rate proportion by number) and estimated harvest rate.

YEAR	LANDINGS NUMBER (MILLIONS)	DISCARDS NUMBER (MILLIONS)	REMOVALS NUMBER (MILLIONS)**	ADJUSTED SURVEY (MILLIONS) ***	HARVEST RATE*, ***	LANDINGS (TONNES)	DISCARDS (TONNES)	DISCARD RATE (%)	DEAD DISCARD RATE (%)	MEAN WEIGHT IN LANDINGS (g)	MEAN WEIGHT IN DISCARDS (g)
1999	161	29	183	1086	16.9	4052	206	15.4	12	25.14	7
2000	145	33	170	1854	9.2	3953	284	18.7	14.7	27.3	8.5
2001	168	65	216	2037	10.6	3991	591	27.9	22.5	23.79	9.11

YEAR	LANDINGS NUMBER (MILLIONS)	DISCARDS NUMBER (MILLIONS)	REMOVALS NUMBER (MILLIONS)**	ADJUSTED SURVEY (MILLIONS) ***	HARVEST RATE*, ***	LANDINGS (TONNES)	DISCARDS (TONNES)	DISCARD RATE (%)	DEAD DISCARD RATE (%)	MEAN WEIGHT IN LANDINGS (g)	MEAN WEIGHT IN DISCARDS (g)
2002	123	26	143	1899	7.5	3305	247	17.6	13.8	26.83	9.37
2003	139	38	168	2157	7.8	3879	381	21.3	16.9	27.86	10.1
2004	141	44	175	2558	6.8	3869	454	23.8	19	27.37	10.26
2005	137	49	174	2208	7.9	3848	452	26.5	21.2	28.11	9.17
2006	177	30	199	1845	10.8	4633	324	14.3	11.1	26.24	10.97
2007	228	66	278	1002	27.7	5471	903	22.4	17.8	23.95	13.73
2008	224	74	279	1617	17.3	5356	605	24.7	19.8	23.91	8.23
2009	179	26	199	1200	16.6	4285	216	12.5	9.6	23.87	8.44
2010	149	12	158	1898	8.3	3846	133	7.7	5.9	25.86	10.76
2011	118	11	126	1851	6.8	3702	92	8.2	6.3	31.1	8.78
2012	133	16	145	889	16.3	3989	145	10.8	8.3	29.17	9.05
2013	136	4	140	1514	9.2	3776	50	3.1	2.4	27.48	11.31
2014	105	19	120	1746	6.9	3179	233	15.6	12.1	29.91	12.04
2015	120	10	128	1850	6.9	3400	121	7.7	5.9	28.15	12.04
2016	177	31	201	2100	9.6	4402	365	14.9	11.6	24.76	11.74
2017	131	13	140	1283	11.0	3757	108	9.4	7	27.76	8.29
2018	91	4	94	1751	5.4	2540	54	4.5	3.4	27.27	12.74
2019	79	4	83	2170	3.8	2220	46	4.9	3.7	28.54	11.22
2020	54	5	57	1866	3.1	1976	46	7.8	6	36.58	9.91
2021	90	7	95	1160	8.2	2193.3	84	7.6	5.8	29.96	11.35
2022	77	6	82	1592	5.1	2286	68	7.3	5.6	33.5	11.21
2023	69	6	74	1494	4.9	2560	91	7.8	5.9	36.55	15.64
2024	-	-	-	1430	-	2561	-	-	-	-	-
Average^									5.8	33.34	12.73

*** Harvest rates previous to 2006 are unreliable.**

**** Removals numbers take the dead discard rate into account.**

***** Values since 2007 have been updated due to revised abundance estimates.**

^Dead discard average: 2021–2023; Mean weight in landings and discards average: 2021–2023.

Table 12.2.3. ***Nephrops*****, South Minch (FU12): Results of the 1995–2024 TV surveys (adjusted for bias).**

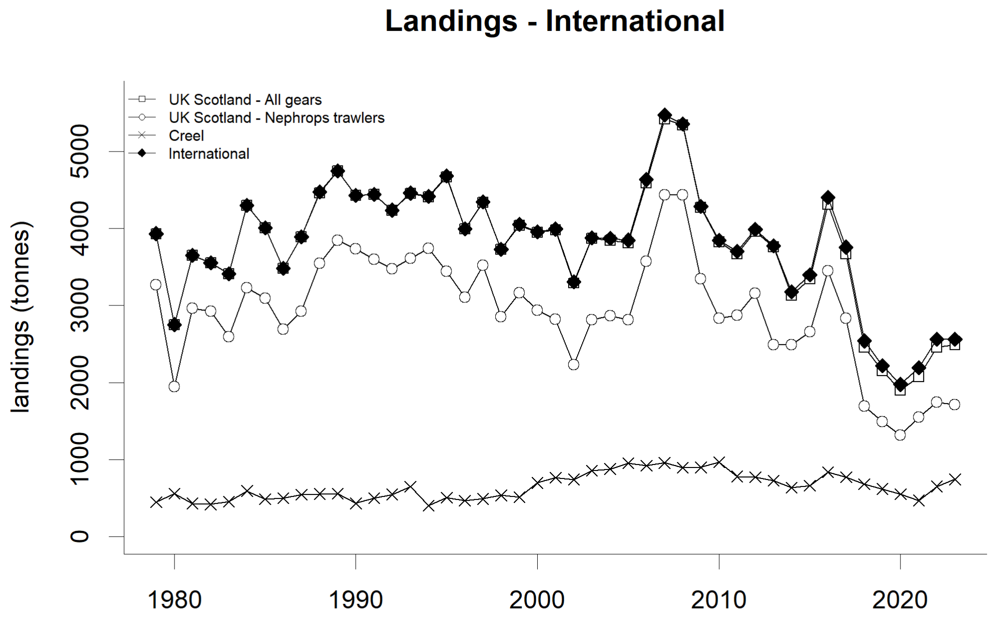
YEAR	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS/m²)*	ABUNDANCE (MILLIONS)*	95% CONFIDENCE INTERVAL (MILLIONS)*
1995	33	0.227	1152	251
1996	21	0.288	1473	530
1997	36	0.212	1086	185
1998	38	0.288	1452	232
1999	37	0.212	1086	260
2000	41	0.364	1854	348
2001	47	0.402	2037	459
2002	31	0.371	1899	567
2003	25	0.424	2157	756
2004	38	0.508	2558	473
2005	33	0.432	2208	740
2006	36	0.364	1845	598
2007	39	0.2	1002	194
2008	33	0.328	1617	230
2009	25	0.22	1200	410
2010	34	0.38	1898	493
2011	36	0.374	1851	496
2012	38	0.181	889	111
2013	38	0.305	1514	155
2014	36	0.348	1746	306
2015	35	0.379	1850	265
2016	37	0.425	2100	251
2017	41	0.257	1283	243
2018	39	0.348	1751	225
2019	40	0.429	2170	391

YEAR	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS/m²)*	ABUNDANCE (MILLIONS)*	95% CONFIDENCE INTERVAL (MILLIONS)*
2020	40	0.381	1866	356
2021	41	0.231	1160	242
2022	41	0.332	1592	300
2023	41	0.299	1494	316
2024	40	0.286	1430	178

***Values since 2007 have been updated due to revised abundance estimates.**

Table 12.2.4. ***Nephrops*** **South Minch (FU12). Results by stratum of the 2022–2024 TV surveys. Note that stratiication was based on a series of sediment strata (M – Mud, SM – Sandy mud, MS – Muddy sand).**

STRATUM	AREA (km²)	NUMBER OF STATIONS	MEAN BURROW DENSITY (no./m²)	OBSERVED VARIANCE	ABUNDANCE (MILLIONS)	STRATUM VARIANCE	PROPORTION OF TOTAL VARIANCE	SURVEY PRECISION LEVEL (CV)
2022 TV Suvey								
M	303	4	0.317	0.057	95.8	1324	0.024	
SM	2741	16	0.448	0.105	1228.9	49419	0.89	
MS	2028	21	0.173	0.024	351.8	4766	0.086	
Total	5071	41			1676.5	55508	1	0.129
2023 TV Suvey								
M	303	3	0.483	0.059	146.2	1794	0.024	
SM	2741	18	0.355	0.131	974.7	54669	0.724	
MS	2028	20	0.258	0.092	523	19009	0.252	
Total	5071	41			1643.9	75502	1	0.161
2024 TV Suvey								
M	303	3	0.328	0.086	99.5	2641	0.097	
SM	2741	16	0.309	0.037	846.1	17111	0.63	
MS	2028	21	0.263	0.038	533.3	7392	0.272	
Total	5071	40			1478.8	27144	0.99	0.112



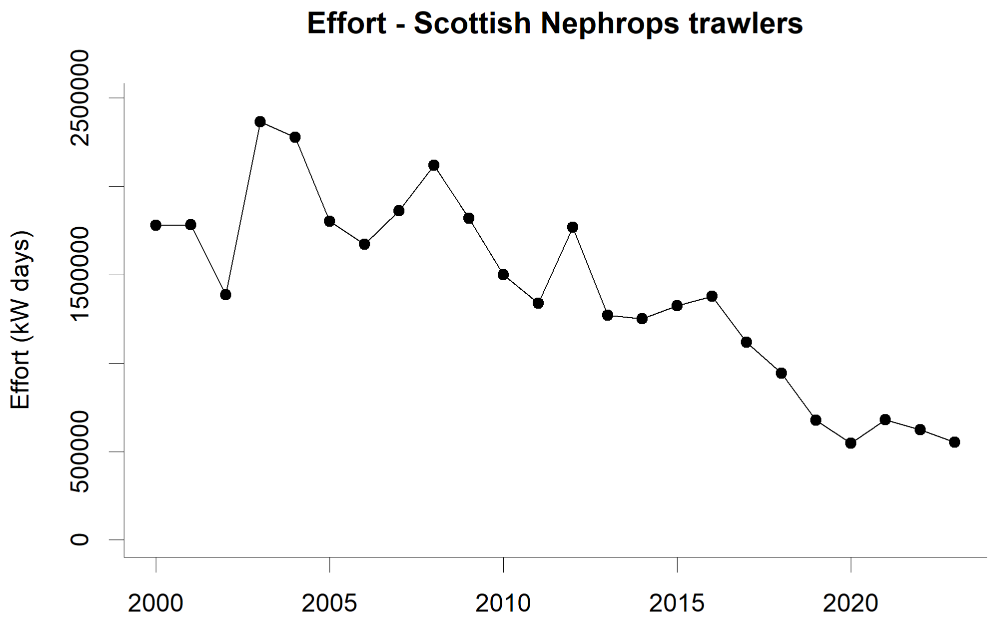


Figure 12.2.1. *Nephrops,* South Minch (FU12). Long-term landings and effort.

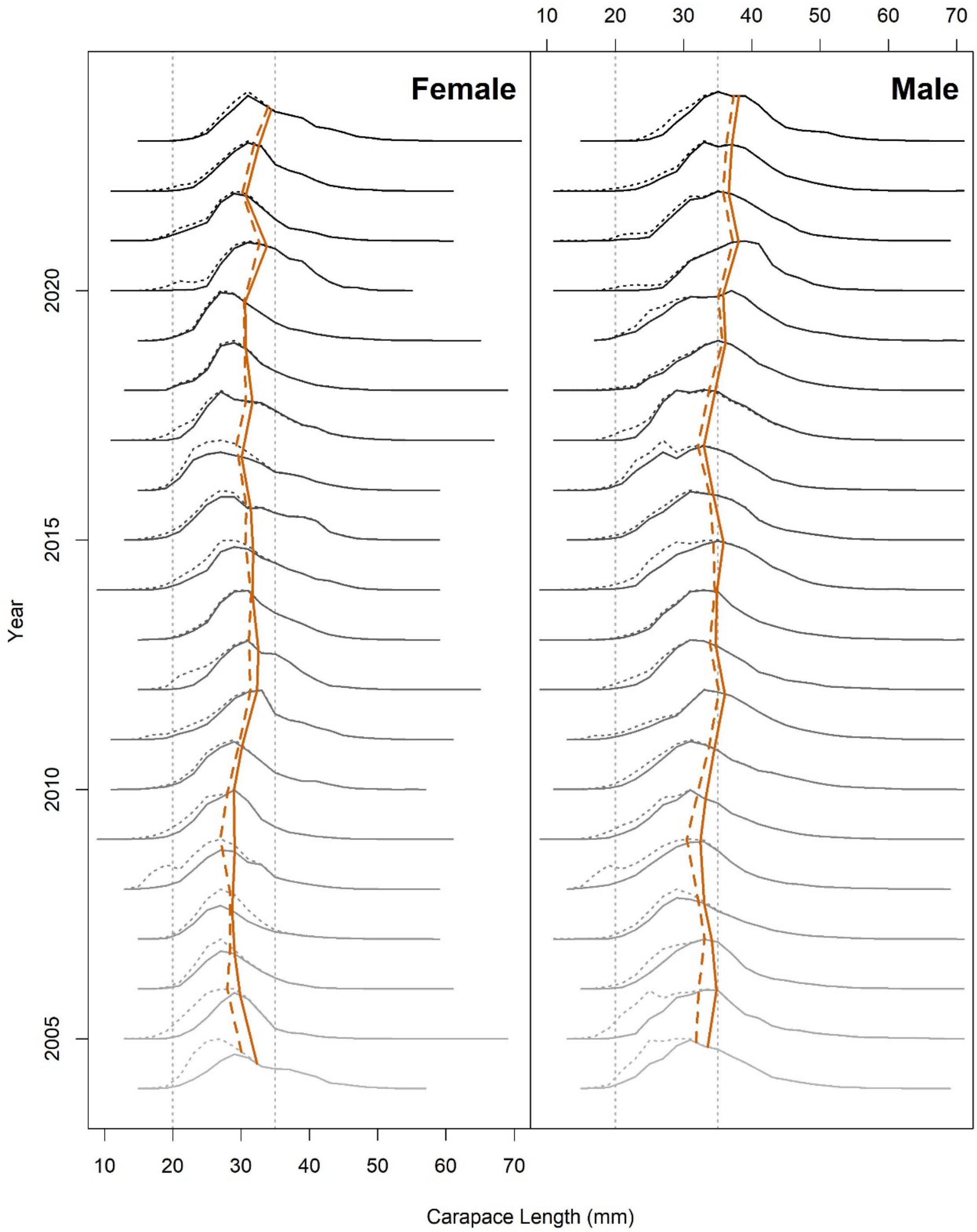


Figure 12.2.2. ***Nephrops*****. South Minch (FU12). Catch length–frequency distribution and mean size in catches (dotted) and landings (solid) for *Nephrops* in the North Minch, 2004–2023. Vertical dotted lines are minimum conservation reference size (20 mm) and 35 mm.**

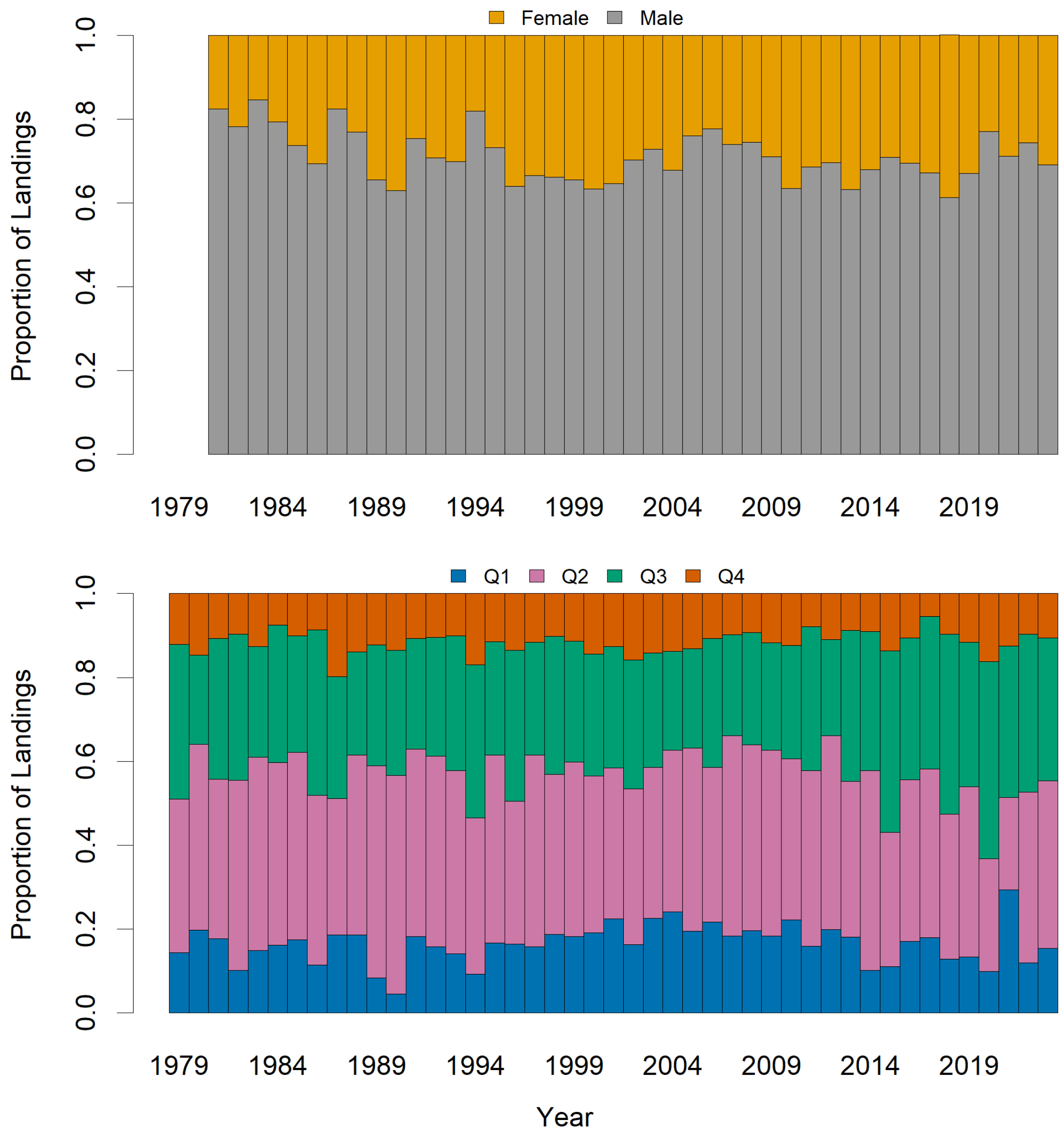


Figure 12.2.3. (a) *Nephrops,* South Minch (FU12). Proportion of landings by sex and quarter from Scottish trawlers.

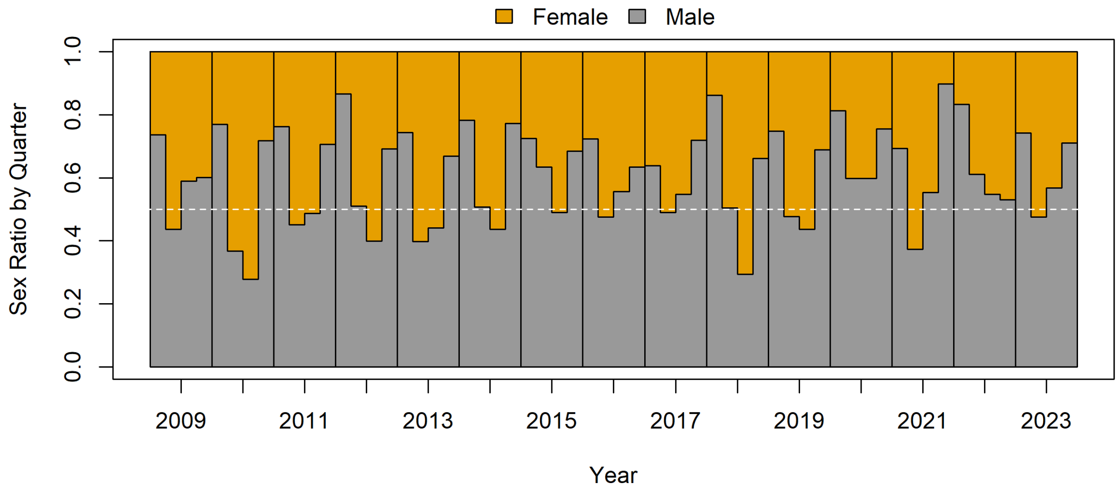


Figure 12.2.3 (b) ***Nephrops,*** **South Minch (FU12), Proportion of males by quarter (2009–2023).**

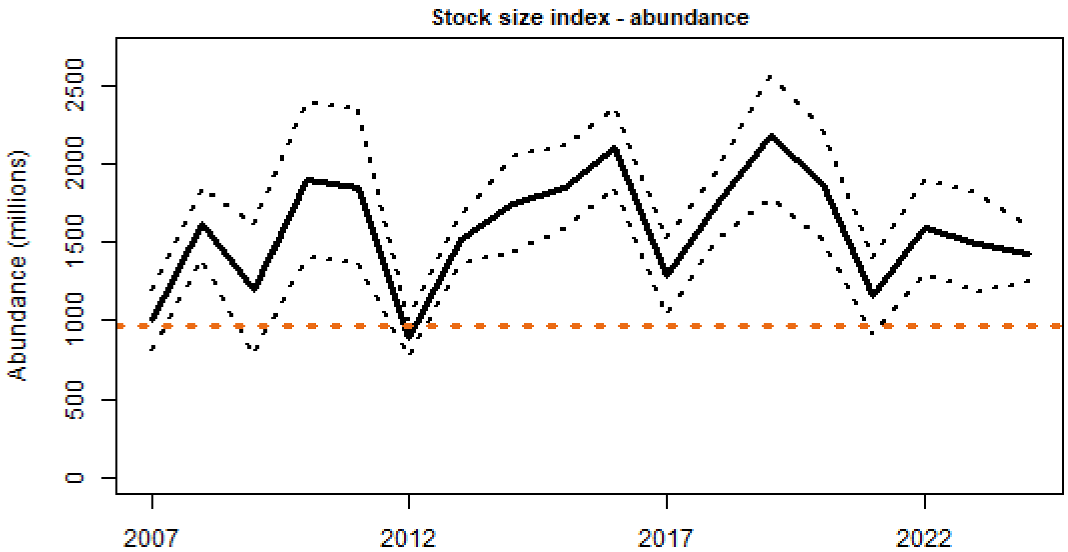


Figure 12.2.4. ***Nephrops*****, South Minch (FU12), Time-series of TV survey abundance estimate (adjusted for bias, solid black line), with 95% confidence intervals (dashed black lines), 2007–2023. The dashed red line is the rounded $B_{trigger}$ value of 960 million individuals.**

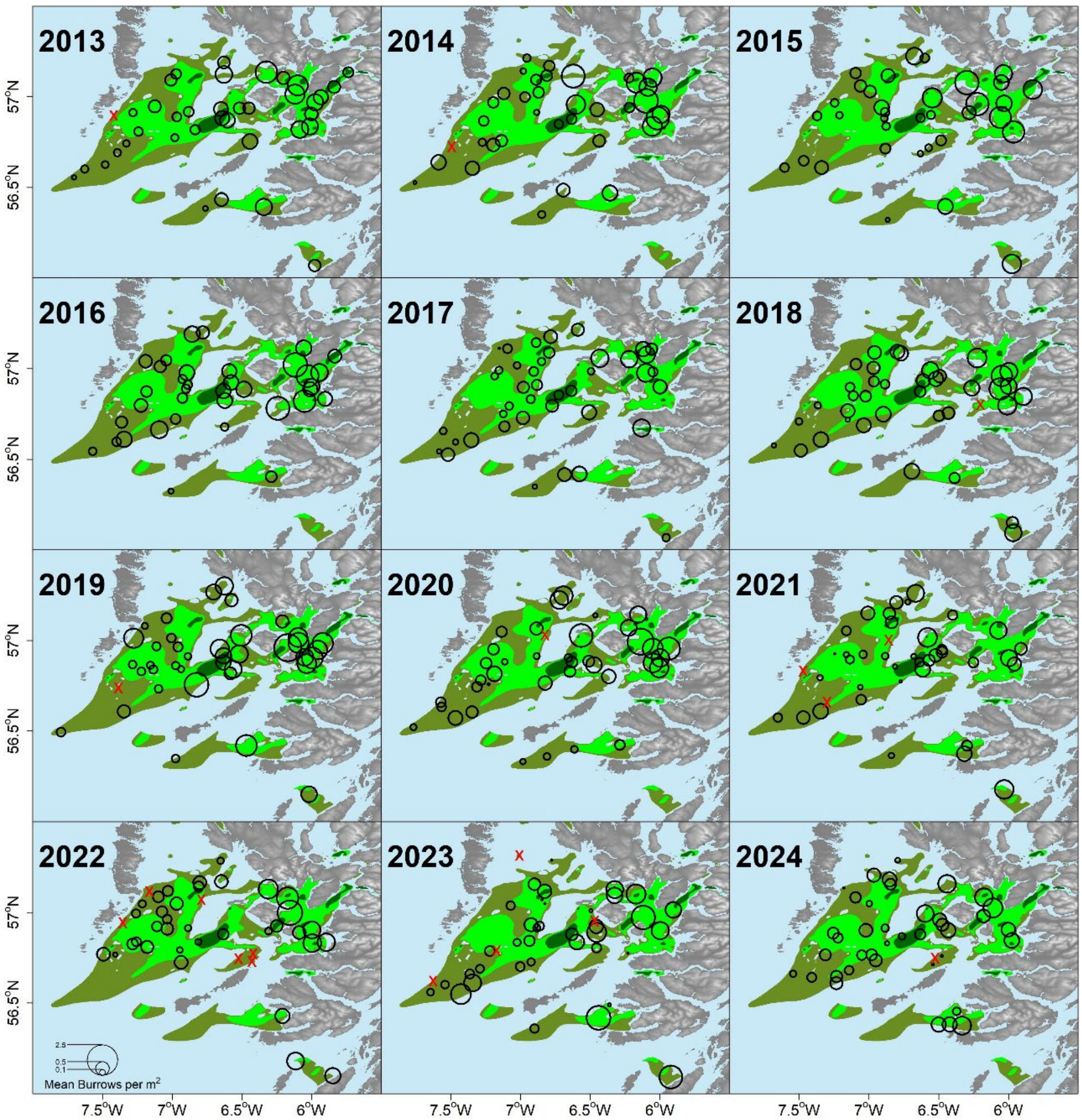


Figure 12.2.5. ***Nephrops*, South Minch (FU12), TV survey station distribution and relative density (burrows/m²), 2013–2024. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles in this figure are all scaled the same. Red crosses represent zero observations.**

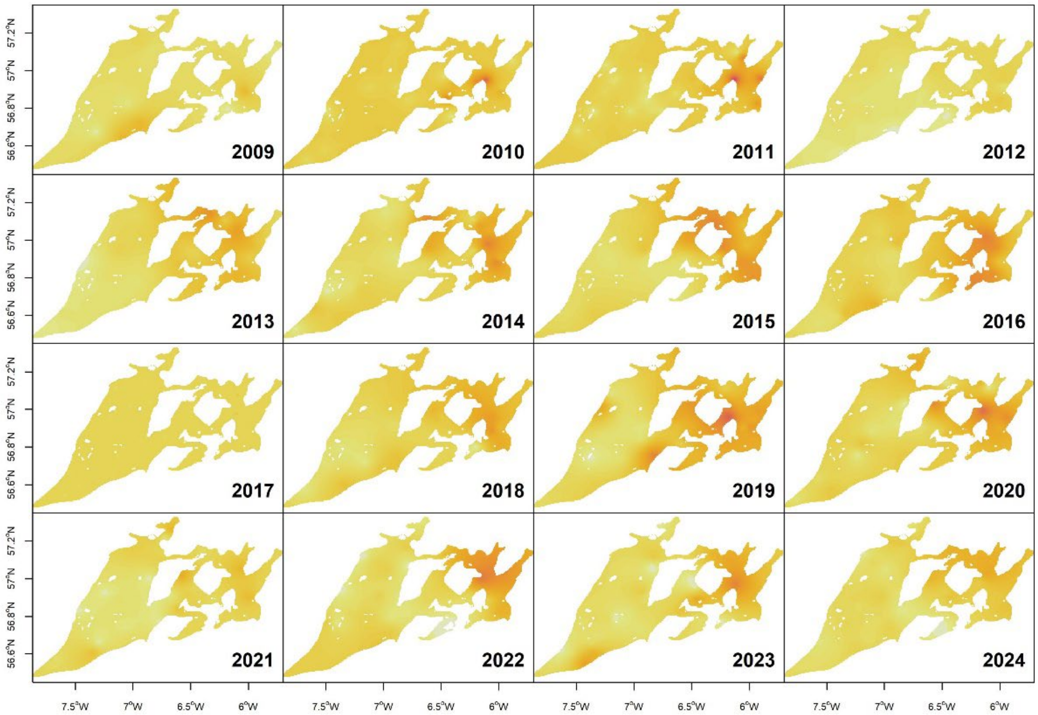


Figure 12.2.6. Time series estimates of kriged *Nephrops* burrow density distribution surfaces for FU 12. Darker red pixels represent areas of higher estimated *Nephrops* burrow density, and lighter yellow pixels represent areas of lower estimated density.

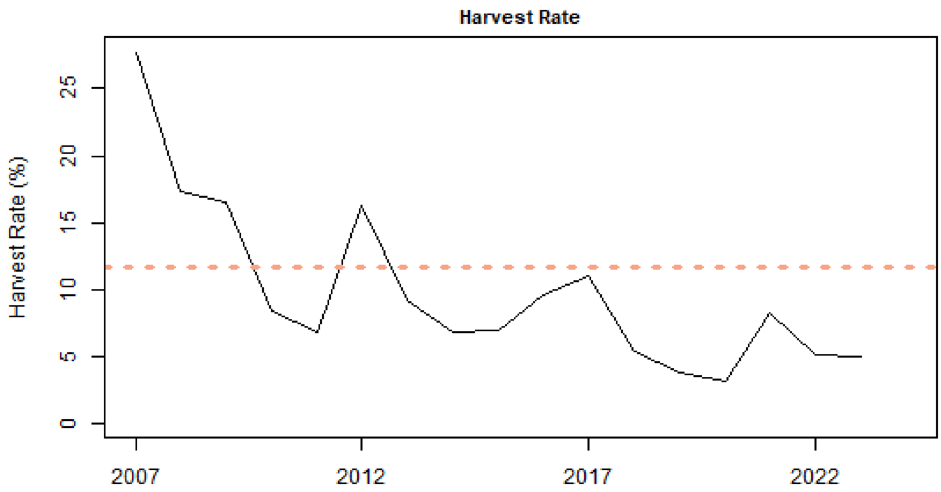


Figure 12.5.1. ***Nephrops*, South Minch (FU12), harvest rate, 2007–2023. The dashed and solid lines are the F_{MSY} proxy harvest rate (11.7%) and the time-series of estimated harvest rates, respectively.**

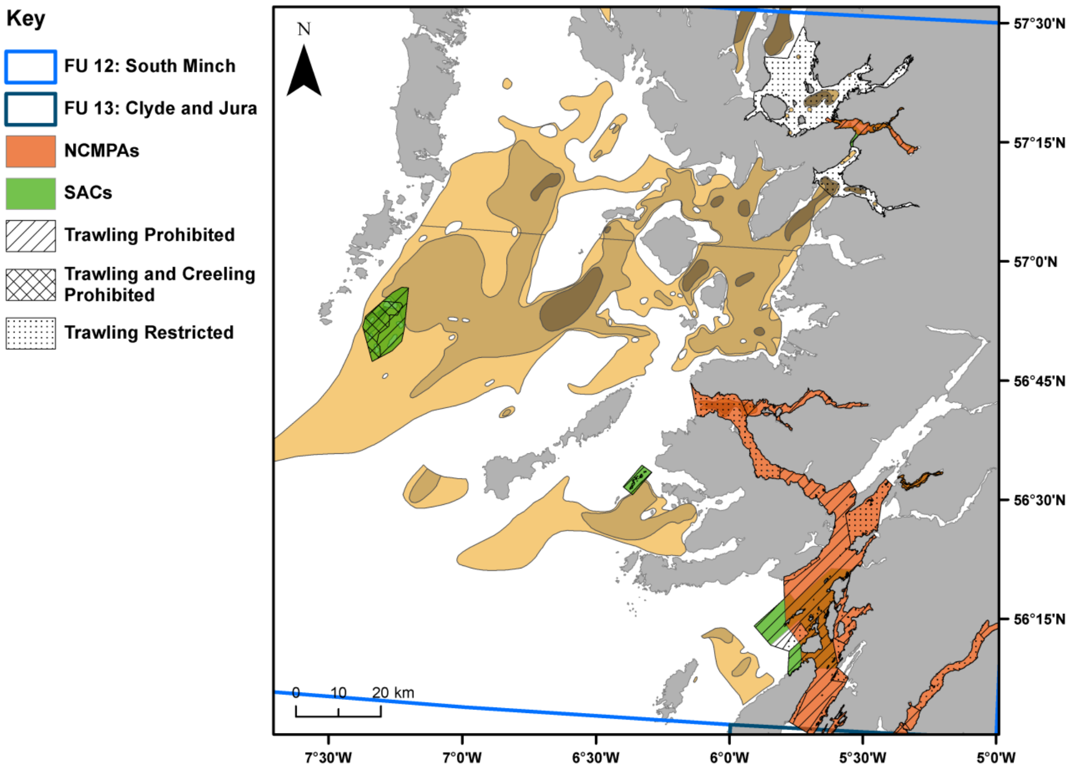


Figure 12.6.1. The area of Nephrops habitat (Mud, Muddy Sand and Sandy Mud) within the South Minch (FU12) relative to the areas of the Nature Conservation MPAs (NCMPAs) and Special Area of Conservations (SACs) with fisheries management measures. Areas where demersal trawling is prohibited, restricted (i.e. vessel size restrictions or seasonal closures) and where creeling is prohibited are displayed. For more detailed information see SG (2016). Geographic Coordinate System: OSGB 1936, Datum: OSGB 1936, Projected Coordinate System: British National Grid. Coastline by Wessel and Smith (2016), MPA sites subsetted from NCMPA (SNH, 2015) and SAC (SNH, 2016) layers, management areas from SG (2017c) and functional units generated from merged ICES rectangles (ICES, 2017b). Map and modified layers created using ArcGIS (ESRI, 2014).

Contents

13 Norway lobster (*Nephrops norvegicus*) in Division 6.a, Functional Unit 13 (West of Scotland, the Firth of Clyde and Sound of Jura)

13.1 Introduction

Type of assessment in 2024

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (WKNEPH, 2009; WKNEPH, 2013). Full details are provided in the stock annex.

ICES advice applicable to 2023

'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 2019–2021, catches in 2023 should be no more than 4596 tonnes (4122 tonnes for the Firth of Clyde and 474 tonnes for the Sound of Jura).

To ensure that the stock in Functional Unit (FU) 13 is exploited sustainably, management should be implemented at the FU level. In this particular FU, additional measures should be implemented to ensure that landings taken in each subarea (the Firth of Clyde and the Sound of Jura) are in line with the advice.

ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 6. ICES considers this plan to be precautionary when implemented at the FU level.'

ICES advice applicable to 2024

'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 2020–2022, catches in 2024 should be no more than 4527 tonnes (3870 tonnes for the Firth of Clyde and 657 tonnes for the Sound of Jura).

To ensure that the stock in Functional Unit (FU) 13 is exploited sustainably, management should be implemented at the FU level. In this particular FU, additional measures should be implemented to ensure that landings taken in each component (the Firth of Clyde and the Sound of Jura) are in line with the advice.

ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 6. ICES considers this plan to be precautionary when implemented at the FU level.'

13.2 General

Stock description

The Clyde functional unit (FU13) is located in the southern waters off the west coast of Scotland (see. Section 11 FU11 North Minch, Figure 11.1). It is comprised of two distinct patches in the Firth of Clyde and the Sound of Jura, to the east and west of the Mull of Kintyre respectively. The hydrography of the two subareas differs, with the Sound of Jura characterised by stronger tidal currents and the Firth of Clyde exhibiting features of a lower energy environment with a shallow entrance sill. Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the two distinct patches, these substrates are distributed according to prevailing hydrographic and bathymetric conditions. The available area of suitable sediment is smaller in the Sound of Jura, occupying only the deepest parts of the Sound, while in the Firth of Clyde these sediments predominate. Further details are provided in the stock annex.

Management applicable to 2023 and 2024

Management is at the ICES subarea level as described at the beginning of Section 11 FU11 North Minch.

Ecosystem aspects

Details of the ecosystem aspects for this functional unit are provided in the stock annex where available.

Fishery description

Information on developments in the fishery was provided by Marine Scotland fishery compliance officers.

In 2023, there were 23 *Nephrops* vessels fishing out of Ayr including 19 trawlers and 4 creelers but no report from the other main port, Campbeltown. Both ports report a continual movement of vessels entering and leaving the fishery, and an overall general decrease in fleet size over the past number of years. All trawlers use 80 mm single or twin rigs with square mesh panels (SMP) of at least 160 mm, in accordance with The Sea Fishing (Licences and Notices) (Scotland) Regulations 2011. *Nephrops* trawling vessels with power >200 kW, or >12m, are required to use a 300 mm SMP.

The activity of Northern Irish vessels was not perceived to be high since 2017, when compared to previous years. Many vessels have moved to other areas where there was better fishing, some travelling as far away as Eyemouth, and vessels fishing in FU13 did not land locally instead going back to their home port because of better fuel and market prices. Many vessels have had difficulty crewing their boats in recent years, as fuel costs have affected wages, and Brexit has limited the available workforce.

Mobile gear is banned in the Inshore Clyde from Friday night to Sunday night as are vessels greater than 21 m in length. Most creel boats operating in the Clyde have two crew members and operate around 1000 creels. Creeling activity now takes place quite widely in the northern parts of the Firth operating on some of the same grounds but often taking place during the weekend trawling ban.

In terms of the influence of Marine Protected Area (MPA) management measures on the fishery, the South Arran Nature Conservation MPA (NCMPA) removed a large sea area for *Nephrops* trawlers to operate over. Trawlers which would have operated in this area were displaced to areas where they would not have targeted previously, or where they would have only operated in poor weather conditions. This allowed creelers to move into the areas were trawling was banned. There have been recent reports of increases in creel numbers in this area and this has resulted in gear conflict within the creel sector. The small area of the Upper Loch Fyne NCMPA closed to trawlers was reported to have had little impact.

Further general information on the fishery can be found in the stock annex.

13.3 Data available

InterCatch

Commercial data for 2023 were uploaded to InterCatch prior to the 2024 WG meeting. Uploaded data were worked up in InterCatch to generate 2023 raised international length–frequency distributions. Allocation schemes for any unsampled fleets are described in the stock annex. Data exploration in InterCatch has previously shown that outputs of raised data were very close to those generated by the previous method applied internally with differences being <0.1%. As such, InterCatch length–frequency outputs have been used in the stock assessment since 2012.

Limitations such as staffing, the COVID-19 pandemic and tensions with stakeholders has resulted in a reduced sampling effort of commercial catches for FU13 since 2020. There were no representative discards samples collected for FU13 by the main contributor the Marine Directorate in 2023. However, 3 discard samples were available for Quarter two from the Northern Irish fleet provided by Agri-Food and Biosciences Institute (AFBI). After exploration of these samples; it was agreed at WGCSE that these Quarter 2 samples would be allocated to only the Northern Irish component of the Quarter 2 fleet due to potential differences in sampling methodology. The remainder of the Quarter 2 fleet and the other three Quarters would be allocated a longer term 10 year average (2010-2019) discard allocation based on the standard Scottish sampling. In 2021, 2022 and 2023 a 3 year discard average had been used to fill in missing discard sampling using the most recent three years that data was available (2017-2019). A 10 year discard average was deemed more suitable this year due to annual fluctuations in the discard rate. Assessment estimates affected by changes in discard rates are annotated hereafter to reflect this; i.e. "*x* (*y/z*)", where *x* is the estimate based on the average discard rate 2017-2019, *y* is based on minimum discard rate, and *z* on maximum discard rate over the same period.

Commercial catch

Official catch statistics (landings) reported to ICES are shown in Table 11.1.1 (see. Section 11 FU11 North Minch). These relate to the whole of area 6.a of which the FU13 is a part. Landings statistics for FU13 provided through national laboratories are presented in Table 13.1.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, although Northern Ireland contributed 886 tonnes in 2023, with England reporting 1 tonne. Total reported Scottish landings in 2023 were 3528 tonnes; consisting of 3175 tonnes landed by trawlers (90%) and 227 tonnes (6%) landed by Scottish creel vessels. Scottish creel landings have generally increased in the most recent years, from approximately 3% in 2012 to 6% of total landings in 2023.

Statistical rectangle 40E4 covers parts of both the Firth of Clyde and the Sound of Jura. Table 13.2.1 shows the split in landings between the two subareas comprising FU13. Historically the allocation of landings to the two components of FU13 was carried out by the fishery office and required them to have detailed knowledge of where vessels have been fishing within 40E4. The apparent decline in landings from the Sound of Jura in 2001 is not considered to be associated with a sudden change in fishing practices and is thought more likely to be due to changes in fishery office recording practices. For this reason, the landings split is considered unreliable in recent years and the commercial landings data are now presented for the combined Firth of Clyde and Sound of Jura. Given the relative magnitudes of the fisheries (Clyde likely to be much bigger), the commercial data are likely to be more representative of the Clyde.

Effort data

In 2015, WGCSE agreed that effort should be reported in kW days, as this is likely to be more informative about changes in the actual fleet effort. Effort shows an overall decreasing trend but was stable through 2010 to 2012 (Figure 13.2.1). Effort increased in 2016 in comparison to 2015, but has been on a generally decreasing trend since then. Note that the effort time-series range (2000–2023) does not match the more extensive year range available for landings due to a lack of confidence in the reliability of older effort data in the Marine Directorate database. The effort is also slightly inconsistent with the landings data because effort is provided for TR2 vessels only, while the '*Nephrops* trawl' landings also includes landings by large mesh trawlers targeting *Nephrops*.

Sampling levels

Length compositions of landings and discards are obtained during market and on-board observer sampling respectively. These sampling levels are shown in Table 11.2.2 (see. Section 11 FU11 North Minch). Sampling of landings length compositions in the Sound of Jura is more infrequent but samples have been included in the FU13 raising procedure when available. Length compositions for the creel fishery are available for landings only. This is because survival in the animals that are discarded (although little quantitative information exists) is assumed to be high (ICES, 2013). Therefore these animals are not considered to be removed from the population, and 100% survival is assumed (ICES, 2013).

Length compositions

Although assessments based on detailed catch analysis are not presently carried out, examination of length compositions can provide a preliminary indication of exploitation effects. Figure 13.2.2 shows a series of annual Clyde length–frequency distributions for the period 2004 to 2023. Catch and landings length compositions, and mean size are shown for each sex. The mean sizes of both sexes have fluctuated around relatively small ranges since 2015. The mean size of females in the catch has remained relatively stable over the past three to four years with a slight increase in 2022 and 2023, whereas the mean size of males showed an increase until 2020, and then a slight decrease in 2021, increasing again in 2022 and 2023.

Sex ratio

Sex ratio in FU 13 shows some variation but males generally make the largest contribution to the annual landings (Figure 13.2.3(a)). This occurs because males are available throughout the year and the fishery takes place in all quarters, although effort is generally reduced during the winter months because of poor weather. Females on the other hand are mainly taken in the summer when they emerge after egg hatching. The seasonal change in proportion of males to females is evident in Figure 13.2.3(b) where males typically dominate in quarters one and four but the ratio is generally more even in quarters two and three. In 2016, males dominated in all quarters, but this was within the observed range of variation typically seen for this stock. The pattern was again fairly typical between 2017 and 2019, but in 2020 all quarterly sex ratios were majority male due to the decreased number of samples which were available for the year. Sampling was also reduced in 2021 & 2022, but an increased proportion of females was observed in quarter 2 for both years. This metric is used as an indicator, whereby increasing proportions of females in the catch might signal an effect of acute overfishing. In this case, however, the atypical sex ratios observed in 2020 (and to some degree 2021) are known to be due to poor sampling, and not a cause for concern to management. In 2023, the sex ratio has returned to follow the typical seasonal pattern.

Mean weights

The mean weights in the landings have fluctuated in this FU over the time-series. Between 2015 and 2018 there was a decreasing trend in this metric, but that trend has since given way to inter-annual variability with no obvious direction. Mean weight for FU13 is generally lower than other areas across the time-series (Table 13.2.3). There is a trend of higher mean weights in the samples of landings for creel catches compared to trawl landings, noticeable for both sexes in recent years. However, sampling levels are relatively low. Given the seasonal variation present in other FUs it is not possible to state with any certainty that this trend is real (Figures 11.2.4 and 11.2.5; see. Section 11 FU11 North Minch).

Discarding

Discarding of undersized and unwanted *Nephrops* occurs in the Clyde fishery, and discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 1990. Discard rates have been high in this FU and have averaged around 25% by number in this FU since 1999. Since 2010, discard rates have been estimated to be substantially lower than the long term average, and in 2018 were at the lowest rate in the time-series at only 2.5% (Table 13.2.2). The discard rate in FU13 increased substantially in 2019 to 19.1%. Due to an absence of discard sampling since 2020, a discard rate of 10.5% (<u>1.8%/26.8%</u>) was calculated based on a mean rate across all quarters 2017-2019, and allocated to all quarters in 2020-2022. Limited discard sampling in 2023 resulted in a discard rate being calculated from Quarter two Northern Irish sampling allocated to the Northern Irish fleet and a 10 year discard rate (2010-2019) being used to fill in the remainder of Quarter two and the other three Quarters. The discard rate (adjusted to account for survival) which will be used in the forecast was estimated by taking a three-year average 2021–2023, amounting to 12.8%.

Studies (Charuau *et al*., 1982; Sangster *et al*., 1997; Wileman *et al*., 1999) suggest that some *Nephrops* survive the discarding process. An estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard survival rate for creel caught *Nephrops* has been shown to be high (ICES, 2013) and a value of 100% is used.

Abundance indices from UWTV surveys

An underwater TV survey of the stock is conducted annually according to standards set out by the Manual for the Nephrops Underwater TV Surveys (Dobby *et al*., 2021). Surveys have been carried out in both subareas since 1995 although the Sound of Jura has been surveyed more infrequently. Underwater television surveys of *Nephrops* burrow distributions avoid the problems associated with traditional trawl surveys that arise from variability in burrow emergence of

Nephrops. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows. Full details of the UWTV approach can be found in the stock annex and the report of WKNEPH in 2009 (ICES, 2009). On average, 37 stations have been considered valid each year for the Firth of Clyde and 11 for the Sound of Jura. These are raised to the estimated ground area available for *Nephrops*; 2080 km^2 based on contoured superficial sediment information (British Geological Surveys).

In 2024, 40 valid stations were used in the final survey analysis for the Firth of Clyde (Table 13.2.3) and 12 stations for the Sound of Jura (Table 13.2.4). Table 13.2.5 shows a detailed breakdown of information from the most recent TV surveys conducted in the Firth of Clyde. This includes estimates of abundance and variability in each of the strata adopted in the stratified random approach. Details for the Sound of Jura are shown in Table 13.2.6. A CV (coefficient of variation, or relative standard deviation) of <20% is considered an acceptable precision level for UWTV survey estimates of abundance (SGNEPS, ICES, 2012). CVs for the three most recent TV surveys in Firth of Clyde and Sound of Jura are lower than the precision level agreed.

Figure 14.2.4 shows the distribution of stations in recent TV surveys (2013–2024) across FU13 (the two distinct subareas can be clearly seen) with the size of the symbols proportional to the *Nephrops* burrow density. Table 14.2.3 and Figure 14.2.5 show the time-series estimated abundance for the TV surveys in the Firth of Clyde, with 95% confidence intervals on annual estimates. Similar information for the Sound of Jura is shown in Table 13.2.4 and Figure 16.2.6. Most surveys have detected generally higher densities in the southern part of the Clyde.

The TV survey estimates of abundance for *Nephrops* in the Firth of Clyde suggest that the population increased until the mid-2000s implying a sustained period of increased recruitment. Following this, abundance has fluctuated around the values previously observed in the early 2000s. In 2023, the overall abundance decreased slightly but remained within recently observed ranges (Figure 14.2.5).

There is not a continuous time-series of abundance in the Sound of Jura and in some years (particularly 2002 and 2006) estimates are associated with large confidence intervals. Abundance has fluctuated with no obvious trend. In 2013, the abundance was at the second lowest point in the time-series. The abundance appeared relatively stable from 2017 until 2024 (Figure 13.2.6).

The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009; ICES, 2013). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative relative to absolute conversion factor estimated for FU13 was 1.19 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 19%.

13.4 Assessment

Comparison with previous assessments

The assessment in 2024 is based on a combination of examining trends in fishery indicators and underwater TV survey data, using an extensive data series for the Firth of Clyde component of FU13 and a more limited time-series of UWTV data from the Sound of Jura subarea. The assessment in 2024 follows that of previous years (since 2015) in that the commercial data for Clyde and Sound of Jura have been combined, because of concerns regarding the accuracy of the landings data. There are also no discard samples and limited market samples available for the Sound of Jura. Therefore, the harvest rate and catches for the two areas are presented as a combined total. *Nephrops* abundance will continue to be monitored separately, with a TV survey being conducted in both subareas where logistically possible.

State of the stock

The underwater TV surveys are presented as the best available information on the stocks of *Nephrops* in the two subareas of FU13. The surveys provide fishery-independent estimates of *Nephrops* abundance. At present, it is not possible to extract any length or age-structure information from the survey and it therefore only provides information on abundance over the area of the survey.

TV survey estimated stock abundance for the Firth of Clyde in 2024 was 1625 million individuals, an 8% increase from the 2023 estimate, well above the $B_{trigger}$ value of 580 million. The abundance estimate for the Sound of Jura in 2023 was 342 million individuals, a 7% increase from the 2023 estimate, but again above the $B_{trigger}$ value of 160 million.

The harvest rate for the FU13 in 2023 (dead removals for both subareas/ Firth of Clyde and Sound of Jura TV abundance = 14.2%) was below the F_{MSY} proxy value (the value associated with high long-term yield and low risk depletion) for the Clyde (15.1%), and the Sound of Jura (12.0%). Note the F_{MSY} proxy values for this stock were revised in October 2015 at WKMSYRef4 (ICES, 2016b).

13.5 Catch Scenarios

Landings predictions and catch scenarios at various harvest rates (based on principles established at WKNEPH (ICES, 2009)), will be made for Firth of Clyde and Sound of Jura on the basis of the 2024 UWTV survey conducted in June. These were presented in September 2024 for the provision of advice.

Catch scenario table inputs and historical estimates of mean weight in landings and harvest rates are presented in Table 13.2.2 and summarised below. The calculation of catch scenarios for the Firth of Clyde follows the procedure outlined in the stock annex.

The table below shows the agreed inputs to the catch scenarios table for FU13.

Variable	Value	Notes
Firth of Clyde stock abundance (2025)	1625	UWTV Survey 2024; individuals in millions
Sound of Jura stock abundance (2025)	342	UWTV Survey 2024; individuals in millions
Mean weight in projected landings (2025)	17.95	Average 2021–2023 (combined for the Firth of Clyde and the Sound of Jura); in grammes
Mean weight in projected discards (2025)	7.72	Average 2021–2023* (combined for the Firth of Clyde and the Sound of Jura); in grammes
Projected discard rate (2025)	12.8	Average 2021–2023* (combined for the Firth of Clyde and the Sound of Jura); percentage by number of the total catch
Discards survival rate (2025)	25	Percentage by number of the discards

* Based on mean discard rate (2010-2019) allocated to the Scottish fleet of Quarter two and all of the remaining Quarters for 2023.

13.6 Reference points

F_{MSY} proxy for this stock was revised in October 2015 at WKMSYRef4 (ICES, 2016a; ICES, 2016b). These were updated on the basis of an average of estimated F_{MSY} proxy harvest rates over a period of years, which corresponds more closely to the methodology for finfish. In cases where there is a clear trend in the values a five-year average was chosen. Similarly, the five-year average of the F at 95% of the YPR obtained at the F_{MSY} proxy reference point was proposed as the F_{MSY} lower bound and the five year average of the F above F_{MAX} that leads to YPR of 95% of the maximum as the upper bound. Using an average value also has the advantage of reducing the effect of any unusually high or low estimates of the F_{MSY} proxy, which occasionally appear. For this functional unit the F_{MSY} proxy has been revised to 15.1% for the Clyde and 12.0% for the Sound of Jura respectively.

For *Nephrops* stocks, MSY $B_{trigger}$ has been defined as the lowest stock size from which the abundance has increased and is calculated as 579 million individuals for the Firth of Clyde. The advice from WKMSYRef4 (ICES, 2016b) rounded this value to give an MSY $B_{trigger}$ of 580 million.

MSY $B_{trigger}$ was not previously proposed for FU13 (SJ) as there were few points in the survey series (due to missing years). WKMSYRef4 stated that the survey series is now considered to be of sufficient length to allow the B_{loss} (abundance in 1995) to be proposed as the MSY $B_{trigger}$. This results in a value of 160 million (ICES, 2016b). Full details are contained in the stock annex.

These should remain under review by WGCSE and may be revised should improved data become available.

Table 13.2.2 and Figure 13.4.1 show the estimated harvest rates over this period. The harvest rate was calculated from the total dead removals for both subareas divided by the combined abundance for the Firth of Clyde TV survey and the Sound of Jura. This does result in some years were the harvest rate is not calculable as we do not have a full time-series of TV surveys for the Sound of Jura. The combined harvest rate peaked in 2007 at 43.0% before declining to around the F_{MSY} level for the Clyde in 2010–2011. The harvest rate has fluctuated since then, increasing in 2021 to 20.6% from 9.4% in 2020 and has now decreased to 14.2% in 2023. It is unlikely that prior to 2006, the estimated harvest rates are representative of actual harvest rates due to under-reporting of landings.

13.7 Management strategies

Scotland has recently established a network of regional Inshore Fisheries Groups (rIFGs), non-statutory bodies that aim to improve the management of Scotland's inshore fisheries out to six nautical miles, and to give commercial inshore fishermen a strong voice in wider marine management developments. The rIFGs will contribute to regional policies and initiatives relating to management and conservation of inshore fisheries, including impacts on the marine environment and the maintenance of sustainable fishing communities and measures designed to better conserve and sustainably exploit stocks of shellfish and sea fish (including salmon) in their local waters. Although no IFG proposals specific to the management of *Nephrops* fisheries have yet been adopted, some of the IFG management plans for the Scottish West Coast include spatial management of *Nephrops* fisheries and the introduction of creel limits.

A weekend ban on mobile gear was introduced in the Clyde in 1986 under a Scottish Statutory Instrument. Mobile gear is banned in the Inshore Clyde from Friday night to Sunday night, as are vessels greater than 21 m in length.

On the 8th of February 2016, phase 1 of the fisheries management measures for inshore MPAs in Scottish waters came into force (SG, 2016). These measures relate to both NCMPA (Marine (Scotland) Act and the UK Marine and Coastal Access Act) and Special Areas of Conservation (EC Habitats Directives – Council Directive 92/43/EEC) both of which have the aim of conserving biological diversity in Scottish waters and along with other protected sites make up Scotland's MPA network (SG, 2017a). Although not specific to the management of the *Nephrops* fishery they will influence spatial patterns of fishing for *Nephrops* where controls on the two main gear types, demersal trawls and creels, are implemented on *Nephrops* habitat. There are three NCMPAs within the Clyde functional unit. The MPA, which extends onto the main patch of *Nephrops* habitat, is the South Arran NCMPA, within the Firth of Clyde subarea, where a complete ban on demersal vessels greater than 120 gross tonnage has been implemented. Partial closures (i.e. zoned management) for demersal trawlers smaller than this size and creelers are also in place. For Loch Sween, north of the main habitat area in the Sound of Jura subarea, demersal trawling by vessels is banned. However, for trawlers smaller than 75 gross tonnage, temporal closures are in place over some of the area. For the Upper Loch Fyne and Loch Goil NCMPA, just north of the main habitat area in Firth of Clyde subarea, demersal trawling by vessels greater than 75 gross tones is banned and the activity of vessels below this is zoned. Creeling activity is also zoned (SG, 2016). The areas of the NCMPAs relative to the estimated *Nephrops* habitat within the Clyde functional unit are presented in Figure 16.6.1.

13.8 Quality of assessment and forecast

There are concerns over the accuracy of historical landings and effort data and because of this the final assessment adopted is independent of official statistics. Harvest rates since 2006 are also considered more reliable due to more accurate landings data reported under new legislation.

One of the main issues for this FU is the problem of not being able to split the landings between the Sound of Jura and Firth of Clyde. This means that we are unable to provide harvest rates for the two subareas separately. What is currently provided is not actually a harvest rate for either sub area; but is likely more representative of the Firth of Clyde. This has an impact on the quality of the assessment but not on the forecast.

In recent years, the length and sex composition of the landings data is considered to be well sampled. However, in 2018 sampling levels fell below this normal standard. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in the Firth of Clyde subarea fishery since 1990, and is considered to represent the fishery adequately. There are few samples available from the Sound of Jura and these have been included in the FU13 raising procedure.

Discard sampling in 2023 has remained low since the COVID-19 pandemic, with no valid samples collected in Functional Unit 13 from the main contributor, the Marine Directorate. Estimates of discard rates for in the assessment were based on mean discard rates across quarters 1,3 and 4 from 2010-2019 and a split discard rate using available Northern Irish samples and the 10 year average in quarter 2 (see "InterCatch", above). This change is considered to have had minimal impact on the quality of the assessment because discard rates have been consistently low in recent years.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are stable throughout the series and relatively low compared with other FUs in area 6.a. In the provision of catch scenarios based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. A three-year average (2021–2023) of discard rate (adjusted to account for some survival of discarded animals) has been used in the calculation of catch advice.

The cumulative relative to absolute conversion factor estimates for FU13 component is largely based on expert opinion (see stock annex). The precision of these bias corrections cannot yet be characterised. The method to derive landings for the catch options is sensitive to the input dead discard rate and mean weight in landings and this introduces uncertainties in the catch forecasts. Precision estimates are needed for these forecast inputs.

The overall area of the ground is estimated from the available BGS contoured sediment data and at present is considered to be a minimum estimate. VMS data, recently made available and linked to landings (from queries of the Scottish FIN database) suggest no major differences between areas fished and the mud sediment maps. The inclusion of vessels smaller than 15 m would likely increase the fished area in some of the inshore locations, while in the Clyde the non-estimated sea loch areas are relatively small.

13.9 Recommendation for next benchmark

This stock was last benchmarked in 2009 (ICES, 2009). WGCSE recommends that the issue concerning the split of landings between Sound of Jura and the Firth of Clyde be examined when this stock is next proposed for benchmark process.

13.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES division level. Management at the Functional Unit level could provide controls to ensure effort and catch were in line with resources available. In this FU, the two subareas imply that additional controls may be required to ensure that the landings taken in each subarea are in line with the landings advice.

Creel fishing takes place in part of this area although the relative scale of the fishery is smaller than in the Minches. Overall effort in terms of creel numbers is not known, and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the Firth of Clyde and estimated discards of whiting and haddock by the TR2 fleet are generally high in area 6.a. It is important that efforts continue to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod include the implementation of large square meshed panels (SMPs) of 120 mm under the west coast emergency measures, and SMPs of 200 mm implemented as part of the previous Scottish Conservation Credits scheme. A seasonal closure (early spring) in the southwest part of the Firth of Clyde is in place to protect spawning cod although *Nephrops* vessels are derogated to fish in those parts where mud sediments are distributed.

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Table 13.1.1. ***Nephrops,*** **Clyde and Sound of Jura (FU13), ICES estimates of landings of** ***Nephrops*****, 1981–2023.**

UK SCOTLAND						OTHER UK	IRELAND	TOTAL**
YEAR	*NEPHROPS* TRAWL	OTHER	CREEL	BELOW MINIMUM SIZE	SUB TOTAL			
1981	2498	404	66	0	2968	0	0	2968
1982	2372	169	79	0	2620	0	0	2620
1983	3889	121	52	0	4062	14	0	4076
1984	3070	153	77	0	3300	10	0	3310
1985	3921	293	65	0	4279	7	0	4286
1986	4073	176	79	0	4328	13	0	4341
1987	2860	82	64	0	3006	3	0	3009
1988	3507	107	43	0	3657	7	0	3664
1989	2577	184	35	0	2796	16	0	2812
1990	2731	121	23	0	2875	34	0	2909
1991	2844	145	26	0	3015	23	0	3038
1992	2530	247	9	0	2786	17	0	2803
1993	3200	110	5	0	3315	28	0	3343
1994	2503	50	28	0	2581	49	0	2630
1995	3766	131	26	0	3923	64	0	3987
1996	3880	108	27	0	4015	42	0	4057
1997	3486	46	26	0	3558	63	0	3621
1998	4540	79	39	0	4658	183	0	4841
1999	3476	29	37	0	3542	210	0	3752
2000	3142	63	75	0	3280	137	0	3417
2001	2890	65	95	0	3050	132	0	3182
2002	3075	53	105	0	3233	151	0	3384
2003	2954	20	119	0	3093	80	0	3173
2004	2619	8	88	0	2715	258	0	2973
2005	3148	5	94	0	3247	148	0	3395
2006	4356	1	179	0	4536	244	0	4780
2007	6069	4	221	0	6294	366	0	6660

UK SCOTLAND						OTHER UK	IRELAND	TO-TAL**
YEAR	*NEPHROPS* TRAWL	OTHER	CREEL	BELOW MINIMUM SIZE	SUB TO-TAL			
2008	5320	3	184	0	5507	416	0	5923
2009	4304	1	191	0	4496	283	0	4779
2010	5162	5	211	0	5378	465	0	5843
2011	5664	9	219	0	5892	540	0	6432
2012	5617	4	203	0	5824	863	0	6687
2013	4708	4	212	0	4924	511	0	5435
2014	4770	1	258	0	5029	1178	0	6207
2015	4035	8	206	0	4249	898	0	5147
2016	4922	6	267	0	5195	1252	4	6447
2017	4195	3	263	0	4461	942	1	5403
2018	3574	13	253	0	3840	303	0	4143
2019	3834	3	265	0	4102	581	0	4683
2020	2869	10	225	0	3104	532	0	3636
2021	3813	50	245	0	4108	907	0	5015
2022	2626	120	251	0	2997	926	0	3923
2023	3175	126	227	0	3528	887	0	4415

Table 13.2.1. ***Nephrops,*** **Clyde (FU13), ICES estimated landings of *Nephrops*, in each of the subareas (Firth of Clyde and Sound of Jura 1981–2023).**

YEAR	UK LANDINGS		
	FIRTH OF CLYDE	SOUND OF JURA	ALL SUBAREAS
1981	2277	691	2968
1982	1983	637	2620
1983	3395	681	4076
1984	2600	710	3310
1985	3561	725	4286
1986	3228	1113	4341
1987	2408	601	3009
1988	3509	155	3664
1989	2595	217	2812
1990	2592	317	2909
1991	2654	384	3038
1992	2383	420	2803
1993	2766	577	3343
1994	2095	535	2630
1995	3692	295	3987
1996	3671	386	4057
1997	3135	486	3621
1998	4373	468	4841
1999	3423	329	3752
2000	3229	188	3417
2001	2979	203	3182
2002	3350	34	3384
2003	3154	19	3173
2004	2965	8	2973
2005	3388	7	3395
2006	4768	12	4780
2007	6580	80	6660

YEAR	UK LANDINGS		
	FIRTH OF CLYDE	SOUND OF JURA	ALL SUBAREAS
2008	5845	78	5923
2009	4688	91	4779
2010	5782	61	5843
2011	6363	69	6432
2012	6634	53	6687
2013	NA	NA	5435
2014	NA	NA	6207
2015	NA	NA	5147
2016	NA	NA	6447
2017	NA	NA	5403
2018	NA	NA	4143
2019	NA	NA	4683
2020	NA	NA	3636
2021	NA	NA	5015
2022	NA	NA	3923
2023	NA	NA	4415

Table 13.2.2. ***Nephrops*, Clyde (FU13): Firth of Clyde and Sound of Jura combined. Adjusted TV survey abundance (Firth of Clyde subarea), landings, discard rate (proportion by number) and estimated harvest rate. The harvest rate was calculated from the total (dead) removals in number for both subareas divided by the combined abundance from both TV surveys.**

YEAR	LANDINGS IN NUMBERS (MILLIONS)	DISCARD IN NUMBERS (MILLIONS)	REMOVALS IN NUMBERS (MILLIONS)**	ADJUSTED SURVEY CLYDE (MILLIONS)	ADJUSTED SURVEY JURA (MILLIONS)	COMBINED HARVEST RATE*	LANDINGS (TONNES)	DISCARDS (TONNES)	DEAD DISCARDS (TONNES)	DISCARD RATE (%)	DEAD DISCARD RATE (%)	MEAN WEIGHT IN LANDINGS (gr)	MEAN WEIGHT IN DISCARDS (gr)
1995	207	82	269	579	160	36.40	3987	619	464	28.4	22.90	19.24	7.54
1996	187	61	233	935	171	21.07	4057	635	476	24.7	19.70	21.68	10.35
1997	150	70	202	1198	NA	NA	3621	598	448	32	26.10	24.21	8.50
1998	269	187	409	1262	NA	NA	4841	1292	969	41	34.20	17.98	6.92
1999	216	93	286	930	NA	NA	3752	566	424	30.2	24.50	17.39	6.05
2000	171	48	207	1411	NA	NA	3417	470	352	22	17.40	19.96	9.75
2001	164	82	225	1486	272	12.80	3182	677	508	33.5	27.40	19.46	8.23
2002	207	50	245	1571	398	12.44	3384	406	305	19.5	15.40	16.35	8.12
2003	166	134	266	1817	260	12.81	3173	1247	935	44.7	37.70	19.13	9.31
2004	158	168	284	1970	NA	NA	2973	1435	1076	51.5	44.30	18.80	8.54
2005	189	69	241	1959	303	10.65	3395	611	458	26.8	21.60	17.96	8.81
2006	248	55	290	1851	430	12.71	4780	515	386	18.2	14.30	19.27	9.31
2007	350	387	640	1233	255	43.01	6660	2566	1924	52.5	45.30	19.05	6.64
2008	357	207	512	1769	NA	NA	5923	1433	1075	36.6	30.30	16.59	6.94
2009	261	169	388	1499	251	22.17	4779	1390	1043	39.3	32.70	18.31	8.23

YEAR	LANDINGS IN NUMBERS (MILLIONS)	DISCARD IN NUMBERS (MILLIONS)	REMOVALS IN NUMBERS (MILLIONS)**	ADJUSTED SURVEY CLYDE (MILLIONS)	ADJUSTED SURVEY JURA (MILLIONS)	COMBINED HARVEST RATE*	LANDINGS (TONNES)	DISCARDS (TONNES)	DEAD DISCARDS (TONNES)	DISCARD RATE (%)	DEAD DISCARD RATE (%)	MEAN WEIGHT IN LANDINGS (gr)	MEAN WEIGHT IN DISCARDS (gr)
2010	276	55	317	1750	376	14.91	5843	536	402	16.7	13.10	21.21	9.68
2011	333	74	388	2165	312	15.66	6432	568	426	18.2	14.30	19.34	7.65
2012	306	93	376	1421	371	20.98	6687	1066	800	23.4	18.60	21.83	11.42
2013	262	62	309	1990	198	14.12	5435	454	341	19	15.00	20.72	7.37
2014	295	78	353	1328	231	22.64	6207	696	522	20.9	16.60	20.79	8.92
2015	232	54	273	1820	376	12.43	5147	401	301	18.9	14.80	22.21	7.43
2016	364	69	416	1946	422	17.57	6447	636	477	15.9	12.40	17.70	9.21
2017	316	32	340	1568	306	18.1	5403	275	199	9.5	7.1	17.02	8.55
2018	268	7	273	2193	275	11.1	4143	68	51	2.5	1.9	16.14	9.79
2019	271	64	319	2083	318	13.3	4683	435	326	19.1	15	17.26	6.81
2020	195	23	212	1941	NA	9.4	3636	174	130	10.5	8.1	18.96	7.59
2021	328	38	356	1414	310	20.6	5015	292	219	10.5	8.1	15.27	7.59
2022	210	25	228	1665	241	12	3923	187	140	10.5	8.1	18.88	7.59
2023	224	47	259	1500	320	14.2	4415	377	283	17.5	13.7	19.69	7.97
2024	-	-	-	1625	342	-	-	-	-	-	-	-	-
Average***											12.8	17.95	7.72

*** Harvest rates previous to 2006 are unreliable. ** Removals numbers take the dead discard rate into account. *** Dead discard average: 2021–2023; Mean weight in landings and discard average: 2021–2023.**

Table 13.2.3. *Nephrops*, Clyde (FU13): Firth of Clyde subarea. Results of the 1995–2024 TV surveys (values adjusted for bias).

YEAR	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS / m²)	ABUNDANCE (MILLIONS)	95% CONFIDENCE INTERVAL (MILLIONS)
1995	29	0.277	579	176
1996	38	0.454	935	242
1997	31	0.571	1198	262
1998	38	0.605	1262	213
1999	39	0.445	930	289
2000	40	0.681	1411	246
2001	39	0.714	1486	268
2002	36	0.756	1571	288
2003	37	0.874	1817	292
2004	32	0.95	1970	367
2005	44	0.941	1959	287
2006	43	0.882	1851	257
2007	40	0.597	1233	218
2008	38	0.849	1769	291
2009	39	0.723	1499	210
2010	37	0.84	1750	327
2011	40	1.041	2165	305
2012	37	0.681	1421	227
2013	34	0.956	1990	246
2014	35	0.639	1328	237
2015	37	0.875	1820	351
2016	37	0.935	1946	249
2017	38	0.754	1568	239
2018	40	1.055	2193	297
2019	38	1.002	2083	381
2020	28	0.933	1941	297
2021	41	0.68	1414	211
2022	30	0.8	1665	316

YEAR	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS / m²)	ABUNDANCE (MILLIONS)	95% CONFIDENCE INTERVAL (MILLIONS)
2023	30	0.72	1500	314
2024	40	0.78	1625	271

Table 13.2.4. *Nephrops*, Clyde (FU13): Sound of Jura subarea. Results of the 1995–2024 TV surveys (values adjusted for bias).

YEAR	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS / m²)	ABUNDANCE (millions)	95% CONFIDENCE INTERVAL (millions)
1995	7	0.42	160	58
1996	10	0.45	171	26
1997	no surveys			
1998				
1999				
2000				
2001	13	0.71	272	76
2002	9	1.04	398	167
2003	12	0.68	260	68
2004	no survey			
2005	11	0.79	303	84
2006	10	1.13	430	134
2007	10	0.67	255	58
2008	no survey			
2009	12	0.66	251	68
2010	12	0.98	376	39
2011	12	0.82	312	73
2012	12	0.98	371	61
2013	9	0.52	198	35
2014	9	0.61	231	90
2015	12	0.98	376	127
2016	12	1.11	422	42
2017	12	0.80	306	71
2018	12	0.72	275	53

YEAR	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS / m²)	ABUNDANCE (millions)	95% CONFIDENCE INTERVAL (millions)
2019	12	0.832	318	61
2020	no survey			
2021	12	0.812	310	98
2022	12	0.632	241	71
2023	10	0.807	320	47
2024	12	0.895	342	48

Table 13.2.5. *Nephrops,* Clyde (FU13): Firth of Clyde subarea. Results by stratum of the 2022–2024 TV surveys. Note that stratification was based on a series of sediment strata (M – Mud, SM – Sandy mud, MS – Muddy sand).

STRATUM	AREA (km²)	NUMBER OF STATIONS	MEAN BURROW DENSITY (no./m²)	OBSERVED VARIANCE	ABUNDANCE (MILLIONS)	STRATUM VARIANCE	PROPORTION OF TOTAL VARIANCE	SURVEY PRECISION LEVEL (CV)
2022 TV survey								
M	716.8	13	0.84	0.094	602.4	3711	0.149	
SM	698.6	9	1.072	0.243	748.8	13169	0.527	
MS	664.6	8	0.471	0.147	313.4	8098	0.324	
Total	2080	30			1664.6	24978	1	0.088
2023 TV survey								
M	716.8	11	0.60	0.049	432	2271	0.092	
SM	698.6	9	0.858	0.245	599.4	13290	0.539	
MS	664.6	10	0.704	0.205	468	9078	0.368	
Total	2080	30			1499.4	24639	1	0.102
2024 TV survey								
M	716.8	14	0.724	0.111	519.3	4072	0.222	
SM	698.6	14	0.913	0.129	637.4	4495	0.245	
MS	664.6	12	0.705	0.266	468.7	9762	0.533	
Total	2080	40			1625.4	18329	1	0.082

Table 13.2.6. *Nephrops,* Clyde (FU13): Sound of Jura subarea. Results by stratum of the 2022, 2023, and 2024 TV surveys. Note that stratification was based on a series of sediment strata.

STRATUM	AREA (km2)	NUMBER OF STATIONS	MEAN BURROW DENSITY (no./m2)	OBSERVED VARIANCE	ABUNDANCE (MILLIONS)	STRATUM VARIANCE	PROPORTION OF TOTAL VARIANCE	SURVEY PRECISION LEVEL SURVEY (CV)
2022 TV survey								
M	90	2	0.626	0.01	56.3	42	0.033	
SM	150	5	0.676	0.011	101.3	47	0.037	
MS	142	5	0.59	0.287	83.8	1159	0.93	
Total	382	12			241.4	1247	1	0.162
2023 TV survey								
M	90	2	0.559	0.013	50.3	52	0.092	
SM	150	4	0.676	0.065	101.5	366	0.258	
MS	142	4	1.185	0.029	168.2	145	0.65	
Total	382	10			320	563	1	0.074
2024 TV survey								
M	90	2	0.681	0.001	61.3	5	0.009	
SM	150	4	0.979	0.04	146.9	224	0.385	
MS	142	6	0.943	0.105	133.9	352	0.606	
Total	382	12			342.1	581	1	0.081

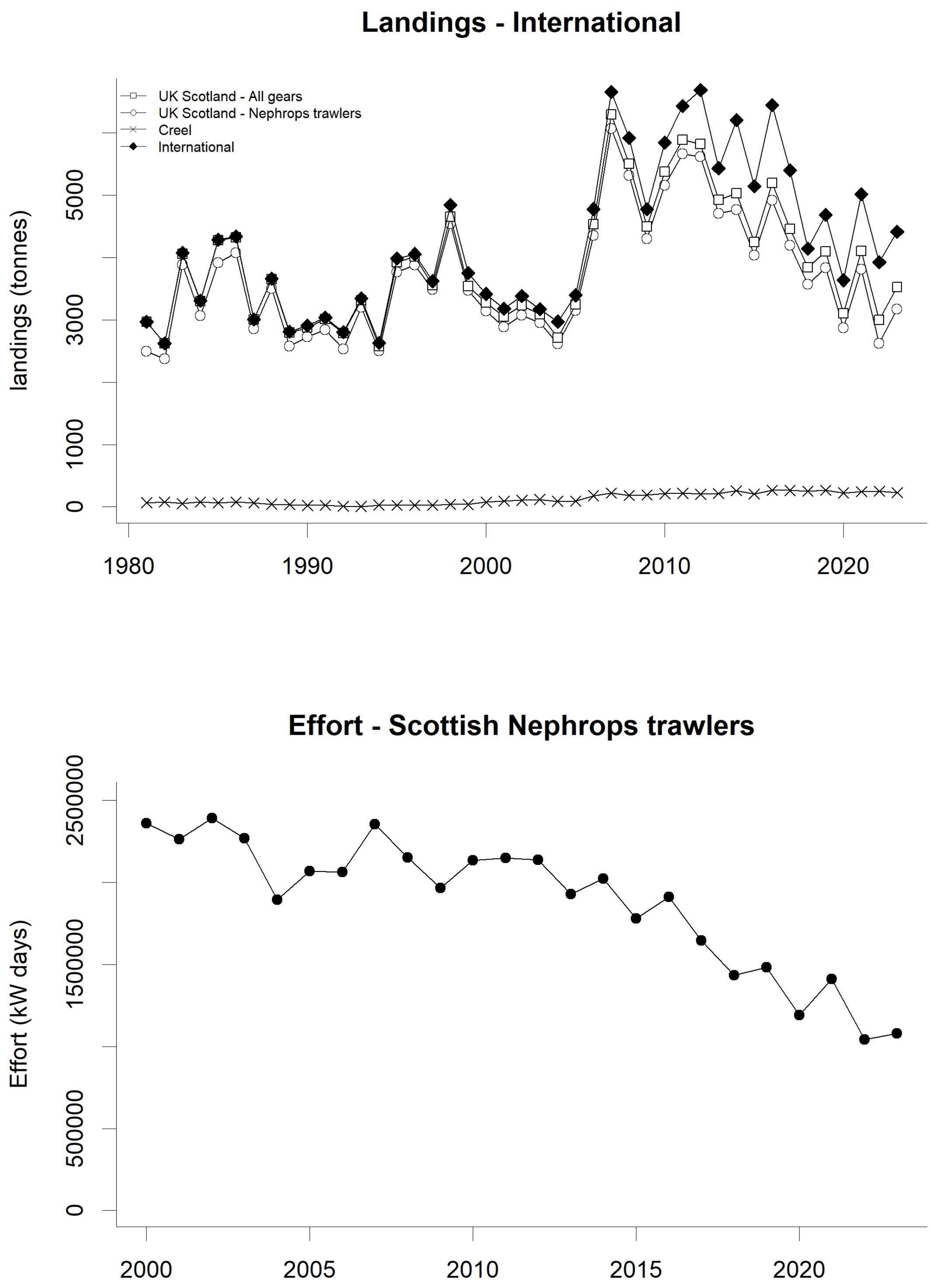


Figure 13.2.1. *Nephrops*, Clyde (FU13). Long-term landings and effort.

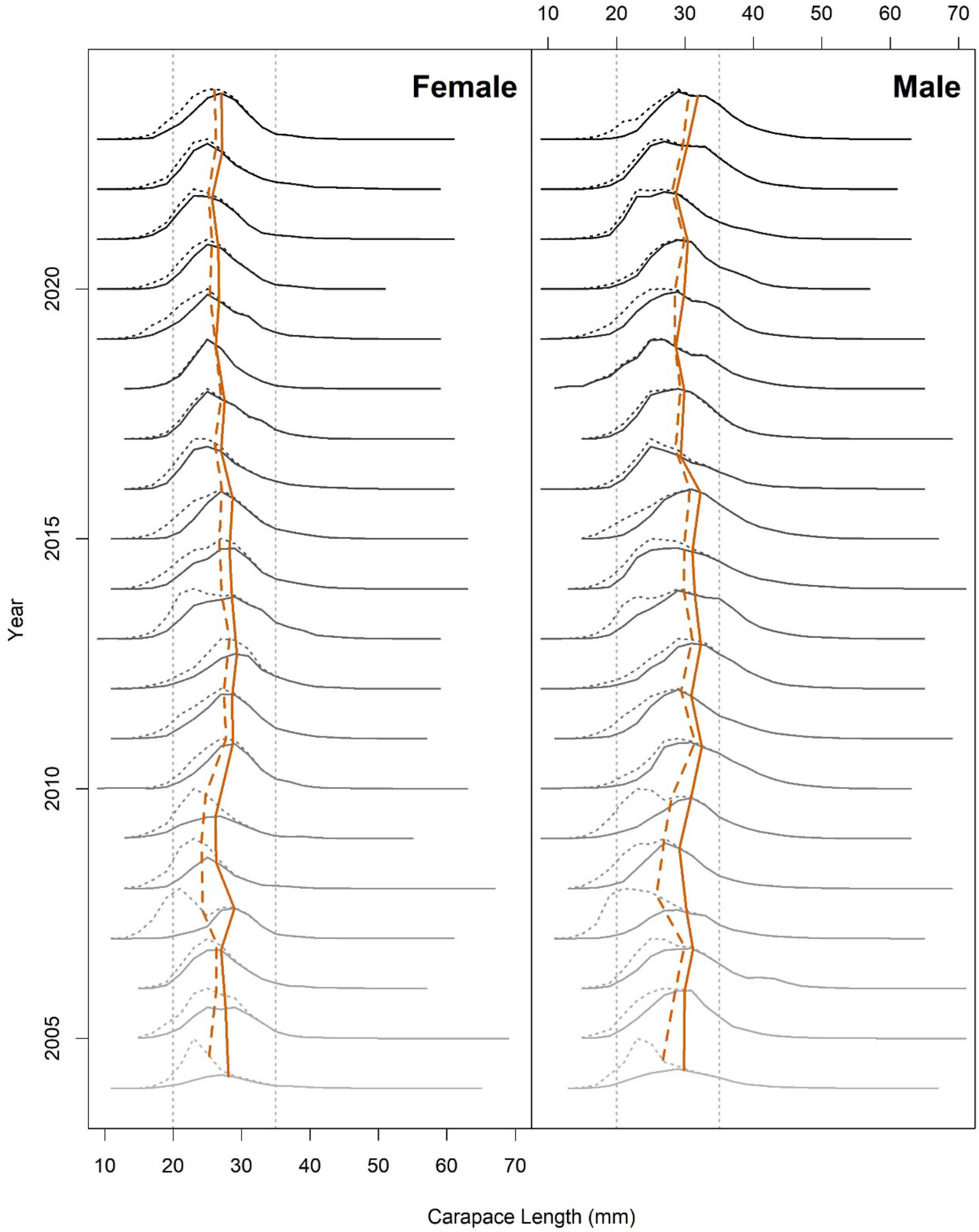


Figure 13.2.2. ***Nephrops,*** **Clyde (FU13). Catch length–frequency distribution (dotted) and landings (solid) for *Nephrops*, 2004–2023. Mean size in catches and landings are represented by solid and dashed *orange* lines, respectively. Vertical dotted lines are minimum conservation reference size (25 mm) and 35 mm.**

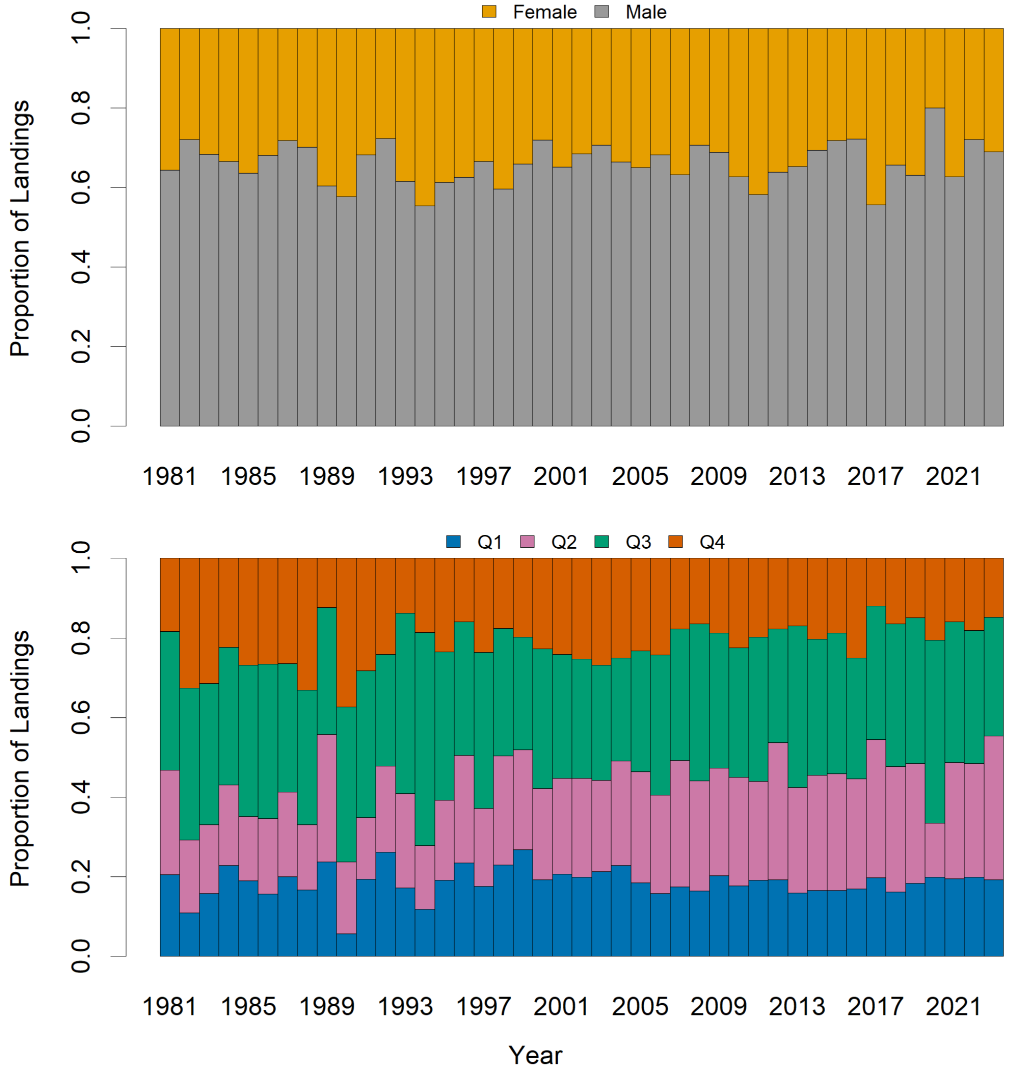


Figure 13.2.3. (a) *Nephrops*, Clyde (FU13). Proportion of landed weight by sex (*top*), by quarter (*bottom*) from Scottish trawlers.

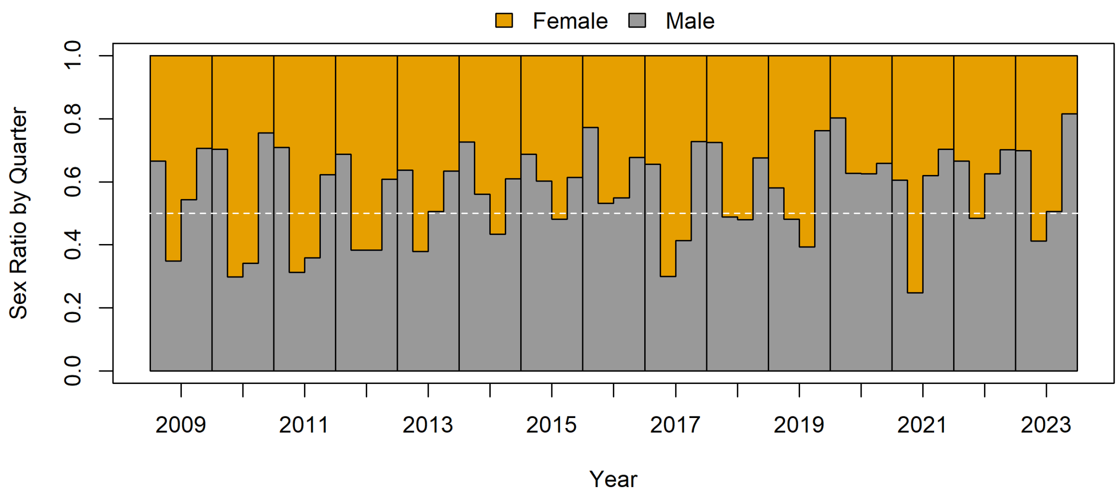


Figure 13.2.3. (b) *Nephrops,* Clyde (FU13), quarterly numeric proportions by sex (2009–2023).

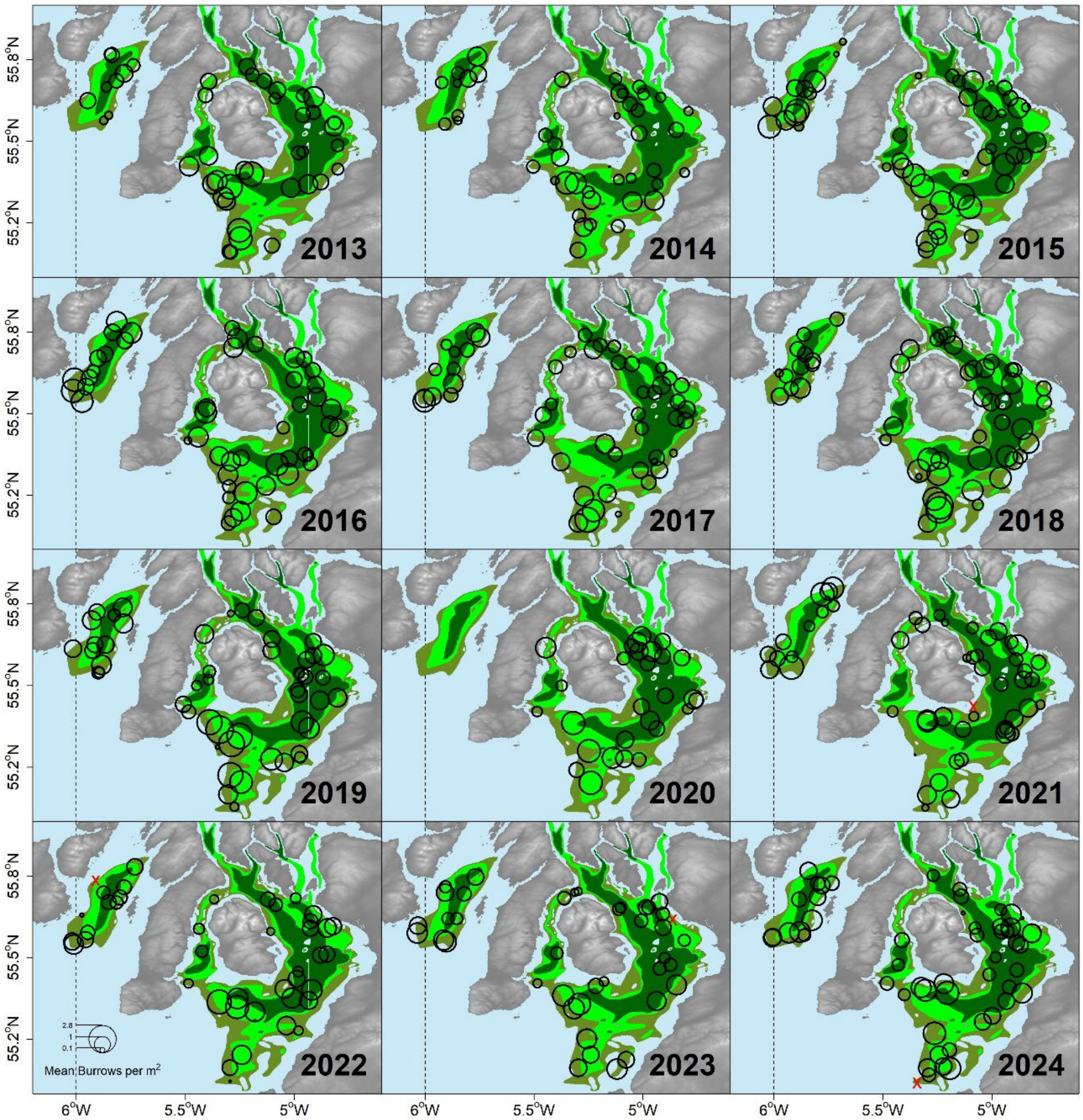


Figure 13.2.4. ***Nephrops*, Clyde (FU13), TV survey station distribution and density (mean burrows/m²) for Firth of Clyde and Sound of Jura subareas, 2013–2024. Sound of Jura located to the east. Shaded *green* and *brown* areas represent areas of suitable sediment for *Nephrops*. Bubbles scaled the same. *Red* crosses represent zero observations.**

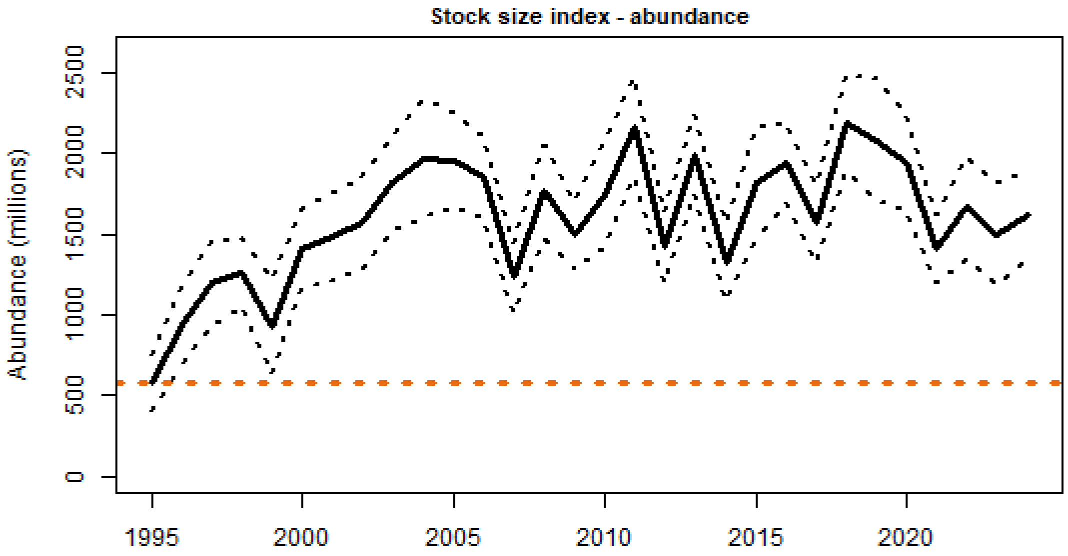


Figure 13.2.5. ***Nephrops*****, Clyde (FU13): Firth of Clyde subarea. Time-series of revised TV survey abundance estimates (adjusted for bias, *solid black line*), with 95% confidence intervals (*dotted black lines*), 1995–2024. The dashed red line is the rounded $B_{trigger}$ value of 580 million individuals.**

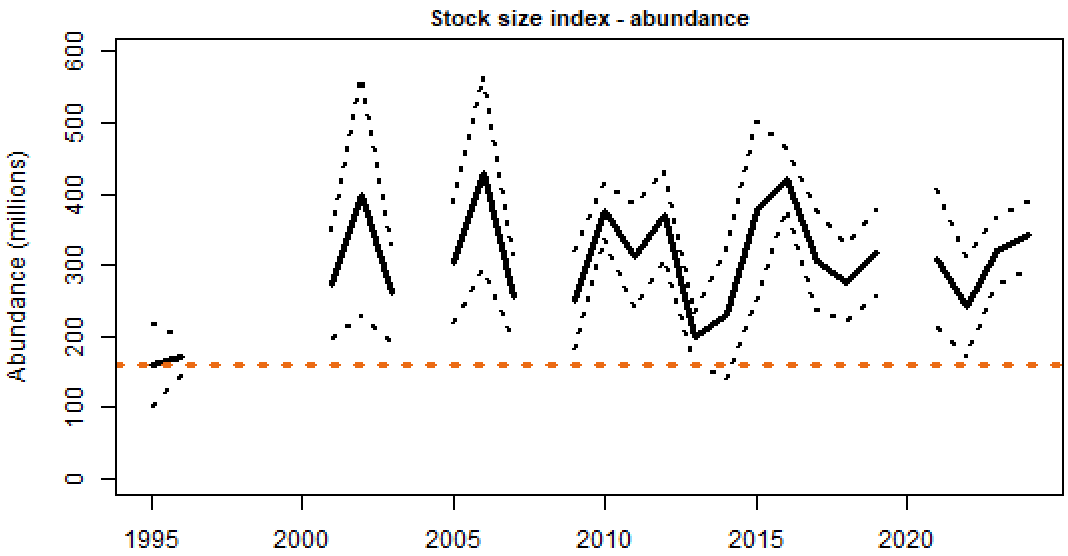


Figure 13.2.6. ***Nephrops*****, Clyde (FU13): Sound of Jura subarea. Time-series of TV survey abundance estimates (adjusted for bias, *solid black line*) with 95% confidence intervals (*dotted black lines*), 1995–2024. The dashed orange line is the rounded $B_{trigger}$ value of 160 million individuals.**

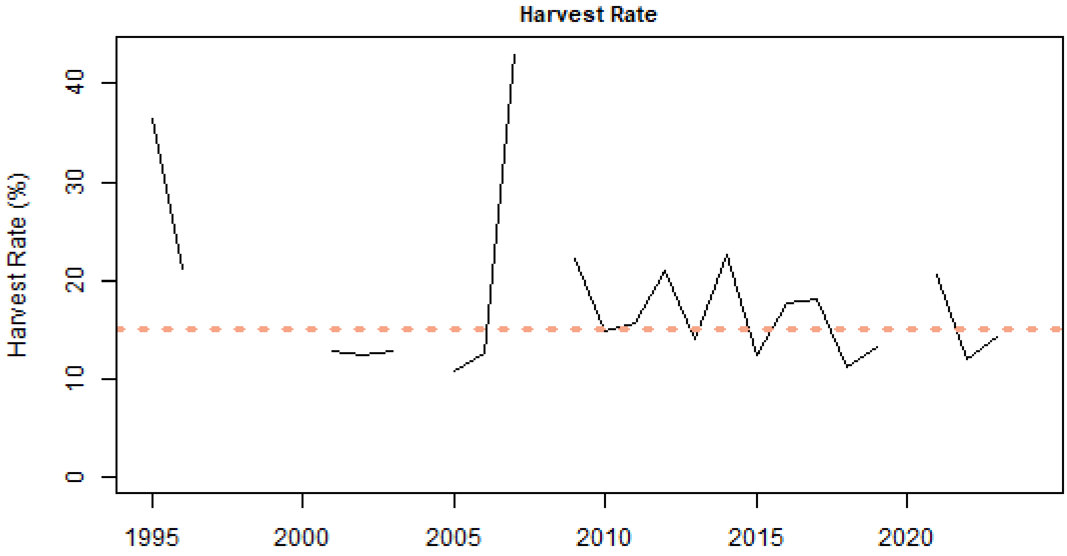


Figure 13.4.1. Clyde (FU13) *Nephrops* harvest rate, 1995–2023. The harvest rate is calculated by dead removals (both subareas combined)/TV abundances (both sub-areas combined). The dashed and solid lines are the F_{MSY} proxy harvest rate (for the Firth of Clyde 15.1%) and the time-series of estimated harvest rates, respectively. Harvest rates prior to 2006 are considered unreliable.

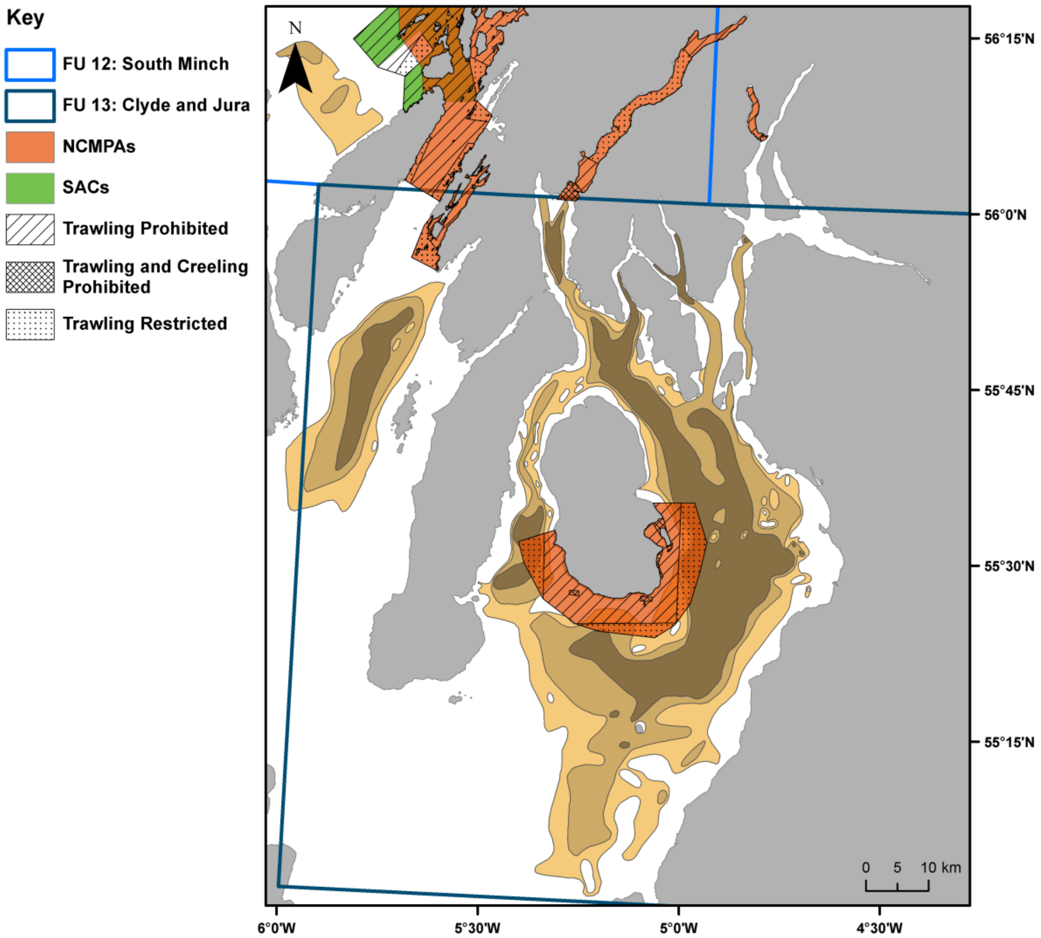


Figure 13.6.1. The area of *Nephrops* habitat (Mud, Muddy Sand and Sandy Mud) within the Clyde functional unit (FU13) relative to the areas of the Nature Conservation MPAs (NCMPAs) which fisheries management measures. Areas where demersal trawling is prohibited, restricted (i.e. vessel size restrictions or seasonal closures) and where creeling is prohibited are displayed. For more detailed information see SG (2016). Geographic Coordinate System: OSGB 1936, Datum: OSGB 1936, Projected Coordinate System: British National Grid. Coastline by Wessel and Smith (2016), MPA sites subsetted from NCMPA (SNH, 2015) and SAC (SNH, 2016) layers, management areas by SG (2017b) and functional units generated from merged ICES rectangles (ICES, 2017). Map and modified layers created using ArcGIS (ESRI, 2014).

Contents

14 Norway lobster (*Nephrops norvegicus)* in Division 7.a (Irish Sea East, FU14)

14.1 General

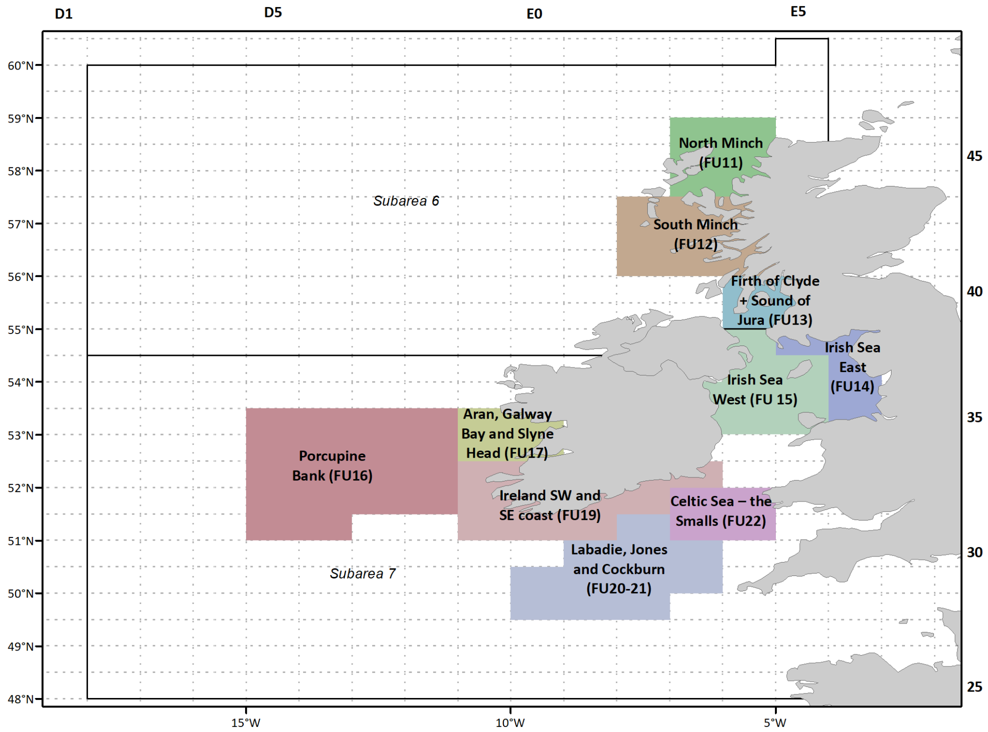
Stock description and management units

A TAC is in place for ICES Area 7 which does not correspond to the assessment units. As *Nephrops* are limited to muddy habitats the distribution of suitable sediment defines the species distribution and the stocks are therefore assessed as eight separate Functional Units. There are also some smaller catches from areas outside these Functional Units. The ICES statistical rectangles covered by the Functional Units in ICES Area 7 are listed in the table below.

FU no.	Name	ICES Divisions	ICES Statistical rectangles
14	Irish Sea East	7a	35–38E6; 38E5
15	Irish Sea West	7a	35E3, 36E3; 35–37 E4–E5; 38E4
16	Porcupine Bank	7b,c,j,k	31–35 D5–D6; 32–35 D7–D8
17	Aran Grounds	7b	34–35 D9–E0
18*	Northwest Irish Coast	7b	36–37 D9; 37E0–E1
19	Southeast and southwest Irish Coast	7a,g,j	31–33 D9–E0; 31E1; 32E1–E2; 33E2–E3
20-21	Labadie, Jones and Cockburn bank	7g,h	28 E0–E2; 29 E0–E3; 30E1–E3; 31E2
22	Smalls Ground	7g	31–32 E3–E4

* Landings from FU18 are reported to other statistical rectangles outside FUs as these are minimal. WGCSE will monitor FU18 landings in case of any fishery developments.

Nephrops Functional Units in Subarea 7 (FU 14–22, noting FU18 not shown). The TAC covers all of Subarea 7. (Note: Functional Units in Subarea 6 (FU 11–13) also shown):



Landings Obligation

All catches of this stock are subject to the landing obligation although there are some exemptions in place. For Subarea 7 there are survival exemptions covering catches with pots, creel or pots as well as for bottom trawls with mesh size equal to or larger than 70mm. In UK waters, bottom trawl mesh sizes between 70 and 99mm must also be used in combination with highly selective gear options. For a more detailed description of exemptions, please refer to Article 15(4)(b) of Regulation (EU) No 1380/2013 (EU 2021) and Under the Sea Fisheries (Amendment etc.) (No. 2) Regulations 2021 (UK 2021).

Minimum Conservation Reference Size (Minimum landing size)

Under the Landing Obligation, minimum landings sizes have been abolished. Instead a Minimum Conservation Reference Size (MCRS) for each species has been introduced. Unless exempt, *Nephrops* below the MCRS must be landed and may be sold but cannot go for human consumption. In most cases, the MCRS is the same as old MLS, being 25 mm carapace length (CL), approximating to 85 mm total length (TL) around Ireland (FUs 16–22); the MCRS is 20 mm CL (>70 mm TL) on the West coast (6.a, FUs 11–13) and the Irish Sea (7a, FUs 14–15).

The MCRS implemented for the Irish Sea at 20 mm CL is less than the rest of the ICES Area 7 (set at 25 mm CL) and applies to the Irish and UK fleets. A more restrictive regulation is adopted by the French Producers' Organisations (110 mm TL approximating to 35 mm CL) to all French trawlers.

Management applicable in 2023 and 2024

The TAC is currently set for the whole Area 7 with a special condition for Porcupine Bank (FU 16). The TAC for 2024 is set at 18,903 tonnes, which is an overall increase of 3% compared to the

18,353 tonnes set for 2023. The TAC area includes a number of *Nephrops* stocks showing different levels of exploitation. A single TAC covering a number of distinct stocks allows the possibility of unrestricted catches being taken from a heavily exploited stock when advice suggests they should be limited.

Details of all regulations including effort controls in place are provided in the stock annex for all functional units under this subarea.

Fishing opportunities for Norway lobster (*Nephrops norvegicus*) in Division 27.7, with specific restrictions for FU 16.

	Allowances 2023 (tonnes)		**Allowances 2024 (tonnes)**		**Change from 2023**	
	Division 27.7	**FU 16**	**Division 27.7**	**FU 16**	**Division 27.7**	**FU 16**
Spain	**981**	**1,142**	**991**	**1,375**	1%	20%
France	**3,974**	**715**	**4,018**	**861**	1%	20%
Ireland	**6,027**	**1,374**	**6,095**	**1,655**	1%	20%
Union	**10,982**	**3,231**	**11,104**	**3,891**	1%	20%
UK	**7,371**	**556**	**7,799**	**669**	6%	20%
TAC	**18,353**		**18,903**		3%	

Sources:

Council Regulation (EU) 2023/194 of 30 January 2023 fixing for 2023 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, as well as fixing for 2023 and 2024 such fishing opportunities for certain deep-sea fish stocks

Council Regulation (EU) 2024/257 of 10 January 2024 fixing for 2024, 2025 and 2026 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, and amending Regulation (EU) 2023/194

Table below gives the summary of reported landings by Functional Unit for ICES Area 7.

Year	FU 14 - Irish Sea East	FU 15 - Irish Sea West	FU 16 - Porcupine Bank	FU 17 - Aran Grounds	*FU 18 - Ireland Northwest Coast	FU 19 - Ireland Southwest and Southeast coast	FU 20–21 - Labadie, Jones, Cockburn	FU 22 - Smalls Grounds	FUs 20+21+22 - All Celtic Sea FUs combined	Other statistical rectangles Outside FUs	Total Landings ICES Subarea 7	TAC for 7
1978	961	7,296	1,744	481						249	10,731	
1979	900	8,948	2,269	452						237	12,806	
1980	730	4,578	2,925	442						205	8,880	
1981	829	7,249	3,381	414						382	12,255	
1982	869	9,315	4,289	210						234	14,917	
1983	763	9,448	3,426	131					3,667	174	17,609	
1984	602	7,760	3,571	324					3,653	187	16,097	
1985	498	6,901	3,919	207					3,599	194	15,318	
1986	671	9,978	2,591	147					2,638	113	16,138	
1987	449	9,753	2,499	62					3,409	107	16,279	24,700
1988	462	8,586	2,375	828					3,165	140	15,556	24,700
1989	401	8,128	2,115	347		899			4,005	134	16,029	26,000
1990	563	8,300	1,895	519		754			4,290	102	16,423	26,000
1991	747	9,554	1,640	410		1077			3,295	169	16,892	26,000
1992	427	7,541	2,015	374		888			4,165	409	15,819	20,000

Year	FU 14 - Irish Sea East	FU 15 - Irish Sea West	FU 16 - Porcupine Bank	FU 17 - Aran Grounds	*FU 18 - Ireland Northwest Coast	FU 19 - Ireland Southwest and Southeast coast	FU 20–21 - Labadie, Jones, Cockburn	FU 22 - Smalls Grounds	FUs 20+21+22 - All Celtic Sea FUs combined	Other statistical rectangles Outside FUs	Total Landings ICES Subarea 7	TAC for 7
1993	515	8,102	1,857	372	10	905	3,466	1,182		455	16,864	20,000
1994	447	7,606	2,512	729	126	390	4,202	941		570	17,523	20,000
1995	584	7,796	2,936	867	26	695	3,536	1081		397	17,917	23,000
1996	475	7,247	2,230	528	46	888	2,822	937		623	15,796	23,000
1997	566	9,971	2,409	841	15	756	2,038	944		340	17,880	23,000
1998	388	9,128	2,155	1,410	78	827	1,713	835		514	17,048	23,000
1999	624	10,786	2,289	1,140	16	579	1,152	1,775		322	18,683	23,000
2000	567	8,370	910	880	9	696	1,778	2,890		243	16,343	21,000
2001	532	7,441	1,222	913	2	815	1,833	2,938		368	16,064	18,900
2002	577	6,793	1,327	1,154	14	1,318	2,674	1,993		243	16,093	17,790
2003	376	7,052	1,064	933	16	1,239	2,953	2,065		186	15,884	17,790
2004	472	7,266	1,406	525	22	1,074	2,443	1,828		161	15,197	17,450
2005	570	6,529	2,197	778	15	712	2,469	2,533		180	15,983	19,544
2006	628	7,535	2,185	637	14	741	2,523	1,761		270	16,294	21,498
2007	959	8,424	2,074	913	3	957	2,419	2,950		206	18,905	25,153
2008	726	10,482	1,000	1,057	1	851	2,980	3,090		322	20,509	25,153

Year	FU 14 - Irish Sea East	FU 15 - Irish Sea West	FU 16 - Porcupine Bank	FU 17 - Aran Grounds	*FU 18 - Ireland Northwest Coast	FU 19 - Ireland Southwest and Southeast coast	FU 20–21 - Labadie, Jones, Cockburn	FU 22 - Smalls Grounds	FUs 20+21+22 - All Celtic Sea FUs combined	Other statistical rectangles Outside FUs	Total Landings ICES Subarea 7	TAC for 7
2009	693	9,166	879	626	10	868	3,145	2,185		316	17,888	24,650
2010	583	8,929	922	939	7	687	1,793	2,714		359	16,933	22,432
2011	561	10,159	1,278	659	13	643	1,237	1,636		110	16,296	21,759
2012	531	10,527	1,258	1,246	28	849	1,189	2,618		325	18,571	21,759
2013	495	8,672	1,141	1,295	0	794	1,387	2,257		194	16,235	23,605
2014	679	8,613	1,189	766	0	468	1,836	2,526		174	16,251	20,989
2015	378	8,632	1,394	370	0	507	2 116	2,350		80	15,827	21,619
2016	237	7,327	2,154	641	0	590	2 453	3,329		118	16,849	23,348
2017	265	6,149	2,632	295	0	420	1,849	3,560		137	15,307	25,356
2018	263	5,756	2,751	536	0	238	1,803	1,974		200	13,521	29,091
2019	270	7,590	2,251	167	0	249	2,723	2,083		216	15,549	19,784
2020	232	6,115	1,899	222	0	249	413	1,518		304	10,887	16,815
2021	519	6,779	2,476	498	0	415	697	1,616		346	13,346	18,026
2022	267	6,741	2,846	452	0	247	795	1,271		441	13,060	17,038
2023	304	6,791	3,011	411	0	260	1,442	1,242		457	13,918	28,353
Average	547	8,083	2,141	612	15	701	2,114	2,020	3589	266	15,765	22,197

***Landings from FU18 are reported to other statistical rectangles outside FUs as these are minimal since 2013. WGCSE will monitor FU18 landings in case of any fishery developments.**

Type of assessment in 2024

This stock was inter-benchmarked in September 2015 (ICES, 2015) and the assessment and provision of advice through the use of the UWTV survey data and commercial fishery data follows the process defined by the inter-benchmark process and described in the stock annex (updated at WGCSE 2023). The UWTV survey undertaken in the summer 2024 forms the basis of advice for this stock.

ICES advice published 31 October 2023

"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 2016–2022, catches in 2024 should be no more than 222 tonnes.

To ensure that the stock in Functional Unit (FU) 14 is exploited sustainably, management should be implemented at the FU level.

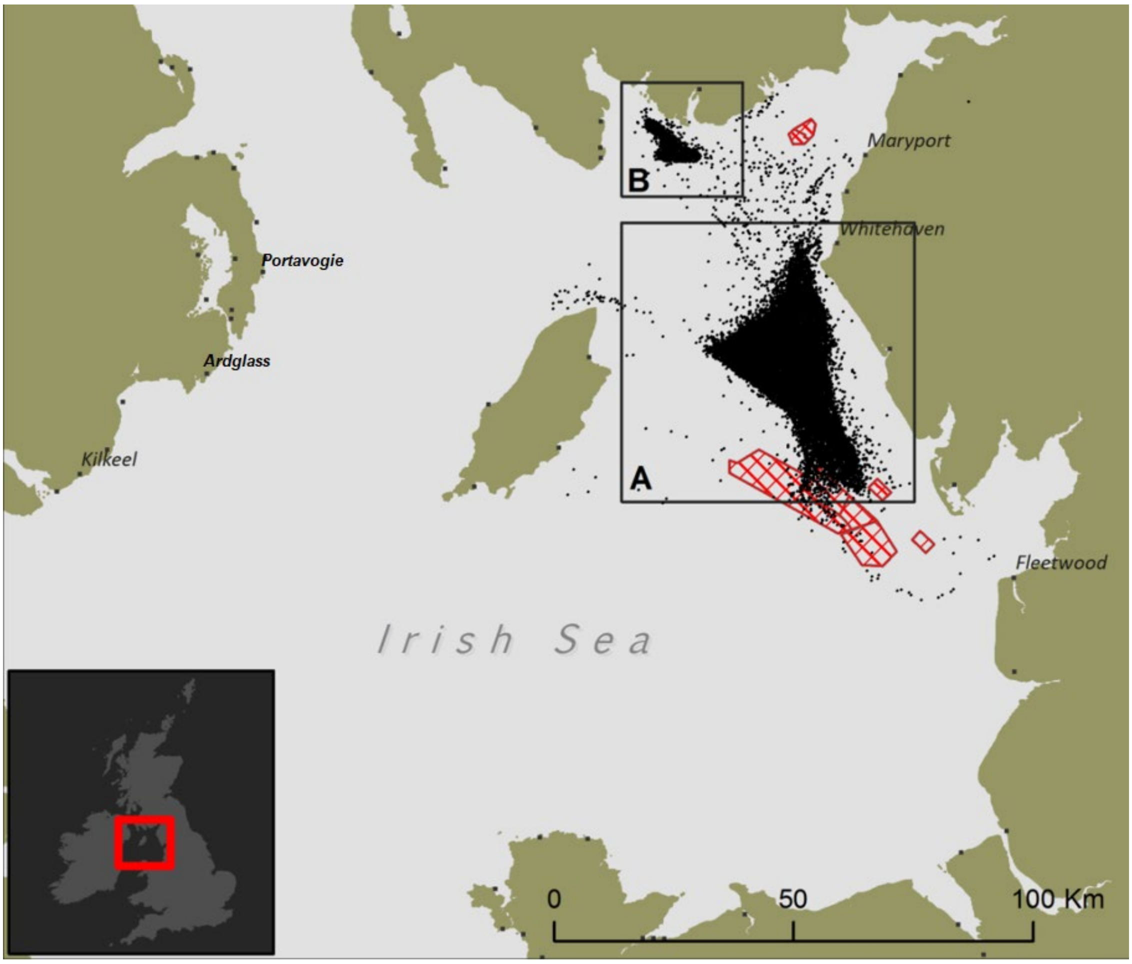
ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 7. ICES considers this plan to be precautionary when implemented at the FU level."

14.2 General

Stock description and management units

The Irish Sea East *Nephrops* stock (FU14) is in ICES Subarea 7 and comprises ICES rectangles 38E5, 38E6, 37E6, 36E6, 35E6.

In FU 14 *Nephrops* are caught on two spatially discrete grounds. Most of the fishery takes place on the main ground located between the West coast of England and Isle of Man, additionally there is also fishing activity in a small inshore ground known as Wigtown Bay.



East Irish Sea fishing grounds: A= Main fishing ground; B= Wigtown bay area. Windfarms represented by red polygons. (Source: ICES, 2015).
Main landing ports: Kilkeel, Portavogie, Ardglass, Whitehaven, Maryport

Fishery in 2023

The Eastern Irish Sea *Nephrops* fishery is relatively small compared to other FUs in the TAC area. Landings have been generally declining since 2009 (Table 15.2), with an isolated high of 679 tonnes in 2014 and a subsequent high of 519 tonnes in 2021. Lows were 237 and 232 tonnes in 2016 and 2020, respectively. Landings in 2023 were 304 tonnes.

The fishery in FU 14 is dominated by UK vessel activity, on average accounting for 91% of the reported annual international landings since 2000. Since 2021, only UK vessels have reported landings from FU 14. In 2023, 82% of landings went into England (up from 58% in 2022), 18% went into Northern Ireland (down from 41% in 2022) and <1% went into Scotland (down from 1% in 2022).

The main fleets targeting *Nephrops* include single- and twin-rig otter trawlers operating out of ports in England, Wales, Northern Ireland, and historically from the Republic of Ireland. In 2023, the TR2 gear class (otter trawls with 70 – 99 mm mesh sizes) accounted for 97% (100% in 2022) of the landings; 3% (<1% in 2022) of landings were reported from the TR1 gear class (otter trawls with >= 100 mm mesh sizes) and <1% were from MIS (miscellaneous) gear classes.

A more detailed historical fishery description is provided in the stock annex.

Information from stakeholders

No additional information was provided.

14.3 Data

InterCatch

Data for 2023 were successfully uploaded to InterCatch prior to the WGCSE 2024 meeting. According to the usual allocation procedure, English landings are allocated to English samples, Northern Irish landings are allocated to Northern Irish samples, and all remaining landings are allocated to pooled English and Northern Irish samples. Due to the impacts of the Covid-19 pandemic, no samples were available for 2020. For 2021, only samples from Northern Ireland were available and these were allocated to all 2021 landings. For 2022 and again in 2023, only samples from England were available and these were allocated to all landings during each of those years. Raising and averaging of sampling data was examined at WGCSE 2023 and documented in the stock annex.

Landings

Official landings as reported to ICES from FU14 are presented in Tables 14.1 and 14.2. There are reported landings for this functional unit since 1973 with a minimum and maximum of 178.7 t (in 1974) and 960.5 t (in 1978) respectively. Between 1987 and 2006 landings from FU 14 appeared relatively stable fluctuating around a long-term average of about 550 t. The introduction of the UK Buyers and Sellers legislation in 2006 precludes direct comparison with previous years, as reported levels are considered to have significantly improved. Over the period 2007–2020, landings have declined considerably from the peak year of 2007 (959 t); landings in 2020 were the lowest in the period (232 t). There were no reported discards in 2020 and discarding (15 t) was estimated based on 2017–2019 rates. In 2023, landings were 304 tonnes (up from 267 tonnes in 2022), all into the UK. Reported and estimated discards totalled 18 tonnes (down from 6 tonnes in 2022).

Effort

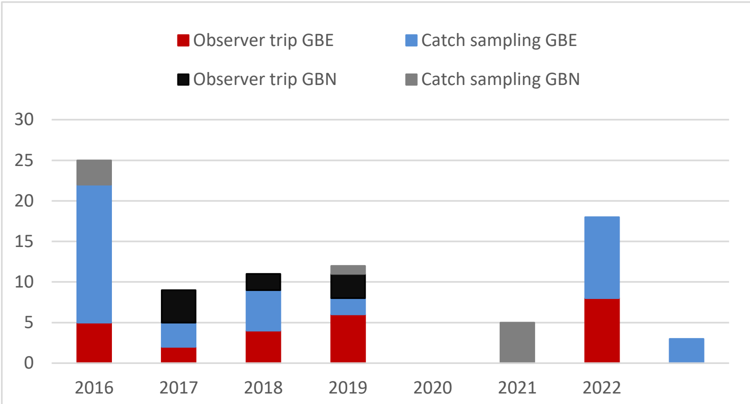
Following discussions at WGCSE, it was concluded that effort should be reported in the WGCSE report in kWdays, and LPUE should be reported in kg/kWdays in the knowledge that the trend is likely to be a biased underestimate because it is not adjusted for efficiency or behavioural changes. Effort calculations are likely to have been unreliable prior the introduction of the Buyers and Sellers legislation in 2006 by the UK and improvement in landings reporting.

Total UK and Irish targeted effort (70-99mm mesh with >30% *Nephrops* by weight) and LPUE is reported in Table 15.3 and shown in Figure 15.2. Until 2020, there was a general decline in targeted effort since 2007 (although 2014 did see a small rise in effort compared to 2013). After 2020, effort has been more variable. Targeted effort tripled in 2021 compared to 2020; in 2022 , it then halved compared to 2021; then it increased in 2023 by approximately a quarter compared to 2022.

Within the UK targeted metier, there are significant differences between sub-fleets and changes in fleet composition may therefore unduly influence catch rate metrics. These issues need to be examined further.

Sampling Levels

Sampling levels, data aggregating and raising procedures were reviewed by IBPNeph 2015, documented in the stock annex, and examined further at WGCSE 2018 and at WGCSE 2023. Recent sampling levels have fluctuated; prior to 2016 sample data have only been available from landings into England, however since 2016 samples have also been available from landings into Northern Ireland. In 2020, there was no sampling activity from the fishery due to impact of the Covid-19 pandemic. For 2021, only Northern Irish samples were available. In 2022 and 2023, only English samples were available.



Number of observer trips on English and Northern Irish vessels, as well as the number of shore-based catch samples.

Commercial length–frequency distributions

The raised catch length distributions are shown in Figure 14.3. Mean individuals weights and carapace lengths are listed in Table 14.4. The mean sizes for both sexes from 2008 fluctuate considerably. For 2020, the mean individual weights and carapace lengths of *Nephrops* were estimated from the average of 2017-2019 values. On the basis of Northern Irish samples, the mean weight and carapace length in landings decreased in 2021 compared with the 2017-2019 values whereas mean weight and carapace length in discards increased. On the basis of English samples since, this effect was reversed in 2022, with mean weight and carapace length increasing in landings and decreasing in discards; mean weight and carapace length in the landings decreased once more in 2023. The averaging period was increased from 3 years to a time series average from 2016 during WGCSE 2023 in order to reduce year effects and is described further in the stock annex.

Length composition

Between 2010 and 2012, sampling levels are considered insufficient to reliably characterise the length composition of extractions. Increased sampling levels from 2013 onwards have allowed for length compositions to be constructed. For 2013 and 2014, a full revision was done through an inter-benchmark process (ICES, 2015; described in the stock annex). Data aggregating and raising procedures from 2015 to 2017 were conducted according to benchmark procedures (ICES, 2005) and referred in the stock annex. These were revised during WGCSE 2018 to account for Northern Irish sampling data since 2016 and are described further in the stock annex. No sampling activity was possible during 2020 due to the effects of COVID-19 pandemic and length composition data from 2017 to 2019 were again used to generate mean sizes. In 2021, the only samples were from Northern Ireland, which were allocated to all landings. In 2022 and 2023, the only samples were from England, which were allocated to all landings for each of the respective years.

Sex ratio

Mature females are mainly caught in the non-berried state between moulting (which peaks in May), and spawning (which peaks in September). Females mature at about 23 mm carapace length. (Thomas and José Figueiredo, 1965).

The catch sex ratio by year is shown in Figure 14.5. The ratio is quite variable but average sex ratio is 57% male (1999–2023). Sex ratio was estimated as an average of 2017 – 2019 sampling for 2020. In 2023, the male sex ratio was 57%, up from 46% in 2022.

Mean weight explorations

The annual mean weight estimate for landings and discards is provided in Table 14.4 and in Figure 15.6. There is a substantial difference between the mean weights prior to 2011 and after 2013 (the gap being where sampling was too low to be reliable). Since 2016, Northern Irish sampling has been included and the mean weight of Northern Irish samples is considerably lower than for English sampling (e.g. for 2017-2019, mean weight of landings from English sampling was 30.9 g compared to 15.2 g in Northern Irish sampling). As a result, comparison with years prior to 2016 is not practical. Mean weights over the years 2016–2019 have been variable without trend. Mean weights were not estimated directly for 2020 due to no sampling. Northern Irish sampling resumed in 2021 but without complementing English sampling; English sampling resumed from 2022, but has been without complementing Northern Irish sampling since. Due to the smaller sizes in the Northern Irish samples, compared with the English samples, the mean individual weights and sizes for these three years need to be treated with scepticism.

Discarding

Discard selection was revised at the IBP process in 2015 (ICES, 2015) and described in the stock annex. Figure 14.4 shows a single discard ogive fitted by pooling all years (2003–2014) and mesh sizes. Final discard selection for the East Irish Sea shows a L50= 23.54 and a L25=24.77 mm CL (Figure 14.4), which shows a selectivity at higher sizes compared with FU15. Due to high interannual variation in mean sizes of both landings and discards, the discard ogive has not since been updated using later data.

Table 14.5 gives raised international landings and discard weight and numbers by year.

At IBPNeph (ICES, 2015), it was agreed that the discard survival rate should be updated from 0% to 10%. Although there are no direct survivability studies available for this area, it is expected that the survivability of discarded animals should be similar to the fishery in FU15 where fishing practices are similar and both are largely spring/summer fisheries and animals discarded are exposed to warmer temperatures before being returned to the sea.

Abundance indices from UWTV surveys

Since August of 2007, the UK has carried out an underwater TV survey of the *Nephrops* grounds in the eastern Irish Sea. The survey is of a fixed grid design and is carried out using the same protocols used in UWTV surveys in the western Irish Sea (ICES, 2007; ICES, 2014, Dobby H., *et al*, 2021). The survey stations used in 2024 are presented in Figure 15.7.

Due to the construction of the windfarm in the southern part of the ground the survey area was reviewed at IBP 2015, but the protocols and standardised process to run the survey were not modified (see stock annex and IBP 2015 report ICES, 2015). The new survey area (based on a co-kriging model) is shown in Figure 14.8. The boundary used to define the ground limits for absolute abundance runs close to the outer survey stations.

Ground	Area Km²	Source
Main ground 2008–2010	1032.75	WGCSE 2008
Main ground 2011–2019	1019.79	IBP 2015 – ICES, 2015
Wigtown Bay	67.21	IBP 2015 – ICES, 2015

Wigtown Bay in relation to Main ground = 6.6% * (increase from 1.9% prior to the windfarm construction).

Abundance indices were revised back to 2011, the year where the effect of effort displacement is clearly visible due to the windfarm construction. Final updated burrow density estimates are presented in Table 14.6 and visualised in Figure 14.9 where the geo-spatial model was updated using the new area based on the co-kriging approach (1019.79 km²) and the extrapolation to Wigtown Bay using 6.6%.

The surveys show a clear spatial distribution pattern, with highest densities in the centre of the patch and more variable in the areas further north and south. The grounds are fairly well delineated by consistently low-density ground to the west (Figure 14.9). CVs over the entire time-series (Table 14.6) are within the accepted precision level of 20% (ICES, 2012).

The abundance estimate for 2024 (222 million) is an increase of 16% compared to the 2023 figure of 191 million (Figure 14.10), 51% lower than the 2008–2023 average of 452 million and 37% lower than the $MSY_{Btrigger}$ value of 350 million.

Following the largest year-on-year change in abundance in the time series between 2022 and 2023, and following ICES survey protocols (Dobby H., *et al*. 2021), a review of the 2022 and 2023 survey footage was presented at WGCSE 2024. This showed no significant changes in abundances from the two surveys.

The use of the UWTV surveys for the provision of *Nephrops* management advice was extensively reviewed by WKNEPH (2009). A number of potential factors were highlighted including those due to edge effects; species burrow misidentification and burrow occupancy. Using the same process adopted at WKNEPH, a cumulative absolute conversion factor for this FU was predicted to be 1.2 for FU 14 (see stock annex) which means the TV survey is likely to overestimate *Nephrops* abundance by 20%. The burrow abundances shown in Table 14.5 and Figure 14.9 have been adjusted using this conversion factor since 2008.

In 2021, a new survey camera system was implemented using high-resolution stills-based footage, generally resulting in improved picture and burrow definition. Comparison of the old and new systems in other survey areas (FU 16 and FU 20-21 combined) has shown no significant difference in density estimates and previous assumptions relating to correction factors are still applied.

14.4 Assessment

Comparison with previous assessments

The methods normally used are in line with WKNEPH (ICES, 2009) and the approach taken by WGCSE for other *Nephrops* stocks in Subareas 27.6 and 27.7. This approach was inter-benchmarked at IBPNeph (ICES, 2015) and is described in the stock annex. Deviations from the standard procedure were required due to the lack of sampling data in 2020. As a result, WGCSE 2021 carried out the assessment for this stock using the same three-year average (2017–2019) for weights and discarding rates as for the 2020 assessment. There has been limited sampling for 2021 (Northern Ireland only) and for 2022 and 2023 (England only) and the current assessment was carried out by WGCSE 2024 using the average weights and discarding rates are based on 2016 to 2023 sampling data. UWTV surveys were carried out uninterrupted and as usual. Therefore, the 2024 abundance value was used for the assessment in 2024, according to the established procedure.

State of the stock

UWTV abundance estimates suggest that the stock size has historically fluctuated between abundance values of 191 and 694 million *Nephrops*. The 2024 estimate (222 million) increased by 16% in relation to 2023 and is 37% below MSY $B_{trigger}$ (350 million). Table 14.5 and Figure 14.11 summarise the abundance estimated including the confidence intervals and the harvest ratios (% total removed / UWTV abundance) which have been below the F_{MSY} proxy.

14.5 Catch scenarios table

Catch scenarios table inputs and historical estimates of mean weight in landings and harvest ratios are presented in Table 14.5 and summarised below. The calculation of catch options for FU14 follows the procedure outlined in the stock annex. The basis for the catch options:

Variable	Value	Notes
Stock abundance (2025)	222	UWTV survey 2024; individuals in millions
Mean weight in projected landings (2025)	20.42	Average 2016—2023*; in grammes
Mean weight in projected discards (2025)	9.02	Average 2016—2023*; in grammes
Projected discard rate (2025)	12.5	Average 2016—2023*; percentage by number of the total catch
Discards survival rate	10	Percentage by number of the discards

***no sampling in 2020**

14.6 Reference points

Reference points were defined for this stock at the IBPNeph (ICES, 2015) and proposals for F_{MSY} ranges made by WKMSYRef4 (ICES, 2016a; 2016b).

Based on the fact that some biological parameters are poorly known; inconsistent biological sampling; uncertainties about the stability of the stock over the reference period and uncertainties about the variability of recruitment it is expected that a combined sex $F_{0.1}$ is a suitable F_{MSY} proxy for this stock. This corresponds to a harvest rate of 11% and this value is expected to deliver high long-term yield with a low probability of recruitment over-fishing. These calculations assume that the UWTV survey has knife-edge selectivity at 17 mm and that the supplied length frequencies represented the population in equilibrium.

Historically, harvest rates have been consistently below the F_{MSY} proxy. The observed harvest rate in was relatively higher in 2021 than in previous years due to increased landings. Lower landings contributed to a lower harvest rate in 2022. In 2023, the harvest rate was 8.6% based on slightly higher landings and a lower stock abundance. Average harvest rate over the previous three years is 6.7%.

At the IBPNeph, a MSY $B_{trigger}$ value was defined for this stock. According with this definition, $B_{trigger}$ was set for FU14 as 350 million, corresponding to the previous lowest observed abundance estimate from the UWTV time-series, which occurred in 2009.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	350 million individuals	The lowest observed abundance estimate from the UWTV survey time-series.	ICES (2015)
	F_{MSY}	11% harvest rate	F_{MSY} proxy equivalent to $F_{0.1}$ for combined sexes.	ICES (2015)
	F_{MSY} lower	9.1% harvest rate	Average of the F at 95 % of the YPR obtained at the F_{MSY} proxy reference point	ICES (2016b)
	F_{MSY} upper	11% harvest rate	Average of the F above F_{MAX} that leads to YPR of 95 % of the maximum; capped at F_{MSY}	ICES (2016b)

14.7 Management strategies

There are no explicit management strategies for this stock.

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to Norway lobster (*Nephrops norvegicus*) by functional unit in ICES Subarea 7 and also demersal stocks. The plan specifies conditions for setting fishing opportunities, depending on stock status and making use of the F_{MSY} ranges. There is no agreement between the EU and UK regarding this plan, and it is not used as the basis for the advice for this stock. ICES provides catch scenarios consistent with the F_{MSY} ranges in the MAP.

14.8 Quality of assessment and forecast

The quality of landings data has improved since 2012, but concerns over the accuracy of earlier years limits the period we can be confident about regarding trends in LPUE and landings.

Underwater TV surveys have been conducted annually for this stock since 2007. The quality of the data from the first survey and the limited number of valid stations in the survey limits the number of useable surveys to 2008–2023.

In 2021, the survey camera system and reviewing method changed. Comparison of the old and new systems in Functional Unit 16 has shown no significant difference in density estimates. However, previous assumptions relating to correction factors are still being applied despite some input parameters (such as field of view) now being different. This should be reviewed at WGNEPS.

A revised algorithm is now used to derive distance covered by the sledge is considered significantly more robust than the previous algorithm. However, comparison of the distances covered by the sledge and ship has shown no significant differences and hence ship position continues to be used for consistency with historic surveys.

The IBP 2015 managed to address key points:

- Revisions to the area of the *Nephrops* grounds based on new available data: VMS, UWTV data and sediment information.
- A review of fishery data and raising procedures.
- Review of Reference points: F_{MSY} proxies and MSY $B_{trigger}$.

After this revision the quality of the assessment improved. Although there are still specific uncertainties and assumptions that need to be examined further for the East Irish Sea before less conservative F_{MSY} proxies could be considered.

There are several key uncertainties and bias sources in the method proposed (these are discussed further in ICES, 2009a). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (ICES, 2007; ICES, 2008; ICES, 2009b). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate but no more precise (ICES, 2009a).

The field of view of the camera system has fluctuated in recent years and this is expected that this will have influenced the correction factor and will reviewed at a forthcoming Nephrops surveys (WGNEPS) working group.

The cumulative absolute conversion factor estimates for FU14 are largely based on expert opinion. However, these were based on experience on other grounds and relatively limited experience on these grounds which would make this less reliable. The precision of these cannot yet be characterised. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates.

The effect of this assumption on realised harvest rates has not been investigated but remains a key uncertainty.

14.9 Recommendation for next benchmark

This stock was last benchmarked by IBPNeph (ICES, 2015). WGCSE will keep the stock under close review and recommend future benchmark as required.

At IBP 2015, it was mentioned that there are specific uncertainties and assumptions that need to be examined further for the East Irish Sea before less conservative F_{MSY} proxies could be considered.

- More accurate mapping of the spatial extent of the grounds and fisheries, this includes having positional data for <12 metre vessels and more survey data in Wigtown Bay area to better define this ground. Station grid was extended to Wigtown Bay in 2016.
- For now the total abundance estimate for FU14 is based on the abundance estimates of the geospatial model for the main ground plus adding the area of Wigtown Bay. As this area is becoming a more significant fishing patch it is worth to consider the use of a separate geospatial model in this ground. This should be explored in a future benchmark work.
- Improvement of spatial coverage and sampling of landings and discards, this includes increasing the sampling levels to cover Northern Irish vessels. Northern Irish sampling has been included in the assessment since 2018
- Area specific length–weight and maturity data to validate the parameters used for this FU.

- Temporal changes in condition (length-weight factors). Fixed condition factors are currently used for this stock however they have demonstrated a slight decreasing trend over the sampling time series.
- Better knowledge of the difference in growth and population structure across the area.
- Following the 2022 advice, after which there was a high uptake recommended catches (78% of F_{MSY}), the stock decreased in 2023 to well below MSY $B_{trigger}$. The basis for setting MSY $B_{trigger}$ is currently from recent history and may be therefore be too high. Current low abundance could also be due to recent low recruitment (transitory issue) or that the F_{MSY} is too high. As such, the $MSY_{trigger}$ reference point needs to be looked into. It was noted that the basis for MSY $B_{trigger}$ was the recent history and that the value may be too high.
- Advice is compiled for ADGNEPH in October. Lagged (one year) TV survey gives good correlation with LPUE, could this be used to calculate harvest rate rather than the in-year ratio?

14.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES division level. Management at the Functional Unit level could allow effort and catch to be controlled in line with the scale of the resource.

There are no explicit recruitment indices.

The UWTV survey data allow for the provision of catch options and also to adopt the MSY approach. The UWTV surveys are conducted annually and a benchmark process has been adopted in 2015. In the past this stock has only been assessed biannually. These data provide the opportunity to reassess this stock more reliably on an annual basis.

14.11 References

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14.12 Tables and Figures

Table 14.8.1. Irish Sea: Landings (tonnes) by FU. In 2012 and 2013 landings outside FU for Area 7a were not provided, so have been calculated from ICES official landings for 7a minus the FU areas.

YEAR	FU14	FU15	OTHER	TOTAL
2000	567	8370	1	8938
2001	532	7441	3	7976
2002	577	6793	1	7371
2003	376	7052	3	7431
2004	472	7267	25	7764
2005	570	6554	103	7227
2006	628	7561	52	8241
2007	959	8491	83	9533
2008	676	1050	122	11306
2009	708	9198	57	9963
2010	582	8963	23	9568
2011	561	10162	61	10784
2012	531	10527	208	11266
2013	495	8672	89	9256
2014	679	8613	NA	9292
2015	378	8632	NA	9010
2016	237	7327	9	7564
2017	265	6149	0	6414
2018	268	5756	0	6024
2019	270	7590	4	7864
2020	232	6115	7	6354
2021	519	6779	20	7318
2022	267	6741		
2023	304	6796	15	7115

Table 14.8.2. Irish Sea East (FU14): Landings (tonnes) by country of landing and total discards.

Year	Rep. Of Ireland	UK	Other Countries	Total Landings	Discards
2000	114	451	2	567	80
2001	26	506	0	532	42
2002	203	373	1	577	42
2003	69	306	1	376	11
2004	62	409	1	472	28
2005	34	536	0	570	33
2006	34	594	0	628	22
2007	86	873	0	959	47
2008	29	652	0	681	37
2009	16	692	0	708	6
2010	45	538	0	583	9
2011	31	530	0	561	0
2012	53	478	0	531	0
2013	35	460	0	495	38
2014	31	648	0	679	35
2015	88	290	0	378	18
2016	21	216	0	237	20
2017	7	258	0	265	28
2018	5	263	0	263	9
2019	9	260	0	270	15
2020	23	209	0	232	15*
2021	0	519	0	519	58
2022	0	267	0	267	6
2023	0	304	0	304	18

*** Based on 2017-2019 discard rates**

Table 14.3. Irish Sea East (FU14): Effort data for the UK and Irish trawl *Nephrops* directed fleet.

	UK direct fleet			Irish direct fleet		
YEAR	EFFORT (KW DAYS)	LANDINGS (TONNES)	LPUE	EFFORT (KW DAYS)	LANDINGS (TONNES)	LPUE
2006	343,249	577.2	1.7	6,932	18.3	2.8
2007	443,319	854.4	1.9	25,309	79.2	3.1
2008	366,696	628.9	1.7	8,136	14.9	1.9
2009	354,210	680.1	1.9	5,516	13.1	2.5
2010	296,097	527.3	1.8	13,496	44.6	3.3
2011	252,607	525.7	2.1	8,955	29.7	3.6
2012	215,851	452.4	2.1	21,224	52.8	2.6
2013	210,108	445.1	2.1	11,304	35.5	3.1
2014	279,606	636.8	2.3	10,259	28.5	2.8
2015	132,751	275.7	2.1	27,128	83.7	3.1
2016	109,449	214.9	2.0	9,496	21.2	2.2
2017	101,657	252.4	2.5	2,620	6.7	2.6
2018	113,740	245.8	2.2	3,042	5.2	1.7
2019	94,606	248.1	2.6	3,591	8.7	2.4
2020	61,747	203.1	3.3	7,660	22.9	3.0
2021	178,301	506.0	2.8	-	0	-
2022	88,341	266.1	3.0	-	0	-
2023	107,604	290.5	3.0	-	0	-

Table 14.4. Irish Sea East (FU14): Mean size (CL) and weight combined by sex for total annual landings and discards and proportion discarded.

Year	Mean CL (mm) Landings	Mean CL (mm) Discards	Mean Weight (g) Landings	Mean Weight (g) Discards	Proportion discarded
2000	29.83	22.32	19.05	7.52	0.26
2001	30.59	22.74	20.87	7.97	0.17
2002	30.64	23.75	22.41	8.98	0.15
2003	33.69	22.43	29.12	7.62	0.10
2004	31.01	22.24	21.93	7.57	0.15
2005	30.74	23.16	21.48	8.44	0.13
2006	32.36	22.75	25.07	7.98	0.10
2007	31.81	21.92	23.94	7.33	0.14
2008	31.07	23.14	22.88	8.49	0.13
2009	35.57	23.21	36.49	8.58	0.04
2010*					
2011*					
2012*					
2013	30.14	22.43	19.94	7.87	0.16
2014	31.01	24.34	22.37	9.60	0.11
2015	32.05	22.57	25.19	7.82	0.13
2016 **	27.39	23.11	15.82	8.38	0.14
2017	29.05	24.07	18.97	9.50	0.18
2018	30.58	24.46	21.39	9.78	0.07
2019	29.49	22.90	20.93	8.40	0.12
2020 ***	29.71	23.81	20.43	9.23	0.12
2021 ****	29.35	24.09	18.19	9.75	0.17
2022 *****	32.78	23.24	26.69	8.61	0.07
2023 *****	30.54	23.33	20.94	8.69	0.13

*** Values for 2010, 2011 and 2012 are not reliable due to poor sampling.**

**** Values for 2016 revised at WGCSE 2018 due to inclusion of Northern Irish sampling in 2016 and 2017.**

***** No sampling in 2020; values for 2020 are based on 2017-2019 averages**

****** Only Northern Irish samples for 2021**

******* Only English samples for 2022 and 2023**

Table 14.5. Irish Sea East (FU14): Sumary table for forecast inputs and historical estimates of raised landings and discards, mean weight in landings and harvest rate.

Year	Landings in number millions	Total discards in number millions	Removals in number millions	Dead Discard Rate number %	Discard Rate number %	UWTV abundance estimate millions	95% Confidence Interval	Harvest rate %	Landings tonnes	Total discards* tonnes	Mean weight in landings gramme	Mean weight in discards gramme
2000	30	11	40	24.4	26.4				567	80	19.05	7.52
2001	26	5	31	15.5	17.0				532	42	20.87	7.97
2002	26	5	30	14.1	15.4				577	42	22.41	8.98
2003	13	1	14	9.0	9.9				376	11	29.39	7.64
2004	22	4	25	13.5	14.8				472	28	21.93	7.57
2005	275	4	30	11.8	13.0				570	33	21.48	8.44
2006	25	3	28	9.2	10.1				628	22	25.07	7.98
2007	40	6	46	12.5	13.8				959	47	23.94	7.33
2008	30	4	34	11.6	12.7	408	63	8.2	676	37	22.88	8.49
2009	19	1	20	3.3	3.7	350	76	5.7	707	6	36.49	8.58
2010						422	103		582			
2011						449	99		561			
2012						694	99		531			
2013	25	5	30	15.0	16.4	487	82	6.0	495	39	19.94	7.87
2014	30	4	34	9.8	10.8	449	92	7.5	679	32	22.37	9.60
2015	15	2	17	11.9	13.0	591	86	2.9	378	18	25.19	7.82
2016*	15	2	17	12.4	13.6	430	106	4.0	237	20	15.82	8.38
2017	14	3	17	16.2	17.6	580	89	2.9	265	29	18.97	9.50
2018	12	1	13	6.3	6.9	514	118	2.6	263	9	21.39	9.78
2019	13	2	14	11.1	12.2	399	69	3.6	270	15	20.93	8.40
2020 **	11	2	13	11.2	12.3	496	84	2.6	232	15	20.43	9.23
2021	29	6	34	15.8	17.2	393	78	8.6	519	29	18.19	9.75

Year	Landings in number	Total discards in number	Removals in number	Dead Discard Rate number	Discard Rate number	UWTV abundance estimate	95% Confidence Interval	Harvest rate	Landings	Total discards*	Mean weight in landings	Mean weight in discards
	millions	millions	millions	%	%	millions		%	tonnes	tonnes	gramme	gramme
2022	10	1	11	6.3	7.0	386	110	2.8	267	6	26.69	8.61
2023	15	2	17	11.8	12.9	191	41	8.6	304	18	20.94	8.69
2024						222	8					

Note: Abundance is adjusted by using a cumulative absolute conversion factor of 1.2. Abundance (millions) including Wigtown Bay (1.9% 2008–2010; 6.6% 2011–2019). Due to poor sampling no estimates for 2010–2012.

*** Values for 2016 revised at WGCSE 2018 due to inclusion of Northern Irish sampling in 2016 and 2017.**
**** Removals for 2020 calculated using 2020 landings and unweighted average of mean weights from 2017-2019.**

Table 14.6. *Nephrops*, Irish Sea East (FU14): Results of the 2008–2020 TV surveys (values adjusted for bias).

Year	No valid stations	Mean Kriged density (no./m²)	Abundance (millions) including Wigtown Bay (1.9% 2008–2010)	Abundance (millions) including Wigtown Bay (6.6% 2011–2018)	95% CI	CV
2007			Unreliable data			
2008	32	0.38	408		63	
2009	32	0.33	350		76	
2010	26	0.4	422		103	
2011	26	0.41		449	99	11.2%
2012	26	0.64		694	99	7.3%
2013	31	0.45		487	82	8.5%
2014	34	0.41		449	92	10.4%
2015	42	0.54		591	86	7.4%
2016	48	0.40		430	106	12.6%
2017	45	0.53		580	89	7.8%
2018	46	0.47		514	118	11.7%
2019	41	0.37		399	69	9.3%
2020	43	0.46		496	84	8.6%
2021	44	0.36		393	78	10.1%
2022	46	0.38		386	110	14.6%
2023	40	0.18		191	41	10.8%
2024	45	0.20		222	8	1.7%

Note: Abundance is adjusted by using a cumulative absolute conversion factor of 1.2. Abundance (millions) including Wigtown Bay (1.9% 2008–2010; 6.6% 2011–2020).

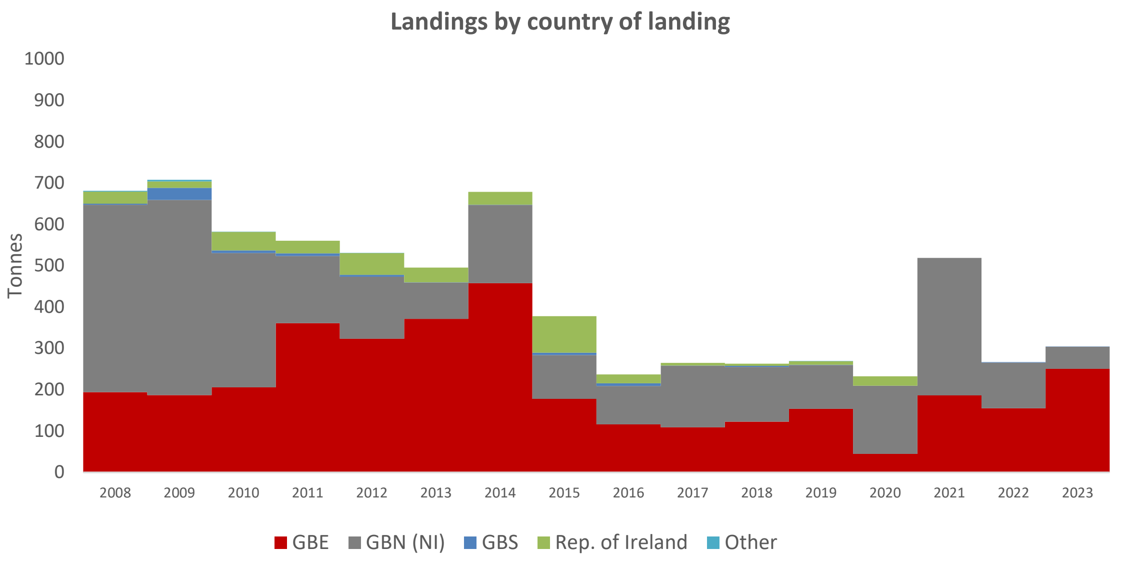


Figure 14.1. Irish Sea East (FU14): Landings in tonnes by country. GBE=England; GBN=Northern Ireland; GBS=Scotland; Rep. of Ireland=Republic of Ireland.

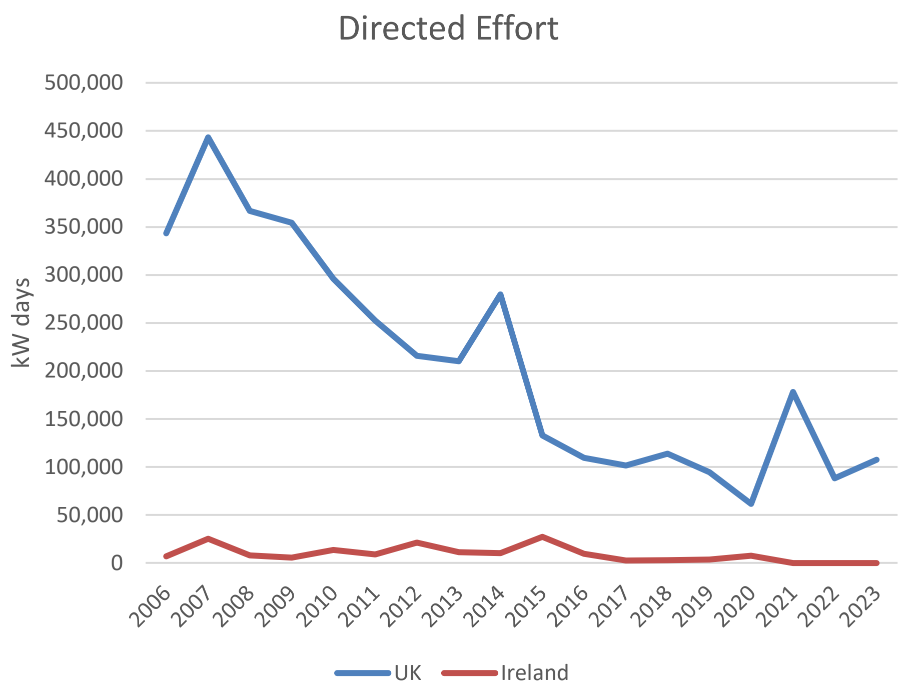


Figure 14.2. Irish Sea East (FU14): Effort data (KW days) for UK and Irish directed *Nephrops* fleet.

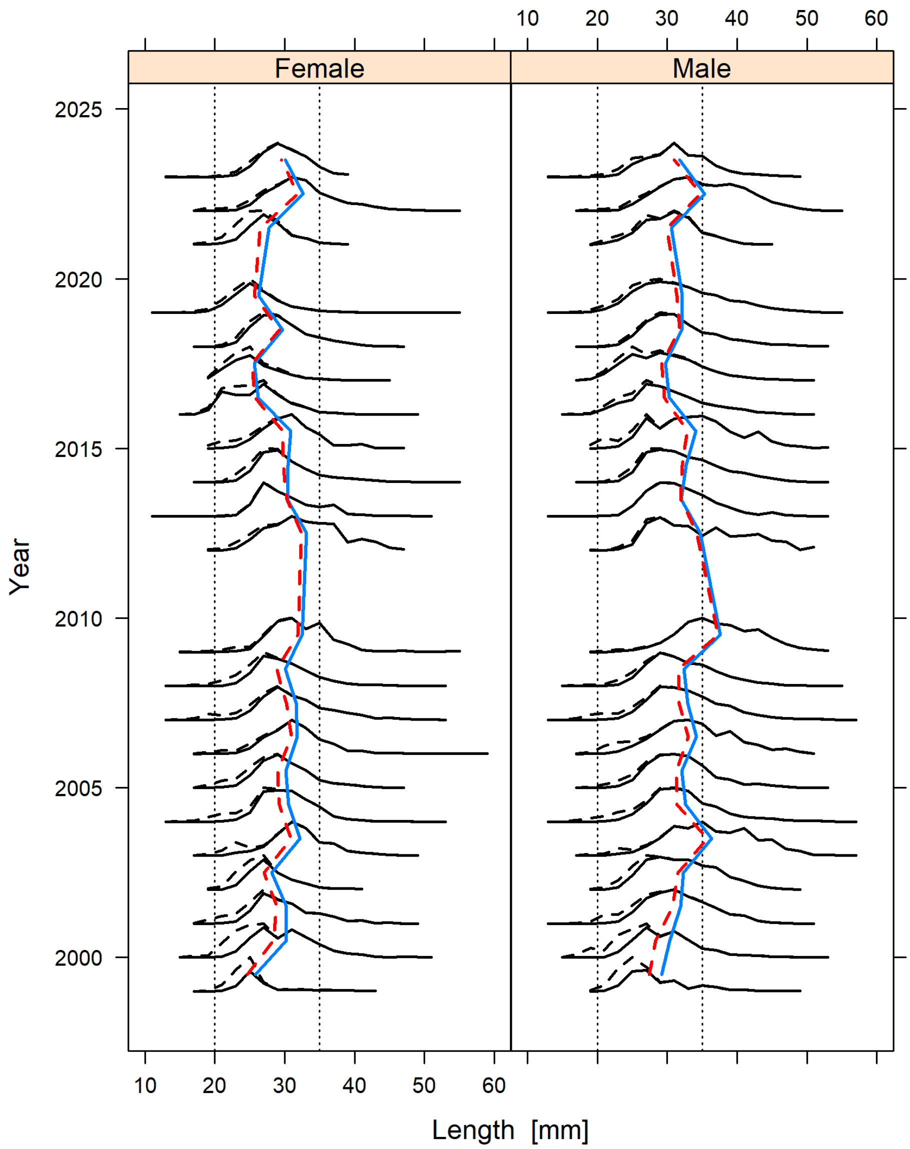


Figure 14.3. Irish Sea East (FU14): Length distribution of landings (solid lines) and catch (dotted lines), 2000–2021. Length frequencies for 2010–2012 are based in very poor sampling so not reliable. No sampling was carried out in 2020. Figure shows a vertical display of MLS (20 mm CL) and 35 mm CL levels.

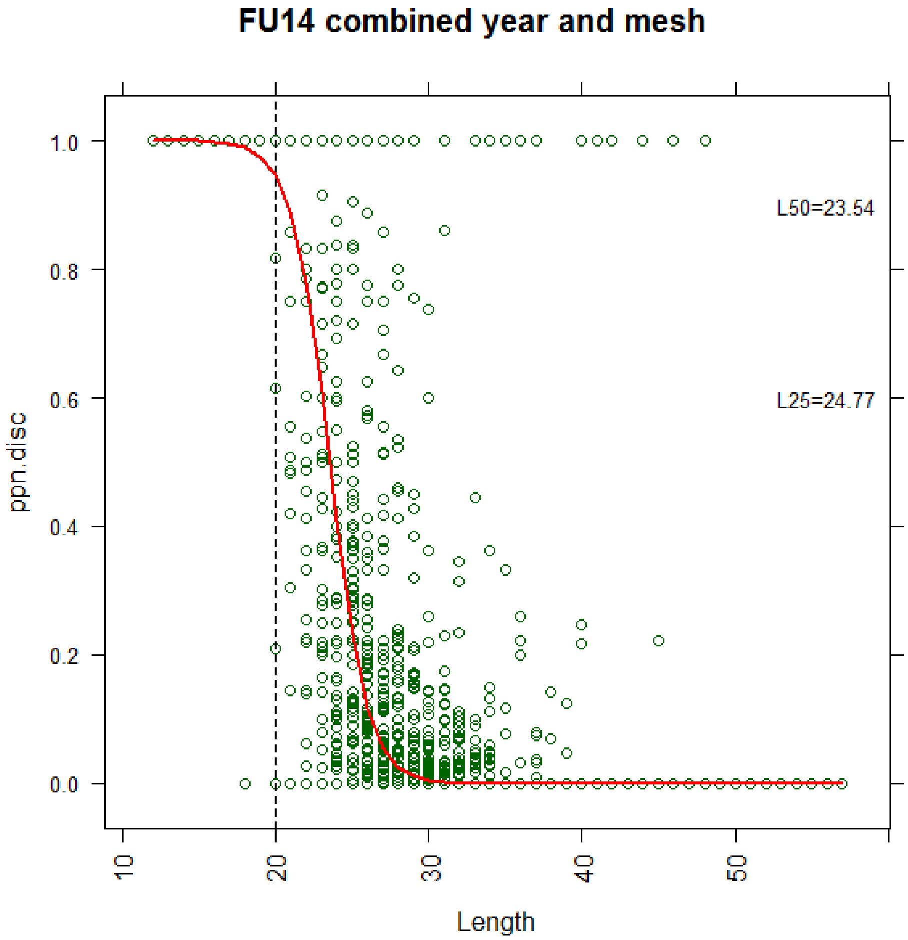


Figure 14.4. Irish Sea East (FU14): Final discard ogive pooled for all years (2003–2014) and mesh sizes. L50=23.54 and L25=24.77, (IBPNeph 2015).

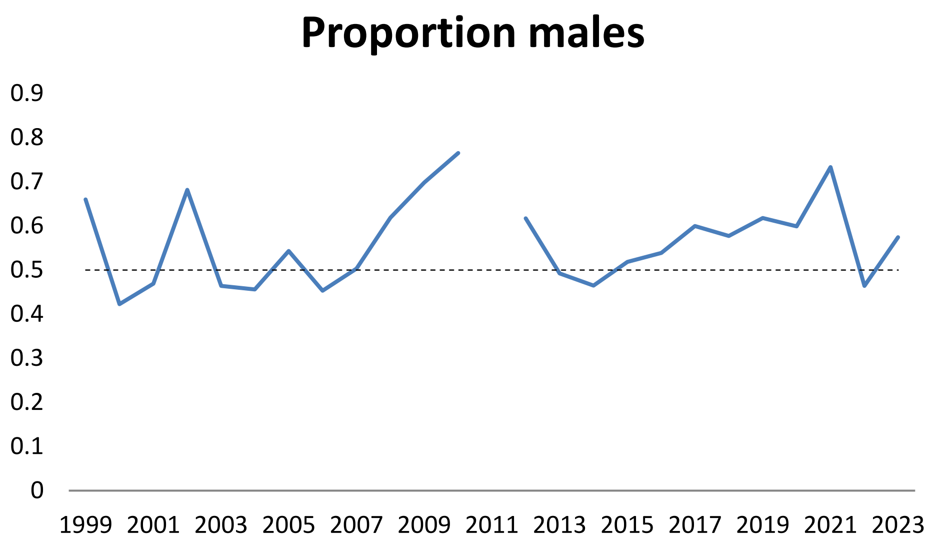


Figure 14.5. Irish Sea East (FU14): Proportion of males in catch since 1999. Between 2010 and 2012 due to poor sampling levels estimates of sex ratio are not reliable. An average of 2017-2019 sampling is used for 2020.

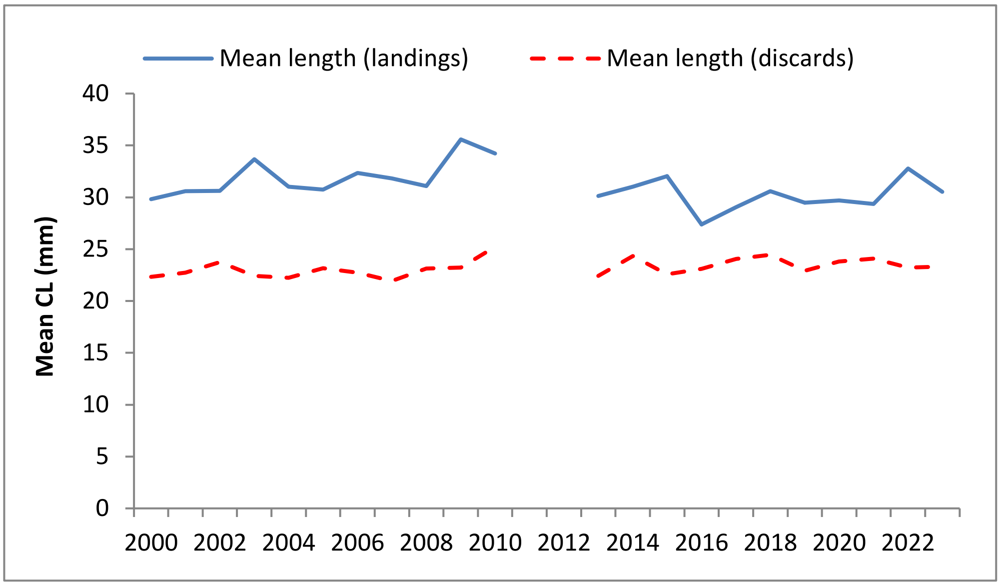


Figure 14.6. Irish Sea East (FU14): Mean weight (g) combined by sex for total annual landings and discards. Values for 2010, 2011 and 2012 are not reliable due to poor sampling. NI sampling included from 2016. An average of 2017-2019 sampling is used for 2020

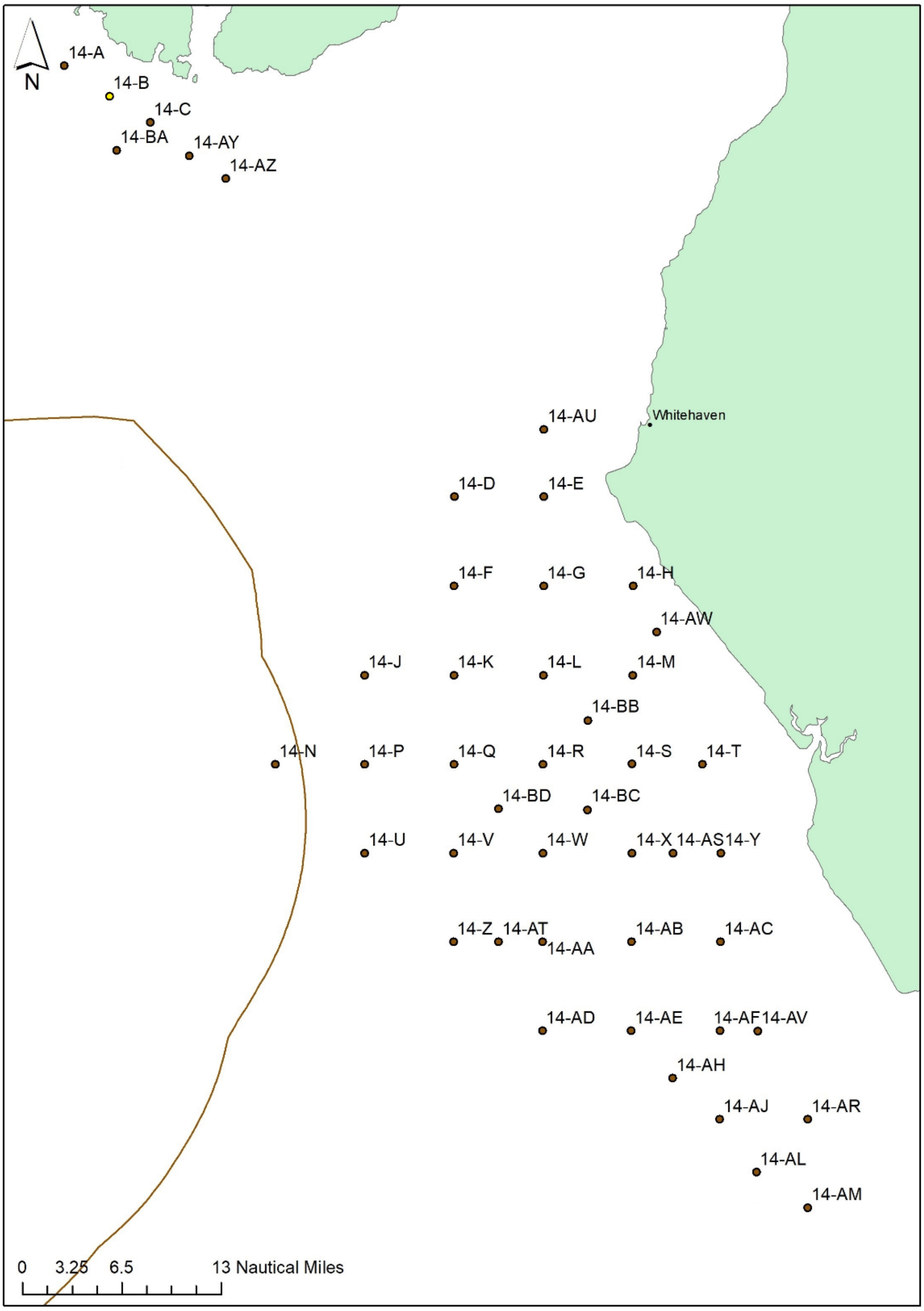


Figure 14.7. Irish Sea East (FU14): UWTV Survey stations for 2023. Highlighted station (14-B) was not used in the assessment this year

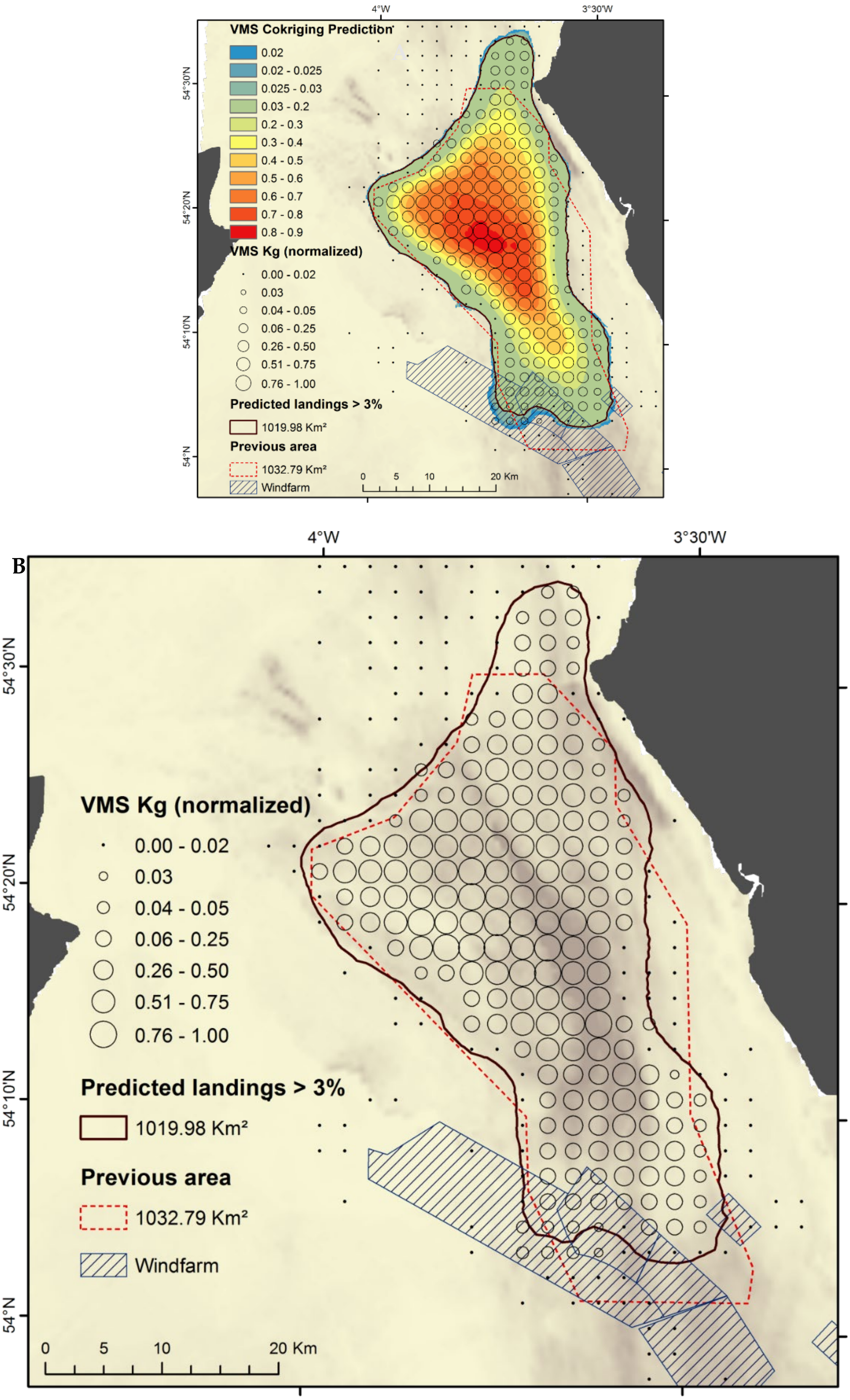
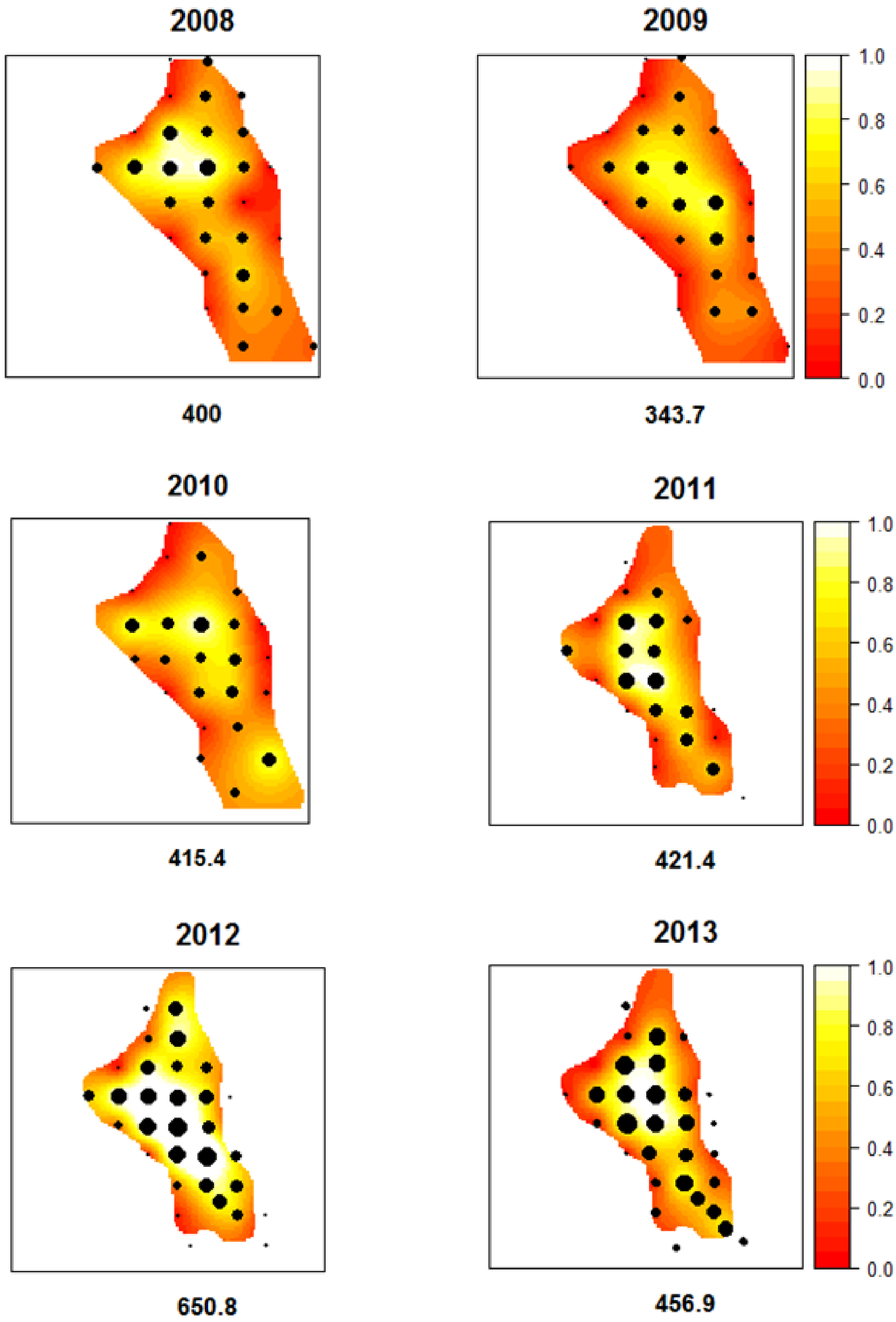
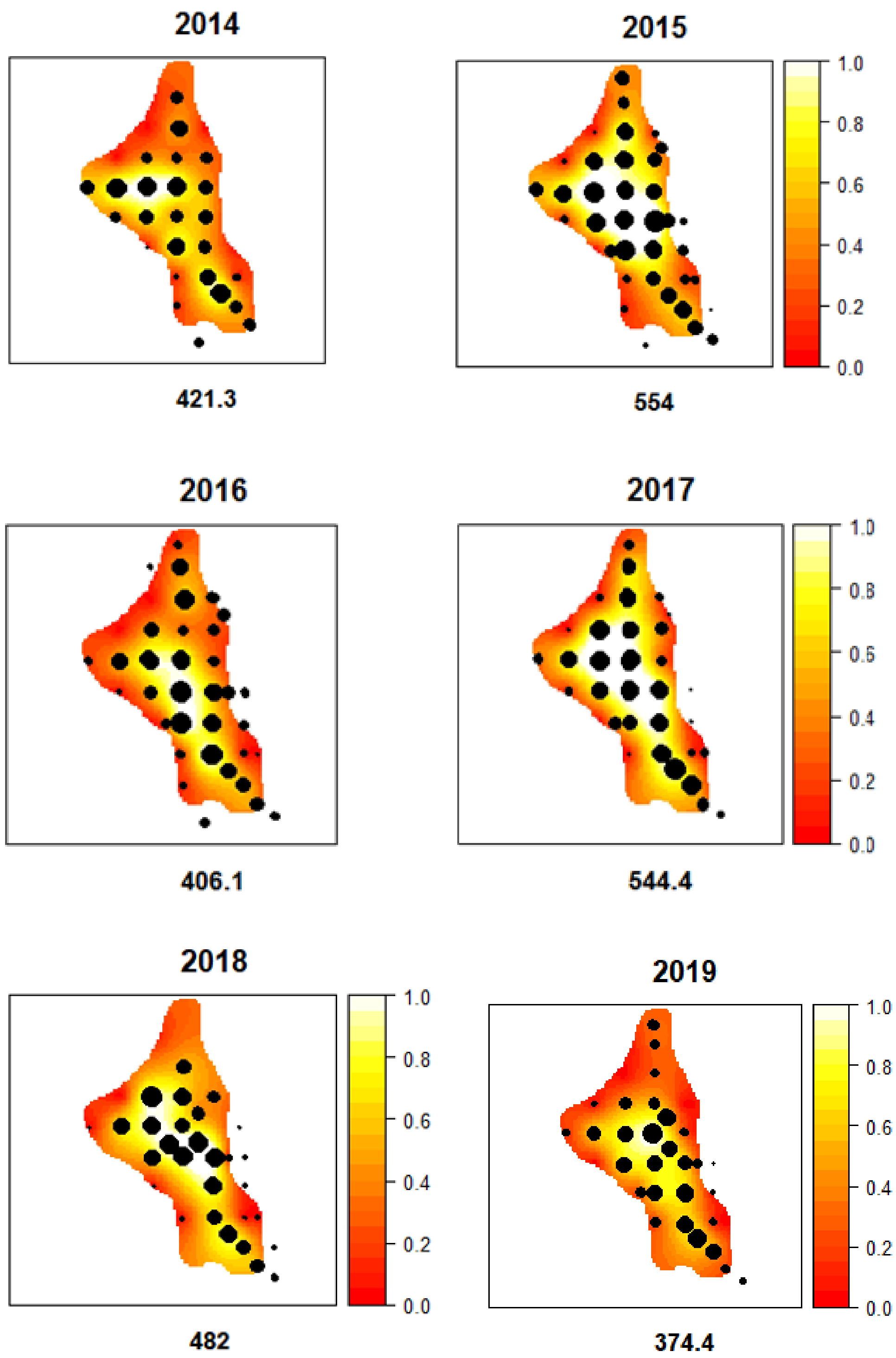


Figure 14.8. Irish Sea East (FU14): Co-kriging approach. Interpolation result of VMS (cut off 3%), survey density (2013–2015) data and mud distribution. A - model output; B - final polygon.


2008
400
2009
343.7
1.0
0.8
0.6
0.4
0.2
0.0
2010
415.4
2011
421.4
1.0
0.8
0.6
0.4
0.2
0.0
2012
650.8
2013
456.9
1.0
0.8
0.6
0.4
0.2
0.0


2014
421.3
2015
554
2016
406.1
2017
544.4
2018
482
2019
374.4
1.0
0.8
0.6
0.4
0.2
0.0

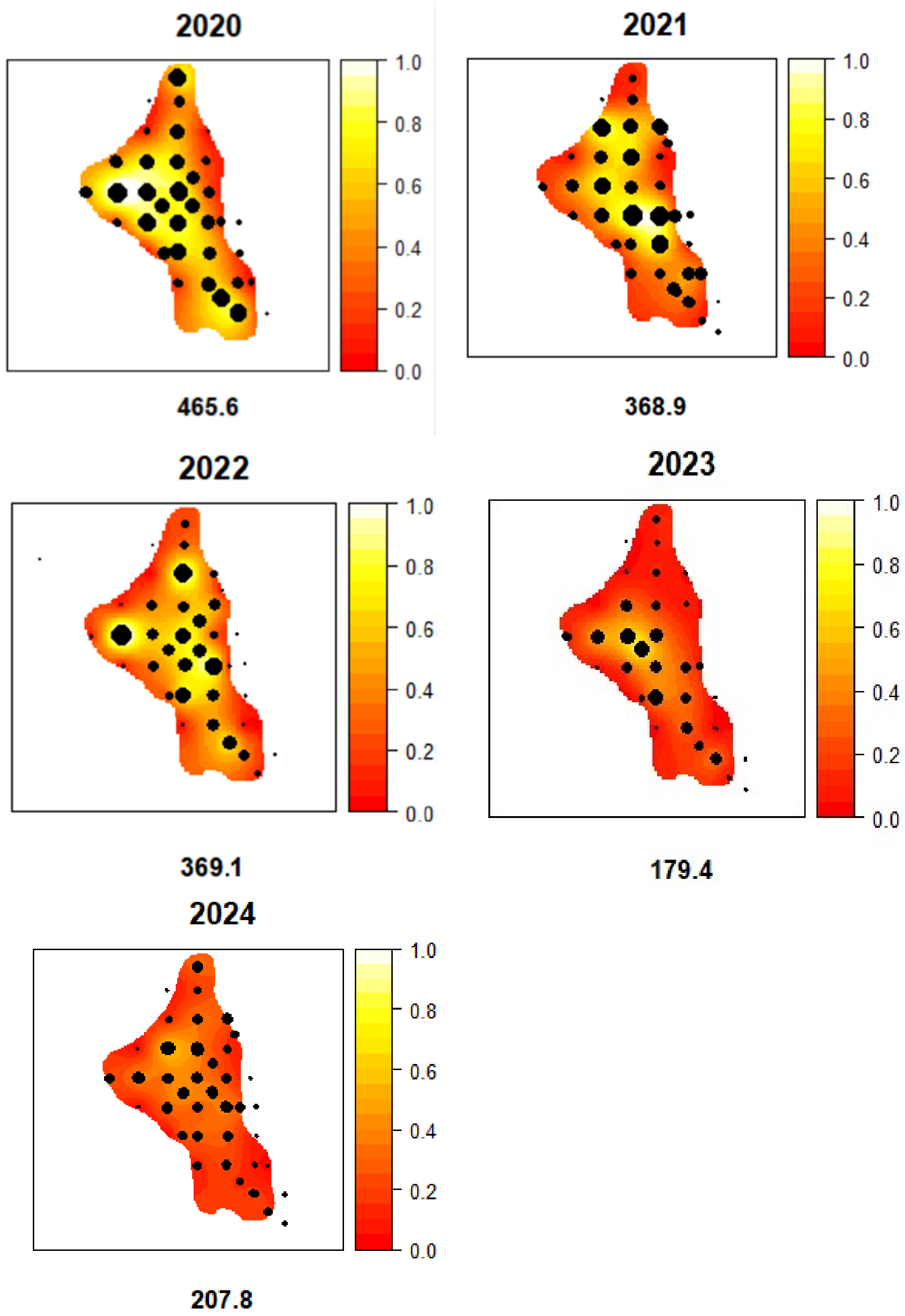


Figure 14.9. Irish Sea East (FU14): Burrow density estimates from the UWTV Survey (individuals / m².) Abundance estimates (millions) given at the bottom of each plot are adjusted with the cumulative absolute conversion factor (but does not contain the additional area for Wigtown Bay). Area of ground = 1032.75 Km² for 2008–2010 and 1019.79 Km² for 2011–2022.

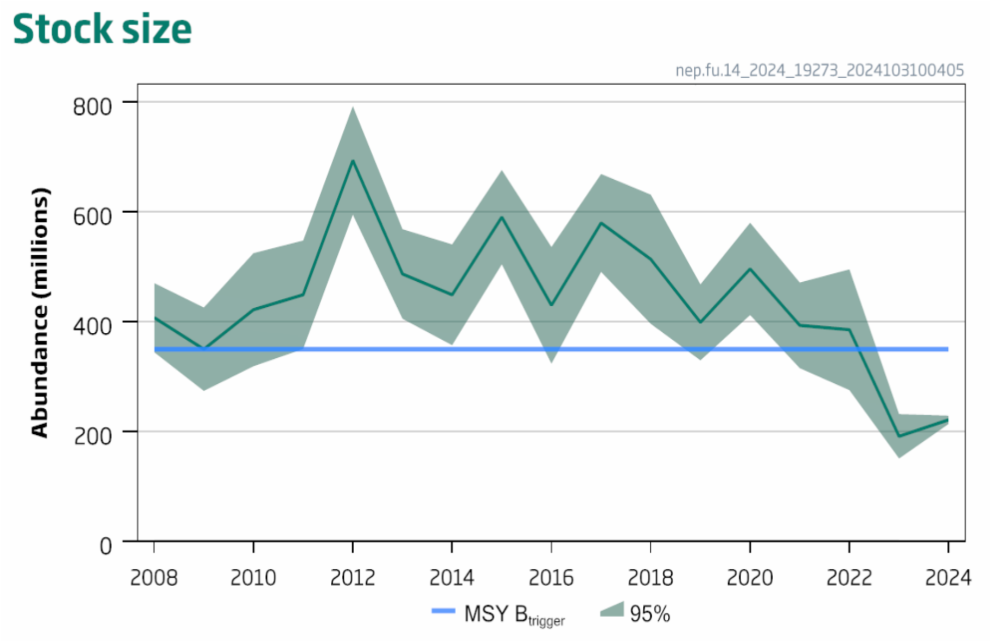


Figure 14.10. Irish Sea East (FU14): Abundance from the UWTV Survey. The shading indicates the 95% confidence interval. $B_{trigger}$ is set at 350 million (blue line).

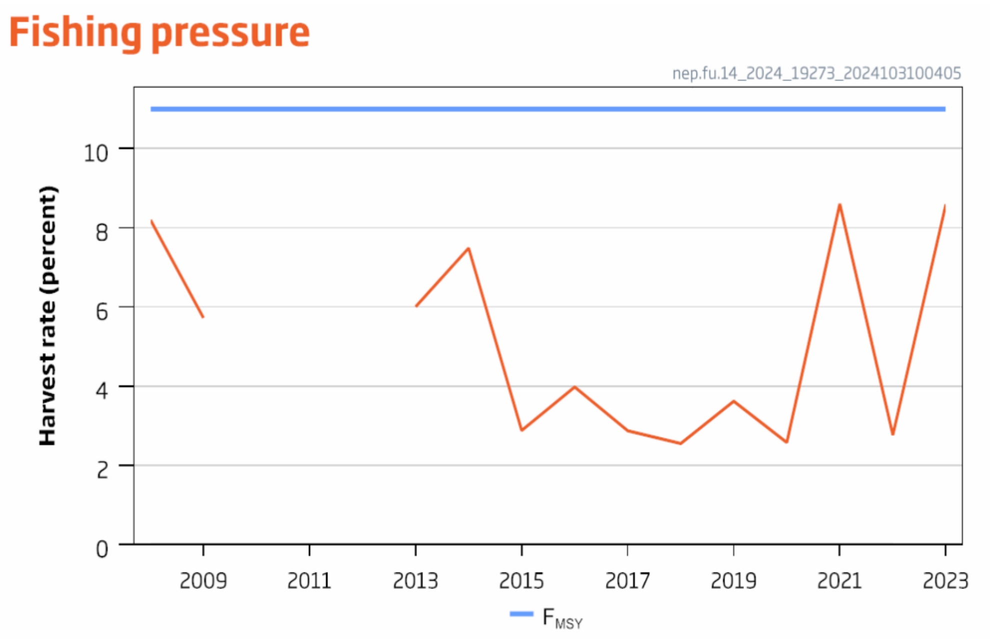


Figure 14.11. Irish Sea East (FU14): Harvest Rate (% dead removed/UWTV abundance). The blue line indicates F_{MSY} proxy (11%). Between 2010 and 2012, due to poor sampling levels, harvest rate estimates are not reliable.

Contents

15 Norway lobster (*Nephrops norvgicus*) in Division 7.a, Functional Unit 15 (Irish Sea, West)

Type of assessment

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the general process defined by WK*NEPH* (2009) described in the stock annex. The TV survey was to be repeated in the summer of 2024 and forms the basis of advice for this stock in the autumn.

ICES advice applicable to 2025

"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 10062 tonnes.

To ensure that the stock in Functional Unit (FU) 15 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."

15.1 General

15.1.1 Stock description and management units

The Irish Sea West (FU15) is comprised of ICES rectangles 35E3–E5, 36E3–E5, 37E3–E5, and 38E4 within 7a. It is included in ICES Area 7 together with the Irish Sea East (FU14), Porcupine Bank (FU16), Aran Grounds (FU17), northwest Irish Coast (FU18), southeast and southwest Irish Coast (FU19), NW Labadie, Baltimore and Galley, and Jones and Cockburn (FU20-21), and the Smalls (FU22).

A TAC is in place for ICES Area 7 which does not correspond to the assessment units. As *Nephrops* are limited to muddy habitats the distribution of suitable sediment defines the species distribution and the stocks are therefore assessed as seven separate Functional Units. The TAC for Area 7 is shown in the tables below.

15.1.2 Fishery description

The FU 15 *Nephrops* fishery first developed in the late 1950s. The environment in the Western Irish Sea is very suitable for *Nephrops*, with a large mud patch and a gyre that retains the larvae over the mud patch, thus ensuring good recruitment. The ground can be characterized as an area of very high densities of small *Nephrops* compared to other functional units. The UK (Northern Ireland) and Ireland are the main countries involved in the FU15 *Nephrops* fishery.

The fishery in 2023

The *Nephrops* fishery in the Irish Sea west is economically one of the most important in ICES Area 7 and is mainly prosecuted by vessels from UK (Northern Ireland) and Ireland. Working group landings from FU15 are presented in Table 16.1 and Figure 16.1. The total declared international *Nephrops* landings reported from FU15 in 2023 was 6791 t, similar to the two preceding years. Since 2012, there has been a trend for Irish and more recently Northern Irish vessels to switch to multi (quad) rig trawls and in general a reduction of single-rig vessel effort; however the last two years saw a return to smaller vessels using twinrigs, as the fuel costs are high and it is difficult to keep crews. Since March 2012, it is mandatory for all Irish vessels to use specified species selective gears. Similar conditions have been introduced in October 2012 for the UK (Northern Ireland) vessels. The introduction of highly selective gears suggests a reduction in bycatch rates of non-target fish species of around 30%.

Further general information on the fishery can be found in the stock annex.

Information from stakeholders

No information from stakeholders.

15.2 Data

Commercial size composition data for landings and discards were provided by Northern Ireland and Ireland. Other biological data used in the assessment were as listed in the stock annex compiled by the Benchmark meeting WK*NEPH* (2009).

InterCatch

Data were available in InterCatch and used to derive assessment input data.

Landings

Working group landings from FU15 are presented in Table 15.1 and Figure 15.1. The total declared international *Nephrops* landings reported from FU15 in 2023 was 6796 t. Landings are derived primarily from Ireland and Northern Ireland.

Effort

Effort by the UK fleet remained relatively stable since 2002 following a steady decline from the early 1990s. There was a further marginal reduction in effort and lpue time-series for Ireland (Table 15.3) compared to 2016, with effort at the lowest reported value in the series. In previous years, these interannual fluctuations have been attributed to the high mobility and flexibility in terms of fishing in other areas within the TAC area, whereas the Northern Irish effort is mostly concentrated on FU15. Fishing activity from the Irish fleet in FU15 increasingly concentrates on good fishing periods during the year, resulting in a larger and increasing lpue. The lpue and effort lpue series for Northern Ireland are updated to provide kW days (kWd) and lpue as kg/kWd. A change to e-logbooks and recording of fishing hours after 2013 means that the recent data are not comparable with the historic series. Recent lpue and effort after 2013 has remained stable. The lpue for the Northern Irish fleet in 2023 decreased to 1.96 kg/kWd while for a second year no effort data was available from the Irish Fleet.

Sampling levels

Fisher self-sampling for Northern Irish vessels achieved 151 samples collected from the reference fleet, with 60, 46, 23, and 22 samples in quarters 1–4 respectively. These rates correspond to one sample per 45 t landed.

Commercial length–frequency distributions

Length and sex compositions of *Nephrops* landed from the Irish Sea West are estimated from port sampling by Ireland and Northern Ireland. Sampling of Northern Ireland catches was not possible during 2003–2007, with the Irish length frequencies raised to the international catch for these years. Northern Ireland sampling resumed in 2008 and these data are combined with those from Ireland for that year.

This Northern Irish fisher self-sampling scheme uses a reference fleet of vessels selected vessels from the main Northern Irish ports. The reference vessels selection is designed to be representative of the entire fleet with systematic rota sampling. The mean sizes of *Nephrops* in the catches of both the Northern Ireland and Ireland fisheries have fluctuated for the last decade (Tables 15.4–15.5; Figure 15.1). There is little evidence to suggest a long-term trend in the mean size of males and females in the landings and catches which continues to fluctuate around the series mean (Figure 15.2).

Sex ratio

The sex ratio by year is shown in Figure 15.3. This shows some fluctuations over time. In general, the sex ratio in landings and catches are biased toward males, with a geomean of 56.2% males in landings (1986–2020) and 52.4% in catches (1986–2020). There was little bias toward males in catches was observed in 2023 comprising 55% in landings total catch. Historically the stronger bias of males in landings relates to the average larger size of male *Nephrops*.

Mean weights

Explorations of the mean weight in the catch samples by sex shows a strong seasonal pattern in the females (Figure 15.4). This corresponds with the emergence of mature females from the burrows to mate in summer. There is no evidence of a recent trend toward decreasing mean weights (Figure 15.5), however compared to the early part of the time-series mean weights have decreased. The mean weights in landings (2021–2023) and mean weights in discards (2021–2023) are used in the basis for calculating catch options (Section 19.4).

Discards

Annual discard rates are estimated using unsorted catch and discards sampling. Unsorted catches and samples of retained catch are provided by vessels. The catch sample is partitioned into landings and discards using a discard selection ogive. This selection ogive can be derived per sample or as aggregation of samples within a quarter or year when sampling rates are low. Sampling effort is stratified weekly, but quarterly aggregations are used for quarterly length frequencies and discard estimates. The length–weight regression parameters given in the stock annex are used to calculate sampled weights and appropriate raising factors. Discarding practice is highly variable, mainly driven by market demand, and was 19% of the catch by number in 2023 (Table 15.6). A discard survival rate of 10% is assumed for *Nephrops* from this FU (WKNEPH 2009).

Surveys

Abundance indices from UWTV surveys

Since 2003, Ireland and Northern Ireland have jointly carried out underwater television surveys of the main *Nephrops* grounds in the western Irish Sea. These surveys were based on a randomised fixed-grid design. The methods used during the surveys were similar to those employed for UWTV surveys of other *Nephrops* stocks and were as agreed by WKNEPHTV (ICES, 2007), WKNEPBID (ICES, 2008), SGNEPS (ICES, 2009; 2010; 2012), WKNEPH (ICES, 2009), and WGNEPS (ICES, 2013; 2014; 2015; 2016). From 2003 to 2011, an average of 146 valid stations was covered by the two surveys combined, and the data were raised to a stock area of around 5290 x 10-6 km² as detailed in Table 15.7. The number of stations were significantly reduced in 2012 following a recommendation from SGNEPS 2012 that a CV (or relative standard error) of <20% is an acceptable precision level for UWTV survey estimates of abundance. This allowed sampling intensity to be reduced and survey effort allocated to other areas and FUs in Area 7. Details of the survey methodology are available in WGNEPS (ICES, 2016). In 2021, there was change to using High Definition 'still' image cameras to collect footage onboard the RV Corystes, this was used again in 2022. This change provides significantly improved image quality. A similar change has also taken place in other functional units in ICES Area 7. A trial in FU 15 showed no significant different in the burrow estimates derived from standard video imagery and high definition still imagery.

In 2024, 97 stations were completed; footage from two stations was not collected because of the presence of static fishing gear; on one station, rocks prevented the deployment of the camera. Figures 15.7–15.10 are contour plot of the krigged-density estimates for FU15 over the period 2003–2024. The resulting krigged burrow abundance estimate was 3 816 million burrows.

An error in the script calculating the distance over ground was detected, which had been used in 2023, resulting in a downscaling of the burrow encountered in 2023 from 4 650 estimated in 2023 to 2 323 estimated in summer 2024, resulting in an abundance below Btrigger in 2023.

At the WGCSE *Nephrops* meeting, it was agreed however to keep the values for 2023 for the moment at the previously estimated level.

A violin plot of the burrow densities observed in the survey (2003–2024) is shown in Figure 15.11. The character of the burrow densities encountered has decreased in 2024; characterized by a relatively high occurrence of low density stations and a normal distribution densities around 0.5-0.6 burrow/m². Confidence in the survey estimates and design are assured through the maintained low coefficient of variation on the burrow estimates. This low coefficient of variation, despite the loss of three survey stations supports that the survey provides high quality information

The use of the UWTV surveys for the provision of *Nephrops* management advice was extensively reviewed by WKNEPH (ICES, 2009) and potential biases were highlighted including those due to edge effects; species burrow misidentification and burrow occupancy. A cumulative bias correction factor estimated for FU15 was 1.14 which means the TV survey is likely to overestimate *Nephrops* abundance by 14%.

Nephrops trawl surveys

In addition to UWTV surveys, Northern Ireland have completed spring (April) and summer (August) *Nephrops* trawl surveys since 1994 and provide data on catch rates, size composition, and biological data from fixed stations in the western Irish Sea as detailed in the Stock Annex (Stock Annex Figure 1). Survey CPUE has remained stable over time. Mean carapace length-by-sex (from the trawl survey) shows inter-annual variation fluctuating around mean with no apparent trend over time (Figure 15.12).

Due to reduced resources, the spring survey series was terminated in 2010 as part of a national rationalization of the survey programme after considering benefits to management and stock assessment. Due to a major ship break-down, no data are available for the 2013 summer survey. The summer trawl survey catch rates correlate somewhat with UWTV survey abundance estimates (Figure 15.12), but showed a deviating trend, especially in 2010. The longer time-series of the trawl survey shows that catch rates in the last few years (2005–2009, 2011) are close to the mean of the series when UWTV burrow abundances were in the range of 5–6 billion burrows. The reduction in the 2010 trawl estimate, that showed a conflicting trend to the UWTV abundance, is most likely associated with the survey taking place in suboptimal tidal conditions.

Usually, the trawl survey coincides with slack tides, but this was not optimal in 2010 due to availability of the ship and synchronisation with the UWTV survey.

15.3 Assessment

Comparison with previous assessments

The assessment approach used by WGCSE 2024 is consistent with that set out in the Stock Annex and WK*NEPH* (WK*NEPH*, 2009). Since the most recent three years of sampling data were available, three-year averages of mean weights in the landings and proportions retained in the fishery have been used. This is in line with the procedure used for other stocks in areas 6 and 7 by WGCSE.

The decline in abundance of individuals by approximately 13% triggered a full review of the assessment, including the estimation of the FoV, the distance over ground, and the counting.

State of the stock

The stock size is estimated to show a decrease, but within the limits previously observed for the stock. The harvest ratio in 2023 (10.8%) remains below F_{MSY} (18.1) (Figure 15.14). This stock has previously sustained landings at around 9 000 t for many years. The stock increased until 2003, with a general decrease until 2014 and a mostly steady abundance since. The most recent UWTV abundance estimate of 3 816 million in 2024 shows a considerably decline from the average size from previous years. Figure 16.14 is the stock summary plot for FU15. Recent harvest rates have fluctuated around F_{MSY}. The stock is estimated to be above $MSYB_{trigger}$ (3 000 million).

15.4 Catch option table3

Catch option table inputs are presented in Table 15.6 and summarized below. A three-year average (2021–2023) of mean weight in the landings and proportion of removals retained was used.

A stock abundance prediction for 2024 was made for FU15 using the approach agreed at the Benchmark Workshop (WK*NEPH*, 2009) and outlined in the stock annex made on the basis of the 2024 UWTV survey.

The basis for the catch options.

Variable	Value	Notes
Stock abundance (2024)	3816	UWTV survey 2024; numbers of individuals in millions
Mean weight in projected landings	15.8	Average 2021–2023; in grammes
Mean weight in projected discards	8.6	Average 2021–2023; in grammes
Projected discard rate	23	Average 2021–2023; percentage by number of the total catch
Discard survival rate	10.0	Percentage by number of the discards

15.5 Reference points

A decision-making framework for the choice of F_{MSY} proxy reference points is available in the introduction to the *Nephrops* ICES advice sheets. The current F_{MSY} proxy reference points for FU15 *Nephrops* was evaluated at WKMSYRef4. The MSY reference point for FU15 *Nephrops* is the F_{max} for combined sexes. No precautionary reference points have been defined for *Nephrops* stocks. Whereas the F_{MSY} proxy reference points were chosen with the intent that they should lead to a low probability of stock overfishing.

Previously the CPUE data from the trawl surveys were scaled to the UWTV index to provide a $B_{trigger}$ approximation based on the mean of the five lowest survey catch rates in the time-series (Figure 15.8), this is still accepted as an appropriate $B_{trigger}$ for FU15.

Stock code	MSY Flower	F_{MSY}	MSY Fupper with AR	MSY $B_{trigger}$	MSY Fupper with no AR
nep-15	12.4	18.2	18.2	3000*	18.2

***Abundance in millions.**

15.6 Management strategy

As of yet, there are no explicit management strategies for this stock.

15.7 Quality of assessment and forecast

Uncertainties in the survey, mean weight in the landings, and discard rates are not taken into account in the deterministic catch option. There is some variability in these over time.

There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009). These have led to a revision in the historical time-series of survey abundance estimates for FU15, which was presented to last year's working group. Ultimately, there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al*., 1996).

Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WK*NEPH* 2009). The survey estimates themselves are very precisely estimated (CVs 2–5%) given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU15 are largely based on expert opinion (see Stock Annex). The precision of these bias corrections cannot yet be characterized but is likely to be higher than that observed in the survey.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. These parameters are quite variable; in future years, the uncertainty in these key parameters should be estimated.

The quality of landings data has improved since 2007 with the implementation of sales notes and buyers and sellers legislation. Prior to that, there were concerns that landings were underreported. The harvest ratio may be under estimated prior to 2007.

General sampling level is 1 sample per 40 t of catch.

15.8 Recommendations for next benchmark

WGCSE will keep the stock under review and recommend future benchmark as required.

15.9 Management considerations

The FU15 *Nephrops* fishery first developed in the late 1950s. Since then, it has sustained landings of around 8 500 t for more than 30 years. Fishing effort in the past has been very high but has declined somewhat in recent years. The environment in the Western Irish Sea is very suitable for *Nephrops* with a large mud patch and gyre, which retains the larvae over the mud patch thus ensuring good recruitment. The ground can be characterised as an area of very high densities of small *Nephrops*. All available information indicates that size structure of catches appears to have changed little since the fishery first began.

The *Nephrops* trawl fisheries take bycatches of other species, especially juvenile whiting, but also cod. Catches of these species should be reduced to as low as possible because of the poor status of these stocks. A conditional national licence has been introduced by Ireland since March 2012, making the use of grids or separator panels mandatory for all TR2 boats fishing in the Irish Sea. Around 55% of the Irish vessels use separator trawls and while 45% have opted to use Swedish grids to reduce bycatch. Additionally, there has been a trend for Irish vessels to switch to multi (quad) rig trawls. Provisional data suggest a ~30% increase in *Nephrops* catch rates and a reduction in fish bycatch of ~30% due to the lower headline height.

Since October 2012, all TR2 vessels in the UK (Northern Ireland) fleet are required to use a highly selective fishing gear. In the Irish Sea these currently include Seltra 300 mm box trawl, 270 mm diamond mesh panel Seltra box trawl and 300 mm square mesh panel. All these gears are being developed with the aim of achieving exemption from the cod recovery plan under Article 11 (less than 1.5% cod catch). Enforcement is through the issue cod recovery zone fishing authorizations, where no authorization is given to a vessel that is not using a highly selective gear.

ICES has repeatedly advised that management should be at a smaller scale than the ICES Subarea 7. Management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort are at the same scale as the resource.

A number of cod recovery measures have been introduced since 2000 to promote recovery of Irish Sea cod stocks. These include a closure of the western Irish Sea cod spawning grounds from mid-February to end of April since 2000, with a later extension to the eastern Irish Sea closure.

Despite a partial derogation for *Nephrops* vessels during the closed period, the distribution of effort on *Nephrops* has been affected by this management plan. There have also been decommissioning schemes to reduce fishing effort. During 2016-2020 the EU landing obligation was applied to all catches of Norway lobster fisheries in ICES Subarea 7 with exemptions for high survival. From 2020, this stock is still under a landing obligation and there are still exemptions in place. Observations from the 2016–2020 fishery indicate that discarding above the minimum conservation reference size (MCRS) continues and has not changed markedly (Figure 15.2).

ICES is providing advice for 2025, assuming average discard rates as observed over the last three years. This is considered to be the most realistic assumption.

15.10 References

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Table 15.1. Irish Sea West (FU15): Landings (tonnes) by country, 2000–2023.

Year	Ireland	Isle of Man	UK	Other countries	Total
2000	3433	0	4937	0	8370
2001	2689	3	4749	0	7441
2002	2291	1	4501	0	6793
2003	2709	4	4352	0	7065
2004	2786	13	4470	1	7270
2005	2133	0	4420	0	6554
2006	2051	1	5508	1	7561
2007	2767	0	5724	0	8491
2008	3132	50	7323	2	10508
2009	2343	1	6855	0	9198
2010	2578	0	6384	0	8963
2011	3575	2	6584	0	10162
2012	3794	3	6732	0.2	10529
2013	2465	31	6175	0.2	8672
2014	2938	0**	5676	0.0	8613
2015	2199	0**	6433	0.3	8632
2016	1609	0**	5715	3	7327
2017	1253	0**	4896	0	6150
2018	1387		4369	0	5756
2019	1859		5731	0	7590
2020	1555		4560		6115
2021	1512		5267		6779
2022	1574		5156	10	6741
2023*	1700		5096	0.5	6791

*** provisional.**

****included in UK landings.**

Table 15.2. Irish Sea West (FU15): Landings (kg), effort ('000 hours trawling), cpue and lpue (kg/hour trawling) Republic of Ireland *Nephrops* Directed Trawlers 2000–2023. No effort data available for 2022 and 2023.

Year	Landings (Kg)	Effort (Hours)	Effort (days)	Effort (kwdays)	lpue
1995	1706969	44459	3516	835977	2.041885
1996	1406140	31409	2326	607785	2.313549
1997	2801501	60502	4518	1124379	2.491599
1998	2696979	52277	4051	1053491	2.560039
1999	4031508	73786	5260	1367903	2.947217
2000	3227565	61936	4396	1199896	2.68987
2001	2428587	51111	3435	939387	2.585289
2002	2015965	46072	2900	873563	2.307749
2003	1620391	47704	3120	878568	1.844355
2004	2586760	52673	3500	1033073	2.503946
2005	2111185	50825	3414	1003901	2.102981
2006	2031881	53461	3535	1084251	1.873995
2007	2728841	52550	3575	1056291	2.583419
2008	3165781	49218	3401	1027919	3.079796
2009	2333433	34651	2368	706178	3.304312
2010	2505061	36504	2546	739345	3.388218
2011	3554343	47640	3229	921298	3.857972
2012	3725318	49313	3560	966006	3.856413
2013	2269336	33818	2571	682793	3.323608
2014	2449612	40371	3007	852740	2.872635
2015	2119880	35898	2733	756719	2.80141
2016	1529418	28249	2301	556452	2.748516
2017	1120690	22516	1749	410628	2.729208
2018	1363911	27084	1919	535002	2.549353
2019	1803134	33981	2304	700132	2.57542

Year	Landings (Kg)	Effort (Hours)	Effort (days)	Effort (kwdays)	lpue
2020	1517909	25717	2250	570314	2.661534
2021	1517909	25717	2250	570314	2.661534
2022	1574476				
2023	1699787				

Table 15.3. Irish Sea West (FU15): Landings (tonnes), effort ('000 hours trawling), lpue (kg/hour trawling), effort ('000 kW days) and lpue (kg/kWd) of Northern Ireland *Nephrops* trawlers, 2000–2023.

Year	Landings	Effort ('000 hours)	lpue ('000 hrs)	kW days ('000)	lpue kWd
2000	4758	168.7	28.2		
2001	4587	163.7	28.0		
2002	4495	130.8	34.4		
2003	4146	136.1	29.0		
2004	4273	144.3	29.6		
2005	4235	138.4	30.6		
2006	5356	144.1	37.2		
2007	5512	126.9	43.4		
2008	7056	141.4	49.9		
2009	6487	134.7	48.2		
2010	5888	141.1	41.7		
2011	5952	132.7	44.9		
2012	5865	137.8	42.6		
2013	5605	135.7	41.3	2151.9	2.60
2014	5190	114.6	45.3	2111.2	2.46
2015	6396			1962.6	3.26
2016	5638			2107.3	2.68
2017	4789			1904.3	2.51
2018	4293			2079.3	2.06
2019	5539			2166.5	2.56
2020	4550			1852.0	2.46
2021	5201				
2022*	5116			1314	3.89
2023*	5079			2589	1.96

*** provisional.**

Table 15.4. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Northern Ireland catches, landings and discards, 2000–2023.

Year	Catches		Landings		Discards	
	Males	Females	Males	Females	Males	Females
2000	27.7	24.5	29.4	26.3	22.5	22.6
2001	25.7	23.6	26.1	24.4	21.7	21.2
2002	26.7	24.1	26.7	24.9	21.8	21.7
2003	na	na	na	na	na	na
2004	na	na	na	na	na	na
2005	na	na	na	na	na	na
2006	na	na	na	na	na	na
2007	na	na	na	na	na	na
2008	25.9	24.6	26.9	25.5	21.4	21.5
2009	27.7	25.1	29.3	26.5	23.6	23.2
2010	28.3	25.6	29.5	26.3	23.2	22.8
2011	27.6	26.0	29.3	27.7	22.6	22.8
2012	26.8	24.3	27.7	25.4	21.7	21.1
2013	26.2	24.2	27.2	25.4	21.5	21.3
2014	26.3	23.9	27.1	24.9	21.1	20.6
2015	25.3	23.4	26.8	24.7	21.6	21.3
2016	25.9	24.3	26.9	25.5	22.3	21.8
2017	27.0	24.8	28.0	26.1	22.9	22.5
2018	27.6	25.1	28.8	26.6	23.3	22.5
2019	27.1	24.1	27.9	24.8	22.6	21.7
2020	27.5	26.5	29.1	28.1	22.6	22.5
2021	27.4	26.3	29.0	27.9	22.3	22.4
2022	29.3	26.5	30.6	27.8	24.7	24.0
2023	28.5	26.3	29.2	27.2	22.0	21.8

na = not available.

Table 15.5. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Republic of Ireland catches, landings and discards, 2000–2023.

Year	Catches		Landings		Discards	
	Males	Females	Males	Females	Males	Females
2000	29.1	27.1	32.2	29.7	24.3	24.0
2001	26.7	24.8	28.6	27.0	23.0	22.2
2002	28.9	25.4	30.2	27.8	24.6	23.6
2003	27.7	24.9	29.7	26.9	24.0	23.1
2004	28.1	26.1	29.7	27.8	23.9	23.7
2005	28.5	26.8	30.1	29.1	23.9	23.2
2006	27.7	25.5	29.5	27.1	23.8	23.1
2007	27.7	25.4	29.8	27.9	24.0	23.3
2008	27.4	24.6	28.9	26.6	22.0	21.4
2009	28.5	26.3	30.5	29.2	24.3	23.4
2010	28.0	25.9	29.6	27.6	23.8	23.3
2011	27.0	25.7	28.8	27.3	23.7	23.5
2012	26.8	25.6	28.3	27.0	23.2	23.0
2013	26.3	25.1	27.4	26.5	23.1	22.6
2014	27.7	24.9	29.2	26.3	23.6	23.3
2015	27.7	25.7	29.5	27.4	24.4	24.0
2016	26.0	25.0	27.3	26.4	23.5	23.3
2017	27.2	25.0	28.1	26.2	23.4	22.6
2018	27.4	24.9	29.8	22.8	24.6	22.8
2019	27.9	25.0	29.5	27.0	22.8	22.3
2020	28.0	26.3	29.7	27.9	24.1	24.1
2021	27.9	25.8	29.6	28.4	23.2	23.9
2022	28.2	24.7	29.1	25.9	22.2	21.7
2023	29.6	27.1	31.2	28.8	25.5	25.1

Table 15.6. Irish Sea West (FU15): Proportion discarded by weight and number from FU15. (Note a 10% survivorship of discards is assumed in HR and forecast calculations).

Year	UWTV abundance estimate	95% Confidence Interval	Landings in number	Total discards in number*	Removals in number	Harvest rate (by number)	Landings	Total discards*	Discard rate (by number)	Dead discard rate (by number)	Mean weight in landings	Mean weight in discards
	Millions		millions			%	tonnes		%		grammes	
2003	5485	0.027	404	291	666	12.1	7065	2659	41.9	39.3	17.5	9.14
2004	5547	0.03	416	218	612	11.0	7270	1993	34.4	32.0	17.5	9.14
2005	5673	0.044	346	157	488	8.6	6554	1412	31.2	29.1	18.9	8.99
2006	5402	0.041	467	261	701	13.0	7561	2285	35.9	33.4	16.2	8.75
2007	5150	0.034	511	375	848	16.5	8491	3246	42.3	39.7	16.6	8.66
2008	4288	0.025	755	191	927	21.6	10508	1421	20.2	18.6	13.9	7.44
2009	4623	0.026	567	335	868	18.8	9198	2934	37.1	34.7	16.2	8.76
2010	4990	0.031	572	180	733	14.7	8963	1539	23.9	22.0	15.7	8.55
2011	4871	0.023	644	332	943	19.4	10162	2683	34.0	31.7	15.8	8.08
2012	5062	0.029	771	258	1003	19.8	10529	1871	25.1	23.1	13.7	7.25
2013	4310	0.027	662	229	867	20.1	8672	1590	25.7	23.6	13.1	6.94
2014	4593	0.025	641	198	819	17.8	8613	1418	23.6	21.7	13.4	7.16
2015	4373	0.029	620	280	872	19.9	8643	2228	31.1	28.9	13.9	7.96
2016	5076	0.03	562	245	783	15.4	7327	1939	30.4	28.2	13.0	7.91
2017	5312	0.03	426	152	563	10.6	6150	1222	26.3	24.3	14.4	8.04

Year	UWTV abundance estimate	95% Confidence Interval	Landings in number	Total discards in number*	Removals in number	Harvest rate (by number)	Landings	Total discards*	Discard rate (by number)	Dead discard rate (by number)	Mean weight in landings	Mean weight in discards
	Millions		millions			%	tonnes		%		grammes	
2018	4932	0.03	360	145	491	10.0	5756	1231	28.7	26.6	16.1	7.43
2019	4404	0.03	536	154	675	15.3	7590	1159	22.3	20.5	14.2	7.54
2020	4775	0.03	371	153	509	10.7	6115	1294	29.2	27.1	15.5	8.64
2021	4733	0.04	440	172	595	12.4	6779	1379	28.1	26.0	15.4	8.02
2022	4498	0.03	415	120	536	11.9	6741	1090	22.4	20.1	16.3	9.01
2023	4650	0.022	406	96	502	10.8	6796	877	19	17.1	15.63	8.84
2024	3816	0.02										

Table 15.7. Irish Sea West (FU15): Results from NI/ROI collaborative UWTV surveys of *Nephrops* Irish Sea west ground in 2003–2023.

Year	Number of stations	Mean Density (No./M^2)	Domain Area (km^2)	Estimate (billions)	CV on Burrow estimate
2003	160	0.99	5295	5.5	3%
2004	147	1.00	5310	5.5	3%
2005	141	1.02	5281	5.7	4%
2006	138	0.97	5194	5.4	4%
2007	148	0.93	5285	5.1	3%
2008	141	0.77	5287	4.3	3%
2009	142	0.83	5267	4.6	3%
2010	149	0.90	5307	5.0	3%
2011	156	0.88	5289	4.9	2%
2012	99	0.91	5291	5.1	3%
2013	80	0.78	5278	4.3	3%
2014	99	0.83	5272	4.6	3%
2015	100	0.79	5279	4.4	3%
2016	100	0.84	5260	5.1	3%
2017	101	0.90	5304	5.3	3%

Year	Number of stations	Mean Density (No./M^2)	Domain Area (km^2)	Estimate (billions)	CV on Burrow estimate
2018	100	0.85	5791	4.9	3%
2019	100	0.76	5370	4.4	3%
2020	99	0.82	5791	4.8	3%
2021	95	0.78	5790	4.7	4%
2022	97	0.75	5791	4.5	3%
2023	96	0.48	5791	2.8	2%
2024	97	0.64	5792	3.8	2%

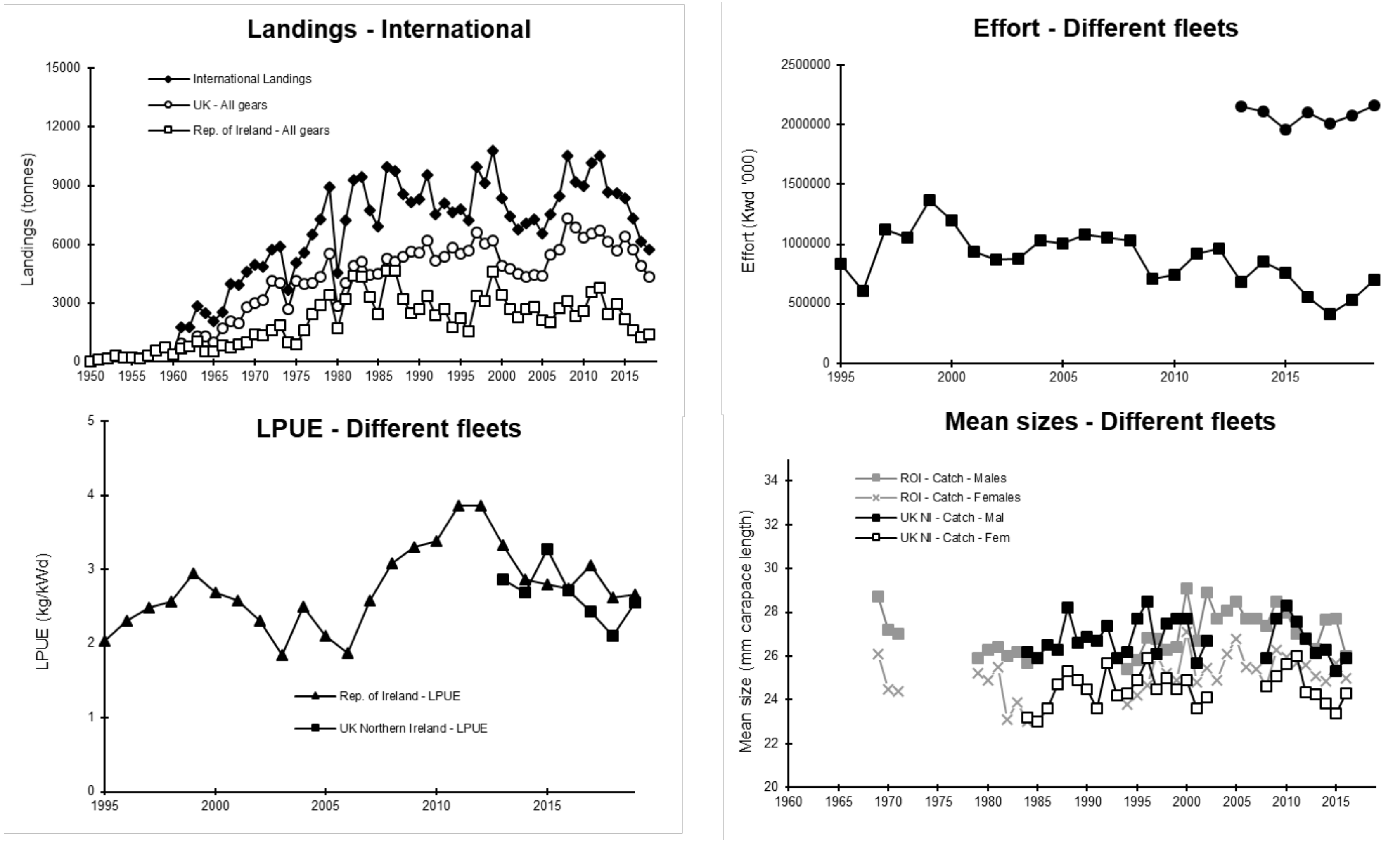


Figure 15.1. Irish Sea West (FU15): Long-term trends in landings, effort, lpue, and mean sizes of *Nephrops*. [The quality of landings data has improved since 2007 with the implementation of sales notes and buyers and sellers legislation, which result in misleading lpue trend plots pre- and post-2007].

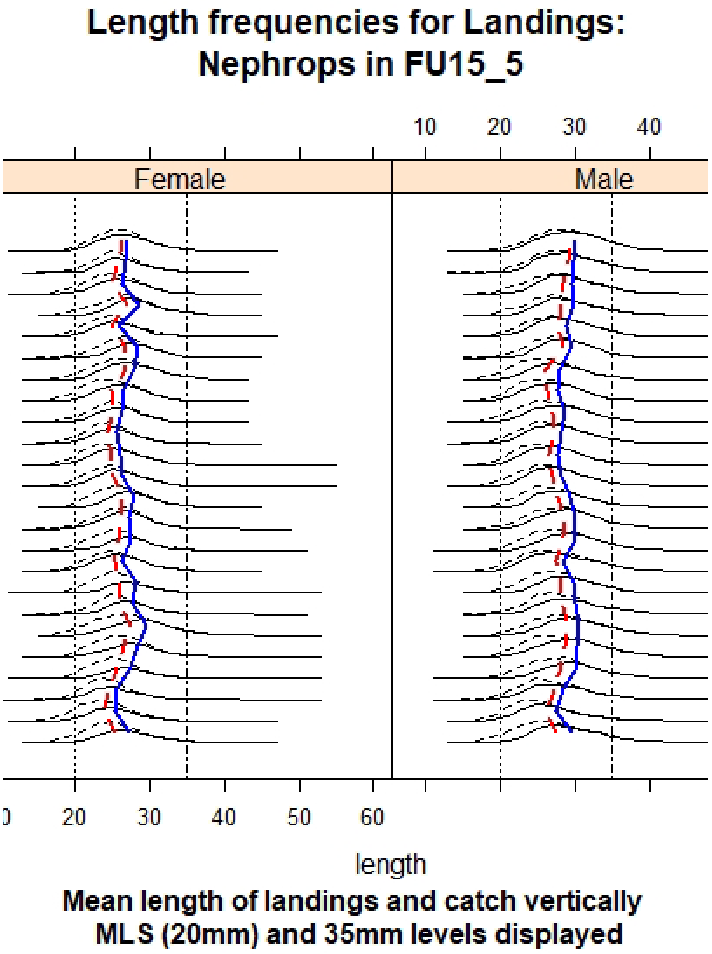


Figure 15.2. Irish Sea West (FU15): Length distributions in the landings (solid) and catches (dotted) 2000–2023.

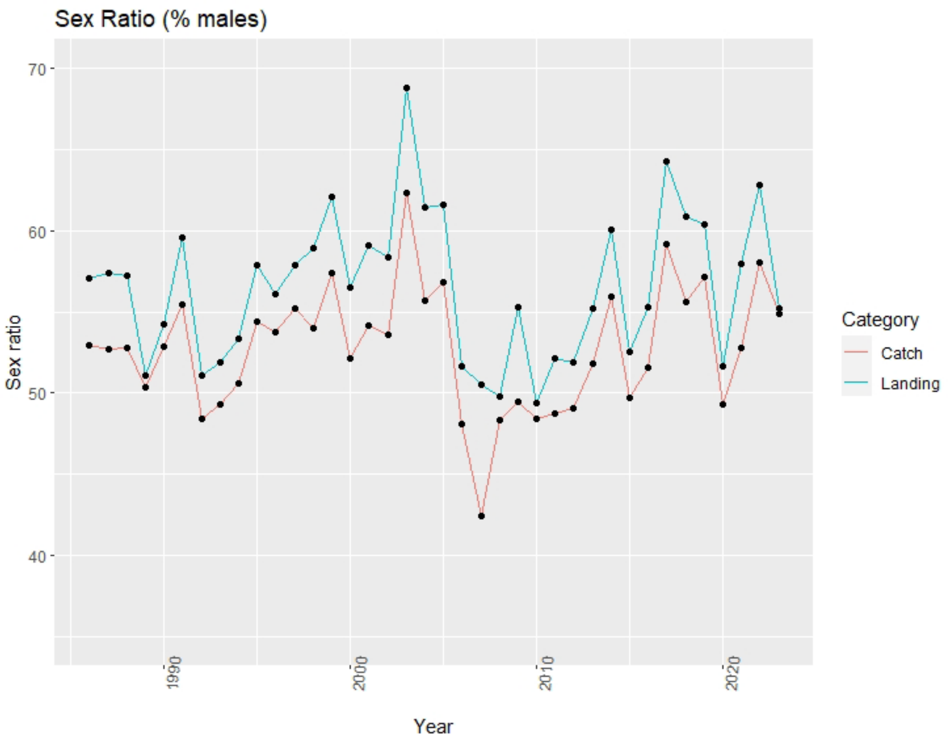


Figure 15.3 ***Nephrops*** **in FU15 (Irish Sea West). Sex ratio (percentage of males) of landings and discards (1986–2023).**

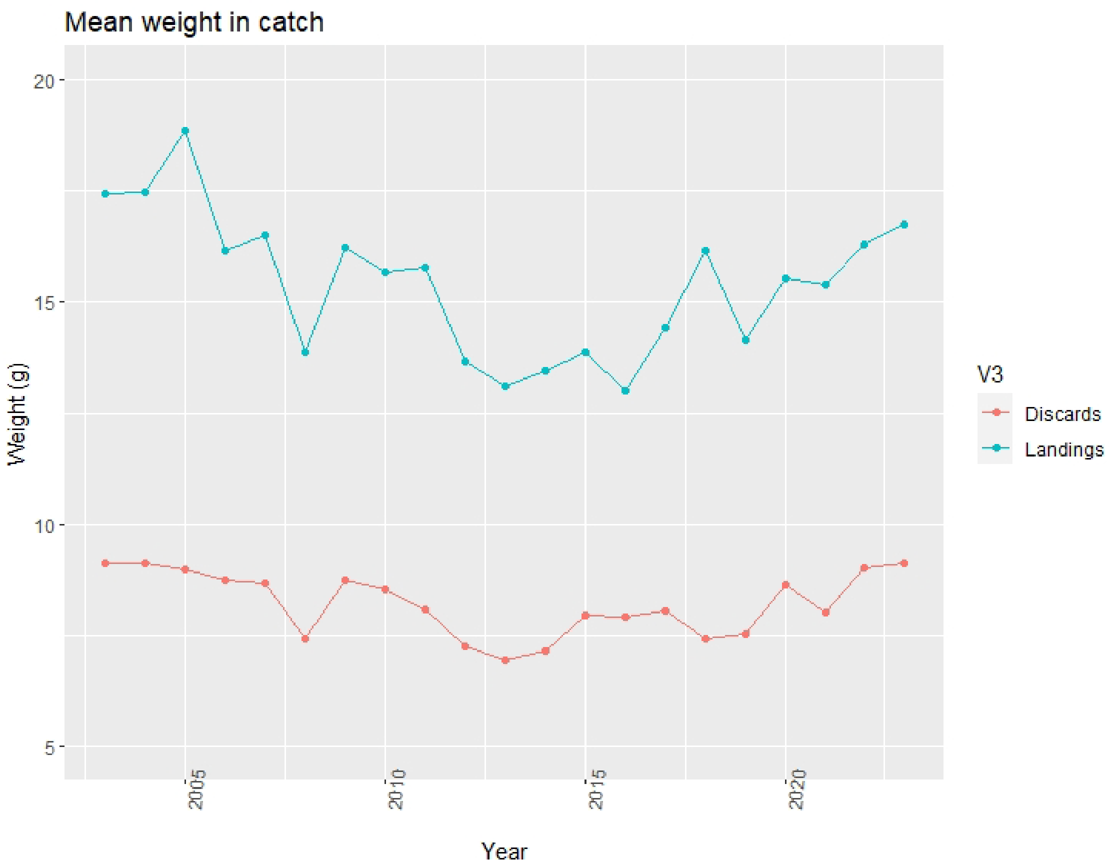


Figure 15.4 ***Nephrops*** **in FU15 (Irish Sea West). Mean weight in landings and discards (2000-2023).**

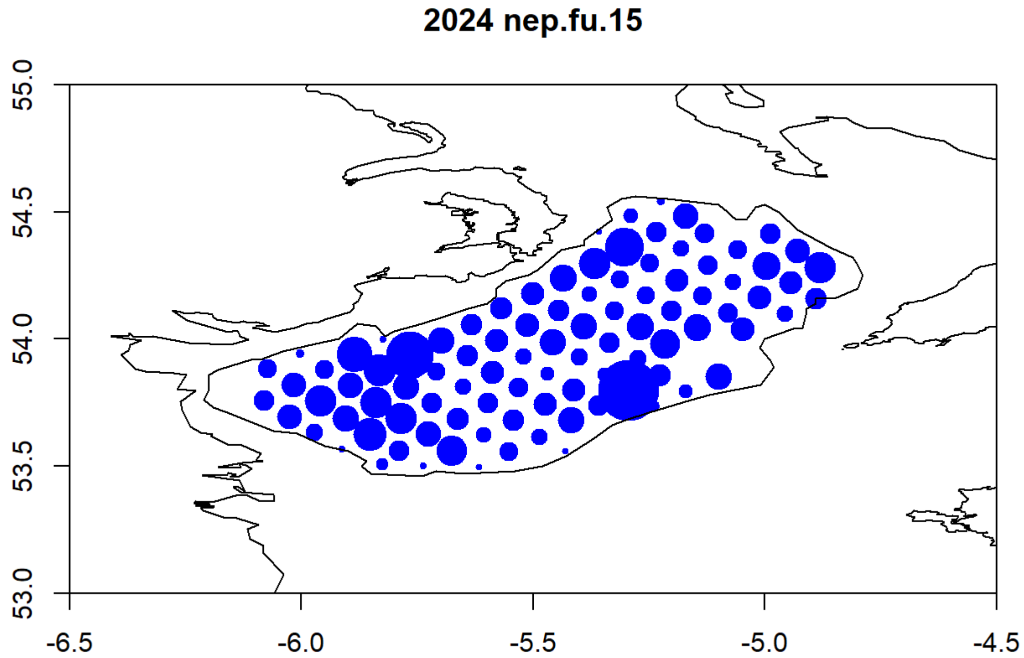


Figure 15.6. Irish Sea West (FU15): 2024 UWTV survey stations, symbol size reflects the burrow density.

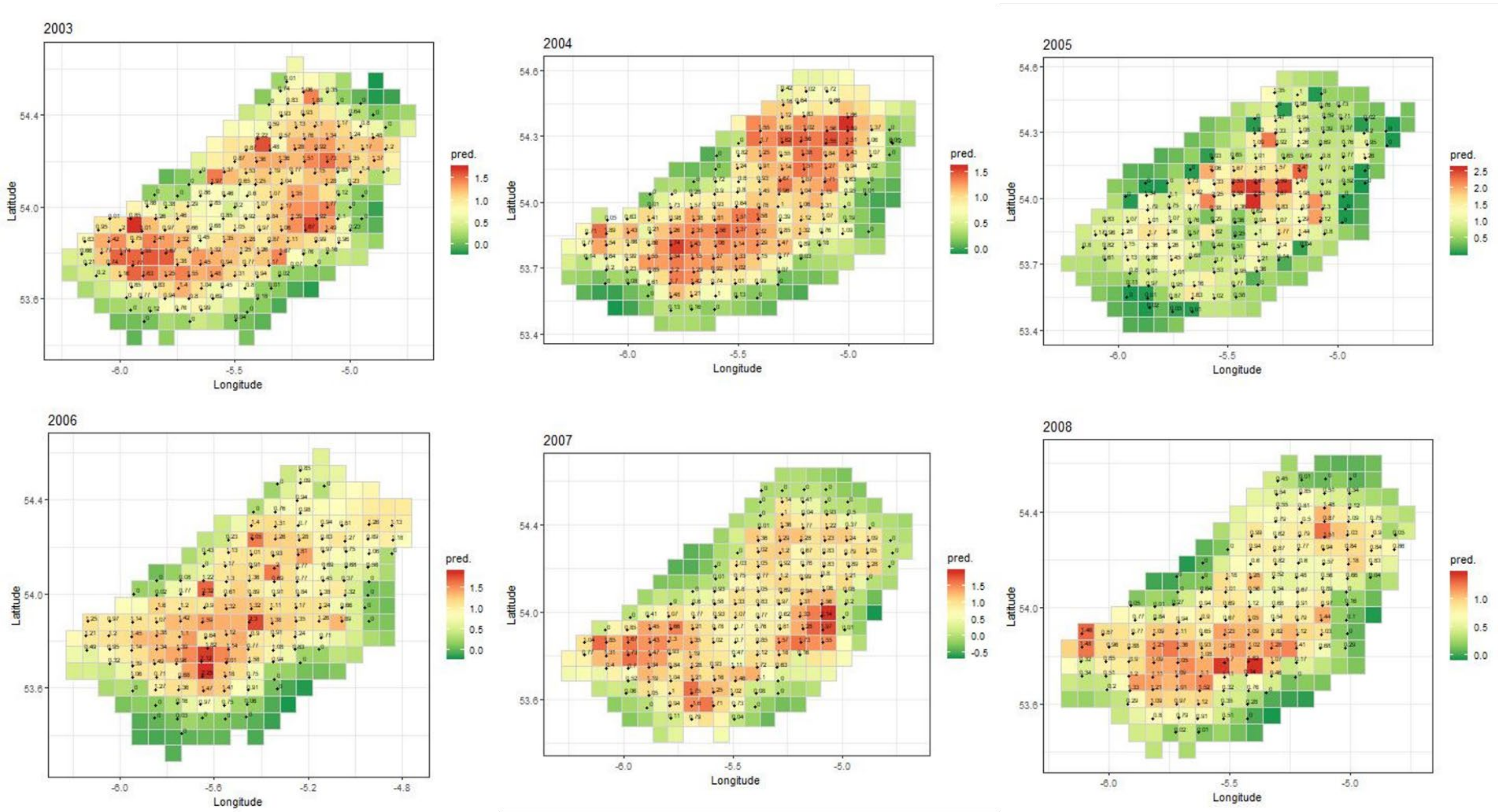


Figure 15.7. Irish Sea West (FU15): Contour plots of the krigged density estimates for the Irish Sea from 2003–2008.

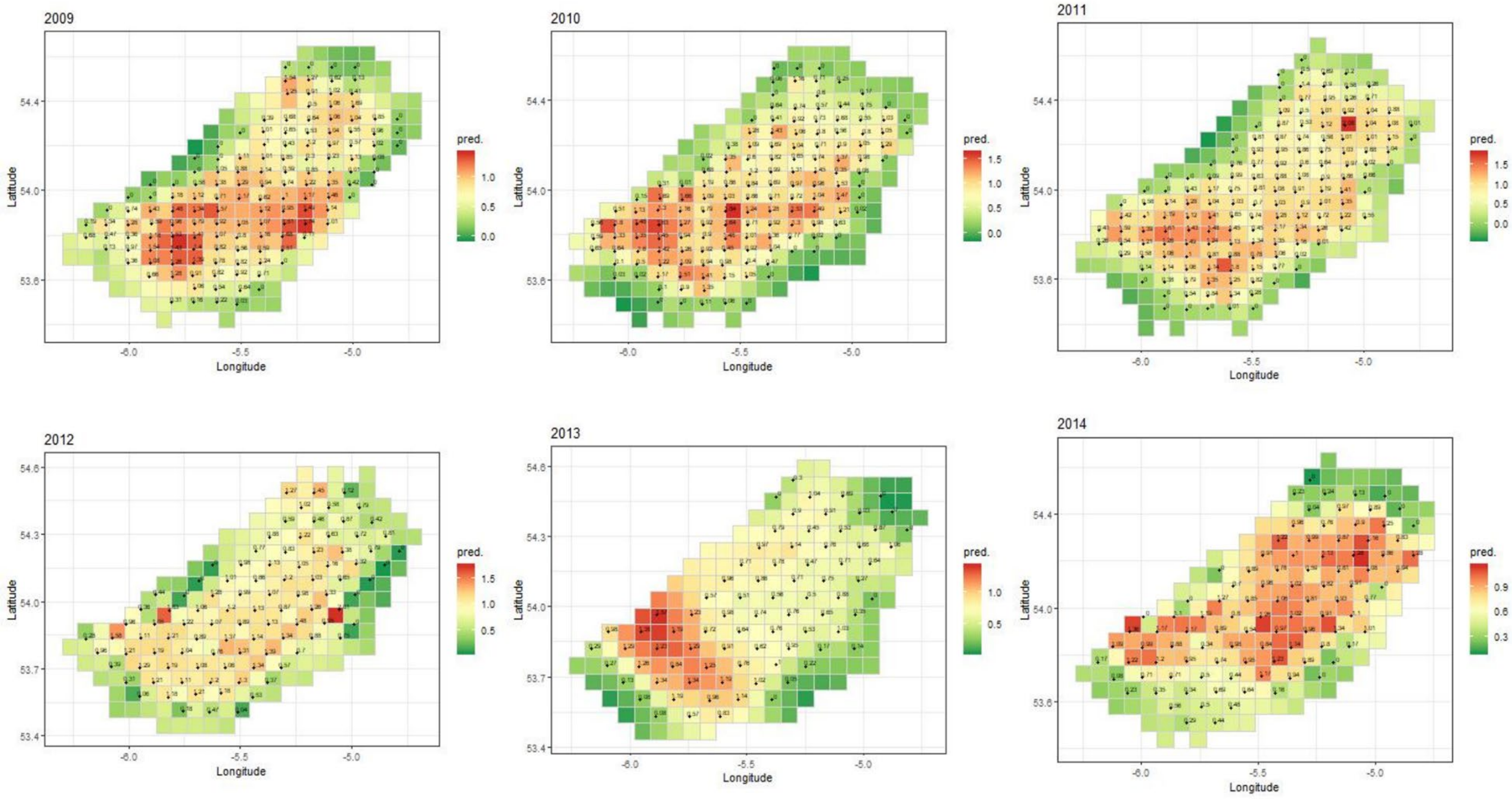


Figure 15.8. Irish Sea West (FU15): Contour plots of the krigged density estimates for the Irish Sea from 2009–2014.

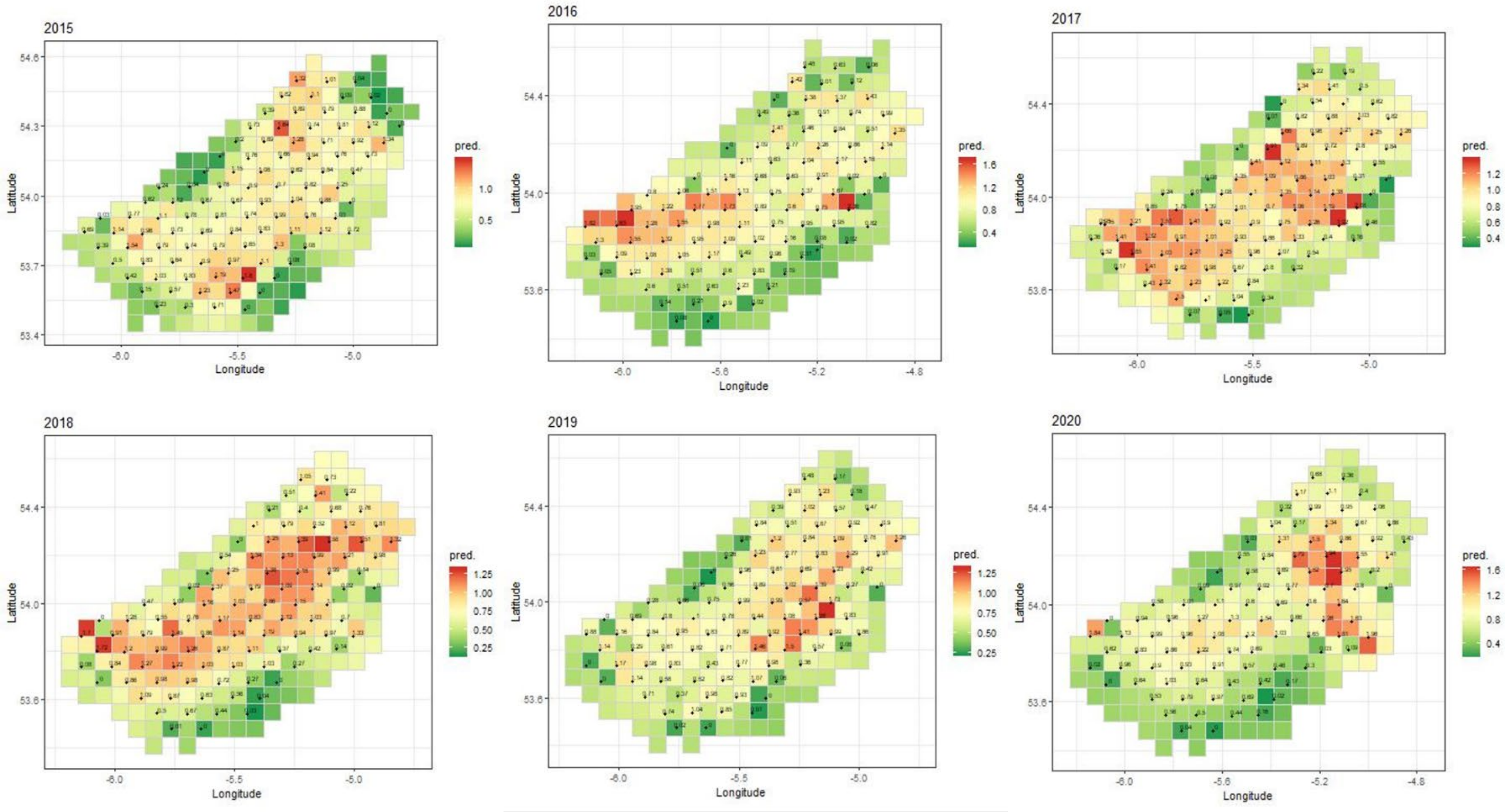


Figure 15.9. Irish Sea West (FU15): Contour plots of the krigged density estimates for the Irish Sea from 2009–2020.

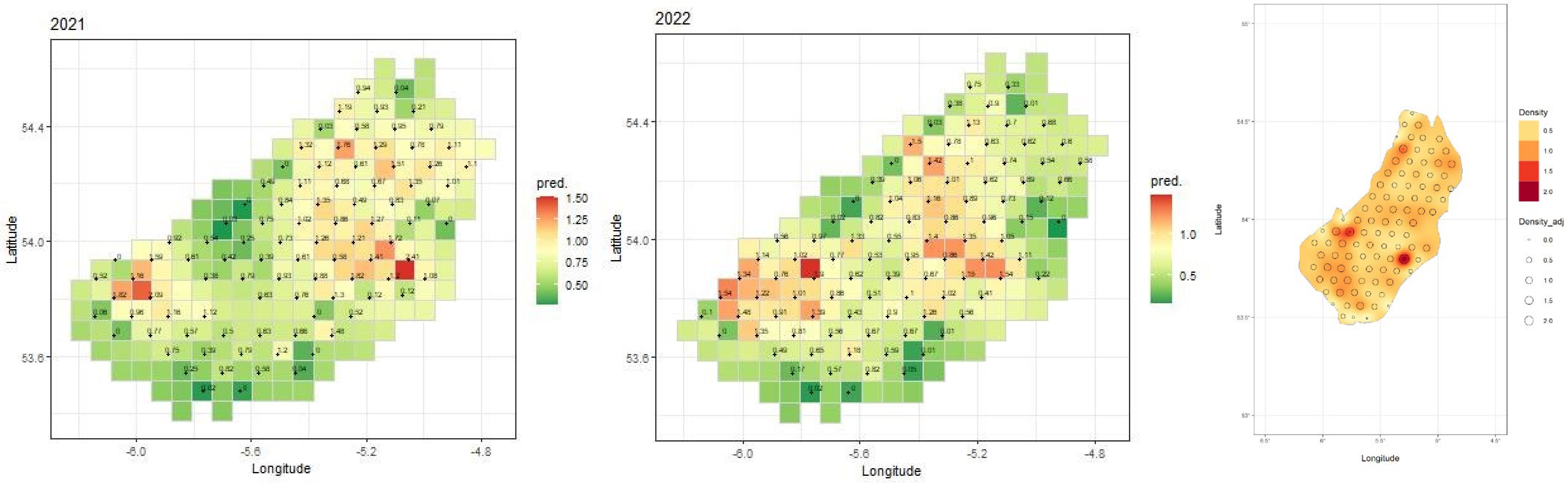


Figure 15.10. Irish Sea West (FU15): Contour plots of the krigged density estimates for the Irish Sea for 2021, 2022 and 2024

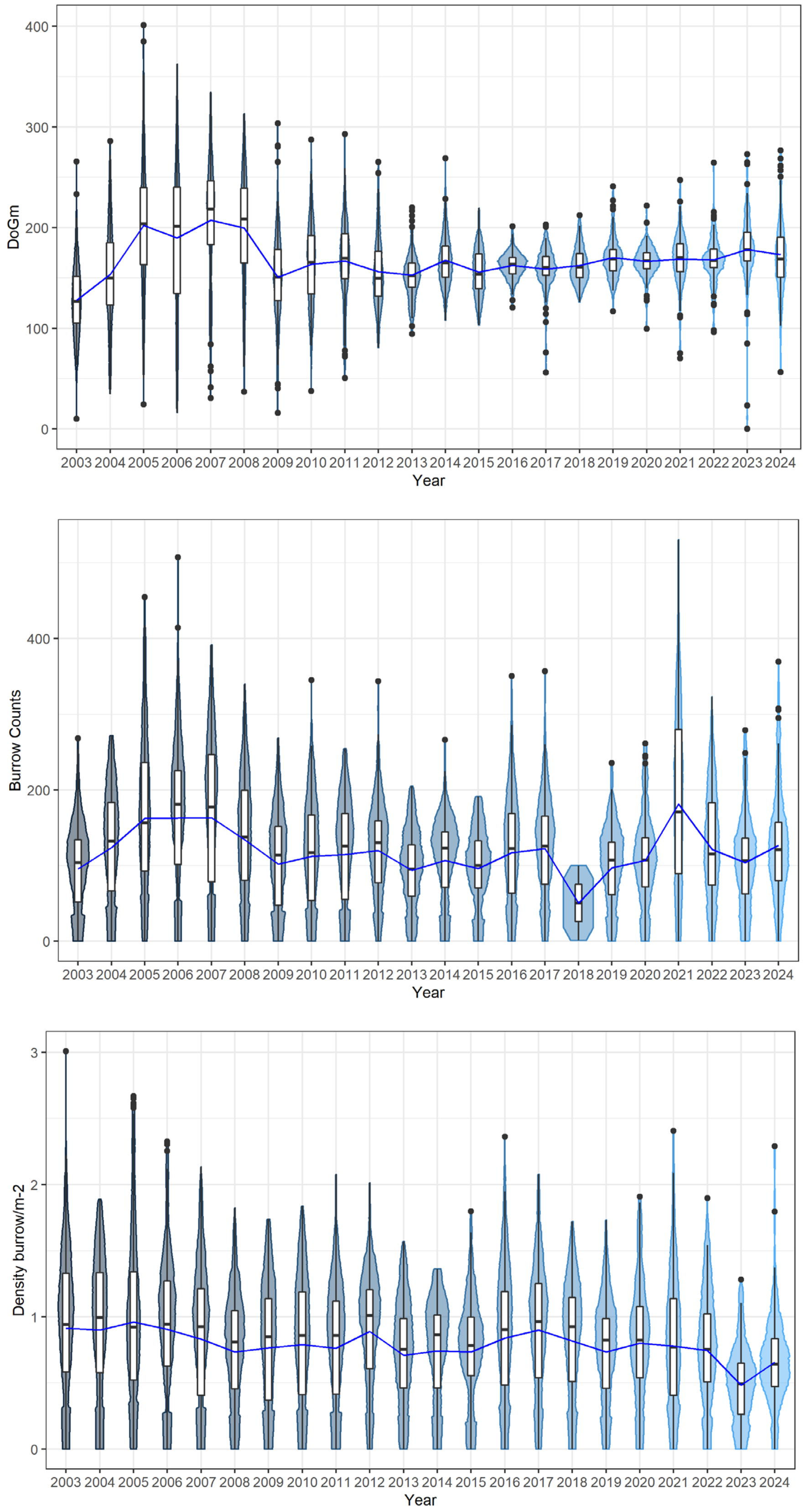


Figure 15.11. Irish Sea West (FU15): Violin plots of DoG, counts and burrow density observed during UWTV survey 2003–2024.

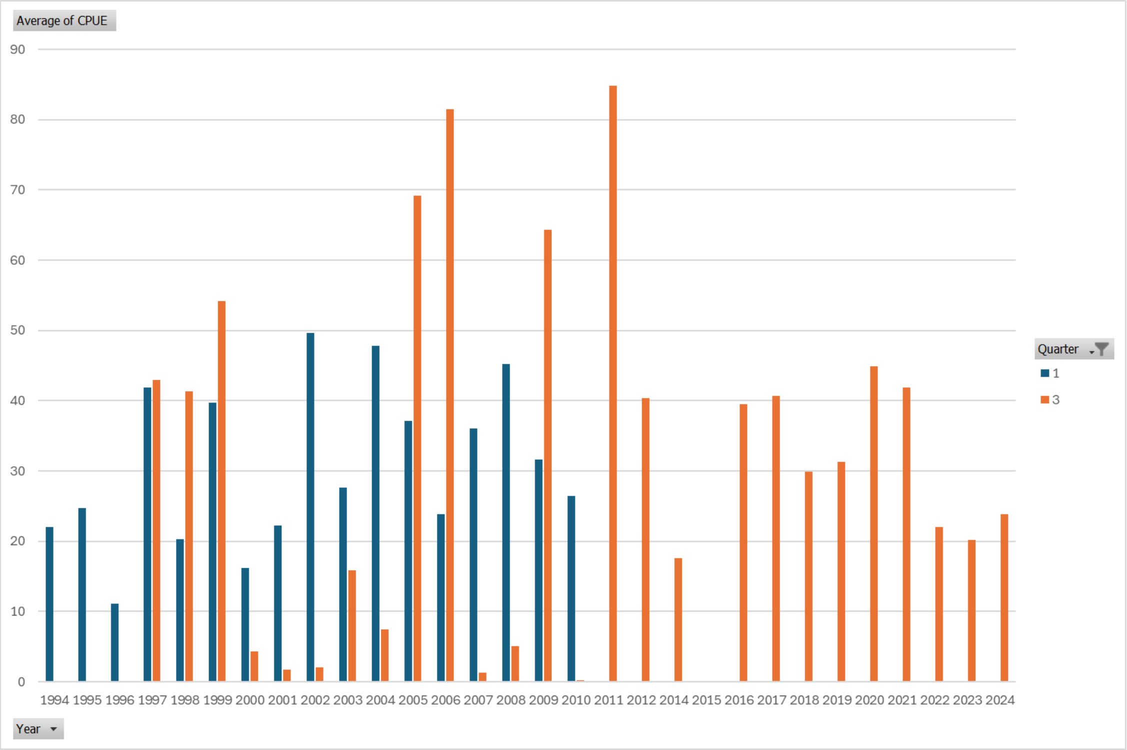


Figure 15.12 Irish Sea West (FU15): *Nephrops* catches (kg per nm) from NI trawl surveys. No data available in 2013 due to ship breakdown.

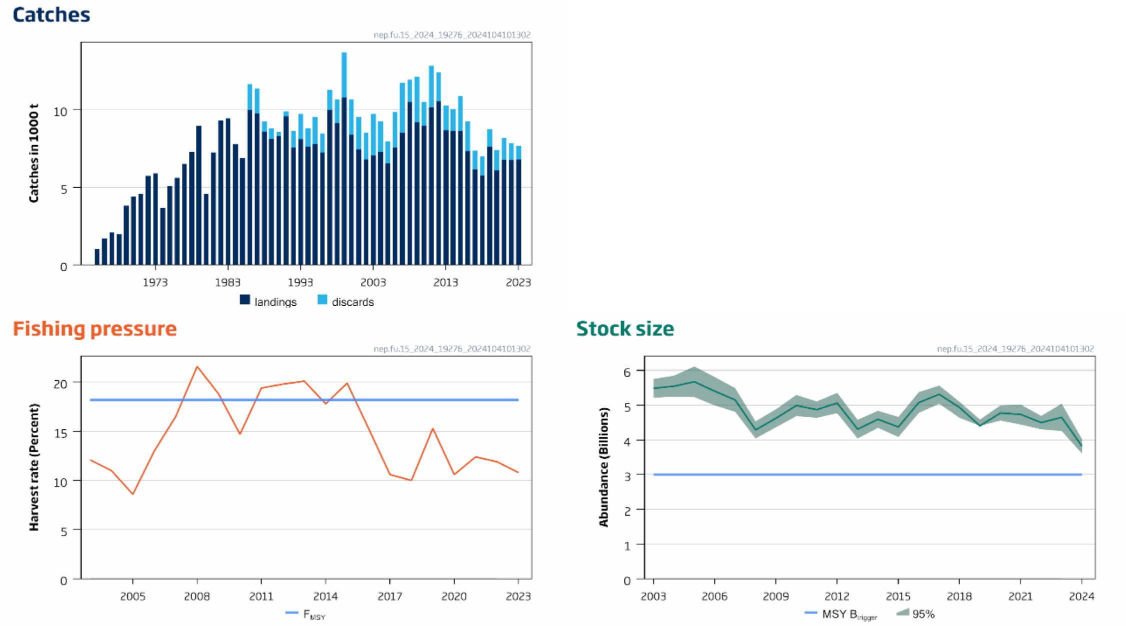


Figure 15.13 Norway lobster in Division 7.a, Functional Unit 15. Summary of the stock assessment. Catches (discard data are only available from 1986), harvest rate (sum of landings and dead discards in numbers, divided by total abundance), survey abundance (Underwater TV, billions; SSB proxy; 95% confidence intervals). Harvest rates between 2003 and 2006 may be underestimated because of underreporting of landings. Orange lines represent MSY Btrigger and the F_{MSY} harvest rate.

Contents

16 Norway lobster (*Nephrops norvegicus*) in divisions 7.b-c and 7.j-km Functional Unit 16 (west and southwest of Ireland)

Type of assessment in 2024

Available data on the fishery for 2023 and other stock indicators have been updated here according to the Stock Annex (*Nephrops* FU16). The assessment and catch options follow the agreed procedures set out in the Stock Annex; however, mean weight calculations since 2020 deviated from the Stock Annex and are detailed in Section 16.4 below.

ICES advice applicable to 2023

"ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, and assuming zero discards, catches in 2023 that correspond to the F ranges in the MAP are between 3 054 and 3 787 tonnes. The entire range is considered precautionary when applying ICES advice rule.

To ensure that the stock in FU 16 is exploited sustainably, management should be continued at the FU level. "

ICES advice applicable to 2024

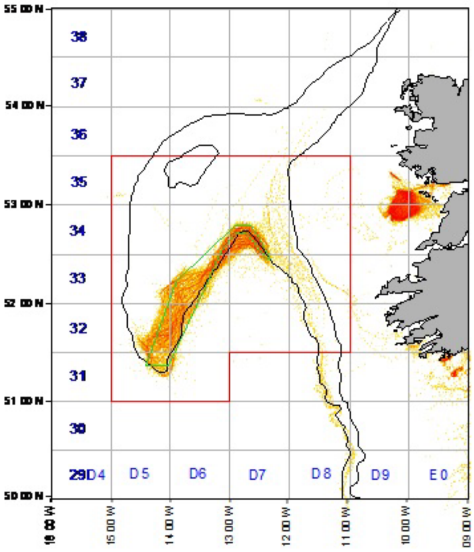
"ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, and assuming zero discards, catches in 2024 that correspond to the F ranges in the MAP are between 3 732 and 4 627 tonnes. The entire range is considered precautionary when applying ICES advice rule.*

To ensure that the stock in Functional Unit (FU) 16 is exploited sustainably, management should be continued at the FU level."

16.1 General

16.1.1 Stock description and management units

The TAC area is Subarea 7; since 2011, an 'of which' clause was introduced specifically for the Porcupine Bank (FU16; see Table 16.1). The Functional Unit for assessment includes some parts of the following ICES divisions: 7.b, c, j, and k. The exact stock area is shown on the map below and includes the following ICES Statistical rectangles: 31–35 D5–D6; 32–35 D7–D8.



The FU16 outlined by the red line. The closed area from 01 May–31 July since 2010 (reduced to only May since 2013) is shown with a green line. Irish *Nephrops* directed fishing effort between 2006–2009 derived from integrated VMS and logbook information is shown as a heat map.

Management applicable to 2023 and 2024

TAC in 2023

Council Regulation (EU) 2023/194 of 30 January 2023 fixing for 2023 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, as well as fixing for 2023 and 2024 such fishing opportunities for certain deep-sea fish stocks.

Species:	Norway lobster *Nephrops norvegicus*		Zone:	7 (NEP/07.)
Spain	981	(1)	Analytical TAC	
France	3 974	(1)		
Ireland	6 027	(1)		
Union	10 982	(1)		
United Kingdom	7 371	(1)		
TAC	18 353	(1)		
(1)	Special condition: within the limits of these quotas, no more than the quantities given below may be taken in the following zone: Functional Unit 16 of subarea 7 (NEP/*07U16)			
Spain	1 142			
France	715			
Ireland	1 374			
Union	3 231			
United Kingdom	556			

TAC in 2024

Consolidated text: Council Regulation (EU) 2024/257 of 10 January 2024 fixing for 2024, 2025 and 2026 the fishing opportunities for certain fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, and amending Regulation (EU) 2023/194

Species:	Norway lobster *Nephrops norvegicus*		Zone:	7 (NEP/07.)
Spain	991	(1)	Analytical TAC	
France	4 018	(1)		
Ireland	6 095	(1)		
Union	11 104	(1)		
United Kingdom	7 799	(1)		
TAC	18 903	(1)		
(1)	Special condition: within the limits of these quotas, no more than the quantities given below may be taken in the following zone: Functional Unit 16 of subarea 7 (NEP/*07U16)			
Spain	1 375			
France	861			
Ireland	1 655			
Union	3 891			
United Kingdom	669			

16.2 Closed area restrictions

A seasonal closed area was put in place for three months, May 01–31 July, between 2010-2012. The period of the EU regulatory closure was reduced to only one month between 2013-2019 (Council Regulation 2019/124, *Article 13*).

The following TCMs are in place for *Nephrops* in Subarea 7 (excluding 7.a) after EC 850/98 in operation since 2000. Minimum Landing Sizes (MLS); total length >85 mm, carapace length >25 mm, tail length >46 mm. Although it is legal to land smaller prawns from this fishery, marketing restrictions imposed by producer organizations in France mean smaller *Nephrops* (<35 mm CL or 115 mm whole length) are not retained in this fishery.

The mesh size restrictions apply to towed gears in subareas 7.b–k targeting *Nephrops* and are given in Section 7.1. Vessels mainly used 80–99 mm mesh to target *Nephrops* on the Porcupine Bank.

The landing obligation applied since 2016 for certain vessels that matched the criteria set out in the discard plans: https://ec.europa.eu/fisheries/cfp/fishing_rules/discards_en

Approximately 14% of the defined fishing ground has been closed to fishing activities using bottom gears since 2023, owing to the implementation of the EU Deep-sea Access regulation (EU, 2016).

16.3 Fishery in 2023

WGCSE reviewed effort trends for Irish vessels that accounted for 53% of the total landings in 2023. The Irish fishery in 2023 took place up to April, after which the fishery was closed, but was reopened from October to December. In 2017, the industry reported very good catches of *Nephrops* but commented that the mean size declined significantly; however, mean sizes increased in 2018 and 2019. In recent years, mean weights have decreased again, and 2023 mean weights are the lowest in the history of the stock (Figure 16.4).

Effect of regulations

Prior to 2011, TACs and quotas were applied to the whole Subarea 7, so the FU16 fishery was not restricted by quotas. Since 2011, the 'of which' clause was implemented in the TAC regulation specifically for the Porcupine Bank. Quotas have been very restrictive for Irish vessels and this has led to various changes in fishing patterns. Vessels have tried to optimize the economic value of the catch by targeting areas and periods with relatively smaller[1] volumes of larger higher value *Nephrops*. The FU16 specific quota has also increased area misreporting in the past and the risk of discarding. An unallocated component related to area misreporting was included in the assessment from 2011 to 2017. Since 2018, following the implementation of new legislation limiting fishing trips to single functional units, misreporting was not included in the assessment.

[1] There is a large price differential between the large and small grades. So less volume of the larger grade generates an economically viable return for fishing.

Information from stakeholders

The provision of grade information by individual fishers and coops remains a highly important assessment input. However, since 2020, graded information has not been used in the assessment.

Year	% of Irish landings where grade data were provided
2011	60%
2012	45%
2013	57%
2014	33%
2015	44%
2016	49%
2017	31%
2018	31%
2019	50%

The industry collaborated with the development of an Irish Fisheries Science Research Partnership survey in 2010 (Stokes and Lordan, 2011).

The Irish industry considers that the stock has increased significantly and no longer requires the Functional Unit ‘of which’ clause.

16.4 Data

InterCatch

Data were available in InterCatch and used on a trial basis.

Landings

Total international landings increased by 5.8% in 2023 to 3 011 t (Figure 16.1 and Table 16.2). From 2011 to 2017, total landings for FU16 had included ‘unallocated landings’ from other FU due to misreporting. Since 2018, no reallocation has been applied as there was no information concerning misreporting.

Sampling levels

Sampling levels, data aggregating, and raising procedures were reviewed by WKNEPH 2013, and are documented in the Stock Annex. Recent sampling rate is provided in Table 16.3.

Since 2010, landings length distributions have been reconstructed using the methods outlined in the Stock Annex. This involves using samples of the grade length structure from Irish sampling and estimates of the volume of each commercial size grade provided by the fishing industry. This was used to reconstruct Irish LFDs; landings by other fleets, which accounted for ~23% of the total landings from 2010 to 2019, were unsampled.

Since 2020, due to the low sampling levels of graded landings caused by COVID-19 restrictions, efforts were made to adapt the sampling programme. Unsorted catch samples were collected from 5, 12, 9, and 31 *Nephrops* fishing trips, respectively in 2020, 2021, 2022, and 2023.

Commercial length–frequency distributions

The time-series of raised international length–frequency distributions of the sampled landings by sex are given in Figure 16.2. This also shows significant shift towards larger individuals in the landings between 2002–2009 when few individuals at smaller sizes were observed. The length distribution in 2019 was similar to 2018. The mean lengths by sex and year are presented in Table 16.4. These figures and tables have not been updated since 2019.

Sex ratio

Previous *Nephrops* working groups have highlighted stability in sex ratio as an important indicator for *Nephrops* stocks. The landings and fishery-independent survey catches show a dramatic switch in the sex ratio for this stock with larger proportions of females in the catches of 2008 and 2009 (Figure 16.3). Both the commercial and survey data indicate that sex ratio switched back to a more usual situation since 2010 with males accounting for larger proportions of the catch/landings.

Nephrops moult once a year shortly after hatching of eggs in April or May. There is a 24-hour period after moulting when the male *Nephrops* can mate with the female (Farmer, 1974). If there are insufficient males in the population to mate with the recently moulted females, this can result in a change in female behaviour whereby unmated females concentrate on feeding and growth instead of reproduction. This so-called ‘sperm limitation’ hypothesis could explain the sex ratio changes observed in the Porcupine *Nephrops*. WKNEPH 2013 examined the available scientific data on proportions of females mated observed on the Spanish survey. These results showed high proportions of unmated females and a high L_{50} for mated females in catches in 2009. Simulations were also carried out to investigate the densities at which sperm limitation may become an issue given plausible ranges of stock density, sex ratios, search radii. The conclusion was that at the densities recently observed on the Porcupine Bank that sperm limitation was a real possibility.

Mean weight explorations

The mean weights in the landings are shown for the full time-series in Figure 16.4 and Table 16.5. Since 2020, due to COVID-19 restrictions, mean weight calculations deviated from the Stock Annex and were estimated using the average mean weights of catch samples from *Nephrops* fishing trips.

Discards

There are few historical estimates of discards for this stock. Irish sampling up to 2016 observed very minimal discarding (mainly limited to small and damaged individuals <5% by number). Four Irish trips were sampled in 2016. Discards were not recorded on one of these trips. However, on the other three trips, discards were estimated to be around 8%, 9%, and 15% by number (3%, 3%, and 6% by weight). In 2017 there were two trips where discards were recorded, 17% and 43% by number. In 2018, discards were observed on one of the two trips (74% by number); no discards were observed on the other trip. In 2019, discards were observed in two of the four trips (13% and 29% by number). In 2020, discards were observed in two of the five trips. In 2021, discards were observed in four of the 12 trips. In 2022, discards were observed in three of the nine trips. In 2023, discards were observed in 21 of the 31 trips. The discarding observed on these trips is likely not reflective of the overall discard pattern as the skippers advised the scientist on board that they had increased their discards to remain within quota during the observed trip.

This means that the current discard pattern is unknown, but can be no longer considered negligible.

A detailed examination of discard estimates was provided in Spain in 2014. No estimate was provided in InterCatch by Spain since 2015.

Abundance indices from UWTV surveys

Operational details of the 2024 UWTV survey are available (Aristegui *et al*., 2024). These surveys use the standard UWTV methodology and conforms to WGNEPS best practice and guidelines, documented in Dobby H., *et al*., 2021. WKNEPH 2013 recommended that these surveys could be used for assessment and provision of catch options. The results are given in Table 16.6. Further detail of the survey is provided in the annex and annual survey reports are available at http://oar.marine.ie/handle/10793/59 (Aristegui *et al*., 2024).

Trawl surveys

The longest time-series of fishery-independent source of data is from the Spanish Porcupine trawl survey 2001–2023 (SpPGFS-WIBTS-Q4). This survey is carried out in September when *Nephrops* catchability is quite low, particularly of adults. Further information on this survey is provided in the IBTS report (ICES, 2015) and in previous IBTS reports. Data from 2022 survey for this report was taken from Fernández-Zapico *et al.* (2023).

Distribution of *Nephrops* catches and biomass in Porcupine surveys between 2001 and 2023 is shown in Figure 16.5. There was a year effect in 2008 when unusual gear parameters were observed. Catch rates in 2011 may also have been reduced due to exceptionally poor weather and gear performance issues. The stratified abundance estimate and biomass increased significantly from 2015 to 2018, decreased in 2019 and 2020, and has increased again in recent years (Figure 16.6).

The size structure of the catches in the survey shows two things: a lower mean size than in the commercial fleets and an increasing trend in mean size for both sexes up to 2008. In 2009, there is large reduction of mean size in both sexes due to a recruiting year class with a modal length at around 27 mm (possibly the 2006 year class). Tracking of cohorts was carried out at WKNEPH 2013 but the results are inconclusive (ICES, 2013). The survey showed increased recruitment since 2013, with significantly increased catch rates of individuals <21 mm (Figure 16.7). This has also led to increase catch rates of juveniles and adult *Nephrops* since 2016.

An Irish Fisheries Science Research Partnership (IFSRP) survey was developed in collaboration with the Irish fishing industry to obtain data from the closed area in 2010–2012. Details of the design and methodology are presented in Stokes and Lordan (2011). The survey uses both commercial gear (Comm) and a baca trawl similar to the SpPGFS-WIBTS-Q4. WKNEPH concluded that the IFSRP trawl survey is too short (with changes in coverage, gears and vessels) to draw an inference about CPUE changes reflecting changing stock abundance (ICES, 2013). The surveys carried out between 2010–2012 provided very useful data on population structure across the ground as well as data on grade structure and maturity-at-length.

Commercial CPUE

In the past, the *Nephrops* fishery on the Porcupine Bank was both seasonal and opportunistic with increased targeting during periods of high *Nephrops* emergence and good weather. Freezing of catches at sea has become increasingly prevalent since 2006, and the fishery now operates throughout the year, mainly targeting larger more valuable *Nephrops* in lower volumes. Fishing effort has fluctuated considerably in the recent past in response to availability of *Nephrops*.

Effort and lpue/CPUE data are generally not standardized, and hence do not take into account vessel capacity, efficiency, seasonality, or other factors that may bias perception of lpue/CPUE and abundance trends over the longer term. WKNEPH concluded that effort and lpue series should be maintain in the WGCSE report for information purposes (ICES, 2013). WGCSE 2016 recommended presenting the effort in KWDays and lpue in tonnes/ KWDays. Any inferences about changes in stock abundance from these data, should take account of the quality and bias concerns raised above.

These data are presented by country in Table 16.7.

16.5 Stock assessment

Comparison with previous assessments

This assessment is based on UWTV approach outlined in WKNEPH 2013 and using parameter in the stock annex (ICES, 2013). This year's assessment has been updated based on the results of the May-June 2024 UWTV survey (Aristegui *et al.* 2024).

State of the stock

The UWTV results are shown in Table 16.6. In 2017, the harvest rate was above FMSY for the first time. From 2018 to 2021, the harvest rate was below F_{MSY}, due to relatively high abundance estimates on UWTV surveys since 2018, and to the increase in mean weight in the landings, which resulted in a decrease in the landed numbers. In 2022, the harvest rate was above F_{MSY} again, due to an increase in landings. In 2023, the harvest rate is again below F_{MSY}. Total abundance decreased in 2024, but it is still the second highest value in the time-series.

Catch options table

The inputs to the catch options are given below. At this point, it is not possible to estimate the numbers and mean weights of discards in the fishery, although there are indications that discards have increased since 2016.

Variable	Value	Notes
Stock abundance (2025)	1677	UWTV survey 2024; individuals in millions
Mean weight in projected landings (2025)	33.55	Average 2021–2023; in grammes
Mean weight in projected discards (2025)	-	Unknown
Projected discards rate (2025)	-	Unknown
Discards survival rate (2025)	-	Not applicable

16.6 Reference points

New reference points were evaluated by WKMSYREF4 (ICES, 2016a) and advised by ICES (2016b). The F_{MSY} for this stock was increased from 5.0% to 6.2%. The F_{MSY} for this stock is based on $F_{0.1}$ for both sexes combined given the low density of *Nephrops* on the Porcupine Bank.

Stock code	MSY Flower*	F_{MSY}*	MSY F_{upper}* with AR	MSY $B_{trigger}$	MSY F_{upper}* with no AR
nep-16	5.0%	6.2%	6.2%	Not defined	6.2%

*** Harvest rate (HR).**

16.7 Management strategies

The EU multiannual plan (MAP) for stocks in the Western Waters and adjacent waters applies to this stock. The plan specifies conditions for setting fishing opportunities depending on stock status and for making use of the FMSY range for the stock. ICES considers the MAP to be precautionary when implemented at the FU level. Full details of the plan are described in EU (2019).

16.8 Quality of assessment and forecast

The main quality considerations for this stock are related to mean weight and discarding. The mean weight for this stock has been fluctuating, the most recent estimates maybe overestimate due to the non-inclusion of discards. The mean weight declined from 2014 to 2017 as strong year classes recruit to the fishery. Since 2017, a recent mean weight in the landing was considered the most appropriate basis in the calculation of catch scenarios. In previous years, a long-term mean weight was used.

There is good evidence from surveys and length structure of landings that recruitment improved between 2015 and 2017, and this resulted in a reduction in mean weight in the stock in those years. As expected, the mean weight increased in 2018 and 2019 as the stronger cohorts grows; however, in recent years mean weight has decreased, and 2023 mean weight is the lowest in the history of the stock. Currently, there is no methodology to take this into account in the calculation of catch options.

Up to 2015, discarding was considered negligible for this functional unit. Since 2016, the amount of discards observed on catch sampling trips have increased. This may be temporary linked to incoming recruitment. Sampling levels are insufficient to estimate total discards accurately, and projections assume no discards. The main concern is that the mean weight derived from the landings grades may be biased due to unknown discarding levels. Not including discards in the assessment results in an underestimate of the actual fishing pressure. The current estimate is above F_{MSY}.

The UWTV survey provides abundance since 2012 (except 2015) with high precision.

The landings are considered fairly well estimated up to 2023 (an unallocated component related to area misreporting was included from 2011 to 2017).

16.9 Recommendation for next benchmark

This stock was benchmark in 2013 at WK*NEPH*. WGCSE will keep the stock under close review and recommend future benchmark as required.

16.10 Management considerations

There is a separate catch limit for Functional Unit (FU) 16 within the wider TAC for Subarea 7. This has resulted in very restrictive quotas for some vessels which increased area misreporting and the risk of discarding from 2011 to 2017. Area misreporting diminished in 2018, with the introduction of a national legislation restricting Irish vessels' fishing areas, where since March 2018 Irish vessels targeting *Nephrops* in subareas 6 and 7 may only fish in either: (1) Subarea 6 and Subarea 7, excluding FU16; or (2) FU16 of Subarea 7 (Fisheries Management Notice No. 20 of 2018). Given the vulnerability of this stock to over exploitation, the separate catch limit for Functional Unit (FU) 16 should remain in place.

A seasonal closed area (01 May–31 July) has been in place since 2010. The period of the closure was reduced to one month, May, since 2013. There hasn't been an ICES evaluation of the impact of this closure and whether it provides a conservation benefit over and above catch limits. Some sectors of the fishing industry want to extend the period of closure because they believe that this is a more effective conservation measure than catch limits.

Productivity of deep-water *Nephrops* stocks is generally lower than that in shelf waters, though individual *Nephrops* grow to relatively large sizes and attain high market prices. Other deep-water *Nephrops* stocks off the Spanish and Portuguese coast have collapsed and have been subject to recovery measures for several years (e.g. FU25, 26, 27, and 31). Recruitment in *Nephrops* populations in deep water may be more sporadic than for shelf stocks with strong larval retention mechanisms. This makes these stocks more vulnerable to over exploitation and potential recruitment failure as has been observed on the Porcupine Bank in the early 2000s.

From 2019 vessels using highly selective gears in Subarea 7 can be exempted from the landings obligation on the basis of the high survival exemption (see discard plans). It is unknown if *Nephrops* discarded on the Porcupine Bank could actually survive the discarding process.

Discarding by the *Nephrops* trawl fishery is around 50% of the total catch by weight. The main species that are discarded by weight are blue mouth-red fish, blue whiting, and argentines (Marine Institute and Bord Iascaigh Mhara, 2011).

16.11 References

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16.12 Tables and Figures

Table 16.1. *Nephrops* Porcupine Bank (FU 16): Of which catch limit.

Year	France	Ireland	Spain	UK	Total
2011	241	454	377	188	1260
2012	238	457	380	185	1260
2013	340	653	543	264	1800
2014	349	671	557	271	1848
2015	349	671	558	272	1850
2016	349	671	558	272	1850
2017	586	1124	935	455	3100
2018	516	992	825	401	2734
2019	500	959	798	388	2645
2020	498	957	795	387	2637
2021	621	1194	992	483	3290
2022	530	1016	846	412	2804
2023	715	1374	1142	556	3787
2024	861	1655	1375	669	4560

Table 16.2. *Nephrops* Porcupine Bank (FU 16): Landings (tonnes) by country.

Year	France	Ireland	Spain	UK (E& W)	UK (NI)	UK (Scotland)	Unallocated	Total
1965	514							514
1966	0							0
1967	441							441
1968	441							441
1969	609							609
1970	256							256
1971	500		1444					1944
1972	0		1738					1738
1973	811		2135					2946
1974	900		1894					2794
1975	0		2150					2150
1976	6		1321					1327
1977	0		1545					1545
1978	2		1742					1744
1979	14		2255					2269
1980	21		2904					2925
1981	66		3315					3381
1982	358		3931					4289
1983	615		2811					3426
1984	1067		2504					3571
1985	1181		2738					3919
1986	1060		1462	69				2591
1987	609		1677	213				2499
1988	600		1555	220				2375
1989	324	350	1417	24				2115
1990	336	169	1349	41				1895
1991	348	170	1021	101				1640
1992	665	311	822	217				2015
1993	799	206	752	100				1857

Year	France	Ireland	Spain	UK (E& W)	UK (NI)	UK (Scotland)	Unallocated	Total
1994	1088	512	809	103				2512
1995	1234	971	579	152				2936
1996	1069	508	471	182				2230
1997	1028	653	473	255				2409
1998	879	598	405	273				2155
1999	1047	609	448	185				2290
2000	351	227	213	120				910
2001	425	369	270	158				1222
2002	369	543	276	139				1327
2003	131	307	489	108		29		1064
2004	289	494	468	126		28		1406
2005	397	754	681	208		156		2197
2006	462	731	636	201		155		2185
2007	302	1060	384	146		183		2074
2008	26	562	234	41		138		1000
2009	4	356	348	13		159		879
2010	4	579	240	10		90		922
2011	8	643	182	23		122	301	1278
2012	0.46	605	198	0		134	320	1258
2013	5.8	651	132	1		118	234	1141
2014	3	813	129	0		96	148	1189
2015	3	744	84	0		109	454	1394
2016	35	1052	58	1		160	849	2154
2017	63	743	73	4	245	131	1373	2632
2018	81	2079	158	8	280	144	0	2751
2019	54	1529	112	7	325	201	0	2229

Year	France	Ireland	Spain	UK (E& W)	UK (NI)	UK (Scotland)	Unallocated	Total
2020	41	1516	82	1	259	<1	0	1899
2021	49	1611	318	1	329	169	0	2476
2022	210	1649	380	<1	483	125	0	2846
2023	183	1585	416	11	701	115	0	3011

Table 16.3. *Nephrops* Porcupine Bank (FU 16): Recent sampling used in the assessment.

Year	Spain		France		Ireland	
	Number of Trips	Type	Number of Trips	Type	Number of Trips	Type
2010	0		0		3	Graded Landings
2011	0		0		2	Graded Landings
2012	0		0		3	Graded Landings
2013					3	Graded Landings
2014					3	Graded Landings
2015					3	Graded Landings
2016					4	Graded Landings
2017					2	Graded Landings
2018					2	Graded Landings
2019					4	Graded Landings
2020					5	Unsorted Catch
2021					12	Unsorted Catch
2022					9	Unsorted Catch
2023					31	Unsorted Catch

Table 16.4. ***Nephrops*** **Porcupine Bank (FU 16): Mean sizes (mm CL) of male and female** ***Nephrops*** **in Spanish, French and Irish landings and the Spanish Porcupine Groundfish survey.**

Year	Spain Landings		Ireland Landings		France Landings		Porcupine Survey Catch	
	Males	Females	Males	Females	Males	Females	Males	Females
1981	39.9	34.5	-	-	-	-	-	-
1982	40.9	34.8	-	-	-	-	-	-
1983	40.8	34.0	-	-	-	-	-	-
1984	39.7	33.1	-	-	-	-	-	-
1985	38.7	33.5	-	-	-	-	-	-
1986	40.7	36.4	-	-	-	-	-	-
1987	39.3	35.0	-	-	-	-	-	-
1988	40.7	38.3	-	-	-	-	-	-
1989	40.5	36.8	-	-	-	-	-	-
1990	41.0	36.1	-	-	-	-	-	-
1991	39.4	34.5	-	-	-	-	-	-
1992	39.2	34.1	-	-	-	-	-	-
1993	41.6	36.1	-	-	-	-	-	-
1994	40.8	36.5	-	-	-	-	-	-
1995	41.3	36.6	40.7	36.5	43.2	38.3	-	-
1996	41.6	35.1	34.6	35.3	41.7	38.9	-	-
1997	39.7	34.8	35.9	34.5	41.9	38.4	-	-
1998	41.1	34.6	37.2	35.6	41.9	38.4	-	-
1999	41.5	35.7	36.6	33.7	43.1	39.1	-	-
2000	41.1	34.8	na	na	45.3	40.5	-	-
2001	41.1	36.3	37.8	35.4	45.4	39.4	36.0	28.9
2002	39.7	35.3	36.1	38.5	45.3	40.3	37.5	31.7
2003	41.4	37.8	44.5	36.2	46.2	38.9	39.7	30.9
2004	43.5	38.5	43.5	35.7	46.4	41.5	39.9	30.5
2005	43.4	38.1	46.9	40.6	45.9	41.0	45.1	33.8
2006	43.9	38.0	na	na	48.9	41.4	44.3	35.0

Year	Spain Landings		Ireland Landings		France Landings		Porcupine Survey Catch	
	Males	Females	Males	Females	Males	Females	Males	Females
2007	43.7	41.0	na	na	48.3	43.8	45.9	37.8
2008	51.0	40.6	43.3	37.5	na	na	48.8	38.7
2009	43.0	42.7	44.1	40.1	na	na	32.6	28.9
2010	na	na	43.2	40.4	na	na	36.3	31.8
2011	na	na	39.5	38.4	na	na	39.0	33.6
2012	na	na	41.1	38.1	na	na	41.1	30.8
2013	na	na	42.9	38.9	na	na	37.6	25.1
2014	na	na	45.1	40.9	na	na	36.4	31.0
2015	na	na	40.3	39.7	na	na	35.5	32.7
2016	na	na	37.8	37.3	na	na	32.2	27.8
2017	na	na	35.7	32.9	na	na	34.1	26.8
2018	na	na	38.8	35.3	na	na	35.0	28.2
2019	na	na	41.3	36.2	na	na	35.2	29.3
2020	na	na	na	na	na	na	37.5	29.0
2021	na	na	na	na	na	na	34.6	29.8
2022	na	na	na	na	na	na	34.3	27.6
2023	na	na	na	na	na	na	33.2	27.8

Table 16.5. *Nephrops* Porcupine Bank (FU16): Time-series of numbers landed and mean weight in the landings.

Year	Numbers (millions)	Weight Landed (Tonnes)	Mean Weight in landings (gr)
1986	55.7	2591	46.53
1987	60.3	2499	41.42
1988	48.1	2375	49.34
1989	45.6	2115	46.4
1990	38.9	1895	48.67
1991	37.3	1640	43.98
1992	47	2015	42.84
1993	38.5	1857	48.29
1994	54.4	2512	46.15
1995	65.5	2936	44.79
1996	52.9	2230	42.15
1997	59.1	2409	40.73
1998	49.9	2155	43.16
1999	52.3	2290	43.76
2000	15.1	910	60.13
2001	24.6	1222	49.65
2002	32	1327	41.49
2003	18.4	1064	57.76
2004	21.5	1406	65.28
2005	31.5	2197	69.84
2006	28.7	2185	76.24
2007	29.2	2074	71.05
2008	17.9	1000	55.89
2009	16.5	879	53.19
2010	14.1	922	65.32
2011	27.9	1278	45.81
2012	25.0	1258	50.36
2013	19.8	1141	57.54
2014	17.3	1189	68.54

Year	Numbers (millions)	Weight Landed (Tonnes)	Mean Weight in landings (gr)
2015	27.4	1394	50.86
2016	53.5	2154	40.29
2017	84.9	2632	31.01
2018	66.2	2751	41.55
2019	42.2	2251	53.38
2020	49.6	1899	38.26
2021	57.9	2476	42.77
2022	92.4	2846	30.81
2023	111.3	3011	27.06
Average 2021–2023			33.55

Table 16.6. ***Nephrops*** **Porcupine Bank (FU16): Assessment summary.**

Year	Low	UWTV abundance estimate	High	Landings in number	Total discards in number*	Removals in number	Harvest rate (by number)**	Landings	Total discards*	Discard rate (by number)	Dead discard rate (by number)	Mean weight in landings	Mean weight in discards
	millions						%	tonnes		%		grammes	
2012	708	787	866	25	0	25	3.2	1258	0	0	0	50.36	n/a
2013	707	768	829	20	0	20	2.6	1141	0	0	0	57.54	n/a
2014	687	722	757	17.3	0	17.3	2.4	1189	0	0	0	68.54	n/a
2015	No survey			27	0	27	3.3***	1394	0	0	0	50.86	n/a
2016	890	958	102	53	n/a	53	5.6	2154	n/a	n/a	n/a	40.29	n/a
2017	760	850	939	85	n/a	85	10.0	2632	n/a	n/a	n/a	31.01	n/a
2018	102	1117	120	66	n/a	66	5.9	2751	n/a	n/a	n/a	41.55	n/a
2019	910	1010	111	42	n/a	42	4.1	2229	n/a	n/a	n/a	53.38	n/a
2020	117	1264	135	50	n/a	50	3.9	1899	n/a	n/a	n/a	38.26	n/a
2021	927	1018	111	58	n/a	58	5.7	2476	n/a	n/a	n/a	42.77	n/a
2022	127	1363	145	92	n/a	92	6.8	2846	n/a	n/a	n/a	30.81	n/a
2023	188	2002	212	111	n/a	111	5.6	3011	n/a	n/a	n/a	27.06	n/a
2024	158	1677	177										

***Discarding up to 2015 was considered to be negligible. Discard estimates are not available since 2016 and are therefore not included in the assessment.**

**** Values since 2016 onwards may be underestimated owing to insufficient discard data.**

***** The harvest rate is estimated based on a linear interpolation of abundance, as no survey was carried out in this year.**

n/a = not available

Table 16.7. ***Nephrops*** **Porcupine Bank (FU16): Effort and lpue for the various different fleets exploiting the stock.**

Year	Spain[1]		France[2]		Ireland[3]	
	Effort ('000's Hrs)	Lpue (kg/hr)	Effort[2] ('000's Hrs)	Lpue (>10%) (kg/hr)	Effort[3] ('000's KwDays)	Lpue (t/KWdays)
1980	318	9				
1981	272	12				
1982	237	17				
1983	196	14	18	35		
1984	194	13	30	35		
1985	200	14	33	36		
1986	162	9	28	38		
1987	174	10	24	26		
1988	180	9	22	27		
1989	173	8	14	23		
1990	159	9	15	23		
1991	138	7	19	18		
1992	96	9	32	21		
1993	80	9	36	22		
1994	80	10	38	28		
1995	67	9	42	30	584.9	1.4
1996	58	8	41	26	192.5	1.59
1997	57	8	41	25	327.3	1.26
1998	56	7	40	22	284.6	1.59
1999	53	8	43	21	278	1.29
2000	47	5	23	14	92.8	1.25
2001	44	6	24	15	230.2	1.12
2002	54	5	18	18	339.8	1.3

Year	Spain[1]		France[2]		Ireland[3]	
	Effort ('000's Hrs)	Lpue (kg/hr)	Effort[2] ('000's Hrs)	Lpue (>10%) (kg/hr)	Effort[3] ('000's KwDays)	Lpue (t/KWdays)
2003	66	5	7	19	294.7	0.8
2004	59	10	9	25	569.2	0.68
2005	60	13	15	26	756.2	0.83
2006	65	9	22	21	952.8	0.72
2007	58	8	17	18	1199.4	0.81
2008	42	6	4	7	830.7	0.67
2009	44	7	na	na	411.3	0.83
2010	42	6	na	na	704.1	0.81
2011	na	na	na	na	986.9	0.63
2012	15	na	na	na	817.1	0.63
2013	na	na	na	na	885.7	0.92
2014	na	na	na	na	1019.8	0.92
2015	na	na	na	na	1219.2	0.99
2016	na	na	na	na	1359.3	1.43
2017	na	na	na	na	1328.9	1.59
2018	na	na	na	na	1721.2	1.21
2019	na	na	na	na	1463.3	1.01
2020	na	na	na	na	1468.3	0.97
2021	na	na	na	na	1647.1	0.94
2022	na	na	na	na	1875.4	0.88
2023	na	na	na	na	1454.1	1.11

[1] = Effort and lpue between 1980 and 2010 was estimated based on fishing days in 7. Effort in 2012 was based on logbooks for FU16.

2 = Effort and lpue for vessels where <10% of landed value was *Nephrops*.

3 = Effort and lpue for vessels where 30% of the landed weight was *Nephrops*.

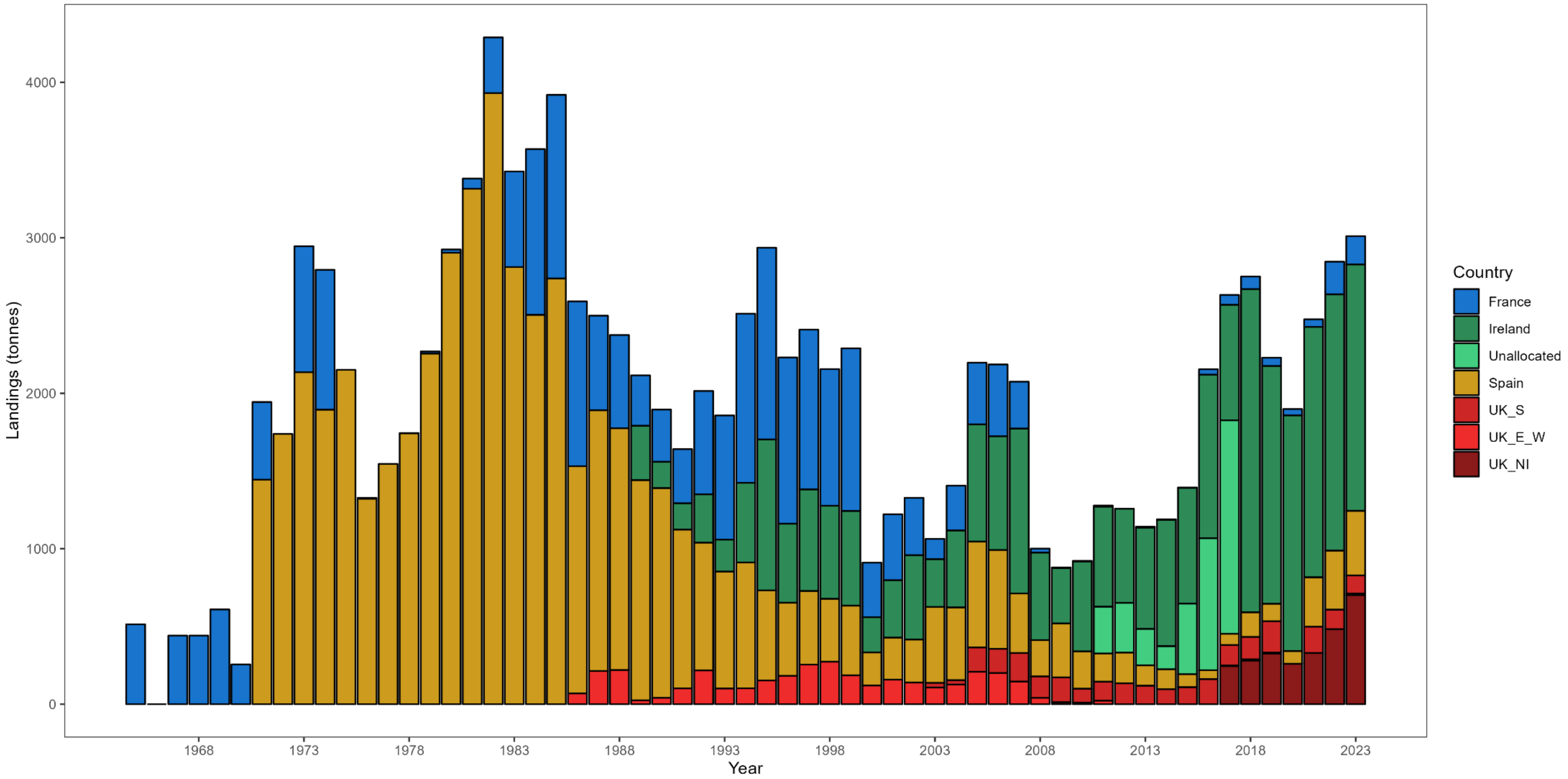


Figure 16.1. ***Nephrops*** **in FU16 (Porcupine Bank). WG's best estimates of landings in tonnes by country.**

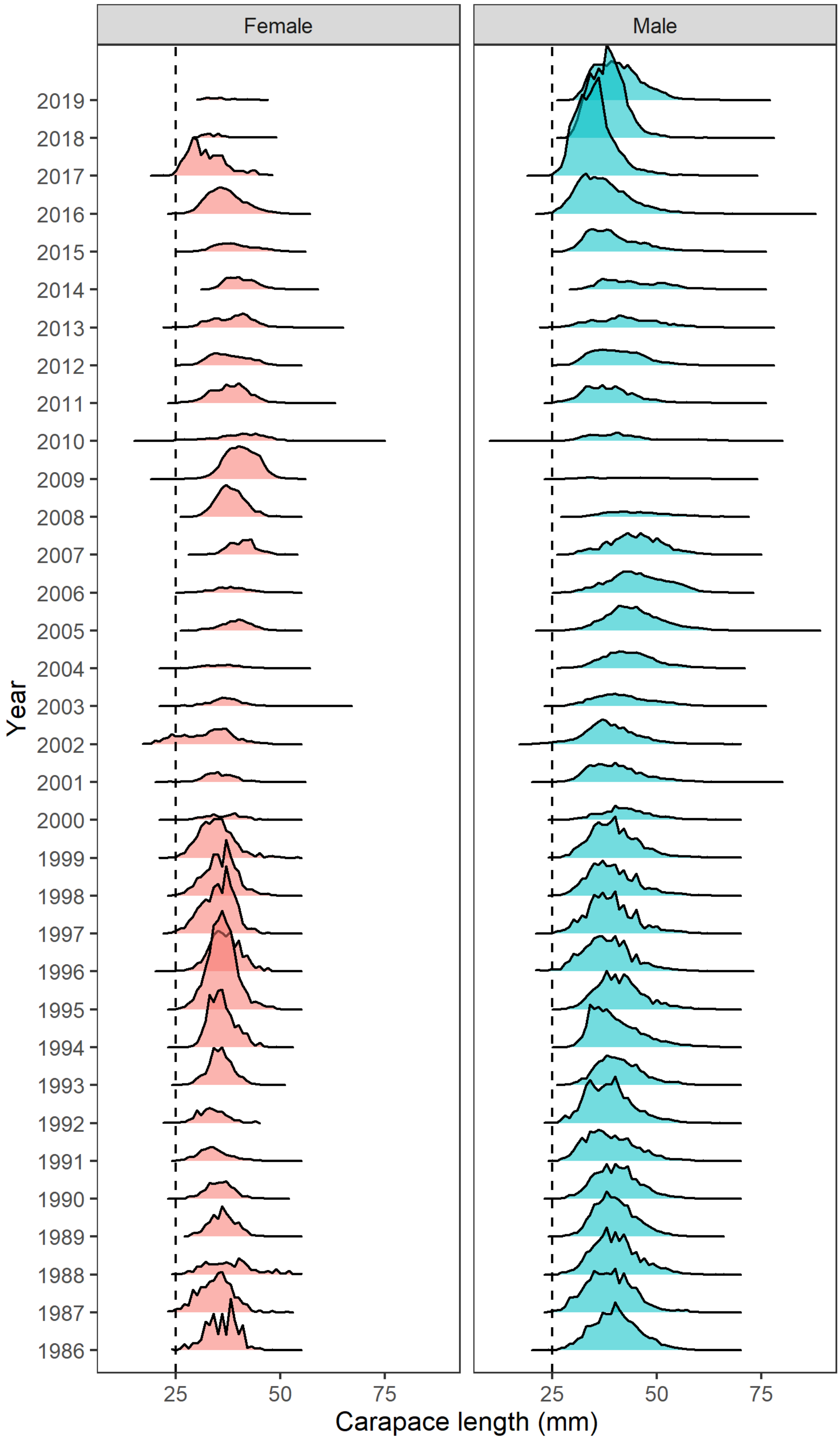


Figure 16.2. *Nephrops* in FU16 (Porcupine Bank). Female and male length distributions of raised international landings. Vertical dashed lines refer to Minimum Landing Size (25 mm).

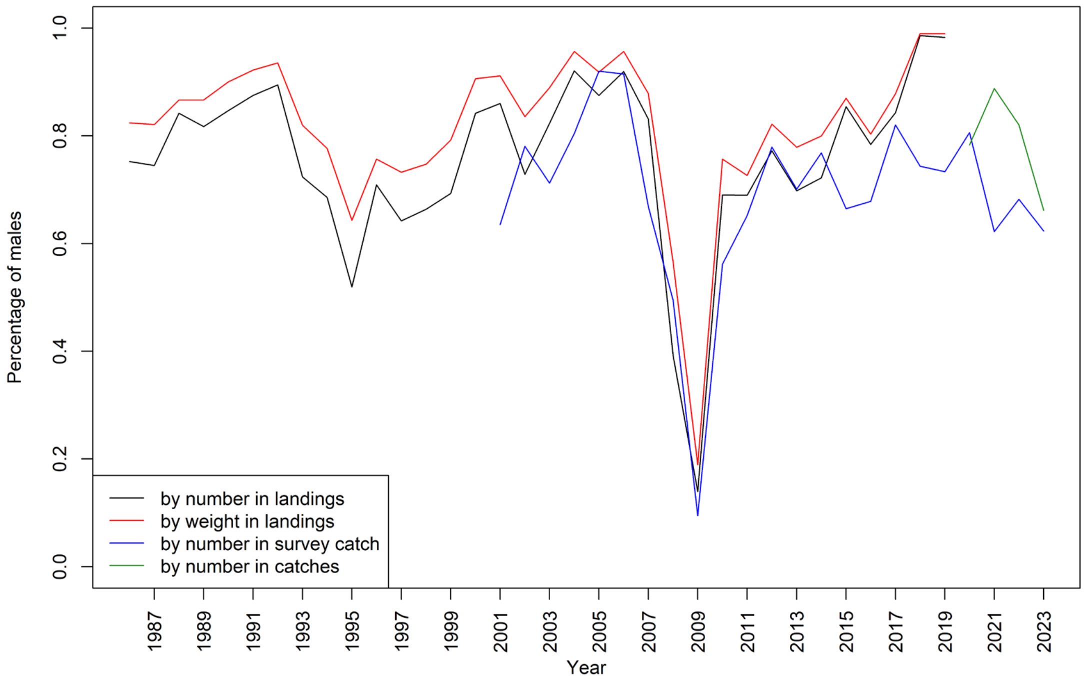


Figure 16.3. ***Nephrops*** **in FU16 (Porcupine Bank). The percentage males in the landings, survey and catches over time.**

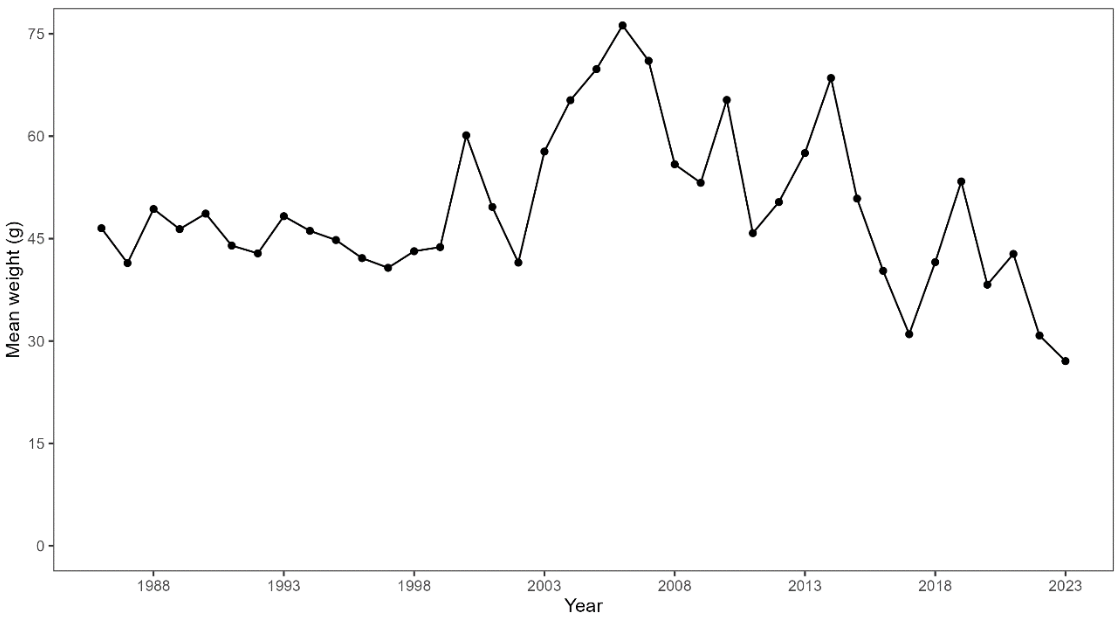


Figure 16.4. ***Nephrops*** **in FU16 (Porcupine Bank). Mean weight in the commercial landings.**

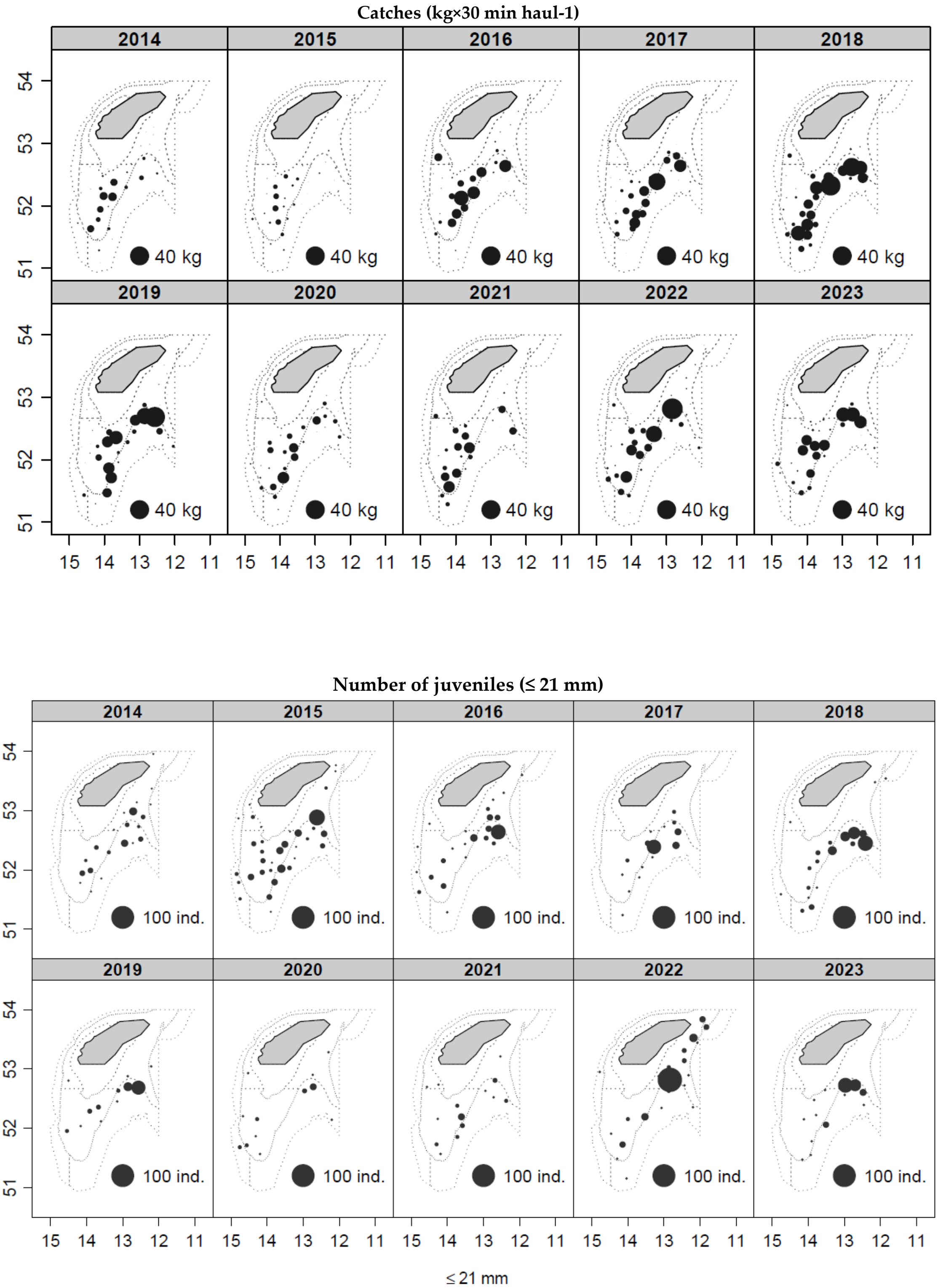


Figure 16.5. ***Nephrops*** **in FU16 (Porcupine Bank). Geographic distribution of** ***Nephrops norvegicus*** **in Porcupine surveys between 2014 and 2023. Top panel: catches (kg×30 min haul-1). Bottom panel: Number of juveniles (≤ 21 mm carapace length). (Fernández-Zapico** ***et al.*** **2023)**

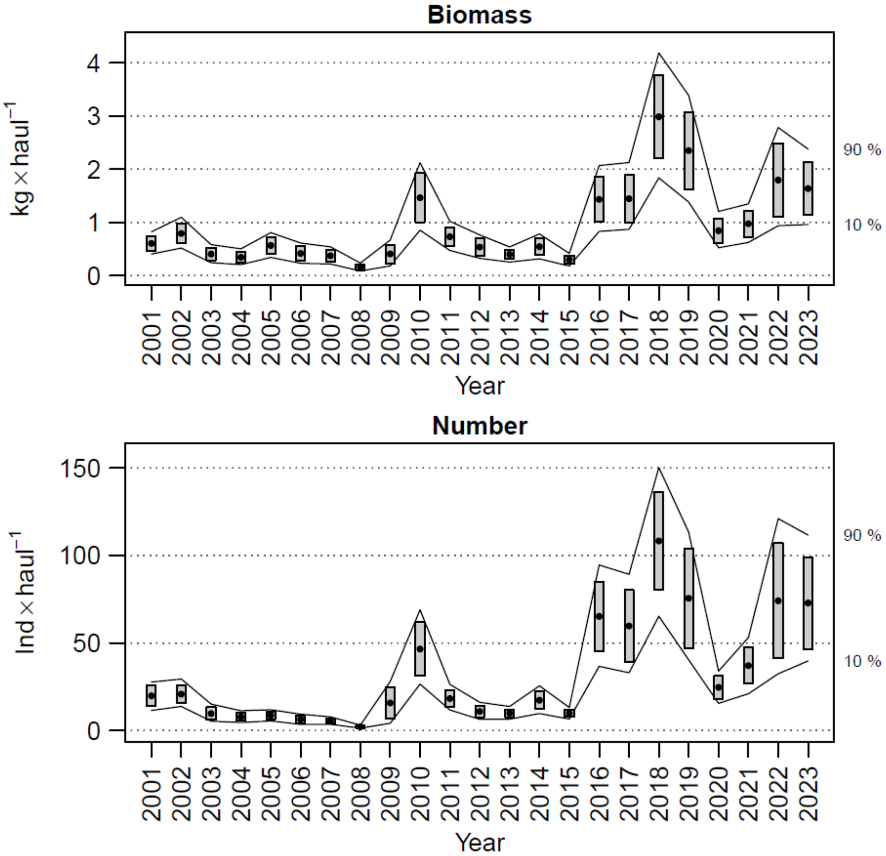


Figure 16.6. ***Nephrops*** **in FU16 (Porcupine Bank). Evolution of** ***Nephrops norvegicus*** **biomass and abundance indices in Porcupine surveys (2001-2023). Boxes mark parametric standard error of the stratified abundance index. Lines mark boot-strap confidence intervals (α = 0.80, bootstrap iterations = 1000). (Fernández-Zapico** ***et al.*** **2023)**

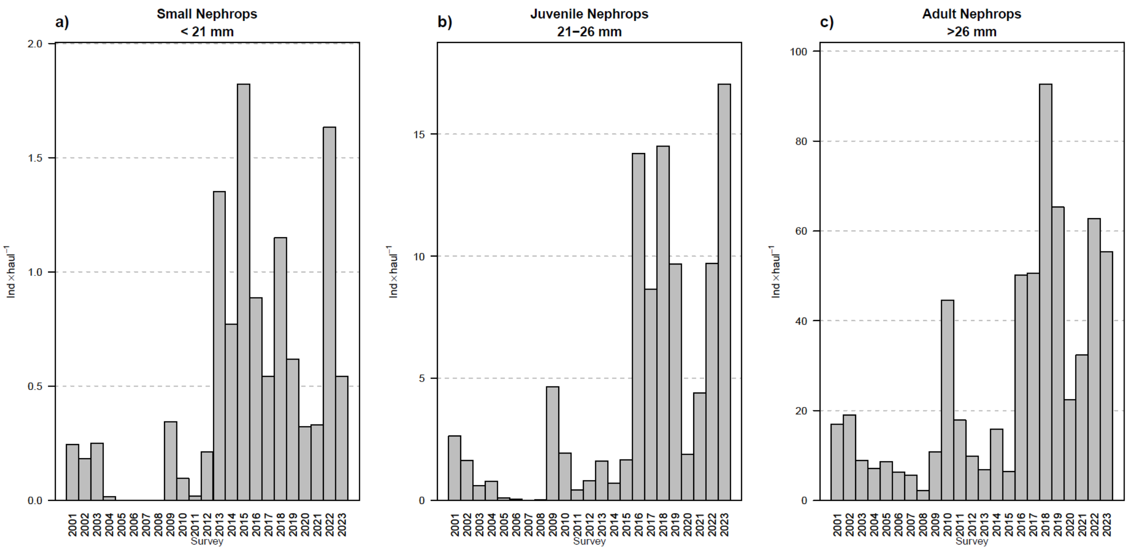


Figure 16.7. Abundance of small ***Nephrops*** **(<21 mm) [a], juveniles between 21-26 mm [b] and adults (>26 mm) [c] in the Porcupine survey 2001-2023. (Fernández-Zapico** ***et al.*** **2023)**

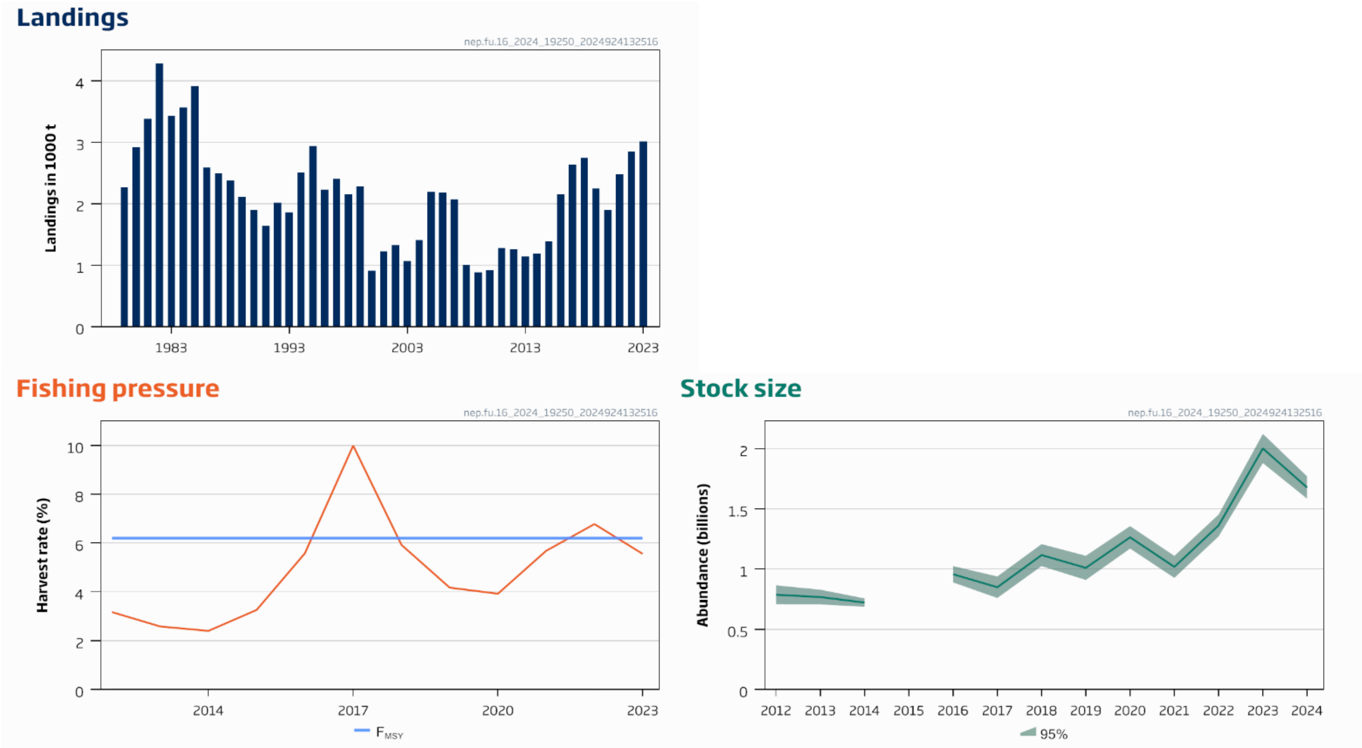


Figure 16.8. *Nephrops* in FU16 (Porcupine Bank). Summary of stock status for Porcupine *Nephrops*.

Contents

17 Norway lobsters (*Nephrops norvegicus*) in Division 7.b, Functional Unit 17 (west of Ireland, Aran grounds)

Type of assessment in 2024

This stock was inter-benchmarked in September 2015 by correspondence (ICES, 2016a). The assessment and catch options follow the agreed procedures set out in the stock annex.

ICES advice applicable to 2023

"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 2019–2021, catches in 2023 that correspond to the F ranges in the MAP are between 316 and 363 tonnes.

To ensure that the stock in Functional Unit (FU) 17 is exploited sustainably, management should be implemented at the FU level."

ICES advice applicable to 2024

"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 2020–2022, catches in 2024 that correspond to the F ranges in the MAP are between 395 and 454 tonnes.

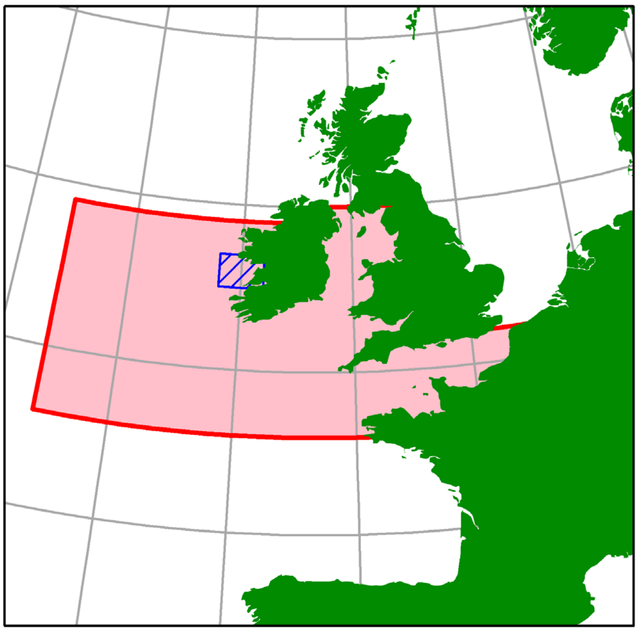
To ensure that the stock in Functional Unit (FU) 17 is exploited sustainably, management should be implemented at the FU level. A transfer of advised catch from other FUs to FU 17 could lead to overexploitation."

17.1 General

17.1.1 Stock description and management units

The Aran grounds *Nephrops* stock (FU17) covers ICES rectangles 34–35 D9–E0 within 7.b. This stock is included as part of the TAC Area 7 *Nephrops* which includes the following stocks: Irish Sea East and West (FU14, FU15), Porcupine Bank (FU16), north-western Irish Coast (FU18), south-eastern and south-western Irish Coast (FU19), and the Celtic Sea (FU20–22).

The map below shows FU17 assessment area (blue) and TAC area (red). See Section 16.1 for details on *Nephrops* Subarea 7 general section.



Ecosystem aspects

Details of the ecosystem on the Aran grounds are provided in the Stock Annex updated by IBPNeph (ICES, 2016a).

17.1.2 Fishery description

A description of the fleet is given in the Stock Annex. The time-series of numbers of vessels is updated in Figure 17.1.1. The numbers of vessels had been relatively stable from 1995 to 2018, but it decreased in 2019 and 2020 to half and increased again to previous numbers in recent years. The time-series of vessel power is shown as a box and kite plot in Figure 17.1.2.

The majority of the landings are made with 80 mm mesh.

The majority of the landings come from the grounds to the west and southwest of the Aran Islands known as the 'back of the Aran ground' (See Stock Annex). The fishery on the Aran grounds operates throughout the year, weather permitting with a seasonal trend (See Stock Annex).

Fishery in 2023

In recent years several newer vessels specializing in *Nephrops* fishing have participated periodically in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. There has been a trend for Irish vessels to switch to multi (quad) rig trawls since 2012. These vessels are more efficient at catching *Nephrops* (BIM, 2014).

Information from stakeholders

Voluntary effort restriction was put in place by the Irish fishing industry in April and May 2015. These measures reduced catches and effort significantly on the stock in advance of the 2015 UWTV survey.

17.2 Data

InterCatch

Data were available in InterCatch and used for catch data only.

Landings

The reported landings time-series is shown in Figure 17.2.1 and Table 17.2.1. The 2023 landings decreased by about 9% from those made in 2022 and amounted to 411 t.

Effort

The IBPNeph 2015 reviewed Irish commercial landings and effort data in detail. They concluded that effort should be reported in the WGCSE report in KWdays and lpue should be reported in KG/kwdays in the knowledge that the trend is likely to be a biased underestimate because it is not adjusted for efficiency or behavioural changes. The time-series of effort and lpue is updated in Figure 17.2.2 and Table 17.2.2. There was a significant decline in lpue and effort in 2015 due to the local management efforts put in place in April and May. In 2016, effort level increased to values similar to those observed previously prior to 2011. However, since 2017 effort levels have declined, reaching in 2020 the lowest values in the data series, but have slightly increased in recent years.

Sampling levels

Sampling levels, data aggregating, and raising procedures were reviewed by IBPNeph 2015 and are documented in the Stock Annex. The time-series of samples is shown in Figure 17.2.3 and Table 17.2.3. Given the low level of landings in recent years, it has been challenging to obtain sufficient samples to provide robust estimates of mean weights.

Commercial length–frequency distributions

The raised catch length distributions are shown in Figure 17.2.4. The mean length of females decreased in 2018, hence increasing the discard rate for females. Female lengths increased in 2019 and 2020 to similar values of 2017, but they decreased again in recent years. In 2022 and 2023, the mean length of males also decreased, increasing their discard rate.

Sex ratio

In 2022 and 2023, the difference on the sex ratios between the catches and the landings (Figure 17.2.5) is explained by the higher discarding of females (Figure 17.2.4). Sex ratio has a distinct seasonal pattern with lowest male proportions in the samples in May and June. Males dominate the catches in the autumn and winter.

Mean weight explorations

Explorations of the mean weight in the catch samples by sex shows a strong cyclical pattern in females, which corresponds with the emergence of mature females from the burrows to mate in summer (Figure 17.2.6). The annual mean weight estimate for landings and discards is shown in Figure 17.2.7. The mean weight estimates had been relatively stable from between 2011 and 2019. Mean weights have fluctuated in recent years, but always within reasonable values.

Discarding

Table 17.2.4 gives weights, numbers and proportions of the landings, and discards raised internationally according to the Stock Annex. A 25% discard survival rate is assumed in line with other *Nephrops* stocks in the Celtic Sea (see Stock Annex) as the basis for the catch scenarios. Gear selectivity trials by Bord Iascaigh Mhara (BIM, 2017) reported a 64% survivor rate for *Nephrops* caught in a trawl with a SELTRA selectivity device in the outer Galway Bay area.

Abundance indices from UWTV surveys

The spatial extent of the *Nephrops* grounds in FU17 was re-defined by IBPNeph 2015 and the total abundance estimates were revised using a new procedure (ICES, 2016a). The redefinition of the polygons in FU17 resulted in ~30% increase in overall area from 1 007 km² to 1 320 km² (see Stock Annex). Operational details of the 2023 UWTV survey are available at http://oar.marine.ie/handle/10793/59 (Aristegui *et al.*, 2024).

The spatial distributions of burrow densities are shown in Figure 17.2.8. The densities have fluctuated considerably over the time-series and throughout the Aran grounds. In general, the densities are higher towards the middle-western side of the ground and there is a notable trend towards lower densities towards the east. On the south-western boundary, there are often high densities close to the boundary. In this area, there is a sharp transition from mud to rocky substrate.

The summary statistics from this geostatistical analysis are given in Table 17.2.5 and plotted in Figure 17.2.10. The geostatistical abundance estimate adjusted is derived using the mean of the krigged grid where the mean of the observations is reported in Table 17.2.5. In 2024, the Aran grounds accounted for ~95% of the total estimated burrow abundance from FU17 (Table 17.2.5). Galway Bay accounted for ~4% and Slyne Head for ~1% (Table 17.2.6). The Galway Bay estimates fluctuate widely but are highly correlated with the Aran ground (Figure 18.2.9). Estimates for the Slyne Head ground also fluctuate considerably but show no significant correlation with the other areas except for the peaks of 2010, 2015 and 2018 (Figure 17.2.9).

Aran ground abundance estimate's CV (Table 18.2.5) has been always well below the recommendation of 20% by SGNEPS (ICES, 2012). The CV on the abundance estimates for Galway Bay and Slyne Head have also stayed low (Table 17.2.6) and within the recommendation, showing the surveys are precise. Figure 17.2.10 and Table 17.2.7 show the total abundance estimate for FU17 with the IBPNeph proposed MSY $B_{trigger}$. The 2024 combined abundance estimate (451 million) was 20% higher than in 2023 and is below the MSY $B_{trigger}$ (540 million).

Comparison with previous assessments

The WGCSE 2024 carried out an UWTV based assessment for this stock. The methods used were very much in line with WKNEPH (ICES, 2009a) and the approach taken for other *Nephrops* stocks in subareas 6 and 7 by WGCSE. This approach was inter-benchmarked at IBPNeph (ICES, 2016a).

State of the stock

UWTV abundance estimates suggest that the stock size has fluctuated widely with an overall declining trend and is below MSY $B_{trigger}$ since 2012 (except 2015 and 2018). The stock has been below MSY $B_{trigger}$ since 2019. The 2024 abundance is slightly higher than 2023, but remains below the average of the series (geomean [2002–2024]: 595 million). Harvest rate [calculated as (landings + dead discards)/abundance estimate] in 2023 was below $F_{MSYproxy}$ (Table 17.3.1 and Figure 17.3.1).

17.3 Catch scenario table

Catch scenario table inputs and historical estimates of mean weight in landings and harvest ratios are presented in Table 17.3.1 and summarized below. The calculation of catch options for the Aran grounds follows the procedure outlined in the Stock Annex.

The basis for the catch scenarios.

Variable	Value	Notes
Stock abundance (2025)	451	UWTV survey 2024; individuals in millions
Mean weight in projected landings (2025)	22.32	Average 2008–2023; in grammes
Mean weight in projected discards (2025)	11.32	Average 2008–2023; in grammes
Projected discard rate (2025)	35	Average 2021–2023; percentage by number of the total catch
Discard survival rate (2025)	25	Percentage by number of the discards

Given the fluctuations observed in mean weights for landings and discards (Figure 17.2.7), an average from 2008 to the most recent year is used in the calculation of catch options as set out in the Stock Annex. The discard rates and proportions for the last three years are used to account for recent on-board retention practices (this is also according to the Stock Annex).

17.4 Reference points

New reference points were defined for this stock at the IBPNeph (ICES, 2016a) and no new proposals were made by WKMSYRef4 (ICES, 2016b). For *Nephrops* stocks, MSY $B_{trigger}$ has been defined as the lowest stock size from which the abundance has increased. This corresponds to the abundance observed in 2008, rounded to the nearest 10 = 540 million individuals (Figure 17.2.10 and Table 17.2.7).

The F_{MSY} proxy was revised during the benchmark in 2015. The observed burrow density has declined, from high average density at the start of the series (0.83 individuals/m^2; year range 2002–2006) to medium density towards the end of the time-series (average density 0.33 individuals/m^2; year range 2015–2024). The nature of the fishery has also changed, from a continuous fishery throughout the year to a fishery which is more concentrated on sporadic periods of high catch rates. For these reasons a harvest rate consistent with a combined sex $F_{0.1}$ = 8.5% is considered an appropriate proxy for F_{MSY}.

These should remain under review by WGCSE and may be revised while data become available.

17.5 Management strategies

As yet there are no explicit management strategies for this stock but there have been some discussions among the fishing industry and scientists about developing a long-term plan for the management of the Aran fishery. Sustainable utilization of the *Nephrops* stock will form the cornerstone of any management strategy for this fishery.

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to Norway lobster (*Nephrops norvegicus*) by functional unit in ICES Subarea 7 and also demersal stocks.

17.6 Quality of assessment and forecast

Biological sampling for this stock is adequate. Since 2002, a dedicated annual UWTV survey has provided abundance estimates for the Aran grounds with high precision. The area of the Aran grounds was revised in 2015, resulting in a recalculation of the abundance time-series which now also includes Galway Bay and Slyne Head. A number of other biological parameters such as mean weights and length distributions have also been revised. The revisions were made as part of an inter-benchmark process and have improved the quality of the assessment.

In the provision of catch options based on the absolute survey estimates, additional uncertainties related to mean weight in the landings and the discard rates also arise. From 2016, fisheries catching *Nephrops* in Subarea 7 are covered by the EU landings obligation (EU, 2015). Creel fisheries are exempted from the landings obligation, with a *de minimis* exemption consisting of a 5% discard rate by weight for the trawl fishery in 2019 (reduced from 6% in 2018 and 7% in both 2016 and 2017). The average discard rate by weight for FU17 over the last three years is 21.9%. Catch advice and scenarios are provided this year on the assumption that discarding is assumed to continue at recent average.

Irish discard survival experiments indicate that the trawl discard survival may be around 64% (BIM, 2017). As a result, an exemption from the landings obligation based on high survivability has been granted by the European Commission. ICES continues to use the survival rate of 25% (ICES, 2016c) as the survival rates estimated by BIM (2017) have not been evaluated by ICES.

There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*Neph* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009b; WGNEPS 2014; WKNEPS 2016d; Dobby *et al.*, 2021). Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al.*, 1996). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate, although no more precise (ICES, 2009a).

Landings data were adjusted to take into account landings that had been misreported from FU16 from 2011 to 2017. This adjustment is thought to be reasonably accurate.

17.7 Recommendation for next benchmark

This stock was last benchmarked by IBPNeph (ICES, 2016a). WGCSE will keep the stock under close review and recommend future benchmark as required.

17.8 Management considerations

A meeting was held with stakeholders in March 2015 to discuss the state of the Aran *Nephrops* stock. In response to this meeting, voluntary effort limits were put in place for April, May, and June 2015. These voluntary measures have significantly reduced effort and catches on the Aran grounds in 2015 before the UWTV survey.

Small whole *Nephrops* are the main species comprising the discards. The main fish species discarded are haddock, hake, whiting, megrim, and dogfish (Anon, 2011).

The ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could provide controls to ensure effort and catch were in line with resources available.

17.9 References

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17.10 Tables and Figures

Table 17.2.1. *Nephrops* in FU17 (Aran grounds). Landings in tonnes by country.

Year	France	Rep. of Ireland	UK	Total
1974	477			477
1975	822			822
1976	131			131
1977	272			272
1978	481			481
1979	452			452
1980	442			442
1981	414			414
1982	210			210
1983	131			131
1984	324			324
1985	207			207
1986	147		1	148
1987	62		0	62
1988	14	814		828
1989	27	317	3	347
1990	30	489		519
1991	11	399		410
1992	11	361	2	374
1993	11	361	0	372
1994	18	707	4	729
1995	91	774	2	867
1996	2	519	7	528
1997	2	839	0	841
1998	9	1401	0	1410
1999	0	1140	0	1140
2000	1	879	0	880

Year	France	Rep. of Ireland	UK	Total
2001	1	912	0	913
2002	2	1152	0	1154
2003	0	933	0	933
2004	0	525	0	525
2005	0	778	0	778
2006	0	637	0	637
2007	0	913	0	913
2008	0	1050	7	1057
2009	0	625	0	625
2010	0	930	9	939
2011	0	659	0	659
2012	0	1246	0	1246
2013	0	1295	0	1295
2014	0	766	0	766
2015	0	370	0	370
2016	0	641	0	641
2017	0	295	0.4	295
2018	0	494	42	536
2019	0	162	4	167
2020	0	188	34	222
2021	0	490	8	498
2022	0	445	8	452
2023	0	382	29	411

Table 17.2.2. ***Nephrops* in FU17 (Aran grounds). Effort data for the Irish otter trawl *Nephrops* directed fleet.**

Year	Effort (Kw Days)	Landings (Kgs)
1995	286,939	522,007
1996	174,030	312,421
1997	260,676	442,218
1998	445,308	940,902
1999	366,839	782,407
2000	293,684	561,244
2001	362,754	586,462
2002	350,346	798,744
2003	492,284	801,813
2004	355,673	420,652
2005	396,202	708,540
2006	337,503	618,515
2007	460,396	905,282
2008	512,245	1,052,077
2009	319,873	613,220
2010	441,080	910,346
2011	332,300	667,564
2012	488,721	1,139,413
2013	571,916	1,239,469
2014	460,818	774,097
2015	232,190	461,409
2016	396,502	578,420
2017	277,117	258,052
2018	233,793	483,723
2019	136,278	148,795
2020	91,263	177,895
2021	184,881	444,551
2022	225,430	444,615
2023	154,382	368,348

Table 17.2.3. ***Nephrops*** **in FU17 (Aran grounds). Sampling levels.**

Year	Quarter	Number of samples		Numbers Measured	
		Catch	Discards	Catch	Discards
2008	1	2	3	565	1376
2008	2	9	8	2224	3758
2008	3	5	4	1266	1834
2008	4	3	3	889	1733
2009	1	3	3	800	1184
2009	2	6	6	1685	1978
2009	3	6	6	2260	2726
2009	4	2	2	1491	1149
2010	1	4	4	3322	2322
2010	2	8	7	3577	2957
2010	3	2	2	951	742
2010	4	6	4	3209	1802
2011	1	7	7	3755	3537
2011	2	7	7	7399	6617
2011	3	4	2	3531	2386
2011	4	5	5	2440	2271
2012	1	3	3	1538	1250
2012	2	17	15	6481	5113
2012	3	0	0	-	-
2012	4	5	5	2333	1945
2013	1	10	9	3108	2983
2013	2	11	11	3733	3733
2013	2	3	3	1163	1263
2013	4	7	7	2956	1779
2014	1	3	3	1208	1223
2014	2	12	12	5365	3563
2014	3	2	2	786	499
2014	4	8	8	3542	2760

Year	Quarter	Number of samples		Numbers Measured	
		Catch	Discards	Catch	Discards
2015	1	2	2	827	611
2015	2	2	2	961	664
2015	3	0	0	-	-
2015	4	2	2	1047	1388
2016	1	5	4	2292	876
2016	2	11	11	4756	3383
2016	3	6	5	3020	2048
2016	4	6	6	1389	1311
2017	1	3	3	1214	845
2017	2	6	4	2911	1569
2017	3	2	1	1018	223
2017	4	3	3	1176	839
2018	1	3	3	1224	1241
2018	2	8	8	3179	2971
2018	3	1	1	467	388
2018	4	6	6	1894	2487
2019	1	3	3	1151	1368
2019	2	5	5	1552	1441
2019	3	2	2	628	480
2019	4	2	2	519	558
2020	1	4	4	1037	984
2020	2	5	5	1706	1666
2020	4	1	0	302	0
2021	1	3	3	740	778
2021	2	5	4	1558	1059
2022	1	4	4	1132	1126
2022	2	1	1	385	261
2022	4	2	2	647	552

Year	Quarter	Number of samples		Numbers Measured	
		Catch	Discards	Catch	Discards
2023	1	5	5	2166	1230
2023	2	1	0	324	0
2023	4	6	6	2000	2095

Table 17.2.4. ***Nephrops*** **in FU17 (Aran grounds). Raised landings and discard weight and numbers by year.**

Year	Landings (t)	Discards (t)	Landings in number ('000s)	Discards in number ('000s)	Discards by weight (%)	Discards by number (%)
2008	1057	248	48,162	22,074	19.0	31.4
2009	626	129	24,935	9,487	17.1	27.6
2010	939	224	37,341	15,246	19.3	29.0
2011	659	92	31,950	8,542	12.2	21.1
2012	1246	86	61,076	8,292	6.5	12.0
2013	1295	129	60,016	12,034	9.1	16.7
2014	766	48	33,882	5,038	5.9	12.9
2015	370	15	17,693	1,622	3.8	8.4
2016	641	69	30,231	6,375	9.7	17.4
2017	295	38	13,269	3,605	11.3	21.4
2018	536	106	22,049	10,490	16.5	32.2
2019	167	21	7,568	2,098	11.1	21.7
2020	222	54	9,516	3,525	19.5	27.0
2021	498	88	22,750	7,049	15.0	23.7
2022	452	122	23,436	13,949	21.2	37.3
2023	411	170	16,994	12,961	29.3	43.3

Table 17.2.5. *Nephrops* in FU17 (Aran grounds). Results summary table for geostatistical analysis of UWTV survey.

Ground	Year	Number of stations	Mean Density adjusted** (burrow/m²)	Domain Area (km²)	Geostatistical Abundance Estimate adjusted (millions burrows)	CV on Burrow estimate %
Aran grounds	2002	49	0.79	1196	947	3
	2003	41	0.94	1196	1118	6
	2004	64	1.08	1196	1297	3
	2005	70	0.81	1196	972	2
	2006	67	0.46	1196	556	3
	2007	71	0.69	1196	828	2
	2008	63	0.41	1196	494	3
	2009	82	0.52	1196	627	2
	2010	87	0.63	1196	752	2
	2011	76	0.51	1196	609	2
	2012	31*	0.33	1196	397	3
	2013	31*	0.33	1196	390	4
	2014	33*	0.28	1196	332	4
	2015	34*	0.40	1197	480	4
	2016	34*	0.29	1197	343	3
	2017	31*	0.31	1196	377	3
	2018	33*	0.40	1196	488	3
	2019	31*	0.39	1196	458	4
	2020	34	0.29	1196	359	4
	2021	34*	0.26	1196	311	4
	2022***	-	-	-	-	-
	2023	34*	0.29	1196	356	3
	2024	33*	0.36	1196	429	3

*** reduced isometric grid.**

**** mean density of the observations.**

***** no UWTV survey.**

Table 17.2.6. ***Nephrops*** **in FU17 (Galway Bay and Slyne Head). Results summary table for analysis of UWTV survey. Random stratified estimates given for these grounds only.**

Ground	Year	Number of stations	Mean Density adjusted (burrow/m²)	Domain Area (km²)	Raised Abundance Estimate adjusted (millions burrows)*	CV on Burrow estimate %
Galway Bay	2002	7	1.18	79.0	93.1	7
	2003	3	1.30	79.0	102.6	16
	2004	8	1.17	79.0	92.2	14
	2005	4	1.30	79.0	103.0	11
	2006	3	0.74	79.0	58.8	9
	2007	5	0.91	79.0	71.8	8
	2008	5	0.40	79.0	31.6	4
	2009	8	0.71	79.0	56.3	4
	2010	10	1.24	79.0	97.6	11
	2011	6	0.55	79.0	43.2	12
	2012	4	0.64	79.0	50.9	10
	2013	5	0.37	79.0	29.6	10
	2014	3	0.50	79.0	39.8	6
	2015	5	0.71	79.0	55.8	15
	2016	7	0.32	79.0	25.1	7
	2017	5	0.20	79.0	15.8	4
	2018	5	0.41	79.0	32.5	17
	2019	5	0.29	79.0	22.8	11
	2020	5	0.34	79.0	27.2	13
	2021	5	0.15	79.0	11.5	2
	2022*	5	0.19	79.0	14.8	3
	2023	5	0.19	79.0	15.1	7
	2024	5	0.21	79.0	16.3	3

* 2022 abundance estimate for Galway Bay was not used in the assessment, as the rest of the stations in the Aran grounds and Slyne Head were not completed due to disruption to the survey schedule.

Ground	Year	Number of stations	Mean Density adjusted (burrow/m²)	Domain Area (km²)	Raised Abundance Estimate adjusted (millions burrows)*	CV on Burrow estimate %
Slyne Head	2002	5	0.76	39.1	29.8	8
	2003*	0	0.65	39.1	25.3	0
	2004	3	0.53	39.1	20.8	10
	2005	3	0.44	39.1	17.4	1
	2006	3	0.30	39.1	11.8	9
	2007	4	0.51	39.1	19.8	12
	2008*	0	0.41	39.1	16.0	0
	2009	6	0.31	39.1	12.2	7
	2010	7	0.73	39.1	28.7	4
	2011	7	0.51	39.1	20.0	5
	2012	3	0.52	39.1	20.5	2
	2013	4	0.54	39.1	21.1	10
	2014	4	0.28	39.1	11.0	6
	2015	5	0.50	39.1	19.6	4
	2016	4	0.27	39.1	10.8	3
	2017	4	0.27	39.1	10.7	4
	2018	5	0.84	39.1	33.0	12
	2019	5	0.29	39.1	11.5	8
	2020	5	0.19	39.1	7.4	4
	2021	5	0.23	39.1	9.1	2
	2022**	0	-	-	-	-
	2023	5	0.12	39.1	4.6	4
	2024	5	0.14	39.1	5.5	3

***estimated as no survey data available for these years.**

**** no UWTV survey.**

Table 17.2.7. *Nephrops* in FU17. Results summary table for analysis of UWTV survey for the combined grounds.

Year	Abundance (Millions)	Upper bound	Lower bound
2002	1070	1154	985
2003	1246	1434	1059
2004	1410	1517	1302
2005	1092	1154	1030
2006	627	703	551
2007	920	982	858
2008	541	588	494
2009	696	739	653
2010	879	926	831
2011	672	720	624
2012	468	520	417
2013	441	506	376
2014	383	440	327
2015	556	627	484
2016	379	420	339
2017	404	445	362
2018	554	637	471
2019	493	558	427
2020	394	453	335
2021	331	362	301
2022	353*		
2023	375	415	336
2024	451	482	421

*** 2022 abundance value is an interpolated value from 2021 and 2023 abundances**

Table 17.3.1. *Nephrops* in FU17 (Aran grounds). Forecast inputs (bold) and historical estimates of mean weight in landings and harvest rate. Removals estimated in years with no sampling using ratio of removals to landings in adjacent years. n/a = not available due to non-cooperation with sampling programmes. Low and High refer to 95% confidence intervals

Year	Low	UWTV abundance estimate	High	Landings in number	Total discards in number*	Removals in number	Harvest rate (by number)***	Landings	Total discards*	Discard rate (by number)	Dead discard rate (by number)	Mean weight in landings	Mean weight in discards
	millions						%	tonnes		%		grammes	
2002	986	1070	1154	55	18	68	6.3	1154	192	24.5	19.6	21.2	10.8
2003	1059	1246	1433	44	18	58	4.6	933	183	29.3	23.7	21.2	10.0
2004	1302	1410	1518	29	11	38	2.7	525	112	28.2	22.9	18.1	9.9
2005	1030	1092	1154	42	20	57	5.2	778	182	31.7	25.9	18.4	9.2
2006	551	627	703	n/a	n/a	50	7.9	637	n/a	n/a	n/a	n/a	n/a
2007	858	920	982	n/a	n/a	57	6.2	913	n/a	n/a	n/a	n/a	n/a
2008	494	541	588	48	22	65	12.0	1057	248	31.4	25.6	21.94	11.23
2009	653	696	739	25	9	32	4.6	625	129	27.6	22.2	25.12	13.63
2010	832	879	926	37	15	49	5.6	939	224	29.0	23.4	25.16	14.70
2011	624	672	720	32	9	38	5.7	659	92	21.1	16.7	20.62	10.75
2012	416	468	520	61	8	67	14.4	1246	86	12.0	9.2	20.40	10.39
2013	376	441	506	60	12	69	15.7	1295	129	16.7	13.1	21.59	10.73
2014	326	383	440	34	5	38	9.8	766	48	12.9	10.0	22.62	9.56

Year	Low	UWTV abundance estimate	High	Landings in number	Total discards in number*	Removals in number	Harvest rate (by number)***	Landings	Total discards*	Discard rate (by number)	Dead discard rate (by number)	Mean weight in landings	Mean weight in discards
	millions						%	tonnes		%		grammes	
2015	485	556	627	18	2	19	3.4	370	15	8.4	6.4	20.91	9.13
2016	338	379	420	30	6	35	9.2	641	69	17.4	13.7	21.21	10.85
2017	363	404	445	13	4	16	4.0	295	38	21.4	16.9	22.23	10.46
2018	471	554	637	22	10	30	5.4	536	106	32.2	26.3	24.33	10.11
2019	427	493	559	8	2	9	1.9	167	21	21.7	17.2	22.00	9.94
2020	335	394	453	10	4	12	3.1	222	54	27.0	21.7	23.31	15.29
2021	300	331	362	23	7	28	8.5	498	88	23.6	18.9	21.88	12.48
2022		No survey		23	14	34	9.6**	452	122	37.3	30.9	19.30	8.74
2023	336	375	415	17	13	27	7.1	411	170	43	36	24.20	13.15
2024	421	451	482										

*** Dead + surviving discards.**

**** The harvest rate is estimated based on a linear interpolation of abundance (353 million), as no survey was carried out in this year.**

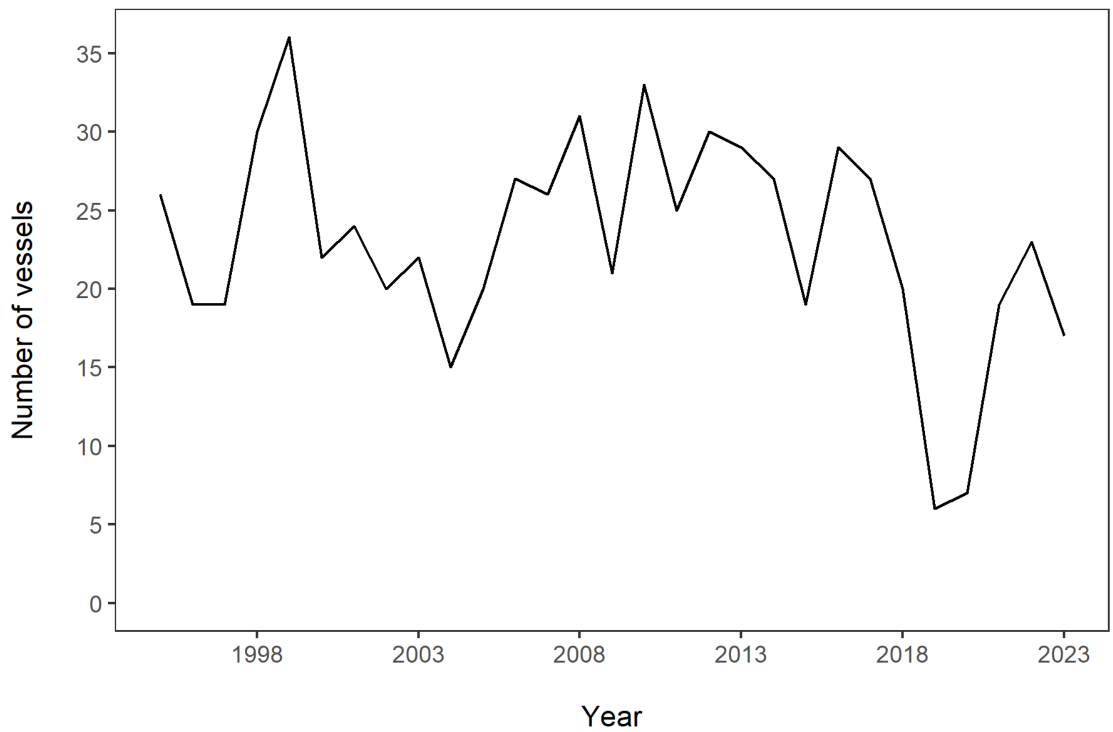


Figure 17.1.1. ***Nephrops*** **in FU17 (Aran grounds). Time-series of the number of Irish vessels reporting landings of** ***Nephrops*** **from FU17 with a >10 t threshold.**

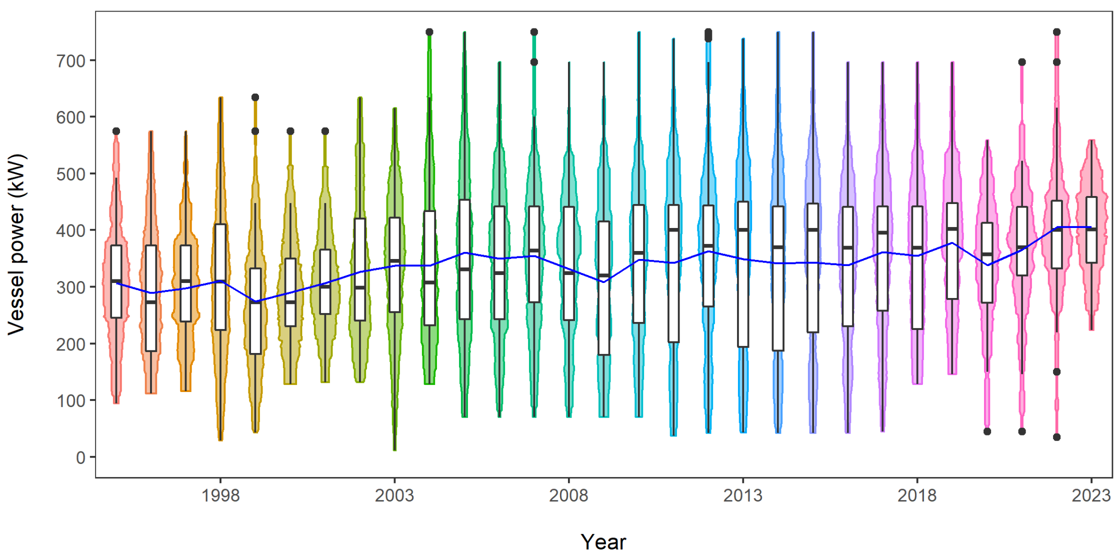


Figure 17.1.2. ***Nephrops*** **in FU17 (Aran grounds). Combined box and kite plot of Irish vessel's power on the Aran grounds by year. The blue line indicates the mean.**

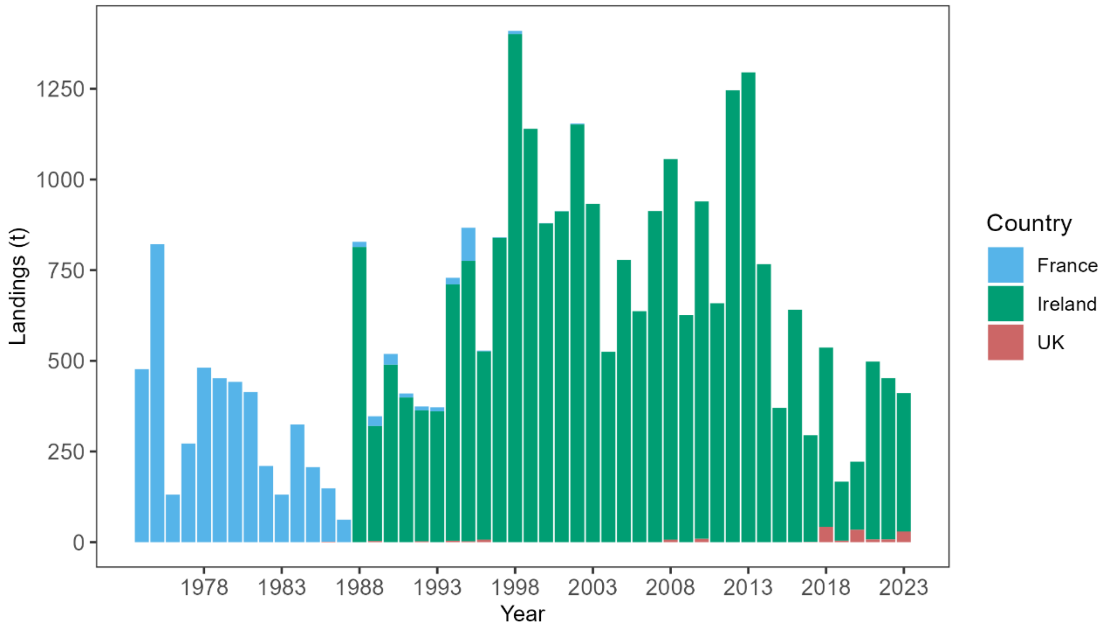


Figure 17.2.1. ***Nephrops*** **in FU17 (Aran grounds). Landings in tonnes by country.**

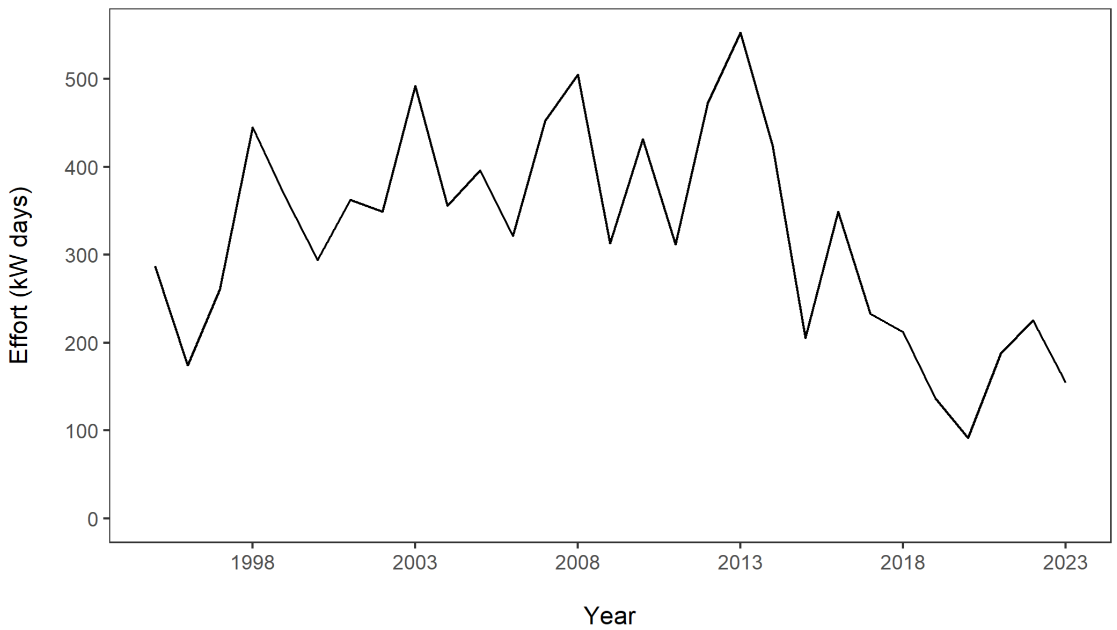


Figure 17.2.2. ***Nephrops*** **in FU17 (Aran grounds). Effort data (kW days) for Irish directed** ***Nephrops*** **fleet.**

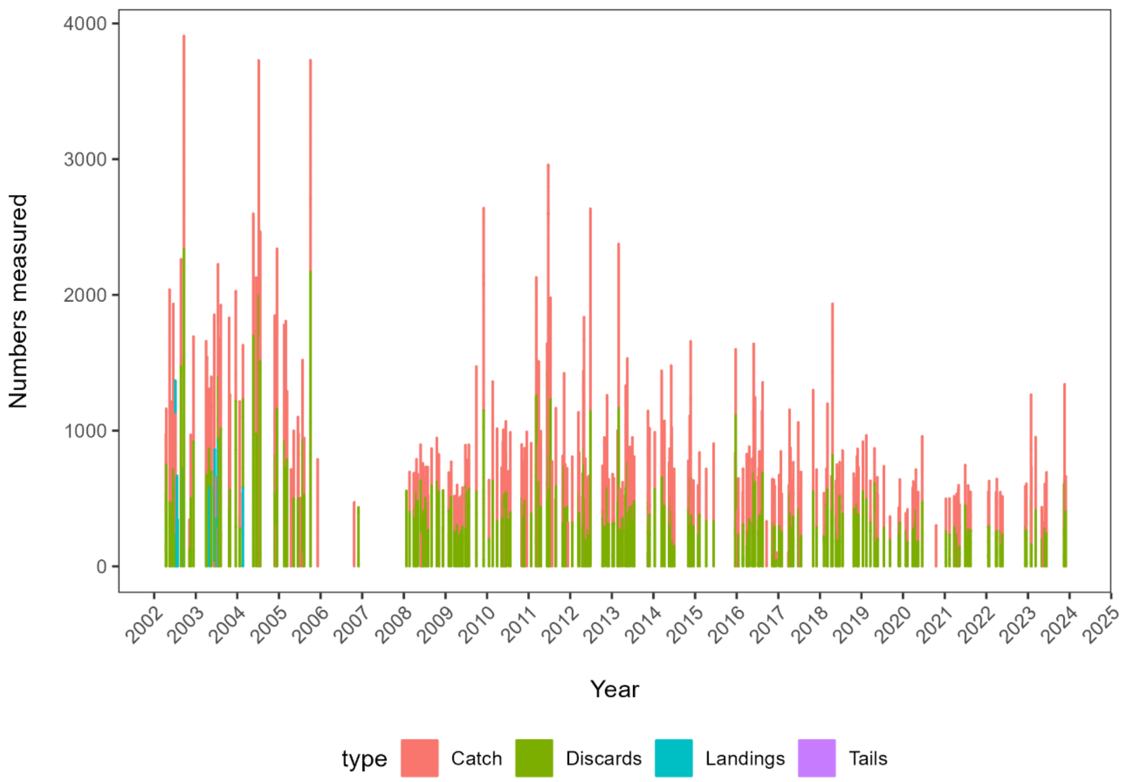


Figure 17.2.3. ***Nephrops*** **FU17 (Aran grounds). Sampling levels for the Aran grounds.**

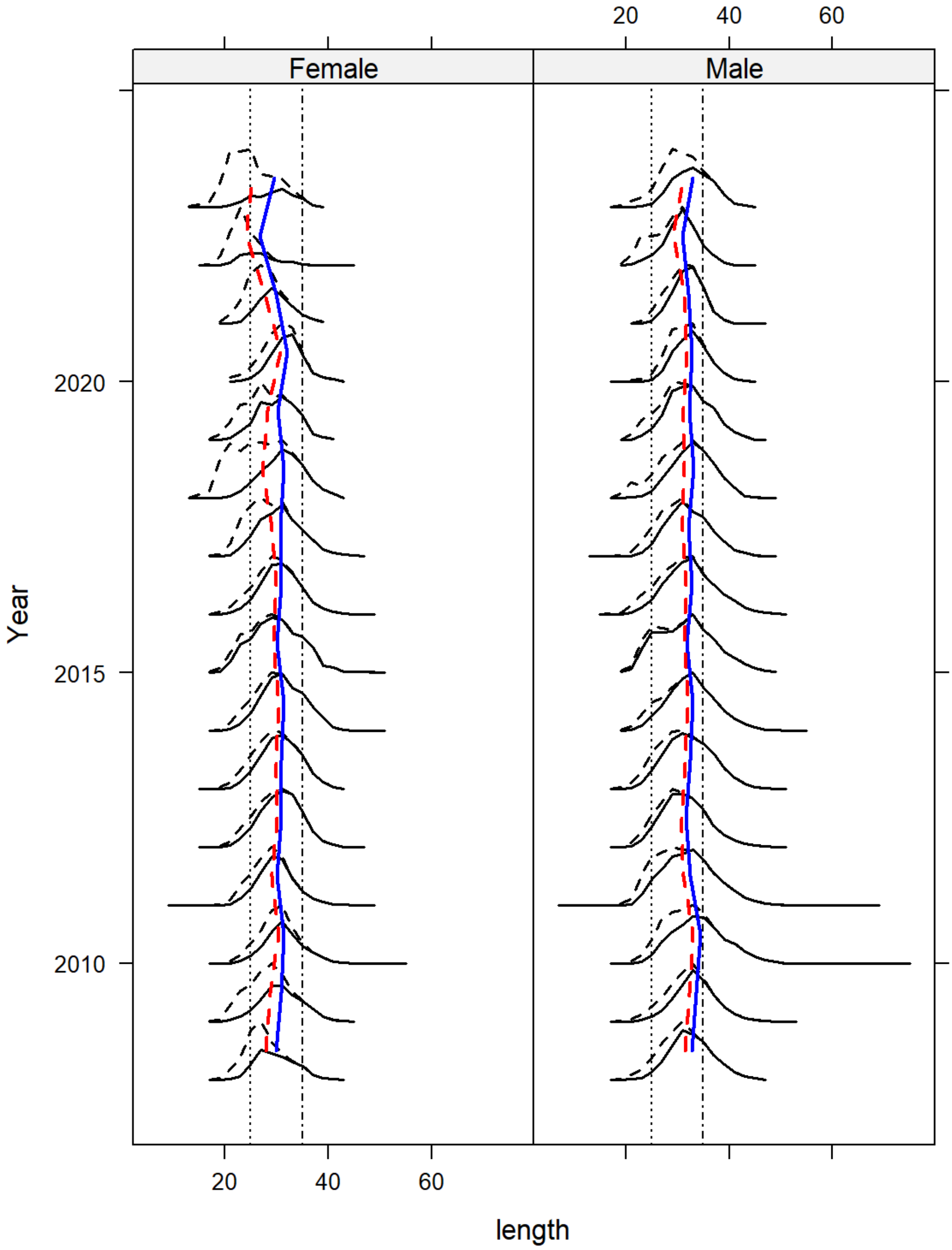


Figure 17.2.4. ***Nephrops*** **FU17 Aran grounds. Annual length composition of catches (dotted line) and landings (solid line) for females (left) and males (right) from 2008 (bottom) to 2023 (top). Annual mean length of catches (dotted vertical line) and landings (solid vertical line) are also shown. Minimum Landing Size (25 mm) and 35 mm levels are also displayed with vertical lines.**

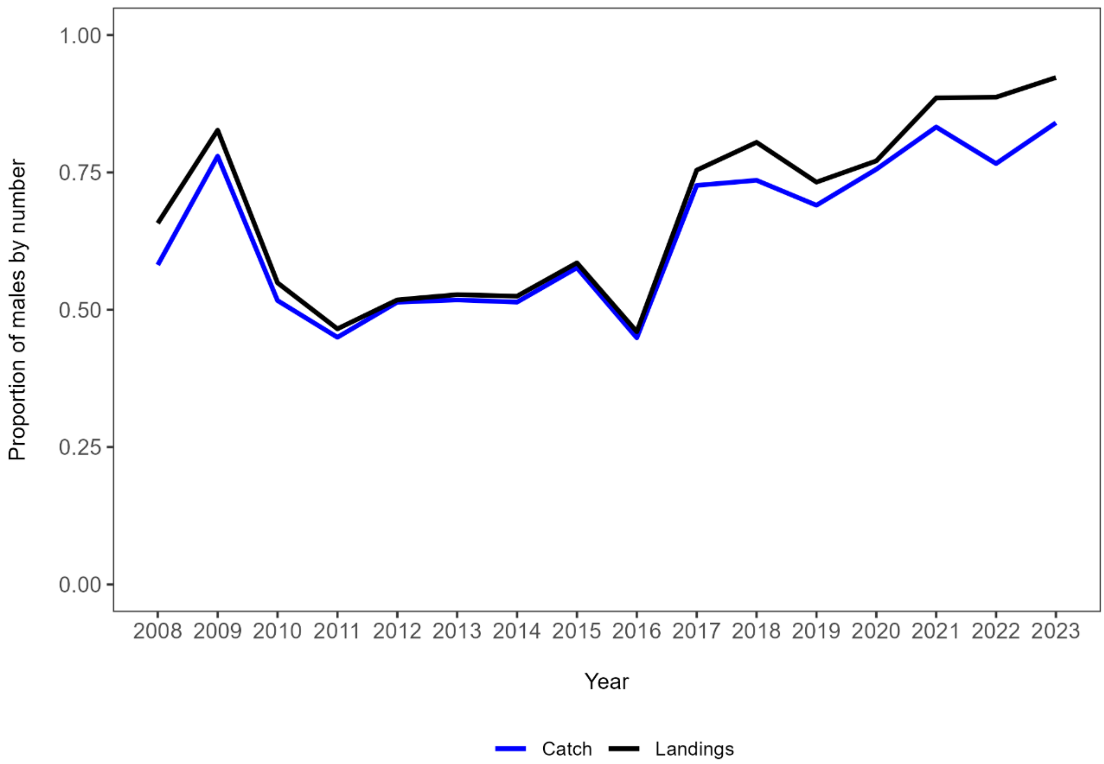


Figure 17.2.5. *Nephrops* FU17 (Aran grounds). Proportion of males by number in the catch (blue) and landings (black).

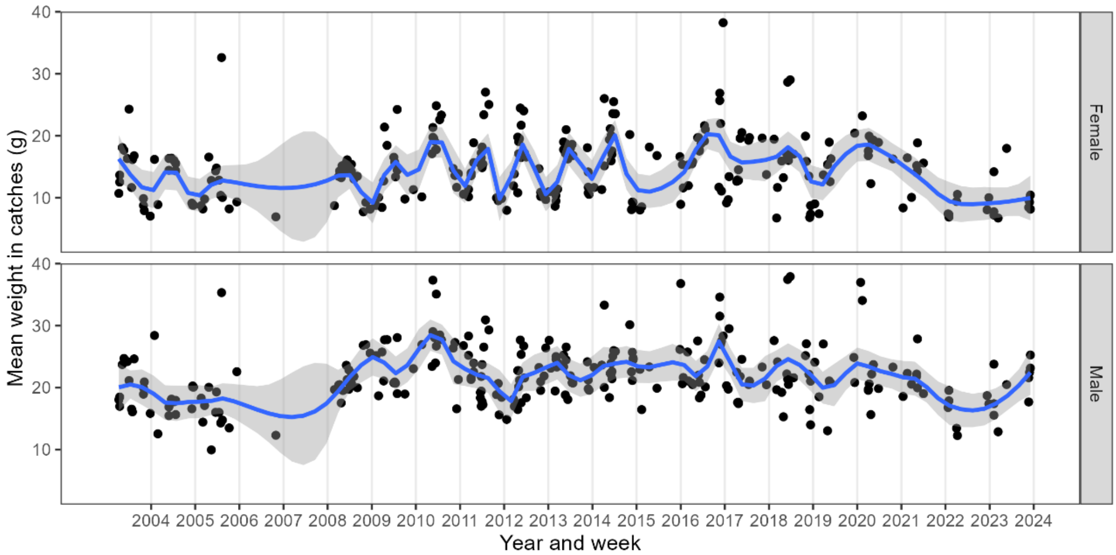


Figure 17.2.6. *Nephrops* FU17 (Aran grounds). Mean weight in catch samples by sex showing cyclical trends.

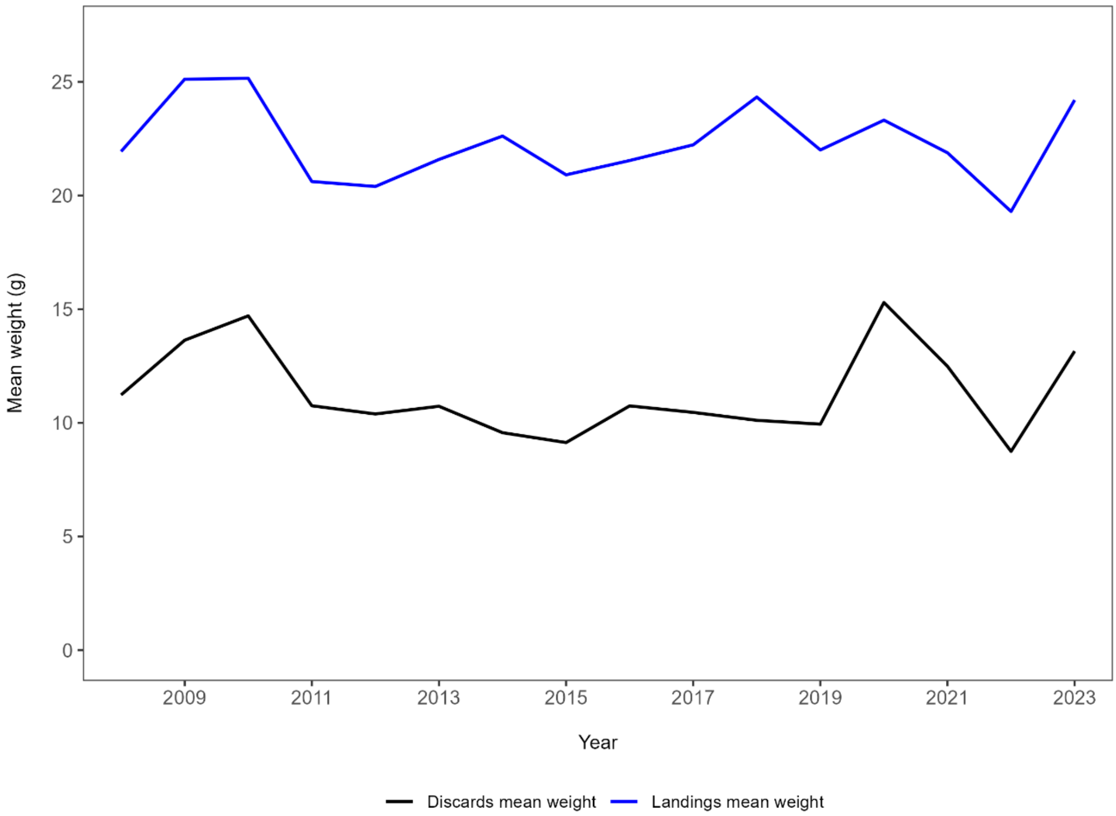


Figure 17.2.7. *Nephrops* FU17 (Aran grounds). Annual mean weight (g) estimates of landings (blue) and discards (black).

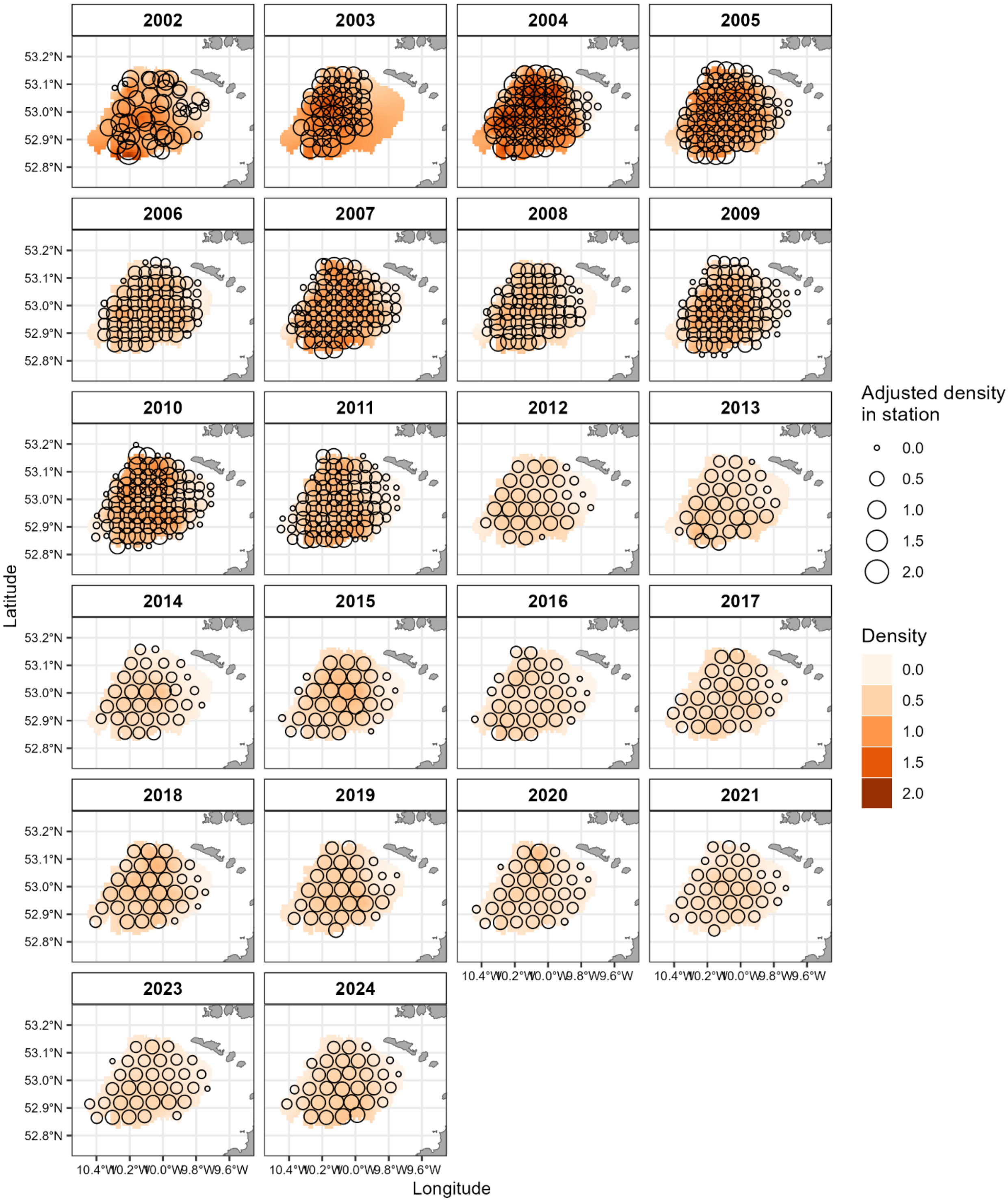


Figure 17.2.8. ***Nephrops*** **in FU17 (Aran grounds). Contour plots of the krigged density estimates for the Aran Ground UWTV surveys from 2002 (top left) to 2024 (bottom right). No UWTV survey in 2022.**

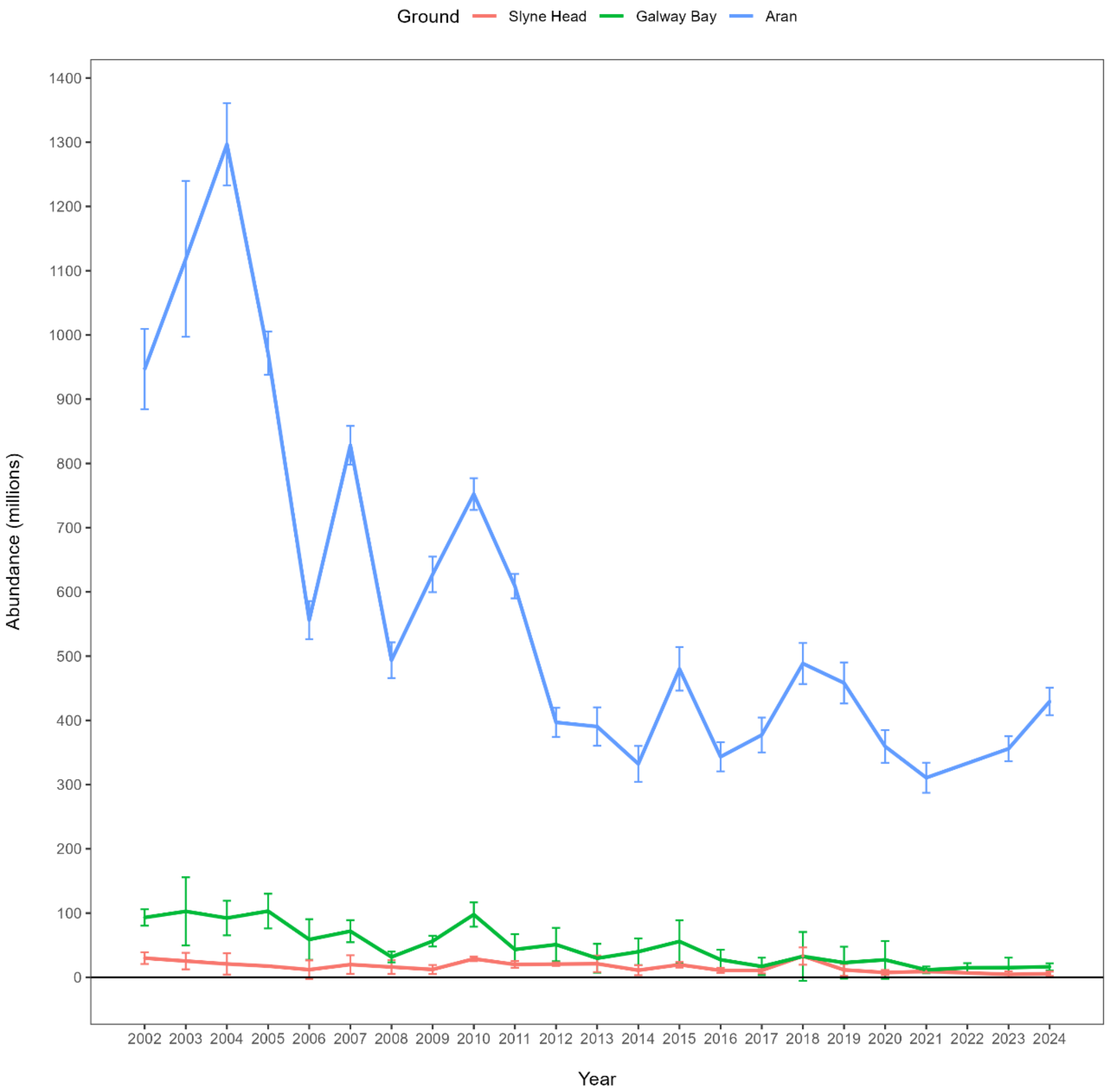


Figure 17.2.9. *Nephrops* FU17 Aran grounds. *Nephrops* burrow estimates in FU17 Aran (blue), Galway Bay (green) and Slyne Head (red) grounds 2002–2024. 2022 UWTV was only carried out in Galway Bay.

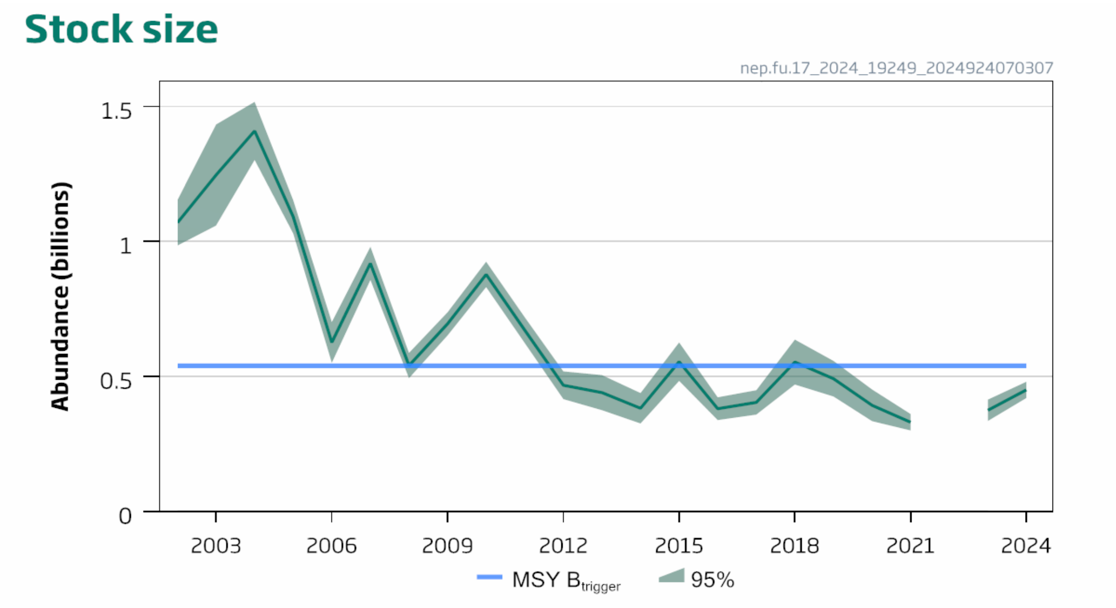


Figure 17.2.10. Time-series of total abundance estimates for FU17.

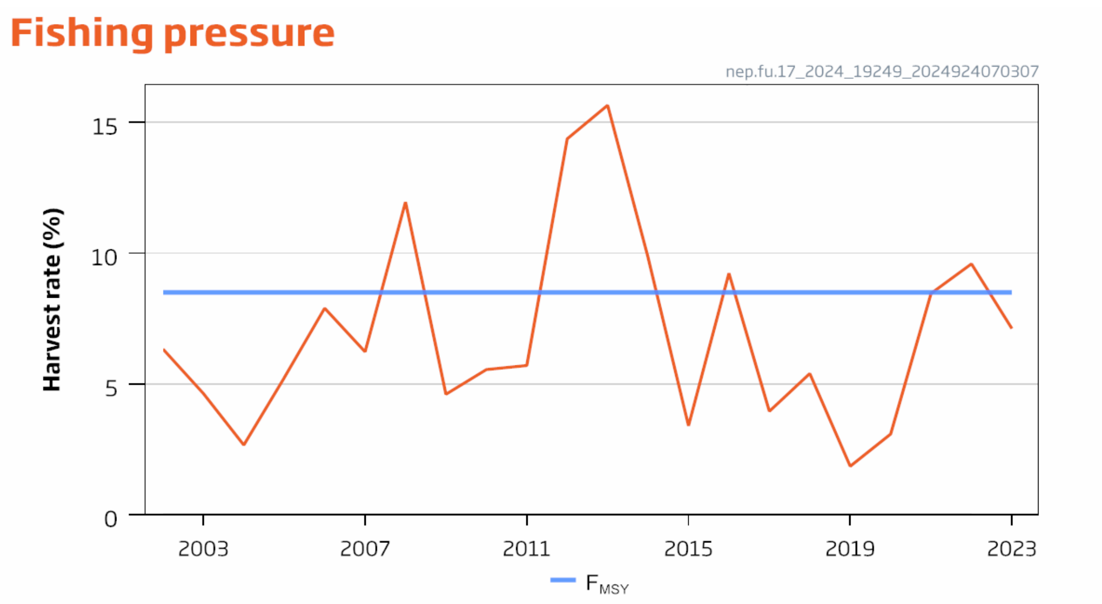


Figure 17.3.1. *Nephrops* FU17 Aran grounds. Harvest Rate represented by red line (% dead removed/UWTV abundance). The harvest rate in 2022 was calculated using an interpolated value for abundance, as no survey data are available.

Contents

18 Norway lobster (*Nephrops norvegicus*) in divisions 7.a, 7.g, and 7.j, Functional Unit 19 (Irish Sea, Celtic Sea, eastern part of southwest of Ireland)

Type of assessment in 2024

This stock was benchmarked in February 2014 and the assessment and provision of catch advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (ICES, 2014, 2019) and set out in the Stock Annex. This stock assessment is available in the ICES Transparent Assessment Framework (TAF).

ICES advice applicable to 2023

"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 2019–2021, catches in 2023 that correspond to the F ranges in the MAP are between 302 and 338 tonnes.

To ensure that the stock in Functional Unit (FU) 19 is exploited sustainably, management should be implemented at the FU level."

ICES advice applicable to 2024

"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 2020–2022, catches in 2024 that correspond to the F ranges in the MAP are between 224 and 248 tonnes.

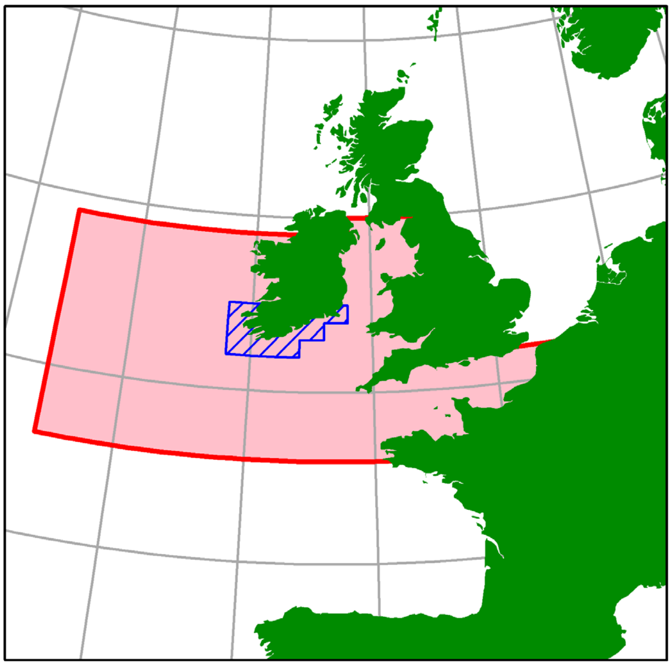
To ensure that the stock in Functional Unit (FU) 19 is exploited sustainably, management should be implemented at the FU level. A transfer of advised catch from other FUs to FU 19 could lead to overexploitation."

18.1 General

18.1.1 Stock description and management units

In FU19 *Nephrops* are caught on a large number of spatially discrete small inshore grounds and on some larger grounds further offshore and of these the 'Galley ground 4' and around Cork channels appear to be the most important (see Figure 19.1.1). The *Nephrops* stock (FU19) covers ICES rectangles ; 31–33 D9–E0; 31E1; 32E1–E2; 33E2–E3 within 7.a, 7.g, and 7.j. This stock is included as part of the TAC Area 7 *Nephrops* which includes the following stocks: Irish Sea East and West (FU14, FU15), Porcupine Bank (FU16), northwestern Irish Coast (FU18), and the Celtic Sea (FU20–22).

The map below shows FU19 assessment area (blue) and TAC area (red). There is no evidence that the individual functional units belong to the same stock. See Section 16 for details on *Nephrops* in Subarea 7 general section.



Ecosystem aspects

This section is detailed in the Stock Annex. There are no updates.

18.1.2 Fishery description

A description of the fleet is given in the Stock Annex.

The time-series of numbers of vessels reporting landings greater than 10 t is updated in Figure 18.1.2. The numbers of vessels have been relatively stable from 1995 except since 2018, where there was a sharp decrease that has levelled. The time-series of vessel power is shown as a box and kite plot in Figure 18.1.3.

Fishery in 2023

There has been a trend for Irish vessels (>18 m) to switch to multi (quad) rig trawls. Provisional data suggest a ~30% increase in *Nephrops* catch rates and a reduction in fish bycatch of ~30% due to the lower headline height. The number of French vessels reporting landings in FU19, has decreased from 35 vessels in 2005 to five vessels in 2023.

Information from stakeholders

None available.

18.2 Data

InterCatch

All data were available in InterCatch and used for catch data only. French catch data provided directly by the national expert and not extracted from InterCatch.

Landings

No revisions to catch data this year.

Landings data for FU19 are summarized in Table 18.2.1. Ireland, France, and the UK report landings for FU19. Landings data for Ireland were revised back to 2008 which resulted in minor revisions in the order of 1% to 5% (see Stock Annex). The Republic of Ireland landings have fluctuated considerably throughout the time-series, with a marked dip in 1994 (Table 18.2.1; Figure 18.2.1). The highest landings in the time-series were observed in 2002–2004 (>1000 t). Landings in 2005 and 2006 have been below average for the series. In 2017, landings decreased by approximately 30% for the Irish fleet and were below the series average. This can be explained due to the poor weather conditions in Quarter 1, which hampered fishing activities of smaller vessels and the larger vessels maximising effort in other FUs. Landing in 2023 were at a similar level to that reported in 2022 with a slight increase. Landings by the French fleet have fluctuated with a declining trend throughout the time-series from the highest value in 1989 of 245 t to 1.1 t in 2020 with an increase in 2023 to 2.3 t. UK landings are minor < 0.5 t in 2023.

Total landings for years 2019 (value 249.1477 t) and 2020 (value 248.9602 t) are the same (249 t) due to rounding.

Effort

In line with WGCSE 2015, recommendation effort is reported in KWdays and lpue reported in KG/kwdays in the knowledge that the trend is likely to be a biased underestimate because it is not adjusted for efficiency or behavioural changes. The effort series is based on the same criteria for FU15, 16, 17, 22, and 20–21 (30% landings threshold) and will be contingent on the accuracy of landings data reported in logbooks.

Disaggregated effort and landings data are available for the Irish *Nephrops* directed fleet in FU19 from 1995–2023 for all vessels and vessels >18 metres total length. (Table 18.2.2; Figure 18.2.2). For vessels >18, effort (since early 2000s) has fluctuated with an overall decreasing trend in the recent three-year period. This can be explained by fleet mobility where vessels target *Nephrops* in this area in periods of good emergence. For vessels <18, effort has decreased in 2017 to 2019 due to weather conditions.

Sampling levels

Sampling levels, data aggregating and raising procedures were reviewed by WKCELT 2014, and are documented in the Stock Annex. The time-series of samples is shown in Figure 21.2.3 and Table 21.2.3. Sampling levels in 2023 were adequate where it is difficult due to the heterogenous nature of this fishery.

Commercial length–frequency distributions

Length–frequency data of the landings were collected on a regular basis from 2002 to 2023. Spatial and temporal coverage is problematic with landings from FU19 coming from several discrete grounds (see Stock Annex.) The sampling intensity and coverage has varied over the time-series (see Stock Annex). Since 2008, sampling has been adequate although the majority of the samples come from Bantry Bay until 2016. This pattern has changed somewhat due to spatial extent of the discrete mud patches. Also, sampling of the discards is quite sparse over the time-series and are difficult to obtain due to the spatial coverage of the grounds. The catch samples from 2008 to 2023 were split using the discard selection ogive agreed at the benchmark (WKCELT). The length–weight regression parameters given in the Stock Annex are used to calculate sampled weights and appropriate quarterly raising factors. The length distributions are shown in Figure 18.2.4. The mean size has remained relatively stable and mean size shows a slight decreasing trend in recent years.

Sex ratio

The sex ratio in the landings is male biased in most years but there is a trend towards increased percentage of females in the landings (Figure 18.2.5). The proportion of females was higher in 2013 and this was confirmed by the industry.

Mean weight explorations

Explorations of the mean weight in the catch samples by sex shows a strong cyclical pattern in the females for all grounds combined (Figure 18.2.6). This corresponds with the emergence of mature females from the burrows to mate in summer. These data also show an increase in mean weights for males in 2016. The annual mean weight estimate for landings and discards is shown in Figure 19.2.7. The landings mean weight estimates increased in 2019 and then show a slight decrease in 2023.

Discarding

Sampling of the discards has quite sparse over the time-series and are difficult to obtain due to the spatial coverage of the grounds (see Stock Annex). Since 2002, discard rates have been estimated using unsorted catch and discards sampling (as described in the Stock Annex). WKCELT 2014 examined the available discard data observations for FU19. An average discard selection ogive using data from Bantry Bay in years 2008 and 2013 was generated and deemed appropriate given the variable sampling intensity and coverage. The catch data from 2008 were then revised and split into landings and discards. Catch data sampling for years previous to 2008 was not revised as was considered to be not of good enough quality. The catch data were split using this selection ogive for the time series to date.

Discard rates range between 11–39% of total catch by weight and 18–56% of total catch by number (Table 19.2.4). These high discard rates are very high compared with other FUs. This is because the fleet is mainly smaller inshore vessels with limited space for extra crew. On-board ‘tailing’ of the smaller *Nephrops* is not usually practised and the bigger *Nephrops* are picked from catches. There is no information on discard survival rate in this fishery but a 25% discard survival rate is assumed in line with other *Nephrops* stocks in the Celtic Sea.

Gear selectivity trials by Bord Iascaigh Mhara (BIM, 2017) reported a 64% survivor rate for *Nephrops* caught in a trawl with a SELTRA selectivity device in the outer Galway Bay area.

Table 19.3.1 gives weights, numbers and mean weights of the landings and discard raised internationally according to the Stock Annex.

Abundance indices from UWTV surveys

The methods used during the survey were similar to those employed for UWTV surveys [U5917] of *Nephrops* stocks around Ireland and elsewhere are documented by WKNEPHTV (ICES, 2007), WKNEPHBID (ICES, 2008), SGNEPS (ICES, 2009; 2010; 2012), WGNEPS (ICES, 2013; 2014; 2015; 2016a; 2017; 2018a, 2020, 2021, 2022), WKNEPS (ICES, 2016b; 2018b), Leocádio, A., *et al*, 2018, and

Dobby H., *et al*, 2021. SGNEPS 2012 (ICES, 2012) recommended that a CV (or relative standard error) of <20% as an acceptable precision level for UWTV survey estimates of abundance. Given the scale of the area and the number of distinct patches, it is unrealistic to expect sufficient stations (~10) in each individual patch to estimate densities separately. The random stratified approach may cause problems in years where the planned survey coverage is not achieved. WKCELT 2014 concluded that WGCSE or WGNEPS should make recommendations on the most appropriate fill in procedure to be adopted in these cases.

The spatial extent of the *Nephrops* grounds in FU19 has been re-defined by WKCELT 2014 and the abundance estimates are calculated using these areas. The redefinition of the polygons in FU19 resulted in ~16% increase in overall area from 1653 km² to 1973 km² (see Stock Annex). The discrete grounds have been named as: Bantry Bay, Galley Ground 1–4, Cork Channels, and Helvick 1–2 and are shown in Figure 18.1.1. In terms of area, the Galley Grounds (1–4) account for 61% of the total grounds in FU19 and Galley Ground 4 is the largest of these representing 47% of the total area (Table 18.2.5). Helvick patches 2 and 3 were also amalgamated and renamed Helvick 2 based on the information from the VMS data.

From 2011 to 2024 an average of 42 stations have been completed annually. The survey design is based on randomly picked stations from the ground polygons and the sampling effort on each ground was determined by relative area.

All grounds except Galley Ground 4 in 2011 and Galley Ground 1 in 2012 were covered by the TV survey. Since 2015, a new patch Kenmare Bay was surveyed.

Detailed summary statistics for the various *Nephrops* patches in FU19 over the time-series are presented in Table 21.2.6. The mean density varies across the different patches, but there is some consistency to the estimates over time. In 2024, all discrete grounds were covered by the TV survey (Doyle *et al.*, 2024).

The 2024 mean density estimates vary between patches from the lowest value 0.06 (no./m²) observed at Galley Grounds 1 and Helvick 2 to the highest observed at 0.59 (no./m²) at Galley Ground 2 (Table 18.2.6, Figure 18.2.8). The overall mean density for FU19 in 2024 is 0.15 (no./m²) which is the fifth lowest observed in the time-series (Table 18.2.7). The number of zero density stations observed is also shown in Table 18.2.8 which could account for the low abundance estimates observed over the time series.

Figure 18.2.9 and Table 18.2.7 shows the total abundance estimate for FU19 with the WKMSYRef4 proposed MSY $B_{trigger}$ (ICES, 2016XX; 2016YY). The 2024 abundance estimate was 32% higher than in 2023 and at 291 million is below the MSY $B_{trigger}$ (430 million) with a RSE of 15% which is below the 20% limit recommended by SGNEPs (2012).

Information from Irish Groundfish survey

Length–frequency data of the *Nephrops* catches on the Irish groundfish survey-Q4: IGFS-WIBTS-Q4 [G7212] from 2003–2023 are available (Stokes *et al.*, 2014; ICES, 2015). These data were investigated for trends in indicators such as possible recruitment signals (Figure 18.2.10). The mean size of males and females in from the survey was fairly stable over time at 33 mm for males and 25 mm for females.

18.3 Assessment

Comparison with previous assessments

The WGCSE 2019 carried out an UWTV based assessment for this stock. The methods used were very much in line with WK*NEPH* (ICES, 2009) and the approach taken for other *Nephrops* stocks in subareas 6 and 7 by WGCSE. This approach was benchmarked at WKCELT 2014 (ICES, 2014).

State of the stock

UWTV abundance estimates suggest that the stock size has fluctuated with a declining trend in the recent five years. The 2024 estimate is the fifth lowest observed and is below the MSY $B_{trigger}$. The 2024 abundance remains below the average of the series (geomean: [2011–2024]: 376 million).

Table 18.3.1 summarizes recent abundance estimates, harvest rates for the stock along with other stock parameters. Harvest rate is calculated as (landings + dead discards)/(abundance estimate).

Table 18.3.1.and Figure 18.3.1 summarize recent harvest ratios which have been below the F_{MSY} proxy for the last three years.

18.4 Catch scenario table

Catch scenario table inputs and historical estimates of mean weight in landings and harvest ratios are presented in Table 19.3.1 and summarised below.

The basis for the catch options:

Variable	Value	Notes
Stock abundance (2025)	291	Numbers of individuals (millions); UWTV survey 2024
Mean weight in projected landings (2025)	27.66	Average 2021–2023 in grammes
Mean weight in projected discards (2025)	13.47	Average 2021–2023 in grammes
Projected discards (2025)	48.6	Proportion by number; average 2021–2023
Discards survival (2025)	25	Proportion by number

The average in the recent three years is used to calculate the mean weight for landings and discards. The discard rates and proportions for the last three years are used to account for recent on-board retention practices (this is also according to the Stock Annex).

A prediction of landings for the FU19 using the approach agreed procedure proposed at WK*NEPH* 2009 and outlined in the Stock Annex will be made on the basis of the 2024 UWTV survey. This will be presented in October 2024 for the provision of advice.

18.5 Reference points

WKMSYRef4 updated the F_{MSY} reference points for FU19 (ICES, 2016XX; 2016YY) on the basis of an average of estimated F_{MSY} proxy harvest rates over a period of years; this corresponds more closely to the methodology for finfish. The updated harvest rate calculated at 9.3% is expected to deliver high long-term yield with a low probability of recruitment overfishing. This is close to the harvest rate of 8.1% calculated by WKCELT (ICES, 2014)

This stock previously did not have MSY $B_{trigger}$ specified; the time-series and range of indicator biomass is also limited such that direct use of B_{loss} is considered too close to equilibrium biomass. The workshop proposed to use the 5% interval on the probability distribution of indicator biomass assuming a normal distribution, which is analogous to the 5% on B_{MSY} proposed for finfish stocks assuming these *Nephrops* FU have been exploited at a rate close to near HR_{MSY}. The MSY $B_{trigger}$ for FU 19 is 434 million individuals rounded to 430 million.

These reference points shown in text table below should remain under review by WGCSE should improved data become available.

Stock code	MSY F_{lower}*	F_{MSY}*	MSY F_{upper}* with AR	MSY Btrigger	MSY F_{upper}* with no AR
nep-19	8.3%	9.3%	9.3%	430***	9.3%

*** Harvest rate (HR).**

***** Abundance in millions.**

18.6 Management strategies

No specific management plan exists for this stock.

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to Norway lobster (*Nephrops norvegicus*) by functional unit in ICES Subarea 7 and also demersal stocks.

18.7 Quality of assessment and forecast

Biological sampling for this stock is improving given the spatial distribution of the *Nephrops* mud patches. A number of other biological parameters such as mean weights and length distributions have also been revised. The revisions were made as part of the benchmark process and have improved the quality of the assessment.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU19, deterministic estimates of the mean weight in the landings and discard rates for 2021–2023 are used although there is some variability of these over time.

From 2016, fisheries catching *Nephrops* in Subarea 7 are covered by the EU landings obligation (EU, 2015). Creel fisheries are exempted from the landings obligation, with a *de minimis* exemption consisting of a 5% discard rate by weight for the trawl fishery in 2019 (reduced from 6% in 2018 and 7% in both 2016 and 2017).

Irish discard survival experiments indicate that the trawl discard survival may be around 64% (BIM, 2017). As a result, an exemption from the landings obligation based on high survivability has been granted by the European Commission. The average discard rate by weight for FU19 over the last three years is 32%. Catch advice and scenarios are provided this year on the assumption that discarding is assumed to continue at the recent average.

There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009; WGNEPS 2014). Ultimately, there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al.*, 1996). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate, although no more precise WK*NEPH* (ICES, 2009). Different densities are apparent on the various different grounds within this FU. For the 2024 survey, the number of observations on each individual patch is relatively low making the relative standard error (RSE) estimates not that relevant. Aggregating all areas together gives a mean burrow density of 0.15 with a RSE of around 15% which is below the 20% threshold recommended by SGNEPS (ICES, 2012). The cumulative bias estimates for FU19 are largely based on expert opinion. The precision of these bias corrections cannot yet be characterized, but is likely to be lower than that observed in the survey.

Landings data are adjusted to take into account landings that have been misreported from FU16 since 2011. This adjustment is thought to be reasonably accurate.

18.8 Recommendations for next benchmark

This stock was benchmarked by ICES in February 2014 (ICES, 2014). WGCSE will keep the stock under close review and recommend future benchmark as required.

18.9 Management considerations

The trends from the fishery (landings, effort, mean size, etc.) appear to show a decline. The UWTV abundance and mean density estimates vary between the discrete patches and population dynamics between these are not fully understood. The 2024 survey result is the fifth lowest observed in the time-series and below MSY $B_{trigger}$.

In recent years, several newer vessels specializing in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. Since the introduction of effort management associated with the cod long-term plan (EC 1342/2008), there have been concerns that effort will be displaced towards FU19 and other *Nephrops* grounds where effort control has not been put in place.

Nephrops fisheries in this area are fairly mixed also catching megrim, anglerfish, and other demersal species. There are also some catches of hake, and in the offshore parts of the area. The *Nephrops* grounds in FU19 coincide with an important nursery area for juvenile hake and anglerfish among other species (ICES, 2009).

18.10 References

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18.11 Tables and Figures

Table 18.2.1. *Nephrops* in FU19 (SW and SE Ireland). Landings in tonnes by country. The figures in the table are rounded. Calculations were done with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table. Landings presented for Belgium from 2017 onwards only.

Year	FU 19				
	France	Rep. of Ireland	UK	Belgium	Total
1989	245	652	2		899
1990	181	569	4		754
1991	212	860	5		1077
1992	233	640	15		888
1993	229	672	4		905
1994	216	153	21		390
1995	175	507	12		694
1996	145	736	7		888
1997	93	656	7		756
1998	92	733	2		827
1999	77	499	3		579
2000	144	541	11		696
2001	111	702	2		815
2002	188	1130	0		1318
2003	165	1075	0		1240
2004	76	997	1		1074
2005	62	648	2		712
2006	65	675	1		741
2007	63	894	0		957
2008	46	790	15		851
2009	55	798	15		868
2010	14	660	13		687
2011	23	619	1		643
2012	11	837	1		849

Year		FU 19			
	France	Rep. of Ireland	UK	Belgium	Total
2013	4	783	6		794
2014	6	459	3		468
2015	5	502	0		507
2016	4	583	3		590
2017	4	412	4	0	420
2018	4	229	5	0	238
2019	2	247	1	0	249
2020	1	247	<0.5	0	249
2021	1	413	1	<0.5	415
2022	5	242	<0.5	0	247
2023	2	258	<0.5	1	260

Table 18.2.2. ***Nephrops*** **in FU19 (SW and SE Ireland). Irish** ***Nephrops*** **directed effort (Kw Days) and landings. Irish Fleet -** ***Nephrops*** **trawlers (>30% landings weight)**

Year	All Vessels		Vessels >18 m	
	kW days ('000)	Landings Tonnes	kW days ('000)	Landings Tonnes
1995	222.0	380	80.7	121
1996	178.6	355	55.6	86
1997	161.0	306	53.9	101
1998	329.6	498	144.6	189
1999	182.9	236	42.3	47
2000	142.0	217	56.2	86
2001	193.3	397	89.1	139
2002	506.7	883	323.7	446
2003	555.9	693	318.8	364
2004	488.1	558	303.0	311
2005	405.0	471	220.6	219
2006	424.2	478	208.8	186
2007	558.8	713	287.4	262
2008	534.1	643	288.1	319
2009	472.0	613	224.5	243
2010	382.2	494	103.7	114
2011	337.3	449	142.9	167
2012	355.5	541	91.9	126
2013	336.1	571	88.6	133
2014	213.6	332	52.1	74
2015	244.6	393	85.5	118
2016	287.3	558	111.2	233
2017	118.2	425	111.4	179
2018	71.6	107.1	24.1	29.9
2019	91.4	145.9	31.6	37.5

Year	All Vessels		Vessels >18 m	
	kW days ('000)	Landings Tonnes	kW days ('000)	Landings Tonnes
2020	72.3	133.4	12.7	19.1
2021	125	261	29	47
2022	79	143	13	14
2023	86	131	32	36

Table 18.2.3. ***Nephrops*** **in FU19 (SW and SE Ireland). Irish Sampling levels.**

Year	Quarter	Number of samples			Numbers Measured		
		Catch	Discards	Landings	Catch	Discards	Landings
2008	1	3	0	0	1502	0	0
2008	2	6	0	0	3521	0	0
2008	3	6	0	0	6412	0	0
2008	4	3	0	0	876	0	0
2009	1	3	0	0	1347	0	0
2009	2	6	0	0	3369	0	0
2009	3	2	0	0	1003	0	0
2009	4	5	0	0	1882	0	0
2010	1	2	0	0	840	0	0
2010	2	7	0	0	2989	0	0
2010	3	4	0	0	1457	0	0
2010	4	6	0	0	2376	0	0
2011	1	3	0	0	1493	0	0
2011	2	5	0	0	2747	0	0
2011	3	2	0	0	938	0	0
2011	4	5	0	0	2686	0	0
2012	1	6	0	0	2053	0	0
2012	2	7	0	0	3956	0	0
2012	3	4	0	0	1980	0	0
2012	4	4	0	0	1969	0	0
2013	1	3	0	0	1857	0	0
2013	2	8	5	0	4117	2059	0
2013	2	3	3	0	1177	1250	0
2013	4	3	3	0	1472	1276	0
2014	1	3	2	0	1137	941	0
2014	2	7	7	0	3331	2319	0
2014	3	3	2	0	1344	682	0

Year	Quarter	Number of samples			Numbers Measured		
		Catch	Discards	Landings	Catch	Discards	Landings
2014	4	10	8	0	3455	2200	0
2015	1	1	1	0	417	310	0
2015	2	3	3	0	1417	1267	0
2015	3	2	2	1	856	648	321
2015	4	3	2	0	1250	774	0
2016	1	3	3	0	1500	1631	0
2016	2	6	5	0	2310	1760	0
2016	3	9	7	0	3328	2448	0
2016	4	5	5	0	1,923	1521	0
2017	1	4	4	0	1860	1283	0
2017	2	3	3	0	1572	1281	0
2017	3	2	2	0	998	943	0
2017	4	4	2	0	1200	785	0
2018	1	1	1	0	304	380	0
2018	2	7	7	0	3579	3230	0
2018	3	1	1	0	255	275	0
2018	4	1	1	0	370	404	0
2019	1	4	5	0	1630	2222	0
2019	2	3	3	0	1275	1398	0
2019	3	0	0	0	0	0	0
2019	4	4	4	0	1810	1798	0
2020	1	2	2	0	728	702	0
2020	2	7	7	0	3095	2855	0
2020	3	1	1	0	489	404	0
2020	4	3	4	0	1671	1900	0
2021	1	2	2	0	842	782	0
2021	2	5	5	0	2530	2484	0
2021	3	3	3	0	1497	1326	0

Year	Quarter	Number of samples			Numbers Measured		
		Catch	Discards	Landings	Catch	Discards	Landings
2021	4	4	4	0	2363	2415	0
2022	1	3	3	0	1090	1117	0
2022	2	2	2	0	833	876	0
2022	3	2	2	0	700	590	0
2022	4	1	1	0	633	519	0
2023	1	3	3	0	1561	1473	0
2023	2	3	3	0	1729	1409	0
2023	3	3	3	0	1184	1137	0
2023	4	2	3	0	1035	801	0

Table 18.2.4. ***Nephrops*** **in FU19 (SW and SE Ireland). Landings and estimated discards by weight.**

	Female		Male		Both sexes
Year	Landings (t)	Discards (t)	Landings (t)	Discards (t)	% Discard
2008	99	29	691	69	11.0
2009	117	106	681	141	23.7
2010	138	98	522	148	27.2
2011	169	155	450	250	38.9
2012	190	202	647	265	35.8
2013	259	210	525	220	35.4
2014	106	71	353	87	25.6
2015	79	64	423	101	24.8
2016	154	91	429	100	24.7
2017	133	58	280	79	24.9
2018	71	27	157	40	22.9
2019	66	48	181	63	31.1
2020	40	46	207	89	35.3
2021	83	63	331	109	29.4
2022	32	38	210	67	30.2
2023	62	61	196	77	35.0

Table 18.2.5. ***Nephrops*** **in FU19 (SW and SE Ireland). Landings and estimated discards by number.**

	Female Numbers '000s		Male Numbers '000s		Both sexes
Year	Landings	Discards	Landings	Discards	% Discard
2008	3,893	1,781	19,516	3,255	17.7
2009	5,819	8,250	20,324	8,793	39.5
2010	6,276	8,147	16,001	10,117	45.1
2011	7,295	12,895	16,900	18,192	55.7
2012	9,266	17,635	22,540	19,108	53.6
2013	11,680	18,945	17,399	17,034	55.3
2014	4,862	5,647	11,183	5,572	41.1
2015	3,706	5,255	13,111	6,462	41.1
2016	6,877	6,761	12,610	6,668	40.8
2017	5,295	4,400	9,022	5,044	39.7
2018	2,908	1,866	5,197	2,454	34.8
2019	2,970	3,909	6,023	4,474	48.2
2020	2,006	3,971	7,595	6,026	51.0
2021	3,701	5,133	10,817	7,481	46.5
2022	1,669	3,062	7,035	4,413	46.2
2023	3,054	5,248	6,570	5,600	53.0

Table 18.2.6. *Nephrops* in FU19 (SW and SE Ireland). Area (Km²) of discrete patches and percentage contribution to overall area.

Ground	Area (Km²)	% Contribution
Bantry	121.5	6%
Cork Channels	562.0	28%
Galley Grounds 1	60.9	3%
Galley Grounds 2	76.7	4%
Galley Grounds 3	133.9	7%
Galley Grounds 4	925.1	47%
Helvick 1	33.1	2%
Helvick 2	59.5	3%
Total	1972.8	

Table 18.2.7. ***Nephrops*** **in FU19 (SW and SE Ireland). Detailed summary statistics for the various** ***Nephrops*** **patches in FU19 over the time-series. (N = number of stations, Mean Density (burrow/m²) is adjusted for the bias correction factor in Table 3, sd, se and ci are the standard deviation, standard error and 95% confidence intervals on the mean density).**

Year	Ground	N	Mean Density	sd	se	ci
2006	Galley Grounds 4	6	0.21	0.18	0.08	0.19
2011	Bantry	5	0.33	0.23	0.1	0.28
2011	Cork Channels	12	0.35	0.32	0.09	0.2
2011	Galley Grounds 1	3	0.52	0.41	0.24	1.02
2011	Galley Grounds 2	3	0.59	0.43	0.25	1.07
2011	Galley Grounds 3	4	0.58	0.22	0.11	0.35
2011	Helvick 1	3	0.6	0.01	0.01	0.04
2011	Helvick 2	5	0.12	0.21	0.09	0.26
2012	Bantry	1	0.2	NA	NA	NA
2012	Cork Channels	9	0.27	0.17	0.06	0.13
2012	Galley Grounds 2	4	0.59	0.12	0.06	0.19
2012	Galley Grounds 3	1	0.51	NA	NA	NA
2012	Galley Grounds 4	16	0.39	0.16	0.04	0.09
2012	Helvick 1	3	0.33	0.13	0.08	0.33
2012	Helvick 2	6	0.33	0.41	0.17	0.43
2013	Bantry	4	0.38	0.2	0.1	0.31
2013	Cork Channels	11	0.12	0.1	0.03	0.07
2013	Galley Grounds 1	2	0.23	0.18	0.13	1.59
2013	Galley Grounds 2	3	0.48	0.44	0.25	1.09
2013	Galley Grounds 3	4	0.59	0.24	0.12	0.38
2013	Galley Grounds 4	13	0.19	0.27	0.07	0.16
2013	Helvick 1	1	0.09	NA	NA	NA
2013	Helvick 2	2	0.06	0.05	0.04	0.48
2014	Bantry	4	0.25	0.05	0.03	0.09
2014	Cork Channels	10	0.1	0.06	0.02	0.04
2014	Galley Grounds 1	2	0.61	0.41	0.29	3.69
2014	Galley Grounds 2	2	0.82	0.14	0.1	1.23

Year	Ground	N	Mean Density	sd	se	ci
2014	Galley Grounds 3	4	0.66	0.23	0.12	0.37
2014	Galley Grounds 4	14	0.29	0.29	0.08	0.17
2014	Helvick 1	2	0.67	0.28	0.2	2.53
2014	Helvick 2	2	0.03	0.04	0.03	0.39
2015	Bantry	2	0.32	0.11	0.08	1.02
2015	Cork Channels	10	0.08	0.11	0.03	0.08
2015	Galley Grounds 1	2	0.32	0.46	0.32	4.12
2015	Galley Grounds 2	2	0.53	0.08	0.06	0.74
2015	Galley Grounds 3	4	0.40	0.14	0.07	0.23
2015	Galley Grounds 4	14	0.27	0.19	0.05	0.11
2015	Helvick 1	2	0.30	0.23	0.16	2.08
2015	Helvick 2	2	0.09	0.09	0.06	0.79
2015	Kenmare Bay	1	0.30	NA	NA	NA
2016	Bantry	4	0.20	0.07	0.04	0.12
2016	Cork Channels	10	0.21	0.11	0.03	0.08
2016	Galley Grounds 1	2	0.03	0.01	0.01	0.08
2016	Galley Grounds 2	2	0.53	0.12	0.09	1.11
2016	Galley Grounds 3	4	0.16	0.12	0.06	0.19
2016	Galley Grounds 4	14	0.17	0.20	0.05	0.12
2016	Helvick 1	2	0.38	0.08	0.06	0.70
2016	Helvick 2	2	0.07	0.09	0.06	0.81
2016	Kenmare Bay	2	0.24	0.15	0.11	1.33
2017	Bantry	3	0.29	0.15	0.09	0.37
2017	Cork Channels	10	0.25	0.20	0.06	0.14
2017	Galley Grounds 1	2	0.24	0.11	0.08	1.00
2017	Galley Grounds 2	2	0.63	0.06	0.04	0.55
2017	Galley Grounds 3	3	0.45	0.12	0.07	0.30
2017	Galley Grounds 4	15	0.16	0.16	0.04	0.09
2017	Helvick 1	2	0.46	0.07	0.05	0.66

Year	Ground	N	Mean Density	sd	se	ci
2017	Helvick 2	2	0.16	0.23	0.16	2.03
2017	Kenmare Bay	2	0.16	0.22	0.16	1.97
2018	Bantry	4	0.06	0.02	0.01	0.04
2018	Cork Channels	10	0.11	0.11	0.04	0.08
2018	Galley Grounds 1	2	0.06	0.01	0.01	0.10
2018	Galley Grounds 2	2	0.19	0.19	0.14	1.75
2018	Galley Grounds 3	4	0.11	0.09	0.05	0.14
2018	Galley Grounds 4	14	0.07	0.08	0.02	0.05
2018	Helvick 1	2	0.11	0.10	0.07	0.92
2018	Helvick 2	2	0.06	0.03	0.02	0.28
2018	Kenmare Bay	2	0.07	0.03	0.02	0.25
2019	Bantry	4	0.13	0.04	0.02	0.06
2019	Cork Channels	10	0.16	0.17	0.06	0.13
2019	Galley Grounds 1	2	0.12	0.17	0.12	1.57
2019	Galley Grounds 2	2	0.66	0.38	0.27	3.40
2019	Galley Grounds 3	4	0.21	0.14	0.07	0.23
2019	Galley Grounds 4	14	0.18	0.23	0.06	0.13
2019	Helvick 1	2	0.34	0.27	0.19	2.46
2019	Helvick 2	2	0.00	0.00	0.00	0.00
2019	Kenmare Bay	2	0.27	0.10	0.07	0.88
2020	Bantry	0.31	0.11	0.05	0.17	0.31
2020	Cork Channels	0.13	0.20	0.06	0.14	0.13
2020	Galley Grounds 1	0.13	0.10	0.07	0.87	0.13
2020	Galley Grounds 2	0.43	0.24	0.17	2.14	0.43
2020	Galley Grounds 3	0.20	0.15	0.08	0.24	0.20
2020	Galley Grounds 4	0.10	0.10	0.03	0.06	0.10
2020	Helvick 1	0.24	0.05	0.04	0.48	0.24
2020	Helvick 2	0.06	0.08	0.06	0.73	0.06
2020	Kenmare Bay	0.18	0.12	0.09	1.11	0.18

Year	Ground	N	Mean Density	sd	se	ci
2021	Bantry	4	0.09	0.03	0.01	0.04
2021	Cork Channels	10	0.20	0.19	0.06	0.14
2021	Galley Grounds 1	2	0.08	0.06	0.04	0.54
2021	Galley Grounds 2	2	0.31	0.10	0.07	0.87
2021	Galley Grounds 3	4	0.22	0.13	0.06	0.20
2021	Galley Grounds 4	14	0.09	0.07	0.02	0.04
2021	Helvick 1	2	0.09	0.08	0.05	0.69
2021	Helvick 2	2	0.08	0.05	0.04	0.48
2021	Kenmare Bay	2	0.05	0.03	0.02	0.30
2022	Bantry	4	0.08	0.06	0.03	0.10
2022	Cork Channels	10	0.10	0.13	0.04	0.09
2022	Galley Grounds 1	2	0.06	0.01	0.01	0.13
2022	Galley Grounds 2	2	0.39	0.26	0.19	2.35
2022	Galley Grounds 3	4	0.17	0.05	0.03	0.08
2022	Galley Grounds 4	14	0.15	0.11	0.03	0.07
2022	Helvick 1	2	0.14	0.00	0.00	0.02
2022	Helvick 2	2	0.08	0.08	0.06	0.74
2022	Kenmare Bay	2	0.04	0.05	0.04	0.46
2023	Bantry	4	0.21	0.11	0.05	0.17
2023	Cork Channels	10	0.06	0.12	0.04	0.08
2023	Galley Grounds 1	2	0.04	0.00	0.00	0.04
2023	Galley Grounds 2	2	0.24	0.24	0.17	2.12
2023	Galley Grounds 3	4	0.33	0.06	0.03	0.09
2023	Galley Grounds 4	14	0.05	0.07	0.02	0.04
2023	Helvick 1	2	0.14	0.05	0.04	0.45
2023	Helvick 2	2	0.09	0.09	0.07	0.85
2023	Kenmare Bay	2	0.12	0.06	0.04	0.50
2024	Bantry	4	0.07	0.04	0.02	0.06
2024	Cork Channels	10	0.10	0.12	0.04	0.08

Year	Ground	N	Mean Density	sd	se	ci
2024	Galley Grounds 1	2	0.06	0.02	0.01	0.16
2023	Galley Grounds 2	2	0.59	0.12	0.09	1.11
2023	Galley Grounds 3	4	0.22	0.03	0.01	0.04
2023	Galley Grounds 4	14	0.15	0.11	0.03	0.06
2023	Helvick 1	2	0.15	0.14	0.10	1.23
2023	Helvick 2	2	0.06	0.09	0.06	0.78
2023	Kenmare Bay	2	0.12	0.10	0.07	0.93

Table 18.2.7. *Nephrops* in FU19 (SW and SE Ireland). Summary statistics for FU19 combined over the time-series.

Year	Number of stations	Mean Density adjusted (burrow /m²)	Standard Deviation	Raised abundance estimate adjusted (million burrows)	Upper 95%CI on Abundance	Lower 95%CI on Abundance	CVs (%)
2006^	6	0.21	0.18	408	789	26	36
2007*							
2008*							
2009*							
2010*							
2011	35	0.34	0.26	665	836	494	13
2012	40	0.3	0.18	594	705	484	9
2013	40	0.25	0.26	487	648	326	17
2014	40	0.32	0.31	636	823	448	15
2015	39	0.24	0.2	482	608	356	13
2016	42	0.2	0.17	399	498	299	13
2017	41	0.25	0.20	499	619	379	12
2018	42	0.09	0.09	176	229	124	15
2019	42	0.20	0.21	386	514	259	17
2020	42	0.16	0.16	320	412	227	15
2021	42	0.14	0.13	270	347	193	15
2022	42	0.13	0.12	259	332	185	14
2023	42	0.11	0.13	220	296	145	17
2024	42	0.15	0.14	291	376	206	15

^ exploratory survey.

***No TV survey from 2007 to 2010.**

Table 18.2.8. ***Nephrops*** **in FU19 (SW and SE Ireland). Number of UWTV stations with zero density observed.**

Year	Number of zero density stations	Total Number of Stations achieved
2006^	0	6
2007*		
2008*		
2009*		
2010*		
2011	5	35
2012	1	40
2013	6	40
2014	4	40
2015	7	39
2016	4	42
2017	6	41
2018	7	42
2019	11	42
2020	5	42
2021	1	42
2022	3	42
2023	10	42
2024	4	42

^ exploratory survey.

***No TV survey from 2007 to 2010.**

Table 18.3.1. *Nephrops* in FU19 (SW and SE Ireland). Forecast inputs (bold) and historical estimates of mean weight in landings and harvest rate (landings + dead discards)/(abundance estimate), discard rate (discards divided by landings + discards) and dead discard rate as dead discards divided by removals (landings + dead discards).

Year	Landings in number	Total discards* in number	Removals in number	Discard Rate number	Dead discard rate number	UWTV abundance estimate	95% Conf. intervals	Harvest rate	Landings	Total discards*	Mean weight in landings	Mean weight in discards
	millions	**millions**	**millions**	**%**	**%**	**millions**	**millions**	**%**	**tonnes**	**tonnes**	**grammes**	**grammes**
2006	26.2	2.6	28.1	8.9	6.8		No Survey		741	37	28.3	14.4
2007	30.8	1.5	31.9	4.8	3.6				957	26	31.1	17
2008	25.2	5.4	29.3	17.7	13.9				851	105	33.7	19.4
2009	28.4	18.5	42.3	39.5	32.8				868	269	30.5	14.5
2010	23.2	19.0	37.4	45.1	38.1				687	257	29.6	13.5
2011	25.8	32.4	50.1	55.7	48.5	665	171	7.5	643	409	24.9	12.6
2012	32.3	37.3	60.2	53.6	46.4	594	111	10.1	849	473	26.3	12.7
2013	29.5	36.5	56.8	55.3	48.1	487	161	11.7	794	436	26.9	11.9
2014	16.3	11.4	24.9	41.1	34.4	636	188	3.9	468	161	28.6	14.1
2015	17.0	11.8	25.9	41.1	34.3	482	126	5.5	507	167	29.8	13.8
2016	19.7	13.6	29.9	40.8	34.1	399	99	7.5	590	193	29.9	14.2
2017	14.6	9.6	21.8	39.7	33.1	499	120	4.4	420	139	28.8	14.5
2018	8.4	4.5	11.8	34.8	28.6	176	53	6.7	238	71	28.2	15.7
2019	9.1	8.5	15.4	48.2	41.1	386	127	4.0	249	112	27.4	13.3
2020	9.7	10.1	17.2	51	43.9	320	93	5.4	249	136	25.8	13.5
2021	14.6	12.7	24.1	46.5	39.4	270	77	8.9	415	173	28.5	13.6
2022	8.9	7.6	14.6	46.2	39.2	259	73	5.7	247	107	27.8	14.0
2023	9.7	11.0	18.0	53.0	45.8	220	75	8.1	260	141	26.8	12.8
2024						291	85					
Average 2021–2023				**48.6**	**41.5**						**27.7**	**13.5**

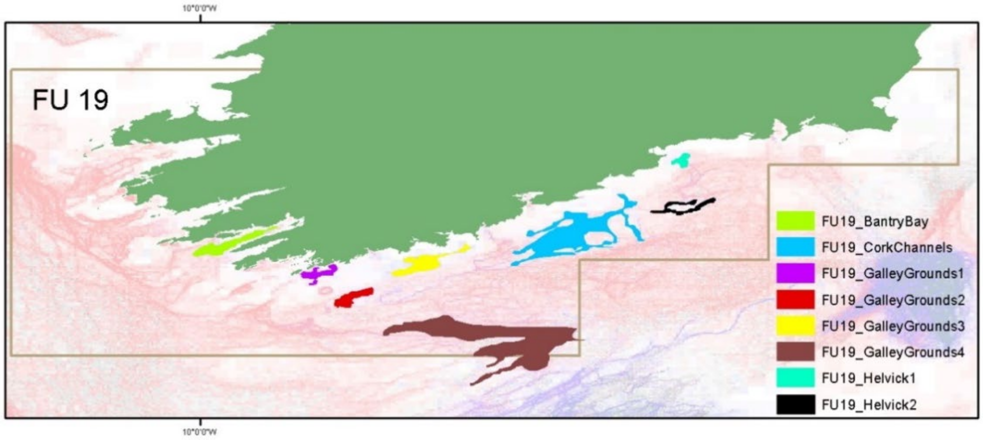


Figure 18.1.1. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Revised discrete patches overlaid on overlaid on proportion of** ***Nephrops*** **in the Irish landings overlaid on international OTB effort (red=0%** ***Nephrops*****; blue=50–60%** ***Nephrops*****; grey=unknown (no Irish landings).**

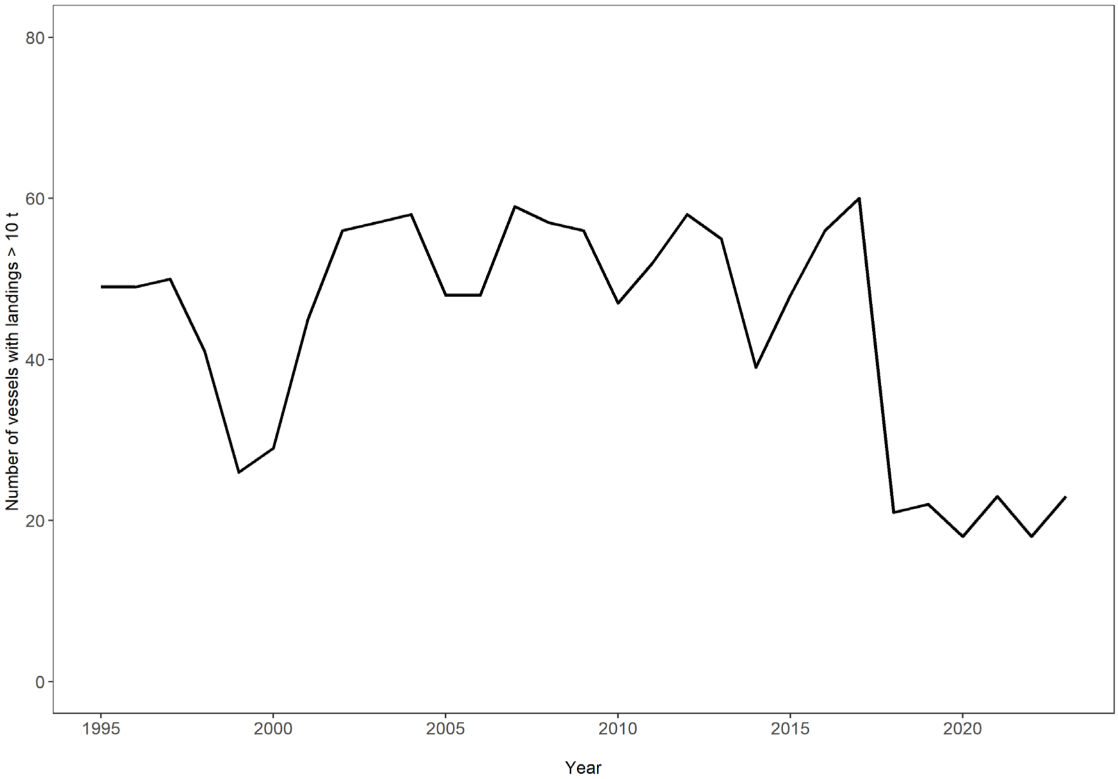


Figure 18.1.2. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Time-series of the number of Irish vessels reporting landings of** ***Nephrops*** **from FU19 with a >10 t threshold.**

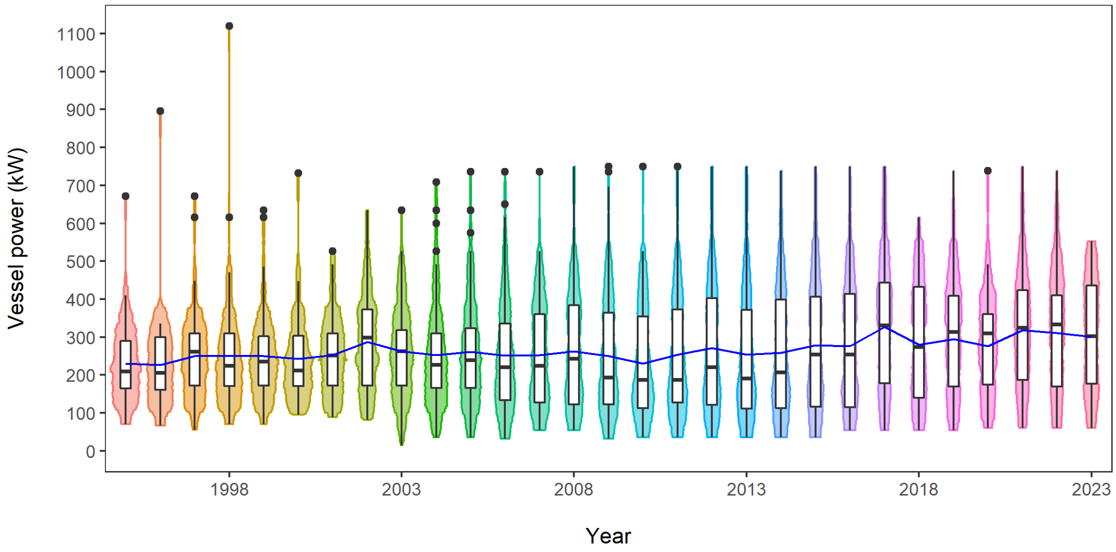


Figure 18.1.3. *Nephrops* in FU19 (Ireland SW and SE Coast). Combined box and kite plot of vessel power by year. The blue line indicates the mean.

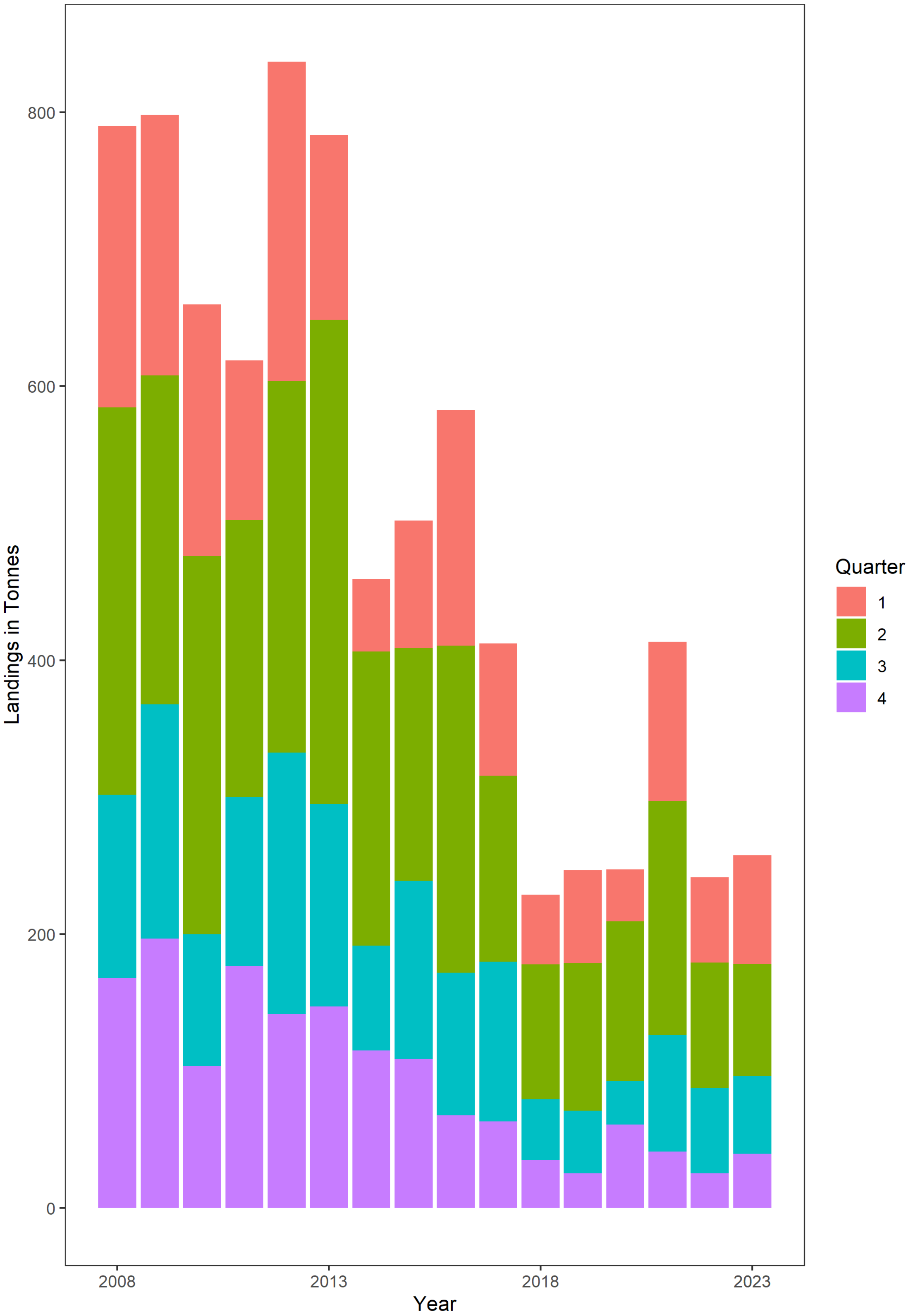


Figure 18.2.1. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Landings in tonnes by country.**

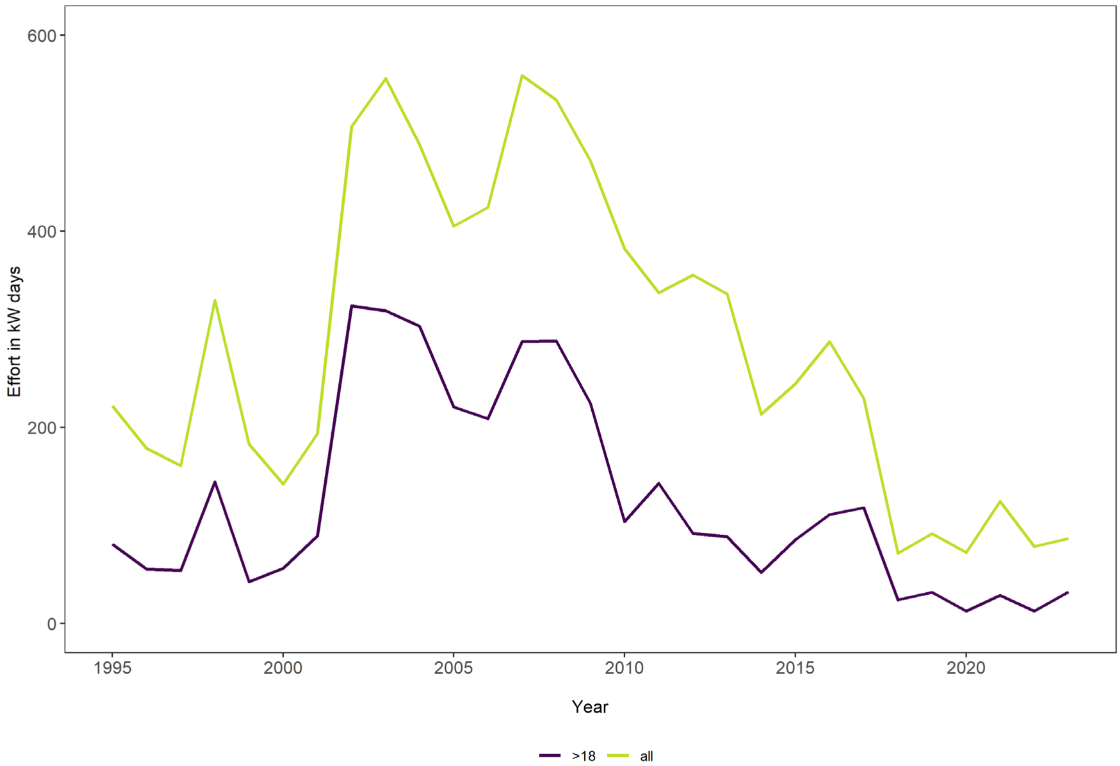


Figure 18.2.2. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Trawl effort for Irish OTB vessels where >30% of landed weight was** ***Nephrops*****.**

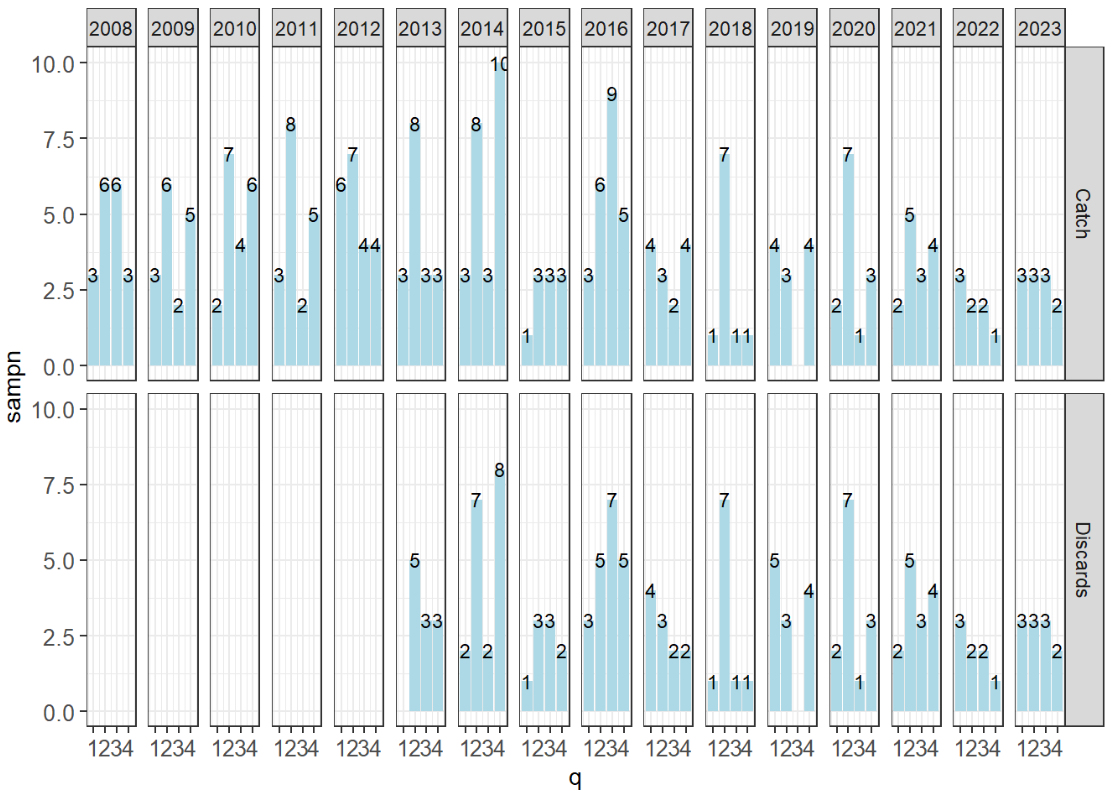


Figure 18.2.3. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Sampling levels for FU19.**

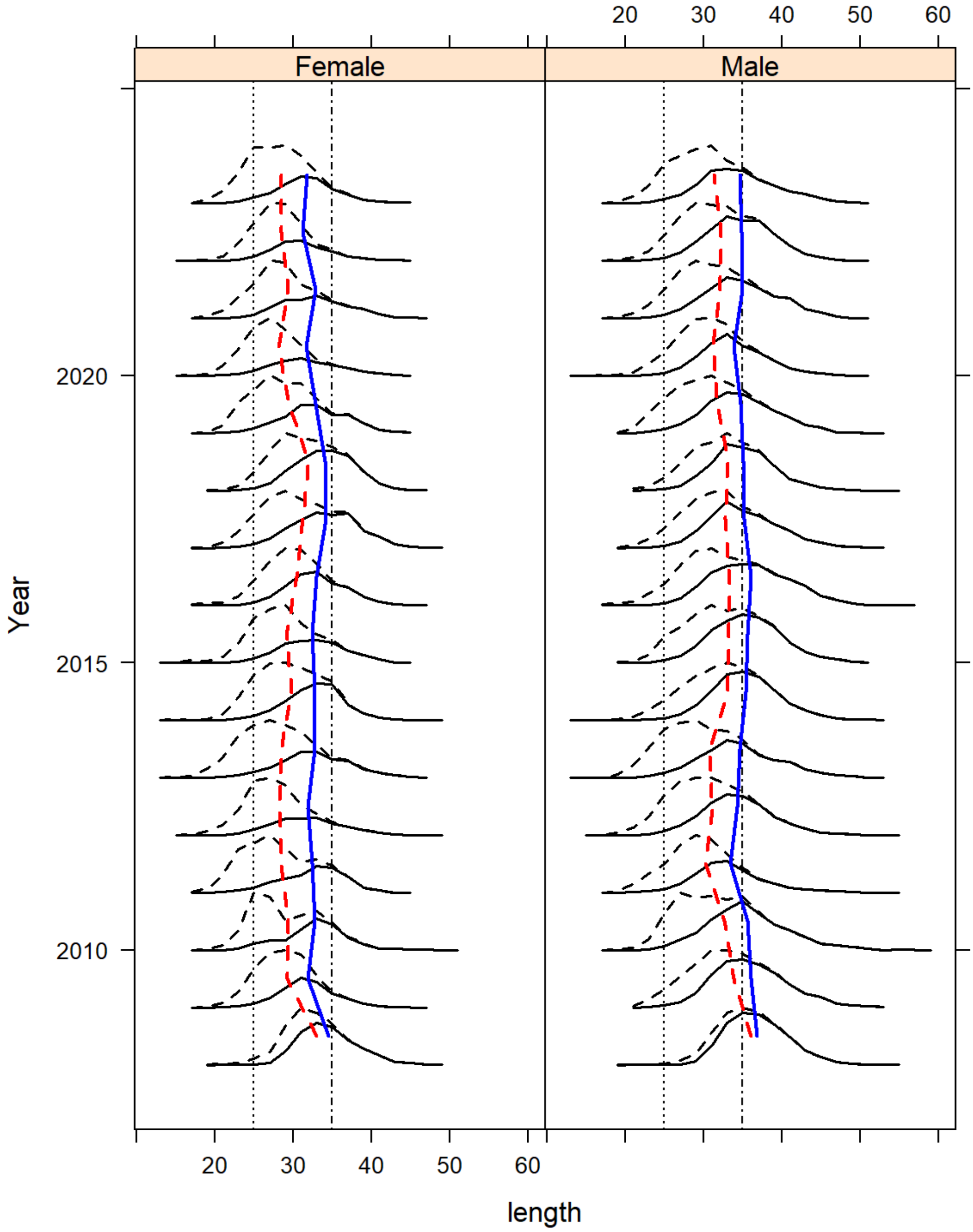


Figure 18.2.4. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Mean size trends for catches (dotted) and whole landings (solid) by sex 2002–2023. Vertical lines displayed are Minimum Conservation Reference Size 25 mm Carapace Length (CL) and visual reference 35 mm CL.**

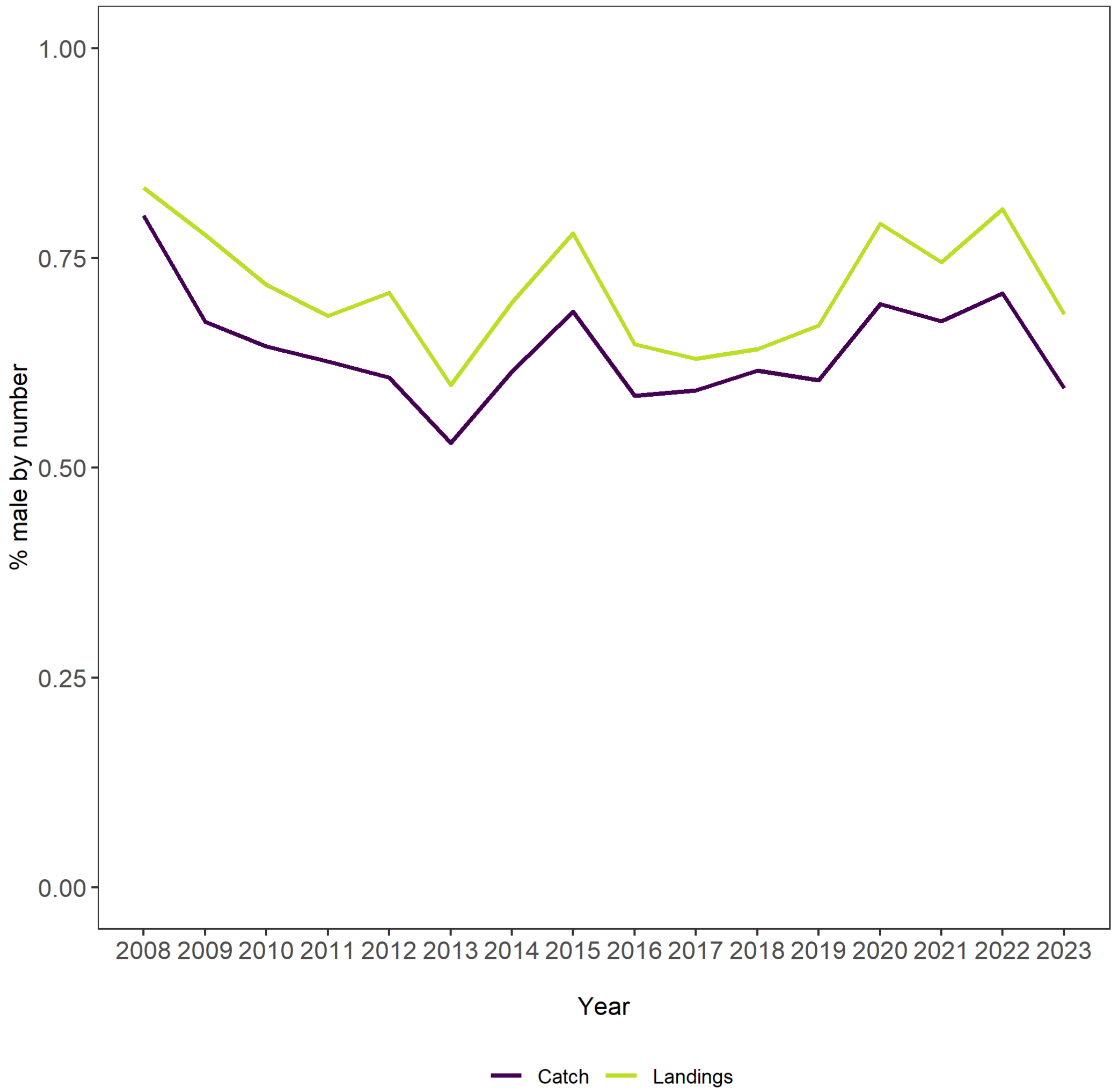


Figure 18.2.5. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Annual sex ratio of landings from available time series.**

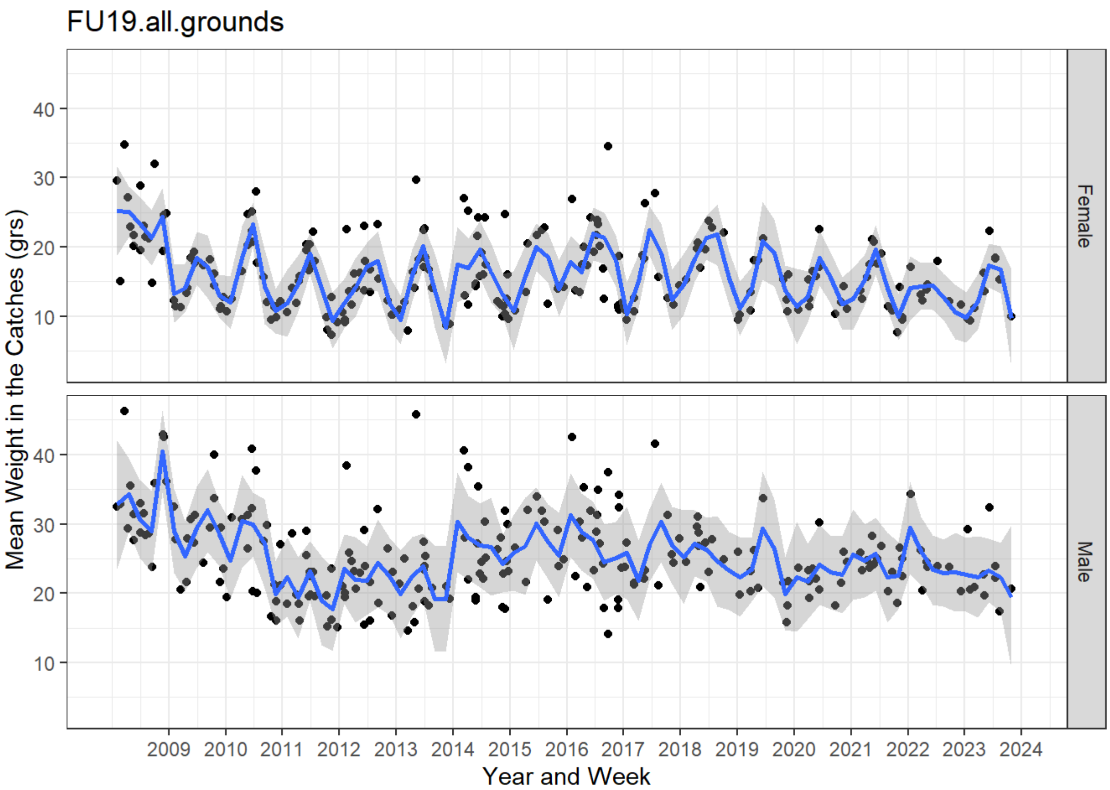


Figure 18.2.6. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Mean weight in available catch data for all grounds in FU19 by sex with loess smoother and showing cyclical trends.**

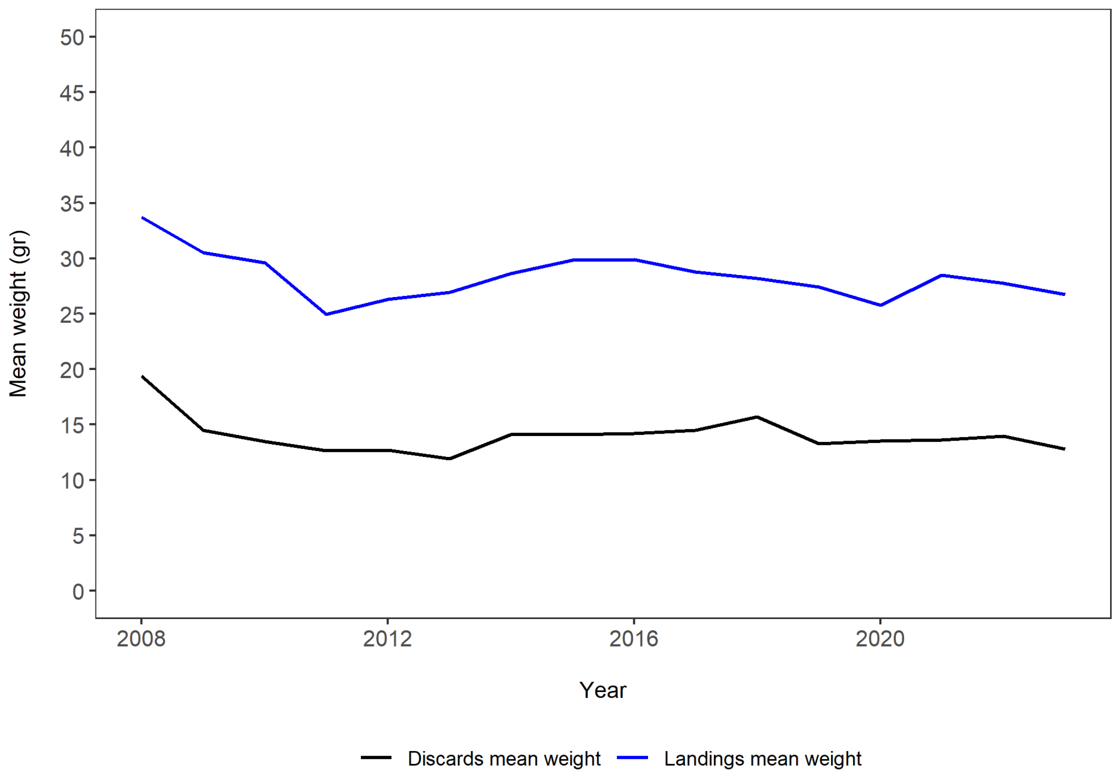


Figure 18.2.7. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Annual estimated mean weights (gr) in the landings and discards.**

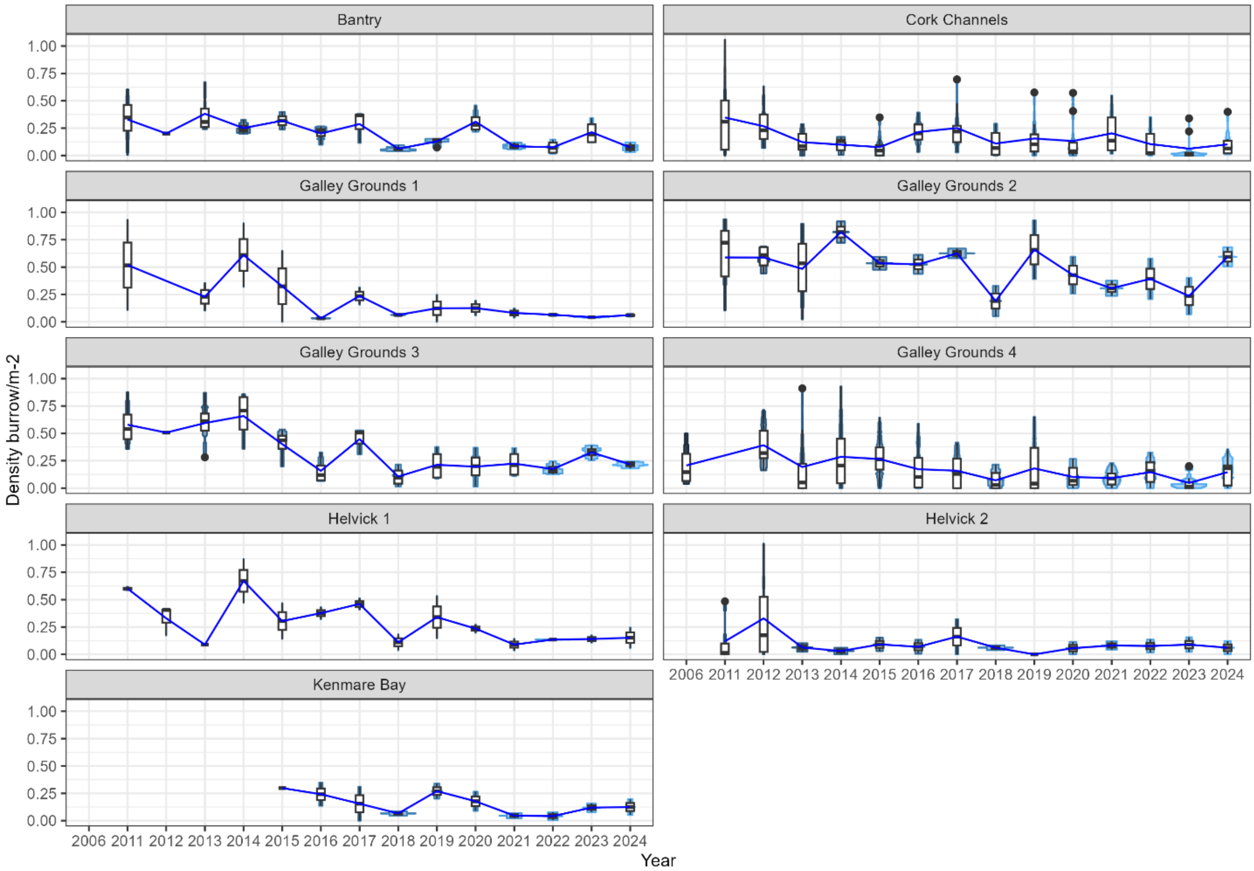


Figure 18.2.8. *Nephrops* in FU19 (Ireland SW and SE Coast). Violin and box plot of adjusted burrow density (burrow/m²) distributions by year from 2006–2024. The blue line indicates the mean density over time. The horizontal black line represents the median, white box is the interquartile range, the black vertical line is the range and the black dots are outliers. No estimate available for Galley Ground 4 in 2011, Galley Ground 1 in 2012. No TV survey from 2007 to 2010.

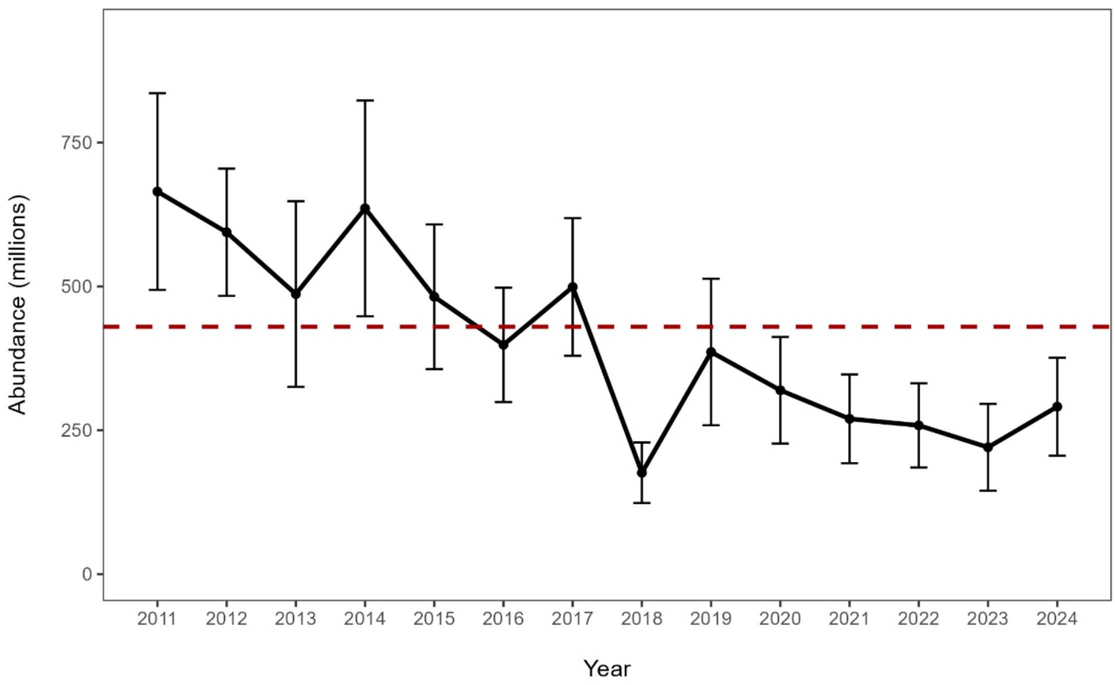


Figure 18.2.9. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Time-series of total abundance estimates for FU19 (error bars indicate 95% confidence intervals) and $B_{trigger}$ is dashed line.**

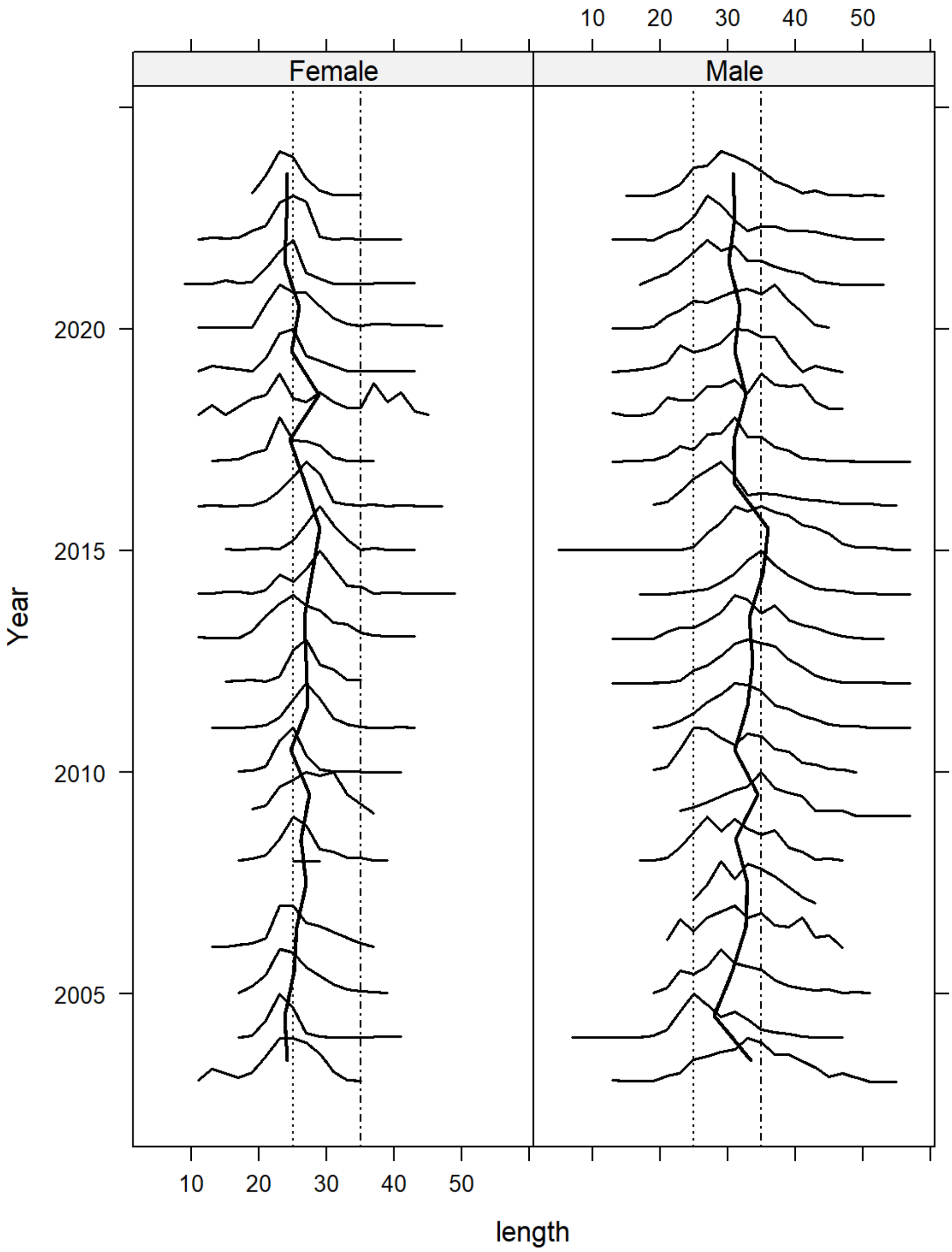


Figure 18.2.10. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Mean size trends for catches by sex from IGFS-WIBTS-Q4 [G7212] Irish survey 2003–2023. Vertical lines displayed are Minimum Conservation Reference Size 25 mm Carapace Length (CL) and visual reference 35 mm CL.**

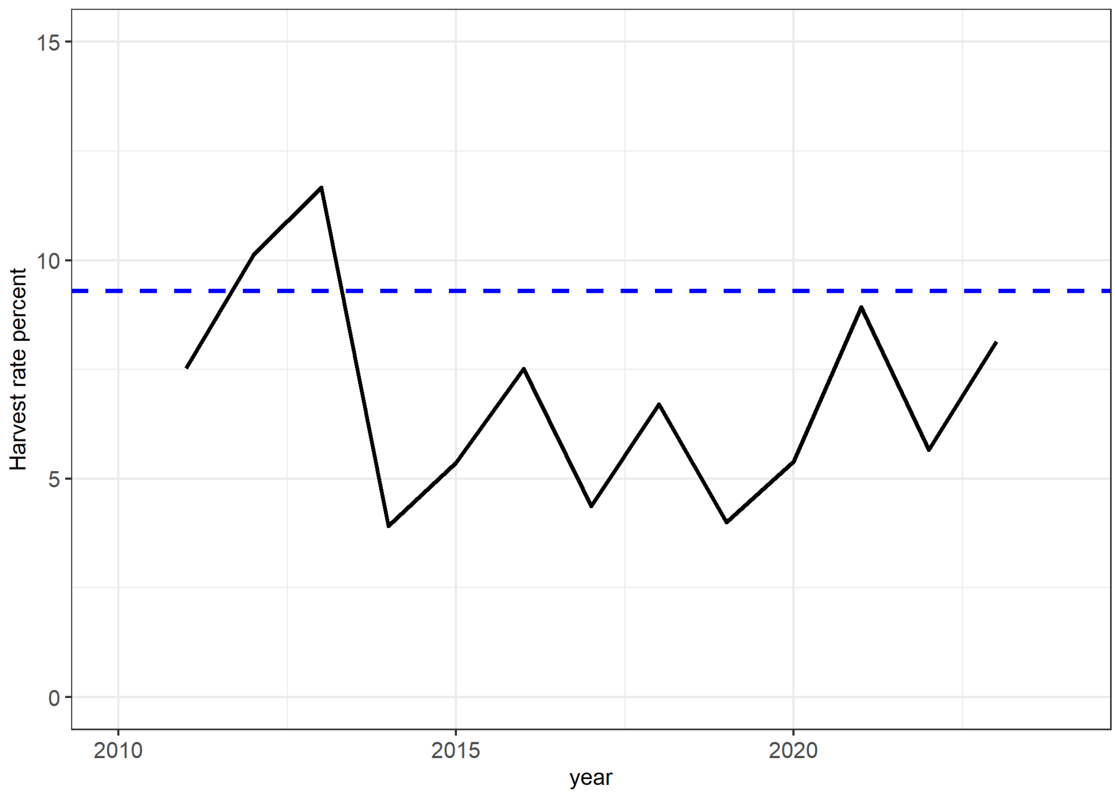


Figure 18.3.1. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Harvest Rate (% dead removed/UWTV abundance). The dashed and solid lines are the MSY proxy and the harvest rate respectively.**

Contents

19 Norway lobster (*Nephrops novegicus*) in divisions 7.g and 7.h, Functional Units 20 and 21 (Celtic Sea)

Type of assessment in 2024

A full UWTV based assessment was carried out and catch options based on the stock-specific F_{MSY} reference point estimated by WGCSE 2016 using the methods applied to other *Nephrops* stocks at WKFMSYREF4 (ICES, 2016) and a newly proposed MSY $B_{trigger}$ estimate (ICES, 2021a; Annex 3). The Stock Annex has been updated. This stock assessment is available in the ICES Transparent Assessment Framework (TAF) here.

ICES advice applicable to 2023

"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 2019–2021, catches in 2023 should be no more than 1803 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 FU 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."

ICES advice applicable to 2024

"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 2020–2022, catches in 2024 should be no more than 1 865 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."

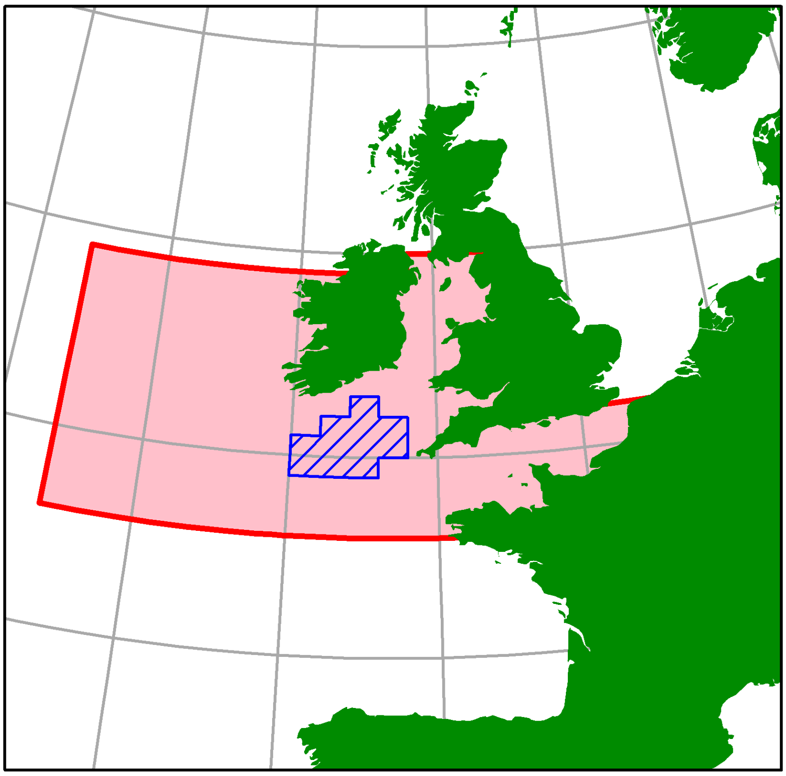
19.1 General

19.1.1 Stock description and management units

The FU20–21 *Nephrops* stock is included in the whole ICES Area 7 together with Irish Sea East and West [FU14, FU15], Porcupine Bank [FU16], Aran Islands [FU17], northwest Irish Coast [FU18], southeast and southwest Irish Coast [FU19], and Smalls [FU22]. The TAC is set for Subarea 7 which does not correspond to the stock area.

Historically, FU20–22 fishery and sampling data covered an amalgamation of several spatially distinct mud patches: FU20 NW Labadie, Baltimore, and Galley; FU21 Jones and Cockburn; and FU22 the Smalls. WGCSE 2013 recommended that FU20–22 should be split into FU20–21 (combined) and FU22 for the purposes of assessment and advice provision. There is evidence that the Celtic Sea *Nephrops* patches are linked in meta-population sense (O'Sullivan *et al.*, 2015). However, fishing mortality and biological parameters (density, growth, M, etc.) may vary across the different patches.

The map below shows FU20–21 assessment area (blue) and TAC area (red). There is no evidence that the individual functional units belong to the same stock. See Section 16 for details on *Nephrops* in Subarea 7 general section.



Ecosystem aspects

Details of the ecosystem on FU20–21 are provided in the Stock Annex updated by WKCELT.

19.1.2 Fishery description

Ireland, France, and the UK are the main countries involved in the FU20–21 *Nephrops* fishery. In the early 2000s, the Republic of Ireland fleet had on average less than 10% of the landings and this has increased to over 80% from this FU in the recent three-year period. A description of this fleet is given in the Stock Annex. The fishery on FU20–21 grounds operates throughout the year with a seasonal trend (quarters 2 and 3), weather permitting, and has expanded in the mid-2000s. The time-series of numbers of vessels with landings greater than 10 tonnes is updated in Figure 20.1.1. The time-series of vessel power is shown as a box and kite plot in Figure 19.1.2. In recent years, the Irish fleet have increased landings from the southern part of the grounds (see Stock Annex). Recently, several newer vessels specializing in *Nephrops* fishing have participated periodically in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. There has been a trend for Irish vessels to switch to multi (quad) rig trawls since 2012. These vessels are more efficient at catching *Nephrops* (BIM, 2015).

French trawlers targeting *Nephrops* in the Celtic Sea operate mainly in the FU20–21. France dominated the landings in the early 2000s with, on average, 90% of landings and this has decreased to about 14% in recent five-year period (2019–2023). A description of this fleet is given in the Stock Annex.

There is an increase in participation by the UK in this fishery in the most recent years. The UK fleet had on average 5% of the landings from this FU in the recent five-year period (2019–2023) with highest landings recorded in 2018 (411 t).

Fishery in 2023

Ireland

In 2023, 49 Irish vessels reported landings from FU20-21. Of these, 38 vessels reported landings in excess of 10 t which is a significant increase compared to 2022.

Landings by metier is quite mixed compared to other *Nephrops* fishery; however, since 2020, there was a significant decrease in landings by metier OTB_CRU-100_119 as shown in Figure 19.1.3, with the majority of landings now taken by the OTB_DEF_100-119 metier. The reason for this is not known and will be investigated.

France

In 2023, 33 French vessels reported landings from FU20–21 where many of these switch between FU20–21 and FU22 within a trip. Of these, seven vessels reported landings in excess of 10 t.

UK

In 2023, 16 UK vessels reported landings from FU20-21. Five of these vessels reported landings in excess of 10 t.

Information from stakeholders

None presented.

19.2 Data

InterCatch

Data were available in InterCatch and used for catch data only. French data were provided directly by the national expert and not extracted from InterCatch.

Landings

A minor revision to landings reported by Ireland for year 2021 was presented and accepted by the working group. This data is used in assessment and resulted in a minimal impact on assessment.

The reported landings time-series is shown in Figure 19.2.1 and Table 19.2.1.

The reported Irish landings from FU20-21 have increased since the mid-2000s to the highest in the Irish time-series in 2019 (2 219 t). In 2020, Irish landings were the lowest value reported since 2005 and have shown a small increasing trend up to 2023. French landings have gradually decreased since the early 2000s to the present reported landings of 109 t. Reported landings from the UK have fluctuated with an increasing trend since 2015, with a decrease noted in years 2020-2022. Minor landings were reported by Belgium (1.3 t) in 2023.

The overall fishing profile remains typically seasonal with the majority of the Irish and UK landings coming from the second quarter (see Stock Annex).

Effort

Effort data are available for the Irish *Nephrops* directed fleet in FU20-21 from 1995–2023. The effort series is based on the same criteria for FU15, 16, 17, 19, and 22 (30% landings threshold) and will be contingent on the accuracy of landings data reported in logbooks. Effort data are not standardized, and hence do not take into account vessel capabilities, efficiency, seasonality, or other factors that may bias perception of lpue as an abundance trend over the longer term. These data are not used in the assessment.

WGCSE 2015 recommended that effort data in KW days should be presented as these data are more informative than effort data uncorrected for vessel power. Effort data are available from 1995 for the Irish otter trawl *Nephrops* directed fleet. In 2023, this fleet accounted for ~90% of the Irish landings compared with an average of 70% over the time period. Effort shows a generally increasing trend since the mid-2000s with a sharp decrease between 2015 and 2017 and also since 2020. (Figure 20.2.2 and Table 20.2.2).

Effort data in KW days are not available for France. Previously effort data were reported from 1983 to 2008 for the French *Nephrops* fleet for the combined Celtic Sea FU20–22 (see Stock Annex). Since 2009, a new registration system of official French statistics has changed the way fishing effort is computed and a new threshold method of 500 kg landed by trip is used to report effort. French fishing effort reported in hours and lpue (kg/hr) since 2009 shows an overall declining trend (Table 19.2.3). Data has not been reported in recent years (2020-2023) due to very low level participation in this fishery.

Sampling levels

Sampling levels, data aggregating, and raising procedures were reviewed by WKCELT 2014 and are documented in the Stock Annex. The time-series of sampling levels is shown in Table 20.2.4, which had been sparse in early part of the time series due to the offshore nature of the fishery, although good progress is being made by Ireland in recent years.

There was a revision to the Ireland 2019 sampling data set due to the inclusion of a valid sample that was discovered as a result of QA process of a SQL server migration. The inclusion of this sample data to the 2019 Ireland fishery data summary had a minor impact on the assessment summary. The details data of this revision was presented to the WGCSE 2020 meeting and was accepted.

Commercial length–frequency distributions

Prior to 2012, there was insufficient Irish sampling to generate length–frequency distributions, although since then sampling levels have improved. For France, limited data were available for 1997 and 2010–2013. In 2019, sampling data was not used due to quality issues (see Stock Annex for details). In 2020, one sample was available but not deemed useful for assessment purposes. In 2021, two samples were available but again not deemed useful for assessment.

Length–frequency distributions of landings and discards for both countries from 2012 to 2023 are presented in Figure 19.2.3, along with the European minimum conservation reference size (25 CL mm) and French (35 CL mm) minimum landings size also shown. In 2019, France provided sample data numbers and raised data; however, it was not included in the assessment that year due to data quality issues. In 2020, sampling data were not available from France due to the COVID-19 pandemic and since 2021 due to the quite low level of participation in the fishery.

There is a lack of small individuals in the catch in 2020 from Irish sampling the reason for this is unclear at present.

The short series on LFDs for both countries shows that the LFDs differ between the two countries. A higher proportion of the French catch consists of large individuals (>35 mm) - on average 70% compared to 41% for the Irish fishery for the available comparable time-series.

Sex ratio

The sex ratio is male biased from the available French and Irish sampling data (Table 19.2.5).

Mean weight explorations

The French dataset provided to WGCSE 2017 (years 2012–2015) results in an increase in mean weights and decrease in removals from that previously reported at WGCSE 2016 (Table 19.2.6). The working group accepted the French dataset, and this is used to calculate the estimated annual mean weights in the landings and discards.

The length–weight relationship as described in the Stock Annex is used to raise both countries sampling data, which are based on Scottish data (Pope and Thomas, 1955).

The mean weight in the landings for France is higher than that in the Irish landings (Table 19.2.7). The estimated annual mean weights in the landings and discards by country and also combined scaled to the international landings is shown in Table 19.2.8 and Figure 19.2.4. There is a big decline in 2016 to 2017 which coincides with the very high UWTV estimate of abundance – which could indicate a strong year class.

Discards

For the Irish data, discard rates have been estimated using unsorted catch and discards sampling. This involves unsorted catch and discard samples being provided by vessels or collected by observers at-sea on discard trips. The catch sample is partitioned into landings and discards using an on-board discard selection ogive derived for the discard samples. Due to sparse sampling effort, annual data are used to derive length distributions and selection ogives. Figure 19.2.5 shows the annual discard ogive from the Irish sampling used to partition the catch. The lack of smaller individuals was also evident in the 2020 discard ogive. The length–weight regression parameters given in the stock annex are used to calculate sampled weights and appropriate annual raising factors. The sampling intensity and coverage has varied over the short time-series, and is considered adequate for stock assessment purposes given it is based on the Irish sampling programme which has developed well in recent years

Estimated discard rates range between 12–41% of total catch by number and 6–27% of total catch by weight in the Irish fishery shown in Table 19.2.7. The 2020 discard rates could be related to a change in this fishery mainly comprised of OTB_DEF metiér; however, this will be investigated further. In the French fishery, estimated discard rates range between 25–78% of total catch by number and 16–56% of total catch by weight shown in Table 19.2.6.

Estimated discard rates for both countries combined in shown in Table 19.2.8 and these range between 12–52% of total catch by number and 6–31% of total catch by weight. Discard rate of females tends to be higher due to the smaller average size and market reasons as is observed in other *Nephrops* fisheries.

There is no information on discard survival rate in this fishery; 25% is assumed in line with other *Nephrops* stocks in the Celtic Sea (Charuau *et al*., 1982).

Gear selectivity trials by Bord Iascaigh Mhara (BIM, 2017) reported a 64% survivor rate for *Nephrops* caught in a trawl with a SELTRA selectivity device in the outer Galway Bay area.

Table 19.3.1 gives weights, numbers, and mean weights of the landings and discard raised internationally according to the Stock Annex.

Abundance indices from UWTV surveys

The methods used during the survey were similar to those usually employed for UWTV surveys [U5917] of *Nephrops* stocks around Ireland and elsewhere and are documented by WKNEPHTV (ICES, 2007), WKNEPHBID (ICES, 2008), SGNEPS (ICES, 2009; 2010; 2012), WGNEPS (ICES, 2013; 2014; 2015; 2016a; 2017; 2018a, 2020, 2021, 2022), WKNEPS (ICES, 2016b; 2018b), Leocádio, A., *et al*, 2018, and Dobby H., *et al*, 2021.

SGNEPS (ICES, 2012) recommended that a CV (or relative standard error) of <20% is an acceptable precision level for UWTV survey estimates of abundance. UWTV surveys conducted in 2012 are deemed exploratory as stations were chosen based on areas heavily fished by vessels (Doyle *et al*., 2013). These are likely to give biased estimates of density and cannot be extrapolated to estimate density for the whole area. A randomized isometric grid design was employed with UWTV stations at 6.0 nmi intervals since 2013.

A review of the kriging analyses by two different software packages for survey years 2013 and 2014 was investigated as part of the transition of the assessment to the ICES TAF process This was reviewed by an external expert. The results from SURFER and RGeostats software were very close and full details are available on the ICES TAF stock GitHub repo and also in Annex 3 (ICES, 2021a). The summary statistics from the RGeostats software are now used in the assessment for those years. The 2013 survey achieved partial coverage ~60% of the total area. The 2013 abundance has been scaled up to the entire area since densities in the un-surveyed part of the ground were not significantly different in 2014. From 2014 to 2023, full survey coverage was achieved.

In 2024, 90% (84/93 planned stations) of the survey grid was achieved. The potential impact of the missing nine stations in the 2024 survey was explored by comparing the densities estimations of the kriging model to densities in adjoining areas from the current survey year and also to densities in the same gap-area from previous survey years. This is considered to have had minimal impact on the abundance estimate and quality of the survey, based on burrow densities in adjoining areas and comparing coefficients of variation from the current and previous survey years. The geo-statistical analysis for years 2013 to 2024 follows the steps documented in White *et al*., 2024.

The 2024 mean burrow density was 0.11 burrows/m^2 compared with 0.10 burrows/m^2 in 2023. The 2024 geostatistical abundance estimate was 1 152 million a 12% increase on the abundance for 2023 with a CV of 6% which is well below the upper limit of 20% recommended by SGNEPS 2012 (Figure 19.2.8). There was a slight decrease in densities observed in 2023. Figure 19.2.6 shows the kriged contour and density plots for the time-series. The summary statistics from this geostatistical analysis are given in Table 19.2.9 and plotted in Figure 20.2.7. The geostatistical abundance estimate adjusted is derived using the mean of the kriged grid, where the mean of the observations is reported in Table 19.2.9. The estimation variance of the survey is very low (CVs in the order 6%).

Groundfish survey data

There are two IBTS-GFS catching *Nephrops* in FU20–21: French groundfish survey EVHOE-WIBTS-Q4 [G9527] since 1997 and Irish groundfish survey-Q4: IGFS-WIBTS-Q4 [G7212] commenced in 2003 (Stokes *et al.,* 2014). These provide information on length–frequency compositions, mean size in the catches, CPUE of *Nephrops* in FU20–21 (ICES, 2015). The mean size of the catches is stable over the time-series except in 2006 and 2008 which signals recruitment into the fishery in 2006 and 2007 as shown by the Irish IBTS survey in Figure 23.2.8 and the French IBTS survey (Figure 23.2.9). There is also a signal of recruitment in 2018 mean size from IGFS survey. There is no 2017 length dataset for EVHOE due to research vessel breakdown. There is an increase in mean length for both sexes for both surveys in 2023.

19.3 Assessment

Comparison with previous assessments

The WGCSE 2024 carried out a full UWTV based assessment for this stock using the stock-specific reference points were estimated by the 2016 working group based on methods for other *Nephrops* stocks used by WKMSYREF4 (ICES, 2016). This is in accordance with recommendations by WKCELT 2014 where data improvements have been made for this stock such as:

- complete survey coverage of the stock area giving quality assured density estimates and abundance estimates conforming to WGNEPS recommendations;
- improved sampling data achieving better coverage and robust estimates of the various parameters needed to calculate catch options (e.g. mean weight in the landings and discards, discard percentage in numbers); and
- proposal of MSY $B_{trigger}$ based on seven years of survey data.

State of the stock

UWTV abundance estimates suggest that the stock size has fluctuated over the time-series. The 2024 estimate is an increase from 2023 estimate by 12%.

The 2024 estimate is above the newly proposed MSY $B_{trigger}$ (450 million). The 2024 estimate (1 152 million) is below the average of the series (geomean [2014–2024]: 1 508 million).

Table 23.3.1 and Figure 23.3.1 summarize recent harvest rates which have been below the F_{MSY} proxy except in 2019 where the harvest rate is 19.2% which is a result of the low stock abundance estimate and high catches.

19.4 Catch scenario table

Catch scenario table inputs and estimates of mean weight in landings and harvest rates are presented in Table 23.3.1 and summarized below.

In line with previous practice, an average (2021–2023) of mean weights is used to account for this variability. Three year average (2021–2023) of proportion of removals retained was used as is standard for other *Nephrops* stocks.

The basis for the catch scenario:

Variable	Value	Notes
Stock abundance (2025)	1026	UWTV survey 2024; individuals in millions
Mean weight in projected landings (2025)	31.2	Average 2021–2023; in grammes
Mean weight in projected discards (2025)	16.5	Average 2021–2023; in grammes
Projected discards (2025)	13.0	Average 2021–2023; percentage by number of the total catch
Discards survival (2025)	25	Percentage by number of the discards

A prediction of landings for the FU20–21 using the approach agreed procedure proposed at WK*NEPH* 2009 and outlined in the Stock Annex will be made on the basis of the 2024 UWTV survey. This will be presented in October 2025 for the provision of advice.

19.5 Reference points

New reference points were estimated by WGCSE 2016 using the same method and approach used at WKMSYREF4 (ICES, 2016). The detailed analysis is available in Working Document 11 (WGCSE, 2016). In the case of FU20–21, there is a limited number of years for which length–frequency data were available, so the three-year moving window could only be applied to give two estimates. The resulting potential F_{MSY} harvest rates and ranges are given in the following table.

YEAR	FMAX	FMAX.LOW	FMAX.UP	F35	F35.LOW	F35.UP	F0.1	F0.1.LOW	F0.1.UP
2012	9.12	6.51	12.60	11.03	6.11	13.21	5.91	5.08	15.11
2013	9.45	6.71	13.26	11.17	6.30	13.78	6.10	5.23	15.93

Given the low density in the area and combined sex, $F_{0.1}$ was considered and appropriate F_{MSY} proxy.

STOCK CODE	MSY FLOWER*	FMSY*	MSY FUPPER*WITH AR	MSY BTRIGGER	MSY FUPPER*WITH NO AR
nep-2021	5.9%	6.0%	6.0%	Not defined	6.0%

*** Harvest rate (HR).**

At WGCSE 2021, MSY $B_{trigger}$ estimate was proposed using the same method and process used at WKMSYREF4 (ICES, 2016). The detailed analysis is available and was externally reviewed (ICES, 2021a; Annex 3). The estimate was based data on survey years 2014 to 2021, excluding year 2017, and value is given in table below:

STOCK CODE	MSY $B_{TRIGGER}$
nep-2021	450 million

19.6 Management plans

There is no specific management plan for the FU 20–21 *Nephrops.*

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to Norway lobster (*Nephrops norvegicus*) by functional unit in ICES Subarea 7 and also demersal stocks. There is currently no agreement with the UK regarding this plan.

19.7 Quality of assessment and forecast

Since the benchmark in 2014, UWTV and sampling coverage has been improving in this area. There are now nine years of full UWTV survey coverage (2014–2023) and 89% coverage in 2024. Analysis of kriged density estimates for the missing stations in 2024 is considered to have had minimal impact on the abundance estimate and quality of the survey. Since 2019, the survey camera system and reviewing method changed where a new HD system is used (ICES, 2019). A comparison showed no significant difference in density estimates between the new (HD) and the old method (SD) for FU 20-21 (ICES, 2022b). Previous assumptions relating to correction factors are still applied for this FU 20-21.

There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009; WGNEPS 2014, and Dobby et al, 2021). Ultimately, there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al.*, 1996). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate, although no more precise (WK*NEPH*, 2009). The survey estimates themselves are very precisely estimated (CVs ~6%) given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU20–21 are largely based on expert opinion. The precision of these bias corrections cannot yet be characterized but is likely to be lower than that observed in the survey.

At WGCSE 2018, the group recommended that a review of historical survey data should be undertaken given the large fluctuations observed in the short time-series to date for this survey, that is, to randomly check 20% of UWTV stations in years 2016 and 2017. This process was conducted in July 2018 during the FU20–21 UWTV survey. The analysis was presented to WGNEPS (2018a) and subsequently to the 2019 WGCSE meeting where full details are available in R-markdown (ICES, 2018a; Annex 7). Results are briefly summarized as follows. The analyses showed a low increase in the review counts for 2016 stations comparing them with the survey counts (3.8% increase), and a high decrease in the review counts for 2017 stations comparing them with the survey counts (30.8% decrease). Next, the review count data were swapped with the survey count data and abundance was calculated for both years using the 'RGeostats' package (Renard D. *et al.*, 2015), following the same procedure that was carried out in those years previously. The geo-statistical results showed an increase of 4.6% in 2016 abundance estimate (from 1 879 million to 1 966 million), and a decrease of 4% in 2017 abundance estimate (from 4 428 million to 4 250 million). The geo-statistical CVs were in the order of 3.7% to 4.4%, which are well below the upper limit recommendation of 20% (ICES, 2012).

Following this analysis, WGNEPS 2018 recommended to include guidelines on quality control where there are large unexplained fluctuations between abundance estimates from previous years in the manual for *Nephrops* underwater TV surveys (Dobby *et al.*, 2021). In that it is recommended to review 20% of the survey stations, and when the partial review differs more than 20% from the survey counts, then a full review of the survey should be considered.

These were also followed in 2019 given the substantial decrease observed. A random selection of 20% of UWTV stations were reviewed. Full details are available in R-markdown (ICES, 2019). The results showed an overall increase in the review counts for these selected stations comparing them with the survey counts (15.5% increase). This process confirmed the observed low-density estimates which are used to calculate the abundance estimate for determining catch scenarios for 2020.

Sampling of landing and discards for FU20–21 remains low but there is a limited number of years for which length–frequency data were available so the three year moving window could only be applied to give two estimates to calculate F_{MSY} reference points.

French and Irish trawlers cover different areas and have presented contrasting features over the last decade. The French fleet moved gradually from the "Smalls" Ground (mainly 31E3) to the "Labadie" (30E2, increase of 28E2 in the early 2010s, although no trend is revealed within FU20–21 throughout the overall time-series); in the late 1990s, more than 40% of French landings were reported from the "Smalls" area whereas by the end of 2000s the contribution of this rectangle became minor (less than 10%). Irish vessels have increased their production on FU20–21 since the mid-2000s and a gradual expansion towards the southern rectangles is obvious during the recent years (see Stock Annex).

19.8 Recommendations for next benchmark

This stock was last benchmarked by WKCELT (ICES, 2014). WGCSE will keep the stock under close review and recommend future benchmark as required.

19.9 Management considerations

The indications are the *Nephrops* in FU20–21 are well exploited now relative to the past. Overall effort in the French fishery has declined to less than 25% of the peak effort observed in the early 1990s, whereas there has been a big increase in Irish effort over the recent years with sharp decline in 2020.

Overall, the Irish fishery in the area expanded with the exception of 2020, whereas the French fishery continued to decline. The fishing patterns of the French and Irish fleet are very different, with the Irish fleet specializing on *Nephrops* whereas the French fishery remains more mixed. French *Nephrops* fisheries in this area are fairly mixed, also catching whiting, cod, megrim, anglerfish, and other demersal species (Davie and Lordan, 2011). *Nephrops* tend to dominate the landings of Irish fisheries in the area but catches are more mixed in the North (~50% *Nephrops*) and cleaner *Nephrops* towards the south (~75% *Nephrops*) (Gerritsen *et al.*, 2012). The French trawlers showed an overall decline in effort and landings during the last decade, mainly explained by decommissioning schemes associated with constraints linked to fuel prices.

In recent years several newer vessels specializing in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates.

From 2016, fisheries catching *Nephrops* in Subarea 7 are covered by the EU landings obligation (EU, 2015). A high survivability exemption applies to creel fisheries from the landings obligation. Irish discard survival experiments indicate that the trawl discard survival may be around 64% (BIM, 2017). As a result, an exemption from the landings obligation based on high survivability has been granted by the European Commission. The average discard rate by weight for FU20–21 over the last three years is 8%. Catch advice and scenarios are provided this year on the assumption that discarding is assumed to continue at the recent average.

Coverage has been good and consistent over several years now. The survey being conducted in summer allows an in-year estimate of density and abundance and used for catch advice released the same autumn. Landings data are adjusted to take into account landings that have been misreported from FU16 since 2011. This adjustment is thought to be reasonably accurate (see Section 19).

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES division level. Management at the functional unit level could provide controls to ensure effort and catch were in line with resources available.

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19.11 Tables and Figures

Table 19.2.1. *Nephrops* FU 20–21. Landings in tonnes by country.

	FU 20–21 Landings (t)				
Year	**France**	**Rep. of Ireland**	**UK**	**Belgium**	**Total**
1995	3419	117	na		3536
1996	2721	101	na		2822
1997	1957	81	na		2038
1998	1583	130	na		1713
1999	1051	83	18		1152
2000	1661	107	10		1778
2001	1750	69	14		1833
2002	2559	104	11		2674
2003	2796	148	9		2953
2004	2140	299	4		2443
2005	2008	455	6		2469
2006	2066	450	7		2523
2007	1816	600	3		2419
2008	2036	937	7		2980
2009	1930	1202	13		3145
2010	975	756	62		1793
2011	566	637	34		1237
2012	453	708	28		1189
2013	486	844	57		1387
2014	465	1342	29		1837
2015	355	1620	141		2116
2016	477	1531	445		2453
2017	341	1113	395	0.2	1849
2018	195	1197	411	0.2	1803
2019	218	2219	286	0.1	2723

	FU 20–21 Landings (t)				
Year	**France**	**Rep. of Ireland**	**UK**	**Belgium**	**Total**
2020	75	336	2	0.03	413
2021	114	572	9	3	697
2022	148	640	6	<0.5	795
2023	109	1195	137	1	1442

Table 19.2.2. ***Nephrops*** **FU 20–21. Effort data for the Irish otter trawl** ***Nephrops*** **directed fleet. Effort for vessels where 30% of the landed weight was** ***Nephrops*****.**

Year	Effort ('000's KwDays)	Landings (tonnes)
2005	255	360
2006	301	348
2007	402	512
2008	562	920
2009	801	1,249
2010	498	633
2011	424	535
2012	357	534
2013	445	672
2014	885	1,170
2015	1,180	1,542
2016	920	1,404
2017	704	1,004
2018	695	1,084
2019	1,185	2,153
2020	184	245
2021	342	443
2022	350	506
2023	620	916

Table 19.2.3. *Nephrops* **FU 20–21. Effort data for the French fleet.** *French values from 2009 onwards are calculated as indicated in Stock Annex.*

Year	Effort France ('000 hrs)	Lpue France (kg/hr)
1983	231	14
1984	205	16
1985	203	16
1986	163	15
1987	190	15
1988	171	16
1989	179	17
1990	230	16
1991	225	11
1992	277	12
1993	268	13
1994	259	14
1995	239	15
1996	220	14
1997	187	13
1998	155	13
1999	151	11
2000	194	14
2001	170	15
2002	166	19
2003	192	18
2004	153	16
2005	147	16
2006	137	16
2007	102	19
2008	100	23
2009	93	23
2010	67	17

Year	Effort France ('000 hrs)	Lpue France (kg/hr)
2011	52	12
2012	42	13
2013	48	12
2014	36	15
2015	35	11
2016	35	15
2017	34	11
2018	21	10
2019	22	11
2020	12.5	6.1
2021	14.2	8.6
2022	17.0	10.0
2023	15.3	8.7

Table 19.2.4.a. *Nephrops* FU 20–21. Sampling levels by Ireland.

IRELAND		Number of Samples			Numbers Measured		
Year	Quarter	Catch	Discards	Landings	Catch	Discards	Landings
2009	2	1	0		489	0	
2010	2	1	0		461	0	
2011	2	1	0		270	0	
2012	1	8	5	1	2,654	2,024	1,747
2013	1	1	1		319	423	
2013	2	9	7	1	2,514	2,038	2,187
2014	2	2	2		718	782	
2015	1	0	0	1	0	0	1,724
2015	2	6	6	2	2,714	3,997	3,204
2015	3	0	0	4	0	0	4,750
2015	4	2	2		650	419	
2016	2	8	5	1	2,859	1,485	384
2016	4	3	2	4	767	1,678	1,743
2017	1	2	1	1	722	297	1,616
2017	2	7	4	1	2,813	1,035	365
2017	3	3	1		1,154	296	
2017	4	12	7		3,631	1,983	
2018	1	3	3		987	1,036	
2018	2	17	17		6,691	5,742	
2018	3	2	0		389	0	
2018	4	2	1		544	369	
2019	1	8	6		2,691	3,103	
2019	2	12	10		4318	3,738	
2019	3	1	1		373	520	
2019	4	0	0		0	0	
2020	1	11	9		3,412	1,934	
2020	2	10	8		3,581	2,448	

IRELAND		Number of Samples			Numbers Measured		
Year	Quarter	Catch	Discards	Landings	Catch	Discards	Landings
2020	3	2	0		689	0	
2020	4	0	0		0	0	
2021	1	9	5		2,987	1,495	
2021	2	14	10		5,991	3,807	
2021	3	4	3		1,897	1,277	
2021	4	1	1		349	376	
2022	1	7	3		2,631	1,087	
2022	2	10	4		4,150	1,049	
2022	3	10	4		3,944	1,083	
2022	4	2	1		761	20	
2023	1	12	6		5556	2919	
2023	2	14	11		6121	3382	
2023	3	1	0		472	0	
2023	4	8	2		3903	962	

Table 19.2.4.b. *Nephrops* FU 20–21. Sampling levels by France.

FRANCE		Number of Samples			Numbers Measured		
Year	Quarter	Catch	Discards	Landings	Catch	Discards	Landings
2012	1		31	9		391	1431
2012	2		13	8		198	1202
2012	3		47	8		667	1155
2012	4		6	6		16	860
2013	1		0	12		0	1362
2013	2		68	72		1,120	3151
2013	3		16	68		131	1917
2013	4		2	14		12	1303
2014	1		0	10		0	1221
2014	2		40	47		1,127	3536
2014	3		20	33		458	1934
2014	4		0	9		0	1360
2015	1		2	14		60	1508
2015	2		24	44		520	3249
2015	3		1	9		1	1366
2015	4		0	9		0	1357
2016	1		3	44		464	3164
2016	2		4	42		519	1263
2016	3		1	25		217	1971
2016	4		2	20		5	1935
2017	1		3	46		429	1659
2017	2		3	80		852	2390
2017	3		2	9		84	344
2017	4		1	23		307	952
2018	1		8	8		460	36
2018	2		9	9		1190	254
2018	3		30	30		1140	105
2018	4		10	10		149	19

FRANCE		Number of Samples			Numbers Measured		
Year	Quarter	Catch	Discards	Landings	Catch	Discards	Landings
2019	1		8	12		588	51
2019	2		9	21		1,501	46
2019	3		30	5		486	32
2019	4		10	3		631	27
2020*	all		-	-	-	-	-
2021*	all		-	-	-	-	-
2022*	all		-	-	-	-	-
2023*	all		-	-	-	-	-

***Spare sampling due to low level fishery participation – not relevant for assessment.**

Table 19.2.5. *Nephrops* FU 20–21. Sex ratio in the landings by country based on available sampling.

		Ireland	
Year	Females ('000s)	Males ('000s)	% Males in Landings
2012	1,171	25,304	96
2013	8,369	15,596	65
2014	13,650	25,503	65
2015	8,930	39,078	81
2016	15,807	23,835	60
2017	11,836	29,183	71
2018	15,967	28,486	64
2019	23,578	51,264	68
2020	2,768	9,124	77
2021	4,539	12,770	74
2022	5,535	14,246	72
2023	9,946	24,306	71

		France	
Year	Females ('000s)	Males ('000s)	% Males in Landings
2012	1,545	9,323	86
2013	1,678	7,641	82
2014	3,292	7,316	69
2015	1,144	6,244	85
2016	819	8,815	91
2017	1,119	5,110	82
2018	1,863	3,605	66
2019*	-	-	-
2020**	-	-	-
2021**	-	-	-
2022**	-	-	-
2023**	-	-	-

***Sampling data provided but not used due to quality issues.**

**** Spare sampling due to low level fishery participation – not relevant for assessment.**

Table 19.2.6. *Nephrops* FU 20–21. Landings and discards by number and weight (t), dead discard rate and discard rate by number, discard rate by weight and estimated mean weights (grs) in the landings and discards for France. 25% discards survival.

France										
Year	Landings in number	Total discards in number*	Removals in number	Dead Discard Rate number	Discard Rate number	Discard Rate weight	Landings	Total discards*	Mean weight in landings	Mean weight in discards
	millions	millions	millions	%	%	%	tonnes	tonnes	gramme	gramme
2012	10.9	17.8	24.2	55.1	62.1	41.5	453	322	41.7	18.1
2013	9.3	10.0	16.9	44.7	51.9	26.6	486	176	52.2	17.6
2014	10.6	37.0	38.4	72.4	77.7	55.8	465	588	43.8	15.9
2015	7.4	7.7	13.2	43.9	51.1	31.7	355	165	48.1	21.4
2016	9.6	3.2	12.0	19.7	24.7	16.2	477	92	49.5	29.1
2017	6.2	5.9	10.7	41.6	48.7	26.2	341	121	54.8	20.5
2018	5.5	4.7	9.0	39.0	46.1	32.3	195	93	35.6	19.9
2019*	-	-	-	-	-	-	-	-	-	-
2020**	-	-	-	-	-	-	-	-	-	-
2021**	-	-	-	-	-	-	-	-	-	-
2022**	-	-	-	-	-	-	-	-	-	-
2023**	-	-	-	-	-	-	-	-	-	-

***Sampling data provided but not used due to quality issues.**

****Sampling data not available due to low level fishery participation.**

Table 19.2.7. ***Nephrops*** **FU 20–21. Landings and discards by number and weight (t), dead discard rate and discard rate by number, discard rate by weight and estimated mean weights (grs) in the landings and discards for Ireland. 25% discards survival.**

	Ireland									
Year	Landings in number	Total discards in number*	Removals in number	Dead Discard Rate number	Discard Rate number	Discard Rate weight	Landings	Total discards*	Mean weight in landings	Mean weight in discards
	millions	millions	millions	%	%	%	tonnes	tonnes	gramme	gramme
2012	26.5	17.5	39.6	33.1	39.7	22.6	708	207	26.7	11.9
2013	24.2	8.3	30.5	20.5	25.6	14.0	844	137	34.9	16.4
2014	39.1	17.6	52.3	25.3	31.1	14.8	1342	233	34.3	13.3
2015	47.9	18.6	61.9	22.5	27.9	13.3	1620	248	33.8	13.4
2016	39.6	27.5	60.3	34.2	41.0	26.9	1531	564	38.6	20.5
2017	41.0	9.2	47.9	14.4	18.4	9.7	1113	120	27.1	13.0
2018	44.5	11.9	53.4	16.8	21.2	14.4	1197	201	26.9	16.9
2019	74.8	29.2	96.7	22.6	28.1	16.5	2219	439	29.7	15.0
2020	11.9	1.7	13.1	9.5	12.3	7.6	336	28	28.2	16.7
2021	17.3	2.3	19.0	8.9	11.5	6.3	572	38	33.0	17.0
2022	19.8	3.6	22.5	11.9	15.3	8.1	640	56	32.4	15.8
2023	34.3	6.9	39.4	13.1	16.7	8.2	1097	98	32.0	14.3

Table 19.2.8. *Nephrops* FU 20–21. Landings and discards by number and weight (t), dead discard rate and discard rate by number, discard rate by weight and estimated mean weights (grs) in the landings combined by both countries based on available sampling and scaled to international landings. 25% discards survival.

Combined and scaled to the international landings										
Year	Landings in number	Total discards in number*	Removals in number	Dead Discard Rate number	Discard Rate number	Discard Rate weight	Landings	Total discards*	Mean weight in landings	Mean weight in discards
	millions	millions	millions	%	%	%	tonnes	tonnes	gramme	gramme
2012	38.2	36.1	65.3	41.4	48.5	31.3	1,189	542	31.1	15.0
2013	34.8	19.2	49.2	29.3	35.6	19.1	1,387	327	39.9	17.0
2014	50.6	55.5	92.2	45.2	52.3	31.2	1,836	834	36.3	15.0
2015	59.4	28.1	80.5	26.2	32.2	17.3	2,116	442	35.7	15.7
2016	60.2	37.5	88.3	31.8	38.4	24.6	2,453	801	40.7	21.4
2017	60.1	19.2	74.5	19.4	24.3	14.2	1,849	306	30.8	15.9
2018	64.7	21.5	80.8	20.0	25.0	17.5	1,803	381	27.9	17.7
2019	91.8	35.8	118.7	22.6	28.1	16.5	2,723	539	29.7	15.0
2020	14.6	2.0	16.2	9.5	12.3	7.6	413	34	28.2	16.7
2021	21.1	2.8	23.2	8.9	11.5	6.3	697	47	33.0	17.0
2022	24.6	4.4	27.9	11.9	15.3	8.1	795	70	32.4	15.8
2023	45.0	9.1	51.8	13.1	16.7	8.2	1442	129	32.0	14.3

Table 19.2.9. *Nephrops* FU 20–21. Results summary table for geo-statistical analysis of UWTV survey.

Ground	Year	Number of stations	Mean Density* (burrows/m²)	Domain Area (Km²)	Geostatistical Abundance Estimate adjusted (millions burrows)	CV on Burrow estimate (%)	Analysis Method software
FU 2021	2012	54	0.57		nr	nr	na
	2013**	55	0.16	10, 014	1640	8.1	RGeostats
	2014	98	0.19	10, 014	2021	3.9	RGeostats
	2015	96	0.2	10,014	2003	3.2	RGeostats
	2016	93	0.18	10,014	1879	4.3	RGeostats
	2017	86	0.44	10,014	4428	3.8	RGeostats
	2018	96	0.27	10,014	2721	4.0	RGeostats
	2019	95	0.06	10,014	617	4.8	RGeostats
	2020	97	0.10	10,014	1020	4.8	RGeostats
	2021	97	0.12	10, 014	1202	3.9	RGeostats
	2022	92	0.10	10, 014	1032	4.8	RGeostats
	2023	100	0.10	10, 014	1026	4.4	RGeostats
	2024***	84	0.11	10, 014	1152	5.6	RGeostats

nr= no reliable abundance estimate could be calculated because survey coverage was partial.

***mean density adjusted of the observations.**

**** the 2013 survey achieved partial coverage ~60% of the total area. The abundance has been scaled up to the entire area since densities in the unsurveyed part of the ground were not significantly different in 2014.**

***** 84 / 93 planned stations achieved.**

Table 19.3.1. ***Nephrops*** **FU 20–21. Short-term catch options prediction inputs and recent estimates of mean weight in landings and harvest rates. Cells in bold indicates inputs to catch option calculations.**

Year	Landings in number	Total discards in number*	Removals in number	Dead Discard Proportion	Discard Proportion number	UWTV abundance estimate	95% Confidence Interval	Harvest rate	Landings	Total discards*	Mean weight in landings	Mean weight in discards
	millions	millions	millions	%	%	millions		%	tonnes	tonnes	gramme	gramme
2012	38.2	36.1	65.3	41.4	48.5				1189	542	31.1	15.0
2013	34.8	19.2	49.2	29.3	35.6	1640	261	3.0	1387	327	39.9	17.0
2014	50.6	55.5	92.2	45.2	52.3	2021	154	4.6	1836	834	36.3	15.0
2015	59.4	28.1	80.5	26.2	32.2	2003	129	4.0	2116	442	35.7	15.7
2016	60.2	37.5	88.3	31.8	38.4	1879	157	4.7	2453	801	40.7	21.4
2017	60.1	19.2	74.5	19.4	24.3	4428	332	1.7	1849	306	30.8	15.9
2018	64.7	21.5	80.8	20.0	25.0	2721	212	3.0	1803	381	27.9	17.7
2019	91.8	35.8	118.7	22.6	28.1	617	58	19.2	2723	539	29.7	15.0
2020	14.6	2.0	16.2	9.5	12.3	1020	96	1.6	413	34	28.2	16.7
2021	21.1	2.8	23.2	8.9	11.5	1202	92	1.93	697	47	33.0	17.0
2022	24.6	4.4	27.9	11.9	15.3	1032	96	2.7	795	70	32.4	15.8
2023	45.0	9.1	51.8	13.1	16.7	1026	89	5.0	1442	129	32.0	14.3
2024						1152	128					
Average 2021–2023				**11.3**	**14.5**						**32.5**	**15.7**

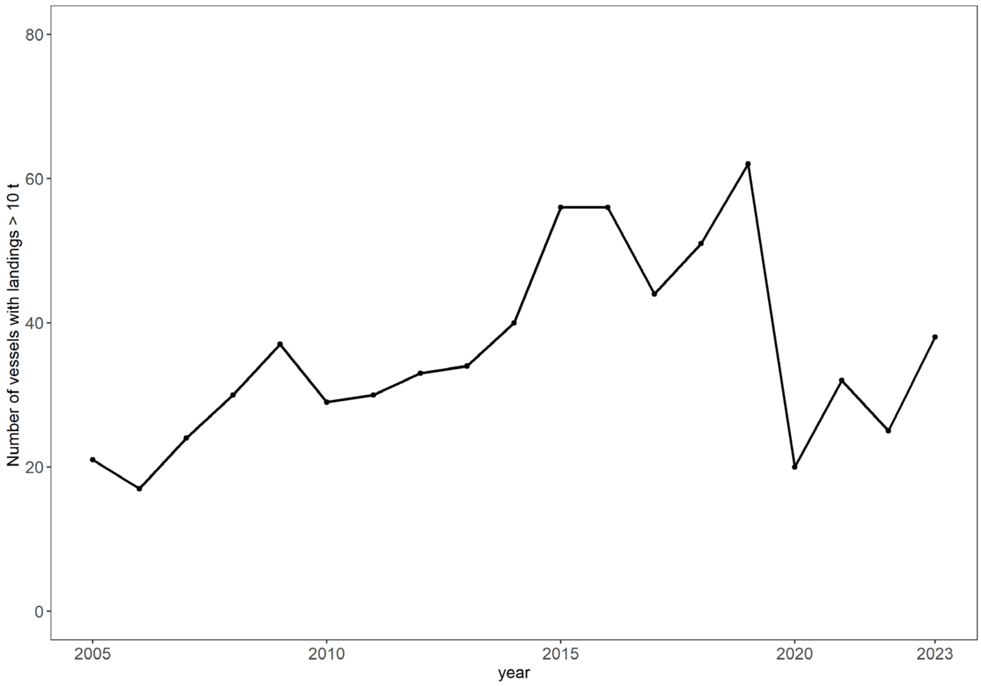


Figure 19.1.1. ***Nephrops*** **FU 20–21. Number of Irish vessels reporting landings >10 t by year.**

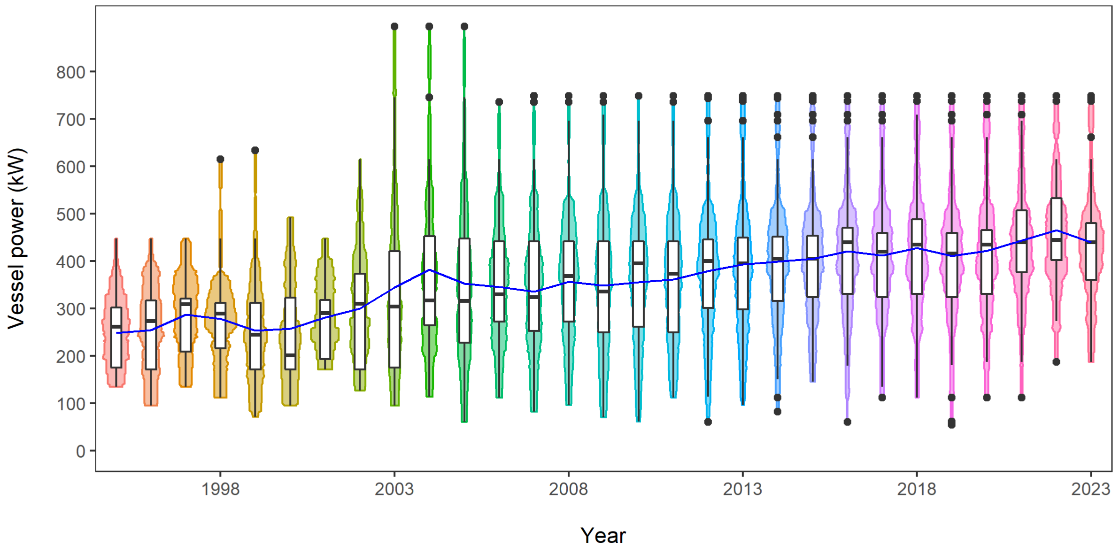


Figure 19.1.2. ***Nephrops*** **FU 20–21. Combined box and kite plot of vessel power on the FU20–21 grounds by year. The blue line indicates the mean.**

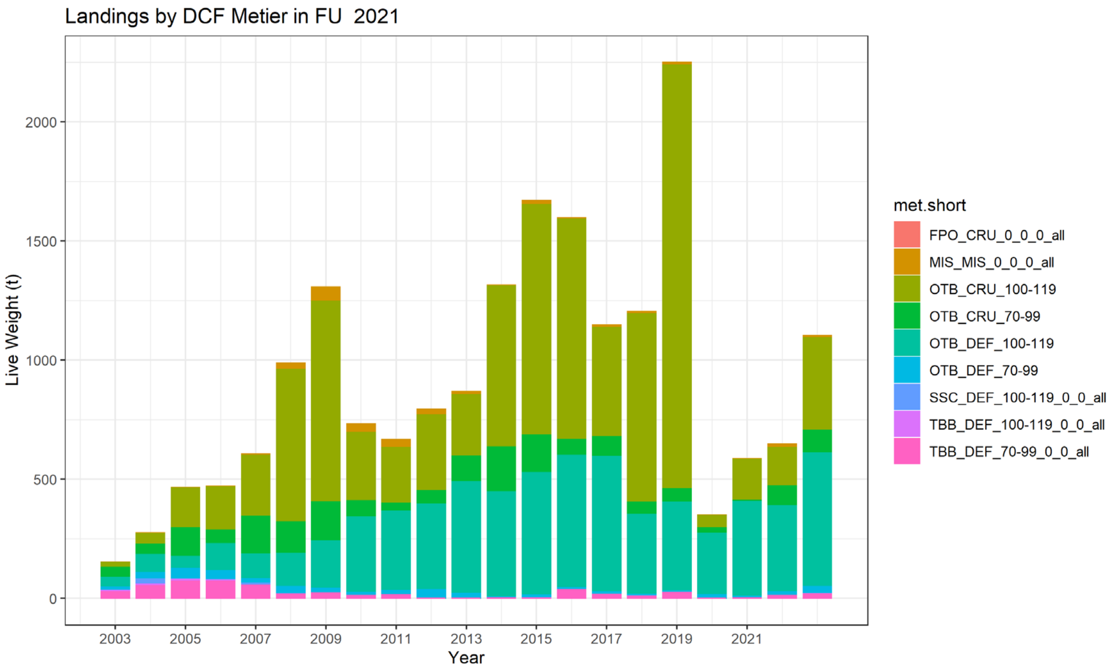


Figure 19.1.3. ***Nephrops*** **FU 20–21. Irish Landings by DCF Metiér.**

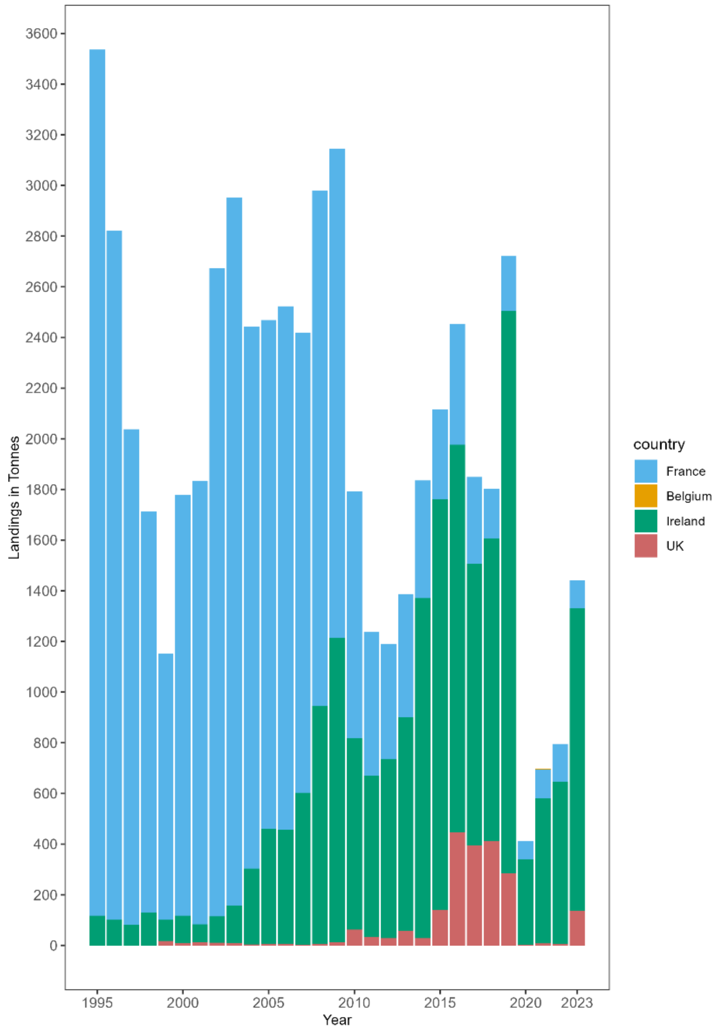


Figure 19.2.1. ***Nephrops*** **FU 20–21. Landings in tonnes by country.**

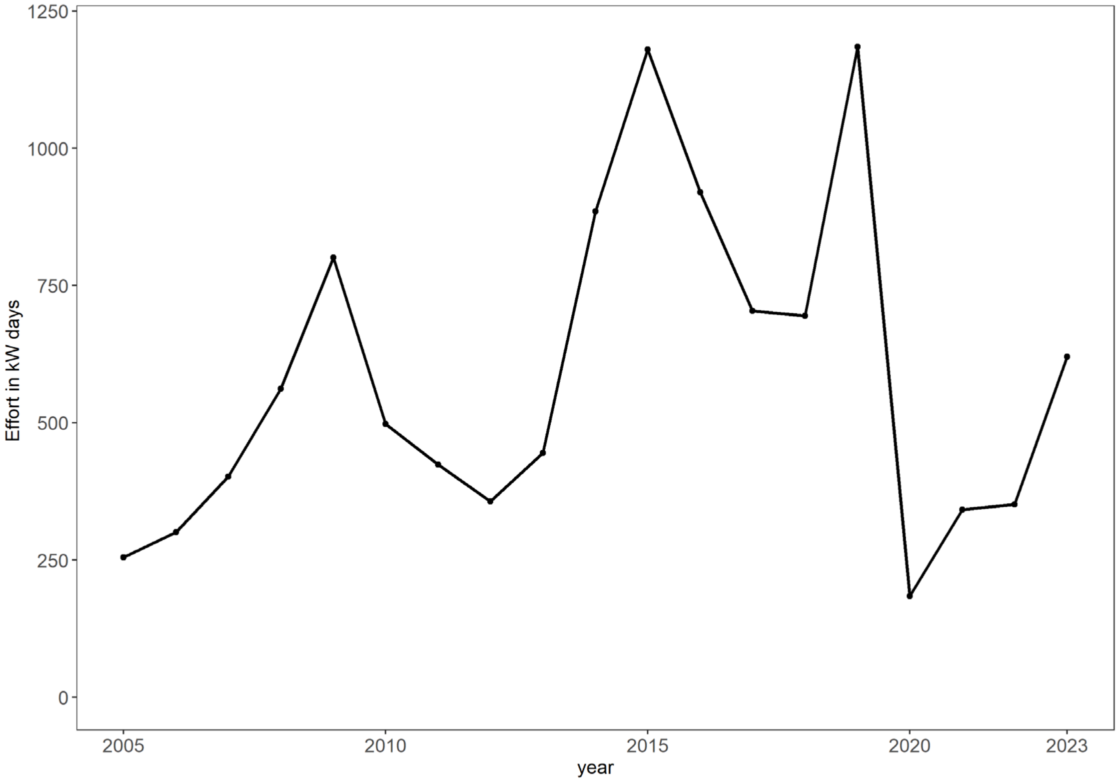


Figure 19.2.2. ***Nephrops*** **FU 20–21. Effort data (Kw days) for the Irish otter trawl** ***Nephrops*** **directed fleet.**

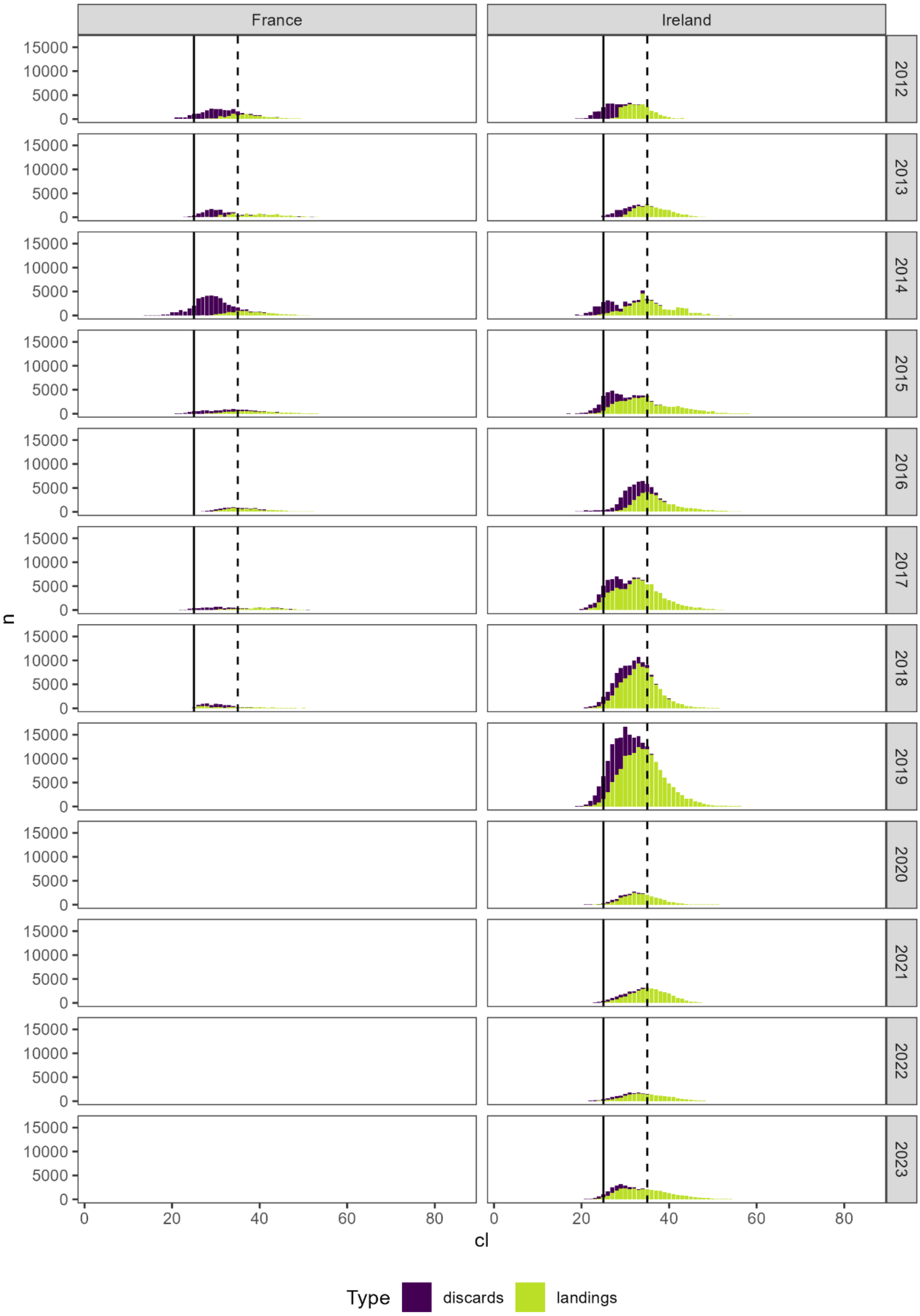


Figure 19.2.3. ***Nephrops*** **FU 20–21. Commercial length–frequency distribution by country. Minimum conservation reference size of 25 CL mm (European MCR) and 35 CL mm (French MLS) displayed. 2019 data provided by France but not included in the assessment. Data not available for France since 2020 due to low fishery participation.**

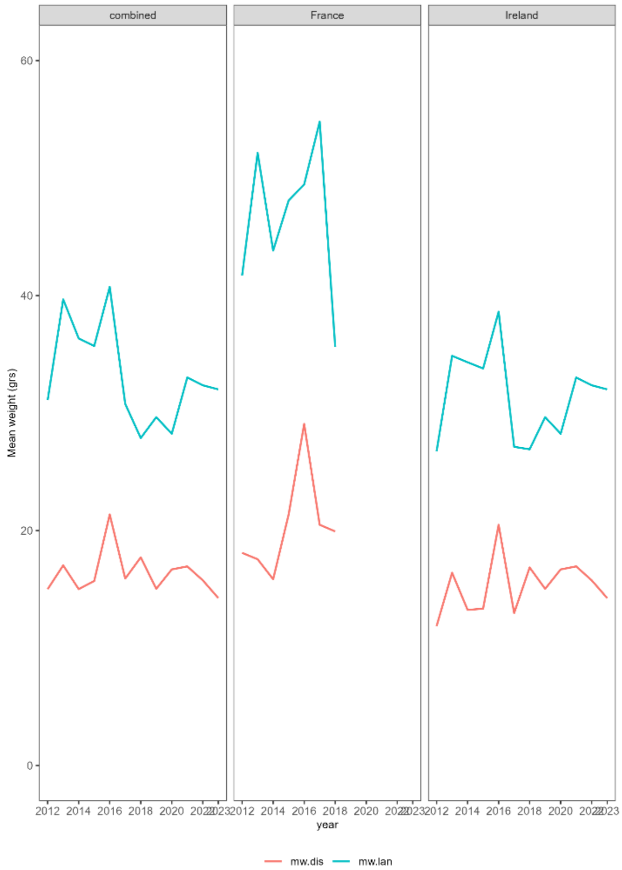


Figure 19.2.4. *Nephrops* FU 20–21. Annual mean weights (gr) in the landings (blue line) and discards (red line) by country and combined scaled to international landings.

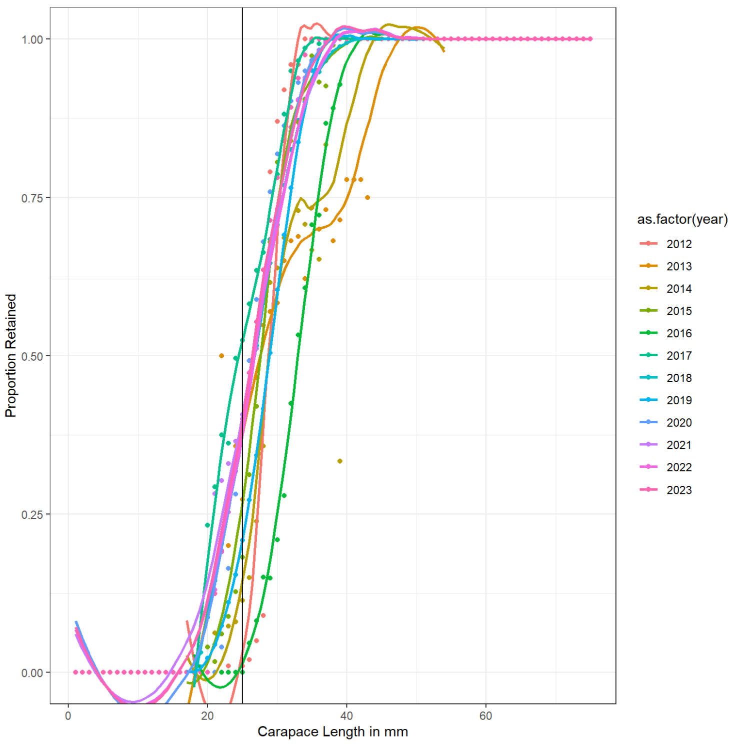


Figure 19.2.5. *Nephrops* FU 20–21. Annual discard ogive derived from Irish sampling. Minimum landing size of 25 CL mm (European MCR) as black solid line.

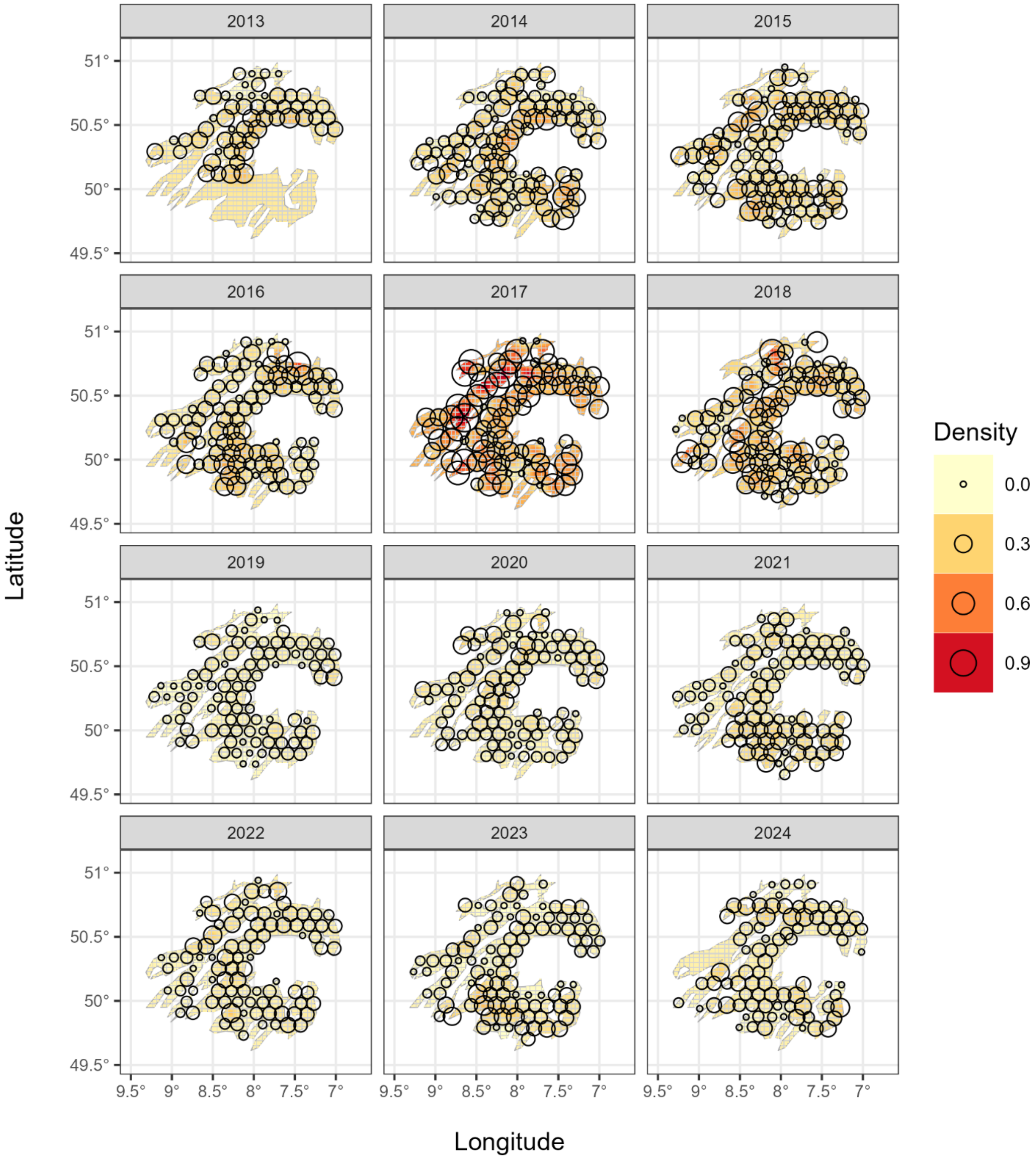


Figure 19.2.6. *Nephrops* FU 20–21. Contour plots of kriged density estimates for the UWTV surveys from 2013 to 2024.

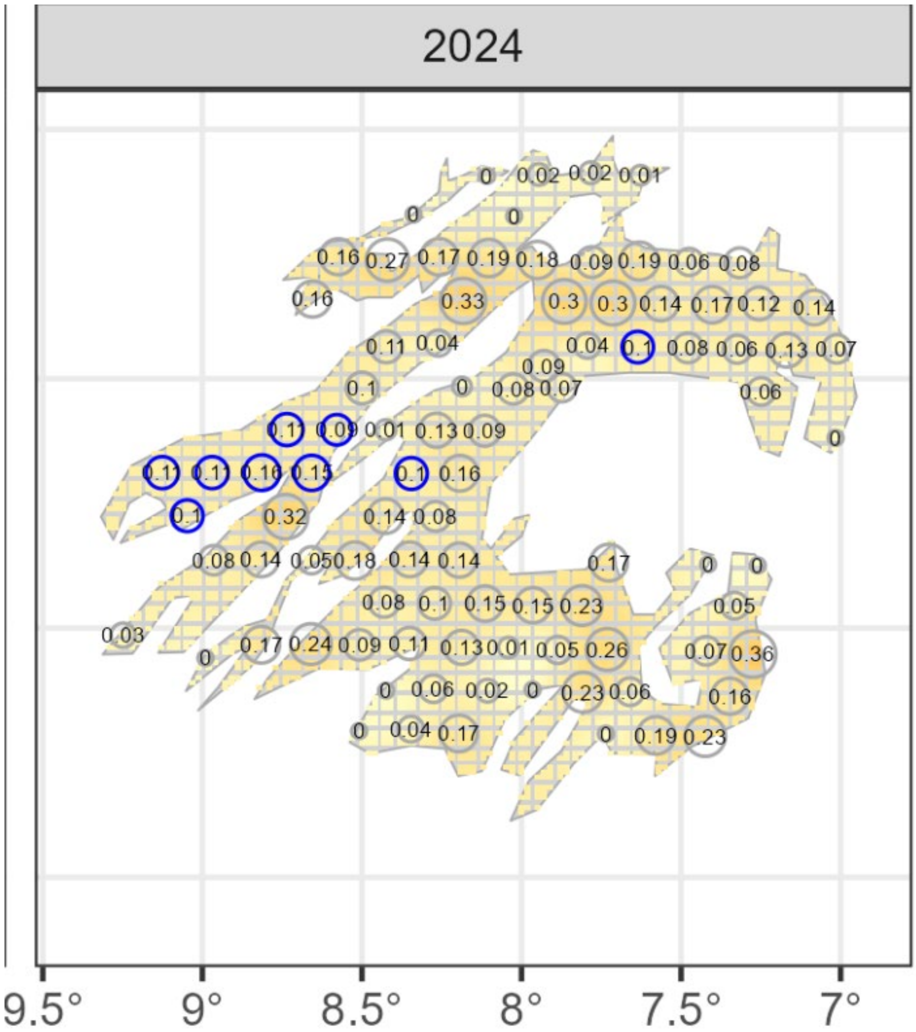


Figure 19.2.7. ***Nephrops*** **FU 20–21. Contour plot of kriged density estimates for the 2024 UWTV survey. Missing stations denoted (blue circle) with predicted kriged density estimates.**

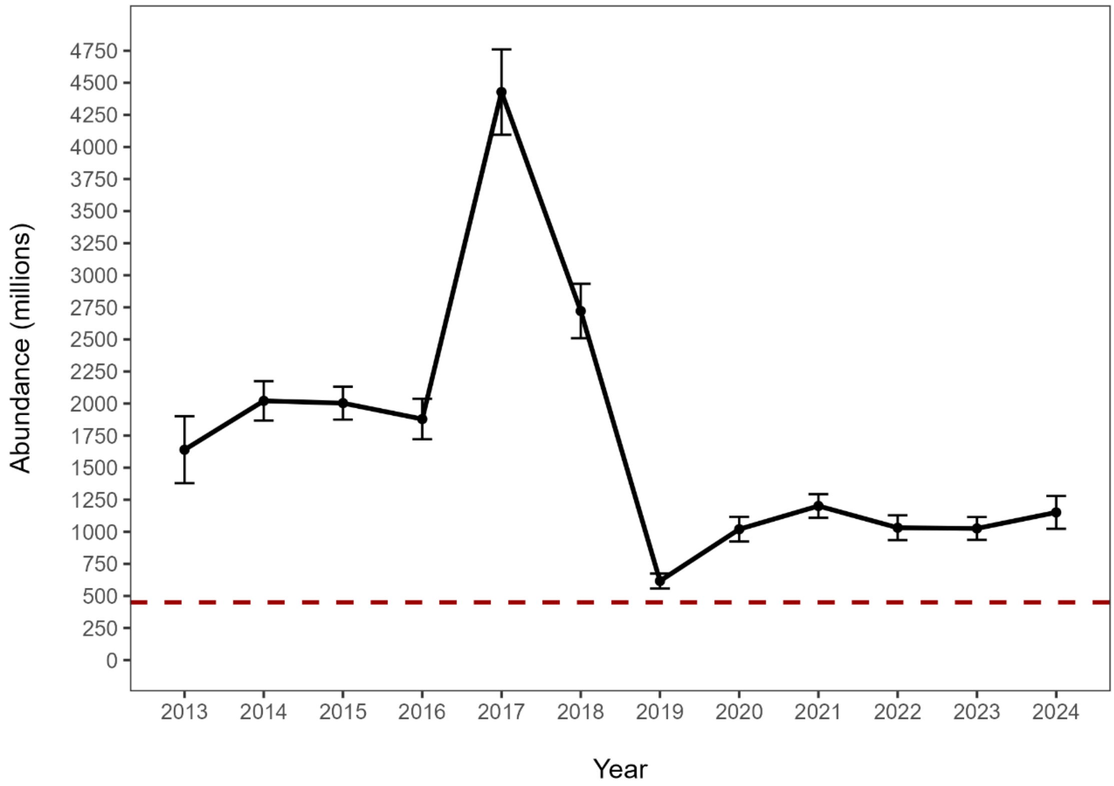


Figure 19.2.8. ***Nephrops*** **FU 20–21. Time-series of abundance estimates (millions burrows) for FU20–21 (error bars indicate 95% confidence intervals) and MSY $B_{trigger}$ is dashed line.**

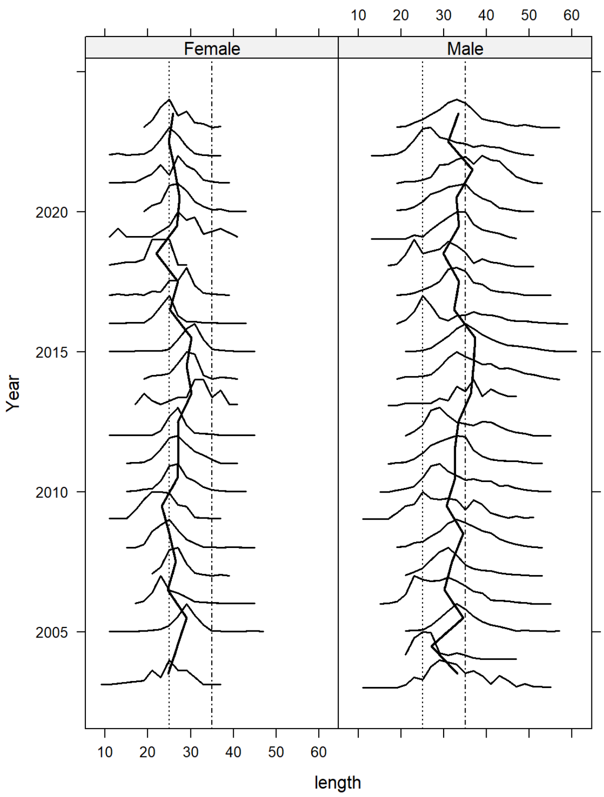


Figure 19.2.9. ***Nephrops*** **FU 20–21. Mean size trends for catches by sex from the IGFS- WIBTS-Q4 [G7212] Irish survey. Vertical lines displayed are Minimum Conservation Reference Size 25 mm Carapace Length (CL) and 35 mm CL.**

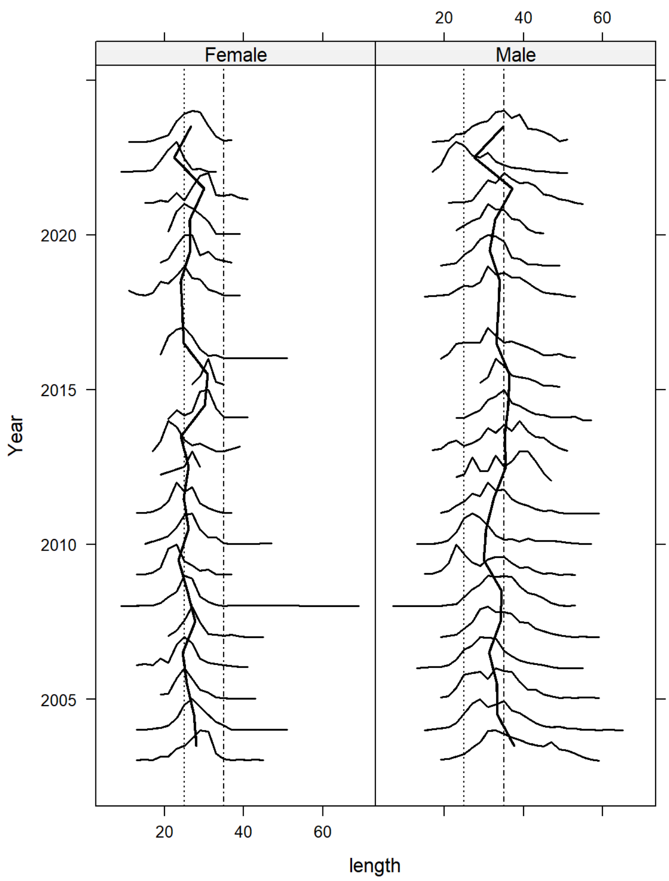


Figure 19.2.10. ***Nephrops*** **FU 20–21. Mean size trends for catches by sex from the EVHOE- WIBTS-Q4 [G9527] French survey. No survey data available for 2017. Vertical lines displayed are Minimum Conservation Reference Size 25 mm Carapace Length (CL) and 35 mm CL.**

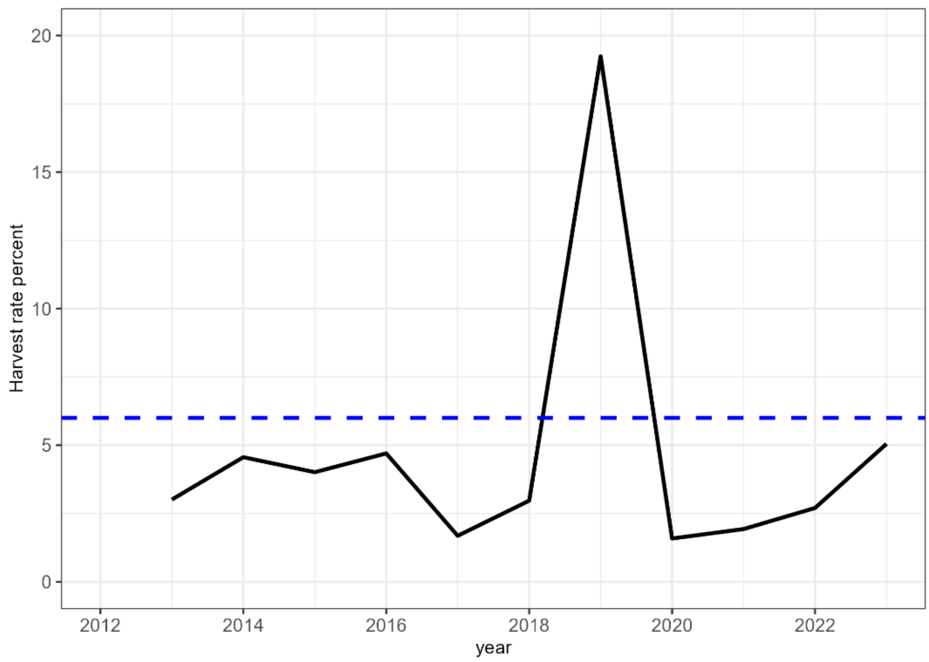


Figure 19.3.11. ***Nephrops*** **FU 20–21. Harvest rate (% dead removed / UWTV abundance). The dashed and solid lines are the MSY proxy and the harvest rate respectively.**

Contents

20 Norway lobster (Nephrops norvegicus) in divisions 7.g and 7.f, Functional Unit 22 (Celtic Sea, Bristol Channel)

20.1 General

Type of assessment in 2024

UWTV based assessment using WK*NEPH* 2009 protocol as described in the stock annex. The TV survey is due to be repeated in the summer 2024 and the new survey will form the basis of advice for this stock in the autumn. This stock assessment is available in the ICES Transparent Assessment Framework (TAF)

ICES advice applicable to 2023

"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 2019–2021, catches in 2023 should be no more than 2548 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."

ICES advice applicable to 2024

"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 2020–2022, catches in 2024 should be no more than 1 912 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."

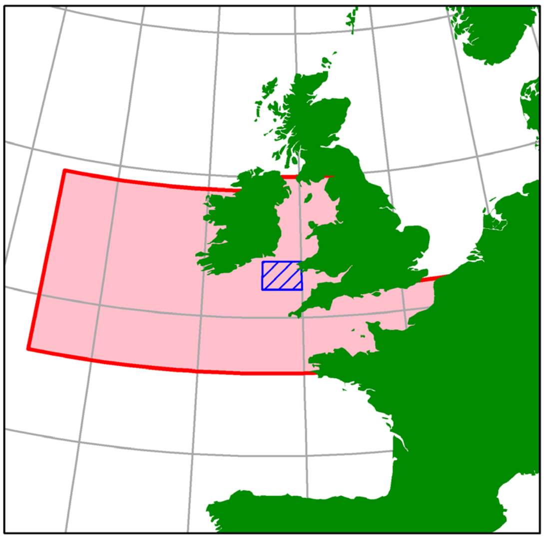
20.2 General

Stock description and management units

The Smalls *Nephrops* stock (FU22) covers ICES rectangles 31–32E3, 31–32E4 within 7.f.g. It is included in the whole ICES Area 7 together with Irish Sea East and West [FU14, FU15], Porcupine

Bank [FU16], Aran Grounds [FU17], northwest Irish Coast [FU18], southeast and southwest Irish Coast [FU19], NW Labadie, Baltimore and Galley [FU20–21], Jones and Cockburn [FU21].

Historically FU20–22 has covered an amalgamation of several spatially distinct mud patches; FU 20 NW Labadie, Baltimore and Galley, FU 21 Jones and Cockburn and FU22 the Smalls. There is no evidence that the whole exploited area belongs to the same stock or that there are several patches linked in meta-population sense. WGCSE 2013 recommended that FU20–22 should be split into FU20–21 and FU22 for the purposes of assessment and advice provision. The map below shows FU22 assessment area (blue) and TAC area (red). See Section 16 for details on *Nephrops* in Subarea 7 general section.



Ecosystem aspects

This section is detailed in stock annex.

Fishery description

Ireland, France and the UK are the main countries involved in the FU22 *Nephrops* fishery. In the early 2000s the Irish fleet had on average over 70% of the landings and this has increased to over 85% from this FU in recent times. A description of this fleet is given in the stock annex. The time-series of numbers of vessels is updated in Figure 20.1.1. The numbers of vessels has been decreasing in recent years where the highest number was recorded in 2016. The time-series of vessel power is shown as a box and kite plot in Figure 20.1.2.

Irish landings from this FU come mainly from ICES statistical rectangle 31E3. The fishery on the Smalls grounds operates throughout the year, weather permitting with a seasonal trend.

French trawlers targeting *Nephrops* in the Celtic Sea operate mainly in FU20–21. In the early 2000s French fleet had on average 30% of the landings from FU22 where this has decreased to <1% in recent times. 80–90% of the FU22 French landings come from ICES statistical rectangle 31E3.

UK fleet had on average ~10% of the landings in recent years and is mainly UK-Northern Irish vessels in this fishery.

Fishery in 2023

In 2023, 43 Irish vessels reported landings from FU22. Of these, 35 vessels reported landings in excess of 10 t. Vessels >18 m account for 90% of the landings in 2023. In recent years several newer vessels specializing in *Nephrops* fishing have participated periodically in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates.

In 2023, eight French trawlers reported landings for FU22. French vessels switch between FU20–21 and FU22.

The French minimum mesh size of codend was set at 100 mm since January 2000 the majority of Irish landings are from vessels with 80–99 mm codend mesh.

Information from stakeholders

None presented.

20.3 Data

InterCatch

Data were available in InterCatch and used for catch data only. French catch data provided directly by the national expert and not extracted from InterCatch.

Landings

There were no revisions to the catch data reported for this stock.

The reported landings time-series by country is shown in Figure 21.2.1 and Table 21.2.1. The reported Irish landings from FU22 have increased since 2000 with the highest landings in 2016. Since then there has been an overall declining trend to the lowest level observed in 2023 (1,088 t). French landings have gradually decreased since the early 2000s to the present. Reported landings from the UK have fluctuated with an increase in 2023. Belgium reported minimal landings on average < 15t in general from this FU.

Effort

In line with WGCSE 2015 recommendation effort is reported in Kwdays and lpue reported in t/Kwdays in the knowledge that the trend is likely to be a biased underestimate because it is not adjusted for efficiency or behavioural changes. The effort series is based on the same criteria for FU15, 16, 17, 22 and 20–21 (30% landings threshold) and will be contingent on the accuracy of landings data reported in logbooks. Effort data are available for the Irish *Nephrops* directed fleet in FU22 from 1995–2023. The time-series of effort and lpue is updated in Figure 21.2.2 and Table 21.2.2.

Effort shows an increasing trend since the early 2000s (Table 21.2.2. and Figure 21.2.2) with a decreasing trend since 2018.

Sampling levels

Dedicated sampling of landings and discards began in 2003 by Ireland. Sampling levels in 2023 were considered acceptable (Figure 20.2.3).

Sampling and Raising Procedure Review

The national sample raising procedures for FU22 were reviewed and fully documented through an R markdown document (Annex 3, ICES, 2018 and stock annex). Annual discard ogives are calculated and are applied to quarterly length distributions and then raised to total quarterly landings before aggregation. A further raising procedure is applied to raise the annual sampled Irish data, where this addresses quarters with missing length samples. Next the international raising factor is applied. This raising procedure is used to assess this stock and to calculate mean weights, sex ratio and discard rates as inputs for catch scenarios and advice. A minor data revision to 2018 sample data was presented to WGCSE 2020 and resulting calculations were accepted. The revision to 2020 landings data for Ireland resulted in an increase in numbers in landings, discards and removals. This resulted in an increase in the harvest rate for 2020 to 10.1% (previous 9.7%) which was still below F_{MSY}.

Commercial length–frequency distributions

The Irish sampling programme started in 2003 and since then coverage and intensity have been very good covering the seasonal trend of the fishery. The mean size of *Nephrops* in Irish landings has decreased slightly in 2023 for both sexes. The mean size of *Nephrops* in the catch has remained relatively stable since 2005 (Figure 20.2.5). There is an increase in mean size in the catches in 2007 to 2009 for both sexes which is linked to the recruitment signal picked up by both the 2006 UWTV [U5917] and IGFS-WIBTS-Q4 [G7212].

Sex ratio

The sex ratio by year is shown in Figure 20.2.6. This shows some fluctuations over time. The sex ratio has a distinct seasonal pattern (Figure 20.2.7) with lowest male proportions in the samples in May and June. Males dominate the catches in the autumn and winter.

Mean weight explorations

Explorations of the mean weight in the catch samples by sex shows a strong cyclical pattern in the females (Figure 20.2.7). This corresponds with the emergence of mature females from the burrows to mate in summer. There is an increase in mean weight in 2007 to 2009 for both sexes which is linked to the recruitment signal picked up by both the UWTV [U5917] and IGFS-WIBTS-Q4 [G7212] (Figure 20.2.11). The annual mean weight estimate for landings and discards is shown in Figure 20.2.8. The mean weight estimates in the landings showed an increasing trend since 2019 with a decrease in 2023.

Discarding

Since 2003 discard rates have been estimated using unsorted catch and discards sampling. This involves unsorted catch and discard samples being provided by vessels or collected by observers at sea on discard trips. The catch sample is partitioned into landings and discards using an onboard discard selection ogive derived for the discard samples. Sampling effort is stratified monthly, but annual aggregations are used to derive length distributions and selection ogives.

The length–weight regression parameters given in the stock annex are used to calculate sampled weights and appropriate quarterly raising factors. The sampling intensity and coverage has varied over the time-series, but overall has been good.

Discard rates range between 9–39% of total catch by weight and 15–52% of total catch by number (Table 20.2.3). Discard rate of females tends to be higher due to the smaller average size and market reasons. There is no information on discard survival rate in this fishery. 25% is assumed in line with other *Nephrops* stocks in the Celtic Sea (Charuau *et al*., 1982). Highest discard rates were observed in 2007 as a result of the recruitment into the fishery in 2006.

Gear selectivity trials by Bord Iascaigh Mhara (BIM, 2017) reported a 64% survivor rate for *Nephrops* caught in a trawl with a SELTRA selectivity device in the outer Galway Bay area.

Table 20.3.1 gives weights, numbers and mean weights of the landings and discard raised internationally according to the stock annex.

Surveys

Abundance indices from UWTV surveys

The methods used during the survey were similar to those employed for UWTV surveys [U5917] of *Nephrops* stocks around Ireland and elsewhere are documented by WKNEPHTV (ICES, 2007), WKNEPHBID (ICES, 2008), SGNEPS (ICES, 2009; 2010; 2012), WGNEPS (ICES, 2013; 2014; 2015; 2016a; 2017; 2018a, 2020, 2021, 2022, 2023), WKNEPS (ICES, 2016b; 2018b), Leocádio, A., *et al*, 2018 and Dobby H., *et al*, 2021. SGNEPS 2012 (ICES, 2012) recommended that a CV (or relative standard error) of <20% is an acceptable precision level for UWTV survey estimates of abundance. This allowed sampling intensity to be reduced from around 90 stations in the past to around 39 on the Smalls grounds in 2024 which allowed survey coverage of other FUs. A randomised isometric grid design was employed with UWTV stations at 4.5 nmi intervals, whereas previously a 3.0 nmi square grid was used.

Operational details of the 2024 UWTV survey are available (Doyle *et al*., 2024). Seven stations in FU22 were not surveyed successfully in 2015 due to very poor visibility conditions encountered as a result of strong tides. WKCELT 2014 concluded that WGCSE or WGNEPS should make recommendations on the most appropriate fill in procedure to be adopted in cases when stations could not be surveyed. WGCSE 2015 agreed the following procedure for this case: Two buffer zones of 1 nmi and 2 nmi distance were generated around the missing stations. The counts and mean of historic density estimates within the 1 and 2 nmi buffers were calculated. The standard kriging procedure was carried out and summary results were computed for the 1 and 2 nmi "fill-ins". Finally, the mean of historic densities within 2 nmi buffer of the planned stations were used in the calculation of the 2015 abundance.

The blanked krigged contour plot and posted point density data are shown in Figure 20.2.9. The krigged contours correspond very well to the observed data. In general, the densities are higher in the central area of the ground with a localised hotspot centrally and also in the southwestern leg. Densities and abundance have remained stable for most of the time-series with the exception of the first year and 2017, which were the highest in the series. There is a declining trend in the recent years. The 2024 mean density 0.24 burrows/m^2 is approximately 11% decrease compared with density 0.27 burrows/m^2 in 2023. The summary statistics from this geostatistical analysis are given in Table 20.2.4 and plotted in Figure 20.2.10. The geostatistical abundance estimate adjusted is derived using the mean of the krigged grid where the mean of the observations is reported in Table 20.2.4.

The 2024 estimate of 703 million burrows is below the MSY $B_{trigger}$ (990 million). The estimation variance of the survey as calculated by EVA is very low (CVs in the order <9%).

Groundfish survey data

The Irish groundfish survey IGFS-WIBTS-Q4 [G7212] and French EVHOE- WIBTS-Q4 [G9527] survey operate in the Celtic Sea (Stokes *et al*., 2014; ICES, 2017b). These provide information on length–frequency compositions, mean size in the catches, cpue of *Nephrops* in FU22. The mean size of the catches is stable over the time-series except in 2006 and 2008, which signals recruitment into the fishery in 2006 and 2007 (Figure 21.2.11 and 21.2.12). This signal of recruitment was also picked up during the 2006 UWTV [U5917] survey (Doyle *et al*., 2012). The groundfish surveys in the Celtic Sea provide a useful indicator of recruitment in this FU.

20.4 Assessment

Comparison with previous assessments

The WGCSE 2021 carried out an UWTV-based assessment for this stock. The methods used were very much in line with WK*NEPH* (ICES, 2009) and the approach taken for other *Nephrops* stocks in areas 6 and 7 by WGCSE.

State of the stock

UWTV abundance estimates suggest that the stock size shows a recent declining trend. The 2023 estimate is below the MSY $B_{trigger}$ (990 million). The 2024 estimate (703 million) is below the average of the series (geomean [2006–2024]: 1076 million).

Harvest rate is calculated as (landings + dead discards)/(abundance estimate). Table 20.3.1 and Figure 20.3.1 summarize recent harvest rates. Recent harvest rates have fluctuated due to recruitment pulses into the fishery in 2006 and 2010 and is currently 8.8% which is below F_{MSY}.

20.5 Catch scenarios table

Catch scenario table inputs and historical estimates of mean weight in landings and harvest rates are presented in Table 20.3.1 and summarised below.

Since 2003, mean weight in the landings has varied between 18–27 grammes (Figure 20.2.8). WGCSE 2019 decided that given the stability in mean weights in the recent years, the recent three year average of mean weights is to be used to calculate catch scenarios. The three year average (2021–2023) of proportion of removals retained was used as is standard for other *Nephrops* stocks. The estimate harvest rate has also varied a lot, from 6–27% with 2007 being the highest observed (Figure 20.3.1). This is a result of recruitment into the fishery in 2006 and 2007.

The basis for the catch scenarios:

Variable	Value	Notes
Stock abundance (2025)	703	UWTV survey 2024; individuals in millions
Mean weight in projected landings (2025)	25.6	Average 2021–2023; in grammes
Mean weight in projected discards (2025)	13.0	Average 2021–2023; in grammes
Projected discard rate (2025)	21.9	Average 2021–2023; percentage by number of the total catch
Discard survival (2025)	25	Proportion by number

A prediction of landings for FU22 using the approach agreed procedure proposed at WK*NEPH* 2009 and outlined in the stock annex will be made on the basis of the 2024 UWTV survey. This will be presented in October 2024 for the provision of advice.

20.6 Reference points

New reference points were derived by WKMSYRef4 (ICES, 2016c, 2016d) for FU22. These were updated on the basis of an average of estimated F_{MSY} proxy harvest rates over a period of years, this corresponds more closely to the methodology for finfish. In cases where there is a clear trend in the values a five year average was chosen. Similarly, the five year average of the F at 95% of the YPR obtained at the F_{MSY} proxy reference point was proposed as the F_{MSY} lower bound and the five year average of the F above F_{max} that leads to YPR of 95% of the maximum as the upper bound. Using an average value also has the advantage of reducing the effect of any unusually high or low estimates of the F_{MSY} proxy which occasionally appear.

This stock previously did not have MSY $B_{trigger}$ specified, the time-series and range of indicator biomass is also limited such that direct use of B_{loss} is considered too close to equilibrium biomass. The workshop proposed to use the 5% interval on the probability distribution of indicator biomass assuming a normal distribution, which is analogous to the 5% on B_{MSY} proposed for finfish stocks assuming these *Nephrops* FU's have been exploited at a rate close to near HR_{MSY}. The MSY $B_{trigger}$ for FU22 is 987 million individuals rounded to 990 million.

Stock code	MSY F_{lower}*	F_{MSY}*	MSY Fupper* with AR	MSY $B_{trigger}$	MSY Fupper* with no AR
nep-22	10.2%	12.8%	12.8%	990***	12.8%

*** Harvest rate (HR).**

***** Abundance in millions.**

20.7 Management strategies

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to Norway lobster (*Nephrops norvegicus*) by functional unit in ICES subarea 7 and also demersal stocks. There is currently no agreement with the UK regarding this plan.

20.8 Quality of assessment and forecast

Since 2006, a dedicated annual UWTV survey has provided abundance estimates for FU22 with high precision. There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009; WGNEPS 2016, WGNEPS 2018b). Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al.*, 1996). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate, although no more precise (WK*NEPH* 2009). The survey estimates themselves are very precisely estimated (CVs 2–9%) given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU22 are largely based on expert opinion. The precision of these bias corrections cannot yet be characterised, but is likely to be lower than that observed in the survey.

In 2015, there is added uncertainty, not accounted for in the model or CV estimate, because 17% of the planned TV stations could not be successfully surveyed due to poor visibility on the seabed. However, the spatial distributions of densities have been fairly consistent over time and the overall density has also been relatively stable. The fill in procedure used to generate density estimates for the seven missing stations should be a good approximation.

A review of sampling and raising procedures was presented to WGCSE 2018 and is accepted as the current method to calculate the fishery dependant inputs FU22 (Annex 3, ICES, 2018 and stock annex).In the provision of catch scenarios based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. Given the recent stability in mean weights in landings and unwanted catch - for FU22 deterministic estimates of the mean weight in the landings and discard rates for 2021–2023 are used by the WG. Previously the full time series was used to account for the variability over time where this had occurred when large recruitments are observed in the stock as was the case in 2006 and 2007.

From 2016, fisheries catching *Nephrops* in Subarea 7 are covered by the EU landings obligation with several exemptions (EU, 2015). The average discard rate by weight for FU22 over the last three years is 13%. Irish discard survival experiments indicate that the trawl discard survival may be around 64% (BIM, 2017). As a result, an exemption from the landings obligation based on high survivability has been granted by the European Commission. Catch advice and scenarios are provided this year on the assumption that discarding is assumed to continue at the recent average. Landings data are adjusted to take into account landings that have been misreported from FU16 since 2011. This adjustment is thought to be reasonably accurate.

Sampling and discard estimates have improved over the time-series.

20.9 Recommendation for next benchmark

This stock has not been formally benchmarked by ICES although the approach used has. WGCSE recommends that the issue list below can be addressed through an inter-bench process:

- The biological parameters used as inputs to the SCA should be reconsidered; growth parameters, length-at-maturity and natural mortality.
- The historical time-series of landings and effort by rectangle should be disaggregated and options for standardisation of lpue investigated.
- Historical sampling and groundfish survey data in this FU should also be disaggregated as far as possible back in time, and investigated for useful trends and signals.

20.10 Management considerations

The trends from the fishery (landings, effort, mean size, etc.) appear to show stock is exploited. The UWTV abundance and mean density estimates show some fluctuations in burrow abundance in the recent years. There are fluctuations in the harvest rates which are related to the signals of recruitment into the fishery in 2006 and 2007 picked up by the UWTV survey and IGFS-WIBTS-Q4. Recent harvest rates for the FU22 Smalls fluctuate and suggest the stock is exploited below F_{MSY}.

A new survey point available in September 2024 will provide a more up to date prognosis of stock status. This up to date survey information will be used to generate catch options and the provision of advice in October 2024.

In recent years, several newer vessels specializing in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. There have been concerns that effort could be displaced towards the Smalls and other *Nephrops* grounds due to effort controls in 7.a and 6.a. This has not happened to date, and the 2023 effort was just below the recent average in the time-series.

There has been a trend for Irish vessels (>18 m) to switch to multi (quad) rig trawls. Provisional data suggest a ~30% increase in *Nephrops* catch rates and a reduction in fish bycatch of ~30% due to the lower headline height.

Nephrops fisheries in the Smalls have non-*Nephrops* bycatch composition. Cod, whiting and to a lesser extent haddock are the main bycatch species (Davie and Lordan, 2011). A targeted whiting fishery also overlaps with the *Nephrops* fishery in this area, but this has negligible bycatch of *Nephrops*.

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Table 20.2.1. *Nephrops* in FU22 (Smalls Grounds). Landings in tonnes by country.

FU 22 Landings (t)					
Year	France	Rep. of Ireland	UK	Belgium	Total
1999	1034	741	0		1775
2000	1192	1687	11		2890
2001	882	2054	2		2938
2002	598	1392	3		1993
2003	799	1257	10		2065
2004	454	1349	26		1828
2005	478	1987	68		2533
2006	293	1442	19	7	1761
2007	216	2716	13	5	2950
2008	301	2539	241	9	3090
2009	258	1609	306	12	2185
2010	129	2219	351	15	2714
2011	64	1521	44	7	1636
2012	65	2506	41	6	2618
2013	83	2054	107	12	2257
2014	29	2428	61	8	2526
2015	9	2215	121	5	2350
2016	5	2967	354	3	3329
2017	7	2815	737	1	3560
2018	3	1639	331	1	1974
2019	9	1884	187	2	2083
2020	3	1491	22	2	1518
2021	<1	1537	69	10	1616
2022	4	1242	17	9	1271
2023	2	1088	144	8	1242

Table 20.2.2. *Nephrops* in FU22 (Smalls Grounds). Effort data for the Irish otter trawl *Nephrops* directed fleet.

Year	Effort (‘000s Kw Days)	Landings (tonnes)	lpue (t/KwDays)
1995	552	1226	2.2
1996	412	1010	2.5
1997	474	1096	2.3
1998	524	1353	2.6
1999	292	620	2.1
2000	586	1335	2.3
2001	789	1964	2.5
2002	615	1298	2.1
2003	639	1000	1.6
2004	620	981	1.6
2005	986	1882	1.9
2006	855	1374	1.6
2007	1131	2677	2.4
2008	1047	2501	2.4
2009	702	1605	2.3
2010	962	2198	2.3
2011	724	1497	2.1
2012	970	2260	2.3
2013	902	1849	2.0
2014	915	2182	2.4
2015	971	2076	2.1
2016	1270	2761	2.2
2017	1229	2712	2.2
2018	748	1509	2.0
2019	786	1736	2.2
2020	681	1408	2.1
2021	666	1450	2.2
2022	599	1156	1.9
2023	461	988	2.1

Table 20.2.3. *Nephrops* in FU22 (Smalls Grounds). Landings and discards weight and numbers by year from Irish sampling programme.

Year	Landings (t)	Discards (t)	Landings ('000s numbers)	Discards ('000s numbers)	Discards by weight (%)	Discards by number (%)
2003	1257	438	57.9	41.1	25.8	41.5
2004	1349	149	52.1	9.7	9.9	15.6
2005	1987	1292	93.6	100.9	39.4	51.9
2006	1442	372	82.0	37.0	20.5	31.1
2007	2716	1755	152.1	166.5	39.3	52.3
2008	2539	237	118.0	21.4	8.5	15.3
2009	1609	274	67.7	24.3	14.5	26.4
2010	2219	520	99.6	36.4	19.0	26.8
2011	1521	183	55.7	12.2	10.7	18.0
2012	2506	332	115.2	30.0	11.7	20.7
2013	2054	452	85.1	36.5	18.1	30.0
2014	2428	442	96.3	32.1	15.4	25.0
2015	2215	424	107.6	41.8	16.1	28.0
2016	2967	463	142.7	47.7	13.5	25.1
2017	2815	336	130.0	31.0	10.7	19.2
2018	1639	279	81.2	25.3	14.5	23.7
2019	1884	237	73.1	17.3	11.2	19.2
2020	1491	283	58.3	21.1	15.9	26.5
2021	1537	142	58.4	10.8	8.5	15.6
2022	1242	138	47.5	11.2	10.0	19.1
2023	1088	273	44.8	20.0	20.1	30.9

Table 20.2.4. *Nephrops* in FU22 (Smalls Grounds). Results summary table for geostatistical analysis of UWTV survey.

Year	Number of stations	Mean Density adjusted** (burrows/m²)	Domain Area (km²)	Geostatistical Abundance Estimate adjusted (millions burrows)	CV on Burrow estimate %
2006	100	0.49	2962	1503	2.4
2007	107	0.37	2955	1136	5.7
2008	76	0.36	2698	1114	5.6
2009	67	0.36	2824	1093	5.0
2010	90	0.37	2861	1141	3.9
2011	107	0.41	2881	1256	2.9
2012*	47	0.49	2934	1498	8.1
2013*	41	0.41	2975	1254	7.2
2014*	52	0.53	2970	1622	8.4
2015*	40	0.49	3064	1363	7.0
2016*	41	0.31	3063	866	6.6
2017*	40	0.55	3063	1600	4.9
2018*	42	0.31	3063	876	9.0
2019*	41	0.40	3063	1121	6.4
2020*	40	0.27	3063	750	8.0
2021*	42	0.23	3063	656	6.7
2022*	41	0.31	3063	895	6.5
2023*	41	0.27	3063	776	6.9
2024*	39	0.25	3063	703	7.1

*** reduced isometric grid 4.5 nmi**

**** mean density adjusted of the observations.**

Table 20.3.1. *Nephrops* in FU22 (Smalls Grounds). Short-term catch option prediction inputs and recent estimates of mean weight in landings and harvest rate (cells in bold indicates inputs to catch scenario calculations).

Year	Landings in number millions	Total discards in number* millions	Removals in number millions	Dead Discard Rate number %	Discard Rate number %	UWTV abundance estimate millions	95% Confidence Interval	Harvest rate %	Landings tonnes	Total discards* tonnes	Mean weight in landings gramme	Mean weight in discards gramme
2003	95.2	67.6	145.8	34.7	41.5	NA	NA	NA	2,065	720	21.7	10.7
2004	70.7	13.1	80.5	12.2	15.6	NA	NA	NA	1,828	202	25.9	15.4
2005	119.3	128.6	215.7	44.7	51.9	NA	NA	NA	2,533	1648	21.2	12.8
2006	100.2	45.2	134.1	25.3	31.1	1503	70	8.9	1,761	454	17.6	10.1
2007	165.2	180.9	300.8	45.1	52.3	1136	126	26.5	2,950	1906	17.9	10.5
2008	143.6	26.0	163.1	12.0	15.3	1114	123	14.6	3,090	289	21.5	11.1
2009	92.0	33.0	116.8	21.2	26.4	1093	108	10.7	2,185	371	23.7	11.3
2010	121.8	44.5	155.2	21.5	26.8	1141	88	13.6	2,714	636	22.3	14.3
2011	60.0	13.2	69.8	14.1	18.0	1256	72	5.6	1,636	196	27.3	14.9
2012	120.3	31.4	143.9	16.3	20.7	1498	239	9.6	2,618	347	21.8	11.1
2013	93.5	40.1	123.6	24.3	30.0	1254	177	9.9	2,257	497	24.1	12.4
2014	100.2	33.4	125.2	20.0	25.0	1622	268	7.7	2,526	460	25.2	13.8

Year	Landings in number	Total discards in number*	Removals in number	Dead Discard Rate number	Discard Rate number	UWTV abundance estimate	95% Confidence Interval	Harvest rate	Landings	Total discards*	Mean weight in landings	Mean weight in discards
	millions	millions	millions	%	%	millions		%	tonnes	tonnes	gramme	gramme
2015	114.1	44.4	147.4	22.6	28.0	1363	180	10.8	2,350	450	20.6	10.1
2016	160.2	53.5	200.3	20.0	25.1	866	112	23.1	3,329	519	20.8	9.7
2017	164.4	39.2	193.7	15.2	19.2	1600	153	12.1	3,560	424	21.7	10.8
2018	97.8	30.4	120.6	18.9	23.7	876	154	13.8	1,974	336	20.2	11.0
2019	80.9	19.2	95.2	15.1	19.2	1121	141	8.5	2,083	262	25.8	13.7
2020	59.4	21.5	75.5	21.3	26.5	750	118	10.1	1518	288	25.6	13.4
2021	61.4	11.4	69.9	12.2	15.6	656	87	10.7	1616	149	26.3	13.1
2022	48.7	11.5	57.3	15.0	19.1	895	115	6.4	1271	141	26.1	12.3
2023	51.1	22.8	68.2	25.0	30.9	776	105	8.8	1242	312	24.3	13.7
2024						703	97					
Average 2021-2023				**17.4**	**21.9**						**25.6**	**13.0**

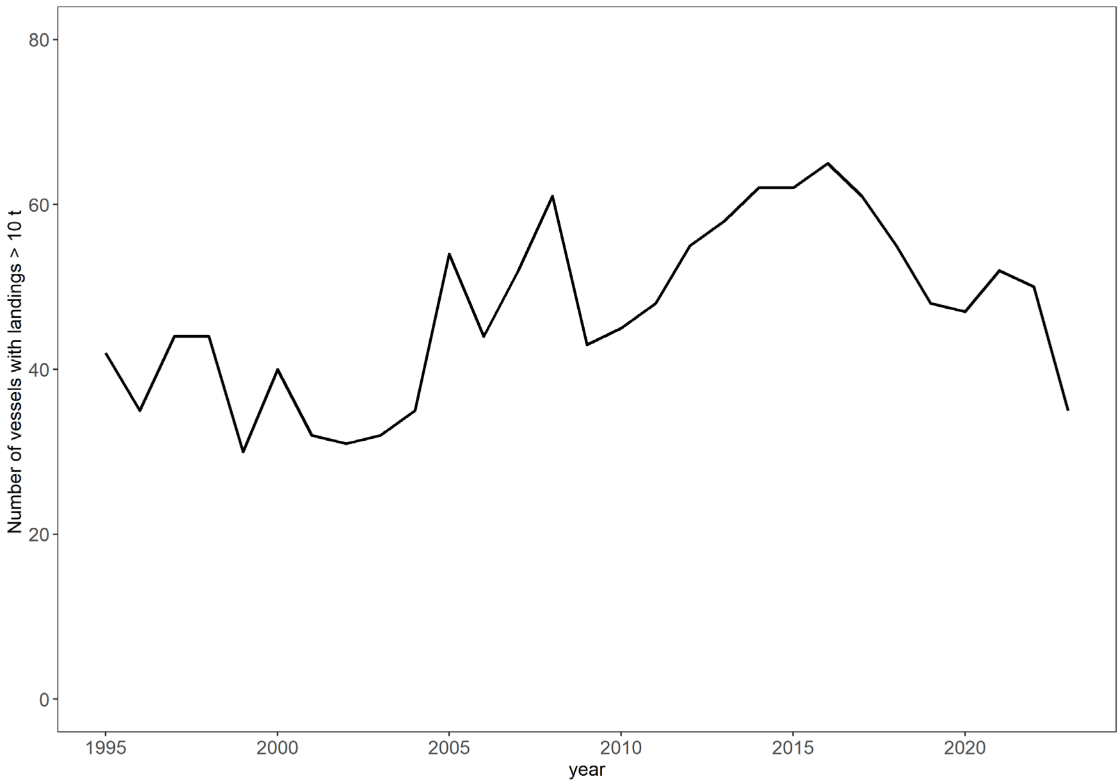


Figure 20.1.1. *Nephrops* in FU22 (Smalls Grounds). Time-series of the number of Irish vessels reporting landings of *Nephrops* from FU22 with a >10 t threshold.

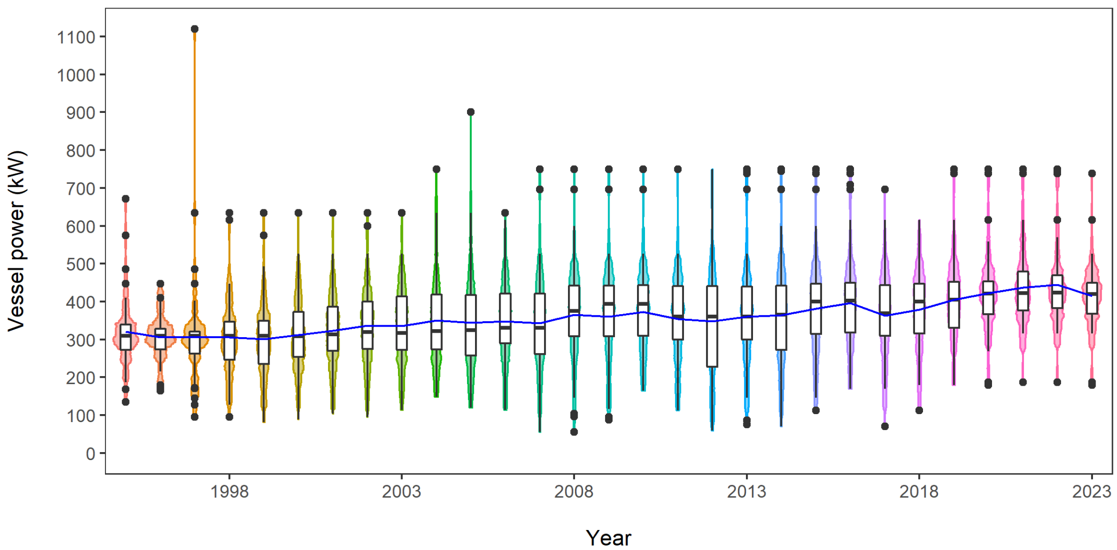


Figure 20.1.2. *Nephrops* in FU22 (Smalls Grounds). Combined box and kite plot of vessel power on the Smalls Grounds by year. The blue line indicates the mean.

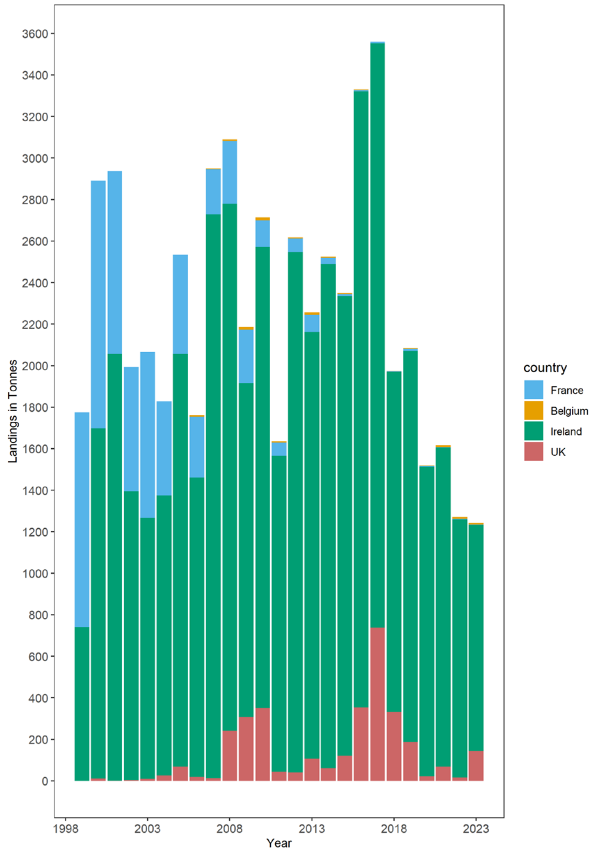


Figure 20.2.1. ***Nephrops*** **in FU22 (Smalls Grounds). Landings in tonnes by country.**

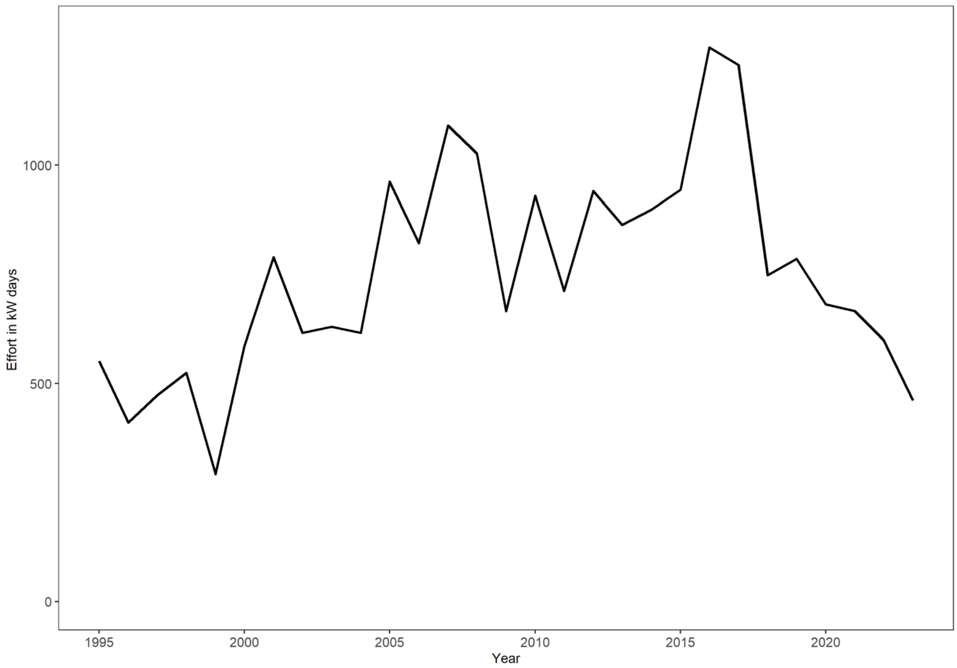


Figure 20.2.2. ***Nephrops*** **in FU22 (Smalls Grounds). Fishing effort Kw days for the Irish otter trawl** ***Nephrops*** **directed fleet (30% of** ***Nephrops*** **weight in total landings).**

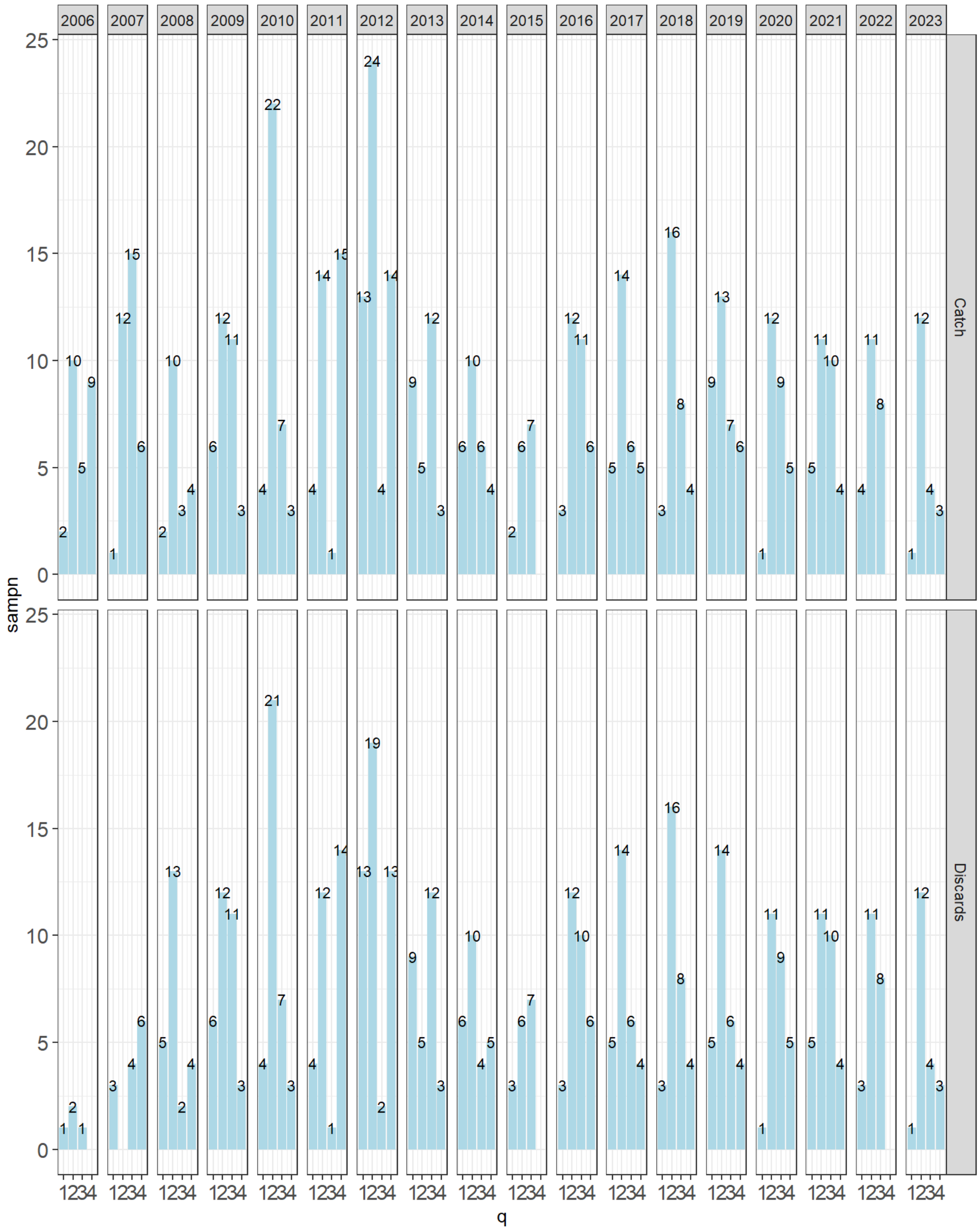


Figure 20.2.3. ***Nephrops*** **in FU22 (Smalls Grounds). Sampling levels (numbers) by year and quarter and sample type.**

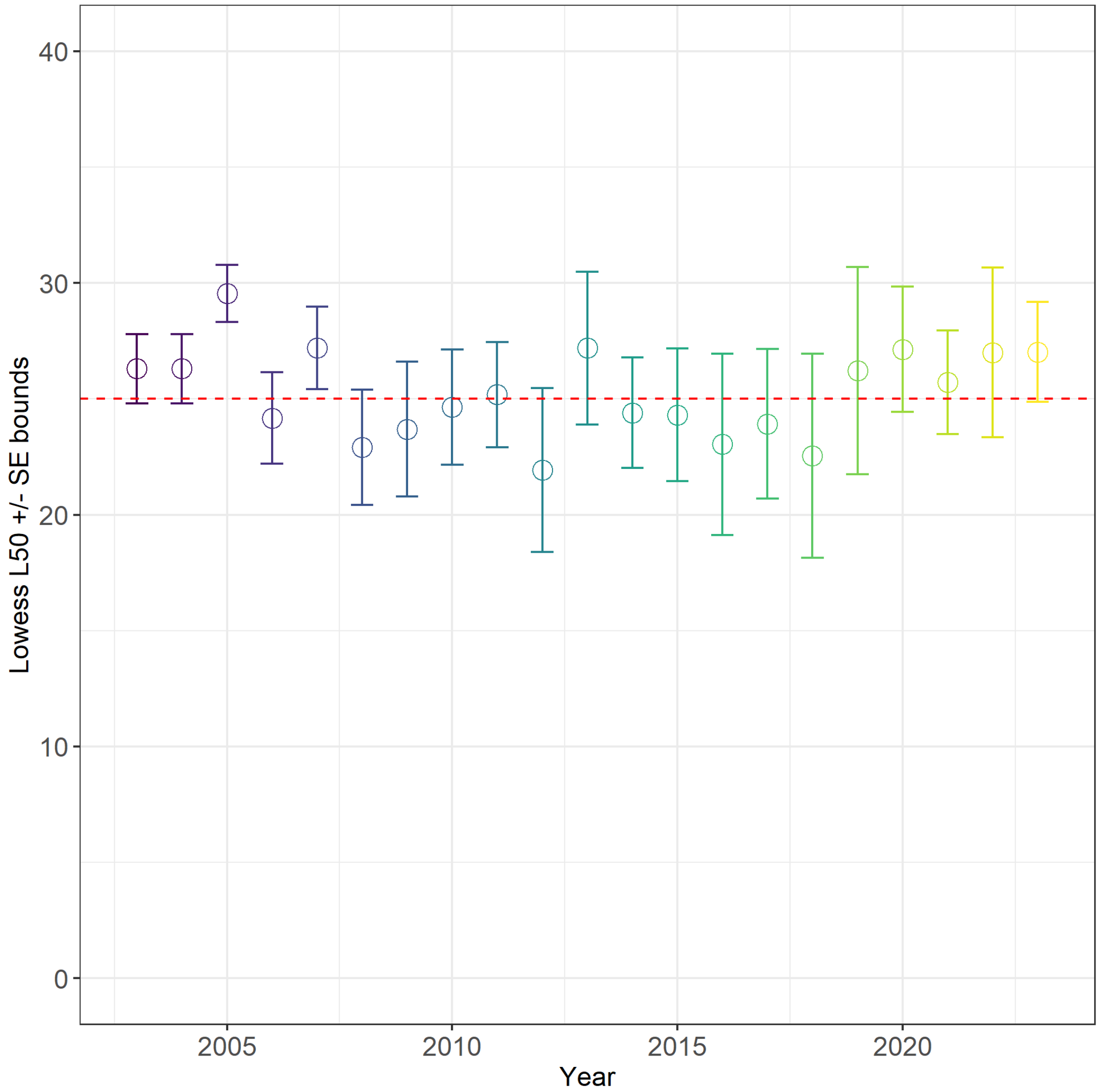


Figure 20.2.4. ***Nephrops*** **in FU22 (Smalls Grounds). The annual estimated L_{50} with standard error bounds for the on-board retention ogives for samples from the Smalls grounds. Minimum conservation size (MCR) 25 Carapace Length (CL mm) shown as dashed line.**

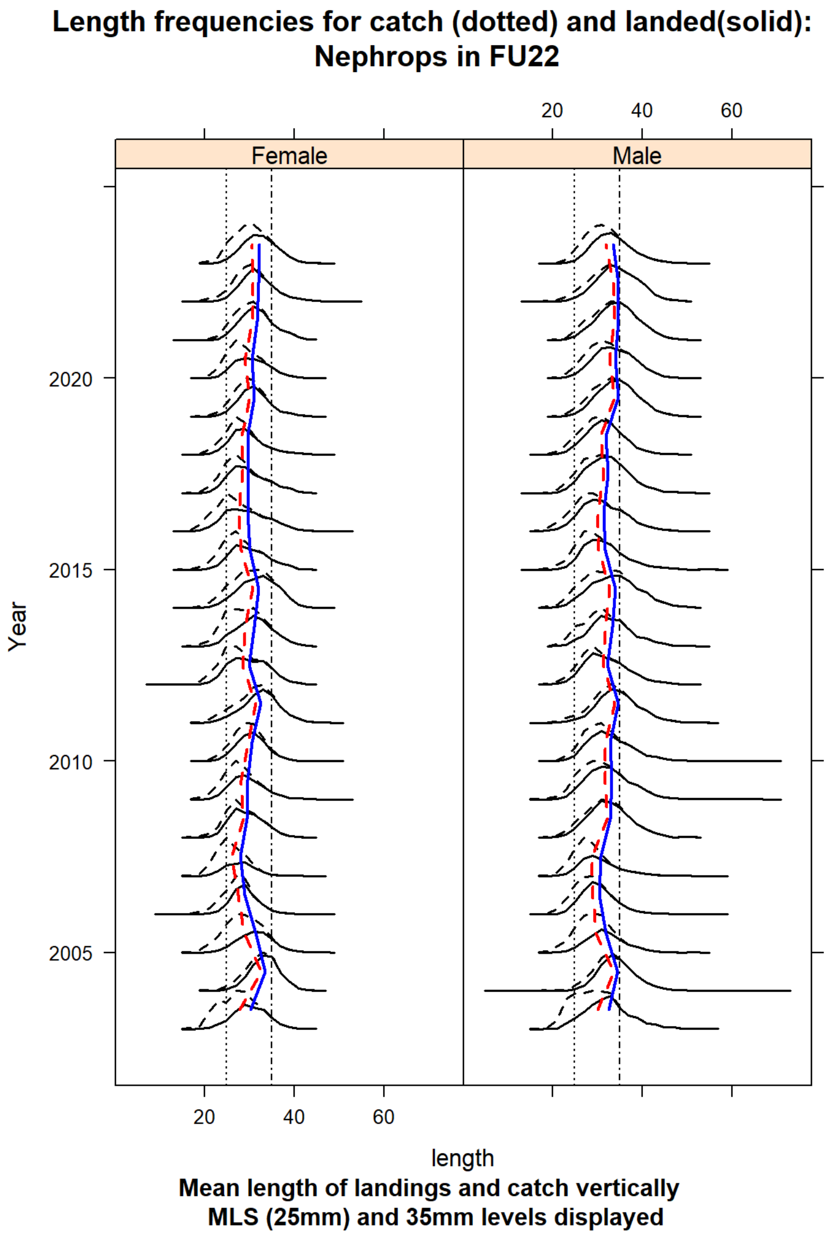


Figure 20.2.5. *Nephrops* in FU22 (Smalls Grounds). Mean size trends for catches and whole landings by sex over the time-series.

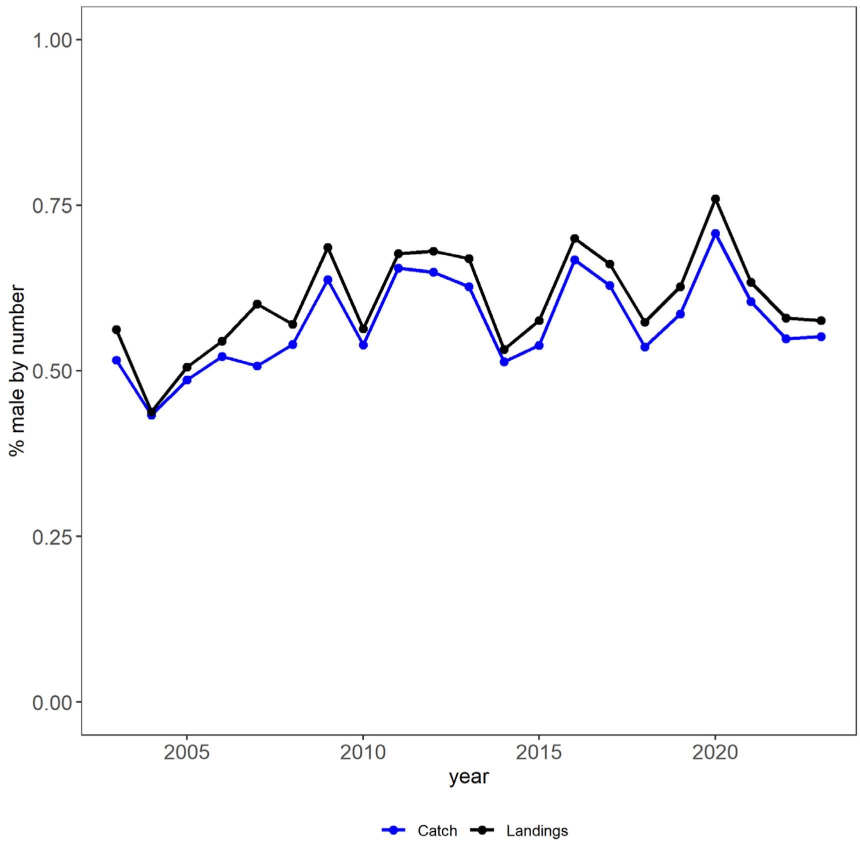
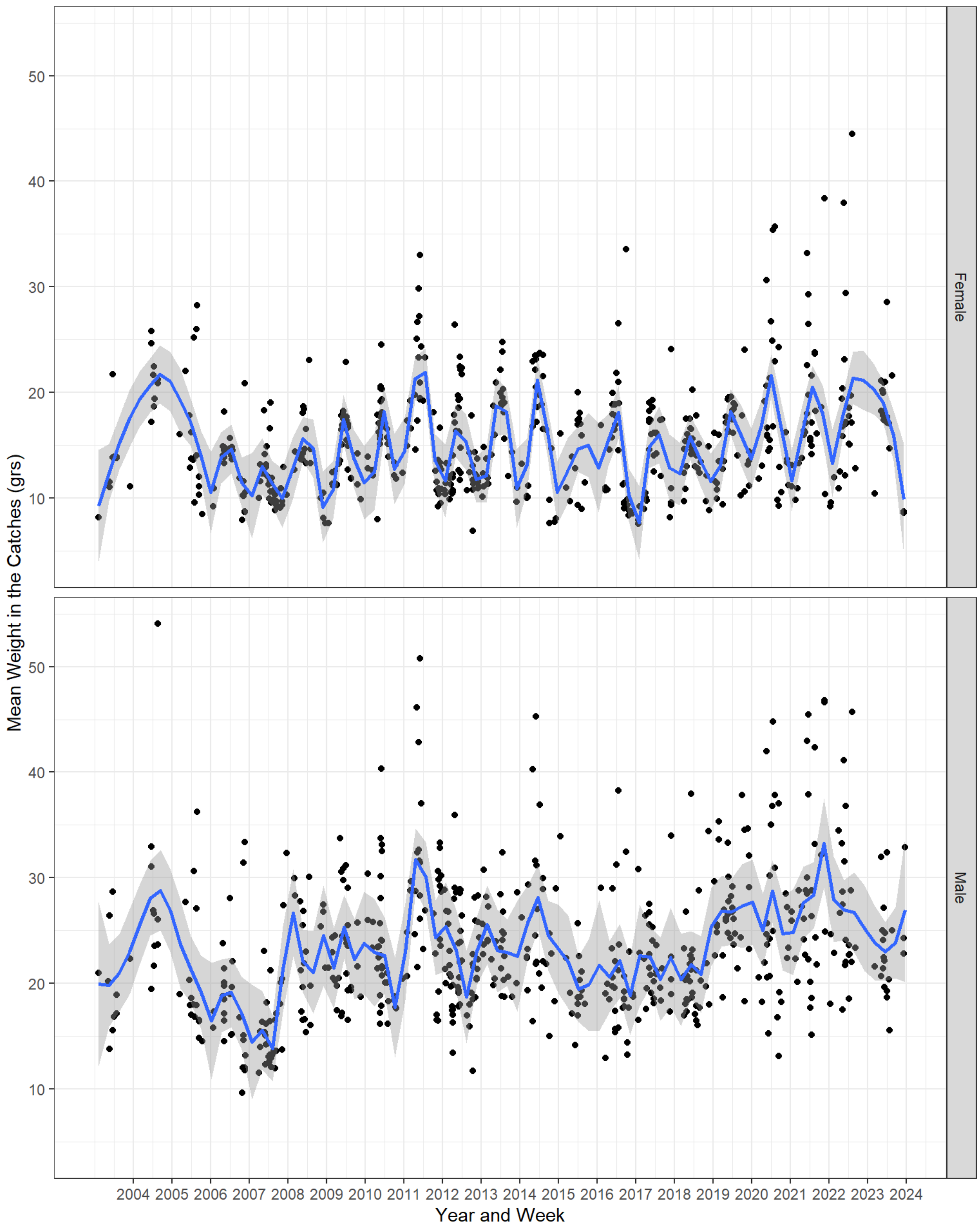


Figure 20.2.6. *Nephrops* in FU22 (Smalls Grounds). Sex ratio of the percentage males over the time-series.



~~Figure~~ 20.2.7. *Nephrops* in FU22 (Smalls Grounds). Mean weight in catch samples by sex with loess smoother and showing cyclical trends.

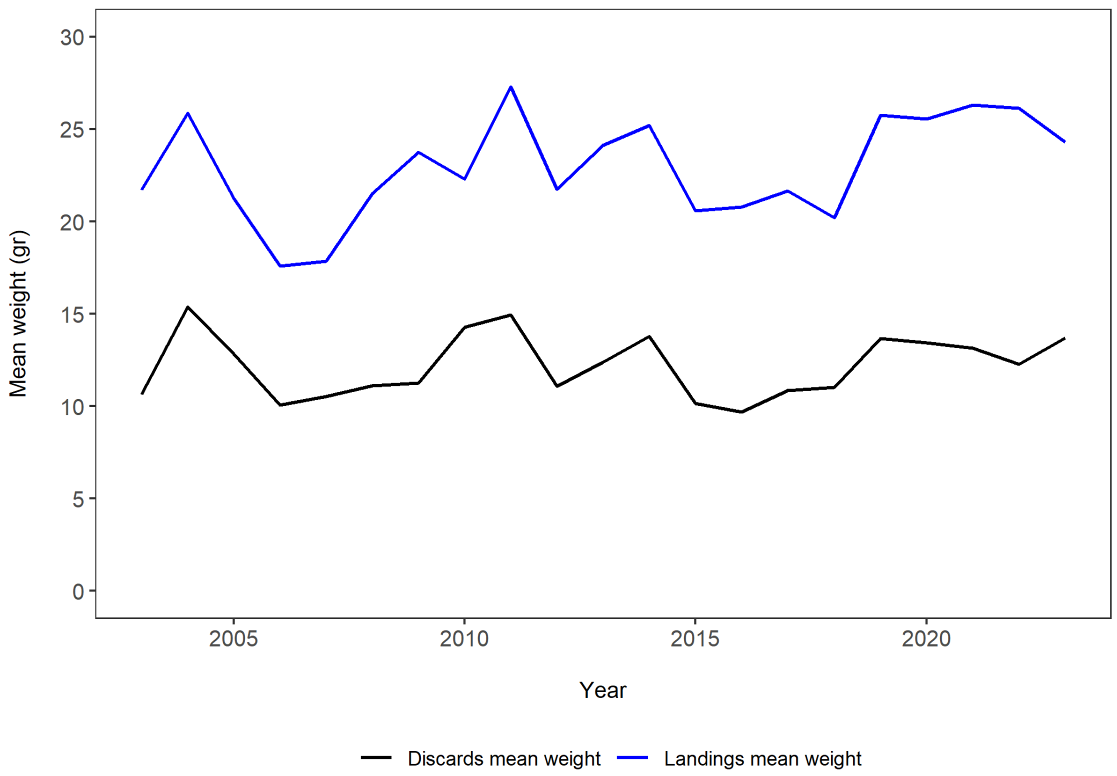


Figure 20.2.8. *Nephrops* in FU22 (Smalls Grounds). Annual mean weights (gr) in the landings and discards.

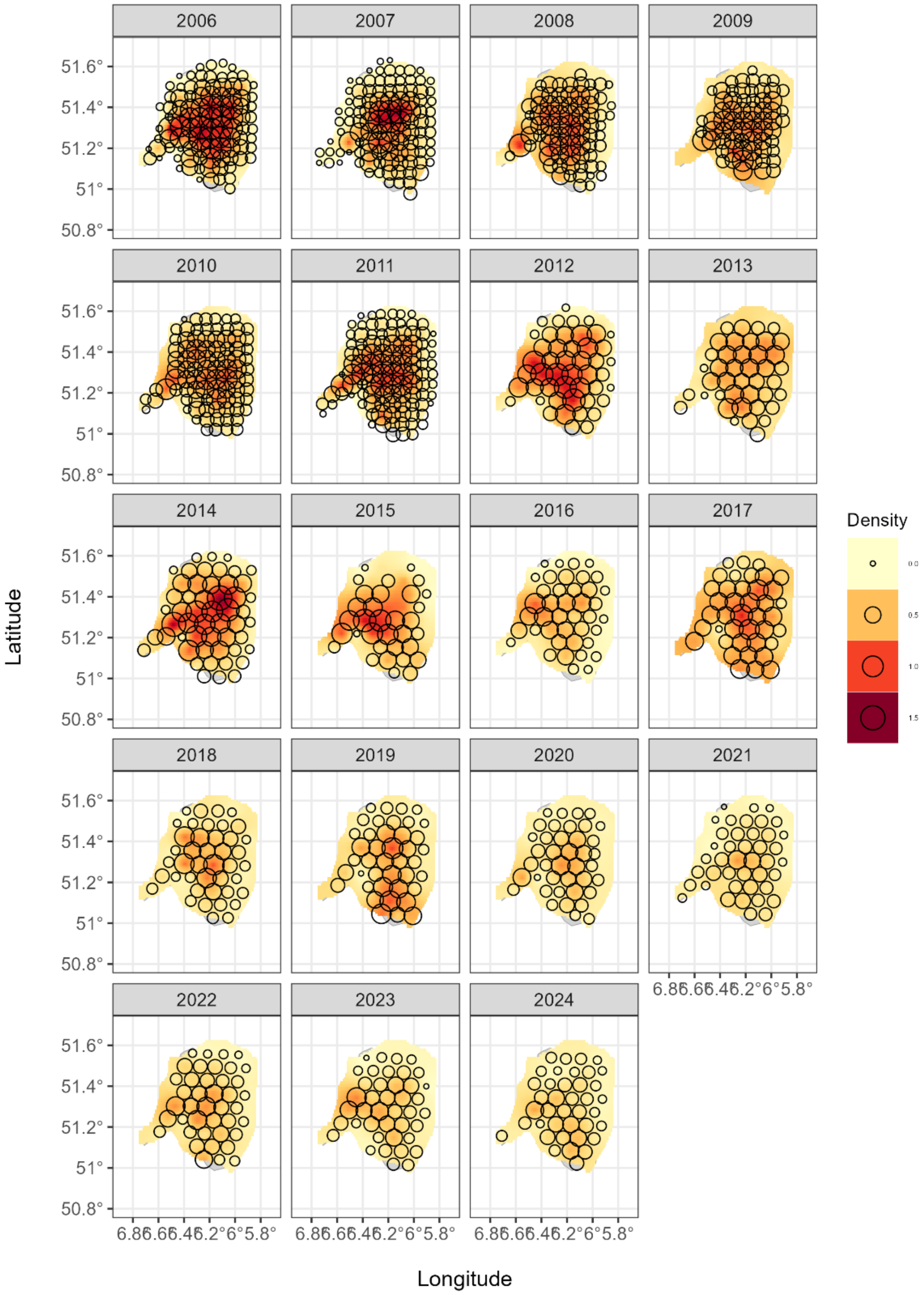


Figure 20.2.9. ***Nephrops*** **in FU22 (Smalls Grounds). Contour plots of the krigged density estimates for the UWTV surveys over the time-series.**

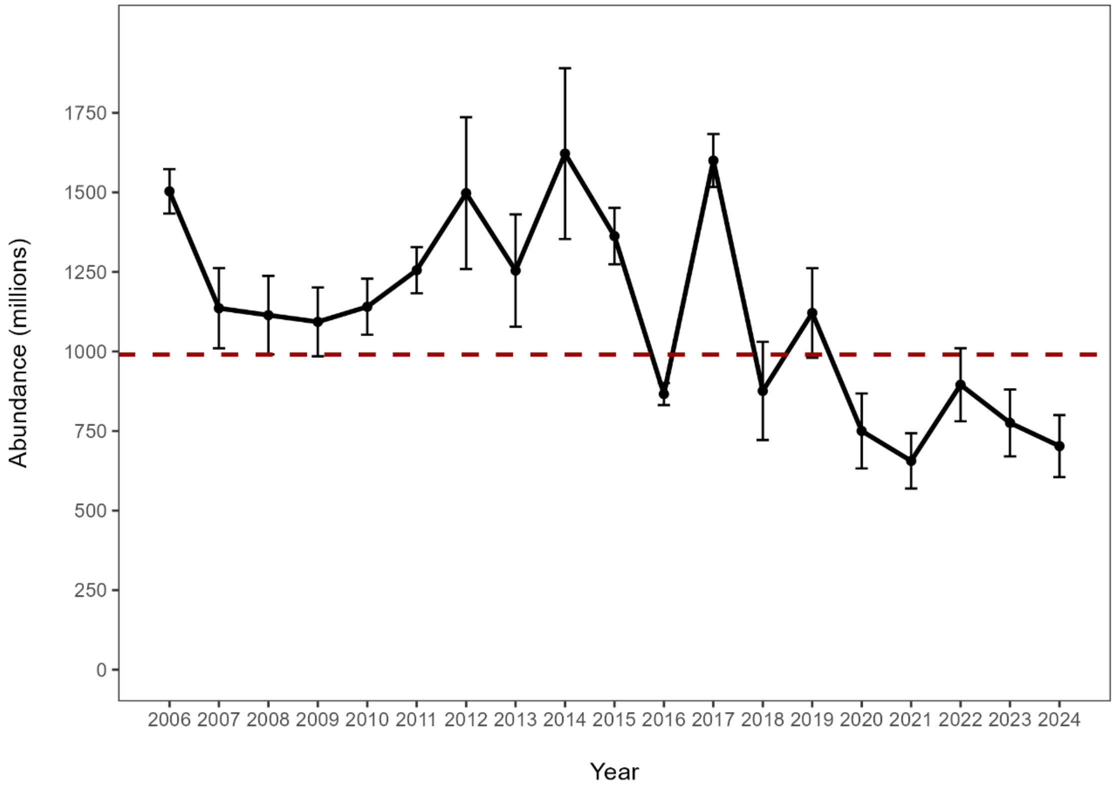


Figure 20.2.10. *Nephrops* in FU22 (Smalls Grounds). Time-series of abundance estimates for FU22 (error bars indicate 95% confidence intervals) and MSY $B_{trigger}$ is dashed line.

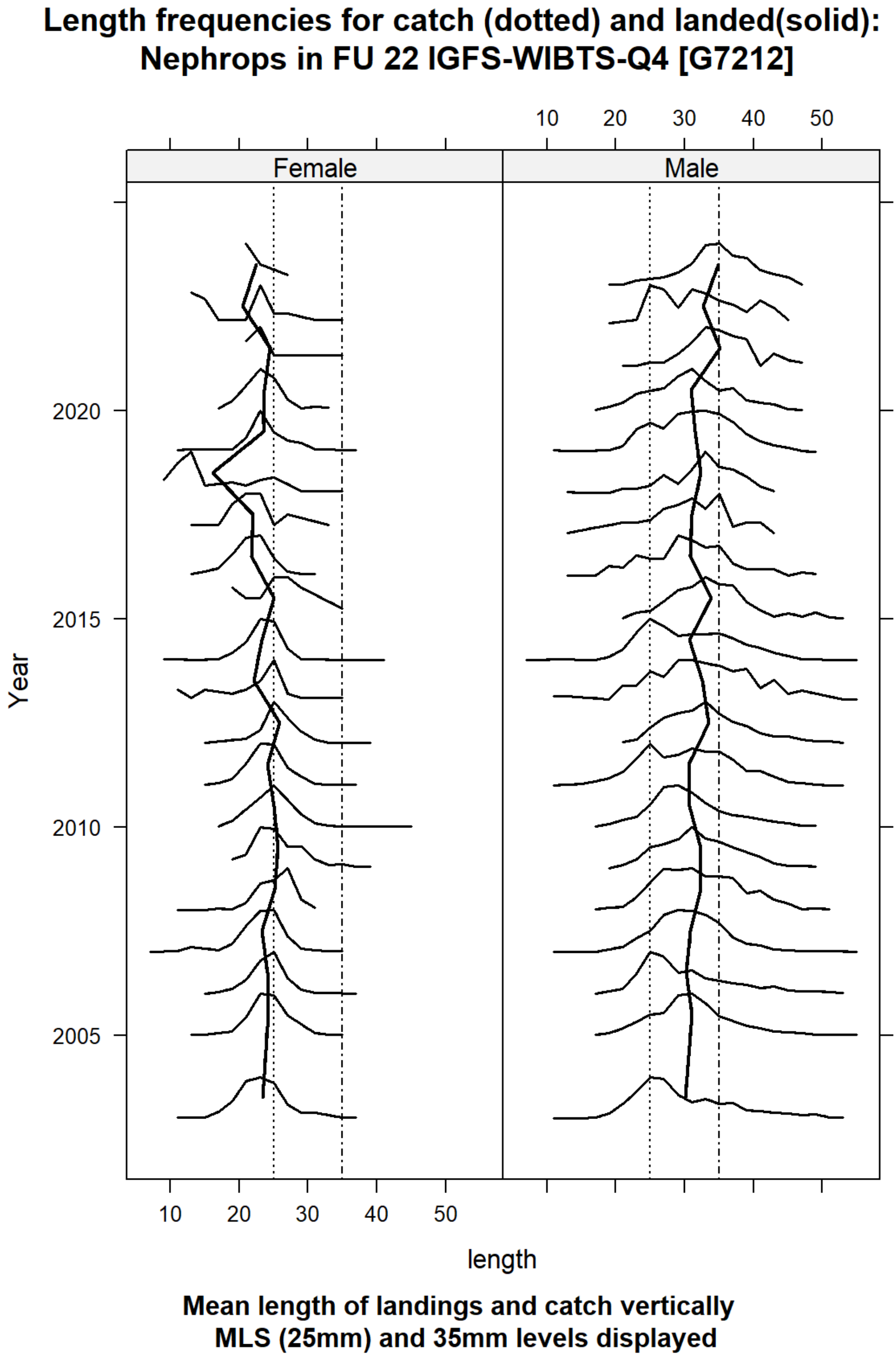


Figure 20.2.11. ***Nephrops*** **in FU22 (Smalls Grounds). Mean size trends (Carapace length CL mm) for catches by sex from IGFS-WIBTS-Q4 [G7212]. Vertical lines displayed are Minimum Conservation Reference Size 25 mm Carapace Length (CL) and 35 mm CL.**

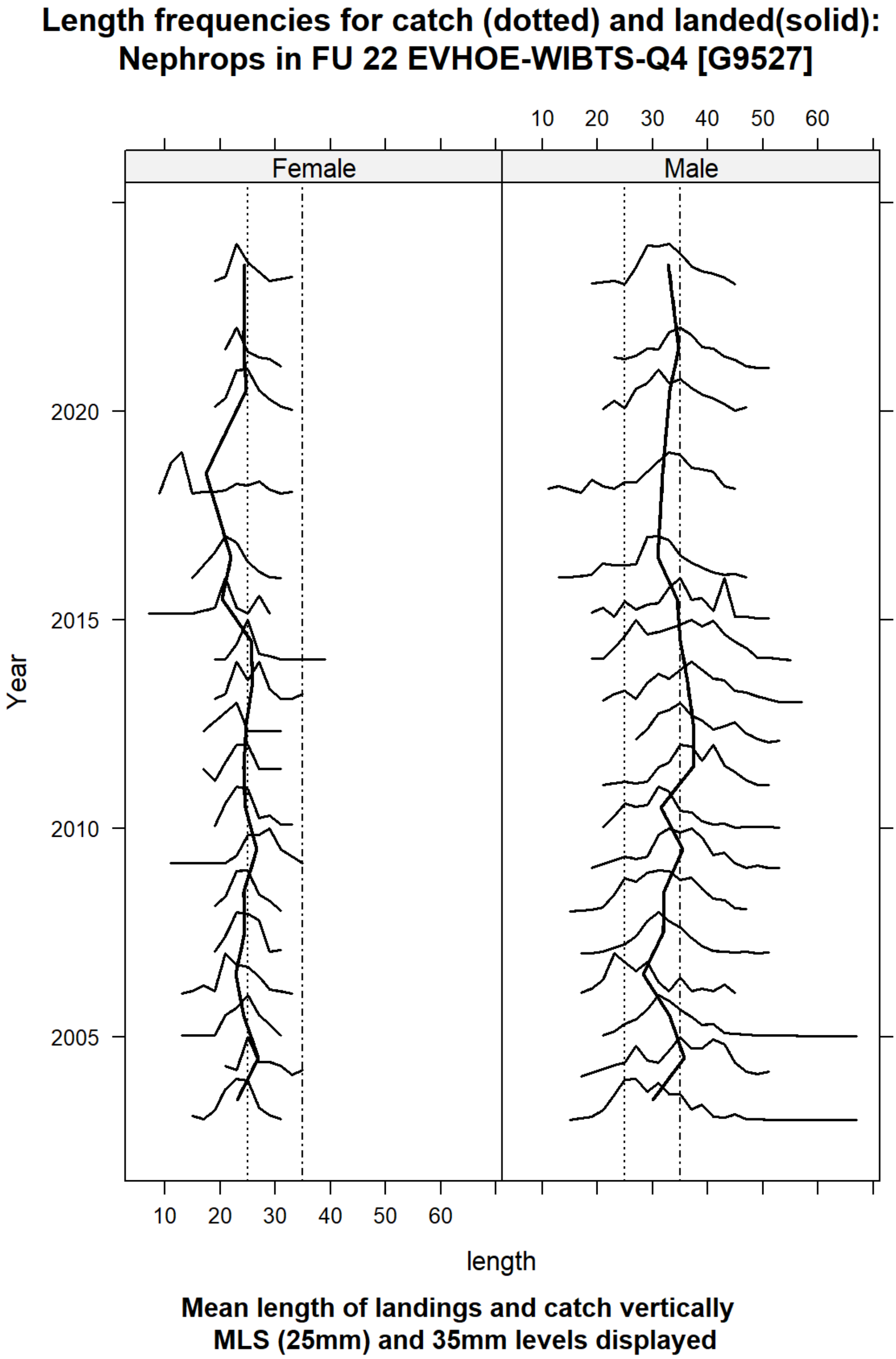


Figure 20.2.12. Nephrops in FU22 (Smalls Grounds). Mean size trends (Carapace length CL mm) for catches by sex from EVHOE- WIBTS-Q4 [G9527] French survey. Vertical lines displayed are Minimum Conservation Reference Size 25 mm Carapace Length (CL) and 35 mm CL.

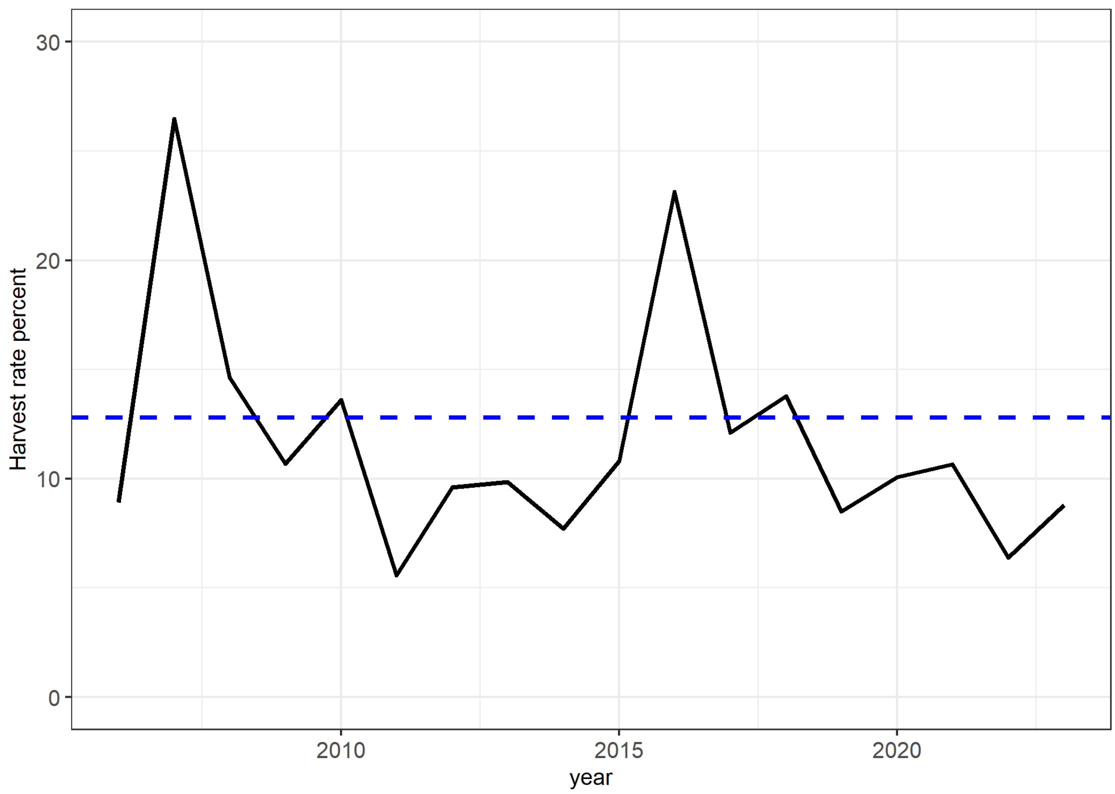


Figure 20.3.1. *Nephrops* in FU22 (Smalls Grounds). Harvest Rate (% dead removed/UWTV abundance). The dashed and solid lines are the MSY proxy and the harvest rate respectively.

Contents

21 Norway lobster (Nephrops norvegicus) in Functional Unit 23 and 24

This stock was not assessed by the Working Group in 2024.

Contents

22 Plaice (*Pleuronectes platessa*) in Division 27.7.a (Irish Sea)

22.1 Introduction

Type of assessment in 2024

WKIrish3 (ICES, 2017) benchmarked this assessment and choose the SAM model, including estimates of discards-at-age into the catch matrix. A baseline run of the model was performed using discards since 1981 reconstructed according to the medium discard scenario (ICES, 2017).

ICES advice applicable to 2023

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 2019–2021, total catches in 2023 should be no more than 2039 tonnes.

Advice for 2023 is available at:

https://ices-library.figshare.com/articles/report/Plaice_Pleuronectes_platessa_in_Division_7_a_Irish_Sea_/19453592?backTo=/collections/ICES_Advice_2022/5796935?backTo=/collections/ICES_Advice_2022/5796935?backTo=/collections/ICES_Advice_2022/5796935?backTo=/collections/ICES_Advice_2022/5796935

ICES advice applicable to 2024

ICES advises that when the MSY approach is applied catches in 2024 should be no more than 1902 tonnes.

Advice for 2024 is available at:

https://ices-library.figshare.com/articles/report/Plaice_Pleuronectes_platessa_in_Division_7_a_Irish_Sea_/21840978?backTo=/collections/ICES_Advice_2023/6398177

22.2 General

Stock description and management units

The stock assessment area and the management unit are both Division 27.7.a (Irish Sea).

Management applicable in 2022 and 2023

Management of plaice in Division 27.7.a is by TAC and there is a Minimum Conservation Reference Size (MCRS) of 27 cm in force. The agreed TACs and associated implications for plaice in Division 27.7.a are detailed in the tables below.

2023

Species:	Plaice *Pleuronectes platessa*	Zone:	7a (PLE/07A.)
Belgium	44	Analytical TAC	
France	19	Article 7(2) of this Regulation applies	
Ireland	767		
Netherlands	13		
Union	843		
United Kingdom	1 042		
TAC	2 039		

(Source: Council Regulation (EU) 2023/194, ANNEX IA)

2024

Species:	Plaice *Pleuronectes platessa*	Zone:	7a (PLE/07A.)
Belgium	33	Analytical TAC	
France	14	Article 7(2) of this Regulation applies	
Ireland	570		
Netherlands	10		
Union	627		
United Kingdom	972		
TAC	1 902		

(Source: Council Regulation (EU) 2024/257, ANNEX IA)

The fishery in 2023

National landings data reported to ICES* and Working Group estimates of total landings are given in Table 22.1. A summary by gear is given below.

Catch (2023)		Landings			Discards		
72% dead	28% surviving	Beam trawl	Otter trawl	Other gear types	Beam trawl	Otter trawl	Other gear types
		77%	29%	3%	63%	34%	2%
539 tonnes		156 tonnes			383 tonnes		
					60% dead		40% surviving

*** The figures in the table are rounded. Calculations were done with unrounded inputs, and computed values may not match exactly when calculated using the rounded figures in the table.**

The TAC for 2023 was 2039 tonnes and the working group estimate of landings in 2023 was 156 tonnes. The poor uptake of the quota is not a consequence of an inability to catch sufficient quantities of plaice greater than the MCRS but rather is most likely due to the limited market demand and poor value of the catch.

Landings (based on working group estimates) by the Irish, NI, UK and Belgian fleets comprised of 12%, 2%, 14% and 72% respectively of total landings in 2023. The landings of plaice are mainly split between beam trawlers (79%; primarily Belgian vessels then Irish vessels) targeting sole, and otter trawlers (21%; primarily UK and Irish vessels). Historically, otter trawling was dominated by UK vessels fishing for whitefish, but in recent years, many vessels have switched to target *Nephrops* (Figure 22.1). Otter trawlers from Ireland and N. Ireland typically target *Nephrops* in the western Irish Sea.

High levels of discarding are known to occur in all fisheries that catch plaice in the Irish Sea (see Figures 22.4 and 22.5).

A general description of the fishery can be found in the stock annex and also in 'Other Relevant Data' section below.

22.3 Data

Landings

National landings data reported to ICES and Working Group estimates of total landings are given in Table 22.1. The working group procedures used to determine the total international landings numbers- and weights-at-age are documented in the stock annex. As a result of increased rates of discarding, landed numbers-at-age for the younger ages (ages 2 to 4) have declined more rapidly over the last two decades than landings of older fish (Figure 24.2a). Age compositions of landed fish are available for Belgian beam trawl, Irish beam and otter trawl and English otter trawl (Figure 22.5).

Discards

Discard sampling has been conducted by the UK(E&W) since 2002 and by Ireland since 1993; Northern Ireland has collected data from 1996 (but not between 2003 and 2005), and Belgium since 2003. Age compositions of discarded fish are available for Belgian beam trawl and Irish otter trawl, discard estimates are also available for Northern Irish otter trawl. Discard rates for unsampled fleets are taken from the sampled fleets separately for fisheries targeting demersal fish and *Nephrops* (Figure 22.4 and Figure 22.5). Age compositions of discarded fish are available for Belgian beam trawl (used for gears targeting demersal fish) and Irish otter trawl (used for gears targeting *Nephrops*) (Figure 22.5).

WKFLAT (ICES, 2011) first estimated total international discards-at-age and introduced them to the assessment of the stock for the first time. Due to limitations in the data available by gear type, discards for Ireland, France and Northern Ireland, for the years 2004–2011 were raised using UK estimates on the basis of equivalent gear types. A raising factor based on tonnages landed for these countries was calculated and applied to the UK(E&W) estimates of discard numbers. Finally, these estimates were added to those calculated for Belgium to give estimates of total international discard numbers-at-age.

There is a considerable historic time period (1981–2003) for which no international raised discard estimates are available. The method for reconstructing discards prior to 2004 is based on size-varying discard rates and is documented in Annex 4 of the WKIrish3 report (ICES, 2017).

Since 2012, catch data (landings and discards) are available from InterCatch disaggregated by country and fleet. Total international discards are raised from available discards data.

The total discard estimates (Table 22.1, Figure 22.2b) confirm the significant proportion of discarding that occurs in the fishery, which has increased in time. Since 2004, the majority of the catch has been discarded (61% and 82% average discard in weight and in numbers respectively).

Biological

Landings numbers-at-age are given in Table 22.5 and plotted in Figure 22.2a. Weights-at-age in the landings are given in Table 22.6. Discard weights-at-age are given in Table 22.7 and weights-at-age in the stock in Table 22.8. The history of the derivation of the landings weights and stock weights used in this assessment is described in the stock annex.

Mean weight-at-age in the landings and survey data indicate declines in both sexes throughout the Irish Sea since 1993 so that plaice at ages ≤4 are typically below MCRS.

Surveys

All available tuning data are shown in Tables 22.2, 22.3 (a and b) and 22.4. Due to inconsistencies in the available commercial tuning fleets, Irish Sea plaice assessments since 2004 have only included the UK (E&W) beam trawl survey (UK (E&W)-BTS-Q3) (B6596) and the two NIGFS-WIBTS spawning biomass indices based on ground fish surveys (NIGFS-WIBTS-Q1 (G7144) and NIGFS-WIBTS-Q4 (G7655)). For more information see WGNSDS (ICES, 2004). The UK (E&W)-BTS-Q3 index was revised by WKFLAT 2011 to include stations in the western Irish Sea and in St George's Channel. A second revision was conducted in 2017 to correct for some inconsistency in the index calculation This revision did not substantially change the trend of the biomass index (see WD Cambiè and Earl, 2017 in the WGCSE 2017 report).

Reviews of the UK (E&W)-BTS-Q3 mean standardised CPUE trends have indicated that the survey has good internal consistency in monitoring trends across the stock area. For the entire Irish Sea, the biomass index calculated from the UK (E&W)-BTS-Q3 (Figure 22.3, right) indicates two periods of upwards trend, 1993–2003 and from 2007–2015. It is however, detected to have dropped from 2016. An increase of numbers in older ages is observed until around 2015, followed by a steep decline (Figure 22.3, left). The NIGFS-WIBTS surveys show similar increases in biomass between 1993 and 2003, reaching the highest level in 2016, then a subsequently decrease until most recent years.

In 2022, an error was discovered in the calculation of the tuning index from the NIGFS-WIBTS (Autumn and Spring), going back four years for the Autumn series and three years for the Spring series. The most recent datapoints were not calculated in the same units as previously, and so had to be corrected. The revision increased these data points by a factor of 3. An update of the 2021 assessment using the corrected data led to the SSB at the start of the interim year being revised up by 13% and a minor improvement to the model fit. In 2023 part of the NIGFS-WIBTS-Q4 survey was not conducted. As a consequence, the survey was included in the model with the missing stations' values being replaced by a 3-year average (2020-2022). Sensitivity analyses has indicated that this has produced a minimal impact on the perception of the stock status.

The NIGFS-WIBTS survey strata can be disaggregated into western (Strata 1–3) and eastern (Strata 4–7) subareas, where the subareas are divided by the deep trench that runs roughly north–south to the west of the Isle of Man (Figure 22.6, Tables 22.3a and b).

The SSB of plaice in the Irish Sea was also independently estimated using the Annual Egg Production Method (AEPM), according to Armstrong *et al.*, 2001 methodology.

Year	SSB (tonnes)	Catch/SSB harvest rate
1995	9081	
2000	13 303	
2006	14 417	15.16
2008	14 352	12.77
2010	15 071	19.5

Catch (discards available from 2004) to egg survey biomass ratios indicate historically that the plaice in the Irish Sea has been lightly exploited. Splitting the SSB estimates from the AEPM into eastern and western Irish Sea areas (Figure 22.7) also indicates that the perceived increase in plaice biomass is due to increased production in the eastern Irish Sea only (for more details see stock annex).

In summary, the UK (E&W)-BTS-Q3 in September, the NIGFS-WIBTS-Q4 index in October (but not NIGFS-WIBTS-Q1 March), and the AEPM indicate a sustained increasing trend in biomass in the eastern Irish Sea, but this rise does not appear to extend across the deep channel to plaice in the western Irish Sea (Figure 22.7).

Commercial CPUE

Age-based tuning data available for this assessment, comprise three commercial fleets: the UK(E&W) otter trawl fleet (UK(E&W) OTB, from 2008), the UK(E&W) beam trawl fleet (UK(E&W) BT, from 1989) and the Irish otter trawl fleet (IR-OTB, from 1995). Due to inconsistencies in the available tuning fleets, Irish Sea plaice assessments since 2004 have omitted these indices. For more information, see WGNSDS 2004. The effort and catch by these commercial fleets have been very low in recent years and the CPUE data are no longer considered informative.

Other relevant data

Table 22.2 and Figure 22.1 show that effort levels have decreased since 2002 for the majority of fleets. Both the UK otter and beam trawl fleets are close to their lowest recorded effort levels in time-series extending back to 1972 and 1983 respectively. Effort by UK *Nephrops* trawlers has greatly increased in the years 2006–2014 but has decreased in the last years. However, this fleet is now the dominant UK fleet in terms of hours fished in 27.7.a. Belgian vessels operating in Division 7 typically move in and out of the Irish Sea, depending on the season, from specifically the Bristol Channel and Celtic Sea, the Bay of Biscay and the southern North Sea.

Since 2013, a problem with the gear effort information (000s hours fished) reported for the UK (E&W) commercial beam trawl fleet has been registered. Effort information from this fleet is largely missing as a result of a larger component of the fleet using the EU electronic logbook system to report its activities. Gear effort information reporting has not been mandatory with this system to date. As a result, few trips reported their gear effort information rendering the overall effort reported and resulting LPUE unusable. However, an initial inspection of an alternate effort indicator for this gear (days fished) suggests that UK beam trawl effort in 2013, 2014, 2015, 2016, and 2017 is at the level observed in 2012. The otter trawl fleet effort reporting was unaffected by this as these vessels were not reporting their landings via this method in these years.

22.4 Historical stock development

Model: Age-based analytical assessment (State–space Assessment Model, SAM) that uses landings and discards (Nielsen and Berg, 2014).

Software: R version 4.0.2 with additional packages (version in parenthesis):

stockassessment (0.12.0); Pander (0.6.5); knitr (1.39); captioner (2.2.3); rmarkdown (2.14); icesAdvice (2.1.1); reshape (0.8.8); cowplot (1.1.1); ggplot2 (3.4.4); icesTAF (4.2.0).

Model options chosen

The AP model (Aarts and Poos, 2009) was replaced by SAM. WGCSE (ICES, 2016) agreed that the AP model was not the definitive assessment tool for Irish Sea plaice but a temporary solution to the fitting of datasets which included recent discards estimates but for which historic discard information was not available. Reconstructed values of historic discards (prior 2004) were provided in the WKIrish3 (ICES, 2017). The SAM model incorporates the estimated historic discards and is used to run the assessment since 2017.

The model runs were performed using the R package 'stockassessment'. Settings for this update stock assessment are given in the table below. The update assessment follows the same procedure as in the stock annex (ICES, 2017). A baseline run of the model was performed using discards since 1981 reconstructed according to the medium discard scenario (ICES, 2017). Discard survival was set at 40%, and natural mortality followed a Lorenzen curve, scaled to 0.12.

Input data types and characteristics

Commercial catch-at-age data. Discards values available from 2004. Estimates of discards reconstructed for 1981–2003 (ICES, 2017). Only the dead fraction of discards (0.6) is accounted for in the model. Three survey indices (UK (E&W)-BTS-Q3, NIGFS-WIBTS-Q1, and NIGFS-WIBTS-Q4); fixed maturity ogive; natural mortality constant over years and different across ages.

Final update assessment

WKIrish3 (ICES, 2017) benchmarked this assessment and included estimates of discards-at-age into the catch matrix.

The assessment settings are shown in the following table. Historic settings are given in the stock annex.

Assess-ment year		2020	2021	2022	2022	2023
Assess-ment model		SAM	SAM	SAM	SAM	SAM
Tuning fleets	UK (E&W)-BTS-Q3	Survey omit-ted	Survey omit-ted	Survey omit-ted	Survey omit-ted	Survey omit-ted
	Extended UK (E&W)-BTS-Q3	1993–2019, ages 1–7	1993–2019, ages 1–7	1993–2021, ages 1–7	1993–2022, ages 1–7	1993–2023, ages 1–7
	UK(E&W) BTS Mar	Survey omit-ted	Survey omit-ted	Survey omit-ted	Survey omit-ted	Survey omit-ted
	UK(E&W) OTB	Series omitted	Series omitted	Survey omit-ted	Survey omit-ted	Survey omit-ted
	UK(E&W) BT	Series omitted	Series omitted	Survey omit-ted	Survey omit-ted	Survey omit-ted
	IR-OTB	Series omitted	Series omitted	Survey omit-ted	Survey omit-ted	Survey omit-ted
	NIGFS-WIBTS-Q1	1992–2019	1992–2020	1992–2021	1992–2022	1992–2023
	NIGFS-WIBTS-Q4	1992–2019	1992–2020	1992–2021	1992–2022	1992–2023
Selectivity model		Correlated random walk	Correlated random walk	Correlated random walk	Correlated random walk	Correlated random walk
Discard fraction		Estimated by WKIrish3	Estimated by WKIrish3	Estimated by WKIrish3	Estimated by WKIrish3	Estimated by WKIrish3
Landings N at age		1981–2019, ages 1–8+	1981–2020, ages 1–8+	1981–2021, ages 1–8+	1981–2022, ages 1–8+	1981–2023, ages 1–8+
Discards N at age		1981–2019, ages 1–8+	1981–2020, ages 1–8+	1981–2021, ages 1–8+	1981–2022, ages 1–8+	1981–2023, ages 1–8+

The estimated selectivity patterns split into the landed and discarded components are shown in Figure 24.8. Until early 1990s, the landings selectivity had the highest values for fish aged 4 (indicating that four-year aged fish were selected). This selectivity shifted to age 5 in late the 1990s and early 2000s, due to the increase of the MCRS in 1998 (from 250 mm to 270 mm). Since late 2000s landings gradually fell over time to very low values relative to the discard pattern, which became dominant and expanded to the older aged fish during the most recent years.

The catchability of the UK(E&W)-BTS-Q3 survey is elevated for ages 1 and 2 and reflects the nature of the survey, which was designed as a recruit index (Figure 22.9).

Diagnostic output from the SAM model is shown in Figure 24.10. In the catch residuals, negative values are apparent in ages 8+ from 1998. A year effect in 2004 is present in the UK(E&W)–BTS-Q3 residuals (which is the first year for which discard data are available). A pattern of negative residuals between 2004 and 2009 is present in the residuals of the NIGFS-WIBTS due to large fluctuations in the SSB indices, which are due potentially to variable catchability of the survey.

Recruitment is estimated to be fluctuating without an overall trend until 2015, and then estimated at its lowest values in 2017–2022. The standardised values of the recruitment estimated by the SAM model and the standardised value of age 1 from the UK-BTS survey are characterised by similar pattern, demonstrating consistency in the model estimates (Figure 22.11).

The estimated SSB from the SAM model shows an increasing trend from 1995 until 2004–2005, followed by a drop in 2006 and 2007. This change in SSB trend from 2004 is probably due to the inclusion of more reliable discards values since 2004, when international raised discard estimates became available. Since 2012, SSB has increased reaching the highest value of the whole time-series in 2016, followed by a decrease in estimated SSB since then. The SSB trends are largely in agreement with independent SSB estimates from the Annual Egg Production Method (AEPM), up to the most recent estimate in 2010, as well as showing a similar trend to the survey data used in the assessment (NIGFS-WIBTS-Q1 and -Q4; UK(E&W)-BTS-Q3, Figure 22.12).

Estimates of numbers-at-age in the landings, discards and population, and fishing mortality numbers-at-age are given in Tables 22.9–22.12. A summary plot for the SAM assessment is shown in Figure 22.13 and the time-series estimates for F_{bar}, SSB and recruitment are given in Table 22.13.

Comparison with previous assessments

In 2017, the Aarts and Poos model was replaced by the state–space assessment model (SAM). The assessment used the Lorenzen M scaled to 0.12, and the most recent maturity ogive for the survey.

The methodology provided is as robust as possible and does not currently appear to suffer from a serious retrospective pattern (Figures 22.14 and 22.15). The ten assessment model configurations compared in WKIrish3 (ICES, 2017) perform similarly in terms of temporal trends in SSB, recruitment, catch and F_{bar}. Small retrospective bias in SSB in 2004 likely resulted from the introduction of discards estimates based on samples collected from that year (prior to 2004, discards estimates are reconstructed values based on size-varying discard rates). A Mohn's rho analysis for a five-year peel resulted in values of -1.3% for recruitment, 12.7% for SSB and -12% for F_{bar}.

State of the stock

Trends in F_{bar} SSB, recruitment and catch, for the full time-series, are shown in Table 24.13 and Figure 24.13. The assessment consistently estimates that fishing mortality declined from high levels in the 1980s and early 1990s to very low levels, having been <0.1 since 2013. Since 2012, SSB has increased reaching the highest value of the whole time-series in 2016, whereas it has slightly decreased in 2017 and in the most recent years. Estimated recruitments are highly variable. An increasing trend was present until 2015 although it seems to have dropped to the lowest values in 2017–2020. A gradual slightly increase has been seen in the last two years. Catch has decreased to low levels and, since 2006, the majority of the catch has been discarded (61% in weight and 82% in number respectively, averaged since 2004).

22.5 Short-term projections

Forecasting takes the form of short-term stochastic projections. A total of 1000 samples are generated from the estimated distribution of survivors. These replicates are then simulated forward according to model and forecast assumptions (see table below), using the usual exponential decay equations, but also incorporating the stochastic survival process (using the estimated survival standard deviation) and subject to different catch-options scenarios. Recruitment in the intermediate year (2024) was taken as the median from a distribution about the assessment estimate. Estimates of recruitment for intermediate year and subsequent years were resampled from the 2015–2023 year classes, reflecting recent low levels of recruitment. These re-sampled recruitments are used in SAM forecasts in order to evaluate future stock dynamics.

Initial stock size	Starting populations are simulated from the estimated distribution at the start of the intermediate year (including covariances)
Maturity	Average of final three years of assessment data
Natural mortality	Average of final three years of assessment data
F and M before spawning	Both taken as zero
Weight-at-age in the catch	Average of final three years of assessment data
Weight-at-age in the stock	Assumed to be the same as weight-at-age in the catch
Exploitation pattern	Fishing mortalities taken as a three-year average
Stock–recruitment model used	Recruitment for the intermediate year onwards is sampled, from 2015 to the final year of catch data
Procedures used for splitting projected catches	An average of final three years of landing fractions are used in the forecast period, Discard values are raised to include the live portion. Discard numbers multiplied by 5/3 to account for discard survival. Total catch is sum of three components: landings, discards assumed to die, and discards assumed to survive

F estimates 2017–2019 has fluctuated around similar values, with a slightly increase in recent years (2021 and 2022). F *status quo*, Fsq, has been estimated by averaging the F over 2021–2023 (0.086).

A full management options table is provided in Table 22.15, based on the intermediate year assumption in Table 22.14. Note that the values that appear in the catch scenarios are medians from the distributions that result from the stochastic forecast. Implementing the management plan for this stock with F_{MSY}=0.196 leads to a total catch of 1504 t (485 t of landings and 1019 t of discards including dead and survivors) in 2024 and SSB of 8237 t in 2026.

22.6 Medium-term projections

There are no medium-term projections for this stock.

22.7 MSY explorations

The reference points for this stock were estimated in 2018 (ICES, 2018) as ICES request for EU western waters stocks and are presented in the table below. In 2021, ICES changed the basis for F_{pa} to $F_{p.05}$, and the updated F_{pa} value is shown in the table below.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	8757 tonnes	Lower 5th percentile of B F_{MSY}	ICES (2018)
	F_{MSY}	0.196	Stochastic simulations with segmented regression from the entire time-series (1981–2017)	ICES (2018)
	$F_{MSY\ lower}$	0.133	F at 95% MSY (below FMSY), based on simulation using a segmented regression stock–recruitment relationship (EqSim)	ICES (2018)
	$F_{MSY\ upper}$	0.293	F at 95% MSY (above FMSY), based on simulation using a segmented regression stock–recruitment relationship (EqSim)	ICES (2018)
Precautionary approach	B_{lim}	3958 tonnes	B_{loss} = minimum SSB observed	ICES (2018))
	B_{pa}	5294 tonnes	$B_{lim} \times \exp(1.645 \times \sigma)$; $\sigma = 0.177$	ICES (2018)
	F_{lim}	0. 50	F with 50% probability of SSB < B_{lim}	ICES (2018)
	F_{pa}	0.403	$F_{p.05}$; the F that leads to SSB ≥ B_{lim} with 95% probability	ICES (2018)
Management plan	SSB_{mgt}	Not applicable		
	F_{mgt}	Not applicable		

Yield per Recruit analysis

There are no yield per recruit analyses for this stock.

22.8 Management plans

There are no management plans for this stock.

22.9 Uncertainties and bias in assessment and forecast

The assessment was benchmarked in 2017 (WKIrish3), which resulted in the SAM model being fitted using catches based on reconstructed estimates of discards prior to 2004. This discard reconstruction introduces additional uncertainty in the model. The model estimates of stock development since 2004 are more reliable as based on direct discard estimates. The SAM model considered only the dead portion of the discards (60%), but in the forecast the estimates are raised to include the surviving discards. The Mohn’s rho measure of retrospective bias for this assessment is low (Section 22.3).

The assessment indicates that recruitment and F have both been falling in recent years, and as a result the average age of catches has been increasing. An increasing amount of the stock is contained within the modelled plus group (47% in the last five years is age 8+). Consequently, the assessment and forecast have increased uncertainty and a pattern of retrospective adjustment of terminal year SSB downwards is seen in the recent history of the assessment.

22.10 Recommendations for next benchmark

There is evidence of substantial substock structure and incorporating information about the differences in growth and maturity between the east and west sides of the Irish Sea, as well as by sex should be explored.

Incorporating data on changes in maturity and natural mortality over time, linked to the decreasing in weights-at-age observed in survey data, should also be considered. There is evidence of a decline in weight-at-age from the commercial landings data and survey data. The UK(E&W)-BTS-Q3 survey data also indicate declines in length-at-age and maturity-at-age.

Creating age-based indices for the NI groundfish surveys would improve the assessment.

Ecosystem information ought to be explored.

Type	Problem/Aim	Work required	Data required	Expertise required
Sampling	The split between OTB and BTT has changed, and sample raising may not adequately reflect the changed split	Review consistency of sample raising to ensure the change of OTB/BTT is accurately and consistently reflected in the raised samples	Data already available in InterCatch	Catch sampling expertise
Assessment method	The assessment indicates that recruitment and F have both been falling in recent years, and as a result the average age of catches has been increasing. An increasing amount of the stock is contained within the modelled plus group (47% in the last five years is age 8+). Consequently, the assessment and forecast have increased uncertainty and a pattern of retrospective adjustment of terminal year SSB downwards is seen in the recent history of the assessment.	Recompile age distributions with a higher plus group, test effect of different Catchability assumptions in this age group. Consider whether F_{bar} age range needs changing. Possible recalculation of reference points	Landings data by age, as disaggregated as possible. Should be available post-2004 in InterCatch, but historic data availability unknown	Historic catch age composition raising
Other issues	Fits to NIGFS indices use SSB indices, assuming constant selectivity for all age/length	Explore whether age/length compositions can inform the selectivity of the survey and whether this can be included in the assessment	Survey age/length compositions	Survey index compilation experts
Biological parameters	Natural mortality and maturity may be connected with size which has varied substantially over time and between parts of the stock.	Investigate whether time varying biological parameters can be derived and used in this stock	stock size data, relationships between M and stock size, relationships between maturity and stock size. Has the catch split changed between East and West of the area, and does this affect average M and maturity?	

22.11 Management considerations

The high level of discarding in this fishery indicates a mismatch between the minimum landing size and the mesh size of the gear being used. Any measures that effect a reduction in discards will result in increased future yield. However, the market demand for plaice is poor and small plaice are particularly undesirable. Strong year effects are seen in the discard data and these are likely due to spatial structure in the stock. Spatial management of fleets in the Irish Sea may reduce the discarding of plaice.

The overall state of the stock is consistently estimated to have low fishing mortality and high spawning biomass. Therefore, the stock is considered to be within safe biological limits.

Discarding has increased throughout the period in which data are available, while landings of plaice have decreased, even though the TAC is not restrictive. Effort has decreased in fisheries targeting plaice (including UK(E&W) and Belgian beam-trawl fisheries, and UK(E&W) and Irish otter trawl fisheries targeting demersal fish). In contrast, effort by the UK(E&W) *Nephrops* fleet has increased, however, this is still small in comparison to effort by the Irish *Nephrops* fleet. The main *Nephrops* grounds are located in the western Irish Sea, where relatively small plaice are found. Technical measures to mitigate discarding by all *Nephrops* fleets could include the use of sorting grids: gear selectivity trials and monitoring from four Irish *Nephrops* trawlers using grids since 2009 indicate a potential reduction in fish discarding by 75% (BIM, 2009).

22.12 References

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Table 22.1. Plaice in Division 7.a. History of official landings and ICES estimates of discards. Weights are in tonnes.

Year	Belgium	France	Ireland	Netherlands	UK (NI, Eng.&Wales)	UK (Isle of Man)	UK (Scotland)	Total official landings	Discards
1994	332	13	547	-	1082	14	63	2051	
1995	327	10	557	-	1050	20	60	2024	
1996	344	11	538	69	878	16	18	1874	
1997	459	8	543	110	798	11	25	1954	
1998	327	8	730	27	679	14	18	1803	
1999	275	5	541	30	687	5	23	1566	
2000	325	14	420	47	610	6	21	1443	
2001	482	9	378	-	607	1	11	1488	
2002	636	8	370	-	569	1	7	1591	
2003	628	7	490	-	409	1	9	1544	
2004	431	2	328	-	369	0	4	1134	1031
2005	566	9	272	-	422	0	1	1270	1210
2006	343	2	179	0	413	0	0	937	1254
2007	194	2	194	0	412	0	-	802	1744
2008	157	2	102	0	300	1	1	563	1268
2009	197	0	73	0	184	1	2	457	1132
2010	138	0	89	0	147	0	3	377	2561
2011	332	0	118	0	146	0	0	596	603
2012	236	0	107	0	164	0	0	507	1010
2013	144	0	103	0	92	0	0	339	725
2014	100	0	123	0	59	0	0	282	943
2015	115	0	244	0	80	0	0	439	572
2016	82	0	541	-	56	-	-	679	437
2017	77	0	446	-	62	1	-	585	852
2018	53	0	316	-	66	-	-	435	395
2019	168	0	[c]	-	57	0	-	255[c]	537
2020	84	-	177	-	70	1	-	332	271
2021	103	0	107	-	70	1	-	279	392
2022*	101	0	43	-	35	0	0	179	484
2023*	109	0	22	-	25	0	0	156	383

*** Preliminary.**

[c] Incomplete/missing due to part of the data being unavailable under national GDPR clauses.

Table 22.2. Irish Sea plaice: English standardised LPUE and effort, Belgian beam trawl LPUE and effort and Irish otter trawl LPUE and effort series.

Year	CPUE			LPUE							Effort							
	UK(E&W) Beam trawl survey[1]			UK (E&W)[2]				Belgian[5]	Irish[7]		UK (E&W)					Belgian	Irish[9]	
	March	September Prime only	September Extended	Otter[3] Trawl	Otter[4] Trawl	Beam[3] Trawl	Beam[4] Trawl	Beam Trawl	Otter Trawl	Beam Trawl	Otter[3] Trawl	Otter[4] Trawl	Beam Trawl	Beam[4] Trawl	Nephrops[3] Trawl	Beam Trawl	Otter Trawl	Beam Trawl
1972				6.96				9.8			128.4					6.8		
1973				6.33				9.0			147.6					16.5		
1974				7.45				10.4			115.2					14.2		
1975				7.71				10.7			130.7					16.2		
1976				5.03				5.8			122.3					15.1		
1977				4.82				5.3			101.9					13.4		
1978				6.77		4.88		6.9			89.1		0.9			12.0		
1979				7.18		15.23		8.0			89.9		1.7			13.7		
1980				8.24		8.98		8.6			107.0		4.3			20.8		
1981				6.87		4.91		7.1			107.1		6.4			26.7		
1982				4.92		1.77		4.4			127.2		5.5			21.3		
1983				5.32	1021	3.08	0	7.8			88.1	1716.5	2.8	0		18.5		
1984				7.77	1472	6.98	810	6.8			103.1	7932.1	4.1	263		13.6		
1985				9.97	1946	25.70	5487	8.8			102.9	6930.8	7.4	428.1		21.9		
1986				9.27	1597	4.21	753	8.7			90.3	6693.2	17.0	1122.9		38.3		
1987				7.20	1479	3.57	963	8.2			130.6	9008.9	22.0	1178.5		43.2		
1988		392		5.02	1060	3.05	743	6.3			132.0	8292.4	18.6	1019.2		32.7		
1989		253		5.51	1109	13.59	2559	6.2			139.5	16161.4	25.3	1344.5		36.7		
1990		239		5.93	1074	12.02	3011	7.2			117.1	7724.5	31.0	1473.1		38.3		
1991		157		4.79	916	10.56	2807	7.5			107.3	7081.1	25.8	1211.3		15.4		
1992		188		4.20	719	9.99	2303	11.9			96.8	6671.8	23.4	908.1		23.0		
1993	91	235	149	3.97	667	9.50	2220	5.0			78.9	6013.1	21.5	826.9		24.4		
1994	128	225	132	4.90	770	7.79	1020	9.2			43.0	3060	20.1	1451.6	0	31.6		
1995	134	169	109	5.08	806	7.69	1001	9.5	3.2	17.3	43.1	3357	20.9	1429.4	0	27.1	80.1	8.5
1996	-[6]	210	111	5.37	732	12.96	2587	11.8	4.1	19.0	42.2	3085.1	13.3	894.3	0	22.2	64.7	6.2
1997	147	262	148	5.25	662	7.66	944	13.9	3.1	13.7	39.9	2903.3	10.8	784.4	0	29.3	92.0	9.9
1998	113	249	146	5.00	657	5.66	766	12.3	3.7	22.3	36.9	2620.6	10.4	696	0	23.8	93.5	11.5
1999	-[6]	264	151	5.38	632	7.76	895	7.1	2.3	23.2	22.9	1803.5	11.0	778.9	0	37.2	109.7	14.7
2000	-[6]	357	169	5.02	828	13.04	1773	7.8	2.0	13.8	27.0	2034.9	6.3	410.7	0	27.0	82.6	11.4
2001		281	147	3.35	539	8.33	1017	9.2	2.9	14.0	33.0	2352.9	12.5	767.4	0	41.9	77.4	13.1
2002		340	200	5.66	840	5.46	445	7.4	2.8	7.9	24.8	1774	8.0	535.1	0	52.5	77.4	17.7
2003		503	247	2.60	414	3.76	400	7.5	4.1	9.5	23.9	1728.3	14.0	863.7	0	48.7	73.8	18.6
2004		540	249	3.17	472	4.20	255	11.2	2.1	8.6	23.5	1727	7.4	419.9	0	36.1	72.5	14.2
2005		367	177	4.85	540	4.67	381	12.8	2.0	8.0	16.7	1313.6	11.6	627.8	1	42.1	69	14.7
2006		356	166	6.50	610	2.19	202	10.8	1.4	6.2	5.2	478.5	4.6	280.1	10.9	28.9	66.8	12.2
2007		432	190	17.94	756	4.22	550	6.9	1.3	6.1	4.4	397.2	3.2	193.5	12.6	23.8	75.9	14.2
2008		416	189	9.03	469	4.47	267	9.5	0.9	5.1	2.7	320.4	1.3	98	11.5	12.4	59.9	9.5
2009		467	199	6.46	338	1.21	169	10.1	1.1	3.8	1.5	157.7	0.46	24.9	10.0	14.7	42.8	7.6
2010		400	164	11.55	371	14.39	151	7.9	1.0	4.8	1.0	151	0.19	10.2	9.2	15.2	45.8	9.4
2011		417	140	4.35	183	11.95	701	17.3	1.2	6.8	0.69	72.7	1.56	91.2	8.6	16.4	54.5	8.1
2012		460	188	0.74	276	7.25	164	14.9	1.0	5.0	0.4	85	0.9	60.7	12.1	14.5	58.3	7.2
2013		550	207	7.41	236	-[8]	0	14.0	1.6	5.4	0.3	31.9	-[8]	1.3	10.6	8.9	42.6	5.0
2014		592	255	-	87	-[8]	0	13.9	1.5	8.3	-	16.1	-[8]	0.4	8.3	5.1	47.8	6.0
2015		564	230	-	0	-[8]	48	20.4	3.3	8.6	-	0	-[8]	0.9	4.5	4.6	39.8	8.3
2016		582	220	-	0	-[8]	0	26.4	4.6	32.8	-	0	-[8]	3.9	2.5	2.5	33.4	7.9
2017		525	170	-	244	-[8]	0	17.1	11.3	35.4	-	160.7	-[8]	0	0.3	4.2	12.1	7.5
2018		554	139	-	237	-[8]	0	14.6	8.4	19.5	-	238	-[8]	0	-	3.5	13.6	9.6
2020		-	-	-	1239	-[8]	277	5.9	4.5	10.6	-	73	-[8]	199	-	13.6	13.3	10.4
2021		265	-	-	852	-[8]	203	6.4	1.4	9.6	-	194	-[8]	223	-	14.8	13.2	8.9
2022		250	-	-	274	-[8]	104	5.0	0.8	5.3	-	133	-[8]	118	-	18.9	13.0	6.0
2023		197	-	-	150	-[8]	60	6.1	0.9	2.3	-	218	-[8]	128	-	17.0	9.3	5.5

[1] Kg/100km. Sept Prime: ISS/ISN Traditional Prime Stations Only. Sept Extended: ISS/ISN/ISW/SGC All Stations.

[2] Whole weight (kg) per corrected hour fished, weighted by area

[3] '000 hours fished (corrected for fishing power GRT)

[4] days fished

[5] Corrected for fishing power (HP) [data for 1999-2010, replaced at 2011WG following recalculation at WKFLAT 2011]

[6] Carhelmar survey, Kg/100km not available

[7] All years updated in 2007 due to slight historical differences

[8] Effort not reported in hours for this fleet, see Section 6.7.2 for more detail

[9] '000s hours

Fishing power corrections are detailed in Appendix 2 of the 2000 working group report

Table 22.3a. Irish Sea plaice: NIGFS-WIBTS-Q1 indices of relative biomass trends by region in spring.

NIGFS-WIBTS-Q1	ESTIMATED MEAN ABUNDANCE (kg/3 miles)			ESTIMATED STANDARD ERROR		
Mar (Spring)	Combined	West	East	Combined	West	East
Year	Str 1–7	Str 1–3	Str 4–7	Str 1–7	Str 1–3	Str 4–7
1992	8.35	5.47	9.20	3.45	1.96	4.44
1993	12.36	18.43	10.54	2.14	4.78	2.39
1994	9.65	4.47	11.09	2.43	1.46	3.12
1995	7.27	4.79	7.64	1.24	0.83	1.59
1996	7.29	12.60	5.70	1.64	5.71	1.28
1997	13.87	14.72	13.54	3.19	5.68	3.77
1998	10.40	13.32	9.00	2.73	7.10	2.84
1999	10.71	13.53	9.59	1.81	4.92	1.84
2000	12.92	26.29	8.88	4.11	17.00	1.66
2001	12.06	18.03	9.92	1.41	4.25	1.31
2002	15.27	27.95	11.17	2.53	8.39	2.14
2003	20.97	40.71	15.09	6.11	23.98	3.44
2004	8.55	5.69	9.40	1.74	1.21	2.24
2005	11.10	19.43	8.62	1.93	5.99	1.76
2006	7.85	12.14	6.39	1.39	4.62	1.16
2007	6.25	14.47	3.80	1.27	4.80	0.83
2008	4.46	5.11	4.57	0.76	1.23	0.91
2009	7.90	7.85	7.86	1.27	2.04	1.53
2010	19.40	8.77	17.30	1.86	2.70	2.28
2011	16.34	26.20	13.03	3.51	10.11	3.41
2012	14.22	21.47	11.05	2.37	7.48	2.13
2013	21.89	28.98	16.57	3.74	8.04	4.21
2014	11.43	10.96	9.65	2.04	4.82	2.22
2015	22.81	22.57	18.66	2.84	7.18	3.01
2016	34.52	30.29	35.77	7.17	9.95	8.82
2017	16.10	14.85	16.47	3.16	3.90	3.70
2018	19.26	22.86	18.18	4.11	10.19	4.39
2019	16.42	19.83	15.40	3.41	6.18	4.03
2020	17.69	12.84	19.13	3.47	3.79	4.36
2021	13.25	11.27	13.85	2.91	4.91	3.48
2022	13.17	16.61	12.15	2.90	8.39	2.81
2023	10.44	7.68	11.26	1.96	2.40	2.44

Table 22.3b. Irish Sea plaice: NIGFS-WIBTS-Q4 indices of relative biomass trends by region in autumn.

NIGFS-WIBTS-Q4	ESTIMATED MEAN ABUNDANCE (kg/3 miles)			ESTIMATED STANDARD ERROR		
Oct (Autumn)	Combined	West	East	Combined	West	East
Year	Str 1–7	Str 1–3	Str 4–7	Str 1–7	Str 1–3	Str 4–7
1992	4.81	2.31	5.55	0.92	1.10	1.15
1993	4.48	2.08	5.20	1.00	0.87	1.27
1994	8.73	5.49	9.69	2.30	2.83	2.86
1995	4.17	5.50	3.77	1.13	2.23	1.31
1996	8.68	8.85	8.63	2.25	5.94	2.33
1997	7.93	5.76	8.58	2.24	2.59	2.80
1998	5.33	3.68	5.82	1.46	2.48	1.74
1999	5.81	4.30	6.26	1.67	3.08	1.97
2000	9.75	2.20	12.00	5.76	1.13	7.47
2001	13.85	2.30	17.30	6.57	1.67	8.51
2002	9.80	5.90	10.97	3.91	3.61	4.97
2003	18.01	7.52	21.14	5.84	4.16	7.48
2004	7.79	1.64	9.63	1.80	0.81	2.33
2005	11.35	3.41	13.72	4.51	2.18	5.82
2006	6.61	2.56	7.82	1.53	1.42	1.94
2007	7.15	4.07	8.07	1.41	2.00	1.73
2008	8.68	3.28	10.27	2.20	2.09	2.78
2009	12.44	4.06	15.01	2.59	3.12	3.23
2010	15.58	5.83	18.53	5.26	5.21	6.65
2011	14.48	5.39	15.94	3.55	2.66	4.55
2012	16.05	17.89	15.65	4.43	11.16	4.68
2013	17.90	13.55	19.09	4.33	11.27	4.51
2014	22.18	27.67	20.35	7.61	24.88	6.52
2015	18.21	11.15	20.31	4.39	8.76	5.06
2016	17.57	0.95	22.53	4.52	0.43	5.86
2017	18.55	2.96	23.20	4.25	1.59	5.50
2018	21.62	20.66	21.90	5.57	18.24	4.77
2019	16.63	9.50	18.76	4.06	6.89	4.86
2020	18.07	3.39	22.45	4.09	1.98	5.29
2021	14.34	4.06	17.41	3.31	2.08	4.25
2022	8.42	2.20	10.28	1.90	0.97	2.46
2023	5.39	2.62	6.22	1.12	1.50	1.39

Table 22.4. Irish Sea plaice: UK (E&W)-BTS-Q3 biomass index (extended area). Ages in bold are those used in the assessment (ages 1–7).

Year	Distance towed (kms)	0	1	2	3	4	5	6	7	8	9+
1993	292.77	0.13	4.64	4.03	0.82	0.43	0.03	0.04	0.08	0.01	0.02
1994	218.65	0.33	4.13	2.48	1.42	0.28	0.10	0.03	0.02	0.03	0.04
1995	218.65	0.78	5.56	1.96	0.84	0.41	0.07	0.05	0.02	0.00	0.03
1996	222.36	0.26	5.79	2.17	0.53	0.19	0.20	0.05	0.02	0.00	0.02
1997	218.65	0.96	5.47	2.91	1.26	0.30	0.16	0.17	0.05	0.02	0.03
1998	218.65	0.56	4.50	4.26	1.09	0.38	0.21	0.08	0.06	0.01	0.04
1999	214.95	1.86	3.96	3.91	1.99	0.68	0.29	0.09	0.07	0.03	0.05
2000	218.65	1.22	8.74	2.80	1.47	1.11	0.47	0.12	0.09	0.03	0.04
2001	214.95	0.83	5.99	3.62	1.11	0.60	0.54	0.11	0.06	0.02	0.01
2002	214.95	0.23	6.46	4.94	2.27	0.88	0.53	0.48	0.10	0.04	0.04
2003	211.24	2.07	6.12	5.85	2.61	1.58	0.58	0.38	0.25	0.07	0.07
2004	214.95	1.09	8.07	5.36	3.94	1.88	1.15	0.21	0.19	0.13	0.10
2005	211.24	1.75	3.76	4.75	1.98	1.42	0.80	0.48	0.11	0.09	0.06
2006	214.95	3.56	5.01	3.45	2.46	1.10	0.79	0.36	0.20	0.02	0.07
2007	214.95	1.15	7.97	4.47	1.66	1.20	0.65	0.33	0.25	0.14	0.06
2008	200.12	1.22	4.68	5.71	2.03	1.15	0.82	0.31	0.12	0.08	0.05
2009	214.95	1.23	4.74	3.40	3.30	0.99	0.66	0.63	0.16	0.11	0.20
2010	211.24	2.01	6.22	4.31	2.05	1.44	0.66	0.54	0.36	0.20	0.19
2011	211.24	1.02	6.73	4.28	1.75	1.00	1.08	0.47	0.27	0.24	0.37
2012	214.95	1.40	6.52	6.37	1.71	1.03	0.47	0.53	0.30	0.14	0.42
2013	214.95	2.04	4.33	5.05	3.08	1.60	1.07	0.47	0.44	0.20	0.42
2014	214.95	1.56	7.82	6.85	3.13	2.16	0.99	0.77	0.44	0.20	0.28
2015	214.95	1.02	6.16	6.88	2.60	1.80	1.04	0.66	0.37	0.19	0.50
2016	211.24	0.18	2.91	5.97	3.95	2.45	1.61	0.96	0.74	0.45	0.58
2017	214.95	0.03	1.35	4.77	2.81	2.23	1.84	0.75	0.59	0.38	0.26
2018	214.95	0.36	1.97	2.75	2.28	1.51	1.37	1.24	0.75	0.56	0.27
2019	214.95	0.33	3.02	4.50	2.31	1.48	1.22	1.00	0.90	0.41	0.20
2020	0	-	-	-	-	-	-	-	-	-	-
2021	214.95	0.23	1.77	2.50	1.49	0.72	0.55	0.44	0.28	0.23	0.06
2022	174.18	0.36	3.86	2.66	1.09	0.97	0.35	0.38	0.22	0.14	0.27
2023	214.94	0.31	2.85	2.94	1.04	0.43	0.35	0.21	0.19	0.13	0.17
Year	Distance towed (kms)	0	1	2	3	4	5	6	7	8	9+

Table 22.5. Irish Sea plaice: Landings number-at-age 1 to 8+ (thousands), where rows are years 1981–2023 and columns are ages 1 to 8+.

IRISH SEA PLAICE

1 2

1981 2023

1 8

1

22	1742	5939	2984	837	222	105	236
27	715	3288	3082	1358	330	137	213
51	2924	2494	3211	1521	648	211	252
41	3159	5179	1182	1054	459	299	252
4	2357	6152	3301	614	429	262	340
31	1652	5280	2942	1287	344	371	308
62	3717	5317	5252	1341	1072	123	338
46	2923	5040	2552	1400	750	316	405
24	1735	5945	2671	854	436	214	364
15	1019	2715	2935	1132	465	259	223
180	2008	1506	1929	1205	465	182	226
151	1958	3209	1435	1358	903	388	294
28	910	1649	1357	474	556	377	302
97	1146	2173	1309	644	318	245	263
21	961	1703	1936	764	318	138	157
37	856	1345	1196	943	370	128	135
28	830	1590	1513	1003	482	285	257
6	691	1739	1025	612	476	403	385
68	803	1505	1294	696	280	196	242
0	450	1174	1284	686	212	219	203
14	374	1138	1083	767	409	179	166
1	206	940	1482	842	539	318	170
0	286	1031	1314	707	415	253	222
8	198	967	1104	705	247	114	186
6	228	708	1177	890	461	204	213
5	180	620	550	684	346	220	218
0	64	351	860	507	401	151	164
1	99	386	389	409	215	141	119
0	13	204	374	351	272	117	120
0	7	75	271	306	193	160	115
2	53	199	357	483	305	194	191
0	8	150	292	301	367	218	226
1	16	87	203	166	149	144	165
3	6	65	165	160	143	70	158
0	1	43	93	185	210	149	349
14	14	58	162	224	346	180	482
0	4	24	145	206	241	209	520
0	6	84	110	201	178	151	358
0	11	53	145	273	219	187	356
2	17	24	118	192	168	150	287
0	30	80	146	154	106	127	199
0	6	21	81	91	89	76	147
2	26	82	117	101	93	62	78

Table 22.6. Irish Sea plaice: Landings weight-at-age 1 to 8+ (kg), where rows are years 1981–2023 and columns are ages 1 to 8+,

IRISH SEA PLAICE

1 3

1981 2023

1 8

1

0.069	0.176	0.267	0.376	0.512	0.592	0.678	1.085
0.201	0.274	0.284	0.348	0.421	0.545	0.650	0.889
0.232	0.261	0.290	0.319	0.368	0.426	0.484	0.699
0.260	0.290	0.330	0.380	0.470	0.560	0.660	0.964
0.290	0.310	0.340	0.390	0.470	0.540	0.630	0.851
0.270	0.280	0.340	0.420	0.500	0.540	0.630	0.980
0.260	0.290	0.315	0.370	0.440	0.520	0.610	0.916
0.230	0.260	0.300	0.370	0.460	0.550	0.680	1.243
0.227	0.272	0.321	0.374	0.430	0.491	0.555	0.761
0.200	0.257	0.316	0.376	0.439	0.504	0.570	0.747
0.247	0.267	0.295	0.332	0.377	0.431	0.494	0.652
0.169	0.218	0.274	0.337	0.407	0.484	0.568	0.799
0.260	0.270	0.292	0.328	0.375	0.436	0.508	0.690
0.156	0.207	0.268	0.338	0.416	0.504	0.600	0.816
0.189	0.224	0.262	0.329	0.353	0.406	0.461	0.699
0.204	0.223	0.270	0.333	0.398	0.493	0.584	0.837
0.205	0.233	0.241	0.286	0.354	0.410	0.510	0.620
0.185	0.226	0.249	0.316	0.353	0.410	0.468	0.655
0.205	0.236	0.250	0.300	0.375	0.457	0.483	0.615
0.000	0.259	0.270	0.307	0.337	0.429	0.437	0.623
0.232	0.233	0.271	0.334	0.396	0.439	0.571	0.764
0.228	0.271	0.267	0.308	0.386	0.476	0.518	0.673
0.000	0.235	0.289	0.335	0.383	0.458	0.567	0.678
0.214	0.239	0.258	0.297	0.347	0.416	0.543	0.571
0.235	0.245	0.265	0.292	0.322	0.394	0.441	0.632
0.200	0.256	0.265	0.282	0.321	0.378	0.425	0.568
0.000	0.280	0.266	0.281	0.320	0.371	0.416	0.481
0.246	0.228	0.257	0.281	0.311	0.364	0.431	0.553
0.000	0.257	0.256	0.265	0.305	0.330	0.395	0.482
0.000	0.260	0.265	0.282	0.301	0.356	0.392	0.492
0.236	0.251	0.257	0.283	0.298	0.354	0.404	0.513
0.117	0.259	0.254	0.281	0.299	0.318	0.345	0.430
0.249	0.245	0.249	0.267	0.297	0.330	0.386	0.417
0.181	0.250	0.282	0.300	0.336	0.373	0.457	0.492
NA	0.183	0.264	0.287	0.299	0.340	0.403	0.617
0.113	0.149	0.229	0.318	0.422	0.362	0.433	0.660
0.166	0.222	0.273	0.345	0.370	0.405	0.442	0. 505
0.000	0.292	0.327	0.353	0.345	0.398	0.399	0.465
0.108	0.251	0.270	0.283	0.288	0.350	0.379	0.509
0.107	0.130	0.190	0.280	0.331	0.360	0.363	0.390
0	0.253	0.281	0.295	0.299	0.342	0.343	0.388
0.072	0.211	0.247	0.285	0.306	0.351	0.362	0.429
0.200	0.234	0.245	0.258	0.272	0.274	0.296	0.355

Table 22.7. Irish Sea plaice: Discards weight-at-age 1 to 8+ (kg), where rows are years 1981–2023 and columns are ages 1 to 8+.

IRISH SEA PLAICE

1 23

1981 2023

1 8

1

0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.087	0.105	0.130	0.153	0.170	0.231	0.318	0.211
0.057	0.115	0.145	0.164	0.211	0.290	0.238	0.210
0.099	0.117	0.134	0.179	0.178	0.277	0.644	0.356
0.141	0.113	0.141	0.145	0.162	0.210	0.274	0.077
0.044	0.081	0.113	0.140	0.150	0.205	0.219	0.243
0.096	0.097	0.116	0.135	0.151	0.173	0.217	0.170
0.033	0.080	0.119	0.147	0.165	0.196	0.232	0.276
0.083	0.101	0.138	0.183	0.201	0.140	0.194	0.225
0.077	0.098	0.116	0.141	0.157	0.168	0.164	0.176
0.026	0.038	0.081	0.119	0.162	0.200	0.157	0.182
0.064	0.069	0.094	0.116	0.144	0.157	0.181	0.181
0.056	0.067	0.084	0.120	0.128	0.150	0.152	0.153
0.088	0.059	0.079	0.101	0.095	0.126	0.152	0.136
0.136	0.103	0.109	0.120	0.146	0.161	0.155	0.170
0.093	0. 080	0. 118	0. 124	0. 128	0. 153	0. 137	0. 157
0.022	0.053	0.075	0.109	0.142	0.143	0.146	0.202
0.054	0.062	0.082	0.104	0.127	0.136	0.167	0.149
0.513	0.081	0.103	0.121	0.133	0.150	0.157	0.151
0.040	0.095	0.121	0.1387	0.167	0.172	0.204	0.258
0.048	0.079	0.102	0.121	0.143	0.153	0.176	0.186
0.067	0.091	0.113	0.132	0.139	0.140	0.137	0.126

Table 22.8. Irish Sea plaice: New stock weights-at-age modified to include discard element (kg), where rows are years 1981–2023 and columns are ages 1 to 8+.

IRISH SEA PLAICE

1 4

1981 2023

1 8

1

0.087	0.124	0.190	0.351	0.509	0.592	0.678	1.085
0.091	0.141	0.210	0.327	0.418	0.545	0.650	0.889
0.097	0.173	0.231	0.303	0.366	0.426	0.484	0.699
0.100	0.196	0.275	0.362	0.467	0.560	0.660	0.964
0.089	0.203	0.293	0.374	0.468	0.540	0.630	0.851
0.098	0.171	0.292	0.401	0.497	0.540	0.630	0.980
0.102	0.208	0.266	0.353	0.437	0.519	0.610	0.916
0.104	0.171	0.250	0.351	0.456	0.549	0.680	1.243
0.100	0.183	0.261	0.352	0.425	0.490	0.555	0.761
0.090	0.172	0.253	0.349	0.431	0.502	0.570	0.747
0.140	0.165	0.230	0.305	0.369	0.429	0.494	0.652
0.106	0.159	0.209	0.302	0.395	0.481	0.568	0.799
0.097	0.141	0.209	0.291	0.363	0.434	0.508	0.690
0.101	0.134	0.193	0.299	0.400	0.501	0.600	0.816
0.091	0.138	0.184	0.289	0.340	0.404	0.461	0.699
0.091	0.130	0.181	0.286	0.377	0.488	0.583	0.837
0.091	0.118	0.168	0.247	0.335	0.406	0.509	0.620
0.088	0.116	0.148	0.223	0.305	0.399	0.466	0.655
0.100	0.125	0.150	0.216	0.321	0.444	0.480	0.615
NA	0.121	0.157	0.222	0.300	0.420	0.436	0.623
0.091	0.119	0.161	0.239	0.352	0.431	0.569	0.764
0.088	0.114	0.161	0.228	0.347	0.467	0.517	0.673
NA	0.115	0.165	0.234	0.335	0.448	0.566	0.678
0.070	0.131	0.169	0.217	0.304	0.407	0.540	0.570
0.103	0.127	0.161	0.238	0.234	0.377	0.454	0.602
0.141	0.122	0.162	0.175	0.256	0.323	0.417	0.564
0.044	0.084	0.123	0.167	0.209	0.290	0.335	0.377
0.096	0.100	0.131	0.168	0.204	0.279	0.397	0.285
0.033	0.081	0.125	0.173	0.213	0.266	0.333	0.413
0.083	0.101	0.140	0.191	0.211	0.190	0.226	0.290
0.078	0.104	0.137	0.182	0.221	0.271	0.334	0.364
0.026	0.038	0.088	0.142	0.199	0.246	0.232	0.294
0.065	0.071	0.098	0.133	0.185	0.240	0.292	0.363
0.056	0.068	0.089	0.135	0.153	0.194	0.214	0.296
0.088	0.060	0.083	0.115	0.130	0.163	0.269	0.515
0.133	0.105	0.117	0.152	0.240	0.259	0.307	0.522
0. 093	0. 081	0. 121	0. 145	0. 163	0.198	0.223	0. 303
0.022	0.054	0.098	0.138	0.199	0.253	0.269	0.39
0.054	0.062	0.088	0.127	0.180	0.218	0.304	0.427
0.063	0.084	0.106	0.151	0.198	0.240	0.269	0.298
0.040	0.1	0.131	0.170	0.227	0.236	0.289	0.381
0.048	0.080	0.105	0.138	0.168	0.191	0.212	0.311
0.069	0.095	0.125	0.149	0.177	0.183	0.202	0.210

Table 22.9. Irish Sea plaice: Estimated landed numbers-at-age (thousands).

year\age	1	2	3	4	5	6	7	8	total
1981	22	1742	5939	2984	837	222	105	236	12087
1982	27	715	3288	3082	1358	330	137	213	9150
1983	51	2924	2494	3211	1521	648	211	252	11312
1984	41	3159	5179	1182	1054	459	299	252	11625
1985	4	2357	6152	3301	614	429	262	340	13459
1986	31	1652	5280	2942	1287	344	371	308	12215
1987	62	3717	5317	5252	1341	1072	123	338	17222
1988	46	2923	5040	2552	1400	750	316	405	13432
1989	24	1735	5945	2671	854	436	214	364	12243
1990	15	1019	2715	2935	1132	465	259	223	8763
1991	180	2008	1506	1929	1205	465	182	226	7701
1992	151	1958	3209	1435	1358	903	388	294	9696
1993	28	910	1649	1357	474	556	377	302	5653
1994	97	1146	2173	1309	644	318	245	263	6195
1995	21	961	1703	1936	764	318	138	157	5998
1996	37	856	1345	1196	943	370	128	135	5011
1997	28	830	1590	1513	1003	482	285	257	5988
1998	6	691	1739	1025	612	476	403	385	5336
1999	68	803	1505	1294	696	280	196	242	5083
2000	0	450	1174	1284	686	212	219	203	4228
2001	14	374	1138	1083	767	409	178	166	4130
2002	1	206	940	1482	842	539	318	170	4497
2003	0	286	1031	1314	707	415	253	222	4227
2004	8	198	967	1104	705	247	114	186	3529
2005	6	228	708	1177	890	461	204	213	3888
2006	5	180	620	550	684	346	220	218	2823
2007	0	64	351	860	507	401	151	164	2497
2008	1	99	386	389	409	215	141	119	1757
2009	0	13	204	374	351	272	117	120	1451
2010	0	7	75	271	306	193	160	115	1127
2011	2	53	199	357	483	305	194	191	1785
2012	0	8	150	292	301	367	218	226	1561
2013	1	16	87	203	166	149	144	165	931
2014	3	6	65	165	160	143	70	158	772
2015	0	1	43	93	185	210	149	349	1030
2016	14	14	58	162	224	346	180	482	1479
2017	0	4	24	145	206	241	209	519	1348
2018	0	6	84	109	201	178	151	358	1087
2019	0	11	53	145	273	219	187	356	1245

year\age	1	2	3	4	5	6	7	8	total
2020	2	17	24	118	192	168	150	287	959
2021	0	30	80	146	154	106	127	199	842
2022	0	6	21	81	91	89	76	147	512
2023	2	26	82	117	101	93	62	78	561

Table 22.10. Irish Sea plaice: Estimated discarded numbers-at-age (thousands). All discards are included (dead and alive portions).

year\age	1	2	3	4	5	6	7	8	total
1981	451	4589	7613	377	7	0	0	0	13037
1982	765	2570	3062	375	14	0	0	0	6786
1983	724	3771	1457	346	18	1	0	0	6316
1984	532	3218	1970	102	11	1	0	0	5834
1985	508	2572	1781	232	5	1	0	0	5098
1986	495	2707	1572	228	12	1	0	0	5015
1987	668	2962	1917	446	14	2	0	0	6010
1988	360	3903	2081	249	21	2	0	0	6615
1989	240	1987	2710	290	17	2	0	0	5246
1990	604	1278	1398	403	34	3	0	0	3719
1991	364	3363	980	348	50	4	0	0	5109
1992	528	2124	2661	342	75	9	1	0	5740
1993	460	3187	1726	358	29	6	1	0	5767
1994	406	2849	2606	353	45	4	0	0	6265
1995	507	2502	2423	561	59	4	0	0	6057
1996	1205	3086	2329	417	94	7	0	0	7138
1997	935	7406	3079	619	116	11	1	0	12166
1998	686	6642	9665	1364	215	31	6	0	18609
1999	582	4459	7451	1734	247	18	4	0	14495
2000	0	3763	4922	1558	193	10	3	0	10449
2001	513	2934	4078	1201	186	16	1	0	8931
2002	490	3399	3168	1558	188	21	1	0	8825
2003	0	3281	3685	1623	204	19	1	0	8813
2004	85	1381	3570	1679	324	19	1	0	7059

year\age	1	2	3	4	5	6	7	8	total
2005	198	2844	2793	1096	1392	78	14	26	8441
2006	854	2775	2964	1968	479	170	12	2	9224
2007	837	4704	4892	3568	947	381	104	127	15560
2008	831	4393	3188	1354	837	171	27	278	11079
2009	56	2862	4318	1318	677	251	71	60	9613
2010	980	4066	4113	3254	2853	638	836	359	17099
2011	540	1344	1134	888	589	245	79	151	4970
2012	219	4415	3492	1755	800	567	329	274	11851
2013	238	1610	3066	1633	450	163	122	49	7331
2014	1027	1886	2710	1843	1149	591	274	218	9697
2015	18	1348	1659	1104	896	997	170	93	6285
2016	101	300	858	831	430	364	149	189	3222
2017	45	529	1057	1376	1198	1118	530	723	6576
2018	321	1464	823	814	524	235	159	143	4482
2019	167	2147	1729	990	549	352	103	105	6142
2020	9	289	511	501	395	227	128	177	2237
2021	186	951	1112	577	184	175	82	10	3278
2022	208	1017	959	709	486	380	319	138	4217
2023	127	987	857	733	246	194	89	135	3368

Table 22.11. Irish Sea plaice: Estimated population numbers-at-age (thousands).

year\age	1	2	3	4	5	6	7	8	total
1981	17134	19755	17881	7228	2021	692	330	766	65808
1982	22045	12723	13191	7773	3291	1011	394	661	61089
1983	23433	20362	7904	6404	3343	1671	571	647	64336
1984	22541	21040	14262	3366	2758	1502	890	707	67067
1985	21008	20127	14603	7269	1550	1428	815	947	67748
1986	21296	17664	14697	7025	3503	789	842	1005	66819
1987	20551	19477	12272	7586	3140	1841	403	1053	66323
1988	15697	19957	13096	5349	2982	1411	878	823	60194
1989	12948	13443	14566	5987	2184	1292	652	893	51966
1990	15893	9387	9149	7475	2760	1080	679	800	47223
1991	16326	14430	5588	4587	3689	1387	562	797	47366
1992	17647	12835	9720	2464	2139	2076	775	763	48419
1993	16044	16435	7653	4254	845	886	1153	796	48066
1994	15304	12328	11739	3534	1685	513	454	988	46544
1995	17949	10742	7552	5577	1533	815	296	744	45208
1996	21853	13433	6668	3455	2958	960	429	638	50394
1997	22492	17530	9810	3902	2125	1920	726	759	59264
1998	19745	20631	11975	4836	2288	1299	1155	1013	62943
1999	19026	16950	15447	6521	2683	1374	925	1306	64232
2000	24230	14553	11793	9520	3810	1512	1084	1444	67945
2001	24342	18602	10483	6980	5965	2085	1005	1653	71115
2002	24998	20803	15144	7349	4979	4465	1601	1816	81155
2003	22561	22550	16847	11531	4726	3630	3152	2434	87432
2004	21139	17861	18054	12034	7841	2707	2400	3395	85431
2005	18044	18591	13140	11199	7783	4958	1860	3629	79204
2006	22610	15082	14734	8777	6639	4518	3012	3384	78756
2007	26504	18551	12003	10733	5729	3890	3165	3980	84555
2008	21484	23247	13129	8540	7648	3564	2274	4661	84548
2009	17860	16478	18695	9142	6522	6313	2578	4695	82283

year\age	1	2	3	4	5	6	7	8	total
2010	23486	16169	12899	13442	7587	5487	5404	5569	90043
2011	27016	17408	11481	8323	9501	5630	4062	7706	91128
2012	24052	24921	14052	9561	6157	7239	4640	8843	99464
2013	23630	20467	19776	12141	8425	5377	5893	9536	105246
2014	27947	22145	17868	15617	10312	7526	5196	11717	118327
2015	17329	23965	17873	14144	11801	9258	5973	13786	114129
2016	14092	15600	19178	16128	12231	10411	8552	16015	112206
2017	10110	13433	13649	15489	14440	10203	8763	18706	104792
2018	12046	11034	11599	10981	11872	11504	8560	17729	95325
2019	10985	12380	10456	9606	9100	9673	9615	16670	88485
2020	8425	8805	8077	7382	7101	6619	7646	17189	71244
2021	10000	8159	7905	5692	5322	5089	4739	14016	60923
2022	12748	8940	6240	6021	3926	4223	3953	11732	57783
2023	11910	10973	6792	4432	3980	2910	3179	10772	54947

Table 22.12. Irish Sea plaice: Estimated fishing mortality-at-age.

year\age	1	2	3	4	5	6	7	8	F_{bar} (3-6)
1981	0.020	0.27	0.64	0.68	0.57	0.48	0.42	0.42	0.59
1982	0.020	0.27	0.62	0.67	0.57	0.48	0.42	0.42	0.59
1983	0.021	0.28	0.67	0.72	0.62	0.53	0.46	0.46	0.63
1984	0.0189	0.25	0.59	0.64	0.56	0.48	0.42	0.42	0.57
1985	0.0184	0.24	0.57	0.63	0.55	0.48	0.42	0.42	0.56
1986	0.0192	0.25	0.59	0.66	0.58	0.51	0.45	0.45	0.59
1987	0.023	0.30	0.70	0.78	0.68	0.60	0.52	0.52	0.69
1988	0.022	0.29	0.68	0.76	0.68	0.60	0.52	0.52	0.68
1989	0.020	0.26	0.60	0.67	0.59	0.53	0.46	0.46	0.60
1990	0.021	0.27	0.59	0.66	0.58	0.52	0.45	0.45	0.59
1991	0.022	0.28	0.61	0.67	0.59	0.51	0.44	0.44	0.59
1992	0.027	0.33	0.73	0.81	0.72	0.63	0.54	0.54	0.72
1993	0.024	0.30	0.64	0.71	0.65	0.56	0.48	0.48	0.64
1994	0.025	0.30	0.64	0.70	0.63	0.54	0.46	0.46	0.63
1995	0.025	0.29	0.61	0.64	0.57	0.48	0.41	0.41	0.58
1996	0.024	0.29	0.58	0.59	0.51	0.42	0.36	0.36	0.52
1997	0.025	0.29	0.57	0.58	0.49	0.41	0.34	0.34	0.51
1998	0.025	0.28	0.56	0.56	0.47	0.39	0.32	0.32	0.50
1999	0.0199	0.23	0.44	0.44	0.36	0.29	0.24	0.24	0.38
2000	0.0167	0.189	0.37	0.36	0.30	0.24	0.189	0.189	0.32
2001	0.0145	0.163	0.32	0.32	0.26	0.21	0.159	0.159	0.27
2002	0.0123	0.137	0.27	0.27	0.22	0.173	0.130	0.130	0.23
2003	0.0102	0.113	0.22	0.22	0.180	0.139	0.101	0.101	0.189
2004	0.0079	0.086	0.165	0.167	0.137	0.105	0.074	0.074	0.143
2005	0.0108	0.116	0.21	0.22	0.176	0.132	0.090	0.090	0.185
2006	0.0130	0.135	0.24	0.24	0.189	0.140	0.092	0.092	0.20
2007	0.0149	0.153	0.27	0.26	0.21	0.150	0.097	0.097	0.22
2008	0.0122	0.122	0.21	0.20	0.161	0.119	0.076	0.076	0.172
2009	0.0090	0.090	0.153	0.149	0.122	0.091	0.058	0.058	0.129

year\age	1	2	3	4	5	6	7	8	F_{bar} (3-6)
2010	0.0131	0.129	0.22	0.21	0.175	0.132	0.083	0.083	0.184
2011	0.0089	0.085	0.141	0.140	0.117	0.090	0.057	0.057	0.122
2012	0.0089	0.085	0.141	0.141	0.119	0.094	0.059	0.059	0.124
2013	0.0062	0.058	0.095	0.094	0.080	0.065	0.040	0.040	0.083
2014	0.0063	0.058	0.095	0.097	0.084	0.070	0.043	0.043	0.086
2015	0.0039	0.037	0.061	0.064	0.059	0.051	0.032	0.032	0.059
2016	0.0036	0.033	0.054	0.057	0.052	0.046	0.030	0.030	0.052
2017	0.0047	0.042	0.068	0.071	0.065	0.056	0.036	0.036	0.065
2018	0.0055	0.049	0.075	0.076	0.065	0.054	0.033	0.033	0.068
2019	0.0062	0.055	0.084	0.084	0.071	0.058	0.034	0.034	0.074
2020	0.0044	0.040	0.061	0.062	0.053	0.043	0.025	0.025	0.055
2021	0.0066	0.058	0.089	0.088	0.072	0.057	0.032	0.032	0.077
2022	0.0081	0.072	0.110	0.109	0.089	0.070	0.039	0.039	0.094
2023	0.0074	0.066	0.101	0.100	0.081	0.063	0.034	0.034	0.086

Table 22.13. Irish Sea plaice: SAM stock assessment summary ('High' and 'Low' refer to approximate 95% confidence intervals). Recruitment (000s), spawning–stock biomass (SSB, tonnes), mean fishing mortality (F_{bar}) for ages 3–6, total stock biomass (TSB, tonnes) and dead catch tonnage (the sum of landings and 60% of discards).

Year	Recruitment (thousands)			SSB (t)			F_{bar} (3–6)			TSB (t)			Dead catch (t)		
	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
1981	11328	17134	25917	5634	7091	8924	0.45	0.59	0.78	10440	12894	15924	3187	4393	6056
1982	15391	22045	31574	5488	6806	8442	0.45	0.59	0.76	10284	12473	15128	3096	4057	5316
1983	16493	23433	33292	5001	6105	7454	0.49	0.63	0.82	10639	12937	15732	3039	3899	5001
1984	15963	22541	31831	6296	7718	9462	0.44	0.57	0.73	12981	15853	19359	3528	4563	5903
1985	14921	21008	29578	6918	8488	10413	0.43	0.56	0.72	13599	16587	20232	3892	5055	6565
1986	15112	21296	30009	7411	9084	11136	0.46	0.59	0.75	13828	16720	20215	4173	5399	6985
1987	14526	20551	29074	7002	8513	10349	0.54	0.69	0.88	13658	16483	19892	4433	5696	7318
1988	11150	15697	22099	6544	7982	9737	0.53	0.68	0.87	12226	14735	17759	4027	5148	6581
1989	8995	12948	18638	5805	7121	8735	0.46	0.6	0.77	10682	12973	15755	3352	4356	5660
1990	11354	15893	22246	5278	6479	7954	0.46	0.59	0.75	9259	11158	13447	2907	3752	4844
1991	11740	16326	22703	4249	5172	6295	0.47	0.59	0.76	9044	10880	13088	2366	3004	3815
1992	12828	17647	24276	4278	5205	6333	0.57	0.72	0.91	8424	10109	12130	2687	3404	4313
1993	12065	16044	21334	3597	4390	5357	0.5	0.64	0.82	7602	9133	10971	2209	2792	3528
1994	11474	15304	20412	3742	4625	5718	0.49	0.63	0.8	7472	9022	10894	2288	2896	3667
1995	13487	17949	23886	3214	3984	4937	0.45	0.58	0.74	6651	8035	9706	1888	2389	3022
1996	16372	21853	29169	3441	4299	5370	0.41	0.52	0.68	7178	8703	10552	1825	2287	2865

Year	Recruitment (thousands)			SSB (t)			F_{bar} (3–6)			TSB (t)			Dead catch (t)		
	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
1997	16877	22492	29974	3684	4588	5714	0.4	0.51	0.66	7766	9420	11426	1966	2467	3097
1998	14827	19745	26295	3955	4961	6224	0.38	0.5	0.65	8044	9802	11944	2074	2612	3288
1999	14190	19026	25509	4575	5800	7353	0.29	0.38	0.51	9035	11091	13614	1972	2485	3132
2000	17790	24230	33000	5011	6421	8226	0.23	0.32	0.43	9302	11522	14271	1749	2226	2832
2001	18097	24342	32741	5953	7740	10064	0.199	0.27	0.38	10581	13232	16546	1741	2192	2760
2002	18495	24998	33787	7074	9280	12173	0.168	0.23	0.32	11957	15112	19100	1756	2202	2761
2003	16533	22561	30789	8444	11206	14870	0.134	0.189	0.27	13619	17448	22354	1717	2177	2760
2004	15572	21139	28697	8414	11193	14889	0.1	0.143	0.21	13199	17011	21925	1329	1701	2178
2005	13308	18044	24464	8105	10756	14273	0.131	0.185	0.26	12816	16381	20937	1559	1973	2496
2006	16800	22610	30428	7168	9544	12709	0.144	0.2	0.28	12473	15853	20149	1477	1859	2341
2007	19445	26504	36126	5912	7882	10509	0.157	0.22	0.31	8972	11516	14781	1277	1613	2039
2008	15954	21484	28932	5934	7892	10495	0.123	0.172	0.24	10270	13068	16627	1111	1395	1752
2009	13067	17860	24411	6752	9069	12180	0.091	0.129	0.182	9425	12258	15942	881	1124	1434
2010	17383	23486	31732	6916	9145	12093	0.13	0.184	0.26	10928	13924	17741	1273	1636	2103
2011	19873	27016	36727	8075	10963	14884	0.087	0.122	0.172	12160	15812	20560	942	1185	1492
2012	17788	24052	32521	6766	9247	12638	0.088	0.124	0.174	8784	11639	15422	750	945	1189
2013	17464	23630	31974	8226	11260	15413	0.059	0.083	0.118	11674	15359	20207	648	815	1027

Year	Recruitment (thousands)			SSB (t)			F_{bar} (3–6)			TSB (t)			Dead catch (t)		
	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
2014	19954	27947	39141	8358	11394	15533	0.061	0.086	0.122	11812	15523	20401	688	867	1092
2015	12634	17329	23769	10812	15194	21353	0.041	0.059	0.083	14065	19051	25805	549	698	887
2016	10390	14092	19113	15765	21801	30146	0.037	0.052	0.075	19994	26851	36058	736	931	1178
2017	7317	10110	13970	11966	16452	22620	0.046	0.065	0.092	14737	19765	26510	689	869	1097
2018	8833	12046	16428	12798	17773	24683	0.048	0.068	0.096	14383	19673	26908	680	860	1088
2019	8016	10985	15053	11744	16501	23184	0.052	0.074	0.106	13491	18573	25569	629	799	1014
2020	5841	8425	12152	9027	12643	17708	0.038	0.055	0.08	10668	14598	19978	372	478	615
2021	7341	10000	13623	7793	10947	15379	0.054	0.077	0.109	9382	12814	17501	457	577	730
2022	9200	12748	17663	5395	7665	10889	0.066	0.094	0.135	6884	9395	12823	388	493	626
2023	8140	11910	17427	4162	5850	8223	0.059	0.086	0.125	6082	8119	10838	318	408	523

Table 22.14 Short-term forecast. Annual catch options. Intermediate year assumptions.

Variable	Value	Notes
$F_{\text{ages 3–6}}$ (2024)	0.086	$F_{sq}=F_{\text{average (2021-2023)}}$
SSB (2025)	8134	Tonnes; Fishing at *status quo* (F_{sq}).
R_{age} 1 (2024 and 2025)	11910	Median resampled recruitment (2015–2023) as estimated by a stochastic projection; in thousands.
Total catch (2024)	674	Tonnes; Fishing at F_{sq} plus surviving discards.
Projected landings (2024)	217	Tonnes; Assuming average discard pattern (2021–2023).
Projected discards (2024)	457	Tonnes; Assuming average discard pattern (2021–2023).
Discard survival rate	40%	Catchpole *et al*. (2015).
Projected surviving discards (2024)	183	Tonnes; Assuming average discard pattern (2021–2023) where 40% of the discards survive.
Projected dead discards (2024)	274	Tonnes; Assuming average discard pattern (2021–2023) where 40% of the discards survive.

Table 22.15. Short-term forecast. Annual catch options. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected Surviving discards (2025)	Projected dead discards (2025)	Total projected discards* (2025)	F_{total} (2025)	$F_{\text{projected landings}}$ (2025)	$F_{\text{projected discards}}$** (2025)	SSB (2026)	% SSB change ***	% advice change^	Probability of SSB (2026) < Blim (%)
ICES advice basis												
MSY approach: $F=F_{MSY} \times SSB_{2025}$/MSY $B_{trigger}$	1504	485	408	612	1019	0.182	0.048	0.134	8237	1.27	-21	0
Other scenarios												
F_{MSY}	1610	519	436	655	1091	0.196	0.051	0.145	8167	0.41	-15.4	0
$F_{MSY\ lower} \times SSB_{2025}$/MSY $B_{trigger}$	1043	336	283	424	707	0.124	0.032	0.091	8539	5.0	-45	0
$F_{MSY\ upper} \times SSB_{2025}$/MSY $B_{trigger}$	2166	698	587	881	1468	0.27	0.071	0.20	7794	-4.2	13.9	0.6
$F= F_{MSY\ lower}$	1119	361	303	455	758	0.133	0.035	0.098	8486	4.3	-41	0
$F= F_{MSY\ upper}$	2312	745	627	940	1567	0.29	0.077	0.22	7678	-5.6	22	0.6
$F= F_{pa}$	3054	984	828	1242	2070	0.40	0.105	0.26	7130	-12.3	61	2.1
F = 0	0	0	0	0	0	0	0	0	9329	14.7	-100	0
$F = F_{lim}$	3625	1168	983	1474	2457	0.50	0.130	0.37	6723	-17.0	91	4.4
$SSB_{2026} = B_{lim}$	7560	2436	2050	3074	5124	1.41	0.37	1.04	3958	-51	297	50
$SSB_{2026} = B_{pa}$	5619	1811	1523	2285	3808	0.88	0.23	0.65	5294	-35	195	21.7
SSB_{2026} = MSY $B_{trigger}$	743	239	201	302	503	0.087	0.023	0.064	8757	7.7	-61	0
Rollover advice	1902	613	516	773	1289	0.24	0.062	0.174	7990	-1.77	0	0.1
$F = F_{2024}$	734	236	199	298	497	0.086	0.022	0.063	8765	7.8	-61	0
$SSB_{2026} = SSB_{2025}$	1676	540	454	682	1136	0.21	0.054	0.151	8134	0	-11.9	0

*** Dead + surviving projected discards.**

**** $F_{\text{projected discards}}$ concerns dead projected discards only.**

***** SSB 2026 relative to SSB 2025.**

^ Advice value for 2025 relative to the advice value for 2024 (1902 tonnes). TAC 2024 was equal to the advice value.

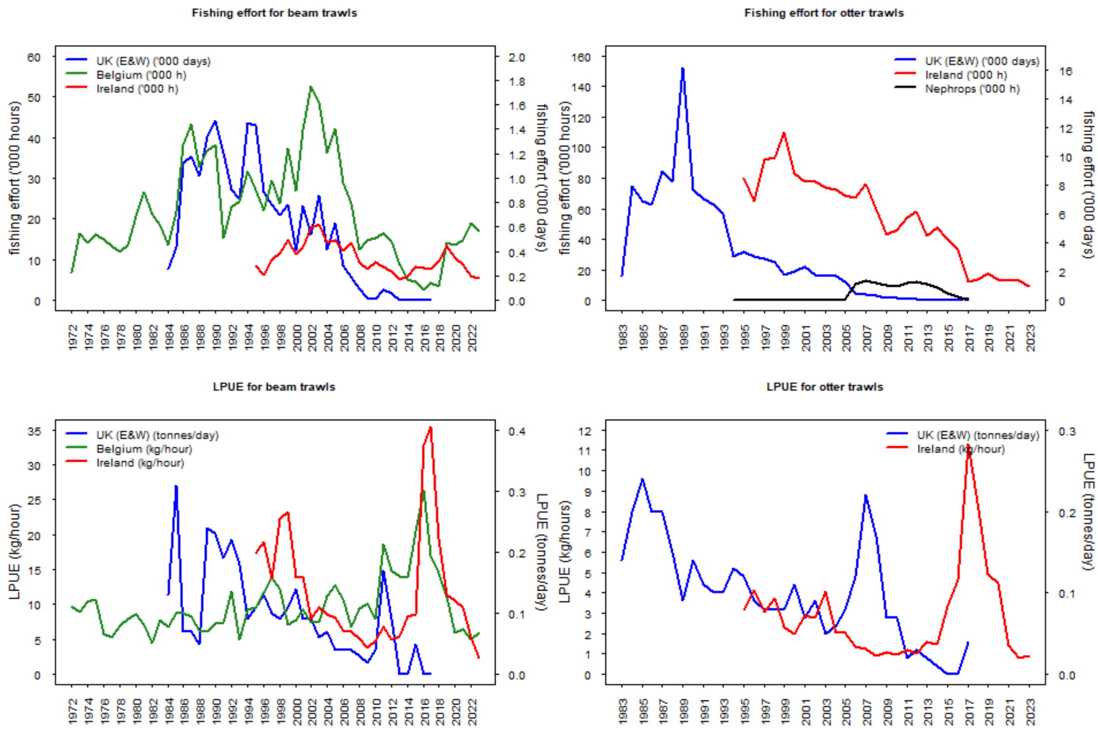


Figure 22.1. Irish Sea plaice: Effort and LPUE for commercial fleets from UK (E&W), Ireland and Belgium.

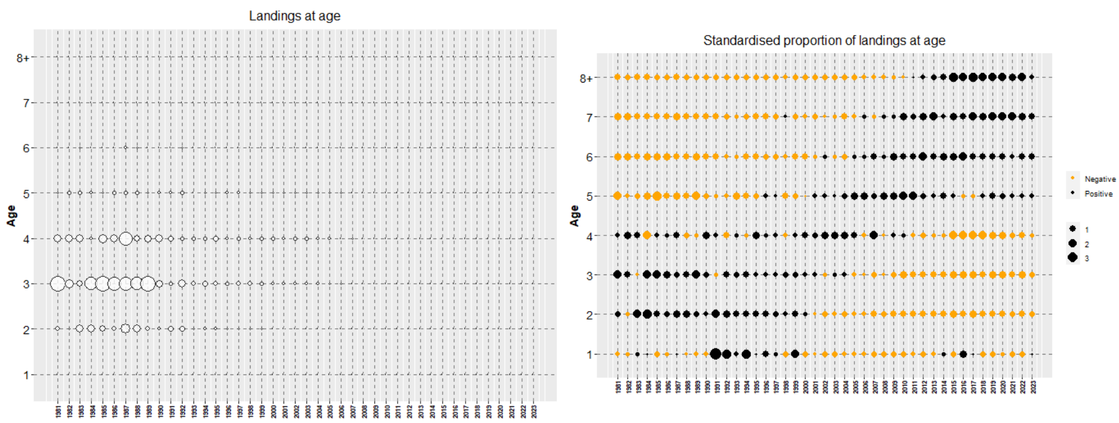


Figure 22.2a. Landings-at-age data (left) and mean standardised proportion-at-age (right, black bubbles are positive values and orange bubbles are negative). Mean standardised proportion-at-age = [(proportion-at-age in year) – mean (proportion-at-age over all years)] / STDEV(proportion-at-age over all years).

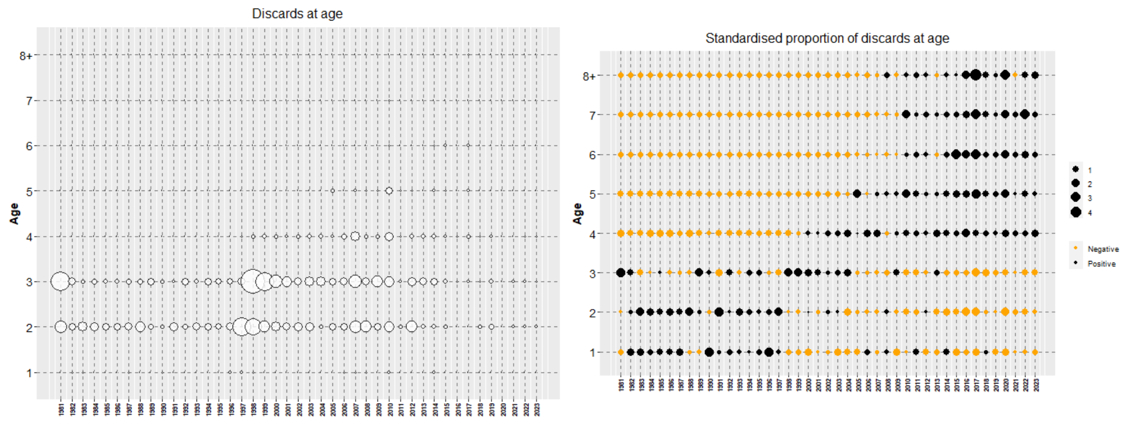


Figure 22.2b. Discards-at-age data (left) and mean standardised proportion-at-age (right, black bubbles are positive values and orange bubbles are negative). Mean standardised proportion-at-age = [(proportion-at-age in year) – mean (proportion-at-age over all years)] / STDEV(proportion-at-age over all years).

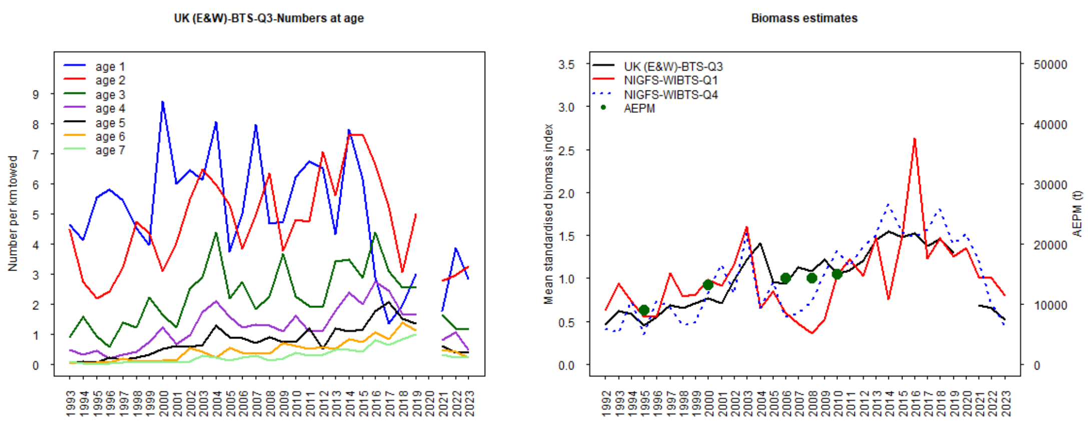


Figure 22.3. Left: UK(E&W)-BTS-Q3 (extended area) CPUE by age (circles in 2021 due to missing data in 2020). Right: standardised indices of SSB derived from NIGFS-WIBTS, biomass from UK(E&W)-BTS-Q3 (extended area) (black circle in 2021 due to missing data in 2020) and the SSB estimates from the Annual Egg Production Methods (circles, right).

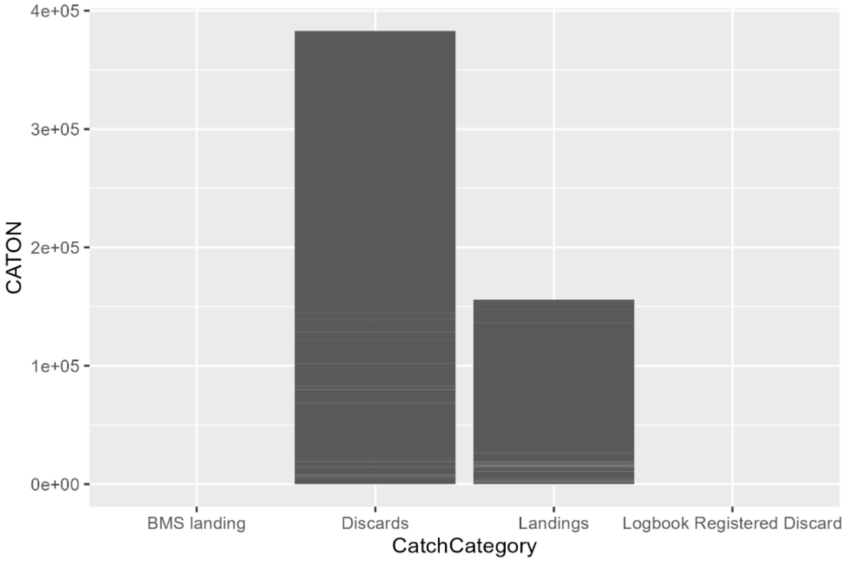


Figure 22.4. Make up of catch estimates from InterCatch.

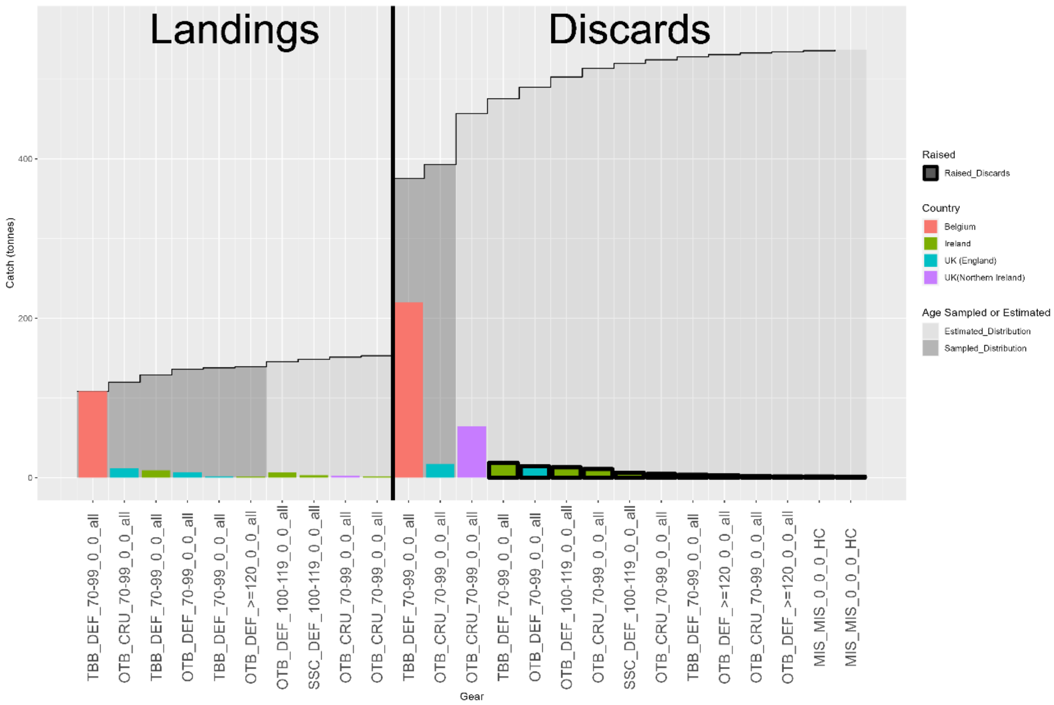


Figure 22.5. Catch sampling for landings (left) and discards (right) by country and gear type. Gears contributing less than 1 tonne are excluded for clarity.

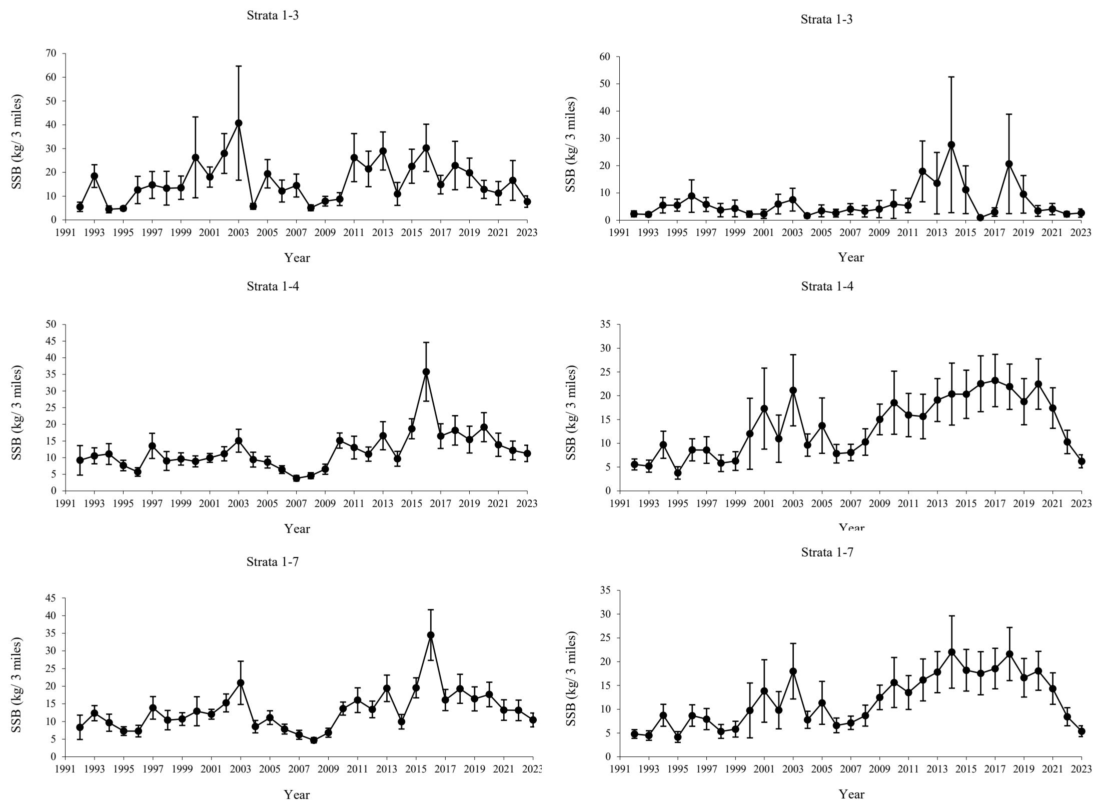


Figure 22.6. Northern Irish Groundfish Survey SSB indices split into spring (left hand panels) and autumn (right hand panels) sampling by western strata (1–3), eastern strata (4–7) and total survey area (strata 1–7) with confidence intervals (± 1 standard error, vertical lines).

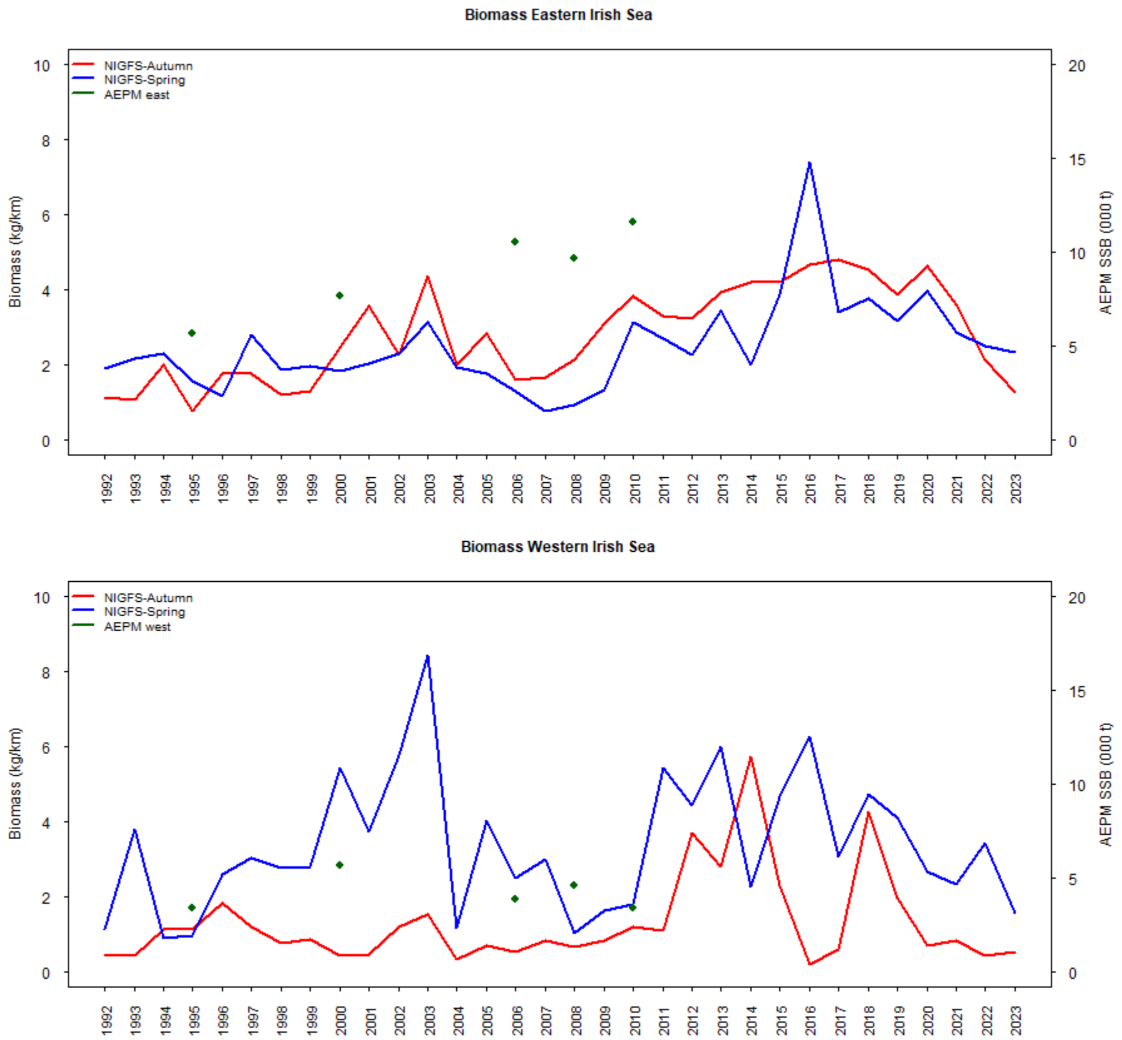


Figure 22.7. Trends in biomass indices (kg per km towed) the NIGFS-WIBTS-Q1 and -Q4 (blue and red lines respectively) in the eastern Irish Sea (top) and the western and southern Irish Sea (bottom). Also shown (green dots, right axis) are the estimates of SSB from the Annual Egg Production Method (AEPM) from Armstrong *et al*. (2001).

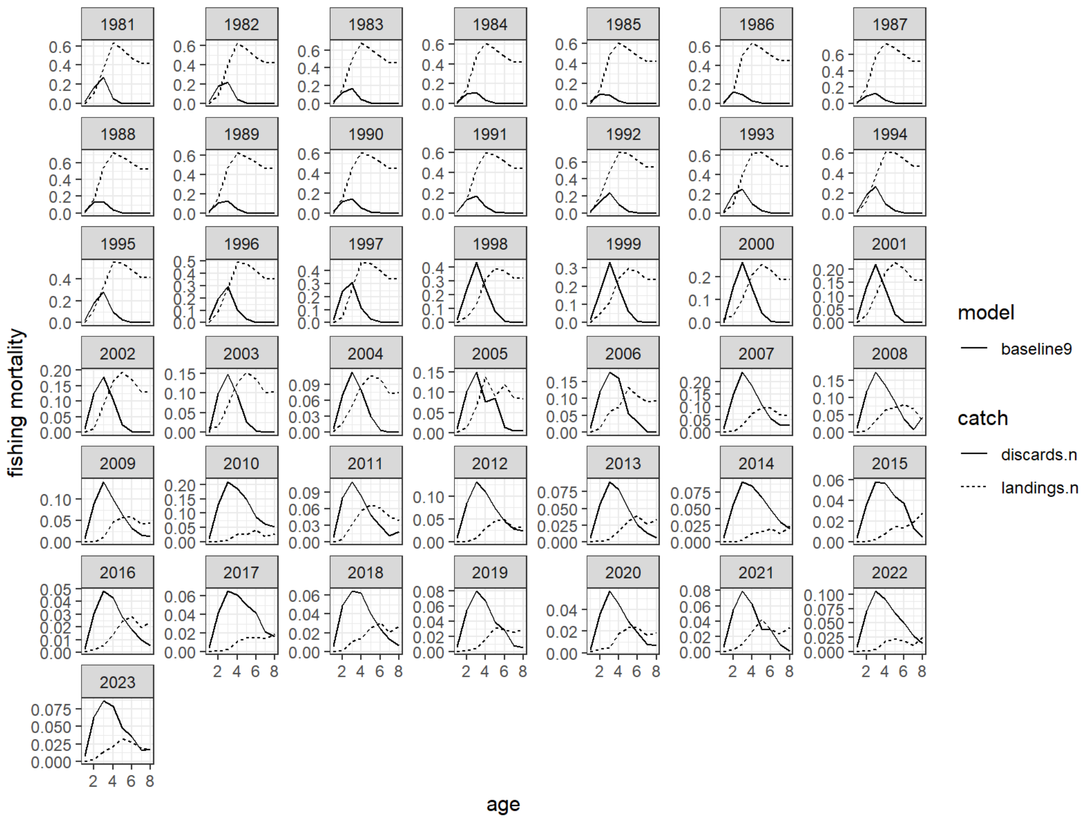


Figure 22.8. Selectivity of the fishery split into the landed (dashed) and discarded (solid) components as estimated by the SAM model, where the x-axis shows age and the y-axis gives the fishing mortality-at-age split by the proportion of fish (by number) discarded and landed at-age.

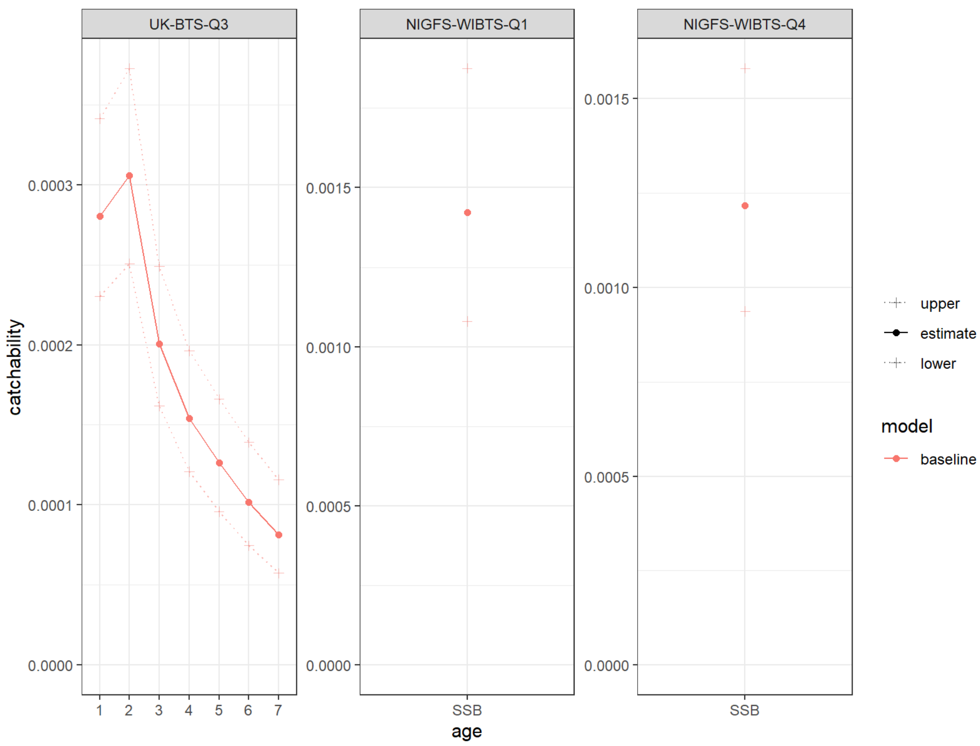


Figure 22.9. Catchability for the UK (E&W)-BTS-Q3 extended index by age, NIGFS-WIBTS-Q1 and NIGFS-WIBTS-Q4 as estimated by the SAM model.

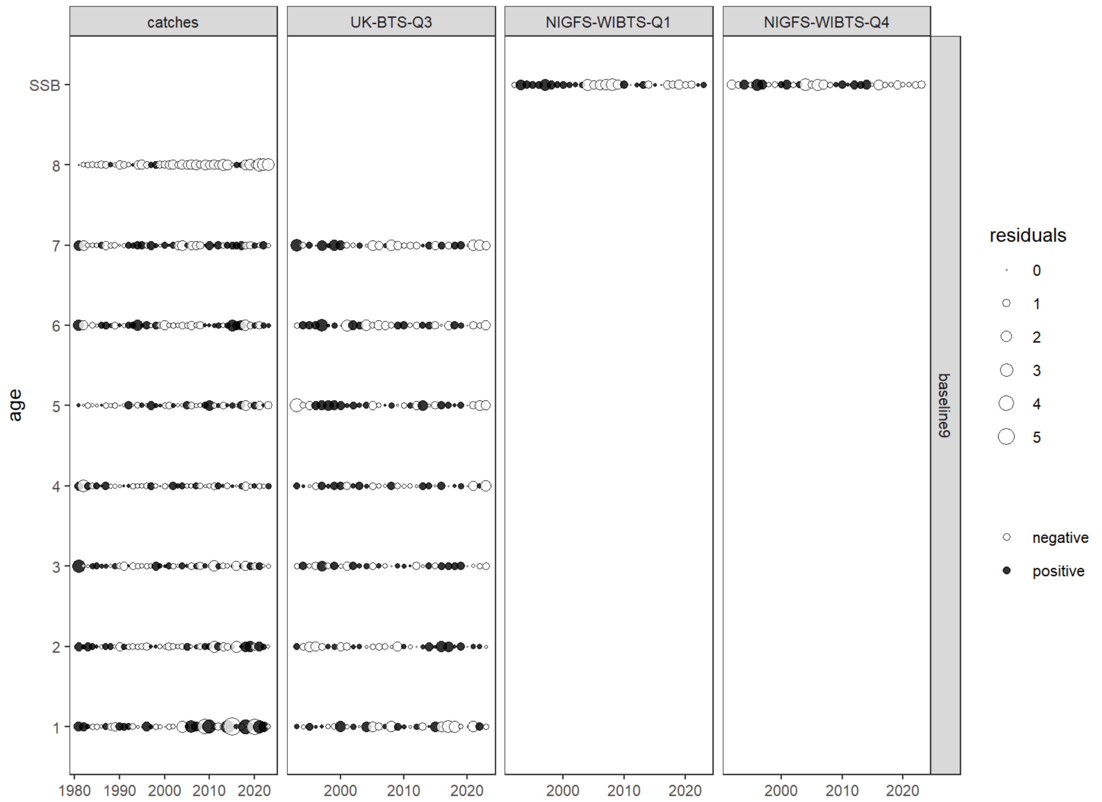


Figure 22.10. Residuals in fits to catch and survey data from the baseline model. Expected values were estimated by the SAM model.

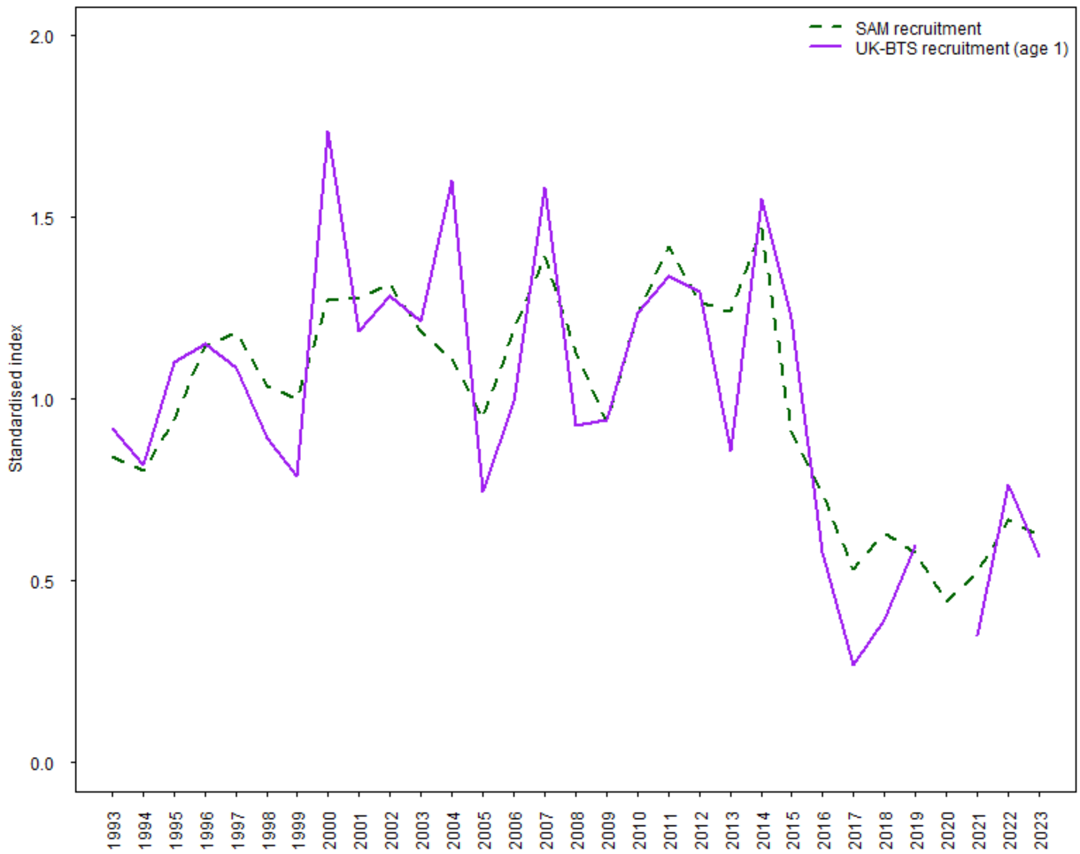


Figure 22.11. Comparison of the standardised age 1 index from the UK (E&W)-BTS-Q3 extended area (purple line) and the standardised recruitment (green dashed line) estimated by the SAM model.

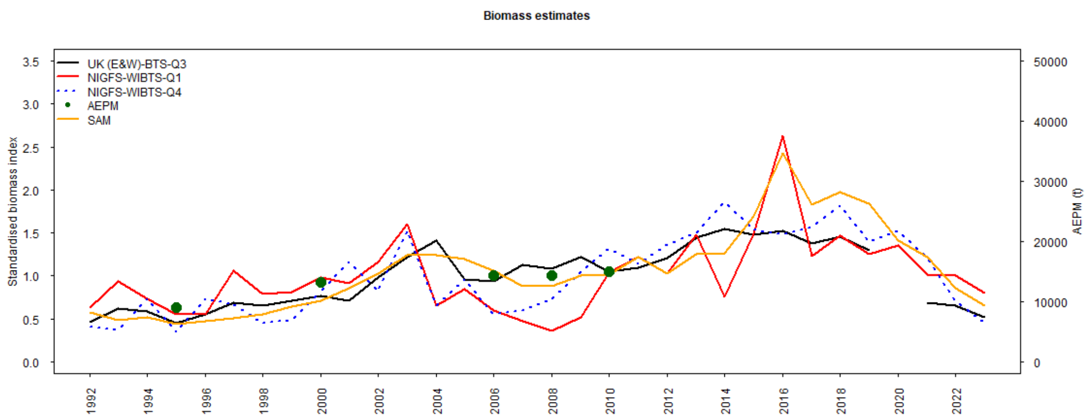


Figure 22.12. SAM model estimates of mean standardised SSB (orange line) overlaid with standardised NIGFS in spring (red) and autumn (blue dashed) relative SSB indices, standardised biomass (ages 1–4) from the UK(E&W)-BTS (black solid line) and AEPM SSB index (circles, right axis). Standardized: minus mean and divided by standard deviation.

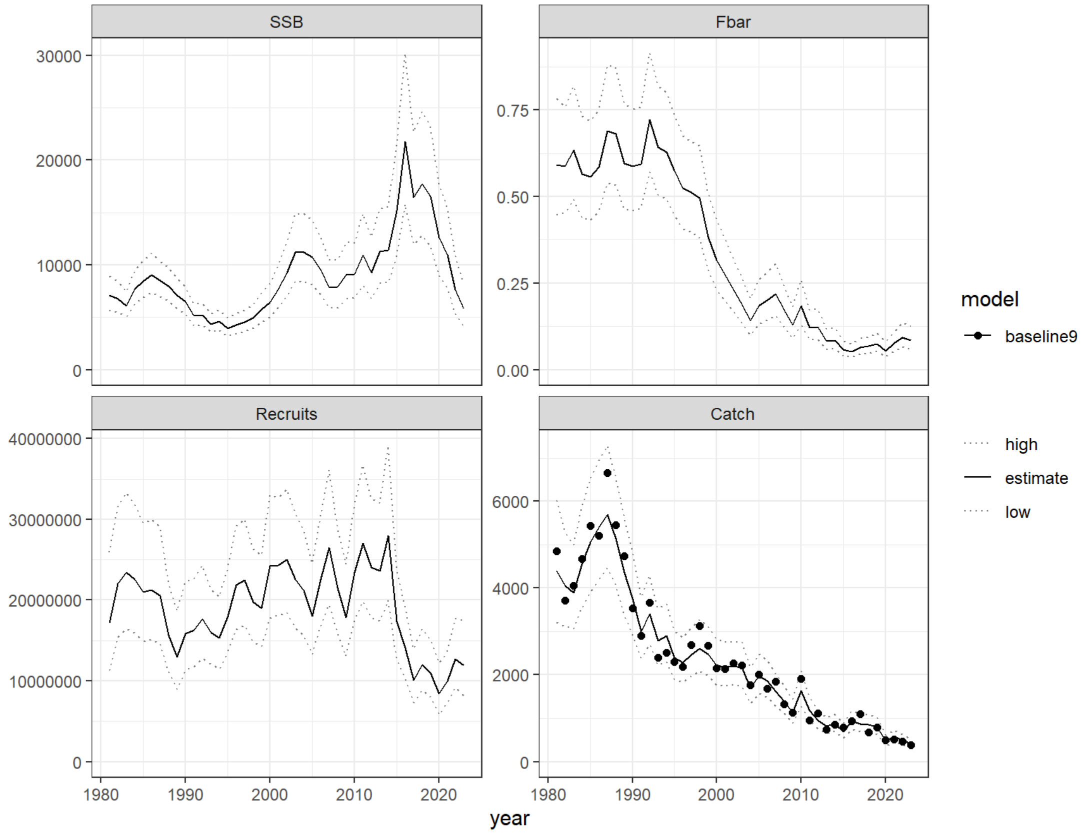


Figure 22.13. Modelled SSB (tonnes, top left), recruitment (thousands, bottom left), F_{bar} (ages 3–6, bottom right) catch tonnage (bottom right) using the SAM model. Error dashed lines indicate approximate 95% confidence intervals.

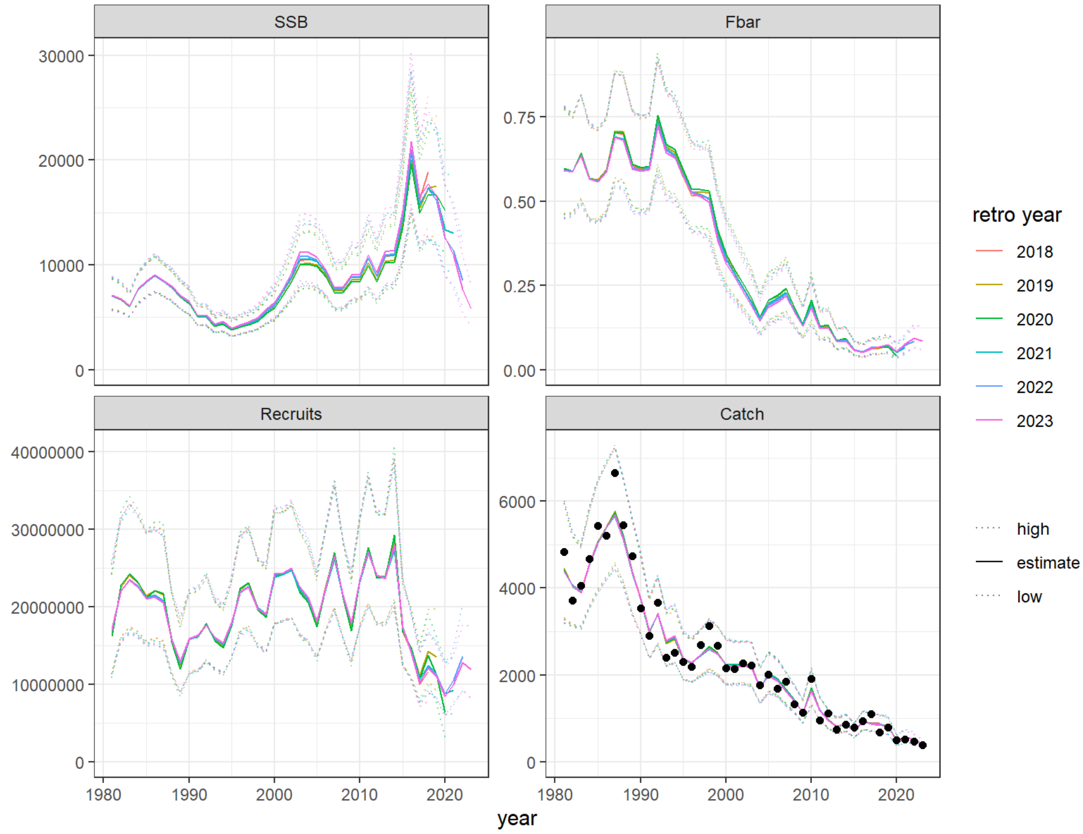


Figure 22.14. Retrospective assessments for years 2018–2023 from the baseline model. SSB (tonnes, top left), recruitment (thousands, bottom left), F_{bar} (ages 3–6, bottom right) catch tonnage (bottom right). Error dashed lines indicate approximate 95% confidence intervals.

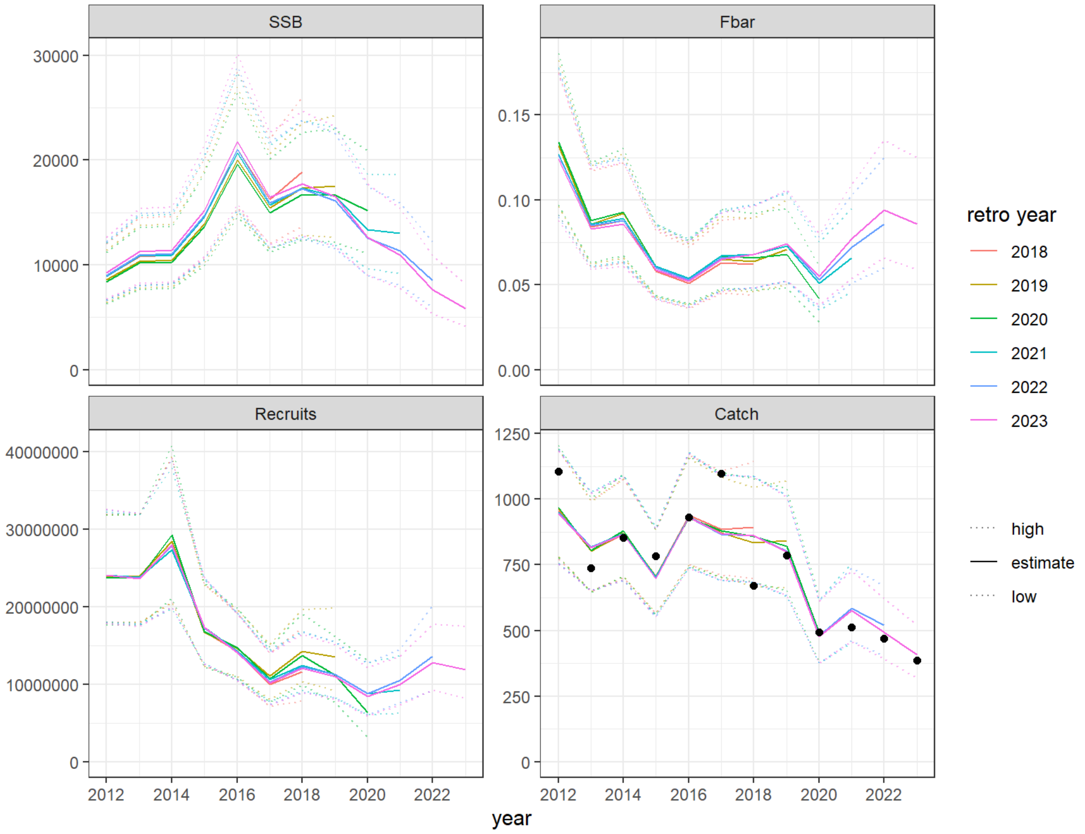


Figure 22.15. Retrospective assessments for years 2018–2023 from the baseline model, showing final years. SSB (tonnes, top left), recruitment (thousands, bottom left), F_{bar} (ages 3–6, bottom right) catch tonnage (bottom right). Error dashed lines indicate approximate 95% confidence intervals.

Contents

23 Plaice (*Pleuronectes platessa*) in Division 7.bc (West of Ireland)

Type of assessment in 2024

There is no assessment for this stock. Advice is provided on a triennial basis (and was provided last year for 2024, 2025 and 2026) according to the approach outlined below.

In 2023, the updated advice followed the agreed procedures for category 6 as set out in the stock annex. For stocks without information on abundance or exploitation, ICES considers that a precautionary reduction of catches should be implemented unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

23.1 General

Advice

The advice for 2021, 2022 and 2023 was for catches of no more than 15 tonnes (Table 32.1).

ICES framework for category 6 stocks was applied (ICES, 2012). For stocks without information on abundance or exploitation, ICES considers that a precautionary reduction of catches should be implemented where there is no ancillary information clearly indicating that the current level of exploitation is appropriate for the stock. The precautionary buffer was last applied in 2020 (for the 2021-2023 advice), and with no new information available to support the current level of catches the precautionary buffer was applied for the 2024 advice. Discarding patterns are unknown.

Table 23.1 Plaice in divisions 7.b and 7.c. The basis for the catch scenarios. *

Advised landings (2021-2023)	19 tonnes	
Discard rate	Unknown	
Precautionary buffer	Applied	0.8
Landings advice **	15 tonnes	
% advice change ***	-20	

*** The figures in the table are rounded. Calculations were done with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table.**

**** [Recent advised landings] × [precautionary buffer].**

***** Advice value for 2024 relative to the advice value for 2023.**

Stock Identity

Plaice in 7.b are mainly caught by Irish vessels on sandy grounds in coastal areas. Plaice catches in 7.c are negligible. There are two distinct areas in which plaice are caught by Irish vessels in 7.b: an area around Galway Bay and an area in the north of 7.b, which extends into 6.a (the Stags and Broadhaven Ground). During 1995–2000 a large proportion of the 7.bc plaice landings were taken from the Stags Grounds (Rectangles 37D8, 37D9, 37E0 and 37E1). The landings and lpue in this area have dropped sharply since 2000, in line with a general decrease of lpue in Division 6.a. Plaice in this area appear to be more linked with 6.a than populations further south. The landings and lpue on the Aran grounds appear to have been more or less stable since the start of the logbooks' time-series in 1995 (WD 1, WGCSE 2009). It is not known how much exchange there is between plaice on the Aran grounds and those on the Stags ground. The commercial lpue time-series may not be reflective of overall stock abundance due to changing fishing practices.

Data

The time-series of official landings is presented in Table 23.2 and Figure 23.1a and b.

Sampling is carried out in Ireland but numbers of samples varies over time due to the low landings levels and varying encounter probability, and is therefore not sufficient to generate a time-series of annual length or age distributions. In 2023, there were 12 sampling trips on board OTB_CRU vessels in the area.

Table 23.2. Plaice in divisions 7.b and 7.c. History of commercial catch and landings; both the official and ICES estimated values are presented for each country. All weights are in tonnes.

Year	France	UK	Ireland	Others	Total	ICES estimates
1908	0	0	135	0	135	
1909	0	0	49	0	49	
1910	0	0	36	0	36	
1911	0	2	54	0	56	
1912	0	1	40	0	41	
1913	0	0	54	0	54	
1914	0	0	85	0	85	
1915	0	1	23	0	24	
1916	0	0	22	0	22	
1917	0	0	36	0	36	
1918	0	0	29	0	29	
1919	0	1	32	0	33	
1920	0	25	15	0	40	
1921	0	9	34	0	43	
1922	0	1	37	0	38	
1923	0	1	30	0	31	
1924	0	4	166	0	170	
1925	0	5	28	0	33	
1926	13	10	42	0	65	
1927	126	14	45	0	185	

Year	France	UK	Ireland	Others	Total	ICES estimates
1928	40	7	35	0	82	
1929	262	25	31	0	318	
1930	96	6	44	0	146	
1931	238	8	58	0	304	
1932	411	19	76	0	506	
1933	595	29	29	0	653	
1934	406	31	33	0	470	
1935	249	18	33	0	300	
1936	265	47	37	0	349	
1937	242	59	25	0	326	
1938	359	25	20	0	404	
1939	0	0	24	0	24	
1940	0	0	47	0	47	
1941	0	0	43	0	43	
1942	0	0	41	0	41	
1943	0	0	29	0	29	
1944	0	0	42	0	42	
1945	0	0	30	0	30	
1946	0	5	32	0	37	
1947	0	9	36	5	50	
1948	0	8	47	0	55	
1949	0	20	63	0	83	
1950	289	16	42	0	347	
1951	100	12	31	0	143	
1952	120	18	46	0	184	
1953	340	8	48	0	396	
1954	273	5	72	0	350	
1955	111	3	96	0	210	
1956	174	1	64	0	239	

Year	France	UK	Ireland	Others	Total	ICES estimates
1957	80	1	60	0	141	
1958	204	0	71	0	275	
1959	392	5	54	0	451	
1960	197	3	46	0	246	
1961	182	0	30	0	212	
1962	239	0	42	0	281	
1963	471	2	67	0	540	
1964	427	2	66	0	495	
1965	417	2	99	0	518	
1966	0	1	127	0	128	
1967	182	2	112	0	296	
1968	403	0	89	0	492	
1969	281	2	99	0	382	
1970	124	0	110	0	234	
1971	0	1	89	0	90	
1972	110	0	124	0	234	
1973	60	1	124	0	185	
1974	45	1	106	0	152	
1975	10	0	153	0	163	
1976	9	0	133	0	142	
1977	4	0	135	0	139	
1978	16	0	122	0	138	
1979	6	0	117	2	125	
1980	12	0	142	65	219	
1981	9	4	135	58	206	
1982	8	4	122	22	156	
1983	37	0	108	7	152	
1984	2	6	110	0	118	
1985	10	7	150	0	167	

Year	France	UK	Ireland	Others	Total	ICES estimates
1986	11	5	114	0	130	
1987	13	1	153	0	167	
1988	9	2	157	0	168	
1989	1	14	159	0	174	
1990	11	92	130	0	233	
1991	9	3	179	0	191	
1992	3	9	180	0	192	
1993	2	3	191	0	196	
1994	1	5	200	0	206	
1995	5	2	239	0	246	
1996	1	2	248	0	251	240
1997	3	0	206	0	209	213
1998	0	1	160	0	161	183
1999	0	2	157	0	159	172
2000	31	0	99	0	130	108
2001	8	0	70	0	78	87
2002	17	2	51	0	70	71
2003	7	0	56	2	65	72
2004	14	0	39	1	54	55
2005	12	0	25	0	37	38
2006	11	0	20	1	32	30
2007	12	0	23	0	35	34
2008	9	0	21	1	31	35
2009	7	0	45	0	52	53
2010	6	0	27	0	33	33
2011	2	0	16	0	18	16
2012	9	0	20	0	29	26
2013	3	0	15	0	18	18
2014	6	0	17	0	23	23

Year	France	UK	Ireland	Others	Total	ICES estimates
2015	7	0	15	0	22	22
2016	12	0	17	0	29	29
2017	1	0	11	0	12	12
2018	5	< 1	7	0	9	9
2019	< 1	0	< 1 [c]	< 1	1[c]	9
2020	< 1	0	0 [c]	< 1	<1 [c]	6
2021	< 1	0	3	< 1	3	3
2022*	< 1	0	2	< 1	2	2
2023*	< 1	0	2	0	2	2

***Preliminary official landings**

[c] Incomplete/missing, as part of the data is unavailable under data confidentiality clauses.

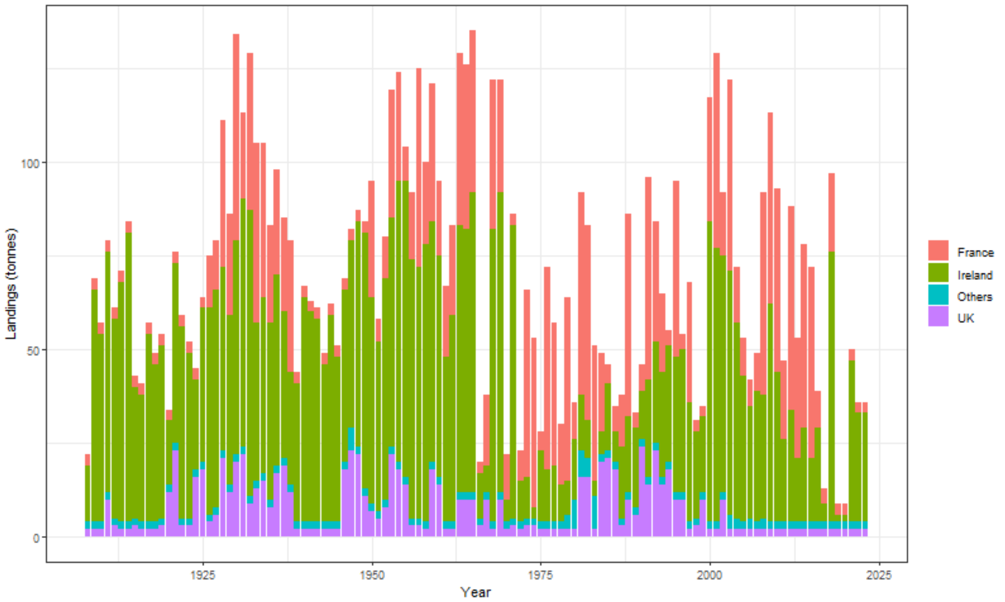


Figure 23.1a. Landings of plaice in 7.bc as officially reported to ICES (1908–2023).

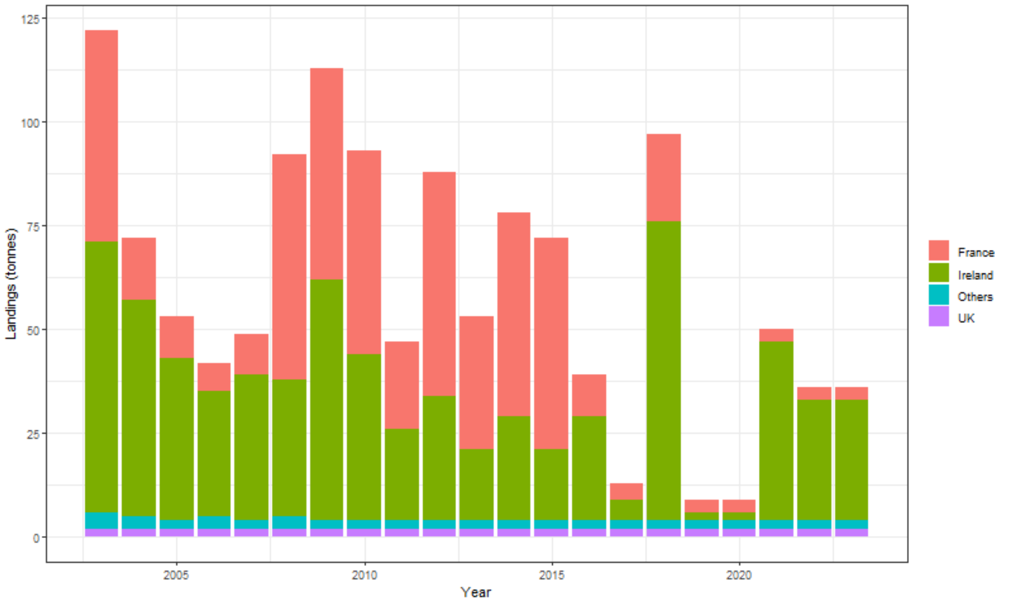


Figure 23.1b. Landings of plaice in 7.bc as officially reported to ICES (2003–2022).

Contents

24 Plaice (*Pleuronectes platessa*) in Division 7.e (western English Channel)

In 2022, ICES gave biennial advice for 2023 and 2024.

Type of assessment in 2022

The WGCSE 2022 assessment report is available at: http://doi.org/10.17895/ices.pub.19863796.

Plaice in Division 7.e is a Category 3 data-limited stock and the advice is based on the rfb rule (Fischer *et al*., 2021b).

ICES advice applicable to 2023 and 2024

The 2022 advice is available at https://doi.org/10.17895/ices.advice.19453631 and stated:

"ICES advises that when the MSY approach is applied, catches should be no more than 1219 tonnes in each of the years 2023 and 2024."

ICES Transparent Assessment Framework

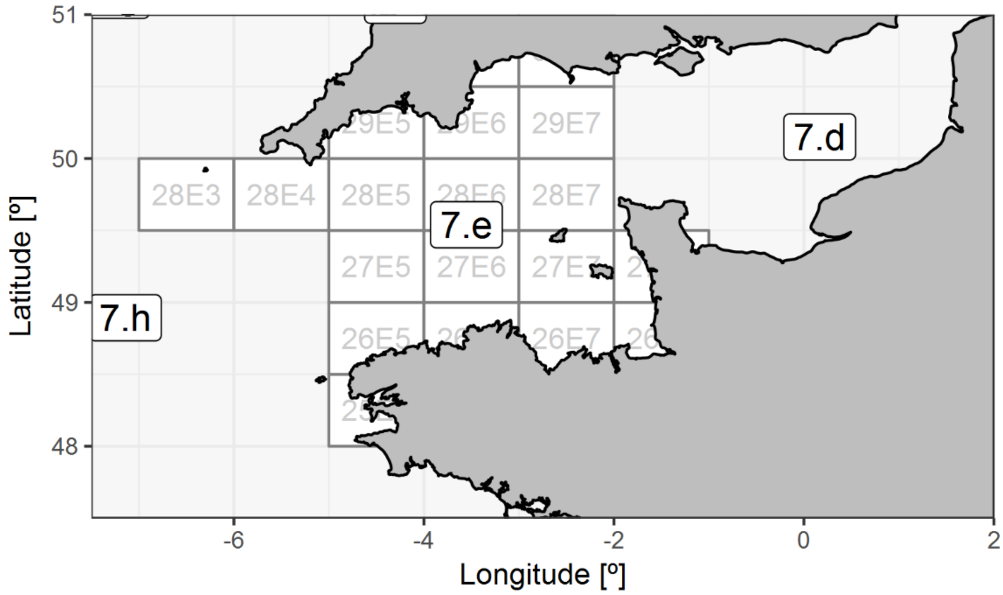
The Division 7.e plaice stock is included in the ICES Transparent Assessment Framework (TAF, https://taf.ices.dk, https://github.com/ices-taf). All WGCSE assessments since 2019 are available from the ICES TAF GitHub page (please note, access to these repositories is so far restricted to ICES and members of WGCSE). Since 2024, there are two repositories for this stock. One repository is for the data processing (processing raw data into a format for the stock assessment, https://github.com/ices-taf/2024_ple.27.7e_data) and a separate repository for the stock assessment (https://github.com/ices-taf/2024_ple.27.7e_assessment).

The TAF repositories include all input data, R scripts for processing data, preparing and running the stock assessment and forecast, and scripts for creating all figures and tables presented in this report. The repositories also contain documentation on how to reproduce the WGCSE assessment for plaice.

24.1 General

24.1.1 Stock description and management units

The ICES advice for this stock is strictly that for ICES Division 7.e, called the western English Channel. Historically, the total allowable catch (TAC) was given for the English Channel combining ICES divisions 7.e and 7.d. Since 2024, the TACs are given separately for divisions 7.e and 7.d. WKFLAT 2010 (ICES, 2010) found that a significant proportion of the catches of the 7.e stock are taken in the adjacent division during the spawning period. Plaice is not the main target species in 7.e, and it is generally taken as bycatch in fisheries targeting sole.



24.1.2 Management applicable to 2023 and 2024

There are technical measures in operation, including a minimum 80 mm mesh size and a minimum landings size (27 cm) for this species.

Until 2023, the TAC was given for the entire English Channel (ICES divisions 7.e and 7.d). Since 2024, the TAC also includes area-specific considerations (see tables below).

The TAC and the national quotas by country for 2023

Species	Plaice *Pleuronectes platessa*	Zone: 7d and 7e (PLE/7DE.)
Belgium	889	Analytical TAC
France	2963	Article 7(2) of this Regulation applies
Union	3852	
United Kingdom	2020	
TAC	6775	

(Source: Council Regulation (EU) 2023/194, EU, 2023).

The TAC and the national quotas by country for 2024

Species	Plaice *Pleuronectes platessa*	Zone:	7d and 7e (PLE/7DE.)
Belgium	439	Analytical TAC	
France	1463	Article 7(2) of this Regulation applies	
Union	1902 [3][4]		
United Kingdom	1176 [1][2]		
TAC	3930		

[1] Of which up to 346 tonnes may be fished in United Kingdom and Union waters of 7d (PLE/*07D.).

[2] Of which up to 830 tonnes may be fished in United Kingdom and Union waters of 7e (PLE/*07E.).

[3] Of which up to 1 649 tonnes may be fished in United Kingdom and Union waters of 7d (PLE/*07D.). Within the limits of these quotas, no more than the quantities given below may be taken in area 7d:

7d	
Belgium	381
France	1268

[4] Of which up to 253 tonnes may be fished in United Kingdom and Union waters of 7e (PLE/*07E.). Within the limits of these quotas, no more than the quantities given below may be taken in area 7e:

7e	
Belgium	58
France	195

(Source: Table 84, Council Regulation (EU) 2024/257, EU, 2024).

24.1.3 Landing obligation

The EU landing obligation was phased in between 2019 and 2021 for plaice in 7.e with a discard plan defined in the Commission Delegated Regulation (EU) 2018/2034 (EU, 2018) and Commission Delegated Regulation (EU) 2019/2239 (EU, 2019) and referring to Regulation (EU) No 1380/2013 (EU, 2013). According to this discard plan, the landing obligation applies to plaice in 7.e. since 01 January 2019. There are, however, survivability exemptions for plaice when caught with specific gears. This includes all (a) trammelnets (gear codes GTR, GTN, GEN, GN) and (b) otter trawls (gear codes OTT, OTB, TBS, TBN, TB, PTB, OT, PT, TX). Furthermore, Commission Delegated Regulation (EU) 2018/2034 (EU, 2018a) set a provisional exemption for 2019, including BT2 beam trawls (i.e. 80 mm to 120 mm mesh size) for (c) vessels with a maximum engine power greater than 221 kW and fitted with a flip-up rope or benthic release panel, and (d) for vessels with a maximum engine power of 221 kW or a maximum length of 24 m, when fishing within 12 nautical miles of the coast and with average tow durations of no more than 1:30 hours (Commission Delegated Regulation (EU) 2018/2034, Article 6, EU, 2018a).

This provisional exemption was extended to 2020 in Commission Delegated Regulation (EU) 2019/2239 (EU, 2019) and points (c) and (d) extended to beam trawls irrespective of mesh size (Commission Delegated Regulation (EU) 2019/2239, Article 6, EU, 2019).

Prior to introducing the landing obligation, a substantial part of the plaice 7.e catches has been discarded and not accounted for in the stock assessment. In the first year of the phasing in of the landing obligation, the exemptions are likely to cover most of the plaice catches, and the impact on fishing or stock assessment is likely to be negligible. In the following years of the discard plan, the situation should be closely monitored because of potential changes in the landings data and composition, which might affect the stock assessment.

24.2 Data

24.2.1 InterCatch

International catch data are collated on the ICES InterCatch platform (https://intercatch.ices.dk). In the Western English Channel, plaice is taken mainly as bycatch in beam trawls targeting sole and anglerfish. In 2023, 73.4% of the catches (landings and discards) were taken by beam trawls, 21.3% by otter trawls, 3.2% by gillnets and 2.1% by other gears. Of the total international catches, 82.5% were taken by the UK, 6.6% by France, 10.9% by Belgium, and <0.1% by the Netherlands (Table 24.1, Figures 24.1 and 24.2).

The official landings from this area amounted to 16% of the combined 7de TAC in 2023, 12% in 2022, 15% in 2021, and 14% in 2020. The combined landings of plaice in 7.de accounted for 29% of the TAC in 2023, 30% in 2022, 34% in 2021, and 74% in 2020.

24.2.2 Landings

National landings data reported to ICES and estimates of total landings used by the working group are given in Table 24.1. Total international plaice landings in Division 7.e were 1 104 tonnes in 2023, very similar to the 1 103 tonnes in 2022. Age samples were provided for 91% of landings in 2021, 90% in 2022, and 88% in 2023.

In addition to the estimated 2023 landings for Division 7.e, an extra of 45 tonnes (85 tonnes in 2023) were added from the 7.d plaice stock, representing an adjustment for migration of 15% of the mature component of Quarter 1 landings between the two divisions. This process was agreed at WKFLAT 2010 (ICES, 2010), and the migration correction was revised at WKPLE 2015 (ICES, 2015a). The process is described in the Stock Annex. A reciprocal correction is made to the 7.d plaice stock. Figure 24.3 shows the total annual landings split by divisions 7.e and 7.d.

24.2.3 Discards

Although discards have not been used in the assessment of 7.e plaice historically, some discard data are available. Discard tonnages are available within InterCatch and were provided by the UK(E&W) for the years 2012–2023, France for 2014–2023, Belgium for 2012–2013 and 2015–2023, the Netherlands for 2015–2019. and Ireland for 2017–2021 (zero discards reported).

Discard coverage and sampling are generally at a high level for this stock. Discard estimates were provided for 91% in 2021, 81% in 2022, and 92% in 2023. Of these discard estimates, age samples were provided for 18% in 2020, 79% in 2021, 85% in 2022, and 79% in 2023.

In analogy to the landings, the discards are also increased by a migration correction from 7.d. For 2023, 139 tonnes (15% of the mature quarter 1 plaice discards in 7.d, down from 178 tonnes in 2022) were added, resulting in total discards of 268 tonnes for the 7.e plaice stock.

The discard rate for this stock is calculated using the catches that include the migration correction. The discard rate was 18.9% in 2023, 31.1% in 2022, and 13.1% in 2021 (Figure 24.4).

24.2.4 Sampling

The current stock assessment with rfb rule does not use age-disaggregated catches. However, age samples are submitted to InterCatch. Sampling levels for this stock have been high in recent years. Age samples were provided for 88.1% of landings and 79% of discards in 2023. Figures 25.5. and 25.6 show the available age and length samples from InterCatch.

24.2.5 Revisions

No revisions to data prior to 2023 were provided in 2024.

24.2.6 Biological

The current ICES stock assessment (rfb rule) does not use values for natural mortality and maturity at age.

Currently, the assessment for this plaice stock is based on the rfb rule (see Section 24.6). In the absence of stock-specific information, the reference length for the rfb rule is calculated following the ICES technical guidelines (ICES, 2022) with the generic assumption of M/k=1.5 (where M is the natural mortality and k the von Bertalanffy individual growth rate; see Section 24.6.3 for details).

24.2.7 Surveys

Two surveys currently provide abundance estimates to the working group (Figures 24.7, 24.8, and 24.9; Tables 24.2 and 24.3).

24.2.7.1 UK Fisheries Science Partnership

The UK Western Channel sole and plaice survey (previously called Fisheries Science Partnership survey; UK-FSP, Quarter 3, ICES survey code B4381, Burt *et al*., 2024) conducted another survey of sole and plaice abundance in the Western English Channel in 2023. The survey uses two 4 m beam trawls with 80 mm nominal codend mesh and focuses on the area around the English coast. 90 out of 90 tows were completed in 2023. 248 plaice otoliths were collected for ageing in 2023.

For this survey, catch rates are reported standardized as numbers and biomass (kg) per hour per meter of beam length.

The plaice biomass from the FSP survey decreased from an all-time high in 2014 until 2020, then increased slightly by 2021 but has decreased again since then. Plaice was the most abundant commercial flatfish species caught in the survey and was encountered at more than 70% of survey stations.

24.2.7.2 Q1SWBeam

The second survey used for sole is the Quarter 1 South West Beam trawl (Q1SWBeam, also called Q1SWECOS, ICES survey code B2732), which started in 2006. This survey deploys two 4 m beam trawls and uses a fully random stratified approach. In contrast to the FSP survey, the Q1SWBeam covers the entire western English Channel and, if conditions permit, adjacent areas.

The 2022 survey was disrupted and only 55 out of 81 planned tows were fished. In 2023, the survey returned to normal operations and 77 out of 81 tows were completed (Figures 24.8 and 24.9). Similar to previous years, plaice were mainly encountered along the English coast with few catches towards the French coast.

24.2.7.3 Commercial fleet effort and LPUE

UK(E&W) beam trawl and otter trawl time series are shown in Figure 24.15.

UK(E&W) beam trawl effort has been relatively stable at high levels since the early 2000s but the landings have been decreasing since 2017.

24.3 ICES advice considerations

Since 2015, ICES has classified this stock as Category 3 data-limited for advice purposes. Until 2021, ICES advice was provided following the 2012 data-limited stocks framework (ICES, 2012) and the catch advice was based on the "2 over 3" rule (method 3.2 in ICES, 2012). The stock trend used in the 2 over 3 rule was based on the SSB estimate of a landings-only XSA assessment.

In 2022, ICES introduced new data-limited advice rules for Category 3 stocks developed by ICES WKLIFE X (ICES, 2020, 2022). Since 2022, the advice for this plaice stock has been based on the rfb rule (Fischer *et al*., 2020, 2021a,b, ICES, 2020, 2022) and the method was first applied in 2022 to give biennial advice for 2023 and 2024. This year (2024) is the second time the rfb rule has been applied.

24.4 Choice of method for providing advice

The choice of method for providing advice for plaice in 2022 was based on the new ICES technical guidelines for stocks in categories 2 and 3 (ICES, 2022).

The first step in choosing a method is considering whether a surplus production model (such as SPiCT, Pedersen and Berg, 2017) has been fit successfully to the stocks and whether the model fit meets acceptance criteria. In previous years, WGCSE has conducted extensive explorations of SPiCT for this plaice stock. However, this was not successful. The model exhibited very large uncertainty and was sensitive to the first and last year of data used in the model. Alternative model configurations, fixing parameters, or including priors on model parameters did not lead to a suitable model. Consequently, SPiCT was rejected by WGCSE as this model does not appear to be able to model the stock dynamics appropriately.

For this stock, an index of abundance and length data are available. Following ICES (2022), the choice of the method then depends on the individual growth rate (quantified by the von Bertalanffy growth model parameter *k*). Von Bertalanffy growth parameters were estimated in 2022 with data from 2017 to 2021:

von Bertalanffy parameter	L_∞	k	t_0
value	58.5 cm	0.11 year^{-1}	-2.3 years

Following ICES (2022), this means that the "rfb rule" was applied in 2022 because k<0.32 year^{-1}. Figure 24.11 and Table 24.4 detail age-length data and von Bertalanffy growth parameters.

24.5 Application of the rfb rule

The rfb rule (Fischer *et al.*, 2020, 2021a,b, ICES, 2020, 2022) is an empirical harvest control rule of the form:

$$A_{y+1} = A_y \, r \, f \, b \, m$$

where A_{y+1} is the new advised catch for year $y+1$, A_y the previously advised catch, r a biomass ratio following the trend in a biomass index, f a fishing pressure proxy using catch length data, b a biomass safeguard protecting against low stock size, and m a multiplier ensuring long-term precautionary exploitation.

The rfb rule includes a conditional and asymmetric uncertainty cap restricting changes in A_{y+1} relative to A_y to $+20\%$ and -30%, but is only implemented if $b = 1$. Furthermore, the rfb rule provides biennial catch advice, i.e. once set, the advice is kept for two years.

Table 24.6 summarizes this year's application of the rfb rule and the following report sections detail and justify the calculations.

It should be noted that reference points (length at first capture L_c, reference length $L_{F=M}$, biomass index trigger value I_{trigger}) were not updated, following recommendations for the Category 3 empirical harvest control rules (ICES, 2023b), and the values defined in 2022 were used again this year.

The rfb rule is implemented with the cat3advice R package (https://github.com/shfischer/cat3advice).

24.5.1 Component A_y

The rfb rule derives the catch advice by adjusting a reference catch, usually the previously advised catch. Figure 24.12 illustrates the catch in comparison to the ICES advice over the past years. The catches loosely follow the advice and, therefore, the reference catch A_y corresponds to the previous catch advice of 1 219 tonnes given in 2022 for each of the years 2023 and 2024.

24.5.2 Component r

Component r of the rfb rule informs on the biomass trend of the stock. WGCSE 2022 decided to use the UK-FSP survey to derive the biomass index for the rfb rule because (1) it occurs later in the year in Quarter 3 and therefore provides a more recent estimate of stock biomass, (2) it had a higher contribution compared Q1SWBeam in previous stock assessment model fits and shows better internal consistency and appears more robust and less susceptible to noise in the data, (3) it covers the main habitat for plaice, and (4) it is the only survey for which a time-series of standardised biomass estimates (in kg per hour per metre of beam) were available. For the biomass index, only ages 2–8 were considered because these were the ages previously selected in age-structured assessments and younger as well as older fish might not be fully selected and likely provide more noise than signal.

Component r of the rfb rule is calculated as (ICES, 2022):

$$r = \frac{\sum_{i=y-2}^{y-1} I_i/2}{\sum_{i=y-5}^{y-3} I_i/3} = \frac{\sum_{i=2022}^{2023} I_i/2}{\sum_{i=2019}^{2021} I_i/3} = \frac{0.72}{0.82} = 0.87,$$

where I is the biomass of the UK-FSP survey, aggregated over ages 2–8 (in kg per hour per metre of beam of the survey gear). Figure 24.13 illustrates the biomass index and the calculation of r.

24.5.3 Component f

Component f of the rfb rule is a proxy for the fishing pressure and uses catch length data. Catch length distributions were generated from InterCatch.

Component f requires the definition of length at first capture L_c, defined as the first (smallest) length class for which the catch numbers are at or above the mode of the distribution (the length class with the highest catch numbers, Figure 25.14). Following the ICES guidelines (ICES, 2022), L_c was defined in 2022 using data from 2017-2021 as L_c = 26.4cm. This value is kept and used again in the following years.

The annual mean length in catch L_{mean}, for length classes above L_c was calculated as the mean of length classes above L_c, weighted by the catch numbers per length class (Table 24.5, Figure 24.15).

The mean catch length can be compared to an MSY proxy reference length to infer fishing pressure on the stock. $L_{F=M}$ is used as a reference length (ICES, 2022), and was calculated in 2022 as:

$$L_{F=M} = 0.75L_c + 0.25L_\infty = 0.75 \times 26.4\text{ cm} + 0.25 \times 58.5\text{ cm} = 34.4\text{ cm}$$

This is an approximation and assumes $M/k = 1.5$, and was used for plaice because natural mortality M is not known reliably.

L_{mean} can then be compared to the reference length $L_{F=M}$ (Figure 24.16). L_{mean} was below $L_{F=M}$ for 2014–2023, which indicates overfishing of the plaice 7.e stock. Figure 24.17 shows the inverse of the indicator, as presented in ICES advice sheets.

Component f of the rfb rule is then calculated as (ICES, 2022):

$$f = \frac{L_{\text{mean}}}{L_{F=M}} = \frac{L_{2023}}{L_{F=M}} = \frac{31.7\text{ cm}}{34.4\text{ cm}} = 0.92$$

24.5.4 Component b

The biomass safeguard (component b) protects against low stock size and includes a biomass index trigger value (I_{trigger}). The same biomass index as for component r is used for b. In the absence of better knowledge, I_{trigger} was calculated in 2022 based on the lowest observed biomass index value (I_{loss}):

$$I_{\text{trigger}} = I_{\text{loss}} \times 1.4 = I_{2007} \times 1.4 = 0.28\text{ kg hr}^{-1}\text{ m beam}^{-1} \times 1.4 = 0.39\text{kg hr}^{-1}\text{ m beam}^{-1}$$

Component b is then calculated as (ICES, 2022):

$$b = \min\left\{1, \frac{I_{y-1}}{I_{\text{trigger}}}\right\} = \left\{1, \frac{I_{2023}}{I_{\text{trigger}}}\right\} = \min\left\{1, \frac{0.68}{0.39}\right\} = 1$$

24.5.5 Component m

The multiplier m is set depending on the von Bertalanffy parameter k (ICES, 2022):

$$m = \begin{cases} 0.95, & \text{if } k < 0.20\text{ year}^{-1} \\ 0.90, & \text{if } 0.20 \le k < 0.32\text{ year}^{-1} \end{cases}$$

and because for plaice $k < 0.20\text{ year}^{-1}$, m was set to $m = 0.95$ in 2022.

24.5.6 Combining the rfb rule's components

The catch advice with the rfb rule is calculated as

$$A_{y+1} = A_y\ r\ f\ b\ m = 1219 \text{ tonnes } \times 0.87 \times 0.92 \times 1 \times 0.95 = 927 \text{ tonnes}$$

The rfb rule is used in combination with a conditional uncertainty cap (stability clause; +20%, −30%), implemented only when $b = 1$. This year, $b = 1$, and the stability clause was considered. However, the change in the advised catch is within the limits of the stability clause, so it is not applied. This means the final catch advice for the 7.e plaice stock is 927 tonnes in each of the years 2025 and 2026 (biennial advice), which is a reduction of 24%.

To calculate the landings corresponding to the catch advice, a discard rate is needed. The discard rate is calculated as the average over all available years (2012-2023) and was 26%. This leads to landings of 682 tonnes.

Table 24.6 summarizes the ICES catch advice.

24.5.7 Area-based advice for ICES Division 7.e

The advice for plaice in ICES Division 7.e is based on the assumed stock unit and includes a migration component from Division 7.d. In the past years, the area-based advice (advice for ICES Division 7.e) was derived by calculating the ratio of the catches of the stock that come from Division 7.e and applying this ratio to the advice values for the stock. In 2023, ICES responded to an "EU/UK request for consistency between ICES advice relevant to North Sea and English Channel plaice (Pleuronectes platessa), ple.27.420, ple.27.7d, and ple.27.7e" (ICES, 2023). The outcome was that the headline advice will still be based on the stock, but the area-based advice calculation will change.

The short-term forecast of the 7.d stock now includes a consideration of catches that come from the 7.e stock. This catch value is then deducted from the advice for the 7.e stock and the remaining advised catch corresponds to the advised catch for the Division 7.e area. This 7.e area catch is then further split into discards and landings based on the discard rate in Division 7.e.

The 2024 short-term forecast for the 7.d plaice stock estimated that for the 2025 catch, 119 tonnes (43 tonnes discards, 76 tonnes landings) come from the 7.e stock. This means the catch advice for Division 7.e is: 927 tonnes (7.e stock advice, see previous section) – 119 tonnes (from 7.d forecast) = 809 tonnes (rounded, calculations are done with unrounded values). The discard rate in 7.e (average for 2012-2023) is 23%. This leads to 621 tonnes of landings corresponding to the catch advice in Division 7.e (Table 24.6).

24.6 Management plans

There is no management plan in place for this stock apart from the EU multiannual plan for the region.

24.7 Uncertainty about the stock structure

A degree of uncertainty exists over the landings statistics for this stock, given that mature plaice migrate between 7.d and 7.e during the spawning period. The current assessment applies a spawning migration correction that reallocates 15% of Quarter 1 landings for the mature proportion of the catch from 7.d to 7.e. Consequently, the assessment results depend on the mixing rate assumption estimated from existing tagging data. This assumed migration is based on a study from 1996. Further work is required to examine the stock structure and the mixing rate during the spawning period.

24.8 Benchmark planning

The plaice stock in ICES Division 7.e will be part of the WKBPLAICE benchmark in 2024, with the data evaluation workshop planned for June 2024 and the benchmark meeting in October 2024. This benchmark workshop will conduct a stock-specific management strategy evaluation (MSE) and tune a category 3 empirical harvest control rule.

The following three sections are kept from the previous WGCSE report (ICES, 2023c) to justify the need for a benchmark and to explain the plan for the benchmark.

24.8.1 Issue list

The plaice in Division 7.e stock has been recommended for a benchmark and an issue list is kept on the ICES system for rolling issues (https://sid.ices.dk/Manage/rollingissues.aspx) and also listed here:

- Stock structure
    - There is uncertainty about the stock structure and some mixing between 7.d and 7.e is considered.
    - Migration between different areas should be further investigated but can likely not be resolved in the near future. Assumptions about migration are likely to have a higher impact on analytical stock assessment models but are less important for category 3 empirical harvest control rules because these follow trends in the data without having to estimate population dynamics.
- Discards
    - Previously used age-structured stock assessment models did not include discards but discards are considered substantial.
    - Discard estimates are available in InterCatch for 2012–2022 and have been extrapolated back in time by WGCSE. Available discard data should be analysed, and it should be investigated whether more historical discard data are available.
- Surveys
    - Two scientific surveys (UK-FSP Q3 and UK-Q1SWBeam Q1) are routinely conducted for this stock. The current rfb rule only uses the UK-FSP survey. The Q1SWBeam survey was revised in 2020, data for 2022 are missing, and the cohort tracking of this survey is poor; in some cases, negative correlations were observed between ages.
    - The suitability of the surveys, particularly the Q1SWBeam survey, should be checked. It should be checked if the Q1SWBeam survey is appropriate to inform on the plaice stock.
- Biological data
    - Natural mortality (time and age invariant) and maturity ogives (time invariant) were borrowed from other plaice stocks, but are not used for these stocks anymore after benchmarks.
    - Updates to biological data should be considered. Natural mortality is unknown and no studies for this stock area exist. The assumptions for natural mortality have a crucial influence on the output of age-structured stock assessment models and depending on the assumptions, the stock status can vary considerably. This is likely to impair the use of age-structured stock assessment models. Maturity data is routinely collected by the two surveys but has not been explored.

  - Stock and catch weights are currently derived by applying a smoother to the annual weights-at-age from InterCatch. The use of raw weight-at-age or alternative formulations (e.g. von Bertalanffy growth model) and their impact should be explored. Raw catch weights for 2012-2022 are available from InterCatch.
- Assessment method
  - The advice for this stock is based on the Category 3 data-limited rfb rule. The rfb rule is applied with generic parameters leading to a precautionary advice. There is potential to explore moving the stock to a Category 1 data-rich assessment or to conduct a case-specific MSE. Recently published work on a comparison of Category 1 and Category 3 stocks through MSE included this stock as a case study.
  - The main conclusions were (1) that a single age-structured data-rich stock assessment can likely not capture the full dynamics of this stock because of high uncertainty, (2) a Category 1 approach following ICES guidelines leads to an unacceptably high risk, and (3) that Category 3 empirical methods can be tuned for this stock and provide a better management performance (higher catch, lower risk) compared to the default ICES category 1 approach.
  - An MSE framework for this stock already exists and only needs to be updated with the latest data. This stock is an ideal candidate for conducting case-specific MSE to tune Category 3 methods.

24.8.2 Progress of work on the stock with relevance for a benchmark

This plaice stock is relatively data-rich for an ICES Category 3 data-limited stock and is an ideal candidate for conducting a case-specific management strategy evaluation (MSE, in the sense of a closed-loop simulation) to tune the Category 3 empirical harvest control rules, as recommended by WKLIFE X (ICES, 2020) and WKLIFE XI (ICES, 2023b) and stated in the ICES technical guidelines (ICES, 2022).

Recently, work on a comparison of the new ICES Category 3 data-limited empirical harvest control rules and the ICES data-rich Category 1 MSY rule was published in Fischer et al. (2023) and has implications for ICES and advice provision for this stock:

> Abstract:
>
> Fisheries management needs to ensure that resources are exploited sustainably, and the risk of depletion is at an acceptable level. However, often uncertainty about resource dynamics exists, and data availability may differ substantially between fish stocks. This situation can be addressed through tiered systems, where tiers represent different data limitations, and tier-specific stock assessment methods are defined, aiming for risk equivalence across tiers. As case studies, we selected stocks of European plaice, Atlantic cod and Atlantic herring, where advice is provided by the International Council for the Exploration of the Sea (ICES). We conducted a closed-loop simulation to compare risk equivalence between the data-rich ICES MSY rule, based on a quantitative stock assessment, and the revised data-limited empirical management procedures of the ICES advice framework. The simulations indicated that the data-limited approaches were precautionary and did not lead to a higher risk of depletion than the data-rich approach. Although the catch based on generic data-limited approaches was lower, stock-specific optimisation improved management performance with catch levels comparable with the data-rich approach. Furthermore, the simulation indicated the ICES MSY rule can fail to meet management objectives due to increased depletion risk when management reference points are set suboptimally. We conclude that the recent revisions of the ICES system explicitly

account for risk equivalence for data-limited fisheries management and are a major step forward. Finally, we advocate further consideration of simple empirical management procedures irrespective of data limitations due to their ability to meet fisheries management objectives with greater simplicity.

This work included the plaice stock in Division 7.e as a case study and an MSE was conducted. This work has implications for the way ICES assesses and provides advice for this stock.

Fischer *et al*. (2023) conditioned seven operating models based on different parameterisation of the state–space SAM model. Operating models included a (1) most-plausible baseline operating model, and six alternative operating models with different assumptions:

- Recruitment (default: a Beverton–Holt model with autocorrelated residuals): (2) recruitment failure, (3) without autocorrelation in the recruitment residuals.
- Natural mortality (default: 0.12 for all ages): (4) higher mortality (+50%), (5) lower mortality (-50%), (6) age-dependent mortality following a Gislason model.
- Catch (default: landings and discards): (7) assume 100% discard survival.

The MSE framework was used to estimate stochastic reference points (B_{lim}, F_{MSY}, B_{MSY}, etc.) consistent with operating models and their uncertainty characterisation. It was shown that the reference points and the stock status crucially depend on the specific operating model. All operating models indicated that the stock is currently fished well above F_{MSY} and the SSB is below B_{MSY}. The conclusion for the operating model conditioning was that a single model (i.e. a single SAM stock assessment model) is not able to encompass the full uncertainty of this stock because important metrics such as natural mortality are unknown. This means that a Category 1 assessment is unlikely to be useful in providing advice.

Management procedures were then tested for the operating models and included the default ICES Category 1 approach (i.e. the ICES MSY rule based on a SAM assessment and short-term forecast, with reference points estimated with EqSim following ICES guidelines) and Category 3 empirical harvest control rules (rfb rule, chr rule, with default parameterisations and also tuned to maximize yield while staying precautionary, Figures 24.18 and 24.19). For the plaice stock, the Category 1 approach (ICES MSY rule) resulted in consistently high risks (risk of falling below B_{lim} above 30% for most operating models, i.e. well above the 5% limit imposed by the ICES precautionary approach) and often low biomass ($\leq 0.5B_{MSY}$) in the long term. On the other hand, the Category 3 methods (rfb and chr rules) met the ICES precautionary approach criterion. However, the catch was relatively low for the default ICES parameterizations of the methods, but the catch could be substantially increased by tuning the parameters.

24.8.3 Conclusions and proposed path forward for the next benchmark

The conclusion from Fischer *et al*. (2023) with relevance for ICES and WGCSE is that although an upgrade of the stock to Category 1 is possible, this is likely not a good idea because (1) an individual age-structured stock assessment model cannot model the full uncertainty about the stock dynamics and data and (2) the use of the ICES MSY rule with reference points estimated by EqSim leads to fisheries management that violates the ICES precautionary approach. Furthermore, an upgrade of the stock to Category 2 (i.e. using SPiCT) is infeasible because it has been shown several times over the years that SPiCT cannot model the stock dynamics of this stock and would lead to unacceptably high uncertainty bounds. However, the Category 3 methods (rfb and chr rules) work as intended and can be tuned with a case-specific MSE simulation.

Based on the conclusions of Fischer *et al*. (2023), the next benchmark should not purely aim to "upgrade" the stock to Category 1 but instead allow a wider scope and include the option to conduct a case-specific MSE to tune Category 3 empirical harvest control rules. The most promising method is the chr rule because it can provide the overall best management performance (high catch, low risk, less susceptible to recruitment failure, e.g. caused by environmental changes). The use of a case-specific MSE is explicitly recommended by the ICES technical guidelines (ICES, 2022). A case-specific MSE framework for this stock already exists and has been peer-reviewed and published in Fischer *et al*. (2023). The next benchmark could update the operating models with the latest data and use these in an MSE.

The benefits of developing/tuning simple empirical harvest control rules with MSE are that the method (1) has been simulation tested to show that it works and is robust to uncertainty, (2) is simpler to test and optimise in a simulation because there is no computing-intensive stock assessment in the feedback loop, (3) is simpler to understand and explain to stakeholders, (4) less susceptible to potentially subjective decisions required when conducting complex stock assessment models and short-term forecasts annually, (54) the application of the harvest control rule requires fewer data (no need for age data), (64) explicitly aligns with the ICES MSY and precautionary approach, and (7~~5~~) can at least match or even exceed the management performance of more data-rich approaches as shown by Fischer *et al*. (2023).

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24.10 Tables

Table 24.1. Plaice in 7.e. History of official landings by country and ICES estimates of landings and discards. All weights are in tonnes.

Year	Belgium	Netherlands	France	UK (E &W) incl. CI's	Others	Official total	ICES landings in 7.e	7.e stock caught in 7.d*	ICES landings for the stock**	ICES discards for the stock**
1976	5	-	323	312	-	640	640	-	640	
1977	3	-	336	363	-	702	702	-	702	
1978	3	-	314	467	-	784	784	-	784	
1979	2	-	458	515	-	975	977	-	977	
1980	23	-	325	609	9	966	1079	99	1178	
1981	27	-	537	953	-	1517	1501	175	1676	
1982	81	-	363	1109	-	1553	1688	190	1878	
1983	20	-	371	1195	-	1586	1495	219	1714	
1984	24	-	278	1144	-	1446	1547	211	1758	
1985	39	-	197	1122	-	1358	1441	236	1677	
1986	26	-	276	1389	-	1691	1810	268	2078	
1987	68	-	435	1419	-	1922	1958	314	2272	
1988	90	-	584	1654	-	2328	2458	377	2835	
1989	89	-	448	1712	-	2249	2358	384	2742	
1990	82	-	N/A	1891	2	1977	2593	392	2985	
1991	57	-	251	1326	-	1634	1848	335	2183	
1992	25	-	419	1110	14	1568	1624	258	1882	
1993	56	-	284	1080	24	1444	1417	197	1614	
1994	10	-	277	998	-	1285	1156	248	1404	
1995	13	-	288	857	-	1158	1031	216	1247	
1996	4	-	279	855	-	1138	1044	222	1266	
1997	6	-	329	1038	1	1374	1323	260	1583	
1998	22	-	327	892	1	1242	1131	215	1346	
1999	12	-	194	947	-	1153	1299	244	1543	
2000	4	-	360	926	< 1	1290	1281	345	1625	

Year	Belgium	Netherlands	France	UK (E &W) incl. CI's	Others	Official total	ICES landings in 7.e	7.e stock caught in 7.d*	ICES landings for the stock**	ICES discards for the stock**
2001	12	-	303	797	-	1112	1106	204	1310	
2002	27	-	242	978	< 1	1247	1257	215	1472	
2003	39	-	216	985	-	1240	1277	110	1387	
2004	46	-	184	912	-	1142	1212	126	1337	
2005	48	-	198	887	-	1133	1203	117	1319	
2006	52	-	223	965	< 1	1239	1313	97	1411	
2007	84	-	202	680	-	966	1003	143	1146	
2008	66	-	148	679	-	893	976	135	1112	
2009	53	2	191	731	-	977	923	101	1024	
2010	51	2	227	843	-	1123	1092	116	1208	
2011	141	3	274	936	-	1354	1334	83	1417	
2012	134	2	224	1004	< 1	1364	1366	126	1492	448
2013	97	1	221	1041	-	1360	1351	121	1472	351
2014	41	-	323	976	-	1340	1341	149	1490	1133
2015	111	1	224	912	1	1249	1246	178	1424	1276
2016	145	< 1	204	1430	-	1780	1777	235	2013	618
2017	151	< 1	153	1605	1	1911	1915	213	2128	821
2018	143	3	118	1377	3	1644	1644	236	1880	633
2019	73	2	97	1351	-	1523	1520	204	1725	366
2020	73	1	79	1124	-	1278	1275	98	1373	514
2021	107	1	91	1130	-	1327	1331	72	1403	211
2022***	106	< 1	80	916	-	1102	1103	85	1188	536
2023***	108	< 1	74	921	-	1103	1104	45	1148	268

*** Migration correction (15% of the mature population caught in quarter 1 in Division 7.d) added to stock.**

**** Includes the migration correction.**

***** Preliminary official landings.**

Table 24.2. Plaice in 7.e. Tuning fleet data available.

```
ple.27.7e WGCSE 2024
104
FSP-7e
2003 2023
1 1 0.75 0.80
1 27
1             0.0208308983  0.343191287   0.3442133438  0.2159837678  0.0410974522
              0.041976317   0.0508841287  0.0336638371  0.02200358    0.0021228935
              0.0009134145  0.0004882973  0.0001062793  3.28811e-05   0
              3.28811e-05   0             3.28811e-05   0.000191009   0             0
              0             0             0             0             0             0
1             0.0064839178  0.2038605169  0.8332283703  0.1717563494  0.292419703
              0.0329951812  0.0188283869  0.0462013544  0.0114987231  0.0027995203
              0.0008821426  0.0002175867  0.0001580957  0             0.0001883997  0
              0             0             0.0001228108  0             0             0
              0             0             0             0             0
1             0.0084930716  0.3271099173  0.4255951803  0.2404409927  0.0900371664
              0.0395287705  0.0127361504  0.0174592138  0.0371790541  0.0070178609
              0.0043464537  0             0             0             0.0006865187
              0.0006011272  0.0005708894  0             0.0005994339  0.0014134667  0
              0             0             0             0             0             0
1             0.0264706605  0.6226160902  0.4216897498  0.1859126341  0.099837907
              0.0442377935  0.0213837161  0.0045703626  0.0063647949  0.0140975761
              0.0015007319  0.0043230363  0             0             0.0005854935  0
              0             0.0006888159  0             0             0             0
              0             0             0             0             0
1             0             0.117014537   0.2742350811  0.1567513605  0.0653599832
              0.026616889   0.008325896   0.0058923584  0.0054585815  0.005636939
              0.0019316523  0.002303838   0.0022915293  0             0             0
              0             0             0             0             0             0
              0             0             0             0             0
1             0.0017564806  0.4978930589  0.2151254659  0.1256971005  0.0317905814
              0.0192454357  0.0153051535  0.0046721637  0.0019192342  0.0005160863
              0.0002430666  0.0001799535  0.0001019815  2.40095e-05   2.69813e-05
              2.40095e-05   0             2.69813e-05   2.69813e-05   2.69813e-05   0
              0             0             0             0             0             0
1             0.0211943046  0.4353288543  0.4422219627  0.1528394796  0.0598128665
              0.0331030404  0.0226941756  0.0079648565  0.0033431925  0.0013018772  0
              0.0026037544  0             0             0             0             0
              0             0             0             0             0             0
              0             0             0             0             0
1             0.0647388571  0.7402133171  0.5829812879  0.3845761643  0.0479189382
              0.0415029509  0.0119952249  0.0061701869  0.0023009922  0.0047470993
              0.0011504961  0.006622702   0             0             0             0
              0             0             0             0             0             0
              0             0             0             0             0
1             0.0027064253  1.036328659   0.8036287912  0.3154335609  0.1107105991
              0.0103143038  0.0181250757  0.0132568988  0.0021477361  0.0020080925
              0.001613695   9.26398e-05   9.26398e-05   0.0029814941  0
              0.0011831925  0             3.26964e-05   0             0             0
              0             0             0             0             0             0
1             0.0494306424  0.3200764359  1.2441938399  0.5826747491  0.1365325422
              0.1347918963  0.0121371085  0.0144254043  0.0115270917  0.0025913556
              0.0051989993  0.0049471333  0             0             0             0
              0             0             0             0             0             0
              0             0             0             0             0
1             0             0.2266890224  1.4641865697  1.2671043524  0.4403084123
              0.2032552981  0.0755061094  0.0275649015  0.0077368789  0.0037886636  0
              0.0012684957  0.0012684957  0             0             0             0
              0.0012684957  0             0             0             0             0
              0             0             0             0
1             0.03548275    1.319797284   1.6647790616  2.1308293497  0.8328568122
              0.6237114226  0.1572964824  0.0350538578  0.0371484109  0
              0.0035336667  0.00265025    0             0             0.0011778889  0
              0             0             0             0             0             0
              0             0             0             0             0
1             0.0016784148  0.8297622663  1.257130266   0.9233582109  1.0196856517
              0.5143799529  0.1222145317  0.0128907617  0.0566920837  0.0023809853
              0.0093154347  4.08854e-05   4.08854e-05   2.04427e-05   0
              2.04427e-05   0             2.04427e-05   0             0             0
              0             0             0             0             0             0
1             0.0033568296  0.3887210579  1.50073462    0.8157445965  0.3896522219
              0.3426977969  0.2351356472  0.0186050167  0.056730528   0
              0.0098937394  0             0.0028762403  0             0             0
              0             0             0             0             0             0
              0             0             0             0             0
1             0.0083920741  0.2734688532  0.5985856837  1.5809798468  0.3446727423
              0.4536494278  0.2886734237  0.0563499887  0.1485529321  0.013814645
              0.0264081583  0.0106433051  0.0054248655  0             0.0033568296  0
              0             0             0             0             0             0
              0             0             0             0             0
1             0             0.2730774994  0.765289223   0.9806866884  0.6563497784
              0.1850327432  0.1112903326  0.0873483927  0.0302633863  0.0263229229
              0.0030350849  0.0017983016  0             0             0             0
```

	0	0	0	0	0	0
	0	0	0	0	0	
1	0.0002718205	0.1740269794	0.4983369021	0.5247507552	0.482077924	
	0.3039476624	0.1153367817	0.0630658514	0.0315684791	0.01902716	
	0.0124644406	0	0.0012684957	0.0015856197	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	0.7236873888	0.6876859008	0.286551445	0.1324310278	
	0.0833516837	0.0646730791	0.0146861296	0.0183201245	0.0088404566	
	0.0073055273	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.00211269	0.9929342784	1.7363595162	1.1438702468	0.1841311612	
	0.0630358958	0.0510755065	0.0349013699	0.0058015804	0.008438062	
	0.0073611358	0.0031734158	0.0031734158	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	0.0894816048	0.8265493022	1.0442538664	0.7623101953	
	0.1276319238	0.0531152777	0.0238752361	0.0209026032	0.0094869995	
	0.0065594582	0.0013602948	0.0034165864	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	0.016958983	0.4596220962	0.6834579675	0.751074495	
	0.4581301353	0.1192706075	0.0354425007	0.0065118516	0.0069936192	
	0.0017099467	0.0030685344	0.0042428849	2.34239e-05	0	
	2.34239e-05	0	0	0	0	0
	0	0	0	0	0	0
Q1SWBeam						
2006 2023						
1 1 0 0.25						
1 27						
1	1.43546	27.2685	20.338	12.017	5.2557	
	2.2812	0.1513	0.11942	0.23884	0.56317	0
	0.34656	0.1976	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0		
1	0.61114	10.2989	18.83	12.842	2.8274	
	3.2172	1.4288	2.69707	0.16687	1.39158	
	0.16687	0.83811	0.63929	0.16687	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.88478	20.2884	9.009	4.394	3.1109	
	0.9659	1.5113	0.67578	0.43978	0	
	0.87797	0.12102	0.18772	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.7943	38.2773	31.332	8.543	5.917	
	2.1977	2.2199	0.29821	0.17878	0.29821	
	0.29821	0	0.49542	0	0.61889	0
	0	0	0	0	0	0
	0.7539	0	0	0	0	
1	0.92626	35.0943	29.932	16.803	2.7883	
	1.7498	1.4653	0.76424	0.37545	0	0
	0.18772	0	0.91703	0	0	0
	0	0.11942	0	0	0	0
	0	0	0	0		
1	1.80958	46.7994	61.533	21.93	5.0857	
	5.0716	2.4951	0.46795	0.31664	0.11377	
	0.35757	0	0.11919	0.11919	0.11919	
	0.51986	0	0	0	0	0
	0	0	0	0	0	0
1	0	8.9195	43.986	21.985	7.3573	
	3.898	3.4557	0.41169	0.62539	0	0
	0.18772	0	0	0.14385	0	0
	0	0	0	0	0	0
	0	0	0.11942	0		
1	0.30036	14.4447	70.222	47.038	9.5129	
	3.4241	2.4899	1.49112	0.76159	0	0
	0	0.12571	0	0	0	
	0.11374	0	0	0	0	0
	0	0	0	0	0	
1	0.91256	59.9883	126.353	155.252	54.2658	
	9.1101	1.2602	2.13621	0.93872	0.48829	
	0.28101	0.15884	0.1706	0	0	0
	0.15884	0	0	0	0	0
	0	0	0	0	0	
1	0	27.9925	37.992	23.687	31.7222	
	21.0818	4.3911	2.77409	0.94758	0.59519	0
	0.99022	0	0.18772	0	0.1976	0
	0	0	0	0	0	0
	0	0	0	0		
1	0.22085	13.5105	111.182	40.711	20.3641	
	29.3592	18.746	5.94891	6.07238	0.70284	
	3.49464	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	

1	0	13.4532	62.155	136.027	27.7294	
	23.144	13.3396	2.65757	5.00905	0.37686	
	2.11134	0	0.30715	0	0.18772	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	9.1815	35.068	25.308	41.1936	
	16.2552	8.7963	7.3514	4.9955	1.1739	
	0.94606	0.11942	0	0.11942	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.18772	11.7845	23.997	41.835	28.0116	
	29.9151	10.5676	6.31033	2.9624	1.61848	
	1.29572	0	0	0.17878	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	39.4876	51.941	26.132	13.9655	
	8.2149	4.8533	4.06797	2.75253	1.70314	
	1.87588	0.25359	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	29.1579	105.289	72.068	15.8407	
	5.9395	6.6512	2.37311	0.87082	1.04314	
	0.18474	0.14949	0.10857	0.1976	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.59622	39.4343	82.267	152.864	38.7923	
	6.1971	8.5095	1.51816	3.8522	0.78904	
	0.27394	4.11552	0.16225	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	32.1785	35.129	43.401	33.1528	
	4.2339	1.2712	1.49993	0.55602	0	0
	0	0.10857	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0		
FSP-7e-biomass						
2003 2023						
1 1 0.75 0.80						
1 27						
1	0.0052812316	0.1214828714	0.1531033234	0.1098120407	0.0272487986	
	0.0304201638	0.0393681457	0.0232002676	0.0214281584	0.0030271399	
	0.0016428305	0.0009884526	0.0001635945	5.26496e-05	0	
	5.26496e-05	0	5.26496e-05	0.000412429	0	0
	0	0	0	0	0	0
1	0.0012496045	0.0618894775	0.3255162908	0.0891264545	0.1484769724	
	0.0200974905	0.0143048894	0.045553886	0.0094392277	0.004749798	
	0.0011765782	0.0002265226	0.0001733172	0	0.0002950505	0
	0	0	0.0002408385	0	0	0
	0	0	0	0	0	
1	0.0018342644	0.1115845973	0.1623681927	0.1157913399	0.0549227138	
	0.0270754542	0.0102591669	0.0178596772	0.0345549048	0.0076868425	
	0.0060651528	0	0	0	0.0012186908	
	0.0009625308	0.0013530215	0	0.0012943051	0.0027718823	0
	0	0	0	0	0	0
1	0.0049869953	0.1883520601	0.1532175116	0.0972687325	0.0609787764	
	0.028978287	0.0158729934	0.0040622491	0.0063580172	0.0152819209	
	0.0025594871	0.0036230017	0	0	0.0003474219	0
	0	0.0011029388	0	0	0	0
	0	0	0	0	0	
1	0	0.0346774134	0.1038624689	0.0708829128	0.0391171264	
	0.0201717899	0.0079485584	0.0036769609	0.0052152438	0.0057022622	
	0.0022468606	0.0041954154	0.0012809892	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.000762555	0.1657577188	0.0961174603	0.0704822029	0.0231913179	
	0.016570394	0.0147893043	0.0059644543	0.0015792971	0.0007371656	
	0.0003311276	0.0003043854	0.0001676491	3.09129e-05	5.29117e-05	
	3.09129e-05	0	5.29117e-05	5.29117e-05	5.29117e-05	0
	0	0	0	0	0	0
1	0.0043287082	0.1540895933	0.1971841642	0.0805515208	0.0407740691	
	0.0305261874	0.0183867908	0.0071709534	0.0053531527	0.0025530495	0
	0.0038770762	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0		
1	0.0077953986	0.2223438938	0.2405488301	0.2007688219	0.0326819925	
	0.0283853654	0.0115565349	0.0061370637	0.0029625913	0.00716298	
	0.002042332	0.0030410605	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.0002805555	0.2829662462	0.2761618781	0.1433564943	0.0670930341	
	0.0063305371	0.0198754767	0.0109279083	0.0030117023	0.0027646397	
	0.0022008464	0.0001439101	0.0001439101	0.0042099026	0	
	0.0015336494	0	5.23538e-05	0	0	0
	0	0	0	0	0	0
1	0.0087738262	0.0812171528	0.4006800608	0.2357713074	0.076459253	
	0.0802592315	0.0132626993	0.0093944286	0.011571324	0.0024658113	
	0.0058594291	0.0047321321	0	0	0	0

```
               0              0              0              0              0              0
               0              0              0              0              0
1              0              0.0493426842   0.4016846323   0.4665376235   0.2069123712
               0.1086554592   0.0542549173   0.0202150747   0.010110847    0.0035528435   0
               0.0014550441   0.0014550441   0              0              0              0
               0.0032902929   0              0              0              0              0
               0              0              0              0
1              0.0041401004   0.296033996    0.4567809683   0.7176828738   0.3407222057
               0.2615754031   0.0794357472   0.025108143    0.0290915886   0
               0.0049700235   0.0018371369   0              0              0.000926584    0
               0              0              0              0              0              0
               0              0              0              0              0
1              0.0001666927   0.1856975988   0.3967680662   0.3549554577   0.4325974812
               0.2540259792   0.0773165321   0.0127163242   0.037526888    0.0015570551
               0.0131987723   6.54661e-05    6.54661e-05    3.27331e-05    0
               3.27331e-05    0              3.27331e-05    0              0              0
               0              0              0              0              0              0
1              0.0002572494   0.0887311254   0.4321700691   0.33029376     0.1870151822
               0.1805528336   0.1252767374   0.0139593132   0.0459469671   0
               0.0088635596   0              0.0019439633   0              0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              0.0007166172   0.0636257313   0.1688606232   0.5508671938   0.1523064567
               0.2072453377   0.1556498663   0.0338106702   0.0918858901   0.0124465021
               0.0197142882   0.0106094533   0.0053076674   0              0.003212512    0
               0              0              0              0              0              0
               0              0              0              0              0
1              0              0.0661520004   0.2126996576   0.3263252307   0.2835986161
               0.105983836    0.0688427721   0.0691574641   0.0223061018   0.0231423024
               0.003509849    0.0035265638   0              0              0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              2.6996e-05     0.0393153105   0.1478059346   0.1767266556   0.2051981134
               0.1566429404   0.069133305    0.0459155059   0.0218357553   0.0174043329
               0.0104956824   0              0.0016332234   0.0006883778   0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              0              0.1423399221   0.1795707795   0.0997959997   0.0633599822
               0.0495348585   0.0472016563   0.0178293735   0.0199326151   0.0084231594
               0.0096456266   0              0              0              0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              0.0001139874   0.1691897597   0.3913748139   0.2967467074   0.0759081909
               0.0322075728   0.033996438    0.02900624     0.0065776229   0.0085331584
               0.005266963    0.0053902308   0.0032274068   0              0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              0              0.0160475517   0.1662976213   0.2459625277   0.2242757915
               0.055865624    0.03182025     0.0175851743   0.024181703    0.0065944177
               0.0068735054   0.001234795    0.0062180483   0              0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              0              0.0020388775   0.08005655     0.1423365974   0.21066549
               0.1609382773   0.0576492185   0.0213340465   0.0067666723   0.0070830716
               0.0016161544   0.0021459949   0.0061912267   3.0159e-05     0
               3.0159e-05     0              0              0              0              0
               0              0              0              0              0              0
Q1SWBeam-biomass
2006 2023
1 1 0  0.25
1 27
1              0.12035        9.2164         7.7537         7.9217         3.3419
               1.7754         0.1014         0.11082        0.20851        0.4145         0
               0.46799        0.50547        0              0              0              0
               0              0              0              0              0              0
               0              0              0              0
1              0.02135        3.0196         8.3939         7.7399         1.6069
               2.9256         1.2243         2.45044        0.20975        2.51116
               0.26331        1.30998        0.99608        0.09445        0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              0.09066        7.8498         4.1288         1.8044         1.68
               0.6308         2.1707         0.45787        0.14293        0
               0.84162        0.0881         0.20086        0              0              0
               0              0              0              0              0              0
               0              0              0              0              0
1              0.06007        14.703         19.1933        5.9551         4.0478
               0.9913         3.524          0.31974        0.09029        0.46086
               0.49588        0              0.30245        0              1.2582         0
               0              0              0              0              0              0
               1.6616         0              0              0              0
1              0.0688         15.4548        20.1264        10.8517        1.7483
               1.5576         1.1519         0.77088        0.45598        0              0
               0.36644        0              1.07659        0              0              0
               0              0.1568         0              0              0              0
               0              0              0              0
```

1	0.09345	19.6284	31.6835	11.2165	2.8871	
	3.8983	1.959	0.40039	0.17478	0.13766	
	0.59833	0	0.1938	0.24672	0.16722	
	0.7694	0	0	0	0	0
	0	0	0	0	0	0
1	0	1.9939	30.784	12.7499	5.2572	
	2.9496	3.8255	0.31074	0.58699	0	0
	0.22452	0	0	0.22124	0	0
	0	0	0	0	0	0
	0	0	0.23765	0		
1	0.01066	2.6609	27.216	28.2107	5.253	
	1.8391	2.1848	1.69589	0.60333	0	0
	0	0.21282	0	0	0	
	0.17697	0	0	0	0	0
	0	0	0	0	0	
1	0.03901	11.7525	41.5609	68.5151	28.6957	
	6.6238	0.8834	2.00325	0.94888	0.32748	
	0.17367	0.4179	0.19654	0	0	0
	0.3261	0	0	0	0	0
	0	0	0	0	0	
1	0	5.4919	11.9003	9.4354	13.4005	
	18.4278	2.85	2.21869	1.09044	0.23391	0
	0.96299	0	0.27746	0	0.24799	0
	0	0	0	0	0	0
	0	0	0	0		
1	0.00663	1.6765	34.0805	15.0162	9.8247	
	19.0269	11.2737	4.33753	3.99252	1.08588	
	3.24396	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	2.4658	19.0353	71.9125	13.3156	
	17.4481	14.3461	2.60427	4.50389	0.13017	
	2.75627	0	0.30162	0	0.46274	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	1.0821	8.2927	7.4714	20.0618	
	10.5001	5.9581	8.37374	3.98406	0.96612	
	1.16021	0.0283	0	0.16074	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.00601	1.3522	4.1161	9.715	9.078	
	15.5802	6.1833	5.28081	2.68211	2.68581	
	2.13058	0	0	0.2292	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	7.7914	14.5251	12.4326	8.7137	
	6.4323	4.7747	4.2097	3.09837	1.9466	
	2.71674	0.27591	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	4.0692	21.7834	20.6372	4.2096	
	1.7934	3.3653	2.34356	0.51753	1.45942	
	0.04933	0.27686	0.17805	0.34956	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0.02266	3.7484	13.2588	41.8971	11.7192	
	2.6722	6.8961	0.91863	3.42418	0.75848	
	0.34571	5.22556	0.36101	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	
1	0	3.3385	7.3351	11.7266	11.2589	
	1.2374	0.429	1.01244	0.49596	0	0
	0	0.1179	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0		

Table 24.3. Plaice in 7.e. Biomass index (FSP, ages 2-8).

Year	Index value
2003	0.504636
2004	0.704965
2005	0.499861
2006	0.548731
2007	0.280337
2008	0.392873
2009	0.528683
2010	0.742423
2011	0.806712
2012	0.897044
2013	1.307603
2014	2.177339
2015	1.714077
2016	1.357999
2017	1.332366
2018	1.13276
2019	0.840738
2020	0.599633
2021	1.02843
2022	0.757855
2023	0.675019

Table 24.4. Plaice in 7e. von Bertalanffy growth parameters.

Year	k (year^{-1})	L_∞ (cm)	t_0 (years)
2006	0.14	57.97	-2.09
2007	0.20	52.96	-1.28
2008	0.23	47.53	-1.43
2009	0.19	52.38	-1.43
2010	0.21	53.59	-1.07
2011	0.15	58.64	-1.43
2012	0.17	56.71	-1.04
2013	0.14	60.02	-1.61
2014	0.15	56.18	-1.15
2015	0.12	62.35	-1.66
2016	0.11	59.99	-2.28
2017	0.11	58.88	-1.91
2018	0.15	54.06	-1.28
2019	0.12	56.54	-1.98
2020	0.11	62.42	-2.53
2021	0.08	61.58	-3.39
2017–2021	0.11	58.51	-2.30
2022	0.08	76.45	-2.02
2023	0.05	98.76	-2.99

Table 24.5. Plaice in 7e. Parameters of the commercial catch length distribution. The table shows length at first capture L_c and mean length in the catch L_{mean} above L_c.

Year	Annual L_c (cm)	L_c (cm) (used for L_{mean})	L_{mean} (cm)
2014	24	26.4	31.65716
2015	26	26.4	32.73429
2016	26	26.4	33.68649
2017	27	26.4	32.99144
2018	26	26.4	33.13459
2019	26	26.4	34.36544
2020	26	26.4	32.59554
2021	27	26.4	32.27811
2022	23	26.4	31.26334
2023	26	26.4	31.66333
2017–2021 (averaged)	26.4		
2017–2021 (pooled)	26		

Table 24.6. Plaice in 7e. The basis for the catch options in 2025 and 2026. Note that one catch option is provided for stocks in ICES data categories 3–6. The values presented here are the values presented during the working group.

Division 7.e plaice stock	
Previous catch advice A_y (advised catch for 2024)	1219 tonnes
Stock biomass trend	
Index A (2023, 2022)	0.72 kg hr^{-1} m $beam^{-1}$
Index B (2019, 2020, 2021)	0.82 kg hr^{-1} m $beam^{-1}$
r: multiplier for stock biomass trend (index ratio A/B)	0.87
Fishing pressure	
Mean catch length (L_{mean}=L_{2023})	31.7 cm
MSY proxy length ($L_{F=M}$)	34.4 cm
Fishing pressure proxy ($L_{F=M}/L_{mean}$)	1.09
f: multiplier for relative mean length in catches ($L_{2023}/L_{F=M}$)	0.92
Biomass safeguard	
Last index value (I_{2023})	0.68 kg hr^{-1}
Index trigger value ($I_{trigger}=I_{loss}\times1.4$)	0.39 kg hr^{-1}
b: multiplier for index relative to trigger, min{$I_{2023}/I_{trigger}$, 1}	1
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability	
m: multiplier (generic multiplier based on life history)	0.95
RFB calculation (A_y × r × f × b × m)	927 tonnes
Stability clause (+20%/-30% compared to A_y, only applied if b=1)	Not applied
Catch advice for 2025 and 2026 (A_y × r × f × b × m)	927 tonnes
Discard rate	26%
Projected landings corresponding to advice**	682 tonnes
% advice change^	-24%
Plaice in Division 7.e	
Catches of Division 7.e stock caught in Division 7.d	119 tonnes
Area based discard rate	23%
Catch of plaice in Division 7.e corresponding to the advice for the stock	809 tonnes
Projected landings of plaice in Division 7.e corresponding to the advice for the stock**	621 tonnes

*** The figures in the table are rounded. Calculations were done with unrounded inputs, and computed values may not match exactly when calculated using the rounded figures in the table.**

**** [Advised catch for 2025] × [1 – discard rate].**

^ Advice value for 2025 relative to the advice value for 2024 (1219 tonnes).

24.11 Figures

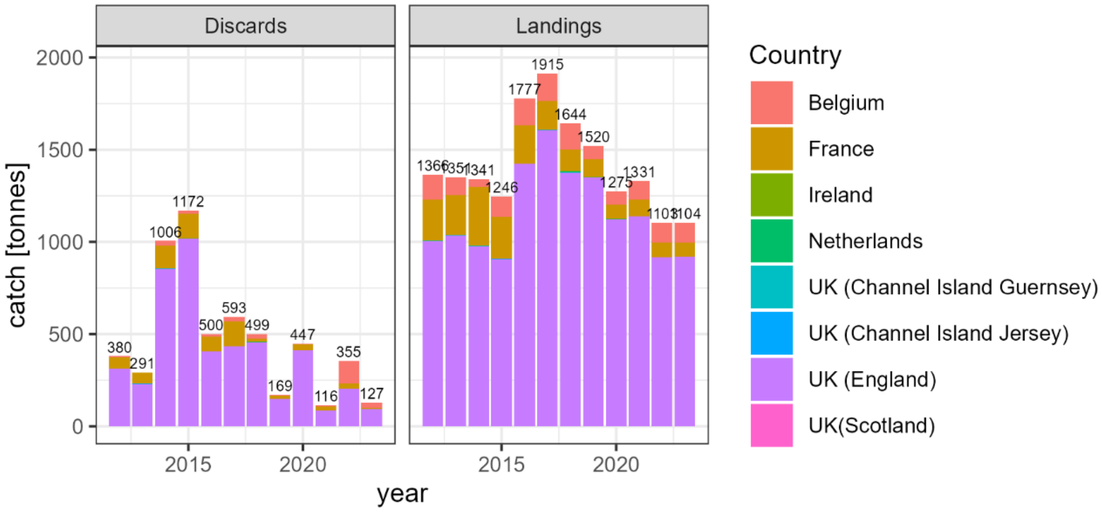

Figure 24.1. Plaice in 7.e. International landings and discards by country as extracted from InterCatch.

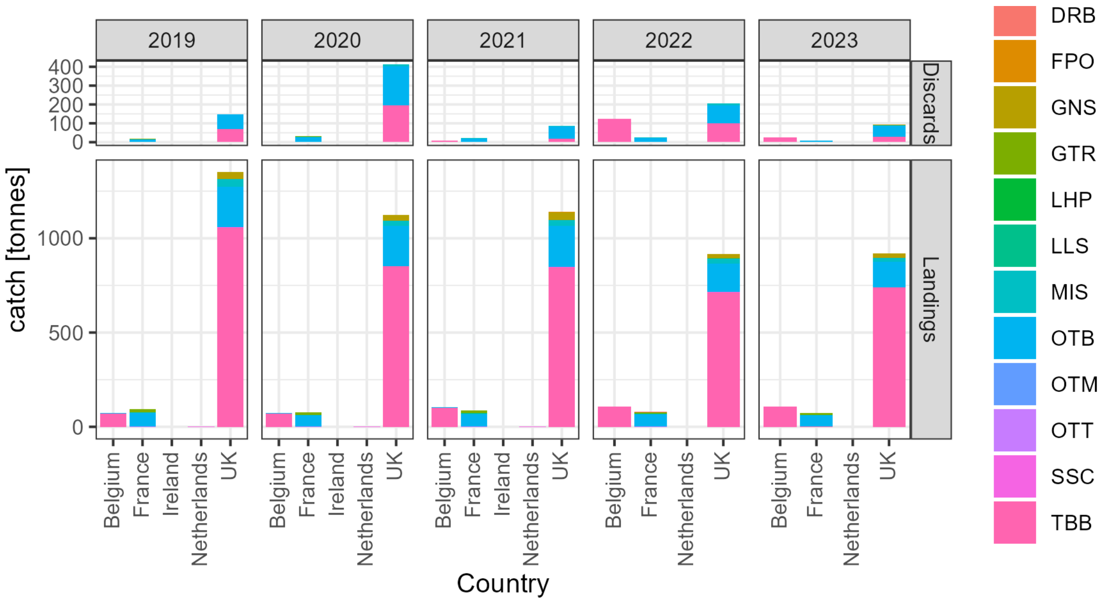

Figure 24.2. Plaice in 7.e. International landings and discards reported to InterCatch per country and fleet.

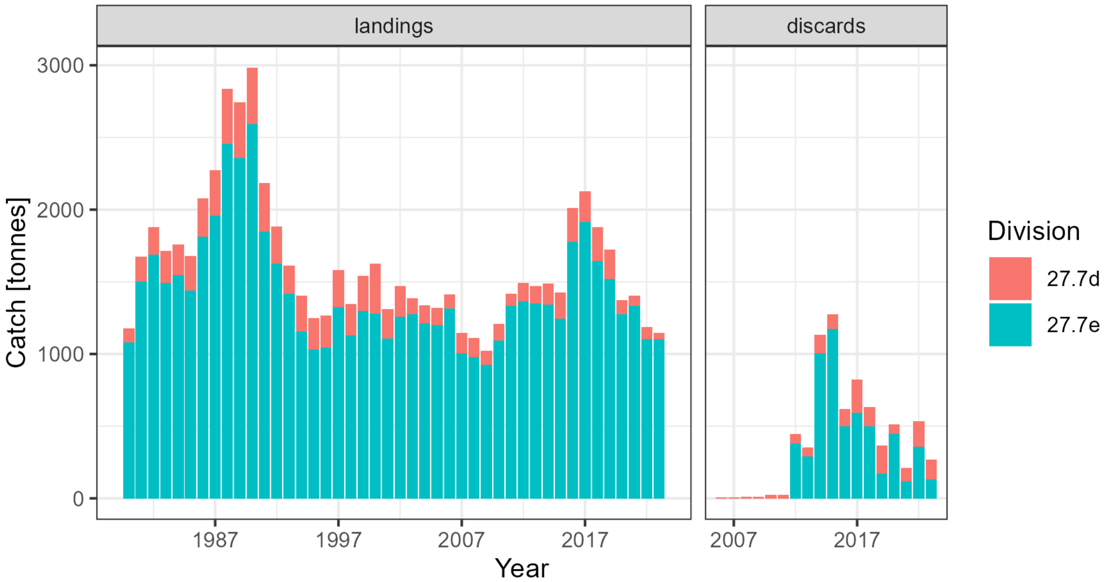

Figure 24.3. Plaice in 7.e. Landings and discards of the plaice 7.e stock disaggregated by the 7.e and the migration component from 7.d. Discard data are only available starting from 2012 for the Division 7.e.

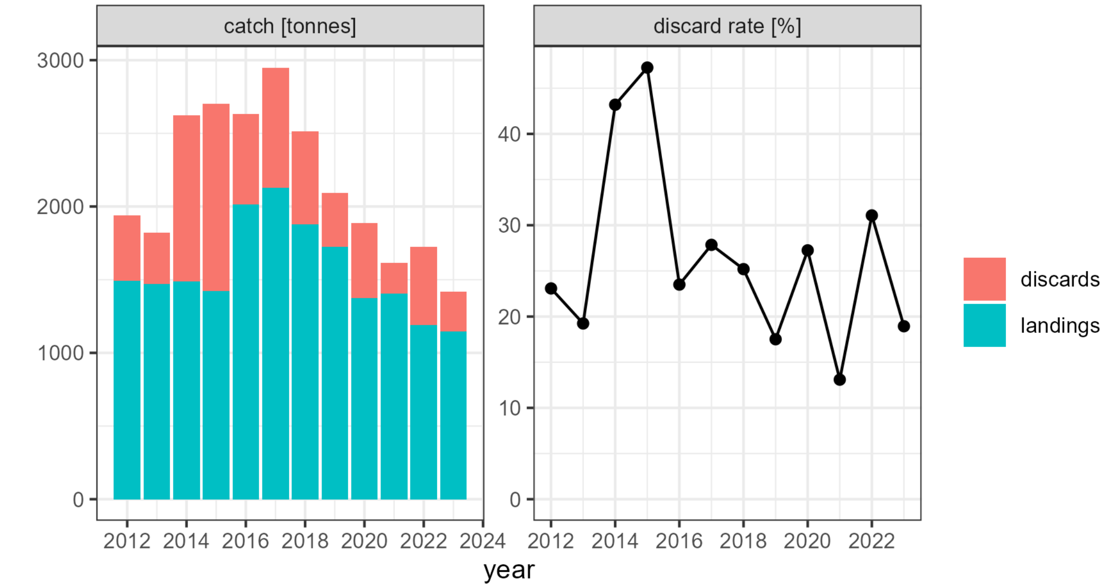

Figure 24.4. Plaice in 7.e. Landings, Discards and discard rate.

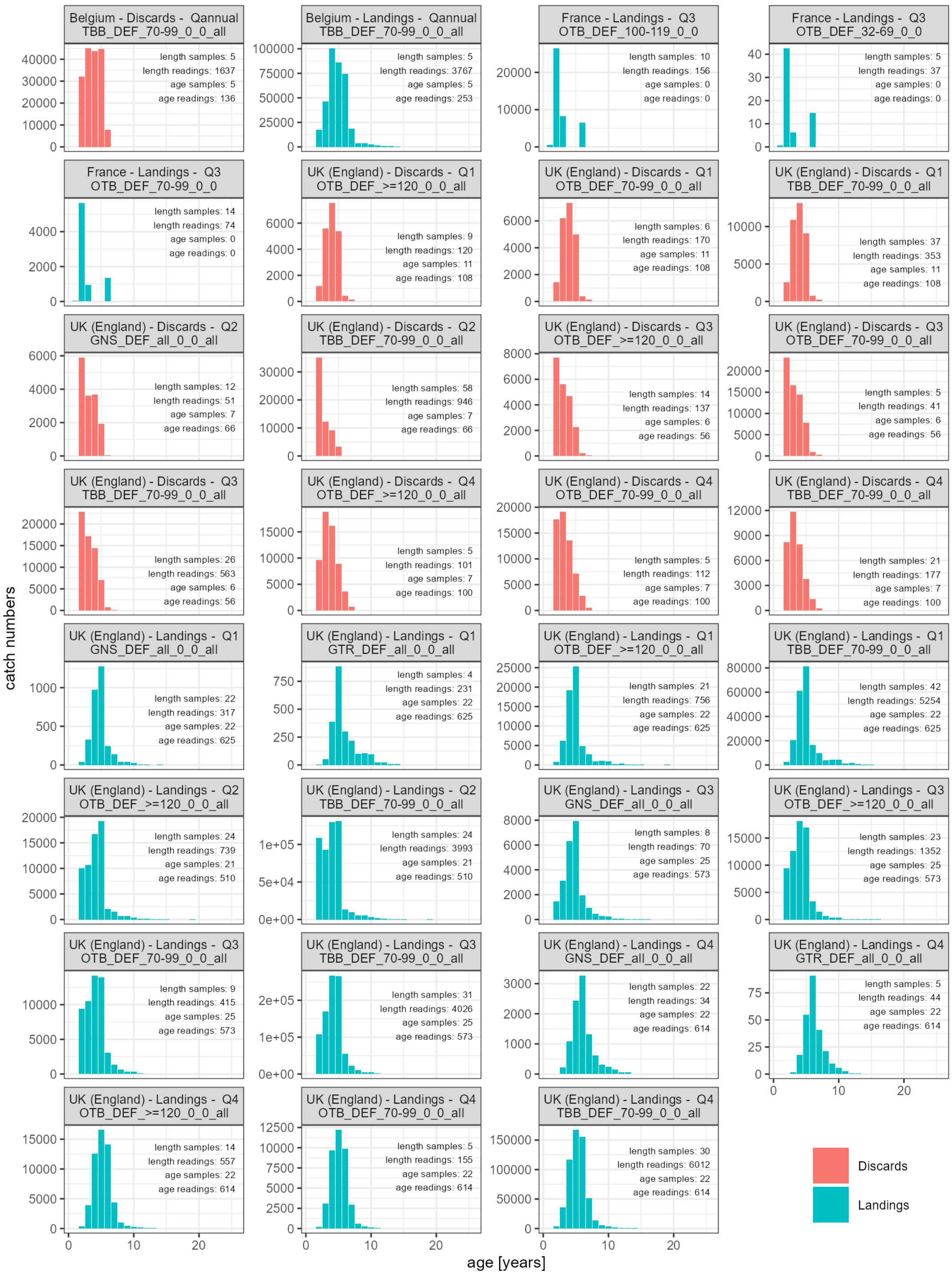

Figure 24.5. Plaice in 7.e. Age samples from InterCatch. The numbers are raised to fleet level.

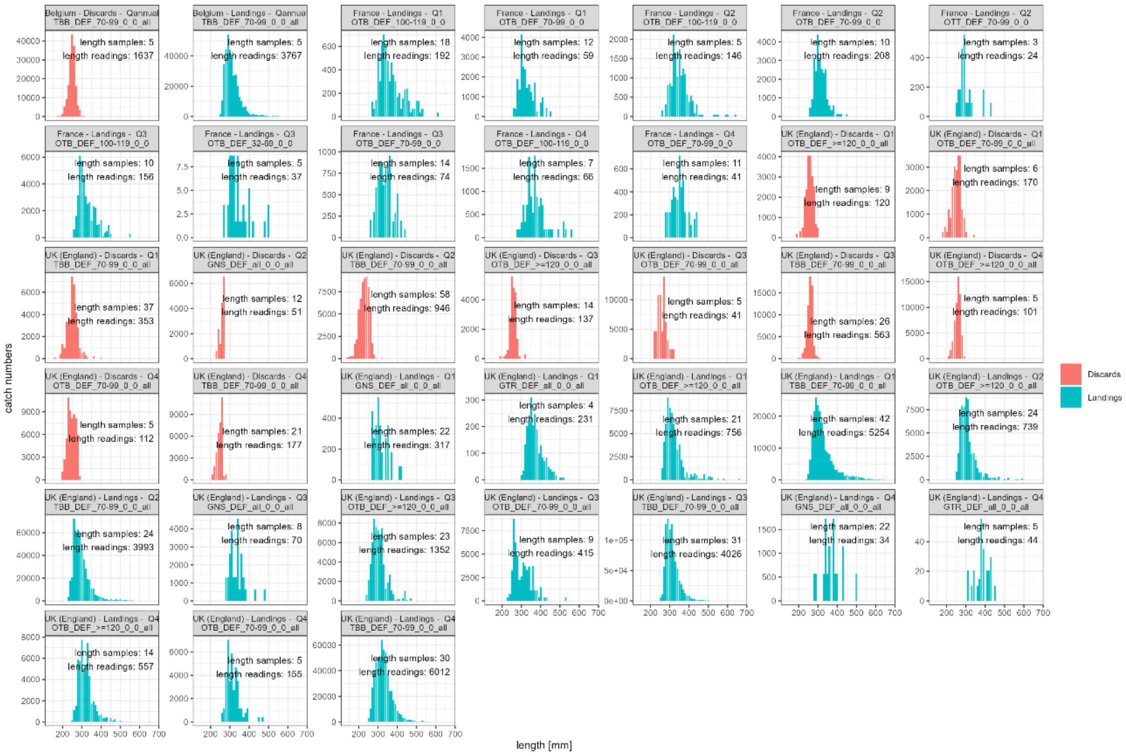

Figure 24.6. Plaice in 7.e. Length samples from InterCatch. The numbers are raised to fleet level.

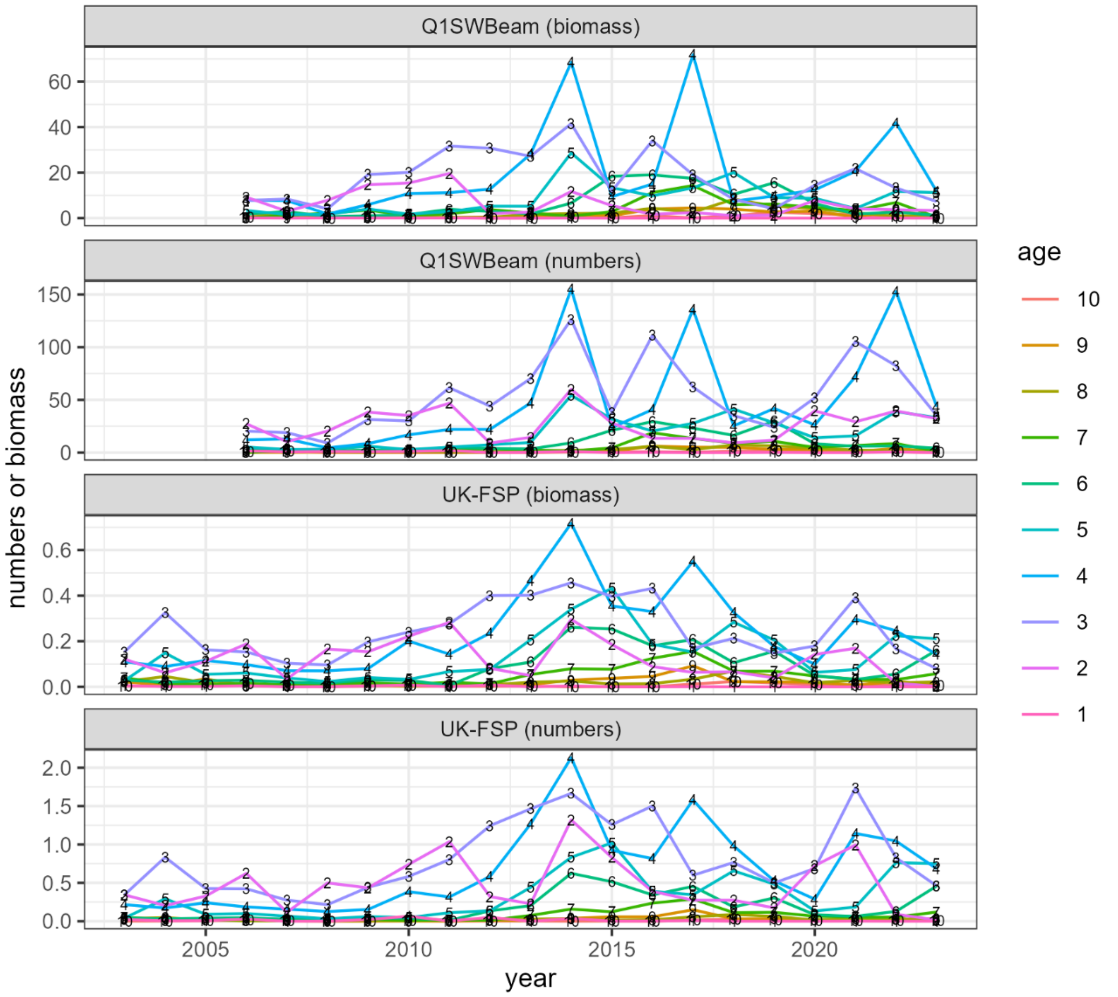

Figure 24.7. Plaice in 7.e. Scientific tuning information from the two surveys.

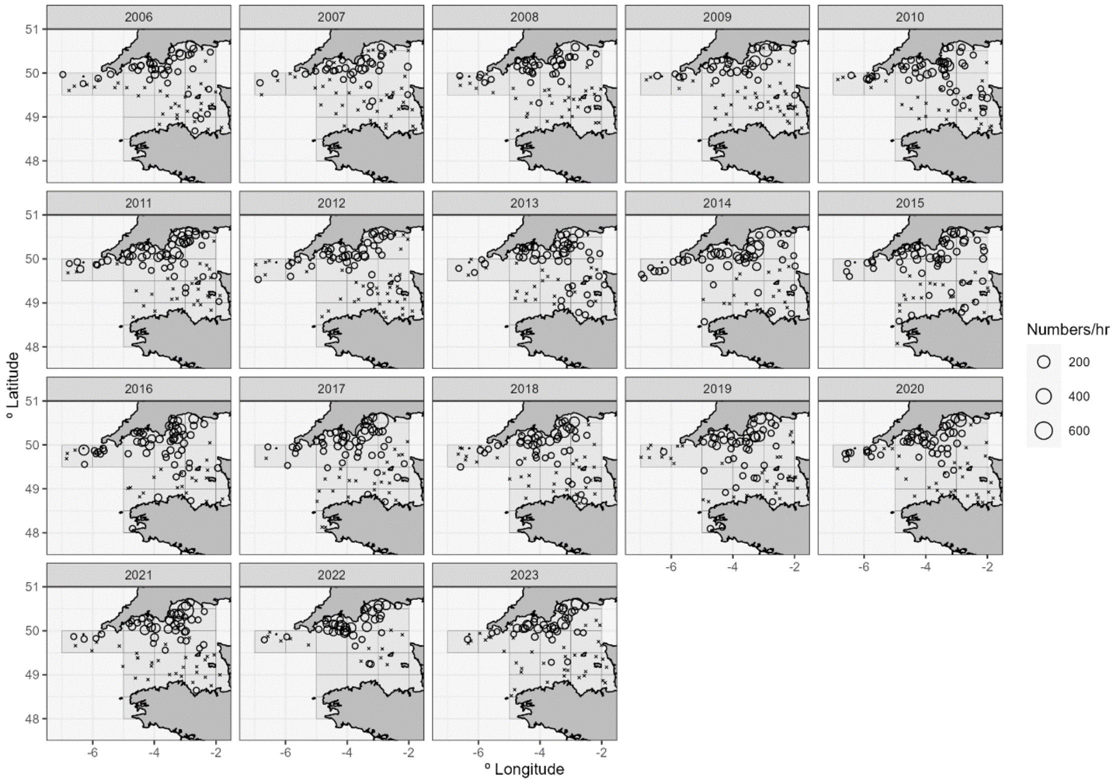

Figure 24.8. Plaice in Division 7.e. Plaice catch rates (numbers per hour) for the Q1SWBeam survey.

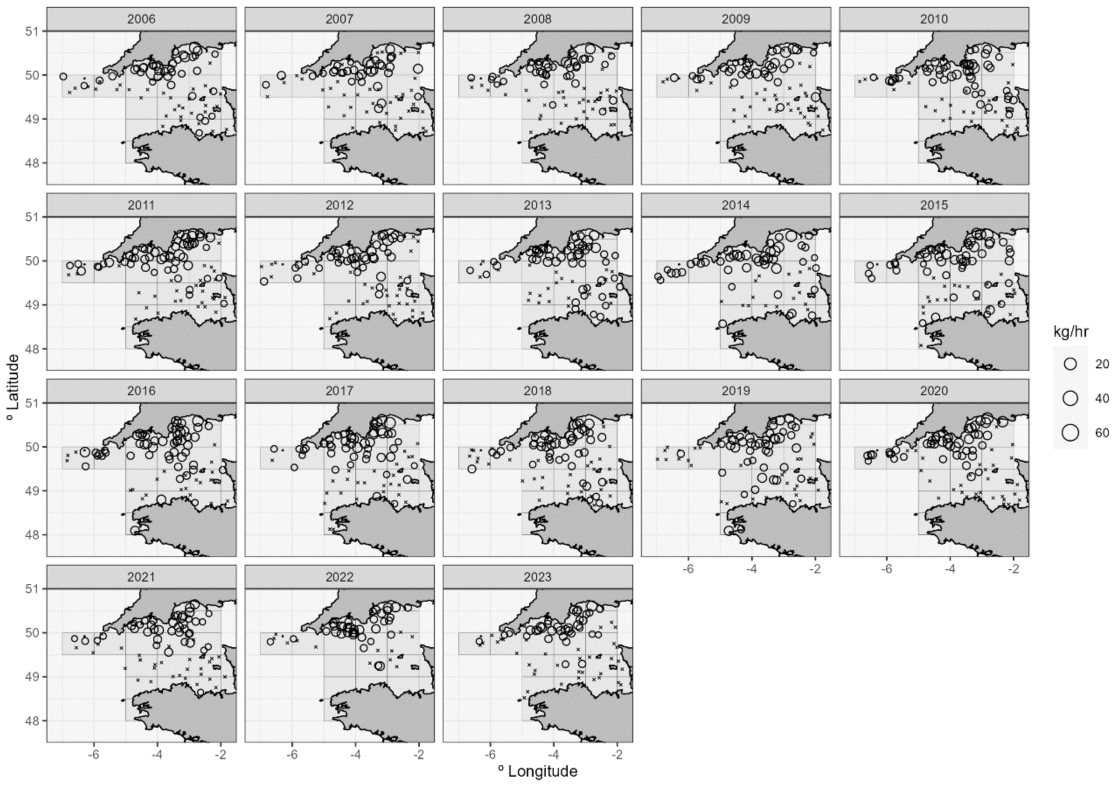

Figure 24.9. Plaice in Division 7.e. Plaice catch rates (kg per hour) for the Q1SWBeam survey.

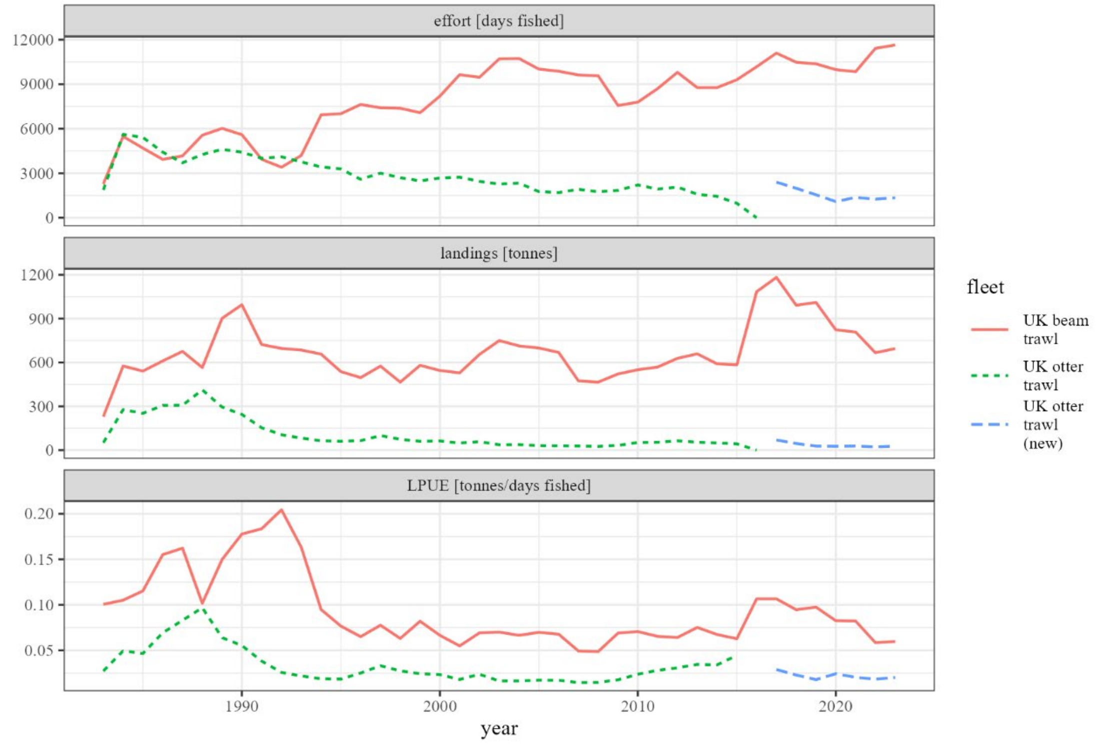

Figure 24.10. UK commercial LPUE time-series.

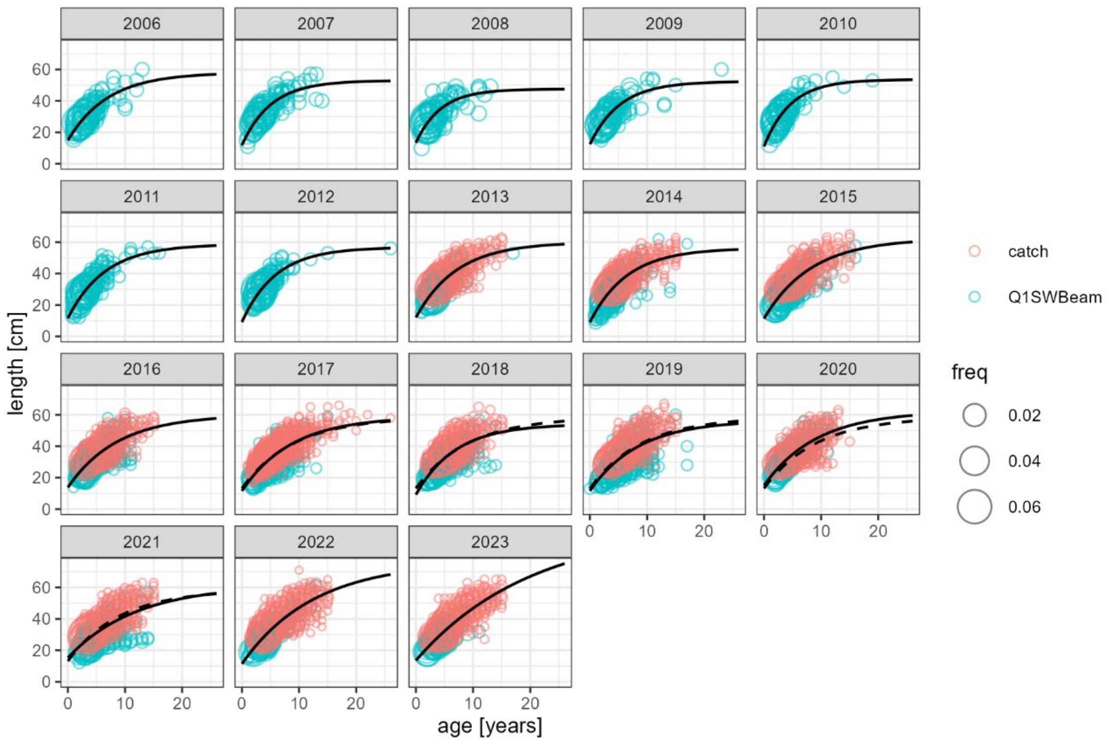

Figure 24.11. Plaice in 7.e. Age–length keys. The red circles represent data from sampling of the UK commercial catches and blue/green circles represent the fish aged from the Q1SWBeam survey. Solid black curves indicate annual fits of a von Bertalanffy growth function, dashed lines a fit to the combined data from 2017–2021.

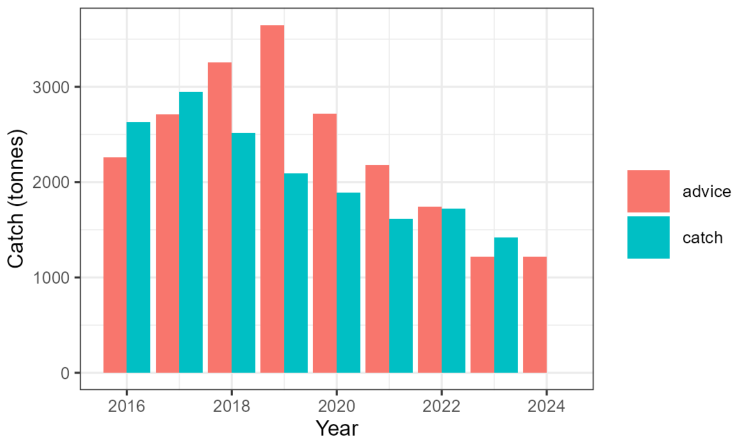

Figure 24.12. Plaice in 7.e. Comparison of catches (for the stock, including the migration component) to the catch advice.

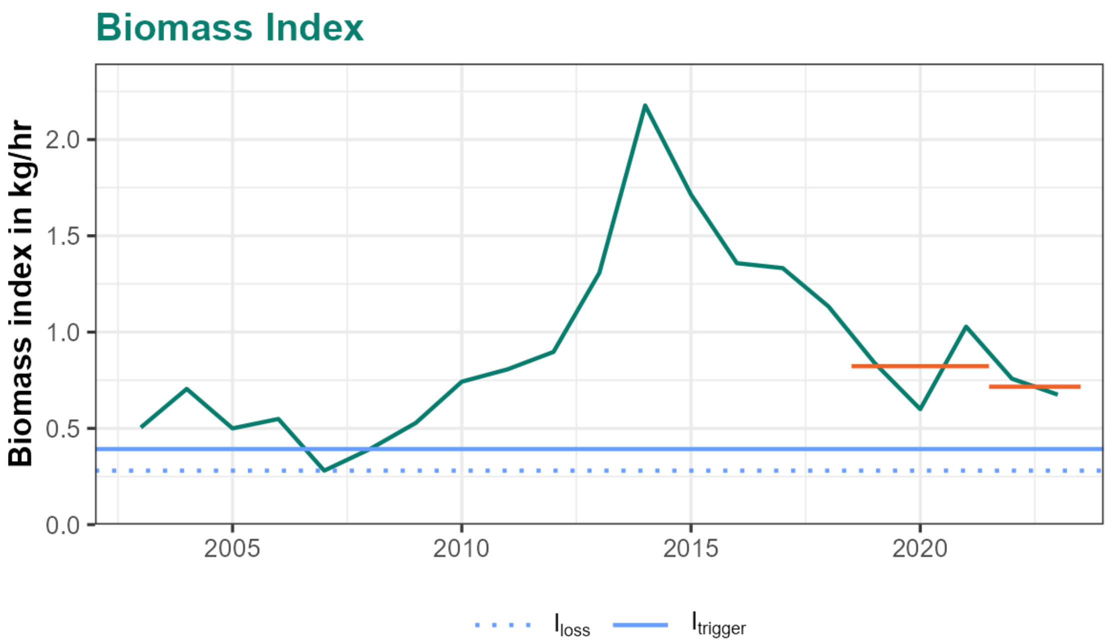

Figure 24.13. Plaice in 7.e. The biomass index used in the rfb rule. The biomass index is based on the UK-FSP survey and includes ages 2–8. The horizontal orange lines indicate the average of the biomass index for 2019 to 2021 and for 2022 to 2023.

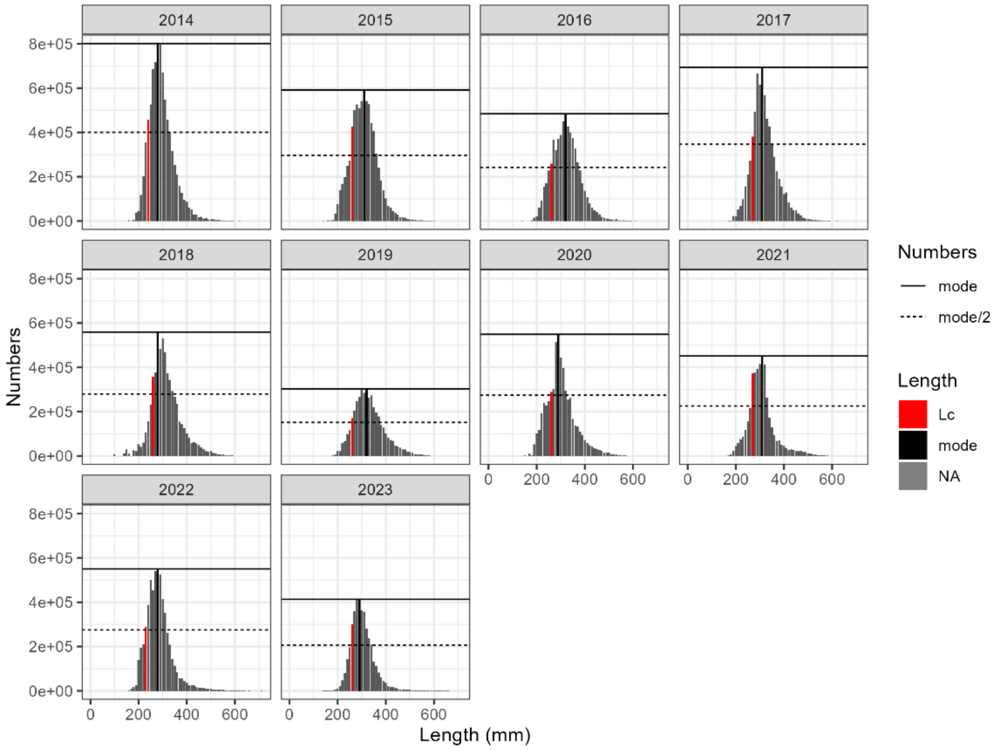

Figure 24.14. Plaice in 7.e. Total international length frequencies as raised within InterCatch for landings and discards, including length of first capture (Lc, calculated annually as first length class where the abundance is bigger or equal to half of maximum abundance).

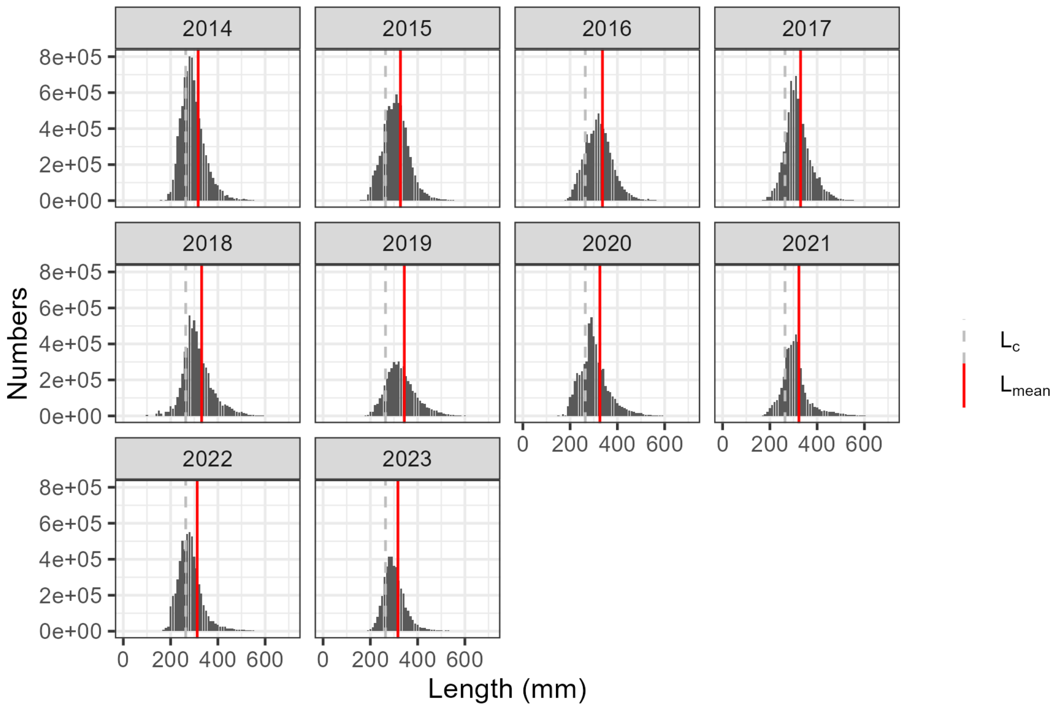

Figure 24.15. Plaice in 7.e. Total international length frequencies as raised within InterCatch for landings and discards, including mean catch length (L_{mean}) above length of first capture (L_c, constant for all years).

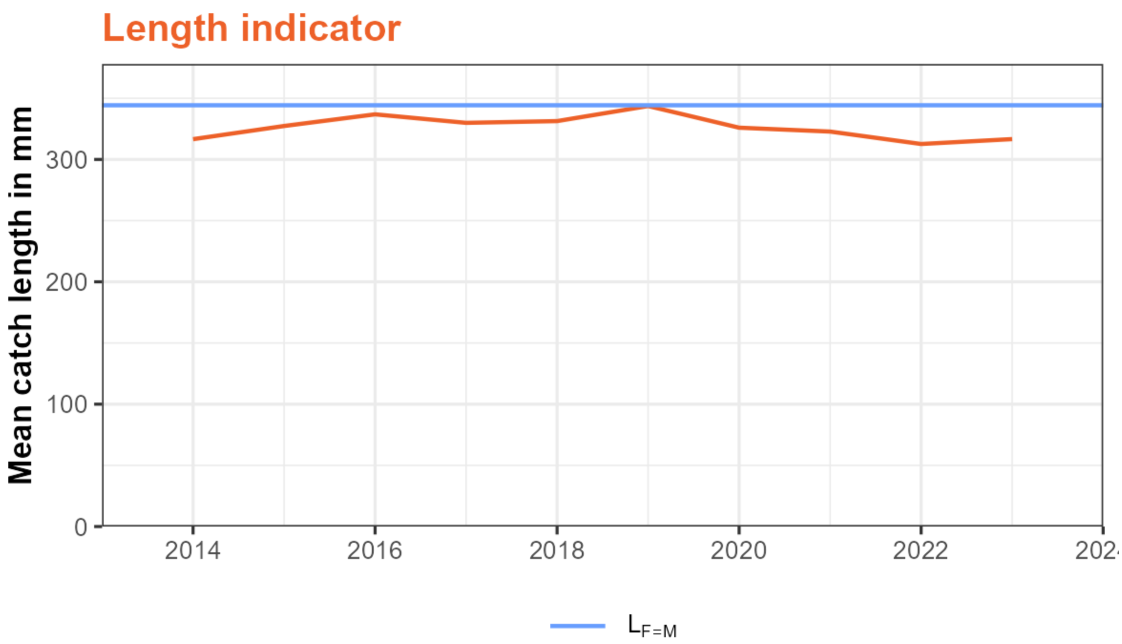

Figure 24.16. Plaice in 7.e. Mean catch length in comparison to the MSY proxy reference length $L_{F=M}$.

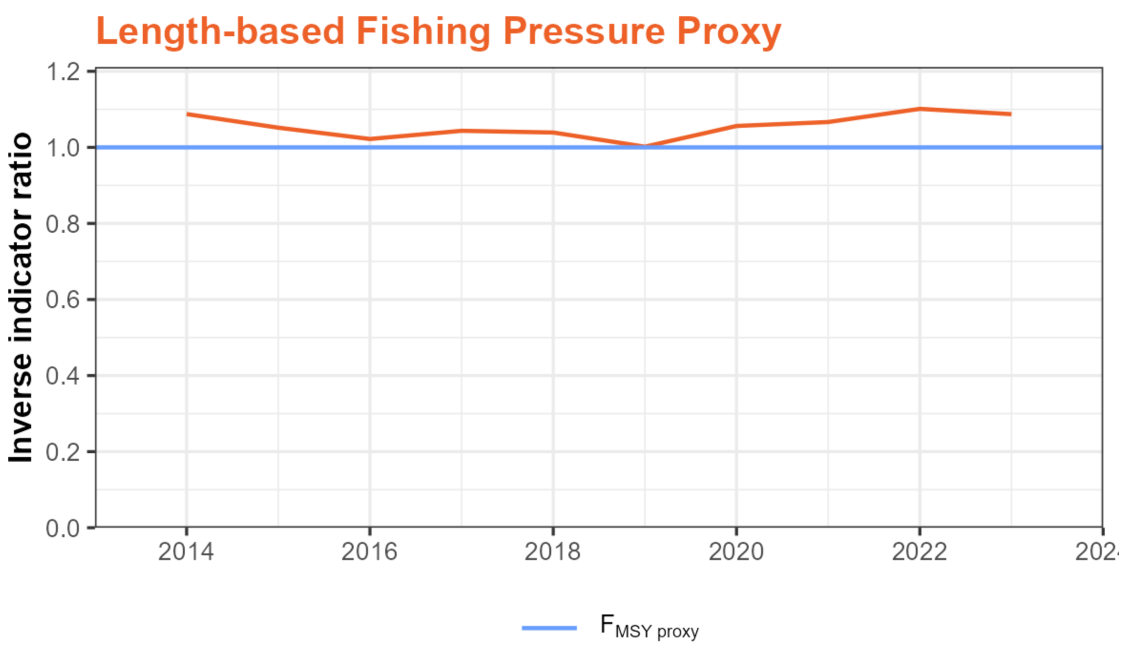

Figure 24.17. Plaice in 7.e. The length-based fishing pressure proxy. The values shown in this figure correspond to the inverse values for the previous figure (Figure 25.15).

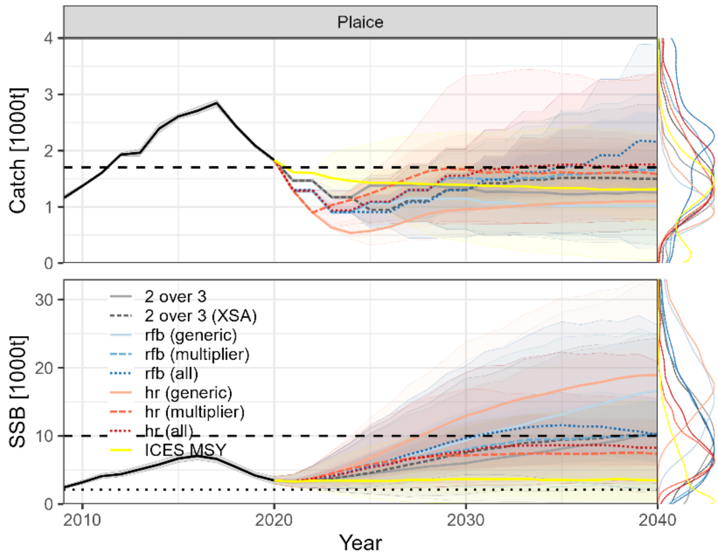

Figure 24.18. Plaice in 7.e. Projections corresponding to the management procedures for the baseline operating model. The curves represent medians, surrounded by 50% and 90% confidence intervals (shaded areas). The dashed horizontal lines indicate MSY reference values (MSY, B_{MSY}), and the dotted lines are the biomass limit reference value (B_{lim}). The lines on the right of the panels show the distribution in the last simulation year (2040). Source: Fischer *et al.*, (2023).

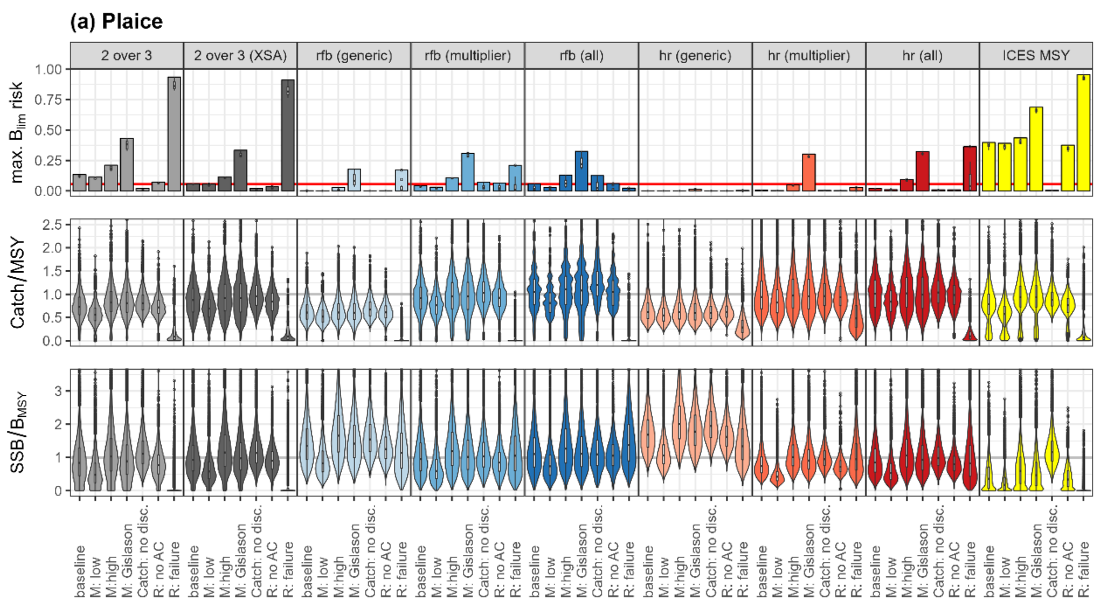

Figure 24.19. Plaice in 7.e. Summary statistics of all tested management procedures for plaice and all alternative operating models. Source: Fischer *et al.*, (2023).

Contents

25 Plaice in Divisions 7.f–g (Celtic Sea)

25.1 Type of assessment in 2024

In 2024, the stock was assessed as a category 3 stock and the rfb rule (ICES, 2022a) was applied to provide advice for 2025 and 2026. The previous assessment report (ICES, 2022b) is available at: http://doi.org/10.17895/ices.pub.19863796

ICES advice applicable to 2022

Advice applied to 2022 (ICES, 2021) is available at https://doi.org/10.17895/ices.advice.7823 and stated:

ICES advises that when the precautionary approach is applied, catches in 2022 should be no more than 1735 tonnes.

ICES advice applicable to 2023 and 2024

Advice applicable to 2023 and 2024 (ICES, 2022c) is available at https://doi.org/10.17895/ices.advice.19453634 and stated:

ICES advises that when the MSY approach is applied, catches should be no more than 402 tonnes in each of the years 2023 and 2024.

25.2 General

Stock description and management units

A TAC is allocated to ICES areas 7.f–g which corresponds to the stock area.

Management applicable to 2023 and 2024

TACs and quotas set for 2023 (source COUNCIL REGULATION (EU) No 194/2023)

Species: Plaice *Pleuronectes platessa*, Zone: 7.f and 7.g (PLE/7FG.)

Belgium	44
France	79
Ireland	147
Total EU	270
United Kingdom	103
Total TAC	402

TACs and quotas set for 2024 (source COUNCIL REGULATION (EU) 2024/257) available at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32024R0257#d1e42-1-1

Species: Plaice *Pleuronectes platessa*, Zone: 7.f and 7.g (PLE/7FG.)

Belgium	42
France	76
Ireland	142
Total EU	260
United Kingdom	105
Total TAC	402

25.2.1 Fishery in 2023

Most of the landings in 2023 came from ICES area 7.g (Figure 25.1). Plaice was harvested throughout the year. Total offical landings were 283t. The fleets harvesting plaice in the Celtic Sea primarily involved vessels from Belgium, France, Ireland and the UK, with negligible amounts taken by Netherlands. In 2023, Belgium reported 46.3% of the landings, France 8.5%, Ireland 31.1% and the UK 14.1%. The contribution of individual countries to total landings was similar to 2013–2023. The Working Group estimated that the reconstructed total catch (the sum of landings and discards) for 2023 was 518 t (Table 25.1), which is 129% of the TAC (402 t). Reconstructed discards represented 45.4% of the catch.

Most of the catch (65.0%) was taken by beam trawlers and 26.1% by bottom otter trawlers, seines accounted for 8.5%. Role of other métiers was insignificant. Effort and lpue of fishing fleets are presented in Table 25.2 - Table 25.4.

25.3 Intercatch data

25.3.1 Landings

International catch data are collated on the ICES InterCatch platform (https://intercatch.ices.dk). All landings are reported and recreational catch is supposed to be negligible. As usually, most of the landings were taken by beam trawlers Figure 25.2.

25.3.2 Discards

Discarding in this fishery is considered high (Table 25.1). During the 2024 working group, discard information was made available as annual summaries for Belgium, and on a quarterly basis for Ireland. As in previous years, most of dicarded fish was coming from beam trawlers with some input from otter trawlers targeting both demersal fish and crustaceans Figure 25.3. If discards were not reported for a particular year-quarter-country-métier combination, they are assumed to be unknown (non-zero) and they were estimated (i.e. raised) using Intercatch. Discard estimates were calculated based on the discard rates of similar fleets in terms of gear and mesh size in the same quarter.

WG estimates of discards show a steady increase from 2004 (when estimates started) to a peak in 2013, after which discard levels have remained variable but high, with discard estimates often exceeding landings. Since 2019 discarding rates decreased (Figure 25.4). Estimated discards for 2023 were 235t.

25.3.3 Biological information

25.3.3.1 Length composition

Length compositions for landings and discards were provided by the UK (England) and Ireland on a quarterly basis and on annual basis by Belgium; sampling covered 71.4% of all submitted landings and 60. 1% of submitted discards. Length compositions from national sampling programmes in 2023 are summarised in Figure 25.5. No important discarding of fish of the commercial size was found.

Catch length distributions were generated from InterCatch. If they were not reported, length distributions were calculated based on similar fleets in terms of gear and time (quarter /annual).

Length at first capture L_c was calculated annually for 2018–2023 following the ICES guidelines (ICES, 2022), which define L_c as the first (smallest) length class for which the catch numbers are at or above the mode of the distribution (the length class with the highest catch numbers). L_c showed little variability over the years (22-24 cm, Figure 25.6 and Table 25.5) and was 22 cm in 2023.

The annual mean length in catch L_{mean}, for length classes above L_c was calculated as the mean of length classes above L_c, weighted by the catch numbers per length class (Table 25.5, Figure 25.6).

25.3.4 Surveys

Indices of abundance from the UK(E&W)-BTS-Q3 beam trawl survey in 7.f and the Irish IBTS survey (IGFS-WIBTS-Q4) in 7.g are presented in Table 25.6 and Table 25.7. . The UK(E&W)-BTS-Q3 started in 1988 and was always used for tuning the AP model. The Irish Celtic Explorer IBTS survey (IGFS-WIBTS-Q4) time-series started in 2003 and was not used in earlier years. Both survey time-series were used for the stock trends-based advice in the years 2015, 2016 and 2017 and for SPiCT in 2018–2020.

In 2022, before applying rfb rule the UK(E&W)-BTS-Q3 survey and IGFS-WIBTS-Q4 survey total biomass indices were standardised and compared. They were found to show similar trends as well as it occurred in 2023 (Figure 25.7). The UK BTS was chosen for the assessment as carried out by a proper gear efficiently catching flatfish and covering the area of maximum abundance that includes also nursery grounds.

25.3.5 Commercial landings per unit of effort

Commercial indices of abundance from the different fisheries provide contradictory trends (Figure 25.8 - Figure 25.10), due to plaice not being primary target but rather a bycatch (to sole) species and varying discarding practices between fleets. Belgium beam-trawling fleet takes the largest portion of catch and therefore, it potentially might be the most reliable source of LPUE data to be used in an age-structured model or for stock trends. However, the Belgian landings and effort data are influenced by policy decisions, particularly often changing limits of how much plaice might be taken per fishing days depending on season, year and boat size. The resulting LPUE therefore should only be used for indicative purposes and be considered qualitatively (Nimmegeers et al., 2021).. Therefore, these LPUEs, regardless their precision and objectiveness, could not be considered as proxies for adult fish abundance. However, in 2018 and particularly in 2019–2023 the situation began to return to normal when most of fish of commercial size.

25.3.6 Other relevant data

There were no early closures of the fishery for plaice in 2023. Misreporting is not considered to be a problem in this stock. Recent research on discard survival in the English Channel has indicated that discard mortality of adult plaice captured by beam trawl varied with season, fish size and other factors like vessel type (Revill *et al*., 2013; Depestele *et al*., 2014; Uhlmann *et al*., 2016 a,b). Therefore, significant amounts (4 to 93%, mostly <50% in Belgian beam trawlers and mean 48% in French beam trawlers) might survive discarding which has been confirmed by several (3–15) days of observations in captivity (Depestele *et al*., 2014; Uhlmann *et al*., 2016 a). The survival estimate for the UK otter trawl fishery in the Western Channel was 47–63% and for the trammel net fishery 71–72%. The discard survival was also estimated as 19–20% for the North Sea UK otter trawl fishery and 4–15% in the Western Channel UK beam trawl fishery (Catchpole *et al*., 2015). Smaller undersized plaice that represent the bulk of discards are likely to have relatively higher mortality as with other flatfish species (review: Hendrikson, Nies, 2007). Generally, discard survival in a combined fleet of the different metérs is expected to be ~40% (Catchpole *et al*., 2015). There is no formal mixed-fishery analysis for this area, but plaice in 7.fg is considered to be primarily a bycatch of the targeted sole fishery, so changes in effort in the directed sole fishery as well as multiannual management measures (EU 2019) will impact fishing mortality on plaice.

25.4 Stock assessment

25.4.1 Assessment model

In 2022, WGCSE provided advice for 2023 and 2024 following the protocol for Category 3 stocks. As the SPiCT model did not provide satisfactory results, the rfb rule was implemented.

25.4.2 State of the stock

Index of the stock biomass is estimated to have been increasing between 2005 and 2015 and from 2016 declined until reaching the lowest values observed in 2023. The stock size index was below MSY $_{\text{Btrigger proxy}}$ (I_{trigger}). Figure 25.12). A similar trend was shown by CPUE of IrGFS (Figure 25.7).

25.4.3 Short-term projections

The short-term projections for the stock are not established.

25.4.4 Precautionary approach reference points

The length-based fishing pressure proxy on the stock was above FMSY proxy (Figure 25.12, Table 25.5), and last biomass index value was below the index trigger value established as 57.0 kg / 100 km. The stability clause was not applied because the recent biomass index value was below MSY Btrigger proxy.

25.4.5 Catch advice

The catch advice for plaice of the Celtic Sea and Bristol Channel resulted in estimate of 114 tonnes with projected landings of 68 tonnes.

Previous catch advice A_y (advised catch for 2024)	402 tonnes
Biomass index trend	
Index A (2022, 2023)	36 kg / 100 km
Index B (2019, 2020, 2021)	64 kg / 100 km
r: stock biomass trend (index ratio A/B)	0.55
Fishing pressure	
Mean catch length ($L_{mean} = L_{2023}$)	28.0 cm
MSY proxy length ($L_{F=M}$)	30.2 cm
Fishing pressure proxy ($L_{F=M}/L_{2023}$)	1.08
f: multiplier for relative mean length in catches ($L_{2023}/L_{F=M}$)	0.93
Biomass safeguard	
Last index value (I_{2023})	33 kg / 100 km
Index trigger value ($I_{trigger} = I_{loss} \times 1.4$)	57 kg / 100 km
b: multiplier for index relative to trigger, min{$I_{2023}/I_{trigger}$, 1}	0.58
Precautionary multiplier to maintain biomass above B_{lim} with 95% probability	
m: multiplier (generic multiplier based on life history)	0.95
RFB calculation**	114 tonnes
Stability clause (+20%/−30% compared to A_y, only applied if b = 1)	Not applied
Discard rate	40 %
Catch advice for 2025 and 2026 [$A_y \times r \times f \times b \times m$]	114 tonnes
Projected landings corresponding to advice ***	68 tonnes
% advice change^	−72%

25.5 Management plans

The EU has proposed a multiannual management plan for the Western Waters (EU, 2018). However, this stock was excluded from the final version (EU 2019, approved on 05/03/2019 Meeting n°3676 - https://www.consilium.europa.eu/en/meetings/env/2019/03/05/). Therefore, there is no management plan for Celtic Sea plaice.

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25.7 Tables

Table 25.1. Plaice in divisions 7.f–g. Official landings (t) by country as reported to ICES, and total landings as used by ICES WGCSE.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Belgium	214	196	171	372	365	341	314	283	357	665
UK (Engl. & Wales)	150	152	176	227	251	196	279	366	466	529
France	365	527	467	706	697	568	532	558	493	878
Ireland	28	0	49	61	64	198	48	72	91	302
N. Ireland										
Netherlands										9
Scotland	0	0	0	7	0	0	0	0	0	1
Total reported	757	875	863	1373	1377	1303	1173	1279	1407	2384
Unallocated	0	0	0	0	0	0	-27	-69	345	-693
Landings used by WG	757	875	863	1373	1377	1303	1146	1210	1752	1691
Catch as used by WG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Discards as used by WG*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	581	617	843	794	836	371	542	350	346	410
UK (Engl. & Wales)	496	629	471	497	392	302	290	251	284	239
France	708	721	1089	767	444	504	373	298	254	246
Ireland	127	226	180	160	155	180	89	82	70	83
N. Ireland		1								
Scotland				1		5	9	1	2	
Total reported	1912	2194	2583	2219	1827	1362	1303	982	956	978
Unallocated	-11	-78	-432	-137	-326	-174	-189	88	72	-26
Landings used by WG	1901	2116	2151	2082	1501	1188	1114	1070	1028	952
Catch as used by WG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Discards as used by WG*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	594	540	371	224	241	248	221	212	168	172
UK (Engl. & Wales)	258	176	170	134	136	105	127	87	55	88
France	329	298		287	262	186	165	145	132	106
Ireland	78	135	115	76	45	79	51	45	44	48
Total reported	1259	1149	656	721	684	618	564	489	399	414
Unallocated	-42	-82	312	-3	30	24	30	21	-13	-10
Landings used by WG	1217	1067	968	718	714	642	594	510	386	404
Catch as used by WG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	784	707	857
Discards as used by WG*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	274	321	453

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Belgium	194	188	216	188	210	203	185	182	185	243
UK	61	63	55	54	45	45	41	25	25	27
France	104	70	NA	136	98	125	106	155	111	108
Ireland	58	64	63	63	67	76	80	49	59	52
Total reported	417	385	NA	442	420	450	412	411	381	430
Unallocated	-7	52	-1	-9	7	-8	-2	-1	0	0
Landings used by WG	410	437	481	442	427	442	414	410	381	431
Catch as used by WG	1698	1020	1089	1112	1534	1565	1688	1183	1159	1002
Discards as used by WG*	1288	583	608	670	1107	1123	1274	772	778	571

	2017	2018	2019	2020	2021	2022^	2023^
Belgium	179	204	263	332	263	300	131
UK	38	40	45	47	48	40	40
France	108	127	84	47	51	51	24
Spain			1	<1	0.5	5	
Netherlands			<1	<1			<1
Ireland	63	51	**	110	106	128	88
Total reported	388	422	394 **	536	474	524	283

Unallocated	1	0	-2	0	6	-2	0
Landings used by WG	389	422	642	536	468	522	283
Catch as used by WG	1284	930	831	893	846	748	518
Discards as used by WG*	895	508	189	357	378	226	235

*** Discard estimated by the working group.**

**** Incomplete / missing due to part of the data being unavailable under national GDPR clauses.**

^Preliminary official landings.

Table 25.2. Plaice in divisions 7.f–g: lpue and cpue for UK(E&W) fleets.

	LANDINGS PER UNIT OF EFFORT (LPUE) kg\day						EFFORT, fishing days					
	VIIf		VIIg EAST		VIIg WEST		VIIf		VIIg EAST		VIIg WEST	
	lpue		lpue		lpue		Effort		Effort		Effort	
	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM
YEAR		TRAWL		TRAWL		TRAWL	(Days fished)	(Days fished)	(Days fished)	(Days fished)	(Days fished)	(Days fished)
1983	86.39	30.33	71.84	54.85	0	75.69	620	195	82	149	0	8
1984	79.67	99.69	94.5	106.65	0	66.96	1723	901	316	298	0	129
1985	115.93	122.91	119.63	174.39	67.62	233.25	1493	1101	206	285	23	92
1986	119.81	113.62	103.37	183.72	49.93	380.2	1125	973	334	180	35	29
1987	131.27	114.34	223.13	291.3	33.68	446.46	1211	1681	364	187	26	26
1988	232.51	247.91	217.11	356.02	48.43	670.38	838	1102	351	77	20	36
1989	130.84	138.62	137.76	293.89	86.54	575.3	966	861	327	125	15	7
1990	75.55	88.83	59	166.69	78.13	147.13	1229	1256	435	165	24	194
1991	48.2	93.83	44.9	73.4	42.22	109.4	1066	1667	306	483	45	104
1992	49.33	57.2	41.29	69.8	45	70.04	898	1420	303	633	435	90
1993	43.85	69.98	23.83	65.14	56.64	32.85	836	1669	251	694	30	135
1994	39.67	40.41	31.76	49.39	10.7	70.61	623	2219	225	610	19	116
1995	41.81	43.01	30.91	54.05	61.67	37.12	580	2303	196	694	30	128
1996	38.8	33.67	26.25	27.49	6.15	11.82	593	2391	341	560	105	220
1997	34.61	31.01	21.37	33.42	17.47	7.5	577	2661	370	770	122	146

	LANDINGS PER UNIT OF EFFORT (LPUE) kg\day						**EFFORT, fishing days**					
	VIIf		VIIg EAST		VIIg WEST		VIIf		VIIg EAST		VIIg WEST	
	lpue		lpue		lpue		Effort		Effort		Effort	
	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM	TRAWL	BEAM
YEAR		TRAWL		TRAWL		TRAWL	(Days fished)	(Days fished)	(Days fished)	(Days fished)	(Days fished)	(Days fished)
1998	21.86	26.07	15.53	15.33	5.12	12.65	517	2846	385	591	94	159
1999	35.6	26.62	20.65	12	5.14	11.96	395	3058	176	1461	235	312
2000	32.09	16.1	40.58	11.64	3.35	10.1	284	3133	187	1007	160	200
2001	34.02	16.69	32.3	15.26	4.66	11.04	309	3172	187	1155	179	91
2002	19.78	15.64	48.8	20.81	7.43	4.81	416	2652	123	463	170	60
2003	23.45	18.24	8.19	20.78	4.48	1.49	696	2669	51	772	124	158
2004	18.77	15.54	8.66	7.81	3.09	3.39	641	2503	198	923	125	178
2005	11.2	11	2.14	8.25	0.25	1.33	876	1968	21	618	154	116
2006	21.21	12.77	5.91	15.19	0.64	0.58	924	1330	23	630	233	70
2007	14.79	17.93	20.42	10.58	1.71	5.9	798	1407	31	518	219	12
2008	18.01	21.2	21.1	10.22	0.08	1.72	711	1202	109	290	229	5
2009	14.4	15.66	11.58	14.77	1.63	0.76	656	1105	244	266	296	48
2010	14.09	27.93	12.88	11.82	0.31	1.06	565	1162	84	327	469	78
2011	11.11	32.98	5.43	17.11	2.09	0.76	525	868	8	180	353	111
2012	10.96	17.7	3.11	9.38	0.67	0.51	543	1408	138	275	487	102
2013	6.4	12.29	0.89	8.18	0.44	0.61	280	1611	72	265	37	77

YEAR	LANDINGS PER UNIT OF EFFORT (LPUE) kg\day VIIf lpue TRAWL	VIIf lpue BEAM TRAWL	VIIg EAST lpue TRAWL	VIIg EAST lpue BEAM TRAWL	VIIg WEST lpue TRAWL	VIIg WEST lpue BEAM TRAWL	EFFORT, fishing days VIIf Effort TRAWL (Days fished)	VIIf Effort BEAM (Days fished)	VIIg EAST Effort TRAWL (Days fished)	VIIg EAST Effort BEAM (Days fished)	VIIg WEST Effort TRAWL (Days fished)	VIIg WEST Effort BEAM (Days fished)
2014	5.76	15.52	7.43	10.61	0.08	2.5	156	959	10	131	176	24
2015	18.82	11.87	37.87	14.58	0	3.65	79	726	3	245	165	56
2016	0	14.91	0	9.57	0.07	0.05	136	915	0	396	329	34
2017	24.98	18.57	2.97	10.28	0.05	2.47	93	986	95	514	193	74
2018	11.1	19.53	27.1	7.77	0.93	10.7	127	1071	71	440	210	15
2019	19.62	32.97	11.95	26.73	1.11	8.58	169	981	34	255	277	8
2020	8.4	34.41	2.31	26.41	0	0.17	100	1012	10	346	40	99
2021	6.28	23.68	35.1	17.14	17.35	0.16	155	1260	22	547	28	102
2022	14.79	17.24	7.89	21.64	6.34	0.95	90	1275	4	207	36	77
2023	10.88	22.48	0.35	19.67	0.96	0.12	120	970	22	338	115	92

Table 25.3. Plaice in divisions 7.f–g: lpue and effort for Belgian fleets in 7.f–g.

		BELGIAN Beam Trawl 7fg	
Year	Landings (t)	Effort (000 hr)	lpue (kg/h)
1996	356.89	53.27	6.70
1997	474.71	57.36	8.28
1998	443.38	57.79	7.67
1999	410.22	55.11	7.44
2000	230.63	51.34	4.49
2001	274.84	54.90	5.01
2002	259.80	49.60	5.24
2003	215.95	62.73	3.44
2004	207.27	78.73	2.63
2005	153.73	64.50	2.38
2006	134.44	50.28	2.67
2007	139.39	45.72	3.05
2008	106.29	26.71	3.70
2009	140.76	30.84	4.56
2010	127.15	32.74	3.88
2011	159.03	41.41	3.84
2012	165.73	46.25	3.58
2013	155.973	45.159	3.454
2014	155.317	31.271	4.967
2015	165.17	31.792	5.195
2016	212.01	32.34	6.556
2017	169.03	33.35	5.07
2018	186.861	31.48	5.94
2019	226.443	32.033	7.131
2020	293.355	41.699	7.035
2021	246.11	35.446	6.943
2022	280.004	42.274	6.624

	BELGIAN Beam Trawl 7fg		
Year	Landings (t)	Effort (000 hr)	lpue (kg/h)
2023	121.809	44.872	2.715

Table 25.4. Plaice in Divisions 7.f–g: lpue and effort for Irish otter trawl, beam and seine fleets in 7.g.

	IR-OTB-7G			IR-SCC-7G		
Year	Landings (t)	Effort (000 hr)	lpue (kg/h)	Landings (t)	Effort (000 hr)	lpue (kg/h)
1995	94.23	63.56	1.48	9.55	6.43	1.49
1996	133.66	60.04	2.23	14.20	9.73	1.46
1997	119.84	65.10	1.84	38.79	16.13	2.40
1998	96.72	72.30	1.34	21.38	14.94	1.43
1999	60.05	51.66	1.16	10.40	8.01	1.30
2000	26.78	60.60	0.47	11.40	9.90	1.15
2001	23.82	69.43	0.34	10.93	16.33	0.67
2002	42.30	77.69	0.54	16.42	20.86	0.79
2003	26.35	86.79	0.30	13.80	20.91	0.66
2004	26.62	96.99	0.27	5.04	19.38	0.26
2005	22.78	124.40	0.18	6.47	14.81	0.44
2006	25.17	119.23	0.21	5.10	14.79	0.34
2007	30.99	136.52	0.23	4.76	15.82	0.30
2008	39.17	125.81	0.31	8.38	11.65	0.72
2009	43.81	137.11	0.32	7.98	8.19	0.98
2010	44.29	140.65	0.31	10.71	9.69	1.11
2011	44.68	120.33	0.37	11.12	11.01	1.01
2012	43.21	121.08	0.35	18.41	14.15	1.30
2013	31.91	118.13	0.28	11.10	12.06	0.84
2014	26.00	127.40	0.22	7.60	12.00	0.61
2015	33.34	132.69	0.25	8.36	9.28	0.90
2016	34.80	148.17	0.23	9.37	10.44	0.90
2017	40.86	135.98	0.30	10.49	9.75	1.08

	IR-OTB-7G			IR-SCC-7G			
2018	33.64	105.81	0.32	8.13	9.69	0.84	
2019	33.89	103.89	0.33	16.40	14.26	1.15	
2020	54.63	89.91	0.61	17.45	13.59	1.28	
2021	52.04	83.90	0.62	25.13	14.80	1.70	
2022	56.23	64.4	0.87	28.54	14.30	2.00	
2023	121.809	44.872	2.715	24.96	16.54	1.509	
		IR-TBB-7G					
Year	Landings (t)	Effort (000 hr)	lpue (kg/h)	Year	Landings (t)	Effort (000 hr)	lpue (kg/h)
1995	37.92	20.78	1.83	2010	6.56	40.22	0.16
1996	53.02	26.76	1.98	2011	6.71	35.33	0.19
1997	94.59	26.25	3.35	2012	33.63	40.33	0.83
1998	122.13	35.25	3.46	2013	32.32	38.48	0.84
1999	25.80	40.87	0.63	2014	12.50	37.80	0.33
2000	12.62	37.03	0.34	2015	12.10	37.79	0.32
2001	4.80	39.71	0.12	2016	9.83	39.55	0.25
2002	7.08	31.62	0.22	2017	12.39	35.21	0.35
2003	9.37	49.26	0.19	2018	9.62	37.42	0.26
2004	6.17	54.86	0.11	2019	20.32	34.08	0.60
2005	9.49	49.65	0.19	2020	43.20	29.14	1.48
2006	14.46	60.48	0.24	2021	49.07	31.57	1.55
2007	21.18	55.86	0.38	2022	52.46	22.50	2.33
2008	14.18	37.22	0.38	2023	36.26	28.85	1.257
2009	6.96	37.96	0.18				

Table 25.5. Annual values for length at first capture (Lc), mean length (Lmean) and MSY proxy length ($L_{F=M}$) reference point for plaice in areas 7.f and 7.g.

Year	Lmean (cm)	Lc (cm)	$L_{F=M}$ (cm)
2018	29.5	24	30.2
2019	30.1	24	30.2
2020	26.7	24	30.2
2021	26.3	22	30.2
2022	29.2	24	30.2
2023	28.0	22	30.2

Table 25.6. Plaice in divisions 7.f–g: Survey abundance indices (numbers at age) by age class (1 to 8+) for the Irish IBTS survey in area 7.g.

Year/Age	1	2	3	4	5	6	7	8+
2003	832	0	45	84	37	8	3	1
2004	980	2	6	31	51	20	13	1
2005	845	39	63	83	19	9	3	3
2006	1046	3	105	80	22	18	11	12
2007	1168	2	51	166	68	22	9	8
2008	1139	7	113	106	72	19	8	5
2009	1018	213	199	548	247	100	21	16
2010	1381	233	871	304	479	197	84	23
2011	1392	250	1150	701	195	210	84	107
2012	1470	358	992	901	277	50	49	71
2013	1439	37	386	894	473	173	47	148
2014	1487	9	195	354	336	151	84	54
2015	1236	16	778	580	267	312	61	102
2016	1438	27	332	805	333	221	215	101
2017	1233	17	236	264	267	222	76	95
2018	1028	3	94	168	113	135	54	56
2019	1386	37	167	134	303	134	118	92
2020	1178	15	160	137	100	116	74	129
2021	1349	14	623	686	391	126	100	116
2022	1152	5	55	85	97	72	26	49
2023	1344	23	56	80	102	77	50	60

Table 25.7. Plaice in divisions 7.f–g: Survey abundance indices (number per 100 km towed) by age class for the UK-BTS survey in area 7.f

UK(E&W)-BTS-Q3												
	Age class											
Year	0	1	2	3	4	5	6	7	8	9	10+	Total
1993	3	102	90	37	2	4	0	1	0	0	0	239
1994	122	107	32	16	8	1	0	0	0	0	0	286
1995	1	240	90	17	3	7	2	0	0	2	0	361
1996	8	224	288	31	1	3	1	0	0	0	0	555
1997	7	225	102	35	4	2	2	1	0	0	0	378
1998	5	237	126	47	9	2	1	0	0	0	1	428
1999	162	153	80	29	20	7	0	0	2	0	0	452
2000	85	340	63	31	7	6	0	1	0	0	0	532
2001	36	211	156	16	9	4	3	2	0	0	0	437
2002	1	137	175	80	6	6	2	4	1	0	0	412
2003	61	98	80	61	22	3	2	1	1	2	0	330
2004	164	259	33	27	13	2	1	1	2	0	2	505
2005	3	193	75	21	8	11	3	1	0	0	1	314
2006	81	86	102	34	10	2	9	0	2	1	0	326
2007	35	150	92	47	15	2	3	1	2	1	0	347
2008	6	141	217	47	16	5	1	2	0	0	1	435
2009	186	162	56	79	21	11	4	2	0	1	0	522
2010	143	332	89	26	40	7	4	1	0	1	2	644
2011	8	362	300	55	22	21	14	3	3	1	0	789
2012	17	142	431	101	22	9	13	5	1	0	0	740
2013	64	330	139	185	47	6	4	8	3	1	0	786
2014	0	372	202	65	106	24	2	3	2	2	2	778
2015	19	28	454	162	52	77	48	15	8	4	4	873
2016	0	13	163	268	102	28	33	16	6	1	1	631

UK(E&W)-BTS-Q3												
	Age class											
Year	0	1	2	3	4	5	6	7	8	9	10+	Total
2017	2	11	104	137	121	92	19	27	11	0	0	525
2018	87	4	45	90	58	75	58	18	10	4	5	456
2019	22	115	139	38	15	11	35	25	10	6	5	421
2020	2	7	113	140	43	12	10	8	19	2	4	359
2021	12	38	44	76	43	7	15	8	6	2	1	252
2022	62	18	45	26	35	19	8	2	5	2	2	224
2023	1	37	117	18	16	9	3	3	3	1	3	210

25.8 Figures

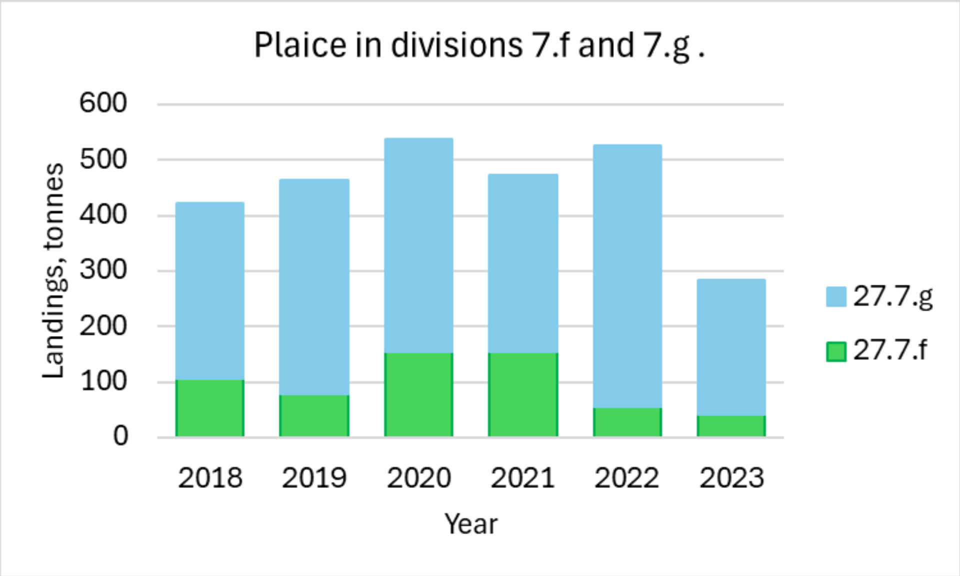

Figure 25.1. Plaice in divisions 7.f-g: Distribution of landings of plaice (*Pleuronectes platessa*) by ICES area in 2023.

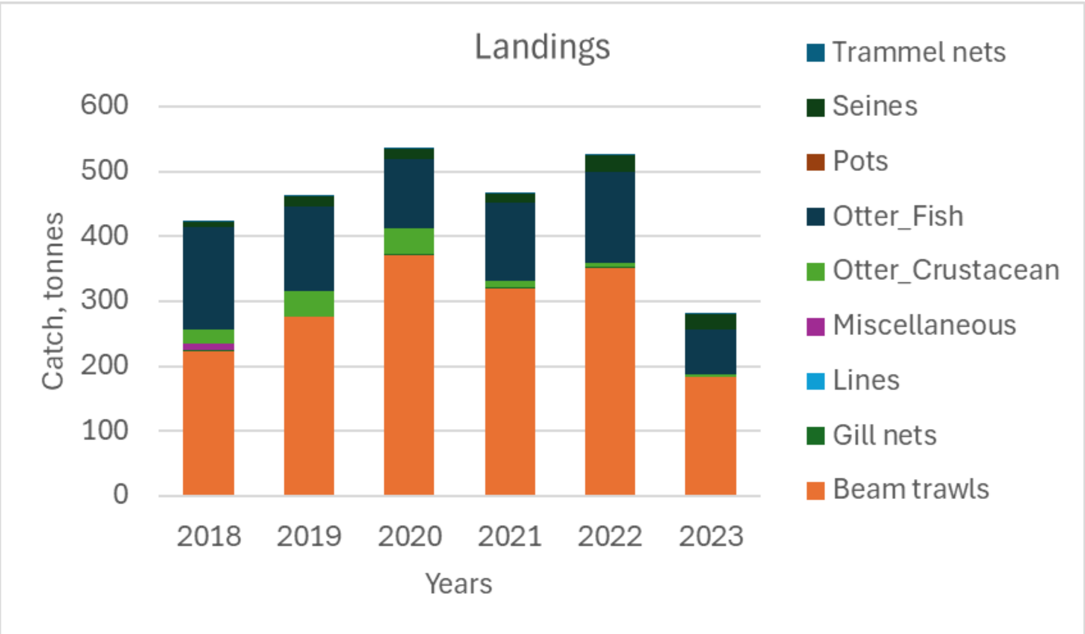

Figure 25.2. Plaice in divisions 7.f-g. InterCatch landings data by year, country and gear.

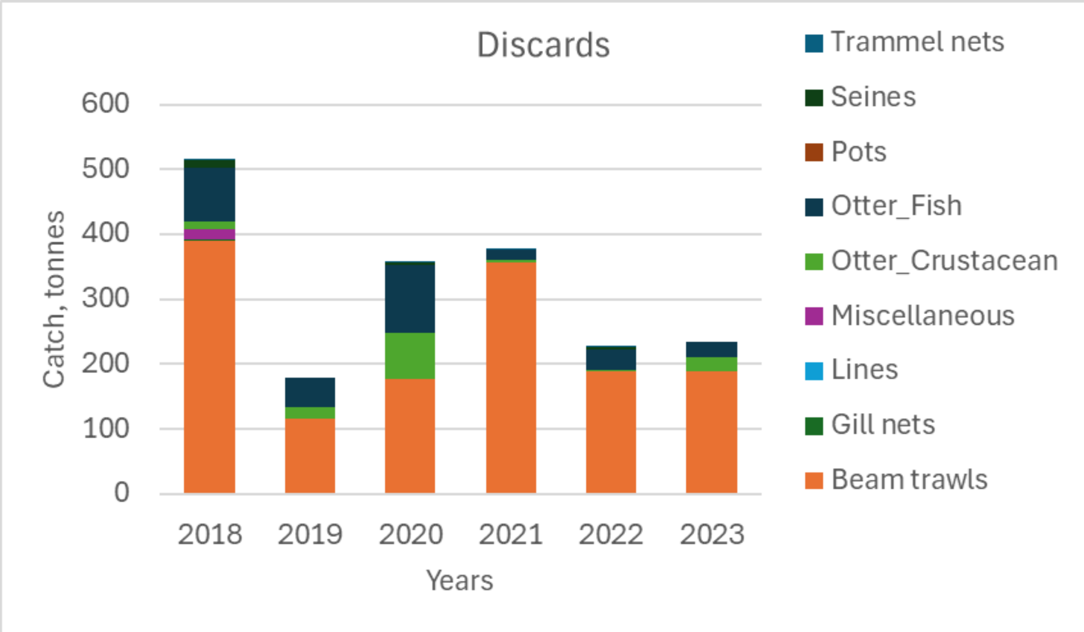

Figure 25.3. Plaice in divisions 7.f-g. InterCatch discards data by year, country and gear.

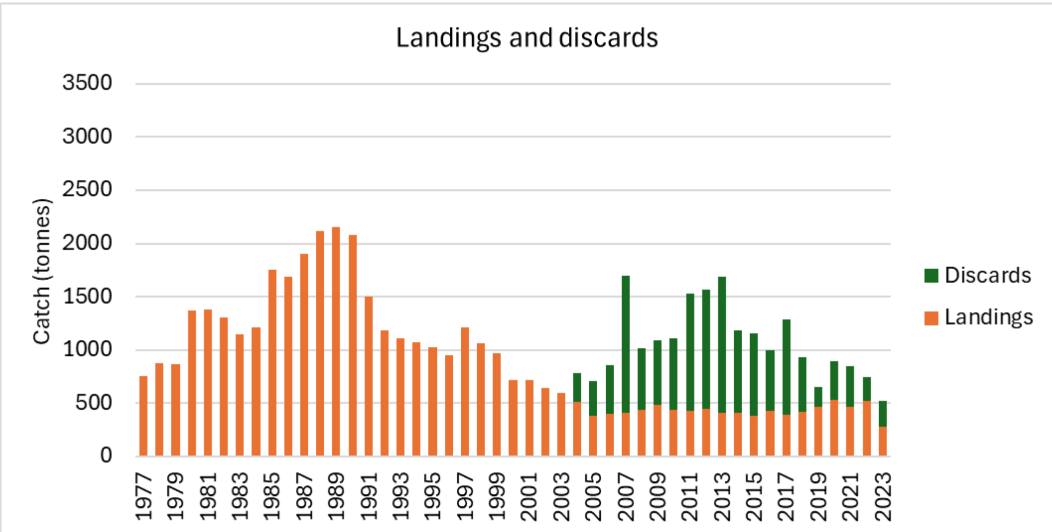

Figure 25.4. Plaice in divisions 7.f-g. Raised catch as estimated by WGCSE.

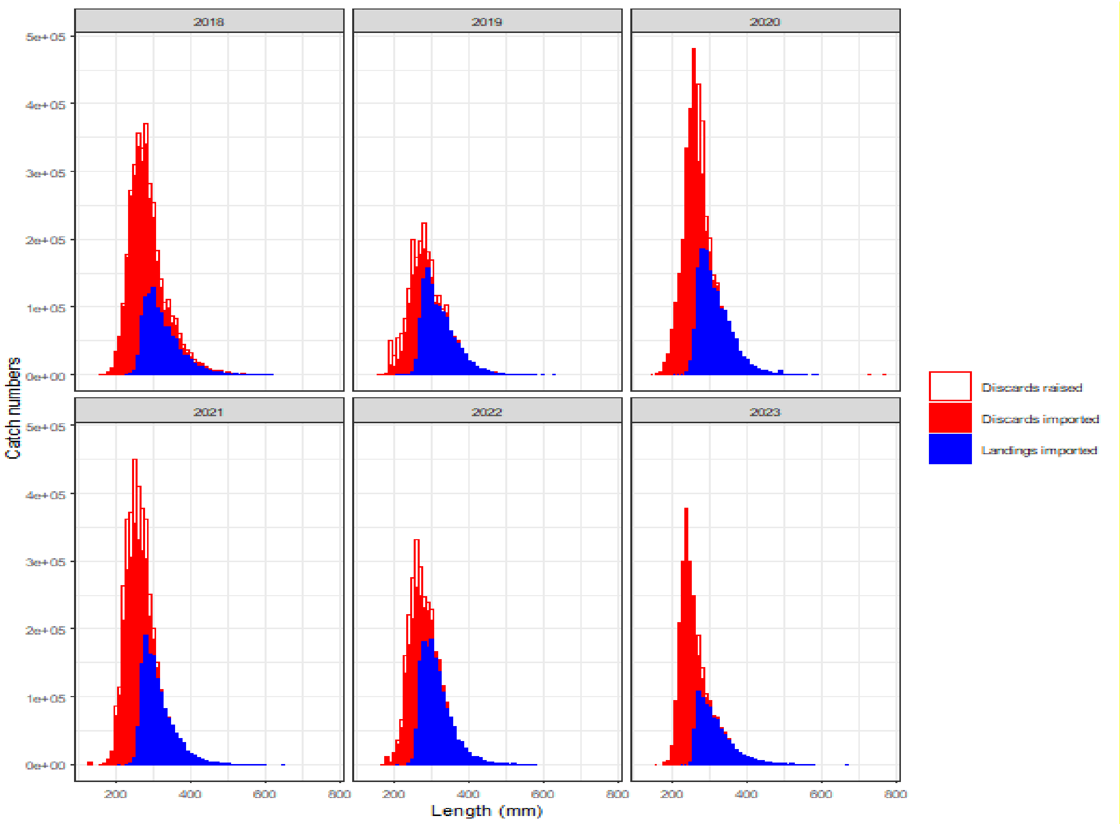

Figure 25.5. Plaice in divisions 7.f-g. Length-frequencies of landings and discards. Note near-absence of discarding of fish of commercial size

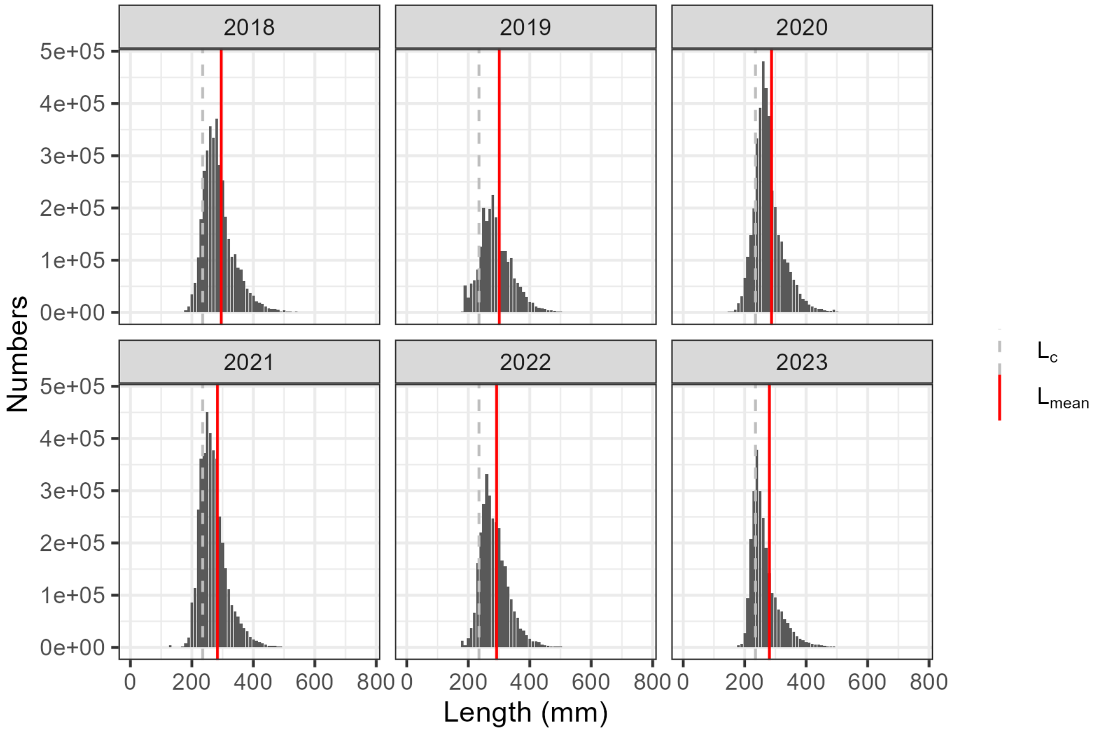

Figure 25.6. Plaice in divisions 7.f-g. Total international length frequencies for 2018–2023, length of first capture (Lc), and mean length in the catch (Lmean, mean length above Lc).

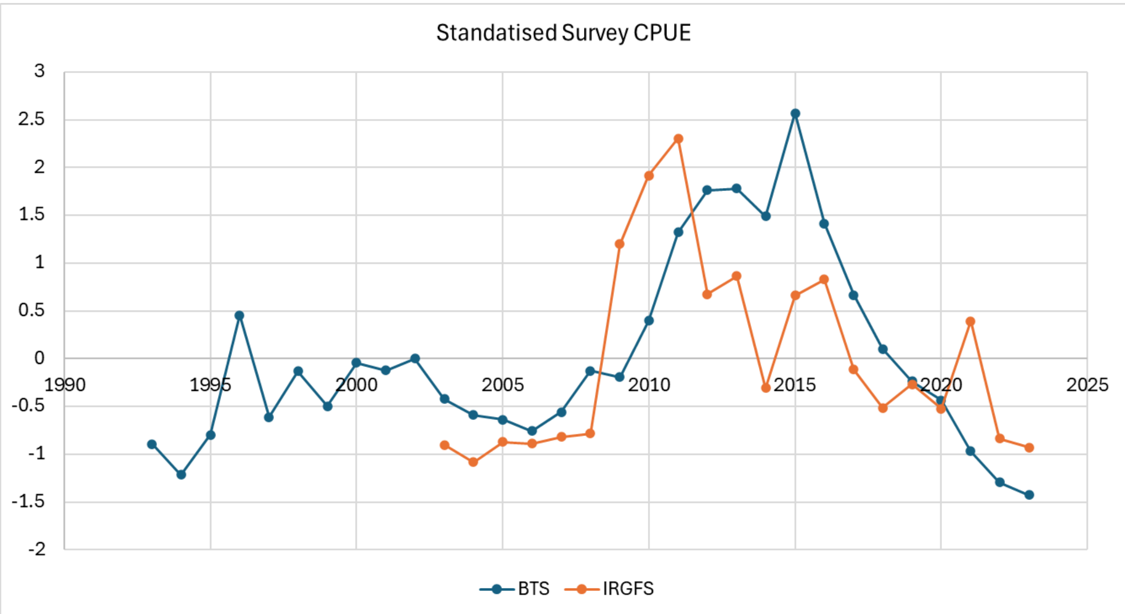

Figure 26.7. Plaice in divisions 7.f–g: Biomass index (standardised CPUEs) from UKBTS-Q3 and a comparative index from IrGFS-Q4 survey.

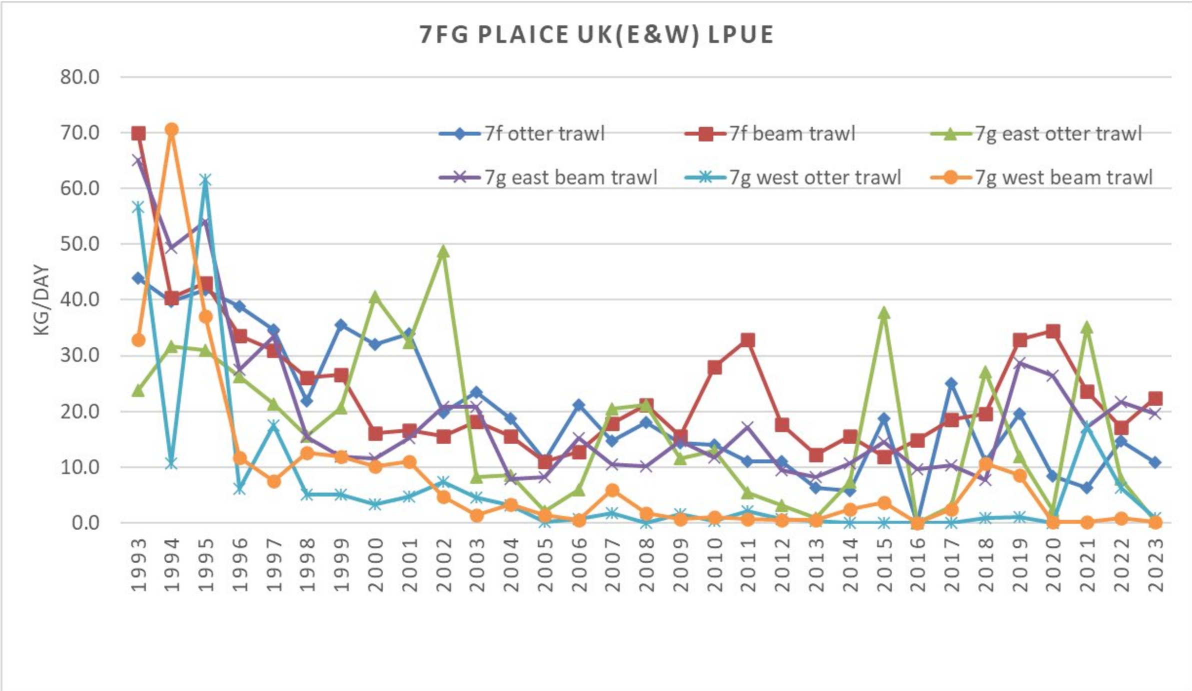

Figure 25.8. Plaice in divisions 7.f–g: Trends in CPUE by the UK fleets.

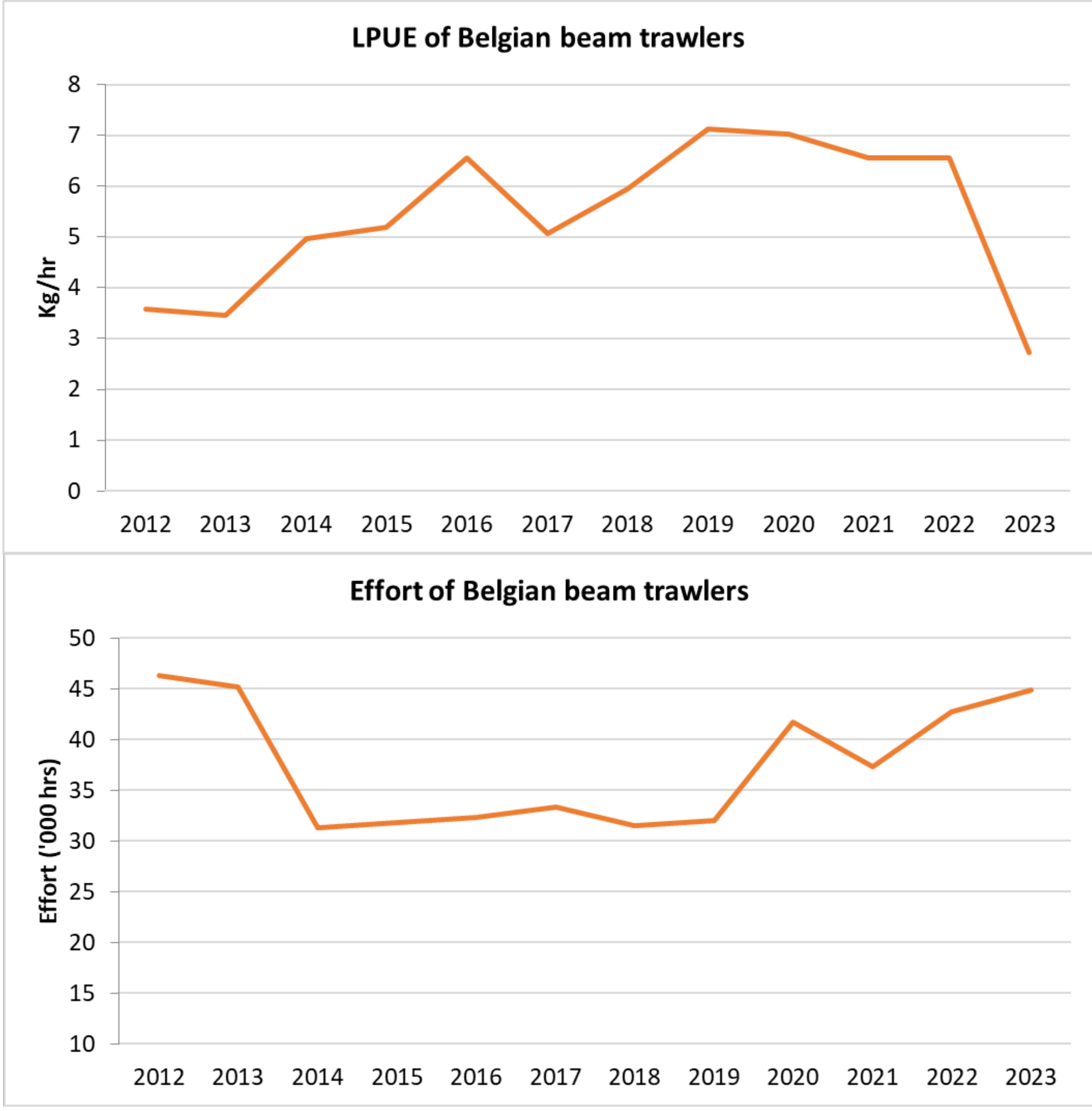

Figure 25.9. Plaice in divisions 7.f–g: Trends in LPUE and effort by the Belgian beam trawl fleet.

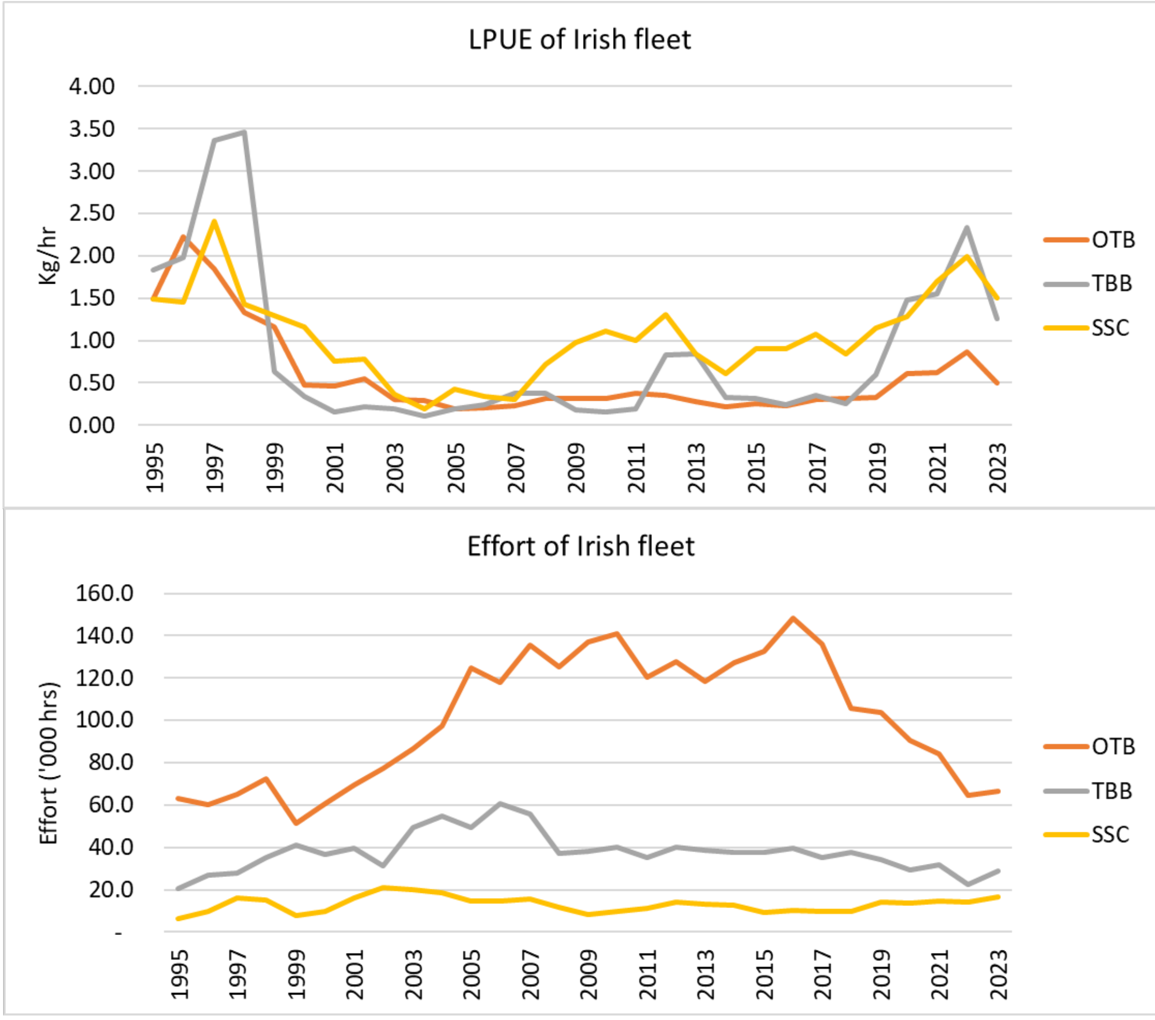

Figure 25.10. Plaice in divisions 7.f–g: Trends in CPUE and effort by the Irish fleets.

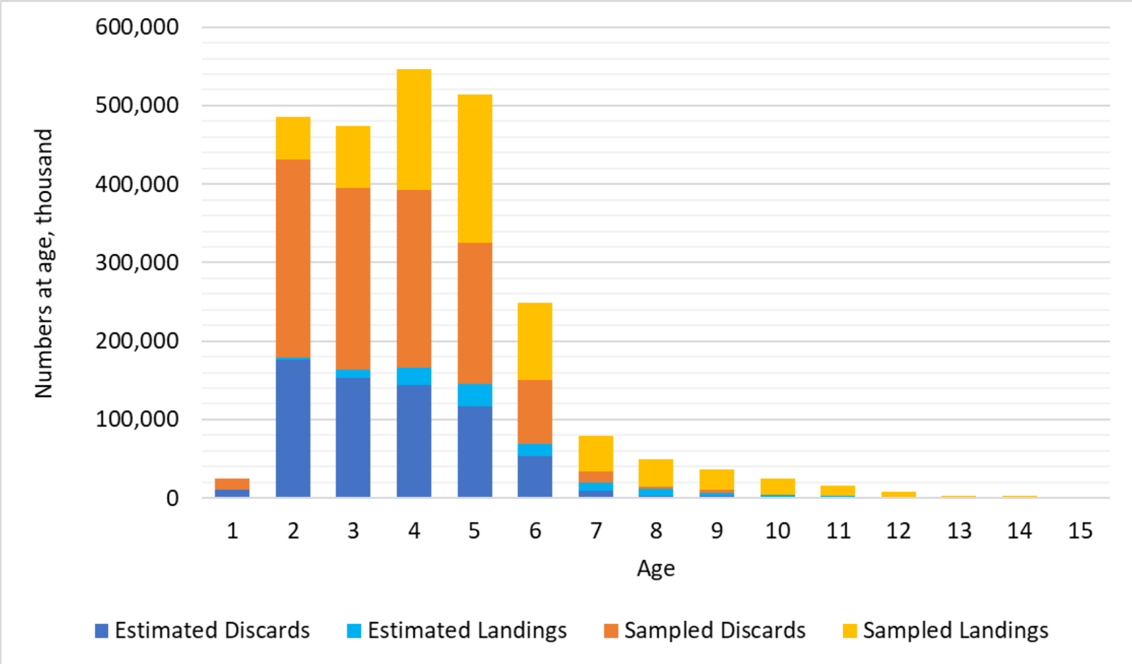

Figure 25.11. Plaice in divisions 7.f–g: Raised size structure of landings and discards in 2018–2022.

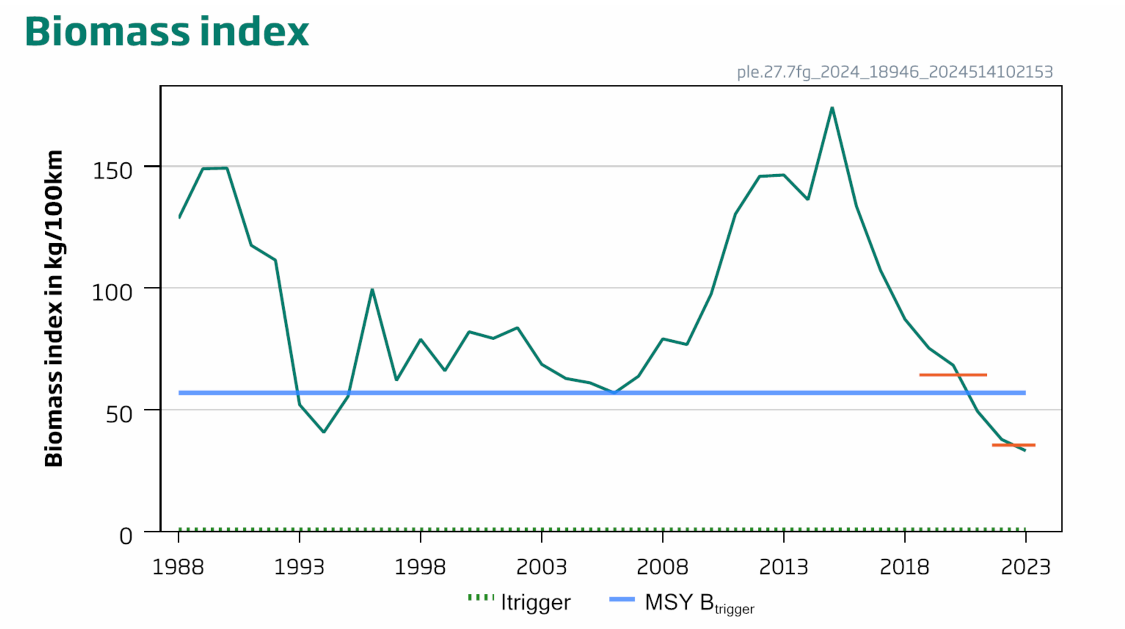

Figure 25.12. Plaice in divisions 7.f and 7.g. Biomass index. The short orange lines in the biomass index indicate the average values of the respective years (2019 to 2021 and 2022 to 2023).

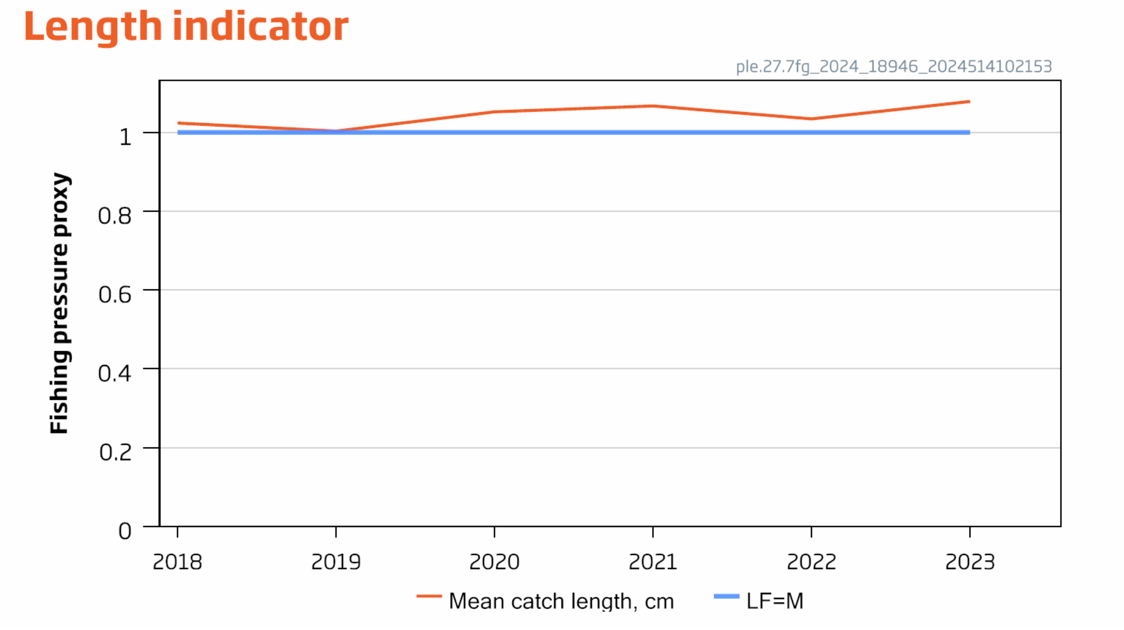

Figure 25.13. Plaice in divisions 7.f-g:. Position of mean catch length in respect to the length indicator $L_{F=M}$.

Contents

26 Plaice (*Pleuronectes platessa*) in divisions 7h–k (Celtic Sea South, southwest of Ireland)

26.1 Introduction

Type of assessment in 2024

ICES advises that when the MSY approach is applied, catches should be no more than 130 tonnes in each of the years 2025 and 2026. A trends based assessment was conducted using a combined survey index produced using VAST biomass index of the VAST model to which an 'rfb' advice rule was applied. Stock status, $F_{MSY\ proxy}$ reference point, was estimated from LBI analysis, assuming M/K = 1.5. $L_{F=M}$ is based on L_c (length at 50% of modal abundance), which varies each year.

26.2 General

26.2.1 Stock description and management units

The TAC specified for plaice in ICES Division 7.h-k is consistent with the assessment area. Official national landings data as reported to ICES and the landings estimates as used by the Working Group are given in Table 29.1. Official landings in 2023 were 67 t, a 50% undershoot of the 2023 TAC (132 t).

Plaice in 7.h–k is on the south-western margins of the species distribution. Landings of plaice are similar in ICES divisions 7h and 7j, but are considered negligible in 7k. Plaice in 7j is typically targeted by the Irish otter trawl fleet, which operate on sandy grounds off the southwest of Ireland, close to shore and this species is a small, but valuable component of the landings in a mixed fishery. Whereas, plaice in 7h is mostly targeted by the beam trawl fleet, and some otter trawl, which operate close to the boundaries of other plaice stocks (ple.27.7.fg & ple.27.7.e)(Fig 26.1).

To date no stock identification studies have been conducted on plaice in 7h-k, which is on the south-western margins of the species distribution, which is reflected in the reported landings that show high landings in adjoining stock areas, 27.7.e and 27.7.fg (Fig 26.1). There are no relevant tagging studies completed in this area. There is evidence in other areas to suggest that plaice is a highly mobile species, and therefore it is possible that ple.27.7.h-k is an extension of larger adjoining populations, but tagging and genetic would need to be completed to determine this (ICES 2021).

26.2.2 Landings obligation

The EU multiannual plan (MAP) for stocks in the Western Waters and adjacent waters (EU, 2019) applies to bycatches of this stock. As of 2020, the EU landing obligation fully applied to plaice in Divisions 7h-k. The landing obligation was phased in between 2016–2019 (Commission Delegated Regulations (EU) 2015/2438, 2016/2375, 2018/46, EU, 2015, 2016, 2018). A survivability exemption for plaice caught in ICES divisions 7h-k for vessels using beam trawls, with a maximum engine power of 221 kW, a maximum length of 24 metres, fishing within 12 nautical miles of the coast and with tow durations of no more than ninety minutes, and by vessels using beam trawls with an engine power of more than 221 kW, using a flip-up rope or benthic release panel (Commission Delegated Regulations (EU) 2020/2015). Additional survivability exemption available for plaice caught in pots, traps and creels in North-Western Waters (ICES subareas 5, 6 and 7) (Commission Delegated Regulations (EU) 2020/2015).

26.2.3 Management applicable to 2024 and 2023

TAC table 2024

Species:	Plaice *Pleuronectes platessa*		Zone:	7h, 7j and 7k (PLE/7HJK.)
Belgium	8	(1)	Precautionary TAC	
France	16	(1)	Article 8 of this Regulation applies	
Ireland	54	(1)		
Netherlands	31	(1)		
Union	109	(1)		
United Kingdom	23	(1)		
TAC	132	(1)		
(1)	Exclusively for by-catches. No directed fisheries for plaice are permitted under this quota.			

TAC table 2023

Species:	Plaice *Pleuronectes platessa*		Zone:	7h, 7j and 7k (PLE/7HJK.)
Belgium	8	(1)	Precautionary TAC	
France	16	(1)	Article 8 of this Regulation applies	
Ireland	55	(1)		
Netherlands	31	(1)		
Union	110	(1)		
United Kingdom	22	(1)		
TAC	132	(1)		
(1)	Exclusively for by-catches. No directed fisheries for plaice are permitted under this TAC.			

26.3 Data

26.3.1 Commercial catch data

Belgium, France, Ireland, Spain, and the United Kingdom (England) uploaded commercial catch data for 2023 to InterCatch (Figures 26.2 and 26.3). Landings reported to InterCatch for this stock totalled 67 tonnes in 2023.

Discards submitted to InterCatch of plaice in Divisions 7.h-k totalled 5 tonnes in 2023, a significant decrease on the 22 tonnes reported in 2022. At the last benchmark for this (ICES 2021b) it was concluded that there was sufficient data to calculate discard rates. These rates are highly variable over time (Figure 26.4), this variability may be driven by low and variable sample numbers over time.

In 2024 WGCSE decided to discards for the time series should be estimated using a mean of the selected year ranges and not a geometric mean (excluding) as was previously used in 2022 (ICES 2022). Discard estimates are not available for the early part of the time series (1995–2003). ICES discards are derived from estimated discard rates, 41% from 2004–2019 (mean 2004–2019), 45% in 2020 (mean 2016–2020), 50% in 2021 (mean 2017–2021), 48% in 2022 (mean 2018–2022), 35% in 2023 (mean 2019–2023) (Table 26.3). This change in approach was to account for true zeros being reported to InterCatch, and resulted in a slightly higher discard rate across the time series (Table 26.4)

26.3.2 Survey indices

Seven fisheries-independent surveys were combined to model the first biomass index for plaice in this stock area. This modelled index was produced using VAST, which is a Vector Autoregressive Spatiotemporal model in R (Thorson et al., 2016). This model implements a spatial delta-generalized linear mixed model (delta-GLMM) to standardizing survey. VAST is spatially explicit model that predicts population density for all locations within a spatial domain, and then predicts derived quantities (i.e. biomass abundance) by aggregating population density across spatial domain while weighting density estimates by the area associated with each estimate.

The model was parametrised using haul level data from seven fisheries-independent surveys undertaken in the Celtic Sea (1997 – 2023)(Table 26.2). The coverage of these surveys varies in space and time, a full description of which can be found in Table 26.2 and Figure 26.5. The raw survey data was checked for quality (specifically, the estimated weights of the catch numbers-at-length were checked against the reported catch weights). For each valid haul, the catch weight, tow duration, tow position (midpoint), survey series and year were used as input values for the VAST model. The model was specified to have spatial autocorrelation but no temporal autocorrelation (i.e. years are independent). VAST can optionally estimate, and correct for, differences in catchability between the two survey series as there is a significant spatial overlap between the two surveys. The model first estimates the likelihood of occurrence and then the biomass using a gamma error distribution or the abundance using a lognormal error distribution. Historically none of these surveys were used to estimate abundances of plaice as individually they do not cover the full stock area, spatially/ temporally, and now of the surveys have been designed with this stock and species in mind. Vast offers a number of advantages over more traditional ways of estimating abundances. It has an ability to deal with gaps in survey coverage, and an ability to account for differences in catchability between surveys or vessels, providing an objective way to combine multiple indices even when the gear is not standardised.

The spatial domain was defined as 1000 knots, and implemented using k-means clustering to give knot positions proportional to sampling intensity (Thorson, 2019) (Figure 26.6). Residual diagnostics on the encounter probability appeared acceptable (Fig 26.7). Visualisation of the Pearson's residuals of positive catches (Fig 26.8a) and encounter probability (Fig 26.8b) show no strong patterns. These plots are the default output from the package, however in the future the presence/absence residuals should be revisited. The estimated survey biomass indices are presented in Table 26.3 and Figure 26.10, along with associated uncertainty. Visualisation of spatio-temporal variability in estimated log density of plaice in ICES division 7h-k (Fig 26.9), show distributional trends in areas of high abundance that mirror that of the known fishery, with high incidence of reported landings occurring in areas similar to the biomass from this VAST index, along the south west coast of Ireland and the south west coast of the UK. It is clear that these patches of high abundance spill over into adjoining stock area, plaice 7fg, where landings are substantially higher than the plaice in 27.7h-k.

26.3.3 Biological

A number of length based parameters are required for the calculation of the new 'rfb' catch advice rule (ICES 2020): mean length in observed catch ($\bar{L}_{y-1}$), the length at first capture relative to the target length ($L_{F=M}$) , asymptotic length at which growth is zero (L_{∞}), length at first catch (length at 50% of mode) L_c.

The calculation of the 'rfb' catch advice rule requires the calculation of *f* which is the ratio of mean length ($\bar{L}_{y-1}$) in the observed catch that is above the length of the first capture relative to the target length ($L_{F=M}$). The mean length in the observed catch was calculated by plotting the landings and discards data submitted to InterCatch over all years (2004 – 2021). The length of the first capture relative to the target length ($L_{F=M}$) is calculated ($L_{F=M} = 0.75*L_c + 0.25*L_\infty$). Length at first catch (length at 50% of mode)(L_c) was calculated from the landings and discards data submitted to InterCatch. L_c was calculated for each year, but was found to be highly variable due to the variable and low sample number submitted for discards (Figure 26.15, Figure 26.12). Therefore, a mean of the time series, 228.9 mm, was estimated as the L_c of this stock (Figure 26.13) and used in the calculation of rfb. Similarly, the mean length in observed catch ($\bar{L}_{y-1}$) was found to be was found to be highly variable due to the variable and low sample number submitted for discards (Figure 26.11, Figure 26.12). Therefore a mean of the time series, 297.3 mm, was estimated as the $\bar{L}_{y-1}$ of this stock (Figure 26.14) and used in the calculation of rfb.

L_∞ is calculated from the von Bertalanfy growth model. Samples available through DATRAS were used to calculate these length parameters. These samples were collected by three surveys, Irish ground fish survey (IGFS, 2004 - 2021), Irish anglerfish and megrim survey (IAMS, 2016 - 2021) and the French Southern Atlantic bottom trawl survey (EVOHE, 2014 - 2021). Although none of these surveys are designed to capture the dynamics of this stock, they do provide the samples required to produce estimates of life history parameters. Only samples from 7j (n= 1648) were used to calculate these parameters due to low sample size in 7h (n=11).

The FSA package in R (Ogle et al. 2022) was used to determine the starting values Ford-Walford (vbStarts{FSA}) and to fit a Von Bertalanfy growth curve was fit to the survey data for all areas combined, by bootstrapping a nonlinear regression (nls{stats}(R Core 2020)). Due to the uneven sample size it was not possible to determine if these growth parameters vary between ICES division 7j and 7h. However, we could estimate the growth parameters for the whole stock as linf = 466.83 mm (SD ± 22.85), K = 0.18 (SD± 0.03), t0 = -2.13 (SD± 0.31) (Figure 26.15). Residuals of model fitted considered acceptable (Figure 26.16)

26.4 Advice

26.4.1 Analyses of stock trends and potential status indicators

Advice was given based on trends in the VAST survey biomass index, The LBI-estimated values of the ratio *Lmean/LF=M* are used to estimate exploitation status relative to the proxy MSY reference point, as described in the stock annex. The advice for 2025, 2026 and 2027 was set using the HCR 'rfb' as outlined in the table below. This advice was produced using the R package cat3advice (Fischer 2024).

Previous catch advice Ay (advised catch for 2024)	132 tonnes
Stock biomass trend	
Index A (2022, 2023)	420 tonnes
Index B (2019, 2020, 2021)	500 tonnes
r: Index ratio (A/B)	0.84
Fishing pressure	
Mean catch length ($L_{mean} = L_{2023}$)	34.4 cm
MSY proxy length ($L_{F=M}$)	27.9 cm
Fishing pressure proxy ($L_{F=M}/L_{2023}$)	0.81
f: multiplier for relative mean length in catches ($L_{2023}/L_{F=M}$)	1.24
Biomass safeguard	
Last index value (I_{2023})	409 tonnes
Index trigger value ($I_{trigger} = I_{loss} \times 1.4$)	139 tonnes
b: multiplier for index relative to trigger min{$I_{2023}/I_{trigger}$, 1}	1
Precautionary multiplier to maintain biomass above Blim with 95% probability	
m: multiplier to maintain the biomass above B_{lim} to with 95% probability	0.95
RFB calculation**	130 tonnes
Stability clause (+20%/−30% compared to Ay, only applied if b=1)	Not applied
Discard rate	35%
Catch advice for 2025 and 2026 (Ay × stability clause)	130 tonnes
Projected landings corresponding to advice***	85 tonnes
% advice change^	-1.40 %

These results suggest that the relative fishing mortality is below the reference F_{MSY} proxy and the relative biomass is well-above the reference B_{MSY}* 0.5 proxy. Therefore, the Precautionary Approach Buffer (PA Buffer) was not applied for the advice for this stock as advice change was only 1.4% in comparison to last year.

26.4.2 State of the stock

On the relative scale, the spawning biomass is estimated to have been since 2004 and has in remained high and stable in recent years (Figure 29.21). Estimated F was below F_{MSY} from 2004, and is now at the lowest point in the time series.

26.4.3 Biological reference points

The table below summarises all known reference points for plaice in 27.7h-k and their technical basis. The LBI-estimated values of the ratio *Lmean/LF=M* are used to estimate exploitation status relative to the proxy MSY reference point

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger\ proxy}$	139	Biomass index trigger value ($I_{trigger}$), defined as $I_{trigger} = I_{loss} \times 1.4$, where I_{loss} is the lowest observed historical biomass index value from 2005. In estimated metric tonnes from derived from VAST.	ICES (2024)
	$F_{MSY\ proxy}$	1	$L_{mean}/L_{F=M}$; Mean catch length divided by MSY proxy reference length ($L_{F=M}$).	ICES (2020)
Precautionary approach	B_{lim}	Not defined		
	B_{pa}	Not defined		
	F_{lim}	Not relevant		
	F_{pa}	Not relevant		
Management plan	SSB_{mgt}	Not applicable		
	F_{mgt}	Not applicable		

26.5 Recommendations for the next benchmark

This stock should be considered for the next SPiCT workshop to assess if it can be moved to a category 2 stock.

26.6 References

Fischer S (2024). cat3advice: ICES category 3 empirical harvest control rules. R package version 0.0.6, commit a4fd5d4576cfe64404309fbbc8583707b77baced, https://github.com/shfischer/cat3advice.

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26.7 Tables and Figures

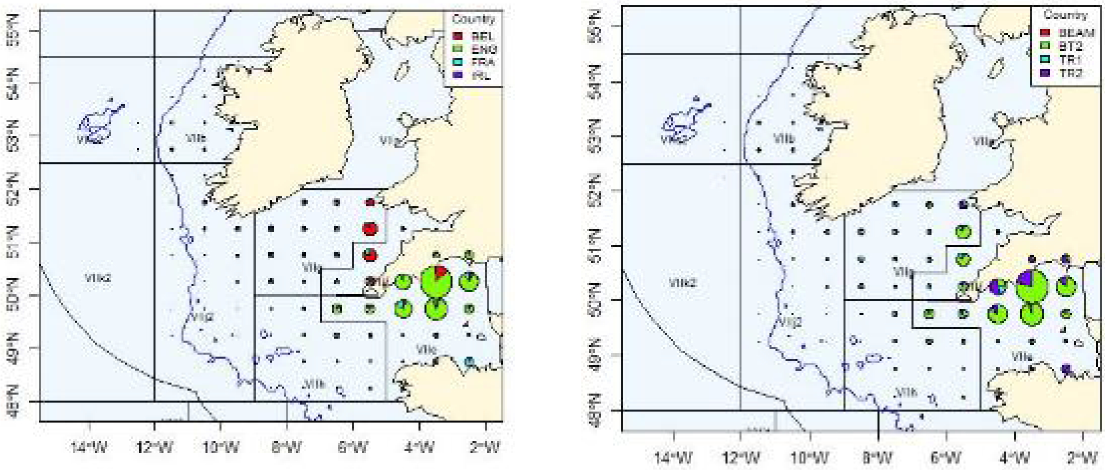

Figure 26.1 The spatial distribution of plaice landings reported to the STECF fisheries dependant information data call in 2016 (the last data year available), disaggregated by Member State (left) and gear (right). Note beam trawlers are described as beam and BT2, and otter trawlers are described as TR1 and TR2.

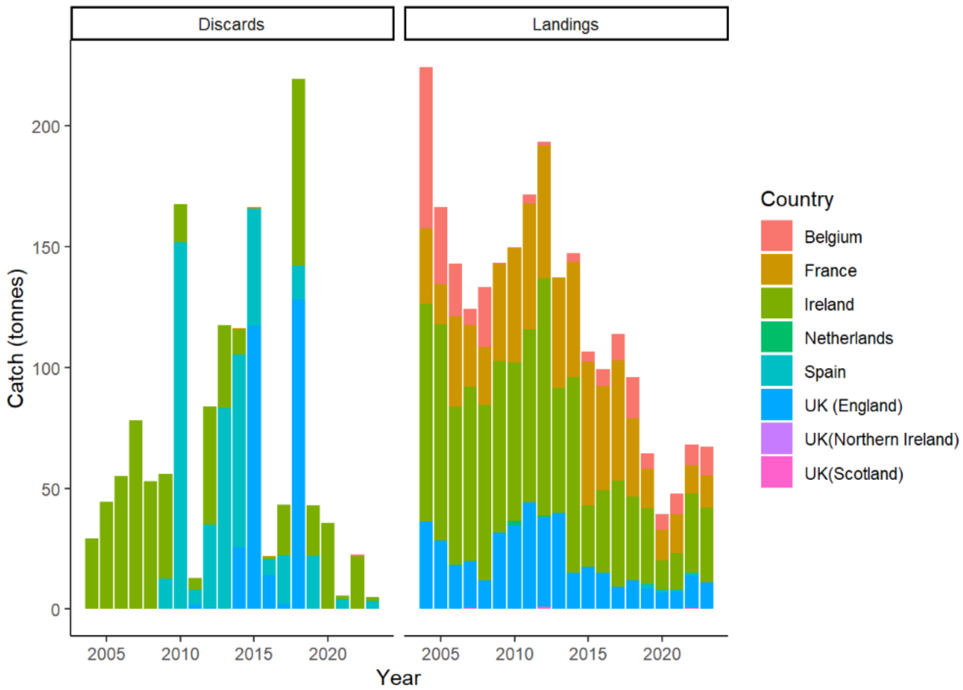

Figure 26.2. Plaice in Divisions 7.h-k. Landings and discards reported in InterCatch by country

Figure 26.3 Plaice in Division 7.h-k. International landings reported in InterCatch by fleet and year.

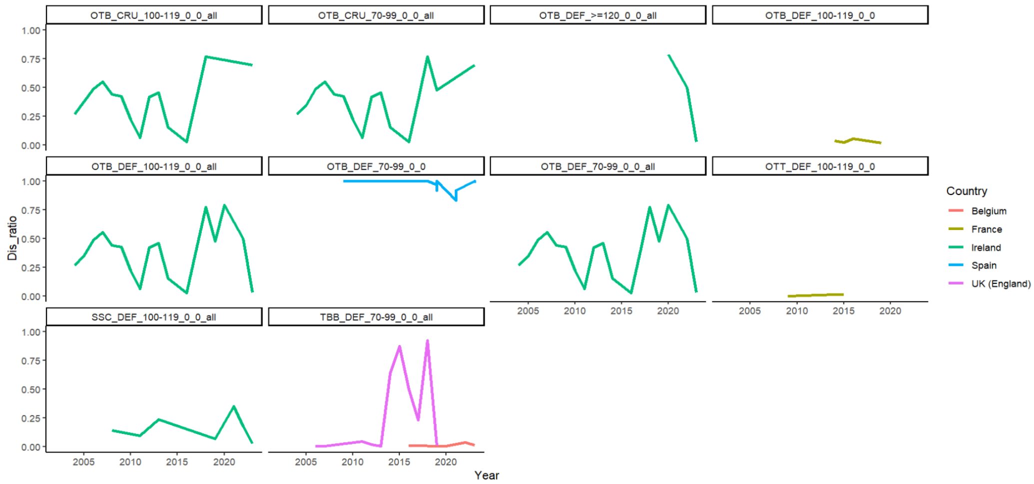

Figure 26.4. Plaice in Division 7.h-k. raw variable discard rates

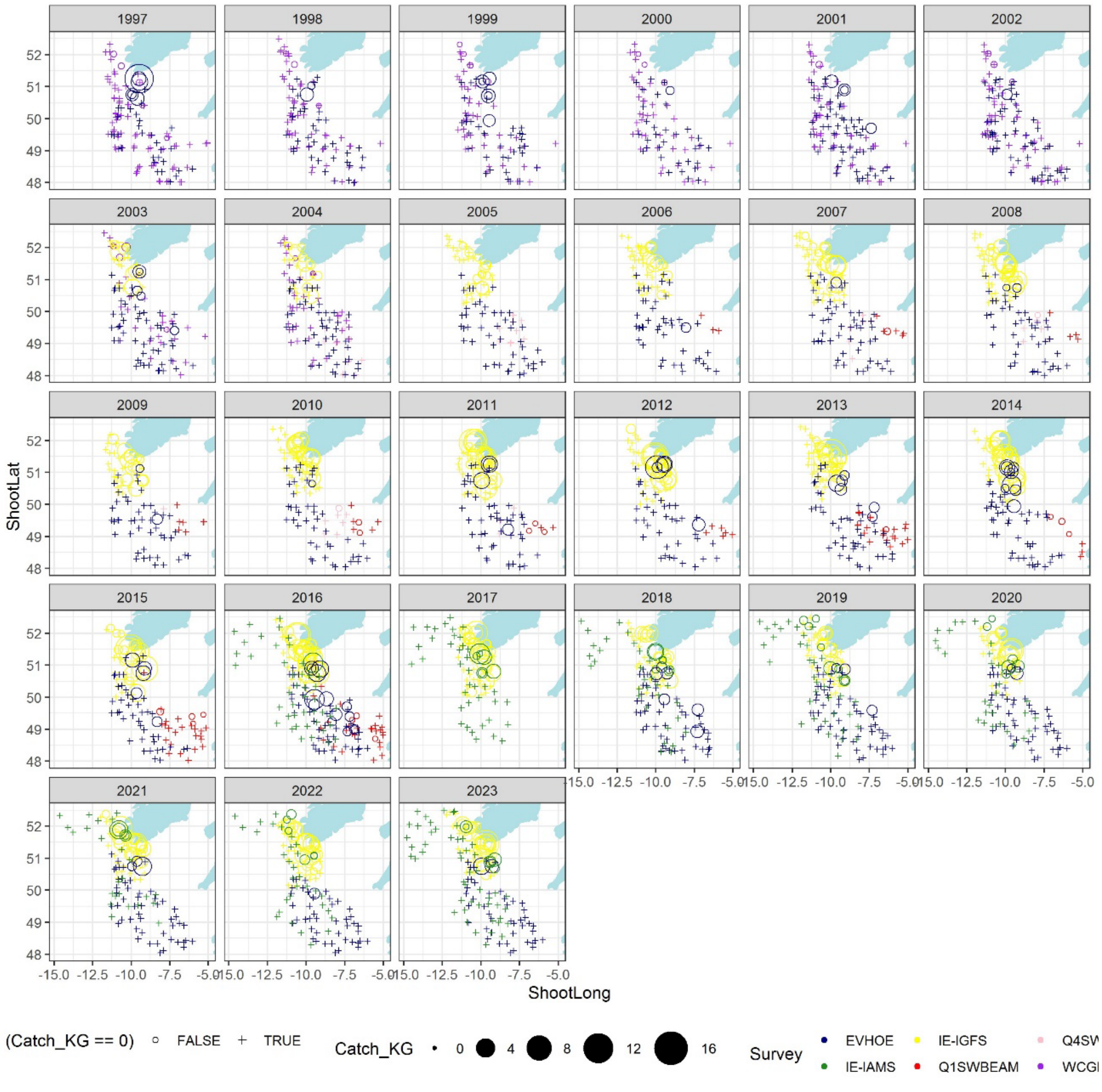

Figure 26.5. Plaice in Division 7.h-k. Survey numbers per haul by year. Each point represents haul with a positive count shown as a circle and a zero as a '+' symbol. Circle diameter is proportional to the count. Colours denote the surveys.

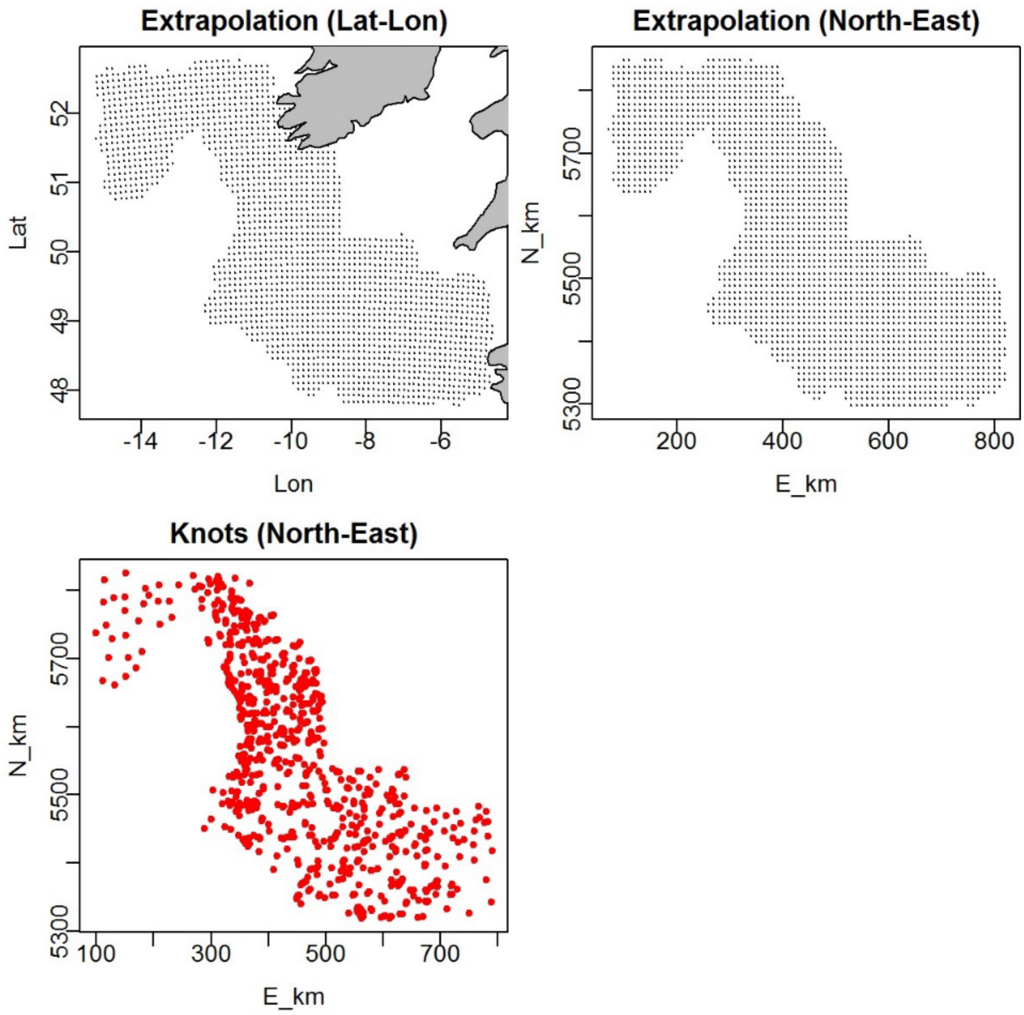

Figure 26.6. Plaice in Division 7.h-k. The spatial area defined within the model in terms of latitude and longitude (top left), kilometres (top right) and knots (bottom).

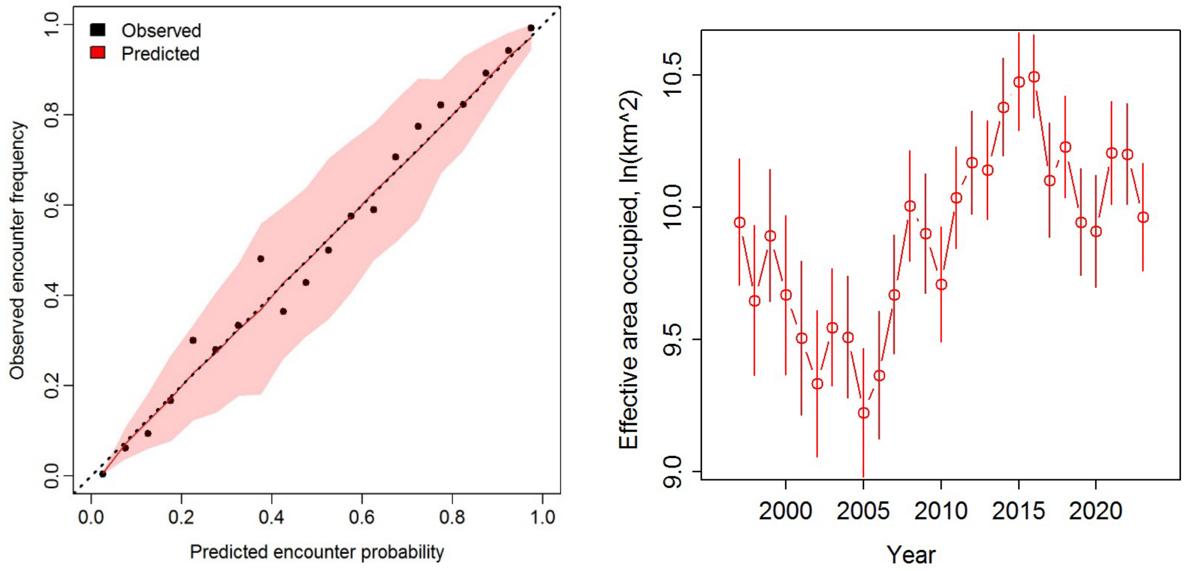

Figure 26.7. Plaice in Division 7.h-k. Residual diagnostics showing predicted encounter probability against observed encounter probability (left) and the effective area occupied (right).

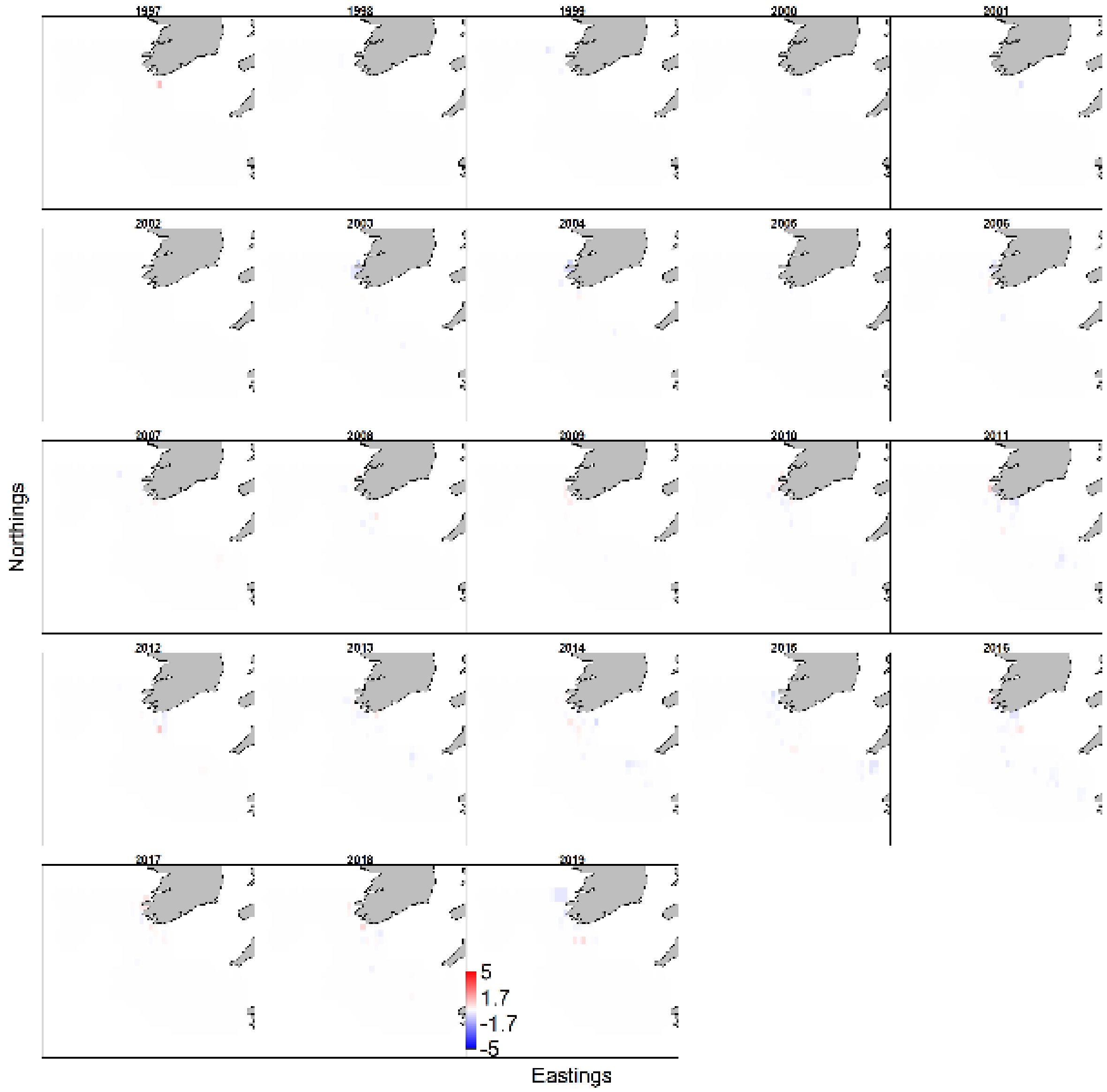

Figure 26.8(a). Plaice in Division 7.h-k. Spatiotemporal persons residuals (1) of encounter probability

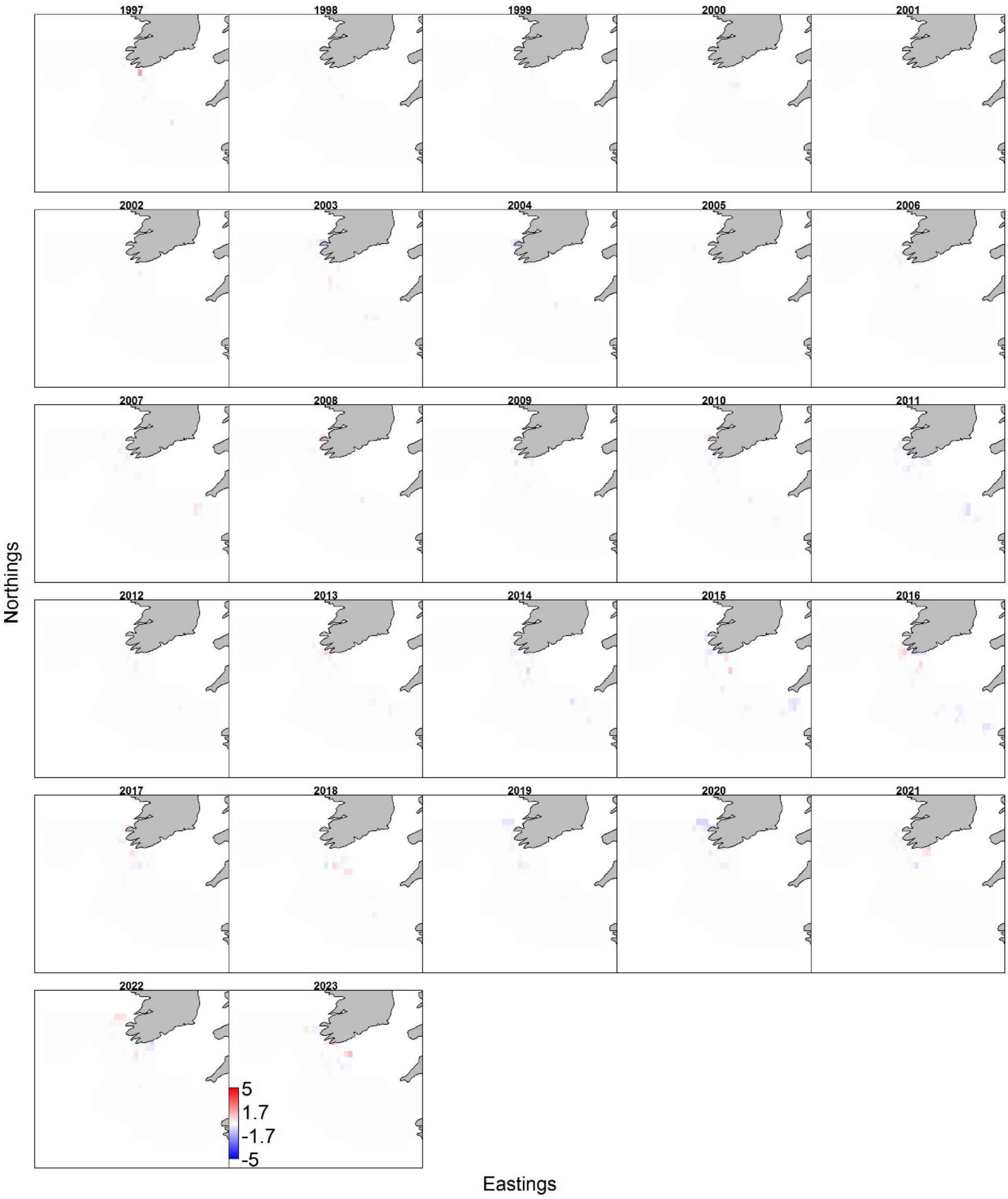

Figure 26.8(b). Plaice in Division 7.h-k. Spatiotemporal persons residuals (2) of encounter probability

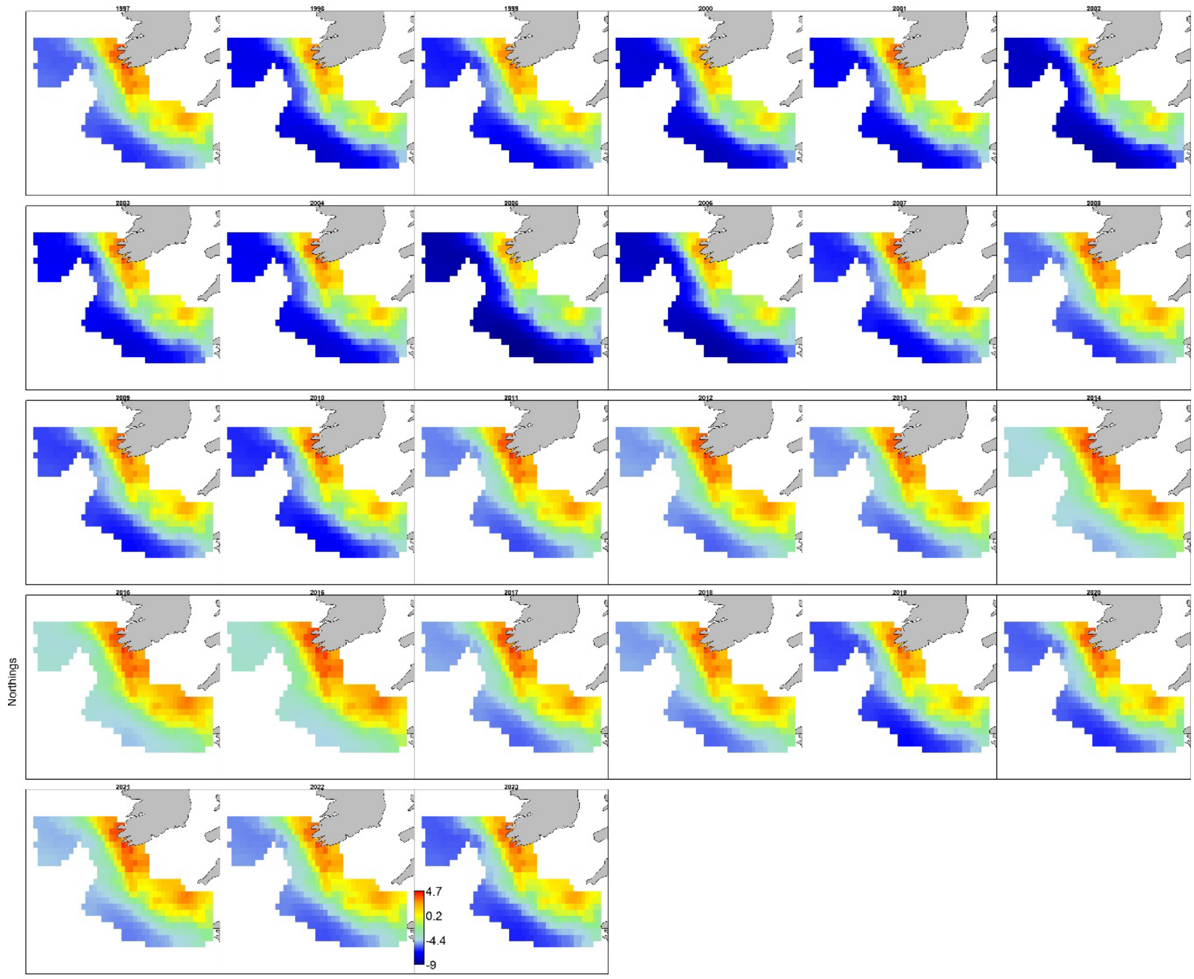

Figure 26.9. Plaice in Division 7.h-k. Spatiotemporal variability in estimated log density of plaice.

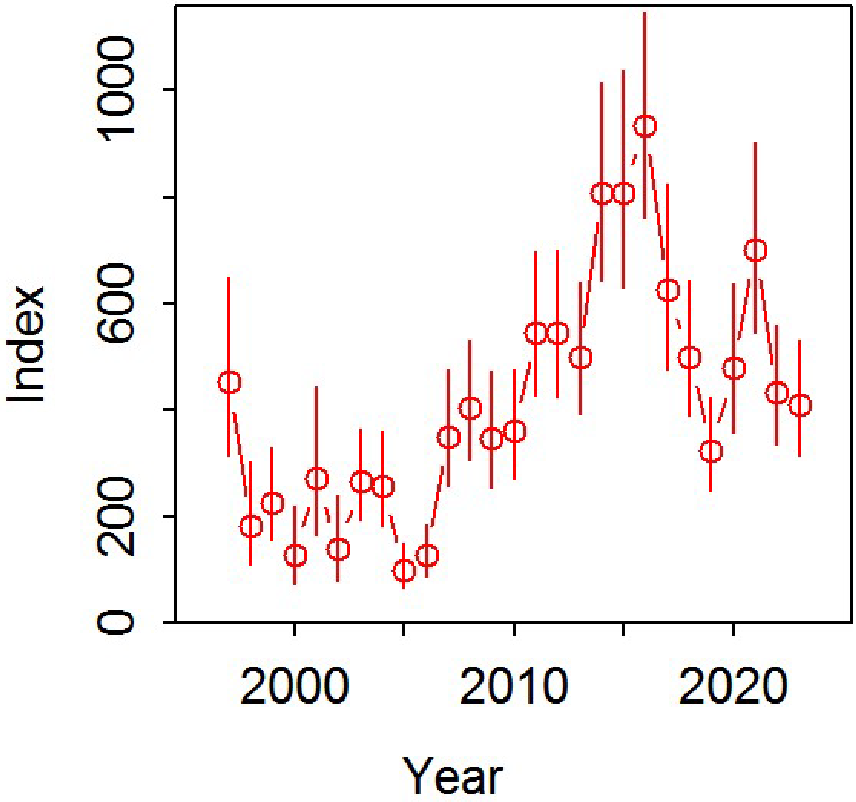

Figure 26.10. Plaice in Division 7.h-k. VAST estimated biomass in tonnes.

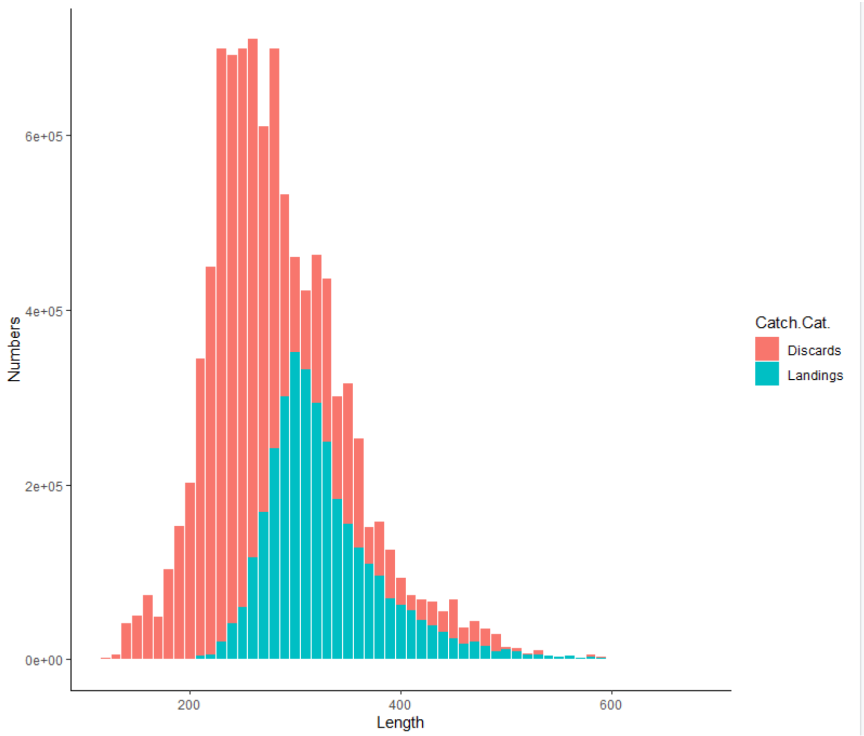

Figure 26.11. Plaice in Division 7.h-k.

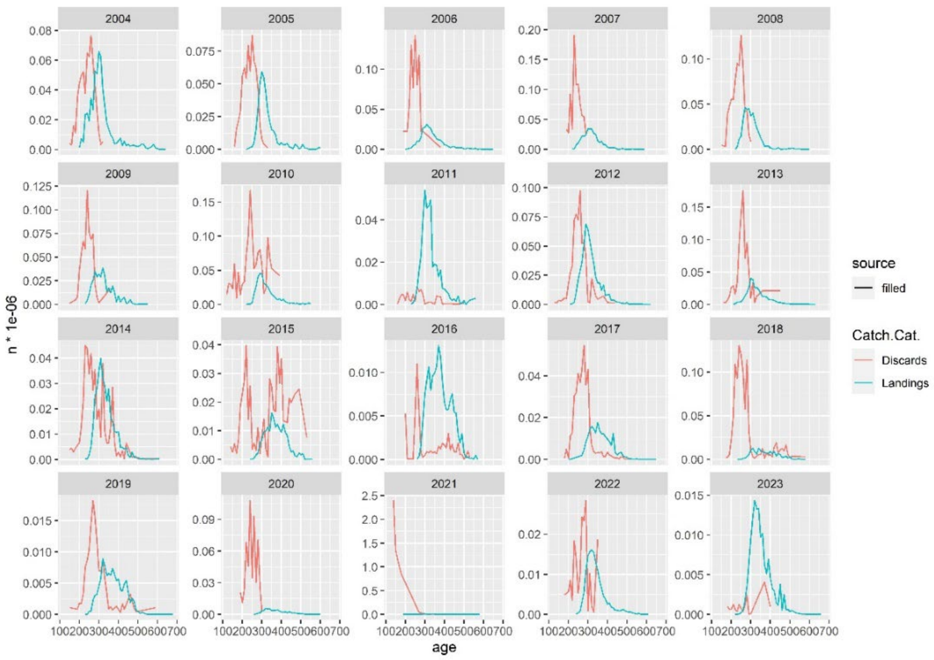

Figure 26.12. Plaice in Division 7.h-k. Raised length landings and discard samples.

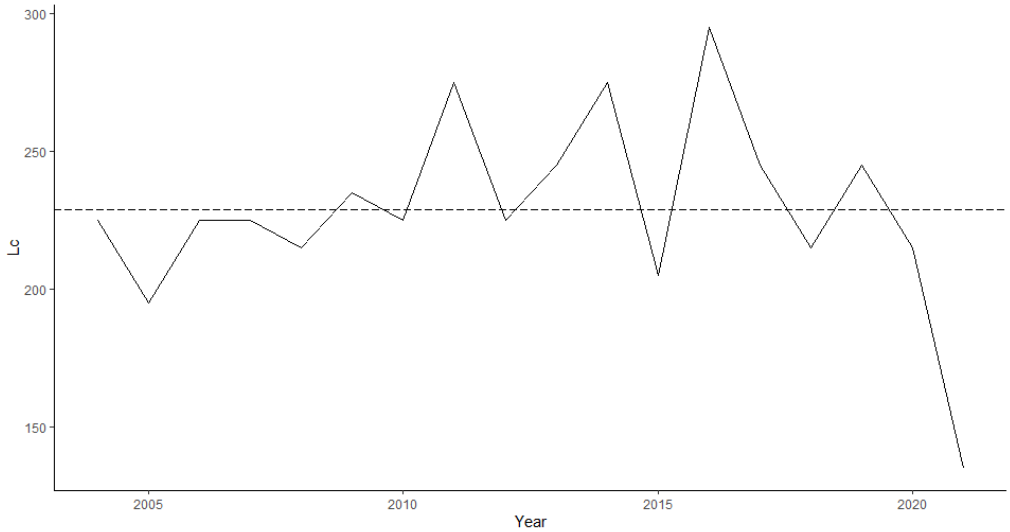

Figure 26.13. Plaice in Division 7.h-k. Lc

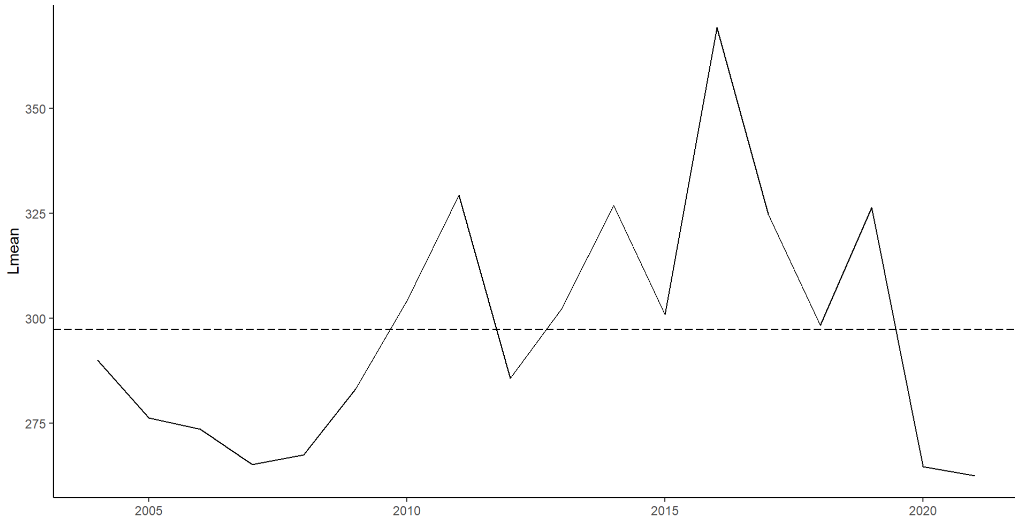

Figure 26.14. Plaice in Division 7.h-k. Lmean

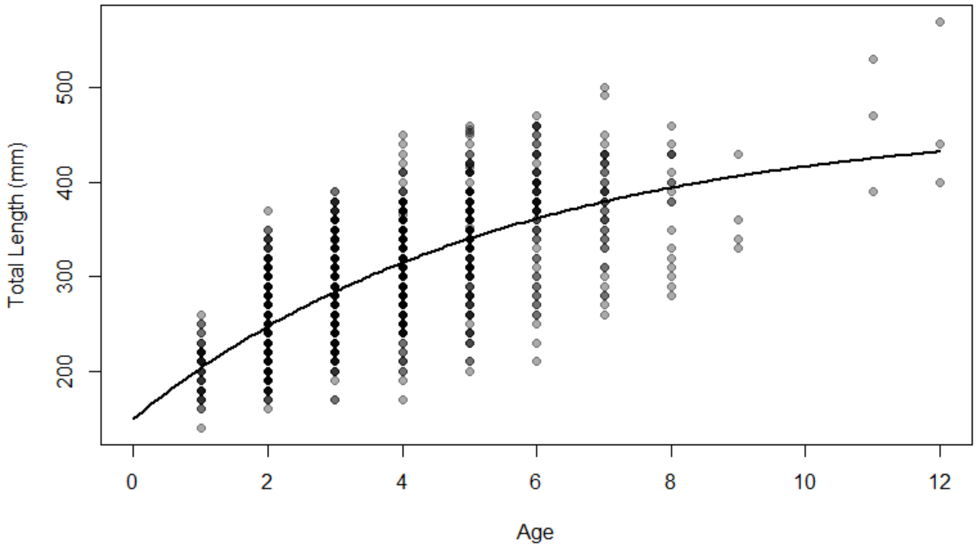

Figure 26.15. Plaice in Division 7.h-k. Length (mm) versus age (dots) with superimposed best-fit von Bertalanffy growth function (black line) of all plaice in ICES divisions 27.7h and 27.7j available in Datras.

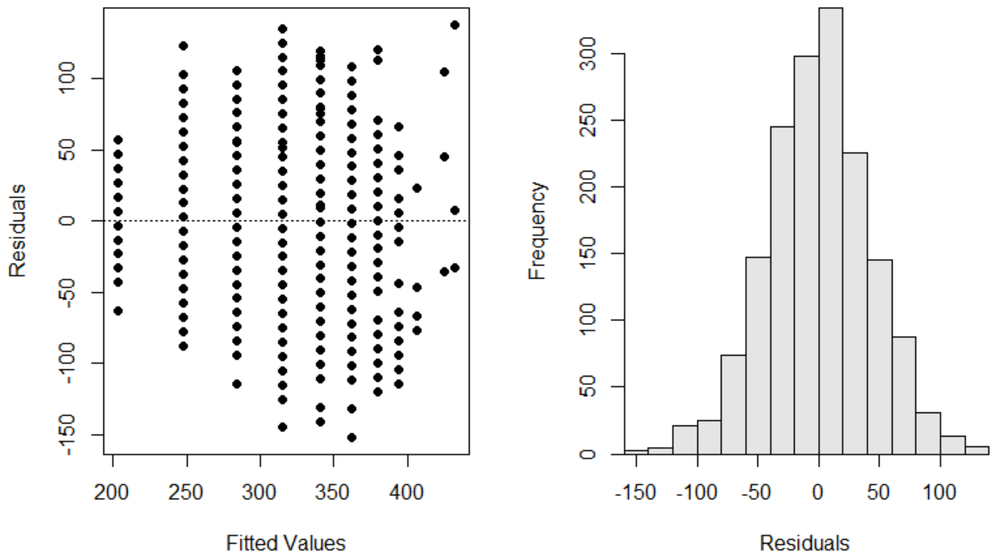

Figure 26.16. Plaice in Division 7.h-k. Residual plot (left) and histogram of residuals (right) of von Bertalanffy growth function (black line) on plaice in ICES divisions 27.7h and 27.7j available in Datras.

Table 26.1. Plaice in divisions 7.h–k. History of official landings by country and ICES estimated landings (tonnes).

Year	Belgium	France	Ireland	UK	Other	Official landings	ICES landings
1995	0	60	321	286	0	667	
1996	0	48	305	155	52	560	
1997	0	69	344	138	0	551	
1998	0	49	286	106	13	454	
1999	45	0	299	82	1	427	
2000	4	54	200	76	7	341	
2001	27	50	160	73	3	313	
2002	69	45	155	59	2	330	
2003	20	32	127	56	6	241	
2004	67	32	91	36	6	232	224
2005	32	20	90	28	0	170	167
2006	22	42	66	19	3	152	143
2007	7	39	72	22	23	163	124
2008	25	18	73	13	2	131	133
2009	1	51	72	34	0	157	143
2010	0	65	66	36	0	167	150
2011	4	69	72	46	0	191	172
2012	2	79	100	40	0	220	193
2013	0	63	52	40	0	155	137
2014	4	63	83	15	0	164	147
2015	5	70	25	18	0	117	107
2016	7	52	32	15	0	106	99
2017	11	66	42	10	0	129	114
2018	17	40	32	12	0	101	96
2019	6	20	†	9	4	39	64
2020	7	14	12	7	2	41	39
2021	9	14	15	7	1	47	48
2022*	8	12	33	14	0	67	68
2023*	12	13	31	11	<1	67	67

Table 26.3. Plaice in divisions 7.h–k. Mean estimated discard rate, year range over which rate is estimated and year it is applied

Year applied	Year range over which estimated	Mean discard rate
2004 - 2019	2004 -2019	41%
2020	2016,2017, 2018, 2019, 2020	45%
2021	2017, 2018, 2019, 2020, 2021	50%
2022	2018, 2019, 2020, 2021, 2022	48%
2023	2019, 2020, 2021, 2022, 2023	35%

Table 26.4. Plaice in divisions 7.h–k. Outcome of application of estimated discard rates.

Year	Landings	Discards estimated with geometric mean (ICES 2022)	Discard estimated with mean	Increase in discards
2020	39	27	33	+ 5 tonnes
2021	48	44	48	+ 4 tonnes
2022	68	58	63	+ 5 tonnes
2023	67	28	37	+ 9 tonnes

Table 26.2. Plaice in divisions 7.h–k. Surveys incorporated into VAST biomass index

Survey	Years	Quarters	Gear	Sources	Wing spread
IGFS	2003 – 2023	4	Otter	DATRAS	Available at haul level
IAMS	2003 – 2023	1	Otter & Beam	DATRAS	Available at haul level
EVOHE	2003 – 2023	4	Otter	DATRAS	Available at haul level
WGCFS	1997 – 2004	1,2,4	Otter	CEFAS	Set to 21 m (average of other otter trawl surveys in series)
SWBEAM	2006 – 2023	1	Beam	DATRAS	Available at haul level
SWIBTS	2003 – 2011	4	Otter	CEFAS	Set to 21 m (average of other otter trawl surveys in series)

Table 26.3. Plaice in divisions 7.h–k. Table abundance index – what is the SD log and SD mt

Year	Biomass estimate (tonnes)	SD_log	SD_mt
1997	451.76	0.36	164.17
1998	182.75	0.51	92.54
1999	226.37	0.38	85.32
2000	126.08	0.55	69.16
2001	271.13	0.50	134.43
2002	137.26	0.56	77.12
2003	266.06	0.31	82.86
2004	256.78	0.34	87.65
2005	99.16	0.42	41.59

Year	Biomass estimate (tonnes)	SD_log	SD_mt
2006	126.67	0.37	46.97
2007	350.10	0.31	108.48
2008	402.54	0.28	111.87
2009	346.88	0.31	108.44
2010	359.82	0.28	101.30
2011	545.25	0.25	134.73
2012	544.82	0.25	136.19
2013	500.44	0.25	123.34
2014	807.99	0.23	184.06
2015	808.29	0.25	203.15
2016	935.42	0.20	191.01
2017	626.50	0.28	172.34
2018	499.77	0.25	126.01
2019	323.26	0.27	86.91
2020	477.50	0.29	137.27
2021	701.40	0.25	177.72
2022	431.98	0.26	111.45
2023	409.45	0.26	107.04

Table 26.4. Plaice in Divisions 7.h–k. Assessment summary. High and low refer to 95% confidence intervals for biomass index. Weights are in tonnes.

Year	Biomass index			Length-based fishing pressure proxy ($L_{F=M}/L_{mean}$)	ICES landings	ICES discards*
	Low	Value	High			
1995					667	
1996					560	
1997	222	452	921		551	
1998	68	183	493		454	
1999	108	226	474		427	
2000	43	126	370		341	
2001	103	271	717		313	
2002	46	137	413		330	
2003	145	266	490		241	
2004	132	257	501	0.953	224	156

Year	Biomass index			Length-based fishing pressure proxy ($L_{F=M}/L_{mean}$)	ICES landings	ICES discards*
	Low	Value	High			
2005	44	99	226	0.961	167	115
2006	61	127	262	1.009	143	99
2007	191	350	643	1.032	124	86
2008	234	403	694	1.021	133	93
2009	188	347	640	0.983	143	100
2010	207	360	625	0.913	150	104
2011	336	545	885	0.859	172	119
2012	334	545	889	0.976	193	135
2013	309	500	811	0.937	137	96
2014	517	808	1263	0.877	147	103
2015	494	808	1323	0.729	107	74
2016	627	935	1396	0.758	99	69
2017	365	627	1074	0.868	114	79
2018	305	500	819	0.916	96	67
2019	191	323	548	0.883	64	45
2020	272	478	839	1.033	39	33
2021	427	701	1153	0.783	48	48
2022	261	432	716	0.899	68	63
2023	245	409	684	0.81	67	37

Contents

27 Pollack in subareas 6 and 7 (Celtic seas and the English Channel)

27.1 Introduction

Type of assessment in 2024

The Celtic Seas and the English Channel (subareas 6 and 7) Pollack stock assessment was conducted using a Surplus Production model in Continuous Time (SPiCT) with data from commercial landings and a VAST survey index. This assessment was benchmarked in 2023 (ICES, 2023).

ICES advice applicable to 2025

ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2025.

27.2 General

Stock Identity

This section is not dedicated to a 'stock', it relates to a species in a wider region where data are available. The stock structure of Pollack populations in this ecoregion is not clear. ICES does not necessarily advocate that subareas 6 and 7 constitutes a management unit for Pollack, and further work is required.

Management applicable to 2023

The 2023 TAC for Pollack was set for ICES subareas 6 (including United Kingdom and international waters of 5b and international waters of 12 and 14) and 7 separately, Table 27.1.

The 2023 TAC for Subarea 6 was 125 tonnes and uptake low at 20% and varied considerably between countries. France, which holds 47% of the TAC, only utilised 6.5% of their quota, whilst the UK utilised 30% of the 37% TAC allocation. Ireland has 14% of the total TAC and had the largest uptake using 40% of their TAC allocation.

In Subarea 7, which comprises the vast majority of landings and a TAC of 6410 tonnes, the uptake was also low at 21% and again varied considerably between countries. France, which holds the majority of the TAC allocation (66%), only utilised 12% of this. The UK utilised 37% of its 23% TAC allocation, Ireland utilised 69% of its 7.1% TAC allocation, Belgium and Spain, which hold very low TAC allocations at 2.9% and 0.2%, utilised 2.8% and 7.5% respectively.

27.3 Fishery in 2023

Landings

1403 tonnes of pollack were landed in 2023, 98% of which came from Subarea 7.

The official landings for ICES subareas 6 and 7 are shown in Tables 28.2 and 28.3 respectively and have been decreasing since 2016 (Figure 27.1).

For Subarea 6, there was an 26% decrease in landings (25 tonnes) in 2023 compared to the landings in 2022 (33 tonnes), which is way below the TAC of 125 tonnes. The UK declared the highest landings (55%) followed by Ireland (29%) and France (16%).

For Subarea 7, there was a 10% decrease in landings (1378 tonnes) in 2023 compared to the landings in 2022 (1525 tonnes). The UK had the highest landings (40%) followed by France (37%), Ireland (23%), Belgium (0.4%) and Spain (0.06%).

Landings by division

In 2022, 98% of catches came from Subarea 7, with only 2% of landings derived from Subarea 6 and of those, over 99% came from Division 6.a. The division with the highest proportion of landings within Subarea 7 derived from 7.e (45%) followed by 7.h (17%), 7.g (14%), 7.j (12%), 7.f (9.6%) and 7.d (1.2%). Landings in divisions 7.a, b, c and k were negligible (<1%).

Landings by gear

The majority of Pollack landings in the Celtic Sea ecoregions were caught by gillnets and trammelnets (49%) followed by set lines (25%), bottom trawlers (14%) and miscellaneous gears (12%). When separated by subarea, the predominant gears landing pollack in Subarea 6 were bottom trawlers (57%) followed by lines (16%) nets (12%) and miscellaneous gears (16%). In Subarea 7, nets had the highest landings (49%) followed by lines (26%), bottom trawlers (13%), and miscellaneous gears (12%).

Landings by quarter

Pollack are not historically targeted throughout the entire year, and are mainly targeted during the first quarter, which coincides with spawning. The breakdown of landings per quarter in 2023 shows that the highest landings were in quarter 1 (38%) followed by quarter 2 (26%), quarter 3 (21%) and quarter 4 (16%) respectively.

Discards

Discarding was negligible at 9.8 tonnes in 2023.

Landings uncertainty

Pollack is a known recreational fishing species, however; it is unknown as to the quantities exploited by recreational fisheries. A phone study conducted in France in 2011–2013 by Levrel *et al.* (2013) estimated that 3300 tonnes are landed annually through recreational fishing, 2274 tonnes of which are retained. Radford *et al.*, 2018 further suggest that pollack landings may be similar to or above commercial landings. Work is currently being undertaken to provide recreational landing data.

27.4 Stock assessment

The stock was benchmarked at WKBMSYSPiCT2 (ICES, 2023) and advice is based on a SPiCT assessment since 2023. In 2024 the following improvements were implemented to the SPiCT model to ensure the consistency in the forecast:

- WGCSE applied a new methodology developed by AFWG that amends the number of biomass index years removed on the retrospective analysis. The updated retrospective analysis for the assessment showed a constant overestimation of biomass, with a Mohn's Rho value of 0.236 (Figure 27.2), which is considered a major retrospective pattern in ICES guidelines. However, the zero catch advice for 2025 cannot be more precautionary.
- When using a constant F approach, SPiCT keeps the fishing mortality constant from the end of the intermediate year. However, the F_{sq} catch scenario within ICES guidelines considers to keep fishing mortality constant from the last year of the time-series. WGCSE decided to follow ICES guidelines and applied the latest option to the F_{sq} scenario.

- The default SPiCT functions count the fixed intermediate year catches as an additional year of data, and then SPiCT is rerun including the intermediate year data. As a result of this, in the case of Pollack in subareas 6 and 7, the selection of intermediate year catches has a large impact on the biomass and fishing mortality prior to the intermediate year. The SPiCT developers recommended using a different approach for this stock that did not allow biomass and fishing mortality to change before the intermediate year. WGCSE decided to use the newly developed functions by SPiCT developers in order to apply this methodology.

27.4.1 2024 Results

In 2024, for the first time in the time-series, the TAC was lower than the recent estimated catches. Therefore, the 2024 TAC was used as basis of the advice for the intermediate year, instead of using the recent three year catch average as last year (Table 27.4).

The stock has been above F_{lim} since 2012 (Figure 27.3) and below B_{lim} since 2016 (Figure 27.4). None of the catch scenarios analysed estimates a recovery of the stock above B_{lim} (Table 27.5), and thus a catch advice of zero tonnes is advised.

27.5 Uncertainties in assessment and forecast

Due to the uncertainties in the assessment input data and their representativeness for the stock (listed below on this section), the assessment results imply a considerable amount of uncertainty.

The surveys used to calculate the biomass index do not target preferred pollack habitat, and the index is based on few samples. Although the index is uncertain, it shows a strong declining trend.

Recreational catch is likely to be a large component of the total catch. Due to lack of data, recreational catch is not included in the assessment; however, the current assessment has been shown to be robust to a range of assumptions of recreational catch levels.

The stock structure is poorly defined.

27.6 Management considerations

TAC for Subarea 7 includes ICES Division 7.d, which is not in the remit of the Celtic Sea ecoregion. TAC set for both subareas 6 (including United Kingdom and international waters of 5b and international waters of 12 and 14) and 7 are not in line with the current estimates of catches and estimated sustainable yields, and therefore are not constraining.

Management plan

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to demersal stocks including pollack in ICES subareas 6 and 7.

27.7 Recommendations

This stock was benchmarked in 2023 (ICES, 2023), and the SPiCT assessment was accepted by WGCSE in 2024. However, work needs to be done to validate the biomass index due to the low pollack catches and to explore the impacts of the substantial recreational catches. There is potential to collaborate with ICES Working Group on Recreational Fisheries Surveys (WGRFS) to improve on the existing UK data and to bolster ongoing work in France and Ireland to provide data on the extent of their recreational fishing of Pollack.

It is proposed to benchmark the stock for 2025. This would aim to:

- reassess the survey index
- explore potential commercial cpue indices
- evaluate new recreational fishing estimates and potentially reconstruct historical data
- explore an stock synthesis model that can incorporate the available age and length data

27.8 References

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27.9 Tables and Figures

Table 27.1. 2023 TAC for Pollack in ICES subareas 6 (and 5.a, b; international waters of 12 and 14) and 7.

Species:	Pollack *Pollachius pollachius*		Zone:	6; United Kingdom and international waters of 5b; international waters of 12 and 14 (POL/56-14)
Spain	2		Precautionary TAC	
France	59			
Ireland	18			
Union	79			
United Kingdom	46			
TAC	125			

Species:	Pollack *Pollachius pollachius*		Zone:	7 (POL/07.)
Belgium	185	(1)	Precautionary TAC	
Spain	11	(1)		
France	4 255	(1)		
Ireland	453	(1)		
Union	4 904	(1)		
United Kingdom	1 506	(1)		

Table 27.2. Landings of Pollack in Subarea 6 as officially reported to ICES.

Year	Belgium	Denmark	France	Germany	Ireland	Netherlands	Norway	Portugal	Spain	Sweden	UK	Total Sub-area 6
1950	1	-	-	-	-	-	-	-	-	-	295	296
1951	-	-	-	-	-	-	-	-	-	-	484	484
1952	-	-	-	-	-	1	-	-	-	-	503	504
1953	-	-	-	-	-	-	-	-	-	-	422	422
1954	-	-	-	-	-	-	-	-	-	-	452	452
1955	-	-	-	-	-	-	-	-	-	-	566	566
1956	-	-	-	-	-	-	-	-	-	-	528	528
1957	-	-	-	-	-	-	-	-	-	-	547	547
1958	.	-	-	23	-	-	-	-	-	-	710	733
1959	1	-	-	6	-	-	-	-	-	-	607	614
1960	15	-	-	-	-	-	-	-	-	-	441	456
1961	1	-	-	1	125	-	-	-	-	-	259	386
1962	2	-	-	8	197	-	-	-	-	-	235	442
1963	6	-	-	2	204	-	-	-	-	-	320	532

Year	Bel-gium	Den-mark	France	Germany	Ire-land	Nether-lands	Nor-way	Portu-gal	Spain	Swe-den	UK	Total Sub-area 6
1964	1	-	-	1	130	-	-	-	-	-	368	500
1965	1	-	-	1	402	-	-	-	-	-	496	900
1966	2	-	-	-	200	-	-	-	-	-	428	630
1967	1	-	-	1	263	-	-	-	-	1106	413	1784
1968	5	-	-	2	214	-	148	-	-	1012	500	1881
1969	1	-	-	4	282	-	-	-	-	1224	667	2178
1970	2	-	-	1	398	-	-	-	-	756	447	1604
1971	1	-	-	5	75	-	-	-	-	750	256	1087
1972	1	-	-	1	127	-	-	-	-	779	317	1225
1973	2	-	-	-	-	-	-	-	-	-	503	505
1974	6	-	-	-	-	3	-	-	-	-	359	368
1975	< 0.5	-	-	1	-	1	4	-	-	-	393	399
1976	7	-	-	-	-	1	-	-	-	-	519	527
1977	-	-	196	-	-	1	2	-	-	-	493	692
1978	-	-	196	-	-	-	4	-	-	-	553	753
1979	-	-	310	-	-	-	-	-	-	-	350	660
1980	-	-	36	-	-	-	-	-	-	-	233	269
1981	-	-	342	-	-	-	-	-	55	-	185	582
1982	-	< 0.5	272	-	-	-	-	-	95	-	103	470
1983	-	-	331	-	-	-	-	-	86	-	148	565
1984	-	-	212	-	-	-	-	-	222	-	194	628
1985	< 0.5	-	224	1	-	-	-	-	283	-	328	836
1986	-	-	145	-	223	-	-	-	2217	-	187	2772
1987	-	< 0.5	108	-	103	-	-	-	860	-	259	1330
1988	-	< 0.5	128	-	163	-	-	-	1925	-	221	2437
1989	-	< 0.5	111	1	103	-	-	-	-	-	179	394
1990	-	-	76	-	150	-	1	-	-	-	192	419
1991	-	-	31	-	145	-	-	-	4	-	189	369
1992	-	< 0.5	21	-	23	-	-	-	< 0.5	-	203	247
1993	-	-	39	-	12	-	-	-	-	-	273	324
1994	-	-	34	< 0.5	26	-	< 0.5	-	-	-	276	336
1995	-	-	64	3	83	-	-	-	-	-	354	504
1996	-	< 0.5	29	< 0.5	97	-	1	-	-	-	210	337
1997	-	-	14	1	69	-	2	-	-	-	162	248
1998	-	-	21	-	60	-	-	< 0.5	< 0.5	-	147	228
1999	-	-	-	-	73	-	3	-	< 0.5	-	136	212
2000	-	-	11	2	62	-	-	-	-	-	116	191
2001	-	-	8	-	108	-	-	-	-	-	101	217

Year	Belgium	Denmark	France	Germany	Ireland	Netherlands	Norway	Portugal	Spain	Sweden	UK	Total Subarea 6
2002	-	-	9	-	26	-	-	-	-	-	96	131
2003	< 0.5	-	3	-	88	-	1	-	-	-	111	203
2004	< 0.5	-	2	-	68	-	1	-	-	-	65	136
2005	-	-	23	-	28	-	-	-	-	-	16	67
2006	-	-	3	< 0.5	31	-	< 0.5	-	4	-	5	42
2007	-	-	10	< 0.5	26	-	7	-	-	-	21	64
2008	-	-	8	-	21	-	1	-	-	-	23	54
2009	-	-	7	-	6	-	< 0.5	-	-	-	25	38
2010	-	-	6	-	34	-	< 0.5	-	-	-	39	80
2011	-	-	2	-	12	-	1	-	-	-	36	51
2012	-	-	2	-	10	-	< 0.5	-	2	-	33	48
2013	-	-	1	-	34	-	< 0.5	-	-	-	22	58
2014	-	-	1	-	25	-	< 0.5	-	-	-	18	44
2015	-	-	< 0.5	-	23	-	< 0.5	-	-	-	25	49
2016	-	-	< 0.5	-	44	-	< 0.5	-	-	-	31	76
2017	-	-	< 0.5	-	33	-	< 0.5	-	-	-	14	47
2018	-	-	< 0.5	-	22†	-	< 0.5	-	-	-	29	51†
2019	-	-	3	-	22†	-	< 0.5	-	-	-	27	51†
2020	-	-	< 0.5	-	16†	-	-	-	-	-	32	48†
2021	-	-	2	-	30†	-	-	-	< 0.5	-	43	75†
2022*	-	-	7	1	11	-	-	-	-	-	16	36
2023*	-	-	4	-	7	-	-	-	-	-	13	24

*** Preliminary official landings.**

† Incomplete/missing as a result of part of the data being unavailable under data confidentiality clauses.

Table 27.3. Landings of Pollack in Subarea 7 as officially reported to ICES.

Year	Belgium	Denmark	France	Germany	Ireland	Netherlands	Norway	Spain	UK	Total Subarea 7
1950	93	-	-	-	-	-	-	-	375	468
1951	74	-	-	2	-	-	-	-	380	456
1952	80	-	-	10	-	-	-	-	336	426
1953	34	-	-	-	-	-	-	-	252	286
1954	17	-	-	4	-	-	-	-	365	386
1955	38	-	-	-	-	-	-	-	247	285
1956	67	-	-	1	-	-	-	-	155	223
1957	219	-	-	6	-	-	-	-	367	592

Year	Belgium	Denmark	France	Germany	Ireland	Netherlands	Norway	Spain	UK	Total Subarea 7
1958	342	-	-	17	-	-	-	-	233	592
1959	158	-	-	32	-	-	-	-	251	441
1960	317	-	-	-	-	-	-	-	267	584
1961	268	-	-	-	360	-	-	-	210	838
1962	367	-	-	1	369	-	-	-	170	907
1963	95	-	-	-	411	-	-	-	176	682
1964	299	-	-	-	342	-	-	-	194	835
1965	362	-	-	-	335	-	-	-	231	928
1966	456	-	-	-	438	-	-	-	175	1069
1967	417	-	-	-	474	-	-	-	202	1093
1968	214	-	-	-	508	-	-	-	167	889
1969	142	-	-	-	794	-	-	-	161	1097
1970	165	-	-	1	724	-	-	-	120	1010
1971	114	-	-	-	673	-	-	-	116	903
1972	142	-	-	-	1073	-	-	-	123	1338
1973	89	-	-	-	-	3	-	-	127	219
1974	299	-	-	-	-	13	-	-	223	535
1975	295	-	-	-	-	17	-	-	290	602
1976	339	-	-	-	-	4	-	-	421	764
1977	157	1	3569	-	-	1	-	-	465	4193
1978	186	21	5496	14	-	8	-	-	515	6240
1979	151	18	5119	76	-	1	-	-	696	6061
1980	237	7	5242	-	-	1	-	1	769	6257
1981	244	-	5814	-	-	3	-	23	780	6864
1982	154	-	4253	-	-	-	-	32	1022	5461
1983	167	-	6214	-	-	-	-	26	1045	7452
1984	207	-	3927	-	-	-	-	486	1100	5720
1985	269	-	3741	-	-	-	-	20	1022	5052
1986	241	-	4574	-	1335	-	-	17	1795	7962
1987	149	-	5213	-	848	-	-	19	2010	8239
1988	191	-	5211	-	1066	-	-	22	1740	8230
1989	145	-	3893	-	994	-	-	18	1487	6537
1990	133	-	4831	-	1066	-	-	26	1914	7970
1991	76	-	3211	-	1045	-	-	22	1962	6316
1992	62	-	2849	-	1014	-	-	19	1889	5833
1993	55	-	2325	-	1137	-	-	7	2135	5659
1994	94	-	2621	-	921	-	-	8	2391	6035
1995	88	2	2315	-	1107	-	-	4	2168	5684

Year	Belgium	Denmark	France	Germany	Ireland	Netherlands	Norway	Spain	UK	Total Subarea 7
1996	94	-	2684	-	1190	6	-	5	2519	6498
1997	99	-	2443	-	984	4	< 0.5	7	2540	6077
1998	92	-	2375	-	886	1	-	11	2347	5712
1999	86	-	-	-	976	-	3	19	1703	2787
2000	71	-	2422	-	1069	-	-	5	1810	5377
2001	100	-	2515	-	1274	-	-	9	1987	5885
2002	117	-	2481	-	1308	-	-	17	1999	5922
2003	113	-	2284	-	1151	-	-	12	1788	5348
2004	104	-	1914	-	1049	1	-	13	1705	4786
2005	98	-	2198	-	728	1	-	16	1684	4725
2006	78	-	2223	-	1144	1	-	50	1569	5066
2007	90	-	2003	-	1034	3	-	2	1850	4982
2008	76	-	1606	-	1058	1	-	20	1544	4305
2009	41	-	1686	-	1198	4	-	5	1614	4548
2010	35	-	1859	-	1367	2	-	6	1515	4784
2011	37	-	1801	-	1296	2	-	8	1908	5052
2012	43	-	1430	-	1520	1	< 0.5	4	1898	4896
2013	39	-	1813	-	1730	1	-	22	1936	5541
2014	84	-	2068	-	1508	1	-	27	2184	5872
2015	32	-	1176	-	1447	1	-	25	1501	4182
2016	42	-	1257	-	1536	< 0.5	-	23	1958	4817
2017	19	-	960	-	1487	< 0.5	-	23	1398	3887
2018	21	-	819	-	878†	9	-	25	1267	3018†
2019	12	-	550	-	14†	2	-	5	988	1570†
2020	17	-	584	-	602†	2	-	3	974	2182†
2021	7	-	588	-	590†	2	-	1	802	1990†
2022*	7	-	494	-	355	1	-	< 0.5	671	1528
2023*	5	-	493	< 0.5	312	< 0.5	-	1	555	1366

***Preliminary commercial landings.**

† Incomplete due to part of the data being unavailable under national GDPR clauses.

Table 26.4. Assumptions made for the interim year and in the forecast of pol.27.67.

Variable	Value	Notes
F (2024)/F_{MSY}	1.62	Based on a catch of 925 tonnes for 2024
B (2025)/B_{MSY}	0.089	Short-term forecast based on a catch of 925 tonnes for 2024
Catch (2024)	925	TAC for 2024; in tonnes

Table 26.5. Annual catch scenarios of pol.27.67.

Basis	Total catch (2025)	Fishing mortality F_{2025}/F_{MSY}	Stock size B_{2026}/B_{MSY}	% B change ^	% TAC change ^^	% advice change ^^^
ICES advice basis						
MSY approach (F = 0)	0	0	0.144	61	-100	
Other scenarios						
F_{MSY}	131	0.178	0.137	54	-86	
F_{SQ}	1348	2.40	0.079	-11.5	46	
F = 0	0	0	0.144	61	-100	

^ Biomass 2026 relative to biomass 2025.

^^ Total catch in 2025 relative to the sum of 'Subarea 7' TAC 2024 and 'Subarea 6; United Kingdom and international waters of 5b; international waters of 12 and 14' TAC 2024 (925 tonnes).

^^^ Advice in 2025 relative to advice in 2024 (0 tonnes), options were left blank because they cannot be calculated.

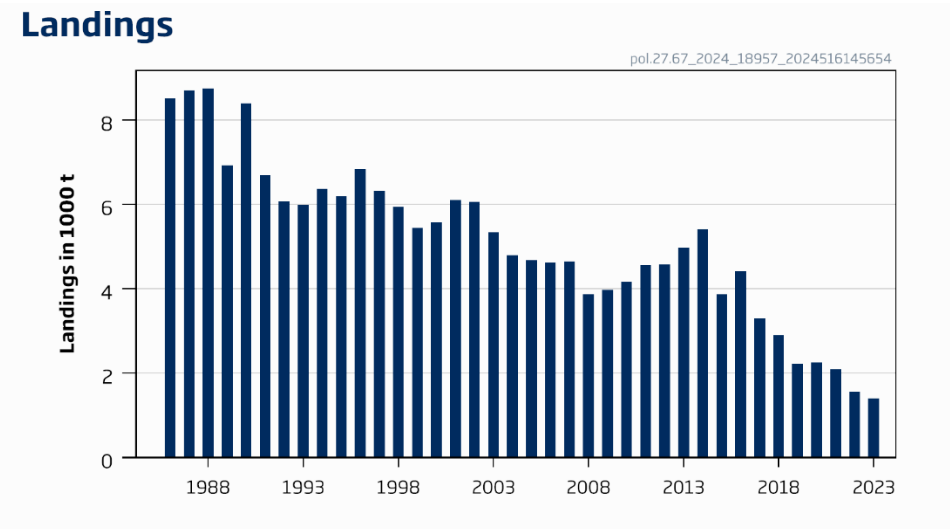


Figure 26.1. Landings of pol.27.67. Official landings prior to 2003, when ICES landings became available.

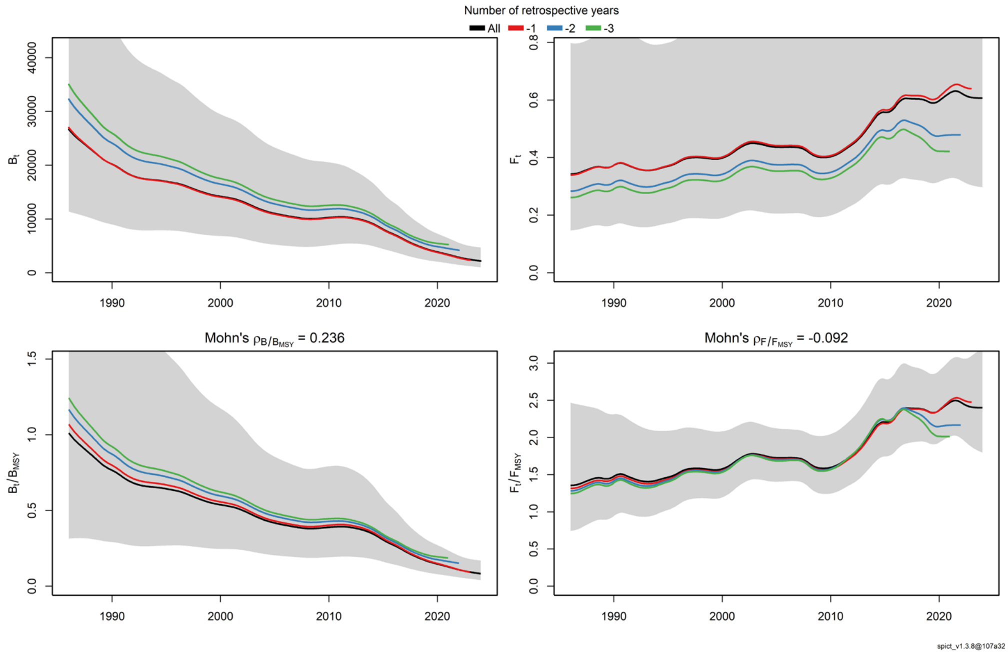


Figure 26.2. Retrospective patterns and Mohn's Rho calculations for relative biomass (left) and relative fishing pressure (right).

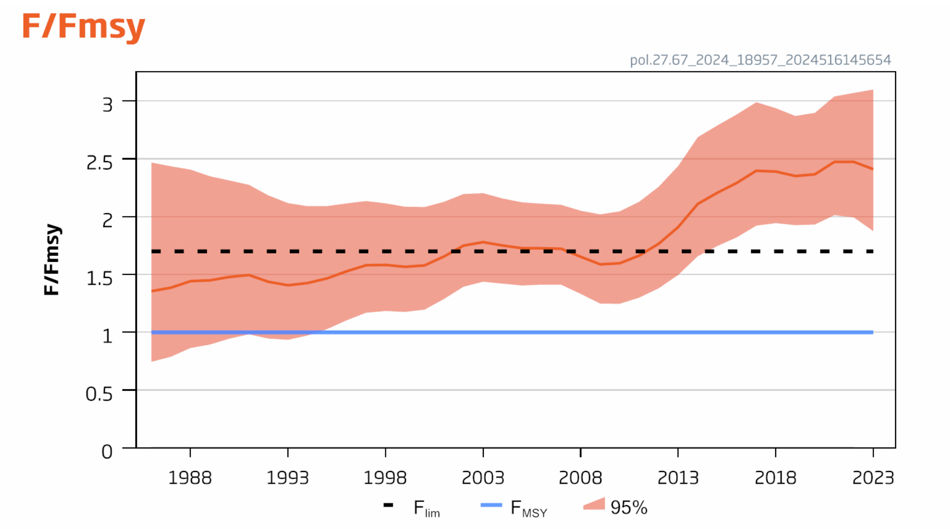


Figure 26.3. Relative fishing pressure for pol.27.67, including F_{lim} and F_{MSY} levels.

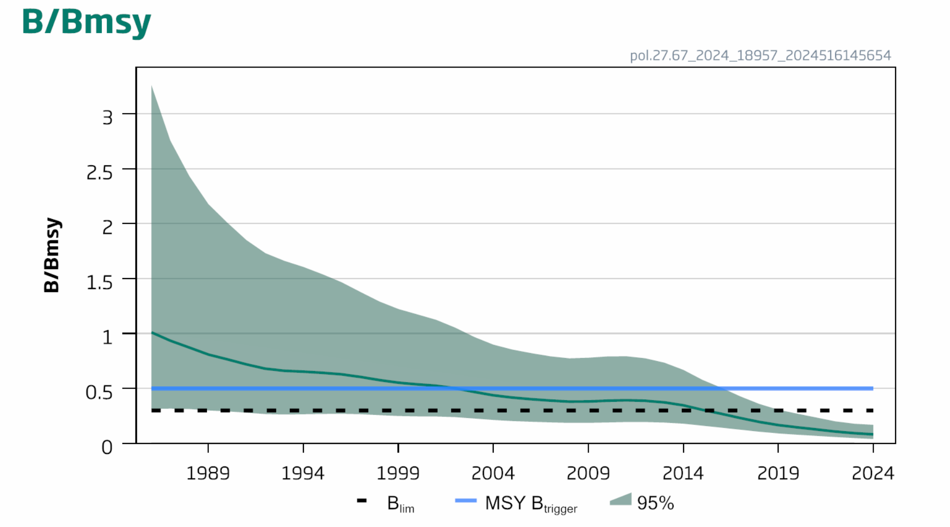


Figure 26.4. Relative stock size for pol.27.67, including B_{lim} and MSY $B_{trigger}$ levels.

Contents

28 Sea bass (*Dicentrarchus labrax*) in divisions 4.b–c, 7.a, and 7.d–h (central and southern North Sea, Irish Sea, English Channel, Bristol Channel, and Celtic Sea)

28.1 Introduction

Type of assessment

This is an update of the assessment accepted as the agreed methods to use at the benchmark workshop for the sea bass: WKBASS (ICES, 2017–2018). The assessment is performed using the Stock Synthesis model implementation (SS3; Methot, 2000; 2011). The stock is treated as Category 1 with a full analytical assessment and forecast.

ICES advice applicable to 2023

ICES advises that when the MSY approach is applied, total removals† in 2023 should be no more than 2542 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock.

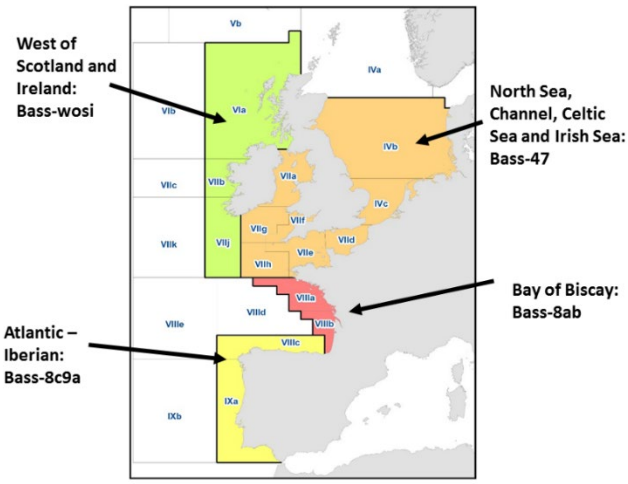
ICES advice applicable to 2024

ICES advises that when the MSY approach is applied, total removals† in 2024 should be no more than 2432 tonnes. ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock

28.2 General

28.2.1 Stock definition and ecosystem aspects

Currently Atlantic stock identities are assumed to be as follows (ICES, 2012a,b):



A better understanding of the stock identity was reported during the first step of the benchmark (ICES, 2023), and this would be integrated, if possible, in the new assessment model during the next steps of the benchmark.

28.2.2 Management

Historical management is described in the Stock Annex.

28.2.2.1 Management applicable from 2021 to 2024

In 2021-2024 the sea bass fishery of stock bss.27.4bc7ad–h was prohibited, with derogations as shown in the simplified tables below for professional and recreational fishermen (season length, catch limits given per vessel for commercial and per fisher for recreational). See official regulations 2020-2024 respectively for full details[1,2,3,4,5]

	Year	Recreational
2021	January–February–December 2021	0 fish/day
	01/03/2021 to 30/11/2021	2 fish/day
2022	January–February–December 2022	0 fish/day
	01/03/2022 to 30/11/2022	2 fish/day
2023	January–February 2023	0 fish/day
	01/03/2023 to 31/12/2023	2 fish/day
2024	January–February 2024	0 fish/day
	01/03/2024 to 31/12/2024	2 fish/day

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R0123

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02021R0092-20211101

[3] https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=CELEX:32022R0515

[4] https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=CELEX:32023R0194

[5] https://eur-lex.europa.eu/eli/reg/2024/257/oj

28.2.3 Fishery description

28.2.3.1 Total landings (official)

The history of the fishery is described in the Stock Annex. Table 1 and Figure 1 present official and total ICES landings. A large decrease in total landings was observed in 2014 due to poor weather conditions during winter and then from 2015 onwards due to management measures. Historically the bulk of the landings were made by the French fishery, but since implementation of management measures, landings are shared between French, UK and NL, and to a lesser extent Belgium. In 2023, 1379 tonnes were landed (official source): 675 t by UK, 437 t by France, 231 t by Netherland, 32 t by Belgium 2t by Denmark, 2t by Germany and <1t by Channel Island. Landings from France and the UK by gear are given in Figure 2.

28.3 Data

28.3.1 Commercial landings

Landings are used for six fleets where selectivity is modelled (Table 2): fleet 1- UK bottom trawls and nets; fleet 2- UK lines; fleet 3- UK midwater pair trawls; fleet 4- French combined fleets; fleet 5- other countries plus UK gears not included in fleet 1, with selectivity based on fleet 4; and fleet 6- recreational fisheries, where 2012 is the reference year. The source of information for the commercial fleets is the ICES database InterCatch. The time-series of recreational fisheries removals is calculated iteratively, so that fishing mortality remains constant and equal to the fishing mortality in 2012 over the period 1985–2014. After the implementation of the management in 2015, a multiplier is applied to recreational fishing mortality based on the severity of the measures (see chapter below). The landings are census data (EU logbooks and/or sales slips) from several sources:

1. Official statistics recorded in the ICES official landings database since the mid-1970s, with data from 1985 are used in this assessment.
2. French landings for 2000–present from a separate analysis of logbook, auction data and VMS data (SACROIS database) by Ifremer – extracted from the ICES database InterCatch.
3. Landings for Belgian vessels – extracted from the ICES database InterCatch.
4. Landings for Netherlands – extracted from the ICES database InterCatch Exception where a mistake was found in InterCatch, i.e. 2018 landings were updated for the 2020 assessment using official data.
5. UK landings by gear type recorded in official UK landings databases (historically and "InterCatch" database).

Details of the methodology used to calculate French and UK historical landings can be found in the Stock Annex.

NB : Between 2015 and 2022 Netherlands Intercatch landings have been much lower than official landings. Issue appears to be related to data confidentiality for vessels <12m making it hard to link landings to area. This has been now resolved for WGCSE 2024: 2023 assessment has been rerun with updated NL landings 2015-2022 and very little change to stock perception due to the revised NL landings has been observed. This has also be treated as data correction and landings 2015-2022 have been updated (Table 2).

28.3.2 Commercial length and age compositions

IBPBass2 (ICES, 2016) developed the Stock Synthesis model to include both the length and age compositions for the landings of fleets for which selectivity is estimated (Fleet 1: UK combined bottom trawl and nets -1985 onwards; Fleet 2: UK lines -1985 onwards; Fleet 3: UK midwater trawlers -1985 onwards; Fleet 4: French combined gears -2000 onwards). Fitting to length composition data helps the estimation of length-based selectivity, whilst the age compositions (from application of age–length keys to length frequencies according to stratified sampling schemes) provide direct fitting of model estimates of catch-at-age. Since the length data are effectively being used twice, the length and age datasets are down weighted to avoid over-fitting of the data. The composition data for the fleets are given in the SS3 data file. Input sample sizes for the multinomial composition data are derived from numbers of fishing trips sampled, as proxy for effective sample size. The relative sample sizes between years are maintained in any reweighting.

In 2024, an update was provided to landings from the Netherlands for 2017-2022 following work presented to the ongoing benchmark (WKBSEABASS). The inclusion of landings from under 12m vessels led to a substantial revision of the total catch from this country, however as the Netherlands contribute a relatively small part of the landings, the effect on the total landings was small. A sensitivity run to investigate the effect of this revision on the assessment is described in section 28.3.1.9.

28.3.2.1 Sampling rates

UK (England and Wales) sampling effort for length and age compositions by gear group are given in Table 3. The UK midwater trawl fleet landings were not sampled in 1997, 2013–2017 and since 2019 due to the small number of trips targeting sea bass. This has negligible impact on the assessment as this UK metier represented only 1% of total sea bass landings in 2013 and landed 2 t or less each year since 2014. In addition, Stock Synthesis will impute age distributions for missing years from the selectivity curve and landings.

Sampling of sea bass in France also varied between gears (Table 4). Numbers of fish sampled decreased from 2015 due to the implementation of management measures and the fact that relatively few fish are now landed. The level of sampling was very low in 2019, with some of the main metiers, including lines and nets, not sampled. Level of sampling has nevertheless increased from 2020 onwards.

The number of trips sampled in the UK is used as input in the stock assessment, with exception of a set number being attributed to UK midwater trawl and French fleet age composition. These numbers are then iteratively adjusted using the Francis method of weighting, reducing the disproportionate effect of the different datasets used.

28.3.2.2 Length composition estimates

Figure 3 and Table 5 give fleet-raised length compositions for all French gears combined. French numbers-at-length are available from 2000 onwards. The French fleet is the combination of several types of subfleets using a variety of fishing gears: pelagic trawlers, bottom trawlers, netters, liners, Danish seiners and purse-seiners (see details in Table 4). Figure 4, Figure 5 and Figure 6 give fleet-raised length compositions per UK metier used in the assessment (UK bottom trawls and nets; Lines; Midwater trawls).

28.3.2.3 Age composition estimates

The French age composition time-series from 2000 is from the application of an annual age–length key to the annual length composition of landings (Table 6).

Fleet-raised age compositions were obtained for UK fleets from 1985 onwards by application of age–length keys developed for the areas 4. bc, 7.d, 7.e&h, and 7.a,f,g. The annual age compositions for the combined bottom trawl and nets fleet and the line fleet are given in Table 7 and Table 8, and the age compositions for the UK midwater pair trawl fleet since 1996 are given in Table 9.

28.3.3 Commercial discards

28.3.3.1 Discards and post release mortality

Discarding of sea bass below the MCRS occurs in most commercial fisheries to a variable extent. Previously, ICES advice sheets indicated overall international discard rates of only 5% by weight for the bss.27.4bc7ad–h stock. The WGCSE and WKBASS (ICES, 2017) showed that discard rates have typically been the highest in bottom otter trawls (OTB) and have increased following the introduction of additional management measures in 2015. Discards are now included in the assessment of this stock and in the absence of any data on discard survival, this has been assumed to be zero for all commercial fisheries. This has the potential to overestimate commercial fishing mortality, but the effect was initially expected to be small due to the low discard rates prior to 2015. This has changed in recent years, since the management measures have been implemented and discard rates are expected to increase in the short term as fishers adjust to take account of the changes, such as the increase in minimum conservation reference size from 36 cm to 42 cm.

Survival of fish discarded by commercial line vessels may be similar to survival of recreational angling releases (see next section), but work is needed to establish the typical gear, handling, and condition of fish to be released. Survival of sea bass caught by trawls, seines, fixed or driftnets and longlines will depend on many factors including tow duration, soaking times, gear design, deep-hooking, and time on deck. There is need for studies on discard survival of sea bass in different commercial fisheries.

28.3.3.2 Commercial discards data

Data sources for discards estimates and sampling design are described in the Stock Annex, with a summary of data from the UK and French on-board sampling programmes from 1985 to present given in Tables 10-12. Note that in the assessment, from 2015 onwards, discards from French observer data were replaced by logbook estimates, more realistic (French fishers have been encouraged to report their discards in logbooks because of the landings obligation). Discarding is mainly attributed to bottom trawlers where sea bass is often a bycatch. Note that the level of sampling of the UK fleets since 2017 and FR fleets since 2019 has been low and so no raised estimate of discard length distribution was included in the assessment for these years.

28.3.4 Recreational catches

The approach used for recreational catches is described in detail in the Stock Annex, but is briefly summarised here including the latest relevant data.

28.3.4.1 Recreational catches point estimates

Only a single year of recreational catches was available: 1440 t in 2012. This value of 1440 t was obtained by summing international recreational activities survey estimates for France, the Netherlands and the UK. It represented total removals through adding the retained fish and releases assuming a 5% post-release mortality. A composite length–frequency distribution was generated for recreational removals from the same survey data, with a post-release mortality of 5% applied to the release component.

28.3.4.2 Recreational removals time-series reconstruction

F for the recreational fishery was assumed to be constant prior to the introduction of management measures in 2015. Limited survey data were available after the implementation of management measures at the time of the benchmark in 2017–2018, so no reliable catch estimates existed. As a result, a method was developed for estimating the impact of combinations of the MCRS, season length and bag limits on removals by recreational fishing. A multiplier was derived from 2012 catches in terms of numbers of fish for the recreational F that related to the reduction in catch due to management. This corresponded to multipliers of 0.821 in 2015, 0.282 in 2016 and 2017, 0.191 in 2018, 0.312 in 2019 and 0.464 for 2020–2024 (Table 13).

Since completion of the benchmark in 2018, further surveys have been conducted in the UK, France, Belgium, and the Netherlands that provide estimates of recreational catches of sea bass. However, these surveys have been done in different years, using different methods, and have different associated biases. It is not obvious how best to combine the data for use in the assessment and would represent a significant departure from the current approach. Hence, this should be done as part of the next benchmark and peer-reviewed to ensure it robustness. As a result, the current approach will continue to be used until the next benchmark and recreational catches included on the issue list.

28.3.5 Biological data

All parameters for growth, weight, maturity, natural mortality and ageing error were as described in the Stock Annex.

28.3.6 Survey data used in assessment

28.3.6.1 Pre-recruit surveys in UK

An inshore trawl survey in autumn in a major bass nursery area in the Solent (7.d English coast) provides abundance indices-at-ages 2 to 4 for the stock assessment (Figure 7). Data are available from 1982, although there are intermittent years when the survey did not take place. The index calculation was updated in 2020 after a rigorous quality assessment was conducted (Table 14 and Table 15). The Stock Annex provides details of this survey (SBTS, G9863) and of some other pre-recruit survey series not considered appropriate by previous WGs and IBPBass for inclusion in the assessment.

28.3.6.2 Pre-recruit surveys in France

Four similar surveys have been done by Ifremer along the coast of France since 2014 to provide insight into French sea bass nurseries areas and pre-recruit dynamics. The new time-series will be provided to WKSEABASS to be considered for inclusion in the new assessment. In the Channel, the survey takes place in the Seine estuary and in the Douarnenez Bay and indices are available respectively from 2017 and 2018.The working group will encourage its continuation after the index generated is reviewed and if it provides valuable information and supports the assessments. The ultimate objective would be to fund them in a sustainable manner through the Data Collection Framework (DCF)

28.3.6.3 Channel Groundfish survey FR-CGFS

The French Channel Groundfish survey (FR-CGFS, G3425) has been carried out in October each year since 1988. It provides swept-area indices of sea bass abundance in the Eastern Channel (7.d) together with length compositions. The swept-area indices are given in Table 16. Details of the survey can be found in Coppin *et al*. (2002) and sampling stations shown in Figure 8. The majority of sea bass are caught in the coastal waters of England and France. The original time-series finished in 2014 as a new vessel was used for the survey from 2015. The new time-series now includes nine years of data, so may be considered for inclusion in the assessment at the next benchmark.

28.3.7 Commercial landings per unit of effort

Following the recommendation from WKBASS (ICES, 2018) the French LPUE index is now calculated by modelling the zeros and non-zeros values using a delta-GLM approach (see Stock Annex for details). Confidence interval calculated through a bootstrap estimation are presented in Table 17 and Figure 9, with the updated LPUE series used in the assessment.

28.3.8 Other relevant data

None.

28.4 Stock assessment

28.4.1 Model structure and input data / parameters for update assessment

The assessment was conducted using Stock Synthesis (Methot, 2000; 2011), using version 3.24u (Methot, 2011). The structure and input data / parameters of the SS3 model are summarized below and details are available in previous sections.

28.4.1.1 Model structure

- Temporal unit: annual based data (landings, discards, survey and commercial tuning indices, age and length frequencies).
- Spatial structure: One area.
- Sex: Both sexes combined.

28.4.1.2 Fleet definition

Six fleets defined: 1. UK bottom trawls, nets; 2. UK lines; 3. UK midwater trawls; 4. French fleets (combined); 5. Other (other countries and other UK fleets combined); 6. Recreational fisheries.

28.4.1.3 Landings and discards

Annual landings in tonnes from 1985 to final assessment year for the five fleets from ICES subdivisions 4.b and c, 7.a, d–h. Recreational catch for 2012 with the time-series from 1985 to present iteratively reconstructed conditioned on the 2012 estimated value of 1440 t.

Discards in tonnes for fleet 1 (UK bottom trawls, nets) from 2002 and fleet 4 (French) from 2009.

28.4.1.4 Abundance indices and compositional data

Channel Groundfish Survey in 7.d in autumn (France), 1988 to 2014 (FR-CGFS, G9527): total swept-area abundance index and associated length composition data (Table 16). Input CV for survey is 0.60 for 1988–1990 and 0.30 for 1991 to 2014. First three years of composition data are excluded due to sampling levels and high uncertainty in the data. For remaining years, number of stations with sea bass is used as input effective sample size of compositional length data.

Cefas Solent Autumn bass survey (7.d) (SBTS, G9863): years 1986 to 2009, 2011, 2013 to present, for ages 2–4. Selection was fitted as a function of length using a double normal model, with minimum and maximum ages specified as 2 and 4 in the age selection function (Table 15).

French LPUE: as updated every year.

28.4.1.5 Fishery landings age composition data

The age bin is set from 0 to 15 with a plus group for ages 16 and over. Age compositions for fleets are expressed as fleet-raised numbers-at-age, although they are treated as relative compositions in SS3. Year range for UK bottom trawls/nets and UK lines is 1985 to present; UK midwater pair trawl is 1996 to 2018 (no samples for 1997, 2013–2014, 2016–2017, 2019-present); French is all fleets from 2000 to present.

28.4.1.6 Fishery landings length composition data

The length bin is set from 4 to 100 cm by 2 cm intervals. Length compositions for fleets are expressed as fleet-raised number-at-length. Year range for UK bottom trawls/nets is 1985 to present; UK lines 1985 to present; UK midwater pair trawl 1985 to 2012 (no samples for 1997, 2013–2019-present); French all fleets from 2000 to present.

28.4.1.7 Model assumptions and parameters

Table 18 summarises key model assumptions and parameters. Other parameter values and input data characteristics are defined in the SS3 control file BassIVVII.ctl, the start.SS file, the forecast file Forecast.SS and the data file BassIVVII.dat.

28.4.1.8 Incorporation of recreational fishery catch estimates

2012 catch input and F multipliers on all other years to iteratively estimate the full time-series of recreational catches; calculations for the final assessment run are given in Table 21.

28.4.1.9 Sensitivity test to revised landings data

Following the revision to landings data submitted by the Netherlands, a sensitivity run was carried out comparing the 2023 final assessment with an assessment where these numbers had been revised. The effect on the key assessment quantities was negligible, e,g SSB in Figure 10. As a result these revisions were included in the 2024 final assessment with no need to reconsider reference points.

28.4.1.10 Final update assessment: diagnostics

The likelihood components (log L * Lambda) for the update SS3 assessment are given below:

Likelihood components	Likelihood
TOTAL	740.3
Catch	9.17e-013
Equilibrium catch	0.028
Survey	-40.91
Discards	35.49
Length compositions	401.9
Age compositions	319.4
Recruitment	24.16
Forecast Recruitment	0.300

Parameter soft bounds	0.019

A range of model outputs and diagnostics are given in Figures 12–34.

Good correspondence was found between the observed and fitted length and age compositions for each fleet (Figures 17–29). However, the fit to the French length compositions was poorer in 2014–2019 and the fit to French age composition was variable throughout the time-series. Some diagonal residual patterns are noted in the commercial age compositions indicating some problems in fitting extreme variations in recruitment.

Any smearing of age estimates from a strong year class into neighbouring weak ones could be responsible for year-class residuals in the UK age compositions that are apparent in the first half of the series. The age error vector included in the model helps to accommodate this in the fit to age compositions. The combined fit of the age and length composition data aggregated over the series look good (Figure 20 and Figure 26).

The survey abundance indices both fisheries-independent and fishery-dependent are fitted reasonably well (Figure 27, Figure 28 and Figure 29).The UK Solent autumn survey is characterised by a large variability with outliers present in the model fit (Figure 27). The model fits closely to the low indices for recent years because there are few fishery composition data for estimating these recent year classes.

Total discard estimates for the UKOTB nets and French fleets are shown in Figure 30. Estimates of discards from the UKOTB nets have been very low, and substantially lower than observations since 2015. Discards from the French fleet are estimated to have remained relatively constant, despite the increasing observations since 2016.

The model is able to predict recruitment deviations back to around the 1974 year class due to the strong year classes captured in the data in the early years (Figure 31) allowing a longer term perception of recruitment dynamics. Recruitment is highly variable with no evidence of a reduction in average recruitment at the lower SSB values (Figure 31) although this perception is affected by the imposition of a steepness value of 0.999 for the fitted Beverton–Holt stock–recruit curve. Sensitivities to differing values for this parameter carried out during the benchmark workshops found that likelihoods progressively worsened as the steepness value was reduced.

28.4.2 Analytical retrospective analyses

Retrospective analysis with a five-year peel was carried out for the calculation of the Mohn's rho. This analysis shows that there is some evidence of a retrospective pattern, see table below and Figure 32, for recruitment, SSB and fishing mortality. However, the retrospective bias is within the tolerance threshold accepted by ICES (-15 to +20) for SSB and fishing mortality, there has been no tolerance threshold set for recruitment.

	Mohn's rho
Spawn–stock biomass (5yrs)	0.072
Fishing mortality (ages 4–15) (5yrs)	-0.053
Recruitment (age 0) (3yrs)	0.18

The model is sensitive to the recent change in selectivity due to management measures where a block change in the selectivity and retention parameter estimates where introduced for data proceeding 2015.

28.4.3 Final update assessment: long-term trends

The time-series of estimates of numbers-at-age, combined recreational and commercial $F_{(4–15)}$, are given in Table 19 and Table 20, and a summary of SSB, recruitment, F and commercial and recreational catch are given in Table 21 and Figure 33. These series are based on the final SS3 update run with 2021 set as the final year.

A sharp increase in F between 2011 and 2013 is generated because the assessment model interprets that landings were maintained despite a rapid decline in biomass. This may be a plausible scenario where aggregations or predictable migration routes of sea bass can be targeted, and it is possible for fisheries to maintain landings as total stock size declines, and hence inflict an increasing fishing mortality rate. The F has since decreased in-line with sharp reduction in catches due to the discontinuation of the French midwater trawl and the implementation of additional management measures. In 2022 F has not changed compared to 2021, reflecting the latest management measures. SSB increased slightly which may have resulted from the management measures in place since 2015, and some above average recruitment events since 2013 as described below. However, the total biomass has decreased from 2022 to 2023 due to a decrease in fish age 3–5, so not all mature although some available to the fishery.

WGCSE has concluded that strong year classes in 1989 and some subsequent years caused a rapid increase in biomass throughout the stock area, and landings and fishing mortality in the commercial fishery also increased. The combined commercial and recreational fishery F was well above F_{MSY} prior to 2015. Recruitment has been declining since the mid-2000s, and has been poor since 2008, however the recruitment estimated for 2013, 2014 and 2016 was above the long-term geometric mean. Uncertainties in the assessment are explored in a subsequent section.

28.4.4 Comparison with previous assessments

With the addition of the 2023 data and the updated French LPUE, the time-series of recreational catch was updated to remain consistent with the assumption of a constant F for the period 1985 to 2014 and an F multiplier reduction for 2015 to present (Figure 34).

With these changes included in the update assessment, the perception of the stock has remained largely unchanged. The spawning–stock biomass, fishing mortality and recruitment estimated in 2023 when compared with the recent assessment (Figure 35) are very close, especially for SSB and F, well within the 95% confidence intervals.

28.4.5 The state of the stock

The marked increase in biomass in the 1990s was driven by the very strong 1989 year class and a number of subsequent strong year classes. The biomass prior to this was declining during a period of poor recruitment, and the recent decline in biomass also coincided with a period of poor recruitment, but under conditions of higher F than estimated for the 1980s. The stock has been characterised by periods of poor recruitment in the 1980s and since 2008. These periods of poor recruitment have a major impact on biomass, which is exacerbated by any increase in F. Total biomass changes more quickly than SSB, due to the time taken for fish to reach maturity. An increasing trend in spawning biomass was estimated since 2018, which may have resulted from the management measures in place to restrict catches since 2015 and the occurrence of a number of just above average recruitment events since 2013. However, the last one of those appears to be in 2016, with a downward revision this year of the 2018 and 2019 recruitments, and so this year a decreased estimate of immature fish has led to a decrease estimate of total biomass in the interim year.

The period of increasing SSB in the 1990s and early 2000s also coincided with expansion of the stock in the North Sea. The enhanced productivity and geographic range of the stock at this time also coincided with a period of elevated sea temperatures (see WGCSE and Stock Annex for UK inshore sea temperature trends in relation to sea bass recruitment).

The assumption of a constant recreational fishing mortality over time implies that recreational harvests were a much larger fraction of total fishery removals in the 1980s compared with the 2000s onwards (Figure 10). It is likely that in the 1970s or earlier, sea bass was primarily the target of recreational fishing.

28.5 Biological reference points

The fishing pressure and biomass PA and MSY reference points defined by WKBASS (2018) were updated during WGCSE 2019 due to the inclusion of additional 2018 data and a new LPUE series which changed the perception of the stock. The details of the calculations of the new reference points are given in the Stock Annex with reference points given below.

In 2021, ICES revised the basis F_{pa} for all stocks to use $F_{P.05}$, as a result the value is now 0.203. All other reference points were unchanged.

Reference points	Value
Precautionary Approach	
B_{lim}	10313
B_{pa}	14439
F_{lim}	0.254
F_{pa}	0.203
MSY Approach	
F_{MSY}	0.1713
$F_{MSY\ lower}$	0.142
$F_{MSY\ upper}$	0.1713
MSY $B_{trigger}$	14439

28.6 Short-term predictions

Inputs for a short-term forecast are given in Table 22, and their derivation is explained below.

28.6.1 Recruiting year-class strength

Recruitment estimates for sea bass were below average from 2008 to 2012 (Table 21). Since recruitment is at a low level since 2008 the working group agreed to only include 2012 to 2021 (ten years) for the geometric mean recruitment for the forecast (13 308 thousand), this was also identified and advised by the ADG in 2019. This is summarised in the text table below:

Year class	SS3 (age 0)	GM 2012–2021
2021	22 694 thousand	
2022		13 308 thousand
2023		13 308 thousand
2024		13 308 thousand

28.6.2 Numbers of fish in 2024

These were derived from the update Stock Synthesis run with final year set at 2023. The numbers for ages 0–2 in 2024 were adjusted using the ratio of LTGM to SS3 values for 2022–2024 age 0 as explained above and in Stock Annex.

28.6.3 F-at-age vectors

Status quo F-at-age for the commercial fishery was taken as the average F-at-age as estimated from the last three years derived from the update Stock Synthesis run with final year set at 2023. This approach was taken to allow for the change in selectivity associated with the implementation of new management measures (Table 13).

The recreational F vector was estimated in a similar way using the average of the last three years, however the final F_{bar} was scaled using F multipliers on the 2012 F in Table 13 taking into account the management measures in place. For the intermediate year (2024), this was a nine-month open season with a two bag limit and a MCRS of 42 cm. Additional years' Fs were scaled to keep the F of the recreational fleet proportional to the F of the commercial fleet as in the intermediate year 2024.

28.6.4 Weights-at-age

Mean weights-at-age in the stock were taken from the Stock Synthesis output. The commercial fishery weights for 2024-25 were derived as a weighted mean of the values for French and UK fleets given in the Stock Synthesis output, using the model estimates of catch numbers for the two fleets as weighting factors. The annual weights-at-age for any fleet are time-invariant, as they are derived from length-at-age derived from von Bertalanffy growth curve parameters, with selectivity applied where appropriate. Length at A_{MAX} (30 years) was estimated as 80.26 cm.

28.6.5 Maturity ogive

The proportion mature at-age is the length-based ogive applied to the length-at-age distributions around the input VB growth curve, calculated within Stock Synthesis.

28.6.6 Detailed short-term forecast output at *status quo* F

A detailed short-term forecast is given in Table 23, assuming that F in 2024 is the average of 2021–2023 from the assessment for the commercial fleet, and for the recreation fleet the partial F used is that described in Section 29.5.3.

Fishing in 2024 at the same fishing mortality as in 2021–2023 for the commercial fleet, and with the current two bag limit for nine months for the recreational fleet, an SSB of 13 358t is predicted in 2024, increasing from 13 158 t in 2023. With the same fishing effort in 2025 the SSB would go further increase to 14 022t. There is uncertainty incorporated in the forecast, as the actual rate of change in population abundance in recent years is likely to be more uncertain than indicated by the SS3 model confidence limits. Also, the effect of the final package of technical and other management measures for sea bass in 2015 to present are not fully known at this stage, and information will be needed on their implementation and effectiveness before their impact on fishing mortality can be ascertained. The assumption of constant recreational F is also untested.

28.6.7 Management options

WGCSE provides management options in which F multipliers are applied proportionally to commercial and recreational F-at-age (Table 23). In reality, fisheries managers may wish to allocate the combined forecasted landings in any way considered appropriate, and this would imply differing F-multipliers applied to each fishery.

The management options table includes options for a number of different scenarios and include F of 0.159 calculated by reducing F_{MSY} by the stock size relative to MSY $B_{trigger}$ for combined commercial and recreational fishing. This would provide combined commercial and recreational catches of 2776 tonnes. This would be an increase of 14.1% compared to the advice for 2024. The allocation between commercial and recreational fisheries depends on the balance of controls applied on recreational and commercial fishing in 2024 and 2025.

Spawning stock biomass is currently below MSY $B_{trigger}$, and expected to remain their for the intermediate year. To target achieving MSY $B_{trigger}$ at the start of 2026, total removals should be no more than 1553t.

28.7 Uncertainties and bias in assessment and forecast

28.7.1 Landings and discards data

Historical landings of small-scale national fisheries not supplying EU logbooks or sales slips are known to be inaccurate. IBPBass ran the Stock Synthesis model with and without additional UK landings for nets and lines estimated from a separate Cefas logbook scheme, and found this had relatively little impact on stock trends or fishing mortality, but rescaled the biomass and recruitment due to the additional catch. However, if the extent of non-reporting is changing over time, for example to develop track record in the possible event of a future TAC, then bias will be introduced in the assessment trends.

Discard rates are low in most fisheries other than trawls. Estimates of discards are available only from the early 2000s, but do not cover all fisheries, are imprecise, and are only included for some fleets in the assessment. The overall discard rate by weight is thought to be less than 5% before the implementation of management measures, increasing in recent years. Nonetheless, a time-series of discards at-length or -age is needed for all fleets if the impact of technical measures to improve selectivity is to be evaluated as part of any future bass management.

28.7.2 Fishery composition data

The ability to fit selectivity patterns for defined groups of fishery métiers, and to detect changes in selectivity, depends on collection of adequate numbers of independent, representative samples of length and age to sufficiently characterise the length or age compositions of the selected métier groups. What constitutes "sufficient" is impossible to define without simulation studies to examine relationship between precision of input data and the precision of estimates required for management.

The absence of length composition data for French fisheries prior to 2000 is a serious deficiency in the model preventing any evaluation of changes in selectivity that may have occurred, for example due to changes in the mix of gear types. The numbers of trips of each métier group sampled on shore in France and the UK has varied widely over time, and in the UK has declined substantially since the 2000s. In France, sampling effort has also been very low in recent years and now appears to only cover trawls when a large portion of the fleet is composed of other nets and lines. Currently, there are no composition data supplied by Belgium. In 2022, age data were provided by Netherland. Their inclusion in the assessment should be considered during WKSEA BASS.

ICES has developed extensive advice on establishing statistically-sound sampling designs for estimating fishery length and age compositions and discard quantities (see reports of ICES Workshops on Practical Implementation of Statistically Sound Catch Sampling Programmes (WKPICS1–3, available on ICES website). Stratified random sampling of fishing vessels or harbours may lead to low sample sizes for species such as sea bass for which large fractions of the total catches may be taken in relatively small numbers of fishing trips. The cost-benefit of expanding the sampling in vessel or harbour strata where most sea bass landings are recorded, without compromising statistical sampling design, should be investigated. The next benchmark should evaluate if sampling is currently sufficient to support continued application of Stock Synthesis fitting selection parameters to fishery composition data.

28.7.3 Recreational fishery harvests

Current assessments accommodate an estimate of recreational fishery landings in the assessment and forecasts based on landings from 2012 (ICES, 2016; 2018). This a crude approach based on surveys for only a year or two in France, UK, and the Netherlands, and leads to an assumption of constant recreational fishing mortality over time. Recreational catches have been observed to vary significantly over time in other fisheries, so this assumption of constant mortality is unlikely to be true.

Since completion of the benchmark in 2018, further surveys have been done of recreational catches, but it is not obvious how best to combine the data for use in the assessment and would represent a significant departure from the current approach. Hence, the current benchmark is reviewing the data availability and assumptions made related to changes in recreational fishing mortality and selectivity over time, to consider splitting recreational catches by country and/or fate of fish.

Release rates are expected to increase due to bag limits and increases in MCRS that are in place or planned. Current studies of post-release mortality are limited, and more studies are needed to develop a better understanding of the fate of released fish given the high incidence of catch-and-release practices in sea angling for sea bass.

28.7.4 Surveys

The Channel Groundfish Survey included in the assessment provides data on a wider range of sizes and ages than the Cefas Solent survey, though with a steeply domed size selection pattern. From 2015 onwards, Ifremer no longer used the scientific vessel "Gwen Drez" which was replaced by the larger vessel "Thalassa". A calibration exercise was carried out in 2014 to assess the effect of this change to a larger vessel. WGCSE noted a concern that coverage of the coastal waters of 7.d could be altered by the use of this new vessel (the size of the vessel may prevent fishing as close to the coast as was possible with the previous vessel). The results of the calibration exercise were evaluated and it was found that the series could not be extended beyond 2014 and that a new series would need to be created from 2015 onward. This new dataseries is still to be considered for inclusion in the assessment and has been reviewed during WKBSEABASS.

The Cefas pre-recruit surveys are now reduced to just the Solent autumn survey, with the Solent spring and the Thames survey having been removed by previous benchmark assessments as being unsuitable. Recruitment estimates for the most recent years are heavily dependent on the Solent survey, and it is important to maintain this series.

However, there is a need for information on recruitment trends in other areas, as it cannot be assumed that the Solent index will in the long term represent overall recruitment patterns throughout areas 4 and 7. There are several studies that have demonstrated spatial and temporal variation in abundance of sea bass in estuaries in the UK, France, and Ireland. It would be useful to review and, if possible, include additional time-series at the current benchmark and consider a developing a broader survey of nursery habitats for all species. For information, such a survey has been conducted in France from 2017 onwards in the Seine estuary and in the Douarnenez

Bay through the project Nourdem (and also in the Bay of Biscay in the Loire estuary from 2016 and in the Gironde estuary from 2019). Also a juvenile sea bass index should be tested in the model. The trawl used was developed for catching sea bass. A working document describing the Nourdem Project is found in Annex 5 (WD provisional Nourdem). Times series of Nourdem have been presented to WKSEABASS, WGBIE and WGCSE : the 3 groups support the need for funding to continue the Nourdem survey in future.

28.7.5 Commercial LPUE indices

The reliance of the assessment on the Solent and Channel trawl surveys is a potential source of bias because they cover only a part of the stock range, and the selectivity is heavily skewed towards young bass. This is of principle concern in establishing the current rate of decline in spawning–stock biomass and associated trends in fishing mortality. In the absence of relative abundance indices for older bass from surveys or commercial fishing vessels covering the range of the stock, it is difficult for the model to fit the recent stock trends and fishing mortality. Statistical modelling of French LPUE data by vessel and rectangle by Laurec and Drogou (WGCSE 2015, Annex 3, WD 07) is used in the assessment.

Analyses of UK commercial fishery LPUE, based on averaging across ICES rectangles where the bulk of sea bass catches have been recorded, was presented to IBPNEW in 2012 (ICES, 2012a). There were divergent trends between fleets where sea bass is typically a bycatch, and mainly under 10 m vessels where increased targeting has probably been occurring using lines and nets. Future development of UK LPUE indices together with equivalent French data would require careful evaluation of potential for LPUE of each fleet to track abundance. Further analyses on the validity of the French LPUE as an index of abundance should also be considered, especially in light of the current restrictions of fishing activities.

28.7.6 Stock structure and migrations

The assessment treats all sea bass in 4.b,c and 7.a,d–h as a single biological stock, but there can be extensive migrations. For example, migrations are expected to occur between the south of the area and the Bay of Biscay (which is treated separately in the WGBIE group), or between the North Sea and the Channel, there is also strong site fidelity (Pawson *et al*., 2008) resulting in a high proportion of tagged fish being recaptured at the same coastal location, even in subsequent years after migrations to offshore spawning sites. Immature sea bass may remain close inshore, and exploitation of young fish in coastal waters (<6 nautical miles offshore) may be predominantly by inshore fleets of that country. Mature fish originating from coastal waters of the UK, France or Netherlands or other countries may become increasingly vulnerable to offshore pelagic pair trawlers fishing mainly on mature fish during December to April. These spatial, ontogenetic patterns may lead to complex responses of length and age compositions to previous fishery catches of each country and fleet. This could potentially be addressed using spatial structuring in Stock Synthesis, but the data demands would increase substantially. Both the UK (England) and France have studies underway to improve knowledge of sea bass movement and mixing.

WKBASSID concluded that existing evidence does not support current ICES stock advice units for sea bass in divisions 8.a-b (northern and central Bay of Biscay) and divisions 4.b–c, 7.a and 7.d–h (central and southern North Sea, Irish Sea, English Channel, Bristol Channel and Celtic Sea).

Firstly, there is evidence from the genetics/genomics and tagging studies of sea bass genetic structuring within divisions 4.b–c, 7.a and 7.d–h, with evidence of differentiation between the Irish (ICES Division 7.a) and Celtic Sea (ICES divisions 7.f–g) compared to the southern North Sea (ICES Division 4.c) populations, which was further supported by Child *et al*. (1992) who highlighted similar genetic breaks, but also connectivity between the southern North Sea and English Channel (ICES division 7.d–e). Tagging studies have contributed substantially to helping the group delineate sea bass boundaries. For example, Wright *et al.* (unpublished) revealed little movement of sea bass tagged within the Irish or northern Celtic Sea (ICES divisions 7.f–g) beyond these regions, further strengthening this east-west break within the existing northern sea bass stock unit.

Secondly, there is evidence from genetic/genomic and tagging studies of connectivity between sea bass from the northern part of the Bay of Biscay (ICES Division 8.a), English Channel (ICES Division 7.e) and southern Celtic Sea (ICES Division 7.h). The tagging data provided by both de Pontual *et al.* (2019), de Pontual *et al.* (in revision) and Wright *et al.* (unpublished), as well as the pelagic connectivity research undertaken by Beraud *et al.* (2018) and Graham *et al.* (2023) evidenced substantial areas of connectivity within the northern Bay of Biscay (ICES Division 8.a), eastern English Channel (ICES Division 7.d), western English Channel (ICES Division 7.e) southern Celtic Sea (ICES Division 7.h) and southern North Sea (ICES Division 4.c). The genomics study by Lamb *et al.* (unpublished) found no significant genetic differences among sea bass within these ICES divisions, further suggesting substantial connectivity. These areas of connectivity, i.e. mixing, suggest the use of 'meta-population' terminology due to multiple biological and behavioural interaction levels, such as breeding habitats and summer feeding regions revealing, for the first time, a potential seasonal component to probable stock units (Pontual *et al.*, 2019; de Pontual *et al.*, in revision; Wright *et al.*, unpublished).

Thirdly, from existing tagging data there is no evidence of connectivity between the southern Bay of Biscay (ICES Division 8.b) sea bass and any ICES division within the current northern sea bass stock unit (de Pontual *et al.*, 2019). This information suggests a some-what isolated subpopulation within this region but with some connectivity with ICES Division 8.a (northern Bay of Biscay) as highlighted by the lack of genetic differentiation between these two regions (Robinet *et al.*, 2020). However, it should be noted that research regarding the connectivity of the southern component of the Bay of Biscay to the Celtic/Irish Sea and English Channel is somewhat lacking and therefore cannot be ruled out completely.

Overall, the existing evidence supports the presence of a single metapopulation with three subpopulations, hypotheses of which are described below. While this workshop has added to the previous dearth of information regarding sea bass population structures and stock units, the group strongly believes that further research is required. Questions such as specific mixing regions, identification of regionally specific SNP's and connectivity or boundaries among non-assessed ICES regions must be clarified. This workshop should be viewed as just the beginning of the stock identification process and not the end.

28.7.7 Biological parameters

The maturity ogive used in the assessment was derived from sampling from the 1980s onwards. There has been no coordinated sampling across the full range of the stock in recent years to determine if the current ogive is still valid. Sporadic recent sampling has suggested that sea bass may be spawning at sizes smaller than recorded historically (see Stock Annex). This would alter the F_{MSY} and could also be associated with changes in growth parameters. Mean length-at-age in UK samples remained more or less constant over several decades of sampling, but this analysis needs updating. Changes in growth, or inappropriate growth parameters, will lead to bias in fitting length-selectivity parameters to the French fishery and survey data.

28.7.8 Intermediate year fishing mortality and catch levels for forecasts

Measures introduced by the UK government and EU commission to reduce fishing mortality toward F_{MSY} have the potential to affect the short-term forecast assumptions for this stock. Table 22 and Table 23 provide a detailed short-term *status quo* forecast and a range of management options from the forecast run.

28.8 Recommendations

28.8.1 Management considerations

Sea bass in this stock are characterised by slow growth, late maturity and low natural mortality of adults, which imply the need for comparatively low rates of fishing mortality to avoid depletion of spawning potential in each year class. Productivity of the stock is affected by extended periods of enhanced or reduced recruitment, which appear to be related to changes in sea temperature. Warm conditions facilitate northward penetration of sea bass in the North Sea and Northeast Atlantic and enhance the growth and survival of young fish in estuarine and other coastal nursery habitats. A period of above-average sea temperatures and enhanced recruitment between 1989 and the mid-2000s generated a large increase in biomass and a geographic expansion.

Since 2013, the European Commission developed a package of management measures to promote recovery of the stock. This resulted in emergency measures to stop the offshore pelagic trawl fishery on spawning aggregations between January and April 2015, bag limits for recreational fishing, and an increase the MCRS to 42 cm. Further measures to restrict catches without resorting to a TAC have been implemented. Any management measures applied to commercial and recreational fisheries should take into account the need for collection of data to demonstrate the effectiveness of the measures, and the ability to enforce the measures adequately.

WGCSE notes that protection of juvenile fish through technical measures is good to improve the fishery selectivity and increase the number of sea bass that are able to spawn at least once, but this is probably not enough to ensure a sufficient decrease in F. Protection of juveniles already exists to an extent already through designation of 37 UK sea bass nursery areas where certain types of fishing on sea bass is prevented annually or seasonally.

No bio-economic scenarios are available at present to appreciate the effect of management measures for sea bass, based on economic considerations, and work is urgently needed in this area. The importance of sea bass to recreational fisheries, artisanal and other inshore commercial fisheries and large-scale offshore fisheries in different regions means that resource sharing is an important management consideration that has implications for the type of scientific evidence needed. A number of studies have shown that recreational catches of bss.27.4bc7ad–h represent around one quarter of the total catch (Armstrong *et al.*, 2013; Hyder *et al.*, 2018b; Radford *et al.*, 2018).

The current stock structure assumptions are pragmatic and need further evaluation. The sea bass population in coastal waters of the Republic of Ireland is currently considered as a separate stock, although it extends into at least one of the ICES divisions defining the 4.bc and 7.a,d–h stock. Further studies are needed to determine if the sea bass in Irish coastal waters are indeed functionally separate, or if they also mix with the other stock during spawning time and contribute to commercial catches on the offshore spawning grounds. Moreover, the Bay of Biscay is also currently considered as a separate stock although tagging program indicates some exchange with the area 4 and 7 stock studied assessed by WGCSE.

As bass is, at present, a non-TAC species, there is potential for continued displacement of fishing effort from other species with limiting quotas. The fisheries on sea bass have grown in the 1990s and 2000s due to good recruitment, and new markets have been established, competing with farmed bass. Fishing mortality gradually increased over time and was above F_{MSY} for many years. With the stock in decline measures were introduced to prevent the risk of stock collapse. Currently, the likelihood of collapse remains high unless strong year classes are produced again and the management measures in place are continued and remain flexible to improving the fishery selection pattern, and limit total fishing mortality across all ages of sea bass.

28.9 References

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28.10 Tables and Figures

Table 28.1. Bss.27.4bc7ad–h: Annual landings from 4b&c and 7a, d–h (official landings per country and total ICES estimates).

Year	Belgium	Denmark	Germany	France	UK	Netherlands	Channel Is.	Total	Total ICES
1985	0	0	0	620	105	0	18	743	994
1986	0	0	0	841	124	0	15	980	1319
1987	0	0	0	1226	123	0	14	1363	1980
1988	0	18	0	714	173	8	12	925	1239
1989	0	2	0	675	192	2	48	919	1161
1990	0	0	0	609	189	0	25	824	1063
1991	0	0	0	726	239	0	16	982	1227
1992	0	0	0	721	148	0	36	906	1186
1993	0	1	0	718	230	0	45	994	1255
1994	0	1	0	593	535	0	49	1178	1371
1995	0	1	0	801	708	0	69	1579	1835
1996	0	1	0	1703	563	8	56	2331	3022
1997	0	1	0	1429	561	1	74	2066	2620
1998	0	2	0	1363	488	48	79	1980	2390
1999	0	1	0	na	685	32	108	826	2670
2000	0	5	0	1522	407	60	130	2124	2407
2001	0	2	0	1619	458	77	80	2236	2500
2002	0	1	0	1580	627	96	73	2377	2622
2003	154	1	0	1903	586	163	84	2891	3459
2004	159	1	0	1883	617	191	159	3010	3731
2005	206	1	0	1937	512	327	220	3203	4430
2006	211	2	0	2116	736	308	23	3396	4377
2007	178	1	0	2075	873	376	18	3521	4064
2008	187	0	0	1506	934	380	20	3027	4107
2009	174	0	0	2904	801	395	15	4288	3889
2010	216	4	0	3441	879	399	14	4952	4562
2011	152	2	0	2688	928	395	17	4183	3858
2012	154	3	0	2492	946	376	12	3982	3987

Year	Belgium	Denmark	Germany	France	UK	Netherlands	Channel Is.	Total	Total ICES
2013	146	4	2	2868	841	370	12	4243	4137
2014	148	1	1	1322	1080	253	11	2816	2682
2015	40	0	0	1113	701	218	9	2081	2066
2016	23	0	1	545	551	156	24	1300	1295
2017	22	0	0	423	438	132	12	1027	984
2018	18	0	0	297	432	172	11	931	948
2019	19	0	0	309	411	209	22	970	972
2020	24	0	0	387	526	223	15	1175	1042
2021*	45	0	0	385	613	231	1	1275	1126
2022*	24	1	1	404	617	225	1	1273	1126
2023*	32	2	2	437	675	231	<1	1379	1397

Source: Official Landings Statistics. *2021 and 2022 provisional data.

Total ICES, from InterCatch database.

Table 2. Bss.27.4bc7ad–h: Landings for the country / fleet components included separately in the assessment model.

Year	Fleet 1: UK Trawls, nets	Fleet 2: UK Lines	Fleet 3: UK pelagic trawlers	Fleet 4: France combined gears	Fleet 5: Other countries and gears	Fleet 6: RecFish
1985	70	30	1	870	23	1771
1986	84	33	2	1180	19	1597
1987	96	18	0	1840	25	1457
1988	129	30	8	1028	44	1353
1989	141	29	7	917	67	1253
1990	128	18	22	849	47	1129
1991	152	60	14	971	29	1037
1992	105	23	8	1001	49	1061
1993	146	62	1	979	68	1235
1994	354	154	0	786	76	1481
1995	424	169	4	1057	181	1661
1996	308	128	87	2395	104	1673
1997	335	119	71	1984	111	1588
1998	241	121	85	1773	170	1534
1999	274	148	220	1843	185	1536
2000	236	53	52	1805	261	1590
2001	263	58	97	1883	199	1675
2002	361	75	110	1825	251	1771
2003	353	65	127	2471	443	1852
2004	380	72	131	2604	544	1896
2005	353	59	68	3161	789	1892
2006	359	119	11	3259	629	1860
2007	413	166	37	2771	677	1855
2008	514	163	17	2750	663	1862
2009	486	147	9	2649	598	1836
2010	452	183	42	3236	649	1739
2011	462	143	98	2526	629	1598
2012	564	185	49	2610	579	1440

Year	Fleet 1: UK Trawls, nets	Fleet 2: UK Lines	Fleet 3: UK pelagic trawlers	Fleet 4: France combined gears	Fleet 5: Other countries and gears	Fleet 6: RecFish
2013	530	191	39	2871	506	1229
2014	751	236	1	1303	391	1021
2015	440	199	0	1110	524*(317)	703
2016	305	210	2	547	382*(231)	215
2017	125	147	0	442	392*(270)	212
2018	160	267	0	313	344*(208)	153
2019	134	259	1	329	255*(249)	277
2020	190	306	0	409	290*(137)	447
2021	228	361	0	413	279*(124)	489
2022	236	337	0	408	295*(145)	509
2023	285	324	0	448	340	538

*Values updated with NL landings revised.

(Numbers in parentheses are numbers revised)

Table 3. Bss.27.4bc7ad–h: Sampling of commercial fishery landings of otter (A.), pelagic midwater trawls (A.), lines (B.) and nets (B.) for length and age in the UK (England and Wales). Nsamp is the number of landings (trips) sampled; Nfish is the number of fish measured.

A.	UK Otter trawl					UK Pelagic/midwater				
	Age		Length		Landings (t)	Age		Length		Landings (t)
Year	Nsamp	Nfish	Nsamp	Nfish		Nsamp	Nfish	Nsamp	Nfish	
1985	45	235	15	225	27	3	44	2	43	1
1986	18	216	28	2591	24					2
1987	41	421	54	1181	41	4	42	1	589	0.02
1988	23	257	23	1298	65	2	64	2	1684	8
1989	63	531	44	1595	80	4	126	4	1451	7
1990	63	883	48	773	67	8	19			22
1991	92	983	32	731	39	12	125	1	1490	14
1992	69	699	17	398	41	2	50	2	220	8
1993	118	1219	38	836	80	9	39			1
1994	182	1927	113	3925	125			1	127	0.3
1995	28	529	66	1995	162			1	19	4
1996	49	660	39	1041	122	1	41	3	392	87
1997	59	1660	52	2445	140	1	49			71
1998	28	676	39	1442	133	20	95	4	167	85
1999	24	379	46	1216	138	12	382	9	770	220
2000	92	759	42	1814	133	23	847	14	2463	52
2001	45	851	49	2152	141	3	58	5	691	97
2002	54	523	47	1454	161			4	545	110
2003	48	512	45	1418	207	15	459	4	744	127
2004	33	361	31	1295	173	8	161	5	522	131
2005	35	498	31	2432	181	3	149	2	299	68
2006	15	252	17	810	160	1	43	1	100	11
2007	44	385	21	903	173	1	20	3	355	37
2008	37	580	32	2151	196	6	409	8	1283	17
2009	24	1184	13	807	175	8	317	6	625	9
2010	25	360	28	1312	150	7	153	3	376	42
2011	25	577	49	1903	137	3	103	4	463	98
2012	18	182	41	751	157			1	199	49
2013	15	289	23	859	125					39
2014	14	164	22	523	104					1
2015	28	377	39	1277	100	1	4	1	4	1
2016	19	256	90	527	52					2
2017	38	510	128	915	51	0	0	0	0	0
2018	43	263	43	492	28	1	15	1	33	0
2019	30	105	89	686	15	0	0	0	0	1
2020	47	90	47	251	27	0	0	0	0	0
2021	51	151	51	376	36	0	0	0	0	0

2022	36	136	36	500	69	0	0	0	0	0
2023	49	146	49	102	100	0	0	0	0	0

B.	UK linesLines					UK Nets				
	Age		Length		Landings (t)	Age		Length		Landings (t)
Year	Nsamp	Nfish	Nsamp	Nfish		Nsamp	Nfish	Nsamp	Nfish	
1985	53	395	19	285	30	34	332	15	181	43
1986	60	496	31	894	33	18	251	18	1132	61
1987	92	313	69	557	18	37	528	44	1321	55
1988	66	538	53	1325	30	37	584	40	1397	64
1989	249	652	26	310	29	49	469	45	1248	60
1990	281	918	22	260	18	24	207	11	456	61
1991	346	1468	53	963	60	57	481	30	583	113
1992	418	2905	111	2077	23	40	281	28	1248	64
1993	287	1787	123	1426	62	127	1141	94	1686	66
1994	212	1616	155	3783	154	146	2846	157	5130	229
1995	160	1043	107	1493	169	95	1786	150	6248	262
1996	155	1326	106	1790	128	85	1371	113	3348	186
1997	141	1262	137	2072	119	73	1055	106	2747	195
1998	182	1215	111	2820	121	88	1119	82	2465	108
1999	237	1304	149	3793	148	127	1189	74	2966	137
2000	405	1395	65	1964	53	119	1719	104	5482	103
2001	451	2485	114	2935	58	140	2027	92	3309	122
2002	210	1286	146	3031	75	220	3800	206	6680	201
2003	151	1009	90	3108	65	171	1720	224	5899	146
2004	127	906	66	1980	72	83	974	150	3567	207
2005	87	380	25	921	59	73	768	33	1126	172
2006	54	359	67	989	119	56	598	47	1197	199
2007	94	713	31	1088	166	90	753	40	1811	239
2008	37	552	28	1325	163	100	1444	63	3361	318
2009	49	304	18	915	147	116	1571	100	3247	311
2010	34	418	40	970	183	63	1214	66	2350	302
2011	46	1091	55	2250	143	34	793	41	1433	324
2012	89	1295	100	2215	185	35	909	56	2809	407
2013	41	896	42	1236	191	42	1123	49	2342	405
2014	67	1247	73	1889	236	60	1161	71	2781	647
2015	72	1183	79	3055	199	48	776	67	3985	338
2016	69	1151	110	1236	210	59	1165	83	1974	252
2017	28	303	171	2225	158	0	0	41	727	74
2018	103	1478	123	2166	267	55	694	55	1763	132
2019	99	1815	103	3083	259	57	783	92	1929	120
2020	95	943	95	2425	306	61	572	61	1872	163
2021	136	1362	136	3412	242	42	399	42	1424	154

2022	118	1505	118	3369	337	48	569	48	1711	189
2023	99	1706	99	3524	324	35	528	35	1181	219

Table 4. Bss.27.4bc7a d–h: Sampling of commercial fishery sea bass landings for length and age in France for lines, nets (A), Danish seines and other gears (B), and pelagic trawls and bottom trawls (C) (2017 real sampling excluding simulated). Nsamp is the number of landings (trips) sampled; Nfish is the number of fish measured.

A.	FR_lines					FR_nets				
	Age		Length		Landings	Age		Length		Landings
Year	Nsamp	Nfish	Nsamp	Nfish		Nsamp	Nfish	Nsamp	Nfish	
2000	NA	NA	53	1613	305	NA	NA	2	72	108
2001	NA	NA	101	2659	375	NA	NA	1	5	110
2002	NA	NA	79	2076	349	NA	NA	0	0	128
2003	NA	NA	78	1732	438	NA	NA	1	4	152
2004	NA	NA	78	1748	381	NA	NA	6	84	150
2005	NA	NA	34	949	439	NA	NA	4	110	148
2006	NA	NA	73	1719	554	NA	NA	11	291	140
2007	NA	NA	69	2235	560	NA	NA	28	641	158
2008	NA	NA	41	1280	425	NA	NA	25	496	128
2009	12	211	33	1339	251			25	159	94
2010	4	169	10	334	278			49	615	160
2011	39	443	17	540	359			156	278	129
2012	37	385	10	681	295			60	408	142
2013	6	174	16	309	291	3	130	26	512	126
2014			10	299	285			29	218	163
2015	23	70	16	326	210			35	242	109
2016			2	84	156	5	67	32	293	64
2017			9	219	166			18	151	35
2018			4	208	151	9	45	9	45	74
2019			0	0	139			0	0	70
2020			27	703	164			13	193	78
2021			34	759	162			38	662	75
2022			66	1367	130			53	496	80
2023			74	1567	114			84	990	77

B.	FR_danish seine					FR_other gears				
	Age		Length		Landings	Age		Length		Landings
Year	Nsamp	Nfish	Nsamp	Nfish		Nsamp	Nfish	Nsamp	Nfish	
2000	NA	NA	0	0	0	NA	NA	0	0	20
2001	NA	NA	0	0	0	NA	NA	0	0	27
2002	NA	NA	0	0	0	NA	NA	0	0	22
2003	NA	NA	0	0	0	NA	NA	0	0	23
2004	NA	NA	0	0	0	NA	NA	0	0	17
2005	NA	NA	0	0	0	NA	NA	0	0	17
2006	NA	NA	0	0	0	NA	NA	0	0	35
2007	NA	NA	0	0	0	NA	NA	0	0	24
2008	NA	NA	0	0	0	NA	NA	0	0	40
2009			0	0	27			0	0	127
2010			0	0	61			2	2	90
2011			2	6	43			36	292	62
2012	16	153	6	370	112			7	154	91
2013			2	28	18			1	1	82
2014			12	23	9			1	1	25
2015	10	36	0	12	26			0	0	16
2016			28	78	20			0	0	20
2017			14	42	22			0	0	40
2018			0	0	9			0	0	16
2019			0	0	21			0	0	22
2020			2	77	11			0	0	20
2021			2	33	16			0	0	17
2022			8	118	19			0	0	19
2023			13	297	21			0	0	21

C.	FR_pelagic trawl					FR_bottom trawl				
	Age		Length		Landings	Age		Length		Landings
Year	Nsamp	Nfish	Nsamp	Nfish		Nsamp	Nfish	Nsamp	Nfish	
2000	NA	NA	2	629	681	NA	NA	2	196	692
2001	NA	NA	0	0	659	NA	NA	0	0	713
2002	NA	NA	3	680	415	NA	NA	4	710	911
2003	NA	NA	4	753	773	NA	NA	8	998	1087
2004	NA	NA	6	938	820	NA	NA	12	887	1236
2005	NA	NA	11	1239	1319	NA	NA	14	689	1239
2006	NA	NA	16	2597	1420	NA	NA	11	1240	1110
2007	NA	NA	8	1800	841	NA	NA	11	588	1187
2008	NA	NA	8	1065	1012	NA	NA	18	1927	1145
2009	13	299	55	899	1098	20	164	93	1468	1052
2010	14	741	28	1299	1828	37	201	64	626	819
2011	38	1591	30	2309	1142	61	525	151	1955	791
2012	33	1587	9	1649	1143	51	478	87	1204	824
2013	17	737	10	1253	1516	34	344	73	2060	737
2014	11	202	23	455	242	50	326	137	2139	571
2015			12	158	107	57	203	76	1628	642
2016			6	48	17	103	407	183	1396	271
2017			0	0	6	37	120	126	495	33
2018			0	0	1	23	265	31	163	63
2019			0	0	1	13	73	22	104	76
2020			0	0	2			30	572	133
2021			2	33	3			61	1789	140
2022			7	21	2			103	1978	157
2023			3	5	3			152	2489	213

Table 5. Bss.27.4bc7a d-h: Numbers-at-length in French commercial all-gears fishery landings (input to assessment at lengths 14–94 cm with <20 and >88 size classes empty).

#_Yr	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
l20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
l22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
l24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
l26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	0	0	0	0	0	0
l28	0	0	0	3455	0	0	0	0	0	292	0	0	1219	0	0	291	0	0	0	0	0	0	0	36
l30	0	0	1015	13054	14	0	15689	0	0	473	0	0	0	146	0	346	71	0	0	0	0	0	0	0
l32	0	0	0	58717	13057	9903	32459	181	8250	2239	9811	1976	1583	0	3076	2678	1481	0	0	0	0	80	0	0
l34	9931	17962	12469	105655	78811	29872	179130	4715	28986	10714	28290	13885	6518	1504	3620	5102	1440	137	0	0	0	0	27	36
l36	34932	19809	38249	125326	127801	97890	285704	39335	229758	124925	169311	57121	85760	29667	33532	44175	2814	2646	0	0	194	90	118	166
l38	85866	68920	46427	180475	124051	128022	217657	102714	263071	211881	177571	87842	172510	88507	68262	75546	4340	2523	91	0	1030	763	2491	2412
l40	126730	76594	62503	119495	227214	231750	178250	146272	266408	225545	182105	128838	140273	149070	74871	93273	7417	3572	814	0	6255	7417	9937	10436
l42	102836	98008	82461	145456	282390	266905	196868	145122	237160	193030	283064	187586	147895	146130	82684	115713	24816	9257	2444	2034	16127	24659	29248	28752
l44	80478	109595	91064	104545	243107	344681	289998	164011	270810	222613	251956	201447	162333	123170	51365	122460	20422	14861	2954	2198	17867	22303	32840	30610
l46	93344	106857	86723	130023	188494	270532	285451	130859	228996	238849	230227	199487	180752	140677	61292	95208	22427	9603	4379	1948	12708	20722	30358	32345
l48	80934	77694	62163	115806	126685	239265	263272	100043	142650	155222	188149	194697	158490	127136	39844	59668	20653	7367	2606	635	9921	13639	26198	26259
l50	55399	57055	55905	91915	72581	169478	200874	99210	112385	159658	186310	145447	130759	116842	38109	51436	15619	6801	3549	1246	5488	11644	22521	22895
l52	52948	51658	46180	93878	82331	115269	119836	75929	74336	114530	109212	124239	107214	99156	29929	37860	10415	4599	2861	345	3890	7315	15998	17267
l54	42094	36737	35998	48742	50633	62106	99509	74405	66260	84649	120550	92526	90638	103818	39911	21406	16034	3586	2702	456	2456	5362	10399	11823

#_Yr	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
l56	26460	35839	26001	60839	60284	67741	99674	55147	48853	96257	71590	72471	78934	89197	32298	20681	9753	1012	2538	415	1515	4242	6270	12466
l58	27357	22762	19019	31614	31334	61132	54522	46087	39689	51578	62211	46869	54869	59004	30016	13591	12328	2519	3581	0	1226	3181	5562	6397
l60	23581	25834	14210	33688	19126	43591	45908	28056	29840	36547	31544	31690	35387	65851	21467	11946	7678	913	2008	0	1064	1996	3564	4524
l62	14295	18773	11129	30691	23996	35774	23763	23057	28335	57472	19076	19998	33085	64579	16797	11776	7506	1120	1669	373	636	1617	3691	3033
l64	18044	13532	16771	18823	14799	25788	20607	18091	14420	24016	62005	17624	17714	53482	16261	9356	4348	1369	1641	0	641	1199	1752	1442
l66	10773	11068	11011	13230	10650	12456	14969	8715	12694	21415	26388	14720	15170	37744	8387	6653	2634	510	778	124	333	695	1371	1468
l68	9903	9120	5447	7960	8569	13360	13976	8793	9039	27466	9340	7906	9374	23884	5579	2485	4465	315	463	124	378	882	825	631
l70	5709	11771	4795	5374	4880	8908	9653	4835	6821	20198	8541	6114	8114	32512	8995	1163	1353	345	255	0	133	468	910	234
l72	5721	5733	4559	5617	2974	8053	4521	2707	4714	12083	29128	2082	4147	14996	3027	660	956	408	47	0	62	141	347	338
l74	2345	5345	1825	3275	2675	9811	3424	1962	1623	7551	1884	1163	2313	9001	642	628	219	652	0	0	0	121	529	196
l76	2595	2782	1260	1356	2567	5020	2883	1010	1257	979	2114	1096	1540	2640	773	431	0	92	0	0	0	76	76	56
l78	2102	1691	357	297	548	2378	731	399	534	1765	182	476	1134	2073	0	9	127	718	0	0	0	5	0	37
l80	888	583	155	783	425	1365	201	158	261	264	5525	148	282	176	198	16	0	0	0	0	0	0	181	0
l82	1021	296	109	112	149	107	261	37	8	1004	6097	104	451	1566	0	278	0	92	0	0	0	3	0	0
l84	548	204	0	148	295	0	30	59	0	0	863	0	29	0	0	0	0	0	0	0	0	0	0	0
l86	123	0	0	0	0	0	0	0	0	0	0	0	27	1115	0	0	301	0	0	0	0	0	0	0
l88	0	61	0	0	149	0	0	0	0	0	1207	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6. Bss.27.4bc7ad–h: Numbers-at-age in French commercial fishery landings, 2000–2023, all gears combined (with <2 year old age classes empty).

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
a2	0	0	0	2611	3	0	3138	0	1208	878	0	0	0	0	0	0	0	0	0	0	0	10	0	0
a3	0	2651	8114	10800	4	24195	74600	5307	79917	17293	6830	0	0	0	0	0	0	98	0	0	34	1505	1157	420
a4	9440	55640	73892	364427	80483	77794	131099	73224	175402	92501	64071	3481	265	0	2300	10607	1850	1065	735	2251	7217	13637	23133	8080
a5	222655	47734	125531	241694	627951	253455	564668	135809	545960	77583	74708	109582	17233	6417	4138	28960	20182	1605	5490	2392	17734	30515	44663	38367
a6	273687	298773	90294	318445	438799	735235	361515	460583	401231	49868	135505	152702	216615	16487	36582	39482	18999	6568	1582	2391	37642	23147	42533	38503
a7	139562	211740	236147	96562	297961	352182	841651	124606	456312	17981	112579	142896	266517	133787	54484	30417	18589	4507	1571	112	3170	34777	35979	58553
a8	79413	90962	86108	254050	65297	443765	146484	139879	143871	17887	117368	121070	240104	88986	43902	60049	20496	6102	776	1682	4038	11829	35191	23058
a9	47258	44742	31151	114829	131612	39104	253945	79978	147881	0	57320	264916	222113	109206	41316	27137	14682	3870	2704	454	6130	9287	13174	22704
a10	43924	21074	23025	57883	77533	161572	13655	69214	40719	28366	22351	105282	172833	143048	4541	17343	14879	2085	70	231	4343	0	4990	4643
a11	49293	39908	17823	26223	25416	69617	132370	33191	57341	1248	10523	58721	82759	103915	1742	5353	10075	1160	0	386	211	2465	135	2660
a12	20207	36007	14760	19879	14848	26314	84910	65868	17882	0	10414	24328	35102	47660	202	3804	0	727	306	0	1403	0	211	602
a13	10767	17787	15912	14232	14254	17996	22068	68599	35092	0	7096	18672	21967	18471	178	2650	1423	649	0	0	0	976	0	148
a14	4925	4394	9752	18088	13528	19238	6648	11131	12669	0	7652	4666	8640	16817	121	4485	131	351	0	0	0	471	0	0
a15	4927	6838	3743	6600	7628	17974	6999	9034	5518	0	213	3149	2570	1275	0	0	81	455	0	0	0	0	0	0
a16	10901	8034	1553	4028	5270	22718	16069	5486	6091	0	2322	410	1374	4149	0	0	0	0	0	0	0	0	0	0

Table 7. Bss.27.4bc7ad–h: Numbers-at-age in the UK (England and Wales) bottom trawl, nets (with <2 year old age classes empty).

UK OTB NET	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16+
1985	65	11844	30828	6121	9692	1240	3914	9713	2454	2581	1320	343	841	286	892
1986	0	15673	20303	18759	3453	7662	704	3197	10503	1833	1403	2889	1222	1688	3595
1987	0	439	30263	58458	13753	2095	2437	656	726	5731	2565	1889	761	817	2796
1988	0	1930	20862	54472	41710	12803	1721	2315	780	451	5503	2024	1312	801	2589
1989	33394	5411	1223	7659	43911	26891	9002	3076	2901	1878	2896	8914	1499	1286	3436
1990	0	3035	2503	3770	16047	31459	21020	5042	2186	1463	846	1100	4837	353	2703
1991	1533	6933	36938	2381	1283	6576	18064	16248	7033	589	2617	2321	480	6659	3674
1992	0	15982	55550	33557	1183	796	1956	4750	4762	1230	451	433	139	497	3202
1993	0	657	81429	65981	21858	1351	627	1796	4803	3920	1500	710	735	475	2347
1994	2	1328	30970	369416	41472	16079	1130	294	2282	5842	4387	1596	650	646	3717
1995	0	5599	37064	81529	334815	17932	6931	702	415	1046	3440	3215	1846	2699	2680
1996	191	11473	43831	31632	64618	173733	8235	3622	216	315	454	1881	1688	534	1784
1997	0	2490	8501	64000	45238	39229	145407	8105	4456	632	640	294	2689	1712	2235
1998	0	1103	44997	49461	69489	25366	15136	41057	2671	860	96	96	385	623	811
1999	241	82	80414	146338	43841	28582	9612	6192	18072	1112	729	40	270	97	830
2000	0	9528	2584	151515	72747	11772	11046	4992	4636	8323	818	184	14	55	643
2001	614	11085	92408	29064	105169	25329	7388	8742	5811	8136	7522	804	768	69	759
2002	338	11495	43605	240476	16779	67647	16021	7450	8022	2682	3842	10166	645	193	568
2003	0	5698	75254	70415	154267	8719	38901	14072	4789	3196	2260	1599	3937	937	756
2004	0	4406	38270	214112	76652	95133	2733	12227	4039	1583	994	802	263	1029	221
2005	0	18910	135210	89202	124422	33796	30175	3112	7357	1390	1123	363	173	650	842
2006	0	20497	141335	144890	54069	56281	17344	24148	2207	3475	2277	859	210	188	1433
2007	0	955	33606	169272	96625	44423	34061	12877	14366	11530	4527	1621	11	254	428
2008	0	9338	110875	296983	139083	47617	19838	17332	8660	6128	852	793	988	317	824

UK OTB NET	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16+
2009	0	2659	73056	169969	172602	64997	19002	14443	9064	8631	3610	2235	1302	0	249
2010	0	319	77100	155258	118179	78410	28938	11821	6979	6043	2645	2083	2273	534	1663
2011	0	845	28630	124625	92582	71094	54338	31775	10438	11227	6347	2933	2203	675	1692
2012	0	1620	14135	166965	219883	61319	39609	31669	15268	9427	4092	3864	2546	538	930
2013	0	0	45016	60547	182858	117821	33448	30222	22727	17473	11825	2908	2687	2429	2133
2014	0	6622	31923	107001	58412	114826	78809	38859	27037	30548	19853	5152	1776	1857	1487
2015	0	50	3716	20172	45807	36830	63272	35025	17302	12685	10431	2917	7265	7308	966
2016	0	0	1591	7863	13991	31088	24925	40386	24807	10618	8218	4788	1960	2098	1528
2017	0	0	39	454	2176	1179	881	928	852	713	107	257	41	144	236
2018	0	130	4361	18582	26874	18792	9488	6826	4615	6186	5377	1562	1164	960	766
2019	0	105	2168	26492	29521	14508	9155	4501	4944	4192	4556	2635	1331	803	2067
2020	0	1058	4481	16161	85080	29885	12476	5890	3316	3182	2712	2768	2351	1456	1772
2021	0	270	2643	9490	20563	70224	23930	11483	5748	3157	2275	4297	2012	421	716
2022	0	0	2360	15630	44573	40540	69169	18778	7351	3573	1820	971	676	985	748
2023	0	33	2313	8280	18964	37283	14435	21896	3945	3034	1174	469	426	63	316

Table 8. Bss.27.4bc7ad–h: Numbers-at-age in the UK (England and Wales) lines (with <2 year old age classes empty).

	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16+
1985	0	9225	11491	3441	5902	891	1113	5133	1176	694	913	46	122	134	936
1986	0	577	8939	3343	933	2354	358	758	5428	960	871	953	573	645	1307
1987	0	108	1052	3719	2132	581	477	432	523	1578	845	211	167	179	1187
1988	0	33	1751	13389	5067	2398	551	1014	209	456	1863	895	715	523	977
1989	22	0	538	8171	36046	1842	371	104	208	58	215	1040	115	87	334
1990	0	305	82	185	1284	3456	2407	897	357	369	193	242	1261	81	828
1991	0	131	8420	471	177	792	4927	4024	1842	89	1229	1685	367	4831	2887
1992	0	1195	5473	5267	294	269	518	1193	1633	563	130	195	169	143	1411
1993	16	526	11652	11776	7569	590	289	931	3941	3344	1367	663	703	643	3789
1994	0	71	4059	119784	18540	9393	943	173	1754	5414	5570	1205	639	274	2790
1995	0	486	6943	21979	97509	7380	5313	480	699	831	5684	3696	1936	840	4733
1996	0	210	8804	12487	15338	57127	4566	4979	127	510	364	2521	1573	1300	2346
1997	59	454	3102	15613	11415	8287	50819	2853	1635	557	354	243	2195	1065	1570
1998	0	3676	8366	10920	22630	10485	6452	28231	2949	1091	138	196	793	1381	1254
1999	479	255	25158	37306	13589	13697	5288	5001	20522	1669	2038	247	777	315	3314
2000	0	421	294	19380	12402	2696	3285	1476	1248	4697	330	258	16	88	559
2001	54	471	7385	1392	17864	7702	2027	3239	1685	1761	3774	440	301	27	420
2002	30	729	2609	14173	2686	17358	7757	2621	5179	1463	1766	3687	322	101	180
2003	0	80	7166	7917	25014	2167	10164	3262	1473	982	796	681	1704	186	166
2004	0	279	1697	13884	8601	17310	2398	6365	3626	1181	1189	1172	406	2243	143
2005	0	621	2669	5059	14699	5529	6985	589	5697	1845	236	1307	33	189	606
2006	0	44	16121	35990	13714	22306	5794	12717	1644	3135	1258	305	358	1016	734
2007	0	22	6611	31578	28396	14511	17834	8499	10951	5163	3121	5119	85	344	485
2008	0	199	5010	27319	42071	21561	12265	12566	5458	4960	1372	1032	3431	198	992
2009	0	315	8415	19843	33661	25695	12017	9320	5021	5371	4748	811	1075	0	0
2010	0	814	7029	45515	54766	39716	15835	5147	2395	2910	706	522	359	81	277
2011	0	8	5209	11538	24667	19293	16668	13032	4947	6066	2695	1941	2187	522	657
2012	0	91	1695	18362	28593	23507	22946	17909	10199	7725	2994	2672	2158	596	820

	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16+
2013	0	0	1187	6979	35135	32251	18057	14762	10333	10543	6106	3730	2886	1957	1938
2014	0	980	4985	26081	20743	39548	28357	15323	12440	12413	8018	4889	1976	1673	1322
2015	0	6	1834	5941	23369	22221	31442	19014	10344	8210	7036	2504	3136	744	798
2016	0	0	742	7020	11858	20142	15479	25838	13362	7406	5904	4674	2548	3894	2567
2017	0	0	1734	4007	5766	2324	2362	1036	4159	993	356	469	202	475	330
2018	0	454	6992	23652	41538	31173	17352	16753	11214	14117	9044	4650	3791	2220	3945
2019	0	85	3010	36477	41315	26099	16791	9320	10364	11061	9434	5936	3248	2068	4291
2020	0	431	3437	11667	90256	53606	27720	13526	7890	7117	5823	5194	3678	2127	3185
2021	0	206	5501	21294	39528	93379	41709	26913	12827	6814	10191	4230	3570	3866	5300
2022	0	0	2260	13346	43096	51174	90982	27064	10304	7761	6486	1614	1332	1046	1157
2023	0	159	2083	9688	20642	39916	18699	31249	7313	6530	2376	1693	1885	958	1719

Table 9. Bss.27.4bc7ad–h: Numbers-at-age in the UK (England and Wales) midwater pair trawl fleet (no samples for 1997, 2013-2017, 2019-present) (with <3 year old age classes empty).

	Age 3	Age 4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16+
1996	0	289	796	3892	7166	5583	1648	21	334	154	622	485	199	559
1998	0	245	5979	1184	8553	8135	2513	2517	345	93	53	119	893	569
1999	0	298	1840	1510	2714	1381	1806	4309	4389	1686	324	387	308	2689
2000	15	60	2476	7587	3270	4497	1459	2830	7077	634	174	39	96	420
2001	0	179	899	1977	2029	7042	5268	3124	2845	9666	857	636	123	261
2002	3	37	2380	1578	2408	9693	6297	5978	450	5664	9215	0	0	530
2003	0	268	1061	3925	7971	4055	1029	3162	3254	618	169	4043	77	281
2004	7	125	1250	1437	4810	3199	2069	8010	353	1797	1141	91	968	18
2005	0	114	2103	1532	1439	1740	1907	5182	0	1831	99	0	40	599
2006	0	227	567	608	4076	1423	3085	254	176	111	0	0	0	53
2007	0	385	2517	7038	5387	6833	2795	1900	631	807	12	37	19	121
2008	45	445	1540	3279	1787	1412	1557	755	960	30	183	490	0	40
2009	0	90	635	2175	2596	843	784	168	298	173	11	169	0	0
2010	9	36	1741	5546	8261	6678	4755	403	3786	152	294	313	551	50
2011	0	255	4397	1023	1364	1590	1364	4424	4233	2773	1688	1003	264	423
2012	0	391	4461	1077	1001	8757	5789	2741	1134	290	433	143	127	226
2015	0	7	23	85	103	137	30	6	3	0	0	0	0	0
2018	0	0	2	9	5	1	1	0	0	0	0	0	0	0

Table 10. Bss.27.4bc7ad–h: Numbers of trips sampled for discards by Cefas (UK): 2002–2023, by gear group and area.

Division & fleet	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
(a) bottom otter trawls																						
4bc	16	34	56	37	41	85	58	49	46	42	54	30	53	45	12	0	1	3				4
7.afg	8	15	23	8	11	43	50	28	22	22	22	12	14	16	2	0	0	5				0
7.d	1	2	4	3	1	2	1	6	7	9	4	5	7	3	13	1	1	7		11		5
7.eh	9	24	37	31	49	90	87	38	29	32	29	45	73	68	29	0	10	18	4	9	1	6
Total	34	75	120	79	102	220	196	121	104	105	109	92	147	132	56	1	12	33	4	20	1	15
(b) Fixed/driftnets																						
4bc	0	0	2	1	11	31	15	20	15	11	13	18	10	7	0	0	0	0				0
7.afg	3	7	5	3	7	8	9	10	7	16	22	16	25	12	3	0	0	0				0
7.d	0	0	1	0	0	17	6	4	1	7	10	42	25	17	10	0	0	16				0
7.eh	1	5	9	2	3	16	10	14	19	17	25	24	24	15	0	0	0	0				0
Total	4	12	17	6	21	72	40	48	42	51	70	100	84	51	13	0	0	16				0
(c) Lines																						
4bc	0	1	0	0	0	1	2	0	0	0	0	0	1	1	0	0	0	0				0
7.afg	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0				0
7.d	0	0	0	0	0	0	0	0	0	0	0	0	1	0	33	2	0	0				0
7.eh	0	0	1	0	0	0	0	0	0	0	1	0	8	5	4	0	0	0				5

Division & fleet	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total	0	1	1	0	0	1	2	0	0	0	2	1	10	6	37	2	0	0				5
(d) Midwater trawls																						
4bc	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0
7.afg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0
7.d	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0
7.eh	0	1	1	1	2	1	0	0	0	0	0	2	1	0	0	0	0	0				0
Total	1	1	1	3	2	1	0	0	0	0	0	2		0	0	0	0	0				0
(e) Other gears																						
4bc	8	5	10	1	2	1	1	7	6	8	4	10		0	6	0	0	0				3
7.afg	4	11	8	4	9	1	2	3	3	1	4	8		0	5	0	0	0				0
7.d	0	1	5	2	3	1	1	2	4	1	2	3	1	2	0	0	0	0				0
7.eh	10	17	27	16	24	32	18	13	17	27	22	21	14	15	1	0	0	0			12	26
Total	22	34	50	23	38	35	22	25	30	37	32	42	15	17	12	0	0	0			12	29

Table 11. Bss.27.4bc7ad–h: Estimated annual numbers and weight of sea bass retained and discarded by UK using fixed or driftnets, otter trawl, beam trawl and lines fleets in areas 4, 7.d, 7.eh and 7.afg, based on at-sea sampling, and raised from landings in sampled strata to landings in all strata. Numbers of sampled trips (Ntrip) are shown. Not used in assessment (lack of information. High probability of underestimation considering management measures).

	Otter trawl				Nets				Beam trawl				Lines				Total OTB, nets, lines and BTS		
	discards	retained	rate (%)	Nti-rip	discards	retained	rate %	Nti-rip	discards	retained	rate %	Nti-rip	discards	retained	rate (%)	Nti-rip	discards	retained	rate%
2002	17	161	9	34	0	201	0	4	0.2	24	0.7	-	-	-	-	-	17	386	4
2003	16	207	7	75	0	146	0	12	1.9	21	8.1	-	-	-	-	-	18	374	5
2004	59	173	25	120	0	207	0	17	0.3	24	1.3	-	-	-	-	-	59	404	13
2005	6	181	3	79	90	172	34	6	2.4	15	13.7	-	-	-	-	-	99	368	21
2006	34	160	17	102	19	199	9	21	0.4	14	2.5	-	-	-	-	-	53	373	12
2007	49	173	22	220	1	239	0.4	72	0.0	19	0.0	-	-	-	-	-	50	432	10
2008	5	196	3	196	3	318	0.9	40	1.2	21	5.6	-	-	-	-	-	9	535	2
2009	85	175	33	121	0	311	0.1	48	0.2	10	1.5	-	-	-	-	-	86	495	15
2010	49	150	25	104	1	302	0.3	42	1.2	6	17.1	-	-	-	-	-	51	458	10
2011	8	137	6	105	14	324	4.2	51	0.0	5	0.0	-	-	-	-	-	22	467	5
2012	27	157	15	109	2	407	0.5	70	0.0	5	0.0	-	-	-	-	-	29	569	5
2013	4	125	3	92	2	405	0.4	100	1.1	4	20.1	-	-	-	-	-	6	534	1
2014	1	104	1	147	6	647	0.9	84	0.0	8	0.0	-	-	-	-	-	7	758	1
2015	6	77	7	132	1	340	0.4	51	0.0	8	0.0	-	-	-	-	-	7	425	2
2016	35	52	40	56	8	252	3	13	0.1	23	0.0		8.4	210.0	4.0	37.0	52	537	9
2017*	0	35	1	1	-	74	-	0	-	16	-	0	11	147	7	2	11	272	-
2018	11	13	46	5	-	132	-	0	15	13	54	7	-	267	-	0	26	425	6
2019	83	15	85	3	6	120	5		0.1	12	1		0	258	0		89	410	18
2020	12	27	31	1	0	163	0	3	13	15	46	0	0	306	0	0	25	522	5
2021	8	33	20	20	0	195	0	0	0	13	0	0	0	361	0	20	8	607	1
2022	0	41	0	1	0	189	0	0	9	23	29	12	0	337	0	0	9	567	2
2023	22	100	18	?	0	219	0	?	8	34	19	?	6	324	2	?	37	675	5

Table 12. Bss.27.4bc7ad–h: Number of fishing trips sampled for retained and discarded weight of sea bass on French vessels using different gear types: 2009–2023. (Data are clearly underestimated from 2015 and are not used in assessment).

Pelagic trawl FR	discards (t)	Landings (t)	discard rates	cv indicator	Nb trip sampled	Nb fish sampled
2003	0	773	0.00%	NA		
2004	0	820	0.00%	NA		
2005	0	1319	0.00%	NA		
2006	0	1420	0.00%	NA		
2007	0	841	0.00%	NA	12	2
2008	2	1012	0.20%	3.93	21	4
2009	21.2	1098	1.89%	0.05		
2010	7.4	1828	0.40%	0.71	35	106
2011	7.2	1142	0.63%	0.12	9	46
2012	0.9	1143	0.08%	2.38	7	29
2013	0.3	1516	0.02%	2		
2014	0	242	0.00%	NA		
2015	11.7	107	9.86%	0.03	32	5
2016*	0.5	17.43081	2.79%	NA	19	2
2017*		6		NA	0	0
2018*	0.2	1	17%		28	1
2019*		1				
2020*	-	2	-	-	0	0
2021*	0	3				
2022*	0	2	0		0	0
2023*	0	3	0		0	0

bottom trawlFR	discards (t)	Landings (t)	discard rates	cv indicator	Nb trip sampled	Nb fish sampled
2003	73.8	1087	6.36%	0.35	18	26
2004		1236	NA	NA	24	3
2005	43.9	1239	3.42%	0.9		
2006	42.9	1110	3.72%	1.07	24	36
2007	9.6	1187	0.80%	0.73		
2008	40.7	1145	3.43%	0.94	57	63
2009		1052	NA	NA	143	102
2010	76.6	819	8.55%	0.32	137	5
2011	27.2	791	3.32%	0.46	122	57
2012	24.5	824	2.89%	0.23	151	118
2013	26.3	737	3.45%	0.37	139	145
2014		571	NA	NA	133	29
2015	35.4	642	5.23%	0.49	189	356
2016*	126.9	271	31.86%	NA	512	90
2017*	156	178	47%	NA	61	141
2018*	32	72	31%		217	71
2019*	76	76	50%		9	31
2020*	3	133	2%	-	4	4
2021*	11	140				
2022*	18	157	10		50	54
2023*	38	213	15		267	34

netsFR	discards (t)	Landings (t)	discard rates	cv indicator	Nb trip sampled	Nb fish sampled
2003	31.7	152	17.26%	1.2		
2004	77.6	150	34.09%	0.1		
2005	0	148	0.00%	NA		
2006	125.5	140	47.27%	0.34		
2007	2.2	158	1.37%	0.61	32	2
2008	0.5	128	0.39%	0.79		
2009	6.4	94	6.37%	0.41	196	3
2010	6.1	160	3.67%	0.29	108	5
2011	9	129	6.52%	0.35		
2012	11.8	142	7.67%	0.55	269	9
2013	21.6	126	14.63%	0.18	173	2
2014	21.7	163	11.75%	0.11	118	3
2015	14.7	109	11.88%	0.2	217	8
2016*	19.4	64	23.25%	NA	258	209
2017*	0.7	34	2%	NA	0	0
2018*	2	74	3%		101	17
2019*	3	70	4%			
2020*	-	78	-	-	12	0
2021*	-	75	-	-		
2022*	0	80	0		41	1
2023*	0	77	0		56	2

linesFR	discards (t)	Landings (t)	discard rates	cv indicator	Nb trip sampled	Nb fish sampled
2003	0	438	0.00%	NA		
2004	0	381	0.00%	NA		
2005	0	439	0.00%	NA		
2006	0	554	0.00%	NA		
2007	0	560	0.00%	NA		
2008	100.3	425	19.09%	0.35		
2009	5.6	251	2.18%	0.71	17	21
2010	3.9	278	1.38%	1.24		
2011	13.1	359	3.52%	0.35		
2012	15.8	295	5.08%	0.26		
2013	14.2	291	4.65%	0.45		
2014	15.8	285	5.25%	0.4		
2015	7.4	210	3.40%	0.32	28	21
2016*		156		NA		
2017*		166		NA	0	0
2018*		151			0	0
2019*		139				
2020*	-	164	-	-	0	0
2021*	2	162				
2022*	6	130	4.4		4	23
2023*	15	114	12		9	13

OtherFR	discards (t)	Landings (t)	discard rates	cv indicator	Nb trip sampled	Nb fish sampled
2003	0	23	0.00%	NA		
2004	6.6	17	27.97%	NA		
2005	0	17	0.00%	NA		
2006	0	35	0.00%	NA		
2007	0	24	0.00%	NA		
2008	0	40	NA	NA		
2009	0	127	NA	NA		
2010	0	90	0.00%	NA		
2011	44.8	62	41.95%	5.97		
2012	1.1	91	1.19%	0.25	6	9
2013	0	82	0.00%	NA		
2014	0	25	0.00%	NA	130	96
2015	11	11	50.00%	0.58		
2016*	5.9	19.82406	22.94%	NA	64	9
2017*	5	58	8%	NA	0	0
2018*		15			0	0
2019*		43				
2020*	-	20	-	-	-	-
2021*	-	33	-	-	-	-
2022*	0	19	0		0	0
2023*	0	21	0		0	0

FR_ALL	discards (t)	Landings (t)	discard rates	cv indicator	Nb trip sampled	Nb fish sampled
2003	105.5	2473	4%		18	26
2004	84.2	2604	3%		24	3
2005	43.9	3162	1%		0	0
2006	168.4	3259	5%		24	36
2007	11.8	2770	0%		44	4
2008	143.5	2750	5%		78	67
2009^	33.2	2622	1%		356	126
2010^	94	3175	3%		280	116
2011^	101.3	2483	4%	7.25	131	103
2012^	54.1	2495	2%	3.67	433	165
2013^	62.4	2752	2%		312	147
2014^	37.5	1286	3%		381	128
2015^	80.2	1079	7%	1.62	466	390
2016*	152.7	529	22%		853	310
2017*	161.7	442	27%		61	141
2018*	34.2	313	10%			
2019*	79.2	329	19%		9	31
2020*	3	409	1%		16	4
2021*	13	413	3%		41	66
2022*	24	388	6%		99	78
2016**	155.6	529	23%			
2017**	270.9	442	38%			
2018**	456.4	313	59%			
2019**	374.6	329	53%			
2020**	313	409	43%			
2021**	404	413	49%			
2022**	196	388	34%			
2023**	294	448	40%			

^ included in the assessment (source onboard sampling programme).

*** not included in the assessment (source onboard sampling programme).**

**** included in the assessment (source logbook data).**

Table 13. Bss.27.4bc7ad–h: Values of expected recreational F reductions associated with management measures applied to bss.27.4bc7ad–h since 2015. Frec multiplier represents the recreational F relative to 2012. Note that the emergency measures were implemented part way through 2015, so the reduction was applied for half the year.

Year	Management scenario			Frec Multiplier
	MCRS	Bag limit	Open season	
Pre-2015	36 cm	none	All year	1.000
2015 Jan–Jun	36 cm	none	All year	0.821
2015 Jul–Dec	42 cm	three fish		
2016 & 2017	42 cm	one fish	6 months	0.282
2018	42 cm	one fish	3 months	0.191
2019	42 cm	one fish	7 months	0.312
2020	42 cm	two fish	9 months	0.464
2021	42 cm	two fish	9 months	0.464
2022	42 cm	two fish	9 months	0.464
2023	42 cm	two fish	9 months	0.464
2024	42 cm	two fish	9 months	0.464

Table 14. Bss.27.4bc7ad–h: Time-series of Cefas Solent autumn survey of juvenile sea bass. Indices were revised in 2020 and updated in the assessment. A change in trawl design took place in 1993, and calibration factors are applied.

Year	Solent Index prior to 2020 revision	2023 Solent Index
1986	5.84	5.84
1987	2.6	2.6
1989	7.05	7.05
1990	3.98	3.98
1991	3.32	3.32
1992	19.7	19.7
1993	14.63	14.63
1994	5.46	6.69
1995	10.24	10.53
1996	6.06	6.35
1997	38.2	40.4
1998	7.34	7.22
1999	20.91	19.02
2000	17.46	17.8
2001	39.91	42.69
2002	11.7	13.95
2003	13.55	14.18
2005	21.93	23.46
2006	19.73	19.76
2007	5.5	5.5
2008	25.52	25.52
2009	19.83	19.83
2011	4.05	4.05
2013	1.52	1.56
2014	1.4	1.45
2015	7.44	7.45
2016	6.03	6.2
2017	3.54	3.54
2018	2.66	2.66
2019		1.95
2020		4.92
2021		3.59
2022		1.54
2023		2.53

Table 15. Bss.27.4bc7ad–h: Numbers-at-age in Solent survey 1986–present: updated time-series of Cefas Solent autumn survey of juvenile sea bass.

	Age 2	Age 3	Age 4
1986	0.27	4.26	1.31
1987	0.05	0.28	2.27
1989	6.68	0.37	0.00
1990	2.81	1.15	0.02
1991	3.08	0.21	0.03
1992	0.95	18.59	0.16
1993	6.65	3.59	4.39
1994	3.67	2.69	0.34
1995	4.19	5.88	0.46
1996	5.86	0.38	0.12
1997	33.78	6.54	0.08
1998	1.23	5.41	0.58
1999	17.62	0.59	0.82
2000	5.91	11.86	0.03
2001	36.70	4.21	1.77
2002	7.07	6.56	0.31
2003	8.51	5.07	0.60
2005	14.21	8.37	0.88
2006	9.53	9.21	1.02
2007	3.42	1.78	0.30
2008	18.52	6.66	0.34
2009	13.19	6.31	0.32
2011	2.25	1.39	0.41
2013	1.38	0.08	0.10
2014	0.76	0.67	0.02
2015	6.95	0.44	0.05
2016	3.86	2.24	0.11
2017	0.86	2.56	0.12
2018	2.17	0.32	0.18
2019	0.57	1.36	0.02
2020	3.85	0.87	0.20
2021	1.94	1.60	0.05
2022	0.87	0.61	0.06
2023	1.69	0.74	0.10

Table 16. Bss.27.4bc7ad–h: Sea bass indices of abundance 2000–2014 (swept area) from the Channel Groundfish Survey. The relative standard error CV is the log-transformed value used in SS3 (sqrt(loge (1+CV^2)).

year	Total hauls	No. hauls with seabass	Percentage of hauls with seabass	Mean no. seabass per positive haul	Swept-area abundance index	CV
1988	68	6	9	2	245776	0.15
1989	61	3	5	1	77716	0.58
1990	75	8	11	8	1129914	0.12
1991	79	19	24	9	4250636	0.03
1992	60	23	38	13	2617986	0.11
1993	65	21	32	8	2299919	0.10
1994	86	19	22	5	1097828	0.11
1995	166	17	10	5	1021741	0.09
1996	134	26	19	3	1224238	0.13
1997	169	31	18	6	1817599	0.12
1998	82	38	46	8	2531043	0.08
1999	102	37	36	8	1642271	0.12
2000	100	36	36	9	2570994	0.08
2001	109	39	36	9	3150674	0.14
2002	100	44	44	12	3872427	0.11
2003	94	41	44	20	8739056	0.11
2004	94	44	47	8	3598436	0.10
2005	105	40	38	7	3005315	0.08
2006	110	36	33	14	5518000	0.12
2007	103	33	32	8	3661314	0.14
2008	105	40	38	10	6468839	0.15
2009	102	26	26	7	2564694	0.09
2010	101	30	30	4	1804538	0.10
2011	108	27	25	4	1513742	0.12
2012	96	25	26	5	2034552	0.11
2013	96	19	20	4	995987	0.13
2014	98	20	20	3	669931	0.13

Table 17. Bss.27.4bc7ad–h: Commercial LPUE index for French fleet updated for the 2024 assessment.

Year	Index	sd
2001	0.91	0.125
2002	0.96	0.099
2003	0.94	0.104
2004	0.92	0.078
2005	1.01	0.066
2006	1.02	0.082
2007	1.11	0.081
2008	1.08	0.096
2009	1.00	0.060
2010	0.93	0.037
2011	0.81	0.048
2012	0.74	0.041
2013	0.73	0.056
2014	0.60	0.045
2015	0.62	0.065
2016	0.51	0.054
2017	0.47	0.067
2018	0.50	0.081
2019	0.67	0.100
2020	0.74	0.099
2021	0.91	0.141
2022	0.80	0.116
2023	1.04	0.166

Table 18. Bss.27.4bc7ad–h: Key model assumptions and parameters from the WGCSE 2024 update assessment.

Characteristic	Settings
Starting year	1985
Ending year	Assessment year-1 (2023)
Equilibrium commercial catch for starting year	0.82* landings in 1985 by fleet.
Equilibrium recreational catch for starting year	Constant F estimated using 2012 survey results 1985–2014; 2015–present Frec multiplier on F 2012 survey results
Number of areas	1
Number of seasons	1
Number of fishing fleets	6
Number of surveys	2: CGFS; Solent autumn survey.
Number of commercial tunning fleets	1
Individual growth	von Bertalanffy, parameters fixed, combined sex
Number of active parameters	114
Population characteristics	
Maximum age	30
Genders	1
Population length bins	4–100, 2 cm bins
Ages for summary total biomass	0–30
Data characteristics	
Data length bins (for length structured fleets)	6–94, 2 cm bins
Data age bins (for age structured fleets)	0–16+
Minimum age for growth model	2
Maximum age for growth model	30
Maturity	Logistic 2-parameter – females; L50 = 40.65 cm
Fishery characteristics	
Fishery timing	-1 (whole year)
Fishing mortality method	Hybrid
Maximum F	2.9
Fleet 1: UK Trawl/nets selectivity	Double normal, length-based
Fleet 2: UK Line selectivity	Asymptotic, length-based
Fleet 3: UK Midwater trawl selectivity	Asymptotic, length-based
Fleet 4: Combined French fleet selectivity	Asymptotic 1985–2014, Double normal 2015–present, length-based
Fleet 5: Other fleets/gears selectivity	Mirrors French fleet
Fleet 6: Rrecreational fishery	Double normal, length-based
Blocks: Selectivity and Retention	Fleets 1, 2, 4, 5 and 6 2015 to present
Survey characteristics	
Solent autumn survey timing (yr)	0.83

Characteristic	Settings
CGFS survey timing (yr)	0.75
French LPUE timing (yr)	-1
Catchabilities (all surveys)	Analytical solution
Survey selectivities: Solent autumn:	Double normal, length-based constrained by Min-Max age selectivity, age-based
Survey selectivities: CGFS	Double normal, length-based
Tunning fleet: French LPUE	Mirrors French fleet
Fixed biological characteristics	
Natural mortality	0.24
Beverton–Holt steepness	0.999
Recruitment variability (σR)	0.9
Weight–length coefficient	0.00001296
Weight–length exponent	2.969
Maturity inflection (L50%)	40.649 cm
Maturity slope	-0.33349
Length-at-age Amin	19.6 cm at Amin=2
Length-at-Amax	80.26 cm
von Bertalanffy k	0.09699
von Bertalanffy Linf	84.55 cm
von Bertalanffy t0	-0.730 yr
Std. Deviation length-at-age (cm)	SD = 0.1166 * age + 3.5609
Age error matrix	CV 12% at-age
Other model settings	
First year for main recruitment deviations	1955
Last year for recruit deviations	2019
Last year no bias adjustment	1973.7
First year full bias adjustment	1981.6
Last year full bias adjustment	2020.8
First year recent year no bias adjustment	2021.8
Maximum bias adjustment	0.915

Table 19. Bss.27.4bc7ad–h: Final sea bass update assessment: model estimated stock numbers-at-age (thousands of fish).

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1985	823	1195	22029	8135	4975	1607	1468	1221	1678	4239	1432	902	689	532	391	272	599
1986	2512	647	938	17224	6290	3772	1188	1061	866	1179	2960	997	627	479	370	272	605
1987	21647	1976	508	733	13277	4741	2764	847	741	597	806	2016	678	426	325	251	596
1988	17376	17028	1551	396	561	9892	3411	1921	573	491	391	525	1308	439	276	210	548
1989	91834	13668	13370	1210	305	422	7213	2417	1332	392	333	264	354	881	296	186	512
1990	7362	72239	10732	10435	931	229	307	5104	1674	910	266	225	178	238	594	199	471
1991	15129	5791	56720	8376	8027	699	166	217	3527	1141	615	179	151	120	160	399	451
1992	22798	11901	4545	44212	6422	5981	502	116	147	2354	754	405	117	99	79	105	559
1993	8514	17934	9339	3542	33897	4790	4309	350	79	98	1553	495	265	77	65	51	434
1994	33516	6698	14076	7281	2719	25329	3459	3013	239	53	65	1026	326	174	50	43	320
1995	49250	26365	5260	10989	5600	2036	18347	2433	2076	162	36	44	691	220	117	34	245
1996	3073	38741	20699	4102	8432	4174	1464	12777	1656	1393	108	24	29	458	145	78	186
1997	57414	2418	30379	16083	3123	6197	2934	985	8307	1051	871	67	15	18	282	90	163
1998	16916	45163	1896	23626	12265	2302	4376	1989	647	5344	668	550	42	9	11	177	159
1999	56900	13307	35429	1475	18043	9068	1633	2982	1314	419	3412	423	347	27	6	7	212
2000	24541	44759	10437	27553	1125	13304	6393	1101	1941	835	263	2125	263	215	16	4	136
2001	27098	19304	35108	8118	21032	832	9447	4365	728	1257	534	167	1342	166	136	10	88
2002	44493	21316	15142	27310	6198	15550	591	6444	2884	471	802	338	105	846	104	85	62
2003	43854	35000	16722	11782	20850	4580	11031	403	4259	1867	301	510	214	66	535	66	94

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
2004	34125	34497	27438	12982	8952	15274	3204	7370	259	2673	1153	184	310	130	40	325	97
2005	22727	26843	27040	21292	9854	6544	10649	2131	4720	162	1639	700	111	187	79	24	255
2006	24059	17878	21026	20935	16077	7136	4497	6946	1331	2857	96	960	408	65	109	46	162
2007	26947	18926	14003	16276	15800	11628	4892	2926	4328	804	1690	56	558	236	37	63	120
2008	14837	21197	14830	10853	12316	11477	8022	3211	1845	2653	484	1006	33	329	139	22	108
2009	12467	11672	16611	11495	8210	8937	7909	5263	2026	1132	1599	289	598	20	195	83	78
2010	2703	9807	9147	12882	8706	5972	6184	5219	3344	1254	689	964	173	358	12	117	96
2011	10834	2126	7680	7076	9701	6264	4057	3975	3207	1990	730	397	551	99	204	7	122
2012	4582	8522	1666	5950	5345	7016	4291	2637	2478	1942	1183	430	232	322	58	119	75
2013	15615	3604	6675	1288	4473	3826	4728	2732	1606	1463	1124	677	245	132	183	33	111
2014	31938	12283	2820	5147	962	3156	2519	2916	1600	906	806	611	366	132	71	99	78
2015	6903	25124	9628	2185	3867	684	2105	1593	1778	954	534	472	357	214	77	42	105
2016	28721	5430	19751	7531	1668	2777	451	1294	945	1043	559	314	279	212	128	46	89
2017	6054	22593	4271	15494	5826	1243	1956	302	844	611	675	363	204	182	139	84	90
2018	15254	4762	17768	3351	11997	4358	887	1344	204	566	410	453	244	138	123	94	118
2019	6994	11999	3745	13951	2606	9097	3176	621	919	138	384	278	308	166	94	84	146
2020	26244	5502	9437	2940	10859	1985	6699	2260	433	637	96	266	193	214	116	66	161
2021	22694	20644	4326	7404	2284	8231	1449	4713	1556	296	435	65	182	133	147	80	157
2022	16210	17852	16234	3395	5756	1735	6034	1024	3256	1067	203	298	45	125	91	102	164
2023	21728	12751	14039	12739	2640	4377	1275	4283	712	2249	736	140	206	31	87	63	185
2024	21728	17092	10027	11015	9898	2002	3200	899	2954	488	1538	504	96	142	21	60	172

Table 20. Bss.27.4bc7ad–h: Final sea bass update assessment: model estimated fishing mortality-at-age.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1985	0.000	0.001	0.006	0.017	0.037	0.062	0.085	0.103	0.114	0.119	0.122	0.123	0.124	0.124	0.124	0.124	0.123
1986	0.000	0.002	0.007	0.020	0.043	0.071	0.098	0.119	0.132	0.140	0.144	0.146	0.147	0.147	0.147	0.147	0.146
1987	0.000	0.003	0.010	0.026	0.054	0.089	0.124	0.151	0.170	0.182	0.189	0.193	0.194	0.195	0.195	0.195	0.194
1988	0.000	0.002	0.008	0.022	0.046	0.076	0.104	0.126	0.140	0.148	0.152	0.154	0.155	0.155	0.154	0.154	0.153
1989	0.000	0.002	0.008	0.022	0.047	0.077	0.106	0.128	0.141	0.149	0.153	0.155	0.155	0.155	0.155	0.155	0.153
1990	0.000	0.002	0.008	0.022	0.047	0.078	0.108	0.130	0.144	0.151	0.155	0.157	0.158	0.158	0.157	0.157	0.155
1991	0.000	0.002	0.009	0.026	0.054	0.090	0.123	0.148	0.164	0.174	0.179	0.181	0.181	0.181	0.181	0.180	0.178
1992	0.000	0.002	0.009	0.026	0.053	0.088	0.121	0.148	0.165	0.176	0.182	0.185	0.186	0.186	0.186	0.186	0.184
1993	0.000	0.002	0.009	0.024	0.051	0.085	0.118	0.142	0.159	0.169	0.174	0.177	0.178	0.178	0.178	0.177	0.176
1994	0.000	0.002	0.008	0.023	0.049	0.082	0.112	0.133	0.145	0.152	0.155	0.156	0.156	0.155	0.154	0.154	0.150
1995	0.000	0.002	0.009	0.025	0.054	0.090	0.122	0.145	0.159	0.167	0.171	0.172	0.172	0.171	0.171	0.170	0.166
1996	0.000	0.003	0.012	0.033	0.068	0.113	0.156	0.191	0.214	0.229	0.237	0.241	0.243	0.243	0.243	0.243	0.240
1997	0.000	0.003	0.011	0.031	0.065	0.108	0.149	0.180	0.201	0.214	0.221	0.224	0.225	0.225	0.225	0.224	0.221
1998	0.000	0.003	0.011	0.030	0.062	0.103	0.144	0.175	0.196	0.209	0.216	0.219	0.221	0.221	0.221	0.220	0.218
1999	0.000	0.003	0.011	0.031	0.065	0.109	0.154	0.189	0.212	0.226	0.234	0.237	0.239	0.239	0.239	0.238	0.235
2000	0.000	0.003	0.011	0.030	0.062	0.102	0.142	0.173	0.195	0.208	0.216	0.219	0.221	0.221	0.221	0.221	0.219
2001	0.000	0.003	0.011	0.030	0.062	0.103	0.143	0.174	0.196	0.209	0.216	0.220	0.221	0.222	0.222	0.221	0.219
2002	0.000	0.003	0.011	0.030	0.062	0.103	0.143	0.174	0.195	0.207	0.214	0.217	0.218	0.218	0.217	0.217	0.214
2003	0.000	0.003	0.013	0.035	0.071	0.117	0.163	0.200	0.226	0.242	0.251	0.256	0.258	0.258	0.258	0.258	0.255
2004	0.000	0.004	0.014	0.036	0.073	0.121	0.168	0.206	0.232	0.249	0.259	0.263	0.265	0.266	0.266	0.265	0.262
2005	0.000	0.004	0.016	0.041	0.083	0.135	0.187	0.231	0.262	0.283	0.295	0.301	0.304	0.305	0.305	0.304	0.302
2006	0.000	0.004	0.016	0.041	0.084	0.137	0.190	0.233	0.264	0.285	0.297	0.303	0.306	0.307	0.307	0.307	0.304
2007	0.000	0.004	0.015	0.039	0.080	0.131	0.181	0.221	0.250	0.268	0.279	0.284	0.286	0.287	0.286	0.286	0.283
2008	0.000	0.004	0.015	0.039	0.081	0.132	0.181	0.221	0.248	0.266	0.276	0.281	0.283	0.283	0.282	0.282	0.278

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
2009	0.000	0.004	0.014	0.038	0.078	0.128	0.176	0.213	0.240	0.257	0.266	0.271	0.273	0.273	0.273	0.272	0.268
2010	0.000	0.004	0.017	0.044	0.089	0.147	0.202	0.247	0.279	0.300	0.312	0.319	0.321	0.322	0.321	0.321	0.317
2011	0.000	0.004	0.015	0.041	0.084	0.138	0.191	0.232	0.262	0.280	0.290	0.296	0.297	0.298	0.297	0.296	0.292
2012	0.000	0.004	0.017	0.045	0.094	0.155	0.211	0.256	0.287	0.307	0.318	0.323	0.325	0.324	0.323	0.322	0.316
2013	0.000	0.005	0.020	0.053	0.109	0.178	0.243	0.295	0.332	0.356	0.370	0.376	0.379	0.379	0.378	0.376	0.370
2014	0.000	0.004	0.015	0.046	0.101	0.165	0.218	0.255	0.277	0.290	0.295	0.296	0.295	0.292	0.289	0.286	0.273
2015	0.000	0.001	0.006	0.030	0.091	0.176	0.246	0.282	0.293	0.294	0.291	0.286	0.282	0.277	0.273	0.268	0.248
2016	0.000	0.000	0.003	0.017	0.054	0.110	0.161	0.188	0.196	0.196	0.193	0.190	0.186	0.183	0.179	0.176	0.160
2017	0.000	0.000	0.003	0.016	0.050	0.097	0.135	0.154	0.160	0.160	0.159	0.157	0.155	0.153	0.150	0.148	0.138
2018	0.000	0.000	0.002	0.011	0.037	0.077	0.117	0.140	0.147	0.148	0.146	0.144	0.142	0.140	0.138	0.136	0.126
2019	0.000	0.000	0.002	0.011	0.032	0.066	0.100	0.120	0.126	0.127	0.126	0.125	0.123	0.122	0.120	0.119	0.112
2020	0.000	0.000	0.003	0.013	0.037	0.074	0.112	0.133	0.141	0.142	0.141	0.139	0.138	0.136	0.134	0.133	0.125
2021	0.000	0.000	0.002	0.012	0.035	0.070	0.108	0.130	0.137	0.138	0.138	0.136	0.134	0.132	0.131	0.129	0.122
2022	0.000	0.000	0.002	0.012	0.034	0.068	0.103	0.123	0.130	0.131	0.130	0.129	0.127	0.126	0.124	0.122	0.115
2023	0.000	0.000	0.003	0.012	0.036	0.073	0.110	0.131	0.139	0.140	0.138	0.137	0.135	0.133	0.131	0.129	0.120

Table 21. Bss.27.4bc7ad–h: Final sea bass update assessment: stock summary table.

Year	Low	Recruitment (Age 0, thousands)	High	Low	SSB (Tonnes)	High	Low	F(4-15)	High	$F_{commercial}$	$F_{recreational}$	Commercial landings	Commercial discards*	Recreational removals
1985	71	823	1575	17845	23880	29914	0.077	0.105	0.133	0.068	0.037	994		1857
1986	457	2512	4567	15538	20935	26332	0.090	0.123	0.157	0.069	0.055	1318		1671
1987	15374	21647	27920	13846	18658	23471	0.117	0.161	0.20	0.069	0.092	1979		1522
1988	9947	17376	24805	12592	16934	21275	0.096	0.130	0.165	0.069	0.062	1239		1411
1989	77450	91834	106217	12203	16258	20314	0.096	0.131	0.166	0.068	0.063	1161		1302
1990	2253	7362	12470	11032	14879	18726	0.096	0.133	0.171	0.068	0.065	1064		1169
1991	9040	15129	21218	9418	13012	16606	0.109	0.153	0.197	0.068	0.085	1226		1072
1992	15728	22798	29869	8106	11404	14701	0.111	0.155	0.199	0.069	0.086	1186		1097
1993	3968	8514	13060	8747	11792	14838	0.112	0.149	0.185	0.069	0.080	1256		1280
1994	24006	33516	43026	11538	14449	17359	0.105	0.134	0.162	0.068	0.066	1370		1537
1995	38602	49250	59898	15167	18186	21205	0.118	0.147	0.175	0.068	0.079	1835		1720
1996	467	3073	5680	16917	20127	23337	0.162	0.20	0.24	0.069	0.133	3022		1724
1997	45446	57414	69382	15978	19225	22471	0.151	0.188	0.23	0.069	0.120	2620		1628
1998	7770	16916	26062	14731	17910	21089	0.147	0.184	0.22	0.069	0.115	2390		1566
1999	43581	56900	70219	14144	17208	20271	0.158	0.198	0.24	0.069	0.129	2670		1564
2000	15270	24541	33811	14233	17212	20192	0.146	0.183	0.22	0.069	0.115	2407		1614
2001	15079	27098	39118	15096	18115	21134	0.147	0.184	0.22	0.069	0.115	2500		1696
2002	29682	44493	59305	15820	18893	21967	0.146	0.182	0.22	0.069	0.113	2622	17	1790
2003	31105	43854	56603	16899	20043	23187	0.171	0.21	0.26	0.069	0.144	3459	16	1870
2004	23323	34125	44926	17546	20751	23956	0.176	0.22	0.26	0.069	0.150	3731	59	1914
2005	14872	22727	30582	17980	21248	24516	0.198	0.25	0.30	0.069	0.180	4430	96	1909
2006	16585	24059	31534	17441	20764	24087	0.199	0.25	0.30	0.069	0.183	4377	53	1878
2007	18217	26947	35677	16999	20296	23592	0.188	0.24	0.28	0.069	0.168	4064	50	1876

Year	Low	Recruitment (Age 0, thousands)	High	Low	SSB (Tonnes)	High	Low	F(4-15)	High	$F_{commercial}$	$F_{recreational}$	Commercial landings	Commercial discards*	Recreational removals
2008	8229	14837	21445	17384	20591	23797	0.188	0.23	0.28	0.069	0.166	4107	8	1886
2009	7800	12467	17134	17776	20883	23990	0.183	0.23	0.27	0.069	0.158	3889	151	1860
2010	404	2703	5001	17642	20631	23619	0.21	0.26	0.32	0.069	0.196	4562	148	1757
2011	7309	10834	14359	16209	19014	21819	0.20	0.25	0.29	0.069	0.178	3858	22	1608
2012	2282	4582	6882	14907	17503	20100	0.22	0.27	0.32	0.069	0.202	3987	157	1440
2013	10034	15615	21195	13096	15528	17960	0.25	0.31	0.38	0.069	0.245	4137	53	1219
2014	22828	31938	41048	10472	12818	15164	0.197	0.25	0.31	0.068	0.187	2682	25	1005
2015	2453	6903	11354	8454	10769	13084	0.192	0.25	0.32	0.056	0.199	2273	40	681
2016	18635	28721	38807	6446	8735	11023	0.120	0.168	0.22	0.019	0.148	1446	199	204
2017	2355	6054	9752	5601	7881	10162	0.098	0.140	0.182	0.019	0.121	1106	271	202
2018	7414	15254	23093	5543	7899	10256	0.087	0.126	0.165	0.013	0.113	1084	482	149
2019	2259	6994	11729	6239	8824	11409	0.075	0.109	0.142	0.022	0.087	978	464	280
2020	5536	26244	46953	7468	10473	13477	0.084	0.122	0.159	0.032	0.090	1195	325	472
2021	1736	22694	43653	8350	11812	15274	0.081	0.118	0.155	0.032	0.086	1281	412	509
2022		13308**		8887	12794	16700	0.076	0.112	0.149	0.032	0.080	1276	196	530
2023		13308**		8930	13190	17451	0.078	0.119	0.161	0.032	0.087	1397	316	537
2024		13308**		8610	13158	17706								

*** Incomplete for some fleets 2002–2008.**

****Geometric mean recruitment 2012–2021.**

Table 22. Bss.27.4bc7ad–h: Inputs for short-term forecast. Fishing mortality is the estimates for 2024. Numbers-at-ages 0–2 in 2024 are adjusted by replacing Stock Synthesis values for 0-group in 2022–2023 (years with no recruit deviations estimated) with the long-term GM, adjusted for natural mortality.

age	Stock numbers 2023	weight in stock	Proportion mature (female)	H.Cons retained mean F (2022)	H.Cons Discarded mean F (2022)	H.Cons retained mean weights	H.Cons discarded mean weights	H.Cons proportion retained	Recreational F	Recreational removals mean weight	M
0	13308	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.24
1	10469	0.024	0.000	0.000	0.001	0.117	0.117	0.382	0.000	0.080	0.24
2	8232	0.097	0.000	0.003	0.004	0.236	0.236	0.384	0.002	0.192	0.24
3	11015	0.210	0.000	0.011	0.013	0.383	0.384	0.463	0.005	0.342	0.24
4	9898	0.369	0.092	0.034	0.017	0.567	0.560	0.664	0.011	0.531	0.24
5	2002	0.571	0.296	0.069	0.012	0.789	0.751	0.857	0.019	0.750	0.24
6	3200	0.807	0.577	0.092	0.005	1.006	0.966	0.951	0.026	0.991	0.24
7	899	1.072	0.797	0.100	0.002	1.242	1.220	0.985	0.032	1.250	0.24
8	2954	1.357	0.915	0.101	0.000	1.511	1.505	0.995	0.034	1.525	0.24
9	488	1.657	0.965	0.100	0.000	1.804	1.805	0.999	0.035	1.818	0.24
10	1538	1.964	0.986	0.098	0.000	2.105	2.112	1.000	0.035	2.122	0.24
11	504	2.274	0.994	0.096	0.000	2.408	2.418	1.000	0.036	2.429	0.24
12	96	2.582	0.997	0.095	0.000	2.707	2.721	1.000	0.036	2.734	0.24
13	142	2.885	0.998	0.093	0.000	2.999	3.016	1.000	0.036	3.033	0.24
14	21	3.180	0.999	0.091	0.000	3.282	3.302	1.000	0.036	3.323	0.24
15	60	3.464	1.000	0.090	0.000	3.554	3.577	1.000	0.036	3.602	0.24
16	172	4.225	1.000	0.000	0.000	4.195	4.914	1.000	0.036	3.869	0.24

Age 0,1,2 over-written as follows:

2024 yc	**2024 age 0 replaced by 2012–2021 LTGM (13 308);**
2023 yc	**2024 age 1 from SS3 survivor estimate at-age 1, 2024 * LTGM / SS3 estimate of age 0 in 2023;**
2022 yc	**2024 age 2 from SS3 survivor estimate at-age 2, 2024* LTGM / SS3 estimate of age 0 in 2022.**

Table 23. Bss.27.4bc7ad–h: Management options table.

Table 2 Sea bass in divisions 4.b–c, 7.a, and 7.d–h. Annual catch scenarios. Weights are in tonnes.

Basis	Total removals* (2025)	F_{total} (2025)	SSB (2026)	% SSB change**	% advice change ***
ICES advice basis					
MSY approach: $F = F_{MSY} \times SSB_{2025}/MSY\ B_{trigger}$	2776	0.159	13477	0.89	14.1
Other scenarios					
EU MAP^: $F_{MSY} \times SSB_{2025}/MSY\ B_{trigger}$	2776	0.159	13477	0.89	14.1
EU MAP^: $F_{MSY\ lower} \times SSB_{2025}/MSY\ B_{trigger}$	2330	0.131	13827	3.5	-4.2
EU MAP^: $F_{MSY\ upper} \times SSB_{2025}/MSY\ B_{trigger}$	2776	0.159	13477	0.89	14.1
$F = F_{MSY\ lower}$	2506	0.142	13689	2.5	3.0
$F = F_{MSY}$	2984	0.1713	13315	-0.32	23
$F = F_{MSY\ upper}$	2984	0.1713	13315	-0.32	23
F = 0	0	0	15672	17.3	-100
F_{pa}	3486	0.203	12923	-3.3	43
F_{lim}	4265	0.254	12319	-7.8	75
$SSB_{2026} = B_{lim}$	6893	0.45	10313	-23	183
$SSB_{2026} = B_{pa}$	1553	0.086	14439	8.1	-36
SSB_{2026} = MSY $B_{trigger}$	1553	0.086	14439	8.1	-36
$F = F_{2024}$	2082	0.117	14022	5.0	-14.4
$SSB_{2026} = SSB_{2025}$	2928	0.168	13358	0	20

* Includes commercial catch and recreational removals (taking mortality of released fish into account, estimated at approximately 5%).

** SSB 2026 relative to SSB 2025.

*** Advice value for 2025 relative to the advice value for 2024 (2432 tonnes).

^ MAP multiannual plan (EU, 2019).

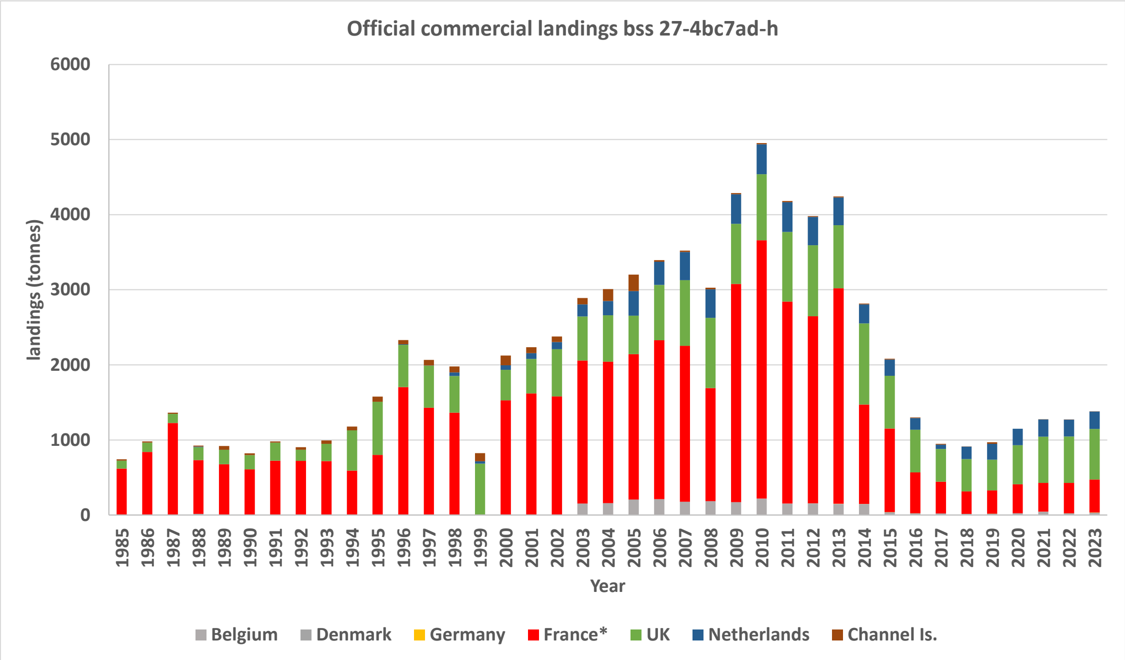
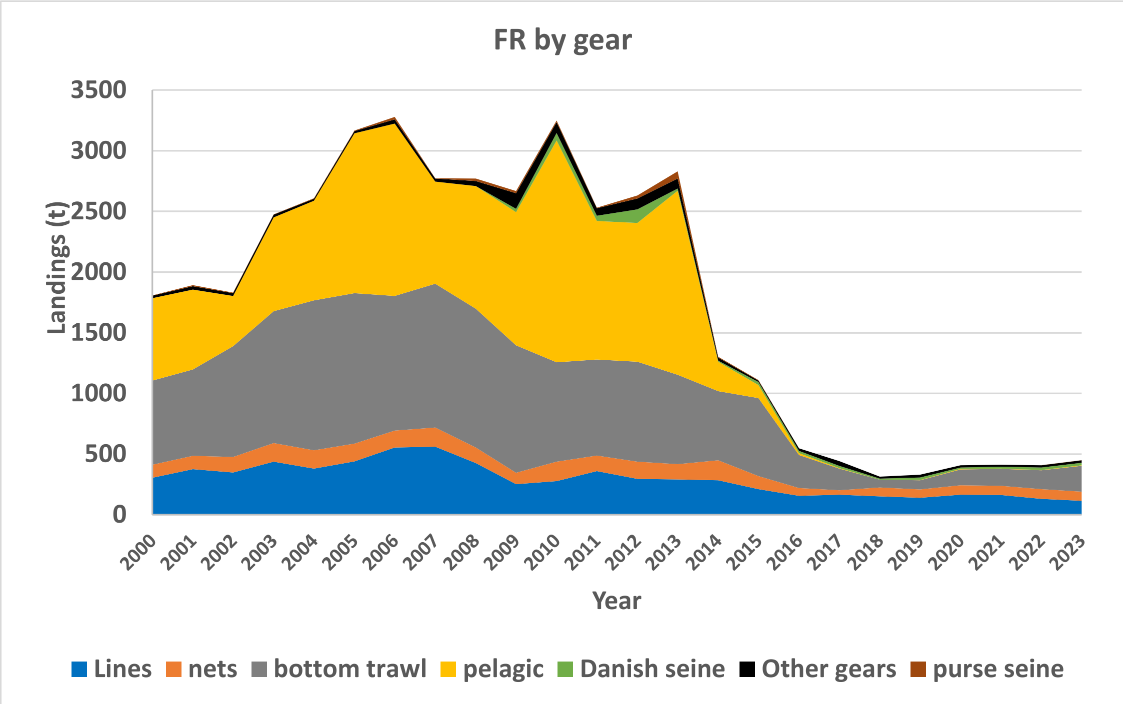


Figure 1. Bss.27.4bc7ad–h: Trends in official sea bass landings by country.



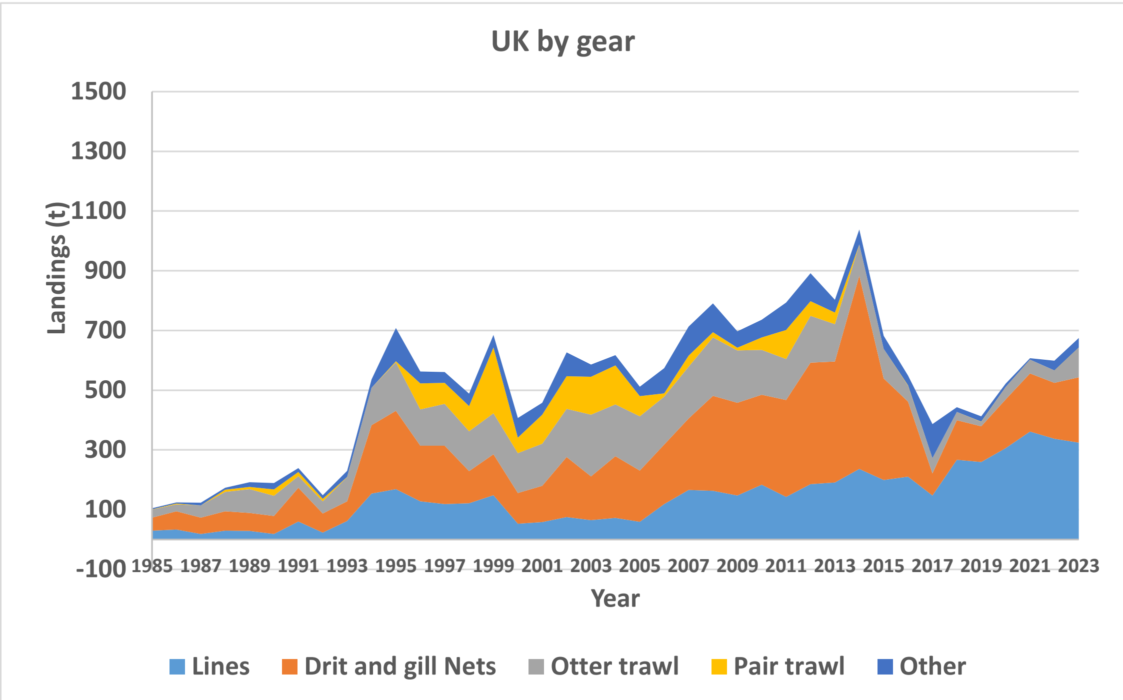


Figure 2. Bss.27.4bc7ad–h: Trends in ICES estimates of sea bass landings by gear (France –top- and UK –bottom).

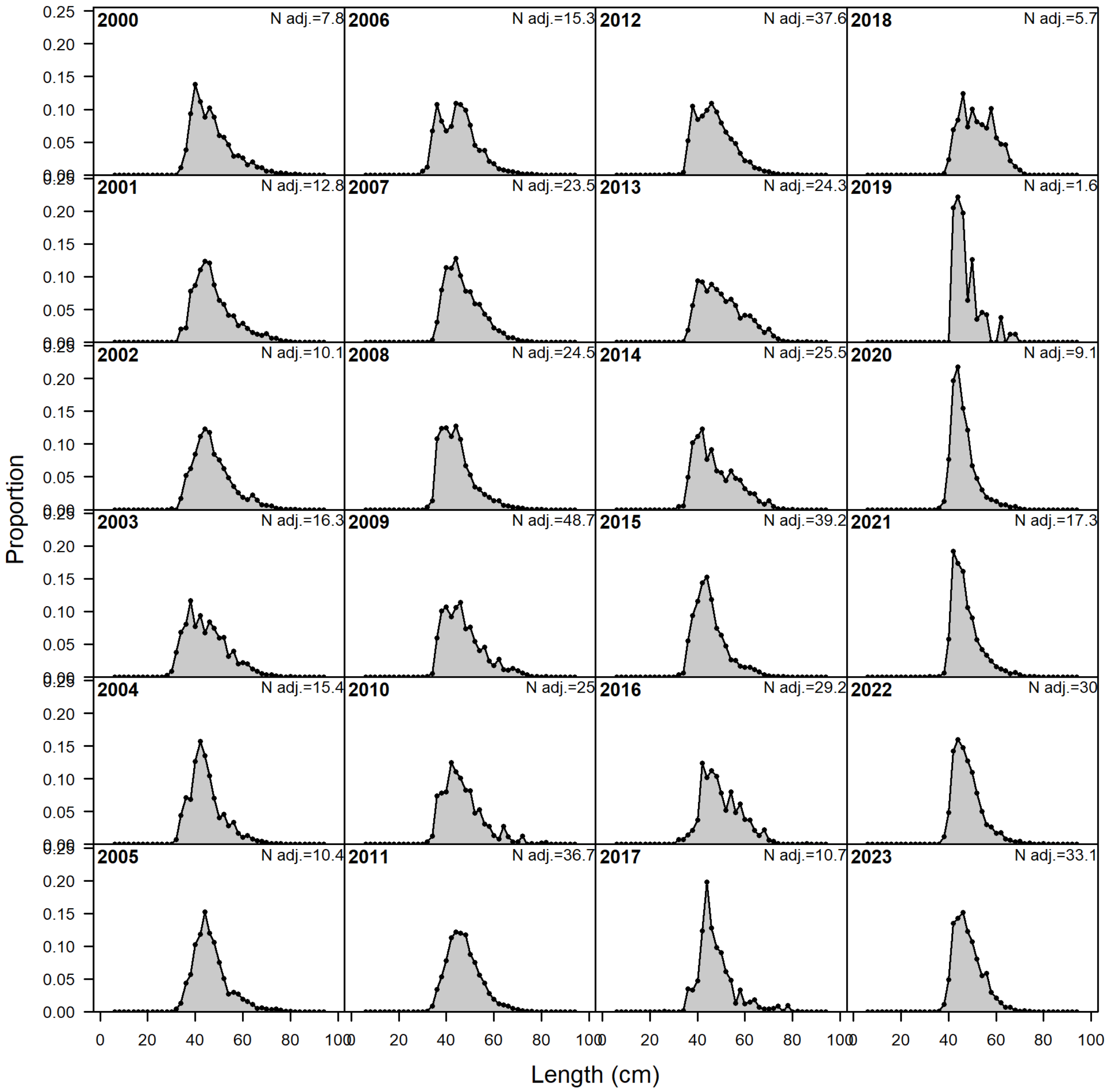
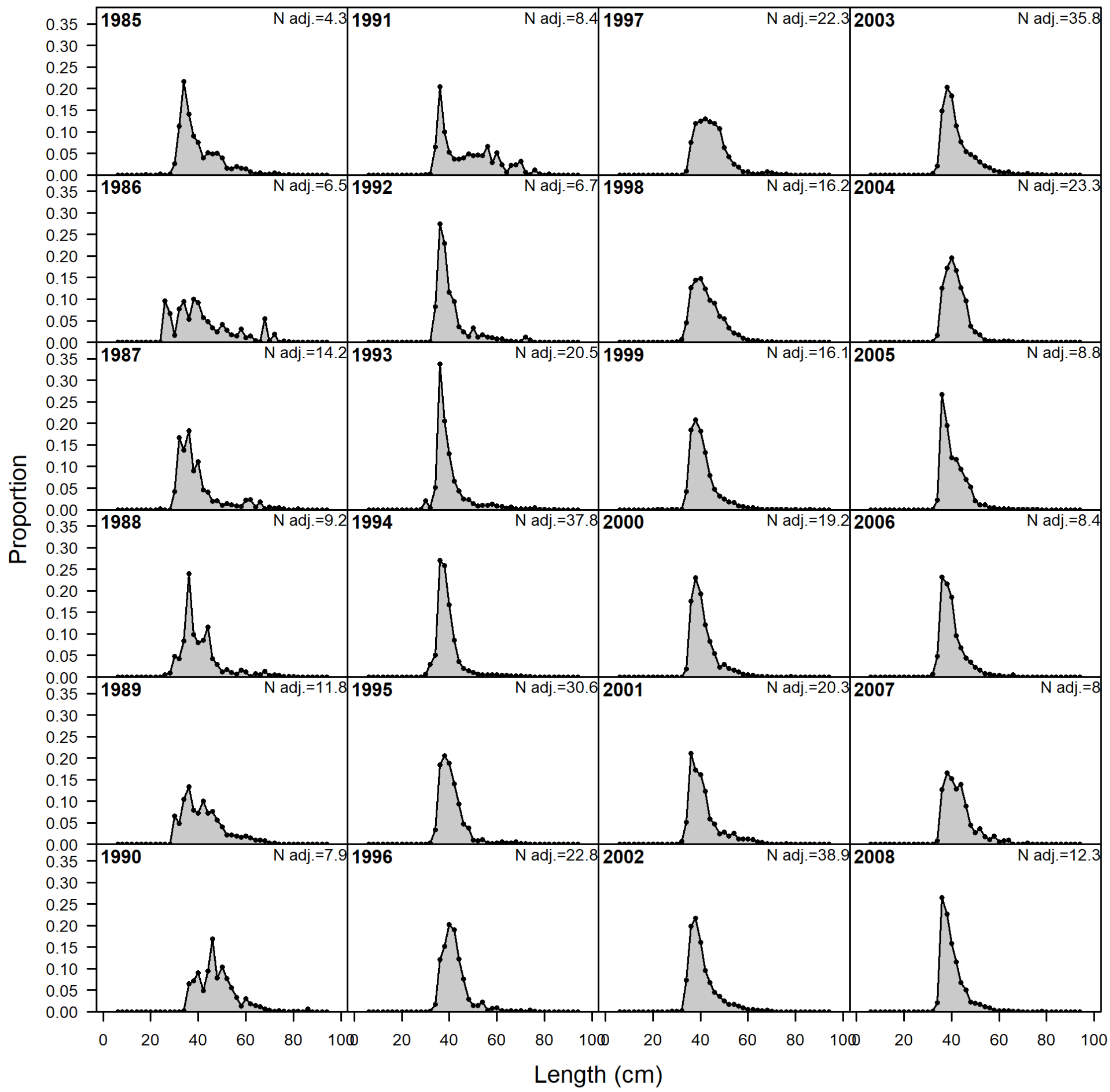


Figure 3. Bss.27.4bc7ad–h: Length composition for the combined French fleet from 2000 onwards.



1985
N adj.=4.3
1991
N adj.=8.4
1997
N adj.=22.3
2003
N adj.=35.8
1986
N adj.=6.5
1992
N adj.=6.7
1998
N adj.=16.2
2004
N adj.=23.3
1987
N adj.=14.2
1993
N adj.=20.5
1999
N adj.=16.1
2005
N adj.=8.8
1988
N adj.=9.2
1994
N adj.=37.8
2000
N adj.=19.2
2006
N adj.=8.4
1989
N adj.=11.8
1995
N adj.=30.6
2001
N adj.=20.3
2007
N adj.=8
1990
N adj.=7.9
1996
N adj.=22.8
2002
N adj.=38.9
2008
N adj.=12.3
Proportion
Length (cm)

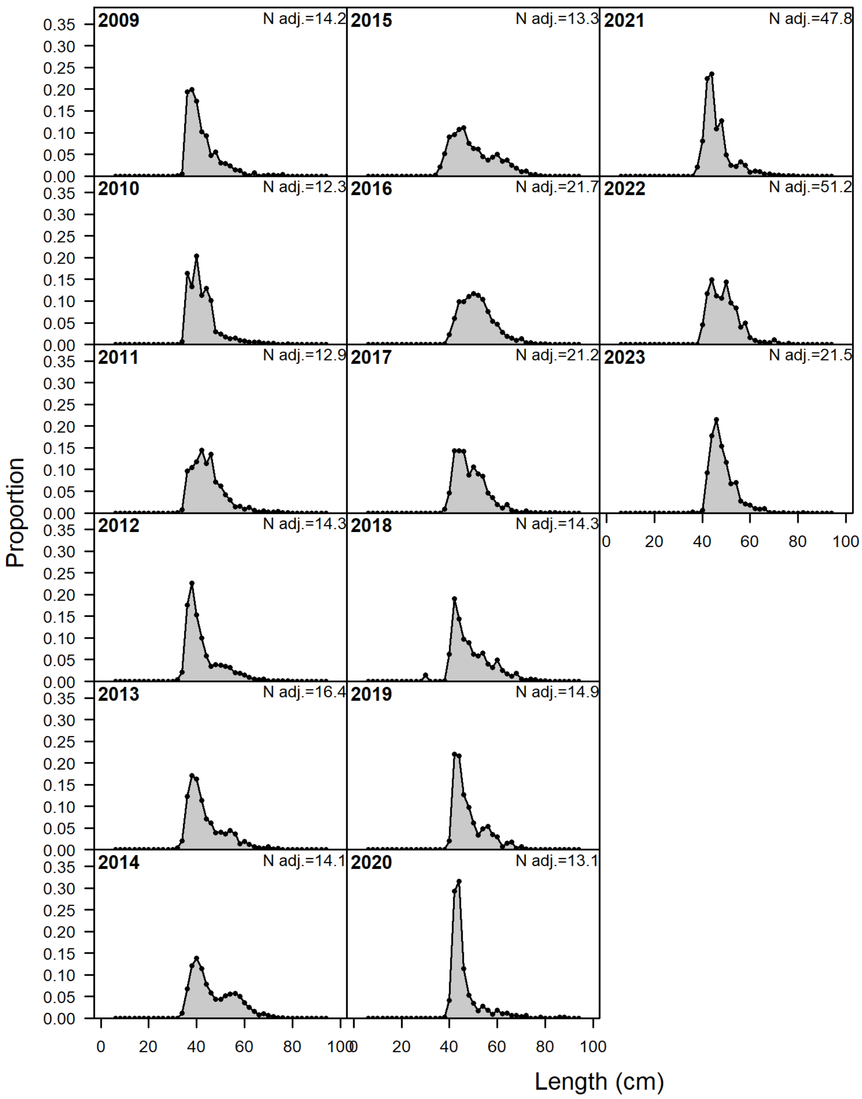
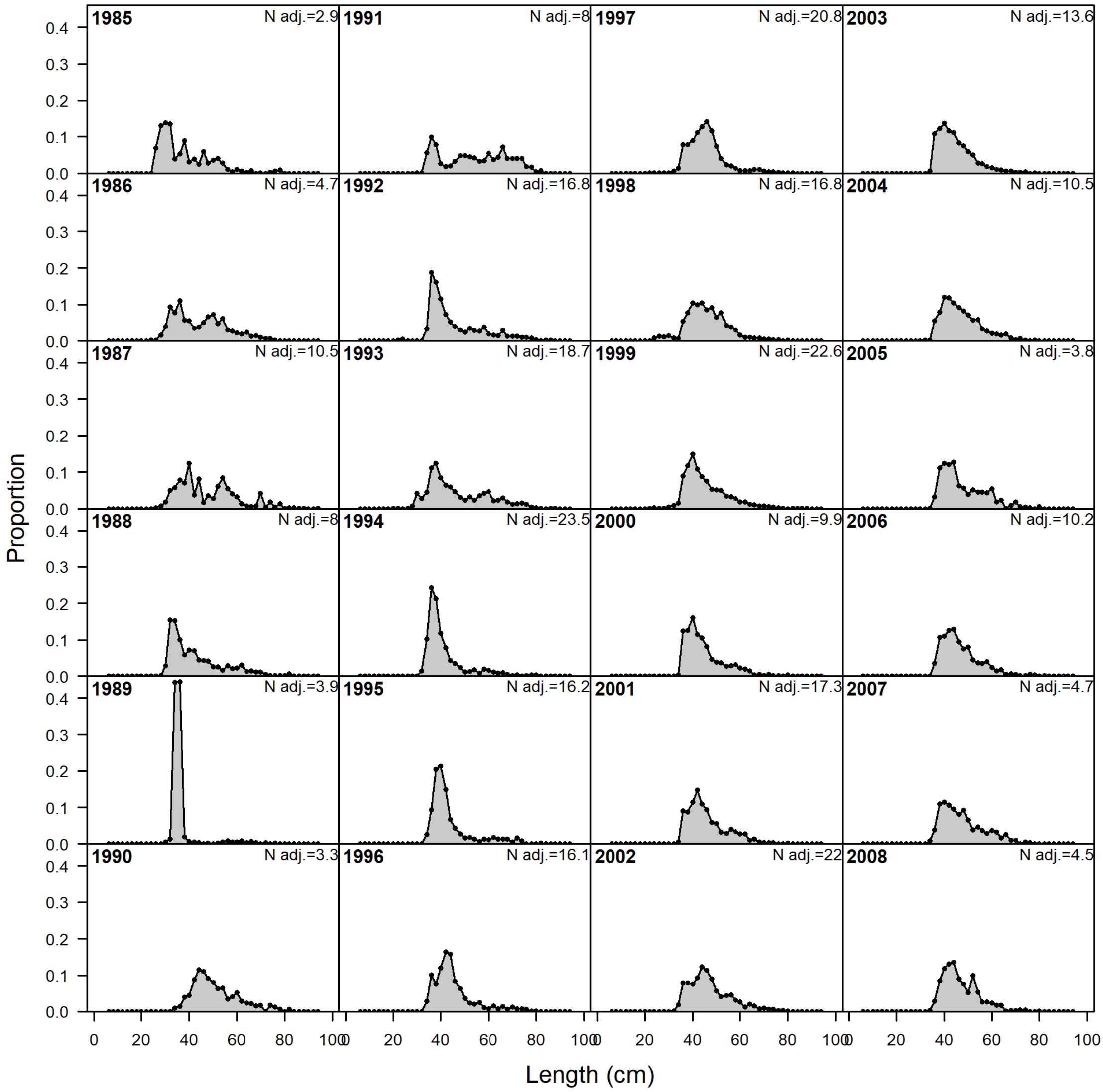


Figure 4. Bss.27.4bc7ad–h: Length composition of UK bottom trawls and nets fleet landings from 1985 onwards.


1985
N adj.=2.9
1991
N adj.=8
1997
N adj.=20.8
2003
N adj.=13.6
1986
N adj.=4.7
1992
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1998
N adj.=16.8
2004
N adj.=10.5
1987
N adj.=10.5
1993
N adj.=18.7
1999
N adj.=22.6
2005
N adj.=3.8
1988
N adj.=8
1994
N adj.=23.5
2000
N adj.=9.9
2006
N adj.=10.2
1989
N adj.=3.9
1995
N adj.=16.2
2001
N adj.=17.3
2007
N adj.=4.7
1990
N adj.=3.3
1996
N adj.=16.1
2002
N adj.=22
2008
N adj.=4.5
Proportion
Length (cm)

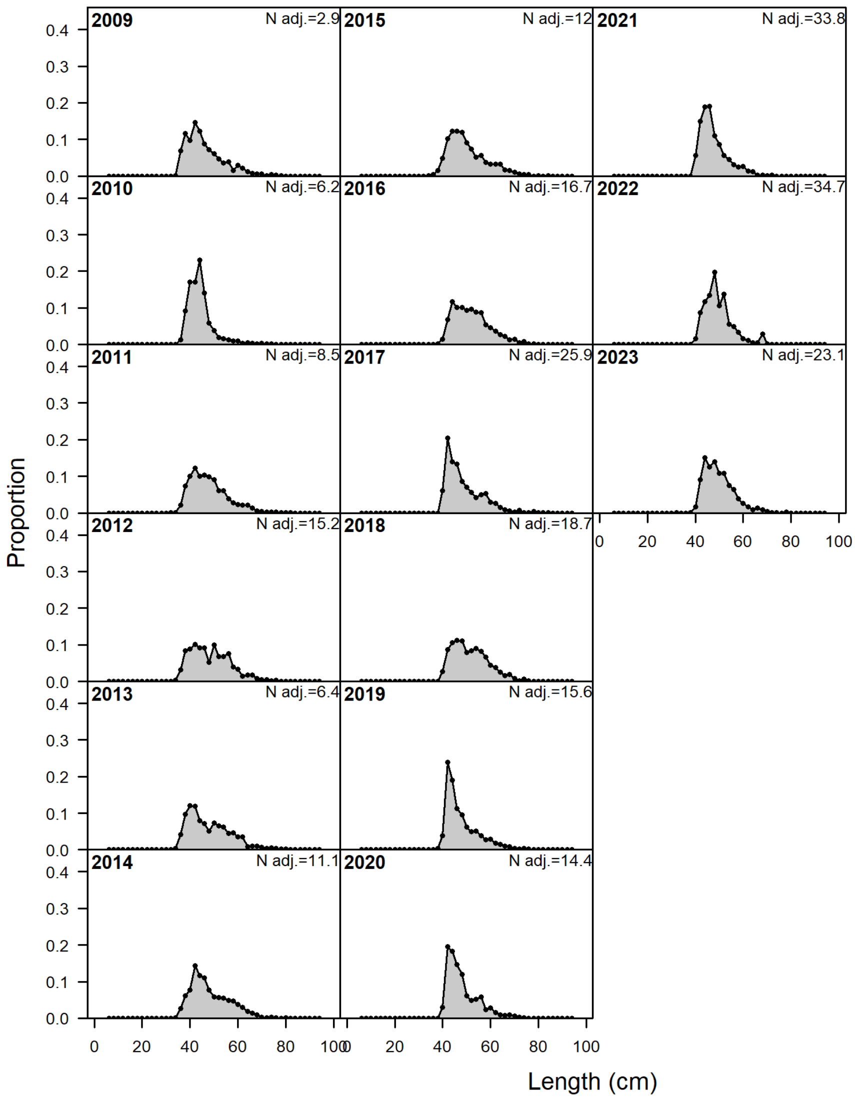
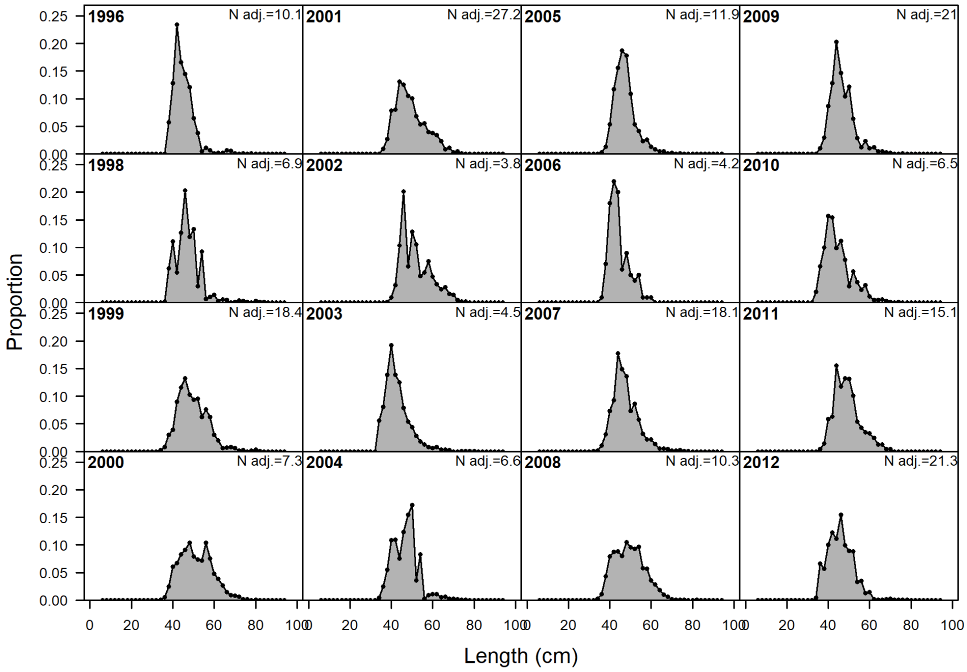


Figure 5. Bss.27.4bc7ad–h: Length composition of UK Lines fleet landings from 1985 onwards.



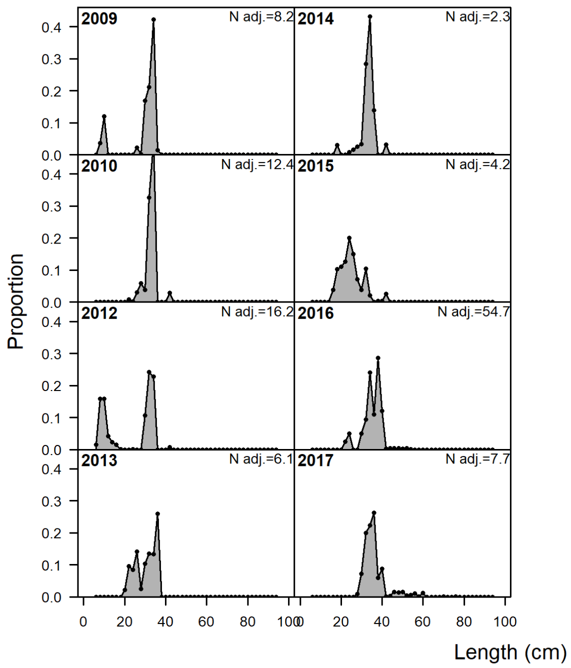


Figure 6. Bss.27.4bc7ad–h: Available length composition of UK Midwater pair trawl fleet landings.

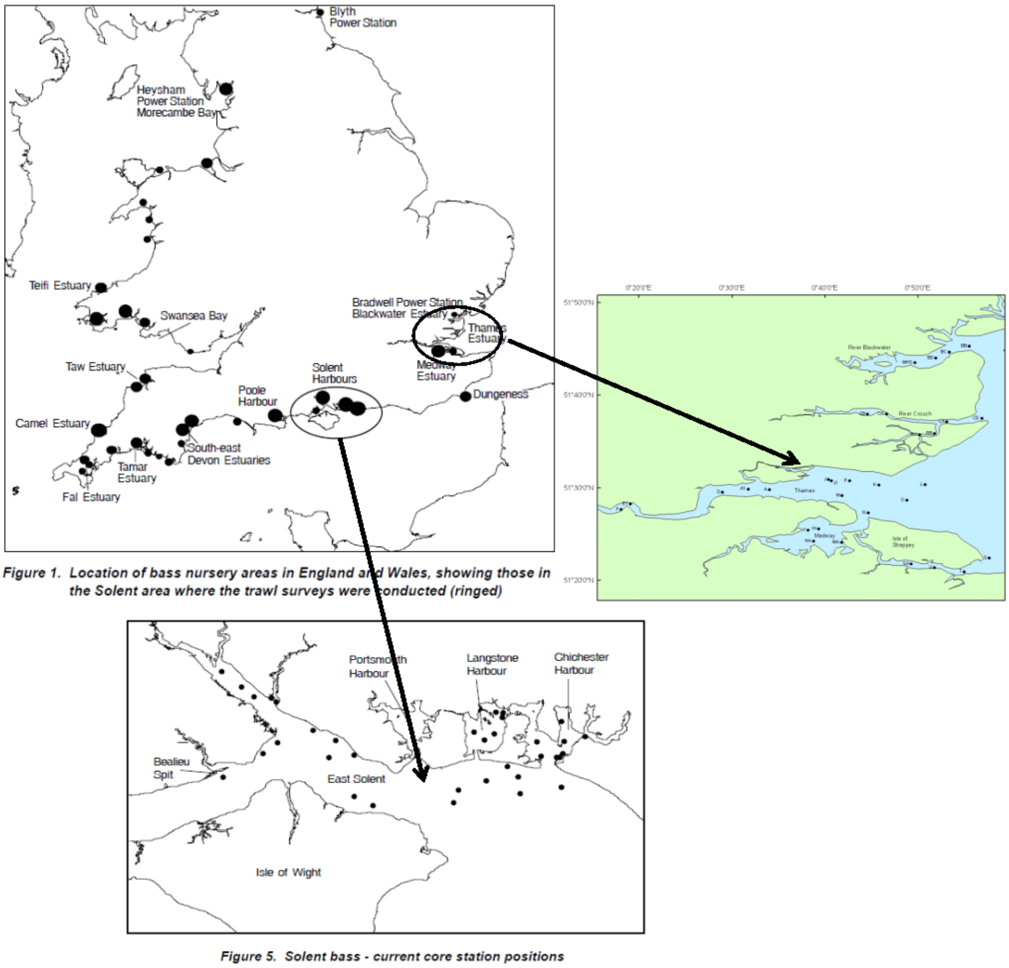


Figure 7. Bss.27.4bc7ad–h: Location of Cefas Solent and Thames juvenile sea bass surveys.

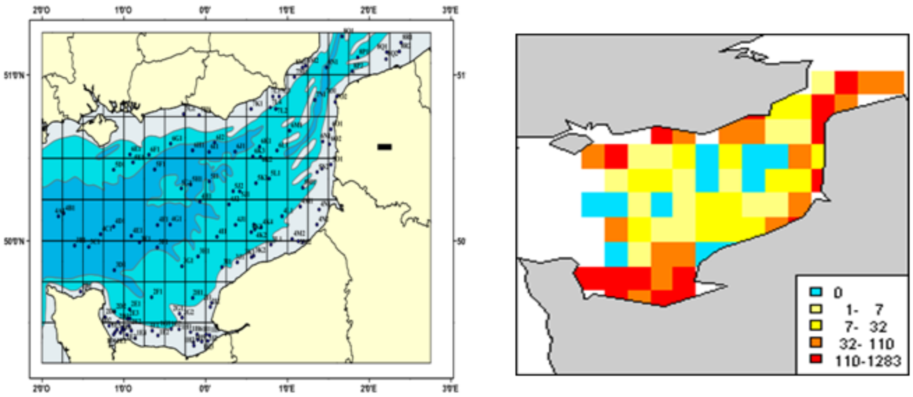


Figure 8. Bss.27.4bc7ad–h: Left: stations fished during the Channel Groundfish Survey carried out annually by France. Right: distribution of total catches of sea bass over the survey series.

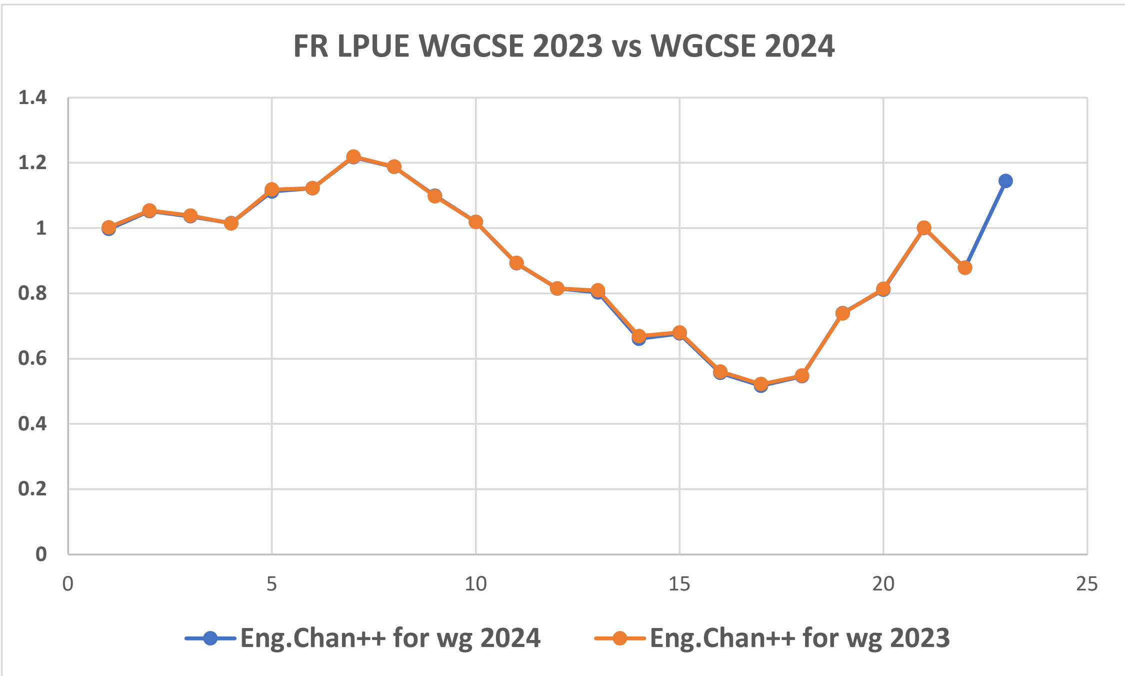


Figure 9. Bss.27.4bc7ad–h: Comparison of French commercial LPUE index for European sea bass in ICES divisions 4bc and 7a,d–h between last year's assessment and the updated 2023 LPUE.

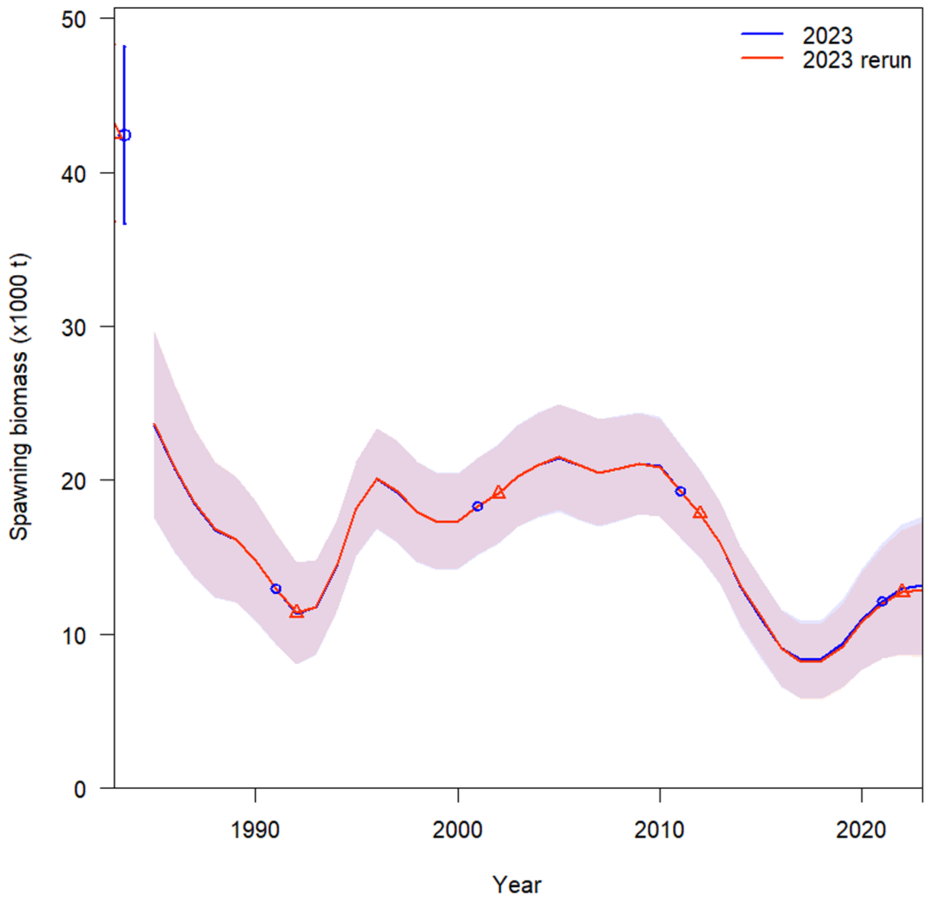
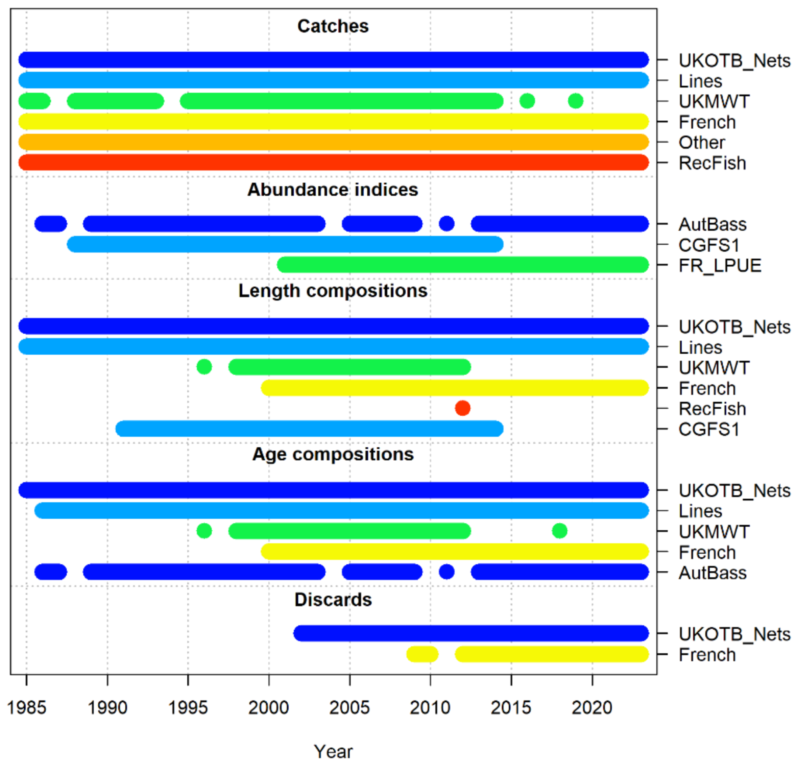


Figure 10: Comparison of the SSB estimates from the 2023 final assessment (2023) with a model where Netherlands landings data had been revised (2023 rerun). See section 29.2.1 and 29.3.1.19 for further details.



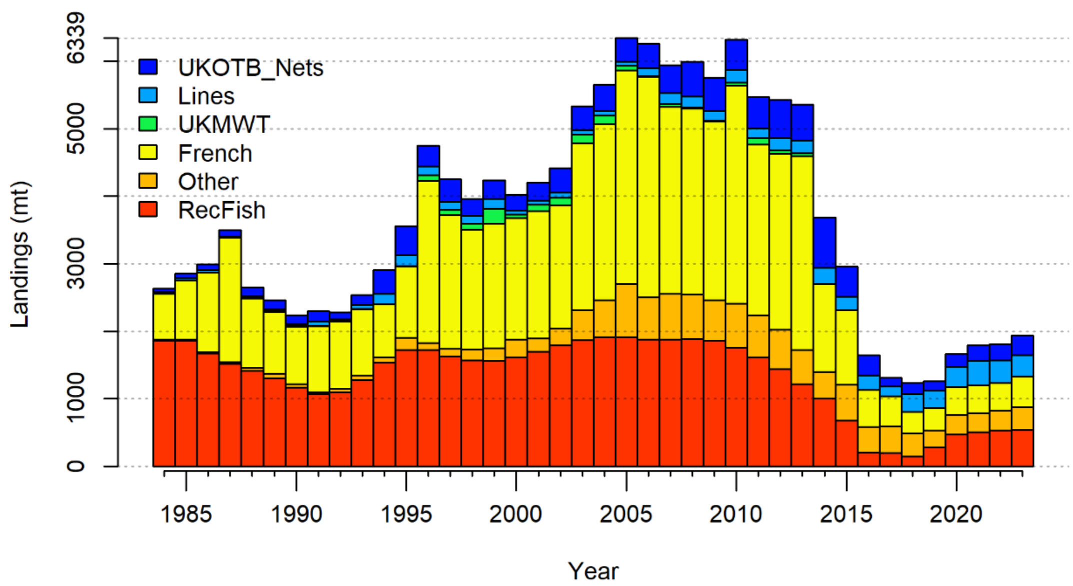


Figure 11. Bss.27.4bc7ad–h: Top: Datasets used in the updated assessment. Bottom: Landings series for the six fleets.

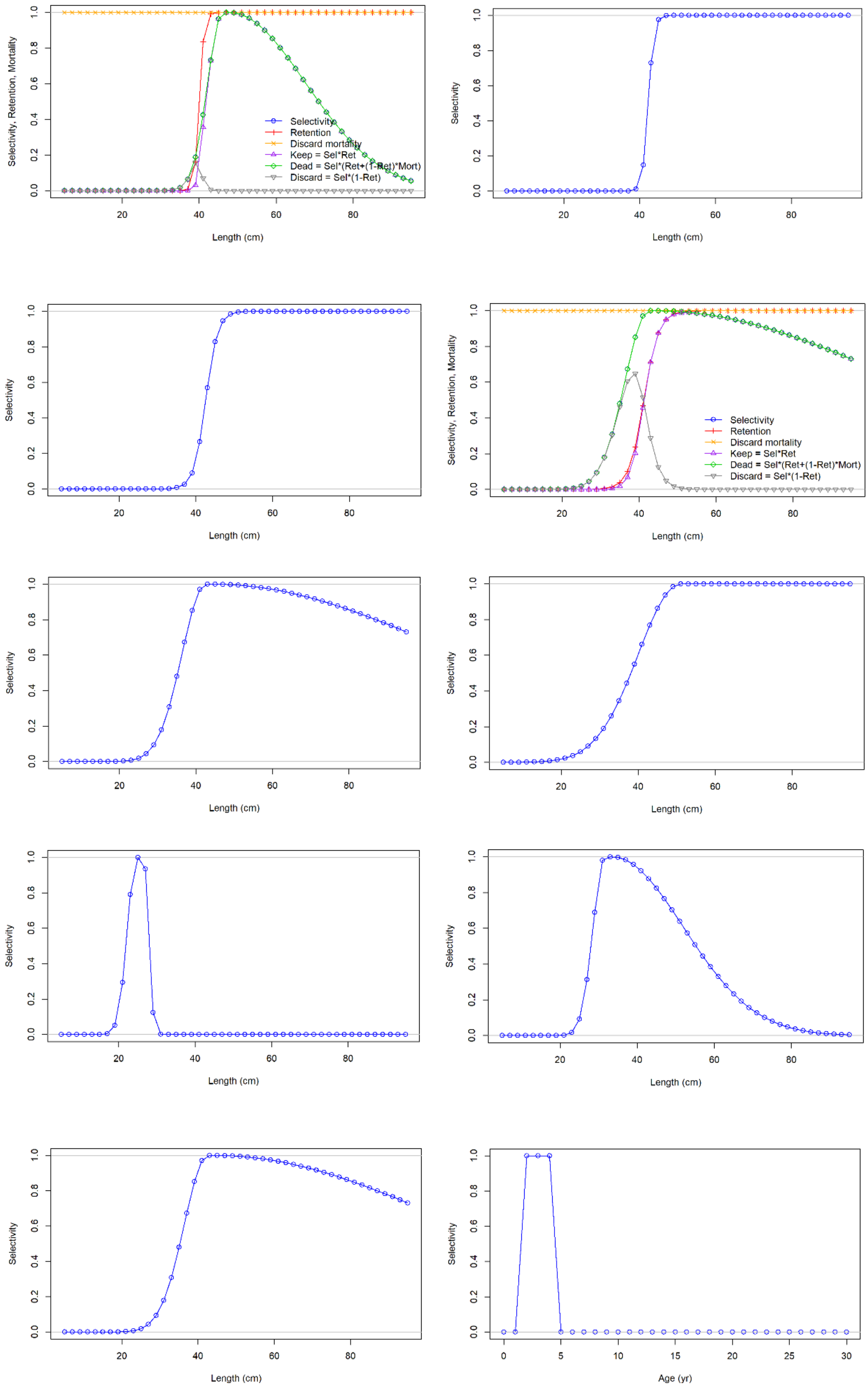


Figure 12. Bss.27.4bc7ad–h: Final sea bass update assessment: Fitted length-based and age-based selectivity curves.

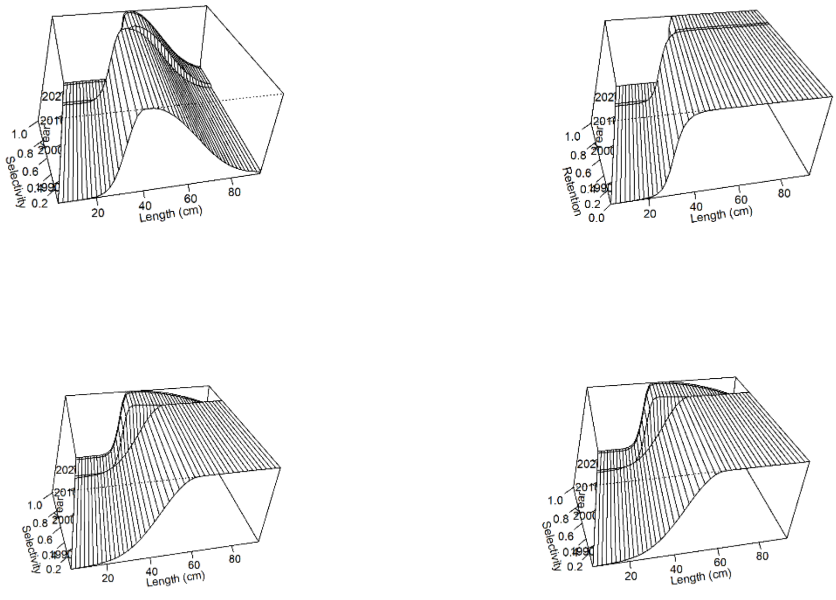


Figure 13. Bss.27.4bc7ad–h: Final sea bass update assessment: Fitted time-series of length-based and age-based selectivity and retention curves for fleets with blocks.

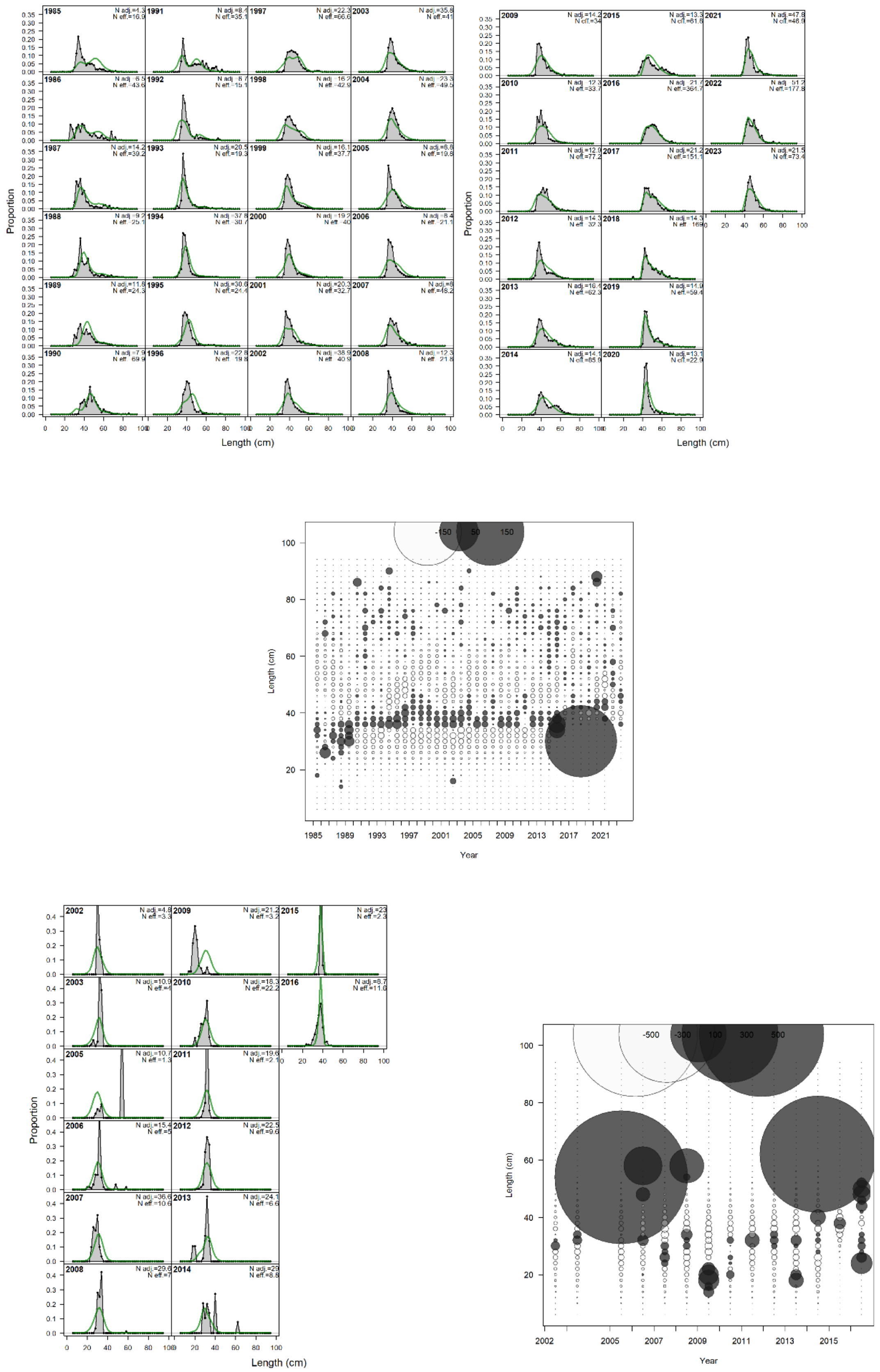
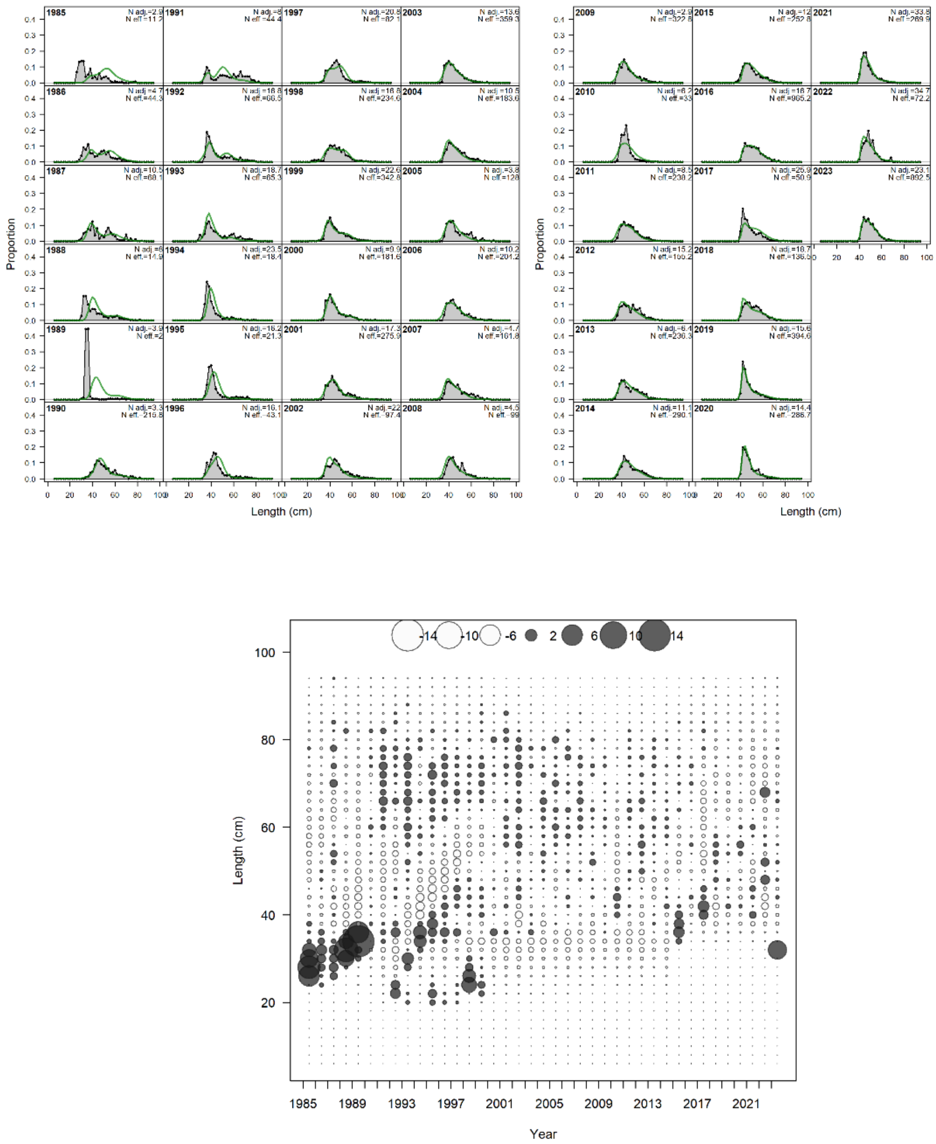


Figure 14. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of UK trawl and net fishery-length composition data for the retained (top 3) and discarded (bottom 2) catch components.



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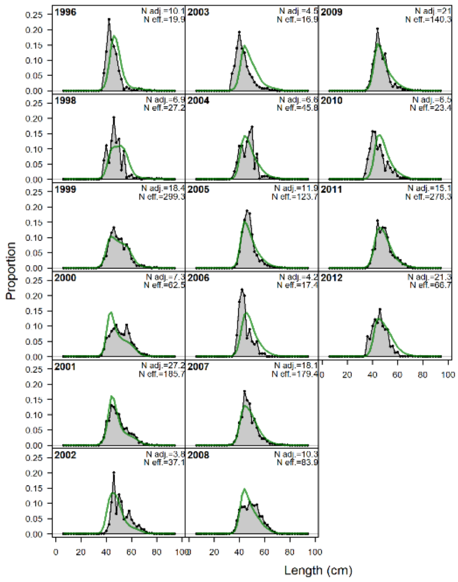


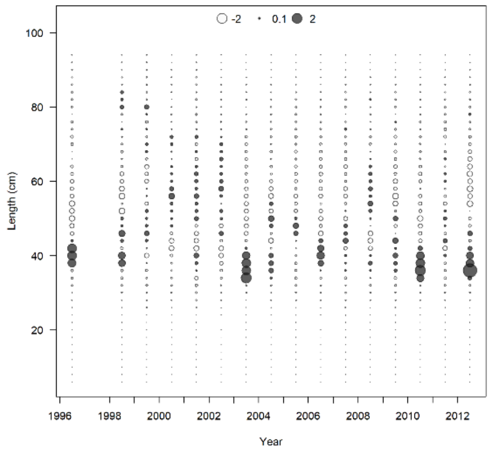


Figure 16. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of UK midwater trawl fishery length-composition data for the retained catch components.

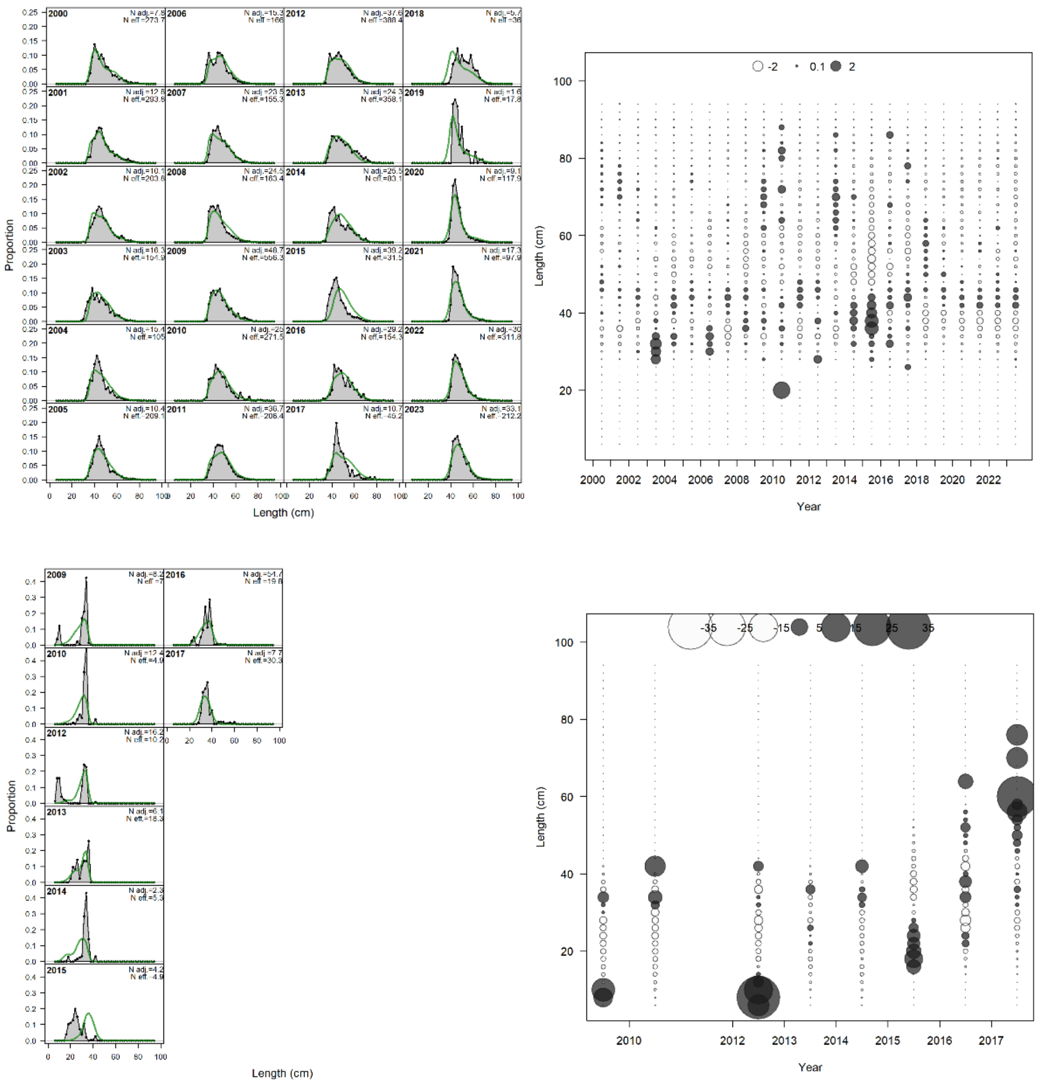


Figure 17. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of French fishery length-composition data for the retained (top row) and discarded (bottom row) catch components.

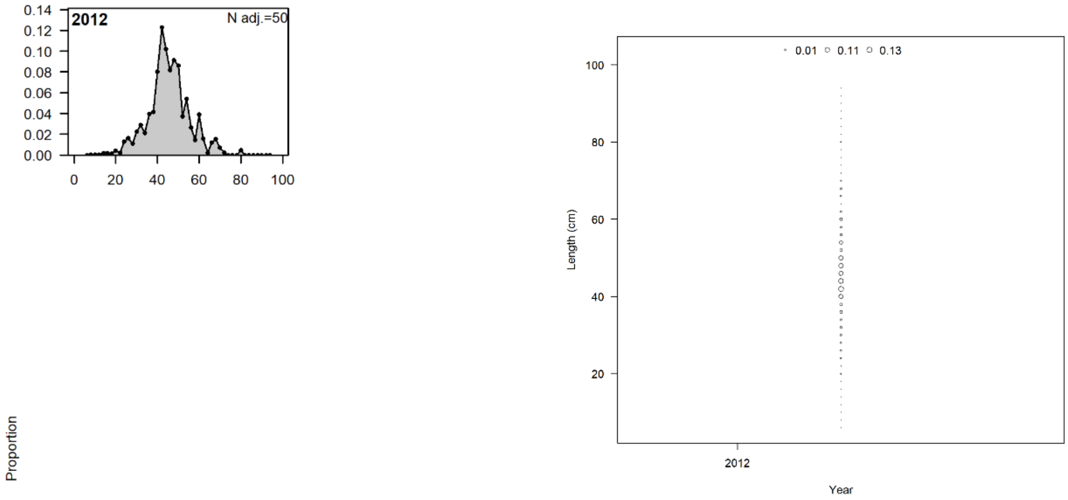
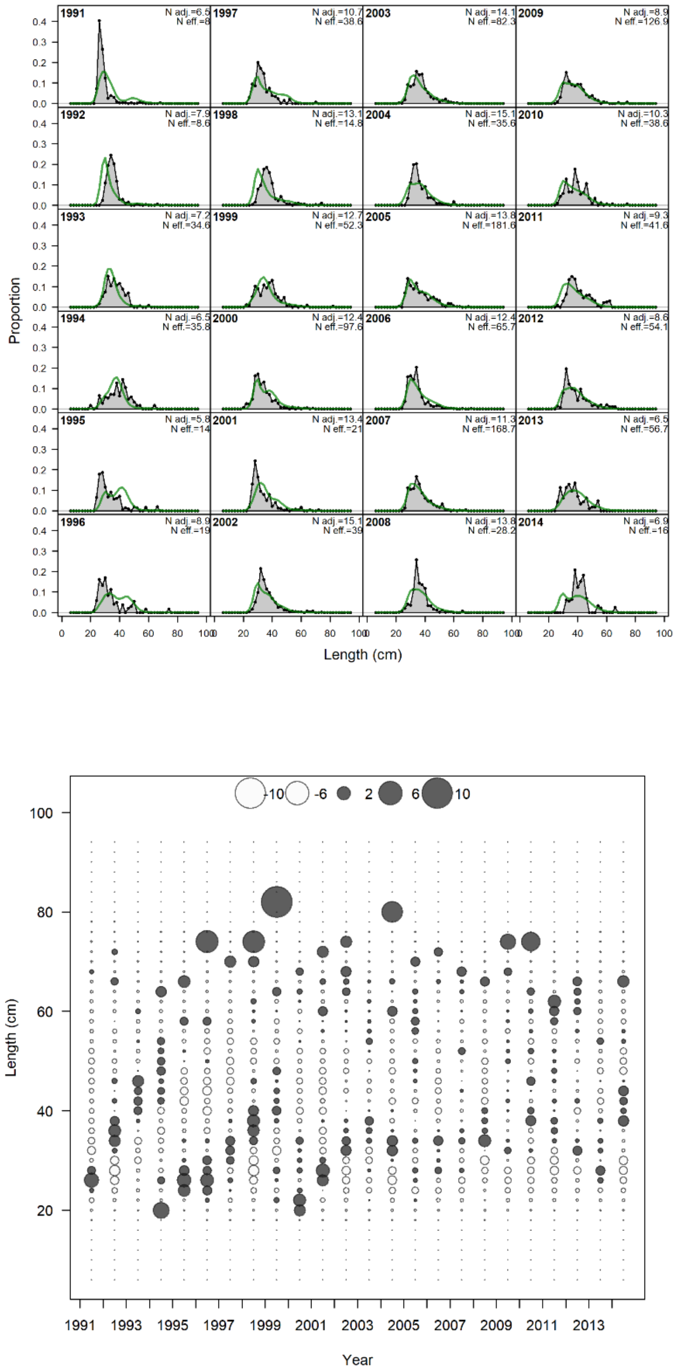


Figure 18. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of recreational length compositions data.



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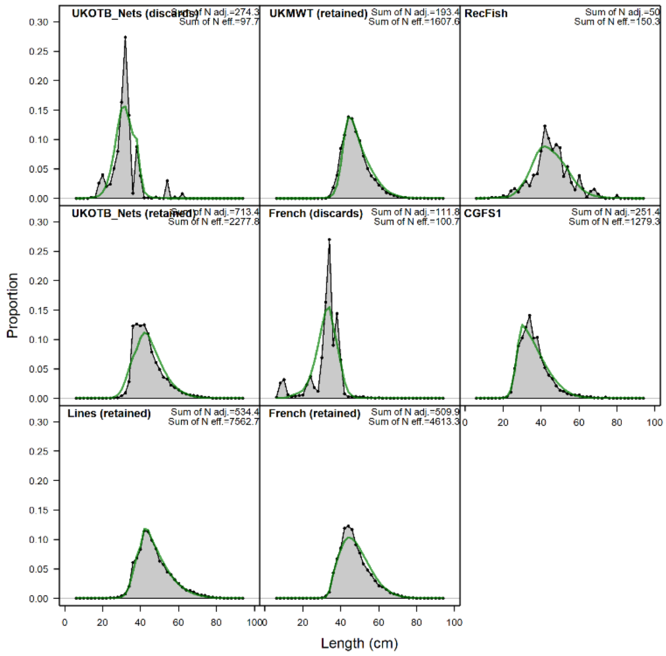


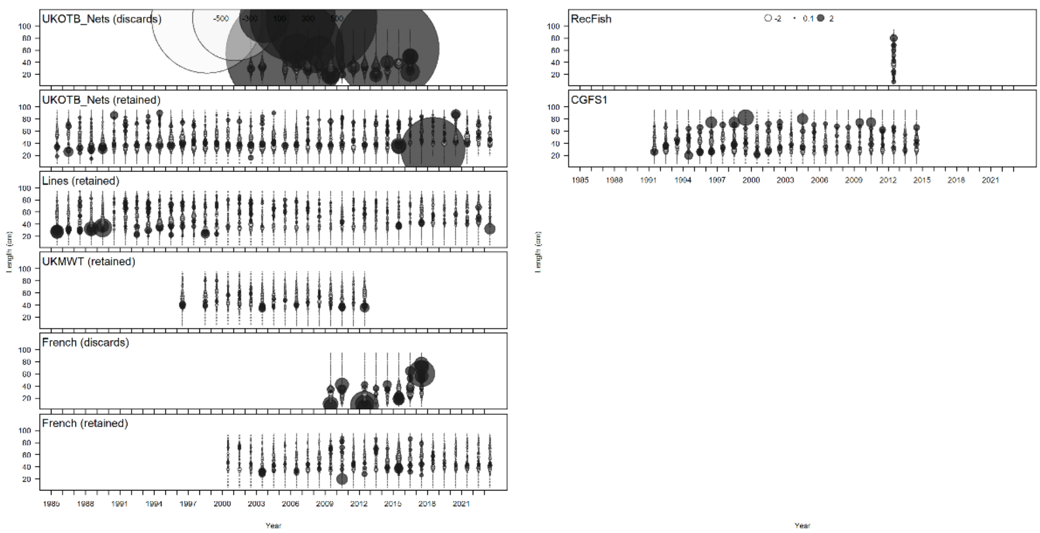
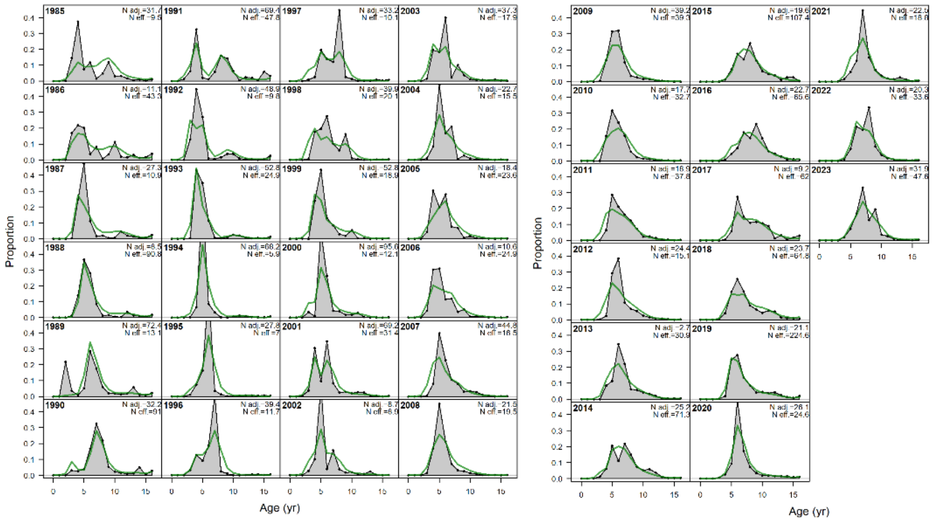


Figure 20. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of the commercial fisheries and Channel groundfish survey length compositions, aggregated across time for the retained and discarded catch components.



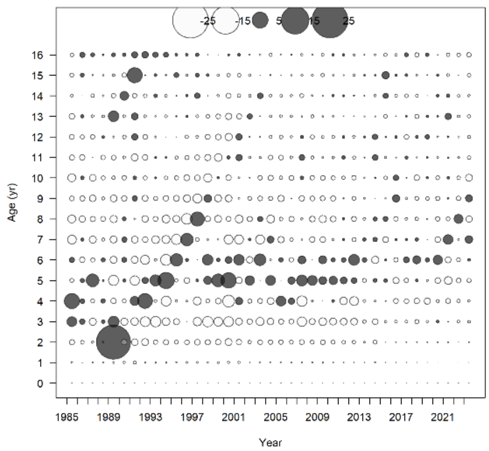
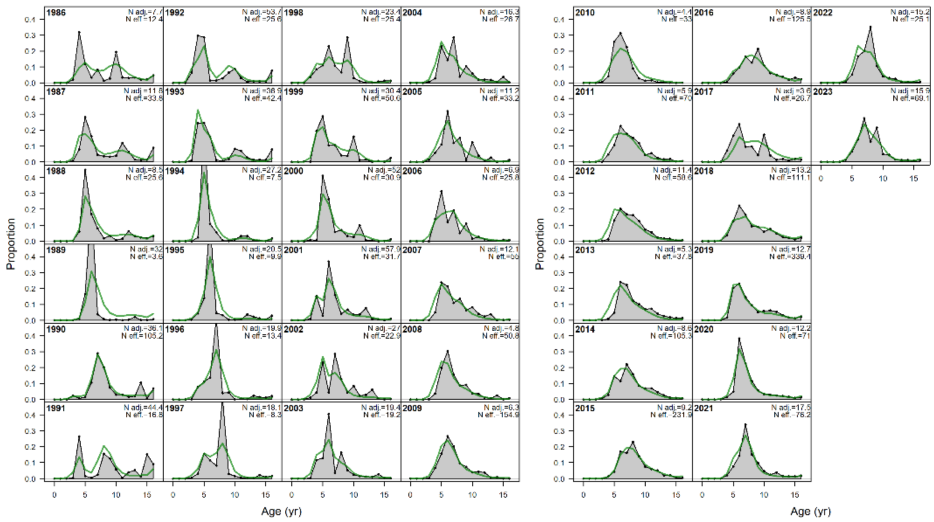


Figure 21. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the combined UK otter trawl and nets fleets.



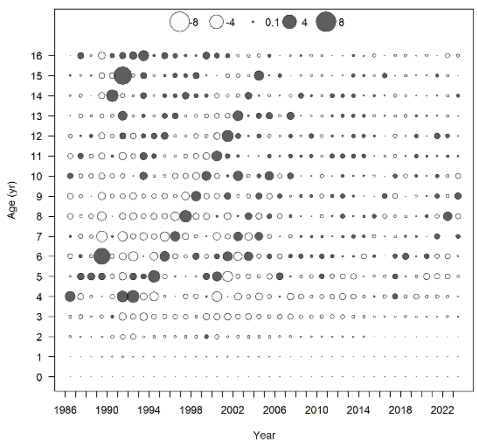


Figure 22. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the combined UK lines fleet.

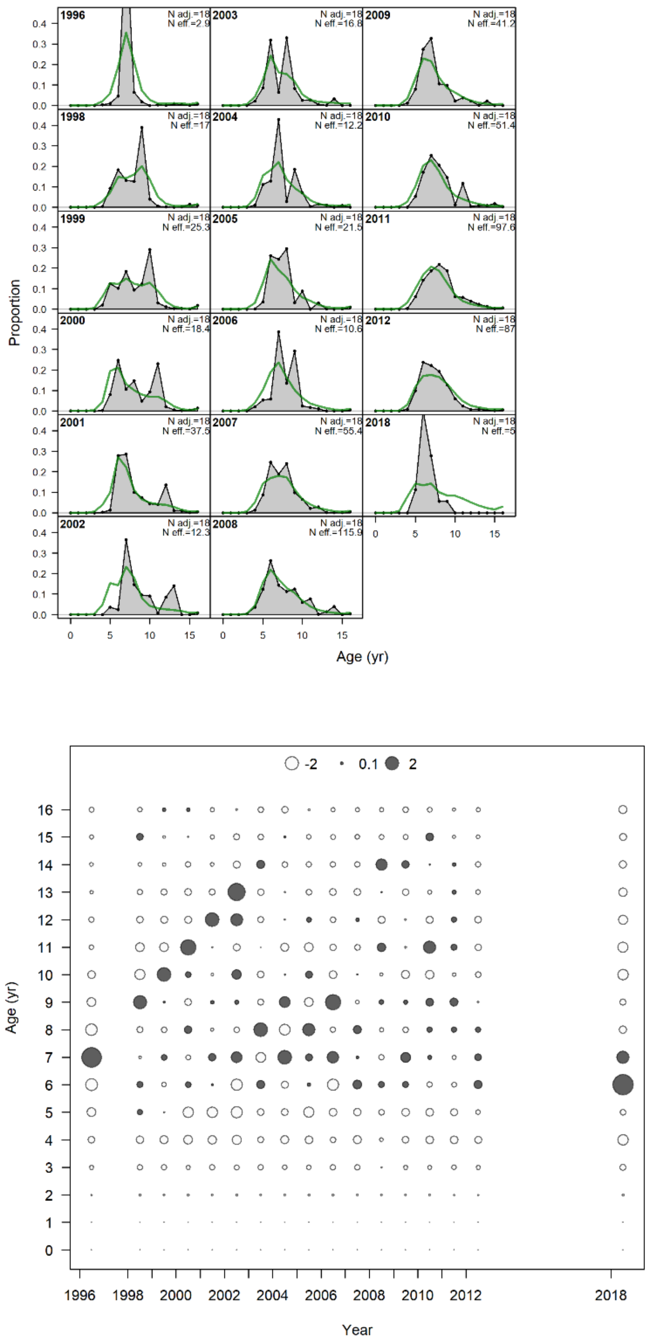
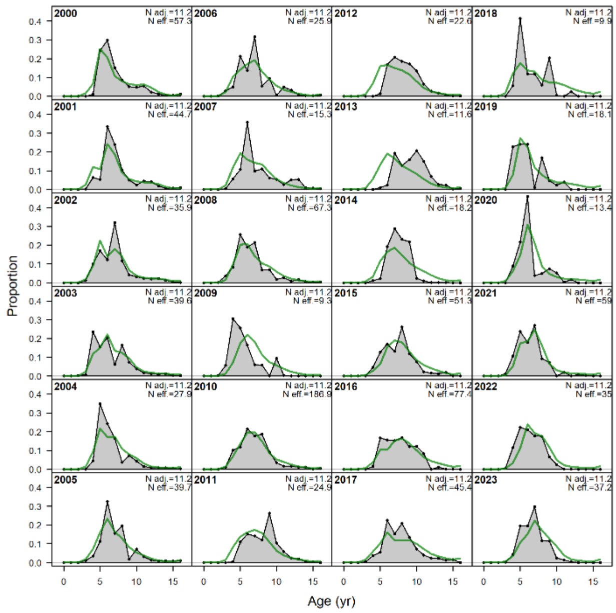


Figure 23. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the UK mid-water trawl fleet.



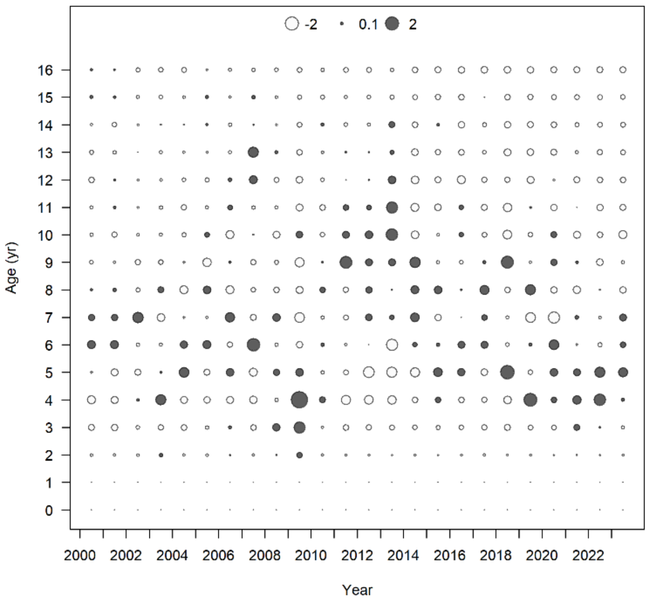


Figure 24. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the combined French fleets.

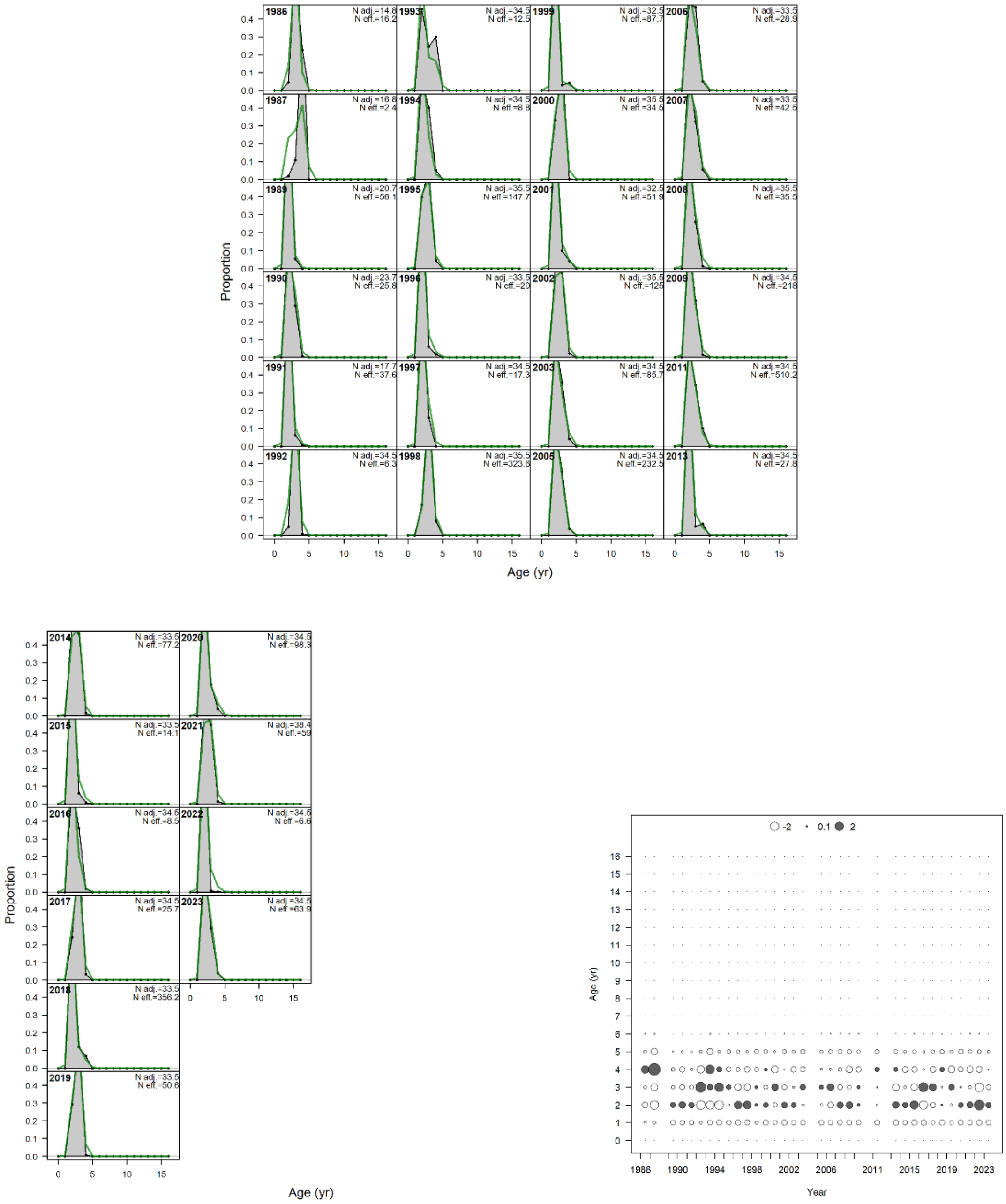


Figure 25. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the Solent Autumn bass survey.

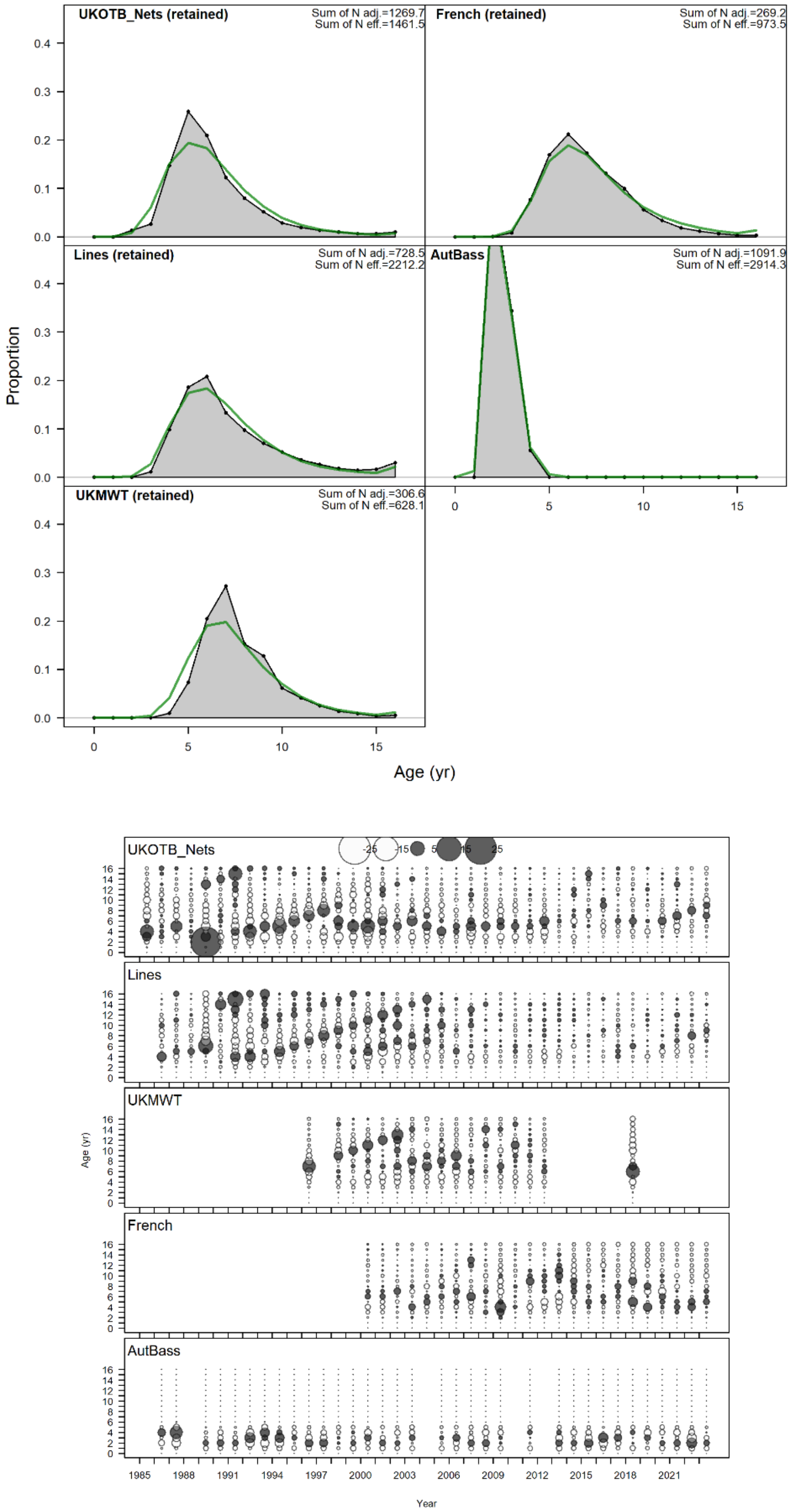


Figure 26. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of UK fleets age compositions, aggregated across time.

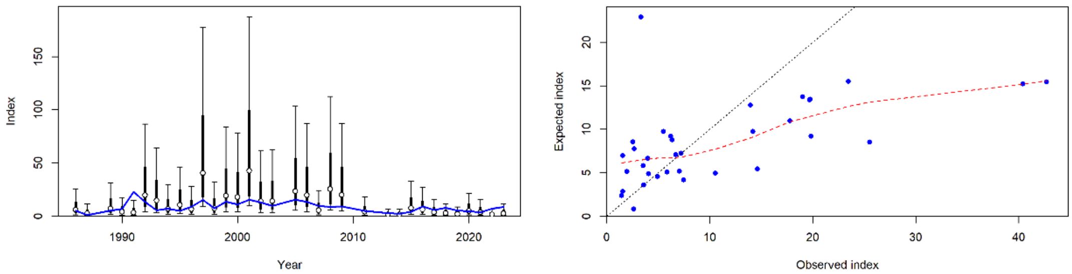


Figure 27. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit to Solent Autumn bass survey total abundance index, accounting for age and length-based selectivity.

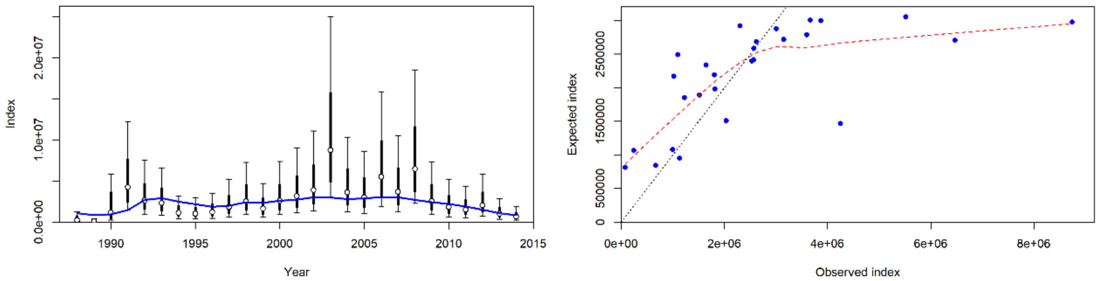


Figure 28. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit to Channel groundfish survey total abundance index, accounting for length-based selectivity.

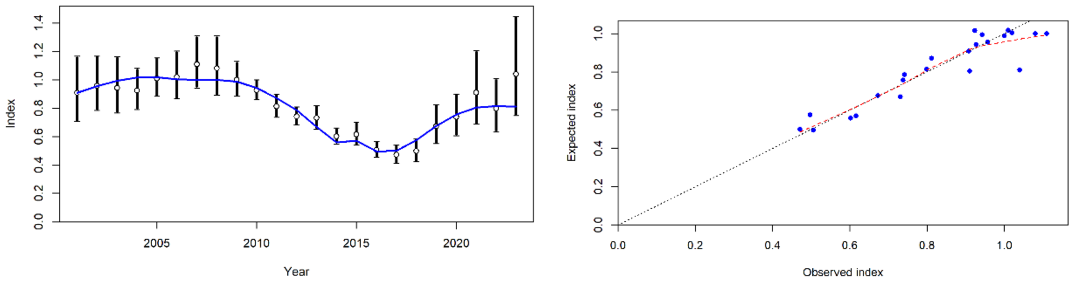


Figure 29. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit to the French landings per unit of effort commercial index, accounting for length-based selectivity.

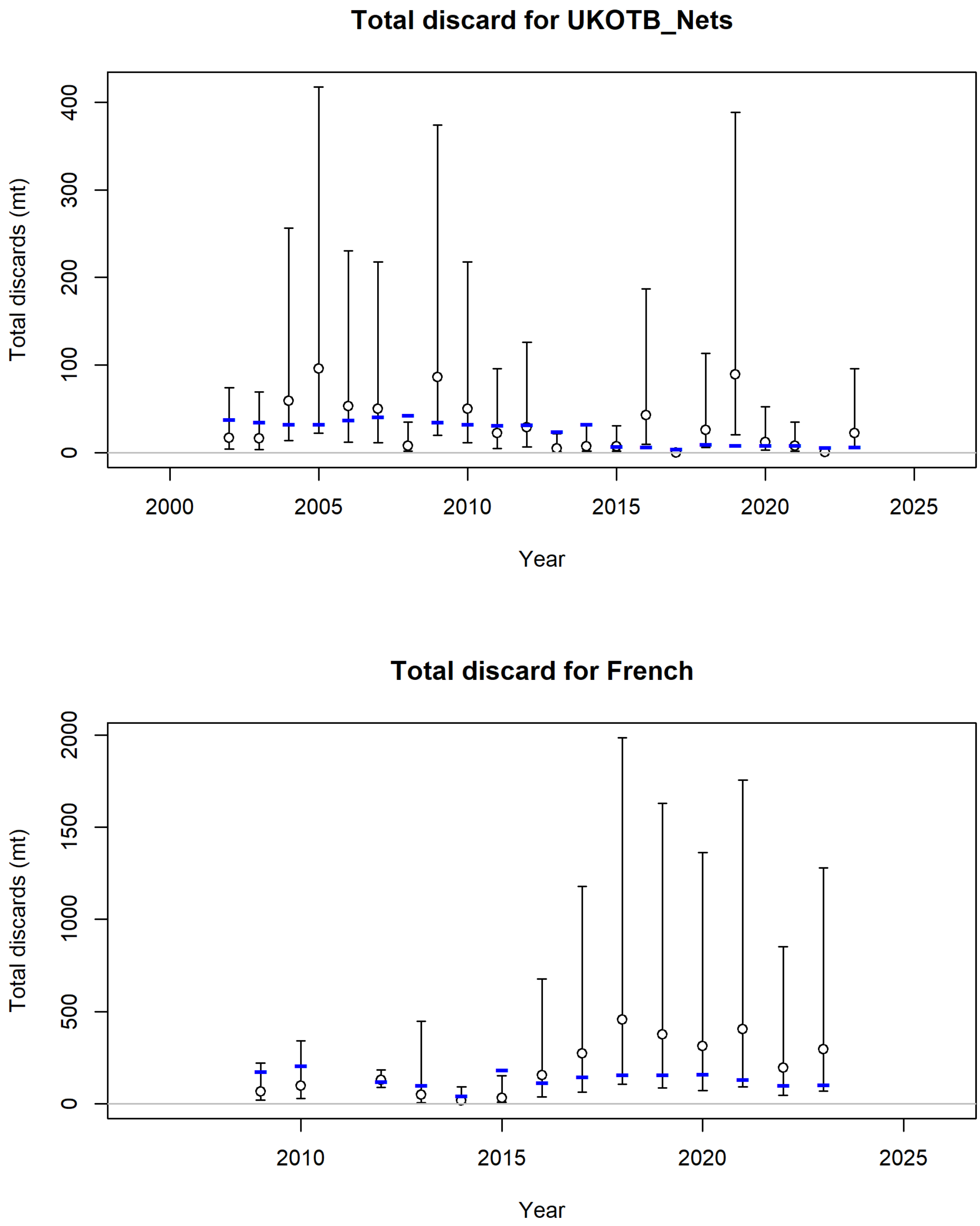


Figure 30. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit (blue dashes) to total discard (points with 95% confidence intervals as whiskers)) for the UK_OTB fleet (top) and French fleet (bottom).

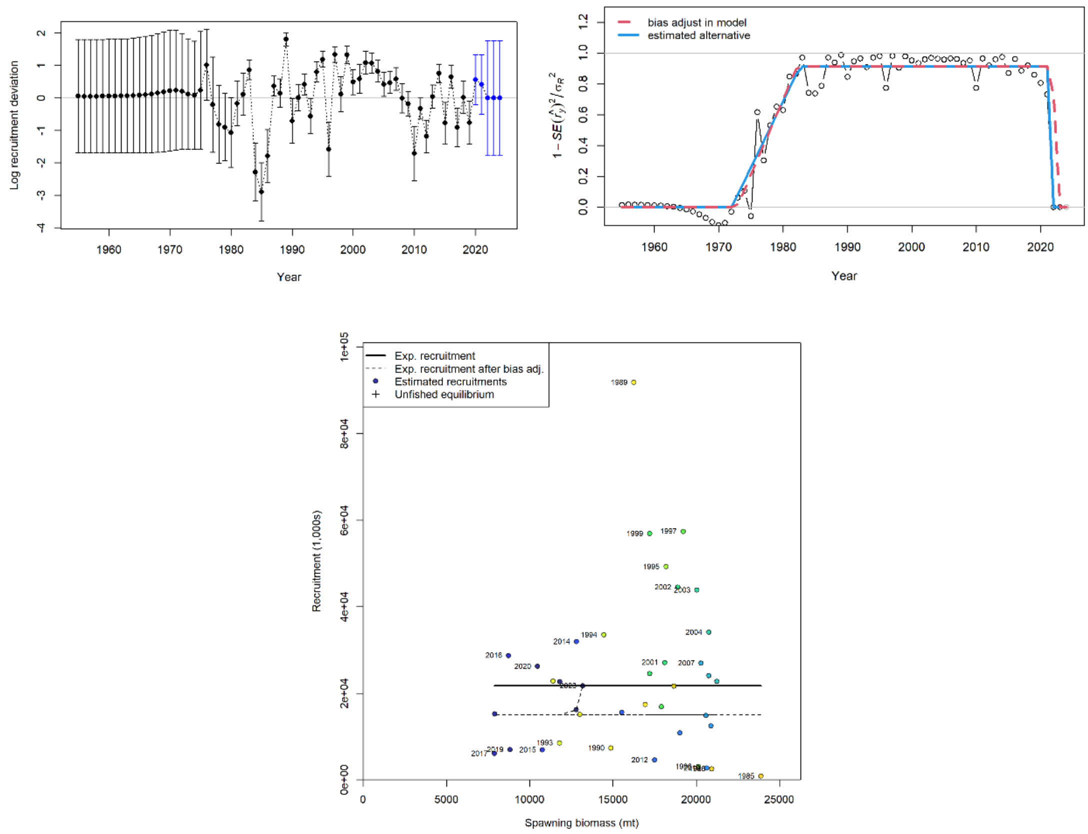


Figure 31. Bss.27.4bc7ad–h: Final sea bass update assessment: Top: time-series of log-recruit deviations (deviations for 1965–1984 precede the period of input catch data). Below: stock–recruit scatter (model is fitted assuming Beverton–Holt stock–recruit model and steepness = 0.999).

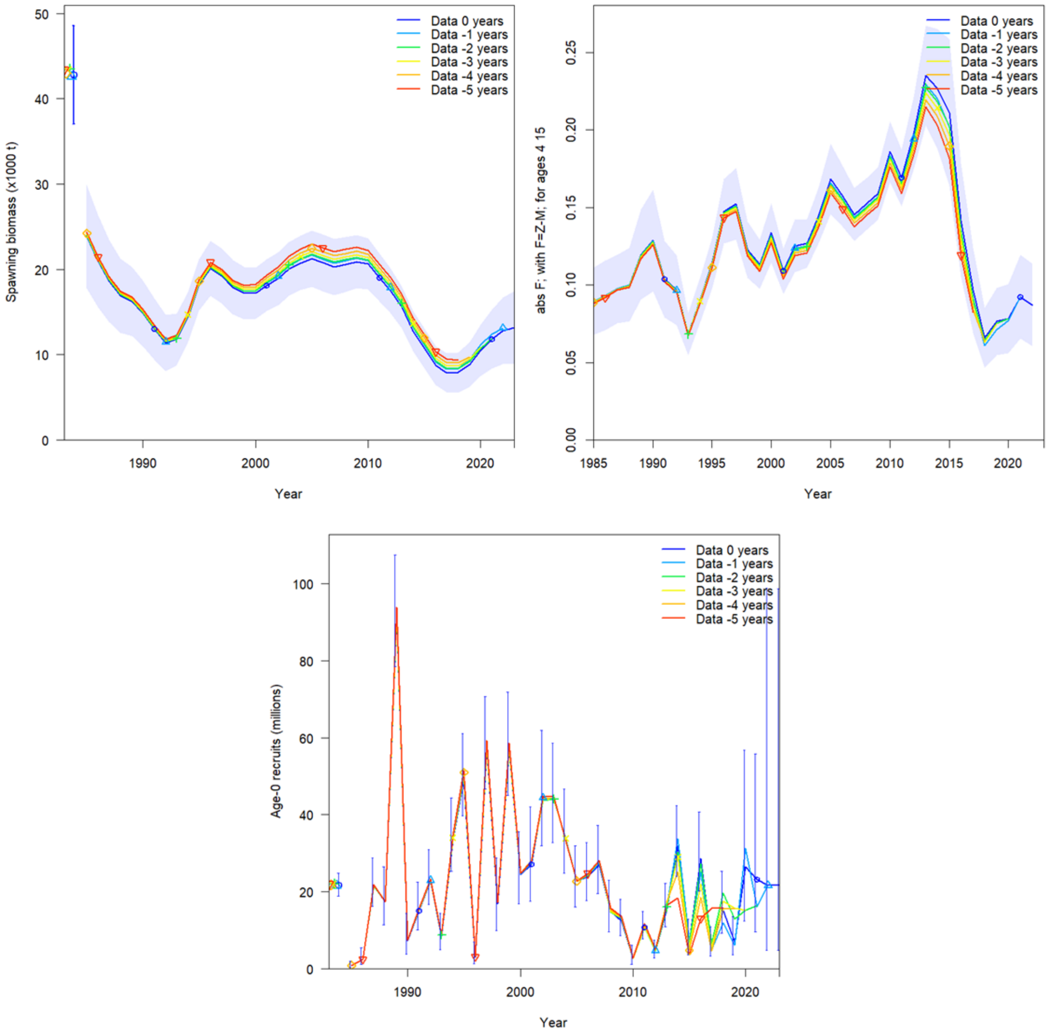


Figure 32. Bss.27.4bc7ad–h: Retrospective analysis of stock trends from final update assessment, based on Stock Synthesis run final year set to 2023 and peeling back five years (for the final run, terminal F is for 2023 and SSB and total biomass terminate in 2024).

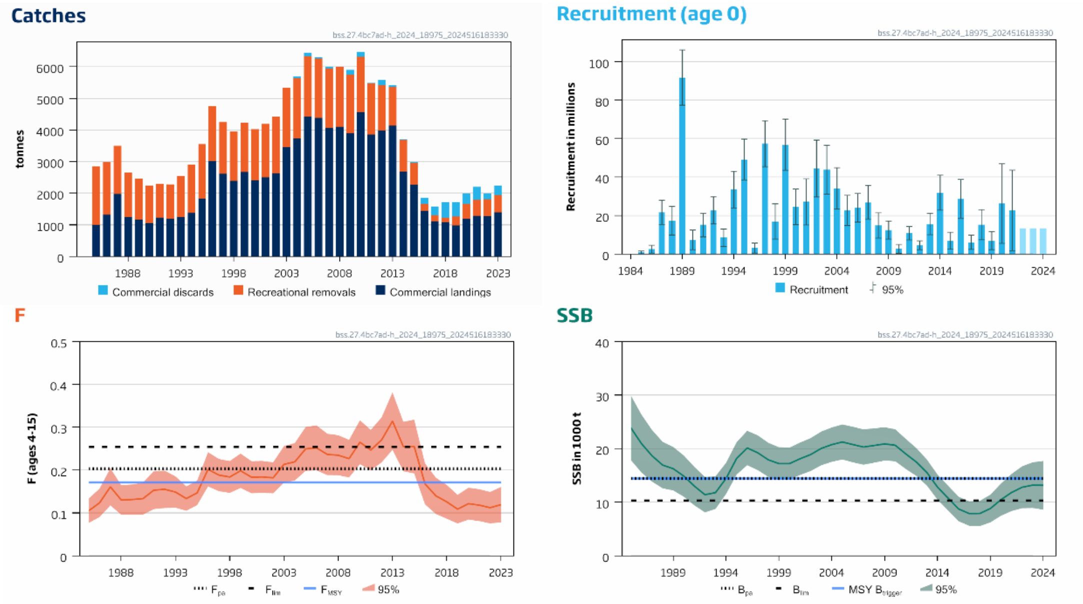


Figure 33. Bss.27.4bc7ad–h: Stock trends from final update assessment, based on Stock Synthesis run final year set at 2023 to give 2024 numbers and biomass and 2023 F. Recruitment in 2022–2024 is the geometric mean 2012–2021. Recruitment, F and SSB are shown with 95% confidence intervals.

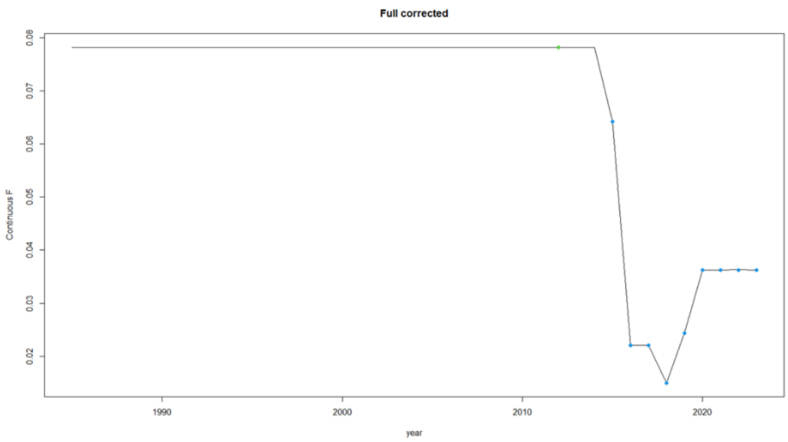


Figure 34. Bss.27.4bc7ad–h: Recreational F estimates based on multipliers for management measures.

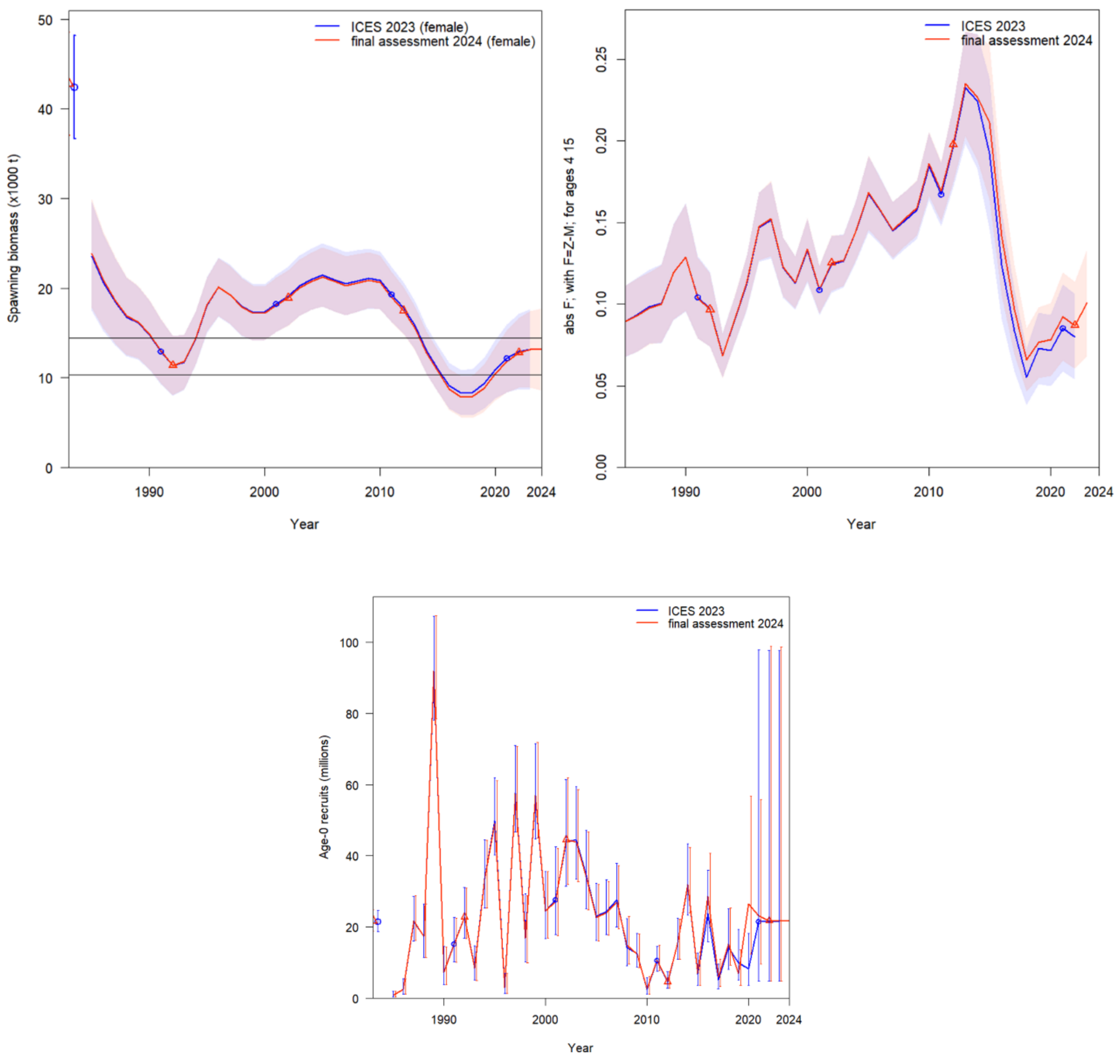


Figure 35. Bss.27.4bc7ad–h: Comparison between stock trends from this year's final update assessment and last year WGCSE assessment.

Contents

29 Sea bass (*Dicentrarchus labrax*) in divisions 6.a, 7.b, and 7.j (West of Scotland, West of Ireland, eastern part of southwest of Ireland)

Type of assessment

There is no assessment for this stock component.

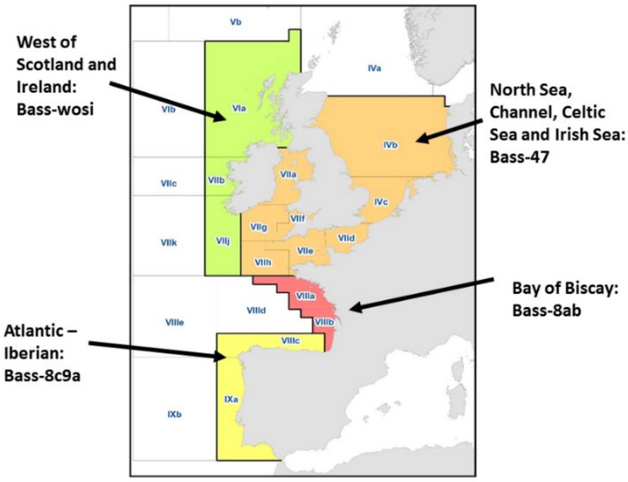
ICES advice applicable to 2024, 2025 & 2026

ICES advises that when the precautionary approach is applied, commercial landings should be no more than 2 tonnes in each of the years 2024, 2025, and 2026. ICES cannot quantify total catches.

29.1 General

Stock description and management units

Currently Atlantic stock identities are assumed to be as follows (ICES, 2012a,b):



At IBP-NEW (2012a), it was agreed that sea bass in the North Sea (4.b&c) and in the Irish Sea, Channel and Celtic Sea (7.a, d, e,f,g&h) would be treated as a functional stock unit as there is no clear basis from fishery data, tagging and genetics studies to subdivide the populations in the Irish Sea, Celtic Sea, Channel and North Sea into independent stock units. It was proposed based on previous ICES bass study group reports to allocate sea bass in 6.a, 7.b and 7.j to a separate stock, although it is recognised that sea bass in Irish coastal waters of 7.g and 7.a are likely to be from the same stock as in 7.j. As there are negligible commercial fishery catches of sea bass in Irish coastal waters due to the moratorium on commercial fishing for bass by Irish vessels, the splitting of the stock between 7.g and is not likely to have any impact on the bass assessment in 4.b,c and 7.a,d–h. Supporting information can be found in the IBP-NEW (ICES, 2012a) report.

In 2022, a workshop for WKSEABASS met to review evidence and propose plausible stock structure scenarios for the ICES sea bass benchmark in 2023. Conclusion mentioned that “although this meeting exclusively examined the northern and southern sea bass stock units, future studies must extend this effort to investigate evidence of boundaries and/or connectivity with other areas. ICES advice is currently provided for divisions 8.a-b (northern and central Bay of Biscay), as well as divisions 4.b–c, 7.a and 7.d–h (central and southern North Sea, Irish Sea, English Channel, Bristol Channel and Celtic Sea (de Pontual *et al.*, 2019). Additionally, two stocks are recognised but no advice is provided by ICES: divisions 8.c-9.a (Iberian), and divisions 6.a, 7.b, 7.j (West of Scotland and Ireland) (de Pontual *et al.*, 2019). Due to the high degree of connectivity revealed by this report, it is highly unlikely that the Iberian and West of Scotland/Ireland sea bass are isolated components. Therefore, additional genomics, tagging, pelagic connectivity and microchemistry will need to be undertaken to reveal how sea bass within these regions link to existing stock units. "

West of Scotland and Ireland ICES divisions 6.a, 7.b and 7.j stock is also not included in WKSEABASS.

Management applicable

Sea bass are not subject to EU TACs and quotas. A moratorium on commercial fishing for sea bass has been in place for Irish vessels fishing in areas 6 and 7 since 1990.

For recreational fisheries, European Sea Bass legislation was first introduced to Ireland in 1990 after the stock collapsed. It has been followed by various statutory instruments and byelaws which make it illegal to take more than a certain number of European Sea Bass from Irish territorial waters. Bass legislation changes annually. In 2022, in Northern Atlantic waters (ICES divisions 4b, 4c, 6a and 7a to 7k), only catch-and-release is allowed in January, February and December. From March until November, the bag limit of two fish per day and per angler was applied, with a minimum size which remains at 42 cm.

Fishery in 2023

Landings data used by the WG are given in Table 29.2.1. Due to the Irish sea bass moratorium, landings are close to 0 from 2012 onwards (source: official landings).

29.2 Data

Commercial landings data

Official Landings data are given in Table 29.2.1.

Commercial discards

No estimates of sea bass discards are available.

Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development and are described by the ICES Working Group on Recreational Fishery Surveys (ICES, 2012b). A survey was conducted in Ireland in 2010 and 2011 (O'Reilly and Roche, 2012). Domestic shore bass anglers are estimated at 11 600 individuals and these anglers harvested and estimates of 30 t and 44 t of bass in 2010 and 2011. The 2010 estimate was considered to be more robust. In addition, between 75% and 80% of bass caught were returned to the water. The survey doesn't disaggregate the angling catch estimates by ICES division.

More recently, The Irish Marine Recreational Angling (IMREC) done a pilot study (2019–2021) which continued in 2022 to develop and test methods to produce robust estimates of participation, effort and catches of nominated species by sea anglers' resident in Ireland

Also Recreational catch data exist for Ireland and the West of Scotland but data streams need to be reviewed and refined.

Biological data

Data on growth and maturity for this stock component were not reviewed by WGCSE.

Survey data

No survey data were available to WGCSE for this stock.

Other relevant data

None.

29.3 Assessment model, diagnostics and retrospectives

ICES advises that when the precautionary approach is applied, commercial landings should be no more than 2 tonnes in each of the years 2024, 2025, and 2026. ICES cannot quantify total catches. Without clear information on the stock status, the precautionary buffer was last applied in 2021 for the 2022 and 2023 advice and has therefore been considered this year.

The reduction in advice (-33%) compare to the previous years is due to the application of the precautionary buffer and rounding.

29.4 Historical stock development

No information is available for this stock area.

29.5 Management plans

There are no existing management plans for European sea bass.

29.6 Management considerations

Sea bass grow slowly, do not mature until 4–7 years of age, and have been recorded at up to 28 years of age. Juvenile bass up to three years of age, occupy nursery areas in estuaries whilst adults undertake seasonal migrations from inshore habitats to offshore spawning sites. After spawning, sea bass tend to return to the same coastal sites each year. The combination of slow growth, late maturity, spawning aggregation and strong site fidelity, increase the vulnerability of sea bass to overexploitation and localized depletion.

Management of sea bass fisheries needs to consider the distinctive characteristics and economic value of the different fisheries. Sea bass is of high social and economic value to sea angling in Ireland, which contributes substantially to local economies.

The current stock structure assumptions are pragmatic, and need further evaluation. Further studies are needed to determine if the sea bass in Irish coastal waters are indeed functionally separate, or if they also mix with the other stock during spawning time and contribute to commercial catches on the offshore spawning grounds.

29.7 Data needs

Time-series of relative abundance indices need to be developed throughout the range of the stock, for both the adult and pre-recruit components of the stock.

There is a need to develop a time-series of recreational fishery catch, effort, and catch composition.

Further studies using tagging, genetics, and other stock and individual markers are needed to more accurately define stock boundaries suitable for assessment and management purposes. A tagging programme has been undertaken by the Marine Institute of Ireland to investigate the distribution of the European sea bass in Irish waters. This project is being carried out in conjunction with the Beaufort Scientific Group and University College Cork. A total of 12 adult European sea bass *Dicentrarchus labrax* were tagged with pop-off satellite archival tags (PSAT) in Irish coastal waters and in offshore waters in the northeast Celtic Sea between 2015 and 2016. Archived data were successfully recovered from five of the 12 tags deployed, three from fish released in inshore Irish waters and two from fish released offshore in the eastern Celtic Sea. All three fish tagged in inshore waters were found to undertake migrations into the open ocean coinciding with the spawning period. These fish also exhibited fidelity to inshore sites post-migration, returning to the same general location (within approximately 73 km, which is roughly the predicted mean accuracy of the method) of their original release site. Although the number of tracks obtained here was limited, some degree of aggregation between inshore and offshore tagged fish in the eastern Celtic Sea was noted during the expected spawning period suggesting PSATs can provide new information on specific spawning locations of European sea bass (O'Neill *et al*., 2018).

Studies are needed to document the survival of recreationally caught and released sea bass. IBP-NEW (ICES, 2012a) noted that a range of studies on striped bass in the USA indicated hooking mortalities of around 20% on average, although a lower value of around 9% from one specific study is currently considered most appropriate for inclusion in the assessments.

29.8 References

ICES. 2012a. Report of the Inter-Benchmark Protocol on New Species (Turbot and Sea bass; IBPNew 2012). ICES CM 2012/ACOM:45.

ICES. 2012b. Report of the Working Group on Recreational Fisheries Surveys (WGRFS). ICES CM 2012/ACOM:23. 55 pp.

ICES. 2023. Benchmark on selected sea bass stocks, stock ID workshop (WKBSEA BASS-STOCKID). ICES Scientific Reports. 5:52. 30 pp. https://doi.org/10.17895/ices.pub.22794737

O'Neill, R., Ó Maoiléidigh, N., McGinnity, P., Bond, N., and Culloty, S. 2018. The novel use of pop-off satellite tags (PSATs) to investigate the migratory behaviour of European sea bass *Dicentrarchus labrax*. Journal of fish biology, 92(5), 1404–1421.

O'Reilly, S. and Roche, W. 2012. Pilot study to estimate recreational angling landings of bass in Ireland. Inland Fisheries Ireland report IFI/2012/1-4099. http://www.miextranet.ie/fss/sites/DCMAP/Annual%20Report/Annex_2_DCF_Bass_Landings_2010_11.pdf.

Ryan, D. K., Leonard, E., Casserly, C. M. and Roche. W. 2021. Marine Recreational Angling Catches in Ireland. Pilot Study Report (2019–2021). Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

29.9 Tables and Figures

Table 29.2.1. European sea bass in Divisions 6.a, 7.b and 7.j. Official landings: all countries (predominantly France).

Year	Official landings
2000	1
2001	4
2002	4
2003	2
2004	8
2005	4
2006	2
2007	5
2008	5
2009	4
2010	9
2011	7
2012	1
2013	0
2014	2
2015	0.8
2016	0.1
2017	0
2018	1
2019	0.04
2020	0.002
2021	0.039
2022*	0.095
2023*	1.57

***Preliminary. Source Official landings.**

Contents

30 Sole (*Solea solea*) in Division 7.a (Irish Sea)

30.1 Introduction

Type of assessment

This assessment of sole in division 7.a is an update assessment because the first assessment after the benchmark (WKBFLATFISH1, ICES 2024) in February 2024 was done before the current assessment in order to replace the 2023 assessment as requested by the European Commission.

ICES advice applicable to 2024

Advice published on 30 June 2023:

ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2024.

EU standing request on catch scenarios for zero-TAC stocks 2023 provides three catch scenarios with a spawning-stock biomass (SSB) target and two illustrative mixed fisheries catch scenarios are discussed. The SSB target scenarios are:

- *a catch option of 203 tonnes is estimated if the SSB is assumed to be equal to Blim in 2025;*
- *a catch option of 385 tonnes is estimated if the SSB is assumed to remain stable between 2024 and 2025, resulting in an SSB in 2025 (2340 tonnes) below B lim (2500 tonnes);*
- *a catch option of 118 tonnes is estimated if the SSB is assumed to increase by 10% between 2024 and 2025, resulting in an SSB in 2025 (2597 tonnes) just above B lim*

This advice was revised on 31 May 2024, based on the outcome of the benchmark (WKBFLATFISH1, ICES 2024):

ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 625 tonnes.

Comments made by the audit of last year's assessment

The 2023 assessment was revised based on the outcome of the benchmark (WKBFLATFISH1, ICES 2024) and an updated report section is available in Annex 3. Therefore comments from last year's audit maybe not longer be relevant.

30.2 General

Stock description and management units

Stock identity of sole stocks was investigated in the first and second quarter of 2022 using genetic markers (SNPs) (Maes et al. in prep). Sole was collected onboard commercial fishing vessels from 3 different rectangles in Division 27.7a (33E4 Cardigan Bay, 36E4 south of the Isle of Man and 36E6 Liverpool Bay). Results showed low, but significant genetic differentiation with sole from neighbouring areas 7f and 7g (based on both outlier and neutral SNP markers). Within 7a, there was no genetic differentiation between the Liverpool Bay and Isle of Man samples (36E6 and 36E4, respectively). Both areas did show low neutral genetic differentiation with sole collected in Cardigan Bay (33E4), although not significant. On an adaptive level, however, sole from the

Liverpool Bay and Isle of Man were significantly differentiated from the samples in Cardigan Bay.

The sole fisheries in the Irish Sea are managed by TAC (see tables below) and technical measures, with the assessment area corresponding to the stock area. Technical measures in force are minimum mesh sizes and minimum conservation reference size (MCRS, 24 cm (EU legislation); 25 cm for Belgian vessels from March 11th 2017 onwards; except vessels <221 kW and/or < 80 GT). In addition, beam trawlers, fishing with mesh sizes equal to or greater than 80 mm, are obliged to have 180 mm mesh sizes in the entire upper half of the anterior part of their net. More details can be found in Council Regulation (EC) N°254/2002 and the Stock Annex.

Since 2000, a spawning closure for cod has been in force. The first year of the regulation the closure covered the western and eastern Irish Sea. Since then, closure has been mainly in the western part whereas the sole fishery takes place mainly in the eastern part of the Irish Sea (Liverpool Bay and Cardigan Bay). No direct impact on the sole stock is expected from this closure.

Since the 1st of April 2015 all Belgian beam trawl vessels with mesh size of 80–119 mm fishing in ICES Division 7.a are obliged by national decree to use the 'Flemish Panel' to increase selectivity. This means the last tapered netting section of a beam trawl anterior is directly attached to the codend, the upper and lower netting sections are constructed of at least 120 mm mesh (as measured between the knots) and the stretched length is at least 3 m.

Sole in the Irish Sea is fully under the landing obligation since 2020 ((EU) 2019/2239). There is a de minimis exemption in place which allow for discarding of undersized sole in Division 7.a, for vessels using TBB gear with a mesh size of 80–119 mm equipped with the Flemish panel (max. 3% of annual catches).

Management applicable to 2023 and 2024

The TAC and the national quotas by country for 2023:

Species:	Common sole *Solea solea*	Zone:	7a (SOL/07A.)
Belgium	270	Analytical TAC	
France	3	Article 3 of Regulation (EC) No 847/96 shall not apply	
Ireland	94	Article 4 of Regulation (EC) No 847/96 shall not apply	
Netherlands	86		
Union	453		
United Kingdom	140		
TAC	605		

The TAC and the national quotas by country for 2024 (dd May 2024):

Species:	Common sole *Solea solea*		Zone:	7a (SOL/07A.)
Belgium	62	(1)	Analytical TAC	
France	1	(1)	Article 3(2) and (3) of Regulation (EC) No 847/96 shall not apply	
Ireland	69	(1)	Article 4 of Regulation (EC) No 847/96 shall not apply	
Netherlands	20	(1)		
Union	152	(1)		
United Kingdom	47	(1)		
TAC	203	(1)		
(1)	Exclusively for by catches. No directed fisheries for sole are permitted under this quota.			

30.3 Fisheries

An overview of the landings data and discard data provided and used by the Working Group (WG) is shown in Table 31.1 and Figure 31.1. The landings reached a level of 2808 t in the mid-1980s due to good recruitments in 1982–1984, but then subsequently dropped to a lowest of 818 t in 2000. After a small increase to 1090 t in the beginning of the 2000s, the landings have fallen to under 350 t in 2008–2013. From 2014 to 2018 the landings continued to decrease as they dropped to under 100 t. In 2017, the record low value of 34 t was recorded. From 2016 to 2018, there has been no targeted fisheries for sole in ICES Division 7.a. Afterwards the landings increased again to around 400 t in 2019 and 2020, and to around 500 t in 2021 and 2022. The landings in 2023 fel back to 386 tonnes. As a result of the WKBFLATFISH1 benchmark (ICES, 2024), the Belgian beam trawl landing numbers were corrected for area misreporting in the time periods 2006-2013 and 2019-2023 (Table 31.1). Small differences between estimated and reported landings (0.7-18.3 %) were noted for 2006-2013 and 2019-2020, whereas in the most recent years (2021-2023) substantial over-reporting (reported landings around 52 % higher than estimated landings) was found. The period 2014-2018 was excluded from the misreporting analysis as there is not enough information to make a quantitative estimation of the landings.

In 2023, the WG estimated landings are 386 t, of which Belgium landed 71% (276 t), Ireland 15% (56 t), 11% (41 t) by the UK (England and Wales) and the remainder by Northern Ireland, Scotland, Isle of Man and France. Discards were estimated to be at 57 t. This catch figure (443 t) corresponds to an international uptake of 73% of the agreed TAC in 2023 (605 t).

In 2023, 85% of the landings were taken by beam trawls, 14% by otter trawls and <1% by other gears.

30.4 Data

The countries contributing most to the landings of sole in division 27.7.a are Belgium (44%-82%, 69% average 2003-2015; 2019-2023)), Ireland (10%-44%, 19% average 2003-2015; 2019-2023)), and UK (England) (2%-20%, 9% average 2003-2015; 2019-2023)). The remaining countries (UK (Scotland), UK (Northern Ireland), UK (Isle of Man), France and the Netherlands are responsible for less than 5% of the landings.

ICES catch estimates (InterCatch)

The estimation of the catch data was revised during the WKBFLATFISH1 benchmark (ICES, 2024). Data were processed in InterCatch from 2003 onwards with the exception of the years 2016-2018 because of the low sampling intensity related to the low bycatch TAC. Those years were prepared using the methodology from the previous benchmark (ICES, 2011).

Discards are included in the assessment from 2024 onwards. If discards are unavailable for a particular year-quarter-country-métier combination, they are assumed to be unknown (non-zero) and therefore raised (InterCatch). The weighting factor for raising the discards was '*Landings CATON*' (landings catch).

Discard raising was performed on a **gear level** regardless of season or country, except for the years 2016-2018, where all available strata were considered. The following groups were distinguished based on gear:

- TBB
- OTB including OTB, OTT, SSC, SDN
- GTR including GTR and GNS

The remaining gears were combined in a REST group (including MIS, FPO, DRB, LHM, LLS).

Raising within a gear group was performed when the proportion of landings for which discard weights are available was **equal or larger than 50%** compared to the total landings of that group. When the threshold was not reached for a gear group, it was pooled with the REST group to raise discards based on all available information, except for discard rates higher than 50% as sometimes found in the OTB group.

The percentage of discards that were raised is rather low (31%, average 2003-2023, 28% for 2023).

To **allocate age** compositions, landings and discards were handled separately; samples from landings were used only for landings and *vice versa*. When age distributions (both landings and discards) had to be borrowed from other strata, allocations were performed on a **gear level**. The same gear groups (TBB, OTB, GTR and REST) as used for discard raising were applied. When the **threshold of 50%** was reached for the proportion of landings or discards covered by age, allocation of age occurred with all available information within that gear group. When the threshold was not reached, unsampled data were pooled in the REST group and ages were allocated using all sampled data. The weighting factor was '*Mean Weight weighted by numbers at age*'.

The age coverage of the imported landings and discards is rather high (86% for the landings and 91% for the discards, average 2003-2022 (excluding 2016-2018); 89% for 2023 landings and 95% for 2023 discards).

From 2016 to 2018, there has been no targeted fisheries for sole in ICES division 7.a, and a bycatch TAC of 40 t was in force. Because of the low sampling intensity, those years were excluded from the InterCatch age allocation procedure and the discard numbers-at-age and mean weights-at-age for the those years were estimated using the average (2013-2015, 2019-2021) ratio of discards to landings by age. The average (2013-2015, 2019-2021) number and mean weight at age 1 was considered for the age 1 information in the years 2016-2018, for both landings and discards.

Catch numbers-at-age are given in Table 30.2 and in Figures 30.2ab; Weights-at-age in the catch are given in Table 30.3 and Figure 30.3. The standardised catch proportion-at-age is presented in Figure 30.4.

Annual length compositions for 2023 are given by fleet in Table 30.4 and of retained and discarded catches of sole by the Belgium beam trawl fleet in Figure 30.5.

Reconstruction of discards

Raised discard data from InterCatch were available from 2003 onwards. To estimate discards mean weights- and numbers-at-age prior to 2003, a constant ratio of discards to landings by age was applied using data from 2003-2007 (Figure 30.6).

Discard rate

The discard rate, calculated as the ratio between ICES discard estimates (tonnes) and ICES catch estimates (tonnes), fluctuates around 6% over the years 2003–2017. However, in the last six years this rate increased up to approximately 14.6% (average 2018-2023). The 2023 discard rate is estimated to be 12.8%.

Biological

Stock weights-at-age (Table 30.5, Figure 30.7) were revised during the WKBFLATFISH1 benchmark (ICES, 2024). The stock weight for age 1 obtained from the UK(E&W) September beam-trawl survey (UK(E&W)-BTS-Q3) biological data was combined with the catch weights for the remaining ages. Prior to 1988, no age 1 information is available from the UK(E&W)-BTS-Q3. Therefore, the mean (1988-2023) age 1 UK(E&W)-BTS-Q3 weight was obtained for the age 1 information in the years 1970-1987. The combined set of weights at age was then back calculated to the first of January using the Rivard method. (http://nft.nefsc.noaa.gov./).

A time varying maturity ogive (Figure 30.8) was estimated during the WKBFLATFISH1 benchmark (ICES, 2024) using the UK-BTS-Q3 female biological data. Prior to 1988 the average maturity-at-age proportions (1988-1992) were set. More information on how this was achieved is provided in the WKBFLATFISH1 report and the associated working document

During the WKBFLATFISH1 benchmark (ICES, 2024), natural mortality estimates were derived from UK-BTS-Q3 non-linear catch curves in 2016-2018. In this period from 2016 until 2018, the targeted fishery for sole in the Irish Sea was closed and only a small by-catch quotum was in force. During those years It can be assumed that the value of F (fishing mortality) was close to zero, and that M approximates Z (total mortality). The natural mortality estimates derived from the catch curve analysis were scaled to 0.31 of the mean (see table below) as this resulted in the lowest AIC value in the SAM model.

Age	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10(+)**
M	0.5971610	0.3767715	0.3105819	0.2814876	0.2669404	0.2589395	0.2545753	0.2523932	0.2509385	0.2502112

Tuning series

The Irish Sea sole stock assessment uses one scientific survey index: UK(E&W)-BTS-Q3 (1988–2023). The survey was unable to cover the 7.a Division in 2020 due to the Covid-19 disruption. Therefore, the 2020 information is missing. The UK(E&W)-BTS-Q3 indices were revised during WKBFLATFISH1 benchmark (ICES, 2024), using the biological data of all available survey stations and comprises the fitting of a continuation logit ratio model to predict the age-length relationship and the fitting of a generalized additive model (GAM) to standardize the catch per unit effort data for each age group. The series was extended with information of age 1 but not with the older ages, as they have a higher standard deviation and represent only a small proportion of the total numbers. The UK(E&W)-BTS-Q3 appears to track the stronger year classes reasonably well. The internal consistency plot indicates also a reasonable fit for most of the ages (Figures 31.9-10).

During the WKBFLATFISH1 benchmark (ICES, 2024) a Belgian commercial biomass index (Figure 31.11a) was introduced in the assessment. It was obtained using the landings-per-unit-effort by day, ICES statistical rectangle, trip and vessel from the Belgian beam trawl fleet fishing exclusively in the Irish Sea as input for the GAM model. The modelled biomass tuning series has data from 2004 up to and including 2023, but misses information in 2017 and 2018. No information on the ICES statistical rectangle was available before 2006 and the targeted sole fishery in the Irish Sea was not allowed from 2016 to 2018. Consequently, in 2017 and 2018, no observations from the exclusive 7.a division trips were available to provide an index. A weighting factor based on 1/CV was added for this fleet in the assessment model (Figure 31.11b).

All available tuning data are given in Table 31.6, with the data used in the assessment highlighted in bold.

30.5 Surveys

The LPUE from the UK(E&W)-BTS-Q3 (Table 31.7b and Figure 31.12) has fluctuated since the beginning of the time-series (1988) between 90 and 200 kg/100 Km fished. Since 2000, it has dropped gradually to the lowest value in 2012 (26.47 kg/100 Km fished). Thereafter, it gradually increased to 118.66 kg/100 Km fished in 2019. For 2020 no information is available due to Covid-

19 and for the following three years a value between 63.6 kg/100 Km fished and 71.4 kg/100 Km fished was noted.

Commercial LPUE

Trends in LPUE and effort are given in Table 30.7 and Figures 30.13 and 30.14.

Commercial LPUE and effort data were available for Belgian beam trawlers, UK (E&W) beam and otter trawlers and Irish otter and beam trawlers. It should be noted that the most recent LPUE values of the UK (E&W) beam trawlers (2013–2023) and the UK (E&W) otter trawlers (2014–2023) are based on days fished instead of hours fished. In 2013, the UK administration switched to the EU electronic logbook system. Therefore, a lot of the reported effort is missing and the 2013 value cannot be used as an absolute number. Details of the 2013 UK beam trawl were unavailable due to reduced numbers of trips reporting this gear specific effort information via the newly introduced e-logbook system. The otter trawl fleet effort reporting was unaffected by this as these vessels were not reporting their landings via this method in 2013. However, from 2014 onwards, both the UK beam trawl and otter trawl effort values (hours fished) are unavailable because of the reporting issues. Because of the misreporting practises noted for this stock, an LPUE estimation of the Belgian beam trawlers was added based on trips with effort exclusively in ICES division 7.a ('pure trips') and not in multiple ICES divisions, among which the sole 7a stock area. A quantitative estimation of those LPUE values was only possible for the years 2006-2013 and 2019-2023.

Effort from both Belgian and UK commercial beam trawl fleets increased from the early seventies until the beginning of the nineties. Since then UK beam trawl effort has shown a continuing declining trend. Inspection of an alternate effort indicator (days fished) suggests that the declining trend continues in the period 2013–2018, followed by a slight increase in 2019. In 2020 and 2021, effort continues to increase to a similar level as observed in 2007. In 2022, the effort dropped again to half the value of 2021, followed by a slight increase in 2023. In contrast, the Belgian beam trawl effort has shown a more fluctuating pattern. After the decline in the early nineties, it reached its highest level in 2002 and decreased again afterwards. For the period 2008–2012, it remained stable at a very low level but in 2013 it continued to decrease and in 2016, it dropped to the lowest level in the time-series. In 2019, there's a substantial increase and in the period 2019–2023, effort remains at the level recorded in 2008-2012. The substantial decrease of the Belgian and UK commercial beam trawl effort in the period 2013–2018, is in line with the substantial reductions of the TAC. From 2019 onwards, a sole-directed fisheries is again allowed and a higher TAC is set. This is clearly reflected in the higher activity of the Belgian beam trawlers from 2019 onwards.

The effort of the Irish beam trawlers shows a slow decline since 2004 and reached the lowest level in the time-series in 2013. Since 2014, the Irish beam trawl effort has increased, followed by a decrease since 2020. In 2008, all beam trawl fleets showed a substantial reduction in effort compared to 2007.

The effort from the UK otter trawlers remained stable until the beginning of the nineties. Since then the UK otter trawl effort has continuously declined and is at the lowest level in 2013. As, in 2015 and 2016 all otter trawl vessels active in the Irish Sea were under 12 m, no effort (days fished) was recorded. Since 2017, the otter trawl effort (days fished) fluctuates at a low level. The Irish otter trawlers have shown a striking reduction in effort since 2000, followed by a slight increase in the period 2010–2012. In 2017, the Irish otter trawl effort fell back to a lower observed level in the time-series. It remains at this lower level, except for the slightly higher value observed in 2019. In 2023, the lowest observed level in the time-series is recorded.

LPUE for both UK and Belgian beam trawlers was at a high level in the late seventies and early eighties but since early 2000s, LPUE for these fleets has fluctuated at a lower level. In the period

2007–2009 there has been a small increase in the UK beam trawl LPUE. However, in 2012 the LPUE has dropped to a remarkable low level in the time-series (4.3 kg/hour fished). An update for 2013–2017 was not available. However, the alternate LPUE indicator (kg/days fished) suggests that the UK beam trawl LPUE increased in 2015. For 2016–2018 no catches of sole and/or no effort were recorded therefore the LPUE is zero. After a slight increase in 2019, the LPUE further increased in 2020–2022 to a similar level as observed in 2009. In 2023, a slight decrease was noted. The Belgian beam trawler LPUE estimation based on trips that fished exclusively in ICES division 7.a, showed an increase to 18.23 kg/hr in 2011 but then fell again. In the period 2014-2018, there is no 'pure trips' LPUE calculation available but the LPUE estimation based on all the trips, indicates that the lowest levels in the time-series are reached. In 2019, there's a substantial increase to 31.33 kg/hour fished and this is maintained over the following years (average 2019-2022 = 31 kg/hr). In 2023, as slight decease to 25 kg/hr is estimated. The Irish beam trawl LPUE shows a gradually diminishing trend over the whole time-series. After the slight increase in 2013, it fell back to a record low level in 2016-2018. Since 2019 there's an increasing trend. However, in 2023 a slight decrease is noted, similar as recorded for the other beam trawl fleets.

The UK otter trawl LPUE remained stable until the beginning of the 2000s but is at the record low level in 2012. The alternative LPUE indicator (kg/days fished) suggests that the declining trend continues after 2012. After the record low level in 2017 (5.6 kg/days fished), the LPUE gradually increases to 192.7 kg/days fished) in 2021. In 2022, the LPUE dropped again to half the value of 2021 and continues to halve in 2023. In 2012–2016, the LPUE of Irish otter trawlers is fluctuating at a lower level. In 2017–2022 a higher value was recorded, with a peak in 2022. In 2023, the LPUE fell back to the level of 2017.

In 2020 during which the COVID-19 disruptions took place, a shift between the UK beam and otter trawl fleet was noted, as the activity of the beam trawlers substantially increased whereas that of the otter trawlers was substantially reduced. Further, no substantial changes in effort or LPUE compared to 2019 were recorded.

30.6 Stock assessment

30.6.1 Historical Stock Development

In 2010, the Irish Sea sole assessment was based on XSA with two survey tuning indices (UK(E&W)-BTS-Q3 and UK(E&W)-BTS-Q1). The UK(E&W)-BTS-Q1 indices only provide information for the years 1993 up to 1999 and therefore no longer contribute to the final survivor estimates. At WKFLAT 2011 (ICES, 2011), the exclusion of the UK(E&W)-BTS-Q1 from the assessment was investigated and it was found that there was little effect on the catchability residuals and that the retrospective pattern was slightly improved. WKFLAT 2011 therefore decided to omit this survey from the assessment. Since 2021, the assessment was performed without tuning data for 2020, as the UK(E&W)-BTS-Q3 could not take place in Division 7.a due to the Covid-19 disruptions.

During the WKBFLATFISH1 benchmark (ICES, 2024) in 2024, the assessment was transferred to a state–space stock assessment model (SAM). This was done by using the stock assessment package, which enables to interface a performant SAM implementation (https://github.com/fishfollower/SAM/) in *Template Model Builder* (TMB)[1] from the R statistical software. Besides the revised age-structured UK(E&W)-BTS-Q3 survey tuning series, a Belgian commercial biomass index was

[1] TMB offers a modelling framework for fast estimation of hierarchical models written in C code through the Laplace approximation. In addition, increased performance of nonlinear optimization procedures is achieved through the use of AUTODIFF (automatic differentiation), and performant C libraries for linear algebra (Eigen and CholMod).

introduced in the assessment. The model was further optimized in terms of parameter configuration for the process and observation models (see table below).

The Fbar calculates the mean fishing mortality for the set age range and should represent a significant part of the catch. The Fbar in the WGCSE 2023 assessment was set at age 4–7. However, as age 3 represents a large proportion of the catch (Figure 30.4), during the WKBFLATFISH1 benchmark it was decided to expand the Fbar to ages 3–7. The Fbar with ages 3–7 represents on average 80% of the catch. The plusgroup was adjusted from age 8 to age 10 and the catch numbers for age 1 were set to NA prior to 2003.

The SAM model input and configuration are shown in the table below and in Table 30.8.

	Years	Ages	α-β
Commercial tuning fleets:			
BEL-CBT	2004-2023 (2017, 2018 missing)	Biomass	
Survey tuning fleets:			
UK(E&W)-BTS-Q3	1988–2023 (2020 missing*)	1–7 (no plusgroup)	0.75–0.85
Settings			
First data year	1970		
Last data year	2023		
First age Last age	1 10+		
Fbar	3-7		
Model Configuration			
stock-recruitment	plain random walk on logN(1)		
correlation F-at-age (corFlag)	AR(1)		
F parameters-at-age (keyLogFsta)	9 = 0, 1, 2, 3, 4, 5, 6, 7, 8, 8		
q parameters (-at-age) (keyLogFpar):			
UK(E&W)-BTS-Q3	1988–2023 (2020 missing*)	6 = 0, 1, 2, 3, 4, 5, 5, -1, -1, -1	
σ² F parameters-at-age (keyVarF)	1 = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0		
σ² N parameters-at-age (keyVarLogN)	2 = 0, 1, 1, 1, 1, 1, 1, 1, 1, 1		

	Years	Ages	α-β
σ² obs pars (-at-age) (keyVarObs):			
catch numbers-at-age	5 = 0, 1, 2, 3, 3, 4, 4, 4, 4, 4		
UK(E&W)-BTS-Q3	1988–2023 (2020 missing*)	4 = 5, 6, 6, 6, 7, 7, 8, -1, -1, -1	
ρ observations at-age (obsCorStruct):			
catch numbers-at-age	"AR(1)" (single ρ for all ages)		
UK(E&W)-BTS-Q3	1988–2023 (2020 missing*)	"ID"	

***2020 not available due to COVID-19 and therefore not included in the assessment.**

30.6.2 Final Assessment

The SAM model fitting diagnostics and survey catchabilities are shown in Table 31.9, the fishing mortalities in Table 31.10, the stock numbers in Table 31.11, SSB-at-age in Table 31.12 and the assessment summary in Table 31.13 and Figure 31.15.

In general, the estimated catches from the SAM model corroborate well with the observed catches.

The one step ahead residuals for the catch data do not indicate strong patterns (Figure 31.16), except for the larger residuals in the period 2016-2018 (linked to the low sampling level in those years when the bycatch quotum was in force) and in the beginning of the time series. The BEL-CBT biomass series shows an alternating pattern of negative residuals in de beginning and the end of the time series and positive residuals in the middle of the time series. The UK(E&W)-BTS-Q3 tuning series has higher residuals in the beginning of the time series and a year effect in 2013 but no strong patterns.

The process residuals do not indicate any problems with respect to the model configuration.

A Mohn's rho analysis was conducted based on the SAM results, i.e. the last data year (2023) was used as the final year for comparison of SSB, F and recruitment and based on a five-year retrospective analysis. The results from the Mohn's rho analysis are shown in the following table:

	SSB	F (ages 3–7)	recruitment
Mohn's rho value	0.04719	-0.0734	0.42608

The Mohn's rho values of SSB and F for this assessment are low and are well within the ICES WKFORBIAS thresholds (+0.20, -0.15), indicating that the current assessment has sufficient consistency for advice purposes. However, the retrospective analysis (Figure 31.17) of the recruitment estimates performs poorer.

The leave-one-out runs (Figure 30.18) show a stronger dependency of the model on the UK(E&W)-BTS-Q3 tuning series in the earlier part of the time series and it is more pronounced for F than for SSB. In the more recent years, there appears to be a more similar dependency on the survey and on the commercial tuning series.

30.6.3 Comparison with previous assessments

A comparison of the estimates of the current assessment with last year's (revised 2023WGCSE assessment) is given in Figure 30.19. Trends in fishing mortality, SSB and recruitment are very similar.

The 2021 recruitment estimate (11167 thousand fish) in last year's assessment was revised upwards by 10% in this year's assessment (12260 thousand fish) and the 2022 recruitment (14146 thousand fish) was revised downwards by 8.1% (12998 thousand fish). In last year's assessment, F and SSB for 2022 were estimated to be 0.153 and 4986 t respectively; this year's estimates for 2022 are 0.148 and 4927 t, an downward revision of 3.3% for F and 1.2% for SSB.

30.6.4 State of the stock

Estimated trends of Irish Sea sole landings, SSB, fishing mortality and recruitment are presented in Table 30.13 and Figure 30.15. Since the late eighties the cathes of Irish Sea sole have been declining to the lowest level of the time-series (34 t) in 2017. Since 2019, again higher catches are reported. SSB has been at a higher level until the late eighties. Since then it gradually decreased and has been fluctuating around $MSYB_{trigger}$ (3129 t) until 2005. Since 2006 it has been fluctuating around B_{lim} (2235 t) and in 2008 a record low value of 1573 t was estimated. SSB gradually increased again to above $MSYB_{trigger}$ since 2017. In 2022 and 2023, SSB dropped to 4927 t and 4026 t respectively.

High fishing mortalities were observed during the late eighties until the mid-2000s. Thereafter fishing mortality declined to below F_{MSY} (0.164) in 2010. In 2017-2018, the lowest level of the time-series was recorded (0.012). The decline in F is supported by a substantial reduction of the TAC in this period. As in 2019 the TAC increased (Figure 30.20) and the sole targeted fisheries was again permitted, F gradually increased to 0.148 in 2022. In 2023, F dropped to 0.098, which is about the same level as in 2020. F is estimated to be below F_{lim} over the entire time series.

Since 2001 recruitment has been well below the mean (23823 thousand fish) and the 2010 recruitment (year class 2009) is estimated to be the lowest in the time-series (3714 thousand fish). The 2015 recruitment (18558 thousand fish, year class 2014) is estimated to be five times higher than the record low recruitment in 2010. Thereafter, higher and lower recruitments alternate. The 2018 year class *(*29707 thousand*)* is estimated to be highest recorded in the last 25 years, followed by the weaker 2019-2021 year classes (12998 thousand in 2022). The 2023 recruitment (16997 thousand) is again slightly higher compaired to 2022.

30.7 Short-term projections

This year's forecast assumptions

Figure 31.21 shows three different targets for the intermediate year: F_last (F = F_{2023} or status quo), F_average (F = $F_{average\ 2021\text{-}2023}$), and catch. For the 'catch' target, the revised 2024 advised catch value of 625 t was assumed and this assumption implies a fishing mortality in 2024 of 0.170 and results in an SSB of 4503 t in 2025. This option was not agreed by the WG because the revised 2024 advice was not published yet and because the substantial over-reporting of the Belgian beam trawl fleet in recent years is likely to continue in 2024.

The F in 2023 (0.098) is slightly lower than the mean F over the last three years ($F_{average\ 2021–2023}$ = 0.116) and using this F to project the stock into 2024, would result in slightly lower catches (370 t) compaired to the F average option (436 t). Taking into account that there is no trend in F over the last three years, the WG agreed to use F average as target for the intermediate year (2024). This results in an SSB of 4647 t in 2025.

As input for the forecast fishing mortality, catch and stock weights-at-age were calculated as the mean of 2021–2023. Population numbers at the start of 2024 for ages 2 and older, were taken from the SAM output. The short-term median resampled recruitment (2015–2022) as estimated by a stochastic projection (SAM, 16877 thousand fish) was assumed for recruitment in 2024 and subsequent years, as this corresponds with the recent period of higher recruitments.

Last year's forecast assumptions

A comparison of the estimates of this year's assessment and forecast with last year's (revised 2023WGCSE assessment and forecast) is given in Figure 30.22.

The 2010–2013 recruitments have been the lowest in the time-series. Higher recruitment was observed from 2015 onwards. The 2022 year class ((2023 recruitment) is now estimated at 16997 thousand fish at age 1 (Table 31.13), which is 1.3% higher than the short-term median resampled recruitment (2015–2021) (16786 thousand fish) used in last year's forecast.

The age 1 estimates are hihgly dependent on the UK(E&W)-BTS-Q3 age 1 abundance. From 2010 to 2013, the UK(E&W)-BTS-Q3 abundance index for age 1 fluctuated around the lowest abundance of the time series. In 2015, 2017 and 2019 again higher age 1 abundance indices were noted. The 2022 and 2023 UK(E&W)-BTS-Q3 abundance index for age 1 are slightly higher than the level of 2018.

In last year's assessment the 2023 SSB was estimated at 5099 t, however this year, the 2023 SSB is revised downwards by 21% (4026 t). An F of 0.108 was assumed for the intermediate year (based on a catch constraint of 443t) in last year's forecast, this value (F in 2023) is now estimated to be 9.3% lower (0.098).

MSY forecast

Table 31.14 and Figure 31.23 show the output of the forecast targeting F = F_{MSY} for 2025–2026 and the slight reduction in advice compared to last year's advice (revised advice for 2024) is due to the overoptimistic forecasted SSB last year and the projected small decrease in SSB.

Implementing the MSY approach with F = F_{MSY} = 0.164 leads to a total yield of 609 t in 2025, and an SSB of 4502 t in 2026.

Figure 31.24 shows the contribution of the assumed median resampled recruitment (2015–2022) to the forecast yield and SSB. The assumed recruitment accounts for about 5.6% of the catch in 2025 and about 30.4% of the 2026 SSB.

Additional options

A management options table is provided in Table 30.14

30.8 Biological reference points

The table below summarizes all known reference points for sole in Division 27.7.a and their technical basis. Reference points have been redefined as a result of the WKBFLATFISH1 benchmark (ICES, 2024). The stock–recruitment relationship is shown in Figure 30.25.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	3129	Tonnes; 5th percentile on the distribution of SSB when fishing at F_{MSY}
	F_{MSY}	0.164	Stochastic simulations (EqSim) with Beverton-Holt and Ricker in combination with Segmented regression.
	F_{lower}	0.125	The minimum F which produces at least 95% of maximum yield
	F_{upper}	0.183	The maximum F which produces at least 95% of maximum yield
Precautionary approach	B_{lim}	2235	Tonnes; the average value of the breakpoint at 10% of B0* and 30% of B0*
	B_{pa}	3129	Tonnes; Blim × 1.4
	F_{lim}	0.570	The F that on average leads to B_{lim} from EqSim
	F_{pa}	0.183	F_{P05} ; F that leads to SSB ≥ Blim with 95% probability
Management plan	SSBmgt	Not applicable	
	Fmgt	Not applicable	

*B0 is the estimated unexploited spawning biomass

30.9 Management plans

No management plan is currently in place for Irish Sea sole.

30.10 Uncertainties and bias in assessment and forecast

Sampling

The targeted sole fishery in the Irish Sea was not allowed from 2016 to 2018. Consequently, sampling levels were also significantly reduced in this period. In 2019 the TAC increased again and additionally a scientific sole quota is reserved for Belgian vessels fishing in ICES Division 7.a to assure a qualitative sampling. Due to Covid-19, only discard information from the Belgian beam trawl fleet was provided for 2020 and 2021.

Landings

The Belgian commercial fishing fleet has fishing opportunities in several ICES divisions and are allowed to fish in different ICES divisions within one trip (e.g. while steaming from a Belgian harbour to a foreign harbour). This flexibility of fishing in different ICES divisions creates opportunity for non-compliance. During the WKBFLATFISH1 benchmark (ICES, 2024) a misreporting analysis was conducted and the landing numbers have been corrected for the time periods 2006-2013 and 2019-2022 . For 2006-2013 and 2019-2020 a correction in the range of 0.7-18.3 %

was applied (varying direction), whereas in the most recent years (2021-2023) a downward correction of around 34 % was applied on the reported landings. The period 2014-2018 was excluded from the misreporting analysis as there is not enough information to make a quantitative estimation of the landings.

Discards

Discard estimates used to be low (discard rate around 6% over the years 2003–2017), but are increasing (discard rate around 15% over the years 2018-2023). Discards are included in the assessment since the WKBFLATFISH1 benchmark (ICES, 2024).

Effort

There are no indications of Irish Sea sole fisheries misreporting effort. Effort in beam trawl fisheries that target sole has declined substantially in the last few years in accordance with the significant reductions in TAC. In 2019–2023 higher effort values were recorded as the TAC increased and sole directed fisheries were again allowed.

Surveys

The UK(E&W)-BTS-Q3 survey appears to track year-class strength well and is also consistent in estimating year-class strength of the same year class at different ages. The UK(E&W)-BTS-Q3 survey data for 2020 were not available due to COVID-19. The UK(E&W)-BTS-Q3 indices were revised during WKBFLATFISH1 benchmark (ICES, 2024) using the biological data of all available survey stations and a modelled approach. This index now also includes age 1 information.

Model formulation

During the WKBFLATFISH1 benchmark (ICES, 2024) in 2024, the assessment was transferred to a state–space stock assessment model (SAM). The main feature of SAM is that it includes both process models on survival, recruitment and fishing mortality, describing the internal states of the system, and observation models for catch and tuning data. Additionally, tuning data can be introduced in different ways, e.g. as SSB (spawning–stock biomass), TSB (total stock biomass) or landings indices, while the random effects formulation of the process models resulting from the hierarchical nature of the state–space modelling framework, can easily be used to handle missing observations as is the case with catch information on age 1. Finally, SAM allows to specify different model configurations, and parametrization of both process and observation models.

30.11 Recommendations for next Benchmark

The fact that the outcome of the reference points calculation is highly dependent on the functional form of the stock-recruitment relationship, the WKBFLATFISH1 benchmark (ICES, 2024) had difficulties to come to an objective conclusion. Therefore it is highly recommended to develop guidance to approach reference points for stocks like Irish Sea sole and 2) to perform intermediate re-evaluation of reference points for this stock.

30.12 Management considerations

Sole is caught in a mixed-fishery with other flatfish as well as gadoids predominantly caught by beam trawl fleets.

30.13 Ecosystem considerations

Considerable changes to the Irish Sea ecosystem have occurred over the past decades, with for example the decline of commercially important finfish stocks and their slow response to management recovery plans. This triggered the need for a holistic exploration into the impact of environmental change and food web effects to identify the drivers underpinning stock dynamics. Bentley et al. (2019) identified correlations between largescale climatic indicators, temperature, primary and secondary productivity, and fish recruitment in the Irish Sea and incorporated them into an Ecopath with Ecosim food web model. While this study was mainly focussed on cod and whiting, it is recommended to consider sole in this set-up and identify drivers of stock-recruitment. More ecosystem information can be found in the stock annex.

30.14 References

ICES. 2024. Benchmark workshop on selected flatfish stocks (WKBFLATFISH). ICES Scientific Reports. 6:30. 729pp. https://doi.org/10.17895/ices.pub.25471987

ICES. 2011. Report of the Benchmark Workshop on Flatfish (WKFLAT), 1–8 February 2011, Copenhagen, Denmark. ICES CM 2011/ACOM:39. 257 pp. https://doi.org/10.17895/ices.pub.19280879

Bentley, J.W., Serpetti, N., Fox, C.J., Heymans, J.J., Reid, D.G., 2019. Retrospective analysis of the influence of environmental drivers on commercial stocks and fishing opportunities in the Irish Sea. Fiseries Oceanography DOI: 10.1111/fog.12486.

Sole DNA (Maes et al. in prep)

30.15 Tables and Figures

Table 30.1. Sol.27.7a - Nominal landings (tonnes) as officially reported by ICES, and working group estimates of the landings (including area misreported landings and historical data revisions) and discards. Last year's landings are preliminary. TAC 2024: dd May 2024

[1] 1989 onwards: N. Ireland included with England & Wales.

C Incomplete/missing due to part of the data being unavailable under data confidentiality clauses.

Year	Belgium	France	Ireland	Netherlands	UK (E+W)	UK (Isle of Man)	UK (N. Ireland)[1]	UK (Scotland)	Officially reported	Total used by WG	Area misreported landings	TAC	Discards
1973	793	12	27	281	258	-	46	11	1428	1428	-	-	26
1974	664	54	28	320	218	-	23	-	1307	1307	-	-	16
1975	805	59	24	234	281	-	24	15	1442	1441	-	-	25
1976	674	72	74	381	195	-	49	18	1463	1463	-	-	12
1977	566	39	84	227	160	-	49	21	1146	1147	-	-	15
1978	453	65	127	177	189	-	57	30	1098	1106	-	-	14
1979	779	48	134	247	290	-	47	42	1587	1614	-	-	26
1980	1002	41	229	169	367	-	44	68	1920	1941	-	-	26
1981	884	13	167	186	311	-	41	45	1647	1667	-	-	19
1982	669	9	161	138	277	-	31	44	1329	1338	-	-	11
1983	544	3	203	224	219	-	33	29	1255	1169	-	-	10
1984	425	10	187	113	230	-	38	17	1020	1058	-	-	43
1985	589	9	180	546	269	-	36	28	1657	1146	-	-	29
1986	930	17	235	-	637	1	50	46	1916	1995	-	-	50
1987	987	5	312	-	599	3	72	63	2041	2808	-	2100	57
1988	915	11	366	-	507	1	47	38	1885	1999	-	1750	22
1989	1010	5	155	-	613	2	-	38	1823	1833	-	1480	21
1990	786	2	170	-	569	10	-	39	1576	1583	-	1500	36
1991	371	3	198	-	581	44	-	26	1223	1212	-	1500	58
1992	531	11	164	-	477	14	-	37	1234	1259	-	1350	43

Year	Belgium	France	Ireland	Netherlands	UK (E+W)	UK (Isle of Man)	UK (N. Ireland)[1]	UK (Scotland)	Officially reported	Total used by WG	Area misreported landings	TAC	Discards
1993	495	8	98	-	338	4	-	28	971	1023	-	1000	15
1994	706	7	226	-	409	5	-	14	1367	1374	-	1500	28
1995	675	5	176	-	424	12	-	8	1300	1266	-	1300	22
1996	533	5	133	149	194	4	-	5	1023	1002	-	1000	14
1997	570	3	130	123	189	5	-	7	1027	1003	-	1000	40
1998	525	3	134	60	161	3	-	9	895	911	-	900	32
1999	469	<1	120	46	165	1	-	8	810	863	-	900	32
2000	493	3	135	60	133	1	-	8	833	818	-	1080	21
2001	674	4	135	-	195	+	-	4	1012	1053	-	1100	31
2002	817	4	96	-	165	+	-	3	1085	1090	-	1100	22
2003	687	4	103	-	217	+	-	3	1014	1015	-	1010	48
2004	527	1	77	-	106	+	-	1	712	714	-	800	7
2005	662	3	85	-	103	+	-	1	854	855	-	960	40
2006	419	1	85	-	71	-	-	2	576	524	-47	960	27
2007	306	1	115	-	70	-	-	4	492	439	-51	820	15
2008	216	1	66	-	37	-	-	-	320	319	1	669	48
2009	257	-	47	-	20	1	-	1	325	295	-11	502	19
2010	217	-	47	-	12	-	-	-	277	290	13	402	20
2011	250	<1	49	-	31	-	-	-	330	330	-11	390	14
2012	222	<1	51	-	23	-	-	-	297	281	-18	300	23
2013	96	<1	40	-	12	-	-	-	148	160	11	140	14
2014	43	-	43	-	10	-	-	-	96	99	-	95	6
2015	36	<1	32	-	7	-	-	-	75	77	-	90	7
2016	14	-	15	-	6	-	-	-	35	37	-	40	2
2017	14	<1	14	-	4	2	-	-	34	34	-	40	2
2018	14	-	16	-	6	<1	-	-	36	36	-	40	9

Year	Belgium	France	Ireland	Netherlands	UK (E+W)	UK (Isle of Man)	UK (N. Ireland)[1]	UK (Scotland)	Officially reported	Total used by WG	Area misreported landings	TAC	Discards
2019	329	<1	c	-	15	<1	-	-	345c	388	-12	414	68
2020	284	<1	48	-	65	<1	-	-	398	371	-33	457	52
2021	480	<1	81	-	74	<1	-	-	635	474	-157	768	63
2022	542	<1	69	-	75	<1	-	-	687	507	-178	787	99
2023	414	< 1	56	-	54	< 1	-	-	524	386	-135	605	57

Table 30.2. Sol.27.7a - Catch numbers-at-age (in thousands).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	41	160	44	522	35	371	41	315	92	153	265	99	11
3	998	485	753	406	998	820	418	466	1070	1148	1051	648	387
4	1044	2171	757	2273	596	2469	1378	1339	672	3554	2040	1727	1285
5	474	1148	1562	566	1740	547	2364	786	1025	842	3104	1503	1318
6	1478	235	545	827	389	855	251	1082	449	646	529	1664	722
7	290	881	172	268	423	157	546	150	640	327	513	114	643
8	228	141	523	112	232	227	134	218	98	285	361	184	91
9	803	106	97	329	58	158	151	89	204	65	352	86	113
10+	1530	1676	900	716	695	627	458	348	288	272	437	603	195

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	52	924	218	200	269	45	251	801	1863	513	118	173	187	86
3	184	880	1790	3728	3746	496	860	1326	1419	2716	608	1500	1030	526
4	1033	393	1124	3588	4250	4917	801	1022	870	950	2036	1107	1495	1232
5	770	619	348	975	3234	2133	4039	607	305	565	568	1603	748	753
6	768	348	339	239	857	1329	1196	2355	229	193	255	400	1025	436
7	417	425	164	278	308	204	554	594	1175	156	200	133	180	510
8	334	178	259	210	224	83	121	333	255	524	147	98	62	142
9	69	251	188	187	139	76	23	38	125	217	257	141	48	49
10+	311	132	296	461	450	365	112	96	81	192	287	290	245	160

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0	0	0	0	0	0	35	1	34	23	8	21	1
2	1116	236	426	252	341	209	565	179	646	279	257	343	109
3	797	1933	1195	1013	1609	1037	863	694	1192	694	396	508	400
4	492	482	1303	939	851	1679	889	328	632	506	308	253	309
5	722	260	302	609	728	751	640	294	338	210	190	218	133
6	415	320	117	152	519	584	242	267	225	94	95	113	117
7	259	192	136	55	80	255	177	141	115	84	50	77	63
8	295	126	82	70	65	79	144	42	124	83	43	30	11
9	85	150	37	53	67	30	25	28	82	47	38	33	10
10+	155	150	114	137	142	109	119	72	50	64	91	47	25

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	10	0	0	6	1	6	9	7	26	73	11	3	31	108
2	94	64	109	55	42	46	3	5	29	285	393	198	283	394
3	381	246	169	125	88	69	22	49	37	746	305	781	337	380
4	273	386	353	100	75	53	25	21	57	308	459	424	1093	224
5	172	185	310	139	45	44	16	15	16	311	197	390	410	408
6	88	104	132	93	42	23	12	5	11	98	180	139	312	174
7	73	63	29	45	49	21	8	6	3	87	94	138	175	118
8	39	56	11	37	17	28	9	2	2	29	48	38	152	67
9	12	32	13	8	8	9	11	3	1	16	25	18	85	85
10+	41	45	18	35	22	15	14	8	7	33	54	36	79	37

Table 30.3. Sol.27.7a - Catch weights-at-age (kg).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
2	0.114	0.132	0.11	0.132	0.12	0.113	0.105	0.074	0.081	0.117	0.127	0.141	0.099
3	0.145	0.169	0.155	0.169	0.165	0.163	0.153	0.138	0.139	0.157	0.16	0.174	0.162
4	0.175	0.2	0.197	0.2	0.205	0.206	0.196	0.198	0.193	0.195	0.189	0.203	0.221
5	0.202	0.228	0.234	0.227	0.238	0.242	0.237	0.248	0.24	0.232	0.217	0.232	0.272
6	0.23	0.255	0.269	0.253	0.269	0.272	0.273	0.29	0.283	0.268	0.244	0.261	0.317
7	0.259	0.283	0.306	0.282	0.301	0.303	0.312	0.33	0.325	0.31	0.275	0.296	0.361
8	0.29	0.312	0.337	0.309	0.328	0.327	0.348	0.36	0.361	0.352	0.305	0.331	0.399
9	0.321	0.34	0.369	0.335	0.353	0.347	0.383	0.384	0.394	0.395	0.337	0.369	0.432
10+	0.414	0.426	0.46	0.424	0.415	0.384	0.511	0.398	0.474	0.566	0.473	0.497	0.493

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
2	0.165	0.166	0.125	0.106	0.117	0.097	0.109	0.118	0.116	0.13	0.089	0.152	0.112	0.136
3	0.201	0.213	0.179	0.156	0.155	0.139	0.155	0.154	0.163	0.168	0.148	0.188	0.172	0.183
4	0.233	0.252	0.226	0.199	0.192	0.179	0.197	0.188	0.204	0.203	0.201	0.223	0.227	0.223
5	0.263	0.285	0.269	0.238	0.229	0.216	0.235	0.225	0.238	0.236	0.245	0.258	0.274	0.26
6	0.295	0.315	0.307	0.274	0.265	0.249	0.268	0.262	0.269	0.271	0.282	0.298	0.315	0.293
7	0.332	0.347	0.346	0.31	0.307	0.285	0.303	0.306	0.3	0.31	0.317	0.346	0.355	0.327
8	0.369	0.374	0.38	0.344	0.35	0.319	0.336	0.354	0.326	0.348	0.345	0.397	0.389	0.358
9	0.41	0.4	0.412	0.375	0.395	0.352	0.366	0.404	0.349	0.39	0.366	0.453	0.419	0.387
10+	0.558	0.459	0.481	0.442	0.534	0.447	0.449	0.622	0.394	0.445	0.382	0.57	0.465	0.455

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.13	0.13	0.13	0.13	0.13	0.13	0.112	0.127	0.11	0.153	0.111	0.084	0.206
2	0.134	0.163	0.156	0.122	0.152	0.141	0.161	0.2	0.161	0.161	0.179	0.129	0.127
3	0.187	0.198	0.206	0.179	0.171	0.163	0.204	0.275	0.213	0.21	0.245	0.188	0.209
4	0.232	0.229	0.247	0.245	0.266	0.207	0.295	0.361	0.286	0.256	0.319	0.261	0.26
5	0.272	0.26	0.282	0.308	0.29	0.28	0.354	0.431	0.332	0.33	0.409	0.275	0.348
6	0.308	0.292	0.31	0.364	0.322	0.324	0.404	0.432	0.397	0.358	0.349	0.29	0.373
7	0.344	0.33	0.341	0.428	0.42	0.332	0.432	0.4	0.433	0.378	0.396	0.353	0.379
8	0.376	0.369	0.365	0.384	0.465	0.417	0.375	0.476	0.333	0.395	0.446	0.397	0.53
9	0.406	0.411	0.387	0.456	0.382	0.277	0.662	0.667	0.39	0.495	0.412	0.32	0.474

10+	0.458	0.522	0.426	0.58	0.448	0.366	0.494	0.531	0.559	0.567	0.517	0.365	0.458

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.107	0.123	0.106	0.099	0.097	0.091	0.089	0.089	0.089	0.089	0.075	0.086	0.085	0.11
2	0.145	0.143	0.123	0.133	0.131	0.14	0.129	0.13	0.112	0.114	0.109	0.113	0.105	0.163
3	0.19	0.2	0.199	0.19	0.184	0.195	0.201	0.223	0.193	0.196	0.19	0.182	0.15	0.201
4	0.264	0.265	0.243	0.241	0.251	0.249	0.258	0.31	0.276	0.242	0.259	0.244	0.197	0.233
5	0.32	0.335	0.294	0.287	0.294	0.276	0.344	0.385	0.359	0.297	0.294	0.32	0.219	0.245
6	0.351	0.393	0.353	0.324	0.324	0.333	0.316	0.495	0.418	0.364	0.331	0.345	0.267	0.262
7	0.375	0.371	0.451	0.354	0.358	0.389	0.415	0.493	0.484	0.356	0.337	0.376	0.255	0.307
8	0.375	0.408	0.528	0.358	0.392	0.4	0.427	0.503	0.567	0.399	0.353	0.407	0.301	0.267
9	0.419	0.435	0.367	0.47	0.448	0.403	0.379	0.472	0.716	0.522	0.431	0.492	0.231	0.299
10+	0.436	0.46	0.535	0.43	0.45	0.468	0.492	0.44	0.408	0.541	0.479	0.543	0.31	0.358

Table 30.4. Sol.27.7a - Annual length distributions (in thousands) by country (2023).

Length (cm)	UK (England & Wales) All gears	Belgium TBB	Ireland All gears
21	38	0	0
22	0	0	850
23	0	11394	85
24	967	94857	5517
25	9663	182271	7664
26	13653	146188	7566
27	13780	109000	12876
28	14677	93812	9913
29	12188	83972	14521
30	10504	79035	16672
31	9246	59855	17742
32	9750	39948	13573
33	7177	37535	12510
34	5394	32989	16656
35	2191	23539	7454
36	2381	16972	3630

Length (cm)	UK (England & Wales) All gears	Belgium TBB	Ireland All gears
37	1374	11365	3557
38	735	7559	3770
39	532	5831	2502
40	214	3750	571
41	173	2150	1205
42	76	1948	513
43	54	774	13
44	25	860	30
45	33	341	0
46	14	72	37
47	11	223	9
48	0	77	81
49	0	71	0
50	0	0	0
51	0	37	0
52	0	0	0
53	5	0	0
Total	114855	1046425	159517

Table 30.5. Sol.27.7a - Stock weights-at-age (kg).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.037	0.041	0.037	0.039	0.04	0.042	0.049	0.047	0.039	0.038	0.036	0.043	0.033
2	0.093	0.087	0.079	0.086	0.083	0.08	0.077	0.065	0.068	0.081	0.085	0.089	0.075
3	0.124	0.139	0.143	0.136	0.147	0.14	0.132	0.12	0.102	0.113	0.137	0.149	0.151
4	0.153	0.17	0.182	0.176	0.186	0.184	0.179	0.174	0.163	0.165	0.172	0.18	0.196
5	0.18	0.199	0.217	0.212	0.218	0.223	0.221	0.221	0.218	0.212	0.206	0.209	0.235
6	0.207	0.227	0.247	0.244	0.247	0.255	0.257	0.262	0.265	0.254	0.238	0.238	0.271
7	0.237	0.255	0.279	0.276	0.276	0.285	0.292	0.3	0.307	0.296	0.272	0.269	0.307
8	0.268	0.285	0.309	0.308	0.304	0.314	0.325	0.335	0.345	0.338	0.308	0.302	0.344
9	0.301	0.314	0.339	0.336	0.33	0.337	0.354	0.366	0.377	0.378	0.344	0.336	0.378
10+	0.399	0.411	0.438	0.431	0.403	0.385	0.486	0.411	0.452	0.544	0.486	0.463	0.465

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.033	0.038	0.041	0.039	0.043	0.026	0.028	0.026	0.03	0.033	0.024	0.028	0.033	0.035
2	0.097	0.097	0.084	0.077	0.082	0.074	0.068	0.073	0.07	0.08	0.064	0.083	0.071	0.085
3	0.141	0.187	0.173	0.14	0.128	0.128	0.122	0.13	0.139	0.14	0.139	0.129	0.162	0.143
4	0.195	0.225	0.22	0.189	0.173	0.167	0.166	0.171	0.177	0.182	0.184	0.181	0.207	0.196
5	0.241	0.258	0.261	0.232	0.213	0.204	0.205	0.211	0.212	0.22	0.223	0.228	0.247	0.243
6	0.283	0.288	0.296	0.272	0.251	0.239	0.241	0.248	0.246	0.254	0.258	0.27	0.285	0.283
7	0.324	0.32	0.33	0.309	0.29	0.275	0.275	0.287	0.28	0.289	0.293	0.312	0.325	0.321
8	0.365	0.352	0.363	0.345	0.33	0.313	0.31	0.328	0.316	0.323	0.327	0.355	0.367	0.356
9	0.405	0.384	0.393	0.378	0.369	0.351	0.342	0.368	0.352	0.357	0.357	0.395	0.408	0.388
10+	0.532	0.474	0.462	0.448	0.495	0.466	0.432	0.572	0.428	0.401	0.4	0.47	0.499	0.458

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.029	0.034	0.031	0.037	0.041	0.03	0.041	0.045	0.043	0.049	0.05	0.034	0.037
2	0.086	0.092	0.094	0.078	0.095	0.093	0.093	0.118	0.105	0.104	0.116	0.094	0.082
3	0.159	0.163	0.183	0.167	0.144	0.158	0.17	0.211	0.207	0.184	0.199	0.184	0.164
4	0.206	0.207	0.221	0.225	0.218	0.188	0.219	0.272	0.28	0.234	0.259	0.253	0.221
5	0.247	0.246	0.254	0.276	0.267	0.273	0.271	0.356	0.346	0.307	0.324	0.296	0.301
6	0.283	0.282	0.284	0.321	0.315	0.307	0.337	0.391	0.414	0.345	0.339	0.344	0.32
7	0.318	0.319	0.315	0.364	0.391	0.327	0.374	0.402	0.433	0.387	0.376	0.351	0.332
8	0.35	0.356	0.347	0.362	0.446	0.419	0.353	0.453	0.365	0.414	0.411	0.397	0.432
9	0.381	0.393	0.378	0.408	0.383	0.359	0.525	0.5	0.431	0.406	0.403	0.378	0.434
10+	0.441	0.485	0.44	0.526	0.48	0.388	0.475	0.568	0.563	0.55	0.516	0.397	0.4

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.04	0.038	0.048	0.043	0.036	0.036	0.04	0.043	0.048	0.038	0.038	0.039	0.033	0.041
2	0.092	0.094	0.083	0.095	0.09	0.089	0.084	0.087	0.081	0.085	0.077	0.078	0.076	0.095
3	0.156	0.171	0.169	0.153	0.157	0.16	0.168	0.17	0.158	0.148	0.147	0.141	0.13	0.146
4	0.235	0.225	0.221	0.219	0.218	0.214	0.224	0.249	0.248	0.216	0.225	0.216	0.19	0.187
5	0.289	0.298	0.279	0.264	0.266	0.263	0.293	0.315	0.334	0.286	0.266	0.288	0.231	0.22
6	0.35	0.354	0.344	0.309	0.305	0.313	0.295	0.413	0.401	0.362	0.314	0.318	0.292	0.24
7	0.374	0.361	0.421	0.354	0.34	0.355	0.372	0.395	0.49	0.386	0.35	0.352	0.296	0.286
8	0.377	0.391	0.443	0.402	0.373	0.378	0.408	0.457	0.529	0.439	0.354	0.37	0.336	0.261
9	0.471	0.404	0.387	0.498	0.401	0.398	0.39	0.449	0.6	0.544	0.415	0.417	0.306	0.3
10+	0.455	0.435	0.505	0.456	0.452	0.471	0.465	0.439	0.431	0.498	0.492	0.516	0.393	0.311

Table 30.6. Sol.27.7a - Tuning series (values in bold are used in the assessment).

BE-	**Belgium Commercial Beam trawl (Effort = Corrected formula)**										
2004	2023										
1	1	0	0								
-1	-1										
1	**384.720586**										
1	**407.585585**										
1	**328.319872**										
1	**360.262841**										
1	**440.398147**										
1	**399.186324**										
1	**399.730595**										
1	**509.134679**										
1	**492.626707**										
1	**427.591027**										
1	**554.173640**										
1	**250.352526**										
1	**171.281877**										
1	**NA**										
1	**NA**										
1	**883.080350**										
1	**687.151252**										
1	**874.838340**										
1	**782.546267**										
1	**641.415553**										
UK(E&W)-BTS-Q3											
1988	2023										
1	1	0.75	0.85								
1	10										
1	**709.4186**	**1152.37**	**1674.14**	**3835.56**	**825.935**	**351.670**	**14.0098**	22.3226	15.81352	52.6726	
1	**1913.298**	**1582.85**	**1417.37**	**873.852**	**2769.14**	**549.845**	**232.511**	21.5171	5.592261	48.8282	
1	**7775.977**	**2845.53**	**720.174**	**225.703**	**479.283**	**1093.11**	**201.301**	127.853	42.3914	44.7478	
1	**763.173**	**5660.82**	**1093.40**	**255.9**	**100.974**	**34.7245**	**238.198**	84.7733	35.93631	3.83851	
1	**1444.188**	**1376.84**	**4295.52**	**896.389**	**259.839**	**121.745**	**72.2368**	275.268	74.60424	47.8415	
1	**558.1408**	**1916.64**	**833.655**	**1248.91**	**278.790**	**84.9008**	**34.7436**	47.6655	149.1715	68.4746	
1	**493.6071**	**2061.69**	**1027.2**	**459.266**	**633.034**	**218.447**	**47.3609**	39.8297	22.90272	179.854	
1	**1962.872**	**999.270**	**1190.02**	**511.297**	**159.684**	**293.221**	**59.7927**	12.4496	12.91683	84.4420	
1	**5474.895**	**806.056**	**223.344**	**460.527**	**241.857**	**121.600**	**142.320**	33.5690	13.44492	54.7545	

UK(E&W)-BTS-Q3										
1	**7461.282**	**3351.62**	**424.076**	**160.597**	**272.141**	**135.788**	**71.3080**	129.911	41.78311	55.2521
1	**4565.447**	**3264.57**	**1480.16**	**168.674**	**30.4511**	**137.570**	**100.147**	13.6532	87.45533	56.8303
1	**3387.68**	**1850.30**	**1201.53**	**914.747**	**103.527**	**53.5806**	**87.4594**	10.0541	29.01272	127.713
1	**2529.991**	**2892.36**	**837.908**	**821.164**	**418.459**	**68.7518**	**7.07508**	42.6827	23.65351	107.090
1	**1122.295**	**1775.86**	**1398.06**	**414.662**	**427.080**	**269.822**	**35.6186**	8.39260	42.10121	53.4450
1	**1283.095**	**475.976**	**662.827**	**764.071**	**217.893**	**310.694**	**171.302**	8.99325	1.706225	74.3027
1	**1964.034**	**1249.04**	**383.36**	**579.385**	**428.233**	**176.370**	**144.648**	81.1689	1.859083	49.8075
1	**2101.96**	**1213.95**	**715.840**	**160.877**	**299.815**	**228.952**	**186.564**	65.9455	97.95409	54.9200
1	**300.6704**	**787.666**	**396.121**	**181.124**	**61.4855**	**141.411**	**127.283**	23.3529	38.22359	97.2572
1	**813.6854**	**458.884**	**470.439**	**246.911**	**150.947**	**41.9720**	**63.5566**	58.9732	46.20967	105.078
1	**968.1239**	**653.322**	**342.728**	**325.274**	**200.318**	**65.7730**	**26.0028**	30.2927	75.8423	105.812
1	**1073.117**	**788.837**	**332.624**	**105.345**	**158.330**	**99.1445**	**24.3539**	4.88181	40.49258	80.4730
1	**554.1711**	**1045.22**	**376.728**	**188.365**	**76.9399**	**118.882**	**47.4595**	16.6444	0.467040	84.7078
1	**164.3207**	**421.757**	**558.162**	**195.425**	**84.3029**	**25.8468**	**35.0586**	35.2503	16.35686	17.9558
1	**409.6278**	**186.397**	**556.478**	**431.943**	**189.643**	**70.9760**	**34.5997**	55.9532	25.62767	64.4512
1	**144.6677**	**349.181**	**145.258**	**273.486**	**191.652**	**75.4478**	**33.1444**	24.3896	29.22059	67.9854
1	**473.0468**	**534.064**	**233.768**	**118.941**	**227.134**	**126.387**	**82.8205**	33.8198	14.80288	66.1168
1	**1061.27**	**524.362**	**229.445**	**257.743**	**134.150**	**160.712**	**172.230**	75.9932	37.27083	67.4129
1	**2433.425**	**935.636**	**286.924**	**131.260**	**119.619**	**65.2636**	**73.4649**	128.350	32.34104	124.435
1	**952.9697**	**2321.23**	**584.127**	**234.049**	**152.736**	**140.138**	**53.2329**	42.0469	60.57398	99.6273
1	**2497.25**	**892.893**	**1200.06**	**385.044**	**152.878**	**125.455**	**56.6355**	34.1619	45.88925	135.204
1	**1276.221**	**2617.31**	**624.814**	**952.102**	**241.055**	**107.180**	**55.279**	46.8441	30.04475	97.4877
1	**5582.972**	**1339.17**	**1482.77**	**429.030**	**658.692**	**165.592**	**50.3991**	27.2181	15.28797	110.694
1	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	NA	NA	NA
1	**923.464**	**629.408**	**1746.13**	**482.682**	**269.083**	**132.748**	**244.491**	4.76128	8.630392	23.1018
1	**1561.507**	**976.208**	**687.986**	**1544.01**	**228.187**	**276.427**	**77.5970**	191.827	36.50494	25.3041
1	**1774.862**	**935.985**	**741.14**	**308.921**	**756.432**	**166.030**	**234.477**	82.9684	97.23299	58.4559

Table 30.7a. Sol.27.7a - Effort series.

	Belgium	UK(E&W)				Ireland	
	beam[1]	beam [2]	beam[3]	otter[2]	otter[3]	otter[4]	beam[4]
Year	Whole year	Whole year	Whole year	Whole year	Whole year	Whole Year	Whole Year
1972	-	-	-	128.4	-	-	-
1973	-	-	-	147.6	-	-	-
1974	-	-	-	115.2	-	-	-
1975	28.4	-	-	130.7	-	-	-
1976	24.9	-	-	122.3	-	-	-
1977	22.1	-	-	101.9	-	-	-
1978	17.5	0.9	-	89.1	-	-	-
1979	20.4	1.7	-	89.9	-	-	-
1980	32.0	4.3	-	107.0	-	-	-
1981	36.5	6.4	-	107.1	-	-	-
1982	26.5	5.5	-	127.2	-	-	-
1983	28.7	2.8	0.0	88.1	1716.5	-	-
1984	17.5	4.1	263.0	103.1	7932.1	-	-
1985	27.0	7.4	428.1	102.9	6930.8	-	-
1986	44.5	17.0	1122.9	90.3	6693.2	-	-
1987	51.6	22.0	1178.5	130.6	9008.9	-	-
1988	38.2	18.6	1019.2	132.0	8292.4	-	-
1989	42.2	25.3	1344.5	139.5	16161.4	-	-
1990	42.4	31.0	1473.1	117.1	7724.5	-	-
1991	17.1	25.8	1211.3	107.3	7081.1	-	-
1992	25.1	23.4	908.1	96.8	6671.8	-	-
1993	23.9	21.5	826.9	78.9	6013.1	-	-
1994	32.5	20.1	1451.6	43.0	3060.0	-	-
1995	28.6	20.9	1429.4	43.1	3357.0	80.3	8.6
1996	23.2	13.3	894.3	42.2	3085.1	64.8	6.3
1997	30.7	10.8	784.4	39.9	2903.3	92.2	9.9

	Belgium	UK(E&W)				Ireland	
	beam[1]	beam [2]	beam[3]	otter[2]	otter[3]	otter[4]	beam[4]
Year	Whole year	Whole year	Whole year	Whole year	Whole year	Whole Year	Whole Year
1998	24.7	10.4	696.0	36.9	2620.6	93.5	11.6
1999	22.7	11.0	778.9	22.9	1803.5	110.3	14.7
2000	26.0	6.3	410.7	27.0	2034.9	82.7	11.4
2001	36.8	12.5	767.4	32.8	2352.9	77.5	13.1
2002	47.0	8.0	535.1	24.8	1774.0	77.9	17.7
2003	44.3	14.0	863.7	23.9	1728.3	73.9	18.7
2004	32.3	7.4	419.9	23.5	1727.0	72.5	14.2
2005	37.5	11.4	627.8	16.7	1313.6	68.3	14.7
2006	24.8	4.6	280.1	5.2	478.5	66.2	12.2
2007	19.5	3.2	193.5	4.4	397.2	74.1	14.2
2008	10.3	1.3	98.0	2.7	320.4	58.8	9.5
2009	11.7	0.5	24.9	1.5	157.7	42.8	7.6
2010	11.3	0.2	10.2	1.4	151.0	45.8	9.4
2011	12.4	1.6	91.2	0.7	72.7	54.5	8.1
2012	10.9	0.9	60.7	0.4	85.0	58.3	7.2
2013	7.0	0.0	1.3	0.3	31.9	42.6	5.0
2014	3.9	-	0.4	-	16.1	47.7	6.0
2015	3.5	-	0.9	-	0.0	39.8	8.3
2016	1.8	-	3.9	-	0.0	33.4	7.9
2017	3.0	-	0.0	-	160.7	12.1	7.5
2018	2.5	-	0.0	-	238.1	13.6	9.6
2019	10.1	-	7.0	-	247.2	17.2	13.3
2020	9.5	-	199.0	-	72.6	13.3	10.4
2021	10.2	-	222.6	-	193.6	13.2	8.9
2022	13.0	-	117.6	-	133.1	13.0	6.0
2023	11.5	-	127.6	-	218.0	9.3	5.5

[1]000' hours fishing. [2]000'hours fished (GRT corrected >40 vessels). [3] days fished. [4] 000'hours.

Table 30.7b. Sol.27.7a – LPUE.

	Belgium		UK(E&W)						Ireland	
	beam[1,5]	Beam[6]	beam[3]	beam[2]	otter[3]	otter[2]	beam survey[4]		otter[1]	beam[1]
Year	Whole year	Wholeyear	Whole year	Whole year	Whole year	Whole year	Sept	March	Whole year	Whole year
1972	-	-	-	-	1.06	-	-	-	-	-
1973	-	-	-	-	1.06	-	-	-	-	-
1974	-	-	-	-	1.09	-	-	-	-	-
1975	21.39	-	-	-	1.39	-	-	-	-	-
1976	23.13	-	-	-	0.94	-	-	-	-	-
1977	19.79	-	-	-	0.80	-	-	-	-	-
1978	18.10	-	34.32	-	1.04	-	-	-	-	-
1979	33.41	-	32.01	-	1.43	-	-	-	-	-
1980	28.18	-	31.70	-	1.01	-	-	-	-	-
1981	22.16	-	21.32	-	0.75	-	-	-	-	-
1982	22.01	-	29.94	-	0.53	-	-	-	-	-
1983	13.88	-	37.31	0.0	0.57	150.2	-	-	-	-
1984	22.47	-	16.24	2851.4	0.71	119.3	-	-	-	-
1985	20.58	-	17.34	2956.3	0.56	135.7	-	-	-	-
1986	19.12	-	19.23	3925.7	0.84	174.9	-	-	-	-
1987	17.73	-	14.82	3726.9	0.77	144.9	-	-	-	-
1988	21.29	-	11.81	2673.3	0.46	80.3	161.92	-	-	-
1989	21.93	-	9.17	1750.6	0.70	138.9	150.07	-	-	-
1990	17.52	-	9.52	2300.9	0.61	119.7	196.90	-	-	-
1991	18.70	-	10.43	2420.9	1.12	177.4	175.76	-	-	-
1992	19.21	-	9.50	2763.0	1.02	126.0	162.64	-	-	-
1993	19.97	-	7.60	1879.8	0.54	69.1	100.16	104.7	-	-
1994	19.06	-	11.76	1479.9	0.74	88.1	110.71	91.9		-
1995	18.12	-	14.96	1721.1	0.95	142.3	92.04	79.3	0.38	12.69
1996	17.72	-	9.44	1471.7	0.53	47.7	89.48	-	0.25	14.94
1997	16.62	-	10.49	961.8	0.73	103.2	155.79	63.3	0.23	8.53

	Belgium		UK(E&W)						Ireland	
	beam[1,5]	Beam[6]	beam[3]	beam[2]	otter[3]	otter[2]	beam survey[4]		otter[1]	beam[1]
Year	Whole year	Wholeyear	Whole year	Whole year	Whole year	Whole year	Sept	March	Whole year	Whole year
1998	18.96	-	8.42	907.8	0.48	50.5	144.97	89.3	0.38	7.77
1999	19.47	-	9.94	1124.9	0.60	64.8	116.02	-	0.29	9.22
2000	15.52	-	12.90	1604.7	0.44	34.6	130.70	-	0.29	8.49
2001	15.02	-	11.72	1537.4	0.15	23.4	96.87	-	0.38	7.86
2002	14.95	-	16.73	1484.3	1.48	98.8	76.73	-	0.32	4.67
2003	15.41	-	13.20	1351.6	0.15	340.4	88.55	-	0.34	4.20
2004	16.25	-	13.86	941.7	0.17	27.6	98.92	-	0.14	4.31
2005	17.52	-	9.14	1199.9	0.19	21.3	48.91	-	0.16	4.70
2006	16.32	12.21	7.83	826.1	0.52	34.8	52.63	-	0.16	6.00
2007	14.32	13.03	16.38	1629.9	0.42	21.4	53.05	-	0.37	6.37
2008	19.85	14.78	15.25	887.4	0.30	16.4	50.67	-	0.20	6.08
2009	19.96	15.93	18.88	1201.2	0.22	13.6	45.75	-	0.28	4.53
2010	18.68	17.36	13.90	262.3	0.46	17.8	27.80	-	0.19	4.09
2011	19.34	18.23	4.45	322.5	0.18	13.7	36.97	-	0.30	4.13
2012	19.61	14.89	4.27	99.9	0.08	4.4	26.47	-	0.14	5.41
2013	13.23	15.13	-	27.7	0.10	16.3	31.65	-	0.22	6.27
2014	9.16	-	-	0.0	-	13.0	41.14	-	0.14	5.40
2015	9.24	-	-	146.1	-	34.2	58.88	-	0.18	3.14
2016	6.81	-	-	0.0	-	21.3	69.35	-	0.18	1.17
2017	3.81	-	-	0.0	-	5.6	64.24	-	0.36	1.23
2018	5.36	-	-	0.0	-	12.6	78.51	-	0.28	1.49
2019	32.26	31.33	-	124.8	-	48.5	118.66	-	0.63	2.23
2020	30.81	25.69	-	1305.4	-	97.2	-	-	0.67	2.92
2021	44.9	36.30	-	1079.7	-	192.7	63.60	-	0.72	5.79
2022	40.1	30.56	-	1416.1	-	101.9	71.43	-	1.18	8.59
2023*	34.2	24.87	-	910.2	-	59.2	65.49	-	0.4	7.34

[1] Kg/hr. [2] Kg/day. [3] Kg/000'hr fished (GRT corrected >40' vessels). [4] Kg/100 km fished. [5] without misreporting correction. [6] Kg/hr from fishing trips with registered fishing effort exclusively in ICES division 7.a. * Provisional.

Table 30.8a. Sol.27.7a – Configuration.

$minAge										
[1] 1										
$maxAge										
[1] 10										
$maxAgePlusGroup										
[1] 1 0 0										
$keyLogFsta										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] 0 1 2 3 4 5 6 7 8 8									
[2	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$corFlag										
[1] 2										
$keyLogFpar										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[2	] 0 1 2 3 4 5 5 -1 -1 -1									
[3	] 6 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$keyQpow										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[2	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$keyVarF										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] 0 0 0 0 0 0 0 0 0 0									
[2	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$keyVarLogN										
[1] 0 1 1 1 1 1 1 1 1 1										
$keyVarLogP										
numeric(0)										
$keyVarObs										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] 0 1 2 3 3 4 4 4 4 4									
[2	] 5 6 6 6 7 7 8 -1 -1 -1									
[3	] 9 -1 -1 -1 -1 -1 -1 -1 -1 -1									

Table 30.8b. Sol.27.7a – Configuration.

$obsCorStruct										
[1] AR ID ID										
Levels: ID AR US										
$keyCorObs										
1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10										
[1	] 0 0 0 0 0 0 0 0 0									
[2	] NA NA NA NA NA NA -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1									
$stockRecruitmentModelCode										
[1] 0										
$noScaledYears										
[1] 0										
$keyScaledYears										
numeric(0)										
$keyParScaledYA										
<0 x 0 matrix>										
$fbarRange										
[1] 3 7										
$keyBiomassTreat										
[1] -1 -1 0										
$obsLikelihoodFlag										
[1] LN LN LN										
Levels: LN ALN										
$fixVarToWeight										
[1] 0 0 0										
$fracMixF										
[1] 0										
$fracMixN										
[1] 0 0 0 0 0 0 0 0 0 0										
$fracMixObs										
[1] 0 0 0										
$constRecBreaks										
numeric(0)										
$predVarObsLink										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[2	] -1 -1 -1 -1 -1 -1 -1 NA NA NA									
[3	] NA NA NA NA NA NA NA NA NA NA									

Table 30.8c. Sol.27.7a – Configuration.

$stockWeightModel										
[1] 0										
$keyStockWeightMean										
[1] NA NA NA NA NA NA NA NA NA NA										
$keyStockWeightObsVar										
[1] NA NA NA NA NA NA NA NA NA NA										
$catchWeightModel										
[1] 0										
$keyCatchWeightMean										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] NA NA NA NA NA NA NA NA NA NA									
$keyCatchWeightObsVar										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] NA NA NA NA NA NA NA NA NA NA									
$matureModel										
[1] 0										
$keyMatureMean										
[1] NA NA NA NA NA NA NA NA NA NA										
$mortalityModel										
[1] 0										
$keyMortalityMean										
[1] NA NA NA NA NA NA NA NA NA NA										
$keyMortalityObsVar										
[1] NA NA NA NA NA NA NA NA NA NA										
$keyXtraSd										
[	1] [	2] [	3] [	4]						
$logNMeanAssumption										
[1] 0 0										
$initState										
[1] 0										

Table 30.9. Sol.27.7a – Diagnostics.

Name	Type	Years	Ages	LogQ _age1	Sd _age1	LogQ _age2	Sd _age2	LogQ _age3	Sd _age3	LogQ _age4	Sd _age4
UK-BTS-Q3	age-based	1988-2023, 2020 missing	1-7	-1.877	0.111	-1.523	0.07	-1.611	0.071	-1.721	0.076
BE-CBT	biomass	2004-2023, 2017-2018 missing	-1	-1.728	0.109	NA	NA	NA	NA	NA	NA

Name	Type	Years	Ages	LogQ _age5	Sd _age5	LogQ _age6	Sd _age6	LogQ _age7	Sd _age7
UK-BTS-Q3	age-based	1988-2023, 2020 missing	1-7	-1.811	0.096	-1.939	0.1	-1.939	0.1
BE-CBT	biomass	2004-2023, 2017-2018 missing	-1	NA	NA	NA	NA	NA	NA

log(L)	#par	AIC
-428.166	22	900.3323

Table 30.10. Sol.27.7a - Fishing mortality.

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001
2	0.008	0.009	0.008	0.008	0.008	0.009	0.009	0.008	0.008	0.011	0.013	0.012	0.012
3	0.058	0.066	0.06	0.061	0.06	0.064	0.068	0.061	0.06	0.078	0.093	0.084	0.082
4	0.17	0.193	0.177	0.179	0.177	0.187	0.201	0.176	0.173	0.219	0.258	0.228	0.218
5	0.227	0.256	0.234	0.234	0.233	0.246	0.264	0.23	0.228	0.287	0.338	0.292	0.272
6	0.198	0.221	0.203	0.205	0.205	0.216	0.231	0.204	0.205	0.259	0.312	0.272	0.253
7	0.178	0.197	0.18	0.179	0.179	0.188	0.201	0.177	0.178	0.224	0.271	0.235	0.22
8	0.171	0.188	0.172	0.172	0.171	0.179	0.189	0.165	0.166	0.208	0.256	0.223	0.206
9	0.164	0.18	0.164	0.165	0.164	0.174	0.184	0.162	0.161	0.2	0.245	0.214	0.197
10+	0.164	0.18	0.164	0.165	0.164	0.174	0.184	0.162	0.161	0.2	0.245	0.214	0.197

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.002	0.002
2	0.013	0.012	0.015	0.021	0.025	0.021	0.022	0.03	0.025	0.026	0.026	0.032	0.036	0.039
3	0.088	0.083	0.1	0.139	0.169	0.138	0.14	0.185	0.152	0.156	0.155	0.19	0.207	0.223
4	0.224	0.2	0.231	0.309	0.363	0.282	0.268	0.338	0.268	0.267	0.26	0.312	0.332	0.345
5	0.276	0.245	0.283	0.38	0.448	0.34	0.309	0.37	0.289	0.292	0.282	0.332	0.35	0.361
6	0.26	0.233	0.272	0.374	0.452	0.346	0.308	0.363	0.281	0.282	0.275	0.321	0.333	0.342
7	0.228	0.207	0.245	0.343	0.423	0.326	0.288	0.336	0.263	0.265	0.258	0.296	0.302	0.308
8	0.213	0.194	0.232	0.328	0.407	0.317	0.277	0.32	0.251	0.255	0.25	0.286	0.29	0.295
9	0.204	0.183	0.217	0.302	0.37	0.287	0.247	0.283	0.225	0.233	0.23	0.266	0.268	0.271
10+	0.204	0.183	0.217	0.302	0.37	0.287	0.247	0.283	0.225	0.233	0.23	0.266	0.268	0.271

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.002
2	0.044	0.042	0.036	0.033	0.041	0.055	0.054	0.042	0.065	0.048	0.037	0.04	0.032
3	0.246	0.231	0.191	0.172	0.209	0.276	0.268	0.206	0.311	0.227	0.172	0.181	0.143
4	0.367	0.335	0.27	0.236	0.281	0.365	0.344	0.259	0.39	0.284	0.217	0.232	0.189
5	0.386	0.355	0.285	0.246	0.289	0.366	0.336	0.25	0.377	0.274	0.211	0.227	0.186
6	0.364	0.335	0.269	0.237	0.279	0.348	0.314	0.23	0.339	0.247	0.191	0.203	0.164
7	0.328	0.301	0.241	0.213	0.251	0.313	0.283	0.205	0.298	0.221	0.173	0.183	0.147
8	0.315	0.291	0.232	0.207	0.246	0.303	0.27	0.19	0.271	0.197	0.152	0.155	0.121
9	0.287	0.264	0.21	0.188	0.221	0.27	0.242	0.171	0.242	0.176	0.136	0.138	0.106

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
10+	0.287	0.264	0.21	0.188	0.221	0.27	0.242	0.171	0.242	0.176	0.136	0.138	0.106

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.002	0.002	0.001	0.001	0.001	0	0	0	0	0.001	0.001	0.001	0.002	0.001
2	0.029	0.028	0.025	0.02	0.012	0.008	0.004	0.002	0.002	0.015	0.018	0.021	0.03	0.02
3	0.131	0.124	0.11	0.084	0.052	0.035	0.015	0.009	0.01	0.061	0.073	0.081	0.117	0.078
4	0.177	0.171	0.153	0.118	0.072	0.049	0.022	0.013	0.013	0.084	0.102	0.114	0.165	0.109
5	0.179	0.175	0.155	0.121	0.075	0.051	0.023	0.014	0.014	0.085	0.103	0.114	0.165	0.108
6	0.159	0.156	0.135	0.105	0.066	0.046	0.021	0.012	0.012	0.076	0.092	0.101	0.147	0.097
7	0.143	0.142	0.121	0.097	0.062	0.044	0.02	0.012	0.012	0.075	0.092	0.1	0.145	0.095
8	0.119	0.119	0.101	0.083	0.053	0.038	0.018	0.011	0.01	0.064	0.078	0.084	0.123	0.081
9	0.104	0.103	0.087	0.072	0.047	0.034	0.016	0.01	0.01	0.059	0.073	0.079	0.116	0.077
10+	0.104	0.103	0.087	0.072	0.047	0.034	0.016	0.01	0.01	0.059	0.073	0.079	0.116	0.077

Table 30.11. Sol.27.7a - Stock numbers-at-age (start of year, in thousands).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	50117	19866	59342	33032	32145	22950	67050	44011	38444	27479	20973	10147	24978
2	11566	28092	10492	33773	17968	17795	12271	38013	24073	21235	15095	11642	5401
3	20261	7944	19577	6863	23574	12263	12054	8122	26655	16346	14542	10126	7969
4	8395	13676	5399	14290	4566	16572	8330	8773	5412	19186	10948	9918	6810
5	2731	5561	8326	3318	9099	2864	10822	4793	5663	3421	12074	6488	6145
6	9307	1663	3322	4882	2073	5451	1692	6348	2903	3418	1871	6831	3746
7	1743	5918	1059	2122	2914	1326	3344	1060	3918	1844	2057	993	3989
8	1329	1122	3734	696	1434	1821	884	2064	698	2450	1129	1242	609
9	5481	856	726	2435	450	958	1158	587	1377	469	1552	640	778
10+	11044	10939	7571	5482	5254	3787	3090	2709	2171	2350	1859	2157	1692

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	63000	76211	93058	20386	15711	16874	24413	52966	18962	22728	18588	8638	10555
2	13732	35169	41911	52984	10927	8578	9394	13370	29886	10372	12704	10608	4708
3	3599	9366	24021	28618	37782	7064	5865	6345	8559	19974	6952	8717	7231
4	5610	2471	6173	16033	17364	25890	4281	3441	3872	5130	11863	4536	5339
5	3815	3290	1606	3559	9226	8905	15868	2420	1699	2260	2931	6709	2599
6	3717	2122	1914	962	1778	4594	4841	8894	1297	1011	1195	1725	3681

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
7	2271	2278	1268	1095	537	823	2520	2712	4620	831	618	665	964
8	2476	1398	1430	785	586	272	462	1492	1513	2578	549	376	376
9	388	1609	927	867	442	297	150	263	842	943	1460	361	224
10+	1561	1195	1821	1768	1540	1087	790	571	493	848	1128	1540	1144

age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	31296	27895	22068	27842	17181	8975	11384	12128	10026	6293	8093	9045	11774
2	5609	17368	14996	11795	15430	9377	4811	6246	6618	5492	3456	4455	4960
3	2977	3649	11214	9433	7549	10221	6005	3179	3931	4256	3523	2279	2951
4	4500	1743	2069	6288	5668	4510	6003	3403	1768	2148	2281	2052	1352
5	2808	2454	926	1186	3446	3391	2678	2952	1760	1068	1058	1290	1288
6	1470	1506	1284	511	687	2027	1951	1503	1545	1051	557	599	818
7	2013	835	821	713	309	408	1113	1019	908	881	573	338	365
8	568	1145	471	479	434	207	249	602	573	584	499	359	222
9	221	335	655	271	299	278	128	139	330	382	343	308	245
10+	821	634	585	763	680	648	593	454	372	430	490	541	539

age	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	7672	3714	4810	4722	6202	8613	18558	12702	23613	16877	29707	10399	12260	12998
2	6578	4297	2029	2664	2647	3423	4697	10387	6794	13114	9077	16587	5583	6841
3	3223	4438	3061	1406	1822	1763	2321	3082	7278	4696	8927	6038	11276	3733
4	1808	2030	3004	2131	988	1283	1202	1701	2157	5336	3494	5835	4191	7813
5	803	1108	1326	1981	1380	697	929	860	1340	1596	3920	2426	3815	2868
6	815	501	700	876	1328	902	493	687	629	1045	1266	2707	1681	2513
7	537	541	326	458	584	973	626	352	519	475	794	956	1932	1200
8	215	365	374	208	331	411	728	461	252	385	375	552	697	1380
9	152	146	254	263	141	232	303	545	350	186	293	278	382	518
10+	506	459	420	461	533	499	543	644	891	921	804	770	721	752

age	2023
1	16997
2	7070
3	4637
4	2419

age	2023
5	4822
6	1894
7	1635
8	817
9	994
10+	831

Table 30.12. Sol.27.7a – Spawning stock biomass-at-age (start of year, in tonnes).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	13	6	15	9	9	7	23	14	10	7	5	3	6
2	221	502	170	597	307	293	194	508	336	354	264	213	83
3	1670	734	1861	620	2303	1141	1058	648	1807	1228	1324	1003	800
4	1071	1939	820	2098	708	2544	1244	1273	736	2641	1571	1489	1113
5	444	1000	1632	635	1792	577	2160	957	1115	655	2247	1225	1304
6	1819	356	775	1125	483	1312	411	1570	726	820	420	1535	958
7	400	1460	286	567	778	366	945	308	1164	528	541	258	1185
8	349	314	1132	210	428	561	282	678	236	812	341	368	206
9	1626	265	243	806	146	318	404	212	512	175	526	212	290
10+	4369	4460	3287	2341	2102	1448	1491	1103	974	1267	897	991	781

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	14	20	26	5	5	3	10	4	2	5	1	0	1	6
2	274	701	724	839	184	129	153	259	428	95	113	37	26	64
3	337	1164	2762	2663	3215	485	459	625	972	1593	502	380	432	231
4	912	464	1133	2528	2506	3125	518	524	661	806	1699	499	721	618
5	830	767	379	746	1775	1635	2752	444	356	454	590	1118	466	558
6	993	577	535	247	421	1055	1056	2048	310	246	276	361	845	340
7	712	705	405	328	151	219	666	740	1277	233	167	180	260	546
8	887	483	509	266	190	84	140	476	474	808	164	110	118	180
9	155	609	359	323	161	104	51	94	295	327	471	111	85	81
10+	824	561	835	786	756	504	339	325	208	337	414	650	513	334

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	1	1	1	9	2	13	45	61	11	21	20	1	9
2	87	83	72	245	115	182	361	563	310	112	231	81	189
3	264	800	736	780	632	729	485	752	745	425	331	281	329
4	211	301	889	916	684	996	714	454	562	413	441	258	336
5	396	178	222	782	705	688	771	608	354	259	376	266	201
6	347	281	118	186	530	560	495	588	418	152	188	242	230
7	218	228	155	104	140	347	375	356	364	201	117	87	168
8	333	150	137	141	90	102	206	258	206	184	139	84	87
9	102	231	90	112	90	43	73	163	159	128	120	85	63
10+	249	243	303	327	281	226	209	209	236	255	270	189	192

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	6	23	20	6	5	7	43	55	110	140	55	75	93	56
2	159	108	116	107	94	106	552	229	645	463	832	306	382	380
3	535	422	181	231	209	228	478	911	653	1148	794	1462	434	585
4	413	584	406	172	236	207	371	472	1243	719	1268	886	1405	403
5	292	367	500	337	165	211	249	386	515	1096	633	1080	639	984
6	172	240	280	372	261	143	200	244	406	450	836	528	720	426
7	192	115	171	178	320	206	130	191	226	300	328	668	350	446
8	134	144	89	123	143	239	187	109	200	164	195	257	456	202
9	66	101	99	70	86	114	212	154	110	158	114	157	155	290
10+	197	181	226	240	219	242	297	383	394	397	376	371	292	255

Table 30.13. Sol.27.7a – Summary ('Catch' refers to model estimate).

year	R(age 1)_low	R(age 1)_value	R(age 1)_high	TSB _low	TSB _value	TSB _high	SSB _low	SSB _value	SSB _high	Catch _low	Catch _value	Catch _high	Fbar (3-7) _low	Fbar (3-7) _value	Fbar (3-7) _high
1970	35141	50117	71477	12985	15969	19639	9415	11983	15251	1334	1762	2327	0.122	0.166	0.226
1971	13986	19866	28217	12090	14765	18032	8773	11036	13883	1487	1889	2399	0.139	0.186	0.25
1972	42097	59342	83652	11937	14443	17475	8195	10220	12745	1224	1547	1955	0.127	0.171	0.229
1973	23548	33032	46336	11255	13514	16227	7294	9009	11126	1100	1382	1736	0.128	0.172	0.229
1974	22875	32145	45171	10989	13096	15606	7449	9057	11012	1070	1341	1680	0.128	0.171	0.228

year	R(age 1)_low	R(age 1)_value	R(age 1)_high	TSB _low	TSB _value	TSB _high	SSB _low	SSB _value	SSB _high	Catch _low	Catch _value	Catch _high	Fbar (3-7) _low	Fbar (3-7) _value	Fbar (3-7) _high
1975	16315	22950	32282	10050	11914	14125	7097	8566	10340	1134	1420	1777	0.136	0.18	0.239
1976	47573	67050	94501	11243	13315	15770	6786	8210	9933	1193	1504	1897	0.145	0.193	0.258
1977	31719	44011	61067	10277	12099	14245	6037	7271	8758	924	1163	1465	0.128	0.17	0.225
1978	27652	38444	53449	9980	11685	13683	6381	7617	9092	917	1153	1450	0.128	0.169	0.223
1979	19728	27479	38276	10488	12199	14190	7181	8486	10030	1344	1684	2110	0.163	0.214	0.28
1980	15061	20973	29206	9644	11191	12986	6919	8136	9567	1478	1846	2305	0.195	0.255	0.332
1981	7260	10147	14183	8238	9604	11198	6175	7297	8623	1245	1563	1961	0.171	0.222	0.29
1982	17990	24978	34680	7496	8742	10196	5672	6727	7977	1120	1417	1793	0.159	0.209	0.274
1983	45637	63000	86970	8270	9611	11170	4992	5939	7065	957	1207	1522	0.165	0.215	0.281
1984	55327	76211	104978	10716	12480	14534	5171	6051	7082	785	990	1249	0.148	0.193	0.253
1985	65456	93058	132300	13729	15978	18596	6613	7666	8888	1025	1295	1636	0.174	0.226	0.293
1986	14823	20386	28036	12760	14729	17002	7595	8731	10036	1639	2063	2597	0.242	0.309	0.395
1987	11714	15711	21073	11406	13097	15039	8120	9362	10794	2322	2924	3684	0.292	0.371	0.472
1988	12684	16874	22448	8873	10138	11582	6374	7343	8459	1691	2123	2667	0.224	0.286	0.366
1989	18303	24413	32562	7327	8397	9624	5295	6145	7131	1398	1761	2217	0.205	0.263	0.336
1990	39783	52966	70519	7136	8174	9364	4759	5540	6448	1222	1571	2020	0.248	0.319	0.409
1991	14248	18962	25235	6542	7494	8585	4308	4982	5760	819	1041	1323	0.194	0.251	0.324
1992	17104	22728	30200	6844	7813	8920	4246	4903	5661	966	1214	1525	0.198	0.252	0.322
1993	13879	18588	24894	5884	6704	7637	3811	4395	5069	889	1114	1394	0.191	0.246	0.316
1994	6486	8638	11503	5497	6271	7155	2964	3446	4006	1118	1387	1720	0.229	0.29	0.368
1995	7914	10555	14076	5041	5763	6589	2984	3467	4028	990	1241	1555	0.24	0.305	0.388
1996	23448	31296	41770	4614	5288	6060	2542	2958	3441	795	987	1226	0.25	0.316	0.4
1997	20846	27895	37326	4646	5348	6155	1884	2209	2590	731	913	1139	0.268	0.338	0.427
1998	16529	22068	29463	5160	5947	6852	2141	2497	2913	773	982	1249	0.245	0.311	0.397
1999	20950	27842	37002	5551	6363	7294	2344	2723	3162	736	930	1173	0.195	0.251	0.324
2000	12915	17181	22855	5494	6296	7214	3113	3603	4171	696	876	1104	0.17	0.221	0.287
2001	6727	8975	11974	5172	5927	6792	2817	3269	3794	851	1072	1351	0.202	0.262	0.339
2002	8497	11384	15253	4300	4941	5677	3357	3887	4501	884	1106	1383	0.258	0.333	0.431
2003	9117	12128	16134	3920	4553	5288	3189	3734	4371	839	1049	1310	0.237	0.309	0.402
2004	7523	10026	13360	4083	4774	5582	3406	4013	4729	607	778	997	0.172	0.23	0.307

year	R(age 1)_low	R(age 1)_value	R(age 1)_high	TSB _low	TSB _value	TSB _high	SSB _low	SSB _value	SSB _high	Catch _low	Catch _value	Catch _high	Fbar (3-7) _low	Fbar (3-7) _value	Fbar (3-7) _high
2005	4710	6293	8407	3533	4136	4842	2848	3364	3974	664	841	1066	0.26	0.343	0.453
2006	6061	8093	10807	2776	3292	3904	1773	2150	2606	420	527	660	0.189	0.251	0.333
2007	6772	9045	12079	2738	3253	3866	1842	2232	2703	331	419	530	0.143	0.193	0.26
2008	8770	11774	15808	2478	2937	3481	1292	1573	1915	262	329	415	0.153	0.205	0.275
2009	5664	7672	10393	2348	2793	3323	1487	1802	2183	251	318	403	0.123	0.166	0.224
2010	2742	3714	5030	2366	2827	3377	1795	2166	2614	251	316	397	0.118	0.158	0.212
2011	3562	4810	6496	2311	2765	3308	1893	2284	2756	266	332	416	0.115	0.154	0.206
2012	3490	4722	6389	2176	2630	3178	1708	2088	2552	205	260	330	0.099	0.135	0.183
2013	4590	6202	8380	2010	2441	2965	1487	1835	2265	139	175	219	0.078	0.105	0.142
2014	6353	8613	11677	2006	2437	2962	1401	1738	2155	85	107	134	0.048	0.065	0.088
2015	13711	18558	25116	2477	2987	3602	1378	1701	2101	62	78	99	0.033	0.045	0.06
2016	9416	12702	17136	2978	3564	4266	2254	2717	3276	34	44	55	0.015	0.02	0.027
2017	17478	23613	31900	4153	4931	5855	2618	3135	3755	32	41	52	0.009	0.012	0.016
2018	12458	16877	22863	4947	5835	6882	3801	4503	5333	37	48	61	0.009	0.012	0.017
2019	21611	29707	40836	5601	6587	7747	4268	5035	5939	256	332	429	0.056	0.076	0.104
2020	7565	10399	14295	5414	6392	7547	4588	5432	6430	337	426	537	0.069	0.093	0.125
2021	8697	12260	17284	5500	6511	7708	4870	5790	6885	421	531	670	0.076	0.102	0.137
2022	8255	12998	20467	4689	5588	6659	4120	4927	5893	441	557	704	0.109	0.148	0.202
2023	7292	16997	39618	4212	5251	6546	3306	4026	4903	293	374	477	0.07	0.098	0.135

Table 31.14. Sol.27.7a – Short term forecast.

Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{ages\ 3–7}$ (2024)	0.116	F = Faverage (2021-2023)
SSB(2025)	4647	Short-term forecast; tonnes
$R_{age\ 1}$ (2024, 2025)	16877	Median recruitment, resampled from the years 2015–2022; in thousands
Catch (2024)	436	Short-term forecast; tonnes
Projected landings (2024)	382	Short-term forecast; assuming average landings ratio by age 2021–2023; in tonnes
Projected discards (2024)	54	Short-term forecast; assuming average discard ratio by age 2021–2023; in tonnes

Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings* (2025)	Projected discards** (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change ***	% TAC change ^	% advice change ^^	Probability of SSB (2026) < Blim (%)
ICES advice basis											
MSY approach: F = F_{MSY}	609	529	80	0.164	0.131	0.033	4502	-3.1	200	-2.6	0.06
Other scenarios											
$F_{MSY\ lower}$	472	410	62	0.125	0.1	0.025	4633	-0.3	133	-24	0.03
$F_{MSY\ upper}$	673	585	88	0.183	0.147	0.036	4442	-4.4	232	7.7	0.110
F = 0	0	0	0	0	0	0	5088	9.5	-100	-100	0
F= F_{pa}	717	623	94	0.196	0.157	0.039	4402	-5.3	253	14.7	0.140
F= F_{lim}	1786	1543	243	0.57	0.46	0.114	3471	-25	780	186	8.06
SSB_{2025} = B_{lim}	3239	2769	470	1.40	1.12	0.28	2235	-52	1496	420	50
SSB_{2025} = B_{pa} = MSY $B_{trigger}$	2189	1887	302	0.75	0.6	0.149	3129	-33	978	250	16
F = F_{2023}	457	397	60	0.121	0.097	0.024	4647	0	117	-27	0.02
SSB_{2025} = SSB_{2024}	440	382	58	0.116	0.093	0.023	4662	0.32	125	-30	0.01

***** SSB 2026 relative to SSB 2025.**

^ Total catch in 2025 relative to TAC 2024 (203 tonnes, dd May 2024).

^^ advice values for 2025 relative to the previous advice for 2024. The advice for 2024 was revised on 31 May 2024.

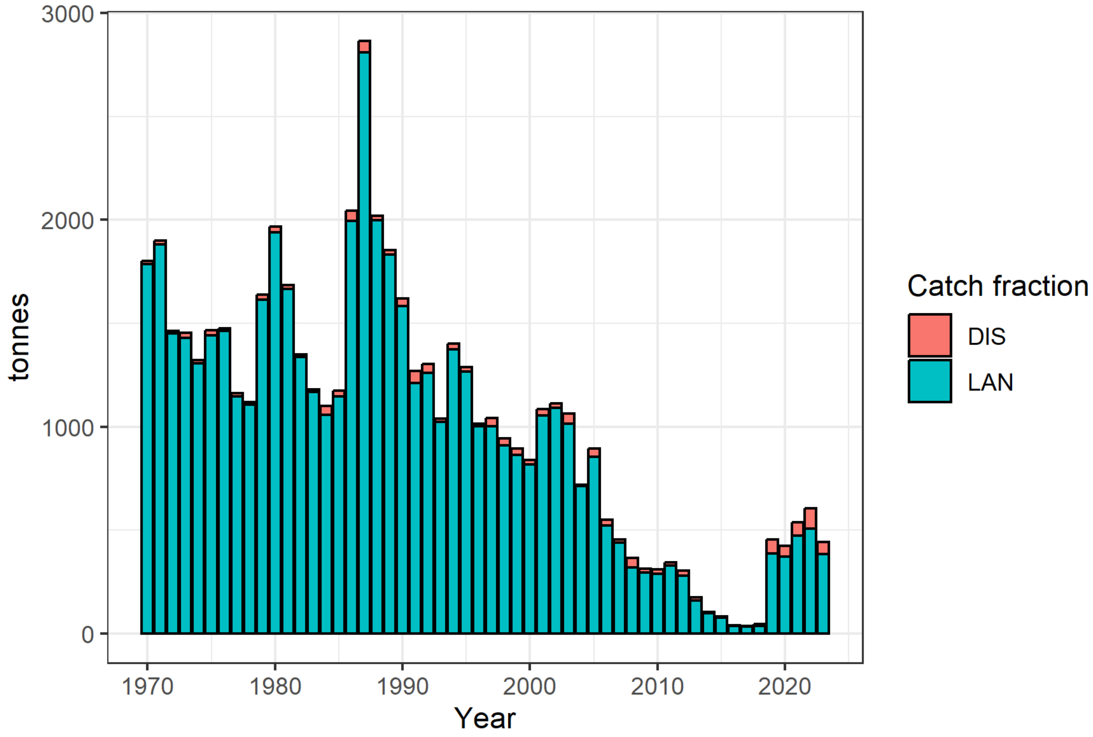


Figure 30.1. Sol.27.7a - Landings and discards estimates by weight, as used by the WG.

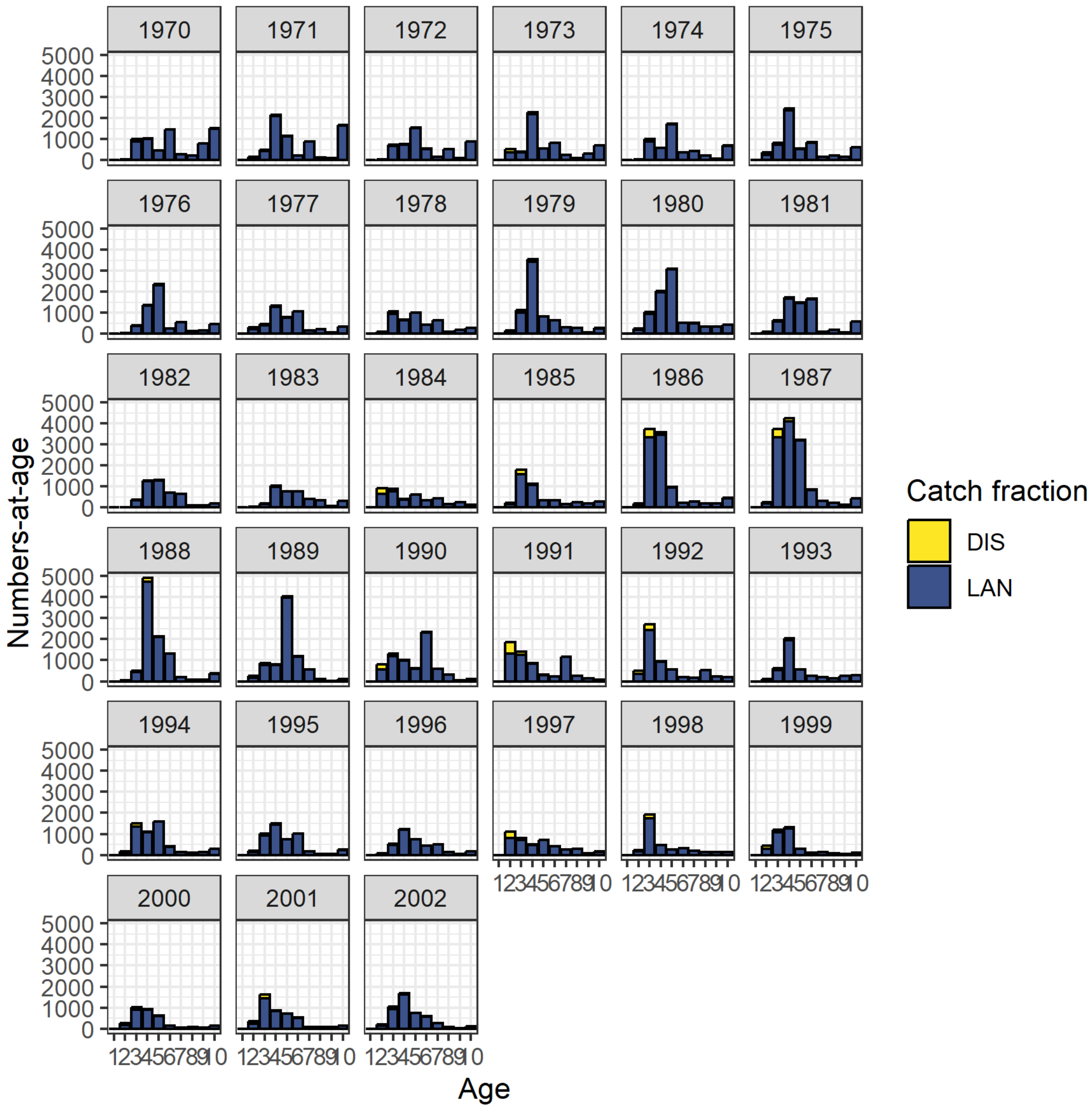


Figure 30.2a. Sol.27.7a - Age composition of catch.

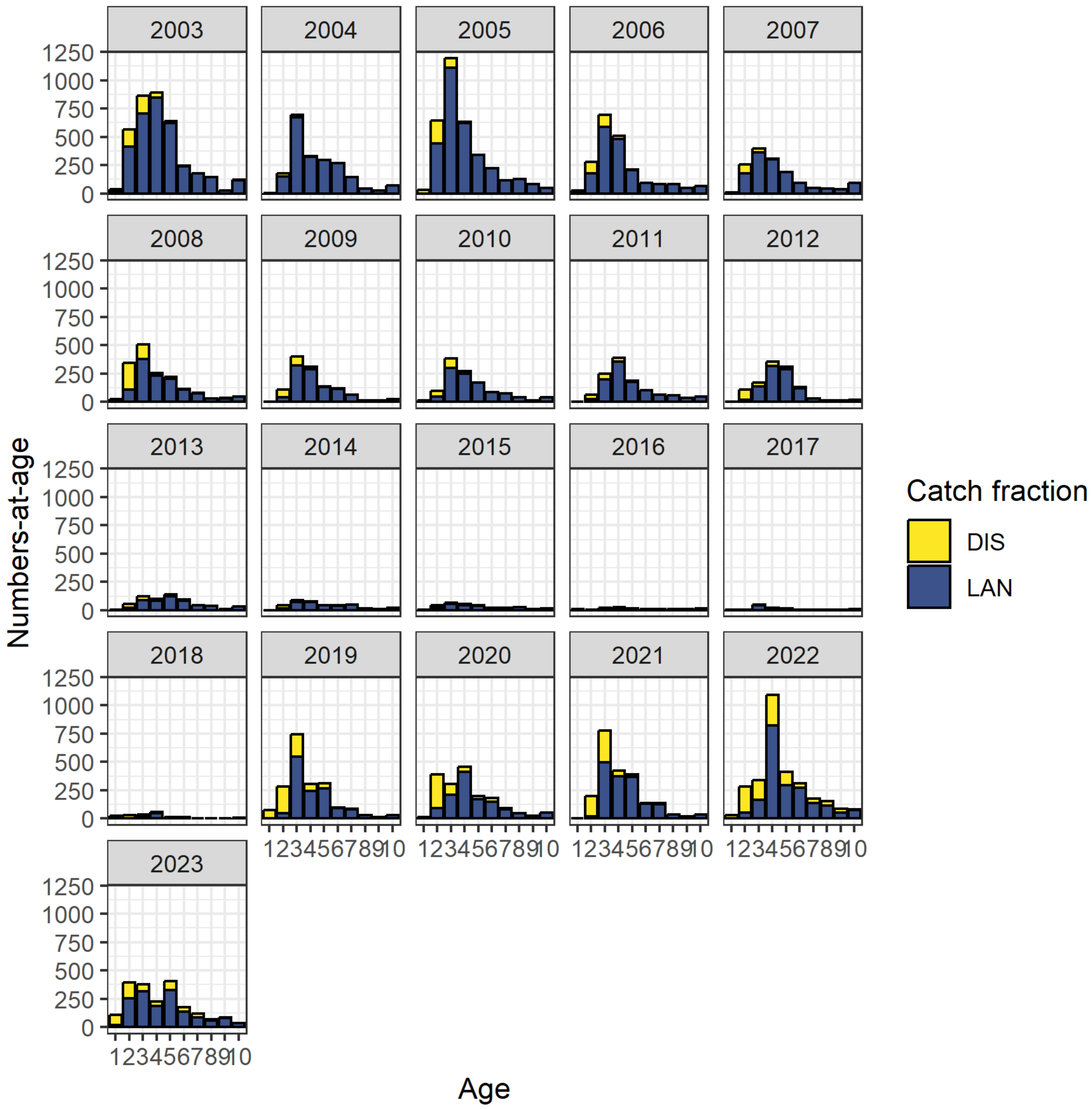


Figure 30.2b. Sol.27.7a - Age composition of catch.

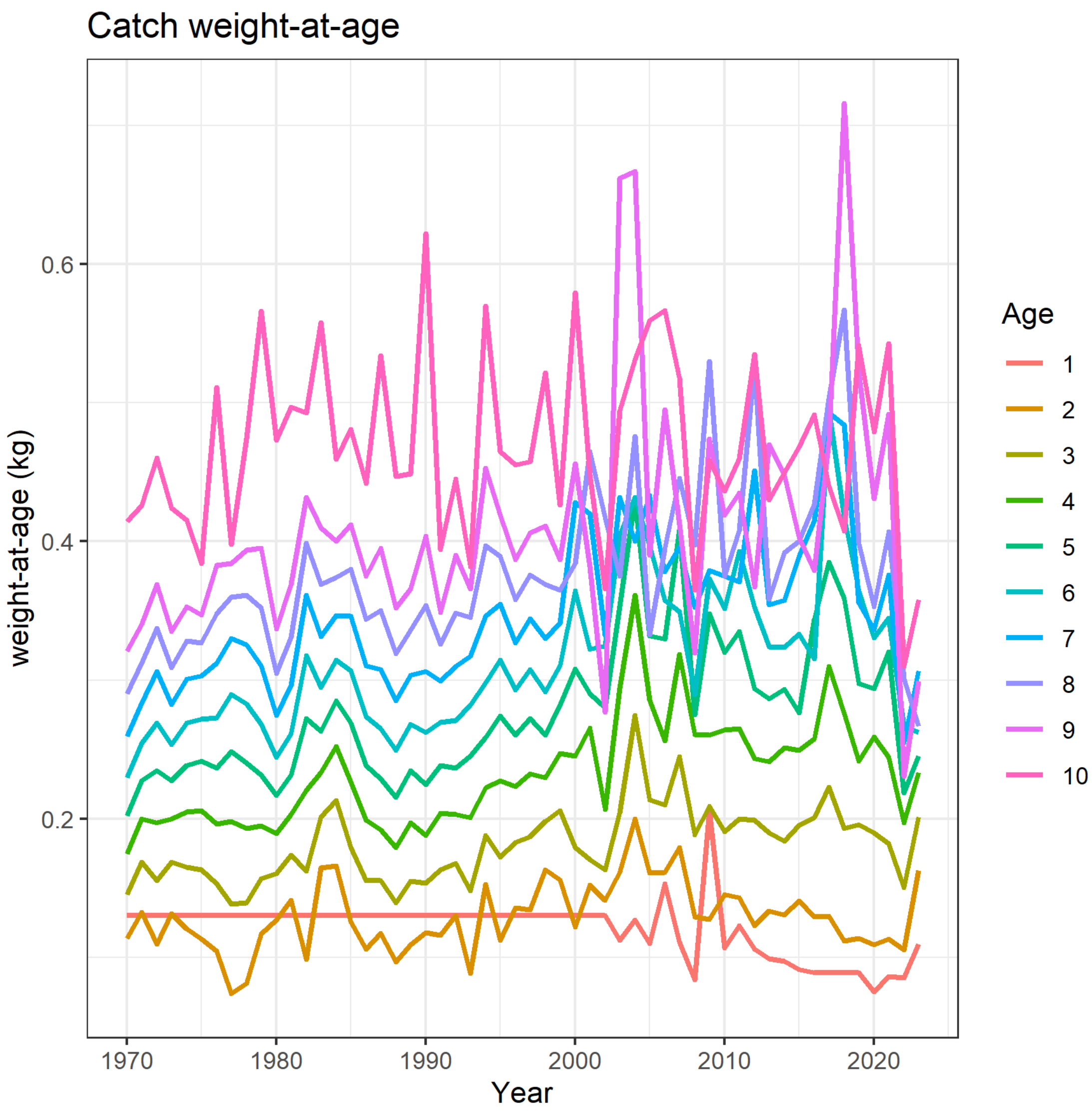


Figure 30.3. Sol.27.7a - Catch weights-at-age (kg).

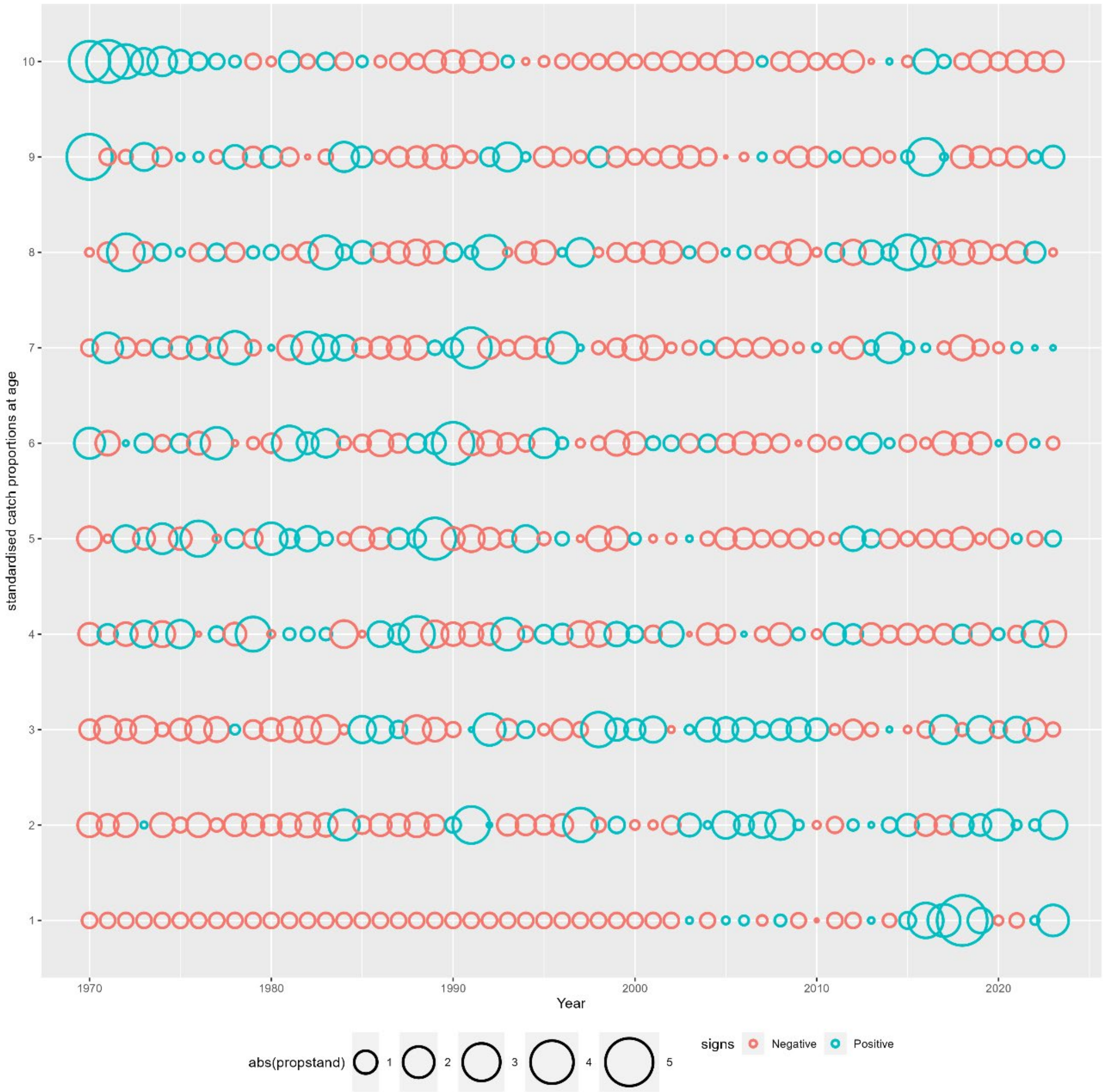


Figure 30.4. Sol.27.7a - Standardized catch proportions.

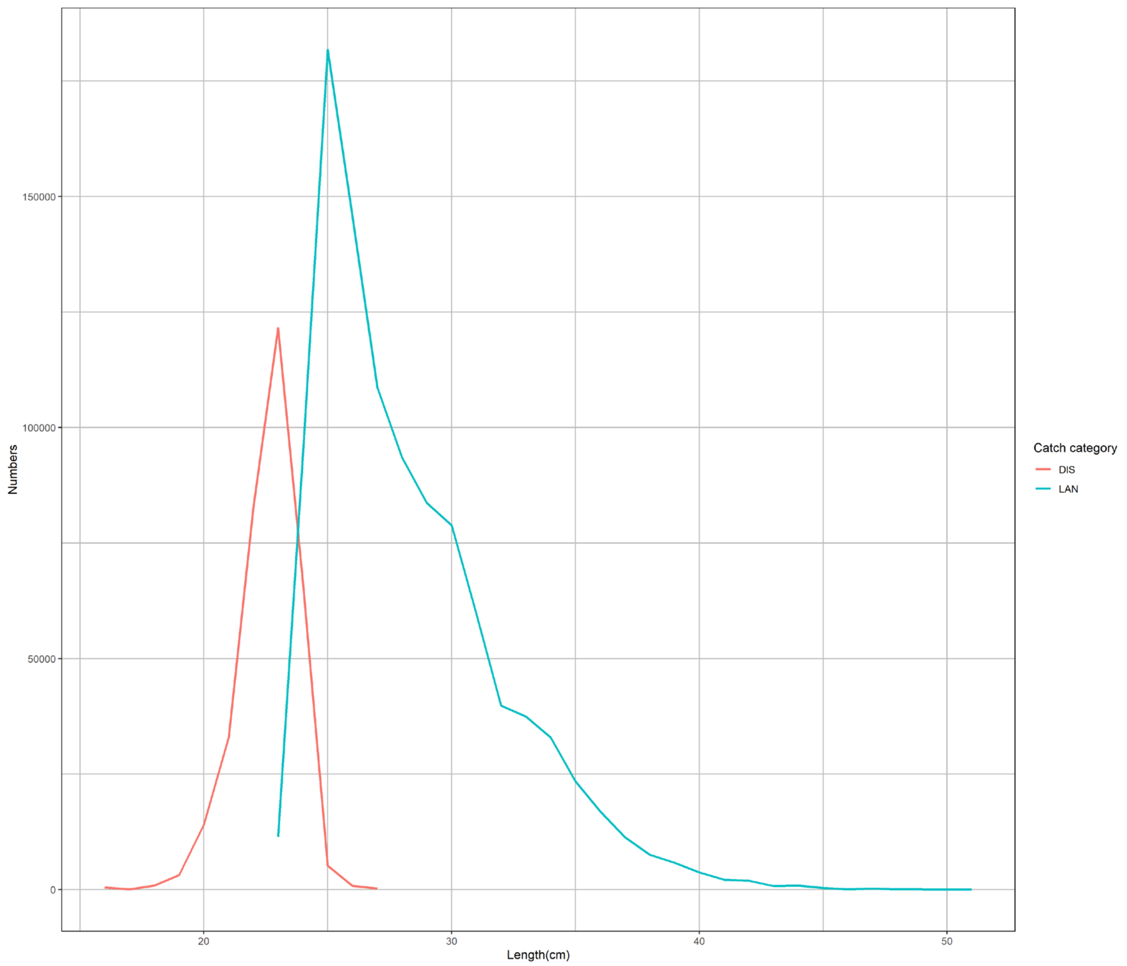


Figure 30.5. Sol.27.7a - Length distributions of discarded and retained fish from discard sampling studies in 2023 (Belgian Beam trawl).

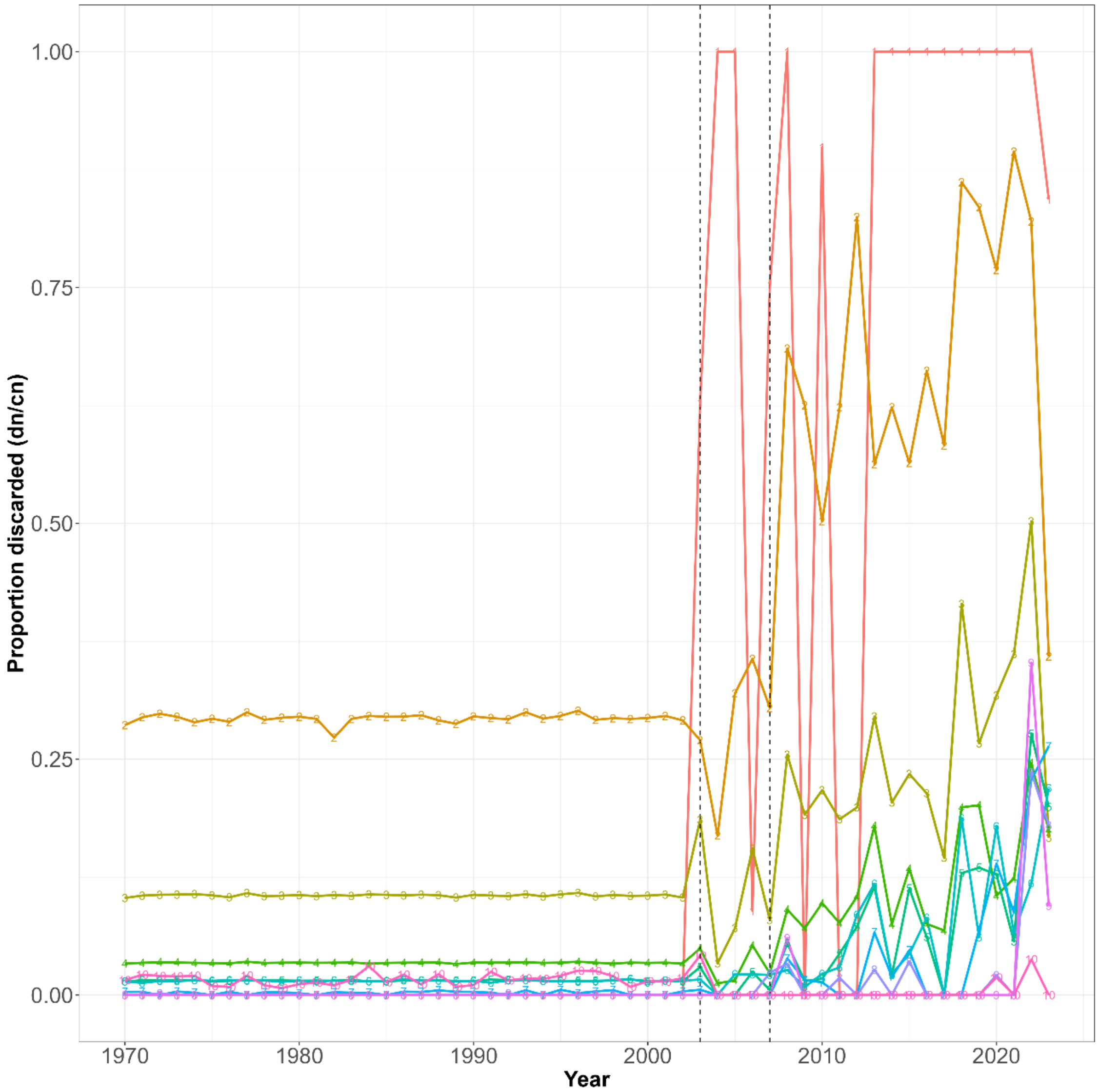


Figure 30.6. Sole 27.7.a - Proportion discarded (discard numbers at age/catch numbers at age) (data prior to 2003 are estimated using an average discard proportion at age for the period 2003-2007 (indicated by dotted lines)).

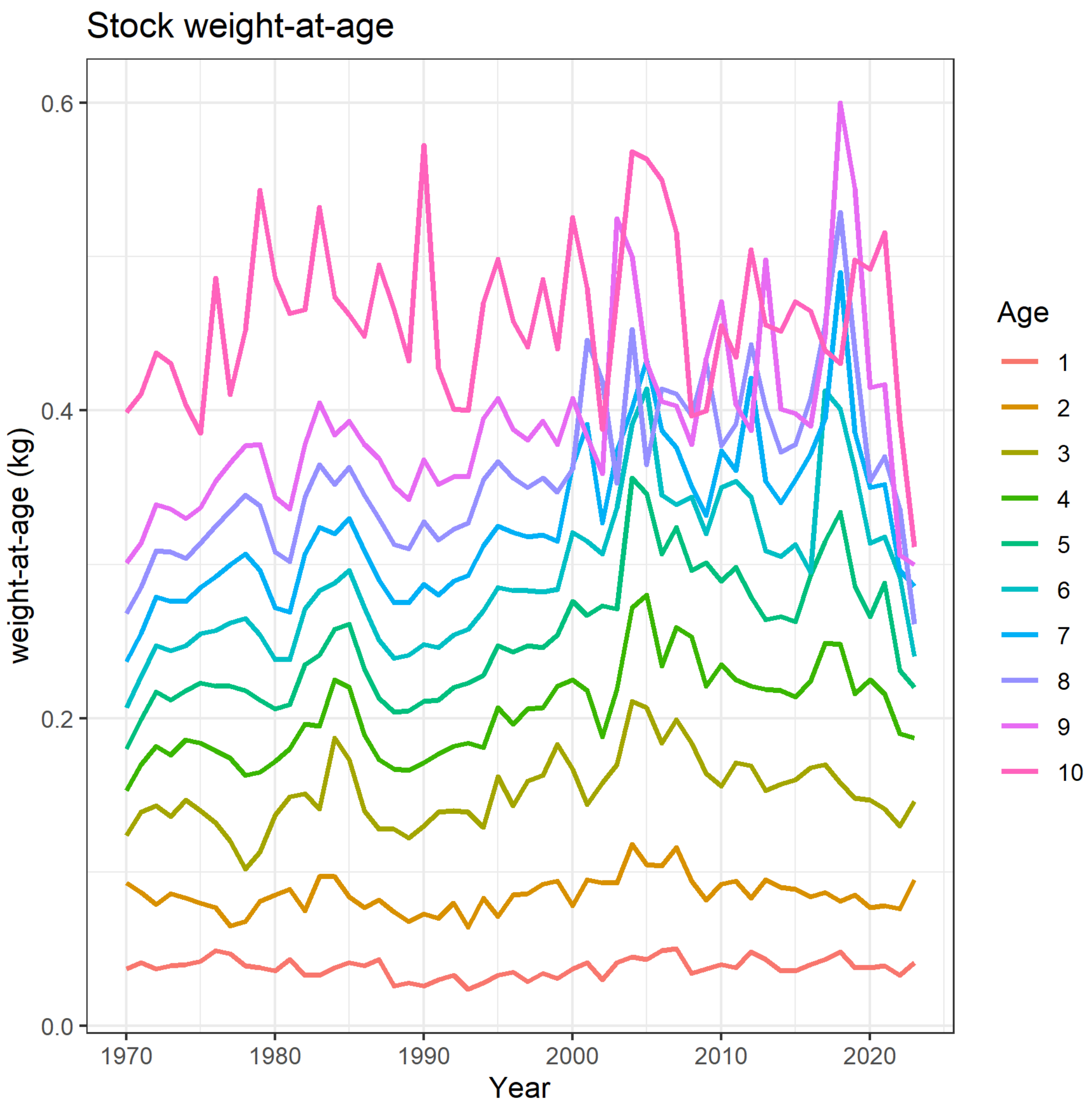


Figure 30.7. Sol.27.7a - Stock weights-at-age (kg).

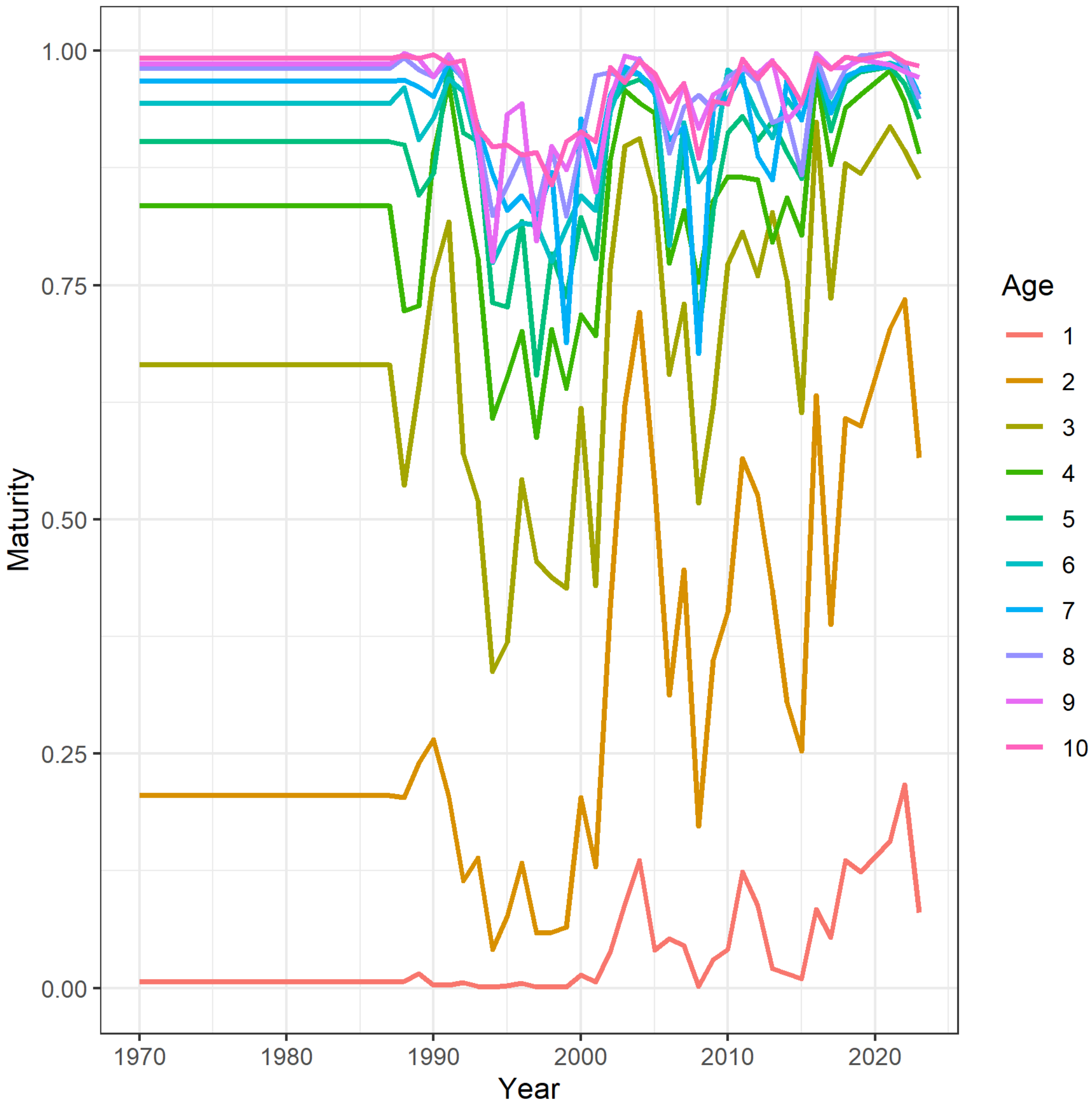


Figure 30.8. Sol.27.7a - Maturity-at-age.

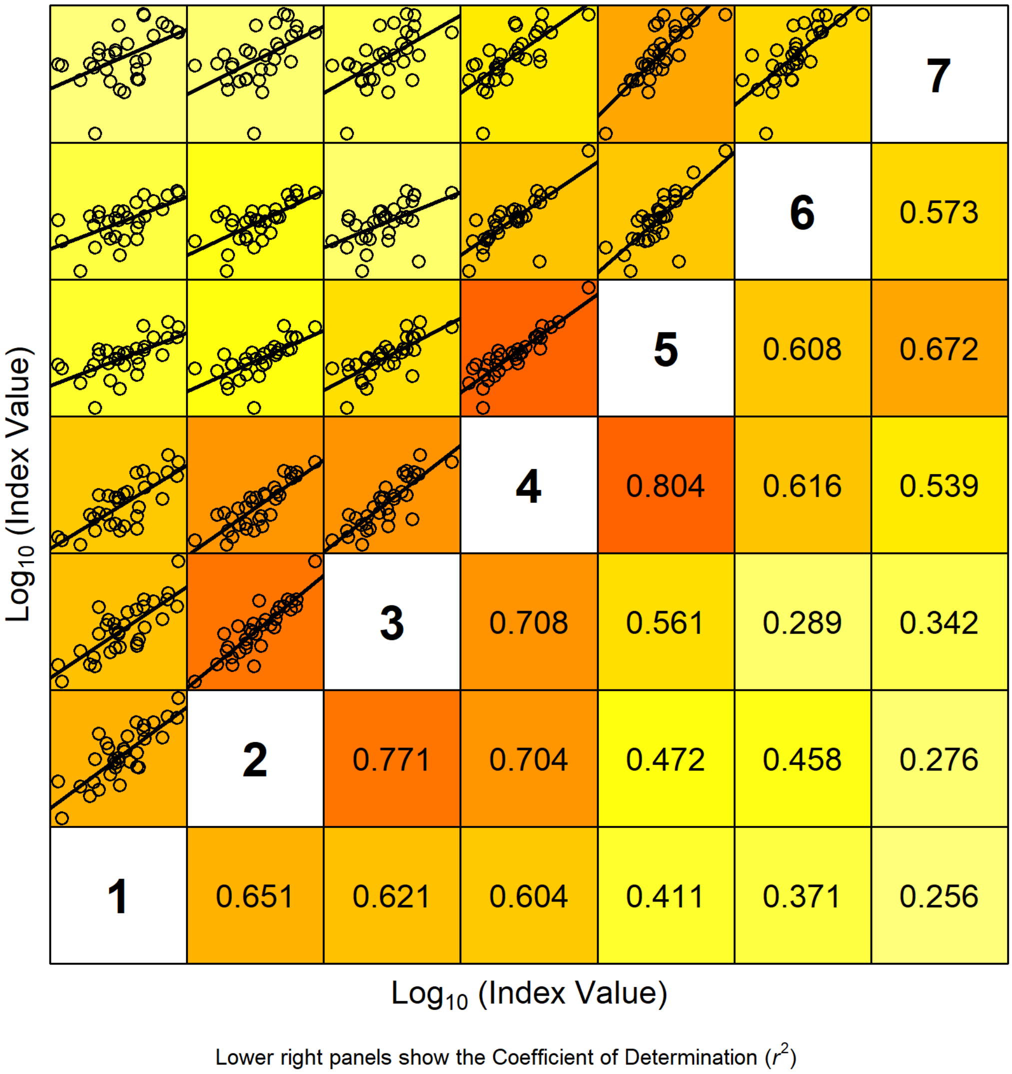


Figure 30.9. Sol.27.7a - Consistency plot UK(E&W)-BTS-Q3 survey.

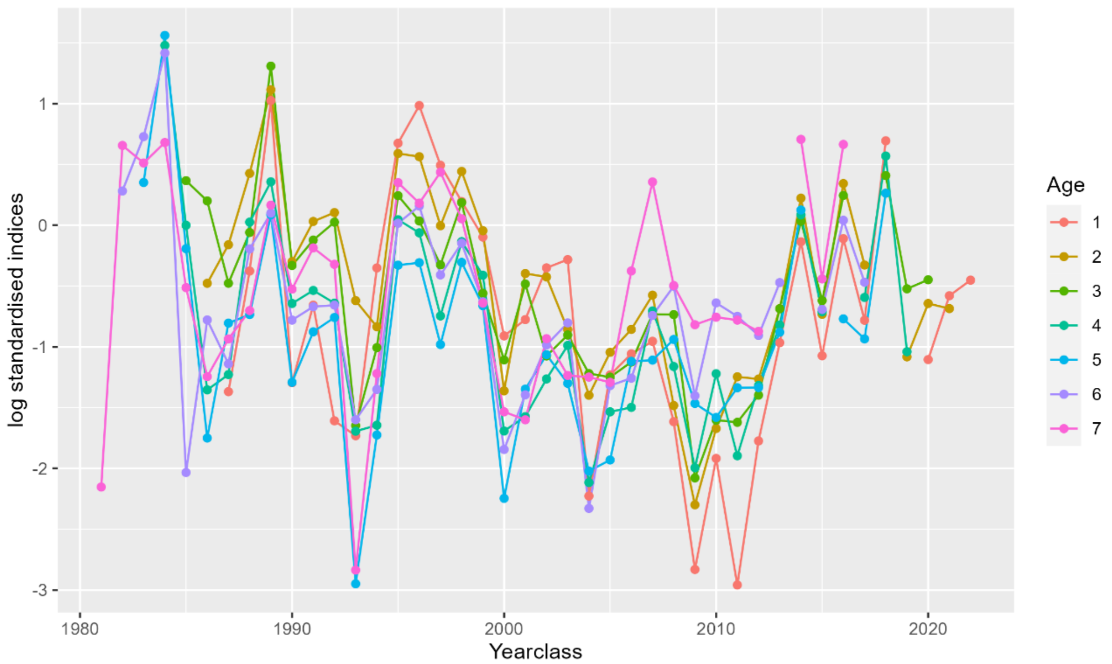


Figure 30.10a. Sol.27.7.a - Mean-standardised indices (UK(E&W)-BTS-Q3).

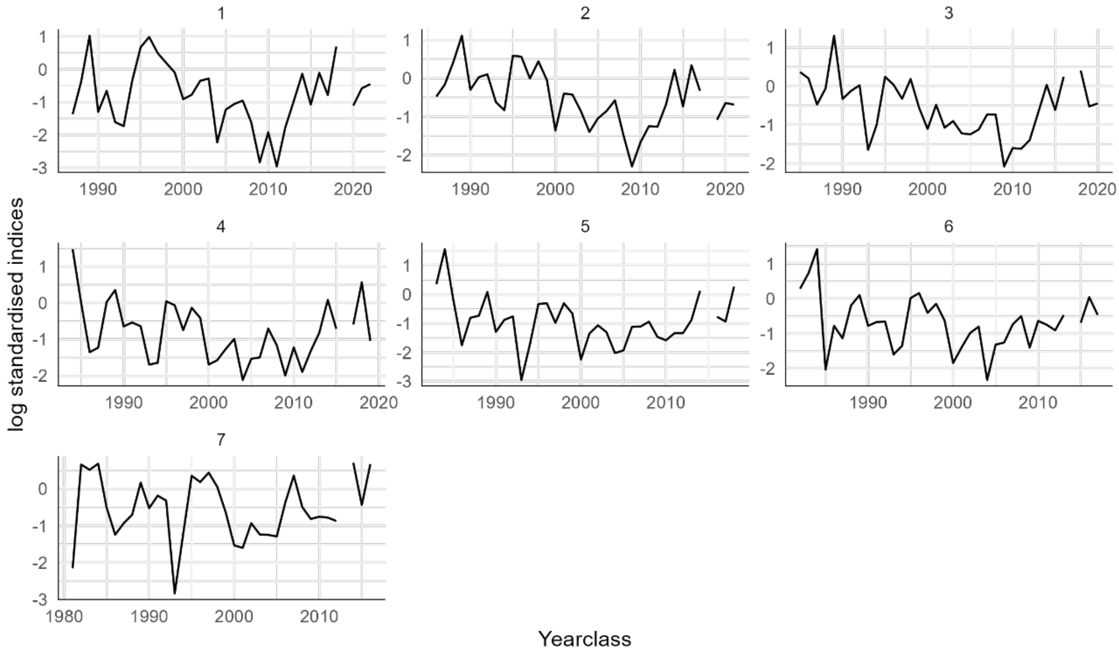


Figure 30.10b. Sol.27.7.a - Mean-standardised indices (UK(E&W)-BTS-Q3), plotted separate by age.

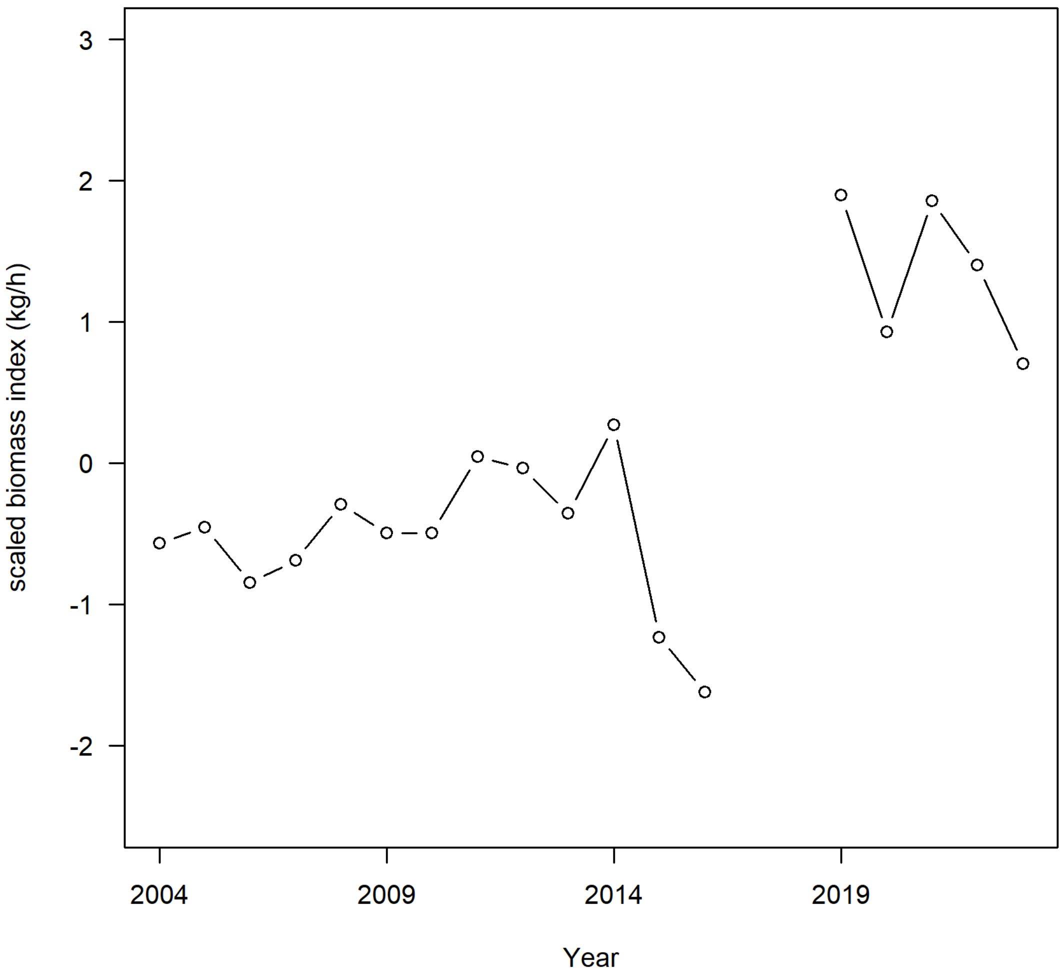


Figure 30.11a. Sol.27.7a - Commercial biomass tuning index (BEL-CBT).

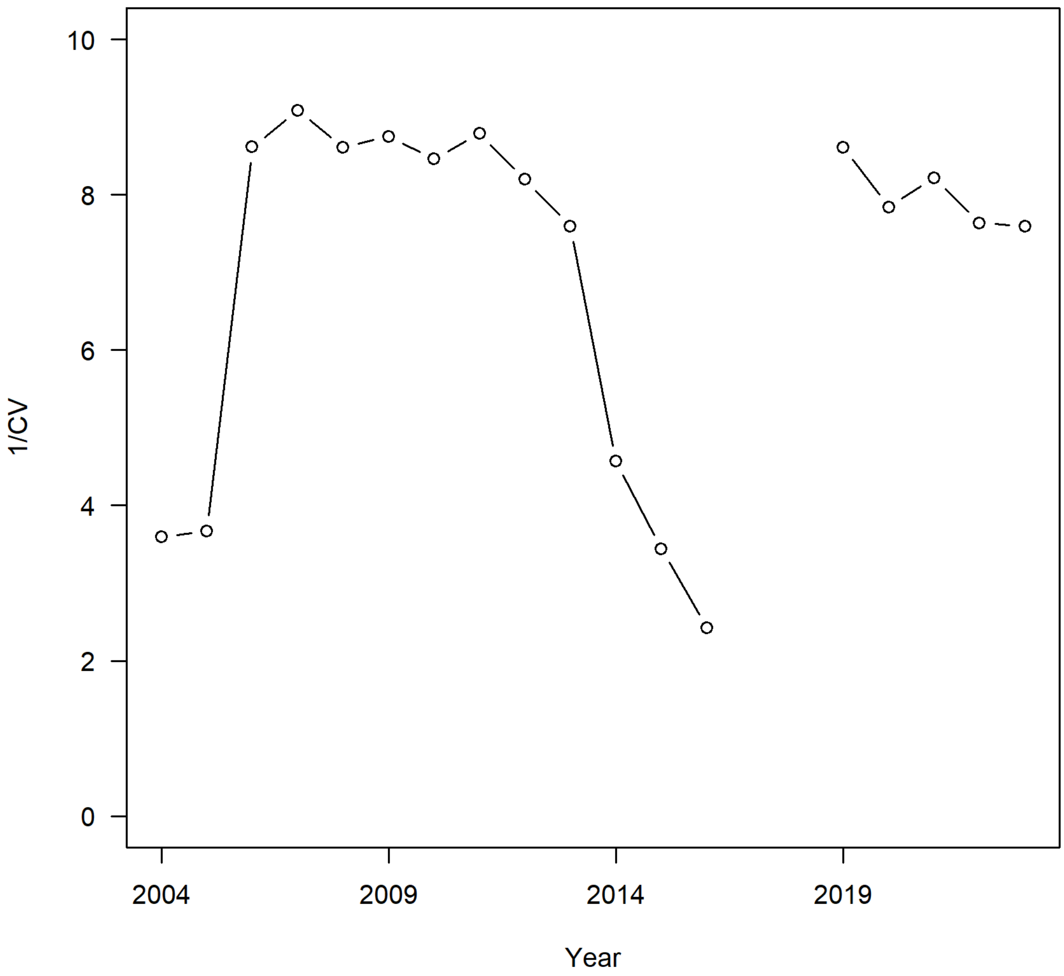


Figure 30.11b. Sol.27.7a- Weighting factor based on 1/CV applied on the biomass tuning series of BEL-CBT.

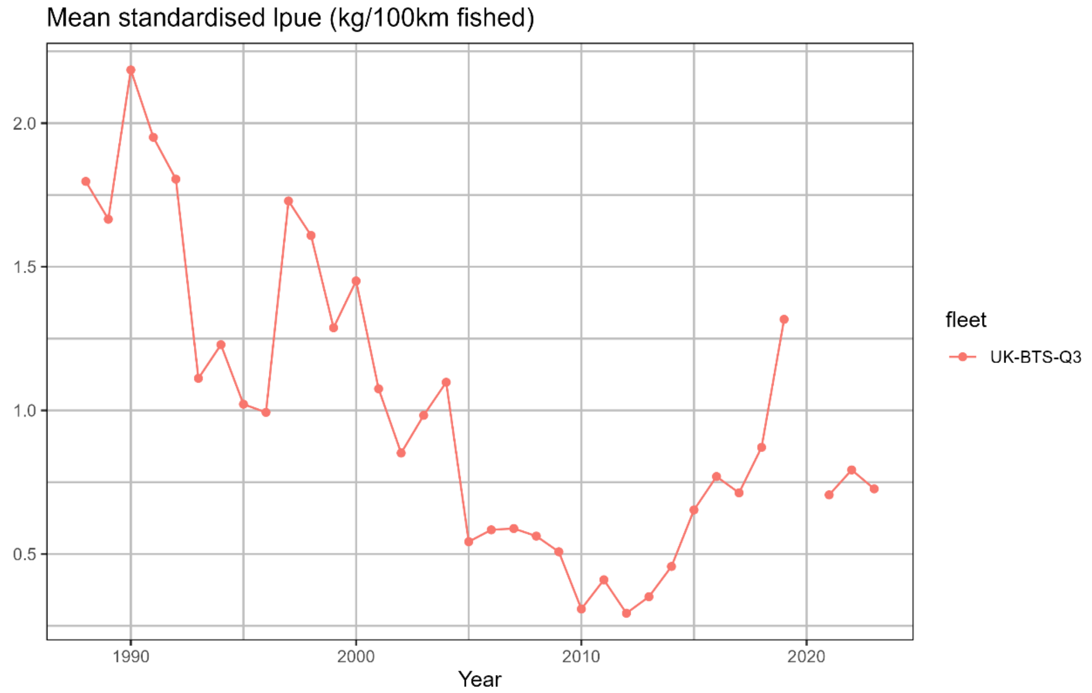
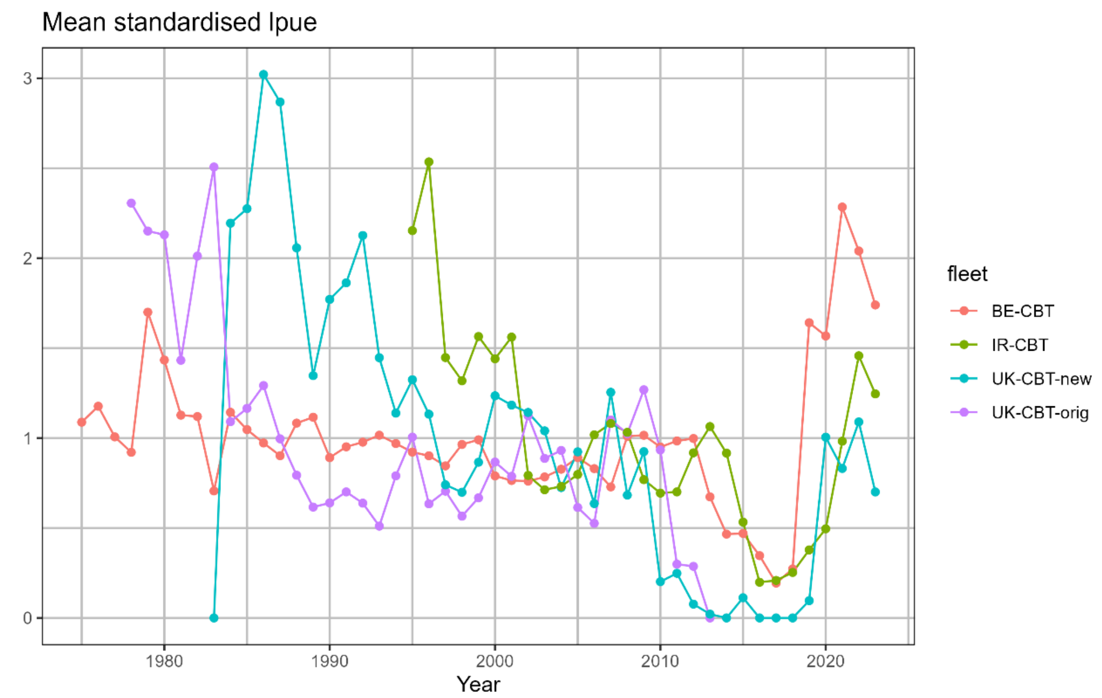
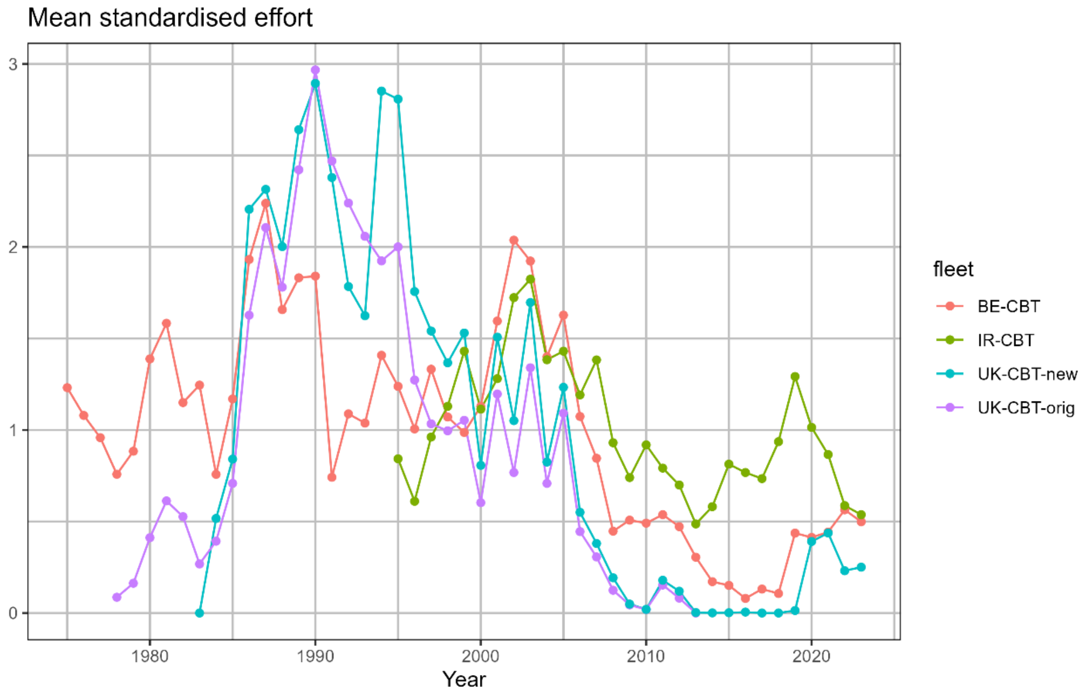


Figure 30.12 Sole in 7.a - Mean standardised LPUE (kg/100 Km fished) of UK(E&W)-BTS-Q3.

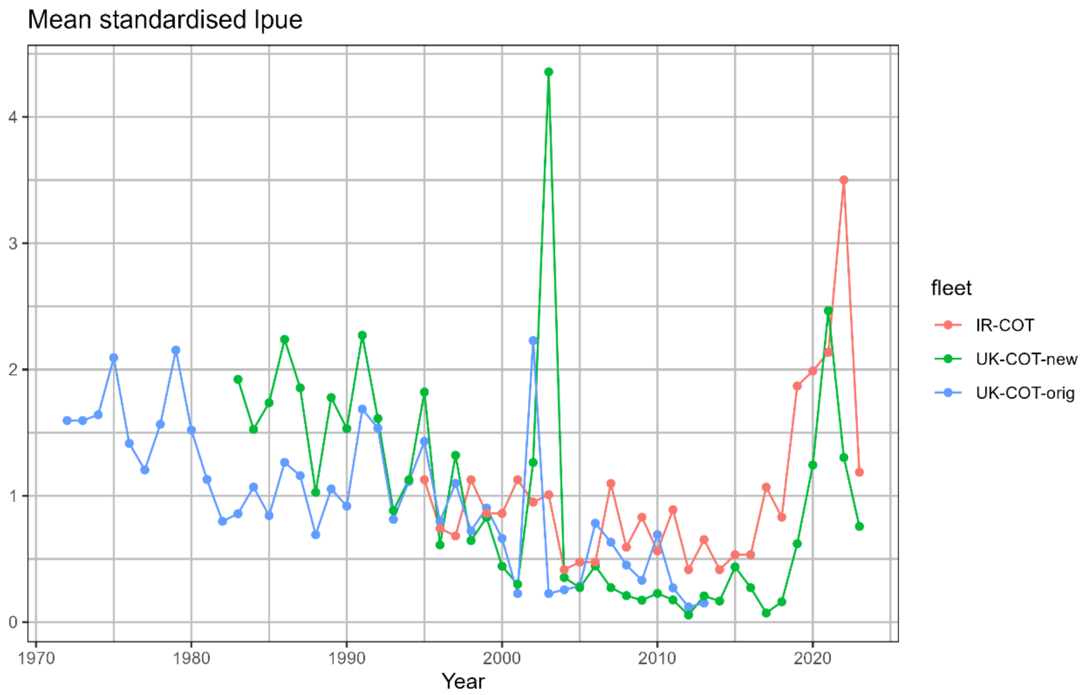


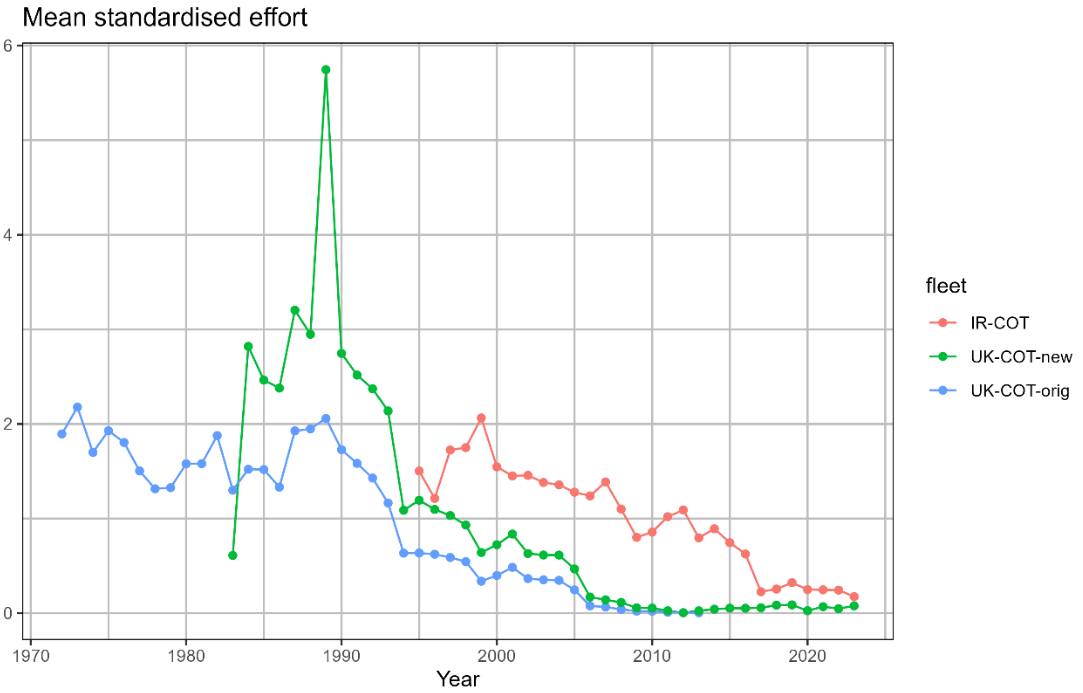


LPUE: BE-CBT (without misreporting correction) and IR-CBT: Kg/hr; UK-CBT-new: Kg/day; UK-CBT-orig: Kg/000'hr fished (GRT corrected >40' vessels).

EFFORT: BE-CBT: 000' hours fishing; IR-CBT: 000'hours; UK-CBT-new: days fished; UK-CBT-orig: 000'hours fished (GRT corrected >40' vessels).

Figure 30.13. Sole in 7.a - Mean standardised effort and LPUE for the commercial beam trawl fleets.





LPUE: IR-COT: Kg/hr; UK-COT-new: Kg/day; UK-COT-orig: Kg/000'hr fished (GRT corrected >40' vessels).

EFFORT: IR-CBT: 000'hours; UK-CBT-new: days fished; UK-CBT-orig: 000'hours fished (GRT corrected >40' vessels).

Figure 30.14. Sole in 7.a - Mean standardised effort and LPUE for the commercial otter trawl fleets.

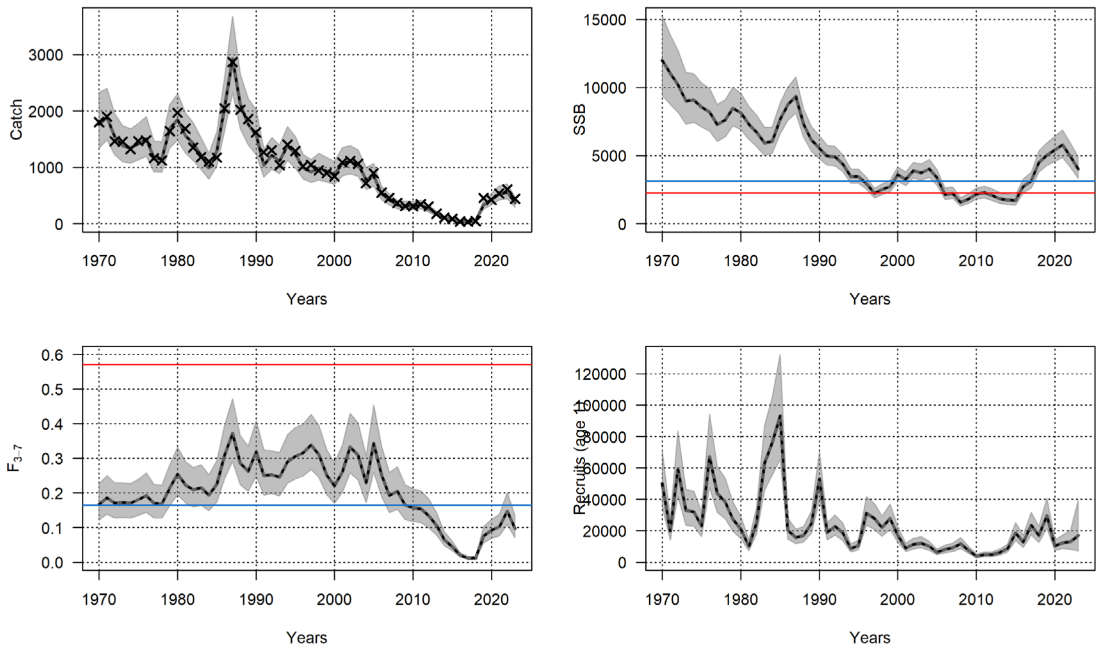


Figure 30.15. Sol.27.7a - Summary plots. Red lines = precautionary reference points (lim) and blue lines = MSY reference points

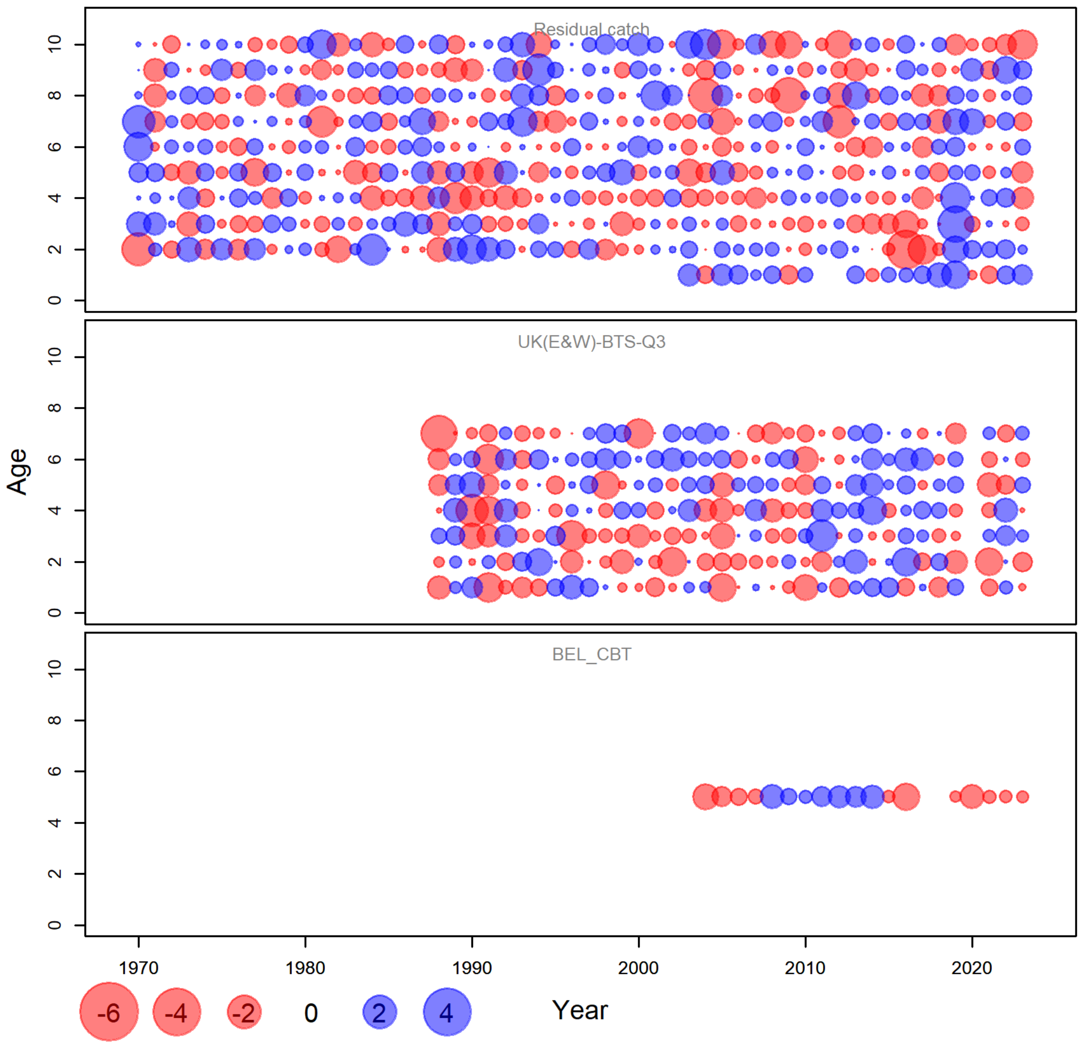


Figure 31.16. Sol.27.7a - One Step Ahead residuals for the final SAM run.

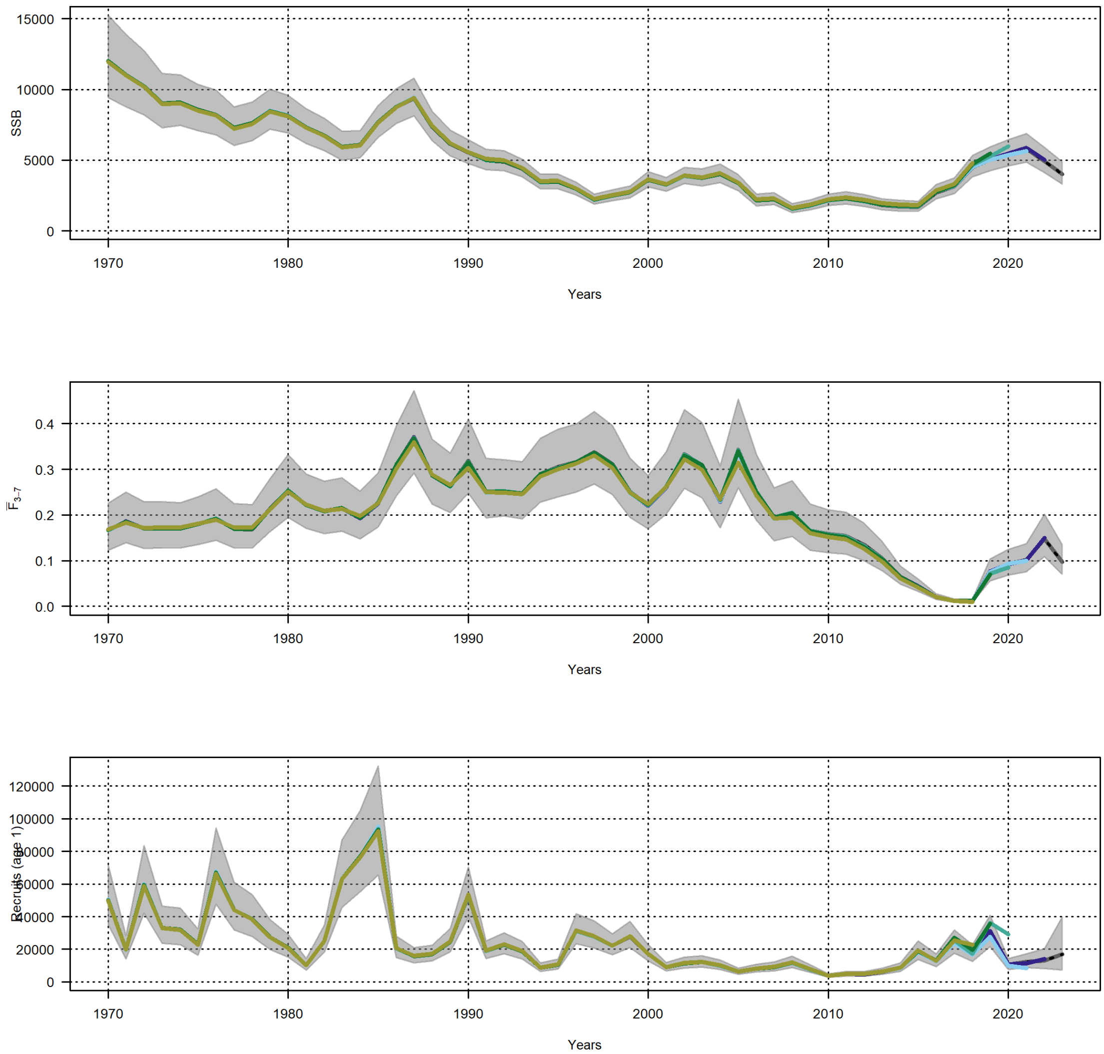


Figure 30.17. Sol.27.7a - Retrospective analysis.

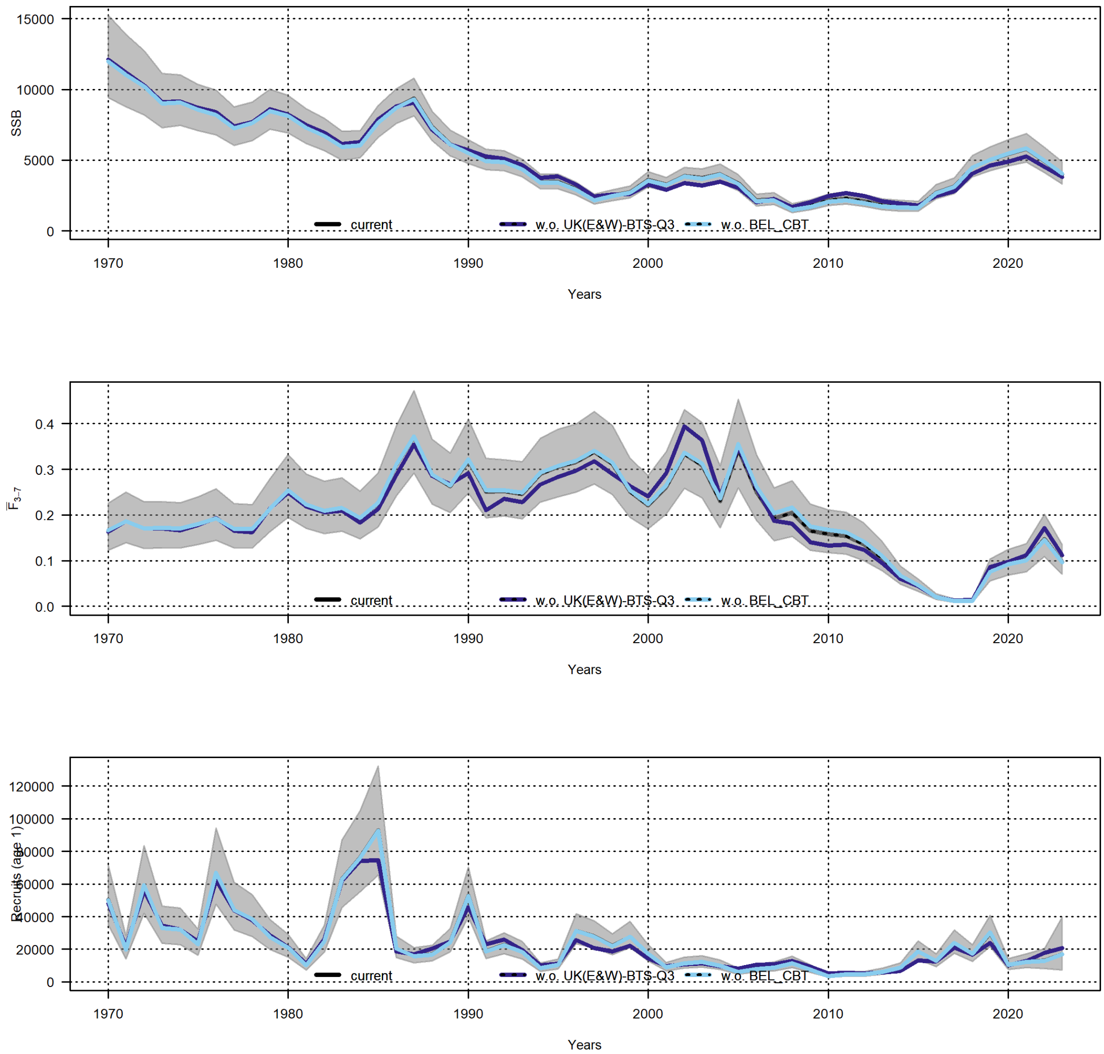


Figure 30.18. Sol.27.7a – Leave-one-out analysis.

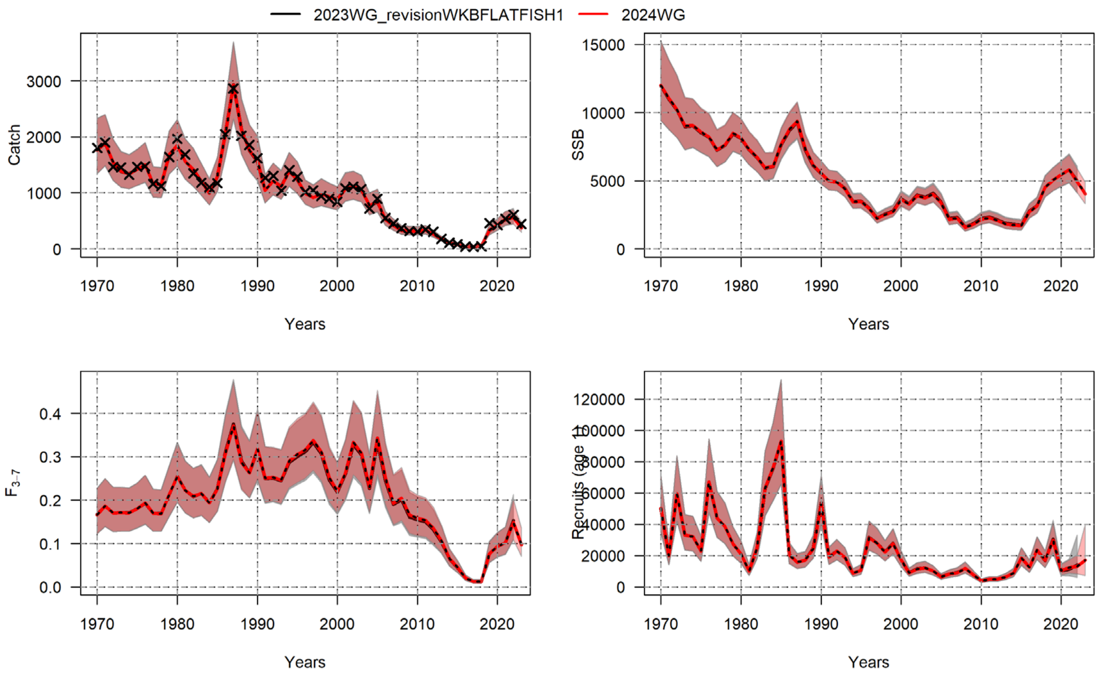


Figure 30.19. Sol.27.7a - comparison with last year's assessment (revised 2023WGCSE assessment).

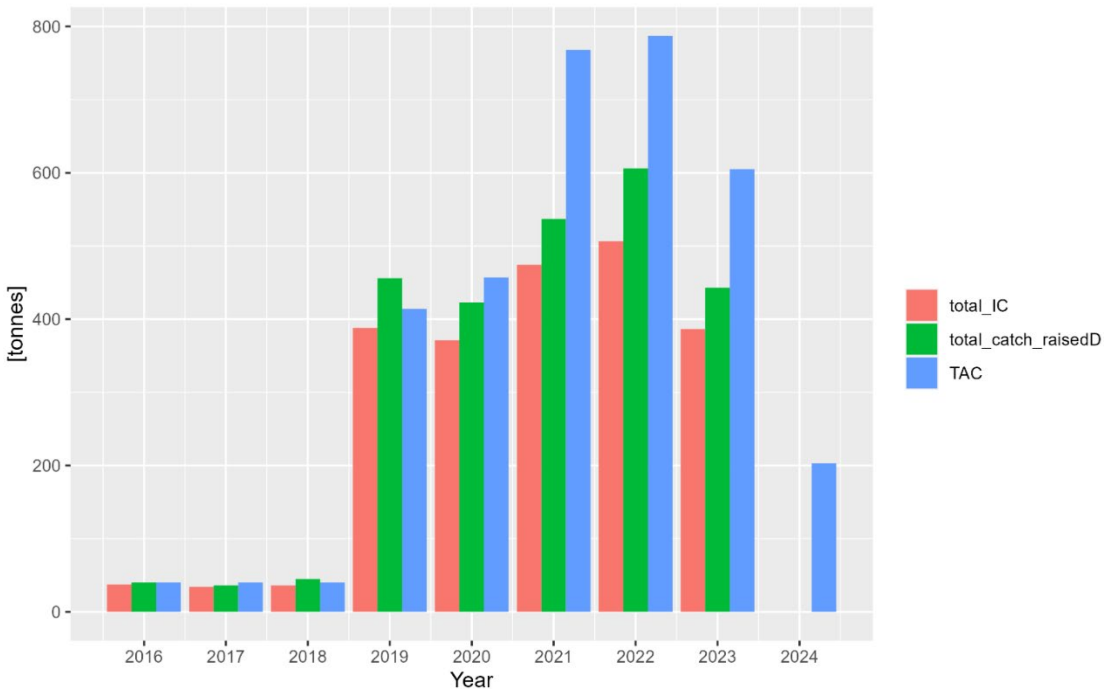


Figure 30.20. Sol.27.7a - Comparison of international TAC (TAC 2024: dd May 2024) , catch and landings.

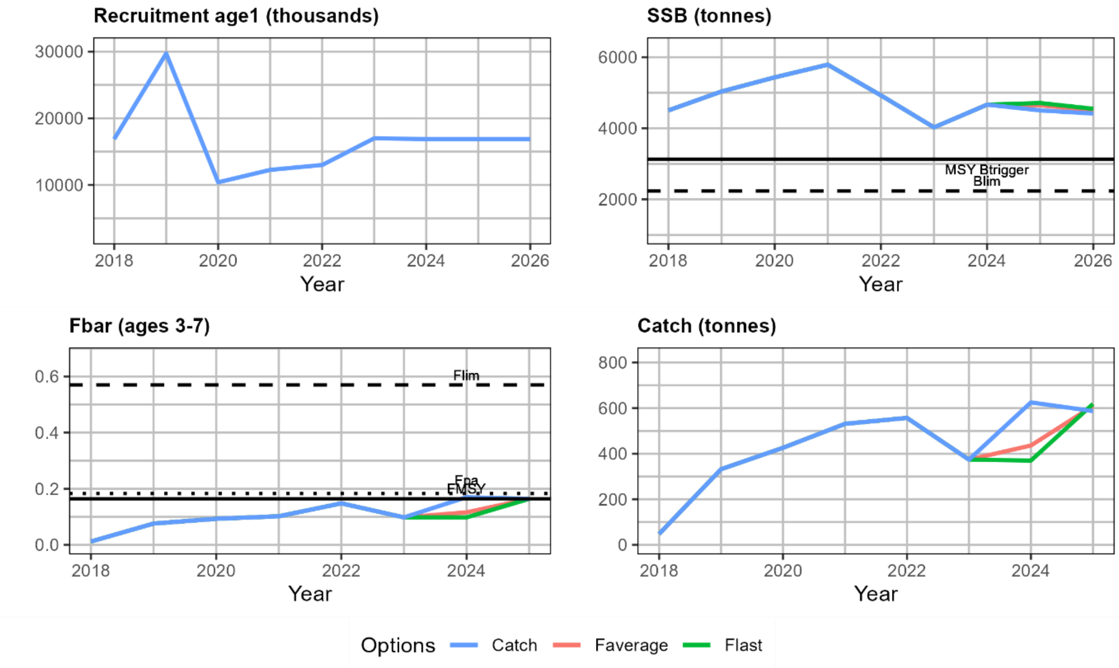


Figure 30.21. Sol.27.7a - Options for the intermediate year in the short-term forecast.

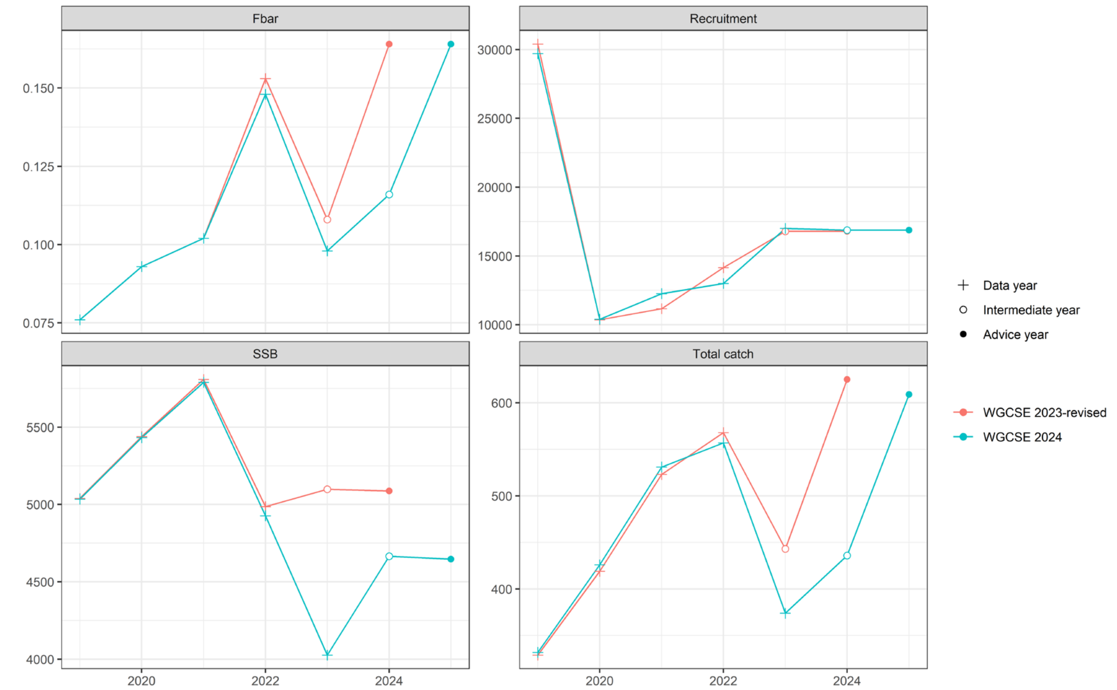


Figure 30.22. Sol.27.7a - comparison with last year's assessment (revised 2023WGCSE assessment) – short-term forecast assumptions.

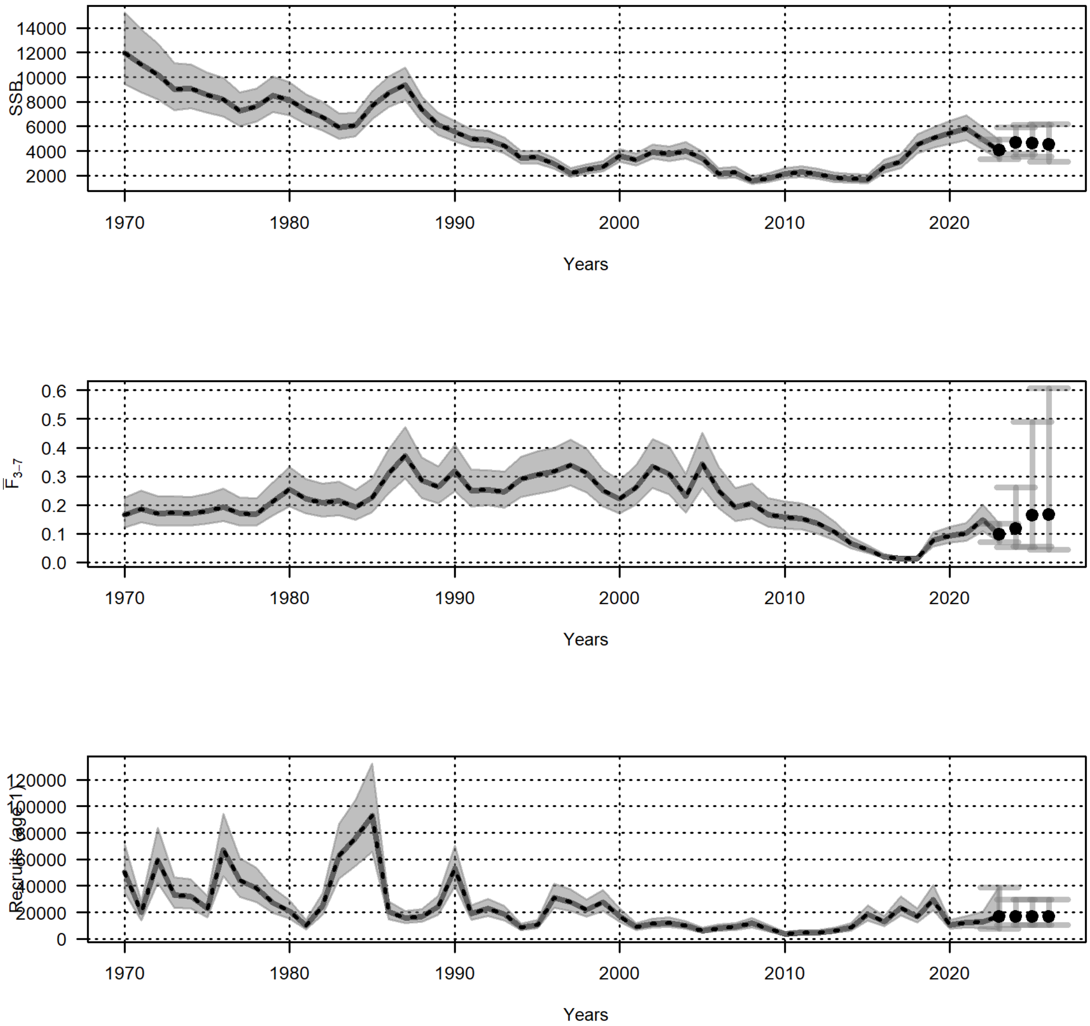


Figure 30.23. Sol.27.7a - SAM forecast assuming Faverage in the intermediate year followed by targeting F_{MSY} in subsequent years.

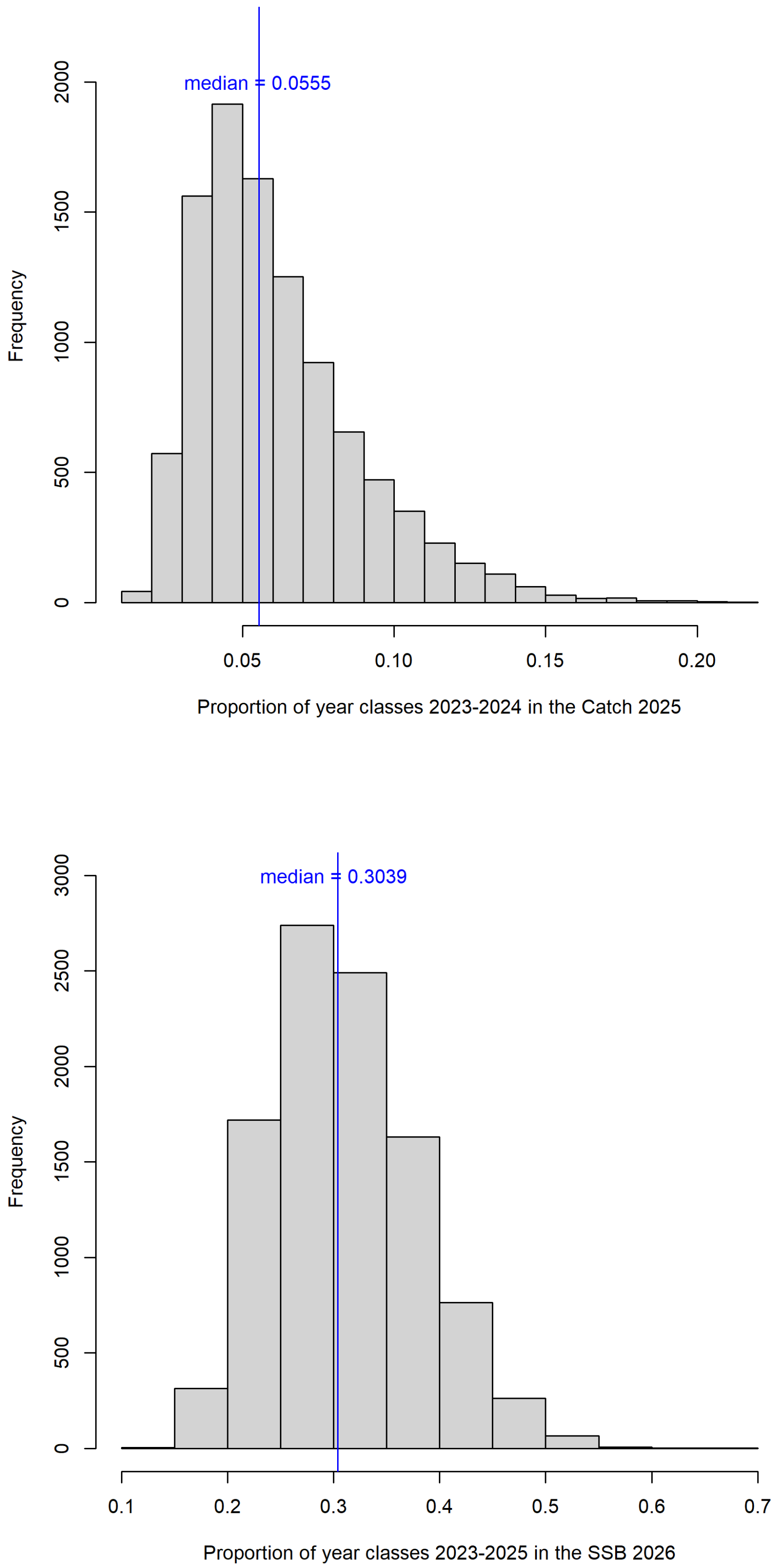


Figure 30.24. Sol.27.7a - Contributions of the recruitment assumption for the short-term forecast.

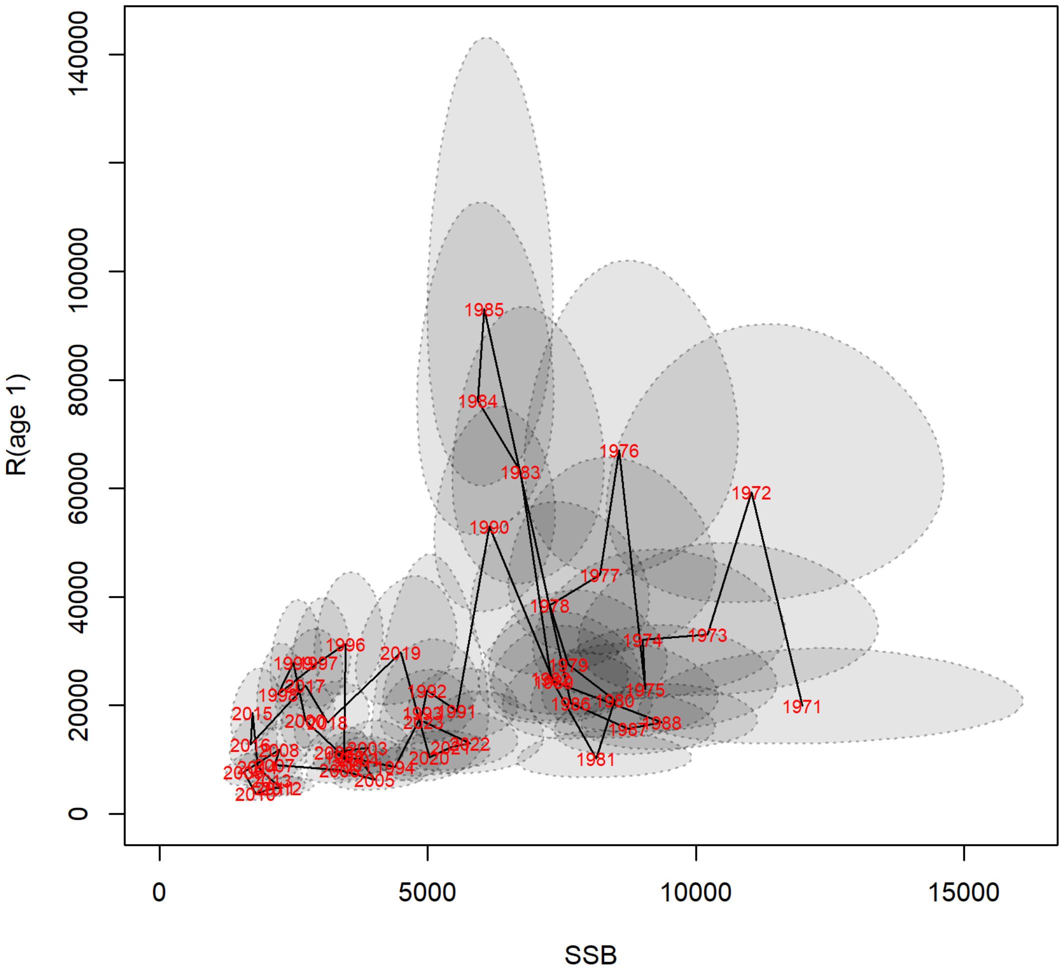


Figure 30.25. Sol.27.7a – Stock–recruitment plot.

Contents

31 Sole (*Solea solea*) in Divisions 7.b and 7.c

Type of assessment in 2024

There is no assessment for this stock. Advice is provided on a triennial basis (and was provided last year for 2024, 2025 and 2026) according to the approach outlined below.

In 2023, the updated advice followed the agreed procedures for category 6 as set out in the stock annex. For stocks without information on abundance or exploitation, ICES considers that a precautionary reduction of catches should be implemented unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

31.1 General

31.1.1 Advice

The advice for 2021, 2022 and 2023 was for catches of no more than 15 tonnes (Table 31.1).

ICES framework for category 6 stocks was applied (ICES, 2012). For stocks without information on abundance or exploitation, ICES considers that a precautionary reduction of catches should be implemented where there is no ancillary information clearly indicating that the current level of exploitation is appropriate for the stock. The precautionary buffer was last applied in 2020 (for the 2021-2023 advice), and with no new information available to support the current level of catches the precautionary buffer is applied for the 2024 advice. Discarding is considered negligible.

Table 31.1 Sole in divisions 7.b and 7.c. The basis for the catch scenarios. *

Advised catches (2021-2023)	19 tonnes	
Discard rate	Negligible	
Precautionary buffer	Applied	0.8
Catch advice **	15 tonnes	
% advice change ***	-20	

* The figures in the table are rounded. Calculations were done with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table.

** [Recent advised catch] × [precautionary buffer].

*** Advice value for 2024 relative to the advice value for 2023.

31.1.2 Stock identity

Sole in 7.b are mainly caught by Irish vessels on sandy grounds in coastal areas. Sole catches in 7.c are negligible. In 7.b there are two distinct areas where sole are caught: an area around Galway Bay and an area in the north of 7.b, which extends into 6.a (the Stags and Broadhaven Ground). The landings and lpue of sole in 7.bc appear to have been more or less stable since the start of the logbooks' time-series in 1995. It is not known how much exchange there is between sole on the Aran Grounds and those on the Stags and Broadhaven Ground.

31.2 Data

The time-series of official landings is presented in Table 32.2 and Figure 32.1a and b. In recent years the official landings differ from the ICES estimates due to confidentiality of data reported to Eurostat. The ICES estimated landings are presented in figure 31.2.

The time-series of otter-trawl landings effort and LPUE since 1995 are shown in Figure 32.3. Landings and effort have gradually declined since the late 1990s and early 2000s, giving rise to relatively stable LPUE over the time-series, with fluctuations. In 2023, there were 12 sampling trips on board OTB_CRU vessels in the area.

31.2.1 Historical stock development

No analytical assessment was performed.

Table 31.1. Sole in divisions 7.b and 7.c. History of official landings presented by country; ICES unallocated and estimated values. All weights are in tonnes.

Year	Official landings					ICES estimates
	France	UK	Ireland	Other countries	Total	
1908	0	1	37	0	38	
1909	0	0	32	0	32	
1910	0	0	28	0	28	
1911	0	1	22	0	23	
1912	0	1	22	0	23	
1913	0	1	25	0	26	
1914	0	1	43	0	44	
1915	0	1	12	0	13	
1916	0	0	14	0	14	
1917	0	0	6	0	6	
1918	0	0	7	0	7	
1919	0	0	6	0	6	
1920	0	9	5	0	14	
1921	0	10	9	0	19	
1922	0	4	9	0	13	
1923	0	2	10	0	12	
1924	0	15	64	0	79	
1925	0	11	18	0	29	

Year	Official landings					ICES estimates
	France	UK	Ireland	Other countries	Total	
1926	7	10	18	0	35	
1927	47	11	19	0	77	
1928	49	8	16	0	73	
1929	74	11	18	0	103	
1930	52	5	22	0	79	
1931	82	9	29	0	120	
1932	122	10	27	0	159	
1933	411	10	10	0	431	
1934	217	10	13	0	240	
1935	40	7	11	0	58	
1936	43	20	9	0	72	
1937	32	25	14	0	71	
1938	44	21	7	0	72	
1939	0	0	13	0	13	
1940	0	0	19	0	19	
1941	0	0	14	0	14	
1942	0	0	8	0	8	
1943	0	0	11	0	11	
1944	0	0	16	0	16	
1945	0	0	20	0	20	
1946	0	12	10	0	22	
1947	0	6	8	15	29	
1948	0	11	14	0	25	
1949	41	12	12	0	65	
1950	24	9	6	0	39	
1951	27	7	6	0	40	
1952	40	2	6	0	48	
1953	99	2	4	0	105	
1954	116	1	7	0	124	
1955	66	1	9	0	76	
1956	161	1	6	0	168	
1957	94	1	4	0	99	

Year	Official landings					ICES estimates
	France	UK	Ireland	Other countries	Total	
1958	163	2	6	0	171	
1959	327	1	8	0	336	
1960	80	1	9	0	90	
1961	110	1	12	0	123	
1962	100	0	8	0	108	
1963	172	0	19	0	191	
1964	159	1	24	0	184	
1965	95	5	24	0	124	
1966	0	1	11	0	12	
1967	78	0	11	0	89	
1968	121	0	8	0	129	
1969	86	1	9	0	96	
1970	3	0	8	0	11	
1971	0	2	5	0	7	
1972	4	0	13	0	17	
1973	0	0	12	0	12	
1974	25	0	12	0	37	
1975	7	0	19	0	26	
1976	6	0	44	0	50	
1977	3	0	14	0	17	
1978	3	0	16	0	19	
1979	6	0	13	0	19	
1980	9	0	24	0	33	
1981	6	0	47	0	53	
1982	5	1	55	0	61	
1983	9	0	40	0	49	
1984	3	0	17	0	20	
1985	6	0	44	0	50	
1986	8	0	29	0	37	
1987	2	0	39	0	41	
1988	2	1	34	0	37	
1989	0	0	38	0	38	

Year	Official landings					ICES estimates
	France	UK	Ireland	Other countries	Total	
1990	0	0	41	0	41	
1991	5	0	46	0	51	
1992	2	0	43	0	45	
1993	1	0	59	0	60	60
1994	1	0	60	0	61	70
1995	2	0	59	0	61	59
1996	2	0	52	0	54	57
1997	3	1	51	0	55	55
1998	0	0	49	0	49	66
1999	0	0	68	0	68	72
2000	12	0	65	0	77	68
2001	7	0	53	0	60	60
2002	14	0	50	0	64	61
2003	19	0	50	0	69	64
2004	18	0	49	0	67	69
2005	7	0	38	0	45	44
2006	12	0	31	0	44	43
2007	7	0	34	0	42	42
2008	7	0	32	0	39	40
2009	5	0	46	0	50	51
2010	8	0	35	0	44	43
2011	5	0	22	0	27	22
2012	7	0	38	0	45	43
2013	3	0	30	0	33	33
2014	3	0	24	0	28	27
2015	3	<1	31	0	35	34
2016	6	<1	36	0	42	42
2017	5	<1	22	0	27	27
2018	2	<1	16	0	18 [c]	18
2019	3	0	0[c]	<1	4 [c]	18
2020	2	<1	0[c]	1	3[c]	17
2021	2	<1	15	<1	17	18

Year	Official landings					ICES estimates
	France	UK	Ireland	Other countries	Total	
2022 *	1	0	22	<1	24	26
2023 *	<1	<1	10	<1	13	13

*Preliminary official landings

c Incomplete/missing, as part of the data is unavailable under data confidentiality clauses.

*Preliminary official landings

c Incomplete/missing, as part of the data is unavailable under data confidentiality clauses.

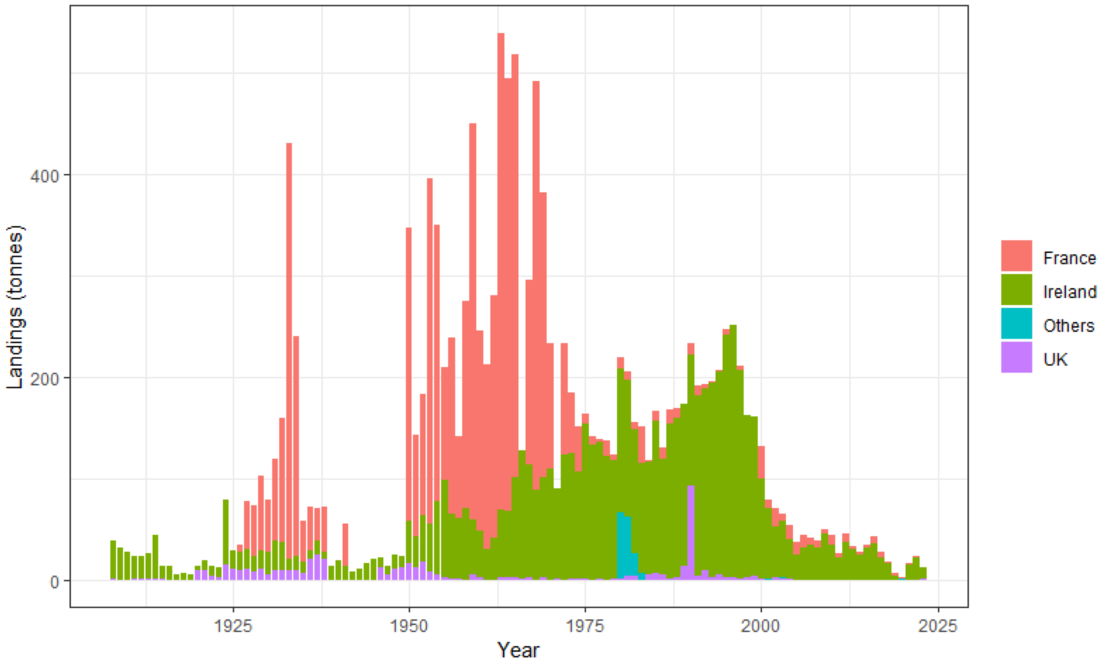


Figure 31.1a. Landings of Sole in 7.bc as officially reported to ICES (1908–2022). Data in some years effected by confidentiality, see Table 31.1

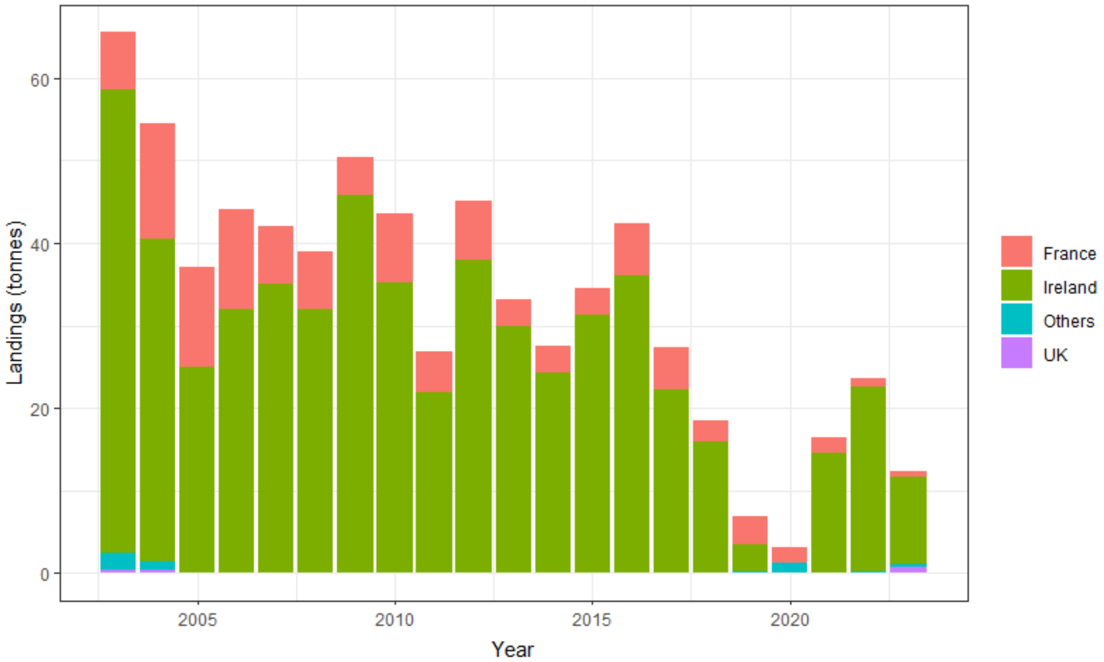


Figure 31.1b. Landings of Sole in 7.bc as officially reported to ICES (2010–2022). Data in some years effected by confidentiality, see Table 31.1

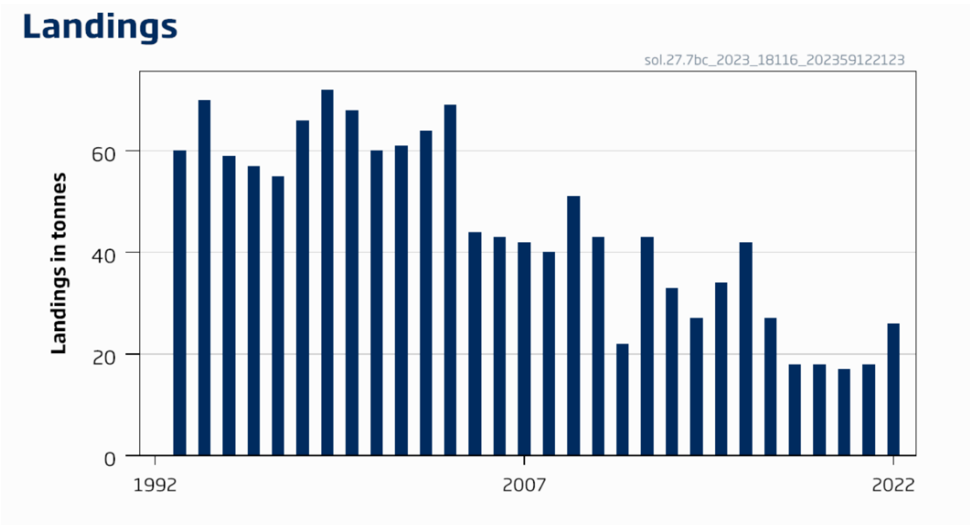


Figure 31.2 Sole in divisions 7.b and 7.c. ICES estimated landings.

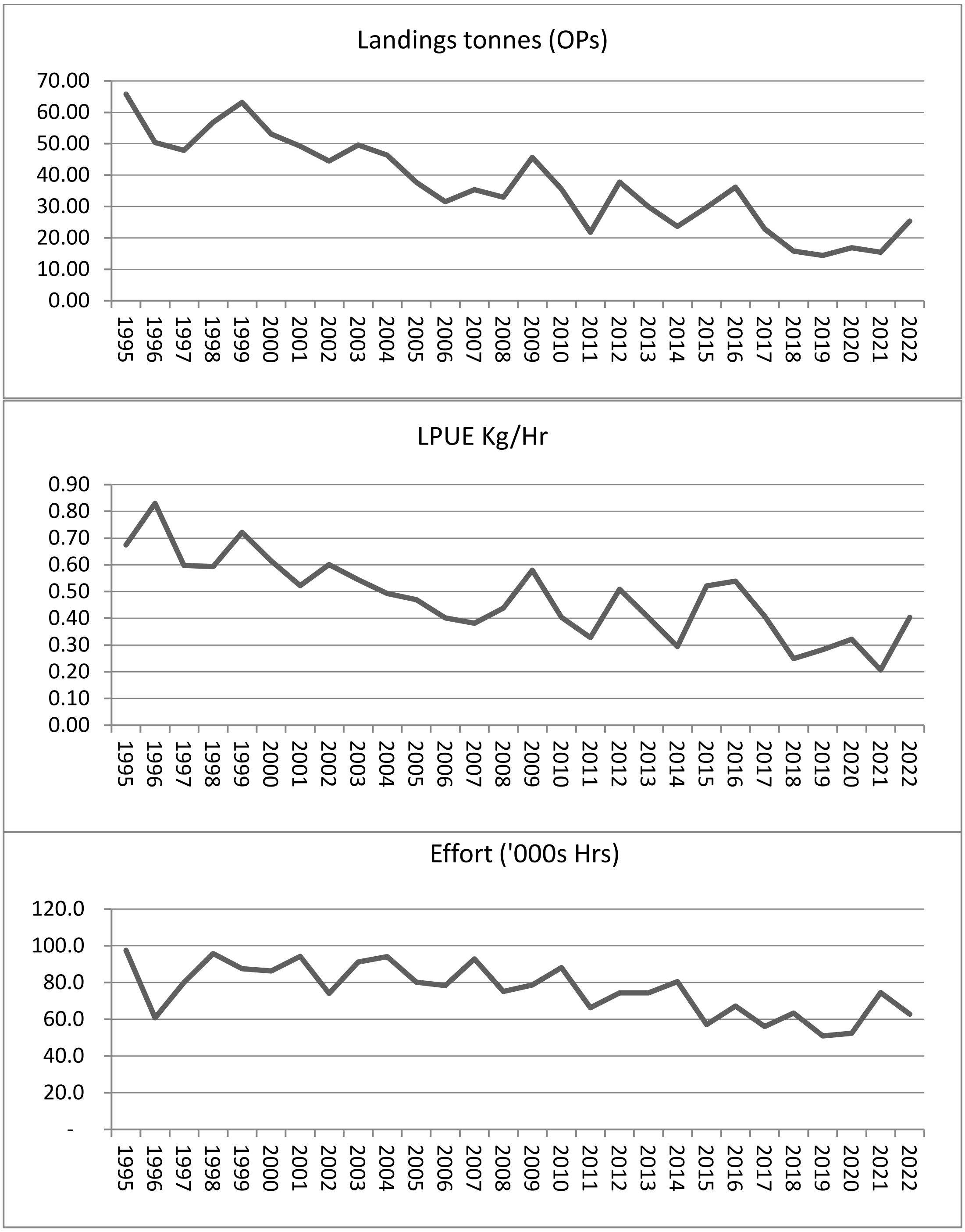


Figure 31.3. Sole in 7.b Irish otter trawl landings (top) effort (middle) and landings per Unit effort (LPUE; bottom) from 1995 - 2022.

Contents

32 Sole (*Solea Solea)* in Division 7.e (western English Channel)

32.1 Introduction

Type of assessment in 2023

Last year's assessment report is available at:

https://doi.org/10.17895/ices.pub.22268980

ICES advice applicable to 2024

Last year's advice is available at https://doi.org/10.17895/ices.advice.21864300 and stated:

ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 1057 tonnes.

32.2 ICES Transparent Assessment Framework

The Division 7.e sole stock is included in the ICES Transparent Assessment Framework (TAF, https://taf.ices.dk, https://github.com/ices-taf). All WGCSE assessments since 2018 are available from the ICES TAF GitHub page (please note, access to these repositories is so far restricted to ICES and members of WGCSE). Since 2024, there are two repositories for this stock. One for the data processing (processing raw data into a format for the stock assessment, https://github.com/ices-taf/2024_sol.27.7e_data) and a separate repository for the stock assessment (https://github.com/ices-taf/2024_sol.27.7e_assessment). All changes to the stock assessment and input data can be accessed with the following link: https://github.com/ices-taf/2024_sol.27.7e_assessment/compare/2b99512...main.

The TAF repositories include all input data, R scripts for processing data, preparing and running the stock assessment and forecast, and scripts for creating all figures and tables presented in this report. The repositories also contain documentation on how to reproduce the WGCSE assessment for sole.

32.3 General

Stock description and management units

The TAC specified for ICES Division 7.e is consistent with the assessment area.

Official national landings data as reported to ICES and the landings estimates as used by the Working Group are given in Table 33.1.

Official landings in 2023 were 1238 t, an 11% undershoot of the 2023 TAC (1394 t).

The TAC and the national quotas by country for 2023

Species	Sole *Solea solea*	Zone:	7e (Sol/07E.)
Belgium	46		Analytical TAC
France	487		
Union	533		
United Kingdom	861		
TAC	1394		

(Source: Council Regulation (EU) 2023/194, EU, 2023).

The TAC and the national quotas by country for 2024

Species	**Sole** ***Solea solea***	**Zone:**	**7e** **(Sol/07E.)**
Belgium	38		Analytical TAC
France	409		
Union	447		
United Kingdom	737		
TAC	1184		

(Source: Council Regulation (EU) 2024/257, EU, 2024).

Landing obligation

As of 2020, the EU landing obligation fully applied to sole in Division 7.e. However, a de minimis exemption allowed up to 3% of total annual catches to be discarded for trammel and gillnets and beam trawls with mesh size 80–119 mm with a Flemish panel (Commission Delegated Regulation (EU) 2020/2015, EU, 2020).

A landing obligation also applies in UK waters and includes a *de minimis* exemption for sole for trammel and gillnets (MMO, 2020a) and beam trawls with a Flemish panel (MMO, 2020b). However, the UK landing obligation specifies the de minimis exemption as a "small percentage of the total catch" without specifying a value.

The EU landing obligation was phased in between 2016–2019 (Commission Delegated Regulations (EU) 2015/2438, 2016/2375, 2018/46, EU, 2015, 2016, 2018). During the phasing in, the landing obligation applied to all catches of sole in 7.e with trammel and gillnets (gear codes GNS, GN, GND, GNC, GTN, GTR, GEN) and all beam trawls. However, a *de minimis* exemption applied, allowing up to 3% discards of annual catches for all trammel and gillnets and for beam trawls with a mesh size of 80–199 mm with increased selectivity. In 2016, the first year of the application, the landing obligation applied only to vessels for which the total landings consisted of more than 10% sole during two reference years (2013 and 2014, Commission Delegated Regulation (EU) 2015/2438, EU, 2015). This threshold was tightened for 2017, and the landing obligation applied to vessels landing more than 5% in the reference years 2014 and 2015 (Commission Delegated Regulation (EU) 2016/2375, EU, 2016). Subsequently, this restriction was lifted altogether, and for 2018 (Commission Delegated Regulation (EU) 2018/46, EU, 2018), the landing obligation applied to all vessels using trammel and gillnets and beam trawls, as described above.

Given the low discards observed in the fishery, the landing obligation is unlikely to impact this stock or the advice significantly.

32.4 Data

InterCatch

International catch data are collated using the ICES InterCatch platform. For 2023, data for Belgium, France, Ireland, and the United Kingdom (England, and the Channel Island Guernsey) were uploaded into InterCatch (Figures 33.1 and 33.2). All submitted age samples are presented in Figure 33.8 and length samples in Figure 33.9. The raising procedure is described in the Stock Annex.

Landings

Landings of sole in Division 7.e have been increasing in recent years but decreased in 2023 and were 1239 t in 2023.

The UK, France and Belgium provided age-structured landings samples in InterCatch (Figure 33.8).

Total international landings numbers-at-age (Table 33.2 and Figure 33.5) and landings and stock weights-at-age (Tables 33.3 and 33.4 and Figure 33.6), as used in the assessment, were derived following the procedures outlined in the Stock Annex.

The fleets for which age distributions were submitted accounted for 92.5% of the 2023 total international landings, based on the InterCatch level (year, country, fleet, and quarter), the same level as in 2022.

Discards

Discards for this stock are very low and not included in the assessment. Discards submitted to InterCatch were 2.2t in 2023.

For 2023, discards estimates were provided by Belgium, France, and the UK for some fleets in InterCatch based on discard sampling. Discard age samples were provided for the annual Belgian TBB_DEF_70-99 and the Q2 UK TBB_DEF_70-99 data.

Discards data are only available from InterCatch since 2012. In general, the discard rates are low (Figure 33.3). A higher discard rate was observed in 2015, attributed to high discards from the multirig otter trawl (mesh size 90–99 mm) fleet. The three-year average (2021–2023) discard rate is 0.45%.

The discard rate by fleet and country is shown in Figure 33.4 (shown are only discards submitted to InterCatch, discards are not raised).

No discard information is included in the assessment, given that it is currently not possible to provide discard estimates for the entire time-series. Nevertheless, excluding discard estimates from the assessment is unlikely to have any major impact on the perception of stock status given the minor scale of the problem.

Biological data

Natural mortality was assumed to be constant over all ages and years at 0.1. The maturity ogive used for this stock was originally borrowed from divisions 7.f and 7.g, following the procedures outlined in the Stock Annex and adopted in previous assessments.

In agreement with the Stock Annex, stock and catch weights-at-age were derived by fitting a second-degree polynomial model to the raw landings weights-at-age extracted from InterCatch (Figure 33.7). For 2023 data, the youngest age for which data (catch numbers and weights) were provided was age 1.

Survey indices

Abundance estimates derived from the surveys as used in the assessment are given in Table 33.6 and shown in Figures 33.11–33.13, and internal consistencies in Figures 33.14–33.16. In general, cohort tracking and internal consistency are better in the commercial tuning fleets and less pronounced in the scientific surveys.

The UK-FSP survey

The UK Western Channel sole and plaice survey (previously called Fisheries Science Partnership survey; UK-FSP, quarter 3, ICES survey code B4381, Burt *et al*., 2024) conducted another survey of sole and plaice abundance in the Western English Channel in 2023. The survey uses two 4 m beam trawls with 80 mm nominal codend mesh and focuses on the area around the English coast. 90 out of 90 tows were completed in 2023. 350 sole otoliths were collected for ageing in 2023.

Catch rates are reported standardised as numbers per hour per meter of beam length. The results indicate that sole continues to be widespread in the area (Figure 33.17). The total CPUE decreased since 2019 to its lowest value of the time-series in 2022 and a small increase in 2023. The index is mainly driven by ages 3, 4, and 6. The internal consistency in the survey is good for ages 3+. Some year and cohort effects are visible.

The Q1SWBeam survey

The second survey used for sole is the Quarter 1 South West Beam trawl (Q1SWBeam, also called Q1SWECOS, ICES survey code B2732), which started in 2006. This survey deploys two 4 m beam trawls and uses a fully random stratified approach. In contrast to the FPS survey, the Q1SWBeam covers the entire western English Channel and, if conditions permit, adjacent areas. Figure 33.18 shows the spatial distribution catches for the entire Q1SWBeam time series.

The 2022 survey was disrupted and only 55 out of 81 planned tows were fished. This meant that the 2022 values from this survey were excluded from the assessment from 2023 onwards. In 2023, 77 out of 81 tows were completed.

Similar to previous years, the highest catches of sole were around the English coast. Fish aged 3, 5, 7, and 9 were most abundant.

Commercial fleets effort and lpue

Two commercial tuning series from the UK are used (commercial beam trawl UK-CBT and commercial otter trawl UK-COT).

Effort for under 24 m UK beam trawlers in days fished steadily increased from 1992, and reached the highest levels on record in 2012 and stayed around this level until the end of the time-series (Figure 33.10). Currently, the effort is well above the long-term average. In contrast, the effort for over 24 m UK beam trawlers increased from 1992 to 2004 and then decreased to below the average of the time-series, reaching a minimum in 2013. Since then, the effort increased again and has exceeded the long-term average in recent years. When the effort of all UK beam trawl vessels is combined, the effort stayed relatively constant since the early 2000s with a slight increase in recent years.

UK otter trawl (UK-COT) effort has been in continual decline since the early 1970s and was at the lowest levels on record in 2015. For 2016, this fleet reported zero effort and landings. This could be explained by a shift in the size of fishing vessels to smaller vessels. Since 2017, a new database is being used for recording, but the data are not consistent with historical data and are therefore not used in the stock assessment.

Age-disaggregated commercial abundance indices for the UK-CBT-late (UK-CBT values from 2003 onwards) and UK-COT fleets as used in the assessment are given in Tables 33.5 and 33.6 and plotted in Figures 33.11–33.13.

32.5 Stock assessment

Model used: Extended Survivors Analysis (XSA) as outlined in the Stock Annex by IBPWCFlat2 2015.

Software used: FLR – FLXSA.

Model options chosen: Data included in the assessment were identical to previous years, apart from one additional data year.

Assessment input data characteristics: catch numbers-at-age excluding discards and four tuning fleets (two fishery-independent surveys: UK-FSP and Q1SWBeam; and two commercial LPUE time-series: UK-CBT-late and UK-COT).

Data screening

Data screening procedures identified no major anomalies in the catch numbers-at-age, weights or tuning information used in the WGCSE 2024 assessment.

Over the past years, there have been several notable strong cohorts and these track well in the landings at age; starting with fish aged 3 in 2017 (not visible anymore in 2023), age 3 in 2019 (age 7 in 2023), age 3 in 2021 (age 5 in 2023). Compared to previous years, the age distribution does not have one or two large age classes in 2023, instead ages 3, 5, and 7 are fairly strong but well below the peaks seen in previous years (Figure 33.5).

Tuning information consisted of four fleets: two UK commercial time-series (UK-CBT-late and UK-COT) and two UK standardised research surveys (UK-FSP and Q1SWBeam).

The UK commercial otter trawl fleet (UK-COT) reported zero effort in 2016. Therefore, there is no LPUE value for this fleet for 2016. Consequently, this tuning index only influences the assessment up to and including 2015.

Details of the derivation of the tuning fleets are presented in the Stock Annex. The tuning information available for this assessment is shown in Table 33.6.

Final update assessment

The working group fitted the XSA model developed by WKFLAT 2012 (ICES, 2012) using the updated assessment settings agreed at IBPWCFlat2 (ICES, 2015).

The XSA assessment settings used at the last three working groups are shown in the table below, and more historical settings have been included in the Stock Annex.

	WGCSE 2022	WGCSE 2023	WGCSE 2023
Assessment age range	2–12+	2–12+	2–12+
F_{bar} age range	F(3–9)	F(3–9)	F(3–9)
Assessment method	XSA	XSA	XSA
Tuning Fleets:			
Q1SWBeam	2006–2021 Ages 2–11 (non-offset)	2006–2021 Ages 2–11 (non-offset)	2006–2021, 2023 Ages 2–11 (non-offset)
UK-FSP	2014–2021 Ages 2–11	2014–2022 Ages 2–11	2014–2023 Ages 2–11
UK combined beam (late)	2003–2021 Ages 3–11	2003–2022 Ages 3–11	2003–2023 Ages 3–11
UK otter trawl	1988–2016 Ages 3–11	1988–2016 Ages 3–11	1988–2016 Ages 3–11
Time taper	Yes	Yes	Yes
Power model	Tricubic	Tricubic	Tricubic
Taper range	15 years	15 years	15 years
P shrinkage	No	No	No
Q plateau age	7	7	7
F shrinkage S.E	0.5	0.5	0.5
Number of years	3	3	3
Number of ages	5	5	5
Fleet S.E.	0.4	0.4	0.4

Figure 32.19 shows the results from the final XSA model fit, Figure 32.20 the model residuals, Figure 32.21 a comparison of the current assessment with last years' assessments, Figure 32.22 XSA survivor weightings for the last two years and Figure 32.23 a five-year retrospective.

The survey residuals show relatively large values in earlier years. This is an expected feature of the XSA assessment, which includes a taper range of 15 years. This means that older survey observations are down-weighted and any observations 15 years or older are not used in the assessment.

A Mohn's rho analysis with five peels was conducted based on the XSA stock assessment results, i.e. the last data year (2023) was used as the final year for comparison of SSB, F, and recruitment and based on a five-year retrospective analysis. The results from the Mohn's rho analysis are shown in the following table:

	SSB	F (ages 3–9)	recruitment
Mohn's rho value	-0.088	0.151	0.188

The Mohn's rho values for this assessment are well within the ICES WKFORBIAS thresholds (+0.20, -0.15), i.e. the current assessment indicates sufficient consistency for advice purposes.

XSA diagnostic of the final assessment are presented in Table 33.7, stock numbers-at-age in Table 32.8, fishing mortalities-at-age in Table 32.9 and an assessment summary in Table 32.10.

Consistency of the stock assessment

The comparison of historical stock assessment results (historical retro, Figure 32.21) and the analytical retrospective analysis (Figure 32.23) show slightly different retrospective patterns. It is worth noting that the historical comparison (Figure 32.21) shows the assessment results (including short-term forecast assumptions for the intermediate year) from conducting the stock assessment in the corresponding years. These values are stored in an ICES database and not updated afterwards. On the other hand, the analytical retrospective analysis (Figure 32.23) is conducted with the most recent version of the input data, and its retrospective runs are also based on these most recent (possibly updated or revised) data and only removing data years from the end.

The differences between the historical and analytical retro can be explained through revisions of historical input data over the years, namely:

- Q1SWBeam: The scientific Q1SWBeam survey was revised in 2020 and again in 2022 because of a quality control process of the survey data and data processing. This is described in previous reports. This has led to some changes in historical data, which means historical assessment results are based on slightly different historical Q1SWBeam data compared to the assessment afterwards.
- Q1SWBeam: WGCSE 2023 decided not to include 2022 values of this survey because of a substantially reduced survey coverage, however, values from 2023 were included again.
- FSP: The FSP survey index values used in the assessment are a product of a model fitting to the raw data. This means that the entire time-series is updated every year, including historical values.
- The 2017 and 2018 catch data were revised in 2023, which would have led to lower estimates of SSB and higher estimates of F in recent years.

Furthermore, the terminal year of the historical retro includes assumptions for the intermediate year. In the following year's assessment, the observed perception of the fishery can be different from that assumed in the previous year.

State of the stock

Stock trends are shown in Table 32.10 and plotted in Figure 32.19. The SSB is in a desirable state above all biomass reference points but declining over the past two years. F has increased in previous years but is estimated to be below F_{MSY}.

The age structure of sole in 7.e continues to be more extended than other sole stocks in European waters, implying low mortality rates, with the plus group at age 12 containing a relatively high proportion of the catches and including some individuals aged 33–38 in recent years.

32.6 Short-term projections

Forecast assumptions

Figure 32.24 shows three different targets for the intermediate year: status quo (F = F_{2023}), average (F = $F_{average\ 2021–2023}$), and the F corresponding to the TAC.

Landings have been below the international TAC and the advised catch in previous years (Figure 32.25). However, TACs have been decreasing since 2021 and the 2023 landings (1237t) were close to the TAC for 2024 (1184t). Anecdotal information from England (the main country fishing in this area) suggests that the TAC is becoming restrictive for some fleet segments. This indicates that the TAC for 2024 of 1184 t is likely to be taken by the fishery. Three options were considered for the intermediate year of the short-term forecast (Figure 32.24) and lead to very similar outcomes. The three-year average (2021-2023) F assumption and the TAC assumption are nearly identical (landings of 1184t vs 1179t in 2024). The landings when using the last F (2023) are slightly higher (1140t). The working group decided to select the option corresponding to the TAC for the intermediate year (2024). However, the impact of the intermediate year assumption on the projected landings in the advice year (2025) is minor. Because the assessment is based on landings only, the TAC of 1184 t was corrected for the assumed discard rate (average of 2021–2023, 0.45%), and a landings value of 1179 t was used for the intermediate year in the short-term forecast.

Weights-at-age were calculated as the average of the last three historical years, as in previous years.

Recruitment estimates do not indicate periods of consistent high or low recruitment periods in recent years. Consequently, the long-term average (geometric mean of 1969–2023) of the recruitment was used for the intermediate year and advice year, following the Stock Annex.

The forecast was conducted with FLR's FLash R package using the output from the landings only XSA assessment. The resulting yield was obtained by adding discards to the landing with an average discard rate of the last three historical years (2021–2023, 0.45%).

The input data for the short-term forecast are shown in Table 32.11.

MSY forecast

Table 32.12 shows a detailed output of the forecast targeting F_{MSY} for 2025–2026, and Table 32.13 the year classes contributing to the forecast yield and SSB.

Figure 32.26 shows the forecast results for F_{MSY}, and Figure 33.27 the forecast, including F_{MSY} ranges.

Implementing the MSY approach with F_{MSY}=0.29 leads to a total catch of 1151 t in 2025 (1146 t of landings, 5 t of discards), and an SSB of 3706 t in 2026 in the short-term forecast.

A management options table is provided in Table 32.14, and Table 32.15 shows additional options.

The advice is an increase of 8.9% compared to the advice for 2024. The following report section describes the changes in the advice.

32.7 Explanation of the change in advice

This year's assessment (WGCSE 2024) led to a rescaling of SSB and F for around the past 10 years. SSB is now estimated to be higher and F lower than estimated by last year's assessment (WGCSE 2023). However, this year's assessment (WGCSE 2024) is much closer to the estimates from the stock assessment from two years ago (WGCSE 2022). Despite the rescaling in SSB, the terminal SSB value (2024) is now very similar to the terminal estimate from last year (2023 SSB from WGCSE 2023). The fishing mortality is now estimated to be below F_{MSY}.

Last year's assessment (WGCSE 2023) showed some rescaling to the previous assessment (WGCSE 2023) because of a revision of historical catch data (2017 and 2018) and the loss of 2022 Q1SWBeam survey data. This year's rescaling (WGCSE 2024) was caused by (1) the addition of an additional year of data (including the addition of 2023 Q1SWBeam survey data after no 2022 data were available) which changed the perception of the stock and (2) F is now estimated to be below F_{MSY}, giving some scope for increasing F and the corresponding increase in the catch.

This year's advice is an increase to the previously advised catch value because the addition of an additional year of data led to a more optimistic perception of the stock status.

Figure 32.28 shows a comparison of this year's assessment (including intermediate year) to last year's assessment. Figure 33.29 shows a comparison of this year's values-at-age (stock numbers, stock weight, stock biomass, selectivity) for the assessment and forecast and the corresponding values from last year's analysis.

Figure 32.30 illustrates the contribution of cohorts to the SSB and the catch from this year's assessment and short-term forecast. Figure 32.31 shows the same but for numbers.

32.8 Biological reference points

The most recent reference points for this stock were developed by WKMSYREF4 in 2015 (ICES, 2016). These reference points are presented in the following table. Please note that ICES changed the basis for F_{pa} to $F_{p.05}$ in 2021, and the updated F_{pa} value is shown here.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	2900 t	The 5th percentile of the distribution of SSB when fishing at F_{MSY} (0.29) with no error.	ICES (2016, 2017)
	F_{MSY}	0.29	The peak of the median landings yield curve.	ICES (2016, 2017)
	F_{MSY} lower	0.16	Minimum F which produces at least 95% of maximum yield.	ICES (2016, 2017)
	F_{MSY} upper	0.34	Maximum F which produces at least 95% of maximum yield.	ICES (2016, 2017)
	B_{lim}	2000 t	Rounded B_{pa}/1.4.	ICES (2016, 2017)

Framework	Reference point	Value	Technical basis	Source
Precautionary approach	B_{pa}	2900 t	Rounded B_{loss} (1999 year class). Lowest SSB with high recruitment.	ICES (2016, 2017)
	F_{lim}	0.44	Segmented regression simulation of recruitment with B_{lim} as the breakpoint and no error.	ICES (2016, 2017)
	F_{pa}	0.39	$F_{p.05}$; the F that leads to SSB ≥ B_{lim} with 95% probability.	ICES (2016, 2017)
Previous management plan	SSB_{MGT}	Not defined		
	F_{MGT}	0.27		EU (2007)

32.9 Management plan

The European Commission implemented a management plan for the recovery of the stock early in 2007 (Council Regulation (EC) No 509/2007). The management plan has not been formally evaluated, but the working group concluded that: The long-term management target (F_{MGT} = 0.27) is precautionary in the sense that it ensures that there is a less than 5% chance of SSB declining below previously observed levels, as well as maintaining yield within 10% of MSY (*WGCSE note: long-term yield at F_{MAX}*) (working group, 2005; working group, 2006).

This management plan has not been used in recent years, and the ICES advice has been based on the MSY approach, targeting F_{MSY}.

The management plan (Council Regulation (EC) No 509/2007) is no longer in force since 2019 and has been repealed by an EU multiannual plan for stocks fished in the Western Waters and adjacent waters (Regulation (EU) 2019/472, EU, 2019) which aims at targeting MSY.

32.10 Uncertainties in assessment and forecast

The methodology provided is as robust as possible and does not currently appear to suffer from a serious retrospective pattern.

Discarding

Discarding is considered negligible in the sole fishery, averaging <1% of the total international catch weight in the past years. Nevertheless, a time-series of available discards information raised to the fleet level should be developed to effectively deal with potential future discard issues and improve estimates of total mortality. The EU landing obligation was implemented during 2016–2019 with a discard plan and seemed to have reduced the already low discards even more. The landings advice has been topped up with the available discard information to give catch advice. Developing a time-series of discard information appears to be less urgent than in the past.

Surveys

The assessment methodology includes two survey indices. The UK-Q1SWBeam survey added to the assessment in 2012 covers the entire management area, providing fishery-independent tuning information for the entire age range used in the assessment. Therefore, the assessment relies much less on the commercial tuning information and is less susceptible to localised exploitation by the fishery. Consequently, commercial tuning information is still used in the assessment to maintain the balance between accuracy and precision required by management. Survey information for the recruiting year class remains temporally variable and is not used in the forecast for this reason.

Sampling

Age and length sampling for this stock is mostly adequate. Age data from the largest sector operating in this fishery (UK) are included in the assessment. There are limited discard age samples, but this does not impose a problem on the assessment or forecast due to very low discarding.

Consistency

The assessment for this stock was last benchmarked in 2012, and an inter-benchmark was held in 2015. The 2024 assessment is fairly consistent with the previous assessments conducted in recent years.

32.11 Recommendation for the next benchmark

There is no urgent requirement to benchmark this stock in the short term.

The XSA assessment uses a taper range of 15 years for the tuning indices, effectively down-weighting older tuning data and removing data older than 15 years altogether. As tuning time-series become longer, potentially important information might get lost in the process. Therefore, a re-evaluation of assessment parametrisation should be considered.

LPUE estimates for the UK-CBT and UK-COT fleets should be closely monitored to avoid the recurrence of inaccuracies in commercial tuning information observed at the 2014 and 2015 working groups. A rescaling observed in the 2018 and 2019 assessments can be explained by underlying data. Consequently, the next benchmark should evaluate the temporal stability of the retrospective patterns and determine whether the assessment settings need to be revised.

The UK-COT effort has been in continuous decline and reported no activity in 2016 and subsequently, due to a new database system, cannot be replicated anymore. Consequently, a benchmark could investigate the removal of commercial tuning information altogether from the assessment.

As the time-series on discards increases, a future benchmark might look into including discard estimates in the assessment and estimating historical discards. Discards are very low and, due to the implementation of the landing obligation in 2016, unlikely to become a problem in the future.

Age samples for 2017 and 2018 catches from England were revised in 2023 due to an error found in the data. The data for remaining years could also be checked if similar issues occurred in other years.

Some genetic work on the stock identity for sole in the Celtic Seas ecoregion has been conducted and there is also further work ongoing. The outcome of such work should be closely followed and could inform future benchmarks for this stock.

The current reference points were estimated at ICES WKMSYREF4 in 2015 (ICES, 2016). While some rescaling of the stock assessment results has occurred in the past years, this has mainly affected later years in the time series and not the overall trends and magnitude, so is unlikely to substantially alter reference point estimates. Any re-estimation of reference points should likely wait for the outcomes of the WKNEWREF workshop series.

32.12 Management considerations

France provided discard estimates for the first time at the 2016 working group. Discard estimates from France are higher than from the other countries.

Plaice is taken as bycatch in this fishery, and therefore management advice for sole must also consider the advice for plaice. Anglerfish, cuttlefish, and lemon sole are also important bycatches in this fishery.

32.13 Ecosystem considerations and changes in the environment

See Stock Annex.

32.14 Regulations and their effects

Management of this stock is mainly by TAC. In 2005, effort restrictions were implemented for beam trawlers and entangling gears targeting sole in this fishery to enforce the TAC and improve data quality. The effort restrictions were included in the 2007 management plan (EU, 2007) and are continued in the EU multiannual plan (EU, 2019). The effort restrictions limit the number of days at sea for vessels in 7.e using beam trawls (≥80 mm mesh size) and static nets (≤120 mm mesh size). The limits for effort are set annually in the EU council with the TAC and apply only for vessels which catch more than 300 kg of sole annually.

Mesh restrictions for towed gears are set to 80 mm codends, which correspond well with the minimum landing size of sole at 24 cm (25 cm for Belgian vessels since December 2017).

32.15 References

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32.16 Tables

Table 32.1. Sole in Division 7.e. History of official landings and ICES estimates. All weights are in tonnes.

Year	Belgium	France	Netherlands	Ireland	UK and Channel Islands	Official total	ICES landings	ICES discards
1974		323				323	427	
1975	3	271			217	491	491	
1976	4	352			260	616	616	
1977	3	331			272	606	606	
1978	4	384			453	841	861	
1979	1	515			665	1181	1181	
1980	45	447		13	764	1269	1269	
1981	16	415	1		788	1220	1215	
1982	98	321			1028	1447	1446	
1983	47	405	3		1043	1498	1498	
1984	48	421			901	1370	1370	
1985	58	130			911	1099	1409	
1986	62	467			840	1369	1419	
1987	48	432			632	1112	1280	
1988	67	98			784	949	1444	
1989	69	112	6		613	800	1390	
1990	41	81			636	758	1315	
1991	35	325			477	837	852	
1992	41	267			468	776	895	
1993	59	236			498	793	904	
1994	33	257			546	836	800	
1995	21	294			565	880	856	
1996	8	297			428	733	833	
1997	13	348		1	496	858	949	
1998	40	343			389	772	880	
1999	13				396	409	957	
2000	4	241			413	658	914	
2001	19	224			407	650	1069	
2002	33	198			309	540	1106	
2003	1	363		1	255	620	1078	
2004	7	302			185	494	1075	
2005	26	406			527	959	1039	

Year	Belgium	France	Netherlands	Ireland	UK and Channel Islands	Official total	ICES landings	ICES discards
2006	32	357			575	964	1022	
2007	34	384			536	953	1015	
2008	28	312		< 1	474	815	908	
2009	17	386			382	785	701	
2010	17	375			369	761	698	
2011	22	424			431	877	801	
2012	39	325		< 1	506	871	872	2
2013	30	319			540	889	883	1
2014	25	351		< 1	510	886	885	10
2015	42	245		< 1	490	777	774	54
2016	46	245			624	915	913	10
2017	56	198		< 1	746	1000	1007	4
2018	68	217	< 1	< 1	801	1086	1075	3
2019	47	208	< 1	< 1	926	1182	1185	4
2020	58	194	< 1		969	1222	1219	< 1
2021	104	252	< 1	< 1	1048	1403	1392	13
2022*	132	231		< 1	1044	1407	1409	3
2023*	104	193	< 1	< 1	941	1238	1239	2

*** Preliminary.**

Table 32.2. Sole in Division 7.e. Landings numbers-at-age (thousands).

YEAR\AGE	2	3	4	5	6	7	8	9	10	11	12+	TOTAL
1969	89	322	80	148	210	21	50	26	20	9	63	1037
1970	53	232	322	90	83	112	13	35	52	22	113	1127
1971	51	200	246	198	65	80	156	10	35	54	113	1207
1972	146	412	167	115	112	14	25	134	38	54	106	1323
1973	71	396	433	89	99	120	17	52	30	4	136	1446
1974	45	349	220	178	71	80	43	32	24	55	106	1202
1975	82	567	170	199	115	28	53	26	22	24	171	1456
1976	167	419	472	161	135	92	46	58	51	14	213	1830
1977	426	318	384	206	102	70	74	10	24	32	159	1804
1978	250	1123	347	214	189	103	72	77	38	27	203	2644
1979	227	803	811	250	229	174	103	90	104	28	290	3108

YEAR\AGE	2	3	4	5	6	7	8	9	10	11	12+	TOTAL
1980	175	559	497	630	126	183	140	65	56	130	342	2902
1981	245	806	651	467	389	179	126	76	58	55	211	3262
1982	128	1451	916	553	352	240	136	113	81	61	294	4324
1983	91	753	1573	583	351	267	294	119	73	37	262	4401
1984	333	663	826	758	325	204	129	152	54	28	255	3727
1985	287	1700	756	469	585	179	97	103	85	29	125	4414
1986	246	1618	971	421	321	336	84	75	90	74	127	4363
1987	487	808	1090	427	204	224	229	47	50	41	162	3770
1988	443	1438	596	728	374	153	162	109	39	50	171	4262
1989	390	871	1233	497	509	225	110	107	113	48	214	4316
1990	341	902	581	553	244	264	143	103	75	85	235	3525
1991	450	415	482	289	220	93	111	68	37	31	145	2341
1992	316	1434	417	297	115	112	61	74	26	23	90	2964
1993	209	704	1107	350	219	151	78	60	56	31	79	3045
1994	97	657	558	558	112	106	49	57	44	50	99	2388
1995	95	308	629	427	411	131	101	61	33	18	142	2356
1996	365	445	364	298	235	257	68	61	49	37	143	2321
1997	216	831	724	325	180	194	173	44	20	40	88	2835
1998	265	606	536	336	209	151	80	127	35	34	162	2543
1999	280	915	500	398	255	114	103	54	107	25	123	2874
2000	307	599	751	367	229	107	53	68	51	88	91	2710
2001	145	1401	531	497	268	178	100	55	43	42	159	3419
2002	332	1251	843	387	322	129	105	94	33	18	85	3599
2003	598	835	953	645	130	74	50	58	63	14	61	3482
2004	398	1080	448	445	526	164	116	61	54	35	85	3412
2005	258	468	834	449	366	293	113	80	45	24	96	3027
2006	500	786	472	606	250	224	185	85	56	31	87	3282
2007	201	852	755	293	362	179	130	110	55	27	99	3062
2008	281	752	678	376	163	184	105	71	67	39	89	2805
2009	166	540	385	333	202	66	74	37	50	35	65	1955
2010	68	348	394	329	204	127	49	71	20	34	78	1723
2011	91	499	476	405	233	156	80	39	34	28	93	2136
2012	31	227	525	400	355	231	137	67	44	39	124	2180
2013	120	324	483	595	280	214	147	98	48	23	110	2441

YEAR\AGE	2	3	4	5	6	7	8	9	10	11	12+	TOTAL
2014	198	320	466	426	410	168	112	79	61	27	97	2364
2015	177	329	395	336	261	206	115	78	45	30	82	2054
2016	92	420	469	276	249	242	189	67	50	33	107	2194
2017	134	747	561	288	238	196	142	130	83	64	124	2708
2018	130	375	768	429	203	209	155	98	95	73	156	2691
2019	115	874	659	633	381	198	168	123	70	86	157	3463
2020	169	558	1194	613	444	254	137	83	72	33	159	3716
2021	115	841	693	1182	576	329	173	122	80	48	178	4338
2022	356	505	937	648	845	311	213	107	55	55	194	4226
2023	271	659	480	610	429	549	180	136	69	56	141	3581

Table 32.3. Sole in Division 7.e. Landings weights-at-age (kg).

year\age	2	3	4	5	6	7	8	9	10	11	12+
1969	0.188	0.245	0.332	0.329	0.367	0.522	0.455	0.463	0.606	0.648	0.661
1970	0.188	0.224	0.295	0.315	0.355	0.436	0.500	0.444	0.514	0.530	0.596
1971	0.151	0.222	0.296	0.367	0.350	0.359	0.431	0.455	0.476	0.388	0.654
1972	0.194	0.227	0.272	0.369	0.408	0.458	0.496	0.402	0.454	0.509	0.601
1973	0.203	0.224	0.262	0.311	0.382	0.415	0.460	0.467	0.538	0.655	0.562
1974	0.183	0.224	0.281	0.379	0.434	0.372	0.465	0.476	0.488	0.475	0.732
1975	0.178	0.210	0.293	0.351	0.395	0.427	0.487	0.580	0.638	0.525	0.663
1976	0.170	0.218	0.287	0.324	0.391	0.455	0.414	0.476	0.479	0.585	0.629
1977	0.197	0.249	0.303	0.357	0.400	0.503	0.464	0.518	0.485	0.553	0.683
1978	0.178	0.239	0.300	0.387	0.435	0.374	0.482	0.485	0.484	0.535	0.665
1979	0.189	0.239	0.330	0.427	0.464	0.472	0.481	0.570	0.527	0.574	0.732
1980	0.189	0.254	0.343	0.389	0.525	0.560	0.609	0.646	0.655	0.600	0.783
1981	0.174	0.225	0.321	0.381	0.477	0.514	0.533	0.598	0.619	0.708	0.660
1982	0.214	0.209	0.278	0.347	0.426	0.498	0.510	0.523	0.526	0.564	0.663
1983	0.187	0.250	0.271	0.306	0.388	0.417	0.473	0.530	0.608	0.551	0.665
1984	0.210	0.243	0.306	0.381	0.391	0.481	0.542	0.562	0.604	0.726	0.643
1985	0.163	0.226	0.298	0.360	0.391	0.472	0.523	0.534	0.522	0.588	0.822
1986	0.174	0.237	0.297	0.354	0.407	0.456	0.502	0.544	0.583	0.618	0.703
1987	0.174	0.245	0.310	0.370	0.425	0.474	0.518	0.557	0.590	0.618	0.665
1988	0.170	0.244	0.312	0.375	0.432	0.484	0.531	0.572	0.608	0.639	0.694
1989	0.167	0.222	0.275	0.326	0.375	0.422	0.467	0.510	0.551	0.590	0.692

year\age	2	3	4	5	6	7	8	9	10	11	12+
1990	0.217	0.272	0.324	0.372	0.419	0.461	0.501	0.538	0.571	0.601	0.669
1991	0.182	0.255	0.323	0.386	0.445	0.499	0.549	0.594	0.634	0.669	0.741
1992	0.166	0.238	0.305	0.366	0.423	0.474	0.520	0.561	0.597	0.627	0.683
1993	0.146	0.209	0.268	0.324	0.376	0.425	0.470	0.513	0.551	0.587	0.672
1994	0.183	0.241	0.295	0.347	0.396	0.442	0.484	0.524	0.561	0.595	0.671
1995	0.192	0.248	0.301	0.351	0.397	0.441	0.481	0.518	0.552	0.583	0.652
1996	0.214	0.262	0.308	0.354	0.399	0.442	0.484	0.524	0.564	0.602	0.694
1997	0.186	0.244	0.300	0.354	0.406	0.455	0.503	0.548	0.592	0.633	0.734
1998	0.191	0.247	0.300	0.350	0.397	0.441	0.482	0.520	0.555	0.586	0.661
1999	0.208	0.257	0.303	0.347	0.389	0.429	0.468	0.503	0.536	0.567	0.637
2000	0.202	0.258	0.310	0.358	0.401	0.441	0.476	0.508	0.535	0.558	0.647
2001	0.203	0.245	0.287	0.326	0.365	0.402	0.438	0.472	0.505	0.537	0.616
2002	0.181	0.236	0.290	0.342	0.391	0.439	0.485	0.529	0.570	0.610	0.706
2003	0.173	0.241	0.306	0.367	0.425	0.479	0.530	0.577	0.620	0.660	0.746
2004	0.176	0.230	0.282	0.334	0.385	0.435	0.485	0.534	0.582	0.629	0.757
2005	0.180	0.236	0.290	0.343	0.394	0.444	0.493	0.540	0.586	0.630	0.747
2006	0.169	0.228	0.282	0.333	0.381	0.424	0.464	0.501	0.533	0.562	0.672
2007	0.183	0.244	0.299	0.350	0.395	0.436	0.471	0.501	0.526	0.546	0.616
2008	0.197	0.245	0.292	0.337	0.382	0.425	0.468	0.509	0.549	0.588	0.652
2009	0.176	0.252	0.322	0.385	0.443	0.494	0.540	0.579	0.612	0.639	0.703
2010	0.169	0.258	0.339	0.412	0.476	0.532	0.580	0.619	0.650	0.673	0.699
2011	0.200	0.261	0.319	0.375	0.428	0.480	0.528	0.575	0.618	0.660	0.749
2012	0.162	0.240	0.311	0.373	0.428	0.476	0.516	0.548	0.572	0.589	0.664
2013	0.172	0.228	0.283	0.337	0.389	0.439	0.489	0.536	0.583	0.628	0.740
2014	0.191	0.254	0.313	0.366	0.415	0.459	0.499	0.533	0.563	0.588	0.709
2015	0.182	0.250	0.313	0.370	0.423	0.471	0.513	0.551	0.583	0.611	0.697
2016	0.215	0.282	0.345	0.401	0.453	0.499	0.541	0.576	0.606	0.631	0.720
2017	0.209	0.264	0.315	0.364	0.409	0.451	0.490	0.527	0.56	0.59	0.664
2018	0.237	0.289	0.338	0.383	0.425	0.463	0.498	0.529	0.558	0.582	0.666
2019	0.18	0.233	0.284	0.333	0.379	0.423	0.464	0.503	0.54	0.574	0.682
2020	0.188	0.235	0.28	0.323	0.365	0.406	0.445	0.483	0.519	0.553	0.642
2021	0.157	0.213	0.265	0.313	0.358	0.399	0.435	0.468	0.498	0.523	0.592
2022	0.144	0.207	0.266	0.322	0.375	0.424	0.47	0.512	0.551	0.586	0.665
2023	0.212	0.249	0.286	0.324	0.362	0.4	0.439	0.479	0.518	0.559	0.668

Table 32.4. Sole in Division 7.e. Stock weights-at-age (kg).

year\age	2	3	4	5	6	7	8	9	10	11	12+
1969	0.125	0.200	0.270	0.330	0.380	0.425	0.460	0.490	0.520	0.550	0.609
1970	0.120	0.195	0.255	0.305	0.355	0.395	0.430	0.465	0.490	0.510	0.541
1971	0.090	0.170	0.240	0.295	0.345	0.390	0.420	0.445	0.470	0.490	0.544
1972	0.130	0.200	0.265	0.325	0.380	0.420	0.460	0.490	0.520	0.540	0.558
1973	0.105	0.170	0.235	0.290	0.340	0.390	0.435	0.475	0.510	0.540	0.585
1974	0.125	0.200	0.265	0.320	0.370	0.410	0.455	0.490	0.515	0.530	0.571
1975	0.144	0.221	0.267	0.327	0.385	0.435	0.479	0.516	0.545	0.569	0.628
1976	0.146	0.198	0.247	0.294	0.338	0.380	0.417	0.456	0.491	0.523	0.595
1977	0.156	0.221	0.278	0.332	0.382	0.425	0.462	0.497	0.527	0.553	0.629
1978	0.156	0.217	0.276	0.330	0.380	0.425	0.463	0.498	0.526	0.555	0.630
1979	0.141	0.216	0.287	0.352	0.414	0.463	0.502	0.539	0.574	0.608	0.719
1980	0.125	0.206	0.288	0.360	0.436	0.513	0.575	0.620	0.650	0.674	0.714
1981	0.119	0.197	0.276	0.358	0.427	0.490	0.543	0.582	0.616	0.645	0.699
1982	0.117	0.195	0.265	0.335	0.398	0.455	0.506	0.536	0.562	0.585	0.632
1983	0.120	0.195	0.250	0.307	0.365	0.420	0.475	0.520	0.570	0.615	0.709
1984	0.108	0.192	0.268	0.339	0.400	0.453	0.501	0.545	0.577	0.607	0.696
1985	0.150	0.204	0.258	0.311	0.364	0.416	0.468	0.520	0.571	0.621	0.790
1986	0.140	0.206	0.268	0.326	0.381	0.432	0.480	0.524	0.564	0.601	0.691
1987	0.137	0.210	0.278	0.341	0.398	0.450	0.497	0.538	0.574	0.605	0.659
1988	0.131	0.208	0.278	0.344	0.404	0.459	0.508	0.552	0.591	0.624	0.687
1989	0.139	0.195	0.249	0.300	0.350	0.398	0.444	0.488	0.531	0.571	0.675
1990	0.187	0.243	0.296	0.346	0.393	0.437	0.478	0.516	0.551	0.583	0.654
1991	0.144	0.219	0.290	0.355	0.416	0.473	0.524	0.572	0.614	0.652	0.731
1992	0.128	0.202	0.272	0.336	0.395	0.449	0.498	0.542	0.580	0.613	0.677
1993	0.114	0.178	0.239	0.296	0.350	0.401	0.448	0.492	0.532	0.570	0.659
1994	0.153	0.212	0.268	0.322	0.372	0.419	0.463	0.505	0.543	0.578	0.659
1995	0.163	0.221	0.275	0.326	0.374	0.419	0.461	0.500	0.536	0.568	0.641
1996	0.189	0.238	0.285	0.331	0.376	0.420	0.463	0.504	0.544	0.583	0.677
1997	0.156	0.215	0.272	0.327	0.380	0.431	0.480	0.526	0.570	0.612	0.717
1998	0.162	0.220	0.274	0.325	0.374	0.419	0.462	0.501	0.537	0.571	0.650
1999	0.183	0.233	0.280	0.326	0.369	0.410	0.448	0.485	0.519	0.551	0.624
2000	0.172	0.230	0.284	0.333	0.379	0.421	0.458	0.492	0.521	0.546	0.643

year\age	2	3	4	5	6	7	8	9	10	11	12+
2001	0.181	0.224	0.266	0.307	0.346	0.384	0.420	0.455	0.489	0.521	0.602
2002	0.152	0.209	0.263	0.316	0.367	0.415	0.462	0.507	0.550	0.591	0.688
2003	0.137	0.207	0.274	0.337	0.396	0.452	0.505	0.554	0.599	0.641	0.732
2004	0.149	0.203	0.256	0.308	0.360	0.410	0.460	0.509	0.557	0.605	0.734
2005	0.152	0.208	0.263	0.316	0.368	0.419	0.468	0.516	0.562	0.607	0.726
2006	0.138	0.197	0.254	0.306	0.355	0.400	0.442	0.479	0.514	0.544	0.661
2007	0.151	0.214	0.272	0.325	0.373	0.416	0.454	0.486	0.514	0.536	0.614
2008	0.172	0.221	0.268	0.315	0.360	0.404	0.447	0.489	0.529	0.569	0.640
2009	0.136	0.215	0.287	0.354	0.415	0.469	0.518	0.560	0.596	0.626	0.698
2010	0.121	0.215	0.300	0.376	0.445	0.505	0.557	0.600	0.636	0.663	0.696
2011	0.169	0.231	0.290	0.347	0.402	0.454	0.504	0.552	0.597	0.639	0.738
2012	0.120	0.202	0.276	0.343	0.402	0.453	0.497	0.532	0.561	0.581	0.664
2013	0.144	0.200	0.256	0.310	0.363	0.414	0.464	0.513	0.560	0.606	0.729
2014	0.157	0.223	0.284	0.340	0.391	0.438	0.480	0.517	0.549	0.576	0.706
2015	0.147	0.217	0.282	0.342	0.397	0.448	0.493	0.533	0.568	0.598	0.692
2016	0.178	0.248	0.313	0.373	0.427	0.476	0.519	0.557	0.59	0.617	0.714
2017	0.181	0.237	0.290	0.340	0.387	0.430	0.471	0.509	0.543	0.575	0.655
2018	0.210	0.264	0.314	0.361	0.404	0.444	0.481	0.514	0.544	0.570	0.660
2019	0.152	0.207	0.259	0.309	0.356	0.401	0.444	0.484	0.522	0.557	0.672
2020	0.165	0.212	0.257	0.302	0.344	0.386	0.426	0.464	0.501	0.536	0.632
2021	0.128	0.186	0.240	0.290	0.336	0.379	0.417	0.452	0.483	0.511	0.586
2022	0.111	0.176	0.237	0.295	0.349	0.400	0.447	0.491	0.532	0.569	0.656
2023	0.193	0.23	0.267	0.305	0.343	0.381	0.42	0.459	0.498	0.538	0.657

Table 32.5. Sole in Division 7.e. Landings, effort and mean standardised LPUE for the UK commercial fleets.

Fleet	Year	Effort [days]	Landings [tonnes]	Lpue [tonnes/1000 days]	means standardised lpue
UK-CBT<24 m	1988	2527	293	115.97	1.93
	1989	1956	162	83.06	1.38
	1990	1958	179	91.51	1.52
	1991	1458	134	92.22	1.53
	1992	1342	142	106.22	1.76
	1993	1432	154	107.71	1.79
	1994	2241	161	71.97	1.19
	1995	2017	134	66.28	1.10
	1996	1999	106	52.99	0.88
	1997	1991	132	66.30	1.10
	1998	2357	99	42.12	0.70
	1999	2518	115	45.70	0.76
	2000	2913	134	45.85	0.76
	2001	3746	148	39.57	0.66
	2002	3482	110	31.55	0.52
	2003	3785	93	24.44	0.41
	2004	3512	64	18.12	0.30
	2005	3305	191	57.72	0.96
	2006	3277	224	68.27	1.13
	2007	4027	225	55.77	0.93
	2008	4629	213	45.94	0.76
	2009	4040	185	45.85	0.76
	2010	4727	201	42.42	0.70
	2011	5913	258	43.65	0.72
	2012	7188	314	43.65	0.72
	2013	6322	329	52.02	0.86
	2014	5870	308	52.54	0.87
	2015	6260	310	49.54	0.82
	2016	6114	355	58.1	0.96
	2017	6578	402	61.08	1.01
	2018	6366	386	60.66	1.01

Fleet	Year	Effort [days]	Landings [tonnes]	Lpue [tonnes/1000 days]	means standardised lpue
	2019	6067	397	65.49	1.09
	2020	5643	393	69.61	1.15
	2021	5354	399	74.5	1.24
	2022	6085	377	61.94	1.03
	2023	6034	350	57.93	0.96
UK-CBT>24 m	1988	2971	391	131.77	2.74
	1989	3938	340	86.37	1.79
	1990	3518	314	89.12	1.85
	1991	2412	206	85.47	1.78
	1992	1993	197	98.63	2.05
	1993	2678	194	72.54	1.51
	1994	4574	236	51.50	1.07
	1995	4917	257	52.30	1.09
	1996	5592	178	31.84	0.66
	1997	5377	199	37.10	0.77
	1998	4945	164	33.19	0.69
	1999	4512	141	31.32	0.65
	2000	5237	151	28.84	0.60
	2001	5874	142	24.11	0.5
	2002	5957	104	17.51	0.36
	2003	6810	94	13.78	0.29
	2004	7100	69	9.66	0.20
	2005	6684	236	35.27	0.73
	2006	6595	236	35.79	0.74
	2007	5594	196	35.10	0.73
	2008	4924	154	31.36	0.65
	2009	3523	115	32.66	0.68
	2010	3064	94	30.64	0.64
	2011	2790	92	32.95	0.68
	2012	2609	86	33.01	0.69
	2013	2444	93	38.13	0.79
	2014	2900	104	35.95	0.75
	2015	3039	101	33.12	0.68

Fleet	Year	Effort [days]	Landings [tonnes]	Lpue [tonnes/1000 days]	means standardised lpue
	2016	4064	166	40.79	0.84
	2017	4556	207	45.41	0.93
	2018	4116	231	56.17	1.15
	2019	4329	313	72.36	1.48
	2020	4335	321	74.07	1.52
	2021	4505	354	78.56	1.61
	2022	5329	349	65.48	1.34
	2023	5614	318	56.7	1.16
UK-CBT	1988	5497	684	124.51	2.34
	1989	5894	503	85.27	1.6
	1990	5476	493	89.97	1.69
	1991	3870	341	88.02	1.65
	1992	3334	339	101.69	1.91
	1993	4111	349	84.79	1.59
	1994	6814	397	58.23	1.09
	1995	6935	391	56.37	1.06
	1996	7591	284	37.41	0.70
	1997	7368	331	44.99	0.84
	1998	7302	263	36.07	0.68
	1999	7031	256	36.47	0.68
	2000	8150	285	34.92	0.66
	2001	9620	290	30.13	0.57
	2002	9439	214	22.69	0.43
	2003	10596	186	17.59	0.33
	2004	10612	132	12.46	0.23
	2005	9990	427	42.70	0.80
	2006	9873	460	46.57	0.87
	2007	9621	421	43.75	0.82
	2008	9552	367	38.42	0.72
	2009	7563	300	39.70	0.75
	2010	7791	294	37.79	0.71
	2011	8703	350	40.22	0.75
	2012	9797	400	40.82	0.77

Fleet	Year	Effort [days]	Landings [tonnes]	Lpue [tonnes/1000 days]	means standardised lpue
	2013	8767	422	48.15	0.90
	2014	8769	413	47.05	0.88
	2015	9298	411	44.17	0.82
	2016	10178	521	51.19	0.96
	2017	11114	606	54.57	1.02
	2018	10482	617	58.9	1.1
	2019	10396	711	68.35	1.27
	2020	9978	714	71.55	1.33
	2021	9859	753	76.35	1.42
	2022	11414	726	63.59	1.18
	2023	11648	668	57.34	1.07
UK-COT	1988	4265	29	6.77	1.43
	1989	4607	28	6.18	1.31
	1990	4423	26	5.97	1.27
	1991	4004	14	3.39	0.72
	1992	4108	12	3.02	0.64
	1993	3761	15	3.95	0.84
	1994	3423	18	5.27	1.12
	1995	3294	13	3.99	0.84
	1996	2589	12	4.83	1.02
	1997	3011	15	4.96	1.05
	1998	2699	11	4.22	0.89
	1999	2486	13	5.16	1.09
	2000	2681	11	4.11	0.87
	2001	2732	13	4.90	1.04
	2002	2448	9	3.66	0.78
	2003	2273	8	3.31	0.70
	2004	2334	6	2.46	0.52
	2005	1762	12	6.86	1.45
	2006	1699	8	4.57	0.97
	2007	1917	9	4.90	1.04
	2008	1750	7	4.26	0.90
	2009	1847	10	5.36	1.14

Fleet	Year	Effort [days]	Landings [tonnes]	Lpue [tonnes/1000 days]	means standardised lpue
	2010	2213	10	4.53	0.96
	2011	1930	8	4.08	0.86
	2012	2068	12	5.96	1.26
	2013	1587	8	4.96	1.05
	2014	1440	8	5.56	1.18
	2015	978	5	4.98	1.06
	2016	0	0	NA	NA
UK-COT new	2016	2020	14	7.08	0.68
	2017	2398	15	6.1	0.58
	2018	1986	17	8.42	0.81
	2019	1548	14	9.33	0.89
	2020	1076	15	14.17	1.35
	2021	1369	20	14.7	1.4
	2022	1252	17	13.85	1.32
	2023	1346	14	10.03	0.96

Table 32.6. Sole in Division 7.e. Tuning data file. Not all tuning time-series, years and ages shown here were used in the assessment.

sol.27.7e WGCSE 2024

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UK-CBT-late

2003 2023

1 1 0 1

3 14

10.59557 130.7 168.87 129.96 21.43 18.32 10.28 13.49 6.67 2.19 2.06 3.35 2.82

10.61183 146.5 61.53 53.46 75.23 11.35 14.96 7.49 5.98 4.27 2.12 1.18 1.89

9.98951 210.39 326.3 132.94 155.21 132.09 27.41 32.6 22.54 14.24 8.3 5.95 4.84

9.87254 376.87 186.46 243.45 85.59 108.34 106.98 37.22 20.67 13.69 13.61 6.68 2.99

9.6207 456.04 261.42 105.82 103.55 54.21 62.07 51.47 15.34 11.12 10.41 8.44 8.17

9.55231 294.03 286.06 126.1 67.89 65.42 42.34 39.54 36.27 14.54 11.8 4.3 6

7.56283 190.03 182.63 152.83 89.59 26.02 27.9 13.23 16.1 12.91 4.85
3.74 1.92

7.79112 80.09 179.7 157.57 101.24 51.98 25.24 22.59 8.23 16.75 25.39
7.42 3.88

8.70287 243.76 148.58 186.66 121.43 81.66 35.56 15.79 20.25 10.83 14.11
8.26 2.1

9.79734 129.79 307.88 139.02 143.59 91.49 66.22 30.49 17.81 14.83 8.55
12.25 11.03

8.76655 81.92 242.49 288.92 134.34 93.18 72.27 44.15 24.5 10.73 9.84
8.14 9.84

8.7692 111.72 201.15 169.62 201.19 99.91 67.46 43.84 30.63 15.94 7.71
9.34 4.9

9.29849 137.05 178.21 198.83 135.74 117.19 65.74 45.95 31.78 20.59 11.01
5.52 5.96

10.17804 263.46 217.34 158.93 161.88 118.88 102.14 49.07 45.22 21.3 23.14
13.03 5.69

11.11408 454.27 353.27 177.37 142.06 120.28 81.72 72.95 42.23 28.03 16.59
11.97 9.63

10.48248 217.63 454.82 260.75 116.59 118.4 76.79 51.54 49.36 33.91 24.42
21.84 10.92

10.39628 618.98 411.51 357.08 217.83 105.4 69.38 57 36.74 40.95 22.94
13.23 10.34

9.97809 366.92 668.85 351.1 232.9 155.35 85.53 44.65 28.78 13.68 12.36
13.5 10.39

9.85862 489.94 449.21 574.6 243.75 181.18 96.72 47.65 40.73 26.66 25.03
24.62 14.92

11.4142 314.76 615.56 308.94 431.17 155.05 97.63 53.46 28.42 22.66 18.31
11.61 14

11.64815 369.56 308.81 394.31 224.1 286.77 100.46 72.9 45.59 25.81 21.33
16.77 9.98

UK-COT

1988 2016

1 1 0 1

3 11

4264.71 30.97 15.73 19.29 8.63 2.55 2.55
1.83 0.35 0.76

4607.04 15.09 18.34 9.22 11.75 4.72 2.42
2.36 2.01 1.4

4422.52 18.3 12.56 9.21 6.09 5.53 2.08
1.83 1.12 0.9

4004.37 10.04 7.03 4.12 2.46 0.96 1.44
0.42 0.41 0.23

4107.71	26.24 0.65	6 0.17	3.6 0.09	1.19	1.14	0.48
3761	12.45 1	17.56 0.92	5.38 0.56	3.44	2.49	1.26
3423.03	12.42 1.35	11.46 1.03	12.35 1.18	2.5	2.6	1.23
3294.06	5.25 0.91	9.75 0.52	6.34 0.25	6.17	1.89	1.49
2589.38	9.47 0.76	6.54 0.68	4.37 0.45	3.15	3.54	0.95
3010.66	15.16 0.63	8.81 0.28	4.78 0.43	2.83	2.9	2.53
2698.6	8.74 1.47	7.58 0.31	4.25 0.44	2.49	1.53	0.93
2486.17	11.56 0.74	5.84 1.49	4.91 0.39	2.89	1.45	1.46
2680.63	6.67 0.81	8.41 0.62	4.03 0.99	2.64	1.24	0.59
2731.54	18.02 0.7	5.27 0.51	4.96 0.5	2.69	2.01	1.12
2448.37	9.88 0.33	6.12 0.2	2.39 0.25	2.67	1.27	0.82
2272.9	4.61 0.54	5.87 0.27	4.8 0.13	1.04	0.85	0.49
2334.16	6.05 0.3	2.58 0.24	2.23 0.18	3.25	0.46	0.57
1762.36	6.44 0.9	9.56 0.58	3.53 0.45	4.13	3.44	0.74
1699.49	6.93 0.6	3.27 0.31	4.13 0.2	1.36	1.63	1.75
1916.84	9.32 1.13	5.44 0.36	2.3 0.21	2.32	1.19	1.41
1750.36	5.61 0.75	4.85 0.7	2.08 0.32	1.15	1.18	0.75
1847.2	7.97 0.39	5.47 0.52	3.92 0.45	2.17	0.64	0.83
2212.85	2.71 0.74	5.85 0.3	4.74 0.6	3.15	1.63	0.81
1930.5	6.51 0.31	3.32 0.37	3.89 0.19	2.46	1.64	0.58
2068.16	4.24 0.82	9.16 0.49	3.97 0.46	4.06	2.3	1.76

1586.58	2.01	4.55	5.64	2.66	1.74	1.49
	0.89	0.56	0.26			
1440.22	2.13	3.57	2.99	3.56	1.8	1.29
	0.9	0.68	0.34			
977.63	1.62	1.98	1.86	1.59	1.35	0.7
	0.5	0.42	0.25			
0	0	0	0	0	0	0
	0	0	0			

Q1SWBeam-nonoffset

2006 2023

1 1 0.1 0.25

1 27

1	0	10.2831	14.4378	7.2725	14.4377	5.5961
	7.13	6.861	2.907	2.82859	3.60271	
	0.64983	1.18363	0.42807	0.658	6.79316	
	0.83462	0.39699	0	0	0	0
	0	0	0	0	0	
1	0.16687	9.8812	27.8597	10.5167	1.6884	5.7311
	2.0168	2.1298	3.7204	2.51892	3.10315	
	0.11374	1.15808	0.96954	0.33416	0	
	0.63993	0.28599	0	0	0	
	0.40667	0	0	0.09932	0	0
1	0	10.8269	22.4315	19.0395	8.8652	6.4496
	2.5605	6.4218	6.1821	3.83386	1.82804	1.542
	1.64694	0.84895	0.4194	0.09932	0.87867	
	1.39078	2.27897	0	0	0	0
	0	0	0	0		
1	0	2.7029	18.4684	14.3973	9.4283	5.5118
	1.9591	2.4189	0.8923	3.0406	3.50273	
	0.66769	0.63782	0.14701	0.72372	0	
	1.16367	1.29584	1.49235	0	0	0
	0	0	0.10455	1.05699	1.05699	
1	0	17.4225	17.8979	19.3542	13.2345	8.318
	7.1591	1.6078	1.6558	1.39785	0.81183	
	1.18174	0.71617	0.66769	0.51741	0	
	0.49475	0	0.66245	0	0.66769	0
	0	0	0	0	0	
1	0	9.6518	17.797	14.2866	10.5999	4.6691
	2.7641	2.5717	1.4705	0.22467	1.24853	
	0.77389	0.31664	0.3873	0.12102	0.09459	0.3333
	0	0.11919	0	0	0.09459	0
	0	0	0	0		
1	0	1.7917	16.9977	18.5256	7.7153	6.3403
	8.0401	4.0948	2.8642	0.13376	1.0617	
	1.84127	0.33928	0.98069	0.09932	0.44749	0

	0.09932	0.66245	0	0	0	
	0.33416	0	0	0	0	
1	0	3.0941	10.5562	18.2857	17.3685	
	11.5663	9.7466	6.5411	6.149	5.15539	
	0.85402	4.97234	0.82806	3.43062	0.7629	0
	0	0	0	0	0	
	1.88505	0.66831	0	0	0	0
1	0.7539	3.9292	20.2852	24.4269	9.9905	
	14.2817	10.2697	18.9533	5.8138	2.3858	
	3.74314	1.0254	1.32124	0.7671	1.01737	
	0.92041	1.23376	0	0	0.92041	
	0.21026	0	0	0	0	0
	0					
1	0.56543	4.112	8.5863	8.7851	7.6517	7.4502
	8.6561	5.0026	5.0313	2.451	1.65758	
	0.81713	1.80827	1.7988	0	2.41582	
	0.27347	0.92815	0.14558	0.178	1.25309	0
	0	0	0	0	0	
1	0.20429	10.1608	22.8495	9.7784	10.0088	7.0214
	6.1444	10.0515	1.772	1.58774	3.13678	
	1.70091	0.90133	0.06207	0	0.33416	0
	0	0	0.79506	0	0.1204	0
	0	0	0	0		
1	1.3311	4.2408	13.9577	12.7983	7.3733	5.7578
	4.9765	2.1543	1.766	1.74008	1.29402	
	3.12057	0.99117	0.94877	0.1442	0.24464	0
	0	0.95282	0.31664	0.19391	0	0
	0	0	0	0		
1	0	9.7449	15.9118	22.0253	16.018	5.515
	7.3314	5.4841	4.6341	4.26519	1.04742	
	3.18642	3.36517	3.81071	0.83888	0	0
	0	0	0.32885	0	0	0
	0	0	0	0		
1	0.35174	14.1628	35.5258	15.708	15.9896	8.4814
	2.9977	2.5971	2.6027	1.74875	4.73319	
	0.12722	2.11464	1.22713	2.10488	0	0
	0.34295	0	0.22567	0	0	
	0.66769	0	0	0	0	
1	0.23884	13.4637	18.2356	21.9305	11.0805	8.2492
	5.533	3.5814	2.3138	1.46077	3.42926	2.0927
	0.66215	0.66769	0.15604	0	0	0
	0	0	0	0.18073	0	0
	0	0	0			
1	0.18772	5.0725	37.1815	20.8599	32.7296	
	11.1961	9.7452	14.9424	1.9538	3.94729	
	2.14387	0.17896	0.338	1.96585	0	0

	1.85926	0	0	0	0.1093	0
	0.11083	0	0	0	0	
1	0.27394	10.2775	11.6372	17.2343	14.7067	
	19.2967	8.2653	1.9945	4.0839	6.22742	
	1.93206	1.88248	1.19079	1.98107	1.39072	0
	0	0.18058	0	0	0	
	0.19917	0	0	0	0	0
1	0.15195	9.4657	18.8168	10.6968	18.0547	9.7368
	21.7861	5.0311	12.7096	4.37038	1.32971	
	4.28408	1.92774	0.24723	1.12406	0.6146	
	0.14579	1.41607	0	0	0	0
	0	0	0	0	0	

FSP-UK

2003 2023

1 1 0.7 0.75

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1	0.0005996525	0.1640287001	0.3331577428	0.3421042854	0.3077896855	
	0.0276877607	0.0434349878	0.0011860104	0.0608003593	0.0451763227	
	0.0762193328	0.0041632567	0.0044569891	0.0017184351	0.0003489357	
	0.0014186342	0	0	0.0001163119	0.0001163119	0
	0.0002326238	0.0001163119	0	0.0001163119	0	0
1	0.0001223836	0.148565371	0.5397033838	0.3098782034	0.2630863645	
	0.129056707	0.0616661114	0.0863136593	0.0352755756	0.0161903753	
	0.0177121487	0.0099731816	0.0063903378	0.0068742824	0.0044894467	
	0.0015712354	0.0011647284	0.0011509869	0.0035892687	0.0013945057	
	0.0005120651	0.0013717113	0.0023661077	0.0007329086	0.0008245222	0
	0					
1	0	0.1033295175	0.19641048	0.2419913717	0.1091266279	
	0.1568026119	0.145326301	0.036140277	0.0293963588	0.0143508007	
	0.0153718894	0.0071929565	0.0067527739	0.0018681385	0.009940521	
	0.00740716	0.0023788354	0.002716705	0.0021409311	0.0017422746	
	0.0005904058	0.0033955813	0.0006752624	0	0	
	0.0002352598	0				
1	0.0039596329	0.1530500071	0.3381328362	0.1553895918	0.2150083739	
	0.0964529823	0.1165659253	0.1314578928	0.0263335654	0.0257367117	
	0.0180380169	0.0143720469	0.0090822273	0.0017959477	0.0041795766	
	0.0037964376	0.0035431007	0.0026203905	0.0019622031	0.0012689076	
	0.0005610368	0.0007510883	0.000569457	0.0012689076	3.21242e-05	
	3.21242e-05	0				
1	0.0010962171	0.1222741336	0.4498553047	0.2031795541	0.0752568916	
	0.0913421932	0.0585642238	0.0482046412	0.0990784093	0.0183456175	
	0.0234301884	0.0051412317	0.0112336251	0.0042618881	0.0040821708	
	0.0039301402	0	0.0003138761	0.0004997104	0.0009808918	
	0.0008212451	0.0011351212	0.001694755	0.0009721986	0	0
	0					

1	2.13237e-05	0.2195359609	0.3064631629	0.2655855663	0.2476263144	
	0.043108973	0.0375100475	0.0146095245	0.057007758	0.0329403724	
	0.0020443892	0.0103735097	0.005214212	0.00033916	0.0019450962	
	0.0012325515	0.0002575085	0.0023031566	0.0017526933	0.0001122039	
	0.0019527171	0.0014567991	3.94624e-05	0.0001032939	0.0016011921	
	1.01841e-05	0				
1	0	0.0871756844	0.2996241409	0.3111598691	0.1612888821	
	0.0607181418	0.0399573377	0.0280004615	0.0151930886	0.0179131136	
	0.047375509	0.0070657871	0.0029069767	0.0028085641	0.0034248136	0
	0.0023009922	0	0	0	0.0014487729	0
	0	0	0	0	0	
1	0	0.1198634134	0.196874246	0.2457977047	0.1811689438	
	0.1272699744	0.0356769991	0.020992322	0.0271910269	0.0175688686	
	0.0235333828	0.0111317663	0.0040175529	0.0028670567	0.0098378335	
	0.0061571312	0	0	0.0017165606	0	
	0.0014381202	0.001962611	0.0014381202	0	0	0
	0					
1	0	0.06241178	0.4007807363	0.0936432403	0.1661392336	
	0.0841713673	0.0489667592	0.0045350684	0.0133309554	0.0072992036	
	0.0107241145	0.0124110167	0.0133136094	0.0012401452	0.003746497	
	7.47075e-05	0.0047437213	4.48245e-05	0.0012252037	1.49415e-05	
	2.9883e-05	5.9766e-05	2.9883e-05	1.49415e-05	1.49415e-05	
	0.0034480627	0				
1	0	0.0462429317	0.3661074051	0.3751123378	0.171327639	
	0.1173729434	0.0335259216	0.0443997936	0.0276582094	0.0030666751	
	0.0064196299	0.0001183835	0.0090514008	0.0102432905	0.0064879186	
	0.0063170946	0.0019806469	0	5.91917e-05	5.91917e-05	
	0.0012992471	0.0001183835	5.91917e-05	0	5.91917e-05	0
	0					
1	0	0.0497881333	0.3584337435	0.4301705234	0.3611324055	
	0.1699642895	0.0915132656	0.0522974874	0.0372679269	0.0063585644	0
	0.0155682804	0.0169229843	0.0150488511	0	0.0065329235	
	0.0065015519	0	0	0	0.0005752481	0
	0	0	0	0	0	
1	0	0.0992979309	0.3132769061	0.404824384	0.3187756661	
	0.2144234295	0.1202334108	0.0707920098	0.0346720214	0.0427286271	
	0.0019981129	0.0122453312	0.0035399024	0.0091491166	0.0040710437	
	0.0080827697	0.0039462729	0.0059770088	9.99056e-05	0.0015076265	
	9.99056e-05	0	0	9.99056e-05	0	0
	0					
1	0.0048896085	0.1093931233	0.2409909098	0.342222128	0.1843469436	
	0.1273706237	0.1082327865	0.0763853928	0.0576452317	0.0237495021	
	0.0250038238	0.00933254	0.0036693854	0.0111649666	0.0028229153	
	0.0031227752	0.0034365469	0.0047588703	0.0011504961	0	0
	0	0	0	0.0014642678	0	0
1	0	0.106692296	0.462891223	0.1532642147	0.1442259017	
	0.1230641606	0.0781141924	0.102312786	0.0301074486	0.0478016471	
	0.014684173	0.0168037935	0.0050194129	0.0033997592	0.0021956008	

0.0063508475 0.0048557028 0.003975375 0.0011243485 0.0027226531 0
0.0017564806 0 0 0 0 0

1 0 0.12886873 0.4887237516 0.3304347223 0.0960669305
0.0858467213 0.0726999591 0.0391128558 0.0589537549 0.0200598221
0.0122974024 0.0180049259 0.0119845876 0.0039815527 0.0027961056 0
0.0024247625 0.005117608 0.0059944095 0.0011243485 0 0
0 0 0 0 0

1 0 0.1586709782 0.2933003672 0.4153420564 0.2476762135
0.0907601391 0.0694807344 0.0922203076 0.0271016214 0.0610983845
0.0369478639 0.0380261073 0.0120135944 0.0073046846 0.0019174935 0
0 0.0011504961 0.0014381202 0.0026932068 0.0024055828 0
0 0 0.0011504961 0 0

1 0 0.2112724882 0.9077480144 0.1994578656 0.1528107317
0.0897784456 0.0471313352 0.0455976848 0.0374275951 0.0276157117
0.0403826099 0.0079840292 0.0096721581 0.0032406206 0.0017564806 0
0.0017564806 0.0028808291 0.0064020338 0 0.0045777045 0
0.00148414 0 0 0 0

1 0.001278329 0.3004545955 0.3368668308 0.4213025839 0.1902005191
0.136689404 0.0642090392 0.0395978829 0.0304360262 0.0543729347
0.0184030591 0.0425811321 0.0141248287 0.0039849478 0.0064433092
0.0041423169 0.0024755343 0.0012205598 0.0001167728 2.33546e-05
0.0022739516 0.0053185882 4.67091e-05 2.33546e-05 2.33546e-05
2.33546e-05 0

1 0 0.0457153066 0.3479819938 0.2646579215 0.3520245785
0.0947774833 0.0712985299 0.0333363482 0.0224343434 0.0129740757
0.0234239362 0 0.0232988167 0.0018886193 0.0018886193
0.0064010685 0.0081597965 0.0029903139 0 0
0.0019875965 0.0018886193 0 0 0 0
0

1 0.0004082631 0.0787689915 0.1276190299 0.2410218467 0.0760160683
0.1630479195 0.0575640538 0.0266022743 0.020039252 0.0144115392
0.0125687649 0.0060149665 0.0056990821 0.0147704741 0.0034450312
0.0089225878 0.0020648209 0.0037529077 1.9588e-05 3.9175905e-06
0.0011282661 1.17528e-05 0.0014991313 0 0 0
0

1 0 0.0567422771 0.3046803054 0.073854748 0.15984611
0.0745462583 0.1700907935 0.0790899025 0.0514997681 0.0157802539
0.0301199806 0.0057913537 0.0040140523 0.0021735887 0.0049551029
0.008168637 0.0021576863 0.0113345956 0.0046875515 5.15572e-05
0.0020626069 0.0001149993 6.34421e-05 2.37698e-05 3.96723e-05
1.18849e-05 0

UK-CBT-early

1988 2002

1 1 0 1

3 11

5.50	660.36	337.83	439.11	199.29	63.46	62.34
	58.95	13.18	21.70	13.33	27.52	6.95
5.89	334.92	420.18	206.01	239.87	86.59	36.69
	36.30	34.02	21.23	13.23	14.64	8.91
5.48	330.59	249.78	187.83	120.79	118.15	45.22
	34.04	22.00	18.96	10.14	16.62	8.71
3.87	169.69	178.00	138.03	89.94	39.06	50.15
	27.73	13.14	9.08	16.74	3.98	7.26
3.33	569.33	159.31	112.20	42.39	44.18	21.30
	30.70	7.94	5.60	5.48	5.88	5.21
4.11	276.52	436.07	135.24	82.61	58.75	29.82
	23.11	22.81	11.35	3.31	8.58	5.80
6.81	347.00	282.99	271.57	54.29	49.16	24.17
	27.27	20.69	23.17	11.03	8.54	4.49
6.93	139.39	287.26	193.06	187.53	57.49	45.54
	26.86	14.72	8.08	17.93	7.45	5.17
7.59	146.04	118.70	100.89	81.14	87.63	23.24
	21.23	16.83	12.69	13.77	12.60	5.11
7.37	300.18	244.82	114.67	60.06	66.02	58.33
	14.54	6.74	13.71	5.51	6.41	4.75
7.30	188.05	166.31	103.86	61.72	44.52	23.65
	35.65	9.80	9.76	8.10	8.57	3.78
7.03	264.75	137.13	101.88	64.10	27.00	25.49
	13.29	26.52	5.87	9.91	2.81	2.98
8.15	194.23	235.47	112.00	69.45	33.41	16.90
	19.70	14.88	26.19	2.84	4.35	1.86
9.62	400.24	142.06	135.26	69.22	46.01	25.81
	13.47	11.17	10.68	12.43	4.64	3.50
9.44	280.20	169.83	62.21	62.54	27.88	19.67
	8.64	3.97	4.69	2.63	4.92	2.28

UK-WEC-BTS

1988 2013

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128.20	2.00	39.00	129.00	52.00	75.00	22.00
	0.00	12.00	3.00			
165.70	5.00	56.00	120.00	107.00	34.00	40.00
	17.00	5.00	7.00			
175.70	23.00	52.00	76.00	31.00	24.00	7.00
	15.00	3.00	6.00			
171.70	11.00	231.00	79.00	51.00	23.00	21.00
	5.00	17.00	4.00			

196.60	5.00 7.00	140.00 5.00	316.00 11.00	44.00	36.00	12.00
189.20	5.00 9.00	54.00 3.00	115.00 3.00	105.00	14.00	10.00
205.90	6.00 5.00	47.00 2.00	106.00 3.00	62.00	44.00	5.00
187.20	14.00 4.00	37.00 5.00	44.00 5.00	42.00	26.00	31.00
184.40	28.00 17.00	112.00 3.00	67.00 2.00	25.00	32.00	20.00
184.70	11.00 13.00	130.00 14.00	126.00 5.00	43.00	14.00	16.00
185.50	11.00 14.00	141.00 6.00	114.00 8.00	76.00	22.00	10.00
187.90	11.00 4.00	97.00 4.00	128.00 4.00	47.00	23.00	8.00
180.40	12.00 5.00	136.00 3.00	70.00 5.00	52.00	23.00	16.00
178.00	9.00 12.00	197.00 4.00	162.00 1.00	52.00	31.00	12.00
180.00	6.00 3.00	37.00 2.00	113.00 0.00	48.00	27.00	6.00
170.70	23.00 1.00	124.00 1.00	78.00 2.00	56.00	28.00	6.00
164.90	16.00 16.00	110.00 9.00	120.00 4.00	24.00	15.00	10.00
186.60	8.00 6.00	110.00 2.00	39.00 4.00	53.00	12.00	12.00
184.70	5.00 7.00	120.00 9.00	95.00 0.00	26.00	37.00	10.00
181.00	7.00 3.00	188.00 3.00	135.00 1.00	50.00	11.00	23.00
174.70	10.00 14.00	85.00 3.00	158.00 6.00	77.00	40.00	2.00
172.00	11.00 13.00	104.00 12.00	126.00 1.00	96.00	49.00	13.00
179.90	20.00 20.00	175.00 7.00	154.00 12.00	84.00	59.00	31.00
176.20	9.00 24.00	156.00 8.00	231.00 2.00	62.00	39.00	25.00
179.70	3.00 13.00	47.00 3.00	162.00 6.00	125.00	40.00	27.00

181.60	4.00	36.00	100.00	106.00	80.00	21.00
	9.00	6.00	3.00			

Table 32.7. Sole in Division 7.e. Detailed XSA survivor diagnostics.

FLR XSA Diagnostics 2024-04-18 16:29:27

CPUE data from indices

Catch data for 55 years 1969 to 2023. Ages 2 to 12.

	fleet	first age	last age	first year	last year	alpha	beta
1	UK-CBT-late	3	11	2003	2023	<NA>	<NA>
2	UK-COT	3	11	1988	2015	<NA>	<NA>
3	Q1SWBeam-nonoffset	2	11	2006	2023	<NA>	<NA>
4	FSP-UK	2	11	2004	2023	<NA>	<NA>

Time series weights :

Tapered time weighting applied
Power = 3 over 15 years

Catchability analysis :

Catchability independent of size for all ages

Catchability independent of age for ages > 6

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 3 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1

Minimum standard error for population
estimates derived from each fleet = 0.4

prior weighting not applied

Regression weights

age \ year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
all	0.482	0.61	0.725	0.82	0.893	0.944	0.976	0.993	0.999	1

Fishing mortalities

age \ year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2	0.064	0.044	0.017	0.028	0.014	0.024	0.026	0.041	0.079	0.070
3	0.124	0.128	0.124	0.165	0.092	0.114	0.139	0.156	0.224	0.184
4	0.209	0.198	0.244	0.217	0.228	0.208	0.201	0.229	0.233	0.307
5	0.264	0.205	0.185	0.207	0.229	0.265	0.271	0.280	0.310	0.210
6	0.249	0.228	0.206	0.215	0.198	0.291	0.268	0.390	0.294	0.309
7	0.207	0.171	0.305	0.222	0.265	0.269	0.286	0.291	0.335	0.282
8	0.188	0.191	0.210	0.262	0.245	0.314	0.269	0.286	0.276	0.294
9	0.207	0.174	0.145	0.196	0.260	0.278	0.226	0.362	0.258	0.254
10	0.215	0.156	0.144	0.244	0.191	0.266	0.232	0.315	0.246	0.236
11	0.202	0.140	0.148	0.246	0.308	0.236	0.173	0.215	0.330	0.373
12	0.202	0.140	0.148	0.246	0.308	0.236	0.173	0.215	0.330	0.373

XSA population number (Thousand)

year \ age	2	3	4	5	6	7	8	9	10	11	12
2014	3376	2894	2599	1933	1955	944	689	442	332	156	558
2015	4371	2867	2314	1908	1344	1379	694	517	325	242	661
2016	5805	3786	2282	1718	1407	968	1052	519	393	252	816
2017	5089	5165	3027	1618	1292	1036	646	772	406	308	596
2018	9564	4477	3963	2205	1190	943	750	450	574	288	618
2019	5110	8529	3694	2855	1588	884	655	532	314	429	783

2020	6932	4514	6886	2716	1981	1074	611	433	364	218	1048
2021	3039	6111	3554	5095	1875	1371	730	423	313	261	966
2022	4941	2640	4730	2557	3485	1149	927	496	266	206	721
2023	4197	4132	1909	3389	1697	2349	744	637	347	188	475

Estimated population abundance at 1st Jan 2024

age											
year	2	3	4	5	6	7	8	9	10	11	12
2024	0	3540	3112	1270	2486	1127	1603	501	447	248	117

Fleet: UK-CBT-late

Log catchability residuals.

year													
age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
3	-0.469	-0.672	0.394	0.581	0.696	0.351	0.076	-0.762	-0.095	-0.503	-0.853	-0.433	-0.275
4	-0.654	-1.332	0.120	0.197	0.186	0.135	-0.064	-0.237	-0.489	-0.236	-0.023	-0.196	-0.265
5	-0.784	-1.391	-0.109	0.306	0.112	-0.080	0.099	0.035	-0.035	-0.368	0.094	-0.069	0.016
6	-1.698	-0.939	0.095	-0.123	-0.045	0.083	0.165	-0.081	-0.078	-0.107	0.005	0.030	-0.058
7	-1.306	-2.020	0.158	0.190	-0.085	0.008	-0.271	-0.049	-0.108	-0.130	-0.051	0.038	-0.257
8	-1.381	-1.162	-0.702	0.408	0.074	0.162	-0.213	-0.033	-0.208	-0.114	0.130	-0.049	-0.139
9	-0.706	-1.368	0.141	0.008	0.136	-0.005	-0.375	-0.096	-0.306	-0.148	-0.062	-0.027	-0.211
10	-1.234	-1.046	0.207	0.208	-0.448	0.200	-0.341	-0.607	0.041	0.075	0.100	-0.096	-0.125
11	-1.333	-1.204	0.387	0.162	0.114	-0.084	-0.240	-0.014	-0.143	-0.021	0.095	0.001	-0.272

year								
age	2016	2017	2018	2019	2020	2021	2022	2023
3	0.008	0.173	-0.396	0.024	0.190	0.197	0.479	0.152
4	-0.121	-0.018	0.029	-0.002	-0.101	0.187	0.072	0.304
5	-0.203	-0.110	0.034	0.116	0.192	0.072	0.009	-0.096
6	-0.028	-0.158	-0.223	0.166	0.042	0.212	-0.029	0.023
7	0.083	-0.099	0.057	0.016	0.258	0.182	0.077	-0.068
8	-0.196	0.005	-0.157	-0.081	0.217	0.183	-0.199	0.039
9	-0.253	-0.318	-0.036	-0.086	-0.108	0.057	-0.184	-0.146

10	-0.058	-0.200	-0.356	-0.004	-0.372	0.179	-0.199	-0.016
11	-0.363	-0.332	0.013	-0.222	-0.629	-0.113	-0.131	0.090

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

	3	4	5	6	7	8	9	10	11
Mean_Logq	-4.8832	-4.3839	-4.3590	-4.3051	-4.3051	-4.3051	-4.3051	-4.3051	-4.3051
S.E_Logq	0.4508	0.3627	0.3697	0.4269	0.5300	0.4317	0.3292	0.3907	0.4156

Fleet: UK-COT

Log catchability residuals.

year													
age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3	1.161	0.800	1.072	0.798	0.765	0.723	0.955	0.400	0.842	1.173	0.839	0.937	0.501
4	0.678	0.494	0.492	0.038	-0.005	0.233	0.487	0.568	0.556	0.367	0.375	0.273	0.352
5	0.574	0.454	0.339	-0.222	-0.381	0.309	0.237	0.228	0.346	0.389	0.063	0.322	0.126
6	0.387	0.344	0.504	-0.525	-1.306	-0.071	-0.083	-0.205	0.056	0.021	0.197	0.025	-0.081
7	-0.316	0.202	0.112	-0.796	-0.948	-0.164	0.125	0.049	-0.174	0.259	-0.062	0.220	-0.529
8	-0.125	-0.067	-0.076	-0.751	-1.167	-0.435	-0.466	-0.023	0.016	-0.337	-0.355	0.456	-0.349
9	-0.507	0.175	0.141	-1.112	-1.270	0.040	0.050	-0.467	-0.051	-0.180	-0.456	-0.171	0.316
10	-1.233	-0.114	-0.043	-0.826	-1.699	-0.542	0.635	-0.567	-0.207	-0.887	-0.407	-0.026	-0.063
11	-0.343	0.451	-0.408	-1.082	-2.053	-0.101	0.116	-0.305	-0.156	-0.479	-0.012	0.309	-0.133

year													
age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
3	0.888	0.566	0.275	0.204	1.191	0.893	0.968	0.637	0.862	-0.341	0.336	0.179	-0.303
4	-0.014	-0.319	-0.053	-0.569	0.746	0.333	0.347	0.176	0.258	0.018	-0.364	0.225	0.131
5	0.168	-0.409	-0.229	-0.739	0.312	0.304	0.212	-0.173	0.160	0.104	-0.085	-0.053	0.182
6	0.041	0.046	-0.956	-0.339	0.431	-0.278	-0.002	-0.070	0.082	-0.065	-0.243	0.110	0.020
7	0.071	-0.130	-0.609	-1.484	0.472	-0.019	-0.063	-0.083	-0.338	-0.025	-0.282	-0.030	-0.095
8	-0.321	-0.247	-0.658	-0.688	-0.351	0.282	0.130	0.053	-0.091	0.015	-0.591	0.042	0.186
9	0.216	-1.026	-0.157	-0.843	0.514	-0.133	0.158	-0.046	-0.261	-0.028	-0.503	0.019	-0.029

```
 10  0.409 -0.445 -0.674 -0.519  0.509 -0.005 -0.360  0.177 -0.137 -0.433 -0.228  0.265  0.258
 11  0.145  0.352 -0.390 -0.628  0.895 -0.077 -0.014  0.024  0.041  0.144 -0.452  0.289  0.312
   year
age    2014   2015
 3  -0.038  0.088
 4   0.000 -0.091
 5   0.014 -0.088
 6   0.029 -0.025
 7   0.056 -0.241
 8   0.028 -0.202
 9   0.121 -0.251
 10  0.130  0.029
 11  0.188 -0.203
```

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

```
               3        4        5        6        7        8        9        10       11
Mean_Logq -14.3394 -13.7124 -13.5817 -13.4405 -13.4405 -13.4405 -13.4405 -13.4405 -13.4405
S.E_Logq    0.4296   0.3158   0.2964   0.3779   0.4048   0.3513   0.4355   0.5197   0.5405
```

Fleet: Q1SWBeam-nonoffset

Log catchability residuals.

```
   year
age    2006   2007   2008   2009   2010   2011   2012   2013   2014   2015   2016   2017   2018
 2   0.412  0.517  0.562 -0.721  0.833  0.593 -1.092 -0.466 -0.238 -0.454  0.162 -0.578 -0.379
 3   0.019  0.577  0.449  0.209  0.251 -0.091  0.217 -0.270  0.489 -0.360  0.340 -0.457 -0.195
 4  -0.024 -0.040  0.433  0.210  0.384  0.116  0.033  0.346  0.652 -0.257 -0.127 -0.146  0.130
 5   0.427 -1.092  0.204  0.049  0.328 -0.027 -0.270  0.160 -0.026 -0.290  0.080 -0.162  0.308
 6   0.181  0.041  0.730  0.163  0.258 -0.391 -0.189  0.494  0.325  0.046 -0.063 -0.175 -0.139
 7   0.504 -0.385 -0.241 -0.049  0.792 -0.546  0.477  0.629  0.716  0.160  0.194 -0.099  0.390
 8   0.692 -0.278  1.265  0.143  0.052  0.109  0.156  0.661  1.641  0.302  0.587 -0.456  0.325
```

9	0.500	0.522	1.171	-0.263	0.099	0.264	0.538	0.908	0.906	0.600	-0.453	-0.845	0.671
10	1.222	0.764	0.967	0.792	0.475	-1.515	-1.795	1.479	0.303	0.341	-0.285	-0.209	0.332
11	1.855	1.842	0.848	1.257	-0.205	0.626	0.369	0.497	1.508	0.241	0.842	-0.228	-0.362

year

age	2019	2020	2021	2022	2023
2	0.623	0.268	0.119	NA	0.425
3	-0.033	-0.059	0.354	NA	0.069
4	-0.142	-0.432	0.185	NA	0.152
5	0.054	-0.262	0.194	NA	-0.005
6	0.020	-0.234	0.148	NA	0.094
7	-0.438	-0.018	0.305	NA	0.570
8	-0.274	0.109	1.362	NA	0.256
9	-0.070	0.009	-0.112	NA	1.331
10	0.057	-0.278	0.884	NA	0.868
11	0.735	1.080	0.435	NA	0.313

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

	2	3	4	5	6	7	8	9	10	11
Mean_Logq	-6.4896	-5.4108	-5.2649	-5.1754	-5.1834	-5.1834	-5.1834	-5.1834	-5.1834	-5.1834
S.E_Logq	0.5663	0.3064	0.2735	0.3483	0.2783	0.4216	0.5863	0.5881	0.8834	0.6700

Fleet: FSP-UK

Log catchability residuals.

year

age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	0.967	0.206	0.487	0.371	0.921	0.087	0.078	-0.216	-0.528	-0.358	0.335	0.159	-0.169	0.160
3	0.566	0.184	0.327	0.510	0.210	0.093	-0.284	0.092	0.331	0.317	0.296	0.046	0.418	0.191
4	0.701	0.205	0.391	0.295	0.390	0.530	0.162	-0.743	0.275	0.765	0.718	0.658	-0.098	0.368
5	0.726	0.184	0.672	0.223	1.027	0.325	0.372	0.161	0.277	0.642	0.890	0.312	0.157	-0.173
6	0.231	0.664	0.543	0.374	0.140	0.037	0.418	-0.059	0.216	0.642	0.496	0.334	0.238	-0.030

```
 7  0.272 0.812 0.806 0.526 -0.030 0.400 -0.142 -0.236 -0.609  0.336  0.615 0.105  0.229  0.030
 8  1.209 0.115 1.160 0.328 -0.381 0.038  0.055 -1.882 -0.001  0.215  0.386 0.457  0.347 -0.089
 9  0.787 0.605 0.198 1.304  0.844 0.005  0.387 -0.089  0.268  0.170  0.130 0.458 -0.216  0.095
 10 0.599 0.309 0.999 0.239  0.604 0.014  0.409 -0.595 -1.145 -0.845  0.631 0.022  0.523 -0.306
 11 0.840 1.019 0.987 1.381 -1.539 1.307  0.600  0.246 -0.322 10.270 -1.685 0.356 -0.209 -0.517
   year
age    2018   2019   2020   2021   2022   2023
 2  -0.273  0.647  0.696 -0.352 -0.266 -0.437
 3  -0.229  0.272 -0.065 -0.323 -0.437 -0.045
 4   0.336 -0.343 -0.222 -0.005 -0.382 -0.603
 5   0.480 -0.234  0.038  0.031 -0.790 -0.401
 6   0.095 -0.137  0.046 -0.177 -0.324 -0.376
 7   0.109 -0.211 -0.084 -0.220 -0.226  0.104
 8   0.606  0.088 -0.016 -0.354 -0.826  0.497
 9  -0.095  0.073  0.034 -0.148 -0.497  0.195
 10  0.423  0.287  0.791 -0.428 -0.212 -0.394
 11  0.695  0.333  0.180  0.269 -0.034  0.963
```

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

```
                 2       3       4       5       6       7       8       9      10      11
Mean_Logq -10.6509 -9.2647 -9.2612 -9.3362 -9.3605 -9.3605 -9.3605 -9.3605 -9.3605 -9.3605
S.E_Logq    0.4533  0.2807  0.4443  0.4402  0.3028  0.3744  0.6645  0.4159  0.5745  2.3856
```

Terminal year survivor and F summaries:

,Age 2 Year class =2021

```
source
                  scaledWts survivors yrcls
Q1SWBeam-nonoffset    0.403      5414  2021
FSP-UK                0.488      2287  2021
fshk                  0.109      5193  2021
```

,Age 3 Year class =2020

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.313	3624	2020
Q1SWBeam-nonoffset	0.313	3333	2020
FSP-UK	0.313	2976	2020
fshk	0.060	3307	2020

,Age 4 Year class =2019

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.343	1722	2019
Q1SWBeam-nonoffset	0.343	1479	2019
FSP-UK	0.240	695	2019
fshk	0.075	1839	2019

,Age 5 Year class =2018

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.346	2258	2018
Q1SWBeam-nonoffset	0.346	2473	2018
FSP-UK	0.240	1665	2018
fshk	0.068	1743	2018

,Age 6 Year class =2017

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.311	1153	2017
Q1SWBeam-nonoffset	0.311	1239	2017
FSP-UK	0.311	774	2017
fshk	0.068	1089	2017

,Age 7 Year class =2016

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.332	1497	2016
Q1SWBeam-nonoffset	0.265	2834	2016
FSP-UK	0.332	1779	2016
fshk	0.070	1466	2016

,Age 8 Year class =2015

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.493	521	2015
Q1SWBeam-nonoffset	0.126	648	2015
FSP-UK	0.276	825	2015
fshk	0.106	536	2015

,Age 9 Year class =2014

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.405	386	2014
Q1SWBeam-nonoffset	0.106	1692	2014
FSP-UK	0.405	543	2014
fshk	0.084	395	2014

,Age 10 Year class =2013

source

	scaledWts	survivors	yrcls
UK-CBT-late	0.501	244	2013
Q1SWBeam-nonoffset	0.140	591	2013
FSP-UK	0.258	167	2013
fshk	0.101	217	2013

,Age 11 Year class =2012

source

scaledWts survivors yrcls

UK-CBT-late 0.546 128 2012

Q1SWBeam-nonoffset 0.143 160 2012

FSP-UK 0.185 307 2012

fshk 0.127 167

Table 32.8. Sole in Division 7.e. Estimated stock numbers-at-age (thousands).

year\age	2	3	4	5	6	7	8	9	10	11	12+	total
1969	1874	2380	625	966	1513	159	507	572	262	90	636	9585
1970	1343	1611	1848	490	732	1170	124	412	494	218	1123	9564
1971	3826	1164	1237	1365	358	584	952	100	340	397	821	11144
1972	2568	3414	863	885	1047	262	452	713	81	274	542	11102
1973	2264	2185	2698	621	691	840	224	386	518	37	1222	11687
1974	3107	1981	1600	2029	478	532	646	187	300	440	850	12149
1975	2967	2769	1461	1238	1667	365	406	544	138	248	1756	13559
1976	2791	2606	1966	1160	931	1399	304	317	468	105	1598	13645
1977	6556	2367	1960	1330	896	714	1178	230	231	375	1866	17703
1978	4657	5527	1839	1408	1007	714	580	995	199	186	1385	18497
1979	4389	3976	3933	1334	1070	732	547	456	827	144	1493	18901
1980	4702	3755	2834	2787	970	751	497	397	327	650	1702	19372
1981	8130	4088	2866	2091	1923	758	506	316	298	243	934	22154
1982	4679	7124	2932	1974	1448	1370	516	337	214	214	1035	21844
1983	3866	4113	5066	1782	1260	976	1011	337	198	117	828	19554
1984	5968	3412	3006	3087	1058	806	629	635	192	110	982	19885
1985	6982	5083	2456	1934	2073	648	535	446	430	123	532	21242
1986	3765	6044	2982	1504	1303	1319	417	392	306	309	529	18870
1987	5848	3173	3930	1774	961	874	874	297	283	191	754	18959
1988	3878	4828	2102	2519	1199	675	578	573	224	208	713	17497
1989	3735	3088	3000	1335	1587	729	465	369	415	166	743	15632
1990	2818	3009	1965	1542	736	952	445	316	232	268	739	13022

year\age	2	3	4	5	6	7	8	9	10	11	12+	total
1991	7161	2225	1864	1225	870	434	610	267	189	139	656	15639
1992	3902	6052	1619	1228	834	578	304	446	177	136	528	15802
1993	3350	3230	4112	1068	829	645	416	217	334	136	344	14680
1994	2378	2832	2254	2667	633	541	440	302	140	249	487	12923
1995	3452	2059	1938	1508	1883	466	389	351	218	84	646	12996
1996	3939	3034	1570	1155	958	1312	297	256	259	167	649	13598
1997	3333	3217	2322	1074	762	644	943	205	174	188	412	13274
1998	4400	2810	2121	1412	663	518	398	689	144	138	648	13940
1999	3607	3729	1966	1409	958	401	325	284	502	97	478	13756
2000	6486	2997	2504	1304	896	624	254	197	206	352	366	16186
2001	5400	5577	2143	1552	830	593	463	179	114	138	516	17504
2002	3875	4749	3714	1433	931	497	367	323	110	62	287	16348
2003	5421	3190	3106	2559	929	536	327	232	203	68	304	16877
2004	2876	4337	2092	1904	1702	717	414	249	155	124	298	14867
2005	4017	2224	2896	1467	1300	1040	492	265	167	89	351	14307
2006	4658	3389	1566	1827	900	828	662	338	163	109	304	14744
2007	3984	3739	2319	968	1077	576	537	423	224	95	351	14293
2008	4186	3414	2573	1380	598	630	351	362	278	150	339	14262
2009	3754	3520	2373	1683	891	386	395	218	260	188	347	14016
2010	5087	3239	2671	1781	1206	614	287	287	162	188	435	15957
2011	3589	4538	2600	2042	1299	897	434	213	192	127	419	16350
2012	3583	3160	3631	1899	1463	953	663	317	155	141	454	16421
2013	3324	3213	2643	2786	1338	986	643	470	223	99	478	16203
2014	3376	2894	2599	1933	1955	944	689	442	332	156	558	15877
2015	4371	2867	2314	1908	1344	1379	694	517	325	242	661	16621
2016	5805	3786	2282	1718	1407	968	1052	519	393	252	816	18997
2017	5089	5165	3027	1618	1292	1036	646	772	406	308	596	19955
2018	9564	4477	3963	2205	1190	943	750	450	574	288	618	25022
2019	5110	8529	3694	2855	1588	884	655	532	314	429	783	25372
2020	6932	4514	6886	2716	1981	1074	611	433	364	218	1048	26777
2021	3039	6111	3554	5095	1875	1371	730	423	313	261	966	23737
2022	4941	2640	4730	2557	3485	1149	927	496	266	206	721	22118
2023	4197	4132	1909	3389	1697	2349	744	637	347	188	475	20063

Table 33.9. Sole in Division 7.e. Estimated fishing mortality-at-age.

year\age	2	3	4	5	6	7	8	9	10	11	12+	F_{bar} (3–9)
1969	0.051	0.153	0.144	0.176	0.157	0.151	0.108	0.048	0.084	0.11	0.11	0.134
1970	0.043	0.164	0.203	0.213	0.126	0.106	0.115	0.093	0.118	0.112	0.112	0.146
1971	0.014	0.2	0.234	0.165	0.212	0.155	0.188	0.109	0.113	0.156	0.156	0.181
1972	0.062	0.136	0.228	0.147	0.12	0.059	0.059	0.219	0.69	0.23	0.23	0.138
1973	0.034	0.212	0.185	0.163	0.163	0.162	0.081	0.152	0.063	0.124	0.124	0.16
1974	0.015	0.205	0.156	0.097	0.17	0.171	0.072	0.199	0.089	0.14	0.14	0.153
1975	0.029	0.243	0.13	0.185	0.075	0.083	0.147	0.051	0.181	0.108	0.108	0.131
1976	0.065	0.185	0.291	0.158	0.166	0.072	0.176	0.216	0.122	0.151	0.151	0.18
1977	0.071	0.152	0.23	0.178	0.128	0.108	0.069	0.048	0.114	0.093	0.093	0.13
1978	0.058	0.24	0.221	0.174	0.22	0.165	0.14	0.085	0.226	0.167	0.167	0.178
1979	0.056	0.239	0.244	0.219	0.254	0.287	0.221	0.232	0.142	0.228	0.228	0.242
1980	0.04	0.17	0.204	0.271	0.147	0.295	0.352	0.188	0.198	0.236	0.236	0.232
1981	0.032	0.232	0.273	0.268	0.239	0.285	0.305	0.289	0.229	0.27	0.27	0.27
1982	0.029	0.241	0.398	0.349	0.295	0.203	0.325	0.434	0.503	0.353	0.353	0.321
1983	0.025	0.214	0.395	0.421	0.347	0.34	0.365	0.462	0.489	0.402	0.402	0.363
1984	0.061	0.229	0.341	0.298	0.39	0.309	0.244	0.29	0.35	0.317	0.317	0.3
1985	0.044	0.433	0.391	0.294	0.352	0.342	0.212	0.277	0.232	0.284	0.284	0.329
1986	0.071	0.33	0.419	0.348	0.3	0.312	0.238	0.226	0.37	0.29	0.29	0.31
1987	0.092	0.312	0.345	0.292	0.253	0.314	0.322	0.182	0.205	0.256	0.256	0.288
1988	0.128	0.376	0.354	0.362	0.398	0.273	0.349	0.224	0.201	0.289	0.289	0.333
1989	0.116	0.352	0.565	0.496	0.411	0.393	0.285	0.363	0.337	0.359	0.359	0.409
1990	0.136	0.379	0.373	0.473	0.428	0.346	0.41	0.417	0.413	0.404	0.404	0.404
1991	0.068	0.218	0.318	0.285	0.309	0.256	0.212	0.311	0.23	0.264	0.264	0.273
1992	0.089	0.286	0.316	0.293	0.156	0.229	0.237	0.191	0.167	0.196	0.196	0.244
1993	0.068	0.26	0.333	0.423	0.326	0.283	0.221	0.341	0.194	0.274	0.274	0.312
1994	0.044	0.279	0.302	0.248	0.206	0.23	0.126	0.223	0.405	0.238	0.238	0.231
1995	0.029	0.171	0.418	0.353	0.261	0.349	0.317	0.202	0.171	0.261	0.261	0.296
1996	0.102	0.167	0.279	0.316	0.298	0.231	0.274	0.288	0.221	0.263	0.263	0.265
1997	0.071	0.317	0.397	0.383	0.285	0.381	0.214	0.254	0.132	0.254	0.254	0.319
1998	0.065	0.257	0.309	0.288	0.403	0.366	0.237	0.216	0.295	0.304	0.304	0.297
1999	0.085	0.298	0.311	0.352	0.328	0.357	0.403	0.223	0.255	0.314	0.314	0.325
2000	0.051	0.236	0.379	0.351	0.313	0.199	0.246	0.449	0.302	0.303	0.303	0.31
2001	0.029	0.307	0.302	0.41	0.414	0.379	0.259	0.39	0.506	0.391	0.391	0.351

year\age	2	3	4	5	6	7	8	9	10	11	12+	F_{bar} (3–9)
2002	0.094	0.324	0.273	0.334	0.452	0.318	0.358	0.364	0.374	0.374	0.374	0.346
2003	0.123	0.322	0.389	0.308	0.16	0.158	0.174	0.304	0.396	0.239	0.239	0.259
2004	0.157	0.304	0.255	0.282	0.393	0.276	0.349	0.296	0.459	0.356	0.356	0.308
2005	0.07	0.25	0.361	0.389	0.351	0.351	0.277	0.382	0.33	0.339	0.339	0.337
2006	0.12	0.279	0.381	0.429	0.346	0.334	0.347	0.308	0.444	0.357	0.357	0.346
2007	0.054	0.274	0.419	0.382	0.436	0.395	0.294	0.319	0.301	0.35	0.35	0.36
2008	0.073	0.263	0.324	0.337	0.337	0.367	0.377	0.232	0.294	0.322	0.322	0.32
2009	0.048	0.176	0.187	0.233	0.273	0.198	0.22	0.198	0.226	0.22	0.22	0.212
2010	0.014	0.12	0.169	0.216	0.196	0.246	0.198	0.3	0.142	0.208	0.208	0.206
2011	0.027	0.123	0.214	0.234	0.209	0.202	0.214	0.215	0.208	0.265	0.265	0.202
2012	0.009	0.079	0.165	0.251	0.294	0.294	0.245	0.252	0.352	0.338	0.338	0.226
2013	0.039	0.112	0.213	0.254	0.249	0.259	0.274	0.247	0.259	0.276	0.276	0.23
2014	0.064	0.124	0.209	0.264	0.249	0.207	0.188	0.207	0.215	0.202	0.202	0.207
2015	0.044	0.128	0.198	0.205	0.228	0.171	0.191	0.174	0.156	0.14	0.14	0.185
2016	0.017	0.124	0.244	0.185	0.206	0.305	0.21	0.145	0.144	0.148	0.148	0.203
2017	0.028	0.165	0.217	0.207	0.215	0.222	0.262	0.196	0.244	0.246	0.246	0.212
2018	0.014	0.092	0.228	0.229	0.198	0.265	0.245	0.26	0.191	0.308	0.308	0.216
2019	0.024	0.114	0.208	0.265	0.291	0.269	0.314	0.278	0.266	0.236	0.236	0.248
2020	0.026	0.139	0.201	0.271	0.268	0.286	0.269	0.226	0.232	0.173	0.173	0.237
2021	0.041	0.156	0.229	0.28	0.39	0.291	0.286	0.362	0.315	0.215	0.215	0.285
2022	0.079	0.224	0.233	0.31	0.294	0.335	0.276	0.258	0.246	0.33	0.33	0.276
2023	0.07	0.184	0.307	0.21	0.309	0.282	0.294	0.254	0.236	0.373	0.373	0.263

Table 32.10. Sole in Division 7.e. Assessment summary.

Year	Recruitment Age 2 [thousands]	TSB [tonnes]	SSB [tonnes]	Landings [tonnes]	Yield/SSB	F_{bar} (Ages 3–9)
1969	1874	2927	2437	353	0.14	0.134
1970	1343	3023	2652	390	0.15	0.146
1971	3826	2838	2390	432	0.18	0.181
1972	2568	3091	2395	437	0.18	0.138
1973	2264	3266	2778	458	0.16	0.160
1974	3107	3512	2896	427	0.15	0.153
1975	2967	4428	3670	501	0.14	0.131
1976	2791	4102	3403	614	0.18	0.180
1977	6556	5339	4098	605	0.15	0.130
1978	4657	5429	4074	868	0.21	0.178
1979	4389	6014	4865	1170	0.24	0.242
1980	4702	6387	5338	1268	0.24	0.232
1981	8130	5957	4572	1218	0.27	0.270
1982	4679	5916	4575	1438	0.31	0.321
1983	3866	5377	4374	1504	0.34	0.363
1984	5968	5462	4430	1363	0.31	0.300
1985	6982	5568	4009	1400	0.35	0.329
1986	3765	5257	4013	1418	0.35	0.31
1987	5848	5310	4112	1279	0.31	0.288
1988	3878	5120	4043	1443	0.36	0.333
1989	3735	4318	3442	1389	0.40	0.409
1990	2818	4222	3287	1306	0.40	0.404
1991	7161	4219	2991	852	0.28	0.273
1992	3902	4100	2937	896	0.30	0.244
1993	3350	3579	2810	904	0.32	0.312
1994	2378	3786	3053	800	0.26	0.231
1995	3452	3876	3068	856	0.28	0.296
1996	3939	4153	3054	833	0.27	0.265

Year	Recruitment Age 2 [thousands]	TSB [tonnes]	SSB [tonnes]	Landings [tonnes]	Yield/SSB	F_{bar} (Ages 3–9)
1997	3333	3831	2921	950	0.33	0.319
1998	4400	3942	2910	880	0.30	0.297
1999	3607	3952	2832	956	0.34	0.325
2000	6486	4300	2868	912	0.32	0.310
2001	5400	4502	2896	1069	0.37	0.351
2002	3875	4187	3008	1105	0.37	0.346
2003	5421	4408	3287	1078	0.33	0.259
2004	2876	4035	3106	1074	0.35	0.308
2005	4017	3981	3101	1037	0.33	0.337
2006	4658	3717	2738	1016	0.37	0.346
2007	3984	3819	2780	1015	0.36	0.360
2008	4186	3853	2727	908	0.33	0.320
2009	3754	3937	2988	700	0.23	0.212
2010	5087	4492	3470	698	0.20	0.206
2011	3589	4888	3685	801	0.22	0.202
2012	3583	4711	3857	872	0.23	0.226
2013	3324	4628	3765	882	0.23	0.230
2014	3376	4973	4061	885	0.22	0.207
2015	4371	5125	4139	774	0.19	0.185
2016	5805	6193	4690	911	0.19	0.203
2017	5089	6004	4422	998	0.23	0.212
2018	9564	7607	5065	1074	0.21	0.216
2019	5110	6778	5007	1184	0.24	0.248
2020	6932	7209	5470	1219	0.22	0.237
2021	3039	6351	5260	1391	0.26	0.285
2022	4941	5954	5078	1409	0.28	0.276
2023	4197	5971	4670	1237	0.26	0.263

Table 32.11. Sole in Division 7.e. Input data for the short-term forecast.

Age	N2024	N2025	N2026	M	Mat	PF	PM	SWt	Sel	CWt
2	4083	4083	4083	0.1	0.14	0	0	0.144	0.061	0.171
3	3540	3469	3456	0.1	0.45	0	0	0.197	0.180	0.223
4	3112	2656	2573	0.1	0.88	0	0	0.248	0.246	0.272
5	1270	2181	1833	0.1	0.98	0	0	0.297	0.255	0.320
6	2486	882	1489	0.1	1	0	0	0.343	0.317	0.365
7	1127	1618	562	0.1	1	0	0	0.387	0.290	0.408
8	1603	755	1064	0.1	1	0	0	0.428	0.273	0.448
9	501	1092	505	0.1	1	0	0	0.467	0.279	0.486
10	447	340	726	0.1	1	0	0	0.504	0.254	0.522
11	248	310	232	0.1	1	0	0	0.539	0.293	0.556
12	414	442	493	0.1	1	0	0	0.633	0.293	0.642

Table 32.12. Sole in Division 7.e. Single option output of the short-term forecast (targeting F_{MSY}).

Age	F	Catch.No	Yield	Stock.No	Biomass	SSNo	SSB
Year = 2024, F_{bar} = 0.273							
2	0.063	237	41	4083	588	572	82
3	0.187	576	128	3540	698	1593	314
4	0.255	669	182	3112	772	2738	679
5	0.265	282	90	1270	377	1245	369
6	0.329	666	243	2486	852	2486	852
7	0.301	279	114	1127	436	1127	436
8	0.284	378	169	1603	686	1603	686
9	0.29	120	59	501	234	501	234
10	0.264	99	52	447	225	447	225
11	0.304	62	35	248	134	248	134
12	0.304	104	66	414	262	414	262
Total	NA	3472	1179	18831	5264	12974	4274
Year = 2025, F_{bar} = 0.290							
2	0.067	251	43	4083	588	572	82
3	0.199	596	133	3469	685	1561	308
4	0.271	602	164	2656	659	2337	580
5	0.282	511	163	2181	647	2138	634

Age	F	Catch.No	Yield	Stock.No	Biomass	SSNo	SSB
6	0.35	248	91	882	302	882	302
7	0.32	422	172	1618	626	1618	626
8	0.302	187	84	755	323	755	323
9	0.308	276	134	1092	510	1092	510
10	0.281	79	41	340	171	340	171
11	0.323	82	45	310	167	310	167
12	0.323	116	75	442	279	442	279
Total	NA	3371	1146	17828	4958	12046	3984
Year = 2026, F_{bar} = 0.290							
2	0.067	251	43	4083	588	572	82
3	0.199	594	132	3456	682	1555	307
4	0.271	583	159	2573	638	2265	562
5	0.282	429	137	1833	544	1796	533
6	0.35	420	153	1489	510	1489	510
7	0.32	147	60	562	217	562	217
8	0.302	264	118	1064	455	1064	455
9	0.308	128	62	505	236	505	236
10	0.281	170	89	726	366	726	366
11	0.323	61	34	232	125	232	125
12	0.323	130	83	493	312	493	312
Total	NA	3175	1070	17016	4674	11259	3706

Units are thousands (for numbers) and tonnes (for weights).

Table 32.13. Sole in Division 7.e. Year-class sources and contributions for the short-term forecast (in percent).

cohort	Yield 2024	Yield 2025	SSB 2024	SSB 2025	SSB 2026
2012	5.6		6.1		
2013	2.9	6.5	3.1	7	
2014	4.4	4	5.3	4.2	8.4
2015	5	3.6	5.5	4.3	3.4
2016	14.4	11.7	16.1	12.8	9.9
2017	9.7	7.3	10.2	8.1	6.4
2018	20.6	15	19.9	15.7	12.3
2019	7.7	7.9	8.6	7.6	5.9

cohort	Yield 2024	Yield 2025	SSB 2024	SSB 2025	SSB 2026
2020	15.4	14.3	15.9	15.9	13.8
2021	10.9	14.3	7.4	14.6	14.4
2022	3.4	11.6	1.9	7.7	15.2
2023		3.8		2.1	8.3
2024					2.2

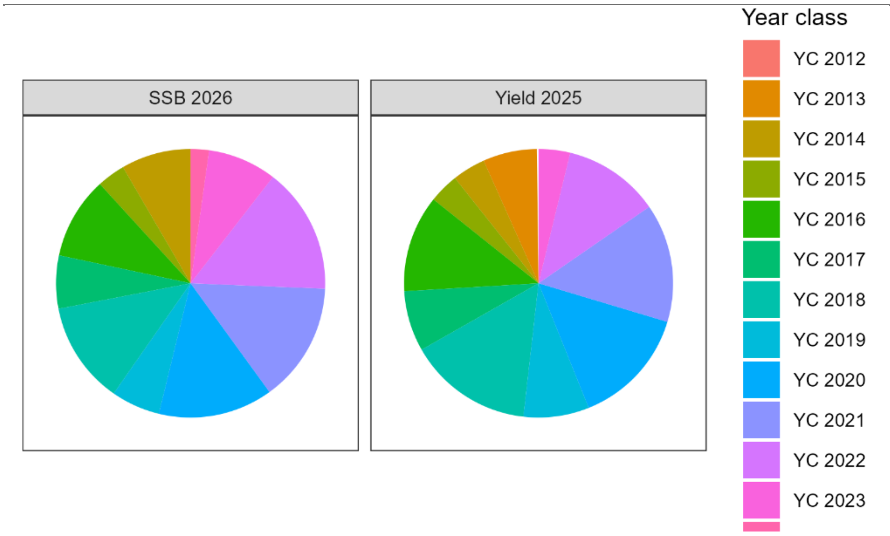


Table 32.14. Sole in Division 7.e. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch* (2025)	Projected landings (2025)	Projected discards (2025)	$F_{projected\ landings}$ (2025)	SSB (2026)	% SSB change **	% TAC change***	% advice change^
ICES advice basis								
MSY approach: F_{MSY}	1151	1146	5	0.29	3706	-7.0	-2.8	8.9
Other options								
EU MAP^^^: F_{MSY}	1151	1146	5	0.29	3706	-7.0	-2.8	8.9
F = MPA $F_{MSY\ lower}$	674	671	3	0.160	4166	4.6	-43	-36
F = $F_{MSY\ upper}$	1319	1313	6	0.34	3544	-11.0	11.4	25
F = 0	0	0	0	0	4819	21	-100	-100
F = F_{pa}	1479	1473	7	0.39	3390	-14.9	25	40
F = F_{lim}	1632	1625	7	0.44	3243	-18.6	38	54
SSB2026 = Blim	2946	2933	13	1.01	2000	-50	149	179
Rollover TAC	1184	1179	5	0.30	3674	-7.8	0	12.0
SSB_{2026} = B_{pa}= MSY $B_{trigger}$	1992	1983	9	0.57	2900	-27	68	88
SSB_{2026} = SSB_{2025}	863	859	4	0.21	3984	0	-27	-18.4
F = F_{2024}	1092	1087	5	0.27	3762	-5.6	-7.8	3.3

*** Total catch derived from the projected landings and the assumed discard rate.**

**** SSB 2026 relative to SSB 2025.**

***** Total catch in 2025 relative to TAC 2024 (1184).**

^ Advice value for 2025 relative to the advice value for 2024 (1057 tonnes).

^^ EU multiannual plan (MAP) for the Western Waters (EU, 2019).

Table 33.15. Sole in Division 7.e. Annual catch scenarios (more options and more digits provided, sorted by fishing mortality in intermediate year). All weights are in tonnes.

Basis	Total catch* (2024)	Projected landings (2024)	Projected discards (2024)	$F_{projected\ landings}$ (2024)	SSB (2025)	% SSB change **	% TAC change***	% advice change^^
F0	0	0	0	0	4819.49	20.98391	-100	-100
Fsq0.6	664.8949	661.897	2.997966	0.157652	4174.671	4.796979	-43.8433	-37.096
FMSY_lower	674.0594	671.0201	3.039288	0.16	4165.808	4.574478	-43.0693	-36.229
F=0.17	712.8564	709.6422	3.214221	0.17	4128.292	3.632735	-39.7925	-32.5585
F=0.18	751.2848	747.8973	3.387492	0.18	4091.147	2.700263	-36.5469	-28.9229
F=0.19	789.3481	785.789	3.559117	0.19	4054.367	1.776968	-33.3321	-25.3218
F=0.2	827.0501	823.321	3.729113	0.2	4017.948	0.862757	-30.1478	-21.755
SSB_stable	862.6423	858.7527	3.889596	0.209529	3983.58	-1.11E-14	-27.1417	-18.3877
F=0.21	864.3944	860.4969	3.897495	0.21	3981.888	-0.04246	-26.9937	-18.2219
Fsq0.8	865.1462	861.2453	3.900885	0.210202	3981.162	-0.06068	-26.9302	-18.1508
TAC085	901.3844	897.3202	4.064281	0.22	3946.182	-0.93878	-23.8696	-14.7224
F=0.22	938.0239	933.7944	4.229486	0.23	3910.828	-1.82629	-20.775	-11.256
F=0.23	974.3162	969.9231	4.393125	0.24	3875.821	-2.70508	-17.7098	-7.8225
F=0.24	1006.4	1001.862	4.537789	0.24892	3844.883	-3.4817	-15	-4.78713
Fsq	1010.265	1005.71	4.555215	0.25	3841.157	-3.57523	-14.6736	-4.42149
F=0.25	1045.873	1041.157	4.715771	0.26	3806.834	-4.43684	-11.6661	-1.05267
TAC	1081.145	1076.27	4.874809	0.27	3772.848	-5.29	-8.68709	2.28428
F=0.26	1081.145	1076.27	4.874809	0.27	3772.848	-5.29	-8.68709	2.28428
MP2	1081.145	1076.27	4.874809	0.27	3772.848	-5.29	-8.68709	2.28428

Basis	Total catch* (2024)	Projected landings (2024)	Projected discards (2024)	$F_{projected\ landings}$ (2024)	SSB (2025)	% SSB change **	% TAC change***	% advice change^^
MP	1091.955	1087.031	4.923551	0.273084	3762.435	-5.55141	-7.77407	3.307002
F=0.27	1116.083	1111.051	5.032342	0.28	3739.196	-6.13478	-5.73624	5.589684
F=0.28	1150.691	1145.503	5.188387	0.29	3705.874	-6.97127	-2.81326	8.863855
FMSY	1184	1178.661	5.338576	0.299715	3673.814	-7.77607	2.22E-14	12.01514
TAC115	1184.972	1179.629	5.342959	0.3	3672.878	-7.79955	0.082101	12.1071
F=0.3	1218.93	1213.434	5.496071	0.31	3640.206	-8.61972	2.950137	15.31974
F=0.31	1252.567	1246.919	5.647739	0.32	3607.854	-9.43185	5.791115	18.50206
F=0.32	1285.887	1280.089	5.797976	0.33	3575.82	-10.236	8.605305	21.65438
F=0.33	1318.893	1312.946	5.946798	0.34	3544.099	-11.0323	11.39298	24.77699
FMSY_upper	1361.6	1355.461	6.139362	0.353081	3503.072	-12.0622	15	28.81741
Fpa	1479.321	1472.651	6.670158	0.39	3390.091	-14.8984	24.94266	39.9547
Flim	1632.355	1624.995	7.360179	0.44	3243.465	-18.5791	37.86784	54.43285
Bpa	1992.098	1983.116	8.982236	0.567707	2900	-27.2012	68.25155	88.46721
Btrigger	1992.098	1983.116	8.982236	0.567707	2900	-27.2012	68.25155	88.46721
Blim	2946.139	2932.855	13.28394	1.005218	2000	-49.7939	148.8293	178.7265

*** Total catch derived from the projected landings and the assumed discard rate.**

**** SSB 2026 relative to SSB 2025.**

***** Total catch in 2025 relative to TAC 2024 (1184).**

^ Advice value for 2025 relative to the advice value for 2024 (1057 tonnes).

32.17 Figures

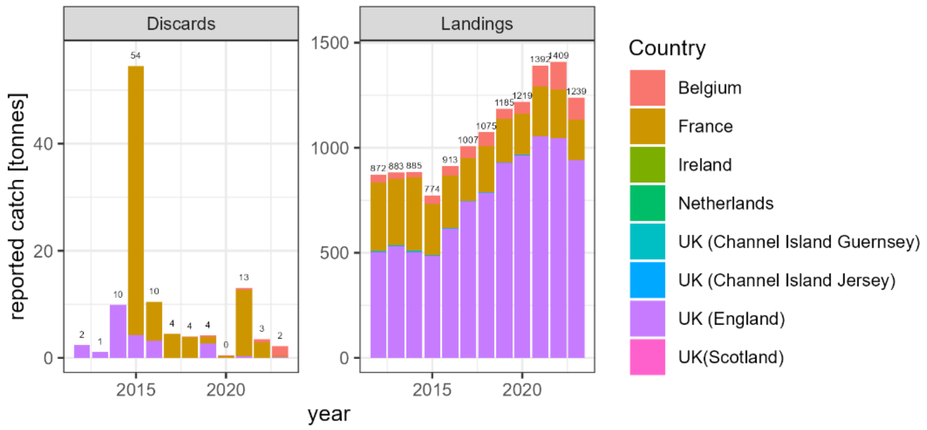


Figure 32.1. Sole in Division 7.e. Landings and discards reported in InterCatch by country.

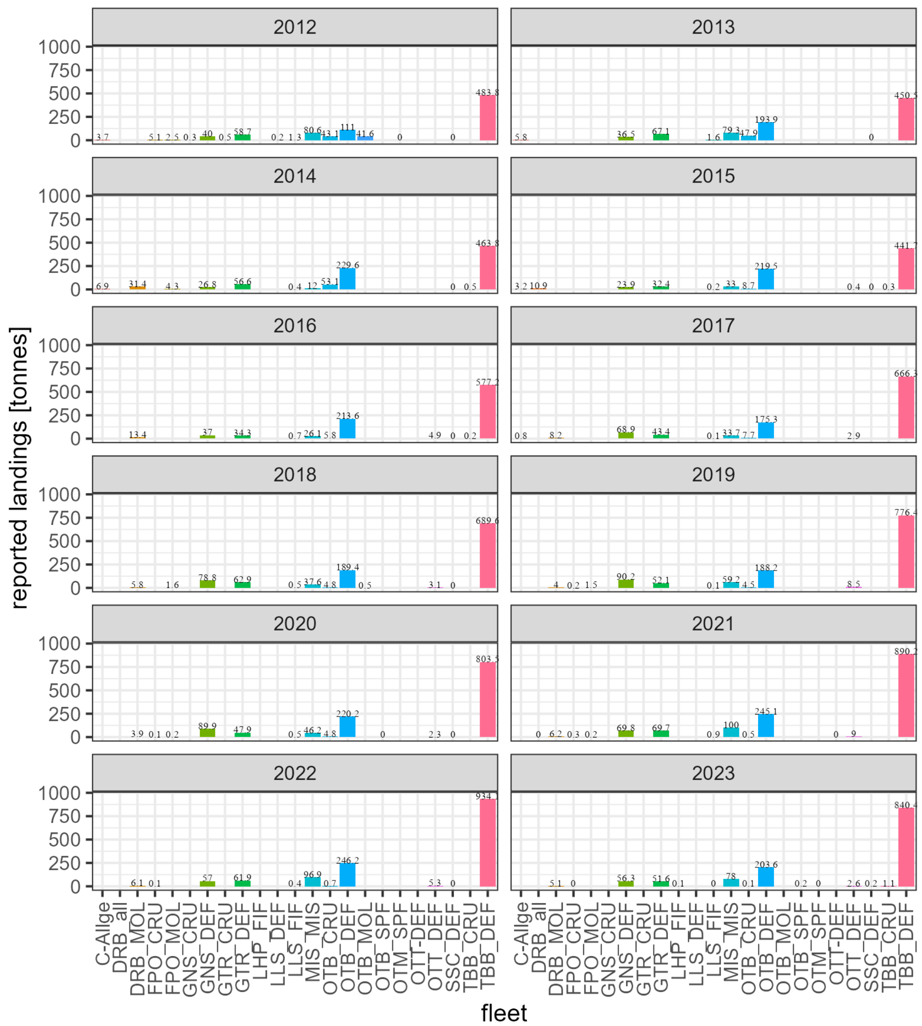


Figure 32.2. Sole in Division 7.e. International landings reported in InterCatch by fleet and year.

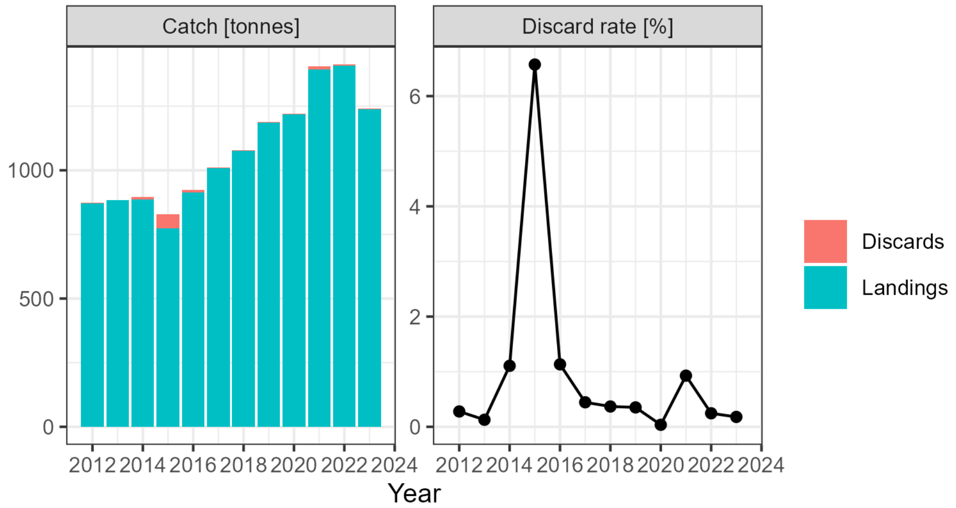


Figure 32.3. Sole in Division 7.e. Discard rates for discards reported in InterCatch.

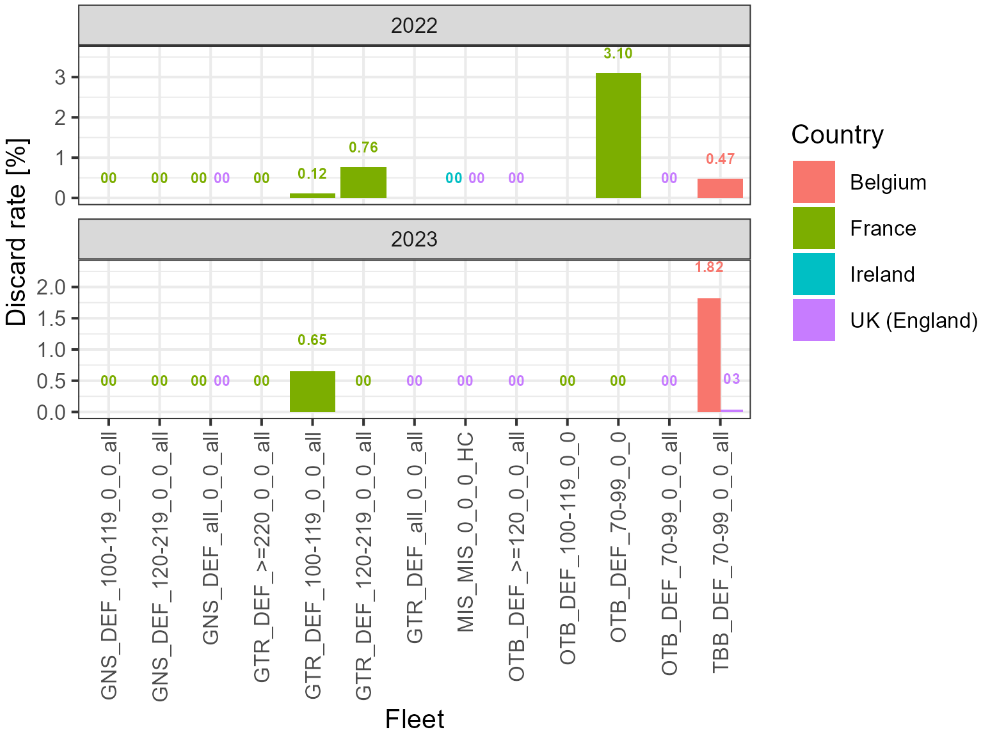


Figure 32.4. Sole in Division 7.e. Annual reported discard rates in InterCatch by fleet and country.

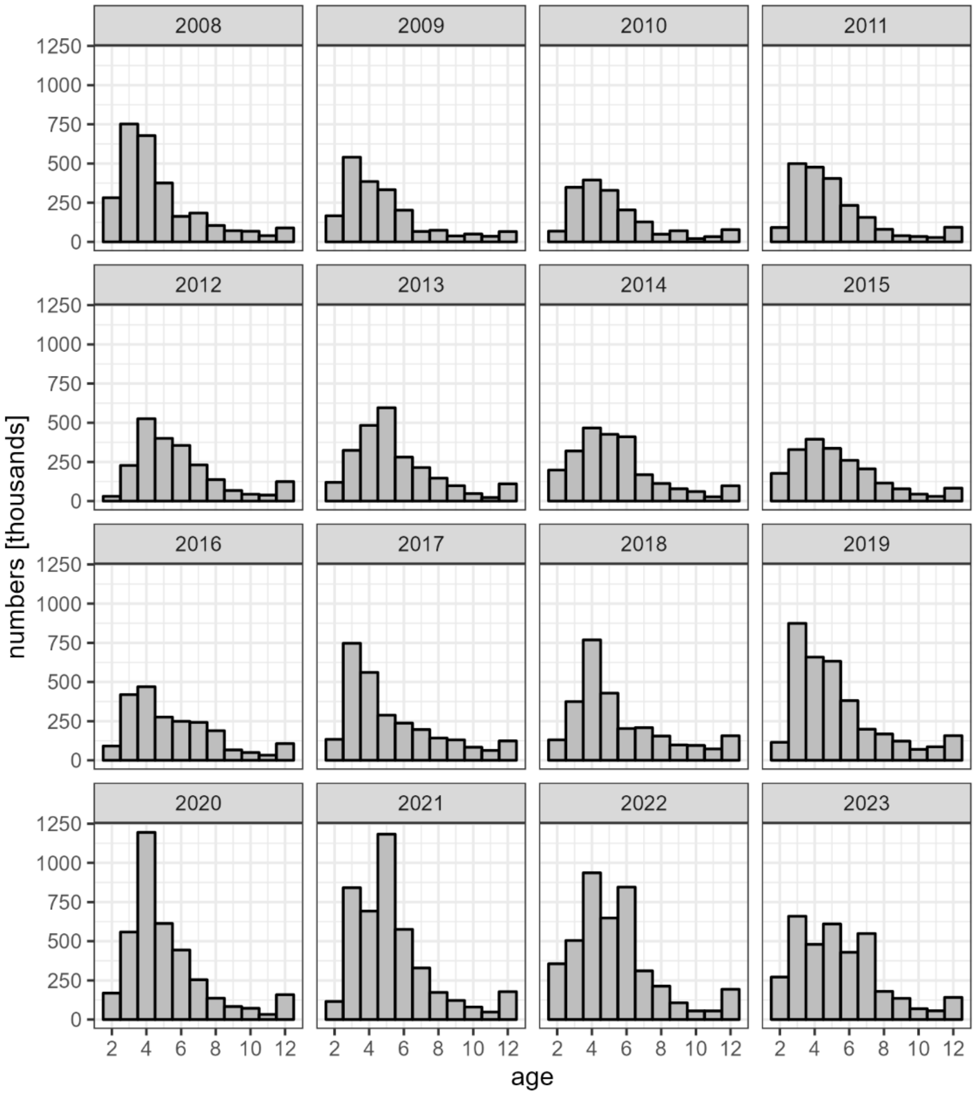


Figure 32.5. Sole in Division 7.e. International landings numbers-at-age (last 16 years).

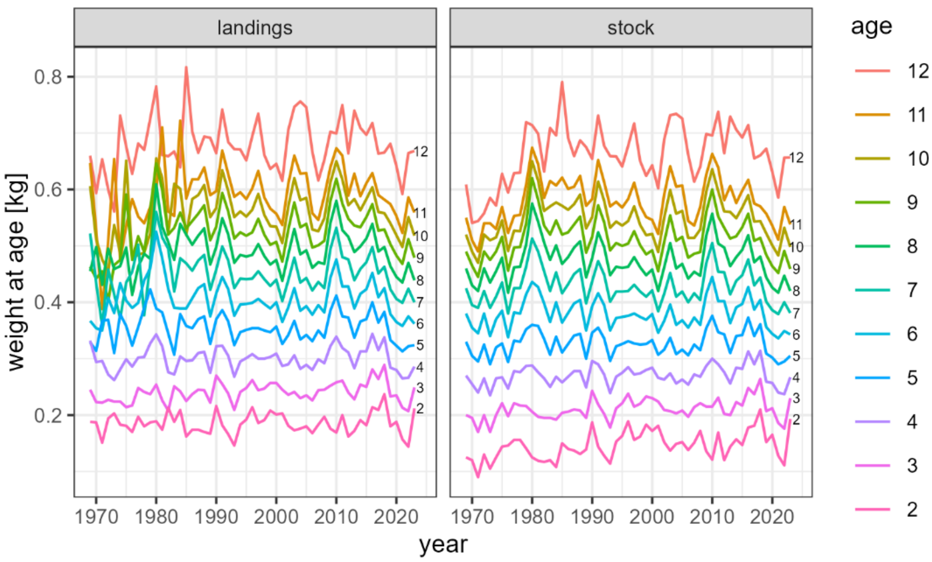


Figure 32.6. Sole in Division 7.e. Catch (landings) and stock weights-at-age.

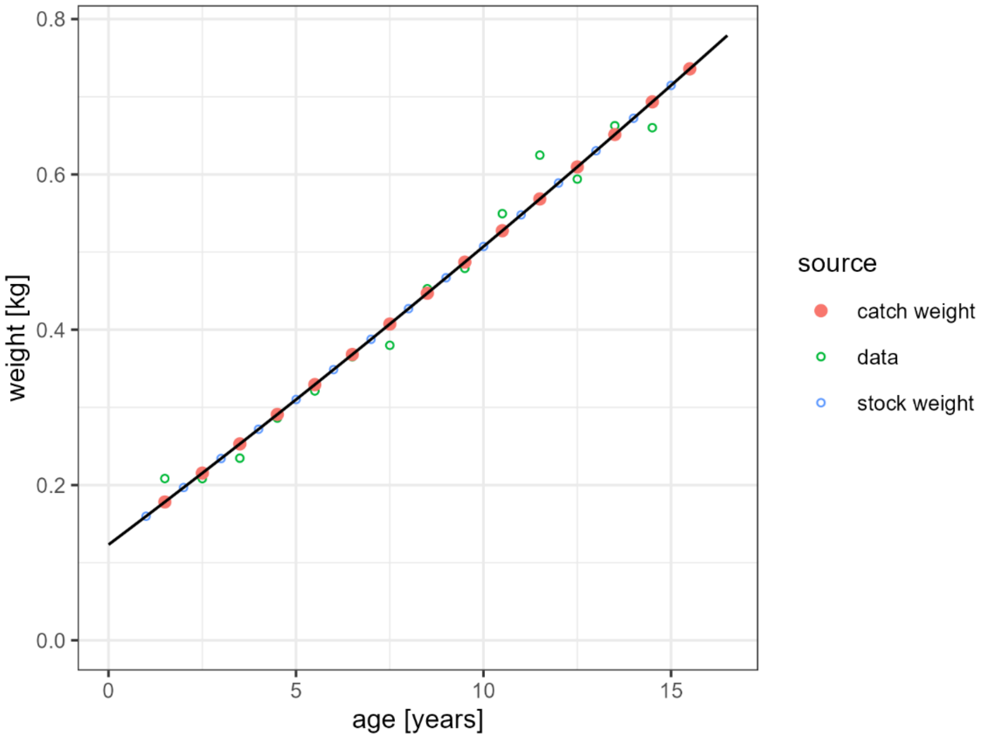


Figure 32.7. Sole in Division 7.e. Generation of stock and catch weights from landings weights-at-age.

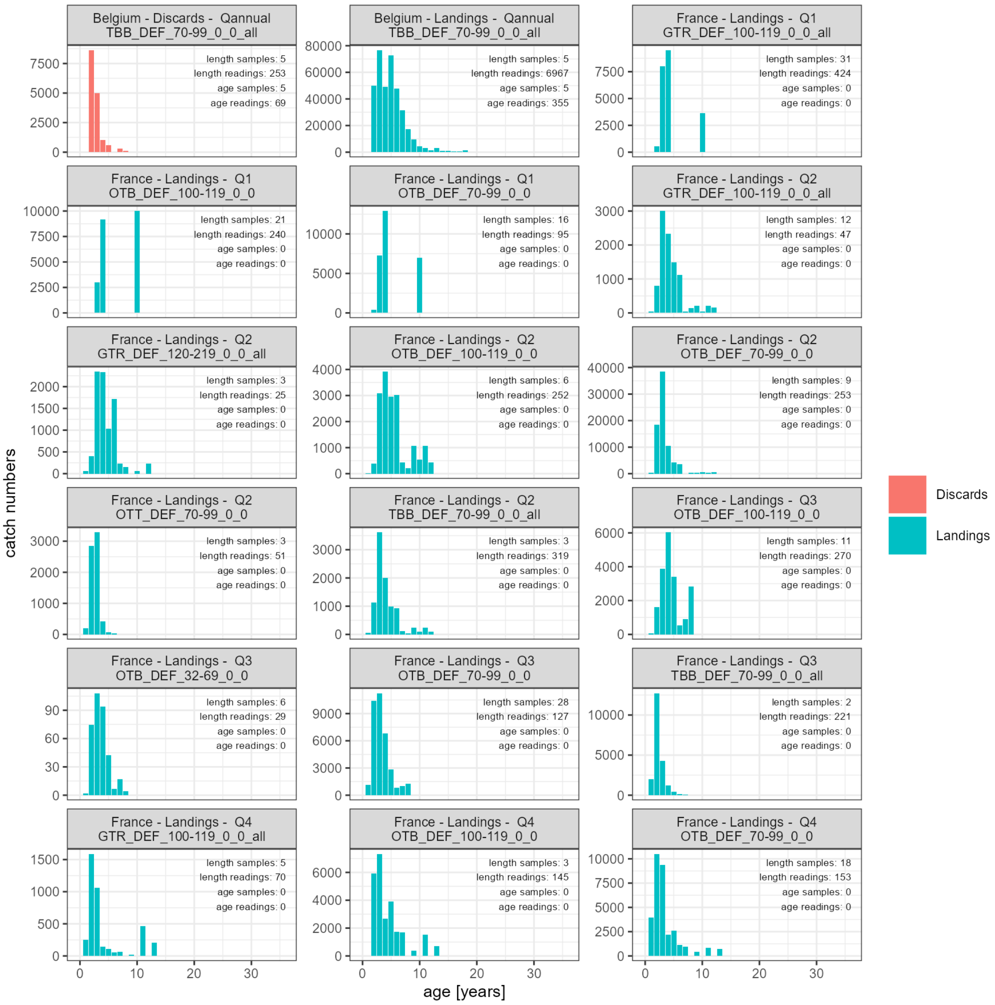


Figure 32.8. Sole in Division 7.e. Landings age distributions submitted to InterCatch. Numbers are raised to fleet level.

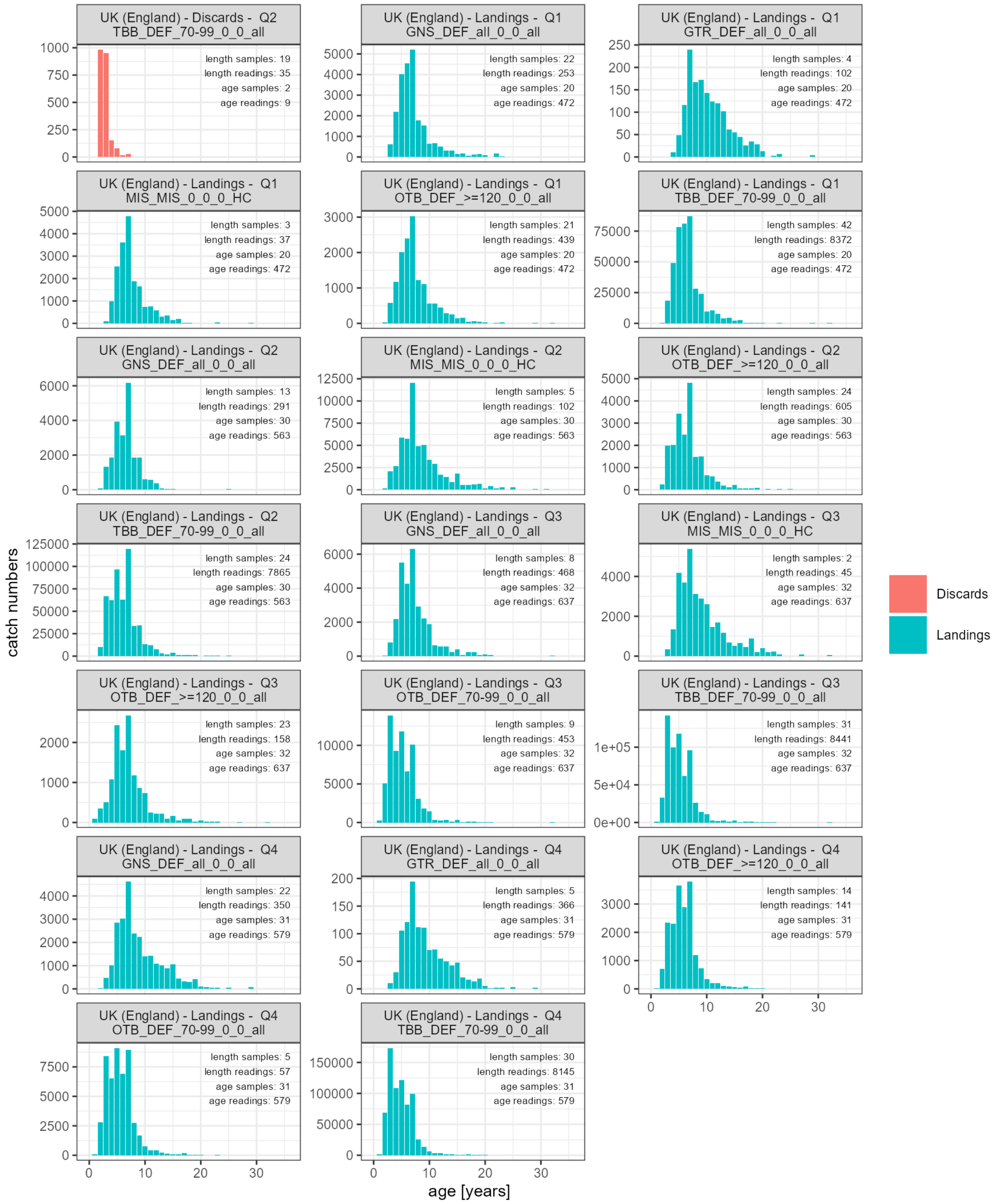


Figure 32.8 (continued). Sole in Division 7.e. Landings age distributions submitted to InterCatch. Numbers are raised to fleet level.

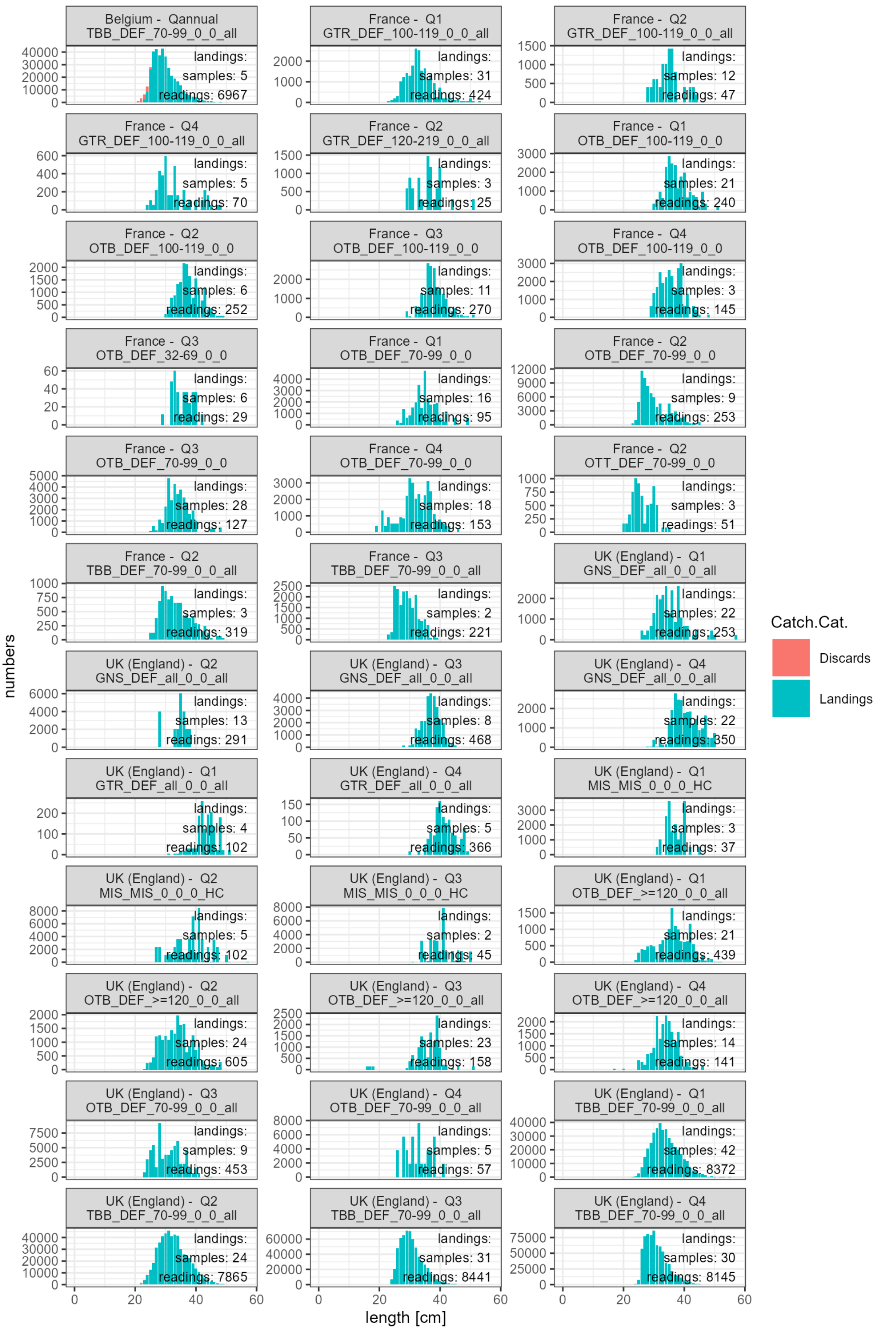


Figure 32.9. Sole in Division 7.e. Length distributions submitted to InterCatch. Numbers are raised to fleet level.

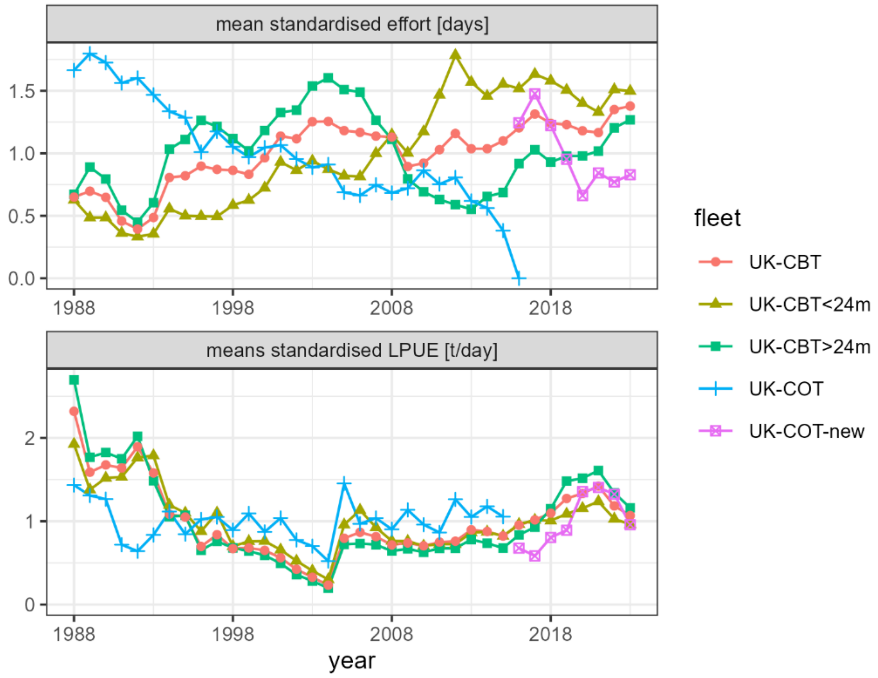


Figure 32.10. Sole in Division 7.e. Means standardised LPUE and effort for the UK commercial fleets.

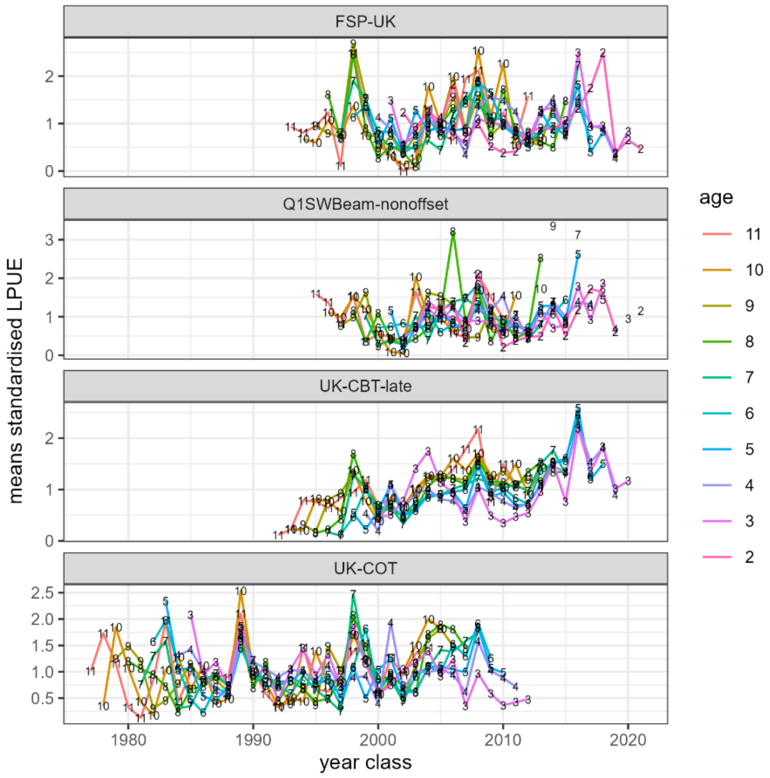


Figure 32.11. Sole in Division 7.e. Means standardised LPUE/CPUE by year class. Note, the cohorts differ on the x-axes due to the differences in the length and age ranges of the tuning series.

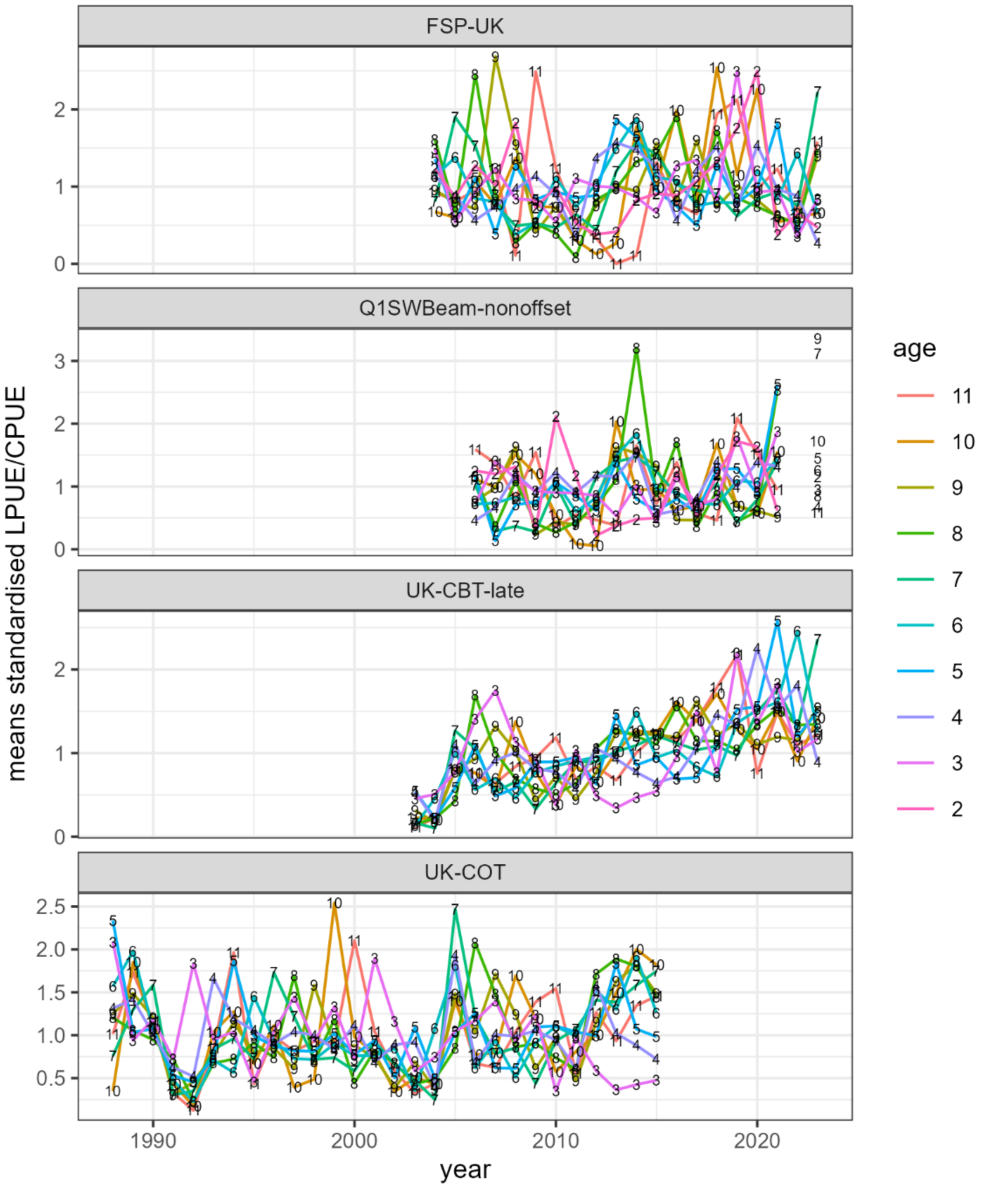


Figure 32.12. Sole in Division 7.e. Means standardised LPUE/CPUE by year. Note, the lines differ on the x-axes due to the differences in the length and age ranges of the tuning series.

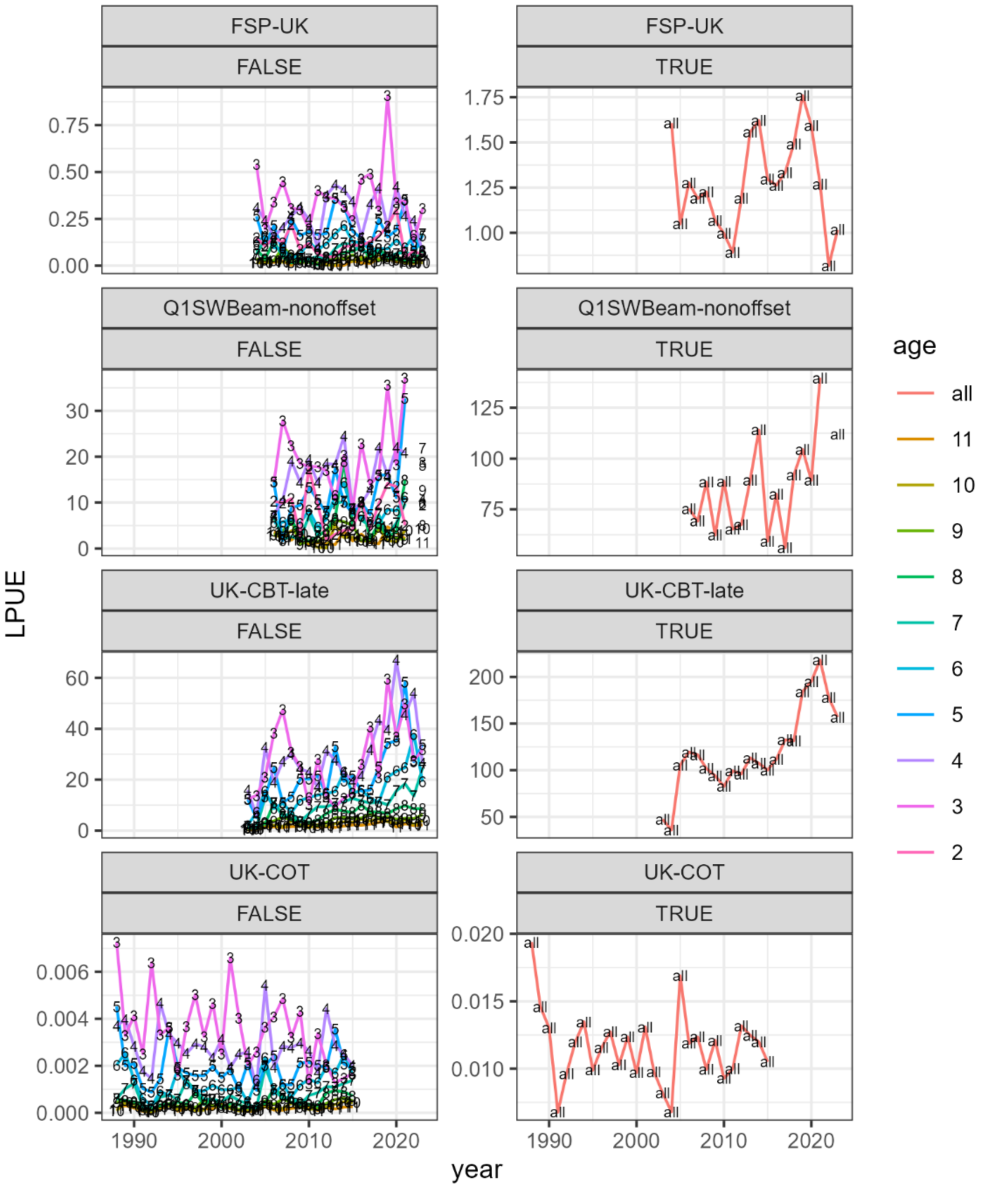


Figure 32.13. Sole in Division 7.e. Survey indices (raw values) for all commercial and scientific surveys. The plots on the left show the index values-at-age, on the right are the values aggregated over all ages.

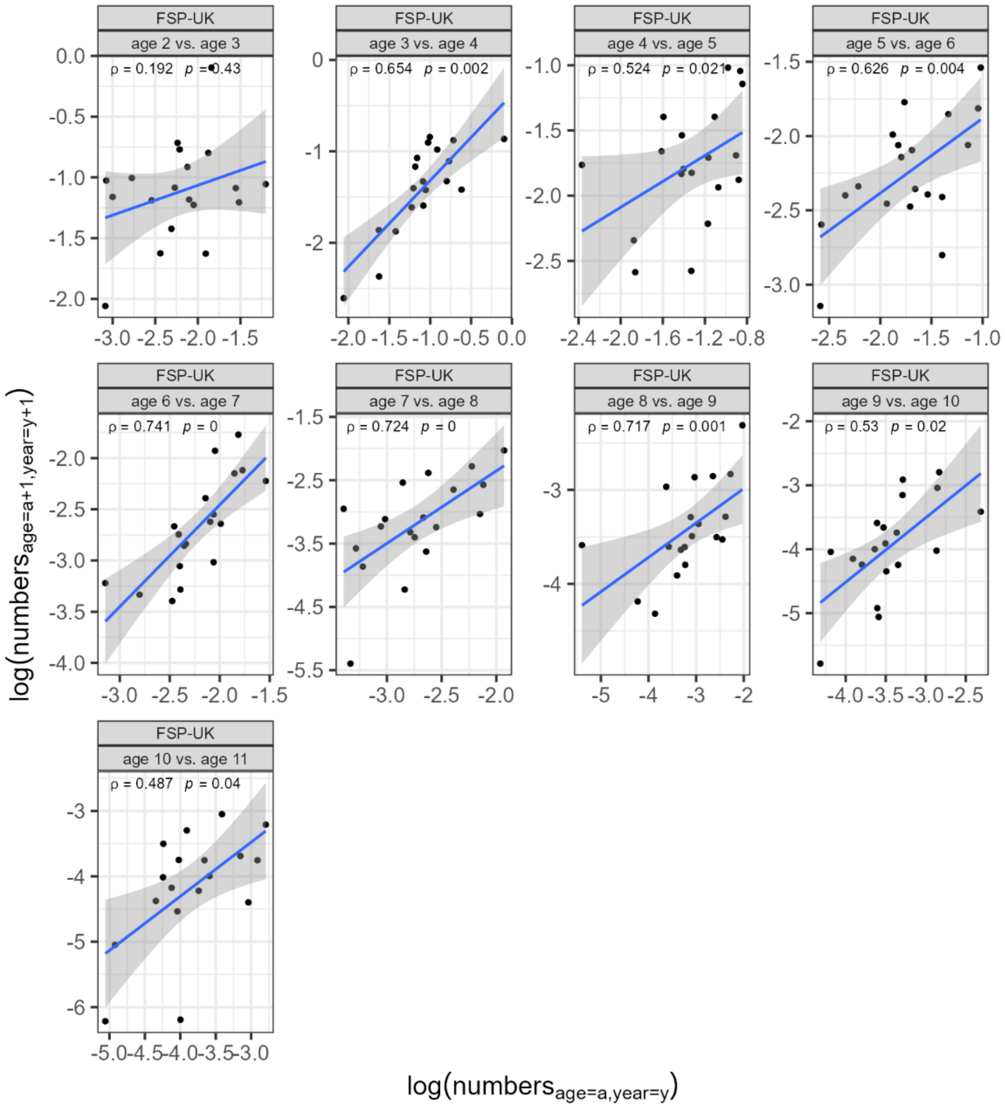


Figure 32.14. Sole in Division 7.e. Internal consistencies in the scientific surveys. Shown is the correlation between numbers-at-age and the numbers of the same cohort one year later, including Pearson correlation coefficient ρ and the p-value.

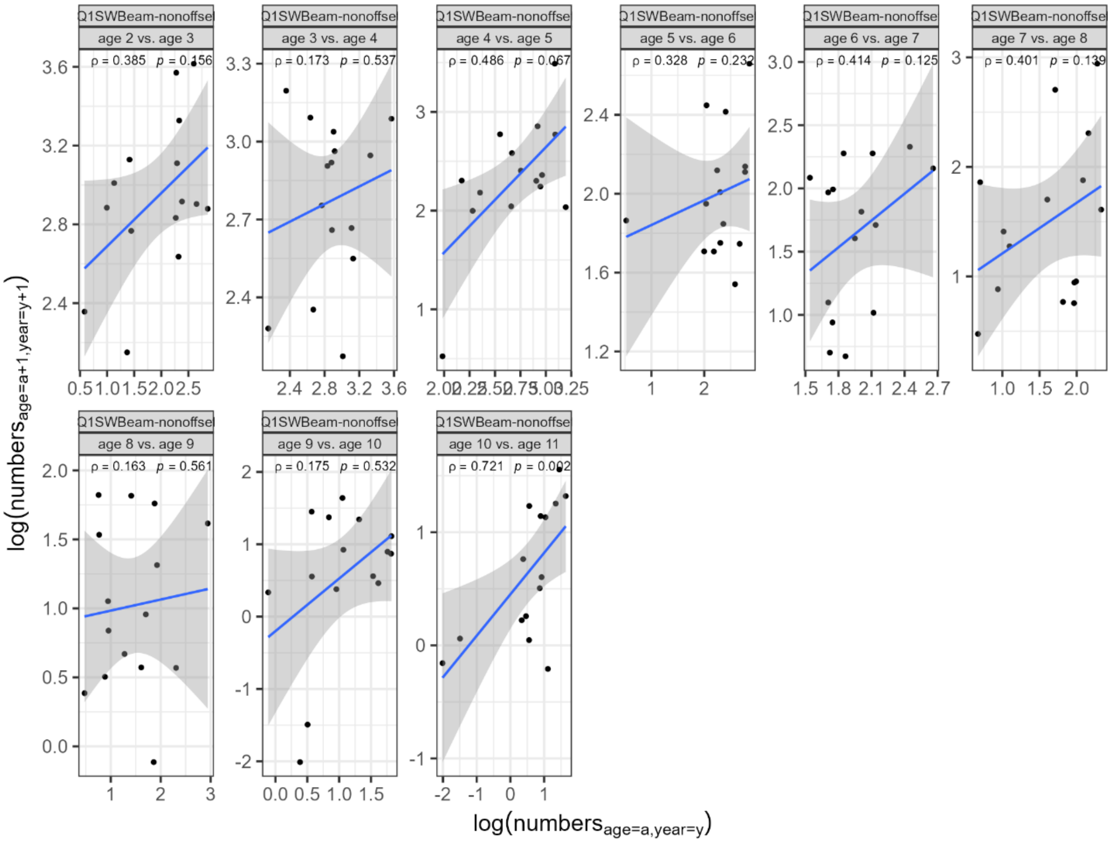


Figure 32.15. Sole in Division 7.e. Internal consistencies in the scientific surveys. Shown is the correlation between numbers-at-age and the numbers of the same cohort one year later, including Pearson correlation coefficient ρ and the p-value.

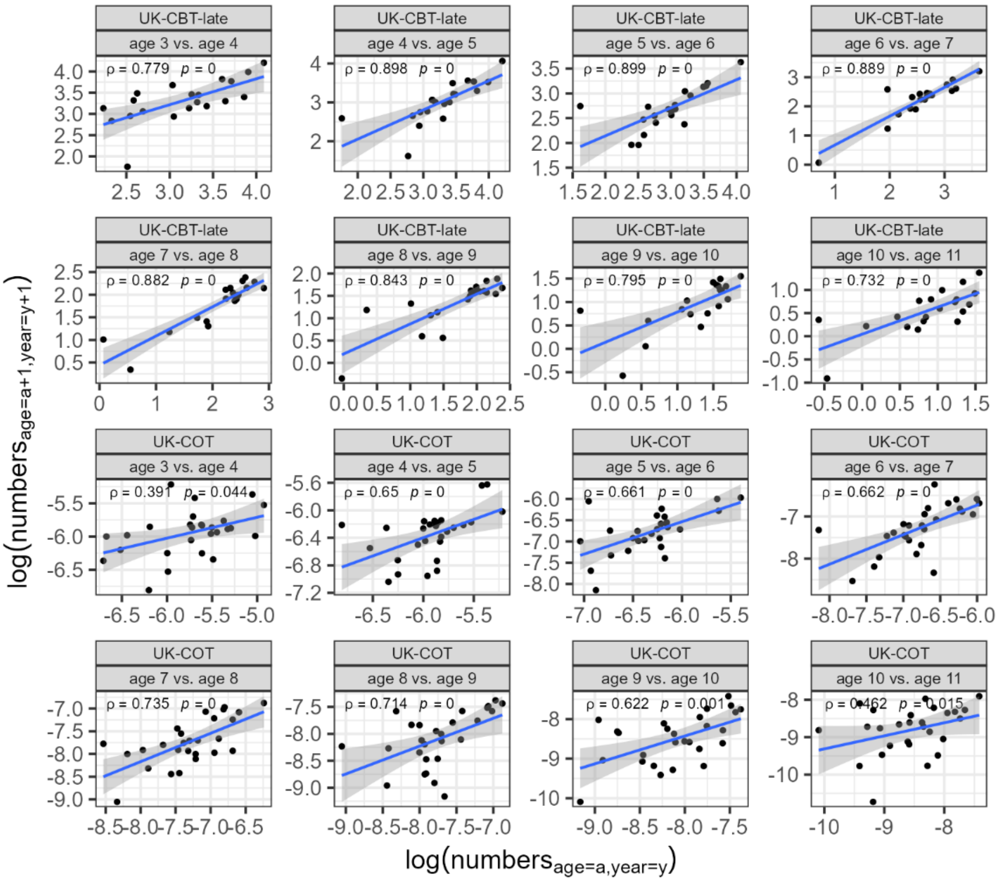


Figure 32.16. Sole in Division 7.e. Internal consistencies in the commercial surveys. Shown is the correlation between numbers-at-age and the numbers of the same cohort one year later, including Pearson correlation coefficient ϱ and the p-value.

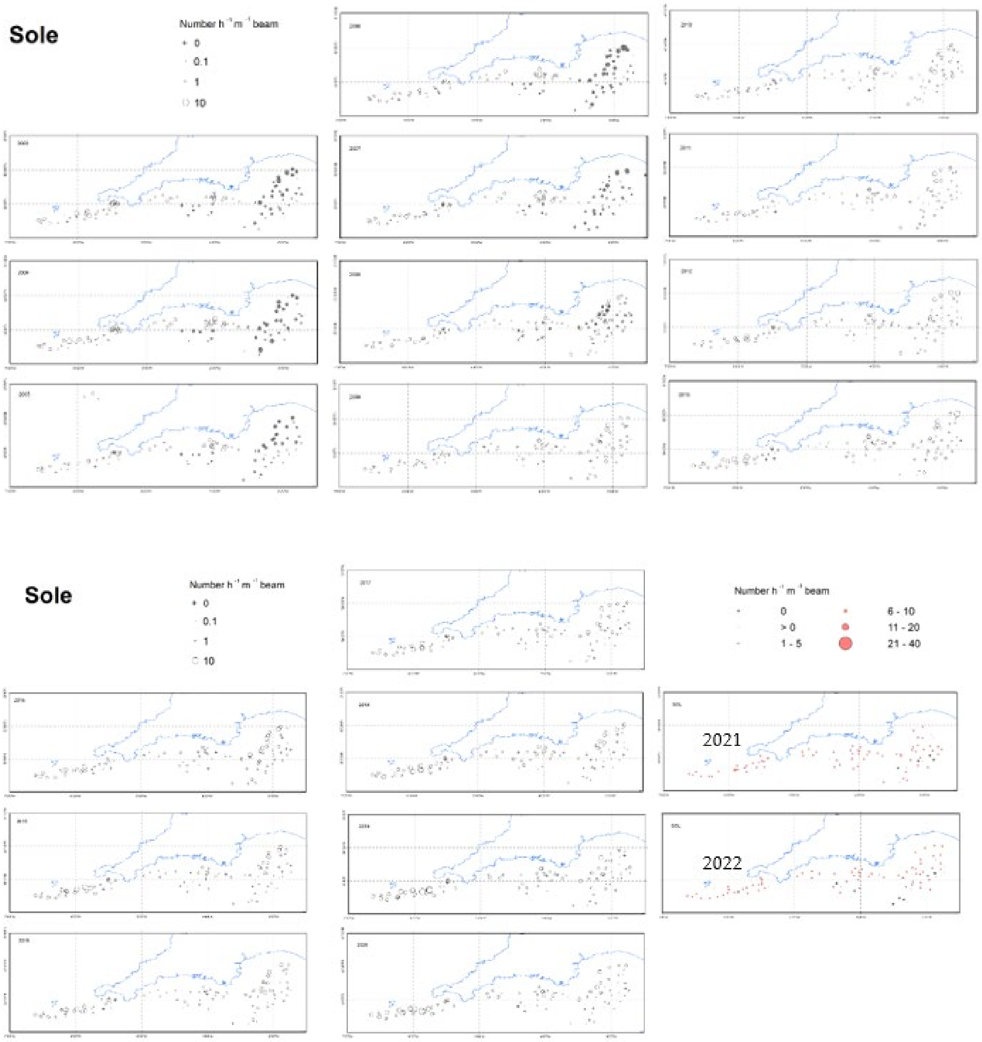


Figure 32.17. Sole in Division 7.e. Sole catch rates during FSP "Western Channel Sole and Plaice" surveys, 2003–2021 (number h^{-1} m beam^{-1}). Open circles: FV Nellie and FV Carhelmar tows; filled black circles: FV Lady T Emiel tows. Please note that 2021–2022 numbers are not to scale. Source: Burt *et al.* (2021, 2022, 2023).

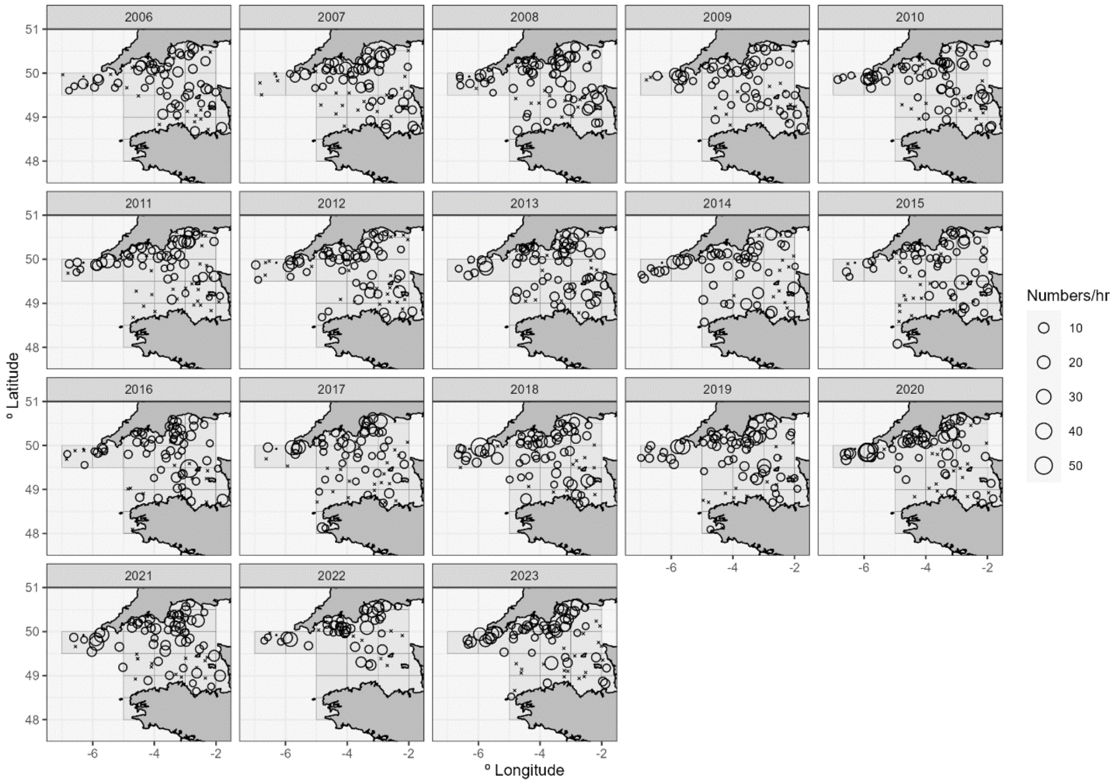


Figure 32.18. Sole in Division 7.e. Catches of sole in the Q1SWBeam survey in numbers per hour. Stations where no sole were caught are indicated by crosses.

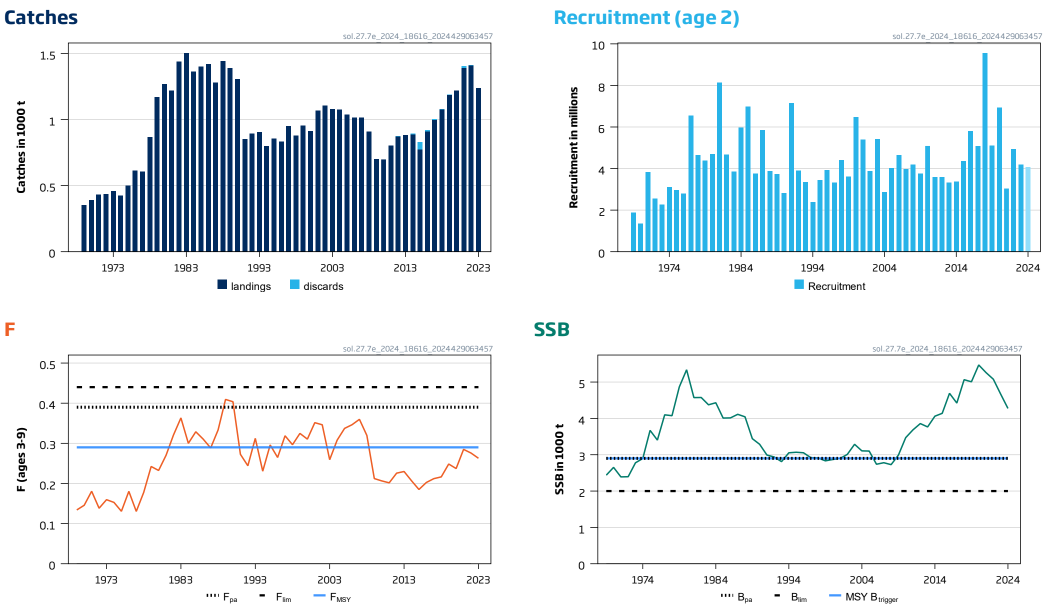


Figure 32.19. Sole in Division 7.e. Results of the final XSA run. Summary of the stock assessment. ICES estimated catches, recruitment (age 2), fishing mortality (F), and spawning–stock biomass (SSB). The assumed recruitment value for 2024 is shaded in a lighter colour. Discard estimates are only available since 2012.

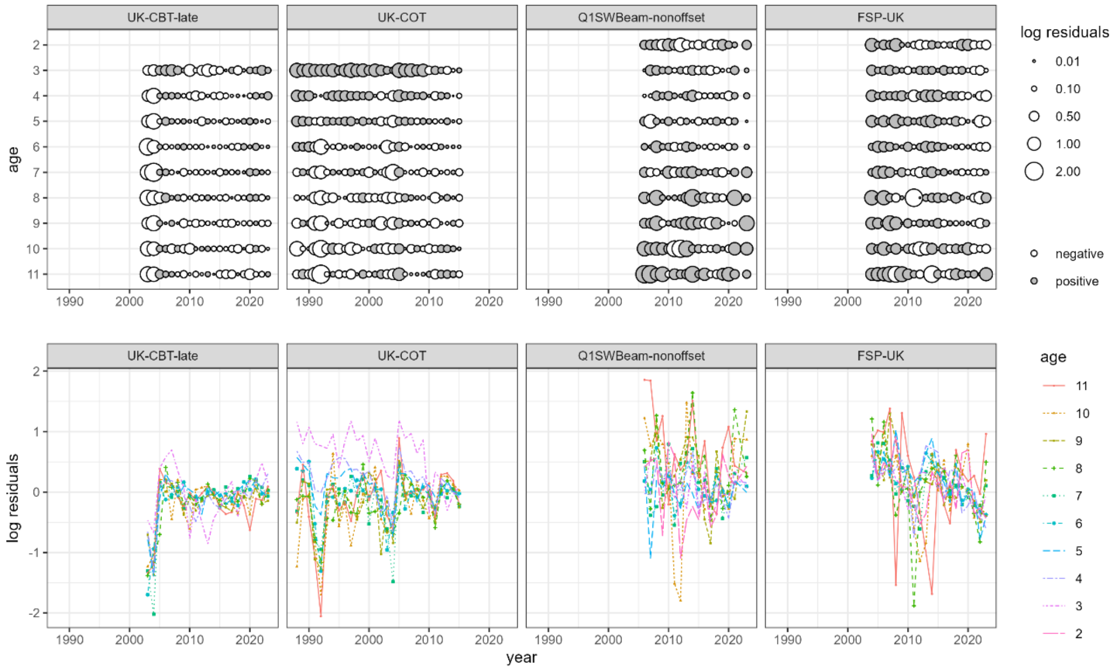


Figure 32.20. Sole in Division 7.e. XSA fleet log catchability residuals. Note that the application of time-series weighting set as a tricubic taper with a range of 15 years excludes log catchability residuals prior to 2005.

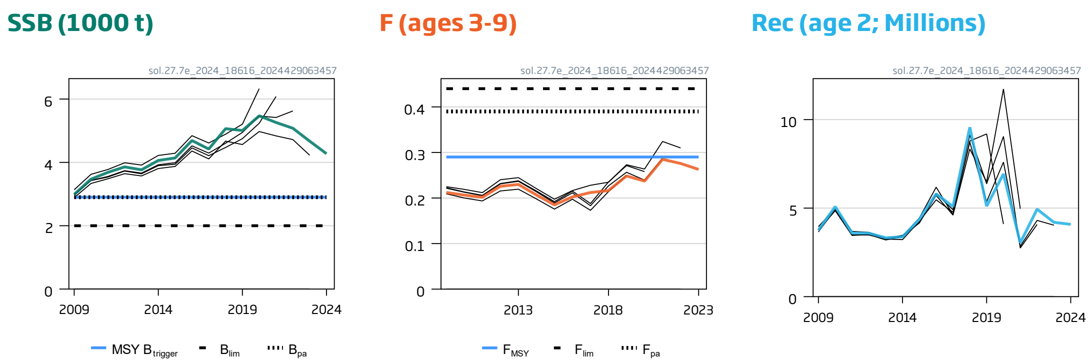


Figure 32.21. Sole in Division 7.e. Comparison of the current XSA assessment with the final assessment runs from the last years.

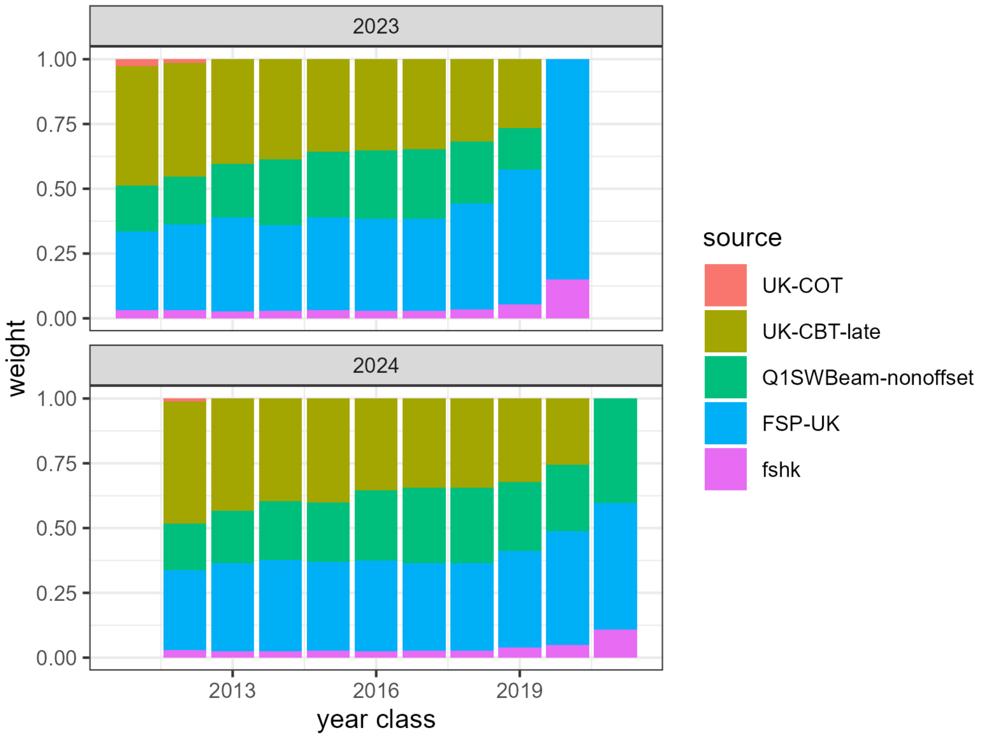


Figure 32.22. Sole in Division 7.e. Scaled weights for the current XSA assessment and the previous XSA assessment conducted at last year's WGCSE.

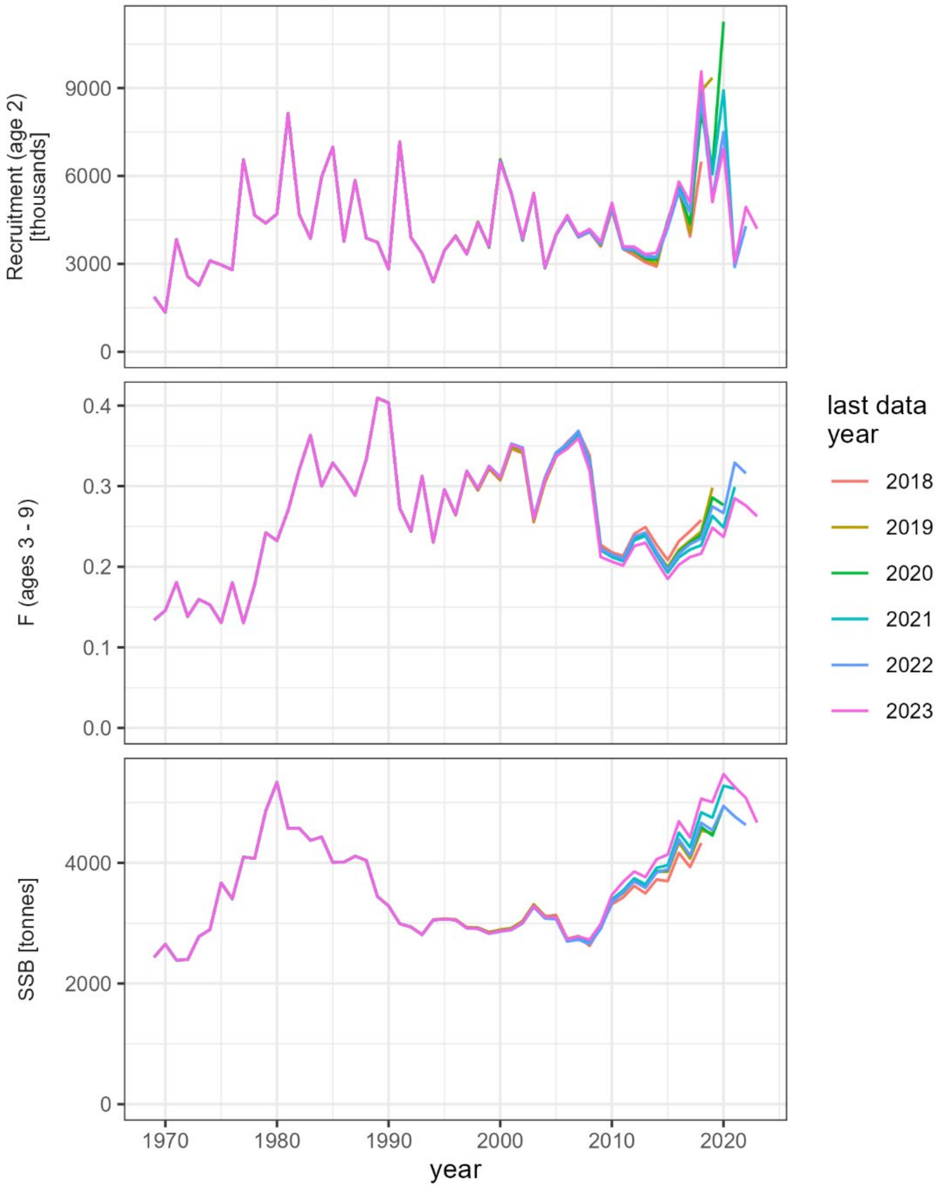


Figure 32.23. Sole in Division 7.e. Five-year retrospective of stock status and fishing mortality estimates.

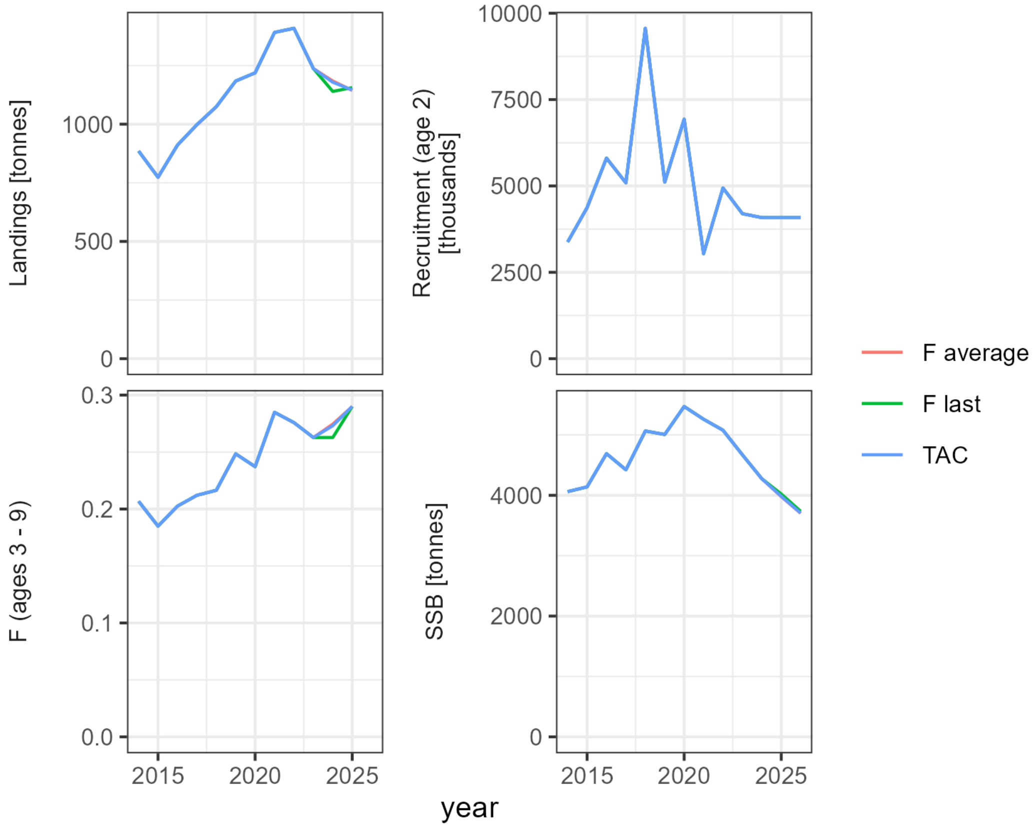


Figure 32.24. Sole in Division 7.e. Options for the intermediate year in the short-term forecast.

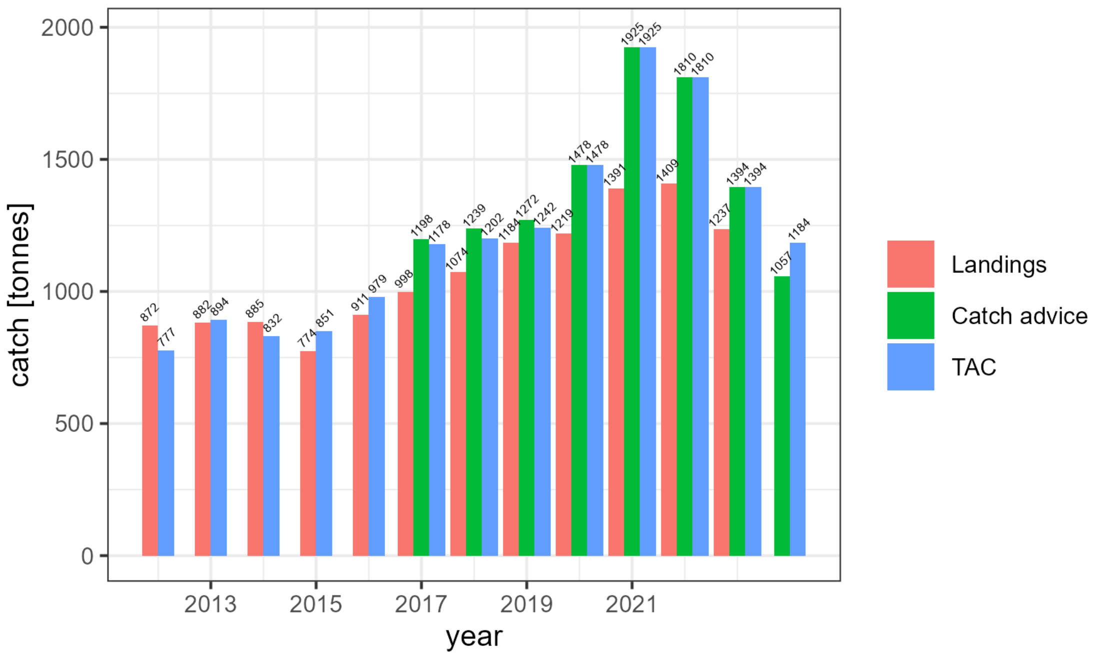


Figure 32.25. Sole in Division 7.e. Comparison of international TAC, catch advice and realised landings.

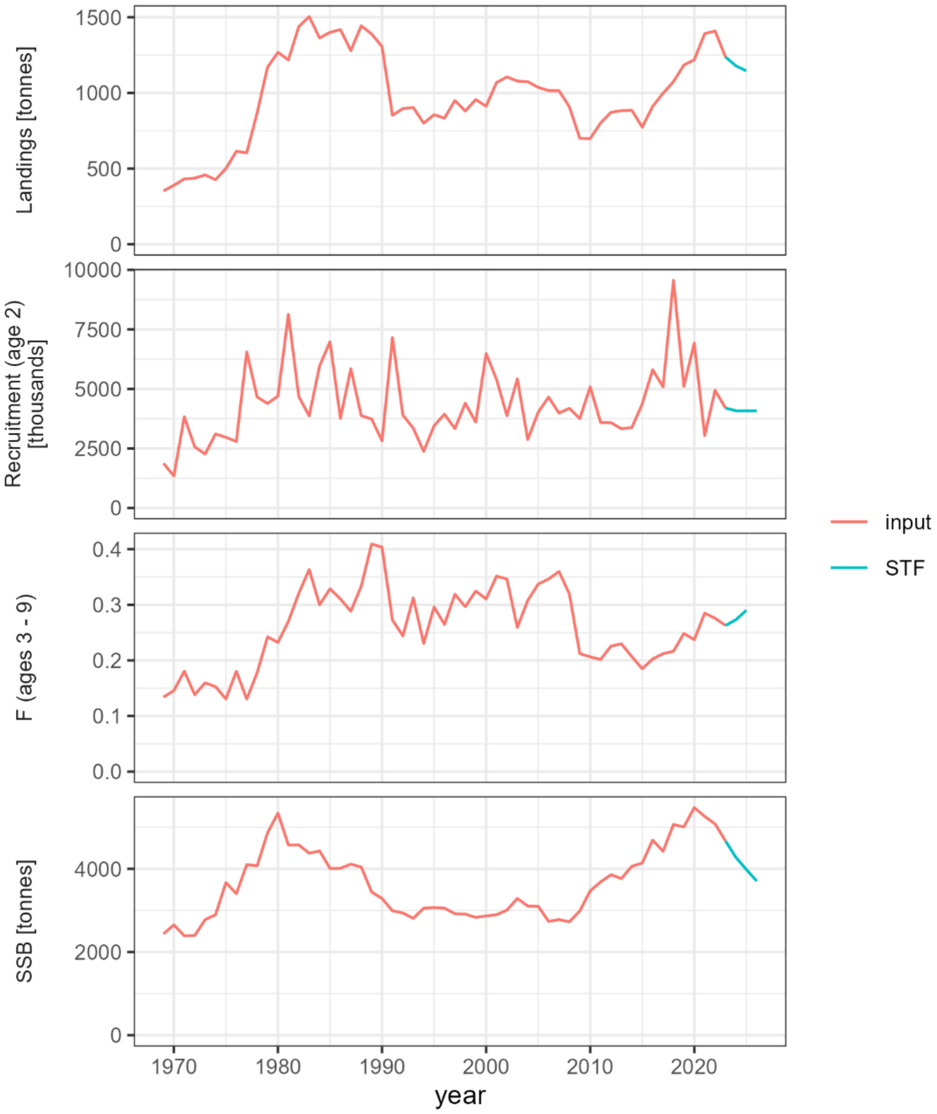


Figure 32.26. Sole in Division 7.e. Output for the short-term forecast under the MSY approach.

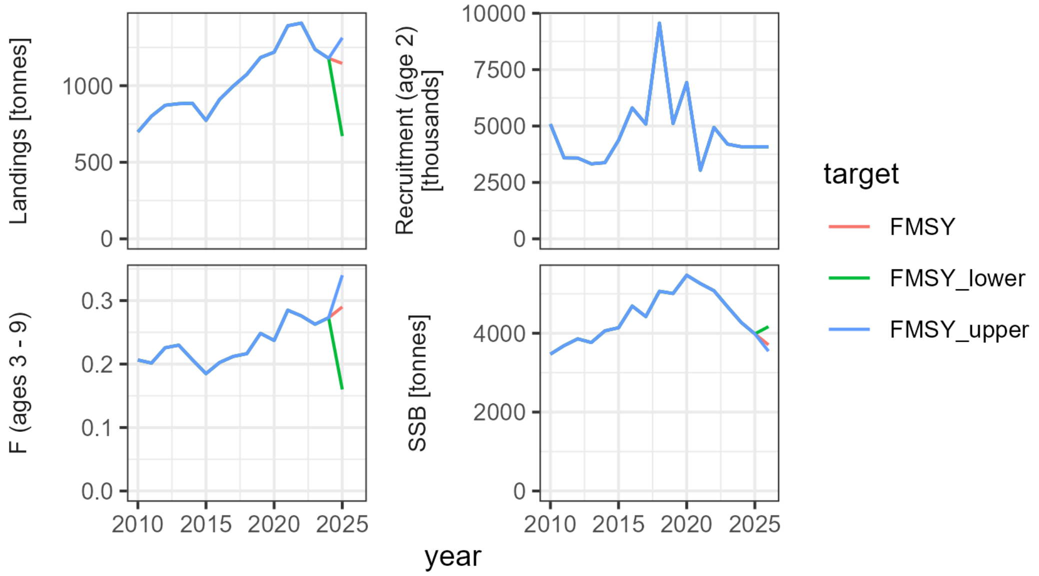


Figure 32.27. Sole in Division 7.e. Output of the short-term forecast of the MSY approach, including FMSY ranges.

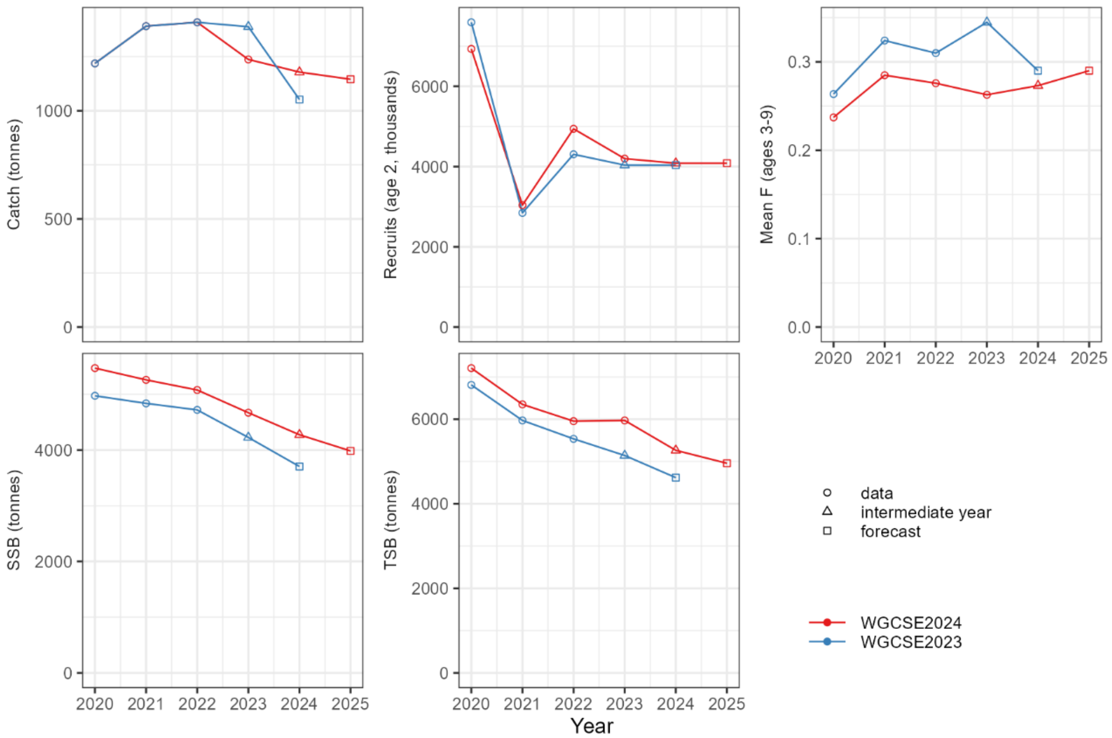


Figure 32.28. Sole in Division 7.e. Comparison of this year's and last year's short-term forecasts.

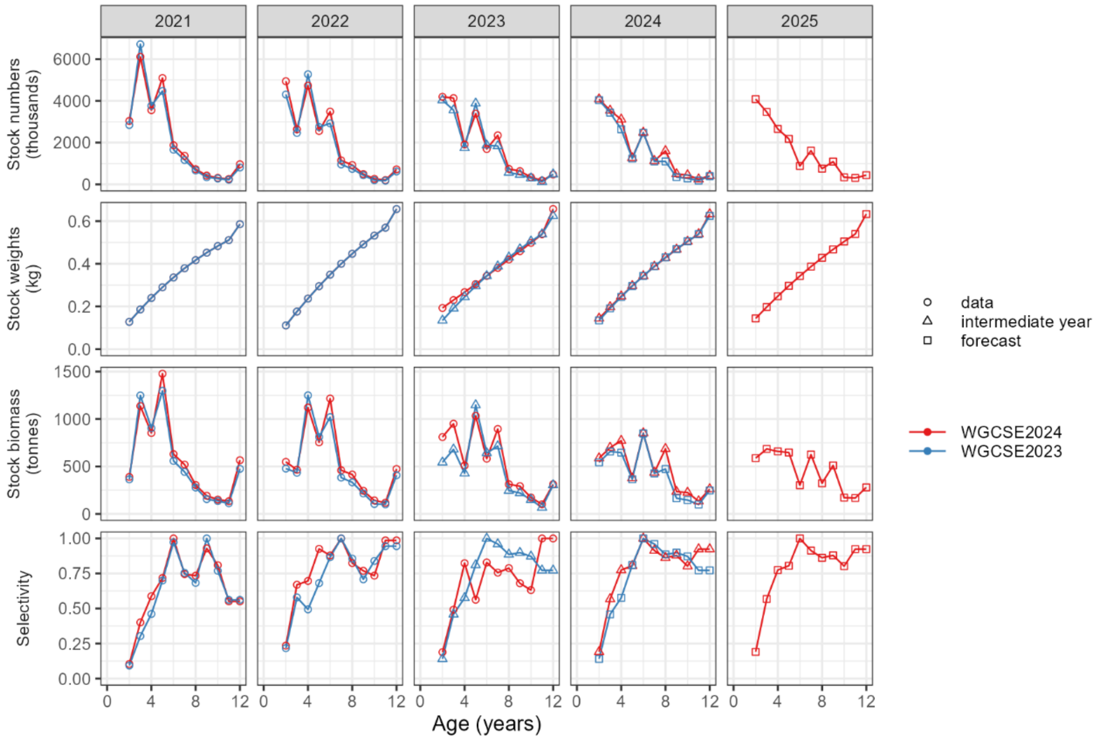


Figure 32.29. Sole in Division 7.e. Comparison of this year's and last year's short-term forecasts by age.

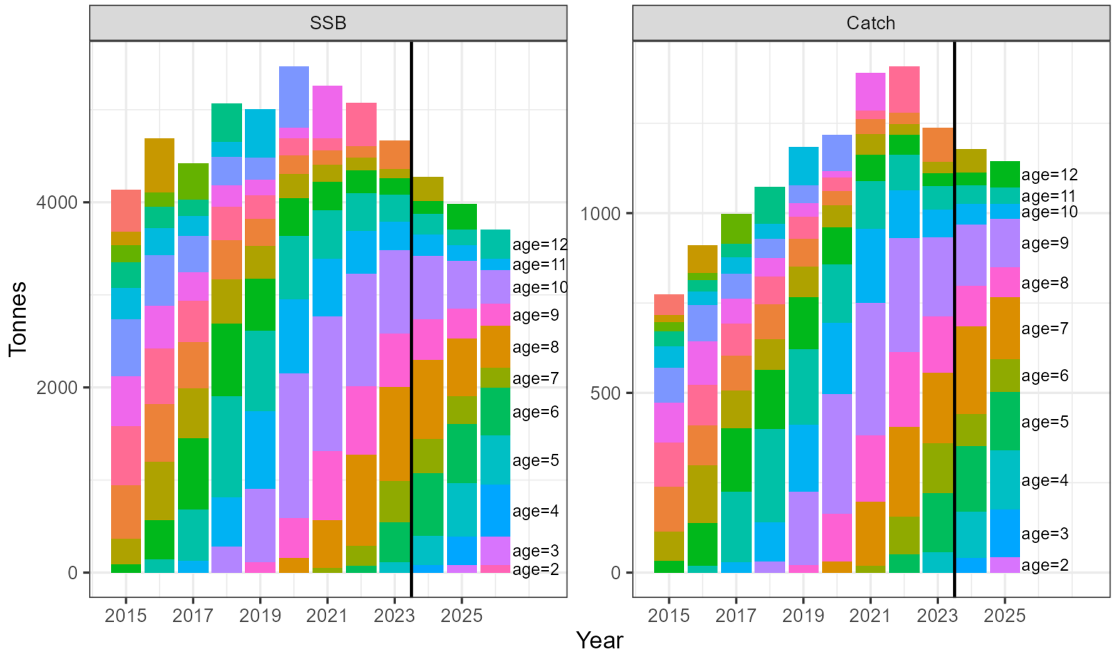


Figure 32.30. Sole in Division 7.e. Age class contributions (biomass) to the SSB and catch. Age 12 is the plus group. The vertical black line indicates where the short-term forecast starts.

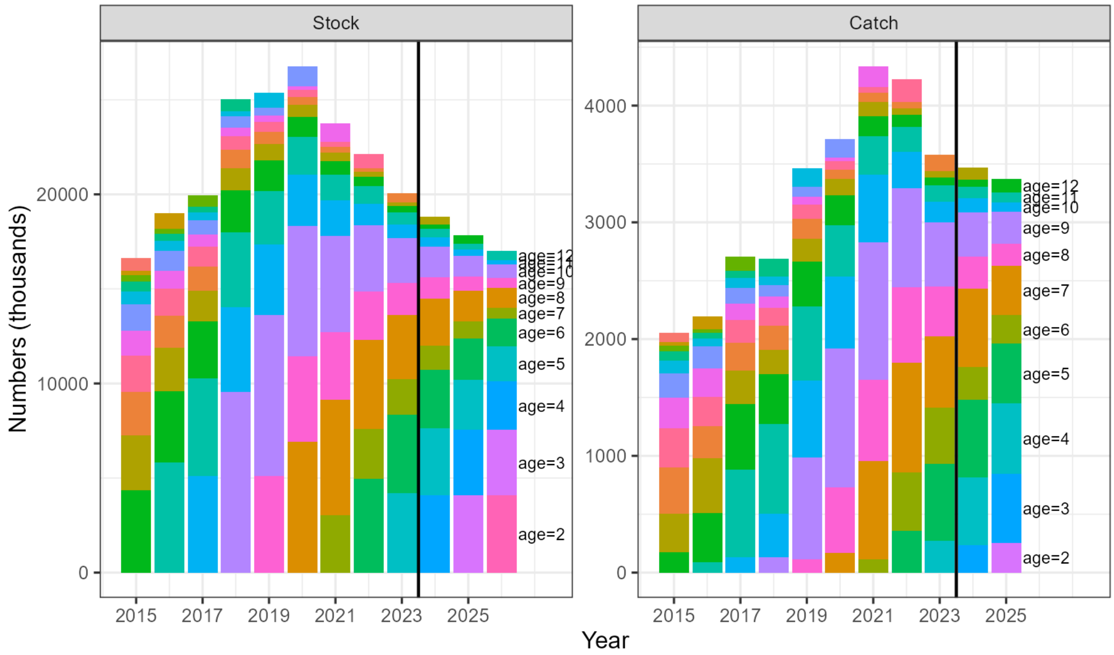


Figure 32.31. Sole in Division 7.e. Age class contributions (numbers) to the stock and catch. Age 12 is the plus group. The vertical black line indicates where the short-term forecast starts.

Contents

33 Sole (*Solea solea*) in Division 7.f and 7.g (Bristol Channel, Celtic Sea)

Type of assessment in 2024

This assessment is an update assessment.

ICES advice applicable to 2024

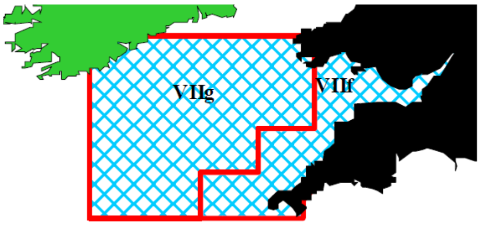
ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 1267 tonnes.

Comments made by the audit of last year's assessment

No major deficiencies for the sole assessment in the Celtic Sea were reported.

33.1 General

Stock description and management units.



Red Boxes - TAC/Management Areas
Blue Shading - Assessment Area

The sole fisheries in the Celtic Sea are managed by TAC and technical measures. A TAC is in place for ICES divisions 7.f and 7.g. These divisions correspond to the stock area. The basis for the stock assessment area 7.f and 7.g is described in detail in the Stock Annex.

The agreed TACs in 2023 and 2024 are presented in the text tables below. Technical measures in force for this stock are minimum mesh sizes and minimum conservation reference sizes (MCRS, 25 cm for Belgian vessels from March 11th 2017 onwards, except vessels with engine power <221 kW and/or volume <70 GT). National regulations also restricted areas for certain types of vessels.

Three rectangles in the Celtic Sea (30E4, 31E4 and 32E3, referred to as the "Trevose Box") were closed during the first quarter of 2005, and in February–March each year from 2006 onwards. A derogation has permitted beam trawlers to fish there in March 2005. The effects of this closure have been discussed in previous WGSSDS meetings and ACFM 2007, and evaluated at WKCELT 2014 (ICES, 2014).

33.1.1 Management applicable to 2023 and 2024

The TAC and the national quotas by country for 2023.

Species:	Common sole *Solea solea*	Zone:	7f and 7g (SOL/7FG.)
Belgium	777	Analytical TAC	
France	78	Article 7(2) of this Regulation applies	
Ireland	39		
Union	894		
United Kingdom	421		
TAC	1 338		

The TAC and the national quotas by country for 2024.

Species:	Common sole *Solea solea*	Zone:	7f and 7g (SOL/7FG.)
Belgium	730	Analytical TAC	
France	72	Article 7(2) of this Regulation applies	
Ireland	37		
Union	840		
United Kingdom	405		
TAC	1 267		

33.2 Fishery in 2023

An overview of the landings and discard data provided and used by the Working Group (WG) is shown in Table 34.1 and Figure 34.1. The landings have fluctuated over the time-series with higher amounts of around 1500–1600 t in 1986, 2003 and 2020-2022.

In 2023, the WG estimated landings are 1210 t, of which Belgium landed 72.1% (873 t), UK (England and Wales) 20% (242 t), Ireland 3.6% (43.6 t), France 3.4% (41.7 t), and the remainder by Northern Ireland, Spain and Scotland. Discards were estimated to be at 134 t. This catch estimate (1344 t) corresponds to an international overshoot of 0.45% of the agreed TAC in 2023 (1338 t).

In 2023, 87% of the landings and discards were taken by beam trawls, 13% by otter trawls and <1% by other gears.

The Belgian commercial fishing fleet has fishing opportunities in several ICES divisions and are allowed to fish in different ICES divisions within one trip (e.g. while steaming from a Belgian harbour to a foreign harbour). This flexibility of fishing in different ICES divisions creates opportunity for non-compliance and therefore a misreporting analysis was conducted (described in detail in the working document (WD_sol.27.7fg_Belgian landings.docx). The differences between estimated landings and reported landings for the period 2006-2018 are in line with the outcome of the misreporting analysis done within the framework of the WKFlatNSCS in 2020 (ICES, 2020). From 2019 onwards, the difference between estimated and reported landings is within the range of 12.89 - 37.78% and larger than the differences in the period 2008-2018. The Belgian beam trawl landing numbers of sole in ICES divisions 7.f and 7.g in the years 2021 and 2022 were adjusted for under-reporting (Table 34.1) as this follows the same approach (threshold (> 22%)) as the misreporting corrections done in 2020 for the period 2004-2007 as a result of the previous benchmark (ICES, 2020).

33.3 Data

Age-compositions and weights-at-age

InterCatch was used for estimation of both landings and discards numbers and age compositions, as input for the assessment. Belgium, Ireland, France, UK, Spain, Northern Ireland and Scotland have provided data this year under the ICES InterCatch format on a métier basis. Quarterly/yearly data for 2023 were available for landing numbers and weight-at-age, for most of the Belgian, Irish and UK fleets. These comprise 89% of the international landings. Discard weights were available for 74% of the landings. The age coverage for the sampled discards is 100% (rounded value).

If discards were not included for a particular year-quarter-country-métier combination, they are assumed to be unknown (non-zero) and therefore raised (InterCatch). The weighting factor for raising the discards was 'Landings CATON' (landings catch). Discard raising was performed on a gear level regardless of season or country. The following groups were distinguished based on gear:

- TBB
- OTB including OTB, OTT, SSC, SDN
- GTR including GTR and GNS

The remaining gears were combined in a REST group (including MIS, FPO, DRB, LHM, LLS).

The proportion of landings within a gear group for which discard weights are available in 2023 are: GNS/GTR: 3.8%, TBB: 79.3%, OTB/OTT/SSC/SDN: 41.0% and REST: 0%.

Raising within a gear group was performed when the proportion of landings for which discard weights are available was equal or larger than 50% compared to the total landings of that group. For the 2023 data, this was only the case for the TBB gear group. When the threshold was not reached for a gear group, it was pooled with the REST group to raise discards based on all available information.

To allocate age compositions, landings and discards were handled separately; samples from landings were used only for landings and *vice versa*. When age distributions (both landings and discards) had to be borrowed from other strata, allocations were performed on a gear level. The same gear groups (TBB, OTB, GTR and REST) as used for discard raising were applied. In 2023, the proportion of landings covered for age composition is respectively 36.8%, 99.5%, 22.1% and 89.9% for the GNS/GTR, TBB, OTB/OTT/SSC/SDN and REST group. The proportion of landings for which discard age coverage is available is respectively 0%, 79.3%, 5.4% and 0% for the GNS/GTR, TBB, OTB/OTT/SSC/SDN and REST group. When the threshold of 50% was reached for the proportion of landings or discards covered by age, allocation of age occurred with all available information within that gear group. For the 2023 landings, this threshold was reached for the TBB and RESTgroup; for the 2023 discards only for the TBB group. When the threshold was not reached, unsampled data were pooled and ages were allocated using all sampled data. The weighting factor was '*Mean Weight weighted by numbers-at-age*'.

Figure. 33.2 shows the available landings and discards data by country, gear and year.

Raised discard data from InterCatch were available from 2004 onwards. To estimate discard mean weight-at-age and numbers-at-age prior to 2004, a constant ratio of discards to landings by age was applied using data from 2004–2018 (WKFlatNSCS, ICES 2020).

Further details on raising methods are given in the stock annex.

Catch numbers-at-age are given in Table 33.2 and age compositions are plotted in Figures 33.3ab. Weights-at-age in the catch are given in Table 33.3 and Figure 33.4. The standardised catch proportion-at-age is presented in Figure 33.5.

Length-compositions

Annual length compositions for 2023 are given by fleet in Table 33.4 Length distributions of the total Belgian and UK(E&W) landings for the last 23 years are plotted in Figure 33.6. Belgian vessels generally land a greater proportion of small fish compared to the UK(England and Wales).

The length distributions for 2023 of retained and discarded catches of sole by the Belgium beam trawl fleet are presented in Figure 33.7. The Belgian beam trawl fleet mainly discarded fish of 22 and 23 cm. According to the Belgian age–length samples, these fish were mainly age 2.

Discard rate

The discard rate, calculated as the ratio between ICES discard estimates (tonnes) and ICES catch estimates (tonnes), fluctuates around 4% over the years 2004–2017. In 2018 and 2019 the discard rate increased to about 13% (average 2018-2019), whereas in the following 3 years it fell back to about 5% (average 2020-2022). The 2023 discard rate is estimated to be 10.0%.

Biological

The stock weights (Table 33.5 and Figure 33.8) were obtained using the Rivard weight calculator (http://nft.nefsc.noaa.gov./), that conducts a cohort interpolation of the catch weights. The resulting stock weight for age 1 was very variable, and it was decided during the benchmark to set the stock weight of age 1 to the lowest estimated stock weight for age 2 for 1971–2019.

A new maturity ogive was estimated during the WKFlatNSCS (ICES, 2020) using only survey data of the UK(E&W)-Q1SWECOS. Maturity data are available for 2013–2019. The new maturity ogive is calculated with a length-based model with sex-specific ALK. This new ogive indicates that >60% of the 2 and 3-year old individuals are mature, while this was not the case in the maturity ogive used until the WGCSE 2019. The maturity at-age 1 was manually set to 0 as no mature sole at age 1 were encountered at the UK(E&W)-Q1SWECOS survey.

Updated maturity at-age based on data from the UK(E&W)-Q1SWECOS survey.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0.0	0.67	0.91	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Natural mortality was assumed to be 0.1 for all ages and years.

Surveys

The WGCSE 2024 Celtic Sea sole stock assessment used one scientific survey index: UK(E&W)-BTS-Q3 (1988–2023), from age 1 to 5. It is the only index providing information on the recruiting age (age 1). Standardised abundance indices for the UK beam trawl survey (UK(E&W)-BTS-Q3)) are shown in Table 33.6 and Figure 33.9. Abundance-at-age 0 is highly variable and not used further on. The UK-survey appears to track the stronger year classes reasonably well. The internal consistency plot indicates also a reasonable fit for most of the ages (Figure 33.10).

After the peak in 2000 (228.46 kg/100 Km fished, Figure 33.11 and Table 33.8), the LPUE from the UK(E&W)-BTS-Q3 dropped gradually to the lowest value in 2006 (68.967 kg/100 Km fished). Thereafter, it fluctuated between 80 kg/100 Km fished and 120 kg/100 Km fished until 2017. In 2018, it increased again to 206.44 kg/100 Km fished and for 2020 and 2021 a lower value of about 112 kg/100 Km fished was noted. In 2022 and 2023, the LPUE slightly increased to 124.67 kg/100 Km fished and 134.14 kg/100 Km fished respectively.

Detailed information on the survey protocols and area coverage can be found in the Stock Annex.

Commercial LPUE

Available estimates of effort and LPUE are presented in Tables 33.7–33.8 and Figure 33.12.

Commercial LPUE and effort data were available for Belgian beam trawlers, UK(E&W) beam and otter trawlers and Irish seiners, otter and beam trawlers. It should be noted that in 2013, the UK administration switched to the EU electronic logbook system. Therefore, effort and LPUE reporting is now based on days fished. It should also be noted that the LPUE reporting of the Belgian beam trawlers does not account for the under-reporting in recent years.

Belgian beam trawl effort was at highest levels in 2003–2005. During these years, effort shifted from the Eastern English Channel (Division 7.d) to the Celtic Sea (divisions 7.fg) because of days-at-sea limitations in the former area. In 2006, these restrictions had been lifted and effort decreased substantially to about half of the values observed in the early 2000s. The sharp effort reduction in 2008 may be a combined result of the unrestricted effort regime in Division 7.d and the high fuel prices. The increase in 2012–2013 is due to the good opportunities of sole catches in the Celtic Sea taken by the mobile Belgian fleet. Afterwards, effort decreased again to lower levels during 2014–2019. Together with the substantial increase of the TAC in 2020, the effort also increased in 2020. It remained at that level in 2022 and 2023, after a slight decrease in 2021.

The effort from the UK(E&W) beam trawl fleet has declined sharply since the early 2000s to a record low in 2011 (area 7f and area 7g east) and 2008 (area 7g west), and fluctuated between this lower value and the time-series mean afterwards. For area 7g a just above average value was noted for 2021. The effort from the UK(E&W) otter trawlers has shown a gradually declining trend over time. The area 7g west otter trawler effort has shown a more fluctuating pattern.

LPUE of the Belgian beam trawlers peaked in 2002. After a sharp decline to its record low in 2004, LPUE has been increasing gradually to around 20–21 kg/hour in 2014–2015. In 2017, a decrease to 15.72 kg/hour was recorded. Afterwards it increased again and was at the highest level of the time-series in 2020 (25.74 kg/hour). The following years lower values were noted: 21.6 kg/hour in 2021, 18.5 kg/hour in 2022 and 18.6 kg/hour in 2023.

At the end of the 1990s and the beginning of the 2000s, the LPUE of the UK beam trawlers was stable at lower levels compared to the period before. Afterwards, the LPUE fluctuated and gradually increased to a value around the time-series mean in 2020–2023. Except for the area 7g west, where the LPUE is lower than the time-series mean in 2023.

The LPUE of the UK otter trawlers is relatively stable at a lower level, but increased in 2022 in area 7f and area 7g east.

Irish effort and LPUE data are also presented. The main target species in the Irish fisheries are megrim, anglerfish, etc. The vessels usually operate on fishing grounds in the Western Celtic Sea with lower sole densities and therefore the LPUE values are low.

Tuning series

All available tuning data are given in Table 33.9, with the data used in the assessment highlighted in bold.

The age-structured UK(E&W)-BTS-Q3 scientific survey tuning series is the only scientific survey used for tuning.

During the WGCSE 2019, two age-structured commercial tuning series (UK(E&W)-CBT and BE-CBT) were used in the assessment. The UK(E&W)-CBT tuning-series used in the WGCSE 2019 assessment was limited to 2012 and earlier, because of effort reporting issues. As the hours fished became an optional field in the logbooks and not consistently filled, this field is inappropriate to use as a metric for effort.

During the WKFlatNSCS (ICES, 2020) an updated UK(E&W)-CBT tuning series was introduced in the assessment. The new UK(E&W)-CBT series from 1987–recent was generated using a random effects model. Activity days was used as an effort measure, since it is mandatory to record.

The Belgian commercial beam trawl tuning fleet consists of two parts (1971–1996 and 2006–recent, BE_CBT and BE_CBT3). During the IBPBrisol (ICES, 2019b), the BE_CBT3 was constructed focusing on the landings and effort data of pure trips from the large fleet segment of the Belgian beam trawl fleet fishing in divisions 7.f and 7.g. Several models were tested and a GLMM including a categorical year effect, a log-linear relationship between the engine power of a beam trawler and the landing rate, a categorical temporal effect ‘month’ and a categorical spatial effect ‘ICES statistical rectangle’ were retained. The exponent of the estimated coefficients of the year effect were used as landing rate for the tuning series. More information is provided in the stock annex and the WKFlatNSCS report (ICES, 2020).

During the Benchmark, these commercial tuning series were used as commercial biomass tuning series. These time-series of the commercial tuning series were split in order to better account for changes in catchability due to e.g. technological creep (see figure below). Figure 33.13 shows the evolution through time of the commercial biomass tuning series. The Belgian BE_CBT_2006–2023 and the UK(E&W)-CBT_2006–2023 tuning series show a relatively similar increasing trend during the last years. However, the UK biomass index starts decreasing from 2022 onwards, and the Belgian biomass index shows a decrease in 2023.

Other relevant data

Reports from UK industry suggest that the main issues affecting the fishery in 7.f and 7.g were displacement of effort due to the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W (Trebilcock and Rozarieux, 2009).

No additional information was received from the Belgian, French and Irish industries.

33.4 Stock assessment

Historical stock development

The method used to assess Celtic Sea sole was XSA until the WGCSE 2019. During the WKFlatNSCS (ICES, 2020), the assessment was transferred to a state–space stock assessment model (SAM). This was done by using the *stock assessment* package, which enables to interface a performant SAM implementation (https://github.com/fishfollower/SAM/) in *Template Model Builder* (TMB)[1] from the R statistical software.

The main feature of SAM is that it includes both process models on survival, recruitment and fishing mortality, describing the internal states of the system, and observation models for catch and tuning data. Additionally, tuning data can be introduced in different ways, e.g. as SSB (spawning–stock biomass), TSB (total stock biomass) or landings indices, while the random effects formulation of the process models resulting from the hierarchical nature of the state–space modelling framework, can easily be used to handle missing observations as is the case with catch information on age 1. Finally, SAM allows to specify different model configurations, and parametrization of both process and observation models.

During the benchmark, it was decided to transfer the age-structured commercial tuning series into biomass indices. These time-series of the commercial tuning series were split, in order to better account for changes in catchability due to e.g. technological creep. The age-structured UK(E&W)-BTS-Q3 survey tuning series was also included. The model was further optimized in terms of parameter configuration for the process and observation models (see table below).

The F_{bar} calculates the mean fishing mortality for the set age range and should represent a significant part of the catch. The F_{bar} in the WGCSE 2019 assessment was set at age 4–8. However, as age 3 represents a large proportion of the catch (Figure 33.3), during the WKFlatNSCS it was decided to expand the F_{bar} to ages 3–8. The F_{bar} with ages 3–8 represents an average 77% of the catch, with a minimum of 48% and a maximum of 97%.

The SAM model input and configuration are shown in the table below and in Table 33.10.

[1] TMB offers a modelling framework for fast estimation of hierarchical models written in C code through the Laplace approximation. In addition, increased performance of nonlinear optimization procedures is achieved through the use of AUTODIFF (automatic differentiation), and performant C libraries for linear algebra (Eigen and CholMod).

DATA & SETTINGS	
tuning indices	
UK(E&W)-BTS survey (1988-(assessment year-1))	Age (1-5)
BE-CBT_1971-1983	Biomass
BE-CBT_1984-1996	Biomass
BE-CBT3_2006-(assessment year-1)	Biomass
UK(E&W)-CBT_1984-2005	Biomass
UK(E&W)-CBT_2006-(assessment year-1)	Biomass
catch numbers-at-age	Catch numbers for age 1 and 2 set to NA prior 2004
maturity ogive	Age1 = 0; Age2 = 0.67; Age3 = .91; Age4 = .98; Age5 = .99; Age6 = .99; Age6+ = 1
natural mortality	0.1 for all ages and years
prop. M < spawning	0 for all years
prop. F < spawning	0 for all years
Plus group	10
Fbar	3-8
MODEL CONFIGURATION	
stock-recruitment	plain random walk on logN(1)
correlation F-at-age	AR(1)
F parameters-at-age	6 = 0, 1, 2, 3, 3, 3, 4, 4, 5, 5
q parameters (-at-age)	
UK(E&W)-BTS survey (1988-(assessment year-1))	4 = 0, 1, 2, 3, 3, -1, -1, -1, -1, -1
BE-CBT_1971-1983	1
BE-CBT_1984-1996	1
BE-CBT3_2006-(assessment year-1)	1
UK(E&W)-CBT_1984-2005	1
UK(E&W)-CBT_2006-(assessment year-1)	1
σ^2 F parameters-at-age	1 = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
σ^2 N parameters-at-age	2 = 0, 1, 1, 1, 1, 1, 1, 1, 1, 1
σ^2 obs pars (-at-age)	
catch numbers-at-age	2 = 0, 0, 1, 1, 1, 1, 1, 1, 1, 1
UK(E&W)-BTS survey (1988-(assessment year-1))	3 = 2, 3, 3, 4, 4, -1, -1, -1, -1
BE-CBT_1971-1983	1
BE-CBT_1984-1996	1
BE-CBT3_2006-(assessment year-1)	1
UK(E&W)-CBT_1984-2005	1
UK(E&W)-CBT_2006-(assessment year-1)	1
ρ observations at-age	
catch numbers-at-age	"AR(1)" (single ρ for all ages)
UK(E&W)-BTS survey (1988-(assessment year-1))	"ID"
BE-CBT_1971-1983	-
BE-CBT_1984-1996	-
BE-CBT3_2006-(assessment year-1)	-
UK(E&W)-CBT_1984-2005	-
UK(E&W)-CBT_2006-(assessment year-1)	-

This year's assessment

The SAM model fitting diagnostics and survey catchabilities are shown in Table 33.11, the fishing mortalities in Table 33.12, the stock numbers in Table 33.13 and the assessment summary in Table 33.14 and Figure 33.14.

In general, the estimated catches from the SAM model corroborate the observed catches. Mainly at the start of the time-series, some observed catches do not fall within the confidence bounds of the estimated catches. The SAM catch estimate for 2020, 2021 and 2022 is also considerably lower than the corresponding ICES catch estimate. The ICES estimated catch for 2021 and 2022 incorporates area misreporting, resulting in higher catches than the reported catches.

Spawning–stock biomass (SSB) has been above MSY $B_{trigger}$ since 2010 and shows an increasing trend over the last years, with the 2019–2021 estimates around the same high level. The 2022 and 2023 estimates are slightly lower than the estimates of the previous three years. Fishing mortality has been above F_{MSY} for most of the time series, except for some years in the beginning of the time series and in 2018. Recruitment has been variable without an overall trend. Recruitment estimates have been above average since 2015, except in 2020. The 2017 recruitment is estimated to be the highest in the time-series and the 2023 recruitment to be the third highest.

The one-step ahead residuals for the final SAM assessment are shown in Figure 33.15.

Retrospective patterns for the final run are shown in Figure 33.16. Retrospective analysis does not indicate major problems; the retrospective patterns are within the confidence bounds. A Mohn's rho analysis was conducted based on the SAM stock assessment results, i.e. the last data year (2023) was used as the final year for comparison of SSB, F and recruitment and based on a five-year retrospective analysis. The Mohn's rho values for this assessment are low and well within the bounds of -15 % to 20% suggested by ICES, i.e. the current assessment indicates sufficient consistency for advice purposes.

The results from the Mohn's rho analysis are shown in the following table:

	SSB	F (AGES 3-8)	RECRUITMENT
Mohn's rho value	-0.02027	-0.03669	0.10629

Comparison with previous assessments

A comparison of the estimates of this year's assessment with last year's is given in Figures 33.17. Trends in fishing mortality, SSB and recruitment are very similar. The 2021 and 2022 recruitment estimates were revised upwards by 8.6% and 1.2% respectively in this year's assessment. In last year's assessment, F and SSB for 2022 were estimated to be 0.244 and 5710 t respectively; this year's estimates for 2022 are 0.309 and 5290 t, an upwardward revision of 26.6% for F and a downward revision of 7.4% for SSB. Similar rescaling is also noted for the 2021 estimates with an upwardward revision of 23.2% for F and a downward revision of 4.5% for SSB.

State of the stock

Trends in catch, SSB, F_{bar}(3–8) and recruitment are presented in Table 33.14 and Figure 33.14.

In the beginning of the time-series, fishing mortality fluctuated around F_{MSY} (0.251). During the eighties and nineties fishing mortality increased (0.51 in 1997) for this stock to levels well above F_{MSY}. In the following decades, fishing mortality decreased and was just below F_{MSY} in 2018. Since 2019, fishing mortality has been above F_{MSY}.

Recruitment has fluctuated around 5 million recruits with occasional strong year classes. The 1998 year class is estimated to be among the strongest in the time-series (13 579 thousand fish). Recruitment has been above average (5972 thousand fish) since 2015 (except in 2020), the recruitment of 2017 is estimated to be the highest of the time-series (14 531 thousand fish) and the recruitment of 2023 is estimated to be the third highest (10 713 thousand fish).

SSB has declined almost continuously from the highest value of 6650 t in 1971 to the lowest observed in the time-series in 1997 (2193 t). The exceptional year class of 1998 has increased SSB to above the long-term average (3972 t) in the years 2001-2004. With the exemption of the period 2007-2009, SSB has been above MSY $B_{trigger}$ (3057 t) since 2001. SSB increased in the years 2019-2021 to the highest level (around 5800 t) since 1973 as a result of the good recruitment. The SSB in 2022 (5290 t) and in 2023 (4950 t) is again slightly lower.

33.5 Short-term projections

This year's forecast assumptions

Figure 33.18 shows three different targets for the intermediate year: F_last ($F = F_{2023}$ or status quo), F_average ($F = F_{average\ 2021\text{-}2023}$), and catch. For the 'catch' target, the 2024 advised catch value or TAC of 1267 t (Figure 33.19) was assumed and this assumption implies a fishing mortality in 2024 of 0.282 and results in an SSB of 5356 t in 2025. This option was not agreed by the WG because the under-reporting of the Belgian beam trawl fleet in recent years is likely to continue in 2024.

The F in 2023 (0.294) is slightly lower than the mean F over the last three years ($F_{average\ 2021–2023}$ = 0.302) and using this F to project the stock into 2024, would result in slightly lower catches (1309 t) compaired to the F average option (1339 t) in 2024. Both options would imply slightly overshoting the 2024 TAC (1267 t). Taking into account that there is no trend in F over the last three years, the WG agreed to use F average as target for the intermediate year (2024). This results in an SSB of 5275 t in 2025.

As input for the forecast fishing mortality, catch and stock weights-at-age were calculated as the mean of 2021–2023. Population numbers at the start of 2024 for ages 2 and older, were taken from the SAM output. The long-term median resampled recruitment (1971–2021) as estimated by a stochastic projection (SAM, 5177 thousand fish) was assumed for recruitment in 2024 and subsequent years, as this corresponds with the recent period of higher recruitments.

Last year's forecast assumptions

A comparison of the estimates of this year's assessment and forecast with last year's is given in Figure 33.20.

Higher recruitment was observed from 2015 onwards. However, the 2022 year class (2023 recruitment) is now estimated at 10 713 thousand fish at age 1 (Table 33.14), which is 108% higher than the median resampled recruitment from the years 1971–2020 (5156 thousand fish), used in last year's forecast.

The age 1 estimates are almost solely coming from the UK(E&W)-BTS-Q3. The above average (5.6) abundance indices for age 1 in 1999 (24.6), 2017 (10.5) and 2023 (13.9) align with the high recruitment in those years.

In last year's assessment the 2023 SSB was estimated to be 6002 t, this year the 2023 SSB is revised downwards by 17.5% (4950 t). An F of 0.264 was assumed for the intermediate year in last year's forecast, this value (F in 2023) is now estimated to be 0.294, an upward revision of 11.4%.

MSY forecast

Table 33.15 and Figure 33.21 show the output of the forecast targeting $F = F_{MSY}$ for 2025–2026. Implementing the MSY approach with $F = F_{MSY} = 0.251$ leads to a total yield of 1149 t in 2025, and an SSB of 5226 t in 2026. This means a decrease in advice compared to last year's advice, caused by the downward revision in recent SSB and an upward revision in recent F.

Figure 33.22 shows the contribution of the assumed median resampled recruitment (1971–2021) to the forecast yield and SSB. The assumed recruitment accounts for about 3.2% of the catch in 2025 and about 18.7% of the 2026 SSB.

Additional options

A management options table is provided in Table 33.15.

33.6 Biological reference points

Current biological reference points calculated during the WGCSE 2020 are given in the text table below:

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	3057	Tonnes; B_{pa}
	F_{MSY}	0.251	EQsim analysis based on the recruitment period 1971–2018
Precautionary approach	B_{lim}	2184	Tonnes; B_{loss} estimated in 2020, corresponding to SSB in 1997
	B_{pa}	3057	Tonnes; B_{lim} × 1.4
	F_{lim}	0.543	EQsim analysis, based on the recruitment period 1971–2018
	F_{pa}	0.402	$Fp_{.05}$; F that leads to SSB ≥ B_{lim} with 95% probability.
Management plan	MAP MSY $B_{trigger}$	3057	Tonnes; MSY $B_{trigger}$
	MAP B_{pa}	3057	Tonnes; B_{pa}
	MAP B_{lim}	2184	Tonnes; B_{lim}
	MAP F_{MSY}	0. 251	F_{MSY}
	MAP range F_{lower}	0.136–0.251	Consistent with ranges provided by ICES (2020), resulting in no more than 5% reduction in long-term yield compared with MSY
	MAP range F_{upper}	0.251–0.462	Consistent with ranges provided by ICES (2020), resulting in no more than 5% reduction in long-term yield compared with MSY

*** EU multiannual plan (MAP) for the Western Waters (EU, 2019).**

33.7 Management plans

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019). This plan applies to demersal stocks including sole in ICES divisions 7.f and 7.g.

33.8 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for 7.f and 7.g sole are sampled (approximately 90% of the total landings). Sampling is considered to be at a reasonable level.

Discards

The annual discard estimate used to be low (2.7%, average 2011-2016), but increased to 14.2% in 2018. In 2021, it decreased to 4.4 and it is now again at a higher level (10% in 2023). Discards are included in the assessment since the WGCSE 2020.

Misreporting

Area misreporting is known to have been considerable over the period 2002–2005. This was due to a combination of the good 1998 year class still being an important part of the catch composition and more restrictive TACs. The area misreporting has been corrected for the years 2002–2006 (WGSSDS 2007). At the WKCELT 2014, analysis revealed that there was additional misreporting taking place in 2002–2003 and 2004, which was not accounted for in the first correction done at WGSSDS in 2007. Since 2007, the area misreporting that could be estimated was negligible. During the WKFlatNSCS (ICES, 2020) a further correction for 2004–2007 Belgian beam trawl landings data was done. The 2021 and 2022 landing numbers were adjusted in the current assessment for under-reporting as this follows the same approach (threshold (> 22%)) as the misreporting corrections done in 2020 WKFlatNSCS (ICES, 2020).

Surveys

The UK(E&W)-BTS-Q3 survey, which is solely responsible for the recruiting estimates, has been able to track year-class strength at-ages greater than 0 rather well in the past. However, the estimates of strong year classes have sometimes been revised downward in previous assessments and may cause bias in the forecast. However, the Mohn's rho value for the recruitment of this assessment is rather low.

33.9 Recommendations for next Benchmark

Sole in 7.f and 7.g have been benchmarked in February 2020. The remaining issues are listed below.

Problem / Aim	**Work needed / Work needed / possible direction of solution**	**Data needed to be able to do this: are these available / where should these come from?**
<u>Natural mortality</u> Alternate rates of natural mortality. Natural mortality is assumed constant over ages and years at 0.1. When new information is available, this should be investigated.	*estimates of natural mortality	*estimates of natural mortality
<u>Effect of changing exploitation patterns</u> Effect of changing exploitation patterns related to the Trevose Box closure. ICES rectangles 30E4, 31E4 and 32E3 form the Trevose Box which is closed for fishing from February 1st until March 31st. This management measure is in place since 2006 and aims to protect spawning fish, cod and other demersal stocks such as sole in particular (ICES special request, 2007). This measure has a significant effect on the behaviour of the fleets. During the first week after re-opening of the Trevose box, catch rates of the Belgian beam trawl fleet are estimated to be twice as high with respect to the situation before the closure of the Trevose Box (prior to 2006) (Sys *et al*., 2017). Those temporal and spatial effects were accounted for in the new modelled Belgian commercial tuning index (ICES, 2019b). However, this change in exploitation pattern may also have an effect on the mortality of mature females or exhibit hyperstability, in which catch per unit effort (CPUE) remains elevated as stock abundance declines.	* Check for hyperstability * Check mortality of mature females	
<u>Scientific survey information</u> The UK-BTS-Q3 survey is the only survey used in the current assessment and is solely providing information on the recruiting age (age 1). The new UK-Q1SWECOS tuning series was considered during the WKFlatNSCS 2020, but not retained. Criteria such as length of the time-series, amount of spatial coverage and consistent statistical sampling design were considered for including/excluding the new UK-Q1SWECOS tuning series. However, we recommend that those survey data will be uploaded into DATRAS and that the survey design will be reviewed by the WGBEAM (The Working Group on Beam Trawl Surveys), to assure quality control of the data. The time-series was too short for any strong conclusions now but the inclusion of those survey indices should be reconsidered during the next benchmark.	*Investigate if additional survey information (e.g. UK-Q1SWBeam, started in 2006) is available and can be incorporated in the assessment. *Additional survey data can confirm the info provided by the UK-BTS-Q3 survey.	*UK-Q1SWBeam tuning series *other available survey data
<u>Fisheries & ecosystem issues and data - Trends in mean weights</u> Trends and reasons for the decreasing catch and stock weights for the older ages	What drives this change? *Is it driven by an ecosystem change? *Is there a similar trend in the weights from other stocks?	*information on the evolution in the Celtic Sea ecosystem

33.10 Management considerations

The stock–recruitment relationship is not well-defined, there is no real evidence of reduced recruitment at low levels of SSB for this (Figure 33.23). Following the recent strong year classes, SSB increased in the years 2019-2021 to the highest level (around 5800 t) since 1973, as a result of the good recruitment in 2017. The SSB in 2022 (5290 t) and in 2023 (4950 t) is again slightly lower.

The Celtic Sea is an area without days-at-sea limitations for demersal fisheries. In this context and given that many demersal vessels are very mobile, changes in effort measures in areas other than the Celtic Sea, can influence the effort regime in the Celtic Sea (cfr. increased effort in Celtic Sea for Belgian beamers during 2004–2005 when days-at-sea limitations were in place for the Eastern English Channel).

33.11 Ecosystem considerations

Sole and plaice are predominantly caught by beam trawl fisheries. Beam trawling is known to have an impact on the benthic communities, although less so on soft substrates and in areas which have been historically exploited by this fishing method. Benthic drop-out panels have been shown to release around 75% of benthic invertebrates from the catches. Information from the UK industry (Trebilcock and Rozarieux, 2009) suggests that uptake in 2008 was minimal.

A complete ecosystem overview can be found in the stock annex Section A.3.

33.12 References

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33.13 Tables and Figures

Table 33.1. Sol.27.7fg - Official Nominal landings and landings and discard data used by the Working Group (t).

Year	Belgium		Denmark	France	Ireland	UK(E.&W, NI)	UK(Scotland)	Spain	Other	Total-Official	Area misreported landings	Used by WG	TAC	Discards**
1986	1039	*	2	146	188	611	-	-	3	1989	-	1600		80
1987	701	*	-	117	9	437	-	-	-	1264	-	1222	1600	56
1988	705	*	-	110	72	317	-	-	-	1204	-	1146	1100	61
1989	684	*	-	87	18	203	-	-	-	992	-	992	1000	70
1990	716	*	-	130	40	353	0	-	-	1239	-	1189	1200	57
1991	982	*	-	80	32	402	0	-	-	1496	-	1107	1200	126
1992	543	*	-	141	45	325	6	-	-	1060	-	981	1200	77
1993	575	*	-	108	51	285	11	-	-	1030	-	928	1100	56
1994	619	*	-	90	37	264	8	-	-	1018	-	1009	1100	52
1995	763	*	-	88	20	294	-	-	-	1165	-	1157	1100	50
1996	695	*	-	102	19	265	0	-	-	1081	-	995	1000	47
1997	660	*	-	99	28	251	0	-	-	1038	-	927	900	46
1998	675	*	-	98	42	198	-	-	-	1013	-	875	850	43
1999	604		-	61	51	231	0	-	-	947	-	1012	960	89
2000	694		-	74	29	243	-	-	-	1040	-	1091	1160	158
2001	720		-	77	35	288	-	-	-	1120	-	1168	1020	101
2002	703		-	65	32	318	+	-	-	1118	-	1345	1070	58
2003	715		-	124	26	342	+	-	-	1207	-	1547	1240	54
2004	735		-	79	33	283	-	-	-	1130	237	1391	1050	140
2005	645		-	101	34	217	-	-	-	997	279	1263	1000	23

Year	Belgium	Denmark	France	Ireland	UK(E.&W, NI)	UK(Scotland)	Spain	Other	Total-Official	Area misreported landings	Used by WG	TAC	Discards**
2006	576	-	75	38	232	-	-	-	921	146	1058	950	41
2007	582	-	85	32	245	-	-	-	943	120	1052	890	36
2008	466	-	68	28	218	-	-	-	781	-	790	964	8
2009	513	-	73	26	195	-	-	-	806	-	772	993	30
2010	620	-	44	27	180	-	-	-	871	-	867	993	56
2011	775	-	54	30	168	-	-	-	1027	-	1027	1241	28
2012	843	-	48	33	175	-	-	-	1099	-	1101	1060	32
2013	789	-	49	42	205	-	-	-	1085	-	1093	1100	26
2014	703	-	58	28	252	-	-	-	1042	-	1041	1001	27
2015	674	-	24	27	105	-	-	-	830	-	831	851	17
2016	563	-	72	21	174	-	-	-	830	-	832	779	31
2017	551	-	49	28	149	-	-	-	777	-	778	845	65
2018	607	-	44	27	171	-	-	-	850	-	850	920	141
2019	800	-	42	33	193	-	<1	-	1068	-	1068	1009	145
2020	1121	-	44	51	291	-	<1	-	1507	-	1524	1652	106
2021	858	-	61	48	395	-	2	-	1364	303	1646	1413	76
2022 ^	840	-	67	31	354	-	7	-	1299	252	1551	1337	86
2023 ^	876	-	42	43	242	-	14	-	1218	-	1210	1338	134

^Landings are preliminary.

*** including 7.g–k.**

**** Discards estimated by ICES.**

Table 33.2. Sol.27.7fg - Catch numbers-at-age (in thousands).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	610	855	575	245	188	493	496	502	519	1038	951	540	1023
3	303	1014	2116	492	323	937	492	833	630	1092	759	934	1212
4	1377	322	768	886	345	575	358	348	767	899	813	317	748
5	638	684	311	420	652	624	277	157	212	596	407	477	290
6	439	334	357	212	308	567	248	161	156	183	382	284	354
7	541	214	120	241	111	263	407	100	198	62	151	208	227
8	770	234	111	98	103	132	121	200	125	97	121	93	194
9	379	317	117	110	68	199	28	72	154	101	95	112	52
10+	1231	739	649	547	375	469	368	175	170	355	383	328	322

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1062	310	781	503	831	757	438	2304	684	559	466	204	280	387
3	951	1656	1457	1076	522	1308	1117	776	1911	970	888	1299	1163	1000
4	622	786	1204	818	902	617	1207	676	661	1133	759	1127	928	615
5	553	577	537	589	450	634	407	507	418	339	882	429	433	408
6	187	300	363	277	393	240	459	153	257	189	287	490	232	256
7	279	101	194	206	128	189	139	157	61	162	150	134	193	128
8	107	141	88	101	79	83	116	56	60	64	66	113	58	127
9	47	74	104	61	68	24	50	46	28	84	42	66	43	45
10+	276	241	330	180	270	102	130	163	89	99	146	109	106	106

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0	0	0	0	0	0	5	12	8	19	10	30	26
2	311	961	2720	1111	46	209	393	418	485	697	180	549	506
3	1048	1931	1664	2155	1647	871	1846	1096	1151	979	515	511	1510
4	743	856	701	883	2261	1294	941	1028	844	721	499	588	657
5	303	288	246	445	674	2111	1086	592	706	435	387	435	380
6	173	145	61	245	253	453	742	499	250	382	212	259	257
7	109	81	56	65	96	250	132	336	229	149	209	164	140
8	51	31	43	39	55	90	100	72	169	142	85	121	103
9	52	23	19	26	36	29	54	55	60	155	109	51	80
10+	87	44	51	81	51	84	100	89	106	93	150	203	119

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	18	29	13	14	0	66	47	4	53	0	0	13	41
2	170	361	545	173	193	727	432	989	373	242	162	749	1253
3	1103	318	998	684	837	458	1157	840	2240	777	857	686	1525
4	1389	1039	523	735	924	635	493	1105	729	2775	1363	979	608
5	394	1339	826	308	433	663	421	275	874	1161	2448	911	840
6	308	370	652	388	145	303	353	293	306	789	1200	1934	475
7	187	222	222	381	201	111	147	186	162	304	441	733	933
8	118	130	104	122	114	132	55	95	115	160	148	212	162
9	56	84	61	99	69	94	59	56	105	106	72	73	116
10+	168	219	160	243	113	70	101	122	118	189	197	237	123

Table 33.3. Sol.27.7fg - Catch weights-at-age (kg).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.039	0.106	0.081	0.063	0.046	0.114	0.098	0.068	0.023	0.048	0.078	0.061	0.085
2	0.11	0.136	0.134	0.13	0.127	0.149	0.15	0.141	0.127	0.134	0.141	0.142	0.153
3	0.168	0.185	0.2	0.202	0.208	0.214	0.229	0.228	0.226	0.228	0.22	0.236	0.247
4	0.224	0.227	0.259	0.27	0.286	0.268	0.297	0.308	0.32	0.315	0.292	0.323	0.329
5	0.273	0.265	0.311	0.329	0.355	0.316	0.355	0.377	0.4	0.391	0.355	0.396	0.397
6	0.316	0.303	0.361	0.385	0.416	0.363	0.408	0.44	0.47	0.459	0.413	0.461	0.458
7	0.353	0.34	0.408	0.436	0.473	0.409	0.46	0.498	0.531	0.523	0.469	0.521	0.513
8	0.384	0.377	0.452	0.483	0.523	0.453	0.506	0.55	0.58	0.578	0.519	0.571	0.56
9	0.408	0.413	0.493	0.524	0.565	0.496	0.548	0.596	0.621	0.625	0.564	0.616	0.602
10+	0.441	0.539	0.602	0.624	0.671	0.665	0.668	0.72	0.664	0.72	0.665	0.704	0.679

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.019	0.089	0.046	0.048	0.074	0.013	0.049	0.054	0.073	0.057	0.081	0.068	0.027	0.074
2	0.126	0.151	0.134	0.136	0.143	0.112	0.128	0.138	0.136	0.128	0.139	0.136	0.122	0.142
3	0.229	0.239	0.23	0.23	0.229	0.196	0.21	0.232	0.212	0.204	0.212	0.216	0.21	0.228
4	0.329	0.316	0.32	0.319	0.308	0.28	0.291	0.319	0.281	0.275	0.276	0.288	0.296	0.306
5	0.414	0.382	0.399	0.395	0.377	0.355	0.362	0.392	0.342	0.338	0.331	0.351	0.371	0.375
6	0.492	0.443	0.47	0.465	0.441	0.423	0.429	0.458	0.397	0.396	0.38	0.408	0.438	0.439
7	0.561	0.499	0.536	0.528	0.502	0.487	0.494	0.516	0.451	0.45	0.425	0.462	0.5	0.5
8	0.621	0.551	0.593	0.583	0.556	0.542	0.552	0.564	0.499	0.5	0.465	0.51	0.551	0.554
9	0.673	0.596	0.643	0.632	0.606	0.592	0.609	0.608	0.543	0.544	0.5	0.552	0.598	0.605
10+	0.771	0.703	0.748	0.74	0.738	0.691	0.747	0.674	0.64	0.645	0.563	0.643	0.677	0.707

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0.079	0.015	0.078	0.066	0.054	0.123	0.099	0.109	0.142	0.161	0.149	0.105	0.11
2	0.147	0.121	0.148	0.137	0.126	0.151	0.152	0.155	0.144	0.157	0.163	0.157	0.144
3	0.237	0.217	0.24	0.22	0.2	0.214	0.194	0.203	0.186	0.221	0.21	0.188	0.179
4	0.319	0.314	0.321	0.296	0.271	0.266	0.274	0.267	0.272	0.284	0.281	0.242	0.234
5	0.392	0.399	0.389	0.362	0.336	0.313	0.347	0.346	0.33	0.335	0.361	0.294	0.312
6	0.461	0.476	0.45	0.424	0.398	0.361	0.371	0.439	0.401	0.372	0.359	0.348	0.358
7	0.527	0.548	0.506	0.482	0.457	0.408	0.459	0.473	0.412	0.414	0.449	0.378	0.387
8	0.589	0.613	0.553	0.533	0.512	0.454	0.522	0.595	0.411	0.488	0.62	0.476	0.414
9	0.647	0.67	0.594	0.579	0.564	0.501	0.524	0.624	0.465	0.511	0.625	0.485	0.524
10+	0.781	0.765	0.665	0.677	0.704	0.639	0.631	0.707	0.574	0.589	0.59	0.546	0.616

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.123	0.102	0.092	0.138	0.135	0.109	0.093	0.082	0.099	0.155	0.12	0.101	0.094
2	0.155	0.142	0.158	0.15	0.132	0.165	0.151	0.175	0.12	0.114	0.127	0.116	0.124
3	0.185	0.206	0.195	0.199	0.193	0.203	0.2	0.187	0.17	0.176	0.168	0.173	0.167
4	0.233	0.243	0.249	0.268	0.248	0.251	0.255	0.251	0.24	0.205	0.209	0.222	0.22
5	0.277	0.271	0.29	0.347	0.311	0.285	0.315	0.294	0.307	0.257	0.249	0.255	0.245
6	0.361	0.312	0.329	0.394	0.367	0.342	0.33	0.327	0.327	0.331	0.256	0.278	0.299
7	0.431	0.35	0.361	0.427	0.438	0.416	0.382	0.385	0.419	0.363	0.346	0.292	0.299
8	0.465	0.38	0.463	0.496	0.502	0.429	0.444	0.436	0.451	0.415	0.41	0.413	0.382
9	0.483	0.417	0.492	0.523	0.463	0.47	0.513	0.425	0.445	0.504	0.497	0.453	0.412
10+	0.688	0.543	0.587	0.702	0.589	0.621	0.549	0.575	0.614	0.556	0.537	0.462	0.489

Table 33.4. - Sol.27.7fg - Annual landings length distributions by fleet.

	UK (England & Wales)	Belgium	Ireland
Length (cm)		Beam trawl	
19			
20			
21			
22	60		
23	1319	1590	
24	2300	137536	163
25	6508	566307	174
26	16040	570490	590
27	23781	509477	1288
28	34866	406739	1479
29	45967	314322	2232
30	48467	265051	3604
31	50532	181746	2795
32	57489	152853	4434
33	48884	124731	4560
34	45086	97918	5100
35	46144	82143	3180
36	29979	59715	2975
37	31330	45061	1808
38	21861	32409	1097
39	19575	24507	717
40	12259	20590	290
41	8154	7896	647
42	4484	7541	309
43	3757	3247	79
44	2655	1839	28
45	1306	1474	22
46	616	305	22
47	456	196	0
48	160	116	6
49	7	328	
50	154		
51	52		
52	0		
53	69		
54			
55			
Total	564317	3616127	37599

Table 33.5. Sol.27.7fg - Stock weights-at-age (kg).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.085	0.073	0.119	0.103	0.089	0.083	0.131	0.118	0.093	0.056	0.082	0.105	0.097
3	0.145	0.143	0.165	0.165	0.165	0.165	0.185	0.185	0.179	0.17	0.172	0.182	0.187
4	0.205	0.196	0.219	0.232	0.241	0.237	0.252	0.266	0.27	0.267	0.258	0.267	0.279
5	0.26	0.244	0.266	0.292	0.31	0.301	0.308	0.335	0.351	0.354	0.334	0.34	0.358
6	0.304	0.288	0.31	0.346	0.37	0.359	0.359	0.395	0.421	0.429	0.402	0.404	0.426
7	0.341	0.328	0.352	0.397	0.426	0.413	0.409	0.451	0.483	0.496	0.464	0.464	0.486
8	0.37	0.365	0.392	0.444	0.477	0.463	0.455	0.503	0.538	0.554	0.521	0.517	0.54
9	0.39	0.398	0.431	0.487	0.523	0.509	0.498	0.549	0.585	0.602	0.571	0.565	0.586
10+	0.416	0.511	0.56	0.599	0.649	0.669	0.643	0.695	0.654	0.7	0.674	0.682	0.676

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.104	0.054	0.109	0.079	0.083	0.091	0.041	0.082	0.086	0.097	0.089	0.105	0.091	0.062
3	0.187	0.174	0.186	0.176	0.176	0.167	0.154	0.173	0.171	0.167	0.165	0.173	0.169	0.167
4	0.285	0.269	0.276	0.271	0.266	0.253	0.239	0.259	0.256	0.242	0.237	0.247	0.253	0.254
5	0.369	0.354	0.355	0.355	0.347	0.331	0.319	0.338	0.33	0.308	0.302	0.311	0.327	0.333
6	0.442	0.428	0.424	0.43	0.417	0.4	0.39	0.407	0.395	0.368	0.358	0.368	0.392	0.404
7	0.507	0.496	0.487	0.498	0.483	0.463	0.457	0.47	0.454	0.423	0.41	0.419	0.452	0.468
8	0.564	0.556	0.544	0.559	0.542	0.521	0.519	0.528	0.507	0.475	0.458	0.466	0.504	0.526
9	0.614	0.608	0.596	0.612	0.594	0.574	0.575	0.58	0.554	0.521	0.5	0.507	0.552	0.577
10+	0.733	0.716	0.715	0.737	0.729	0.686	0.721	0.673	0.648	0.631	0.578	0.602	0.647	0.681

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.104	0.098	0.047	0.103	0.091	0.09	0.137	0.124	0.125	0.149	0.162	0.153	0.123
3	0.184	0.179	0.17	0.181	0.165	0.164	0.172	0.175	0.17	0.178	0.181	0.175	0.168
4	0.27	0.273	0.264	0.267	0.244	0.231	0.242	0.228	0.235	0.23	0.249	0.226	0.21
5	0.346	0.357	0.35	0.341	0.315	0.292	0.304	0.308	0.297	0.302	0.32	0.287	0.275
6	0.416	0.432	0.423	0.406	0.38	0.348	0.341	0.391	0.373	0.35	0.347	0.355	0.325
7	0.481	0.502	0.491	0.466	0.44	0.403	0.407	0.419	0.425	0.408	0.409	0.368	0.367
8	0.542	0.569	0.55	0.519	0.497	0.456	0.462	0.523	0.441	0.448	0.507	0.462	0.396
9	0.599	0.628	0.603	0.566	0.548	0.507	0.488	0.571	0.526	0.458	0.552	0.548	0.499
10+	0.732	0.739	0.695	0.664	0.688	0.645	0.623	0.668	0.605	0.573	0.569	0.572	0.567

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
2	0.13	0.132	0.127	0.118	0.135	0.149	0.128	0.128	0.099	0.106	0.14	0.118	0.112
3	0.163	0.179	0.167	0.177	0.171	0.164	0.182	0.168	0.172	0.145	0.139	0.148	0.139
4	0.204	0.212	0.227	0.229	0.222	0.221	0.227	0.224	0.212	0.187	0.192	0.193	0.195
5	0.254	0.251	0.266	0.294	0.288	0.266	0.281	0.274	0.277	0.249	0.226	0.231	0.233
6	0.336	0.294	0.299	0.338	0.357	0.326	0.306	0.321	0.31	0.319	0.256	0.263	0.276
7	0.393	0.356	0.336	0.375	0.415	0.391	0.361	0.356	0.37	0.344	0.338	0.273	0.289
8	0.424	0.405	0.403	0.423	0.463	0.434	0.43	0.408	0.417	0.417	0.385	0.378	0.334
9	0.447	0.44	0.432	0.492	0.479	0.486	0.469	0.434	0.44	0.477	0.454	0.431	0.413
10+	0.651	0.574	0.554	0.668	0.596	0.599	0.544	0.558	0.571	0.555	0.544	0.484	0.469

Table 33.6. Sol.27.7fg - Indices of abundance (No/100km) for UK(E&W)-BTS-Q3.

year/age	0	1	2	3	4	5	6	7	8	9
1988	30	81	326	49	19	5	0	0	0	0
1989	144	222	331	176	20	15	7	4	2	2
1990	30	385	313	50	16	4	7	3	0	0
1991	32	241	517	67	17	15	4	0	2	2
1992	4	394	260	139	30	18	10	1	2	1
1993	3	169	320	43	19	1	2	2	1	1
1994	1	333	387	99	14	7	7	0	0	2
1995	27	124	222	52	11	6	12	1	1	1
1996	3	150	212	54	23	6	3	3	1	3
1997	32	433	180	18	11	12	4	3	5	0
1998	91	770	411	50	10	8	4	2	1	4
1999	24	2464	250	32	13	6	3	4	1	0
2000	13	916	1356	31	22	5	0	2	1	1
2001	22	379	600	259	19	8	5	2	0	2
2002	8	663	239	127	102	12	6	2	3	0
2003	12	392	530	46	25	47	8	3	3	0
2004	56	749	378	86	13	19	37	3	3	0
2005	37	343	225	32	13	6	4	14	1	2
2006	11	273	201	40	13	7	0	2	10	0
2007	91	358	108	43	13	7	6	3	3	11
2008	5	1039	105	13	15	6	8	3	3	4
2009	1	509	318	24	7	8	3	3	3	2
2010	18	85	471	121	17	2	4	8	3	2
2011	18	502	52	138	69	7	2	6	3	0
2012	13	542	231	8	53	24	1	1	1	3
2013	9	279	518	43	13	24	15	1	5	1
2014	34	244	257	76	13	5	23	8	1	1
2015	28	746	48	44	31	7	3	13	6	0
2016	26	573	359	12	27	13	7	3	5	8
2017	6	1046	174	67	13	16	17	4	3	11
2018	27	434	906	279	45	17	9	15	11	4
2019	2	708	325	164	23	29	3	6	7	4
2020	3	331	238	74	67	24	17	2	6	7
2021	57	896	154	45	37	33	12	12	0	3
2022	121	1100	168	48	28	25	23	5	8	0
2023	19	1389	115	51	22	21	15	12	1	4
Mean	29.37	562.83	327.92	75.01	25.05	13.22	8.06	4.33	2.95	2.36

Table 33.7. Sol.27.7fg- Effort.

	England & Wales						Belgium		Ireland		
Year	Otter trawl[1]	Beam trawl[1]	Otter trawl[2]	Beam trawl[2]	Otter trawl[3]	Beam trawl[3]	Beam trawl[4]	Beam trawl[6]	Otter trawl[5]	Scottish seine[6]	Beam trawl[6]
1971							11.06	-	-	-	-
1972							8.44	-	-	-	-
1973							17.39	-	-	-	-
1974							18.83	-	-	-	-
1975							16.38	-	-	-	-
1976							28.07	-	-	-	-
1977							24.11	-	-	-	-
1978							18.09	-	-	-	-
1979							18.90	-	-	-	-
1980							29.02	-	-	-	-
1981							35.39	-	-	-	-
1982							28.77	-	-	-	-
1983	620	195	82	149	0	8	34.95	-	-	-	-
1984	1723	901	316	298	0	129	33.48	-	-	-	-
1985	1493	1101	206	285	23	92	40.49	-	-	-	-
1986	1125	973	334	180	35	29	52.46	-	-	-	-
1987	1211	1681	364	187	26	26	37.26	-	-	-	-
1988	838	1102	351	77	20	36	42.92	-	-	-	-
1989	966	861	327	125	15	7	53.58	-	-	-	-
1990	1229	1256	435	165	24	194	40.27	-	-	-	-
1991	1066	1667	306	483	45	104	18.05	-	-	-	-
1992	898	1420	303	633	435	90	25.47	-	-	-	-
1993	836	1669	251	694	30	135	31.27	-	-	-	-
1994	623	2219	225	610	19	116	38.35	-	-	-	-
1995	580	2303	196	694	30	128	47.81	-	63.33	6.43	20.69
1996	593	2391	341	560	105	220	47.63	53.27	59.97	9.73	26.70
1997	577	2661	370	770	122	146	51.98	57.36	65.00	16.07	28.06
1998	517	2846	385	591	94	159	52.11	57.79	72.25	14.88	35.21
1999	395	3058	176	1461	235	312	55.03	55.11	51.48	8.01	40.83
2000	284	3133	187	1007	160	200	56.05	51.34	60.56	9.86	36.83
2001	309	3172	187	1155	179	91	52.06	54.90	69.37	16.33	39.50
2002	416	2652	123	463	170	60	43.24	49.60	77.20	20.88	31.49
2003	696	2669	51	772	124	158	42.81	62.73	86.78	20.07	49.22
2004	641	2503	198	923	125	178	-	78.73	97.12	18.42	54.89
2005	876	1968	21	618	154	116	-	64.50	124.67	14.64	49.56
2006	924	1330	23	630	233	70	-	49.61	118.04	14.78	60.47
2007	798	1407	31	518	219	12	-	45.91	135.36	15.81	55.81
2008	711	1202	109	290	229	5	-	28.72	125.41	11.65	37.20
2009	656	1105	244	266	296	48	-	30.65	137.11	8.18	37.94
2010	565	1162	84	327	469	78	-	32.46	140.79	9.68	40.22
2011	525	868	8	180	353	111	-	38.77	120.33	11.01	35.33
2012	543	1408	138	275	487	102	-	46.25	127.68	14.14	40.33
2013	280	1611	72	265	37	77	-	45.23	118.20	13.15	38.48
2014	156	959	10	131	0	24	-	31.30	127.34	12.46	37.84
2015	79	726	3	245	0	56	-	31.79	132.69	9.28	37.79
2016	0	915	0	396	0	34	-	32.34	148.17	10.44	39.55
2017	93	986	95	514	193	74	-	33.35	136.05	9.75	35.21
2018	127	1071	71	440	210	15	-	31.48	105.81	9.69	37.42
2019	169	981	34	255	277	8	-	32.03	103.89	14.26	34.08
2020	100	1012	10	346	40	99	-	41.70	89.91	13.59	29.14
2021	155	1260	22	547	28	102	-	37.33	83.91	14.80	31.57
2022	90	1275	4	207	36	77	-	42.72	64.45	14.30	22.50
2023	120	970	22	338	115	92	-	44.87	66.38	16.54	28.85

1. Division 7.f only -days fished (Corrected).

2. 7.g EAST - days fished (corrected).

3. 7.g WEST - days fished (corrected).

4. Fishing hours (x 10^3) corrected for fishing power using P = 0.000204 BHP^1.23.

5. Division 7.g only - Fishing hours (x10^3).

6. Fishing hours (x10^3).

Table 33.8. Sol.27.7fg – LPUE.

Year	UK BT Survey[1] Div VIIfg	UK Otter trawl[2] Div VIIf	UK Beam trawl[2] Div VIIf	UK Otter trawl[2] Div VIIgEast	UK Beam trawl[2] Div VIIgEast	UK Otter trawl[2] Div VIIgWest	UK Beam trawl[2] Div VIIgWest	Belgium Beam trawl[3,5] Div VIIfg	Belgium Beam trawl[4,5] Div VIIfg	Ireland Otter trawl[4] Div VIIg	Ireland Scottish sein[4] Div VIIg	Ireland Beam trawl[4] Div VIIg
1971	-	-	-	-	-	-	-	47.92	-	-	-	-
1972	-	-	-	-	-	-	-	37.06	-	-	-	-
1973	-	-	-	-	-	-	-	39.47	-	-	-	-
1974	-	-	-	-	-	-	-	37.81	-	-	-	-
1975	-	-	-	-	-	-	-	31.41	-	-	-	-
1976	-	-	-	-	-	-	-	30.50	-	-	-	-
1977	-	-	-	-	-	-	-	27.90	-	-	-	-
1978	-	-	-	-	-	-	-	23.35	-	-	-	-
1979	-	-	-	-	-	-	-	33.19	-	-	-	-
1980	-	-	-	-	-	-	-	29.73	-	-	-	-
1981	-	-	-	-	-	-	-	24.03	-	-	-	-
1982	-	-	-	-	-	-	-	25.93	-	-	-	-
1983	-	30.54	201.80	35.75	250.70	0.00	39.68	22.18	-	-	-	-
1984	-	19.53	204.65	28.04	130.61	0.00	63.21	20.78	-	-	-	-
1985	-	26.58	240.45	37.31	235.62	33.78	188.28	17.94	-	-	-	-
1986	-	25.55	247.74	21.27	190.11	10.22	184.94	17.83	-	-	-	-
1987	-	19.85	179.34	36.02	225.56	0.47	113.56	17.32	-	-	-	-
1988	79.52	11.13	110.35	8.88	304.43	1.82	230.65	15.29	-	-	-	-
1989	150.02	17.36	130.42	18.75	247.17	10.28	707.10	11.33	-	-	-	-
1990	93.61	13.41	148.47	18.08	269.40	8.12	106.57	15.64	-	-	-	-
1991	122.06	12.26	119.52	16.20	117.12	15.23	169.61	24.24	-	-	-	-
1992	121.41	17.90	105.84	20.99	119.32	20.62	127.52	18.57	-	-	-	-
1993	76.37	8.85	118.08	4.27	119.85	9.83	358.96	15.21	-	-	-	-
1994	109.74	13.00	70.00	3.50	74.32	5.72	116.30	13.94	-	-	-	-
1995	69.91	13.76	73.20	12.75	63.20	15.20	41.46	13.62	-	0.40	0.62	0.81
1996	71.71	9.69	65.05	6.95	43.84	0.68	12.41	11.27	11.45	0.73	0.05	0.88
1997	81.67	12.55	53.81	6.42	43.77	0.44	16.05	9.96	9.68	0.42	0.23	1.16
1998	137.11	8.24	44.86	4.85	27.16	0.04	47.84	10.12	9.64	0.48	0.11	1.11
1999	168.46	13.25	52.36	8.18	26.19	0.01	14.01	11.26	12.14	0.17	0.09	0.50
2000	228.46	7.01	53.85	23.26	36.94	0.09	14.9	11.90	13.77	0.19	0.05	0.26
2001	158.08	17.1	62.39	27.5	33.01	0.11	22.69	13.25	13.60	0.31	0.55	0.18
2002	121.89	11.61	79.47	47.01	54.15	0.11	43.04	18.71	17.80	0.43	0.29	0.14
2003	123.91	8.03	80.85	0.00	45.42	0.70	52.96	19.48	11.40	0.12	0.03	0.19
2004	152.03	8.84	76.09	2.70	37.88	0.05	91.33	-	9.17	0.19	0.02	0.20
2005	76.28	10.67	70.02	3.07	41.36	0.20	80.99	-	9.78	0.14	0.00	0.29
2006	68.96	16.40	81.57	6.23	45.13	0.10	20.93	-	10.63	0.11	0.05	0.26
2007	80.95	10.75	92.17	15.04	43.57	0.05	39.00	-	11.53	0.13	0.02	0.20
2008	115.96	11.94	94.85	10.67	41.48	0.00	19.96	-	14.35	0.12	0.02	0.29
2009	90.64	13.13	69.37	6.88	50.65	0.00	9.81	-	14.01	0.10	0.00	0.28
2010	109.55	13.59	79.90	8.63	53.69	0.00	44.89	-	16.68	0.13	0.01	0.20
2011	99.47	20.78	109.20	4.47	98.38	0.00	50.73	-	17.90	0.19	0.01	0.20
2012	101.45	24.10	80.16	5.17	53.43	0.00	42.43	-	17.01	0.15	0.01	0.48
2013	119.38	27.81	82.82	4.62	44.52	0.07	39.60	-	16.54	0.14	0.01	0.65
2014	86.75	6.19	107.25	11.56	42.11	0	18.57	-	21.30	0.12	-	0.34
2015	85.45	51.13	103.07	5.62	57.39	0	42.64	-	20.14	0.11	-	0.31
2016	113.55	0.00	113.16	0	33.65	0	34.17	-	16.25	0.10	0.01	0.20
2017	111.38	31.29	100.03	18.09	35.05	0.22	58.81	-	15.72	0.18	0.05	0.22
2018	206.44	36.37	119.89	4.86	47.74	0.15	52.26	-	18.09	0.18	-	0.27
2019	150.04	46.55	129.79	11.12	61.33	0.12	23.35	-	23.08	0.25	0.00	0.26
2020	111.72	51.82	168.07	5.58	117.30	0	92.58	-	25.74	0.31	0.02	0.93
2021	112.38	88.53	156.87	6.41	78.38	9.80	136.10	-	21.55	0.34	0.02	0.54

	UK							Belgium		Ireland		
Year	BT Survey[1] Div VIIfg	Otter trawl[2] Div VIIf	Beam trawl[2] Div VIIf	Otter trawl[2] Div VIIgEast	Beam trawl[2] Div VIIgEast	Otter trawl[2] Div VIIgWest	Beam trawl[2] Div VIIgWest	Beam trawl[3,5] Div VIIfg	Beam trawl[4,5] Div VIIfg	Otter trawl[4] Div VIIg	Scottish sein[4] Div VIIg	Beam trawl[4] Div VIIg
2022	124.67	108.90	113.46	28.44	131.02	0.00	103.38	-	18.52	0.33	0.02	0.53
2023*	134.14	46.61	123.44	7.59	122.69	9.26	65.06	-	18.59	0.45	0.01	0.57

[1] **Kg/100 km.**

[2] **Kg/day.**

[3] **Kg/hr corrected for fishing power using P = 0.000204 BHP^1.23.**

[4] **Kg/hour.**

[5] **without misreporting correction.**

***Provisional.**

Table 33.9. Sol.27.7fg - Tuning series.

BE-CBT_1971_1983	Belgium Beam trawl (Biomass tuning index)		
1971	1983		
1	1	0	0
1	-1		
1	**45.319**		
1	**33.193**		
1	**35.906**		
1	**35.915**		
1	**29.286**		
1	**27.369**		
1	**25.677**		
1	**23.971**		
1	**32.663**		
1	**28.343**		
1	**23.326**		
1	**26.083**		
1	**20.742**		

BE-CBT_1984_1996	Belgium Beam trawl (Biomass tuning index)		
1984	1996		
1	1	0	0
1	-1		
1	**19.788**		
1	**20.556**		
1	**19.824**		
1	**18.996**		
1	**15.129**		
1	**12.805**		
1	**16.620**		
1	**23.442**		
1	**20.455**		
1	**16.472**		
1	**15.722**		
1	**15.199**		
1	**12.243**		

BE-CBT3-2006-2023	Belgium Beam trawl (Biomass tuning index)		
2006	2023		
1	1	0	0
1	-1		
1	**2.381528**		
1	**2.168798**		
1	**2.07615**		
1	**1.884788**		
1	**2.312626**		
1	**2.669895**		
1	**2.67652**		
1	**2.301635**		
1	**2.906322**		
1	**2.720626**		
1	**2.603039**		
1	**2.836455**		
1	**3.41186**		
1	**4.148661**		
1	**4.207157**		
1	**4.800401**		
1	**3.772017**		
1	**3.49148**		

UK(E&W)-CBT_1984_2005	UK(E+W) Beam trawl (Biomass tuning index)		
1984	2005		
1	1	0	0
1	-1		
1	**145.56**		
1	**128.25**		
1	**140.79**		
1	**103.92**		
1	**90.35**		
1	**72.65**		
1	**92.04**		
1	**69.29**		
1	**54.8**		
1	**44.32**		
1	**46.04**		
1	**47.83**		
1	**41.71**		
1	**56.61**		
1	**78.31**		
1	**84.84**		
1	**58.93**		
1	**53.26**		
1	**63.71**		
1	**75.05**		
1	**82.39**		
1	**86.68**		

UK(E&W)-CBT_2006_2023	UK(E+W) Beam trawl (Biomass tuning index)		
2006	2023		
1	1	0	0
1	-1		
1	**132.54**		
1	**220.31**		
1	**243.9**		
1	**211.31**		
1	**235.43**		
1	**284.15**		
1	**252.03**		
1	**215**		
1	**300.75**		

1	**238.46**
1	**204.46**
1	**210**
1	**259.23**
1	**240.04**
1	**300.59**
1	**354.42**
1	**360.09**
1	**329.07**

UK(E&W)-BTS-Q3 - Ages used in the assessment are in bold										
1988	2023									
1	1	0.75	0.85							
0	9									
74.12	22	**60**	**242**	**36**	**14**	**4**	0	0	0	0
91.909	132	**204**	**304**	**162**	**18**	**14**	6	4	2	2
69.858	21	**269**	**219**	**35**	**11**	**3**	5	2	0	0
123.41	40	**297**	**638**	**83**	**21**	**18**	5	0	3	2
125.078	5	**493**	**325**	**174**	**37**	**23**	12	1	2	1
127.672	6	**207**	**436**	**52**	**28**	**3**	2	2	1	1
120.816	1	**424**	**430**	**133**	**23**	**11**	9	0	0	3
114.886	31	**142**	**255**	**60**	**13**	**7**	14	1	1	1
118.592	3	**178**	**251**	**64**	**27**	**7**	3	4	1	3
114.886	37	**498**	**207**	**21**	**13**	**14**	5	3	6	0
114.886	104	**885**	**472**	**58**	**11**	**9**	5	2	1	5
118.592	29	**2922**	**297**	**38**	**16**	**7**	4	5	1	0
118.592	16	**1086**	**1608**	**37**	**26**	**6**	0	2	1	1
118.592	26	**449**	**711**	**307**	**23**	**9**	6	2	0	2
118.592	9	**786**	**283**	**151**	**121**	**14**	7	2	3	0
118.592	14	**465**	**628**	**55**	**30**	**56**	9	3	3	0
114.886	64	**860**	**434**	**99**	**15**	**22**	42	4	3	0
118.592	44	**407**	**267**	**38**	**16**	**7**	5	17	1	2
118.592	13	**324**	**238**	**47**	**16**	**8**	0	2	12	0
118.592	108	**424**	**128**	**51**	**16**	**8**	7	3	4	13
118.592	6	**1232**	**124**	**15**	**18**	**7**	9	4	3	5
118.592	1	**604**	**377**	**29**	**8**	**10**	4	3	3	2
118.592	21	**101**	**558**	**144**	**20**	**2**	5	9	4	2
118.592	21	**595**	**62**	**164**	**82**	**8**	2	7	3	0
118.592	16	**643**	**274**	**9**	**63**	**28**	1	1	1	3
118.592	11	**331**	**614**	**51**	**16**	**29**	18	1	6	1
118.592	40	**289**	**305**	**90**	**16**	**6**	27	9	1	1
118.592	33	**885**	**57**	**52**	**37**	**8**	4	16	7	0
118.592	31	**680**	**426**	**14**	**32**	**15**	8	4	6	9
118.592	7	**1240**	**206**	**80**	**15**	**19**	20	5	4	13
118.592	32	**515**	**1074**	**331**	**53**	**20**	11	18	13	5
118.592	2	**840**	**386**	**195**	**27**	**34**	4	7	8	5
118.592	3	**393**	**282**	**88**	**80**	**28**	20	2	7	8
118.592	68	**1062**	**183**	**53**	**44**	**39**	14	14	0	3
118.592	143	**1305**	**199**	**57**	**33**	**30**	27	6	10	0
118.592	23	**1647**	**136**	**61**	**26**	**25**	18	14	1	5

Table 33.10. Sol.27.7fg – Configuration.

```
$minAge
[1] 1

$maxAge
[1] 10

$maxAgePlusGroup
[1] 1 0 0 0 0 0 0

$keyLogFsta
   [      1] [      2] [      3] [      4] [      5] [      6] [      7] [      8] [      9] [     10]
[1      ]  0  1  2  3  3  3  4  4  5  5
[2      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[3      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[4      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[5      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[6      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[7      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$corFlag
[1] 2

$keyLogFpar
   [      1] [      2] [      3] [      4] [      5] [      6] [      7] [      8] [      9] [     10]
[1      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[2      ]  0  1  2  3  3 -1 -1 -1 -1 -1
[3      ]  4 -1 -1 -1 -1 -1 -1 -1 -1 -1
[4      ]  5 -1 -1 -1 -1 -1 -1 -1 -1 -1
[5      ]  6 -1 -1 -1 -1 -1 -1 -1 -1 -1
[6      ]  7 -1 -1 -1 -1 -1 -1 -1 -1 -1
[7      ]  8 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyQpow
   [      1] [      2] [      3] [      4] [      5] [      6] [      7] [      8] [      9] [     10]
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[2      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[3      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[4      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[5      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[6      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[7      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyVarF
   [      1] [      2] [      3] [      4] [      5] [      6] [      7] [      8] [      9] [     10]
[1      ]  0  0  0  0  0  0  0  0  0  0
[2      ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
```

```
[3          ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[4          ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[5          ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[6          ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
[7          ] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyVarLogN
 [1] 0 1 1 1 1 1 1 1 1 1

$keyVarLogP
numeric(0)

$keyVarObs
   [          1] [          2] [          3] [          4] [          5] [          6] [          7] [          8] [          9] [          10]
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[2          ]  2  3  3  4  4 -1 -1 -1 -1 -1
[3          ]  5 -1 -1 -1 -1 -1 -1 -1 -1 -1
[4          ]  6 -1 -1 -1 -1 -1 -1 -1 -1 -1
[5          ]  7 -1 -1 -1 -1 -1 -1 -1 -1 -1
[6          ]  8 -1 -1 -1 -1 -1 -1 -1 -1 -1
[7          ]  9 -1 -1 -1 -1 -1 -1 -1 -1 -1

$obsCorStruct
[1] AR ID ID ID ID ID ID
Levels: ID AR US

$keyCorObs
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[1          ]  0  0  0  0  0  0  0  0  0
[2          ] NA NA NA NA -1 -1 -1 -1 -1
[3          ] -1 -1 -1 -1 -1 -1 -1 -1 -1
[4          ] -1 -1 -1 -1 -1 -1 -1 -1 -1
[5          ] -1 -1 -1 -1 -1 -1 -1 -1 -1
[6          ] -1 -1 -1 -1 -1 -1 -1 -1 -1
[7          ] -1 -1 -1 -1 -1 -1 -1 -1 -1

$stockRecruitmentModelCode
[1] 0

$noScaledYears
[1] 0

$keyScaledYears
numeric(0)

$keyParScaledYA
<0 x 0 matrix>
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```
$fbarRange
[1] 3 8

$keyBiomassTreat
[1] -1 -1  0  0  0  0  0

$obsLikelihoodFlag
[1] LN LN LN LN LN LN LN
Levels: LN ALN

$fixVarToWeight
[1] 0

$fracMixF
[1] 0

$fracMixN
 [1] 0 0 0 0 0 0 0 0 0 0

$fracMixObs
[1] 0 0 0 0 0 0 0

$constRecBreaks
numeric(0)

$predVarObsLink
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[2,]   -1   -1   -1   -1   -1   NA   NA   NA   NA    NA
[3,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[4,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[5,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[6,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA
[7,]   NA   NA   NA   NA   NA   NA   NA   NA   NA    NA

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$keyStockWeightMean
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$keyStockWeightObsVar
 [1] NA NA NA NA NA NA NA NA NA NA

$catchWeightModel
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$keyCatchWeightMean
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```
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[1          ]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA

$keyCatchWeightObsVar
    [          1] [          2] [          3] [          4] [          5] [          6] [          7] [          8] [          9] [          10]
[1          ]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA

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$keyMatureMean
 [1] NA NA NA NA NA NA NA NA NA NA

$mortalityModel
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$keyMortalityMean
 [1] NA NA NA NA NA NA NA NA NA NA

$keyMortalityObsVar
 [1] NA NA NA NA NA NA NA NA NA NA

$keyXtraSd
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$logNMeanAssumption
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$initState
[1] 0
```

Table 33.11. Sol.27.7fg – Diagnostics.

Name	Type	Years	Ages	LogQ _age1	Sd _age1	LogQ _age2	Sd _age2	LogQ _age3	Sd _age3	LogQ _age4	Sd _age4	LogQ _age5	Sd _age5
UK-BTS-Q3	age-based	1988-2023	1-5	-7.157	0.099	-7.449	0.099	-8.625	0.098	-9.222	0.063	-9.222	0.063
BE-CBT_71-83	biomass	1971-1983	-1	-5.114	0.065	NA	NA	NA	NA	NA	NA	NA	NA
BE-CBT_84-96	biomass	1984-1996	-1	-5.242	0.055	NA	NA	NA	NA	NA	NA	NA	NA
BE-CBT_06-23	biomass	2006-2023	-1	-7.233	0.048	NA	NA	NA	NA	NA	NA	NA	NA
UK-CBT_84-05	biomass	1984-2005	-1	-3.805	0.075	NA	NA	NA	NA	NA	NA	NA	NA
UK-CBT_06-23	biomass	2006-2023	-1	-2.77	0.066	NA	NA	NA	NA	NA	NA	NA	NA

log(L)	#par	AIC
-265.694	24	579.3873

Table 33.12. Sol.27.7fg - Fishing mortality.

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004
2	0.091	0.085	0.08	0.077	0.075	0.086	0.078	0.072	0.077	0.086	0.097	0.101	0.106
3	0.28	0.261	0.246	0.234	0.229	0.262	0.24	0.22	0.234	0.265	0.298	0.313	0.329
4	0.329	0.304	0.283	0.269	0.262	0.299	0.272	0.249	0.265	0.301	0.339	0.359	0.379
5	0.329	0.304	0.283	0.269	0.262	0.299	0.272	0.249	0.265	0.301	0.339	0.359	0.379
6	0.329	0.304	0.283	0.269	0.262	0.299	0.272	0.249	0.265	0.301	0.339	0.359	0.379
7	0.291	0.268	0.249	0.237	0.231	0.263	0.239	0.217	0.23	0.26	0.293	0.311	0.329
8	0.291	0.268	0.249	0.237	0.231	0.263	0.239	0.217	0.23	0.26	0.293	0.311	0.329
9	0.27	0.248	0.231	0.22	0.214	0.242	0.218	0.198	0.208	0.234	0.263	0.277	0.29
10+	0.27	0.248	0.231	0.22	0.214	0.242	0.218	0.198	0.208	0.234	0.263	0.277	0.29

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005
2	0.107	0.114	0.124	0.121	0.117	0.112	0.116	0.113	0.111	0.119	0.128	0.14	0.141	0.144
3	0.331	0.354	0.383	0.375	0.364	0.345	0.36	0.349	0.344	0.367	0.396	0.433	0.438	0.446
4	0.386	0.417	0.459	0.455	0.447	0.425	0.446	0.432	0.425	0.457	0.495	0.544	0.549	0.558
5	0.386	0.417	0.459	0.455	0.447	0.425	0.446	0.432	0.425	0.457	0.495	0.544	0.549	0.558
6	0.386	0.417	0.459	0.455	0.447	0.425	0.446	0.432	0.425	0.457	0.495	0.544	0.549	0.558
7	0.333	0.358	0.392	0.389	0.38	0.359	0.375	0.362	0.354	0.38	0.412	0.452	0.456	0.465
8	0.333	0.358	0.392	0.389	0.38	0.359	0.375	0.362	0.354	0.38	0.412	0.452	0.456	0.465
9	0.293	0.315	0.345	0.342	0.335	0.316	0.331	0.322	0.317	0.342	0.372	0.407	0.411	0.42
10+	0.293	0.315	0.345	0.342	0.335	0.316	0.331	0.322	0.317	0.342	0.372	0.407	0.411	0.42

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003
2	0.136	0.122	0.107	0.104	0.105	0.113	0.116	0.113	0.107	0.101	0.093	0.087	0.083
3	0.42	0.374	0.326	0.316	0.32	0.345	0.355	0.342	0.324	0.303	0.276	0.258	0.245
4	0.525	0.466	0.407	0.399	0.408	0.445	0.46	0.447	0.427	0.404	0.373	0.355	0.34
5	0.525	0.466	0.407	0.399	0.408	0.445	0.46	0.447	0.427	0.404	0.373	0.355	0.34
6	0.525	0.466	0.407	0.399	0.408	0.445	0.46	0.447	0.427	0.404	0.373	0.355	0.34
7	0.438	0.387	0.339	0.334	0.343	0.376	0.391	0.383	0.371	0.356	0.334	0.321	0.311
8	0.438	0.387	0.339	0.334	0.343	0.376	0.391	0.383	0.371	0.356	0.334	0.321	0.311
9	0.397	0.352	0.311	0.309	0.318	0.351	0.37	0.366	0.357	0.346	0.326	0.315	0.306
10+	0.397	0.352	0.311	0.309	0.318	0.351	0.37	0.366	0.357	0.346	0.326	0.315	0.306

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.003	0.003
2	0.084	0.088	0.088	0.088	0.081	0.074	0.068	0.064	0.066	0.072	0.077	0.079	0.076
3	0.246	0.259	0.258	0.256	0.235	0.214	0.195	0.184	0.19	0.206	0.223	0.228	0.219
4	0.345	0.368	0.371	0.37	0.339	0.308	0.281	0.266	0.275	0.3	0.325	0.332	0.316
5	0.345	0.368	0.371	0.37	0.339	0.308	0.281	0.266	0.275	0.3	0.325	0.332	0.316
6	0.345	0.368	0.371	0.37	0.339	0.308	0.281	0.266	0.275	0.3	0.325	0.332	0.316
7	0.32	0.344	0.348	0.351	0.32	0.291	0.265	0.252	0.261	0.287	0.31	0.316	0.3
8	0.32	0.344	0.348	0.351	0.32	0.291	0.265	0.252	0.261	0.287	0.31	0.316	0.3
9	0.315	0.341	0.347	0.352	0.322	0.292	0.266	0.253	0.262	0.285	0.306	0.312	0.296
10+	0.315	0.341	0.347	0.352	0.322	0.292	0.266	0.253	0.262	0.285	0.306	0.312	0.296

Table 33.13. Sol.27.7fg - Stock numbers-at-age (start of year, in thousands).

age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	8718	4556	3435	3497	3537	5277	4880	5223	3757	4917	5076	5069	6474
2	5302	8298	3987	3023	3158	3091	4953	4350	4872	3226	4523	4590	4479
3	1831	4349	7303	3227	2461	2656	2486	4321	3653	4164	2546	3811	3745
4	4679	1399	2935	5016	2321	1838	1665	1718	3299	2669	2916	1552	2473
5	2034	2804	1084	2008	3432	1743	1324	1041	1155	2170	1684	1935	976
6	1514	1265	1743	793	1402	2379	1132	999	727	807	1360	1092	1240
7	1807	1000	786	1143	547	975	1748	773	779	505	523	830	699
8	2658	1155	711	545	771	367	671	1273	606	553	416	333	520
9	1469	1728	768	529	405	601	220	478	956	463	385	325	212
10+	4846	4024	3828	3081	2410	1976	1798	1320	1296	1687	1553	1376	1247

age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	5724	5613	4001	5701	4650	4903	7375	4981	5057	4753	4338	3816	4425	6378
2	6017	5116	5195	3403	5380	4375	4382	7206	4419	4570	4441	3899	3482	4049
3	3620	5049	4085	4261	2572	4515	3673	3431	6078	3478	3631	3593	3039	2762
4	2373	2307	3164	2399	2830	1662	2980	2376	2113	3726	2128	2252	2144	1705
5	1590	1528	1374	1797	1272	1730	966	1719	1387	1163	2112	1115	1127	1095
6	610	948	900	778	1042	698	1068	547	954	768	670	1148	592	585
7	835	398	554	499	452	590	403	617	320	531	460	360	584	313
8	455	535	274	325	267	295	355	241	378	209	295	277	203	322
9	297	300	336	186	203	148	189	206	151	259	135	183	156	120
10+	1097	984	900	782	671	563	501	489	439	380	425	348	329	295

age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	7952	13579	9145	5735	7101	5421	4778	4269	3533	3891	7288	6791	3184
2	5826	6883	12671	8169	4906	6584	4826	4333	3887	3165	3326	6901	6377
3	3230	4560	5326	10349	6557	3808	5374	3763	3514	3191	2541	2639	6487
4	1593	1967	2636	3229	7178	4257	2435	3193	2303	2237	2068	1766	2006
5	872	774	1109	1512	1878	4476	2625	1429	1884	1341	1347	1304	1166
6	543	464	389	684	919	1024	2376	1484	806	1153	808	827	855
7	295	297	272	246	402	585	541	1288	861	480	716	528	540
8	175	154	179	178	168	265	356	319	761	539	296	458	353
9	176	107	94	111	124	106	169	216	203	505	360	187	313
10+	249	245	236	240	234	264	261	284	323	332	547	617	539

age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	5400	6402	5177	4020	7810	8418	14531	7055	7164	5121	7942	7991	10713
2	2601	4918	5819	4791	3322	7303	7078	14393	6357	6282	4354	7277	7006
3	5604	2033	4034	4850	4019	2663	6360	5839	13319	5548	5272	3462	6234
4	5129	3998	1535	2852	3533	2749	2020	4903	4404	10791	4548	3908	2367
5	1363	3411	2430	1023	1748	2263	1789	1447	3439	3632	8002	2978	2723
6	851	950	1970	1463	653	1123	1433	1198	1113	2278	2854	5600	1871
7	567	578	630	1184	903	442	745	904	775	804	1455	1854	3850
8	379	373	372	403	666	557	312	528	593	520	529	909	1061
9	228	252	235	247	265	434	353	232	410	412	336	326	612
10+	625	614	575	546	463	422	550	594	570	718	812	785	692

Table 33.14. Sol.27.7fg - Summary ('Catch' refers to model estimate).

year	R (age1) low	R (age1) value	R (age1) high	TSB low	TSB value	TSB high	SSB low	SSB value	SSB high	Catch low	Catch value	Catch high	Fbar (3-8) low	Fbar (3-8) value	Fbar (3-8) high
1971	5853	8718	12985	6184	7210	8406	5647	6650	7832	1372	1696	2098	0.246	0.308	0.386
1972	3184	4556	6520	5357	6230	7245	4927	5771	6760	1187	1405	1663	0.234	0.285	0.346
1973	2399	3435	4918	5452	6321	7329	5057	5894	6870	1196	1412	1666	0.219	0.266	0.322
1974	2442	3497	5009	5006	5811	6745	4701	5485	6400	1053	1246	1476	0.207	0.252	0.307
1975	2461	3537	5084	4610	5351	6211	4325	5049	5895	961	1138	1348	0.201	0.246	0.301
1976	3708	5277	7510	4253	4927	5707	3912	4564	5324	910	1088	1300	0.23	0.281	0.343
1977	3435	4880	6931	4193	4829	5561	3759	4356	5048	828	974	1145	0.211	0.256	0.31
1978	3653	5223	7467	4253	4896	5636	3819	4424	5124	772	926	1111	0.188	0.234	0.289
1979	2604	3757	5421	4330	4973	5711	3972	4586	5295	868	1032	1226	0.204	0.248	0.303
1980	3464	4917	6979	4303	4934	5659	3974	4584	5288	1003	1184	1397	0.235	0.281	0.337
1981	3576	5076	7206	4038	4605	5251	3667	4209	4831	958	1134	1343	0.266	0.317	0.378
1982	3566	5069	7206	4039	4576	5185	3622	4128	4705	1041	1229	1451	0.282	0.335	0.399
1983	4540	6474	9232	4034	4556	5146	3576	4062	4614	1062	1255	1484	0.299	0.354	0.419
1984	4010	5724	8171	4204	4736	5336	3726	4212	4761	1090	1285	1515	0.304	0.359	0.424
1985	3933	5613	8011	3845	4334	4885	3456	3912	4428	1143	1355	1605	0.329	0.387	0.455
1986	2802	4001	5713	3982	4496	5075	3579	4050	4583	1215	1451	1732	0.358	0.424	0.503
1987	4041	5701	8043	3545	3995	4502	3164	3582	4055	1110	1317	1561	0.356	0.42	0.495
1988	3329	4650	6497	3283	3691	4151	2912	3289	3715	977	1159	1374	0.349	0.411	0.484
1989	3510	4903	6849	3144	3523	3949	2760	3106	3495	844	1002	1191	0.331	0.39	0.46
1990	5252	7375	10356	2968	3323	3721	2567	2889	3251	936	1108	1313	0.345	0.408	0.483
1991	3589	4981	6914	3250	3674	4154	2827	3201	3625	954	1141	1365	0.334	0.395	0.467
1992	3663	5057	6982	3276	3707	4195	2873	3262	3703	897	1087	1316	0.325	0.388	0.462
1993	3431	4753	6584	3078	3460	3890	2697	3042	3432	908	1085	1296	0.353	0.416	0.49
1994	3141	4338	5993	2848	3191	3575	2500	2810	3159	914	1086	1289	0.386	0.451	0.527
1995	2743	3816	5311	2767	3095	3463	2433	2729	3060	960	1143	1360	0.422	0.495	0.58
1996	3182	4425	6156	2523	2819	3150	2204	2470	2769	883	1042	1231	0.427	0.499	0.584
1997	4599	6378	8846	2314	2594	2908	1948	2193	2470	832	990	1178	0.431	0.508	0.6
1998	5684	7952	11126	2658	3009	3407	2134	2416	2734	812	970	1160	0.405	0.479	0.565
1999	9619	13579	19170	3116	3546	4035	2354	2678	3046	785	947	1141	0.358	0.424	0.502
2000	6613	9145	12646	3148	3577	4063	2550	2904	3307	897	1106	1364	0.308	0.371	0.447
2001	4114	5735	7995	4380	5035	5787	3755	4328	4988	1124	1373	1678	0.305	0.363	0.433
2002	5131	7101	9827	4380	5001	5711	3849	4421	5078	1222	1479	1791	0.315	0.372	0.439
2003	3937	5421	7464	4116	4666	5289	3648	4156	4733	1242	1497	1804	0.345	0.405	0.476
2004	3499	4778	6525	4094	4609	5187	3618	4083	4608	1214	1451	1735	0.356	0.42	0.494
2005	3144	4269	5795	3702	4139	4628	3300	3703	4155	1106	1310	1552	0.347	0.408	0.48
2006	2594	3533	4812	3269	3633	4039	2921	3255	3627	876	1027	1204	0.332	0.391	0.46
2007	2857	3891	5300	3035	3382	3768	2686	2997	3345	824	963	1126	0.314	0.372	0.439
2008	5232	7288	10153	3087	3477	3916	2616	2941	3308	735	858	1001	0.289	0.344	0.409
2009	4965	6791	9289	3241	3725	4281	2656	3042	3483	620	729	858	0.275	0.327	0.389
2010	2287	3184	4433	3394	3825	4311	2945	3323	3750	715	841	989	0.265	0.315	0.374
2011	3971	5400	7342	3619	4044	4519	3211	3601	4040	869	1022	1201	0.271	0.32	0.379
2012	4711	6402	8699	3651	4079	4557	3157	3541	3971	855	1011	1195	0.288	0.342	0.407
2013	3801	5177	7050	3574	3990	4455	3088	3454	3864	850	999	1174	0.288	0.344	0.412
2014	2913	4020	5547	3693	4137	4634	3284	3687	4141	945	1113	1309	0.285	0.345	0.417
2015	5726	7810	10653	3626	4063	4552	3114	3510	3955	798	940	1106	0.26	0.315	0.382
2016	6241	8418	11356	3846	4324	4862	3162	3559	4006	706	833	982	0.236	0.287	0.348
2017	10418	14531	20266	4369	4926	5555	3470	3909	4403	718	848	1002	0.214	0.261	0.319
2018	5150	7055	9664	5258	5961	6758	4375	4946	5590	835	996	1189	0.202	0.247	0.303
2019	5235	7164	9802	5760	6486	7303	5089	5746	6489	1048	1235	1455	0.211	0.256	0.311
2020	3636	5121	7211	5717	6418	7204	5200	5859	6602	1226	1453	1722	0.231	0.28	0.34
2021	5479	7942	11512	5646	6370	7187	5048	5734	6513	1265	1517	1820	0.245	0.303	0.374
2022	4925	7991	12963	5284	5983	6776	4654	5290	6012	1177	1406	1679	0.245	0.309	0.39
2023	5450	10713	21056	4887	5747	6758	4263	4950	5748	1029	1239	1493	0.226	0.294	0.384

Table 33.15. Sol.27.7fg – Short-term forecast.

Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
Fages 3–8 (2024)	0.302	F = FAverage (2021–2023)
SSB(2025)	5275	Short-term forecast; in tonnes
Rage 1 (2024, 2025)	5177	Median recruitment, resampled from the years 1971–2021; in thousands
Catch (2024)	1347	Short-term forecast; in tonnes
Projected landings (2024)	1252	Short-term forecast; assuming average landings ratio by age 2021–2023; in tonnes
Projected discards (2024)	95	Short-term forecast; assuming average discard ratio by age 2021–2023; in tonnes

Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings* (2025)	Projected discards** (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change ***	% advice change^	Probability of SSB (2026) < Blim (%)
ICES advice basis										
MSY approach: F = F_{MSY}	1149	1080	69	0.251	0.237	0.014	5226	-0.93	-9.3	0
Other scenarios										
EU MAP^^: F_{MSY}	1149	1080	69	0.251	0.237	0.014	5226	-0.93	-9.3	0
EU MAP^^: $F_{MSY\ lower}$	656	617	39	0.136	0.128	0.008	5734	8.7	-48	0
EU MAP^^ : $F_{MSY\ upper}$	1922	1802	120	0.462	0.436	0.026	4425	-16.1	52	0.01
F = 0	0	0	0	0	0	0	6427	22	-100	0
F= F_{pa}	1718	1611	107	0.402	0.379	0.023	4637	-12.1	36	0
F= F_{lim}	2180	2042	138	0.543	0.513	0.03	4159	-21	72	0.06
SSB_{2026} = B_{lim}	4117	3823	294	1.48	1.393	0.083	2184	-59	220	50
SSB_{2026} = B_{pa} = MSY $B_{trigger}$	3252	3037	215	0.96	0.91	0.054	3057	-42	157	8.3
SSB_{2026} = SSB_{2025}	1101	1034	67	0.24	0.226	0.013	5275	0	-13.1	0
F = F_{2024}	1350	1267	83	0.30	0.285	0.017	5017	-4.9	6.6	0

*** Marketable landings, assuming recent discard rate.**

**** Including BMS landings (EU stocks), assuming recent discard rate.**

***** SSB 2026 relative to SSB 2025.**

^ Advice value for 2025 relative to the advice value for 2024 (1267 tonnes). The 2024 TAC is similar to the advice value.

^^ EU multiannual plan (MAP) for the Western Waters and adjacent waters (EU, 2019).

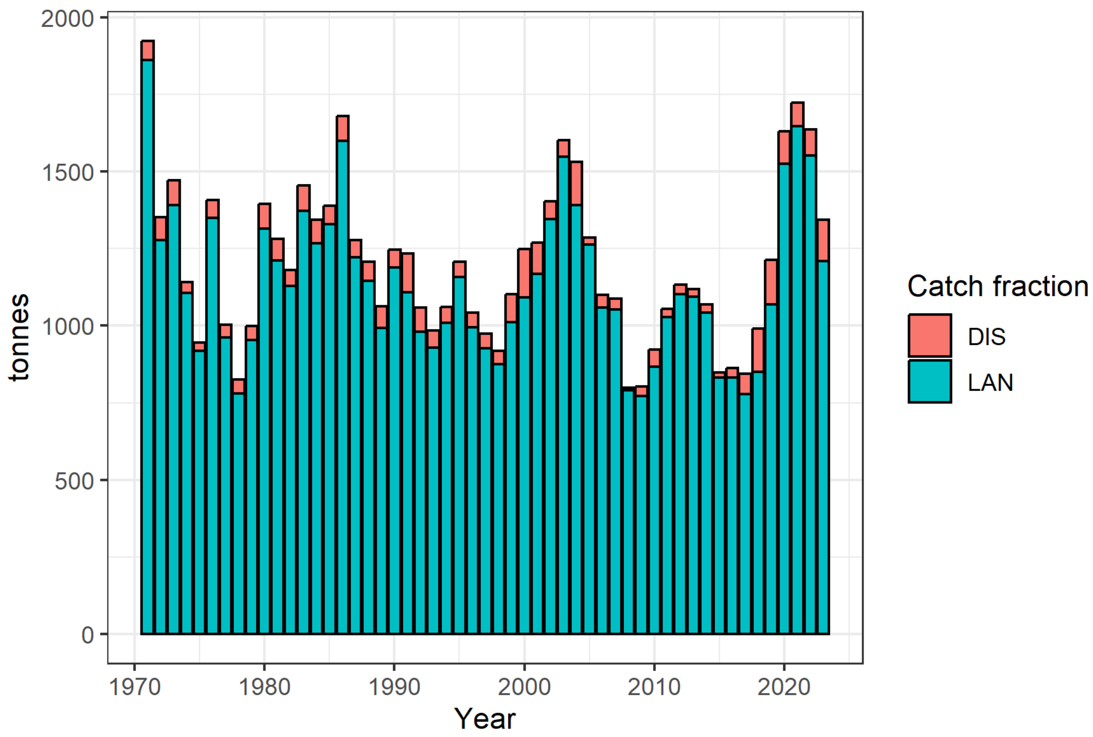

Figure 33.1. Sol.27.7fg - Landings and discards estimates by weight, as used by the WG.

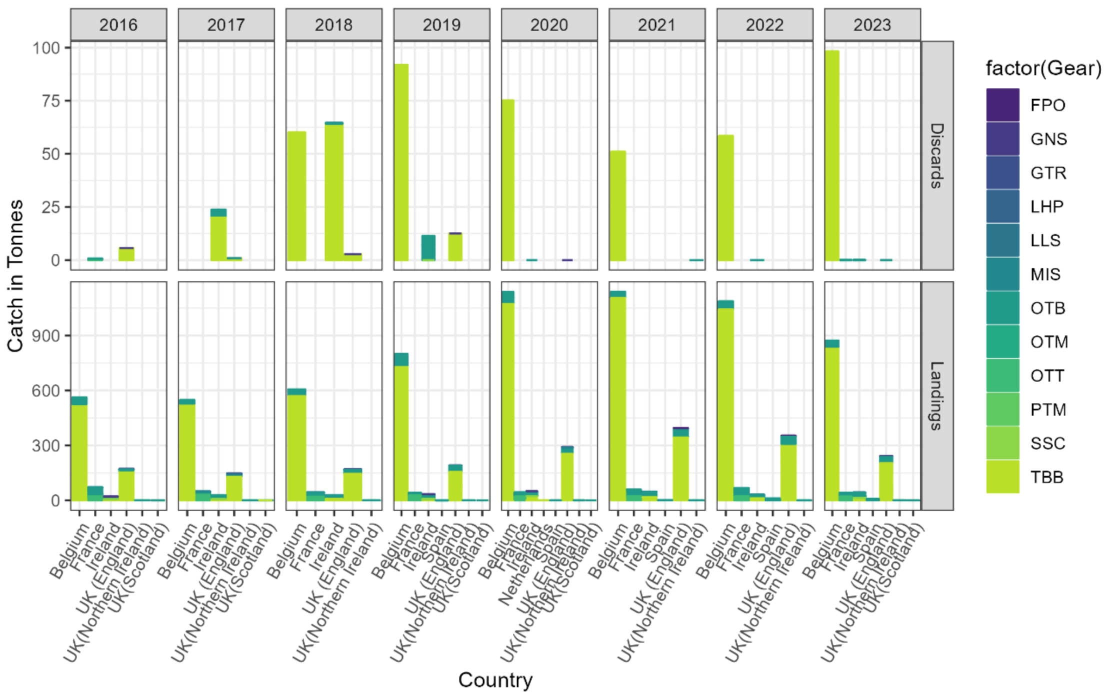

Figure 33.2. Sol.27.7fg - InterCatch landings and discard data by year, country and gear.

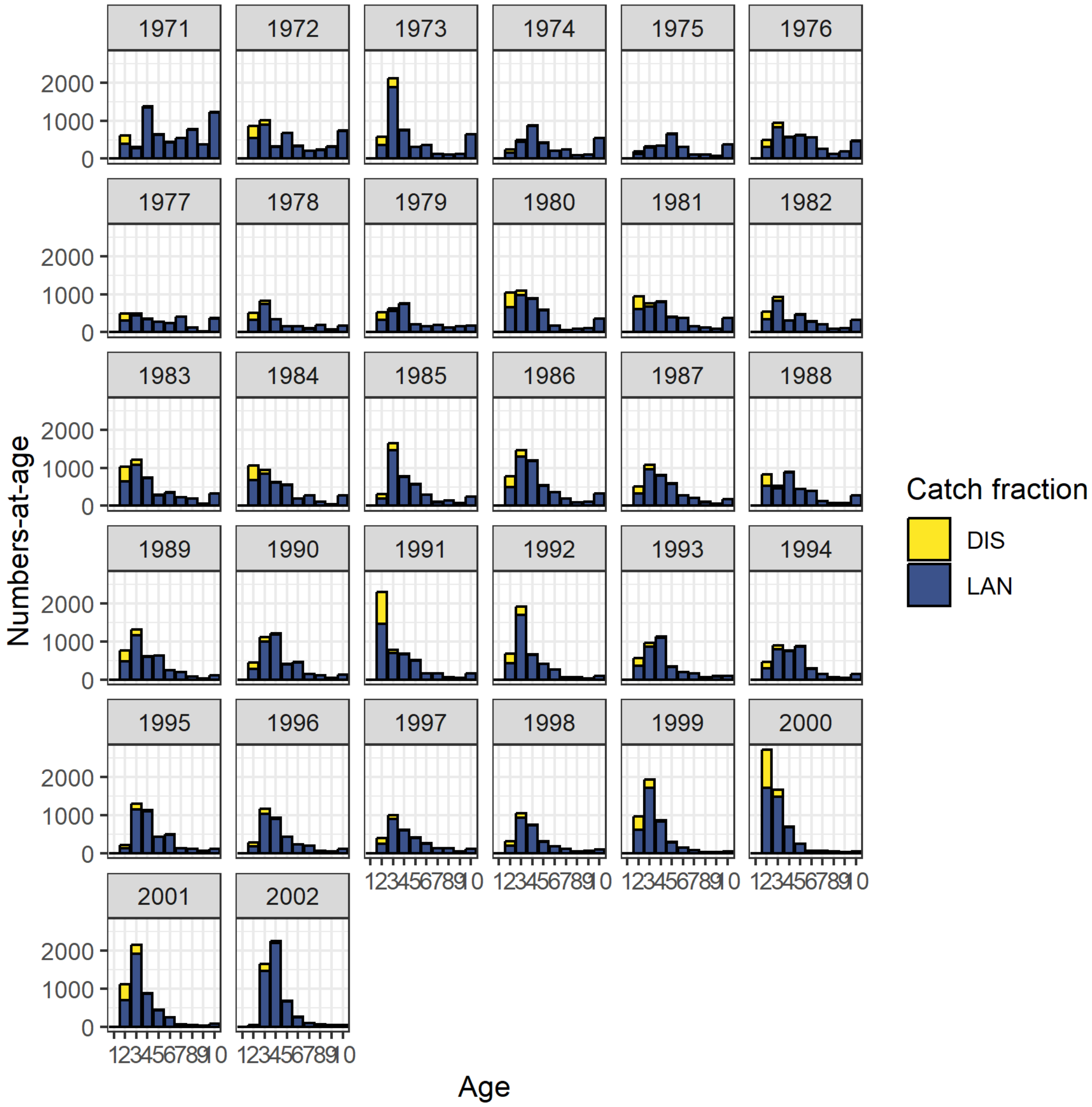

Figure 33.3a. Sol.27.7fg - Age composition of the catch.

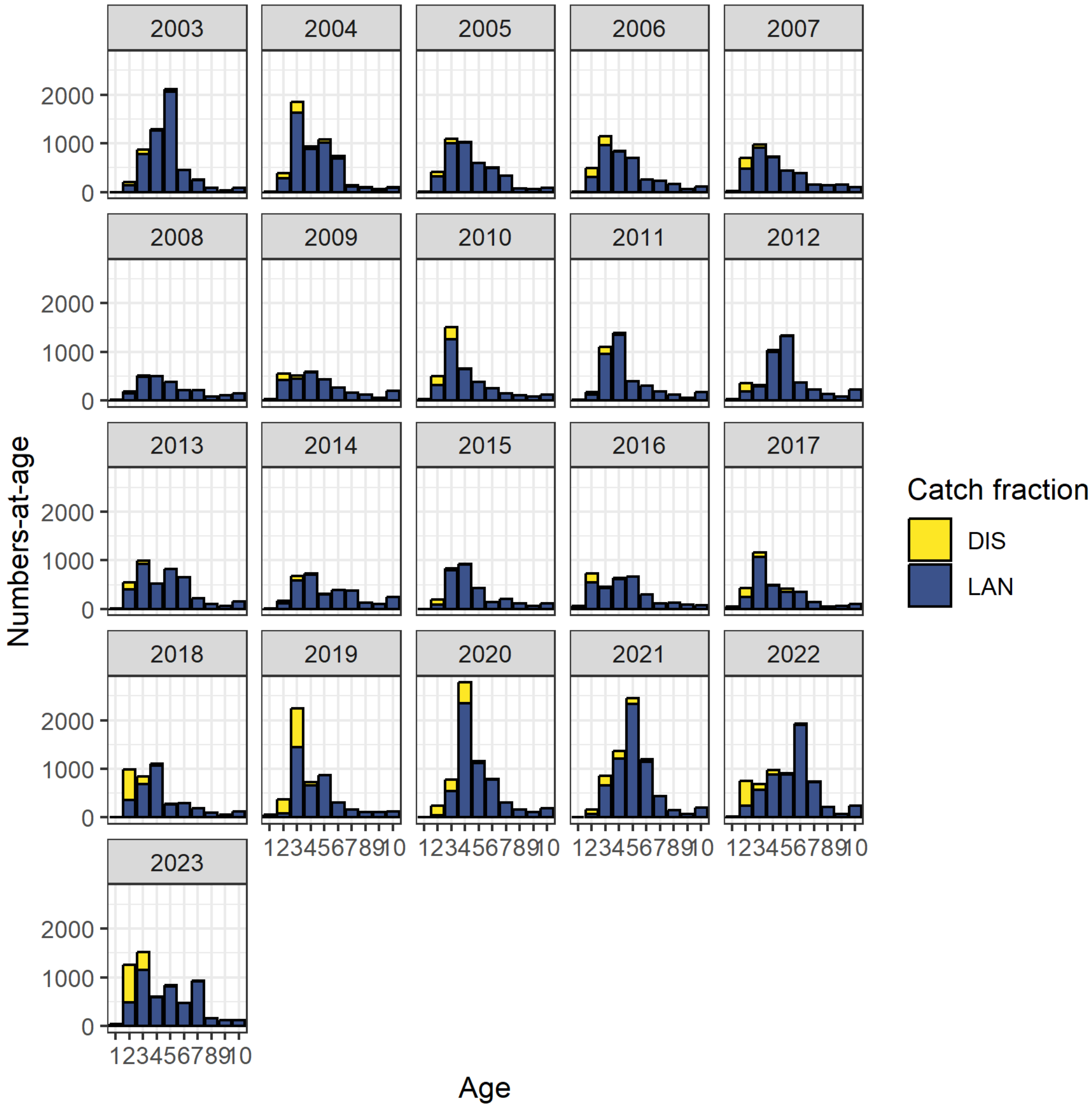

Figure 33.3b. Sol.27.7fg - Age composition of the catch.

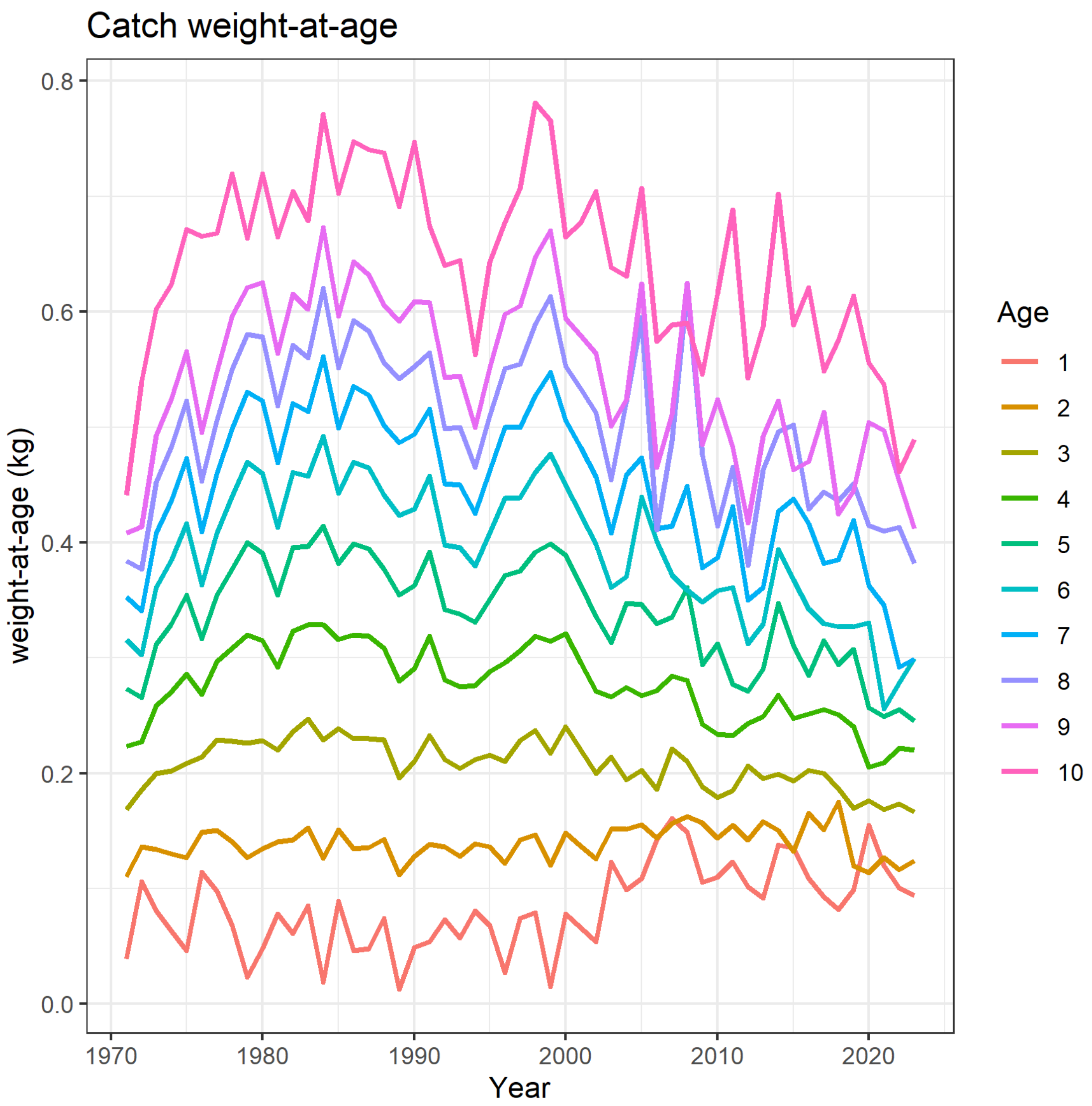

Figure 33.4. Sol.27.7fg - Catch weights-at-age (kg).

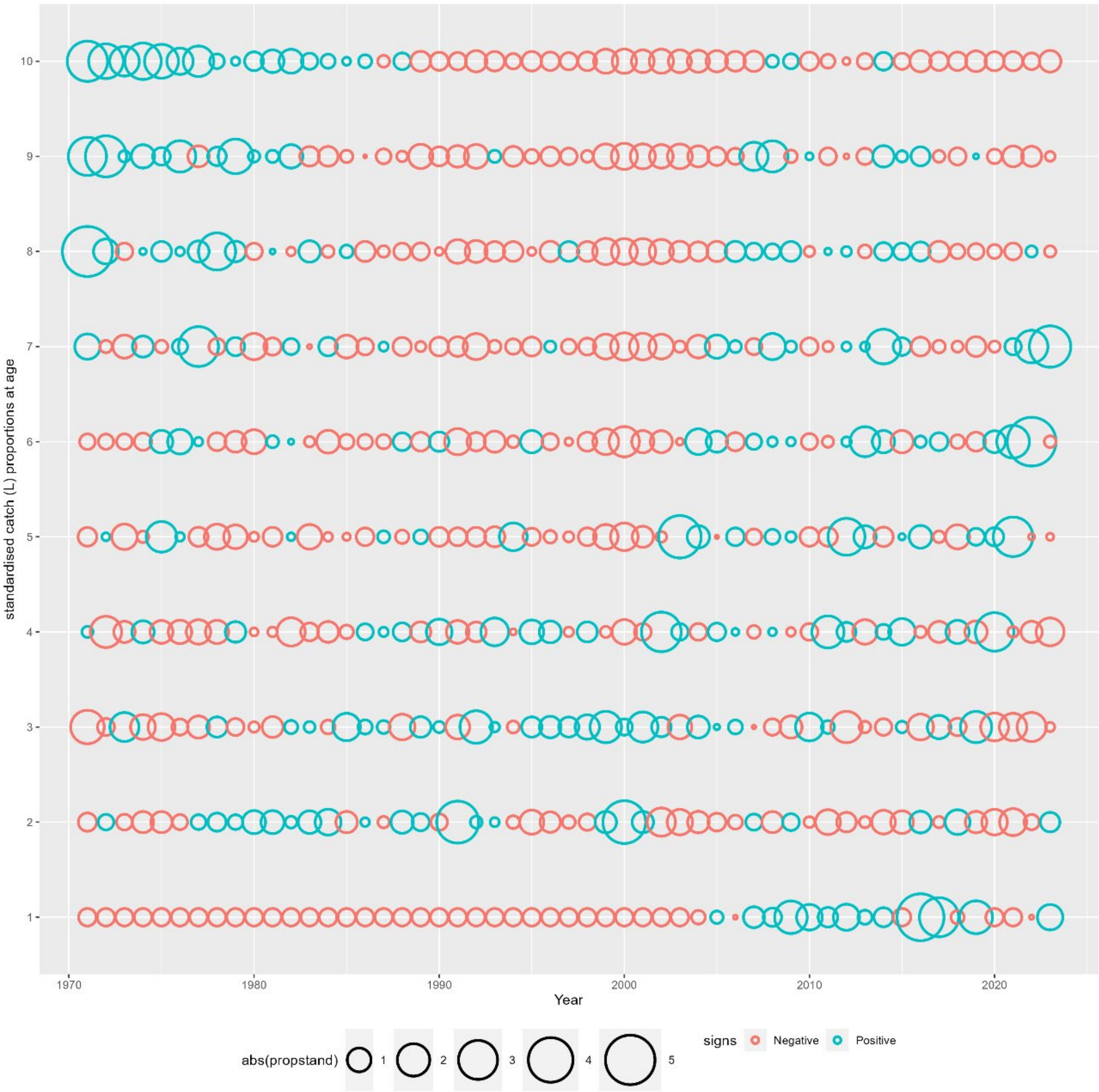

Figure 33.5. Sol.27.7fg - Standardized catch proportion.

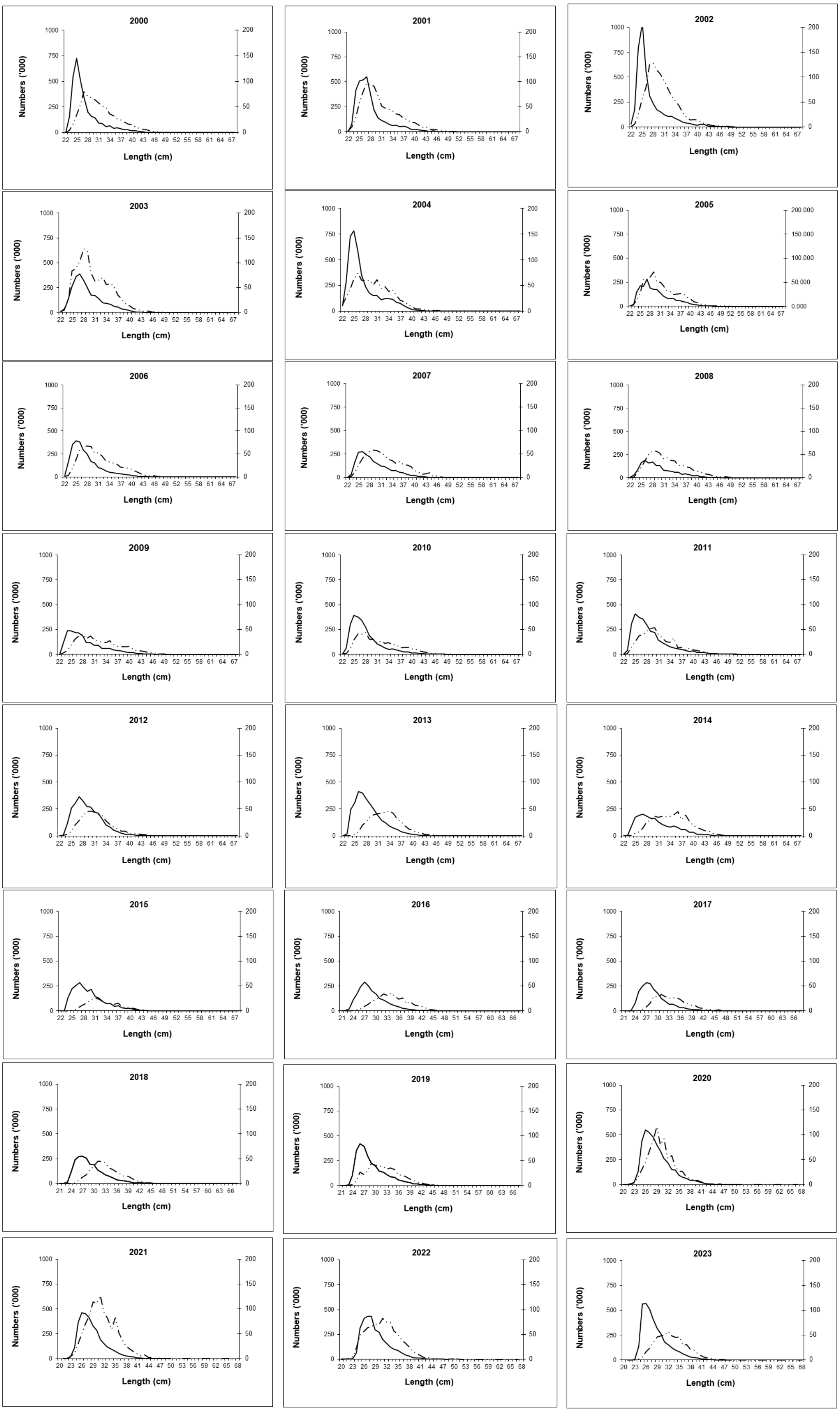

Figure 33.6. Sol.27.7fg - The length distributions of UK (England and Wales) landings (dotted lines) and of Belgian landings (solid lines).

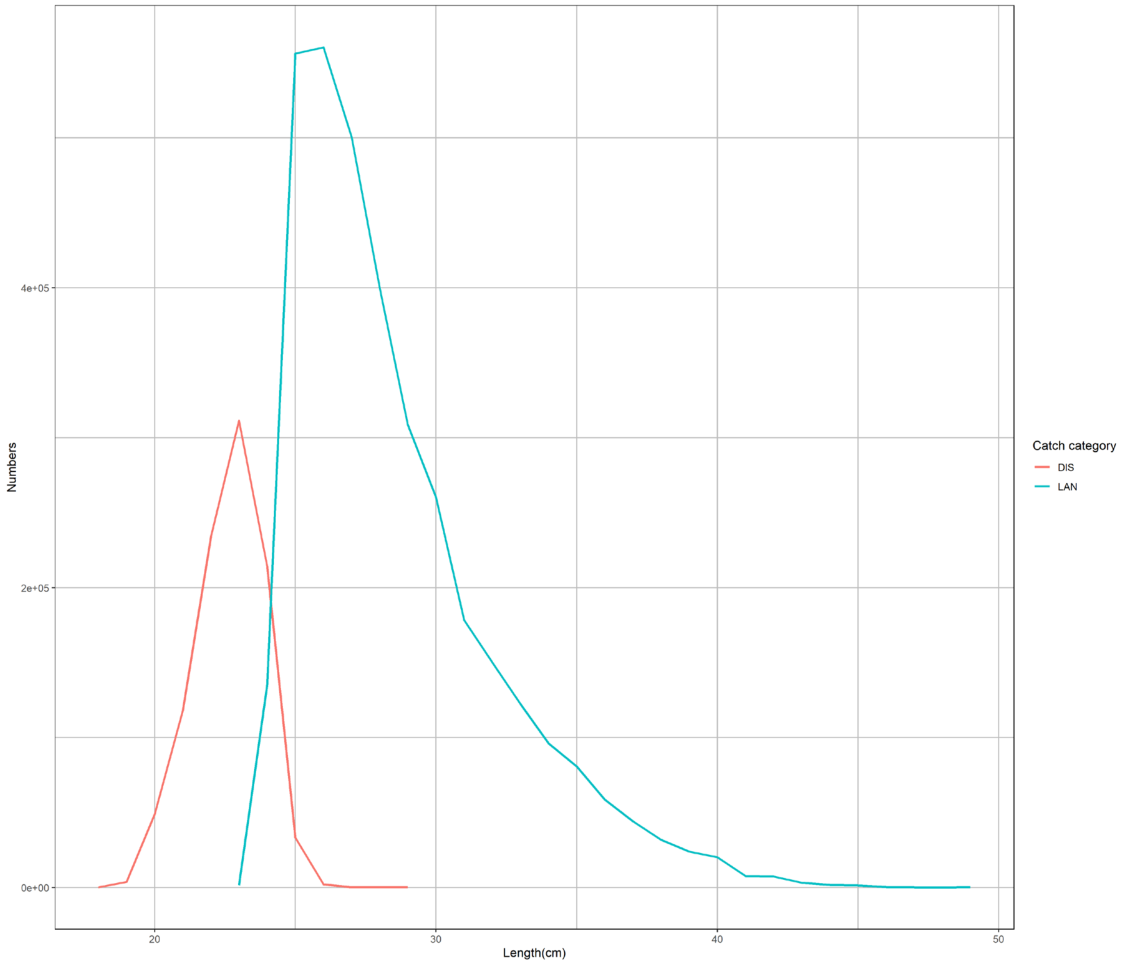

Figure 33.7. Sol.27.7fg - Belgian length distributions of discarded and retained fish from discard sampling studies.

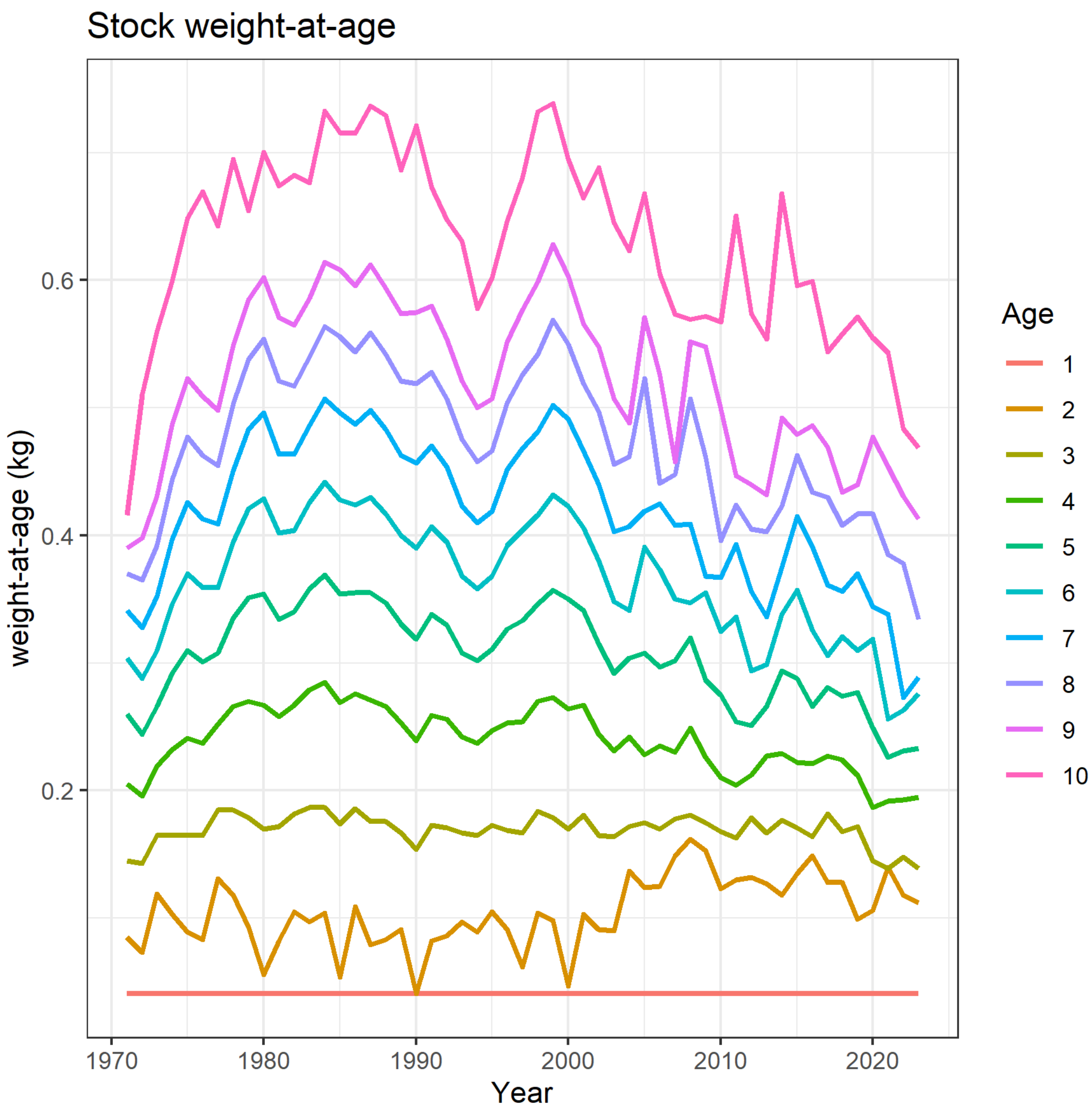

Figure 33.8. Sol.27.7fg - Stock weights-at-age (kg).

Figure 33.9a. Sol.27.7.fg - Mean-standardised indices.

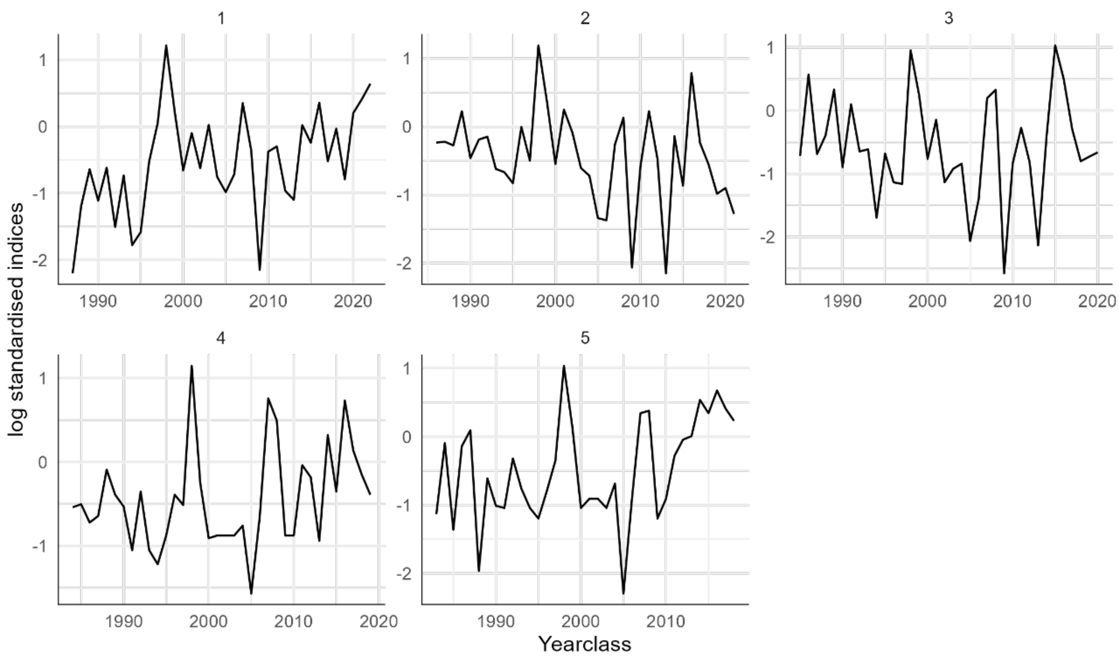

Figure 33.9b. Sol.27.7.fg - Mean-standardised indices.

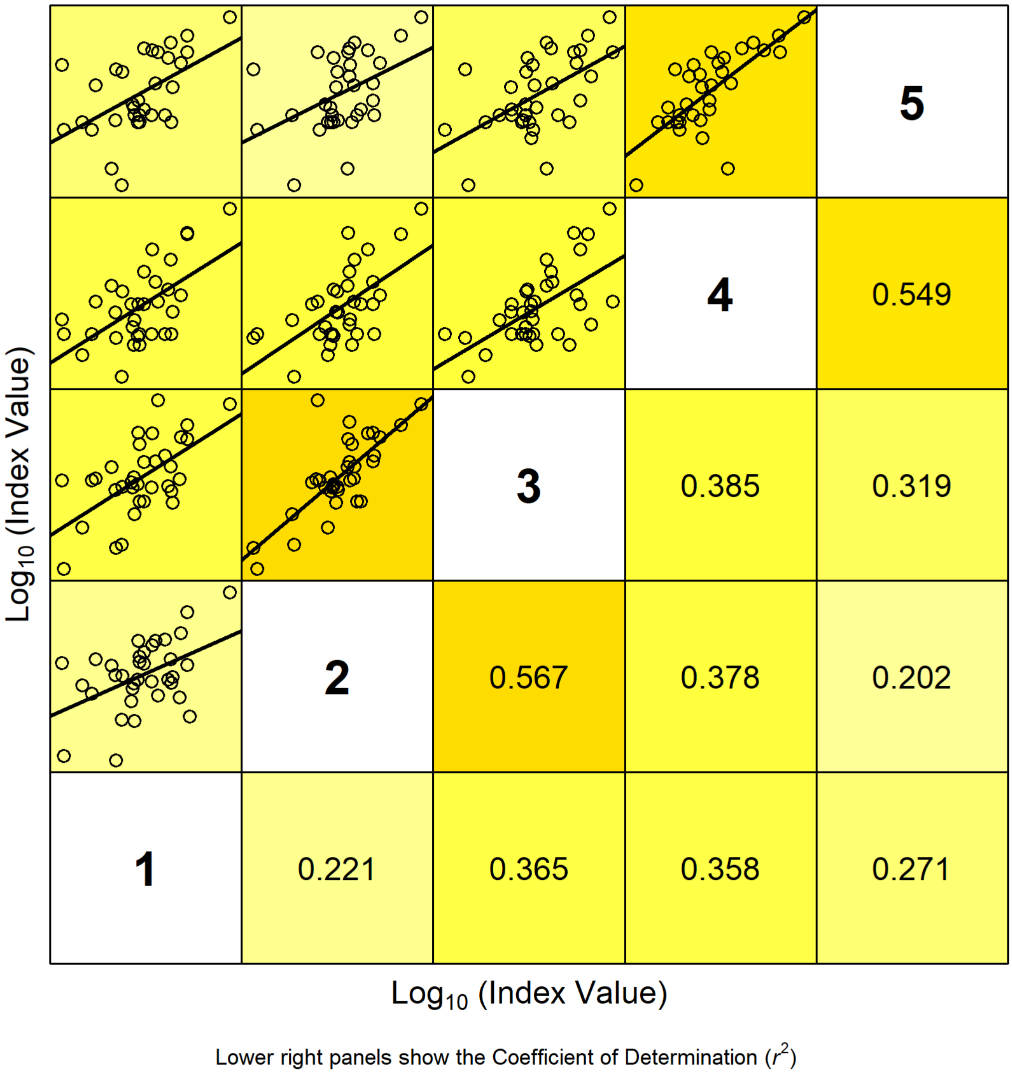

Figure 33.10. Sol.27.7fg - Consistency plot UK(E&W)-BTS-Q3 survey.

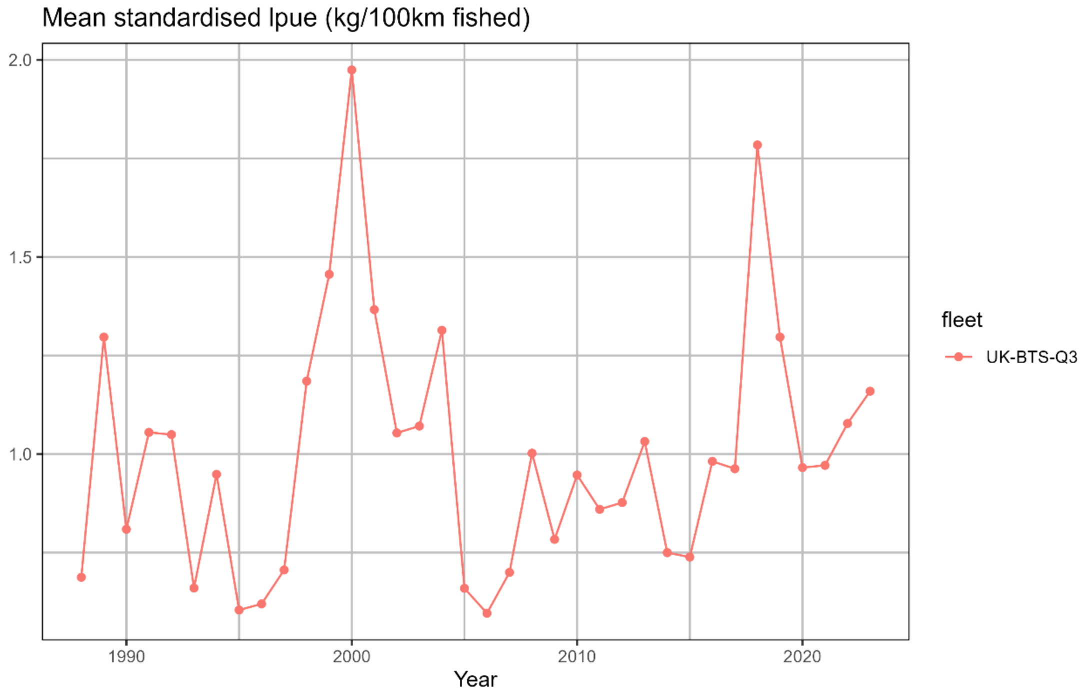

Figure 33.11. Sol.27.7fg – Mean standardized LPUE UK(E&W)-BTS-Q3 survey (kg/100 km fished).

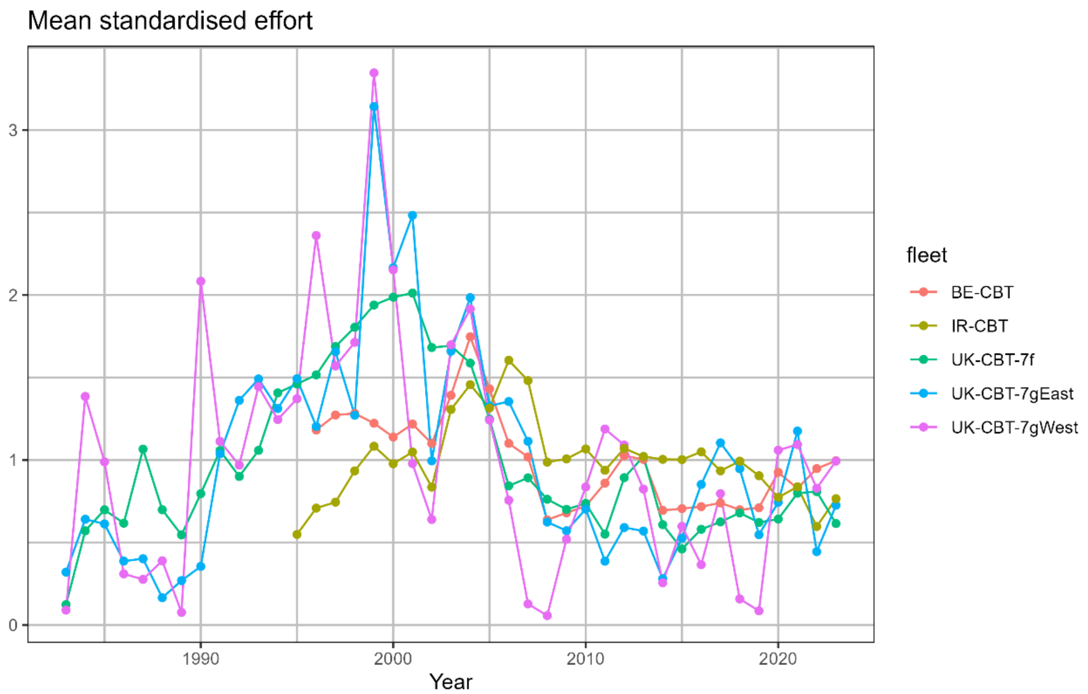

Figure 33.12a. Sol.27.7fg - Mean standardised Effort (fishing hours (BE-CBT and IR-CBT), days fished (UK-CBT)).

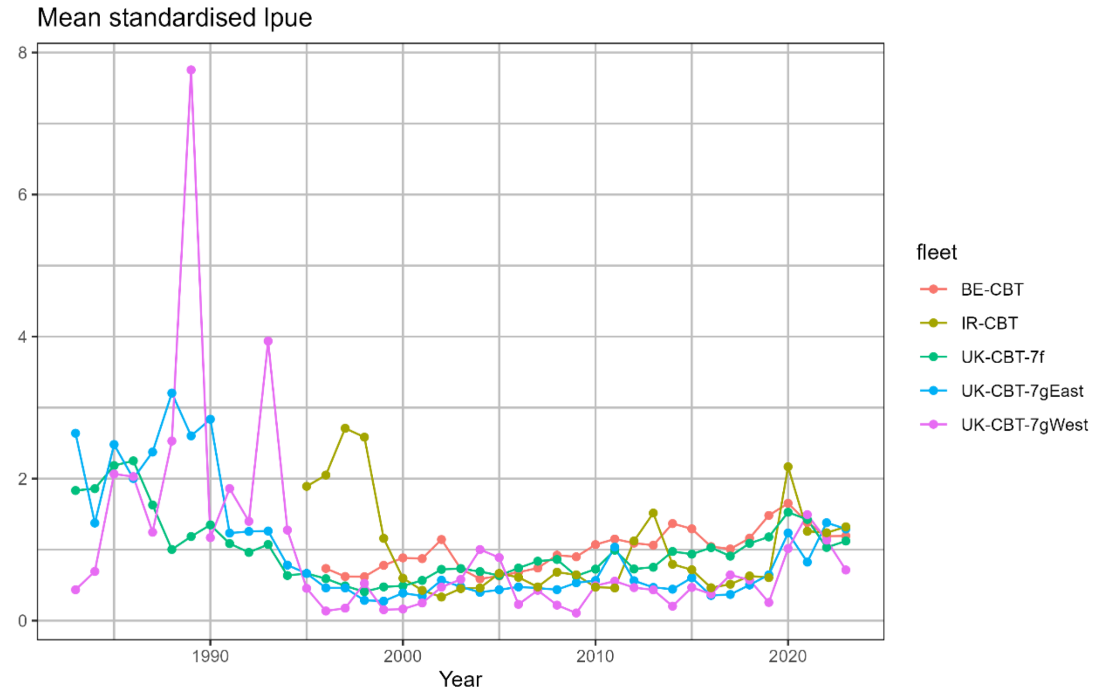

Figure 33.12b. Sol.27.7fg - Mean standardised LPUE (kg/hour (BE-CBT and IR-CBT), kg/day (UK-CBT)).

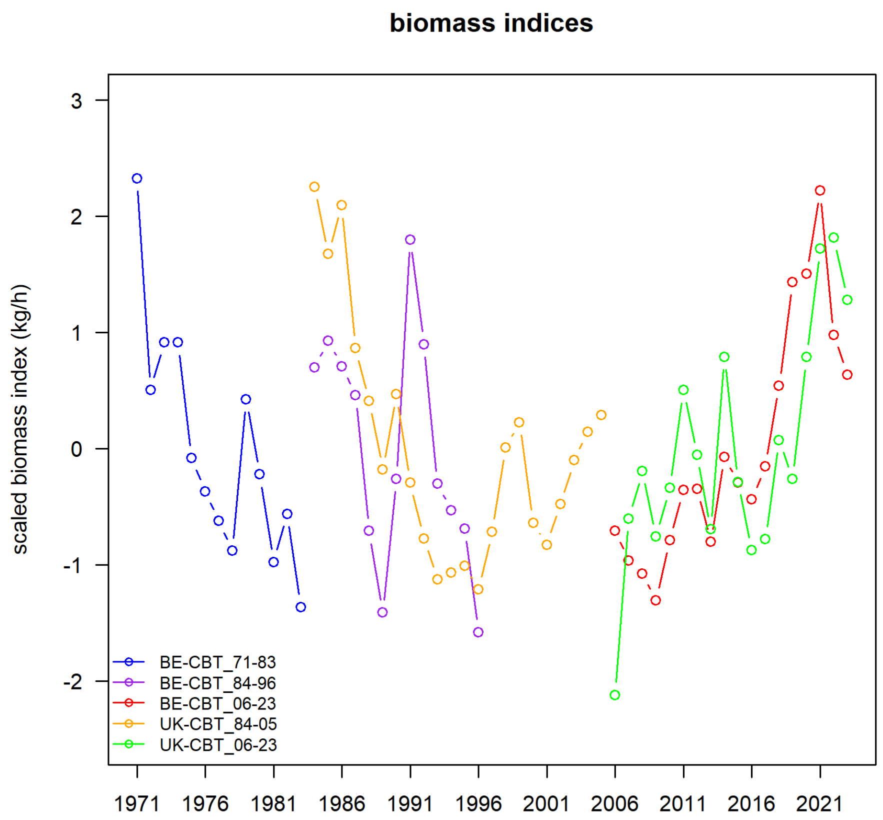

Figure 33.13. Sol.27.7fg - Commercial biomass tuning indices.

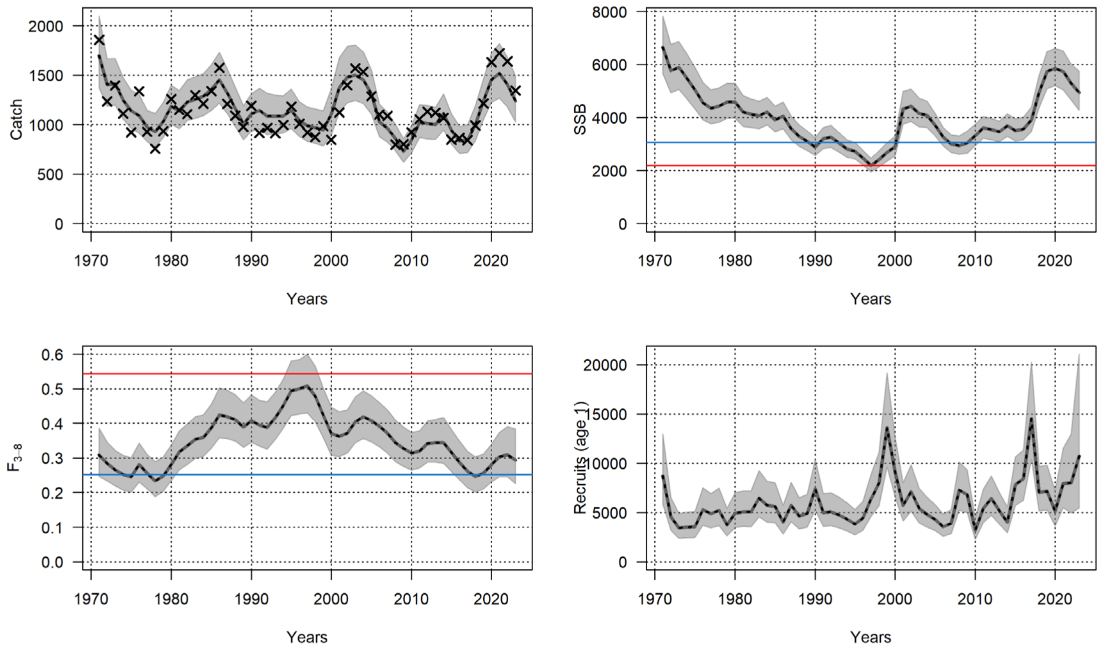

Figure 33.14. Sol.27.7fg - Summary plots. Red lines = precautionary reference points (lim) and blue lines = MSY reference points

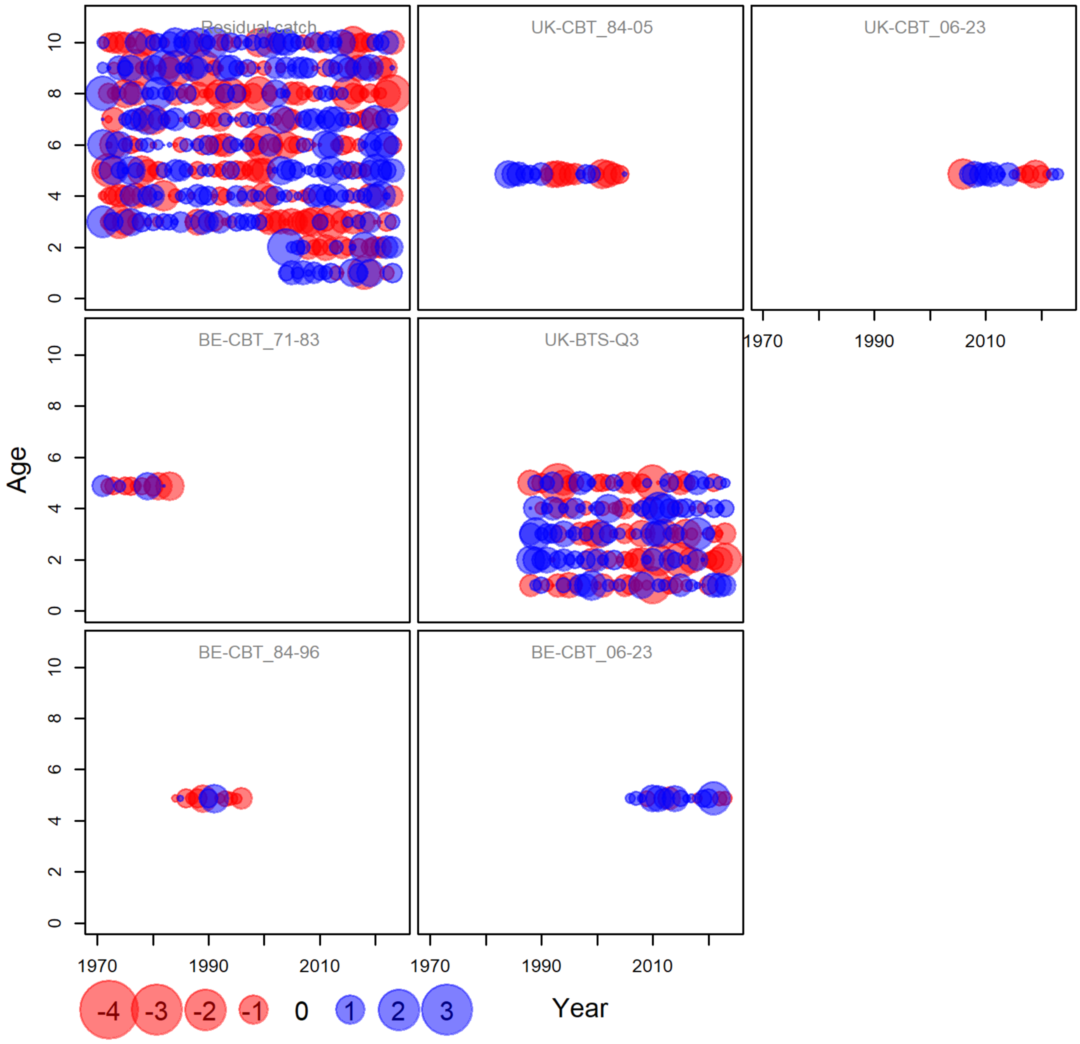

Figure 33.15. Sol.27.7fg - One Step Ahead residuals.

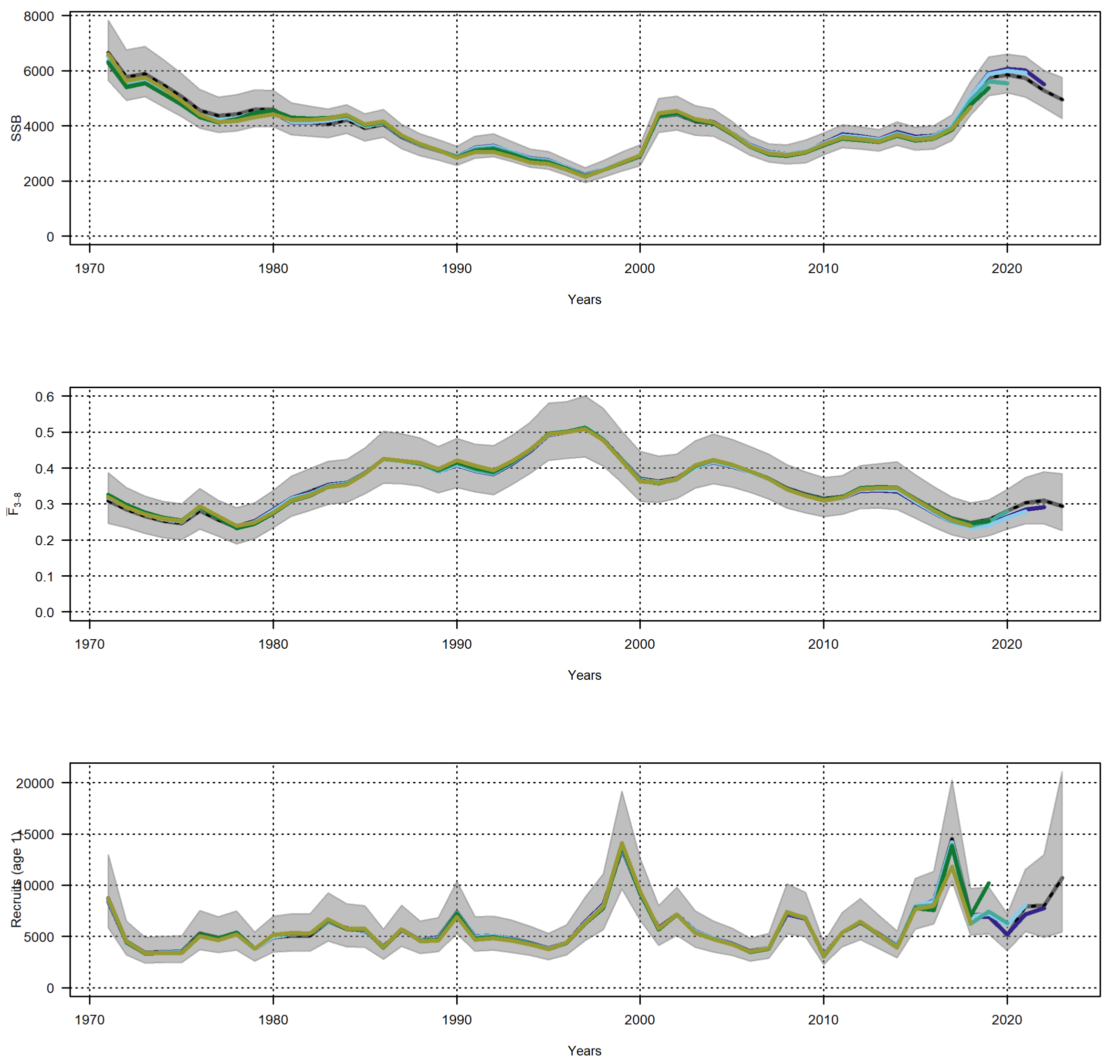

Figure 33.16. Sol.27.7fg - Retrospective analysis.

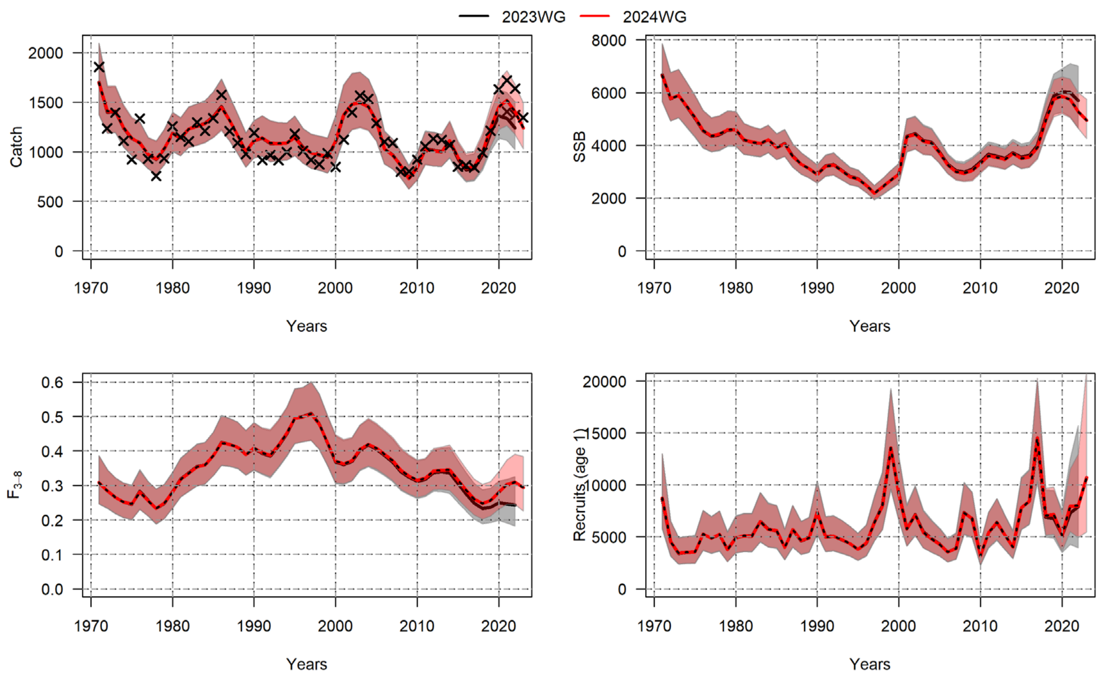

Figure 33.17. Sol.27.7fg - Comparison with last year's assessment.

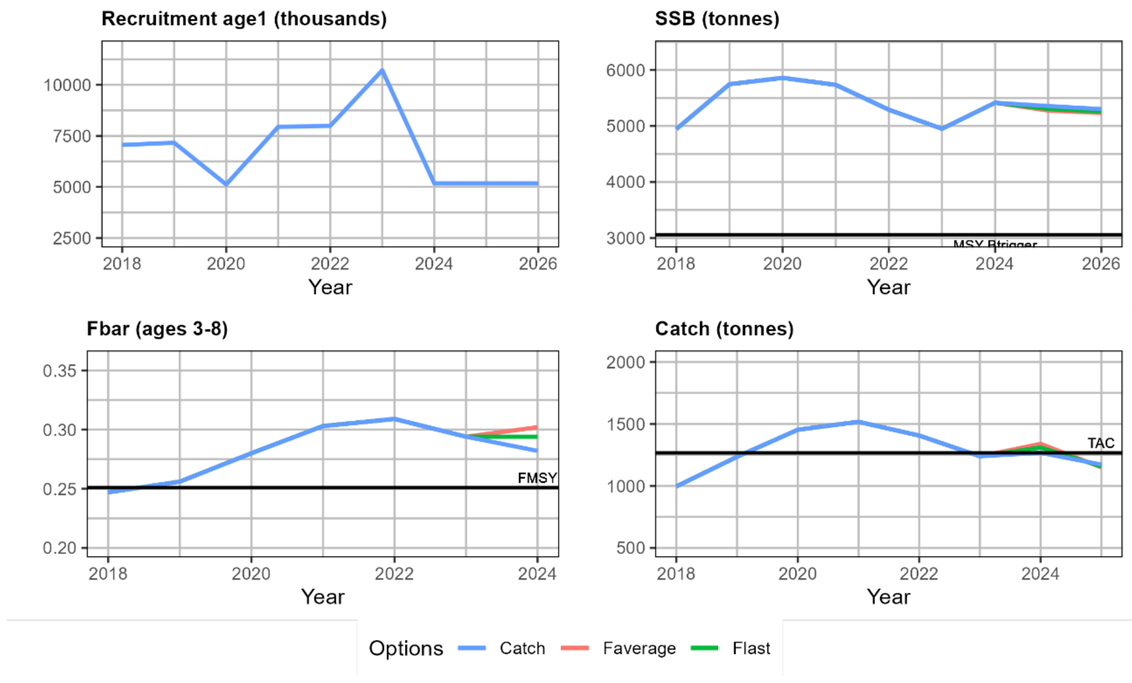

Figure 33.18. Sol.27.7fg - Options for the intermediate year in the short-term forecast.

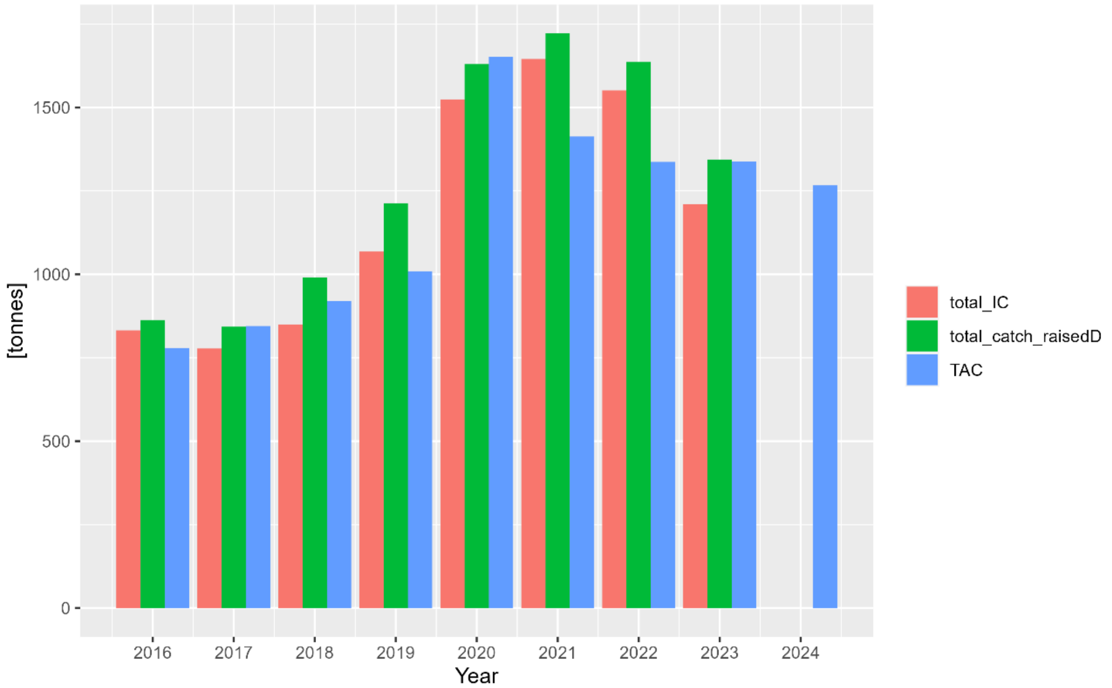

Figure 33.19. Sol.27.7fg - Comparison of international TAC, catch and landings.

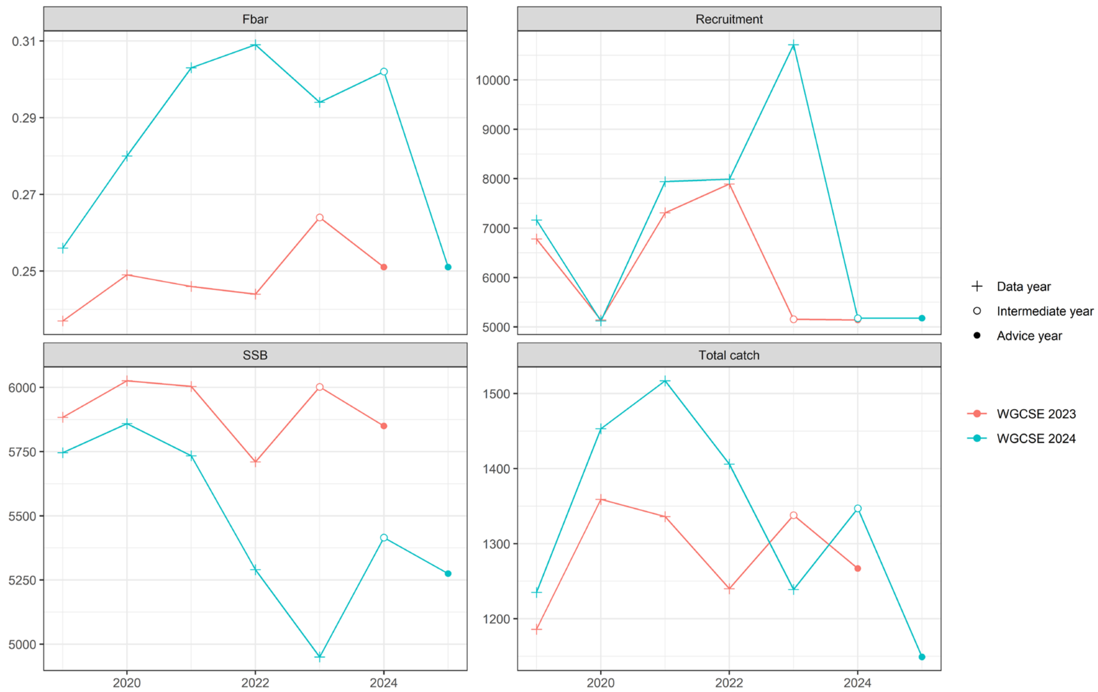

Figure 33.20. - Sol.27.7fg - Comparison with last year's assessment – short-term forecast assumptions.

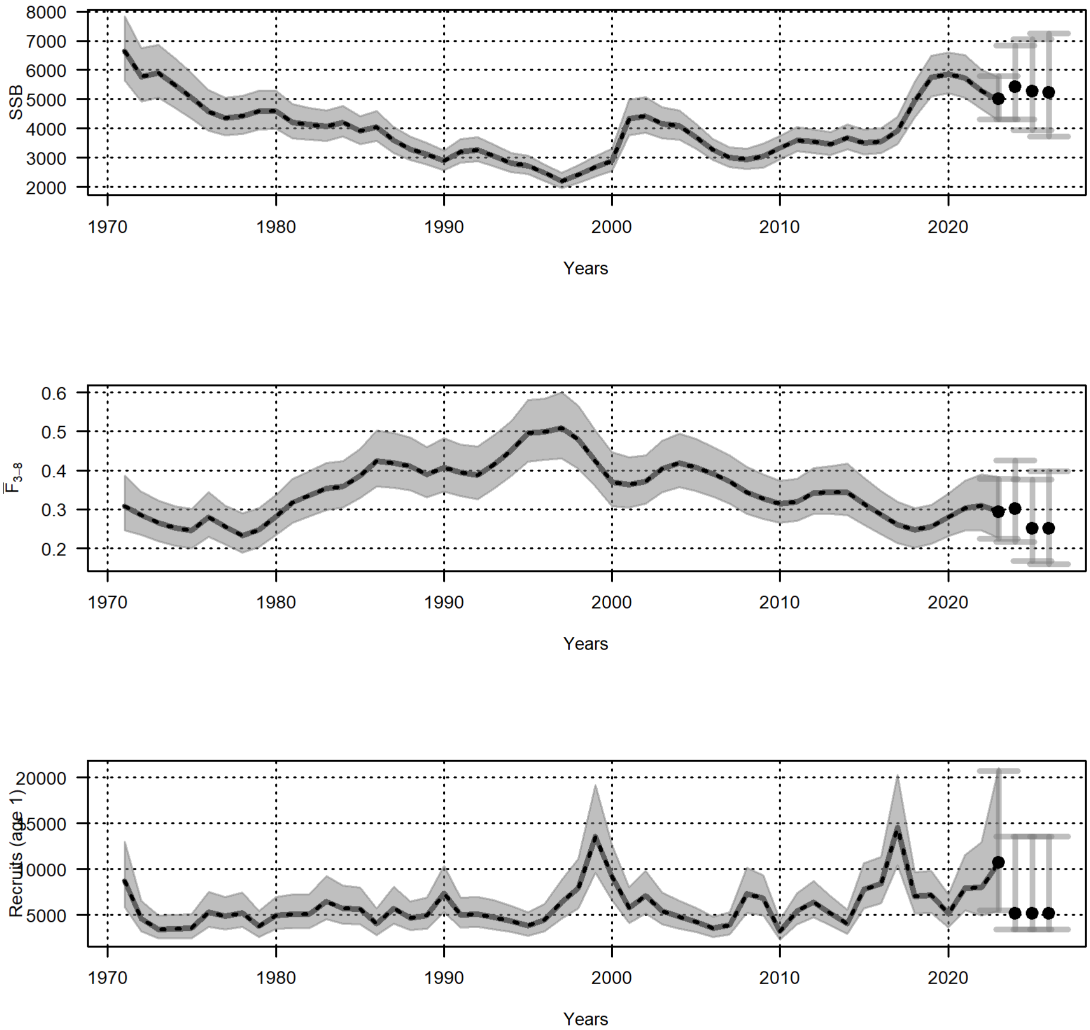

Figure 33.21. Sol.27.7fg - SAM forecast assuming F average in the intermediate year followed by targeting F_{MSY} in subsequent years.

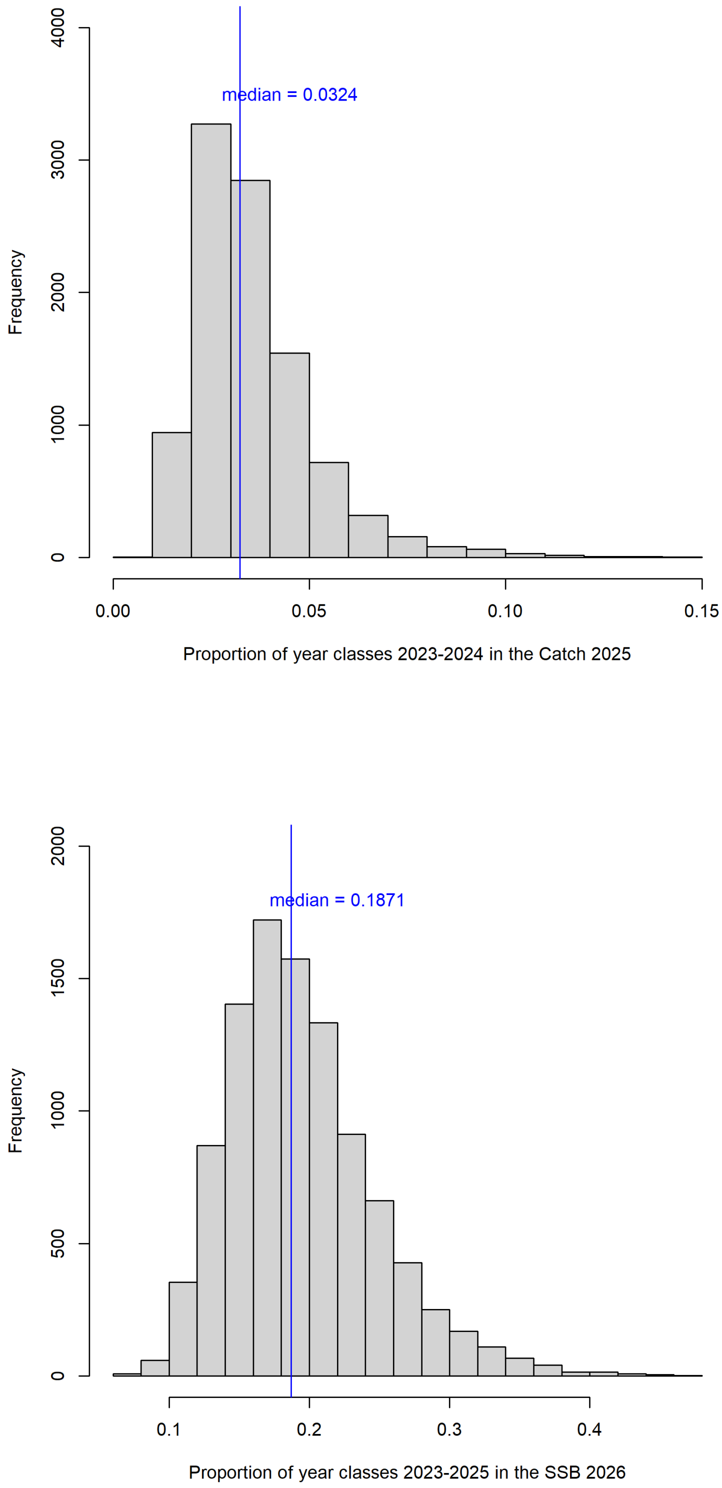

Figure 33.22. Sol.27.7fg - Contributions of the recruitment assumption for the short-term forecast.

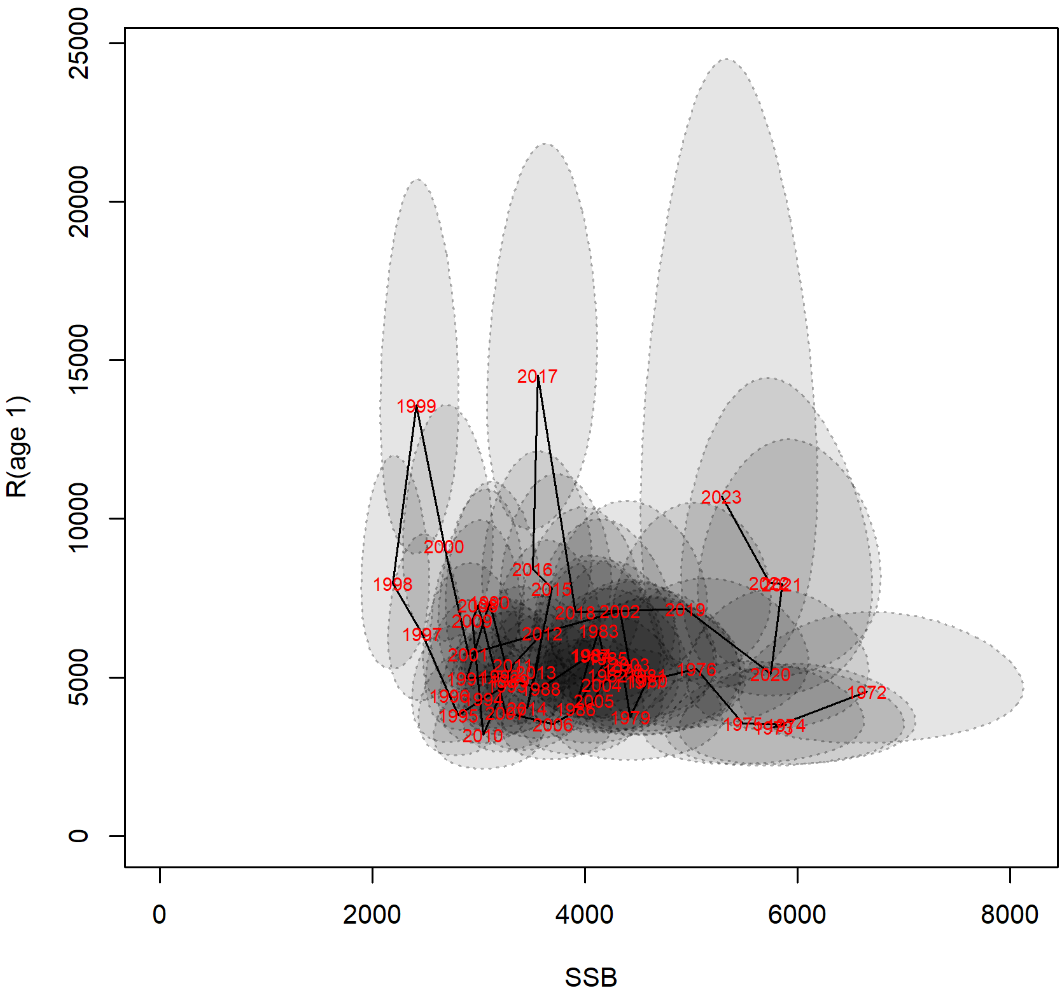

Figure 33.23. Sol.27.7fg – Stock–recruitment plot.

Contents

34 Sole (*Solea solea*) in Divisions 7.h-k (Celtic Sea South, southwest of Ireland)

This chapter will not be updated in the final report for 2024. This stock has existing multiannual advice that is still relevant for the reporting period.

Contents

35 Section 35

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36 Whiting (*Merlangius merlangus*) in Division 6.a (West of Scotland)

Type of assessment in 2024

This year's assessment is an update of the procedure used last year (SPALY). Following the decision made earlier during the benchmark meeting WKNSEA 2021 (ICES, 2021), it was carried out using the state-based assessment model (SAM; Nielsen and Berg, 2014) along with catch and survey data. The assessment followed the procedure outlined in the Stock Annex.

A forecast was conducted with short-term stochastic projections according to model and forecast assumptions agreed upon at the WG meeting. These differ to the assumptions agreed at the benchmark and detailed in the Stock Annex as it was believed to be important to account for the change in discarding which appears to have occurred in the fishery since the full implementation of the landing obligation in 2019 (see further details in Section 36.4).

ICES advice applicable to 2024

"ICES advises that when the MSY approach is applied, catches in 2024 should be no more than 3879 tonnes.

Management should be implemented at the stock level."

https://ices-library.figshare.com/articles/report/Whiting_Merlangius_merlangus_in_Division_6_a_West_of_Scotland_/21864327

ICES advice applicable to 2023

"ICES advises that when the MSY approach is applied, catches in 2023 should be no more than 4155 tonnes.

Management should be implemented at the stock level."

https://ices-library.figshare.com/articles/report/Whiting_Merlangius_merlangus_in_Division_6_a_West_of_Scotland_/19457426?backTo=/collections/ICES_Advice_2022/5796935

36.1 General

Stock description

General information is presented in the Stock Annex.

Management applicable to 2023 and 2024

The TAC for whiting (in tonnes) is set for ICES subareas 6, 12 and 14 and EU and international waters of ICES Division 5b, for 2024 and 2023 is shown below.

TAC for 2024

Species:	Whiting *Merlangius merlangus*	Zone:	6; United Kingdom and International waters of 5b; international waters of 12 and 14 (WHG/56-14)
Germany	8	Analytical TAC	
France	157	Article 8 of this Regulation applies	
Ireland	935		
Union	1 100		
United Kingdom	2 063		
TAC	3 163		

(Council Regulation (EU) 2024/257 of 10 January 2024).

TAC for 2023

Species:	Whiting *Merlangius merlangus*		Zone:	6; United Kingdom and International waters of 5b; international waters of 12 and 14 (WHG/56-14)
Germany	7	(1)	Analytical TAC	
France	135	(1)	Article 8 of this Regulation applies	
Ireland	802	(1)	Article 3 of Regulation (EC) No 847/96 shall not apply	
Union	944	(1)	Article 4 of Regulation (EC) No 847/96 shall not apply	
United Kingdom	1 692	(1)		
TAC	2 636	(1)		
(1)	Exclusively for by-catches of whiting in fisheries for other species. No directed fisheries for whiting are permitted under this quota.			

(Council Regulation (EU) 2023/194 of 30 January 2023).

Fishery in 2023

A description of the fisheries in the West of Scotland is given in the Stock Annex.

The year 2023 was the fifth year during which the landing obligation was applied in full force. The overall increase in TAC in 2019–2023 following the introduction of the landing obligation has resulted, in general, in an increase in landings.

Total landings (nominal landings, ICES statistics) in 2023 were 559 t, down by 10% from 2022 (Table 36.1). They were, however, the third highest in the last 19 years. The majority were landed by Scottish and Irish vessels, and smaller amounts – by French vessels. The UK landings in Division 6.a in 2023 constituted less than a quarter of the quota for the UK, while Ireland used one fifth of its quota. Total landings in 2023 constituted 21% of the TAC for that year.

The total estimated international catch of all age groups in 2023 was 677 t, of which 118 t were discards (Table 36.2). Of the discards, 99% were discarded by the trawl fleet targeting crustaceans (*Nephrops*).

Mandatory introduction of larger square mesh panels for the *Nephrops* fleet in 2008 seems not to have had much of an effect in the following years on the discards of whiting in Division 6.a. However, in terms of quantity, the discards in 2023 (all ages) were lower (by 4%) than those in 2022 and they were also below the average in the last decade. In terms of discard rate (discards as a proportion of catch), they were the third lowest in the time-series from 1981 onwards (Table 36.2).

36.2 Data

Landings

Total landings, as officially reported to ICES, are shown in Figure 36.1 (in 1965–2023) and Table 36.2 (in 1981–2023).

In the past, there had been concerns that the quality of landings data was deteriorating, giving a possible reason for the different stock dynamics implied by the commercial fleet and the annual survey (ScoGFS-WIBTS-Q1) being in operation at that time (see Section 5.1.6.1.3 in the 2005 WG Report; ICES, 2005). However, a review of previously supplied estimates of misreporting and underreporting (ICES, 2012) carried out at WKNSEA (ICES, 2021) suggested this to have been a relatively minor issue (in the order of ~5% of total landings) in the past (since 2001). Therefore, the benchmark agreed that no catch scaling factor for the period 1995–2006 was required in which it differs from previous analytical assessments of this stock.

During WKDEM 2020, the catch data (landings and discards) for 2003 onwards were revised using InterCatch (ICES, 2020a). The age structure in unsampled landings was estimated from that in sampled landings. This was done separately for the two fleets, TR1 (gadoid fishery) and TR2 (*Nephrops* fishery), on account of the different discard rates observed in them.

The sampling levels in 2023 in the Scottish fleet (taking the majority of the catch) were different compared to 2022. Four trips of the demersal trawl fleet were sampled for landings last year (with only two in the preceding year). For discards, the sampling level decreased in 2023 and this was the case both for the TR1 and TR2 fleets. The number of primary sampling units (PSU = number of trips sampled) in the area from 2019 to 2023 is shown in the table below:

Year	UK (Scotland)				Ireland			
	Landings		Discards		Landings		Discards	
	TR1	TR2	TR1	TR2	TR1	TR2	TR1	TR2
2023	4	0	7	6	36	0	16	0
2022	2	0	13	11	39	0	36	0
2021	11	0	8	4	80	0	32	0
2020	11	1	12	4	28	0	20	0
2019	16	0	18	23	23	0	28	0

Landings uploaded to InterCatch by métier and country for 2023 are shown in Figure 36.2. As in previous assessments, age distributions were estimated from market samples. Total catch (including landings) by métier for 2023 is shown in Figure 36.3. Catch numbers-at-age (in different catch categories) in 2023 are shown in Figure 36.4. Overall, these were very low which contrasted with relatively high catch numbers (especially of young fish) observed in earlier years (Figure 36.5).

Annual numbers-at-age in the landings are given in Table 36.3. Annual mean weights-at-age in the landings are given in Table 36.6 and shown in Figure 36.6. Overall, the mean weights-at-age in the landings have been variable in recent years mainly due to the variability associated with low sample sizes. Efforts to increase sampling in these fisheries are being pursued.

Estimates of mean weights-at-age in 2022 landings were considered particularly unreliable, due to reduced sampling of the demersal trawl fleet in that year.

Discards

This WG's estimates of discards have been based on data collected in the Irish and Scottish discard programme and raised by landings. Discard age compositions from Scottish and Irish samples have been applied to unsampled fleets. As agreed at WKDEM 2020, the raising and age allocations for discards were done separately for the TR1 and TR2 fleets (ICES, 2020a).

Discards uploaded to InterCatch by métier and country for 2023 are shown in Figure 36.2.

Annual numbers-at-age in the discards are given in Table 36.4. Annual mean weights-at-age in the discards are given in Table 36.7 and shown in Figure 36.6.

Biological

Annual numbers-at-age in the total catch are given in Table 36.5. Annual mean weights-at-age in the total catch are given in Table 36.8 and shown in Figure 36.6.

In previous assessments prior to 2021, mean catch weights-at-age were used as mean stock weights-at-age. Since 2021, the latter have been estimated using the method elaborated at WKNSEA 2021 (ICES, 2021) that combines catch and survey weights-at-age (see the Stock Annex). Two sets of stock mean weights-at-age are delivered: one to be used to estimate size-dependent natural mortality-at-age, and one to be used as stock weights-at-age input into the SAM stock assessment model to calculate SSB. The latter weights (obtained by smoothing with a General Additive Model, GAM) are shown in Table 36.9 and Figure 36.6.

In previous assessments of whiting in Division 6.a, natural mortality was assumed to vary and be dependent on fish weight (Lorenzen, 1996). *M* values were time-invariant and were calculated as:

$$M_a = 3.0\overline{W}_a^{-0.29}$$

where M_a is natural mortality-at-age *a*, $\overline{W}_a$ is the mean stock weight-at-age *a* (in g) and the numbers are the Lorenzen's parameters for fish in natural ecosystems.

During WKNSEA in 2021 it was agreed to first smooth the time-series of stock mean weights-at-age using a GAM and then use these smoothed weights-at-age in the Lorenzen (1996) equation to obtain a time-series of mortality-at-age estimates to be used as input in the stock assessment model (ICES, 2021).

The time-series of smoothed stock mean weights-at-age obtained from a combination of catch data and survey data from Q1 and Q4 are used in the Lorenzen equation. The smoothed stock mean weights-at-age are shown in Figure 36.7. The estimated natural mortality-at-age is shown in Table 36.10 and Figure 36.8.

In earlier assessments prior to 2021, maturity-at-age was assumed to be knife-edge with the value 0 at age 1 and full maturity-at-age 2+. An analysis of Scottish survey data conducted at WKDEM 2020 and updated at WKNSEA 2021, showed no clear temporal trends in maturity (ICES, 2020a; ICES, 2021). The analysis provided coefficients of the logistic model (being time-invariant, with data up to 2020).

The method for calculating the maturity ogive for this stock was corrected last year (ICES, 2024) – it was applied then more strictly in accordance with the calculation procedure originally set out at WKMOG 2008 (ICES, 2008). The maturity ogive re-estimation (with the same raw data) resulted in derivation of the following coefficients: -4.690 (intercept) and 4.225 (slope). The midpoint of the revised maturity ogive, A50, was estimated to be 1.110 (±0.013) years. The re-estimated proportions of mature whiting are shown in the table below:

Age	0	1	2	3	4	5	6	7+
Maturity ogive	0	0.386	0.977	1	1	1	1	1

The re-estimation revealed that considerable proportion of fish at age 1 (39%) and nearly all fish at age 2 (98%) were mature. There was little variability in the data, which resulted in relatively narrow confidence intervals (Figure 36.9).

Surveys

Five research vessel survey series for whiting in 6.a were available to the WG in previous years. They included the two 'old' Scottish surveys:

- Scottish first-quarter west coast groundfish survey (ScoGFS-WIBTS-Q1, G1179): all ages 1 and older, years 1985–2010;
- Scottish fourth-quarter west coast groundfish survey (ScoGFS-WIBTS-Q4, G4299): all ages including age 0, years 1996–2009.

The Q1 Scottish Groundfish Survey was performed using a repeat station format with the GOV survey trawl together with the west coast groundgear rig 'C'. The Q4 Scottish Groundfish Survey also used the GOV survey trawl with groundgear 'C' and the fixed station format. The Q4 survey was not carried out in 2010 due to an engine breakdown of the research vessel.

In 2011, the Q1 and Q4 Scottish Groundfish Surveys were re-designed. The previous repeat station survey format consisting of the same series of survey trawl positions being sampled at approximately the same temporal period every year is considered a rather imprecise method for surveying both these subareas. Therefore, a move towards some sort of random stratified survey design was judged necessary (see further details of the modified survey design in the Stock Annex). The introduction of the new design initiated two 'new' time-series:

- Scottish first-quarter west coast groundfish survey (UK-SCOWCGFS-Q1, G4748): all ages 1 and older, years 2011–2024 (excluding 2022);
- Scottish fourth-quarter west coast groundfish survey (UK-SCOWCGFS-Q4, G4815): all ages including age 0, years 2011–2023.

The distribution and densities of whiting at-age (standardised as CPUE) in the Q1 and Q4 surveys in 2019–2024 are shown in Figure 36.10. The Q4 survey in 2013 was not fully implemented due to adverse weather conditions. It covered only the northern half of Division 6.a and therefore, the index for that year was not used in assessments prior to 2020. Due to vessel breakdown, the Q1 survey was not carried out in 2022. As a result, 13 years of data are currently available in the time-series for the Q1 survey and 12 years of data for the Q4 survey (as valid indices).

The Irish Groundfish Survey has partly been conducted in Division 6.a:

- Irish fourth-quarter west coast groundfish survey (IGFS-WIBTS-Q4, G7212): all ages including age 0, years 2003–2023.

The distribution and densities of whiting at-age in the two Q4 surveys, UK-SCOWCGFS-Q4 and IGFS-WIBTS-Q4 in 2018–2023 are shown in Figure 36.11 (only the southern part of Division 6.a). The Irish survey uses the RV Celtic Explorer and is part of the IBTS coordinated western waters surveys. The vessel uses a GOV trawl, and the design is a depth-stratified survey with randomised stations. Effort is recorded in terms of minutes towed. The previous Irish survey (IreGFS), being in operation in 1993–2002 (see the Stock Annex), is not used anymore in the assessment.

Further descriptions of the above five surveys can be found in 'Manual of the IBTS North Eastern Atlantic Surveys' (ICES, 2017) and in the last IBTSWG report (ICES, 2023).

During WKNSEA 2021, it was agreed to combine all the three Q4 surveys (ScoGFS-WIBTS-Q4, UK-SCOWCGFS-Q4, and IGFS-WIBTS-Q4) into one survey index for use in the stock assessment and covering the period 1996 onwards (ICES, 2021). The analysis of the combined index was conducted using a GAM-based delta-lognormal model Berg *et al.* (2014) including a number of explanatory variables. The combined index (denoted as Comb-WCGFS-Q4) derived from the model fit is shown in Figure 36.12. The index provides a more complete representation of the population compared to the respective indices used on their own. It simplifies the modelling procedure in the annual assessments of the stock (with three rather than five indices) and provides a longer continuous time-series.

Commercial cpue

Four commercial catch-effort time-series were previously available to the WG, but they have not been used for a number of years. They are only presented in the Stock Annex.

36.3 Stock assessment

In the years 2011–2019, the assessment was done using a Time-Series Analysis (TSA) model (Gudmundson, 1994; Fryer, 2002; Needle and Fryer, 2002). At that time, the stock was classified as category 1. During the benchmark process of WKDEM 2020, it was found that running TSA with the new data and changed survey configuration posed a challenge (ICES, 2020a). Poorly converged optimisation runs (with some parameters being found on the boundary of the assumed parameter space) in conjunction with excessive running times were a major obstacle to complete the assessment successfully. In these circumstances, it was decided *ad hoc* to run the benchmark assessment using an alternative method; namely, a SPiCT model (Pedersen and Berg, 2017). At the same time, the stock was downgraded to category 3 and further to category 5 according to the ICES guidelines for data-limited stocks (ICES, 2019).

In the benchmark process of WKNSEA 2021, it was decided to use SAM as the assessment method (ICES, 2021). It was agreed that the model should be run over the entire time period for which catch numbers-at-age data were available in order to capture the earliest part of the time-series (during which catches were relatively high). To facilitate this in SAM, it was assumed that catch and discards mean weights-at-age 0 between 1981 and 2002, and landings mean weights-at-age 0 for the entire modelled time period, were equal to the average of mean weights-at-age 0 between 2003 and 2020. In addition, stock mean weights-at-age and natural mortality-at-age between 1981 and 1984 were assumed to equal estimates for the equivalent quantity from the earliest available year (i.e. 1985). Catch numbers-at age 0 are only available from 2003 onwards (from the WKDEM data call) and therefore values between 1981 and 2002 were treated as missing and estimated in the assessment model.

Data screening

The diagnostics for commercial catch data and the three indices considered as tuning series (ScoGFS-WIBTS-Q4, UK-SCOWCGFS-Q1, and Comb-WCGFS-Q4) for the assessment are shown in Figures 36.13–36.15).

The log catch curves for the commercial catch and for the surveys in the current assessment are shown in Figure 36.13. In most cases, the curves are relatively linear and not very noisy. They also show a fairly steep and consistent drop in abundance. The curves for the commercial catch in the later part of the time-series are more noisy and have a strong 'hook', especially at age 0 (from 2003 onwards).

The plots of mean standardised catch proportions at age by year (Figure 36.14) demonstrate general consistency in the estimates of year-class strength across age groups. They indicate strong year classes in recent years (e.g. 2009 and 2014 year classes), but also markedly weak year classes (e.g. 2012 and 2017 year classes). A strong year effect can be seen for ages 1+ in 2008 and to a lesser extent in 2007 and 2012 in the combined survey series.

The within-survey correlation plots generally show high correlations between adjacent age groups (i.e. between age 1 and age 2, between age 2 and age 3 etc.; Figure 36.15). Also here, there is general consistency with regard to year-class strength across age groups, with the points being more scattered for old age groups.

The three indices used as tuning series in the current assessment are shown in Table 36.11.

Final assessment

Model used: SAM

Software used: stockassessment package in R; stockassessment.org

Input data types and characteristics:

- Catch numbers-at-age: ages 1–7+, 1981–2023 (excluding age 1 in 2021, see below); age 0, 2003–2023 (excluding 2020 and 2021, see below)
- Landings fraction at age, ages 0–7+, years 1981–2023,
- Catch weights-at-age: ages 1–7+, 1981–2023; age 0, 2003–2023 (excluding 2020, see below)
- Landings weights-at-age, ages 0–7+, years 1981–2023 (excluding age 1 in 2021, see below),
- Discards weights-at-age: ages 1–7+, years 1981–2023; age 0, 2003–2023 (excluding 2020, see below)
- ScoGFS-WIBTS-Q1, ages 1–6, years 1985–2010,
- UK-SCOWCGFS-Q1, ages 1–6, years 2011–2024 (excluding 2022, see below),
- Modelled Q4 index, Comb-WCGFS-Q4, fitted to data from ScoGFS-WIBTS-Q4, UK-SCOWCGFS-Q4, and IGFS-WIBTS-Q4; ages 0–7+ with variance estimates, 1996–2023.

No age-0 discards were recorded in 2020. This is assumed to be due to a lack of discard sampling in the *Nephrops* fishery from Q2 onwards and therefore age-0 discards are treated as missing in 2020 (as in the years before 2003). Missing catch weights-at-age 0 are assumed equal to the average of 2003–2019. There were no age-1 fish recorded in the landings in 2021, therefore landings weight-at-age 1 for 2021 is a three-year average value (2018–2020). Catch numbers-at-age 0 and 1 for 2021 were considered unreliable due to low sampling levels, and were thus removed from the dataset. Unknown/removed catch numbers-at-age values are estimated in the model. The UK-SCOWCGFS-Q1 index was not available in 2022 as there was no survey carried out due to vessel maintenance.

The assessment of whiting in 6.a was conducted using a SAM model fitted to the updated catch and survey data series. Full details of the model implementation are presented in the Stock Annex. The SAM configuration file for the final assessment model run is given in Table 36.12. To summarise the main configuration settings:

- Fishing mortality states processes are uncoupled across all age groups.
- Catchabilities for each survey index are freely estimated with the exception of the two oldest age groups for each index; ages 5 and 6 in ScoGFS-WIBTS-Q1 and UK-SCOWCGFS-Q1, and ages 6 and 7+ in Comb-WCGFS-Q4.
- Catch observation variance parameters are allowed to differ for age 0 and age 7+ while all other age groups are coupled.
- Survey observation variance parameters are coupled across all ages for ScoGFS-WIBTS-Q1 and UK-SCOWCGFS-Q1, whereas for Comb-WCGFS-Q4 observation variance parameters were uncoupled for age 0, and coupled for ages 1 to 4 and ages 5 to 7+.
- The catch, ScoGFS-WIBTS-Q1, and UK-SCOWCGFS-Q1 fleets are modelled with independent covariance structures, whereas the Comb-WCGFS-Q4 fleet is modelled with a first order autoregressive variance structure (AR1) with ages 0 and 1, ages 1 to 6, and ages 6 and 7+ coupled.
- Recruitment is modelled as a random walk.
- $\bar{F}$ was calculated for ages 1 to 3 in order to reflect changes in fishery selectivity, moving from a target fishery in the 1980s and 1990s to a bycatch and discard component of the *Nephrops* trawl fishery from the early 2000s onwards. This is a change from previously accepted analytical assessments of this stock which used an $\bar{F}$ range of ages 2 to 4.

Table 36.13 shows the SAM parameter estimates for the assessment model. Table 36.14 shows the population numbers-at-age estimated in SAM, and estimated F-at-age is shown in Table 36.15. A summary of the full model output is detailed in Table 36.16. The summary plots for the final assessment are shown in Figure 36.16.

The fits of the model to observations (catch and survey indices on a log scale) are shown in Figure 36.17. The fits to the ScoGFS-WIBTS-Q1 appear to overestimate ages 1 and 2 in the early part of the time-series, and for ages 3 and 4 some of the trends in the time series are not fully captured. Fits to Comb-WCGFS-Q4 are also generally good, although there is a tendency towards overestimation of age 0 individuals for part of the time-series, and some overestimation and deficiency in tracking the variability of age 7+. The shorter time-series of UK-SCOWCGFS-Q1 makes it more difficult to assess the model fit in terms of trends, but the model seems to fit the observations reasonably well. The model also appears to follow the catch data well for most ages, but perhaps tracks less of the interannual variability for ages 7+. particularly from 2000 onwards.

The diagnostics of the quality of the model fit were: examination of the residuals, a leave-one-out analysis of the relative influence of indices on model estimates, and a retrospective peel analysis. One observation ahead residuals-at-age for catch and survey indices are shown in Figure 36.18. The residuals were not substantially affected by the updates made to the model, showing similar patterns to last year’s assessment model. There is an observable trend in the catch residuals from the late 1990s to mid-2000s, particularly between ages 2 and 4, where the fishery shifted from being directly targeted to bycatch. There is some tendency towards negative residuals in the oldest age group of the Q4 survey index, occasionally interspersed with positive residual values. Otherwise, there are no obvious problematic trends, either in magnitude or direction.

The model leave-one-out analysis is shown in Figure 36.19. Exclusion of each index in turn results in estimates of SSB, $\bar{F}$, and recruitment which follow very similar trends over time, suggesting generally good agreement between indices. Estimates of SSB in more recent years have a tendency towards being generally lower with the exclusion of ScoGFS-WIBTS-Q1 and Comb-WCGFS-Q4, while remaining reasonable stable with the exclusion of UK-SCOWCGFS-Q1, when compared to the final model. Leave-one-out estimates remain within the confidence interval of full model estimates in all cases. Estimates of $\bar{F}$ in each case diverge the most between 2000 and 2009. Excluding ScoGFS-WIBTS-Q1 results in higher estimates of $\bar{F}$ for much of the time-series from 2000 onwards, while excluding Comb-WCGFS-Q4 results in generally lower estimates of $\bar{F}$ for the same period.

Retrospective peels for the updated assessment model are shown in Figure 36.20. Retrospective bias in SSB is not substantial, with some downward revision with the addition of new data in recent years. This year's model shows a slight downward revision on last year's model's recent estimates of SSB, while maintaining a declining trend in SSB in the final year. However, this year's model's recruitment estimate for the last year (2023) indicates an upward trend, The Mohn's rho values are as follows:

SSB	$\bar{F}$	Recruitment
0.05	0.34	0.09

Despite the high Mohn's rho value for F, only one peel falls outside the confidence interval envelope.

The SAM stock–recruit plot is presented in Figure 36.21 and suggests a relationship which has experienced a number of reasonably distinct phases over time. SSB and recruitments were relatively high, but decreasing, in the early 1980s. At the latest benchmark (ICES, 2021), it was suggested that this phase was related to the gadoid outburst of the 1960s and 1970s, and the decreasing stock size at the beginning of the modelled period is the time at which the population was returning to its usual size (Holden, 1991; Hislop, 1996). Stock size was then relatively stable for much of the 1990s, but declined in the early 2000s. SSB has shown an increasing trend since around 2010, although this trend has slowed or levelled off since 2018. Average recruitment between 2010 and 2020 was higher than in the previous 10 years, but has been low since 2020.

Comparison with last year's assessment

This year, the WG estimates from SAM are as follows:

$\bar{F}_{(1\text{-}3)}$ in 2023 = 0.0132

SSB in 2024 = 20 410 t

The estimated fishing pressure continued to be very low. The stock biomass was estimated to decrease slightly in 2024. The estimates of SSB from this year's assessment are revised downward (Figure 36.22). There is a slight downward revision in $\bar{F}$ and a significant upward revision in recruitment.

SURBAR analysis

An alternative exploratory assessment conducted using SURBA (Needle, 2015) was presented at the WKNSEA benchmark (ICES, 2021) and the following assessments by WGCSE. Its updated run was presented to the WG this year.

This method requires stock weights-at-age (ages 0–7), maturity ogive (ages 0–7) and survey indices (ages 1–7 for Q1 or ages 0–7 for Q4). The smoothed estimates of stock weights-at-age were deployed in the model (those used to calculate SSB and shown in Table 36.9). The same three tuning series were considered for the model for SAM:

- ScoGFS-WIBTS-Q1 for the period 1985–2010;
- UK-SCOWCGFS-Q1 for the period 2011–2021 and 2023 (the 2024 data not being usable for all ages 0–7);
- Comb-WCGFS-Q4 for the period 1996–2023.

The model used the following settings:

- Three survey series (as above);
- Reference age for separable model = 3;
- Lambda smoother = 1.0;
- All SSQ weightings and catchabilities q set to 1.0.

The model produced the output given in Figures 36.23. The stock summary plots show rather variable estimates of mean Z being generally lower from the mid-1990s onwards. SSB rose to a peak in the mid-1990s, before dropping to very low levels in the late 2000s and increasing substantially in the more recent period. Recruitment between 2005 and 2013 was on a very low level. It increased in the following years but remained rather low in the last few years.

The assessment with SURBAR shows similar trends to those seen in the SAM runs (Figure 36.24).

State of the stock

The spawning–stock biomass (SSB) in 2024 is estimated to be below MSY $B_{trigger}$. It increased between 2010 and 2020, and levelled off since then at estimates consistent with those for the late 1990s (Figure 36.25). $\bar{F}$ declined almost continuously from 2000–2008, and has been below F_{MSY} since 2005. Recruitment was at historically low levels in the mid-2000s, and from around 2014 to 2020 has been variable around relatively low values. Recruitment estimates have remained low in recent years.

36.4 Short-term projections

The WG conducted a forecast using SAM in the form of short-term stochastic projections. A total of 1×10^5 samples was generated from the estimated distribution of survivors. These replicates were then simulated forward according to model and forecast assumptions (see below), using the usual exponential decay equations, but also incorporating the stochastic survival process (using the estimated survival standard deviation) and subject to different catch-options scenarios.

Recruitment in the intermediate year (2024) was taken as the SAM estimate, equal to the estimate of recruitment for 2023. The estimate of recruitment for the forecast year(s) was resampled from 2015–2024, to reflect recent levels of recruitment.

Fishing mortality in the intermediate year (2024) was taken as a five-year average over 2019 to 2023 (Figure 36.26) of the exploitation pattern rescaled to the 2023 mean F.

The stock has been subject to the landings obligation since 2019, at which point a bycatch TAC of 1112 t was set to allow fisheries with a whiting bycatch component to continue (this represented an increase from the 213 t TAC set for the preceding three years). This increased TAC appears to have resulted in a change in discarding practices since 2019. In Figure 36.27, the observed proportion discarded at-age shows a significant decline in the proportion of discards for ages three to five between 2019 and 2021, with a decline in proportion of discards at age two from 2020 onwards. For the forecast, total catch is partitioned into landings and discards on the basis of the mean discard proportions-at-age between 2021 and 2023 (rather than the five year average agreed at the benchmark and documented in the Stock Annex) with the assumption that this observed change in behaviour will continue in 2024 and 2025.

The observed mean weights-at-age 0 and 1 in the 2021 discard data were considered unreliable due to limited sampling of fleets discarding whiting (COVID-19 pandemic related sampling issue, see Section 36.2 for further details). For the purpose of forecasting, the mean value for those ages in 2021 were replaced with the average of the equivalent values across 2019 and 2020. Estimates of mean weights-at-age in the 2022 landings were considered unreliable, due to reduced sampling of the demersal trawl fleet in that year. For the short-term forecast, these values were replaced with averages calculated across the preceding three years (2019–2021).

Variable	Value	Notes
$F_{\text{ages 1–3}}$ (2024)	0.0132	F = $F_{\text{average (2019-2023)}}$ rescaled to F_{2023}
SSB (2025)	23 554	Short-term forecast, tonnes
$R_{\text{age 0}}$ (2024-2025)	260 622	Median recruitment, resampled from the years 2015–2024, in thousands
Catch (2024)	647	Short-term forecast; tonnes
Projected landings (2024)^	520	Short-term forecast; assuming average landings ratio by age 2021–2023; tonnes
Projected discards (2024)^	127	Short-term forecast; assuming average discard ratio by age 2021–2023; tonnes

^ Due to inadequate discard sampling coverage of the fishery in 2021, average landings and discards weights from 2019–2020 were used for ages 0 and 1

Under the forecast assumption of *status quo* F, landings in 2024 are predicted to be 520 t and discards to be 127 t. The SSB in 2025 is forecast to be 23 554 t, which is above B_{lim} and below MSY $B_{trigger}$. A summary of the forecast run under different catch scenarios for 2024 is shown in Table 36.17 (the values that appear in the catch scenarios are medians from the distributions that result from the stochastic forecast).

The forecast stock trajectory under the proposed advice for 2025 (4 952 t) shows a decrease in SSB in 2026 (Figure 36.28). Figure 36.29 shows the contribution by recruitment year to SSB in 2026 and catch in 2025 (when fished at $F_{MSY} \times SSB_{2024}$/MSY $B_{trigger}$). The assumption regarding recruitment in 2024 and 2025 contribute approximately 35% and 8% to the forecast 2026 SSB, and 26% and 14% to the forecast 2025 catch, respectively.

There is a 28% increase in advice compared to last year, which is attributable to higher recruitment estimated in this year’s assessment and which results in higher stock numbers-at-age and biomass-at-age compared to those projected in 2023 (Figure 36.30 and 36.31).

36.5 MSY and biological reference points

The reference points for this stock were updated at WKNSEA 2021 (ICES, 2021), following the general approach agreed at WKMSYREF4 (ICES, 2016).

The reference points estimated in 2021 are summarised in the table below:

Reference point	WKMSY-REF4 2016	WGCSE 2016	WKNSEA 2021	Rationale (WKNSEA 2021); details
B_{lim}	28 500 t	31 900 t	17 286	Lowest SSB (1999) within period of high recruitment (pre 2000)
B_{pa}	39 900 t	44 600 t	25 597	B_{lim} x exp(1.645 x σ); σ = 0.239 (CV on estimate of SSB (2020))
F_{lim}	0.25	0.27	0.31	F giving 50% probability of SSB<B_{lim} in stochastic simulation (EqSim) Uses segmented regression recruitment with breakpoint=Blim (S-R pairs from 1985 onwards).
F_{pa}	0.18	0.19	0.21	$F_{P.05}$; the F that leads to SSB ≥ B_{lim} with 95% probability.
F_{MSY}	0.22	0.23	0.21	$F_{P.05}$ (FMSY uncapped = 0.23)
F_{MSY} upper	0.34	0.32	0.21	$F_{P.05}$ (FMSY upper uncapped = 0.27)
F_{MSY} lower	0.16	0.15	0.173	F resulting in no more than 5% reduction in long-term yield compared with MSY without ICES AR (95 % yield at $F_{P.05}$).

36.6 Management plans

There are no specific management objectives or a management plan for this stock, but the EU multiannual plan takes bycatch of this species into account (EU, 2019).

36.7 Uncertainties and bias in the assessment and forecast

Some uncertainties signalled in previous assessments were related to area misreporting of landings. Marine Scotland Compliance have provided estimates based on their surveillance and monitoring programme which suggest area misreporting of whiting to be in the order of 10–15% of reported landings in recent years (ICES, 2012). This issue is thus considered to be of relatively minor importance.

As a result of the 2021 benchmark, the stock was changed from a category 5 stock to a category 1 stock. The assessment, which is now based on SAM, includes revised catch and survey data, updated biological parameters, and accounts for changes in fishery selectivity (rather than changes in survey catchability). These changes have resulted in an improved assessment of the stock status.

The retrospective bias observed for recruitment is potentially an issue; the Mohn's rho has been found outside the bounds suggested by WKFORBIAS (ICES, 2020b). However, the assessment is deemed to be valid and provide advice based on the WKFORBIAS decision tree.

The lack of an intermediate year survey in Q1 2022 required a change to the recruitment assumptions and this increased the uncertainty of the forecast.

The sampling levels both in 2020 and in 2021 were lower compared to previous years due to COVID-19. As a result, total discards were underestimated for 2021, and the estimates of catch numbers for ages 0 and 1 were excluded from the stock assessment. Sensitivity analyses indicate that these issues are likely to have minimal impact on the assessment.

Estimates of mean weights-at-age in the landings in 2022 were considered unreliable (due to reduced sampling of the demersal trawl fleet in that year), but using a three-year average in the short-term forecast seems a reasonable choice in this case.

36.8 Recommendation for next benchmark

Although the combined Q4 index is considered as representative of the population, there is scope for its further improvement. During WKNSEA 2021, the potential need for inclusion of an interaction term between year and geographical coordinates was discussed. Exploratory analysis suggested some temporal changes in the distribution of age groups, but it was found that the inclusion of the interaction term had little effect on the index values or the internal consistency. Additional analyses and careful sense checking of estimated covariates would be necessary to find optimal settings for such an augmented model.

The Q1 indices used in the assessment represent CPUE calculated for age groups. While they integrate information for specific areas or strata, other sources information are thereby ignored. It seems plausible that these indices can be improved by including other explanatory variables, in a similar way as for the Q4 index.

Alternative approaches could be considered to estimate stock mean weights. Currently, they are smoothed with a GAM independently in each age group. As a result, two adjacent age groups may occasionally show different trends, which is quite unlike and which makes such stock weight estimates more uncertain.

While a Random Walk on recruitment was selected for the assessment for practical reasons, alternative approaches should be explored in modelling the S–R relationship model with internal calculation of reference points.

36.9 Management considerations

SSB in 2024 is estimated to be below MSY $B_{trigger}$. It has increased since 2010 and is now at a level consistent with that estimated for the late 1990s. Fishing pressure (F) declined almost continuously since around 2000 and is below F_{MSY} since 2005. After a period of somewhat higher recruitment (2014–2019), recruitment in the four last years was estimated to be lower. The fourth non-zero advice in a row has been given this year. The SSB is forecast to increase and then to decrease in the following two years in all catch scenarios.

Whiting are caught and heavily discarded in small-meshed fisheries for *Nephrops*. Under the landing obligation (since 2019), discards have considerably reduced. However, they still make up a considerable proportion of the catch (16% in 2022). Reported BMS landings are negligible; they are much lower than ICES estimates of catches below minimum size (i.e. estimated discards at age 0–2).

TAC increased under the landing obligation to allow continuation of mixed fisheries. In response to this, the discard rate declined. The forecast assumes that this behaviour will continue in 2024 and 2025.

It should be noted that TAC have been set for a larger area than Division 6.a. and include areas 6.b, 5.b and international waters of 12 and 14 (Annex IA to Regulation (EU) 2022/109).

Whiting are caught in mixed fisheries with cod and haddock in Division 6.a. There have been several technical conservation measures introduced in the 6.a gadoid fishery in recent years. The increase in mesh size from 100 mm to 120 mm, established under the emergency measures since 2010, and the introduction of large square mesh panels in the *Nephrops* fishery, are likely to have contributed to the observed reductions in fishing mortality.

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Table 36.1. Whiting in Division 6.a. Nominal landings (in tonnes) as officially reported to ICES in 1989–2022.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Belgium	1	-	+	-	+	+	+	-	1	1	+	-	-	-	-	+	-	-	-	-
Denmark	1	+	3	1	1	+	+	+	+	-	-	-	-	-	+	+	-	-	-	-
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
France	199	180	352	105	149	191	362	202	108	82	300	48	52	21	11	6	9	7	6	1
Germany	+	+	+	1	1	+	-	+	-	-	+	-	-	-	-	-	-	+	1	-
Ireland	1 315	977	1 200	1 377	1 192	1213	1 448	1 182	977	952	1121	793	764	577	568	356	172	196	56	69
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	1	-	1	2	+	-	2	-	-	-	-	-	-	-
UK (E, W and NI)	44	50	218	196	184	233	204	237	453	251	210	104	71	73	35	13	5	2	1	
UK (Scot.)	6 109	4 819	5 135	4 330	5 224	4 149	4 263	5 021	4 638	3 369	3 046	2 258	1 654	1 064	751	444	103	178	424	
UK (total)																				370
Total landings	7 669	6 026	6 908	6 010	6 751	5 786	6 278	6 642	6 178	4 657	4 677	3 203	2 543	1 735	1 365	819	289	383	488	441

Table 36.1. Continued.

Country	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
Belgium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Denmark	-	-	-	-	-	-	-	-	-	2	56	10	-	4	-
Faroe Islands	-	+	1	1	-	-	-	-	-	-	-	-	-	-	-
France	1	3	+	+	1	1	+	5	3	2	7	10	35	9	7
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	125	99	149	96	97	97	88	77	53	72	**	126	161	236	160
Netherlands	-	-	-	-	-	-	11	52	19	4	23	4	+	-	-
Norway	2	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-
UK (E, W and NI)															
UK (Scot.)															
UK (total)	354	247	80	204	116	83	122	98	94	108	241	387	654	371	392
Total landings	482	349	230	301	214	181	221	232	169	189	327**	537	851	621	559

*** Preliminary.**

**** Incomplete/missing due to part of the data being unavailable under national GDPR clauses.**

+ <0.5 t.

Table 36.2. Whiting in Division 6.a. Landings, discards and catch estimates for 1981–2022, as used by the WG. Values are totals for ages 1 to 7+ (in 1981–2002) and for ages 0 to 7+ (in 2003–2022). Discard and catch values for the years 1981–2002 are revised compared to previous assessments because of a revised method for raising discards (Millar and Fryer, 2005). Landings, discard, and catch values for the years 2003–2018 are revised InterCatch estimates (ICES, 2020a) compared to previous assessments.

Year	Landings	Discards	Total	Discard rate (%)
1981	12 203	2 132	14 335	15
1982	13 871	5 485	19 356	28
1983	15 970	6 294	22 264	28
1984	16 458	4 017	20 475	20
1985	12 893	4 840	17 733	27
1986	8 454	2 669	11 123	24
1987	11 544	11 918	23 462	51
1988	11 352	8 132	19 484	42
1989	7 531	5 876	13 407	44
1990	5 643	4 530	10 173	45
1991	6 660	4 883	11 543	42
1992	6 004	9 249	15 253	61
1993	6 872	4 759	11 631	41
1994	5 901	3 455	9 356	37
1995	6 076	5 771	11 847	49
1996	7 156	7 940	15 096	53
1997	6 285	5 251	11 536	46
1998	4 631	9 216	13 847	67
1999	4 613	3 975	8 588	46
2000	3 010	13 285	16 295	82
2001	2 438	4 263	6 701	64
2002	1 709	2 851	4 560	63
2003	1 331	1 984	3 316	60
2004	798	2 887	3 686	78
2005	335	972	1 307	74
2006	378	746	1 124	66
2007	481	366	847	43

Year	Landings	Discards	Total	Discard rate (%)
2008	441	156	598	26
2009	480	826	1 305	63
2010	345	1091	1 436	76
2011	231	630	861	73
2012	300	742	1 042	71
2013	215	1 172	1 387	85
2014	181	745	926	80
2015	221	1 458	1 679	87
2016	227	1 040	1 266	82
2017	168	1 331	1 498	89
2018	189	666	855	78
2019	484	960	1 444	66
2020	541	834	1 375	61
2021	852	261	1 114	23
2022	628	123	751	16
2023	558	118	677	17
Min	168	118	598	15
Mean	4 341	3 486	7 827	53
Max	16 458	13 285	23 462	89

Table 36.3. Whiting in Division 6.a. Landings-at-age (thousands).

	Age						
Year	1	2	3	4	5	6	7+
1981	3 593	24 395	11 297	4 611	1 518	452	201
1982	2 991	5 783	29 094	6 821	2 043	803	348
1983	3 418	7 094	8 040	22 757	6 070	1 439	540
1984	7 209	12 765	8 221	4 387	14 825	1 953	858
1985	4 139	19 520	8 574	3 351	1 997	4 764	822
1986	2 674	14 824	9 770	2 653	532	291	529
1987	6 430	13 935	13 988	5 442	837	330	259
1988	1 842	20 587	9 638	6 168	1 949	290	207
1989	2 529	5 887	11 889	4 767	1 266	468	71
1990	3 203	8 028	2 393	4 009	1 326	204	37
1991	3 294	8 826	10 046	1 208	1 391	286	51
1992	2 695	9 440	4 473	4 782	396	373	106
1993	1 051	10 179	6 293	2 673	2 738	163	147
1994	909	4 889	9 158	3 607	712	715	69
1995	215	4 322	6 516	5 654	1 397	376	282
1996	990	5 410	7 675	5 052	2 461	583	157
1997	877	3 658	8 514	4 316	1 441	338	106
1998	840	3 504	4 277	3 698	1 442	338	288
1999	1 013	6 131	4 546	2 040	1 774	355	112
2000	484	2 952	4 211	1 570	485	328	89
2001	461	3 271	2 630	1 567	401	131	16
2002	62	1 624	3 018	799	227	23	13
2003	98	652	1 309	1 481	414	93	2
2004	49	699	544	517	620	74	33
2005	26	273	460	145	107	49	5
2006	83	135	386	276	67	86	25
2007	193	190	294	361	152	31	53
2008	3	277	387	335	150	54	25
2009	108	255	258	417	107	49	14
2010	50	81	150	148	141	43	52
2011	0	256	144	94	27	26	8

	Age						
Year	1	2	3	4	5	6	7+
2012	13	39	374	203	53	16	9
2013	4	41	76	269	74	19	6
2014	13	26	130	101	101	23	11
2015	7	74	56	157	71	73	30
2016	19	93	147	77	86	19	28
2017	17	37	167	69	52	39	10
2018	0	73	89	199	60	8	8
2019	23	54	427	255	258	48	5
2020	7	309	258	310	156	39	3
2021	0	318	674	375	366	67	37
2022	2	79	439	279	144	206	2
2023	0	53	222	470	301	85	47

Table 36.4. Whiting in Division 6.a. Discards-at-age (thousands). Previous discard estimates for the years 1978–2003 were replaced by those estimated by Millar and Fryer (2005).

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	NA	1 128	10 415	1 397	201	27	12	0
1982	NA	19 511	3 421	12 683	1 197	187	4	0
1983	NA	21 690	6 748	2 909	5 372	158	8	0
1984	NA	34 330	2 400	909	371	811	73	1
1985	NA	17 615	9 858	3 273	672	205	363	40
1986	NA	6 159	9 823	1 962	185	1	0	10
1987	NA	97 611	17 427	1 763	154	0	0	0
1988	NA	28 057	38 019	2 239	467	11	0	0
1989	NA	31 079	5 598	8 570	223	13	5	0
1990	NA	20 952	11 176	71	23	3	0	0
1991	NA	23 211	7 540	7 355	266	236	56	0
1992	NA	50 665	16 729	2 810	954	0	0	0
1993	NA	14 057	11 139	2 903	588	431	0	1
1994	NA	12 700	6 859	3 872	1 152	189	150	4
1995	NA	21 974	21 786	3 416	484	7	1	1
1996	NA	33 621	18 625	5 086	1 535	13	1	20
1997	NA	22 422	9 632	3 806	540	71	2	1
1998	NA	53 742	16 058	3 553	847	177	31	8
1999	NA	7 928	17 097	1 402	503	275	44	0
2000	NA	158 913	5 254	2 238	154	16	41	0
2001	NA	5 666	23 084	715	172	0	0	0
2002	NA	11 055	8 531	2 428	415	175	9	3
2003	5 678	9 448	2 489	1 775	375	25	7	1
2004	10 577	14 941	5 095	1 011	660	125	4	2
2005	7 873	3 246	2 298	769	60	22	8	4
2006	5 866	4 691	528	637	169	29	6	2
2007	1 259	1 016	966	283	88	38	3	0
2008	840	630	144	114	31	37	4	0
2009	9 685	6 880	114	66	44	15	4	0
2010	5 903	17 678	1 581	264	37	54	6	16

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
2011	13 306	2 047	998	122	7	2	0	0
2012	1 434	7 810	429	547	94	19	1	0
2013	3 188	16 415	1 578	172	255	8	2	2
2014	6 261	9 831	51	55	27	30	8	3
2015	17 740	7 930	909	287	112	18	17	0
2016	3 745	5 506	1 910	268	16	12	4	2
2017	8 518	7 563	788	889	65	160	2	0
2018	1 777	2 371	962	469	276	21	5	0
2019	2 188	10 379	526	413	232	34	0	0
2020	NA	23 481	807	59	29	10	3	0
2021	2 579	156	467	80	44	89	0	0
2022	581	198	64	139	34	8	6	0
2023	2 076	211	71	7	2	1	0	0

Table 36.5. Whiting in Division 6.a. Total catch-at-age (thousands).

	Age							
Year	0	1	2	3	4	5	6	7+
1981	NA	4 721	34 810	12 694	4 812	1 545	464	201
1982	NA	22 502	9 204	41 777	8 018	2 230	807	348
1983	NA	25 108	13 842	10 949	28 129	6 228	1 447	540
1984	NA	41 539	15 165	9 130	4 758	15 636	2 026	859
1985	NA	21 754	29 378	11 847	4 023	2 202	5 127	862
1986	NA	8 833	24 647	11 732	2 838	533	291	539
1987	NA	104 041	31 362	15 751	5 596	837	330	259
1988	NA	29 899	58 606	11 877	6 635	1 960	290	207
1989	NA	33 608	11 485	20 459	4 990	1 279	473	71
1990	NA	24 155	19 204	2 464	4 032	1 329	204	37
1991	NA	26 505	16 366	17 401	1 474	1 627	342	51
1992	NA	53 360	26 169	7 283	5 736	396	373	106
1993	NA	15 108	21 318	9 196	3 261	3 169	163	148
1994	NA	13 609	11 748	13 030	4 759	901	865	73
1995	NA	22 189	26 108	9 932	6 138	1 404	377	283
1996	NA	34 611	24 035	12 761	6 587	2 474	584	177
1997	NA	23 299	13 290	12 320	4 856	1 512	340	107
1998	NA	54 582	19 562	7 830	4 545	1 619	369	296
1999	NA	8 941	23 228	5 948	2 543	2 049	399	112
2000	NA	159 397	8 206	6 449	1 724	501	369	89
2001	NA	6 127	26 355	3 345	1 739	401	131	16
2002	NA	11 117	10 155	5 446	1 214	402	32	16
2003	5 678	9 546	3 141	3 083	1 856	439	100	3
2004	10 577	14 990	5 794	1 556	1 176	745	78	35
2005	7 873	3 272	2 571	1 229	205	129	57	10
2006	5 866	4 773	663	1 023	445	96	93	27
2007	1 259	1 209	1 156	578	449	190	33	53
2008	840	632	421	500	366	187	58	25
2009	9 685	6 988	370	324	462	123	53	14
2010	5 903	17 729	1 662	414	185	196	49	68
2011	13 306	2 048	1 254	267	101	29	26	8

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
2012	1 434	7 823	469	920	298	72	17	9
2013	3 188	16 419	1 619	247	523	82	21	7
2014	6 261	9 844	77	185	127	130	31	14
2015	17 740	7 937	983	343	269	90	90	30
2016	3 745	5 525	2003	415	92	98	23	30
2017	8 518	7 580	825	1 056	134	212	41	10
2018	1 777	2 371	1 035	557	475	81	13	8
2019	2 188	10 402	580	840	486	293	48	5
2020	NA	23 488	1 116	317	339	166	42	3
2021	2 579	156	785	754	419	456	67	37
2022	581	201	142	578	312	153	211	2
2023	2 076	211	124	229	472	302	85	47

Table 36.6. Whiting in Division 6.a. Mean weight-at-age (kg) in landings.

	Age							
Year	0*	1	2	3	4	5	6	7+
1981	0.035	0.192	0.228	0.289	0.382	0.409	0.409	0.547
1982	0.035	0.184	0.22	0.276	0.352	0.505	0.513	0.526
1983	0.035	0.216	0.249	0.28	0.34	0.409	0.494	0.51
1984	0.035	0.216	0.259	0.313	0.371	0.412	0.458	0.458
1985	0.035	0.185	0.238	0.306	0.402	0.43	0.461	0.538
1986	0.035	0.174	0.236	0.294	0.365	0.468	0.482	0.499
1987	0.035	0.188	0.237	0.304	0.373	0.511	0.52	0.576
1988	0.035	0.176	0.215	0.301	0.4	0.483	0.567	0.6
1989	0.035	0.171	0.22	0.279	0.348	0.459	0.425	0.555
1990	0.035	0.225	0.251	0.324	0.359	0.417	0.582	0.543
1991	0.035	0.199	0.22	0.291	0.354	0.391	0.442	0.761
1992	0.035	0.193	0.23	0.288	0.349	0.388	0.397	0.51
1993	0.035	0.186	0.242	0.314	0.361	0.412	0.452	0.474
1994	0.035	0.161	0.217	0.29	0.371	0.451	0.482	0.483
1995	0.035	0.19	0.225	0.296	0.381	0.469	0.473	0.528
1996	0.035	0.195	0.245	0.288	0.365	0.483	0.526	0.569
1997	0.035	0.198	0.245	0.297	0.384	0.522	0.629	0.661
1998	0.035	0.215	0.236	0.301	0.364	0.438	0.5	0.646
1999	0.035	0.181	0.225	0.28	0.365	0.44	0.524	0.594
2000	0.035	0.205	0.241	0.298	0.336	0.419	0.488	0.617
2001	0.035	0.173	0.234	0.303	0.37	0.395	0.376	0.595
2002	0.035	0.213	0.257	0.304	0.363	0.464	0.650	0.707
2003	0.035	0.236	0.272	0.301	0.373	0.349	0.409	0.659
2004	0.035	0.189	0.257	0.296	0.342	0.376	0.378	0.305
2005	0.035	0.215	0.253	0.297	0.366	0.426	0.455	0.383
2006	0.035	0.221	0.290	0.321	0.395	0.452	0.496	0.574
2007	0.035	0.215	0.289	0.356	0.416	0.497	0.598	0.667
2008	0.035	0.285	0.245	0.319	0.379	0.516	0.534	0.652
2009	0.035	0.288	0.317	0.406	0.446	0.439	0.444	0.603
2010	0.035	0.286	0.353	0.436	0.540	0.647	0.654	0.575
2011	0.035	0.201	0.356	0.396	0.502	0.571	0.578	0.370

Year	Age 0*	1	2	3	4	5	6	7+
2012	0.035	0.320	0.300	0.374	0.504	0.594	0.665	0.482
2013	0.035	0.225	0.325	0.355	0.441	0.546	0.597	0.770
2014	0.035	0.248	0.295	0.375	0.457	0.528	0.641	0.678
2015	0.035	0.261	0.347	0.447	0.468	0.508	0.596	0.600
2016	0.035	0.137	0.325	0.483	0.509	0.606	0.676	0.664
2017	0.035	0.340	0.352	0.413	0.546	0.497	0.510	0.684
2018	0.035	0.173	0.407	0.396	0.435	0.520	0.472	0.564
2019	0.035	0.244	0.288	0.415	0.506	0.529	0.698	0.879
2020	0.035	0.235	0.406	0.482	0.551	0.597	0.657	1.058
2021	0.035	0.217**	0.301	0.418	0.585	0.577	0.620	0.658
2022	0.035	0.347	0.417	0.465	0.476	0.694	0.685	0.526
2023	0.035	0.275***	0.365	0.458	0.493	0.515	0.552	0.759

*** For age 0, mean weights-are assumed to be the average for discards in 2003–2019.**

**** For age 1 in 2021, mean weight-is assumed to be the average for age 1 in 2018–2020.**

***** For age 1 in 2023, mean weight-is assumed to be the average for age 1 in 2019–2020 and 2022.**

Table 36.7. Whiting in Division 6.a. Mean weight-at-age (kg) in discards.

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	0.035*	0.108	0.16	0.195	0.298	0.286	0.295	NA
1982	0.035*	0.096	0.18	0.209	0.243	0.283	0.44	NA
1983	0.035*	0.141	0.186	0.228	0.237	0.267	0.267	NA
1984	0.035*	0.087	0.199	0.246	0.26	0.259	0.303	0.227
1985	0.035*	0.102	0.191	0.237	0.286	0.326	0.312	0.316
1986	0.035*	0.092	0.17	0.196	0.245	0.258	0.33	0.263
1987	0.035*	0.085	0.182	0.233	0.249	0.225	NA	NA
1988	0.035*	0.076	0.143	0.203	0.227	0.262	NA	NA
1989	0.035*	0.099	0.177	0.205	0.209	0.294	0.305	NA
1990	0.035*	0.124	0.171	0.214	0.219	0.237	0.264	NA
1991	0.035*	0.085	0.169	0.205	0.223	0.226	0.281	NA
1992	0.035*	0.109	0.173	0.219	0.227	NA	NA	NA
1993	0.035*	0.118	0.197	0.225	0.242	0.256	NA	0.436
1994	0.035*	0.087	0.157	0.22	0.283	0.297	0.253	0.299
1995	0.035*	0.075	0.154	0.189	0.246	0.278	0.597	0.493
1996	0.035*	0.095	0.18	0.203	0.229	0.302	0.421	0.26
1997	0.035*	0.112	0.182	0.221	0.235	0.243	0.422	0.819
1998	0.035*	0.098	0.179	0.225	0.254	0.282	0.264	0.245
1999	0.035*	0.077	0.168	0.217	0.205	0.266	0.268	NA
2000	0.035*	0.075	0.164	0.203	0.233	0.282	0.250	NA
2001	0.035*	0.094	0.154	0.196	0.203	0.381	0.000	NA
2002	0.035*	0.073	0.162	0.212	0.245	0.240	0.295	0.276
2003	0.051	0.091	0.161	0.193	0.243	0.209	0.291	0.278
2004	0.020	0.091	0.178	0.223	0.233	0.302	0.343	0.282
2005	0.028	0.074	0.145	0.207	0.188	0.302	0.289	0.368
2006	0.037	0.047	0.195	0.233	0.285	0.311	0.494	0.361
2007	0.042	0.064	0.157	0.232	0.223	0.231	0.787	0.266
2008	0.019	0.076	0.211	0.305	0.350	0.423	0.233	0.289
2009	0.043	0.051	0.283	0.227	0.262	0.250	0.248	NA
2010	0.018	0.040	0.119	0.239	0.360	0.360	0.382	0.224
2011	0.029	0.034	0.136	0.307	0.256	0.228	NA	NA

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
2012	0.042	0.057	0.152	0.292	0.362	0.356	0.386	NA
2013	0.027	0.041	0.209	0.229	0.358	0.385	0.299	0.371
2014	0.040	0.045	0.182	0.289	0.362	0.427	0.422	0.757
2015	0.035	0.072	0.171	0.212	0.336	0.316	0.427	NA
2016	0.050	0.068	0.206	0.276	0.292	0.304	0.261	0.367
2017	0.033	0.066	0.197	0.351	0.409	0.331	0.881	NA
2018	0.054	0.067	0.184	0.250	0.307	0.414	1.107	NA
2019	0.029	0.055	0.199	0.267	0.278	0.436	0.489	NA
2020	0.035*	0.028	0.163	0.254	0.313	0.286	0.255	NA
2021	0.029	0.143	0.236	0.279	0.270	0.236	NA	NA
2022	0.063	0.101	0.208	0.276	0.320	0.302	0.323	NA
2023	0.037	0.133	0.168	0.240	0.201	0.208	NA	NA

*** For age 0 in 1981–2002 and 2020, mean weights-are assumed to be the average for 2003–2019.**

Table 36.8. Whiting in Division 6.a. Mean weight-at-age (kg) in total catch.

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	0.035*	0.172	0.208	0.279	0.378	0.407	0.406	0.547
1982	0.035*	0.108	0.205	0.256	0.336	0.486	0.513	0.526
1983	0.035*	0.151	0.218	0.266	0.320	0.405	0.493	0.510
1984	0.035*	0.109	0.250	0.306	0.362	0.404	0.452	0.458
1985	0.035*	0.118	0.222	0.287	0.383	0.420	0.450	0.528
1986	0.035*	0.117	0.210	0.278	0.357	0.468	0.482	0.495
1987	0.035*	0.091	0.206	0.296	0.370	0.511	0.520	0.576
1988	0.035*	0.082	0.168	0.283	0.388	0.482	0.567	0.600
1989	0.035*	0.104	0.199	0.248	0.342	0.457	0.424	0.555
1990	0.035*	0.137	0.204	0.321	0.358	0.417	0.582	0.543
1991	0.035*	0.099	0.197	0.255	0.330	0.367	0.416	0.761
1992	0.035*	0.113	0.194	0.261	0.329	0.388	0.397	0.510
1993	0.035*	0.123	0.218	0.286	0.340	0.391	0.452	0.474
1994	0.035*	0.092	0.182	0.269	0.350	0.419	0.442	0.473
1995	0.035*	0.076	0.166	0.259	0.370	0.468	0.473	0.528
1996	0.035*	0.098	0.195	0.254	0.333	0.482	0.526	0.534
1997	0.035*	0.115	0.199	0.274	0.367	0.509	0.628	0.662
1998	0.035*	0.100	0.189	0.267	0.344	0.421	0.480	0.635
1999	0.035*	0.089	0.183	0.265	0.333	0.417	0.496	0.594
2000	0.035*	0.075	0.192	0.265	0.327	0.415	0.462	0.617
2001	0.035*	0.100	0.164	0.280	0.353	0.395	0.376	0.595
2002	0.035*	0.074	0.177	0.263	0.323	0.366	0.550	0.626
2003	0.051	0.092	0.184	0.239	0.347	0.341	0.401	0.516
2004	0.020	0.091	0.188	0.249	0.281	0.364	0.377	0.304
2005	0.028	0.075	0.156	0.241	0.313	0.405	0.432	0.376
2006	0.037	0.050	0.214	0.266	0.353	0.410	0.495	0.557
2007	0.042	0.088	0.179	0.295	0.378	0.444	0.613	0.666
2008	0.019	0.077	0.233	0.316	0.376	0.498	0.514	0.648
2009	0.043	0.054	0.307	0.369	0.429	0.415	0.430	0.603
2010	0.018	0.040	0.130	0.311	0.504	0.567	0.622	0.492
2011	0.029	0.034	0.181	0.355	0.485	0.546	0.578	0.370

	Age							
Year	0	1	2	3	4	5	6	7+
2012	0.042	0.057	0.164	0.325	0.459	0.531	0.643	0.482
2013	0.027	0.041	0.212	0.268	0.401	0.530	0.571	0.679
2014	0.040	0.045	0.220	0.349	0.437	0.505	0.581	0.694
2015	0.035	0.072	0.185	0.250	0.413	0.469	0.565	0.600
2016	0.050	0.068	0.211	0.349	0.472	0.568	0.601	0.649
2017	0.033	0.066	0.204	0.361	0.480	0.372	0.524	0.684
2018	0.054	0.067	0.199	0.273	0.361	0.492	0.731	0.564
2019	0.029	0.055	0.207	0.342	0.397	0.518	0.697	0.879
2020	0.035*	0.028	0.230	0.439	0.531	0.579	0.625	1.058
2021	0.029	0.143	0.262	0.403	0.552	0.510	0.620	0.658
2022	0.063	0.104	0.323	0.420	0.459	0.672	0.675	0.526
2023	0.037	0.133	0.252	0.452	0.492	0.514	0.552	0.759

*** For age 0 in 1981–2002 and 2020, mean weights-are assumed to be the average for 2003–2019.**

Table 36.9. Whiting in Division 6.a. Mean weight-at-age (kg) in stock. These are smoothed estimates for use in SSB calculation.

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	0.038	0.048	0.151	0.271	0.374	0.478	0.558	0.634
1982	0.038	0.048	0.151	0.271	0.374	0.478	0.558	0.634
1983	0.038	0.048	0.151	0.271	0.374	0.478	0.558	0.634
1984	0.038	0.048	0.151	0.271	0.374	0.478	0.558	0.634
1985	0.038	0.048	0.151	0.271	0.374	0.478	0.558	0.634
1986	0.037	0.048	0.152	0.268	0.369	0.472	0.555	0.629
1987	0.037	0.048	0.152	0.266	0.365	0.466	0.553	0.625
1988	0.037	0.048	0.153	0.263	0.361	0.46	0.551	0.62
1989	0.037	0.048	0.152	0.26	0.358	0.455	0.548	0.615
1990	0.036	0.048	0.152	0.258	0.355	0.45	0.545	0.61
1991	0.036	0.049	0.151	0.256	0.354	0.445	0.541	0.606
1992	0.036	0.049	0.149	0.254	0.353	0.442	0.538	0.601
1993	0.036	0.049	0.147	0.252	0.352	0.44	0.535	0.596
1994	0.036	0.049	0.145	0.25	0.351	0.439	0.532	0.592
1995	0.035	0.049	0.143	0.249	0.349	0.439	0.53	0.588
1996	0.035	0.049	0.141	0.248	0.347	0.438	0.527	0.584
1997	0.035	0.049	0.139	0.247	0.345	0.436	0.525	0.581
1998	0.035	0.05	0.138	0.247	0.341	0.433	0.523	0.578
1999	0.034	0.05	0.137	0.247	0.338	0.429	0.522	0.576
2000	0.034	0.05	0.136	0.248	0.334	0.424	0.52	0.575
2001	0.034	0.05	0.135	0.25	0.331	0.421	0.52	0.574
2002	0.034	0.05	0.136	0.252	0.33	0.419	0.52	0.573
2003	0.034	0.05	0.136	0.255	0.331	0.42	0.522	0.574
2004	0.033	0.051	0.138	0.259	0.335	0.426	0.525	0.576
2005	0.033	0.051	0.14	0.264	0.344	0.435	0.53	0.578
2006	0.033	0.051	0.142	0.269	0.357	0.449	0.537	0.581
2007	0.033	0.051	0.145	0.275	0.374	0.465	0.546	0.585
2008	0.033	0.051	0.148	0.282	0.392	0.483	0.555	0.59
2009	0.033	0.051	0.152	0.288	0.411	0.5	0.566	0.595
2010	0.033	0.052	0.155	0.294	0.428	0.515	0.576	0.6

Year	Age 0	1	2	3	4	5	6	7+
2011	0.033	0.052	0.158	0.3	0.442	0.529	0.586	0.606
2012	0.034	0.052	0.16	0.305	0.452	0.538	0.595	0.612
2013	0.034	0.052	0.163	0.309	0.458	0.545	0.603	0.618
2014	0.034	0.052	0.164	0.313	0.461	0.55	0.609	0.623
2015	0.035	0.052	0.165	0.316	0.461	0.552	0.614	0.629
2016	0.035	0.053	0.165	0.319	0.46	0.552	0.618	0.634
2017	0.035	0.053	0.164	0.321	0.457	0.55	0.619	0.639
2018	0.036	0.053	0.162	0.323	0.453	0.547	0.62	0.643
2019	0.036	0.053	0.16	0.324	0.448	0.542	0.618	0.647
2020	0.036	0.053	0.157	0.325	0.44	0.535	0.616	0.649
2021	0.037	0.053	0.154	0.325	0.429	0.525	0.613	0.652
2022	0.037	0.053	0.15	0.324	0.415	0.514	0.609	0.654
2023	0.038	0.054	0.146	0.323	0.4	0.502	0.604	0.656
2024	0.038	0.054	0.142	0.321	0.383	0.489	0.599	0.657

Table 36.10. Whiting in Division 6.a. Natural mortality.

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	1.048	1.014	0.710	0.591	0.538	0.499	0.479	0.462
1982	1.048	1.014	0.710	0.591	0.538	0.499	0.479	0.462
1983	1.048	1.014	0.710	0.591	0.538	0.499	0.479	0.462
1984	1.048	1.014	0.710	0.591	0.538	0.499	0.479	0.462
1985	1.048	1.014	0.710	0.591	0.538	0.499	0.479	0.462
1986	1.050	0.997	0.708	0.593	0.540	0.502	0.479	0.463
1987	1.052	0.981	0.706	0.595	0.543	0.504	0.480	0.464
1988	1.054	0.967	0.704	0.596	0.544	0.507	0.480	0.465
1989	1.055	0.954	0.702	0.598	0.546	0.510	0.481	0.466
1990	1.057	0.941	0.700	0.599	0.547	0.512	0.482	0.467
1991	1.059	0.929	0.698	0.600	0.548	0.514	0.484	0.468
1992	1.061	0.918	0.696	0.601	0.548	0.515	0.485	0.469
1993	1.063	0.907	0.694	0.602	0.548	0.515	0.486	0.470
1994	1.065	0.898	0.692	0.602	0.547	0.514	0.488	0.471
1995	1.067	0.888	0.689	0.601	0.547	0.512	0.489	0.472
1996	1.069	0.880	0.686	0.601	0.547	0.510	0.491	0.473
1997	1.070	0.872	0.683	0.600	0.546	0.509	0.493	0.474
1998	1.072	0.865	0.680	0.599	0.547	0.510	0.494	0.474
1999	1.074	0.859	0.677	0.597	0.547	0.512	0.496	0.475
2000	1.077	0.854	0.674	0.596	0.548	0.516	0.497	0.475
2001	1.079	0.849	0.671	0.594	0.549	0.521	0.499	0.476
2002	1.081	0.845	0.668	0.592	0.550	0.526	0.499	0.476
2003	1.083	0.841	0.665	0.590	0.550	0.530	0.499	0.476
2004	1.085	0.838	0.662	0.587	0.548	0.531	0.497	0.476
2005	1.086	0.836	0.659	0.584	0.545	0.528	0.495	0.476
2006	1.087	0.834	0.656	0.580	0.540	0.522	0.492	0.475
2007	1.087	0.832	0.653	0.576	0.533	0.513	0.488	0.474
2008	1.087	0.830	0.651	0.572	0.527	0.505	0.484	0.474
2009	1.087	0.829	0.649	0.568	0.520	0.496	0.480	0.473
2010	1.086	0.827	0.646	0.564	0.515	0.490	0.476	0.472
2011	1.084	0.825	0.645	0.561	0.510	0.485	0.472	0.471

	Age							
Year	0	1	2	3	4	5	6	7+
2012	1.082	0.824	0.643	0.559	0.507	0.482	0.469	0.470
2013	1.080	0.822	0.642	0.557	0.506	0.481	0.467	0.469
2014	1.077	0.820	0.642	0.556	0.505	0.481	0.465	0.468
2015	1.074	0.819	0.642	0.555	0.505	0.481	0.464	0.467
2016	1.071	0.817	0.642	0.554	0.506	0.482	0.464	0.466
2017	1.068	0.816	0.643	0.554	0.507	0.482	0.464	0.465
2018	1.064	0.815	0.645	0.554	0.508	0.483	0.465	0.464
2019	1.061	0.814	0.646	0.555	0.510	0.485	0.466	0.463
2020	1.057	0.813	0.648	0.557	0.514	0.488	0.468	0.463
2021	1.053	0.812	0.651	0.560	0.518	0.492	0.470	0.462
2022	1.050	0.812	0.654	0.563	0.524	0.497	0.473	0.462
2023	1.046	0.811	0.657	0.566	0.531	0.505	0.476	0.461
2024	1.042	0.811	0.660	0.570	0.539	0.513	0.479	0.461

Table 36.11. Whiting in Division 6.a. Survey data made available to the WG. For the Scottish and Irish surveys, numbers are standardised to catch-rate per ten hours. The Scottish surveys from 2011 have been conducted according to the new design and ground gear.

ScoGFS-WIBTS-Q1 – Scottish Groundfish Survey – numbers-at-age/10 h								
Year	Effort	Age						
	(hours)	1	2	3	4	5	6	7
1985	10	3 140	1 792	380	85	23	156	18
1986	10	1 456	1 525	403	68	10	9	10
1987	10	6 938	1 054	584	142	36	2	1
1988	10	567	3 469	654	189	42	5	1
1989	10	910	505	586	237	48	3	0
1990	10	1 818	571	122	216	61	4	1
1991	10	3 203	276	299	22	39	9	1
1992	10	4 777	1 597	410	517	56	18	0
1993	10	5 532	6 829	644	91	30	11	2
1994	10	6 614	2 443	1 487	174	56	15	6
1995	10	5 598	2 831	1 160	370	70	17	32
1996	10	9 385	2 237	635	341	135	30	4
1997	10	5 663	2 444	1 531	355	102	17	4
1998	10	9 851	1 352	294	195	50	14	1
1999	10	6 125	4 952	489	103	16	1	0
2000	10	12 862	471	152	34	10	11	0
2001	10	4 653	1 955	242	41	8	1	1
2002	10	5 542	1 028	964	89	15	1	1
2003	10	6 934	746	436	300	32	2	4
2004	10	5 887	1 566	189	131	44	9	1
2005	10	1 308	723	183	35	8	11	2
2006	10	1 441	466	282	77	0	3	1
2007	10	614	522	127	75	16	3	2
2008	10	593	127	77	26	8	3	0
2009	10	906	387	103	105	20	9	7
2010	10	3 523	340	108	52	40	4	3

Table 36.11. Continued.

UK-SCOWCGFS-Q1 – Scottish Groundfish Survey – numbers-at-age/10 h															
		Index							Variance						
Year	Effort	Age							Age						
	(hours)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2011	10	222	1 884	397	64	37	45	12	6 431	150 861	5 654	209	80	133	11
2012	10	3 441	293	738	72	14	5	7	600 264	8 104	18 380	184	9	2	3
2013	10	552	1 031	302	463	61	7	3	62 915	46 672	50 56	15 023	443	7	1
2014	10	5 805	125	246	110	74	7	1	2 230 995	556	2 133	657	333	2	0
2015	10	2 545	760	285	259	65	58	8	144 266	46 202	8 599	4 562	305	352	10
2016	10	3 226	3 485	576	148	84	42	25	397 138	1 880 448	28 776	691	260	95	48
2017	10	4 970	1 981	1 707	203	49	32	5	2 335 667	309 373	227 966	2 958	172	99	3
2018	10	1 960	1 827	1 069	1 142	132	14	2	763 992	330 295	91 346	108 990	2 138	70	0
2019	10	3 231	666	577	191	99	25	0	345 197	29 689	21 447	1 786	536	30	0
2020	10	3 795	2 263	711	572	178	110	27	1 369 852	699 830	68 242	27 213	3 694	1 736	415
2021	10	774	1 679	703	272	140	24	11	29 371	129 127	23 776	3 259	1 173	30	10
2022	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2023	10	1 408	809	670	563	98	29	21	152 501	105 577	37 319	34 070	622	114	119
2024	10	2 324	594	341	219	99	8	2	421 333	16 839	8 880	2 729	731	5	0

Table 36.11. Continued.

Comb-WCGFS-Q4 – Combined Scottish and Irish Groundfish Survey – numbers-at-age per hour									
Index									
Year	Effort	Age							
	(hours)	0	1	2	3	4	5	6	7+
1996	1	9 215.1	442.2	98.8	30.3	7.8	3.0	0.5	0.0
1997	1	2 088.1	700.4	159.9	34.8	10.9	2.3	0.4	0.1
1998	1	698.0	644.7	204.7	21.9	9.7	2.1	0.4	0.7
1999	1	2 637.2	220.2	97.3	14.7	4.7	2.1	0.1	0.3
2000	1	3 214.2	1 041.4	161.5	26.0	1.5	1.2	0.2	0.4
2001	1	327.0	394.2	399.5	30.6	4.8	2.5	0.3	0.1
2002	1	2 563.8	277.4	110.6	57.0	4.1	1.3	0.4	0.1
2003	1	668.1	479.4	73.5	32.9	10.4	2.0	0.5	0.2
2004	1	249.4	197.3	74.7	7.7	4.6	3.1	0.2	0.2
2005	1	201.4	68.0	43.7	10.7	1.1	0.4	0.1	0.1
2006	1	144.2	50.0	27.3	11.8	3.2	0.7	0.1	0.0
2007	1	134.1	58.6	39.2	11.3	4.5	2.6	0.3	0.1
2008	1	20.8	41.0	19.3	16.1	4.2	3.1	0.5	0.1
2009	1	1 807.6	22.6	16.6	5.1	2.6	0.8	0.4	0.4
2010	1	84.1	306.5	35.4	9.0	2.6	1.2	0.2	0.3
2011	1	501.6	32.7	157.0	20.5	7.2	2.4	1.3	0.4
2012	1	99.4	237.9	51.2	70.6	17.0	2.4	0.7	0.3
2013	1	2 410.7	38.5	92.4	28.3	30.4	5.0	0.6	0.1
2014	1	9 118.8	240.1	46.3	39.0	10.4	8.2	1.9	0.2
2015	1	932.9	763.4	119.4	28.3	19.1	4.5	2.8	0.2
2016	1	648.8	310.5	293.7	40.4	9.0	10.6	1.6	2.2
2017	1	682.6	158.6	112.2	120.0	18.9	2.7	1.3	0.7
2018	1	3 391.5	131.8	92.3	37.4	20.3	2.9	0.1	0.4
2019	1	3 417.2	436.8	46.7	22.6	9.5	3.5	0.6	0.1
2020	1	1 252.3	422.3	167.2	24.1	12.1	4.0	2.1	0.2
2021	1	1 808.0	129.1	156.6	35.9	6.7	4.0	2.0	0.2
2022	1	374.7	250.4	99.2	70.7	16.2	3.3	0.6	0.4
2023	1	1 495.5	198.0	91.4	51.2	29.9	5.4	0.6	0.5

Table 36.11. Continued.

Comb-WCGFS-Q4 – Combined Scottish and Irish Groundfish Survey – numbers-at-age per hour									
Variance									
Year	Effort	Age							
	(hours)	0	1	2	3	4	5	6	7+
1996	1	23 961 466.1	34 136.3	1 362.5	112.7	6.8	1.2	0.0	0.0
1997	1	818 438.9	59 116.2	2 574.1	115.1	10.0	0.4	0.0	0.0
1998	1	101 826.3	53 669.8	4 316.2	37.4	8.1	0.4	0.0	0.0
1999	1	1 235 315.9	5 446.8	976.2	19.7	2.0	0.5	0.0	0.0
2000	1	1 414 249.8	112 345.6	2 063.0	38.3	0.2	0.1	0.0	0.0
2001	1	19 840.7	11 835.8	12 644.5	52.4	1.3	0.4	0.0	0.0
2002	1	886 163.9	6 145.8	694.2	162.9	0.8	0.1	0.0	0.0
2003	1	50 261.8	12 924.1	228.3	34.6	3.3	0.1	0.0	0.0
2004	1	7 654.9	2 303.1	244.7	2.3	0.8	0.3	0.0	0.0
2005	1	4 382.9	247.7	86.1	4.6	0.1	0.0	0.0	0.0
2006	1	3 775.0	123.3	31.3	5.1	0.4	0.0	0.0	0.0
2007	1	1 948.5	192.7	66.9	4.7	0.7	0.2	0.0	0.0
2008	1	122.2	113.7	20.9	11.2	0.6	0.3	0.0	0.0
2009	1	301 119.1	42.2	14.1	1.2	0.3	0.0	0.0	0.0
2010	1	1 967.0	12 744.8	120.5	7.8	0.9	0.2	0.0	0.0
2011	1	29 617.7	66.1	1 152.7	15.9	1.7	0.2	0.1	0.0
2012	1	1 979.9	3 268.8	113.2	156.2	9.0	0.2	0.0	0.0
2013	1	929 854.7	112.1	498.1	42.2	40.9	0.9	0.0	0.0
2014	1	6 966 939.4	2 775.1	107.0	52.2	3.8	1.8	0.1	0.0
2015	1	71 987.0	30 170.3	628.7	30.5	11.5	0.6	0.2	0.0
2016	1	41 891.0	5 222.7	3 417.7	56.5	3.1	3.2	0.1	0.1
2017	1	53 311.8	1 579.5	558.1	563.5	12.6	0.2	0.1	0.0
2018	1	1 232 936.0	942.3	448.1	53.7	13.7	0.3	0.0	0.0
2019	1	1 193 191.5	10 707.7	90.9	17.2	3.3	0.4	0.0	0.0
2020	1	178 139.6	11 162.3	1 303.5	24.1	4.8	0.6	0.1	0.0
2021	1	327 793.5	1 022.5	966.2	49.4	1.9	0.6	0.1	0.0
2022	1	17 641.2	3 573.9	478.3	192.0	9.3	0.4	0.0	0.0
2023	1	233 225.7	2 382.7	402.8	99.5	26.0	0.9	0.0	0.0

Table 36.12. Whiting in Division 6.a. SAM configuration settings for assessment of 6.a whiting agreed at WKNSEA 2021.

Model Setting	Setting name	Configuration & details
Minimum age in model	$minage	0
Maximum age in model	$maxAge	7
Maximum age plus group	$maxAgePlusGroup	Maximum age plus group applies to both the commercial catch data and modelled Q4 survey index
Coupling of the fishing mortality states processes	$keyLogFsta	Uncoupled across all age classes
Correlation of fishing mortality across ages	$corFlag	AR(1) first order autoregressive
Coupling of the survey catchability parameters	$keyLogFpar	WCIBTS.Q1: ages 1 to 4 uncoupled; ages 5 and 6 coupled SCO.Q1: ages 1 to 4 uncoupled; ages 5 and 6 coupled SWC.Q4: ages 0 to 5 uncoupled; ages 6 and 7+ coupled
Density dependent catchability power parameters	$keyQpow	n/a
Coupling of process variance parameters for *log*(F) process	$keyVarF	Coupled across all age classes
Coupling of the recruitment and survival process variance parameters	$keyVarLogN	Age 0 uncoupled; ages 1 to 7+ coupled
Coupling of the variance parameters for the observations	$keyVarObs	Catch: age 0 uncoupled; ages 1 to 6 coupled; age 7+ uncoupled WCIBTS.Q1: ages 1 to 6 coupled SCO.Q1: ages 1 to 6 coupled SWC.Q4: age 0 uncoupled; ages 1 to 4 coupled; ages 5 to 7+ coupled
Covariance structure for each fleet	$obsCorStruct	Catch: Independent (”ID”) WCIBTS.Q1: ”ID” SCO.Q1: ”ID” SWC.Q4: first order autoregressive (”AR1”)
Coupling of correlation parameters for fleet covariance	$keyCorObs	SWC.Q4: ages 0 and 1 coupled; ages 1 to 6 coupled; ages 6 and 7+ coupled
Stock recruitment code	$stockRecruitmentModelCode	0; Plain random walk
Number of years where catch scaling is applied	$noScaledYears	0
Years where catch is scaled	$keyScaledYears	n/a
Matrix specifying the couplings of scale parameters	$keyParScaledYA	n/a
Lowest and highest ages included in $\bar{F}$	$fbarRange	1, 3

Model Setting	Setting name	Configuration & details
Biomass survey configuration	$keyBiomassTreat	n/a
Observational likelihood	$obsLikelihoodFlag	Catch: ”LN” WCIBTS.Q1: ”LN” SCO.Q1: ”LN” SWC.Q4: ”LN”
Observation weighting configuration	$fixVarToWeight	0
Fraction of t(3) distribution used in logF increment distribution	$fracMixF	0
Fraction of t(3) distribution used in logN increment distribution	$fracMixN	0
Fraction of t(3) distribution used in distribution of fleets	$fracMixObs	Catch: 0 WCIBTS.Q1: 0 SCO.Q1: 0 SWC.Q4: 0
Break years between which recruitment is constant	$constRecBreaks	n/a
Coupling of parameters used in a prediction-variance link for observations	$predVarObsLink	n/a

Table 36.13. Whiting in Division 6.a. Parameter estimates from the updated SAM assessment model.

Parameter name	par	sd(par)	exp(par)	Low	High
logFpar_0	-5.940	0.158	0.003	0.002	0.004
logFpar_1	-5.980	0.159	0.003	0.002	0.003
logFpar_2	-6.139	0.163	0.002	0.002	0.003
logFpar_3	-6.262	0.173	0.002	0.001	0.003
logFpar_4	-6.956	0.197	0.001	0.001	0.001
logFpar_5	-5.887	0.233	0.003	0.002	0.004
logFpar_6	-5.735	0.243	0.003	0.002	0.005
logFpar_7	-5.529	0.241	0.004	0.002	0.006
logFpar_8	-5.762	0.251	0.003	0.002	0.005
logFpar_9	-6.476	0.249	0.002	0.001	0.003
logFpar_10	-4.586	0.221	0.010	0.007	0.016
logFpar_11	-5.192	0.182	0.006	0.004	0.008
logFpar_12	-5.205	0.180	0.005	0.004	0.008
logFpar_13	-5.606	0.185	0.004	0.003	0.005
logFpar_14	-6.057	0.201	0.002	0.002	0.003
logFpar_15	-6.451	0.239	0.002	0.001	0.003
logFpar_16	-7.375	0.270	0.001	0.000	0.001
logSdLogFsta_0	-0.932	0.130	0.394	0.304	0.511
logSdLogN_0	-0.534	0.159	0.586	0.426	0.806
logSdLogN_1	-1.780	0.241	0.169	0.104	0.273
logSdLogObs_0	-0.146	0.199	0.864	0.581	1.287
logSdLogObs_1	-1.015	0.084	0.362	0.306	0.429
logSdLogObs_2	-0.387	0.146	0.679	0.507	0.909
logSdLogObs_3	-0.333	0.066	0.716	0.628	0.817
logSdLogObs_4	-0.416	0.092	0.659	0.548	0.793
logSdLogObs_5	0.905	0.144	2.471	1.854	3.294
logSdLogObs_6	0.747	0.134	2.110	1.613	2.761
logSdLogObs_7	1.192	0.098	3.295	2.708	4.009
transfIRARdist_0	3.362	1033.357	28.842	0.000	Inf
transfIRARdist_1	-0.944	0.290	0.389	0.218	0.695
transfIRARdist_2	3.338	959.230	28.172	0.000	Inf
itrans_rho_0	1.381	0.174	3.977	2.808	5.632

*** The relatively large standard deviation (and associated uncertainty) around the estimate of transfIRARdist_0, the coupled AR1 parameter for ages 0 and 1, indicates a weak to non-existent level of autocorrelation between age groups 0 and 1.**

Table 36.14. Whiting in Division 6.a. SAM estimated population numbers-at-age (thousands).

	Age							
Year	0	1	2	3	4	5	6	7+
1981	771 432	192 865	474 697	81 624	22 401	7 027	2 135	1 947
1982	802 649	262 956	71 768	212 370	36 032	9 644	3 102	2 031
1983	1 057 279	265 560	79 471	31 584	89 364	14 702	3 916	2 343
1984	882 653	365 190	79 836	27 120	11 379	31 668	4 747	2 448
1985	755 450	290 866	112 582	26 945	7 699	3 347	8 907	2 344
1986	1 327 500	234 687	98 440	36 825	7 135	1 668	721	2 687
1987	508 129	502 497	89 866	37 853	12 750	2 193	503	1 380
1988	76 1756	146 708	158 894	32 327	11 530	3 505	548	705
1989	662 646	253 360	39 585	46 144	10 375	2 781	771	406
1990	869 151	205 377	90 202	11 492	13 356	3 117	653	367
1991	1 154 035	283 768	66 846	39 946	4 230	4 603	1 051	415
1992	797 123	397 768	100 263	24 849	16 641	1 565	1 547	616
1993	810 718	252 008	138 349	36 766	9 182	6 542	582	939
1994	774 685	268 850	92 099	53 005	13 953	3 348	2 418	713
1995	699 336	257 475	105 162	38 448	19 549	5 084	1 242	1 357
1996	652 068	227 365	93 417	38 981	14 122	6 339	1 757	1 155
1997	671 256	201 825	68 123	33 465	12 189	4 037	1 670	1 165
1998	419 217	223 678	63 950	20 820	11 390	3 463	1 180	1 264
1999	881 000	119 337	66 536	15 818	5 583	3 107	776	972
2000	345 682	316 660	39 532	17 586	3 466	1 338	748	697
2001	214 355	98 346	90 077	12 064	3 958	878	316	538
2002	286 421	64 670	35 239	27 576	3 909	1 252	261	403
2003	222 286	90 773	17 493	13 023	8 335	1 451	519	336
2004	124 051	73 846	28 515	5 412	4 419	3 137	569	463
2005	113 382	36 684	22 036	8 962	1 626	1 462	1 160	537
2006	72 258	37 407	13 125	8 712	3 614	751	733	957
2007	66 243	21 993	14 727	5 944	3 747	1 781	385	979
2008	114 582	21 120	8 254	7 248	2 831	1 946	869	790
2009	319 627	39 232	9 686	4 198	3 779	1 468	1 052	961

	Age							
Year	0	1	2	3	4	5	6	7+
2010	100 434	120 512	16 014	5 027	2 139	2 187	780	1 210
2011	207 373	27 457	46 321	8 103	2 697	1 095	1 297	1 115
2012	112 734	73 875	12 134	21 188	5 212	1 345	640	1 358
2013	248 821	34 603	27 633	7 250	11 377	2 748	788	1 181
2014	466 898	81 534	10 453	12 221	4 433	5 686	1 600	1 235
2015	309 414	155 808	27 667	6 807	7 478	2 602	3 638	1 761
2016	262 163	97 775	68 137	13 619	3 842	4 286	1 570	3 287
2017	200 433	90 726	37 660	34 450	7 501	2 255	2 380	2 614
2018	412 457	60 039	37 013	19 371	16 450	4 073	1 178	2 643
2019	470 407	147 908	23 122	17 980	10 193	7 722	2 301	2 068
2020	194 516	175 917	54 593	12 213	10 222	5 258	4 160	2 324
2021	150 456	61 661	66 152	23 737	7 142	6 236	2 927	3 543
2022	137 953	48 601	26 872	32 357	11 723	4 055	3 773	3 261
2023	260 622	45 560	20 833	15 300	17 598	5 988	2 274	4 145
2024	260 622	91 255	20 014	10 597	8 396	9 672	2 985	3 952

Table 36.15. Whiting in Division 6.a. SAM estimates for F-at-age

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	0.025	0.059	0.123	0.219	0.278	0.313	0.329	0.160
1982	0.038	0.097	0.192	0.313	0.370	0.407	0.424	0.203
1983	0.053	0.138	0.290	0.473	0.552	0.613	0.631	0.289
1984	0.060	0.160	0.359	0.603	0.725	0.801	0.835	0.370
1985	0.061	0.164	0.411	0.714	0.931	1.037	1.095	0.459
1986	0.048	0.124	0.304	0.486	0.631	0.708	0.781	0.327
1987	0.077	0.214	0.457	0.631	0.785	0.883	0.961	0.376
1988	0.092	0.263	0.537	0.686	0.867	1.003	1.046	0.393
1989	0.082	0.230	0.477	0.621	0.755	0.895	0.901	0.329
1990	0.061	0.166	0.325	0.420	0.508	0.588	0.565	0.211
1991	0.060	0.164	0.334	0.435	0.507	0.557	0.512	0.192
1992	0.059	0.159	0.323	0.422	0.482	0.502	0.452	0.173
1993	0.046	0.122	0.262	0.383	0.482	0.522	0.465	0.175
1994	0.042	0.109	0.235	0.356	0.459	0.491	0.441	0.162
1995	0.054	0.148	0.308	0.439	0.545	0.569	0.486	0.173
1996	0.075	0.212	0.420	0.591	0.712	0.743	0.577	0.191
1997	0.075	0.215	0.413	0.574	0.649	0.675	0.498	0.157
1998	0.102	0.303	0.571	0.784	0.835	0.897	0.668	0.193
1999	0.094	0.281	0.550	0.817	0.899	0.933	0.724	0.190
2000	0.111	0.339	0.558	0.811	0.943	0.887	0.676	0.164
2001	0.079	0.230	0.392	0.552	0.675	0.613	0.433	0.100
2002	0.083	0.247	0.366	0.469	0.516	0.424	0.263	0.062
2003	0.079	0.233	0.319	0.421	0.453	0.359	0.215	0.051
2004	0.103	0.304	0.357	0.482	0.488	0.359	0.214	0.055
2005	0.061	0.169	0.162	0.215	0.220	0.162	0.104	0.030
2006	0.054	0.150	0.123	0.177	0.206	0.169	0.119	0.037
2007	0.040	0.115	0.091	0.136	0.175	0.150	0.109	0.036
2008	0.032	0.094	0.065	0.098	0.136	0.119	0.086	0.029
2009	0.049	0.157	0.080	0.106	0.136	0.113	0.076	0.026
2010	0.064	0.214	0.093	0.108	0.128	0.108	0.073	0.025

	Age							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
2011	0.041	0.135	0.046	0.049	0.055	0.046	0.031	0.011
2012	0.050	0.183	0.054	0.056	0.062	0.054	0.034	0.012
2013	0.064	0.258	0.063	0.058	0.060	0.051	0.033	0.011
2014	0.033	0.119	0.028	0.030	0.034	0.034	0.023	0.008
2015	0.036	0.127	0.038	0.044	0.045	0.047	0.029	0.009
2016	0.029	0.102	0.032	0.038	0.036	0.039	0.022	0.007
2017	0.029	0.105	0.035	0.043	0.042	0.048	0.024	0.006
2018	0.021	0.076	0.028	0.037	0.036	0.037	0.017	0.004
2019	0.024	0.089	0.035	0.050	0.052	0.052	0.023	0.005
2020	0.021	0.072	0.028	0.043	0.047	0.048	0.021	0.004
2021	0.013	0.038	0.019	0.040	0.057	0.071	0.035	0.006
2022	0.005	0.014	0.008	0.021	0.036	0.055	0.033	0.005
2023	0.005	0.011	0.008	0.021	0.038	0.063	0.041	0.007

Table 36.16. Whiting in Division 6.a. Assessment summary with weights in tonnes and recruitment in thousands. 'High' and 'Low' refer to 95% confidence intervals.

Year	Recruitment age 0			SSB			Landings*	Discards*	Fishing mortality ages 1-3		
	Low	Value	High	Low	Value	High			Low	Value	High
1981	447 333	771 432	1 330 348	78 174	109 887	154 463	12 194	2 132	0.087	0.134	0.205
1982	488 672	802 649	1 318 360	70 025	94 116	126 495	13 880	5- 485	0.140	0.201	0.288
1983	647 377	1 057 279	1 726 720	53 923	69 323	89 123	15 962	6 294	0.214	0.301	0.422
1984	541 412	882 653	1 438 970	39 615	49 488	61 821	16 459	4 017	0.269	0.374	0.520
1985	457 178	755 450	1 248 321	32 037	40 235	50 532	12 879	4 840	0.313	0.430	0.590
1986	800 206	1 327 500	2 202 253	26 990	34 346	43 706	8 458	2 669	0.218	0.305	0.425
1987	306 759	508 129	841 688	31 670	39 541	49 368	11 542	11 918	0.32	0.434	0.589
1988	449 723	761 756	1 290 288	32 150	41 485	53 531	11 349	8 132	0.366	0.495	0.67
1989	405 113	662 646	1 083 895	22 269	28 222	35 767	7 523	5 876	0.319	0.443	0.615
1990	536 682	869 151	1 407 581	20 636	26 890	35 038	5 642	4 530	0.216	0.304	0.428
1991	711 101	1 154 035	1 872 867	23 381	29 820	38 033	6 657	4 883	0.223	0.311	0.433
1992	492 847	797 123	1 289 252	28 684	36 199	45 684	6 004	9 249	0.215	0.302	0.423
1993	503 813	810 718	1 304 578	32 075	40 882	52 107	6 871	4 759	0.181	0.256	0.361
1994	486 052	774 685	1 234 716	31 461	39 459	49 490	5 900	3 455	0.165	0.233	0.331
1995	440 565	699 336	1 110 100	31 894	39 646	49 283	6 078	5 771	0.214	0.298	0.415
1996	410 235	652 068	1 036 461	29 222	3 6114	4 4630	7 158	7 940	0.297	0.408	0.560
1997	429 078	671 256	1 050 122	23 291	28 854	35 744	6 291	5 251	0.290	0.401	0.553
1998	263 848	419 217	666 076	20 044	24 813	30 716	4 628	9 216	0.405	0.553	0.753
1999	554 886	881 000	1 398 775	15 348	19 301	24 272	4 613	3 975	0.398	0.549	0.758
2000	218 617	345 682	546 602	14 495	18 240	22 953	3 011	13 285	0.418	0.569	0.775
2001	129 212	214 355	355 604	14 446	18 947	24 851	2 439	4 263	0.275	0.392	0.557
2002	180 480	286 421	454 548	11 512	15 061	19 704	1 768	2 851	0.244	0.361	0.533
2003	143 184	222 286	345 087	8 467	11 229	14 892	1 331	1 991	0.211	0.324	0.497

Year	Recruitment age 0			SSB			Landings*	Discards*	Fishing mortality ages 1-3		
	Low	Value	High	Low	Value	High			Low	Value	High
2004	78 845	124 051	195 175	7 424	10 082	13 692	798	2 897	0.240	0.381	0.606
2005	71 637	113 382	179 452	5 788	8 222	11 681	334	975	0.114	0.182	0.289
2006	44 955	72 258	116 143	5 257	7 477	10 635	378	750	0.096	0.150	0.234
2007	40 884	66 243	107 333	5 007	7 166	10 256	481	365	0.073	0.114	0.179
2008	69 645	114 582	188 514	4 618	6 651	9 579	442	156	0.055	0.086	0.135
2009	191 974	319 627	532 164	4 802	6 874	9 840	480	832	0.073	0.114	0.178
2010	60 084	100 434	167 882	6 668	9 539	13 645	337	1 104	0.087	0.139	0.220
2011	126 304	207 373	340 475	8 891	13 340	20 015	229	631	0.046	0.076	0.126
2012	66 856	112 734	190 095	9 418	14 133	21 207	305	772	0.059	0.098	0.162
2013	147 941	248 821	418 488	9 949	15 249	23 373	216	1 223	0.072	0.126	0.221
2014	278 445	466 898	782 898	9 149	14 052	21 582	181	745	0.034	0.059	0.101
2015	183 218	309 414	522 528	11 701	17 964	27 579	224	1 459	0.042	0.070	0.118
2016	155 923	262 163	440 790	15 681	24 516	38 330	227	1 039	0.034	0.057	0.098
2017	115 517	200 433	347 770	17 160	26 760	41 730	178	1 329	0.036	0.061	0.104
2018	241 840	412 457	703 446	16 479	25 452	39 313	191	648	0.028	0.047	0.081
2019	273 839	470 407	808 074	15 736	23 978	36 535	502	929	0.034	0.058	0.098
2020	109 175	194 516	346 566	17 869	27 323	41 780	544	817	0.028	0.047	0.081
2021	80 949	150 456	279 646	19 136	29 372	45 082	873	166**	0.018	0.032	0.056
2022	72 942	137 953	260 903	17 266	26 796	41 586	613	123	0.008	0.014	0.025
2023	112 219	260 622	605 283	14 727	23 001	35 923	591	119	0.007	0.013	0.024
2024	61 536	260 622***	1103799	12892	20410	32313					

*** Calculated using Sum of Products from the catch numbers-at-age and mean weights-at-age. Pre-2003 Discards are estimated for ages 1+ only.**

**** Underestimate due to reduced discard sampling from the *Nephrops* fleet.**

***** Median resampled recruitment (2015–2024).**

Table 36.17. Whiting in Division 6.a. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change *	% advice change **	% probability of being below B_{lim} in 2026
ICES advice basis										
MSY approach = F_{MSY} × SSB (2024) /MSY $B_{trigger}$	4 952	2 807	2 145	0.192	0.077	0.115	21 722	-7.8	28	26
Other scenarios										
MSY approach: $F_{MSY\ lower}$ × SSB (2025) /MSY $B_{trigger}$	4 149	2 354	1 795	0.158	0.063	0.095	22 435	-4.8	7.0	22
MSY approach: $F_{MSY\ upper}$ × SSB (2025) /MSY $B_{trigger}$	4 952	2 807	2 145	0.192	0.077	0.115	21 722	-7.8	28	26
F = 0	0	0	0	0	0	0	26 276	11.6	-100	8.3
F= F_{MSY}	5 376	3 047	2 329	0.21	0.084	0.126	21 354	-9.3	39	27
F= $F_{MSY\ lower}$	4 512	2 559	1 953	0.173	0.069	0.104	22 113	-6.1	16.3	24
F= F_{pa}	5 376	3 047	2 329	0.21	0.084	0.126	21 354	-9.3	39	27
F= F_{lim}	7 560	4 279	3 281	0.31	0.124	0.186	19 461	-17.4	95	38
SSB (2026) = B_{lim}	10 166	5 737	4 429	0.44	0.178	0.27	17 286	-27	162	50
SSB (2026) = B_{pa} = MSY $B_{trigger}$ ***										
SSB (2026) = SSB (2025)	2 937	1 665	1 272	0.112	0.045	0.067	23 554	0	-24	17.9
F = F_{2024}	372	212	160	0.013	0.005	0.008	25 921	10.0	-90	9.2

*** SSB 2026 relative to SSB 2025.**

**** Advice value for 2025 relative to the corresponding 2024 value (3879 tonnes).**

***** This option was left blank because it cannot be achieved in 2026, even with zero catch in 2025.**

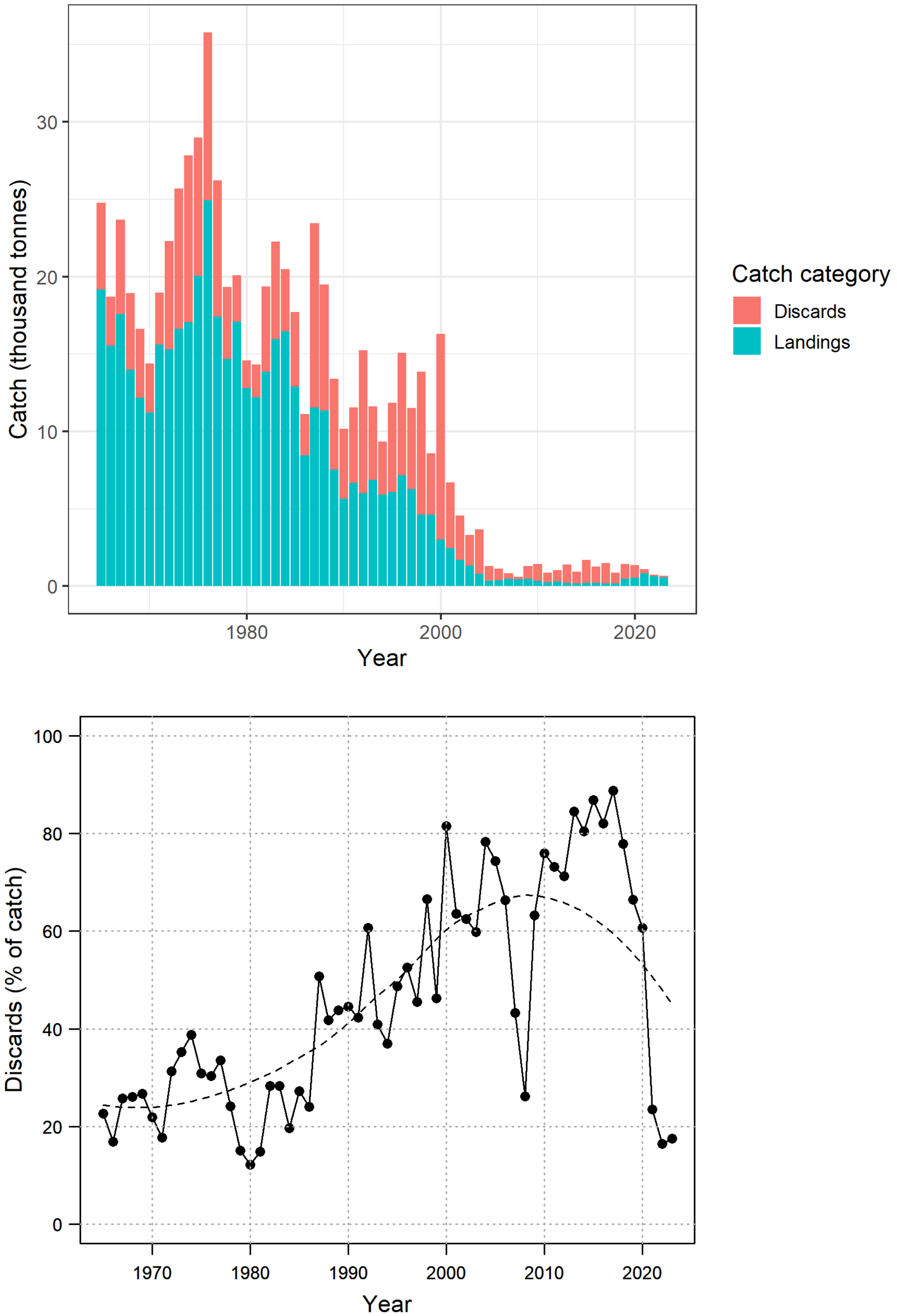


Figure 36.1. Whiting in Division 6.a. Landings and discards (in thousand tonnes) as officially reported to ICES (upper panel) and discards (as % of catch, lower panel). Pre-2003 discards are estimated for ages 1+ only; from 2003 onwards, they are estimated for all ages.

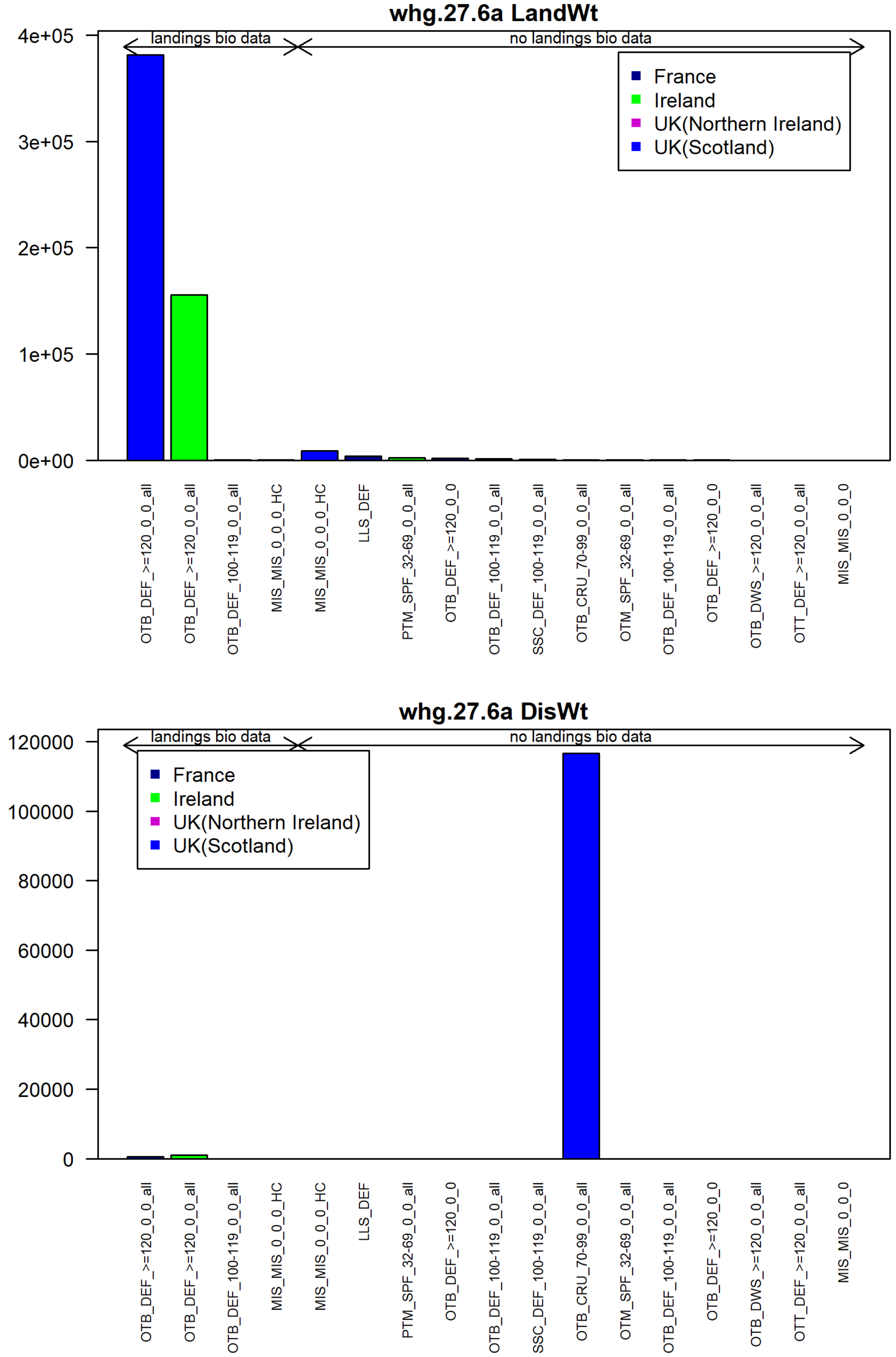


Figure 36.2. Whiting in Division 6.a. Landings (upper panel) and discards (all ages, lower panel) by métier (kg) in 2023 as entered into InterCatch.

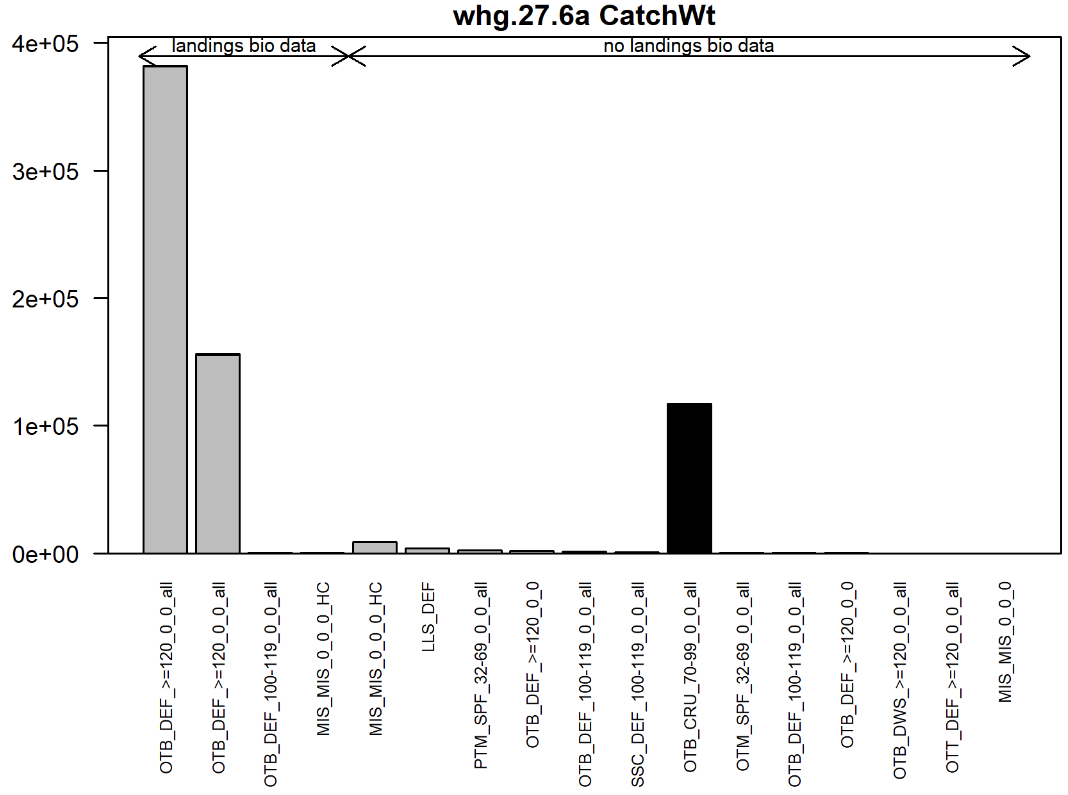


Figure 36.3. Whiting in Division 6.a. Landings (sampled and unsampled, in grey), sampled discards (in black) and raised unsampled discards (in red) after allocations within InterCatch.

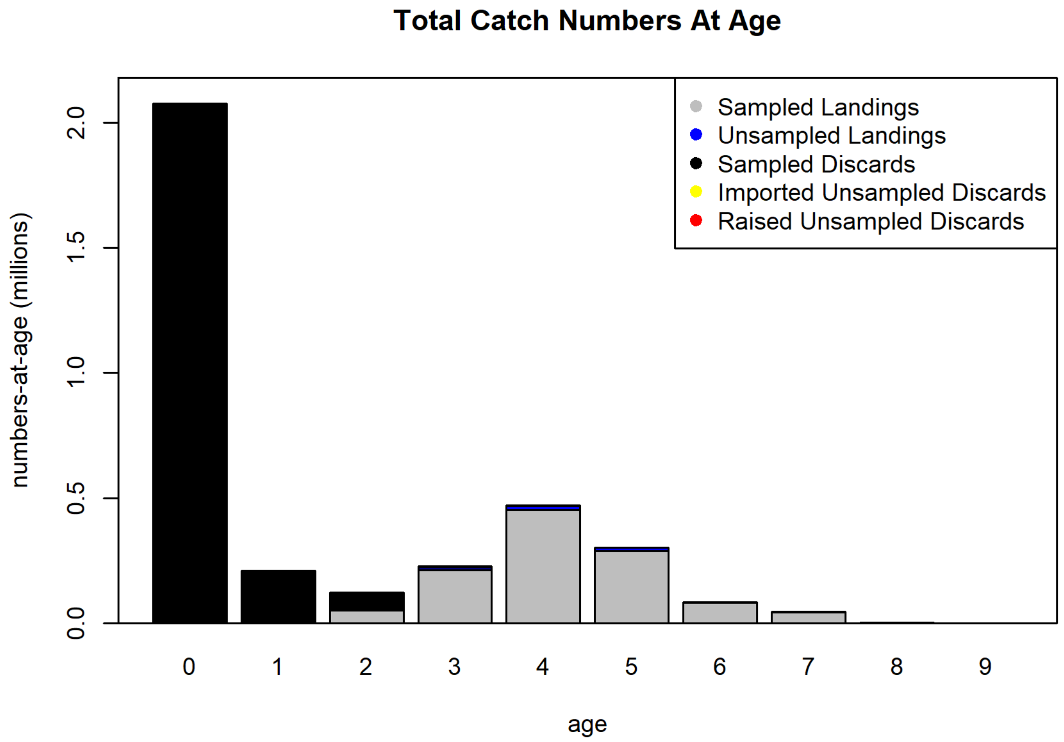


Figure 36.4. Whiting in Division 6.a. Catch numbers-at-age by sampled and unsampled landings, and sampled and raised (unsampled) discards, after allocations within InterCatch.

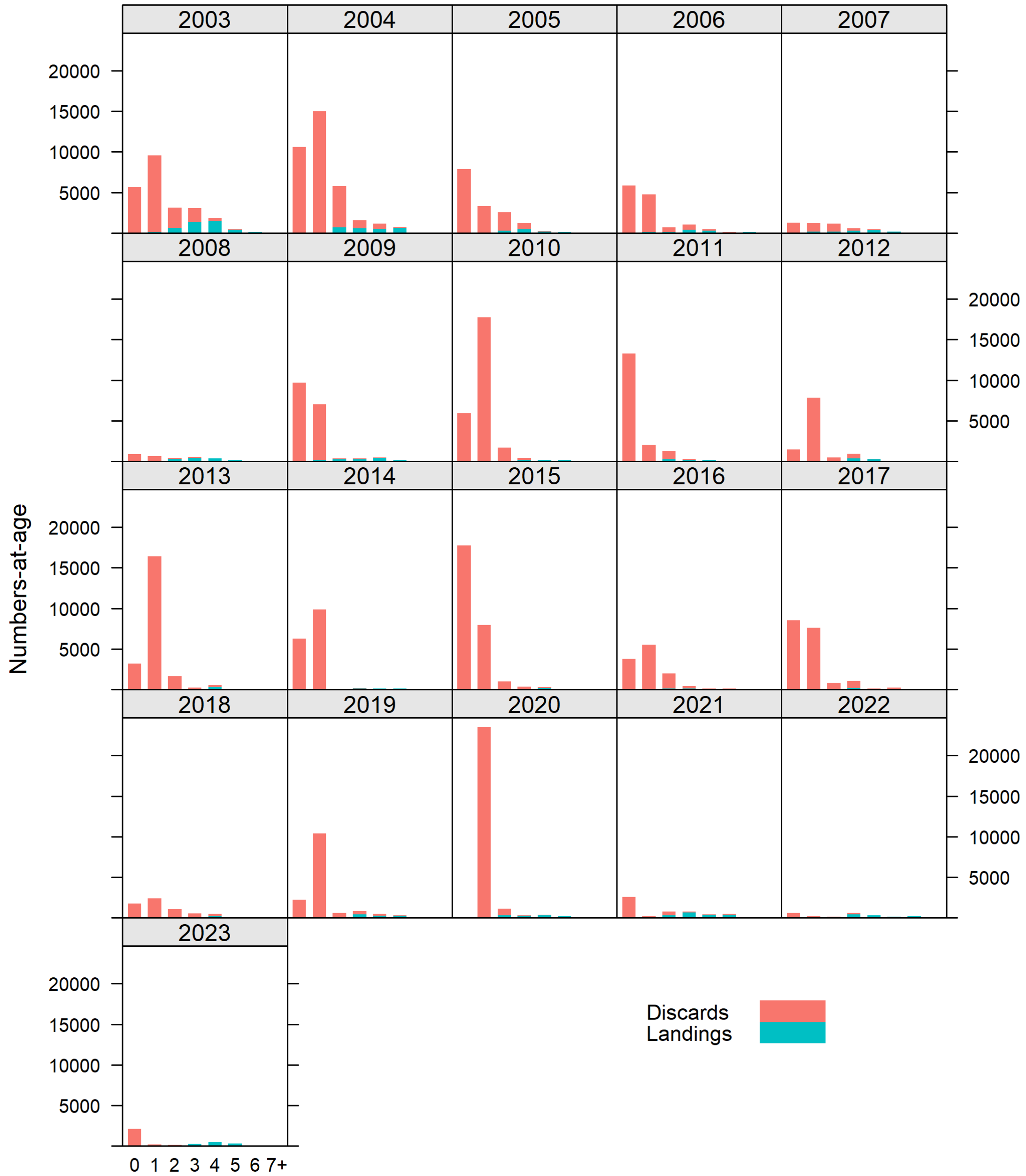


Figure 36.5. Whiting in Division 6.a. Catch numbers-at-age by year in 2003–2023.

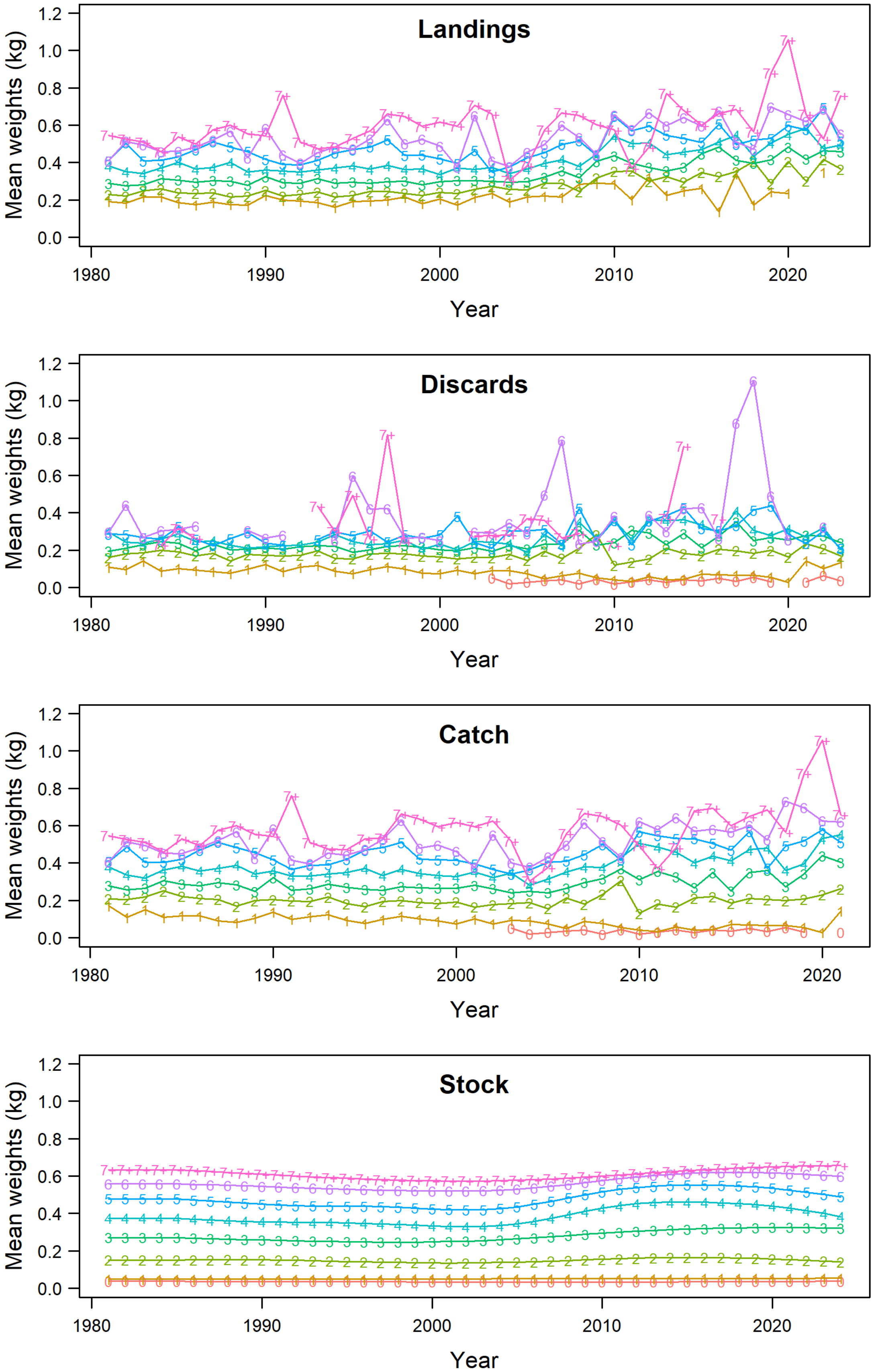


Figure 36.6. Whiting in Division 6.a. Mean weight-at-age in the landings, discards, catch and stock.

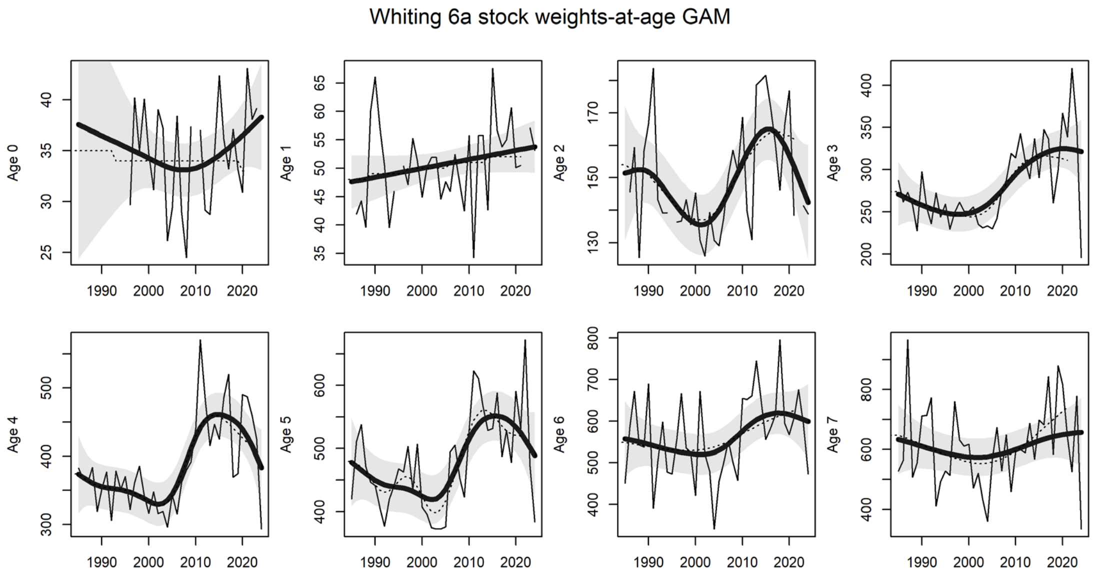


Figure 36.7. Whiting in Division 6.a. Combined Q1 and Q4 survey weights-at-age time-series for 6a whiting, together with catch weights-at-age time-series. Only Q4 surveys contain data for the zero age class. The smoothed estimates were used for M calculation.

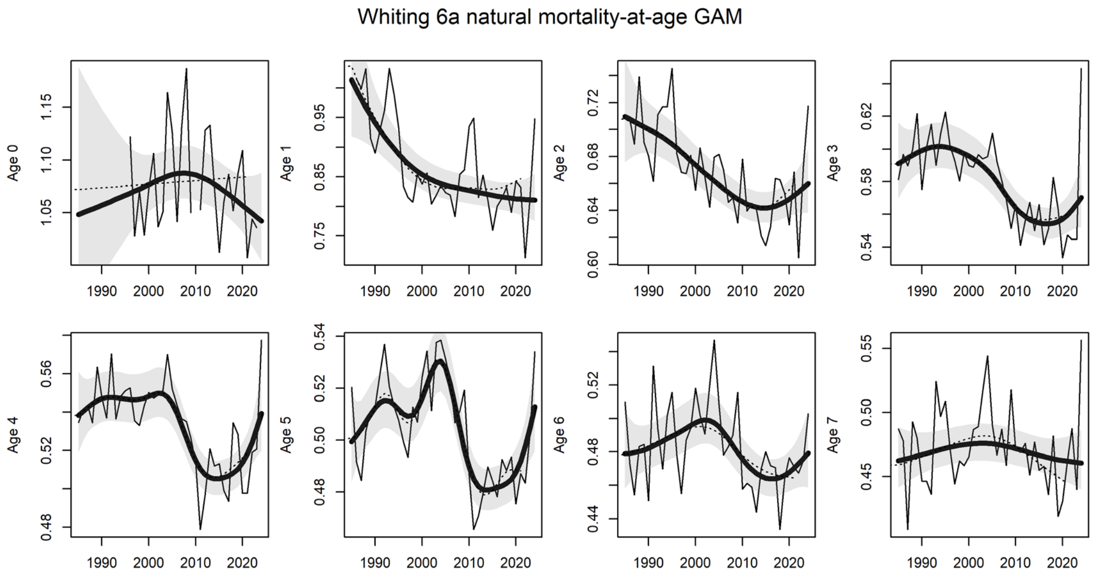


Figure 36.8. Whiting in Division 6.a. Time-series of natural mortality-at-age estimated with Lorenzen's (1996) model. The thick black line shows the natural mortality obtained with the smoothed weights-at-age with the corresponding 95% confidence interval shown in grey. The thin black line shows the natural mortality obtained with unsmoothed weights-at-age, for comparison.

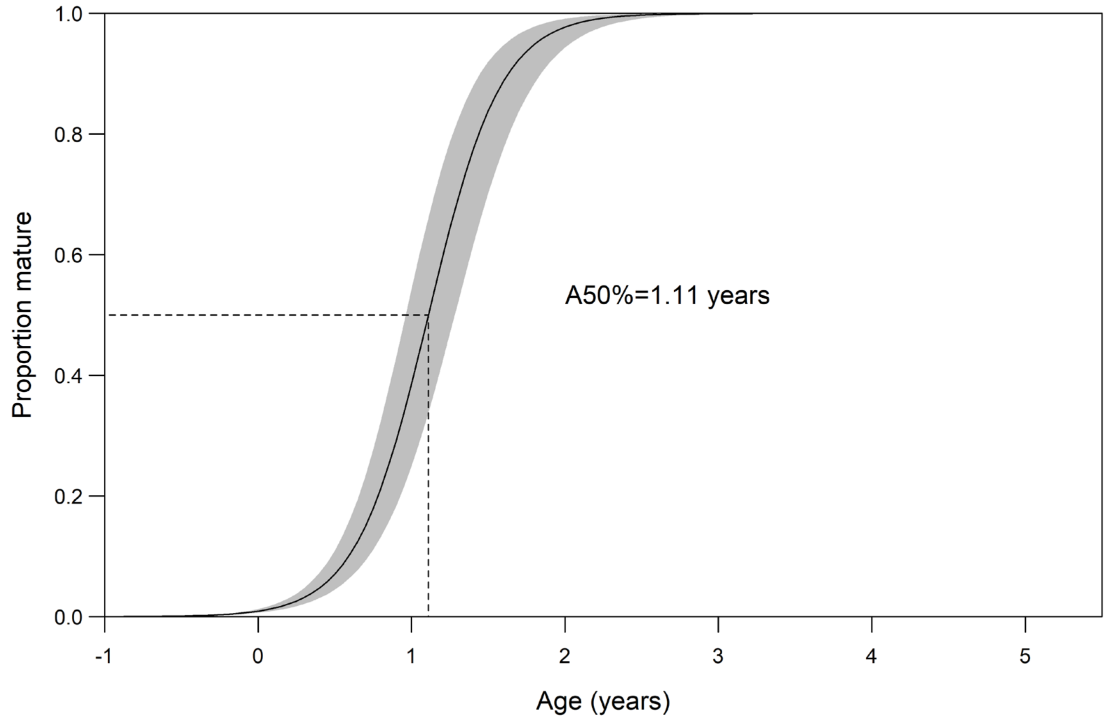


Figure 36.9. Whiting in Division 6.a. The re-estimated maturity ogive (solid black line) with the corresponding 95% confidence interval shown (grey bands). The previous maturity ogive was estimated at WKNSEA 2021 is not shown here. The midpoint of the current maturity ogives (A50%) is indicated.

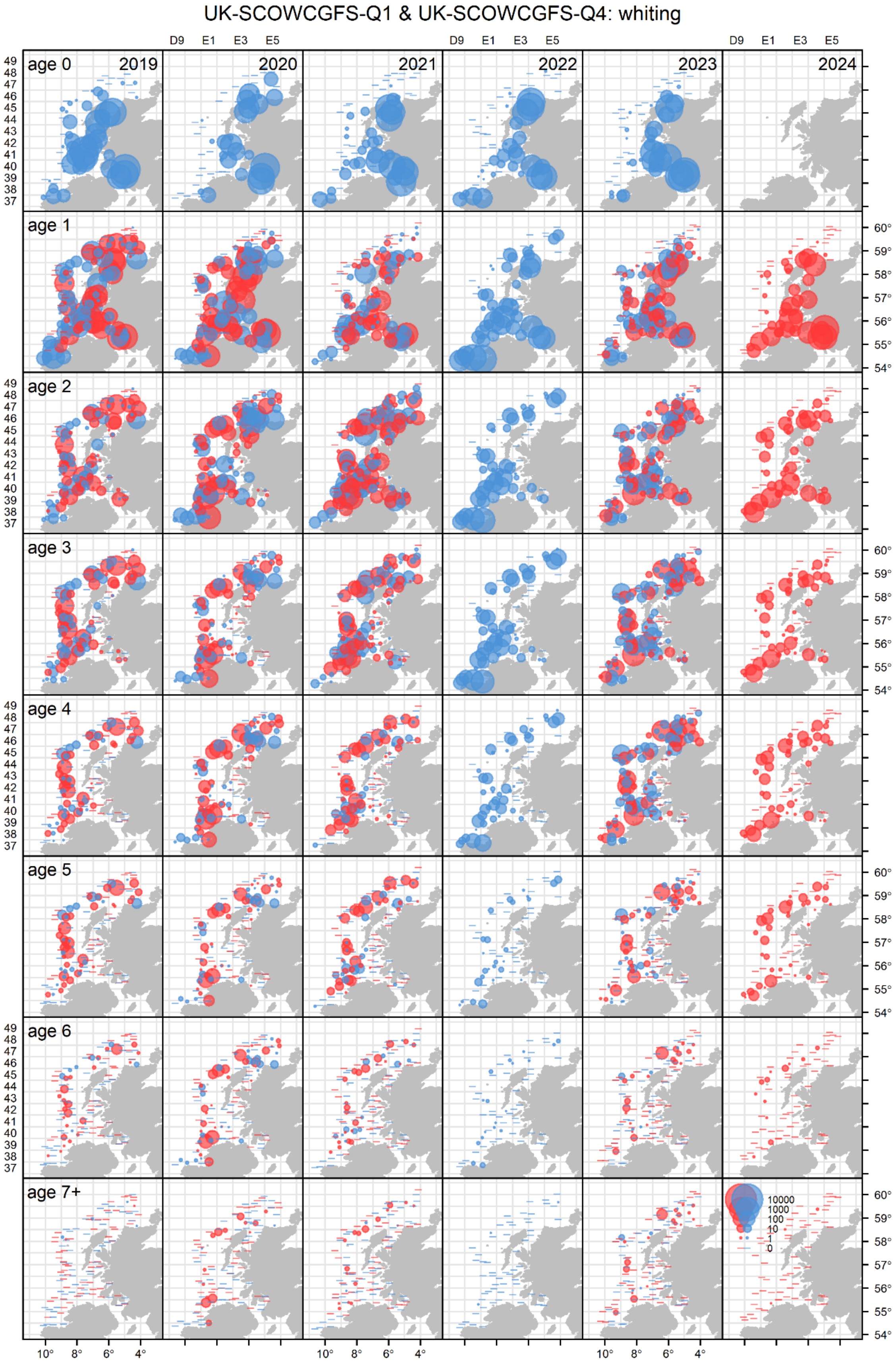


Figure 36.10. Whiting in Division 6.a. CPUE from the Scottish first quarter west coast groundfish survey (UK-SCOWCGFS-Q1, in red) and the Scottish fourth quarter groundfish survey (UK-SCOWCGFS-Q4, in blue) in 2019–2024. Numbers are standardised to 30 minutes towing.

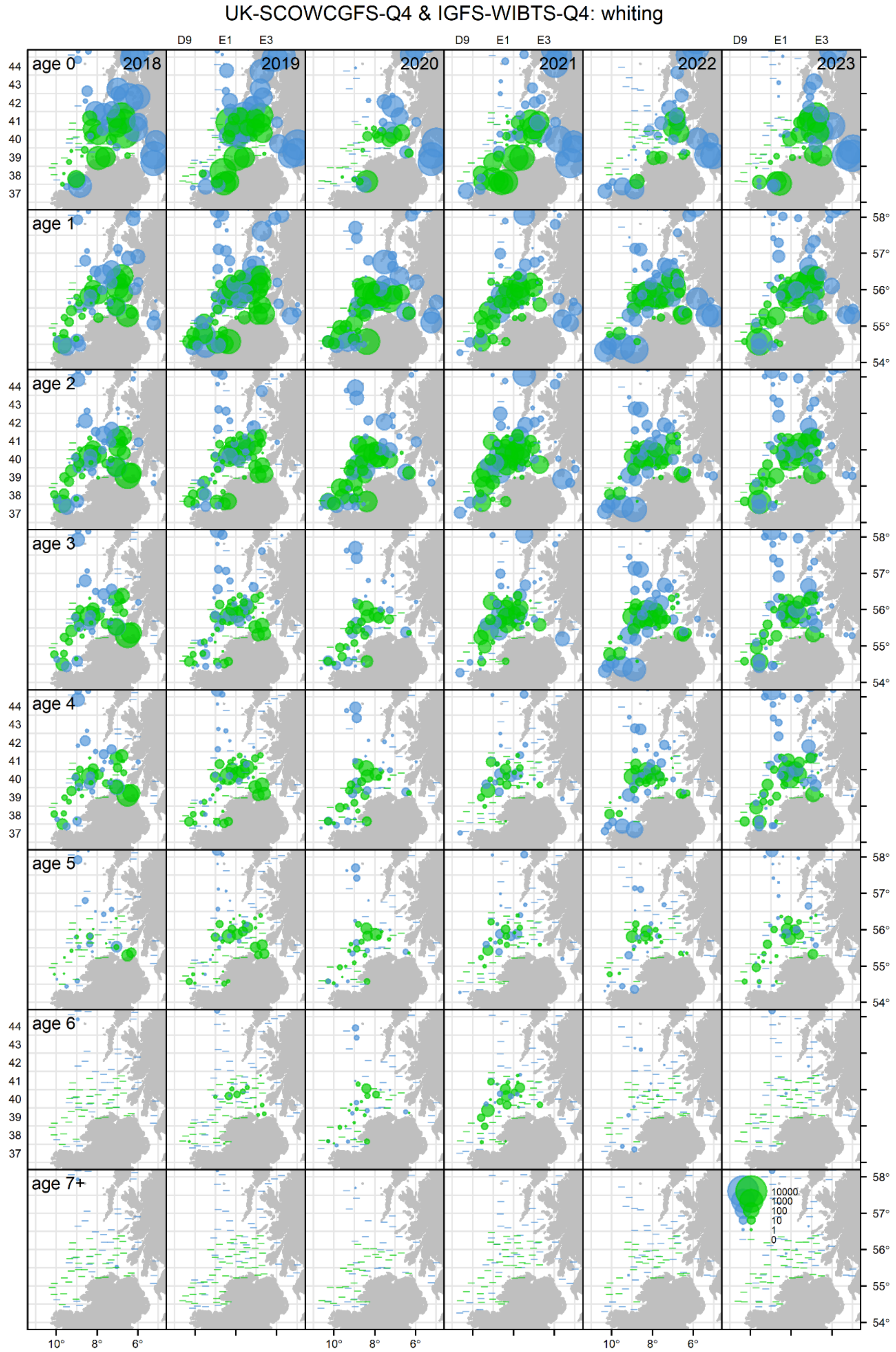


Figure 36.11. Whiting in Division 6.a. CPUE from the Scottish fourth quarter west coast groundfish survey (UK-SCOWCGFS-Q4, only the southern part of the survey area, in blue) and the Irish fourth quarter groundfish survey (IGFS-WIBTS-Q4, in green) in 2018–2023. Numbers are standardised to 30 minutes towing.

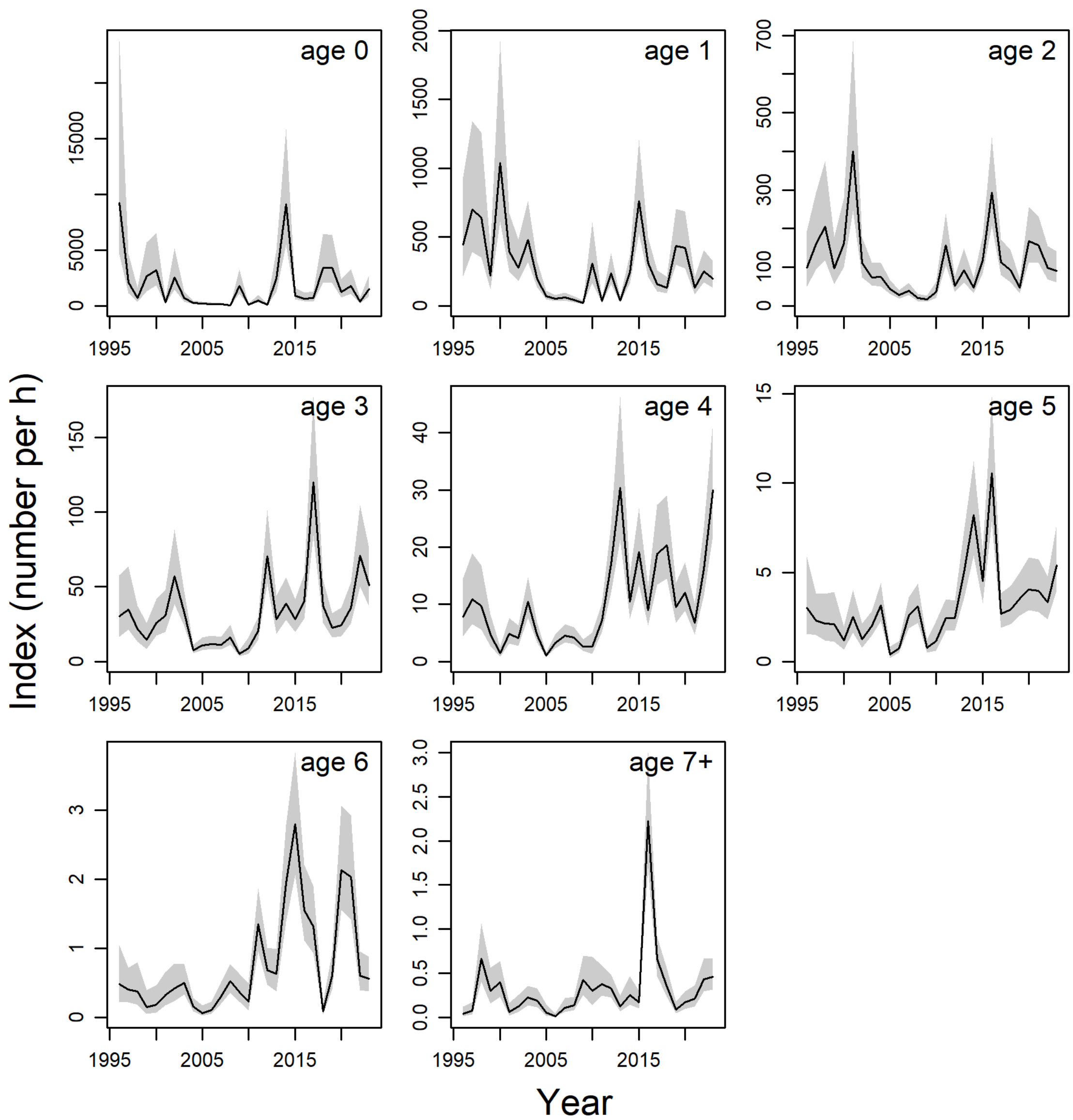


Figure 36.12. Whiting in Division 6.a. The combined index derived from a delta-GAM model fit to data from the three Q4 surveys (black line) with 95% confidence limits (in grey). Indices are derived by summing model predictions on a spatial grid.

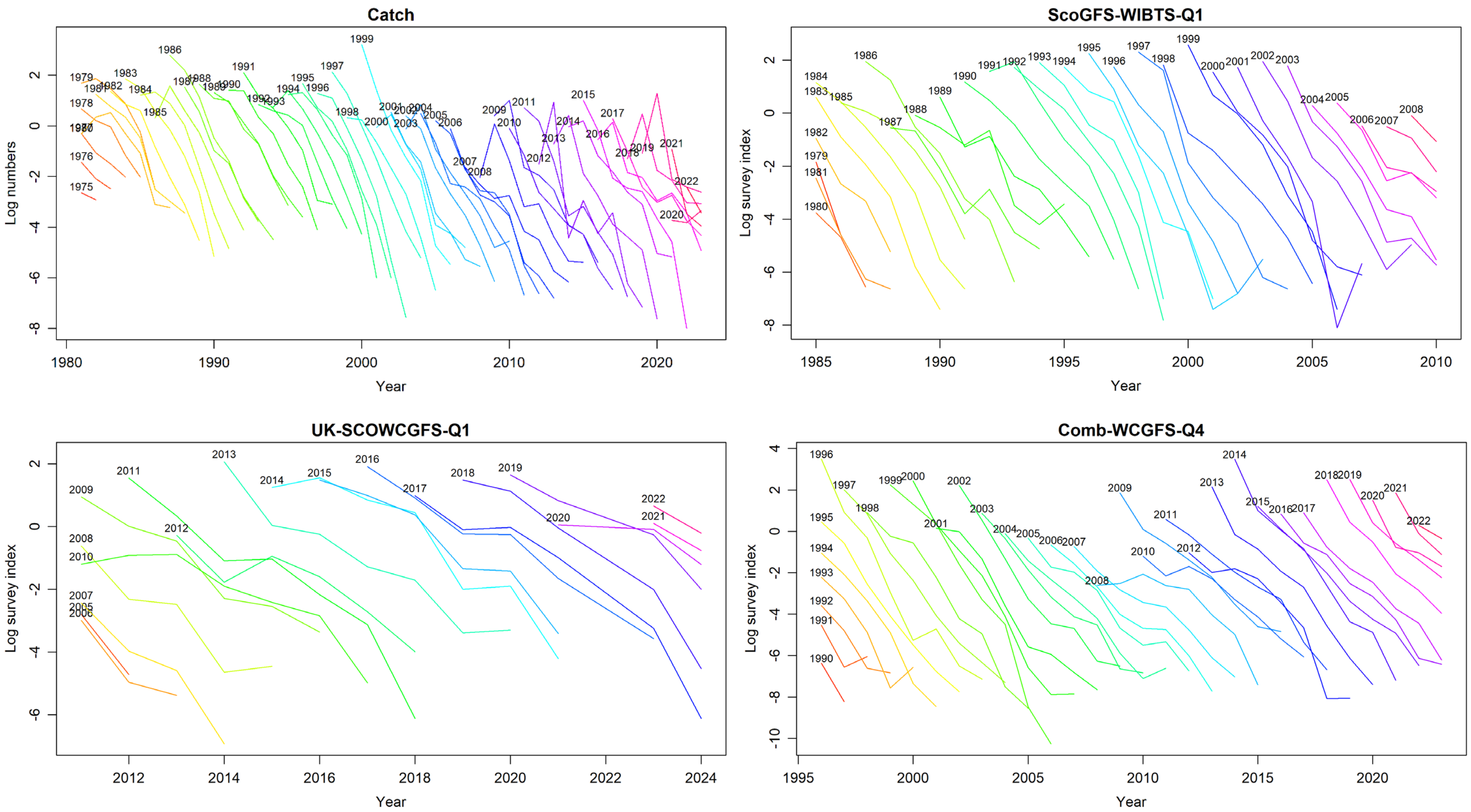


Figure 36.13. Whiting in Division 6.a. Log abundance indices by year with a line for each cohort, for catch and the three survey series. The spawning year of each cohort is indicated at the start of each line. Note the age range 1–7+ in 1981–2002 and 0–7+ in 2003–2022 for the catch data.

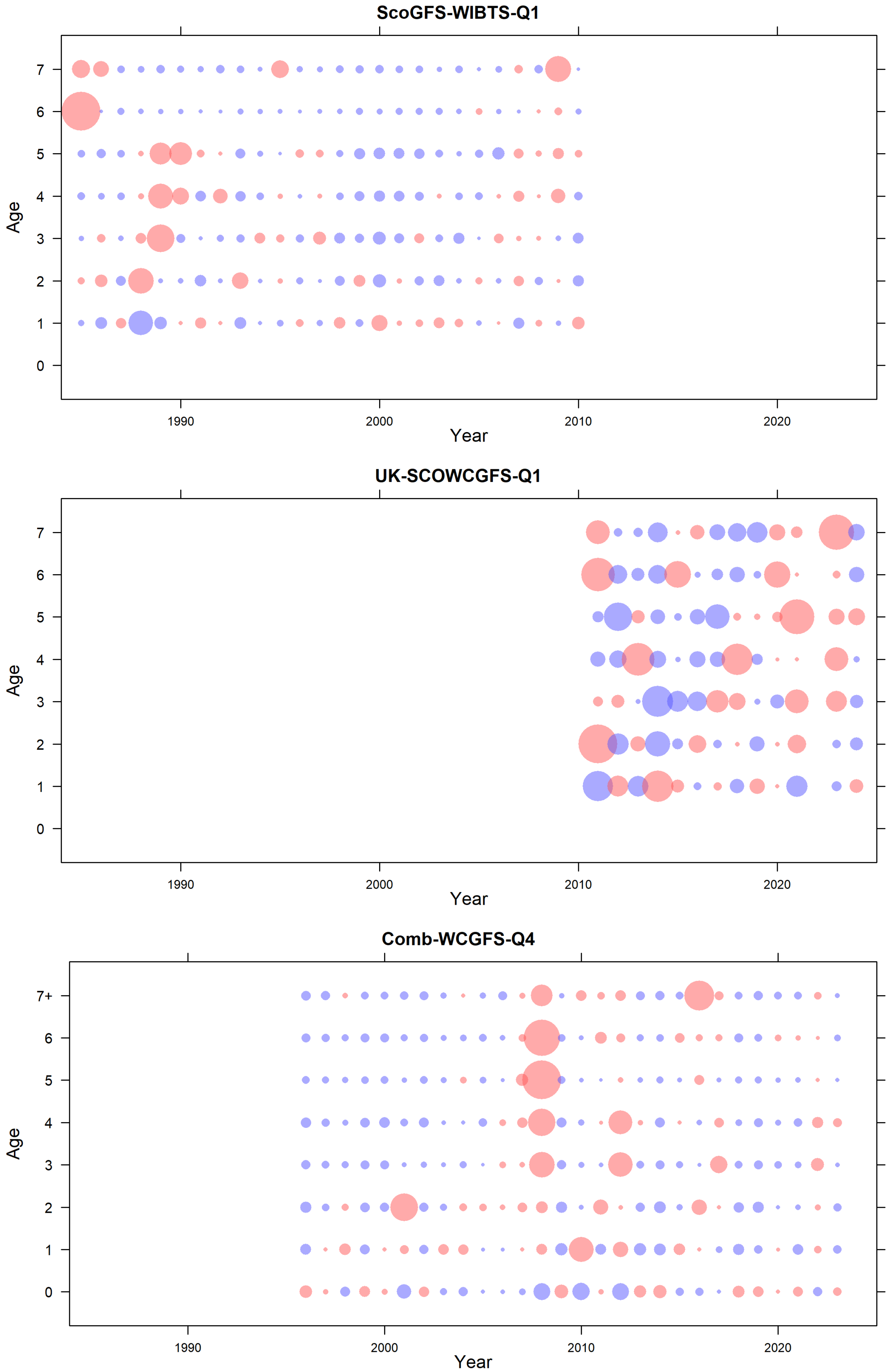


Figure 36.14. Whiting in Division 6.a. Standardised proportions-at-age per year ("spay") for the three survey series. The positive values are shown in red, the negative values are shown in blue.

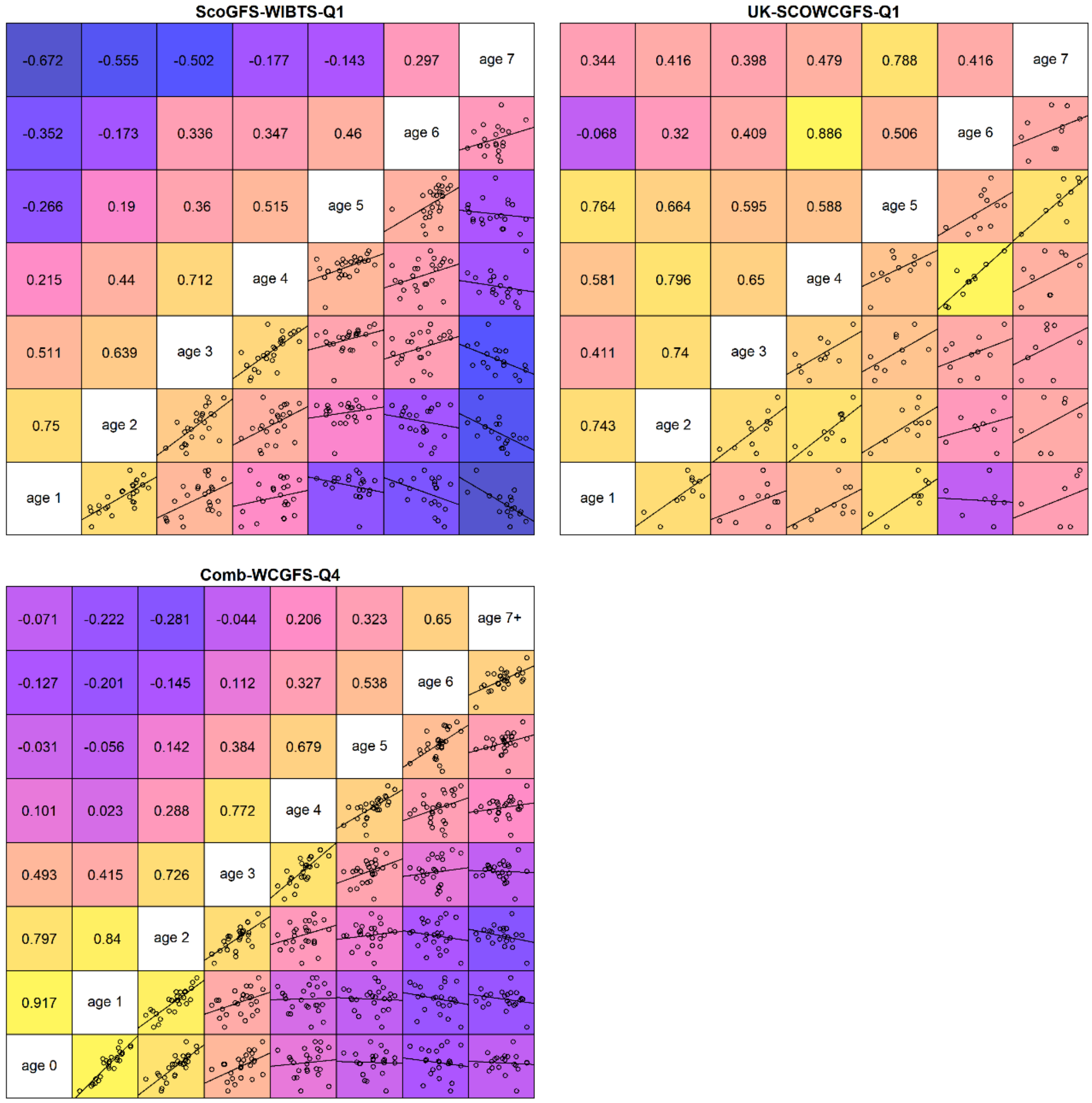


Figure 36.15. Whiting in Division 6.a. Within-survey correlations comparing index values at different ages for the same year classes for the three survey series. The straight line is a linear regression.

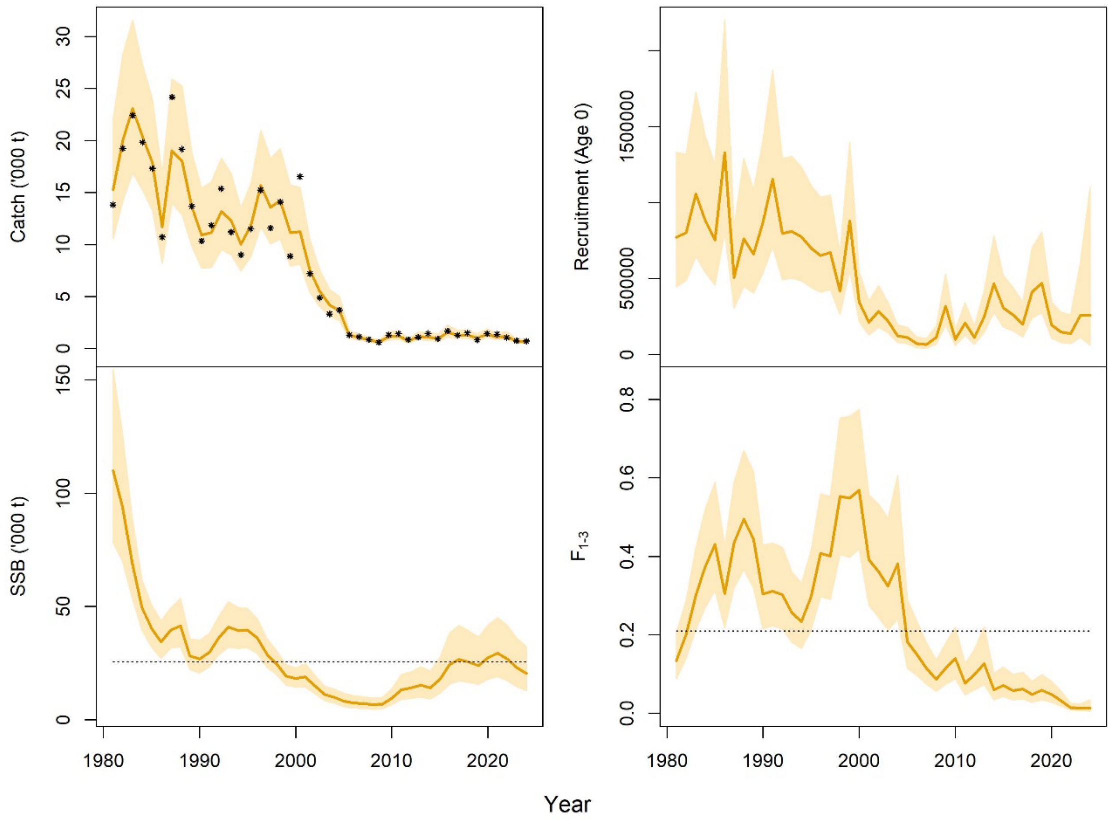


Figure 36.16. Whiting in Division 6.a. Summary of the SAM assessment model estimates (orange line) with 95% confidence intervals (yellow polygon).

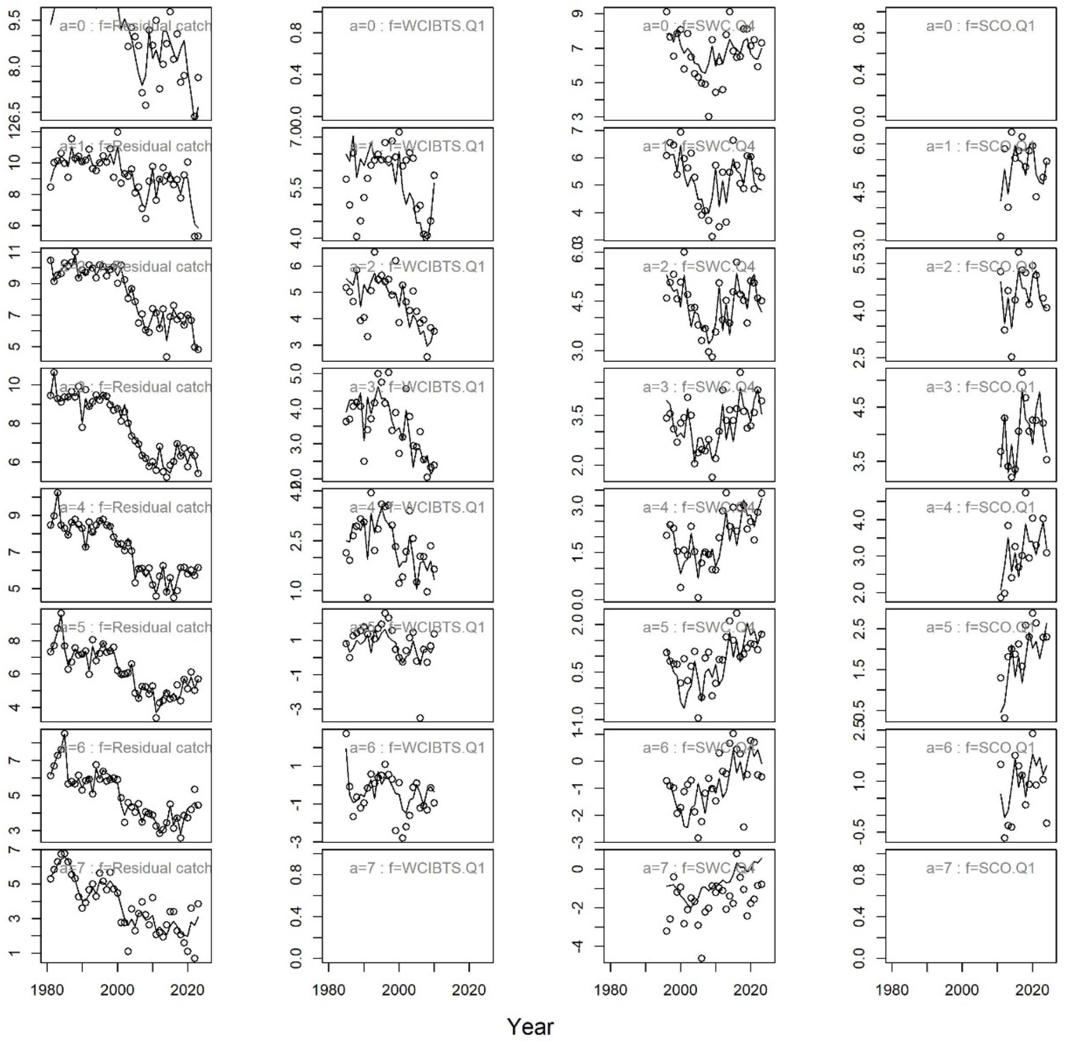


Figure 36.17. Whiting in Division 6.a. Comparison of the SAM assessment model estimates with observed log catch numbers-at-age (first column of panels) and observed log survey indices-at-age for ScoGFS-WIBTS-Q1 (second column), Comb-WCGFS-Q4 (third column), and UK-SCOWCGFS-Q1 (fourth column).

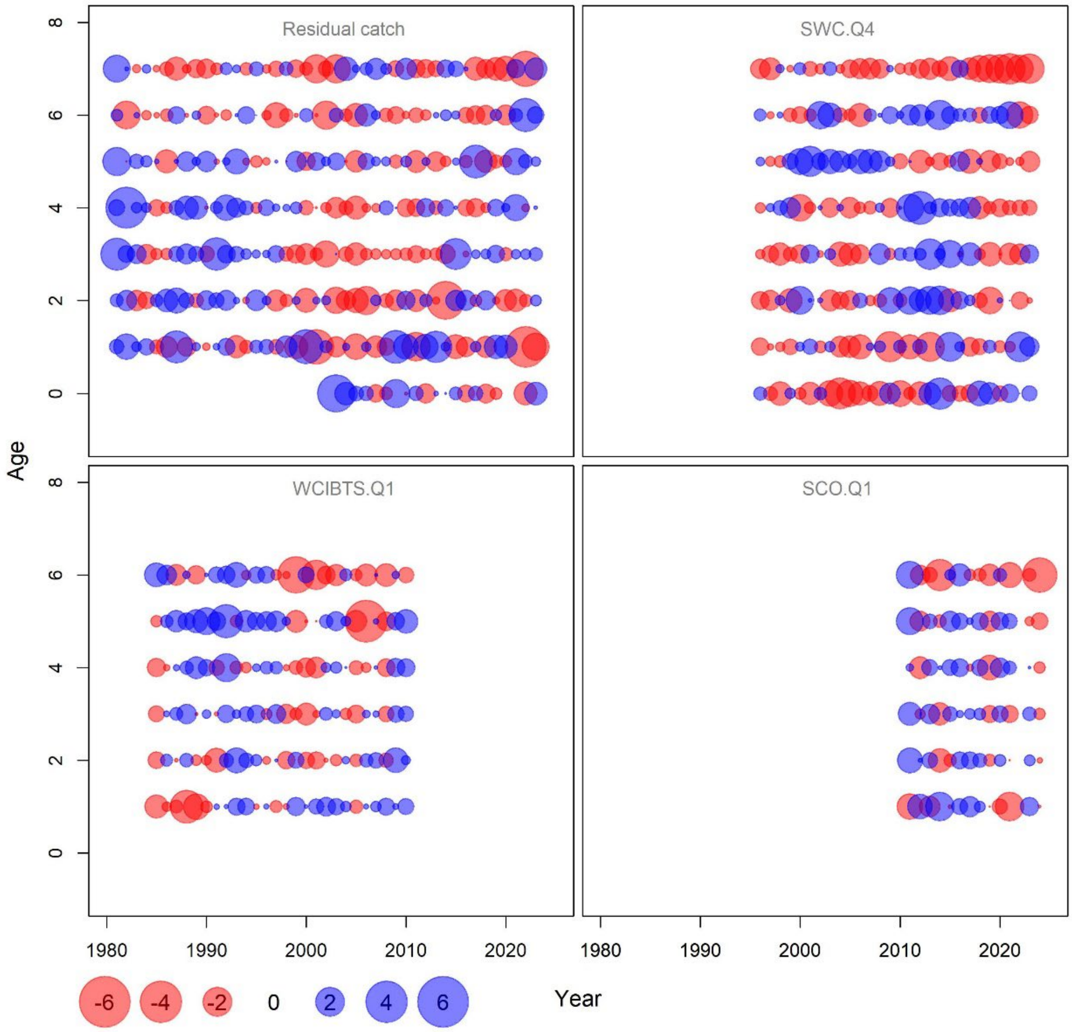


Figure 36.18. Whiting in Division 6.a. Standardized one-observation-ahead residuals-at-age by fleet from the SAM assessment model: catch (top left), ScoGFS-WIBTS-Q1 (bottom left), UK-SCOWCGFS-Q1 (bottom right), and Comb-WCGFS-Q4 (top right).

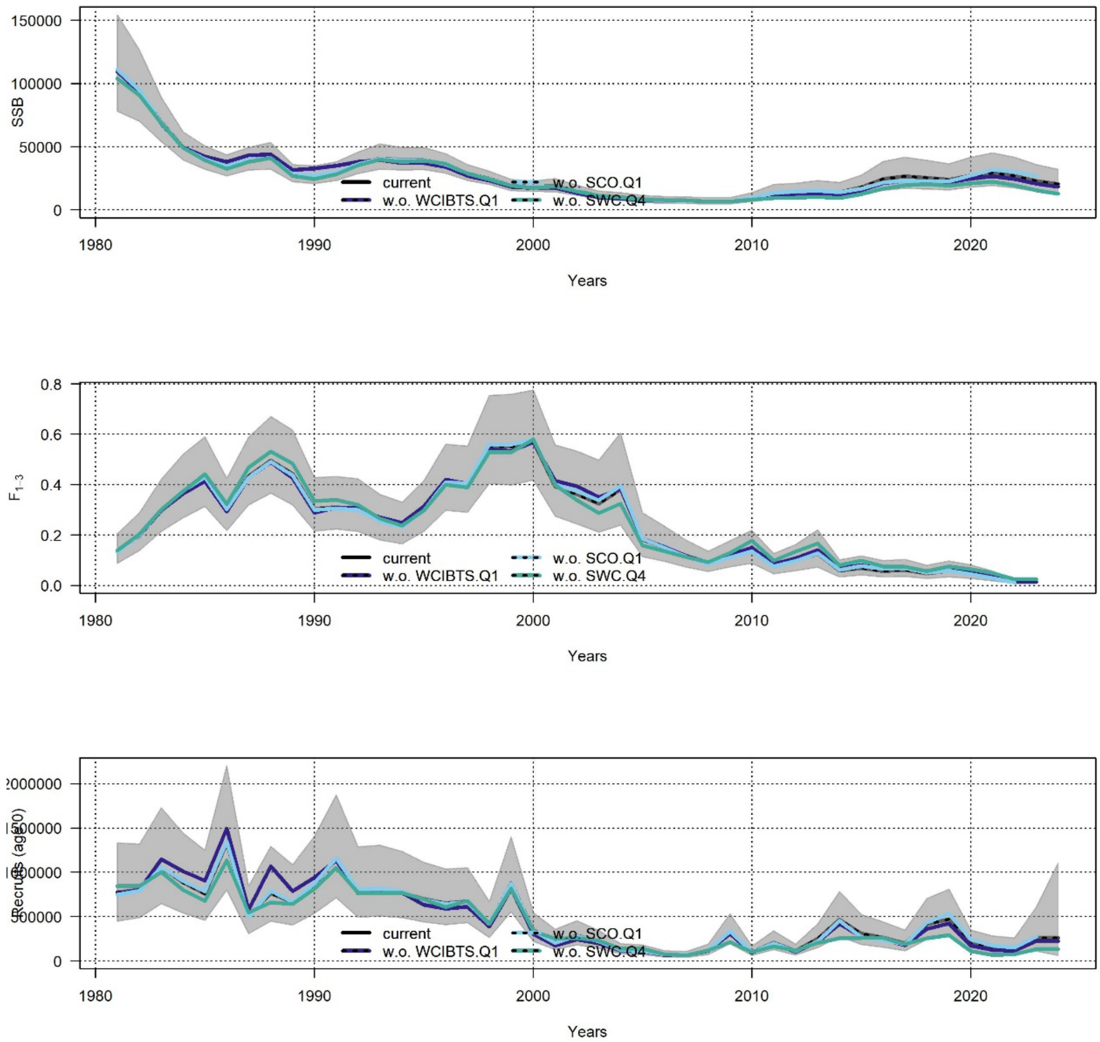


Figure 36.19. Whiting in Division 6.a. Leave-one-out sensitivity analysis of the SAM assessment model.

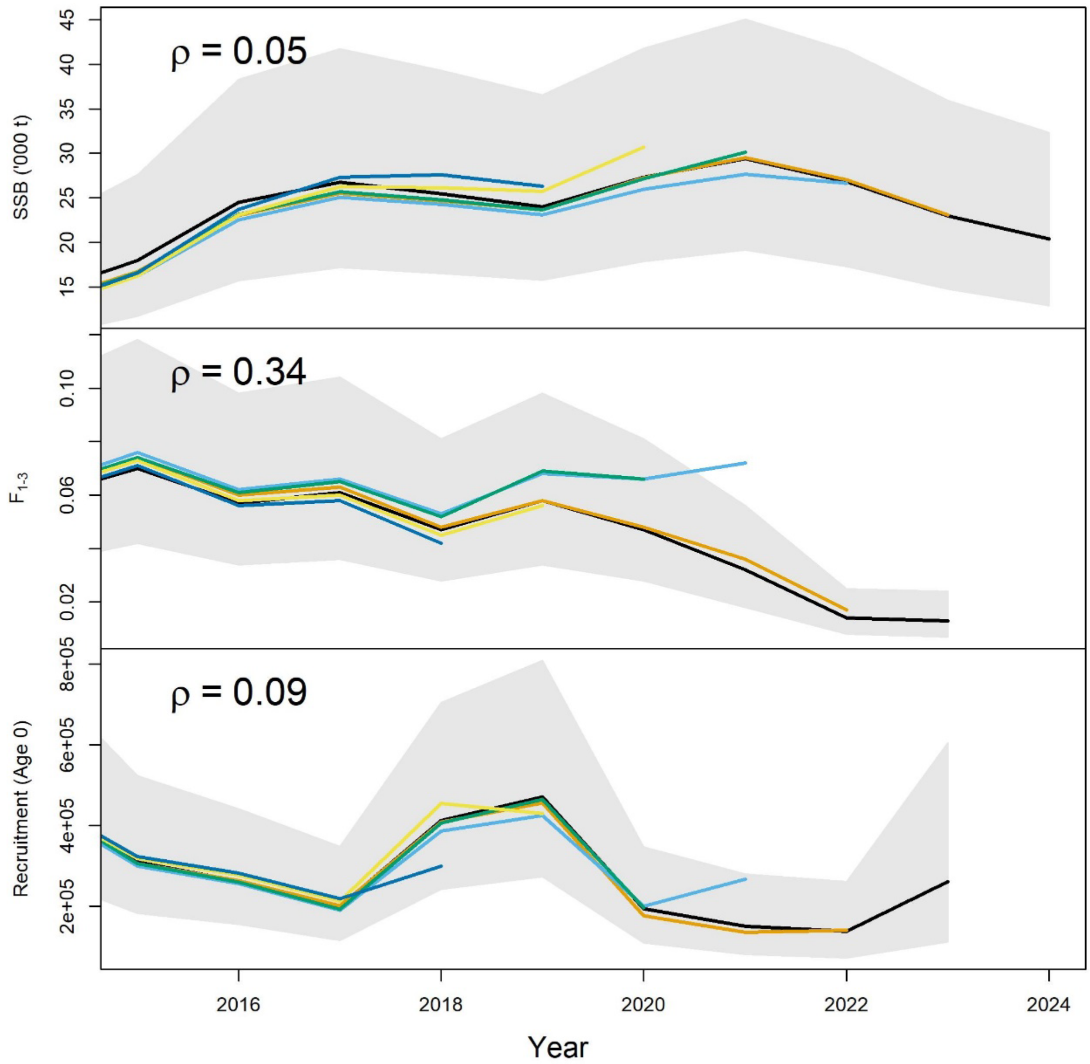


Figure 36.20. Whiting in Division 6.a. Retrospective patterns for the SAM assessment model.

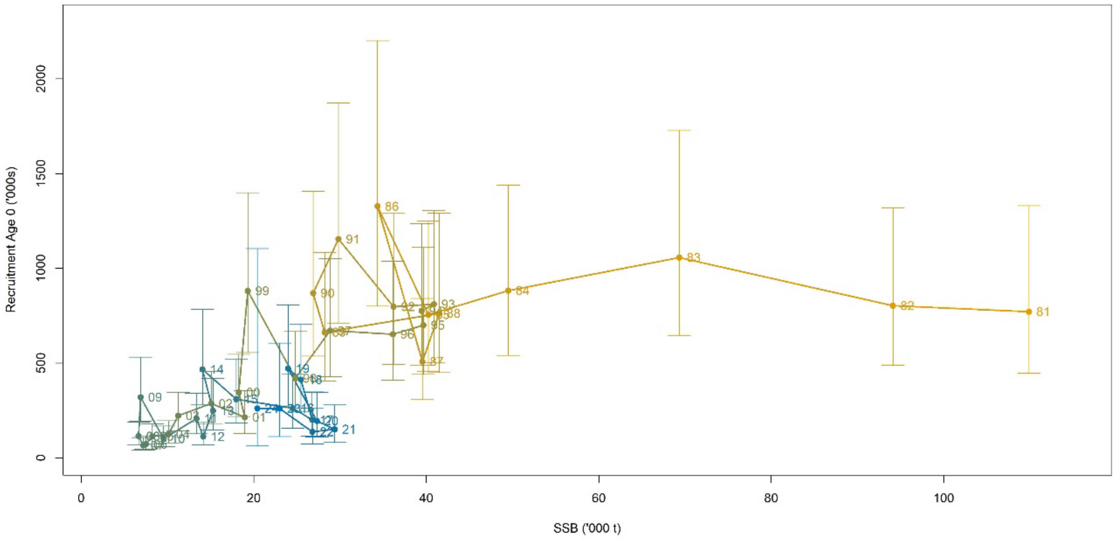


Figure 36.21. Whiting in Division 6.a. The SAM assessment model Stock-Recruit relationship.

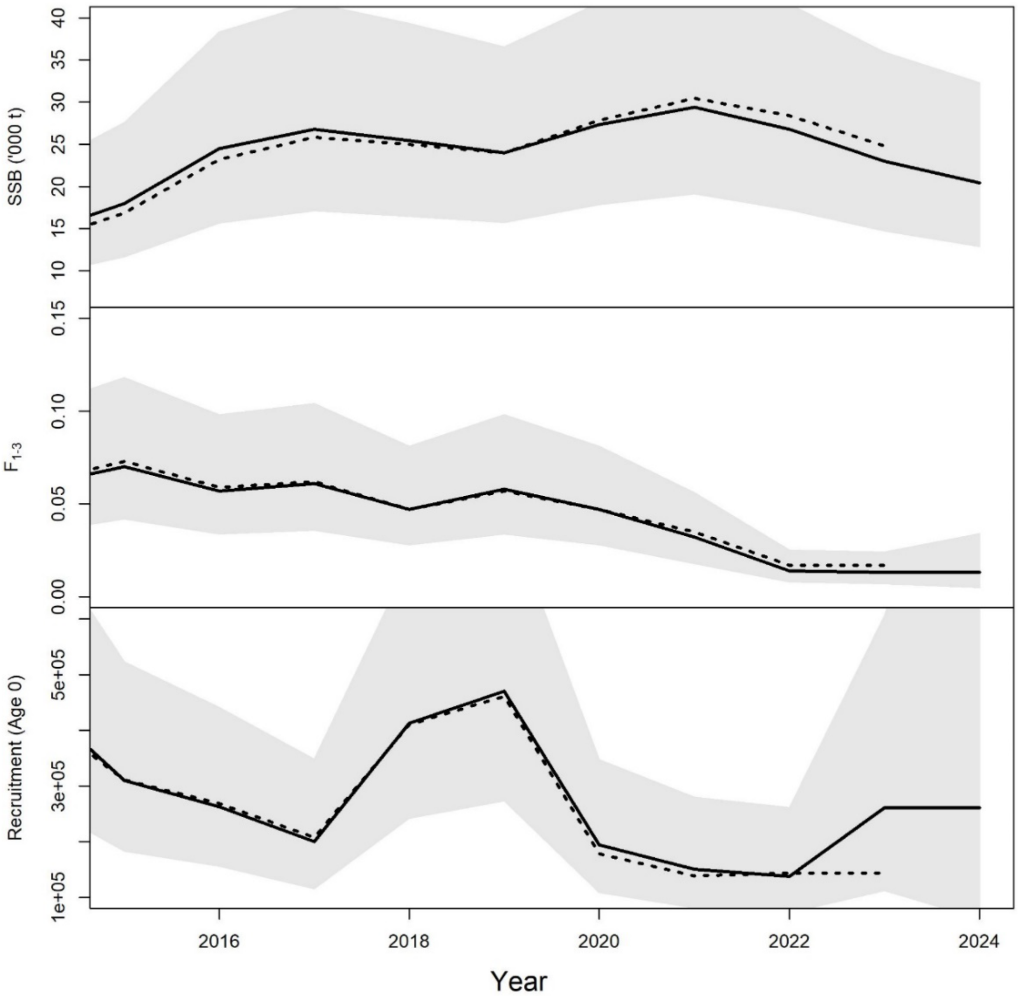


Figure 36.22. Whiting in Division 6.a. Comparison of 2023 SAM assessment estimates (solid lines) with revised 2022 SAM assessment estimates (dotted lines).

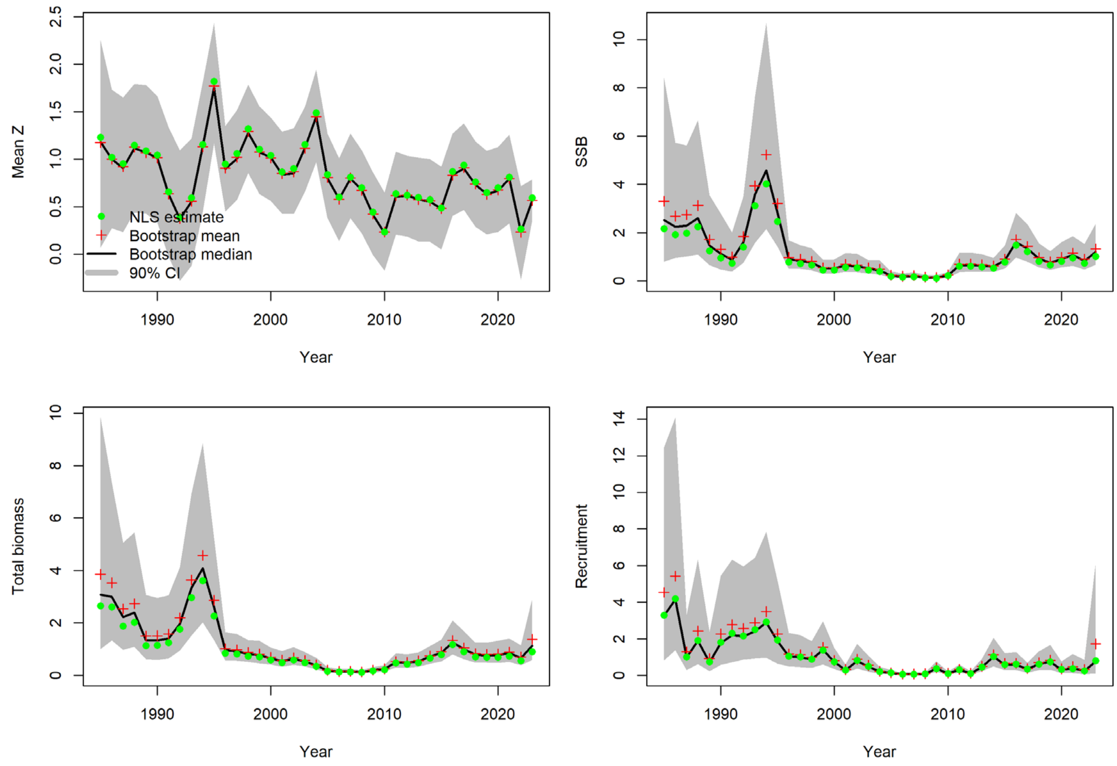


Figure 36.23. Whiting in Division 6.a. Results of SURBAR analysis (see legend on mean Z plot for details). SSB, TSB and recruitment are relative estimates.

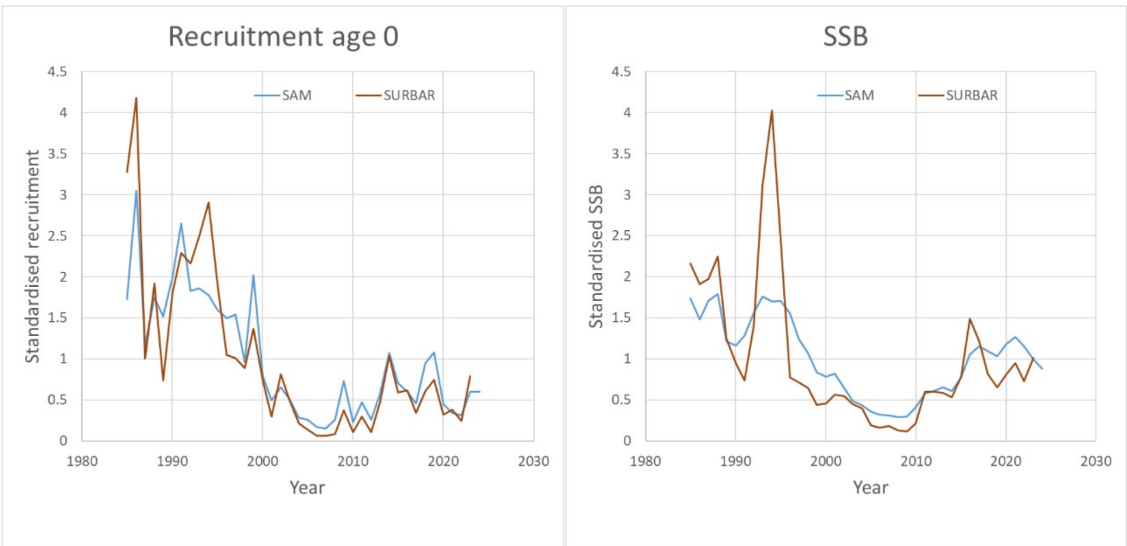


Figure 36.24. Whiting in Division 6.a. Comparison of the Recruitment and SSB estimates by SAM and SURBAR (the run with three tuning series).

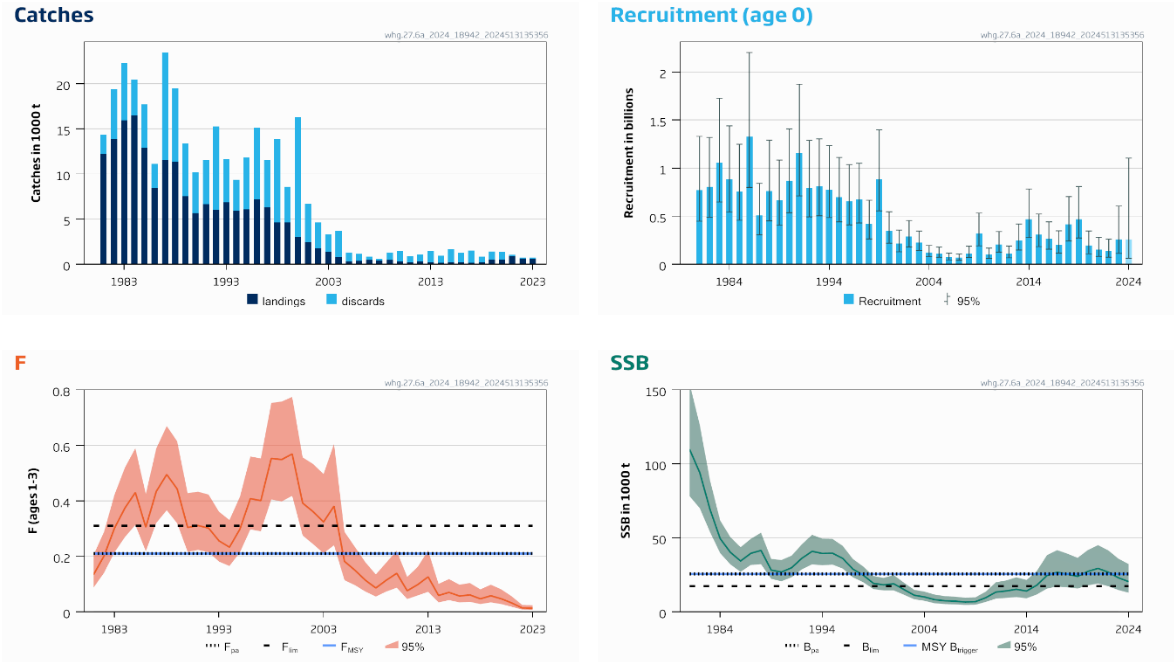


Figure 36.25. Whiting in Division 6.a. ICES Standard Graphs for the SAM assessment. The assumed recruitment value for 2024 is shaded in a lighter colour.

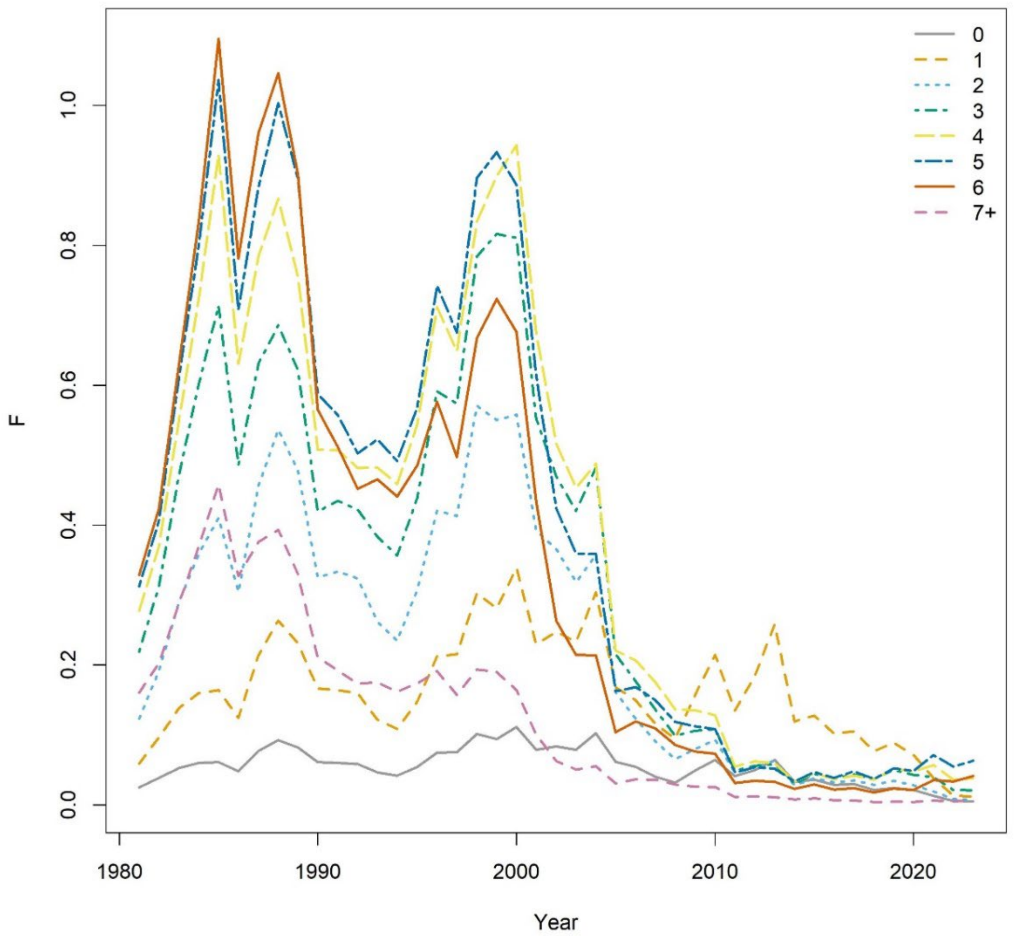


Figure 36.26. Whiting in Division 6.a. The SAM assessment model estimated F-at-age.

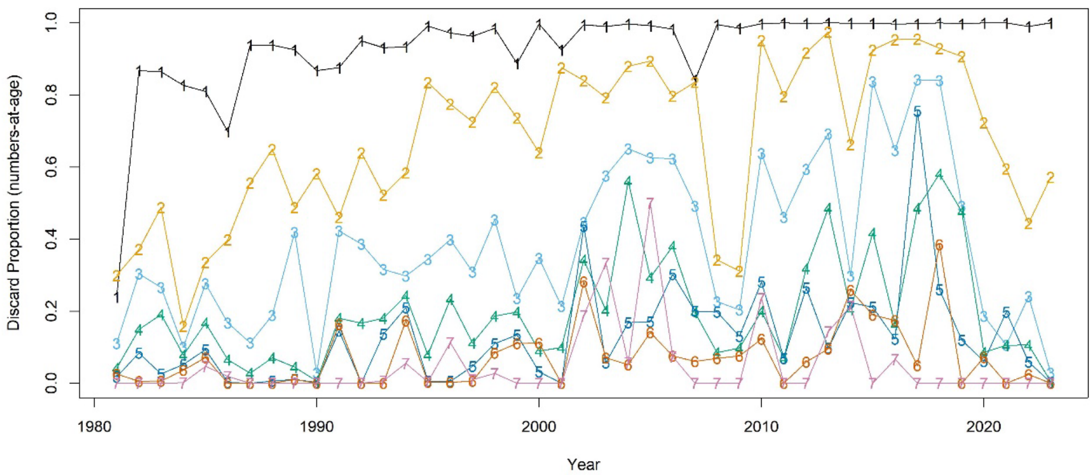


Figure 36.27. Whiting in Division 6.a. Proportion of catch discarded-at-age, from SAM landing fraction input file.

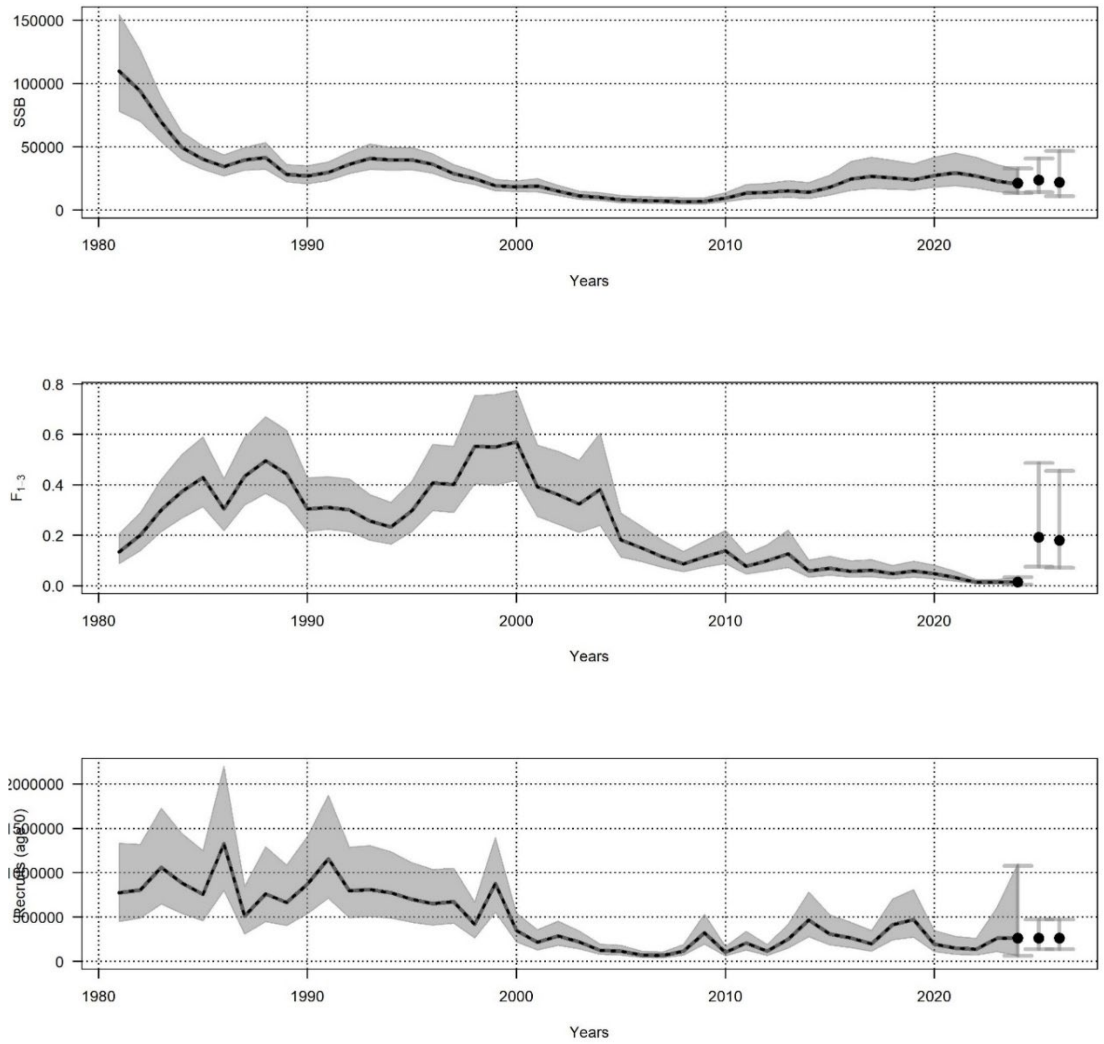


Figure 36.28. Whiting in Division 6.a. SAM forecast in the intermediate year followed by F_{MSY} (the proposed advice) in subsequent years.

Figure 36.29. Whiting in Division 6.a. Contribution of recruitment years to projected 2025 catch and 2026 SSB under an F_{MSY} catch scenario.

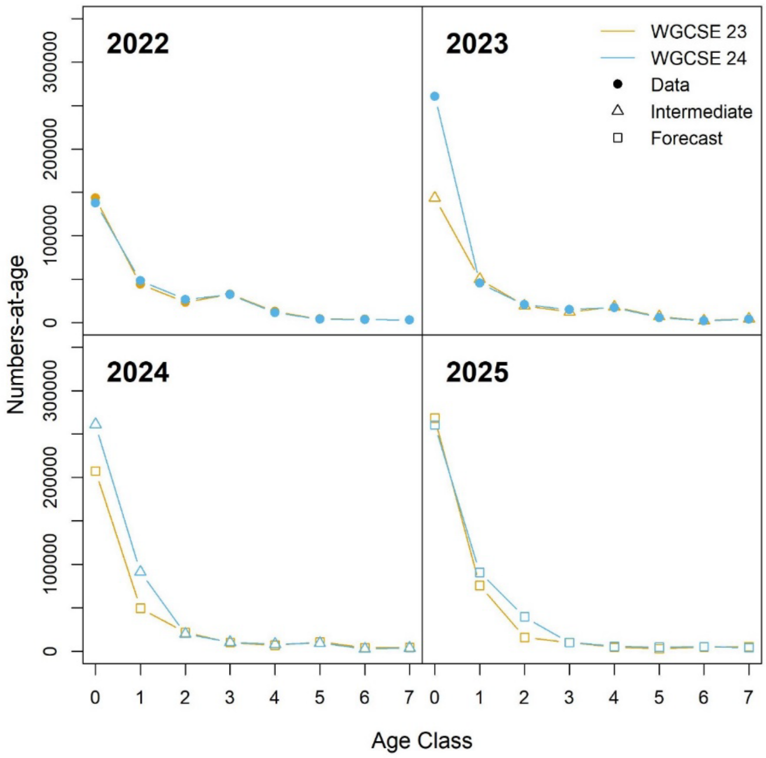


Figure 36.30. Whiting in Division 6.a. Comparison of numbers-at-age: data (circles), intermediate year assumptions (triangles), and median forecast estimates (squares) from 2022 (orange) and 2023 (blue) assessment models.

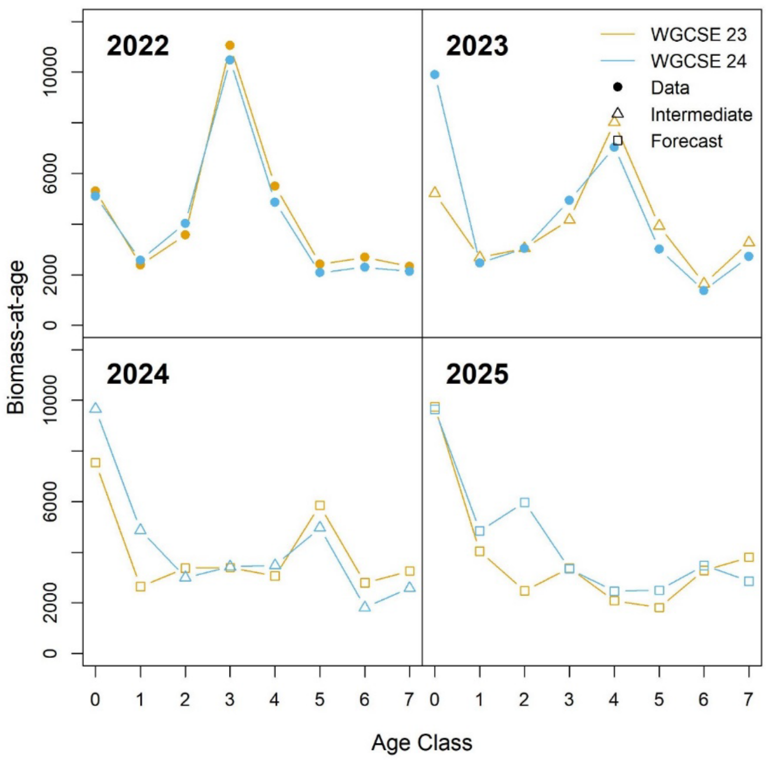


Figure 36.31. Whiting in Division 6.a. Comparison of stock biomass-at-age: data (circles), intermediate year assumptions (triangles), and median forecast estimates (squares) from 2022 (orange) and 2023 (blue) assessment models.

Contents

37 Whiting (*Merlangius merlangus*) in Division 6.b (Rockall)

Type of assessment in 2024

No assessment was performed in 2024.

ICES advice applicable to 2022–2024

In 2021, ICES provided multiyear advice:

"ICES advises that when the precautionary approach is applied, landings should be no more than 7 tonnes in each of the years 2022, 2023, 2024. ICES cannot quantify the corresponding total catches."

https://ices-library.figshare.com/articles/report/Whiting_Merlangius_merlangus_in_Division_6_b_Rockall_/18639044

37.1 General

Stock description

There is an absence of information on whiting stock structure in this region and whiting caught at Rockall may potentially be part of the adjacent 6.a stock.

Management applicable to 2023 and 2024

The TAC for whiting (in tonnes) is set for ICES subareas 6, 12 and 14 and EU and international waters of ICES Division 5b, for 2024 and 2023 is shown below.

TAC for 2024

Species:	Whiting *Merlangius merlangus*	Zone:	6; United Kingdom and International waters of 5b; international waters of 12 and 14 (WHG/56-14)
Germany	8	Analytical TAC	
France	157	Article 8 of this Regulation applies	
Ireland	935		
Union	1 100		
United Kingdom	2 063		
TAC	3 163		

(Council Regulation (EU) 2024/257 of 10 January 2024).

TAC for 2023

Species:	Whiting *Merlangius merlangus*		Zone:	6; United Kingdom and International waters of 5b; international waters of 12 and 14 (WHG/56-14)
Germany	7	(1)	Analytical TAC Article 8 of this Regulation applies Article 3 of Regulation (EC) No 847/96 shall not apply Article 4 of Regulation (EC) No 847/96 shall not apply	
France	135	(1)		
Ireland	802	(1)		
Union	944	(1)		
United Kingdom	1 692	(1)		
TAC	2 636	(1)		
(1)	Exclusively for by-catches of whiting in fisheries for other species. No directed fisheries for whiting are permitted under this quota.			

(Council Regulation (EU) 2023/194 of 30 January 2023).

Fishery in 2023

No specific information is available for 2023. Whiting at Rockall are taken as a bycatch in fisheries for other species such as haddock and anglerfish.

37.2 Data

Landings data for whiting in 27.6.b are shown by nation in Table 37.1 (for 1989 onwards) and Figure 37.1 (for 1975 onwards). Total officially reported landings were 49 t in 2023, of which 29 t were reported by the UK and 20 t by Ireland. In the past, official landings have shown very high interannual variation and it is not known whether these are a true reflection of removals.

Both landings and discards for 2023 have been uploaded to InterCatch (Figure 37.2). Total catch by category (including raised discards) is shown in Figure 37.3. All the landings and discards were from the TR1 fleet. The overall discard rate was 12%. In addition to catch, some landings and discards age compositions (only from the Scottish fleet) were also uploaded to InterCatch. Catch numbers-at-age (in different catch categories) are shown in Figure 37.4. The overview of catch data (including raised discards) by country and catch category is shown below:

Country	Landings(tonnes)	Discards (tonnes)	Total (tonnes)
Ireland	19.4	0.6	20.0
UK (Scotland)	29.2	6.2	35.4
Total	48.6	6.8	55.5

Survey catch rates of whiting at Rockall are extremely low (Table 37.2) and are therefore unlikely to provide a reliable index of abundance.

Catches of whiting (both survey and commercial) are too low to support the collection of the necessary information for an assessment of stock status.

37.3 Target category

In 2012, advice was provided using the DL approach for category 6; stocks with negligible landings stocks and stocks caught in minor amounts as bycatch with no indication of F in relation to reference points and no marked positive trends in stock indicators. WKLIFE has previously suggested a target category of 4 for this stock. Given the information in Section 37.2 regarding the potential unreliability of landings data and lack of sampled data, WGCSE considers that whiting in 27.6.b is likely to remain a category 6 stock.

37.4 Management considerations

Rockall whiting is managed under a TAC for the combined Divisions 6.a and 6.b and therefore cannot be effective in limiting catches in Rockall.

Table 36.1. Whiting in Division 27.6.b. Nominal landings (in tonnes) as officially reported to ICES.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	32	10	4	23	3	1	-	-	10	-	2	3	3	104
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
UK (E, W & NI)	16	6	1	5	10	2	5	26	49	20	-	-	-	-	-	-	-	-
UK (Scotland)	18	482	459	283	86	68	53	36	65	23	44	58	4	7	11	1	1	1
UK (all)																		
Total	34	488	460	288	128	80	62	85	117	44	44	58	14	7	13	4	4	105

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
France	+	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-
Ireland	16	23	4	2	3	-	+	6	6	9	7	9	24	13	6	2	20
Norway	-	-	-	-	-	-	-	-	-	1	-	+	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK (E, W & NI)	-	-	-	-	-	-	-	-									
UK (Scotland)	1	8	12	16	6	1	3	23									
UK (all)									46	22	32	34	65	25	11	11	29
Total	17	31	16	18	9	1	3	29	52	33	40	43	89	38	17	13	49

*** Preliminary.**

+ < 0.5 t

Table 37.2. Whiting in Division 27.6.b. Survey data made available to the WG: Scottish Q3 groundfish survey (UK-SCORoc-Q3). Catch rates are given as number per ten hours.

	UK-SCORoc-Q3 – Scottish Groundfish Survey – numbers at age/10 h								
Year	Effort	Age							
	(hours)	0	1	2	3	4	5	6	7
2011	10	0	0	0	0	0	0	0	0
2012	10	33.3	0	0.4	0	0	0	0	0
2013	10	6.7	1.9	0	0	0	0	0	0
2014	10	17.4	3.4	0.8	0.3	0	0	0	0
2015	10	8.9	0.6	0.6	0.6	0	0	0	0
2016	10	250.0	0.8	0	0.2	0.4	0	0	0
2017	10	23.1	10.8	0	0	0	0	0	0
2018	10	0.5	0.8	0.9	0	0	0.3	0	0
2019	10	0.1	0.2	0.2	0	0	0.1	0	0
2020	10	9.4	0	0	0	0	0	0	0
2021	10	26.1	0.9	0	0	0	0.2	0	0
2022	10	1.7	23.1	1.0	0	0	0	0	0
2023	10	0.6	1.7	5.2	0.3	0	0	0	0

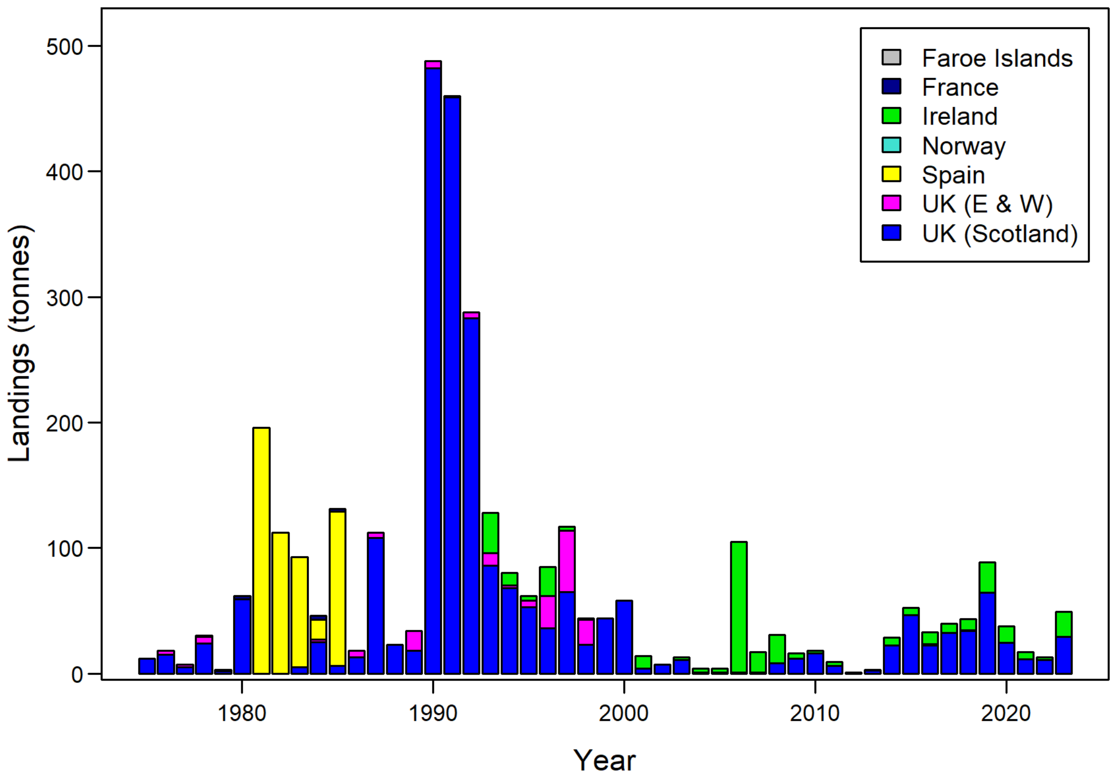


Figure 37.1. Whiting in Division 27.6.b. Official landings of whiting in 27.6.b by nation.

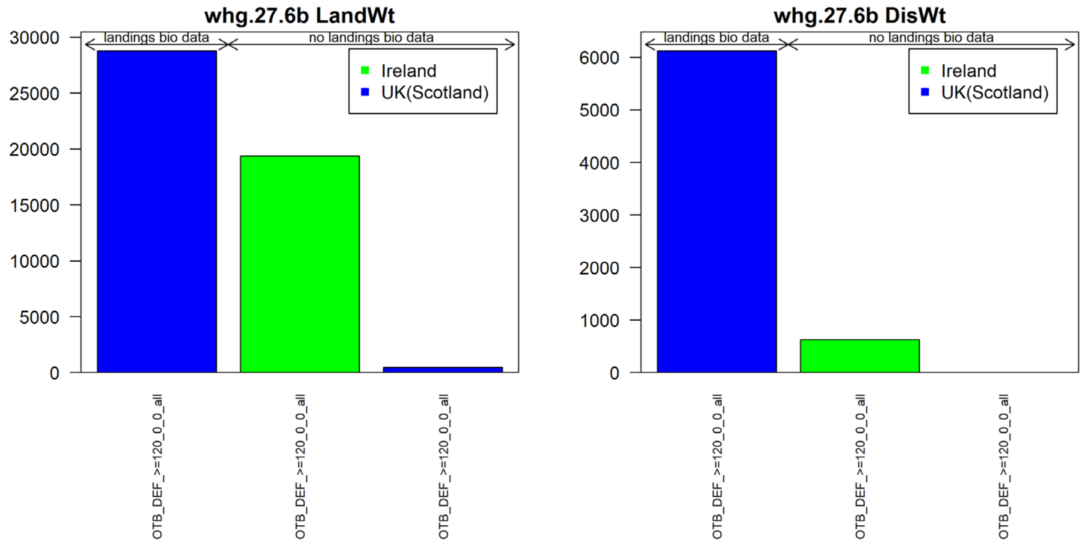


Figure 37.2. Whiting in Division 27.6.b. Landings (left panel) and discards (right panel) by metier (kg) in 2022 as entered into InterCatch.

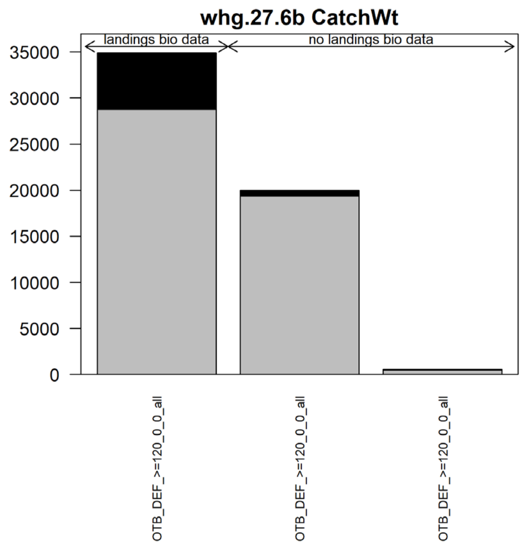


Figure 37.3. Whiting in Division 27.6.b. Landings (sampled and unsampled, in grey), sampled discards (in black) and raised unsampled discards (in red) after allocations within InterCatch.

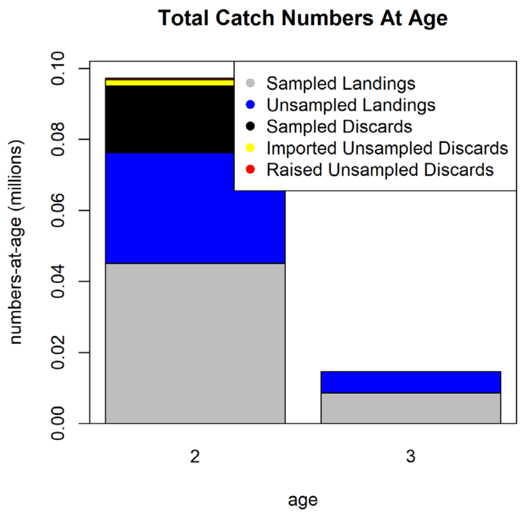


Figure 37.4. Whiting in Division 27.6.b. Catch numbers-at-age by sampled and unsampled landings, and sampled and raised (unsampled) discards, after allocations within InterCatch.

Contents

38 Whiting (*Merlangius merlangius*) in Division 7.a (Irish Sea)

2023 Assessment and advice

WGCSE 2024 updated the assessment with 2023 data. The advice for this stock is biennial so does not change; however, a short-term forecast was run to update the data.

This is a category 1 stock where a full analytical assessment and forecast is carried out.

Type of assessment

SPALY update of ASAP assessment.

ICES advice applicable to 2024 (and 2025)

ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catches in 2024 and 2025.

https://doi.org/10.17895/ices.advice.21864330.v1

Technical Service 2022

EU DGMARE has requested that ICES evaluate the following:

For by-catch and for target stocks (except data-limited deep sea stocks) where ICES is advising zero catch but the stock is caught in mixed fisheries with other species where non-zero catches are advised, and where sufficient data and understanding of processes exist, ICES will provide estimates of the likely catches of stocks for which there is zero catch advice, under the assumption that TACs for the target stocks are set in line with ICES advice, respectively in line with FMSY point and with FMSY lower, where available. In doing so, for the stocks for which there is zero catch advice, ICES will for the likely catches quantify corresponding changes in biomass and the probability of the biomass being above Blim at the end of the projection year.
For stocks where ICES is advising zero ca*tches, ICES will identify stocks for which a sentinel fishery is required to monitor stock development. For such stocks, where possible, ICES will provide the minimum level of catches needed to provide sufficient data for ICES to continue providing scientific advice on the state of the stock. In doing so, ICES should in particular consider the following stocks for which there was advice for zero catches in 2022 and for which a sentinel fishery was conducted in 2023 or was being considered for 2023.*
This technical service provides one additional scenario based on expected bycatch of status quo fishing effort. For whiting in Division 7.a:

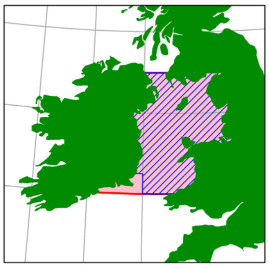
- 1318 tonnes are estimated to be caught as bycatch if fishing effort continues at status quo levels (average 2020–2022), which would result in a whiting spawning-stock biomass (SSB) of 982 tonnes in 2025.

https://doi.org/10.17895/ices.advice.24720399.v1

38.1 General

Stock description and management units

The stock and the management unit are both ICES Division 7.a (Irish Sea). Whiting landings taken or reported in ICES rectangles 33E2 and 33E3 have been reassigned to the 7.b,c,e–k whiting stock since 2003.



Management applicable to 2022

The minimum conservation reference size of whiting is 27 cm. This stock is subject to the landings obligation as part of the Commission Delegated Regulation (EU) 2018/2034.

In 2023 and 2024, the TAC was set at 721 t, with slightly differing country quotas between the two years.

Official landings as reported to ICES in 2023 were 63 t, a decrease from 78 t in 2022.

TAC 2023

Species:	Whiting *Merlangius merlangus*		Zone:	7a (WHG/07A.)
Belgium	2	(1)	Analytical TAC	
France	21	(1)	Article 8 of this Regulation applies	
Ireland	269	(1)	Article 3 of Regulation (EC) No 847/96 shall not apply	
Netherlands	1	(1)	Article 4 of Regulation (EC) No 847/96 shall not apply	
Union	293	(1)		
United Kingdom	428	(1)		
TAC	721	(1)		
(1)	Exclusively for by-catches of whiting in fisheries for other species. No directed fisheries for whiting are permitted under this quota.			

TAC 2024

Species:	Whiting *Merlangius merlangus*		Zone:	7a (WHG/07A.)
Belgium	2	(1)	Analytical TAC	
France	21	(1)	Article 8 of this Regulation applies	
Ireland	262	(1)	Article 3(2) and (3) of Regulation (EC) No 847/96 shall not apply	
Netherlands	1	(1)	Article 4 of Regulation (EC) No 847/96 shall not apply	
Union	286	(1)		
United Kingdom	435	(1)		
TAC	721	(1)		

(1) Exclusively for by-catches of whiting in fisheries for other species. No directed fisheries for whiting are permitted under this quota.

Fishery in 2023

The characteristics of the fishery are described in the stock annex.

The fishery in 2023 was prosecuted by the same fleets and gears as in recent years.

The majority of catches are discards are from *Nephrops* directed fleets. The main fleets landing whiting are fin-fish directed fleets from Ireland and Northern Ireland. In recent years landings were submitted for the PTM_SPF metier. These are likely from trips targeting herring where whiting is a bycatch. Figure 38.2 shows the contribution of catch by fleet.

Table 38.1 gives the official nominal landings of 7.a whiting as reported by each country to ICES. Working Group estimates of the landings and discards for the main fleets are given in Table 38.2. In recent years the values provided to the WG are very similar to officially reported landings.

Belgium and UK(NI) submitted discard estimates for 2023. However, there were no OTB_CRU discard estimates from Ireland. This metier constitutes on average 17% of the overall OTB_CRU discards for the stock. In order to determine an estimate from this component of the catch for 2023, a linear model was applied to the total weight of whiting discards and effort from the Irish OTB_CRU fleet from 2010-2021 weighted by the number of trips. This resulted in an estimate of 219 t for the Irish OTB_CRU fleet for 2023. A similar approach was used for the Irish OTB_DEF fleet which resulted in an estimate of 4 t for this fleet.

Total discards were estimated to be 952 t in 2023.

No BMS landings or logbook registered discards were submitted to ICES for 2023.

The closure of the western Irish Sea to whitefish fishing from mid-February to the end of April, designed to protect cod, was continued in 2023 but is unlikely to have affected whiting catches which are mainly bycatch in the derogated *Nephrops* fishery. *Nephrops* vessels can obtain a derogation to fish in certain sections of the closed area, providing they fit separator panels to their nets to allow escape of cod and other fish. The TR2 fleet in 7.a are obliged to use one of four types of cod selective measures, namely a ‘Swedish’ grid; the inclined separator panel, SELTRA trawl or 300 square mesh panel.

A summary of the 2023 catches by main gear types is presented below.

Catch	Landings*			Discards		
982 tonnes	Finfish-directed otter trawls	*Nephrops*-directed otter trawls	Other gears	Finfish-directed otter trawls	*Nephrops*-directed otter trawls	Other gears
	80%	5%	15%	1%	81%	81%
	30 tonnes			952 tonnes		

*Landings from statistical rectangles 33E2 and 33E3 reallocated to whiting landings in divisions 27.7b-ce-k

38.2 Information from the industry

There was no information on the whiting stock from the industry.

38.3 Data

Data were provided by all countries according to the data call.

For WGCSE (2024) all data have been updated where possible. To allow an age based assessment, catch numbers at age, catch weights at age, stock weights at age have all be constructed since 2003 (WGCSE, 2017). These updates are documented in the Stock Annex.

Fishery landings

Working Group estimates of catch available since 1980 are illustrated in Figure 38.1 and indicate the declining trend since the start of the time-series. In 2023, there was a decrease in landings from 57 t to 30 t.

The introduction of UK and Irish legislation requiring registration of fish buyers and sellers may mean that the reported landings from 2006 onwards are more representative of actual landings.

Working group estimates of landings are corrected for misreporting in the past. There is information that officially reported landings of whiting, especially around the mid-1990s, have been inaccurate due to misreporting. Landings data have previously been partially corrected for by using sample-based estimates of landings at a number of Irish Sea ports. Due to the low level of landings recently, this has not been carried out since 2003. As for 7.a cod and haddock, the whiting landings taken or reported in ICES rectangles 33E2 and 33E3 have been reassigned to the 7.e–k whiting stock since 2003 (Table 38.3).

Fishery discards

Discard estimates are available from Northern Ireland, Irish and Belgian fleets. Raising methods used are described in the stock annex for 7.a whiting.

Landings-at-age data

Landings numbers at age are given in Table 38.4. For the 2003 data onwards, the catch and mean weight-at-age are estimated using combined UK (NI) and Irish quarterly length–weight relationships and age–length keys. This data is raised to the international catch data provided to ICES. Typically, quarterly landings are provided by the UK (Scotland), Belgium and France and annual landings are provided by UK (IOM). The quality of the landings-at-age data has been declining in recent years due to reduced sample numbers commensurate with the decline in landings. In 2023, landings at-age were provided by Ireland and Northern Ireland.

Sampling and raising methods previously used are described in the stock annex for 7.a whiting. Methods for estimating quantities and composition of landings are described in the stock annex.

Discards numbers-at-age data

In 2023, discard sampling numbers at age were only available from Northern Ireland.

Discard number at age are given in Table 38.5. Discarding of whiting is high within the Irish Sea. Discard Numbers at age were combined for ages 0 to 6+ and then raised to the international discards. There has been a high number of age 1 and 2 discarded at the start of the time series with almost all age 1 , 2, 3 and 4 discarded later in time series (Figure 38.4).

The length frequency of discards of national sampled fleets in 2019 is given in Figure 38.3 This information has not been updated for 2023. More detailed information is available in the stock annex.

Biological data

The derivation of these parameters and variables is described in the stock annex. The Lorenzen method was used to estimate M. This was derived during WKIRISH, 2 and investigated during WKIRISH, 3. Maturity at age is knife edge at age 2. Stock weights were also revised at the benchmark meeting. Stock weights-at-age were derived from the catch weights and then smoothed using a three year moving average. Figure 38.5 shows the stock weights used. There are strong trends in mean weights at age over the time series with a minimum around 2000s for most ages. There was a small increase in the mid-2000s but overall mean weights are significantly lower than at the start of the series.

Survey data used in assessment

Table 38.6 describes the survey data made available to the Working Group.

Survey series for whiting provided to the Working Group are further described in the stock annex for 7.a whiting (Section B.3). Five survey series were available. The inclusion of the different available surveys was tested in a series of preliminary model runs at WKIRISH, 3

The three surveys used in the assessment are NIGFS-WIBTS-Q1 (G7144), NIGFS-WIBTS-Q4 (G7655), and NI MIK (I9826). There was no new information available for the NI MIK (I9826) survey in 2022. Previous sensitivity analysis has shown that missing data from this survey has little impact on the overall assessment.

Figure 38.6 shows the log standardized indices by cohort of the tuning fleets used in the assessment. There are very little cohort signals in any of the indices. The survey data shows a major change in the age structure of the stock around the mid-2000s. The two NI surveys show that older fish disappear around 2003 in the Q1 survey and around 2004 in the Q4 survey. This is mainly due to a decline whiting catches in the Eastern Irish Sea stratum which was explored in detail at WKIRISH. There is no indication of a year affect in 2023.

38.4 Historical Stock Development

Model used: ASAP

Software used: ASAP V3.0.17 NOAA Fisheries toolbox (http://nft.nefsc.noaa.gov)

FLR with R version 3.6.1 (64-bit) with packages FLEDA 2.5.2, FLCore 2.6.15, FLAssess 2.6.3, and Flash (http://flr-project.org)

Data screening

The general approach to data screening and analysis was followed in addition to the data exploration tools available in the FLR package FLEDA. The results of the data screening are fully documented using R markdown and are available in the folder 'Data\Whg 7.a \Assessment. on SharePoint. Table 38.7 shows the ASAP input data.

Final update assessment

The final assessment was run using the same settings as described in WKIRISH, 3. These final settings are described in the Stock Annex. The exception to this is the CV of 0.3 used for catch numbers at age for 2020.

Figure 38.7 shows the selectivity at age in the catch. Full selectivity is assumed for age 3 and the model is allowed to estimate ages 1 and 2. Table 38.8 shows the model estimates.

The observed and predicted index cpue values are shown in Figure 38.8. There is poor fit to the Northern Irish groundfish survey indices in the first half of the series but it improves in recent years.

The observed and predicted catches are shown in Figure 38.9. Fit to the overall catch is reasonably good. There is some deviation in the early to mid 1990's. This is most likely due to the introduction of the survey data into the assessment model.

Figure 38.10 shows the retrospective analysis. The predicted catch shows no obvious retrospective pattern. There is some deviation in the early part of the time series when the surveys were first introduced. However, recent estimates of SSB and F are consistent with no apparent bias. In some years, recruitment appears to be overestimated in the assessment.

A Mohn's rho analysis was conducted based on the ASAP stock assessment results, i.e. the last data year (2022) was used as the final year for comparison of SSB, F and recruitment and based on a five-year retrospective analysis. The results from the Mohn's rho analysis are shown in the following table:

	SSB	F (ages 1-3)	recruitment
Mohn's rho value	0.0976	-0.129	0.26

The Mohn's rho values for this assessment are below the threshold imposed by ICES of 20% for spawning stock biomass and 15% for fishing mortality.

The state of the stock

Table 38.9 shows the estimated fishing mortality-at-age and Table 38.10 shows the stock numbers-at-age. The stock summary is given in Table 38.11 and Figure 38.11.

The present stock size is extremely low. SSB has declined since the start of the time series and has been well below B_{lim} since the mid 1990's. Recruitment has been low since the early 1990's with a slight increase in recent years. Large variations in fishing mortality estimates have been observed in recent years. F has been well above F_{lim} since the early 1990's.

38.5 Short-term predictions

Short-term projections were performed using FLR libraries. Recruitment for 2023–2024 was estimated at 118237 (GM 2000-2022:thousands). As the retrospective pattern has shown an overestimate of recruitment for some years, the terminal year was excluded from the GM for the WGCSE, 2024 assessment. Three year averages (2021-2023) were used for F (unscaled) and weights-at-age.

Input data for the short-term forecast are given in Table 38.12. The single-option output is given in Table 38.13 , Table 38.14 and Table 38.15 gives the management options.

Estimates of the relative contribution of recent year classes to the 2024 landings and 2025 SSB are shown in Figure 38.12. The 2021-2022 year class estimates from ASAP accounts for 75% of the projected landings in 2025. The 2024 GM assumption contributes considerably to the estimated SSB in 2026 as does the 2023 ASAP assessment.

38.6 Medium-term predictions

There is no analytical assessment for this stock.

38.7 MSY evaluations and Biological References Points

ICES carried out and evaluation of MSY and PA reference points for this stock at WKIRISH, 3. The results are summarized below:

	Type	Value	Technical basis
MSY	MSY Btrigger	16300 t	Bpa
Approach	F_{MSY}	0.22	Median point estimates of EqSim with combined SR
	$F_{MSY\ lower}$	0.158	Median point estimates of EqSim with combined SR
	$F_{MSY\ upper}$	0.294	Median point estimates of EqSim with combined SR
	Blim	10000 t	Below 10,000 t recruitment is impaired
Precautionary	Bpa	16300 t	Blim combined with the assessment error
Approach	Flim	0.37	F with 50% probability of SSB less than Blim
	Fpa	0.22	$F_{p.05}$; the F that leads to SSB ≥ Blim with 95% probability

In 2021, ICES updated the basis for Fpa as "the F that leads to SSB ≥ Blim with 95% probability", ICES (2021). Prior to this, it was based on "Flim combined with the assessment error", ICES (2017). The Fpa value of 0.22 remains unchanged.

38.8 Management Plans

No management plan has been agreed.

38.9 Uncertainties and bias in assessment and forecast

This stock was benchmarked in January 2017. The result of the benchmark was that the stock was elevated from a category 3 stock (trend-based assessment) to a category 1 stock (analytical assessment). The assessment includes information from the commercial fishery, including both landings and discards, and takes into account selectivity changes that have occurred in 1995. Three survey series are used within the assessment. Natural mortality parameters were updated to reflect current stock dynamics. The highly fluctuating estimates of fishing mortality in recent years (2002 – present) are likely to be the result of variability in the sampling data and discard estimates. Despite this inherent uncertainty it is clear from the assessment and additional information from surveys that the stock remains extremely low.

38.10 Recommendations for next benchmark assessment

This stock was benchmarked in 2017 as part of the WKIRISH process. A number of recommendations for future work were made and these are listed below. This stock is due to be benchmarked again in 2025. The explorations of which are detailed below:

Assessment method

Currently a single fleet ASAP with fixed selection assumption is used. Exploring alternative modelling frameworks which allow for changes in selection should be investigated. There is very little data to inform the question whether survey catchability is flat-topped or dome-shaped. At the moment the highly truncated age structure means that this makes little difference in the model outputs. However, if the stock recovers and more older fish appear then this will need to be revisited.

Biological parameters

New natural mortality estimates from the Irish Sea EWE model should be included in the assessment. The stock shows very strong changes in weights-at-age over time (they can change by a factor of up to 2). This is likely to affect the natural mortality. Further information to support this would be very useful for future benchmarks.

Maturity estimate are available from Northern Ireland. This was explored at WGCSE 2023 where the NI maturity estimates were used in alternative assessment run. It had little impact on the overall stock status but it more likely better estimated as it is derived from real data.

Discards

Discards data remain highly uncertain for this stock. This probably contributes to the variable F patterns observed. Partitioning catch data into landings and discards or by fleet with different CVs may help smooth out some of this variability.

Life history parameters

Mean weights show trends which are currently smoothed. This should be explored further with a view to improving the approach and possibly using it in forecasts.

Other issues

Stock identity is assumed to be appropriate but there are East -West differences in population structure and in the past there has been speculation about emigration to 7g.

Dietary and Genetic Analysis

AFBI have recently undertaken a project looking at the genetic and dietary status of whiting in the Irish Sea, the results of which will help life history parameters of the whiting stock.

Ecosystem Models

There are several ecosystem models developed for the Irish sea, the most recent of which looks at food web interactions. Incorporating ecosystem models into the assessment and advice process will better inform on sustainable fisheries management and species conservation.

Sampling

Discard sampling should be improved for this stock since discards account for the vast majority of the catch in number. Despite various management initiatives discarding remains sporadic and high in the *Nephrops* fishery.

Tuning series

Currently calculated survey CVs are not used in ASAP. It might be worth exploring the impacts of using actual values instead of an assumed fixed CV in future assessment models.

The FSP survey potentially has useful information on the older fish (even though the survey is discontinued). Including the survey in the final assessment run resulted in many of the retrospective runs to fail to converge. It appears therefore that it causes the model to be unstable and was omitted from the final run. For future benchmarks it may be useful to investigate why this survey makes the model unstable.

38.11 Management Considerations

Discarding in the *Nephrops* fishery is the main management issue. Despite the implementation of several technical measures, which experimentally reduce whiting catches, as part of the cod long-term management plan and the full implementation of the landings obligation in 2019, the discards estimates still remain high, c.1,089 t. This stock is a major ‘choke species’ for the 7.a *Nephrops* fishery in the context of the landing obligation.

Effort limitations are in force within the Irish Sea as a result of the cod long-term management plan. These effort limitations have not significant reduced mortality on whiting.

Whiting has a low market value, which is likely to contribute to discarding rates.

Technical measures applied to this stock include a minimum conservation reference size (≥27 cm), whiting now mature well below this MCRS.

38.12 References

ICES, 2017 :Report of the Benchmark Workshop on the Irish Sea Ecosystem (WKIrish3), 30 January-3 February 2017, Galway, Ireland, ICES CM 2017/BSG:01

ICES, 2017 : Report of the Second Workshop on the Impact of Ecosystem and Environmental Drivers on Irish Sea Fisheries Management (WKIrish2),26-29 September 2016, Belfast, Northern Ireland, ICES CM 2016/BSG:02

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ICES. 2021. Whiting (Merlangius merlangus) in Division 7.a (Irish Sea). In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, whg.27.7a. https://doi.org/10.17895/ices.advice.7887

38.13 Tables and Figures

Table 38.1 Official landings (t) of Whiting in Division 7.a as reported to ICES

Year	Belgium	France	Ireland	Netherlands	UK(NI, Engl. & Wales)	Spain	UK (Isle of Man)	UK (Scotland)	UK	Total human consumption
1988	90	1,063	4,394		5,823		15	107		11,492
1989	92	533	3,871		6,652		26	154		11,328
1990	142	528	2,000		5,202		75	236		8,183
1991	53	611	2,200		4,250		74	223		7,411
1992	78	509	2,100		4,089		44	274		7,094
1993	50	255	1,440		3,859		55	318		5,977
1994	80	163	1,418		3,724		44	208		5,637
1995	92	169	1,840		3,125		41	198		5,465
1996	80	78	1,773	17	3,557		28	48		5,581
1997	47	86	1,119	14	3,152		24	30		4,472
1998	52	81	1,260	7	1,900		33	22		3,355
1999	46	150	509	6	1,229		5	44		1,989
2000	30	59	353	1	670		2	15		1,130
2001	27	25	482		506		1	25		1,066
2002	22	33	347		284		1	27		714
2003	13	29	265		130	85	1	31		554
2004	11	8	96		82		1	6		204
2005	10	13	94		47			<0.5		164
2006	4	4	55		22			<0.5		85
2007	3	3	187		3		1	<0.5		197
2008	2	2	68		11		1			84
2009	2		78		20					100
2010	5	3	97		16		<0.5			121
2011	4	3	95		16		<0.5			118
2012	5	1	58		10			1	11	86
2013	2	<0.5	44				<0.1	2	20	68
2014	2	<0.5	60		11		<0.1			73
2,015	1	<0.5	49		8					59
2,016	1	<0.5	44		5		<0.1			50
2,017	2	<0.5	32		17		<0.1			50
2018	1		44		19		<0.5			63
2019	4		129		63		<0.1			196
2020	5	<0.1	56		42		<0.1			102
2021	2	<0.1	109		38					149

Year	**Belgium**	**France**	**Ireland**	**Netherlands**	**UK(NI, Engl. & Wales)**	**Spain**	**UK (Isle of Man)**	**UK (Scotland)**	**UK**	**Total human consumption**
2022	4	0.1	34		40					78
2023*	4	0.1	34		25		<0.5			63

* Preliminary

Table 38.2 ICES estimates of discards, landings and catch of whiting in Division 7.a

Year	**Discards by Country/Fleet**					**Discards**	**Landings**	**Catch**
	Nephrops fishery [b]	IR-OTB fleet[ce]	UK (NI) [d]	Belgium	UK (E&W) fleet			
1988	1.611					1.611	10.245	11.856
1989	2.103					2.103	11.305	13.408
1990	2.444					2.444	8.212	10.656
1991	2.598					2.598	7.348	9.946
1992	4.203					4.203	8.588	12.791
1993	2.707					2.707	6.523	9.230
1994	1.173					1.173	6.763	7.936
1995	2.151					2.151	4.893	7.044
1996	3.631					3.631	4.335	7.966
1997	1.928					1.928	2.277	4.205
1998	1.304					1.304	2.229	3.533
1999	1.092					1.092	1.670	2.762
2000	2.118					2.118	762	2.880
2001	1.012					1.012	733	1.745
2002	740					740	747	1.487
2003		480				480	517	996
2004		905				905	133	1.038
2005		272				272	125	397
2006		1.580	193			1.773	64	1.837
2007		725	787			1.512	35	1.547
2008		693	476			1.169	37	1.206
2009		688	633			1.321	39	1.360
2010		240	914			1.154	30	1.184
2011		330	616			946	31	977
2012		257	1.065	17	1	1.339	60	1.399
2013		95	833	17	3	948	33	981
2014		263	1.645	15	28	1.951	23	1.974
2015		438	1.074	9	1	1.521	28	1.549
2016		173	589		3	765	15	780
2017		122	544		1	667	36	703
2018		98	754		<0.5	853	46	899

Year	Discards by Country/Fleet					Discards	Landings	Catch
	Nephrops fishery [b]	IR-OTB fleet[ce]	UK (NI) [d]	Belgium	UK (E&W) fleet			
2019		86	897	20	87	1.089	172	1.261
2020		102[f]	906	22	Na	1.030	88	1.118
2021		431	1.118	22		1.571	81	1.662
2022		213[g]	721	49	4	986	57	1.043
2023		224[h]	553	173	3	952	30	982

[b] Based on UK(N.Ireland) and Ireland data.

[f] Average IR-OTB discards (2017-2019)

[c] Based on data from Ireland

[g] Of which 211 is based on LM (2010-2021)

[d] Based on data from Northern Ireland

[*] Preliminary (and rounded)

[e] Raised using Days

[h] Based on LM (2010-2021)

Table 38.3 Whiting landings taken or reported in ICES rectangles 33E2, 33E3 and 33E4 have been reassigned to the 7.e–k whiting stock since 2003.

Year	Official landings	ICES landings	ICES Discards	ICES catch	Landings taken or reported in rectangles 33E2 and 33E3
1988	11,492	10,245	1,611	11,856	
1989	11,328	11,305	2,103	13,408	
1990	8,183	8,212	2,444	10,656	
1991	7,411	7,348	2,598	9,946	
1992	7,094	8,588	4,203	12,791	
1993	5,977	6,523	2,707	9,230	
1994	5,637	6,763	1,173	7,936	
1995	5,465	4,893	2,151	7,044	
1996	5,581	4,335	3,631	7,966	
1997	4,472	2,277	1,928	4,205	
1998	3,355	2,229	1,304	3,533	
1999	1,989	1,670	1,092	2,762	
2000	1,130	762	2,118	2,880	
2001	1,066	733	1,012	1,745	
2002	714	747	740	1,487	
2003	554	517	480	996	159
2004	204	133	905	1,038	51
2005	164	125	272	397	33
2006	85	64	1,773	1,837	22
2007	197	35	1,512	1,547	161
2008	84	37	1,169	1,206	44
2009	100	39	1,321	1,360	63
2010	121	30	1,154	1,184	91
2011	118	31	946	977	75

Year	Official landings	ICES landings	ICES Discards	ICES catch	Landings taken or reported in rectangles 33E2 and 33E3
2012	86	60	1,339	1,399	43
2013	68	33	948	981	33
2014	73	23	1,951	1,974	50
2015	59	28	1,521	1,549	34
2016	50	15	765	780	40
2017	50	36	667	703	20
2018	63	46	853	899	18
2019	196	172	1,089	1,261	24
2020	102	88	1,030	1,118	14
2021	149	91	1,571	1,662	59
2022	78	57	986	1,043	21
2023	63	30	952	982	33

Table 38.4 Whiting7.a. Landings numbers-at-age

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1980	0	14520	21811	6468	2548	350	0
1981	0	11203	29011	16004	2596	821	0
1982	41	5427	18098	19340	6108	813	0
1983	0	4886	9943	9100	4530	1165	321
1984	0	18254	12683	5257	2571	1045	402
1985	0	15540	35324	8687	996	0	675
1986	0	6306	16839	10809	1877	285	0
1987	0	10149	21563	6968	1943	242	0
1988	0	6983	25768	6989	1513	396	0
1989	0	11645	14029	13011	3645	490	0
1990	0	9502	17604	4734	1477	318	0
1991	102	7426	18406	5829	993	0	311
1992	0	8380	21907	7959	1374	462	0
1993	38	2742	21468	7327	932	0	135
1994	0	3245	6983	18509	1801	208	0
1995	0	1124	10095	3020	4444	233	0
1996	129	1652	6162	7432	1263	1082	135
1997	0	610	4239	2567	1795	87	79
1998	0	329	3287	4727	888	261	95
1999	1	341	2806	2607	741	160	119
2000	0	319	1364	1002	299	115	15
2001	0	111	1189	1006	171	53	20
2002	0	67	748	1480	376	48	41
2003	0	89	1051	606	199	0	0
2004	0	0	17	117	150	17	0
2005	0	0	101	216	95	21	3
2006	0	34	41	88	39	9	1
2007	0	24	41	32	10	3	0
2008	0	38	66	25	5	1	0
2009	0	65	44	22	4	1	0
2010	0	18	83	11	3	0	0
2011	0	1	17	59	15	3	0
2012	0	4	29	80	60	9	1
2013	8	81	36	20	5	1	1
2014	0	2	25	24	11	1	1
2015	0	2	25	24	11	1	1
2016	0	0	6	21	10	3	0
2017	0	0	9	50	43	5	1
2018	0	1	14	70	38	19	2
2019	0	0	146	181	72	45	23
2020	0	0	58	138	93	18	10
2021	0	0	32	119	62	42	6

2022	0	0	16	83	58	11	1
2023	0	6	15	26	8	17	0

Table 38.5 Whiting7.a. Discard numbers-at-age

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1980	12786	32318	6888	65	26	0	0
1981	9865	24935	9162	162	26	0	0
1982	4047	8489	560	19	0	0	0
1983	23847	7328	2036	9	0	0	0
1984	26394	33900	1568	11	0	0	0
1985	12380	26461	1859	9	0	0	0
1986	28364	21111	1464	33	0	0	0
1987	16594	40598	1875	0	0	0	0
1988	6922	17958	1940	0	0	0	0
1989	17247	20701	2476	26	0	0	0
1990	4216	31810	3353	72	0	0	0
1991	20349	29334	3823	146	1	0	0
1992	1497	61451	10404	97	0	0	0
1993	12639	13979	17707	426	5	0	0
1994	3731	12063	1812	1702	29	0	0
1995	7118	17613	7015	492	234	0	0
1996	12732	39647	8168	1976	81	0	0
1997	8163	25497	5352	689	141	0	0
1998	6096	27131	2293	550	44	0	0
1999	20851	7677	2117	228	34	2	2
2000	7321	38922	4395	564	55	1	10
2001	16940	12631	3150	102	10	0	0
2002	8538	13412	1588	231	33	0	1
2003	12389	4595	201	0	0	0	0
2004	19699	14938	345	59	0	0	0
2005	643	5797	346	16	3	0	0
2006	15764	20590	613	21	0	0	0
2007	17436	24319	747	50	0	0	0
2008	10645	19994	676	16	0	0	0
2009	6622	27448	1176	0	0	0	0
2010	3946	15102	2810	64	1	0	0
2011	25982	8197	658	314	0	0	0
2012	6637	31020	790	37	1	3	0
2013	8493	11945	613	4	0	0	0
2014	13467	27553	2425	259	10	0	0
2015	3883	23595	2603	223	1	0	0
2016	4509	5780	4804	294	15	0	0
2017	3559	5870	4385	240	14	0	0
2018	6523	7386	2557	614	92	10	0
2019	6429	14041	3986	571	57	7	0
2020	11987	26870	978	50	3	0	0
2021	4272	18880	6496	396	18	4	0

2022	2837	18777	1468	270	67	12	1
2023	4088	7318	6193	1114	92	10	0

Table 38.5 Whiting in 7.a. Survey data available

NIGFS-WIBTS-Q1: Northern Ireland March Groundfish Survey

1993	2023					
1	1	0.21	0.25			
1	6					
1	665.6	710.3	81.2	11.7	4.3	0.8
1	1804.6	262.1	299.2	44.7	11.9	8.1
1	1688.9	635.7	174.2	88.4	22.0	6.3
1	1468.4	334.0	213.0	35.1	37.2	5.4
1	1406.1	1536.4	156.0	52.8	4.5	13.7
1	1485.0	754.4	415.4	29.7	7.4	1.8
1	1369.4	373.2	111.2	41.5	3.7	1.0
1	2302.4	410.9	181.8	26.6	3.7	0.0
1	1065.7	696.5	124.6	13.7	5.9	2.7
1	2307.7	686.7	175.3	52.9	11.2	1.4
1	1495.1	905.2	130.2	10.9	1.6	0.1
1	1609.8	231.7	61.4	2.7	1.3	0.2
1	689.3	124.0	28.5	12.3	2.8	0.1
1	959.8	235.6	30.3	6.0	0.1	0.1
1	905.0	158.6	14.9	2.7	0.2	0.0
1	756.7	347.0	45.0	2.8	0.3	0.4
1	1062.3	281.1	36.3	1.8	0.2	0.1
1	739.4	545.8	51.6	4.7	6.4	0.0
1	586.4	156.5	36.0	3.9	0.6	0.0
1	972.2	354.4	42.3	5.9	1.2	0.0
1	629.6	649.3	66.7	3.5	0.5	0.0
1	922.1	367.6	67.0	4.3	0.2	0.1
1	2797.3	469.3	18.8	2.3	0.0	0.0
1	1409.1	924.8	38.7	1.5	0.1	0.1
1	888.1	831.8	142.2	11.2	0.7	0.1
1	431.4	296.8	119.4	17.9	2.3	0.0
1	568.0	831.9	347.2	43.2	6.2	0.5
1	1573.5	583.4	127.3	9.2	0.3	0.6
1	569.4	951.5	86.2	9.9	2.9	0.6
1	1900.5	503.1	119.9	4.2	1.8	0.4
1	384.4	604.4	144.8	17.2	0.16	0.0

NIGFS-WIBTS-Q4: Northern Ireland October Groundfish Survey

1993	2023						
1	1	0.83	0.88				
0	6						
1	714.0	1040.5	475.9	67.5	8.2	3.1	0.3
1	1113.1	1320.0	208.6	150.7	33.9	2.3	0.5
1	3124.4	477.3	166.5	30.6	35.6	5.4	1.2
1	2306.2	591.2	134.4	52.4	10.5	7.0	1.3
1	2626.5	676.6	497.6	61.0	18.2	4.6	4.5
1	2863.5	466.8	153.8	72.8	6.2	2.2	0.1
1	2478.4	1079.7	192.0	51.7	43.3	3.7	1.8
1	2374.3	1084.7	126.0	20.0	16.9	6.0	2.7
1	6356.4	658.3	270.8	28.9	4.9	2.3	0.0
1	2692.4	1322.5	268.3	41.6	4.5	1.2	0.0
1	4431.0	1572.3	921.1	74.8	16.8	1.5	0.0
1	4457.1	699.6	268.3	113.8	4.4	1.9	0.0
1	2377.2	487.8	183.3	15.8	1.5	0.4	0.0
1	2849.2	144.8	46.8	7.9	1.8	0.0	0.0
1	2163.1	957.6	149.1	16.7	4.8	4.3	0.2
1	4884.6	1312.6	114.3	3.8	0.2	0.0	0.0
1	2246.5	510.8	71.7	7.5	1.6	0.0	0.2
1	2274.4	312.1	259.6	8.2	0.7	0.2	0.0
1	3534.1	348.4	139.7	26.3	3.5	0.9	0.0
1	1330.9	402.5	134.7	19.5	6.2	0.1	0.0
1	7135.8	354.7	155.9	31.1	1.5	0.5	0.9
1	4504.0	507.7	135.5	8.8	0.7	0.0	0.0
1	2802.4	891.0	115.2	6.3	0.7	0.0	0.0
1	2718.7	859.3	203.5	31.7	3.5	0.4	0
1	3011.1	714.1	368.4	78.4	4.2	0.0	0.1
1	4424.7	897.5	367.6	23.4	8.3	0.2	0.04
1	5613.5	643.2	148.5	27.4	3.2	0.3	0.00
1	2416.2	1157.8	98.4	16.0	0.2	0.5	0.00
1	5376.7	1018.7	143.1	25.6	4.9	0.0	0.1
1	1934.2	1178.4	174.9	33.7	1.6	0.9	0.00
1	3309.1	620.7	421.6	25.1	7.8	0.1	0.00

NIMIK : Northern Ireland MIK Net Survey

1994	2023			
1	1		0.46	0.5
0	0			
1	778	1994		
1	225	1995		
1	397	1996		
1	205	1997		
1	59	1998		
1	91	1999		
1	40	2000		
1	167	2001		
1	19	2002		
1	148	2003		
1	101	2004		
1	135	2005		
1	118	2006		
1	82	2007		
1	99	2008		
1	173	2009		
1	78	2010		
1	122.2	2011		
1	123.9	2012		
1	197.6	2013		
1	54.9	2014		
1	59.5	2015		
1	6.7	2016		
1	175.45	2017		
1	90.74	2018		
1	164.42	2019		
1	N/A	2020		
1	108.4	2021		
1	N/A	2022		
1	202	2023		

UK (E&W)-BTS-Q3: Corystes Irish Sea Beam-Trawl Survey - Prime stations only – Effort and numbers at age (per km towed)

1988	2023		
1	1	0.75	0.79
0	1		
1	96	26	1988
1	93	21	1989
1	99	33	1990
1	216	25	1991
1	405	206	1992
1	253	95	1993
1	205	125	1994
1	1949	87	1995
1	169	194	1996
1	409	254	1997
1	893	199	1998
1	550	137	1999
1	320	122	2000
1	585	195	2001
1	280	96	2002
1	456	229	2003
1	917	330	2004
1	849	294	2005
1	1010	228	2006
1	339	89	2007
1	780	72	2008
1	389	371	2009
1	324	33	2010
1	1002	341	2011
1	442	426	2012
1	1535	228	2013
1	261	113	2014
1	211	112	2015
1	666	213	2016
1	489	230	2017
1	662	380	2018
1	307	186	2019
1	N/A	N/A	2020
1	340	132	2021
1	379	226	2022
1	274	80	2023

Eastern Irish Sea FSP: Isadale 2005 – 2013: Numbers of fish per hour towed

2005	2013					
1	1	0.16	0.20			
1	6					
1	0.22	11.06	21.12	5.28	0.98	0
	0.69					
1	8.69	46.65	15.22	1.85	0.53	0.013
	0					
1	4.24	10.77	5.55	1.01	0.28	0.02
	0					
1	3.7	10.29	8.58	1.99	0.38	0.29
	0					
1	27.3	84.91	48.67	3.61	0.33	0
	0					
1	4.54	57.92	43.5	4.95	0.16	0.05
	0.02					
1	2.22	8.42	31.85	5.13	0.96	0.02
	0					
1	5.15	80.9	29.75	22.08	1.24	0.13
	0					
1	4.21	47.35	26.43	3.13	1.72	0.01
	0					

Table 38.6 Whiting 7.a. ASAP input data

ASAP VERSION 3.0
Irish Sea Whiting
#
ASAP GUI 15 AUG 2012
#
Number of Years
44
First Year
1980
Number of Ages
7
Number of Fleets
1
Number of Sensitivity Blocks
2
Number of Available Survey Indices
5
Natural Mortality

1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518

1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518
1.078	0.803	0.718	0.608	0.554	0.518	0.518

Fecundity Option
0
Fraction of year that elapses prior to SSB calculation (0=Jan-1)
0
Maturity

0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1

0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1
0	0	1	1	1	1	1

Number of Weights at Age Matrices

2

Weight Matrix - 1

0.034	0.11	0.235	0.363	0.529	0.63	0.772
0.04	0.118	0.24	0.364	0.529	0.63	0.888
0.031	0.135	0.265	0.365	0.533	0.63	0.736
0.033	0.146	0.256	0.397	0.491	0.605	0.655
0.032	0.125	0.244	0.403	0.55	0.7	0.745
0.021	0.107	0.245	0.333	0.478	0.567	0.642
0.025	0.1	0.217	0.342	0.512	0.709	0.94
0.024	0.101	0.217	0.363	0.535	0.72	0.933
0.021	0.088	0.201	0.33	0.547	0.763	1.005
0.026	0.111	0.193	0.269	0.433	0.68	1.079
0.036	0.094	0.204	0.31	0.436	0.676	0.8
0.031	0.077	0.194	0.263	0.352	0.453	0.692
0.014	0.063	0.17	0.272	0.361	0.513	1.007
0.029	0.067	0.142	0.228	0.331	0.454	0.892
0.03	0.074	0.183	0.221	0.301	0.378	0.496
0.031	0.063	0.179	0.257	0.326	0.551	1.32
0.027	0.057	0.159	0.23	0.284	0.364	0.715
0.026	0.044	0.153	0.222	0.287	0.396	0.679
0.017	0.035	0.156	0.228	0.268	0.35	0.421
0.028	0.044	0.161	0.246	0.324	0.351	0.325
0.024	0.038	0.127	0.218	0.291	0.347	0.31
0.017	0.036	0.132	0.301	0.338	0.538	0.337
0.016	0.033	0.124	0.253	0.339	0.449	0.425
0.02	0.048	0.232	0.295	0.259	0	0
0.017	0.034	0.131	0.324	0.509	0.466	0
0.017	0.037	0.148	0.263	0.363	0.36	0.32
0.017	0.069	0.152	0.268	0.361	0.36	0.32
0.023	0.042	0.122	0.295	0.434	0.624	1.26
0.022	0.044	0.118	0.262	0.374	0.834	1.354
0.023	0.039	0.094	0.34	0.323	0.543	0
0.02	0.048	0.125	0.256	0.401	0.375	0
0.018	0.044	0.104	0.196	0.405	0.462	0.799
0.023	0.035	0.109	0.275	0.398	0.41	0.305
0.03	0.052	0.112	0.24	0.346	0.28	0.38
0.03	0.042	0.133	0.226	0.425	0.659	1.012
0.022	0.044	0.127	0.291	0.448	0.298	0.482

0.022	0.035	0.085	0.195	0.341	0.466	0.882
0.028	0.032	0.075	0.198	0.362	0.432	0.5
0.021	0.045	0.104	0.161	0.24	0.319	0.408
0.02	0.033	0.104	0.175	0.268	0.436	0.433
0.019	0.027	0.067	0.166	0.27	0.358	0.367
0.026	0.045	0.084	0.187	0.311	0.398	0.342
0.02	0.04	0.105	0.2	0.369	0.445	0.559
0.028	0.043	0.069	0.083	0.115	0.324	0.304

Weight Matrix - 2

0	0.0733	0.1733	0.2992	0.446	0.5795	0.7203
0	0.0785	0.1797	0.3003	0.4468	0.5795	0.7143
0	0.084	0.1873	0.311	0.4408	0.576	0.6948
0	0.085	0.194	0.321	0.45	0.5813	0.6668
0	0.079	0.1918	0.3163	0.4473	0.5743	0.6628
0	0.0697	0.1807	0.3038	0.4455	0.5825	0.6998
0	0.0643	0.1685	0.2907	0.4338	0.5893	0.7485
0	0.0598	0.1572	0.2857	0.4387	0.6195	0.8123
0	0.0617	0.15	0.2662	0.425	0.6262	0.8682
0	0.0607	0.1497	0.2533	0.3963	0.6057	0.8412
0	0.0608	0.1473	0.24	0.355	0.5375	0.7817
0	0.0545	0.1417	0.2393	0.3318	0.4772	0.718
0	0.048	0.1233	0.2218	0.3148	0.4282	0.7055
0	0.0463	0.117	0.2045	0.2927	0.3982	0.6358
0	0.0462	0.118	0.2002	0.2798	0.396	0.6755
0	0.0473	0.1208	0.202	0.2695	0.3752	0.6523
0	0.042	0.1142	0.205	0.2675	0.3703	0.6678
0	0.0367	0.1053	0.1952	0.258	0.3345	0.521
0	0.0322	0.101	0.194	0.2598	0.3227	0.4225
0	0.0313	0.0945	0.1937	0.2632	0.3212	0.3588
0	0.0312	0.0895	0.2015	0.2742	0.3532	0.3367
0	0.0293	0.0835	0.1987	0.2888	0.3812	0.3847
0	0.029	0.0992	0.2054	0.2847	0.4021	0.4114
0	0.0281	0.1007	0.2267	0.3261	0.3847	0.4357
0	0.0288	0.1045	0.2282	0.3338	0.3984	0.4062
0	0.0323	0.0918	0.2277	0.3525	0.3862	0.3827
0	0.0331	0.0939	0.2097	0.3355	0.4296	0.5145
0	0.0352	0.0901	0.2082	0.3326	0.4961	0.7133
0	0.0311	0.0815	0.2152	0.3261	0.5283	0.9183
0	0.0331	0.077	0.1989	0.3325	0.4804	0.9181
0	0.0326	0.0756	0.1883	0.3311	0.4127	0.784
0	0.0313	0.078	0.175	0.3326	0.3957	0.5933
0	0.032	0.0753	0.1748	0.3127	0.3924	0.455
0	0.0334	0.0808	0.1777	0.3134	0.4162	0.4746
0	0.0369	0.0836	0.1851	0.3267	0.4009	0.5369
0	0.0339	0.0805	0.1806	0.3283	0.4403	0.6021
0	0.0308	0.068	0.1713	0.3104	0.4016	0.555
0	0.0306	0.0625	0.1401	0.2712	0.3946	0.505
0	0.0301	0.0658	0.133	0.2375	0.3551	0.4336
0	0.029	0.0641	0.1307	0.2187	0.3307	0.3992
0	0.0275	0.06	0.1337	0.2251	0.3284	0.3758
0	0.0296	0.0603	0.1346	0.2462	0.3417	0.4099

0	0.0323	0.0618	0.1211	0.2246	0.3529	0.401
0	0.0323	0.0648	0.1181	0.2177	0.3625	0.4265

Weights at Age Pointers
1
1
1
1
2
2
Selectivity Block Assignment
Fleet 1 Selectivity Block Assignment
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2

```
2
2
2
2
# Selectivity Options for each block 1=by age, 2=logisitic, 3=double logistic
2  2
# Selectivity Block #1 Data
0	1	0	0.25
0.5	1	0	0.25
0.9	1	0	0.25
1	-1	0	0.25
1	-1	0	0.25
1	-1	0	0.25
1	-1	0	0.25
3	1	0	1
0.5	1	0	1
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
# Selectivity Block #2 Data
0.2	1	0	0.5
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
2	1	0	1
0.5	1	0	1
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
# Fleet Start Age
1
# Fleet End Age
7
# Age Range for Average F
2  4
# Average F report option (1=unweighted, 2=Nweighted, 3=Bweighted)
1
# Use Likelihood constants? (1=yes)
1
# Release Mortality by Fleet
1
# Catch Data
# Fleet-1 Catch Data
12786	46838	28699	6533	2574	350	621	16737
9865	36138	38173	16166	2622	821	339	21331
4088	13916	18658	19359	6108	813	400	17969
```

23847	12214	11979	9109	4530	1165	321	12405
26394	52154	14250	5268	2571	1045	402	14999
12380	42001	37183	8696	996	675	372	18169
28364	27417	18303	10842	1877	285	270	12129
16594	50747	23438	6968	1943	242	111	14270
6922	24941	27708	6989	1513	396	197	11856
17247	32346	16505	13037	3645	490	177	13408
4216	41312	20957	4806	1477	318	128	10656
20451	36760	22229	5975	994	311	84	9946
1497	69831	32311	8056	1374	462	93	12791
12677	16721	39175	7753	937	135	27	9230
3731	15308	8795	20211	1830	208	50	7936
7118	18737	17110	3512	4678	233	21	7044
12861	41299	14330	9408	1344	1082	135	7966
8163	26107	9591	3256	1936	87	79	4205
6096	27460	5580	5277	932	261	95	3533
20852	8018	4923	2835	776	161	121	2762
7321	39242	5758	1566	354	115	25	2880
16940	12742	4338	1108	181	53	20	1745
8538	13480	2336	1710	408	48	42	1487
12389	4685	1252	606	199	0	0	996
19699	14938	362	176	150	17	0	1038
643	5797	448	232	98	21	3	397
15764	20624	654	109	39	9	1	1837
17436	24343	787	82	10	3	0	1547
10645	20032	742	41	5	1	0	1206
6622	27513	1220	22	4	1	0	1360
3946	15120	2894	75	4	0	0	1184
25982	8198	675	373	15	3	0	977
6637	31023	819	116	61	12	1	1399
8501	12026	649	24	5	1	1	981
13467	27555	2450	284	21	1	1	1974
3883	23595	2613	267	15	1	1	1549
4509	5780	4809	315	25	3	0	780
3559	5871	4394	290	57	5	1	704
6523	7386	2571	684	129	29	2	899
6429	14041	4132	752	129	52	23	1261
11987	26870	1036	188	96	18	10	1118
4272	18880	6527	514	80	46	6	1662
2837	18777	1468	270	67	12	1	1043
4088	7324	6208	1141	100	27	0	982

Discards

Fleet-1 Discards Data

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Release Proportion
Fleet-1 Release Data

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

```
# Survey Index Data
# Aggregate Index Units
2 2 2 2 2
# Age Proportion Index Units
2 2 2 2 2
# Weight at Age Matrix
1 1 1 1 1
# Index Month
3 10 5 9 5
# Index Selectivity Link to Fleet
-1 -1 -1 -1 -1
# Index Selectivity Options 1=by age, 2=logisitic, 3=double logistic
1 1 1 1 2
# Index Start Age
2 1 1 1 2
# Index End Age
7 7 1 2 7
# Estimate Proportion (Yes=1)
1 1 0 0 0
# Use Index (Yes=1)
```

1 1 1 0 0
Index-1 Selectivity Data

0	-1	0	0
0.5	1	0	0.5
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
2	1	0	1
0.5	1	0	1
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-2 Selectivity Data

0.2	1	0	0.5
0.5	1	0	0.5
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
2	1	0	1
0.5	1	0	1
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-3 Selectivity Data

1	-1	0	0
0	-1	0	0
0	-1	0	0
0	-1	0	0
0	-1	0	0
0	-1	0	0
0	-1	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-4 Selectivity Data

1	-1	0	1
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0
1	-1	0	0

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-5 Selectivity Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	1	0	1
0.5	1	0	1
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-1 Data

1980	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0
1993	1474	0.3	0	0.452	0.482	0.055	0.008	0.003	0.001	50
1994	2431	0.3	0	0.742	0.108	0.123	0.018	0.005	0.003	50
1995	2615	0.3	0	0.646	0.243	0.067	0.034	0.008	0.002	50
1996	2093	0.3	0	0.702	0.16	0.102	0.017	0.018	0.003	50
1997	3169	0.3	0	0.444	0.485	0.049	0.017	0.001	0.004	50
1998	2694	0.3	0	0.551	0.28	0.154	0.011	0.003	0.001	50
1999	1900	0.3	0	0.721	0.196	0.059	0.022	0.002	0.001	50
2000	2925	0.3	0	0.787	0.14	0.062	0.009	0.001	0	50
2001	1909	0.3	0	0.558	0.365	0.065	0.007	0.003	0.001	50
2002	3235	0.3	0	0.713	0.212	0.054	0.016	0.003	0	50
2003	2543	0.3	0	0.588	0.356	0.051	0.004	0.001	0	50
2004	1907	0.3	0	0.844	0.121	0.032	0.001	0.001	0	50
2005	857	0.3	0	0.804	0.145	0.033	0.014	0.003	0	50
2006	1232	0.3	0	0.779	0.191	0.025	0.005	0	0	50
2007	1081	0.3	0	0.837	0.147	0.014	0.002	0	0	50
2008	1152	0.3	0	0.657	0.301	0.039	0.002	0	0	50
2009	1382	0.3	0	0.769	0.203	0.026	0.001	0	0	50

2010	1348	0.3	0	0.549	0.405	0.038	0.003	0.005	0	50
2011	783	0.3	0	0.749	0.2	0.046	0.005	0.001	0	50
2012	1376	0.3	0	0.707	0.258	0.031	0.004	0.001	0	50
2013	1350	0.3	0	0.466	0.481	0.049	0.003	0	0	50
2014	1361	0.3	0	0.677	0.27	0.049	0.003	0	0	50
2015	3288	0.3	0	0.851	0.143	0.006	0.001	0	0	50
2016	2374	0.3	0	0.594	0.39	1E-06	0.016	0.001	0	50
2017	1874	0.3	0	0.474	0.444	0.076	0.006	0.001	0	50
2018	868	0.3	0	0.497	0.342	0.138	0.021	0.003	0	50
2019	1797	0.3	0	0.316	0.463	0.193	0.024	0.003	0	50
2020	2294	0.3	0	0.686	0.254	0.055	0.004	0	0	50
2021	1620	0.3	0	0.351	0.587	0.053	0.006	0.002	0	50
2022	2530	0.3	0	0.751	0.199	0.047	0.002	0.001	0	50
2023	1151	0.3	0	0.334	0.525	0.126	0.015	0	0	50
# Index-2 Data										
1980	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0
1993	2309	0.3	0.309	0.451	0.206	0.029	0.004	0.001	0	50
1994	2829	0.3	0.393	0.467	0.074	0.053	0.012	0.001	0	50
1995	3841	0.3	0.813	0.124	0.043	0.008	0.009	0.001	0	50
1996	3103	0.3	0.743	0.191	0.043	0.017	0.003	0.002	0	50
1997	3889	0.3	0.675	0.174	0.128	0.016	0.005	0.001	0.001	50
1998	3566	0.3	0.803	0.131	0.043	0.02	0.002	0.001	0	50
1999	3851	0.3	0.644	0.28	0.05	0.013	0.011	0.001	0	50
2000	3631	0.3	0.654	0.299	0.035	0.006	0.005	0.002	0.001	50
2001	7322	0.3	0.868	0.09	0.037	0.004	0.001	0	0	50
2002	4331	0.3	0.622	0.305	0.062	0.01	0.001	0	0	50
2003	7017	0.3	0.631	0.224	0.131	0.011	0.002	0	0	50
2004	5545	0.3	0.804	0.126	0.048	0.021	0.001	0	0	50
2005	3066	0.3	0.775	0.159	0.06	0.005	0	0	0	50
2006	3050	0.3	0.934	0.047	0.015	0.003	0.001	0	0	50
2007	3296	0.3	0.656	0.291	0.045	0.005	0.001	0.001	0	50
2008	6315	0.3	0.773	0.208	0.018	0.001	0	0	0	50
2009	2838	0.3	0.791	0.18	0.025	0.003	0.001	0	0	50
2010	2855	0.3	0.797	0.109	0.091	0.003	0	0	0	50
2011	4053	0.3	0.872	0.086	0.034	0.006	0.001	0	0	50
2012	1894	0.3	0.703	0.213	0.071	0.01	0.003	0	0	50
2013	7680	0.3	0.929	0.046	0.02	0.004	0	0	0	50
2014	5157	0.3	0.873	0.098	0.026	0.002	0	0	0	50
2015	3816	0.3	0.734	0.234	0.03	0.002	0	0	0	50

```
2016 3817 0.3 0.712 0.225 0.053 0.008 0 0 0 50
2017 4176 0.3 0.721 0.171 0.088 0.019 0 0 0 50
2018 5722 0.3 0.774 0.157 0 0.064 0 0 0 50
2019 6436 0.3 0.872 0.1 0.023 0.004 0 0 0 50
2020 3689 0.3 0.655 0.314 0.027 0.004 0 0 0 50
2021 6569 0.3 0.818 0.155 0.022 0.004 0.001 0 0 50
2022 3324 0.3 0.582 0.355 0.053 0.01 0 0 0 50
2023 4384 0.3 0.755 0.142 0.096 0.006 0.002 0 0 50
# Index-3 Data
1980 0 0 0 0 0 0 0 0 0 0
1981 0 0 0 0 0 0 0 0 0 0
1982 0 0 0 0 0 0 0 0 0 0
1983 0 0 0 0 0 0 0 0 0 0
1984 0 0 0 0 0 0 0 0 0 0
1985 0 0 0 0 0 0 0 0 0 0
1986 0 0 0 0 0 0 0 0 0 0
1987 0 0 0 0 0 0 0 0 0 0
1988 0 0 0 0 0 0 0 0 0 0
1989 0 0 0 0 0 0 0 0 0 0
1990 0 0 0 0 0 0 0 0 0 0
1991 0 0 0 0 0 0 0 0 0 0
1992 0 0 0 0 0 0 0 0 0 0
1993 0 0 0 0 0 0 0 0 0 0
1994 778 0.5 0 0 0 0 0 0 0 0
1995 225 0.5 0 0 0 0 0 0 0 0
1996 397 0.5 0 0 0 0 0 0 0 0
1997 205 0.5 0 0 0 0 0 0 0 0
1998 59 0.5 0 0 0 0 0 0 0 0
1999 91 0.5 0 0 0 0 0 0 0 0
2000 40 0.5 0 0 0 0 0 0 0 0
2001 167 0.5 0 0 0 0 0 0 0 0
2002 19 0.5 0 0 0 0 0 0 0 0
2003 148 0.5 0 0 0 0 0 0 0 0
2004 101 0.5 0 0 0 0 0 0 0 0
2005 135 0.5 0 0 0 0 0 0 0 0
2006 118 0.5 0 0 0 0 0 0 0 0
2007 82 0.5 0 0 0 0 0 0 0 0
2008 99 0.5 0 0 0 0 0 0 0 0
2009 173 0.5 0 0 0 0 0 0 0 0
2010 78 0.5 0 0 0 0 0 0 0 0
2011 122.2 0.5 0 0 0 0 0 0 0 0
2012 123.9 0.5 0 0 0 0 0 0 0 0
2013 197.6 0.5 0 0 0 0 0 0 0 0
2014 54.9 0.5 0 0 0 0 0 0 0 0
2015 59.5 0.5 0 0 0 0 0 0 0 0
2016 6.7 0.5 0 0 0 0 0 0 0 0
2017 175.4 0.5 0 0 0 0 0 0 0 0
2018 90.74 0.5 0 0 0 0 0 0 0 0
2019 164.4284624 0.5 0 0 0 0 0 0 0 0
2020 0 0.5 0 0 0 0 0 0 0 0
2021 108.4 0.5 0 0 0 0 0 0 0 0
```

2022	0	0.5	0	0	0	0	0	0	0	0
2023	202	0.5	0	0	0	0	0	0	0	0

Index-4 Data

1980	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0
1988	96	0.5	0	0	0	0	0	0	0	0
1989	93	0.5	0	0	0	0	0	0	0	0
1990	99	0.5	0	0	0	0	0	0	0	0
1991	216	0.5	0	0	0	0	0	0	0	0
1992	405	0.5	0	0	0	0	0	0	0	0
1993	253	0.5	0	0	0	0	0	0	0	0
1994	205	0.5	0	0	0	0	0	0	0	0
1995	1949	0.5	0	0	0	0	0	0	0	0
1996	169	0.5	0	0	0	0	0	0	0	0
1997	409	0.5	0	0	0	0	0	0	0	0
1998	893	0.5	0	0	0	0	0	0	0	0
1999	550	0.5	0	0	0	0	0	0	0	0
2000	320	0.5	0	0	0	0	0	0	0	0
2001	585	0.5	0	0	0	0	0	0	0	0
2002	280	0.5	0	0	0	0	0	0	0	0
2003	456	0.5	0	0	0	0	0	0	0	0
2004	917	0.5	0	0	0	0	0	0	0	0
2005	849	0.5	0	0	0	0	0	0	0	0
2006	1010	0.5	0	0	0	0	0	0	0	0
2007	339	0.5	0	0	0	0	0	0	0	0
2008	780	0.5	0	0	0	0	0	0	0	0
2009	389	0.5	0	0	0	0	0	0	0	0
2010	324	0.5	0	0	0	0	0	0	0	0
2011	1002	0.5	0	0	0	0	0	0	0	0
2012	442	0.5	0	0	0	0	0	0	0	0
2013	1535	0.5	0	0	0	0	0	0	0	0
2014	261	0.5	0	0	0	0	0	0	0	0
2015	211	0.5	0	0	0	0	0	0	0	0
2016	666	0.5	0	0	0	0	0	0	0	0
2017	489	0.5	0	0	0	0	0	0	0	0
2018	661.75	0.5	0	0	0	0	0	0	0	0
2019	307	0.5	0	0	0	0	0	0	0	0
2020	0	0.5	0	0	0	0	0	0	0	0
2021	340	0.5	0	0	0	0	0	0	0	0
2022	379	0.5	0	0	0	0	0	0	0	0
2023	274	0.5	0	0	0	0	0	0	0	0

Index-5 Data

1980	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0

1983	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0
2005	38.66	0.5	0	0	0	0	0	0	0	0
2006	72.953	0.5	0	0	0	0	0	0	0	0
2007	21.87	0.5	0	0	0	0	0	0	0	0
2008	25.23	0.5	0	0	0	0	0	0	0	0
2009	164.82	0.5	0	0	0	0	0	0	0	0
2010	111.12	0.5	0	0	0	0	0	0	0	0
2011	48.6	0.5	0	0	0	0	0	0	0	0
2012	139.25	0.5	0	0	0	0	0	0	0	0
2013	82.85	0.5	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0	0	0

Phase Control

Phase for F mult in 1st Year

1

Phase for F mult Deviations

1

Phase for Recruitment Deviations

3

Phase for N in 1st Year

1

Phase for Catchability in 1st Year

2
Phase for Catchability Deviations
-5
Phase for Stock Recruitment Relationship
3
Phase for Steepness
-5
Recruitment CV by Year
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Lambdas by Index
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Lambda for Total Catch in Weight by Fleet
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Lambda for Total Discards at Age by Fleet
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Catch Total CV by Year and Fleet
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Discard Total CV by Year and Fleet
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Catch Effective Sample Size by Year and Fleet
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Discard Effective Sample Size by Year and Fleet
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Lambda for F Mult in First year by Fleet
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CV for F Mult in First year by Fleet
0.9
Lambda for F Mult Deviations by Fleet
0
CV for F Mult Deviations by Fleet
0.9
Lambda for N in 1st Year Deviations
0
CV for N in 1st Year Deviations
.9
Lambda for Recruitment Deviations
.1
Lambda for Catchability in First year by Index
0 0 0 0 0
CV for Catchability in First year by Index

0.9 0.9 0.9 0.9 .9
Lambda for Catchability Deviations by Index
0 0 0 0 0
CV for Catchability Deviations by Index
.9 .9 .9 .9 .9
Lambda for Deviation from Initial Steepness
0
CV for Deviation from Initial Steepness
.9
Lambda for Deviation from Unexploited Stock Size
0
CV for Deviation from Unexploited Stock Size
.9
NAA Deviations Flag
1
Initial Numbers at Age in 1st Year
1000000 500000 250000 125000 60000 30000 10000
Initial F Mult in 1st Year by Fleet
1
Initial Catchabilty by Index
.001 .001 .001 .001 0.001
Stock Recruitment Flag
0
Initial Unexploited Stock
1000
Initial Steepness
1
Maximum F
2.5
Ignore Guesses (Yes=1)
0
Projection Control
Do Projections (Yes=1)
0
Fleet Directed Flag
1
Final Year in Projection
2024
Projection Data by Year
2024 -1 3 -99 1
Do MCMC (Yes=1)
0
MCMC Year Option
1
MCMC Iterations
0
MCMC Thinning Factor
0
MCMC Random Seed
0
Agepro R Option

-1
Agepro R Option Start Year
0
Agepro R Option End Year
0
Export R Flag
1
Test Value
-23456
######
FINIS
Fleet Names
#$All
Survey Names
#$NI-Q1
#$NI_Q2
#$NI-MIK
#$UK-BTS
#$UK-FSP
#

Table 38.7 Whiting 7.a. Selectivity of the catches and indices.

Age	Catch	NI-Q1	NI-Q4	NI-MIK
0	0.108	0	0.667	1.00
1	0.817	0.471	0.756	0.00
2	0.994	1.00	1.00	0.00
3	1.000	1.00	1.00	0.00
4	1.000	1.00	1.00	0.00
5	1.000	1.00	1.00	0.00
6	1.000	1.00	1.00	0.00

Table 38.8 Whiting 7.a Fishing mortality- (F) -at age.

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1980	0.026	0.175	0.422	0.493	0.502	0.503	0.503
1981	0.031	0.211	0.508	0.594	0.604	0.605	0.606
1982	0.035	0.234	0.563	0.658	0.67	0.671	0.671
1983	0.035	0.237	0.572	0.668	0.68	0.681	0.681
1984	0.043	0.288	0.694	0.811	0.825	0.826	0.827
1985	0.052	0.352	0.847	0.99	1.007	1.009	1.009
1986	0.041	0.274	0.661	0.772	0.785	0.787	0.787
1987	0.043	0.29	0.699	0.817	0.831	0.833	0.833
1988	0.037	0.248	0.597	0.697	0.709	0.711	0.711
1989	0.052	0.348	0.838	0.979	0.997	0.998	0.999
1990	0.044	0.297	0.716	0.837	0.851	0.853	0.853

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1991	0.045	0.303	0.73	0.853	0.868	0.869	0.869
1992	0.075	0.503	1.211	1.415	1.44	1.443	1.443
1993	0.06	0.401	0.966	1.129	1.149	1.151	1.151
1994	0.062	0.415	1	1.169	1.189	1.191	1.191
1995	0.099	0.749	0.911	0.916	0.916	0.916	0.916
1996	0.108	0.818	0.995	1.001	1.001	1.001	1.001
1997	0.093	0.707	0.861	0.866	0.866	0.866	0.866
1998	0.131	0.997	1.213	1.22	1.22	1.22	1.22
1999	0.104	0.791	0.962	0.968	0.968	0.968	0.968
2000	0.135	1.029	1.252	1.259	1.26	1.26	1.26
2001	0.11	0.834	1.015	1.021	1.021	1.021	1.021
2002	0.151	1.146	1.394	1.402	1.402	1.402	1.402
2003	0.075	0.57	0.694	0.698	0.698	0.698	0.698
2004	0.211	1.606	1.954	1.965	1.965	1.965	1.965
2005	0.058	0.438	0.532	0.535	0.536	0.536	0.536
2006	0.186	1.413	1.718	1.729	1.729	1.729	1.729
2007	0.147	1.115	1.356	1.364	1.364	1.364	1.364
2008	0.119	0.906	1.102	1.109	1.109	1.109	1.109
2009	0.135	1.024	1.246	1.253	1.253	1.253	1.253
2010	0.14	1.065	1.296	1.303	1.303	1.303	1.303
2011	0.106	0.804	0.978	0.984	0.984	0.984	0.984
2012	0.139	1.058	1.287	1.294	1.294	1.294	1.294
2013	0.081	0.613	0.746	0.751	0.751	0.751	0.751
2014	0.184	1.4	1.703	1.713	1.713	1.713	1.713
2015	0.121	0.916	1.114	1.121	1.121	1.121	1.121
2016	0.069	0.521	0.634	0.638	0.638	0.638	0.638
2017	0.055	0.417	0.508	0.511	0.511	0.511	0.511
2018	0.055	0.418	0.509	0.512	0.512	0.512	0.512
2019	0.093	0.707	0.861	0.866	0.866	0.866	0.866
2020	0.099	0.752	0.915	0.921	0.921	0.921	0.921
2021	0.112	0.849	1.033	1.039	1.04	1.04	1.04
2022	0.062	0.472	0.575	0.578	0.578	0.578	0.578
2023	0.072	0.547	0.665	0.669	0.669	0.669	0.669

Table 38.9 Whiting 7.a Stock Numbers-at-age (start of year) ('1000)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1980	637486	390074	124892	21042	7460	1024	1827
1981	322139	211327	146638	39932	6995	2595	1027
1982	284158	106222	76652	43017	12004	2196	1178
1983	882907	93380	37658	21283	12126	3531	1027

1984	633181	289990	32991	10369	5942	3532	1374
1985	514434	206401	97383	8039	2510	1496	1279
1986	872689	166111	65041	20360	1627	527	603
1987	473888	285062	56560	16386	5123	426	306
1988	485228	154424	95515	13708	3941	1282	190
1989	594097	159126	53994	25650	3717	1114	431
1990	513350	191939	50328	11388	5244	788	339
1991	659842	167110	63865	11995	2686	1286	286
1992	230657	214616	55290	15015	2784	648	393
1993	212467	72820	58137	8031	1986	379	147
1994	182634	68101	21837	10787	1414	362	99
1995	335907	58417	20138	3918	1825	247	83
1996	200522	103575	12376	3950	853	420	79
1997	169374	61273	20485	2233	791	180	109
1998	165785	52511	13531	4225	511	191	73
1999	206439	49478	8682	1963	679	87	46
2000	108697	63301	10048	1617	406	148	30
2001	190471	32302	10131	1401	250	66	30
2002	78863	58074	6283	1791	275	52	21
2003	120098	23080	8274	760	240	39	11
2004	93243	37913	5847	2017	206	69	15
2005	105583	25685	3409	404	154	17	7
2006	153232	33917	7429	976	129	52	8
2007	103271	43297	3700	650	94	13	6
2008	148028	30346	6362	465	90	14	3
2009	91929	44709	5494	1031	84	17	3
2010	91809	27338	7193	771	160	14	3
2011	150168	27155	4222	960	114	25	3
2012	78430	45969	5445	774	196	24	6
2013	160354	23220	7152	733	116	31	5
2014	194948	50334	5633	1654	189	31	10
2015	122009	55178	5563	501	162	20	4
2016	80653	36803	9893	891	89	30	5
2017	101800	25624	9788	2559	256	27	11
2018	106002	32789	7563	2874	836	88	14
2019	210159	34139	9670	2218	938	288	36
2020	111559	65155	7538	1994	508	227	81
2021	179062	34383	13755	1472	432	116	73
2022	75242	54487	6588	2387	283	88	40
2023	154568	24060	15221	1809	729	91	43
2024	118237	48944	6239	3817	504	215	41

Table 38.10 Whiting 7.a Stock Summary: weights in tonnes: CatchPred is predicted catch from ASAP. Recruitment at age zero ('1000), Fbar ages (1-3)

Year	Lan	Dis	Cat	CatPred	Tsb	Ssb	SsbCv	Recr	RecrCv	Fbar	FbarCv
1980	13422	3314	16737	16691.79	61768.39	33175.95	0.330179	637485.5	0.327	0.364	0.322
1981	18267	3064	21331	21136.3	60294.28	43705.13	0.24766	322138.7	0.425	0.438	0.295
1982	17167	801	17969	17941.1	44032.68	35110.06	0.270045	284157.8	0.446	0.485	0.332
1983	10577	1829	12405	12357.87	30269.13	22331.86	0.348404	882907	0.254	0.492	0.389
1984	11619	3380	14999	14735.62	38113.6	15204.35	0.415453	633181.2	0.314	0.598	0.355
1985	15525	2644	18169	17958.34	37310.16	22923.99	0.296506	514434.1	0.345	0.730	0.326
1986	10063	2066	12129	12074	29026.23	18345.3	0.324574	872689.3	0.263	0.569	0.351
1987	10411	3859	14270	14063.02	33379.84	16333.12	0.339715	473887.5	0.347	0.602	0.324
1988	10245	1611	11856	11792.61	30146.68	20618.71	0.280498	485228.4	0.323	0.514	0.327
1989	11305	2103	13408	13391.26	26749.02	17090.05	0.307817	594096.8	0.267	0.722	0.322
1990	8212	2444	10656	10631.62	24366.94	12697.06	0.328525	513349.8	0.251	0.617	0.305
1991	7348	2598	9946	9909.51	22738.07	13630.58	0.261816	659842.2	0.168	0.628	0.253
1992	8588	4203	12791	12551.13	21880.35	11578.77	0.209772	230657.4	0.152	1.043	0.183
1993	6523	2707	9230	6729.115	12641.22	9269.658	0.150534	212467.4	0.130	0.832	0.166
1994	6763	1173	7936	4969.317	8488.129	5341.868	0.157316	182633.8	0.136	0.861	0.172
1995	4893	2151	7044	4502.295	6626.329	3863.215	0.159541	335907	0.117	0.859	0.167
1996	4335	3631	7966	4349.858	7009.449	2659.291	0.182842	200521.9	0.128	0.938	0.146
1997	2277	1928	4205	2979.086	5162.7	2913.997	0.148295	169373.8	0.138	0.811	0.163
1998	2229	1304	3533	2871.645	4102.392	2411.538	0.156979	165785.3	0.129	1.143	0.163
1999	1670	1092	2762	2233.155	2972.687	1424.019	0.194092	206439.1	0.127	0.907	0.174
2000	762	2118	2880	2343.066	3373.971	1398.992	0.187142	108697	0.138	1.180	0.150
2001	733	1012	1745	1609.898	2179.792	1233.352	0.170227	190471.3	0.130	0.957	0.180
2002	747	740	1487	1878.563	2782.741	1098.606	0.192435	78863.01	0.135	1.314	0.154
2003	517	480	996	1275.683	1751.916	1103.374	0.168284	120098.2	0.148	0.654	0.234
2004	133	905	1038	2051.076	2265.227	1173.334	0.194795	93242.83	0.124	1.841	0.160
2005	125	272	397	508.1619	1297.931	468.3194	0.253417	105582.8	0.138	0.502	0.274
2006	64	1773	1837	2552.025	2094.634	971.9815	0.213584	153232.2	0.125	1.620	0.177
2007	35	1512	1547	1509.598	2035.136	511.097	0.269342	103270.7	0.130	1.278	0.165
2008	37	1169	1206	1278.324	1601.86	658.1004	0.204619	148028.1	0.124	1.039	0.188
2009	39	1321	1360	1487.126	2146.968	667.09	0.211501	91929.13	0.133	1.174	0.170
2010	30	1154	1184	1438.508	1641.66	750.4518	0.189552	91809.04	0.127	1.221	0.183
2011	31	946	977	975.0654	1396.786	546.8325	0.227126	150168.3	0.125	0.922	0.193
2012	60	1339	1399	1423.411	2089.969	618.9473	0.21005	78429.97	0.134	1.213	0.166
2013	33	948	981	1033.199	1535.16	759.6008	0.194576	160353.5	0.139	0.703	0.218
2014	23	1951	1974	2611.059	2713.985	856.6748	0.209566	194948.4	0.117	1.605	0.171
2015	28	1521	1549	1732.558	2473.345	602.8174	0.249661	122009.2	0.115	1.050	0.173
2016	15	765	780	818.6892	2001.198	867.6521	0.176926	80653.22	0.126	0.598	0.198
2017	36	668	704	696.3796	1840.009	1055.904	0.159598	101799.9	0.122	0.478	0.210
2018	46	853	899	876.3238	2102.592	1115.636	0.164319	106001.8	0.138	0.479	0.207
2019	172	1089	1261	1435.107	2214.659	1224.63	0.162514	210158.7	0.136	0.811	0.222
2020	88	1030	1118	1298.827	2730.134	938.3667	0.219424	111559	0.140	0.863	0.231
2021	91	1571	1662	1758.299	2221.475	1203.75	0.181715	179062.3	0.121	0.974	0.189
2022	57	986	1043	1079.861	2566.834	806.8964	0.209506	75241.73	0.181	0.542	0.232
2023	30	952	982	979.6904	2187.185	1410.042	0.192335	154568.1	0.235605	0.627	0.282761
2024*	NA	NA	NA	NA	NA	1072.522	NA	118237	NA	0.7142	NA

Table 38.11 Whiting 7.a . Input values for short-term forecast. Note that Sel and CWt refer to the landings and DSel and DCWt refer to the discards. Numbers in thousands; Weights in kg.

2024

Age	N	M	Mat	PF	PM	SWt	Sel	CWt	DSel	DCWt
0	118237	1.078	0	0	0	0	0	0	0.082	0.025
1	48944	0.803	0	0	0	0.031	0.062	0.241	0.561	0.043
2	6239	0.718	1	0	0	0.062	0.302	0.289	0.455	0.085
3	3817	0.608	1	0	0	0.125	0.534	0.34	0.229	0.125
4	504	0.554	1	0	0	0.23	0.679	0.399	0.083	0.189
5	215	0.518	1	0	0	0.352	0.739	0.484	0.023	0.179
6	41	0.518	1	0	0	0.412	0.754	0.403	0.008	0

2025

Age	N	M	Mat	PF	PM	SWt	Sel	CWt	DSel	DCWt
0	118237	1.078	0	0	0	0	0	0	0.082	0.025
1	37067	0.803	0	0	0	0.031	0.062	0.241	0.561	0.043
2	11762	0.718	1	0	0	0.062	0.302	0.289	0.455	0.085
3	1426	0.608	1	0	0	0.125	0.534	0.34	0.229	0.125
4	970	0.554	1	0	0	0.23	0.679	0.399	0.083	0.189
5	135	0.518	1	0	0	0.352	0.739	0.484	0.023	0.179
6	71	0.518	1	0	0	0.412	0.754	0.403	0.008	0

2026

Age	N	M	Mat	PF	PM	SWt	Sel	CWt	DSel	DCWt
0	118237	1.078	0	0	0	0	0	0	0.082	0.025
1	37067	0.803	0	0	0	0.031	0.062	0.241	0.561	0.043
2	8908	0.718	1	0	0	0.062	0.302	0.289	0.455	0.085
3	2689	0.608	1	0	0	0.125	0.534	0.34	0.229	0.125
4	362	0.554	1	0	0	0.23	0.679	0.399	0.083	0.189
5	260	0.518	1	0	0	0.352	0.739	0.484	0.023	0.179
6	57	0.518	1	0	0	0.412	0.754	0.403	0.008	0

Table 38.12 Whiting 7.a .Single-option output of the short-term forecast (F = mean F 2021–2023). Numbers in thousands, weights in tonnes.

2024

Age	F (lan)	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos	SSB
0	0	0	0	0.082	5735	141	118237	0	0	0
1	0.062	4	1	0.561	16237	693	48944	1537	0	0
2	0.302	15	4	0.455	2456	210	6239	389	6239	389
3	0.534	297	101	0.229	1286	161	3817	476	3817	476
4	0.679	122	49	0.083	92	17	504	116	504	116
5	0.739	76	37	0.023	17	3	215	76	215	76
6	0.754	18	7	0.008	0	0	41	17	41	17
Total	0.299	532	199	0.415	25823	1225	177997	2611	10816	1074

2025

Age	F (lan)	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos	SSB
0	0	0	0	0.082	5735	141	118237	0	0	0
1	0.062	3	1	0.561	12297	525	37067	1164	0	0
2	0.302	28	8	0.455	4630	395	11762	733	11762	733
3	0.534	111	38	0.229	481	60	1426	178	1426	178
4	0.679	234	94	0.083	177	33	970	223	970	223
5	0.739	48	23	0.023	10	2	135	48	135	48
6	0.754	31	12	0.008	0	0	71	29	71	29
Total	0.299	455	176	0.415	23330	1156	169668	2375	14364	1211

2026

Age	F (lan)	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos	SSB
0	0	0	0	0.082	5735	141	118237	0	0	0
1	0.062	3	1	0.561	12297	525	37067	1164	0	0
2	0.302	21	6	0.455	3507	299	8908	555	8908	555
3	0.534	209	71	0.229	906	113	2689	335	2689	335
4	0.679	88	35	0.083	66	12	362	83	362	83
5	0.739	92	44	0.023	20	4	260	92	260	92
6	0.754	25	10	0.008	0	0	57	24	57	24
Total	0.299	438	167	0.415	22531	1094	167580	2253	12276	1089

Table 38.13 Whiting 7.a. Management options table. Weights in tonnes.

Fmult	Catch25	Land25	Dis25	FCatch25	FLand25	FDis25	SSB26	dSSB	dTac
0	0	0	0	0	0	0	2175	79.75%	-100%
0.1	169	23	145	0.071	0.0049	0.066	2029	67.69%	-76.98%
0.2	328	45	283	0.143	0.0099	0.133	1893	56.45%	-55.20%
0.3	479	66	413	0.21	0.0148	0.199	1766	45.95%	-34.67%
0.4	622	85	537	0.29	0.0197	0.27	1648	36.20%	-15.26%
0.5	756	103	654	0.36	0.025	0.33	1538	27.11%	3.19%
0.6	884	119	765	0.43	0.03	0.4	1435	18.60%	20.53%
0.7	1005	135	871	0.5	0.034	0.47	1339	10.66%	37.03%
0.8	1120	149	971	0.57	0.039	0.53	1250	3.31%	52.71%
0.9	1229	163	1066	0.64	0.044	0.6	1166	-3.64%	67.55%
1	1332	176	1157	0.71	0.049	0.66	1088	-10.08%	81.69%
1.1	1430	188	1243	0.79	0.054	0.73	1016	-16.03%	95.15%
1.2	1524	199	1325	0.86	0.059	0.8	948	-21.65%	107.91%
1.3	1612	209	1403	0.93	0.064	0.86	885	-26.86%	119.97%
1.4	1697	219	1478	1	0.069	0.93	826	-31.74%	131.48%
1.5	1777	228	1549	1.07	0.074	1	771	-36.28%	142.44%
1.6	1854	237	1617	1.14	0.079	1.06	720	-40.50%	152.98%
1.7	1927	245	1682	1.21	0.084	1.13	672	-44.46%	162.97%
1.8	1996	252	1744	1.29	0.089	1.2	628	-48.10%	172.54%
1.9	2063	260	1803	1.36	0.094	1.26	586	-51.57%	181.55%
2	2126	266	1860	1.43	0.099	1.33	547	-54.79%	190.29%
2.1	2187	272	1915	1.5	0.103	1.4	511	-57.77%	198.61%
2.2	2245	278	1967	1.57	0.108	1.46	477	-60.58%	206.52%
2.3	2301	284	2017	1.64	0.113	1.53	446	-63.14%	214.15%
2.4	2354	289	2065	1.71	0.118	1.6	416	-65.62%	221.50%
2.5	2406	294	2111	1.79	0.123	1.66	389	-67.85%	228.57%

Table 38.14 Whiting 7.a. Management options Advice table. Weights in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F total (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change*	% advice change^^
MSY approach: F = 0	0	0	0	0	0	0	2175	80	-
Other scenarios									
$F_{MSY} = F_{pa}$	489	67	422	0.22	0.0151	0.2	1758	45	-
F = 0	0	0	0	0	0	0	2175	80	-
$F_{MSY\ lower}$	361	50	311	0.158	0.0109	0.147	1865	54	-
$F_{MSY\ upper}$	489	67	422	0.22	0.0151	0.2	1758	45	-
$F_{MSY} \times SSB_{2025}$/MSY $B_{trigger}$	39	5	34	0.0163	0.00112	0.0151	2140	77	-
$F_{MSY\ lower} \times SSB_{2025}$/MSY $B_{trigger}$	28	4	24	0.0117	0.00081	0.0109	2150	78	-
$F_{MSY\ upper} \times SSB_{2025}$/MSY $B_{trigger}$	39	5	34	0.0163	0.00112	0.0151	2140	77	-
F_{lim}	780	106	674	0.37	0.026	0.34	1518	25	-
$SSB_{2026} = B_{lim}$^									
$SSB_{2026} = B_{pa}$ = MSY $B_{trigger}$^									
$SSB_{2026} = SSB_{2025}$	1172	156	1016	0.6	0.042	0.56	1210	0	-
$SSB_{2026} = SSB_{2025}$ x 1.2	863	116	746	0.42	0.029	0.39	1452	20	-
$F = F_{2024}$	1332	176	1157	0.71	0.049	0.66	1088	-10.1	-

* SSB 2026 relative to SSB 2025.

^ The B_{lim}, B_{pa}, and MSY $B_{trigger}$ options were left blank because B_{lim}, B_{pa}, and MSY $B_{trigger}$ cannot be achieved in 2026, even with zero catch.

^^ This is not provided as catch advice for 2024 and 2025 was 0.

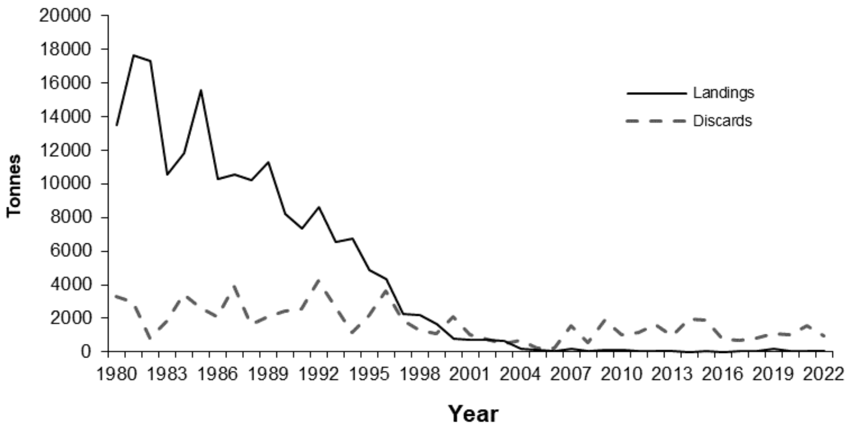


Figure 38.1 Whiting 7.a Working group estimates of International landings and discards

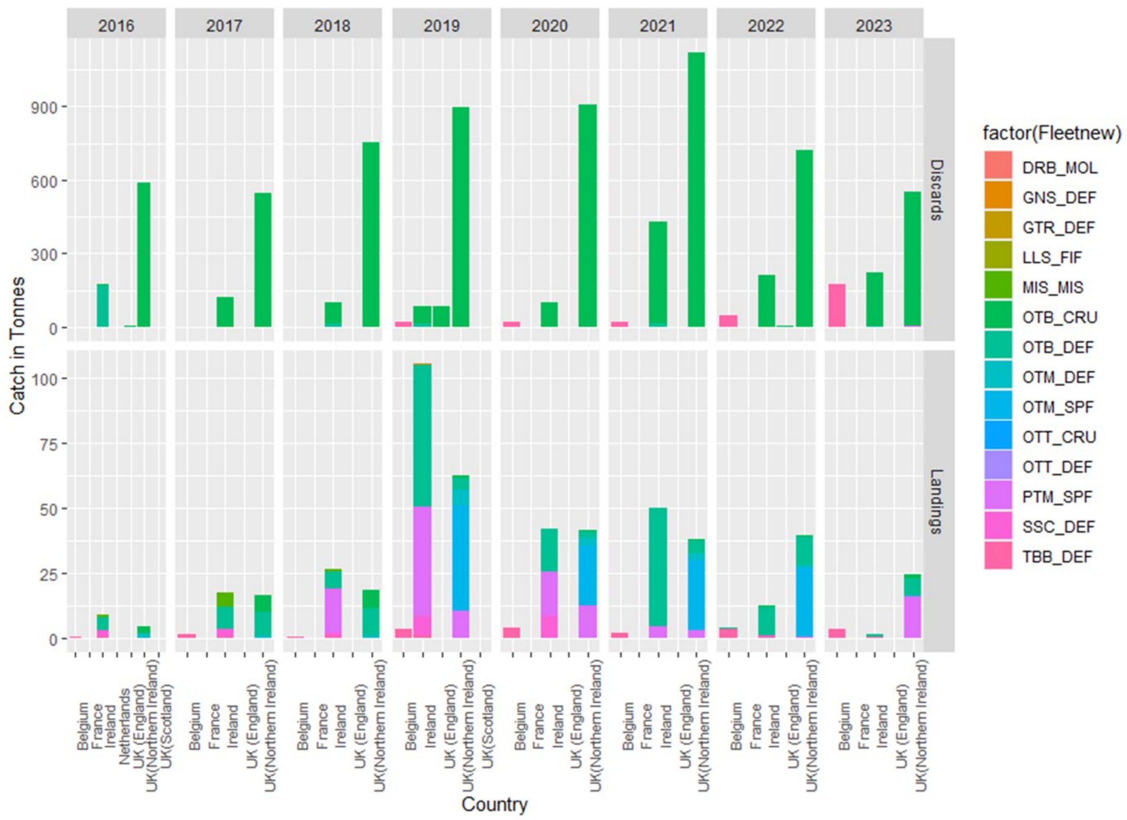
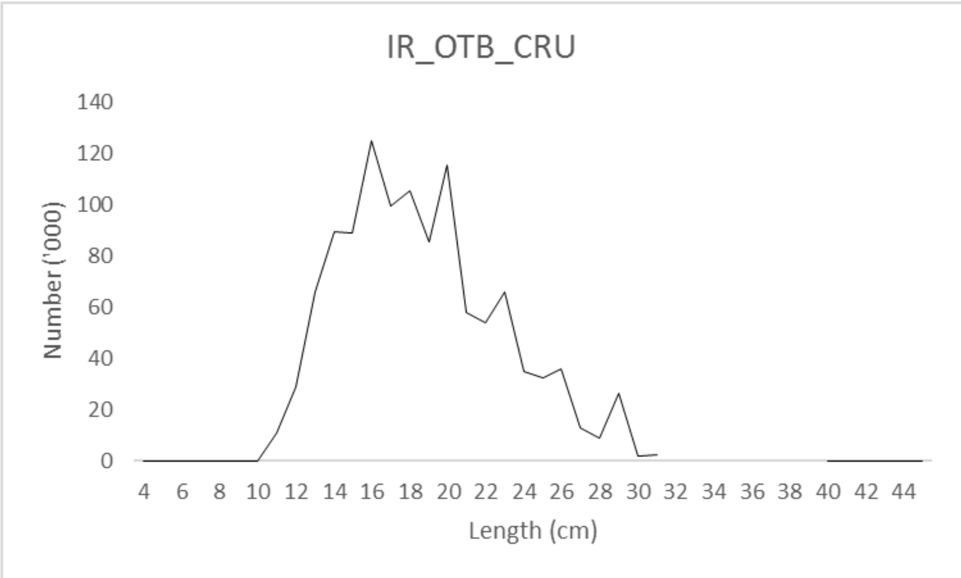


Figure 38.2 Whiting 7.a Landings and discards by fleet



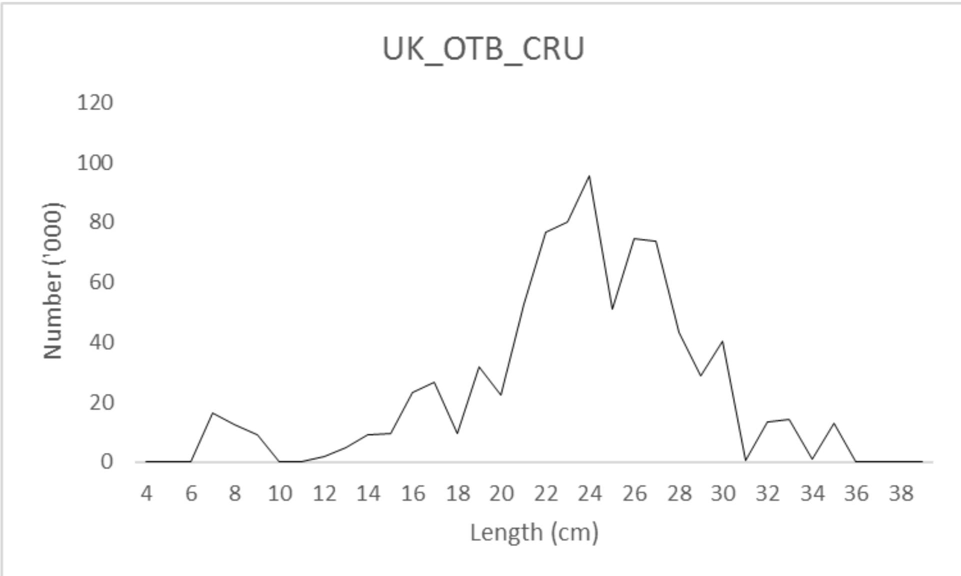


Figure 38.3 Whiting 7.a discard length–frequency by national fleets for the OTB_CRU metier. Note due to low levels of retained catch, and hence low sampling, these data are not presented. Not updated at WGCSE, 2024

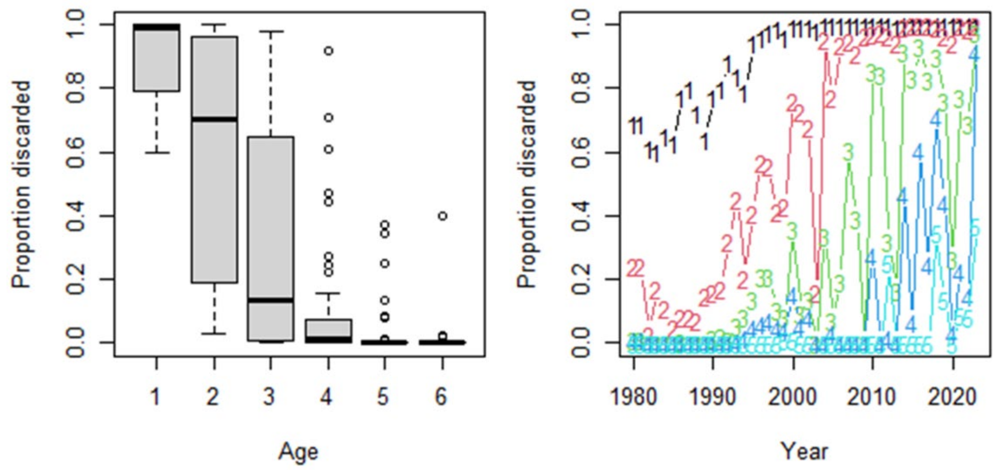


Figure 38.4 Whiting 7.a Proportion of discards by age (left) and year (right)

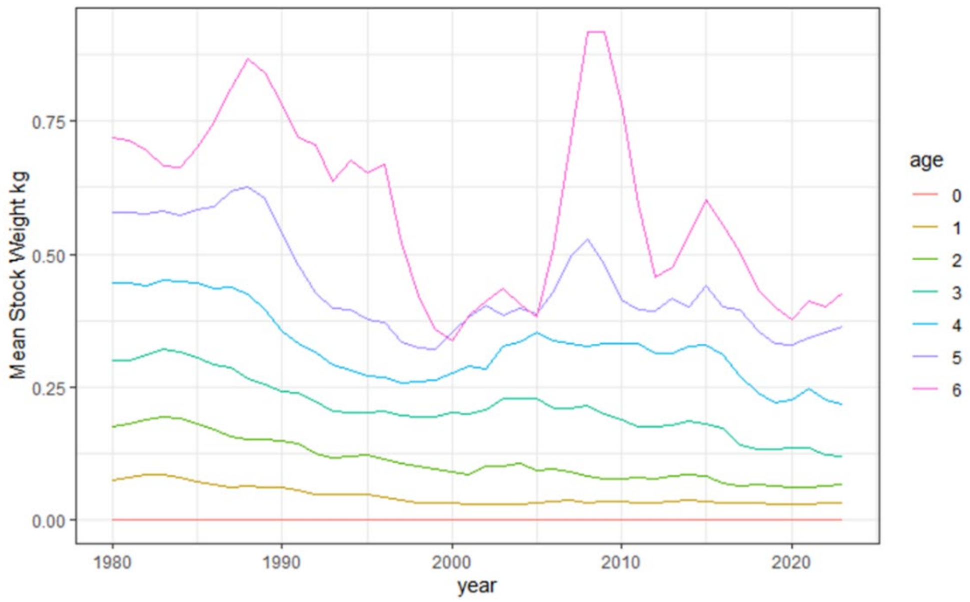


Figure 38.5 Whiting 7.a Smoothed Stock Weights (Three year running average)

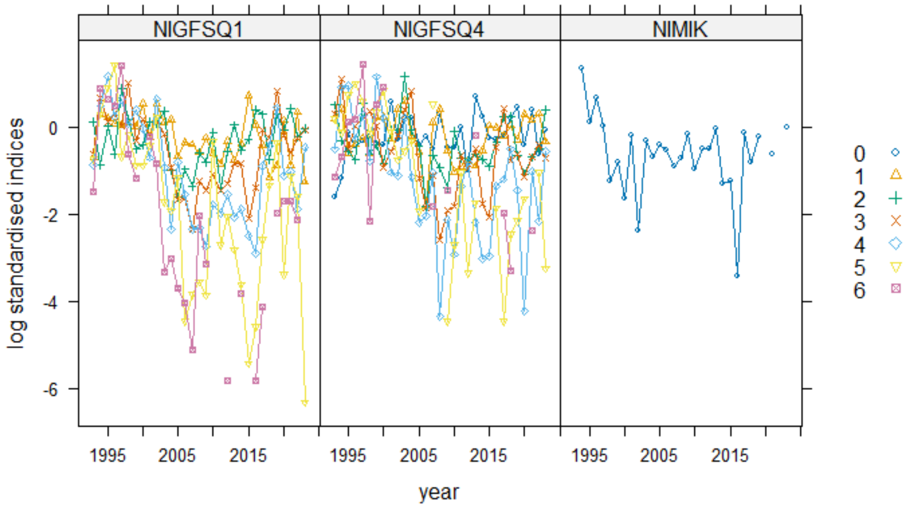


Figure 38.3 Whiting 7.a. Log Standardized indices of tuning fleets by cohort.

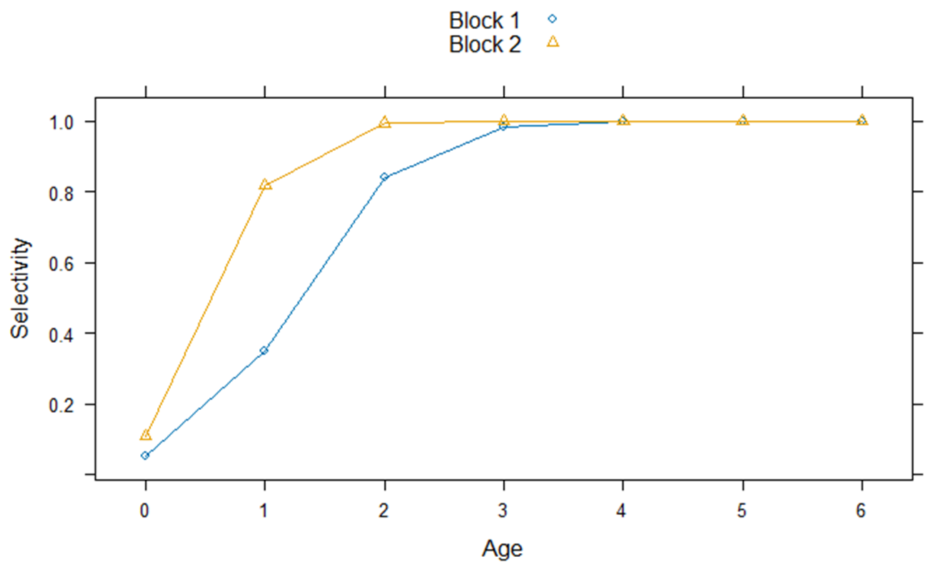


Figure 38.7 Whiting 7.a. Selectivity at age in the Catch.

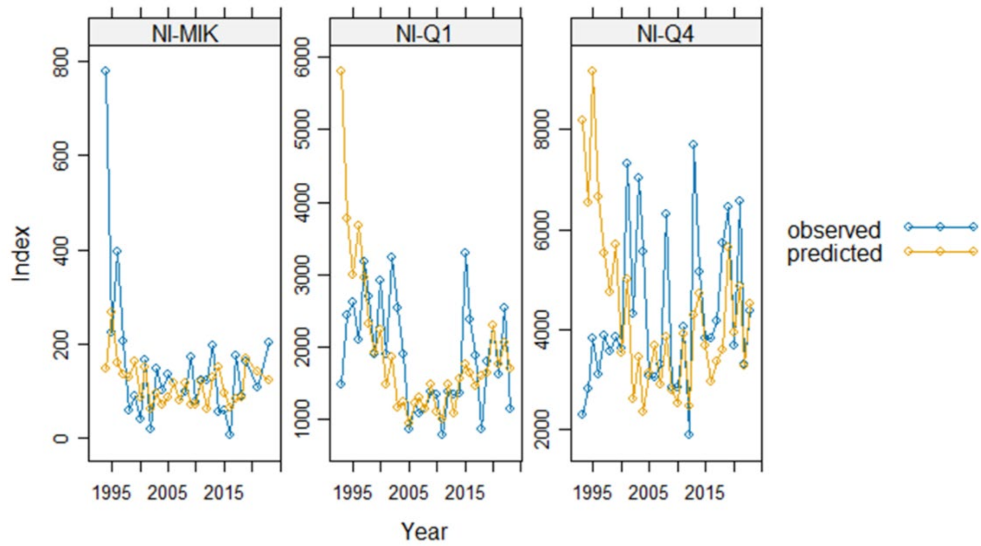


Figure 38.8 Whiting 7.a. Observed and Predicted index cpue

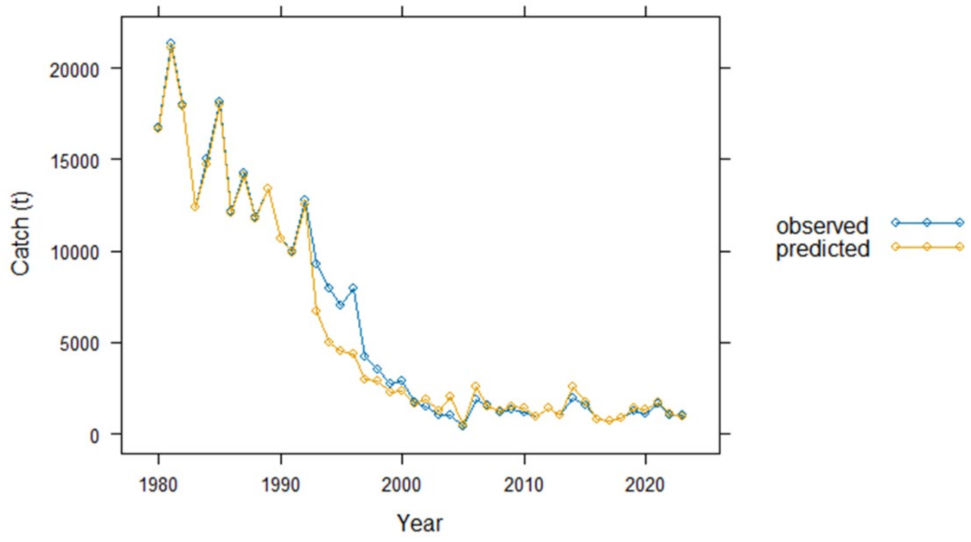


Figure 38.9 Whiting 7.a. Observed and Predicted catch

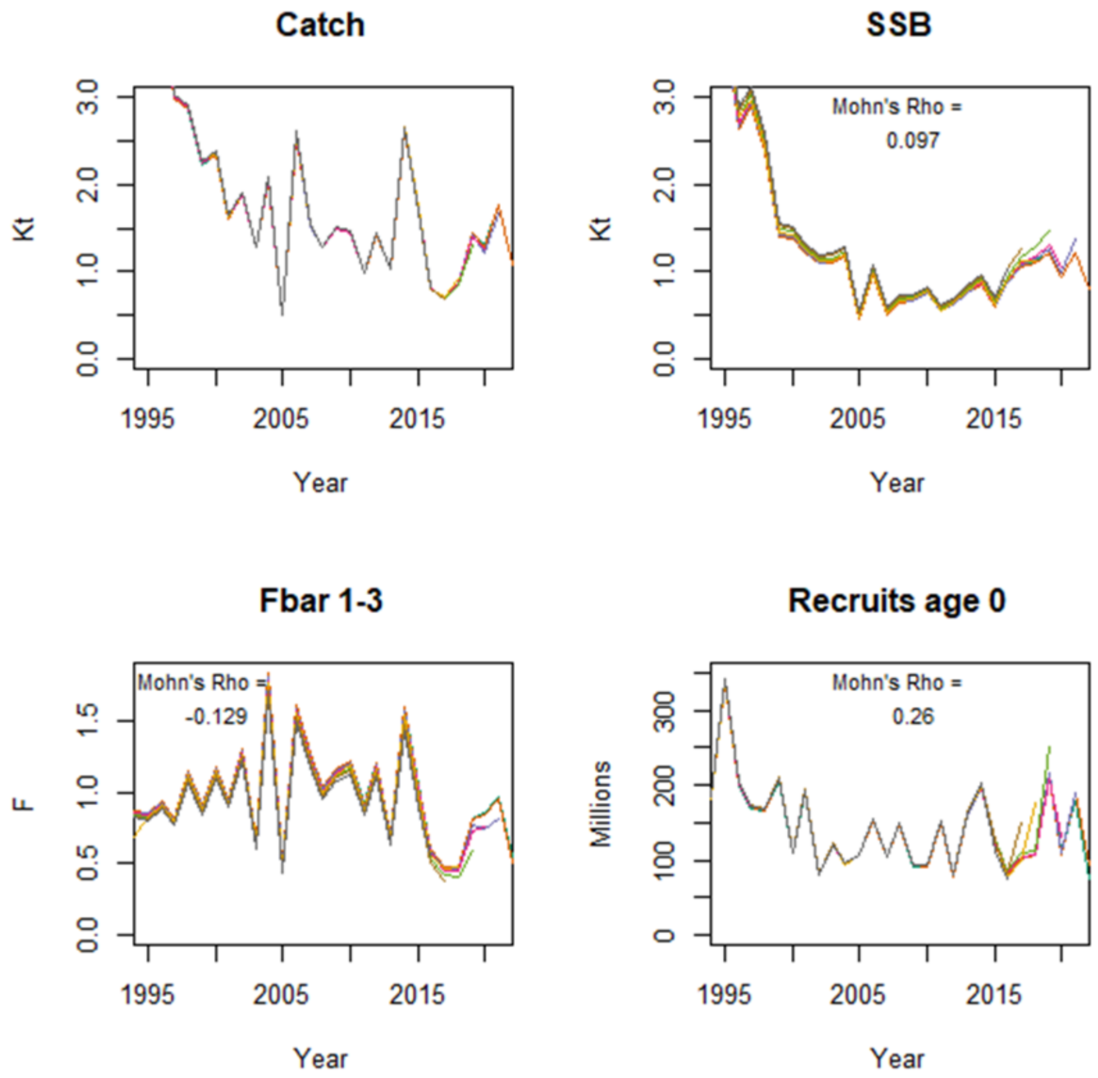


Figure 38.4 Whiting 7.a. Retrospective analysis of the final ASAP run with Mohn's Rho calculation. Image shows >5 peels but calculation is based on 5 peels only.

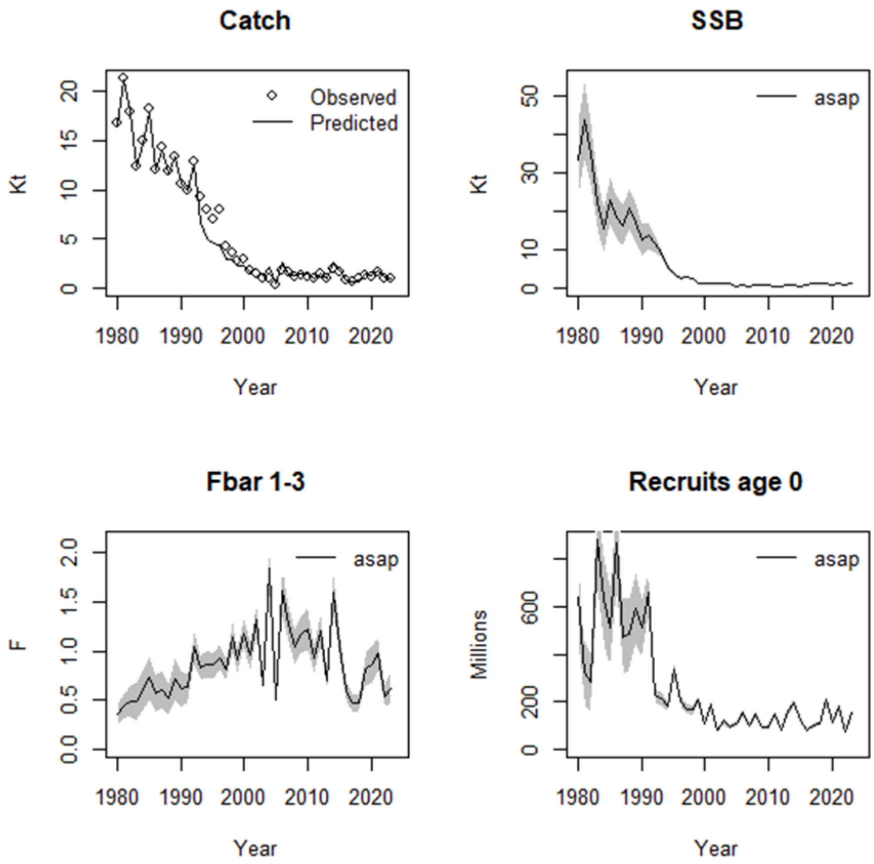


Figure 38.11 Whiting 7.a. Stock Summary Plot. The thick black line represents the ASAP assessment. Standard deviations from ASAP are shaded grey. The thick black line in the catch plot represents the predicted catch from ASAP.

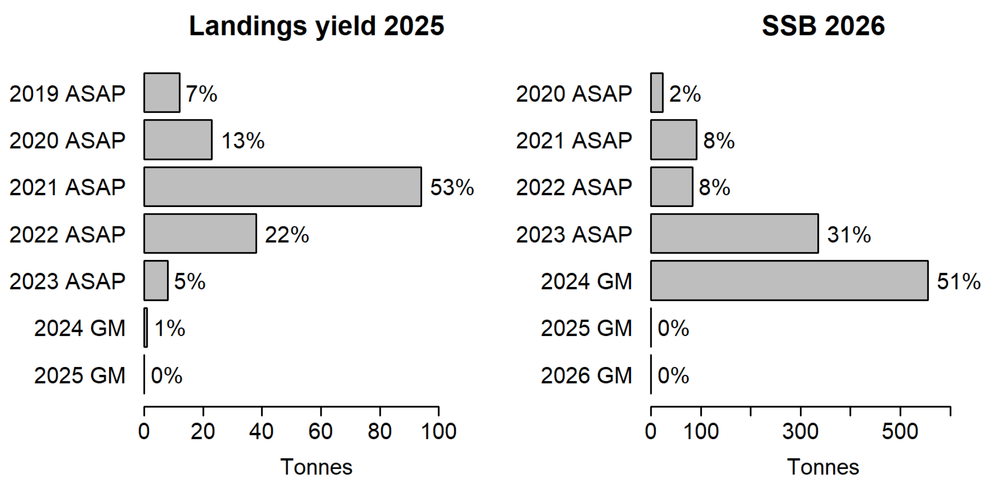


Figure 38.12 Whiting 7.a. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Contents

39 Whiting (*Merlangius merlangus*) in divisions 7.b–c and 7.e–k (southern Celtic Seas and eastern English Channel)

Type of assessment in 2024

The stock assessment is a stochastic State–Space Assessment Model (SAM) and detailed in the Stock Annex. The model input data were updated with commercial catch, sampling and survey data as in previous years.

ICES advice applicable to 2022

ICES advises that when the MSY approach is applied, catches in 2022 should be no more than 4452 tonnes.

ICES advice applicable to 2023

ICES advises that when the MSY approach is applied, catches in 2023 should be no more than 1715 tonnes.

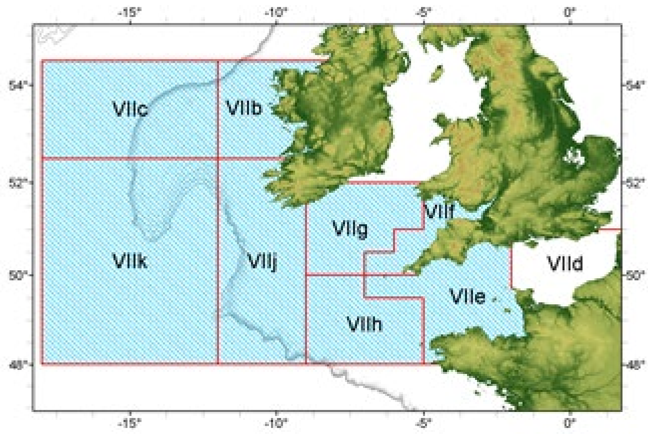
ICES advice applicable to 2024

ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2024.

39.1 General

Stock description and management units

The TAC for whiting is set for divisions 7.b, 7.c, 7.d, 7.e, 7.f, 7.g, 7.h, 7.j and 7.k. The assessment area does not correspond to the TAC area where whiting in 7.d remain part of the WGNSSK assessment of the North Sea stock. Any management measures implemented for this stock should be consistent with the assessment area.



Red Boxes-TAC/Management Areas Blue Shading-Assessment Area.

The TAC for whiting 7.b-ce–k decreased from 19 184t (2019) to 3877t (2023). From 2024 however the TAC has now been explicitly split into a 7.d and 7.b-ce–k component with the latter being for bycatch only (EU–Norway–UK, 2023). This also helps recognize the existing 7.b-ce–k zero catch advice for 2024 as well as healthier assessment of stock status for the 7.d component.

TAC in 2024

Table 50				
Species:	Whiting *Merlangius merlangus*		Zone:	7b, 7c, 7d, 7e, 7f, 7g, 7h, 7j and 7k (WHG/7X7A-C)
Belgium	225		Analytical TAC	
France	13 834			
Ireland	6 411			
Netherlands	113			
Union	20 583	(3)(4)		
United Kingdom	2 663	(1)(2)		
TAC	23 709			

(1) Of which up to 540 tonnes may be fished in United Kingdom, Union and international waters of 7b, 7c, 7e, 7f, 7g, 7h, 7j and 7k (WHG/*7XAD). This amount is exclusively for bycatches, no directed fisheries for whiting are permitted.

(2) Of which up to 2 123 tonnes may be fished in United Kingdom and Union waters of 7d (WHG/*07D.).

(3) Of which up to 4 178 tonnes may be fished in United Kingdom, Union and international waters of 7b, 7c, 7e, 7f, 7g, 7h, 7j and 7k (WHG/*7XAD). Exclusively for bycatches. No directed fisheries for whiting are permitted under this 'of which'. Within the limits of these quotas, no more than the quantities given below may be taken as bycatches in area 7b, 7c, 7e, 7f, 7g, 7h, 7j and 7k:

7b, 7c, 7e, 7f, 7g, 7h, 7j and 7k	
Belgium	46
France	2 808
Ireland	1 301
Netherlands	23

(4) Of which up to 16 405 tonnes may be fished in United Kingdom and Union waters of 7d (WHG/*07D.). Within the limits of these quotas, no more than the quantities given below may be taken in area 7d:

7d	
Belgium	179
France	11 026
Ireland	5 110
Netherlands	90

The human consumption fishery (HCF) catch split between Subarea 4 and Division 7.d from 2019 to 2023 is based on historical proportions of HCF catch between Subarea 4 and Division 7.d in each year. This assumes that management for Division 7.d is separate from other divisions in Subarea 7. Total catches are based on a combined discard rate for Subarea 4 and Division 7.d. From 2023 onwards, 80.23% of the TAC is now allocated to Subarea 4, and 19.77% to Division 7.d (EU–Norway–UK, 2022). As a result, the assumed HCF catch split value is no longer given. The advised HCF catch for 7.d in 2023 was ≤ 23,953 t and for 7.b-ce-k was 1,715 t.

Landings obligation

Since 2017 the landings obligation (LO) has applied to this stock in accordance with Delegated Regulation (EC, 2016) superseded by (EU) 2019/2239[1]. This requires that all catches of whiting in the Celtic Sea and Western Channel by those vessels must be landed. However, a 6% *de minimus*

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R2239

applies to bottom trawls using a mesh size of ≥80 mm, as well as pelagic trawls and beam trawls using 80–119 mm mesh. There are also three specific technical measures in operation for vessels using bottom trawls or seines in the Celtic Sea Protection Zone.

A significant proportion of unwanted catch has historically been above the Minimum Conservation Reference Size (MCRS = 27 cm) in whiting. Rates of unwanted catch in 7.b-ce–k are assessed by ICES to have reduced in 2023 to 9% from 32% in 2022. This may in part be due to a recent partial shift in the fishery towards seiners and away from the more traditional otter trawl fishing, but the fishery remains > 70% otter trawlers for both wanted and unwanted catch. With catches at the current low levels, it appears most are now being landed for the Irish OBT fleet anyway.

Whiting is the least limiting stock for most fleets in a mixed-fishery context for the Celtic Sea, where cod is most considered the choke species.

39.2 The fishery in 2023

ICES officially reported landings for divisions 7.b-ce–k and catches used by the Working Group are given in Table 1. In addition, catches for 7.d are included for historic context given the shared TAC between 7.b-ce-k and 7.d.

The 7.b-ce–k whiting stock is primarily targeted by otter trawlers and to a lesser extent Scottish seines and beam trawls. An overview of landings and discards by fleet is given in Table 2 and a more general review of trends in effort across fleets is provided by the Atlas of Commercial Fisheries Around Ireland[2].

The spatial distribution of international otter trawl effort by country 2018–2023 is given in Figure 1. Irish OTB effort is primarily from within 7.g (the Smalls fishing grounds gadoid fishery) and to a lesser extent 7.j and the Porcupine Bank (*Nephrops* fishery). In previous years, French landings have exhibited similar spatial and temporal concentration around the Smalls.

39.3 Data

Catch

Data are submitted to InterCatch (IC) by France, Ireland, Belgium, UK, Spain and the Netherlands. A standardized approach to international catch data exploration and QC is taken across the cod, haddock and whiting stocks in the form of shared R markdown documents[3]. In so far as is possible, the allocation of sampling to un-sampled métiers is standardized across the cod, haddock and whiting stocks using the same R markdown template and editing only where necessary using the approach developed during the 2020 benchmark (ICES, 2020).

Fishery-dependent data are therefore collated in InterCatch, but raised and documented outside InterCatch using these Markdown documents.

Raising of un-sampled catches to International CNAA is implemented using a simple hierarchy for available samples where priority was given in the following order:

[2] https://doi.org/10/mfb7

[3] https://community.ices.dk/ExpertGroups/benchmarks/2019/wkceltic/2014%20Meeting%20docs/02.%20Background%20documents/WHG/aggregate_IC_data_whg.27.7b-ce-k_Oct_2020.html

1. Country & Season & Year
2. Season & Year
3. Year

With gears aggregated into to either: GNS_DEF, OTB_CRU, OTB_DEF, TBB_DEF, SSC_DEF, PTM_SPF and MIS_MIS.

Discard raising is likewise implemented where samples were missing by estimating ratios at three levels:

1. Year, country and gear
2. Year and gear
3. Year

The international catch numbers-at-age are given in Table 3 and Figure 2. It is possible to track the strong 1999 and 2013 year classes, but the strong 2009 recruitment is only apparent at some older ages. Generally, the proportion of un-sampled catch that requires raising is minimal (Figure 3) although inevitably increased during Covid. The age distribution has remained similar over time with the exception of periods where strong year classes pass through to older ages.

While poorly represented in the survey data, 0-group fish are incorporated into the assessment to allow inclusion of 0-group indices, although catches at this age are minimal in most years. Catch weights-at-age and mean weights-at-age in the catch are given in Table 4 and 5 respectively. Rivard corrected stock weights (Table 7) were derived as per methodology described in the stock annex. The stock weights are shown in Figure 7. There is some variability of stock weights, particularly at older ages, but 0–5 year old corrected weights are relatively stable. There was a notable increase in the 0-group stock weights in 2021 and drop in 1-group so they appear to overlap. This is not apparent in the 2022 mean weights-at-age.

Discards

Discarding of age 2 and above suggests moderately high fishing mortality above the minimum conservation reference size (MCRS – 27cm). Discarding appears to have reduced significantly in the Irish fleet in recent years and again in 2023 (Fig 4). This might be expected as Ireland still has targeted fishery for whiting and with recent poor recruitment there are also less fish in the <27cm size group. No strong shift in landings length classes seem apparent to suggest a significant shift in behaviour of the major fleets otherwise.

Procedures for raising discards to international catch-at-age are summarised above and detailed in the stock annex. More accurate national data have been available through InterCatch since the benchmark and are included in the assessment. Historically, Irish and French OTB discards were simply raised to international landings to produce an estimate of discards-at-age.

A summary of discarding for the time-series 2003–2023 available in InterCatch is presented in Figure 5. The two main fleets exploiting whiting, FRA_OTB and IRL_OTB, have shown some downward trend in discarding in recent years. There is a notable shift also from OTB_DEF to OTB_CRU in the Irish fleet. The remaining lesser métiers have remained largely constant over time. Numbers and weights by age and country for the most recent data year (2022) are given in Table 6 for both landings and discards.

Figure 6 presents the proportion of landings and discards. The data indicate that the proportion of young being landed rather than discarded has increased significantly since about 2018 suggesting a distinct shift towards landing more fish around the MCRS.

Biological

Rivard corrected mean stock and catch weights-at-age data are calculated following the methodology described in the stock annex and presented in Figure 7 and Table 7. Natural mortality is based on Lorenzen's model and a power function of mean catch weights-at-age from the IBTS surveys is used.

Mortality Ogive

Age	0	1	2	3	4	5	6	7+
Proportion Mature	1.22	0.86	0.65	0.50	0.43	0.40	0.38	0.36

Maturity was historically knife-edge at age 2, but has been replaced at the Benchmark to a revised maturity ogive based on survey data.

Maturity Ogive

Age	0	1	2	3	4	5	6	7+
Proportion Mature	0	0.61	0.94	0.97	0.97	1	1	1

Surveys

Two IBTS Q4 surveys, FR-EVHOE and IE-IGFS, have been combined to provide the survey index for the assessment of Celtic Sea whiting since the previous benchmark in 2014. The approach adopted was the VAST (Vector Autoregressive Spatio-Temporal) model (www.github.com/james-thorson/VAST).

Internal consistency between age group 0 and 1 has almost doubled between 2022 and 2023 survey data to 0.603 (Figure 8). Correlation between the other age groups remains quite similar although currently only ages 0-2 yrs is included in the assessment (Table 8).

Log mean standardised indices are given in Figure 8. Plotting by cohort the index is seen to be quite noisy in recent years. Plotting by years shows the disparity between 0 and 1-group fish in 2022 and higher correlation in 2023. The overall downward trend since 2015 across age classes in the survey is also apparent.

Commercial LPUE

An updated French commercial tuning fleet for whiting is also available (Table 9). The Working Document Laviale *et al.*, 2019[4] details issues and work done to provide the updated French commercial tuning index. While the French otter trawl fleet generally accounts for approximately 56% of the landings and 72% of the discards in 2023 it is ostensibly concentrated around the 7d Channel area and eastern Celtic Sea (Table 2).

[4] https://community.ices.dk/ExpertGroups/benchmarks/2019/wkceltic/2014%20Meeting%20docs/04.%20Working%20documents/WD_03_WKCELTIC%20-%20French%20commercial%20tuning%20fleets_Final_2020.pdf

39.4 Historical stock development

A State–space (SAM) assessment is used for this stock applying the settings as agreed at WKCELTIC. Runs are available at Stockassessment.org. The full time-series was used (1999–2021) with one survey index (VAST) and one commercial index (FRA-OTB-LPUE). The settings are detailed within the stock annex.

Data screening

The methodology agreed at WKCELTIC is implemented and documented as an R Markdown document and available on the WGCSE[5] SharePoint site.

Final update assessment

The final assessment was run as per https://www.stockassessment.org/set-Stock.php?stock=whg.7b-ce-k-2024_WGCSE24_v1.

Final model inputs and settings were:

- Full time-series of catch data(1999 to 2023, ages 0 to 7+)
- SAM Model-filled discards for ages 5–7+ in 1999–2002
- VAST Model index for ages 0–2 from IGFS:EVHOE 2003–2023
- French Commercial biomass index in Kg/Hr for 2000–2023
- Fishing mortality states were bound for ages 6+
- Catchability for ages 1+ were bound for the survey index
- Default settings for remaining configuration
- Observation error on the first age in the survey was estimated separately from the older ages (i.e. ages 1–2 were bound).

Fishing mortality-at-age and stock numbers-at-age are presented in Table 10 and Table 11 respectively. Summary plots for SSB, F_{bar} and Recruitment are given in Figure 9. The last small pulse in recruitment in 2013 resulted in a small rise in SSB as harvestable 2 year olds in 2015. With poor recruitment since there has been little to bolster the stock or fishery since the 2013 cohort.

Model fits to the data are presented in Figure 10. The overall fit to catch data is reasonably good while the IBTS survey observations are also oscillating around the SAM model. Fit for the commercial biomass index is less predictable however, likely due in part to spatial coverage where French fleet are mostly fishing towards the Channel area and healthier 7d stock component. The residual patterns are presented in Figure 11 with virtually all age classes in the catch and survey appearing below the model prediction for 2023. The one exception being in the plus group.

Comparison with previous assessments

The assessment continues to show retrospective bias, highlighted by the Mohn's Rho values (Figure 12). Spawning–stock biomass has been over estimated annually and fishing mortality

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[5] https://community.ices.dk/ExpertGroups/wgcse/2022%20Meeting%20Documents/06.%20Data/whg-7b-ce-k/aggregate_IC_data_whg.27.7b-ce-k_Sept_2022.html

consistently revised upwards. Inclusion of the 2023 data however, has somewhat reversed that trend.

State of the stock

Trends in landings, $F_{(2–5)}$, SSB, and recruitment are presented in Table 12. For the recent time-series, SSB displays a peak biomass in 2010 following relatively strong recruitment from the 2008–2009 year classes. Again in 2014–2015 following the 2013 recruitment.

Fishing mortality ($F_{bar\ 2\text{-}5}$) has decreased since 2018 and in 2023 is assessed to be 0.276 and below Blim (0.375). SSB is estimated to be increasing very slowly, but still below agreed reference points.

39.5 Short-term projections

The short-term projections were carried out in SAM (stockassessment.org) as described in the stock annex. However, given the ongoing bias, a revision to the recruitment assumption was implemented at WGCSE 2023 and continues. Only the recent recruitment time-series ≥2015 is included rather than incorporating the more productive historic figures. This removes the moderately high 2013 recruitment point, producing a more conservative estimate of recruitment and therefore SSB in the forecast.

Whiting in the Celtic Sea, as with many gadoid fisheries, is heavily reliant on younger age classes and therefore recruitment. Recruitment is highly sporadic and thus the span over which a mean or median recruitment assumption is taken for the intermediate year is important.

The median resampled recruitment then from 2015–2023 in 000s is estimated as 350 153. This was used as 0-group numbers in the forecast for 2024–2025.

The basis for the catch forecast is given in Table 14. Whiting is aligned with the other WKCELTIC benchmarked species (cod and haddock) in this mixed-fishery. A catch constraint producing the TAC in 2024 was used as the F assumption. The resulting F_{TAC24} (0.268) is unscaled and the average $F_{2020–2023}$ used as the F assumption for the intermediate year (2024).

Table 13 gives the management options table. Given the probability of SSB being below B_{lim} of >97% for all scenarios other than zero catch, F=0 is advised. Fishing at 0 gives a 3% likelihood of being above B_{lim} with a spawning–stock biomass forecast of 26 691 t in 2026. The assumed recruitment in 2024 and 2025 used in the forecast, continues to be a significant part (47.2%) of the projected SSB in 2026 (Figure 13).

39.6 MSY evaluations and Biological reference points

ICES carried out an evaluation of MSY and PA reference points for this stock at IBPCSWhiting (ICES, 2021). The results are summarised below:

Reference points

Reference Point	IBPCSWhiting 2021 Value	WKCELTIC 2020 Value	Rationale
MSY $B_{trigger}$	50 818 t	47 963 t	B_{pa}
F_{MSY}	0.375	0.4	From EqSim with segmented regression and fixed break-point (B_{lim}) capped to $F_{p0.5}$.
$F_{MSYLower}$	0.315	0.332	Median lower point estimates of (F_{05})
$F_{MSYUpper}$	0.375	0.4	$F_{p.05}$
B_{lim}	36 571 t	34 516 t	B_{loss}; lowest observed SSB (2008) from which stock recovery was observed.
B_{pa}	50 818 t	47 963 t	B_{lim} combined with the assessment error; B_{lim} × exp (1.645 × σ); σ = 0.20 (default setting)
F_{lim}	0.64	0.89	F with 50% probability of SSB less than B_{lim}

39.7 Management plans

ICES is aware of the multiannual management plan (MAP) which has been adopted by the EU for this stock (EU, 2019) and which ICES considers to be precautionary. There is no agreed shared management plan with the UK for this stock, and ICES provides advice according to ICES MSY approach. Catch scenarios consistent with the MAP F_{MSY} ranges are provided.

39.8 Uncertainties and bias in assessment and forecast

Sampling

Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches. Revised time-series data for 2002–2023 are now included in the assessment with sampling from more countries which should give greater accuracy. While the overall SOP checks have invariably been ≤3%, any difference in the sampled catch-at-age going into the assessment vs those coming out will cause concern. Rather than correct the national data provided, a SOP correction is applied as part of the revised raising procedures outlined above and the stock annex.

Ageing

Cohort tracking in the landings-at-age matrix appears consistent up to age 6. Tracking deteriorates at older ages.

Discards

Discarding has been major feature of most fleets catching whiting in the Celtic Sea. Sampling coverage of discarding has improved over time particularly since 2004. Discard estimates for the UK and Belgium are now included along with those of Ireland and France.

Selectivity

Square-mesh panels were introduced in the second half of 2012 to reduce catches and discards of smaller whiting and haddock. The current assessment has not shown an obvious reduction in F-at-age since the introduction of this TCM, the recent trend seems more a function of availability rather than selectivity.

Surveys

The survey indices for whiting are prone to some year effects. However, cohort tracking for the 1+ fish is consistent and has improved further using the VAST modelling approach. There is a noticeable downward trend since 2016 in the indices plotted by year and higher noise when plotted by cohort (Figure 8).

Misreporting

The level of misreporting for this stock is not known. Underreporting has previously been considered unlikely to be a significant source of unaccounted mortality in the assessment because the TAC has been in excess of recent catches. That may no longer the case from 2024 onward however as the new TAC regime is implemented.

39.9 Recommendation for next benchmark

The survey indices were truncated from 0–5 year olds down to 0–2 year olds as part of model fit optimization. This should be revisited again to ensure the model is not over fitting to the catch data. Commercial tuning was only available from France at the recent benchmark, whose fleet have a different spatial extent to that of Ireland, the other main country involved in the fishery. Potential to extend the coverage of the commercial tuning index should be examined otherwise whether the SAM fit to the LPUE index is reasonable.

39.10 Management considerations

Catches and SSB in 7.b, c, e–k whiting fluctuate considerably depending on year-class strength. The 2008 and 2009 year classes were above average with 2013 being third highest in the time-series. These contributed to catches and SSB in the short term but the upturn in catches and SSB was short lived, as recruitment is episodic and SSB is now below all reference points.

Discarding in this stock for different fleets is highly variable depending on gear and year-class strength. High levels of discarding for a species like whiting reduce the longer term yields as one might expect, so efforts to improve selection and reduce discards in the mixed-fishery should be encouraged. ICES notes the introduction of square-mesh panels in all trawl fisheries operating in ICES divisions 7.fg. It is important that these measures are fully implemented and their effectiveness in reducing discards and the impact on commercial catches is monitored and evaluated. Further gear modifications to increase the likelihood of small whiting passing through the gear, such as introduction of larger minimum mesh sizes, separator panels, or grids may be needed.

Ireland has the only directed fishery for whiting which is part of mixed-fishery throughout the Celtic Sea, as well as bycatch within *Nephrops* fisheries. Discard rates have been high as a consequence of the low market value of the species, particularly at smaller sizes. However, whether small whiting are less available or fisheries are maximising their catch, there has been a clear reduction in discarding. How that will evolve and interact with the new TAC and catch advice is not clear.

From the 1 February to the 31 March fishing activity has been prohibited within ICES rectangles: 30E4, 31E4, 32E3 (excluding within six nautical miles from the baseline) annually since 2005 to protect the cod stock.

There have been major changes in fleet dynamics over the period of the assessment. Effort in the French gadoid fleet has been declining since 1999, but the effort has fluctuated in recent years due to the way the effort series is derived. Irish otter trawl effort in 7.b–k has also declined slightly over the time-series.

The full impact of the Landings Obligation is complex and unknown and will depend on whether there is a measurable impact on discarding behaviour or whether variable practices continue and simply data become more reliable (for a summary of issues see http://www.discardless.eu/media/results/Celtic_Sea_Year2.pdf).

39.11 References

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39.12 Tables and figures

Table 1. Whiting in Divisions 7.bc,e–k. Nominal Landings (t) as reported to ICES, and total landings as used by the Working Group.

	Official ICES Landings						**[b]Transfers**	**Used by WG**		**Total Catch**		
Year	BEL	FRA	IRL	UK_EW	Others	Total	33E2 & 33E3	WG Catch	WG Discards	Catch 7b-k Est	7.d Catch	TAC
1998	479	11748	5549	1853	81	19710	-	-	-	-	7810	
1999[a]	448	16418	6013	1354	27	24260	-	20178	5420	28178	8000	25000
2000	194	9184	5358	1279	15	16030	-	15645	4400	24074	8429	22200
2001	171	7317	5365	963	16	13832	-	13192	9877	22101	8909	21000
2002	149	7546	5718	860	22	14295	-	13640	7336	20796	7156	31700
2003	129	5989	4516	772	12	11418	-	22125	10337	28439	6314	27000
2004	180	4870	4350	594	125	10119	165.6	29842	19522	35099	5257	27000
2005	218	5886	5774	482	136	12496	51.2	26173	13598	33182	7009	21600
2006	128	4710	4570	413	129	9951	35.2	15006	5098	20740	5734	19940
2007	127	3574	4864	575	87	9226	21.8	17863	8439	22880	5017	19940
2008	121	3072	2406	618	37	6255	158.4	9841	3760	16255	6414	19940
2009	87	2814	2798	827	25	6551	44.1	10855	4281	18861	8006	16949
2010	102	3463	4330	792	92	8779	61.7	14916	5346	26548	11632	14407
2011	100	4312	4752	739	175	10077	90.4	13834	3750	22166	8332	16658
2012	170	3710	5841	763	142	10627	74.2	15950	5116	22752	6802	19053

	Official ICES Landings						[b]Transfers	Used by WG		Total Catch		
Year	BEL	FRA	IRL	UK_EW	Others	Total	33E2 & 33E3	WG Catch	WG Discards	Catch 7b-k Est	7.d Catch	TAC
2013	226	4006	6888	907	93	12119	43.0	16156	4026	22650	6494	24500
2014	222	4928	6874	1057	40	13121	33.0	17655	4672	23489	5834	19162
2015	152	5634	6437	825	100	13149	49.6	19638	6528	28242	8604	17742
2016	186	6294	7700	891	39	15110	33.7	23460	8259	29473	6013	22778
2017	102	5256	6323	603	34	12318	40.0	15168	2791	20072	4904	27500
2018	103	3666	4636	594	871	9870	20.1	11146	2139	17190	6044	22213
2019	73	3234	2344	486	136	6273	17.6	7559	970	13033	5474	19184
2020	82	2669	2475	335	140	5701	24.1	7197	1266	13154	5957	10863
2021	82	2666	2923	354	66	6091	13.9	7376	1224	14334	6958	10259
2022*	75	2750	1943	308	14	5089	58.5	7577	2462	12319	4742	10696
2023*	69	2385	1419	329	32	4234	21.3	4663	397	7265	2602	9650

***Provisional data.**

****ICES preliminary landings.**

[a] French Official landings not available, not updated.

[b] Landings re-allocated from 7a to 7b–ce-k WG Landings.

Table 2. Whiting in Divisions 7.b–ce–k. 2023 Landings and discards data (t) by fleet used by the working group.

LANDINGS	Others	OTB	SSC	TBB	Total	%
BEL	14	0	54	0	69	2%
FRA	2330	0	0	55	2385	56%
IRL	549	882	12	9	1452	34%
UK	180	16	71	52	318	7%
Others	11	32	0	0	42	1%
Total	3083	929	137	117	4266	100%
	72%	22%	3%	3%	100%	
DISCARDS	**Others**	**OTB**	**SSC**	**TBB**	**Total**	**%**
BEL	2	0	41	0	43	11%
FRA	282	0	0	5	287	72%
IRL	13	7	6	0	26	7%
UK	12	0	14	12	39	10%
Others	1	0	0	0	1	0%
Total	312	7	61	17	397	100%
	78%	2%	15%	4%	100%	

Table 3. Whiting in divisions 7.bc,e–k. The strong 1999 year class is distinct in both the catch and landings data, with evidence of the strong 2009 and 2013 year classes appearing at older ages. Catch numbers-at-age ('000).

1999	2023						
0	7						
1							
5370.0	20744.1	25957.7	14662.4	8744.8	8987.8	6670.2	1498.7
8176.3	26561.7	26303.7	12529.9	6122.5	2605.9	2100.9	2424.3
8795.0	26105.8	51390.6	13715.2	5317.1	2049.0	763.1	627.3
4568.6	13387.4	34319.6	24356.6	5968.2	1057.6	291.6	111.0
13563.8	20962.0	34625.2	14881.0	15187.9	2698.4	369.8	4.2
35663.6	20301.8	60277.3	30276.2	15671.1	6833.3	541.1	77.0
5540.3	33978.7	44751.0	18055.2	8245.2	6434.5	2651.8	126.4
13472.7	16455.6	8974.9	9465.6	4559.3	2821.7	4419.0	634.9
926.1	10977.9	29863.4	22446.5	6347.2	2601.3	821.3	1016.0
1430.2	10540.5	14640.9	10936.2	3775.9	865.0	220.4	89.7
809.6	6124.2	17584.6	10350.5	3958.6	1266.2	248.0	78.2
495.8	12773.2	15669.6	14991.2	4803.2	1207.5	283.2	104.8
559.8	4153.3	15044.6	12540.0	6502.9	1626.1	375.8	102.2
3798.5	6573.8	9025.6	15864.1	7519.9	2653.6	605.5	134.1
770.0	3346.0	8808.5	7320.9	12392.4	4809.3	1054.1	294.5
133.9	14770.7	6808.8	7768.4	6684.4	7574.4	1746.7	301.5
4647.2	5651.8	32558.2	7710.9	6203.1	2815.4	3111.9	650.8
2074.9	10980.8	13651.0	33791.0	5935.6	3085.0	1079.9	1193.1
933.6	2840.6	12286.9	7615.0	11764.8	2010.4	771.2	282.8
1803.3	2888.6	8804.0	7711.5	3749.0	3979.7	575.2	219.5
93.0	3025.8	4713.2	4371.8	3044.0	1017.7	745.5	75.3
1417.2	3684.5	8679.1	3972.3	1534.9	758.1	219.9	126.2
48.7	4556.3	5814.8	8063.6	1688.6	422.1	124.2	34.9
77.7	5989.0	7120.2	5525.3	3878.4	513.3	71.4	9.4
21.0	417.8	3222.5	2727.8	2208.4	984.6	108.7	29.6

Table 4. Whiting in divisions 7.bc,e–k. Catch weights-at-age (Tons).

1999	**2022**						
0	7						
1							
603.1	2588.8	6681.7	4496.2	6085.5	1416.0	250.9	2.5
748.8	3135.3	10982.9	7433.9	4674.5	2629.2	204.7	32.8
229.2	3989.7	8773.7	5791.2	3439.3	2739.9	1143.7	66.1
467.9	2433.0	2529.3	3491.9	2416.2	1601.7	1673.4	392.8
42.6	1403.4	5695.9	6364.0	2407.3	1230.4	374.8	345.0
54.0	1298.9	3080.3	3088.6	1658.0	424.3	159.9	76.6
54.7	844.6	3662.2	3466.6	1780.3	838.7	147.6	60.2
20.4	1932.4	3935.0	5696.2	2404.7	684.4	183.8	59.5
17.7	716.1	3557.8	4520.9	3559.4	1104.6	263.8	94.0
217.0	677.7	2014.9	6407.2	4094.8	1945.2	462.3	130.5
35.2	493.6	1860.8	2657.4	6926.6	3052.4	905.4	225.0
6.5	2046.5	1742.6	3076.4	3667.0	5455.4	1365.1	295.4
258.3	682.6	7744.0	2961.8	3345.0	2059.2	2125.4	461.4
89.3	1355.3	2896.0	12098.1	3279.0	2093.7	777.7	871.1
39.6	409.9	2885.4	3015.1	6421.4	1450.4	689.8	256.3
98.4	364.0	1742.9	2878.6	2260.6	3064.2	516.5	221.3
5.8	496.3	1608.6	2056.9	1890.0	794.9	625.9	80.2
27.4	609.7	2686.0	2080.6	964.8	536.8	174.2	117.3
2.3	413.3	1672.8	3742.6	1092.5	327.2	88.5	37.0
7.1	997.9	1758.2	2300.8	2094.1	352.9	56.9	9.7
0.8	92.0	1060.6	1320.6	1379.9	691.8	94.2	23.0

Table 5. Whiting in divisions 7.bc,e–k. Mean catch weights-at-age (kg).

	Age							
		1	2	3	4	5	6	7+
1999	0.0271	0.1331	0.2216	0.3412	0.4274	0.4402	0.4963	0.623
2000	0.0314	0.069	0.2204	0.3955	0.5053	0.563	0.5804	0.5868
2001	0.0315	0.1116	0.1853	0.3778	0.5293	0.6335	0.76	0.7775
2002	0.0272	0.0965	0.1966	0.3506	0.5315	0.7069	0.8249	1.0133
2003	0.0445	0.1235	0.1930	0.3021	0.4007	0.5248	0.6786	0.6038
2004	0.0210	0.1544	0.1822	0.2455	0.2983	0.3848	0.3783	0.4263
2005	0.0414	0.1174	0.1961	0.3207	0.4171	0.4258	0.4313	0.5232
2006	0.0347	0.1479	0.2818	0.3689	0.5300	0.5676	0.3787	0.6186
2007	0.0460	0.1278	0.1907	0.2835	0.3793	0.4730	0.4563	0.3395
2008	0.0377	0.1232	0.2104	0.2824	0.4391	0.4905	0.7256	0.8543
2009	0.0675	0.1379	0.2083	0.3349	0.4497	0.6624	0.5952	0.7689
2010	0.0411	0.1513	0.2511	0.3800	0.5007	0.5668	0.6489	0.5674
2011	0.0316	0.1724	0.2365	0.3605	0.5474	0.6793	0.7019	0.9197
2012	0.0571	0.1031	0.2232	0.4039	0.5445	0.7331	0.7635	0.9731
2013	0.0457	0.1475	0.2113	0.3630	0.5589	0.6347	0.8589	0.7641
2014	0.0484	0.1386	0.2559	0.3960	0.5486	0.7202	0.7815	0.9798
2015	0.0556	0.1208	0.2379	0.3841	0.5392	0.7314	0.6830	0.7089
2016	0.0431	0.1234	0.2121	0.3580	0.5524	0.6787	0.7201	0.7301
2017	0.0424	0.1443	0.2348	0.3959	0.5458	0.7214	0.8945	0.9065
2018	0.0546	0.1260	0.1980	0.3733	0.6030	0.7700	0.8980	1.0080
2019	0.0625	0.1640	0.3413	0.4705	0.6209	0.7811	0.8396	1.0646
2020	0.0193	0.1655	0.3095	0.5238	0.6286	0.7081	0.7922	0.9297
2021	0.0473	0.0907	0.2877	0.4641	0.6470	0.7751	0.7123	1.0611
2022	0.0911	0.1666	0.2469	0.4164	0.5399	0.6874	0.7960	1.0251
2023	0.0383	0.2201	0.3291	0.4841	0.6249	0.7026	0.8667	0.7765

Table 6. Whiting in divisions 7.e–k. Summary of landings and discard data for 2023 provided to the Working Group.

Weight in tonnes										
DISCARDS	Country	0	1	2	3	4	5	6	7	Grand Total
	Belgium	0.1	4.6	25.0	10.8	1.7	1.3	0.0	0.0	43.5
	France	0.6	31.3	176.5	61.0	13.9	3.9	0.1	0.0	287.4
	Ireland	0.0	0.1	10.3	12.6	0.0	3.0	0.0	0.0	26.0
	UK (England)	0.1	6.1	21.0	6.5	3.9	0.8	0.1	0.0	38.6
	Other	0.0	0.1	0.8	0.4	0.1	0.0	0.0	0.0	1.4
	Total	0.8	42.1	233.7	91.3	19.6	9.1	0.2	0.0	396.9
Landings	Belgium	0.0	0.5	9.6	19.3	24.9	12.2	1.8	0.5	68.7
	France	0.0	45.7	663.1	719.2	702.1	194.1	46.9	13.8	2385.0
	Ireland	0.0	0.7	80.2	384.6	509.7	429.4	39.7	7.3	1451.6
	UK (England)	0.0	2.7	69.6	94.5	107.2	38.9	4.5	0.9	318.4
	Other	0.0	0.2	4.4	11.7	16.4	8.1	1.2	0.3	42.3
	Total	0.0	49.8	826.9	1229.3	1360.3	682.7	94.0	22.9	4266.0

Weight in tonnes										
Number in 000's										
Discards	Country	0	1	2	3	4	5	6	7	Grand Total
	Belgium	2.1	29.8	131.7	36.5	5.5	3.3	0.0	0.0	208.9
	France	17.3	179.6	788.7	201.6	38.9	9.4	0.2	0.1	1235.8
	Ireland	0.0	1.4	74.7	39.5	0.0	7.3	0.0	0.0	122.8
	UK (England)	1.5	44.2	111.6	26.8	12.3	1.6	0.1	0.0	198.2
	Other	0.0	0.7	3.9	1.3	0.2	0.1	0.0	0.0	6.3
	Total	21.0	255.6	1110.5	305.7	56.9	21.7	0.4	0.1	1772.0
Landings	Belgium	0.0	1.6	24.9	38.2	39.2	17.2	2.1	0.6	123.8
	France	0.0	147.0	1629.1	1308.2	1007.3	247.4	46.4	17.4	4402.7
	Ireland	0.0	2.2	229.4	839.5	887.6	635.3	53.1	9.7	2656.9
	UK (England)	0.0	10.8	216.2	212.4	191.5	51.7	5.3	1.3	689.1
	Other	0.0	0.7	12.3	23.8	25.9	11.3	1.5	0.4	75.8
	Total	0.1	162.2	2111.9	2422.1	2151.5	962.9	108.3	29.4	7948.4

Table 7. Whiting in divisions 7.bc,e–k. Q1 Stock weights-at-age (kg) from Rivard corrected annual mean catch weights.

	Age							
	0	1	2	3	4	5	6	7+
1999	0.01666	0.04324	0.17128	0.29605	0.41522	0.49054	0.50546	0.53966
2000	0.01666	0.04324	0.17128	0.29605	0.41522	0.49054	0.50546	0.53966
2001	0.01800	0.05920	0.11307	0.28856	0.45753	0.56578	0.65413	0.67176
2002	0.01277	0.05513	0.14812	0.25488	0.44811	0.61169	0.72289	0.87756
2003	0.02386	0.05796	0.13646	0.24372	0.37481	0.52812	0.69262	0.70572
2004	0.00888	0.08287	0.15001	0.21767	0.30021	0.39264	0.44557	0.53789
2005	0.02189	0.04965	0.17401	0.24175	0.32003	0.35639	0.40736	0.44489
2006	0.01810	0.07821	0.18191	0.26893	0.41229	0.48660	0.40155	0.51652
2007	0.02814	0.06663	0.16793	0.28266	0.37405	0.50066	0.50894	0.35856
2008	0.01974	0.07532	0.16400	0.23209	0.35283	0.43133	0.58582	0.62434
2009	0.04512	0.07214	0.16020	0.26545	0.35639	0.53931	0.54035	0.74693

2010	0.02006	0.10108	0.18610	0.28131	0.40949	0.50489	0.65564	0.58114
2011	0.01753	0.08418	0.18915	0.30089	0.45605	0.58317	0.63073	0.77257
2012	0.03555	0.05711	0.19619	0.30905	0.44307	0.63344	0.72017	0.82641
2013	0.02627	0.09181	0.14758	0.28466	0.47513	0.58788	0.79348	0.76382
2014	0.03067	0.07960	0.19432	0.28924	0.44625	0.63448	0.70429	0.91734
2015	0.03730	0.07648	0.18154	0.31354	0.46211	0.63345	0.70137	0.74435
2016	0.02352	0.08282	0.16007	0.29182	0.46064	0.60495	0.72574	0.70617
2017	0.02459	0.07882	0.17025	0.28982	0.44206	0.63130	0.77912	0.80794
2018	0.03146	0.07309	0.16901	0.29608	0.48862	0.64827	0.80488	0.94954
2019	0.03837	0.09459	0.20738	0.30519	0.48142	0.68629	0.80404	0.97773
2020	0.00894	0.10166	0.22530	0.42281	0.54384	0.66306	0.78664	0.88352
2021	0.02518	0.04190	0.21818	0.37900	0.58214	0.69800	0.71020	0.91686
2022	0.10726	0.08875	0.14967	0.34611	0.50061	0.66689	0.78544	0.85452
2023	0.04712	0.07744	0.19772	0.38264	0.54220	0.67599	0.76076	0.88496

Table 8. Whiting in divisions 7.bc,e–k. Combined (IE-IGFS and FR_EVHOE) VAST recruitment survey index for age groups 0–2 (No/Km²).

IGFSEVHOE No/Hr			
	Age		
		1	2
2003	41780	44499	13400
2004	132621	32288	8013
2005	36400	35165	5865
2006	72875	23976	7779
2007	225747	30164	4873
2008	145051	43926	9810
2009	236920	62114	10882
2010	24270	54305	23367
2011	68296	16907	27992
2012	39821	20148	10844
2013	221306	13319	8269

2014	26232	44894	7381
2015	72186	16029	19746
2016	77019	22339	12767
2017	58193	11081	5078
2018	87930	7586	2866
2019	49081	26917	3896
2020	45375	10610	5209
2021	55161	23518	8149
2022	10964	18465	5504
2023	15082	3425	3822

Table 9. Whiting in divisions 7.bc,e–k. FRA-OTB commercial biomass index (Kg/Hr).

	Kg/Hr
2000	38.1036
2001	20.7203
2002	19.7279
2003	15.0461
2004	15.0812
2005	24.6578
2006	24.1190
2007	14.6645
2008	11.0597
2009	11.1447
2010	14.6829
2011	13.0133
2012	10.4575
2013	13.1697
2014	19.6047
2015	20.3092
2016	25.6908
2017	25.0667
2018	22.2050
2019	22.4371
2020	18.5756
2021	16.4738
2022	18.2615
2023	26.9427

Table 10. Whiting in divisions 7.b, c, e–k. Fishing mortality (F)-at-age. F_{bar} range is 2–5.

	0	1	2	3	4	5	6	7+
1999	0.009	0.096	0.428	0.659	0.944	1.187	1.558	1.558
2000	0.008	0.090	0.388	0.630	0.969	1.233	1.743	1.743
2001	0.008	0.088	0.357	0.578	1.056	1.570	2.392	2.392
2002	0.008	0.075	0.283	0.395	0.700	1.091	1.927	1.927
2003	0.009	0.090	0.327	0.373	0.597	0.987	1.564	1.564
2004	0.015	0.163	0.636	0.700	0.690	0.853	1.283	1.283
2005	0.013	0.157	0.618	0.794	0.789	0.836	1.297	1.297
2006	0.006	0.073	0.272	0.540	0.737	1.044	1.594	1.594
2007	0.007	0.104	0.492	1.036	1.366	1.762	2.158	2.158
2008	0.004	0.059	0.279	0.629	0.838	1.028	1.240	1.240
2009	0.003	0.046	0.223	0.532	0.789	1.006	1.182	1.182
2010	0.002	0.039	0.177	0.442	0.678	0.853	1.015	1.015
2011	0.002	0.033	0.140	0.323	0.543	0.723	0.889	0.889
2012	0.002	0.038	0.154	0.297	0.480	0.678	0.841	0.841
2013	0.002	0.038	0.158	0.299	0.498	0.718	0.885	0.885
2014	0.002	0.040	0.168	0.328	0.567	0.771	0.963	0.963
2015	0.003	0.060	0.248	0.431	0.659	0.878	1.138	1.138
2016	0.004	0.082	0.352	0.638	0.869	1.112	1.417	1.417
2017	0.004	0.077	0.356	0.634	0.886	1.115	1.434	1.434
2018	0.003	0.079	0.396	0.763	1.073	1.367	1.734	1.734
2019	0.002	0.052	0.275	0.675	1.061	1.331	1.645	1.645
2020	0.002	0.045	0.233	0.594	1.029	1.412	1.710	1.710
2021	0.001	0.035	0.186	0.461	0.833	1.178	1.380	1.380
2022	0.001	0.034	0.179	0.367	0.646	0.847	0.935	0.935
2023	0.001	0.020	0.102	0.185	0.345	0.474	0.571	

Table 11. Whiting in divisions 7.b, c, e–k. Stock number-at-age ('000).

	0	1	2	3	4	5	6	7+
1999	2061283	290858	94624	37221	17463	14774	9930	2520
2000	1715750	613517	111586	31695	11642	4457	3000	1820
2001	1413419	502622	240903	39530	9891	2853	889	584
2002	1264455	410910	195492	91235	13559	2179	389	93
2003	982785	373693	161478	78739	38471	4348	504	47
2004	846402	290018	145064	62115	37158	13999	1025	79
2005	741840	238139	105262	39980	18046	13668	4064	210
2006	802157	219095	79948	29050	10863	5136	4499	802
2007	1005697	230049	86611	34858	10152	3389	1169	744
2008	1184078	295623	84584	27650	7690	1673	383	152
2009	1326913	350697	115471	32697	8806	2195	407	107
2010	638132	404932	138298	48094	11613	2579	534	109
2011	631240	189197	168760	58740	18219	3816	740	160
2012	570373	187505	80121	79187	25463	6643	1245	254
2013	1295170	159961	77298	36190	37523	10395	2212	445
2014	526563	409724	64320	34844	16567	15578	3374	750
2015	510454	156240	179133	29018	15407	5980	4960	1081
2016	324656	148534	63360	76222	11925	5248	1658	1333
2017	282497	90874	55228	22409	24157	3365	1160	499
2018	518988	78540	33693	19459	7184	6396	754	273
2019	408528	155056	29433	11088	5430	1621	1084	124
2020	475619	120708	60526	11363	3204	1197	291	160
2021	350153	141219	49976	25525	3737	726	193	56
2022	133450	107437	55650	22001	9699	1053	147	43
2023	116494	38327	43232	23383	9275	3264	301	

Table 12. Whiting in divisions 7.b, c, e–k. Summary table.

Year	Recruitment age 0			SSB			Land-ings	Dis-cards	Fishing mortality (ages 2–5)		
	Low	Value	High	Low	Value	High			Low	Value	High
1999	1425451	2061283	2980733	48523	54255	60664	20180	5420	0.694	0.804	0.932
2000	1175506	1715750	2504282	46293	52624	59820	15644	4400	0.696	0.805	0.930
2001	1047958	1413419	1906330	51999	61797	73441	13196	9877	0.771	0.890	1.029
2002	947466	1264455	1687497	60338	71183	83978	13640	7336	0.518	0.617	0.735
2003	734521	982785	1314961	60790	69205	78784	11788	10337	0.474	0.571	0.687
2004	633054	846402	1131650	57602	65048	73455	10321	19522	0.611	0.720	0.848
2005	560241	741840	982303	41141	46027	51493	12575	13598	0.658	0.759	0.877
2006	592080	802157	1086771	36377	40765	45683	9908	5098	0.546	0.648	0.769
2007	751954	1005697	1345064	34130	38821	44158	9424	8439	1.007	1.164	1.346
2008	889835	1184078	1575619	32018	36520	41655	6080	3760	0.585	0.693	0.821
2009	938942	1326913	1875195	40084	45768	52258	6574	4281	0.529	0.637	0.768
2010	474115	638132	858891	59685	68612	78875	9570	5346	0.437	0.537	0.662
2011	474654	631240	839482	58898	67740	77910	10084	3750	0.346	0.432	0.540
2012	427276	570373	761393	54061	61305	69519	10834	5116	0.324	0.402	0.499
2013	873184	1295170	1921091	49189	55174	61888	12131	4026	0.341	0.418	0.512
2014	396133	526563	699939	54344	61538	69684	12983	4672	0.381	0.459	0.552
2015	374619	510454	695543	54727	61661	69474	13110	6528	0.469	0.554	0.654
2016	217499	324656	484607	43254	49262	56103	15201	8259	0.637	0.743	0.865
2017	196898	282497	405309	29827	33298	37172	12377	2791	0.644	0.748	0.868
2018	383075	518988	703121	20557	22860	25421	9007	2139	0.778	0.900	1.041
2019	296339	408528	563192	19669	22608	25987	6588	970	0.713	0.836	0.980
2020	337248	475619	670762	23508	27819	32920	5931	1266	0.665	0.817	1.004
2021	241468	350153	507758	21225	26048	31969	6153	1224	0.481	0.664	0.919
2022	81902	133450	217443	20806	26596	33997	5115	2462	0.322	0.509	0.806
2023	55230	116494	245714	19084	25883	35104	4226	397	0.158	0.276	0.485
2024	116494	350153*	518988	15639	22290	31393					

*** Median resampled (2015–2023).**

Table 13. Whiting in divisions 7.b, c, e–k. Management options table.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change*	% advice change **	Probability SSB < Blim in 2026
MSY approach: F=0	0	0	0	0	0	0	26691	25.84		97
Other Scenarios										
EU MAP^^: F_{MSY}	5750	5116	634	0.375	0.316	0.059	21646	2.06		100
EU MAP^^: $F_{MSY\ upper}$	5750	5116	634	0.375	0.316	0.059	21646	2.06		100
EU MAP^^: $F_{MSY\ lower}$	5006	4463	543	0.315	0.265	0.05	22281	5.05		100
$F_{MSY\ upper}$ × SSB2025/MSY $B_{trigger}$	2749	2464	285	0.157	0.132	0.025	24226	14.22		99
F_{MSY} × SSB_{2025}/MSY $B_{trigger}$	2749	2464	285	0.157	0.132	0.025	24226	14.22		99
$F_{MSY\ lower}$ × SSB2025/MSY $B_{trigger}$	2347	2106	241	0.131	0.111	0.02	24580	15.89		99
F= F_{MSY} = F_{pa}	5750	5116	634	0.375	0.316	0.059	21646	2.06		100
SSB_{2026} = B_{lim}^										
SSB_{2026} = B_{pa} = $B_{trigger}$^										
TAC_2024	4718	4242	476	0.289	0.243	0.046	22640	6.74		100
F = F_{2024}	6860	6072	788	0.483	0.407	0.076	20532	-3.20		100
SSB_{2026} = SSB_{2025}	6267	5565	702	0.419	0.353	0.066	21210	0.00		100

* SSB 2026 relative to SSB 2025.

** Advice in 2025 relative to advice in 2024 (0 tonnes), options were left blank because they cannot be calculated.

^ The Blim and MSY Btrigger options were left blank because neither can be achieved in 2026, even with zero catches.

^^ EU multiannual plan (MAP) for the Western Waters and adjacent waters (EU, 2019).

Table 14. Whiting in divisions 7.b, c, e–k. Basis for the catch forecast scenarios.

Variable	Value	Notes
$F_{ages\ 2–5}$ (2024)	0.268	$F_{\_TAC24}$ = F achieving TAC in 2024
SSB (2025)	21210	Short-term forecast; in tonnes.
Recruitment age 0 (2024–2025)	350153	Median resampled (2015–2023); in thousands
Catch (2024)	4718	Short-term forecast; in tonnes.
Projected landings (2024)	4263	Short-term forecast assuming average 2021–2023 landings pattern; in tonnes
Projected discards (2024)	455	Short-term forecast assuming average 2021–2023 discard pattern; in tonnes

39.13 Figures

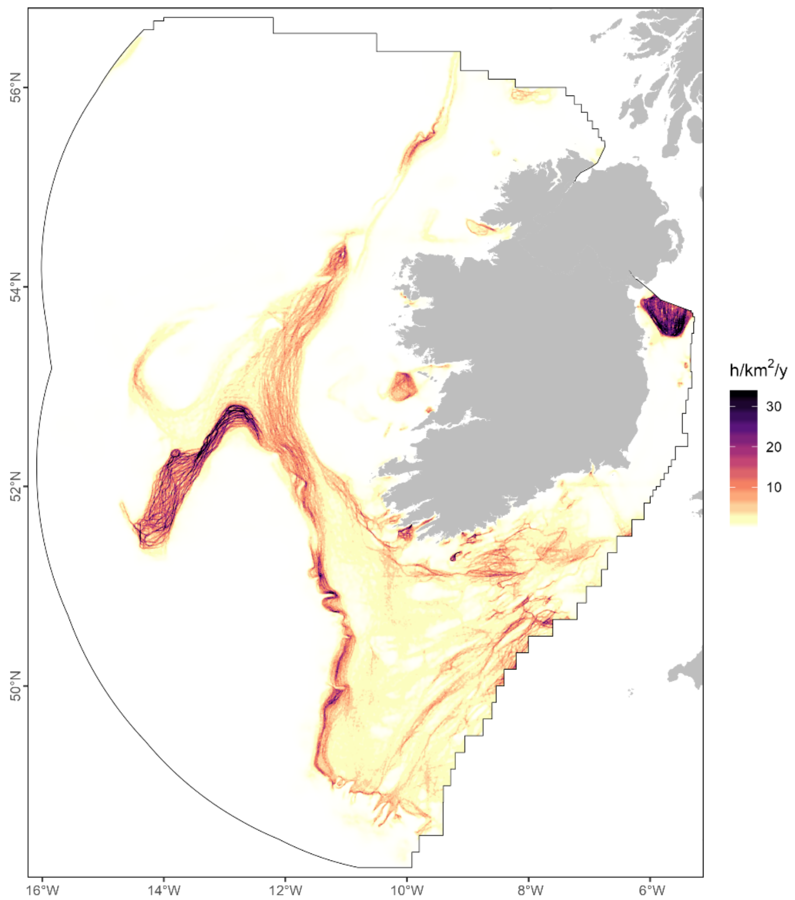


Figure 1. Distribution of international OTB effort within the Irish EEZ 2018–2023.

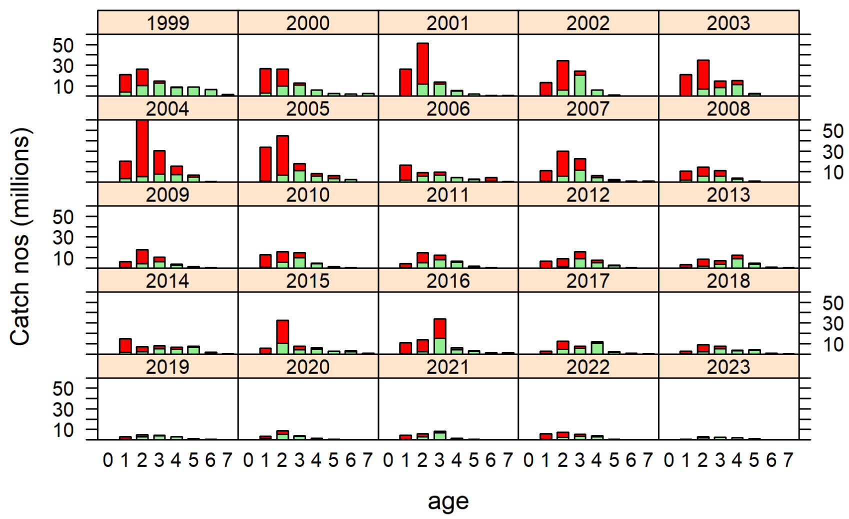


Figure 2. Whiting in 7.b-ce–k (Celtic Sea), annual Landings (Green) and Discards (red) -at-age.

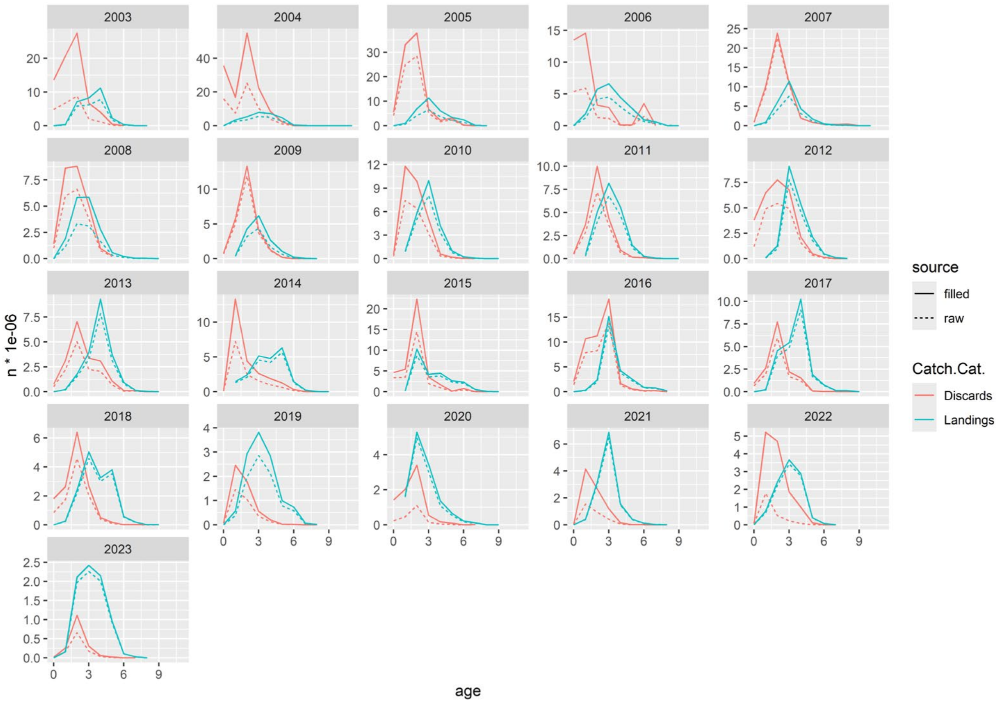


Figure 3. Whiting in 7.b-ce–k (Celtic Sea), annual Landings (Blue) and Discards (red) at age. Dashed lines give raw data uploaded to InterCatch. Solid lines show the final raised International Catch Numbers-at-age used in the assessment.

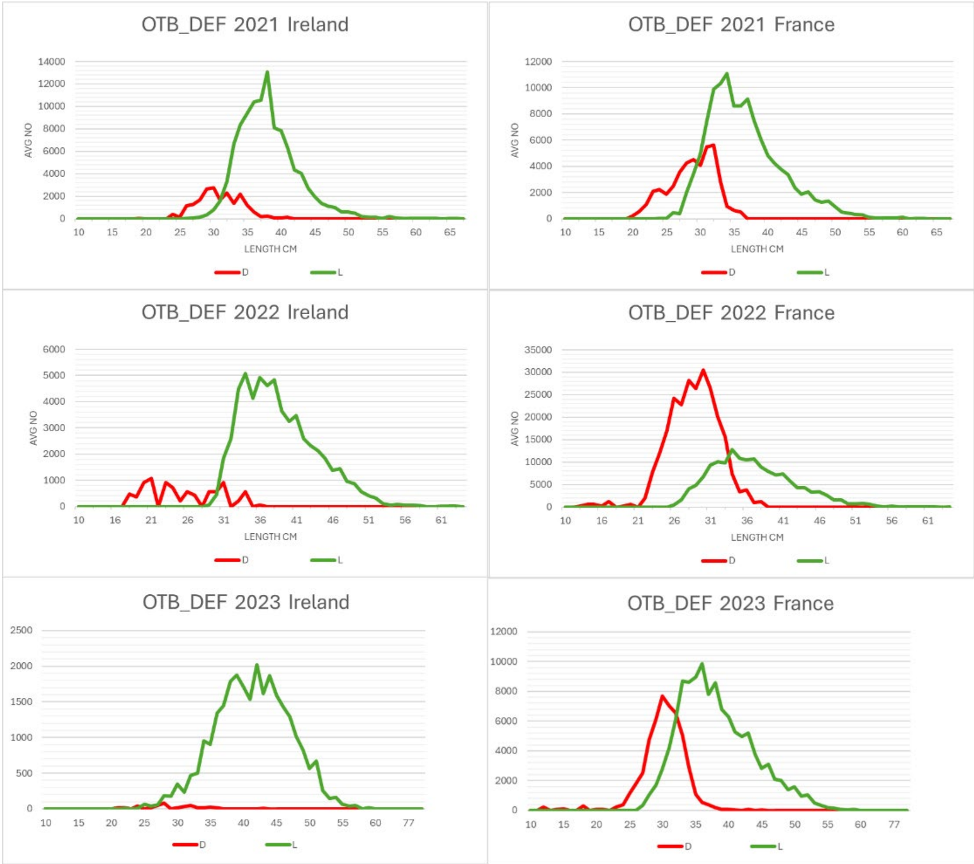


Figure 4. Whiting in 7.b-ce–k (Celtic Sea), average number at length from reported sampling for the main metier (Ireland & France OTB) across regions and quarters.

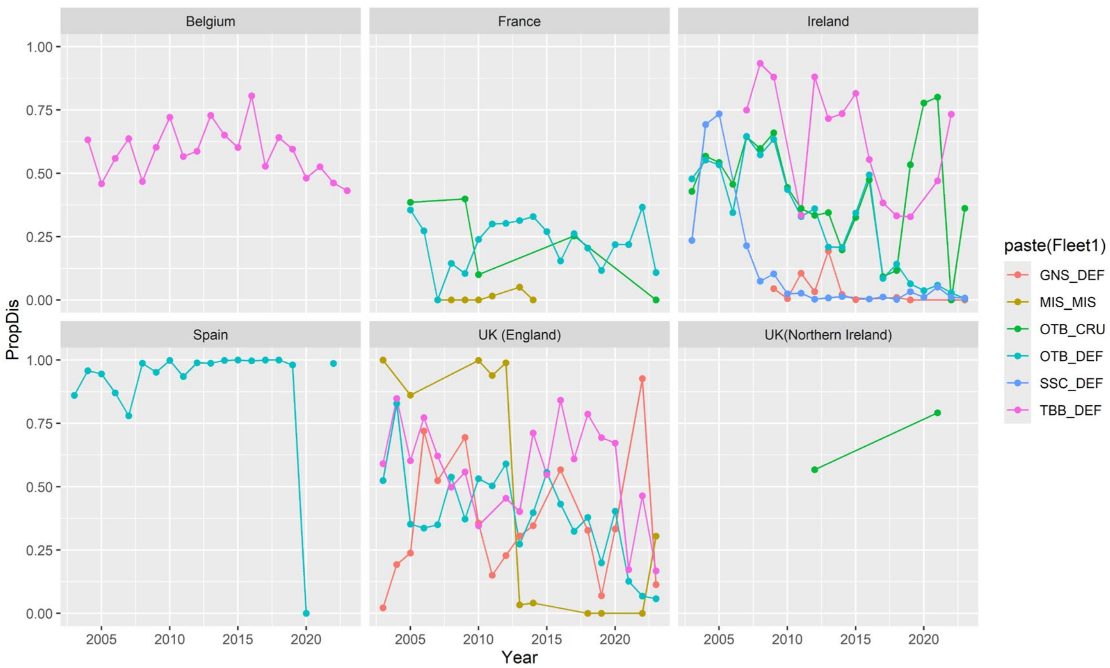


Figure 5. Annual proportions of Discarding (by weight) for the Celtic Sea whiting revised time-series (2003–2023).

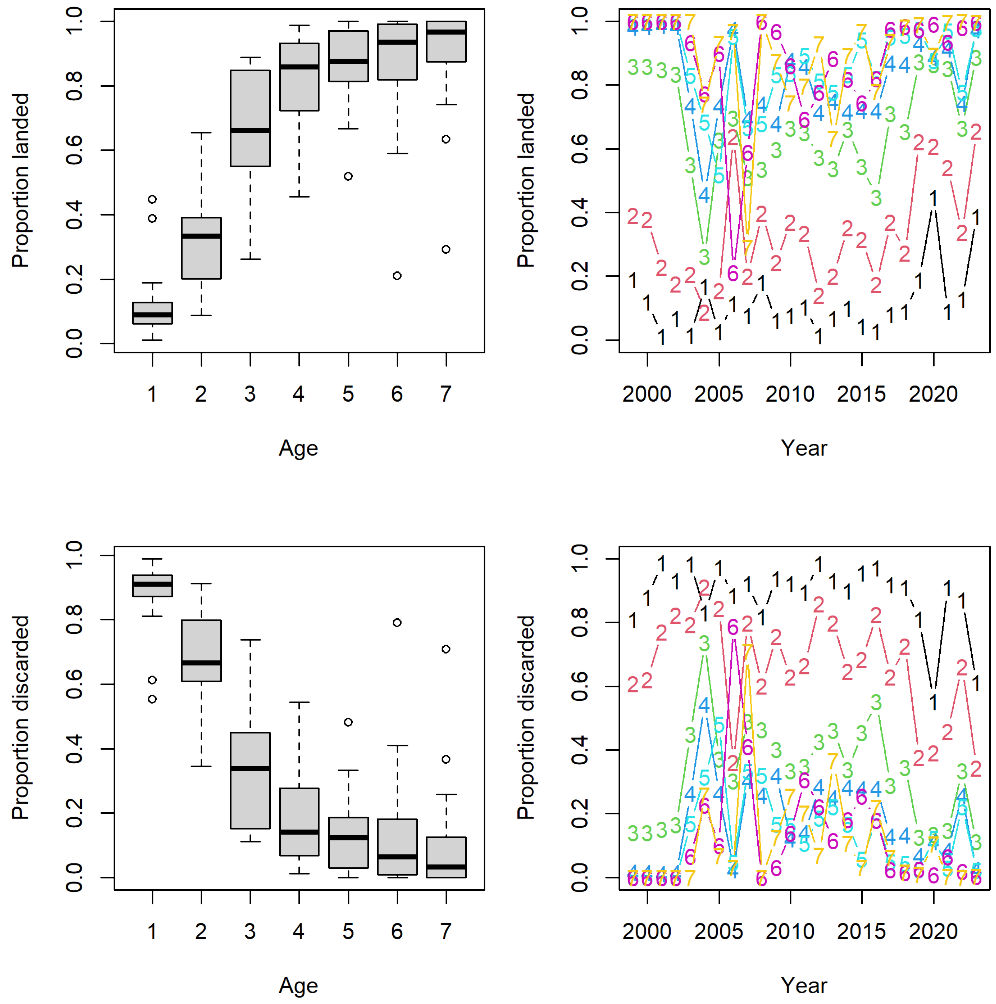


Figure 6. Proportion of landings (upper panel) and discards (lower panel) for Celtic Sea whiting (2003–2023).

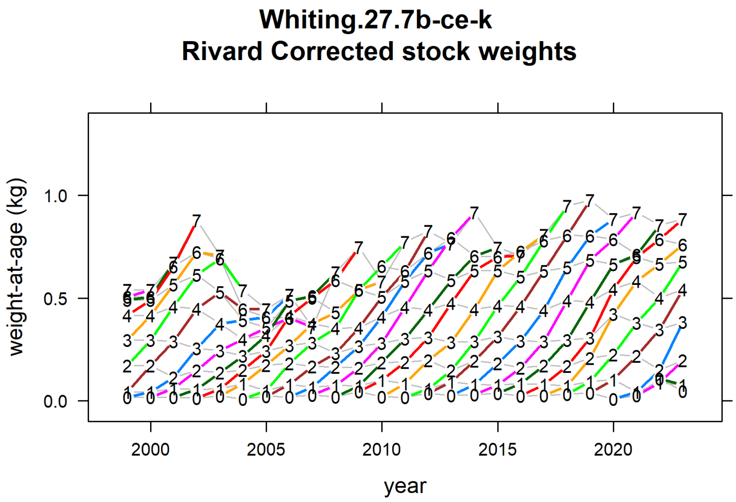


Figure 7. Whiting in 7.b, c, e–k (Celtic Sea). Rivard corrected stock weights-at-age.

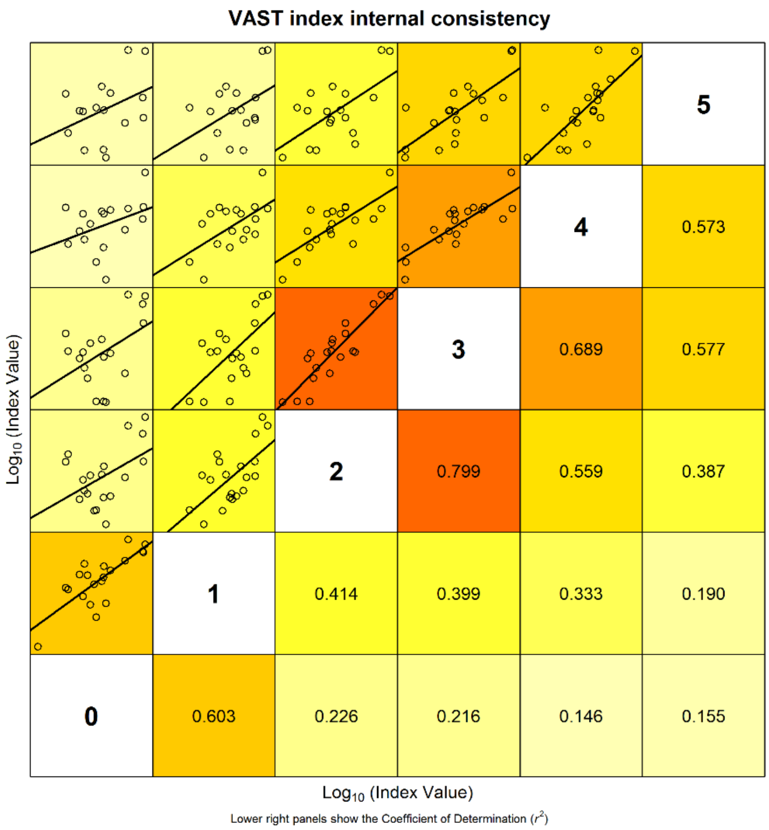
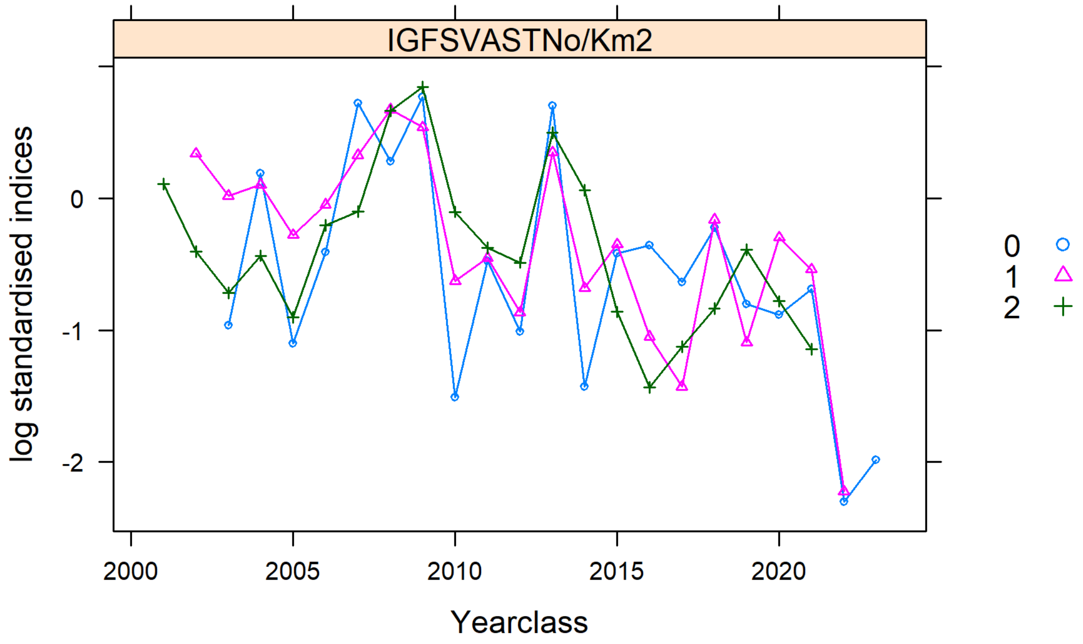


Figure 8. Whiting in 7.b, c, e–k (Celtic Sea). Pairwise scatterplots for the log numbers-at-age for the VAST combined survey index.



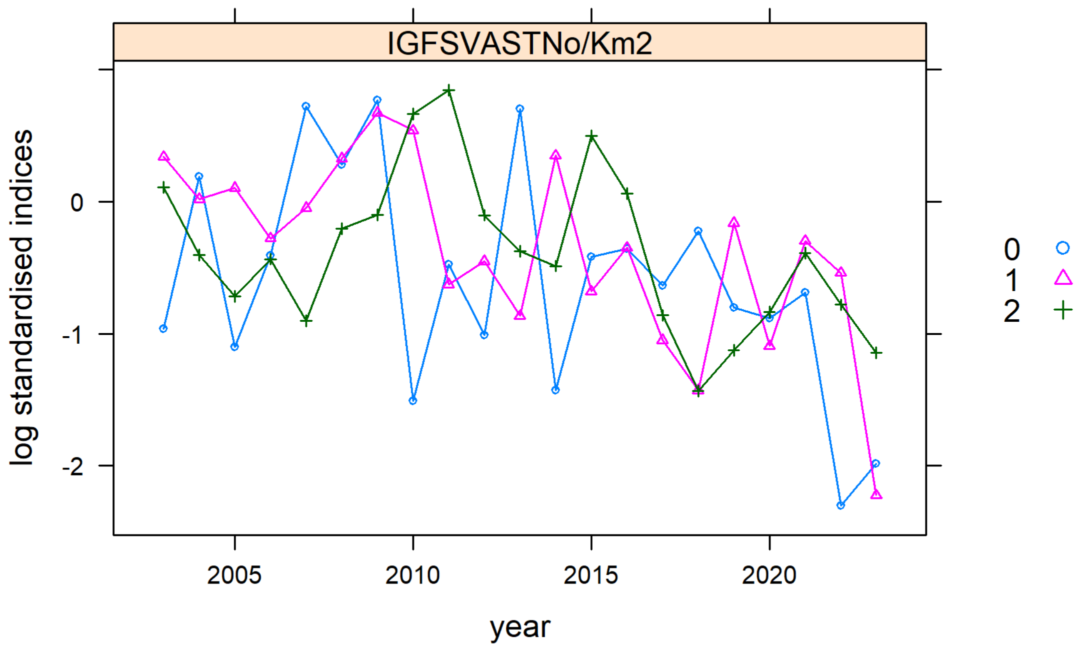


Figure 8. Whiting in 7.e–k (Celtic Sea). Mean log standardized plots of combined IE-IGFS & FR-EVHOE indices by year class (top panel) and by year (lower panel). Only age 0–2 is included in the assessment.

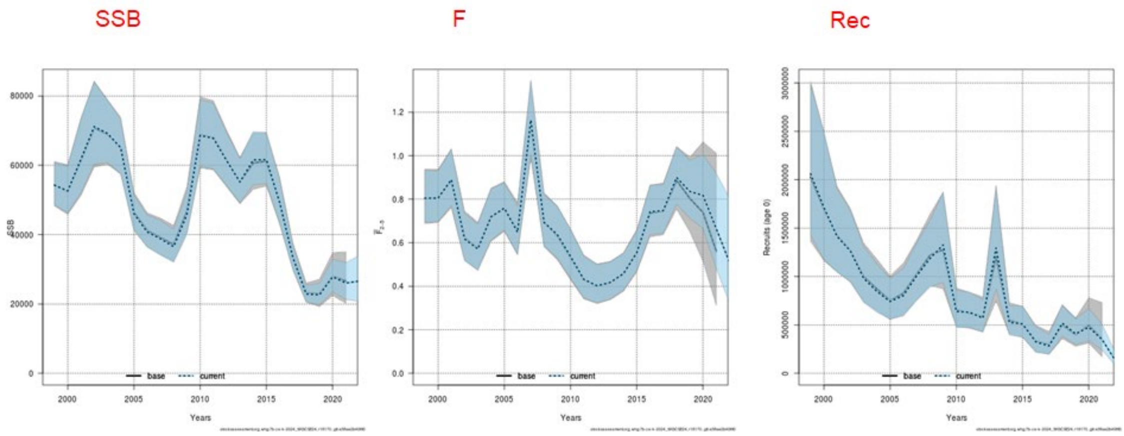


Figure 9. Whiting in 7.b, c, e–k (Celtic Sea). SAM assessment summary plots of SSB, F_{bar} 2–5 and recruitment -at-age 0. Grey line and shaded area indicate the previous year's assessment. An overall downward trend in biomass and recruitment since the last small pulse in 2013 is evident and followed by a significant drop in fishing effort as that biomass was removed.

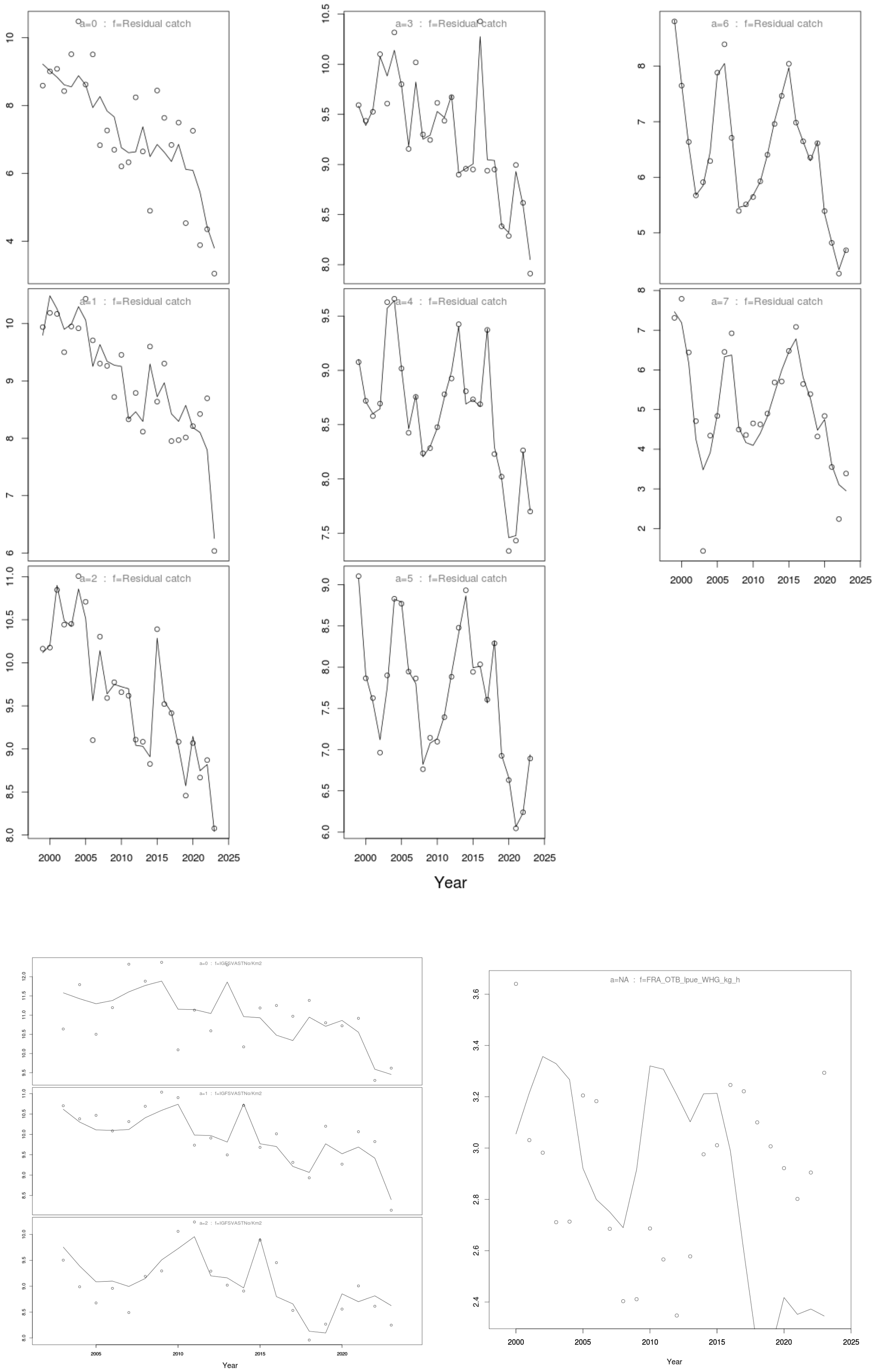


Figure 10. Fit to the catch-at-age data (top) and VAST index (bottom left) for final SAM assessment run. Model fits for commercial biomass index are given in lower right panel. Point observations are presented along with model prediction lines.

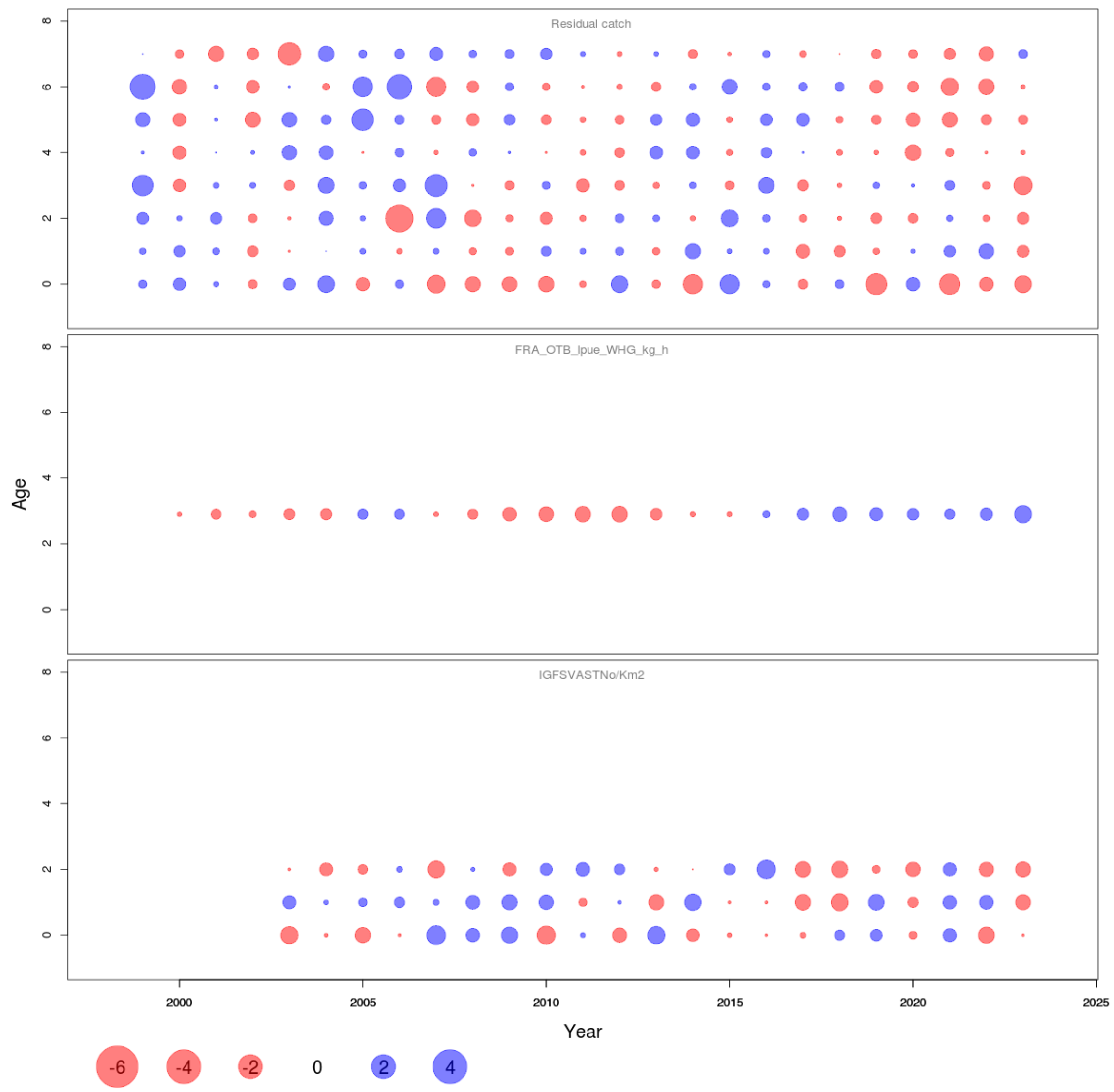
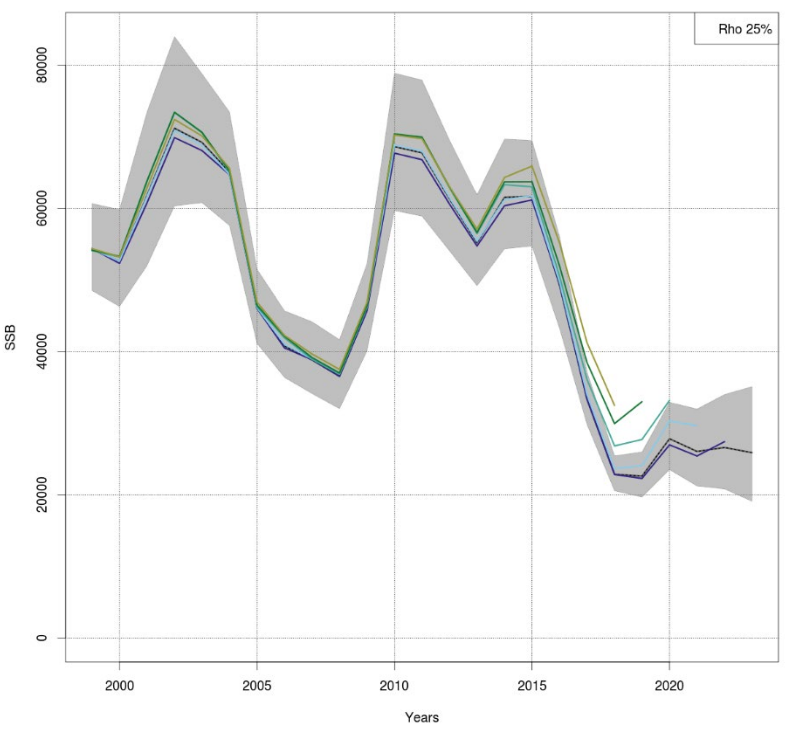
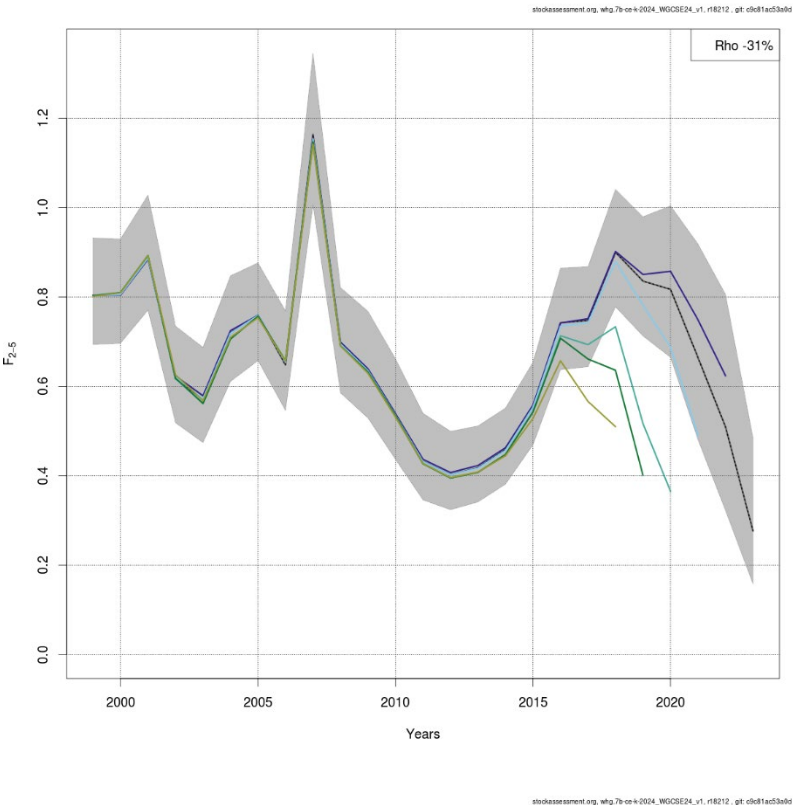


Figure 11. Residual patterns for the catch-at-age data (top), commercial biomass index (middle) and VAST IBTS index (bottom) for final SAM assessment run.



Rho 25%
SSB
80000
60000
40000
20000
0
2000
2005
2010
2015
2020
Years
stockassessment.org, whg.7b-ce-k-2024_WGCSE24_v1, r18212 , git: c9c81ac53a9d



Rho -31%
F_{2-5}
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2000
2005
2010
2015
2020
Years
stockassessment.org, whg.7b-ce-k-2024_WGCSE24_v1, r18212 , git: c9c81ac53a9d

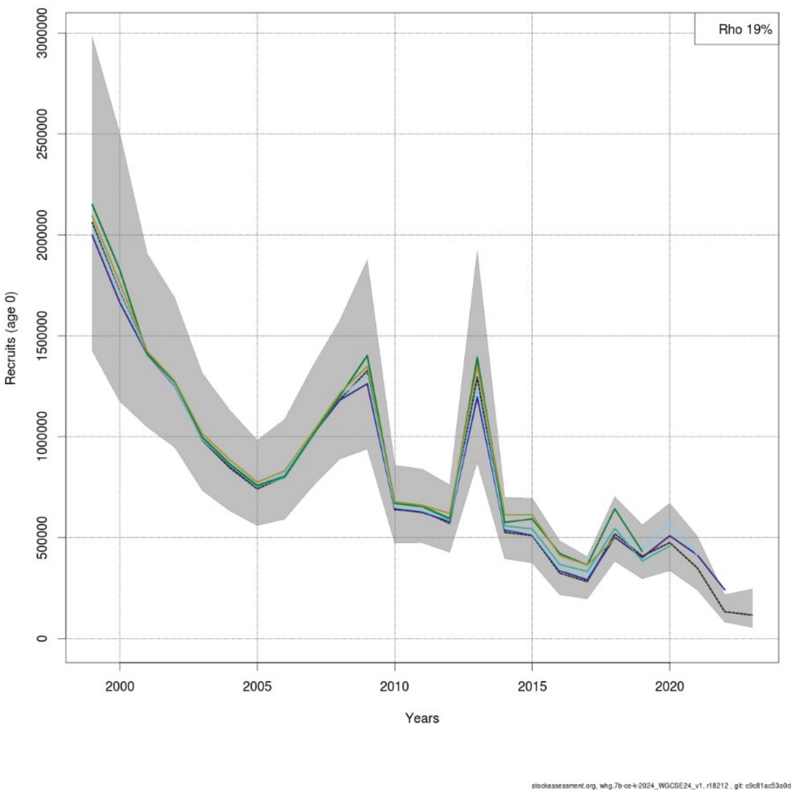


Figure 12. Retrospective patters and Mohn's Rho calculations for SSB (top left), F_{bar} (top right) and recruitment (bottom left).

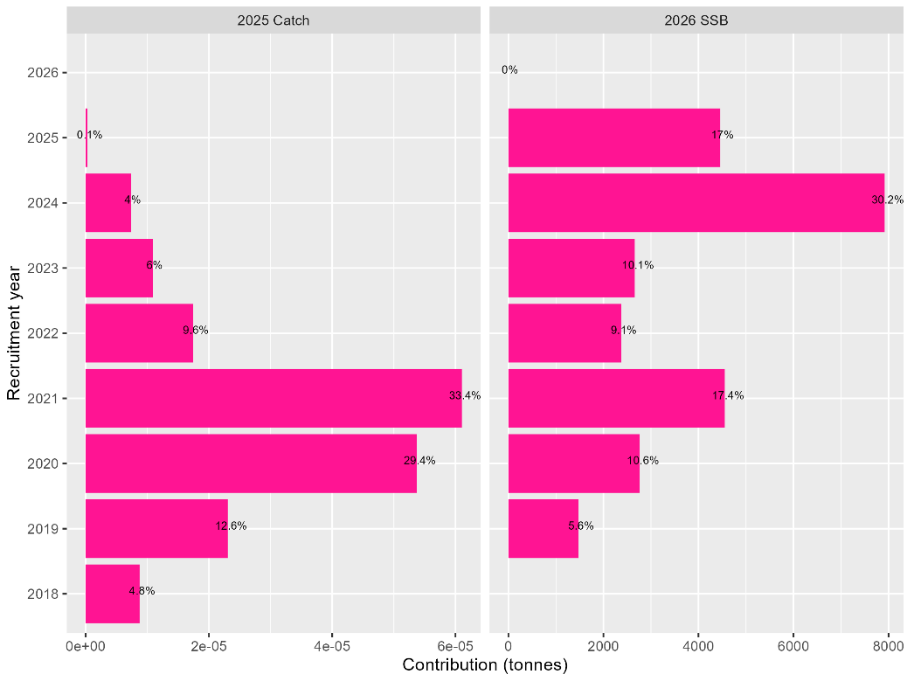


Figure 13. Contribution to advised catch and Spawning–Stock Biomass (SSB) of the recruitment assumption used in the short-term forecast.

Contents

Annex 1: List of participants

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Annex 2: Stock Annexes

The table below provides an overview of the WGCSE Stock Annexes. Stock Annexes for other stocks are available in the ICES Library under the Content Type "Stock Annexes". Use the search facility to find a particular Stock Annex by species or ICES Expert Group, refining your search in the left-hand column to include the *year* and *ecoregion* (in Categories). Stocks marked with * have been benchmarked or drafted in 2024 and will be published in 2025.

Stock ID	Stock name	Last up-dated	Link
anf.27.3a46	Anglerfish (*Lophius budegassa*, *Lophius piscatorius*) in subareas 4 and 6, and in Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)	June 2024*	https://doi.org/10.17895/ices.pub.18622049
bss.27.4bc7d–h	Seabass (*Dicentrarchus labrax*) in divisions 4.b–c, 7.a, and 7.d–h (central and southern North Sea, Irish Sea, English Channel, Bristol Channel, and Celtic Sea)	May 2020	https://doi.org/10.17895/ices.pub.18623210
cod.27.7e–k	Cod (*Gadus morhua*) in divisions 7.e–k (eastern English Channel and southern Celtic Seas)	October 2020	https://doi.org/10.17895/ices.pub.18622229
cod.27.7a	Cod (*Gadus morhua*) in Division 7.a (Irish Sea)	October 2023	https://doi.org/10.17895/ices.pub.24495970
cod.27.6b	Cod (*Gadus morhua*) in Division 6.b (Rockall)	May 2023	https://doi.org/10.17895/ices.pub.23501778
gug-celt	Grey gurnard in Subarea 6 and Divisions 7.a–c and e–k	March 2014	https://doi.org/10.17895/ices.pub.18622463
had.27.7b–k	Haddock (*Melanogrammus aeglefinus*) in divisions 7.b–k (southern Celtic Seas and English Channel)	October 2020	https://doi.org/10.17895/ices.pub.18622523
had.27.7a	Haddock (*Melanogrammus aeglefinus*) in Division 7.a (Irish Sea)	June 2021	https://doi.org/10.17895/ices.pub.18622511
had.27.6b	Haddock (*Melanogrammus aeglefinus*) in Division 6.b (Rockall)	June 2024*	https://doi.org/10.17895/ices.pub.18622496
lez.27.4a6a	Megrim (*Lepidorhombus* ssp.) in divisions 4.a and 6.a (northern North Sea, West of Scotland)	June 2021	https://doi.org/10.17895/ices.pub.18622778
nep.fu.11	Norway lobster (*Nephrops norvegicus*) in Division 6.a, Functional Unit 11 (West of Scotland, North Minch)	May 2016	https://doi.org/10.17895/ices.pub.18622844
nep.fu.12	Norway lobster (*Nephrops norvegicus*) in Division 6.a, Functional Unit 12 (West of Scotland, South Minch)	May 2023	https://doi.org/10.17895/ices.pub.24448741
nep.fu.13	Norway lobster (*Nephrops norvegicus*) in Division 6.a, Functional Unit 13 (West of Scotland, the Firth of Clyde and Sound of Jura)	May 2017	https://doi.org/10.17895/ices.pub.18622859

Stock ID	Stock name	Last up-dated	Link
nep.fu.14	Norway lobster (*Nephrops norvegicus*) in Division 7.a, Functional Unit 14 (Irish Sea, East)	May 2023	https://doi.org/10.17895/ices.pub.24448771
nep.fu.15	Norway lobster (*Nephrops norvegicus*) in Division 7.a, Functional Unit 15 (Irish Sea, West)	May 2018	https://doi.org/10.17895/ices.pub.18622871
nep.fu.16	Norway lobster (*Nephrops norvegicus*) in divisions 7.b–c and 7.j–k, Functional Unit 16 (west and southwest of Ireland, Porcupine Bank)	March 2013	https://doi.org/10.17895/ices.pub.18622910
nep.fu.17	Norway lobster (*Nephrops norvegicus*) in Division 7.b, Functional Unit 17 (west of Ireland, Aran grounds)	May 2016	https://doi.org/10.17895/ices.pub.18622874
nep.fu.19	Norway lobster (*Nephrops norvegicus*) in divisions 7.a, 7.g, and 7.j, Functional Unit 19 (Irish Sea, Celtic Sea, eastern part of southwest of Ireland)	October 2019	https://doi.org/10.17895/ices.pub.18622907
nep.fu.2021	Norway lobster (*Nephrops norvegicus*) in divisions 7.g and 7.h, functional units 20 and 21 (Celtic Sea)	October 2024*	https://doi.org/10.17895/ices.pub.18622925
nep.fu.22	Norway lobster (*Nephrops norvegicus*) in divisions 7.g and 7.f, Functional Unit 22 (Celtic Sea, Bristol Channel)	May 2018	https://doi.org/10.17895/ices.pub.18622919
ple.27.7bc	Plaice (*Pleuronectes platessa*) in divisions 7.b–c (West of Ireland)	April 2013	https://doi.org/10.17895/ices.pub.18622979
ple.27.7h–k	Plaice (*Pleuronectes platessa*) in divisions 7h–k (Celtic Sea South, southwest of Ireland)	May 2024*	https://doi.org/10.17895/ices.pub.18622994
ple.27.7fg	Plaice (*Pleuronectes platessa*) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea)	May 2022	https://doi.org/10.17895/ices.pub.20170799
ple.27.7e	Plaice (*Pleuronectes platessa*) in Division 7.e (western English Channel)	May 2022	https://doi.org/10.17895/ices.pub.20170745
ple.27.7a	Plaice (*Pleuronectes platessa*) in Division 7.a (Irish Sea)	June 2021	https://doi.org/10.17895/ices.pub.18622958
sol.27.7bc	Sole (*Solea solea*) in divisions 7.b and 7.c (West of Ireland)	April 2013	https://doi.org/10.17895/ices.pub.18623267
sol.27.7h–k	Sole (*Solea solea*) in divisions 7.h–k (Celtic Sea South, Southwest of Ireland)	May 2020	https://doi.org/10.17895/ices.pub.18623288
sol.27.7fg	Sole (*Solea solea*) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea)	May 2024*	https://doi.org/10.17895/ices.pub.23501748
sol.27.7e	Sole (*Solea solea*) in Division 7.e (western English Channel)	June 2021	https://doi.org/10.17895/ices.pub.18623264
sol.27.7a	Sole (*Solea solea*) in Division 7.a (Irish Sea)	May 2024*	https://doi.org/10.17895/ices.pub.23501700

Stock ID	Stock name	Last up-dated	Link
whg.27.7b–ce–k	Whiting (*Merlangius merlangus*) in divisions 7.b–c and 7.e–k (southern Celtic Seas and eastern English Channel)	May 2023	https://doi.org/10.17895/ices.pub.23501757
whg.27.7a	Whiting (*Merlangius merlangus*) in Division 7.a (Irish Sea)	May 2017	https://doi.org/10.17895/ices.pub.18623552
whg.27.6b	Whiting (*Merlangius merlangus*) in Division 6.b (Rockall)	May 2013	https://doi.org/10.17895/ices.pub.18623543
whg.27.6a	Whiting (*Merlangius merlangus*) in Division 6.a (West of Scotland)	June 2022	https://doi.org/10.17895/ices.pub.20177060

Contents

Annex 3: Update to the 2023 assessment for Sole (*Solea solea*) in Division 7.a (Irish Sea)

31 Sole (*Solea solea*) in Division 7.a (Irish Sea)

Type of assessment

This assessment of sole in division 7.a is based on the outcome of the benchmark (WKBFLATFISH, ICES 2024) in February 2024 and has 2022 as the final data year. It replaces the 2023 assessment and is the basis to update the catch advice for 2024 as requested by the European Commission and UK.

ICES advice applicable to 2023

ICES advises that when the MSY approach is applied, catches in 2023 should be no more than 605 tonnes.

ICES advice applicable to 2024

ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2024.

EU standing request on catch scenarios for zero-TAC stocks 2023 provides three catch scenarios with a spawning-stock biomass (SSB) target and two illustrative mixed fisheries catch scenarios are discussed. The SSB target scenarios are:

• *a catch option of 203 tonnes is estimated if the SSB is assumed to be equal to Blim in 2025;*

• *a catch option of 385 tonnes is estimated if the SSB is assumed to remain stable between 2024 and 2025, resulting in an SSB in 2025 (2340 tonnes) below B lim (2500 tonnes);*

• *a catch option of 118 tonnes is estimated if the SSB is assumed to increase by 10% between 2024 and 2025, resulting in an SSB in 2025 (2597 tonnes) just above B lim*

31.1 General

Stock description and management units

Stock identity of sole stocks was investigated in the first and second quarter of 2022 using genetic markers (SNPs) (Maes et al. in prep). Sole was collected onboard commercial fishing vessels from 3 different rectangles in Division 27.7a (33E4 Cardigan Bay, 36E4 south of the Isle of Man and 36E6 Liverpool Bay). Results showed low, but significant genetic differentiation with sole from neighbouring areas 7f and 7g (based on both outlier and neutral SNP markers). Within 7a, there was no genetic differentiation between the Liverpool Bay and Isle of Man samples (36E6 and 36E4, respectively). Both areas did show low neutral genetic differentiation with sole collected in Cardigan Bay (33E4), although not significant. On an adaptive level, however, sole from the Liverpool Bay and Isle of Man were significantly differentiated from the samples in Cardigan Bay.

The sole fisheries in the Irish Sea are managed by TAC (see tables below) and technical measures, with the assessment area corresponding to the stock area. Technical measures in force are minimum mesh sizes and minimum conservation reference (MCRS, 24 cm (EU legislation); 25 cm for Belgian vessels from March 11th 2017 onwards; except vessels <221 kW and/or < 80 GT). In addition, beam trawlers, fishing with mesh sizes equal to or greater than 80 mm, are obliged to have 180 mm mesh sizes in the entire upper half of the anterior part of their net. More details can be found in Council Regulation (EC) N°254/2002 and the Stock Annex.

Since 2000, a spawning closure for cod has been in force. The first year of the regulation the closure covered the western and eastern Irish Sea. Since then, closure has been mainly in the western part whereas the sole fishery takes place mainly in the eastern part of the Irish Sea (Liverpool Bay and Cardigan Bay). No direct impact on the sole stock is expected from this closure.

Since the 1st of April 2015 all Belgian beam trawl vessels with mesh size of 80–119 mm fishing in ICES Division 7.a are obliged by national decree to use the 'Flemish Panel' to increase selectivity. This means the last tapered netting section of a beam trawl anterior is directly attached to the codend, the upper and lower netting sections are constructed of at least 120 mm mesh (as measured between the knots) and the stretched length is at least 3 m.

Sole in the Irish Sea is fully under the landing obligation since 2020 ((EU) 2019/2239). There is a de minimis exemption in place which allow for discarding of undersized sole in Division 7.a, for vessels using TBB gear with a mesh size of 80–119 mm equipped with the Flemish panel (max. 3% of annual catches).

Management applicable to 2022 and 2023

The TAC and the national quotas by country for 2022:

Species:	Common sole *Solea solea*	Zone:	7a (SOL/07A.)
Belgium	364	Analytical TAC	
France	5	Article 3 of Regulation (EC) No 847/96 shall not apply	
Ireland	105	Article 4 of Regulation (EC) No 847/96 shall not apply	
Netherlands	116		
Union	590		
United Kingdom	181		
TAC	787		

The TAC and the national quotas by country for 2023:

Species:	Common sole *Solea solea*	Zone:	7a (SOL/07A.)
Belgium	270	Analytical TAC	
France	3	Article 3 of Regulation (EC) No 847/96 shall not apply	
Ireland	94	Article 4 of Regulation (EC) No 847/96 shall not apply	
Netherlands	86		
Union	453		
United Kingdom	140		
TAC	605		

Fisheries

An overview of the landings data and discard data provided and used by the Working Group (WG) is shown in Table 31.1 and Figure 31.1. The landings reached a level of 2808 t in the mid-1980s due to good recruitments in 1982–1984, but then subsequently dropped to a lowest of 818 t in 2000. After a small increase to 1090 t in the beginning of the 2000s, the landings have fallen to under 350 t in 2008–2013. From 2014 to 2018 the landings continued to decrease as they dropped to under 100 t. In 2017, the record low value of 34 t was recorded. From 2016 to 2018, there has been no targeted fisheries for sole in ICES Division 7.a. Afterwards the landings increased again to around 400 t in 2019 and 2020, and to around 500 t in 2021 and 2022. As a result of the WKBFLATFISH benchmark (ICES, 2024), the Belgian beam trawl landing numbers were corrected for misreporting in the time periods 2006-2013 and 2019-2022 (Table 31.1). Small differences between estimated and reported landings (0.7-18.3 %) were noted for 2006-2013 and 2019-2020, whereas in the most recent years (2021-2022) substantial over-reporting (reported landings around 52 % higher than estimated) was found. The period 2014-2018 was excluded from the misreporting analysis as there is not enough information to make a quantitative estimation of the landings.

In 2022, the WG estimated landings are 507 t, of which Belgium landed 71% (362 t), Ireland 14% (69 t), 11% (58 t) by the UK (England and Wales) and the remainder by Northern Ireland, Scotland, Isle of Man and France. Discards were estimated to be at 99 t. This catch figure (606 t) corresponds to an international uptake of 77% of the agreed TAC in 2022 (787 t).

In 2022, 86% of the landings were taken by beam trawls, 12.5% by otter trawls and 1.5% by other gears.

31.2 Data

As a result of the data call for the 2024 WKBFLATFISH benchmark (ICES, 2024), landings and discard time-series (2002-2022) were uploaded to InterCatch. The countries contributing most to the landings of sole in division 27.7.a are Belgium (44%-82%, average 68%), Ireland (10%-44%, average 20%), and UK (England) (2%-20%, average 9%). The remaining countries (UK (Scotland), UK (Northern Ireland), UK (Isle of Man), France and the Netherlands are responsible for less than 5% of the landings. For 2002, no Irish data were provided. Belgium and Ireland could not provide quarterly data and uploaded data on a yearly basis.

ICES catch estimates (InterCatch)

The estimation of the catch data was revised during the WKBFLATFISH benchmark (ICES, 2024). Data were processed in InterCatch from 2003 onwards with the exception of the years 2016-2018 because of the low sampling intensity related to the low bycatch TAC. Those years were prepared using the methodology from the previous benchmark (ICES, 2011).

Discards are included in the assessment from 2024 onwards. If discards are unavailable for a particular year-quarter-country-métier combination, they are assumed to be unknown (non-zero) and therefore raised (InterCatch). The weighting factor for raising the discards was '*Landings CATON*' (landings catch).

Discard raising was performed on a **gear level** regardless of season or country, except for the years 2016-2018, where all available strata were considered. The following groups were distinguished based on gear:

- TBB
- OTB including OTB, OTT, SSC, SDN
- GTR including GTR and GNS

The remaining gears were combined in a REST group (including MIS, FPO, DRB, LHM, LLS).

Raising within a gear group was performed when the proportion of landings for which discard weights are available was **equal or larger than 50%** compared to the total landings of that group.

When the threshold was not reached for a gear group, it was pooled with the REST group to raise discards based on all available information, except for discard rates higher than 50% as sometimes found in the OTB group.

The percentage of discards that were raised is rather low (31%, average 2003-2022).

To **allocate age** compositions, landings and discards were handled separately; samples from landings were used only for landings and *vice versa*. When age distributions (both landings and discards) had to be borrowed from other strata, allocations were performed on a **gear level**. The same gear groups (TBB, OTB, GTR and REST) as used for discard raising were applied. When the **threshold of 50%** was reached for the proportion of landings or discards covered by age, allocation of age occurred with all available information within that gear group. When the threshold was not reached, unsampled data were pooled in the REST group and ages were allocated using all sampled data. The weighting factor was '*Mean Weight weighted by numbers at age*'.

The age coverage of the imported landings and discards is rather high (86% for the landings and 91% for the discards, average 2003-2022 (excluding 2016-2018)).

From 2016 to 2018, there has been no targeted fisheries for sole in ICES division 7.a, and a bycatch TAC of 40 t was in force. Because of the low sampling intensity, those years were excluded from the InterCatch age allocation procedure and the discard numbers-at-age and mean weights-at-age for the those years were estimated using the average (2013-2015, 2019-2021) ratio of discards to landings by age. The average (2013-2015, 2019-2021) number and mean weight at age 1 was considered for the age 1 information in the years 2016-2018, for both landings and discards.

Catch numbers-at-age are given in Table 31.2 and in Figures 31.2ab; Weights-at-age in the catch are given in Table 31.3 and Figure 31.3. The standardised catch proportion-at-age is presented in Figure 31.4.

Annual length compositions for 2022 are given by fleet in Table 31.4 and of retained and discarded catches of sole by the Belgium beam trawl fleet in Figure 31.5.

Reconstruction of discards

Raised discard data from InterCatch were available from 2003 onwards. To estimate discards mean weights- and numbers-at-age prior to 2003, a constant ratio of discards to landings by age was applied using data from 2003-2007 (Figure 31.6).

Discard rate

The discard rate, calculated as the ratio between ICES discard estimates (tonnes) and ICES catch estimates (tonnes), fluctuates around 6% over the years 2003–2017. However, in the last five years this rate increased up to approximately 15% (average 2018-2022).

Biological

Stock weights-at-age (Table 31.5, Figure 31.7) were revised during the WKBFLATFISH benchmark (ICES, 2024). The stock weight for age 1 obtained from the UK(E&W) September beam-trawl survey (UK(E&W)-BTS-Q3) biological data was combined with the catch weights for the remaining ages. Prior to 1988, no age 1 information is available from the UK(E&W)-BTS-Q3.

Therefore, the mean (1988-2022) age 1 UK(E&W)-BTS-Q3 weight was obtained for the age 1 information in the years 1970-1987. The combined set of weights at age was then back calculated to the first of January using the Rivard method. (http://nft.nefsc.noaa.gov./).

A time varying maturity ogive (Figure 31.8) was estimated during the WKBFLATFISH benchmark (ICES, 2024) using the UK-BTS-Q3 female biological data. Prior to 1988 the average maturity-at-age proportions (1988-1992) were set. More information on how this was achieved is provided in the WKBFLATFISH report and the associated working document

During the WKBFLATFISH benchmark (ICES, 2024), natural mortality estimates were derived from UK-BTS-Q3 non-linear catch curves in 2016-2018. In this period from 2016 until 2018, the targeted fishery for sole in the Irish Sea was closed and only a small by-catch quotum was in force. During those years It can be assumed that the value of F (fishing mortality) was close to zero, and that M approximates Z (total mortality). The natural mortality estimates derived from the catch curve analysis were scaled to 0.31 of the mean (see table below) as this resulted in the lowest AIC value in the SAM model.

Age	1	2	3	4	5	6	7	8	9	10(+)
M	0.5971610	0.3767715	0.3105819	0.2814876	0.2669404	0.2589395	0.2545753	0.2523932	0.2509385	0.2502112

Tuning series

The Irish Sea sole stock assessment used one scientific survey index: UK(E&W)-BTS-Q3 (1988–2022). The survey was unable to cover the 7.a Division in 2020 due to the Covid-19 disruption. Therefore, the 2020 information is missing. The UK(E&W)-BTS-Q3 indices were revised during WKBFLATFISH benchmark (ICES, 2024), using the biological data of all available survey stations and comprises the fitting of a continuation logit ratio model to predict the age-length relationship and the fitting of a generalized additive model (GAM) to standardize the catch per unit effort data for each age group. The series was extended with information of age 1 but not with the older ages, as they have a higher standard deviation and represent only a small proportion of the total numbers. The UK(E&W)-BTS-Q3 appears to track the stronger year classes reasonably well. The internal consistency plot indicates also a reasonable fit for most of the ages (Figures 31.9-10).

During the WKBFLATFISH benchmark (ICES, 2024) a Belgian commercial biomass index (Figure 31.11a) was introduced in the assessment. It was obtained using the landings-per-unit-effort by day, ICES statistical rectangle, trip and vessel from the Belgian beam trawl fleet fishing exclusively in the Irish Sea as input for the GAM model. The modelled biomass tuning series has data from 2004 up to and including 2022, but misses information in 2017 and 2018. No information on the ICES statistical rectangle was available before 2006 and the targeted sole fishery in the Irish Sea was not allowed from 2016 to 2018. Consequently, in 2017 and 2018, no observations from the exclusive 7.a division trips were available to provide an index. A weighting factor based on 1/CV was added for this fleet in the assessment model (Figure 31.11b).

All available tuning data are given in Table 31.6, with the data used in the assessment highlighted in bold.

Surveys

The LPUE from the UK(E&W)-BTS-Q3 (Table 31.7b and Figure 31.12) has fluctuated since the beginning of the time-series (1988) between 90 and 200 kg/100 Km fished. Since 2000, it has dropped gradually to the lowest value in 2012 (26.47 kg/100 Km fished). Thereafter, it gradually increased to 118.66 kg/100 Km fished in 2019. For 2020 no information is available due to Covid-19 and 63.6 kg/100 Km fished was noted 2021 and 71.4 kg/100 Km fished for 2022.

Commercial LPUE

Trends in LPUE and effort are given in Table 31.7 and Figures 31.13 and 31.14.

Commercial LPUE and effort data were available for Belgian beam trawlers, UK (E&W) beam and otter trawlers and Irish otter and beam trawlers. It should be noted that the most recent LPUE values of the UK (E&W) beam trawlers (2013–2022) and the UK (E&W) otter trawlers (2014–2022) are based on days fished instead of hours fished. In 2013, the UK administration switched to the EU electronic logbook system. Therefore, a lot of the reported effort is missing and the 2013 value cannot be used as an absolute number. Details of the 2013 UK beam trawl were unavailable due to reduced numbers of trips reporting this gear specific effort information via the newly introduced e-logbook system. The otter trawl fleet effort reporting was unaffected by this as these vessels were not reporting their landings via this method in 2013. However, from 2014 onwards, both the UK beam trawl and otter trawl effort values (hours fished) are unavailable because of the reporting issues. Because of the misreporting practises noted for this stock, an LPUE estimation of the Belgian beam trawlers was added based on trips that fished exclusively in ICES division 7.a ('pure trips') and not in multiple ICES divisions, among which the sole 7a stock area. A quantitative estimation of those LPUE values was only possible for the years 2006-2013 and 2019-2022.

Effort from both Belgian and UK commercial beam trawl fleets increased from the early seventies until the beginning of the nineties. Since then UK beam trawl effort has shown a continuing declining trend. Inspection of an alternate effort indicator (days fished) suggests that the declining trend continues in the period 2013–2018, followed by a slight increase in 2019. In 2020 and 2021, effort continues to increase to a similar level as observed in 2007. In 2022, the effort dropped again to half the value of 2021. In contrast, the Belgian beam trawl effort has shown a more fluctuating pattern. After the decline in the early nineties, it reached its highest level in 2002 and decreased again afterwards. For the period 2008–2012, it remained stable at a very low level but in 2013 it continued to decrease and in 2016, it dropped to the lowest level in the time-series. In 2017–2018, there's a slight increase. In the period 2019–2022, effort further increased to the level recorded in 2008-2012. The substantial decrease of the Belgian and UK commercial beam trawl effort in the period 2013–2018, is in line with the substantial reductions of the TAC. From 2019 onwards, a sole-directed fisheries is again allowed and a higher TAC is set. This is clearly reflected in the higher activity of the Belgian beam trawlers from 2019 onwards.

The effort of the Irish beam trawlers shows a slow decline since 2004 and reached the lowest level in the time-series in 2013. Since 2014, the Irish beam trawl effort has increased, followed by a decrease since 2020. In 2008, all beam trawl fleets showed a substantial reduction in effort compared to 2007.

The effort from the UK otter trawlers remained stable until the beginning of the nineties. Since then the UK otter trawl effort has continuously declined and is at the lowest level in 2013. As, in 2015 and 2016 all otter trawl vessels active in the Irish Sea were under 12 m, no effort (days fished) was recorded. Since 2017, the otter trawl effort (days fished) fluctuates at a low level. The Irish otter trawlers have shown a striking reduction in effort since 2000, followed by a slight increase in the period 2010–2012. In 2017, the Irish otter trawl effort fell back to the lowest observed level in the time-series. It remains at this lower level, except for the slightly higher value observed in 2019.

LPUE for both UK and Belgian beam trawlers was at a high level in the late seventies and early eighties but since early 2000s, LPUE for these fleets has fluctuated at a lower level. In the period 2007–2009 there has been a small increase in the UK beam trawl LPUE. However, in 2012 the LPUE has dropped to a remarkable low level in the time-series (4.3 kg/hour fished). An update for 2013–2017 was not available. However, the alternate LPUE indicator (kg/days fished) suggests that the UK beam trawl LPUE increased in 2015. For 2016–2018 no catches of sole and/or no effort were recorded therefore the LPUE is zero. After a slight increase in 2019, the LPUE further increased in 2020–2022 to a similar level as observed in 2009. The Belgian beam trawler LPUE estimation based on trips that fished exclusively in ICES division 7.a, showed an increase to 18.23 kg/hr in 2011 but then fell again. In the period 2014-2018, there is no 'pure trips' LPUE calculation available but the LPUE estimation based on all the trips, indicates that the lowest levels in the time-series are reached. In 2019, there's a substantial increase to 31.33 kg/hour fished and this is maintained over the following years (average 2019-2022 = 31 kg/hr). The Irish beam trawl LPUE shows a gradually diminishing trend over the whole time-series. After the slight increase in 2013, it fell back to a record low level in 2016-2018. Since 2019 there's an increasing trend.

The UK otter trawl LPUE remained stable until the beginning of the 2000s but is at the record low level in 2012. The alternative LPUE indicator (kg/days fished) suggests that the declining trend continues after 2012. After the record low level in 2017 (5.6 kg/days fished), the LPUE gradually increases to 192.7 kg/days fished) in 2021. In 2022, the LPUE dropped again to half the value of 2021. In 2012–2016, the LPUE of Irish otter trawlers is fluctuating at a lower level. In 2017–2022 a higher value was recorded.

In 2020 during which the COVID-19 disruptions took place, a shift between the UK beam and otter trawl fleet was noted, as the activity of the beam trawlers substantially increased whereas that of the otter trawlers was substantially reduced. Further, no substantial changes in effort or LPUE compared to 2019 were recorded.

31.3 Stock assessment

Historical Stock Development

In 2010, the Irish Sea sole assessment was based on XSA with two survey tuning indices (UK(E&W)-BTS-Q3 and UK(E&W)-BTS-Q1. The UK(E&W)-BTS-Q1 indices only provide information for the years 1993 up to 1999 and therefore no longer contribute to the final survivor estimates. At WKFLAT 2011 (ICES, 2011), the exclusion of the UK(E&W)-BTS-Q1 from the assessment was investigated and it was found that there was little effect on the catchability residuals and that the retrospective pattern was slightly improved. WKFLAT 2011 therefore decided to omit this survey from the assessment. Since 2021, the assessment was performed without tuning data for 2020, as the UK(E&W)-BTS-Q3 could not take place in Division 7.a due to the Covid-19 disruptions.

During the WKBFLATFISH benchmark (ICES, 2024) in 2024, the assessment was transferred to a state–space stock assessment model (SAM). This was done by using the stock assessment package, which enables to interface a performant SAM implementation (https://github.com/fishfollower/SAM/) in *Template Model Builder* (TMB)[1] from the R statistical software. Besides the age-

[1] TMB offers a modelling framework for fast estimation of hierarchical models written in C code through the Laplace approximation. In addition, increased performance of nonlinear optimization procedures is achieved through the use of AUTODIFF (automatic differentiation), and performant C libraries for linear algebra (Eigen and CholMod).

structured UK(E&W)-BTS-Q3 survey tuning series, a Belgian commercial biomass index was introduced in the assessment. The model was further optimized in terms of parameter configuration for the process and observation models (see table below).

The Fbar calculates the mean fishing mortality for the set age range and should represent a significant part of the catch. The Fbar in the WGCSE 2023 assessment was set at age 4–7. However, as age 3 represents a large proportion of the catch (Figure 31.4), during the WKBFLATFISH benchmark it was decided to expand the Fbar to ages 3–7. The Fbar with ages 3–7 represents an average 80% of the catch. The plusgroup was adjusted from age 8 to age 10 and the catch numbers for age 1 were set to NA after 2003.

The SAM model input and configuration are shown in the table below and in Table 31.8.

	Years	Ages	α-β
Commercial tuning fleets:			
BEL-CBT	2004-2022 (2017, 2018 missing)	Biomass	
Survey tuning fleets:			
UK(E&W)-BTS-Q3	1988–2022 (2020 missing*)	1–7 (no plusgroup)	0.75–0.85
Settings			
First data year	1970		
Last data year	2022		
First age	1		
Last age	10+		
Fbar	3-7		
Model Configuration			
stock-recruitment			plain random walk on logN(1)
correlation F-at-age (corFlag)			AR(1)
F parameters-at-age (keyLogFsta)			9 = 0, 1, 2, 3, 4, 5, 6, 7, 8, 8
q parameters (-at-age) (keyLogFpar):			
UK(E&W)-BTS-Q3	1988–2022 (2020 missing*)		6 = 0, 1, 2, 3, 4, 5, 5, -1, -1, -1
σ² F parameters-at-age (keyVarF)			1 = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
σ² N parameters-at-age (keyVarLogN)			2 = 0, 1, 1, 1, 1, 1, 1, 1, 1, 1
σ² obs pars (-at-age) (keyVarObs):			
catch numbers-at-age			5 = 0, 1, 2, 3, 3, 4, 4, 4, 4, 4
UK(E&W)-BTS-Q3	1988–2022 (2020 missing*)		4 = 5, 6, 6, 6, 7, 7, 8, -1, -1, -1
ρ observations at-age (obsCorStruct):			
catch numbers-at-age			"AR(1)" (single ρ for all ages)
UK(E&W)-BTS-Q3	1988–2022 (2020 missing*)		"ID"

***2020 not available due to COVID-19 and therefore not included in the assessment.**

Final Assessment

The SAM model fitting diagnostics and survey catchabilities are shown in Table 31.9, the fishing mortalities in Table 31.10, the stock numbers in Table 31.11, SSB-at-age in Table 31.12 and the assessment summary in Table 31.13 and Figure 31.15.

In general, the estimated catches from the SAM model corroborate well with the observed catches.

The one step ahead residuals for the catch data do not indicate strong patterns (Figure 31.16), except for the larger residuals in the period 2016-2018 (linked to the low sampling level in those years when the bycatch quotum was in force) and in the beginning of the time series. The BEL-CBT biomass series shows an alternating pattern of negative residuals in de beginning and the end of the time series and positive residuals in the middle of the time series. The UK(E&W)-BTS-Q3 tuning series has higher residuals in the beginning of the time series and a year effect in 2013 but no strong patterns.

The process residuals do not indicate any problems with respect to the model configuration.

A Mohn's rho analysis was conducted based on the SAM results, i.e. the last data year (2022) was used as the final year for comparison of SSB, F and recruitment and based on a five-year retrospective analysis. The results from the Mohn's rho analysis are shown in the following table:

	SSB	F (ages 3–7)	recruitment
Mohn's rho value	0.0395	-0.0678	0.4161

The Mohn's rho values of SSB and F for this assessment are low and are well within the ICES WKFORBIAS thresholds (+0.20, -0.15), indicating that the current assessment has sufficient consistency for advice purposes. However, the retrospective analysis (Figure 31.17) of the recruitment estimates performs poorer.

The leave-one-out runs (Figure 31.18) show a stronger dependency of the model on the UK(E&W)-BTS-Q3 tuning series in the earlier part of the time series and it is more pronounced for F than for SSB. In the more years, there appears to be a more similar dependency on the survey and on the commercial tuning series.

Comparison with previous assessments

A comparison of the estimates of the current assessment with last year's is given in Figure 31.19. The current assessment results in a very similar catch pattern compared to last year's XSA, that is only based on landings. Overall the F and SSB trend estimated by SAM are also very similar to the XSA trends but the SSB estimated by SAM is higher for almost the entire time series and the Fbar, that is now representing ages 3-7 in the SAM run compared to ages 4-7 in the XSA, is estimated to be lower for almost the entire time series. The recruiting age in the SAM assessment is age 1, whereas in the XSA assessment it is age 2. The SAM estimated recruitment appears to be much higher compared to the XSA assessment and the pattern is shifted by 1 year because of the age difference.

State of the stock

Estimated trends of Irish Sea sole landings, SSB, fishing mortality and recruitment are presented in Table 31.13 and Figure 31.15. Since the late eighties the cathes of Irish Sea sole have been declining to the lowest level of the time-series (34 t) in 2017. Since 2019, again higher catches are reported. SSB has been at a higher level until the late eighties. Since then it gradually decreased and has been fluctuating around $MSYB_{trigger}$ (3129 t) until 2005. Since 2006 it has been fluctuating around B_{lim} (2235 t) and in 2008 a record low value of 1608 t was estimated. SSB gradually increased again to above $MSYB_{trigger}$ since 2017. In 2022, SSB slightly dropped to 4986 t.

High fishing mortalities were observed during the late eighties until the mid-2000s. Thereafter fishing mortality declined to below F_{MSY} (0.164) in 2009. In 2017-2018, the lowest level of the time-series was recorded (0.012). The decline in F is supported by a substantial reduction of the TAC in this period. As in 2019 the TAC increased (Figure 31.20) and the sole targeted fisheries was again permitted, F gradually increased to 0.153 in 2022. F is estimated to be below F_{lim} over the entire time series.

Since 2001 recruitment has been well below the mean (24010 thousand fish) and the 2010 recruitment (year class 2009) is estimated to be the lowest in the time-series (3753 thousand fish). The 2015 recruitment (18462 thousand fish, year class 2014) is estimated to be five times higher than the record low recruitment in 2010. Thereafter, higher and lower recruitments alternate. The 2018 year class (30392 thousand 1 year old fish) is estimated to be highest recorded in the last 20 years, followed by the weaker 2019-2021 year classes (14146 thousand 1 year old fish in 2022) .

31.4 Short-term projections

This year's forecast assumptions

Figure 31.21 shows three different targets for the intermediate year: F_last (F = F_{2022} or status quo), F_average (F = $F_{average\ 2020\text{-}2022}$), and catch.

The F in 2022 (0.153) is slightly higher than the mean F over the last three years ($F_{average\ 2020–2022}$ = 0.116) and using this F to project the stock into 2023, would result in slightly higher catches (613 t) than the 2023 TAC (605 t). A lower amount of catches (473 t) is resulting from assuming that the F in 2023 will be equal to the mean F over the last three years and is very close to the amount of 2023 catches estimated by ICES (443 t). The working group agreed to use 443 t as a catch constraint for the intermediate year (2023), as this is the most reliable available estimate of the 2023 catches. Assuming a catch constraint for 2023 of 443 t, implies a fishing mortality in 2023 of 0.108. This results in an SSB of 5088 t in 2024.

As input for the forecast fishing mortality, catch and stock weights-at-age were calculated as the mean of 2020–2022. Population numbers at the start of 2023 for ages 2 and older, were taken from the SAM output. The short-term median resampled recruitment (2015–2021) as estimated by a stochastic projection (SAM, 16786 thousand fish) was assumed for recruitment in 2023 and subsequent years, as this corresponds with the recent period of higher recruitments.

Last year's forecast assumptions

A comparison of the estimates of this assessment and forecast with last year's and the one from 2 year's ago is given in Figure 31.22. The WGCSE23 and WGCSE24 estimates are not really comparable as the WGCSE24 estimates were substantially rescaled as a result of the WKBFLATFISH benchmark (ICES, 2024). Moreover, the WGCSE24 estimates in the 'landings' graph represent catches instead of landings. The WGCSE24 recruitment is based on age 1, whereas in the WGCSE22 and WGCSE23 recruitment it is based on age 2. The Fbar is now representing ages 3-7 in the SAM assessment (WGCSE24) compared to ages 4-7 in the XSA assessment (WGCSE22 and WGCSE23).

MSY forecast

Table 31.14 and Figure 31.23 show the output of the forecast targeting F = FMSY for 2024–2025 and the substantial increase in advice compared to last year's advice is due to a change in the perception of the stock after the WKBFLATFISH benchmark (ICES, 2024).

Implementing the MSY approach with F = FMSY = 0.164 leads to a total yield of 625 t in 2024, and an SSB of 4923 t in 2025.

Figure 31.24 shows the contribution of the assumed median resampled recruitment (2015–2021) to the forecast yield and SSB. The assumed recruitment accounts for about 4.2% of the catch in 2024 and about 29.3% of the 2025 SSB.

Additional options

A management options table is provided in Table 31.14

31.5 Biological reference points

The table below summarizes all known reference points for sole in Division 27.7.a and their technical basis. Reference points have been redefined as a result of the WKBFLATFISH benchmark (ICES, 2024). The stock–recruitment relationship is shown in Figure 31.25.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	3129	Tonnes; 5th percentile on the distribution of SSB when fishing at F_{MSY}
	F_{MSY}	0.164	Stochastic simulations (EqSim) with Beverton-Holt and Ricker in combination with Segmented regression.
	F_{lower}	0.125	The minimum F which produces at least 95% of maximum yield
	F_{upper}	0.183	The maximum F which produces at least 95% of maximum yield
Precautionary approach	B_{lim}	2235	Tonnes; the average value of the breakpoint at 10% of B0* and 30% of B0*
	B_{pa}	3129	Tonnes; Blim × 1.4
	F_{lim}	0.570	The F that on average leads to B_{lim} from EqSim
	F_{pa}	0.183	F_{P05} ; F that leads to SSB ≥ Blim with 95% probability
Management plan	SSBmgt	Not applicable	
	Fmgt	Not applicable	

*B0 is the estimated unexploited spawning biomass

31.6 Management plans

No management plan is currently in place for Irish Sea sole.

31.7 Uncertainties and bias in assessment and forecast

Sampling

The targeted sole fishery in the Irish Sea was not allowed from 2016 to 2018. Consequently, sampling levels were also significantly reduced in this period. In 2019 the TAC increased again and additionally a scientific sole quota is reserved for Belgian vessels fishing in ICES Division 7.a to assure a qualitative sampling. Due to Covid-19, only discard information from the Belgian beam trawl fleet was provided for 2020 and 2021.

Landings

The Belgian commercial fishing fleet has fishing opportunities in several ICES divisions and are allowed to fish in different ICES divisions within one trip (e.g. while steaming from a Belgian harbour to a foreign harbour). This flexibility of fishing in different ICES divisions creates opportunity for non-compliance. During the WKBFLATFISH benchmark (ICES, 2024) a misreporting analysis was conducted and the landing numbers have been corrected for the time periods 2006-2013 and 2019-2022 . For 2006-2013 and 2019-2020 a correction in the range of 0.7-18.3 % was applied (varying direction), whereas in the most recent years (2021-2023) a downward correction of around 34 % was applied on the reported landings. The period 2014-2018 was excluded from the misreporting analysis as there is not enough information to make a quantitative estimation of the landings.

Discards

Discard estimates used to be low (discard rate around 6% over the years 2003–2017), but are increasing (discard rate around 15% over the years 2018-2022). Discards are included in the assessment since the WKBFLATFISH benchmark (ICES, 2024).

Effort

There are no indications of Irish Sea sole fisheries misreporting effort. Effort in beam trawl fisheries that target sole has declined substantially in the last few years in accordance with the significant reductions in TAC. In 2019–2022 higher effort values were recorded as the TAC increased and sole directed fisheries were again allowed.

Surveys

The UK(E&W)-BTS-Q3 survey appears to track year-class strength well and is also consistent in estimating year-class strength of the same year class at different ages. The UK(E&W)-BTS-Q3 survey data for 2020 were not available due to COVID-19. The UK(E&W)-BTS-Q3 indices were revised during WKBFLATFISH benchmark (ICES, 2024) using the biological data of all available survey stations and a modelled approach. This index now also includes age 1 information.

Model formulation

During the WKBFLATFISH benchmark (ICES, 2024) in 2024, the assessment was transferred to a state–space stock assessment model (SAM). The main feature of SAM is that it includes both process models on survival, recruitment and fishing mortality, describing the internal states of the system, and observation models for catch and tuning data. Additionally, tuning data can be introduced in different ways, e.g. as SSB (spawning–stock biomass), TSB (total stock biomass) or landings indices, while the random effects formulation of the process models resulting from the hierarchical nature of the state–space modelling framework, can easily be used to handle missing observations as is the case with catch information on age 1. Finally, SAM allows to specify different model configurations, and parametrization of both process and observation models.

31.8 Recommendations for next Benchmark

The fact that the outcome of the reference points calculation is highly dependent on the functional form of the stock-recruitment relationship, the WKBFLATFISH benchmark (ICES, 2024) had difficulties to come to an objective conclusion. Therefore it is highly recommended to develop guidance to approach reference points for stocks like Irish Sea sole and 2) to perform intermediate re-evaluation of reference points for this stock.

31.9 Management considerations

Sole is caught in a mixed-fishery with other flatfish as well as gadoids predominantly caught by beam trawl fleets.

31.10 Ecosystem considerations

Considerable changes to the Irish Sea ecosystem have occurred over the past decades, with for example the decline of commercially important finfish stocks and their slow response to management recovery plans. This triggered the need for a holistic exploration into the impact of environmental change and food web effects to identify the drivers underpinning stock dynamics. Bentley et al. (2019) identified correlations between largescale climatic indicators, temperature, primary and secondary productivity, and fish recruitment in the Irish Sea and incorporated them into an Ecopath with Ecosim food web model. While this study was mainly focussed on cod and whiting, it is recommended to consider sole in this set-up and identify drivers of stock-recruitment.

31.11 References

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Table 31.1. Sol.27.7a - Nominal landings (tonnes) as officially reported by ICES, and working group estimates of the landings and discards. Last year's landings are preliminary.

Year	Belgium	France	Ireland	Netherlands	UK (E+W)	UK (Isle of Man)	UK (N. Ireland)[1]	UK (Scotland)	Officially reported	Total used by WG	Area misreported landings	TAC	Discards
1973	793	12	27	281	258	-	46	11	1428	1428	-	-	26
1974	664	54	28	320	218	-	23	-	1307	1307	-	-	16
1975	805	59	24	234	281	-	24	15	1442	1441	-	-	25
1976	674	72	74	381	195	-	49	18	1463	1463	-	-	12
1977	566	39	84	227	160	-	49	21	1146	1147	-	-	15
1978	453	65	127	177	189	-	57	30	1098	1106	-	-	14
1979	779	48	134	247	290	-	47	42	1587	1614	-	-	26
1980	1002	41	229	169	367	-	44	68	1920	1941	-	-	26
1981	884	13	167	186	311	-	41	45	1647	1667	-	-	19
1982	669	9	161	138	277	-	31	44	1329	1338	-	-	11
1983	544	3	203	224	219	-	33	29	1255	1169	-	-	10
1984	425	10	187	113	230	-	38	17	1020	1058	-	-	43
1985	589	9	180	546	269	-	36	28	1657	1146	-	-	29
1986	930	17	235	-	637	1	50	46	1916	1995	-	-	50
1987	987	5	312	-	599	3	72	63	2041	2808	-	2100	57
1988	915	11	366	-	507	1	47	38	1885	1999	-	1750	22
1989	1010	5	155	-	613	2	-	38	1823	1833	-	1480	21
1990	786	2	170	-	569	10	-	39	1576	1583	-	1500	36
1991	371	3	198	-	581	44	-	26	1223	1212	-	1500	58
1992	531	11	164	-	477	14	-	37	1234	1259	-	1350	43
1993	495	8	98	-	338	4	-	28	971	1023	-	1000	15
1994	706	7	226	-	409	5	-	14	1367	1374	-	1500	28
1995	675	5	176	-	424	12	-	8	1300	1266	-	1300	22
1996	533	5	133	149	194	4	-	5	1023	1002	-	1000	14
1997	570	3	130	123	189	5	-	7	1027	1003	-	1000	40
1998	525	3	134	60	161	3	-	9	895	911	-	900	32
1999	469	<1	120	46	165	1	-	8	810	863	-	900	32
2000	493	3	135	60	133	1	-	8	833	818	-	1080	21
2001	674	4	135	-	195	+	-	4	1012	1053	-	1100	31
2002	817	4	96	-	165	+	-	3	1085	1090	-	1100	22
2003	687	4	103	-	217	+	-	3	1014	1015	-	1010	48
2004	527	1	77	-	106	+	-	1	712	714	-	800	7
2005	662	3	85	-	103	+	-	1	854	855	-	960	40
2006	419	1	85	-	71	-	-	2	576	524	-47	960	27
2007	306	1	115	-	70	-	-	4	492	439	-51	820	15
2008	216	1	66	-	37	-	-	-	320	319	1	669	48
2009	257	-	47	-	20	1	-	1	325	295	-11	502	19
2010	217	-	47	-	12	-	-	-	277	290	13	402	20
2011	250	<1	49	-	31	-	-	-	330	330	-11	390	14
2012	222	<1	51	-	23	-	-	-	297	281	-18	300	23
2013	96	<1	40	-	12	-	-	-	148	160	11	140	14
2014	43	-	43	-	10	-	-	-	96	99	-	95	6
2015	36	<1	32	-	7	-	-	-	75	77	-	90	7
2016	14	-	15	-	6	-	-	-	35	37	-	40	2
2017	14	<1	14	-	4	2	-	-	34	34	-	40	2
2018	14	-	16	-	6	<1	-	-	36	36	-	40	9
2019	329	<1	55	-	15	<1	-	-	400	388	-12	414	68
2020	284	<1	48	-	65	<1	-	-	398	371	-33	457	52
2021	480	<1	81	-	74	<1	-	-	635	474	-157	768	63
2022	542	<1	69	-	75	<1	-	-	687	507	-178	787	99

[1] 1989 onwards: N. Ireland included with England & Wales.

Table 31.2. Sol.27.7a - Catch numbers-at-age (in thousands).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	41	160	44	522	35	371	41	315	92	153	265	99	11
3	998	485	753	406	998	820	418	466	1070	1148	1051	648	387
4	1044	2171	757	2273	596	2469	1378	1339	672	3554	2040	1727	1285
5	474	1148	1562	566	1740	547	2364	786	1025	842	3104	1503	1318
6	1478	235	545	827	389	855	251	1082	449	646	529	1664	722
7	290	881	172	268	423	157	546	150	640	327	513	114	643
8	228	141	523	112	232	227	134	218	98	285	361	184	91
9	803	106	97	329	58	158	151	89	204	65	352	86	113
10+	1530	1676	900	716	695	627	458	348	288	272	437	603	195

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	52	924	218	200	269	45	251	801	1863	513	118	173	187	86
3	184	880	1790	3728	3746	496	860	1326	1419	2716	608	1500	1030	526
4	1033	393	1124	3588	4250	4917	801	1022	870	950	2036	1107	1495	1232
5	770	619	348	975	3234	2133	4039	607	305	565	568	1603	748	753
6	768	348	339	239	857	1329	1196	2355	229	193	255	400	1025	436
7	417	425	164	278	308	204	554	594	1175	156	200	133	180	510
8	334	178	259	210	224	83	121	333	255	524	147	98	62	142
9	69	251	188	187	139	76	23	38	125	217	257	141	48	49
10+	311	132	296	461	450	365	112	96	81	192	287	290	245	160

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0	0	0	0	0	0	35	1	34	23	8	21	1
2	1116	236	426	252	341	209	565	179	646	279	257	343	109
3	797	1933	1195	1013	1609	1037	863	694	1192	694	396	508	400
4	492	482	1303	939	851	1679	889	328	632	506	308	253	309
5	722	260	302	609	728	751	640	294	338	210	190	218	133
6	415	320	117	152	519	584	242	267	225	94	95	113	117
7	259	192	136	55	80	255	177	141	115	84	50	77	63
8	295	126	82	70	65	79	144	42	124	83	43	30	11
9	85	150	37	53	67	30	25	28	82	47	38	33	10
10+	155	150	114	137	142	109	119	72	50	64	91	47	25

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	10	0	0	6	1	6	9	7	26	73	11	3	31
2	94	64	109	55	42	46	3	5	29	285	393	198	283
3	381	246	169	125	88	69	22	49	37	746	305	781	337
4	273	386	353	100	75	53	25	21	57	308	459	424	1093
5	172	185	310	139	45	44	16	15	16	311	197	390	410
6	88	104	132	93	42	23	12	5	11	98	180	139	312
7	73	63	29	45	49	21	8	6	3	87	94	138	175
8	39	56	11	37	17	28	9	2	2	29	48	38	152
9	12	32	13	8	8	9	11	3	1	16	25	18	85
10+	41	45	18	35	22	15	14	8	7	33	54	36	79

Table 31.3. Sol.27.7a - Catch weights-at-age (kg).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
2	0.114	0.132	0.11	0.132	0.12	0.113	0.105	0.074	0.081	0.117	0.127	0.141	0.099
3	0.145	0.169	0.155	0.169	0.165	0.163	0.153	0.138	0.139	0.157	0.16	0.174	0.162
4	0.175	0.2	0.197	0.2	0.205	0.206	0.196	0.198	0.193	0.195	0.189	0.203	0.221
5	0.202	0.228	0.234	0.227	0.238	0.242	0.237	0.248	0.24	0.232	0.217	0.232	0.272
6	0.23	0.255	0.269	0.253	0.269	0.272	0.273	0.29	0.283	0.268	0.244	0.261	0.317
7	0.259	0.283	0.306	0.282	0.301	0.303	0.312	0.33	0.325	0.31	0.275	0.296	0.361
8	0.29	0.312	0.337	0.309	0.328	0.327	0.348	0.36	0.361	0.352	0.305	0.331	0.399
9	0.321	0.34	0.369	0.335	0.353	0.347	0.383	0.384	0.394	0.395	0.337	0.369	0.432
10+	0.414	0.426	0.46	0.424	0.415	0.384	0.511	0.398	0.474	0.566	0.473	0.497	0.493

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
2	0.165	0.166	0.125	0.106	0.117	0.097	0.109	0.118	0.116	0.13	0.089	0.152	0.112	0.136
3	0.201	0.213	0.179	0.156	0.155	0.139	0.155	0.154	0.163	0.168	0.148	0.188	0.172	0.183
4	0.233	0.252	0.226	0.199	0.192	0.179	0.197	0.188	0.204	0.203	0.201	0.223	0.227	0.223
5	0.263	0.285	0.269	0.238	0.229	0.216	0.235	0.225	0.238	0.236	0.245	0.258	0.274	0.26
6	0.295	0.315	0.307	0.274	0.265	0.249	0.268	0.262	0.269	0.271	0.282	0.298	0.315	0.293
7	0.332	0.347	0.346	0.31	0.307	0.285	0.303	0.306	0.3	0.31	0.317	0.346	0.355	0.327
8	0.369	0.374	0.38	0.344	0.35	0.319	0.336	0.354	0.326	0.348	0.345	0.397	0.389	0.358
9	0.41	0.4	0.412	0.375	0.395	0.352	0.366	0.404	0.349	0.39	0.366	0.453	0.419	0.387
10+	0.558	0.459	0.481	0.442	0.534	0.447	0.449	0.622	0.394	0.445	0.382	0.57	0.465	0.455

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.13	0.13	0.13	0.13	0.13	0.13	0.112	0.127	0.11	0.153	0.111	0.084	0.206
2	0.134	0.163	0.156	0.122	0.152	0.141	0.161	0.2	0.161	0.161	0.179	0.129	0.127
3	0.187	0.198	0.206	0.179	0.171	0.163	0.204	0.275	0.213	0.21	0.245	0.188	0.209
4	0.232	0.229	0.247	0.245	0.266	0.207	0.295	0.361	0.286	0.256	0.319	0.261	0.26
5	0.272	0.26	0.282	0.308	0.29	0.28	0.354	0.431	0.332	0.33	0.409	0.275	0.348
6	0.308	0.292	0.31	0.364	0.322	0.324	0.404	0.432	0.397	0.358	0.349	0.29	0.373
7	0.344	0.33	0.341	0.428	0.42	0.332	0.432	0.4	0.433	0.378	0.396	0.353	0.379
8	0.376	0.369	0.365	0.384	0.465	0.417	0.375	0.476	0.333	0.395	0.446	0.397	0.53
9	0.406	0.411	0.387	0.456	0.382	0.277	0.662	0.667	0.39	0.495	0.412	0.32	0.474
10+	0.458	0.522	0.426	0.58	0.448	0.366	0.494	0.531	0.559	0.567	0.517	0.365	0.458

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	0.107	0.123	0.106	0.099	0.097	0.091	0.089	0.089	0.089	0.089	0.075	0.086	0.085
2	0.145	0.143	0.123	0.133	0.131	0.14	0.129	0.13	0.112	0.114	0.109	0.113	0.105
3	0.19	0.2	0.199	0.19	0.184	0.195	0.201	0.223	0.193	0.196	0.19	0.182	0.15
4	0.264	0.265	0.243	0.241	0.251	0.249	0.258	0.31	0.276	0.242	0.259	0.244	0.197
5	0.32	0.335	0.294	0.287	0.294	0.276	0.344	0.385	0.359	0.297	0.294	0.32	0.219
6	0.351	0.393	0.353	0.324	0.324	0.333	0.316	0.495	0.418	0.364	0.331	0.345	0.267
7	0.375	0.371	0.451	0.354	0.358	0.389	0.415	0.493	0.484	0.356	0.337	0.376	0.255
8	0.375	0.408	0.528	0.358	0.392	0.4	0.427	0.503	0.567	0.399	0.353	0.407	0.301
9	0.419	0.435	0.367	0.47	0.448	0.403	0.379	0.472	0.716	0.522	0.431	0.492	0.231
10+	0.436	0.46	0.535	0.43	0.45	0.468	0.492	0.44	0.408	0.541	0.479	0.543	0.31

Table 31.4. Sol.27.7a - Annual length distributions (in thousands) by country (2022).

Length (cm)	UK (England & Wales)	Belgium	Ireland
	All gears	TBB	All gears
21		61	
22		467	
23		8444	
24	174	74697	116
25	517	201469	984
26	1623	218763	1840
27	2266	181777	3110
28	3002	185573	8186
29	3425	145455	8630
30	4072	126628	9244
31	4222	78553	13431
32	3241	57273	13156
33	2120	42376	14266
34	1087	32259	12428
35	538	24366	13801
36	249	12796	8386
37	204	9305	4454
38	212	7244	4157
39	91	4786	3956
40	415	2919	2380
41	45	1395	624
42	28	781	1439
43	0	822	392
44	27	134	74
45		177	0
46		0	11
47		112	
48		0	
49		70	
Total	27558	1418702	125065

Table 31.5. Sol.27.7a - Stock weights-at-age (kg).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.037	0.04	0.037	0.039	0.04	0.041	0.049	0.047	0.039	0.037	0.036	0.043	0.033
2	0.093	0.086	0.079	0.086	0.082	0.08	0.077	0.065	0.068	0.081	0.085	0.089	0.075
3	0.124	0.139	0.143	0.136	0.147	0.14	0.132	0.12	0.102	0.113	0.137	0.149	0.151
4	0.153	0.17	0.182	0.176	0.186	0.184	0.179	0.174	0.163	0.165	0.172	0.18	0.196
5	0.18	0.199	0.217	0.212	0.218	0.223	0.221	0.221	0.218	0.212	0.206	0.209	0.235
6	0.207	0.227	0.247	0.244	0.247	0.255	0.257	0.262	0.265	0.254	0.238	0.238	0.271
7	0.237	0.255	0.279	0.276	0.276	0.285	0.292	0.3	0.307	0.296	0.272	0.269	0.307
8	0.268	0.285	0.309	0.308	0.304	0.314	0.325	0.335	0.345	0.338	0.308	0.302	0.344
9	0.301	0.314	0.339	0.336	0.33	0.337	0.354	0.366	0.377	0.378	0.344	0.336	0.378
10+	0.399	0.411	0.438	0.431	0.403	0.385	0.486	0.411	0.452	0.544	0.486	0.463	0.465

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.033	0.038	0.041	0.039	0.043	0.026	0.028	0.026	0.03	0.033	0.024	0.028	0.033	0.035
2	0.096	0.097	0.084	0.077	0.081	0.074	0.068	0.073	0.07	0.079	0.064	0.083	0.071	0.085
3	0.141	0.187	0.173	0.14	0.128	0.128	0.122	0.13	0.139	0.14	0.139	0.129	0.162	0.143
4	0.195	0.225	0.22	0.189	0.173	0.167	0.166	0.171	0.177	0.182	0.184	0.181	0.207	0.196
5	0.241	0.258	0.261	0.232	0.213	0.204	0.205	0.211	0.212	0.22	0.223	0.228	0.247	0.243
6	0.283	0.288	0.296	0.272	0.251	0.239	0.241	0.248	0.246	0.254	0.258	0.27	0.285	0.283
7	0.324	0.32	0.33	0.309	0.29	0.275	0.275	0.287	0.28	0.289	0.293	0.312	0.325	0.321
8	0.365	0.352	0.363	0.345	0.33	0.313	0.31	0.328	0.316	0.323	0.327	0.355	0.367	0.356
9	0.405	0.384	0.393	0.378	0.369	0.351	0.342	0.368	0.352	0.357	0.357	0.395	0.408	0.388
10+	0.532	0.474	0.462	0.448	0.495	0.466	0.432	0.572	0.428	0.401	0.4	0.47	0.499	0.458

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.029	0.034	0.031	0.037	0.041	0.031	0.041	0.045	0.043	0.048	0.049	0.034	0.037
2	0.086	0.092	0.094	0.077	0.095	0.093	0.093	0.118	0.105	0.104	0.116	0.094	0.082
3	0.159	0.163	0.183	0.167	0.144	0.158	0.17	0.211	0.207	0.184	0.199	0.184	0.164
4	0.206	0.207	0.221	0.225	0.218	0.188	0.219	0.272	0.28	0.234	0.259	0.253	0.221
5	0.247	0.246	0.254	0.276	0.267	0.273	0.271	0.356	0.346	0.307	0.324	0.296	0.301
6	0.283	0.282	0.284	0.321	0.315	0.307	0.337	0.391	0.414	0.345	0.339	0.344	0.32
7	0.318	0.319	0.315	0.364	0.391	0.327	0.374	0.402	0.433	0.387	0.376	0.351	0.332
8	0.35	0.356	0.347	0.362	0.446	0.419	0.353	0.453	0.365	0.414	0.411	0.397	0.432
9	0.381	0.393	0.378	0.408	0.383	0.359	0.525	0.5	0.431	0.406	0.403	0.378	0.434
10+	0.441	0.485	0.44	0.526	0.48	0.388	0.475	0.568	0.563	0.55	0.516	0.397	0.4

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	0.04	0.038	0.048	0.043	0.036	0.036	0.04	0.043	0.047	0.038	0.037	0.039	0.041
2	0.092	0.093	0.083	0.095	0.09	0.089	0.084	0.087	0.081	0.085	0.077	0.078	0.076
3	0.156	0.171	0.169	0.153	0.157	0.16	0.168	0.17	0.158	0.148	0.147	0.141	0.13
4	0.235	0.225	0.221	0.219	0.218	0.214	0.224	0.249	0.248	0.216	0.225	0.216	0.19
5	0.289	0.298	0.279	0.264	0.266	0.263	0.293	0.315	0.334	0.286	0.266	0.288	0.231
6	0.35	0.354	0.344	0.309	0.305	0.313	0.295	0.413	0.401	0.362	0.314	0.318	0.292
7	0.374	0.361	0.421	0.354	0.34	0.355	0.372	0.395	0.49	0.386	0.35	0.352	0.296
8	0.377	0.391	0.443	0.402	0.373	0.378	0.408	0.457	0.529	0.439	0.354	0.37	0.336
9	0.471	0.404	0.387	0.498	0.401	0.398	0.39	0.449	0.6	0.544	0.415	0.417	0.306
10+	0.455	0.435	0.505	0.456	0.452	0.471	0.465	0.439	0.431	0.498	0.492	0.516	0.393

Table 31.6. Sol.27.7a - Tuning series (values in bold are used in the assessment).

BE-CBT	**Belgium Commercial Beam trawl (Effort = Corrected formula)**								
2004	2022								
1	1	0	0						
-1	-1								
1	**387.61**								
1	**410.20**								
1	**332.55**								
1	**364.03**								
1	**439.87**								
1	**404.34**								
1	**401.51**								
1	**514.52**								
1	**500.65**								
1	**434.85**								
1	**579.61**								
1	**259.40**								
1	**172.65**								
1	**NA**								
1	**NA**								
1	**883.84**								
1	**692.71**								
1	**853.40**								
1	**804.98**								
UK(E&W)-BTS-Q3									
1988	2022								
1	1	0.75	0.85						
1	10								
1	**718.18**	**1141.7**	**1636.0**	**3923.1**	**735.35**	**316.81**	**12.41**	19.41	14.96	52.00
1	**1945.7**	**1523.2**	**1366.8**	**942.48**	**2491.8**	**500.08**	**208.39**	20.74	4.93	45.84
1	**7960.8**	**2835.0**	**710.32**	**231.70**	**450.87**	**1023.4**	**188.97**	118.02	40.66	43.49
1	**772.08**	**5590.9**	**1077.8**	**252.91**	**97.68**	**33.69**	**241.54**	81.74	36.27	3.54
1	**1455.3**	**1354.4**	**4196.1**	**899.91**	**242.88**	**119.96**	**73.42**	275.58	75.16	47.55
1	**549.51**	**1881.9**	**820.10**	**1237.9**	**274.67**	**82.20**	**35.39**	46.03	147.41	68.52
1	**481.34**	**2022.6**	**1008.8**	**461.77**	**627.49**	**215.79**	**49.07**	38.94	21.79	181.92
1	**1892.5**	**984.89**	**1167.2**	**510.63**	**159.73**	**291.57**	**62.21**	12.35	12.71	86.17
1	**5240.2**	**793.43**	**218.73**	**459.84**	**240.42**	**121.73**	**149.66**	32.77	13.03	55.54
1	**7352.4**	**3320.0**	**419.23**	**161.30**	**273.16**	**135.30**	**75.15**	127.57	41.07	56.54

1	**4549.7**	**3239.8**	**1457.5**	**167.29**	**30.38**	**136.24**	**105.21**	13.56	86.05	57.76
1	**3346.0**	**1827.9**	**1174.1**	**899.11**	**103.77**	**52.99**	**89.53**	9.86	28.44	128.92
1	**2491.6**	**2855.4**	**824.23**	**805.75**	**423.28**	**69.63**	**7.68**	41.38	23.13	109.64
1	**1132.5**	**1752.7**	**1369.6**	**402.97**	**429.91**	**274.25**	**36.19**	8.19	41.40	54.43
1	**1312.9**	**471.43**	**651.92**	**747.32**	**221.16**	**311.33**	**174.32**	8.90	1.70	76.71
1	**1916.4**	**1235.3**	**376.14**	**563.48**	**433.46**	**175.99**	**146.56**	80.81	2.03	50.71
1	**2058.8**	**1193.9**	**705.55**	**158.00**	**302.32**	**231.23**	**189.45**	64.41	100.29	56.31
1	**310.70**	**774.97**	**388.00**	**176.36**	**61.45**	**141.65**	**129.09**	22.88	38.36	100.62
1	**836.53**	**459.36**	**466.06**	**242.99**	**152.04**	**42.29**	**63.91**	57.13	46.08	110.03
1	**973.48**	**639.39**	**337.68**	**316.44**	**202.51**	**67.84**	**26.54**	28.70	77.22	108.25
1	**1109.1**	**788.19**	**328.12**	**101.93**	**161.33**	**100.75**	**24.72**	5.12	39.83	85.46
1	**570.43**	**1039.3**	**368.91**	**181.79**	**78.12**	**119.10**	**47.64**	16.47	0.45	86.54
1	**164.95**	**415.43**	**540.95**	**183.94**	**86.42**	**25.69**	**35.00**	32.52	16.00	18.37
1	**413.08**	**185.00**	**543.40**	**413.34**	**195.14**	**71.81**	**34.27**	53.51	24.48	66.55
1	**145.04**	**344.45**	**140.19**	**261.56**	**194.77**	**74.90**	**33.16**	23.47	27.65	68.77
1	**483.60**	**531.59**	**229.85**	**115.83**	**231.67**	**128.53**	**83.57**	33.56	14.61	68.49
1	**1059.2**	**515.60**	**223.64**	**243.30**	**137.23**	**160.53**	**170.45**	72.86	35.91	68.54
1	**2482.9**	**921.75**	**281.09**	**126.67**	**121.39**	**66.19**	**72.28**	124.89	32.30	126.84
1	**953.64**	**2290.8**	**574.98**	**224.57**	**154.69**	**144.04**	**51.71**	40.81	59.68	102.53
1	**2637.4**	**872.09**	**1166.8**	**368.01**	**156.57**	**128.55**	**56.31**	33.94	47.27	135.35
1	**1262.9**	**2551.7**	**600.57**	**902.54**	**244.19**	**108.17**	**53.22**	45.62	29.67	98.48
1	**5646.4**	**1317.3**	**1422.4**	**401.93**	**658.62**	**169.11**	**49.40**	26.55	15.75	113.77
1	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	NA	NA	NA
1	**958.11**	**616.46**	**1663.6**	**451.91**	**276.25**	**136.50**	**238.80**	4.27	8.72	20.83
1	**1650.6**	**924.26**	**601.53**	**1428.8**	**222.27**	**290.95**	**70.77**	193.07	35.21	23.34

Table 31.7a. Sol.27.7a - Effort series.

	Belgium	UK(E&W)				Ireland	
	beam[1]	beam [2]	beam[3]	otter[2]	otter[3]	otter[4]	beam[4]
Year	Whole year	Whole year	Whole year	Whole year	Whole year	Whole Year	Whole Year
1972	-	-	-	128.4	-	-	-
1973	-	-	-	147.6	-	-	-
1974	-	-	-	115.2	-	-	-
1975	28.4	-	-	130.7	-	-	-
1976	24.9	-	-	122.3	-	-	-
1977	22.1	-	-	101.9	-	-	-
1978	17.5	0.9	-	89.1	-	-	-
1979	20.4	1.7	-	89.9	-	-	-
1980	32.0	4.3	-	107.0	-	-	-
1981	36.5	6.4	-	107.1	-	-	-
1982	26.5	5.5	-	127.2	-	-	-
1983	28.7	2.8	0.0	88.1	1716.5	-	-
1984	17.5	4.1	263.0	103.1	7932.1	-	-
1985	27.0	7.4	428.1	102.9	6930.8	-	-
1986	44.5	17.0	1122.9	90.3	6693.2	-	-
1987	51.6	22.0	1178.5	130.6	9008.9	-	-
1988	38.2	18.6	1019.2	132.0	8292.4	-	-
1989	42.2	25.3	1344.5	139.5	16161.4	-	-
1990	42.4	31.0	1473.1	117.1	7724.5	-	-
1991	17.1	25.8	1211.3	107.3	7081.1	-	-
1992	25.1	23.4	908.1	96.8	6671.8	-	-
1993	23.9	21.5	826.9	78.9	6013.1	-	-
1994	32.5	20.1	1451.6	43.0	3060.0	-	-
1995	28.6	20.9	1429.4	43.1	3357.0	80.3	8.6
1996	23.2	13.3	894.3	42.2	3085.1	64.8	6.3
1997	30.7	10.8	784.4	39.9	2903.3	92.2	9.9
1998	24.7	10.4	696.0	36.9	2620.6	93.5	11.6
1999	22.7	11.0	778.9	22.9	1803.5	110.3	14.7
2000	26.0	6.3	410.7	27.0	2034.9	82.7	11.4
2001	36.8	12.5	767.4	32.8	2352.9	77.5	13.1
2002	47.0	8.0	535.1	24.8	1774.0	77.9	17.7
2003	44.3	14.0	863.7	23.9	1728.3	73.9	18.7
2004	32.3	7.4	419.9	23.5	1727.0	72.5	14.2
2005	37.5	11.4	627.8	16.7	1313.6	68.3	14.7
2006	24.8	4.6	280.1	5.2	478.5	66.2	12.2
2007	19.5	3.2	193.5	4.4	397.2	74.1	14.2
2008	10.3	1.3	98.0	2.7	320.4	58.8	9.5
2009	11.7	0.5	24.9	1.5	157.7	42.8	7.6
2010	11.3	0.2	10.2	1.4	151.0	45.8	9.4
2011	12.4	1.6	91.2	0.7	72.7	54.5	8.1
2012	10.9	0.9	60.7	0.4	85.0	58.3	7.2
2013	7.0	0.0	1.3	0.3	31.9	42.6	5.0
2014	3.9	-	0.4	-	16.1	47.7	6.0
2015	3.5	-	0.9	-	0.0	39.8	8.3
2016	1.8	-	3.9	-	0.0	33.4	7.9
2017	3.0	-	0.0	-	160.7	12.1	7.5
2018	2.5	-	0.0	-	238.1	13.6	9.6
2019	10.1	-	7.0	-	247.2	17.2	13.3
2020	9.5	-	199.0	-	72.6	13.3	10.4

2021	9.6	-	222.6	-	193.6	13.2	8.9
2022	12.7	-	117.6	-	133.1	13.0	6.0

[1]000' hours fishing.

[2]000'hours fished (GRT corrected >40 vessels).

[3] days fished.

[4] 000'hours.

Table 31.7b. Sol.27.7a – LPUE.

	Belgium		UK(E&W)						Ireland	
	beam[1,5]	Beam[6]	beam[3]	beam[2]	otter[3]	otter[2]	beam survey[4]		otter[1]	beam[1]
Year	Whole year	Whole year	Whole year	Whole year	Whole year	Whole year	Sept	March	Whole year	Whole year
1972	-	-	-	-	1.06	-	-	-	-	-
1973	-	-	-	-	1.06	-	-	-	-	-
1974	-	-	-	-	1.09	-	-	-	-	-
1975	21.39	-	-	-	1.39	-	-	-	-	-
1976	23.13	-	-	-	0.94	-	-	-	-	-
1977	19.79	-	-	-	0.80	-	-	-	-	-
1978	18.10	-	34.32	-	1.04	-	-	-	-	-
1979	33.41	-	32.01	-	1.43	-	-	-	-	-
1980	28.18	-	31.70	-	1.01	-	-	-	-	-
1981	22.16	-	21.32	-	0.75	-	-	-	-	-
1982	22.01	-	29.94	-	0.53	-	-	-	-	-
1983	13.88	-	37.31	0.0	0.57	150.2	-	-	-	-
1984	22.47	-	16.24	2851.4	0.71	119.3	-	-	-	-
1985	20.58	-	17.34	2956.3	0.56	135.7	-	-	-	-
1986	19.12	-	19.23	3925.7	0.84	174.9	-	-	-	-
1987	17.73	-	14.82	3726.9	0.77	144.9	-	-	-	-
1988	21.29	-	11.81	2673.3	0.46	80.3	161.92	-	-	-
1989	21.93	-	9.17	1750.6	0.70	138.9	150.07	-	-	-
1990	17.52	-	9.52	2300.9	0.61	119.7	196.90	-	-	-
1991	18.70	-	10.43	2420.9	1.12	177.4	175.76	-	-	-
1992	19.21	-	9.50	2763.0	1.02	126.0	162.64	-	-	-
1993	19.97	-	7.60	1879.8	0.54	69.1	100.16	104.7	-	-
1994	19.06	-	11.76	1479.9	0.74	88.1	110.71	91.9		-
1995	18.12	-	14.96	1721.1	0.95	142.3	92.04	79.3	0.38	12.69
1996	17.72	-	9.44	1471.7	0.53	47.7	89.48	-	0.25	14.94
1997	16.62	-	10.49	961.8	0.73	103.2	155.79	63.3	0.23	8.53
1998	18.96	-	8.42	907.8	0.48	50.5	144.97	89.3	0.38	7.77
1999	19.47	-	9.94	1124.9	0.60	64.8	116.02	-	0.29	9.22
2000	15.52	-	12.90	1604.7	0.44	34.6	130.70	-	0.29	8.49
2001	15.02	-	11.72	1537.4	0.15	23.4	96.87	-	0.38	7.86
2002	14.95	-	16.73	1484.3	1.48	98.8	76.73	-	0.32	4.67
2003	15.41	-	13.20	1351.6	0.15	340.4	88.55	-	0.34	4.20
2004	16.25	-	13.86	941.7	0.17	27.6	98.92	-	0.14	4.31
2005	17.52	-	9.14	1199.9	0.19	21.3	48.91	-	0.16	4.70
2006	16.32	12.21	7.83	826.1	0.52	34.8	52.63	-	0.16	6.00
2007	14.32	13.03	16.38	1629.9	0.42	21.4	53.05	-	0.37	6.37
2008	19.85	14.78	15.25	887.4	0.30	16.4	50.67	-	0.20	6.08
2009	19.96	15.93	18.88	1201.2	0.22	13.6	45.75	-	0.28	4.53
2010	18.68	17.36	13.90	262.3	0.46	17.8	27.80	-	0.19	4.09
2011	19.34	18.23	4.45	322.5	0.18	13.7	36.97	-	0.30	4.13
2012	19.61	14.89	4.27	99.9	0.08	4.4	26.47	-	0.14	5.41
2013	13.23	15.13	-	27.7	0.10	16.3	31.65	-	0.22	6.27
2014	9.16	-	-	0.0	-	13.0	41.14	-	0.14	5.40
2015	9.24	-	-	146.1	-	34.2	58.88	-	0.18	3.14
2016	6.81	-	-	0.0	-	21.3	69.35	-	0.18	1.17
2017	3.81	-	-	0.0	-	5.6	64.24	-	0.36	1.23
2018	5.36	-	-	0.0	-	12.6	78.51	-	0.28	1.49

2019	32.26	31.33	-	124.8	-	48.5	118.66	-	0.63	2.23
2020	30.81	25.69	-	1305.4	-	97.2	-	-	0.67	2.92
2021	47.70	36.30	-	1079.7	-	192.7	63.60	-	0.72	5.79
2022	40.95	30.56	-	1416.1	-	101.9	71.43	-	1.18	8.59

[1] **Kg/hr.**

[2] **Kg/day.**

[3] **Kg/000'hr fished (GRT corrected >40' vessels).**

[4] **Kg/100 km fished.**

[5] **without misreporting correction.**

[6] **Kg/hr from fishing trips with registered fishing effort exclusively in ICES division 7.a.**

Table 31.8a. Sol.27.7a – Configuration.

$minAge										
[1] 1										
$maxAge										
[1] 10										
$maxAgePlusGroup										
[1] 1 0 0										
$keyLogFsta										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] 0 1 2 3 4 5 6 7 8 8									
[2	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$corFlag										
[1] 2										
$keyLogFpar										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[2	] 0 1 2 3 4 5 5 -1 -1 -1									
[3	] 6 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$keyQpow										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[2	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$keyVarF										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] 0 0 0 0 0 0 0 0 0 0									
[2	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
$keyVarLogN										
[1] 0 1 1 1 1 1 1 1 1 1										
$keyVarLogP										
numeric(0)										
$keyVarObs										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] 0 1 2 3 3 4 4 4 4 4									
[2	] 5 6 6 6 7 7 8 -1 -1 -1									
[3	] 9 -1 -1 -1 -1 -1 -1 -1 -1 -1									

Table 31.8b. Sol.27.7a – Configuration.

$obsCorStruct										
[1] AR ID ID										
Levels: ID AR US										
$keyCorObs										
1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10										
[1	] 0 0 0 0 0 0 0 0 0									
[2	] NA NA NA NA NA NA -1 -1 -1									
[3	] -1 -1 -1 -1 -1 -1 -1 -1 -1									
$stockRecruitmentModelCode										
[1] 0										
$noScaledYears										
[1] 0										
$keyScaledYears										
numeric(0)										
$keyParScaledYA										
<0 x 0 matrix>										
$fbarRange										
[1] 3 7										
$keyBiomassTreat										
[1] -1 -1 0										
$obsLikelihoodFlag										
[1] LN LN LN										
Levels: LN ALN										
$fixVarToWeight										
[1] 0 0 0										
$fracMixF										
[1] 0										
$fracMixN										
[1] 0 0 0 0 0 0 0 0 0 0										
$fracMixObs										
[1] 0 0 0										
$constRecBreaks										
numeric(0)										
$predVarObsLink										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] -1 -1 -1 -1 -1 -1 -1 -1 -1 -1									
[2	] -1 -1 -1 -1 -1 -1 -1 NA NA NA									
[3	] NA NA NA NA NA NA NA NA NA NA									

Table 31.8c. Sol.27.7a – Configuration.

$stockWeightModel										
[1] 0										
$keyStockWeightMean										
[1] NA NA NA NA NA NA NA NA NA NA										
$keyStockWeightObsVar										
[1] NA NA NA NA NA NA NA NA NA NA										
$catchWeightModel										
[1] 0										
$keyCatchWeightMean										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] NA NA NA NA NA NA NA NA NA NA									
$keyCatchWeightObsVar										
[	1] [	2] [	3] [	4] [	5] [	6] [	7] [	8] [	9] [	10]
[1	] NA NA NA NA NA NA NA NA NA NA									
$matureModel										
[1] 0										
$keyMatureMean										
[1] NA NA NA NA NA NA NA NA NA NA										
$mortalityModel										
[1] 0										
$keyMortalityMean										
[1] NA NA NA NA NA NA NA NA NA NA										
$keyMortalityObsVar										
[1] NA NA NA NA NA NA NA NA NA NA										
$keyXtraSd										
[	1] [	2] [	3] [	4]						
$logNMeanAssumption										
[1] 0 0										
$initState										
[1] 0										

Table 31.9. Sol.27.7a – Diagnostics.

Name	Type	Years	Ages	LogQ _age1	Sd _age1	LogQ _age2	Sd _age2	LogQ _age3	Sd _age3	LogQ _age4	Sd _age4
UK-BTS-Q3	age-based	1988-2022	1-7	-1.879	0.113	-1.536	0.071	-1.649	0.073	-1.756	0.078
BE-CBT	biomass	2004-2022	-1	-1.726	0.114	NA	NA	NA	NA	NA	NA

Name	Type	Years	Ages	LogQ _age5	Sd _age5	LogQ _age6	Sd _age6	LogQ _age7	Sd _age7
UK-BTS-Q3	age-based	1988-2022	1-7	-1.836	0.098	-1.958	0.103	-1.958	
BE-CBT	biomass	2004-2022	-1	NA	NA	NA	NA	NA	NA

log(L)	#par	AIC
-418.9713	22	881.9426

Table 31.10. Sol.27.7a - Fishing mortality.

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001
2	0.008	0.009	0.008	0.008	0.008	0.009	0.009	0.008	0.008	0.011	0.013	0.012	0.011
3	0.059	0.066	0.06	0.061	0.06	0.064	0.068	0.061	0.061	0.077	0.093	0.084	0.082
4	0.171	0.192	0.177	0.179	0.177	0.187	0.201	0.177	0.174	0.219	0.259	0.228	0.217
5	0.228	0.255	0.234	0.234	0.234	0.247	0.263	0.23	0.229	0.287	0.339	0.293	0.272
6	0.198	0.22	0.203	0.205	0.205	0.216	0.231	0.205	0.205	0.259	0.313	0.273	0.253
7	0.179	0.196	0.179	0.179	0.179	0.188	0.201	0.178	0.178	0.223	0.272	0.235	0.219
8	0.172	0.188	0.171	0.172	0.171	0.179	0.188	0.166	0.166	0.207	0.256	0.223	0.206
9	0.164	0.179	0.164	0.165	0.165	0.174	0.184	0.162	0.162	0.2	0.246	0.215	0.197
10+	0.164	0.179	0.164	0.165	0.165	0.174	0.184	0.162	0.162	0.2	0.246	0.215	0.197

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
2	0.012	0.012	0.014	0.02	0.025	0.021	0.022	0.029	0.025	0.025	0.026	0.032	0.035	0.039
3	0.088	0.083	0.1	0.14	0.17	0.139	0.139	0.182	0.151	0.154	0.153	0.188	0.204	0.22
4	0.224	0.2	0.231	0.31	0.366	0.284	0.266	0.334	0.266	0.265	0.258	0.307	0.326	0.34
5	0.277	0.246	0.284	0.384	0.453	0.345	0.309	0.367	0.287	0.29	0.28	0.328	0.344	0.356
6	0.261	0.233	0.273	0.377	0.459	0.351	0.309	0.361	0.28	0.281	0.274	0.317	0.328	0.337
7	0.229	0.207	0.245	0.346	0.429	0.332	0.289	0.335	0.263	0.264	0.257	0.293	0.297	0.304
8	0.214	0.194	0.233	0.331	0.413	0.323	0.279	0.319	0.251	0.255	0.249	0.284	0.286	0.292
9	0.205	0.184	0.218	0.304	0.375	0.291	0.248	0.282	0.225	0.233	0.23	0.264	0.265	0.267
10+	0.205	0.184	0.218	0.304	0.375	0.291	0.248	0.282	0.225	0.233	0.23	0.264	0.265	0.267

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.002
2	0.043	0.041	0.035	0.032	0.04	0.054	0.053	0.042	0.063	0.047	0.036	0.038	0.031
3	0.242	0.228	0.188	0.17	0.208	0.273	0.266	0.204	0.305	0.223	0.171	0.178	0.14
4	0.362	0.33	0.265	0.234	0.279	0.36	0.34	0.256	0.382	0.279	0.214	0.228	0.185
5	0.38	0.349	0.279	0.243	0.286	0.36	0.332	0.247	0.367	0.268	0.207	0.221	0.181
6	0.359	0.33	0.264	0.234	0.276	0.342	0.309	0.226	0.328	0.24	0.187	0.197	0.158
7	0.323	0.296	0.235	0.209	0.247	0.306	0.277	0.2	0.289	0.214	0.169	0.178	0.142
8	0.31	0.286	0.227	0.204	0.242	0.296	0.264	0.185	0.261	0.19	0.147	0.149	0.116
9	0.283	0.259	0.205	0.184	0.217	0.262	0.235	0.166	0.231	0.169	0.131	0.131	0.101
10+	0.283	0.259	0.205	0.184	0.217	0.262	0.235	0.166	0.231	0.169	0.131	0.131	0.101

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	0.001	0.001	0.001	0.001	0.001	0	0	0	0	0.001	0.001	0.001	0.001
2	0.028	0.027	0.024	0.019	0.012	0.008	0.004	0.002	0.002	0.014	0.017	0.019	0.028
3	0.128	0.122	0.107	0.082	0.05	0.034	0.015	0.009	0.01	0.06	0.071	0.077	0.114
4	0.174	0.169	0.149	0.115	0.07	0.048	0.021	0.013	0.013	0.085	0.102	0.112	0.167
5	0.175	0.172	0.151	0.119	0.073	0.05	0.023	0.013	0.014	0.087	0.106	0.116	0.175
6	0.155	0.152	0.129	0.102	0.063	0.044	0.02	0.012	0.012	0.075	0.092	0.1	0.151
7	0.14	0.138	0.117	0.095	0.06	0.043	0.02	0.012	0.012	0.076	0.094	0.102	0.155
8	0.115	0.114	0.096	0.079	0.051	0.036	0.017	0.01	0.01	0.062	0.076	0.082	0.125
9	0.099	0.098	0.082	0.068	0.044	0.032	0.016	0.009	0.009	0.056	0.069	0.074	0.114
10+	0.099	0.098	0.082	0.068	0.044	0.032	0.016	0.009	0.009	0.056	0.069	0.074	0.114

Table 31.11. Sol.27.7a - Stock numbers-at-age (start of year, in thousands).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	50014	19827	59368	32981	32053	22897	67007	44003	38410	27423	20917	10107	24902
2	11572	28030	10475	33782	17943	17743	12246	37981	24071	21216	15065	11610	5381
3	20260	7948	19532	6854	23572	12248	12015	8108	26626	16346	14530	10103	7947
4	8397	13670	5402	14256	4561	16562	8321	8745	5403	19162	10948	9912	6792
5	2729	5559	8323	3321	9078	2860	10813	4791	5643	3411	12066	6481	6141
6	9308	1661	3321	4880	2075	5438	1688	6346	2899	3404	1865	6828	3741
7	1743	5918	1059	2122	2910	1326	3337	1059	3914	1842	2050	987	3982
8	1328	1121	3734	697	1437	1816	886	2060	697	2442	1128	1239	606
9	5478	855	726	2435	450	960	1154	589	1375	470	1548	638	776
10+	11041	10933	7566	5480	5254	3787	3090	2706	2168	2346	1859	2157	1687

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	62738	75916	93214	20602	15843	16923	24670	53566	19138	22909	18663	8689	10622
2	13692	35018	41745	53056	11049	8652	9419	13512	30207	10472	12807	10656	4741
3	3587	9340	23911	28508	37838	7145	5917	6378	8658	20198	7030	8802	7281
4	5593	2464	6154	15946	17271	25946	4336	3478	3899	5194	12019	4594	5401
5	3805	3278	1602	3545	9142	8811	15821	2443	1721	2274	2968	6804	2640
6	3717	2111	1905	959	1765	4526	4769	8871	1312	1025	1203	1749	3745
7	2269	2277	1260	1089	534	812	2473	2674	4627	842	628	671	980
8	2472	1396	1428	781	581	269	455	1468	1497	2579	558	382	380
9	386	1607	926	865	439	293	147	258	831	936	1459	368	228
10+	1557	1189	1815	1765	1533	1078	780	563	487	838	1121	1536	1149

age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	31525	28084	22249	28024	17278	9057	11501	12209	10107	6371	8164	9132	11885
2	5651	17512	15103	11895	15536	9434	4857	6309	6665	5538	3499	4491	5008
3	3006	3687	11331	9515	7626	10306	6050	3214	3977	4294	3565	2310	2980
4	4549	1766	2098	6372	5735	4561	6063	3438	1792	2177	2316	2084	1371
5	2851	2489	942	1206	3505	3437	2713	2997	1786	1085	1082	1317	1313
6	1502	1534	1308	523	702	2066	1982	1530	1573	1070	571	616	837
7	2056	856	840	729	318	418	1135	1039	931	899	588	349	377
8	579	1172	484	492	446	214	256	618	587	601	514	371	231
9	224	343	672	280	309	286	132	144	340	394	357	320	255
10+	829	644	598	784	703	671	614	474	389	447	511	567	563

age	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	7736	3753	4864	4780	6291	8693	18462	12528	23621	16786	30392	10363	11167	14146
2	6635	4330	2051	2694	2680	3472	4743	10321	6693	13100	9022	16984	5571	6177
3	3258	4481	3088	1423	1846	1788	2359	3117	7219	4618	8920	5996	11574	3735
4	1831	2056	3041	2154	1003	1302	1222	1731	2180	5257	3418	5839	4150	8110
5	819	1128	1350	2015	1405	711	946	876	1368	1614	3810	2356	3836	2803
6	835	514	717	897	1361	921	506	704	644	1077	1290	2580	1618	2580
7	554	558	336	471	602	1002	641	361	534	488	822	982	1796	1136
8	223	379	388	215	344	426	754	475	259	397	388	576	724	1239
9	159	152	265	274	147	242	315	567	362	192	304	290	404	550
10+	530	482	441	485	562	527	573	678	936	967	845	816	776	829

Table 31.12. Sol.27.7a – Spawning stock biomass-at-age (start of year, in tonnes).

age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	12	5	14	8	8	6	21	13	10	7	5	3	5
2	218	488	168	588	298	287	191	500	331	348	259	209	82
3	1666	733	1853	618	2298	1137	1052	645	1801	1225	1320	999	796
4	1062	1921	813	2074	701	2519	1231	1258	728	2613	1556	1475	1100
5	443	998	1629	635	1785	575	2156	955	1110	652	2242	1222	1302
6	1818	356	774	1124	484	1309	409	1569	725	816	419	1534	957
7	400	1461	286	567	777	366	943	308	1163	528	540	257	1183
8	349	313	1132	210	428	559	282	677	236	810	341	367	205
9	1625	265	243	806	146	319	403	213	511	175	525	211	289
10+	4368	4458	3285	2340	2102	1448	1491	1102	973	1265	897	991	779

age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	14	19	25	5	4	3	10	4	2	4	1	0	1	5
2	266	688	710	827	181	128	151	258	426	93	113	35	25	64
3	335	1158	2744	2647	3213	488	462	628	981	1607	505	384	434	234
4	901	458	1119	2491	2470	3081	510	527	667	813	1718	509	731	628
5	827	763	377	742	1756	1623	2730	449	360	454	599	1132	474	567
6	993	574	532	246	418	1041	1038	2046	313	248	279	366	859	347
7	712	705	402	326	150	217	653	731	1279	236	170	182	264	557
8	885	482	508	264	188	84	138	468	469	806	167	112	120	184
9	154	608	359	322	160	103	50	92	291	324	472	113	86	82
10+	822	559	832	785	753	500	334	321	205	333	414	649	517	338

age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	1	1	1	8	2	13	43	60	11	20	19	1	8
2	87	82	73	243	114	184	365	568	312	114	232	82	191
3	267	810	742	793	636	734	491	762	752	431	337	283	334
4	215	306	902	927	690	1006	722	461	570	420	450	262	340
5	403	182	226	797	716	698	783	617	360	266	385	271	205
6	354	287	120	191	542	569	505	599	426	157	193	247	237
7	223	233	159	107	143	354	382	365	371	206	121	89	173
8	343	156	142	146	93	105	212	264	212	190	144	87	90
9	103	238	93	115	93	45	75	168	164	133	124	88	66
10+	252	249	313	337	291	234	218	219	245	266	283	198	201

age	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	6	22	20	5	5	6	42	53	105	141	53	68	130
2	159	107	116	108	94	106	545	221	644	458	855	308	354
3	541	426	183	233	211	232	484	901	643	1149	790	1504	438
4	419	591	411	171	238	209	377	476	1224	704	1269	877	1466
5	298	375	510	343	169	216	254	395	522	1066	615	1088	627
6	176	246	288	382	267	147	205	251	419	458	798	508	741
7	198	118	176	184	330	211	133	197	233	311	337	622	332
8	139	149	92	128	148	248	193	112	206	170	203	267	410
9	69	105	104	72	90	118	220	159	113	164	119	166	165
10+	207	190	237	253	231	255	313	403	414	417	399	399	322

Table 31.13. Sol.27.7a – Summary ('Catch' refers to model estimate).

year	R(age1) _low	R(age1) _value	R(age1) _high	TSB _low	TSB _value	TSB _high	SSB _low	SSB _value	SSB _high	Catch _low	Catch _value	Catch _high	Fbar (3-7) _low	Fbar (3-7) _value	Fbar (3-7) _high
1970	35018	50014	71432	12985	15963	19624	9402	11962	15218	1338	1766	2332	0.122	0.167	0.227
1971	13943	19827	28193	12042	14706	17959	8743	10997	13832	1482	1884	2396	0.139	0.186	0.249
1972	42049	59368	83821	11933	14434	17459	8179	10195	12709	1220	1544	1955	0.127	0.171	0.229
1973	23470	32981	46346	11250	13505	16212	7266	8971	11076	1098	1381	1738	0.128	0.172	0.23
1974	22771	32053	45117	10965	13066	15568	7428	9029	10975	1069	1342	1684	0.128	0.171	0.228
1975	16253	22897	32257	10019	11876	14079	7065	8526	10289	1131	1419	1780	0.136	0.18	0.239
1976	47473	67007	94577	11229	13299	15750	6763	8179	9892	1186	1498	1894	0.144	0.193	0.257
1977	31648	44003	61182	10267	12087	14231	6013	7239	8716	922	1164	1468	0.128	0.17	0.225
1978	27573	38410	53507	9967	11671	13666	6358	7588	9055	917	1154	1454	0.128	0.169	0.224
1979	19650	27423	38272	10446	12153	14138	7140	8438	9972	1335	1676	2105	0.162	0.213	0.279
1980	14993	20917	29182	9633	11179	12972	6893	8104	9529	1476	1848	2314	0.195	0.255	0.334
1981	7217	10107	14155	8228	9590	11179	6152	7267	8585	1243	1564	1967	0.171	0.223	0.29
1982	17896	24902	34651	7482	8723	10170	5650	6698	7939	1114	1413	1792	0.159	0.209	0.274
1983	45348	62738	86796	8236	9572	11125	4969	5909	7025	955	1207	1525	0.165	0.216	0.282
1984	54982	75916	104819	10671	12437	14495	5140	6014	7037	783	989	1250	0.148	0.194	0.254
1985	65528	93214	132598	13682	15938	18566	6559	7609	8826	1020	1292	1635	0.175	0.227	0.294
1986	14941	20602	28409	12721	14701	16989	7523	8656	9959	1636	2065	2606	0.243	0.311	0.399
1987	11786	15843	21297	11362	13065	15022	8049	9292	10727	2321	2933	3706	0.294	0.375	0.478
1988	12691	16923	22567	8845	10119	11577	6301	7268	8382	1693	2134	2689	0.227	0.29	0.371
1989	18454	24670	32979	7299	8374	9606	5232	6077	7060	1387	1752	2213	0.205	0.263	0.336
1990	40140	53566	71481	7137	8185	9386	4743	5525	6436	1210	1557	2004	0.245	0.316	0.407
1991	14346	19138	25530	6572	7539	8648	4314	4994	5780	818	1041	1325	0.193	0.249	0.323
1992	17201	22909	30510	6877	7864	8992	4253	4918	5686	964	1215	1530	0.196	0.251	0.32
1993	13909	18663	25042	5929	6765	7718	3842	4437	5125	890	1118	1404	0.19	0.245	0.315
1994	6511	8689	11597	5540	6331	7234	2992	3483	4054	1115	1386	1724	0.225	0.287	0.365
1995	7948	10622	14196	5088	5828	6675	3016	3510	4085	986	1239	1555	0.235	0.3	0.382
1996	23567	31525	42170	4664	5356	6151	2578	3005	3504	795	990	1232	0.245	0.312	0.396
1997	20936	28084	37672	4695	5417	6249	1913	2248	2643	731	914	1143	0.263	0.333	0.422
1998	16624	22249	29777	5213	6023	6959	2174	2544	2977	772	983	1252	0.24	0.307	0.392
1999	21036	28024	37333	5605	6443	7406	2378	2772	3230	732	926	1173	0.19	0.246	0.319
2000	12958	17278	23039	5538	6365	7315	3154	3664	4257	697	880	1112	0.167	0.218	0.285
2001	6771	9057	12116	5222	6004	6903	2850	3320	3869	852	1077	1362	0.199	0.259	0.337
2002	8565	11501	15443	4350	5017	5786	3391	3942	4584	881	1105	1387	0.253	0.328	0.426
2003	9156	12209	16281	3962	4622	5391	3226	3795	4464	839	1051	1317	0.232	0.305	0.399
2004	7564	10107	13503	4129	4850	5698	3447	4083	4836	607	780	1002	0.168	0.226	0.305
2005	4756	6371	8535	3572	4202	4943	2882	3422	4064	657	834	1060	0.251	0.334	0.445
2006	6097	8164	10932	2809	3349	3993	1806	2203	2686	418	526	661	0.183	0.245	0.327
2007	6819	9132	12231	2770	3308	3951	1877	2287	2786	332	421	534	0.14	0.19	0.257
2008	8832	11885	15995	2511	2990	3560	1314	1608	1969	260	328	414	0.149	0.2	0.27
2009	5698	7736	10504	2380	2844	3398	1516	1846	2248	248	315	400	0.119	0.161	0.218
2010	2761	3753	5102	2400	2879	3454	1825	2213	2682	249	314	396	0.115	0.154	0.208
2011	3590	4864	6588	2343	2816	3384	1922	2330	2824	264	332	417	0.112	0.151	0.203
2012	3522	4780	6487	2212	2685	3259	1740	2137	2624	202	257	327	0.096	0.131	0.178

2013	4641	6291	8528	2049	2499	3048	1518	1881	2332	138	174	218	0.076	0.103	0.139
2014	6394	8693	11818	2045	2495	3043	1431	1783	2220	84	106	134	0.047	0.064	0.086
2015	13615	18462	25034	2513	3041	3679	1409	1747	2167	62	78	98	0.032	0.044	0.059
2016	9248	12528	16970	3005	3608	4332	2285	2765	3345	34	43	55	0.015	0.02	0.027
2017	17407	23621	32054	4170	4967	5918	2636	3168	3808	31	40	51	0.009	0.012	0.016
2018	12293	16786	22921	4929	5835	6908	3805	4523	5376	37	47	61	0.009	0.012	0.017
2019	21720	30392	42525	5592	6611	7816	4255	5039	5968	253	329	427	0.056	0.076	0.105
2020	7219	10363	14877	5376	6393	7601	4567	5439	6476	331	419	531	0.069	0.093	0.126
2021	7072	11167	17633	5425	6486	7755	4841	5808	6968	413	523	661	0.075	0.102	0.138
2022	6067	14146	32985	4660	5724	7030	4105	4986	6055	446	568	723	0.109	0.153	0.212

Table 31.14. Sol.27.7a – Short term forecast.

Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{ages\ 3–7}$ (2023)	0.108	Based on a catch of 443 tonnes for 2023 (WG estimated catch)
SSB(2024)	5088	Short-term forecast; in tonnes.
$R_{age\ 1}$ (2023)	16786	Median recruitment, resampled from the years 2015–2021; in thousands.
$R_{age\ 1}$ (2024)	16786	Median recruitment, resampled from the years 2015–2021; in thousands.
Catch (2023)	443	TAC for 2023; in tonnes.
Projected landings (2023)	396	Assuming average landings ratio by age 2020-2022; in tonnes.
Projected discards (2023)	47	Assuming average discard ratio by age 2020-2022; in tonnes.

Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2024)	Projected landings* (2024)	Projected discards** (2024)	F_{total} (2024)	$F_{projected\ landings}$ (2024)	$F_{projected\ discards}$ (2024)	SSB (2025)	% SSB change ***	% TAC change ^	% advice change^^
ICES advice basis										
MSY approach: F = F_{MSY}	625	551	74	0.164	0.134	0.03	4923	-3.2	3.3	-
Other scenarios										
$F_{MSY\ lower}$	485	428	57	0.125	0.102	0.023	5060	-0.55	-19.8	-
$F_{MSY\ upper}$	692	610	82	0.183	0.149	0.034	4860	-4.5	14.4	-
F = 0	0	0	0	0	0	0	5535	8.8	-100	-
F= F_{pa}	692	610	82	0.183	0.149	0.034	4860	-4.5	14.4	-
F= F_{lim}	1835	1610	225	0.57	0.465	0.105	3786	-26	200	-
SSB_{2025} = B_{lim}	3553	3069	484	1.61	1.314	0.296	2235	-56	490	-
SSB_{2025} = B_{pa} = MSY $B_{trigger}$	2553	2233	320	0.904	0.738	0.166	3129	-39	320	-
F = F_{2023}	422	372	50	0.108	0.088	0.02	5121	0.65	-30	-
SSB_{2025} = SSB_{2024}	457	403	54	0.117	0.096	0.021	5088	0	-24	-

*** Marketable landings, assuming recent discard rate.**

**** Including BMS landings (EU stocks), assuming recent discard rate.**

***** SSB 2025 relative to SSB 2024.**

^ Total catch in 2024 relative to TAC 2023 (605 tonnes).

^^ advice values for 2024 relative to the previous advice for 2024. This is not provided because catch advice in 2023 was zero.

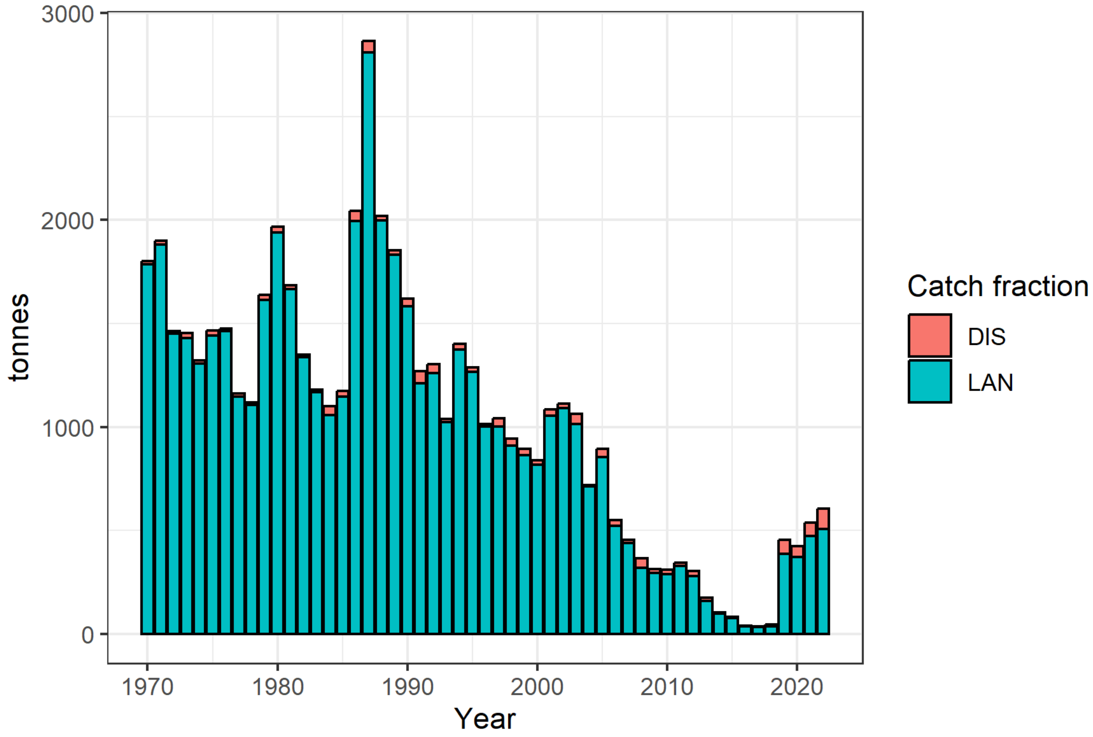


Figure 31.1. Sol.27.7a - Landings and discards estimates by weight, as used by the WG.

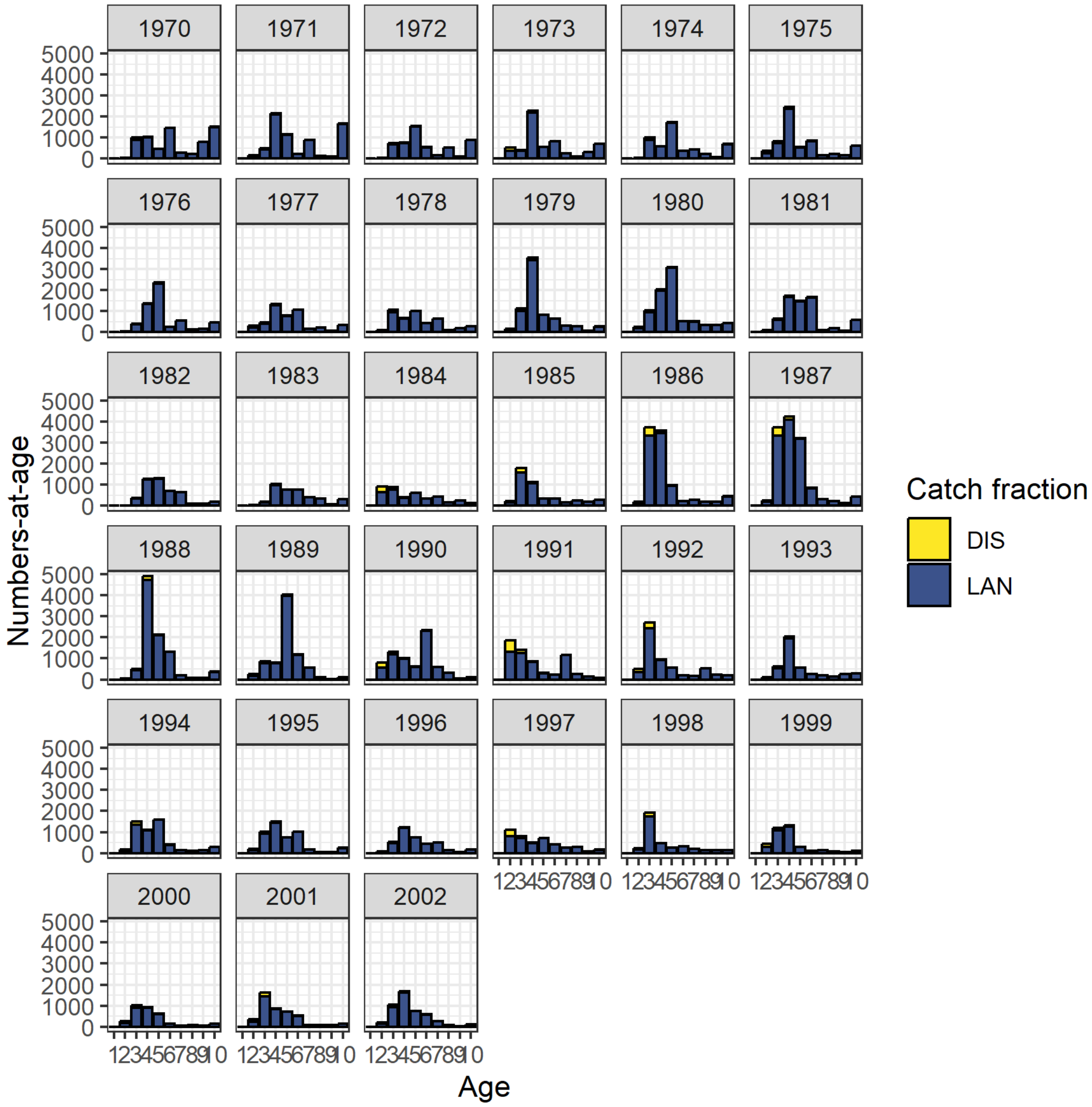


Figure 31.2a. Sol.27.7a - Age composition of catch.

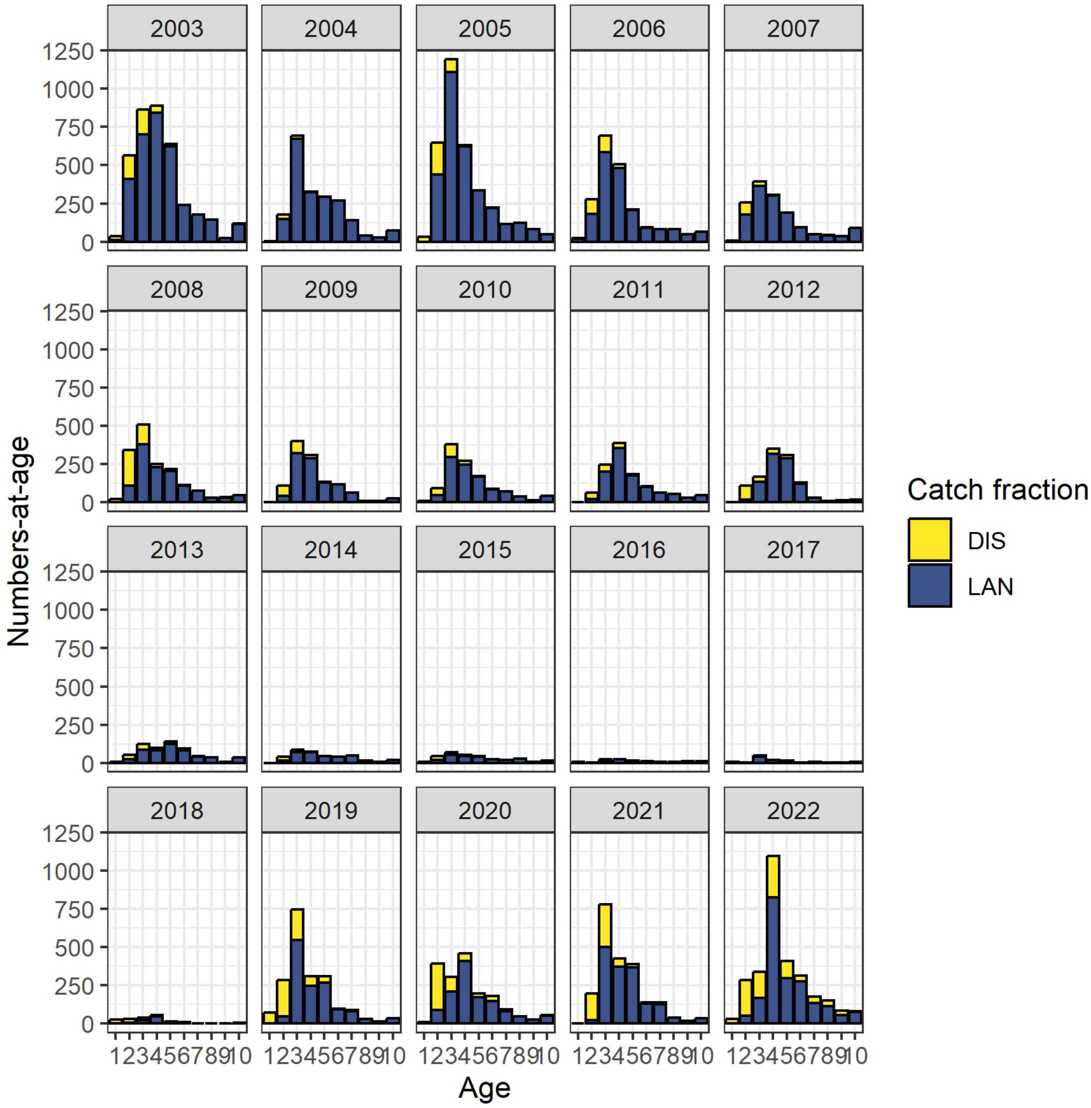


Figure 31.2b. Sol.27.7a - Age composition of catch.

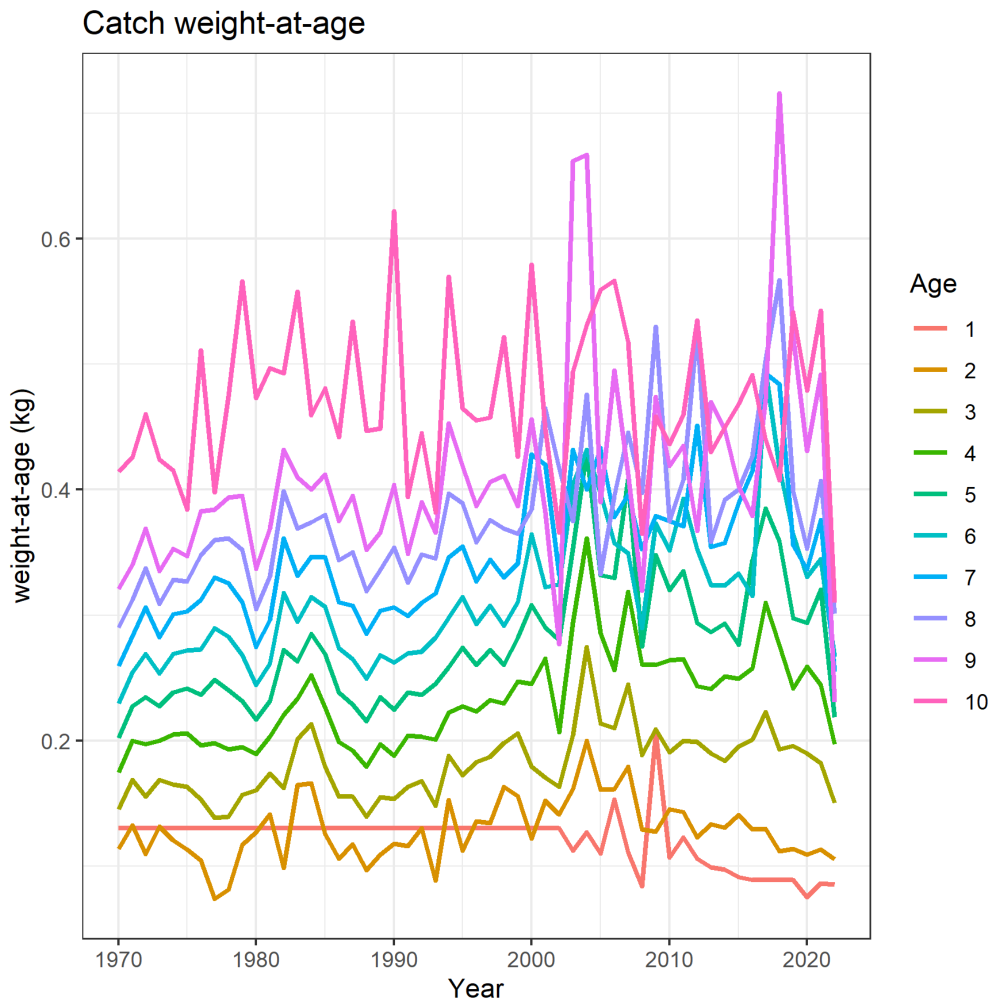


Figure 31.3. Sol.27.7a - Catch weights-at-age (kg).

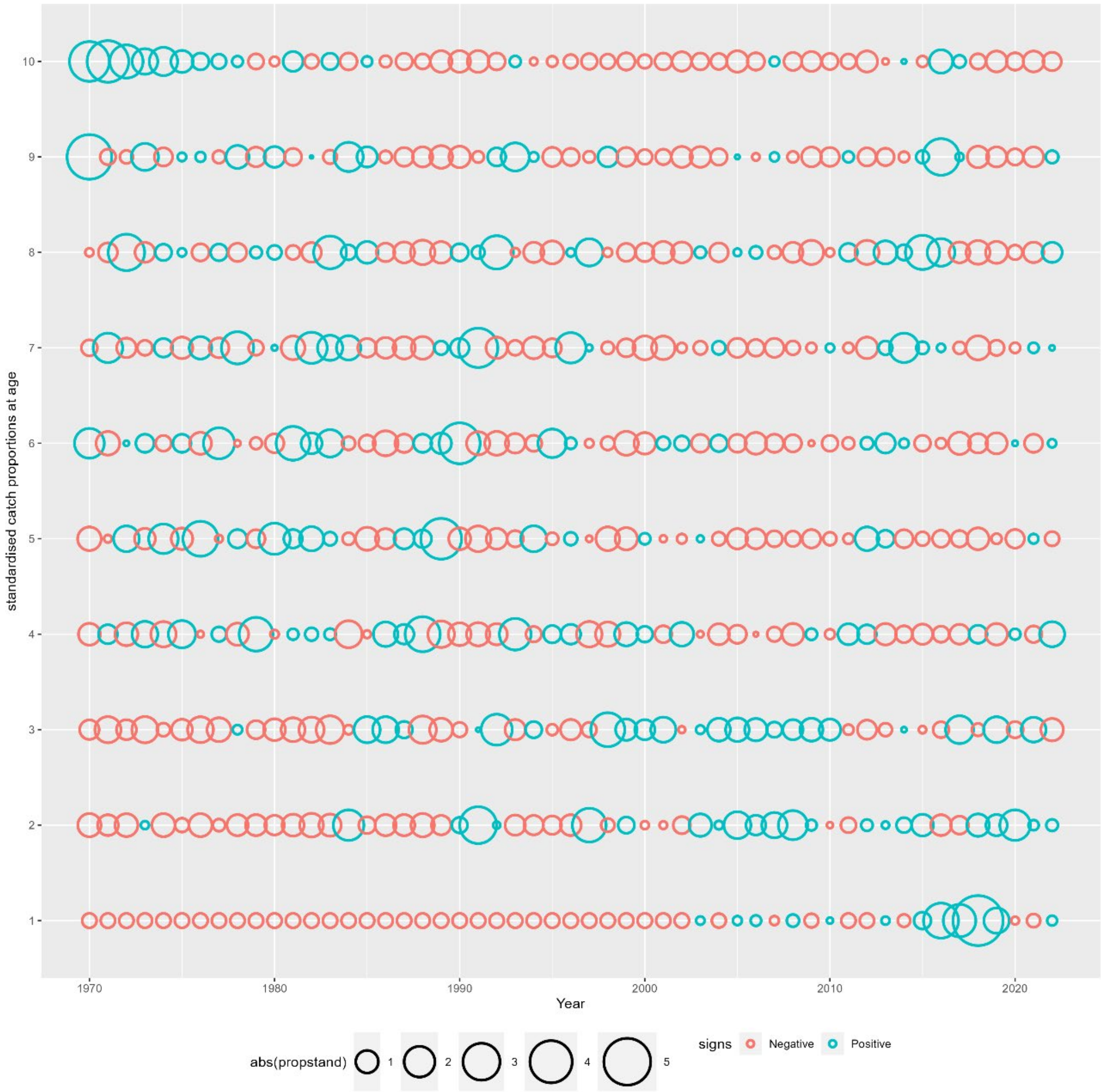


Figure 31.4. Sol.27.7a - Standardized catch proportions.

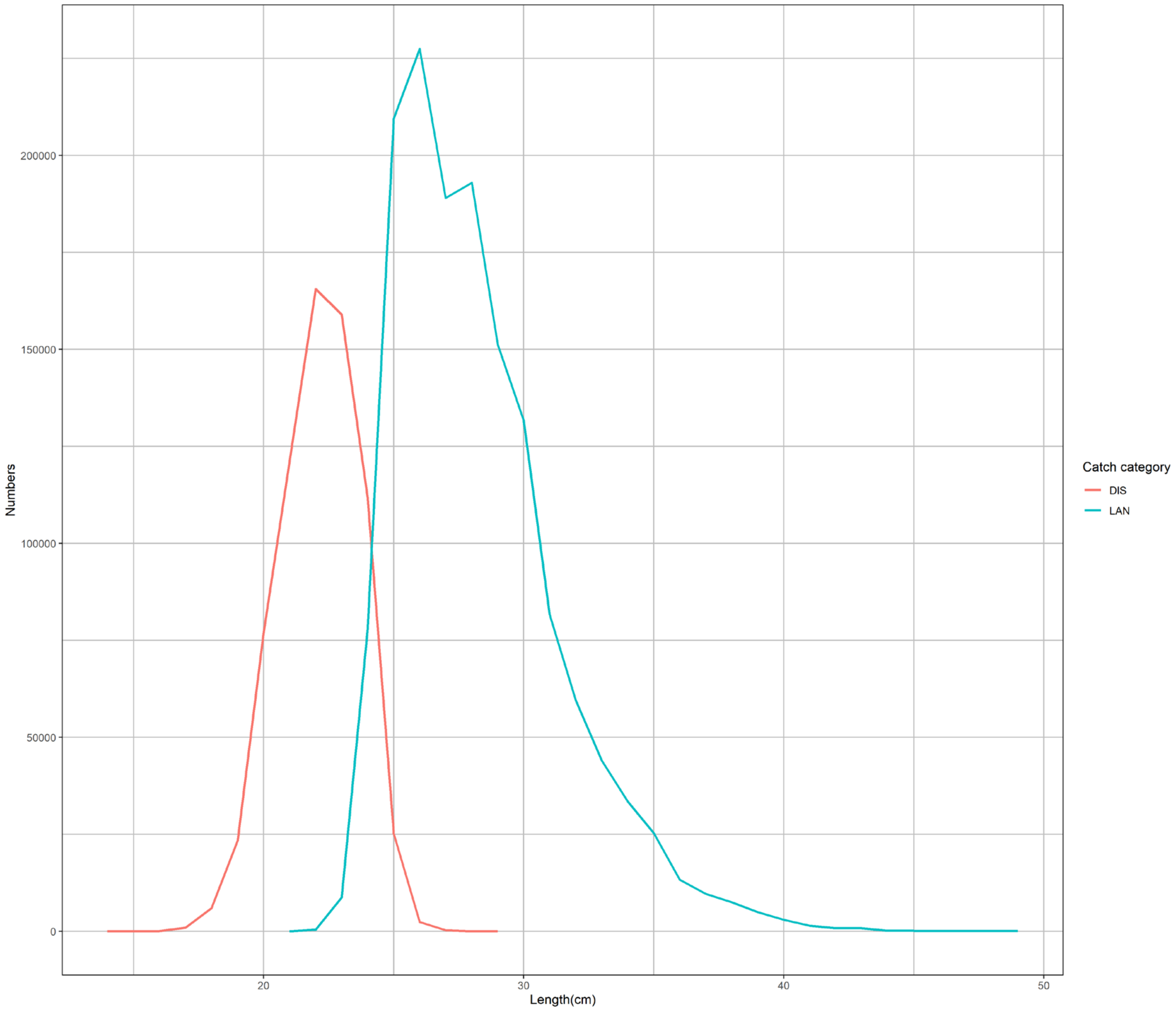


Figure 31.5. Sol.27.7a - BE Length distributions of discarded and retained fish from discard sampling studies in 2022 (Beam trawl).

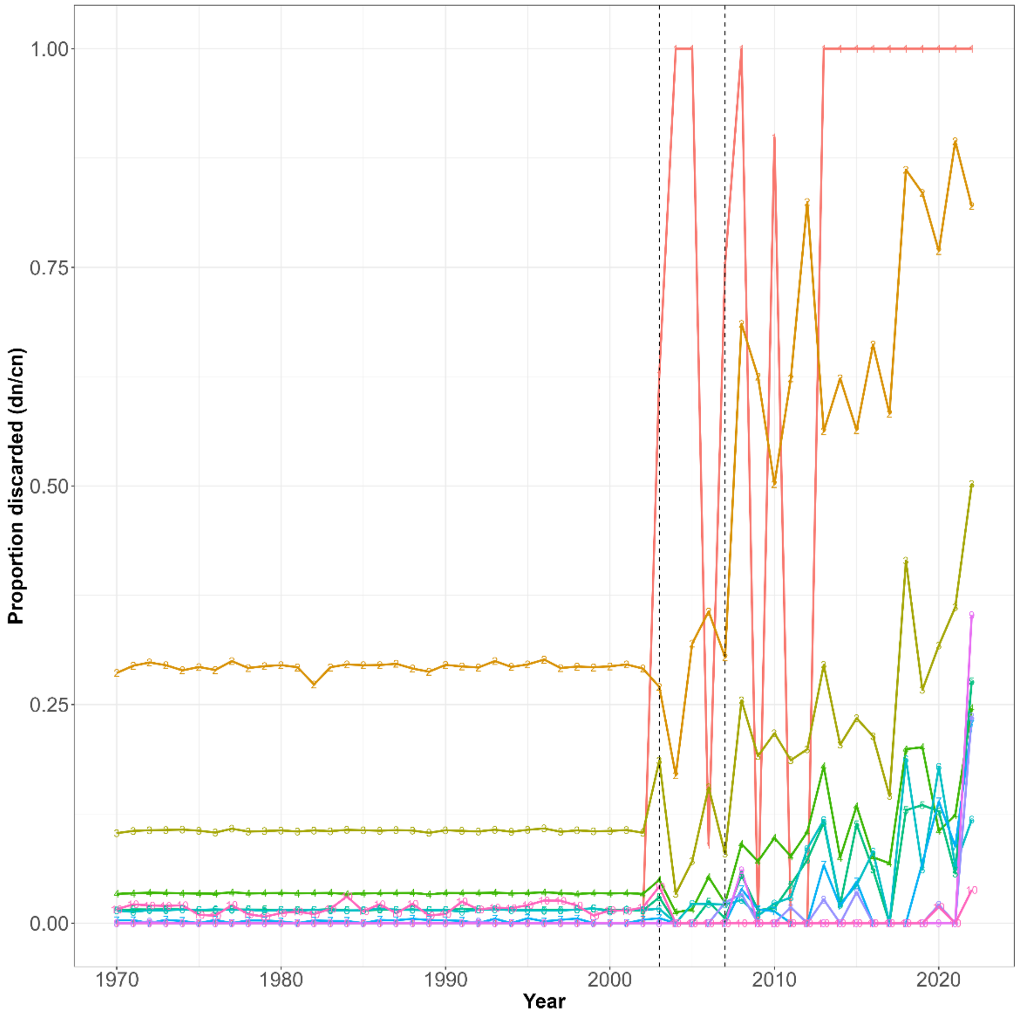


Figure 31.6. Sole 27.7.a - Proportion discarded (discard numbers at age/catch numbers at age) (data prior to 2003 are estimated using an average discard proportion at age for the period 2003-2007 (indicated by dotted lines)).

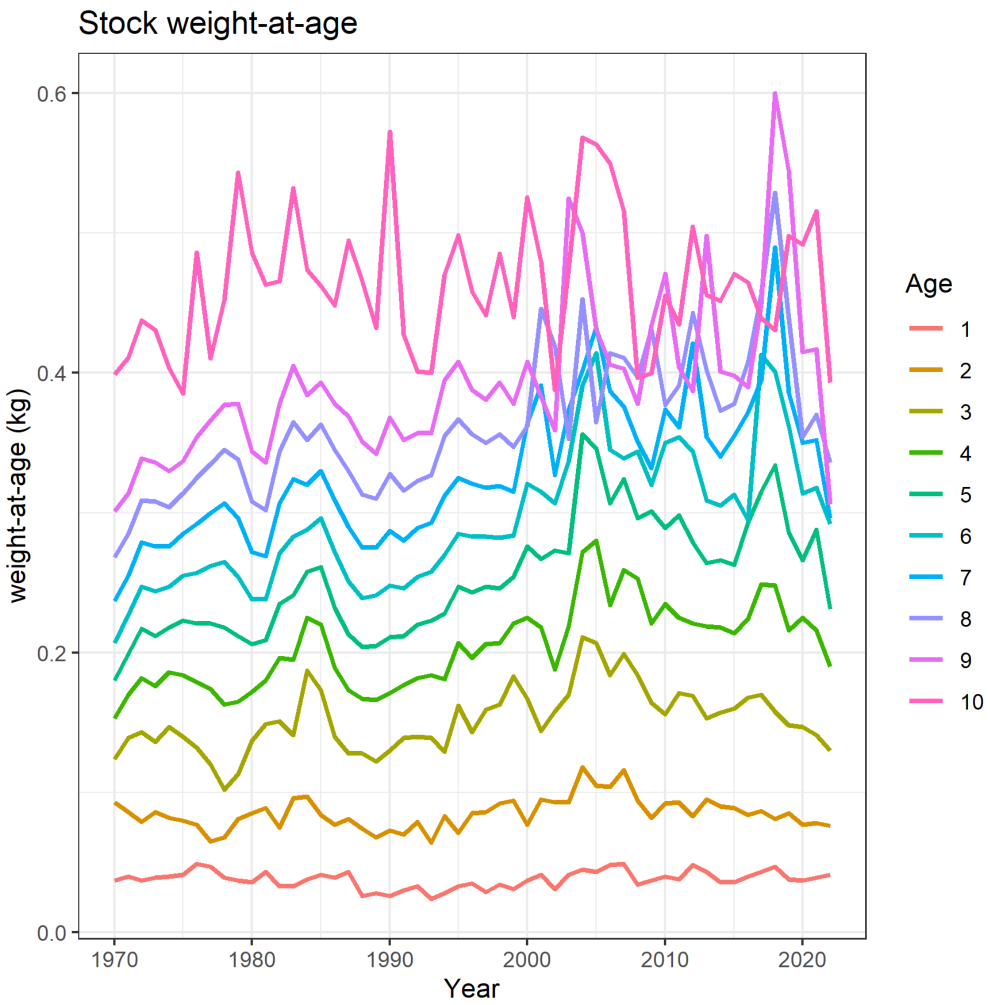


Figure 31.7. Sol.27.7a - Stock weights-at-age (kg).

Figure 31.8. Sol.27.7a - Maturity-at-age.

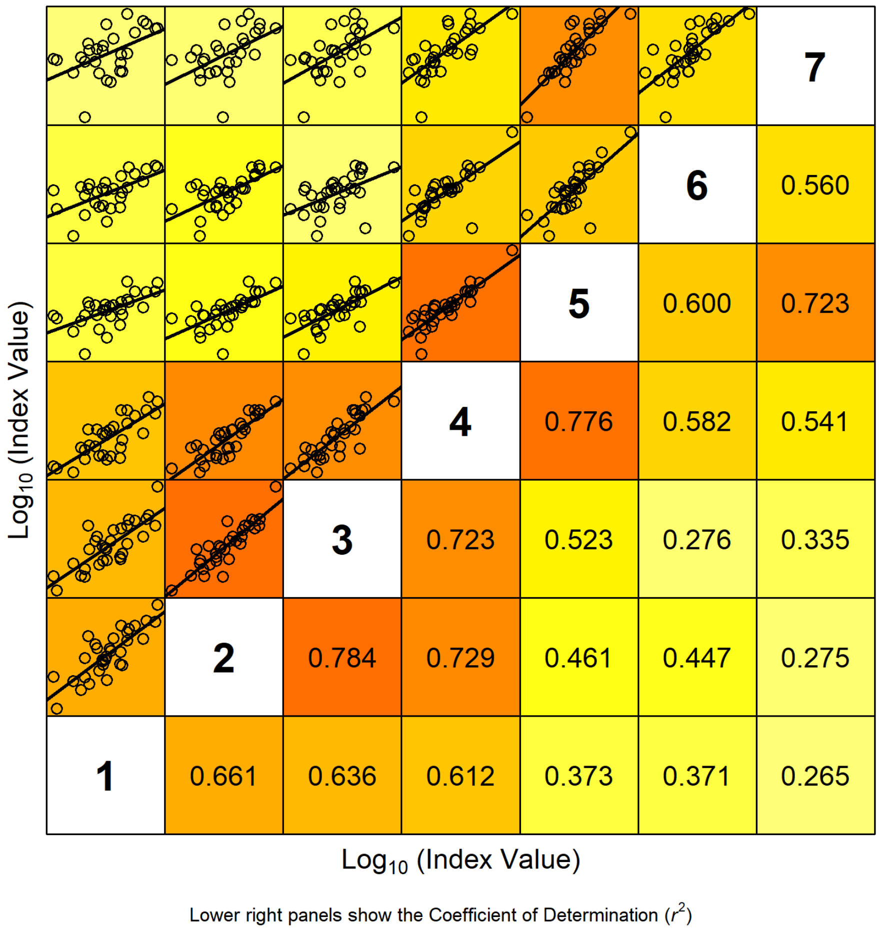


Figure 31.9. Sol.27.7a - Consistency plot UK(E&W)-BTS-Q3 survey.

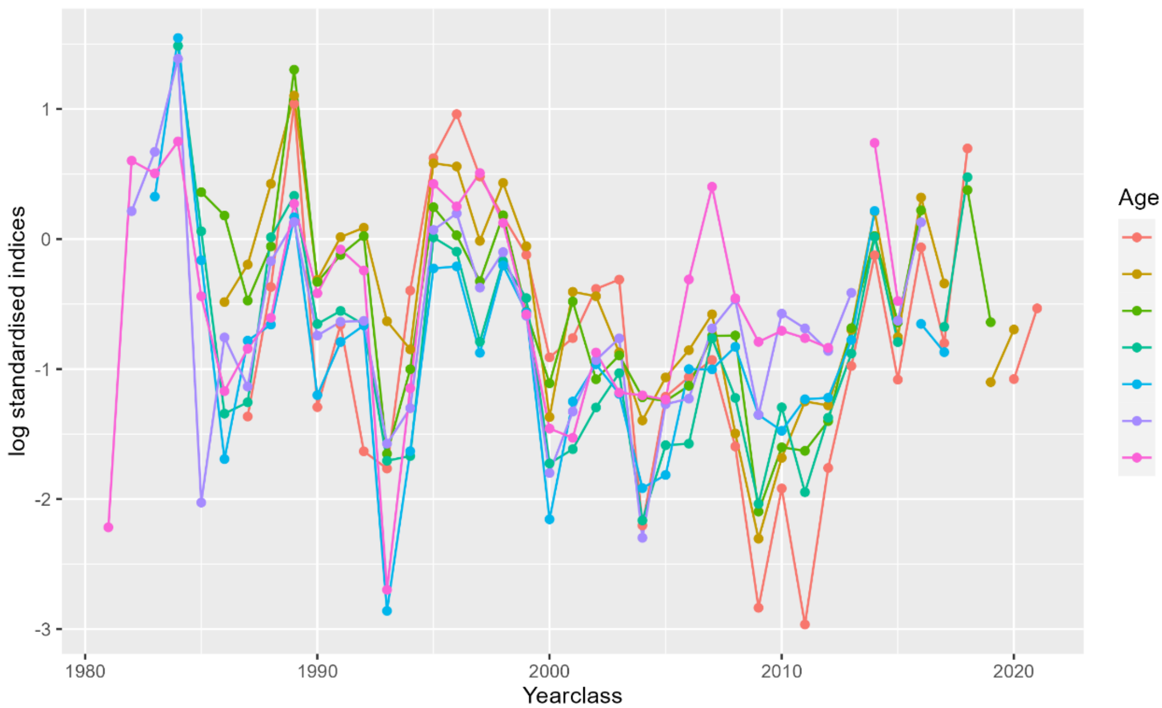


Figure 31.10a. Sol.27.7.a - Mean-standardised indices.

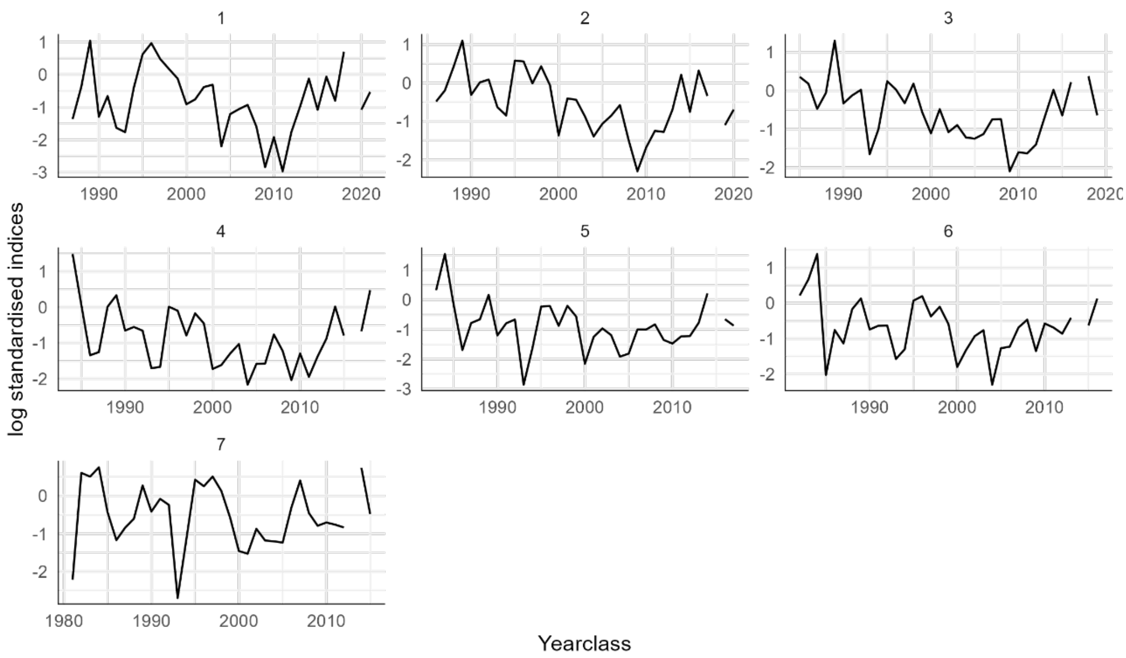


Figure 31.10b. Sol.27.7.a - Mean-standardised indices.

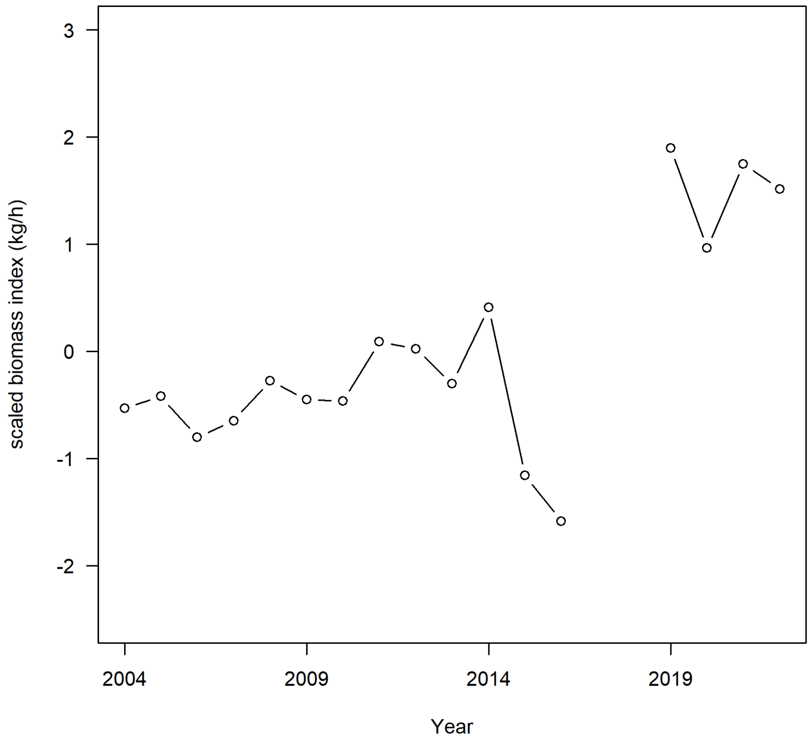


Figure 31.11a. Sol.27.7a - Commercial biomass tuning index (BEL-CBT).

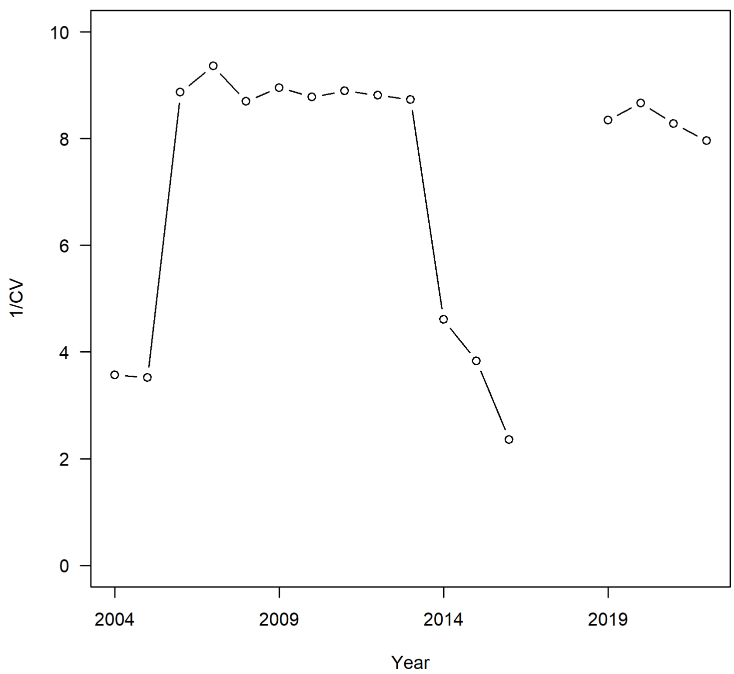


Figure 31.11b. Sol.27.7a- Weighting factor based on 1/CV applied on the biomass tuning series of BEL-CBT.

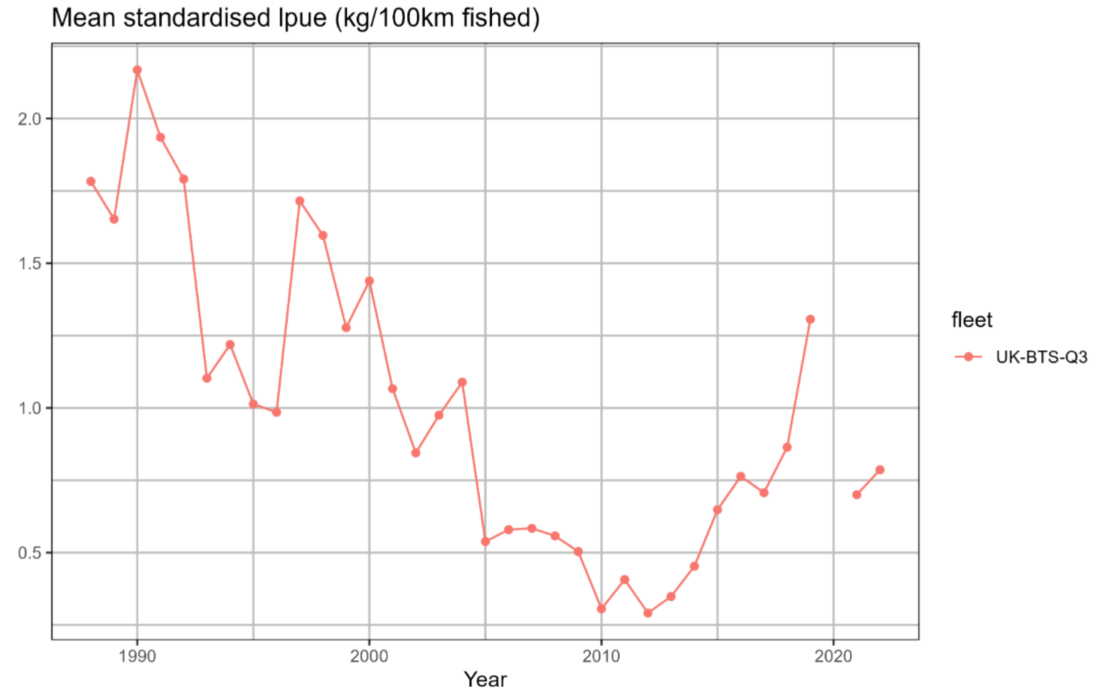
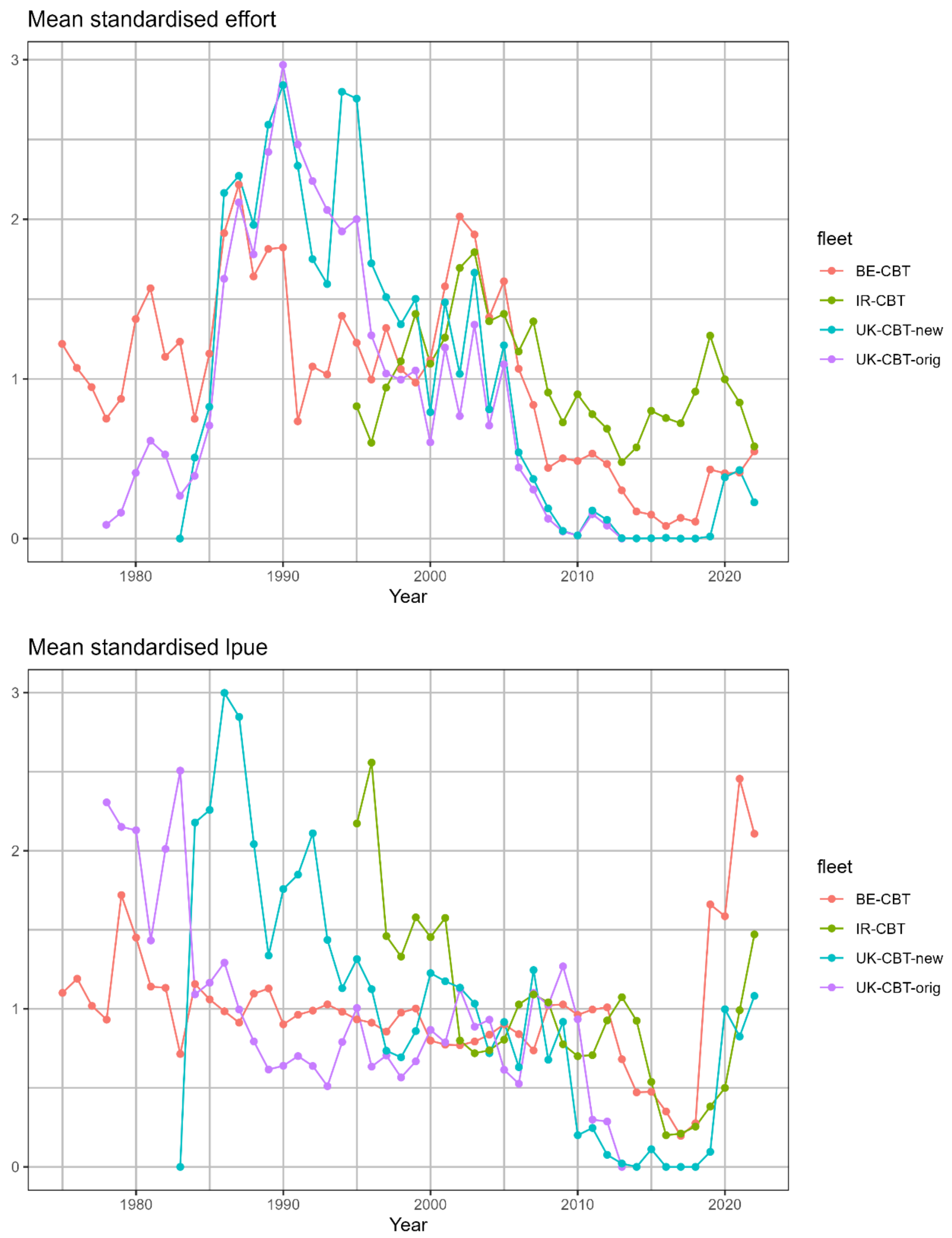


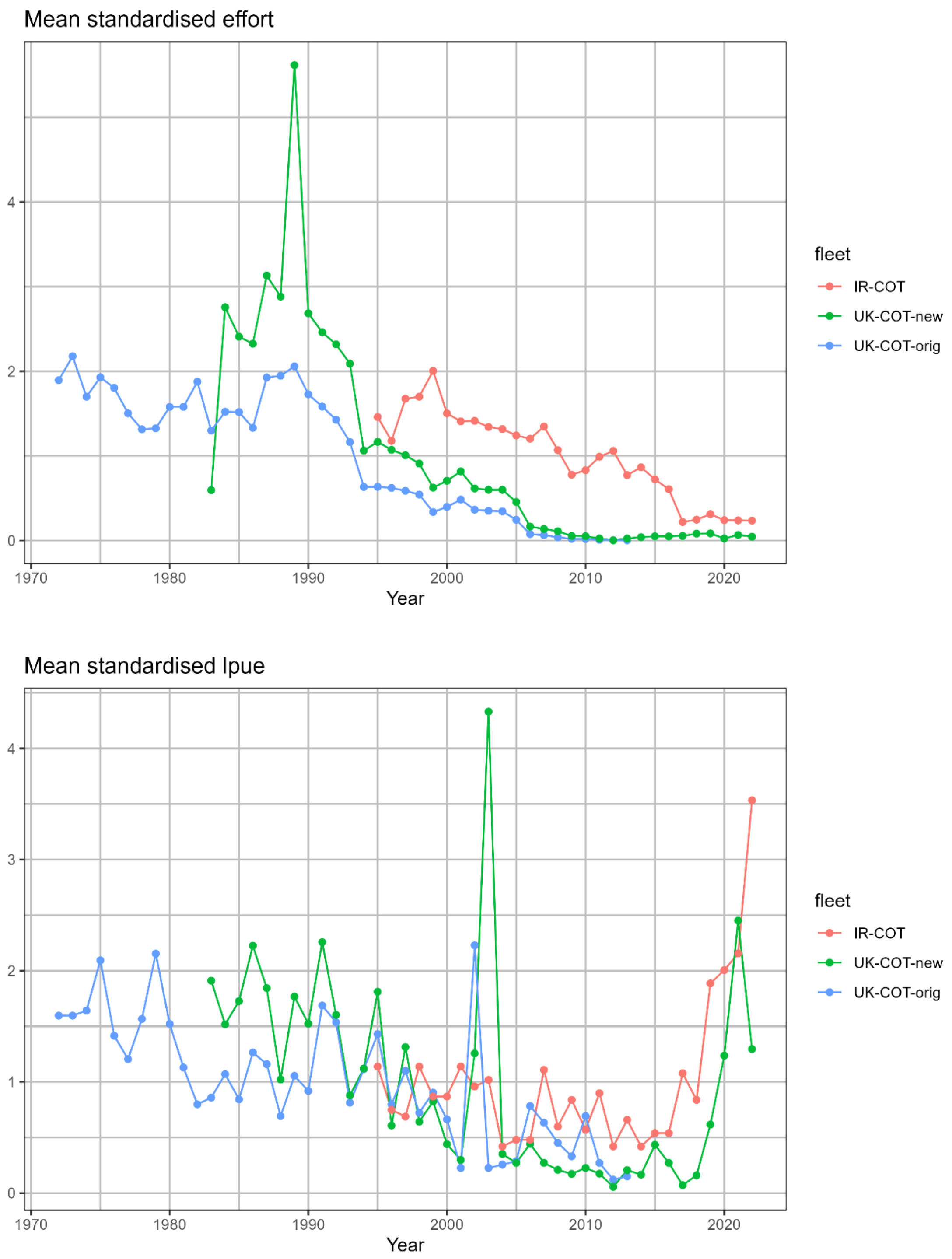
Figure 31.12 Sole in 7.a - Mean standardised LPUE (kg/100 Km fished) for the UK (E&W) September beam-trawl survey (UK(E&W)-BTS-Q3).



LPUE: BE-CBT (without misreporting correction) and IR-CBT: Kg/hr; UK-CBT-new: Kg/day; UK-CBT-orig: Kg/000'hr fished (GRT corrected >40' vessels).

EFFORT: BE-CBT: 000' hours fishing; IR-CBT: 000'hours; UK-CBT-new: days fished; UK-CBT-orig: 000'hours fished (GRT corrected >40' vessels).

Figure 31.13. Sole in 7.a - Mean standardised effort and LPUE for the commercial beam trawl fleets.



LPUE: IR-COT: Kg/hr; UK-COT-new: Kg/day; UK-COT-orig: Kg/000'hr fished (GRT corrected >40' vessels).

EFFORT: IR-CBT: 000'hours; UK-CBT-new: days fished; UK-CBT-orig: 000'hours fished (GRT corrected >40' vessels).

Figure 31.14. Sole in 7.a - Mean standardised effort and LPUE for the commercial otter trawl fleets.

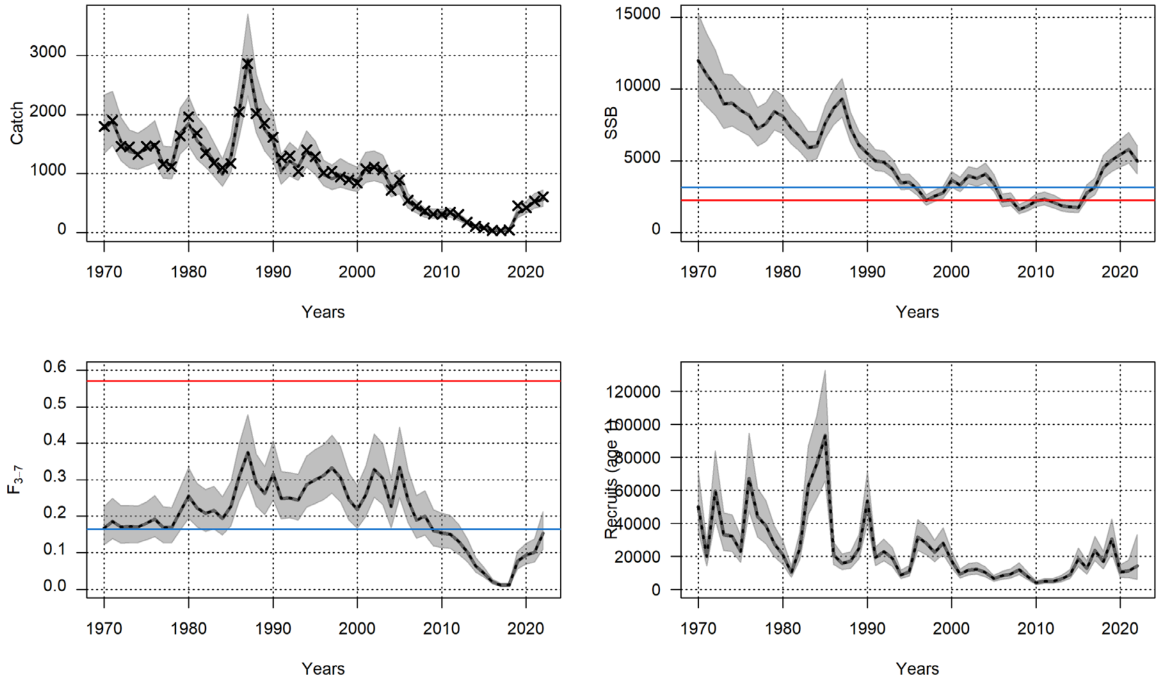


Figure 31.15. Sol.27.7a - Summary plots. Red lines = precautionary reference points (lim) and blue lines = MSY reference points

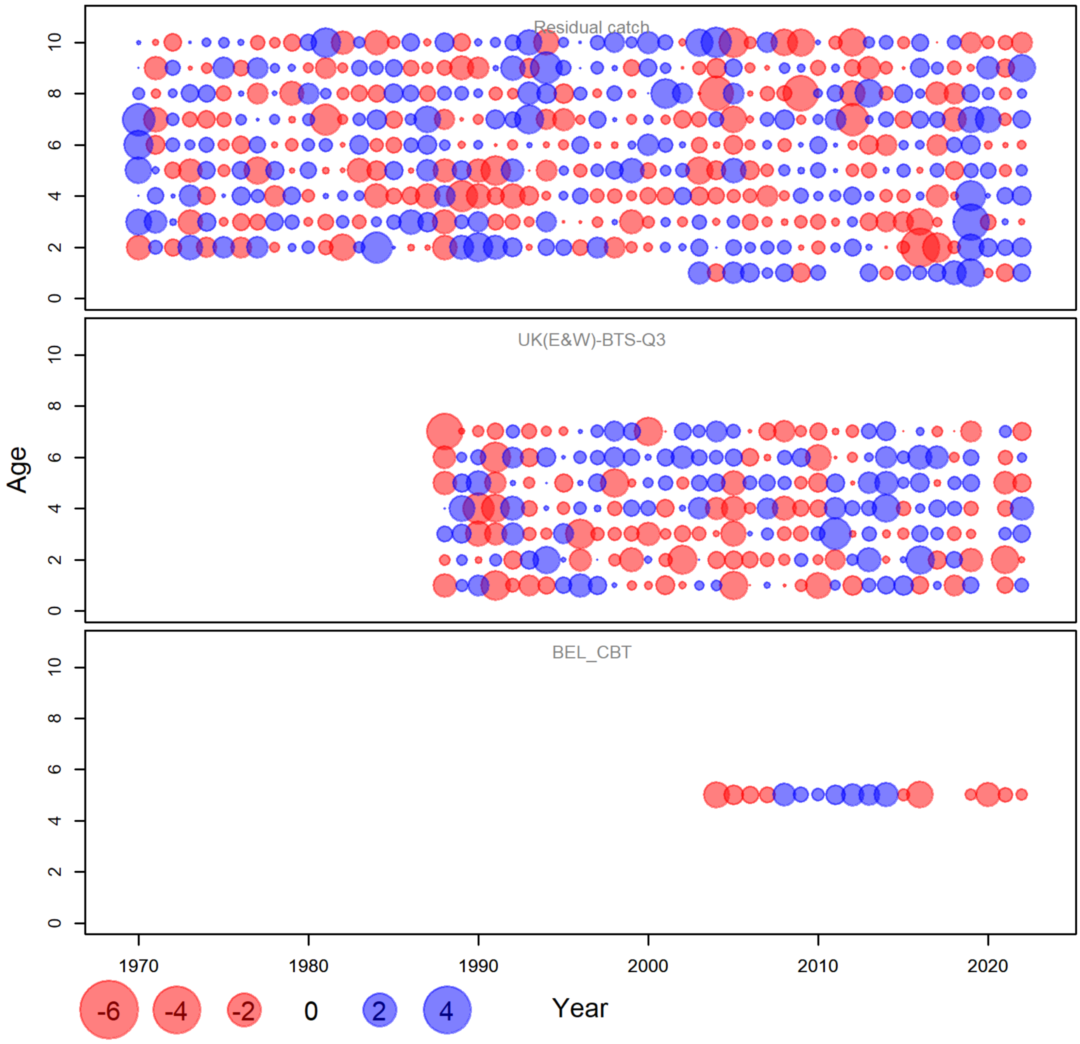


Figure 34.16. Sol.27.7a - One Step Ahead residuals for the final SAM run.

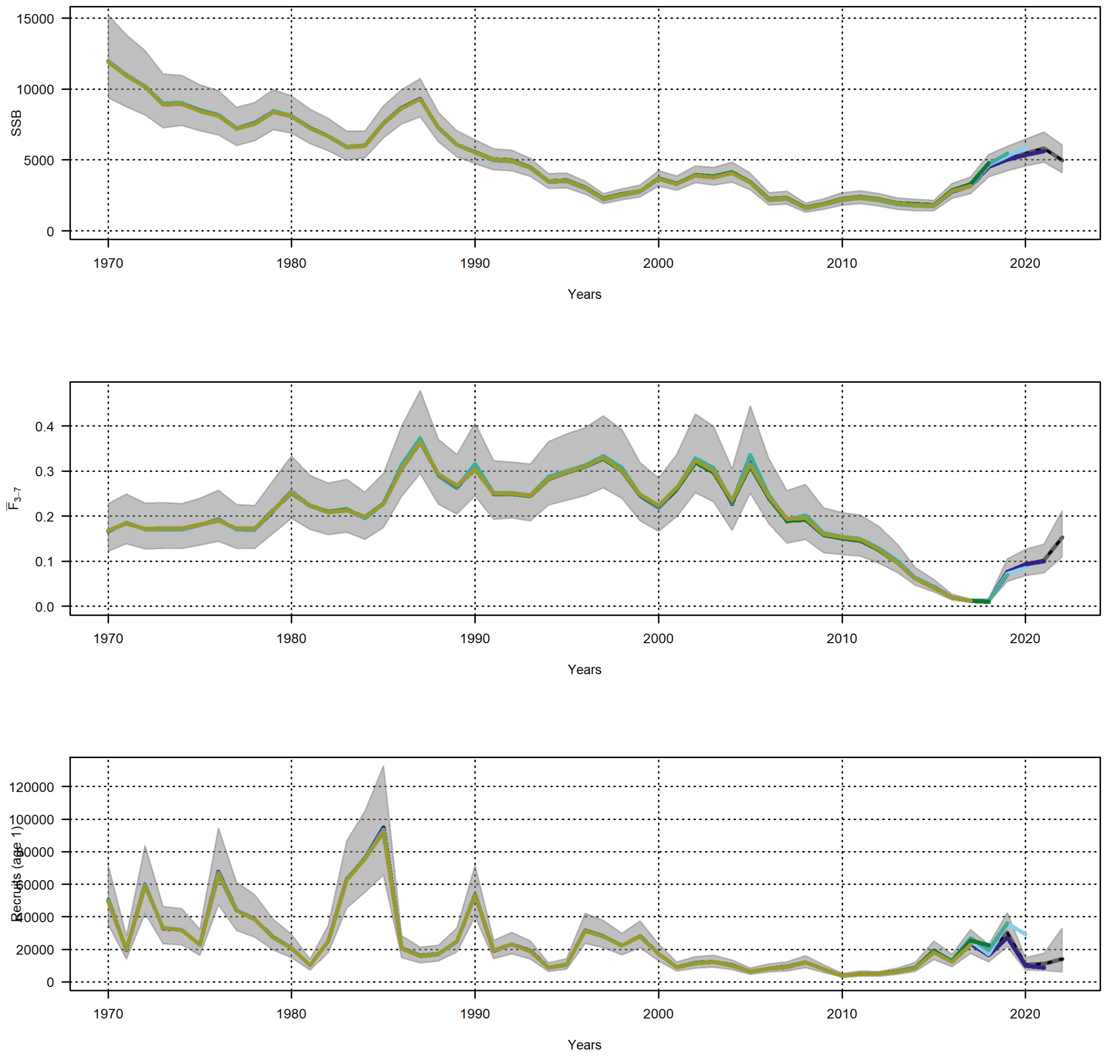


Figure 31.17. Sol.27.7a - Retrospective analysis.

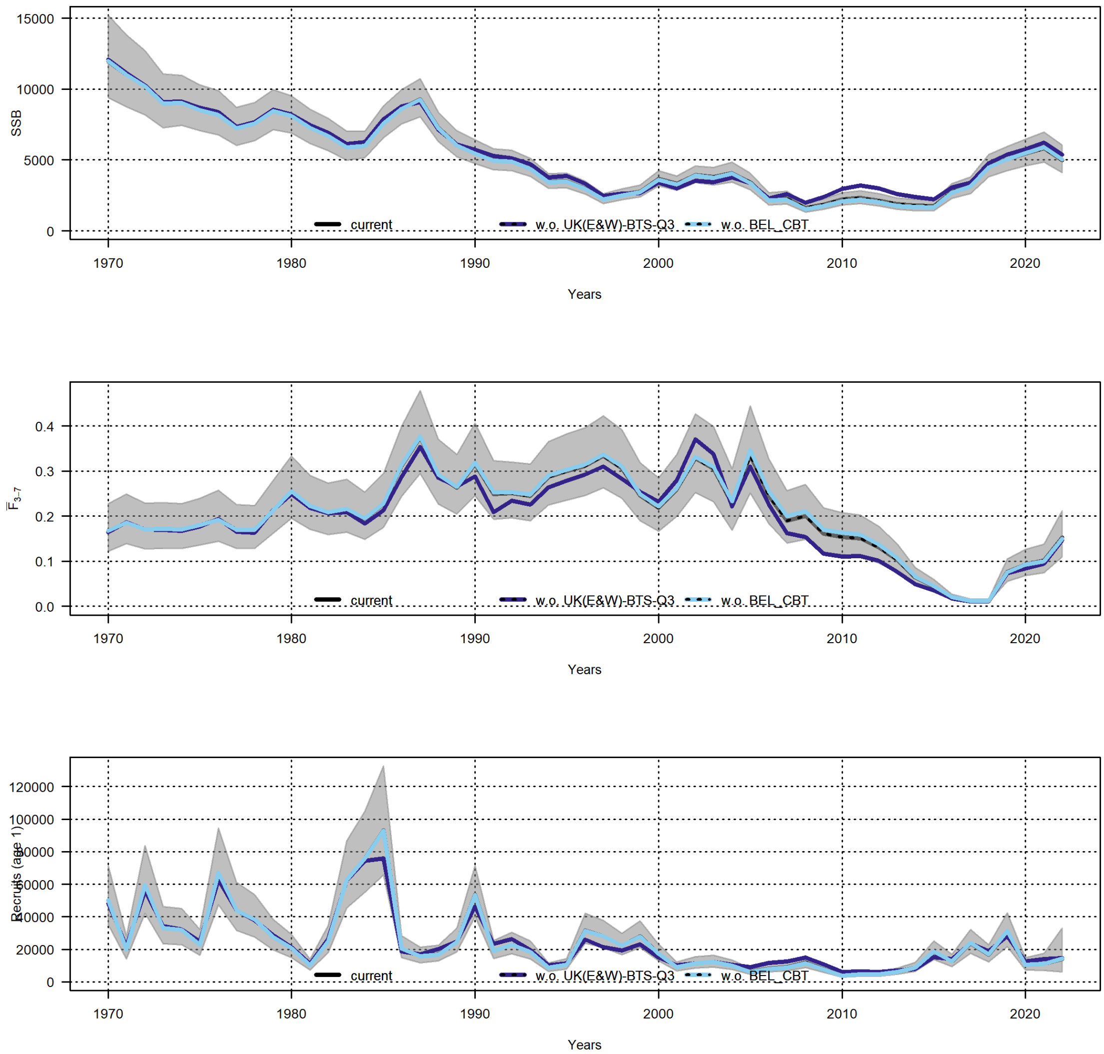


Figure 31.18. Sol.27.7a – Leave-one-out analysis.

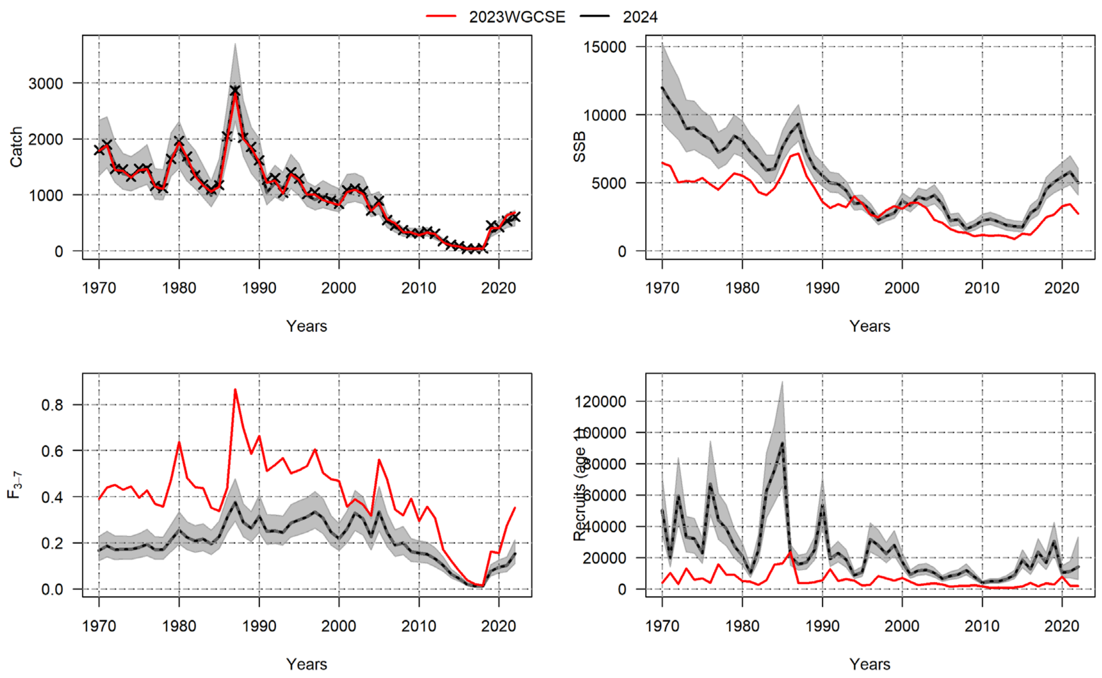


Figure 31.19. Sol.27.7a - comparison with last year's assessment (2023WGCSE).

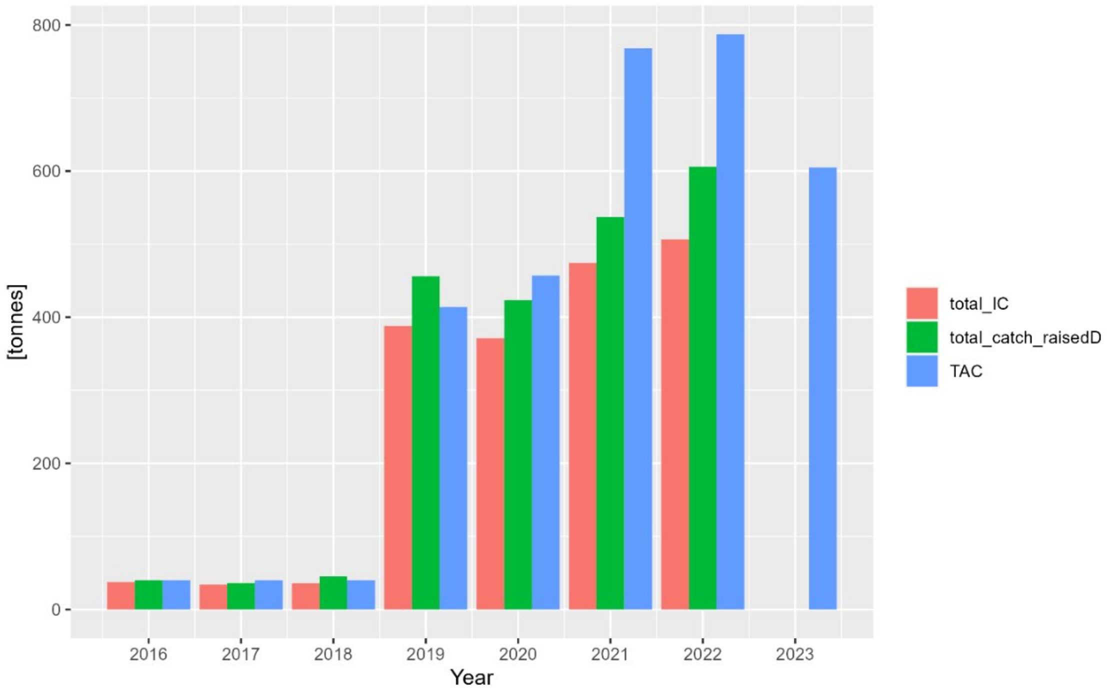


Figure 31.20. Sol.27.7a - Comparison of international TAC, catch and landings.

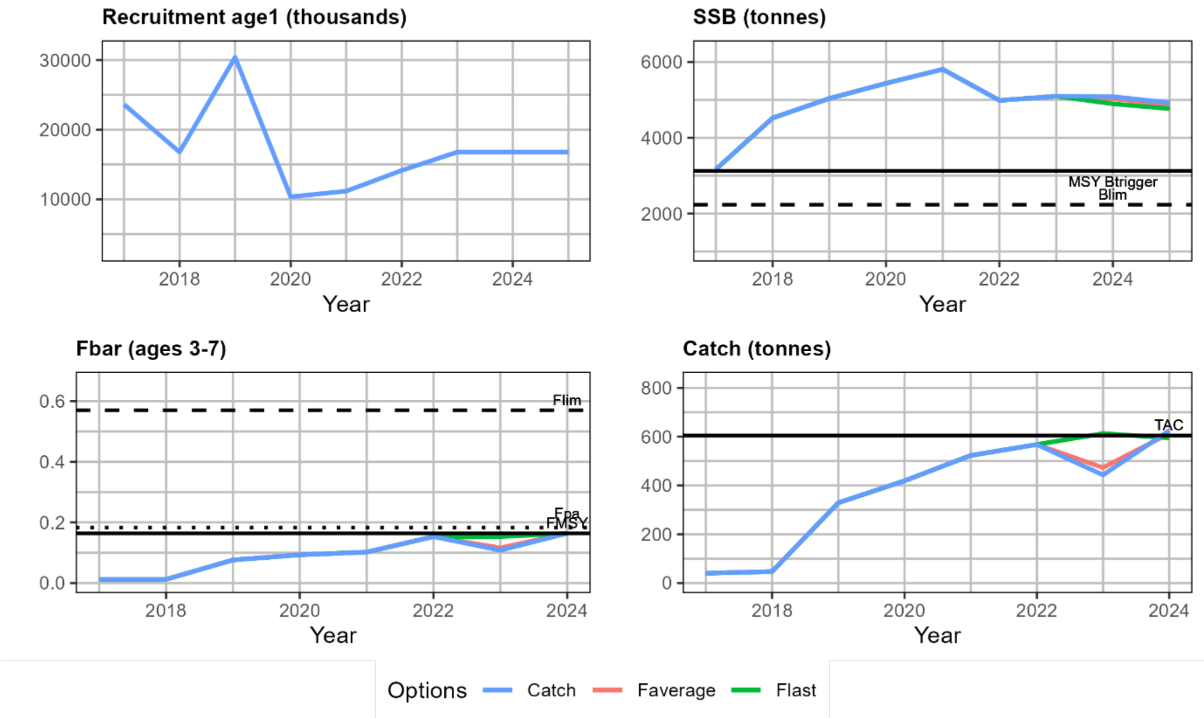


Figure 31.21. Sol.27.7a - Options for the intermediate year in the short-term forecast.

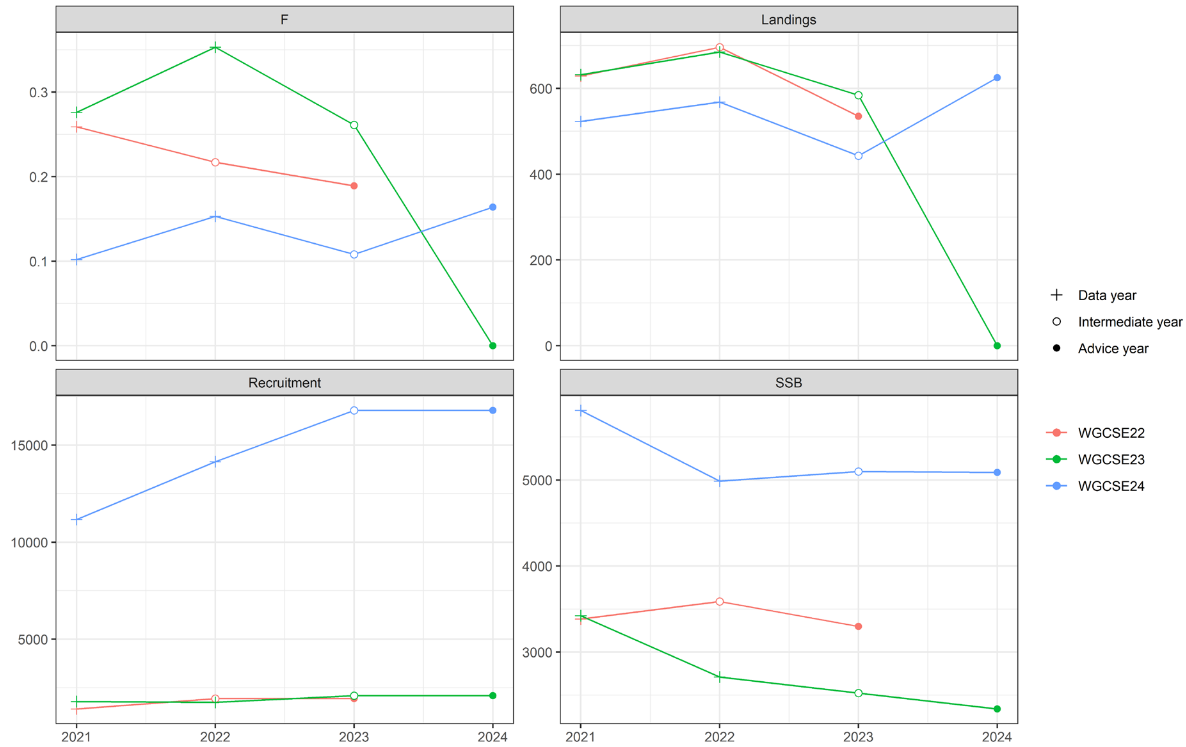


Figure 31.22. Sol.27.7a - comparison with last year's assessment – short-term forecast assumptions.

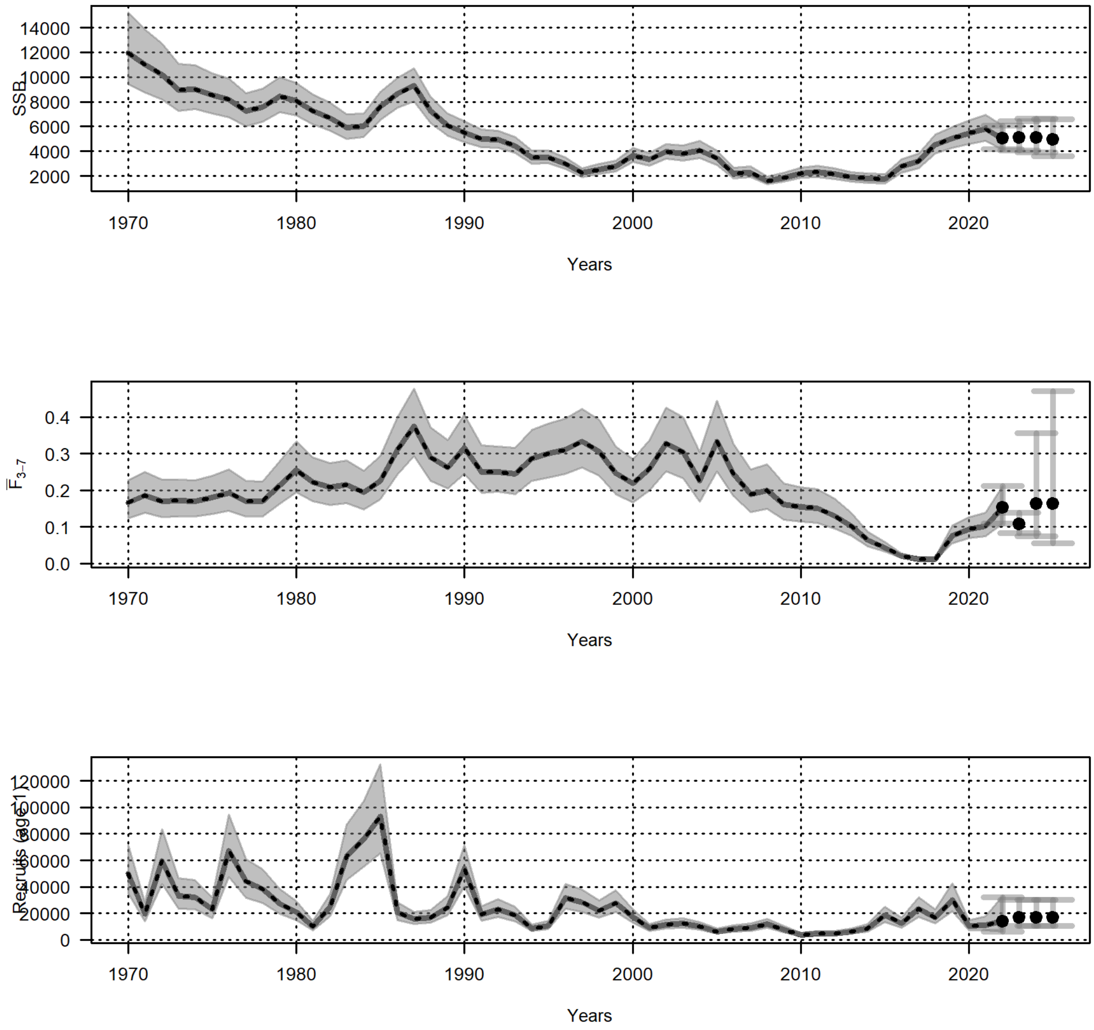


Figure 31.23. Sol.27.7a - SAM forecast assuming catch constraint in the intermediate year followed by targeting F_{MSY} in subsequent years.

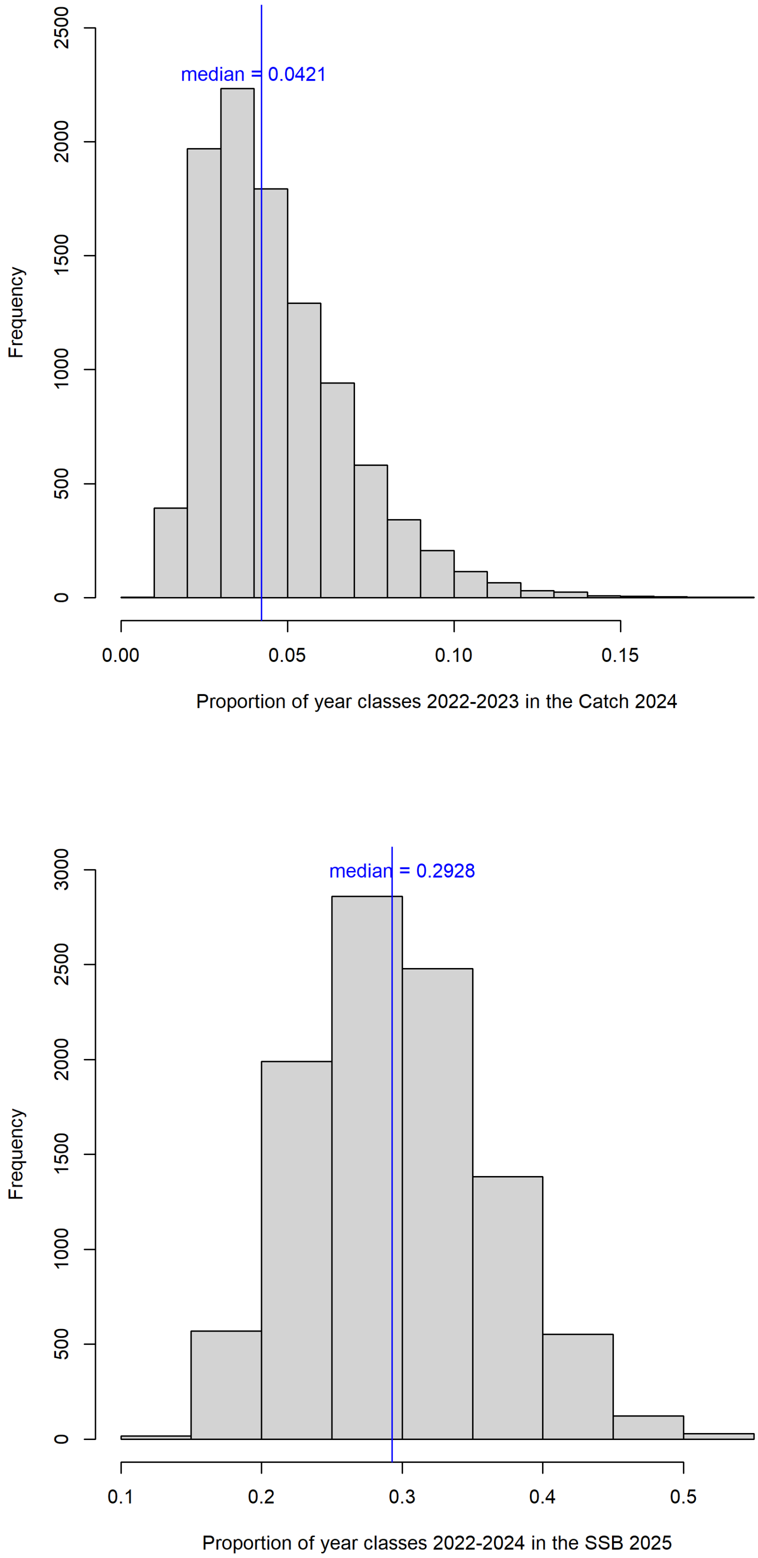


Figure 31.24. Sol.27.7a - Contributions of the recruitment assumption for the short-term forecast..

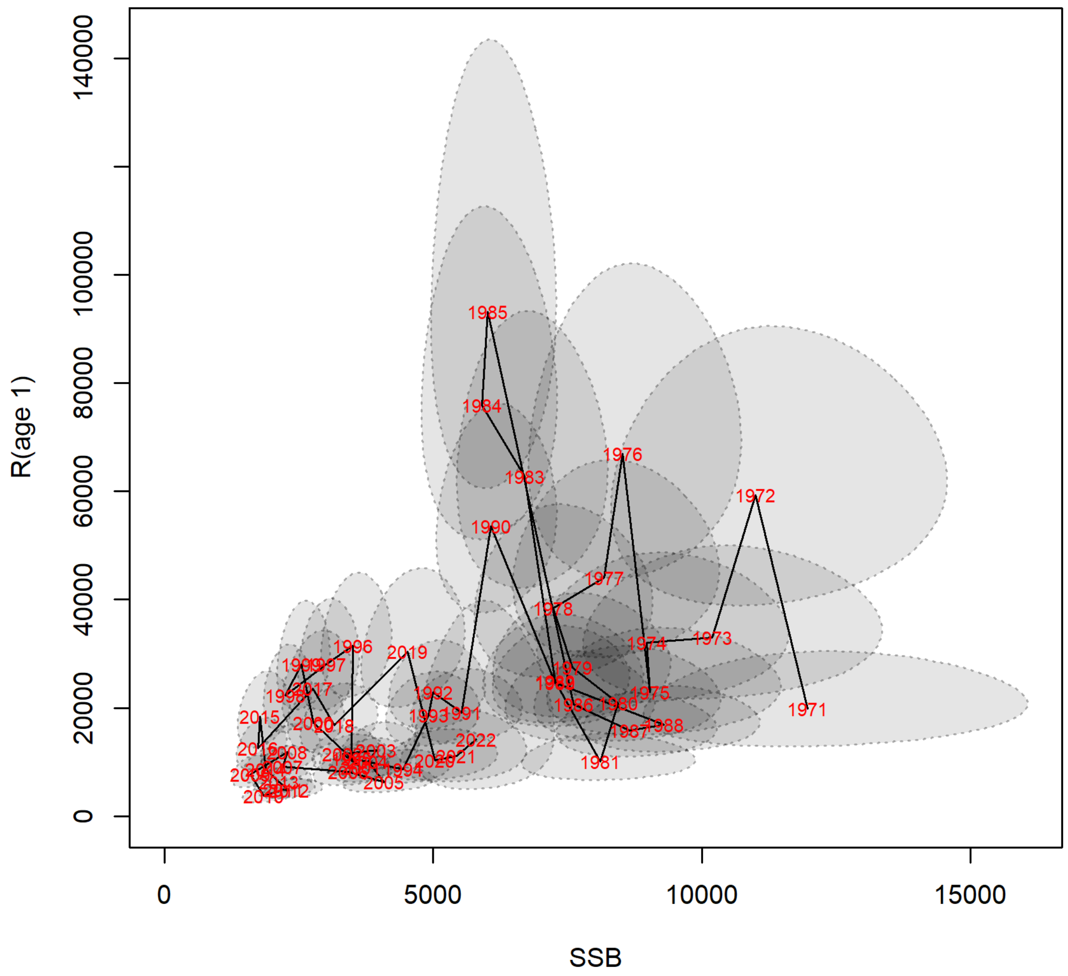


Figure 31.25. Sol.27.7a – Stock–recruitment plot.

Contents

Annex 4: Working Documents

The following working documents are included with this report:

- The French Nourdem Surveys (presented to WGCSE and WGHANSA 2024)
- Belgian commercial beam trawl landings data for sole in the Celtic Sea (ICES divisions 7.f and 7.g)
- FU 15 *Nephrops* UWTV survey work up process for use in stock assessment for 2024.
- Seabass 4bc 7 ad-h: Amendments to WGCSE report from correcting Solent mistyped data point.

Working document

Working Group for the Bay of Biscay and the Iberian Waters Ecoregion

30th April – 08th May 2024

Lisbon, Portugal

Working Group for the Celtic Seas Ecoregion

8th – 17th May 2024

ICES HQ, Copenhaguen, Danemark

The French Nourdem Surveys

Mickael Drogou, Ronan Le Goff, Christophe Lebigre, Damien Delaunay, Anne-Sophie Cornou, Olivier Berthelé, Stéphane Martin, Loïc Le Rû, Hervé Barone, Didier Le Roy, François Garren, Tiphaine Chouvelon, Yann Aminot, Catherine Munschy, Nicolas Briant, Gaël Durand, Gwendolina Limon, Emmanuelle Guillerm, Léa Edin-Leroux, Nicolas Michelet, Pascal Nguyen, Fayza Nfis, Emilie Le Roy, Cindy Marhic, Mathieu Woillez.

1 Introduction

NourDem project has its origins in the BARGIP project, action “nurseries” (2014-2016). This action focused on sea bass juveniles and conducted, at the request of the french Ministry DGAMPA (Department of Maritime Fisheries and Aquaculture of the Ministry in charge of Fisheries), in collaboration with Ifremer and the CNPMEM (National Committee for Marine Fisheries and Fish Farming).

In the ICES advice 2014 bss IVbc, VIIa, and VIId–h, it was mentionned that in Data requirements section, time-series of relative abundance indices need to be developed throughout the range of the stock, for both the adult and pre-recruit components of the stock. This has been regularly mentioned in the advices and reports of the seabass 8.a-b and 4.b-c, 7.a, 7.d-h from 2015 onwards. This has led ifremer to develop projects to answer to this need

The Bargip project enabled the validation of a protocol including the development of the Ifremer-NourDem 11.90m x 16.45m trawl and the production of a first set of reliable data on sea bass in the Loire estuary in 2016. It has been systematically applied from 2017 onwards.

Then from 2017, the aim of the project is to carry out annual trawl surveys in the main french estuaries: Seine, Loire and Gironde and in the coastal Douarnenez Bay (Figure 1) in order to:

- Produce annual abundance indices for sea bass and for major fishery species;
- Produce population indices determined globally, on the scale of the fauna communities;
- Map the main nursery areas and allow in the long-term identifying the environmental factors likely to explain these spatial distributions (salinity, depth, etc.);
- Assess the quality of the four estuaries as nursery areas, based on comparisons of growth rates, stress levels and contamination (trace metals and organochlorine compounds) in juvenile European sea bass (*Dicentrarchus labrax*), the sentinel species.

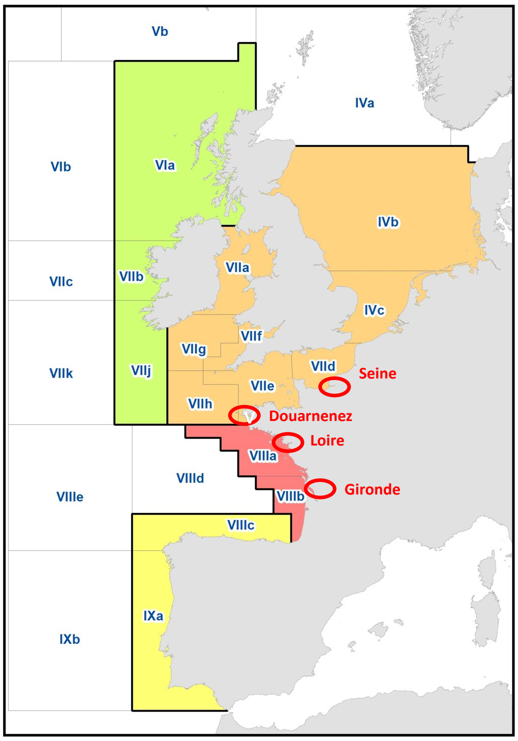


Figure 1 : Localisation of the 4 Nourdem surveys along the French coast

One of the specific features of the project is that sampling survey (trawling) are systematically carried out on board of a small local professional trawlers (Figure 2). This "Scientists/Fishermen" cooperation makes it possible to benefit from the fishers' empirical knowledge of the areas, as well as shallow-draught vessels, which allow trawling in very shallow waters, where the main nurseries are located.

Figure 2 : Vessel used during the Nourdem Douarnenez Survey

For the 3 estuaries Seine, Loire, Gironde, NourDem project was carried out in collaboration between Ifremer and the Comité National des Pêches Maritimes et Elevages Marins (CNPMEM), with operational support from the regional fisheries committees involved: CRPMEM Normandie, COREPEM Pays de la Loire and CRPMEM Nouvelle Aquitaine. The project was financed by the European Fisheries Fund (FEAMP) (measure 40), the Directorate of Maritime Fisheries and Aquaculture (DPMA/DGAMPA) of the French Ministry of Fisheries, and France Filière Pêche (FFP). It was managed on behalf of the Union and the State by the Direction Interministérielle de la Mer de Manche-Est et de la Mer du Nord (DIRM MEMN).

For the Bay of Douarnenez, Nourdem project was carried out in collaboration between Ifremer and the Natural Marine Park of Iroise sea (PNMI) depending of the French Biodiversity Agency (OFB)

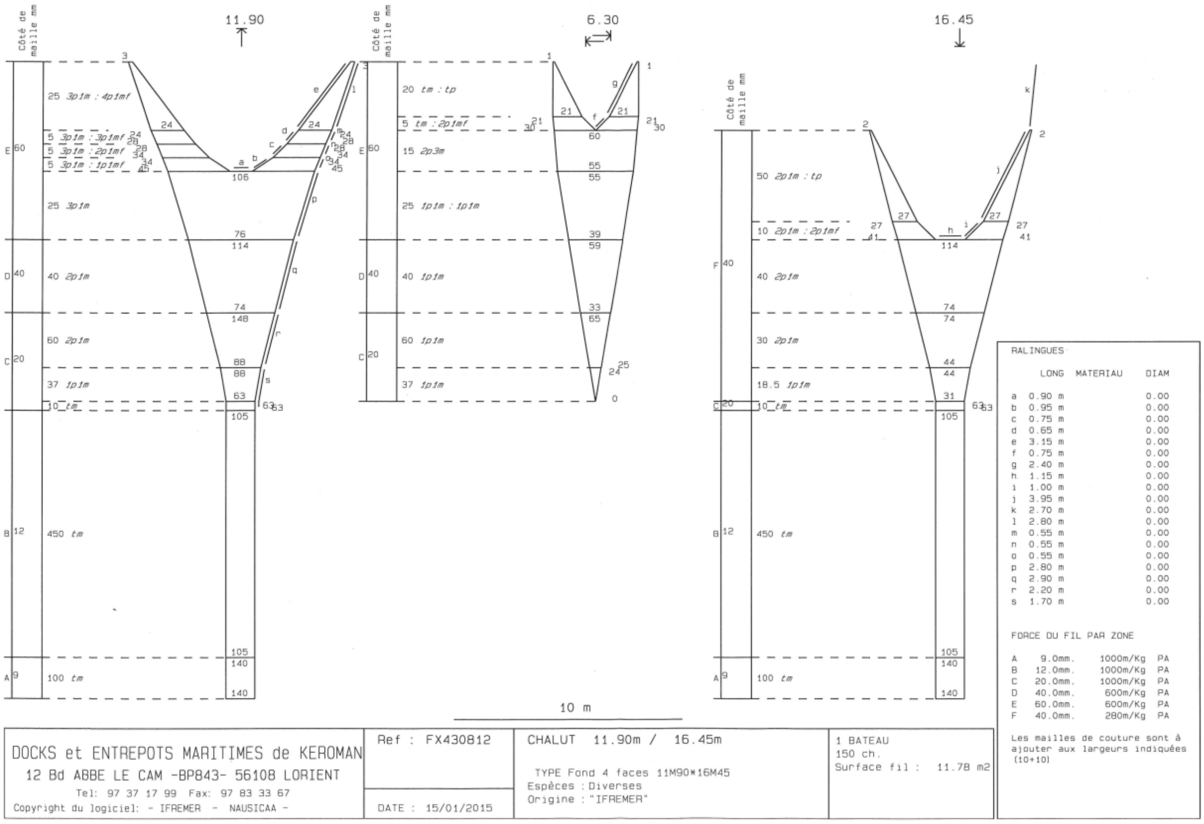
2 Protocol

2.1 Ifremer NourDem trawl

One of the original features of this protocol is the use of the "GOV Ifremer NourDem" trawl developed and improved during the above-mentioned "preparatory" projects. This is a "Large Vertical Opening" (GOV) otter trawl with a bead measuring 11.90 m and a backstroke measuring 16.45 m (Figure 3). The trawl doors (Tiboron) weigh 135kg each and have a surface area of 1.4m². The trawl is designed to be towed at 3.5 knots (surface speed) empty, with around 120 m of wraps. Abundance calculations are based on the area trawled. A set of specific sensors is used to monitor panel spacing during the haul. Horizontal opening is 7 m, and vertical opening is between 1.80 and 2.20 meters.

The end meshes measure 18 mm stretched, enabling us to catch fish as small as 3 to 4 cm in length. The trawl's high pulling speed (3.5 knots relative to the water mass for a small trawl) also enables to catch species with strong acceleration and avoidance capacities. All in all, these features make the trawl ideal for catching benthic species (sole, flounder, etc.), as well as demersal species (sea bass, whiting, etc.) and certain pelagic species (sprat, anchovy, mackerel, etc.).

A multiparameter sensor is also positioned on the trawl to record depth, salinity and temperature during the haul, useful data for characterizing the preferential habitats and functional zones of the species making up the ecosystem (Figure 3).



Bras : 6m acier + chaine ; Triangle acier de 20 cm de côté + émérillons inox Ø 12 mm

Entremise basse : 20 m acier Ø12mm ; entremise haute : 19,55 m Dyneema Ø 14 mm

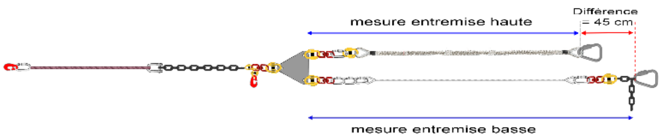


Figure 3: Ifremer NourDem trawl 11.90-16.45 m. Detail of the arms and braces (bottom left). NetSonde" sensor positioned at the center of the back rope to measure the trawl's vertical opening (top right). Panel gap sensor positioned on a panel (center right), and PC screen allowing live monitoring of panel gap and inclination/angulation throughout the tow (to validate the tow, or possibly cancel it if the gap falls outside the tolerances set at 15 and 20 m).

Sampling is carried out aboard small local professional trawlers, around ten meters in length, with a draught of no more than 2 meters, in order to be able to sample the shallower sectors and, in particular, to be able to get onto the foreshore zones as soon as the tide is halfway out. Crews are usually made up of two professional sailors and 4 scientists, three from Ifremer and one from the relevant regional fisheries committee.

The optimization of haul duration was the subject of numerous tests during the first project conducted between 2014 and 2016 (Bargip Nurseries; Cf. Le Goff et al, 2017): this duration is now set at 15 minutes. The times and positions of all the tows are recorded on the MaxSea navigation software embedded in the project, enabling precise trawl times and lengths to be obtained.

Experience has shown that it is imperative to carry out the surveys:

- During neap tides, to minimize tidal currents and zero salinity oscillations during the tide,
- At identical times in each estuary, given the high intra-annual variability in abundance of most species.

As the period of least flow variability in the rivers is between late spring and summer, the dates of the campaigns were set for the low-water periods of late June/early July in the Loire, late July/early August in the Seine and late August/early September in the Gironde.

The areas sampled in the three estuaries extend, as far as possible, from zero salinity upstream to at least the 12 m isobath downstream (which corresponds to a salinity close to 34-35 per thousand in the three estuaries when the campaign is carried out during low-water or low-flow periods), in order to cover all the main estuarine nurseries. The campaigns last 8 full days of trawling, allowing 60 to 75 tows to be made, depending on the estuary. In the first year of sampling an area (the estuary and its immediate downstream reaches), a set of trawlable stations is identified and mapped on the project's navigation software, so that the trawls selected can be carried out as identically as possible in subsequent years.

2.2 Catch processing on board

At the end of each haul, the entire catch is systematically weighed, then the different species are identified and sorted. They are then weighed separately, and all or part of each fish species is measured, to the nearest cm for the vast majority of species, and to the nearest ½ cm for small pelagics. If the trawl is heavily loaded, a sample of the total is weighed and measured: the total weight of the bag is weighed, and a fraction of this total is analyzed after being weighed. Prior to this sampling, the largest individuals, or those belonging to remarkable/rare species, are extracted and processed as "Hors Vrac" (individual measurements and specific weighing). All data acquired (weighing, measurements, debris/waste, haul characteristics, etc.) are then recorded on sea sheets and entered, once ashore, into Ifremer's "Allegro-Campagne" database (which is used to enter all data from the Institute's fishing campaigns). Some individuals are euthanized and frozen before being brought back to the laboratory for measurement, scale sampling, weighing and analysis.

2.3 Catch data processing

2.3.1 Capture, validation and storage of data

Over the last few years, Ifremer has developed a range of IT tools for entering, storing and making available data from the French fishing campaigns for which it is responsible.

Survey data (catches, dates, locations, environmental parameters, metadata, etc.) are entered using the "Allegro campagnes" tool. Once the data have been entered, they are checked using the "tutti control" tool: checking the validity of positions, durations and lengths of hauls, identifying and correcting outliers in length or individual or global weights per species, typing errors when entering data, etc. Once validated, the data is transferred to the "Harmonie" database, where it is both protected (saved permanently) and made available ("public data") via a query website (https://sih.ifremer.fr/Donnees). Harmonie brings together all official

French fisheries data produced by Ifremer. Data from all NourDem campaigns (since 2016 in the Loire, 2017 in the Seine and 2019 in the Gironde) have therefore been saved in Harmonie, and have a DOI. (https://campagnes.flotteoceanographique.fr/search).

2.3.2 Production of specific and community indices: RSUFI

An "R" package for calculating abundance or biodiversity indices, called "RSUFI", was developed by IFREMER in the early 2000's to process data from its fisheries campaigns. The indices produced via RSUFI were selected for their ability to provide information on the impact of fishing, with a view to their integration into dashboards of indicators of changes in species abundance within ecosystems exploited by fishing (Rochet & Trenkel 2003; Trenkel & Rochet 2003; Rochet et al. 2005). RSUFI can be used to produce specific indices, i.e. for each of the main species sampled, or community indices (i.e. at the scale of the entire sampled area, with all species aggregated).

Among the specific indices (for each species taken separately) that RSUFI can produce, we have selected for Sea bass Index calculation the abundance Index (N) associated with its framing ranges at the 5% error threshold (Fourch. = 1.96 times the standard deviation) or the coefficient of variation (CV = standard deviation/IA or IB), expressed in %.

Details of the calculation formulas used by the RSUFI script to produce both types of indicator can be downloaded from the SIH website at http://www.ifremer.fr/SIH-indices-campagnes/.

$$N_i = \sum_j N_{i,j} = \sum_j A_j \sum_{k=1}^{nj} y_{i,k,j} \Big/ \sum_{k=1}^{nj} a_{k,j} \qquad Var(N_i) = \sum_j \frac{A_j^{\,2}}{n_j - 1} \sum_{k=1}^{n_j} \left(\frac{y_{k,j}}{a_{k,j}} - \frac{\sum_{k=1}^{n_j} y_{k,j}}{\sum_{k=1}^{n_j} a_{k,j}} \right)^2$$

Ni(t) Total abundance index for species i

Nl,i (t) Total abundance index for length class l for

species i

Aj Area of stratum j

ak,j Area swept by line k in stratum j

yl,i Number caught in length class l for species i

yi,k j Number of species i caught in haul k in stratum j

wi,k j Number of species i caught in haul k of stratum j

RSUFI is based on a fixed stratification of the sampled areas carried out once and for all, i.e. identical regardless of species or years. For each estuary, the stratification was carried out following the first campaigns, based on bathymetry, water desalination levels, and the respective abundances of juvenile sea bass. This stratification was maintained during the subsequent NourDem campaigns, to enable inter-annual comparisons to be made.

3 NourDem surveys carried out between 2016 and 2022.

The 8-days surveys produced between 58 and 76 tows, depending on the site and the year. Figure 5, Figure 6, Figure 7 and Figure 8 show the positioning of the tows within the three estuaries, and the stratification chosen for the RSUFI data processing script (corresponding to the coloured areas). The aim is to sample all the stations each year, so that inter-annual comparisons can be made. The areas sampled each year extend, if possible, from zero salinity upstream to the 8 m (Seine), 11 m (Loire) and 25 m (Gironde) isobaths. They include channels, lateral flats (infratidal and slikke sectors), and extend to mid-tidal zones (at high tide), as juveniles of many species (sea bass, sole, etc.) are fond of these very shallow sectors, rising and falling on the edges as the tide changes.

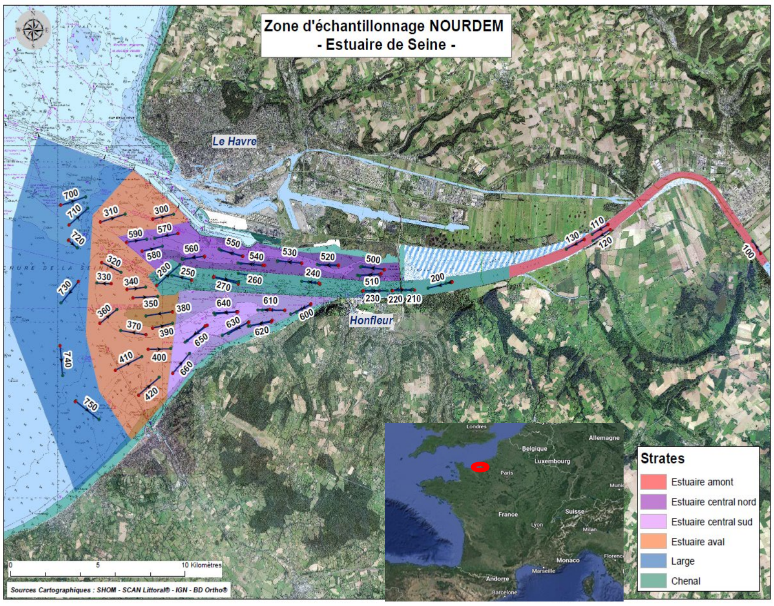


Figure 4 : Nourdem in Seine estuary. Trawling stations and stratification

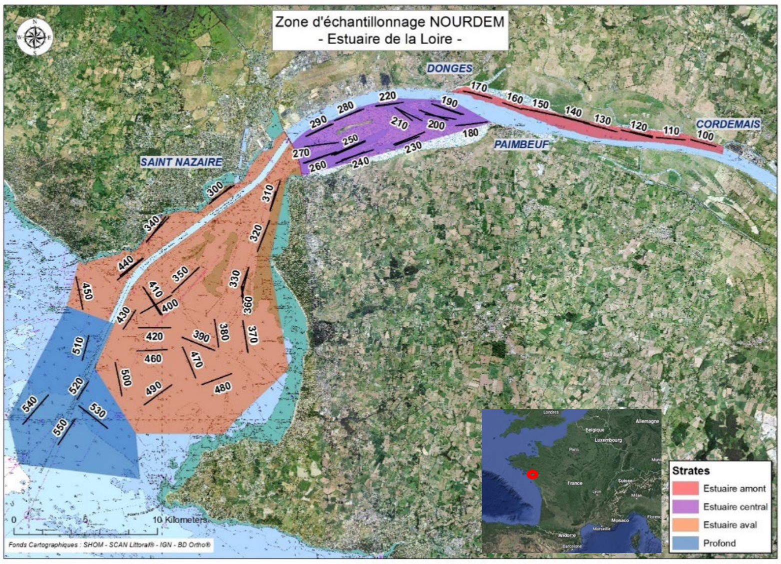


Figure 5 : Nourdem in Loire estuary. Trawling stations and stratification

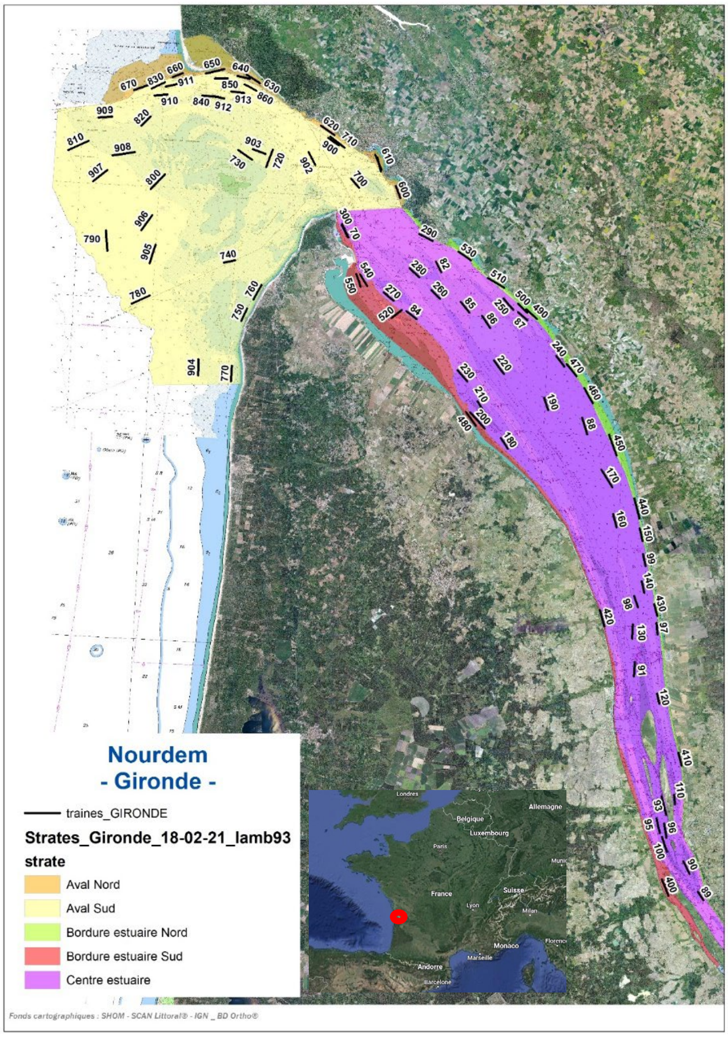


Figure 6 : Nourdem in Gironde estuary. Trawling stations and stratification

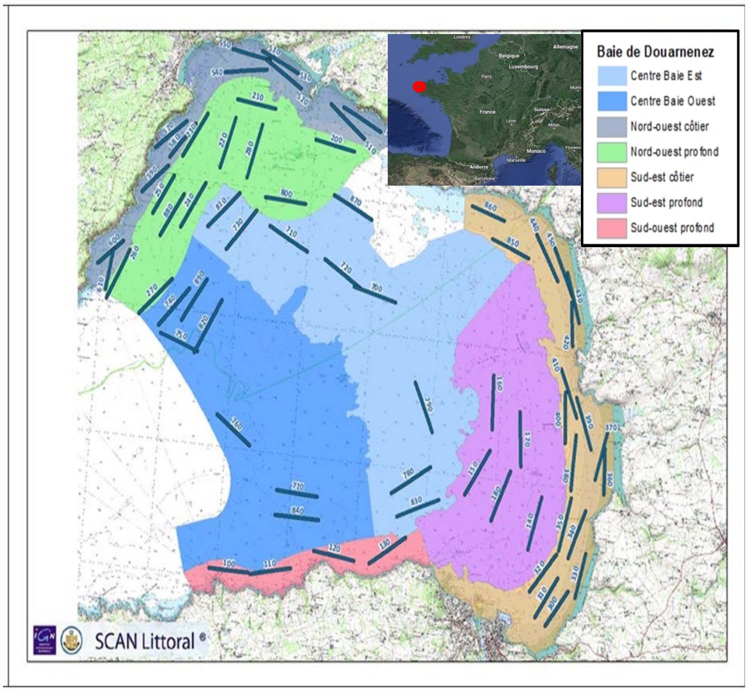


Figure 7 : Nourdem in Douarnenez bay. Trawling stations and stratification

4 RESULTS

Note: results are given until 2022. Studies on the year 2023 are still ongoing. Fulle time series will be available for WKSEABASS in November 2024.

This section provides an overview of data collected during each survey and presents in details results obtained for seabass in the 4 areas by age group, using a plus group (depending of the area). For WKSEABASS, annual indices calculated on all ages, associated with number at length of all the catches and Age length key will be integrated and tested in the future assessment model. Those raw data are presented in section 5.

4.1 European sea bass Dicentrarchus labrax in the Seine estuary

Dicentrarchus labrax has, on average between 2017 and 2022, all age classes combined, a catch occurrence of 76.48% (Tableau 1)

Tableau 1 : Overview of seabass catches in the Seine estuary

Raw data Seine Estuary					
year	Total trawl haul	Number of trawl haul with seabass	Occurrence	Number of seabass	weight (Kg)
2017	67	48	72%	3513	408
2018	74	59	80%	3870	887
2019	73	65	89%	8355	722
2020	73	48	66%	6542	453
2021	70	58	83%	3822	410
2022	73	51	70%	3183	391

Figure 9 presents seabass index calculated across time with standard deviation associated. This index will be tested in the future assessment model. Following chapter details by age group results observed.

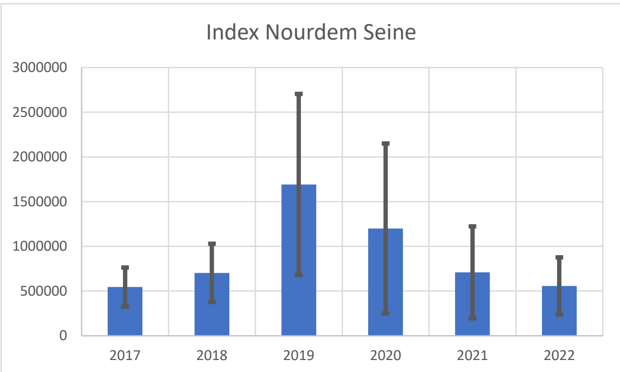
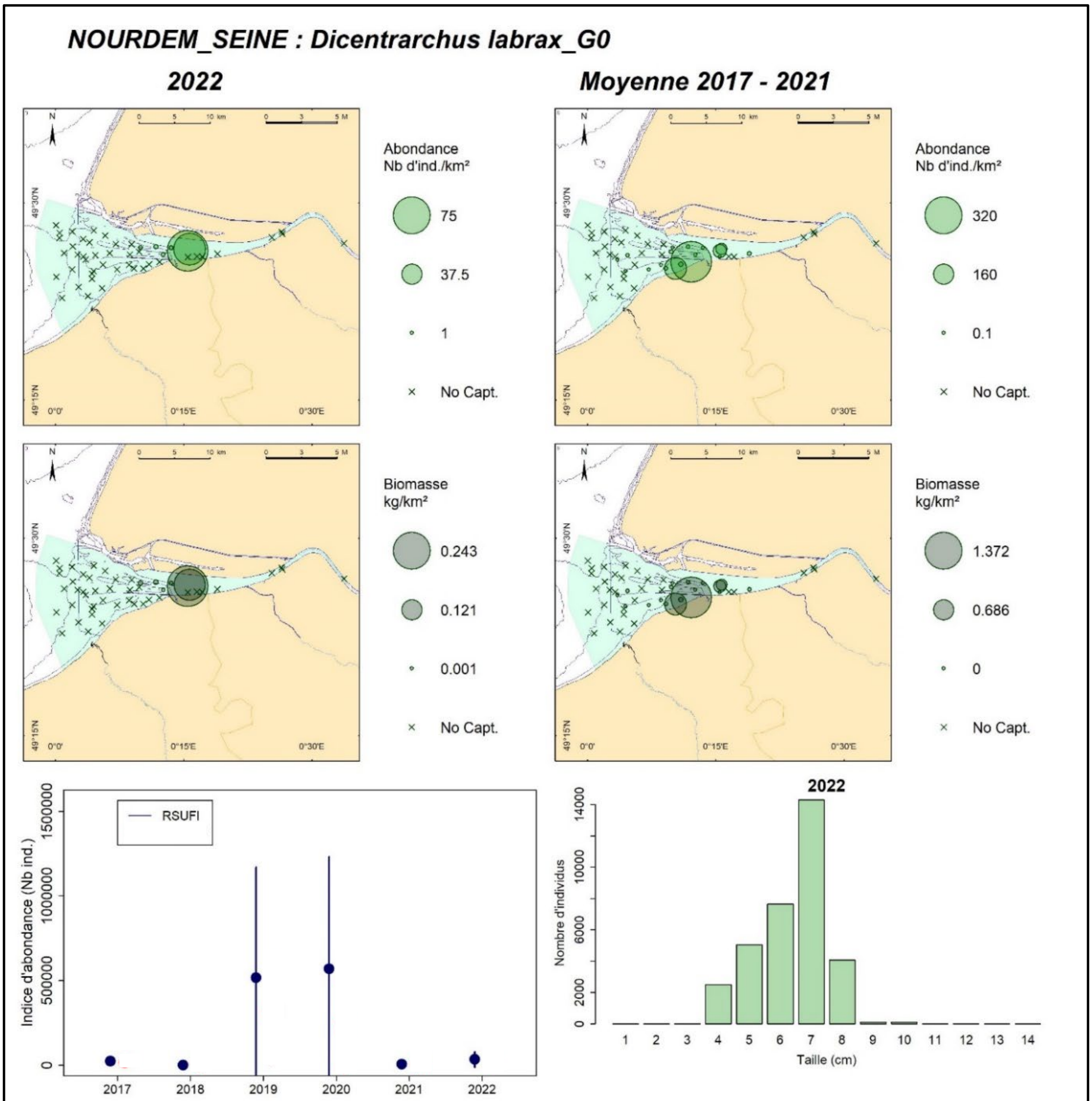


Figure 8 : Seabass index and standard deviation associated across time calculated for Nourdem Seine (all ages combined)

4.2 Group 0 European sea bass in the Seine estuary

Their average catches rate has been 14.89% since monitoring began, and their average abundance index 191,169 individuals.

The abundance index for this age group showed significant inter-annual variation, rising from 5,757 +/- 9,183 individuals in 2021 to over 500,000 +/- ≈ 650,000 individuals and 2019 and 2020. In 2022, the abundance index is estimated at 33,809 +/- 45,705 individuals for a biomass of around 100 kg (Figure 10). This age group, because of its position in very shallow sectors, is difficult to access with a trawl. Numbers are concentrated on just a few tows, mainly located in the "central estuary south" and "central estuary north" strata, which include the lateral banks and flats extending from the outside of the channel to the foreshores. No catches of this age group are recorded on tows deeper than 4 meters (no catches during a tow are symbolized by a cross on the map), and areas less than 2 meters deep. Catch sizes for 2022 are comparable to those obtained on average over the 2017-2021 period: modal value of 7 cm, average size of 6.4 cm, and average weight of around 3 grams.



Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2017	23 269	20 862	134	149	7.6	0.006
2019	516 701	653 101	2 086	2 583	6.9	0.004
2020	567 477	660 792	2 454	2 904	7.2	0.004
2021	5 757	9 183	12	19	5.7	0.002
2022	33 809	45 704	109	146	6.4	0.003

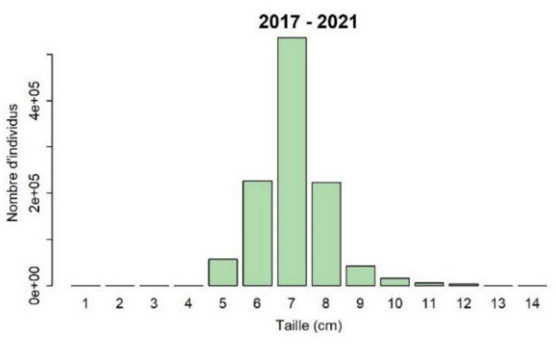


Figure 9: Group 0 European sea bass Dicentrarchus labrax in the Seine estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2017 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI scripts and their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2017-2021 (bottom right).

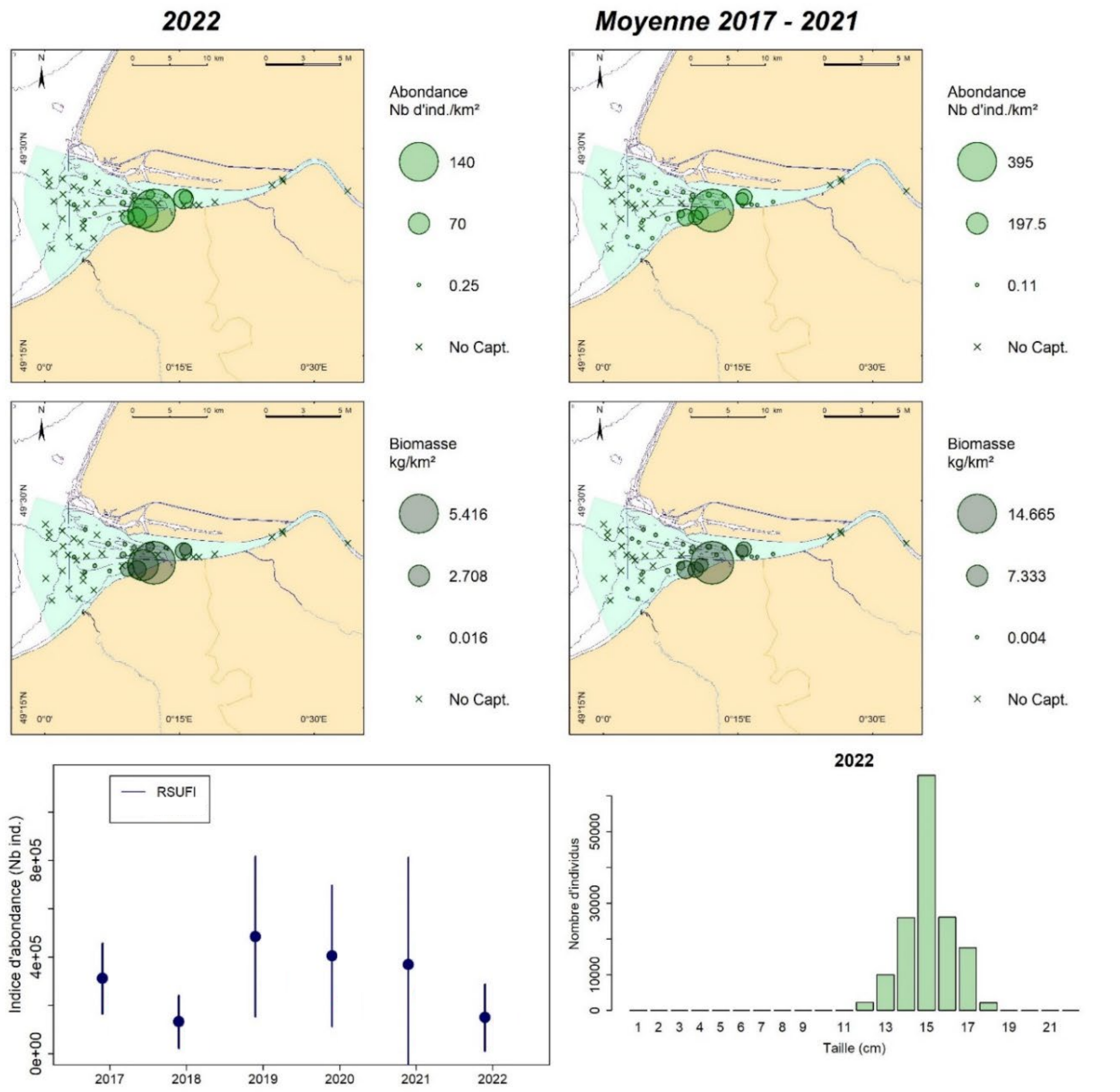
4.3 Group 1 European sea bass in the Seine estuary

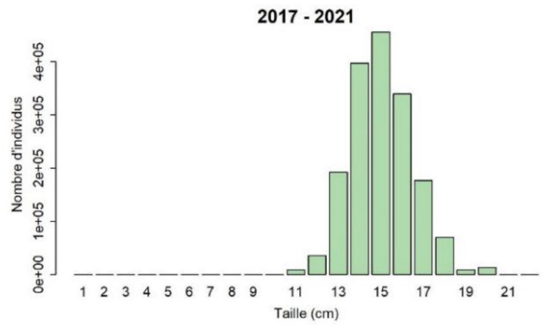
Overall, the average abundance index for juvenile group 1 sea bass since the start of NourDem monitoring in the Seine has been ≈ 308,000 individuals for an average biomass of ≈ 11.7 tonnes. Annual abundance indices are given in Figure 11. 2022 would be, along with 2018, one of the worst years in the series: abundance index of 149,767 +/- 138,813 individuals for a biomass index of 5.7 tonnes.

It should nevertheless be pointed out that although some individuals in group 1 are becoming less dependent on the shallower edge sectors of the estuary, their preferred habitats are still very similar to those of group 0.

Size distributions in 2022 are comparable to those obtained previously: modal value corresponding to the average size, i.e. 15 cm, and average weight of 38 grams.

NOURDEM_SEINE : *Dicentrarchus labrax_G1*





Années	Abondance (nombre)		Biomasse (kg)		Taille moy	Poids moy
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2017	311 463	146 259	10 935	5 097	14.6	0.035
2018	132 230	109 714	6 560	5 271	16.4	0.05
2019	484 751	332 113	17 166	11 727	14.7	0.035
2020	400 802	293 142	17 766	12 613	15.9	0.044
2021	368 938	443 034	12 404	13 480	14.4	0.034
2022	149 767	138 813	5 710	5 355	15	0.038

Figure 10: Group 1 European sea bass in the Seine estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2017 and 2021 (right); graph (center) of annual indices of abundance determined using the RSUFI scripts, and of their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2017-2021 (bottom righ

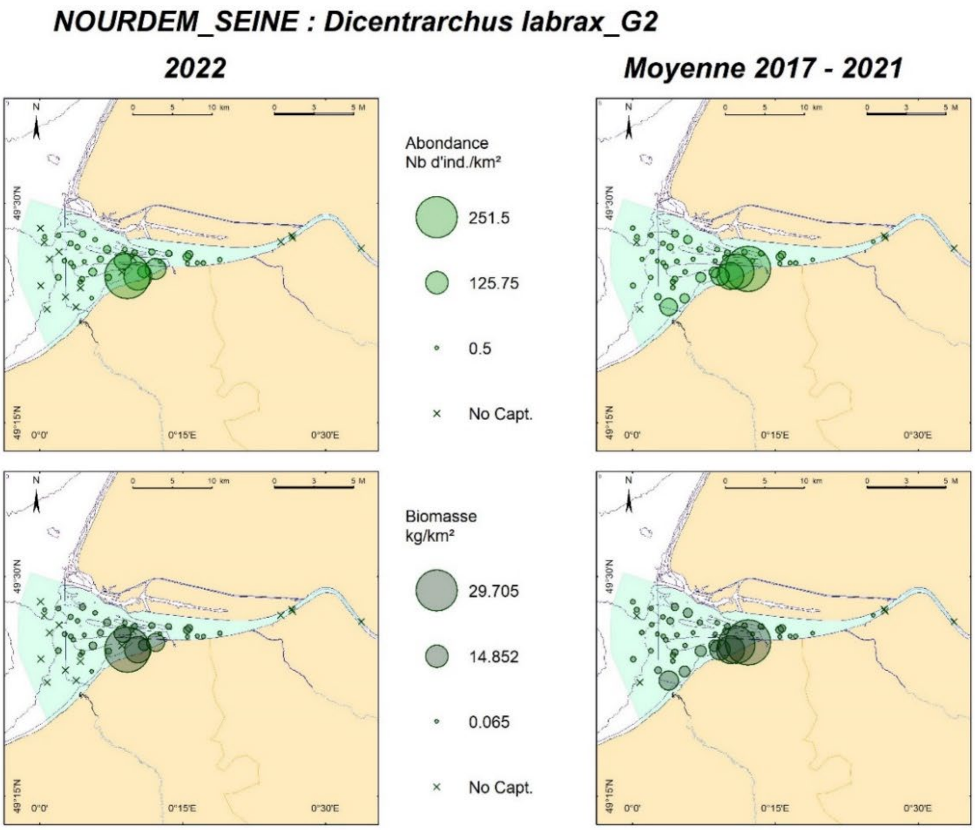
4.4 Group 2 European sea bass in the Seine estuary

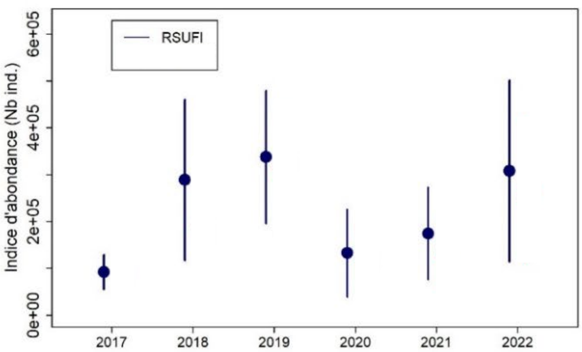
Group 2 sea bass still use the estuary as a nursery, but colonize sectors further downstream and deeper than those of groups 0 and 1 (Figure 12). Average catch occurrences are the highest of the 4 age groups considered (68.34%), and the average abundance index reaches ≈ 221,000 individuals for an average biomass index of ≈ 28.7 tonnes.

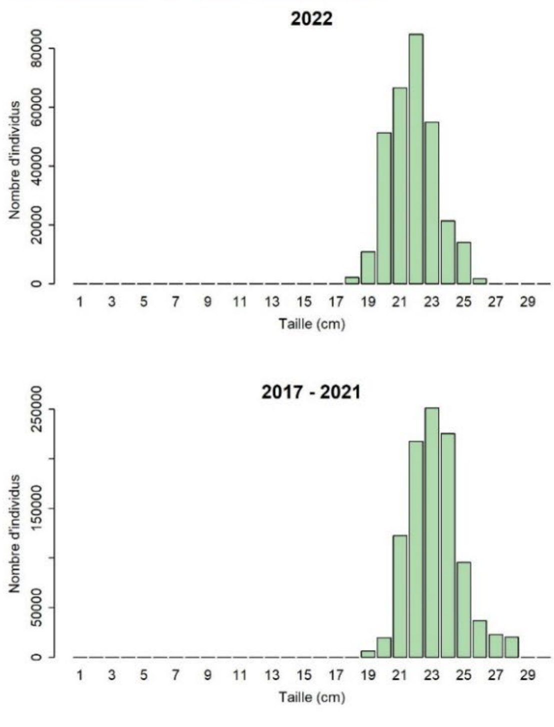
Abundance indices, allow us to conclude that the G2 sea bass abundance index for 2019 was significantly higher than that for 2017 at the 5% error threshold. The RSUFI script does not distinguish any other significant differences. Abundance in 2022 appears higher than in the previous two years, but with no significant difference due to the width of the index framing ranges (307,964 +/- 194,129 individuals).

The entire estuary is colonized, from the most upstream reaches (except for the two most upstream reaches of the channel bottom) to the most downstream reaches. The areas of greatest abundance are the upstream flats of the "south central estuary" stratum, followed by the southernmost coastal sector of the "downstream estuary" stratum.

Between 2017 and 2021, the sizes of Group 2 individuals at the time of the NourDem campaign ranged from 19 to 28 cm, with an average size of between 22.5 and 23.8 cm depending on the year, and a modal value of 23 cm. Measurements for 2022 are slightly lower, with a modal value of 22 cm and an average height of 21.7 cm. These decreases in mean and modal size in 2022 are therefore of the order of 1 to 2 cm, to be confirmed by future monitoring.







Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2017	92 180	37 247	13 659	5 649	23.8	0.148
2018	288 856	171 761	36 120	20 254	22.5	0.125
2019	337 685	141 501	49 726	20 059	23.7	0.147
2020	125 143	94 062	16 004	11 963	22.7	0.128
2021	174 602	98 320	21 828	12 249	22.6	0.125
2022	307 964	194 129	34 609	22 205	21.7	0.112

Figure 11: Group 2 European sea bass in the Seine estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2017 and 2021 (right); graph (center) of annual indices of abundance determined using the RSUFI scripts, and of their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2017-2021 (bottom right).

4.5 European sea bass groups 3+ in the Seine estuary

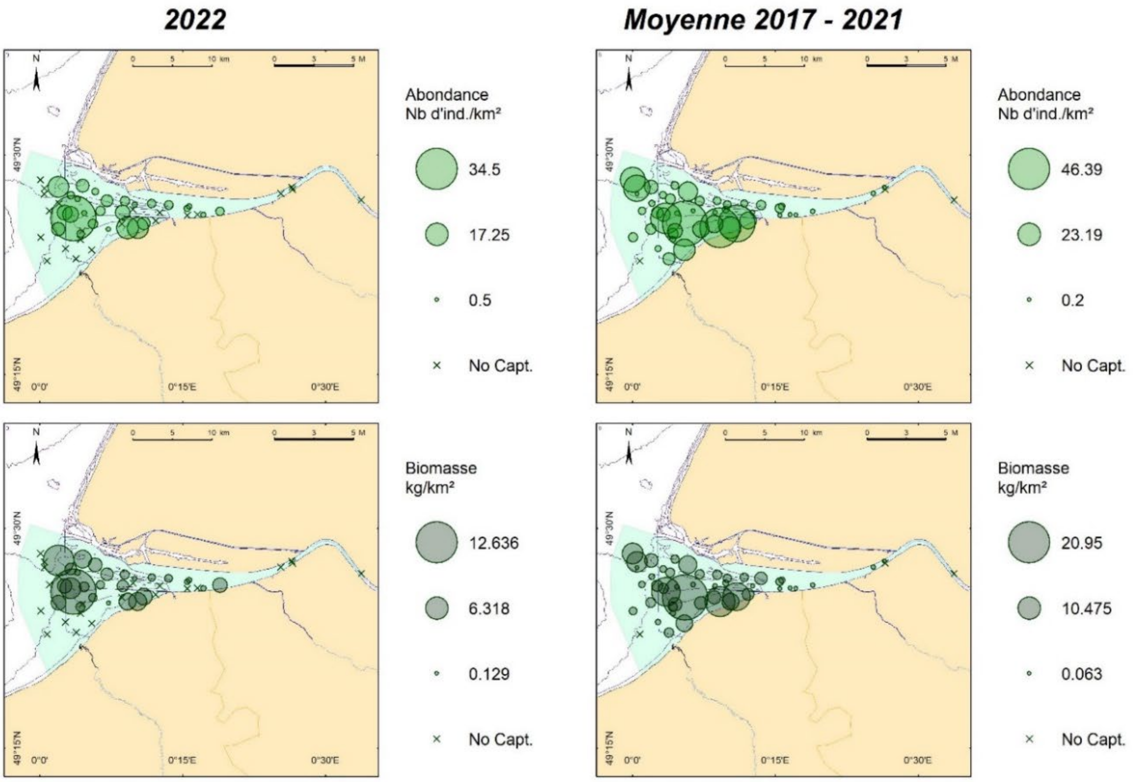
Like those in group 2, European sea bass in groups 3 and above have a high average capture rate of 65.13% over the 2017-2022 period. Their average abundance index is also very comparable to that of group 2 (180,893 individuals). However, their average biomass index is much higher, at around 67.5 tonnes (Figure 13).

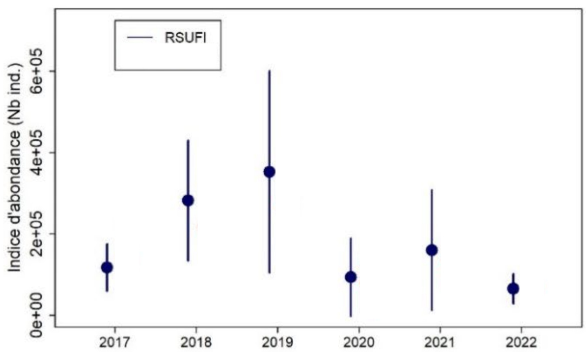
Eastern European sea bass begin their first winter migration offshore in November-December at the end of group 3 or group 4, and return to coastal waters in late spring, as do adults in general. At the time of the NourDem campaign, 3+ groups colonized the entire estuary, from the most upstream to the most downstream stretches (always excluding the two upstream stretches at the bottom of the channel). They are present in greater numbers than group 2 on the northern features of the domain (strata "central estuary north", and above all "downstream estuary" and even "wide").

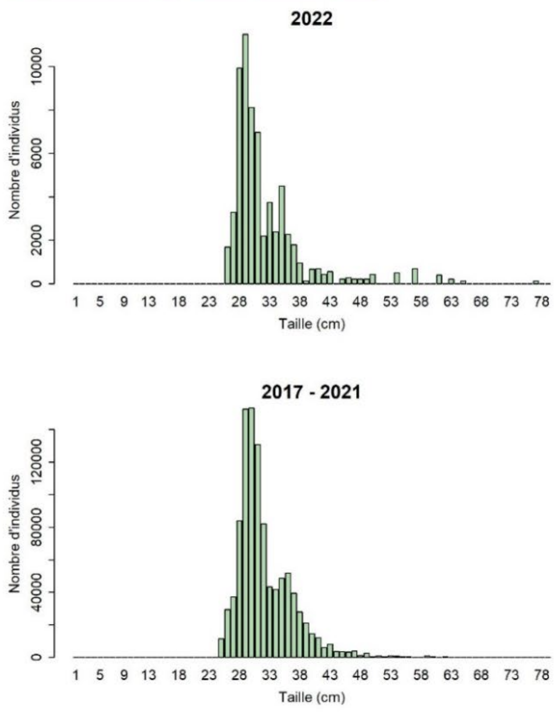
The 2022 abundance index is the lowest in the whole series (65,537 +/- 37,005 individuals), but the difference is only significant at the 5% error threshold with those of 2018 and 2019 (RSUFI indices).

Catch sizes for groups 3+ range from 25 to 76 cm, with average sizes between 31 and 34 cm (32.3 cm in 2022).

NOURDEM_SEINE : Dicentrarchus labrax_G3p







Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2017	117 464	58 236	38 785	19 881	31	0.33
2018	282 156	147 987	115 497	64 804	33.3	0.409
2019	352 858	247 992	124 641	86 574	32.1	0.353
2020	107 205	100 432	45 041	41 993	34	0.42
2021	160 140	147 707	53 971	49 586	30.5	0.337
2022	65 537	37 005	26 789	14 090	32.3	0.409

Figure 12: European sea bass groups 3 and above in the Seine estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2017 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI scripts, and their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2017-2021 (bottom right).

Figure 14 summarizes the average positions of these four age groups. It confirms the gradual descent of juveniles of the species from the shallower areas of the southern edge of the Central Estuary during their first years of life, towards increasingly downstream and deeper sectors, resulting in increasingly complete colonization of the estuary.

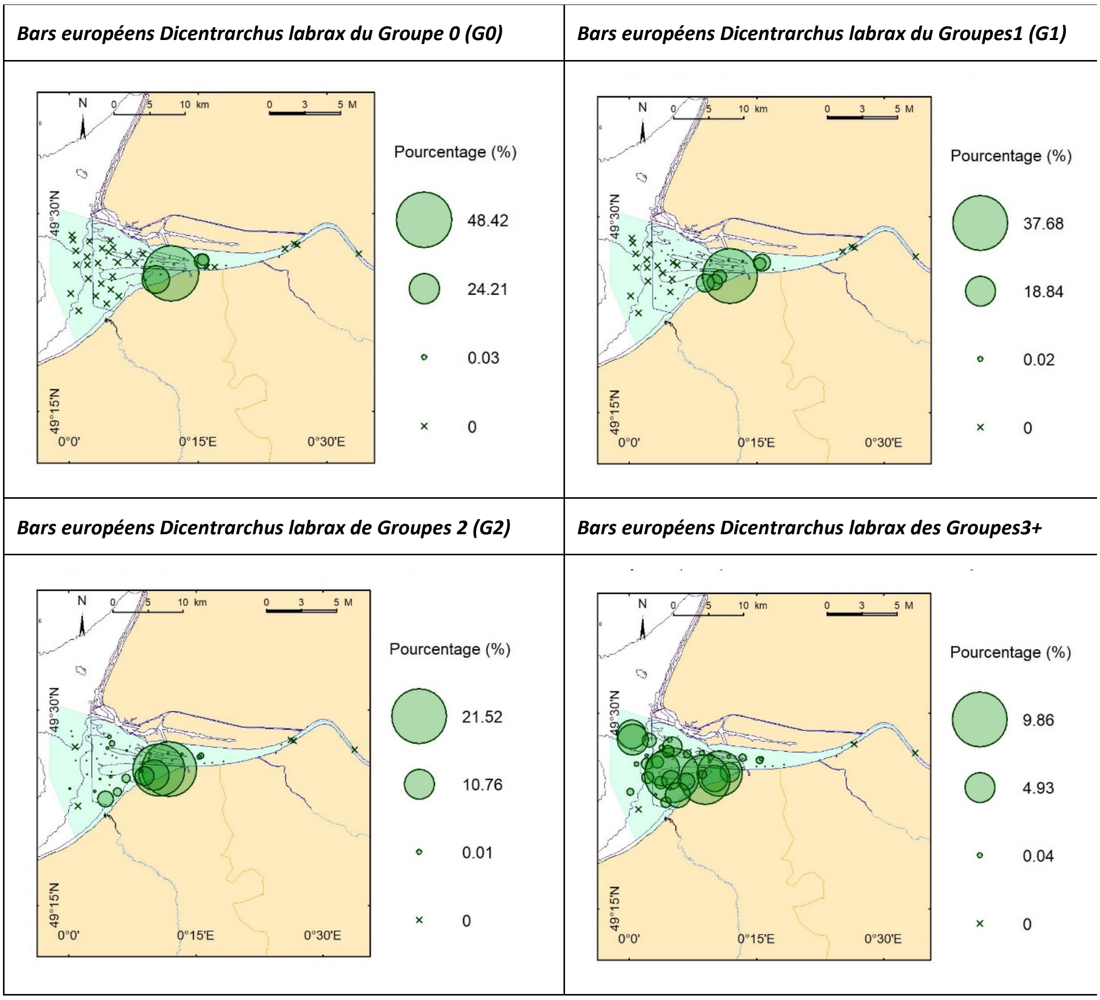


Figure 13: European sea bass in the Seine estuary: averages, over the period 2017-2022, of catches per haul (expressed as a percentage of the total average number of individuals caught) of European sea bass Dicentrarchus labrax of different age groups; NourDem data.

4.6 European sea bass Dicentrarchus labrax in the Loire estuary

The European sea bass is the most common species in the Loire estuary sampling: 88.79% of average occurrence (Tableau 2).

Tableau 2 : Overview of seabass catches in the Loire estuary

Raw data Loire Estuary					
year	Total trawl haul	Number of trawl haul with seabass	Occurrence	Number of seabass	weight (Kg)
2016	73	62	85%	1503	228
2017	74	69	93%	824	179
2018	77	72	94%	3538	288
2019	75	67	89%	8155	662
2020	76	63	83%	1040	164
2021	76	69	91%	1028	274
2022	76	66	87%	1914	383

Figure 15 presents seabass index calculated across time with standard deviation associated. This index will be tested in the future assessment model. Following chapter details by age group results.

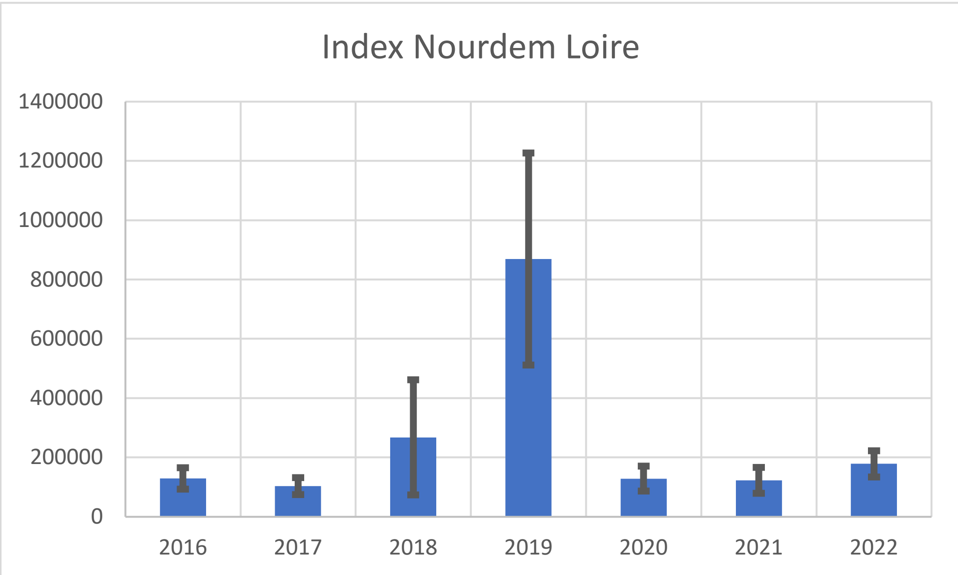
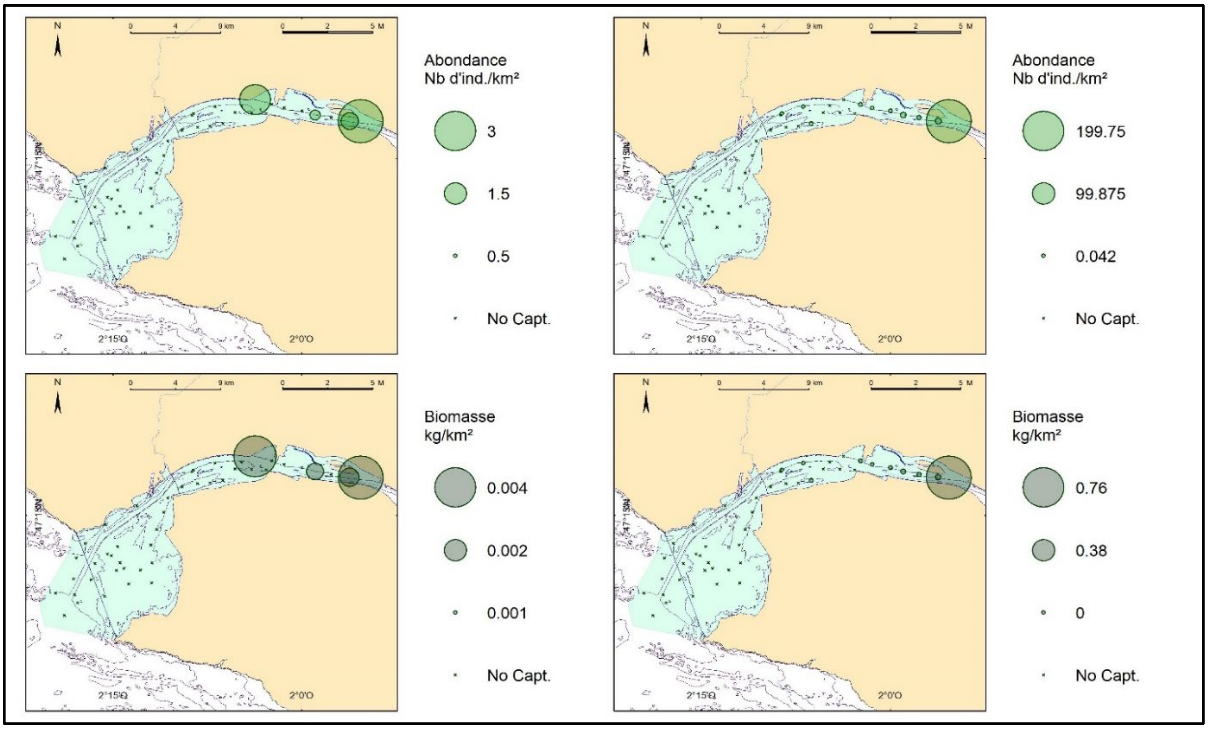


Figure 14 : Seabass index and standard deviation associated across time calculated for Nourdem Loire (all ages combined)

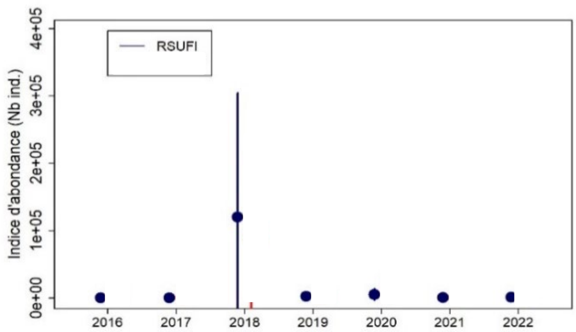
4.7 Group 0 European sea bass

As is the case in the other two estuaries, catches of group 0 sea bass in the Loire are generally low (average catch occurrence over the 2016/2022 period of 5.08%, average abundance index of 18,371 individuals for an average biomass index of 68 kg and variable. Catches are also highly localized, with this age group confined to the most upstream sectors of the estuary ("upstream estuary" stratum), close to zero salinity, and most often at depths of less than 2 meters (Figure 16)

Abundance indices for group 0 individuals are more often than not lower than those for group 1, which in turn are lower than those for group 2, due to the greater vulnerability/capturability of the largest age classes. The capture sizes of these Group 0 individuals range from 2 to 10 cm.



Années	IA	Fourch.IA	IB	Fourch.IB
2016	72	127	0	1
2017	0	0	0	0
2018	120 133	184 222	457	664
2019	2 087	2 628	8	13
2020	5 274	8 610	11	18
2021	302	639	0	1
2022	732	764	1	1



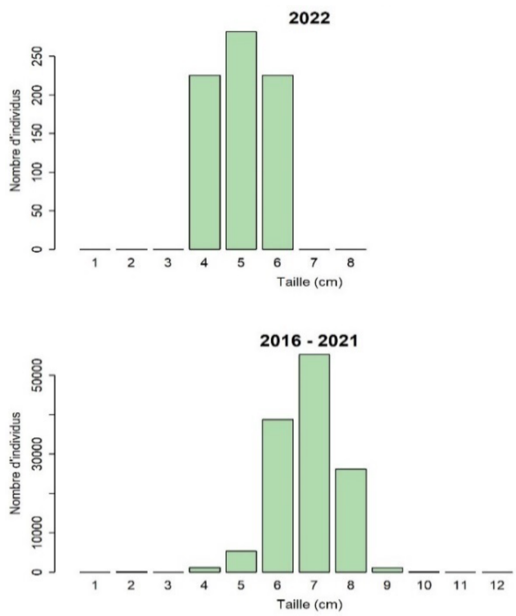


Figure 15: Group 0 European sea bass Dicentrarchus labrax in the Loire estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2016 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI scripts and their framing ranges at the 5% error threshold; summary table of annual values of abundance index (IA) and biomass index (IB) and their framing ranges at the 5% error threshold (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2016-2021 (bottom right).

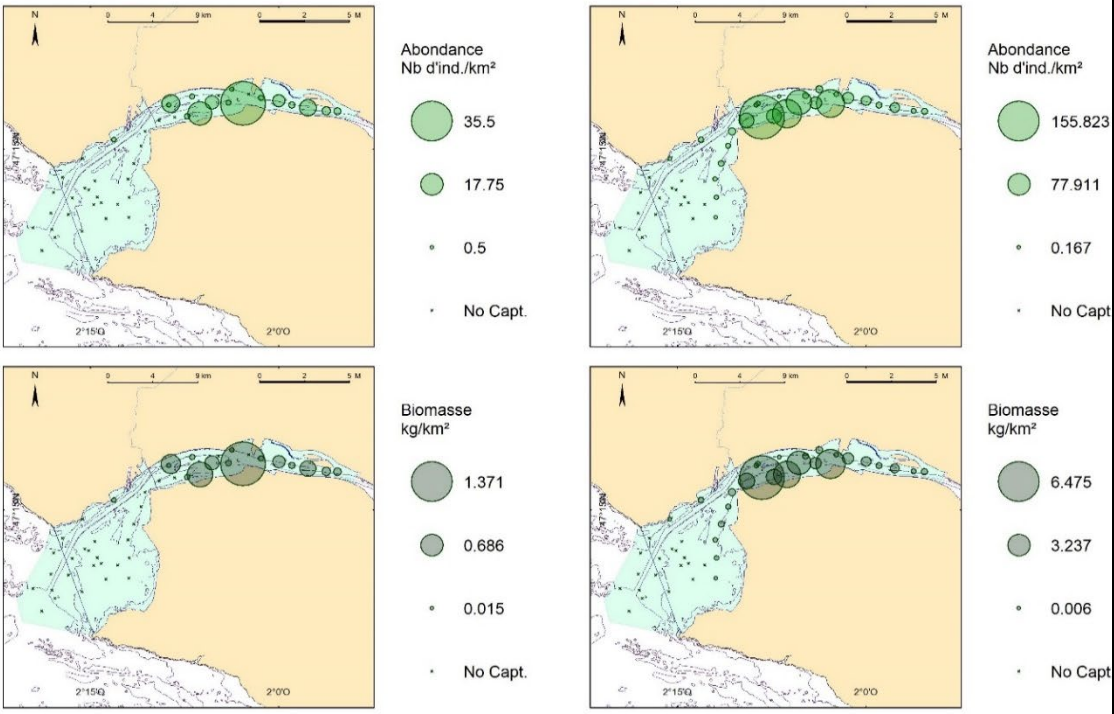
4.8 Group 1 European seabass

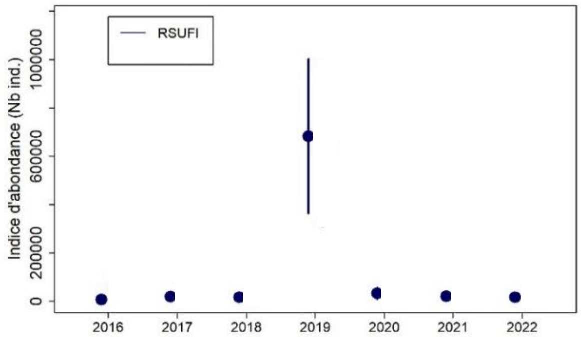
Group 1 sea bass are located slightly further downstream and above all slightly deeper (mainly in the two strata "central estuary" and "upstream estuary", with a few catches in the upstream stratum "downstream estuary") than Group 0 (Figure 16). Their average catch rate over the period 2016-2022 was 37.17%, with an average abundance index of 113,726 individuals and an average biomass index of ≈ 4.85 tons.

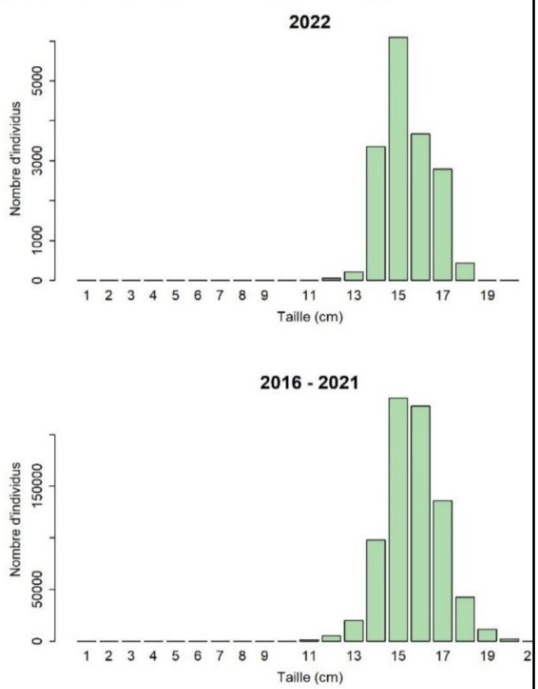
The 2019 abundance index is significantly higher than all other years monitored, which is consistent with the high index obtained in 2018 for Group 0. There are no significant differences among the other annual abundance indices (Figure 17)

NOURDEM LOIRE : *Dicentrarchus labrax* du groupe 1

2022 | Moyenne 2016-2021







Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2016	6 675	3 688	154	83	12.8	0.023
2017	19 497	15 445	914	695	16.2	0.047
2018	16 866	11 190	897	569	16.9	0.053
2019	682 899	319 938	29 258	13 641	15.6	0.043
2020	33 045	23 730	1 276	893	15.2	0.039
2021	20 462	20 369	765	720	14.9	0.037
2022	16 641	9 406	671	370	15.4	0.04

Figure 16: Group 1 European sea bass Dicentrarchus labrax in the Loire estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2016 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI scripts, and their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2016-2021 (bottom right).

4.9 Group 2 European sea bass

Group 2 sea bass are found in slightly deeper areas than Group 1 and especially Group 0, allowing for better sampling of their population. They colonize the entire estuary, from zero salinity to salinities of 35 per thousand, with catches recorded well downstream of the St Nazaire bridge on the "downstream estuary" stratum (Figure 18). Some catches were even recorded on the deepest tows within the "wide" stratum, but the center of their distribution range remains mainly positioned on the two most upstream strata ("central estuary" and "upstream estuary") and the upstream part of the "downstream estuary" stratum. As a result of their improved catchability, and the increased extent of their habitat zone within the sampled area, their catch occurrence is higher than that of the previous two groups. It averages 67.92% over the period 2016-2022 with an average abundance index of 63,553 individuals and an average biomass index of 8.22 tonnes.

In line with what was observed for groups 0 and 1 in previous years, the 2019 abundance index for individuals in group 2 is the highest in the series: it is significantly higher than those for 2016, 2017, 2018 and 2021 (no difference with those for 2020 and 2022). The 2022 index, one of the highest in the series, is significantly higher than those for 2017, 2018 and 2021.

Catch sizes of European sea bass in Group 2 ranged from 18 to 29 cm, with mean annual sizes ranging from 20 cm (year 2016) to 24.5 cm (2019). Average annual individual weights ranged from 86 to 161 grams (in 2016 and 2018 respectively).

4.10 European sea bass groups 3+

Group 3 and above sea bass colonize the entire estuary (Figure 19), and are caught from the furthest upstream to the furthest downstream reaches, with no clearly distinguishable preferential area of presence. Annual capture occurrences are systematically above 70%, averaging 79.93% over the 2016/2022 period. The average abundance index stood at 61,124 individuals over the entire monitoring period, and the average biomass index at 27.84 tonnes.

The annual abundance indices of these large age groups are less variable than those of the younger groups, and only 2020 stands out with an abundance index significantly lower than that of all other years. The abundance index for 2022 is slightly lower, at 61,400 individuals, for a biomass index of around 28.8 tonnes.

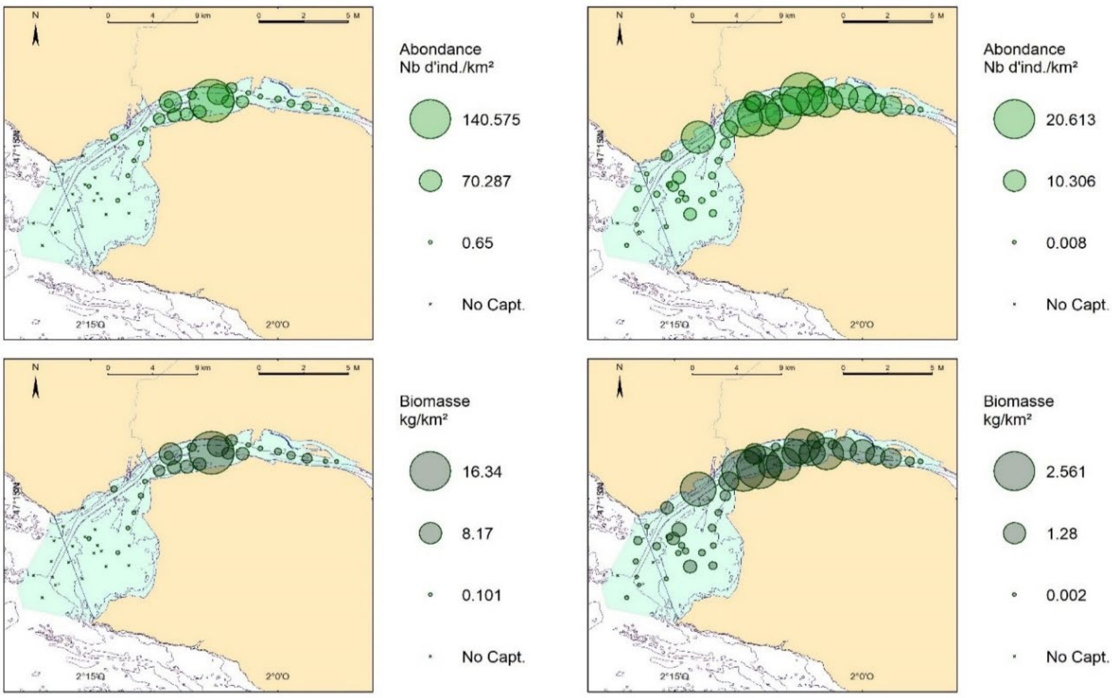
Sizes ranged from 23 to 87 cm (24 to 81 cm in 2022), and the size distribution histograms do not allow us to separate the different age groups beyond group 3. Average annual heights ranged from 29.9 cm (year 2016) to 37.3 cm (2020), and average individual weights from 335 grams (2017) to 634 grams (2020).

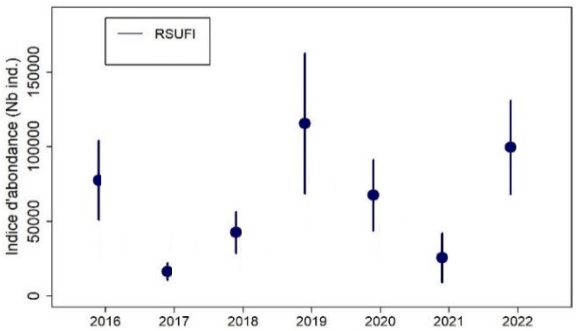
4.11 Summary of age group positioning

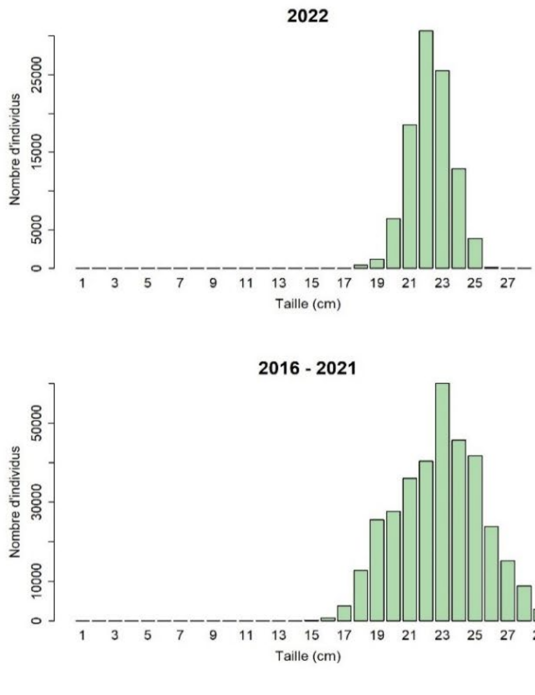
Figure 20 shows catches per haul averaged over the period 2016-2022, providing a summary map of the preferred areas of presence of the different age groups. Even more so than in the Seine estuary, this figure shows that juvenile sea bass in group 0 are found in the most upstream sectors of the area, and that as they age, they tend to colonize more and more of the area, moving into deeper, more downstream sectors, to end up being caught throughout the entire area sampled from group 3 onwards.

NOURDEM LOIRE : *Dicentrarchus labrax* du groupe 2

2022 Moyenne 2016-2021



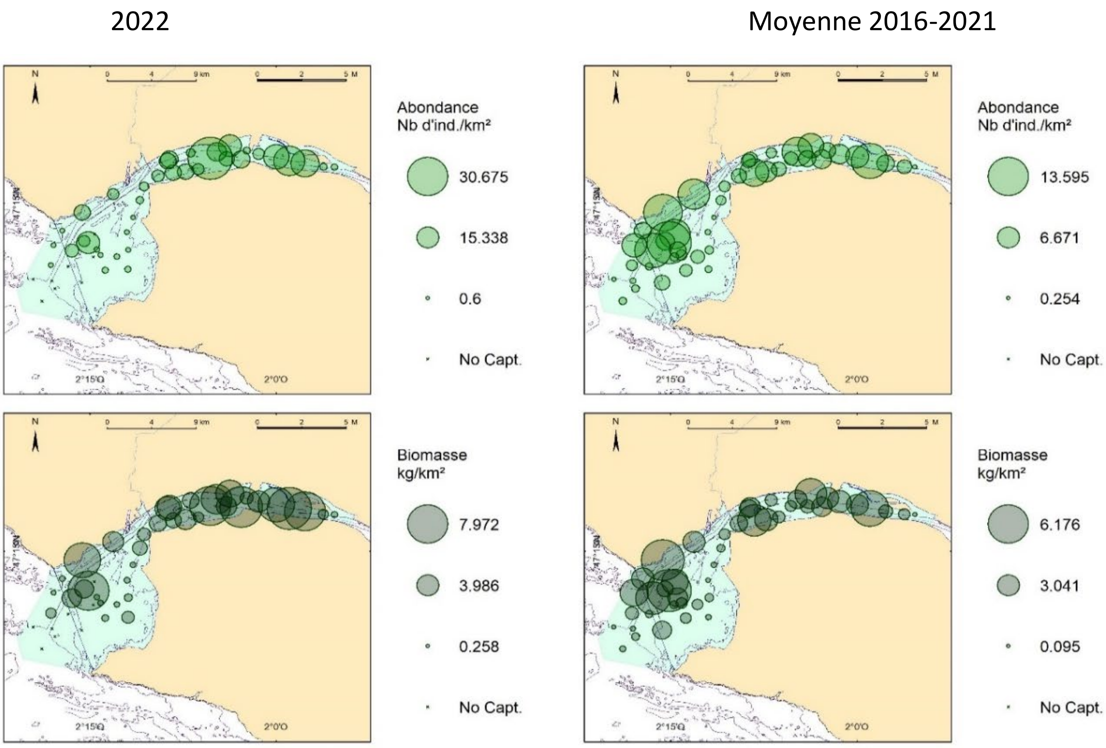


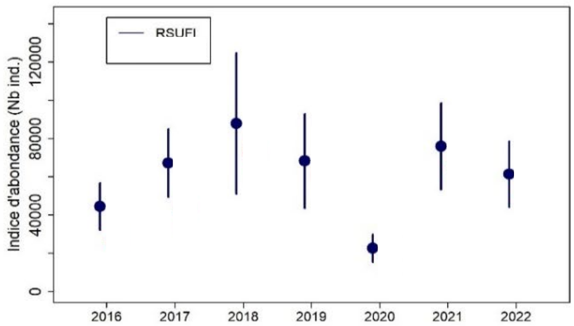


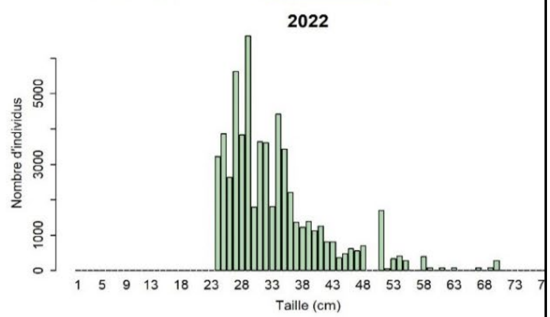
Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2016	77 553	26 618	6 698	2 247	20	0.086
2017	16 353	5 841	2 104	750	22.6	0.129
2018	42 567	13 911	6 864	2 264	23.9	0.161
2019	115 626	47 146	18 346	7 185	24.5	0.159
2020	67 520	23 830	8 476	3 020	22.6	0.126
2021	25 626	16 536	3 157	2 008	22.4	0.123
2022	99 627	31 368	11 891	3 658	22.3	0.119

Figure 17: Group 2 European sea bass Dicentrarchus labrax in the Loire estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2016 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI scripts and their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2016-2021 (bottom right).

NOURDEM LOIRE : *Dicentrarchus labrax* des groupes 3 et plus







Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2016	44 490	12 405	16 172	4 291	29.9	0.363
2017	67 232	17 860	22 529	5 669	30.7	0.335
2018	87 894	36 917	43 467	18 018	35.9	0.495
2019	68 284	24 741	36 887	13 846	36	0.54
2020	22 649	7 257	14 352	4 507	37.3	0.634
2021	75 923	22 644	32 621	8 231	33	0.43
2022	61 393	17 273	28 830	9 694	32.1	0.47

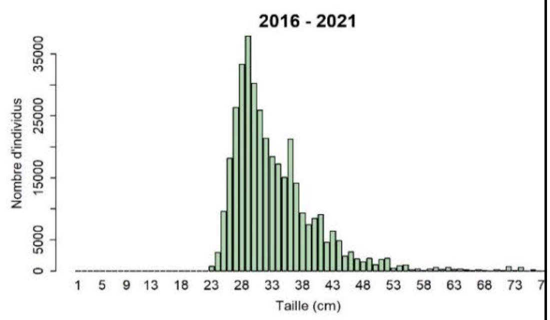


Figure 18: European sea bass Dicentrarchus labrax groups 3 and above in the Loire estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2016 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI scripts and their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). High catch size distributions (domain-wide) in 2022 vs. 2016-2021 (bottom right).

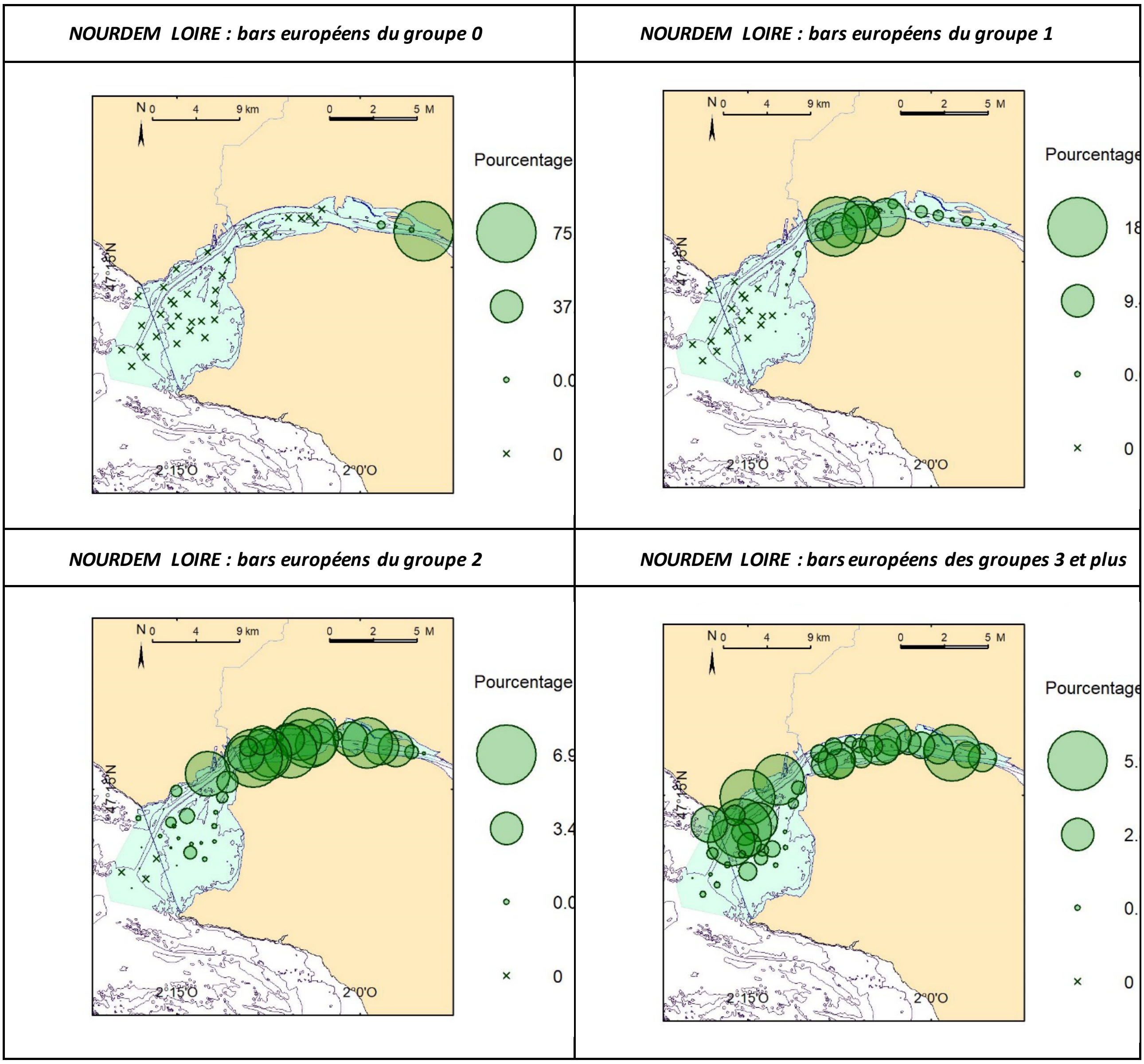


Figure 19: European sea bass Dicentrarchus labrax in the Loire estuary: averages, over the period 2016-2022, of catches per haul (expressed as a percentage of the total average number of individuals caught) of European sea bass Dicentrarchus labrax in age groups 0, 1, 2, and 3+; NourDem (2017-2022) and Bargip Nourriceries (2016) data.

5 European sea bass Dicentrarchus labrax in the Gironde estuary

As in the Seine and Loire, the European sea bass Dicentrarchus labrax is one of the core species of the Gironde estuary, which it uses as a nursery. Its average capture occurrence, all age classes combined, amounted to 40.7% over the 2019-2022 period (Tableau 3)

Tableau 3 : Overview of seabass catches in the Gironde estuary

Raw data Gironde Estuary					
year	Total trawl haul	Number of trawl haul with seabass	Occurrence	Number of seabass	weight (Kg)
2019	91	33	36%	1232	76
2020	61	30	49%	373	48
2021	60	18	30%	207	27
2022	57	27	47%	226	29

Figure 21 presents seabass index calculated across time with standard deviation associated. This index will be tested in the future assessment model. Following chapter details by age group results.

In this estuary, we had to settle for distinguishing two age groups only, juveniles in group 0 on the one hand, and individuals in groups 1 and above on the other, as separating older groups became too random without increasing the number of age determinations from scale "readings".

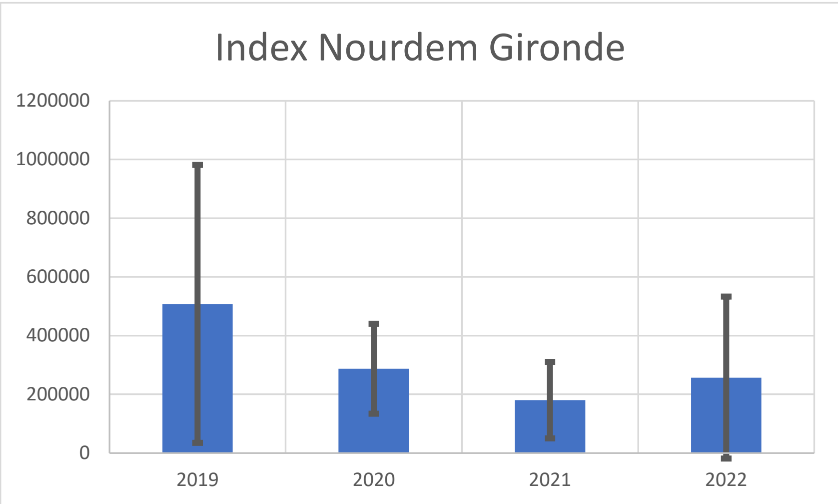


Figure 20 : Seabass index and standard deviation associated across time calculated for Nourdem Gironde (all ages combined)

5.1 Group 0 European sea bass

On average over the four years, these small individuals were caught in 18.45% of tows, and their average index of abundance was around 86,600 individuals (Figure 21).

The index of abundance passed through a minimum value in 2021, with 2022 showing the maximum index, but with no significant inter-annual difference. The catch sizes of these Group 0 individuals ranged from 5 to 14 cm, with mean annual sizes of between 9 and 10.6 cm, and mean weights of between 9 and 15 grams.

European sea bass in group 0 were mainly caught on the shallower, marginal stretches from upstream to downstream of the inner estuary (no catches outside the estuary). A positioning of this age group only upstream, as is clearly the case in the Loire or the Aulne (Le Goff et al, 2017 and 2022), and to a lesser extent in the Seine, is not apparent here. The only constant is that catches are only recorded on shallow-water tows.

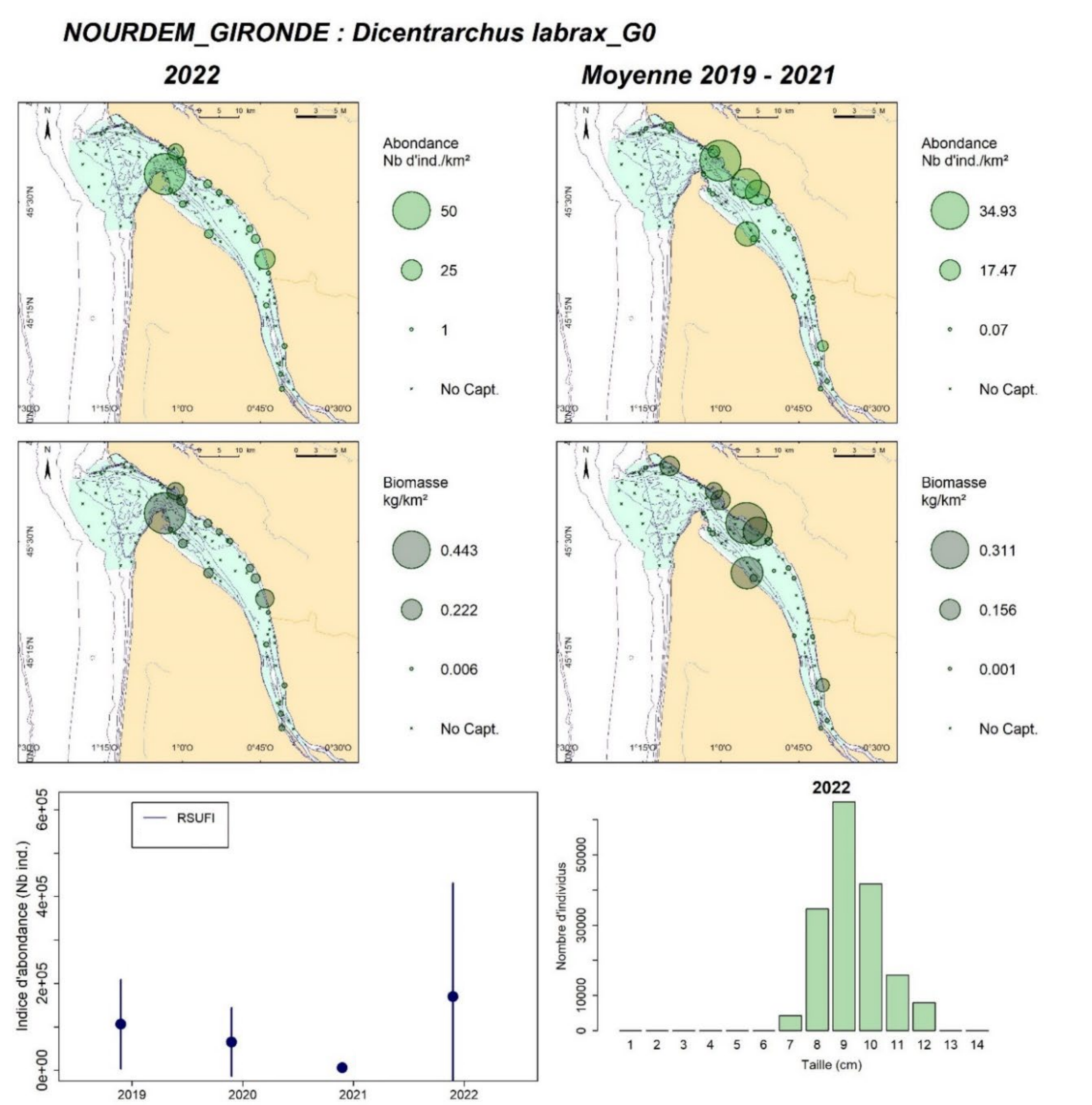
5.2 European bars in groups 1+

Average catch occurrence was 37.03% over the 2019-2022 period, with an average abundance index of 221,434 individuals for an average biomass index of 29.5 tonnes (Figure 21).

Annual indices of abundance appear to be declining over the 2019-2022 period, but the differences are not significant.

Catches are mainly made along the edge of the estuary, almost from the bec d'Ambez upstream to the downstream boundary lines outside the estuary.

Catch sizes range from 13 to 70 cm, with annual averages between 17.7 cm (2019; average weight 82 grams) and 27 cm (2022; average weight 241 grams). This relative increase in the number of large individuals in 2022 is in fact due to the disappearance of the smallest ones, as Group 1 individuals were caught in low proportions in 2022. This is in line with the low recruitment of group 0s observed in 2021, and future campaigns will have to verify whether the slightly higher recruitment of G0s observed in 2022 will translate into an increase in G1+ numbers from 2023 onwards.



Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2019	106 145	102 515	920	593	9	0.009
2020	64 924	78 650	868	1 053	10.4	0.013
2021	5 753	6 764	87	104	10.6	0.015
2022	169 610	261 161	1 593	2 316	9.4	0.009

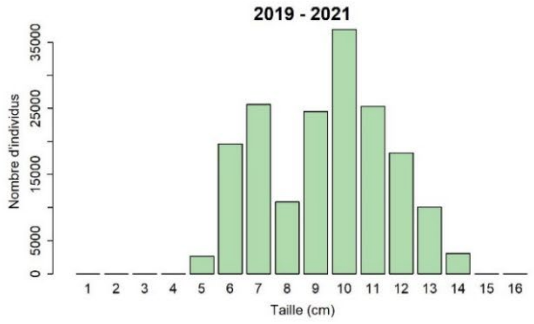
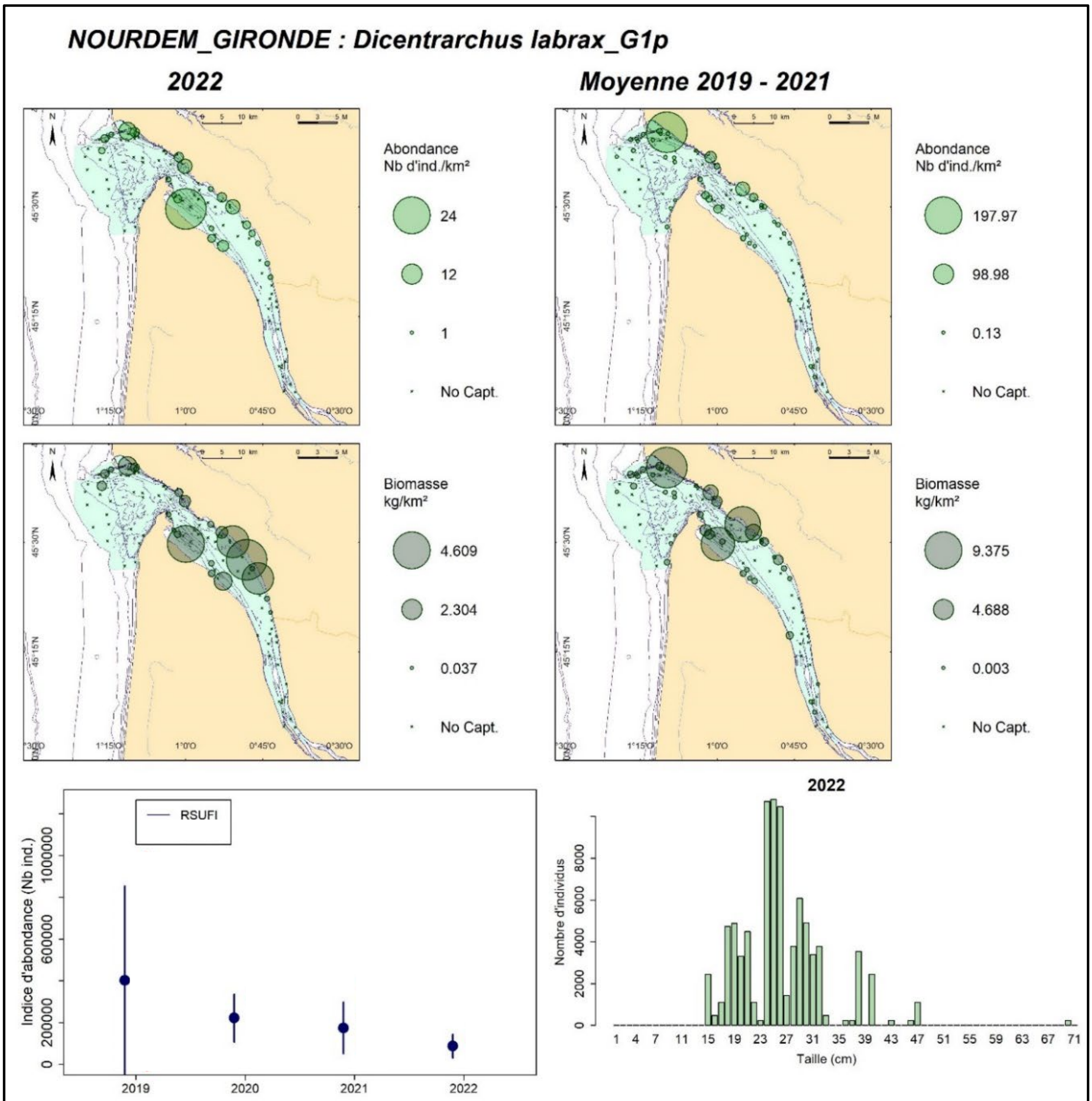
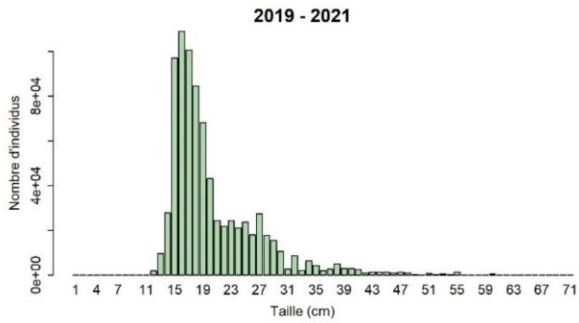


Figure 21: Group 0 European sea bass Dicentrarchus labrax in the Gironde estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2019 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI scripts and their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). Domain-wide high catch size distributions in 2022 vs. 2019-2021 (bottom right).





Années	Abondance (nombre)		Biomasse (kg)		Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(cm)	(kg)
2019	402 833	451 619	33 089	22 932	17.7	0.082
2020	221 573	114 526	36 296	24 179	22.4	0.164
2021	174 151	123 542	27 568	24 829	21.9	0.158
2022	87 180	56 258	21 045	14 175	27	0.241

Figure 22: European sea bass Dicentrarchus labrax groups 1 and above in the Gironde estuary: maps of surface densities and biomasses at each of the stations sampled, in 2022 (left) and between 2019 and 2021 (right); graph (center) of annual abundance indices determined using the RSUFI (blue) and RSTRATI (red) scripts and their framing ranges at the 5% error threshold; summary table of annual values of abundance and biomass indices, their framing ranges at the 5% error threshold, mean sizes and mean weights (RSUFI script; bottom left). Domain-wide high catch size distributions in 2022 vs. 2019-2021 (bottom right).

6 European sea bass Dicentrarchus labrax in the Douarnenez Bay

As in the Seine et Loire, the European sea bass Dicentrarchus labrax is one of the core species of the Douarnenez bay. Its average capture occurrence, all age classes combined, amounted to 48.7% over the 2018-2023 period (Tableau 4)

Tableau 4 : Overview of seabass catches in the Douarnenez bay

Raw data Douarnenez Bay				
year	Total trawl haul	Number of trawl haul with seabass	Number of seabass	weight (Kg)
2018	43	30	747	292
2021	63	8	404	45
2022	64	44	201	77
2023	60	30	323	122

Figure 24 presents seabass index calculated across time with standard deviation associated. This index will be tested in the future assessment model. Following chapter details by age group results.

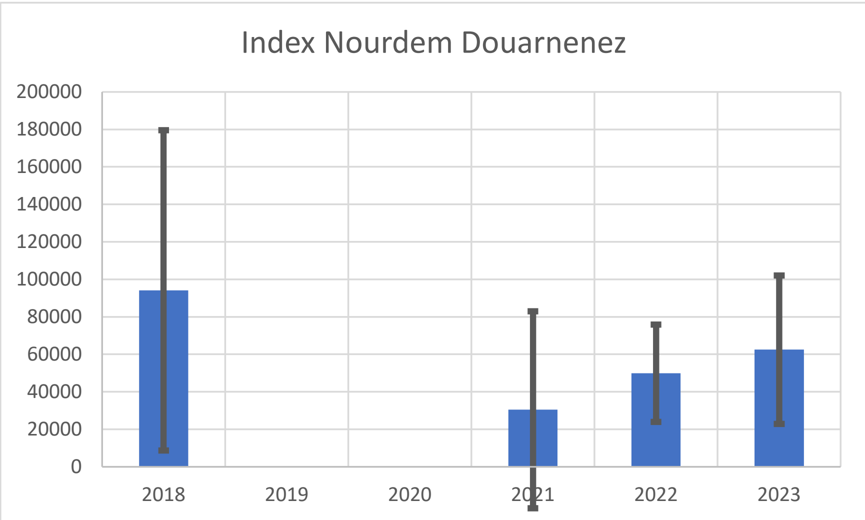


Figure 23 : Seabass index and standard deviation associated across time calculated for Nourdem Douarnenez (all ages combined)

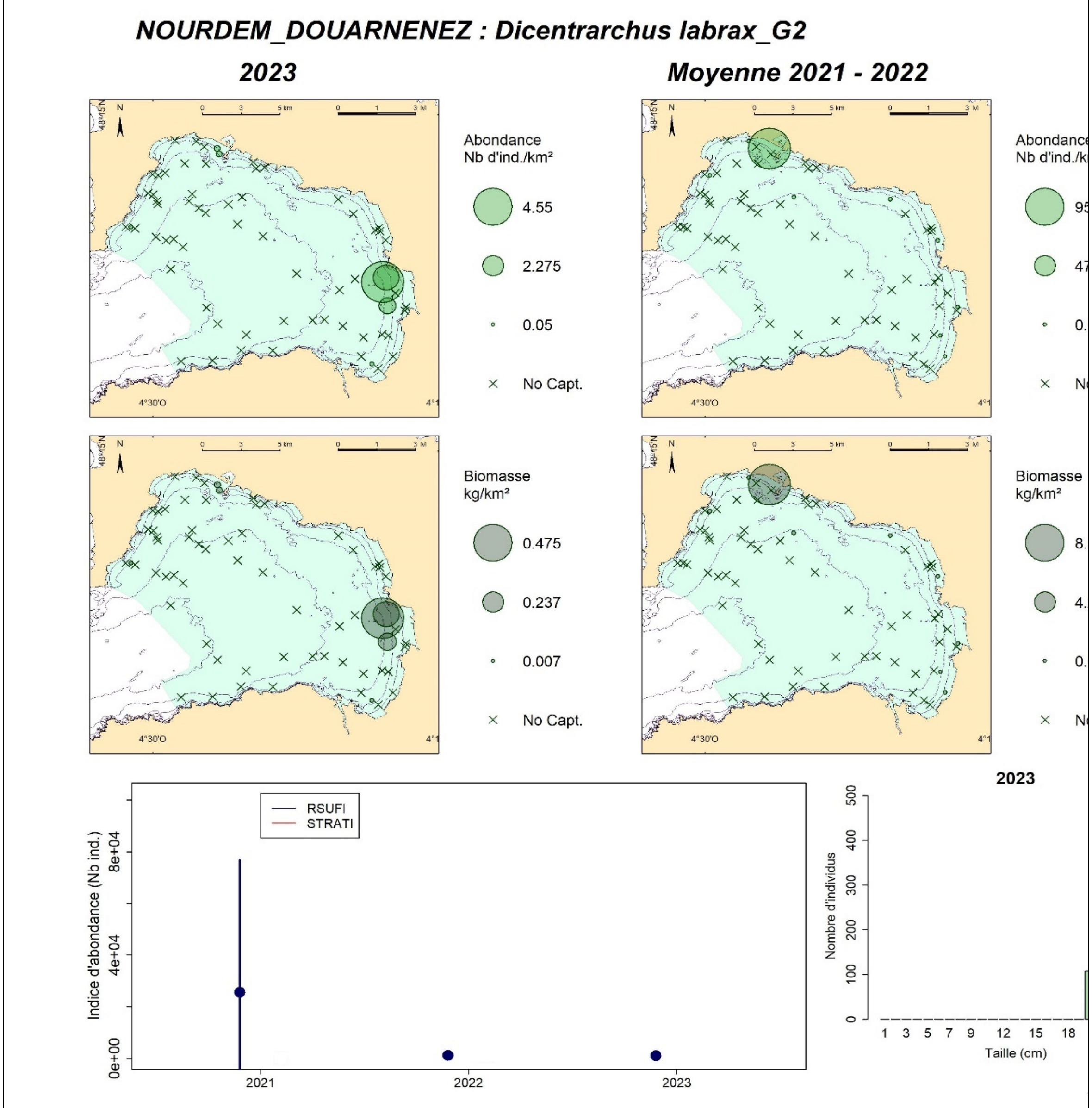
6.1 Group 0 and 1 European sea bass

Although the bay is bordered by fishing "spots" known for their richness in adults, we have not caught any G0 or G1 during the campaigns carried out to date. These very young individuals are known to live in very coastal water, and are therefore difficult to sample using a trawl towed behind a fishing vessel. The Marine Park's PNMI beach trawl surveys show the presence of some juveniles of these first two age groups in the freshwater inlets of the Aber, Kervel and Ris beaches, but in small quantities. The total absence of catches during our NourDem campaigns, coupled with the very low catches recorded by the PNMI as part of its coastal monitoring, indicate that the bay does not constitute a real nursery area for this species.

6.2 Group 2 European sea bass

Catches of G2 bass were infrequent and insignificant (except in 2021) compared with those of G3+ over the 3 campaigns. The average occurrence of catches of individuals in this age group was only 8.5% (Figure 25):

3% in 2021 (i.e. catches during 2 hauls only), and ≈ 11% in 2022 and 2023 (catches during 7 hauls). The abundance and biomass indices are therefore low, and also not very accurate due to the large framing ranges obtained (no significant inter-annual differences). The catches (384 individuals in 2021, 7 in 2022 and 9 in 2023) were recorded almost exclusively on coastal features, and in particular on the beaches of Aber and Kervel, i.e. the places where G0 and G1 catches are recorded by the PNMI. Average annual sizes ranged from 20.2 to 23.4 cm.



Année	Abondance (nombre)		Biomasse (kg)		Occurrence	Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(%)	(cm)	(kg)
2021	25 619	51 314	2 284	4 572	3	20,19	0,089
2022	1 183	1 241	160	166	11	23,41	0,142
2023	1045	1076	112	114	11	21,52	0,108

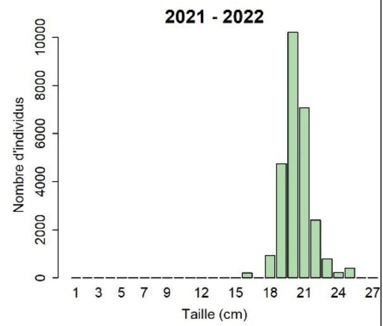


Figure 24 European sea bass Dicentrarchus labrax from Group 2 (i.e. born in 2019 for the 2021 season, in 2020 for the 2022 season and in 2021 for the 2023 season) in Douarnenez Bay: maps of surface abundance and biomass in 2023 (top left) and averaged over the years 2021 and 2022 (top right). Plot of annual changes in abundance indices and their framing ranges at the 5% error threshold. Summary table of the annual values of the indices of abundance and biomass, their framing ranges (RSUFI script; 5% error threshold), capture occurrences, and mean sizes and weights. Histograms of size distributions, raised to the entire domain, in 2023, and cumulated over the years 2021 and 2022. NourDem PNMI-DZ data.

On the other sites monitored as part of the NourDem campaigns (Seine, Loire and Gironde estuaries in particular), the experience acquired to date shows us that group 2 sea bass leave the shallowest waters immediately adjacent to the coast, and that they are therefore fully accessible to sampling using the GOV trawl. The low catches of G2 in Douarnenez Bay support the idea that this bay is not, strictly speaking, a nursery area for this species. This is still only a hypothesis, to be verified in future monitoring.

At the time of the surveys, the individuals in group 2 measured between 16 and 25 cm (for an average size of ≈ 21 cm).

6.3 Group 3+ European sea bass

These age groups showed significantly higher capture occurrences and indices of abundance and biomass than the G2:

- In 2021: 9.5% occurrence (captured during 6 of the 63 tows), with the capture of 19 individuals for a total biomass of 14.17 kg,

- In 2022: 68.75% capture rate (44 hauls out of 64) for a total capture of 195 individuals and a biomass of 85.1 kg.

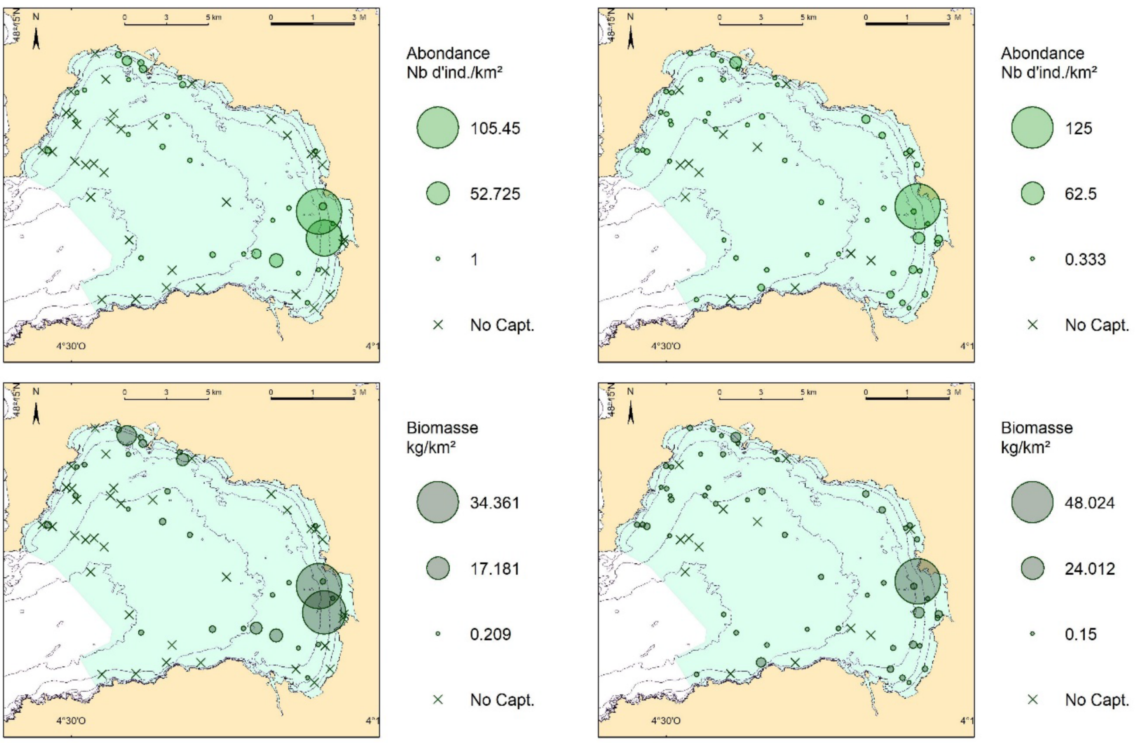
- In 2023: 50% catch rate (30 hauls out of 60) for a total catch of 313 individuals and a biomass of 127.86 kg.

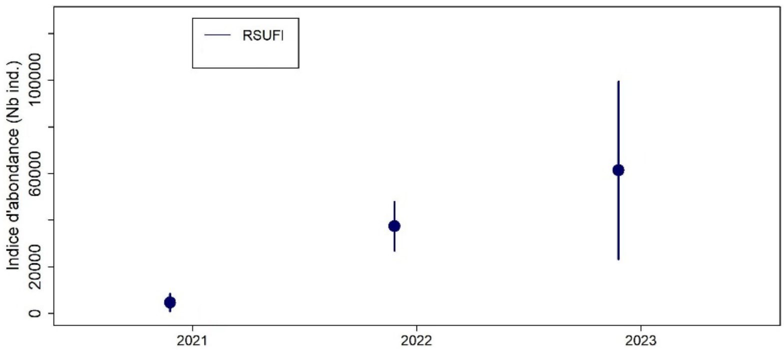
Taken over the entire area sampled, these catches give abundance indices IA of 4,690 +/- 3,776 individuals for a biomass IB of 3,464 +/- 2,998 tonnes in 2021, compared with 37,404 +/- 10,573 individuals and a biomass IB of 18,037 +/- 4,991 tonnes in 2022, 991 tonnes in 2022 and 61,412 +/- 38,162 individuals for 25,771 +/- 13,965 tonnes in 2023. The indices of abundance and biomass for 2022 and 2023 are significantly higher (at the 5% threshold) than those for 2021 but do not differ according to the RSUFI script.

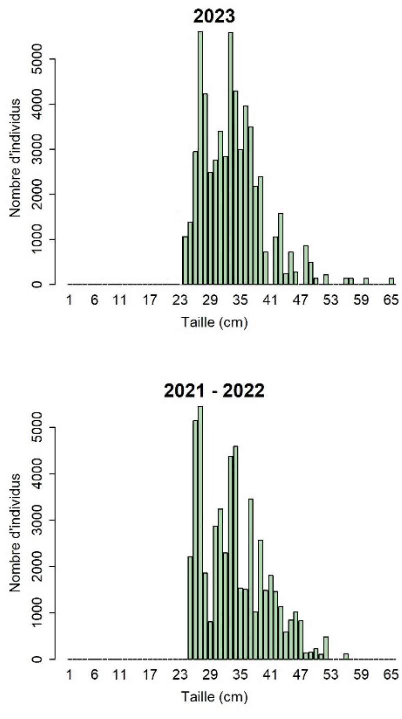
After 3 years of monitoring, the entire area sampled appears to be colonised by G3+ sea bass, with the possible exception of a few deep sectors in the north of the central area of the bay. On the other hand, the coastal sectors around the north-east and the beaches of St Anne la Palud/Kervijen in the east have the highest densities (distribution to be confirmed by future monitoring).

Average catch sizes and weights were highest in 2021: 40.9 cm and 739 grams. In 2022 and 2023, the values are very similar: 32.3 and 33 cm average length for ≈ 420 and 423 grams average individual weight.

NOURDEM_DOUARNENEZ : *Dicentrarchus labrax*_G3p







Années	Abondance (nombre)		Biomasse (kg)		Occurrence	Taille moy.	Poids moy.
	IA	Fourch.	IB	Fourch.	(%)	(cm)	(kg)
2021	4 690	3 776	3 464	2 998	10	40.9	0.739
2022	37 404	10 573	18 037	4 991	69	33	0.423
2023	61 412	38 162	25 771	13 965	49	32.3	0.42

Figure 25: European sea bass Dicentrarchus labrax of Groups 3 and + (born in 2018 or earlier for the 2021 season, in 2019 or earlier for the 2022 season, and in 2020 or earlier for the 2023 season) in Douarnenez Bay: maps of surface abundance and biomass in 2023 (top left) and averaged over the years 2021 and 2022 (top right). Plot of annual changes in abundance indices and their framing ranges at the 5% error threshold. Summary table of the annual values of the indices of abundance and biomass, their framing ranges (RSUFI script; 5% error threshold), capture occurrences, and mean sizes and weights. Histograms of size distributions, raised to the entire domain, in 2023, and cumulated over the years 2021 and 2022. NourDem PNMI-DZ data.

7 ANNEX: Numbers at length and ALK

This section provides all raw information available, numbers at length and Age length key for each survey. These data will be used as input data in the future model developed at WKSEABASS in November 2024. This will complete indices presented in Figure 9, Figure 15, Figure 21, Figure 24.

Loire estuary

size (cm)	Number 2016	size (cm)	Number 2017	size (cm)	Number 2018	size (cm)	Number 2019	size (cm)	Number 2020	size (cm)	Number 2021	size (cm)	Number 2022
0		0		0		0		0		0		0	
1		1		1		1		1		1		1	
2		2		2		2		2	100	2		2	
3		3		3		3		3		3		3	
4		4		4	138	4	511	4	493	4		4	225
5		5		5	3443	5	170	5	1510	5	241	5	282
6		6		6	35394	6	284	6	2960	6	60	6	225
7		7		7	54638	7	397	7	211	7		7	
8	72	8		8	25533	8	567	8		8		8	
9		9		9	964	9	113	9		9		9	
10		10		10	46	10	89	10		10		10	
11	1138	11		11		11	57	11		11		11	
12	2909	12		12		12	1812	12	100	12	543	12	56
13	1460	13	607	13	92	13	14005	13	2246	13	1539	13	220
14	952	14	1804	14	87	14	81109	14	9525	14	4408	14	3355
15	265	15	3948	15	1400	15	213640	15	8940	15	7310	15	6094
16	820	16	4807	16	5128	16	205133	16	7681	16	4712	16	3677
17	3760	17	4914	17	4644	17	122238	17	2531	17	1572	17	2797
18	11738	18	2633	18	4012	18	33804	18	2463	18	755	18	884
19	22886	19	1454	19	2433	19	9354	19	698	19	242	19	1155
20	18449	20	568	20	2644	20	3406	20	3848	20	757	20	6431
21	9970	21	1779	21	2583	21	7650	21	9660	21	4395	21	18522
22	6477	22	2758	22	3313	22	5122	22	14659	22	8084	22	30676
23	3084	23	5489	23	5019	23	20522	23	21107	23	5660	23	25534
24	1749	24	4117	24	4920	24	23178	24	10258	24	4422	24	16081
25	3910	25	3374	25	6218	25	26079	25	7176	25	4516	25	7727
26	5327	26	6516	26	7287	26	14612	26	2055	26	6265	26	2776
27	4806	27	10194	27	4656	27	10046	27	1754	27	10034	27	5630
28	7212	28	12211	28	4960	28	6799	28	542	28	10398	28	3842
29	5970	29	11944	29	5021	29	6460	29	796	29	10573	29	6634
30	4090	30	4177	30	7114	30	7866	30	666	30	6309	30	1794
31	2228	31	3982	31	4864	31	8942	31	468	31	5398	31	3637
32	1477	32	1417	32	6339	32	6214	32	1776	32	4183	32	3615
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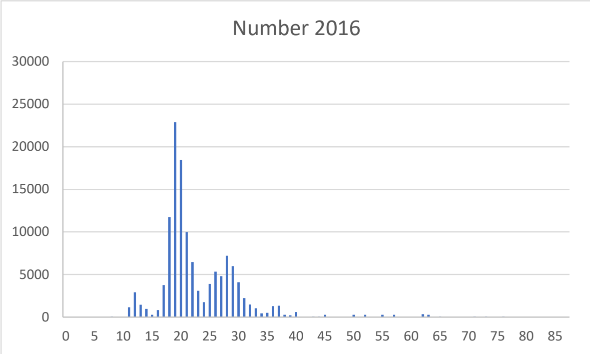
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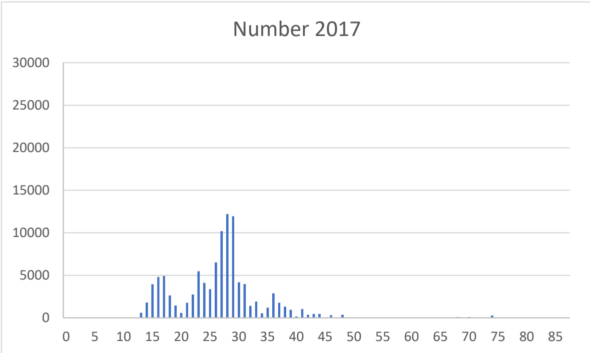
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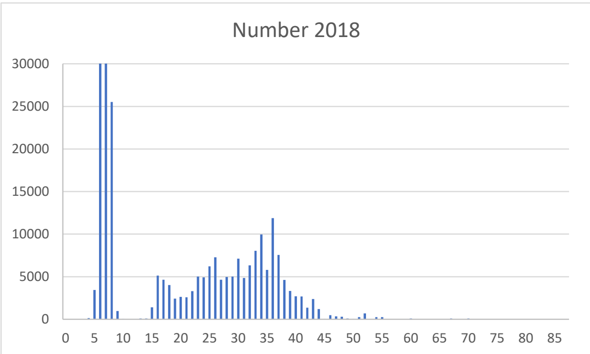
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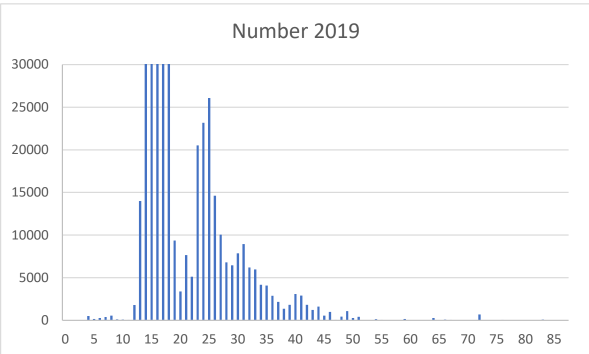
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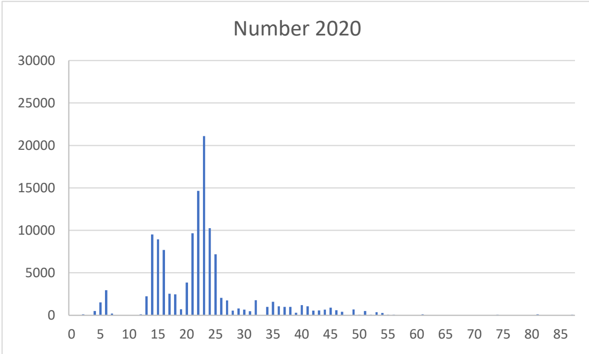
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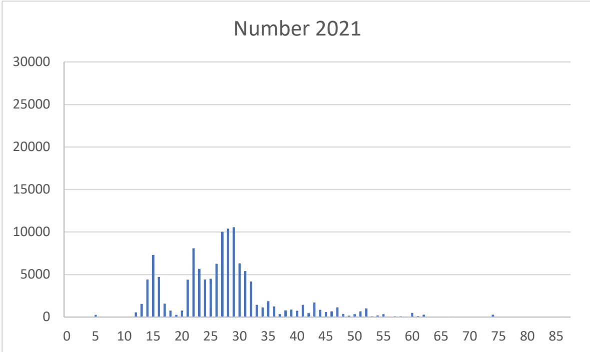
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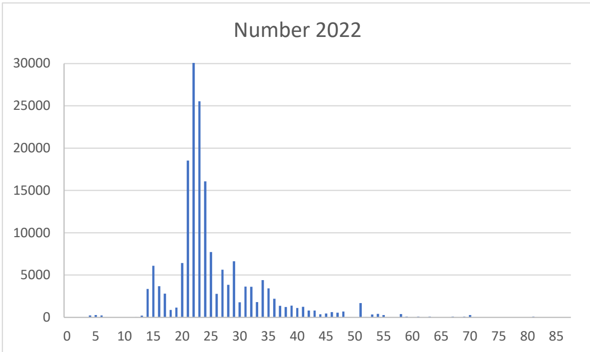
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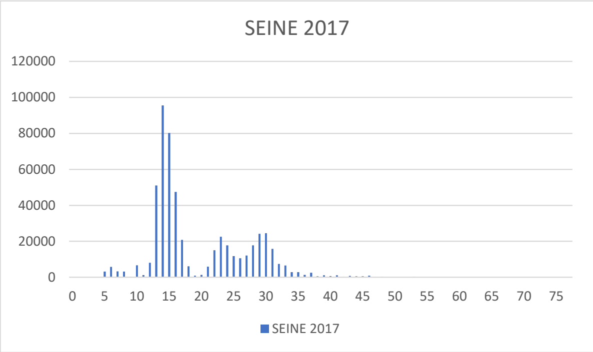
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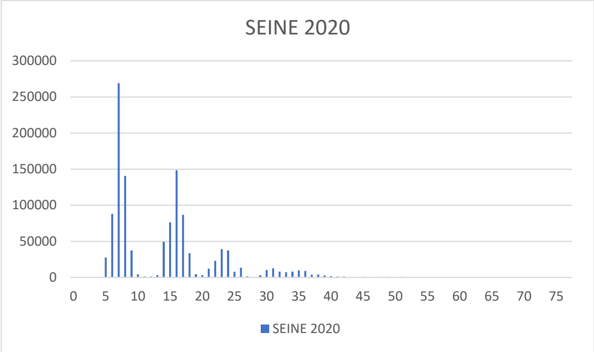
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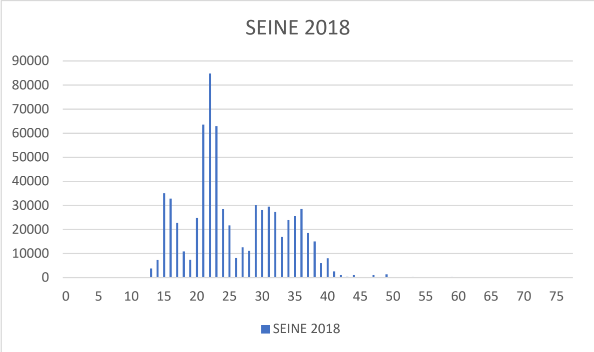
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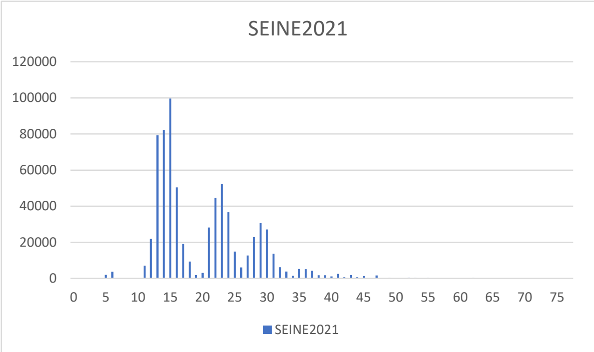
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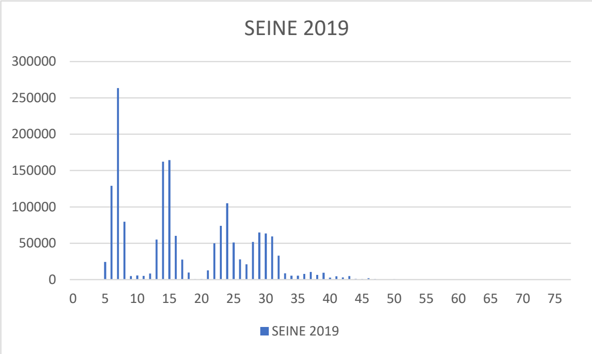
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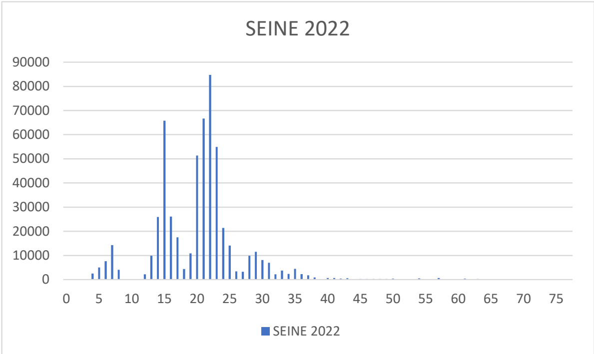
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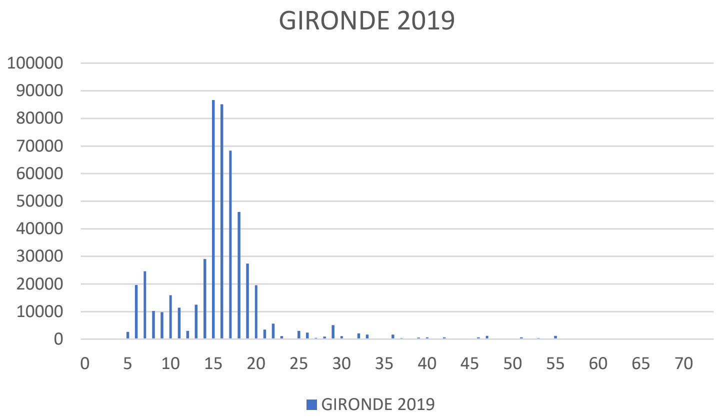
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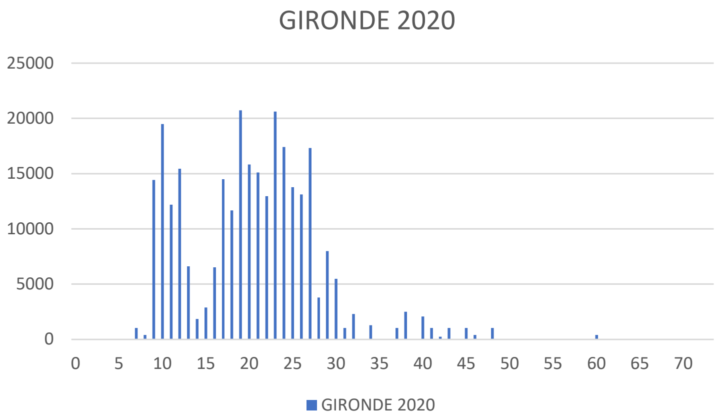
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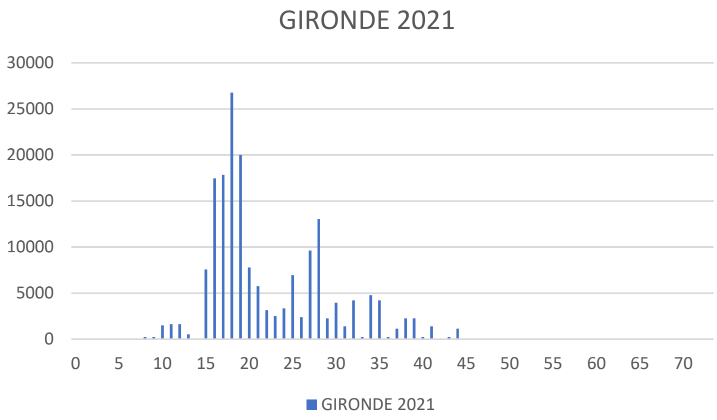
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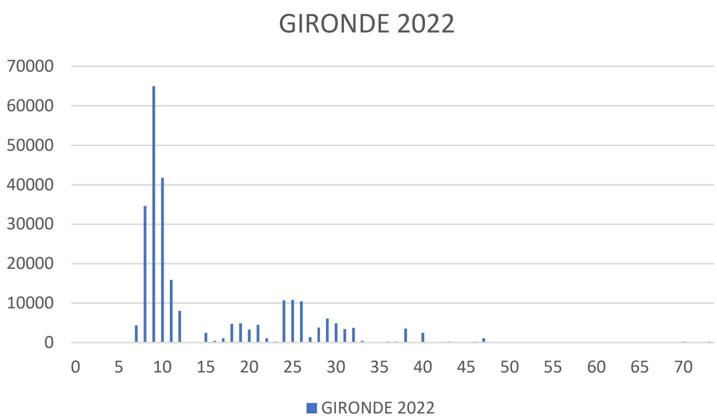
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Douarnenez Bay								
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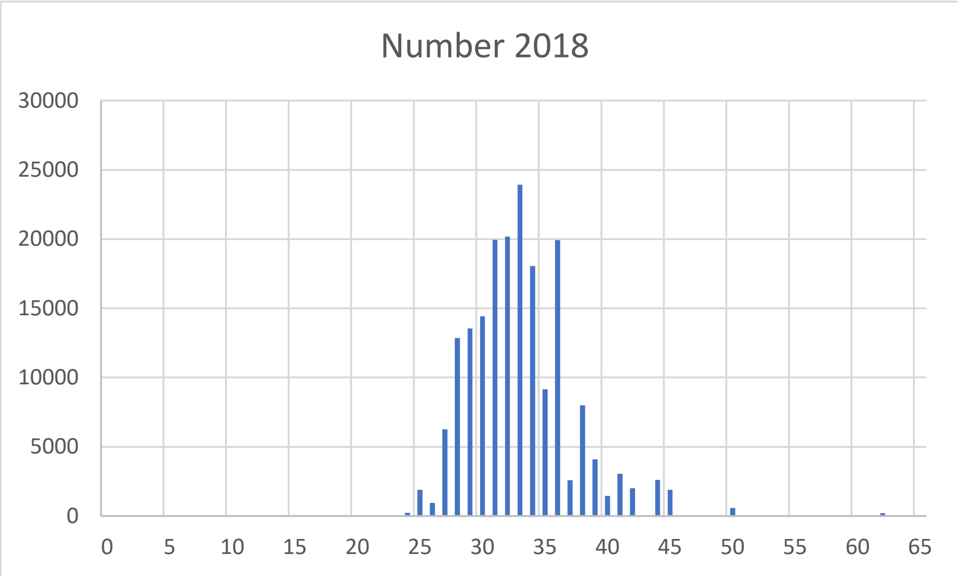
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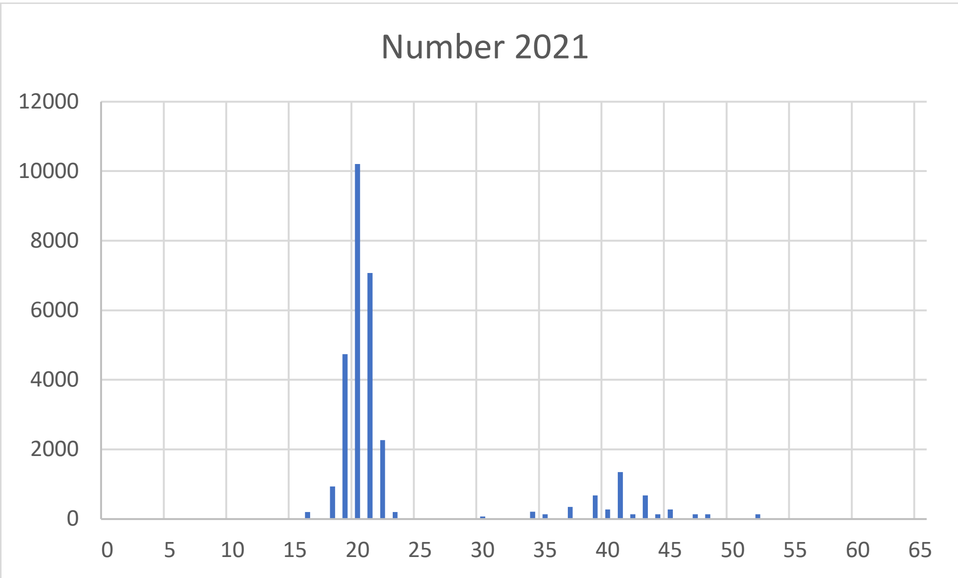
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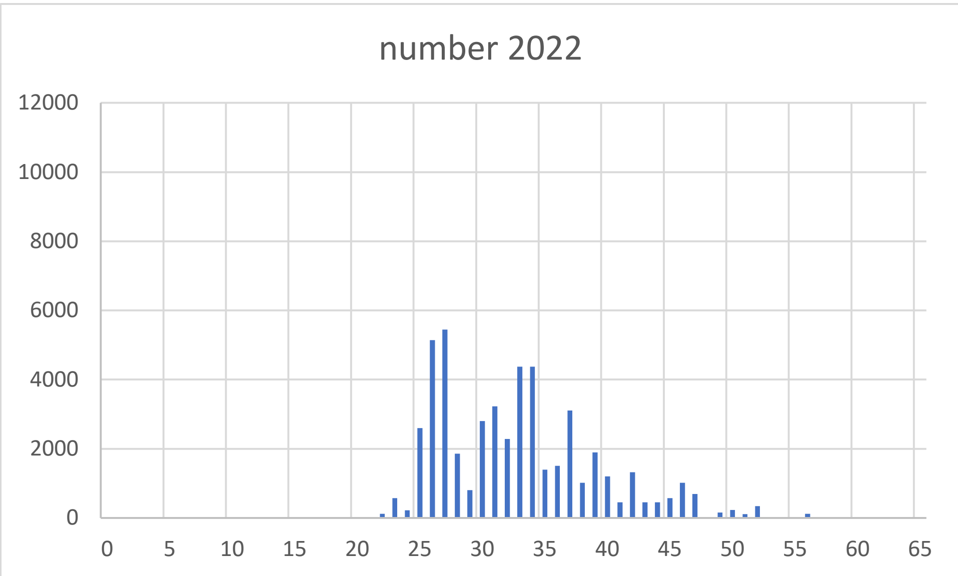
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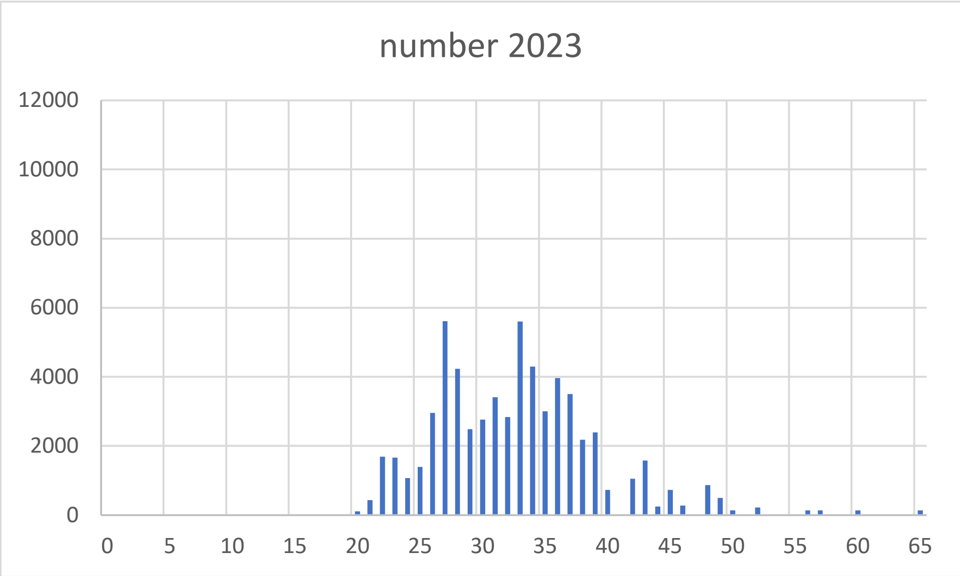
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55
60
65

ALK Seine estuary								
2017								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
40								
50								
60								
70								
80								
90								
100								
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340								
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360								
370								
380								
390								
400								
410								
420								
430								
440								
450								
ALK Seine estuary								
2018								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
40								
50								
60								
70								
80								
90								
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380								
390								
400								
410								
420								
430								
440								
450								
ALK Seine estuary								
2019								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
40								
50								
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80								
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100								
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400					1	1		
410								
420								
430								
440								

450								
ALK Seine estuary								
2020								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
40								
50								
60								
70								
80	4							
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100								
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ALK Seine estuary								
2021								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
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50								
60								
70								
80								
90								
100								
110								
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450						1		
ALK Seine estuary								
2022								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
40								
50								
60								
70								
80								

90								
100								
110								
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ALK Loire estuary								
2016								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
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ALK Loire estuary								
2017								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
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450								

ALK Loire estuary								
2018								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
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450								

ALK Loire estuary								
2019								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
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400						1		
410								
420						1		
430								
440								
450								

ALK Loire estuary								
2020								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
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80								
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100								
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ALK Loire estuary								
2021								
size (mm)	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7
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ALK Douarnenez Bay							
2018							
size (mm)	age0	age1	age2	age3	age4	age5	age6
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450							

ALK Douarnenez Bay				
2021				
size (mm)	age0	age1	age2	age3
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100				
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380				
390				
400				
410				
420				
430				
440				
450				

ALK Gironde estuary						
2019						
size (mm)	age0	age1	age2	age3	age4	age5
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380						
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400						
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430						
440						
450						

ALK Gironde estuary						
2020						
size (mm)	age0	age1	age2	age3	age4	age5
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360						
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380						
390						
400					1	
410					1	1
420						
430					1	
440						
450						

ALK Gironde estuary						
2021						
size (mm)	age0	age1	age2	age3	age4	age5
70						
80						
90						
100						
110						
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420						
430				1		
440					1	
450						

ALK Gironde estuary						
2022						
size (mm)	age0	age1	age2	age3	age4	age5
70						
80						
90						
100						
110						
120						
130						
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170						

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410						
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Working document: Belgian commercial beam trawl landings data for sole in the Celtic Sea (ICES divisions 7.f and 7.g).

Authors: Sofie Nimmegeers, Lies Vansteenbrugge and Klaas Sys (ILVO, Belgium)

1. Introduction

The Belgian commercial fishing fleet has fishing opportunities in several ICES divisions. To allow an efficient exploitation of the stocks over all these areas, vessels are allowed to fish in different ICES divisions within one trip (e.g. while steaming from a Belgian harbour to a foreign harbour). This flexibility of fishing in different ICES divisions might create opportunity for non-compliance. Investigating the Belgian sole landings data revealed that pure trips, *i.e.* trips in which fishing activity was limited to one sole stock area (ICES divisions 7.f and 7.g), have often a considerably different mean landing rate ($kg.h^{-1}$) than mixed trips (*i.e.* trips in which fishing occurred in multiple ICES divisions and crossing multiple stock areas). In this working document, we explore this difference in landing rate and suggest a method to estimate the total landings in divisions 7.f and 7.g accounting for non-compliance.

2. Data sources

Every period of 24 hours, the skipper has to report his fishing activity (fishing hours and catch weight) in the electronic logbook. This includes both the fishing hours and the catch weight. The catch weight registered in the logbooks is an estimated weight (kg, with an upper and lower tolerance of 10%) for all commercial species landed. Often the fishing hours and catch weight are allocated to the ICES statistical rectangle where the vessel is located during the time of registration. If within those 24 hours they switch to another ICES statistical rectangle, the skipper has to report this in the logbook. To calculate the landings per unit effort, the landed weights were divided by the fishing hours (lpue; in kg/h). For the lpue calculation in 2006-2020, the landed weights are derived from the quantities recorded in the sales notes. The sales notes contain information on the quantities auctioned by market category for all species landed, but no area information. Therefore, sales notes are linked to catch information from the logbooks to acquire spatial information (ICES statistical rectangle level) of the catches. For the lpue calculation in 2021-2023, the quantities recorded in the logbooks were used as the actual landed weights. The reason for this difference in methodology is attributed to a change in database system. The Belgian government responsible for aggregating data from the Belgian commercial fishing fleet (logbook, sales and effort data) moved to a new database system from 2021 onwards. The decision to take the quantities from the logbooks from 2021 onwards and not from the sales notes, was made after inconsistencies were noted between the allocation of fishing hours and the quantities recorded in the sales notes by rectangle.

3. Pure versus mixed trips

The most important gear for catching sole in ICES divisions 7.f and 7.g is TBB_DEF_70-99, which accounts for around 87% of the landings (average 2017-2023). The Belgian beam trawl fleet takes about 79% (average 2017-2022) of the beam trawl catches of sole in ICES divisions 7.f and 7g and the large beam trawl fleet segment (> 221 kW) is the most important fleet segment, representing about 94% (average 2006-2023) of the uptake. Therefore, this analysis was performed by combining data from both the small and the large beam trawl fleet segment.

Pure trips are defined as fishing trips during which a vessel registered fishing effort exclusively in one sole stock area, so ICES divisions 7.f and 7.g. The mixed trips, on the other hand are defined as fishing trips during which a vessel registered fishing effort in multiple ICES divisions/stock areas, among which the sole 7fg stock area. An overview of the number of trips over the period 2006-2023 is provided in the table below (Table 1).

Table 1: An overview of the number of pure and mixed trips with catches of sole in ICES divisions 7.f and 7.g from the Belgian beam trawl fleet over the period 2006-2023.

Year	Number of 'pure' trips	Number of 'mixed' trips
2006	101	278
2007	127	250
2008	101	127
2009	110	163
2010	120	144
2011	162	161
2012	219	178
2013	221	161
2014	139	165
2015	160	125
2016	108	182
2017	113	209
2018	102	214
2019	125	230
2020	135	318
2021	81	306
2022	91	351
2023	123	314

Some of the mixed trips from the Belgian large beam trawl fleet showed much higher lpue compared to pure trips (Figure 1 and 2). Moreover, the difference between mixed and pure trips is mainly found at low effort levels (< 20 hours). This supports the hypothesis that fishers may misreport landings in mixed trips from one ICES division to another by fishing for a very short time in the sole stock area (ICES divisions 7.f and 7.g). One pure trip/rectangle combination with an lpue value of 820 $kg.h^{-1}$ was excluded from the analysis.

Figure 1: Scatter plot of fishing effort (in fishing hours) versus sole lpue (kg.h^{-1}) per year from the Belgian beam trawl fleet in ICES divisions 7.f and 7.g. Observations of pure and mixed trips are indicated in blue and red, respectively.

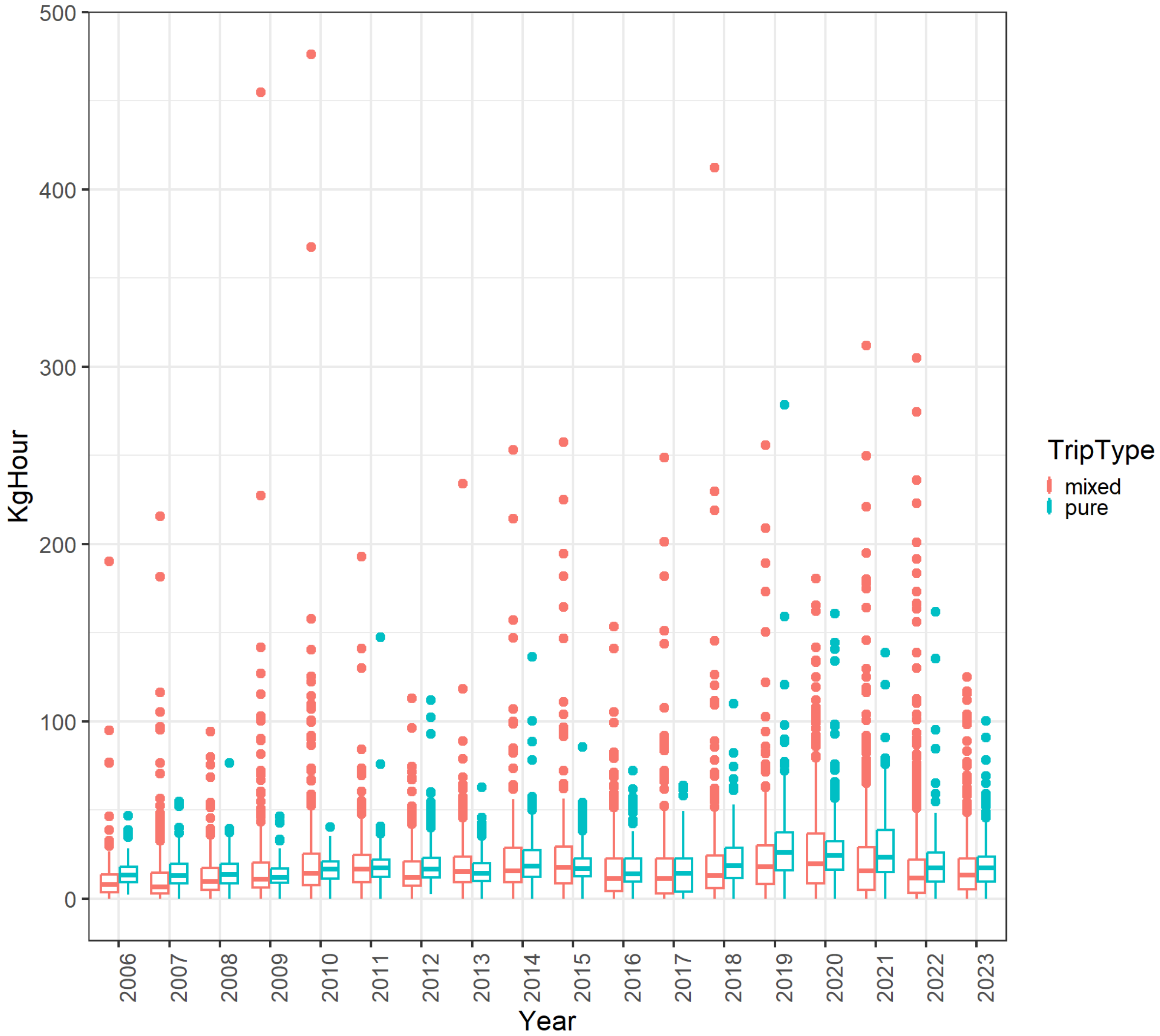


Figure 2: Box plot of sole lpue (kg.h^{-1}) per year from the Belgian beam trawl fleet in ICES divisions 7.f and 7.g. Observations of pure and mixed trips are indicated in blue and red, respectively.

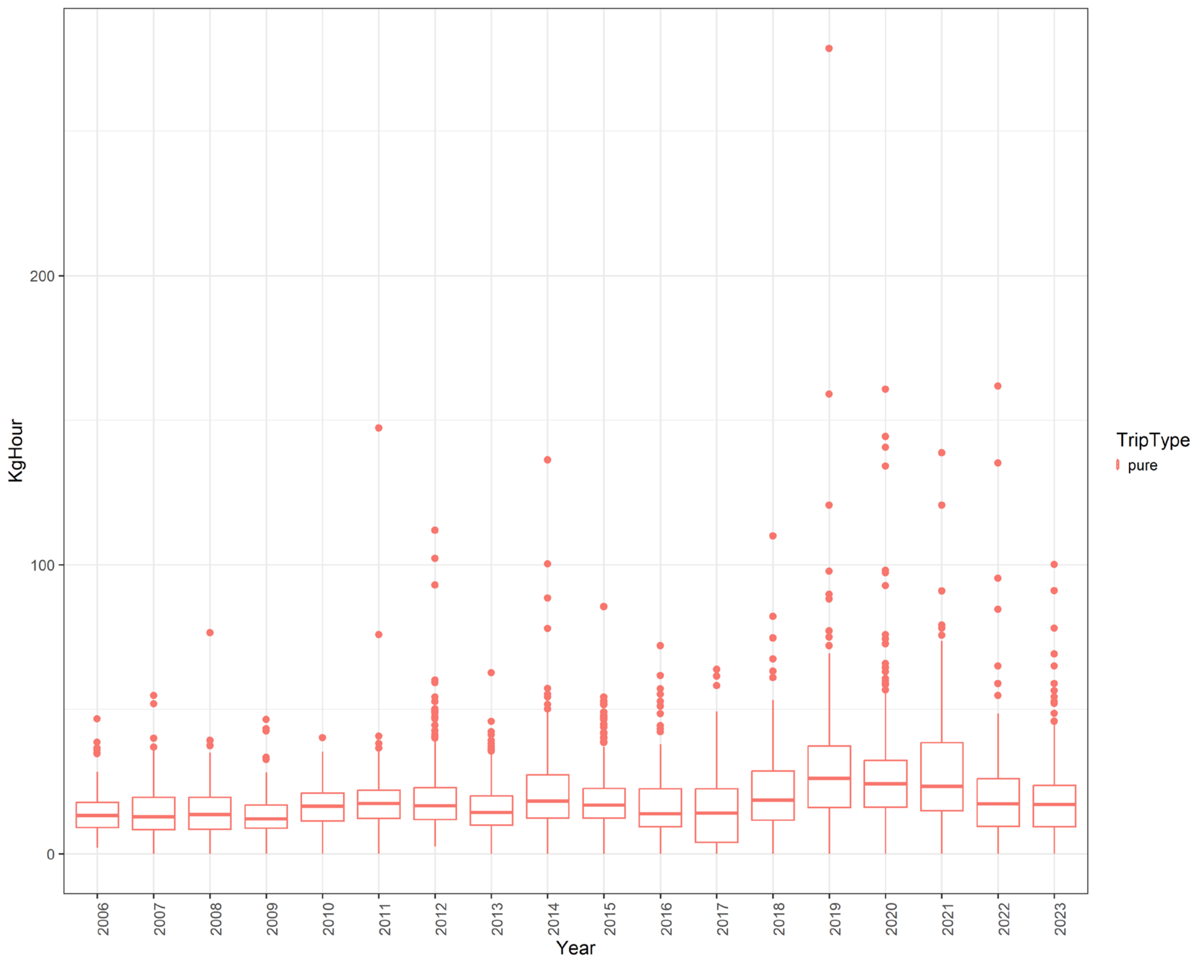


Figure 3: Box plot of sole lpue (kg.h-1) per year from the pure trips of the Belgian beam trawl fleet in ICES divisions 7.f and 7.g.

A low number of trips with zero sole catches were reported in ICES divisions 7.f and 7.g, but the occurrence of zero catches in the mixed trips (11%, average 2006-2023) is higher compared to the pure trips (4%, average 2006-2023). The actual values of the Belgian beam trawl fleet are shown in the table below (Table 2).

Table 2: An overview of the number of pure and mixed trips with zero catches of sole in ICES divisions 7.f and 7.g from the Belgian beam trawl fleet over the period 2006-2023.

Year	Number of 'pure' trips	Number of 'pure' trips with zero catch	Number of 'mixed' trips	Number of 'mixed' trips with zero catch
2006	101	0	278	28
2007	127	1	250	29
2008	101	1	127	10
2009	110	5	163	14
2010	120	2	144	5
2011	162	2	161	3
2012	219	0	178	8
2013	221	4	161	8
2014	139	3	165	13
2015	160	4	125	15
2016	108	1	182	21
2017	113	16	209	37
2018	102	3	214	27
2019	125	8	230	19

2020	135	4	318	31
2021	81	6	306	53
2022	91	9	351	85
2023	123	21	314	61

4. Estimate the landings

First, the annual landings of pure trips were divided by the annual effort of pure trips per ICES statistical rectangle to calculate a pure trip lpue (t ϵ pure,mixed) by rectangle (a ϵ 29E2, 29E3, 29E4, 30E1, 30E2, 30E3, 30E4, 30E5, 31E1, 31E2, 31E3, 31E4, 31E5, 31E6, 32E1, 32E2, 32E3, 32E4, 32E5) and year (y ϵ {2006 to 2023}). Secondly, this lpue was used to estimate the landings from the mixed trips by multiplying the effort (by rectangle and year) reported in these trips with the pure trip lpue derived in step 1. Finally, the estimated landings from the mixed trips were added to the reported landings from the pure trips to estimate the total landings per year.

$$lpue_{a,y,t=pure} = \sum_{a,y,t=pure} landings / \sum_{a,y,t=pure} effort$$

$$landings_y = \sum_y (lpue_{a,y,t=pure} x \; effort_{a,y,t=mixed} + \; landings_{a,y,t=pure})$$

This method assumes that the effort as reported in the mixed (and pure) trips is reliable, and that lpue of pure trips (Figure 3) is representative for the landing rate in mixed trips. In addition, this method accounts for spatial variation, as the lpue is calculated by ICES statistical rectangle (Figure 4). The reported landed weights by ICES statistical rectangle are available from 2006 onwards.

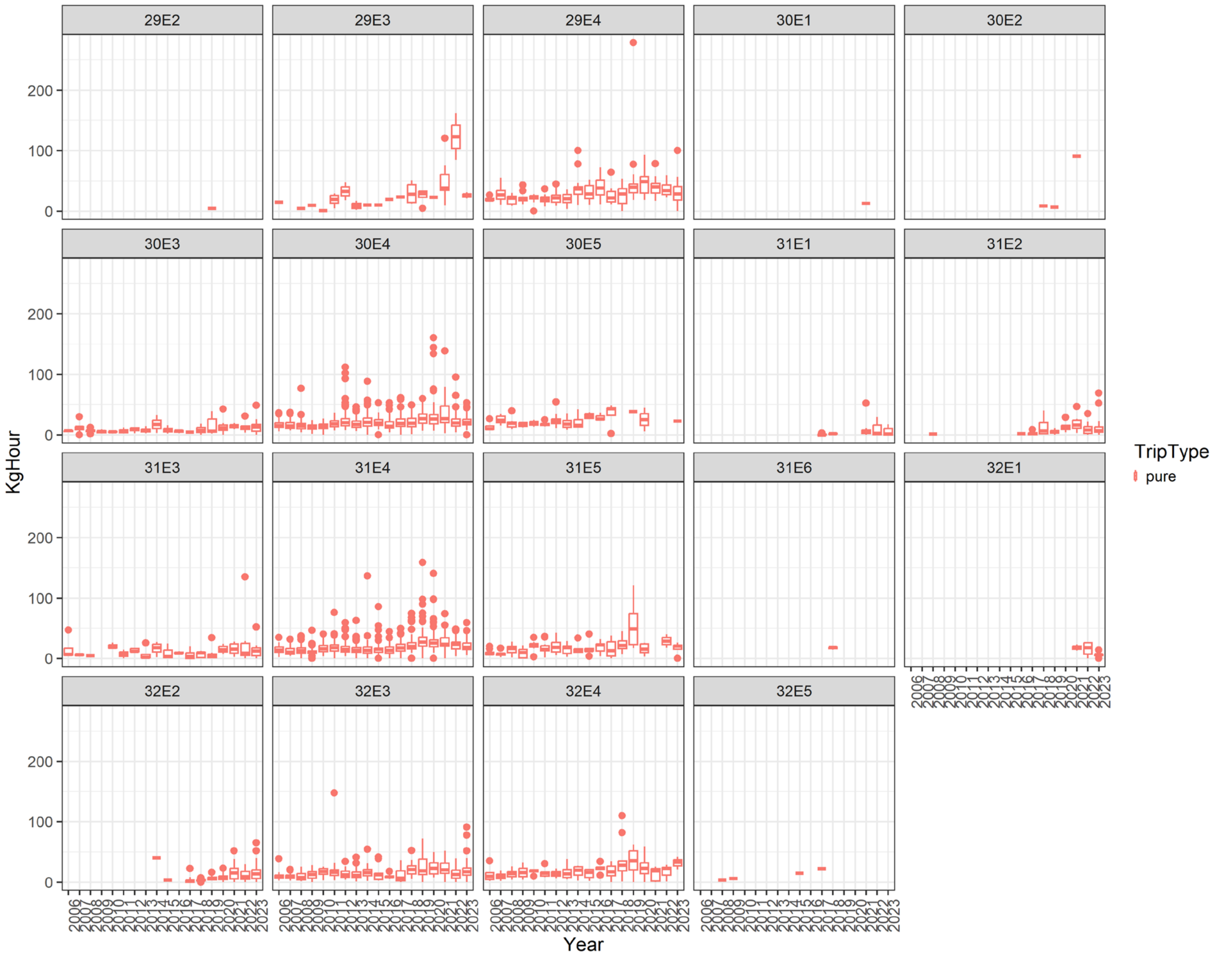


Figure 4: Box plot of sole lpue (kg.h-1) per year and per ICES statistical rectangle from the pure trips of the Belgian beam trawl fleet in ICES divisions 7.f and 7.g.

From a total of 192 combinations of year and ICES statistical rectangle for which landed weights were reported by pure or mixed trips, there were 23 combinations for which no landings were reported from the pure trips. In those cases, it was not possible to derive an estimate for the landings of the mixed trips based on the pure trip lpue. Therefore the reported landings from the mixed trips were assumed as the best available information and added to the reported landings from the pure trips to have the total landings.

Between 2008 and 2018, the difference between estimated landings and reported landings is within the range of 0.22-9.4%, whereas in 2006-2007 a more substantial difference (22.88-28.55%) is shown (Table 3). This is in line with the results of the misreporting analysis done within the framework of the WKFlatNSCS in 2020 (ICES, 2020), and let to the decision to adjust the landing numbers in 2006 and 2007. The misreporting analysis done now is slightly different from the analysis done in 2020, as in the current analysis, the lpue is calculated by ICES statistical rectangle and therefore accounts for the spatial variation. From 2019 onwards, there is consistent under reporting and the ratio of estimated landings to reported landings (1.13- 1.38) is larger than the maximum ratio (1.09) noted in the period 2008-2018. Consequently, the landings for these recent years are estimated to be much higher than what is reported (Figure 5).

Table 3: Effort (fishing hours), landings (tonnes) and mean lpue (kg.h-1) from pure and mixed trips, and estimated landings (tonnes) based on the lpue from pure trips compared to reported sole landings from the beam trawl fleet in ICES divisions 7.f and 7.g.

	PURE			MIXED			ALL		ALL
Year	effort	reported landings	lpue	effort	reported landings	lpue	reported landings	estimated landings	Ratio estimated landings/ reported landings
2006	17938	248.45	11.97	31670	278.27	7.51	526.72	677.12	1.29
2007	18844	273.64	13.55	27062	255.62	8.53	529.26	650.34	1.23
2008	15527	227.35	10.73	13191	184.67	8.62	412.02	419.93	1.02
2009	17048	221.88	12.55	13639	207.54	10.67	429.42	395.66	0.92
2010	19101	311.45	15.56	13359	228.83	18.81	540.28	518.62	0.96
2011	24102	435.94	16.06	14665	257.95	16.99	693.89	692.35	1.00
2012	29753	550.89	16.62	16494	235.94	13.93	786.83	841.25	1.07
2013	31056	509.63	14.52	14169	238.59	20.69	748.23	734.45	0.98
2014	17872	385.71	20.47	13425	281.05	16.83	666.76	677.30	1.02
2015	21720	438.45	16.18	10072	201.73	22.03	640.18	637.86	1.00
2016	14421	255.96	15.93	17919	269.67	10.96	525.63	575.04	1.09
2017	14464	231.15	13.86	18884	293.24	11.80	524.39	563.32	1.07
2018	13037	256.80	15.93	18443	312.79	14.69	569.59	619.83	1.09
2019	15222	414.37	22.09	16811	324.96	20.67	739.33	874.12	1.18
2020	16169	462.63	22.09	25530	610.51	25.83	1073.14	1211.42	1.13
2021	9121	259.69	26.81	28212	557.74	25.23	817.43	1126.27	1.38
2022	11188	240.11	26.86	31486	558.23	20.30	798.34	1052.44	1.32
2023	15404	322.93	19.34	29440	515.40	19.36	838.33	966.10	1.15

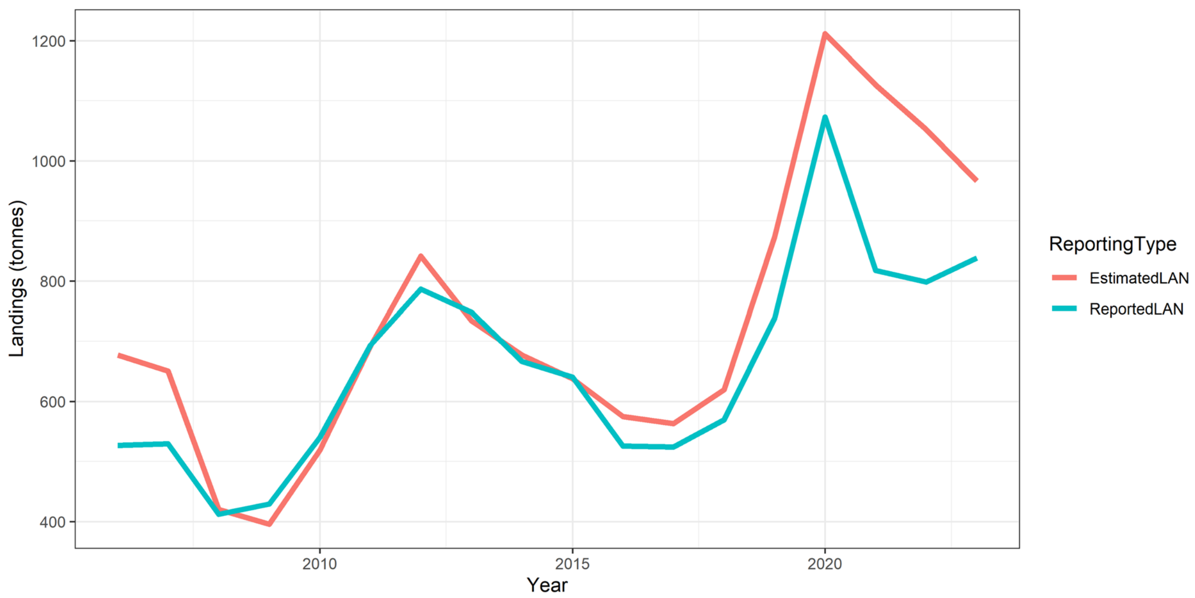


Figure 5: Reported (blue) and estimated landings (red) for sole in ICES divisions 7.f and 7.g from the Belgian beam trawl fleet over the period 2006-2023 based on logbook data.

5. Conclusion

For sole in ICES divisions 7.f and 7.g, the analysis shows differences between estimated and reported landings over the entire time series. The differences between estimated landings and reported landings for the period 2006-2018 are in line with the outcome of the misreporting analysis done within the framework of the WKFlatNSCS in 2020 (ICES, 2020). From 2019 onwards, the difference between estimated and reported landings is within the range of 12.89 - 37.78% and larger than the differences in the period 2008-2018. Similar to sole in ICES division 7.d and sole in ICES division 7.a, corrections of the reported landings were perceived more realistic. However to be consistent with the threshold (> 22%) applied in the WKFlatNSCS (ICES, 2020) misreporting analysis, it was decided to only adjust the landing numbers of sole in ICES divisions 7.f and 7.g in the years 2021 and 2022.

6. References

ICES. 2020. Benchmark Workshop for Flatfish stocks in the North Sea and Celtic Sea (WKFlatNSCS). ICES Scientific Reports. 2:23. 966 pp. http://doi.org/10.17895/ices.pub.5976

Seabass 4bc 7 ad-h: Amendments to WGCSE report from correcting Solent mistyped data point.

Description of the correction

An error was identified in the age data of the Solent survey – wrong value for age 2, year 2022. The value entered in the SS data file was 86.6 when it should have been 0.866.

Having the decimal in the wrong place meant the derived proportion of age 2, 3 and 4 in the 2022 Solent survey data was skewed towards age 2 and so it affected a few years of recruitment estimates.

The full assessment was re-run. See below for a section-by-section revision of section 28 of the 2024 WGCSE report.

Section 28.3.1.10 Final update assessment: diagnostics

See below updated likelihood table. Corrections are kept in track and changes.

Likelihood components	Likelihood
TOTAL	731.4
Catch	9.03e-013
Equilibrium catch	0.028
Survey	- -43.8
Discards	35.38
Length compositions	402.29
Age compositions	313.6
Recruitment	23.79
Forecast Recruitment	0.171
Parameter soft bounds	0.019

Section 28.3.2 Analytical retrospective analyses

See below updated Mohn's rho table. Corrections are kept in track and changes.

	Mohn's rho
Spawn–stock biomass (5yrs)	0.065
Fishing mortality (ages 4–15) (5yrs)	-0.048
Recruitment (age 0) (3yrs)	-0.018

Section 28.5.1 Recruiting year-class strength

Full section update. Corrections are kept in track and changes.

Recruitment estimates for sea bass were below average from 2008 to 2012 (Table 21). Since recruitment is at a low level since 2008 the working group agreed to only include 2012 to 2021 (ten years) for the geometric mean recruitment for the forecast (12 266 thousand), this was also identified and advised by the ADG in 2019. This is summarised in the text table below:

Year class	SS3 (age 0)	GM 2012–2021
2021	12 241 thousand	
2022		12 266 thousand
2023		12 266 thousand
2024		12 266 thousand

Detailed short-term forecast output at status quo F

Full section update. Corrections are kept in track and changes.

A detailed short-term forecast is given in Table 23, assuming that F in 2024 is the average of 2021–2023 from the assessment for the commercial fleet, and for the recreation fleet the partial F used is that described in Section 28.5.3.

Fishing in 2024 at the same fishing mortality as in 2021–2023 for the commercial fleet, and with the current two bag limit for nine months for the recreational fleet, an SSB of 13 414t is predicted in 2025, decreasing from 13 589 t in 2024. With the same fishing effort in 2025 the SSB would further decrease to 13 022t. There is uncertainty incorporated in the forecast, as the actual rate of change in population abundance in recent years is likely to be more uncertain than indicated by the SS3 model confidence limits. Also, the effect of the final package of technical and other management measures for sea bass in 2015 to present are not fully known at this stage, and information will be needed on their implementation and effectiveness before their impact on fishing mortality can be ascertained. The assumption of constant recreational F is also untested.

28.1.1 Management options

Some paragraphs update. Corrections are kept in track and changes.

The management options table includes options for a number of different scenarios and include F of 0.159 calculated by reducing FMSY by the stock size relative to MSY Btrigger for combined commercial and recreational fishing. This would provide combined commercial and recreational catches of 2620 tonnes. This would be an increase of 7.7% compared to the advice for 2024. The allocation between commercial and recreational fisheries depends on the balance of controls applied on recreational and commercial fishing in 2024 and 2025.

Spawning stock biomass is currently below MSY Btrigger, and expected to remain there for the intermediate year. To target achieving MSY Btrigger at the start of 2026, total removals should be no more than 253t.

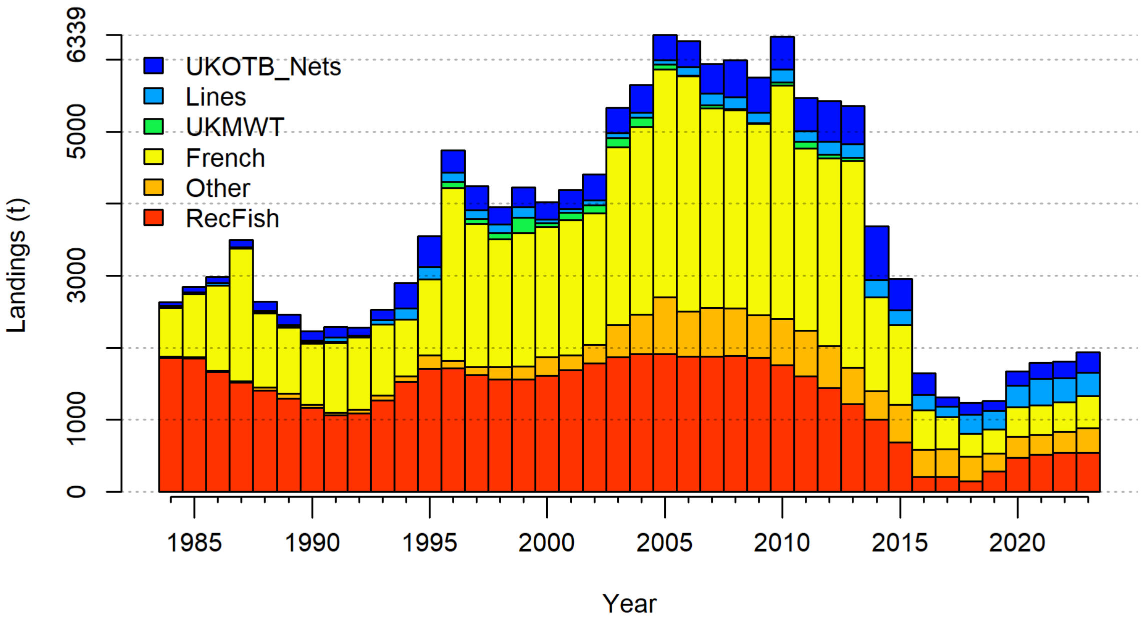
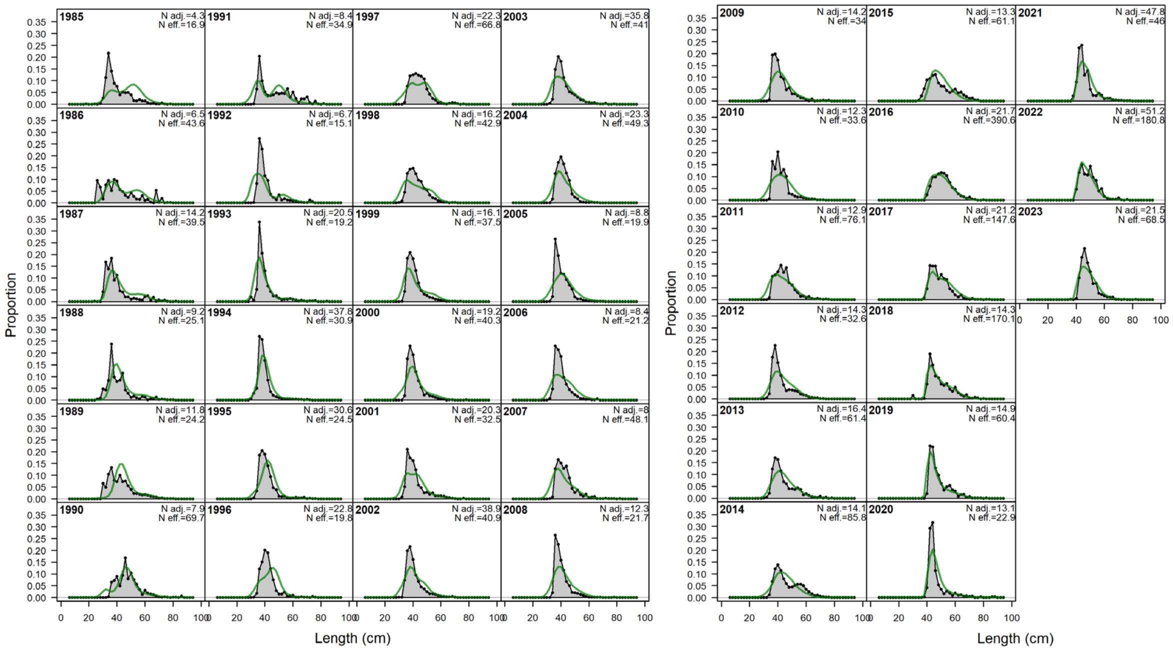
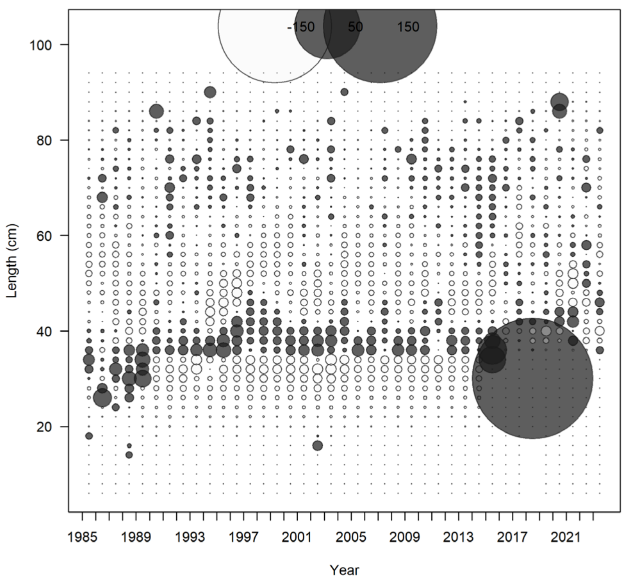


Figure 1. Bss.27.4bc7ad–h: Top: Datasets used in the updated assessment. Bottom: Landings series for the six fleets.



Proportion
Length (cm)
1985 N adj.=4.3 N eff.=16.9
1986 N adj.=6.5 N eff.=43.6
1987 N adj.=14.2 N eff.=39.5
1988 N adj.=9.2 N eff.=25.1
1989 N adj.=11.8 N eff.=24.2
1990 N adj.=7.9 N eff.=69.7
1991 N adj.=8.4 N eff.=34.9
1992 N adj.=6.7 N eff.=15.1
1993 N adj.=20.5 N eff.=19.2
1994 N adj.=37.8 N eff.=30.9
1995 N adj.=30.6 N eff.=24.5
1996 N adj.=22.8 N eff.=19.8
1997 N adj.=22.3 N eff.=66.8
1998 N adj.=16.2 N eff.=42.9
1999 N adj.=16.1 N eff.=37.5
2000 N adj.=19.2 N eff.=40.3
2001 N adj.=20.3 N eff.=32.5
2002 N adj.=38.9 N eff.=40.9
2003 N adj.=35.8 N eff.=41
2004 N adj.=23.3 N eff.=49.3
2005 N adj.=8.8 N eff.=19.9
2006 N adj.=8.4 N eff.=21.2
2007 N adj.=8 N eff.=48.1
2008 N adj.=12.3 N eff.=21.7
2009 N adj.=14.2 N eff.=34
2010 N adj.=12.3 N eff.=33.6
2011 N adj.=12.9 N eff.=76.1
2012 N adj.=14.3 N eff.=32.6
2013 N adj.=16.4 N eff.=61.4
2014 N adj.=14.1 N eff.=85.8
2015 N adj.=13.3 N eff.=61.1
2016 N adj.=21.7 N eff.=390.6
2017 N adj.=21.2 N eff.=147.6
2018 N adj.=14.3 N eff.=170.1
2019 N adj.=14.9 N eff.=60.4
2020 N adj.=13.1 N eff.=22.9
2021 N adj.=47.8 N eff.=46
2022 N adj.=51.2 N eff.=180.8
2023 N adj.=21.5 N eff.=68.5



-150
50
150
Length (cm)
Year

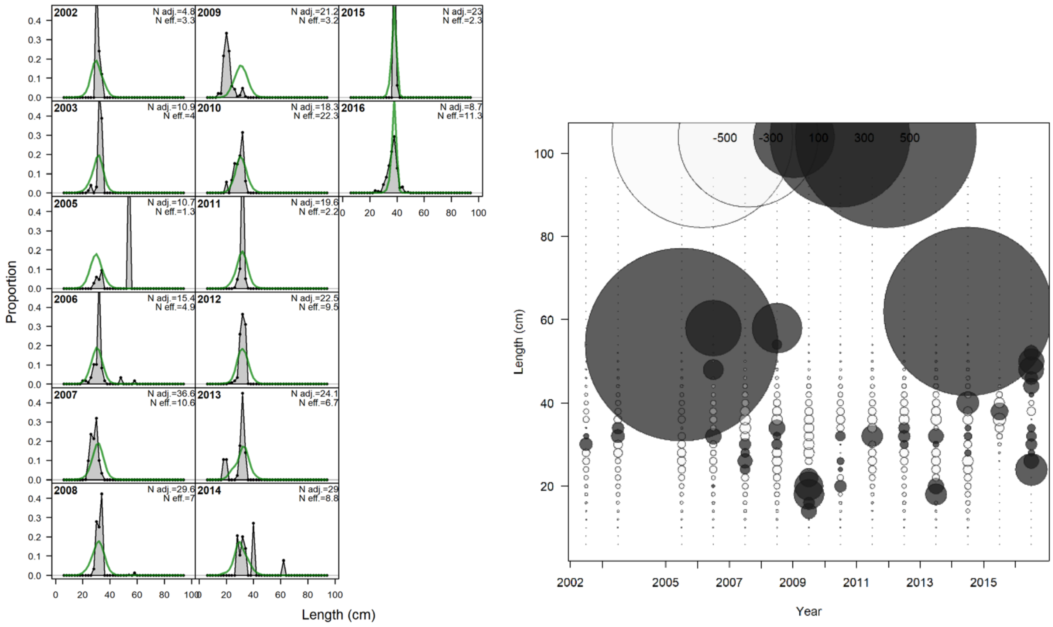


Figure 2. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of UK trawl and net fishery-length composition data for the retained (top 3) and discarded (bottom 2) catch components.

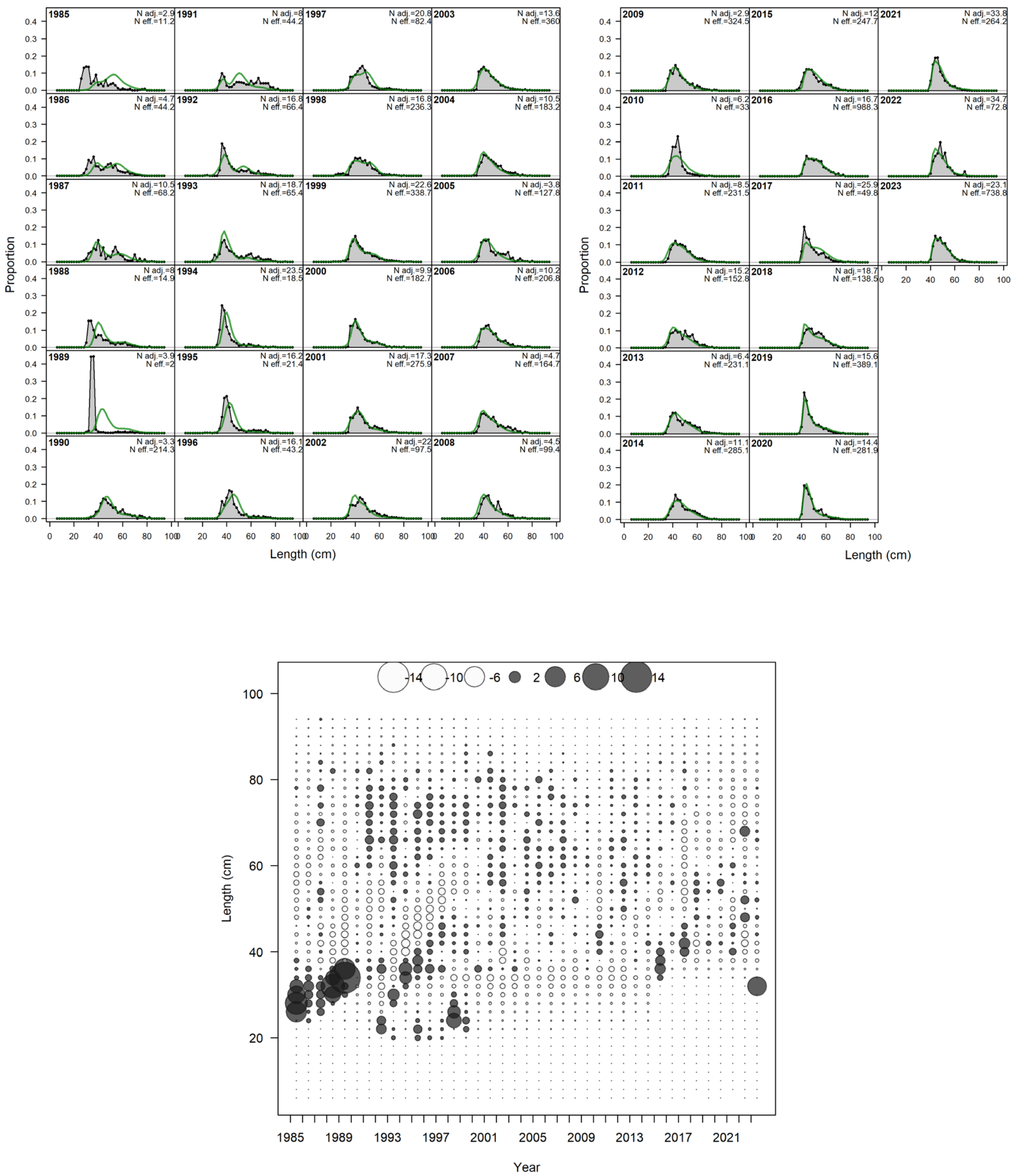


Figure 3. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of UK lines length-composition data for the retained catch components.

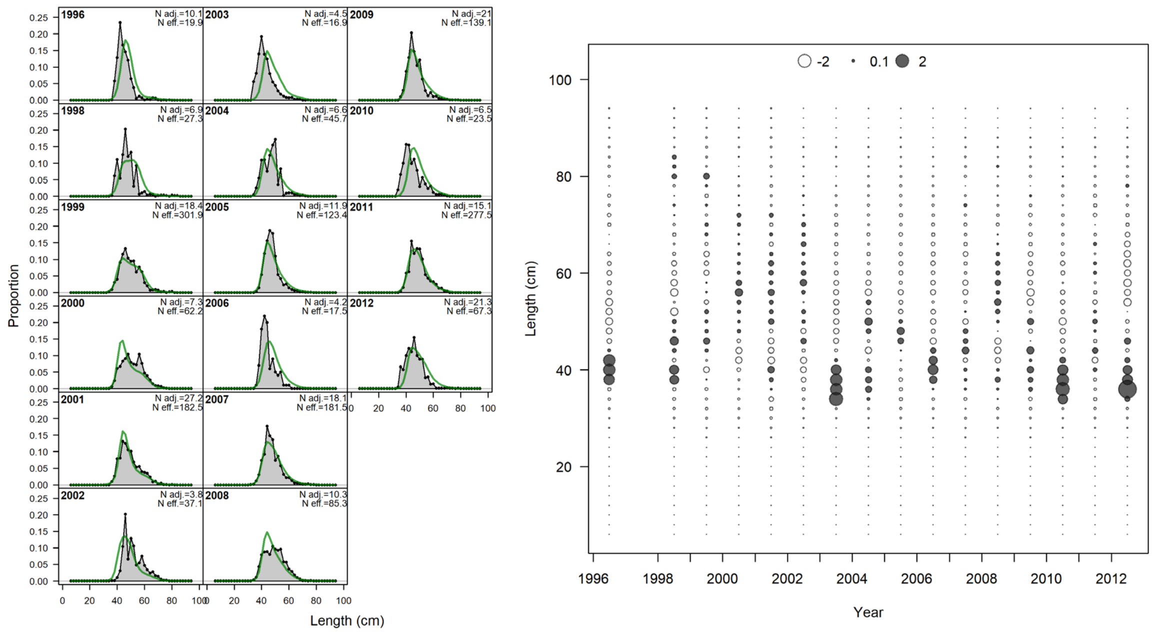


Figure 4. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of UK midwater trawl fishery length-composition data for the retained catch components.

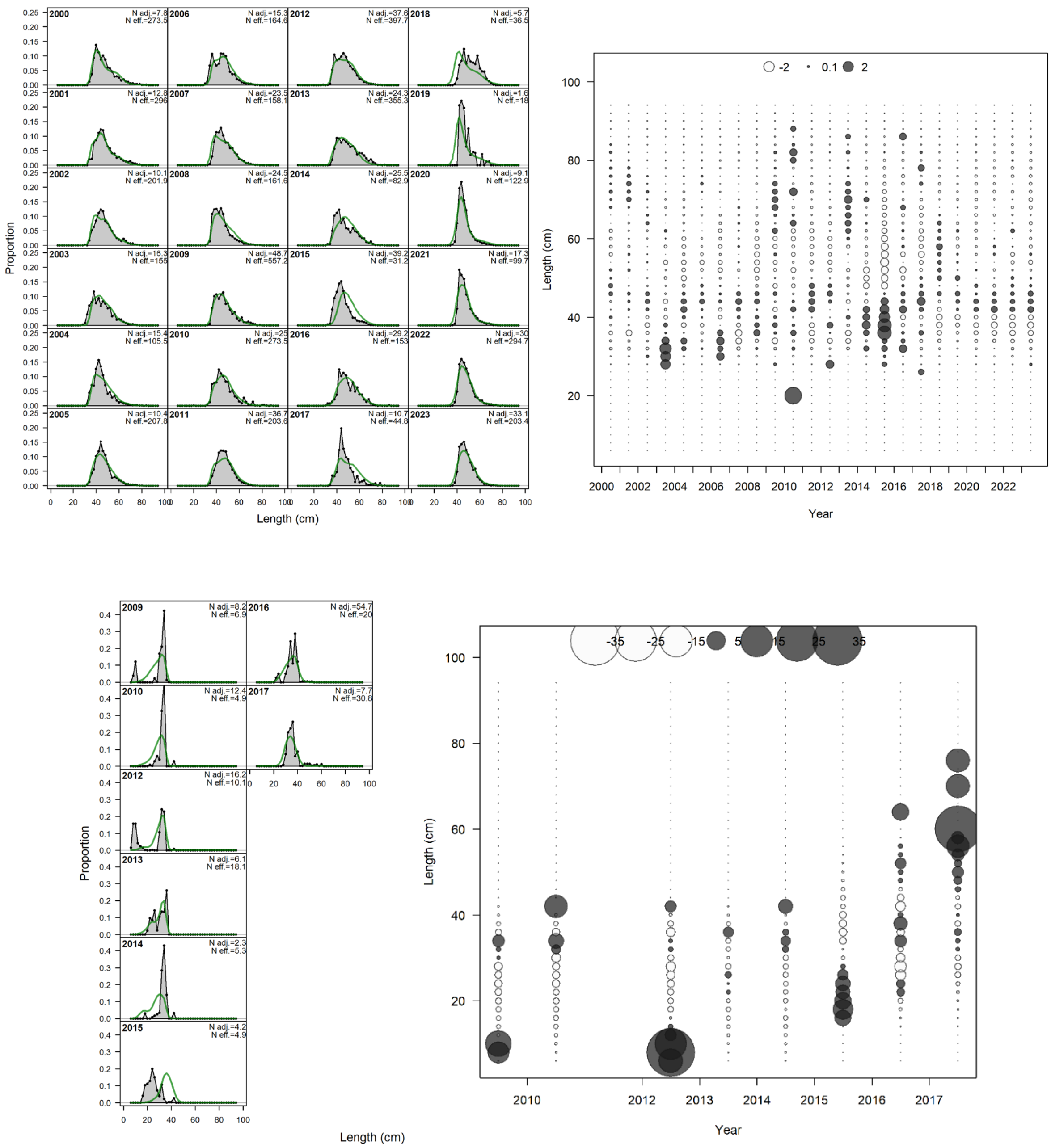


Figure 5. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of French fishery length-composition data for the retained (top row) and discarded (bottom row) catch components.

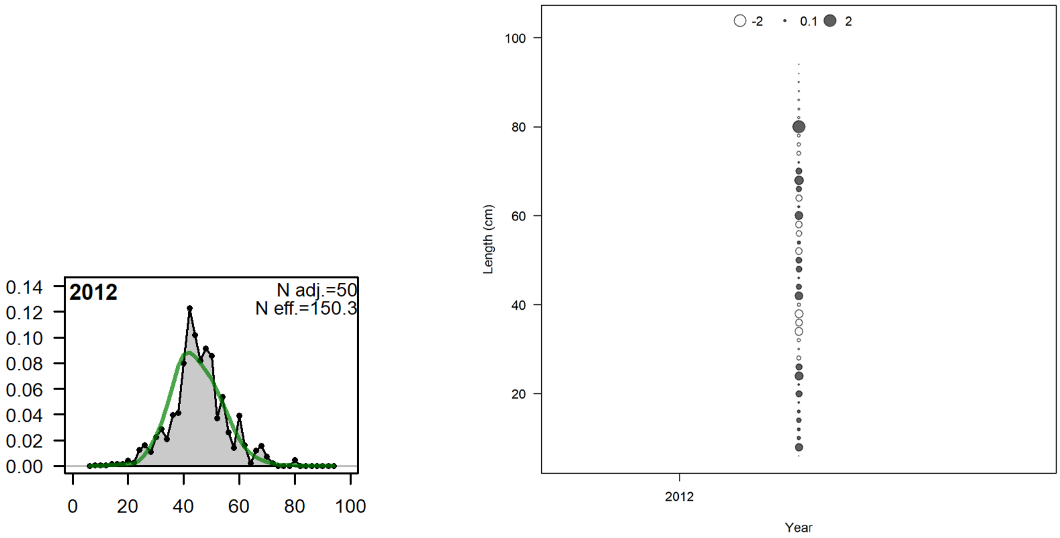


Figure 6. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of recreational length compositions data.

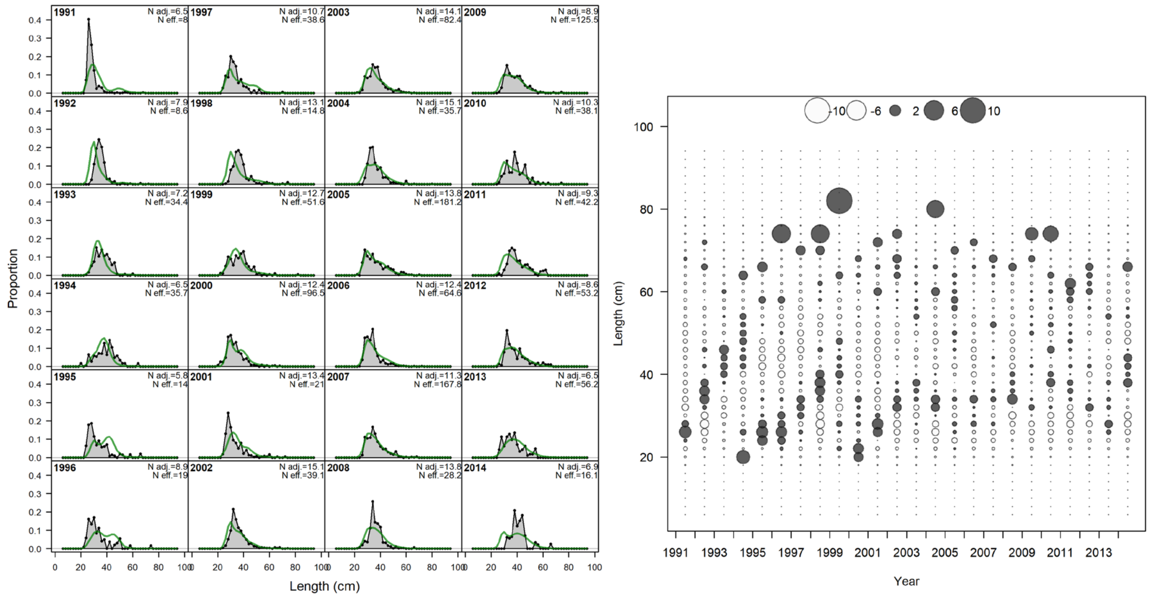


Figure 7. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of Channel groundfish survey length compositions.

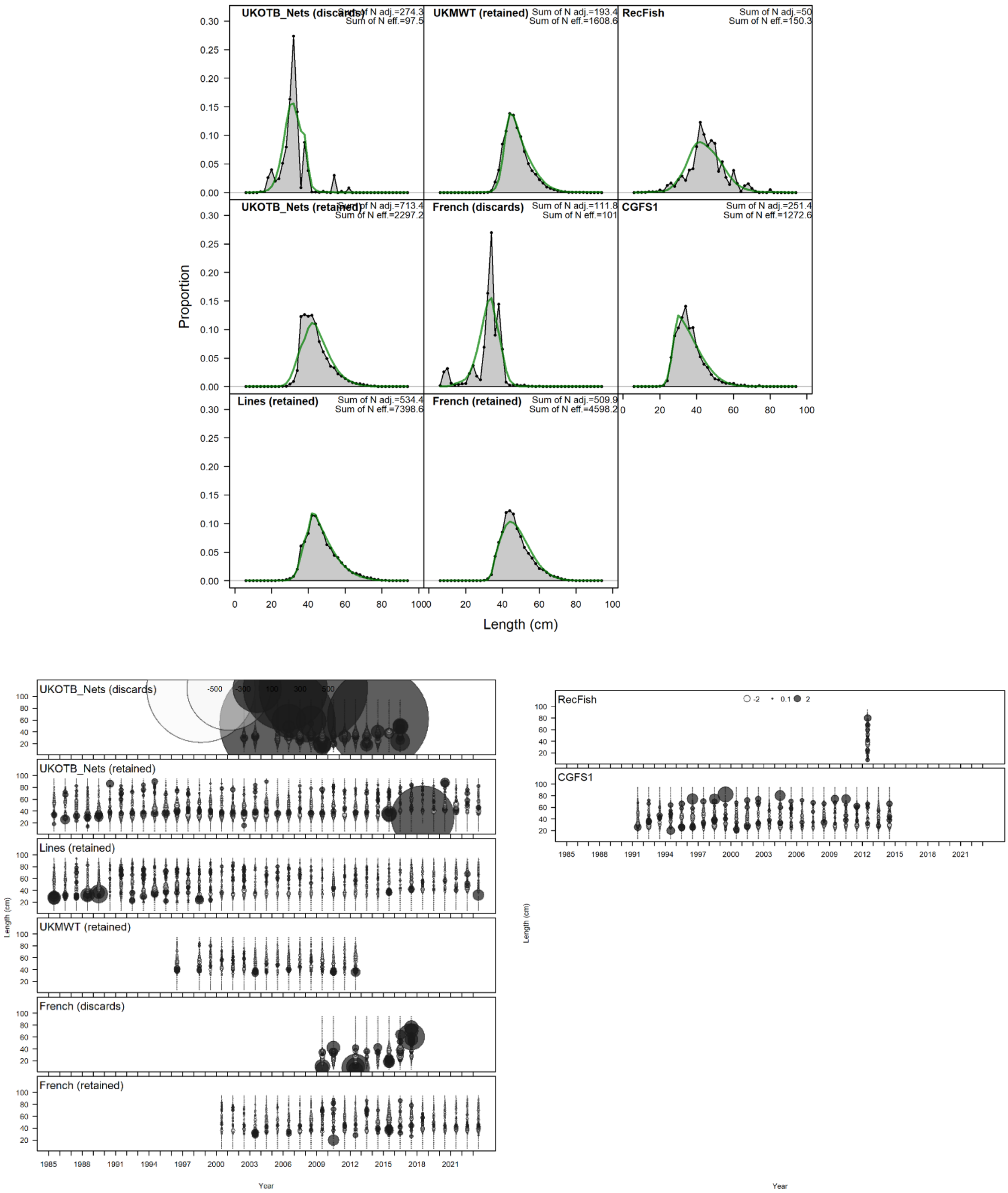


Figure 8. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of the commercial fisheries and Channel groundfish survey length compositions, aggregated across time for the retained and discarded catch components.

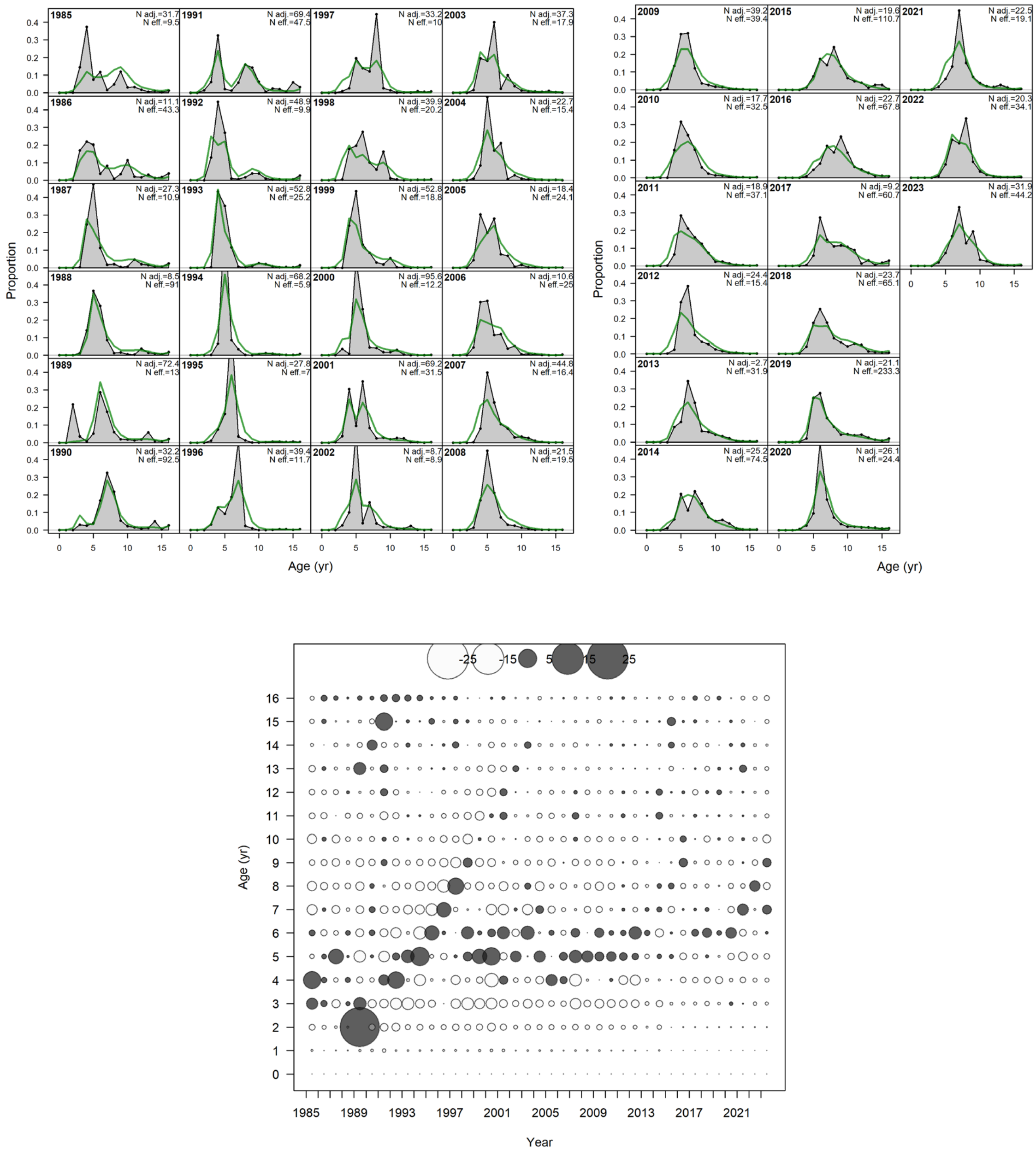


Figure 9. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the combined UK otter trawl and nets fleets.

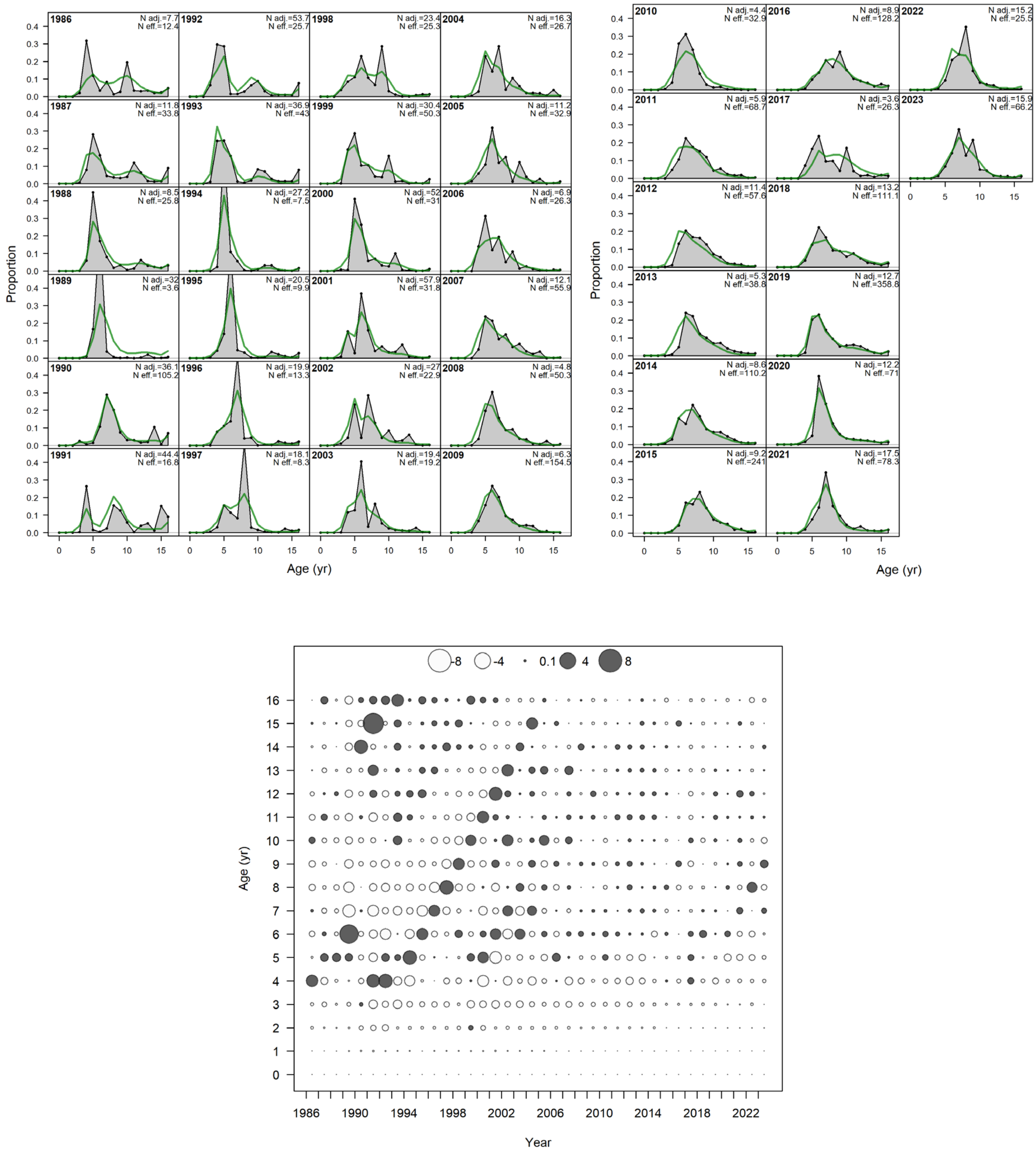


Figure 10. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the combined UK lines fleet.

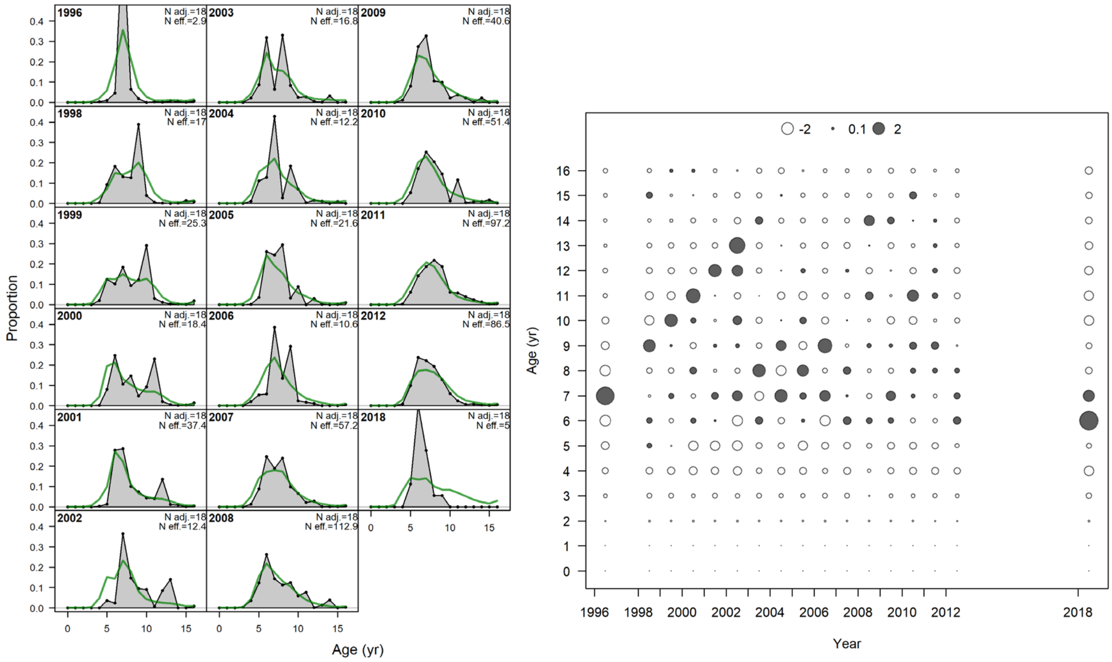


Figure 11. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the UK midwater trawl fleet.

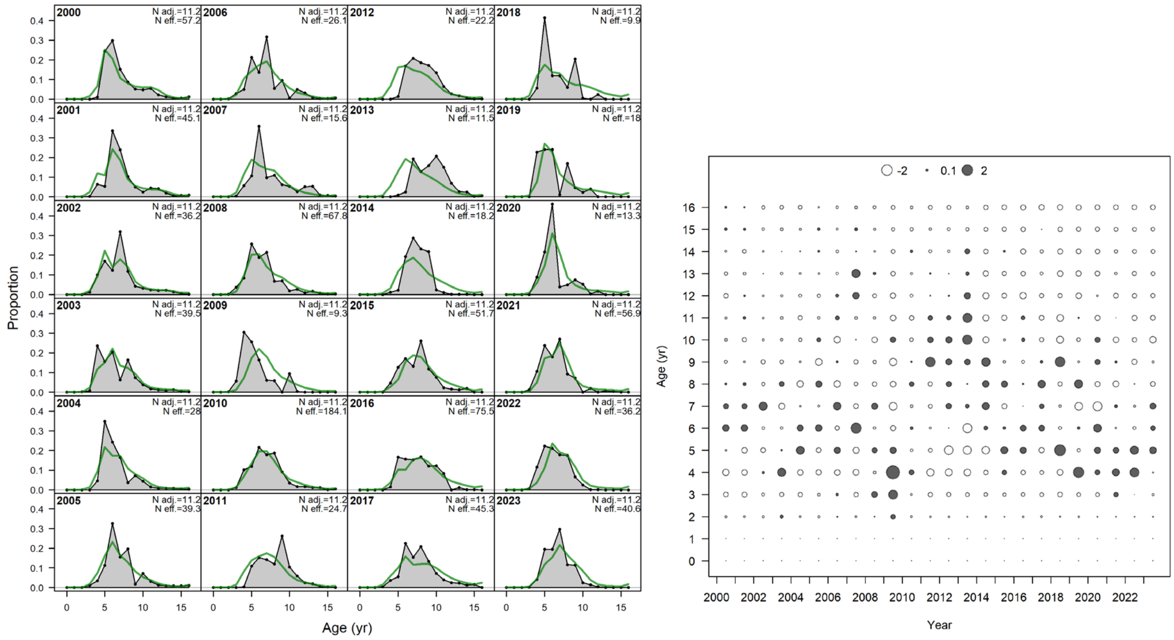
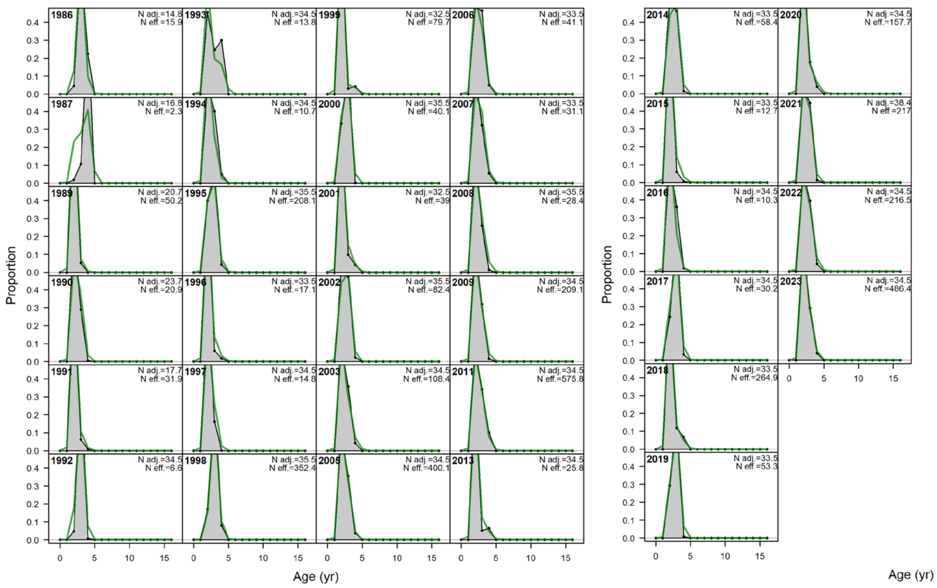


Figure 12. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the combined French fleets.



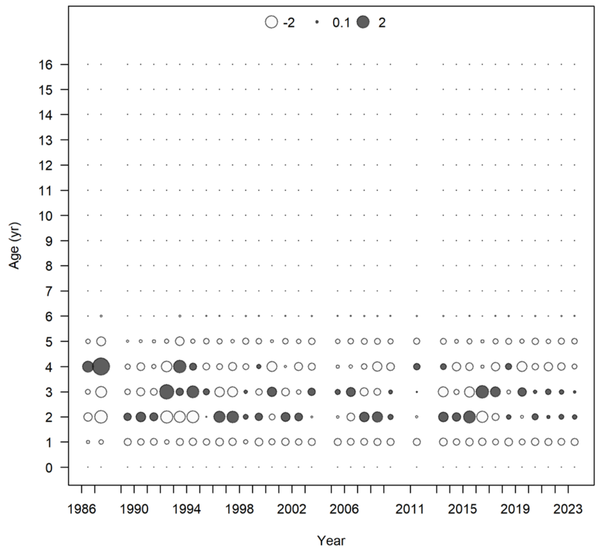


Figure 13. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of age composition data for the Solent Autumn bass survey.

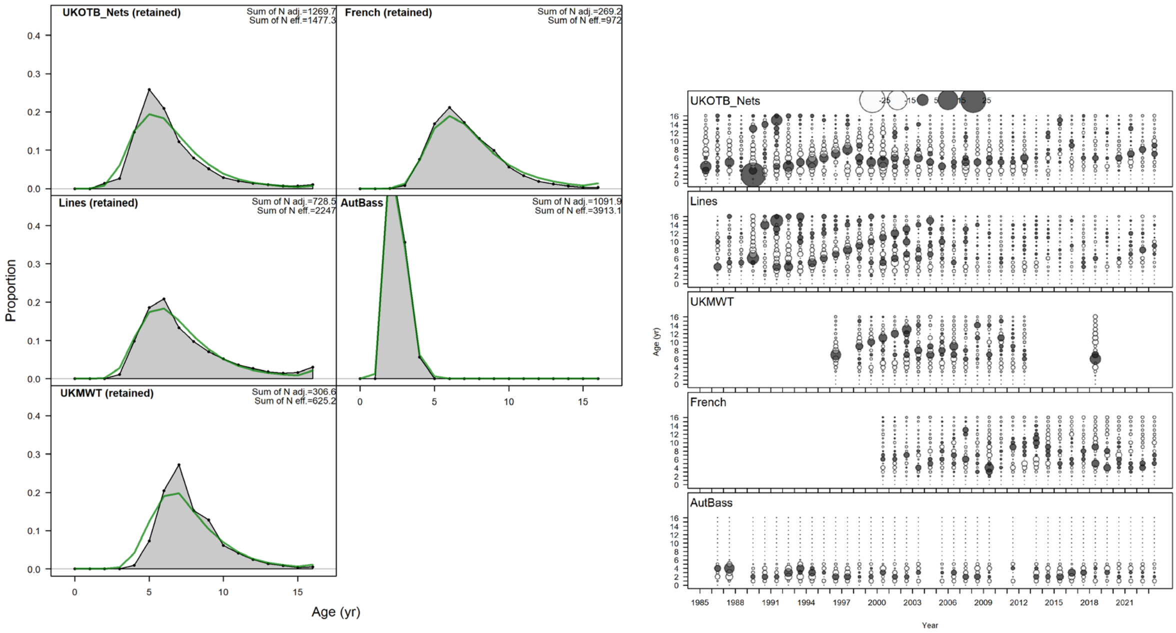


Figure 14. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit and residuals of UK fleets age compositions, aggregated across time.

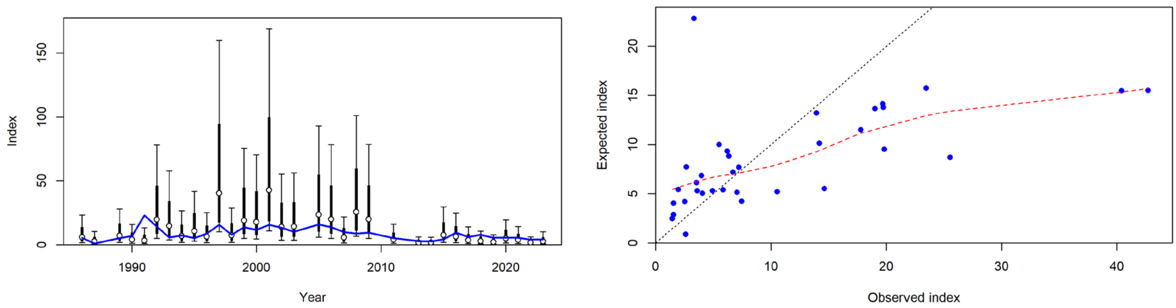


Figure 15. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit to Solent Autumn bass survey total abundance index, accounting for age and length-based selectivity.

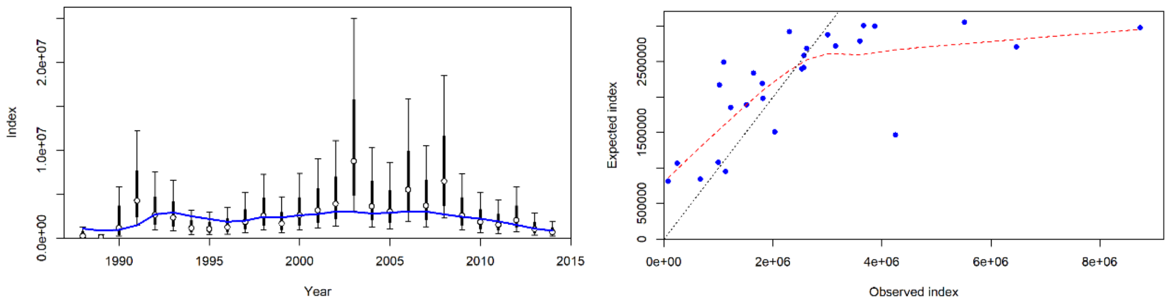


Figure 16. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit to Channel groundfish survey total abundance index, accounting for length-based selectivity.

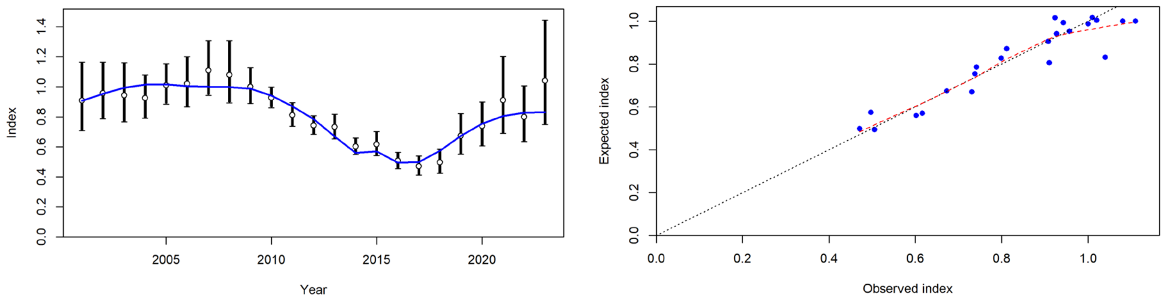
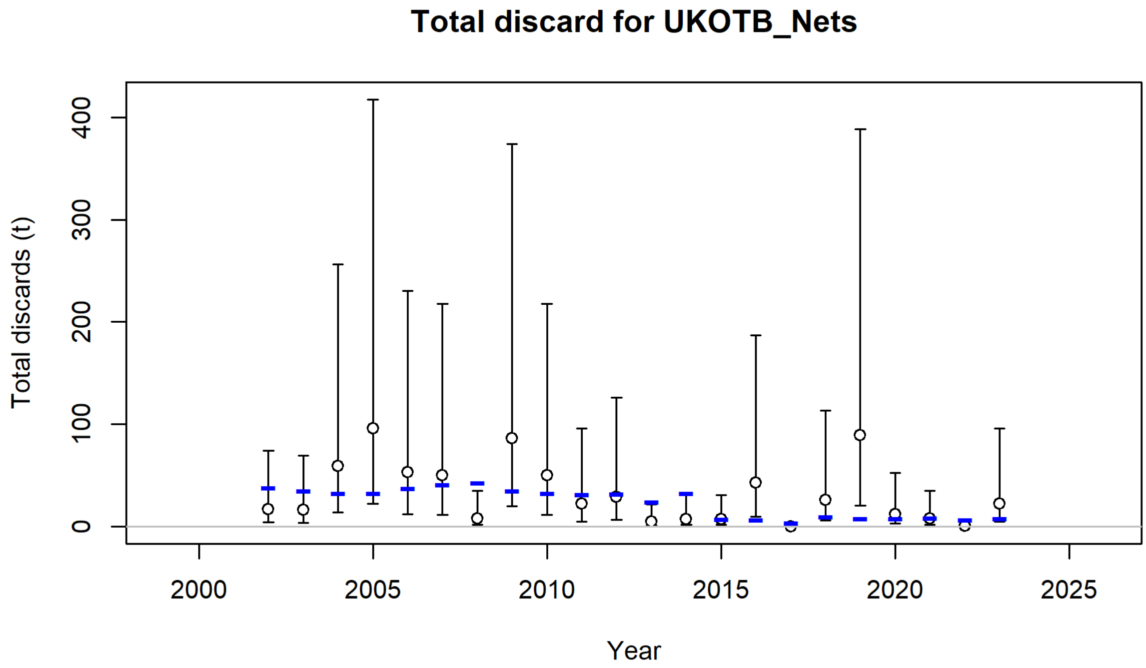


Figure 17. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit to the French landings per unit of effort commercial index, accounting for length-based selectivity.



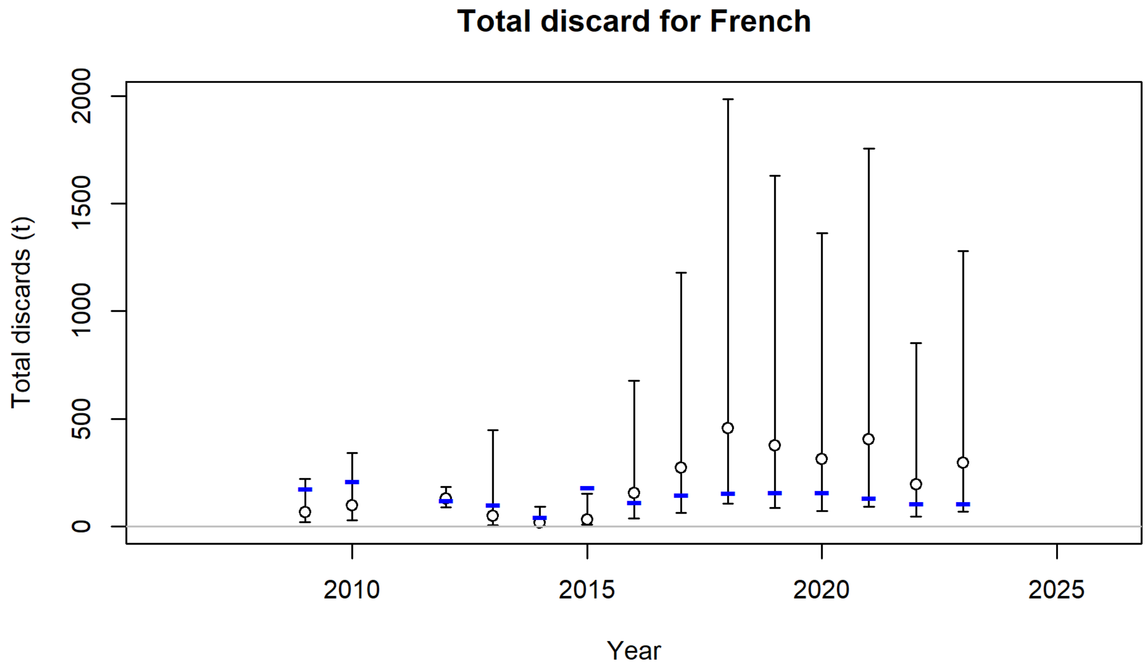


Figure 18. Bss.27.4bc7ad–h: Final sea bass update assessment: Fit (blue dashes) to total discard (points with 95% confidence intervals as whiskers)) for the UK_OTB fleet (top) and French fleet (bottom).

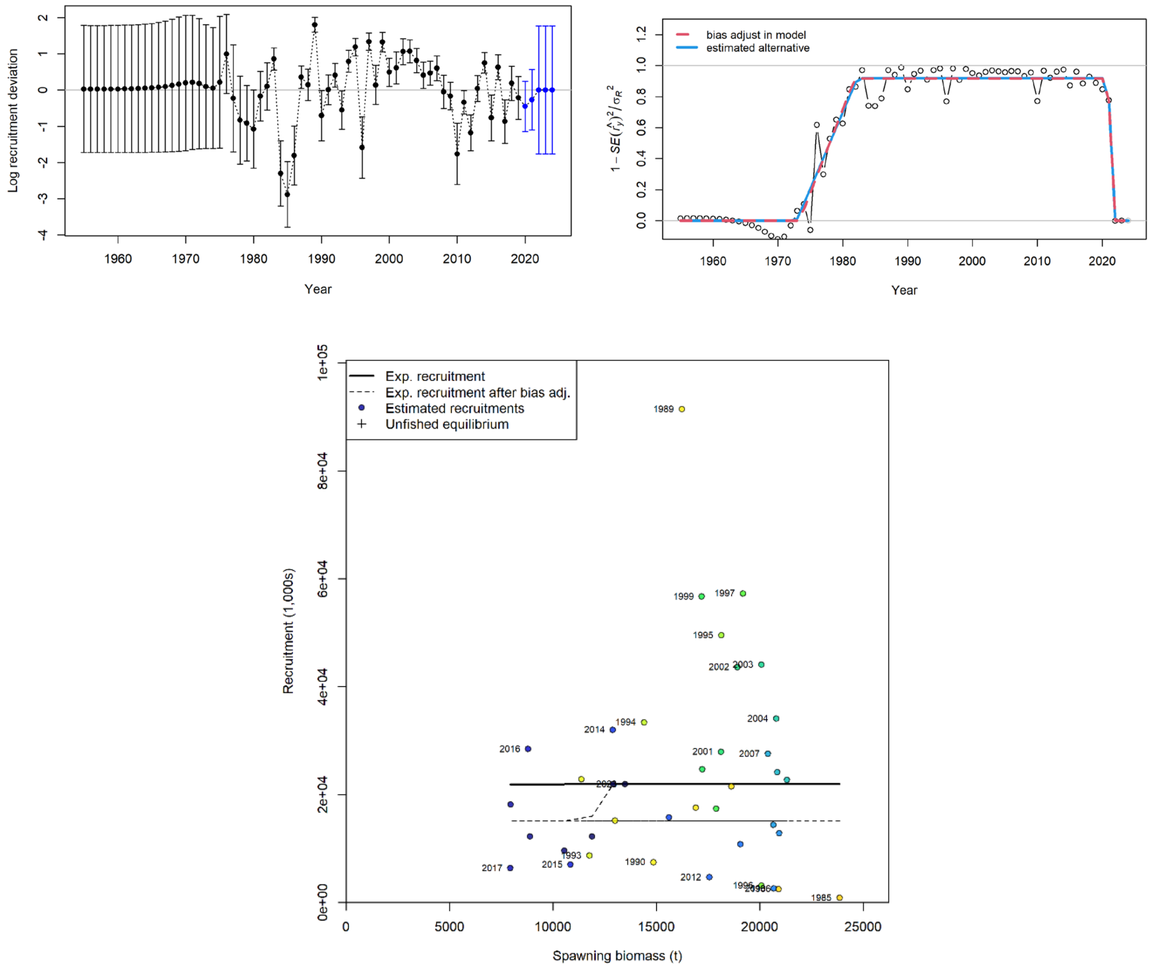


Figure 19. Bss.27.4bc7ad–h: Final sea bass update assessment: Top: time-series of log-recruit deviations (deviations for 1965–1984 precede the period of input catch data). Below: stock–recruit scatter (model is fitted assuming Beverton–Holt stock–recruit model and steepness = 0.999).

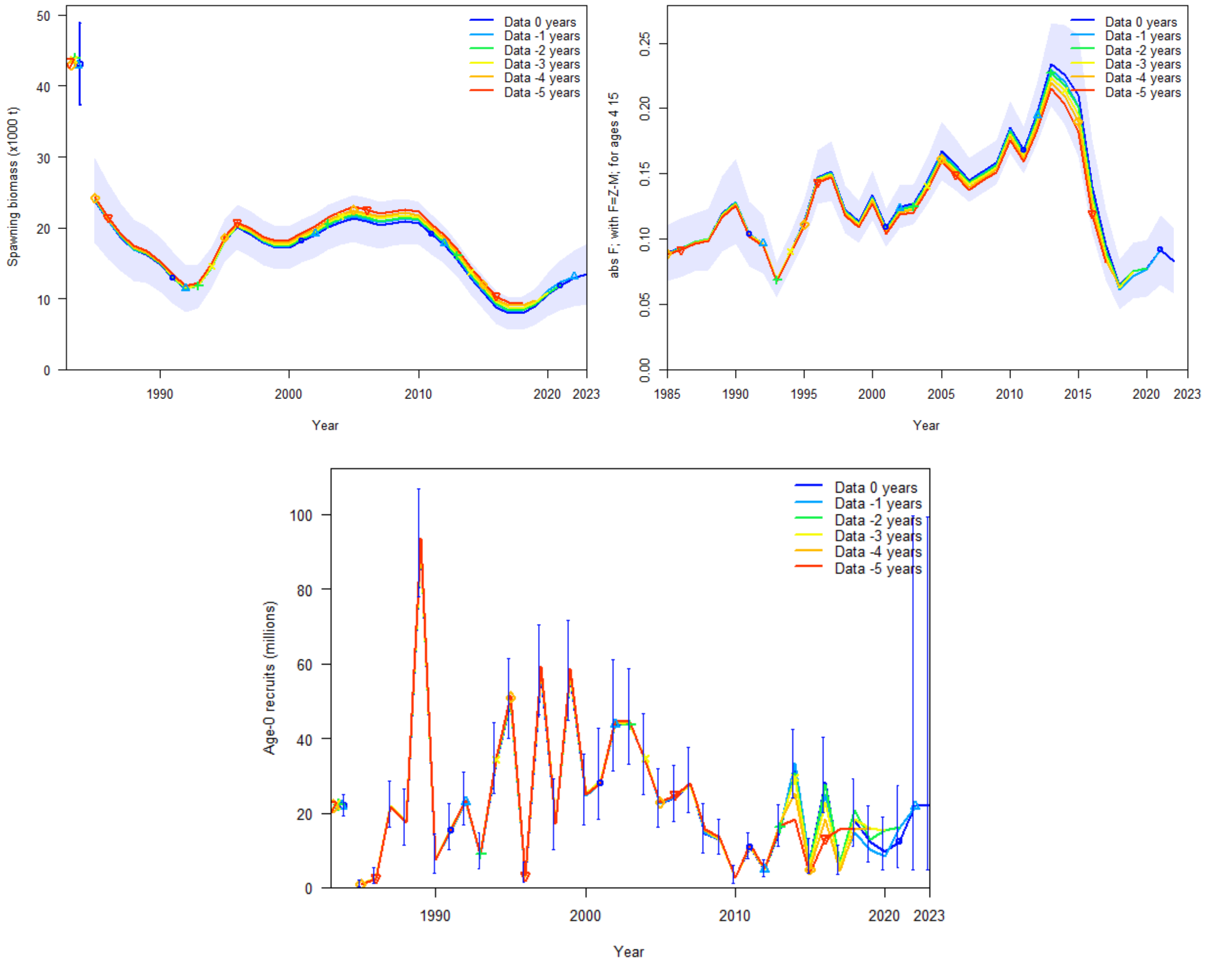


Figure 20. Bss.27.4bc7ad–h: Retrospective analysis of stock trends from final update assessment, based on Stock Synthesis run final year set to 2023 and peeling back five years (for the final run, terminal F is for 2023 and SSB and total biomass terminate in 2024).

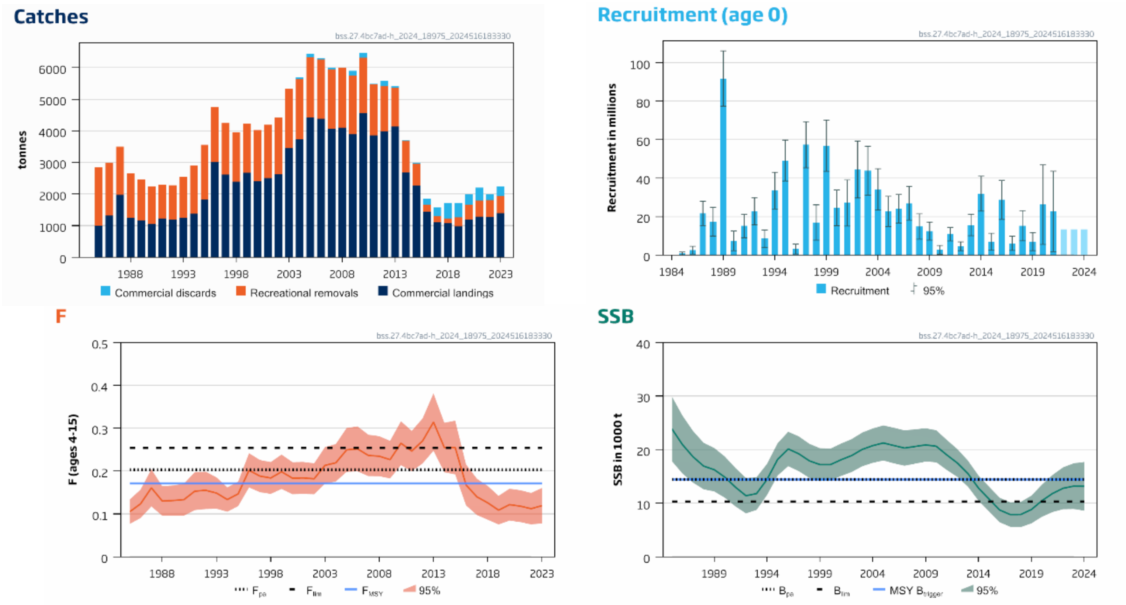


Figure 21. Bss.27.4bc7ad–h: Stock trends from final update assessment, based on Stock Synthesis run final year set at 2023 to give 2024 numbers and biomass and 2023 F. Recruitment in 2022–2024 is the geometric mean 2012–2021. Recruitment, F and SSB are shown with 95% confidence intervals.

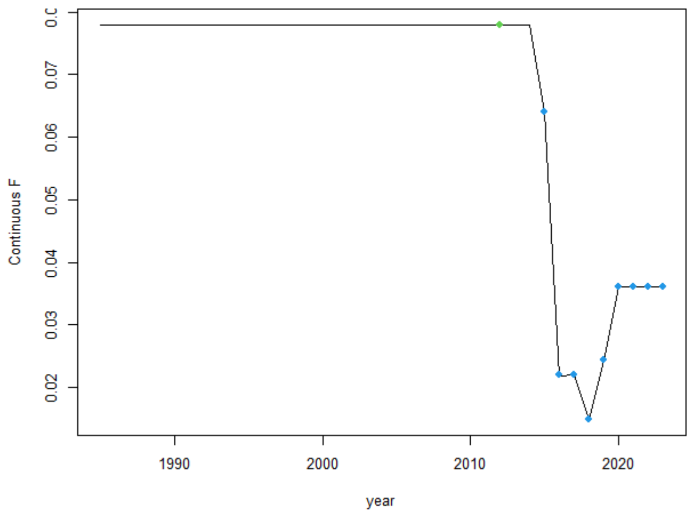


Figure 22. Bss.27.4bc7ad–h: Recreational F estimates based on multipliers for management measures.

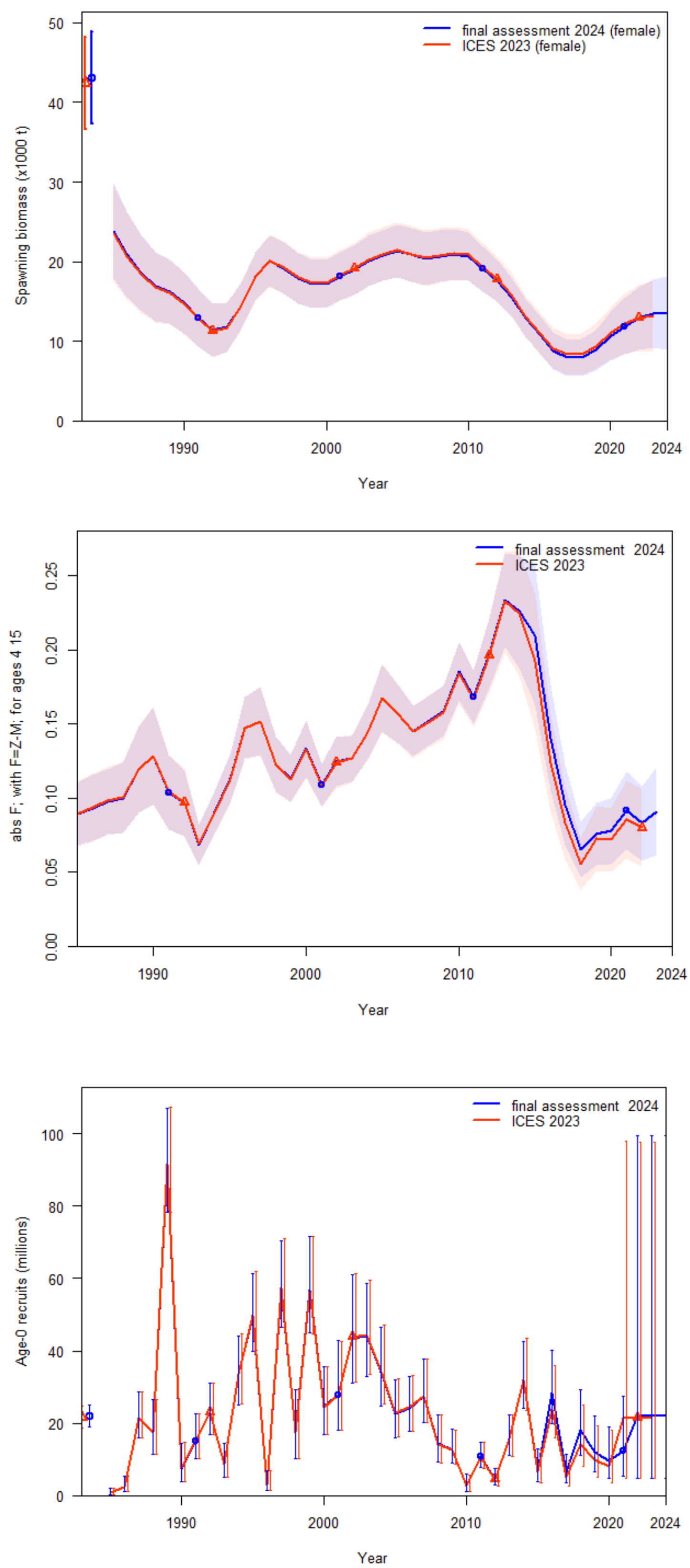


Figure 23. Bss.27.4bc7ad–h: Comparison between stock trends from this year's final update assessment and last year WGCSE assessment.

Table 1. Bss.27.4bc7ad–h: Landings for the country / fleet components included separately in the assessment model.

Year	Fleet 1: UK Trawls, nets	Fleet 2: UK Lines	Fleet 3: UK pelagic trawlers	Fleet 4: France combined gears	Fleet 5: Other countries and gears	Fleet 6: RecFish
1985	70	30	1	870	23	1849
1986	84	33	2	1180	19	1663
1987	96	18	0	1840	25	1514
1988	129	30	8	1028	44	1403
1989	141	29	7	917	67	1296
1990	128	18	22	849	47	1164
1991	152	60	14	971	29	1067
1992	105	23	8	1001	49	1091
1993	146	62	1	979	68	1272
1994	354	154	0	786	76	1528
1995	424	169	4	1057	181	1710
1996	308	128	87	2395	104	1716
1997	335	119	71	1984	111	1621
1998	241	121	85	1773	170	1560
1999	274	148	220	1843	185	1559
2000	236	53	52	1805	261	1609
2001	263	58	97	1883	199	1692
2002	361	75	110	1825	251	1787
2003	353	65	127	2471	443	1869
2004	380	72	131	2604	544	1913
2005	353	59	68	3161	789	1909
2006	359	119	11	3259	629	1878
2007	413	166	37	2771	677	1877
2008	514	163	17	2750	663	1884
2009	486	147	9	2649	598	1857
2010	452	183	42	3236	649	1755
2011	462	143	98	2526	629	1607
2012	564	185	49	2610	579	1440

Year	Fleet 1: UK Trawls, nets	Fleet 2: UK Lines	Fleet 3: UK pelagic trawlers	Fleet 4: France combined gears	Fleet 5: Other countries and gears	Fleet 6: RecFish
2013	530	191	39	2871	506	1221
2014	751	236	1	1303	391	1007
2015	440	199	0	1110	524*(317)	684
2016	305	210	2	547	382*(231)	205
2017	125	147	0	442	392*(270)	203
2018	160	267	0	313	344*(208)	150
2019	134	259	1	329	255*(249)	281
2020	190	306	0	409	290*(137)	473
2021	228	361	0	413	279*(124)	513
2022	236	337	0	408	295*(145)	537
2023	285	324	0	448	340	545

*Values updated with NL landings revised.

(Numbers in parentheses are numbers revised)

Table 2. Bss.27.4bc7ad–h: Final sea bass update assessment: model estimated stock numbers-at-age (thousands of fish).

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1985	846	1194	22030	8080	4974	1595	1462	1214	1670	4239	1433	908	688	529	389	271	599
1986	2481	666	938	17224	6247	3771	1180	1056	862	1173	2961	998	631	479	368	270	605
1987	21514	1952	523	732	13276	4708	2763	841	737	594	802	2017	679	429	325	250	595
1988	17519	16923	1531	407	561	9891	3387	1921	569	489	389	523	1309	440	278	210	547
1989	91407	13781	13288	1195	313	421	7212	2401	1332	389	332	263	352	882	296	187	511
1990	7451	71904	10821	10371	920	235	307	5104	1662	910	264	224	177	237	594	200	471
1991	15183	5861	56456	8444	7977	690	171	217	3527	1133	615	178	151	119	160	400	452
1992	22813	11943	4600	44004	6474	5943	496	119	147	2354	749	405	117	99	78	105	560
1993	8693	17945	9373	3585	33735	4828	4281	346	81	98	1553	491	265	76	65	51	435
1994	33381	6838	14085	7307	2751	25206	3487	2994	236	54	65	1027	324	174	50	43	320
1995	49537	26258	5370	10995	5620	2060	18258	2452	2062	160	37	44	691	218	118	34	245
1996	3097	38968	20615	4188	8436	4189	1481	12715	1669	1384	107	24	29	458	145	78	186
1997	57263	2436	30556	16017	3188	6199	2943	997	8265	1060	866	66	15	18	283	89	163
1998	17373	45045	1911	23763	12213	2349	4378	1996	655	5317	673	546	42	9	11	178	159
1999	56694	13666	35335	1487	18145	9029	1666	2983	1318	423	3395	427	345	26	6	7	213
2000	24645	44597	10719	27479	1134	13379	6366	1123	1941	838	266	2115	265	214	16	4	136
2001	27931	19386	34980	8337	20974	838	9500	4347	743	1257	536	169	1337	167	135	10	89
2002	43613	21971	15206	27210	6364	15508	595	6482	2873	481	803	340	106	843	105	85	62
2003	44062	34307	17236	11831	20774	4704	11002	406	4286	1861	308	510	215	67	534	67	94
2004	34085	34660	26895	13381	8989	15218	3291	7353	261	2691	1150	188	311	131	41	325	98

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
2005	22698	26812	27168	20870	10156	6572	10613	2190	4711	163	1652	699	114	188	79	25	255
2006	24143	17855	21001	21033	15759	7356	4517	6925	1369	2854	97	969	408	66	109	46	163
2007	27534	18991	13984	16257	15875	11399	5045	2941	4319	827	1691	57	563	236	38	63	121
2008	14390	21659	14881	10839	12302	11533	7867	3313	1856	2649	498	1008	34	333	140	23	109
2009	12796	11319	16972	11534	8199	8928	7949	5163	2091	1140	1599	298	599	20	198	83	79
2010	2589	10066	8871	13162	8735	5965	6178	5247	3283	1295	694	965	179	359	12	119	97
2011	10764	2037	7883	6862	9912	6285	4053	3972	3226	1955	755	400	552	102	205	7	123
2012	4647	8467	1596	6107	5183	7169	4306	2636	2478	1955	1163	445	234	323	60	120	76
2013	15753	3655	6631	1234	4591	3711	4833	2744	1607	1465	1133	667	254	134	184	34	112
2014	32000	12391	2860	5114	921	3240	2445	2984	1609	908	808	617	361	137	72	100	79
2015	7028	25172	9713	2216	3843	655	2163	1548	1822	960	535	474	362	212	81	43	106
2016	28433	5528	19789	7599	1693	2763	433	1333	920	1071	564	316	281	215	127	48	90
2017	6329	22366	4348	15525	5880	1262	1949	291	870	596	694	366	206	183	141	83	92
2018	18135	4978	17590	3411	12025	4403	902	1341	196	584	400	466	247	139	124	96	119
2019	12210	14266	3916	13812	2654	9124	3211	632	918	133	396	272	318	168	95	85	148
2020	9600	9605	11219	3074	10753	2022	6723	2287	441	637	92	275	189	221	117	66	163
2021	12241	7552	7553	8803	2389	8154	1478	4734	1576	302	435	63	188	130	152	81	159
2022	21912	9629	5938	5927	6845	1816	5982	1045	3274	1081	207	298	43	130	89	105	166
2023	21895	17236	7572	4660	4610	5208	1336	4251	727	2263	747	143	207	30	90	62	189
2024	21895	17223	13554	5942	3622	3500	3814	943	2940	499	1552	513	98	142	21	62	175

Table 3. Bss.27.4bc7ad–h: Final sea bass update assessment: model estimated fishing mortality-at-age.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1985	0.000	0.001	0.006	0.017	0.037	0.062	0.085	0.103	0.113	0.119	0.122	0.123	0.124	0.124	0.124	0.124	0.123
1986	0.000	0.002	0.007	0.020	0.043	0.071	0.098	0.119	0.132	0.140	0.144	0.146	0.147	0.147	0.147	0.147	0.146
1987	0.000	0.003	0.010	0.027	0.054	0.089	0.124	0.151	0.170	0.182	0.189	0.192	0.194	0.194	0.195	0.194	0.193
1988	0.000	0.002	0.008	0.022	0.046	0.076	0.104	0.126	0.140	0.148	0.152	0.154	0.154	0.154	0.154	0.154	0.152
1989	0.000	0.002	0.008	0.022	0.047	0.077	0.106	0.127	0.141	0.149	0.153	0.155	0.155	0.155	0.155	0.154	0.152
1990	0.000	0.002	0.008	0.022	0.047	0.078	0.107	0.130	0.143	0.151	0.155	0.157	0.157	0.157	0.157	0.157	0.154
1991	0.000	0.002	0.009	0.026	0.054	0.090	0.123	0.148	0.164	0.174	0.179	0.181	0.181	0.181	0.181	0.180	0.177
1992	0.000	0.002	0.010	0.026	0.053	0.088	0.121	0.148	0.165	0.176	0.182	0.185	0.186	0.186	0.186	0.186	0.184
1993	0.000	0.002	0.009	0.025	0.051	0.085	0.118	0.142	0.159	0.169	0.174	0.176	0.177	0.178	0.177	0.177	0.176
1994	0.000	0.002	0.008	0.023	0.049	0.083	0.112	0.133	0.145	0.152	0.155	0.156	0.155	0.155	0.154	0.153	0.150
1995	0.000	0.002	0.009	0.025	0.054	0.090	0.122	0.145	0.159	0.167	0.170	0.172	0.172	0.171	0.170	0.169	0.166
1996	0.000	0.003	0.012	0.033	0.068	0.113	0.156	0.191	0.214	0.229	0.237	0.241	0.243	0.243	0.243	0.242	0.240
1997	0.000	0.003	0.011	0.031	0.065	0.108	0.149	0.180	0.201	0.214	0.221	0.224	0.225	0.225	0.224	0.224	0.220
1998	0.000	0.003	0.011	0.030	0.062	0.104	0.144	0.175	0.196	0.209	0.216	0.219	0.220	0.220	0.220	0.220	0.217
1999	0.000	0.003	0.011	0.031	0.065	0.110	0.154	0.189	0.212	0.226	0.233	0.237	0.238	0.238	0.238	0.238	0.235
2000	0.000	0.003	0.011	0.030	0.062	0.102	0.142	0.173	0.194	0.208	0.215	0.219	0.220	0.221	0.220	0.220	0.218
2001	0.000	0.003	0.011	0.030	0.062	0.103	0.142	0.174	0.196	0.209	0.216	0.219	0.221	0.221	0.221	0.220	0.218
2002	0.000	0.003	0.011	0.030	0.062	0.103	0.143	0.174	0.194	0.206	0.213	0.216	0.217	0.217	0.217	0.216	0.213
2003	0.000	0.003	0.013	0.035	0.071	0.117	0.163	0.200	0.225	0.241	0.251	0.255	0.257	0.257	0.257	0.257	0.254
2004	0.000	0.004	0.014	0.036	0.073	0.120	0.167	0.205	0.232	0.248	0.258	0.262	0.264	0.265	0.264	0.264	0.261
2005	0.000	0.004	0.016	0.041	0.083	0.135	0.187	0.230	0.261	0.282	0.293	0.300	0.302	0.303	0.303	0.303	0.300
2006	0.000	0.004	0.016	0.041	0.084	0.137	0.189	0.232	0.263	0.284	0.296	0.302	0.304	0.305	0.305	0.305	0.302
2007	0.000	0.004	0.015	0.039	0.080	0.131	0.181	0.220	0.249	0.267	0.277	0.282	0.285	0.285	0.285	0.284	0.281
2008	0.000	0.004	0.015	0.039	0.081	0.132	0.181	0.220	0.247	0.265	0.275	0.280	0.281	0.282	0.281	0.280	0.276

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
2009	0.000	0.004	0.014	0.038	0.078	0.128	0.175	0.213	0.239	0.256	0.265	0.270	0.272	0.272	0.271	0.271	0.267
2010	0.000	0.004	0.017	0.044	0.089	0.146	0.202	0.246	0.279	0.299	0.311	0.317	0.320	0.320	0.320	0.319	0.316
2011	0.000	0.004	0.015	0.041	0.084	0.138	0.190	0.232	0.261	0.279	0.289	0.294	0.296	0.296	0.296	0.295	0.290
2012	0.000	0.004	0.017	0.045	0.094	0.154	0.211	0.255	0.286	0.305	0.316	0.321	0.323	0.322	0.321	0.320	0.314
2013	0.000	0.005	0.020	0.053	0.108	0.177	0.242	0.294	0.331	0.354	0.368	0.374	0.376	0.376	0.375	0.374	0.367
2014	0.000	0.004	0.015	0.046	0.100	0.164	0.217	0.253	0.276	0.288	0.293	0.294	0.293	0.290	0.287	0.284	0.271
2015	0.000	0.001	0.005	0.029	0.090	0.174	0.244	0.280	0.291	0.292	0.289	0.285	0.280	0.275	0.271	0.267	0.246
2016	0.000	0.000	0.003	0.016	0.054	0.109	0.160	0.186	0.194	0.194	0.192	0.189	0.185	0.181	0.178	0.174	0.159
2017	0.000	0.000	0.003	0.015	0.049	0.096	0.134	0.153	0.159	0.159	0.158	0.156	0.154	0.152	0.150	0.148	0.138
2018	0.000	0.000	0.002	0.011	0.036	0.076	0.116	0.139	0.146	0.147	0.145	0.143	0.141	0.139	0.137	0.135	0.125
2019	0.000	0.000	0.002	0.010	0.032	0.065	0.099	0.119	0.125	0.126	0.125	0.124	0.122	0.121	0.119	0.118	0.111
2020	0.000	0.000	0.003	0.012	0.037	0.074	0.111	0.132	0.140	0.141	0.140	0.139	0.137	0.135	0.133	0.132	0.124
2021	0.000	0.000	0.002	0.012	0.034	0.070	0.107	0.129	0.136	0.138	0.137	0.135	0.133	0.132	0.130	0.128	0.121
2022	0.000	0.000	0.002	0.011	0.033	0.067	0.102	0.122	0.129	0.130	0.129	0.128	0.126	0.124	0.123	0.121	0.114
2023	0.000	0.000	0.003	0.012	0.035	0.072	0.108	0.129	0.136	0.137	0.136	0.134	0.132	0.130	0.128	0.127	0.118

Table 4. Bss.27.4bc7ad–h: Final sea bass update assessment: stock summary table.

Year	Low	Recruitment (Age 0, thousands)	High	Low	SSB (Tonnes)	High	Low	F(4-15)	High	$F_{commercial}$	$F_{recreational}$	Commercial landings	Commercial discards*	Recreational removals
1985	74	846	1619	17843	23856	29870	0.077	0.105	0.133	0.037	0.068	994		1849
1986	449	2481	4513	15533	20912	26291	0.090	0.123	0.156	0.055	0.068	1318		1663
1987	15292	21514	27736	13834	18632	23429	0.118	0.161	0.20	0.092	0.069	1979		1514
1988	10110	17519	24928	12576	16905	21233	0.096	0.130	0.164	0.062	0.068	1239		1403
1989	77036	91407	105779	12190	16234	20277	0.096	0.131	0.166	0.063	0.068	1161		1296
1990	2301	7451	12601	11024	14860	18696	0.096	0.133	0.170	0.065	0.068	1064		1164
1991	9134	15183	21232	9411	12995	16579	0.109	0.153	0.197	0.085	0.068	1226		1067
1992	15769	22813	29857	8097	11384	14671	0.112	0.155	0.199	0.087	0.068	1186		1091
1993	4105	8693	13282	8726	11761	14797	0.112	0.149	0.185	0.080	0.068	1256		1272
1994	23938	33381	42824	11504	14405	17306	0.105	0.133	0.162	0.066	0.068	1370		1528
1995	38878	49537	60197	15124	18136	21148	0.118	0.147	0.175	0.079	0.068	1835		1710
1996	446	3097	5747	16875	20079	23283	0.162	0.20	0.24	0.133	0.069	3022		1716
1997	45293	57263	69233	15947	19187	22428	0.151	0.188	0.23	0.120	0.068	2620		1621
1998	8114	17373	26632	14712	17886	21060	0.147	0.184	0.22	0.115	0.069	2390		1560
1999	43422	56694	69967	14135	17195	20256	0.158	0.198	0.24	0.129	0.069	2670		1559
2000	15364	24645	33925	14236	17215	20193	0.146	0.183	0.22	0.114	0.069	2407		1609
2001	15819	27931	40043	15112	18132	21152	0.147	0.184	0.22	0.115	0.069	2500		1692
2002	28896	43613	58331	15846	18923	21999	0.146	0.181	0.22	0.113	0.068	2622	17	1787
2003	31348	44062	56776	16933	20081	23229	0.170	0.21	0.25	0.144	0.069	3459	16	1869
2004	23325	34085	44846	17589	20800	24011	0.175	0.22	0.26	0.150	0.069	3731	59	1913
2005	14879	22698	30516	18037	21313	24589	0.198	0.25	0.30	0.179	0.069	4430	96	1909
2006	16694	24143	31591	17515	20847	24178	0.199	0.25	0.30	0.182	0.069	4377	53	1878
2007	18813	27534	36256	17078	20386	23693	0.187	0.23	0.28	0.167	0.069	4064	50	1877

Year	Low	Recruitment (Age 0, thousands)	High	Low	SSB (Tonnes)	High	Low	F(4-15)	High	$F_{commercial}$	$F_{recreational}$	Commercial landings	Commercial discards*	Recreational removals
2008	7878	14390	20902	17443	20663	23883	0.187	0.23	0.28	0.165	0.069	4107	8	1884
2009	8106	12796	17486	17817	20937	24058	0.182	0.23	0.27	0.157	0.069	3889	151	1857
2010	371	2589	4807	17672	20675	23678	0.21	0.26	0.31	0.195	0.069	4562	148	1755
2011	7261	10764	14267	16241	19060	21879	0.199	0.25	0.29	0.177	0.069	3858	22	1607
2012	2331	4647	6962	14955	17563	20170	0.22	0.27	0.32	0.20	0.068	3987	157	1440
2013	10188	15753	21317	13165	15605	18044	0.25	0.31	0.38	0.24	0.069	4137	53	1221
2014	22889	32000	41110	10549	12899	15249	0.196	0.25	0.31	0.186	0.067	2682	25	1007
2015	2529	7028	11526	8530	10848	13165	0.191	0.25	0.31	0.198	0.055	2273	40	684
2016	18433	28433	38432	6516	8806	11095	0.119	0.166	0.21	0.147	0.019	1446	199	205
2017	2472	6329	10185	5666	7946	10227	0.097	0.139	0.181	0.120	0.019	1106	271	203
2018	9304	18135	26967	5607	7962	10317	0.086	0.125	0.164	0.112	0.013	1084	482	150
2019	4836	12210	19583	6309	8893	11478	0.075	0.108	0.141	0.087	0.021	978	464	281
2020	2888	9600	16312	7546	10550	13553	0.084	0.121	0.158	0.089	0.032	1195	325	473
2021	1908	12241	22574	8430	11892	15354	0.081	0.117	0.154	0.086	0.032	1281	412	513
2022		12266**		8998	12910	16821	0.075	0.111	0.147	0.079	0.032	1276	196	537
2023		12266**		9190	13484	17779	0.077	0.117	0.157	0.085	0.032	1397	316	545
2024		12266**		8966	13589	18212								

*** Incomplete for some fleets 2002–2008.**

****Geometric mean recruitment 2012–2021.**

Table 5. Bss.27.4bc7ad–h: Inputs for short-term forecast. Fishing mortality is the estimates for 2024. Numbers-at-ages 0–2 in 2024 are adjusted by replacing Stock Synthesis values for 0-group in 2022–2023 (years with no recruit deviations estimated) with the long-term GM, adjusted for natural mortality.

age	Stock numbers 2023	weight in stock	Proportion mature (female)	H.Cons retained mean F (2022)	H.Cons Discarded mean F (2022)	H.Cons retained mean weights	H.Cons discarded mean weights	H.Cons proportion retained	Recreational F	Recreational removals mean weight	M
0	12266	0.003	0.000	0.000	0.000	0.000	0.000	na	0.000	0.020	0.24
1	9648	0.024	0.000	0.000	0.000	0.117	0.117	0.380	0.000	0.079	0.24
2	7587	0.096	0.000	0.000	0.001	0.236	0.236	0.381	0.002	0.191	0.24
3	5942	0.210	0.000	0.003	0.004	0.382	0.384	0.390	0.005	0.341	0.24
4	3622	0.369	0.092	0.011	0.013	0.567	0.560	0.460	0.011	0.530	0.24
5	3500	0.571	0.295	0.034	0.017	0.790	0.752	0.663	0.019	0.749	0.24
6	3814	0.807	0.577	0.068	0.011	1.006	0.966	0.857	0.026	0.991	0.24
7	943	1.072	0.798	0.090	0.005	1.242	1.220	0.952	0.032	1.249	0.24
8	2940	1.357	0.915	0.098	0.001	1.511	1.505	0.985	0.034	1.525	0.24
9	499	1.656	0.965	0.099	0.000	1.803	1.805	0.996	0.035	1.818	0.24
10	1552	1.964	0.986	0.098	0.000	2.105	2.111	0.999	0.036	2.122	0.24
11	513	2.273	0.994	0.097	0.000	2.408	2.418	1.000	0.036	2.429	0.24
12	98	2.582	0.997	0.095	0.000	2.707	2.721	1.000	0.036	2.734	0.24
13	142	2.884	0.998	0.093	0.000	2.999	3.016	1.000	0.036	3.033	0.24
14	21	3.179	0.999	0.091	0.000	3.282	3.302	1.000	0.036	3.323	0.24
15	62	3.464	1.000	0.090	0.000	3.554	3.577	1.000	0.036	3.602	0.24

16	175	4.228	1.000	0.088	0.000	4.193	3.999	1.000	0.036	3.869	0.24

Age 0,1,2 over-written as follows:

2024 yc 2024 age 0 replaced by 2012–2021 LTGM (12266);

2023 yc 2024 age 1 from SS3 survivor estimate at-age 1, 2024 * LTGM / SS3 estimate of age 0 in 2023;

2022 yc 2024 age 2 from SS3 survivor estimate at-age 2, 2024* LTGM / SS3 estimate of age 0 in 2022.

Table 6. Bss.27.4bc7ad–h: Management options table.

Sea bass in divisions 4.b–c, 7.a, and 7.d–h. Annual catch scenarios. Weights are in tonnes.

Basis	Total removals* (2025)	F_{total} (2025)	SSB (2026)	% SSB change**	% advice change***
ICES advice basis					
MSY approach: $F = F_{MSY} \times SSB_{2025}/MSY\ B_{trigger}$	2620	0.159	12450	-7.2	7.7
EU MAP^: $F_{MSY} \times SSB_{2025}/MSY\ B_{trigger}$	2620	0.159	12450	-7.2	7.7
EU MAP^: $F_{MSY\ lower} \times SSB_{2025}/MSY\ B_{trigger}$	2200	0.132	12801	-4.6	-9.5
EU MAP^: $F_{MSY\ upper} \times SSB_{2025}/MSY\ B_{trigger}$	2620	0.159	12450	-8.3	7.7
$F = F_{MSY\ lower}$	2357	0.142	12670	-5.5	-3.1
$F = F_{MSY}$	2804	0.1713	12297	-8.3	15.3
$F = F_{MSY\ upper}$	2804	0.1713	12297	-8.3	15.3
F = 0	0	0	14653	9.2	-100
F_{pa}	3273	0.203	11906	-11.2	35
F_{lim}	3998	0.254	11306	-15.7	64
$SSB_{2026} = B_{lim}$	5205	0.345	10313	-23	114
$SSB_{2026} = B_{pa}$	253	0.0143	14439	7.6	-90
$SSB_{2026} = MSY\ B_{trigger}$	253	0.0143	14439	7.6	-90
$F = F_{2024}$	1936	0.115	13022	-2.3	-20
$SSB_{2026} = SSB_{2025}$	1469	0.086	13418	0	-39

* Includes commercial catch and recreational removals (taking mortality of released fish into account, estimated at approximately 5%).
** SSB 2026 relative to SSB 2025.
*** Advice value for 2025 relative to the advice value for 2024 (2432 tonnes).
^ MAP multiannual plan (EU, 2019).

WGCSE FU 15 *Nephrops* UWTV survey work up process for use in stock assessment for 2024.

The main data components to estimate *Nephrops* burrow density by station is distance over ground data in meters per minutes , field of view of the camera (meters) to calculate the area of each UWTV track (m^2) and verified burrow counts, that is, number of burrow systems per minute. Internationally agreed standards for carrying out UWTV surveys are documented where they provide best practice guidelines as recommended in the Manual for the *Nephrops* Underwater TV Surveys (TIMES) (Dobby H., *et al.,* 2021).

1. UWTV system background.

1.1 2003 to 2019 Standard Definition Camera System (analogue):

From 2003 to 2019 standard definition camera (SD) system was used to obtain high quality video recorded to domestic DVDs for each TV station for both FU14 and FU15.

Field of view was estimated at 0.75 meter from point lasers that were positioned vertically to the seabed. These point lasers were just visible at the edge of the CRT viewing monitor and were measured on deck for both AFBI and MI.

Distance over ground (DoG) covered by the sledge was calculated either using SHIP data and/ or ultra-short baseline (USBL) sledge sensor position for both institutes when the sledge sensors were available. When the USBL is deemed of high quality this was chosen as data input for calculating distance in meters per minute. If USBL was not in operation, SHIP position was used, where the amount of cable “paid in” or “paid out” was taken from the relevant minute. Since 2005 an ultra-short baseline (USBL) sensor for Marine Institute (MI) survey work has been in use and is preferred option. AFBI is using a USBL sensor which is sometimes unreliable.

The navigational data were quality controlled using an “R” script developed by the Marine Institute (ICES, 2009) an example is shown in Figure 1.1.

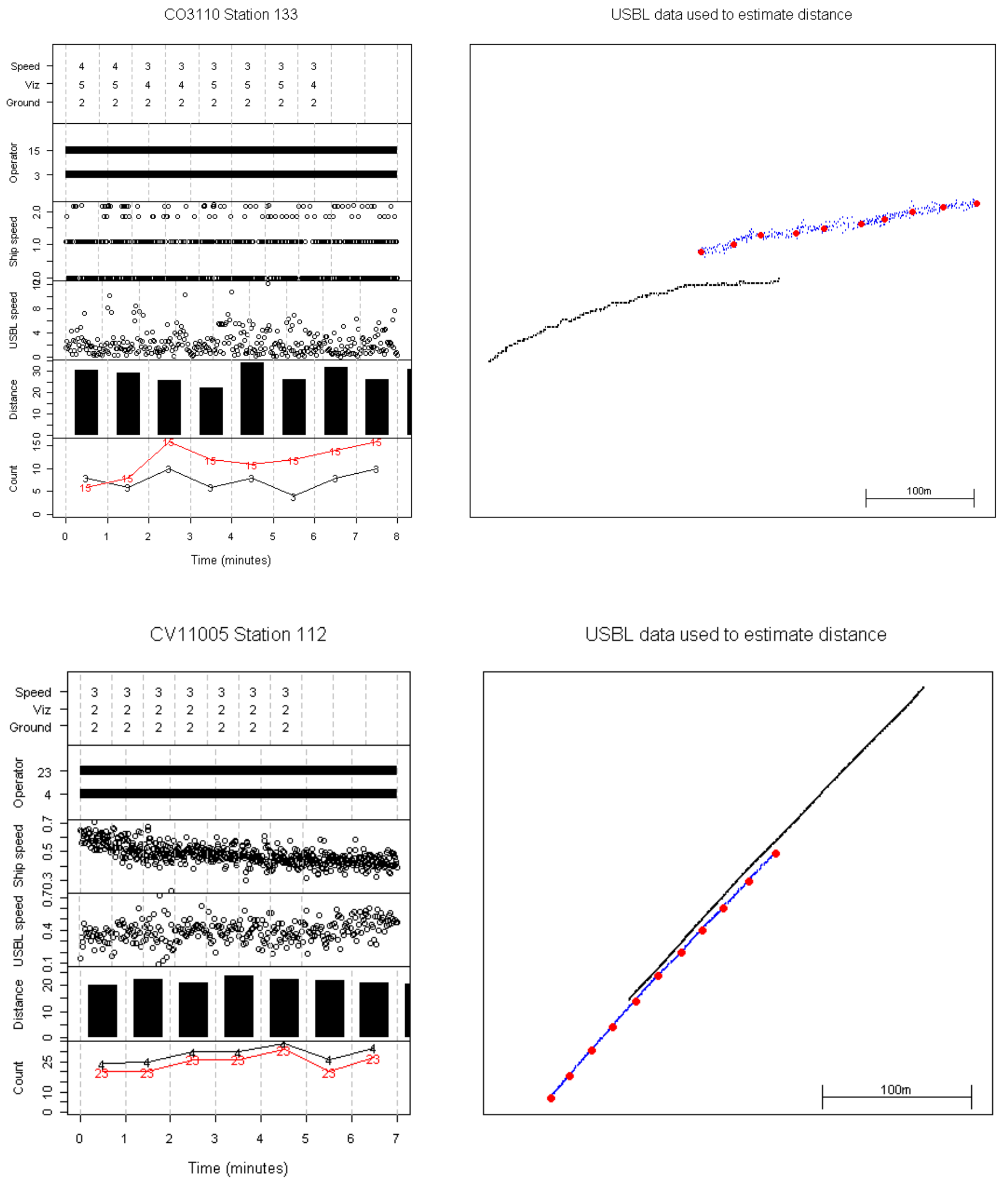


Figure 1.1 2011 QC plot station 133 RV.Corystes and station 112 RV.Celtic Voyager. Left panel: Quality observations, Number of operators (= counters), Ship and USBL speed scatter plot, Distance Over Ground bar plot in metres, Counts by operator and minute. Right panel:Ship track (black dots), Sledge track (blue dots, with red circles denoting minutes)

1.2 2020 to 2024 High Definition Camera System Marine Institute

Since 2019 for MI UWTV surveys, a high definition camera (HD) has been used to survey the *Nephrops* grounds. Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 to 2 seconds. These data were quality controlled using an "R" script developed by the Marine Institute (ICES, 2009) an example is shown in Figure 1.2. Sledge data is used once is it deemed of high quality, ie, outlier positions checked and minimal gaps in the signal.

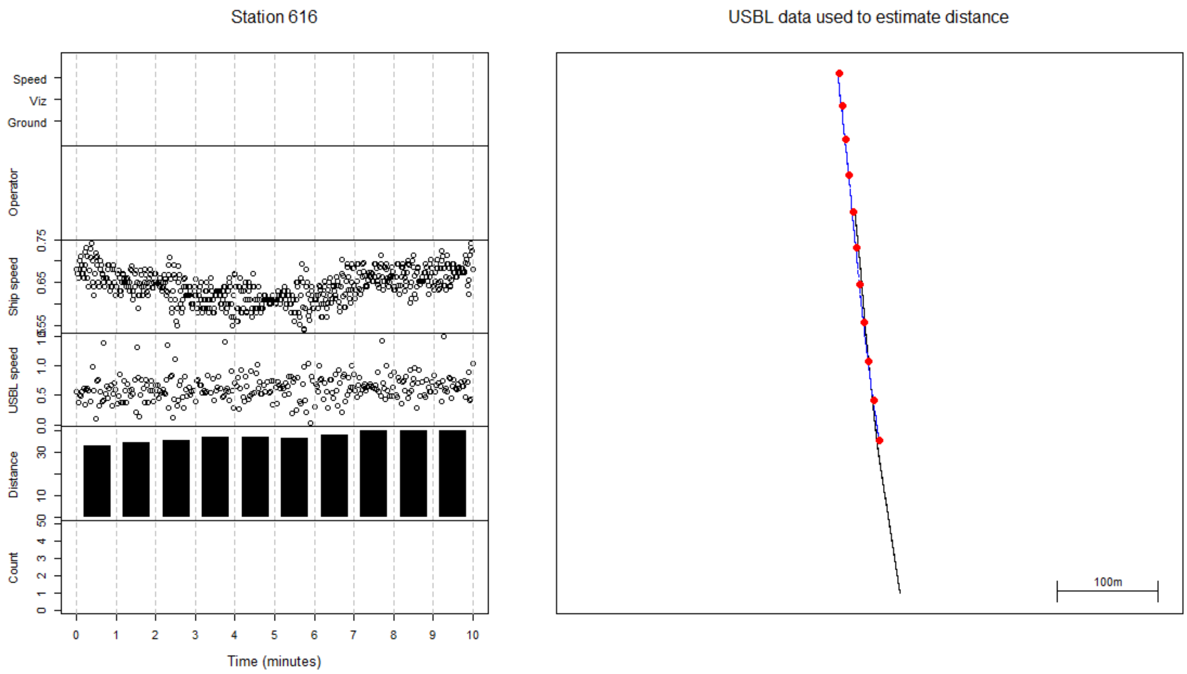


Figure 1.2: 2024 QC plot station 616 RV. Tom Crean. Left panel: Quality observations on the track, Number of operators (= counters), Ship and USBL speed scatter plot by minute, Distance Over Ground bar plot in meters / minute, Counts by operator and minute if counted. Right panel: Ship track (black dots), Sledge track (blue dots, with red circles denoting minutes).

Further inspection of violin and box plots of the total distance by FU from MI surveys shows that FU 15 lies within the main pattern in 2023 and 2024. However, there can be weather, current, vessel and sledge driver effects that add noise to interpreting such data (Figure1.3). Total distance less than 10 metres denotes were a TV track was shortened due to multibeam backscatter data showing hard ground.

All MI survey data is imported and stored in a local MS Access UWTV database during the survey and backed up regularly. On return to the laboratory, the r-scripts (Lin' CCC, Station QC and any additional evolving checks) are re-checked and a work-process document to sign off that the survey data is finalised. Then the quality controlled survey data is uploaded to FEAS_UWTV_Surveys sql server. A dedicated UWTV_density_data_summary_Vw is used to calculate the data for input into the geo-statistical process.

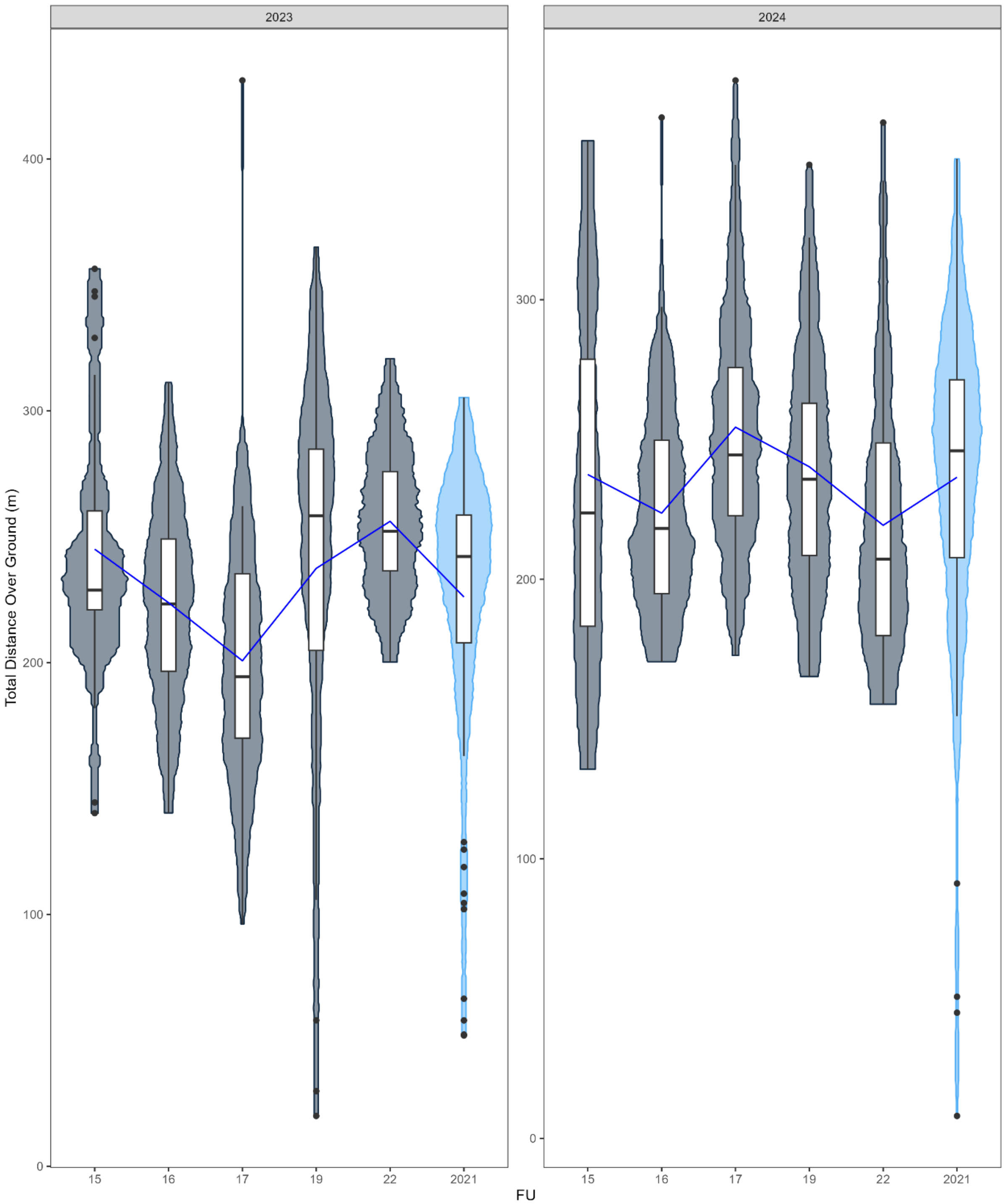


Figure 1.3 Violin and box plot of total distance over ground (metres) by FU for 2023 and 2024 Marine Institute. The blue line indicates the mean distance. The horizontal black lines represent medians, white boxes the inter quartile ranges, the black vertical lines the range and the black dots are outliers

The digital images were stored on a server and can be reviewed at sea through an in-house developed Image annotation R Shiny app (Aristegui, M., 2020) or through IrfanView.

Field of view or 'FOV' is estimated by object tracking method where this is checked annually. 6 random measurements using Irfanview software for each FU and alternating left and right side for tracking where the median value is used in the assessment. Figure 1.4 shows object tracking example.

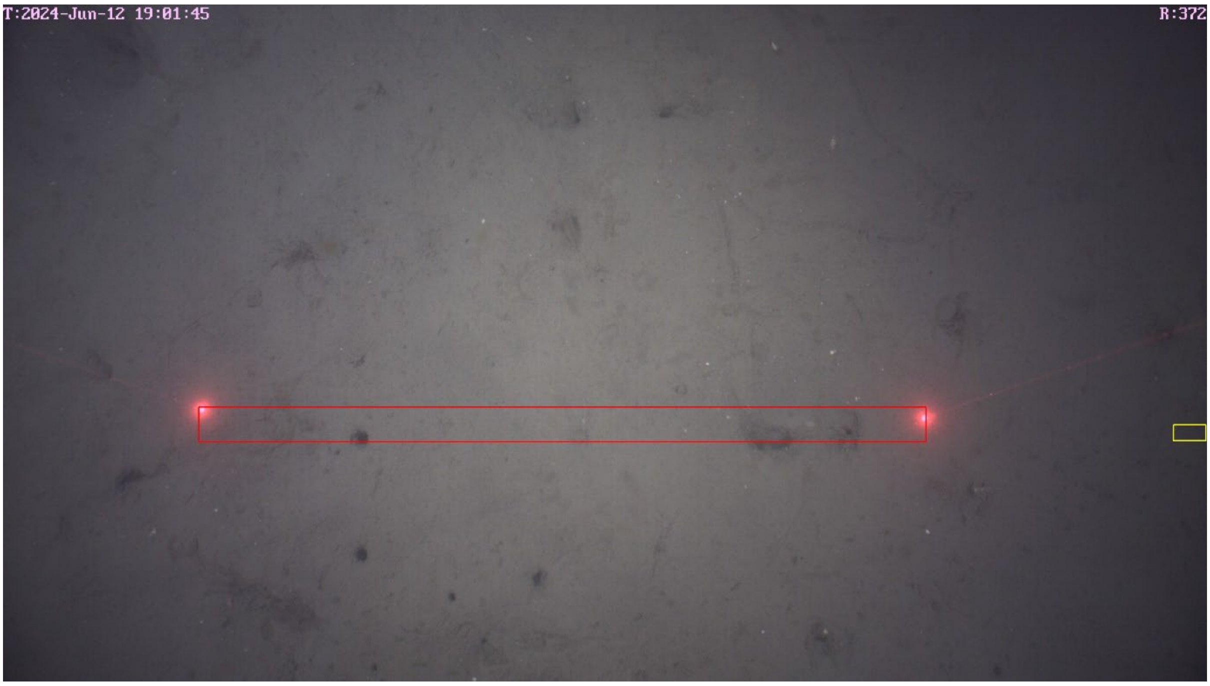


Figure 1.4 is image from station 139 showing where measurements are taken from the lasers and RHS for object tracking in Irfanview.

Table 1.1 below gives summary of 2021 to 2024 data sources and sensors for both institutes involved in the UWTV survey in FU15.

Year	Institute and RV	Camera System	Camera Angle	Image Type	Distance Over Ground	Laser Set Up	Field of View Method	Field of View Estimation (meters)
2024	AFBI; Corystes	HD	45 degrees	Still images and 10 minute TV track	USBL sledge sensor, SHIP	Point lasers	object tracking method	0.95
2024	MI; Tom Crean	HD	75 degrees	12 fps for 10 minute TV track (~7508 images, 1 GB /station	USBL sledge sensor, SHIP as back-up	Point lasers, vertically to sea-bed	object tracking method	1.02
2023	AFBI; Corystes	HD	45 degrees	10 minute TV track	USBL sledge sensor, SHIP	Point lasers	object tracking method	1.07 2023 as measurements from both FU14+FU15 video files as 1.07 median

Year	Institute and RV	Camera System	Camera Angle	Image Type	Distance Over Ground	Laser Set Up	Field of View Method	Field of View Estimation (meters)
2023	MI; Tom Crean	HD	75 degrees	12 fps for 10 minute TV track (~7508 images, 1 GB /station	USBL sledge sensor, SHIP as back-up	Point lasers, vertically to sea-bed	object tracking method	1.01
2021	MI; Celtic Explorer	SD camera system from AFBI					unknown	0.75
2022	AFBI; Corystes	HD		10 minute TV track	From Video footage		unknown	0.85
2021	AFBI; Corystes	HD and SD camera system (after breakdown of HD system)		10 minute TV track				0.75

1.3. R.V. Corystes

The RV Corystes uses an HD camera system fully since 2022; while the HD system was available in both 2020 and 2021, the system was not fully functionable and the “old” camera system had to be used.

Since 2023 footage is recorded in both, stills and as a video, counts are done using the stills and the IrfanView software. However in 2022 no still images were recorded and hence the video stream was used for the counting of burrows using the Microsoft video player. Since 2024 the footage is stored on the general server aboard the vessel during the survey where it can be accessed by the counters and counted.

Footage is generally counted by a team during the survey so that stations with poor footage could be repeated if possible.

The ships position data is saved in “putty” files; all counts and station information are saved in .csv files to further be processed using R-scripts.

Of the stations recorded in 2024 in FU 15 by the RV Corystes, the location files were recorded by the ships and USBL system. Of the spatial tracks recorded, two were corrupted/unusable (3%), 5 (7.5%) had no USBL recording and 90% had USBL recordings.

In cases with poor USBL tracks, the ship tracks were often also poor and minutes with >50 m and <15 m were given an average value of m/min.

The Field of View from 2023 was estimated following the object tracking method and a median of FU14 and FU15 was taken.

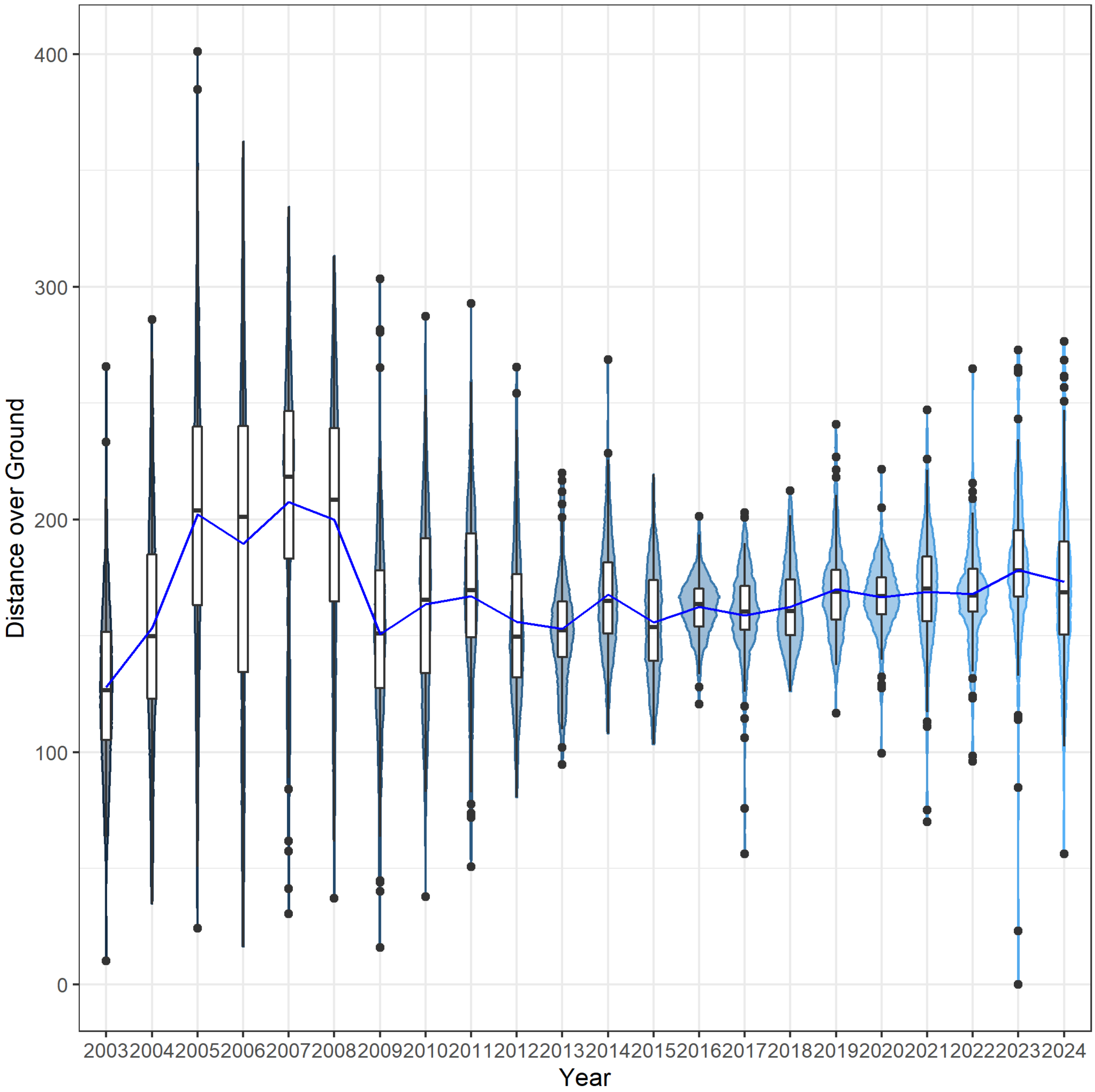


Figure 1.5: Distance over ground/ 8 minute for FU15 by RV Corystes

2. *Nephrops* Burrow counting.

Reference Sets.

SD survey counts:

A dedicated reference set based on SD videos for FU 15 was developed and reference counts generated according to the guidelines set out by the Burrow Identification workshop at that time (ICES, 2008). This was used to train and test counters in advance of reviewing the SD survey images for years 2003-2019.

HD survey counts:

A HD reference set was available for the 2023 survey, which followed the recommendations by the recent Burrow Identification workshop (ICES, 2018). This reference set did not have counts per minute, where each station had a range (low – high count) to train and test the survey counters. Further work was carried out by the 2023 counting team to develop and evaluate reference counts by minute for this HD reference set. This evaluation process was presented and agreed by WGNEPS (ICES, 2023) and used for the counts in 2024.

Verified Survey Counts.

Counting followed the procedure as below:

- 2 randomly assigned counters per station
- 8 Minutes per station are being counted; where the first minute is deemed a familiarization minute and the next 7 good quality minutes are used for the assessment.
- 1st counter to note seconds of a given minute not counted
- Application of Lin's CCC algorithm to check consistency between both counters (eliminate minute 1)
    - Lin's CCC score ≥ 0.5 -> accept both counts (Figure 2.1)
    - Lin's CCC < 0.5
        - Zero counts: No Lin's CCC
        - Very low counts: accept as Lin's CCC method does not perform on counts where number are very low
        - Check the Lin's CCC plot:
        - Large discrepancies in up to 3 Minutes: Counters review indicated minutes consensus counts.
        - More than 3 minutes: Assign 3rd counter, re-run Lin's CCC
            - Lin's CCC between any two counters ≥ 0.5 -> accept the best matching counts
            - Otherwise, accept the two counts that show most similar trend
            - If neither applicable, average across all three counters

Table 2.1 Counters for FU 15 footage

Year	Reference set and counts	Number of Counters	Lin's CCC threshold
2024	HD Reference set available, Reference counts evaluated in 2023 and used to train and test (ICES, 2023)	Onboard: 3 national and 2 international counters Ashore: 4 national and 1 international	0.5
2023	HD Reference set available, reference counts not available but a range by station was used to train and test.	Onboard: 2 national and 1 international counter Ashore: 4 national counters	0.5

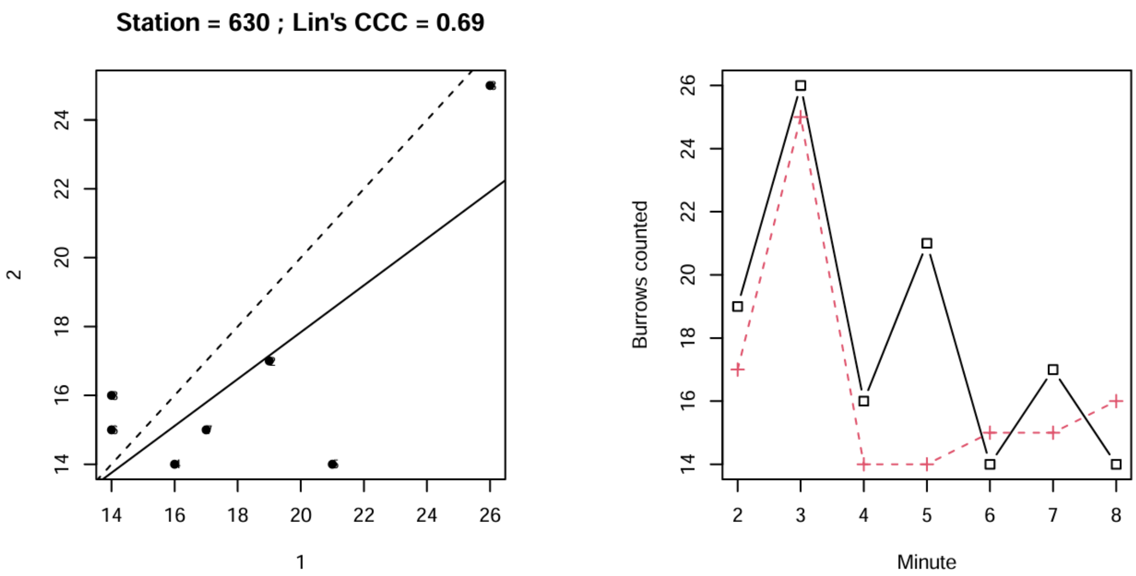


Figure 2.1 Accepted Lin' CCC between two counters

3. Distance over ground

The distance over ground (DoG) for FU15 using the Corystes data acquisition system.

- USBL and ship track are recorded in putty files – however, there seem to be some technical issues as to whether USBL/ship track is being recorded especially at shallow stations or stations where the ground might have large unevenness, the amount of pings/minute, the accuracy. This is what the system can provide at the moment and we have to live with
- For each station, check if USBL has been recorded, if not just use ship track alone (R script will show which stations do not have USBL).
- R script:
  - Find the first and last ping of each recorded minute
  - For each ping within the minute, calculate the straight line distance between the ping and the following using the (standard) formula:
    - tracks$dX <- c(NA, cos((tracks$SY[1:(n-1)]+tracks$SY[2:n]) * pi / 360) * (tracks$SX[1:(n-1)] - tracks$SX[2:n]) * 60)
    - tracks$dY <- c(NA,(tracks$SY[1:(n-1)] - tracks$SY[2:n]) * 60)
    - tracks$Dist <- (((sqrt(tracks$dX^2+tracks$dY^2)))*1.852)*1000
  - Quality control: only use those calculated distances with speed less than 5m/second
  - Since those "raw points are sometimes all over the place, apply a lowess smoother to the latitudes and longitudes of the station and so the same calculation.
  - Plot the smoothed vs the raw distances between pings.
  - Calculate the distance/minute for each station from smoothed distances
  - Further QC: If distance/minute between 20 and 50 m -> ok, otherwise, take average distance /minute across all stations and minutes that are between 20 and 50 (there are quite a few with jumps, estimated speed >5m/second etc
- Final result: CSV file with m/minute/station.

AFBI currently does not account for cable out at each minute, which might slightly change the distance covered; however it rarely happens that the cable gets taken in during the deployment.

A comparison between the estimation of DoG calculated independently by CEFAS and AFBI showed that the estimated DoGs were close (differences are expected due to different methodologies); box plots between the two estimated DoGs for FU15 recorded on the Corystes (both estimations by AFBI and CEFAS) and the stations recorded at the Tom Crean can be seen in Figure 3.1.

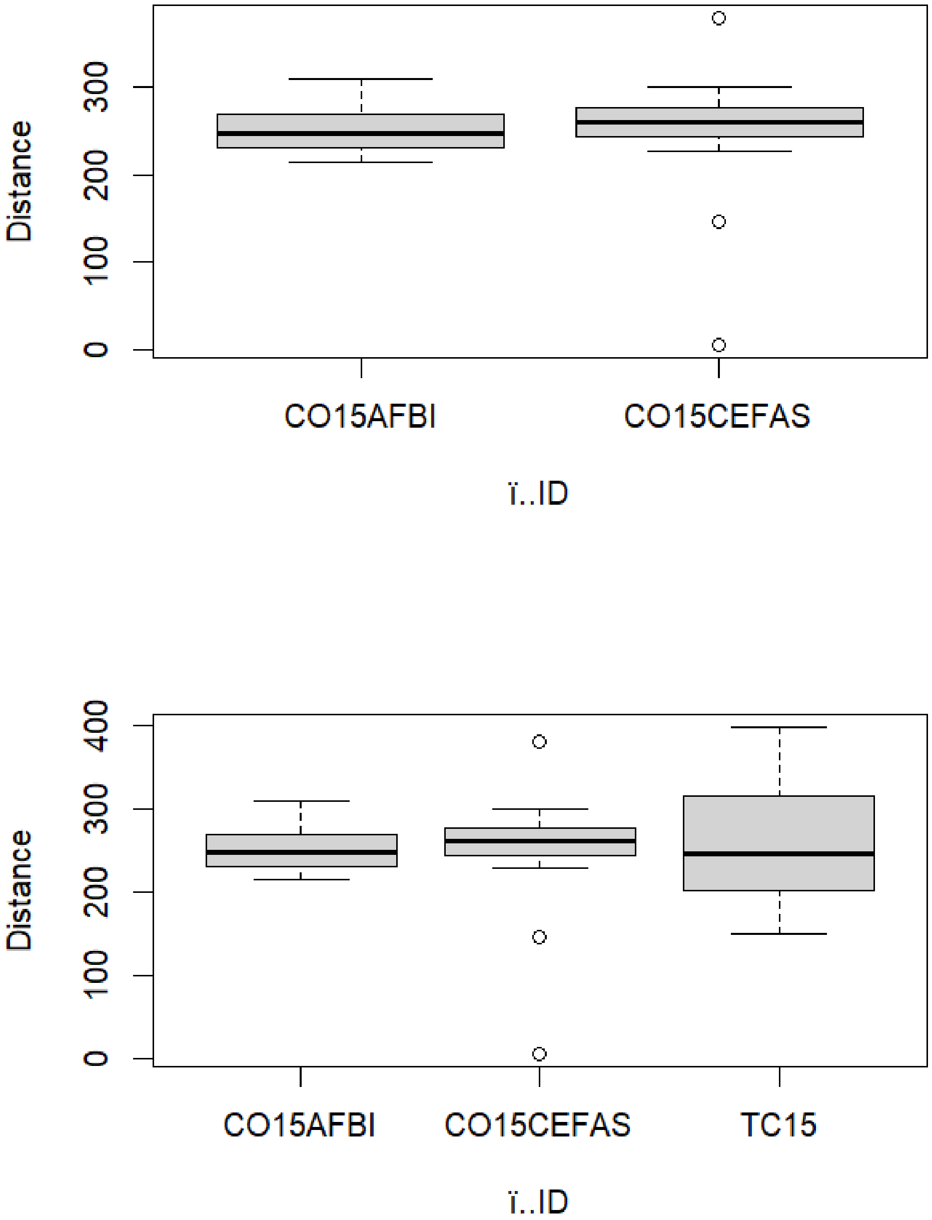


Figure 3.1: Comparison between estimated DoGs from AFBI and CEFAS based on the files recorded on the Corystes FU15 during the survey. The bottom figure compares the DoG between the two estimations from AFBI and CEFAS with the distances recorded on the stations recorded on the Tom Crean.

4. Field of view

The Corystes laser setup over the past years is the same angle as the camera angle, for both FU 14 and FU 15.

- FoV follows object tracking mode (Figure 4.1)
- 6 stations from FU15 and FU14 each, alternate tracking on the left and right, take the median FOV of the 12 stations. The median resulted in a FoV for 2024 at 95.4cm (Table x.x).
- Done and updated annually
- An alternate vertical laser setup was tried in FU15 towards the end of the survey and the FoV calculation was carried out as a comparison, the median FoV had minimal difference (99.38 cm)

In 2023 a process to review the FoV for FU14 and FU15 was conducted. Due to the absence of still images IrfanView could not be used to measure the distances successfully and alternate measuring methods had to be employed, while keeping the overall process the same. Six stations from FU14 and FU15 each were measured, FU14 was measured by CEFAS while FU15 was measured by AFBI. The median value was 1.07 m.

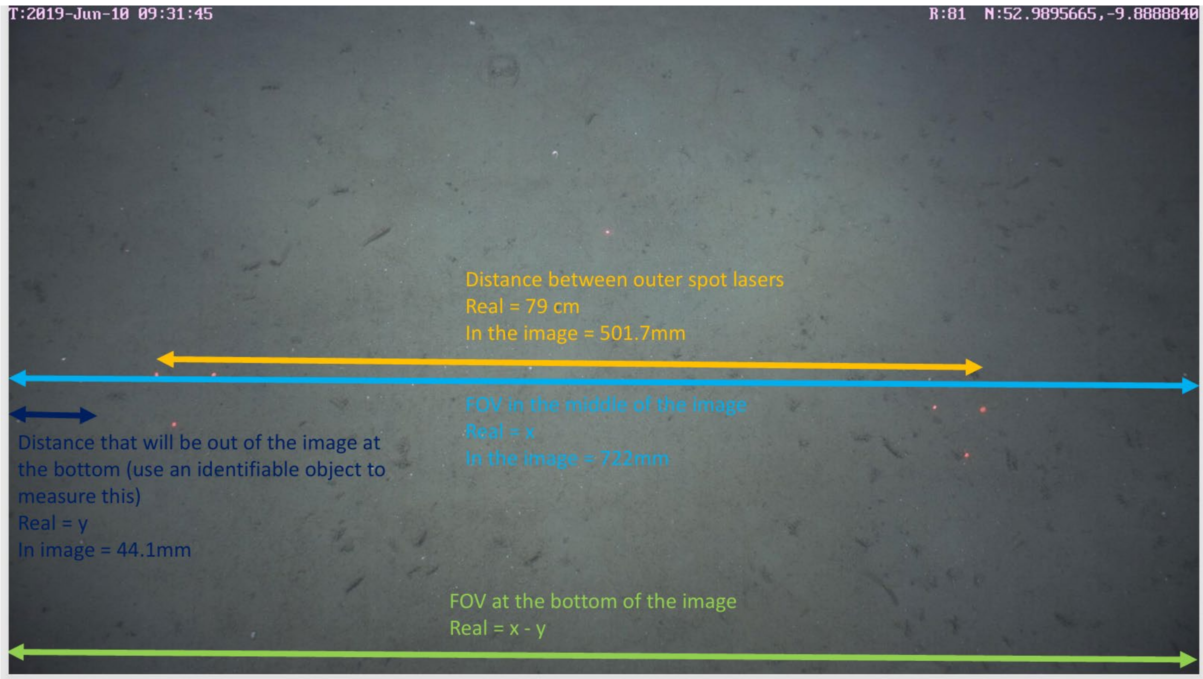


Figure 4.1 FOV calculation: Values in picture are examples and do not represent the values in the actual calculation. They are the measurements taken from the individual station and the individual laser setting.

Table 4.1. The measurements used to estimate the FoV for FU14 and FU15 in 2024.

station	FU	L/R	spot laser distance	spot lased distance in image	FOV in image	Object from side distance image	FOV middle of image	real object distance	FOV bottom of screen	
23	14	L	253	153	722	91.3	1193.895425	150.9732	891.949	
33	14	R	253	148	722	86.4	1234.22973	147.6973	938.8351	
44	14	L	253	147.5	722	85.4	1238.413559	146.4827	945.4481	
1	14	L	253	144.6	722	89.35	1263.250346	156.3316	950.5871	

42	14	R	253	144.3	722	78.3	1265.876646	137.2827	991.3112	
53	14	R	253	144	722	79.4	1268.513889	139.5014	989.5111	
2	15	L	253	148.9	722	89.25	1226.769644	151.6471	923.4755	
35	15	R	253	141.8	722	81.49	1288.19464	145.3947	997.4052	
71	15	L	253	146.8	722	81.84	1244.318801	141.0458	962.2272	
45	15	R	253	154.9	722	93.84	1179.25113	153.27	872.7112	
52	15	L	253	145.3	722	86.08	1257.164487	149.8847	957.3952	
41	15	R	253	139.4	722	89.25	1310.373027	161.9817	986.4096	
								median	953.99	

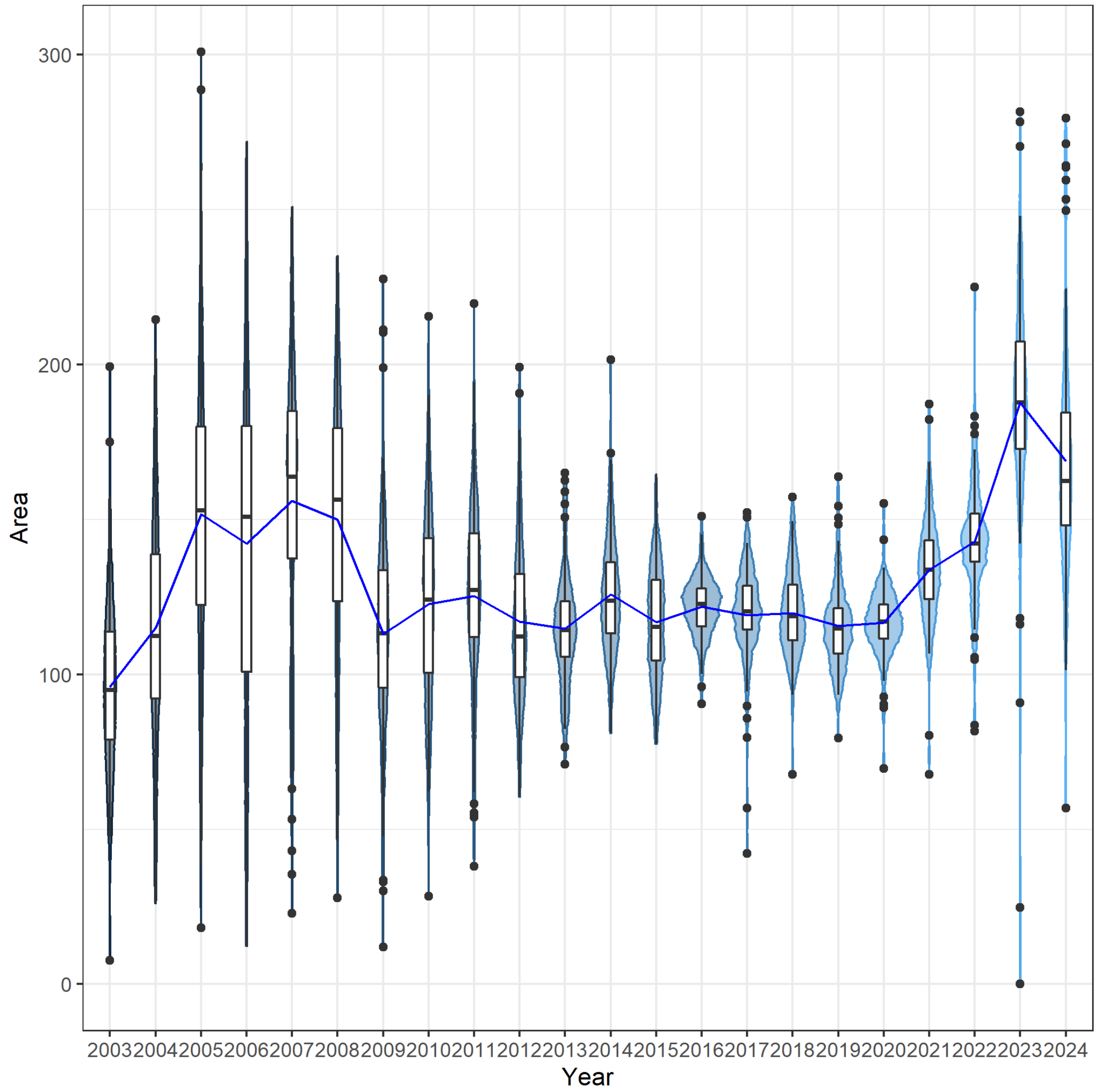
5. Data aggregation (distances, counts, densities)

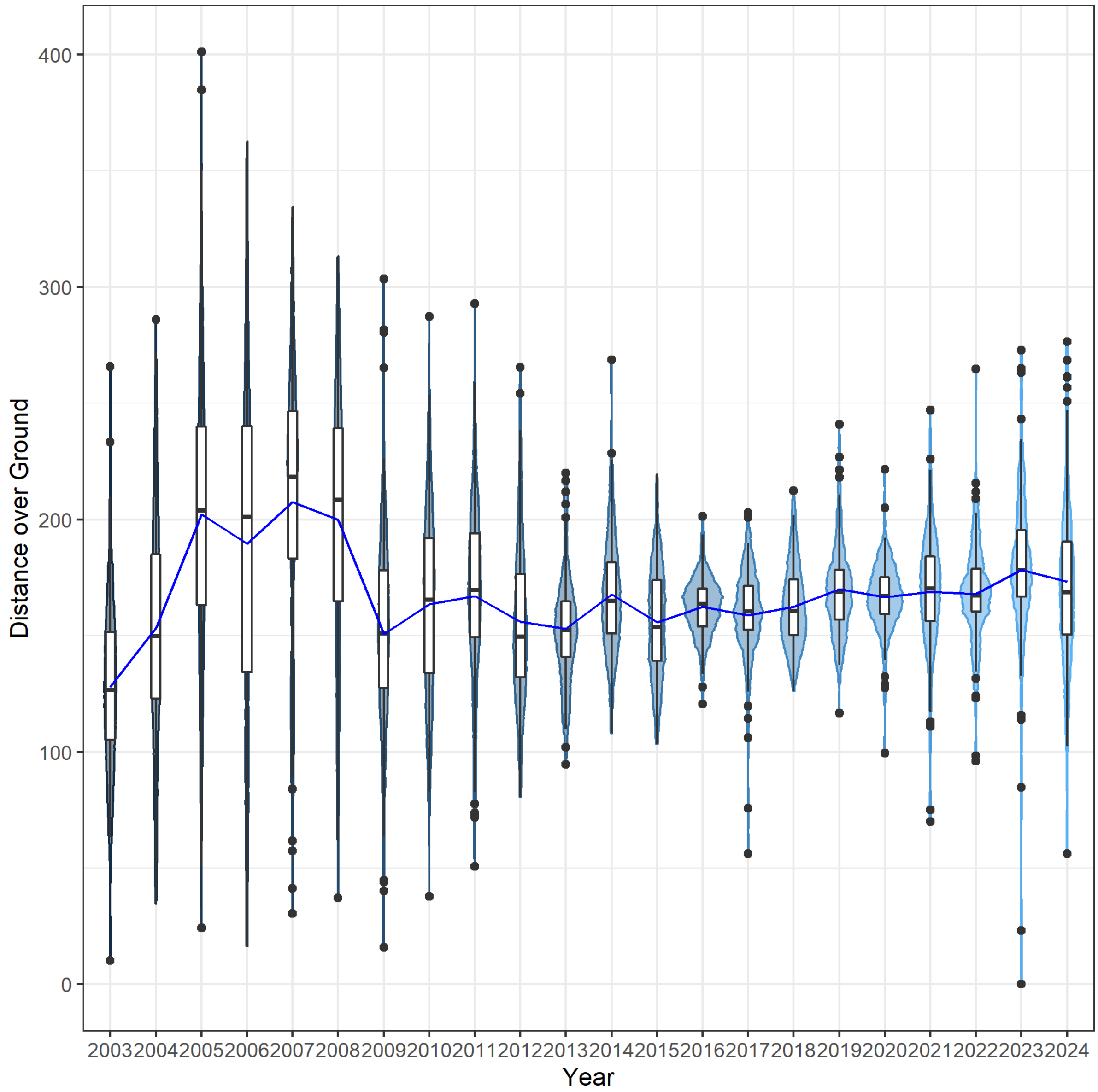
- Files:
  - Raw counts:
    - Stations, minutes, counts (all counts by all counters), seconds not counted, if more than 2 counters: which counters to choose or average of 3
  - Distances: Distance per minute and station, QC'd with missing minutes having been filled in by averages and missing stations being filled in by average stations around;
  - Mid- station location (lat and long) at minute 4 of the transect.
  - FoV (as a number)
  - Correction factor for densities
  - R script:
    - Read in files
    - From Counts file, remove minute1, only choose those counts from agreed counters, average counts/minute from chosen counters
    - Combine counts/minutes with DoG/minute
    - Adjust the DoG with the seconds not counted
    - Calculate area/minute by multiplying adjusted DoG*FoV
    - QC for zero or N/A distances
    - Aggregate counts, area and adjusted Distance per station
    - Density: total counts station/total area/ station
    - Adjusted Density : Density/correction factor
  - Output: File with station, Area, DoG, density and adjusted density

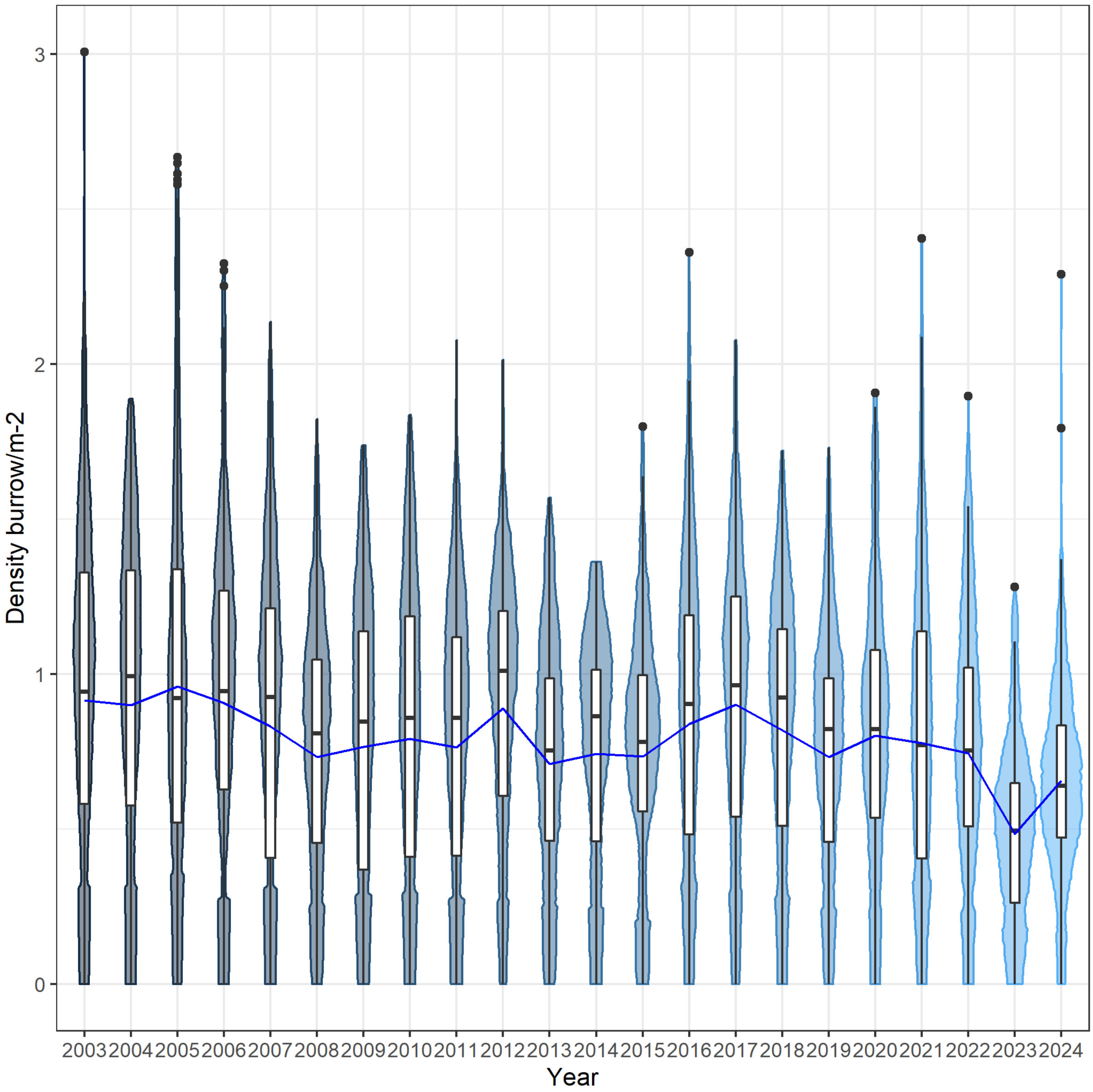
6. Geostatistical analysis:

For 2024 the geostatistical analysis was carried out using the "RGeostats" package (Renard D., *et al*, 2024) and is available as an "R" markdown document. The same steps were carried out as in previous years when this method employed; construction of experimental variogram, a model variogram produced with a spherical or exponential model, create krigged grid file using all data points as neighbours, same boundary used to estimate the domain area, mean density, total burrow abundance and calculate survey precision.

The results of the geospatial analysis can be seen in the corresponding section of the report.




Distance over Ground
400
300
200
100
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Year



Density burrow/m-2
3
2
1
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Year

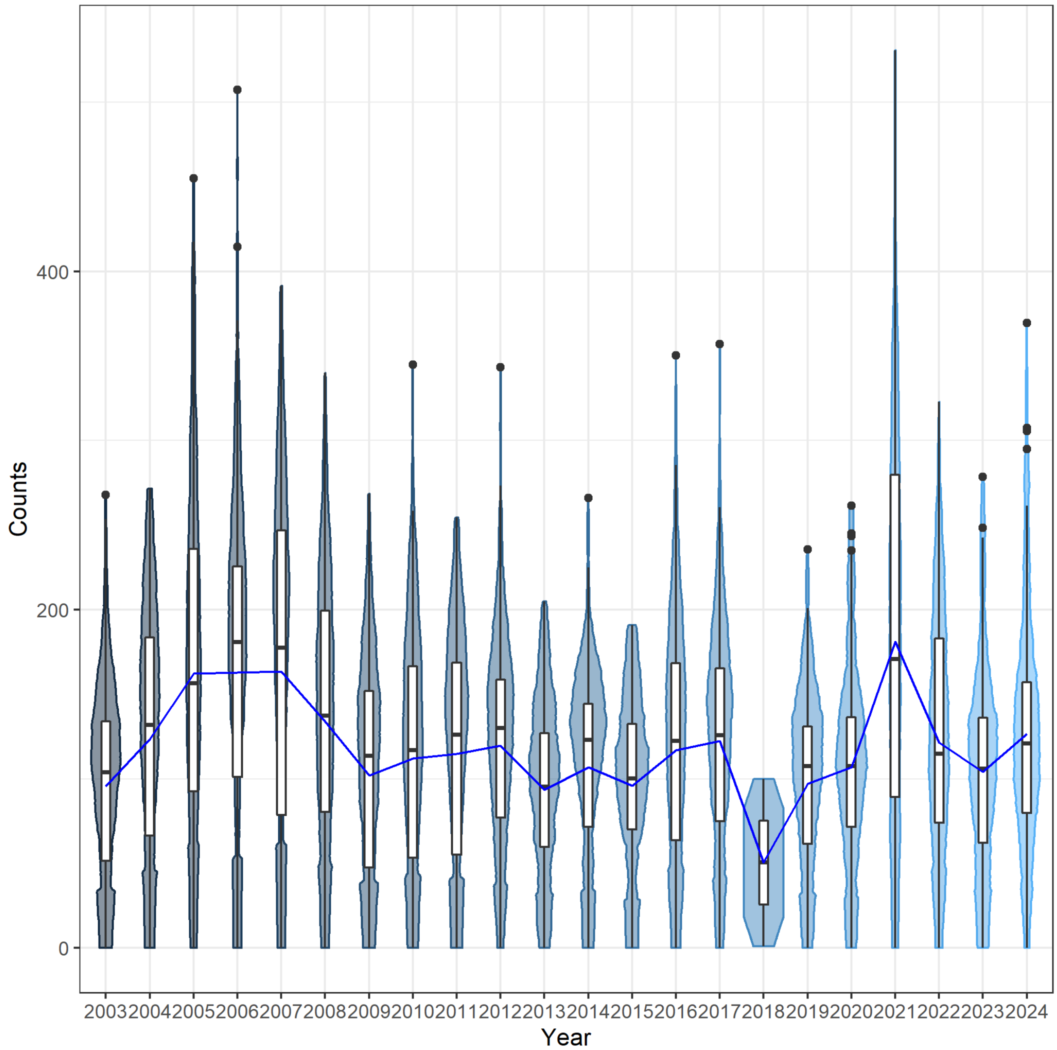


Figure 6.1: QC plots for the DoG (adjusted to the seconds not counted), Area, Density (adjusted with the convergence factor) and counts. All plots are representing the data in the input file to the kriging assessment. Plots include the updated DoG for 2023.

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